NASA/TP—2012–217465

Statistical Aspects of Tropical Cyclone Activity in the North Atlantic Basin, 1945–2010

Robert M. Wilson
Marshall Space Flight Center, Huntsville, Alabama

August 2012

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Marshall Space Flight Center • Huntsville, Alabama 35812

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LIST OF ACRONYMS, ABBREVIATIONS, AND DESIGNATORS

10-yma	10-year moving average
ACE	accumulated cyclone energy
ACE/NSD	ACE divided by NSD
AFL	Northwest Florida
AMM	Atlantic Meridional Mode (index)
<AMM>	yearly or decadal mean of the AMM
AMO	Atlantic Multidecadal Oscillation (index)
<AMO>	yearly or decadal mean of the AMO
AT	Armagh Observatory surface air temperature
<AT>	yearly or decadal mean of the AT
ATX	South Texas
BFL	Southwest Florida
BTX	Central Texas
CAR	Caribbean (index)
<CAR>	yearly or decadal mean of the CAR index
CFL	Southeast Florida
Class.	classification
COADS	Comprehensive Ocean-Atmosphere Data Set
CTX	North Texas
d(ACE)	difference between yearly and 10-yma values of ACE

LIST OF ACRONYMS, ABBREVIATIONS, AND DESIGNATORS (Continued)

d(ACE/NSD)	difference between yearly and 10-yma values of ACE/NSD
d(<AMM>)	difference between yearly and 10-yma values of AMM
d(<AMO>)	difference between yearly and 10-yma values of AMO
d(<AT>)	difference between yearly and 10-yma values of <AT>
d(<CAR>)	difference between yearly and 10-yma values of <CAR>
d(<GSSTEI>)	difference between yearly and 10-yma values of <GSSTEI>
d(HISACE)	difference between yearly and 10-yma values of <HISACE>
d(<JMASSTM>)	difference between yearly and 10-yma values of <JMASSTM>
d(LISNSD)	difference between yearly and 10-yma values of <LISNSD>
d(LP)	difference between yearly and 10-yma values of LP
d(<LP>)	difference between yearly and 10-yma values of <LP>
d(<MEI>)	difference between yearly and 10-yma values of <MEI>
d(<NAO>)	difference between yearly and 10-yma values of <NAO>
d(NH)	difference between yearly and 10-yma values of NH
d(NHD)	difference between yearly and 10-yma values of NHD
d(<N. LAT>)	difference between yearly and 10-yma values of <N. LAT>
d(NMH)	difference between yearly and 10-yma values of NMH
d(NMHD)	difference between yearly and 10-yma values of NMHD
d(NSD)	difference between yearly and 10-yma values of NSD
d(<NSD>)	difference between yearly and 10-yma values of <NSD>
d(<NTA>)	difference between yearly and 10-yma values of <NTA>
d(NTC)	difference between yearly and 10-yma values of NTC

LIST OF ACRONYMS, ABBREVIATIONS, AND DESIGNATORS (Continued)

d(NTCA)	difference between yearly and 10-yma values of NTCA
d(NTS)	difference between yearly and 10-yma values of NTS
d(NUSLFH)	difference between yearly and 10-yma values of NUSLFH
d(<ONI>)	difference between yearly and 10-yma values of <ONI>
d(<PDO>)	difference between yearly and 10-yma values of <PDO>
d(PWS)	difference between yearly and 10-yma values of PWS
d(<PWS>)	difference between yearly and 10-yma values of <PWS>
d(<QBO>)	difference between yearly and 10-yma values of <QBO>
d(<SOI>)	difference between yearly and 10-yma values of <SOI>
d(<TNI>)	difference between yearly and 10-yma values of <TNI>
d(<W. LONG>)	difference between yearly and 10-yma values of <W. LONG>
DFL	Northeast Florida
EN	El Niño
ENSO	El Niño-Southern Oscillation
ENY	El Niño year
EXP	expected
fd	first difference
fd(ACE)	first difference of the 10-yma values of ACE
fd(ACE/NSD)	first difference of the 10-yma values of ACE/NSD
fd(<AMM>)	first difference of the 10-yma values of <AMM>
fd(<AMO>)	first difference of the 10-yma values of <AMO>

LIST OF ACRONYMS, ABBREVIATIONS, AND DESIGNATORS (Continued)

fd(<AT>)	first difference of the 10-yma values of <AT>
fd(<CAR>)	first difference of the 10-yma values of <CAR>
fd(<GSSTEI>)	first difference of the 10-yma values of <GSSTEI>
fd(HISACE)	first difference of the 10-yma values of HISACE
fd(<JMASSTM>)	first difference of the 10-yma values of <JMASSTM>
fd(LISNSD)	first difference of the 10-yma values of LISNSD
fd(LP)	first difference of the 10-yma values of LP
fd(<LP>)	first difference of the 10-yma values of <LP>
fd(<MEI>)	first difference of the 10-yma values of <MEI>
fd(<NAO>)	first difference of the 10-yma values of <NAO>
fd(NH)	first difference of the 10-yma values of NH
fd(NHD)	first difference of the 10-yma values of NHD
fd(<N. LAT>)	first difference of the 10-yma values of <N. LAT>
fd(NMH)	first difference of the 10-yma values of NMH
fd(NMHD)	first difference of the 10-yma values of NMHD
fd(NSD)	first difference of the 10-yma values of NSD
fd(<NSD>)	first difference of the 10-yma values of <NSD>
fd(<NTA>)	first difference of the 10-yma values of <NTA>
fd(NTCA)	first difference of the 10-yma values of NTCA
fd(NTC)	first difference of the 10-yma values of NTC
fd(NTS)	first difference of the 10-yma values of NTS

fd(NUSLFH)	first difference of the 10-yma values of NUSLFH
fd(<ONI>)	first difference of the 10-yma values of <ONI>
fd(<PDO>)	first difference of the 10-yma values of <PDO>
fd(PWS)	first difference of the 10-yma values of PWS
fd(<PWS>)	first difference of the 10-yma values of <PWS>
fd(<QBO>)	first difference of the 10-yma values of <QBO>
fd(<SOI>)	first difference of the 10-yma values of <SOI>
fd(<TNI>)	first difference of the 10-yma values of <TNI>
fd(<W. LONG>)	first difference of the 10-yma values of <W. LONG>
FSD	first storm day
GSSTEI	Global Sea Surface Temperature ENSO index
<GSSTEI>	yearly or decadal mean of the GSSTEI
HISACE	highest individual storm ACE
IAL	inland Alabama (hurricane strike)
IGA	inland Georgia (hurricane strike)
INC	inland North Carolina (hurricane strike)
ISACE	individual storm ACE
ISNHD	individual storm NHD
ISNMHD	individual storm NMHD
ISNSD	individual storm NSD
J–M	January–March (average temperature)
JMA	Japan Meteorological Agency

LIST OF ACRONYMS, ABBREVIATIONS, AND DESIGNATORS (Continued)

JMASSTM	Japan Meteorological Agency SST Mean (index)
<JMASSTM>	yearly or decadal mean of the JMASSTM
LISNSD	longest individual storm NSD
LN	La Niña
LNY	La Niña year
LP	lowest pressure
<LP>	yearly mean LP
LSD	last storm day
MCA	maximum covariance analysis
MEI	multivariate ENSO index
<MEI>	yearly or decadal mean of the MEI
NAO	North Atlantic Oscillation index
<NAO>	yearly or decadal mean of the NAO
NCEP	National Centers for Environmental Prediction
NH	number of hurricanes
NHD	number of hurricane days
N. LAT	north latitude
<N. LAT>	yearly or decadal mean of N. LAT
NMH	number of major hurricanes
NMHD	number of major hurricane days
NOAA	National Oceanic and Atmospheric Administration

LIST OF ACRONYMS, ABBREVIATIONS, AND DESIGNATORS (Continued)

NSD	number of storm days
<NSD>	yearly or decadal mean of the NSD
NTA	North Tropical Atlantic index
<NTA>	yearly or decadal mean of the NTA
NTC	number of tropical cyclones
NTCA	Net Tropical Cyclone Activity index
NTS	number of tropical storms
NTS/NTC	NTS divided by NTC
NUSLFH	number of US landfalling hurricanes
NY	(ENSO) neutral year
OBS	observed
ONI	Oceanic Niño index
<ONI>	yearly or decadal mean of the ONI
PDO	Pacific Decadal Oscillation index
<PDO>	yearly or decadal mean of the PDO
PWS	peak wind speed
<PWS>	yearly or decadal mean of the PWS
QBO	Quasi-Biennial Oscillation index
<QBO>	yearly or decadal mean of the QBO
RES	residual
SLP	sea level pressure

LIST OF ACRONYMS, ABBREVIATIONS, AND DESIGNATORS (Continued)

SNBR	storm number
SOI	Southern Oscillation index
<SOI>	yearly or decadal mean of the SOI
SST	sea surface temperature
THC	thermohaline circulation
TNI	Trans-Niño index
<TNI>	yearly or decadal mean of the TNI
TP	Technical Publication
TS	tropical storm
US	United States
USLFH	US landfalling hurricane
W. LONG	west longitude
<W. LONG>	yearly or decadal mean of the W. LONG

NOMENCLATURE

a	the y-intercept
b	the slope
cl	confidence level
d	difference
fd	first difference
m	mean
$n+$	number above mean
$n-$	number below mean
$n+r$	number of runs above mean
$nr(t)$	number of positive residual runs
P	probability
$P(r)$	probability of r events occurring
r	coefficient of correlation; the number of events occurring per unit time
r^2	coefficient of determination
sd	standard deviation
se	standard error of estimate
t	t-statistic; year
x	independent variable
y	dependent variable
y_1	dependent variable for overall interval
y_2	dependent variable for current interval
z	z-statistic

TECHNICAL PUBLICATION

STATISTICAL ASPECTS OF TROPICAL CYCLONE ACTIVITY IN THE NORTH ATLANTIC BASIN, 1945–2010

1. INTRODUCTION

A tropical cyclone is described as a warm-core, nonfrontal, synoptic-scale system that originates over tropical or subtropical waters and has an organized deep convection and closed surface wind circulation (counterclockwise in the Northern Hemisphere) about a well-defined center.[1] When its maximum sustained surface wind speed is 33 kt or less it is called a tropical depression; when its maximum sustained surface wind speed is 34–63 kt it is called a tropical storm and usually given a name; when its maximum sustained surface wind speed is 64 kt or more it is called a hurricane; and when its maximum sustained surface wind speed is 96 kt or more it is called a major or intense hurricane. Using the Saffir-Simpson Hurricane Wind Scale,[2] a major hurricane is one that is classified as category 3, 4, or 5, where category 4 means the storm has a maximum sustained surface wind speed exceeding 112 kt and category 5 means the storm has a maximum sustained surface wind speed exceeding 136 kt. Major hurricanes generally produce catastrophic damage measured in the tens of billions of United States (US) dollars when they make landfall along the populous US coastline (e.g., Andrew in 1992 and Katrina in 2005) and can result in tremendous loss of life (e.g., the Galveston, TX, category 4 hurricane of 1900, a storm that killed, at least 8,000 people).[3]

Although tropical cyclone occurrences in the North Atlantic basin have been documented historically going back several hundreds of years, a detailed record of their occurrences extends only from 1851 to the present.[4,5] While true, the record considered to be of greatest reliability is much shorter, extending only from about 1945 to the present, owing to the near continuous use of reconnaissance aircraft and especially Earth-orbiting satellites (since the 1960s).[6–9]

Beginning in 1953, tropical cyclones in the North Atlantic basin have been named using a list of names originated by the National Hurricane Center, although now the naming of tropical cyclones is maintained and updated by the World Meteorological Organization following a strict procedure.[10] The 21 yearly names of tropical cyclones are rotated and recycled every 6 yr, with new names being substituted when a name has been retired (i.e., after an especially deadly and/or costly tropical cyclone, like Katrina in 2005). In the event that a hurricane season produces more than 21 storms, additional storm names are employed using the Greek alphabet in sequential order (i.e., alpha, beta, gamma, etc.), as was the case in 2005 when 28 named storms occurred, the most ever to be recorded in a single season. Occasionally, however, a hurricane season might still produce at least one unnamed storm, as what happened in September 2011. (The practice of using alternating male and female names began in 1979, with male names being the first named storm for a yearly hurricane season in even-numbered years, as will be the case for the 2012 hurricane season—Alberto.)

Tropical cyclones are essentially large heat engines, drawing their strength from the condensation of water evaporated from the ocean's surface, which releases heat, thus driving the winds.[11] Warm sea surface temperature (at least 27 °C), lack of severe vertical wind shear, and clustering of thunderstorms are necessary conditions for the formation of a tropical cyclone. In a tropical cyclone, the most violent winds and rain occur near its center, with air rising outward at the top of the eyewall and relatively calm sinking air occurring within the storm's eye (typically, measuring tens of miles in diameter). Surrounding the eyewall and extending outward for a hundred miles or more are the spiral rainbands, which can be tens of miles wide and hundreds of miles long and often are the progenitors of tornadoes, especially in major hurricanes. Because the movement and direction of a tropical cyclone is governed by the interaction of complex atmosphere-ocean weather patterns, accurate forecasting of the strength and path of the storm sometimes can be quite difficult. Also, while strong, violent tropical cyclones are certainly ones not to be ignored, so too are weaker, slow-moving tropical cyclones, since these storms can be quite devastating as well, owing to their copious torrential rainfall and high potential for flooding.

In this Technical Publication (TP), the statistical aspects of tropical cyclones that formed in the North Atlantic basin during the interval 1945 to 2010 are investigated. In particular, the seasonal (or yearly) frequencies of tropical cyclones, tropical storms (i.e., those tropical cyclones that never attained hurricane wind speed), hurricanes, major hurricanes, and hurricanes striking the US coastline are examined and long-term trends (i.e., 10-year moving averages (10-yma)) are determined. Also examined are the statistical aspects (both seasonal and long term) of the positions of origin (i.e., latitude and longitude), peak wind speed and lowest air pressure, accumulated cyclone energy, number of storm days, and net tropical cyclone activity, as well as the statistical aspects (both seasonal and long term) of various markers of surface air temperature and El Niño-Southern Oscillation- (ENSO-) related indices and the interrelationship between these parameters, in particular as related to climatic change and tropical cyclone frequency.[12–19] Parametric values as determined for the 2011 hurricane season are reviewed, and estimates are given for the upcoming 2012 hurricane season. Lastly, examined are decadal variations of the tropical cyclone parameters, the 34 strongest tropical cyclones that occurred in the North Atlantic basin since 1945, and the frequency distributions of selected tropical cyclone parameters. This TP continues the long-term study of tropical cyclone activity and its relationship to climatic factors that has been ongoing since 1997.[20–30]

2. RESULTS AND DISCUSSION

2.1 Seasonal Frequencies of North Atlantic Basin Tropical Cyclones, 1945–2010

Table 1 (see appendix) gives a listing of the North Atlantic basin tropical cyclones for the interval 1945–2010, based on the National Hurricane Center's 'best tracks' archival database, available online at <http://www.nhc.noaa.gov>. For each year the storm number (SNBR), classification (Class.), first storm day (FSD), last storm day (LSD), genesis location (in terms of north latitude (N. LAT) and west longitude (W. LONG) positions), group (i.e., the regional location of the genesis location, where 1 refers to the Gulf of Mexico area, 2 the Caribbean Sea area, 3 the East coast area, 4 the lower North Atlantic-Cape Verde area, and 5 the upper open North Atlantic area), the peak wind speed (PWS), the lowest pressure (LP), the accumulated cyclone energy (ACE), the number of storm days (NSD), the number of hurricane days (NHD), the number of major hurricane days (NMHD), and information regarding US landfalling hurricanes (USLFHs). For each year, a summary is also given (including a calculation of the net tropical cyclone activity index, or NTCA), where the values inside <> represent seasonal averages.

From the summary data given in table 1, tables 2–5 (see appendix) are constructed, where table 2 gives the yearly tropical cyclone parametric values, table 3 gives the 10-yma, table 4 gives the differences (where the difference is $d = x - 10$-yma, x being the yearly value), and table 5 gives the first differences based on the 10-yma values (i.e., the difference in 10-yma values for two consecutive years). At the bottom of tables 2, 4, and 5 are the parametric means and standard deviations (*sd*) for each parameter. Also included in tables 4 and 5 are the number of positive ($n+$) and negative ($n-$) values and the number of positive runs ($n+r$) for each parameter. These tables form the basis for the following discussion regarding the frequency of tropical cyclones in the North Atlantic basin, including all tropical cyclones, tropical cyclones that attained only tropical storm strength, hurricanes, major hurricanes, and US landfalling hurricanes.

2.1.1 The Number of Tropical Cyclones

Figure 1(a) displays the yearly number of tropical cyclones (NTC) in the North Atlantic basin during the interval 1945–2010. The thin, jagged line represents the yearly variation of NTC and the thick, smoothed line represents the 10-yma of NTC (used here to indicate the long-term trend). The thin horizontal line represents the long-term mean frequency for the entire interval. Thus, for the interval 1945–2010, spanning 66 yr, some 715 tropical cyclones have been documented in the North Atlantic basin, yielding a mean of about 11 storms per year. The fewest number of storms during a single year measures 4 (occurring in 1983) and the greatest number of storms during a single year measures 28 (occurring in 2005). Prior to 1995, the average number of tropical cyclones that formed in the North Atlantic basin measured about 9.6 storms per year, while from 1995 onwards, the average number has measured about 14.8 storms per year, an increase of about 54%. Indeed, the difference in means for the two time intervals (1945–1994 versus 1995–2010) is found to be statistically important ($t = -5.39$) at confidence level (*cl*) >99.9%, on the basis of the t-statistic for independent

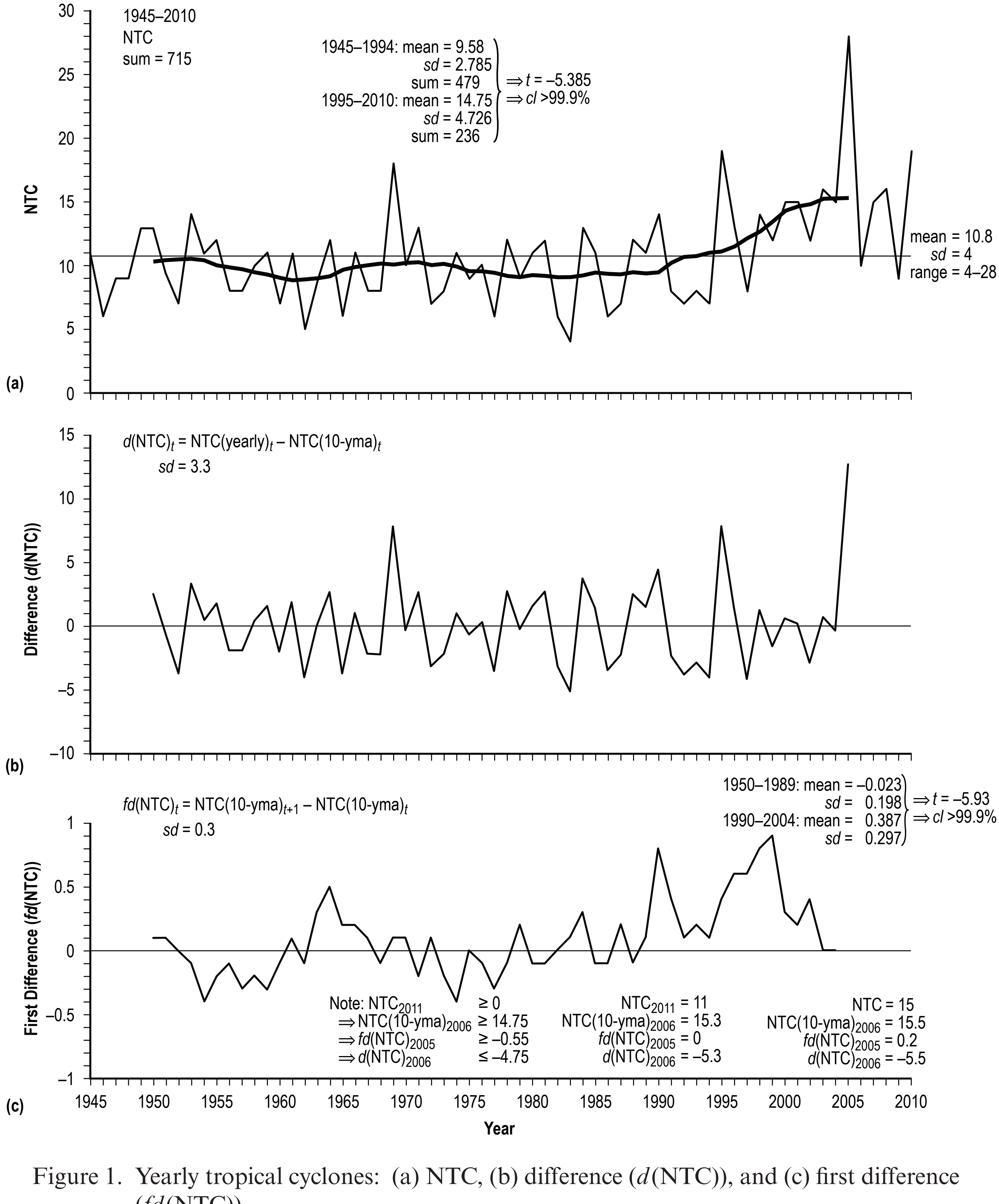

Figure 1. Yearly tropical cyclones: (a) NTC, (b) difference (d(NTC)), and (c) first difference (fd(NTC)).

samples.[31] Obviously, a shift has occurred from a former less active interval to a more active interval that now is being experienced today. How long this active state will persist depends on whether it is part of a quasi-cyclic occurrence of less active and more active intervals or if it is the direct result of climatic change (i.e., the long-term warming of the atmosphere and oceans that the Earth now is experiencing).

Presuming the current, more active state will continue at least for the near-term, foreseeable future, one easily predicts that NTC should average about 15 storms per year with a ±1 *sd* about the mean of about 5 storms, suggesting a yearly rate between 10 and 20 storms per year (the ±1 *sd* prediction interval), assuming a normal distribution. The 50% prediction interval is 14.8 ± 3.3, inferring that there is a 50% chance that NTC for any given year will lie within the range of about 12–18 storms per year during this current, more active interval. The 90% prediction interval is computed to be about 14.8 ± 8.3, yielding the larger range of about 7–23 storms per year; hence, one infers only a 5% chance each that 6 or fewer storms or 24 or more storms would be expected in any given year during this current, more active interval, presuming, of course, a normal distribution for NTC.

Because NTC is a measure of the number of events per unit time (i.e., the number of tropical cyclones per year) and clearly is positively skewed (i.e., a rightward tail towards higher numbers), the more appropriate distribution is the Poisson distribution.[32] Table 6 (see appendix) gives the Poisson probabilities for a specific number of events (r) occurring per year, table 6A for the entire interval (1945–2010) and 6B for the current, more active interval (1995–2010). The central 50% interval for the two time intervals are approximately 10 ± 2 (actually 55%) and 14 ± 2 (actually 48%), respectively. By summing specific ranges of r, one can deduce the probability of observing that range of r's in any given season. Hence, the probability of having 20 or more tropical cyclones per year during the current, more active interval is computed to be $P(20) + P(21) + P(22) + \ldots + P(35) = 12.4\%$, or about 1 chance in 8. Similarly, the probability of having 10 or fewer tropical cyclones per year during the current, more active interval is computed to be about 12.9%, also about 1 chance in 8. Therefore, the probability of having a rate of about 11–19 tropical cyclones in any given season during this current, more active interval measures about 75% (i.e., 100% – 12.4% – 12.9% = 74.7%), based on Poisson statistics.

Figure 1(b) shows the variation of the difference $d(\mathrm{NTC})_t$, where the $d(\mathrm{NTC})_t = \mathrm{NTC(yearly)}_t - \mathrm{NTC(10\text{-}yma)}_t$ and t is the year in question. Visual inspection of $d(\mathrm{NTC})_t$ reveals that there have been 29 positive differences, 27 negative differences, and 19 positive difference runs (18 negative difference runs) between 1950 and 2005, with $sd = 3.3$ (thereby, inferring a reduction in the variance by about 32%). So, presuming that $d(\mathrm{NTC})_t$ is distributed normally, one expects it to measure about ±3.3 units for any given year (i.e., the ±1 *sd* prediction interval). Unfortunately, this poses an untenable conclusion regarding its value for 2006. The yearly NTC for 2006 is already known to be 10. It can be shown (see note at the bottom of fig. 1(c)) that $d(\mathrm{NTC})$ for 2006 must be at least –4.75 or more negative in value. As an example, a value of NTC = 0 in 2011 results in a 10-yma of NTC for 2006 equal to 14.75 and a yearly $d(\mathrm{NTC})$ for 2006 equal to –4.75 (= 10 – 14.75). Instead, using the long-term average (11 storms per year), one finds that the 10-yma of NTC for 2006 equals 15.3 and the yearly $d(\mathrm{NTC})$ for 2006 equals –5.3, while using the current, more active interval average (15 storms per year) one finds that the 10-yma of NTC for 2006 equals 15.5 and the yearly $d(\mathrm{NTC})$ for 2006 equals –5.5. Any value of NTC higher than the current, more active interval average (i.e., NTC >15) for 2011 results in an even higher value of the 10-yma of NTC (>15.5) for 2006 and a more negative value of d(NTC) for 2006 (more negative than –5.5). Runs testing[33] of $d(\mathrm{NTC})_t$ suggests that the distribution of positive difference runs for d(NTC) might be nonrandom (z = 2.39, cl > 95%), inferring that a systematic variation, perhaps, is present within the data.

Figure 1(c) depicts the variation of $fd(\mathrm{NTC})_t$, where $fd(\mathrm{NTC})_t = \mathrm{NTC}(10\text{-yma})_{t+1} - \mathrm{NTC}(10\text{-yma})_t$ and t is again the year. The average first difference during the current, more active interval measures about 0.39, having sd = 0.3, while the average first difference for the years prior to 1995 measures –0.02, having sd = 0.2. The difference in the means is statistically important at cl >99.9%. Plainly, the number of positive-valued first differences is found to greatly outnumber the number of negative-valued first differences, especially in the current, more active interval. In fact, visual inspection of $fd(\mathrm{NTC})_t$ reveals that there have been 34 positive first differences, 21 negative first differences, and 10 positive first difference runs (9 negative first difference runs) between 1950 and 2004, with sd = 0.3. Presuming that $fd(\mathrm{NTC})_t$ is distributed normally, one expects it to measure about ±0.3 units for any given year (i.e., the ±1 sd prediction interval). As with $d(\mathrm{NTC})_t$, runs testing of $fd(\mathrm{NTC})_t$ suggests that the distribution of positive-valued first difference runs might also be nonrandom (z = –2.02, cl >95%). It seems noteworthy that the current, more active interval of positive-valued first differences now spans at least 16 yr, beginning in 1989 (i.e., $0 \le fd \le 0.9$), averaging 0.4 and having sd = 0.3. A linear fit of $fd(\mathrm{NTC})_t$ versus t (for all t between 1950 and 2005) results in the linear regression $y = -18.383 + 0.009x$, where x is the year and y is the expected first difference. The inferred regression (not shown) has a linear correlation coefficient r = 0.513, a coefficient of determination r^2 = 0.263 (meaning that 26.3% of the variance can be explained by the inferred regression), a standard error of estimate se = 0.4, and cl >99.5%. Thus, indeed, there appears to be a systematic, long-term increase in the first difference of 10-yma values of NTC with time (year) during the interval 1950–2004.

Table 7 (see appendix) compares the observed (OBS) and expected (EXP) first differences for the interval 1950–2004, where the observed values are those taken from table 5 and the expected values are those deduced using the inferred regression. The residual (RES) is computed as the difference between the two values (i.e., RES = OBS – EXP). At the bottom of table 7 are located the number of positive residuals ($n(+)$), the number of negative residuals ($n(-)$), the number of positive residual runs ($(n+r)$), the normal deviate z for the sample results, the cl, and the decision based on hypothesis testing as to whether or not the residuals appear to be randomly (yes) or nonrandomly (no) distributed. Indeed, it appears that the residuals (having removed an inferred linear increase) are randomly distributed, with the bulk of the residuals occurring in the interval –0.3 to 0.3 (49 of 55 residual values, or about 89%). The interval –0.1 to 0.1 contains 27 of 55 residual values (49%). Only two residual values are more negative than –0.3 (–0.4 in 1977 and –0.5 in 1974) and only four residual values exceed 0.3 (0.5 in 1964 and 1998 and 0.6 in 1990 and 1999). So, for 2005, one infers its expected first difference to be 0.4 (from the regression), thereby suggesting that the 10-yma of NTC for 2006 will be about 15.7 ± 0.3 (i.e., 15.3 + 0.4 ± 0.3, where 15.3 is the 10-yma of NTC for 2005, 0.4 is the expected first difference from the inferred regression, and ±0.3 is the standard error of estimate). In actuality, the 10-yma of NTC for 2006, indeed, turned out to be 15.7, owing to NTC = 19 in 2011, thereby yielding a first difference of 0.4 for 2005 (and a difference d = –5.7 for 2006). Presuming the inferred regression remains valid for 2006, one expects a first difference of 0.4 for 2006 and a 10-yma of NTC of 15.7 + (0.4 ± 0.3), or about 16.1 ± 0.3 for 2007. Hence, one anticipates a 10-yma of NTC ≥15.8 for 2007, a first difference $fd \geq 0.1$ for 2006, a difference $d \geq 0.8$ for 2007, and NTC ≥10 for 2012 (perhaps as high as 22, the upper limit of the ±1 *sd* prediction interval). (The 10-yma NTC has a minimum value of 15.3 for the year 2007, computed by assuming a frequency of zero NTC in 2012.)

2.1.2 The Number of Tropical Cyclones of Tropical Storm Strength Only

Figure 2 is constructed similarly to figure 1 and is drawn from the data tabulated in tables 2–5. For the interval 1945–2010, the number of tropical cyclones of tropical storm strength only (NTS) is found to average about 5 storms per year, with a range of 1 to 13 storms per year and *sd* of 2.3 storms per year. Thus, on average, about 40% of all tropical cyclones (i.e., 306/715 = 43%) that formed in the North Atlantic basin between 1945 and 2010 never strengthened beyond tropical storm strength (i.e., maximum sustained surface wind speed 34–63 kt). The fewest NTS (1) occurred in 1983 and the most (13) occurred in 2005. Also, noticeable is that the number of tropical storms forming in the North Atlantic basin has increased dramatically from an average of about 3.9 tropical storms per year during the interval prior to 1995 to an average of about 6.8 tropical storms per year since 1995, an increase of about 74%. Thus, a large part of the increase in tropical cyclone formation in the North Atlantic basin since 1945 can be attributed directly to an increase in the number of tropical cyclones of tropical storm strength only. Runs testing of $d(\text{NTS})_t$ suggests that its distribution is random ($z = 1.43$, $cl < 90\%$), having a range of –3 to 5.3 and *sd* of 1.9. In contrast, runs testing of $fd(\text{NTS})_t$ suggests that its distribution is nonrandom ($z = -2.79$, $cl > 99\%$), having a range of –0.3 to 0.4 and *sd* of 0.2. Indeed, a linear fit of $fd(\text{NTS})_t$ versus t results in the regression (not shown) $y = -10.069 + 0.005x$, where x is the year and y is $fd(\text{NTS})_t$, the inferred regression having $r = 0.426$, $r^2 = 0.182$ (meaning 18.2% of the variance can be explained by the inferred regression), $se = 0.22$, and $cl > 98\%$. For 2005, one infers $fd(\text{NTS})_t = 0.2 \pm 0.2$ (the ±1 *sd* prediction interval), suggesting the 10-yma of NTS to be about 7.7 + 0.2 ± 0.2 and the yearly NTS to be about 6 to 14 for 2011. In actuality, NTS for 2011 measured 12, the second highest NTS on record behind the 13 NTS that occurred in 2005, the 10-yma of NTS for 2006 measures 8, and the $fd(\text{NTS})$ measures 0.3. Presuming the inferred regression remains valid for 2006, one expects a first difference of 0.2 for 2006 and a 10-yma of NTS = 8 + (0.2 ± 0.2), or about 8.2 ± 0.2 for 2007. Hence, one anticipates a 10-yma of NTS ≥8 for 2007, a first difference ≥0 for 2006, and NTS ≥2 for 2012 (perhaps as high as 10). (A comparison of the first difference means for the interval prior to 1995 and subsequent to 1995 also clearly shows that the difference in means is statistically important, having $cl > 99.9\%$. The average first difference in the current, more active interval measures 0.22, with *sd* of 0.19. The 10-yma NTS has a minimum value of 7.9 for the year 2007, computed by assuming a frequency of zero NTS in 2012.)

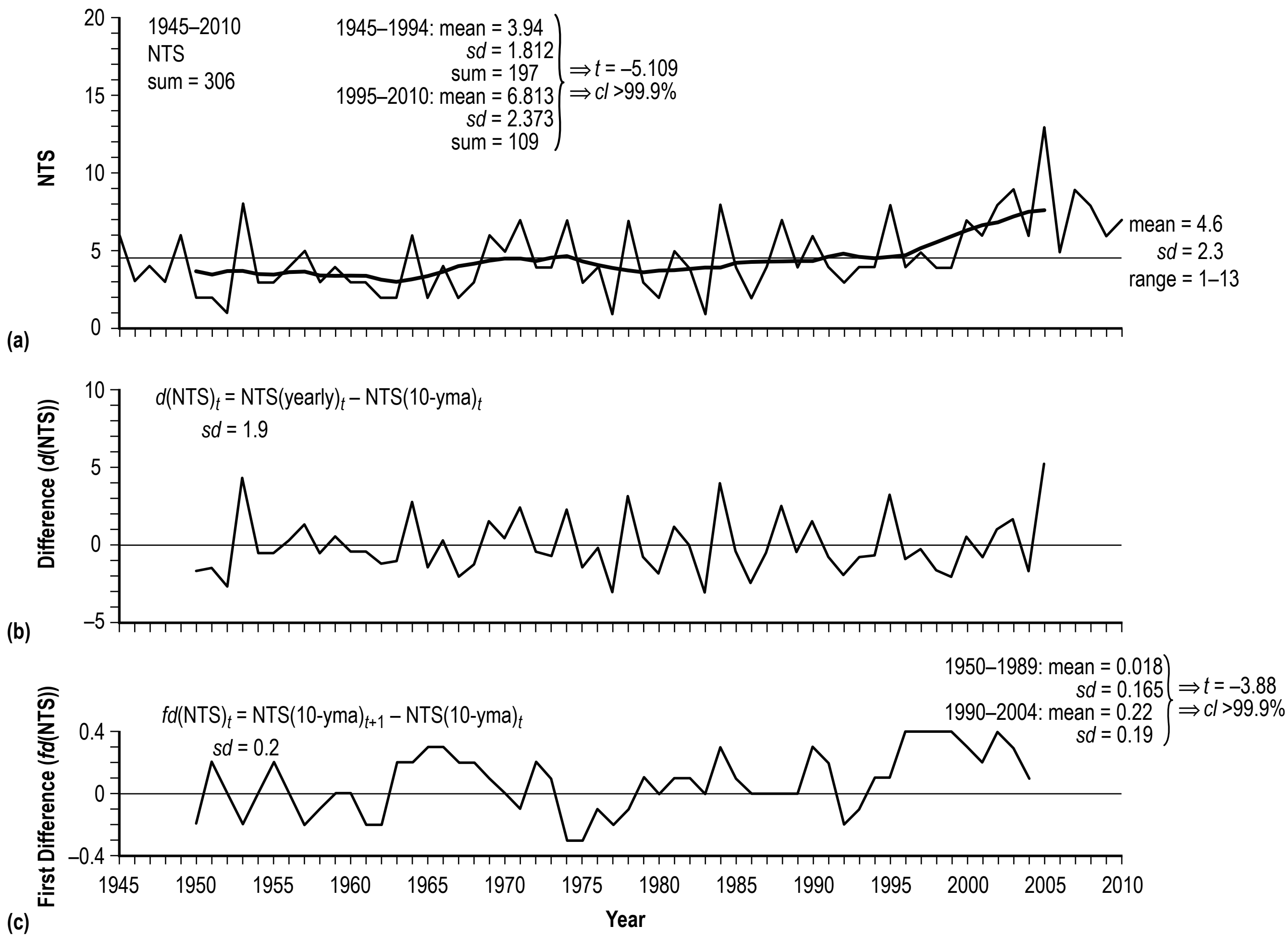

Figure 2. Yearly tropical storms: (a) NTS, (b) difference (d(NTS)), and (c) first difference (fd(NTS)).

Figure 3 displays the yearly ratios of NTS to NTC for the interval 1945–2010. While the ratios appear to be randomly distributed about the mean of 0.42, having an *sd* of 0.14, and range of 0.14 to 0.67, and, the number of ratios below the mean appears to occur slightly more often during the interval 1945 to 1977 (22 of 33 ratios) than during the interval 1978 to 2010 (18 of 33 ratios). For 2011, the ratio measures 0.63 (= 12/19).

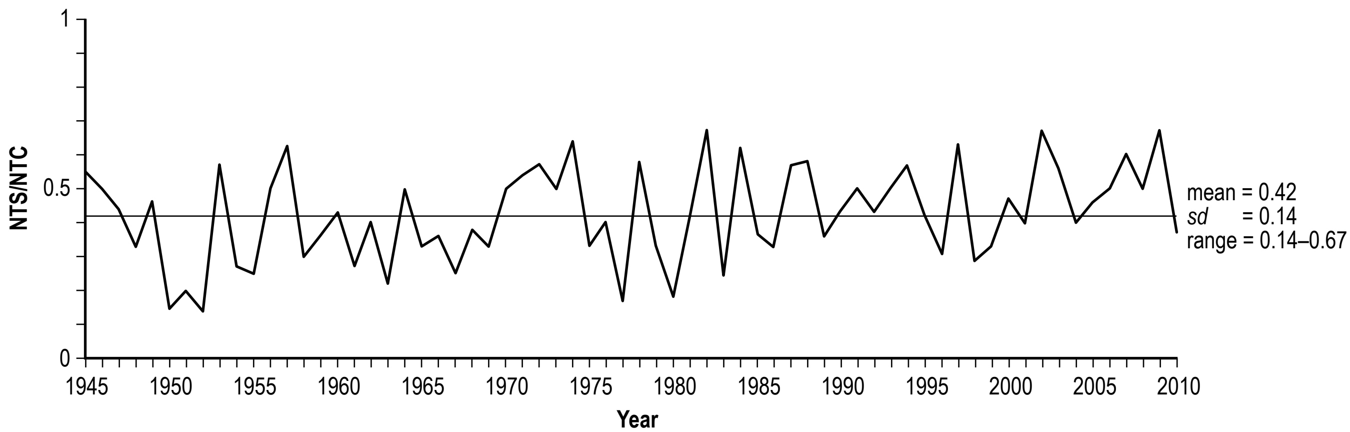

Figure 3. The ratio NTS/NTC versus year.

Based on Poisson statistics (see table 6) for the current, more active interval, one finds $P(r = 4\text{–}8) = 66.2\%$ for NTS. For $r < 4$, $P(r < 4) = 9.3\%$, or about 1 chance in 10, and for $r > 8$, $P(r > 8) = 24.5\%$, or about 1 chance in 4. There is about 1 chance in 22 for NTS ≥12 ($P(r \geq 12) = 4.5\%$).

2.1.3 The Number of Tropical Cyclones of Hurricane Strength

Figure 4 is similarly constructed to figures 1 and 2, being drawn from the data given in tables 2–5. For the interval 1945–2010, the number of hurricanes (NH) is found to average about 6 storms per year, with a range of 2 to 15 storms per year and *sd* of 2.6 storms per year. Thus, about 60% of the tropical cyclones that form in the North Atlantic basin eventually strengthen into hurricanes (i.e., 409/715 = 57%), having a maximum sustained surface wind speed in excess of 63 kt. The fewest NH (2) occurred in 1982 and the most (15) occurred in 2005. As with NTC and NTS, the average for NH is higher since 1995 than before 1995, 7.9 storms per year as compared to 5.6 storms per year, an increase of about 41% (*cl* >99.8%).

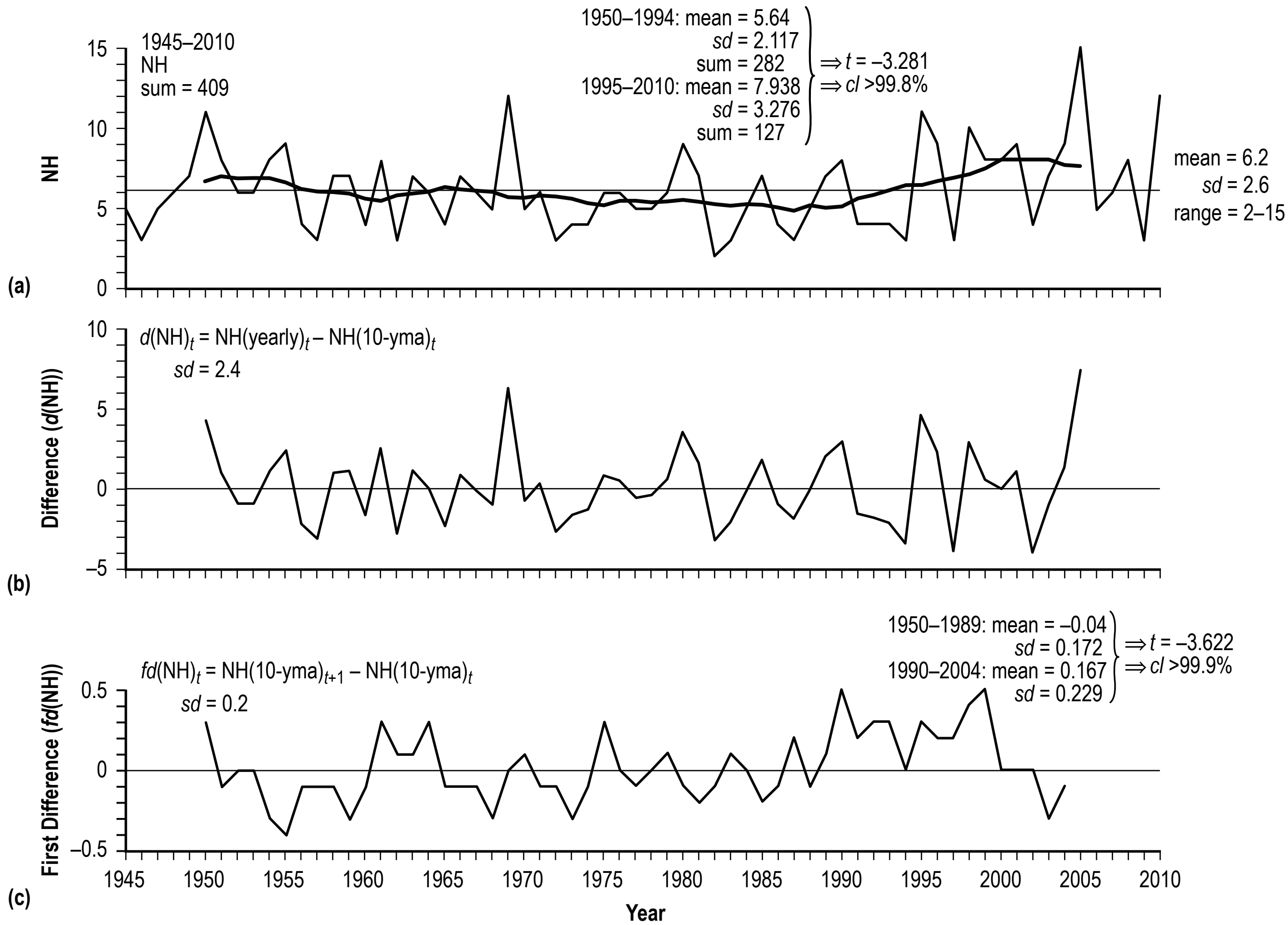

Figure 4. Yearly hurricanes: (a) NH, (b) difference (*d*(NH)), and (c) first difference (*fd*(NH)).

Runs testing of $d(\mathrm{NH})_t$ reveals that its distribution appears random, having $z = 0.27$, $cl < 90\%$, and $sd = 2.4$. However, as was the case for NTC and NTS, the distribution of the first differences of NH appears to be nonrandom, having $z = -2.79$, $cl > 99\%$, and $sd = 0.2$. The mean first difference for the interval prior to 1995 measures –0.04, having $sd = 0.17$, while the mean first difference for the interval since 1995 measures 0.167, having $sd = 0.23$. The difference in means is found to be statistically important, having $cl > 99.9\%$. A linear fit of $fd(\mathrm{NH})_t$ versus t results in the regression (not shown) $y = -8.328 + 0.004x$, where x is the year and y is $fd(\mathrm{NH})_t$, $r = 0.324$, $r^2 = 0.105$, $se = 0.32$, and $cl > 95\%$. For 2005, one infers $fd(\mathrm{NH})_t = 0.13 \pm 0.32$ (the ±1 *sd* prediction interval), suggesting the 10-yma of NH to be about 7.6 + 0.1 ± 0.3 and NH for 2011 to be about 1 to 13. In actuality, NH for 2011 measured 7 (about average in number), the 10-yma of NH for 2006 measures 7.7, and the *fd*(NH) measures 0.1. Presuming the inferred regression remains valid for 2006, one expects a first difference of about 0.1 for 2006 and a 10-yma of NH of 7.7 + (0.1 ± 0.3), or about 7.8 ± 0.3 for 2007. Hence, one anticipates a 10-yma of NH ≥7.5 for 2007, a first difference ≥–0.2 for 2006, and NH ≥2 for 2012 (perhaps as high as 14). (A comparison of the first difference means for the interval prior to 1995 and subsequent to 1995 also clearly shows that the difference in means is statistically important, having $cl > 99.9\%$. The average first difference in the current, more active interval measures 0.17, with *sd* of 0.23. The 10-yma NH has a minimum value of 7.4 for the year 2007, computed by assuming a frequency of zero NH in 2012.)

Based on Poisson statistics (see table 6) for the current, more active interval, one finds $P(r = 5–9) = 49.8\%$ for NH. For $r < 5$, $P(r < 5) = 10.5\%$, or about 1 chance in 10, and for $r > 9$, $P(r > 9) = 39.7\%$, or about 4 chances in 10. There is about 1 chance in 4 for NH ≥12 ($P(r \geq 12) = 23.1\%$).

2.1.4 The Number of Tropical Cyclones of Major Hurricane Strength

As with the preceding summary figures, figure 5 is similarly constructed, drawing from tables 2–5. For the interval 1945–2010, the number of major or intense hurricanes (NMH) is found to average about 3 storms per year, with a range of 0 to 8 storms per year and *sd* of 1.9 storms per year. Thus, about 25% of the tropical cyclones that form in the North Atlantic basin eventually strengthen into major hurricanes (i.e., 179/715 = 25%), having a maximum sustained surface wind speed in excess of 95 kt. About 44% of those tropical cyclones that attain hurricane status eventually become major hurricanes (i.e., 179/409 = 44%). The fewest NMH (0) occurred in 1968, 1972, 1986, and 1994, and the most (8) occurred in 1950. As with NTC, NTS, and NH, the average for NMH is higher since 1995 than before 1995, 3.81 storms per year as compared to 2.36 storms per year, respectively, an increase of about 62% (*cl* >99%). It should be noted that the values of NMH now being experienced (in particular, the 10-yma values of NMH) are very similar to those experienced earlier in the 1950s and 1960s. This suggests, perhaps, that, like the 1950s and 1960s, the present interval is one best described as having increased activity (more active), being in stark contrast with that of the preceding interval of the 1970s and 1980s, which is one best described as having reduced activity (less active), at least in terms of NMH. The question remains, however, regarding the basis for this behavior for NMH: Is its behavior reflective of one that is quasi-cyclic in nature (i.e., consisting of cycles of more and less activity, each tens of years in length) or is its behavior reflective of one that is directly attributable to climatic change (i.e., driven by increasing temperature)? It also seems noteworthy that, although today's 10-yma values of NMH (averaging about 3.8 storms per year) are similar to those of the early 1950s, presently, they still fall slightly below that of the earlier maximum value (4 storms per year in 1953 and 1954). Does this mean that the current active interval has not yet peaked, but will continue for another decade or so before weakening to levels indicative of another less active interval (presuming a cyclic cause) or will it continue to increase unabatedly (presuming a climatic change cause, perhaps, due to increased warming of the atmosphere and oceans)?

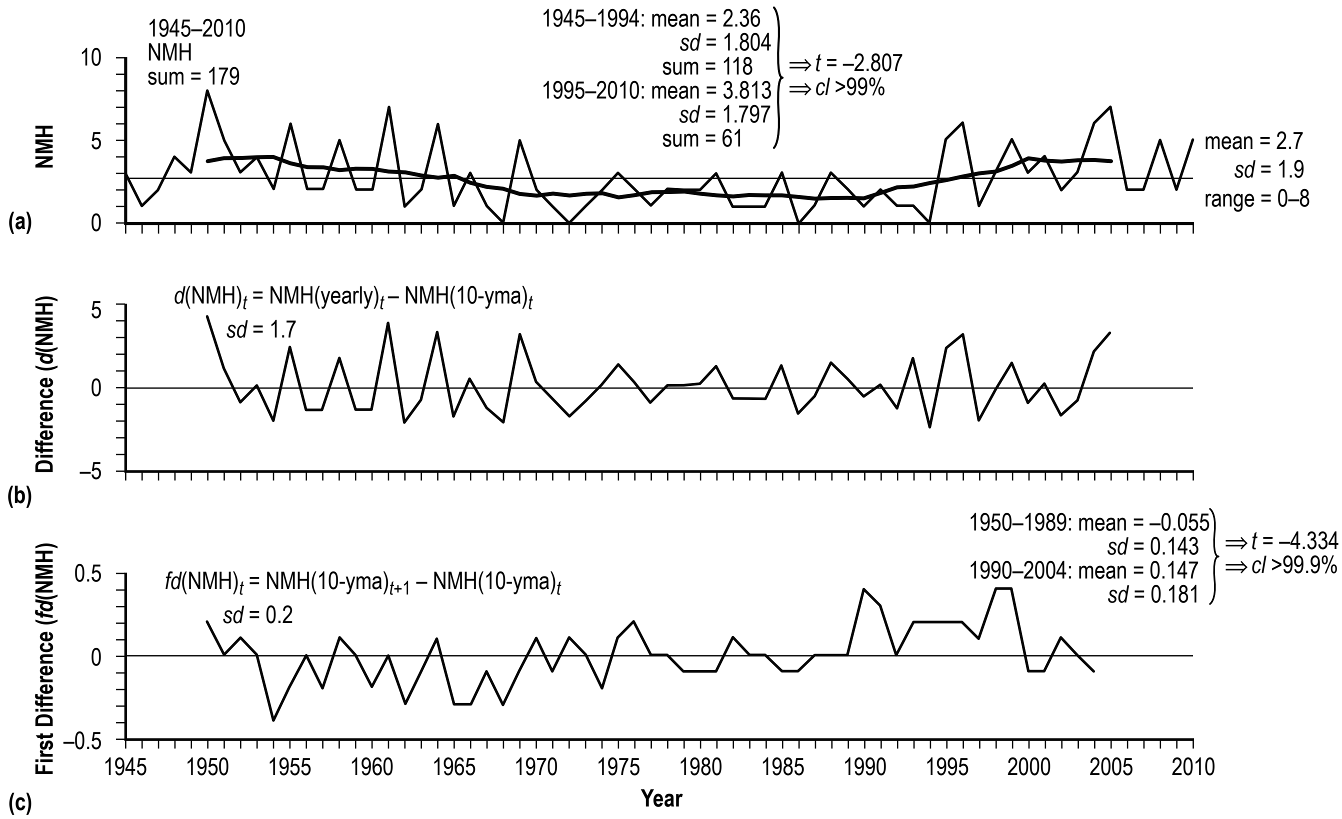

Figure 5. Yearly major hurricanes: (a) NMH, (b) difference (d(NMH)), and (c) first difference (fd(NMH)).

Runs testing of $d(\text{NMH})_t$ and $fd(\text{NMH})_t$ reveals that both distributions probably are random, having $z = 1.86$, $cl >90\%$, and $sd = 1.7$ and $z = -1.46$, $cl <90\%$, and $sd = 0.2$, respectively. The mean difference is expected to be about ±1.7 (±1 sd prediction interval) and the mean first difference is expected to be about ±0.2. Hence, for 2006, $d(\text{NMH})_t$ was expected to measure about ±1.7 and $fd(\text{NMH})_t$ about ±0.2, inferring the 10-yma of NMH for 2006 to be about 2 ± 1.7 (based on the difference) or about 3.7 ± 0.2 (based on the first difference). In actuality, NMH measured 3 for 2011, yielding the 10-yma value of NMH to be 3.75, thereby yielding $d = 1.75$ for 2006 and $fd = 0.05$ for 2005. Assuming the mean difference and first difference values remain valid for 2007 and 2006, respectively, one anticipates a 10-yma of NMH of 2 ± 1.7 (based on the expected difference, 2 being the observed value for NMH in 2007) or 3.75 ± 0.2 (based on the expected first difference, 3.75 being the 10-yma of NMH for 2006), inferring NMH = 3 ± 4 for 2012 (i.e., NMH = 0–7).

A comparison of the first difference means for the interval prior to 1995 and subsequent to 1995 also clearly shows that the difference in first difference means is statistically important, having $cl >99.9\%$. The average first difference in the current, more active interval measures 0.15, with sd of 0.18. Presuming the first difference will be 0.15 ± 0.18 for 2006, one infers that the 10-yma of NMH for 2007 will be 3.75 ± 0.15 ± 0.18, or about 3.9 ± 0.2, inferring NMH = 6 ± 4 in 2012 (i.e., NMH = 2–10). (The 10-yma NMH has a minimum value of 3.7 for the year 2007, computed by assuming a frequency of zero NMH in 2012.)

Based on Poisson statistics (see table 6) for the current, more active interval, one finds $P(r = 2–4) = 56\%$ for NMH. For $r < 2$, $P(r < 2) = 10.7\%$, or about 1 chance in 10, and for $r > 4$, $P(r > 4) = 33.2\%$, or about 1 chance in 3. There is about 1 chance in 10 for NMH ≥7 ($P(r \geq 7) = 9.1\%$).

2.1.5 The Number of US Landfalling Hurricanes

As with the preceding summary figures, figure 6 is similarly constructed and draws data from tables 2–5. For the interval 1945–2010, the number of US landfalling hurricanes (NUSLFH) is found to average about 1–2 storms per year, with a range of 0 to 6 storms per year and *sd* of 1.5 storms per year. Thus, about 15% of the tropical cyclones that form in the North Atlantic basin eventually strengthen into hurricanes that strike the US coastline with hurricane-force winds (maximum sustained surface winds in excess of 63 kt; 108/715 = 15%). Of these, more than one-third (40/108 = 37%) have struck the US as major hurricanes, the two largest being Camille in 1969 (striking Louisiana and Mississippi) and Andrew in 1992 (striking Florida), both striking the US coastline as category 5 hurricanes (maximum sustained surface wind speed in excess of 136 kt).

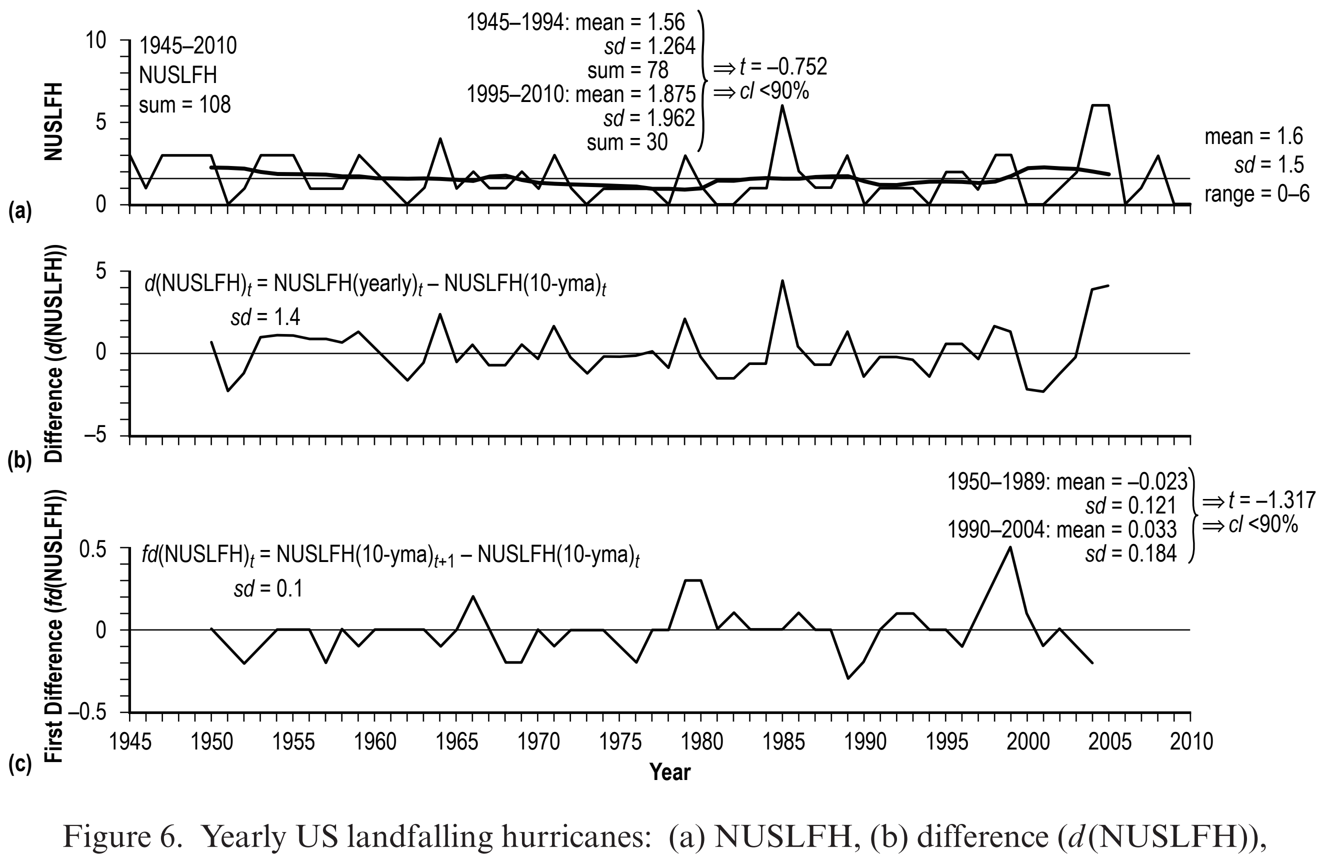

Figure 6. Yearly US landfalling hurricanes: (a) NUSLFH, (b) difference (d(NUSLFH)), and (c) first difference (fd(NUSLFH)).

Examination of figure 6 (and table 2) reveals that only 13 of the 66 yr have had no US landfalling hurricanes, these occurring in the years 1951, 1962, 1973, 1978, 1981, 1982, 1990, 1994, 2000, 2001, 2006, 2009, and 2010. Only three times have there been back-to-back years when no US landfalling hurricanes occurred (1981–1982, 2000–2001, and 2009–2010), and there has never been a 3-yr respite between US landfalling hurricanes. For nearly half the seasons, a US landfalling hurricane has struck as a major hurricane (31/66 yr, or 47%). Fifteen years had back-to-back strikes by major hurricanes along the US coastline; 6 yr had major hurricanes striking along the US coastline after a 1-yr respite; 4 yr each had major hurricane strikes along the US coastline after a 2- and 3-yr respite; and only 1 yr (excluding the present respite) had a major hurricane strike along the US coastline after a 5-yr respite. Including the 2011 season, the respite in major hurricane strikes along the US coastline now spans 6 yr, the longest such respite in the interval 1945–2011. (The last strike by a major hurricane along the US coastline was Wilma in 2005, which struck Florida as a category 3 storm; the 2011 season had one US landfalling hurricane, Irene, but it struck North Carolina as a category 1 storm in August.)

Usually, the major hurricanes that strike the US coastline are singular seasonal events. Of the 40 major hurricanes that have struck the US in 31 seasons, 25 struck the US coastline at the rate of one major hurricane strike per season (25/40 = 63%). Fifteen major hurricanes struck the US coastline at the rates of 2–4 major hurricane strikes per season over 6 seasons, including 8 major hurricane strikes of the US coastline at the rate of 2 strikes per season (1950, 1955, 1985, and 2004), 3 major hurricane strikes in a single season (1954), and 4 major hurricane strikes in a single season (2005).

Of the 40 major hurricane strikes along the US coastline, 27 struck a single state at major hurricane strength (27/40 = 68%) and 13 struck multiple states at major hurricane strength: 8 major hurricanes striking two states at major hurricane strength and 5 major hurricanes striking three states at major hurricane strength. For example, an unnamed storm in 1947 first struck Florida as a category 4 storm, then went on to strike both Louisiana and Mississippi as a category 3 storm. In 1954, Carol struck New York, Connecticut, and Rhode Island as a category 3 storm. In 1960, Donna first struck Florida as a category 4 storm, prior to striking both North Carolina and New York as a category 3 storm. In 1985, Elena struck the states of Alabama, Mississippi, and Florida as a category 3 storm. Lastly, in 1992, Andrew struck the state of Florida twice (first the east coast then the west coast), first as a category 5 storm then as a category 4 storm, and continued onwards striking Louisiana as a category 3 storm.

Runs testing of $d(\mathrm{NUSLFH})_t$ and $fd(\mathrm{NUSLFH})_t$ reveals that both distributions are probably random, having $z = 0.28$, cl <90%, and $sd = 1.4$ and $z = -0.89$, cl <90%, and $sd = 0.1$, respectively. The mean difference is expected to be about ±1.4 (±1 sd prediction interval) and the mean first difference is expected to be about ±0.1. Hence, for 2006, $d(\mathrm{NUSLFH})_t$ was expected to measure about ±1.4 and $fd(\mathrm{NUSLFH})_t$ about ±0.1, inferring the 10-yma of NUSLFH for 2006 to be about 0 ± 1.4 (based on the difference) or about 1.9 ± 0.1 (based on the first difference). In actuality, NUSLFH measured 1 for 2011, yielding the 10-yma value of NUSLFH to be 2, thereby yielding the difference for 2006 to be 2 and the first difference for 2005 to be 0.1. Assuming the mean difference and first difference values remain valid for 2007 and 2006, respectively, one anticipates a 10-yma of NUSLFH for 2007 of 1 ± 1.4 (based on the expected difference, 1 being the observed yearly value for NUSLFH in 2007) and 2 ± 0.1 (based on the expected first difference, 2 being the 10-yma of NUSLFH for 2006), inferring NUSLFH = 1 ± 4 for 2012 (i.e., NUSLFH = 0–5).

A comparison of the first difference means for the interval prior to 1995 and subsequent to 1995 clearly shows that the difference in means is not statistically important, having *cl* <90%. The average first difference in the current, more active interval measures 0.03, with *sd* of 0.18. Presuming the first difference will be 0.03 ± 0.18 for 2006, one infers that the 10-yma of NUSLFH for 2007 will be 2 + 0.03 ± 0.18 or about 2.03 ± 0.18, inferring NUSLFH = 2 ± 4 in 2012 (i.e., NUSLFH = 0–6). (The 10-yma NUSLFH has a minimum value of 1.95 for the year 2007, computed by assuming a frequency of zero NUSLFH in 2012.)

Based on Poisson statistics (see table 6) for the current, more active interval, one finds $P(r = 0–2) = 70.4\%$ for NUSLFH. For $r = 0$, $P(r = 0) = 15\%$, or about 1 chance in 7, and for $r > 2$, $P(r > 2) = 29.6\%$, or about 3 chances in 10. There is about 1 chance in 8 for NUSLFH ≥4 ($P(r \geq 4) = 12.5\%$).

2.2 The Monthly Distribution of Tropical Cyclones, 1945–2010

Tables 8–12 give year-by-year monthly counts of the onsets of all tropical cyclones (table 8), those tropical cyclones that attained only tropical storm strength (table 9), hurricanes (table 10), major hurricanes (table 11), and US landfalling hurricanes (table 12). Table 13 provides the Poisson probabilities for onsets in the months of June–November, the nominal hurricane season in the North Atlantic basin. Each table will be described separately in the appropriate subsections that follow (see appendix for individual tables).

2.2.1 Tropical Cyclones

For the interval 1945–2010, 715 tropical cyclones formed in the North Atlantic basin. Of these, only 22 (table 8) had onsets outside the nominal hurricane season. Thus, 693 (97%) had their onsets during the June–November hurricane season. Of the 693 tropical cyclones that occurred during the nominal hurricane season, 38 (5.5%) occurred in June, 62 (8.9%) in July, 188 (27.1%) in August, 245 (35.4%) in September, 125 (18%) in October, and 35 (5.1%) in November. Together, more than 60% of the tropical cyclones had their onsets in the months of August and September (433/693 = 62.5%), and the combined months of August, September, and October account for about 80% of all tropical cyclone onsets in the North Atlantic basin (558/693 = 80.5%). In the interval 1945–2010, every year saw an onset of at least one tropical cyclone in September, and all but 2 yr (1961 and 1997) saw an onset of at least one tropical cyclone in August. For October, at least one tropical cyclone occurred in every year except the years 1956, 1960, 1966, 1972, 1983, 1986, 1993, 1994, 2002, and 2006.

For the month of June, 31 of the 66 yr had at least one tropical cyclone onset, and 6 of the 66 yr had at least 2 onsets. Only the year 1968 saw at least 3 onsets in June. (The year 2011 saw one tropical cyclone onset in June.)

For the month of July, 37 of the 66 yr had at least one tropical cyclone onset, 15 of the 66 yr had at least 2 onsets, 5 of the 66 yr had at least 3 onsets, and 4 of the 66 yr had at least 4 onsets. Only the year 2005 saw at least 5 onsets in July. (The year 2011 saw 3 onsets in July.)

For the month of August, 64 of the 66 yr had at least one tropical cyclone onset, 52 of the 66 yr had at least 2 onsets, 37 of the 66 yr had at least 3 onsets, 23 of the 66 yr had at least 4 onsets, 6 of the 66 yr had at least 5 onsets, 3 of the 66 yr had at least 6 onsets, and 2 of the 66 yr had at least 7 onsets. Only the year 2004 saw at least 8 onsets in August. (The year 2011 saw 7 onsets in August.)

For the month of September, 66 of the 66 yr had at least one tropical cyclone onset, 63 of the 66 yr had at least 2 onsets, 48 of the 66 yr had at least 3 onsets, 29 of the 66 yr had at least 4 onsets, 17 of the 66 yr had at least 5 onsets, 9 of the 66 yr had at least 6 onsets, and 6 of the 66 yr had at least 7 onsets. Only the years 2002, 2007, and 2010 saw at least 8 onsets in September. Since the year 2000, every year except 2009 had at least 4 onsets in the month of September. (The year 2011 saw 6 onsets in September.)

For the month of October, 56 of the 66 yr had at least one tropical cyclone onset, 35 of the 66 yr had at least 2 onsets, 18 of the 66 yr had at least 3 onsets, 9 of the 66 yr had at least 4 onsets, 4 of the 66 yr had at least 5 onsets, and 2 of the 66 yr had at least 6 onsets. Only the year 2005 saw at least 7 onsets in October. (The year 2011 saw one onset in October.)

For the month of November, 27 of the 66 yr had at least one tropical cyclone onset, and 6 of the 66 yr had at least 2 onsets. Only the years 2001 and 2005 saw at least 3 onsets in November. (The year 2011 saw one onset in November.)

From table 13, the Poisson probabilities for the months of June–November are given. For the month of June, $P(r = 0) = 56\%$, $P(r < 2) = 88.5\%$, and $P(r < 3) = 97.9\%$. For the month of July, $P(r = 0) = 39.1\%$, $P(r < 2) = 75.8\%$, $P(r < 3) = 93\%$, and $P(r < 4) = 98.5\%$. For the month of August, $P(r = 0) = 5.8\%$, $P(r < 2) = 22.3\%$, $P(r < 3) = 45.8\%$, $P(r < 4) = 68.1\%$, $P(r < 5) = 84\%$, $P(r < 6) = 93\%$, and $P(r < 7) = 97.4\%$. For the month of September, $P(r = 0) = 2.4\%$, $\mathrm{P}(r < 2) = 11.5\%$, $P(r < 3) = 28.4\%$, $P(r < 4) = 49.2\%$, $P(r < 5) = 68.5\%$, $P(r < 6) = 82.9\%$, $P(r < 7) = 91.7\%$, and $P(r < 8) = 96.4\%$. For the month of October, $P(r = 0) = 15.1\%$, $P(r < 2) = 43.7\%$, $P(r < 3) = 70.6\%$, $P(r < 4) = 87.6\%$, and $P(r < 5) = 95.7\%$. For the month of November, $P(r = 0) = 58.6\%$, $P(r < 2) = 89.8\%$, and $P(r < 3) = 98\%$. Hence, there appears greater than 50% probability that one would not expect a tropical cyclone onset in June or November, but greater than 50% probability that one would expect at least 1 tropical cyclone onset in July, at least 3 onsets in August, at least 4 onsets in September, and at least 2 tropical onsets in October.

2.2.2 Tropical Cyclones That Attained Only Tropical Storm Strength

For the interval 1945–2010, 306 tropical cyclones occurred that only attained tropical storm strength (306/715 = 42.8%). Of these, only 18 (table 9) had onsets outside the nominal hurricane season in the North Atlantic basin. Thus, 288 (94%) had their onsets during the June–November hurricane season. Of the 288 tropical cyclones that attained only tropical storm strength during the nominal hurricane season, 26 (9%) occurred in June, 35 (12.2%) in July, 78 (27.1%) in August, 84 (29.2%) in September, 52 (18.1%) in October, and 13 (4.5%) in November. Together, nearly 60% of the tropical cyclones that attained only tropical storm strength had their onsets in the months of August and September (162/288 = 56.3%), and the combined months of August, September, and October account for about 75% (214/288 = 74.3%). In the interval 1945–2010, about 70% of the seasons saw an onset of at least one tropical cyclone that attained only tropical storm strength in the months of August and September, and about 50% of the seasons saw an onset of at least one in the month of October.

For the month of June, 25 of the 66 yr had at least one onset of a tropical cyclone that attained only tropical storm strength, and only 1 of the 66 yr had at least 2 onsets (2005). (The year 2011 saw one onset of a tropical cyclone that attained only tropical storm strength in June.)

For the month of July, 30 of the 66 yr had at least one onset of a tropical cyclone that attained tropical storm strength, 4 of the 66 yr had at least 2 onsets (1995, 1997, 2005, and 2006), and only 1 of the 66 yr had at least 3 onsets (1995). (The year 2011 saw 3 onsets in July.)

For the month of August, 44 of the 66 yr had at least one onset of a tropical cyclone that attained only tropical storm strength, 21 of the 66 yr had at least 2 onsets, 11 of the 66 yr had at least 3 onsets, and 2 of the 66 yr had at least 4 onsets (1984 and 1990). (The year 2011 saw 5 onsets in August.)

For the month of September, 47 of the 66 yr had at least one onset of a tropical cyclone that attained only tropical storm strength, 25 of the 66 yr had at least 2 onsets, 7 of the 66 yr had at least 3 onsets, and only 4 of the 66 yr had at least 4 onsets (1984, 2002, 2007, and 2010). (The year 2011 saw 2 onsets in September.)

For the month of October, 34 of the 66 yr had at least one onset of a tropical cyclone that attained only tropical storm strength, 14 of the 66 yr had at least 2 onsets, and only 4 of the 66 yr had at least 3 onsets (1953, 2000, 2003, and 2005). (The year 2011 saw no onsets of tropical cyclones that attained only tropical storm strength in October.)

For the month of November, 12 of the 66 yr had at least one onset of a tropical cyclone that attained only tropical storm strength, and only 1 of the 66 yr had at least 2 onsets (2005). (The year 2011 saw 1 onset in November.)

From table 13, the Poisson probabilities for the months of June–November are given. For the month of June, $P(r = 0) = 67.7\%$, $P(r < 2) = 94.1\%$, and $P(r < 3) = 99.3\%$. For the month of July, $P(r = 0) = 58.9\%$, $P(r < 2) = 90.1\%$, $P(r < 3) = 98.3\%$, and $P(r < 4) = 99.8\%$. For the month of August, $P(r = 0) = 30.7\%$, $P(r < 2) = 67\%$, $P(r < 3) = 88.4\%$, $P(r < 4) = 96.8\%$, and $P(r < 5) = 99.3\%$. For the month of September, $P(r = 0) = 28.1\%$, $P(r < 2) = 63.8\%$, $P(r < 3) = 86.4\%$, $P(r < 4) = 96\%$, and $P(r < 5) = 99\%$. For the month of October, $P(r = 0) = 45.4\%$, $P(r < 2) = 81.2\%$, $P(r < 3) = 95.4\%$, and $P(r < 4) = 99.1\%$. For the month of November, $P(r = 0) = 81.9\%$, $P(r < 2) = 98.2\%$, and $P(r < 3) = 99.9\%$. Hence, there appears greater than 50% probability that one would not expect the onset of a tropical cyclone attaining only tropical storm strength in June, July, or November, but greater than 50% probability that one would expect at least one onset in each of the months of August, September, and October.

2.2.3 Hurricanes

For the interval 1945–2010, 409 tropical cyclones became hurricanes (409/715 = 57.2%). Of these, only 4 (table 10) had onsets outside the nominal hurricane season (2 in May and 2 in December). Thus, 405 (99%) tropical cyclones that became hurricanes had their onsets during the nominal hurricane season. Of these 405 tropical cyclones that became hurricanes, 12 (3%) occurred in June, 27 (6.7%) in July, 110 (27.2%) in August, 161 (39.8%) in September, 73 (18%) in October, and 22 (5.4%) in November. Together, more than 65% of the tropical cyclones that became hurricanes had their onsets in the months of August and September (271/405 = 66.9%), and the combined months of August, September, and October account for about 85% of all those tropical cyclones that became hurricanes (344/405 = 84.9%). In the interval 1945–2010, 56 of the 66 yr had an onset of at least one tropical cyclone that became a hurricane in August, and all but 2 yr (1962 and 1994) saw onsets of at least one tropical cyclone becoming a hurricane in September. For October, at least one tropical cyclone that became a hurricane occurred in 46 of the 66 yr.

For the month of June, 11 of the 66 yr had at least one onset of a tropical cyclone that became a hurricane, with only the year 1968 having had at least 2 onsets. (The year 2011 saw no onsets of tropical cyclones that became hurricanes in June.)

For the month of July, 18 of the 66 yr had at least one onset of a tropical cyclone that became a hurricane, 7 of the 66 yr had at least 2 onsets, and only 2 of the 66 yr had at least 3 onsets (1966 and 2005). (The year 2011 saw no onsets of tropical cyclones that became hurricanes in July.)

For the month of August, 56 of the 66 yr had onsets of at least one tropical cyclone that became a hurricane, 34 of the 66 yr had at least 2 onsets, 12 of the 66 yr had at least 3 onsets, and 6 of the 66 yr had at least 4 onsets. Only the year 2004 saw the onset of at least 5 tropical cyclones that became hurricanes in August. (The year 2011 saw 2 onsets in August.)

For the month of September, 64 of the 66 yr had at least one onset of a tropical cyclone that became a hurricane, 43 of the 66 yr had at least 2 onsets, 30 of the 66 yr had at least 3 onsets, and 18 of the 66 yr had at least 4 onsets. Only the years 1955, 1961, 1981, 2000, and 2005 had at least 5 onsets of tropical cyclones that became hurricanes. (The year 2011 saw 4 onsets in September.)

For the month of October, 46 of the 66 yr had at least one onset of a tropical cyclone that became a hurricane, 17 of the 66 yr had at least 2 onsets, 6 of the 66 yr had at least 3 onsets, and 3 of the 66 yr had at least 4 onsets. Only the year 2010 saw at least 5 onsets of tropical cyclones that became hurricanes in October. (The year 2011 saw 1 onset in October.)

For the month of November, 18 of the 66 yr had at least one onset of a tropical cyclone that became a hurricane, and 3 of the 66 yr had at least 2 onsets. Only the year 2001 saw the onset of at least 3 tropical cyclones that became hurricanes in November. (The year 2011 saw no onsets of tropical cyclones that became hurricanes in November.)

From table 13, the Poisson probabilities for the months of June–November are given. For the month of June, $P(r = 0) = 83.5\%$, $P(r < 2) = 98.6\%$, and $P(r < 3) = 99.9\%$. For the month of July, $P(r = 0) = 66.4\%$, $P(r < 2) = 93.6\%$, and $P(r < 3) = 99.2\%$. For the month of August, $P(r = 0) = 18.8\%$, $P(r < 2) = 50.3\%$, $P(r < 3) = 76.5\%$, $P(r < 4) = 91.1\%$, and $P(r < 5) = 97.2\%$. For the month of September, $P(r = 0) = 8.7\%$, $P(r < 2) = 30\%$, $P(r < 3) = 55.9\%$, $P(r < 4) = 77\%$, $P(r < 5) = 89.9\%$, $P(r < 6) = 96.2\%$, and $P(r < 7) = 98.7\%$. For the month of October, $P(r = 0) = 33\%$, $P(r < 2) = 69.5\%$, $P(r < 3) = 89.8\%$, and $P(r < 4) = 97.4\%$. For the month of November, $P(r = 0) = 71.9\%$, $P(r < 2) = 95.6\%$, and $P(r < 3) = 99.5\%$. Hence, there appears greater than 50% probability that one would not expect an onset of a hurricane in June, July, or November, but greater than 50% probability that one would expect at least 1 hurricane onset in August and October, and at least 2 onsets in September.

2.2.4 Major Hurricanes

For the interval 1945–2010, 179 tropical cyclones became major or intense hurricanes (179/715 = 25% and 179/409 = 43.8%). Of these, only one (table 11) had onset outside the nominal hurricane season (in May 1951). Thus, 178 (99.4%) had onsets during the nominal hurricane season. Of the 178 tropical cyclones that became major hurricanes, 3 (1.7%) occurred in June, 5 (2.8%) in July, 61 (34.3%) in August, 85 (47.8%) in September, 19 (10.7%) in October, and 5 (2.8%) in November. Together, more than 80% of the tropical cyclones that became major hurricanes had onsets in the months of August and September (146/178 = 82%), and the combined months of August, September, and October account for more than 90% of all major hurricane onsets (165/178 = 92.7%). In the interval 1945–2010, 43 of the 66 yr saw an onset of at least 1 tropical cyclone that became a major hurricane in August, and 50 of the 66 yr had at least 1 onset of a tropical cyclone that became a major hurricane in September. For October, it had at least 1 onset in only 17 of the 66 yr. Since 1995, every year (including the 2011 season) had an onset of at least 1 tropical cyclone that became a major hurricane in September, and 13 of the past 17 yr (1995–2011) had an onset of at least 1 tropical cyclone that became a major hurricane in August (exceptions include 1997, 2001, 2002, and 2006). For 32 of the 66 yr, major hurricanes had onsets in both August and September, especially true between 1948 and 1958 (true in 8 of 11 yr) and between 1995 and 2011 (true in 13 of 17 yr), but rarely true in the interim (only 11 of 36 yr between 1959 and 1994).

For the month of June, only 3 of the 66 yr had at least 1 onset of a tropical cyclone that became a major hurricane (1945, 1957, and 1966). The interval of no June onsets for a major hurricane now spans 45 yr (including the 2011 season).

For the month of July, 4 of the 66 yr had at least 1 onset of a tropical cyclone that became a major hurricane, with the year 2005 accounting for 2 onsets. Four of the 5 July onsets have occurred since 1995, the last in 2008.

For the month of August, 43 of the 66 yr had at least 1 onset of a tropical cyclone that became a major hurricane, 13 of the 66 yr had at least 2 onsets, and 4 of the 66 yr had at least 3 onsets. Only the year 1950 had at least 4 onsets in August. (The year 2011 saw 2 onsets in August, Irene and Katia.)

For the month of September, 50 of the 66 yr had at least 1 onset of a tropical cyclone that became a major hurricane, 25 of the 66 yr had at least 2 onsets, 7 of the 66 yr had at least 3 onsets, and 2 of the 66 yr had at least 4 onsets. Only the year 1961 saw the onset of at least 5 tropical cyclones that became major hurricanes in September. Since 1995, every year has seen at least 1 onset of a tropical cyclone that became a major hurricane, accounting for 29 of the 85 September major hurricane onsets. (The year 2011 saw 1 onset in September of a tropical cyclone that became a major hurricane.)

For the month of October, 17 of the 66 yr had at least 1 onset of a tropical cyclone that became a major hurricane, with only the years 1950 and 2005 having at least 2 onsets. Since 1995, 7 onsets have occurred of tropical cyclones that became major hurricanes, including 1 in the 2011 hurricane season (Rina).

For the month of November, 5 of the 66 yr had at least 1 onset of a tropical cyclone that became a major hurricane, 4 of the 5 occurring since 1985. (The year 2011 saw no onsets of tropical cyclones that became major hurricanes in November.)

From table 13, the Poisson probabilities for the months of June–November are given. For the month of June, $P(r = 0) = 95.1\%$ and $P(r < 2) = 99.9\%$. For the month of July, $P(r = 0) = 92.3\%$ and $P(r < 2) = 99.7\%$. For the month of August, $P(r = 0) = 39.9\%$, $P(r < 2) = 76.5\%$, $P(r < 3) = 93.4\%$, and $P(r < 4) = 98.6\%$. For the month of September, $P(r = 0) = 27.5\%$, $P(r < 2) = 63\%$, $P(r < 3) = 85.9\%$, $P(r < 4) = 95.8\%$, and $P(r < 5) = 99\%$. For the month of October, $P(r = 0) = 74.8\%$, $P(r < 2) = 96.5\%$, and $P(r < 3) = 99.7\%$. For the month of November, $P(r = 0) = 92.3\%$ and $P(r < 2) = 99.7\%$. Hence, there appears greater than 50% probability that one would not expect an onset of a major hurricane in June, July, October, or November, but greater than 50% probability that one would expect at least one major hurricane onset in August and September.

2.2.5 US Landfalling Hurricanes

For the interval 1945–2010, 108 tropical cyclones struck the US as hurricanes (table 12), with all strikes occurring during the nominal hurricane season (108/715 = 15.1% and 108/409 = 26.4%). Of the 108 tropical cyclones that struck the US as hurricanes, 5 (4.6%) occurred in June, 12 (11.1%) in July, 38 (35.2%) in August, 40 (37%) in September, 12 (11.1%) in October, and only 1 (0.9%) in November. Together, more than 70% of the tropical cyclones that struck the US did so in the months of August and September (78/108 = 72.2%), and the combined months of July, August, September, and October account for more than 90% of all US strikes by landfalling hurricanes (102/108 = 94.4%). In the interval 1945–2010, there have been no more than 2 strikes in a single month, with the lone exception being August 2004 when 4 strikes occurred in the month. As previously noted, the longest lull between strikes has been 2 yr, occurring only three times, the years 1981–1982, 2000–2001, and 2009–2010. The most US strikes by hurricanes in a single season (6) occurred three times, in the years 1985, 2004, and 2005. Prior to 1985, the most US strikes by hurricanes occurred in 1964 when 4 strikes occurred. Between 1945 and 1960, there were 34 US strikes by hurricanes (34/108 = 31.5%, striking at the mean rate of 2.1 strikes per year), with the years 1947–1950 having 3 strikes each year and only the year 1951 not having a single US strike. (There was only one strike of the US by a hurricane in the 2011 season, Irene, which struck North Carolina as a category 1 hurricane in August.)

From table 13, the Poisson probabilities for the months of June–November are given. For the month of June, $P(r = 0) = 92.3\%$ and $P(r < 2) = 99.7\%$. For the month of July, $P(r = 0) = 83.5\%$ and $P(r < 2) = 98.6\%$. For the month of August, $P(r = 0) = 56\%$, $P(r < 2) = 88.5\%$, and $P(r < 3) = 97.9\%$. For the month of September, $P(r = 0) = 54.3\%$, $P(r < 2) = 87.5\%$, and $P(r < 3) = 97.6\%$. For the month of October, $P(r = 0) = 83.5\%$ and $P(r < 2) = 98.6\%$. For the month of November, $P(r = 0) = 98\%$.

Table 14 (see appendix) gives the yearly distribution of US hurricane landstrikes by state. While there were 108 tropical cyclones that struck the US as hurricanes, they actually accounted for 178 separate hits, with Florida taking the brunt (50/178 = 28.1%), Louisiana and North Carolina each having the second most hits (each 23/178 = 12.9%), and Texas having the next most hits (21/178 = 11.8%). Together, these four states account for nearly two-thirds of all US hits by hurricanes (117/178 = 65.7%).

2.3 The Distribution of Tropical Cyclones by Geographical Region, 1945–2010

The North Atlantic basin can be arbitrarily divided into selected geographical regions or areas of activity. Figure 7 depicts one such division into five areas, denoted by the thick lines and numbered 1–5. Area 1 corresponds to the area of the Gulf of Mexico, area 2 can be regarded as the area of the Caribbean Sea, area 3 is the eastern seaboard area of the US, area 4 is the lower North Atlantic-Cape Verde area, and area 5 is the open North Atlantic basin northward of the Cape Verde Islands. Figures 8–12 show the yearly variation of each grouping, respectively, and table 15 (see appendix) provides the Poisson probabilities for each grouping.

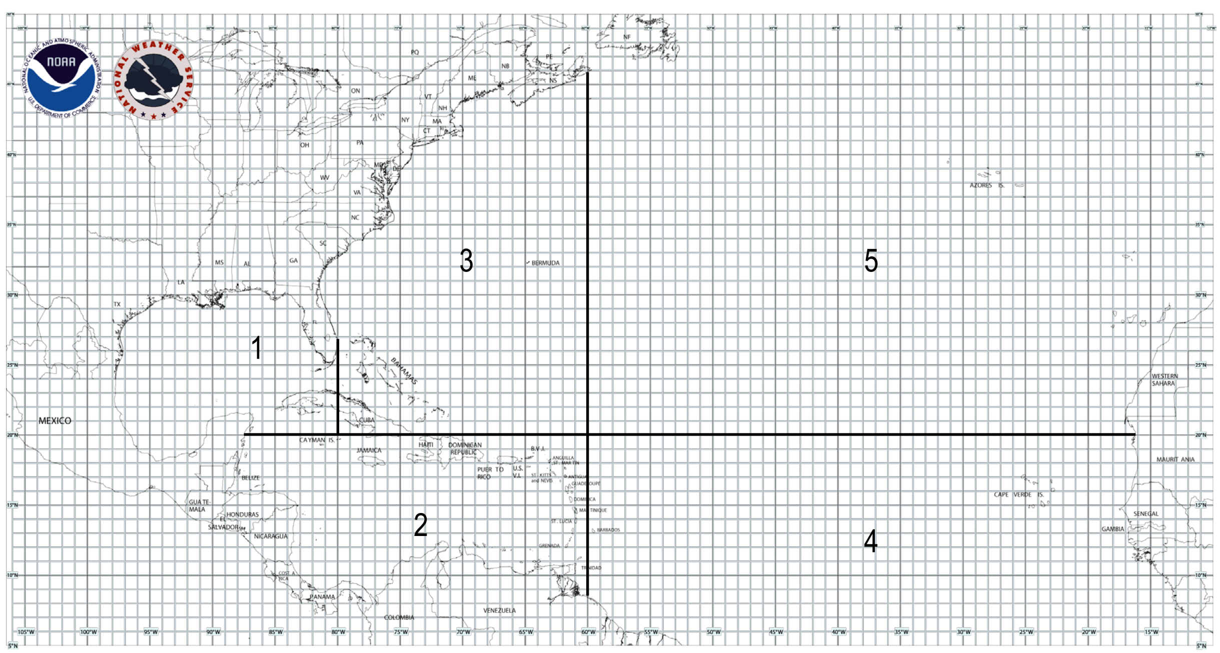

Figure 7. Onset location regions of Atlantic basin tropical cyclones by group—reduced version of the Atlantic basin hurricane tracking chart, National Hurricane Center, Miami, FL.

2.3.1 NTC

Figure 8 shows the yearly variation of NTC in each of the areal groupings. Area or group 4 is the single largest progenitor of tropical cyclones in the North Atlantic basin during the interval 1945–2010, accounting for more than 25% of the total number of tropical cyclones that formed in the North Atlantic basin (199/715 = 27.8%). This is understandable since it is this area where the westerly waves coming off Africa occur. The second largest progenitor of tropical cyclones in the North Atlantic basin is group 3, accounting for almost 25% of the total (165/715 = 23.1%). Together, these two regions account for about 50% of the tropical cyclone formations in the North Atlantic basin in the interval 1945–2010 (364/715 = 50.9%). Including group 1, the third largest progenitor of tropical cyclone formation (149/715 = 20.8%), these three groups account for more than 70% of the tropical cyclones in the North Atlantic basin (513/715 = 71.7%), and, including group 2, the combined total now accounts for more than 85% of the tropical cyclones (624/715 = 87.3%). Group 5 (the open North Atlantic basin) produced the fewest number of tropical cyclone formations (111/715 = 15.5%), which also is understandable because of the cooler surface waters and the strong easterly flows off the US.

Interestingly, visual inspection of group 2 tropical cyclones (fig. 8(b)) suggests that, on average, tropical cyclone formation was higher for this group prior to about 1955 and now subsequent to about 1994 than what was seen between 1955 and 1994. This suggests, perhaps, the existence of a long-term multidecadal variation of tropical cyclone formation within the Caribbean Sea region. Also, group 4 storms (fig. 8(d)) appear to be on the rise since about the mid 1980s (8 formations in the year 1990, and 9 each in the years 1995 and 2010), while group 3 storms (fig. 8(c)) appear to be more frequent progenitors of tropical cyclones between the mid 1960s and the mid 1980s. Group 5 storms are 3 or fewer in number every year in the interval 1945–2010, except the year 2005 when 8 tropical cyclones formed. (For the 2011 season, group 1 accounted for 4 NTC, group 2 accounted for 3 NTC, group 3 accounted for 6 NTC, group 4 accounted for 5 NTC, and group 5 accounted for 1 NTC.)

For group 1 NTC (table 15), $P(r = 0) = 10\%$, $P(r < 2) = 33.1\%$, $P(r < 3) = 59.6\%$, $P(r < 4) = 79.9\%$, $P(r < 5) = 91.6\%$, and $P(r < 6) = 97\%$. For group 2 NTC, $P(r = 0) = 18.3\%$, $P(r < 2) = 49.3\%$, $P(r < 3) = 75.7\%$, $P(r < 4) = 90.7\%$, and $P(r < 5) = 97.1\%$. For group 3 NTC, $P(r = 0) = 8.2\%$, $P(r < 2) = 28.7\%$, $P(r < 3) = 54.4\%$, $P(r < 4) = 75.8\%$, $P(r < 5) = 89.1\%$, $P(r < 6) = 95.8\%$, and $P(r < 7) = 98.6\%$. For group 4 NTC, $P(r = 0) = 5\%$, $P(r < 2) = 19.9\%$, $P(r < 3) = 42.3\%$, $P(r < 4) = 64.7\%$, $P(r < 5) = 81.5\%$, $P(r < 6) = 91.6\%$, $P(r < 7) = 96.6\%$, and $P(r < 8) = 98.8\%$. Lastly, for group 5 NTC, $P(r = 0) = 24.7\%$, $P(r < 2) = 59.2\%$, $P(r < 3) = 83.4\%$, $P(r < 4) = 94.6\%$, and $P(r < 5) = 98.5\%$. The central 3 highest probabilities for NTC are 2 ± 1 (69.9%) for group 1, 1 ± 1 (75.7%) for group 2, 2 ± 1 (67.6%) for group 3, 3 ± 1 (61.6%) for group 4, and 1 ± 1 (83.4%) for group 5.

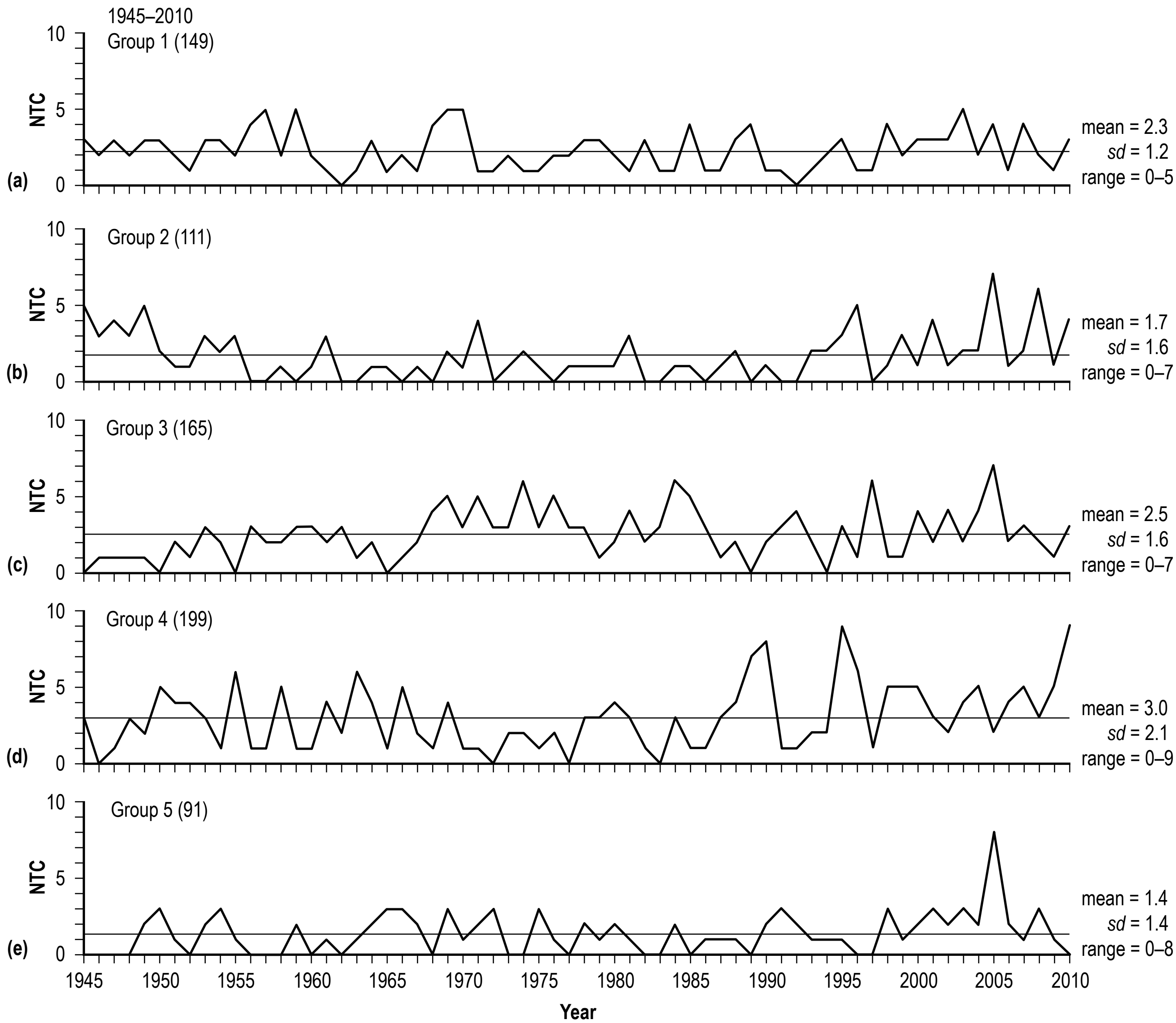

Figure 8. NTC versus year: (a) Group 1, (b) group 2, (c) group 3, (d) group 4, and (e) group.

2.3.2 NTS

Figure 9 displays the variation by group for NTS. Group 1 is the largest progenitor of tropical cyclones that attained only tropical storm strength (88/306 = 28.8%), group 3 is the second largest progenitor of NTS (76/306 = 24.8%), group 4 is the third largest (65/306 = 21.2%), and group 5 is the fourth largest (42/306 = 13.7%). The region of fewest NTS is group 2 (35/306 = 11.4%). The greatest NTS (5) occurred twice in 1974 and 1997, both associated with group 3. The greatest NTS for group 1 (4) occurred in 1957 and 2003, group 2 (3) in 2005, group 4 (4) in 1990, and group 5 (4) in 2005. (For the 2011 season, group 1 accounted for 3 NTS, group 2 accounted for 2 NTS, group 3 accounted for 6 NTS, group 4 accounted for no NTS, and group 5 accounted for 1 NTS.)

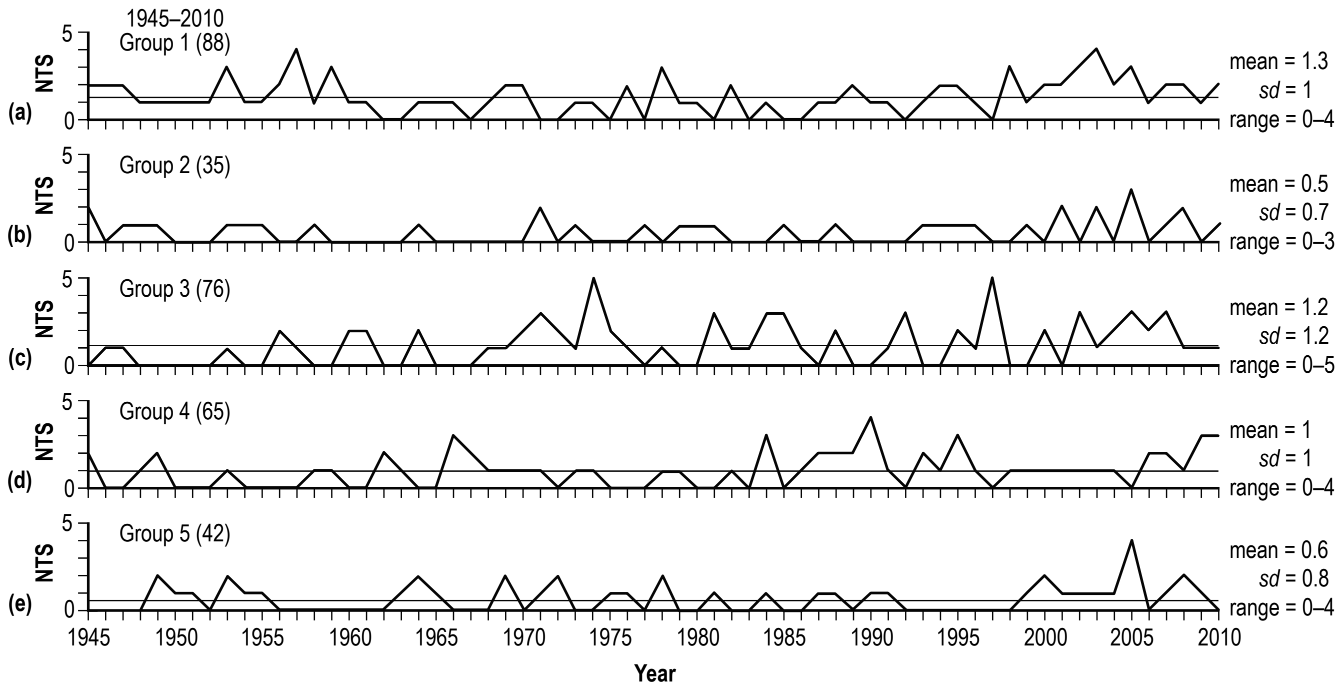

Figure 9. NTS versus year: (a) Group 1, (b) group 2, (c) group 3, (d) group 4, and (e) group 5.

For group 1, $P(r = 0) = 27.3\%$, $P(r < 2) = 62.7\%$, $P(r < 3) = 85.7\%$, $P(r < 4) = 95.7\%$, and $P(r < 5) = 98.9\%$. For group 2, $P(r = 0) = 60.7\%$, $P(r < 2) = 91\%$, and $P(r < 3) = 98.6\%$. For group 3, $P(r = 0) = 30.1\%$, $P(r < 2) = 66.3\%$, $P(r < 3) = 88\%$, $P(\mathrm{i} < 4) = 96.6\%$, and $P(r < 5) = 99.2\%$. For group 4, $P(r = 0) = 36.8\%$, $P(r < 2) = 73.6\%$, $P(r < 3) = 92\%$, and $P(r < 4) = 98.1\%$. For group 5, $P(r = 0) = 54.9\%$, $P(r < 2) = 87.8\%$, and $P(r < 3) = 97.7\%$. The central 3 highest probabilities for NTS are 1 ± 1 (85.7%) for group 1, 1 ± 1 (98.6%) for group 2, 1 ± 1 (88%) for group 3, 1 ± 1 (91.7%) for group 4, and 1 ± 1 (97.7%) for group 5.

2.3.3 NH

Figure 10 displays the variation by group for NH. Group 4 is the largest progenitor of tropical cyclones that attained hurricane strength (134/409 = 32.8%), group 3 is the second largest progenitor of NH (89/409 = 21.8%), group 2 is the third largest (76/409 = 18.6%), and group 1 is the fourth largest (61/ 409 = 14.9%). The region of fewest NH is group 5 (49/409 = 12%). The greatest NH (6) occurred twice in 1995 and 2010, both associated with group 4. The greatest NH for group 1 (4) occurred in 1985, group 2 (4) in 1949, 1996, 2005, and 2008, group 3 (4) in 1969, 1976, and 2005, and group 5 (4) in 2005. (For the 2011 season, group 1 accounted for 1 NH, group 2 accounted for 1 NH, group 3 accounted for no NH, group 4 accounted for 5 NH, and group 5 accounted for no NH.)

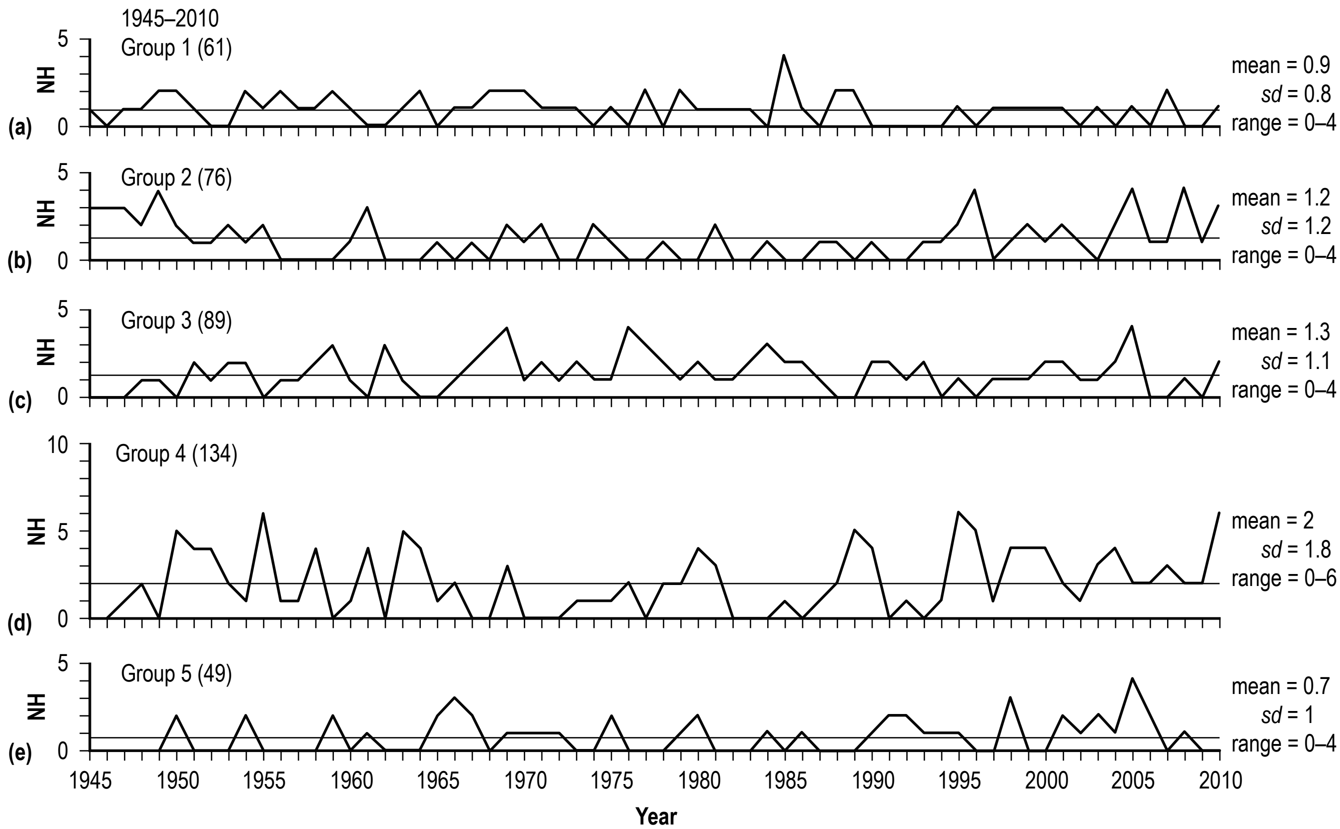

Figure 10. NH versus year: (a) Group 1, (b) group 2, (c) group 3, (d) group 4, and (e) group 5.

For group 1, $P(r = 0) = 40.7\%$, $P(r < 2) = 77.3\%$, $P(r < 3) = 93.7\%$, and $P(r < 4) = 98.7\%$. For group 2, $P(r = 0) = 30.1\%$, $P(r < 2) = 66.3\%$, $P(r < 3) = 88\%$, $P(r < 4) = 96.6\%$, and $P(r < 5) = 99.2\%$. For group 3, $P(r = 0) = 27.3\%$, $P(r < 2) = 62.7\%$, $P(r < 3) = 85.7\%$, $P(r < 4) = 95.7\%$, and $P(r < 5) = 98.9\%$. For group 4, $P(r = 0) = 13.5\%$, $P(r < 2) = 40.6\%$, $P(r < 3) = 67.7\%$, $P(r < 4) = 85.7\%$, $P(r < 5) = 94.7\%$, and $P(r < 6) = 98.3\%$. For group 5, $P(r = 0) = 49.7\%$, $P(r < 2) = 84.4\%$, $P(r < 3) = 96.6\%$, and $P(r < 4) = 99.4\%$. The central 3 highest probabilities for NH are 1 ± 1 (93.7%) for group 1, 1 ± 1 (88%) for group 2, 1 ± 1 (85.7%) for group 3, 2 ± 1 (72.2%) for group 4, and 1 ± 1 (96.6%) for group 5.

2.3.4 NMH

Figure 11 displays the variation by group for NMH. Group 4 is the largest progenitor of tropical cyclones that attained major hurricane strength (93/179 = 52%), group 2 is the second largest progenitor of NMH (43/179 = 24%), group 3 is the third largest (20/179 = 11.2%), and group 1 is the fourth largest (17/179 = 9.5%). The region of fewest NMH is group 5 (6/179 = 3.4%). The greatest NMH (5) occurred twice in 1950 and 1996, both associated with group 4. The greatest NMH for group 1 (2) occurred in 1964 and 1970, group 2 (3) in 1961, 2005, and 2008, group 3 (2) in 1958 and 2005, and group 5 (1) in 1950, 1959, 1991, 2003, 2005, and 2006. (For the 2011 season, group 1 accounted for no NMH, group 2 accounted for 1 NMH, group 3 accounted for no NMH, group 4 accounted for 3 NMH, and group 5 accounted for no NMH.)

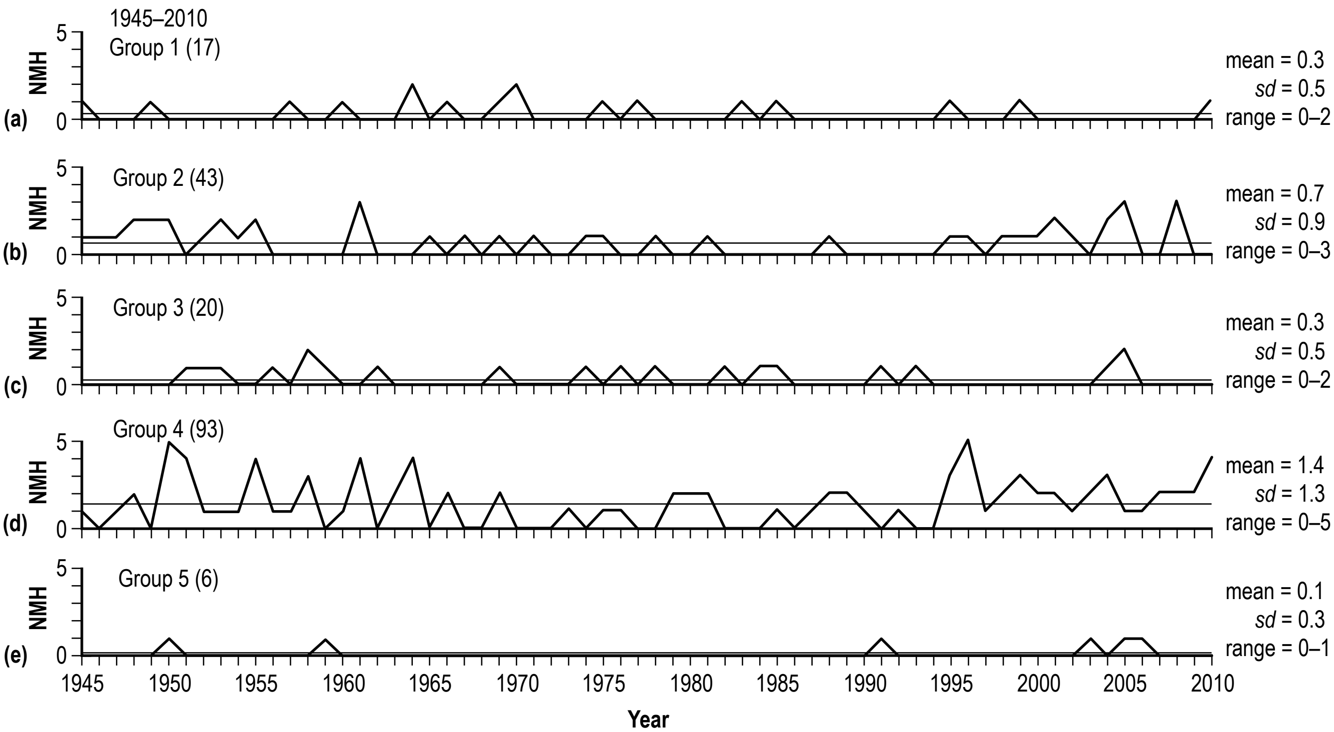

Figure 11. NMH versus year: (a) Group 1, (b) group 2, (c) group 3, (d) group 4, and (e) group 5.

For group 1, $P(r = 0) = 74.1\%$, $P(r < 2) = 96.3\%$, and $P(r < 3) = 99.6\%$. For group 2, $P(r = 0) = 49.7\%$, $P(r < 2) = 84.4\%$, $P(r < 3) = 96.6\%$, and $P(r < 4) = 99.4\%$. For group 3, $P(r = 0) = 74.1\%$, $P(r < 2) = 96.3\%$, and $P(r < 3) = 99.6\%$. For group 4, $P(r = 0) = 24.7\%$, $P(r < 2) = 59.2\%$, $P(r < 3) = 83.4\%$, $P(r < 4) = 94.6\%$, and $P(r < 5) = 98.6\%$. For group 5, $P(r = 0) = 90.5\%$ and $P(r < 2) = 99.5\%$. The central 3 highest probabilities for NMH are 1 ± 1 (99.6%) for group 1, 1 ± 1 (96.6%) for group 2, 1 ± 1 (99.6%) for group 3, 1 ± 1 (83.4%) for group 4, and 1 ± 1 (99.5%) for group 5.

2.3.5 NUSLFH

Figure 12 displays the variation by group for NUSLFH. Group 1 is the largest progenitor of tropical cyclones that struck the US coastline as hurricanes (34/108 = 31.5%), group 4 is the second largest progenitor of NUSLFH (30/108 = 27.8%), group 2 is the third largest (24/108 = 22.2%), and group 3 is the fourth largest (20/108 = 18.5%). The region of fewest NUSLFH is group 5, which produced none. The greatest NUSLFH (4) occurred in 1985, associated with group 1. The greatest NUSLFH for group 2 (2) occurred in 1948, 1950, 2004, 2005, and 2008, group 3 (3) in 2005, and group 4 (3) in 1955. (For the 2011 season, there was only one US landfalling hurricane, it being associated with group 4.)

For group 1, $P(r = 0) = 60.7\%$, $P(r < 2) = 91\%$, and $P(r < 3) = 98.6\%$. For group 2, $P(r = 0) = 67\%$, $P(r < 2) = 93.8\%$, and $P(r < 3) = 98.5\%$. For group 3, $P(r = 0) = 74.1\%$, $P(r < 2) = 96.3\%$, and $P(r < 3) = 99.6\%$. For group 4, $P(r = 0) = 60.7\%$, $P(r < 2) = 91\%$, and $P(r < 3) = 98.6\%$. The central 3 highest probabilities for NUSLFH are 1 ± 1 (98.6%) for group 1, 1 ± 1 (98.5%) for group 2, 1 ± 1 (99.6%) for group 3, and 1 ± 1 (98.6%) for group 4.

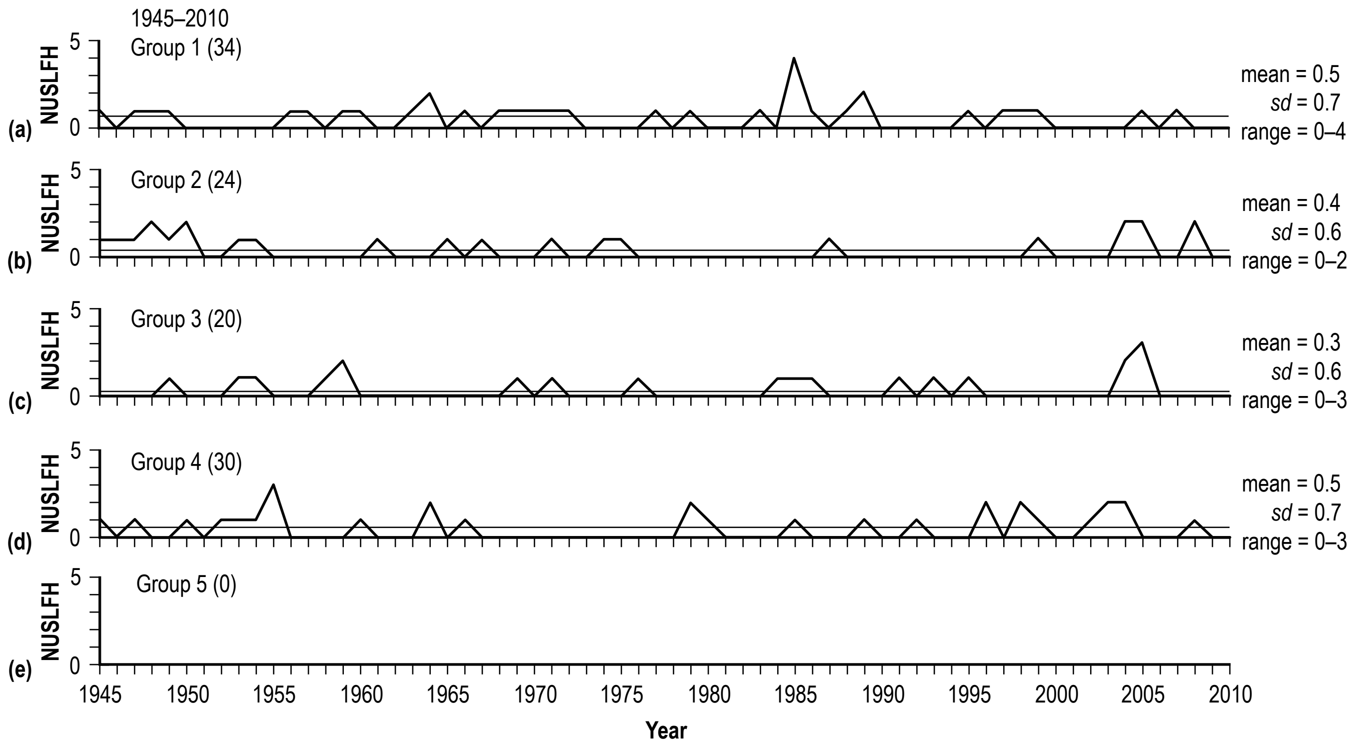

Figure 12. NUSLFH versus year: (a) Group 1, (b) group 2, (c) group 3, (d) group 4, and (e) group 5.

2.4 The Seasonal Centroid Location of Tropical Cyclones, 1945–2010

The National Hurricane Center's 'best tracks' archival database, available online at <http://www.nhc.noaa.gov> provides at 6-hr intervals the position (latitude and longitude in deg) and intensity (wind speed in kt and pressure in mbar) of tropical cyclones that form in the North Atlantic basin, along with other descriptive information regarding them. As an example as to how one determines the seasonal centroid location of tropical cyclones, the following is given: In 1983, four tropical cyclones formed in the North Atlantic basin. These included Alicia, Barry, Chantal, and Dean. Alicia formed on August 15, located at 27.2 deg N. LAT and 91 deg W. LONG; Barry formed on August 24 at 27.4 deg N. LAT and 76.3 deg W. LONG; Chantal formed on September 11 at 31.6 deg N. LAT and 63.3 deg W. LONG; and Dean formed on September 26 at 28 deg N. LAT and 73 deg W. LONG. The mean of all latitudinal and longitudinal positions is 28.6 deg N. and 75.9. deg W., respectively. Thus, the seasonal centroid for 1984 is 28.6 deg N. LAT and 75.9 deg W. LONG.

2.4.1 Latitude

Figure 13 depicts the yearly latitudinal centroid locations of the tropical cyclones for the interval 1945–2010, employing the same construction as used in the preceding parametric summary charts. Figure 13(a) shows that for the interval 1945–2010 the mean latitude is about 22 deg N., having *sd* = 3.4 deg and range 16.4 to 32.2 deg N. Prior to the mid 1960s, the 10-yma values of latitude were always below the long-term mean latitude (i.e., more southerly), rising above the mean

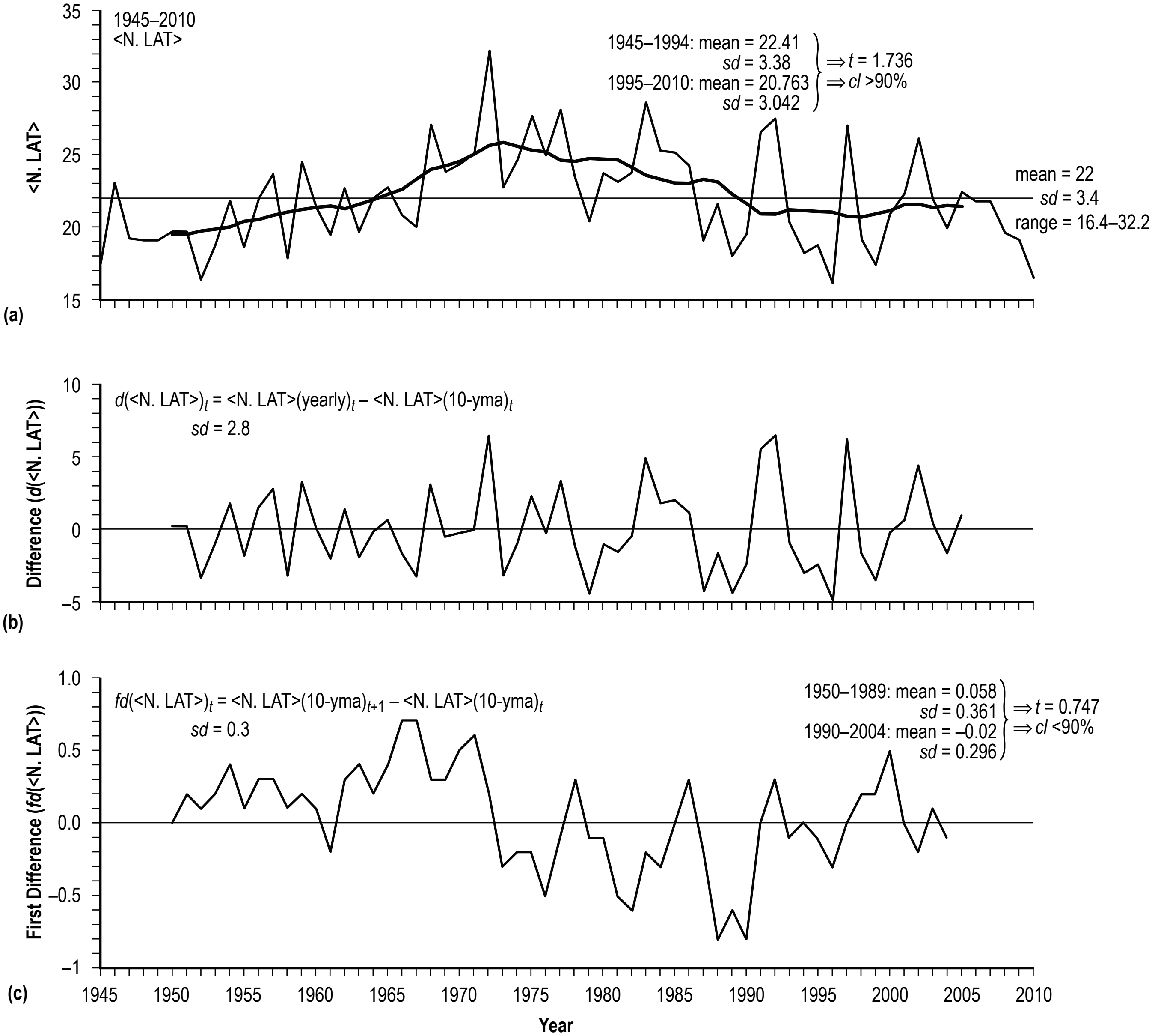

Figure 13. Yearly latitudinal centroid locations of tropical cyclones: (a) <N. LAT>, (b) difference (*d*<N. LAT>), and (c) first difference (*fd*<N. LAT>).

about 1964 (i.e., more northerly) and remaining above the mean until about 1990 when it once again dropped below the long-term mean latitude where it has remained ever since, although the lowest values now being seen are slightly higher than were seen prior to the mid 1960s (20.8 deg N. as compared to 19.5 deg N.). For the interval 1995–2010, latitude averages about 20.8 deg N., having *sd* = 3 deg and range 16.2 to 27.1 deg N. (For the 2011 season, its mean latitude measured 22 deg N.)

Figure 13(b) displays the variation of the difference. Runs testing indicates that, while the differences appear somewhat more variable now (in their extremes) than earlier on, the differences seem to be distributed randomly (z = 0.38, cl <90%, and sd = 2.8 deg). Hence, one should have expected the 10-yma of <N. LAT> = 21.9 ± 2.8 deg N. in 2006, based on the expected difference, where 21.9 deg N. is the yearly value for 2006. As it turns out, the yearly <N. LAT> = 22 deg N. for 2011, thereby yielding the 10-yma of <N. LAT> = 21.2 deg N. for 2006. For 2007, one also expects the 10-yma of <N. LAT> = 21.9 ± 2.8 deg N., based on the expected difference, where 21.9 deg N. is the yearly <N. LAT> for 2007.

Figure 13(c) shows the variation of the first differences. Runs testing indicates that its distribution is nonrandom (z = –3.14, cl >99.5%, and sd = 0.3 deg). For the interval 1950–1972, every year had $fd(\text{N. LAT})_t$ ≥0 deg, except the year 1961, averaging about 0.3 deg, with sd = 0.2 deg. and range –0.2 to 0.7 deg. For the interval 1973–1990, every year had $fd(\text{N. LAT})_t$ <0 deg, except 1978, 1985, and 1986, averaging about –0.3 deg, with sd = 0.3 deg and range –0.8 to 0.3 deg. For the interval 1991–2010, $fd(\text{N. LAT})_t$ ≥0 deg except for the years 1993, 1995, 1996, 2002, and 2004, averaging about 0 deg, with sd = 0.2 deg and range –0.3 to 0.5 deg. (The 10-yma <N. LAT> has a minimum value of 19.9 deg for the year 2007, computed by assuming a frequency of zero NTC in 2012.)

Given that fd(N. LAT) averages about 0 ± 0.3 deg, one expected the 10-yma of <N. LAT> to be about 21.5 ± 0.3 deg N. for 2006 (where 21.5 deg N. is the 10-yma value for 2005), thereby inferring the yearly <N. LAT> = 27.6 ± 6 deg N. for 2011. As noted above, the yearly seasonal latitudinal value for 2011 measured 22 deg N., thus yielding the 10-yma of <N. LAT> = 21.2 deg N. for 2006 and fd(<N. LAT>) = –0.3 deg for 2005. For 2007, one anticipates the10-yma value of <N. LAT> = 21.2 ± 0.3 deg N., inferring the yearly value of <N. LAT> = 26.2 ± 6 deg N. for 2012.

2.4.2 Longitude

Figure 14 depicts the yearly longitudinal centroid locations of the tropical cyclones for the interval 1945–2010, employing the same construction as used in the preceding parametric summary charts. Figure 14(a) shows that for the interval 1945–2010 the mean longitude is about 65 deg W., having sd = 6.6 deg and range 51.8 to 82.6 deg W. Interestingly, the 10-yma values of longitude appear to vacillate more westward and eastward of the long-term mean longitude over time, with the 10-yma values now being consistently eastward of the mean since 1984. In fact, a linear fit of the 10-yma values of <W. LONG> against year suggests that it is moving progressively more eastward (away from the US) with time, such that the expected 10-yma value of <W. LONG> = 62 ± 2.5 deg W. for 2006, based on the inferred regression (not shown) $y = 259.5272 - 0.0985x$, where x is the year and y is the 10-yma value of <W. LONG> (r = –0.727, r^2 = 0.528, se = 2.46 deg, and cl >99.9%), inferring the yearly seasonal value of <W. LONG> = 67.4 ± 5 deg W. for 2011. As it turns out, the yearly seasonal <W. LONG> = 65.2 deg for 2011, yielding the 10-yma value of <W. LONG> = 61.9 deg W. for 2006. For 2007, the inferred regression suggests <W. LONG> = 61.9 ± 2.5 deg W., inferring the yearly seasonal value of <W. LONG> = 68.7 ± 5 deg W. for 2012.

Figure 14(b) displays the variation of the difference. Runs testing indicates that the distribution of the differences is random (z = 1.39, cl <90%, sd = 5.6 deg). Hence, one should have expected the 10-yma of <W. LONG> = 56.6 ± 5.6 deg W. for 2006, based on the expected

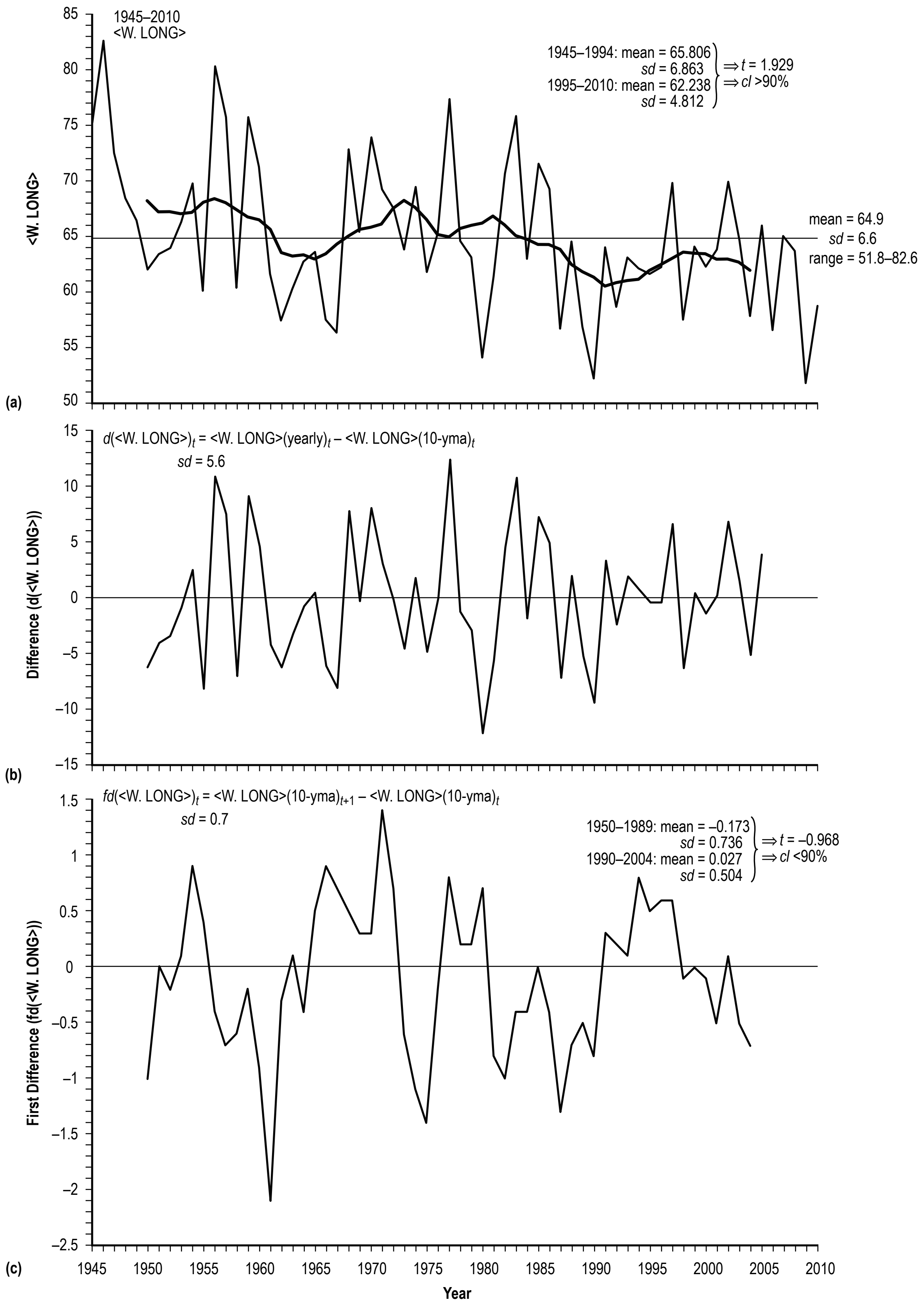

Figure 14. Yearly longitudinal centroid locations of tropical cyclones: (a) <W. LONG>, (b) difference (*d*<W. LONG>), and (c) first difference (*fd*<W. LONG>).

difference. As it turns out, the yearly <W. LONG> = 65.2 deg W. for 2011, thereby yielding the 10-yma of <W. LONG> = 61.9 deg W. in 2006. For 2007, one expects the 10-yma of <W. LONG> = 65.1 ± 5.6 deg W., based on the expected difference, where 65.1 deg W. is the yearly <W. LONG> for 2007.

Figure 14(c) shows the variation of the first differences. Runs testing indicates that its distribution is nonrandom (z = –2.80, cl >99%, and sd = 0.7 deg). Certainly, to the eye, at least, there appears to exist strong variations in *fd*(<W. LONG>), with values, perhaps, trending towards smaller (albeit, negative) values with time (i.e., continued movement of the longitudinal centroid eastward away from the US). (The 10-yma <W. LONG> has a minimum value of 58.5 deg for the year 2007, computed by assuming a frequency of zero NTC in 2012.)

Given that *fd*(W. LONG) averages about –0.1 ± 0.7 deg, one expected the 10-yma of <W. LONG> to be about 62 – 0.1 ± 0.7 deg W. for 2006 (where 62 deg W. is the 10-yma value for 2005), inferring the yearly <W. LONG> = 61.9 ± 14 deg for 2011. As noted above, the yearly seasonal longitude value for 2011 measured 65.2 deg W., thus yielding the 10-yma of <W. LONG> = 61.9 deg W. for 2006 and *fd*(<W. LONG>) = –0.1 deg for 2005. For 2007, one anticipates the 10-yma value of <W. LONG> = 61.9 – 0.1 ± 0.7 deg W. or 61.8 ± 0.7 deg W., inferring the yearly value of <W. LONG> = 61.8 ± 14 deg W. for 2012.

2.4.3 Systematic Variation of Latitude and Longitude

Figure 15 shows the scatter plot of 10-yma values of <N. LAT> against <W. LONG> for the interval 1950–2005. Perhaps surprisingly, one finds evidence for systematic variation to really exist. In the figure, the dots are time tagged at 10-yr intervals. The vertical and horizontal lines represent the means of longitude and latitude, respectively, subdividing the figure into four quadrants. Clearly, the 10-yma values for 1950–1961 appear in the lower-left quadrant, indicating that tropical cyclones during this interval tended to form at lower latitude and in closer proximity to the US than those of later years. For 1962 and 1963, the centroids moved farther eastward into the lower-right quadrant, then moved northward into the upper-right quadrant for 1964–1967. For 1968–1983, the centroids moved farther northward, but also westward into the upper-left quadrant. For 1984–1989, the centroids moved eastward again into the upper-right quadrant. Lastly, for the interval 1990–2005, all 10-yma values are located in the lower-right quadrant. The 10-yma values of latitude and longitude for 2006 (not plotted) have remained in the lower-right quadrant. The projected 10-yma values of latitude (21.2 ± 0.3 deg N.) and longitude (either 61.9 ± 2.5 deg W. from the inferred linear regression or 61.8 ± 0.7 deg W. from the usual first difference) for 2007 are such that one expects the centroids to remain in the lower-right quadrant.

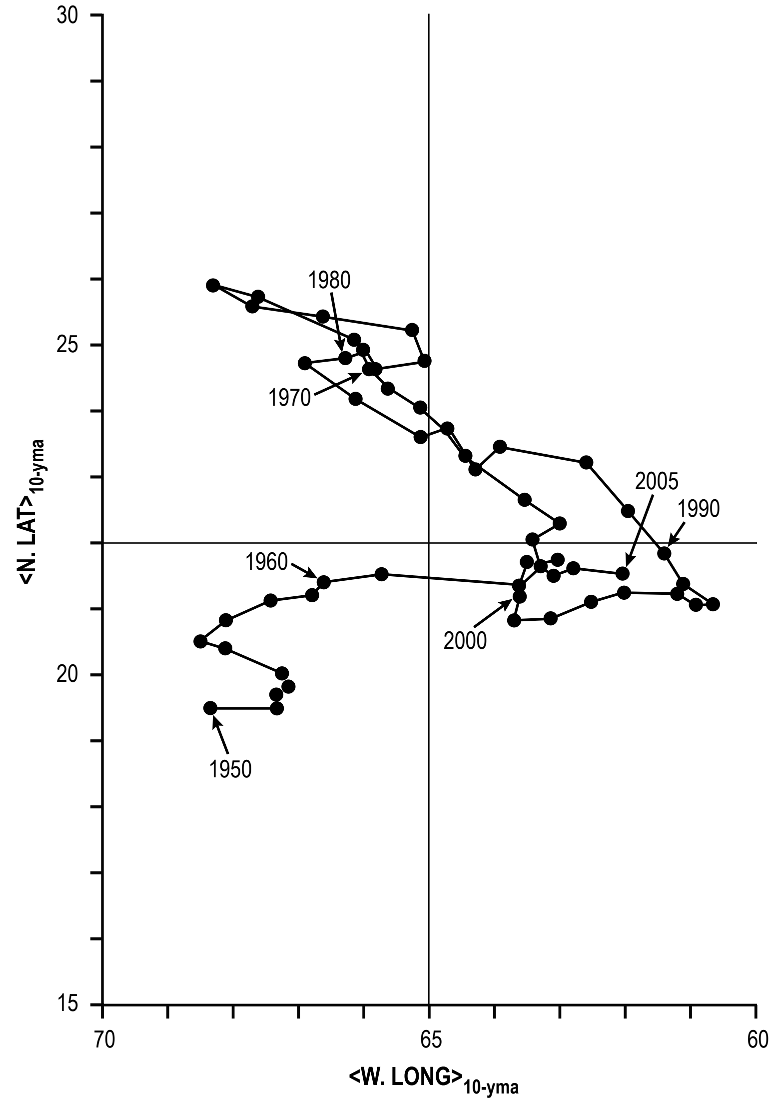

Figure 15. <N. LAT> versus <W. LONG>.

2.5 The Distribution of Peak Wind Speed and Lowest Pressure

2.5.1 PWS

Figure 16(a) displays the yearly variation of the PWS (in kt) for the interval 1945–2010. PWS is defined as the highest sustained maximum wind speed for a tropical cyclone for the year. As an example, the storm with the highest sustained maximum wind speed in 1983 was Alicia, which had PWS = 100 kt. Thus, 100 kt is the PWS for 1983, which is plotted in figure 16(a). The long-term mean is 126.7 kt, having *sd* = 19.7 kt and range 75 to 165 kt. There appears to be no statistical difference in the means for the two intervals 1945–1994 and 1995–2010, although the current, more active interval has a mean that is about 5% higher than the preceding interval (131.6 kt as compared to 125.4 kt).

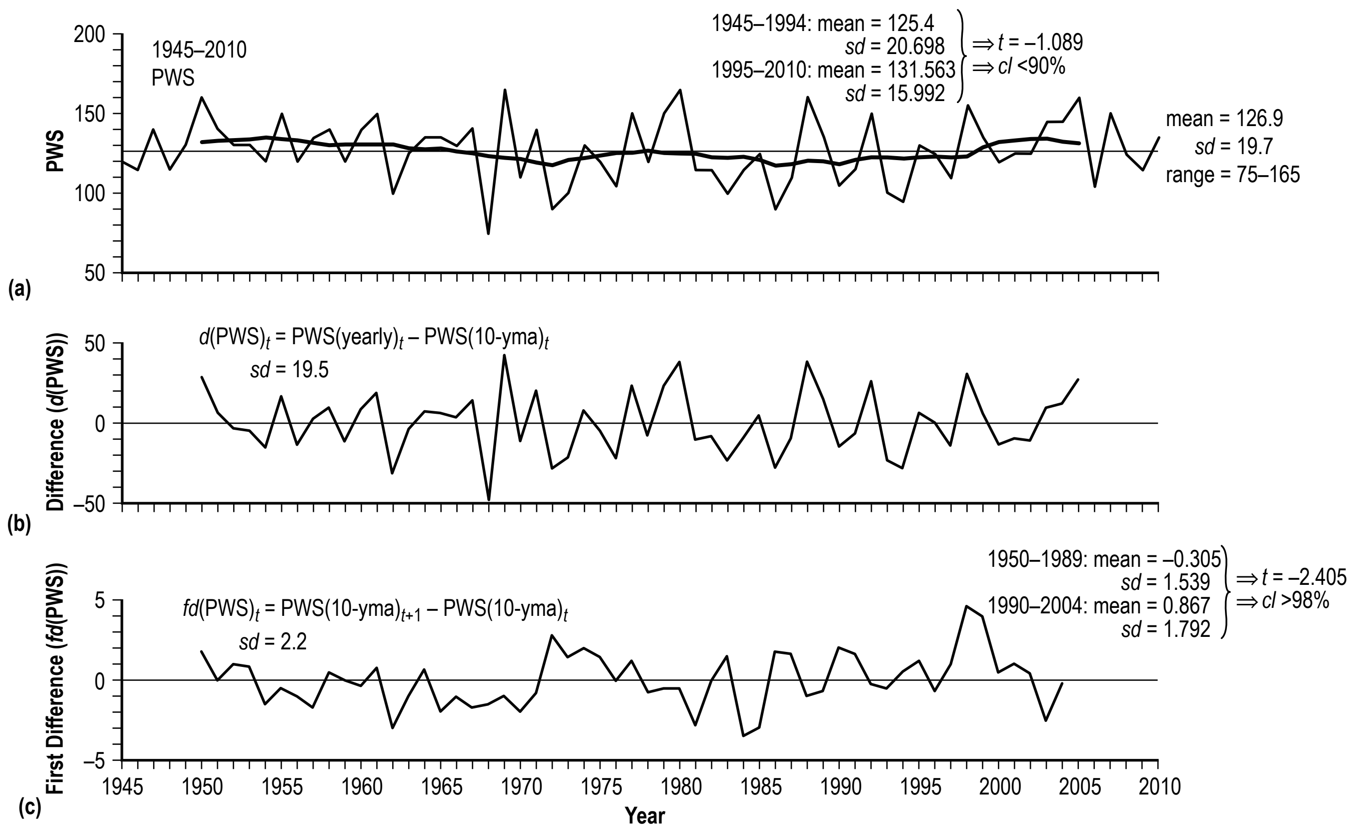

Figure 16. Yearly peak wind speed: (a) PWS, (b) difference (*d*(PWS)), and (c) first difference (*fd*(PWS)).

The highest PWS (165 kt) has occurred twice, in 1969 (Camille) and 1980 (Allen), and the lowest PWS (75 kt) occurred in 1968 (Gladys). The peak 10-yma PWS measured 135 kt in 1954 and 2003, and the lowest 10-yma PWS measured 118 kt in 1972.

Figure 16(b) shows the yearly variation of the difference ($d(\mathrm{PWS})_t$). Runs testing indicates that the distribution of differences is random (z = 0.80, c*l* <90%, *sd* = 19.5 kt). Hence, one should have expected the 10-yma of PWS = 105 ± 19.5 kt in 2006, where 105 kt is the yearly PWS for 2006. As it turns out, PWS = 120 kt in 2011, thereby yielding the 10-yma of PWS = 132.8 kt in 2006, a value outside high the ±1 *sd* prediction interval. For 2007, based on the usual observed difference, one expects the 10-yma of PWS = 150 ±19.5 kt, or PWS >130 kt, where 150 kt is the yearly PWS for 2007.

Figure 16(c) depicts the yearly variation of the first difference ($fd(\mathrm{PWS})_t$). Runs testing indicates that the distribution of first differences is nonrandom (z = –2.27, *cl* >95%, *sd* = 2.2 kt). A comparison of the difference of the means for the intervals 1950–1989 and 1990–2004 is found to be statistically important (*cl* >98%), with the current, more active interval having a mean first difference equal to 0.9 kt and *sd* of 1.8 kt. Hence, one would have anticipated the 10-yma of PWS for 2006 to be about 132.3 + 0.9 ± 1.8 kt, or 133.2 ± 1.8 kt. As noted above, the 2011 season had PWS = 120 kt, thereby yielding the 10-yma of PWS = 132.8 kt for 2006 (up from 132.3 kt in 2005), inferring an $fd = 0.5$ kt for 2005. For 2007, one anticipates the 10-yma of $\text{PWS} = 133.2 + 0.9 \pm 1.8$ kt, or 134.1 ± 1.8 kt, indicating PWS >120 kt in 2012. (The 10-yma PWS has a minimum value of 126.3 kt for the year 2007, computed by assuming a frequency of zero NTC in 2012.)

2.5.2 <PWS>

Figure 17(a) displays the yearly variation of the <PWS> (in kt) for the interval 1945–2010. <PWS> is defined as the seasonal mean of the individual tropical cyclone highest sustained maximum wind speeds. As an example, the four storms of 1983 had PWS equal to 100 kt (Alicia), 70 kt (Barry), 65 kt (Chantal), and 55 kt (Dean), thus yielding a mean of 72.5 kt, which is plotted in figure 17(a). The long-term mean is 74.9 kt, having $sd = 9.1$ kt and range 55.6 to 100.4 kt. There appears to be no statistical difference in the means for the two intervals 1945–1994 and 1995–2010, although the current, more active interval has a mean that is about 2% lower than the preceding interval (73.8 kt as compared to 75.3 kt). The highest <PWS> (100.4 kt) occurred in 1950, and the lowest <PWS> (59.3 kt) occurred in 1987. The peak 10-yma <PWS> measured 82.3 kt in 1952, and the lowest 10-yma <PWS> measured 69.1 kt in 1986.

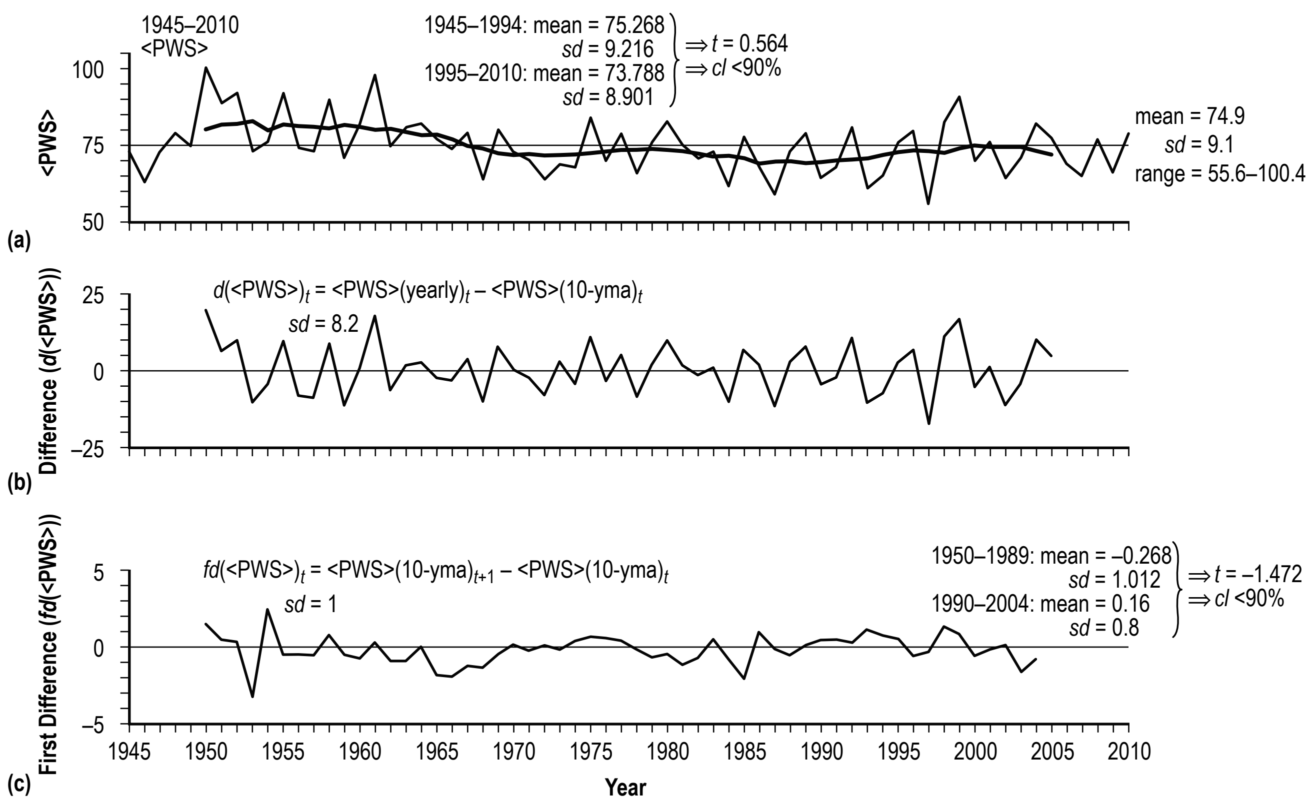

Figure 17. Yearly seasonal mean of individual cyclone's peak wind speed: (a) <PWS>, (b) difference (d<PWS>), and (c) first difference (fd<PWS>).

Figure 17(b) shows the yearly variation of the difference ($d(\langle\mathrm{PWS}\rangle)_t$). Runs testing indicates that the distribution of differences possibly could be nonrandom (z = 1.86, cl >90%, sd = 8.2 kt). Ignoring that the distribution of differences might possibly be nonrandom (albeit, only of marginal statistical importance), one would have expected the 10-yma of <PWS> = 68.5 ± 8.2 kt for 2006, where 68.5 kt is the yearly <PWS> for 2006 (i.e., the same value as determined for 2005). As it turns out, <PWS> = 66.3 kt in 2011, thereby yielding the 10-yma of <PWS> = 72 kt in 2006. For 2007, based on the usual observed difference, one anticipates the 10-yma of <PWS> = 65 ± 8.2 kt, or <PWS> < 73.2 kt, where 65 kt is the yearly <PWS> for 2007.

Figure 17(c) depicts the yearly variation of the first difference ($fd(\langle\mathrm{PWS}\rangle)_t$). Runs testing indicates that the distribution of first differences is random (z = –0.59, cl <95%, sd = 1 kt). A comparison of the difference of the means for the intervals 1950–1989 and 1990–2004 is found not to be statistically important (cl <90%). Hence, one would have expected the 10-yma of <PWS> for 2006 to be about 72 ± 1 kt. As noted above, the 2011 season had <PWS> = 66.3 kt, thereby yielding the 10-yma of <PWS> = 72 kt for 2006 and fd = 0 kt for 2005. For 2007, one again anticipates the 10-yma of <PWS> = 72 ± 1 kt, indicating <PWS> >54.2 kt in 2012. (The 10-yma <PWS> has a minimum value of 68.3 kt for the year 2007, computed by assuming a frequency of zero NTC in 2012.)

2.5.3 LP

Figure 18(a) displays the yearly variation of the LP (in mbar) for the interval 1945–2010. LP is defined as the lowest measured pressure for a tropical cyclone for the year. As an example, the storm with the lowest pressure in 1983 was Alicia, which had LP = 963 mbar. Thus, 963 mbar is the LP for 1983, which is plotted in figure 18(a). The long-term mean is 938.3 mbar, having sd = 20.5 mbar and range 882 to 979 mbar (pressure and wind speed vary in the opposite sense, with lower pressures/higher wind speeds indicative of stronger storms and higher pressures/lower wind speeds indicative of weaker storms). There appears to be no statistical difference in the means for the two intervals 1945–1994 and 1995–2010, although the current, more active interval has a mean that is about 1% lower than the preceding interval (925.4 mbar as compared to 936.4 mbar). The highest (weakest) LP (979 mbar) occurred in 1986 (Earl), and the lowest (strongest) LP (882 mbar) occurred in 2005 (Wilma). The peak 10-yma LP measured 949.1 mbar in 1950, and the lowest 10-yma LP measured 922.1 mbar in 2003. (It is important to note that the measured pressures are incomplete for much of the early record, especially prior to the mid 1970s. Consequently, values of LP before the 1980s should not be considered reliable.)

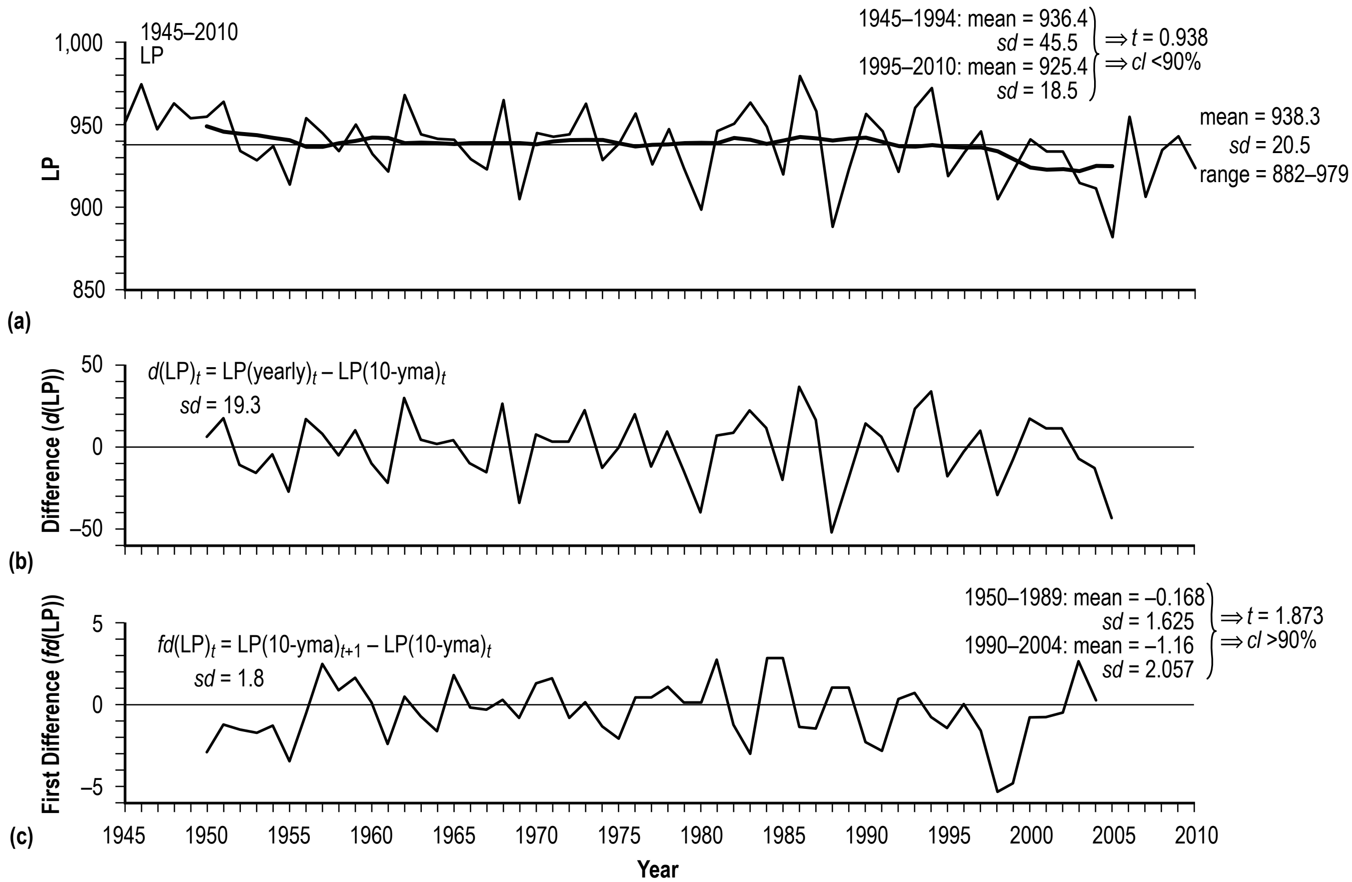

Figure 18. Yearly lowest pressure: (a) LP, (b) difference (*d*(LP)), and (c) first difference (*fd*(LP)).

Figure 18(b) shows the yearly variation of the difference ($d(\text{LP})_t$). Runs testing indicates that the distribution of differences is random (z = –0.25, *cl* <90%, *sd* = 19.3 mbar). Hence, one should have expected the 10-yma of LP = 955 ± 19.3 mbar in 2006, where 955 mbar is the yearly LP for 2006. As it turns out, LP = 940 mbar in 2011, thereby yielding the 10-yma of LP = 924.4 mbar in 2006, a value outside low the ±1 *sd* prediction interval. For 2007, based on the usual observed difference, one expects the 10-yma of LP = 907 ± 19.3 mbar, or LP <926.3 mbar, where 907 mbar is the yearly LP for 2007.

Figure 18(c) depicts the yearly variation of the first difference ($fd(\text{LP})_t$). Runs testing indicates that the distribution of first differences is random (z = –1.13, *cl* <90%, *sd* = 1.8 mbar). A comparison of the difference of the means for the intervals 1950–1989 and 1990–2004 is found to be of marginal statistically importance (*cl* >90%), with the current, more active interval having a mean first difference equal to –1.2 and *sd* of 2.1 mbar. Hence, one expected the 10-yma of LP for 2006 to be about 925 – 1.2 ± 2.1 mbar, or 923.8 ± 2.1 mbar. As noted above, the 2011 season had LP = 940 mbar, thereby yielding the 10-yma of LP = 924.4 mbar for 2006 (down from 925 mbar in 2005), inferring an *fd* = –0.6 mbar for 2005. For 2007, one anticipates the 10-yma of LP = 924.4 – 1.2 ± 2.1 mbar, or 923.2 ± 2.1 mbar, indicating LP <946 mbar in 2012. (The 10-yma LP has a minimum value of 878 mbar for the year 2007, computed by assuming a frequency of zero NTC in 2012.)

2.5.4 <LP>

Figure 19(a) displays the yearly variation of the <LP> (in mbar) for the interval 1945–2010. <LP> is defined as the seasonal mean of the individual tropical cyclone lowest pressure. As an example, the four storms of 1983 had LP equal to 963 mbar (Alicia), 986 mbar (Barry), 994 mbar (Chantal), and 999 mbar (Dean), thus yielding a mean of 985.5 mbar, which is plotted in figure 19(a). The long-term mean is 979.2 mbar, having *sd* = 8.3 mbar and range 951.4 to 992.8 mbar. There appears to be no statistical difference in the means for the two intervals 1945–1994 and 1995–2010, although the current, more active interval has a mean that is lower than the preceding interval (978.7 mbar as compared to 979.3 mbar). The highest (weakest) <LP> (992.8 mbar) occurred in 1986, and the lowest (strongest) <LP> (951.4 mbar) occurred in 1955. The peak 10-yma <LP> measured 983.9 mbar in 1973 and 1982, and the lowest 10-yma <LP> measured 973.2 mbar in 1952, 1954, and 1958.

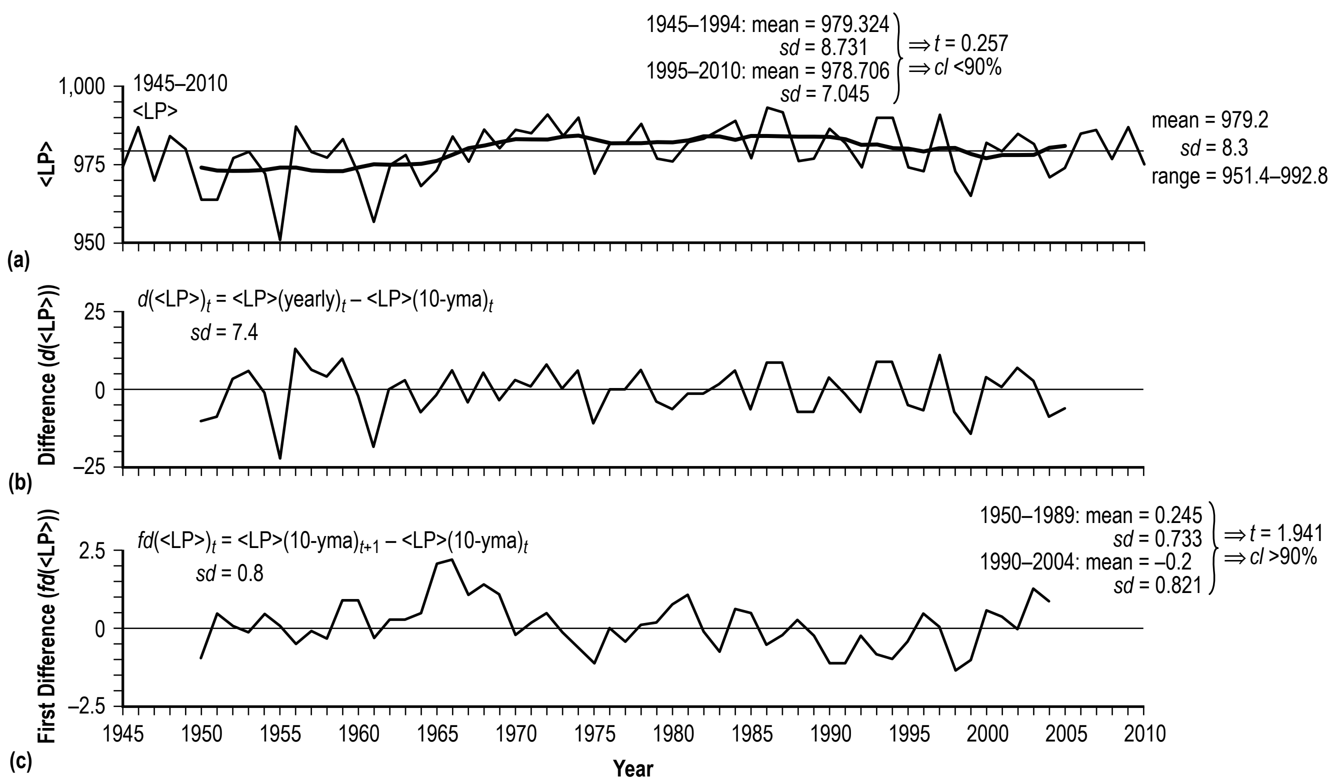

Figure 19. Yearly lowest pressure seasonal mean: (a) <LP>, (b) difference (*d*<LP>), and (c) first difference (*fd*<LP>).

Figure 19(b) shows the yearly variation of the difference ($d(\langle LP\rangle)_t$). Runs testing indicates that the distribution of differences appears random (z = –0.8, *cl* <90%, *sd* = 7.4 mbar). Given that the distribution of differences appears random, one should have expected the 10-yma of <LP> = 984.7 ± 7.4 mbar for 2006, where 984.7 mbar is the yearly <LP> for 2006. As it turns out, <LP> = 984.2 mbar in 2011, thereby yielding the 10-yma of <LP> = 980.5 mbar in 2006. For 2007, based on the usual observed difference, one anticipates the 10-yma of <LP> = 986.1 ± 7.4 mbar, or <LP> <993.5 mbar, where 986.1 mbar is the yearly <LP> for 2007.

Figure 19(c) depicts the yearly variation of the first difference (fd(<LP>)$_t$). Runs testing indicates that the distribution of first differences is random (z = –1.67, cl <90%, sd = 0.8 mbar). A comparison of the difference of the means for the intervals 1950–1989 and 1990–2004 is found to be only of marginal statistical importance (cl >90%). Hence, one should have expected the 10-yma of <LP> = 980.6 ± 0.8 mbar for 2006. As noted above, the 2011 season had <LP> = 984.2 mbar, thereby yielding the 10-yma of <LP> = 980.5 mbar for 2006 and fd = –0.1 mbar for 2005. For 2007, one again anticipates the 10-yma of <LP> = 980.5 ± 0.8 mbar, indicating <LP> <996.6 mbar in 2012. (The 10-yma <LP> has a minimum value of 931.5 mbar for the year 2007, computed by assuming a frequency of zero NTC in 2012.)

2.5.5 Correlation Behavior of LP and PWS and Between <LP> and <PWS>

Figure 20 shows the scatter plots of 10-yma values of (a) LP versus PWS and (b) <LP> versus <PWS>. In the figure, the filled circles correspond to the data for 1991–2005 and the filled squares correspond to the earlier data for 1950–1990. The inferred regressions (the diagonal lines) were determined using only the more recent 1991–2005 data. Plainly, very strong correlations (r >0.99) are inferred to exist between pressure and wind speed when using the 1991–2005 data, which is what one expects. However, there is an obvious lack of correlation, especially in figure 20(a), for most of the data prior to 1991. The lack of correlation is due to the unreliable pressure determinations for the earlier time span, due to the incompleteness of the pressure determination record, especially prior to the 1980s. Regarding figure 20(b), the earlier data suggest a possible correlation between the parameters, however, to the eye, the earlier data appears to be offset right to the shown inferred regression line. (Again, it is important to remember that the earlier record suffers from incompleteness in pressure determinations.).

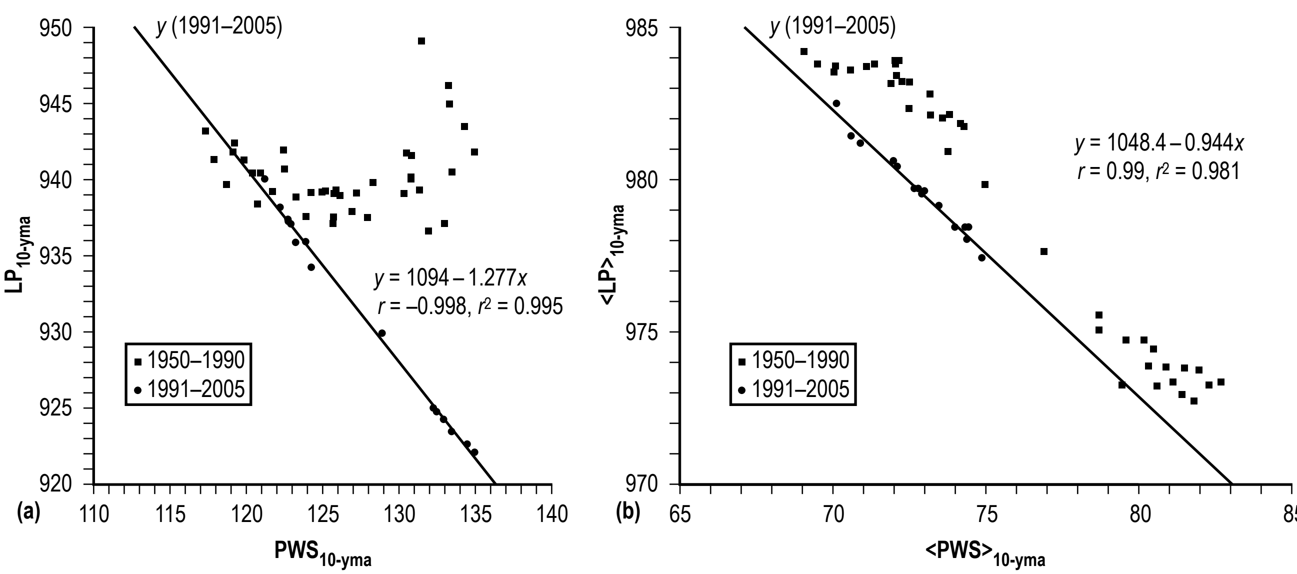

Figure 20. Scatter plots of 10-yma values: (a) LP versus PWS and (b) <LP> versus <PWS>.

2.6 Other Aspects of Tropical Cyclones

2.6.1 ACE

Figure 21(a) displays the yearly variation of the accumulated cyclone energy (ACE) for the interval 1945–2010. For an individual storm, ACE is defined as the sum of the square of the tropical cyclone's maximum wind speed (multiplied by 10^{-4} kt^{-2}) for each 6-hr period when the storm is classified as being either in the tropical cyclone stage or subtropical stage (i.e., when 6-hr wind speed is ≥34 kt; by definition, wind speeds during the extra-tropical stage are excluded in the computation of a storm's ACE). Summing the individual storm ACEs yields the yearly or seasonal ACE, which is plotted in figure 21(a). As an example, the four storms of 1983 had individual ACEs of 6.4 (Alicia), 3.1 (Barry), 4.3 (Chantal), and 3.6 (Dean), thus yielding the total of 17.4 for the yearly or seasonal ACE for 1983, which is plotted in figure 21(a). The long-term mean is 103.5, having *sd* = 58.5 and range 17.4 to 250.3. A statistically important difference (*cl* >99.9%) in the means for the two intervals 1945–1994 and 1995–2010 is apparent, with the current, more active interval having a mean that is more than 63% higher than the preceding interval (146.6 as compared to 89.7). The highest yearly ACE (250.3) occurred in 2005, and the lowest yearly ACE (17.4) occurred in 1983. The peak 10-yma ACE measured 159.7 in 2000, and the lowest 10-yma ACE measured 68.2 in 1987. (Higher seasonal ACE values can be achieved by having more storms to occur in a season, storms with higher 6-hr peak wind speeds, and/or having storms that persist longer in the tropical/subtropical cyclone stages.)

Figure 21(b) shows the yearly variation of the difference ($d(\mathrm{ACE})_t$). Runs testing indicates that the distribution of differences appears random (z = 0.28, *cl* <90%, *sd* = 51.8). Given that the distribution of differences appears random, one should have expected the 10-yma of ACE = 78.5 ± 51.8 for 2006, where 78.5 is the yearly ACE for 2006. As it turns out, ACE = 127.6 in 2011 (down from 166.5 in 2010), thereby yielding the 10-yma of ACE = 144.6 in 2006 (up from 141.3 in 2005 and about 11% higher than the upper limit of the ±1 *sd* prediction interval). For 2007, based on the usual observed difference, one anticipates the 10-yma ACE = 73.8 ± 51.8, or ≤125.6, where 73.8 is the yearly ACE for 2007.

Figure 21(c) depicts the yearly variation of the first difference ($fd(\mathrm{ACE})_t$). Runs testing indicates that the distribution of first differences might be nonrandom (z = –2.16, *cl* >95%, *sd* = 5.5). A comparison of the difference of the means for the intervals 1950–1989 and 1990–2004 is also found to be statistically important (*cl* >99.9%). Hence, one should have expected the 10-yma of ACE = 141.3 + 4.5 ± 7.1, or about 145.8 ± 7.1 for 2006, where 141.3 is the 10-yma value of ACE for 2005, 4.5 is the mean of the current, more active interval, and 7.1 is the *sd* in the current, more active interval. As noted above, the 2011 season had ACE = 127.6, thereby yielding the 10-yma of ACE = 144.6 for 2006 and *fd* = 3.3 for 2005. For 2007, one anticipates the 10-yma of ACE = 144.6 + 4.5 ± 7.1, or about 149.1 ± 7.1, indicating ACE >93 in 2012. (The 10-yma ACE has a minimum value of 137.4 for the year 2007, computed by assuming a frequency of zero NTC in 2012.)

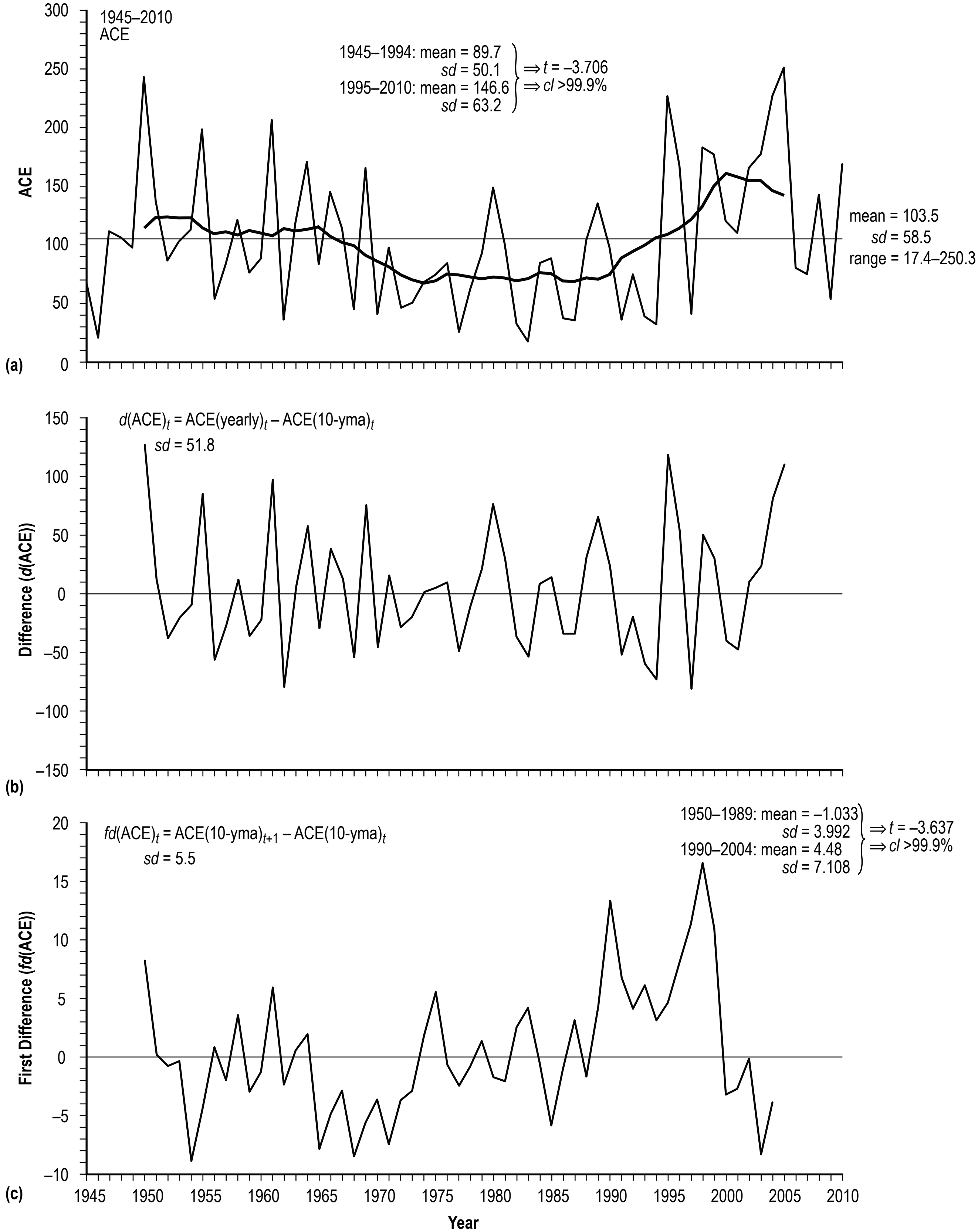

Figure 21. Yearly variation of accumulated cyclone energy: (a) ACE, (b) difference (d(ACE)), and (c) first difference (fd(ACE))

2.6.2 NSD

Figure 22(a) displays the yearly variation of the number of storm days (NSD) for the interval 1945–2010. For an individual storm, NSD is simply defined as the number of days when the storm was in the tropical cyclone stage or subtropical cyclone stage (i.e., when the 6-hr wind speed is ≥34 kt; again, by definition, the extra-tropical stage wind speed days are excluded in the computation of NSD). Summing the individual storm NSDs yields the yearly or seasonal NSD, which is plotted in figure 22(a). As an example, the four storms of 1983 had individual NSDs of 2.75 days (Alicia), 3 days (Barry), 4 days (Chantal), and 4 days (Dean), thus yielding the total of 13.75 days for the yearly or seasonal NSD for 1983, which is plotted in figure 22(a). The long-term mean is 55.71 days, having sd = 30.01 days and range 13.75 to 191.25 days. A statistically important difference (cl >99.9%) in the means for the two intervals 1945–1994 and 1995–2010 is apparent, with the current, more active interval having a mean that is about 75% longer than the preceding interval (82.6 days as compared to 47.1 days). The longest yearly NSD (191.25 days) occurred in 2010, and the shortest yearly NSD (13.75 days) occurred in 1983. The peak 10-yma NSD measured 79.43 days in 2005, and the lowest 10-yma NSD measured 41.35 days in 1979 and 1982.

Figure 22(b) shows the yearly variation of the difference ($d(\mathrm{NSD})_t$). Runs testing indicates that the distribution of differences appears random (z = 0.80, cl <90%, sd = 22 days). Given that the distribution of differences appears random, one should have expected the 10-yma of NSD = 63.75 ± 22 days for 2006, where 63.75 days is the yearly NSD for 2006. As it turns out, NSD = 91.5 days in 2011 (down from 191.25 days in 2010, the highest ever recorded), thereby yielding the 10-yma of NSD = 86.59 days in 2006 (up from 79.43 days in 2005, becoming the new record high, and about 1% higher than the upper limit of the ±1 sd prediction interval). For 2007, based on the usual observed difference, one anticipates the 10-yma of NSD = 38.25 ± 22 days, or ≤60.25 days, where 38.25 days is the yearly NSD for 2007.

Figure 22(c) depicts the yearly variation of the first difference ($fd(\mathrm{NSD})_t$). While runs testing indicates that the distribution of first differences appears to be random (z = –1.62, cl <90%, sd = 2.16 days), a comparison of the difference of the means for the intervals 1950–1989 and 1990–2004 finds that the difference in means is statistically important (cl >99.9%). Hence, one should have expected the 10-yma of NSD = 79.43 + 2.28 ± 2.42 days, or about 81.71 ± 2.42 days for 2006 (using the mean and sd for the current, more active interval). As noted above, however, the 2011 season actually had NSD = 91.5 days (down from the record number of 191.25 days experienced in 2010), thereby yielding the 10-yma of NSD = 86.59 days for 2006 (up from 79.43 days in 2005 and becoming the new record high) and fd = 7.16 days for 2005 (also a record high), about 3% higher than the upper limit of the ±1 sd prediction interval. For 2007, one anticipates the 10-yma of NSD = 86.59 + 2.28 ± 2.42 days, or about 88.87 ± 2.42 days, inferring NSD >31 days in 2012. (The 10-yma NSD has a minimum value of 84.9 days for the year 2007, computed by assuming a frequency of zero NTC in 2012.)

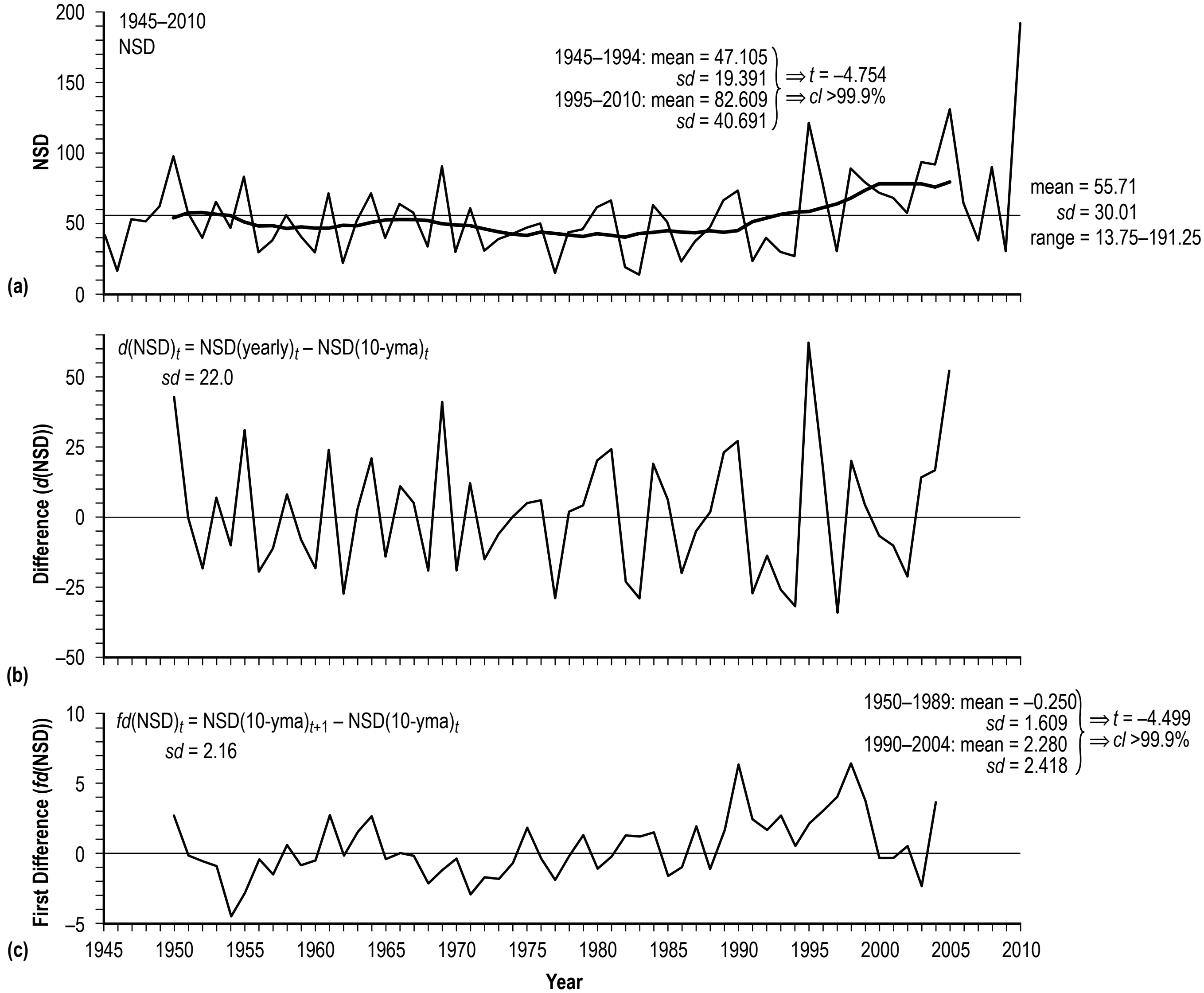

Figure 22. Yearly storm days: (a) NSD, (b) difference (d(NSD)), and (c) first difference (fd(NSD)).

2.6.3 NHD

Figure 23(a) displays the yearly variation of the number of hurricane days (NHD) for the interval 1945–2010. For an individual storm, NHD is simply defined as the number of days when the storm was in the tropical cyclone stage or subtropical cyclone stage and its maximum sustained wind speed exceeded 63 kt (i.e., when the peak 6-hr wind speed is ≥64 kt; again, by definition, the extra-tropical stage wind speed days are excluded in the computation of NHD). Summing the individual storm NHDs yields the yearly or seasonal NHD, which is plotted in figure 23(a). As an example, the four storms of 1983 had individual NHDs of 1.75 days (Alicia), 0.5 days (Barry), 1.25 days (Chantal), and 0 days (Dean), thus yielding the total of 3.5 days for the yearly or seasonal NHD for 1983, which is plotted in figure 23(a). The long-term mean is 24.62 days, having sd = 14.44 days and range 3.5 to 61.25 days. A statistically important difference (cl >98%) in the means for the two intervals

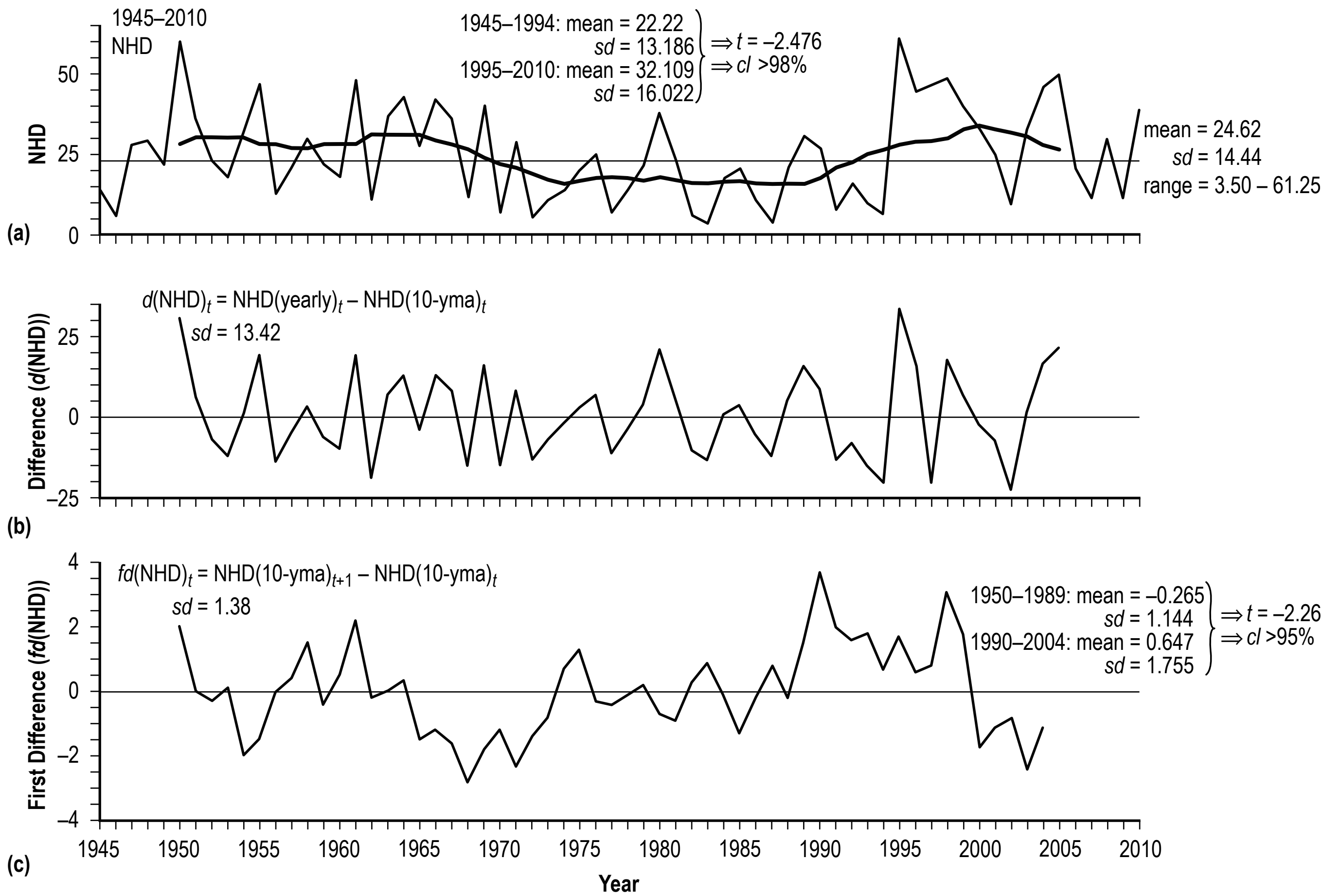

Figure 23. Yearly hurricane days: (a) NHD, (b) difference (d(NHD)), and (c) first difference (fd(NHD)).

1945–1994 and 1995–2010 is apparent, with the current, more active interval having a mean that is about 45% longer than the preceding interval (32.1 days as compared to 22.2 days). The longest yearly NHD (61.25 days) occurred in 1995, and the shortest yearly NHD (3.5 days) occurred in 1983. The peak 10-yma NHD measured 34.46 days in 2000, and the lowest 10-yma NHD measured 15.63 days in 1987.

Figure 23(b) shows the yearly variation of the difference ($d(\mathrm{NHD})_t$). Runs testing indicates that the distribution of differences appears random (z = 0.27, cl <90%, sd = 13.42 days). Given that the distribution of differences appears random, one should have expected the 10-yma of NHD = 21.25 ± 13.42 days for 2006, where 21.25 days is the yearly NHD for 2006. As it turns out, NHD = 26 days in 2011 (down from 38.5 days in 2010), thereby yielding the 10-yma of NHD = 27.68 days in 2006 (up from 27.36 days in 2005). For 2007, based on the usual observed difference, one anticipates the 10-yma of NHD = 12.25 ± 13.42 days, or ≤25.67 days, where 12.25 days is the yearly NHD for 2007.

Figure 23(c) depicts the yearly variation of the first difference ($fd(\text{NHD})_t$). Both runs testing of the distribution of first differences and the difference in means between the intervals 1950–1989 and 1990–2004 suggest a nonrandom distribution in the first differences of NHD (i.e., z = –2.21, cl >95%, sd = 1.38; and t = –2.26 and cl >95%). Hence, one should have expected the 10-yma of NHD = 27.36 + 0.65 ± 1.76 days, or about 28.01 ± 1.76 days for 2006 (using the mean and sd for the current, more active interval). As noted above, the 2011 season actually had NHD = 26 days (down from 38.5 days experienced in 2010), thereby yielding the 10-yma of NHD = 27.68 days for 2006 (up from 27.36 days in 2005) and fd = 0.32 days for 2005. For 2007, one anticipates the 10-yma of NHD = 27.68 + 0.65 ± 1.76 days, or about 28.33 ± 1.76 days, inferring NHD ≥ 0 days in 2012 (perhaps as many as 58 days, the upper limit of the ±1 sd prediction interval). (The 10-yma NHD has a minimum value of 27.21 days for the year 2007, computed by assuming a frequency of zero NTC in 2012.)

2.6.4 NMHD

Figure 24(a) displays the yearly variation of the number of major hurricane days (NMHD) for the interval 1945–2010. For an individual storm, NMHD is simply defined as the number of days when the storm was in the tropical cyclone stage or subtropical cyclone stage and its maximum sustained wind speed exceeded 95 kt (i.e., when the peak 6-hr wind speed is ≥96 kt; again, by definition, the extra-tropical stage wind speed days are excluded in the computation of NMHD). Summing the individual storm NMHDs yields the yearly or seasonal NMHD, which is plotted in figure 24(a). As an example, of the four storms of 1983, only Alicia attained major hurricane status and then only briefly for one 6-hr period; hence NMHD = 0.25 day for1983, which is plotted in figure 24(a). The long-term mean is 6.23 days, having sd = 5.68 days and range 0 to 24.5 days. A statistically important difference (cl >98%) in the means for the two intervals 1945–1994 and 1995–2010 is apparent, with the current, more active interval having a mean that is about 77% longer than the preceding interval (5.25 days as compared to 9.3 days). The longest yearly NMHD (24.5 days) occurred in 1961, and the shortest yearly NMHD (0 days) occurred in 1968, 1972, 1986, and 1994. The peak 10-yma NMHD measured 10.43 days in 2000, and the lowest 10-yma NMHD measured 1.9 days in 1973.

Figure 24(b) shows the yearly variation of the difference ($d(\text{NMHD})_t$). Runs testing indicates that the distribution of differences appears random (z = –0.15, cl <90%, sd = 5.05 days). Given that the distribution of differences appears random, one should have expected the 10-yma of NMHD = 2 ± 5.05 days for 2006, where 2 days is the yearly NMHD for 2006. As it turns out, NMHD = 4.5 days in 2011 (down from 11 days in 2010), thereby yielding the 10-yma of NMHD = 9.39 days in 2006 (up from 9.08 days in 2005). For 2007, based on the usual observed difference, one anticipates the 10-yma of NHD = 6 ± 5.05 days, or ≤11.05 days, where 6 days is the yearly NMHD for 2007.

Figure 24(c) depicts the yearly variation of the first difference ($fd(\text{NMHD})_t$). Both runs testing of the distribution of first differences and the difference in means between the intervals 1950–1989 and 1990–2004 suggest a nonrandom distribution in the first differences of NMHD (i.e., z = –2.27, cl >95%, sd = 0.58; and t = –3.07 and cl >99.5%). Hence, one should have expected the 10-yma of NMHD = 9.08 + 0.38 ± 0.69 days, or about 9.46 ± 0.69 days for 2006 (using the mean and sd for the current, more active interval). As noted above, the 2011 season actually had NMHD = 4.5 days (down from 11 days experienced in 2010), thereby yielding the 10-yma of NMHD = 9.39 days for 2006 (up from 9.08 days in 2005) and fd = 0.31 day for 2005. For 2007, one anticipates the 10-yma of NMHD = 9.39 + 0.38 ± 0.69 days, or about 9.77 ± 0.69 days, inferring NMHD

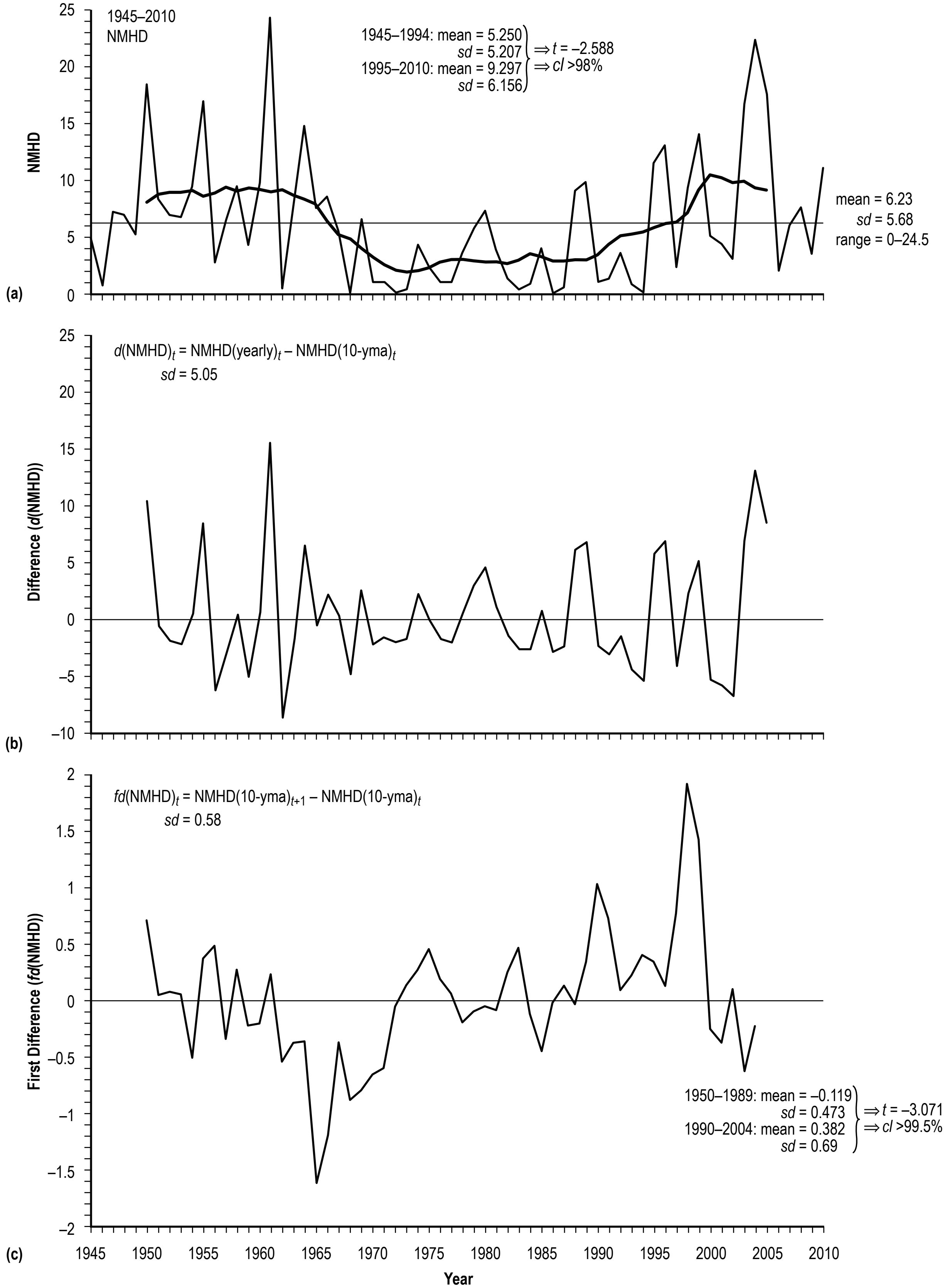

Figure 24. Yearly major hurricane days: (a) NMHD, (b) difference (d(NMHD)), and (c) first difference (fd(NMHD)).

≥ 0 days in 2012 (perhaps as many as 24 days, the upper limit of the ±1 *sd* prediction interval). (The 10-yma NMHD has a minimum value of 9.25 days for the year 2007, computed by assuming a frequency of zero NTC in 2012.)

2.6.5 NTCA

Figure 25(a) displays the yearly variation of the net tropical cyclone activity (NTCA) for the interval 1945–2010. NTCA is a yearly or seasonal parameter rather than an individual storm parameter, developed by Colorado State University to provide a simple comparison to the average seasonal tropical cyclone activity based on 1950–2000 parametric averages. To determine the NTCA, one needs the values of NTC, NSD, NH, NHD, NMH, and NMHD. A convenient calculator for determining NTCA is available online at <http://einstein.atmos.colostate.edu/~mcnoldy/tropics/NTC.html>. As an example, the 1983 season had NTC = 4, NH = 3, NMH = 1, NSD = 13.75 days, NHD = 3.5 days, and NMHD = 0.25 day. Entering these data into the online calculator yields NTCA = 30.5% for the 1983 season, meaning that in comparison to the average seasonal activity for 1950–2000, the 1983 season was only about 30% as active.

The long-term mean of NTCA for the interval 1945–2010 is 112.6%, having *sd* = 59.3% and range 30.5% to 278.3%. A statistically important difference (*cl* >98%) in the means for the two intervals 1945–1994 and 1995–2010 is apparent, with the current, more active interval having a mean that is about 59% higher than the preceding interval (98.6% as compared to 156.5%). The highest yearly NTCA (278.3%) occurred in 2005, and the least yearly NTCA (30.5%) occurred in 1983. The peak 10-yma NTCA measured 160.5% in 2000, and the lowest 10-yma NTCA measured 75.5% in 1987. (The peak 10-yma NTCA value of 160.5% measured in 2000 is about 18% higher than the earlier peak 10-yma NTCA value of 136.1% measured in 1954.)

Figure 25(b) shows the yearly variation of the difference ($d(\mathrm{NTCA})_t$). Runs testing indicates that the distribution of differences appears random (z = –0.21, *cl* <90%, *sd* = 53.1%). Given that the distribution of differences appears random, one should have expected the 10-yma of NTCA = 88.7% ± 53.1% for 2006, where 88.7% is the yearly NTCA for 2006. As it turns out, NTCA = 145.5% in 2011 (down from 230.9% in 2010), thereby yielding the 10-yma of NTCA = 156.1% in 2006 (up from 150.7% in 2005), which is about 10% higher than the upper limit of the ±1 *sd* prediction interval based on the usual observed difference. For 2007, based on the usual observed difference, one anticipates the 10-yma of NTCA = 98.8% ± 53.1%, or ≤151.9%, where 98.8% is the yearly NTCA for 2007.

Figure 25(c) depicts the yearly variation of the first difference ($fd(\mathrm{NTCA})_t$). While runs testing of the distribution of first differences indicates a nonrandom distribution of only marginal statistical importance (z = –1.71, *cl* >90%, *sd* = 5.1%), in contrast, the difference in means between the intervals 1950–1989 and 1990–2004 strongly suggests a nonrandom distribution of the first differences (t = –4.38, *cl* >99.9%). Hence, one should have expected the 10-yma of NTCA = 150.7% + 4.7% ± 6.3%, or about 155.4% ± 6.3% for 2006 (using the mean and *sd* for the current, more active interval). As noted above, the 2011 season actually had NTCA = 145.5% (down from 230.9% experienced in 2010), thereby yielding the 10-yma of NTCA = 156.1% for 2006 (up from 150.7% in 2005) and *fd* = 5.4% for 2005. For 2007, one anticipates the 10-yma of NTCA = 156.1% + 4.7% ± 6.3%, or about 160.8% ± 6.3%, inferring NTCA ≥ 41.2% in 2012 (perhaps as high as 293.2%, the upper limit of the

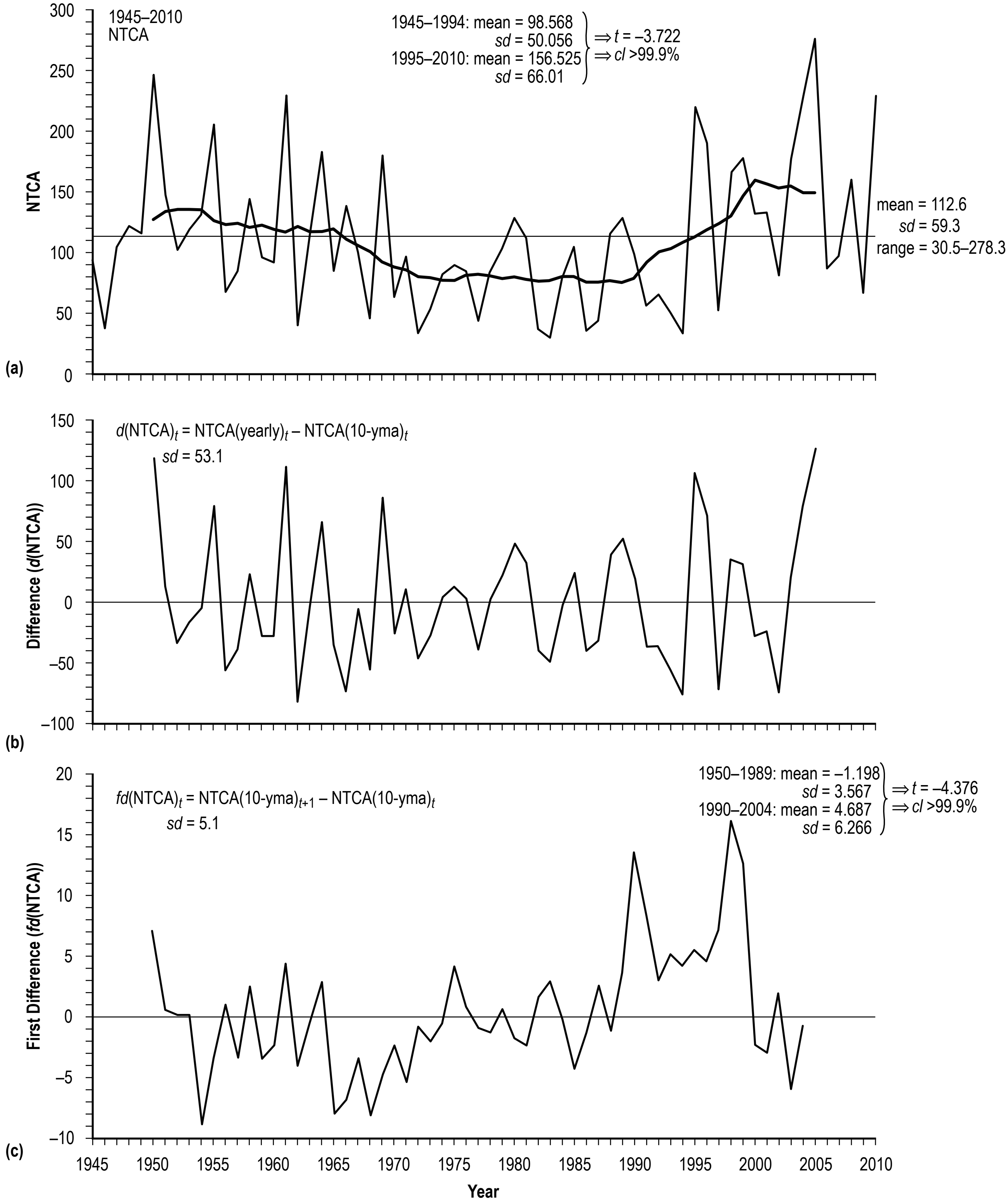

Figure 25. Yearly tropical cyclone activity: (a) NTCA, (b) difference (d(NTCA)), and (c) first difference (fd(NTCA)).

±1 *sd* prediction interval). (The 10-yma NTCA has a minimum value of 152.4% for the year 2007, computed by assuming a frequency of zero NTC in 2012.)

2.6.6 ACE/NSD

Figure 26(a) displays the yearly variation of the ratio of ACE to NSD for the interval 1945–2010. The long-term mean is 1.83, having *sd* = 0.45 and range 0.93 to 2.98. While the difference in the means for the two time intervals 1945–1994 and 1995–2010 does not appear to be statistically important (t = –0.14, *cl* <90%), noticeable is that the 10-yma of ACE/NSD is always above the mean during the interval prior to 1968, always below the mean during the interval 1968–1997, and now is once again above the mean, at least through 2005. Overall, the highest yearly ACE/NSD (2.98) occurred in 1960, and the lowest yearly ACE/NSD (0.93) occurred in 1987. The highest yearly ACE/NSD during the current, more active interval measures 2.88 in 2002, and the lowest yearly ACE/NSD during the current, more active interval measures 0.98 in 2010. Overall, the highest 10-yma of ACE/NSD (2.27) occurred in 1962, and lowest 10-yma of ACE/NSD (1.55) occurred in 1973. During the current, more active interval, the peak 10-yma of ACE/NSD measured 2.01 in 2000 (about 11% smaller than the overall peak of 2.27), and the lowest 10-yma of ACE/NSD measures 1.69 in 1995. (The 10-yma values of ACE/NSD appear to be trending downward since 2000, measuring 1.85 in 2005.)

Figure 26(b) shows the yearly variation of the difference ($d(\mathrm{ACE/NSD})_t$). Runs testing indicates that the distribution of differences appears random (z = 1.33, *cl* <90%, *sd* = 0.36). Given that the distribution of differences appears random, one should have expected the 10-yma of ACE/NSD = 1.23 ± 0.36 for 2006, where 1.23 is the yearly ACE/NSD for 2006. As it turns out, ACE/NSD = 1.39 in 2011 (up from 0.98 in 2010), thereby yielding the 10-yma of ACE/NSD = 1.81 in 2006 (down from 1.85 in 2005 and about 14% higher than the upper limit of the ±1 *sd* prediction interval). For 2007, based on the usual observed difference, one anticipates the 10-yma of ACE/NSD = 1.93 ± 0.39, or <2.32, where 1.93 is the yearly ACE/NSD for 2007.

Figure 26(c) depicts the yearly variation of the first difference ($fd(\mathrm{ACE/NSD})_t$). Runs testing indicates that the distribution of first differences appears nonrandom (z = –3.70, *cl* >99.9%, *sd* = 0.05). A comparison of the difference of the means for the intervals 1950–1989 and 1990–2004 is also found to be statistically important (*cl* >95%). Hence, one should have expected the 10-yma of ACE/NSD = 1.85 + 0.02 + ± 0.05, or about 1.87 ± 0.05 for 2006, where 1.85 is the 10-yma value of ACE/NSD for 2005, 0.02 is the mean of the current, more active interval, and 0.05 is the *sd* in the current, more active interval. As noted above, the 2011 season had ACE/NSD = 1.39, thereby yielding the 10-yma of ACE/NSD = 1.81 for 2006 and *fd* = –0.04 for 2005. For 2007, one anticipates the 10-yma of ACE/NSD = 1.81 + 0.02 ± 0.05, or about 1.83 ± 0.05, indicating ACE/NSD >2.54 in 2012. (The 10-yma ACE/NSD has a minimum value of 1.65 for the year 2007, computed by assuming a frequency of zero NTC in 2012.)

The ratio of ACE/NSD becomes larger if the rate of change in ACE is greater than the rate of change in NSD, and it becomes smaller if the rates are reversed. So, a yearly value of ACE/NSD = 2.54 in 2012 means the 10-yma of ACE/NSD = 1.78 for 2007 and suggests a continuing downward progression of the 10-yma values of ACE/NSD. For the downward trend in the 10-yma of ACE/

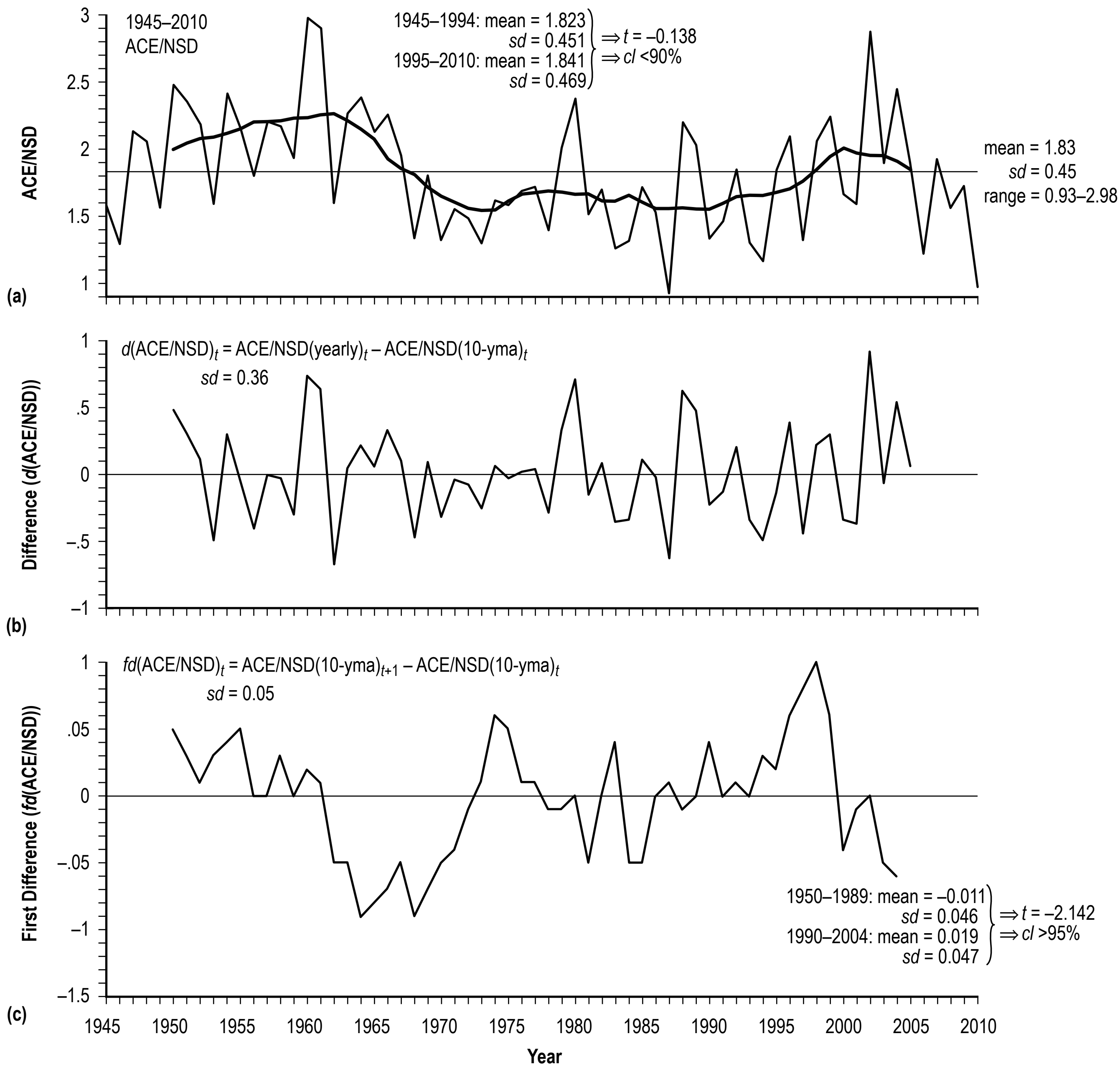

Figure 26. Yearly variation of the ratio: (a) ACE/NSD (b) difference (d(ACE/NSD)), and (c) first difference (fd(ACE/NSD)).

NSD to reverse, the yearly ratio ACE/NSD for 2012 would have to measure ≥3.14, a value never seen before. Therefore, it appears likely that the 10-yma ratio of ACE/NSD will continue to decrease with time, with the first difference of ACE/NSD continuing to be negative.

2.6.7 HISACE

Figure 27(a) displays the yearly variation of the highest individual storm accumulated cyclone energy (HISACE) for the interval 1945–2010. Recall that ACE is defined as the sum of the square of the tropical cyclone's maximum wind speed (multiplied by 10^{-4} kt^{-2}) for each 6-hr period when the storm is classified as being either in the tropical cyclone stage or subtropical stage (i.e., when 6-hr wind speed is ≥34 kt; by definition, wind speeds during the extra-tropical stage are excluded in the computation of a storm's ACE). The highest observed individual storm ACE during a hurricane season by definition is HISACE. As an example, the four storms of 1983 had individual ACEs of 6.4 (Alicia), 3.1 (Barry), 4.3 (Chantal), and 3.6 (Dean). The storm with the highest ACE was Alicia and its value of 6.4 is plotted as HISACE for 1983 in figure 27(a). The long-term mean is 32.8, having sd = 16.1 and range 6.4 to 70.4. A marginally statistically important difference (cl >90%) in the means for the two intervals 1945–1994 and 1995–2010 is apparent, with the current, more active interval having a mean that is more than 28% higher than the preceding interval (39.2 as compared to 30.7). The highest yearly HISACE (70.4) occurred in 2004 (Ivan), and the lowest yearly HISACE (6.4) occurred in 1983 (Alicia). The peak 10-yma HISACE measured 44.1 in 1962, and the lowest 10-yma HISACE measured 21.4 in 1986 and 1987. Interestingly, the 10-yma of HISACE is above the mean during the interval of 1950–1968, below the mean during the interval 1969–1997, and now once again is above the mean during the current interval 1998–2005. The peak 10-yma of HISACE in the current, more active interval (41.4) may have occurred in 2000, measuring about 6% smaller than the peak (44.1) in 1962.

Figure 27(b) shows the yearly variation of the difference ($d(\text{HISACE})_t$). Runs testing indicates that the distribution of differences appears random (z = 0.32, cl <90%, sd = 14.3). Given that the distribution of differences appears random, one should have expected the 10-yma of HISACE = 24.3 ± 14.3 for 2006, where 24.3 (Helene) is the yearly HISACE for 2006. As it turns out, HISACE = 27 (Katia) in 2011 (down from 41.9, Igor, in 2010), thereby yielding the 10-yma of HISACE = 38.2 in 2006 (up from 37.6 in 2005, but within the ±1 sd prediction interval). For 2007, based on the usual observed difference, one anticipates the 10-yma of HISACE = 35.2 ± 14.3, or ≤49.5, where 35.2 (Dean) is the yearly HISACE for 2007.

Figure 27(c) depicts the yearly variation of the first difference ($fd(\text{HISACE})_t$). Both runs testing and the difference in means for the two intervals 1950–1989 and 1990–2004 indicate that the distribution of first differences appears to be nonrandom and statistically important (z = –3.30, cl >99.8%, sd = 1.6, and t = –2.53, cl >98%, respectively). Hence, one should have expected the 10-yma of HISACE = 37.6 + 0.9 ± 1.8, or about 38.5 ± 1.8 for 2006, where 37.6 is the 10-yma value of HISACE for 2005, 0.9 is the mean of the current, more active interval, and 1.8 is the sd in the current, more active interval. As noted above, the 2011 season had HISACE = 27, thereby yielding the 10-yma of HISACE = 38.2 for 2006 and fd = 0.6 for 2005. For 2007, one anticipates the 10-yma of ACE = 38.2 + 0.9 ± 1.8, or about 39.1 ± 1.8, indicating HISACE <65.6 in 2012 (the upper limit of the ±1 sd prediction interval). (The 10-yma HISACE has a minimum value of 37.6 for the year 2007, computed by assuming a frequency of zero NTC in 2012.)

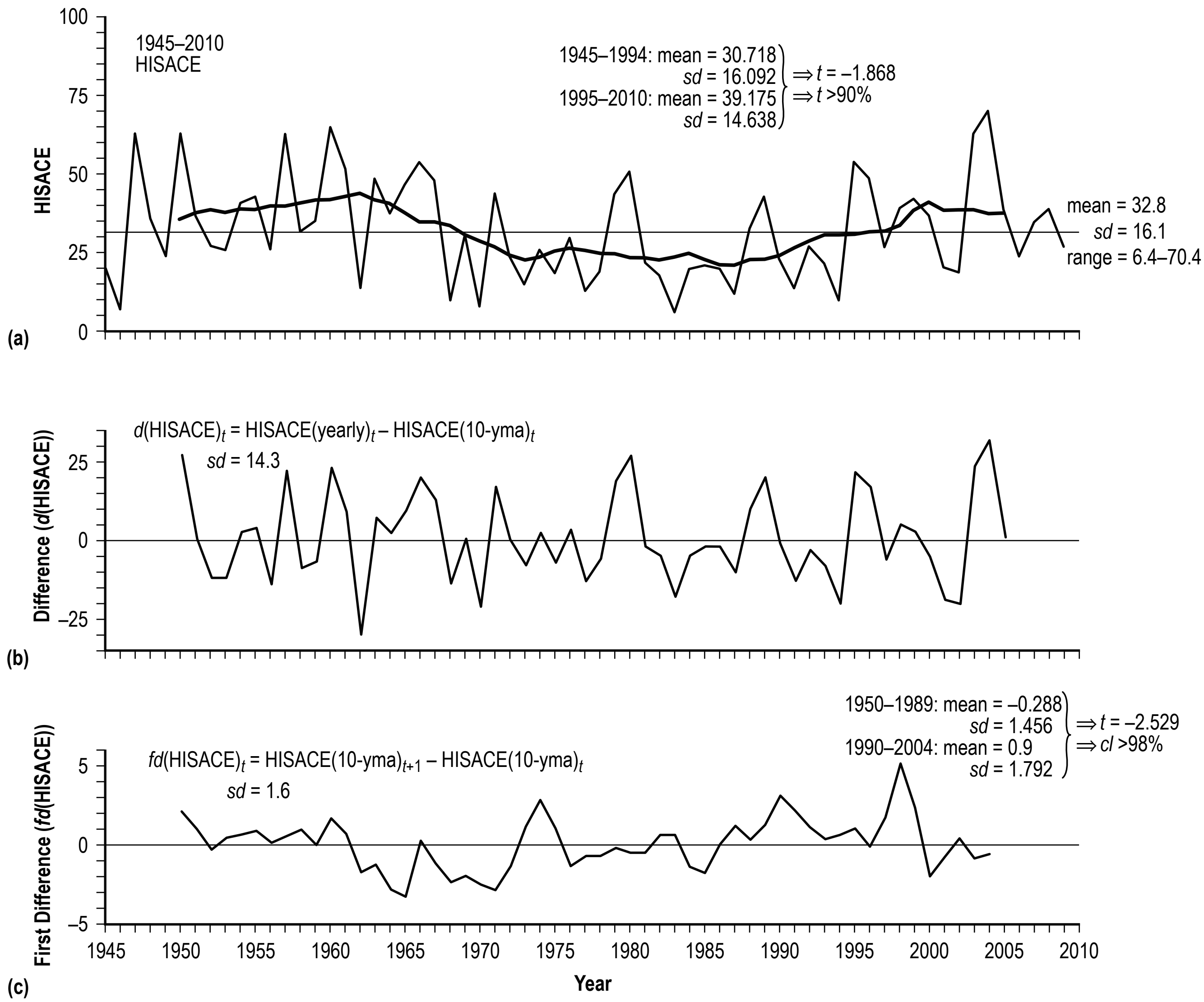

Figure 27. Yearly variation of individual storm cyclone energy: (a) HISACE, (b) difference (d(HISACE)), and (c) first difference (fd(HISACE)).

2.6.8 LISNSD

Figure 28(a) displays the yearly variation of the longest individual storm number of storm days (LISNSD) for the interval 1945–2010. For an individual storm, NSD is simply defined as the number of days when the storm was in the tropical cyclone stage or subtropical cyclone stage (i.e., when the 6-hr wind speed is ≥34 kt; again, by definition, the extra-tropical stage wind speed days are excluded in the computation of NSD). The longest observed individual storm NSD during a hurricane season by definition is LISNSD. As an example, the four storms of 1983 had individual NSDs of 2.75 days (Alicia), 3 days (Barry), 4 days (Chantal), and 4 days (Dean). The storms with the longest NSD were Chantal and Dean, both having NSD = 4 days, and it is this value (4) that is plotted as LISNSD for 1983 in figure 28(a). The long-term mean is about 11.5 days, having sd = 3.6 days and

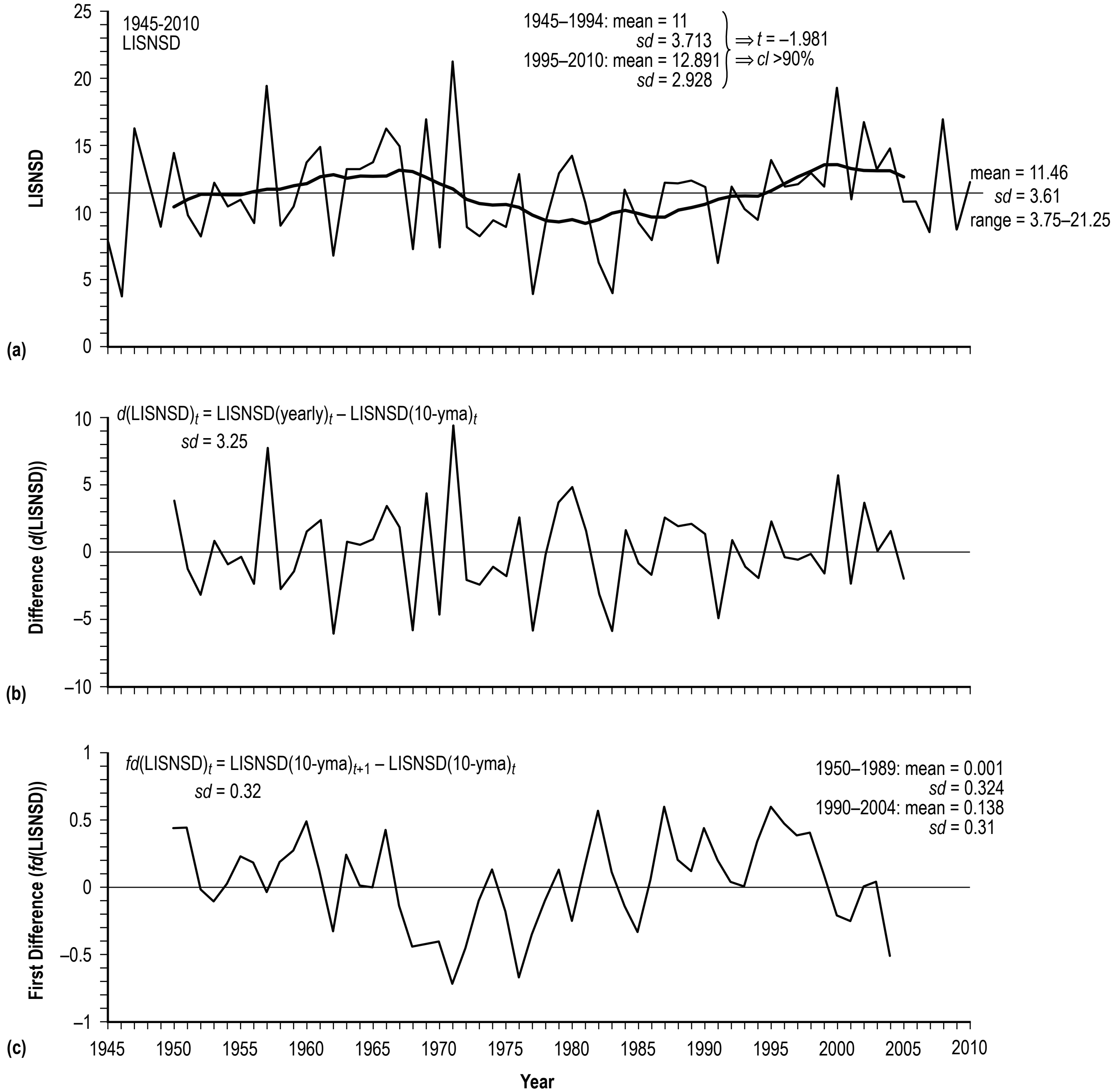

Figure 28. Yearly variation of individual storm storm days: (a) LISNSD, (b) difference (d(LISNSD)), and (c) first difference (fd(LISNSD)).

range 3.75 to 21.25 days. Although the difference in the means for the two intervals 1945–1994 and 1995–2010 is marginally statistically important, it seems noteworthy that the current, more active interval has a mean that is about 17% longer than the preceding interval (12.9 days as compared to 11 days). The longest yearly LISNSD (21.25 days) occurred in 1971 (Ginger), and the shortest yearly LISNSD (3.75 days) occurred in 1946 (2 unnamed storms). The peak 10-yma LISNSD measured 13.66 days in 2000, and the lowest 10-yma LISNSD measured 9.3 days in 1981.

Figure 28(b) shows the yearly variation of the difference (d(LISNSD)$_t$). Runs testing indicates that the distribution of differences appears random (z = 0.28, cl <90%, sd = 3.25 days). Given that the distribution of differences appears random, one should have expected the 10-yma of LISNSD = 10.75 ± 3.25 days for 2006, where 10.75 days is the yearly LISNSD for 2006. As it turns out, LISNSD = 13.75 days (Philippe) in 2011 (down from 12.25 days, Igor, in 2010), thereby yielding the 10-yma of LISNSD = 12.51 days in 2006 (down from 12.73 days in 2005). For 2007, based on the usual observed difference, one anticipates the 10-yma of LISNSD = 8.5 ± 3.25 days, or ≤11.75 days, where 8.5 days (Dean) is the yearly LISNSD for 2007.

Figure 28(c) depicts the yearly variation of the first difference (fd(LISNSD)$_t$). Although runs testing indicates that the distribution of first differences appears nonrandom (z = –2.58, cl >98%, sd = 0.32), a comparison of the difference of the means for the intervals 1950–1989 and 1990–2004 suggests that the difference in means is not statistically important (t = –1.13, cl <90%). Hence, one should have expected the 10-yma of LISNSD = 12.73 ± 0.32 days for 2006, where 12.73 days is the LISNSD for 2005 and 0.32 is the sd of the first difference. As noted above, the 2011 season actually had LISNSD = 13.75 days (up from 12.25 days in 2010), thereby yielding the 10-yma of LISNSD = 12.51 days for 2006 and fd = –0.22 days for 2005, within the ±1 sd prediction interval. For 2007, one anticipates the 10-yma of LISNSD = 12.51 ± 0.32 days, inferring LISNSD >7.55 days in 2012 (perhaps as long as 20.35 days, the upper limit of the ±1 sd prediction interval). (The 10-yma LISNSD has a minimum value of 11.81 days for the year 2007, computed by assuming a frequency of zero NTC in 2012.)

2.7 Surface Air Temperature and ENSO-Related Parameters

Physically, one expects the systematic variations found in the tropical cyclone parametric values during the interval 1945–2010 (shown in the previous summary charts) to be directly related to physical changes in the environment where the tropical cyclones are birthed and grow. In this section, the yearly variations in surface air temperature recorded at the Armagh Observatory (<AT>) and a number of ENSO-related parameters for the same interval 1945–2010 are investigated. The ENSO-related parameters examined herein include the Oceanic Niño index (ONI), Southern Oscillation index (SOI), North Atlantic Oscillation (NAO) index, Pacific Decadal Oscillation (PDO) index, Trans-Niño index (TNI), Multivariate ENSO index (MEI), Global Sea Surface Temperature (SST) ENSO index (GSSTEI), Japan Meteorological Agency SST Mean (JMASSTM) index, North Tropical Atlantic (NTA) index, Caribbean (CAR) index, Quasi-Biennial Oscillation (QBO) index, Atlantic Multidecadal Oscillation (AMO) index, and Atlantic Meridional Mode (AMM) index. Tables 16–19 (see appendix) provide the yearly means, 10-yma values, differences, and first differences of these parameters for the interval 1945–2010. Each parameter will be discussed appropriately in the following subsections.

Monthly values of ONI provide a convenient means for determining the occurrences of ENSO anomalies – El Niño (EN) (warm) and La Niña (LN) (cool) events, where an El Niño is said to be occurring when the monthly ONI anomaly is 0.5 °C or warmer for at least 5 consecutive months and a La Niña is said to be occurring when the monthly ONI anomaly is –0.5 °C or cooler for at least 5 consecutive months. When neither anomaly is occurring, the ENSO condition is described as being ENSO neutral. During the interval 1950–2010, based on monthly ONI values, some 32 anomalous periods can be discerned, consisting of 18 EN and 14 LN events, with EN events averaging about 10 mo in duration and LN events averaging about 15 mo in duration. On average, the recurrence rate for EN events is about 40.5 mo (i.e., the elapsed time in months between starts of EN events), having *sd* = 18.7 mo and range 10 to 75 mo, while, on average, the recurrence rate for LN events is about 56.3 mo, having *sd* = 36.9 mo and range 19 to 137 mo.[30,34]

Table 20 (see appendix) gives the tropical cyclone parametric means and standard deviations for NTC, NTS, NH, NMH, NUSLFH, LAT, LONG, PWS, <PWS>, ACE, NSD, and NTCA based on the yearly ENSO phase condition, where a year is considered EN-related when an EN event was operative for at least 4 mo during the nominal 6-mo hurricane season, LN-related when a LN event was operative at least 4 mo during the 6-mo nominal hurricane season, and ENSO neutral when neither an EN nor LN event was operative during the nominal 6-mo hurricane season. On this basis, there were 16 EN-related years (ENY), 15 LN-related years (LNY), and 35 ENSO neutral years (NY) during the interval 1945–2010. Inspection of table 20 reveals that, on average, every frequency and strength parameter is higher when the year is classified as an LNY or NY than when the year is classified an ENY. Likewise, the position of the centroids is found to be more tropically located and closer to the US during years classified as LNY and NY than during years classified as ENY. Similar results are also found on the basis of simply grouping the years by the sign of the yearly <ONI> (i.e., <ONI> ≥0 or <ONI> <0). For the 31 negative-valued <ONI> years, on average, both the frequency and strength of the tropical cyclones are above long-term means as compared to the 30 positive-valued <ONI> years. Likewise, the storms, on average, are more tropically located and closer to the US when the yearly <ONI> is negative in value than when it is positive in value. On this basis, one should expect both the frequency and strength of the tropical cyclones to be either above long-term means during 2012 if the yearly <ONI> in 2012 is negative in value, or below long-term means if the yearly <ONI> in 2012 is positive in value. (LN events have been associated with increased frequency of landfalling hurricanes along the US coastline and increased damage.[35–40])

Similarly, table 21 (see appendix) gives the Poisson probabilities for the frequencies of NTC, NTS, NH, NMH, and NUSLFH for different ENSO phase conditions (ENY, LNY, and NY). Plainly, when the year is described as an ENY, on average, the frequencies of NTC, NTS, NH, NMH, and NUSLFH are all lower in comparison to when the year is described as a LNY or NY. For ENY, one expects NTC = 9 ± 2 (59.5%), NTC <7 (19.5%), and NTC >11 (21%); NTS = 4 ± 2 (78.3%), NTS <2 (7.1%), and NTS >6 (14.5%); NH = 4 ± 2 (74.2%), NH <2 (4.7%), and NH >6 (21.1%); NMH = 2 ± 1 (72.2%), NMH = 0 (13.5%), and NMH >3 (14.3%); and NUSLFH = 1 ± 1 (89.4%) and NUSLFH >2 (10.6%). For LNY, NTC = 11 ± 2 (53.8%), NTC <9 (25.8%), and NTC >13 (20.4%); NTS = 4 ± 2 (75.6%), NTS <2 (5.3%), and NTS > 6 (19.1%); NH = 7 ± 2 (65.8%), NH <5 (17.3%), and NH > 9 (17%); NMH = 3 ± 1 (59.2%), NMH <2 (13.9%), and NMH >4 (26.9%); and NUSLFH = 2 ± 1 (70.9%), NUSLFH = 0 (11.1%), and NUSLFH >3 (18.1%). For NY, NTC = 11 ± 2 (54.7%), NTC <9 (23.8%), and NTC >13 (21.6%); NTS = 4 ± 2 (74.6%), NTS <2 (4.9%), NTS >6 (20.5%); NH = 6 ± 2 (68%), NH <4 (11.3%), and NH >8 (20.7%); NMH = 2 ± 1 (64.5%), NMH = 0 (6.7%), and NMH >3 (28.8%); and NUSLFH = 1 ± 1 (77.6%), and NUSLFH >2 (22.4%).

Table 22 (see appendix) gives a comparison of the means and *sd*s for <AT> and the ENSO-related parameters based on the yearly ENSO phase condition as determined using ONI, similar in construction to table 20. Table 23 (see appendix) gives Poisson probabilities for the frequencies of

NTC, NTS, NH, NMH, and NUSLFH for each of the <AT> and ENSO-related parameters, in terms of whether the yearly parametric value is above (+) or below (–) its long-term average. These tables will be discussed appropriately in each of the following subsections.

2.7.1 <AT>

Figure 29(a) displays the yearly variation of <AT> (in °C) for the interval 1945–2010. The Armagh Observatory surface air temperature record is one of the longest available for study.[41–50] Mean temperatures based on maximum and minimum thermometers extend continuously from 1844 to the present. The Armagh Observatory lies about 1 km northeast of the center of the ancient city of Armagh in Northern Ireland at 54° 21.2′ N. latitude and 6° 38.9′ W. longitude. It is situated about 64 m above mean sea level at the top of a small hill in an estate of natural woodland and parkland that measures about 7 ha. Previous studies have shown that its rural environment has ensured that the observatory suffers from little or no urban microclimatic effects and that its temperature readings can be used as a proxy for studying long-term trends in annual mean surface air temperature for the Northern Hemisphere and for the Earth as a whole. Hence, it provides a useful measure for studying the effects of surface air temperature changes on the frequency and strength of tropical cyclones that form in the North Atlantic basin.

The construction of figure 29 (and the other summary charts that follow) mimics that of the previously shown summary charts. From figure 29(a), one notes that the long-term mean for the interval 1945–2010 is 9.48 °C, having sd = 0.53 °C and range 8.35 to 10.59 °C. A statistically important difference (t = –5, cl >99.9%) is found between the means for the intervals 1945–1994 and 1995–2010, with the current, more active interval being about 7% warmer than the previous interval (9.97 °C versus 9.33 °C). The yearly value of <AT> = 10.59 °C in 2007 is the warmest annual surface air temperature ever recorded at Armagh Observatory, surpassing the previous high of 10.4 °C recorded in 1846; the coolest <AT> = 7.4 °C occurred in 1879. A local peak may have been seen in the 10-yma of <AT> of 10.13 °C in 2002–2003, this value being the warmest in the entire Armagh Observatory surface air temperature record. The 10-yma of <AT> has since slightly cooled, at least through 2005, although it still remains above 10 °C. The coolest 10-yma of <AT> measured 8.44 °C in 1883; hence, between 1883 and 2007 the 10-yma of <AT> has warmed by about 1.7 °C, or about 0.014 °C per year. Since about 1991, the 10-yma of <AT> has continuously been warmer than the long-term mean, with the current local warming trend having begun about 1982 (9.05 °C). (Noticeable in fig. 29(a) is the sharp decrease in temperature from 10.59 °C in 2007 to 8.74 °C in 2010, the coolest yearly temperature since 1986, which measured 8.57 °C, a decrease of 1.85 °C. Temperature, however, quickly rebounded in 2011 to 10.31 °C, an increase of 1.57 °C from 2010.)

Figure 29(b) depicts the yearly variation of the difference (d<AT>)$_t$. Runs testing indicates that the distribution of differences appears random (z = –0.26, cl <90%, sd = 0.4 °C). Given that the distribution of differences appears random, one should have expected the 10-yma of <AT> = 10.43 ± 0.4 °C for 2006, where 10.43 °C is the yearly <AT> for 2006 and 0.4 °C is the sd of the differences. As it turns out, <AT> = 10.31 °C in 2011 (up substantially from 8.74 °C in 2010), thereby yielding the 10-yma of <AT> = 10 °C in 2006 (down slightly from 10.02 °C in 2005). For 2007, based on the observed differences, one anticipates the 10-yma of <AT> = 10.59 ± 0.4 °C, where 10.59 °C is the yearly <AT> for 2007, inferring the 10-yma of <AT> ≥10.19 °C for 2007. This value, however, is simply too high to be considered realistic, since it indicates a yearly <AT> ≥13.3 °C for 2012,

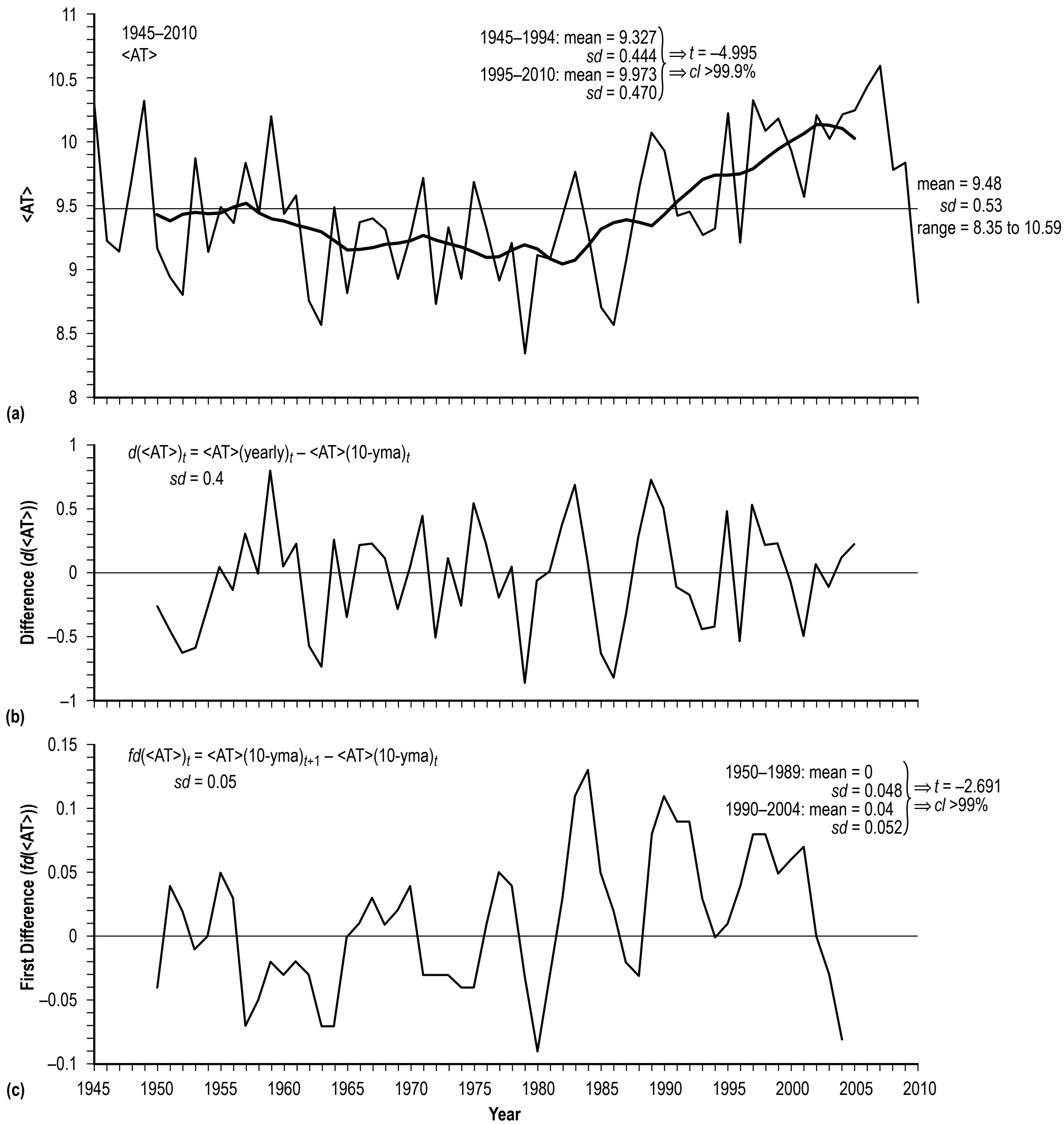

Figure 29. Yearly variation of air temperature: (a) <AT>, (b) difference (d<AT>), and (c) first difference (fd<AT>) .

a value more than 2.7 °C warmer than has ever been measured at Armagh Observatory and a value of about 3 °C, or more, higher than was seen in 2011. A more reasonable value of the 10-yma of <AT> is given below. (It is important to remember that the ±1 *sd* prediction interval is reliable only about 68% of the time, presuming a normal distribution of the differences. So, a value outside the

±1 *sd* prediction interval can still occur, on average, about 32% of the time. Clearly, one expects the 10-yma of <AT> to be <10.19 °C in 2007, implying that the yearly <AT> for 2012 will be <13.3 °C, very probable considerably less. If the 10-yma of <AT> remains the same for 2007 as was observed in 2006, 10 °C, this implies the yearly <AT> = 9.5 °C in 2012. For every 0.01 °C increase or decrease in the 10-yma of <AT>, the yearly <AT> for 2012 will increase or decrease 0.2 °C accordingly.)

Figure 29(c) depicts the yearly variation of the first difference *fd*<AT>$_t$. Runs testing indicates that the distribution of first differences appears nonrandom (z = –4.31, *cl* >99.9%, *sd* = 0.05 °C), as does the difference in the means for the intervals 1950–1989 and 1990–2004 (t = –2.69, *cl* >99%). Hence, one should have expected the 10-yma of <AT> = 10.02 + 0.04 ± 0.05 °C, or about 10.06 ± 0.05 °C for 2006, where 10.02 °C is the 10-yma of <AT> for 2005, 0.04 °C is the mean first difference for the current, more active interval, and 0.05 °C is the *sd* of the first difference. As noted above, the 2011 season actually had <AT> = 10.31 °C (up considerably from 8.74 °C in 2010), thereby yielding the 10-yma of <AT> = 10 °C for 2006 and *fd* = –0.02 °C for 2005. For 2007, one anticipates the 10-yma of <AT> = 10 + 0.04 ± 0.05 °C, or about 10.04 ± 0.05 °C, inferring the yearly <AT> to be >9.3 °C in 2012 (perhaps as warm as 11.3 °C, the upper limit of the ±1 *sd* prediction interval).

From table 22, one finds that the difference in the yearly means for <AT> is not statistically important when comparing the mean yearly <AT> during the 16 EN years (ENY) against the mean yearly <AT> during the 15 LN years (LNY) (t = 0.1, *cl* <90%), or when comparing the mean yearly <AT> during the 30 yr when <ONI> was positive in value against the mean yearly <AT> during the 31 yr when <ONI> was negative in value (t = 0.37, *cl* <90%). Hence, strong correlation between yearly values of <AT> and <ONI> seems unlikely.

From table 23(a), one finds that, based on the Poisson distribution, if the year 2012 has a yearly mean <AT> greater (+) than its long-term average (9.48 °C), then one should expect NTC = 12 ± 2, having $P(r = 10–14)$ = 51.9%; for NTC <10, $P(r < 10)$ = 18.7%; for NTC >14, $P(r > 14)$ = 29.4%; and for NTC >20, $P(r > 20)$ = 2%. For NTS, one should expect NTS = 5 ± 2, having $P(r = 3–7)$ = 69.5%; for NTS <3, $P(r < 3)$ = 6.1%; for NTS >7, $P(r > 7)$ = 24.5%; and for NTS >10, $P(r > 10)$ = 4.5%. For NH, one should expect NH = 6 ± 2, having $P(r = 4–8)$ = 66%; for NH <4, $P(r < 4)$ = 9.1%; for NH >8, $P(r > 8)$ = 24.9%; and for NH >10, $P(r > 10)$ = 8.7%. For NMH, one should expect NMH = 3 ± 1, having $P(r = 2–4)$ = 59.9%; for NMH <2, $P(r < 2)$ = 14.9%; for NMH >4, $P(r > 4)$ = 25.2%; and for NMH >6, $P(r > 6)$ = 5.6%. For NUSLFH, one should expect NUSLFH = 2 ± 1, having $P(r = 1–3)$ = 71.6%; for NUSLFH = 0, $P(r = 0)$ = 12.2%; for NUSLFH >3, $P(r > 3)$ = 16.1%; and for NUSLFH >5, $P(r > 5)$ = 6.2%.

Likewise, from table 23(a), one finds that, based on the Poisson distribution, if the year 2012 has a yearly mean <AT> lesser (–) than its long-term average (9.48 °C), then one should expect NTC = 9 ± 2, having $P(r = 7–11)$ = 59%; for NTC <7, $P(r < 7)$ = 17.4%; for NTC >11, $P(r > 11)$ = 23.5%; and for NTC >15, $P(r > 15)$ = 3.1%. For NTS, one should expect NTS = 3 ± 1, having $P(r = 2–4)$ = 57.3%; for NTS <2, $P(r < 2)$ = 11.8%; for NTS >4, $P(r > 4)$ = 30.9%; and for NTS >8, $P(r > 8)$ = 8%. For NH, one should expect NH = 5 ± 2, having $P(r = 3–7)$ = 70.8%; for NH <3, $P(r < 3)$ = 7.7%; for NH >7, $P(r > 7)$ = 21.6%; and for NH >9, $P(r > 9)$ = 6.5%. For NMH, one should expect NMH = 2 ± 1, having $P(r = 1–3)$ = 70.9%; for NMH = 0, $P(r = 0)$ = 11.2%; for NMH >3, $P(r > 4)$ = 17.9%; and for NMH >5, $P(r > 5)$ = 2.4%. For NUSLFH, one should expect NUSLFH = 1 ± 1, having

$P(r = 0–2) = 86.4\%$; for NUSLFH = 0, $P(r = 0) = 28.1\%$; for NUSLFH >2, $P(r > 2) = 13.6\%$; and for NUSLFH >4, $P(r > 4) = 1\%$.

It should be noted that monthly surface air temperature at Armagh Observatory measured, respectively, 6.3, 6.8, and 9 °C for the months of January, February, and March 2012, all readings among the warmest monthly-specific readings ever recorded at Armagh Observatory and all well above their respective monthly-specific mean temperatures of about 4.4, 4.6, and 6.4 °C, based on the interval 1950–2011. Hence, it seems likely that the yearly mean surface air temperature at Armagh Observatory for 2012 will exceed its long-term average of 9.48 °C, rather than fall below it, suggesting that tropical cyclone frequency likely will be above average for the 2012 hurricane season, unless of course, the summer temperatures at Armagh Observatory turn out to be cooler than usual.

2.7.2 <ONI>

Figure 30(a) displays the yearly variation of <ONI>. <ONI> is the yearly mean of the 3-mo running mean (i.e., 2-mo moving average) of the National Oceanic and Atmospheric Administration's (NOAA'S) Extended Reconstructed SST, version 3b anomalies in the Niño 3.4 region (5 °N.–5 °S., 120–170 °W.) based on the 1971–2000 base period.[51] The long-term mean of <ONI> is –0.01 °C, having *sd* = 0.62 °C and range of –1.24 °C (1955) to 1.29 °C (1987). The difference in means for the intervals 1950–1994 and 1995–2010 is not statistically important ($t = –0.53$, $cl < 90\%$), although the mean for the current, more active interval is about 0.1 °C warmer than the preceding earlier interval (0.06 °C versus –0.04 °C). Prior to 1980, the 10-yma of <ONI> was nearly always negative in value (for all years except 1961, 1962, 1965, and 1968), while from 1980 onwards, the 10-yma of <ONI> has been almost always positive in value (for all years except 2003), with the 10-yma of <ONI> now being very close to 0 °C. (ONI monthly values have recently changed from those used in this analysis.[45] Newer ONI monthly values result in yearly values that are slightly different. For example, in the illustration above, the value of <ONI> for 2010 based on the newer entries is now –3.2/12 = –0.27 rather than –1.8/12 = –0.15.)

In figure 30(a), the positive (warm) spikes generally represent EN-related years and the negative (cool) spikes generally represent LN-related years. The two warmest <ONI> years occurred in 1987 (1.29 °C) and 1997 (1.26 °C), both EN-related years, and the two coolest <ONI> years occurred in 1955 (–1.24 °C) and 1975 (–1.14 °C), both LN-related years. In terms of the 10-yma <ONI>, the warmest <ONI> measured 0.3 °C in 1993, and the coolest <ONI> measured –0.29 °C in 1971. (As already mentioned, the 10-yma of <ONI> now is very near 0 °C.)

Figure 30(b) displays the yearly variation of the difference ($d\langle ONI\rangle_t$). Runs testing indicates that the distribution of differences appears random ($z = –0.66$, $cl < 90\%$, $sd = 0.61$ °C). Given that the distribution of differences appears random, one should have expected the 10-yma of <ONI> = 0.25 ± 0.61 °C for 2006, where 0.25 °C is the yearly <ONI> for 2006 and 0.61 °C is the *sd* of the differences. As it turns out, the yearly <ONI> = –0.6 °C in 2011 (substantially cooler than <ONI> = –0.15 °C that was observed in 2010), thereby yielding the 10-yma of <ONI> = 0.14 °C in 2006 (a value about 0.1 °C warmer than the 0.04 °C that was observed in 2005). For 2007, based on the observed differences, one anticipates the 10-yma of <ONI> = –0.3 ± 0.61 °C, where –0.3 °C is the yearly <ONI>

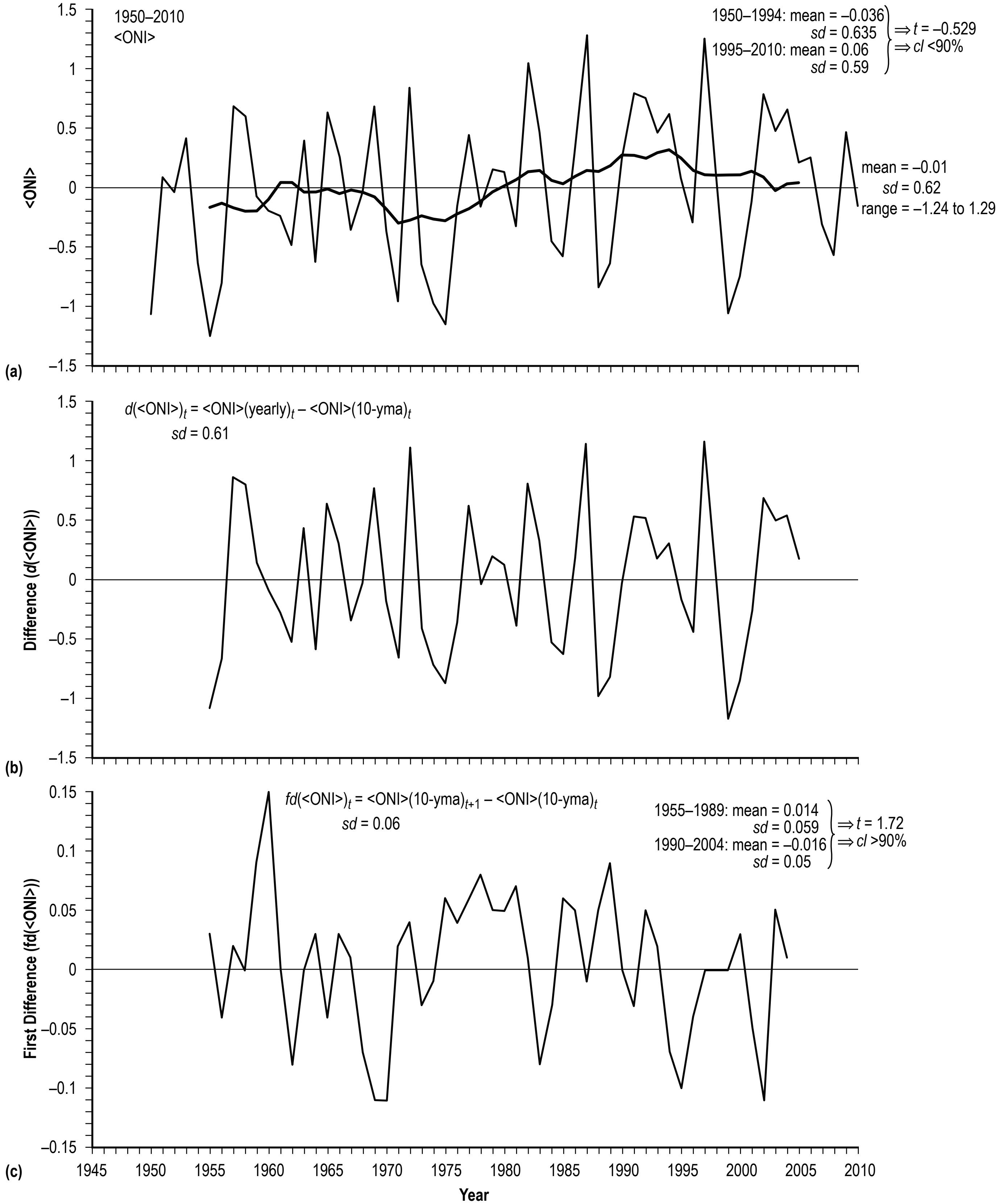

Figure 30. Yearly variation of Oceanic Niño index: (a) <ONI>, (b) difference (d<ONI>), and (c) first difference (fd<ONI>).

for 2007, inferring the 10-yma of <ONI> ≤0.31 °C for 2007. If the 10-yma of <ONI> = 0 °C or less (i.e., more negative in value) for 2007, then the yearly <ONI> = –1.5 °C or more negative in value for 2012, a value indicative of LN conditions. On the other hand, if the 10-yma of <ONI> = 0.1 °C or more positive in value for 2007, then the yearly <ONI> = 0.5 °C or higher in value, a value indicative of possibly ENSO neutral to EN-like conditions in 2012. Therefore, it is apparent that the 10-yma of <ONI> will be very close to 0 °C for 2007. (Based on the previously observed extremes, <ONI> = 1.29 °C in 2012 means that the 10-yma of <ONI> = 0.14 °C in 2007, while <ONI> = –1.24 °C in 2012 means that the 10-yma of <ONI> = 0.01 °C in 2007. Plainly, one expects the 10-yma of <ONI> to lie within the range of 0.01 to 0.14 °C in 2007, inferring $d(<\mathrm{ONI}>)_t$ = –0.31 to –0.17 °C in 2007.)

Figure 30(c) depicts the yearly variation of the first difference ($fd<\mathrm{ONI}>_t$). While runs testing indicates that the distribution of first differences appears random (z = –0.54, *cl* <90%, *sd* = 0.06 °C), the difference in the means for the intervals 1955–1989 and 1990–2004 is found to be marginally statically important (t = 1.72, *cl* >90%). Hence, for 2006 one should have expected the 10-yma of <ONI> = 0.04 ± 0.06 °C (presuming a random distribution of the first difference values) or 0.04 – 0.02 ± 0.05 °C (i.e., about 0.02 ± 0.05 °C), where 0.04 °C is the 10-yma of <ONI> for 2005 and –0.02 °C and 0.05 °C are the mean first difference and *sd*, respectively, for the current, more active interval. As noted above, the 2011 season actually had <ONI> = –0.6 °C (cooler than the –0.15 °C measured in 2010), thereby yielding the 10-yma of <ONI> = 0.14 °C for 2006 and $fd<\mathrm{ONI}>_t$ = 0.1 °C for 2005 (both values outside high the ±1 *sd* prediction intervals). For 2007, one anticipates the 10-yma of <ONI> = 0.14 ± 0.06 °C, based on a normal distribution of the first differences, or 0.14 – 0.02 ± 0.05 °C (i.e., about 0.12 ± 0.05 °C), based on the mean and *sd* of the current, more active interval. Hence, one expects the yearly <ONI> to be ≥0.1 °C in 2012 (perhaps as warm as 2.5 °C, the upper limit of the ±1 *sd* prediction interval), based on the normal distribution of the first difference, or ≥–0.1 °C (perhaps as warm as 1.9 °C, the upper limit of the ±1 *sd* prediction interval for the current, more active interval). These values, if true, are indicative of ENSO neutral to EN-like conditions in 2012. (Recall that the recurrence rate for EN events is about 40–41 mo, on average, and the last EN event, which was one of strong intensity, had its start in June 2009. Hence, the possibility exists that an EN event likely could occur during the 2012 hurricane season.[30])

From table 22, one finds that the difference in the means for <ONI> is highly statistically important, as one would expect, when comparing the mean yearly <ONI> during the 16 ENYs against the mean yearly <ONI> during the 15 LNYs (t = 11.05, *cl* »99.9%), or when comparing the mean yearly <ONI> during the 30 yr when it was positive in value against the mean yearly <ONI> during the 31 yr when it was negative in value (t = 11.91, *cl* »99.9%). Hence, the yearly <ONI> appears to be a robust measure for determining the phase of the ENSO quasi-periodic cycle.

From table 23(b), for <ONI> '+,' NTC = 10 ± 2 (56.2%), NTC <8 (17.3%), and NTC >12 (26.5%); NTS = 4 ± 2 (76.2%), NTS <2 (5.6%), and NTS >6 (18.2%); NH = 5 ± 2 (68.5%), NH <3 (6.3%), and NH >7 (25.2%); NMH = 2 ± 1 (69.1%), NMH = 0 (9.4%), and NMH >3 (21.5%); and NUSLFH = 1 ± 1 (80.9%) and NUSLFH >2 (19.1%). For <ONI> '–,' NTC = 11 ± 2 (54.7%), NTC <9 (20.7%), and NTC >13 (24.6%); NTS = 4 ± 2 (75.2%), NTS <2 (5.1%), and NTS >6 (19.7%); NH = 6 ± 2 (67.6%), NH <4 (10.6%), and NH >8 (21.8%); NMH = 3 ± 1 (61.5%), NMH <2 (19%), and NMH >4 (19.5%); and NUSLFH = 1 ± 1 (78.1%) and NUSLFH >2 (21.9%).

Presently, the monthly values of ONI indicate a weakening LN event. Based on the former version of the ONI values, those used in this analysis, the current LN event began in October 2011, attained a peak anomalous value of –0.9 °C in December 2011 and now measures, respectively, –0.8 and –0.6 °C in January and February 2012; based on the newer version of the ONI values, the LN event began in September 2011, attained a peak anomalous value of –1 °C in November and December 2011 and now measures, respectively, –0.9 and –0.7 °C in January and February 2012. Monthly ONI values are expected to be reflective of ENSO neutral conditions in April 2012.[52] One cannot, as yet, determine the likelihood of whether <ONI> will be positive or negative in value for the year 2012.

2.7.3 <SOI>

While the ONI often is used to describe the oceanic response to anomalous changes in sea surface temperature associated with the quasi-periodic ENSO phenomenon, the SOI similarly is used to describe the atmospheric response to changes in surface air pressure associated with ENSO. Typically, the two parameters vary inversely (i.e., in the opposite sense), with one or the other sometimes slightly leading or lagging. During EN (warm) events, ONI is of positive sustained value (0.5 °C or warmer) and SOI usually is of negative sustained value (≤–8), while during LN (cool) events, ONI is of negative sustained value (–0.5 °C or cooler) and SOI is usually of positive sustained value (≥8). The SOI is calculated using the air pressure differences between Tahiti, French Polynesia and Darwin, Australia. The SOI values used in this study were taken from the Australian Bureau of Meteorology.[53] Monthly values of the SOI are available from 1876 to the present, being based on the means and standard deviations calculated over the interval 1933 to 1992 inclusive.

Figure 31(a) displays the yearly variation of <SOI>. For the interval 1945–2010, <SOI> averages about –0.1, having sd = 6.8 and range = –13.1 to 15.4. For the two intervals, 1945–1994 and 1995–2010, the difference in means is found not to be statistically important (t = –0.43, cl <90%). As with <ONI>, the spikes in <SOI> usually denote years containing anomalous ENSO events. The 2 yr of most positive <SOI> (15.4 and 13.6) are 1950 and 1975, both years being LN-related years. The 2 yr of most negative <SOI> (–13.1) are 1982 and 1987, both years being EN-related years. In terms of the 10-yma of <SOI>, it nearly always was positive in value for the interval 1950–1977 (the lone exception being 1962), and it always was negative in value for the interval 1978–2003. For 2004 and 2005, the 10-yma of <SOI> has been positive in value, but just barely so (0.44 and 0.13, respectively). (The yearly value of <SOI> appears to have turned generally positive in value beginning in 2007, with the interval 2007–2011 having yearly <SOI> = 1.5. 10.2, –0.2, 9.8, and 13.3, respectively. So, the 10-yma of <SOI> is expected to remain positive in value, at least for the near-term, foreseeable future. In fact, the 10-yma of <SOI> grew from 0.13 in 2005 to 0.87 in 2006, an increase of 0.71 units. For the 10-yma of <SOI> to become negative in value in 2007, the yearly <SOI> for 2012 would have to measure <–36.3, a value much more negative than the yearly value of <SOI> = –20, the lowest ever seen, which occurred in 1905; the lowest yearly <SOI> in the interval 1945–2010 is <SOI> = –13.1 in 1982 and 1987, as previously mentioned.)

Figure 31(b) shows the yearly variation of the difference (d<SOI>$_t$). Runs testing indicates that the distribution of differences appears random (z = –1.23, cl <90%, sd = 6.45). Given that the distribution of differences appears random, one should have expected the 10-yma of <SOI> = –1.9

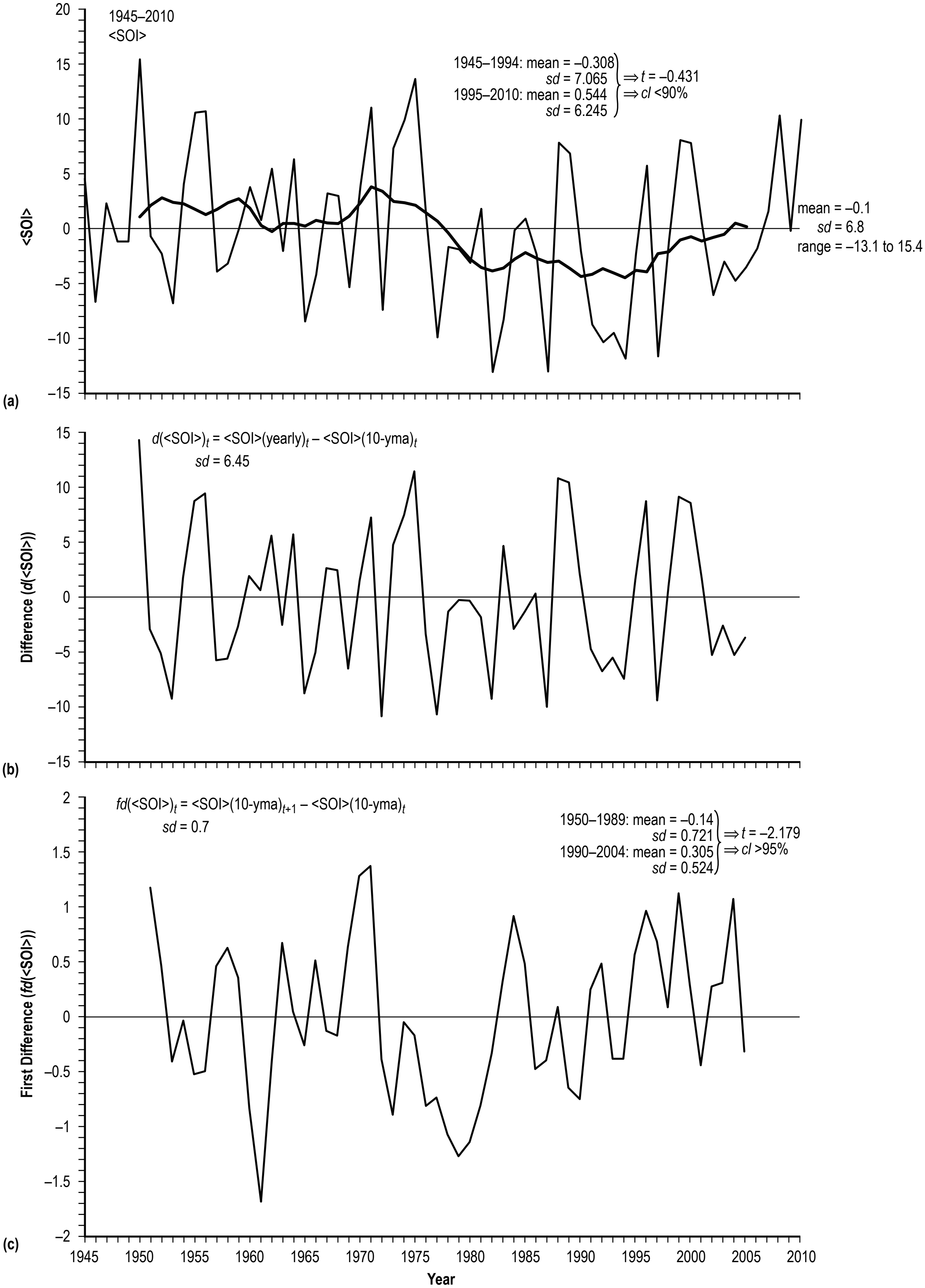

Figure 31. Yearly variation of Southern Oscillation index: (a) <SOI>, (b) difference (d<SOI>), and (c) first difference (fd<SOI>).

± 6.45 for 2006, where –1.9 is the yearly <SOI> for 2006 and 6.45 is the *sd* of the differences. As it turns out, the yearly <SOI> = 13.3 in 2011 (slightly higher than the yearly <SOI> = 9.8 that was observed in 2010), thereby yielding the 10-yma of <SOI> = 0.87 in 2006 (up from 0.13 measured in 2005). For 2007, based on the observed differences, one anticipates the 10-yma of <SOI> = 1.5 ± 6.45, where 1.5 is the yearly <SOI> for 2007. A value of the 10-yma of <SOI> = 1.5 in 2007 means that the yearly <SOI> = –6.3 in 2012; a value of the 10-yma of <SOI> = 1.8 in 2007 means that the yearly <SOI> = –0.3 in 2012; and a value of the 10-yma of <SOI> = 1.2 in 2007 means that the yearly <SOI> = –12.3. Hence, a 10-yma of <SOI> equal to 1.5 or higher yields a yearly value of <SOI> suggestive of ENSO neutral to LN-like conditions in 2012, while a value smaller than 1.5 yields a yearly <SOI> suggestive of EN-like conditions in 2012.

Figure 31(c) depicts the yearly variation of the first difference (*fd*<SOI>$_t$). Both runs testing and the difference in means for the two intervals 1950–1989 and 1990–2004 indicate that the distribution of first differences appears nonrandom (z = –2.25, *cl* >95%, *sd* = 0.70; and t = –2.18, *cl* >95%). Hence, for 2006 one should have expected the 10-yma of <SOI> = 0.13 + 0.31 ± 0.52, or about 0.44 ± 0.52, where 0.13 is the 10-yma of <SOI> for 2005 and 0.31 and 0.52, respectively, are the mean first difference and *sd* for the current, more active interval. As noted above, the 2011 season actually had <SOI> = 13.3 (slightly higher than 9.8 measured in 2010), thereby yielding the 10-yma of <SOI> = 0.87 for 2006 and *fd*<SOI>$_t$ = 0.74 for 2005. For 2007, one anticipates the 10-yma of <SOI> = 0.87 + 0.31 ± 0.52, or about 1.18 ± 0.52, which, if true, suggests that the yearly value of <SOI> = –23.1 to –2.3 for 2012, a range of values indicative of ENSO neutral to EN-like conditions.

From table 22, one finds that the difference in the means for <SOI> is statistically important, when comparing the mean of <SOI> during the 16 ENY against the mean of <SOI> during the 15 LNY (t = –8.86, *cl* >99.9%), or when comparing the mean of <SOI> during the 30 yr when <ONI> was positive in value against the mean of <SOI> during the 31 yr when <ONI> was negative in value (t = –10.36, *cl* >99.9%). Hence, strong inverse correlation between yearly values of <SOI> and <ONI> seems highly likely, as would be expected, with both measures independently serving as robust measures for determining the phase of the ENSO quasi-periodic cycle (i.e., the two parameters vary inversely, being of opposite signs in 58 of the 61 yr in the interval 1950–2010; only the years 1952, 1978, and 1984 were of the same sign).

From table 23(c), for <SOI> '+,' NTC = 11 ± 2 (54.7%), NTC <9 (20.9%), and NTC >13 (24.4%); NTS = 4 ± 2 (75.6%), NTS <2 (5.3%), and NTS >6 (19.1%); NH = 6 ± 2 (67.5%), NH <4 (10.5%), and NH >8 (22%); NMH = 3 ± 1 (61.2%), NMH <2 (18.1%), and NMH >4 (20.7%); and NUSLFH = 1 ± 1 (73.1%) and NUSLFH >2 (26.9%). For <SOI> '–,' NTC = 10 ± 2 (56.4%), NTC <8 (18.1%), and NTC >12 (25.5%); NTS = 4 ± 2 (76.1%), NTS <2 (5.6%), and NTS >6 (18.3%); NH = 5 ± 2 (69.5%), NH <3 (6.9%), and NH >7 (23.7%); NMH = 2 ± 1 (69.3%), NMH = 0 (9.4%), and NMH >3 (21.3%); and NUSLFH = 1 ± 1 (80.9%) and NUSLFH >2 (19.1%).

Monthly values of SOI have returned to values indicative of ENSO neutral conditions, measuring 9.4, 2.5, and 2.9, respectively, for January, February, and March 2012. It is anticipated that ENSO neutral conditions will persist, at least through the middle of 2012.[54] Presuming that an EN event will occur later this year, one anticipates monthly values of SOI that are negative in value (more negative than –8), inferring that <SOI> will be '–' for 2012.

2.7.4 <NAO>

Like the Southern Oscillation, the North Atlantic Oscillation (NAO) is one based on changes in surface air pressure between two widely separated locations (e.g., Iceland and the subtropical Atlantic Ocean basin—the Azores, Portugal, or Gibraltar). The large-scale, air-mass movements described by the NAO thus control the strength and direction of westerly winds and storm tracks across the North Atlantic Ocean. During the positive phase of the NAO, there is a stronger than usual subtropical high pressure center and a deeper than usual Icelandic low, while during the negative phase of the NAO, the opposite is true.[55–58]

Figure 32(a) displays the yearly variation of <NAO>.[59] For the interval 1945–2010, <NAO> averages about –0.03, having $sd = 0.37$ and range = –1.15 to 0.8. For the two intervals, 1945–1994 and 1995–2010, the difference in means is found not to be statistically important ($t = 1.41$, $cl < 90\%$). Unlike <ONI> and <SOI>, the spikes in <NAO> do not always correspond to years when anomalous ENSO events occur. For example, the 2 yr of most positive <NAO> (0.7 and 0.8) are 1989 and 1994, but only the year 1994 is associated with an anomalous ENSO extreme event (EN). Similarly, the 2 yr of most negative <NAO> (–0.94 and –1.15) are 1968 and 2010, but only the year 2010 is associated with an anomalous ENSO extreme event (LN). In terms of the 10-yma of <NAO>, it always was negative in value for the interval 1950–1973, varying between –0.02 and –0.22 and averaging about –0.15 ± 0.06, and it always was positive in value for the interval 1974–1999, varying between 0.02 and 0.34 and averaging about 0.14 ± 0.11. For the interval 2000–2004, the 10-yma of <NAO> has varied between –0.01 to –0.03, averaging about –0.02 ± 0.01. For 2005 and 2006, the 10-yma of <NAO> became significantly more negative in value (–0.12 and –0.16, respectively). For the 10-yma of <NAO> to become positive in value in 2007, the yearly <NAO> must measure in excess of 2.86 in 2012, a value that is about 3.6 times larger than the previously observed largest positive value of 0.8 in 1994. So, it seems highly unlikely that the 10-yma of <NAO> will be positive in value in 2007 (or anytime soon in the near-term, foreseeable future). Instead, it seems highly probable that the 10-yma of <NAO> will remain negative in value. (Presuming a yearly <NAO> = –0.14 ± 0.36 for 2012, the ±1 *sd* prediction interval about the mean for the current, more active interval, one expects the 10-yma of <NAO> = –0.15 ± 0.02 for 2007.)

Figure 32(b) shows the yearly variation of the difference (d<NAO>$_t$). Unlike the differences for <AT>, <ONI>, and <SOI>, runs testing indicates that the distribution of differences for <NAO> might be nonrandom ($z = 2.08$, $cl > 95\%$, $sd = 0.31$). However, if one had assumed that the differences are distributed randomly, one would have estimated the 10-yma of <NAO> = –0.27 ± 0.31 for 2006, where –0.27 is the yearly <NAO> for 2006 and 0.31 is the *sd* of the differences. As it turns out, the yearly <NAO> = 0.29 in 2011, yielding the 10-yma of <NAO> = –0.16 for 2006, within the ±1 *sd* prediction interval. For 2007, again, if one assumes the distribution of differences is random, one expects the 10-yma of <NAO> = 0.17 ± 0.31, or >–0.14, where 0.17 is the yearly <NAO> for 2007 and 0.31 is the *sd* of the differences, which, if true, implies the yearly <NAO> ≥0.06 in 2012. (From above, a yearly <NAO> ≤0.17 in 2012 is expected.)

Figure 32(c) depicts the yearly variation of the first difference (fd<NAO>$_t$). Both runs testing and the difference in means for the two intervals 1955–1989 and 1990–2004 indicate that the distribution of first differences appears nonrandom ($z = -3.33$, $cl > 99.8\%$, $sd = 0.03$; and $t = -5.46$,

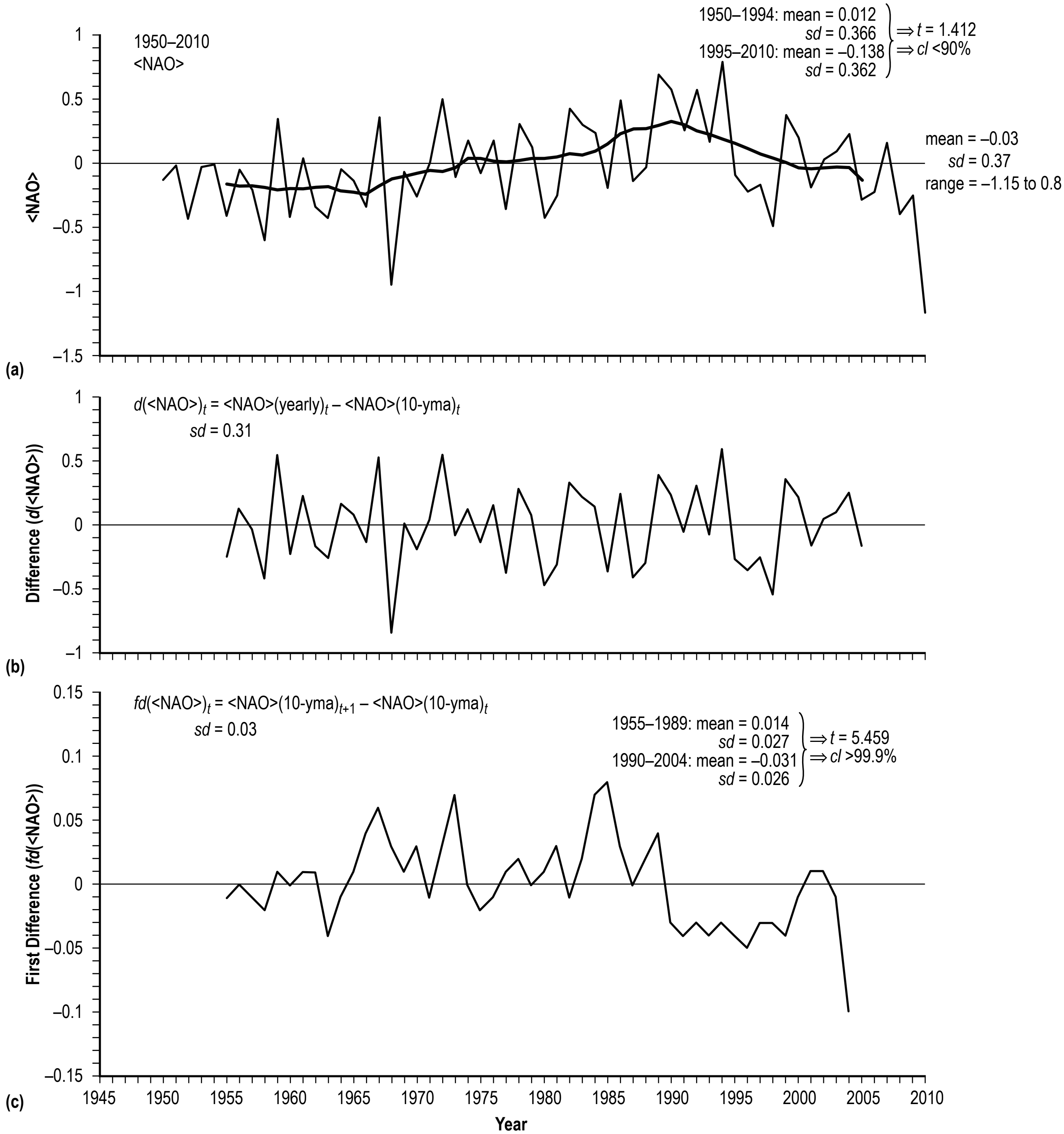

Figure 32. Yearly variation of North Atlantic Oscillation index: (a) <NAO>, (b) difference (d<NAO>), and (c) first difference (fd<NAO>) .

cl >99.9%). Hence, for 2006 one should have expected the 10-yma of <NAO> = –0.12 ± –0.03 ± 0.03, or about –0.15 ± 0.03, where ± 0.12 is the 10-yma of <NAO> for 2005 and ± 0.03 and 0.03, respectively, are the mean first difference and *sd* for the current, more active interval. As noted above, the 2011 season actually had <NAO> = 0.29 (up from ± 1.15 measured in 2010), thereby yielding the 10-yma of <NAO> = ± 0.16 for 2006 and *fd*<NAO>$_t$ = –0.04 for 2005. For 2007, one anticipates the 10-yma of <NAO> = –0.16 – 0.03 ± 0.03, or about –0.19 ± 0.03, which, if true, suggests a yearly value of <NAO> between –0.34 and –1.54 for 2012 (this being in stark contrast to that found above based on the expected difference).

From table 22, one finds that the difference in the means for <NAO> is only of marginal statistical importance or of no statistical importance, respectively, when comparing the mean of <NAO> during the 16 ENY against the mean of <NAO> during the 15 LNY (t = 1.86, *cl* >90%), or when comparing the mean of <NAO> during the 30 yr when <ONI> was positive in value against the mean of <NAO> during the 31 yr when <ONI> was negative in value (t = 0.95, *cl* <90%). Hence, strong correlation between yearly values of <NAO> and <ONI> seems unlikely (i.e., the two parameters are of the same or opposite sign in only 31 of the 62 yr in the interval 1950–2011).

From table 23(d), for <NAO> '+,' NTC = 10 ± 2 (56.5%), NTC <8 (18.2%), and NTC >12 (25.4%); NTS = 4 ± 2 (73.5%), NTS <2 (4.5%), and NTS >6 (22.1%); NH = 5 ± 2 (71.6%), NH <3 (8.4%), and NH >7 (20%); NMH = 2 ± 1 (72.2%), NMH = 0 (13.5%), and NMH >3 (14.3%); and NUSLFH = 1 ± 1 (79.9%) and NUSLFH >2 (20.1%). For <NAO> '–,' NTC = 11 ± 2 (54.7%), NTC <9 (20.7%), and NTC >13 (24.6%); NTS = 4 ± 2 (77.1%), NTS <2 (6.2%), and NTS >6 (16.8%); NH = 6 ± 2 (66.2%), NH < 4 (9.3%), and NH >8 (24.5%); NMH = 3 ± 1 (60.6%), NMH <2 (16.4%), and NMH >4 (235); and NUSLFH = 1 ± 1 (79.1%) and NUSLFH >2 (20.9%).

Presently, the monthly values of NAO are running positive in value, measuring 1.17, 0.42, and 1.27, respectively, for January, February, and March 2012. The string of positive values now spans 7 mo, having begun in September 2011, with the December 2011 value being 2.52, the most positive December value in the span of 1950–2011, surpassing the previous high of 2.02 that was seen in December 1995. The longest string of positive NAO values spans 9 mo, between April and December 1959, averaging 0.51 and ranging 0.06 to 0.89. Two other long, positive value strings have occurred: (1) 8 mo, between August 1999 and March 2000, averaging 0.79 and ranging 0.2 to 1.7; and (2) 7 mo, between September 2007 and March 2008, averaging 0.54 and ranging 0.08 to 0.89. Since 1950, the nominal hurricane season has had slightly more negative values than positive values, 194 to 178. Thus, while it seems likely that monthly values of NAO will turn negative sometime during the year 2012, one cannot, as yet, determine the likelihood that <NAO> for 2012 will be positive or negative in value. From the usual difference, one anticipates that it will be of positive value; however, from the usual first difference, one anticipates that it will be of negative value.

2.7.5 <PDO>

The PDO index is defined as the leading principal component of the monthly SST anomalies in the North Pacific Ocean, northward of 20 °N. Like the ENSO quasi-periodic cycle, the PDO fluctuates between warm (positive) and cool (negative) phases. During the warm phase, the western Pacific Ocean surface waters become cool and part of the eastern Pacific Ocean surface waters becomes warm, while during the cool phase, the opposite is true. While the PDO is a climate index that is based upon patterns of SST variation in the North Pacific Ocean basin, it has been found to correlate with many varied climate records, including sea level pressure, winter land surface temperature and precipitation, stream flow, and salmon catches.[60–68]

Figure 33(a) displays the yearly variation of <PDO>.[69] For the interval 1945–2010, <PDO> averages about –0.13 °C, having *sd* = 0.83 °C and range = –1.95 to 1.82 °C. For the two intervals, 1945–1994 and 1995–2010, the difference in means is found not to be statistically important (*t* = –0.91, *cl* <90%). Like <NAO>, the spikes in <PDO> do not always correspond to years when anomalous ENSO events occur. For example, the 2 yr of most positive <PDO> (1.65 and 1.82 °C) are 1983 and 1987, but only the year 1987 is associated with an anomalous ENSO extreme event (EN) (the year 1983 follows an EN event). Similarly, the 2 yr of most negative <PDO> (–1.81 and –1.95 °C) are 1950 and 1955, both associated with anomalous ENSO extreme events (LN). In terms of the 10-yma of <PDO>, it always was negative in value for the interval 1950–1977, varying between –0.04 and –0.94 °C and averaging about –0.55 ± 0.19 °C, and it always was positive in value for the interval 1974–2002, varying between 0.08 and 0.84 °C and averaging about 0.45 ± 0.22 °C. For the interval 2003–2005, the 10-yma of <PDO> has varied between –0.08 and –0.13 °C, averaging about –0.1 ± 0.03 °C. For the 10-yma of <PDO> to become positive in value in 2007, the yearly <PDO> must measure in excess of 3.24 °C in 2012, a value that is about 1.8 times larger than the previously observed largest positive value of 1.82 in 1987. So, it seems unlikely that the 10-yma of <PDO> will be positive in value in 2007 (or anytime soon in the near-term, foreseeable future). Instead, it seems highly probable that the 10-yma of <PDO> will remain negative in value. (Presuming a yearly <PDO> = 0.03 ± 0.74 °C for 2012, the ±1 *sd* prediction interval about the mean for the current, more active interval, one expects the 10-yma of <PDO> = –0.16 ± 0.04 for 2007.)

Figure 33(b) shows the yearly variation of the difference (*d*<PDO>$_t$). Like the differences for <AT>, <ONI>, and <SOI>, runs testing indicates that the distribution of differences for <PDO> appears to be random (*z* = –1.63, *cl* <90%, *sd* = 0.65 °C). Given that the distribution of differences appears random, one should have expected the 10-yma of <PDO> = 0.19 ± 0.65 °C for 2006, where 0.19 °C is the yearly <PDO> for 2006 and 0.65 °C is the *sd* of the differences. As it turns out, the yearly <PDO> = –1.23 °C in 2011 (considerably more negative in value than the yearly <PDO> = –0.31 °C that was observed in 2010), thereby yielding the 10-yma of <PDO> = –0.16 °C in 2006 (more negative than the –0.12 °C measured in 2005). For 2007, based on the observed differences, one anticipates the 10-yma of <PDO> = –0.2 ± 0.65 °C, where –0.2 °C is the yearly <PDO> for 2007. A value of the 10-yma of <PDO> = –0.2 °C in 2007 means that the yearly <PDO> = –0.76 °C in 2012, while a value more negative (positive) than –0.2 °C for the 10-yma of <PDO> in 2007 means that the yearly <PDO> for 2012 will be more negative (positive) as well. (An increase or decrease of 0.01 °C in the 10-yma of <PDO> for 2007 changes the 2012 estimate for the yearly <PDO> by 0.2 °C, accordingly.)

Figure 33(c) depicts the yearly variation of the first difference (*fd*<PDO>$_t$). Both runs testing and the difference in means for the two intervals 1950–1989 and 1990–2004 indicate that the distribution of first differences appears nonrandom (*z* = –3.26, *cl* >99.5%, *sd* = 0.09; and *t* = –2.68, *cl* >99%). Hence, for 2006, one should have expected the 10-yma of <PD0> = –0.1 – 0.04 ± 0.05 °C, or about –0.14 ± 0.05 °C, where –0.1 °C is the 10-yma of <PDO> for 2005 and –0.04 °C and 0.05 °C, respectively, are the mean first difference and *sd* for the current, more active interval. As noted above, the 2011 season actually had <PDO> = –1.23 °C (more negative than the –0.31 °C measured in 2010), thereby yielding the 10-yma of <PDO> = –0.12 °C for 2006 and *fd*<PDO>$_t$ = –0.02 °C for 2005. For 2007, one anticipates the 10-yma of <PDO> = –0.16 – 0.04 ± 0.05 °C, or about –0.2 ± 0.05 °C, which, if true, suggests that the yearly value of <PDO> = –0.76 ± 1 °C for 2012.

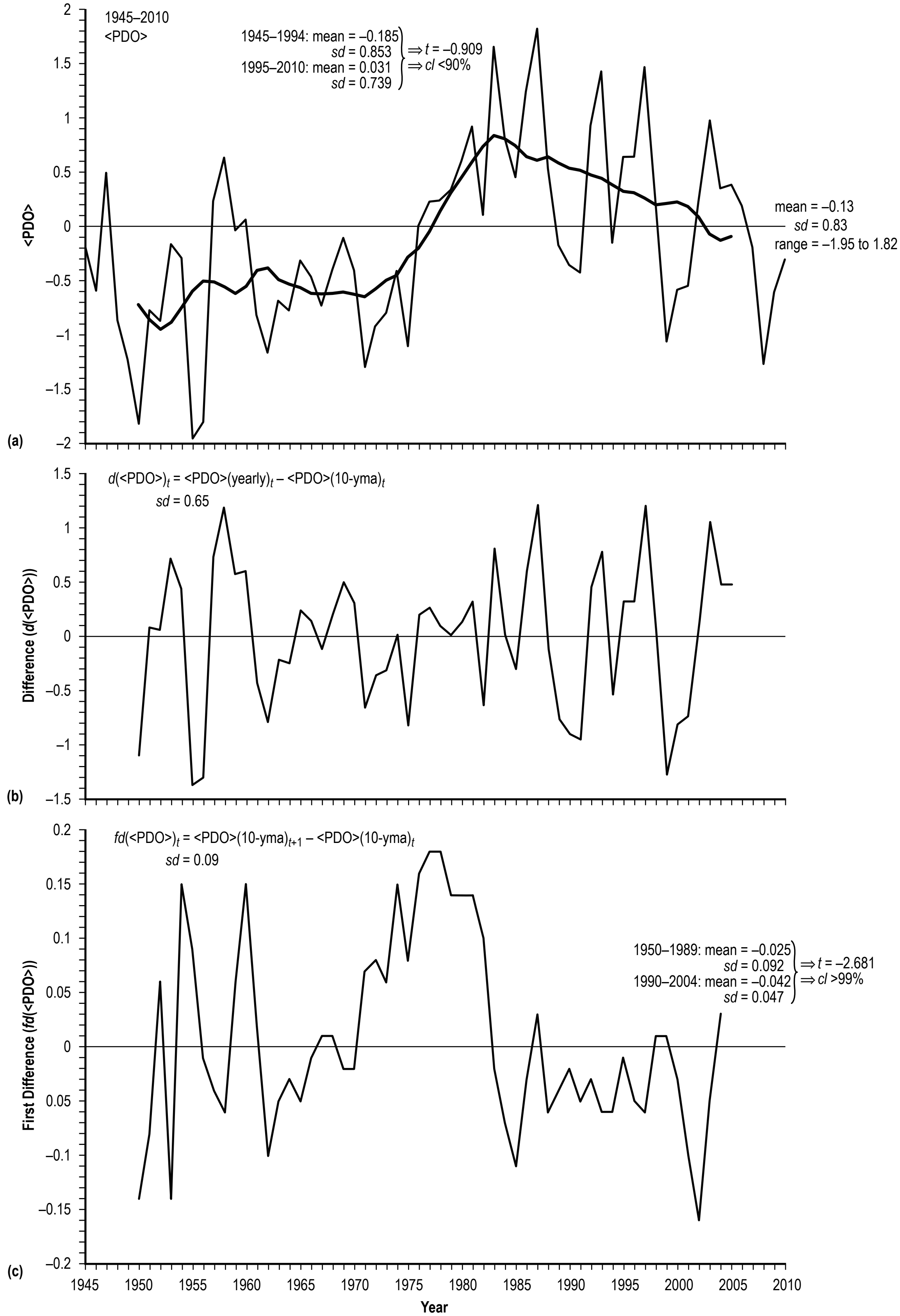

Figure 33. Yearly variation of Pacific Decadal Oscillation index: (a) <PDO>, (b) difference (d<PDO>), and (c) first difference (fd<PDO>).

From table 22, one finds that the difference in the means for <PDO> is statistically important when comparing the mean of <PDO> during the 16 ENY against the mean of <PDO> during the 15 LNY (*t* = 2.85, *cl* >99%), or when comparing the mean of <PDO> during the 30 yr when <ONI> was positive in value against the mean of <PDO> during the 31 yr when <ONI> was negative in value (*t* = 4.09, *cl* >99.9%). Hence, strong correlation between yearly values of <PDO> and <ONI> seems likely, with positive <PDO> tending to occur with positive <ONI> and negative <PDO> tending to occur with negative <ONI> (i.e., the two parameters are of the same sign in 42 of the 62 yr in the interval 1950–2011).

From table 23(e), for <PDO> '+,' NTC = 10 ± 2 (55.3%), NTC <8 (15.5%), and NTC >12 (29.2%); NTS = 4 ± 2 (73.7%), NTS <2 (4.6%), and NTS >6 (21.8%); NH = 5 ± 2 (68.6%), NH <3 (6.4%), and NH >7 (25.1%); NMH = 2 ± 1 (67.6%), NMH = 0 (8.2%), and NMH >3 (24.2%); and NUSLFH = 1 ± 1 (73.3%) and NUSLFH >2 (26.7%). For <PDO> '–,' NTC = 10 ± 2 (55.2%), NTC <8 (15.4%), and NTC >12 (29.4%); NTS = 4 ± 2 (77.2%), NTS <2 (6.3%), and NTS >6 (16.5%); NH = 6 ± 2 (68.6%), NH <4 (12.1%), and NH >8 (19.3%); NMH = 2 ± 1 (62%), NMH = 0 (5.7%), and NMH >3 (32.4%); and NUSLFH = 1 ± 1 (80.1%) and NUSLFH >2 (19.9%).

The monthly values of PDO are running negative in value, measuring –1.38 and –0.85 °C, respectively, for January and February 2012. The string of negative values now spans 21 mo, having begun in June 2010, with the November 2011 value being –2.33 °C, the most negative November value since November 1955 (–3.08 °C, which happens to be the most negative November, as well as the most negative value for any month in the interval 1900–2010). In the interval 1948–2010, the longest string of negative PDO values spans 36 mo, between July 1948 and June 1951, averaging –1.41 °C and ranging –0.25 to –2.93 °C. Four other long negative strings have occurred during the interval 1948–2011: (1) 28 mo, between May 1961 and August 1963, averaging –1.01 °C and ranging –0.06 to –2.28 °C; (2) 25 mo, between February 1955 and February 1957, averaging –1.91 °C and ranging –0.68 to –3.08 °C; (3) 23 mo, between August 1966 and June 1968, averaging –0.68 °C and ranging –0.05 to –1.24 °C; and (4) 23 mo, between September 2007 and July 2009, averaging –1.17 °C and ranging –0.31 to –1.76 °C. Since 1950, the nominal hurricane season has had slightly more negative values than positive values, 194 to 178. Thus, the possibility exists that the year 2012 may indeed turn out to have <PDO> of negative value, although it remains unknown as to how negative its value will be. If the yearly <PDO> for 2012 happens to be of negative value, this would indicate a slightly better chance (1 in 3) that more than 3 major hurricanes will occur in the 2012 hurricane season, as compared to a slightly lesser chance (1 in 4) if the yearly <PDO> for 2012 turns out to be of positive value.

2.7.6 <TNI>

The TNI is an index given by the difference in normalized anomalies of SST between the Niño 1 + 2 and Niño 4 regions, where the Niño 1 + 2 region spans 0–10 °S. and 80– 90 °W. and the Niño 4 region spans 5 °S.–5 °N. and 160 °E.–150 °W.[70] Hence, TNI can be regarded as the gradient in SST across the Pacific region where ENSO events develop.

Figure 34(a) displays the yearly variation of <TNI>.[71] For the interval 1945–2010, <TNI> averages about –0.19 °C, having *sd* = 1.128 °C and range = –2.246 to 3.096 °C. For the two

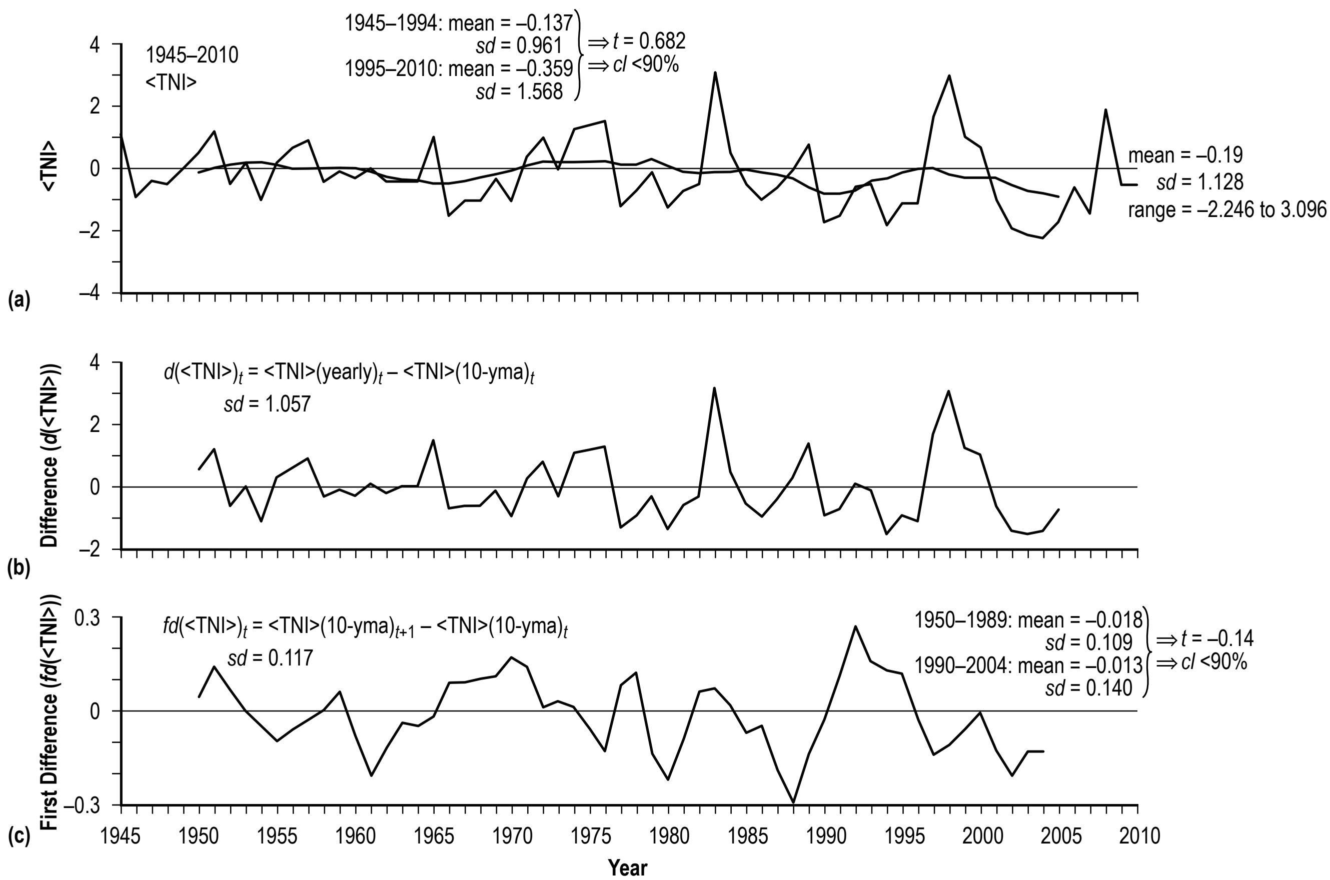

Figure 34. Yearly variation of Trans-Niño index: (a) <TNI>, (b) difference (d<TNI>), and (c) first difference (fd<TNI>).

intervals, 1945–1994 and 1995–2010, the difference in means is found not to be statistically important (t = 0.68, cl <90%). The spikes in <TNI> do not always correspond to the years when anomalous ENSO events occur. For example, the 2 yr of most positive <TNI> (3.096 and 2.985 °C) are 1983 and 1998, but only the year 1998 is associated with an anomalous ENSO extreme event (LN) (the year 1983 follows an EN event). Similarly, the 2 yr of most negative <TNI> (–2.246 and –2.149 °C) are 2004 and 2003, but only the year 2004 is associated with an ENSO extreme event (EN) (the year 2003 precedes the 2004 EN event). In terms of the 10-yma of <TNI>, it essentially has been flat (with excursions of about ±0.4 °C), at least until fairly recently (about 1982). The 10-yma of <TNI> was negative in value between 1957 and 1970, varying between –0.016 and –0.491 °C, except for the year 1960 (0.022 °C), positive in value between 1971 and 1980, varying between 0.068 and 0.246 °C, then negative once again from 1981 through 2005, varying between –0.021 and –0.944 °C, except for the year 1996 (0.013 °C). The 10-yma of <TNI> has its most negative value (–0.944 °C) in 2005 (it was –0.903 °C in 2006). For the 10-yma of <TNI> to become positive in value in 2007, the yearly <TNI> must measure in excess of 14.188 °C in 2012, a value that is about 4.6 times larger than the previously observed largest positive value of 3.096 °C in 1983. So, it seems highly unlikely that the 10-yma of <TNI> will be positive in value in 2007 (or anytime soon in the near-term, foreseeable future). Instead, it is highly probable that the 10-yma of <TNI> will remain negative in value. (Presuming a yearly <TNI> = –0.359 ± 1.568 °C for 2012, the ±1 *sd* prediction interval about the mean for the current, more active interval, one expects the 10-yma of <TNI> = –0.727 ± 0.078 °C for 2007.)

Figure 34(b) shows the yearly variation of the difference (*d*<TNI>$_t$). Like the differences for <AT>, <ONI>, <SOI>, and <PDO>, runs testing indicates that the distribution of differences for <TNI> appears to be random (*z* = –1.54, *cl* <90%, *sd* = 1.057 °C). Given that the distribution of differences appears random, one should have expected the 10-yma of <TNI> = –0.562 ± 1.057 °C for 2006, where –0.562 °C is the yearly <TNI> for 2006 and 1.057 °C is the *sd* of the differences. As it turns out, the yearly <TNI> = 1.044 °C in 2011 (considerably more positive in value than the yearly <TNI> = –0.452 °C that was observed in 2010), thereby yielding the 10-yma of <TNI> = –0.903 °C in 2006 (more positive in value than the –0.944 °C measured in 2005). For 2007, based on the observed differences, one anticipates the 10-yma of <TNI> = –1.444 ± 1.057 °C, where –1.444 °C is the yearly <TNI> for 2007. A value of the 10-yma of <TNI> = –1.444 °C in 2007 means that the yearly <TNI> = –14.692 °C in 2012 (a value about 6.5 times more negative than the most negative value of –2.246 °C in 2004), while a value more negative (positive) than –1.444 °C for the 10-yma of <TNI> in 2007 means that the yearly <TNI> for 2012 will be more negative (positive) as well. (An increase or decrease of 0.001 °C in the 10-yma of <TNI> for 2007 changes the 2012 estimate for the yearly <TNI> by 0.020 °C, accordingly.)

Figure 34(c) depicts the yearly variation of the first difference (*fd*<TNI>$_t$). While the difference in means for the two intervals 1950–1989 and 1990–2004 indicates that the distribution of first differences appears random (*t* = –1.40, *cl* <90%), runs testing suggests that the distribution of first differences is nonrandom (*z* = –4.35, *cl* >99.9%, *sd* = 0.117 °C). Presuming that the first differences are indeed distributed nonrandomly, one should have expected the 10-yma of <TNI> = –0.944 – 0.013 ± 0.140 °C, or about –0.957 ± 0.14 °C for 2006, where –0.944 °C is the 10-yma of <TNI> for 2005 and –0.013 and 0.14 °C, respectively, are the mean first difference and *sd* for the current, more active interval. As noted above, the 2011 season actually had <TNI> = 1.044 °C (more positive than the –0.452 °C measured in 2010), thereby yielding the 10-yma of <TNI> = –0.903 °C for 2006 and *fd*<TNI>$_t$ = 0.041 °C for 2005. For 2007, one anticipates the 10-yma of <TNI> = –0.903 – 0.013 ± 0.14 °C, or about –0.916 ± 0.14 °C, which, if true, suggests that the yearly value of <TNI> = –4.132 ± 2.8 °C for 2012 (i.e., the ±1 *sd* prediction interval is –1.132 to –6.932 °C, inferring that the yearly <TNI> should be negative in value for 2012).

From table 22, one finds that the difference in the means for <TNI> is not statistically important when comparing the mean of <TNI> during the 16 ENY against the mean of <TNI> during the 15 LNY (*t* = –1.65, *cl* <90%), or when comparing the mean of <TNI> during the 30 yr when <ONI> was positive in value against the mean of <TNI> during the 31 yr when <ONI> was negative in value (*t* = –1.18, *cl* <90%). Hence, strong correlation between yearly values of <TNI> and <ONI> seems unlikely (i.e., the two parameters are of the same sign in only 25 of the 62 yr in the interval 1950–2011).

From table 23(f), for <TNI> '+,' NTC = 10 ± 2 (55.3%), NTC <8 (15.5%), and NTC >12 (29.3%); NTS = 4 ± 2 (75.7%), NTS <2 (5.4%), and NTS >6 (18.9%); NH = 6 ± 2 (69.2%), NH <4 (13.7%), and NH >8 (17.1%); NMH = 3 ± 1 (61.5%), NMH <2 (19.3%), and NMH >4 (19.2%); and NUSLFH = 1 ± 1 (73.6%) and NUSLFH >2 (26.4%). For <TNI> "–," NTC = 10 ± 2 (55.2%), NTC

<8 (15.2%), and NTC >12 (29.6%); NTS = 4 ± 2 (75.6%), NTS <2 (5.5%), and NTS >6 (18.9%); NH = 6 ± 2 (69.1%), NH <4 (13.3%), and NH >8 (17.5%); NMH = 2 ± 1 (67.1%), NMH = 0 (8%), and NMH >3 (24.9%); and NUSLFH = 1 ± 1 (79.4%) and NUSLFH >2 (20.6%).

The monthly value of TNI for January 2012 measures 1.356 °C and is part of a string of positive TNI values. The string of positive TNI values now spans 18 mo, having begun in August 2010, with the February 2011 value being 1.851 °C. In the interval December 1949–January 2011, the longest string of positive TNI values spans 40 mo, between September 1973 and December 1976, averaging 1.397 °C and ranging 0.066 to 2.354 °C. Five other long positive strings have occurred during the interval 1949–2011: (1) 27 mo, between November 1949 and January 1952, averaging 0.803 °C and ranging 0.119 to 1.627 °C; (2) 23 mo, between December 1954 and October 1956, averaging 0.577 °C and ranging 0.045 to 1.119 °C; (3) 26 mo, between November 1970 and December 1972, averaging 0.638 °C and ranging 0.087 to 1.659 °C; (4) 22 mo, between September 1982 and June 1984, averaging 2.142 °C and ranging 0.092 to 4.501 °C; and (5) 27 mo, between April 1997 and June 1999, averaging 2.521 °C and ranging 0.174 to 3.484 °C. Since 1950, the nominal hurricane season has had considerably more negative values than positive values, 235 to 137. Thus, the possibility exists that the present string of positive values in TNI may soon end and that the year 2012 might be of negative value as suggested from above.

2.7.7 <MEI>

Originally, the MEI was defined as the first seasonally varying principal component of six atmosphere-ocean variable fields in the tropical Pacific basin, based on the Comprehensive Ocean-Atmosphere Data Set (COADS).[72,73] The six variables included sea level pressure (SLP), zonal and meridional components of the surface wind, SST, surface air temperature, and total fractional cloudiness of the sky. A more simplified method, based only on the Hadley Center SLP and SST (called MEI.ext),[74] is also available for use.

Figure 35(a) displays the yearly variation of <MEI>.[75] For the interval 1945–2010, <MEI> averages about 0.039, having *sd* = 0.768 and range = –1.607 to 1.65. For the two intervals, 1945–1994 and 1995–2010, the difference in means is found not to be statistically important (t = –0.36, *cl* <90%). Like <NAO>, <PDO>, and <TNI>, the spikes in the yearly <MEI> do not always correspond to the years when anomalous ENSO events occur. For example, the 2 yr of most positive <MEI> (1.594 and 1.650) are 1983 and 1987, but only the year 1987 is associated with an anomalous ENSO extreme event (EN) (the year 1983 follows an EN event); however, the 2 yr of most negative <MEI> (–1.607 and –1.426), 1955 and 1971, are both associated with ENSO extreme events (LN). In terms of the 10-yma of <MEI>, it always is negative in value prior to 1978 and always positive in value from 1978. During the interval 1955–1977, the 10-yma <MEI> varied between –0.011 and –0.491, and during the interval 1978–2005, the 10-yma <MEI> varied between 0.01 and 0.58 (the value decreased slightly from 0.081 to 0.047 between 2005 and 2006). For the 10-yma of <MEI> to become negative in value in 2007, the yearly <MEI> must measure less than 0.414 in 2012, a value well within the range of previously observed values in the interval 1950–2010. (Presuming a yearly <MEI> = 0.103 ± 0.638 for 2012, the ±1 *sd* prediction interval about the mean for the current, more active interval, one expects the 10-yma of <MEI> = –0.016 ± 0.032 for 2007.)

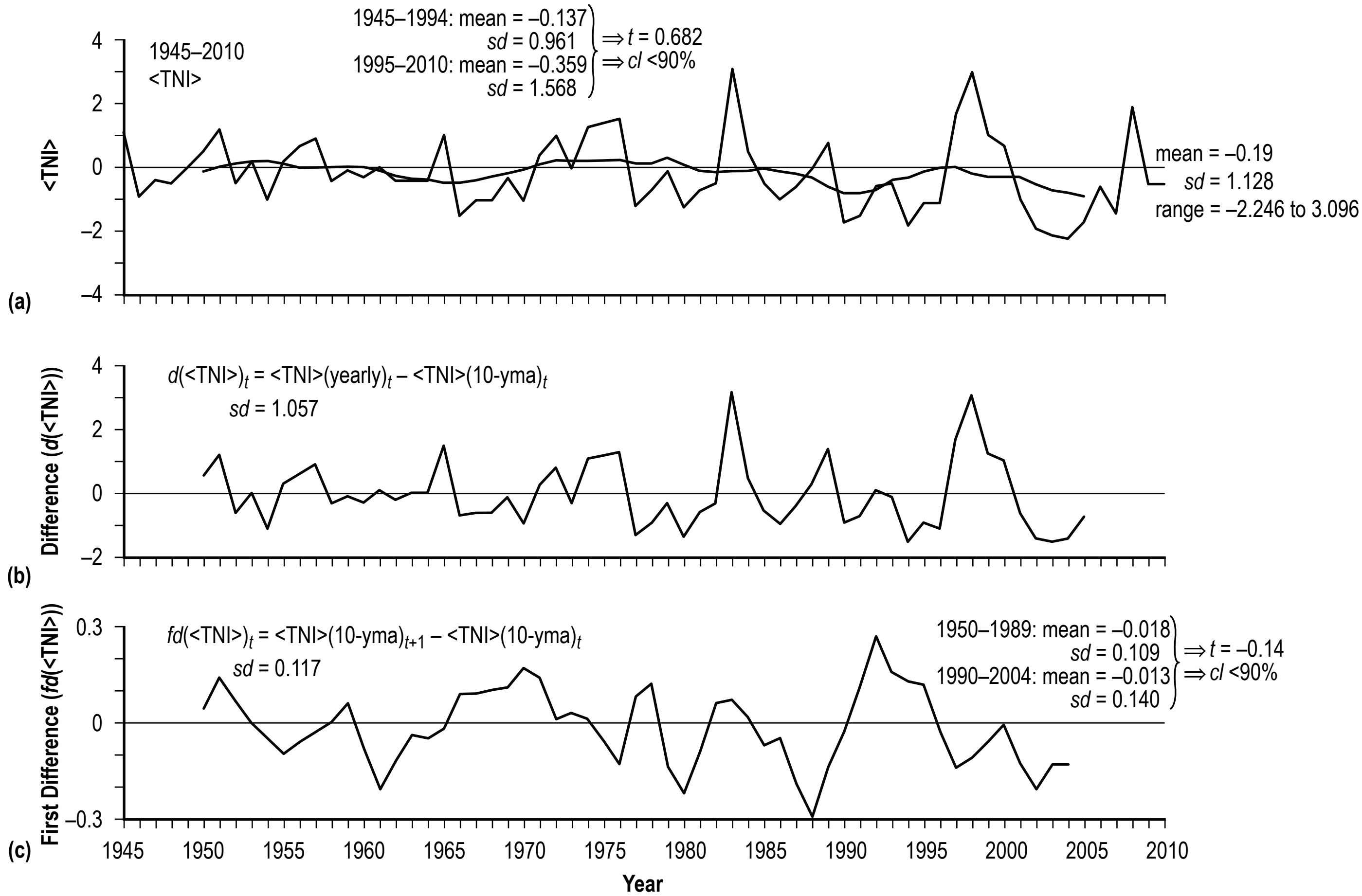

Figure 35. Yearly multivariate ENSO index: (a) <MEI>, (b) difference (d<MEI>), and (c) first difference (fd<MEI>).

Figure 35(b) shows the yearly variation of the difference (d<MEI>$_t$). Runs testing indicates that the distribution of differences for <MEI> appears to be random ($z = –1.25$, cl <90%, $sd = 0.713$). Given that the distribution of differences appears random, one should have expected the 10-yma of <MEI> = 0.307 ± 0.713 for 2006, where 0.307 is the yearly <MEI> for 2006 and 0.713 is the sd of the differences. As it turns out, the yearly <MEI> = –0.935 in 2011 (considerably more negative in value than the yearly <MEI> = –0.429 that was observed in 2010), thereby yielding the 10-yma of <MEI> = 0.047 in 2006 (a value smaller than the 0.081 measured in 2005). For 2007, based on the observed differences, one anticipates the 10-yma of <MEI> = –0.337 ± 0.713, where –0.337 is the yearly <MEI> for 2007. A value of the 10-yma of <MEI> = –0.337 in 2007 means that the yearly <MEI> = –6.326 in 2012 (a value about 3.9 times more negative than the most negative value of –1.607 in 1955), while a value more negative (positive) than –0.337 for the 10-yma of <MEI> in 2007 means that the yearly <MEI> for 2012 will be more negative (positive) as well. (An increase or decrease of 0.001 in the 10-yma of <MEI> for 2007 changes the 2012 estimate for the yearly <MEI> by 0.02, accordingly.)

Figure 35(c) depicts the yearly variation of the first difference (*fd*<MEI>$_t$). While the difference in means for the two intervals 1955–1989 and 1990–2004 indicates that the distribution of first differences appears nonrandom (t = 2.18, cl >95%), runs testing suggests that the distribution of first differences is random (z = –1.66, cl <90%, sd = 0.079). Presuming that the first differences are indeed distributed randomly, one should have expected the 10-yma of <MEI> = 0.081 ± 0.079 for 2006, where 0.081 is the 10-yma of <MEI> for 2005 and 0.079 is the *sd* of the first differences. As noted above, the 2011 season actually had <MEI> = –0.935 (more negative than the –0.429 measured in 2010), thereby yielding the 10-yma of <MEI> = 0.047 for 2006 and *fd*<TNI>$_t$ = –0.034 for 2005. For 2007, one anticipates the 10-yma of <MEI> = 0.047 ± 0.079, which, if true, suggests that the yearly value of <MEI> = 1.354 ± 1.58 for 2012 (i.e., the ±1 *sd* prediction interval is –0.226 to 2.934).

From table 22, one finds that the difference in the means for <MEI> is highly statistically important when comparing the mean of <MEI> during the 16 ENY against the mean of <MEI> during the 15 LNY (t = 7.81, cl >99.9%), or when comparing the mean of <MEI> during the 30 yr when <ONI> was positive in value against the mean of <MEI> during the 31 yr when <ONI> was negative in value (t = 10.85, cl >99.9%). Hence, strong correlation between yearly values of <MEI> and <ONI> seems very likely (i.e., the two parameters are of the same sign in 59 of the 62 yr in the interval 1950–2011, being of different signs only in 1959, 1978 an 1981).

From table 23(g), for <MEI> '+,' NTC = 10 ± 2 (54.6%), NTC <8 (14.6%), and NTC >12 (30.7%); NTS = 4 ± 2 (72.7%), NTS <2 (4.2%), and NTS >6 (23.1%); NH = 6 ± 2 (69.6%), NH <4 (14.9%), and NH >8 (15.5%); NMH = 2 ± 1 (68.1%), NMH = 0 (8.5%), and NMH >4 (23.4%); and NUSLFH = 1 ± 1 (79.4%) and NUSLFH >2 (20.6%). For <MEI> '–,' NTC = 10 ± 2 (55.2%), NTC <8 (15.3%), and NTC >12 (29.5%); NTS = 4 ± 2 (79.6%), NTS <2 (8.8%), and NTS >6 (11.6%); NH = 6 ± 2 (66.2%), NH <4 (9.3%), and NH >8 (24.5%); NMH = 3 ± 1 (60.7%), NMH <2 (16.5%), and NMH >4 (22.8%); and NUSLFH = 1 ± 1 (79.6%) and NUSLFH >2 (20.4%).

The monthly value of MEI for January, February, and March 2012 measures, respectively, –1.046, –0.702, and –0.41 and is part of a string of negative MEI values. The string of negative MEI values now spans 22 mo, having begun in June 2010, with the September 2010 value being –2.037. In the interval January 1950–March 2011, the longest string of negative MEI values spans 37 mo, between May 1973 and May 1976, averaging –1.245 and ranging –0.131 and –2. Three other long negative strings have occurred during the interval 1950–2011: (1) 35 mo, between April 1954 and February 1957, averaging –1.344 and ranging –0.356 to –2.276; (2) 26 mo, between May 1961 and June 1963, averaging –0.591 and ranging –0.038 to –1.093; and (3) 25 mo, between April 1970 and April 1972, averaging –1.057 and ranging –0.056 to –1.898. Since 1950, the nominal hurricane season has had essentially equal numbers of positive and negative values of MEI, 187 to 185. Thus, as yet, one cannot know with any certainty as to whether the yearly <MEI> for 2012 will be positive or negative in value. Because of the inferred strong relationship between the yearly <ONI> and <MEI> and because the ENSO condition is expected to be ENSO neutral to EN-like, the year 2012 may turn out to be positive in value (with <SOI> being negative in value).

2.7.8 <GSSTEI>

The University of Washington Joint Institute for the Study of the Atmosphere and Ocean has developed a new experimental index, called the GSSTEI, with values available only through

February 2011. The index is taken as the average SST equatorward of 20 deg latitude (north and south) minus the average SST poleward of 20 deg latitude (north and south), with anomalies determined relative to the 1950–1979 period. The number of observations contributing to the index is at least 1,000 per month, using product data from the International COADS. Because GSSTEI has not been updated since February 2011, this index, unfortunately, will not serve as a potential useful predictor for the frequency and strength of tropical cyclones in the 2012 hurricane season.

Figure 36(a) displays the yearly variation of <GSSTEI>.[76] For the interval 1945–2010, <GSSTEI> averages about 0.062 °C, having $sd = 0.171$ °C and range = –0.349 to 0.474 °C. For the two intervals, 1945–1994 and 1995–2010, the difference in means is found to be only of marginal statistical importance ($t = -1.94$, $cl > 90\%$). Like <NAO>, <PDO>, <TNI>, and <MEI>, the spikes in the yearly <GSSTEI> do not always correspond to the years when anomalous ENSO events occur. For example, the 2 yr of most positive <GSSTEI> (0.395 and 0.474 °C) are 1983 and 1987, but only the year 1987 is associated with an anomalous ENSO extreme event (EN) (the year 1983 follows an EN event); however, the 2 yr of most negative <GSSTEI> (–0.349 and –0.317 °C), 1950 and 1955, are both associated with ENSO extreme events (LN). In terms of the 10-yma of <GSSTEI>, it always is negative in value prior to 1960 and always positive in value from 1960. During the interval 1950–1959, the 10-yma <GSSTEI> varied between –0.03 and –0.134 °C, and during the interval 1960–2005, the 10-yma <GSSTEI> varied between 0.008 and 0.204 °C (the last available 10-yma value of <GSSTEI> measures 0.079 °C in 2005, up from 0.044 °C in 2004). For the 10-yma of <GSSTEI> to become negative in value in 2006, the yearly <GSSTEI> must measure more negatively than –1.946 °C, a value more than 5.5 times larger in negative value than ever seen. Consequently, one expects the 10-yma of <GSSTEI> to remain positive in value, at least for the near-term, foreseeable future. (Presuming a yearly <GSSTEI> = 0.092 ± 0.141 for 2011, the ±1 sd prediction interval about the mean for the current, more active interval, one would have expected the 10-yma of <GSSTEI> = 0.102 ± 0.007 for 2006.)

Figure 36(b) shows the yearly variation of the difference (d<GSSTEI>$_t$). Runs testing indicates that the distribution of differences for <GSSTEI> appears to be random ($z = -1.23$, $cl < 90\%$, $sd = 0.15$ °C). Given that the distribution of differences appears random, one should have expected the 10-yma of <GSSTEI> = 0.118 ± 0.15 for 2006, where 0.118 is the yearly <GSSTEI> for 2006 and 0.15 is the sd of the differences. Because the yearly value of <GSSTEI> for 2011 is unknown, one cannot determine how well the projection for the 10-yma of <GSSTEI> was for 2006. (For 2007, one expects the 10-yma of <GSSTEI> = 0.068 ± 0.15 °C.)

Figure 36(c) depicts the yearly variation of the first difference (fd<GSSTEI>$_t$). Both the difference in means for the two intervals 1950–1989 and 1990–2004 and runs testing indicate that the distribution of first differences appears nonrandom ($t = 2.11$, $cl > 95\%$; $z = -3.88$, $cl > 99.9\%$, $sd = 0.019$ °C). Presuming that the first differences are indeed distributed nonrandomly, one should have expected the 10-yma of <GSSTEI> = 0.079 – 0.006 ± 0.015 °C, or 0.073 ± 0.015 °C for 2006, where 0.079 °C is the 10-yma of <GSSTEI> for 2005 and 0.006 and 0.015 °C is the mean and sd of the first differences for the current, more active interval. (To predict the value for 2007, one needs to know the 10-yma value of <GSSTEI> for 2006.)

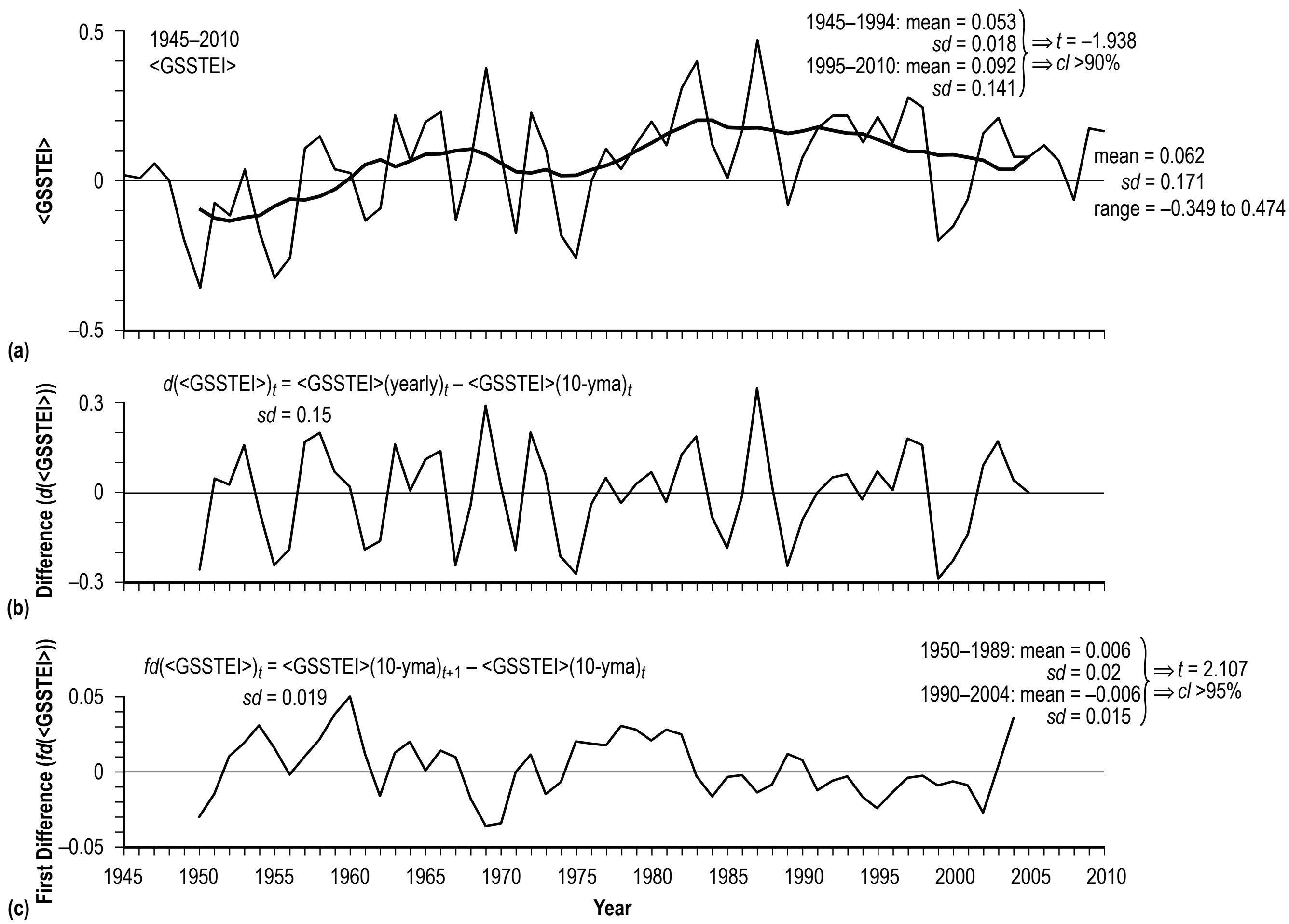

Figure 36. Yearly variations of global sea surface temperature: (a) <GSSTEI>, (b) difference (d<GSSTEI>), and (c) first difference (fd<GSSTEI>).

From table 22, one finds that the difference in the means for <GSSTEI> is statistically important when comparing the mean of <GSSTEI> during the 16 ENY against the mean of <GSSTEI> during the 15 LNY (t = 4.43, cl >99.9%), or when comparing the mean of <GSSTEI> during the 30 yr when <ONI> was positive in value against the mean of <GSSTEI> during the 31 yr when <ONI> was negative in value (t = 7.08, cl >99.9%). Hence, strong correlation between yearly values of <GSSTEI> and <ONI> seems likely (i.e., the two parameters are of the same sign in 46 of the 61 yr in the interval 1950–2010).

From table 23(h), for <GSSTEI> '+,' NTC = 10 ± 2 (55.4%), NTC <8 (15.8%), and NTC >12 (28.8%); NTS = 4 ± 2 (73.4%), NTS <2 (4.4%), and NTS >6 (22.2%); NH = 5 ± 2 (69.2%), NH <3 (6.7%), and NH >7 (24.1%); NMH = 2 ± 1 (56.6%), NMH = 0 (9.2%), and NMH >4 (34.3%); and NUSLFH = 1 ± 1 (78.7%) and NUSLFH >2 (21.3%). For <GSSTEI> '–,' NTC = 11 ± 2 (54.8%), NTC <9 (14.6%), and NTC >13 (30.6%); NTS = 4 ± 2 (79.6%), NTS <2 (8.8%), and NTS >6 (11.6%); NH = 6 ± 2 (65.5%), NH <4 (8.7%), and NH >8 (25.8%); NMH = 3 ± 1 (59.4%), NMH <2 (14.1%), and NMH >4 (26.5%); and NUSLFH = 1 ± 1 (75.7%) and NUSLFH >2 (24.3%).

Presently, there are no monthly values of GSSTEI available after February 2011. Consequently, one cannot determine its yearly values for 2011 or project values for 2012.

2.7.9 <JMASSTM>

While ONI and SOI are two chief measures most often used to describe and characterize the onset dates, intensities, and durations of ENSO events, another index that has come into recent use is the JMASST index. This index is a 5-mo running mean of spatially averaged SST anomalies over the tropical Pacific Ocean, between 4 °S.–4 °N. latitude and 150–90 °W. longitude. When the index is 0.5 °C or greater for at least 6 consecutive months, the ENSO year of October through the following September is categorized as El Niño (warm phase), while when the index is –0.5 °C or more negative for at least 6 consecutive months, the ENSO year of October through the following September is categorized as La Niña (also called El Viejo, or cold phase, by the JMA). When neither anomaly is occurring, the ENSO year is categorized as neutral. (Recall that in this study, the ENSO condition is determined from monthly ONI values, with a year being denoted ENY, LNY, or NY based on whether the anomaly is operative for at least 4 of the 6-mo nominal hurricane season.)

The JMASST index can be found at <ftp://www.coaps.fsu.edu/pub/JMA_SST_Index/>. Two tabulations are available: (1) the mean values and (2) the anomalies, where the anomalies are derived from the means by subtracting 'normals' or 'monthly climatological means' used by the JMA. The monthly normals are 25.4, 26.2, 26.9, 27.1, 26.6, 26.1, 25.2, 24.6, 24.6, 24.6, 24.6, and 24.9 °C, representing, respectively, the months of January–December. As an example, the mean JMASST index for January 2012 is 25.1 °C and the anomaly is –0.3 °C (= 25.1 – 25.4 °C).

Figure 37(a) displays the yearly variation of the JMASST index using the means (i.e., <JMASSTM>). For the interval 1949–2010, <JMASSTM> averages about 25.6 °C, having *sd* = 0.6 °C and range = 24.5 to 27.4 °C. For the two intervals, 1949–1994 and 1995–2010, the difference in means is found not to be statistically important (t = –1.1, *cl* <90%). The spikes in the yearly <JMASSTM> correspond to years when anomalous ENSO events occur, warmer positive spikes with EN events and cooler negative spikes with LN events. In terms of the 10-yma of <JMASSTM>, it always is equal to or below the mean of 25.6 °C prior to 1978 and always above the mean from 1978 onwards. In 2005, the 10-yma of <JMASSTM> measured 25.8 °C. For the 10-yma of <JMASSTM> to fall below the mean in 2006, the yearly <JMASST> must measure cooler than 21.3 °C, much cooler than has ever been seen (24.5 °C in 1955). As it turns out, the yearly <JMASSTM> measured 25.3 °C in 2011, thereby yielding the 10-yma <JMASSTM> = 25.8 °C in 2006, a value unchanged from that of the previous year. For 2012, the yearly <JMASSTM> is expected to be about 25.6 ± 0.6 °C (i.e., the ±1 *sd* prediction interval about the mean), suggesting that the 10-yma <JMASSTM> = 25.76 ± 0.03 °C for 2007, a value slightly higher than the mean. For the 10-yma <JMASSTM> = 25.6 °C or cooler, the yearly <JMASSTM> = 22.5 °C or cooler in 2012, a value also cooler than ever been seen. Consequently, one does not expect the 10-yma <JMASSTM> to fall below the mean in the near-term, foreseeable future. (The January–March 2012 values of JMASST, respectively, are 25.1, 26.2, and 26.9 °C, and the ENSO condition is presently categorized as neutral.)

Figure 37(b) shows the yearly variation of the difference (d<JMASSTM>$_t$). Runs testing indicates that the distribution of differences for <JMASSTM> appears to be random (z = –0.71, *cl* <90%,

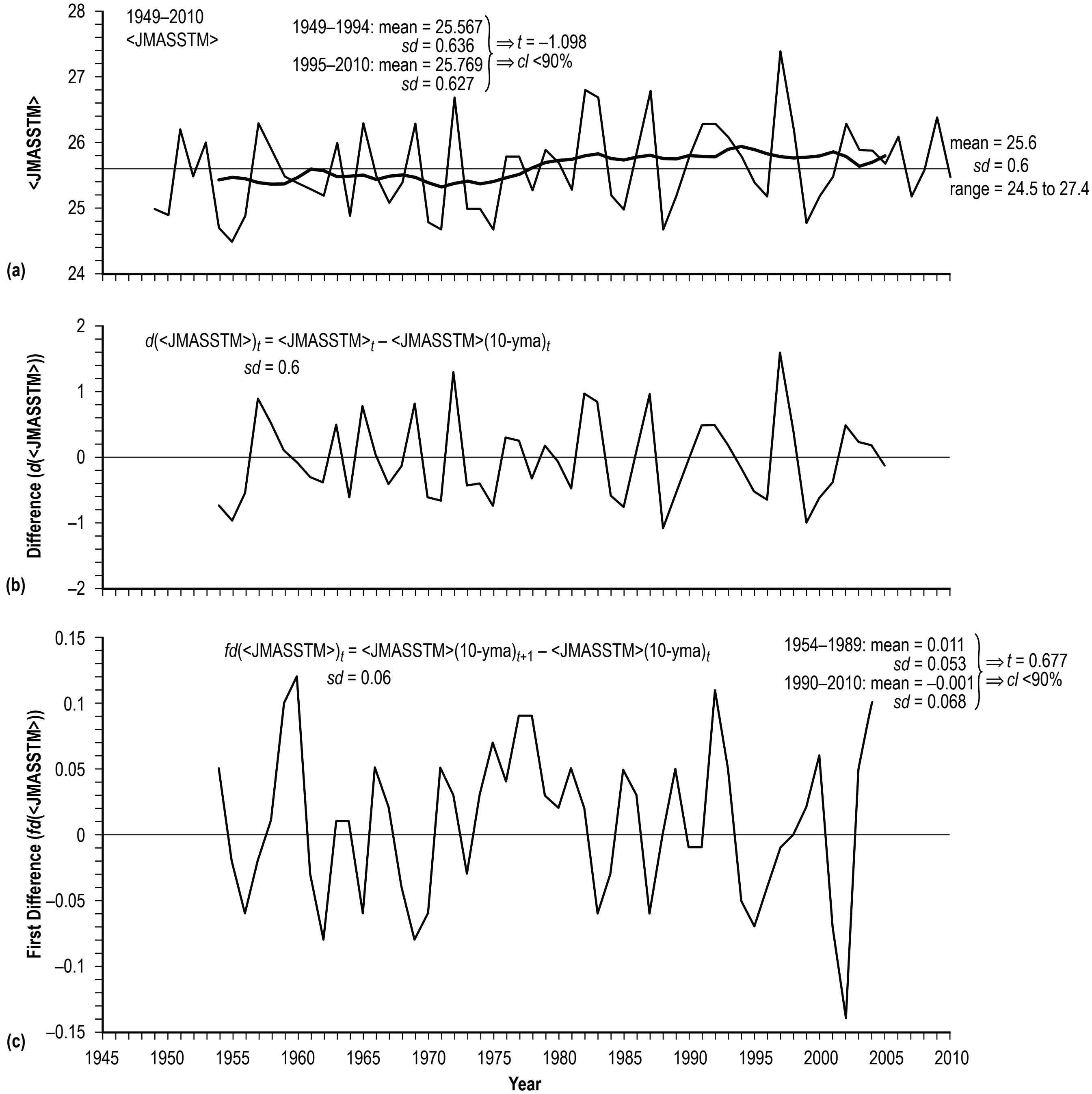

Figure 37. Yearly JMA SST mean index: (a) <JMASSTM>, (b) difference (d<JMASSTM>), and (c) first difference (fd<AJMASSTM>).

sd = 0.6 °C). Given that the distribution of differences appears random, one should have expected the 10-yma of <JMASSTM> = 26.1 ± 0.6 °C for 2006, where 26.1 °C is the yearly <JMASSTM> for 2006 and 0.6 °C is the *sd* of the differences. From above, the yearly <JMASSTM> = 25.3 °C in 2011 and the 10-yma <JMASSTM> = 25.8 °C in 2006. For 2007, the 10-yma <JMASSTM> = 25.2 ± 0.6 °C, based on the observed differences, 25.2 °C being the yearly <JMASSTM> for 2007. Hence, one expects the yearly <JMASSTM> = 14.5 ± 12 °C, or ≤26.5 °C (i.e., the upper limit of the ±1 *sd* prediction interval) in 2012.

Figure 37(c) depicts the yearly variation of the first difference (*fd*<JMASSTM>$_t$). Both the difference in means for the two intervals 1954–1989 and 1990–2004 and runs testing indicate that the distribution of first differences appears random (t = 0.68, *cl* <90%; z = –1.10, *cl* <90%, *sd* = 0.06 °C). Presuming that the first differences are indeed distributed randomly, one should have expected the 10-yma of <JMASSTM> = 25.8 ± 0.06 °C for 2006, where 25.8 °C is the 10-yma of <JMASSTM> for 2005 and 0.06 °C is the *sd* of the first differences, inferring a yearly <JMASSTM> = 25.3 ± 1.2 °C in 2011. As it turns out, the yearly <JMASSTM> = 25.3 °C in 2011, thereby yielding the 10-yma <JMASSTM> = 25.8 °C in 2006. For 2007, one expects the 10-yma<JMASSTM> = 25.8 ± 0.06 °C, inferring the yearly <JMASSTM> = 26.5 ± 1.2 °C in 2012.

From table 22, one finds that the difference in the means for <JMASSTM> is statistically important when comparing the mean of <JMASSTM> during the 16 ENY against the mean of <JMASSTM> during the 15 LNY (t = 9.43, *cl* >99.9%), or when comparing the mean of <JMASSTM> during the 30 yr when <ONI> was positive in value against the mean of <JMASSTM> during the 31 yr when <ONI> was negative in value (t = 10.53, *cl* >99.9%). Hence, strong correlation between yearly values of <JMASSTM> and <ONI> seems highly likely.

From table 23(i), for <JMASSTM> '+,' NTC = 10 ± 2 (56.5%), NTC <8 (18.4%), and NTC >12 (25.1%); NTS = 4 ± 2 (76.2%), NTS <2 (5.6%), and NTS >6 (18.2%); NH = 5 ± 2 (69.7%), NH <3 (7%), and NH >7 (23.3%); NMH = 2 ± 1 (69.6%), NMH = 0 (9.7%), and NMH >3 (20.7%); and NUSLFH = 1 ± 1 (66.7%) and NUSLFH >2 (33.3%). For <JMASSTM> '–,' NTC = 11 ± 2 (54.3%), NTC <9 (19.3%), and NTC >13 (26.4%); NTS = 4 ± 2 (74.8%), NTS <2 (14.7%), and NTS >6 (10.5%); NH = 6 ± 2 (66.7%), NH <4 (9.8%), and NH >8 (23.5%); NMH = 3 ± 1 (61.4%), NMH <2 (14.6%), and NMH >4 (24%); and NUSLFH = 1 ± 1 (76.8%) and NUSLFH >2 (23.2%).

2.7.10 <NTA>

The NTA is an experimental time series of SST anomalies based on the COADS dataset for the interval 1951–1991 and the National Centers for Environmental Prediction dataset afterwards. The SST data are averaged over two regions: 6–18 °N. latitude and 20–60 °W. longitude and over 6–10 °N. latitude and 10–20 °W. longitude. It is calculated relative to the 1951–2000 climatology, smoothed by a 3-mo running mean procedure, and projected onto 20 leading empirical orthogonal functions.[77–79]

Figure 38(a) displays the yearly variation of <NTA>.[80] For the interval February 1951–December 2010, <NTA> averages about 0.063 °C, having *sd* = 0.28 °C and range = –0.495 to 0.915 °C. For the two intervals, 1951–1994 and 1995–2010, the difference in means is found to be statistically important (t = –5.687, *cl* >99.9%). The spikes in the yearly <NTA> do not always correspond to years when anomalous ENSO events occur. For example, the five largest positive spikes are 0.501 (1958), 0.545 (1969), 0.555 (1998), 0.624 (2005), and 0.915 (2010) °C. Of these, only the spikes of 1969 (EN), 1998 (LN), and 2010 (LN) are associated with the occurrences of ENSO anomalies. Similarly, the five largest negative spikes are –0.286 (1954), –0.239 (1965), –0.304 (1972), –0.495

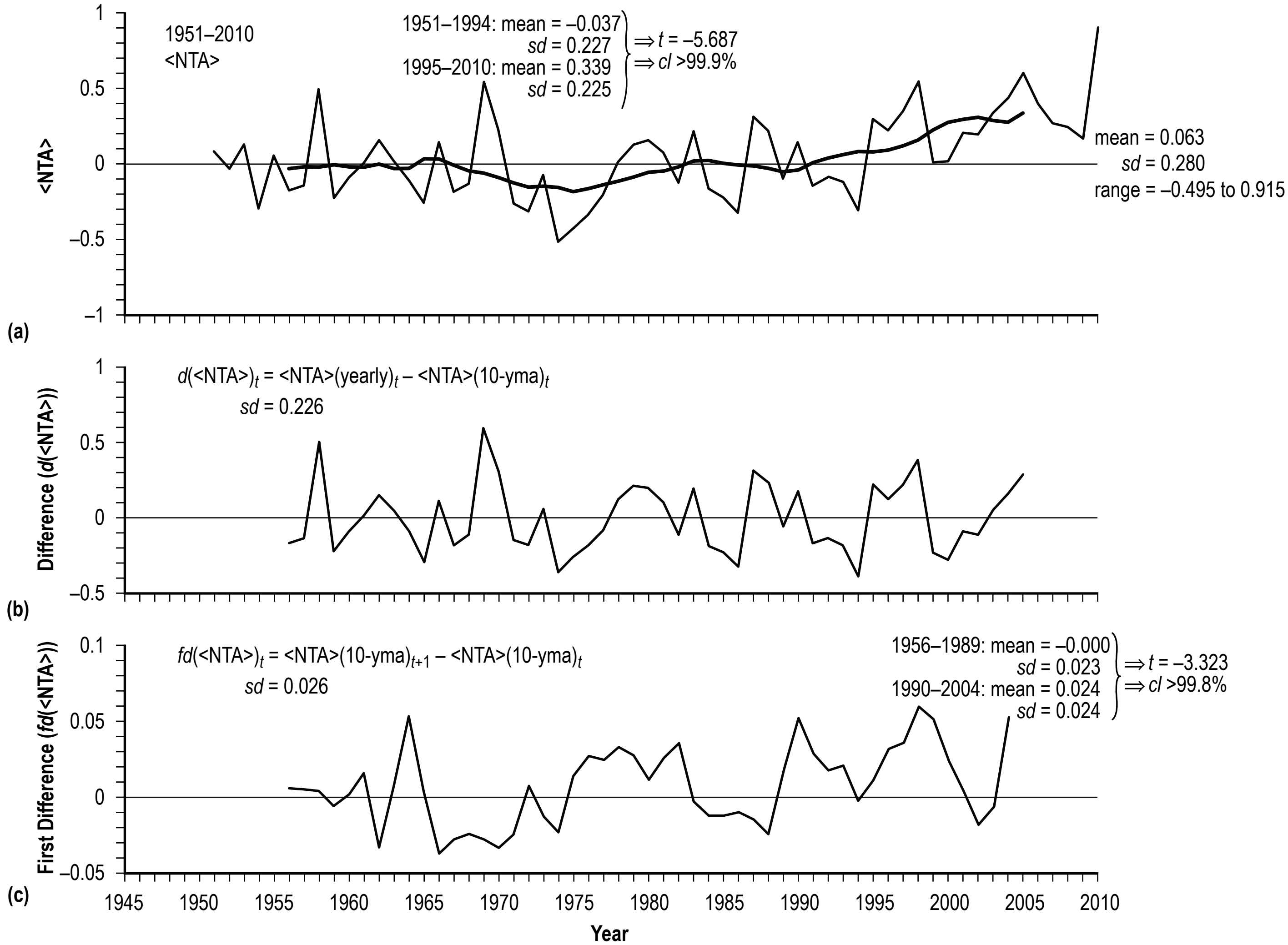

Figure 38. North Tropical Atlantic index yearly variation: (a) <NTA>, (b) difference (*d*<NTA>), and (c) first difference (*fd*<NTA>).

(1974), and –0.286 (1994) °C. Of these, only the spike of 2005 is not associated with an ENSO anomaly. While the other largest negative spikes are associated with ENSO anomalies, the types are different: the spikes of 1954 and 1974 are both associated with LNY events, and the spikes of 1965 and 1972 are both associated with ENY events. In terms of the 10-yma of <NTA>, it was relatively flat between 1956 and the late 1960s, becoming negative between 1968 and 1981 (–0.165 °C in 1975) and positive thereafter, except for the years 1988, 1989, and 1990. Values have been increasingly more positive in value of late, perhaps peaking about 2005 (0.347 °C in 2005). (Monthly values of NTA have not been updated beyond December 2010.)

Figure 38(b) shows the yearly variation of the difference (*d*<NTA>$_t$). Runs testing indicates that the distribution of differences for <NTA> appears to be random (*z* = –1.064, *cl* <90%, *sd* = 0.226 °C). Given that the distribution of differences appears random, one should have expected the 10-yma of <NTA> = 0.412 ± 0.226 °C for 2006, where 0.412 °C is the yearly <NTA> for 2006 and 0.226 °C is the *sd* of the differences. Hence, one expected a 10-yma <NTA> of 0.186–0.638 °C in 2006 (it measured 0.347 °C in 2005 with a difference of 0.277 °C), inferring a yearly <NTA> = 1.001 ± 4.52 °C in 2011. Unfortunately, monthly values of NTA have not been published beyond December 2010, as noted above.

Figure 38(c) depicts the yearly variation of the first difference (*fd*<NTA>$_t$). Both the difference in means for the two intervals 1954–1989 and 1990–2004 and runs testing indicate that the distribution of first differences appears nonrandom (*t* = –3.32, *cl* >99.8%; *z* = –2.51, *cl* >98%, *sd* = 0.026 °C). Presuming that the first differences are indeed distributed nonrandomly, one should have expected the 10-yma of <NTA> = 0.347 + 0.024 ± 0.024 °C, or 0.371 ± 0.024 °C for 2006, where 0.347 °C is the 10-yma of <NTA> for 2005 and 0.024 and 0.024 °C, respectively, are the mean and *sd* of the first differences for the current, more active interval, inferring a yearly <NTA> = –0.183 ± 0.48 °C in 2011.

From table 22, one finds that the difference in the means for <NTA> is not statistically important when comparing the mean of <NTA> during the 16 ENY against the mean of <NTA> during the 14 LNY (*t* = 0.552, *cl* <90%; <NTA> for 1950, a LNY, is not available). However, when comparing the mean of <NTA> during the 30 yr when <ONI> was positive in value against the mean of <NTA> during the 30 yr when <ONI> was negative in value, one finds that the difference in means is statistically important (*t* = 2.12, *cl* >95%). Hence, strong correlation between yearly values of <NTA> and <ONI> possibly exists (i.e., the two parameters were of the same sign in 36 of the 60 yr in the interval 1951–2010.)

From table 23(j), for <NTA> '+,' NTC = 12 ± 2 (52.2%), NTC <10 (19.7%), and NTC >14 (28.1%); NTS = 5 ± 2 (73%), NTS <3 (9.8%), and NTS >7 (17.2%); NH = 7 ± 2 (65.4%), NH <5 (15.5%), and NH >9 (19.2%); NMH = 3 ± 1 (59.7%), NMH = <2 (14.6%), and NMH >4 (25.8%); and NUSLFH = 1 ± 1 (66.7%) and NUSLFH >2 (33.3%). For <NTA> '–,' NTC = 8 ± 2 (60.4%), NTC <6 (13.3%), and NTC >10 (26.3%); NTS = 3 ± 2 (79.3%), NTS = 0 (2.1%), and NTS >5 (18.6%); NH = 4 ± 2 (73.5%), NH <2 (4.5%), and NH >6 (22.1%); NMH = 1 ± 1 (77.8%) and NMH >2 (22.2%); and NUSLFH = 1 ± 1 (78.9%) and NUSLFH >2 (21.2%).

2.7.11 <CAR>

Like NTA, the CAR index is an experimental time series of SST anomalies based on the COADS dataset for the interval 1951–1991 and the National Centers for Environmental Prediction dataset afterwards. The SST data are averaged over the region approximately bounded by 10–26 °N. latitude and the open waters region eastward of Mesoamerica to 60 °W. It is calculated relative to the 1951–2000 climatology, smoothed by a 3-mo running mean procedure, and projected onto 20 leading empirical orthogonal functions.[77] (The Caribbean Sea region appears to be getting warmer and wetter with the passage of time.[81,82])

Figure 39(a) displays the yearly variation of <CAR>.[83] For the interval February 1951–December 2010, <CAR> averages about 0.033 °C, having *sd* = 0.159 °C and range = –0.332 to 0.384 °C. For the two intervals, 1951–1994 and 1995–2010, the difference in means is found to be statistically important (*t* = –4.399, *cl* >99.9%). Like the yearly <NTA>, the spikes in the yearly <CAR> do not always correspond to the years when anomalous ENSO events occur. For example, while the three largest positive spikes are 0.337 (1958), 0.384 (1998), and 0.265 (2005), only the spike of 1998 is associated with an ENSO anomaly (LN); the spike of 1958 follows the 1957 EN and the spike of 2005 follows the 2004 EN. Similarly, while the three largest negative spikes are –0.256 (1971), –0.312 (1974), and –0.332 (1976) °C, only the largest negative spike is not associated with an ENSO anomaly; the other two were associated with LN events. In terms of the 10-yma <CAR>, its behavior mimics somewhat that of the 10-yma <NTA>, being relatively flat early on (through about 1962), declining between 1962 and 1972 to its most negative value, –0.143 °C, then rising to a peak of 0.189 °C in 2002 and remaining relatively flat through 2005 (0.177 °C). Between 1982 and 2005, all 10-yma values of <CAR> are positive, except for 1988 and 1989 (–0.009 and –0.012 °C, respectively). As with monthly values of NTA, monthly values of CAR have not been updated beyond December 2010.

Figure 39(b) shows the yearly variation of the difference ($d\langle\mathrm{CAR}\rangle_t$). Runs testing indicates that the distribution of differences for <CAR> appears to be random (*z* = –1.006, *cl* <90%, *sd* = 0.123 °C). Given that the distribution of differences appears random, one should have expected the 10-yma of <CAR> = 0.164 ± 0.123 °C for 2006, where 0.164 °C is the yearly <CAR> for 2006 and 0.123 °C is the *sd* of the differences. Hence, one expected a 10-yma <NTA> of 0.041–0.287 °C in 2006 (it measured 0.177 °C in 2005 with a difference of 0.013 °C), inferring a yearly <NTA> = –0.352 ± 2.46 °C in 2011. Unfortunately, as noted above for NTA, monthly values of CAR have not been published beyond December 2010.

Figure 39(c) depicts the yearly variation of the first difference ($fd\langle\mathrm{CAR}\rangle_t$). Both the difference in means for the two intervals 1954–1989 and 1990–2004 and runs testing indicate that the distribution of first differences appears nonrandom (*t* = –2.72, *cl* >99%; *z* = –2.68, *cl* >99%, *sd* = 0.017 °C). Presuming that the first differences are indeed distributed nonrandomly, one should have expected the 10-yma of <NTA> = 0.177 + 0.011 ± 0.014 °C, or 0.188 ± 0.014 °C for 2006, where 0.177 °C is the 10-yma of <CAR> for 2005 and 0.011 °C and 0.014 °C, respectively, are the mean and *sd* of the first differences for the current, more active interval, inferring a yearly <CAR> = 0.128 ± 0.28 °C in 2011.

From table 22, one finds that the difference in the means for <CAR> is only of marginal statistical importance when comparing the mean of <CAR> during the 16 ENY against the mean of <CAR> during the 14 LNY (*t* = 1.99, *cl* >90%; <CAR> for 1950, a LNY, is not available). However, when comparing the mean of <CAR> during the 30 yr when <ONI> was positive in value against the mean of <CAR> during the 30 yr when <ONI> was negative in value, one finds that the difference in means is statistically important (*t* = 3.12, *cl* >99.5%). Hence, strong correlation between yearly values of <CAR> and <ONI> possibly exists (i.e., the two parameters were of the same sign in 38 of the 60 yr in the interval 1951–2010.)

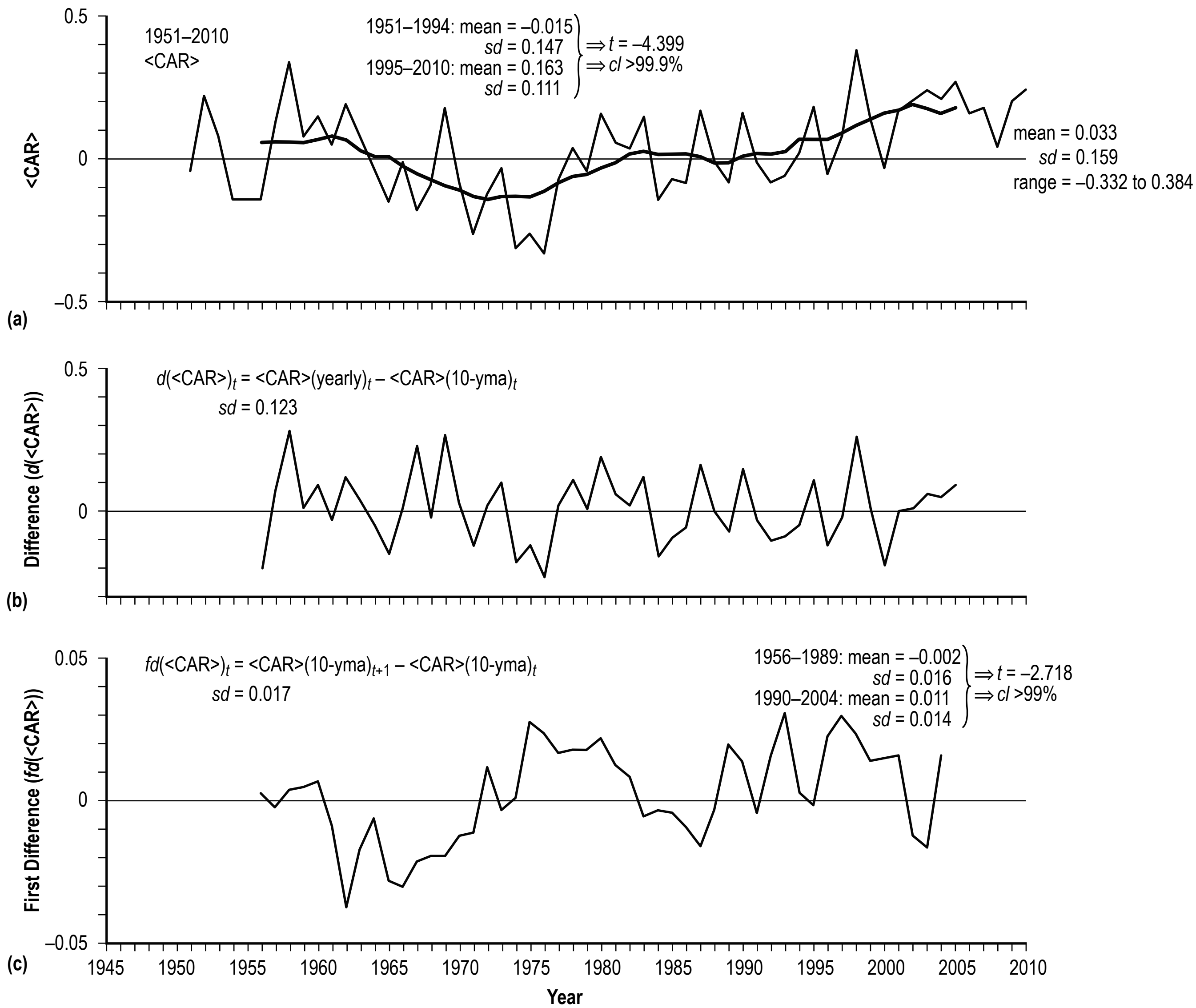

Figure 39. Caribbean index yearly variation: (a) <CAR>, (b) difference (*d*<CAR>), and (c) first difference (*fd*<CAR>).

From table 23(k), for <CAR> '+,' NTC = 11 ± 2 (53%), NTC <9 (16.1%), and NTC >13 (30.9%); NTS = 5 ± 2 (73.4%), NTS <3 (10.5%), and NTS >7 (16.1%); NH = 6 ± 2 (67.1%), NH <4 (10.1%), and NH >8 (22.8%); NMH = 3 ± 1 (61.6%), NMH = <2 (19.9%), and NMH >4 (18.5%); and NUSLFH = 1 ± 1 (82.4%) and NUSLFH >2 (17.6%). For <CAR> '–,' NTC = 9 ± 2 (57.8), NTC <7 (14.7%), and NTC >11 (27.5%); NTS = 4 ± 2 (79.5%), NTS <2 (8.7%), and NTS >6 (11.8%); NH = 5 ± 2 (70.9%), NH <3 (7.8%), and NH >7 (21.3%); NMH = 2 ± 1 (70.8%), NMH = 0 (11%) and NMH >3 (18.3%); and NUSLFH = 1 ± 1 (77.3%) and NUSLFH >2 (22.7%).

2.7.12 <QBO>

The quasi-biennial oscillation (QBO) refers to the quasi-periodic oscillation of the equatorial zonal winds (in ms^{-1}) in the tropical stratosphere, having a mean period of about 28 mo (range 20 to 36 mo) that was first discovered in the 1950s.[84–87] The winds alternate between easterlies (generally the stronger winds) and westerlies (generally the longer lasting winds at higher levels, but shorter lasting winds at lower levels), first developing at the top of the stratosphere and propagating slowly downwards at the rate of about 1 km per month until they dissipate at the tropical tropopause. The phase of the QBO has previously been linked to the frequency of North Atlantic basin tropical cyclones, with increased activity occurring during westerly (positive) zonal wind anomalies and decreased activity during the easterly (negative) zonal wind anomalies.[35]

Figure 40(a) displays the variation of the yearly <QBO> index as measured for the 30 mbar height.[88,89] For the interval 1948–2010, <QBO> averages about –3.65 ms^{-1}, having sd = 7.94 ms^{-1} and range = –17.13 to 10.17 ms^{-1}. For the two intervals, 1948–1994 and 1995–2010, the difference in means is found not to be statistically important (t = –0.07, cl <90%). The 25 positive yearly <QBO> values correspond to years when westerlies dominate and the 38 negative yearly <QBO> values correspond to years when easterlies dominate. The average positive yearly <QBO> measures 4.69 ± 2.86 ms^{-1} (range 0.85 to 10.17 ms^{-1}) and the average negative yearly <QBO> measures –9.14 ± 4.74 ms^{-1} (range –0.55 to –17.13 ms^{-1}). Hence, the easterlies, on average, are about twice as strong as the westerlies based on the 30 mbar data. Regarding the 10-yma <QBO>, it has been continuously negative throughout the entire interval 1953–2005, varying between –2.3 ms^{-1} in 1990 and –4.6 ms^{-1} in 2005. The 10-yma <QBO> in 2005 is essentially the same value as was measured in 1953 (–4.57 ms^{-1}).

For the interval January 1948–December 2011, there were 317 positive QBO monthly values and 451 negative QBO monthly values. The positive QBO monthly values have occurred in 27 runs, averaging about 11 ± 3.7 mo in length (range 2 to 16 mo), while the negative QBO monthly values have occurred in 27 runs, averaging 16 ± 6.1 mo in length (range 3 to 39 mo; this excludes the current run of negative QBO monthly values that started in August 2011 and continues today, at least through March 2012). For the 64 yr (1948–2011), all months more often have been of negative QBO monthly value, except April and May (33 and 32 mo, respectively, of positive QBO monthly value). For 2012, because the current string of negative QBO monthly values measures 8 mo in length (through March 2012) and the average length of a negative QBO monthly run is 16 mo, it may be that negative QBO monthly values will continue for most of the remainder of the year, making the yearly <QBO> negative in value (i.e., the occurrence of dominate easterly wind at 30 mbar height in 2012). Also supporting this view is the observation that back-to-back positive yearly <QBO> has occurred only twice during the interval 1948–2010 (the years 1966–1967 and 1975–1976). Since the year 2011 turned out to be of positive <QBO>, it appears more likely that the yearly <QBO> for 2012 will be of negative value (indicative of ENSO neutral or EN-like conditions).

For the interval 1948–2011, the nominal hurricane season (June–November) has more often been of negative QBO monthly value than of positive QBO monthly value (238 versus 146 mo). For the years 1948–1952, 1954, 1956, 1958, 1960, 1962, 1965, 1967, 1968, 1970, 1972, 1974, 1977, 1979, 1981, 1984, 1986, 1989, 1991, 1994, 1996, 1998, 2000, 2001, 2003, 2005, 2007, and 2009, all months

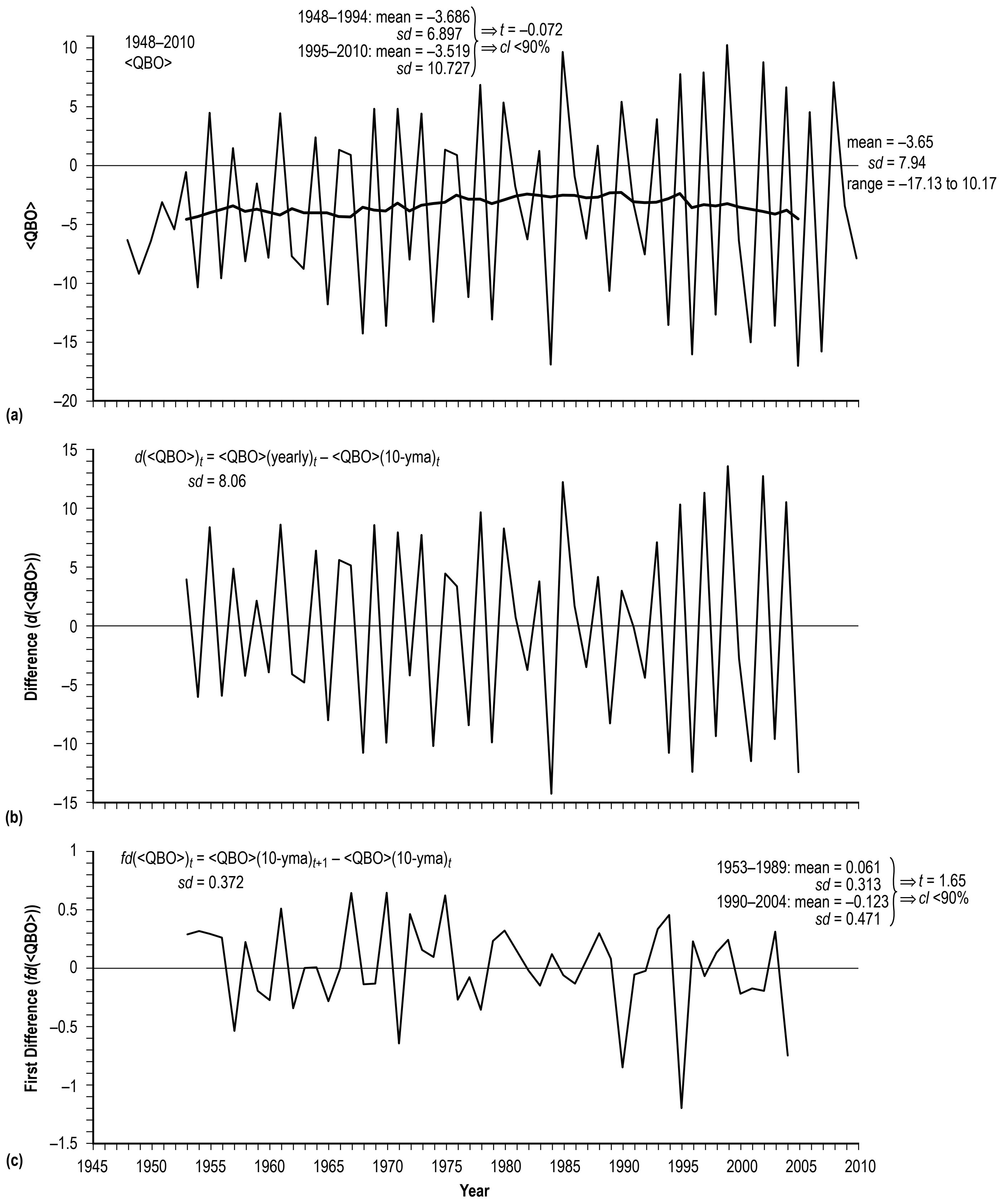

Figure 40. Quasi-Biennial Oscillation index yearly variation: (a) <QBO>, (b) difference (d<QBO>), and (c) first difference (fd<QBO>).

during the nominal hurricane season were of negative QBO monthly value. For the years 1953, 1976, 1983, 1988, 1993, and 2011, 4–5 mo of the nominal hurricane season were of negative QBO monthly value. For the years 1955, 1957, 1961, 1966, 1969, 1971, 1973, 1975, 1978, 1980, 1985, 1990, 1997, 1999, 2002, 2004, 2006, and 2008, all months during the nominal hurricane season were of positive QBO monthly value. For the years 1959, 1995, and 2010, 4–5 mo of the nominal hurricane season were of positive QBO monthly value. Only the years of 1963, 1964, 1982, 1987, and 1992 were years that were evenly divided between negative and positive QBO monthly values during the nominal hurricane season.

Comparison of years since 1950 with ENY, LNY, and NY (as defined in this study) shows the following:

(1) When the nominal hurricane season is of negative QBO monthly value for all months of the hurricane season (true for 30 of the 62 seasons), 7 of the seasons were classified ENY, 6 were classified LNY, and 17 were classified NY.

(2) When the nominal hurricane season is of negative QBO monthly value for 4–5 mo of the hurricane season (true for 6 of the 62 seasons), none was classified ENY, 1 was classified LNY, and 5 were classified NY.

(3) When the nominal hurricane season is of positive QBO monthly value (true for 18 of the 62 seasons), 6 of the seasons were classified ENY, 6 were classified LNY, and 6 were classified NY.

(4) When the nominal hurricane season is of positive QBO monthly value for 4–5 mo of the hurricane season (true for 3 of the 62 seasons), none was classified ENY, 1 was classified LNY, and 2 were classified NY.

(5) When the nominal hurricane season is evenly divided between positive and negative QBO monthly values (true for 5 of the 62 seasons), 3 of the seasons were classified ENY, one was classified LNY, and one was classified NY. Thus, the occurrence of positive/negative QBO monthly values during the nominal hurricane season provides no clear indication as to whether the season will be classified ENY, LNY, or NY.

Figure 40(b) shows the yearly variation of the difference ($d\text{<QBO>}_t$). Runs testing indicates that the distribution of differences for <QBO> appears to be nonrandom (z = 5.03, cl >99.9%, sd = 8.06 ms^{-1}). Presuming instead that the distribution of differences is random, one would have expected the 10-yma of <QBO> = 4.47 ± 8.06 ms^{-1} for 2006, where 4.47 ms^{-1} is the yearly <QBO> for 2006 and 8.06 ms^{-1} is the sd of the differences. For 2011, its yearly <QBO> = 1.96 ms^{-1}, thereby yielding the 10-yma <QBO> = –3.82 ms^{-1} in 2006 (up from –4.6 ms^{-1} in 2005), well within the predicted range. However, for 2007, presuming a random distribution of the differences yields an expected 10-yma <QBO> = –15.91 ± 8.06 ms^{-1}, or about –23.97 to –7.85 ms^{-1}, where –15.91 ms^{-1} is the yearly <QBO> for 2007, which plainly is well outside the range of previously observed 10-yma <QBO> values (i.e., –2.3 to –4.6 ms^{-1}) and implies a yearly <QBO> value for 2012 that is completely unreasonable.

Figure 40(c) depicts the yearly variation of the first difference (*fd*<QBO>$_t$). Both the difference in means for the two intervals 1953–1989 and 1990–2004 and runs testing indicate that the distribution of first differences appears random (t = 1.65, *cl* <90%; z = 0.30, *cl* <90%, *sd* = 0.37 ms^{-1}). Presuming that the first differences are indeed distributed randomly, one should have expected the 10-yma of <QBO> = –4.6 ± 0.37 ms^{-1} for 2006, where –4.6 ms^{-1} is the 10-yma of <QBO> for 2005 and 0.3 ms^{-1} is the *sd* of the first differences, inferring a yearly <QBO> = –13.7 ± 7.4 ms^{-1} in 2011. As it turns out, the yearly <QBO> = 1.96 in 2011, thereby yielding the 10-yma <QBO> = –3.82 ms^{-1} in 2006, a value just outside the ±1 *sd* prediction interval. For 2007, one expects the 10-yma<QBO> = –3.82 ± 0.37 ms^{-1}, inferring the yearly <QBO> = –8.54 ± 7.4 ms^{-1} in 2012.

From table 22, one finds that the difference in the means for <QBO> is not statistically important when comparing the mean of <QBO> during the 16 ENY against the mean of <QBO> during the 15 LNY (t = –0.46, *cl* <90%), or when comparing the mean of <QBO> during the 30 yr when <ONI> was positive in value against the mean of <QBO> during the 31 yr when <ONI> was negative in value (t = 0.44, *cl* <90%). Hence, strong correlation between yearly values of <QBO> and <ONI> seems highly unlikely (substantiating that found above regarding the lack of preferential behavior between the occurrence of positive/negative QBO monthly values during the nominal hurricane season and the classification of the season as either ENY, LNY, or NY).

From table 23(l), for <QBO> '+,' NTC = 11 ± 2 (54.5%), NTC <9 (20.2%), and NTC >13 (25.3%); NTS = 4 ± 2 (73.5%), NTS <2 (4.5%), and NTS >6 (22.1%); NH = 6 ± 2 (68.1%), NH <4 (11.3%), and NH >8 (20.6%); NMH = 3 ± 1 (61.5%), NMH <2 (19.3%), and NMH >4 (19.2%); and NUSLFH = 1 ± 1 (73.1%) and NUSLFH >2 (26.9%). For <QBO> "–," NTC = 10 ± 2 (55.9%), NTC <8 (16.6%), and NTC >12 (27.5%); NTS = 4 ± 2 (77%), NTS <2 (6.1%), and NTS >6 (16.9%); NH = 6 ± 2 (69.3%), NH <4 (13.8%), and NH >8 (17%); NMH = 2 ± 1 (66.9%), NMH = 0 (7.8%), and NMH >3 (25.3%); and NUSLFH = 1 ± 1 (81.6%) and NUSLFH >2 (18.4%).

2.7.13 <AMO>

The AMO is defined as a fluctuation in detrended SST in the North Atlantic Ocean, north of the equator (0–70 °N.).[90–103] The AMO has a cycle length of about 70 yr, fluctuating between warm (positive) and cold (negative) phases. The SST pattern has been suggested to be linked to variations in the strength of the Atlantic thermohaline circulation (THC), a density-driven, global circulation pattern that involves the movement of warm equatorial surface waters to higher latitudes and the subsequent cooling and sinking of these waters into the deep ocean. As such, the warm phase of the AMO represents intervals of faster THC, and the cold phase represents intervals of slower THC.[104]

Figure 41(a) displays the variation of the yearly <AMO> index.[105,106] For the interval 1948–2010, the yearly <AMO> averages about –0.002 °C, having *sd* = 0.191 °C and range = –0.416 to 0.389 °C. For the two intervals 1948–1994 and 1995–2010 the difference in means is found to be statistically important (t = –5.023, *cl* >99.9%). For the interval 1948–2010, the greatest positive spike (0.389 °C) occurred in 1998 and the greatest negative spike (–0.416 °C) occurred in 1974, both years being classified as LNY. In terms of the 10-yma <AMO>, it always is positive in value for the interval 1953–1963, always negative in value for the interval 1964–1995, and again always positive in value from 1996 onwards. In 2005, the 10-yma of <AMO> measured 0.191 °C. For the 10-yma of <AMO> to become negative in 2006, the yearly <AMO> must measure cooler than

–3.999 °C in 2011, much cooler than has ever been seen. As it turns out, the yearly <AMO> measured 0.126 °C in 2011, thereby yielding the 10-yma <AMO> = 0.206 °C in 2006, a value up slightly from 0.191 °C in 2005. For 2012, the yearly <AMO> is expected to be about 0.174 ± 0.124 °C (i.e., the ±1 *sd* prediction interval about the mean for the current, more active interval), suggesting that the 10-yma <AMO> = 0.21 ± 0.06 °C for 2007. For the 10-yma <AMO> to become negative in 2007, the yearly <AMO> in 2012 would have to measure cooler than –4.024 °C, again a value well outside low the observed range since 1948. Consequently, one does not expect the 10-yma <AMO> to become negative anytime soon, certainly not in the near-term, foreseeable future. (The January–March 2012 monthly values of AMO, respectively, are –0.032, 0.037, and 0.058 °C.)

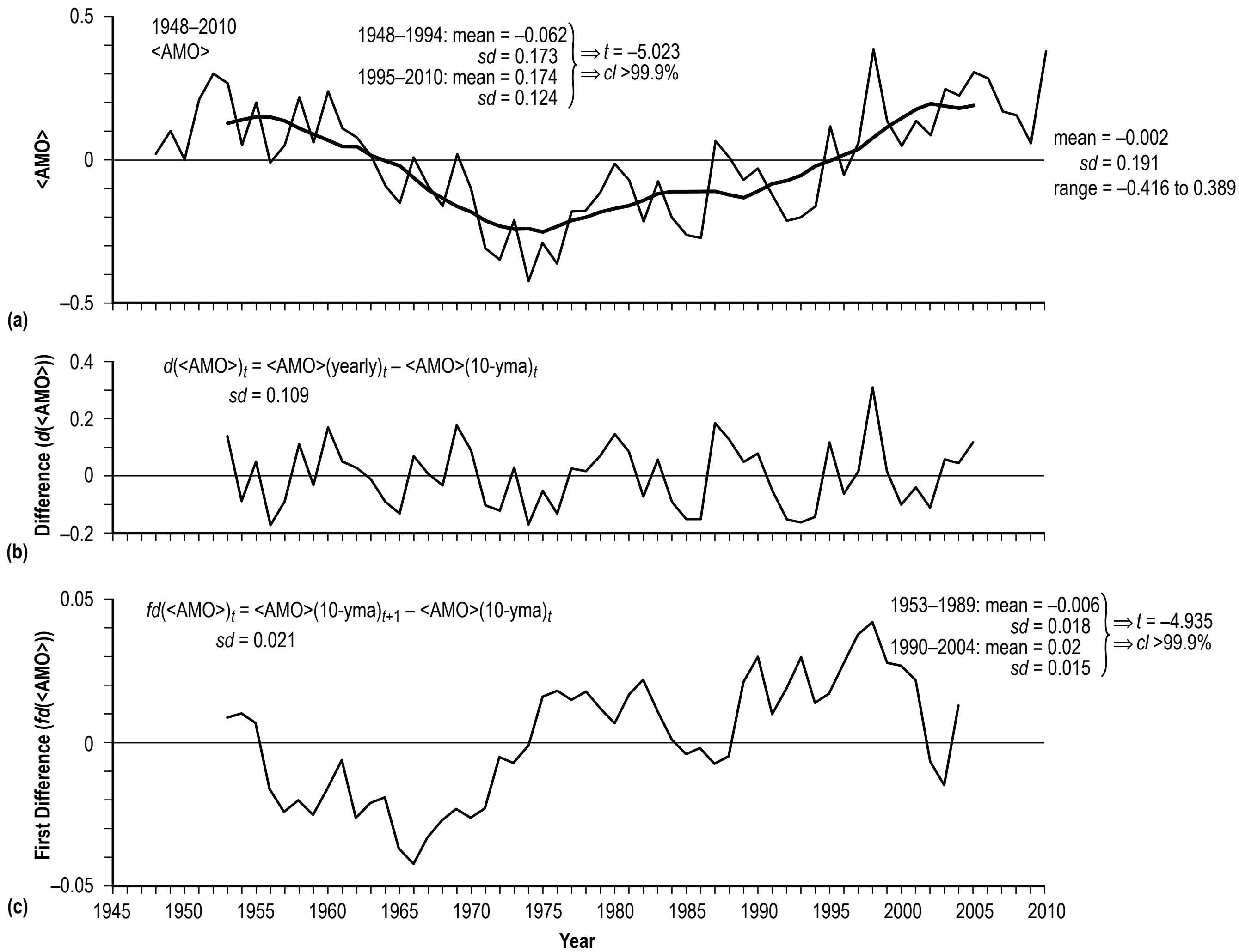

Figure 41. Atlantic Multidecadal Oscillation index yearly variation: (a) <AMO>, (b) difference (*d*<AMO>), and (c) first difference (*fd*<AMO>).

For the interval 1948–2011, there were 381 positive AMO monthly values and 387 negative AMO monthly values (a new positive string began in February 2012). The positive AMO monthly values have occurred in 45 runs, averaging about 8.5 ± 14 mo in length (range 1 to 77 mo), while the negative AMO monthly values have occurred in 46 runs, averaging 8.4 ± 18.7 mo in length (range 1 to 116 mo). For the 64 yr (1948–2011), the months of predominantly positive AMO monthly value include March, April, August, and September (35, 37, 34, and 34 mo, respectively), the months of predominantly negative AMO monthly values include January, February, May, July, October, and November (35, 35, 33, 34, 34, and 36 mo), respectively, and the months evenly split include June and December (32 mo each). For 2012, one cannot say, as yet, whether the year will be turn out to be of positive or negative <AMO> value.

While one cannot strictly determine whether 2012 will be of positive or negative <AMO> value, one should note that 14 of the positive AMO monthly runs have had a length of only 1 mo, 23 have had lengths of 1–2 mo, 30 have had lengths of 1–6 mo, and 37 have had lengths of 1–12 mo; only 8 positive AMO monthly runs have had lengths greater than 12 mo. For negative AMO monthly runs, 13 have had a length of only 1 mo, 20 have had lengths of 1–2 mo, 35 have had lengths of 1–6 mo, and 40 have had lengths of 1–12 mo; only 6 negative AMO monthly runs have had lengths >12 mo. Thus, strings of positive and negative AMO monthly values tend to be short, 1–6 mo, accounting for two-thirds (30/45) of the positive runs and three-fourths (35/46) of the negative runs. The current string of positive AMO monthly values began in February 2012 and the AMO monthly value remained positive in March, meaning that the current string of positive AMO monthly values is, at least, 2 mo in length. (Based on yearly <AMO>, the current string of positive yearly <AMO> measures at least 15 yr, starting in 1997 and running through 2011, which is the longest positive yearly <AMO> run during the interval 1949–2011. The longest negative yearly run was 17 yr, from 1970 through 1986.)

For the interval 1948–2011, the nominal hurricane season (June–November) has more often been of negative AMO monthly value than of positive AMO monthly value (196 versus 188 mo). For the interval 1948–1963, positive AMO monthly values dominate the nominal hurricane season (166 versus 26 mo), with only the years 1950, 1956, and 1963 having 3 or more negative AMO monthly values during the nominal hurricane season—the years 1950 and 1956 were years of negative yearly <AMO>, equal to –0.004 and –0.014 °C, respectively, while the year 1963 measured 0.01 °C, even though the entire nominal hurricane season was of negative AMO monthly value. For the interval 1964–1994, all yearly <AMO> values were of negative value, except for the years 1966 (0.01 °C), 1969 (0.015 °C), 1987 (0.071 °C), and 1988 (0.005 °C), and negative AMO monthly values dominated during the nominal hurricane season (345 versus 27 mo). For the current interval 1995–2011, positive AMO monthly values now once again dominate the nominal hurricane season (194 versus 10 mo), and all years have been of positive yearly <AMO> value, except 1996 (–0.047 °C).

Comparison of years since 1950 with ENY, LNY, and NY (as defined in this study) shows the following:

(1) When the nominal hurricane season is of negative AMO monthly value for all months of the hurricane season (true for 23 of the 62 seasons), 6 of the seasons were classified ENY, 7 were classified LNY, and 10 were classified NY.

(2) When the nominal hurricane season is of negative AMO monthly value for 4–5 mo of the hurricane season (true for 5 of the 62 seasons), 2 were classified ENY, 1 was classified LNY, and 2 were classified NY.

(3) When the nominal hurricane season is of positive AMO monthly value for all months of the hurricane season (true for 19 of the 62 seasons), 5 of the seasons were classified ENY, 4 were classified LNY, and 10 were classified NY.

(4) When the nominal hurricane season is of positive AMO monthly value for 4–5 mo of the hurricane season (true for 10 of the 62 seasons), 2 were classified ENY, 1 was classified LNY, and 7 were classified NY.

(5) When the nominal hurricane season is evenly divided between positive and negative AMO monthly values (true for 5 of the 62 seasons), none was classified ENY, 3 were classified LNY, and 2 were classified NY. Thus, the occurrence of positive/negative AMO monthly values during the nominal hurricane season provides no clear indication as to whether the season will be classified ENY, LNY, or NY.

Figure 41(b) shows the yearly variation of the difference (*d*<AMO>$_t$). Runs testing indicates that the distribution of differences for <AMO> appears to be random (z = –0.40, cl <90%, sd = 0.109 °C). Given that the distribution of differences appears random, one should have expected the 10-yma of <AMO> = 0.287 ± 0.109 °C for 2006, where 0.287 °C is the yearly <AMO> for 2006 and 0.109 °C is the sd of the differences. From above, the yearly <AMO> = 0.126 °C in 2011 and the 10-yma <AMO> = 0.206 °C in 2006. For 2007, the 10-yma <AMO> = 0.169 ± 0.109 °C, based on the observed differences, 0.169 °C being the yearly <AMO> for 2007. Hence, one expects the yearly <AMO> = –0.644 ± 2.18 °C for 2012.

Figure 41(c) depicts the yearly variation of the first difference (*fd*<AMO>$_t$). Both the difference in means for the two intervals 1953–1989 and 1990–2004 and runs testing indicate that the distribution of first differences appears nonrandom (t = –4.94, cl >99.9%; z = –5.22, cl >99.9%, sd = 0.021 °C). Presuming that the first differences are indeed distributed nonrandomly, one should have expected the 10-yma of <AMO> = 0.191 + 0.02 ± 0.015 °C, or about 0.211 ± 0.015 °C for 2006, where 0.191 °C is the 10-yma of <AMO> for 2005 and 0.02 and 0.015 °C are the mean and sd of the first differences for the current, more active interval, inferring a yearly <AMO> = 0.221 ± 0.3 °C in 2011. As it turns out, the yearly <AMO> = 0.126 °C in 2011, thereby yielding the 10-yma <AMO> = 0.206 °C in 2006. For 2007, one expects the 10-yma <AMO> = 0.206 + 0.02 ± 0.015 °C, or about 0.226 ± 0.015 °C, inferring the yearly <AMO> = 0.496 ± 0.3 °C in 2012 (i.e., the yearly <AMO> likely will be of positive value for 2012.)

From table 22, one finds that the difference in the means for <AMO> is not statistically important when comparing the mean of <AMO> during the 16 ENY against the mean of <AMO> during the 15 LNY (t = 0.33, cl <90%), or when comparing the mean of <AMO> during the 30 yr when <ONI> was positive in value against the mean of <AMO> during the 31 yr when <ONI> was negative in value (t = 0.64, cl <90%). Hence, strong correlation between yearly values of <AMO> and <ONI> seems highly unlikely.

From table 23(m), for <AMO> '+,' NTC = 12 ± 2 (52.6%), NTC <10 (21.2%), and NTC >14 (26.1%); NTS = 5 ± 2 (73.3%), NTS <3 (10.4%), and NTS >7 (16.3%); NH = 7 ± 2 (65.6%), NH <5 (16.5%), and NH >9 (17.9%); NMH = 3 ± 1 (59.1%), NMH <2 (13.8%), and NMH >4 (27.1%); and NUSLFH = 1 ± 1 (73.3%) and NUSLFH >2 (26.7%). For <AMO> '–,' NTC = 9 ± 2 (59.1%), NTC

<7 (17.5%), and NTC >11 (23.4%); NTS = 3 ± 2 (77.1%), NTS = 0 (1.9%), and NTS >5 (21%); NH = 5 ± 2 (72.7%), NH <3 (9.5%), and NH >7 (17.8%); NMH = 1 ± 1 (69.6%) and NMH >2 (30.5%); and NUSLFH = 1 ± 1 (83.4%) and NUSLFH >2 (16.7%).

2.7.14 <AMM>

The AMM is part of a broader class of meridional modes that is characterized by an anomalous meridional SST gradient across the mean latitude of the intertropical convergence zone.[107–113] The AMM spatial pattern is defined by applying maximum covariance analysis (MCA) to SST and the zonal and meridional components of the 10-m wind field over the interval 1950–2005, from the NCEP/National Center for Atmospheric Research reanalysis.[114] To determine the spatial pattern, the data are first defined over the region bounded by 21 °S.–32 °N. latitude and 74 °W.–15 °E. longitude and spatially smoothed, the seasonal cycle is removed, the data are detrended, a 3-mo running mean is applied, and the linear fit to the Cold Tongue index (a measure of ENSO variability) is subtracted from each spatial point. The spatial patterns are then defined as the first SST and winds maps resulting from singular value decomposition of the covariance matrix between the two fields, with the AMM time series being calculated by means of projecting SST (or the 10-m wind field) onto the spatial structure resulting from the MCA.

Figure 42(a) displays the variation of the yearly <AMM> index.[115] For the interval 1948–2010, the yearly <AMM> index averages about 0.13, having *sd* = 1.94 and range = –4.13 to 4.98. For the two intervals, 1948–1994 and 1995–2010, the difference in means is found to be statistically important (t = –2.875, *cl* >99%). For the interval 1948–2010, the greatest positive spike (4.98) occurred in 2010 and the greatest negative spike (–4.13) occurred in 1974, both years being classified as LNY. In terms of the 10-yma <AMM>, it always is positive in value for the interval 1953–1967, always negative in value for the interval 1968–1997, and again always positive in value from 1998 onwards. In 2005, the 10-yma of <AMM> measured 1.27. For the 10-yma of <AMM> to become negative in 2006, the yearly <AMM> must measure less than –29.64 in 2011, much more negative in value than has ever been seen. As it turns out, the yearly <AMM> measured 2.48 in 2011, thereby yielding the 10-yma <AMM> = 1.61 in 2006, a value up slightly from 1.27 in 2005. For 2012, the yearly <AMM> is expected to be about 1.27 ± 1.54 (i.e., the ±1 *sd* prediction interval about the mean for the current, more active interval), suggesting that the 10-yma <AMM> = 1.75 ± 0.08 for 2007. For the 10-yma <AMM> to become negative in 2007, the yearly <AMM> in 2012 would have to measure less than –33.72, again a value well outside low the observed range since 1948. Consequently, one does not expect the 10-yma <AMM> to become negative anytime soon, certainly not in the near-term, foreseeable future. (The January–March 2012 monthly values of AMM, respectively, are 3.13, 1.33, and –2.18.)

For the interval 1948–2011, there were 423 positive AMM monthly values and 345 negative AMM monthly values (a new negative string began in March 2012). The positive AMM monthly values have occurred in 57 runs, averaging about 7.4 ± 7.6 mo in length (range 1 to 32 mo), while the negative AMM monthly values have occurred in 56 runs, averaging 6.2 ± 8.4 mo in length (range 1 to 55 mo). For the 64 yr (1948–2011), the months of predominantly positive AMM monthly value include all months except February, which is evenly split between negative and positive AMM monthly values. For 2012, one cannot say, as yet, whether the year will be of positive or negative value.

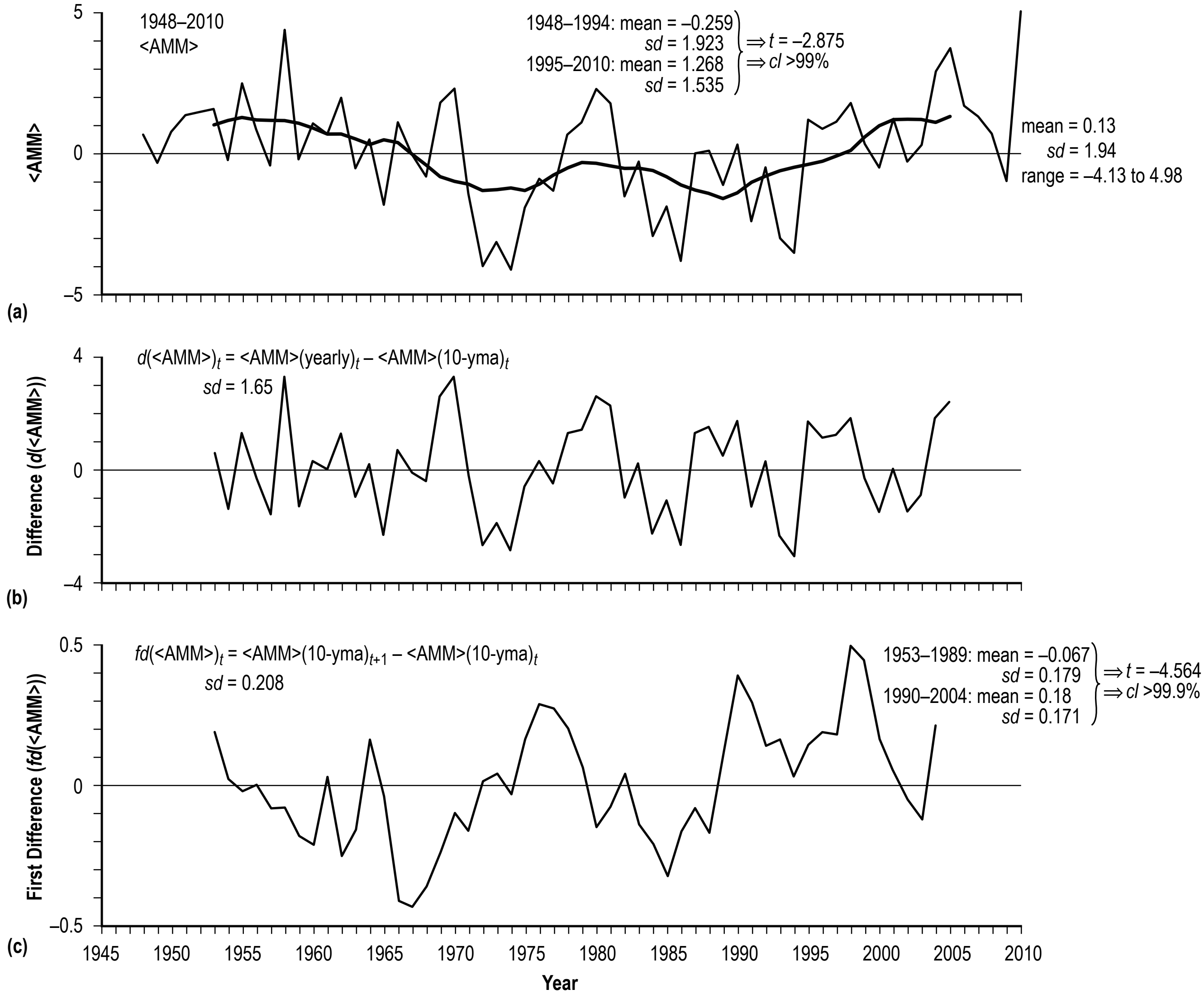

Figure 42. Atlantic Meridional Oscillation index yearly variation: (a) <AMM>, (b) difference (d<AMM>), and (c) first difference (fd<AMM>).

For the interval 1948–2011, the nominal hurricane season (June–November) has more often been of positive AMM monthly value than of negative AMM monthly value (219 versus 165 mo). For the interval 1948–1970, positive AMM monthly values dominate the nominal hurricane season (229 versus 47 mo), with only the years 1951, 1954, 1956, 1959, 1963, 1965, and 1968 having 3 or more negative AMM monthly values during the nominal hurricane season (only the years 1951 and 1956 were years of positive <AMM>, equal to 1.35 and 0.92, respectively). For the interval 1971–1986, all yearly <AMM> values were negative, except for the years 1978–1981 (0.72, 1.09, 2.34, and 1.84, respectively), and negative AMM monthly values dominated during the nominal hurricane season (70 versus 26 mo; positive AMM monthly values dominated in the years 1976, 1980 and 1981, with the years 1978, 1979, and 1983 being even split between positive and negative AMM monthly values). Since 1987, all years have been of positive <AMM> yearly value, except 1989, 1991–1994, 2000, 2002, and 2009, with positive AMM monthly values once again dominating the nominal hurricane season (95 versus 49 mo).

Comparison of years since 1950 with ENY, LNY, and NY (as defined in this study) shows the following:

(1) When the nominal hurricane season is of negative AMM monthly value for all months of the hurricane season (true for 13 of the 62 seasons), 6 of the seasons were classified ENY, 3 were classified LNY, and 4 were classified NY.

(2) When the nominal hurricane season is of negative AMM monthly value for 4–5 mo of the hurricane season (true for 9 of the 62 seasons), 3 were classified ENY, 4 were classified LNY, and 2 were classified NY.

(3) When the nominal hurricane season is of positive AMM monthly value for all months of the hurricane season (true for 16 of the 62 seasons), one of the seasons was classified ENY, 5 were classified LNY, and 10 were classified NY.

(4) When the nominal hurricane season is of positive AMM monthly value for 4–5 mo of the hurricane season (true for 18 of the 62 seasons), 5 were classified ENY, 3 were classified LNY, and 10 were classified NY.

(5) When the nominal hurricane season is evenly divided between positive and negative AMM monthly values (true for 6 of the 62 seasons), one was classified ENY, none was classified LNY, and 5 were classified NY. Thus, the occurrence of positive/negative AMM monthly values during the nominal hurricane season provides no clear indication as to whether the season will be classified ENY, LNY, or NY.

Figure 42(b) shows the yearly variation of the difference (d<AMM>$_t$). Runs testing indicates that the distribution of differences for <AMM> appears to be random (z = 0.21, cl <90%, sd = 1.65). Given that the distribution of differences appears random, one should have expected the 10-yma of <AMM> = 1.73 ± 1.65 for 2006, where 1.73 is the yearly <AMM> for 2006 and 1.65 is the sd of the differences. From above, the yearly <AMM> = 2.48 in 2011 and the 10-yma <AMM> = 1.61 in 2006. For 2007, the 10-yma <AMM> = 1.25 ± 1.65, based on the observed differences, 1.25 being the yearly <AMM> for 2007. Hence, one expects the yearly <AMM> = –8.72 ± 33 for 2012.

Figure 42(c) depicts the yearly variation of the first difference (fd<AMM>$_t$). Both the difference in means for the two intervals 1953–1989 and 1990–2004 and runs testing indicate that the distribution of first differences appear nonrandom (t = –4.56, cl >99.9%; z = –2.47, cl >98%, sd = 0.208). Presuming that the first differences are indeed distributed nonrandomly, one should have expected the 10-yma of <AMM> = 1.27 + 0.18 ± 0.17, or about 1.45 ± 0.17 for 2006, where 1.27 is the 10-yma of <AMM> for 2005 and 0.18 and 0.17 are the mean and sd of the first differences for the current, more active interval, inferring a yearly <AMM> = –0.64 ± 3.4 in 2011. As it turns out, the yearly <AMM> = 2.48 in 2011, thereby yielding the 10-yma <AMM> = 1.61 in 2006. For 2007, one expects the 10-yma <AMM> = 1.61 + 0.18 ± 0.17, or about 1.79 ± 0.17, inferring the yearly <AMM> = 2.08 ± 3.4 in 2012.

From table 22, one finds that the difference in the means for <AMM> is not statistically important when comparing the mean of <AMM> during the 16 ENY against the mean of <AMM> during the 15 LNY (t = –0.93, cl <90%), or when comparing the mean of <AMM> during the 30 yr when <ONI> was positive in value against the mean of <AMM> during the 31 yr when <ONI> was negative in value (t = –0.18, cl <90%). Hence, strong correlation between yearly values of <AMM> and <ONI> seems highly unlikely.

From table 23(n), for <AMM> '+,' NTC = 12 ± 2 (52.6%), NTC <10 (20.9%), and NTC >14 (26.5%); NTS = 5 ± 2 (74.1%), NTS <3 (12%), and NTS >7 (14%); NH = 7 ± 2 (65%), NH <5 (14.4%), and NH >9 (20.6%); NMH = 3 ± 1 (56.7%), NMH <2 (11.3%), and NMH >4 (32.1%); and NUSLFH = 1 ± 1 (73.9%) and NUSLFH >2 (26.1%). For <AMM> '–,' NTC = 9 ± 2 (59.5%), NTC <7 (19.7%), and NTC >11 (20.8%); NTS = 4 ± 2 (79.3%), NTS <2 (8.2%), and NTS >6 (12.6%); NH = 4 ± 2 (72.6%), NH <2 (4.2%), and NH >6 (23.2%); NMH = 1 ± 1 (80.9%) and NMH >2 (19.1%); and NUSLFH = 1 ± 1 (83.6%) and NUSLFH >2 (16.4%).

2.8 Correlation Analyses

In the next 14 subsections, scatter plots are shown of the 10-yma values of NTC, NTS, NH, NMH, and NUSLFH versus the 10-yma values of the surface air temperature and ENSO-related parameters discussed in the previous subsections. In each subpanel, two regressions are drawn: y_1 and y_2, where y_1 is the inferred regression using the 10-yma values for the interval 1950–2010 and y_2 is the inferred regression using only the 10-yma values for the current, more active interval 1990–2005. In each subpanel the arrow indicates the 10-yma value for the year 2005, and the asterisk indicates that the correlation is inferred to be highly statistically significant (cl >99.9%). Table 24 (see appendix) summarizes the results of the linear regression analyses for each time interval, giving the inferred regression equation (of the form $y = a + bx$, where y is the dependent variable, a is the y-intercept, b is the slope, and x is the independent variable), the linear regression coefficient r, the coefficient of determination r^2 (a measure of the amount of variance explained by the regression), the standard error of estimate se, the confidence level cl, and the parametric mean and sd of y presuming no correlation against x.

Recall that there exists a minimum 10-yma value for each parameter for the year 2007 (see fig. 1). This minimum 10-yma value is easily calculated by assuming that the yearly parametric value for 2012 is zero. One computes the minimum 10-yma value for the year 2007 as {2[x(2003) + x(2004) + … + x(2011)] + x(2002)}/20, where x(2003), x(2004), etc. are the yearly parametric values for the years 2003, 2004, etc. As an example, the minimum 10-yma value for NTC for the year 2007 is {2[16 + 15 + …+ 19] + 12}/20 = {2(147) + 12}/20 = 306/20 = 15.3. The minimum 10-yma values for the year 2007 for NTS, NH, NMH, and NUSLFH are 7.9, 7.4, 3.7, and 1.95, respectively. Because a negative value for each of the yearly parametric values for the year 2012 (or any year) is not allowed, the 10-yma parametric value is the smallest allowable 10-yma parametric value for the year in question (in this case, the year 2007).

For each subsection, the expected 10-yma value for the independent variable (i.e., <AT>, <SOI>, <ONI>, etc.) is given and used in the inferred regressions to estimate the 10-yma value for the dependent variables. This value is then compared to various estimates using the minimum 10-yma parametric value, the long-term mean, and the mean for the current, more active interval. It is important to remember that, based on the Poisson distribution for the current, more active interval, there is only about 1 chance in 8 of having NTC >19, about 1 chance in 22 of having NTS >11, about 1 chance in 4 of having NH >11, about 1 chance in 10 of having NMH >6, and about 1 chance in 8 of having NUSLFH >3.

2.8.1 NTC, NTS, NH, NMH, and NUSLFH Versus <AT>

Figure 43 shows the scatter plots of the 10-yma values of NTC, NTS, NH, NMH, and NUSLFH against the 10-yma values of <AT>. For all comparisons the inferred linear regressions are found to be positive (i.e., the y parametric value increases as the x parametric value increases) and highly statistically significant. Also, for all comparisons the inferred regressions based upon the current, more active interval are the stronger of the two, having inferred linear correlation coefficients $r = 0.87$–0.97, as compared to $r = 0.5$–0.9. Therefore, it appears reasonable to assume that, having a reliable estimate for the 10-yma value of <AT>, one should be able to reliably estimate the 10-yma value of the parameter in question.

Recall from section 2.7.1 that, based on the expected first difference $fd(<AT>)_t$, the 10-yma <AT> = 10.04 ± 0.05 °C for 2007 (i.e., the ±1 *sd* prediction interval). Applying the value 10.04 °C in the y_2 regressions results in estimates for the 10-yma values of NTC, NTS, NH, NMH, and NUSLFH for 2007, these being, respectively, about 14.4 ± 0.6, 6.7 ± 0.5, 7.8 ± 0.1, 3.7 ± 0.2, and 2 ± 0.2 (i.e., the ±1 *se* prediction intervals). Comparison of these estimates with the minimum values for the 10-yma parameters for the year 2007 indicates that, while the estimates for NH, NMH, and NUSLFH might be tenable, the estimates for NTC and NTS are not; they simply are too low (i.e., they result in the year 2012 having negative frequencies for NTC and NTS). In order to have meaningful estimates for the 10-yma values of NTC and NTS, presuming the validity of the inferred linear regressions, a higher 10-yma <AT> must occur in 2007, one of value >10.04 °C, inferring a yearly <AT> higher than 10.3 °C for 2012 (recall that the 10-yma <AT> = 10.04 ± 0.05 °C in 2007 implies that the yearly <AT> for 2012 should be between 9.3 and 11.3 °C). Accepting the above 10-yma values for NH, NMH, and NUSLFH, based on using the 10-yma <AT> = 10.04 °C, implies yearly values of 6–10, 0–4, and 0–5, respectively, in 2012. A higher 10-yma <AT> in 2007 results in higher expected frequencies for NH, NMH, and NUSLFH in 2012.

For NTC, its long-term mean is about 11 ± 4, and its mean for the current, more active interval is about 15 ± 5 (i.e., the ±1 *sd* prediction intervals). Presuming NTC = 11 ± 4 in 2012 yields the 10-yma NTC = 15.85 ± 0.2 for 2007, while presuming NTC = 15 ± 5 in 2012 yields the 10-yma NTC = 16.05 ± 0.25 for 2007. Such values suggest higher 10-yma for <AT> equal to 10.19 ± 0.03 °C and 10.22 ± 0.02 °C, respectively, for 2007, these values being higher than the 10.04 ± 0.05 °C suggested for 2007 from the expected $fd(AT>)_t$. Accepting these temperatures, however, implies a yearly <AT> in 2012 that has never been seen before (i.e., <AT> >12.7 °C in 2012; the highest observed yearly <AT> is 10.59 °C in 2007).

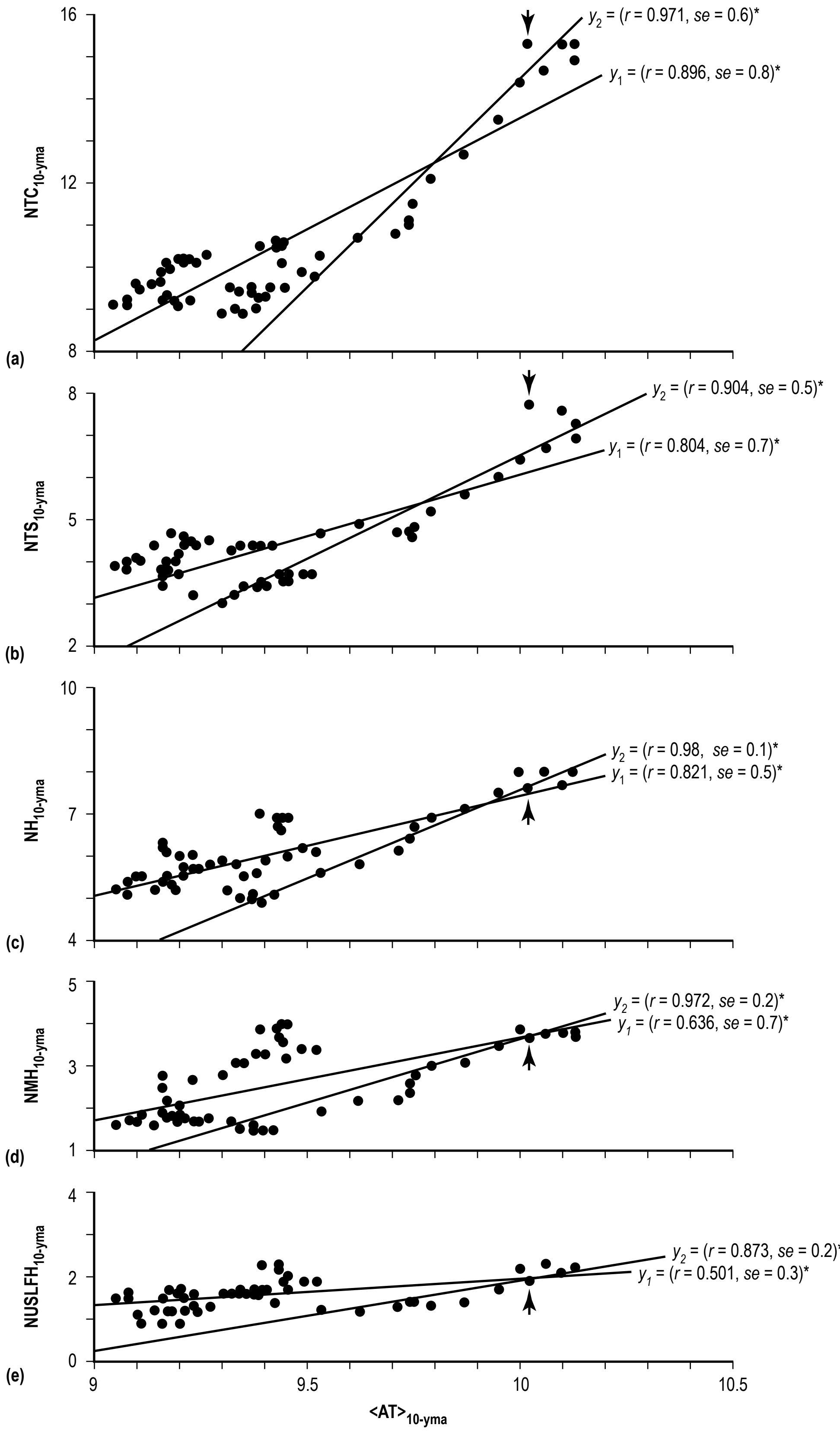

Figure 43. 10-yma values of (a) NTC, (b) NTS, (c) NH, (d) NMH, and (e) NUSLFH versus 10-yma values of <AT>.

Similarly, for NTS, its long-term mean is about 5 ± 2, and its mean for the current, more active interval is about 7 ± 2. Presuming NTS = 5 ± 2 in 2012 yields the 10-yma NTS = 8.15 ± 0.1 for 2007, while presuming NTS = 7 ± 2 in 2012 yields the 10-yma NTS = 8.25 ± 0.1 for 2007. Such values suggest even higher 10-yma for <AT> equal to 10.34 ± 0.02 °C and 10.36 ± 0.02 °C, respectively, for 2007. As with NTC, accepting these higher temperatures implies a yearly <AT> in 2012 that is completely unreasonable (i.e., <AT> >15.9 °C). Hence, the 10-yma <AT> for 2007 appears destined to be a statistical outlier, with respect to NTC and NTS. (For 2006, the 10-yma <AT> was 10 °C, inferring the 10-yma values for NTC, NTS, NH, NMH, and NUSLFH to be 14.08 ± 0.6, 6.5 ± 0.5, 7.59 ± 0.1, 3.52 ± 0.2, and 1.91 ± 0.2, respectively. The observed 10-yma values for 2006 turned out to be 15.7, 8, 7.7, 3.8, and 2. Hence, the differences between the observed and inferred values are 2.7, 3, 1.1, 1.4, and 0.05 *se*.)

2.8.2 NTC, NTS, NH, NMH, and NUSLFH Versus <SOI>

Figure 44 shows the scatter plots of the 10-yma values of NTC, NTS, NH, NMH, and NUSLFH against the 10-yma values of <SOI>. For all comparisons the inferred linear regressions based on the current, more active interval are found to be positive and highly statistically significant, having r = 0.83–0.97. Therefore, having a reliable estimate for the 10-yma value of <SOI> should allow one to reliably estimate the 10-yma value of the parameter in question.

Recall from section 2.7.3 that, based on the expected first difference $fd(<\mathrm{SOI}>)_t$, the 10-yma <SOI> = 1.18 ± 0.52 for 2007 (i.e., the ±1 *sd* prediction interval). Applying the value 1.18 in the y_2 regressions results in estimates for the 10-yma values of NTC, NTS, NH, NMH, and NUSLFH for 2007, these being, respectively, about 16.69 ± 0.5, 8.03 ± 0.3, 8.66 ± 0.4, 4.48 ± 0.3, and 2.36 ± 0.2 (i.e., the ±1 *se* prediction intervals). Comparison of these estimates with the minimum values for the 10-yma parameters for the year 2007 indicates that all estimates exceed the minimum values, suggesting that they might be tenable. (Recall that the 10-yma <SOI> = 1.18 ± 0.52 for 2007 implies that the yearly <SOI> for 2012 should be between –2.3 and –23.1, values indicative of ENSO neutral to EN-like conditions in 2012.)

For NTC, a 10-yma value 16.69 ± 0.5 in 2007 suggests a yearly value of about 18–38 in 2012. For NTS, a 10-yma value 8.03 ± 0.3 in 2007 suggests a yearly value of about 0–9 in 2012. For NH, a 10-yma value 8.66 ± 0.4 in 2007 suggests a yearly value of about 17–33 in 2012. For NMH, a 10-yma value 4.48 ± 0.3 in 2007 suggests a yearly value of about 10–22 in 2012. For NUSLFH, a 10-yma value 2.36 ± 0.2 in 2007 suggests a yearly value of about 4–12 in 2012. In comparison to the Poisson distributions for the current, more active interval, all ±1 *se* prediction intervals for the 2012 season seem too high, suggesting, perhaps, that the 10-yma <SOI> for 2007 is likely too high (i.e., the 10-yma <SOI> probably should be <1.18 in 2007 and the yearly <SOI> for 2012 probably should be more negative than –12.7, which suggests that 2012 likely will be an ENY). (For 2006, the 10-yma <SOI> was 0.87, inferring the 10-yma values for NTC, NTS, NH, NMH, and NUSLFH to be 16.33 ± 0.5, 7.82 ± 0.3, 8.5 ± 0.4, 4.34 ± 0.3, and 2.3 ± 0.2, respectively. Hence, the differences between the observed and inferred values are –1.26, 0.6, –2, –1.8, and –1.5 *se*, respectively.)

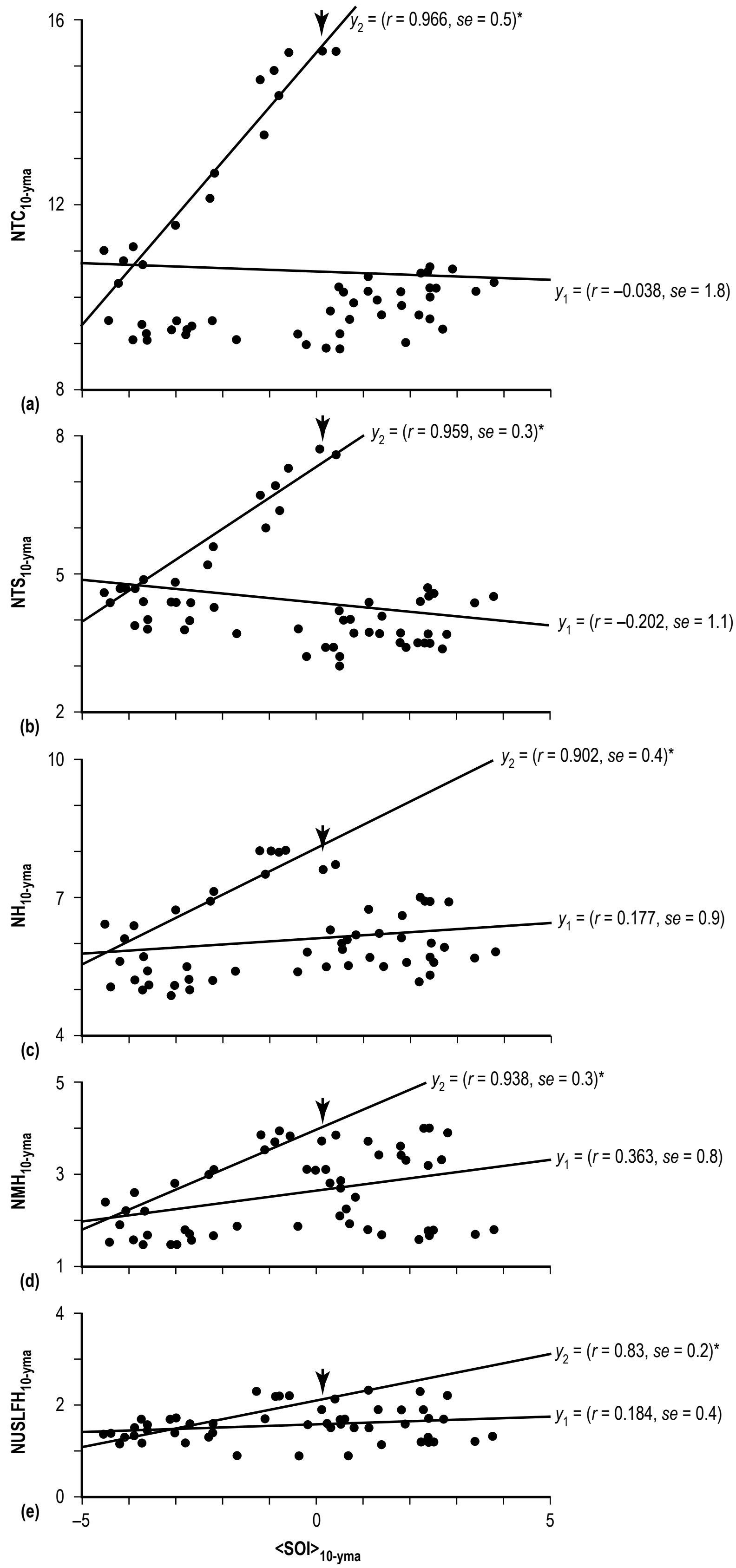

Figure 44. 10-yma values of (a) NTC, (b) NTS, (c) NH, (d) NMH, and (e) NUSLFH versus 10-yma values of <SOI>.

2.8.3 NTC, NTS, NH, NMH, and NUSLFH Versus <ONI>

Figure 45 shows the scatter plots of the 10-yma values of NTC, NTS, NH, NMH, and NUSLFH against the 10-yma values of <ONI>. For all comparisons the inferred linear regressions based on the current, more active interval are found to be negative (i.e., the parameters vary inversely) and highly statistically significant (except for NUSLFH), having r = –0.72 to –0.89. Therefore, having a reliable estimate for the 10-yma value of <ONI> should allow one to reliably estimate the 10-yma value of the parameter in question.

Recall from section 2.7.2 that, based on the expected first difference *fd*(<ONI>)$_t$, the 10-yma <ONI> = 0.12 ± 0.05 °C for 2007 (i.e., the ±1 *sd* prediction interval). Applying the 10-yma value <ONI> = 0.12 in the y_2 regressions results in estimates for the 10-yma values of NTC, NTS, NH, NMH, and NUSLFH for 2007, these being, respectively, about 13.37 ± 1, 6.15 ± 0.6, 7.23 ± 0.5, 3.25 ± 0.4, and 1.77 ± 0.3 (i.e., the ±1 *se* prediction intervals). Comparison of these estimates with the minimum values for the 10-yma parameters for the year 2007 indicates that the estimates for NTC, NTS, NH, and NMH are too low. For NUSLFH, the ±1 *se* prediction interval barely exceeds the minimum values, with NUSLFH = 1.95–2.03, suggesting that it possibly is tenable. (Recall that the 10-yma <ONI> = 0.12 ± 0.05 °C for 2007 implies that the yearly <ONI> for 2012 should be more positive in value than –0.1 °C, an expected value indicative of ENSO neutral to possibly EN-like conditions in 2012.)

For NTC, NTS, NH, and NMH, a 10-yma value of <ONI> = 0.12 °C in 2007 simply is too high to be meaningful. A lower (more negative) value closer to zero should be expected, indicating, perhaps, that ENSO neutral conditions likely will persist in 2012. For NUSLFH, a 10-yma value of 1.95–2.03 implies NUSLFH equal to about 0–2 in 2012. A more negative value of the 10-yma value of NUSLFH increases the expected yearly NUSLFH in 2012. A 10-yma <ONI> = 0 °C in 2007 implies 10-yma values of NTC, NTS, NH, NMH, and NUSLFH of 15.45 ± 1, 7.31 ± 0.6, 8.14 ± 0.5, 4.03 ± 0.4, and 2.11 ± 0.3 in 2007. (For 2006, the 10-yma <ONI> was 0.14 °C, inferring the 10-yma values for NTC, NTS, NH, NMH, and NUSLFH to be 13.03 ± 1, 5.95 ± 0.6, 7.08 ± 0.5, 3.12 ± 0.4, and 1.72 ± 0.3, respectively. Hence, the differences between the observed and inferred values are 2.67, 1.15, –0.88, –0.58, and –0.37 *se*, respectively.)

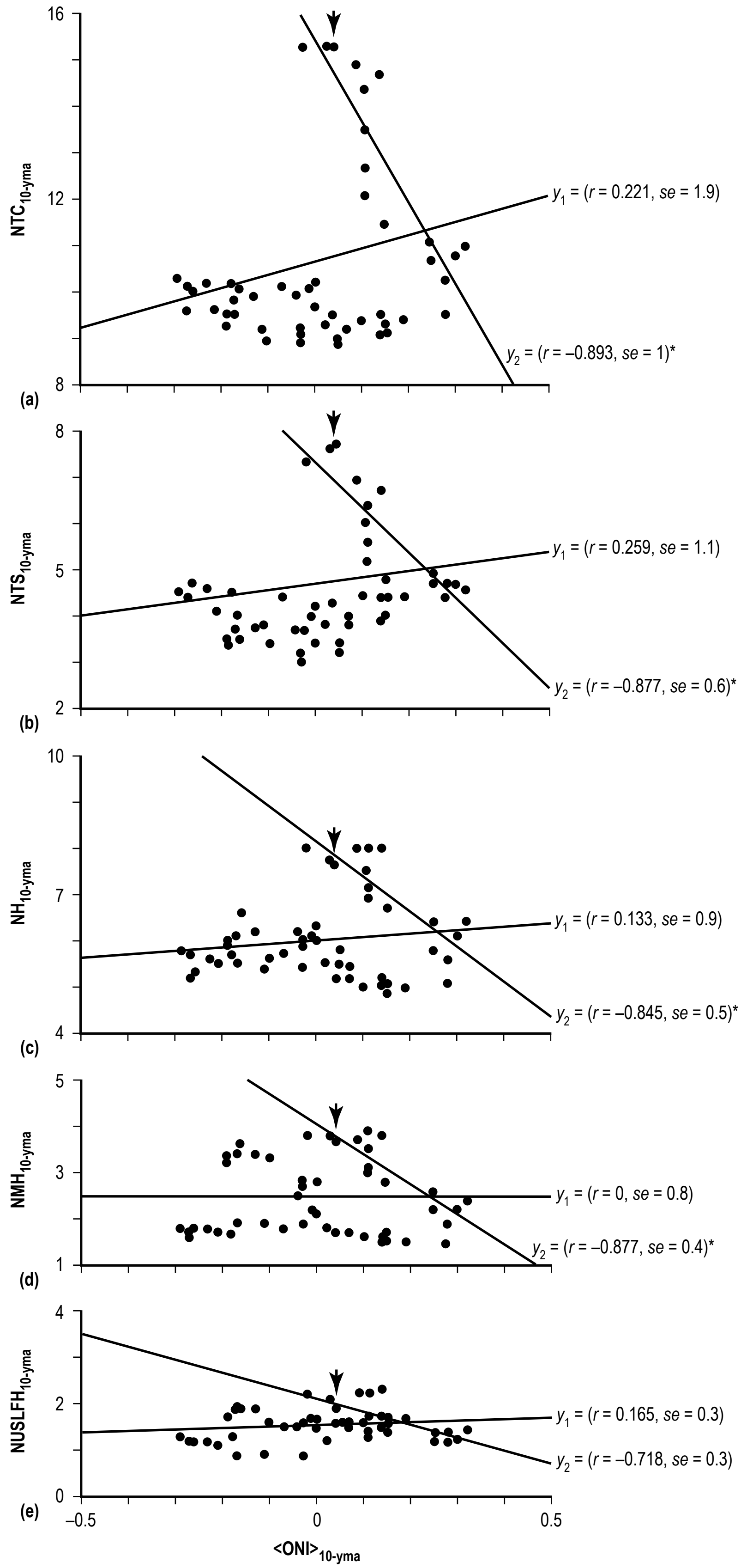

Figure 45. 10-yma values of (a) NTC, (b) NTS, (c) NH, (d) NMH, and (e) NUSLFH versus 10-yma values of <ONI>.

2.8.4 NTC, NTS, NH, NMH, and NUSLFH Versus <NAO>

Figure 46 shows the scatter plots of the 10-yma values of NTC, NTS, NH, NMH, and NUSLFH against the 10-yma values of <NAO>. For all comparisons the inferred linear regressions based on the current, more active interval are found to be negative (i.e., the parameters vary inversely) and highly statistically significant, having r = –0.81 to –0.97. Therefore, having a reliable estimate for the 10-yma value of <NAO> should allow one to reliably estimate the 10-yma value of the parameter in question.

Recall from section 2.7.4 that, based on the expected first difference $fd(\langle NAO \rangle)_t$, the 10-yma <NAO> = –0.19 ± 0.03 for 2007 (i.e., the ±1 *sd* prediction interval). Applying the 10-yma value <NAO> = –0.19 in the y_2 regressions results in estimates for the 10-yma values of NTC, NTS, NH, NMH, and NUSLFH for 2007, these being, respectively, about 16.75 ± 0.6, 7.93 ± 0.5, 8.82 ± 0.3, 4.57 ± 0.2, and 2.35 ± 0.3 (i.e., the ±1 *se* prediction intervals). Comparison of these estimates with the minimum values for the 10-yma parameters for the year 2007 indicates that all estimates exceed the minimum values, suggesting that they might be tenable. (Recall that the 10-yma <NAO> = –0.19 ± 0.03 for 2007 implies that the yearly <NAO> for 2012 should be between –0.34 and –1.54.)

For NTC, a 10-yma value 16.75 ± 0.6 in 2007 suggests a yearly value of about 17–41 in 2012. For NTS, a 10-yma value 7.93 ± 0.5 in 2007 suggests a yearly value of about 0–11 in 2012. For NH, a 10-yma value 8.82 ± 0.3 in 2007 suggests a yearly value of about 22–34 in 2012. For NMH, a 10-yma value 4.57 ± 0.2 in 2007 suggests a yearly value of about 13–21 in 2012. For NUSLFH, a 10-yma value 2.35 ± 0.3 in 2007 suggests a yearly value of about 2–14 in 2012. (For 2006, the 10-yma <NAO> was –0.16, inferring the 10-yma values for NTC, NTS, NH, NMH, and NUSLFH to be 16.33 ± 0.6, 7.7 ± 0.5, 8.62 ± 0.3, 4.41 ± 0.2, and 2.28 ± 0.3, respectively. Hence, the differences between the observed and inferred values are –1.05, 0.6, –3.07, –3.05, and –0.93 *se*, respectively.)

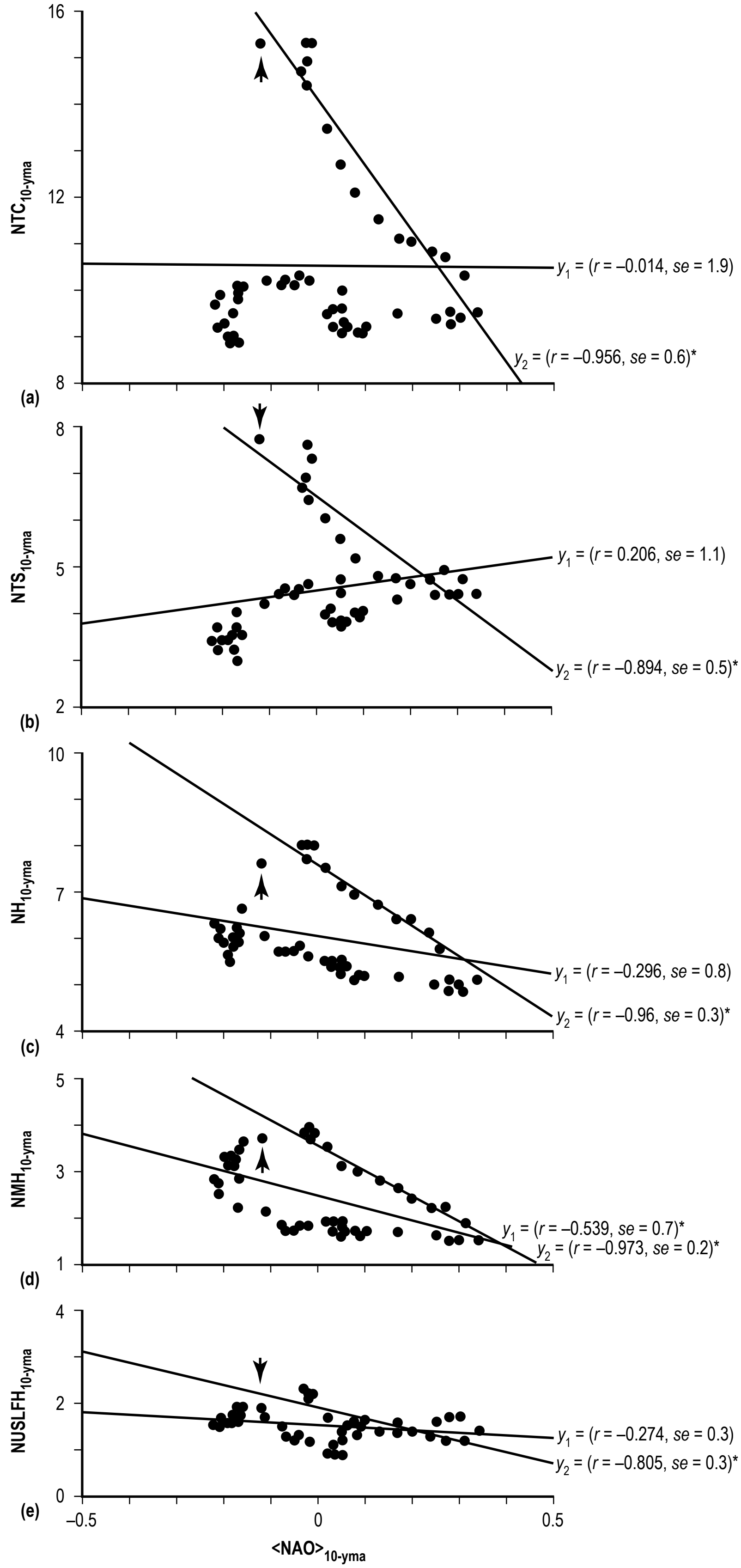

Figure 46. 10-yma values of (a) NTC, (b) NTS, (c) NH, (d) NMH, and (e) NUSLFH versus 10-yma values of <NAO>.

2.8.5 NTC, NTS, NH, NMH, and NUSLFH Versus <PDO>

Figure 47 shows the scatter plots of the 10-yma values of NTC, NTS, NH, NMH, and NUSLFH against the 10-yma values of <PDO>. For all comparisons the inferred linear regressions based on the current, more active interval are found to be negative and highly statistically significant, having r = –0.77 to –0.94. Therefore, having a reliable estimate for the 10-yma value of <PDO> should allow one to reliably estimate the 10-yma value of the parameter in question.

Recall from section 2.7.5 that, based on the expected first difference $fd(\langle PDO\rangle)_t$, the 10-yma <PDO> = –0.2 ± 0.05 °C for 2007 (i.e., the ±1 *sd* prediction interval). Applying the 10-yma value <PDO> = –0.2 °C in the y_2 regressions results in estimates for the 10-yma values of NTC, NTS, NH, NMH, and NUSLFH for 2007, these being, respectively, about 16.66 ± 0.8, 8.04 ± 0.4, 8.62 ± 0.5, 4.43 ± 0.4, and 2.32 ± 0.3 (i.e., the ±1 *se* prediction intervals). Comparison of these estimates with the minimum values for the 10-yma parameters for the year 2007 indicates that all estimates exceed the minimum values, suggesting that they might be tenable. (Recall that the 10-yma <PDO> = –0.2 ± 0.05 °C for 2007 implies that the yearly <PDO> for 2012 should be between –1.76 and 0.24 °C.)

For NTC, a 10-yma value 16.66 ± 0.8 in 2007 suggests a yearly value of about 11–43 in 2012. For NTS, a 10-yma value 8.04 ± 0.4 in 2007 suggests a yearly value of about 0–11 in 2012. For NH, a 10-yma value 8.62 ± 0.5 in 2007 suggests a yearly value of about 14–34 in 2012. For NMH, a 10-yma value 4.43 ± 0.4 in 2007 suggests a yearly value of about 7–23 in 2012. For NUSLFH, a 10-yma value 2.32 ± 0.3 in 2007 suggests a yearly value of about 1–13 in 2012. (For 2006, the 10-yma <PDO> was –0.12, inferring the 10-yma values for NTC, NTS, NH, NMH, and NUSLFH to be 15.94 ± 0.8, 7.62 ± 0.4, 8.31 ± 0.5, 4.16 ± 0.4, and 2.2 ± 0.3, respectively. Hence, the differences between the observed and inferred values are –0.3, 0.95, –1.22, –0.9, and –0.67 *se*, respectively.)

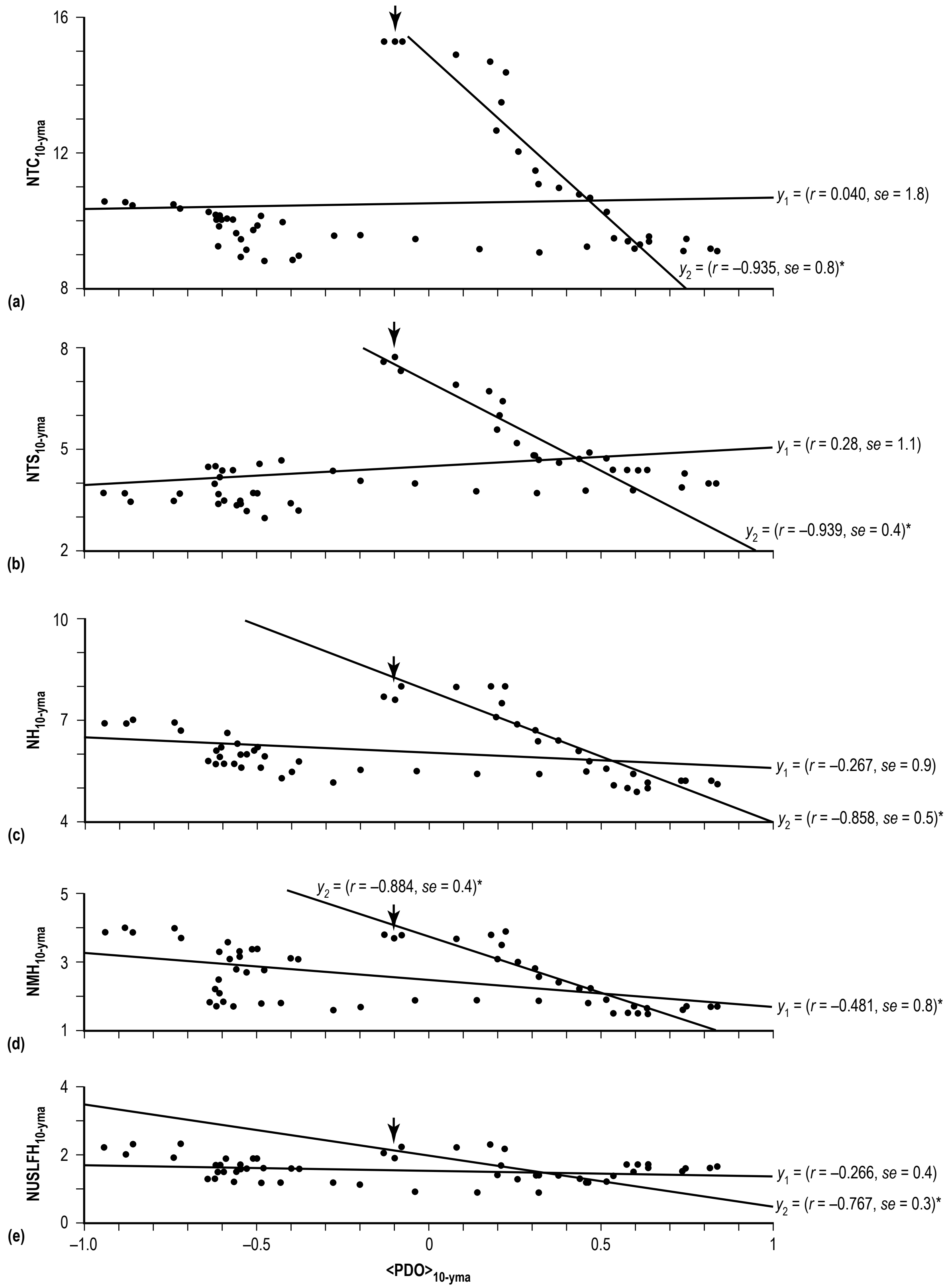

Figure 47. 10-yma values of (a) NTC, (b) NTS, (c) NH, (d) NMH, and (e) NUSLFH versus 10-yma values of <PDO>.

2.8.6 NTC, NTS, NH, NMH, and NUSLFH Versus <TNI>

Figure 48 shows the scatter plots of the 10-yma values of NTC, NTS, NH, NMH, and NUSLFH against the 10-yma values of <TNI>. None of the inferred regressions based on the current, more active interval are found to be statistically important. Hence, as a predictor for tropical cyclone activity in the North Atlantic basin, this particular parameter does not appear to be useful.

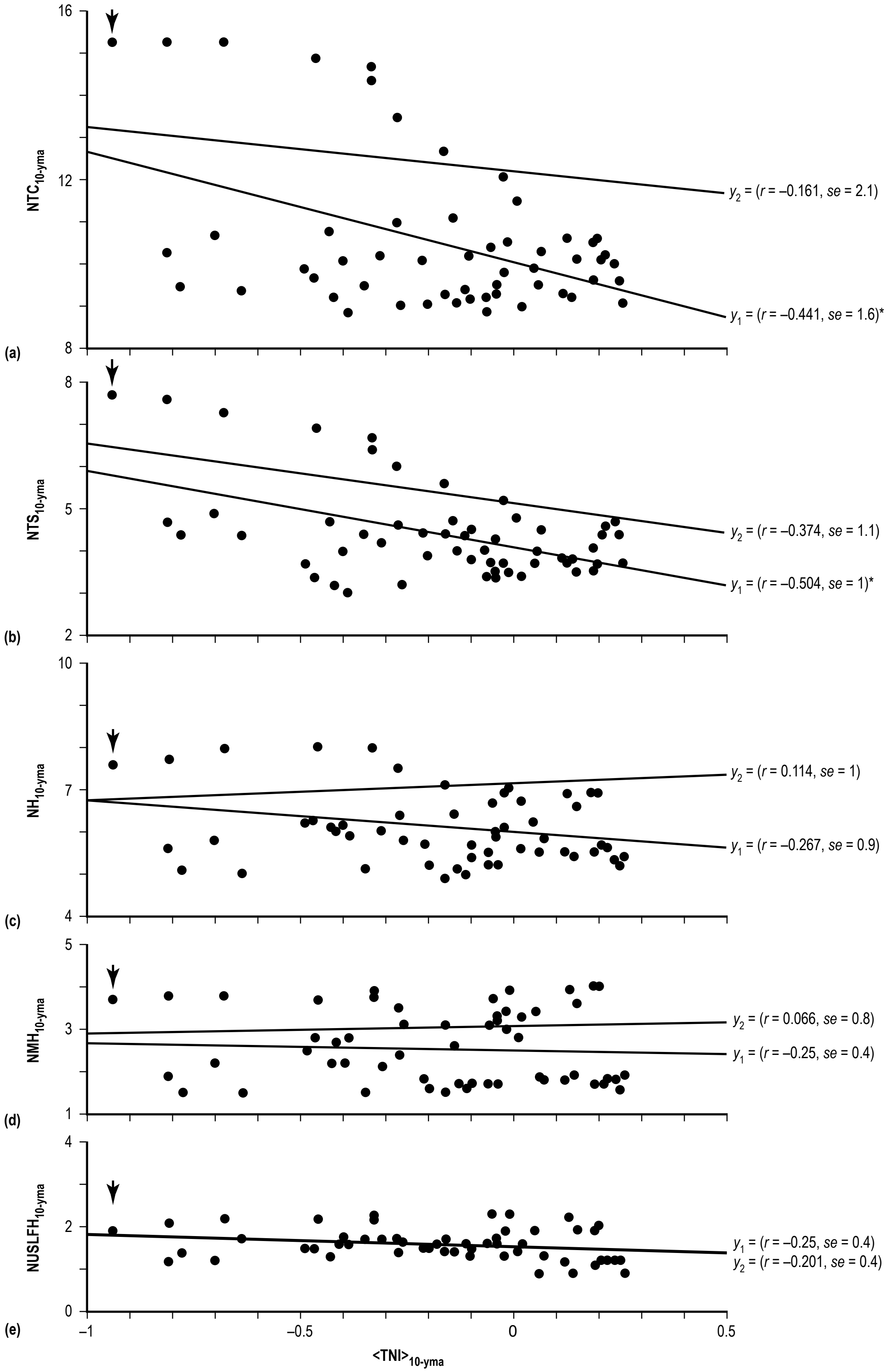

Figure 48. 10-yma values of (a) NTC, (b) NTS, (c) NH, (d) NMH, and (e) NUSLFH versus 10-yma values of <TNI>.

2.8.7 NTC, NTS, NH, NMH, and NUSLFH Versus <MEI>

Figure 49 shows the scatter plots of the 10-yma values of NTC, NTS, NH, NMH, and NUSLFH against the 10-yma values of <MEI>. For all comparisons the inferred linear regressions based on the current, more active interval are found to be negative and highly statistically significant, having r = –0.81 to –0.96. Therefore, having a reliable estimate for the 10-yma value of <MEI> should allow one to reliably estimate the 10-yma value of the parameter in question.

Recall from section 2.7.7 that, based on the expected first difference $fd(\langle MEI \rangle)_t$, the 10-yma <MEI> = 0.047 ± 0.079 for 2007 (i.e., the ±1 *sd* prediction interval). Applying the 10-yma value <MEI> = 0.047 in the y_2 regressions results in estimates for the 10-yma values of NTC, NTS, NH, NMH, and NUSLFH for 2007, these being, respectively, about 15.49 ± 0.7, 7.38 ± 0.3, 8.1 ± 0.5, 4 ± 0.4, and 2.14 ± 0.3 (i.e., the ±1 se prediction intervals). Comparison of these estimates with the minimum values for the 10-yma parameters for the year 2007 indicates that all estimates, except for NTS, exceed the minimum values, suggesting that they might be tenable. (Recall that the 10-yma <MEI> = 0.047 ± 0.079 for 2007 implies that the yearly <MEI> for 2012 should be between –0.226 and 2.934.)

For NTC, a 10-yma value 15.49 ± 0.7 in 2007 suggests a yearly value of about 0–18 in 2012. For NTS, a 10-yma value 7.38 ± 0.3 in 2007 simply is too low to provide a meaningful estimate of the yearly NTS for 2012. For NH, a 10-yma value 8.1 ± 0.5 in 2007 suggests a yearly value of about 4–24 in 2012. For NMH, a 10-yma value 4 ± 0.4 in 2007 suggests a yearly value of about 6–14 in 2012. For NUSLFH, a 10-yma value 2.14 ± 0.3 in 2007 suggests a yearly value of about 0–10 in 2012. (For 2006, the 10-yma <MEI> was 0.047, inferring the 10-yma values for NTC, NTS, NH, NMH, and NUSLFH to be 15.49 ± 0.7, 7.38 ± 0.3, 8.1 ± 0.5, 4 ± 0.4, and 2.14 ± 0.3, respectively. Hence, the differences between the observed and inferred values are 0.3, 2.07, –0.8, –0.5, and –0.47 *se*, respectively.)

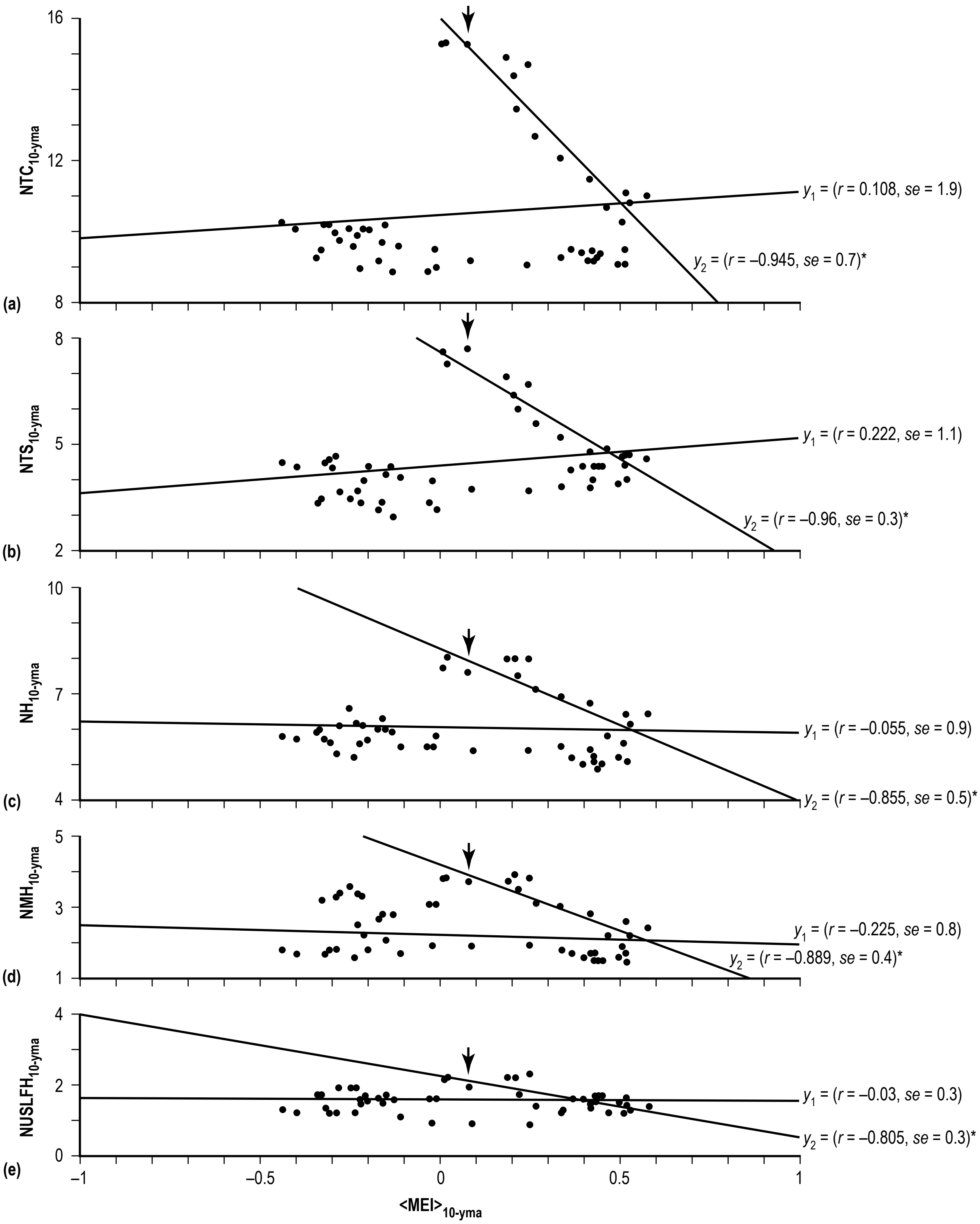

Figure 49. 10-yma values of (a) NTC, (b) NTS, (c) NH, (d) NMH, and (e) NUSLFH versus 10-yma values of <MEI>.

2.8.8 NTC, NTS, NH, NMH, and NUSLFH Versus <GSSTEI>

Figure 50 shows the scatter plots of the 10-yma values of NTC, NTS, NH, NMH, and NUSLFH against the 10-yma values of <GSSTEI>. For all comparisons the inferred linear regressions based on the current, more active interval are found to be negative and highly statistically significant, having r = –0.84 to –0.95. Therefore, having a reliable estimate for the 10-yma value of <MEI> should allow one to reliably estimate the 10-yma value of the parameter in question.

Unfortunately, monthly values of GSSTEI have not been updated beyond February 2011, so the yearly value of <GSSTEI> for 2011 and the 10-yma value of <GSSTEI> for 2006 cannot be computed. Likewise, the 10-yma value of <GSSTEI> cannot be estimated for 2007 (which is the one necessary for predicting NTC, NTS, NH, NMH, and NUSLFH on the basis of <GSSTEI>).

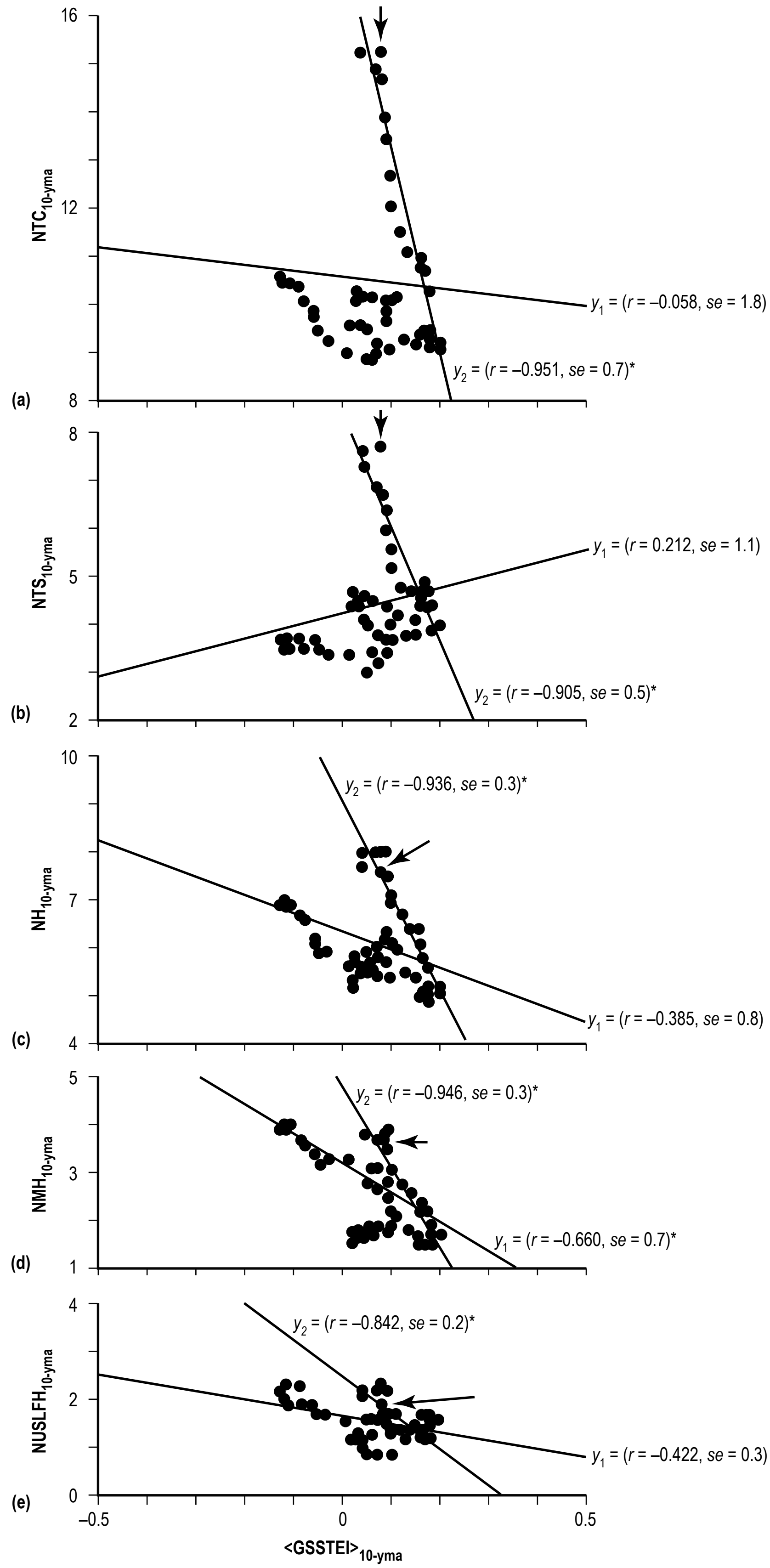

Figure 50. 10-yma values of (a) NTC, (b) NTS, (c) NH, (d) NMH, and (e) NUSLFH versus 10-yma values of <GSSTEI>.

2.8.9 NTC, NTS, NH, NMH, and NUSLFH Versus <JMASSTM>

Figure 51 shows the scatter plots of the 10-yma values of NTC, NTS, NH, NMH, and NUSLFH against the 10-yma values of <JMASSTM>. For all comparisons the inferred linear regressions based on the current, more active interval are found to be negative, but only the one between NTC and <JMASSTM> (having $r = -0.54$) appears to be statistically important. Therefore, having a reliable estimate for the 10-yma value of <MEI> should allow one to reliably estimate the 10-yma value of the parameter in question.

Recall from section 2.7.9 that, based on the expected first difference $fd(\langle \text{JMASSTM} \rangle)_t$, the 10-yma <JMASSTM> = 25.8 ± 0.06 °C for 2007 (i.e., the ±1 *sd* prediction interval). Applying the 10-yma value <JMASSTM> = 25.8 °C in the y_2 regressions results in the estimate for the 10-yma value of NTC = 12.82 ± 1.8 (i.e., the ±1 *se* prediction interval), a value that falls below its minimum value for the 10-yma for the year 2007. Hence, the estimate is untenable. (Recall that the 10-yma <JMASSTM> = 25.8 ± 0.06 °C for 2007 implies that the yearly <JMASSTM> for 2012 should be between 25.3 and 27.7 °C. For 2006, the 10-yma <JMASSTM> also was 25.8 °C, inferring the 10-yma values for NTC to be 12.82 ± 1.8. Hence, the difference between the observed and inferred values is 1.6 *se*.)

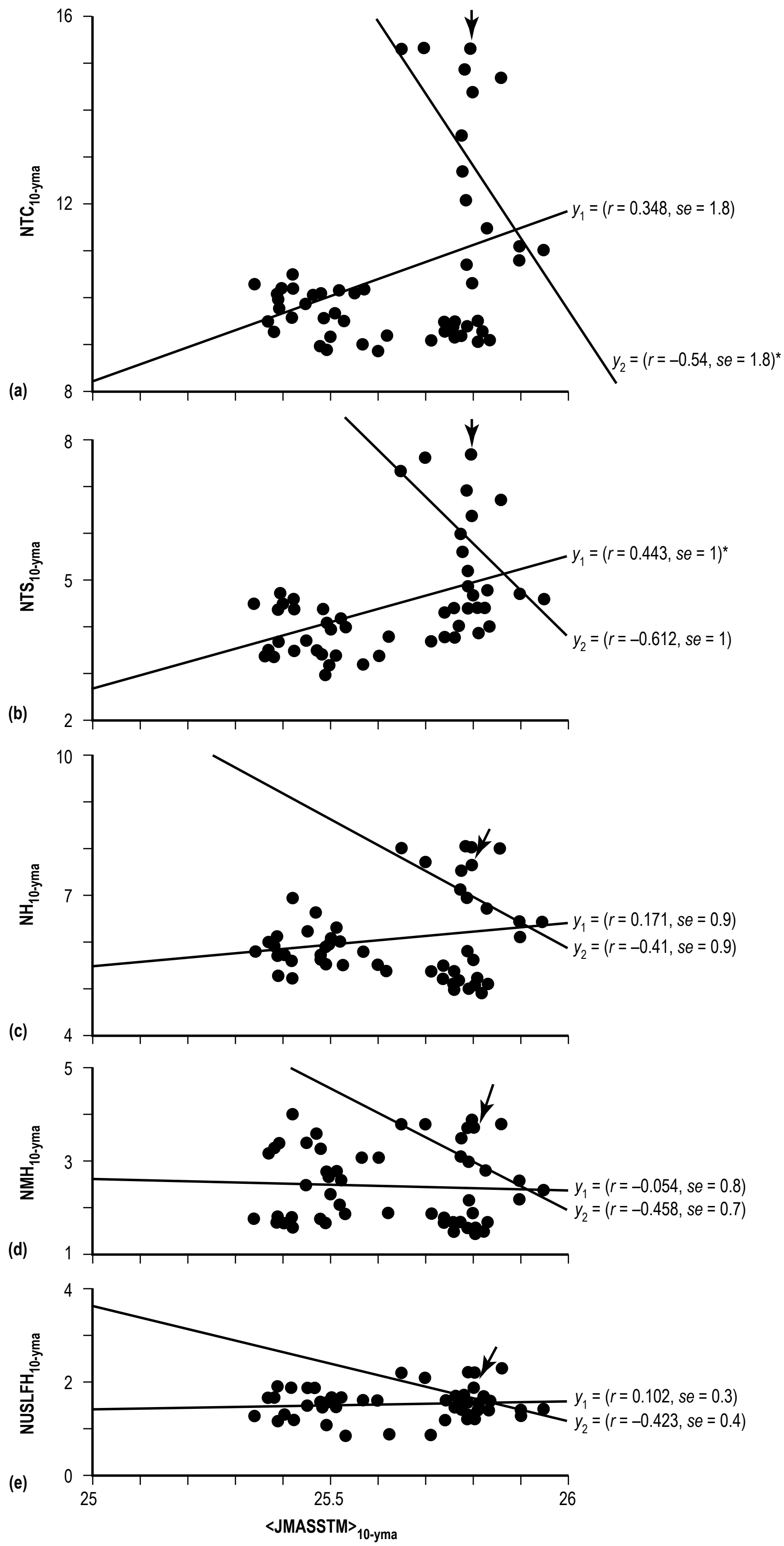

Figure 51. 10-yma values of (a) NTC, (b) NTS, (c) NH, (d) NMH, and (e) NUSLFH versus 10-yma values of <JMASSTM>.

2.8.10 NTC, NTS, NH, NMH, and NUSLFH Versus <NTA>

Figure 52 shows the scatter plots of the 10-yma values of NTC, NTS, NH, NMH, and NUSLFH against the 10-yma values of <NTA>. For all comparisons the inferred linear regressions based on the current, more active interval are found to be positive and highly statistically significant, having $r = 0.90$–0.99. Therefore, having a reliable estimate for the 10-yma value of <NTA> should allow one to reliably estimate the 10-yma value of the parameter in question.

Unfortunately, monthly values of NTA have not been updated beyond December 2010, so the yearly value of <NTA> for 2011 and the 10-yma value of <NTA> for 2006 cannot be computed, nor can an estimate be made for the 10-yma of <NTA> for 2007 (which is the one necessary for predicting NTC, NTS, NH, NMH, and NUSLFH on the basis of <NTA>).

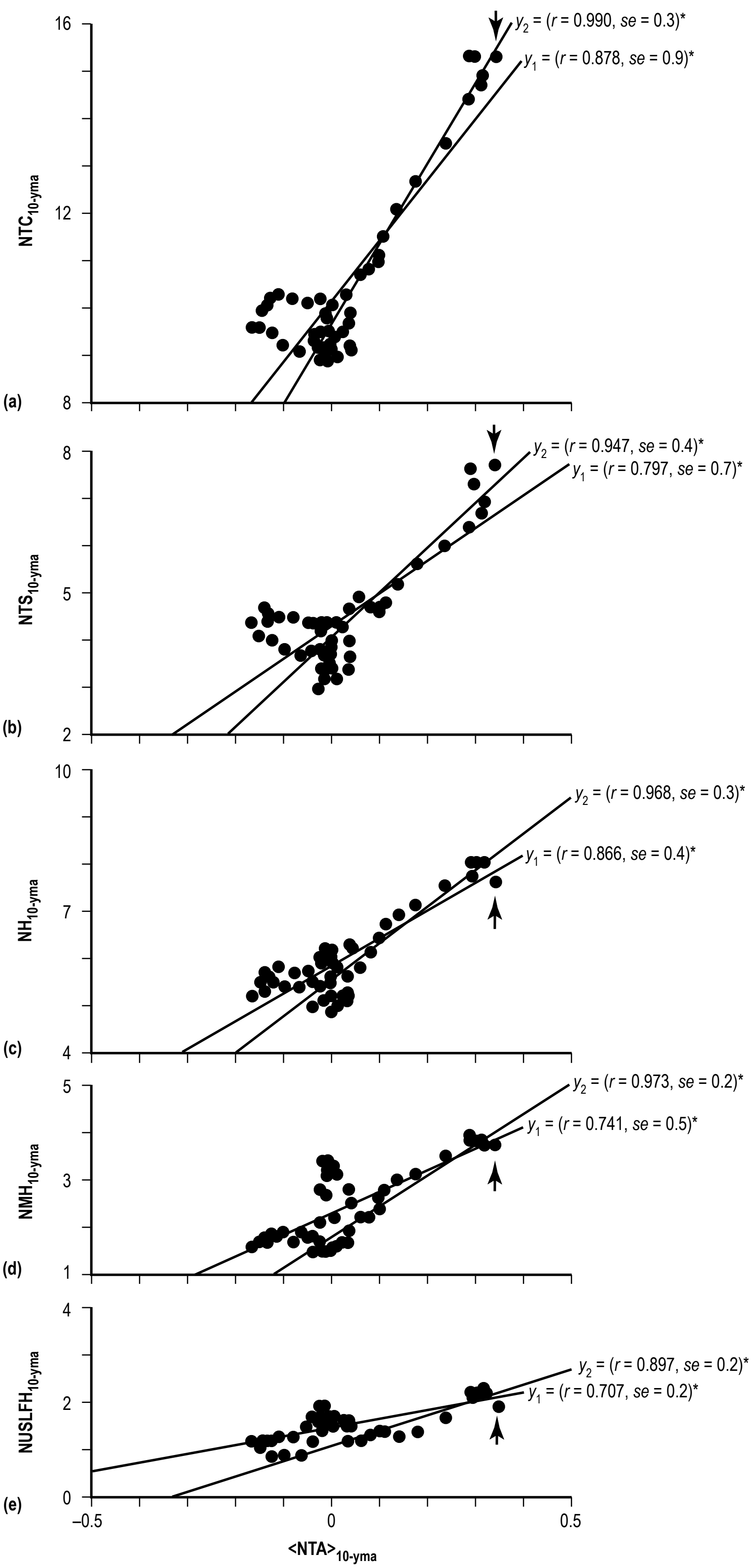

Figure 52. 10-yma values of (a) NTC, (b) NTS, (c) NH, (d) NMH, and (e) NUSLFH versus 10-yma values of <NTA>.

2.8.11 NTC, NTS, NH, NMH, and NUSLFH Versus <CAR>

Figure 53 shows the scatter plots of the 10-yma values of NTC, NTS, NH, NMH, and NUSLFH against the 10-yma values of <CAR>. For all comparisons the inferred linear regressions based on the current, more active interval are found to be positive and highly statistically significant, having $r = 0.90–0.98$. Therefore, having a reliable estimate for the 10-yma value of <NTA> should allow one to reliably estimate the 10-yma value of the parameter in question.

Unfortunately, as above for NTA, monthly values of CAR have not been updated beyond December 2010, so the yearly value of <CAR> for 2011 and the 10-yma value of <CAR> for 2006 cannot be computed, nor can an estimate be made for the 10-yma of <CAR> for 2007 (which is the one necessary for predicting NTC, NTS, NH, NMH, and NUSLFH on the basis of <CAR>).

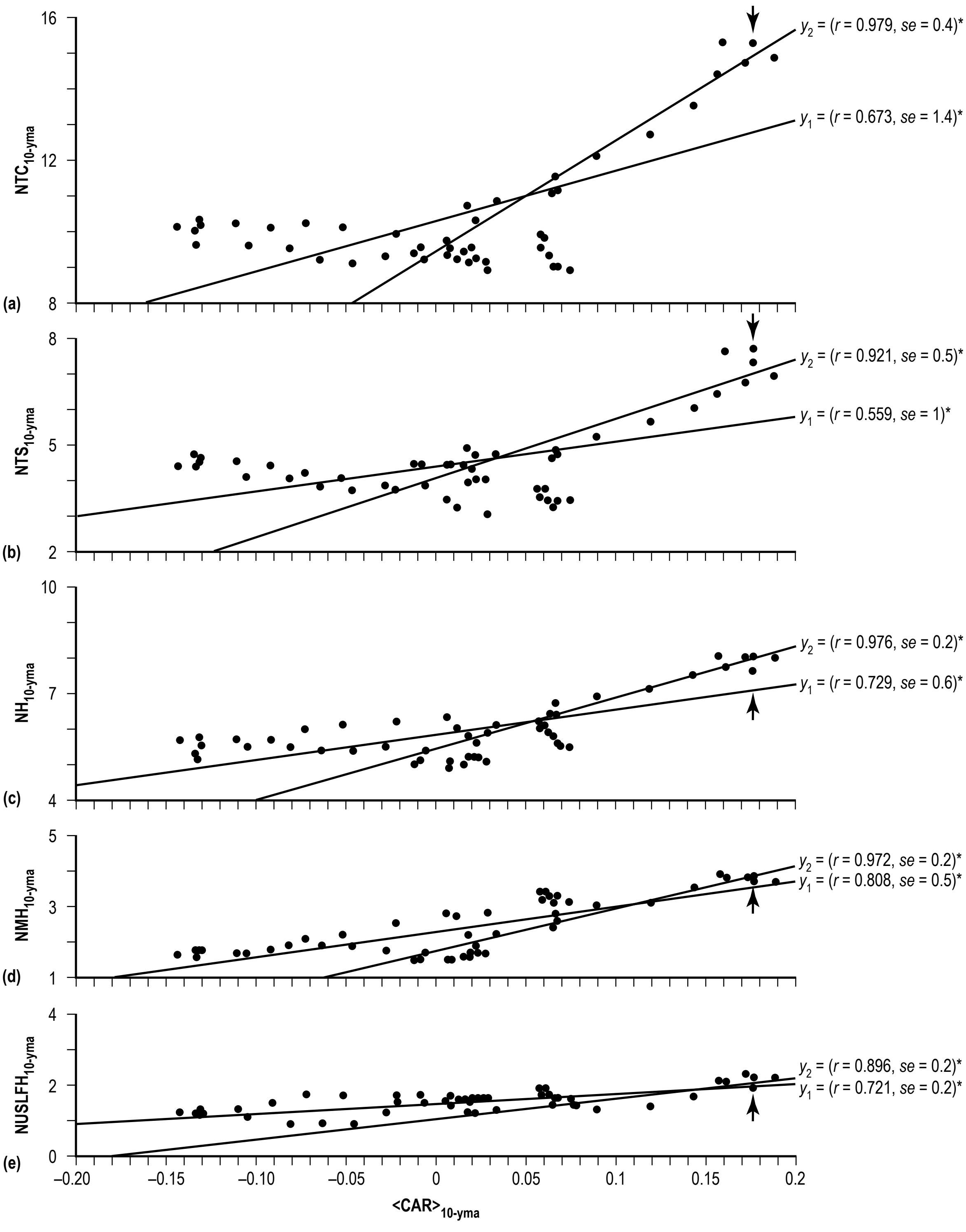

Figure 53. 10-yma values of (a) NTC, (b) NTS, (c) NH, (d) NMH, and (e) NUSLFH versus 10-yma values of <CAR>.

2.8.12 NTC, NTS, NH, NMH, and NUSLFH Versus <QBO>

Figure 54 shows the scatter plots of the 10-yma values of NTC, NTS, NH, NMH, and NUSLFH against the 10-yma values of <QBO>. For all comparisons the inferred linear regressions based on the current, more active interval are found to be negative and highly statistically significant (except for NUSLFH), having r = –0.66 to –0.86. Therefore, having a reliable estimate for the 10-yma value of <QBO> should allow one to reliably estimate the 10-yma value of the parameter in question.

Recall from section 2.7.12 that, based on the expected first difference $fd(\langle QBO \rangle)_t$, the 10-yma <QBO> = –3.82 ± 0.37 ms^{-1} for 2007 (i.e., the ±1 *sd* prediction interval). Applying the 10-yma value <QBO> = –3.82 ms^{-1} in the y_2 regressions results in estimates for the 10-yma values of NTC, NTS, NH, NMH, and NUSLFH for 2007, these being, respectively, about 13.83 ± 1.1, 6.42 ± 0.6, 7.42 ± 0.6, 3.4 ± 0.5, and 1.84 ± 0.3 (i.e., the ±1 *se* prediction intervals). Comparison of these estimates with the minimum values for the 10-yma parameters for the year 2007 indicates that all estimates (except NH) fall below their minimum values, suggesting that they are not tenable. (Recall that the 10-yma <QBO> = –3.82 ± 0.37 ms^{-1} for 2007 implies that the yearly <QBO> for 2012 should be between –15.94 and –1.14 ms^{-1}.)

For NTC, a 10-yma value 13.83 ± 1.1 in 2007 simply is too low since it results in yearly NTC for 2012 that is of negative value. The same is true for NTS. For NH, a 10-yma value 7.42 ± 0.6 in 2007 suggests a yearly value of 0–12 in 2012. For NMH, a 10-yma value 3.4 ± 0.5 in 2007 suggests a yearly value of about 0–4 in 2012. For NUSLFH, a 10-yma value 1.84 ± 0.3 in 2007 suggests a yearly value of about 0–4 in 2012. (For 2006, the 10-yma <QBO> also was –3.82 ms^{-1}, inferring the 10-yma values for NTC, NTS, NH, NMH, and NUSLFH to be 13.83 ± 1.1, 6.42 ± 0.6, 7.42 ± 0.6, 3.4 ± 0.5, and 1.84 ± 0.3, respectively. Hence, the differences between the observed and inferred values are 1.7, 2.63, 0.47, 0.8, and 0.53 *se*, respectively.)

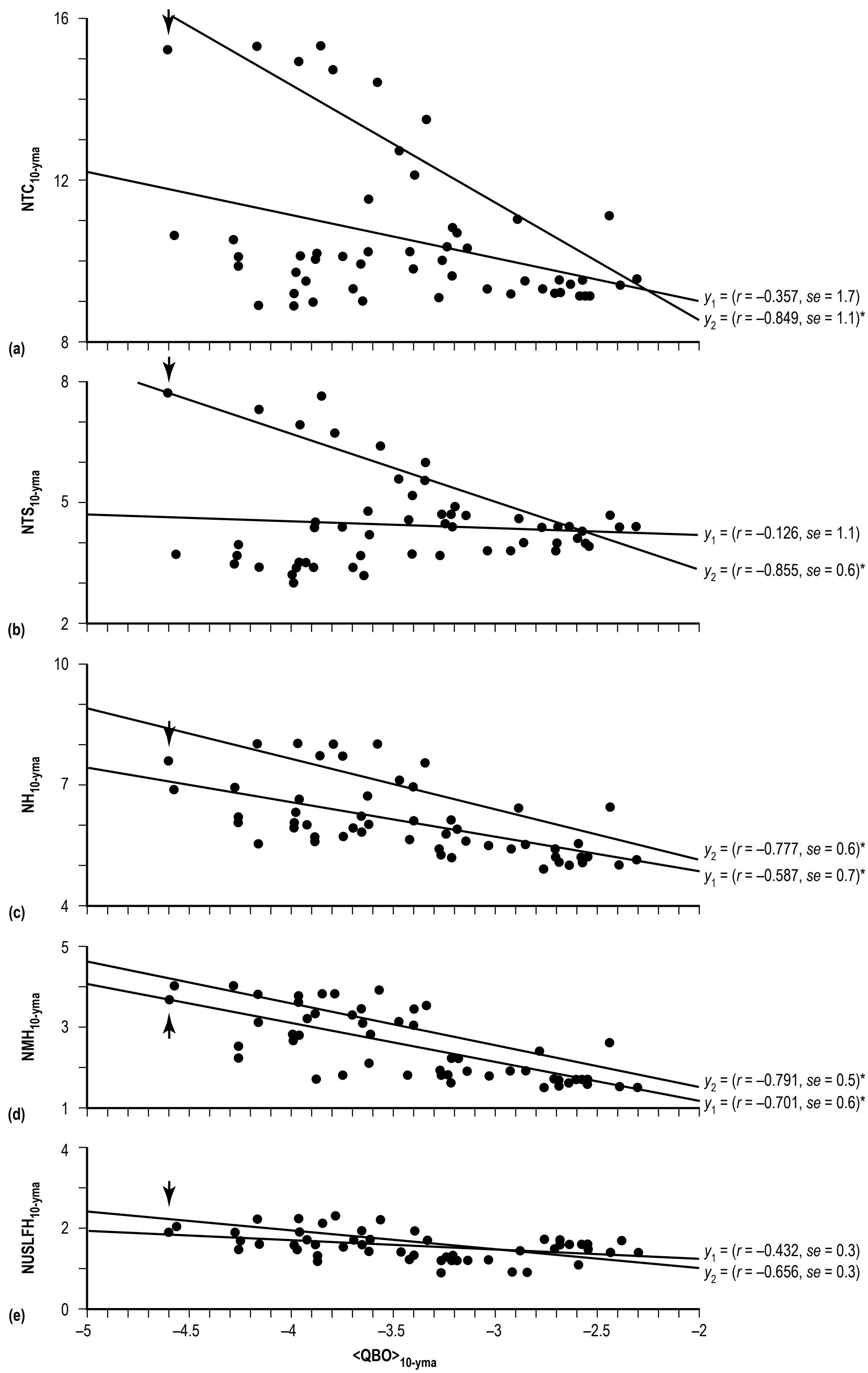

Figure 54. 10-yma values of (a) NTC, (b) NTS, (c) NH, (d) NMH, and (e) NUSLFH versus 10-yma values of <QBO>.

2.8.13 NTC, NTS, NH, NMH, and NUSLFH Versus <AMO>

Figure 55 shows the scatter plots of the 10-yma values of NTC, NTS, NH, NMH, and NUSLFH against the 10-yma values of <AMO>. For all comparisons the inferred linear regressions based on the current, more active interval are found to be positive and highly statistically significant, having $r = 0.9–0.99$. Therefore, having a reliable estimate for the 10-yma value of <AMO> should allow one to reliably estimate the 10-yma value of the parameter in question.

Recall from section 2.7.13 that, based on the expected first difference $fd(\langle AMO \rangle)_t$, the 10-yma <AMO> = 0.226 ± 0.015 °C for 2007 (i.e., the ±1 *sd* prediction interval). Applying the 10-yma value <AMO> = 0.226 °C in the y_2 regressions results in estimates for the 10-yma values of NTC, NTS, NH, NMH, and NUSLFH for 2007, these being, respectively, about 15.7 ± 0.3, 7.39 ± 0.4, 8.31 ± 0.2, 4.13 ± 0.2, and 2.21 ± 0.2 (i.e., the ±1 *se* prediction intervals). Comparison of these estimates with the minimum values for the 10-yma parameters for the year 2007 indicates that all estimates (except NTS) exceed their minimum values, suggesting that they might be tenable. (Recall that the 10-yma <AMO> = 0.226 ± 0.015 °C for 2007 implies that the yearly <AMO> for 2012 should be between 0.196 and 0.796 °C.)

For NTC, a 10-yma value 15.7 ± 0.3 in 2007 suggests a yearly value of about 2–14 for 2012. For NTS, a 10-yma value 7.39 ± 0.4 simply is too low to provide a meaningful estimate of the yearly NTS for 2012. For NH, a 10-yma value 8.31 ± 0.2 in 2007 suggests a yearly value of 14–22 in 2012. For NMH, a 10-yma value 4.13 ± 0.2 in 2007 suggests a yearly value of about 4–13 in 2012. For NUSLFH, a 10-yma value 2.21 ± 0.2 in 2007 suggests a yearly value of about 1–9 in 2012. (For 2006, the 10-yma <AMO> was 0.206, inferring the 10-yma values for NTC, NTS, NH, NMH, and NUSLFH to be 15.32 ± 0.3, 7.19 ± 0.4, 8.13 ± 0.2, 3.99 ± 0.2, and 2.14 ± 0.2, respectively. Hence, the differences between the observed and inferred values are 1.27, 2.03, –2.15, –0.95, and –0.7 *se*, respectively.)

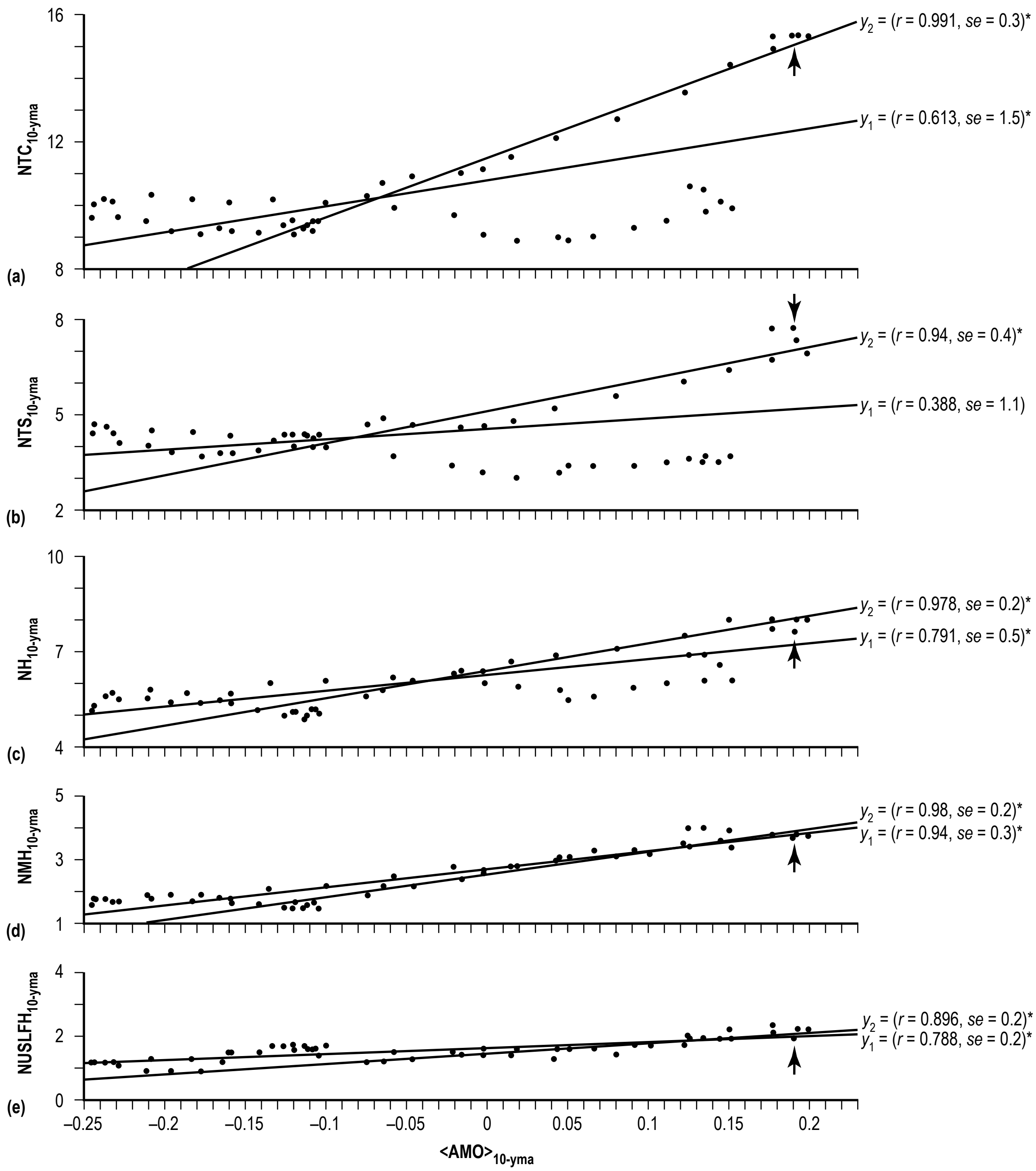

Figure 55. 10-yma values of (a) NTC, (b) NTS, (c) NH, (d) NMH, and (e) NUSLFH versus 10-yma values of <AMO>.

2.8.14 NTC, NTS, NH, NMH, and NUSLFH Versus <AMM>

Figure 56 shows the scatter plots of the 10-yma values of NTC, NTS, NH, NMH, and NUSLFH against the 10-yma values of <AMM>. For all comparisons the inferred linear regressions based on the current, more active interval are found to be positive and highly statistically significant, having r = 0.9–0.99. Therefore, having a reliable estimate for the 10-yma value of <AMM> should allow one to reliably estimate the 10-yma value of the parameter in question.

Recall from section 2.7.14 that, based on the expected first difference $fd(\langle AMM \rangle)_t$, the 10-yma <AMM> = 1.79 ± 0.17 for 2007 (i.e., the ±1 *sd* prediction interval). Applying the 10-yma value <AMM> = 1.79 in the y_2 regressions results in estimates for the 10-yma values of NTC, NTS, NH, NMH, and NUSLFH for 2007, these being, respectively, about 16.33 ± 0.3, 7.73 ± 0.4, 8.6 ± 0.2, 4.37 ± 0.2, and 2.33 ± 0.2 (i.e., the ±1 *se* prediction intervals). Comparison of these estimates with the minimum values for the 10-yma parameters for the year 2007 indicates that all estimates (except NTS) exceed their minimum values, suggesting that they might be tenable. (Recall that the 10-yma <AMM> = 1.79 ± 0.17 for 2007 implies that the yearly <AMM> for 2012 should be between –1.32 and 5.48.)

For NTC, a 10-yma value 16.33 ± 0.3 in 2007 suggests a yearly value of about 15–27 for 2012. For NTS, a 10-yma value 7.73 ± 0.4 suggests a yearly value of about 0–5 for 2012. For NH, a 10-yma value 8.6 ± 0.2 in 2007 suggests a yearly value of 20–28 in 2012. For NMH, a 10-yma value 4.37 ± 0.2 in 2007 suggests a yearly value of about 9–17 in 2012. For NUSLFH, a 10-yma value 2.33 ± 0.2 in 2007 suggests a yearly value of about 4–12 in 2012. (For 2006, the 10-yma <AMM> was 1.61, inferring the 10-yma values for NTC, NTS, NH, NMH, and NUSLFH to be 15.93 ± 0.3, 7.51 ± 0.4, 8.42 ± 0.2, 4.22 ± 0.2, and 2.25 ± 0.2, respectively. Hence, the differences between the observed and inferred values are –0.77, 1.23, –3.6, –2.1, and –1.25 *se*, respectively.)

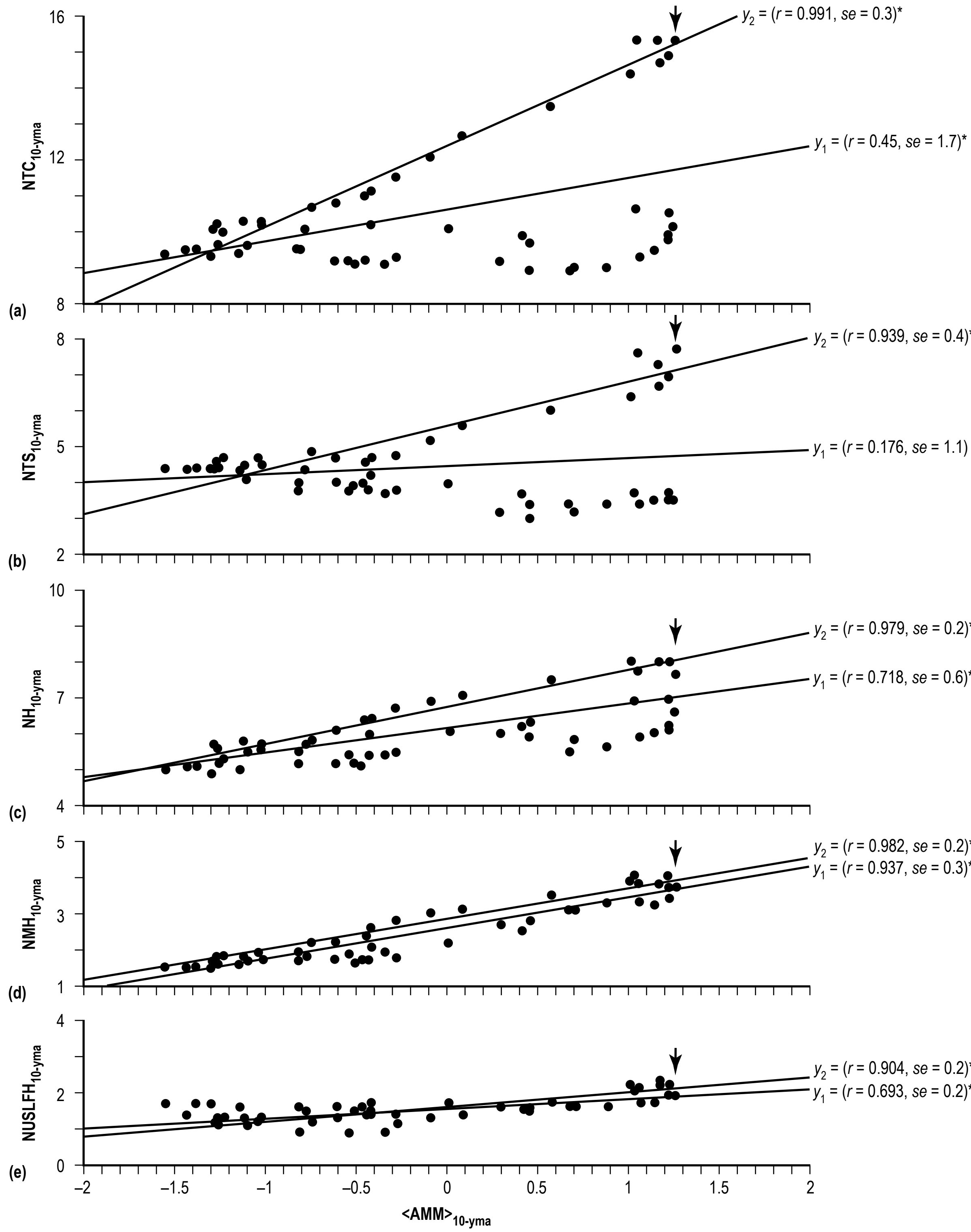

Figure 56. 10-yma values of (a) NTC, (b) NTS, (c) NH, (d) NMH, and (e) NUSLFH versus 10-yma values of <AMM>.

2.9 The Strongest Inferred Correlations

The next 18 subsections describe the relational aspects between 10-yma values of the various tropical cyclone parameters (e.g., PWS, ACE, NTCA, etc.) and the surface air temperature and ENSO-related parameters on the basis of the best linear fits using all available 10-yma values (i.e., the y_1 regressions) and the resultant 2×2 contingency tables. In each scatter plot, the current, more active interval is plotted as filled squares and the parametric values for 2005 are identified using an arrow, as before. Interestingly, 8 of the 18 tropical cyclone parameters have best fits against <AMO> (the only tropical cyclone parameter not strongly tied to <AMO> is <W. LONG>, which better correlates against <ONI>). The final subsection (2.9.19) discusses the relational aspects between the surface air temperature and the ENSO-related parameters.

2.9.1 NTC Versus <AT>

Figure 57 represents the best fit using all available 10-yma values of NTC versus <AT> (from among the 14 fits listed in table 24). The vertical and horizontal lines are the parametric median values and the diagonal line is the inferred linear regression between the two parameters, having $r = 0.9$ and $se = 0.8$ °C. Hence, the inferred regression is one described as being positive (or direct), meaning the higher (lower) the 10-yma <AT> the greater (lesser) the 10-yma NTC. Expressed as a 2×2 contingency table, the probability of obtaining the observed result, or one more suggestive of a departure from independence (chance), is computed using the Fisher's exact test for 2×2 contingency tables[116] to be $P = 0.02\%$. Thus, for the distribution of 10-yma values of NTC versus <AT>, there is only 0.02% chance (i.e., about 1 chance in 5,000) that the observed 2×2 contingency table, or one more suggestive of a departure from independence, occurs purely by chance. Hence, one suspects a strong dependence of NTC on <AT>, especially now in the current, more active interval. In particular, when the 10-yma <AT> is <9.38 °C (the median value), the 10-yma NTC usually is <10.1 (and always ≤10.3) and when the 10-yma <AT> ≥9.38 °C, the 10-yma NTC usually is ≥10.1. When the 10-yma <AT> exceeds 9.7 °C, the 10-yma NTC always exceeds 10.3.

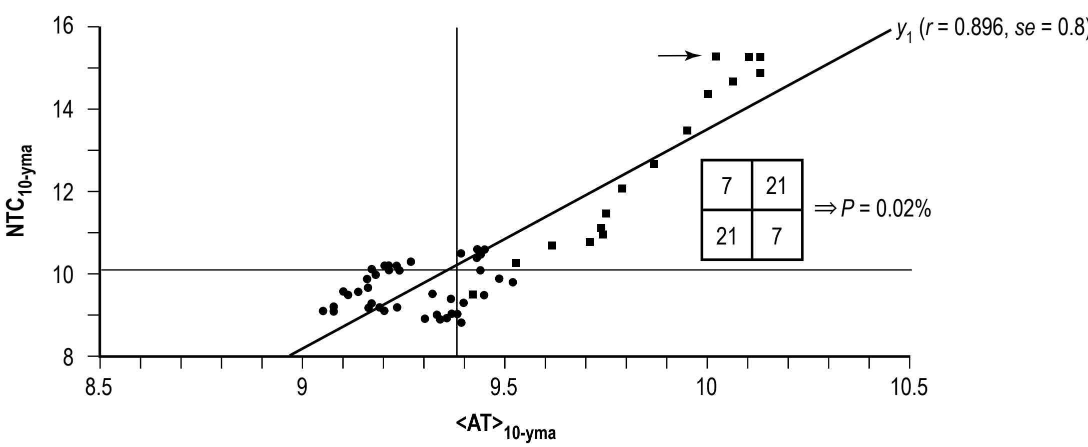

Figure 57. 10-yma values of NTC versus 10-yma values of <AT>.

Interestingly, the probability for obtaining the observed distribution is driven by the current, more active interval (the filled squares), with 15 of the 16 10-yma values for the current, more active interval lying in the upper-right quadrant. Since first difference values do not change radically from one year to the next (see figs. 1 and 29), it is apparent that the current, more active interval likely will persist for another decade or more, presuming the temperature variation is cyclic, or possibly longer if the temperature rise is due to long-term global warming. (The paired point for the year 2006, which is not plotted, remains in the upper-right quadrant, being located at $\langle AT \rangle_{10\text{-yma}} = 10$ °C and $NTC_{10\text{-yma}} = 15.7$.)

As previously mentioned, the expected 10-yma <AT> for 2007 remains above 9.38 °C (actually, about ≥10 °C, see fig. 29). Hence, one strongly suspects that the 10-yma NTC for 2007 will be ≥10.1 (actually, ≥15.3, being located in the upper-right quadrant). Recall that the minimum value for the 10-yma NTC for 2007 is 15.3, computed by assuming a zero frequency for NTC in 2012. Consequently, any yearly value of NTC greater than zero increases the 10-yma NTC above its minimum value.

From figure 1, the 10-yma NTC for 2007 is expected to be about 16.1 ± 0.3, inferring a yearly NTC for 2012 that measures about 10–22. From the Poisson distribution (table 21), if 2012 is classified as ENY, then the probability of having NTC >11 is about 1 chance in 5, while if 2012 turns out to be classified as NY or LNY, then the probability of having NTC >13 is about 1 chance in 5. Based on the Poisson distribution (table 23), when the yearly <AT> is greater than its long-term mean (9.48 °C), the probability of having NTC >14 is about 1 chance in 3. (Yearly <AT> for 2012 is expected to exceed 9.48 °C.)

2.9.2 NTS Versus <AT>

Figure 58 represents the best fit using all available 10-yma values of NTS versus <AT> (from among the 14 fits listed in table 24). As before, the vertical and horizontal lines are the parametric median values and the diagonal line is the inferred linear regression between the two parameters, having $r = 0.8$ and $se = 0.7$ °C. Expressed as a 2×2 contingency table, the probability of obtaining the observed result, or one more suggestive of a departure from independence (chance), is computed using the Fisher's exact test for 2×2 contingency tables to be $P = 9.1\%$. Thus, for the distribution of 10-yma values of NTS versus <AT>, there is only a 9.1% chance (i.e., about 1 chance in 11) that the observed 2×2 contingency table, or one more suggestive of a departure from independence, occurs purely by chance. Hence, one suspects a slight dependence of NTS on <AT>, especially now in the current, more active interval, with warmer surface air temperature at the Armagh Observatory indicative of greater NTS and cooler temperature indicative of lesser NTS. In particular, when the 10-yma <AT> is <9.38 °C, the 10-yma NTS usually is <4.3 (and always ≤4.8) and when the 10-yma <AT> ≥9.38 °C, the 10-yma NTS usually is ≥4.3. When the 10-yma <AT> exceeds 9.7 °C, the 10-yma NTS always exceeds 4.6.

As before, interesting is that the probability for obtaining the observed distribution is driven by the current, more active interval (the filled squares), with 16 of the 16 10-yma values for the current, more active interval lying in the upper-right quadrant. Since first difference values do not change radically from one year to the next (see figs. 2 and 29), it is apparent that the current, more

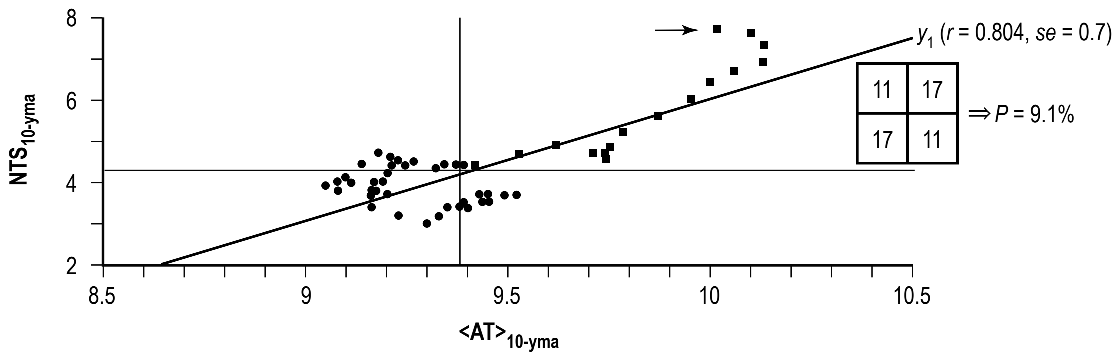

Figure 58. 10-yma values of NTS versus 10-yma values of <AT>.

active interval likely will persist for another decade or more, presuming the temperature variation is cyclic, or possibly longer if the temperature rise is due to long-term global warming. (The paired point for the year 2006, which is not plotted, remains in the upper-right quadrant, being located at $\langle AT \rangle_{10\text{-yma}}$ = 10 °C and $NTS_{10\text{-yma}}$ = 8.)

As previously noted, the expected 10-yma <AT> for 2007 remains above 9.38 °C (actually, about ≥10 °C). Hence, one suspects that the 10-yma of NTS for 2007 will be above 4.3 (actually, ≥7.9, located in the upper-right quadrant, since 7.9 is the minimum value for the 10-yma of NTS for the year 2007).

From figure 2, the 10-yma NTS for 2007 is expected to be about 8.2 ± 0.2, inferring a yearly NTS for 2012 of about 2–10. From the Poisson distribution, if 2012 is classified as ENY, then the probability of having NTS >6 is about 1 chance in 7, while if 2012 turns out to be classified as NY or LNY, then the probability of having NTS >6 is about 1 chance in 5. Also, from the Poisson distribution, when the yearly <AT> is greater than its long-term mean (9.48 °C), the probability of having NTS >7 is about 1 chance in 4.

2.9.3 NH Versus <NTA>

Figure 59 represents the best fit using all available 10-yma values of NH versus <NTA> (from among the 14 fits listed in table 24). As before, the vertical and horizontal lines are the parametric median values and the diagonal line is the inferred linear regression between the two parameters, having r = 0.87 and se = 0.4. Expressed as a 2×2 contingency table, the probability of obtaining the observed result, or one more suggestive of a departure from independence (chance), is computed using the Fisher's exact test for 2×2 contingency tables to be P = 0.51%. Thus, for the distribution of 10-yma values of NH versus <NTA>, there is only 0.51% chance (i.e., about 1 chance in 196) that the observed 2×2 contingency table, or one more suggestive of a departure from independence, occurs purely by chance. Hence, one suspects a dependence of NH on <NTA>, especially now in the current, more active interval, with a warmer North Atlantic temperature anomaly indicative of greater NH and a cooler North Atlantic temperature anomaly indicative of lesser NH. In particular, when the 10-yma <NTA> is negative, the 10-yma NH usually is <5.8 (and always ≤6.2) and when the 10-yma <NTA> is positive in value, the 10-yma NH usually is ≥5.8. When the 10-yma <NTA> exceeds 0.09 °C, the 10-yma NH always exceeds 6.4.

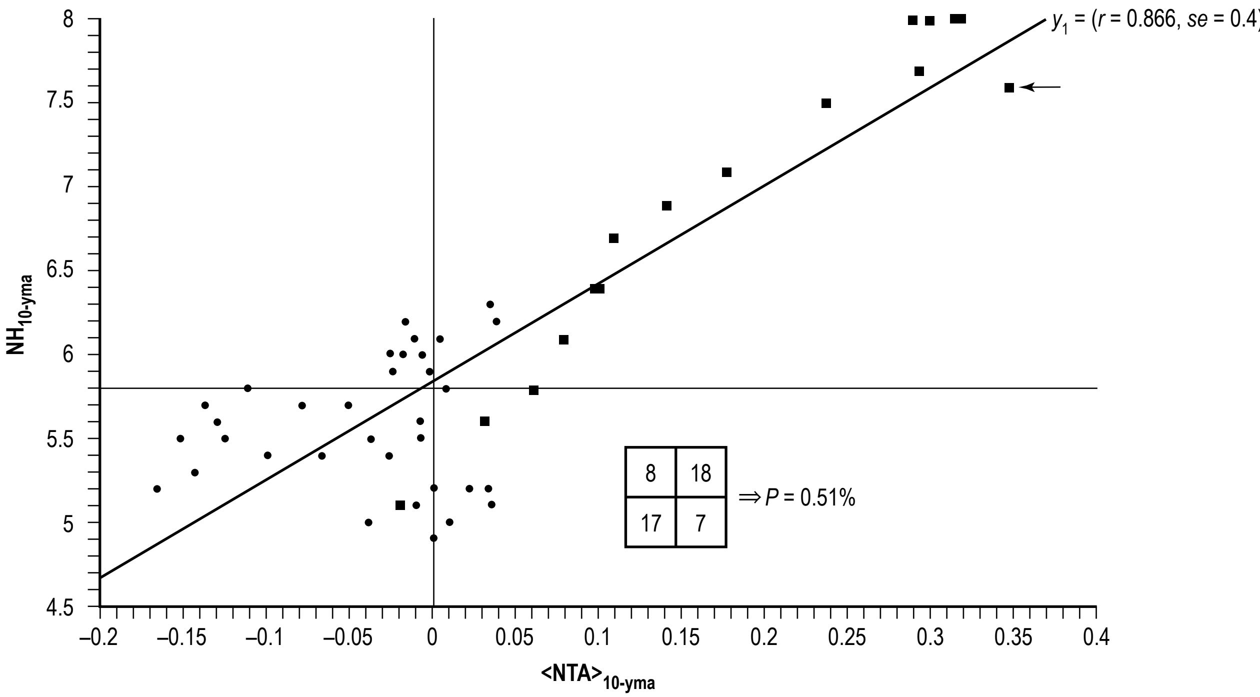

Figure 59. 10-yma values of NH versus 10-yma values of <NTA>.

As before, interesting is that the probability for obtaining the observed distribution is driven by the current, more active interval (the filled squares), with 14 of the 16 10-yma values for the current, more active interval lying in the upper-right quadrant. Since first difference values do not change radically from one year to the next (see figs. 4 and 38), it is apparent that the current, more active interval likely will persist for another decade or more, presuming the temperature anomaly is cyclic, or possibly longer if the temperature anomaly (increased strength) is due to long-term global warming. (The paired point for the year 2006 is unknown since NTA has not been updated beyond December 2010. However, one suspects that, should it become available, it would be located in the upper-right quadrant.)

The second best fit for NH is the one against <AT>, having r = 0.82, se = 0.5 °C, and P = 0.02%. Based on <AT>, the 10-yma NH definitely would be located in the upper-right quadrant; recall that the minimum value for NH in 2007 is 7.4.

From figure 4, the 10-yma NH for 2007 is expected to be about 7.8 ± 0.3, inferring a yearly NH for 2012 of about 2–14. From the Poisson distribution, if 2012 is classified as ENY, then the probability of having NH >6 is about 1 chance in 5; if 2012 turns out to be classified as NY, then the probability of having NH >8 is about 1 chance in 5; and if 2012 turns out to be classified as LNY, then the probability of having NH >9 is about 1 chance in 6. Also, from the Poisson distribution, when the yearly <AT> is greater than its long-term mean (9.48 °C), the probability of having NH >8 is about 1 chance in 4.

2.9.4 NMH Versus <AMO>

Figure 60 represents the best fit using all available 10-yma values of NMH versus <AMO> (from among the 14 fits listed in table 24). As before, the vertical and horizontal lines are the parametric median values and the diagonal line is the inferred linear regression between the two parameters, having $r = 0.94$ and $se = 0.3$ °C. Expressed as a 2×2 contingency table, the probability of obtaining the observed result, or one more suggestive of a departure from independence (chance), is computed using the Fisher's exact test for 2×2 contingency tables to be $P = 4.2 \times 10^{-11}\%$. Thus, for the distribution of 10-yma values of NMH versus <AMO>, there is only $4.2 \times 10^{-11}\%$ chance (i.e., about 1 chance in 2.4×10^{12}) that the observed 2×2 contingency table, or one more suggestive of a departure from independence, can occur purely by chance. Hence, there is little doubt not to believe that NMH is greatly dependent on <AMO>. Obviously, strong positive (warm) <AMO> means much greater likelihood for increased NMH, while strong negative (cool) <AMO> means much greater likelihood of reduced NMH. In particular, when the 10-yma <AMO> is positive in value, the 10-yma NMH always is ≥2.7, and when the 10-yma <AMO> is negative in value, the 10-yma NMH always is ≤2.8.

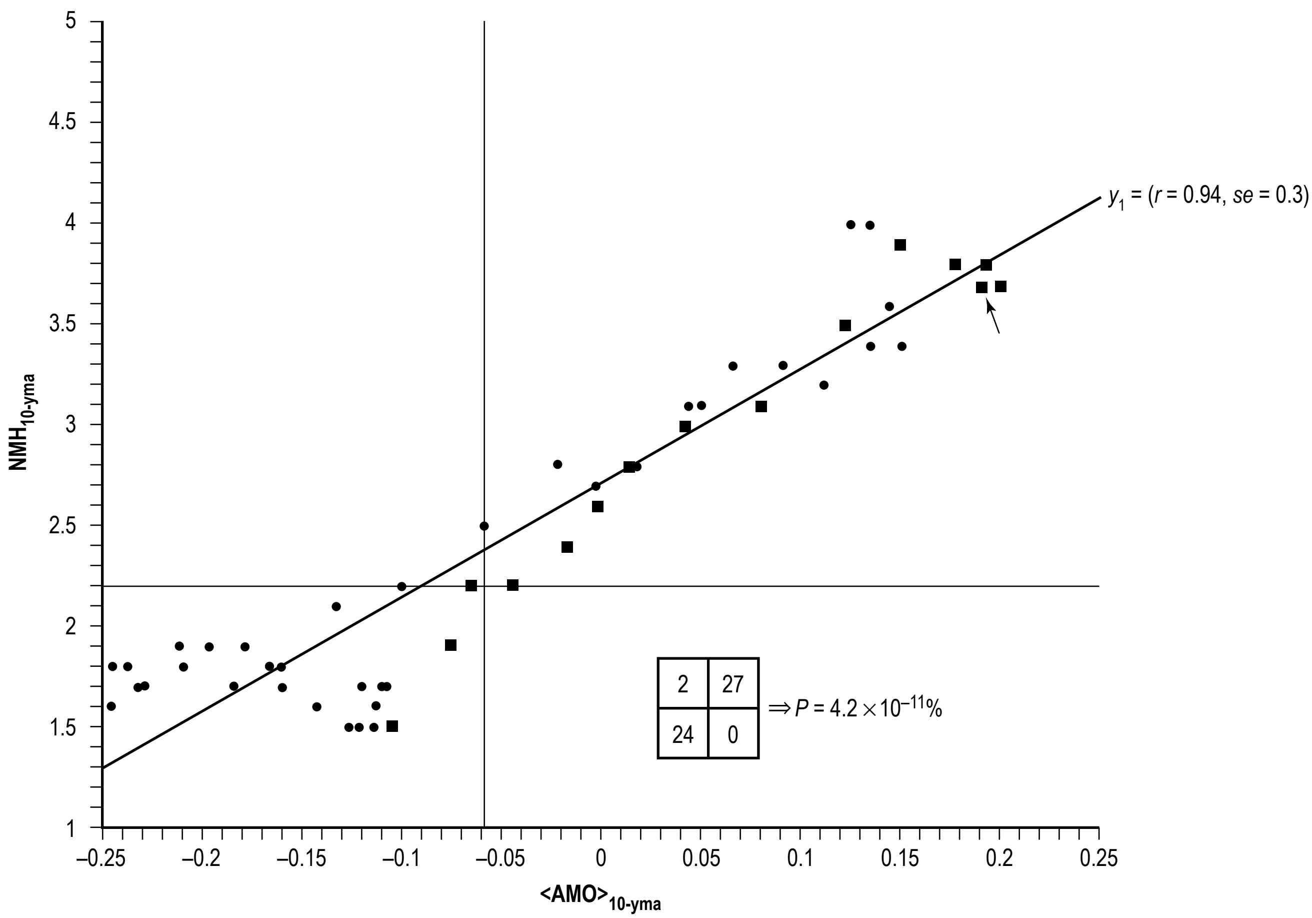

Figure 60. 10-yma values of NMH versus 10-yma values of <AMO>.

Recall that prior to 1964 and subsequent to 1995, the 10-yma <AMO> values always are positive, while during the intervening years (i.e., 1964–1995) they always are negative (see fig. 41 and/or table 17). Such behavior possibly suggests a cyclic nature for <AMO>, which, if true, suggests that the current, more active interval will persist, at least another one or two decades, inferring increased frequencies of major hurricanes over the near-term, foreseeable future. (The paired point for the year 2006, which is not plotted, remains in the upper-right quadrant, being located at <AMO>$_{10\text{-yma}}$ = 0.206 °C and NMH$_{10\text{-yma}}$ = 3.8.)

From figure 41, the 10-yma AMO for 2007 is expected to be about 0.226 ± 0.015 °C, inferring a yearly <AMO> for 2012 that is positive in value, being equal to about 0.496 ± 0.3 °C (i.e., the ±1 *sd* prediction interval). A 10-yma <AMO> = 0.226 °C in 2007 implies a 10-yma NMH = 3.99 ± 0.3 in 2007 (i.e., located in the upper-right quadrant), inferring a yearly NMH for 2012 of about 0–12. From the Poisson distribution, if 2012 is classified as ENY, then the probability of having NMH >3 is about 1 chance in 7; if 2012 turns out to be classified as NY, then the probability of having NMH >3 is about 1 chance in 3; and if 2012 turns out to be classified as LNY, then the probability of having NMH >4 is about 1 chance in 4. Also, from the Poisson distribution, for positive yearly <AMO>, the probability of NMH >4 is about 1 chance in 4.

2.9.5 NUSLFH Versus <AMO>

Figure 61 represents the best fit using all available 10-yma values of NUSLFH versus <AMO> (from among the 14 fits listed in table 24). As before, the vertical and horizontal lines are the parametric median values and the diagonal line is the inferred linear regression between the two parameters, having r = 0.79 and *se* = 0.2 °C. Expressed as a 2×2 contingency table, the probability of obtaining the observed result, or one more suggestive of a departure from independence (chance), is computed using the Fisher's exact test for 2×2 contingency tables to be P = 0.18%. Thus, for the distribution of 10-yma values of NUSLFH versus <AMO>, there is only 0.18% chance (i.e., about 1 chance in 556) that the observed 2×2 contingency table, or one more suggestive of a departure from independence, occurs purely by chance. Hence, there is little doubt not to believe that NUSLFH is dependent on <AMO>. Obviously, strong positive (warm) <AMO> means greater likelihood for increased NUSLFH, while strong negative (cool) <AMO> means greater likelihood of reduced NUSLFH. In particular, when the 10-yma <AMO> ≥0.09 °C, the 10-yma NUSLFH always is ≥1.7, and when the 10-yma <AMO> <0.09 °C, the 10-yma NUSLFH generally is <1.7 (five exceptions: 1967, 1968, 1987, 1988, and 1989).

Recall that prior to 1964 and subsequent to 1995, the 10-yma <AMO> values always are positive, while during the intervening years (i.e., 1964–1995) they always are negative (see fig. 41 and/or table 17). Such behavior possibly suggests a cyclic nature for <AMO>, which, if true, suggests that the current, more active interval will persist, at least another one or two decades, inferring possibly increased frequencies of US landfalling hurricanes over the near-term, foreseeable future, especially if the 10-yma <AMO> stays above about 0.1 °C. (The paired point for the year 2006, which is not plotted, remains in the upper-right quadrant, being located at <AMO>$_{10\text{-yma}}$ = 0.206 °C and NUSLFH$_{10\text{-yma}}$ = 2.)

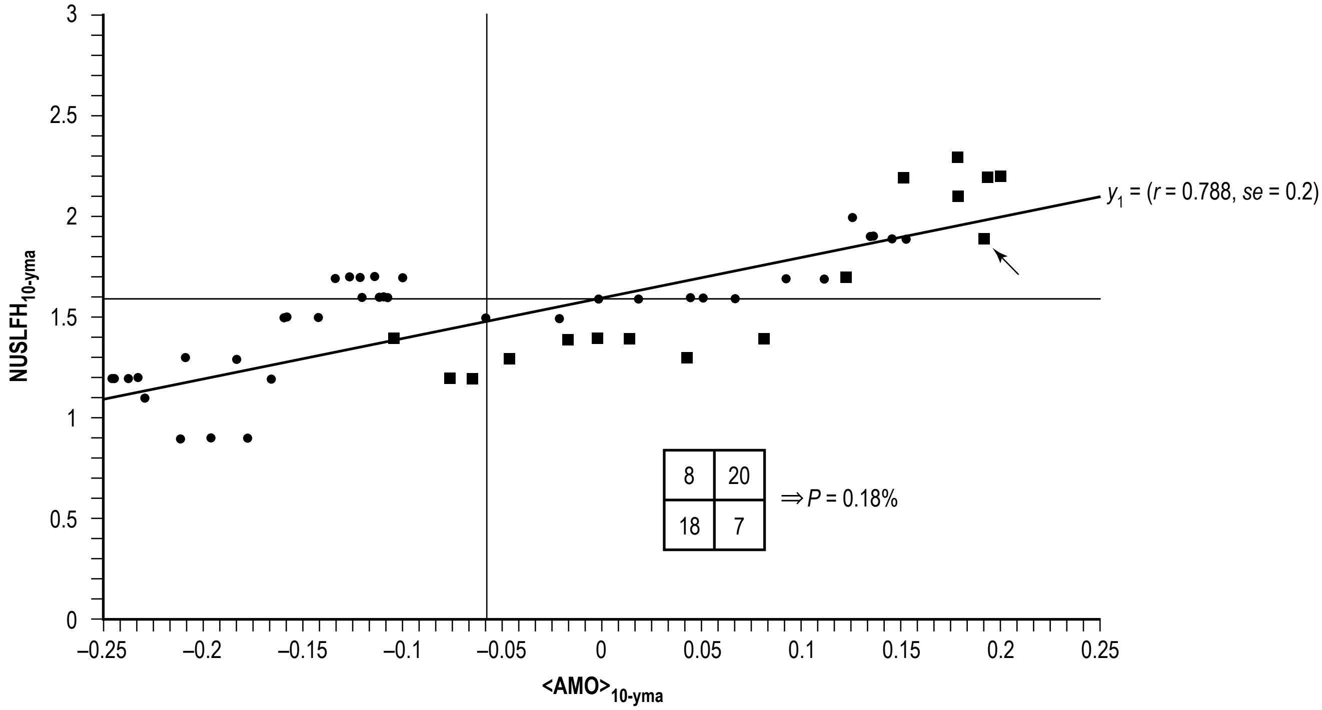

Figure 61. 10-yma values of NUSLFH versus 10-yma values of <AMO>.

As previously noted, from figure 41, the 10-yma AMO for 2007 is expected to be about 0.226 ± 0.015 °C, inferring a yearly <AMO> for 2012 that is positive in value and equal to about 0.496 ± 0.3 °C. A 10-yma <AMO> = 0.226 °C in 2007 implies a 10-yma NUSLFH = 2.05 ± 0.2 in 2007 (i.e., located in the upper-right quadrant), inferring a yearly NUSLFH for 2012 of about 0–6. From the Poisson distribution, if 2012 is classified as ENY, then the probability of having NUSLFH >2 is about 1 chance in 9; if 2012 turns out to be classified as NY, then the probability of having NUSLFH >2 is about 1 chance in 4; and if 2012 turns out to be classified as LNY, then the probability of having NUSLFH >3 is about 1 chance in 6. Also, from the Poisson distribution, for positive yearly <AMO>, the probability of NUSLFH >2 is about 1 chance in 4.

2.9.6 <N. LAT> Versus <AMO>

Figure 62 represents the best fit using all available 10-yma values of <N. LAT> versus <AMO> (from among the 14 fits listed in table 24). As before, the vertical and horizontal lines are the parametric median values and the diagonal line is the inferred linear regression between the two parameters, having r = –0.87 and se = 0.9 °C. Unlike the preceding regressions, the one between <N. LAT> and <AMO> is a negative (or inverse) relationship, meaning that greater (lesser) <N. LAT> tends to be associated with more negative or cooler (positive or warmer) <AMO>. Expressed as a 2×2 contingency table, the probability of obtaining the observed result, or one more suggestive of a departure from independence (chance), is computed using the Fisher's exact test for 2×2 contingency tables to be $P = 7.9 \times 10^{-7}$%. Thus, for the distribution of 10-yma values of <N. LAT> versus <AMO>, there is only 7.9×10^{-7}% chance (i.e., about 1 chance in 1.3×10^{8}) that the observed

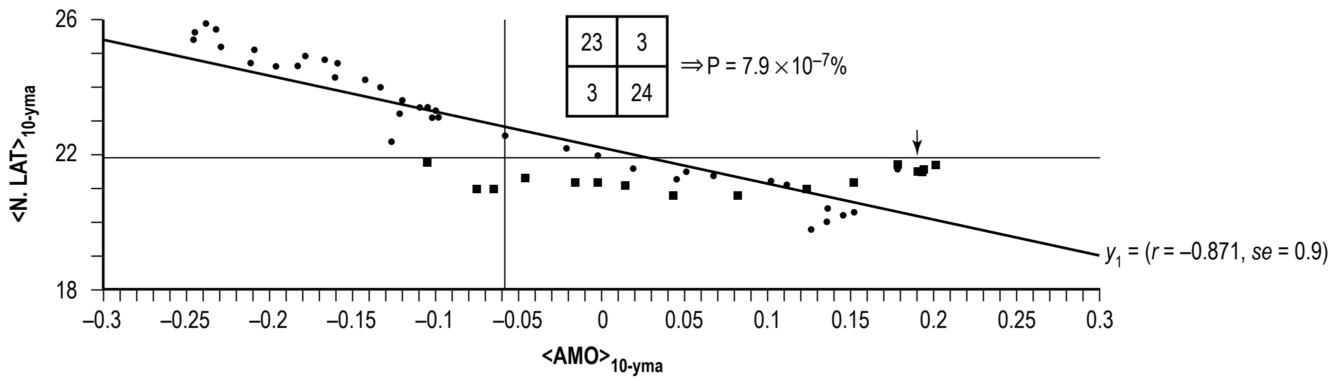

Figure 62. 10-yma values of <N. LAT> versus 10-yma values of <AMO>.

2×2 contingency table, or one more suggestive of a departure from independence, occurs purely by chance. Hence, there is little doubt not to believe that <N. LAT> is strongly dependent on <AMO>. Obviously, strong positive <AMO> means greater likelihood for decreased <N. LAT>, while strong negative <AMO> means greater likelihood of increased <N. LAT>. In particular, when the 10-yma <AMO> ≥0 °C, the 10-yma <N. LAT> always is ≤22 deg, and when the 10-yma <AMO> <0 °C, the 10-yma <N. LAT> generally is >22 deg (six exceptions: 1990–1995).

Recall that prior to 1964 and subsequent to 1995, the 10-yma <AMO> values always are positive, while during the intervening years (i.e., 1964–1995) they always are negative (see fig. 41 and/or table 17). Such behavior possibly suggests a cyclic nature for <AMO>, which, if true, suggests that the current, more active interval will persist at least another one or two decades, inferring the 10-yma <N. LAT> ≤22 °N. over the near-term, foreseeable future. (The paired point for the year 2006, which is not plotted, remains in the low-right quadrant, being located at $\langle AMO\rangle_{10\text{-yma}}$ = 0.206 °C and $\langle N.\ LAT\rangle_{10\text{-yma}}$ = 21.2.)

As previously noted, from figure 41, the 10-yma <AMO> for 2007 is expected to be about 0.226 ± 0.015 °C, inferring a yearly <AMO> for 2012 that is positive in value and equal to about 0.496 ± 0.3 °C. A 10-yma <AMO> = 0.226 °C in 2007 implies a 10-yma <N. LAT> ≤20.7 deg. for 2007 (i.e., located in the lower-right quadrant), inferring a yearly <N. LAT> ≤16.2 deg. for 2012, while from figure 13, one anticipates the 10-yma <N. LAT> ≤21.5 deg for 2007, inferring a yearly <N. LAT> ≥20.2 deg for 2012 (both prediction intervals being ±1 *sd*). Thus, the two ±1 *sd* prediction intervals are incompatible, suggesting that one or the other will be a statistical outlier for 2012.

2.9.7 <W. LONG> Versus <ONI>

Figure 63 represents the best fit using all available 10-yma values of <W. LONG> versus <ONI> (from among the 14 fits listed in table 24). As before, the vertical and horizontal lines are the parametric median values and the diagonal line is the inferred linear regression between the two parameters, having r = –0.81 and se = 1.3 °C. Like the preceding regression, the one between <W. LONG> and <ONI> is an inverse relationship, meaning that greater (lesser) <W. LONG> tends to be associated with more negative or cooler (positive or warmer) <ONI>. Expressed as

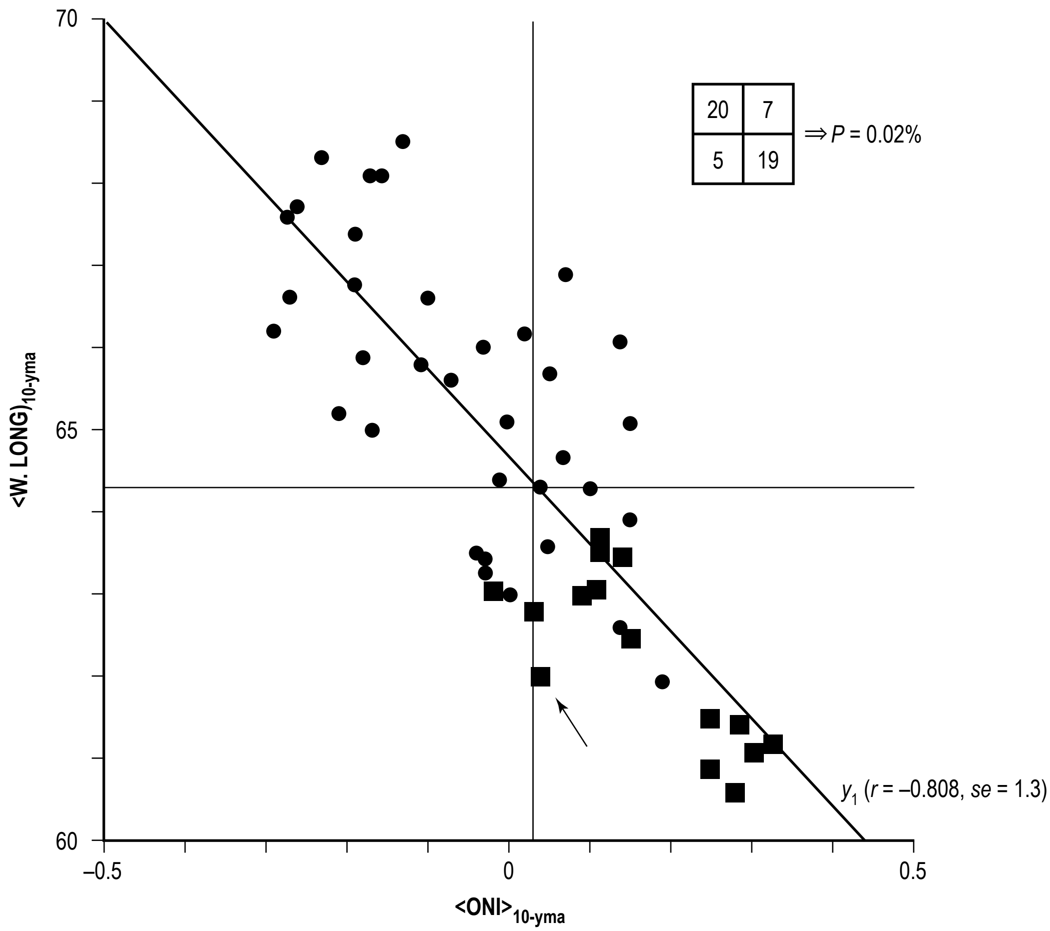

Figure 63. 10-yma values of <W. LONG> versus 10-yma values of <ONI>.

a 2×2 contingency table, the probability of obtaining the observed result, or one more suggestive of a departure from independence (chance), is computed using the Fisher's exact test for 2×2 contingency tables to be $P = 0.02\%$. Thus, for the distribution of 10-yma values of <W. LONG> versus <AMO>, there is only 0.02% chance (i.e., about 1 chance in 5,000) that the observed 2×2 contingency table, or one more suggestive of a departure from independence, occurs purely by chance. Hence, there is little doubt not to believe that <W. LONG> is dependent on <ONI>. Obviously, strong positive (negative) <ONI> means greater likelihood for decreased (increased) <W. LONG>. In particular, when the 10-yma <ONI> ≥0 °C, the 10-yma <W. LONG> usually is ≤64.3 deg, and when the 10-yma <ONI> <0 °C, the 10-yma <W. LONG> usually is >64.3 deg. (Recall that more positive <ONI> values are indicative of years often having an EN event and more negative <ONI> values are indicative of years often having a LN event; when EN events occur, there is a tendency for <W. LONG> to be located farther away from the US coastline (i.e., more eastward), while when LN events occur, there is a tendency for <W. LONG> to be located closer to the US coastline (i.e., more westward).)

From figure 30 (also, see table 3), one finds that the 10-yma <ONI> has been >0 °C since 1980 (the lone exception being 2003, –0.02 °C). For 2007, on the basis of the expected first difference, the 10-yma <ONI> is inferred to be of positive value and equal to about 0.12 ± 0.05 °C (see sec. 2.7.2), suggesting that the yearly <ONI> for 2012 will be between –0.1 and 1.9 °C, values indicative of ENSO neutral to EN-like conditions. If, indeed, the 10-yma <ONI> turns out to be ≥0.07 °C for 2007, then one anticipates that the 10-yma <W. LONG> likely would be located in the lower-right quadrant. (From fig. 14, for 2007 one anticipates the 10-yma <W. LONG> = 61.8 ± 0.7 deg, located in the lower-right quadrant, inferring the yearly <W. LONG> = 66.7 ± 14 deg for 2012. The paired point for the year 2006, which is not plotted, remains in the lower-right quadrant, being located at <ONI>$_{10\text{-yma}}$ = 0.14 °C and <W> LONG>$_{10\text{-yma}}$ = 61.9.)

It is important to recall that the last observed EN had its start in June 2009, on the basis of monthly ONI, and EN events tend to recur, on average, about once every 40–41 mo;[30,34] hence, the possibility exists that a new EN event might arise later in 2012. According to the May 3, 2012, NOAA forecast, ENSO neutral conditions are expected to prevail, at least, through the summer of 2012.[52]

2.9.8 PWS Versus <AMM>

Figure 64 represents the best fit using all available 10-yma values of PWS versus <AMM> (from among the 14 fits listed in table 24). As before, the vertical and horizontal lines are the parametric median values and the diagonal line is the inferred linear regression between the two parameters, having r = 0.93 and se = 1.8 kt. Expressed as a 2×2 contingency table, the probability of obtaining the observed result, or one more suggestive of a departure from independence (chance), is computed using the Fisher's exact test for 2×2 contingency tables to be $P = 2.8 \times 10^{-5}$%. Thus, for the distribution of 10-yma values of PWS versus <AMM>, there is only a 2.8×10^{-5}% chance (i.e., about 1 chance in 3.6×10^{6}) that the observed 2×2 contingency table, or one more suggestive of a departure from independence, occurs purely by chance. Hence, there is little doubt not to believe that PWS is dependent on <AMM>. Obviously, strong positive <AMM> means greater likelihood for increased PWS, while strong negative <AMM> means greater likelihood of decreased PWS. In particular, when the 10-yma <AMM> ≥0, the 10-yma PWS always is ≥124.3 kt (i.e., 124.3–135 kt), and when the 10-yma <AMM> <0 °C, the 10-yma PWS always is ≤127 kt (i.e., 117.7–127 kt).

Recall that prior to 1968 and subsequent to 1997, the 10-yma <AMM> values always are positive, while during the intervening years (i.e., 1968–1997) they always are negative (see fig. 42 and/or table 17). Such behavior possibly suggests a cyclic nature for <AMM>, which, if true, suggests that the current, more active interval will persist at least another one or two decades, inferring the 10-yma PWS ≥126.9 kt over the near-term, foreseeable future. (The paired point for the year 2006, which is not plotted, remains in the upper-right quadrant, being located at <AMM>$_{10\text{-yma}}$ = 1.61 and PWS$_{10\text{-yma}}$ = 132.8.)

From figure 42, the 10-yma <AMM> for 2007 is expected to be about 1.79 ± 0.17, inferring a yearly <AMM> for 2012 that is about 2.08 ± 3.4. A 10-yma <AMM> = 1.79 in 2007 implies a 10-yma PWS = 135.6 ± 1.8 kt for 2007 (i.e., located in the upper-right quadrant), inferring a yearly PWS >150 kt in 2012. However, from figure 16, one anticipates the 10-yma PWS to be about 134.1 ± 1.8 kt for 2007, inferring a yearly PWS >120 kt in 2012.

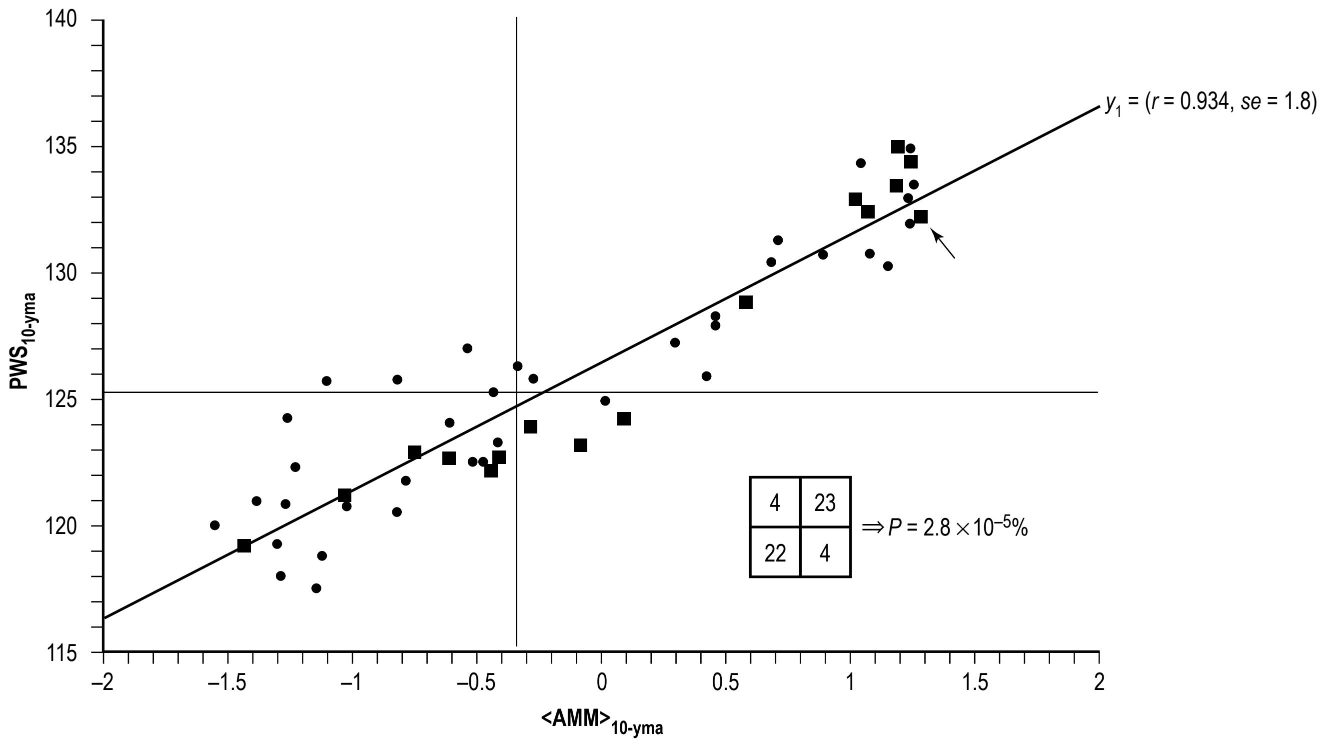

Figure 64. 10-yma values of PWS versus 10-yma values of <AMM>.

2.9.9 <PWS> Versus <NAO>

Figure 65 represents the best fit using all available 10-yma values of <PWS> versus <NAO> (from among the 14 fits listed in table 24). As before, the vertical and horizontal lines are the parametric median values and the diagonal line is the inferred linear regression between the two parameters, having $r = -0.83$ and $se = 2.1$ kt. Likewise, as with the scatter plots of <N. LAT> versus <AMO> and <W. LONG> versus <ONI>, the inferred regression between <PWS> and <NAO> is one that varies inversely (i.e., a negative correlation). Expressed as a 2×2 contingency table, the probability of obtaining the observed result, or one more suggestive of a departure from independence (chance), is computed using the Fisher's exact test for 2×2 contingency tables to be $P = 0.36\%$. Thus, for the distribution of 10-yma values of <PWS> versus <NAO>, there is only a 0.36% chance (i.e., about 1 chance in 278) that the observed 2×2 contingency table, or one more suggestive of a departure from independence, occurs purely by chance. Hence, there is little doubt not to believe that <PWS> is somewhat dependent on <NAO>. Obviously, strong positive <NAO> means greater likelihood for decreased <PWS>, while strong negative <NAO> means greater likelihood of increased <PWS>. In particular, when the 10-yma <NAO> ≥0, the 10-yma <PWS> always is ≤74.3 kt (i.e., 69.1–74.3 kt), and when the 10-yma <NAO> <0 °C, the 10-yma <PWS> always is ≥72 kt (i.e., 72–82.3 kt).

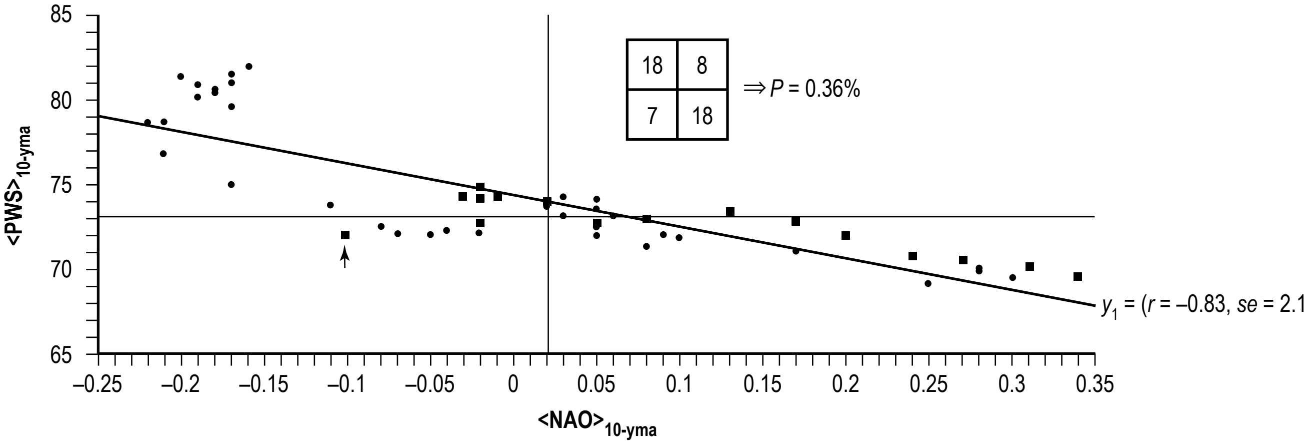

Figure 65. 10-yma values of <PWS> versus 10-yma values of <NAO>.

Recall that prior to 1974 and subsequent to 1999, the 10-yma <NAO> values always are negative, while during the intervening years (i.e., 1968–1997) they always are positive (see fig. 32 and/or table 17). Such behavior possibly suggests a cyclic nature for <NAO>, which, if true, suggests that the current, more active interval will persist at least another one or two decades, inferring the 10-yma <PWS> ≥74.9 kt over the near-term, foreseeable future. (The paired point for the year 2006, which is not plotted, remains in the lower-left quadrant like the paired point for 2005, being located at $\langle NAO \rangle_{10\text{-yma}} = -0.16$ and $\langle PWS \rangle_{10\text{-yma}} = 72$.)

From figure 32, the 10-yma <NAO> for 2007 is expected to be about –0.19 ± 0.03, inferring a yearly <NAO> for 2012 that is about –0.94 ± 0.6. A 10-yma <NAO> = –0.19 in 2007 implies a 10-yma <PWS> = 78.1 ± 2.1 kt for 2007 (i.e., located in the upper-left quadrant), inferring a yearly <PWS> >150 kt in 2012, which is completely unrealistic, since the largest observed <PWS> is 100.4 kt (in 1950). From figure 17, one anticipates the 10-yma <PWS> to be about 72 ± 1 kt for 2007 (i.e., located in the lower-left quadrant), inferring a yearly <PWS> ≤94.2 kt in 2012.

2.9.10 ACE Versus <AMO>

Figure 66 represents the best fit using all available 10-yma values of ACE versus <AMO> (from among the 14 fits listed in table 24). As before, the vertical and horizontal lines are the parametric median values and the diagonal line is the inferred linear regression between the two parameters, having $r = 0.92$ and $se = 12$. Expressed as a 2×2 contingency table, the probability of obtaining the observed result, or one more suggestive of a departure from independence (chance), is computed using the Fisher's exact test for 2×2 contingency tables to be $P = 7.2 \times 10^{-11}\%$. Thus, for the distribution of 10-yma values of ACE versus <AMO>, there is only a $7.2 \times 10^{-11}\%$ chance (i.e., about 1 chance in 1.4×10^{12}) that the observed 2×2 contingency table, or one more suggestive of a departure from independence, occurs purely by chance. Hence, there is little doubt not to believe that ACE is strongly dependent on <AMO>. Obviously, strong positive <AMO> means greater likelihood for increased ACE, while strong negative <AMO> means greater likelihood of decreased ACE. In particular, when the 10-yma <AMO> ≥0 °C, the 10-yma ACE always is ≥108.3 (i.e., 108.3–159.7), and when the 10-yma <AMO> <0 °C, the 10-yma ACE always is ≤114.6 (i.e., 67.4–114.6).

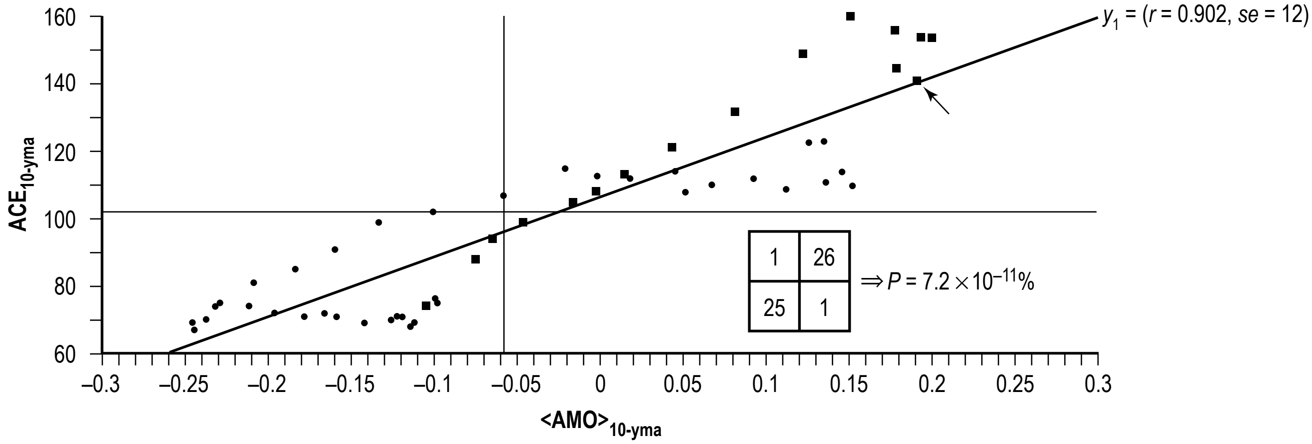

Figure 66. 10-yma values of ACE versus 10-yma values of <AMO>.

Recall that prior to 1964 and subsequent to 1995, the 10-yma <AMO> values always are positive, while during the intervening years (i.e., 1968–1997) they always are negative (see fig. 41 and/or table 17). Such behavior possibly suggests a cyclic nature for <AMO>, which, if true, suggests that the current, more active interval will persist at least another one or two decades, inferring the 10-yma ACE ≥103.5 over the near-term, foreseeable future. (Countering this is the observation that the 10-yma ACE appears to be slowly declining in value from its peak of 159.7 in 2000 to 141.3 in 2005; it did increase slightly in 2006 to 144.6. The paired point for the year 2006, which is not plotted, remains in the upper-right quadrant, being located at $\langle AMO \rangle_{10\text{-yma}}$ = 0.206 °C and $ACE_{10\text{-yma}}$ = 144.6.)

From figure 41, the 10-yma <AMO> for 2007 is expected to be about 0.226 ± 0.015 °C, inferring a yearly <AMO> for 2012 that is about 0.496 ± 0.3 °C. A 10-yma <AMO> = 0.226 °C in 2007 implies a 10-yma ACE = 146.5 ± 12 for 2007 (i.e., located in the upper-right quadrant), inferring a yearly ACE 183 ± 240 in 2012 (the minimum value for the 10-yma ACE in 2007 is 137.4). From figure 21, one anticipates the 10-yma ACE to be about 149.1 ± 7.1 for 2007 (i.e., located in the upper-right quadrant), inferring a yearly ACE >93 in 2012.

2.9.11 NSD Versus <NTA>

Figure 67 represents the best fit using all available 10-yma values of NSD versus <NTA> (from among the 14 fits listed in table 24). As before, the vertical and horizontal lines are the parametric median values and the diagonal line is the inferred linear regression between the two parameters, having $r = 0.93$ and $se = 4.5$ days. Expressed as a 2×2 contingency table, the probability of obtaining the observed result, or one more suggestive of a departure from independence (chance), is computed using the Fisher's exact test for 2×2 contingency tables to be $P = 0.08\%$. Thus, for the distribution of 10-yma values of NSD versus <NTA>, there is only 0.08% chance (i.e., about 1 chance in 1,250) that the observed 2×2 contingency table, or one more suggestive of a departure from independence, occurs purely by chance. Hence, one suspects a dependence of NSD on <NTA>, especially now in the current, more active interval, with a warmer North Atlantic temperature anomaly indicative of

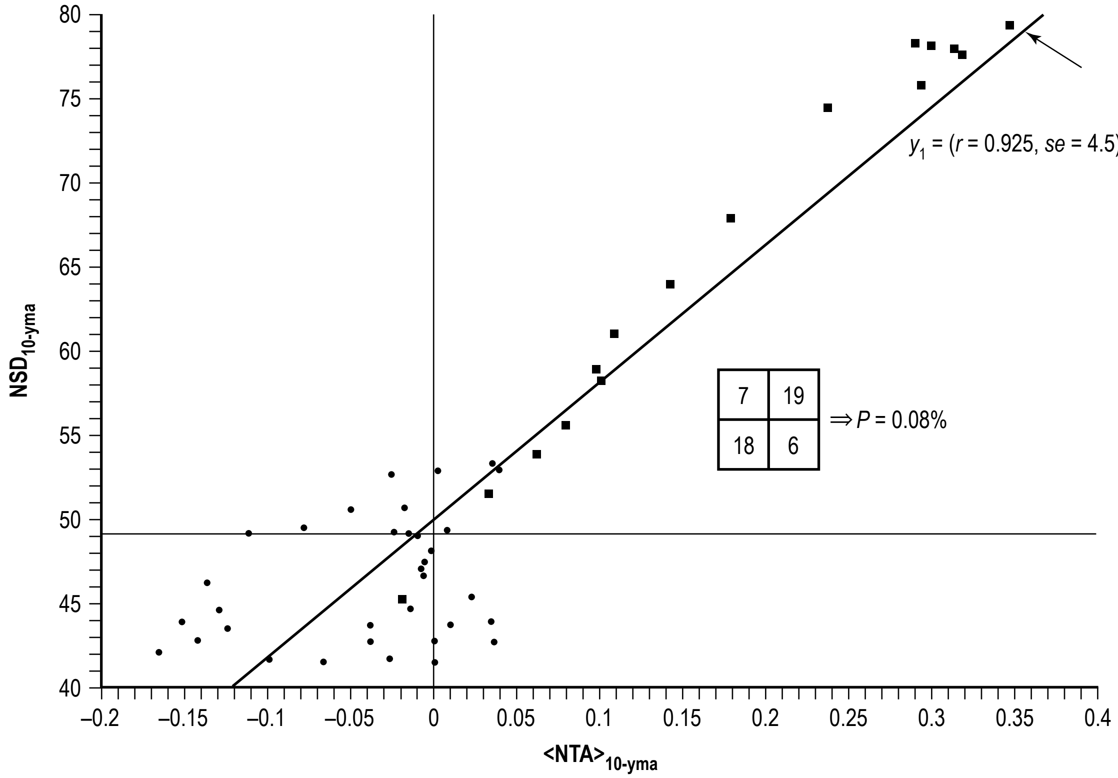

Figure 67. 10-yma values of NSD versus 10-yma values of <NTA>.

greater NSD and a cooler North Atlantic temperature anomaly indicative of lesser NSD. In particular, when the 10-yma <NTA> is negative, the 10-yma NSD usually is <49 days (and always <53 days) and when the 10-yma <NTA> is positive in value, the 10-yma NSD usually is >49 days. When the 10-yma <NTA> exceeds 0.04 °C, the 10-yma NSD always exceeds 53 days.

As before, interesting is that the probability for obtaining the observed distribution is driven by the current, more active interval (the filled squares), with 15 of the 16 10-yma values for the current, more active interval lying in the upper-right quadrant. In fact, during the current, more active interval, the 10-yma NSD has increased steadily from 45.23 days in 1990 to 86.59 days in 2006, an increase of >90%. Since first difference values do not change radically from 1 yr to the next (see figs. 22 and 38), it is apparent that the current, more active interval likely will persist for another decade or more, presuming the temperature anomaly is cyclic, or possibly longer if the temperature anomaly (increased strength) is due to long-term global warming. (The paired point for the year 2006 is unknown since NTA has not been updated beyond December 2010. However, one suspects that, should it become available, it would be located in the upper-right quadrant.)

The second best fit for NSD is the one against <AT>, having r = 0.91, se = 4.7 days, and P = 0.01%. Based on <AT>, the 10-yma NSD definitely would be located in the upper-right quadrant since the minimum value for NSD in 2007 is 84.9 days. From figure 22, the 10-yma NSD for

2007 is expected to be about 88.87 ± 2.42 days, inferring a yearly NSD >31 days for 2012 (to as many as 128 days; the observed range of NSD is 13.75 days in 1983 to 191.25 days in 2010).

2.9.12 ACE/NSD Versus <AMM>

Figure 68 represents the best fit using all available 10-yma values of ACE/NSD versus <AMM> (from among the 14 fits listed in table 24). As before, the vertical and horizontal lines are the parametric median values and the diagonal line is the inferred linear regression between the two parameters, having $r = 0.88$ and $se = 0.1$. Expressed as a 2×2 contingency table, the probability of obtaining the observed result, or one more suggestive of a departure from independence (chance), is computed using the Fisher's exact test for 2×2 contingency tables to be $P = 1.2 \times 10^{-8}\%$. Thus, for the distribution of 10-yma values of ACE/NSD versus <AMM>, there is only a $1.2 \times 10^{-8}\%$ chance (i.e., about 1 chance in 8.3×10^{9}) that the observed 2×2 contingency table, or one more suggestive of a departure from independence, occurs purely by chance. Hence, there is little doubt not to believe that ACE/NSD is dependent on <AMM>. Obviously, strong positive <AMM> means greater likelihood for increased ACE/NSD, while strong negative <AMM> means greater likelihood of decreased ACE/NSD. In particular, when the 10-yma <AMM> ≥0, the 10-yma ACE/NSD always is ≥1.85 (i.e., 1.85–2.27), and when the 10-yma <AMM> <0, the 10-yma PWS always is ≤1.81 (i.e., 1.55–1.81).

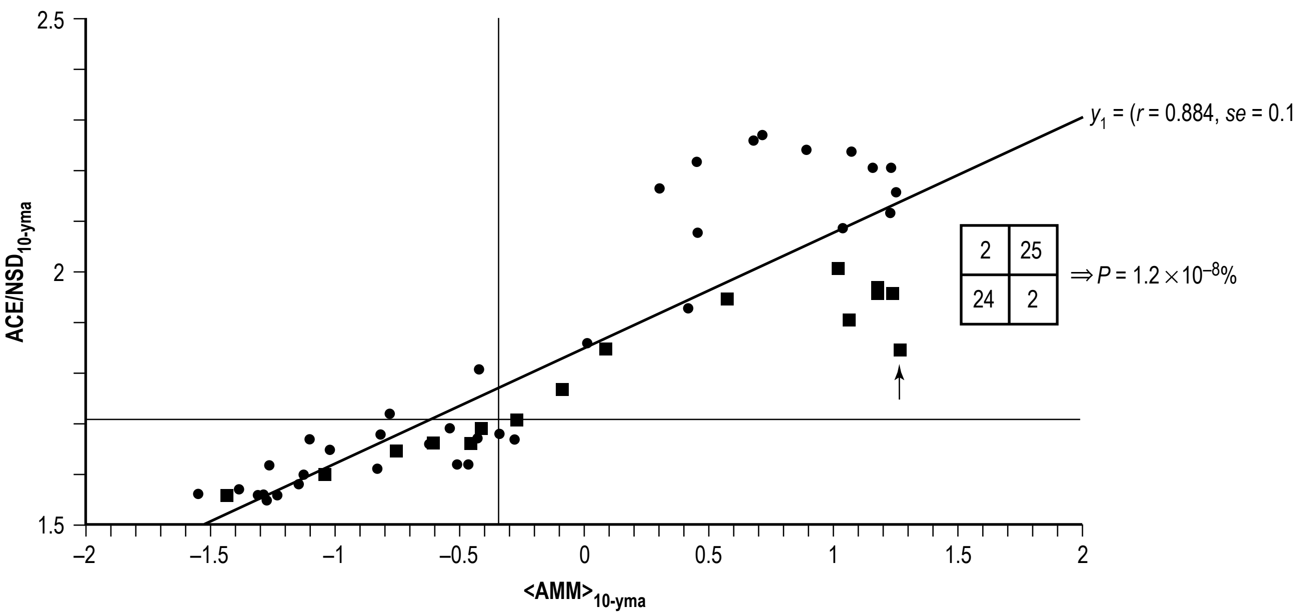

Figure 68. 10-yma values of ACE/NSD versus 10-yma values of <AMM>.

Recall that prior to 1968 and subsequent to 1997, the 10-yma <AMM> values always are positive, while during the intervening years (i.e., 1968–1997) they always are negative (see fig. 42 and/or table 17). Such behavior possibly suggests a cyclic nature for <AMM>, which, if true, suggests that the current, more active interval will persist at least another one or two decades, inferring the 10-yma ACE/NSD ≥1.83 over the near-term, foreseeable future (certainly, ACE/NSD ≥1.71). (The paired point for the year 2006, which is not plotted, remains in the upper-right quadrant, being located at <AMM>$_{10\text{-yma}}$ = 1.61 and ACE/NSD$_{10\text{-yma}}$ = 1.81.)

From figure 42, the 10-yma <AMM> for 2007 is expected to be about 1.79 ± 0.17, inferring a yearly <AMM> for 2012 that is about 2.08 ± 3.4. A 10-yma <AMM> = 1.79 in 2007 implies a 10-yma ACE/NSD = 2.26 ± 0.1 for 2007 (i.e., located in the upper-right quadrant). However, such a value simply is too high, for it suggests a completely unrealistic yearly ACE/NSD ≥10.14 in 2012. From figure 26, one anticipates the 10-yma ACE/NSD to be about 1.83 ± 0.05 for 2007, inferring a yearly ACE/NSD >2.54 in 2012. (The minimum value 10-yma ACE/NSD for 2007 is 1.65. The value of the 10-yma ACE/NSD has been tracking steadily downward from its high in the current, more active interval of 2.01 in 2000 to 1.81 in 2006, suggesting that the 10-yma ACE/NSD will be <1.81 in 2007 if the downward progression continues. The ratio has been tracking downward because 10-yma values of ACE have been decreasing, while 10-yma values of NSD have been increasing.)

2.9.13 HISACE Versus <AMM>

Figure 69 represents the best fit using all available 10-yma values of HISACE versus <AMM> (from among the 14 fits listed in table 24). As before, the vertical and horizontal lines are the parametric median values and the diagonal line is the inferred linear regression between the two parameters, having $r = 0.9$ and $se = 3.3$. Expressed as a 2×2 contingency table, the probability of obtaining the observed result, or one more suggestive of a departure from independence (chance), is computed using the Fisher's exact test for 2×2 contingency tables to be $P = 1 \times 10^{-7}\%$. Thus, for the distribution of 10-yma values of HISACE versus <AMM>, there is only a $1 \times 10^{-7}\%$ chance (i.e., about 1 chance in 1×10^9) that the observed 2×2 contingency table, or one more suggestive of a departure from independence, occurs purely by chance. Hence, there is little doubt not to believe that HISACE is dependent on <AMM>. Obviously, strong positive <AMM> means greater likelihood for increased HISACE, while strong negative <AMM> means greater likelihood of decreased HISACE. In particular, when the 10-yma <AMM> ≥0, the 10-yma HISACE always is ≥34 (i.e., 34–44.1), and when the 10-yma <AMM> <0, the 10-yma HISACE always is ≤33.8 (i.e., 21.4–33.8).

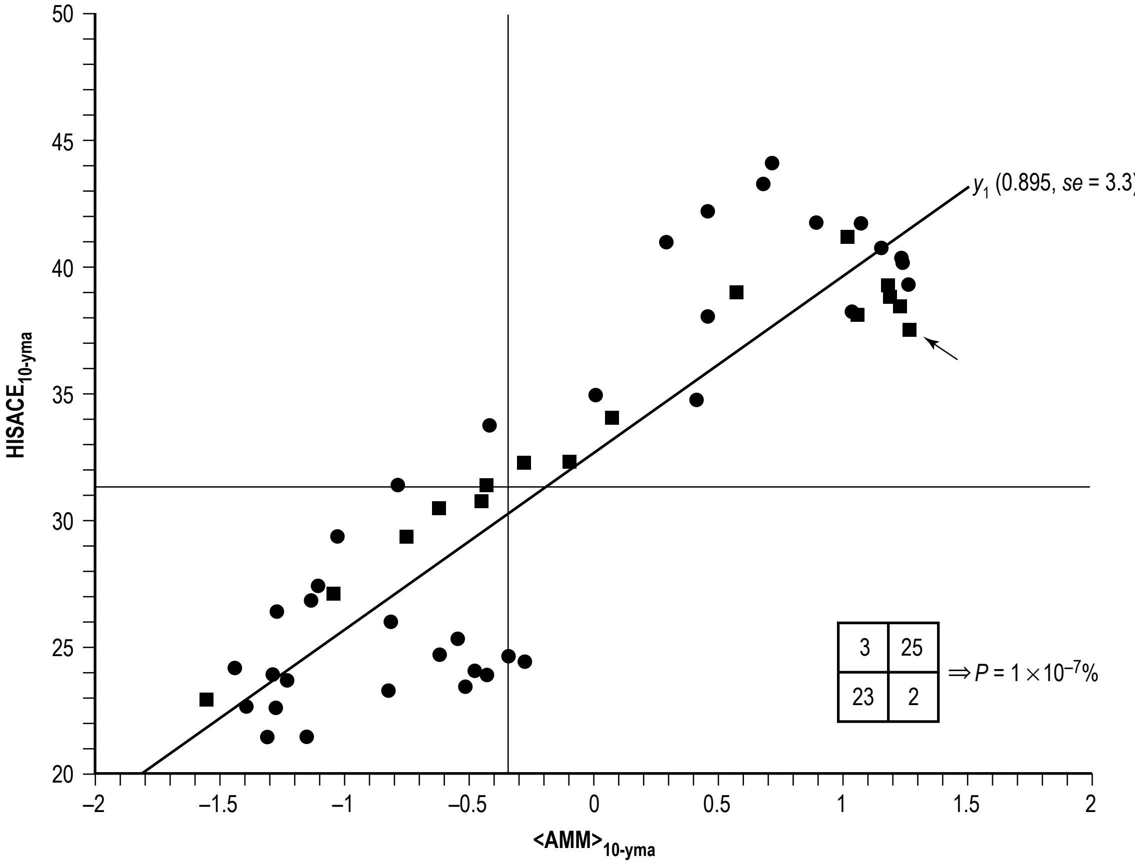

Figure 69. 10-yma values of HISACE versus 10-yma values of <AMM>.

Recall that prior to 1968 and subsequent to 1997, the 10-yma <AMM> values always are positive, while during the intervening years (i.e., 1968–1997) they always are negative (see fig. 42 and/or table 17). Such behavior possibly suggests a cyclic nature for <AMM>, which, if true, suggests that the current, more active interval will persist at least another one or two decades, inferring the 10-yma HISACE ≥32.8 over the near-term, foreseeable future (certainly, HISACE ≥31.4). (The paired point for the year 2006, which is not plotted, remains in the upper-right quadrant, being located at <AMM>$_{\text{10-yma}}$ = 1.61 and HISACE$_{\text{10-yma}}$ = 38.2.)

From figure 42, the 10-yma <AMM> for 2007 is expected to be about 1.79 ± 0.17, inferring a yearly <AMM> for 2012 that is about 2.08 ± 3.4. A 10-yma <AMM> = 1.79 in 2007 implies a 10-yma HISACE = 45.2 ± 3.3 for 2007 (i.e., located in the upper-right quadrant), inferring a yearly HISACE >85.6 in 2012. However, from figure 27, one anticipates the 10-yma HISACE to be about 39.1 ± 1.8 for 2007, inferring a yearly HISACE <65.6 in 2012. (The minimum value 10-yma HISACE for 2007 is 37.6.)

2.9.14 LISNSD Versus <QBO>

Figure 70 represents the best fit using all available 10-yma values of LISNSD versus <QBO> (from among the 14 fits listed in table 24). As before, the vertical and horizontal lines are the parametric median values and the diagonal line is the inferred linear regression between the two parameters, having $r = -0.7$ and $se = 1$. Expressed as a 2×2 contingency table, the probability of obtaining the observed result, or one more suggestive of a departure from independence (chance), is computed using the Fisher's exact test for 2×2 contingency tables to be $P = 1.3 \times 10^{-4}\%$. Thus, for the distribution of 10-yma values of LISNSD versus <QBO>, there is only a $1.3 \times 10^{-4}\%$ chance (i.e., about 1 chance in 7.7×10^5) that the observed 2×2 contingency table, or one more suggestive of a departure from independence, occurs purely by chance. Hence, there is little doubt not to believe that LISNSD is dependent on <QBO>. Obviously, less negative <QBO> means greater likelihood for decreased LISNSD, while more negative <QBO> means greater likelihood of increased LISNSD. In particular, when the 10-yma <QBO> is less negative than –3.43 ms^{-1}, the 10-yma LISNSD usually is <11.64 days, and when the 10-yma <QBO> is more negative than –3.42 ms^{-1}, the 10-yma LISNSD usually is ≥11.64 days.

The 10-yma <QBO> has consistently been negative in value throughout the interval 1950–2005, varying between –2.3 and –4.6 ms^{-1}, while the yearly <QBO> has varied both negatively and positively between –17.13 and 10.17 ms^{-1}. On the other hand, the 10-yma LISNSD has varied between 9.3 and 13.66 days, while the yearly LISNSD has varied between 3.75 and 21.25 days. In particular, between 1952 and 1971 (except for 1954 and 1955), the 10-yma LISNSD consistently was above the long-term mean (11.46 days), while it consistently was below the long-term mean between 1972 and 1994, increasing above the long-term mean in 1995 and continuing to be above the long-term mean since. Such behavior possibly suggests a cyclic nature for LISNSD, but not so much for <QBO>, although the yearly <QBO> seems to be undergoing greater year-to-year swings now than was seen prior to the current, more active interval. (The paired point for the year 2006, which is not plotted, remains in the upper-left quadrant, being located at $\langle QBO \rangle_{10\text{-yma}} = -3.82$ ms^{-1} and $LISNSD_{10\text{-yma}} = 12.51$ days.)

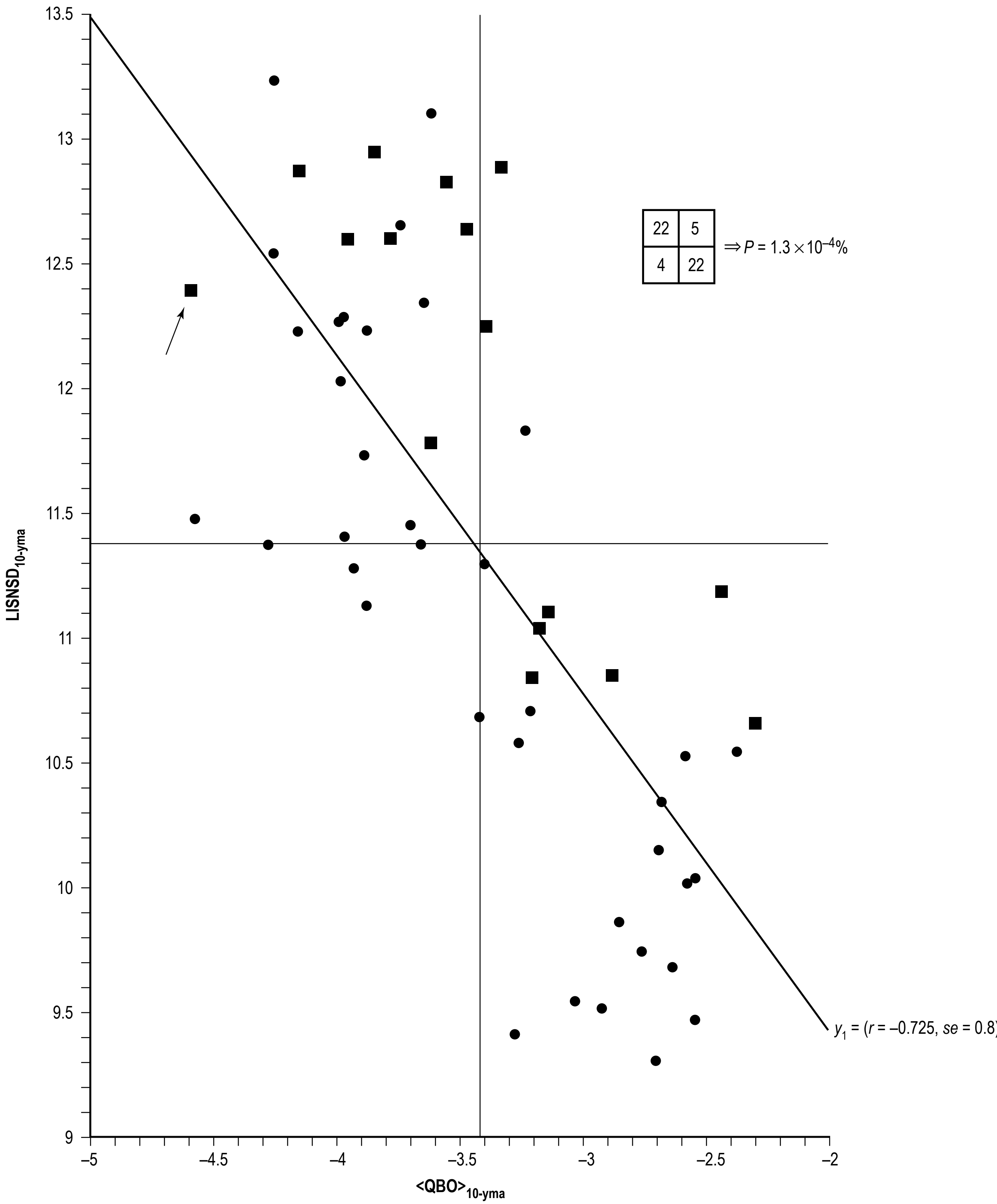

Figure 70. 10-yma values of LISNSD versus 10-yma values of <QBO>.

From figure 40, the value of the 10-yma <QBO> for 2007 is expected to measure about –3.82 ± 0.37 ms^{-1}, inferring a yearly <QBO> value for 2012 of about –8.54 ± 7.4 ms^{-1}. A 10-yma <QBO> = –3.82 ms^{-1} in 2007 implies a 10-yma LISNSD = 12.18 ± 1.3 days for 2007 (i.e., located in the upper-left quadrant), inferring a yearly LISNSD ≤33.35 days in 2012. However, from figure 28, one anticipates the 10-yma LISNSD to be about 12.51 ± 0.32 days for 2007, inferring a yearly LISNSD <21 days in 2012. (The minimum value 10-yma LISNSD for 2007 is 11.81 days.)

2.9.15 <NSD> Versus <AMO>

Figure 71 represents the best fit using all available 10-yma values of <NSD> versus <AMO> (from among the 14 fits listed in table 24). As before, the vertical and horizontal lines are the parametric median values and the diagonal line is the inferred linear regression between the two parameters, having r = 0.73 and se = 0.3 days. Expressed as a 2×2 contingency table, the probability of obtaining the observed result, or one more suggestive of a departure from independence (chance), is computed using the Fisher's exact test for 2×2 contingency tables to be $P = 7.8 \times 10^{-7}\%$. Thus, for the distribution of 10-yma values of <NSD> versus <AMO>, there is only a $7.8 \times 10^{-7}\%$ chance (i.e., about 1 chance in 1.3×10^{8}) that the observed 2×2 contingency table, or one more suggestive of a departure from independence, occurs purely by chance. Hence, there is little doubt not to believe that <NSD> is strongly dependent on <AMO>. Obviously, strong positive <AMO> means greater likelihood for increased <NSD>, while strong negative <AMO> means greater likelihood of decreased <NSD>. In particular, when the 10-yma <AMO> ≥0 °C, the 10-yma <NSD> always is ≥4.91 days (i.e., 4.91–5.52 days), and when the 10-yma <AMO> <0 °C, the 10-yma <NSD> usually is ≤4.91 days (4.28–4.91 days; nine exceptions: 1964–1970, 1994, and 1995).

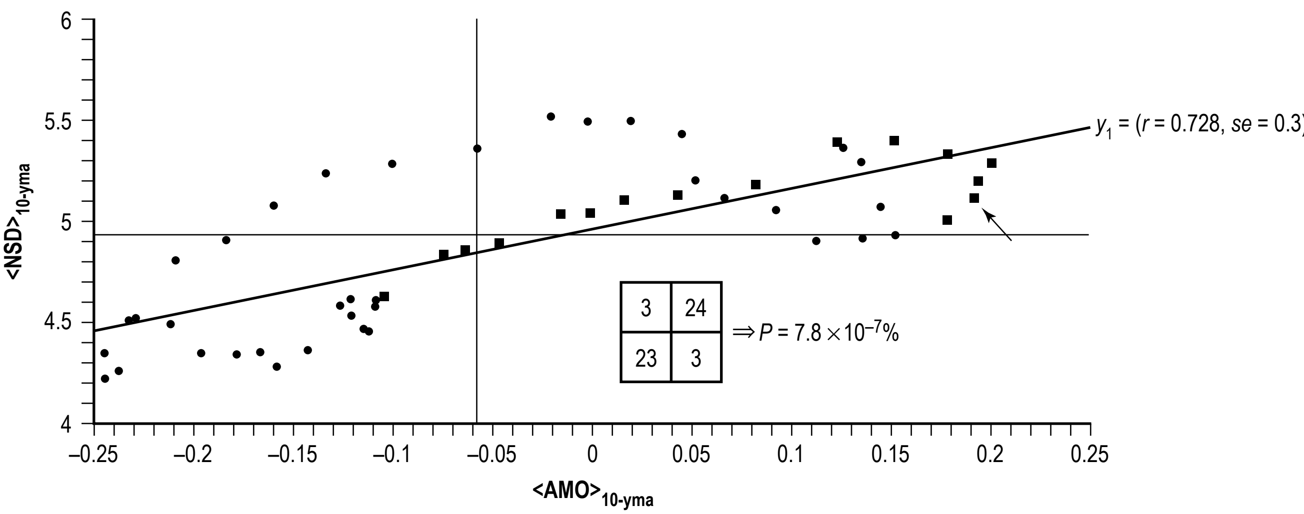

Figure 71. 10-yma values of <NSD> versus 10-yma values of <AMO>.

Recall that prior to 1964 and subsequent to 1995, the 10-yma <AMO> values always are positive, while during the intervening years (i.e., 1968–1997) they always are negative (see fig. 41 and/or table 17). Such behavior possibly suggests a cyclic nature for <AMO>, which, if true, suggests that the current, more active interval will persist, at least, another one or two decades, inferring the 10-yma <NSD> ≥4.94 days over the near-term, foreseeable future. (The paired point for the year 2006, which is not plotted, remains in the upper-right quadrant, being located at <AMO>$_{10\text{-yma}}$ = 0.206 °C and <NSD>$_{10\text{-yma}}$ = 5.4 days.)

From figure 41, the 10-yma <AMO> for 2007 is expected to be about 0.226 ± 0.015 °C, inferring a yearly <AMO> for 2012 that is about 0.496 ± 0.3 °C. A 10-yma <NSD> = 0.226 °C in 2007 implies a 10-yma <NSD> = 5.44 ± 0.3 days for 2007 (i.e., located in the upper-right quadrant), inferring a yearly <NSD> ≤7.29 days in 2012 (the minimum value for the 10-yma <NSD> in 2007 is 5.38 days). Based on the expected first difference during the current, more active interval, one expects the 10-yma <NSD> = 5.43 ± 0.11 days for 2007, inferring a yearly <NSD> ≤3.29 days. (The yearly <NSD> has a range of 2.46–10.07 days, with the two extremes occurring in 1977 and 2010, respectively. In 2011, the yearly <NSD> measured 4.82 days.)

2.9.16 NHD Versus <AMO>

Figure 72 represents the best fit using all available 10-yma values of NHD versus <AMO> (from among the 14 fits listed in table 24). As before, the vertical and horizontal lines are the parametric median values and the diagonal line is the inferred linear regression between the two parameters, having r = 0.82 and se = 3.4 days. Expressed as a 2×2 contingency table, the probability of obtaining the observed result, or one more suggestive of a departure from independence (chance), is computed using the Fisher's exact test for 2×2 contingency tables to be $P = 4.7 \times 10^{-10}$%. Thus, for the distribution of 10-yma values of NHD versus <AMO>, there is only a 4.7×10^{-10}% chance (i.e., about 1 chance in 2.1×10^{11}) that the observed 2×2 contingency table, or one more suggestive of a departure from independence, occurs purely by chance. Hence, there is little doubt not to believe that NHD is strongly dependent on <AMO>. Obviously, strong positive <AMO> means greater likelihood for increased NHD, while strong negative <AMO> means greater likelihood of decreased NHD. In particular, when the 10-yma <AMO> ≥0 °C, the 10-yma NHD always is ≥26.51 days (i.e., 26.51–34.46 days), and when the 10-yma <AMO> <0 °C, the 10-yma NHD usually is ≤25.01 days (i.e., 15.84–25.01 days; 7 exceptions: 1964–1968, 1994, and 1995).

Recall that prior to 1964 and subsequent to 1995, the 10-yma <AMO> values always are positive, while during the intervening years (i.e., 1968–1997) they always are negative (see fig. 41 and/or table 17). Such behavior possibly suggests a cyclic nature for <AMO>, which, if true, suggests that the current, more active interval will persist, at least, another one or two decades, inferring the 10-yma NHD ≥26.51 days over the near-term, foreseeable future. (The paired point for the year 2006, which is not plotted, remains in the upper-right quadrant, being located at <AMO>$_{10\text{-yma}}$ = 0.206 °C and NHD$_{10\text{-yma}}$ = 27.68 days.)

From figure 41, the 10-yma <AMO> for 2007 is expected to be about 0.226 ± 0.015 °C, inferring a yearly <AMO> for 2012 that is about 0.496 ± 0.3 °C. A 10-yma <AMO> = 0.226 °C in 2007 implies a 10-yma NHD = 33.34 ± 3.4 for 2007 (i.e., located in the upper-right quadrant), inferring a yearly NHD ≥54.55 days in 2012. However, from figure 23, one anticipates the 10-yma NHD to be about 28.33 ± 1.76 days for 2007, inferring a yearly NHD <58 days in 2012. (The minimum value for the 10-yma NHD in 2007 is 27.21 days.)

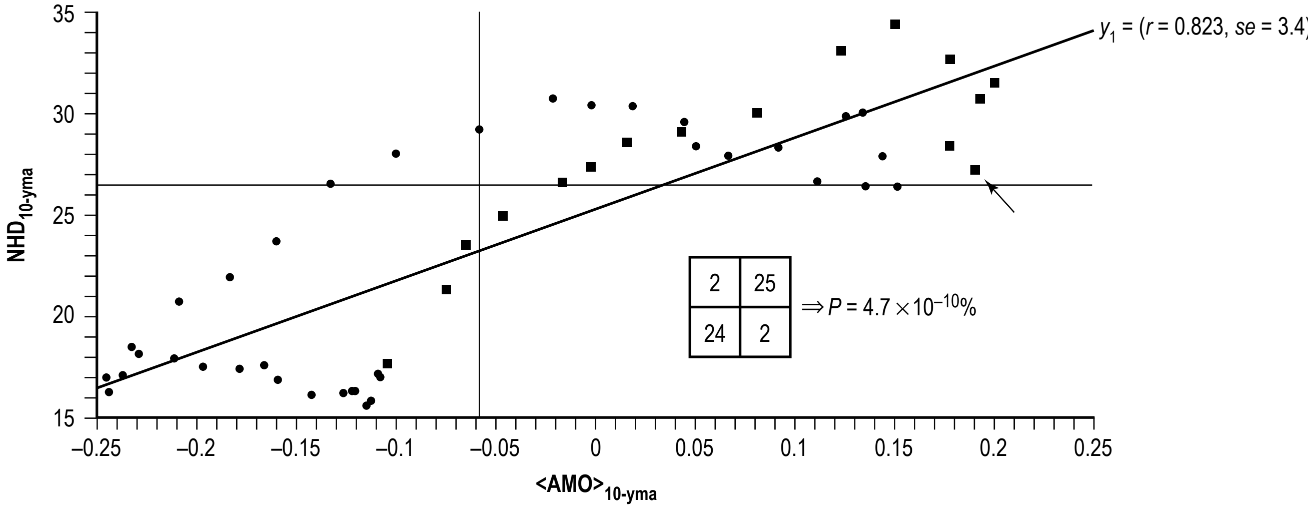

Figure 72. 10-yma values of NHD versus 10-yma values of <AMO>.

2.9.17 NMHD Versus <AMO>

Figure 73 represents the best fit using all available 10-yma values of NMHD versus <AMO> (from among the 14 fits listed in table 24). As before, the vertical and horizontal lines are the parametric median values and the diagonal line is the inferred linear regression between the two parameters, having r = 0.95 and se = 0.9 days. Expressed as a 2×2 contingency table, the probability of obtaining the observed result, or one more suggestive of a departure from independence (chance), is computed using the Fisher's exact test for 2×2 contingency tables to be $P = 7.2 \times 10^{-11}$%. Thus, for the distribution of 10-yma values of ACE versus <AMO>, there is only a 7.2×10^{-11}% chance (i.e., about 1 chance in 14×10^{9}) that the observed 2×2 contingency table, or one more suggestive of a departure from independence, occurs purely by chance. Hence, there is little doubt not to believe that NMHD is strongly dependent on <AMO>. Obviously, strong positive <AMO> means greater likelihood for increased NMHD, while strong negative <AMO> means greater likelihood of decreased NMHD. In particular, when the 10-yma <AMO> ≥0 °C, the 10-yma ACE always is ≥ 6.2 days (i.e., 6.20–10.43 days), and when the 10-yma <AMO> <0 °C, the 10-yma ACE usually is ≤5.85 days (i.e., 1.90–5.85 days; two exceptions: 1964 and 1966).

Recall that prior to 1964 and subsequent to 1995, the 10-yma <AMO> values always are positive, while during the intervening years (i.e., 1968–1997) they always are negative (see fig. 41 and/or table 17). Such behavior possibly suggests a cyclic nature for <AMO>, which, if true, suggests that the current, more active interval will persist at least another one or two decades, inferring the 10-yma NMHD ≥5.85 days over the near-term, foreseeable future. (The paired point for the year 2006, which is not plotted, remains in the upper-right quadrant, being located at $\langle AMO \rangle_{10\text{-yma}}$ = 0.206 °C and $NMHD_{10\text{-yma}}$ = 9.39 days.)

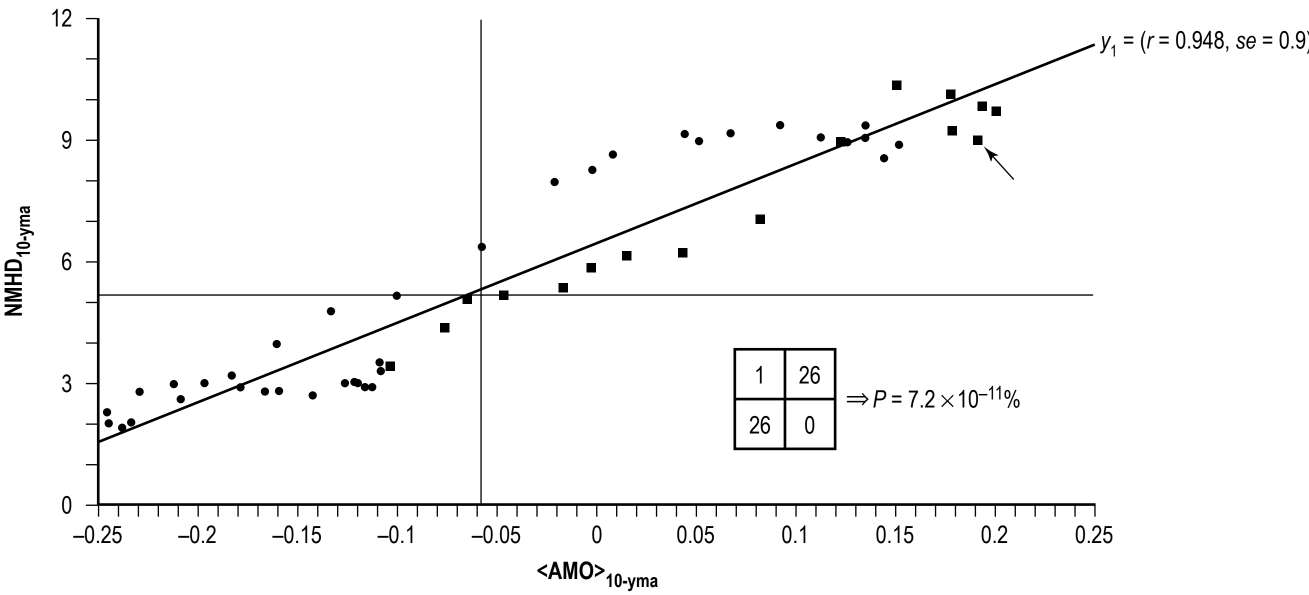

Figure 73. 10-yma values of NMHD versus 10-yma values of <AMO>.

From figure 41, the 10-yma <AMO> for 2007 is expected to be about 0.226 ± 0.015 °C, inferring a yearly <AMO> for 2012 that is about 0.496 ± 0.3 °C. A 10-yma <AMO> = 0.226 °C in 2007 implies a 10-yma NMHD = 10.95 ± 0.9 days for 2007 (i.e., located in the upper-right quadrant), inferring a yearly NMHD = 34 ± 18 days in 2012 (the minimum value for the 10-yma NMHD in 2007 is 9.25 days). However, from figure 24, one anticipates the 10-yma NMHD to be about 9.77 ± 0.69 days for 2007, inferring a yearly NMHD <24 days in 2012. (The minimum value for the 10-yma NHD in 2007 is 27.21 days.)

2.9.18 NTCA Versus <AMO>

Figure 74 represents the best fit using all available 10-yma values of NTCA versus <AMO> (from among the 14 fits listed in table 24). As before, the vertical and horizontal lines are the parametric median values and the diagonal line is the inferred linear regression between the two parameters, having $r = 0.93$ and $se = 9.8$. Expressed as a 2×2 contingency table, the probability of obtaining the observed result, or one more suggestive of a departure from independence (chance), is computed using the Fisher's exact test for 2×2 contingency tables to be $P = 7.2 \times 10^{-11}\%$. Thus, for the distribution of 10-yma values of ACE versus <AMO>, there is only a $7.2 \times 10^{-11}\%$ chance (i.e., about 1 chance in 14×10^9) that the observed 2×2 contingency table, or one more suggestive of a departure from independence, occurs purely by chance. Hence, there is little doubt not to believe that NTCA is strongly dependent on <AMO>. Obviously, strong positive <AMO> means greater likelihood for increased NTCA, while strong negative <AMO> means greater likelihood of decreased NTCA. In particular, when the 10-yma <AMO> ≥0 °C, the 10-yma NTCA always is ≥118% (i.e., 118%–160.5%), and when the 10-yma <AMO> <0 °C, the 10-yma NTCA always is ≤120.4% (i.e., 75.5%–120.4%).

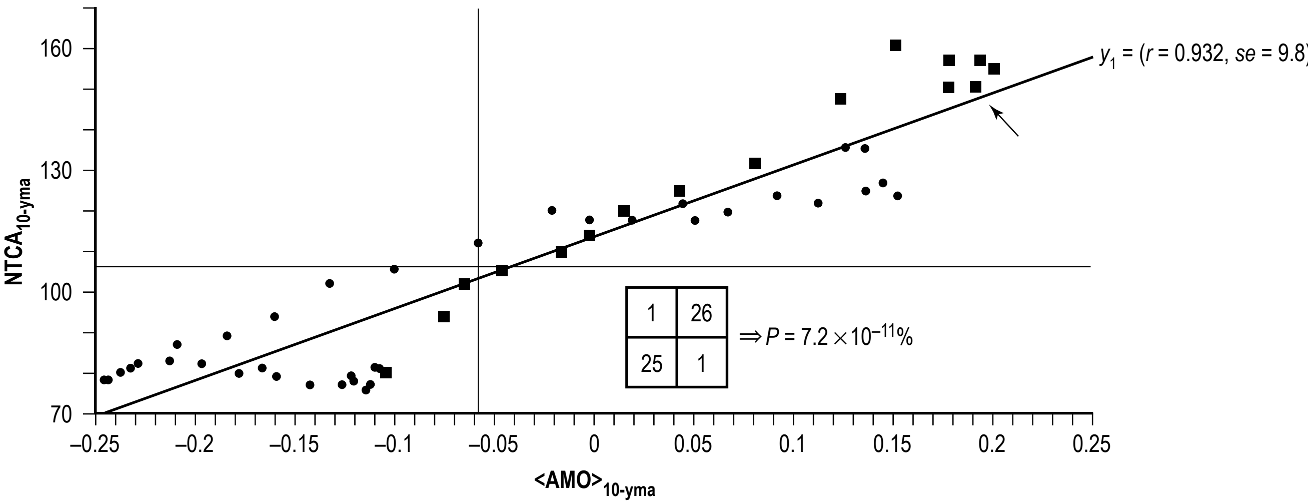

Figure 74. 10-yma values of NTCA versus 10-yma values of <AMO>.

Recall that prior to 1964 and subsequent to 1995, the 10-yma <AMO> values always are positive, while during the intervening years (i.e., 1968–1997) they always are negative (see fig. 41 and/or table 17). Such behavior possibly suggests a cyclic nature for <AMO>, which, if true, suggests that the current, more active interval will persist at least another one or two decades, inferring the 10-yma NTCA ≥105.5% over the near-term, foreseeable future. (The paired point for the year 2006, which is not plotted, remains in the upper-right quadrant, being located at $\langle AMO \rangle_{10\text{-yma}}$ = 0.206 °C and $NTCA_{10\text{-yma}}$ = 156.1%.)

From figure 41, the 10-yma <AMO> for 2007 is expected to be about 0.226 ± 0.015 °C, inferring a yearly <AMO> for 2012 that is about 0.496 ± 0.3 °C. A 10-yma <AMO> = 0.226 °C in 2007 implies a 10-yma NTCA = 153.6% ± 9.8% for 2007 (i.e., located in the upper-right quadrant), inferring a yearly NTCA ≤219.2% in 2012 (the minimum value for the 10-yma NTCA in 2007 is 152.4%). From figure 25, one anticipates the 10-yma NTCA to be about 160.8% ± 6.3% for 2007 (i.e., located in the upper-right quadrant), inferring a yearly NTCA = 41.2%–293.2% in 2012.

2.9.19 Relational Aspects Between Surface Air Temperature and the ENSO-Related Parameters

Also included in table 24 are the inferred regressions between surface air temperature and the ENSO-related parameters for the intervals 1950–2005 and 1990–2005 using 10-yma values. For the larger interval, <AT> correlates strongly (i.e., $r > |\pm 0.7|$) with <NTA> ($r = 0.9$), <CAR> ($r = 0.83$), and <AMO> ($r = 0.76$). For the current, more active interval, <AT> correlates more strongly (i.e., $r > |\pm 0.95|$) with <AMM> ($r = 0.98$), <AMO> ($r = 0.98$), <NTA> ($r = 0.97$), and <CAR> $r > 0.97$. All of these parameters share a common attribute in that they are measures of temperature, <AT> being a measure of surface air temperature in the North Atlantic basin and <AMO>, <AMM>, <NTA>, and <CAR> being measures of ocean temperature anomalies in the North Atlantic basin. So, one should not be surprised by the high degree of correlation between them.

For the ENSO-related parameters, the following appears true:

(1) <ONI> correlates strongly with <SOI> (r = –0.92), <JMASSTM> (r = 0.91), <MEI> (r = 0.9), <GSSTEI> (r = 0.78), and <PDO> (r = 0.74) for the larger interval. For the current, more active interval, <ONI> correlates more strongly with only <MEI> (r = 0.96) and <GSSTEI> (r = 0.95).

(2) <SOI> correlates strongly with <MEI> (r = –0.98), <ONI> (r = –0.92), <JMASSTEI> (r = –0.92), and <PDO> (r = –0.91) for the larger interval. For the current, more active interval, <SOI> correlates more strongly with <MEI> (r = –0.98) and <AMO> (r = 0.95).

(3) <NAO> correlates strongly with <PDO> (r = 0.84), <MEI> (r = 0.81), <QBO> (r = 0.78), <SOI> (r = –0.77), <GSSTEI> (r = 0.73), and <JMASSTM> (r = 0.7) for the larger interval. For the current, more active interval, <NAO> correlates more strongly with <AMO> (r = –0.97), <NTA> (r = –0.97), <CAR> (r = –0.97), and <AMM> (r = –0.97).

(4) <PDO> correlates strongly with <MEI> (r = 0.95), <SOI> (r = –0.91), <JMASSTM> (r = 0.88), <GSSTEI> (r = 0.85), <NAO> (r = 0.84), <QBO> (r = 0.76), and <ONI> (r = 0.74) for the larger interval. For the current, more active interval, <PDO> best correlates with <GSSTEI> (r = 0.94) and <MEI> (r = 0.94).

(5) For <TNI>, there are no strong correlations for either the larger interval or the current, more active interval. The strongest correlations are with <NTA> (r = –0.6) and <ONI> (r = –0.6) for the larger interval and with <JMASSTM> (r = 0.41) for the current, more active interval, although the latter correlation is not statistically significant.

(6) <MEI> correlates strongly with <SOI> (r = –0.98), <JMASSTM> (r = 0.96), <PDO> (r = 0.95), <ONI> (r = 0.9), <GSSTEI> (r = 0.84), and <NAO> (r = 0.81) for the larger interval. For the current, more active interval, <MEI> correlates more strongly with <SOI> (r = –0.98), <ONI> (r = 0.96), and <GSSTEI> (r = 0.95).

(7) <GSSTEI> correlates strongly with <PDO> (r = 0.85), <MEI> (r = 0.84), <SOI> (r = –0.83), <ONI> (r = 0.78), <JMASSTM> (r = 0.77), and <NAO> (r = 0.73) for the larger interval. For the current, more active interval, <GSSTEI> correlates more strongly with <AMO> (r = –0.96), <ONI> (r = 0.95), and <MEI> (r = 0.95).

(8) <JMASSTM> correlates strongly with <MEI> (r = 0.96), <SOI> (r = –0.92), <ONI> (r = 0.91), <PDO> (r = 0.88), <GSSTEI> (r = 0.77), and <NAO> (r = 0.7) for the larger interval. For the current, more active interval the strongest correlations are for <JMASSTM> with <ONI> (r = 0.77) and <MEI> (r = 0.76).

(9) <NTA> correlates strongly with <CAR> (r = 0.91), <AT> (r = 0.9), and <AMO> (r = 0.82) for the larger interval. For the current, more active interval, <NTA> correlates more strongly with <AMM> (r = 0.997), <AMO> (r = 0.991), <CAR> (r = 0.985), <AT> (r = 0.97), and <NAO> (r = –0.97).

(10) <CAR> correlates strongly with <AMO> ($r = 0.93$), <NTA> ($r = 0.91$), <AT> ($r = 0.83$), and <AMM> ($r = 0.75$) for the larger interval. For the current, more active interval, <CAR> correlates more strongly with <AMO> ($r = 0.996$), <AMM> ($r = 0.985$), <NTA> ($r = 0.985$), <AT> ($r = 0.97$), and <NAO> ($r = –0.968$).

(11) <QBO> correlates strongly with <NAO> ($r = 0.78$), <PDO> ($r = 0.76$), and <AMM> ($r = –0.7$) for the larger interval. For the current, more active interval, the strongest correlations are for <QBO> with <NTA> ($r = –0.84$) and <SOI> ($r = –0.84$).

(12) <AMO> correlates strongly with <CAR> ($r = 0.93$), <AMM> ($r = 0.9$), <NTA> ($r = 0.82$), and <AT> ($r = 0.76$) for the larger interval. For the current, more active interval, <AMO> correlates more strongly with <CAR> ($r = 0.996$), <AMM> ($r = 0.993$), <NTA> ($r = 0.991$), <AT> ($r = 0.979$), <NAO> ($r = –0.973$), <GSSTEI> ($r = –0.957$), and <SOI> ($r = 0.949$).

(13) <AMM> correlates strongly with <AMO> ($r = 0.9$), <CAR> ($r = 0.75$), and <QBO> ($r = –0.7$) for the larger interval. For the current, more active interval, <AMM> correlates more strongly with <NTA> ($r = 0.997$), <AMO> ($r = 0.993$), <CAR> ($r = 0.985$), <AT> ($r = 0.982$), and <NAO> ($r = –0.968$).

2.10 Additional Remarks

Seasonal forecasting of North Atlantic basin tropical cyclone activity now spans nearly 30 yr.[17,35,117–119] Typically, these forecasting techniques often are statistical in nature, relying on measurements of SST and SLP anomalies, the phase/strength of the QBO, and the phase/strength of the ENSO. The product output of these investigations include the expected seasonal number of tropical cyclones, the number of storm days, the number of hurricanes, the number of hurricane days, the number of major or intense hurricanes, the number of major or intense hurricane days, the accumulated cyclone energy, the net tropical cyclone activity, and the number/probability of USLFHs.

2.10.1 The 2011 Season Summary

Table 25 (see appendix) provides a listing of the tropical cyclones that formed in the North Atlantic basin during the 2011 hurricane season, along with parametric values and summaries following the format used in table 1. During the 2011 season, some 19 tropical cyclones formed in the North Atlantic basin, including 18 named storms and one unnamed storm. Of these 19 tropical cyclones, 12 were tropical storms only, 7 were hurricanes, and 4 were major hurricanes. Only one US landfalling hurricane (Irene) occurred, which was the first to strike the US coastline since the 2008 hurricane season. The first tropical cyclone formed on June 28 and the last formed on November 8. At least, one tropical cyclone formed in each of the 6 mo comprising the nominal hurricane season (June–November). The most powerful storms were Katia and Ophelia, both having maximum sustained winds of 120 kt (Ophelia had the lowest pressure, measuring 940 mbar). The highest latitudinal formation was 37.6 °N. (Franklin) and the lowest latitudinal formation was 11 °N. (Katia). The least western longitudinal formation was 29.6 °W. (Katia) and the most western longitudinal formation was 93.5 °W. (Arlene). The highest individual storm ACE was 27 (Katia) and the longest individual

NSD was 13.75 days (Philippe). The season as a whole had NTCA = 145%, meaning that it was about 45% more active climatologically.

Based on regional grouping, there were 4 storms that formed in region 1 (the Gulf of Mexico area). These included Arlene, Don, Lee, and Nate, all attaining only tropical storm strength, except Nate (hurricane). Region 2 (the Caribbean Sea area) accounted for 3 storms, including Emily, Harvey, and Rina, with Rina becoming a major hurricane. Region 3 (the US east coast area) accounted for 6 storms, including Bret, Franklin, Gert, Jose, an unnamed storm, and Sean (the last storm of the 2011 season). While region 3 was the most prolific, none of the storms attained hurricane strength. Region 4 (the lower Atlantic-Cape Verde area) accounted for 5 storms, including Irene, Katia, Maria, Ophelia, and Philippe, all becoming major hurricanes, except Maria and Philippe (hurricanes). Region 5 (the open North Atlantic area) accounted for only one storm (Cindy), a tropical storm.

The number of tropical cyclones (19) is tied for second place with the 1995 season, both having fewer NTC than the 2005 season (28 storms). Also, the number of tropical storms attaining only tropical storm strength (12) is second only to that of the 2005 season (13 tropical storms). The number of hurricanes (7) and number of major hurricanes (4), however, were only slightly above average in number. In terms of PWS, its peak wind speed (120 kt) is below the long-term average (126.9 kt), as is its <PWS> (66.3 kt as compared to 74.9 kt), LP (940 mbar as compared to 938.3 mbar), <LP> (984.2 as compared to 979.2 mbar), ACE/NSD (1.39 as compared to 1.83), HISACE (27 as compared to 32.8), <NSD> (4.74 days as compared to 4.98 days), and NMHD (4.5 days as compared to 6.23 days). However, in terms of ACE, NSD, and LISNSD, all were larger than their respective averages: ACE, 126.3 as compared to 103.5; LISNSD, 13.75 days as compared to 11.46 days; and NSD, 90 days as compared to 55.71 days. The seasonal centroid location (<N. LAT> and <W. LONG>) is essentially the same as its long-term average (22 °N., 65.2 °W. as compared to 22 °N., 64.9 °W.).

Prior to the 2011 season, the feeling was that the season would be one that would be above average in number.[30,120,121] Indeed, overall, the 2011 hurricane season was greater in terms of the frequency of NTC, both in comparison to the long-term average (10.8 tropical cyclones per season) and the average during the current, more active interval (14.8 tropical cyclones per season). Recently, NOAA issued its 2011 NHC Forecast Verification Report, noting that the 2011 Atlantic hurricane season had above-normal activity. [122–124] NOAA also announced the retirement of the name ‘Irene’ from the list of North Atlantic basin storm names.[125] ‘Irene’ will be replaced with ‘Irma’ in the 2017 season. (Irene caused widespread damage along the US east coast and was directly responsible for 48 deaths in the Atlantic basin, with damage in the US estimated to be $15.8 billion.)

2.10.2 The 2012 Season Forecast

Early predictions for the 2012 North Atlantic basin hurricane season suggest that it will be of near average to below average activity, although the official NOAA forecast has not yet been issued (as of this writing, early May 2012). For example, because the tropical Atlantic anomalously cooled during the latter portion of 2011 and because of the increased likelihood for an EN event to occur later this year, the Colorado State University team[126] anticipates reduced hurricane activity and below-average probability for a major hurricane landfall along the US coast and in the Caribbean this hurricane season. In particular, they are presently predicting 10 named storms, 40 named storm days, 4 hurricanes, 16 hurricane days, 2 major hurricanes, 3 major hurricane days, an ACE of 70, and an overall NTCA of about 77%, all parameters being below long-term averages and well below averages based strictly on the current, more active interval.

Likewise, the Met Office[127], the United Kingdom's National Weather Service, estimates the most likely number of tropical cyclones during the 2012 hurricane season to be 10, with a 70% chance that the number will be in the range 7 to 13. They also estimate the most likely value of ACE for the 2012 hurricane season to be 90, with a 70% chance that the index will be in the range of 28 to 152. These estimates are slightly below normal activity relative to the 1980–2010 long-term averages, being 12 and 104, respectively.

The Tropical Risk team[128] also anticipates a below-average season for 2012. For the 2012 hurricane season, they predict NTC = 12.5 ± 4.1, NH = 5.6 ± 2.8, NMH = 2.6 ± 1.6, and ACE = 95 ± 55. They also estimate a 33% probability that the 2012 North Atlantic basin hurricane season ACE index will be above average, a 34% probability that it will be near normal, and a 33% probability that it will be below normal.

Climatologically, based on the long-term interval 1945–2010, the yearly values for the parameters are the following: NTC = 10.8 ± 4, NH = 6.2 ± 2.6, NMH = 2.7 ± 1.9, NUSLFH = 1.6 ± 1.5, PWS = 126.9 ± 19.7 kt, <PWS> = 74.9 ± 9.1 kt, LP = 938.3 ± 20.5 mbar, <LP> = 979.2 ± 8.3 mbar, ACE = 103.5 ± 58.5, NSD = 55.7 ± 30 days, ACE/NSD = 1.83 ± 0.45, HISACE = 32.8 ± 16.1, LISNSD = 11.5 ± 3.6 days, NHD = 26.4 ± 14.4 days, NMHD = 6.2 ± 5.7 days, and NTCA = 112.6% ± 59.3% (all values expressed as the ±1 *sd* prediction interval). However, based on the shorter current, more active interval 1995–2010, some of the averages are considerably higher, although not all. For example, NTC averages about 14.8 ± 4.7, NH = 7.9 ± 3.3, NMH = 3.8 ± 1.8, NUSLFH = 1.9 ± 2, PWS = 131.6 ± 16 kt, <PWS> = 73.8 ± 8.9 kt, LP = 925.4 ±18.5 mbar, <LP> = 978.7 ± 7 mbar, ACE = 146.6 ± 63.2, NSD = 82.6 ± 40.7 days, ACE/NSD = 1.84 ± 0.47, HISACE = 39.2 ± 14.6, LISNSD = 12.9 ± 2.9 days, NHD = 32.1 ± 16 days, NMHD = 9.3 ± 6.2 days, and NTCA = 156.5 % ± 66%. Hence, dependent upon whether the 2012 hurricane season remains similar to or not the nature of the 1995–2010 current, more active interval, one expects either NTC = 11 ± 4 (based on the long-term interval) or NTC = 15 ± 5 (based on the current, more active interval), and so forth.

Based on the Poisson probability distribution for the long-term interval, NTC = 10 ± 1 (35.3%), NTC <9 (25%), and NTC >11 (39.7%); NH = 6 ± 1 (45.7%), NH <5 (25.9%), and NH >7 (28.4%); NMH = 2 ± 1 (64.7%), NMH = 0 (6.7%), and NMH >3 (28.6%); and NUSLFH = 1 ± 1 (78.3%) and NUSLFH >2 (21.7%). Based on the Poisson probability distribution for the current, more active interval, NTC = 14 ± 1 (30.4%), NTC <13 (28.5%), and NTC >15 (41.1%); NH = 7 ± 1 (40.6%), NH <6 (20.1%), and NH >8 (39.3%); NMH = 3 ± 1 (56%), NMH <2 (10.7%), and NMH >4 (33.2%); and NUSLFH = 1 ± 1 (70.4%) and NUSLFH >2 (29.6%).

Based on the Poisson probability distribution for the long-term interval and accounting for the ENSO condition (i.e., the year is classified as ENY, LNY, or NY) results in the following:

(1) If 2012 happens to be classified as ENY, then NTC = 9 ± 1 (38.2%), NTC <8 (30.9%), and NTC >10 (31%); NH = 4 ± 1 (50.8%), NH <3 (14.2%), and NH >5 (35.1%); NMH = 2 ± 1 (72.2%), NMH = 0 (13.5%), and NMH >3 (14.3%); and NUSLFH = 1 ± 1 (89.4%) and NUSLFH >2 (10.6%).

(2) If 2012 happens to be classified as LNY, then NTC = 11 ± 1 (34.1%), NTC <10 (27.2%), and NTC >12 (38.6%); NH = 7 ± 1 (42.8%), NH <6 (30.1%), and NH >8 (27.1%); NMH = 3 ± 1 (59.2%), NMH <2 (13.9%), and NMH >4 (26.9%); and NUSLFH = 2 ± 1 (70.9%), NUSLFH = 0 (11.1%), and NUSLFH >3 (18.1%).

(3) If 2012 happens to be classified as NY, then NTC = 11 ± 1 (34.7%), NTC <10 (31.3%), and NTC >12 (34%); NH = 6 ± 1 (44.9%), NH <5 (22.5%), and NH >7 (32.6%); NMH = 2 ± 1 (64.5%), NMH = 0 (6.7%), and NMH >3 (28.8%); and NUSLFH = 1 ± 1 (77.6%) and NUSLFH >2 (22.4%).

Other factors, however, have been found that appear to mitigate the 2012 seasonal prediction (i.e., besides knowing whether the year 2012 will be classified as ENY, LNY, or NY, following the definition used in this study based on monthly ONI values). These other factors include <AT>, <NAO>, <NTA>, <CAR>, <QBO>, <AMO>, and <AMM>. Because <NTA> and <CAR> have not been updated beyond December 2010, only <AT>, <NAO>, <QBO>, <AMO>, and <AMM> offer the opportunity to perhaps improve the predictive ability for the frequency and strength of the 2012 hurricane season. (<SOI> also could be used as a mitigating factor; however, because of its strong inverse correlation against <ONI>, it was decided to ignore the effects of <SOI>. The other factors are less strongly correlated against <ONI>.)

Recall from figures 29 (<AT>), 32 (<NAO>), 40 (<QBO>), 41 (AMO>), and 42 (<AMM>) and from table 24 (correlations) that these particular parameters appear to influence greatly the frequency and strength of tropical cyclones in the North Atlantic basin. In particular, by knowing the sign of the parameters (i.e., whether the yearly value will be above/below average in the case of yearly <AT> or positive/negative in the case of the yearly <NAO>, <QBO>, <AMO>, and <AMM>), one might be able to better determine the prediction intervals and probabilities of NTC, NH, NMH, and NUSLFH for the 2012 season.

For å<AT>, when the yearly temperature exceeds its long-term average (9.48 °C), one expects greater numbers of tropical cyclones than when the yearly temperature is below the long-term mean. For example, when the yearly temperature is higher than the mean, based on the Poisson probability distribution, NTC = 12 ± 1 (32.8%), NTC <11 (27.9%), and NTC >13 (39.3%); NH = 6 ± 1 (43.5%), NH <5 (18.9%), and NH >7 (37.6%); NMH = 3 ± 1 (59.9%), NMH <2 (14.9%), and NMH >4 (25.2%); and NUSLFH = 2 ± 1 (71.6%), NUSLFH = 0 (12.3%), and NUSLFH >3 (16.1%). In contrast, when the yearly temperature (<AT>) is lower than the mean, based on the Poisson probability distribution, NTC = 9 ± 1 (37.9%), NTC <8 (28.1%), and NTC >10 (34%); NH = 5 ± 1 (47.4%), NH <4 (18%), and NH >6 (34.6%); NMH = 2 ± 1 (70.9%), NMH = 0 (11.2%), and NMH >3 (17.9%); and NUSLFH = 1 ± 1 (86.4%) and NUSLFH >2 (13.6%).

For <NAO>, when the yearly value is positive, one expects fewer numbers of tropical cyclones than when the yearly value is negative. For example, when the yearly value is positive, based on the Poisson probability distribution, NTC = 10 ± 1 (36%), NTC <9 (28.4%), and NTC >12 (35.7%); NH

= 5 ± 1 (48.1%), NH <4 (19.3%), and NH >6 (32.7%); NMH = 2 ± 1 (72.2%), NMH = 0 (13.5%), and NMH >3 (14.3%); and NUSLFH = 1 ± 1 (79.9%) and NUSLFH >2 (20.1%). When the yearly value is negative, based on the Poisson probability distribution, NTC = 11 ± 1 (34.7%), NTC <10 (31%), and NTC >12 (34.4%); NH = 6 ± 1 (43.6%), NH <5 (19.2%), and NH >7 (37.2%); NMH = 3 ± 1 (60.6%), NMH <2 (16.4%), and NMH >4 (23%), NMH >6 (4.8%); and NUSLFH = 1 ± 1 (79.1%) and NUSLFH >2 (20.9%).

For <QBO>, when the yearly value is positive, one expects greater numbers of tropical cyclones than when the yearly value is negative. For example, when the yearly value is positive, based on the Poisson probability distribution, NTC = 11 ± 1 (34.6%), NTC <10 (30.3%), and NTC >12 (35.1%); NH = 6 ± 1 (45%), NH <5 (22.6%), and NH >7 (22.4%); NMH = 3 ± 1 (61.5%), NMH <2 (19.3%), and NMH >4 (19.2%); and NUSLFH = 1 ± 1 (73.1%) and NUSLFH >3 (26.9%). When the yearly value is negative, based on the Poisson probability distribution, NTC = 10 ± 1 (35.6%), NTC <9 (26.3%), and NTC >11 (38.1%); NH = 6 ± 1 (45.8%), NH <5 (26.4%), and NH >7 (27.8%); NMH = 2 ± 1 (66.9%), NMH = 0 (7.8%), and NMH >3 (25.3%); and NUSLFH = 1 ± 1 (81.6%) and NUSLFH >2 (18.4%).

For <AMO>, when the yearly value is positive, one expects greater numbers of tropical cyclones than when the yearly value is negative. For example, when the yearly value is positive, based on the Poisson probability distribution, NTC = 12 ± 1 (33.3%), NTC <11 (31.1%), and NTC >13 (35.7%); NH = 7 ± 1 (42.8%), NH <6 (28.9%), and NH >8 (28.3%); NMH = 3 ± 1 (59.1%), NMH <2 (13.8%), and NMH >4 (27.1%); and NUSLFH = 1 ± 1 (73.3%) and NUSLFH >2 (26.7%). When the yearly value is negative, based on the Poisson probability distribution, NTC = 9 ± 1 (37.9%), NTC <8 (28.2%), and NTC >10 (33.9%); NH = 5 ± 1 (48.8%), NH <4 (21.3%), and NH >6 (29.8%); NMH = 1 ± 1 (69.6%) and NMH >2 (30.5%); and NUSLFH = 1 ± 1 (83.4%) and NUSLFH >2 (16.7%).

For <AMM>, when the yearly value is positive, one expects greater numbers of tropical cyclones than when the yearly value is negative. For example, when the yearly value is positive, based on the Poisson probability distribution, NTC = 12 ± 1 (33.2%), NTC <11 (30.7%), and NTC >13 (36.1%); NH = 7 ± 1 (42.4%), NH <6 (25.9%), and NH >8 (31.6%); NMH = 3 ± 1 (56.7%), NMH <2 (11.3%), and NMH >4 (32.1%); and NUSLFH = 1 ± 1 (73.9%) and NUSLFH >2 (26.1%). When the yearly value is negative, based on the Poisson probability distribution, NTC = 9 ± 1 (38.2%), NTC <8 (31.1%), and NTC >10 (30.7%); NH = 4 ± 1 (49.5%), NH <3 (12.8%), and NH >5 (37.7%); NMH = 1 ± 1 (80.9%) and NMH >2 (19.1%); and NUSLFH = 1 ± 1 (83.6%) and NUSLFH >2 (16.4%).

Through the first few months of 2012, the January–March average of monthly AT (7.37 °C) has been running 2.18 °C warmer than the average January–March value (i.e., 5.19 ± 1.22 °C) based on the interval 1945–2011. In fact, the January–March 2012 average is the second warmest January–March average during the interval 1945–2011, second only to the 1996 January–March average (8.37 °C). Since 1995 (i.e., the beginning of the current, more active interval), there have been only 2 yr with yearly <AT> below 9.48 °C (1996 and 2010). Also, since 1995, there have been only 2 yr with a January–March average below 5.19 °C (2001 and 2010). So, during the current interval 1945–2011, when the January–March average exceeds 5.19 °C, 14 of 17 yearly <AT> exceeded 9.48 °C (i.e., 82% of the years during the current, more active interval that had a January–March average temperature above 5.19 °C also had yearly <AT> higher than 9.48 °C). A linear fit of the yearly <AT> versus the January–March average for the interval 1945–2011 (not shown) results in the regression <AT> = 7.977 + 0.292 <J–M>, where <J–M> is the January–March average temperature. The inferred regression has r = 0.658, r^2 = 0.433, se = 0.382 °C, and cl >99.9%. Applying the 2012 <J–M> = 7.37 °C, one infers the yearly <AT> = 10.13 ± 0.38 °C for 2012, a value considerably above the long-term average of 9.48 °C (a difference of about 1.7 *se*). So, unless 2012 turns out to be a statistical outlier, one strongly expects the yearly <AT> for 2012 to exceed its long-term average (probably, being above 10 °C). Hence, the Poisson probability distribution for yearly <AT> above its long-term average should be appropriate for predicting the 2012 hurricane season, thereby, indicating 72.1% probability that NTC ≥10, 81.1% probability that NH ≥5, 85.1% probability that NMH ≥2, and 71.3% probability that NUSLFH ≤3.

For <NAO>, since 1995, 11 of the 17 yearly <NAO> have been of negative value. The first 3 mo of 2012 have seen positive values for NAO (1.17, 0.42, and 1.27). Only 13 previous years during the interval 1945–2011 had positive NAO for the first 3 mo of the years, including the years 1961, 1972, 1973, 1989, 1990, 1993, 1994, 1995, 1999, 2000, 2002, 2003, and 2008. Of these, all turned out to have positive yearly <NAO>, except 1973, 1995, and 2008. So, for 77% of the years that had positive monthly NAO for each of the first 3 mo of the year, those years also turned out to have positive yearly <NAO>. Presuming that 2012 will not be an outlier year, one expects the yearly <NAO> to be positive. Hence, the Poisson probability distribution for positive yearly <NAO> should be appropriate for predicting the 2012 hurricane season, thereby, indicating 71.6% probability that NTC ≥9, 80.7% probability that NH ≥4, 86.5% probability that NMH ≥1, and 79.1% probability that NUSLFH ≤2.

For <QBO>, in the span of 1948–2011, there have been only 26 yr of positive yearly <QBO> (at the 30 mbar height). So, more than half the years have been of negative yearly <QBO> (53.1%). Only on two occasions have there been back-to-back positive <QBO> years. Since 2011 was a positive <QBO> year, it is unlikely that the yearly <QBO> for 2012 will be positive. Indeed, the first 3 mo of 2012 have had negative monthly QBO (–16.09, –15.26, and –16.75). Of the 33 yr having the first 3 mo always of negative monthly QBO value, 27 yr were of negative yearly <QBO> value (81.8%). Presuming 2012 will not be an outlier year, one expects the yearly <QBO> to be negative. Hence, the Poisson probability distribution for negative yearly <QBO> should be appropriate for predicting the 2012 hurricane season, thereby, indicating 73.7% probability that NTC ≥9, 73.6% probability that NH ≥5, 92.2% probability that NMH ≥1, and 81.6% probability that NUSLFH ≤2.

For <AMO>, since 1995, all years, except 1996, have been of positive yearly <AMO>. For 2012, the month of January had negative AMO, while the months of February and March had positive AMO, yielding a positive AMO average value for the first 3 mo of 2012. For the interval 1948–2011, there have been 31 yr with the first 3 mo averaging a positive AMO value. Of these, all turned out to have positive yearly <AMO>, except the years 1950, 1956, 1964, 1967, and 1970 (83.9%). Presuming 2012 will not be an outlier year, one expects the yearly <AMO> to be positive. Hence, the Poisson probability distribution for positive yearly <AMO> should be appropriate for predicting the 2012 hurricane season, thereby indicating 68.9% probability that NTC ≥11, 71.1% probability that NH ≥6, 86.2% probability that NMH ≥2, and 83.4% probability that NUSLFH ≤2.

For <AMM>, since 1995, all years, except 2000 and 2002, have been of positive yearly <AMM>. For 2012, the month of March had negative AMM, while the months of January and February had positive AMM, yielding a positive AMM average value for the first 3 mo of 2012. For the interval 1948–2011, there have been 33 yr with the first 3 mo averaging a positive AMM value. Of these, all turned out to have positive yearly <AMM>, except the years 1954, 1959, 1963, 1967, 2000, and 2002 (81.8%). Presuming 2012 will not be an outlier year, one expects the yearly <AMM> to be positive. Hence, the Poisson probability distribution for positive yearly <AMM> should be appropriate for predicting the 2012 hurricane season, thereby, indicating 69.3% probability that NTC ≥11, 74.1% probability that NH ≥6, 88.7% probability that NMH ≥2, and 83.6% probability that NUSLFH ≤2.

Regarding the other tropical cyclone parameters, when the yearly <AT> is ≥9.48 °C (true for 30 of the 67 yr during the interval 1945–2011 and anticipated to be true for 2012), <N. LAT> = 21.5 ± 3.1 deg, <W. LONG> = 64.4 ± 6.4 deg, PWS = 130.3 ± 16.4 kt, <PWS> = 74.9 ± 9 kt, LP = 932.3 ± 20.7 mbar, <LP> = 977.8 ± 8.9 mbar, ACE = 125.8 ± 59.7, NSD = 65.8 ± 26.4 days, ACE/NSD = 1.87 ± 0.43, HISACE = 35.6 ± 14.6, LISNSD = 12.6 ± 3.7 days, <NSD> = 5 ± 1.1 days, NHD = 28.4 ± 14.2 days, NMHD = 8.1 ± 6.5 days, and NCTA = 135% ± 58.4%. Hence, presuming yearly <AT> ≥9.48 °C in 2012, one anticipates the following yearly parametric values for 2012: <N. LAT> ≤24.6 deg, <W. LONG> ≤70.8 deg, PWS ≤147 kt, <PWS> ≤83.9 kt, LP ≤953 mbar, <LP> ≤986.7 mbar, ACE ≤185.5 (and ACE ≥66.1), NSD ≤92 days (and NSD ≥39 days), ACE/NSD ≤ 2.3, HISACE ≤50.2, LISNSD ≤16 days, <NSD> ≤6.2 days, NHD ≤42.5 days (and NHD ≥14.2 days), NMHD ≤14.6 days (and NMHD ≥1.7 days), and NTCA ≤193.4% (and NTCA ≥76.6%).

When the yearly <NAO> is negative (true for 35 of the 62 yr during the interval 1950–2011 and anticipated to be true for 2012), <N. LAT> = 21.6 ± 3.1 deg, <W. LONG> = 64 ± 6.6 deg, PWS = 130 ± 20.6 kt, <PWS> = 77.4 ± 9.1 kt, LP = 934.7 ± 21.2 mbar, <LP> = 977.5 ± 8.1 mbar, ACE = 113 ± 61.6, NSD = 61.6 ± 35.4 days, ACE/NSD = 1.85 ± 0.46, HISACE = 33.7 ± 15.9, LISNSD = 11.5 ± 3.3 days, <NSD> = 5.3 ± 1.4 days, NHD = 27.7 ± 15.6 days, NMHD = 6.9 ± 5.1 days, and NCTA = 124.9% ± 63.1%. Hence, presuming yearly <NAO> to be negative in 2012, one anticipates the following yearly parametric values for 2012: <N. LAT> ≤24.7 deg, <W. LONG> ≤70.6 deg, PWS ≤151 kt, <PWS> ≤86.5 kt, LP ≤956 mbar, <LP> ≤985.6 mbar, ACE ≤174.6 (and ACE ≥51.4), NSD ≤97 days (and NSD ≥26 days), ACE/NSD ≤2.31, HISACE ≤49.6, LISNSD ≤15 days, <NSD> ≤6.7 days, NHD ≤43 days (and NHD ≥12 days), NMHD ≤12 days (and ≥2 days), and NTCA ≤188% (and NTCA ≥61.8%).

When the yearly <QBO> is negative (true for 38 of the 64 yr during the interval 1948–2011 and anticipated to be true for 2012), <N. LAT> = 21.8 ± 3.6 deg, <W. LONG> = 64.9 ± 6.1 deg, PWS = 125.8 ± 20.1 kt, <PWS> = 75 ± 8.7 kt, LP = 940 ± 19.8 mbar, <LP> = 980.3 ± 7.2 mbar, ACE = 95.7 ± 56.2, NSD = 53.7 ± 33.8 days, ACE/NSD = 1.8 ± 0.42, HISACE = 31.2 ± 15.1, LISNSD = 10.56 ± 2.88 days, <NSD> = 4.87 ± 1.46 days, NHD = 22.8 ± 13.9 days, NMHD = 5.9 ± 5 days, and NCTA = 107.8% ± 60.6%. Hence, presuming yearly <QBO> to be negative in 2012, one anticipates the following yearly parametric values for 2012: <N. LAT> ≤25.4 deg, <W. LONG> ≤71 deg, PWS ≤146 kt, <PWS> ≤83.7 kt, LP ≤960 mbar, <LP> ≤987.5 mbar, ACE ≤151.9 (and ACE ≥39.5), NSD ≤88 days (and NSD ≥20 days), ACE/NSD ≤2.22, HISACE ≤46.3, LISNSD ≤13 days, <NSD> ≤6.3 days, NHD ≤37 days (and NHD ≥9 days), NMHD ≤11 days (and NMHD ≥1 day), and NTCA ≤168.4% (and NTCA ≥47.2%).

When the yearly <AMO> is positive (true for 34 of the 64 yr during the interval 1948–2011 and anticipated to be true for 2012), <N. LAT> = 20.8 ± 2.5 deg, <W. LONG> = 63.6 ± 5.4 deg, PWS = 132.1 ± 16.3 kt, <PWS> = 76.4 ± 9.7 kt, LP = 931.9 ± 20.8 mbar, <LP> = 977.3 ± 8.7 mbar, ACE = 127.3 ± 56.4, NSD = 67.3 ± 34 days, ACE/NSD = 1.95 ± 0.49, HISACE = 37.6 ± 14.6, LISNSD = 12.6 ± 3.1 days, <NSD> = 5.3 ± 1.3 days, NHD = 29.3 ± 13.8 days, NMHD = 8.5 ± 7.7 days, and NCTA = 135.2% ± 60.8%. Hence, presuming yearly <AMO> to be positive in 2012, one anticipates the following yearly parametric values for 2012: <N. LAT> ≤23.3 deg, <W. LONG> ≤69 deg, PWS <148 kt, <PWS> ≤86.1 kt, LP ≤953 mbar, <LP> ≤986 mbar, ACE ≤183.7 (and ACE ≥70.9), NSD ≤101 days (and NSD ≥33 days), ACE/NSD ≤ 2.44, HISACE ≤52.2, LISNSD ≤16 days, <NSD> ≤6.6 days, NHD ≤43 days (and NHD ≥15 days), NMHD ≤16 days (and NMHD ≥1 day), and NTCA ≤196% (and NTCA ≥74.4%).

When the yearly <AMM> is positive (true for 36 of the 64 yr during the interval 1948–2011 and anticipated to be true for 2012), <N. LAT> = 20.7 ± 2.4 deg, <W. LONG> = 63 ± 5.4 deg, PWS = 133.5 ± 18.5 kt, <PWS> = 77.7 ± 10.1 kt, LP = 931.5 ± 21.5 mbar, <LP> = 977 ± 9.1 mbar, ACE = 129.8 ± 60.8, NSD = 69.1 ± 33.5 days, ACE/NSD = 1.9 ± 0.49, HISACE = 36.9 ± 15.4, LISNSD = 12.1 ± 2.5 days, <NSD> = 5.4 ± 1.4 days, NHD = 30.5 ± 15 days, NMHD = 8.7 ± 6.2 days, and NCTA = 143.1% ± 61%. Hence, presuming yearly <AMM> to be positive in 2012, one anticipates the following yearly parametric values for 2012: <N. LAT> ≤23.1 deg, <W. LONG> ≤68.4 deg, PWS ≤152 kt, <PWS> ≤87.8 kt, LP ≤953 mbar, <LP> ≤986.1 mbar, ACE ≤190.6 (and ACE ≥69), NSD ≤103 days (and ≥36 days), ACE/NSD ≤ 2.39, HISACE ≤52.3, LISNSD ≤15 days, <NSD> ≤6.8 days, NHD ≤46 days (and NHD ≥16 days), NMHD ≤15 days (and ≥3 days), and NTCA ≤204.1% (and NTCA ≥82.1%).

It is apparent then, that should the yearly <AT> for 2012 be ≥9.48 °C and the yearly <AMO> and <AMM> be positive, these conditions being expected, one would anticipate seasonal frequencies and parametric values of tropical cyclones in the North Atlantic basin during the 2012 hurricane season to be above long-term averages. Countering this, however, is the expected positive <NAO>, negative <QBO>, and the anticipated recurrence of EN in 2012, which, if true, would suggest near normal to below average frequencies and parametric values. Hence, at this time, it remains disconcertingly uncertain as to how active and strong the 2012 hurricane season will be. If EN fails to recur, then one leans towards the 2012 season being near normal to above average in activity, being driven by the warmer surface air and ocean temperatures. On the other hand, if EN should recur during the hurricane season, then one leans towards the 2012 season being near normal to below average in activity. (Presently, the ENSO condition is that of ENSO neutral, with LN not expected to redevelop later this year. The official NOAA forecast calls for ENSO neutral conditions through the summer of 2012, followed by equal chances of either ENSO neutral or EN conditions after September 2012. It should be noted, however, that about half of the dynamical models predict development of EN conditions during the summer of 2012, although considerable forecast uncertainty continues due largely to the inability of the models to predict whether the warmer SST will result in the ocean-atmosphere coupling required for a sustained EN event.[52,128])

2.10.3 Decadal Trends

Figure 75 displays the decadal frequencies of NTC, NTS, NH, NMH, and NUSLFH for the 6 decades of the 1950s–2000s. Plainly, NTC, NH, and NMH all show a decrease in activity from the 1950s through the 1980s and an increase from the 1980s through the 2000s. For NTS, it has risen throughout, especially after the 1990s. For NUSLFH, it has remained fairly flat, although the variance has increased in the 2000s. What the current decade will be like, however, remains murky.

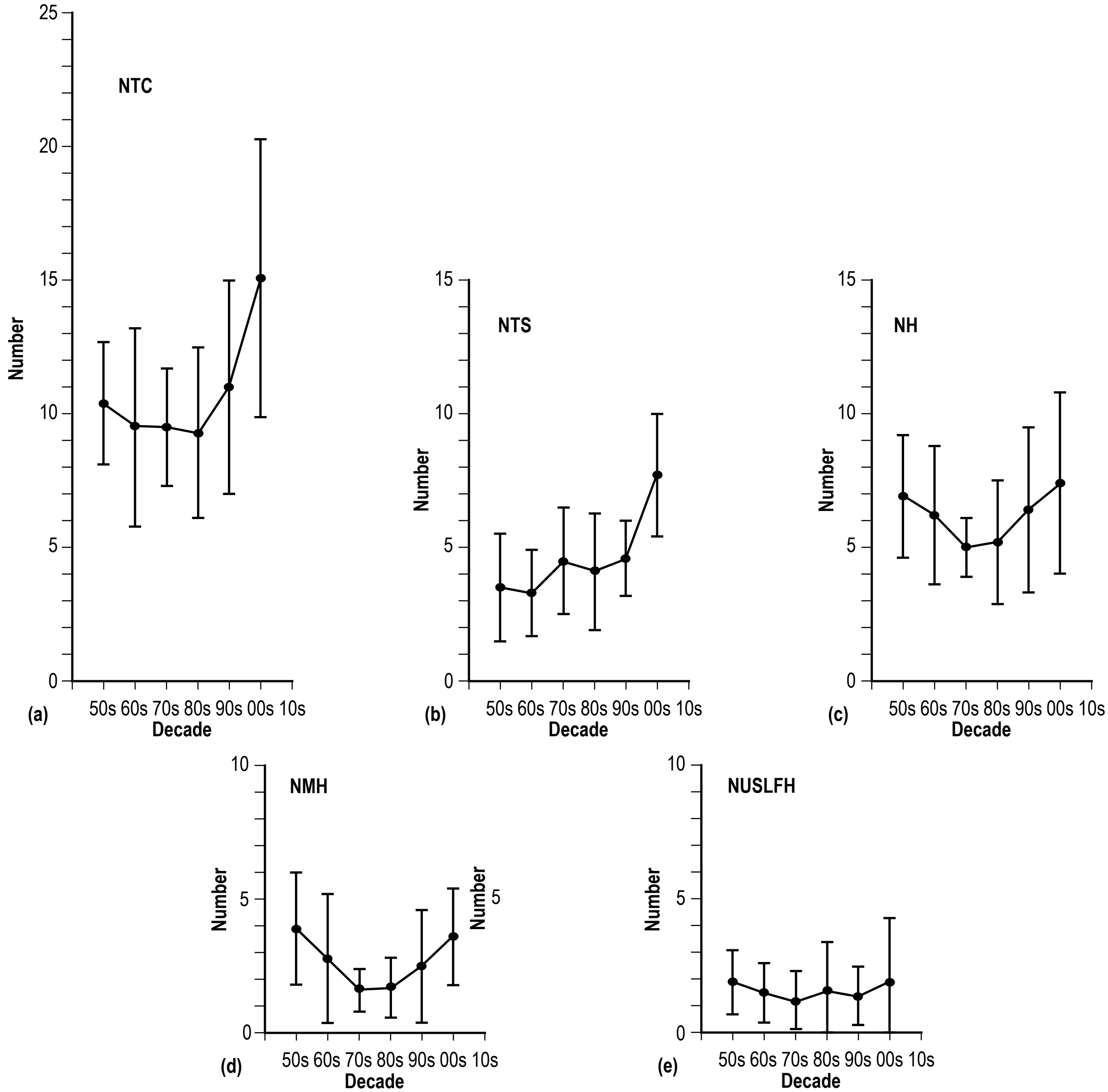

Figure 75. Decadal variations for (a) NTC, (b) NTS, (c) NH, (d) NMH, and (e) NUSLFH.

The year 2012 will be the third year of the decade of the 2010s. The first 2 yr of the current decade have averaged NTC = 19, NTS = 9.5, NH = 9.5, NMH = 4.5, and NUSLFH = 0.5. For NTC, NTS, NH, and NMH, these averages seem reflective of the previous decade, although slightly higher, suggesting that the present decade either will continue to be reflective of an increase in activity and strength or, possibly, flatten, attaining a plateau of similar activity and strength that was seen in the previous decade.

Figures 76–78 show the decadal variation of the other tropical cyclone parameters. For <N. LAT>, plainly there was movement to more northerly latitudes of the latitudinal centroid from the 1950s to the 1970s. However, the centroid is found to have returned to a more tropical location in the 1990s and 2000s. While true, the decade of the 2000s may be the start of a new, more northerly movement that may manifest itself during the decade of the 2010s. Interestingly, the decadal movement of <W. LONG> seems suggestive of a long-term eastward movement over time.

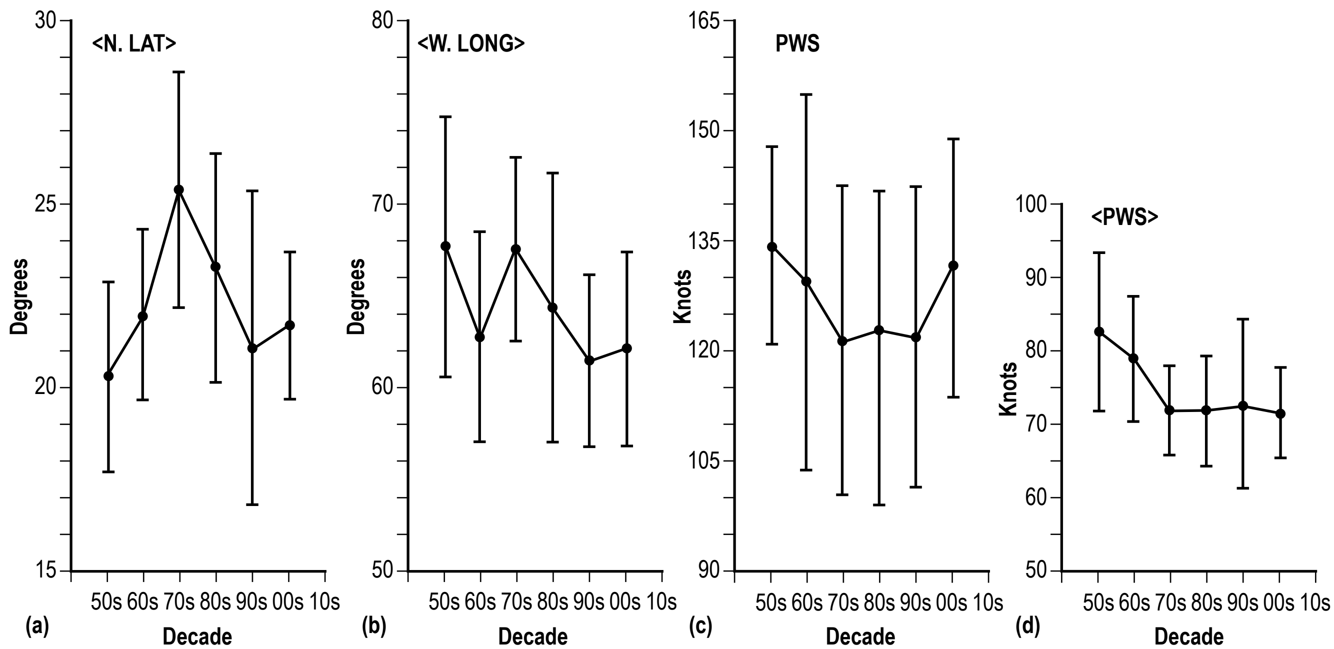

Figure 76. Decadal variations for (a) <N. LAT>, (b) <W. LONG>, (c) PWS, and (d) <PWS>.

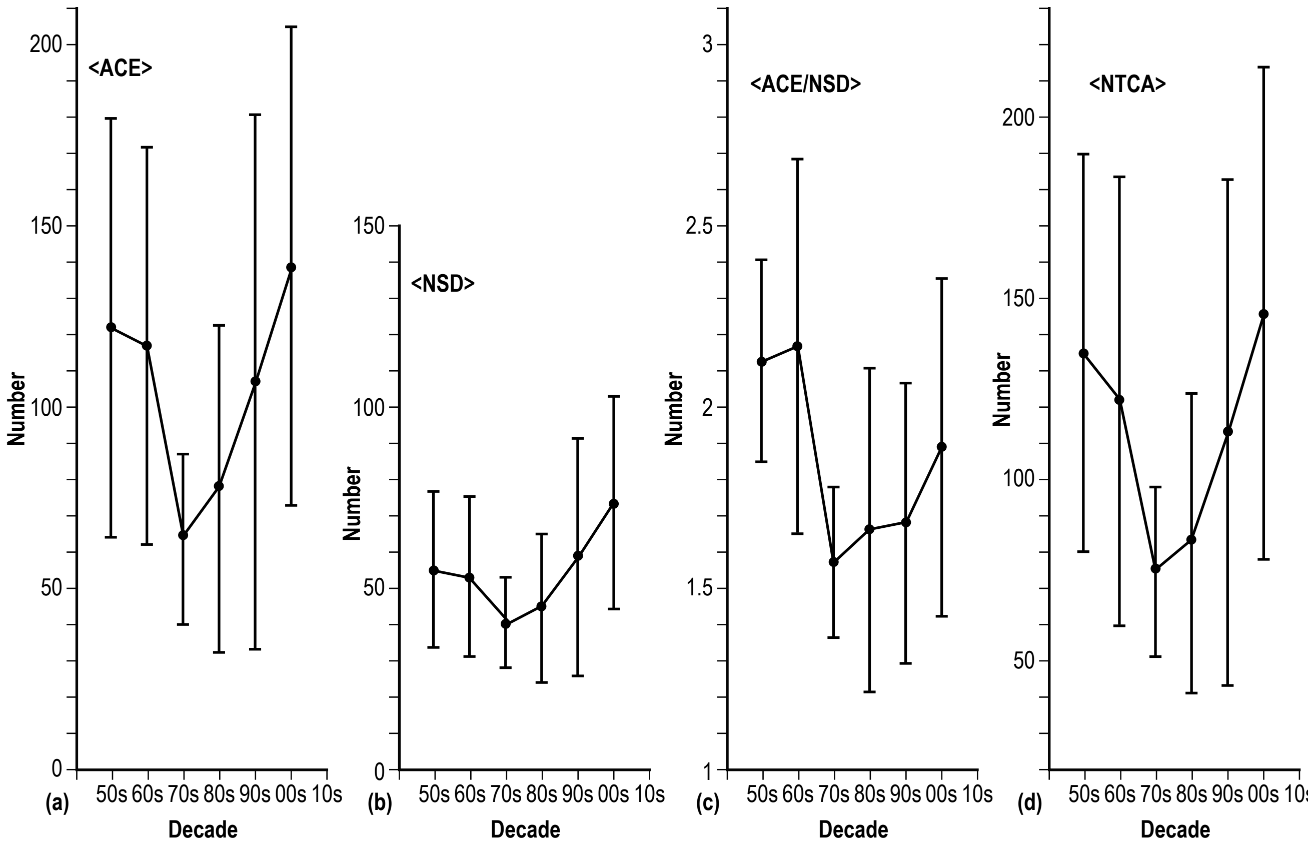

Figure 77. Decadal variations for (a) <ACE>, (b) <NSD>, (c) <ACE/NSD>, and (d) <NTCA>.

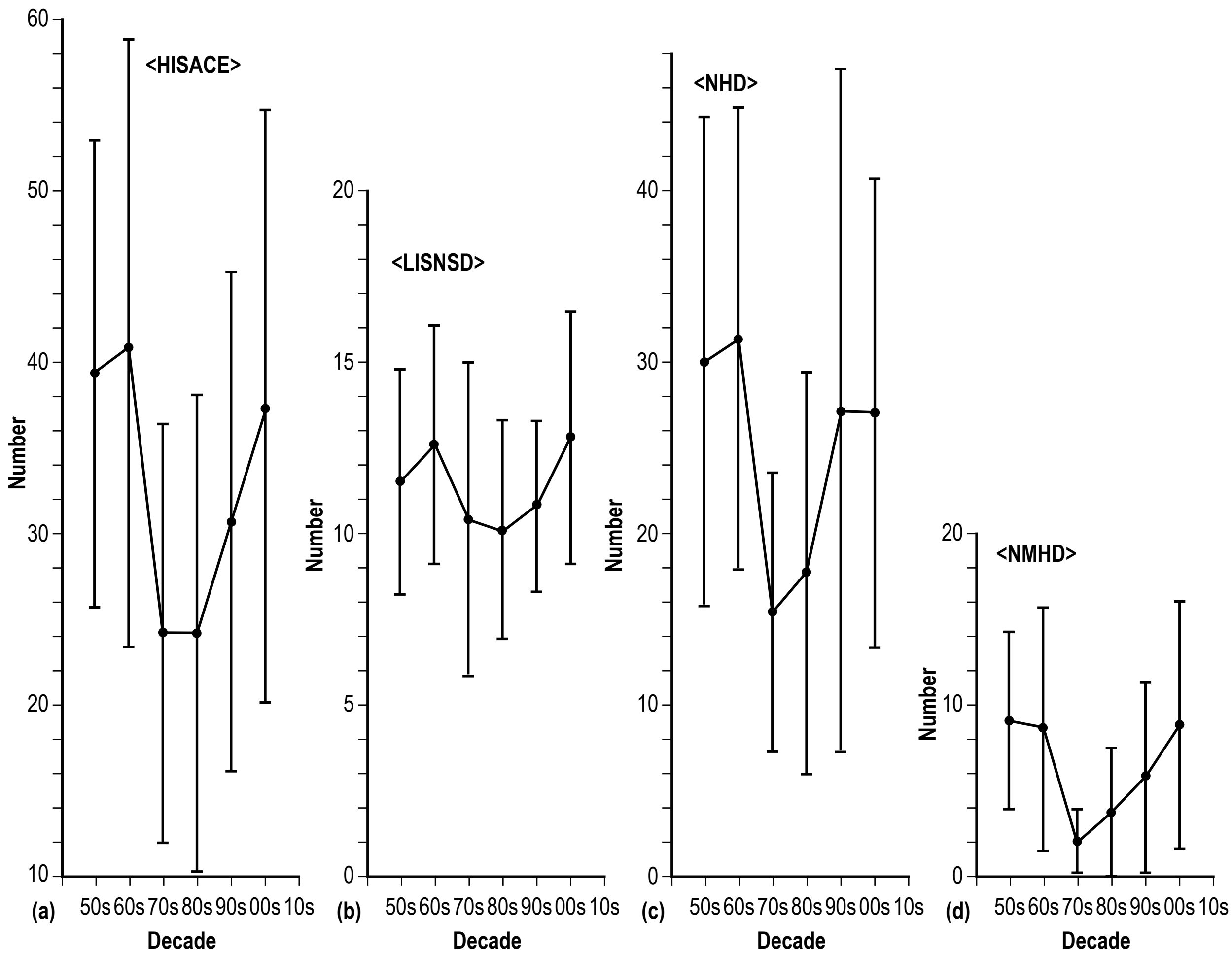

Figure 78. Decadal variations for (a) <HISACE>, (b) <LISNSD>, (c) <NHD>, and (d) <NMHD>.

For PWS, there was a decrease from the 1950s to the 1970s, a flattening from the 1970s to the 1990s, and an increase in the 2000s. Does this mean that the decade of the 2010s will see storms with higher PWS, or will PWS flatten near 135 kt, a la the 1950s?[129] For <PWS>, it shows a decrease from the 1950s to the 1970s and continued flattening near 70 kt (seasonal average) through the decade of the 2000s.

<ACE>, <NSD>, <HISACE>, <LISNSD>, <NHD>, <NMHD>, and <NTCA> all show a decrease from the 1950s to the 1970s. From the 1970s through the 2000s, an increase has been underway to levels typical of the 1950s, if not higher, especially for <ACE>, <NSD>, and <NTCA>.

Figures 79–81 depict the decadal variations for the 14 surface air temperature and ENSO-related parameters. For <AT>, it has been increasing since the decade of the 1970s. The first 2 yr of the present decade have an average <AT> = 9.53 °C, above the long-term mean of 9.48 °C. Because yearly <AT> correlates strongly with yearly measures of atmospheric carbon dioxide obtained at Mauna Loa, Hawaii, and because the trend of atmospheric carbon dioxide is upward, it may be that <AT> will continue to increase during the present decade.[130,131] However, if <AT> is more greatly

influenced by <AMO> and/or <AMM>, its behavior may be more reflective of a cyclic variation (with an embedded global warming component), perhaps, decreasing slightly in the near term.

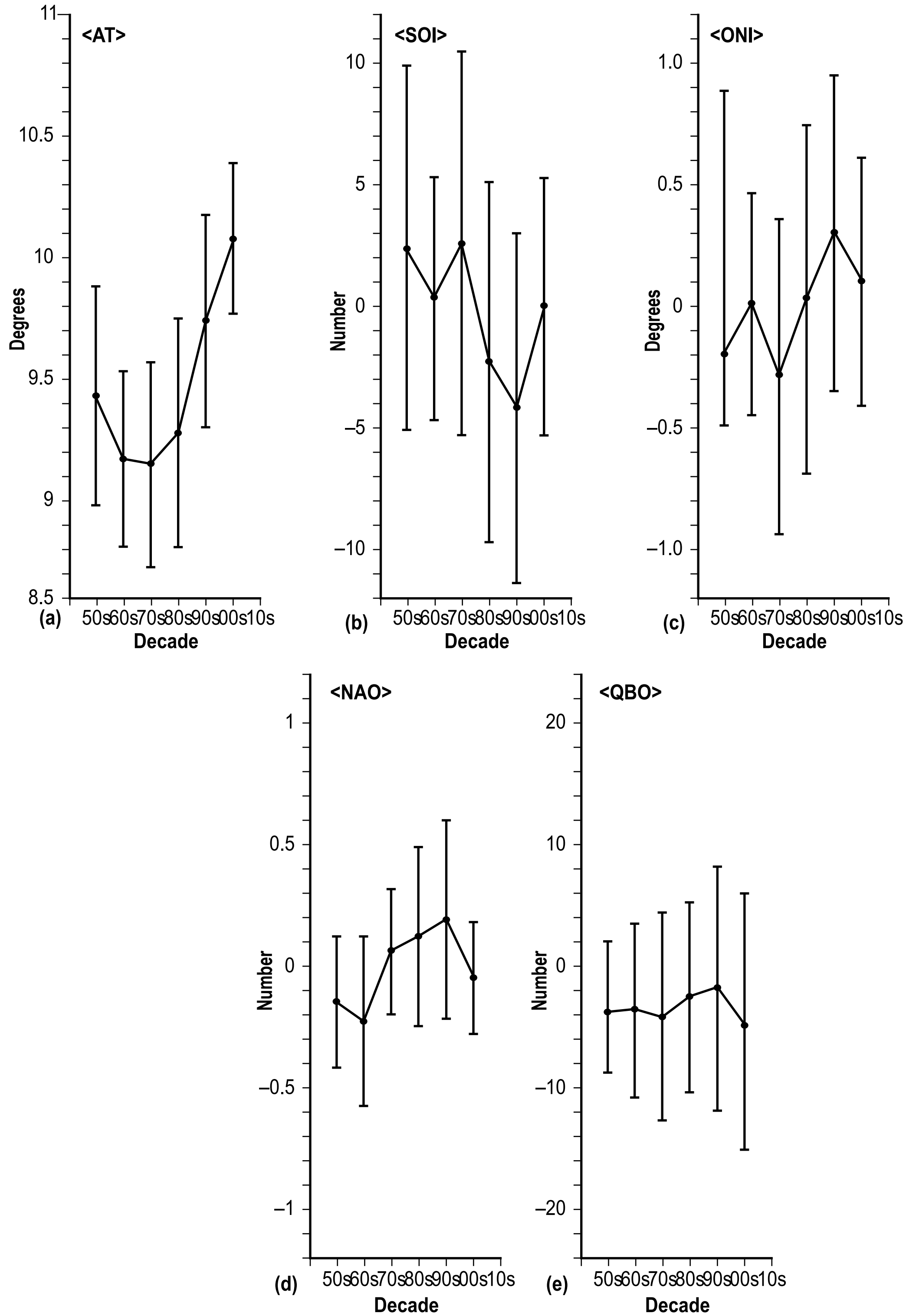

Figure 79. Decadal variations for (a) <AT>, (b) <SOI>, (c) <ONI>, (d) <NAO>, and (e) <QBO>.

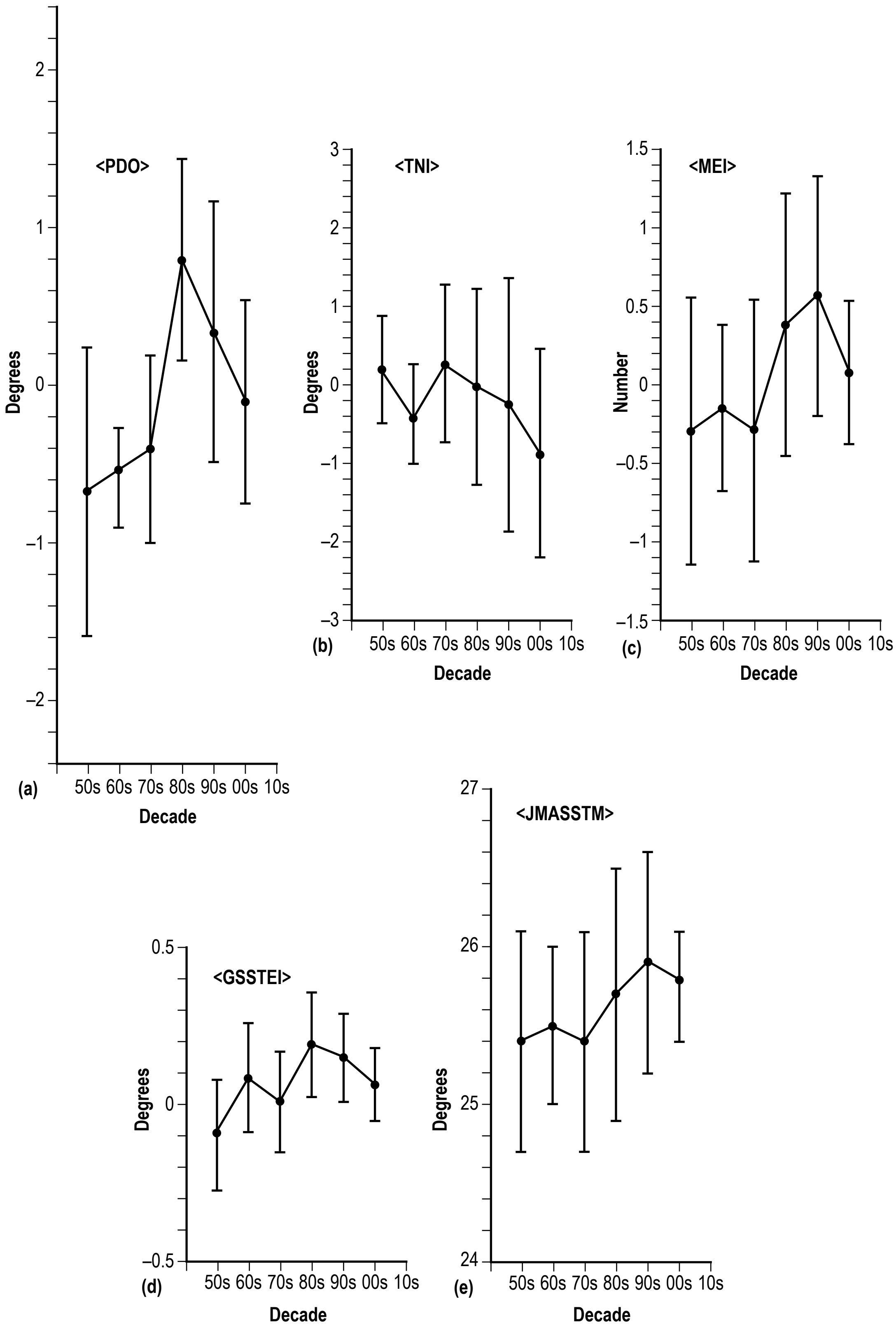

Figure 80. Decadal variations for (a) <PDO>, (b) <TNI>, (c) <MEI>, (d) <GSSTEI>, and (e) <JMASSTM>.

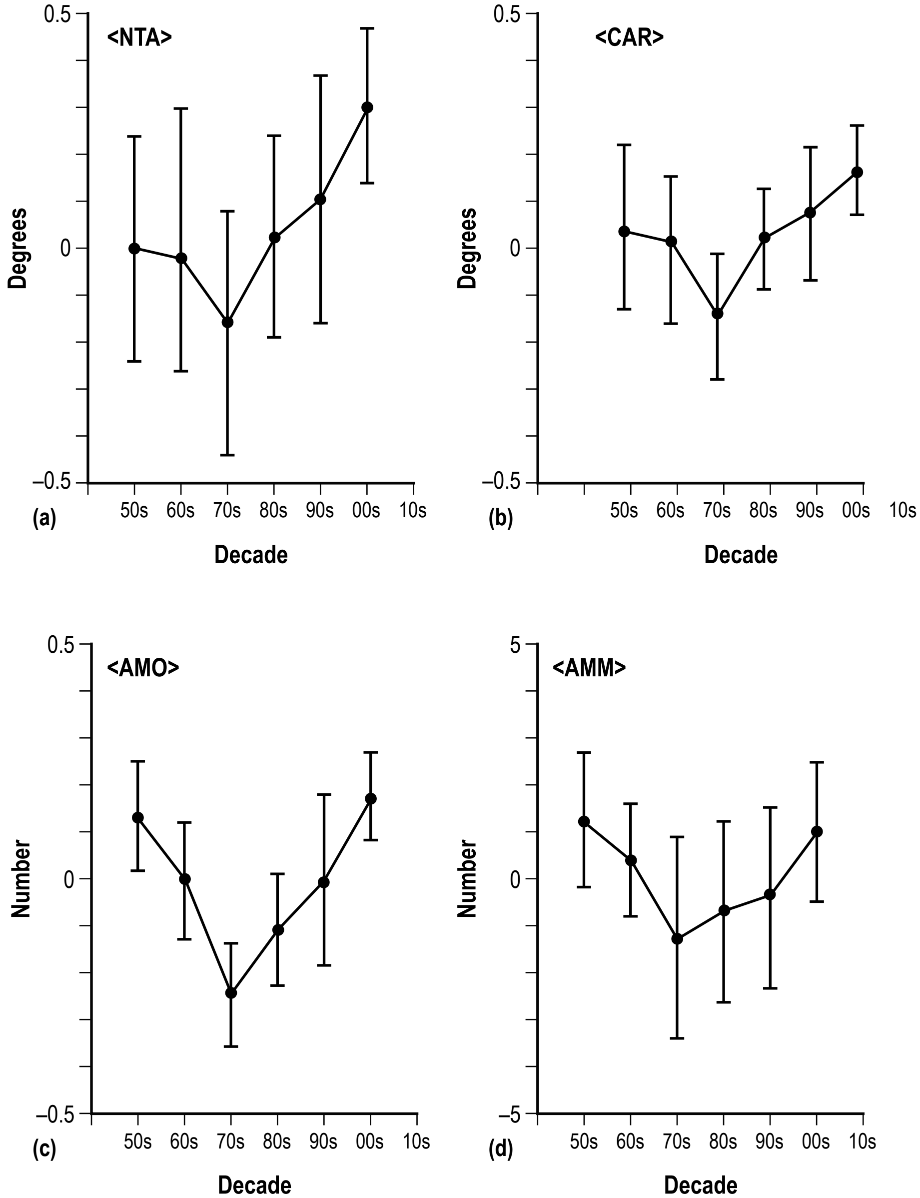

Figure 81. Decadal variations for (a) <NTA>, (b) <CAR>, (c) <AMO>, and (d) <AMM>.

Similar to the decadal <AT> movements are the decadal movements of <NTA>, <CAR>, <AMO>, and <AMM>, with values expected to remain positive (i.e., warmer, on average) during the current decade. The decadal movement of <NAO> appears to be negative for the current decade as are the decadal movements of <PDO> and <TNI>. The decadal <QBO> is always negative. The decadal <JMASSTM> appears to be increasing over time (to warmer temperatures). The decadal movements of <ONI>, <MEI>, and <GSSTEI> are quite similar with anomalous values in the decade of the 2000s down from peak values in the decade of the 1990s (although still of positive value, but near zero). The decadal movement of <SOI> varies inversely with the decadal movement of <ONI>.

2.10.4 The 34 Strongest Tropical Cyclones and the Distributions of PWS, ISACE, ISNSD, ISNHD, ISNMHD, N. LAT, and W. LONG

Table 26 (see appendix) lists the 34 strongest tropical cyclones (based on PWS) of the North Atlantic basin during the interval since 1945. At the top of the list are Camille 1969 and Allen 1980, both having PWS = 165 kt, both having onset dates in August, and both being US landfalling hurricanes (Camille as a category 5 storm). While Camille formed in the Gulf of Mexico area, Allen formed in the lower Atlantic-Cape Verde area. Allen had an LP lower than Camille, a higher individual storm ACE, and a longer individual storm NSD.

Of the 34 strongest tropical cyclones of the North Atlantic basin, only 4 attained PWS ≥160 kt, 10 had PWS of 150 and 155 kt, 12 had PWS of 140 and 145 kt, and 7 had PWS of 135 kt. Only 4 storms had LP less than 900 mbar, with Wilma 2005 having the lowest observed LP (882 mbar). Until Ivan came along in 2004, Donna 1960 had held the record for being the individual storm having the highest ACE for more than 40 yr (Donna had individual storm accumulated cyclone energy (ISACE) = 64.6 and Ivan had ISACE = 70.4). While Carrie 1957 has the longest individual storm number of storm days (ISNSD) on the list (19.5 days), it is not the record holder; that distinction belongs to Ginger 1971 (PWS = 95 kt and ISNSD = 21.25 days).

Only 3 of the strongest storms were birthed in group 1, the Gulf of Mexico area (Camille 1969, Anita 1977, and Ethel 1960); only 2 of the strongest storms were birthed in group 3, the east coast area (Rita 2005 and Katrina 2005); and none were birthed in group 5, the open Atlantic area. By far, the largest number of strongest storms were birthed in group 2 (the Caribbean area), accounting for 9 storms, and group 4 (the lower Atlantic-Cape Verde area), accounting for 20 storms. Only 5 of the strongest storms were birthed outside of the months of August and September (Emily 2005 in July; Wilma 2005, Mitch 1998, and Hattie 1961 in October; and Lenny 1999 in November).

Tables 27–33 (see appendix) provide the distributions of PWS, ISACE, ISNSD, ISNHD, ISNMHD, N. LAT, and W. LONG, respectively, for the tropical cyclones in the North Atlantic basin during the interval 1945–2010. The largest grouping of tropical cyclone PWS is PWS = 45–54 kt, accounting for 136 of the 715 storms (19%). Only 97 storms had PWS ≥ 115 kt (13.6%) and only 34 had PWS ≥135 kt (4.8%; they are identified by name in the comments, being the storms listed in table 26). More than two-thirds of the storms had ISACE ≤9.9 (494 of 715 storms, 69.1%) and more than 90% had ISACE ≤29.9 (667/715 = 93.3%). Only 24 of the storms had ISACE ≥40 (5.6%; they are identified by name in the comments). About half the tropical cyclones had ISNSD ≤4 days (373/715 = 52.2%), with the largest single grouping being ISNSD = 1.1–2 days duration (125/715 = 17.5%). Some 76 storms, however, had ISNSD >10 days (76/715 = 10.6%; they are identified by name in the comments). Some 306 storms had zero ISNHD and more than half of the storms had ISNHD ≤1 day (386/715 = 54%). Only 23 storms had ISNHD ≥10 days (23/715 = 3.2%; they are identified by name in the comments). Some 536 storms had zero ISNMHD and more than 80% had ISNMHD ≤1 day (603/715 = 84.3%). Only two storms (Donna 1960 and Ivan 2004) had ISNMHD ≥10 days. About one-fourth of the storms formed at N. LAT <15 deg (179/715 = 25%) and only 4 storms formed at N. LAT ≥40 deg. Interesting is that the four lowest N. LAT formation storms occurred recentlysince 1990. Finally, about 60% of the storms formed at W. LONG ≥60 deg, with only 4 storms forming at W. LONG = 10–19.9 deg.

3. SUMMARY

In this investigation, examined were the statistical aspects of the 715 tropical cyclones that formed in the North Atlantic basin during the interval 1945–2010, including 306 storms of only tropical storm strength, 409 storms of hurricane strength, 179 storms of major or intense hurricane strength, and 108 storms that struck the US coastline at hurricane strength. The interval 1995–2010 was found, on average, to be about 54% more active than the previous interval 1945–1994 in terms of the number of tropical cyclones that formed in a season, about 73% more active in terms of tropical cyclones that attained only tropical storm strength, about 41% more active in terms of the number storms of hurricane strength, about 62% more active in terms of the number of storms of major hurricane strength, and about 20% more active in terms of storms that made landfall along the US coastline at hurricane strength. Also found was that, on average, the PWS of a tropical cyclone during a season has increased by about 5%, although the <PWS> has slightly decreased by about 2%. Additionally, the seasonal ACE was found to have increased during the current, more active interval, on average, by more than 63%, as did the seasonal NSD by more than 75%, the seasonal NHD by about 45%, the seasonal NMHD by about 77%, and the seasonal NTCA index by about 59%. HISACE and LISNSD, likewise, were found to have increased, on average, by about 28% and 17%, respectively, and strong correlations were found to exist, in particular, between the 10-yma tropical cyclone parametric values and those of the Armagh Observatory (Northern Ireland) surface air temperature, the AMO index, the AMM index, and the NAO index, in addition to those of the ONI and QBO indices.

Poisson probability distributions were determined for the overall interval 1945–2010, as well as strictly for the current, more active interval, 1995–2010. For the overall interval, NTC = 10 ± 1 (35.3%), NTC <9 (25%), and NTC >11 (39.7%); NTS = 4 ± 1 (52.3%), NTS <3 (16.3%), and NTS >5 (31.4%); NH = 6 ± 1 (45.7%), NH <5 (25.9%), and NH >7 (28.4%); NMH = 2 ± 1 (64.7%), NMH = 0 (6.7%), and NMH >3 (28.6%); and NUSLFH = 1 ± 1 (78.3%) and NUSLFH >2 (21.7%). For the current, more active interval, NTC = 14 ± 1 (30.4%), NTC <13 (27.3%), and NTC >15 (42.3%); NTS = 6 ± 1 (43.6%), NTS <5 (19.2%), and NTS >7 (37.2%); NH = 7 ± 1 (40.6%), NH <6 (20.1%), and NH >8 (39.3%); NMH = 3 ± 1 (56%), NMH <2 (10.7%), and NMH >4 (33.2%); and NUSLFH = 1 ± 1 (70.4%) and NUSLFH >2 (29.6%). Therefore, dependent upon whether the 2012 hurricane season is more akin to the overall interval or to the current, more active interval, one predicts the central ±1 storm intervals to be either NTC = 10 ± 1 (35.3%, overall interval) or NTC = 14 ± 1 (30.4%, current, more active interval), and so forth, with greater chance for NTC >11 and NTC >15, respectively, than NTC <9 and NTC <13, respectively, and with the bulk of the storms occurring during the months of August through October.

Accounting for the ENSO condition during the overall interval, when the season is classified as ENY, NTC = 9 ± 1 (38.2%), NTC <8 (30.9%), and NTC >10 (31%); NTS = 4 ± 1 (53.9%), NTS <3 (19.6%), and NTS >5 (26.5%); NH = 4 ± 1 (50.8%), NH <3 (14.2%), and NH >5 (35.1%); NMH = 2 ± 1 (72.2%), NMH = 0 (13.5%), and NMH >3 (14.3%); and NUSLFH = 1 ± 1 (89.4%)

and NUSLFH >2 (10.6%). When the season is classified as LNY, NTC = 11 ± 1 (34.1%), NTC <10 (27.2%), and NTC >12 (38.6%); NTS = 4 ± 1 (51.8%), NTS <3 (15.5%), and NTS >5 (32.6%); NH = 7 ± 1 (42.8%), NH <6 (30.1%), and NH >8 (27.1%); NMH = 3 ± 1 (59.2%), NMH <2 (13.9%), and NMH >4 (26.9%); and NUSLFH = 2 ± 1 (70.9%), NUSLFH = 0 (11.1%), and NUSLFH >3 (18.1%). When the season is classified as NY, NTC = 11 ± 1 (34.7%), NTC <10 (31.3%), and NTC >12 (34%); NTS = 4 ± 1(51%), NTS <3 (14.6%), and NTS >5 (34.4%); NH = 6 ± 1 (44.9%), NH <5 (22.5%), and NH >7 (32.6%); NMH = 2 ± 1 (64.5%), NMH = 0 (6.7%), and NMH >3 (28.8%); and NUSLFH = 1 ± 1 (77.6%) and NUSLFH >2 (22.4%). Therefore, dependent upon what the ENSO condition will be for 2012, one predicts the central ±1 storm intervals to be either NTC = 9 ± 1 (38.2%, ENY), NTC = 11 ± 1 (34.1%, LNY), or NTC = 11 ± 1 (34.7%, NY) and so forth, with higher probabilities for increased frequencies expected if the 2012 hurricane season is classified as non-ENY.

For the yearly <AT> ≥9.48 °C (i.e., the long-term mean surface air temperature at Armagh Observatory, Northern Ireland), NTC = 12 ± 1 (32.8%), NTC <11 (27.9%), and NTC >13 (39.3%); NTS = 5 ± 1 (46.5%), NTS <4 (15.6%), and NTS >6 (37.9%); NH = 6 ± 1 (43.5%), NH <5 (18.9%), and NH >7 (37.6%); NMH = 3 ± 1 (59.9%), NMH <2 (14.9%), and NMH >4 (25.2%); and NUSLFH = 2 ± 1 (71.6%), NUSLFH = 0 (12.3%), and NUSLFH >3 (16.1%). For the yearly <AT> <0.48 °C, NTC = 9 ± 1 (37.9%), NTC <8 (28.1%), and NTC >10 (34%); NTS = 3 ± 1 (57.3%), NTS <2 (11.8%), and NTS >4 (30.9%); NH = 5 ± 1 (47.4%), NH <4 (18%), and NH >6 (34.6%); NMH = 2 ± 1 (70.9%), NMH = 0 (11.2%), and NMH >3 (17.9%); and NUSLFH = 1 ± 1 (86.4%) and NUSLFH >2 (13.6%). Therefore, dependent upon whether or not the yearly <AT> for 2012 exceeds its long-term average, one predicts either NTC = 12 ± 1 (32.8%, above average) or NTC = 9 ± 1 (37.9%, below average), and so forth. Because the yearly <AT> is expected to exceed its long-term average in 2012, one anticipates higher frequencies during the 2012 hurricane season, with NTC ≥11 (72.1%), NTS ≥4 (84.4%), NH ≥5 (81.1%), NMH ≥2 (85.1%), and NUSLFH ≥1 (87.7%).

For the yearly <AMO> being of positive value, NTC = 12 ± 1 (33.3%), NTC <11 (31.1%), and NTC >13 (35.7%); NTS = 5 ± 1 (49.3%), NTS <4 (22.9%), and NTS >6 (27.8%); NH = 7 ± 1 (42.8%), NH <6 (28.9%), and NH >8 (28.3%); NMH = 3 ± 1 (59.1%), NMH <2 (13.8%), and NMH >4 (27.1%); and NUSLFH = 1 ± 1 (73.3%) and NUSLFH >2 (26.7%). For the yearly <AMO> being of negative value, NTC = 9 ± 1 (37.9%), NTC <8 (28.2%), and NTC >10 (33.9%); NTS = 3 ± 1 (54.1%), NTS <2 (9.4%), and NTS >4 (36.5%); NH = 5 ± 1 (48.8%), NH <4 (21.3%), and NH >6 (29.8%); NMH = 1 ± 1 (68.6%) and NMH >2 (31.4%); and NUSLFH = 1 ± 1 (83.4%) and NUSLFH >2 (16.7%). Therefore, dependent upon whether the yearly <AMO> is of positive or negative value for 2012, one predicts either NTC = 12 ± 1 (33.3%, positive) or NTC = 9 ± 1 (37.9%, negative), and so forth. Because the yearly <AMO> is expected to be of positive value in 2012, one anticipates higher frequencies during the 2012 hurricane season, with NTC ≥11 (68.9%), NTS ≥4 (77.1%), NH ≥6 (71.1%), NMH ≥2 (86.2%), and NUSLFH ≥1 (83.3%).

For the yearly <AMM> being of positive value, NTC = 12 ± 1 (33.2%), NTC <11 (30.7%), and NTC >13 (36.1%); NTS = 5 ± 1 (49.7%), NTS <4 (25.7%), and NTS >6 (24.7%); NH = 7 ± 1 (42.4%), NH <6 (25.9%), and NH >8 (31.6%); NMH = 3 ± 1 (56.7%), NMH <2 (11.3%), and NMH >4 (32.1%); and NUSLFH = 1 ± 1 (73.9%) and NUSLFH >2 (26.1%). For the yearly <AMM> being of negative value, NTC = 9 ± 1 (38.2%), NTC <8 (31.1%), and NTC >10 (30.7%); NTS

= 4 ± 1 (54.5%), NTS <3 (21.8%), and NTS >5 (23.7%); NH = 4 ± 1 (49.5%), NH <3 (12.8%), and NH >5 (37.7%); NMH = 1 ± 1 (80.9%) and NMH >2 (19.1%); and NUSLFH = 1 ± 1 (83.6%) and NUSLFH >2 (16.4%). Therefore, dependent upon whether the yearly <AMM> is of positive or negative value for 2012, one predicts either NTC = 12 ± 1 (33.2%, positive) or NTC = 9 ± 1 (38.2%, negative), and so forth. Because the yearly <AMM> is expected to be of positive value in 2012, one anticipates higher frequencies during the 2012 hurricane season, with NTC ≥11 (69.3%), NTS ≥4 (74.3%), NH ≥6 (74.1%), NMH ≥2 (88.7%), and NUSLFH ≥1 (83%).

For the yearly <ONI> being of positive value, NTC = 10 ± 1 (35.8%), NTC <9 (27.2%), and NTC >11 (37%); NTS = 4 ± 1 (52.3%), NTS <3 (16.3%), and NTS >5 (31.4%); NH = 5 ± 1 (45.7%), NH <4 (15.4%), and NH >6 (38.9%); NMH = 2 ± 1 (69.1%), NMH = 0 (9.4%), and NMH >3 (21.5%); and NUSLFH = 1 ± 1 (80.9%) and NUSLFH >2 (19.1%). For the yearly <ONI> being of negative value, NTC = 11 ± 1 (34.7%), NTC <10 (31%), and NTC >12 (34.4%); NTS = 4 ± 1 (51.5%), NTS <3 (15.1%), and NTS >5 (33.3%); NH = 6 ± 1 (44.6%), NH <5 (21.5%), and NH >7 (33.9%); NMH = 3 ± 1 (61.5%), NMH <2 (19%), and NMH >4 (19.5%); and NUSLFH = 1 ± 1 (78.1%) and NUSLFH >2 (21.9%). Therefore, dependent upon whether the yearly <ONI> is of positive or negative value for 2012, one predicts either NTC = 10 ± 1 (35.8%, positive) or NTC = 11 ± 1 (34.7%, negative), and so forth. Because an EN is expected to recur in late 2012, the yearly <ONI> is expected to be of positive value in 2012; hence, one anticipates lower frequencies during the 2012 hurricane season, with NTC ≤11 (63%), NTS ≤5 (68.6%), NH ≤6 (61.1%), NMH ≤3 (68.5%), and NUSLFH ≤2 (80.9%). On the other hand, if an EN event fails to recur during the hurricane season, while the value of <ONI> might be positive for the year, 2012 would be classified as non-ENY (more specifically, NY), thereby, potentially allowing for increased frequencies during the 2012 hurricane season.

For the yearly <NAO> being of positive value, NTC = 10 ± 1 (36%), NTC <9 (28.4%), and NTC >11 (35.7%); NTS = 4 ± 1 (50.2%), NTS <3 (13.5%), and NTS >5 (36.3%); NH = 5 ± 1 (48.1%), NH <4 (19.3%), and NH >6 (32.7%); NMH = 2 ± 1 (72.2%), NMH = 0 (13.5%), and NMH >3 (14.3%); and NUSLFH = 1 ± 1 (79.9%) and NUSLFH >2 (20.1%). For the yearly <NAO> being of negative value, NTC = 11 ± 1 (34.7%), NTC <10 (31%), and NTC >12 (34.4%); NTS = 4 ± 1 (53%), NTS <3 (17.5%), and NTS >5 (29.5%); NH = 6 ± 1 (43.6%), NH <5 (19.2%), and NH >7 (37.2%); NMH = 3 ± 1 (60.6%), NMH <2 (16.4%), and NMH >4 (23%); and NUSLFH = 1 ± 1 (79.1%) and NUSLFH >2 (20.9%). Therefore, dependent upon whether the yearly <NAO> is of positive or negative value for 2012, one predicts either NTC = 10 ± 1 (36%, positive) or NTC = 11 ± 1 (34.7%, negative), and so forth. Because the yearly <NAO> is expected to be of positive value in 2012, one anticipates lower frequencies during the 2012 hurricane season, with NTC ≤11 (64.3%), NTS ≤5 (63.7%), NH ≤6 (67.3%), NMH ≤3 (85.7%), and NUSLFH ≤2 (79.9%).

For the yearly <QBO> being of positive value, NTC = 11 ± 1 (34.6%), NTC <10 (30.3%), and NTC >12 (35.1%); NTS = 4 ± 1 (50.2%), NTS <3 (13.5%), and NTS >5 (36.3%); NH = 6 ± 1 (45%), NH <5 (22.6%), and NH >7 (32.4%); NMH = 3 ± 1 (61.5%), NMH <2 (19.3%), and NMH >4 (19.2%); and NUSLFH = 1 ± 1 (73.1%) and NUSLFH >2 (26.9%). For the yearly <QBO> being of negative value, NTC = 10 ± 1 (35.6%), NTC <9 (26.3%), and NTC >11 (38%); NTS = 4 ± 1 (52.9%), NTS <3 (17.4%), and NTS >5 (29.7%); NH = 6 ± 1 (45.8%), NH <5 (26.4%), and NH >7 (27.8%); NMH = 2 ± 1 (66.9%), NMH = 0 (7.8%), and NMH >3 (25.3%); and NUSLFH = 1

± 1 (81.6%) and NUSLFH >2 (18.4%). Therefore, dependent upon whether the yearly <QBO> is of positive or negative value for 2012, one predicts either NTC = 11 ± 1 (34.6%, positive) or NTC = 10 ± 1 (35.6%, negative), and so forth. Because the yearly <QBO> is expected to be of negative value in 2012, one anticipates lower frequencies during the 2012 hurricane season, with NTC ≤11 (62%), NTS ≤5 (70.3%), NH ≤7 (72.2%), NMH ≤3 (74.7%), and NUSLFH ≤2 (81.6%).

Thus, as can be seen from above, three of the parameters (<AT>, <AMO>, and <AMM>) each suggest that the 2012 hurricane season, likely, will be one described as being of above long-term average activity. On the other hand, three other parameters (<ONI>, <NAO>, and <QBO>) each suggest that the 2012 season, likely, will be one described as being of below long-term average activity. This presents a dilemma. Certainly, the early predictions of the 2012 hurricane season being one that is of near average to below average activity seems very plausible, especially, if EN returns later this year. However, if EN fails to return later this year, the predictions probably will underestimate the actual level of activity.

Since 1995, there have been 5 yr classified as ENY, including 1997, 2002, 2004, 2006, and 2009. During these years NTC has measured, respectively, 8, 12, 15, 10, and 9; NTS has measured, respectively, 5, 8, 6, 5, and 6; NH has measured, respectively, 3, 4, 9, 5, and 3; NMH has measured respectively, 1, 2, 6, 2, and 2; and NUSLFH has measured, respectively, 1, 1, 6, 0, and 0. Hence, if 2012 turns out to be classified as ENY, as is anticipated, then, based on these ENY, one expects NTC = 8–13, NTS = 5–7, NH = 3–7, NMH = 1–5, and NUSLFH = 0–4 for the 2012 hurricane season. On the other hand, if 2012 turns out to be a non-ENY, then one expects NTC = 12–21, NTS = 5–11, NH = 7–12, NMH = 3–6, and NUSLFH = 0–4.

Based on decadal trends, surface air temperature, as measured by <AT>, has increased steadily from about 9.15 °C in the 1970s to 10.08 °C in the 2000s, an increase of nearly 1 °C over the past three decades (i.e., about 0.31 °C per decade). Ocean temperature, as measured by <JMSSTM>, likewise, has increased from about 25.37 °C in the 1970s to 25.78 °C in the 2000s, an increase of 0.41 °C (i.e., about 0.14 °C per decade). Increases have also been seen in <NTA>, <CAR>, <AMO>, <AMM>, and <ONI> over the same time interval. For example, <NTA> increased from –0.161 °C in the 1970s to 0.315 °C in the 2000s, an increase of 0.476 °C (i.e., 0.159 °C per decade); <CAR> increased from –0.145 °C in the 1970s to 0.163 °C in the 2000s, an increase of 0.308 °C (i.e., about 0.103 °C per decade); <AMO> increased from –0.25 °C in the 1970s to 0.174 °C in the 2000s, an increase of 0.424 °C (i.e., about 0.141 °C per decade); <AMM> has increased from –1.26 in the 1970s to 1 in the 2000s, an increase in index value of 2.26 units (i.e., about 0.75 units per decade); and <ONI> has increased from –0.29 °C in the 1970s to 0.1 °C in the 2000s, an increase of 0.39 °C (i.e., about 0.13 °C per decade). If these increases continue through the 2010s, then, undoubtedly, one would anticipate continued above average activity during this decade's hurricane seasons. On the other hand, if cyclic effects begin to dominate and manifest themselves during the present decade (in particular, those associated with <AMO> and <AMM>), then one should expect a lessening in hurricane activity towards long-term averages. (Note added in proof: The official NOAA forecast[132] was released on May 24, 2012. Because of current and projected conditions in the atmosphere and ocean in the North Atlantic basin this season, NOAA has announced that this favors a near normal hurricane season for this year. NOAA's Climate Prediction Center states that there is a 70% chance of seeing 9–15 tropical cyclones, of which 4–8 will strengthen into hurricanes and 1–3 will become major hurricanes. Based on the interval 1981–2010, the average hurricane season in the North Atlantic basin produces 12 tropical cyclones, with 6 becoming hurricanes including 3 becoming major hurricanes. Also, it should be noted that the first and second tropical cyclones of the 2012 North Atlantic basin hurricane season formed in late May off the eastern coast of the US (group 3). Alberto formed on May 19 off the coast of South Carolina, attained tropical storm strength only, and was no longer a tropical storm as of May 22. Subtropical storm Beryl formed on May 25 off the coasts of South Carolina, Georgia, and northern Florida, moving slowly westward. It remains active at the time of this writing.)

APPENDIX

Tables 1–33 provide the basic data upon which the figures are derived.

Table 1. Listing of North Atlantic basin tropical cyclones for the interval 1945–2010, based on National Hurricane Center 'best tracks' archival database, available online at <http://www.nhc.noaa.gov>.

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1945	732	Unnamed	MH	06/20	06/28	17.5	85.7	2	100	-	9.9	7.75	1.50	0.25	AFL1
	733	Unnamed	TS	07/19	07/21	25.5	92.4	1	45	-	1.9	2.75	-	-	
	734	Unnamed	TS	08/01	08/04	12.1	56.3	4	50	-	2.6	3.50	-	-	
	735	Unnamed	TS	08/17	08/20	17.4	55.3	4	60	-	3.0	3.25	-	-	
	736	Unnamed	MH	08/24	08/29	19.4	94.0	1	120	963	15.1	5.00	3.75	1.75	BTX2
	737	Unnamed	TS	08/29	08/31	13.0	82.6	2	50	993	2.0	2.75	-	-	
	738	Unnamed	TS	09/03	09/05	20.0	84.0	1	35	-	0.9	1.75	-	-	
	739	Unnamed	TS	09/10	09/12	18.3	60.3	2	50	-	2.2	2.75	-	-	
	740	Unnamed	MH	09/12	09/18	19.0	56.6	4	120	951	20.0	6.75	5.00	2.75	CFL3
	741	Unnamed	H	10/02	10/05	15.3	80.3	2	85	982	4.5	2.50	1.50	-	
	742	Unnamed	H	10/11	10/13	15.5	79.5	2	85	982	4.7	3.00	2.00	-	

Summary: NTC = 11, NTS = 6, NH = 5, NMH = 3, NUSLFH = 3, PWS = 120, <PWS> = 72.7, LP = 951, <LP> = 974.2, <N. Lat.> = 17.5, <W. Long.> = 75.2, <ACE> = 6.1, Sum ACE = 66.8, <NSD> = 3.80, Sum NSD = 41.75, Sum NHD = 13.75, Sum NMHD = 4.75, NTCA = 94.3%, ACE/NSD = 1.60, HISACE = 20.0, LISNSD = 7.75

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1946	743	Unnamed	TS	06/13	06/16	27.0	85.5	1	35	-	1.5	3.00	-	-	
	744	Unnamed	H	07/05	07/08	29.0	79.0	2	70	1006	4.7	3.75	1.50	-	
	745	Unnamed	TS	08/25	08/25	20.5	93.2	1	35	-	0.5	1.00	-	-	
	746	Unnamed	H	09/12	09/15	23.8	79.6	2	85	975	6.7	3.25	2.50	-	
	747	Unnamed	MH	10/05	10/08	18.0	87.2	2	115	979	7.2	3.75	1.75	0.75	BFL1
	748	Unnamed	TS	10/31	11/02	20.0	71.0	3	40	-	1.1	2.00	-	-	

Summary: NTC = 6, NTS = 3, NH = 3, NMH = 1, NUSLFH = 1, PWS = 115, <PWS> = 63.3, LP = 975, <LP> = 986.7, <N. Lat.> = 23.1, <W. Long.> = 82.6, <ACE> = 3.6, Sum ACE = 21.7, <NSD> = 2.79, Sum NSD = 16.75, Sum NHD = 5.75, Sum NMHD = 0.75, NTCA = 38.2%, ACE/NSD = 1.30, HISACE = 7.2, LISNSD = 3.75

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1947	749	Unnamed	TS	07/31	08/02	19.5	92.0	1	40	-	1.3	2.50	-	-	
	750	Unnamed	H	08/09	08/16	13.7	74.6	2	95	-	10.0	7.25	2.00	-	
	751	Unnamed	H	08/18	08/26	24.0	80.0	1	70	-	9.2	7.50	2.50	-	CTX1
	752	Unnamed	MH	09/04	09/20	14.5	20.1	4	140	947	62.6	16.25	15.00	6.25	CFL4, LA3, MS3, BFL2
	753	Unnamed	TS	09/07	09/08	27.9	85.0	1	40	-	0.6	1.00	-	-	
	754	Unnamed	TS	09/20	09/24	18.6	78.1	2	50	989	3.1	4.25	-	-	
	755	Unnamed	TS	10/06	10/07	22.0	77.0	3	45	-	0.9	1.25	-	-	
	756	Unnamed	H	10/09	10/16	15.4	82.0	2	75	973	10.9	7.50	4.25	-	GA2, SC2, CFL1
	757	Unnamed	MH	10/16	10/21	17.4	62.4	2	105	-	13.8	5.00	4.25	1.00	

Summary: NTC = 9, NTS = 4, NH = 5, NMH = 2, NUSLFH = 3, PWS = 140, <PWS> = 73.3, LP = 947, <LP> = 969.7 <N. Lat.> = 19.2, <W. Long.> = 72.4, <ACE> = 12.5, Sum ACE = 112.4, <NSD> = 5.83, Sum NSD = 52.50, Sum NHD = 28.00, Sum NMHD = 7.25, NTCA = 105.3%, ACE/NSD = 2.14, HISACE = 62.6, LISNSD = 16.25

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1948	758	Unnamed	TS	05/22	05/28	16.0	75.0	2	45	-	3.8	6.00	-	-	
	759	Unnamed	TS	07/07	07/09	26.3	90.6	1	35	-	1.0	2.00	-	-	
	760	Unnamed	MH	08/26	08/31	19.5	58.9	4	105	-	17.5	5.75	5.50	1.50	
	761	Unnamed	TS	08/31	09/01	13.5	53.0	4	50	1007	1.1	1.50	-	-	
	762	Unnamed	H	09/01	09/05	23.8	94.7	1	70	989	4.6	4.00	1.00	-	LA1
	763	Unnamed	MH	09/04	09/15	14.3	19.7	4	115	-	36.4	11.50	10.75	3.50	
	764	Unnamed	MH	09/18	09/24	18.2	78.8	2	105	963	17.6	6.25	5.50	1.25	BFL3, CFL2

Table 1. Listing of North Atlantic basin tropical cyclones for the interval 1945–2010, based on National Hurricane Center 'best tracks' archival database, available online at <http://www.nhc.noaa.gov> (Continued).

Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
	765	Unnamed	MH	10/03	10/16	15.3	81.8	2	115	975	20.7	12.50	4.75	0.75	CFL2
	766	Unnamed	H	11/08	11/10	24.6	63.3	3	70	-	3.8	2.25	1.25	-	

Summary: NTC = 9, NTS = 3, NH = 6, NMH = 4, NUSLFH = 3, PWS = 115, <PWS> = 78.9, LP = 963, <LP> = 983.5
<N. Lat.> = 19.1, <W. Long.> = 68.4, <ACE> = 11.8, Sum ACE = 106.5, <NSD> = 5.75, Sum NSD = 51.75,
Sum NHD = 28.75, Sum NMHD = 7.00, NTCA = 122.0%, ACE/NSD = 2.06, HISACE = 36.4, LISNSD = 12.50

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1949	767	Unnamed	H	08/21	08/25	21.3	62.6	3	95	977	13.1	4.75	4.50	-	NC1
	768	Unnamed	MH	08/23	08/29	18.2	60.0	2	130	954	13.0	6.50	2.25	1.25	CFL3
	769	Unnamed	TS	08/30	09/02	11.9	55.8	4	45	-	2.0	3.00	-	-	
	770	Unnamed	MH	09/03	09/10	18.4	65.0	2	110	-	23.8	7.00	6.50	3.25	
	771	Unnamed	TS	09/03	09/05	23.7	89.0	1	40	1008	1.6	2.50	-	-	
	772	Unnamed	TS	09/05	09/11	27.3	40.4	5	40	-	4.2	6.75	-	-	
	773	Unnamed	TS	09/13	09/16	15.5	33.7	4	50	-	2.7	3.75	-	-	
	774	Unnamed	H	09/20	09/26	26.0	92.0	1	85	-	9.7	6.25	2.50	-	
	775	Unnamed	H	09/21	09/22	16.2	62.5	2	70	-	2.8	1.75	1.25	-	
	776	Unnamed	MH	09/27	10/06	12.5	89.5	P/1	115	-	11.3	9.00	1.75	0.75	CTX2
	777	Unnamed	H	10/12	10/18	18.1	78.6	2	90	-	9.7	5.75	2.75	-	
	778	Unnamed	TS	10/13	10/16	21.8	49.2	5	50	-	2.7	3.75	-	-	
	779	Unnamed	TS	11/03	11/04	17.8	82.0	2	50	-	1.2	1.50	-	-	

Summary: NTC = 13, NTS = 6, NH = 7, NMH = 3, NUSLFH = 3, PWS = 130, <PWS> = 74.6, LP = 954, <LP> = 979.7
<N. Lat.> = 19.1, <W. Long.> = 66.4, <ACE> = 7.5, Sum ACE = 97.8, <NSD> = 4.77, Sum NSD = 62.25,
Sum NHD = 21.50, Sum NMHD = 5.25, NTCA = 117.3%, ACE/NSD = 1.57, HISACE = 23.8, LISNSD = 9.00

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1950#	780	Able	MH	08/12	08/21	16.5	54.5	4	120	-	32.5	9.75	8.00	4.00	
	781	Baker	MH	08/20	08/31	16.3	55.0	4	105	979	17.9	9.50	5.00	0.50	AL1
	782	Charlie	MH	08/21	09/04	13.1	24.0	4	100	-	26.9	14.50	8.00	0.75	
	783	Dog	MH	08/30	09/12	15.2	55.3	4	160	-	62.6	12.50	12.25	6.75	
	784	Easy	MH	09/01	09/07	19.1	84.1	2	110	958	15.1	6.50	4.00	1.75	AFL3
	785	Fox	MH	09/08	09/16	15.6	40.1	4	120	-	27.0	8.75	6.50	3.00	
	786	George	H	09/27	10/05	24.4	52.7	5	95	-	14.6	8.00	4.25	-	
	787	How	TS	10/01	10/04	25.8	88.6	1	50	-	2.4	3.00	-	-	
	788	Item	H	10/08	10/10	20.8	90.6	1	95	-	4.7	2.75	1.50	-	
	789	Jig	MH	10/11	10/17	24.3	47.2	5	105	-	13.6	6.00	4.00	0.75	
	790	King	MH	10/13	10/19	16.0	84.2	2	105	955	11.8	6.00	3.00	1.00	CFL3
	791	Unnamed	TS	10/17	10/24	22.0	42.0	5	60	-	6.5	7.00	-	-	
	792	Love	H	10/18	10/21	27.5	89.2	1	80	-	7.2	3.75	3.00	-	

Summary: NTC 13, NTS = 2, NH = 11, NMH = 8, NUSLFH = 3, PWS = 160, <PWS> = 100.4, LP = 955, <LP> = 964.0,
<N. Lat.> = 19.7, <W. Long.> = 62.1, <ACE> = 18.7, Sum ACE = 242.8, <NSD> = 7.54, Sum NSD = 98.00,
Sum NHD = 59.50, Sum NMHD = 18.50, NTCA = 247.0%, ACE/NSD = 2.48, HISACE = 62.6, LISNSD = 14.50

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1951&	793	Able	MH	05/16	05/23	31.0	75.3	3	100	-	17.2	7.00	5.75	0.75	
	794	Baker	TS	08/02	08/05	22.0	54.3	5	50	-	2.5	3.25	-	-	
	795	Charlie	MH	08/15	08/23	14.3	55.3	4	115	964	26.6	8.75	7.25	2.25	
	796	Dog	MH	08/31	09/05	13.4	46.5	4	100	-	10.7	5.75	2.50	0.50	
	797	Easy	MH	09/02	09/12	14.0	37.0	4	140	-	37.1	9.75	9.00	4.00	
	798	Fox	MH	09/04	09/10	11.8	29.0	4	100	-	17.9	6.75	5.50	0.75	
	799	George	TS	09/20	09/21	19.8	93.0	1	50	-	1.4	1.75	-	-	
	800	How	H	10/01	10/06	26.1	86.8	1	95	-	12.8	5.50	4.00	-	
	801	Item	H	10/13	10/17	16.2	80.2	2	70	-	5.0	4.25	1.25	-	
	802	Jig	H	10/15	10/20	28.1	75.6	3	70	-	5.3	5.00	1.00	-	

Summary: NTC = 10, NTS = 2, NH = 8, NMH = 5, NUSLFH = 0, PWS = 140, <PWS> = 89.0, LP = 964, <LP> = 964.0,
<N. Lat.> = 19.7, <W. Long.> = 63.3, <ACE> = 13.7, Sum ACE = 136.5, <NSD> = 5.78, Sum NSD = 57.75,

Table 1. Listing of North Atlantic basin tropical cyclones for the interval 1945–2010, based on National Hurricane Center 'best tracks' archival database, available online at <http://www.nhc.noaa.gov> (Continued).

Sum NHD = 36.25, Sum NMHD = 8.25, NTCA = 148.0%, ACE/NSD = 2.36, HISACE = 37.1, LISNSD = 9.75

Year	SNBR	Name	Class.	FSD	LSD	Genesis Location N. Lat	Genesis Location W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1952	803	Unnamed	TS	02/02	02/03	20.2	87.4	1	45	-	1.0	1.50	-	-	
	804	Able	H	08/24	09/01	16.4	51.2	4	90	998	13.1	8.00	4.00	-	SC1
	805	Baker	MH	08/31	09/08	16.7	58.4	4	105	969	26.8	8.25	7.50	3.50	
	806	Charlie	MH	09/23	09/29	16.8	67.6	3	105	993	16.7	6.50	4.50	1.75	
	807	Dog	H	09/25	09/29	14.0	51.0	4	75	998	4.6	4.25	0.75	-	
	808	Easy	H	10/07	10/11	15.5	51.0	4	95	968	5.3	4.75	1.00	-	
	809	Fox	MH	10/21	10/27	15.0	80.7	2	130	934	19.6	6.50	5.00	1.75	

Summary: NTC = 7, NTS = 1, NH = 6, NMH = 3, NUSLFH = 1, PWS = 130, <PWS> = 92.1, LP = 934, <LP> = 976.7,
<N. Lat.> = 16.4, <W. Long.> = 63.9, <ACE> = 12.4, Sum ACE = 87.1, <NSD> = 5.68, Sum NSD = 39.75,
Sum NHD = 22.75, Sum NMHD = 7.00, NTCA = 103.1%, ACE/NSD = 2.19, HISACE = 26.8, LISNSD = 8.25

Year	SNBR	Name	Class.	FSD	LSD	Genesis Location N. Lat	Genesis Location W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1953	810	Alice	TS	05/25	06/06	14.4	81.8	2	60	997	9.6	12.25	-	-	
	811	Barbara	H	08/11	08/15	22.8	73.9	3	95	987	9.1	4.50	3.25	-	NC1
	812	Unnamed	TS	08/28	09/01	21.7	82.6	1	50	985	2.3	3.50	-	-	
	813	Carol	MH	08/31	09/07	10.6	37.7	4	130	929	26.4	7.75	5.75	3.00	ME1
	814	Dolly	MH	09/08	09/12	20.3	65.9	3	100	995	10.4	4.50	2.50	0.75	
	815	Edna	MH	09/14	09/18	17.0	62.4	2	110	-	13.8	4.50	3.50	2.00	
	816	Unnamed	TS	09/14	09/20	23.1	94.2	1	60	-	8.6	6.50	-	-	
	817	Florence	MH	09/23	09/26	16.9	75.8	2	110	968	9.1	3.50	2.25	1.00	AFL1
	818	Gail	H	10/02	10/05	13.5	37.0	4	70	-	3.3	3.00	0.75	-	
	819	Unnamed	TS	10/03	10/06	20.3	79.0	3	40	-	1.5	2.75	-	-	
	820	Unnamed	TS	10/05	10/08	18.7	40.2	4	60	-	3.0	3.50	-	-	
	821	Hazel	TS	10/07	10/10	20.5	86.4	1	60	994	3.5	3.50	-	-	
	822	Unnamed	TS	11/23	11/26	22.0	56.5	5	45	-	2.1	3.25	-	-	
	823	Unnamed	TS	12/08	12/09	20.8	53.1	5	35	-	0.7	1.50	-	-	

Summary: NTC = 14, NTS = 8, NH = 6, NMH = 4, NUSLFH = 3, PWS = 130, <PWS> = 73.2, LP = 929, <LP> = 979.3,
<N. Lat.> = 18.8, <W. Long.> = 66.2, <ACE> = 7.4, Sum ACE = 103.4, <NSD> = 4.61, Sum NSD = 64.50,
Sum NHD = 18.00, Sum NMHD = 6.75, NTCA = 119.6%, ACE/NSD = 1.60, HISACE = 26.4, LISNSD = 12.25

Year	SNBR	Name	Class.	FSD	LSD	Genesis Location N. Lat	Genesis Location W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1954#	824	Alice	H	06/24	06/26	22.0	94.0	1	70	-	2.3	1.75	0.75	-	
	825	Barbara	TS	07/28	07/29	28.0	90.5	1	40	-	0.8	1.50	-	-	
	826	Carol	H	08/25	08/31	25.1	75.5	3	85	-	14.3	6.00	4.75	-	NY3, CT3, RI3, NC2
	827	Dolly	H	08/31	09/02	20.9	68.4	3	85	-	4.5	2.25	1.75	-	
	828	Edna	MH	09/04	09/11	19.3	62.8	2	105	-	19.5	7.50	5.00	3.00	MA3, ME1
	829	Florence	H	09/11	09/12	20.9	94.7	1	65	-	1.7	1.50	0.50	-	
	830	Gilda	TS	09/24	09/27	14.1	76.8	2	60	-	3.6	3.25	-	-	
	831	Unnamed	H	09/29	10/06	31.6	48.4	5	85	-	13.0	7.00	4.75	-	
	832	Hazel	MH	10/05	10/15	12.4	59.2	4	120	937	41.3	10.50	10.00	6.50	SC4, NC4, MD2
	833	Unnamed	TS	11/17	11/21	23.8	44.5	5	45	-	3.5	4.50	-	-	
	834	Alice	H	12/30	01/05	22.0	51.6	5	70	1007	8.7	6.00	4.00	-	

Summary: NTC = 11, NTS = 3, NH = 8, NMH = 2, NUSLFH = 3, PWS = 120, <PWS> = 75.5, LP = 937, <LP> = 972.0,
<N. Lat.> = 21.8, <W. Long.> = 69.7, <ACE> = 10.3, Sum ACE = 113.2, <NSD> = 4.25, Sum NSD = 46.75,
Sum NHD = 31.50, Sum NMHD = 9.50, NTCA = 132.4%, ACE/NSD = 2.42, HISACE = 41.3, LISNSD = 10.50

Year	SNBR	Name	Class.	FSD	LSD	Genesis Location N. Lat	Genesis Location W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1955#	835	Brenda	TS	07/31	08/02	27.5	88.4	1	60	-	1.9	1.75	-	-	
	836	Connie	MH	08/03	08/13	15.7	39.2	4	125	936	43.1	10.50	7.75	5.75	NC3, VA1
	837	Diane	MH	08/09	08/20	18.9	54.3	4	105	969	24.3	11.00	5.50	2.75	NC1
	838	Edith	H	08/23	08/31	15.3	51.0	4	85	-	17.9	8.00	6.50	-	

Table 1. Listing of North Atlantic basin tropical cyclones for the interval 1945–2010, based on National Hurricane Center 'best tracks' archival database, available online at <http://www.nhc.noaa.gov> (Continued).

	839	Unnamed	TS	08/23	08/28	17.7	80.0	2	40	-	3.1	5.75	-	-	
	840	Flora	H	09/02	09/08	19.0	31.1	4	90	967	13.9	6.75	5.50	-	
	841	Gladys	H	09/04	09/06	21.5	94.6	1	80	-	2.6	2.25	0.50	-	
	842	Hilda	MH	09/11	09/20	18.6	62.9	2	110	952	22.5	9.00	6.50	1.50	
	843	Ione	MH	09/10	09/21	15.4	44.2	4	105	938	20.9	10.75	5.75	1.75	NC3
	844	Janet	MH	09/21	09/30	13.2	54.3	4	150	914	38.1	8.75	7.50	4.75	
	845	Unnamed	TS	10/10	10/13	28.4	42.0	5	55	-	3.4	3.50	-	-	
	846	Katie	MH	10/15	10/19	12.1	77.7	2	100	984	7.6	4.75	1.25	0.50	

Summary: NTC = 12, NTS = 3, NH = 9, NMH = 6, NUSLFH = 3, PWS = 150, <PWS> = 92.1, LP = 914, <LP> = 951.4, <N. Lat.> = 18.6, <W. Long.> = 60.0, <ACE> = 16.6, Sum ACE = 199.3, <NSD> = 6.90, Sum NSD = 82.75, Sum NHD = 46.75, Sum NMHD = 17.00, NTCA = 206.3%, ACE/NSD = 2.15, HISACE = 43.1, LISNSD = 11.00

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1956#	847	Unnamed	TS	06/12	06/14	24.0	91.0	1	50	1004	1.3	1.75	-	-	
	848	Anna	H	07/26	07/27	20.8	93.5	1	70	991	1.8	1.50	0.50	-	
	849	Betsy	MH	08/09	08/18	13.5	47.2	4	105	954	26.4	9.25	8.00	1.25	
	850	Carla	TS	09/05	09/10	21.5	74.9	3	45	996	3.1	5.50	-	-	
	851	Dora	TS	09/10	09/12	20.5	91.1	1	60	1001	2.9	2.50	-	-	
	852	Ethel	TS	09/12	09/14	25.4	74.3	3	60	999	1.7	1.75	-	-	
	853	Flossy	H	09/22	09/25	22.2	89.8	1	80	980	4.7	3.25	1.50	-	LA2, AFL1
	854	Greta	MH	11/02	11/06	28.1	73.5	3	120	970	12.3	4.50	2.75	1.50	

Summary: NTC = 8, NTS = 4, NH = 4, NMH = 2, NUSLFH = 1, PWS = 120, <PWS> = 73.8, LP = 954, <LP> = 986.9 <N. Lat.> = 22.0, <W. Long.> = 79.4, <ACE> = 6.8, Sum ACE = 54.2, <NSD> = 3.75, Sum NSD = 30.00, Sum NHD = 12.75, Sum NMHD = 2.75, NTCA = 67.7%, ACE/NSD = 1.81, HISACE = 26.4, LISNSD = 9.25

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1957&	855	Unnamed	TS	06/08	06/10	26.2	87.8	1	55	-	1.1	1.75	-	-	
	856	Audrey	MH	06/25	06/28	21.6	93.3	1	125	946	8.6	3.00	2.25	0.50	CTX4, LA4
	857	Bertha	TS	08/08	08/10	27.0	88.9	1	60	998	1.9	1.75	-	-	
	858	Carrie	MH	09/03	09/22	13.7	25.9	4	135	945	62.6	19.50	17.75	6.00	
	859	Debbie	TS	09/07	09/08	23.9	89.8	1	35	-	0.9	1.75	-	-	
	860	Esther	TS	09/17	09/19	23.7	92.8	1	45	1000	1.7	2.25	-	-	
	861	Frieda	H	09/22	09/26	27.8	66.5	3	70	992	5.0	4.50	1.00	-	
	862	Unnamed	TS	10/23	10/26	24.7	60.7	3	50	993	2.0	3.50	-	-	

Summary: NTC = 8, NTS = 5, NH = 3, NMH = 2, NUSLFH = 1, PWS = 135, <PWS> = 72.5, LP = 945, <LP> = 979.0 <N. Lat.> = 23.6, <W. Long.> = 75.7, <ACE> = 10.5, Sum ACE = 83.8, <NSD> = 4.75, Sum NSD = 38.00, Sum NHD = 21.00, Sum NMHD = 6.50, NTCA = 85.7%, ACE/NSD = 2.21, HISACE = 62.6, LISNSD = 19.50

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1958	863	Alma	TS	06/14	06/15	21.7	95.0	1	45	997	0.8	1.25	-	-	
	864	Becky	TS	08/11	08/15	17.7	41.8	4	50	-	3.6	4.50	-	-	
	865	Cleo	MH	08/11	08/20	10.8	21.6	4	140	948	32.0	9.00	7.25	4.00	
	866	Daisy	MH	08/24	08/29	25.2	73.6	3	110	935	15.7	5.50	4.50	1.75	
	867	Ella	MH	08/30	09/06	14.0	59.6	4	100	1009	11.8	7.00	2.00	0.25	
	868	Fifi	H	09/05	09/12	12.2	49.8	4	80	1000	8.7	7.25	1.75	-	
	869	Gerda	TS	09/13	09/15	15.9	64.2	2	60	1004	1.5	2.00	-	-	
	870	Helene	MH	09/23	09/29	22.5	64.8	3	115	934	18.5	6.75	5.25	2.00	NC3
	871	Ilsa	MH	09/24	09/30	17.7	52.1	4	115	998	16.1	5.75	4.50	1.50	
	872	Janice	H	10/05	10/12	20.9	81.5	1	80	968	12.2	6.50	5.00	-	

Summary: NTC = 10, NTS = 3, NH = 7, NMH = 5, NUSLFH = 1, PWS = 140, <PWS> = 89.5, LP = 934, <LP> = 977.0, <N. Lat.> = 17.9, <W. Long.> = 60.4, <ACE> = 12.1, Sum ACE = 120.9, <NSD> = 5.55, Sum NSD = 55.50, Sum NHD = 30.25, Sum NMHD = 9.50, NTCA = 144.5%, ACE/NSD = 2.18, HISACE = 32.0, LISNSD = 9.00

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH

Table 1. Listing of North Atlantic basin tropical cyclones for the interval 1945–2010, based on National Hurricane Center ‘best tracks’ archival database, available online at <http://www.nhc.noaa.gov> (Continued).

1959	873	Arlene	TS	05/29	05/30	25.3	87.7	1	50	1000	1.4	2.00	-	-	
	874	Beulah	TS	06/16	06/18	22.0	95.6	1	60	987	2.6	2.50	-	-	
	875	Unnamed	H	06/18	06/19	30.4	77.7	3	65	974	1.2	1.00	0.25	-	
	876	Cindy	H	07/07	07/11	31.5	77.1	3	65	-	3.6	3.50	0.75	-	SC1
	877	Debra	H	07/23	07/26	27.5	93.1	1	75	984	3.4	2.75	1.25	-	CTX1
	878	Edith	TS	08/18	08/19	14.3	57.9	4	50	-	0.9	1.50	-	-	
	879	Flora	H	09/10	09/12	22.0	46.0	5	65	994	2.7	2.25	1.00	-	
	880	Gracie	MH	09/22	09/30	21.8	74.1	3	120	950	20.2	8.50	7.25	1.25	SC3
	881	Hannah	MH	09/28	10/08	26.9	51.2	5	110	959	34.8	10.50	9.75	3.00	
	882	Irene	TS	10/07	10/08	27.1	88.9	1	50	1001	0.7	1.00	-	-	
	883	Judith	H	10/17	10/21	21.2	85.1	1	70	999	5.9	4.50	1.75	-	

Summary: NTC = 11, NTS = 4, NH = 7, NMH = 2, NUSLFH = 3, PWS = 120, <PWS> = 70.9, LP = 950, <LP> = 983.1, <N. Lat.> = 24.5, <W. Long.> = 75.9, <ACE> = 7.0, Sum ACE = 77.4, <NSD> = 3.64, Sum NSD = 40.00, Sum NHD = 22.00, Sum NMHD = 4.25, NTCA = 96.1%, ACE/NSD = 1.94, HISACE = 34.8, LISNSD = 10.50

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1960	884	Unnamed	TS	06/23	06/24	24.7	96.3	1	40	1002	0.6	1.00	-	-	
	885	Abby	H	07/10	07/15	13.8	61.0	2	85	-	9.6	5.50	3.75	-	
	886	Brenda	TS	07/29	07/31	31.5	81.5	3	50	-	1.4	1.75	-	-	
	887	Cleo	H	08/17	08/21	24.4	75.5	3	80	-	5.6	3.50	1.75	-	
	888	Donna	MH	08/30	09/13	10.3	26.9	4	140	932	64.6	13.75	11.75	9.25	BFL4, NC3, NY3, DFL2, CT2, RI2, MA 1, NH1, ME1
	889	Ethel	MH	09/14	09/16	23.9	90.6	1	140	981	5.3	2.25	1.00	0.50	MS1
	890	Florence	TS	09/18	09/19	21.2	66.8	3	40	-	0.9	1.75	-	-	

Summary: NTC = 7, NTS = 3, NH = 4, NMH = 2, NUSLFH = 2, PWS = 140, <PWS> = 82.1, LP = 932, <LP> = 971.7, <N. Lat.> = 21.4, <W. Long.> = 71.2, <ACE> = 12.57, Sum ACE = 88.0, <NSD> = 4.21, Sum NSD = 29.50, Sum NHD = 18.25, Sum NMHD = 9.75, NTCA = 92.9%, ACE/NSD = 2.98, HISACE = 64.6, LISNSD = 13.75

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1961	891	Anna	MH	07/20	07/24	11.5	60.2	2	100	976	14.3	5.00	4.00	1.50	
	892	Betsy	MH	09/02	09/11	13.3	41.7	4	120	945	32.2	9.75	8.50	2.75	
	893	Carla	MH	09/05	09/13	16.3	82.7	2	150	931	30.0	8.00	6.00	4.25	BTX4
	894	Debbie	MH	09/06	09/16	15.1	24.1	4	105	970	24.3	10.00	9.75	1.75	
	895	Esther	MH	09/11	09/26	14.4	36.7	4	125	927	52.2	15.00	9.75	8.50	
	896	Unnamed	TS	09/14	09/15	34.7	77.9	3	35	-	0.6	1.25	-	-	
	897	Frances	MH	09/30	10/09	16.1	58.7	4	110	948	20.3	9.00	4.75	2.25	
	898	Gerda	TS	10/19	10/20	31.5	71.5	3	60	987	1.6	1.25	-	-	
	899	Hattie	MH	10/27	11/01	11.6	81.5	2	140	920	21.7	5.00	3.75	3.50	
	900	Jenny	H	11/06	11/08	28.8	47.0	5	70	974	3.9	2.75	1.00	-	
	901	Inga	TS	11/05	11/08	20.8	94.7	1	60	992	4.4	3.75	-	-	

Summary: NTC = 11, NTS = 3, NH = 8, NMH = 7, NUSLFH = 1, PWS = 150, <PWS> = 97.7, LP = 920, <LP> = 957.0, <N. Lat.> = 19.5, <W. Long.> = 61.5, <ACE> = 18.7, Sum ACE = 205.5, <NSD> = 6.43, Sum NSD = 70.75, Sum NHD = 47.50, Sum NMHD = 24.50, NTCA = 230.4%, ACE/NSD = 2.90, HISACE = 52.2, LISNSD = 15.00

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1962	902	Alma	H	08/27	08/30	30.6	79.7	3	85	986	5.2	3.25	1.50	-	
	903	Becky	TS	08/28	08/31	19.5	23.3	4	35	-	1.2	2.50	-	-	
	904	Celia	TS	09/12	09/20	16.4	48.7	4	60	995	2.8	3.75	-	-	
	905	Daisy	H	10/02	10/08	21.8	63.2	3	95	968	12.6	6.00	4.75	-	
	906	Ella	MH	10/15	10/22	25.0	72.1	3	100	950	13.7	6.75	4.50	0.50	

Summary: NTC = 5, NTS = 2, NH = 3, NMH = 1, NUSLFH = 0, PWS = 100, <PWS> = 75.0, LP = 968, <LP> = 974.8, <N. Lat.> = 22.7, <W. Long.> = 57.4, <ACE> = 7.1, Sum ACE = 35.5, <NSD> = 4.45, Sum NSD = 22.25, Sum NHD = 10.75, Sum NMHD = 0.50, NTCA = 40.9%, ACE/NSD = 1.60, HISACE = 13.7, LISNSD = 6.75

Table 1. Listing of North Atlantic basin tropical cyclones for the interval 1945–2010, based on National Hurricane Center 'best tracks' archival database, available online at <http://www.nhc.noaa.gov> (Continued).

Year	SNBR	Name	Class.	FSD	LSD	Genesis Location N. Lat	Genesis Location W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1963&	907	Arlene	H	08/02	08/10	11.5	46.0	4	90	969	10.8	5.50	4.00	-	
	908	Beulah	MH	08/21	08/28	15.5	52.8	4	105	958	17.1	7.00	5.75	0.75	
	909	Unnamed	TS	09/11	09/14	34.8	59.7	5	50	992	2.9	3.50	-	-	
	910	Cindy	H	09/16	09/18	26.7	93.7	1	70	996	2.8	2.00	1.25	-	CTX1
	911	Debra	H	09/21	09/24	19.9	47.9	4	65	999	4.2	3.75	1.50	-	
	912	Edith	H	09/24	09/28	12.9	56.5	4	85	990	7.2	4.50	3.25	-	
	913	Flora	MH	09/29	10/12	10.0	52.8	4	125	940	49.4	13.25	12.75	6.25	
	914	Ginny	H	10/19	10/29	30.8	71.8	3	95	958	22.2	10.25	8.75	-	
	915	Helena	TS	10/25	10/28	15.3	59.4	4	45	1001	1.2	2.25	-	-	

Summary: NTC = 9, NTS = 2, NH = 7, NMH = 2, NUSLFH = 1, PWS = 125, <PWS> = 81.1, LP = 944, <LP> = 978.1, <N. Lat.> = 19.7, <W. Long.> = 60.1, <ACE> = 13.1, Sum ACE = 117.8, <NSD> = 5.78, Sum NSD = 52.00, Sum NHD = 37.25, Sum NMHD = 7.00, NTCA = 116.2%, ACE/NSD = 2.27, HISACE = 49.4, LISNSD = 13.25

Year	SNBR	Name	Class.	FSD	LSD	Genesis Location N. Lat	Genesis Location W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1964#	916	Unnamed	TS	06/07	06/11	32.5	78.6	3	50	-	3.1	4.50	-	-	
	917	Unnamed	TS	07/31	08/02	33.7	57.2	5	45	-	1.6	2.00	-	-	
	918	Abby	TS	08/07	08/08	28.5	94.4	1	55	1000	0.8	0.75	-	-	
	919	Brenda	TS	08/08	08/10	32.4	64.9	3	45	1006	1.9	2.50	-	-	
	920	Cleo	MH	08/21	09/05	13.4	46.8	4	135	950	37.7	13.25	9.50	3.50	CFL2
	921	Dora	MH	09/01	09/14	11.7	47.0	4	115	942	35.4	13.00	8.25	4.00	DFL2
	922	Ethel	MH	09/04	09/15	18.0	37.0	4	100	969	23.9	11.25	8.50	0.50	
	923	Florence	TS	09/08	09/10	21.4	29.4	5	40	-	1.5	2.50	-	-	
	924	Glayds	MH	09/13	09/24	15.4	46.0	4	125	945	34.4	11.25	10.25	2.75	
	925	Hilda	MH	09/29	10/04	22.0	84.2	1	130	941	18.9	5.00	3.75	2.75	LA3
	926	Isbell	MH	10/13	10/16	20.0	85.0	1	110	964	9.9	3.50	2.75	1.25	BFL2, CFL2
	927	Unnamed	TS	11/06	11/08	13.9	81.4	2	35	997	0.9	1.75	-	-	

Summary: NTC = 12, NTS = 6, NH = 6, NMH = 6, NUSLFH = 4, PWS = 135, <PWS> = 82.1, LP = 941, <LP> = 968.2, <N. Lat.> = 21.9, <W. Long.> = 62.7, <ACE> = 14.2, Sum ACE = 170.0, <NSD> = 5.94, Sum NSD = 71.25, Sum NHD = 43.00, Sum NMHD = 14.75, NTCA = 183.9%, ACE/NSD = 2.39, HISACE = 37.7, LISNSD = 13.25

Year	SNBR	Name	Class.	FSD	LSD	Genesis Location N. Lat	Genesis Location W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1965&	928	Unnamed	TS	06/14	06/15	24.1	91.1	1	45	-	1.3	2.00	-	-	
	929	Anna	H	08/21	08/25	32.4	51.8	5	80	-	6.1	4.75	2.25	-	
	930	Betsy	MH	08/29	09/11	19.2	63.4	2	135	941	47.0	12.75	11.75	7.50	CFL3, LA3
	931	Carol	H	09/17	10/01	12.4	30.7	4	85	974	22.4	13.75	10.50	-	
	932	Debbie	TS	09/28	09/29	26.5	89.7	5	45	1001	0.8	1.25	-	-	
	933	Elena	H	10/14	10/18	22.0	54.1	5	70	977	6.8	5.00	2.75	-	

Summary: NTC = 6, NTS = 2, NH = 4, NMH = 1, NUSLFH = 1, PWS = 135, <PWS> = 76.7, LP = 941, <LP> = 973.3, <N. Lat.> = 22.8, <W. Long.> = 63.5, <ACE> = 14.1, Sum ACE = 84.4, <NSD> = 6.58, Sum NSD = 39.50, Sum NHD = 27.25, Sum NMHD = 7.50, NTCA = 85.9%, ACE/NSD = 2.14, HISACE = 47.0, LISNSD = 13.75

Year	SNBR	Name	Class.	FSD	LSD	Genesis Location N. Lat	Genesis Location W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1966	934	Alma	MH	06/06	06/13	18.1	84.2	1	110	970	14.4	7.25	4.00	0.50	AFL2
	935	Becky	H	07/02	07/03	35.8	55.3	5	65	985	1.6	1.25	0.50	-	
	936	Celia	H	07/14	07/21	21.3	61.8	3	70	995	3.4	3.00	1.25	-	
	937	Dorothy	H	07/23	07/30	31.8	41.9	5	75	989	10.9	7.25	4.50	-	
	938	Ella	TS	07/24	07/28	16.8	52.2	4	45	1008	3.1	4.00	-	-	
	939	Faith	MH	08/22	09/06	14.3	28.0	4	110	950	45.4	15.50	14.00	1.50	
	940	Greta	TS	09/04	09/06	19.8	59.0	4	50	1004	1.2	1.75	-	-	
	941	Hallie	TS	09/21	09/21	21.5	95.4	1	45	997	0.7	1.00	-	-	
	942	Inez	MH	09/24	10/10	14.8	48.7	4	130	929	54.3	16.25	13.75	6.50	BFL1
	943	Judith	TS	09/28	09/29	12.2	51.2	4	45	1007	1.0	1.50	-	-	
	944	Lois	H	11/06	11/11	23.9	53.5	5	70	986	8.8	5.25	4.00	-	

Table 1. Listing of North Atlantic basin tropical cyclones for the interval 1945–2010, based on National Hurricane Center ‘best tracks’ archival database, available online at <http://www.nhc.noaa.gov> (Continued).

Summary: NTC = 11, NTS = 4, NH = 7, NMH = 3, NUSLFH = 2, PWS = 130, <PWS> = 74.1, LP = 929, <LP> = 983.6,
<N. Lat.> = 20.9, <W. Long.> = 57.4, <ACE> = 13.2, Sum ACE = 144.8, <NSD> = 5.82, Sum NSD = 64.00,
Sum NHD = 42.00, Sum NMHD = 8.50, NTCA = 139.2%, ACE/NSD = 2.26, HISACE = 54.3, LISNSD = 16.25

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1967	945	Arlene	H	08/30	09/04	20.9	44.8	5	75	982	5.6	5.00	1.00	-	
	946	Beulah	MH	09/07	09/22	13.9	60.8	2	140	923	47.9	15.00	10.75	5.50	ATX3
	947	Chloe	H	09/08	09/21	22.7	38.0	5	95	958	23.0	13.00	11.00	-	
	948	Doria	H	09/09	09/17	27.8	79.2	3	75	973	13.0	8.25	5.50	-	
	949	Edith	TS	09/28	09/30	14.4	55.1	4	50	1000	1.1	1.75	-	-	
	950	Fern	H	10/02	10/04	21.5	93.0	1	75	987	3.5	2.50	1.50	-	
	951	Ginger	TS	10/06	10/07	18.0	18.1	4	45	1002	0.8	1.25	-	-	
	952	Heidi	H	10/20	10/31	21.4	61.5	3	80	981	18.9	11.25	6.50	-	

Summary: NTC = 8, NTS = 2, NH = 6, NMH = 1, NUSLFH = 1, PWS = 140, <PWS> = 79.4, LP = 923, <LP> = 975.8,
<N. Lat.> = 20.1, <W. Long.> = 56.3, <ACE> = 14.2, Sum ACE = 113.8, <NSD> = 7.25, Sum NSD = 58.0,
Sum NHD = 36.25, Sum NMHD = 5.50, NTCA = 100.8%, ACE/NSD = 1.96, HISACE = 47.9, LISNSD = 15.00

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1968	953	Abby	H	06/02	06/07	21.4	84.8	1	65	965	5.7	5.00	0.75	-	
	954	Brenda	H	06/21	06/26	30.9	76.3	3	65	990	6.9	5.00	1.50	-	
	955	Candy	TS	06/23	06/24	26.4	96.6	1	60	999	0.6	0.50	-	-	
	956	Dolly	H	08/12	08/16	35.0	71.3	3	70	985	6.0	4.00	2.75	-	
	957	Edna	TS	09/15	09/18	15.8	34.9	4	55	1005	3.7	3.50	-	-	
	958	ST1	SS(H)	09/16	09/23	34.8	67.6	3	70	979	9.9	7.25	1.75	-	
	959	Frances	TS	09/26	09/29	33.2	68.2	3	50	1001	2.1	2.50	-	-	
	960	Gladys	H	10/15	10/21	19.4	83.3	1	75	965	10.3	6.00	5.00	-	AFL2, DFL1

Summary: NTC = 8, NTS = 3, NH = 5, NMH = 0, NUSLFH = 1, PWS = 75, <PWS> = 63.8, LP = 965, <LP> = 986.1,
<N. Lat.> = 27.1, <W. Long.> = 72.9, <ACE> = 5.7, Sum ACE = 45.2, <NSD> = 4.22, Sum NSD = 33.75,
Sum NHD = 11.75, Sum NMHD = 0.00, NTCA = 47.5%, ACE/NSD = 1.34, HISACE = 10.3, LISNSD = 7.25

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1969&	961	Anna	TS	07/27	08/03	11.2	36.0	4	60	1002	5.0	5.50	-	-	
	962	Blanche	H	08/11	08/12	32.5	71.1	3	75	997	2.2	1.25	1.00	-	
	963	Camille	MH	08/14	08/22	19.4	82.0	1	165	905	23.5	6.00	3.25	2.25	LA5, MS5
	964	Debbie	MH	08/15	08/25	14.0	41.5	4	105	951	28.3	10.25	8.50	3.25	
	965	Eve	TS	08/25	08/26	29.8	76.0	3	50	996	1.0	1.25	-	-	
	966	Francelia	MH	08/30	09/04	14.3	72.2	2	100	973	10.2	5.25	2.50	0.25	
	967	Gerda	MH	09/08	09/10	29.7	79.7	3	110	979	5.3	2.00	1.50	0.50	ME1
	968	Holly	H	09/15	09/18	12.7	48.5	4	75	984	5.5	4.00	2.25	-	
	969	Inga	MH	09/21	10/13	16.7	50.2	4	100	964	31.6	17.00	10.50	0.25	
	970	Unnamed	H	09/21	09/26	34.1	70.5	3	65	985	5.7	4.50	1.75	-	
	971	Unnamed	TS	09/25	09/30	35.0	38.5	5	60	990	5.7	4.50	-	-	
	972	ST1	SS(TS)	09/29	10/01	24.0	85.7	1	50	998	1.6	1.75	-	-	
	973	Jenny	TS	10/02	10/03	25.5	82.1	1	40	1000	0.3	0.50	-	-	
	974	Kara	H	10/09	10/18	27.2	73.3	3	90	978	13.2	9.25	3.50	-	
	975	Laurie	H	10/19	10/24	21.5	89.5	1	90	973	8.5	5.25	2.75	-	
	976	Unnamed	TS	10/29	10/31	32.0	44.5	5	60	990	3.2	2.75	-	-	
	977	Unnamed	H	10/31	11/07	39.5	54.0	5	65	988	9.0	6.75	1.00	-	
	978	Martha	H	11/21	11/24	10.3	81.0	2	80	979	5.5	3.50	1.50	-	

Summary: NTC = 18, NTS = 6, NH = 12, NMH = 5, NUSLFH = 2, PWS = 165, <PWS> = 80.0, LP = 905, <LP> = 979.6,
<N. Lat.> = 23.9, <W. Long.> = 65.4, <ACE> = 9.2, Sum ACE = 165.3, <NSD> = 5.07, Sum NSD = 91.25,
Sum NHD = 40.00, Sum NMHD = 6.50, NTCA = 181.2%, ACE/NSD = 1.81, HISACE = 31.6, LISNSD = 17.00

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH

Table 1. Listing of North Atlantic basin tropical cyclones for the interval 1945–2010, based on National Hurricane Center ‘best tracks’ archival database, available online at <http://www.nhc.noaa.gov> (Continued).

1970#	979	Alma	H	05/20	05/22	15.5	82.5	2	70	993	2.2	2.25	0.50	-	
	980	Becky	TS	07/20	07/22	23.3	86.4	1	55	1003	1.9	2.00	-	-	
	981	Celia	MH	08/01	08/04	23.3	85.8	1	110	945	8.2	3.50	2.25	0.50	ATX3
	982	Unnamed	TS	08/18	08/18	37.0	72.5	3	60	992	1.1	1.00	-	-	
	983	Dorothy	TS	08/19	08/22	12.8	50.7	4	60	996	3.5	3.75	-	-	
	984	Ella	MH	09/10	09/13	22.0	89.0	1	110	967	6.1	2.75	2.00	0.50	
	985	Felice	TS	09/15	09/16	26.5	86.5	1	60	997	1.5	1.50	-	-	
	986	Greta	TS	09/26	09/27	22.4	75.4	3	45	1005	0.9	1.25	-	-	
	987	Unnamed	H	10/13	10/17	25.9	65.5	3	90	974	6.5	4.75	1.50	-	
	988	Unnamed	H	10/21	10/28	34.8	45.8	5	65	988	8.3	7.50	0.50	-	

Summary: NTC = 10, NTS = 5, NH = 5, NMH = 2, NUSLFH = 1, PWS = 110, <PWS> = 72.5, LP = 945, <LP> = 986.0,
<N. Lat.> = 24.4, <W. Long.> = 74.0, <ACE> = 4.0, Sum ACE = 40.2, <NSD> = 3.03, Sum NSD = 30.25,
Sum NHD = 6.75, Sum NMHD = 1.00, NTCA = 64.2%, ACE/NSD = 1.33, HISACE = 8.3, LISNSD = 7.50

Year	SNBR	Name	Class.	FSD	LSD	Genesis Location N. Lat	Genesis Location W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1971#	989	Arlene	TS	07/05	07/07	36.7	72.9	3	55	1000	1.8	2.00	-	-	
	990	Unnamed	H	08/05	08/07	40.5	58.5	5	75	974	3.3	2.00	1.25	-	
	991	Beth	H	08/14	08/16	34.4	72.3	3	75	977	4.3	2.50	2.00	-	
	992	Chloe	TS	08/20	08/21	14.3	63.5	2	55	1004	1.3	1.50	-	-	
	993	Doria	TS	08/27	08/28	29.2	77.2	3	55	989	1.9	2.00	-	-	
	994	Edith	MH	09/07	09/17	12.7	69.1	2	140	943	16.4	9.75	3.75	1.00	LA2
	995	Fern	H	09/08	09/12	26.9	92.6	1	80	978	6.1	4.75	1.50	-	BTX1
	996	Ginger	H	09/10	10/01	27.7	66.1	3	95	959	44.2	21.25	19.50	-	NC1
	997	Heidi	TS	09/12	09/14	29.2	74.0	3	55	996	2.4	2.00	-	-	
	998	Irene	H	09/17	09/19	12.5	73.0	2	70	989	3.5	3.00	0.75	-	
	999	Janice	TS	09/22	09/24	12.0	45.8	4	55	1005	2.0	2.25	-	-	
	1000	Kristy	TS	10/20	10/21	33.5	52.8	5	45	992	0.8	1.25	-	-	
	1001	Laura	TS	11/14	11/21	16.6	82.5	2	60	994	8.6	7.50	-	-	

Summary: NTC = 13, NTS = 7, NH = 6, NMH = 1, NUSLFH = 3, PWS = 140, <PWS> = 70.4, LP = 943, <LP> = 984.6,
<N. Lat.> = 25.1, <W. Long.> = 69.3, <ACE> = 7.4, Sum ACE = 96.6, <NSD> = 4.75, Sum NSD = 61.75,
Sum NHD = 28.75, Sum NMHD = 1.00, NTCA = 97.9%, ACE/NSD = 1.56, HISACE = 44.2, LISNSD = 21.25

Year	SNBR	Name	Class.	FSD	LSD	Genesis Location N. Lat	Genesis Location W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1972&	1002	Alpha	SS(TS)	05/26	05/27	34.0	73.5	3	60	991	2.1	2.00	-	-	
	1003	Agnes	H	06/16	06/23	20.0	86.2	1	75	977	6.8	5.25	1.50	-	AFL1, NY1, CT1
	1004	Betty	H	08/24	09/01	37.2	56.2	5	90	976	24.1	9.00	3.25	-	
	1005	Carrie	TS	08/31	09/03	32.5	72.0	3	60	993	3.4	4.00	-	-	
	1006	Dawn	H	09/06	09/12	27.3	77.9	3	70	997	6.6	6.25	1.25	-	
	1007	Charlie	SS(TS)	09/20	09/21	39.5	59.0	5	55	1001	1.1	1.25	-	-	
	1008	Delta	SS(TS)	11/02	11/04	34.7	48.0	5	40	1001	1.8	3.00	-	-	

Summary: NTC = 7, NTS = 4, NH = 3, NMH = 0, NUSLFH = 1, PWS = 90, <PWS> = 64.3, LP = 944, <LP> = 990.9,
<N. Lat.> = 32.2, <W. Long.> = 67.5, <ACE> = 6.6, Sum ACE = 45.9, <NSD> = 4.39, Sum NSD = 30.75,
Sum NHD = 6.00, Sum NMHD = 0.00, NTCA = 35.1%, ACE/NSD = 1.49, HISACE = 24.1, LISNSD = 9.00

Year	SNBR	Name	Class.	FSD	LSD	Genesis Location N. Lat	Genesis Location W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1973#	1009	Alice	H	07/03	07/07	27.8	66.0	3	80	986	7.1	4.25	2.50	-	
	1010	Alfa	SS(TS)	07/31	08/01	35.0	72.5	3	40	1005	0.7	1.25	-	-	
	1011	Brenda	H	08/18	08/21	21.2	86.0	1	80	977	3.9	3.25	0.75	-	
	1012	Christine	TS	08/28	09/03	10.5	30.0	4	60	996	5.8	6.25	-	-	
	1013	Delia	TS	09/03	09/06	24.0	88.0	1	60	986	4.0	3.75	-	-	
	1014	Ellen	MH	09/15	09/22	14.0	25.7	4	100	962	14.9	8.25	4.25	0.25	
	1015	Fran	H	10/09	10/12	30.7	62.3	3	70	978	6.0	3.75	3.00	-	
	1016	Gilda	TS	10/18	10/27	19.5	79.9	2	60	984	8.0	8.00	-	-	

Summary: NTC = 8, NTS = 4, NH = 4, NMH = 1, NUSLFH = 0, PWS = 100, <PWS> = 68.8, LP = 962, <LP> = 984.3,
<N. Lat.> = 22.8, <W. Long.> = 63.8, <ACE> = 6.3, Sum ACE = 50.4, <NSD> = 4.84, Sum NSD = 38.75,

Table 1. Listing of North Atlantic basin tropical cyclones for the interval 1945–2010, based on National Hurricane Center ‘best tracks’ archival database, available online at <http://www.nhc.noaa.gov> (Continued).

Sum NHD = 10.50, Sum NMHD = 0.25, NTCA = 53.6%, ACE/NSD = 1.30, HISACE = 14.9, LISNSD = 8.25

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1974#	1017	ST1	SS(TS)	06/25	06/25	25.4	86.2	1	55	1000	1.0	1.00	-	-	
	1018	ST2	SS(TS)	07/17	07/19	35.0	68.8	3	45	1006	1.7	2.50	-	-	
	1019	ST3	SS(TS)	08/10	08/15	38.0	70.0	3	50	992	3.2	4.75	-	-	
	1020	Alma	TS	08/13	08/15	10.1	52.0	4	55	1007	1.4	2.25	-	-	
	1021	Becky	MH	08/28	09/02	32.1	69.0	3	100	977	14.4	5.25	4.25	1.50	
	1022	Carmen	MH	08/30	09/08	17.0	67.4	2	130	928	25.6	9.50	5.75	2.75	LA3
	1023	Dolly	TS	09/03	09/05	30.2	72.0	3	45	1005	1.3	1.75	-	-	
	1024	Elaine	TS	09/09	09/13	32.3	72.1	3	60	1001	4.0	4.25	-	-	
	1025	Fifi	H	09/16	09/22	17.0	77.8	2	95	971	9.7	4.75	2.50	-	
	1026	Gertrude	H	09/28	10/02	10.8	51.8	4	65	999	4.4	3.75	1.75	-	
	1027	ST4	SS(TS)	10/06	10/08	23.8	77.0	3	45	1006	1.6	2.50	-	-	

Summary: NTC = 11, NTS = 7, NH = 4, NMH = 2, NUSLFH = 1, PWS = 130, <PWS> = 67.7, LP = 928, <LP> = 990.2, <N. Lat.> = 24.7, <W. Long.> = 69.5, <ACE> = 6.2, Sum ACE = 68.3, <NSD> = 3.84, Sum NSD = 42.25, Sum NHD = 14.25, Sum NMHD = 4.25, NTCA = 83.1%, ACE/NSD = 1.62, HISACE = 25.6, LISNSD = 9.50

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1975#	1028	Amy	TS	06/29	07/04	34.4	75.8	3	60	981	6.5	5.50	-	-	
	1029	Blanche	H	07/26	07/28	32.2	74.6	3	75	980	3.4	2.25	1.25	-	
	1030	Caroline	MH	08/29	08/31	23.1	92.6	1	100	963	5.4	2.75	1.75	0.50	
	1031	Doris	H	08/28	09/04	33.3	46.3	5	95	965	13.8	6.75	4.00	-	
	1032	Eloise	MH	09/16	09/23	19.0	65.6	2	110	955	10.6	8.00	1.75	0.50	AFL3, AL1
	1033	Faye	H	09/19	09/29	20.0	39.0	5	90	977	11.8	8.25	3.50	-	
	1034	Gladys	MH	09/24	10/03	13.5	40.4	4	120	939	19.2	9.00	8.00	1.25	
	1035	Hallie	TS	10/26	10/27	32.5	78.7	3	45	1002	0.7	1.00	-	-	
	1036	ST2	SS(TS)	12/09	12/12	41.6	42.9	5	60	985	2.5	3.00	-	-	

Summary: NTC = 9, NTS = 3, NH = 6, NMH = 3, NUSLFH = 1, PWS = 120, <PWS> = 83.9, LP = 939, <LP> = 971.9, <N. Lat.> = 27.7, <W. Long.> = 61.8, <ACE> = 8.2, Sum ACE = 73.9, <NSD> = 5.17, Sum NSD = 46.50, Sum NHD = 20.25, Sum NMHD = 2.25, NTCA = 91.4%, ACE/NSD = 1.59, HISACE = 19.2, LISNSD = 9.00

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1976	1037	ST1	SS(TS)	05/23	05/25	26.3	89.0	1	45	994	2.0	3.00	-	-	
	1038	Anna	TS	07/30	08/01	29.8	42.0	5	40	999	1.5	2.50	-	-	
	1039	Belle	MH	08/07	08/10	25.6	73.2	3	105	957	9.5	3.75	2.25	0.75	NY1
	1040	Candice	H	08/18	08/24	33.4	67.5	3	80	964	8.8	6.00	3.50	-	
	1041	Dottie	TS	08/19	08/21	25.0	81.7	1	45	996	1.0	1.75	-	-	
	1042	Emmy	H	08/22	09/04	16.2	56.0	4	90	974	30.0	13.00	10.00	-	
	1043	Frances	MH	08/28	09/04	14.7	45.3	4	100	963	14.7	6.75	5.50	0.25	
	1044	ST3	SS(TS)	09/14	09/15	31.0	81.2	3*	40	1011	0.7	1.25	-	-	
	1045	Gloria	H	09/27	10/04	25.7	58.0	3	90	970	11.5	6.75	3.00	-	
	1046	Holly	H	10/23	10/28	22.5	58.0	3	65	990	4.5	5.00	1.00	-	

Summary: NTC = 10, NTS = 4, NH = 6, NMH = 2, NUSLFH = 1, PWS = 105, <PWS> = 70.0, LP = 957, <LP> = 981.8, <N. Lat.> = 25.0, <W. Long.> = 65.2, <ACE> = 8.4, Sum ACE = 84.2, <NSD> = 4.98, Sum NSD = 49.75, Sum NHD = 25.25, Sum NMHD = 1.00, NTCA = 86.2%, ACE/NSD = 1.69, HISACE = 30.0, LISNSD = 13.00

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1977	1047	Anita	MH	08/30	09/03	26.8	89.8	1	150	926	12.8	4.00	3.25	1.00	
	1048	Babe	H	09/03	09/05	27.6	88.5	1	65	995	2.3	2.25	0.50	-	LA1
	1049	Clara	H	09/08	09/11	35.1	71.7	3	65	993	3.7	3.50	0.75	-	
	1050	Dorothy	H	09/27	09/29	30.9	65.8	3	75	980	3.4	2.25	1.25	-	
	1051	Evelyn	H	10/14	10/15	30.9	64.9	3	70	994	2.4	1.75	1.00	-	
	1052	Frieda	TS	10/17	10/18	17.2	83.9	2	50	1005	0.8	1.00	-	-	

Table 1. Listing of North Atlantic basin tropical cyclones for the interval 1945–2010, based on National Hurricane Center ‘best tracks’ archival database, available online at <http://www.nhc.noaa.gov> (Continued).

Summary: NTC = 6, NTS = 1, NH = 5, NMH = 1, NUSLFH = 1, PWS = 150, <PWS> = 79.2, LP = 926, <LP> = 982.2, <N. Lat.> = 28.1, <W. Long.> = 77.4, <ACE> = 4.2, Sum ACE = 25.4, <NSD> = 2.46, Sum NSD = 14.75, Sum NHD = 6.75, Sum NMHD = 1.00, NTCA = 44.7%, ACE/NSD = 1.72, HISACE = 12.8, LISNSD = 4.00

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1978	1053	ST1	SS(TS)	01/19	01/22	23.5	47.6	5	40	1002	1.7	3.00	-	-	
	1054	Amelia	TS	07/31	07/31	26.4	97.4	1	45	1005	0.5	0.75	-	-	
	1055	Bess	TS	08/06	08/08	23.9	94.0	1	45	1005	1.2	1.75	-	-	
	1056	Cora	H	08/08	08/11	14.0	41.5	4	80	980	2.0	3.00	1.25	-	
	1057	Debra	TS	08/28	08/29	28.7	94.1	1	50	1000	0.4	0.50	-	-	
	1058	Ella	MH	08/30	09/05	27.3	63.1	3	120	956	19.2	6.00	5.00	2.50	
	1059	Flossie	H	09/04	09/15	14.2	41.2	4	85	976	11.7	9.25	3.25	-	
	1060	Greta	MH	09/14	09/19	12.5	67.5	2	115	947	11.6	5.00	2.75	1.00	
	1061	Hope	TS	09/15	09/21	32.9	64.8	3	55	987	5.4	6.50	-	-	
	1062	Irma	TS	10/04	10/05	35.1	31.5	5	45	1001	0.9	1.25	-	-	
	1063	Juliet	TS	10/08	10/11	18.8	58.7	4	45	1006	2.4	3.25	-	-	
	1064	Kendra	H	10/29	11/01	24.2	73.2	3	70	990	3.8	3.25	1.25	-	

Summary: NTC = 12, NTS = 7, NH = 5, NMH = 2, NUSLFH = 0, PWS = 120, <PWS> = 66.3, LP = 947, <LP> = 987.9, <N. Lat.> = 23.5, <W. Long.> = 64.6, <ACE> = 5.1, Sum ACE = 60.8, <NSD> = 3.63, Sum NSD = 43.50, Sum NHD = 13.50, Sum NMHD = 3.50, NTCA = 85.1%, ACE/NSD = 1.40, HISACE = 19.2, LISNSD = 9.25

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1979	1065	Ana	TS	06/22	06/23	14.2	54.7	4	50	1005	0.8	1.25	-	-	
	1066	Bob	H	07/10	07/11	23.5	93.8	1	65	986	2.1	1.75	0.75	-	LA1
	1067	Claudette	TS	07/17	07/25	17.8	60.3	2	45	997	1.6	2.75	-	-	
	1068	David	MH	08/26	09/06	11.6	42.2	4	150	924	44.0	11.50	8.75	4.50	CFL2, DFL2, GA2, SC2
	1069	Elena	TS	08/30	09/01	26.8	91.8	1	35	1004	1.0	2.00	-	-	
	1070	Frederic	MH	08/30	09/14	11.5	36.0	4	115	943	20.7	13.00	4.00	1.25	AL3, MS3
	1071	Gloria	H	09/06	09/15	22.0	33.8	5	85	975	16.4	8.75	7.00	-	
	1072	Henri	H	09/16	09/19	22.1	92.2	1	75	983	3.7	3.25	1.00	-	
	1073	ST1	SS(H)	10/24	10/25	35.0	64.0	3	65	980	1.6	1.50	0.25	-	

Summary: NTC = 9, NTS = 3, NH = 6, NMH = 2, NUSLFH = 3, PWS = 150, <PWS> = 76.1, LP = 924, <LP> = 977.4, <N. Lat.> = 20.5, <W. Long.> = 63.2, <ACE> = 10.2, Sum ACE = 91.9, <NSD> = 5.08, Sum NSD = 45.75, Sum NHD = 21.75, Sum NMHD = 5.75, NTCA = 103.8%, ACE/NSD = 2.01, HISACE = 44.0, LISNSD = 13.00

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1980	1074	Allen	MH	08/02	08/11	11.0	42.8	4	165	899	51.0	9.50	8.00	6.50	ATX3
	1075	Bonnie	H	08/14	08/19	14.7	37.3	4	85	975	8.8	5.25	3.75	-	
	1076	Charley	H	08/21	08/25	34.0	68.0	3	70	989	5.1	4.50	1.25	-	
	1077	Danielle	TS	09/05	09/06	29.4	93.4	1	50	1004	0.5	0.75	-	-	
	1078	Earl	H	09/05	09/10	17.8	26.7	4	65	985	7.3	5.75	2.25	-	
	1079	Frances	MH	09/06	09/20	12.7	21.8	4	100	958	37.2	14.25	12.25	0.75	
	1080	Georges	H	09/07	09/08	34.4	67.9	3	70	993	2.8	2.00	1.00	-	
	1081	Hermine	TS	09/21	09/25	15.1	81.6	2	60	993	4.5	4.50	-	-	
	1082	Ivan	H	10/04	10/11	35.6	24.6	5	90	970	18.6	7.25	6.00	-	
	1083	Jeanne	H	11/09	11/14	20.8	85.1	1	85	986	7.4	5.50	1.50	-	
	1084	Karl	H	11/25	11/27	36.0	46.0	5	75	985	5.2	3.00	2.25	-	

Summary: NTC = 11, NTS = 2, NH = 9, NMH = 2, NUSLFH = 1, PWS = 165, <PWS> = 83.2, LP = 899, <LP> = 976.1, <N. Lat.> = 23.8, <W. Long.> = 54.1, <ACE> = 13.5, Sum ACE = 148.4, <NSD> = 5.66, Sum NSD = 62.25, Sum NHD = 38.25, Sum NMHD = 7.25, NTCA = 130.3%, ACE/NSD = 2.38, HISACE = 51.0, LISNSD = 14.25

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1981	1085	Arlene	TS	05/07	05/08	19.0	80.6	2	50	999	0.7	1.00	-	-	
	1086	Bret	TS	06/29	07/01	36.0	65.0	3	60	996	2.0	1.75	-	-	

Table 1. Listing of North Atlantic basin tropical cyclones for the interval 1945–2010, based on National Hurricane Center ‘best tracks’ archival database, available online at <http://www.nhc.noaa.gov> (Continued).

	1087	Cindy	TS	08/03	08/05	38.7	64.9	3	50	1002	1.5	1.75	-	-	
	1088	Dennis	H	08/08	08/21	11.3	31.3	4	70	995	6.4	9.00	0.50	-	
	1089	Emily	H	09/01	09/11	29.9	69.7	3	80	966	15.2	10.75	4.00	-	
	1090	Floyd	MH	09/04	09/12	19.0	64.0	2	100	975	13.8	8.00	3.00	1.00	
	1091	Gert	H	09/08	09/14	15.6	60.6	2	90	988	10.1	6.75	2.25	-	
	1092	Harvey	MH	09/12	09/19	19.4	56.3	4	115	946	16.4	6.50	5.50	1.25	
	1093	Irene	MH	09/23	10/02	12.5	40.8	4	105	959	22.2	9.00	6.25	1.50	
	1094	Jose	TS	10/30	11/01	27.7	46.6	5	45	998	1.4	2.75	-	-	
	1095	Katrina	H	11/04	11/07	18.3	81.4	1	75	980	4.2	3.75	1.00	-	
	1096	ST3	SS(TS)	11/12	11/17	31.0	74.0	3	60	978	6.2	5.00	-	-	

Summary: NTC= 12, NTS = 5, NH = 7, NMH = 3, NUSLFH = 0, PWS = 115, <PWS> = 75.0, LP = 946, <LP> = 981.8, <N. Lat.> = 23.2, <W. Long.> = 61.3, <ACE> = 8.3, Sum ACE = 100.1, <NSD> = 5.50, Sum NSD = 66.00, Sum NHD = 22.50, Sum NMHD = 3.75, NTCA = 112.6%, ACE/NSD = 1.52, HISACE = 22.2, LISNSD = 10.75

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1982&	1097	Alberto	H	06/03	06/04	22.8	85.0	1	75	985	2.1	1.75	0.50	-	
	1098	ST1	SS(TS)	06/18	06/20	28.7	82.8	1	60	984	3.0	2.25	-	-	
	1099	Beryl	TS	08/28	09/02	13.9	22.7	4	60	989	5.3	5.00	-	-	
	1100	Chris	TS	09/10	09/11	27.3	94.2	1	55	994	1.3	1.50	-	-	
	1101	Debby	MH	09/14	09/20	23.5	71.9	3	115	950	18.2	6.25	5.25	1.25	
	1102	Ernesto	TS	10/01	10/02	26.5	67.8	3	60	997	1.6	1.75	-	-	

Summary: NTC = 6, NTS = 4, NH = 2, NMH = 1, NUSLFH = 0, PWS = 115, <PWS> = 70.8, LP = 950, <LP> = 983.2, <N. Lat.> = 23.8, <W. Long.> = 70.7, <ACE> = 5.3, Sum ACE = 31.5, <NSD> = 3.08, Sum NSD = 18.50, Sum NHD = 5.75, Sum NMHD = 1.25, NTCA = 37.7%, ACE/NSD = 1.70, HISACE = 18.2, LISNSD = 6.25

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1983	1103	Alicia	MH	08/15	08/19	27.2	91.0	1	100	963	6.4	2.75	1.75	0.25	CTX3
	1104	Barry	H	08/24	08/29	27.4	76.3	3	70	986	3.1	3.00	0.50	-	
	1105	Chantal	H	09/11	09/14	31.6	63.3	3	65	994	4.3	4.00	1.25	-	
	1106	Dean	TS	09/26	09/30	28.0	73.0	3	55	999	3.6	4.00	-	-	

Summary: NTC = 4, NTS = 1, NH = 3, NMH = 1, NUSLFH = 1, PWS = 100, <PWS> = 72.5, LP = 963, <LP> = 985.5, <N. Lat.> = 28.6, <W. Long.> = 75.9, <ACE> = 4.4, Sum ACE = 17.4, <NSD> = 3.44, Sum NSD = 13.75, Sum NHD = 3.50, Sum NMHD = 0.25, NTCA = 30.5%, ACE/NSD = 1.27, HISACE = 6.4, LISNSD = 4.00

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1984	1107	ST1	SS(TS)	08/19	08/21	38.0	56.4	5	50	1000	1.5	2.00	-	-	
	1108	Arthur	TS	08/29	08/31	11.2	55.0	4	45	1004	1.3	2.25	-	-	
	1109	Bertha	TS	08/31	09/01	14.9	45.3	4	35	1007	0.5	1.00	-	-	
	1110	Cesar	TS	08/31	09/02	38.9	65.0	3	50	994	1.5	2.25	-	-	
	1111	Diana	MH	09/08	09/16	28.5	77.4	3	115	949	15.2	7.75	3.25	0.75	NC2
	1112	Edouard	TS	09/14	09/15	20.5	96.2	1	55	998	0.8	1.00	-	-	
	1113	Fran	TS	09/16	09/20	14.8	24.8	4	55	994	3.3	3.50	-	-	
	1114	Gustav	TS	09/18	09/19	32.1	64.7	3	45	1006	0.6	0.75	-	-	
	1115	Hortense	H	09/23	10/02	29.2	59.1	5	65	993	6.6	9.25	0.50	-	
	1116	Isidore	TS	09/26	09/30	24.7	77.0	3	50	999	3.6	4.50	-	-	
	1117	Josephine	H	10/08	10/18	24.1	71.4	3	90	965	19.5	10.25	7.00	-	
	1118	Klaus	H	11/06	11/13	17.0	66.7	2	80	971	12.9	7.00	4.75	-	
	1119	Lili	H	12/12	12/24	34.5	60.5	3	70	980	16.2	11.75	2.75	-	

Summary: NTC = 13, NTS = 8, NH = 5, NMH = 1, NUSLFH = 1, PWS = 115, <PWS> = 61.9, LP = 949, <LP> = 989.2, <N. Lat.> = 25.3, <W. Long.> = 63.0, <ACE> = 6.4, Sum ACE = 83.5, <NSD> = 4.87, Sum NSD = 63.25, Sum NHD = 18.25, Sum NMHD = 0.75, NTCA = 80.3%, ACE/NSD = 1.32, HISACE = 19.5, LISNSD = 11.75

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1985#	1120	Ana	TS	07/16	07/19	31.3	66.6	3	60	996	2.1	2.50	-	-	

Table 1. Listing of North Atlantic basin tropical cyclones for the interval 1945–2010, based on National Hurricane Center ‘best tracks’ archival database, available online at <http://www.nhc.noaa.gov> (Continued).

	1121	Bob	H	07/22	07/25	26.2	83.8	1	65	1002	2.8	3.00	0.50	-	SC1
	1122	Claudette	H	08/11	08/16	34.0	74.0	3	75	980	7.2	6.00	1.75	-	
	1123	Danny	H	08/14	08/16	23.7	87.8	1	80	988	3.5	2.50	1.00	-	LA1
	1124	Elena	MH	08/28	09/03	22.6	80.0	1*	110	953	15.8	5.50	4.25	1.50	AL3, MS3, AFL3
	1125	Fabian	TS	09/16	09/19	26.0	66.5	3	55	994	3.3	3.00	-	-	
	1126	Gloria	MH	09/17	09/27	14.6	28.3	4	125	920	21.2	9.25	6.25	1.50	NC3, NY3, CT2, NH2, ME1
	1127	Henri	TS	09/23	09/24	35.3	74.3	3	50	996	1.1	1.75	-	-	
	1128	Isabel	TS	10/07	10/10	18.5	70.5	2	60	997	3.8	3.75	-	-	
	1129	Juan	H	10/26	11/01	23.8	92.5	1	75	971	8.1	6.00	1.75	-	LA1
	1130	Kate	MH	11/15	11/23	21.1	63.8	3	105	954	19.1	8.00	5.75	1.00	AFL2, IGA1

Summary: NTC = 11, NTS = 4, NH = 7, NMH = 3, NUSLFH = 6, PWS = 125, <PWS> = 78.2, LP = 920, <LP> = 977.4, <N. Lat.> = 25.2, <W. Long.> = 71.6, <ACE> = 8.0, Sum ACE = 88.0, <NSD> = 4.66, Sum NSD = 51.25, Sum NHD = 21.25, Sum NMHD = 4.00, NTCA = 105.8%, ACE/NSD = 1.72, HISACE = 21.2, LISNSD = 9.25

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1986&	1131	Andrew	TS	06/06	06/08	29.7	77.5	3	45	999	2.2	3.00	-	-	
	1132	Bonnie	H	06/24	06/26	26.6	89.5	1	75	992	2.9	2.25	1.00	-	CTX1
	1133	Charley	H	08/15	08/20	32.2	78.5	3	70	987	5.6	5.25	1.00	-	NC1
	1134	Danielle	TS	09/07	09/09	11.2	55.8	4	50	1000	1.6	2.00	-	-	
	1135	Earl	H	09/11	09/18	22.4	51.6	5	90	979	19.7	8.00	7.25	-	
	1136	Frances	H	11/19	11/21	23.9	62.9	3	75	1000	3.8	2.75	1.25	-	

Summary: NTC = 6, NTS = 2, NH = 4, NMH = 0, NUSLFH = 2, PWS = 90, <PWS> = 67.5, LP = 979, <LP> = 992.8, <N. Lat.> = 24.3, <W. Long.> = 69.3, <ACE> = 6.0, Sum ACE = 35.8, <NSD> = 3.88, Sum NSD = 23.25, Sum NHD = 10.50, Sum NMHD = 0.00, NTCA = 36.8%, ACE/NSD = 1.54, HISACE = 19.7, LISNSD = 8.00

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1987&	1137	Unnamed	TS	08/09	08/10	27.3	94.0	1	40	1008	0.6	1.00	-	-	
	1138	Arlene	H	08/11	08/23	29.4	74.4	3	65	987	11.8	12.25	1.75	-	
	1139	Bret	TS	08/18	08/22	15.1	26.0	4	45	1000	2.4	4.00	-	-	
	1140	Cindy	TS	09/07	09/10	24.6	39.3	5	45	1000	1.9	3.25	-	-	
	1141	Dennis	TS	09/10	09/17	10.8	25.0	4	45	1000	4.1	7.50	-	-	
	1142	Emily	MH	09/20	09/26	11.4	56.4	4	110	958	10.2	6.00	1.75	0.50	
	1143	Floyd	H	10/10	10/13	16.0	82.2	2	65	993	3.5	3.25	0.50	-	BFL1

Summary: NTC = 7, NTS = 4, NH = 3, NMH = 1, NUSLFH = 1, PWS = 110, <PWS> = 59.3, LP = 958, <LP> = 992.3, <N. Lat.> = 19.2, <W. Long.> = 56.8, <ACE> = 4.9, Sum ACE = 34.5, <NSD> = 5.32, Sum NSD = 37.25, Sum NHD = 4.00, Sum NMHD = 0.50, NTCA = 44.9%, ACE/NSD = 0.93, HISACE = 11.8, LISNSD = 12.25

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1988#	1144	Alberto	TS	08/07	08/08	41.5	69.0	3*	35	1002	0.5	1.00	-	-	
	1145	Beryl	TS	08/08	08/09	29.7	89.4	1	45	1001	0.8	1.50	-	-	
	1146	Chris	TS	08/28	08/28	28.2	80.0	3*	45	1005	0.5	0.75	-	-	
	1147	Debby	H	09/02	09/03	20.7	95.2	1	65	987	1.6	1.50	0.50	-	
	1148	Ernesto	TS	09/03	09/05	35.2	53.1	5	55	994	1.3	1.50	-	-	
	1149	Unnamed	TS	09/07	09/09	13.8	18.5	4	50	994	1.7	2.25	-	-	
	1150	Florence	H	09/07	09/10	22.7	90.2	1	70	983	3.0	2.75	0.50	-	LA1
	1151	Gilbert	MH	09/09	09/17	14.5	60.1	2	160	888	32.8	8.00	6.25	4.50	
	1152	Helene	MH	09/20	09/30	13.2	33.8	4	125	938	31.6	10.25	9.00	2.50	
	1153	Isaac	TS	09/30	10/01	11.4	56.0	4	40	1005	0.4	0.75	-	-	
	1154	Joan	MH	10/11	10/23	10.1	45.0	4	125	932	23.7	12.25	5.00	2.00	
	1155	Keith	TS	11/20	11/24	17.8	84.5	2	60	985	4.9	4.25	-	-	

Summary: NTC = 12, NTS = 7, NH = 5, NMH = 3, NUSLFH = 1, PWS = 160, <PWS> = 72.9, LP = 888, <LP> = 976.2, <N. Lat.> = 21.6, <W. Long.> = 64.6, <ACE> = 8.6, Sum ACE = 102.8, <NSD> = 3.90, Sum NSD = 46.75, Sum NHD = 21.25, Sum NMHD = 9.00, NTCA = 117.0%, ACE/NSD = 2.20, HISACE = 32.8, LISNSD = 12.25

Table 1. Listing of North Atlantic basin tropical cyclones for the interval 1945–2010, based on National Hurricane Center ‘best tracks’ archival database, available online at <http://www.nhc.noaa.gov> (Continued).

Year	SNBR	Name	Class.	FSD	LSD	Genesis Location N. Lat	Genesis Location W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1989	1156	Allison	TS	06/26	06/27	27.8	95.8	1	45	999	0.9	1.50	-	-	
	1157	Barry	TS	07/11	07/13	17.7	48.2	4	45	1005	1.7	2.75	-	-	
	1158	Chantal	H	07/31	08/02	25.4	91.0	1	70	984	2.5	2.00	0.75	-	CTX1
	1159	Dean	H	08/01	08/09	15.8	49.3	4	90	968	15.4	8.25	6.00	-	
	1160	Erin	H	08/19	08/27	18.5	32.7	4	90	968	14.2	7.50	4.50	-	
	1161	Felix	H	08/26	09/09	17.2	22.9	4	75	979	9.7	9.25	2.00	-	
	1162	Gabrielle	MH	08/31	09/12	11.3	24.8	4	125	937	38.2	12.50	9.25	4.25	
	1163	Hugo	MH	09/11	09/22	12.5	29.2	4	140	918	42.7	11.25	8.75	5.50	SC4, INC1
	1164	Iris	TS	09/18	09/20	11.9	53.2	4	60	1001	2.5	3.00	-	-	
	1165	Jerry	H	10/13	10/16	20.4	93.0	1	75	983	4.0	3.50	0.50	-	CTX1
	1166	Karen	TS	11/30	12/04	20.8	84.2	1	50	1000	2.6	4.25	-	-	

Summary: NTC = 11, NTS = 4, NH = 7, NMH = 2, NUSLFH = 3, PWS = 135, <PWS> = 78.6, LP = 923, <LP> = 976.5, <N. Lat.> = 18.1, <W. Long.> = 56.8, <ACE> = 12.2, Sum ACE = 134.4, <NSD> = 5.98, Sum NSD = 65.75, Sum NHD = 31.75, Sum NMHD = 9.75, NTCA = 129.8%, ACE/NSD = 2.04, HISACE = 42.7, LISNSD = 12.50

Year	SNBR	Name	Class.	FSD	LSD	Genesis Location N. Lat	Genesis Location W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1990	1167	Arthur	TS	07/24	07/27	10.5	56.8	4	60	995	2.3	2.75	-	-	
	1168	Bertha	H	07/28	08/02	28.6	75.8	3	70	973	7.8	5.25	3.50	-	
	1169	Cesar	TS	08/02	08/06	15.4	32.3	4	45	1000	3.4	4.50	-	-	
	1170	Diana	H	08/05	08/08	16.6	83.6	2	85	980	4.3	3.50	0.75	-	
	1171	Edouard	TS	08/03	08/10	39.2	23.3	5	40	1003	1.6	3.00	-	-	
	1172	Fran	TS	08/13	08/14	9.0	53.6	4	35	1007	0.5	1.00	-	-	
	1173	Gustav	MH	08/25	09/03	13.3	49.0	4	105	956	23.3	9.50	7.25	1.00	
	1174	Hortense	TS	08/26	08/29	14.4	40.0	4	55	993	3.3	3.75	-	-	
	1175	Isidore	H	09/05	09/17	10.0	32.7	4	80	979	19.5	12.00	8.25	-	
	1176	Josephine	H	09/24	10/06	19.3	34.2	4	75	980	6.6	7.00	1.50	-	
	1177	Klaus	H	10/03	10/09	16.2	59.6	4	70	985	6.1	5.50	0.75	-	
	1178	Lili	H	10/06	10/14	36.0	44.0	5	65	987	10.7	8.75	2.50	-	
	1179	Marco	TS	10/10	10/11	24.1	82.0	1	55	989	1.4	1.75	-	-	
	1180	Nana	H	10/16	10/20	22.1	62.1	3	75	989	6.2	4.25	2.25	-	

Summary: NTC = 14, NTS = 6, NH = 8, NMH = 1, NUSLFH = 0, PWS = 105, <PWS> = 65.4, LP = 956, <LP> = 987.1, <N. Lat.> = 19.6, <W. Long.> = 52.1, <ACE> = 6.9, Sum ACE = 97.0, <NSD> = 5.18, Sum NSD = 72.50, Sum NHD = 26.75, Sum NMHD = 1.00, NTCA = 100.3%, ACE/NSD = 1.34, HISACE = 23.3, LISNSD = 12.00

Year	SNBR	Name	Class.	FSD	LSD	Genesis Location N. Lat	Genesis Location W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1991&	1181	Ana	TS	07/04	07/05	36.2	70.7	3	45	1000	1.3	1.75	-	-	
	1182	Bob	MH	08/16	08/20	26.4	75.8	3	100	950	8.0	4.00	2.25	0.25	NY2, CT2, RI2, MA2
	1183	Claudette	MH	09/05	09/11	26.2	56.0	5	115	946	14.0	6.25	3.75	1.00	
	1184	Danny	TS	09/08	09/11	10.3	35.0	4	45	998	2.1	3.00	-	-	
	1185	Erika	TS	09/09	09/12	29.3	53.1	5	50	997	2.0	2.50	-	-	
	1186	Fabian	TS	10/15	10/16	20.3	84.1	1	40	1002	0.8	1.25	-	-	
	1187	Grace	H	10/26	10/29	27.2	65.5	3	85	980	5.0	3.50	1.75	-	
	1188	Unnamed	H	10/31	11/02	36.7	71.5	5	65	980	2.5	2.00	0.50	-	

Summary: NTC = 8, NTS = 4, NH = 4, NMH = 2, NUSLFH = 1, PWS = 115, <PWS> = 68.1, LP = 946, <LP> = 981.6, <N. Lat.> = 26.6, <W. Long.> = 64.0, <ACE> = 4.5, Sum ACE = 35.7, <NSD> = 3.03, Sum NSD = 24.25, Sum NHD = 8.25, Sum NMHD = 1.25, NTCA = 57.7%, ACE/NSD = 1.47, HISACE = 14.0, LISNSD = 6.25

Year	SNBR	Name	Class.	FSD	LSD	Genesis Location N. Lat	Genesis Location W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1992	1189	ST1	SS(TS)	04/22	04/23	24.9	61.5	3	45	1002	1.1	1.50	-	-	
	1190	Andrew	MH	08/17	08/27	12.3	42.0	4	150	922	26.5	9.75	4.50	3.50	CFL5, BFL4, LA3
	1191	Bonnie	H	09/18	09/30	33.7	58.0	5	95	965	23.1	12.00	5.75	-	
	1192	Charley	H	09/22	09/27	31.6	34.0	5	95	965	10.9	5.25	3.50	-	
	1193	Danielle	TS	09/22	09/26	32.8	74.2	3	55	1001	2.9	3.75	-	-	

Table 1. Listing of North Atlantic basin tropical cyclones for the interval 1945–2010, based on National Hurricane Center ‘best tracks’ archival database, available online at <http://www.nhc.noaa.gov> (Continued).

	1194	Earl	TS	09/29	10/03	29.7	79.3	3	55	990	3.3	4.00	-	-	
	1195	Frances	H	10/23	10/27	27.7	61.4	3	75	976	6.5	4.00	2.00	-	

Summary: NTC = 7, NTS = 3, NH = 4, NMH = 1, NUSLFH = 1, PWS = 150, <PWS> = 81.4, LP = 922, <LP> = 974.4, <N. Lat.> = 27.5, <W. Long.> = 58.6, <ACE> = 10.6, Sum ACE = 74.3, <NSD> = 5.75, Sum NSD = 40.25, Sum NHD = 15.75, Sum NMHD = 3.50, NTCA = 66.7%, ACE/NSD = 1.85, HISACE = 26.5, LISNSD = 12.00

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1993	1196	Arlene	TS	06/19	06/20	25.9	95.9	1	35	1000	0.5	1.00	-	-	
	1197	Bret	TS	08/05	08/09	10.4	43.4	4	50	1002	3.5	4.50	-	-	
	1198	Cindy	TS	08/14	08/16	14.5	60.9	2	40	1007	1.1	2.25	-	-	
	1199	Dennis	TS	08/24	08/27	15.4	34.0	4	45	1000	2.1	3.00	-	-	
	1200	Emily	MH	08/25	09/04	28.0	60.4	3	100	960	22.1	10.25	7.25	0.75	NC3
	1201	Floyd	H	09/07	09/10	26.2	68.2	3	65	990	3.1	3.00	1.25	-	
	1202	Gert	H	09/15	09/21	11.3	83.0	2	85	970	3.8	3.50	1.00	-	
	1203	Harvey	H	09/20	09/21	31.5	59.0	5	65	990	2.0	1.75	0.25	-	

Summary: NTC = 8, NTS = 4, NH = 4, NMH = 1, NUSLFH = 1, PWS = 100, <PWS> = 60.6, LP = 960, <LP> = 989.9, <N. Lat.> = 20.4, <W. Long.> = 63.1, <ACE> = 4.8, Sum ACE = 38.2, <NSD> = 3.66, Sum NSD = 29.25, Sum NHD = 9.75, Sum NMHD = 0.75, NTCA = 51.5%, ACE/NSD = 1.31, HISACE = 22.1, LISNSD = 10.25

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1994&	1204	Alberto	TS	07/02	07/03	23.7	87.1	1	55	993	1.6	2.00	-	-	
	1205	Beryl	TS	08/15	08/16	29.7	85.6	1	50	1000	0.8	1.00	-	-	
	1206	Chris	H	08/17	08/23	11.7	41.2	4	70	979	7.5	7.00	2.00	-	
	1207	Debby	TS	09/10	09/11	13.7	60.2	2	60	1006	1.2	1.25	-	-	
	1208	Ernesto	TS	09/22	09/24	11.8	30.3	4	50	997	1.5	2.00	-	-	
	1209	Florence	H	11/02	11/08	23.2	47.7	5	95	972	10.4	6.00	4.25	-	
	1210	Gordon	H	11/10	11/20	14.6	82.7	2	75	980	8.4	9.50	1.00	-	

Summary: NTC = 7, NTS = 4, NH = 3, NMH = 0, NUSLFH = 0, PWS = 95, <PWS> = 65.0, LP = 972, <LP> = 989.6, <N. Lat.> = 18.3, <W. Long.> = 62.1, <ACE> = 4.5, Sum ACE = 31.4, <NSD> = 4.11, Sum NSD = 28.75, Sum NHD = 7.25, Sum NMHD = 0.00, NTCA = 35.3%, ACE/NSD = 1.17, HISACE = 10.4, LISNSD = 9.50

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1995	1211	Allison	H	06/03	06/05	19.3	85.7	2	65	988	2.9	2.50	0.75	-	
	1212	Barry	TS	07/07	07/10	31.6	71.0	3	60	989	3.2	3.25	-	-	
	1213	Chantal	TS	07/14	07/20	21.1	64.4	3	60	991	6.5	6.75	-	-	
	1214	Dean	TS	07/30	07/31	28.6	94.0	1	40	999	0.3	0.50	-	-	
	1215	Erin	H	07/31	08/04	22.3	73.2	3	80	974	7.3	4.50	2.50	-	CFL1, AFL2
	1216	Felix	MH	08/08	08/22	15.5	36.4	4	120	929	28.9	14.00	9.25	1.75	
	1217	Gabrielle	TS	08/10	08/11	23.5	96.5	1	60	990	1.4	1.50	-	-	
	1218	Humberto	H	08/22	09/01	13.7	34.3	4	95	968	22.5	10.00	8.50	-	
	1219	Iris	H	08/22	09/04	13.3	50.6	4	95	965	22.7	12.75	7.50	-	
	1220	Jerry	TS	08/23	08/24	26.4	79.7	2	35	1004	0.6	1.25	-	-	
	1221	Karen	TS	08/28	09/02	16.6	41.5	4	45	1000	3.4	5.25	-	-	
	1222	Luis	MH	08/29	09/11	11.6	29.0	4	120	935	53.5	13.50	11.75	8.00	
	1223	Marilyn	MH	09/13	09/22	11.8	52.7	4	100	950	21.1	9.25	7.75	0.50	
	1224	Noel	H	09/27	10/07	12.1	40.6	4	65	987	11.1	9.75	2.50	-	
	1225	Opal	MH	09/30	10/05	21.1	88.5	1	130	919	11.1	5.00	2.75	1.00	AFL3, IAL1
	1226	Pablo	TS	10/05	10/08	10.2	37.5	4	50	994	2.5	3.00	-	-	
	1227	Roxanne	MH	10/09	10/18	16.5	83.1	2	100	958	16.2	10.00	5.00	0.25	
	1228	Sebastien	TS	10/21	10/23	16.0	55.1	4	55	1001	2.1	3.00	-	-	
	1229	Tanya	H	10/27	11/01	26.2	57.9	5	75	972	8.7	5.50	3.00	-	

Summary: NTC = 19, NTS = 8, NH = 11, NMH = 5, NUSLFH = 2, PWS = 130, <PWS> = 76.3, LP = 919, <LP> = 974.4, <N. Lat.> = 18.8, <W. Long.> = 61.7, <ACE> = 11.9, Sum ACE = 226.0, <NSD> = 6.38, Sum NSD = 121.25, Sum NHD = 61.25, Sum NMHD = 11.50, NTCA = 221.4%, ACE/NSD = 1.86, HISACE = 53.5, LISNSD = 14.00

Table 1. Listing of North Atlantic basin tropical cyclones for the interval 1945–2010, based on National Hurricane Center ‘best tracks’ archival database, available online at <http://www.nhc.noaa.gov> (Continued).

Year	SNBR	Name	Class.	FSD	LSD	Genesis Location N. Lat	Genesis Location W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1996	1230	Arthur	TS	06/19	06/20	31.5	78.7	3	40	1004	0.8	1.50	-	-	
	1231	Bertha	MH	07/05	07/14	11.0	39.0	4	100	960	17.4	9.00	5.50	0.50	NC2
	1232	Cesar	H	07/25	07/28	12.1	68.1	2	70	990	4.0	3.50	1.00	-	
	1233	Dolly	H	08/19	08/23	18.2	83.0	2	70	989	3.9	3.75	0.50	-	
	1234	Edouard	MH	08/22	09/03	13.2	31.6	4	125	933	49.3	12.00	10.50	7.75	
	1235	Fran	MH	08/27	09/06	14.6	44.9	4	105	946	22.9	10.25	7.75	2.00	NC3
	1236	Gustav	TS	08/28	09/01	10.6	32.7	4	40	1005	2.4	4.50	-	-	
	1237	Hortense	MH	09/07	09/15	15.4	58.3	4	120	935	21.8	8.50	6.25	2.00	
	1238	Isidore	MH	09/25	10/01	10.3	28.5	4	100	960	12.9	6.25	3.75	0.50	
	1239	Josephine	TS	10/06	10/08	25.1	91.8	1	60	981	1.6	1.50	-	-	
	1240	Kyle	TS	10/11	10/12	16.9	87.1	2	45	1001	0.5	0.75	-	-	
	1241	Lili	MH	10/16	10/27	17.5	83.8	2	100	960	22.6	11.00	9.25	0.25	
	1242	Marco	H	11/19	11/26	13.8	80.9	2	65	983	6.1	6.50	0.50	-	

Summary: NTC = 13, NTS = 4, NH = 9, NMH = 6, NUSLFH = 2, PWS = 125, <PWS> = 80.0, LP = 933, <LP> = 972.8, <N. Lat.> = 16.2, <W. Long.> = 62.2, <ACE> = 12.78, Sum ACE = 166.2, <NSD> = 6.08, Sum NSD = 79.00, Sum NHD = 45.00, Sum NMHD = 13.00, NTCA = 192.2%, ACE/NSD = 2.10, HISACE = 49.3, LISNSD = 12.00

Year	SNBR	Name	Class.	FSD	LSD	Genesis Location N. Lat	Genesis Location W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1997&	1243	ST	SS(TS)	06/01	06/02	33.2	75.3	3	45	1003	0.8	1.25	-	-	
	1244	Ana	TS	07/01	07/03	31.8	75.4	3	40	1000	1.3	2.50	-	-	
	1245	Bill	H	07/11	07/13	31.8	68.9	3	65	987	2.3	2.00	0.50	-	
	1246	Claudette	TS	07/13	07/16	31.9	73.0	3	40	1003	1.6	2.75	-	-	
	1247	Danny	H	07/17	07/26	28.3	91.4	1	70	984	6.0	4.75	1.75	-	LA1, AL1
	1248	Erika	MH	09/03	09/15	12.3	47.1	4	110	946	26.6	12.25	7.25	2.25	
	1249	Fabian	TS	10/05	10/08	26.3	63.1	3	35	1004	1.3	2.75	-	-	
	1250	Grace	TS	10/16	10/17	21.2	64.4	3	40	999	0.8	1.50	-	-	

Summary: NTC = 8, NTS = 5, NH = 3, NMH = 1, NUSLFH = 1, PWS = 110, <PWS> = 55.6, LP = 946, <LP> = 990.8, <N. Lat.> = 27.1, <W. Long.> = 69.8, <ACE> = 5.0, Sum ACE = 39.7, <NSD> = 3.72, Sum NSD = 29.75, Sum NHD = 9.50, Sum NMHD = 2.25, NTCA = 53.7%, ACE/NSD = 1.33, HISACE = 26.6, LISNSD = 12.25

Year	SNBR	Name	Class.	FSD	LSD	Genesis Location N. Lat	Genesis Location W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1998#	1251	Alex	TS	07/29	08/02	13.3	36.8	4	45	1002	2.8	4.75	-	-	
	1252	Bonnie	MH	08/20	08/30	17.3	57.3	4	100	954	24.8	10.25	6.50	3.50	NC2
	1253	Charley	TS	08/21	08/22	26.0	94.5	1	60	1001	0.8	1.00	-	-	
	1254	Danielle	H	08/24	09/03	14.2	37.9	5	90	960	23.1	10.25	9.50	-	
	1255	Earl	H	08/31	09/03	22.4	93.8	1	85	985	3.9	3.00	1.00	-	AFL1
	1256	Frances	TS	09/09	09/11	24.2	95.5	1	55	990	1.6	2.25	-	-	
	1257	Georges	MH	09/16	09/29	10.6	31.3	4	135	937	39.4	13.00	11.25	2.00	BFL2, MS2
	1258	Hermine	TS	09/19	09/20	27.5	91.3	1	40	999	0.6	1.00	-	-	
	1259	Ivan	H	09/20	09/27	16.0	32.6	5	80	975	9.9	7.25	3.25	-	
	1260	Jeanne	H	09/21	09/30	11.0	19.4	4	90	969	18.8	9.25	7.00	-	
	1261	Karl	H	09/24	09/28	33.2	60.7	3	90	970	7.5	4.00	2.50	-	
	1262	Lisa	H	10/05	10/09	14.2	47.1	4	65	995	5.0	4.75	0.50	-	
	1263	Mitch	MH	10/22	11/05	11.6	77.9	2	155	905	35.9	10.75	5.50	3.75	
	1264	Nicole	H	11/24	12/01	27.9	29.1	5	75	979	7.6	6.25	1.50	-	

Summary: NTC = 14, NTS = 4, NH = 10, NMH = 3, NUSLFH = 3, PWS = 155, <PWS> = 83.2, LP = 905, <LP> = 972.7, <N. Lat.> = 19.2, <W. Long.> = 57.5, <ACE> = 13.0, Sum ACE = 181.7, <NSD> = 6.27, Sum NSD = 87.75, Sum NHD = 48.50, Sum NMHD = 9.25, NTCA = 167.9%, ACE/NSD = 2.07, HISACE = 39.4, LISNSD = 13.00

Year	SNBR	Name	Class.	FSD	LSD	Genesis Location N. Lat	Genesis Location W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
1999#	1265	Arlene	TS	06/12	06/16	28.3	57.3	5	50	1006	3.4	4.50	-	-	
	1266	Bret	MH	08/19	08/23	19.8	94.7	1	125	944	11.6	4.25	2.50	1.25	ATX3
	1267	Cindy	MH	08/20	08/31	13.6	26.6	4	120	942	24.6	11.00	5.25	1.75	
	1268	Dennis	H	08/24	09/05	22.4	70.0	3	90	962	20.2	12.00	5.75	-	

Table 1. Listing of North Atlantic basin tropical cyclones for the interval 1945–2010, based on National Hurricane Center ‘best tracks’ archival database, available online at <http://www.nhc.noaa.gov> (Continued).

Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
	1269	Emily	TS	08/24	08/28	11.5	53.8	4	45	1004	2.4	4.00	-	-	
	1270	Floyd	MH	09/08	09/17	15.3	48.2	4	135	921	29.4	9.25	6.25	3.00	NC2
	1271	Gert	MH	09/12	09/23	14.2	31.9	4	130	930	42.3	11.00	9.50	6.00	
	1272	Harvey	TS	09/20	09/22	26.3	87.4	1	50	995	1.9	2.25	-	-	
	1273	Irene	H	10/13	10/19	18.5	83.4	2	95	960	10.4	5.75	4.00	-	BFL1
	1274	Jose	H	10/18	10/25	10.9	52.8	4	85	979	10.1	7.25	2.25	-	
	1275	Katrina	TS	10/29	10/30	13.2	82.9	2	35	999	0.2	0.50	-	-	
	1276	Lenny	MH	11/14	11/21	16.4	79.9	2	135	933	19.9	6.75	4.75	2.00	

Summary: NTC = 12, NTS = 4, NH = 8, NMH = 5, NUSLFH = 3, PWS = 135, <PWS> = 91.3, LP = 921, <LP> = 964.6, <N. Lat.> = 17.5, <W. Long.> = 64.1, <ACE> = 14.7, Sum ACE = 176.4, <NSD> = 6.54, Sum NSD = 78.50, Sum NHD = 40.25, Sum NMHD = 14.00, NTCA = 180.4%, ACE/NSD = 2.25, HISACE = 42.3, LISNSD = 12.00

Year	SNBR	Name	Class.	FSD	LSD	Genesis Location N. Lat	Genesis Location W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
2000	1277	Alberto	MH	08/04	08/23	12.0	22.3	4	110	950	36.9	19.25	11.75	1.00	
	1278	Beryl	TS	08/14	08/15	23.1	94.6	1	45	1007	0.9	1.25	-	-	
	1279	Chris	TS	08/18	08/18	16.2	55.4	5	35	1008	0.1	0.25	-	-	
	1280	Debby	H	08/20	08/24	13.3	46.8	4	75	993	5.8	4.25	2.25	-	
	1281	Ernesto	TS	09/02	09/03	16.2	49.5	4	35	1008	0.7	1.50	-	-	
	1282	Florence	H	09/11	09/17	30.4	72.2	3	70	985	8.5	6.50	2.25	-	
	1283	Gordon	H	09/16	09/18	22.5	86.7	1	70	981	3.4	2.50	1.00	-	
	1284	Helene	TS	09/21	09/25	24.9	86.6	1	60	986	3.5	3.75	-	-	
	1285	Isaac	MH	09/22	10/01	12.3	25.9	4	120	943	28.4	9.75	7.75	2.75	
	1286	Joyce	H	09/26	10/01	11.5	31.9	4	80	975	7.6	5.75	2.25	-	
	1287	Keith	MH	09/29	10/06	17.4	84.8	2	120	941	12.1	5.25	3.25	1.25	
	1288	Leslie	TS	10/05	10/07	29.9	77.3	3	40	1006	1.3	2.25	-	-	
	1289	Michael	H	10/16	10/19	29.9	71.8	3	85	965	5.6	4.00	2.25	-	
	1290	Nadine	TS	10/20	10/21	30.4	57.2	5	50	999	1.2	1.50	-	-	
	1291	ST	SS(TS)	10/25	10/29	24.5	71.7	3	55	978	3.1	3.50	-	-	

Summary: NTC = 15, NTS = 7, NH = 8, NMH = 3, NUSLFH = 0, PWS = 120, <PWS> = 70.0, LP = 941, <LP> = 981.7, <N. Lat.> = 21.0, <W. Long.> = 62.3, <ACE> = 7.9, Sum ACE = 119.1, <NSD> = 4.75, Sum NSD = 71.25, Sum NHD = 32.75, Sum NMHD = 5.00, NTCA = 133.5%, ACE/NSD = 1.67, HISACE = 36.9, LISNSD = 19.25

Year	SNBR	Name	Class.	FSD	LSD	Genesis Location N. Lat	Genesis Location W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
2001	1292	Allison	TS	06/05	06/11	27.5	95.0	1	50	1000	1.0	1.50	-	-	
	1293	Barry	TS	08/02	08/06	26.2	84.9	1	60	990	2.5	3.00	-	-	
	1294	Chantal	TS	08/17	08/21	13.7	64.6	2	60	997	4.6	4.50	-	-	
	1295	Dean	TS	08/22	08/28	17.9	64.3	2	60	994	2.9	2.75	-	-	
	1296	Erin	MH	09/02	09/15	13.2	37.5	4	105	968	20.1	11.00	6.00	1.00	
	1297	Felix	MH	09/11	09/18	18.6	47.7	4	100	962	15.2	7.25	4.50	0.50	
	1298	Gabrielle	H	09/13	09/19	25.3	84.9	1	70	975	6.6	5.75	1.00	-	
	1299	Humberto	H	09/22	09/27	27.9	66.3	3	90	970	9.9	5.50	4.00	-	
	1300	Iris	MH	10/05	10/09	14.8	64.5	2	125	948	10.0	4.00	2.50	0.75	
	1301	Jerry	TS	10/07	10/08	11.0	53.8	4	45	1004	1.2	1.75	-	-	
	1302	Karen	H	10/12	10/15	31.8	64.7	3	70	982	5.1	3.75	0.75	-	
	1303	Lorenzo	TS	10/30	10/31	28.5	44.6	5	35	1007	0.7	1.50	-	-	
	1304	Michelle	MH	11/01	11/05	15.8	83.1	2	120	934	15.7	5.00	3.50	2.00	
	1305	Noel	H	11/04	11/06	33.9	50.4	5	65	986	3.0	2.50	0.50	-	
	1306	Olga	H	11/24	12/03	29.3	50.3	5	80	973	10.7	8.50	2.75	-	

Summary: NTC = 15, NTS = 6, NH = 9, NMH = 4, NUSLFH = 0, PWS = 125, <PWS> = 75.7, LP = 934, <LP> = 979.3, <N. Lat.> = 22.4, <W. Long.> = 63.8, <ACE> = 7.3, Sum ACE = 109.2, <NSD> = 4.55, Sum NSD = 68.25, Sum NHD = 25.50, Sum NMHD = 4.25, NTCA = 135.1%, ACE/NSD = 1.60, HISACE = 20.1, LISNSD = 11.00

Year	SNBR	Name	Class.	FSD	LSD	Genesis Location N. Lat	Genesis Location W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
2002&	1307	Arthur	TS	07/15	07/16	35.5	73.3	3	50	997	1.5	1.75	-	-	
	1308	Bertha	TS	08/05	08/05	29.3	89.2	1	35	1008	0.1	0.50	-	-	
	1309	Cristobal	TS	08/06	08/08	30.4	76.4	3	45	999	1.6	2.25	-	-	

Table 1. Listing of North Atlantic basin tropical cyclones for the interval 1945–2010, based on National Hurricane Center 'best tracks' archival database, available online at <http://www.nhc.noaa.gov> (Continued).

Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
	1310	Dolly	TS	08/29	09/04	9.7	32.2	4	50	997	3.9	5.75	-	-	
	1311	Edouard	TS	09/02	09/05	30.1	79.7	3	55	1002	1.8	3.00	-	-	
	1312	Fay	TS	09/06	09/07	27.8	93.9	1	50	998	1.3	1.50	-	-	
	1313	Gustav	H	09/08	09/12	30.2	71.1	3	85	960	4.8	3.75	1.00	-	
	1314	Hanna	TS	09/12	09/14	26.7	86.4	1	50	1001	1.6	2.50	-	-	
	1315	Isidore	MH	09/18	09/26	17.1	78.1	2	110	934	19.0	8.75	3.75	1.75	
	1316	Josephine	TS	09/18	09/19	34.7	52.7	5	35	1004	0.6	1.25	-	-	
	1317	Kyle	H	09/21	10/12	30.4	51.6	5	75	980	15.5	16.75	1.75	-	
	1318	Lili	MH	09/23	10/04	12.1	54.6	4	125	940	16.3	9.25	3.25	1.25	LA1

Summary: NTC = 12, NTS = 8, NH = 4, NMH = 2, NUSLFH = 1, PWS = 125, <PWS> = 63.8, LP = 934, <LP> = 985.0,
<N. Lat.> = 26.2, <W. Long.> = 69.9, <ACE> = 13.7, Sum ACE = 164.0, <NSD> = 4.75, Sum NSD = 57.00,
Sum NHD = 9.75, Sum NMHD = 3.00, NTCA = 82.6%, ACE/NSD = 2.88, HISACE = 19.00, LISNSD = 16.75

Year	SNBR	Name	Class.	FSD	LSD	Genesis Location N. Lat	Genesis Location W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
2003	1319	Ana	TS	04/20	04/24	32.7	68.9	3	50	994	2.9	4.00	-	-	
	1320	Bill	TS	06/29	07/01	23.4	90.5	1	50	997	1.4	1.75	-	-	
	1321	Claudette	H	07/08	07/16	14.8	70.0	4	75	982	9.2	8.25	0.75	-	BTX1
	1322	Danny	H	07/17	07/20	32.5	55.2	5	65	1000	4.6	3.75	1.00	-	
	1323	Erika	H	08/14	08/16	26.4	83.3	1	65	988	2.0	2.25	0.25	-	
	1324	Fabian	MH	08/28	09/08	15.0	36.2	4	125	939	43.2	11.25	9.75	7.25	
	1325	Grace	TS	08/30	08/31	24.9	93.3	1	35	1007	0.5	1.00	-	-	
	1326	Henri	TS	09/05	09/05	27.7	85.1	1	50	997	0.5	0.75	-	-	
	1327	Isabel	MH	09/06	09/19	13.9	32.7	4	145	915	63.3	13.25	11.75	8.00	NC2, VA1
	1328	Juan	H	09/25	09/29	28.4	62.0	3	90	969	9.4	4.75	3.00	-	
	1329	Kate	MH	09/27	10/07	21.0	44.2	5	110	952	21.9	10.25	6.00	1.50	
	1330	Larry	TS	10/01	10/06	21.0	93.2	1	55	993	4.1	4.50	-	-	
	1331	Mindy	TS	10/10	10/12	19.1	68.8	2	40	1002	0.8	2.50	-	-	
	1332	Nicholas	TS	10/14	10/23	10.9	41.9	4	60	990	7.3	8.50	-	-	
	1333	Odette	TS	12/04	12/07	13.3	75.7	2	55	993	2.8	3.00	-	-	
	1334	Peter	TS	12/07	12/10	27.5	34.5	5	60	990	2.1	2.75	-	-	

Summary: NTC = 16, NTS = 9, NH = 7, NMH = 3, NUSLFH = 2, PWS = 145, <PWS> = 70.6, LP = 915, <LP> = 981.8,
<N. Lat.> = 22.0, <W. Long.> = 64.7, <ACE> = 11.0, Sum ACE = 176.0, <NSD> = 5.78, Sum NSD = 92.50,
Sum NHD = 32.50, Sum NMHD = 16.75, NTCA = 178.6%, ACE/NSD = 1.90, HISACE = 63.3, LISNSD = 13.25

Year	SNBR	Name	Class.	FSD	LSD	Genesis Location N. Lat	Genesis Location W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
2004&	1335	Alex	MH	08/01	08/06	31.6	79.2	3	105	957	11.4	5.00	3.25	0.75	NC1
	1336	Bonnie	TS	08/09	08/12	22.5	87.6	1	55	1001	2.6	3.25	-	-	
	1337	Charley	MH	08/10	08/14	12.9	65.3	2	125	947	10.6	4.75	3.00	0.50	BFL4, CFL1, DFL1 SC1, NC1
	1338	Danielle	H	08/14	08/20	12.6	24.2	4	95	964	12.1	6.75	3.50	-	-
	1339	Earl	TS	08/14	08/15	10.5	53.5	4	45	1009	0.8	1.25	-	-	
	1340	Frances	MH	08/25	09/07	11.5	39.8	4	125	937	45.9	12.50	10.00	6.75	CFL2, BFL1
	1341	Gaston	H	08/28	09/01	31.3	78.2	3	65	986	2.7	3.25	0.25	-	SC1
	1342	Hermine	TS	08/29	08/31	31.1	69.8	3	50	1002	1.3	2.00	-	-	
	1343	Ivan	MH	09/03	09/23	9.7	30.3	4	145	910	70.4	14.75	11.50	10.00	AL3, AFL3
	1344	Jeanne	MH	09/14	09/27	16.4	62.6	2	105	951	20.9	13.00	6.50	0.75	CFL3, BFL1, AFL1
	1345	Karl	MH	09/16	09/24	11.2	32.1	4	125	938	21.4	8.25	7.00	3.50	
	1346	Lisa	H	09/20	10/02	13.5	35.4	5	65	987	11.9	11.00	0.50	-	
	1347	Matthew	TS	10/08	10/10	24.1	94.2	1	40	997	1.0	1.75	-	-	
	1348	Nichole	SS(TS)	10/10	10/11	31.0	66.3	3	45	986	1.2	1.75	-	-	
	1349	Otto	TS	11/29	12/02	29.6	47.9	5	45	996	1.9	3.00	-	-	

Summary: NTC = 15, NTS = 6, NH = 9, NMH = 6, NUSLFH = 6, PWS = 145, <PWS> = 82.3, LP = 912, <LP> = 971.2,
<N. Lat.> = 20.0, <W. Long.> = 57.8, <ACE> = 15.1, Sum ACE = 226.1, <NSD> = 6.15, Sum NSD = 92.25,
Sum NHD = 45.50, Sum NMHD = 22.25, NTCA = 231.4%, ACE/NSD = 2.45, HISACE = 70.7, LISNSD = 14.75

Year	SNBR	Name	Class.	FSD	LSD	Genesis Location N. Lat	Genesis Location W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH

Table 1. Listing of North Atlantic basin tropical cyclones for the interval 1945–2010, based on National Hurricane Center ‘best tracks’ archival database, available online at <http://www.nhc.noaa.gov> (Continued).

2005	1350	Arlene	TS	06/09	06/11	18.2	83.9	2	60	990	2.6	2.75	-	-	
	1351	Bret	TS	06/29	06/29	20.0	95.8	1	35	1005	0.4	0.75	-	-	
	1352	Cindy	H	07/05	07/06	25.1	90.2	1	65	992	1.5	1.50	0.25	-	LA1
	1353	Dennis	MH	07/05	07/11	13.0	65.9	2	130	930	18.8	5.75	4.00	2.50	AFL3, IAL1
	1354	Emily	MH	07/12	07/21	11.0	46.8	4	140	929	32.9	9.25	7.00	4.25	
	1355	Franklin	TS	07/22	07/29	25.7	75.9	3	60	997	6.7	8.00	-	-	
	1356	Gert	TS	07/24	07/25	20.8	95.0	1	40	1005	0.5	1.00	-	-	
	1357	Harvey	TS	08/03	08/08	29.5	68.6	3	55	994	5.4	5.75	-	-	
	1358	Irene	H	08/07	08/18	20.2	45.0	5	90	970	13.1	8.75	3.00	-	
	1359	Jose	TS	08/22	08/23	19.6	95.0	1	45	1001	0.4	0.75	-	-	
	1360	Katrina	MH	08/24	08/30	24.5	76.5	3	150	902	20.0	6.00	4.00	2.25	CFL1, BFL1, LA3, MS3, AL1
	1361	Lee	TS	08/31	08/31	29.0	50.4	5	35	1006	0.2	0.50	-	-	
	1362	Maria	MH	09/02	09/10	21.1	49.4	5	100	962	14.3	8.00	4.75	0.25	
	1363	Nate	H	09/06	09/10	28.4	66.6	3	80	979	7.2	4.75	2.25	-	
	1364	Ophelia	H	09/07	09/17	27.9	78.8	3	75	976	15.7	10.75	3.75	-	NC1
	1365	Philippe	H	09/17	09/23	13.5	54.9	4	70	985	6.0	5.75	1.50	-	
	1366	Rita	MH	09/18	09/25	22.2	72.3	3	155	897	25.1	6.50	4.25	3.25	BFL1, LA3, CTX2
	1367	Stan	H	10/02	10/04	19.5	87.2	2	70	977	2.4	2.50	0.50	-	
	1368	ST	SS(TS)	10/04	10/05	35.9	28.5	5	45	997	0.5	0.75	-	-	
	1369	Tammy	TS	10/05	10/06	27.3	79.7	3	45	1001	0.8	1.25	-	-	
	1370	Vince	H	10/08	10/10	32.9	20.6	5	65	988	2.7	2.75	0.25	-	
	1371	Wilma	MH	10/17	10/25	16.9	79.6	2	160	882	38.9	8.75	7.50	4.75	BFL3, CFL2
	1372	Alpha	TS	10/22	10/23	16.5	68.5	2	45	998	0.7	1.00	-	-	
	1373	Beta	MH	10/27	10/30	11.0	81.3	2	100	962	6.5	3.75	1.50	0.25	
	1374	Gamma	TS	11/15	11/20	14.3	66.0	2	45	1002	1.3	2.00	-	-	
	1375	Delta	TS	11/22	11/28	30.7	40.5	5	60	980	6.0	5.75	-	-	
	1376	Epsilon	H	11/29	12/08	31.5	49.2	5	75	981	13.4	9.25	5.00	-	
	1377	Zeta	TS	12/30	01/06	24.2	36.1	5	55	994	6.3	7.00	-	-	

Summary: NTC = 28, NTS = 13, NH = 15, NMH = 7, NUSLFH = 6, PWS = 160, <PWS> = 76.8, LP = 882, <LP> = 974.4,, <N. Lat.> = 22.5, <W. Long.> = 66.0, <ACE> = 8.9, Sum ACE = 250.3, <NSD> = 4.69, Sum NSD = 131.25, Sum NHD = 49.50, Sum NMHD = 17.50, NTCA = 278.3%, ACE/NSD = 191, HISACE = 38.9, LISNSD = 10.75

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
2006&	1378	Alberto	TS	06/11	06/14	22.5	86.3	1	60	995	2.8	3.25	-	-	
	1379	Unnamed	TS	07/17	07/18	40.0	65.1	3*	45	998	0.6	1.00	-	-	
	1380	Beryl	TS	07/18	07/21	33.0	73.3	3	50	1000	2.3	3.00	-	-	
	1381	Chris	TS	08/01	08/03	16.8	58.9	4	55	1001	2.2	2.50	-	-	
	1382	Debby	TS	08/23	08/26	14.9	28.1	4	45	999	2.3	3.25	-	-	
	1383	Ernesto	H	08/25	09/01	13.7	65.8	2	65	985	5.7	8.00	0.25	-	
	1384	Florence	H	09/05	09/12	16.8	46.1	4	80	974	9.6	7.75	2.75	-	
	1385	Gordon	MH	09/11	09/20	20.9	56.3	5	105	955	22.2	9.50	8.00	1.25	
	1386	Helene	MH	09/14	09/24	12.9	31.9	4	105	955	24.3	10.75	8.25	0.75	
	1387	Isaac	H	09/28	10/02	27.4	54.0	5	75	985	6.5	4.75	2.00	-	

Summary: NTC = 10, NTS = 5, NH = 5, NMH = 2, NUSLFH = 0, PWS = 105, <PWS> = 68.5, LP = 955, <LP> = 984.7, <N. Lat.> = 21.9, <W. Long.> = 56.6, <ACE> = 7.9, Sum ACE = 78.5, <NSD> = 6.38, Sum NSD = 63.75, Sum NHD = 21.25, Sum NMHD = 2.00, NTCA = 88.7%, ACE/NSD = 1.23, HISACE = 24.3, LISNSD = 10.75

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
2007	1388	Andrea	SS(TS)	05/09	05/10	30.8	78.7	3	50	1001	0.9	1.25	-	-	
	1389	Barry	TS	06/01	06/02	23.6	85.7	1	50	997	0.8	1.00	-	-	
	1390	Chantal	TS	07/31	08/01	37.1	65.5	3	45	994	0.7	1.00	-	-	
	1391	Dean	MH	08/14	08/22	11.8	38.3	4	150	907	35.2	8.50	6.75	4.00	
	1392	Erin	TS	08/15	08/16	25.8	94.0	1	35	1003	0.4	0.75	-	-	
	1393	Felix	MH	09/01	09/05	12.1	59.4	4	150	930	18.0	4.25	3.00	2.00	
	1394	Gabrielle	TS	09/08	09/10	30.1	71.8	3	50	1004	1.5	2.25	-	-	
	1395	Humberto	H	09/12	09/13	27.8	95.1	1	80	985	1.8	1.50	0.50	-	CTX1, LA1
	1396	Ingrid	TS	09/13	09/15	13.7	46.7	4	40	1002	1.3	2.50	-	-	

Table 1. Listing of North Atlantic basin tropical cyclones for the interval 1945–2010, based on National Hurricane Center ‘best tracks’ archival database, available online at <http://www.nhc.noaa.gov> (Continued).

Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
	1397	Jerry	TS	09/23	09/24	36.2	46.1	5	35	1003	0.7	1.50	-	-	
	1398	Karen	H	09/25	09/29	10.3	37.0	4	65	988	3.6	4.00	0.50	-	
	1399	Lorenzo	H	09/27	09/28	20.6	95.1	1	70	990	1.5	1.00	0.50	-	
	1400	Melissa	TS	09/29	09/30	14.5	27.4	4	35	1005	0.5	1.00	-	-	
	1401	Noel	H	10/28	11/02	16.3	71.6	2	70	980	5.6	5.50	1.00	-	
	1402	Olga	TS	12/11	12/12	18.4	64.7	2	50	1003	1.3	2.25	-	-	

Summary: NTC = 15, NTS = 9, NH = 6, NMH = 2, NUSLFH = 1, PWS = 150, <PWS> = 65.0, LP = 907, <LP> = 986.1, <N. Lat.> = 21.9, <W. Long.> = 65.1, <ACE> = 4.9, Sum ACE = 73.8, <NSD> = 2.55, Sum NSD = 38.25, Sum NHD = 12.25, Sum NMHD = 6.00, NTCA = 98.8%, ACE/NSD = 1.93, HISACE = 35.2, LISNSD = 8.50

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
2008	1403	Arthur	TS	05/31	06/01	17.5	87.5	2	40	1004	0.8	1.50	-	-	
	1404	Bertha	MH	07/03	07/20	13.1	24.0	4	105	955	28.4	17.00	7.50	0.75	
	1405	Cristobal	TS	07/19	07/23	32.4	78.8	3	55	998	3.7	4.00	-	-	
	1406	Dolly	H	07/20	07/24	17.8	83.6	2	85	967	5.4	4.50	1.25	-	ATX1
	1407	Edouard	TS	08/04	08/05	28.1	88.5	1	55	996	1.7	2.00	-	-	
	1408	Fay	TS	08/15	08/23	18.5	68.8	2	60	986	7.3	8.25	-	-	
	1409	Gustav	MH	08/25	09/02	15.1	69.6	2	125	943	18.2	8.00	3.25	1.25	LA2
	1410	Hanna	H	08/28	09/07	20.1	58.6	5	75	977	10.4	9.75	0.75	-	
	1411	Ike	MH	09/01	09/14	17.3	38.4	4	125	935	39.2	13.00	10.00	4.25	CTX2, LA1
	1412	Josephine	TS	09/02	09/05	12.7	23.2	4	55	994	3.1	3.75	-	-	
	1413	Kyle	H	09/25	09/29	22.0	69.4	3	75	984	5.4	4.00	1.75	-	
	1414	Laura	TS	09/29	10/01	37.0	47.0	5	50	994	2.2	3.25	-	-	
	1415	Marco	TS	10/06	10/07	18.9	93.7	1	55	998	1.3	1.25	-	-	
	1416	Nana	TS	10/12	10/13	16.0	37.1	5	35	1004	0.5	1.00	-	-	
	1417	Omar	MH	10/14	10/18	14.5	69.6	2	115	958	9.3	5.00	3.00	0.25	
	1418	Paloma	MH	11/06	11/09	14.8	82.1	2	125	944	9.2	3.50	2.25	1.00	

Summary: NTC = 16, NTS = 8, NH = 8, NMH = 5, NUSLFH = 3, PWS = 125, <PWS> = 77.2, LP = 935, <LP> = 977.3, <N. Lat.> = 19.7, <W. Long.> = 63.7, <ACE> = 9.4, Sum ACE = 140.7, <NSD> = 5.61, Sum NSD = 89.75, Sum NHD = 29.75, Sum NMHD = 7.50, NTCA = 162.3%, ACE/NSD = 1.57, HISACE = 39.2, LISNSD = 17.00

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
2009&	1419	Ana	TS	08/12	08/16	14.4	33.3	4	35	1003	0.9	1.75	-	-	
	1420	Bill	MH	08/15	08/24	11.2	34.5	4	115	943	26.5	8.75	7.00	3.00	
	1421	Claudette	TS	08/16	08/17	28.2	84.2	1	50	1005	0.7	1.00	-	-	
	1422	Danny	TS	08/26	08/29	24.6	70.1	3	50	1006	2.0	2.75	-	-	
	1423	Erika	TS	09/01	09/03	16.7	57.3	4	45	1004	1.3	2.00	-	-	
	1424	Fred	MH	09/08	09/12	11.7	25.4	4	105	958	9.9	4.75	2.75	0.50	
	1425	Grace	TS	10/04	10/06	38.5	29.5	5	55	986	1.4	2.00	-	-	
	1426	Henri	TS	10/06	10/08	16.1	50.5	4	45	1005	1.2	2.00	-	-	
	1427	Ida	H	11/04	11/10	11.4	81.8	2	90	975	8.1	5.00	2.25	-	

Summary: NTC = 9, NTS = 6, NH = 3, NMH = 2, NUSLFH = 0, PWS = 115, <PWS> = 65.6, LP = 943, <LP> = 987.2, <N. Lat.> = 19.2, <W. Long.> = 51.8, <ACE> = 5.8, Sum ACE = 52.0, <NSD> = 3.33, Sum NSD = 30.00, Sum NHD = 12.00, Sum NMHD = 3.50, NTCA = 68.6%, ACE/NSD = 1.73, HISACE = 26.5, LISNSD = 8.75

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
2010#	1428	Alex	H	06/26	07/01	16.7	84.9	2	90	948	7.7	5.75	1.50	-	
	1429	Bonnie	TS	07/23	07/23	23.1	75.9	3	40	1005	0.4	0.75	-	-	
	1430	Colin	TS	08/03	08/07	13.7	46.6	4	50	1006	2.8	4.75	-	-	
	1431	Danielle	MH	08/22	08/30	11.8	33.1	4	115	942	21.1	8.75	7.00	1.00	
	1432	Earl	MH	08/25	09/04	14.3	29.7	4	125	927	27.7	10.50	6.00	3.50	
	1433	Fiona	TS	08/30	09/03	14.9	47.7	4	55	998	3.1	4.25	-	-	
	1434	Gaston	TS	09/01	09/01	12.7	35.0	4	35	1005	0.2	0.50	-	-	
	1435	Hermine	TS	09/06	09/07	21.8	95.1	1	55	990	1.6	1.75	-	-	
	1436	Igor	MH	09/08	09/21	13.8	23.3	4	135	924	41.9	12.25	9.75	5.00	
	1437	Julia	MH	09/12	09/20	13.1	22.1	4	120	948	15.5	8.00	3.50	1.25	

Table 1. Listing of North Atlantic basin tropical cyclones for the interval 1945–2010, based on National Hurricane Center 'best tracks' archival database, available online at <http://www.nhc.noaa.gov> (Continued).

1438	Karl	MH	09/14	09/18	18.1	83.6	1	110	956	6.3	3.50	1.25	0.25
1439	Lisa	H	09/21	09/26	16.8	31.9	4	75	982	4.1	4.75	0.50	-
1440	Matthew	TS	09/23	09/25	13.9	76.2	2	50	998	1.5	2.00	-	-
1441	Nicole	TS	09/28	09/29	20.4	83.0	1	40	995	0.7	1.25	-	-
1442	Otto	H	10/06	10/10	22.6	67.8	3	75	976	5.4	3.75	1.50	-
1443	Paula	H	10/11	10/15	14.4	82.5	2	90	981	7.5	4.00	2.50	-
1444	Richard	H	10/21	10/25	16.7	80.6	2	85	978	5.0	4.25	1.25	-
1445	Shary	H	10/29	10/30	26.8	63.0	3	65	989	2.1	1.75	0.75	-
1446	Tomas	H	10/29	11/07	9.8	55.3	4	85	982	11.9	8.75	3.00	-

Summary: NTC = 19, NTS = 7, NH = 12, NMH = 5, NUSLFH = 0, PWS = 135, <PWS> = 78.7, LP = 924, <LP> = 975.3, <N. Lat.> = 16.6, <W. Long.> = 58.8, <ACE> = 8.8, Sum ACE = 166.5, <NSD> = 10.07, Sum NSD = 191.25, Sum NHD = 38.50, Sum NMHD = 11.00, NTCA = 230.9%, ACE/NSD = 0.98, HISACE = 41.9, LISNSD = 12.25

Note:
Group 1 (Gulf of Mexico area): 18.0N-30.0N, 80.0W-99.9W and 15.0N-19.9N, 90.0W-94.9W
Group 2 (Caribbean Sea area): 10.0N-19.9N, 60.0W-89.9W
Group 3 (East coast area): 20.0N-39.9N, 60.0W-79.9W
Group 4 (Lower N. Atlantic-Cape Verdi area): 5.0N-19.9N, 15.0W-59.9W
Group 5(Open N. Atlantic area): 20.0N-46.0N, 15.0W-59.9W
P/1 means the tropical cyclone formed in the Pacific Ocean then moved into the Gulf of Mexico
* means it belongs in the group, even though it does not fall within the areal bounds as given above
# means the year is classified as a LNY
& means the year is classified as an ENY

Table 2. Yearly tropical cyclone parametric values.

Year	NTC	NTS	NH	NMH	NUSLFH	<N. LAT>	<W. LONG>	PWS	<PWS>	LP	<LP>	ACE	NSD	ACE/NSD	HISACE	LISNSD	<NSD>	NHD	NMHD	NTCA	Comments
1945	11	6	5	3	3*	17.5	75.2	120	72.7	951	974.2	66.8	41.75	1.60	20.0	7.75	3.80	13.75	4.75	94.3	
1946	6	3	3	1	1	23.1	82.6	115	63.3	975	986.7	21.7	16.75	1.30	7.2	3.75	2.79	5.75	0.75	38.2	(1)
1947	9	4	5	2	3*	19.2	72.4	140	73.3	947	969.7	112.4	52.50	2.14	62.6	16.25	5.83	28.00	7.25	105.3	
1948	9	3	6	4	3*	19.1	68.4	115	78.9	963	983.5	106.5	51.75	2.06	36.4	12.50	5.75	28.75	7.00	122.0	
1949	13	6	7	3	3*	19.1	66.4	130	74.6	954	979.7	97.8	62.25	1.57	23.8	9.00	4.77	21.50	5.25	117.3	
1950#	13	2	11	8	3*	19.7	62.1	160	100.4	955	964.0	242.8	98.00	2.48	62.6	14.50	7.54	59.50	18.50	247.0	(2)
1951&	10	2	8	5	0	19.7	63.3	140	89.0	964	964.0	136.5	57.75	2.36	37.1	9.75	5.78	36.25	8.25	148.0	
1952	7	1	6	3	1	16.4	63.9	130	92.1	934	976.7	87.1	39.75	2.19	26.8	8.25	5.68	22.75	7.00	103.1	
1953	14	8	6	4	3	18.8	66.2	130	73.2	929	979.3	103.4	64.50	1.60	26.4	12.25	4.61	18.00	6.75	119.6	
1954#	11	3	8	2	3*	21.8	69.7	120	75.5	937	972.0	113.2	46.75	2.42	41.3	10.50	4.25	31.50	9.50	132.4	
1955#	12	3	9	6	3*	18.6	60.0	150	92.1	914	951.4	199.3	82.75	2.15	43.1	11.00	6.90	46.75	17.00	206.3	(3)
1956#	8	4	4	2	1	22.0	79.4	120	73.8	954	986.9	54.2	30.00	1.81	26.4	9.25	3.75	12.75	2.75	67.7	
1957&	8	5	3	2	1*	23.6	75.7	135	72.5	945	979.0	83.8	38.00	2.21	62.6	19.50	4.75	21.00	6.50	85.7	
1958	10	3	7	5	1*	17.9	60.4	140	89.5	934	977.0	120.9	55.50	2.18	32.0	9.00	5.55	30.25	9.50	144.5	
1959	11	4	7	2	3*	24.5	75.9	120	70.9	950	983.1	77.4	40.00	1.94	34.8	10.50	3.64	22.00	4.25	96.1	
1960	7	3	4	2	2*	21.4	71.2	140	82.1	932	971.7	88.0	29.50	2.98	64.6	13.75	4.21	18.25	9.75	92.9	
1961	11	3	8	7	1*	19.5	61.5	150	97.7	920	957.0	205.5	70.75	2.90	52.2	15.00	6.43	47.50	24.50	230.4	(4)
1962	5	2	3	1	0	22.7	57.4	100	75.0	968	974.8	35.5	22.25	1.60	13.7	6.75	4.45	10.75	0.50	40.9	
1963&	9	2	7	2	1	19.7	60.1	125	81.1	944	978.1	117.8	52.00	2.27	49.4	13.25	5.78	37.25	7.00	116.2	
1964#	12	6	6	6	4*	21.9	62.7	135	82.1	941	968.2	170.0	71.25	2.39	37.7	13.25	5.94	43.00	14.75	183.9	
1965&	6	2	4	1	1*	22.8	63.5	135	76.7	941	973.3	84.4	39.50	2.14	47.0	13.75	6.58	27.25	7.50	85.9	
1966	11	4	7	3	2	20.9	57.4	130	74.1	929	983.6	144.8	64.00	2.26	54.3	16.25	5.82	42.00	8.50	139.2	
1967	8	2	6	1	1*	20.1	56.3	140	79.4	923	975.8	113.8	58.00	1.96	47.9	15.00	7.25	36.25	5.50	100.8	
1968	8	3	5	0	1	27.1	72.9	75	63.8	965	986.1	45.2	33.75	1.34	10.3	7.25	4.22	11.75	0.00	47.2	(5)
1969&	18	6	12	5	2*	23.9	65.4	165	80.0	905	979.6	165.3	91.25	1.81	31.6	17.00	5.07	40.00	6.50	181.2	(6)
1970#	10	5	5	2	1*	24.4	74.0	110	72.5	945	986.0	40.2	30.25	1.33	8.3	7.50	3.03	6.75	1.00	64.2	
1971#	13	7	6	1	3	25.1	69.3	140	70.4	943	984.6	96.6	61.75	1.56	44.2	21.25	4.75	28.75	1.00	97.9	(7)
1972&	7	4	3	0	1	32.2	67.5	90	64.3	944	990.9	45.9	30.75	1.49	24.1	9.00	4.39	6.00	0.00	35.1	(8)
1973#	8	4	4	1	0	22.8	63.8	100	68.8	962	984.3	50.4	38.75	1.30	14.9	8.25	4.84	10.50	0.25	53.6	
1974#	11	7	4	2	1*	24.7	69.5	130	67.7	928	990.2	68.3	42.25	1.62	25.6	9.50	3.84	14.25	4.25	83.1	
1975#	9	3	6	3	1*	27.7	61.8	120	83.9	939	971.9	73.9	46.50	1.59	19.2	9.00	5.17	20.25	2.25	91.4	
1976	10	4	6	2	1	25.0	65.2	105	70.0	957	981.8	84.2	49.75	1.69	30.0	13.00	4.98	25.25	1.00	86.2	
1977	6	1	5	1	1	28.1	77.4	150	79.2	926	982.2	25.4	14.75	1.72	12.8	4.00	2.46	6.75	1.00	44.7	
1978	12	7	5	2	0	23.5	64.6	120	66.3	947	987.9	60.8	43.50	1.40	19.2	9.25	3.63	13.50	3.50	85.1	
1979	9	3	6	2	3*	20.5	63.2	150	76.1	924	977.4	91.9	45.75	2.01	44.0	13.00	5.08	21.75	5.75	103.8	
1980	11	2	9	2	1*	23.8	54.1	165	83.2	899	976.1	148.4	62.25	2.38	51.0	14.25	5.66	38.25	7.25	130.3	(9)
1981	12	5	7	3	0	23.2	61.3	115	75.0	946	981.8	100.1	66.00	1.52	22.2	10.75	5.50	22.50	3.75	112.6	
1982&	6	4	2	1	0	23.8	70.7	115	70.8	950	983.2	31.5	18.50	1.70	18.2	6.25	3.08	5.75	1.25	37.7	
1983	4	1	3	1	1*	28.6	75.9	100	72.5	963	985.5	17.4	13.75	1.27	6.4	4.00	3.44	3.50	0.25	30.5	(10)
1984	13	8	5	1	1	25.3	63.0	115	61.9	949	989.2	83.5	63.25	1.32	19.5	11.75	4.87	18.25	0.75	80.3	
1985#	11	4	7	3	6*	25.2	71.6	125	78.2	920	977.4	88.0	51.25	1.72	21.2	9.25	4.66	21.25	4.00	105.8	(11)
1986&	6	2	4	0	2	24.3	69.3	90	67.5	979	992.8	35.8	23.25	1.54	19.7	8.00	3.88	10.50	0.00	36.8	(12)
1987&	7	4	3	1	1	19.2	56.8	110	59.3	958	992.3	34.5	37.25	0.93	11.8	12.25	5.32	4.00	0.50	44.9	
1988#	12	7	5	3	1	21.6	64.6	160	72.9	888	976.2	102.8	46.75	2.20	32.8	12.25	3.90	21.25	9.00	117.0	
1989	11	4	7	2	3*	18.1	56.8	135	78.6	923	976.5	134.4	65.75	2.04	42.7	12.50	5.98	31.75	9.75	129.8	
1990	14	6	8	1	0	19.6	52.1	105	65.4	956	987.1	97.0	72.50	1.34	23.3	12.00	5.18	26.75	1.00	100.3	
1991&	8	4	4	2	1	26.6	64.0	115	68.1	946	981.6	35.7	24.25	1.47	14.0	6.25	3.03	8.25	1.25	57.7	
1992	7	3	4	1	1*	27.5	58.6	150	81.4	922	974.4	74.3	40.25	1.85	26.5	12.00	5.75	15.75	3.50	66.7	
1993	8	4	4	1	1*	20.4	63.1	100	60.6	960	989.9	38.2	29.25	1.31	22.1	10.25	3.66	9.75	0.75	51.5	
1994&	7	4	3	0	0	18.3	62.1	95	65.0	972	989.6	31.4	26.75	1.17	10.4	9.50	4.11	7.25	0.00	35.3	
1995	19	8	11	5	2*	18.8	61.7	130	76.3	919	974.4	226.0	121.25	1.86	53.5	14.00	6.38	61.25	11.50	221.4	
1996	13	4	9	6	2*	16.2	62.2	125	80.0	933	972.8	166.2	79.00	2.10	49.3	12.00	6.08	45.00	13.00	192.2	(13)
1997&	8	5	3	1	1	27.1	69.8	110	55.6	946	990.8	39.7	29.75	1.33	26.6	12.25	3.72	9.50	2.25	53.7	(14)
1998#	14	4	10	3	3	19.2	57.5	155	83.2	905	972.7	181.7	87.75	2.07	39.4	13.00	6.27	48.50	9.25	167.9	
1999#	12	4	8	5	3*	17.5	64.1	135	91.3	921	964.6	176.4	78.50	2.25	42.3	12.00	6.54	40.25	14.00	180.4	
2000	15	7	8	3	0	21.0	62.3	120	70.0	941	981.7	119.1	71.25	1.67	36.9	19.25	4.75	32.75	5.00	133.5	
2001	15	6	9	4	0	22.4	63.8	125	75.7	934	979.3	109.2	68.25	1.60	20.1	11.00	4.55	25.50	4.25	135.1	
2002&	12	8	4	2	1	26.2	69.9	125	63.8	934	985.0	164.0	57.00	2.88	19.0	16.75	4.75	9.75	3.00	82.6	
2003	16	9	7	3	2	22.0	64.7	145	70.6	915	981.8	176.0	92.50	1.90	63.3	13.25	5.78	32.50	16.75	178.6	
2004&	15	6	9	6	6*	20.0	57.8	145	82.3	912	971.2	226.1	92.25	2.45	70.4	14.75	6.15	45.50	22.25	231.4	(15)
2005	28	13	15	7	6*	22.5	66.0	160	76.8	882	974.4	250.3	131.25	1.91	38.9	10.75	4.69	49.50	17.50	278.3	(16)
2006&	10	5	5	2	0	21.9	56.6	105	68.5	955	984.7	78.5	63.75	1.23	24.3	10.75	6.38	21.25	2.00	88.7	
2007	15	9	6	2	1	21.9	65.1	150	65.0	907	986.1	73.8	38.25	1.93	35.2	8.50	2.55	12.25	6.00	98.8	
2008	16	8	8	5	3	19.7	63.7	125	77.2	935	977.3	140.7	89.75	1.57	39.2	17.00	5.61	29.75	7.50	162.3	
2009&	9	6	3	2	0	19.2	51.8	115	65.6	943	987.2	52.0	30.00	1.73	26.5	8.75	3.33	12.00	3.50	68.6	(17)
2010#	19	7	12	5	0	16.6	58.8	135	78.7	924	975.3	166.5	191.25	0.98	41.9	12.25	10.07	38.50	11.00	230.9	(18)
Mean	10.8	4.6	6.2	2.7	1.6	22.0	64.9	126.9	74.9	938.3	979.2	103.5	55.71	1.83	32.8	11.46	4.98	24.62	6.23	112.6	
sd	4.0	2.3	2.6	1.9	1.5	3.4	6.6	19.7	9.1	20.5	8.3	58.5	30.01	0.45	16.1	3.61	1.34	14.44	5.68	59.3	

Note: # means classified as a LN year, & means classified as an EN year, and * means at least one of the USLFH was a MH

Comments:

(1) Largest <W. LONG.>
(2) Largest NMH; Highest <PWS>
(3) Lowest <LP>
(4) Highest NMHD
(5) Lowest PWS (Gladys)
(6) Highest PWS (Camille)
(7) Largest LISNSD (Ginger)
(8) Highest <N. LAT.>
(9) Highest PWS (Allen)
(10) Fewest NTC
(11) Highest NUSLFH
(12) Highest LP (Earl)
(13) Lowest <N. LAT.>
(14) Highest <LP>; Lowest <PWS>
(15) Highest NUSLFH, HISACE (Ivan), NHD
(16) Largest NTC, NTS, NH; Lowest LP (Wilma); Highest NUSLFH, NTCE
(17) Lowest <W. LONG.>
(18) Highest NSD, <NSD>

Table 3. 10-yma values of tropical cyclone parameters.

Year	NTC	NTS	NH	NMH	NUSLFH	<N. LAT>	<W. LONG>	PWS	<PWS>	LP	<LP>	ACE	NSD	ACE/NSD	HISACE	LISNSD	<NSD>	NHD	NMHD	NTCA
1950	10.4	3.7	6.7	3.7	2.3	19.5	68.3	131.5	80.3	949.1	973.8	115.4	55.23	2.00	35.6	10.61	5.24	28.23	8.11	128.3
1951	10.5	3.5	7.0	3.9	2.3	19.5	67.3	133.3	81.8	946.2	972.7	123.7	57.94	2.05	37.7	11.05	5.44	30.23	8.83	135.4
1952	10.6	3.7	6.9	3.9	2.2	19.7	67.3	133.3	82.3	945.0	973.2	123.9	57.88	2.08	38.7	11.49	5.43	30.23	8.89	135.9
1953	10.6	3.7	6.9	4.0	2.0	19.8	67.1	134.3	82.7	943.5	973.3	123.2	57.34	2.09	38.4	11.48	5.37	29.95	8.98	136.0
1954	10.5	3.5	6.9	4.0	1.9	20.0	67.2	135.0	79.5	941.8	973.2	122.9	56.41	2.12	38.8	11.38	5.30	30.05	9.05	136.1
1955	10.1	3.5	6.6	3.6	1.9	20.4	68.1	133.5	82.0	940.5	973.7	114.1	51.88	2.16	39.4	11.41	5.08	28.01	8.56	127.3
1956	9.9	3.7	6.2	3.4	1.9	20.5	68.5	133.0	81.5	937.1	973.8	109.8	49.10	2.21	40.3	11.64	4.94	26.51	8.94	123.8
1957	9.8	3.7	6.1	3.4	1.9	20.8	68.1	132.0	81.1	936.6	973.3	110.7	48.88	2.21	40.4	11.83	4.92	26.48	9.43	124.8
1958	9.5	3.5	6.0	3.2	1.7	21.1	67.4	130.3	80.6	939.1	973.2	108.8	47.38	2.21	40.9	11.80	4.91	26.84	9.11	121.5
1959	9.3	3.4	5.9	3.3	1.7	21.2	66.8	130.8	81.4	940.0	972.9	112.4	47.98	2.24	41.8	11.99	5.06	28.38	9.39	123.9
1960	9.0	3.4	5.6	3.3	1.6	21.4	66.6	130.8	80.9	941.6	973.8	109.5	47.04	2.24	41.8	12.26	5.12	27.98	9.18	120.4
1961	8.9	3.4	5.5	3.1	1.6	21.5	65.7	130.5	80.2	941.7	974.7	108.3	46.58	2.26	43.4	12.75	5.21	28.46	8.99	118.0
1962	9.0	3.2	5.8	3.1	1.6	21.3	63.6	131.3	80.5	939.3	974.4	114.3	49.28	2.27	44.1	12.88	5.44	30.69	9.23	122.3
1963	8.9	3.0	5.9	2.8	1.6	21.6	63.3	128.3	79.6	939.8	974.7	112.0	49.19	2.22	42.3	12.56	5.50	30.53	8.70	118.2
1964	9.2	3.2	6.0	2.7	1.6	22.0	63.4	127.3	78.7	939.1	975.0	112.6	50.66	2.17	41.0	12.80	5.50	30.50	8.34	117.6
1965	9.7	3.4	6.3	2.8	1.5	22.2	63.0	128.0	78.7	937.5	975.5	114.6	53.26	2.08	38.1	12.81	5.52	30.83	8.01	120.4
1966	9.9	3.7	6.2	2.5	1.5	22.6	63.5	126.0	76.9	939.3	977.6	106.8	52.85	1.93	34.8	12.81	5.37	29.31	6.40	112.4
1967	10.1	4.0	6.1	2.2	1.7	23.3	64.4	125.0	75.0	939.2	979.8	101.9	52.83	1.86	35.0	13.24	5.29	28.14	5.20	105.5
1968	10.2	4.2	6.0	2.1	1.7	24.0	65.1	123.3	73.8	938.9	980.9	99.0	52.59	1.81	33.8	13.10	5.24	26.56	4.84	102.0
1969	10.1	4.4	5.7	1.8	1.5	24.3	65.6	121.8	72.5	939.2	982.3	90.6	50.48	1.72	31.4	12.66	5.08	23.79	3.98	93.9
1970	10.2	4.5	5.7	1.7	1.3	24.6	65.9	120.8	72.1	938.4	983.4	85.0	49.38	1.65	29.4	12.24	4.91	22.00	3.19	89.1
1971	10.3	4.5	5.8	1.8	1.3	25.1	66.2	118.8	72.3	939.7	983.2	81.4	49.01	1.60	26.8	11.84	4.81	20.81	2.55	86.7
1972	10.1	4.4	5.7	1.7	1.2	25.7	67.6	118.0	72.1	941.3	983.4	74.0	46.14	1.56	23.9	11.13	4.51	18.50	1.95	81.3
1973	10.2	4.6	5.6	1.8	1.2	25.9	68.3	120.8	72.2	940.5	983.9	70.3	44.46	1.55	22.5	10.68	4.25	17.11	1.90	80.4
1974	10.0	4.7	5.3	1.8	1.2	25.6	67.7	122.3	72.1	940.6	983.8	67.4	42.68	1.56	23.6	10.58	4.22	16.29	2.04	78.4
1975	9.6	4.4	5.2	1.6	1.2	25.4	66.6	124.3	72.5	939.2	983.2	69.2	42.00	1.62	26.4	10.71	4.35	16.95	2.31	77.8
1976	9.6	4.1	5.5	1.7	1.1	25.2	65.2	125.8	73.2	937.1	982.1	74.8	43.81	1.67	27.4	10.53	4.52	18.21	2.76	81.9
1977	9.5	4.0	5.5	1.9	0.9	24.7	65.0	125.8	73.8	937.5	982.1	74.2	43.41	1.68	26.0	9.86	4.49	17.89	2.96	82.7
1978	9.2	3.8	5.4	1.9	0.9	24.6	65.8	127.0	74.3	937.9	981.7	71.8	41.55	1.69	25.3	9.51	4.35	17.53	3.03	81.7
1979	9.1	3.7	5.4	1.9	0.9	24.9	66.0	126.3	74.2	939.0	981.8	71.0	41.35	1.68	24.6	9.41	4.34	17.39	2.85	80.4
1980	9.3	3.8	5.5	1.8	1.2	24.8	66.2	125.8	73.6	939.1	982.0	72.4	42.64	1.67	24.4	9.54	4.36	17.63	2.76	81.0
1981	9.2	3.8	5.4	1.7	1.5	24.7	66.9	125.3	73.2	939.2	982.8	70.7	41.55	1.67	23.9	9.30	4.28	16.94	2.80	79.2
1982	9.1	3.9	5.2	1.6	1.5	24.2	66.1	122.5	72.1	941.9	983.9	68.7	41.35	1.62	23.4	9.46	4.37	16.06	2.73	76.8
1983	9.1	4.0	5.1	1.7	1.6	23.6	65.1	122.5	71.4	940.6	983.8	71.3	42.64	1.62	24.0	10.03	4.53	16.31	2.98	78.4
1984	9.2	4.0	5.2	1.7	1.6	23.4	64.7	124.0	71.9	937.6	983.1	75.5	43.80	1.66	24.6	10.15	4.58	17.20	3.45	81.3
1985	9.5	4.3	5.2	1.7	1.6	23.1	64.3	120.5	71.1	940.4	983.7	75.1	45.31	1.61	23.2	10.01	4.61	17.13	3.34	81.1
1986	9.4	4.4	5.0	1.6	1.6	23.1	64.3	117.5	69.1	943.2	984.2	69.3	43.74	1.56	21.4	9.68	4.46	15.84	2.90	76.8
1987	9.3	4.4	4.9	1.5	1.7	23.4	63.9	119.3	70.1	941.8	983.7	68.2	42.74	1.56	21.4	9.74	4.47	15.63	2.89	75.5
1988	9.5	4.4	5.1	1.5	1.7	23.2	62.6	121.0	70.0	940.3	983.5	71.4	44.60	1.57	22.6	10.34	4.61	16.44	3.03	78.0
1989	9.4	4.4	5.0	1.5	1.7	22.4	61.9	120.0	69.5	941.3	983.8	69.8	43.55	1.56	22.9	10.54	4.59	16.20	3.01	76.8
1990	9.5	4.4	5.1	1.5	1.4	21.8	61.4	119.3	69.6	942.4	983.6	74.4	45.23	1.56	24.1	10.66	4.63	17.65	3.35	80.4
1991	10.3	4.7	5.6	1.9	1.2	21.0	60.6	121.3	70.1	940.0	982.5	87.5	51.51	1.60	27.2	11.10	4.83	21.38	4.38	93.9
1992	10.7	4.9	5.8	2.2	1.2	21.0	60.9	123.0	70.6	937.1	981.4	94.3	53.93	1.65	29.4	11.30	4.86	23.38	5.11	102.1
1993	10.8	4.7	6.1	2.2	1.3	21.3	61.1	122.8	70.9	937.4	981.2	98.5	55.60	1.66	30.5	11.34	4.90	25.01	5.21	105.1
1994	11.0	4.6	6.4	2.4	1.4	21.2	61.2	122.3	72.1	938.1	980.4	104.6	58.29	1.66	30.8	11.35	5.04	26.80	5.44	110.2
1995	11.1	4.7	6.4	2.6	1.4	21.2	62.0	122.8	72.9	937.3	979.5	107.8	58.86	1.69	31.4	11.69	5.05	27.53	5.85	114.4
1996	11.5	4.8	6.7	2.8	1.4	21.1	62.5	124.0	73.5	935.9	979.1	112.5	61.00	1.71	32.4	12.29	5.11	28.69	6.20	119.9
1997	12.1	5.2	6.9	3.0	1.3	20.8	63.1	123.3	73.0	935.9	979.6	120.7	64.04	1.77	32.3	12.76	5.13	29.25	6.33	124.6
1998	12.7	5.6	7.1	3.1	1.4	20.8	63.7	124.3	72.7	934.3	979.7	132.1	68.04	1.85	34.0	13.15	5.19	30.09	7.10	131.7
1999	13.5	6.0	7.5	3.5	1.7	21.0	63.6	129.0	74.0	929.0	978.4	148.7	74.48	1.95	39.1	13.56	5.40	33.14	9.01	147.9
2000	14.4	6.4	8.0	3.9	2.2	21.2	63.6	133.0	74.9	924.2	977.4	159.7	78.25	2.01	41.4	13.66	5.41	34.46	10.43	160.5
2001	14.7	6.7	8.0	3.8	2.3	21.7	63.5	133.5	74.4	923.4	978.0	156.5	77.99	1.97	39.4	13.44	5.34	32.69	10.18	158.2
2002	14.9	6.9	8.0	3.7	2.2	21.7	63.0	134.5	74.3	922.6	978.4	153.8	77.65	1.96	38.6	13.19	5.30	31.64	9.81	155.3
2003	15.3	7.3	8.0	3.8	2.2	21.5	63.1	135.0	74.4	922.1	978.4	153.5	78.18	1.96	39.0	13.20	5.21	30.84	9.91	157.3
2004	15.3	7.6	7.7	3.8	2.1	21.6	62.8	132.5	72.8	924.7	979.7	145.2	75.85	1.91	38.2	13.24	5.01	28.49	9.30	151.4
2005	15.3	7.7	7.6	3.7	1.9	21.5	62.0	132.3	72.0	925.0	980.6	141.3	79.43	1.85	37.6	12.73	5.12	27.36	9.08	150.7

Table 4. Differences of tropical cyclone parametric values ($d = x$ – 10-yma).

Year	NTC	NTS	NH	NMH	NUSLFH	<N. LAT>	<W. LONG>	PWS	<PWS>	LP	<LP>	ACE	NSD	ACE/NSD	HISACE	LISNSD	<NSD>	NHD	NMHD	NTCA
1950	2.6	-1.7	4.3	4.3	0.7	0.2	-6.2	28.5	20.1	5.9	-9.8	127.4	42.77	0.48	27.0	3.89	2.30	31.27	10.39	118.7
1951	-0.5	-1.5	1.0	1.1	-2.3	0.2	-4.0	6.7	7.2	17.8	-8.7	12.8	-0.19	0.31	-0.6	-1.30	0.34	6.02	-0.58	12.6
1952	-3.6	-2.7	-0.9	-0.9	-1.2	-3.3	-3.4	-3.3	9.8	-11.0	3.5	-36.8	-18.13	0.11	-11.9	-3.24	0.25	-7.48	-1.89	-32.8
1953	3.4	4.3	-0.9	0.0	1.0	-1.0	-0.9	-4.3	-9.5	-14.5	6.0	-19.8	7.16	-0.49	-12.0	0.77	-0.76	-11.95	-2.23	-16.4
1954	0.5	-0.5	1.1	-2.0	1.1	1.8	2.5	-15.0	-4.0	-4.8	-1.2	-9.7	-9.66	0.30	2.5	-0.88	-1.05	1.45	0.45	-3.7
1955	1.9	-0.5	2.4	2.4	1.1	-1.8	-8.1	16.5	10.1	-26.5	-22.3	85.2	30.87	-0.01	3.7	-0.41	1.82	18.74	8.44	79.0
1956	-1.9	0.3	-2.2	-1.4	-0.9	1.5	10.9	-13.0	-7.7	16.9	13.1	-55.6	-19.10	-0.40	-13.9	-2.39	-1.19	-13.76	-6.19	-56.1
1957	-1.8	1.3	-3.1	-1.4	-0.9	2.8	7.6	3.0	-8.6	8.4	5.7	-26.9	-10.88	0.00	22.2	7.67	-0.17	-5.48	-2.93	-39.1
1958	0.5	-0.5	1.0	1.8	-0.7	-3.2	-7.0	9.7	8.9	-5.1	3.8	12.1	8.12	-0.03	-8.9	-2.80	0.64	3.41	0.39	23.0
1959	1.7	0.6	1.1	-1.3	1.3	3.3	9.1	-10.8	-10.5	10.0	10.2	-35.0	-7.98	-0.30	-7.0	-1.49	-1.42	-6.38	-5.14	-27.8
1960	-2.0	-0.4	-1.6	-1.3	0.4	0.0	4.6	9.2	1.2	-9.6	-2.1	-21.5	-17.54	0.74	22.8	1.49	-0.91	-9.73	0.57	-27.5
1961	2.1	-0.4	2.5	3.9	-0.6	-2.0	-4.2	19.5	17.5	-21.7	-17.7	97.2	24.17	0.64	8.8	2.25	1.22	19.04	15.51	112.4
1962	-4.0	-1.2	-2.8	-2.1	-1.6	1.4	-6.2	-31.3	-5.5	28.7	0.4	-78.8	-27.03	-0.67	-30.4	-6.13	-0.99	-19.94	-8.73	-81.4
1963	0.1	-1.0	1.1	-0.8	-0.6	-1.9	-3.2	-3.3	1.5	4.2	3.4	5.8	2.81	0.05	7.1	0.69	0.28	6.72	-1.70	-2.0
1964	2.8	2.8	0.0	3.3	2.4	-0.1	-0.7	7.7	3.4	1.9	-6.8	57.4	20.59	0.22	-3.3	0.45	0.44	12.50	6.41	66.3
1965	-3.7	-1.4	-2.3	-1.8	-0.5	0.6	0.5	7.0	-2.0	3.5	-2.2	-30.2	-13.76	0.06	8.9	0.94	1.06	-3.58	-0.51	-34.5
1966	1.1	0.3	0.8	0.5	0.5	-1.7	-6.1	4.0	-2.8	-10.3	6.0	38.0	11.15	0.33	19.5	3.44	0.45	12.69	2.10	-73.2
1967	-2.1	-2.0	-0.1	-1.2	-0.7	-3.2	-8.1	15.0	4.4	-16.2	-4.0	11.9	5.17	0.10	12.9	1.76	1.96	8.11	0.30	-4.7
1968	-2.2	-1.2	-1.0	-2.1	-0.7	3.1	7.8	-48.3	-10.0	26.1	5.2	-53.8	-18.84	-0.47	-13.5	-5.85	-1.02	-14.81	-4.84	-54.8
1969	7.9	1.6	6.3	3.2	0.5	-0.4	-0.2	43.2	7.5	-34.2	-2.7	74.7	40.77	0.09	0.2	4.34	-0.01	16.21	2.52	87.3
1970	-0.2	0.5	-0.7	0.3	-0.3	-0.2	8.1	-10.8	0.4	6.6	2.6	-44.8	-19.13	-0.32	-21.1	-4.74	-1.88	-15.25	-2.19	-24.9
1971	2.7	2.5	0.2	-0.8	1.7	0.0	3.1	21.2	-1.9	3.3	1.4	15.2	12.74	-0.04	17.4	9.41	-0.06	7.94	-1.55	11.2
1972	-3.1	-0.4	-2.7	-1.7	-0.2	6.5	-0.1	-28.0	-7.8	2.7	7.5	-28.1	-15.39	-0.07	0.2	-2.13	-0.12	-12.50	-1.95	-46.2
1973	-2.2	-0.6	-1.6	-0.8	-1.2	-3.1	-4.5	-20.8	-3.4	21.5	0.4	-19.9	-5.71	-0.25	-7.6	-2.43	0.59	-6.61	-1.65	-26.8
1974	1.0	2.3	-1.3	0.2	-0.2	-0.9	1.8	7.7	-4.4	-12.6	6.4	0.9	-0.43	0.06	2.0	-1.08	-0.38	-2.04	2.21	4.7
1975	-0.6	-1.4	0.8	1.4	-0.2	2.3	-4.8	-4.3	11.4	-0.2	-11.3	4.7	4.50	-0.03	-7.2	-1.71	0.82	3.30	-0.06	13.6
1976	0.4	-0.1	0.5	0.3	-0.1	-0.2	0.0	-20.8	-3.2	19.9	-0.3	9.4	5.94	0.02	2.6	2.47	0.46	7.04	-1.76	4.3
1977	-3.5	-3.0	-0.5	-0.9	0.1	3.4	12.4	24.2	5.4	-11.5	0.1	-48.8	-28.66	0.04	-13.2	-5.86	-2.03	-11.14	-1.96	-38.0
1978	2.8	3.2	-0.4	0.1	-0.9	-1.1	-1.2	-7.0	-8.0	9.1	6.2	-11.0	1.95	-0.29	-6.1	-0.26	-0.72	-4.03	0.47	3.4
1979	-0.1	-0.7	0.6	0.1	2.1	-4.4	-2.8	23.7	1.9	-15.0	-4.4	20.9	4.40	0.33	19.4	3.59	0.74	4.36	2.90	23.4
1980	1.7	-1.8	3.5	0.2	-0.2	-1.0	-12.1	39.2	9.6	-40.1	-5.9	76.0	19.61	0.71	26.6	4.71	1.30	20.62	4.49	49.3
1981	2.8	1.2	1.6	1.3	-1.5	-1.5	-5.6	-10.3	1.8	6.8	-1.0	29.4	24.45	-0.15	-1.7	1.45	1.22	5.56	0.95	33.4
1982	-3.1	0.1	-3.2	-0.6	-1.5	-0.4	4.6	-7.5	-1.3	8.1	-0.7	-37.2	-22.85	0.08	-5.2	-3.21	-1.29	-10.31	-1.48	-39.1
1983	-5.1	-3.0	-2.1	-0.7	-0.6	5.0	10.8	-22.5	1.1	22.4	1.7	-53.9	-28.89	-0.35	-17.6	-6.03	-1.09	-12.81	-2.73	-47.9
1984	3.8	4.0	-0.2	-0.7	-0.6	1.9	-1.7	-9.0	-10.0	11.4	6.1	8.0	19.45	-0.34	-5.1	1.60	0.29	1.05	-2.70	-1.0
1985	1.5	-0.3	1.8	1.3	4.4	2.1	7.3	4.5	7.1	-20.4	-6.3	12.9	5.94	0.11	-2.0	-0.76	0.05	4.12	0.66	24.7
1986	-3.4	-2.4	-1.0	-1.6	0.4	1.2	5.0	-27.5	-1.6	35.8	8.6	-33.5	-20.49	-0.02	-1.7	-1.68	-0.58	-5.34	-2.90	-40.0
1987	-2.3	-0.4	-1.9	-0.5	-0.7	-4.2	-7.1	-9.3	-10.8	16.2	8.6	-33.7	-5.49	-0.63	-9.6	2.51	0.85	-11.63	-2.39	-30.6
1988	2.5	2.6	-0.1	1.5	-0.7	-1.6	2.0	39.0	2.9	-52.3	-7.3	31.4	2.15	0.63	10.2	1.91	-0.71	4.81	5.97	39.0
1989	1.6	-0.4	2.0	0.5	1.3	-4.3	-5.1	16.0	9.1	-18.3	-7.3	64.6	23.20	0.48	19.8	1.96	1.39	15.55	6.74	53.0
1990	4.5	1.6	2.9	-0.5	-1.4	-2.2	-9.3	-14.3	-4.2	13.1	3.5	22.6	27.27	-0.22	-0.8	1.34	0.55	9.10	-2.35	19.9
1991	-2.3	-0.7	-1.6	0.1	-0.2	5.6	3.4	-6.3	-2.0	6.0	-0.9	-51.8	-27.26	-0.13	-13.2	-4.85	-1.80	-13.13	-3.13	-36.2
1992	-3.7	-1.9	-1.8	-1.2	-0.2	6.5	-2.3	27.0	10.8	-15.1	-7.0	-20.0	-13.68	0.20	-2.9	0.79	0.89	-7.63	-1.61	-35.4
1993	-2.8	-0.7	-2.1	1.8	-0.3	-0.9	2.0	-22.8	-10.3	22.6	8.7	-60.3	-26.35	-0.34	-8.4	-1.09	-1.24	-15.26	-4.46	-53.6
1994	-4.0	-0.6	-3.4	-2.4	-1.4	-2.9	0.9	-27.3	-7.1	33.9	9.2	-73.2	-31.54	-0.49	-20.4	-1.85	-0.93	-19.55	-5.44	-74.9
1995	7.9	3.3	4.6	2.4	0.6	-2.4	-0.3	7.2	3.4	-18.3	-5.1	118.2	62.39	-0.14	22.1	2.31	1.33	33.72	5.65	107.0
1996	1.5	-0.8	2.3	3.2	0.6	-4.9	-0.3	1.0	6.5	-2.9	-6.3	53.7	18.00	0.39	16.9	-0.29	0.97	16.31	6.80	72.3
1997	-4.1	-0.2	-3.9	-2.0	-0.3	6.3	6.7	-13.3	-17.4	10.1	11.2	-81.0	-34.29	-0.44	-5.7	-0.51	-1.41	-19.75	-4.08	-70.9
1998	1.3	-1.6	2.9	-0.1	1.6	-1.6	-6.2	30.7	10.5	-29.3	-7.0	49.6	19.71	0.22	5.4	-0.15	1.08	18.41	2.15	36.2
1999	-1.5	-2.0	0.5	1.5	1.3	-3.5	0.5	6.0	17.3	-8.0	-13.8	27.7	4.02	0.30	3.2	-1.56	1.14	7.11	4.99	32.5
2000	0.6	0.6	0.0	-0.9	-2.2	-0.2	-1.3	-13.0	-4.9	16.8	4.3	-40.6	-7.00	-0.34	-4.5	5.59	-0.66	-1.71	-5.43	-27.0
2001	0.3	-0.7	1.0	0.2	-2.3	0.7	0.3	-8.5	1.3	10.6	1.3	-47.3	-9.74	-0.37	-19.3	-2.44	-0.79	-7.19	-5.93	-23.1
2002	-2.9	1.1	-4.0	-1.7	-1.2	4.5	6.9	-9.5	-10.5	11.4	6.6	10.2	-20.65	0.92	-19.6	3.56	-0.55	-21.89	-6.81	-72.7
2003	0.7	1.7	-1.0	-0.8	-0.2	0.5	1.6	10.0	-3.8	-7.1	3.4	22.5	14.32	-0.06	24.3	0.05	0.57	1.66	6.84	21.3
2004	-0.3	-1.6	1.3	2.2	3.9	-1.6	-5.0	12.5	9.5	-12.7	-8.5	80.9	16.40	0.54	32.2	1.51	1.14	17.01	12.95	80.0
2005	12.7	5.3	7.4	3.3	4.1	1.0	4.0	27.7	4.8	-43.0	-6.2	109.0	51.82	0.06	1.3	-1.98	-0.43	22.14	8.42	127.6
n+	29	21	28	28	21	25	26	28	29	30	29	30	29	29	26	27	29	29	25	26
n-	27	35	28	28	35	31	30	28	27	26	27	26	27	27	30	29	27	27	31	30
n+r	19	16	15	18	14	15	17	16	18	14	13	15	16	17	15	15	15	15	14	14
mean	0.1	0.0	0.1	0.1	0.0	0.0	-0.1	0.8	0.6	-0.9	-0.4	4.2	1.3	0.02	0.8	-0.06	0.03	0.81	0.39	2.0
sd	3.3	1.9	2.4	1.7	1.4	2.8	5.6	19.5	8.2	19.3	7.4	51.8	22.0	0.36	14.3	3.25	1.05	13.42	5.05	53.1

Table 5. First-differences of tropical cyclone parametric values based on 10-yma values.

Year	NTC	NTS	NH	NMH	NUSLFH	<N. LAT>	<W. LONG>	PWS	<PWS>	LP	<LP>	ACE	NSD	ACE/NSD	HISACE	LISNSD	<NSD>	NHD	NMHD	NTCA
1950	0.1	-0.2	0.3	0.2	0.0	0.0	-1.0	1.8	1.5	-2.9	-1.1	8.3	2.71	0.05	2.1	0.44	0.20	2.00	0.72	7.1
1951	0.1	0.2	-0.1	0.0	-0.1	0.2	0.0	0.0	0.5	-1.2	0.5	0.2	-0.06	0.03	1.0	0.44	-0.01	0.00	0.06	0.5
1952	0.0	0.0	0.0	0.1	-0.2	0.1	-0.2	1.0	0.4	-1.5	0.1	-0.7	-0.54	0.01	-0.3	-0.01	-0.06	-0.28	0.09	0.1
1953	-0.1	-0.2	0.0	0.0	-0.1	0.2	0.1	0.7	-3.2	-1.7	-0.1	-0.3	-0.93	0.03	0.4	-0.10	-0.07	0.10	0.07	0.1
1954	-0.4	0.0	-0.3	-0.4	0.0	0.4	0.9	-1.5	2.5	-1.3	0.5	-8.8	-4.53	0.04	0.6	0.03	-0.22	-2.04	-0.49	-8.8
1955	-0.2	0.2	-0.4	-0.2	0.0	0.1	0.4	-0.5	-0.5	-3.4	0.1	-4.3	-2.78	0.05	0.9	0.23	-0.14	-1.50	0.38	-3.5
1956	-0.1	0.0	-0.1	0.0	0.0	0.3	-0.4	-1.0	-0.4	-0.5	-0.5	0.9	-0.22	0.00	0.1	0.19	-0.02	-0.03	0.49	1.0
1957	-0.3	-0.2	-0.1	-0.2	-0.2	0.3	-0.7	-1.7	-0.5	2.5	-0.1	-1.9	-1.50	0.00	0.5	-0.03	-0.01	0.36	-0.32	-3.3
1958	-0.2	-0.1	-0.1	0.1	0.0	0.1	-0.6	0.5	0.8	0.9	-0.3	3.6	0.60	0.03	0.9	0.19	0.15	1.54	0.28	2.4
1959	-0.3	0.0	-0.3	0.0	-0.1	0.2	-0.2	0.0	-0.5	1.6	0.9	-2.9	-0.94	0.00	0.0	0.27	0.06	-0.40	-0.21	-3.5
1960	-0.1	0.0	-0.1	-0.2	0.0	0.1	-0.9	-0.3	-0.7	0.1	0.9	-1.2	-0.46	0.02	1.6	0.49	0.09	0.48	-0.19	-2.4
1961	0.1	-0.2	0.3	0.0	0.0	-0.2	-2.1	0.8	0.3	-2.4	-0.3	6.0	2.70	0.01	0.7	0.13	0.23	2.23	0.24	4.3
1962	-0.1	-0.2	0.1	-0.3	0.0	0.3	-0.3	-3.0	-0.9	0.5	0.3	-2.3	-0.09	-0.05	-1.8	-0.32	0.06	-0.16	-0.53	-4.1
1963	0.3	0.2	0.1	-0.1	0.0	0.4	0.1	-1.0	-0.9	-0.7	0.3	0.6	1.47	-0.05	-1.3	0.24	0.00	-0.03	-0.36	-0.6
1964	0.5	0.2	0.3	0.1	-0.1	0.2	-0.4	0.7	0.0	-1.6	0.5	2.0	2.60	-0.09	-2.9	0.01	0.02	0.33	-0.33	2.8
1965	0.2	0.3	-0.1	-0.3	0.0	0.4	0.5	-2.0	-1.8	1.8	2.1	-7.8	-0.41	-0.15	-3.3	0.00	-0.15	-1.52	-1.61	-8.0
1966	0.2	0.3	-0.1	-0.3	0.2	0.7	0.9	-1.0	-1.9	-0.1	2.2	-4.9	-0.02	-0.07	0.2	0.43	-0.08	-1.17	-1.20	-6.9
1967	0.1	0.2	-0.1	-0.1	0.0	0.7	0.7	-1.7	-1.2	-0.3	1.1	-2.9	-0.24	-0.05	-1.2	-0.14	-0.05	-1.58	-0.36	-3.5
1968	-0.1	0.2	-0.3	-0.3	-0.2	0.3	0.5	-1.5	-1.3	0.3	1.4	-8.4	-2.11	-0.09	-2.4	-0.44	-0.16	-2.77	-0.86	-8.1
1969	0.1	0.1	0.0	-0.1	-0.2	0.3	0.3	-1.0	-0.4	-0.8	1.1	-5.6	-1.10	-0.07	-2.0	-0.42	-0.17	-1.79	-0.79	-4.8
1970	0.1	0.0	0.1	0.1	0.0	0.5	0.3	-2.0	0.2	1.3	-0.2	-3.6	-0.37	-0.05	-2.6	-0.40	-0.10	-1.19	-0.64	-2.4
1971	-0.2	-0.1	-0.1	-0.1	-0.1	0.6	1.4	-0.8	-0.2	1.6	0.2	-7.4	-2.87	-0.04	-2.9	-0.71	-0.30	-2.31	-0.60	-5.4
1972	0.1	0.2	-0.1	0.1	0.0	0.2	0.7	2.8	0.1	-0.8	0.5	-3.7	-1.68	-0.01	-1.4	-0.45	-0.26	-1.39	-0.05	-0.9
1973	-0.2	0.1	-0.3	0.0	0.0	-0.3	-0.6	1.5	-0.1	0.1	-0.1	-2.9	-1.78	0.01	1.1	-0.10	-0.03	-0.82	0.14	-2.0
1974	-0.4	-0.3	-0.1	-0.2	0.0	-0.2	-1.1	2.0	0.4	-1.4	-0.6	1.8	-0.68	0.06	2.8	0.13	0.13	0.66	0.27	-0.6
1975	0.0	-0.3	0.3	0.1	-0.1	-0.2	-1.4	1.5	0.7	-2.1	-1.1	5.6	1.81	0.05	1.0	-0.18	0.17	1.26	0.45	4.1
1976	-0.1	-0.1	0.0	0.2	-0.2	-0.5	-0.2	0.0	0.6	0.4	0.0	-0.6	-0.40	0.01	-1.4	-0.67	-0.03	-0.32	0.20	0.8
1977	-0.3	-0.2	-0.1	0.0	0.0	-0.1	0.8	1.2	0.5	0.4	-0.4	-2.4	-1.86	0.01	-0.7	-0.35	-0.14	-0.36	0.07	-1.0
1978	-0.1	-0.1	0.0	0.0	0.0	0.3	0.2	-0.7	-0.1	1.1	0.1	-0.8	-0.20	-0.01	-0.7	-0.10	-0.01	-0.14	-0.18	-1.3
1979	0.2	0.1	0.1	-0.1	0.3	-0.1	0.2	-0.5	-0.6	0.1	0.2	1.4	1.29	-0.01	-0.2	0.13	0.02	0.24	-0.09	0.6
1980	-0.1	0.0	-0.1	-0.1	0.3	-0.1	0.7	-0.5	-0.4	0.1	0.8	-1.7	-1.09	0.00	-0.5	-0.24	-0.08	-0.69	0.04	-1.8
1981	-0.1	0.1	-0.2	-0.1	0.0	-0.5	-0.8	-2.8	-1.1	2.7	1.1	-2.0	-0.20	-0.05	-0.5	0.16	0.09	-0.88	-0.07	-2.4
1982	0.0	0.1	-0.1	0.1	0.1	-0.6	-1.0	0.0	-0.7	-1.3	-0.1	2.6	1.29	0.00	0.6	0.57	0.16	0.25	0.25	1.6
1983	0.1	0.0	0.1	0.0	0.0	-0.2	-0.4	1.5	0.5	-3.0	-0.7	4.2	1.16	0.04	0.6	0.12	0.05	0.89	0.47	2.9
1984	0.3	0.3	0.0	0.0	0.0	-0.3	-0.4	-3.5	-0.8	2.8	0.6	-0.4	1.51	-0.05	-1.4	-0.14	0.03	-0.07	-0.11	-0.2
1985	-0.1	0.1	-0.2	-0.1	0.0	0.0	0.0	-3.0	-2.0	2.8	0.5	-5.8	-1.57	-0.05	-1.8	-0.33	-0.15	-1.29	-0.44	-4.3
1986	-0.1	0.0	-0.1	-0.1	0.1	0.3	-0.4	1.8	1.0	-1.4	-0.5	-1.1	-1.00	0.00	0.0	0.06	0.01	-0.21	-0.01	-1.3
1987	0.2	0.0	0.2	0.0	0.0	-0.2	-1.3	1.7	-0.1	-1.5	-0.2	3.2	1.86	0.01	1.2	0.60	0.14	0.81	0.14	2.5
1988	-0.1	0.0	-0.1	0.0	0.0	-0.8	-0.7	-1.0	-0.5	1.0	0.3	-1.6	-1.05	-0.01	0.3	0.20	-0.02	-0.24	-0.02	-1.2
1989	0.1	0.0	0.1	0.0	-0.3	-0.6	-0.5	-0.7	0.1	1.1	-0.2	4.3	1.68	0.00	1.2	0.12	0.04	1.45	0.34	3.6
1990	0.8	0.3	0.5	0.4	-0.2	-0.8	-0.8	2.0	0.5	-2.4	-1.1	13.4	6.28	0.04	3.1	0.44	0.20	3.73	1.03	13.5
1991	0.4	0.2	0.2	0.3	0.0	0.0	0.3	1.7	0.5	-2.9	-1.1	6.8	2.42	0.05	2.2	0.20	0.03	2.00	0.73	8.2
1992	0.1	-0.2	0.3	0.0	0.1	0.3	0.2	-0.2	0.3	0.3	-0.2	4.2	1.67	0.01	1.1	0.04	0.04	1.63	0.10	3.0
1993	0.2	-0.1	0.3	0.2	0.1	-0.1	0.1	-0.5	1.2	0.7	-0.8	6.1	2.69	0.00	0.3	0.01	0.14	1.79	0.23	5.1
1994	0.1	0.1	0.0	0.2	0.0	0.0	0.8	0.5	0.8	-0.8	-0.9	3.2	0.57	0.03	0.6	0.34	0.01	0.73	0.41	4.2
1995	0.4	0.1	0.3	0.2	0.0	-0.1	0.5	1.2	0.6	-1.4	-0.4	4.7	2.14	0.02	1.0	0.60	0.06	1.16	0.35	5.5
1996	0.6	0.4	0.2	0.2	-0.1	-0.3	0.6	-0.7	-0.5	0.0	0.5	8.2	3.04	0.06	-0.1	0.47	0.02	0.56	0.13	4.7
1997	0.6	0.4	0.2	0.1	0.1	0.0	0.6	1.0	-0.3	-1.6	0.1	11.4	4.00	0.08	1.7	0.39	0.06	0.84	0.77	7.1
1998	0.8	0.4	0.4	0.4	0.3	0.2	-0.1	4.7	1.3	-5.3	-1.3	16.6	6.44	0.10	5.1	0.41	0.21	3.05	1.91	16.2
1999	0.9	0.4	0.5	0.4	0.5	0.2	0.0	4.0	0.9	-4.8	-1.0	11.0	3.77	0.06	2.3	0.10	0.01	1.32	1.42	12.6
2000	0.3	0.3	0.0	-0.1	0.1	0.5	-0.1	0.5	-0.5	-0.8	0.6	-3.2	-0.26	-0.04	-2.0	-0.22	-0.07	-1.77	-0.25	-2.3
2001	0.2	0.2	0.0	-0.1	-0.1	0.0	-0.5	1.0	-0.1	-0.8	0.4	-2.7	-0.34	-0.01	-0.8	-0.25	-0.04	-1.05	-0.37	-2.9
2002	0.4	0.4	0.0	0.1	0.0	-0.2	0.1	0.5	0.1	-0.5	0.0	-0.3	0.53	0.00	0.4	0.01	-0.09	-0.80	0.10	2.0
2003	0.0	0.3	-0.3	0.0	-0.1	0.1	-0.5	-2.5	-1.6	2.6	1.3	-8.3	-2.33	-0.05	-0.8	0.04	-0.20	-2.35	-0.61	-5.9
2004	0.0	0.1	-0.1	-0.1	-0.2	-0.1	-0.8	-0.2	-0.8	0.3	0.9	-3.9	3.58	-0.06	-0.6	-0.51	0.11	-1.13	-0.22	-0.7
n+	34	41	30	34	38	34	27	28	25	25	31	24	24	34	31	34	29	25	29	26
n-	21	14	25	21	17	21	28	27	30	30	24	31	31	21	24	21	26	30	26	29
n+r	10	7	9	11	11	8	9	10	13	12	11	10	11	7	8	9	8	10	10	11
mean	0.1	0.1	0.0	0.0	0.0	0.0	-0.1	0.2	-0.2	-0.4	0.1	0.5	0.44	0.00	0.0	0.04	0.00	-0.02	0.02	0.4
sd	0.3	0.2	0.2	0.2	0.1	0.3	0.7	2.2	1.0	1.8	0.8	5.5	2.16	0.05	1.6	0.32	0.12	1.38	0.58	5.1

Table 6. Poisson probability distributions for Atlantic basin tropical cyclones: (a) 1945–2010 and (b) 1995–2010.

A. 1945-2010

	P(r)				
	NTC	NTS	NH	NMH	NUSLFH
r	(m = 10.8)	(m = 4.6)	(m = 6.2)	(m = 2.7)	(m = 1.6)
0	0.00002	0.01005	0.00203	0.06721	0.20190
1	0.00022	0.04624	0.01258	0.18145	0.32303
2	0.00119	0.10635	0.03901	0.24496	0.25843
3	0.00428	0.16307	0.08061	0.22047	0.13783
4	0.01156	0.18753	0.12495	0.14882	0.05513
5	0.02498	0.17253	0.15494	0.08036	0.01764
6	0.04496	0.13227	0.16012	0.03616	0.00470
7	0.06937	0.08692	0.14180	0.01395	0.00108
8	0.09365	0.04998	0.10990	0.00471	0.00022
9	0.11238	0.02554	0.07571	0.00141	0.00004
10	0.12137	0.01175	0.04694	0.00038	0.00001
11	0.11916	0.00491	0.02646	0.00009	0.00000
12	0.10724	0.00188	0.01367	0.00002	
13	0.08909	0.00067	0.00652	0.00000	
14	0.06873	0.00022	0.00289		
15	0.04949	0.00007	0.00119		
16	0.03340	0.00002	0.00046		
17	0.02122	0.00001	0.00017		
18	0.01273	0.00000	0.00006		
19	0.00724		0.00002		
20	0.00391		0.00001		
21	0.00201		0.00000		
22	0.00099				
23	0.00046				
24	0.00021				
25	0.00009				
26	0.00004				
27	0.00001				
28	0.00001				
29	0.00000				

Table 6. Poisson probability distributions for Atlantic basin tropical cyclones: (a) 1945–2010 and (b) 1995–2010 (Continued).

B. 1995-2010

Poisson probability distributions for Atlantic basin tropical cyclones, 1995-2010

	P(r)				
r	NTC (m = 14.8)	NTS (m = 6.8)	NH (m = 7.9)	NMH (m = 3.8)	NUSLFH (m = 1.9)
0	0.00000	0.00111	0.00037	0.02237	0.14957
1	0.00001	0.00757	0.00293	0.08501	0.28418
2	0.00004	0.02575	0.01157	0.16152	0.26997
3	0.00020	0.05837	0.03047	0.20459	0.17098
4	0.00075	0.09923	0.06017	0.19436	0.08122
5	0.00221	0.13495	0.09507	0.14771	0.03086
6	0.00545	0.15294	0.12517	0.09355	0.00977
7	0.01153	0.14857	0.14126	0.05079	0.00265
8	0.02133	0.12628	0.13950	0.02412	0.00063
9	0.03508	0.09541	0.12245	0.01019	0.00013
10	0.05192	0.06488	0.09673	0.00387	0.00000
11	0.06985	0.04011	0.06947	0.00134	
12	0.08615	0.02273	0.04574	0.00042	
13	0.09808	0.01189	0.02779	0.00012	
14	0.10368	0.00577	0.01568	0.00003	
15	0.10230	0.00262	0.00826	0.00001	
16	0.09463	0.00111	0.00408	0.00000	
17	0.08238	0.00045	0.00190		
18	0.06773	0.00017	0.00083		
19	0.05276	0.00006	0.00035		
20	0.03904	0.00002	0.00014		
21	0.02752	0.00001	0.00005		
22	0.01851	0.00000	0.00002		
23	0.01191		0.00001		
24	0.00735		0.00000		
25	0.00435				
26	0.00248				
27	0.00136				
28	0.00072				
29	0.00037				
30	0.00018				
31	0.00009				
32	0.00004				
33	0.00002				
34	0.00001				
35	0.00000				

Table 7. Comparison of observed and expected first differences.

	NTC		
Year	OBS	EXP	RES
1950	0.1	-0.2	0.3
1951	0.1	-0.2	0.3
1952	0.0	-0.1	0.1
1953	-0.1	-0.1	0.0
1954	-0.4	-0.1	-0.3
1955	-0.2	-0.1	-0.1
1956	-0.1	-0.1	0.0
1957	-0.3	-0.1	-0.2
1958	-0.2	-0.1	-0.1
1959	-0.3	-0.1	-0.2
1960	-0.1	-0.1	0.0
1961	0.1	-0.1	0.0
1962	-0.1	-0.1	0.0
1963	0.3	0.0	0.3
1964	0.5	0.0	0.5
1965	0.2	0.0	0.2
1966	0.2	0.0	0.2
1967	0.1	0.0	0.1
1968	-0.1	0.0	-0.1
1969	0.1	0.0	0.1
1970	0.1	0.0	0.1
1971	-0.2	0.0	-0.2
1972	0.1	0.0	0.1
1973	-0.2	0.1	-0.3
1974	-0.4	0.1	-0.5
1975	0.0	0.1	-0.1
1976	-0.1	0.1	-0.2
1977	-0.3	0.1	-0.4
1978	-0.1	0.1	-0.2
1979	0.2	0.1	0.1
1980	-0.1	0.1	-0.2
1981	-0.1	0.1	-0.2
1982	0.0	0.1	-0.1
1983	0.1	0.1	0.0
1984	0.3	0.2	0.1
1985	-0.1	0.2	-0.3
1986	-0.1	0.2	-0.3
1987	0.2	0.2	0.0
1988	-0.1	0.2	-0.3
1989	0.1	0.2	-0.1
1990	0.8	0.2	0.6
1991	0.4	0.2	0.2
1992	0.1	0.2	-0.1
1993	0.2	0.2	0.0
1994	0.1	0.2	-0.1
1995	0.4	0.3	0.1
1996	0.6	0.3	0.3
1997	0.6	0.3	0.3
1998	0.8	0.3	0.5
1999	0.9	0.3	0.6
2000	0.3	0.3	0.0
2001	0.2	0.3	-0.1
2002	0.4	0.3	0.1
2003	0.0	0.3	-0.3
2004	0.0	0.3	-0.3

n+	30
n-	25
n+r	12
z	-1.17
cl	<90%
random?	yes

Table 8. Monthly counts of the number of tropical cyclone onsets.

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Sum
1945						1	1	4	3	2			11
1946						1	1	1	1	2			6
1947							1	2	3	3			9
1948					1		1	2	3	1	1		9
1949								3	7	2	1		13
1950								4	3	6			13
1951					1			3	3	3			10
1952		1						2	2	2			7
1953					1			3	4	4	1	1	14
1954						1	1	2	4	1	1	1	11
1955							1	4	5	2			12
1956						1	1	1	4		1		8
1957						2		1	4	1			8
1958						1		4	4	1			10
1959					1	2	2	1	3	2			11
1960						1	2	2	2				7
1961							1		6	2	2		11
1962								2	1	2			5
1963								2	5	2			9
1964						1	1	3	5	1	1		12
1965						1		2	2	1			6
1966						1	4	1	4		1		11
1967								1	4	3			8
1968						3		1	3	1			8
1969							1	5	6	5	1		18
1970					1		1	3	3	2			10
1971							1	4	6	1	1		13
1972					1	1		2	2		1		7
1973							2	2	2	2			8
1974						1	1	4	4	1			11
1975						1	1	2	3	1		1	9
1976					1		1	5	2	1			10
1977								1	3	2			6
1978	1						1	4	3	3			12
1979						1	2	3	2	1			9
1980								3	5	1	2		11
1981					1	1		2	5	1	2		12
1982						2		1	2	1			6
1983								2	2				4
1984								4	6	1	1	1	13
1985							2	3	3	2	1		11
1986						2		1	2		1		6
1987								3	3	1			7
1988								3	7	1	1		12
1989						1	2	4	2	1	1		11
1990							2	6	2	4			14
1991							1	1	3	3			8
1992				1				1	4	1			7
1993						1		4	3				8
1994							1	2	2		2		7
1995						1	4	7	3	4			19
1996						1	2	4	2	3	1		13
1997						1	4		1	2			8
1998							1	4	6	2	1		14
1999						1		4	3	3	1		12
2000								4	7	4			15
2001						1		3	4	4	3		15
2002							1	3	8				12
2003				1		1	2	3	4	3		2	16
2004								8	4	2	1		15
2005						2	5	5	5	7	3	1	28
2006						1	2	3	4				10
2007					1	1	1	2	8	1		1	15
2008					1		3	4	4	3	1		16
2009								4	2	2	1		9
2010						1	1	4	8	5			19
Sum	1	1		2	10	38	62	188	245	125	35	8	715

Table 9. Monthly counts of the number of tropical cyclones that attained only tropical storm strength.

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Sum
1945							1	3	2				6
1946						1		1		1			3
1947							1		2	1			4
1948					1		1	1					3
1949								1	3	1	1		6
1950										2			2
1951								1	1				2
1952		1											1
1953					1			1	1	3	1	1	8
1954							1		1		1		3
1955							1	1		1			3
1956						1			3				4
1957						1		1	2	1			5
1958						1		1	1				3
1959					1	1		1		1			4
1960						1	1		1				3
1961									1	1	1		3
1962								1	1				2
1963									1	1			2
1964						1	1	2	1		1		6
1965						1			1				2
1966							1		3				4
1967									1	1			2
1968						1			2				3
1969							1	1	2	2			6
1970							1	2	2				5
1971							1	2	2	1	1		7
1972					1			1	1		1		4
1973							1	1	1	1			4
1974						1	1	2	2	1			7
1975						1				1		1	3
1976					1		1	1	1				4
1977										1			1
1978	1						1	2	1	2			7
1979						1	1	1					3
1980									2				2
1981					1	1		1		1	1		5
1982						1		1	1	1			4
1983									1				1
1984								4	4				8
1985							1		2	1			4
1986						1			1				2
1987								2	2				4
1988								3	3		1		7
1989						1	1		1		1		4
1990							1	4		1			6
1991							1		2	1			4
1992				1					2				3
1993						1		3					4
1994							1	1	2				4
1995							3	3		2			8
1996						1		1		2			4
1997						1	2			2			5
1998							1	1	2				4
1999						1		1	1	1			4
2000								2	2	3			7
2001						1		3		2			6
2002							1	3	4				8
2003				1		1		1	1	3		2	9
2004								3		2	1		6
2005						2	2	3		3	2	1	13
2006						1	2	2					5
2007					1	1	1	1	4			1	9
2008					1		1	2	2	2			8
2009								3	1	2			6
2010							1	2	4				7
Sum	1	1		2	8	26	35	78	84	52	13	6	306

Table 10. Monthly counts of the number of tropical cyclones that attained hurricane storm strength.

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Sum
1945						1		1	1	2			5
1946							1		1	1			3
1947								2	1	2			5
1948								1	3	1	1		6
1949								2	4	1			7
1950								4	3	4			11
1951					1			2	2	3			8
1952								2	2	2			6
1953								2	3	1			6
1954						1		2	3	1		1	8
1955								3	5	1			9
1956							1	1	1		1		4
1957						1			2				3
1958								3	3	1			7
1959						1	2		3	1			7
1960							1	2	1				4
1961							1		5	1	1		8
1962								1		2			3
1963								2	4	1			7
1964								1	4	1			6
1965								2	1	1			4
1966						1	3	1	1		1		7
1967								1	3	2			6
1968						2		1	1	1			5
1969								4	4	3	1		12
1970					1			1	1	2			5
1971								2	4				6
1972						1		1	1				3
1973							1	1	1	1			4
1974								2	2				4
1975							1	2	3				6
1976								4	1	1			6
1977								1	3	1			5
1978								2	2	1			5
1979							1	2	2	1			6
1980								3	3	1	2		9
1981								1	5		1		7
1982						1			1				2
1983								2	1				3
1984									2	1	1	1	5
1985							1	3	1	1	1		7
1986						1		1	1		1		4
1987								1	1	1			3
1988									4	1			5
1989							1	4	1	1			7
1990							1	2	2	3			8
1991								1	1	2			4
1992								1	2	1			4
1993								1	3				4
1994								1			2		3
1995						1	1	4	3	2			11
1996							2	3	2	1	1		9
1997							2		1				3
1998								3	4	2	1		10
1999								3	2	2	1		8
2000								2	5	1			8
2001									4	2	3		9
2002									4				4
2003							2	2	3				7
2004								5	4				9
2005							3	2	5	4	1		15
2006								1	4				5
2007								1	4	1			6
2008							2	2	2	1	1		8
2009								1	1		1		3
2010						1		2	4	5			12
Sum					2	12	27	110	161	73	22	2	409

Table 11. Monthly counts of the number of tropical cyclones that attained major or intense hurricane storm strength.

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Sum
1945						1		1	1				3
1946										1			1
1947									1	1			2
1948								1	2	1			4
1949								1	2				3
1950								4	2	2			8
1951					1			2	2				5
1952								1	1	1			3
1953								1	3				4
1954									1	1			2
1955								2	3	1			6
1956								1			1		2
1957						1			1				2
1958								3	2				5
1959									2				2
1960								1	1				2
1961							1		5	1			7
1962										1			1
1963								1	1				2
1964								1	4	1			6
1965								1					1
1966						1		1	1				3
1967									1				1
1968													0
1969								3	2				5
1970								1	1				2
1971									1				1
1972													0
1973									1				1
1974								2					2
1975								1	2				3
1976								2					2
1977								1					1
1978								1	1				2
1979								2					2
1980								1	1				2
1981									3				3
1982									1				1
1983								1					1
1984									1				1
1985								1	1		1		3
1986													0
1987									1				1
1988									2	1			3
1989								1	1				2
1990								1					1
1991								1	1				2
1992								1					1
1993								1					1
1994													0
1995								2	2	1			5
1996							1	2	2	1			6
1997									1				1
1998								1	1	1			3
1999								2	2		1		5
2000								1	2				3
2001									2	1	1		4
2002									2				2
2003								1	2				3
2004								3	3				6
2005							2	1	2	2			7
2006									2				2
2007								1	1				2
2008							1	1	1	1	1		5
2009								1	1				2
2010								2	3				5
Sum					1	3	5	61	85	19	5		179

Table 12. Monthly counts of the number of tropical cyclones that became US landfalling hurricanes.

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Sum
1945						1		1	1				3
1946										1			1
1947								1	1	1			3
1948									2	1			3
1949								2	1				3
1950								1	1	1			3
1951													0
1952								1					1
1953								2	1				3
1954								1	1	1			3
1955								2	1				3
1956									1				1
1957						1							1
1958									1				1
1959							2		1				3
1960								1	1				2
1961									1				1
1962													0
1963									1				1
1964								1	2	1			4
1965								1					1
1966						1			1				2
1967									1				1
1968										1			1
1969								1	1				2
1970								1					1
1971									3				3
1972						1							1
1973													0
1974								1					1
1975									1				1
1976								1					1
1977									1				1
1978													0
1979							1	2					3
1980								1					1
1981													0
1982													0
1983								1					1
1984									1				1
1985							1	2	1	1	1		6
1986						1		1					2
1987										1			1
1988									1				1
1989							1		1	1			3
1990													0
1991								1					1
1992								1					1
1993								1					1
1994													0
1995							1		1				2
1996							1	1					2
1997							1						1
1998								2	1				3
1999								1	1	1			3
2000													0
2001													0
2002									1				1
2003							1		1				2
2004								4	2				6
2005							2	1	2	1			6
2006													0
2007									1				1
2008							1	1	1				3
2009													0
2010													0
Sum						5	12	38	40	12	1		108

Table 13. Poisson probabilities by onset month, June–November, 1945–2010.

A. NTC

r	June (m = 0.58)	July (m = 0.94)	August (m = 2.85)	September (m = 3.71)	October (m = 1.89)	November (m = 0.53)
0	0.5599	0.3906	0.0578	0.0245	0.1511	0.5856
1	0.3247	0.3672	0.1649	0.0908	0.2855	0.3120
2	0.0942	0.1726	0.2349	0.1685	0.2698	0.0827
3	0.0182	0.0541	0.2232	0.2083	0.1700	0.0146
4	0.0026	0.0127	0.1590	0.1932	0.0803	0.0019
5	0.0003	0.0024	0.0906	0.1434	0.0304	0.0002
6	0.0000	0.0004	0.0431	0.0886	0.0096	0.0000
7		0.0001	0.0175	0.0470	0.0026	
8		0.0000	0.0062	0.0218	0.0006	
9			0.0020	0.0090	0.0001	
10			0.0006	0.0033	0.0000	
11			0.0001	0.0011		
12			0.0000	0.0003		
13				0.0001		
14				0.0000		

B. NTS

r	June (m = 0.39)	July (m = 0.53)	August (m = 1.18)	September (m = 1.27)	October (m = 0.79)	November (m = 0.20)
0	0.6771	0.5886	0.3073	0.2808	0.4538	0.8187
1	0.2641	0.3120	0.3626	0.3567	0.3585	0.1637
2	0.0515	0.0827	0.2139	0.2265	0.1416	0.0164
3	0.0067	0.0146	0.0841	0.0959	0.0373	0.0011
4	0.0007	0.0019	0.0248	0.0304	0.0074	0.0001
5	0.0001	0.0002	0.0059	0.0077	0.0012	0.0000
6	0.0000	0.0000	0.0012	0.0016	0.0002	
7			0.0002	0.0003	0.0000	
8			0.0000	0.0000		

C. NH

r	June (m = 0.18)	July (m = 0.41)	August (m = 1.67)	September (m = 2.44)	October (m = 1.11)	November (m = 0.33)
0	0.8353	0.6637	0.1882	0.0872	0.3296	0.7189
1	0.1503	0.2721	0.3144	0.2127	0.3658	0.2372
2	0.0135	0.0558	0.2625	0.2595	0.2030	0.0391
3	0.0008	0.0076	0.1461	0.2110	0.0751	0.0043
4	0.0000	0.0008	0.0610	0.1287	0.0208	0.0004
5		0.0001	0.0204	0.0628	0.0046	0.0000
6			0.0057	0.0255	0.0009	
7			0.0014	0.0089	0.0001	
8			0.0003	0.0027	0.0000	
9			0.0001	0.0007		
10			0.0000	0.0002		
11				0.0000		

D. NMH

r	June (m = 0.05)	July (m = 0.08)	August (m = 0.92)	September (m = 1.29)	October (m = 0.29)	November (m = 0.08)
0	0.9512	0.9231	0.3985	0.2753	0.7483	0.9231
1	0.0476	0.0738	0.3666	0.3551	0.2170	0.0738
2	0.0012	0.0030	0.1687	0.2290	0.0315	0.0030
3	0.0000	0.0001	0.0517	0.0985	0.0030	0.0001
4		0.0000	0.0119	0.0318	0.0002	0.0000
5			0.0022	0.0082	0.0000	
6			0.0003	0.0018		
7			0.0000	0.0003		
8				0.0001		
9				0.0000		

E. NUSLFH

r	June (m = 0.08)	July (m = 0.18)	August (m = 0.58)	September (m = 0.61)	October (m = 0.18)	November (m = 0.02)
0	0.9231	0.8353	0.5599	0.5434	0.8353	0.9802
1	0.0738	0.1503	0.3247	0.3314	0.1503	0.0196
2	0.0030	0.0135	0.0942	0.1011	0.0135	0.0002
3	0.0001	0.0008	0.0182	0.0206	0.0008	0.0000
4	0.0000	0.0000	0.0026	0.0031	0.0000	
5			0.0003	0.0004		
6			0.0000	0.0000		

Table 14. Yearly US hurricane landstrikes by state.

										State														
Year	IAL	AL	CT	AFL	BFL	CFL	DFL	IGA	GA	LA	MA	MD	ME	MS	INC	NC	NH	NY	RI	SC	ATX	BTX	CTX	VA	Total
1945				1		1																1			3
1946					1																				1
1947					1	2			1	1				1						1			1		8
1948					1	2				1															4
1949						1										1							1		3
1950		1		1		1																			3#
1951																									0&
1952																				1					1
1953				1									1			1									3
1954			1								1	1	1			2		1	1	1					9#
1955																3								1	4#
1956				1						1															2#
1957										1													1		2&
1958																1									1
1959																				2			1		3
1960			1		1		1				1		1	1		1	1	1	1						10
1961																						1			1
1962																									0
1963																							1		1&
1964					1	2	1			1															5#
1965						1				1															2&
1966				1	1																				2
1967																					1				1
1968				1			1																		2
1969										1			1	1											3&
1970																					1				1#
1971										1						1						1			3#
1972			1	1														1							3&
1973																									0#
1974										1															1#
1975		1		1																					2#
1976																		1							1
1977										1															1
1978																									0
1979		1				1	1		1	1				1						1					7
1980																					1				1
1981																									0
1982																									0&
1983																							1		1
1984																1									1
1985		1	1	2				1		2			1	1		1	1	1		1					13#
1986																1							1		2&
1987					1																				1&
1988										1															1#
1989															1					1			2		4
1990																									0
1991			1								1							1	1						4&
1992					1	1				1															3
1993																1									1
1994																									0&
1995	1			2		1																			4
1996																2									2
1997		1								1															2&
1998				1	1									1		1									4#
1999					1											1					1				3#
2000																									0
2001																									0
2002										1															1&
2003																1						1		1	3
2004		1		2	3	3	1									2				2					14&
2005	1	1		1	3	2				3				1		1							1		14
2006																									0&
2007										1													1		2
2008										2											1		1		4
2009																									0&
2010																									0#
Total	2	7	5	16	16	18	5	1	2	23	3	1	5	7	1	22	2	6	3	10	5	4	12	2	178

Note: # means year classified as a LNY and & means year classified as an ENY, based on the ONI being in the prescribed
ENSO condition for 4 or more months during June-November

Table 15. Poisson probabilities by geographical grouping, 1945–2010.

A. NTC

r	Group 1 (m = 2.3)	Group 2 (m = 1.7)	Group 3 (m = 2.5)	Group 4 (m = 3.0)	Group 5 (m = 1.4)
0	0.1003	0.1827	0.0821	0.0498	0.2466
1	0.2306	0.3106	0.2052	0.1494	0.3452
2	0.2652	0.2640	0.2565	0.2240	0.2417
3	0.2033	0.1496	0.2138	0.2240	0.1128
4	0.1169	0.0636	0.1336	0.1680	0.0395
5	0.0538	0.0216	0.0668	0.1008	0.0111
6	0.0206	0.0061	0.0278	0.0504	0.0026
7	0.0068	0.0015	0.0099	0.0216	0.0005
8	0.0019	0.0003	0.0031	0.0081	0.0001
9	0.0005	0.0001	0.0009	0.0027	0.0000
10	0.0001	0.0000	0.0002	0.0008	
11	0.0000		0.0000	0.0002	
12				0.0001	
13				0.0000	

B. NTS

r	Group 1 (m = 1.3)	Group 2 (m = 0.5)	Group 3 (m = 1.2)	Group 4 (m = 1.0)	Group 5 (m = 0.6)
0	0.2725	0.6065	0.3012	0.3679	0.5488
1	0.3543	0.3033	0.3614	0.3679	0.3293
2	0.2303	0.0758	0.2169	0.1839	0.0988
3	0.0998	0.0126	0.0867	0.0613	0.0198
4	0.0324	0.0016	0.0260	0.0153	0.0030
5	0.0084	0.0002	0.0062	0.0031	0.0004
6	0.0018	0.0000	0.0012	0.0005	0.0000
7	0.0003		0.0002	0.0001	
8	0.0001		0.0000	0.0000	
9	0.0000				

C. NH

r	Group 1 (m = 0.9)	Group 2 (m = 1.2)	Group 3 (m = 1.3)	Group 4 (m = 2.0)	Group 5 (m = 0.7)
0	0.4066	0.3012	0.2725	0.1353	0.4966
1	0.3659	0.3614	0.3543	0.2707	0.3476
2	0.1647	0.2169	0.2303	0.2707	0.1217
3	0.0494	0.0867	0.0998	0.1804	0.0284
4	0.0111	0.0260	0.0324	0.0902	0.0050
5	0.0020	0.0062	0.0084	0.0361	0.0007
6	0.0003	0.0012	0.0018	0.0120	0.0001
7	0.0000	0.0002	0.0003	0.0034	0.0000
8		0.0000	0.0001	0.0009	
9			0.0000	0.0002	
10				0.0000	

D. NMH

r	Group 1 (m = 0.3)	Group 2 (m = 0.7)	Group 3 (m = 0.3)	Group 4 (m = 1.4)	Group 5 (m = 0.1)
0	0.7408	0.4966	0.7408	0.2466	0.9048
1	0.2222	0.3476	0.2222	0.3452	0.0905
2	0.0333	0.1217	0.0333	0.2417	0.0045
3	0.0033	0.0284	0.0033	0.1128	0.0002
4	0.0003	0.0050	0.0003	0.0395	0.0000
5	0.0000	0.0007	0.0000	0.0111	
6		0.0001		0.0026	
7		0.0000		0.0005	
8				0.0001	
9				0.0000	

E. USLFH

r	Group 1 (m = 0.5)	Group 2 (m = 0.4)	Group 3 (m = 0.3)	Group 4 (m = 0.5)
0	0.6065	0.6703	0.7408	0.6065
1	0.3033	0.2681	0.2222	0.3033
2	0.0758	0.0464	0.0333	0.0758
3	0.0126	0.0072	0.0033	0.0126
4	0.0016	0.0001	0.0003	0.0016
5	0.0002	0.0000	0.0000	0.0002
6	0.0000			0.0000
7				

Table 16. Yearly surface air temperature and ENSO parametric values.

Year	<AT>	<SOI>	<ONI>	<NAO>	<PDO>	<TNI>	<MEI>	<GSSTEI>	<JMASSTM>	<NTA>	<CAR>	<QBO>	<AMO>	<AMM>	Comments
1945	10.29	4.6	-	-	-0.19	1.125	-	0.018	-	-	-	-	-	-	
1946	9.23	-6.7	-	-	-0.58	-0.926	-	0.011	-	-	-	-	-	-	
1947	9.15	2.3	-	-	0.50	-0.356	-	0.064	-	-	-	-	-	-	
1948	9.71	-1.2	-	-	-0.87	-0.455	-	-0.003	-	-	-	-6.25	0.017	0.72	
1949	10.32	-1.1	-	-	-1.23	0.026	-	-0.191	25.0	-	-	-9.16	0.097	-0.30	
1950#	9.17	15.4	-1.06	-0.12	-1.81	0.516	-1.094	-0.349	24.9	-	-	-6.43	-0.004	0.76	(1)
1951&	8.95	-0.7	0.09	-0.01	-0.77	1.243	0.053	-0.072	26.2	0.086	-0.039	-3.05	0.208	1.35	
1952	8.81	-2.3	-0.03	-0.43	-0.87	-0.454	-0.015	-0.108	25.5	-0.021	0.224	-5.38	0.300	1.47	
1953	9.87	-6.8	0.42	-0.02	-0.16	0.154	0.345	0.038	26.0	0.144	0.082	-0.55	0.269	1.64	
1954#	9.15	4.1	-0.63	0.00	-0.29	-1.044	-0.916	-0.167	24.7	-0.286	-0.143	-10.31	0.048	-0.17	
1955#	9.49	10.6	-1.24	-0.40	-1.95	0.403	-1.607	-0.317	24.5	0.059	-0.141	4.45	0.197	2.50	(2)
1956#	9.37	10.7	-0.80	-0.04	-1.80	0.685	-1.281	-0.253	24.9	-0.172	-0.141	-9.60	-0.014	0.92	
1957&	9.83	-3.9	0.69	-0.20	0.23	0.856	0.634	0.105	26.3	-0.136	0.133	1.50	0.045	-0.36	
1958	9.45	-3.2	0.61	-0.59	0.64	-0.378	0.805	0.145	25.9	0.501	0.337	-8.12	0.219	4.42	
1959	10.20	0.0	-0.06	0.35	-0.03	-0.134	0.131	0.043	25.5	-0.207	0.075	-1.48	0.058	-0.23	
1960	9.44	3.8	-0.19	-0.41	0.06	-0.269	-0.283	0.028	25.4	-0.084	0.154	-7.76	0.241	1.14	
1961	9.58	0.8	-0.23	0.04	-0.82	0.017	-0.257	-0.129	25.3	0.014	0.048	4.42	0.105	0.66	
1962	8.76	5.4	-0.47	-0.34	-1.16	-0.448	-0.763	-0.091	25.2	0.165	0.189	-7.73	0.077	2.01	
1963&	8.57	-2.0	0.40	-0.42	-0.69	-0.384	0.058	0.216	26.0	0.039	0.070	-8.75	0.010	-0.48	
1964#	9.49	6.3	-0.62	-0.04	-0.77	-0.437	-0.791	0.073	24.9	-0.101	-0.037	2.38	-0.090	0.45	
1965&	8.82	-8.4	0.64	-0.13	-0.31	1.017	0.718	0.198	26.3	-0.239	-0.148	-11.93	-0.154	-1.77	
1966	9.38	-4.2	0.26	-0.33	-0.46	-1.510	0.275	0.228	25.5	0.157	-0.009	1.29	0.010	1.07	
1967	9.40	3.2	-0.35	0.37	-0.73	-1.040	-0.634	-0.133	25.1	-0.170	-0.179	0.93	-0.092	-0.04	
1968	9.32	3.0	-0.03	-0.94	-0.40	-0.957	-0.313	0.068	25.4	-0.124	-0.092	-14.41	-0.161	-0.82	
1969&	8.93	-5.4	0.69	-0.06	-0.10	-0.311	0.530	0.383	26.3	0.545	0.178	4.81	0.015	1.82	
1970#	9.28	3.9	-0.36	-0.25	-0.40	-1.027	-0.570	0.088	24.8	0.240	-0.083	-13.76	-0.098	2.28	
1971#	9.72	11.0	-0.95	0.01	-1.29	0.366	-1.426	-0.165	24.7	-0.246	-0.256	4.80	-0.307	-1.36	
1972&	8.74	-7.4	0.84	0.51	-0.92	0.990	0.882	0.225	26.7	-0.304	-0.123	-8.10	-0.348	-4.02	
1973#	9.33	7.3	-0.64	-0.09	-0.80	-0.044	-0.472	0.100	25.0	-0.060	-0.031	4.40	-0.211	-3.13	
1974#	8.94	9.9	-0.97	0.18	-0.41	1.299	-1.178	-0.183	25.0	-0.495	-0.312	-13.42	-0.416	-4.13	(3)
1975#	9.69	13.6	-1.14	-0.07	-1.10	1.413	-1.306	-0.250	24.7	-0.414	-0.256	1.25	-0.294	-1.88	
1976	9.33	1.1	-0.15	0.19	0.01	1.499	-0.115	-0.001	25.8	-0.322	-0.332	0.85	-0.359	-0.85	(4)
1977	8.92	-9.9	0.45	-0.34	0.23	-1.207	0.622	0.106	25.8	-0.189	-0.066	-11.27	-0.184	-1.34	
1978	9.21	-1.7	-0.15	0.32	0.24	-0.707	0.123	0.041	25.3	0.027	0.044	6.81	-0.175	0.72	
1979	8.35	-1.9	0.16	0.14	0.34	-0.052	0.516	0.133	25.9	0.149	-0.037	-13.16	-0.105	1.09	(5)
1980	9.11	-3.1	0.14	-0.41	0.60	-1.161	0.544	0.203	25.7	0.174	0.164	5.27	-0.013	2.34	
1981	9.09	1.8	-0.32	-0.24	0.92	-0.688	0.059	0.122	25.3	0.095	0.058	-1.91	-0.071	1.84	
1982&	9.43	-13.1	0.95	0.43	0.11	-0.483	1.095	0.306	26.8	-0.097	0.035	-6.44	-0.207	-1.50	(6)
1983	9.77	-8.3	0.47	0.31	1.65	3.096	1.594	0.395	26.7	0.234	0.150	1.15	-0.065	-0.30	(7)
1984	9.29	-0.1	-0.45	0.25	0.84	0.461	-0.152	0.117	25.2	-0.148	-0.135	-17.02	-0.201	-2.86	
1985#	8.70	0.9	-0.58	-0.18	0.45	-0.543	-0.401	0.005	25.0	-0.197	-0.066	9.63	-0.259	-1.91	(8)
1986&	8.57	-2.4	0.28	0.50	1.24	-1.010	0.448	0.173	25.9	-0.295	-0.075	-0.98	-0.265	-3.82	
1987&	9.07	-13.1	1.29	-0.12	1.82	-0.568	1.650	0.474	26.8	0.324	0.167	-6.25	0.071	0.00	(9)
1988#	9.65	7.8	-0.83	-0.01	0.53	-0.049	-0.531	0.187	24.7	0.228	-0.012	1.56	0.005	0.09	
1989	10.07	6.8	-0.63	0.70	-0.18	0.758	-0.550	-0.077	25.2	-0.082	-0.080	-10.70	-0.073	-1.08	
1990	9.93	-2.2	0.25	0.59	-0.36	-1.668	0.384	0.076	25.8	0.157	0.155	5.28	-0.026	0.27	
1991&	9.42	-8.8	0.80	0.27	-0.42	-1.524	0.800	0.179	26.3	-0.128	-0.010	-3.24	-0.122	-2.35	
1992	9.45	-10.4	0.76	0.58	0.93	-0.628	1.305	0.216	26.3	-0.070	-0.081	-7.61	-0.211	-0.50	
1993	9.27	-9.5	0.47	0.18	1.42	-0.533	1.086	0.222	26.1	-0.101	-0.059	3.90	-0.201	-3.04	
1994&	9.32	-11.9	0.62	0.80	-0.15	-1.759	0.725	0.133	25.8	-0.286	0.020	-13.67	-0.160	-3.51	
1995	10.22	-2.3	0.08	-0.08	0.64	-1.064	0.198	0.208	25.4	0.314	0.180	7.82	0.120	1.24	
1996	9.22	5.7	-0.29	-0.21	0.64	-1.069	-0.351	0.129	25.2	0.242	-0.051	-16.06	-0.047	0.86	
1997&	10.32	-11.7	1.26	-0.16	1.46	1.722	1.547	0.280	27.4	0.364	0.075	7.86	0.064	1.08	(10)
1998#	10.09	-1.1	0.09	-0.48	0.25	2.985	0.847	0.253	26.2	0.555	0.384	-12.83	0.389	1.84	(11)
1999#	10.18	8.0	-1.06	0.39	-1.06	0.986	-0.928	-0.198	24.8	0.012	0.156	10.17	0.140	0.32	
2000	9.93	7.8	-0.74	0.21	-0.59	0.733	-0.532	-0.149	25.2	0.023	-0.031	-6.49	0.047	-0.45	
2001	9.57	0.5	-0.12	-0.18	-0.56	-0.957	-0.157	-0.058	25.5	0.223	0.170	-15.24	0.141	1.16	
2002&	10.20	-6.1	0.78	0.04	0.22	-1.872	0.580	0.160	26.3	0.210	0.202	8.72	0.086	-0.28	
2003	10.02	-3.1	0.48	0.10	0.97	-2.149	0.452	0.207	25.9	0.348	0.241	-13.81	0.252	0.32	
2004&	10.21	-4.8	0.56	0.24	0.35	-2.246	0.413	0.083	25.9	0.454	0.208	6.60	0.226	2.85	(12)
2005	10.24	-3.6	0.21	-0.27	0.38	-1.692	0.317	0.076	25.7	0.624	0.265	-17.13	0.312	3.67	(13)
2006&	10.43	-1.9	0.25	-0.21	0.19	-0.562	0.307	0.118	26.1	0.412	0.164	4.47	0.287	1.73	
2007	10.59	1.5	-0.30	0.17	-0.20	-1.444	-0.337	0.068	25.2	0.281	0.181	-15.91	0.169	1.25	(14)
2008	9.78	10.2	-0.56	-0.38	-1.27	1.857	-0.682	-0.058	25.6	0.264	0.035	6.97	0.160	0.70	
2009&	9.83	-0.2	0.47	-0.24	-0.61	-0.514	0.397	0.183	26.4	0.182	0.198	-3.49	0.062	-0.98	
2010#	8.74	9.8	-0.15	-1.15	-0.31	-0.452	-0.429	0.165	25.5	0.915	0.237	-7.95	0.375	4.98	(15)
Mean	9.48	-0.1	-0.01	-0.03	-0.13	-0.190	0.039	0.062	25.6	0.063	0.033	-3.65	-0.002	0.13	
sd	0.53	6.8	0.62	0.37	0.83	1.128	0.768	0.171	0.6	0.280	0.159	7.94	0.191	1.94	

Comments:

(1) Most positive <SOI>; most negative <GSSTEI>
(2) Most negative <ONI>; most negative <PDO>; most negative <MEI>; lowest <JMASSTM>
(3) Most negative <NTA>; most negative <AMO>; most negative <AMM>
(4) Most negative <CAR>
(5) Lowest <AT>
(6) Most negative <SOI>
(7) Most positive <TNI>; most positive <MEI>
(8) Most positive <QBO>
(9) Most negative <SOI>; most positive <ONI>; most positive <PDO>; most positive <GSSTEI>
(10) Highest <JMASSTM>
(11) Most positive <CAR>; most positive <AMO>
(12) Most negative <TNI>
(13) Most negative <QBO>
(14) Highest <AT>
(15) Most negative <NAO>; most positive <NTA>; most positive <AMM>

Table 17. 10-yma of surface air temperature and ENSO parametric values.

Year	<AT>	<SOI>	<ONI>	<NAO>	<PDO>	<TNI>	<MEI>	<GSSTEI>	<JMASSTM>	<NTA>	<CAR>	<QBO>	<AMO>	<AMM>
1950	9.43	1.06	-	-	-0.72	-0.053	-	-0.093	-	-	-	-	-	-
1951	9.39	2.23	-	-	-0.86	-0.009	-	-0.123	-	-	-	-	-	-
1952	9.43	2.79	-	-	-0.94	0.132	-	-0.134	-	-	-	-	-	-
1953	9.45	2.38	-	-	-0.88	0.197	-	-0.124	-	-	-	-4.57	0.126	1.04
1954	9.44	2.34	-	-	-0.74	0.193	-	-0.105	25.42	-	-	-4.28	0.135	1.23
1955	9.44	1.81	-0.16	-0.16	-0.59	0.145	-0.254	-0.075	25.47	-	-	-3.96	0.145	1.25
1956	9.49	1.31	-0.13	-0.17	-0.50	0.045	-0.229	-0.059	25.45	-0.015	0.058	-3.66	0.152	1.23
1957	9.52	1.77	-0.17	-0.17	-0.51	-0.016	-0.282	-0.061	25.39	-0.010	0.061	-3.40	0.136	1.23
1958	9.45	2.39	-0.19	-0.18	-0.55	-0.043	-0.334	-0.051	25.37	-0.005	0.059	-3.93	0.112	1.15
1959	9.40	2.74	-0.19	-0.20	-0.61	-0.039	-0.342	-0.030	25.38	-0.001	0.063	-3.70	0.092	1.07
1960	9.38	1.90	-0.10	-0.19	-0.55	0.022	-0.219	0.008	25.48	-0.007	0.068	-3.89	0.067	0.89
1961	9.35	0.21	0.05	-0.19	-0.40	-0.057	-0.025	0.058	25.60	-0.006	0.075	-4.16	0.051	0.68
1962	9.33	-0.19	0.05	-0.18	-0.38	-0.262	-0.011	0.070	25.57	0.009	0.066	-3.65	0.045	0.71
1963	9.30	0.48	-0.03	-0.17	-0.48	-0.386	-0.130	0.054	25.49	-0.024	0.029	-3.99	0.019	0.46
1964	9.23	0.52	-0.03	-0.21	-0.53	-0.423	-0.166	0.067	25.50	-0.017	0.012	-3.99	-0.002	0.30
1965	9.16	0.26	0.00	-0.22	-0.56	-0.470	-0.160	0.087	25.51	0.036	0.006	-3.98	-0.021	0.46
1966	9.16	0.77	-0.04	-0.21	-0.61	-0.491	-0.233	0.088	25.45	0.040	-0.022	-4.26	-0.058	0.42
1967	9.17	0.64	-0.01	-0.17	-0.62	-0.401	-0.209	0.102	25.50	0.003	-0.052	-4.26	-0.100	0.01
1968	9.20	0.47	0.00	-0.11	-0.61	-0.312	-0.154	0.112	25.52	-0.025	-0.073	-3.62	-0.133	-0.42
1969	9.21	1.11	-0.07	-0.08	-0.60	-0.209	-0.199	0.094	25.48	-0.050	-0.092	-3.75	-0.160	-0.78
1970	9.23	2.39	-0.18	-0.07	-0.62	-0.102	-0.320	0.059	25.40	-0.078	-0.111	-3.88	-0.183	-1.02
1971	9.27	3.76	-0.29	-0.04	-0.64	0.068	-0.441	0.025	25.34	-0.111	-0.132	-3.24	-0.209	-1.12
1972	9.24	3.37	-0.27	-0.05	-0.57	0.210	-0.397	0.025	25.39	-0.136	-0.143	-3.88	-0.232	-1.28
1973	9.21	2.48	-0.23	-0.02	-0.49	0.215	-0.313	0.036	25.42	-0.129	-0.131	-3.42	-0.237	-1.27
1974	9.18	2.42	-0.26	0.05	-0.43	0.240	-0.292	0.022	25.39	-0.142	-0.134	-3.26	-0.244	-1.23
1975	9.14	2.24	-0.27	0.05	-0.28	0.246	-0.237	0.015	25.42	-0.165	-0.133	-3.21	-0.245	-1.26
1976	9.10	1.43	-0.21	0.03	-0.20	0.187	-0.107	0.035	25.49	-0.151	-0.105	-2.59	-0.229	-1.10
1977	9.11	0.69	-0.17	0.02	-0.04	0.061	-0.022	0.054	25.53	-0.124	-0.081	-2.85	-0.211	-0.81
1978	9.16	-0.38	-0.11	0.03	0.14	0.144	0.092	0.072	25.62	-0.099	-0.064	-2.92	-0.196	-0.54
1979	9.20	-1.66	-0.03	0.05	0.32	0.259	0.247	0.102	25.71	-0.066	-0.046	-3.27	-0.178	-0.34
1980	9.17	-2.80	0.02	0.05	0.46	0.119	0.343	0.130	25.74	-0.038	-0.028	-3.03	-0.166	-0.28
1981	9.08	-3.61	0.07	0.06	0.60	-0.104	0.417	0.151	25.76	-0.026	-0.006	-2.70	-0.159	-0.43
1982	9.05	-3.94	0.14	0.09	0.74	-0.197	0.496	0.179	25.81	0.001	0.019	-2.54	-0.142	-0.51
1983	9.08	-3.63	0.15	0.08	0.84	-0.133	0.515	0.204	25.83	0.037	0.028	-2.55	-0.120	-0.47
1984	9.19	-2.72	0.07	0.10	0.82	-0.059	0.429	0.201	25.77	0.035	0.023	-2.69	-0.109	-0.61
1985	9.32	-2.24	0.04	0.17	0.75	-0.044	0.368	0.184	25.74	0.023	0.020	-2.57	-0.108	-0.82
1986	9.37	-2.72	0.10	0.25	0.64	-0.111	0.397	0.181	25.79	0.011	0.016	-2.63	-0.112	-1.14
1987	9.39	-3.12	0.15	0.28	0.61	-0.160	0.444	0.179	25.82	0.001	0.007	-2.76	-0.114	-1.30
1988	9.37	-3.04	0.14	0.28	0.64	-0.349	0.429	0.166	25.76	-0.014	-0.009	-2.68	-0.121	-1.38
1989	9.34	-3.69	0.19	0.30	0.58	-0.641	0.448	0.158	25.76	-0.038	-0.012	-2.38	-0.126	-1.55
1990	9.42	-4.44	0.28	0.34	0.54	-0.778	0.522	0.169	25.81	-0.019	0.008	-2.30	-0.105	-1.43
1991	9.53	-4.20	0.28	0.31	0.52	-0.807	0.512	0.177	25.80	0.033	0.022	-3.14	-0.075	-1.04
1992	9.62	-3.72	0.25	0.27	0.47	-0.696	0.466	0.165	25.79	0.062	0.018	-3.19	-0.065	-0.75
1993	9.71	-4.10	0.30	0.24	0.44	-0.430	0.530	0.159	25.90	0.080	0.034	-3.21	-0.046	-0.61
1994	9.74	-4.48	0.32	0.20	0.38	-0.267	0.580	0.156	25.95	0.101	0.065	-2.88	-0.016	-0.45
1995	9.74	-3.92	0.25	0.17	0.32	-0.135	0.516	0.139	25.90	0.099	0.068	-2.43	-0.002	-0.42
1996	9.75	-2.96	0.15	0.13	0.31	0.013	0.422	0.115	25.83	0.110	0.067	-3.62	0.015	-0.28
1997	9.79	-2.28	0.11	0.08	0.26	-0.021	0.338	0.101	25.79	0.142	0.090	-3.40	0.043	-0.09
1998	9.87	-2.19	0.11	0.05	0.20	-0.164	0.270	0.097	25.78	0.178	0.120	-3.47	0.081	0.09
1999	9.95	-1.07	0.11	0.02	0.21	-0.269	0.223	0.094	25.78	0.238	0.144	-3.34	0.123	0.58
2000	10.00	-0.78	0.11	-0.02	0.22	-0.325	0.213	0.085	25.80	0.290	0.158	-3.57	0.151	1.02
2001	10.06	-1.22	0.14	-0.03	0.18	-0.331	0.252	0.078	25.86	0.314	0.173	-3.79	0.178	1.18
2002	10.13	-0.94	0.09	-0.02	0.08	-0.464	0.190	0.067	25.79	0.318	0.189	-3.96	0.200	1.23
2003	10.13	-0.63	-0.02	-0.01	-0.08	-0.678	0.020	0.040	25.65	0.300	0.177	-4.16	0.193	1.18
2004	10.10	0.44	0.03	-0.02	-0.13	-0.810	0.010	0.044	25.70	0.294	0.161	-3.85	0.178	1.06
2005	10.02	0.13	0.04	-0.12	-0.10	-0.944	0.081	0.079	25.80	0.347	0.177	-4.60	0.191	1.27

Table 18. Differences of surface air and ENSO parametric values ($d = x$ – 10-yma).

Year	<AT>	<SOI>	<ONI>	<NAO>	<PDO>	<TNI>	<MEI>	<GSSTEI>	<JMASSTM>	<NTA>	<CAR>	<QBO>	<AMO>	<AMM>
1950	-0.26	14.34	-	-	-1.09	0.569	-	-0.256	-	-	-	-	-	-
1951	-0.44	-2.93	-	-	0.09	1.252	-	0.051	-	-	-	-	-	-
1952	-0.62	-5.09	-	-	0.07	-0.586	-	0.026	-	-	-	-	-	-
1953	-0.58	-9.18	-	-	0.72	-0.043	-	0.162	-	-	-	4.02	0.143	0.60
1954	-0.26	1.76	-	-	0.45	-1.237	-	-0.062	-0.72	-	-	-6.03	-0.087	-1.40
1955	0.05	8.79	-1.08	-0.24	-1.36	0.258	-1.353	-0.242	-0.97	-	-	8.41	0.052	1.25
1956	-0.12	9.39	-0.67	0.13	-1.30	0.640	-1.052	-0.194	-0.55	-0.157	-0.199	-5.94	-0.166	-0.31
1957	0.31	-5.67	0.86	-0.03	0.74	0.872	0.916	0.166	0.91	-0.126	0.072	4.90	-0.091	-1.59
1958	0.00	-5.59	0.80	-0.41	1.19	-0.335	1.139	0.196	0.53	0.506	0.278	-4.19	0.107	3.27
1959	0.80	-2.74	0.13	0.55	0.58	-0.095	0.473	0.073	0.12	-0.206	0.012	2.22	-0.034	-1.30
1960	0.06	1.90	-0.09	-0.22	0.61	-0.291	-0.064	0.020	-0.08	-0.077	0.086	-3.87	0.174	0.25
1961	0.23	0.59	-0.28	0.23	-0.42	0.074	-0.232	-0.187	-0.30	0.020	-0.027	8.58	0.054	-0.02
1962	-0.57	5.59	-0.52	-0.16	-0.78	-0.186	-0.752	-0.161	-0.37	0.156	0.123	-4.08	0.032	1.30
1963	-0.73	-2.48	0.43	-0.25	-0.21	0.002	0.188	0.162	0.51	0.063	0.041	-4.76	-0.009	-0.94
1964	0.26	5.78	-0.59	0.17	-0.24	-0.014	-0.625	0.006	-0.60	-0.084	-0.049	6.37	-0.088	0.15
1965	-0.34	-8.66	0.64	0.09	0.25	1.487	0.878	0.111	0.79	-0.275	-0.154	-7.95	-0.133	-2.23
1966	0.22	-4.97	0.30	-0.12	0.15	-0.660	0.508	0.140	0.05	0.117	0.013	5.55	0.068	0.65
1967	0.23	2.56	-0.34	0.54	-0.11	-0.639	-0.425	-0.235	-0.40	-0.173	0.231	5.19	0.008	-0.05
1968	0.12	2.53	-0.03	-0.83	0.21	-0.645	-0.159	-0.044	-0.12	-0.099	-0.019	-10.79	-0.028	-0.40
1969	-0.28	-6.51	0.76	0.02	0.50	-0.102	0.729	0.289	0.82	0.595	0.270	8.56	0.175	2.60
1970	0.05	1.51	-0.18	-0.18	0.22	-0.925	-0.250	0.029	-0.60	0.318	0.028	-9.88	0.085	3.30
1971	0.45	7.24	-0.66	0.05	-0.65	0.298	-0.985	-0.190	-0.64	-0.135	-0.124	8.04	-0.098	-0.24
1972	-0.50	-10.77	1.11	0.56	-0.35	0.780	1.279	0.200	1.31	-0.168	0.020	-4.22	-0.116	-2.74
1973	0.12	4.82	-0.41	-0.07	-0.31	-0.259	-0.159	0.064	-0.42	0.069	0.100	7.82	0.026	-1.86
1974	-0.24	7.48	-0.71	0.13	0.02	1.059	-0.886	-0.205	-0.39	-0.353	-0.178	-10.16	-0.172	-2.90
1975	0.55	11.36	-0.87	-0.12	-0.82	1.167	-1.069	-0.265	-0.72	-0.249	-0.123	4.46	-0.049	-0.62
1976	0.23	-0.33	-0.36	0.16	0.21	1.312	-0.008	-0.036	0.31	-0.171	-0.227	3.44	-0.130	0.25
1977	-0.19	-10.59	0.62	-0.36	0.27	-1.268	0.644	0.052	0.27	-0.065	0.015	-8.42	0.027	-0.53
1978	0.05	-1.32	-0.04	0.29	0.10	-0.851	0.031	-0.031	-0.32	0.126	0.108	9.73	0.021	1.26
1979	-0.85	-0.24	0.19	0.09	0.02	-0.311	0.269	0.031	0.19	0.215	0.009	-9.89	0.073	1.43
1980	-0.06	-0.30	0.12	-0.46	0.14	-1.280	0.201	0.073	-0.04	0.212	0.192	8.30	0.153	2.62
1981	0.01	-1.81	-0.39	-0.30	0.32	-0.584	-0.358	-0.029	-0.46	0.121	0.064	0.79	0.088	2.27
1982	0.38	-9.16	0.81	0.34	-0.63	-0.286	0.599	0.127	0.99	-0.098	0.016	-3.90	-0.065	-0.99
1983	0.69	4.67	0.32	0.23	0.81	3.229	1.079	0.191	0.87	0.197	0.122	3.70	0.055	0.17
1984	0.10	-2.82	-0.52	0.15	0.02	0.520	-0.581	-0.084	-0.57	-0.183	-0.158	-14.33	-0.092	-2.25
1985	-0.62	-1.34	-0.62	-0.35	-0.30	-0.499	-0.769	-0.179	-0.74	-0.220	-0.086	12.20	-0.151	-1.09
1986	-0.80	0.32	0.18	0.25	0.60	-0.899	0.051	-0.008	0.11	-0.306	-0.059	1.65	-0.153	-2.68
1987	-0.32	-9.98	1.14	-0.40	1.21	-0.408	1.206	0.295	0.98	0.323	0.160	-3.49	0.185	1.30
1988	0.28	10.84	-0.97	-0.29	-0.11	0.300	-0.960	0.021	-1.06	0.242	-0.003	4.24	0.126	1.47
1989	0.73	10.49	-0.82	0.40	-0.76	1.399	-0.998	-0.235	-0.56	-0.044	-0.068	-8.32	0.053	0.47
1990	0.51	2.24	-0.03	0.25	-0.90	-0.890	-0.138	-0.093	-0.01	0.176	0.147	2.98	0.079	1.70
1991	-0.11	-4.60	0.52	-0.04	-0.94	-0.717	0.288	0.002	0.50	-0.161	-0.032	-0.10	-0.047	-1.31
1992	-0.17	-6.68	0.51	0.31	0.46	0.068	0.839	0.051	0.51	-0.132	-0.099	-4.42	-0.146	0.25
1993	-0.44	-5.40	0.17	-0.06	0.78	-0.103	0.556	0.063	0.20	-0.181	-0.093	7.11	-0.155	-2.43
1994	-0.42	-7.42	0.30	0.60	-0.53	-1.492	0.145	-0.023	-0.15	-0.387	-0.045	-10.79	-0.144	-3.06
1995	0.48	1.62	-0.17	-0.25	0.32	-0.929	-0.318	0.069	-0.50	0.215	0.112	10.25	0.122	1.66
1996	-0.53	8.66	-0.44	-0.34	0.33	-1.082	-0.773	0.014	-0.63	0.132	-0.118	-12.44	-0.062	1.14
1997	0.53	-9.42	1.15	-0.24	1.20	1.743	1.209	0.179	1.61	0.222	-0.015	11.26	0.021	1.17
1998	0.22	1.09	-0.02	-0.53	0.05	3.149	0.577	0.156	0.42	0.377	0.264	-9.36	0.308	1.75
1999	0.23	9.07	-1.17	0.37	-1.27	1.255	-1.151	-0.292	-0.98	-0.226	0.012	13.51	0.017	-0.26
2000	-0.07	8.58	-0.85	0.23	-0.81	1.059	-0.745	-0.234	-0.60	-0.267	-0.189	-2.92	-0.104	-1.47
2001	-0.49	1.72	-0.26	-0.15	-0.74	-0.626	-0.409	-0.136	-0.36	-0.091	-0.003	-11.45	-0.037	-0.02
2002	0.07	-5.16	0.69	0.06	0.14	-1.408	0.390	0.093	0.51	-0.108	0.013	12.68	-0.114	-1.51
2003	-0.11	-2.47	0.50	0.11	1.05	-1.471	0.432	0.167	0.25	0.048	0.064	-9.65	0.059	-0.86
2004	0.11	-5.24	0.53	0.26	0.48	-1.436	0.403	0.039	0.20	0.160	0.047	10.45	0.048	1.79
2005	0.22	-3.73	0.17	-0.15	0.48	-0.748	0.236	-0.003	-0.10	0.277	0.088	-12.53	0.121	2.40
n+	30	26	24	26	34	22	26	32	23	23	22	27	28	26
n-	26	30	27	25	22	34	25	24	29	27	28	26	25	27
n+r	14	12	12	17	11	11	11	12	12	11	11	23	13	15
mean	-0.03	-0.14	0.00	0.00	0.00	-0.015	0.001	-0.002	-0.02	0.003	0.013	0.40	0.002	0.03
sd	0.40	6.45	0.61	0.31	0.65	1.057	0.713	0.150	0.62	0.226	0.123	8.06	0.109	1.65

Table 19. First differences of surface air temperature and ENSO parametric values based on 10-yma values.

Year	<AT>	<SOI>	<ONI>	<NAO>	<PDO>	<TNI>	<MEI>	<GSSTEI>	<JMASSTM>	<NTA>	<CAR>	<QBO>	<AMO>	<AMM>
1950	-0.04	1.17	-	-	-0.14	0.044	-	-0.030	-	-	-	-	-	-
1951	0.04	0.46	-	-	-0.08	0.141	-	-0.014	-	-	-	-	-	-
1952	0.02	-0.41	-	-	0.06	0.065	-	0.010	-	-	-	-	-	-
1953	-0.01	-0.04	-	-	-0.14	-0.004	-	0.019	-	-	-	0.29	0.009	0.19
1954	0.00	-0.53	-	-	0.15	-0.048	-	0.030	0.05	-	-	0.32	0.010	0.02
1955	0.05	-0.50	0.03	-0.01	0.09	-0.100	0.025	0.016	-0.02	-	-	0.30	0.007	-0.02
1956	0.03	0.46	-0.04	0.00	-0.01	-0.061	-0.053	-0.002	-0.06	0.005	0.003	0.26	-0.016	0.00
1957	-0.07	0.62	0.02	-0.01	-0.04	-0.027	-0.052	0.010	-0.02	0.005	-0.002	-0.53	-0.024	-0.08
1958	-0.05	0.35	0.00	-0.02	-0.06	0.004	-0.008	0.021	0.01	0.004	0.004	0.23	-0.020	-0.08
1959	-0.02	-0.84	0.09	0.01	0.06	0.061	0.123	0.038	0.10	-0.006	0.005	-0.19	-0.025	-0.18
1960	-0.03	-1.69	0.15	0.00	0.15	-0.079	0.194	0.050	0.12	0.001	0.007	-0.27	-0.016	-0.21
1961	-0.02	-0.40	0.00	0.01	0.02	-0.205	0.014	0.012	-0.03	0.015	-0.009	0.51	-0.006	0.03
1962	-0.03	0.67	-0.08	0.01	-0.10	-0.124	-0.119	-0.016	-0.08	-0.033	-0.037	-0.34	-0.026	-0.25
1963	-0.07	0.04	0.00	-0.04	-0.05	-0.037	-0.036	0.013	0.01	0.007	-0.017	0.00	-0.021	-0.16
1964	-0.07	-0.26	0.03	-0.01	-0.03	-0.047	0.006	0.020	0.01	0.053	-0.006	0.01	-0.019	0.16
1965	0.00	0.51	-0.04	0.01	-0.05	-0.021	-0.073	0.001	-0.06	0.004	-0.028	-0.28	-0.037	-0.04
1966	0.01	-0.13	0.03	0.04	-0.01	0.090	0.024	0.014	0.05	-0.037	-0.030	0.00	-0.042	-0.41
1967	0.03	-0.17	0.01	0.06	0.01	0.089	0.055	0.010	0.02	-0.028	-0.021	0.64	-0.033	-0.43
1968	0.01	0.64	-0.07	0.03	0.01	0.103	-0.045	-0.018	-0.04	-0.025	-0.019	-0.13	-0.027	-0.36
1969	0.02	1.28	-0.11	0.01	-0.02	0.107	-0.121	-0.035	-0.08	-0.028	-0.019	-0.13	-0.023	-0.24
1970	0.04	1.37	-0.11	0.03	-0.02	0.170	-0.121	-0.034	-0.06	-0.033	-0.012	0.64	-0.026	-0.10
1971	-0.03	-0.39	0.02	-0.01	0.07	0.142	0.044	0.000	0.05	-0.025	-0.011	-0.64	-0.023	-0.16
1972	-0.03	-0.89	0.04	0.03	0.08	0.005	0.084	0.011	0.03	0.007	0.012	0.46	-0.005	0.01
1973	-0.03	-0.06	-0.03	0.07	0.06	0.025	0.021	-0.014	-0.03	-0.013	-0.003	0.16	-0.007	0.04
1974	-0.04	-0.18	-0.01	0.00	0.15	0.006	0.055	-0.007	0.03	-0.023	0.001	0.05	-0.001	-0.03
1975	-0.04	-0.81	0.06	-0.02	0.08	-0.059	0.130	0.020	0.07	0.014	0.028	0.62	0.016	0.16
1976	0.01	-0.74	0.04	-0.01	0.16	-0.126	0.085	0.019	0.04	0.027	0.024	-0.26	0.018	0.29
1977	0.05	-1.07	0.06	0.01	0.18	0.083	0.114	0.018	0.09	0.025	0.017	-0.07	0.015	0.27
1978	0.04	-1.28	0.08	0.02	0.18	0.115	0.155	0.030	0.09	0.033	0.018	-0.35	0.018	0.20
1979	-0.03	-1.14	0.05	0.00	0.14	-0.140	0.096	0.028	0.03	0.028	0.018	0.24	0.012	0.06
1980	-0.09	-0.81	0.05	0.01	0.14	-0.223	0.074	0.021	0.02	0.012	0.022	0.33	0.007	-0.15
1981	-0.03	-0.33	0.07	0.03	0.14	-0.093	0.079	0.028	0.05	0.027	0.013	0.16	0.017	-0.08
1982	0.03	0.31	0.01	-0.01	0.10	0.064	0.019	0.025	0.02	0.036	0.009	-0.01	0.022	0.04
1983	0.11	0.91	-0.08	0.02	-0.02	0.074	-0.086	-0.003	-0.06	-0.002	-0.005	-0.14	0.011	-0.14
1984	0.13	0.48	-0.03	0.07	-0.07	0.015	-0.061	-0.017	-0.03	-0.012	-0.003	0.12	0.001	-0.21
1985	0.05	-0.48	0.06	0.08	-0.11	-0.067	0.029	-0.003	0.05	-0.012	-0.004	-0.06	-0.004	-0.32
1986	0.02	-0.40	0.05	0.03	-0.03	-0.049	0.047	-0.002	0.03	-0.010	-0.009	-0.13	-0.002	-0.16
1987	-0.02	0.08	-0.01	0.00	0.03	-0.189	-0.015	-0.013	-0.06	-0.015	-0.016	0.08	-0.007	-0.08
1988	-0.03	-0.65	0.05	0.02	-0.06	-0.292	0.019	-0.008	0.00	-0.024	-0.003	0.30	-0.005	-0.17
1989	0.08	-0.75	0.09	0.04	-0.04	-0.137	0.074	0.011	0.05	0.019	0.020	0.08	0.021	0.12
1990	0.11	0.24	0.00	-0.03	-0.02	-0.029	-0.010	0.008	-0.01	0.052	0.014	-0.84	0.030	0.39
1991	0.09	0.48	-0.03	-0.04	-0.05	0.111	-0.046	-0.012	-0.01	0.029	-0.004	-0.05	0.010	0.29
1992	0.09	-0.38	0.05	-0.03	-0.03	0.266	0.064	-0.006	0.11	0.018	0.016	-0.02	0.019	0.14
1993	0.03	-0.38	0.02	-0.04	-0.06	0.163	0.050	-0.003	0.05	0.021	0.031	0.33	0.030	0.16
1994	0.00	0.56	-0.07	-0.03	-0.06	0.132	-0.064	-0.017	-0.05	-0.002	0.003	0.45	0.014	0.03
1995	0.01	0.96	-0.10	-0.04	-0.01	0.122	-0.094	-0.024	-0.07	0.011	-0.001	-1.19	0.017	0.14
1996	0.04	0.68	-0.04	-0.05	-0.05	-0.034	-0.084	-0.014	-0.04	0.032	0.023	0.22	0.028	0.19
1997	0.08	0.09	0.00	-0.03	-0.06	-0.143	-0.068	-0.004	-0.01	0.036	0.030	-0.07	0.038	0.18
1998	0.08	1.12	0.00	-0.03	0.01	-0.105	-0.047	-0.003	0.00	0.060	0.024	0.13	0.042	0.49
1999	0.05	0.29	0.00	-0.04	0.01	-0.056	-0.010	-0.009	0.02	0.052	0.014	0.23	0.028	0.44
2000	0.06	-0.44	0.03	-0.01	-0.03	-0.006	0.039	-0.007	0.06	0.024	0.015	-0.22	0.027	0.16
2001	0.07	0.28	-0.05	0.01	-0.10	-0.133	-0.062	-0.009	-0.07	0.004	0.016	-0.17	0.022	0.05
2002	0.00	0.31	-0.11	0.01	-0.16	-0.214	-0.170	-0.027	-0.14	-0.018	-0.012	-0.20	-0.007	-0.05
2003	-0.03	1.07	0.05	-0.01	-0.05	-0.132	-0.010	0.004	0.05	-0.006	-0.016	0.31	-0.015	-0.12
2004	-0.08	-0.31	0.01	-0.10	0.03	-0.134	0.071	0.035	0.10	0.053	0.016	-0.75	0.013	0.21
n+	33	26	33	28	24	24	27	28	30	30	26	28	27	27
n-	22	29	17	22	31	31	23	27	21	19	23	24	25	25
n+r	6	10	11	7	8	6	10	7	11	8	8	14	4	9
mean	0.01	-0.02	0.00	0.00	0.01	-0.017	0.007	0.003	0.01	0.007	0.002	0.003	0.002	0.004
sd	0.05	0.70	0.06	0.03	0.09	0.117	0.079	0.019	0.06	0.026	0.017	0.372	0.021	0.208

Table 20. Tropical cyclone parametric means and standard deviations based on the yearly ENSO phase condition.

A. Frequencies

Condition	NTC	NTS	NH	NMH	NUSLFH
ENY(16)	9.1(3.4)	4.3(1.7)	4.8(2.8)	2.0(1.8)	1.1(1.5)
LNY(15)	11.7(2.7)	4.7(1.7)	7.0(2.6)	3.5(2.1)	2.2(1.7)
NY(35)	11.3(4.6)	4.8(2.7)	6.5(2.4)	2.7(1.7)	1.6(1.3)
ONI>0.0(30)	10.6(5.0)	4.6(2.6)	6.0(3.2)	2.7(2.4)	1.5(1.5)
ONI<0.0(31)	11.3(3.0)	4.7(2.1)	6.6(2.1)	3.1(2.0)	1.6(1.5)

B. Other aspects

Condition	<N. LAT>	<w. LONG>	PWS	<PWS>	ACE	NSD	NTCA
ENY(16)	23.0(3.8)	64.0(6.4)	119.7(20.8)	70.6(9.1)	85.2(60.1)	44.50(22.82)	86.8(57.0)
LNY(15)	21.9(3.2)	65.9(6.1)	133.0(17.9)	79.4(9.5)	121.6(62.8)	66.92(40.42)	135.3(63.1)
NY(35)	21.6(3.2)	64.9(7.0)	124.7(27.2)	74.9(8.2)	104.1(54.9)	56.04(26.54)	114.7(55.8)
ONI>0.0(30)	22.6(3.7)	63.4(6.7)	127.5(22.5)	73.1(8.6)	102.0(67.0)	53.58(30.52)	105.6(65.4)
ONI<0.0(31)	21.9(3.1)	65.1(5.6)	126.0(20.0)	77.1(9.7)	108.6(52.6)	59.51(31.18)	122.2(56.1)

Table 21. Poisson probability distributions for North Atlantic basin tropical cyclones based on ENSO phase condition.

A. ENY

r	NTC (m = 9.13)	NTS (m = 4.31)	NH (m = 4.81)	NMH (m = 2.00)	NUSLFH (m = 1.13)
0	0.0001	0.0134	0.0081	0.1353	0.3230
1	0.0010	0.0579	0.0392	0.2707	0.3650
2	0.0045	0.1248	0.0943	0.2707	0.2062
3	0.0137	0.1793	0.1511	0.1804	0.0777
4	0.0314	0.1931	0.1817	0.0902	0.0219
5	0.0573	0.1665	0.1748	0.0361	0.0050
6	0.0872	0.1196	0.1401	0.0120	0.0009
7	0.1137	0.0736	0.0963	0.0034	0.0002
8	0.1298	0.0397	0.0579	0.0009	0.0000
9	0.1316	0.0190	0.0309	0.0002	
10	0.1202	0.0082	0.0149	0.0000	
11	0.0998	0.0032	0.0065		
12	0.0759	0.0012	0.0026		
13	0.0533	0.0004	0.0010		
14	0.0348	0.0001	0.0003		
15	0.0212	0.0000	0.0001		
16	0.0121		0.0000		
17	0.0065				
18	0.0033				
19	0.0016				
20	0.0007				
21	0.0003				
22	0.0001				
23	0.0000				

B. LNY

r	NTC (m = 11.67)	NTS (m = 4.67)	NH (m = 7.00)	NMH (m = 3.47)	NUSLFH (m = 2.20)
0	0.0000	0.0094	0.0009	0.0311	0.1108
1	0.0001	0.0438	0.0064	0.1080	0.2438
2	0.0006	0.1022	0.0223	0.1873	0.2681
3	0.0023	0.1591	0.0521	0.2167	0.1966
4	0.0066	0.1857	0.0912	0.1880	0.1082
5	0.0154	0.1735	0.1277	0.1305	0.0476
6	0.0300	0.1350	0.1490	0.0754	0.0174
7	0.0500	0.0901	0.1490	0.0374	0.0055
8	0.0729	0.0526	0.1304	0.0162	0.0015
9	0.0945	0.0273	0.1014	0.0063	0.0004
10	0.1103	0.0127	0.0710	0.0022	0.0001
11	0.1171	0.0054	0.0452	0.0007	0.0000
12	0.1138	0.0021	0.0263	0.0002	
13	0.1022	0.0008	0.0142	0.0001	
14	0.0852	0.0003	0.0071	0.0000	
15	0.0663	0.0001	0.0033		
16	0.0483	0.0000	0.0014		
17	0.0332		0.0006		
18	0.0215		0.0002		
19	0.0132		0.0001		
20	0.0077		0.0000		
21	0.0043				
22	0.0023				
23	0.0012				
24	0.0006				
25	0.0003				
26	0.0001				
27	0.0000				

Table 21. Poisson probability distributions for North Atlantic basin tropical cyclones based on ENSO phase condition (Continued).

C. NY

r	NTC (m = 11.26)	NTS (m = 4.77)	NH (m = 6.49)	NMH (m = 2.71)	NUSLFH (m = 1.63)
0	0.0000	0.0085	0.0015	0.0665	0.1959
1	0.0001	0.0405	0.0099	0.1803	0.3194
2	0.0008	0.0965	0.0320	0.2443	0.2603
3	0.0031	0.1534	0.0692	0.2207	0.1414
4	0.0086	0.1829	0.1123	0.1495	0.0576
5	0.0194	0.1745	0.1457	0.0810	0.0188
6	0.0365	0.1387	0.1576	0.0366	0.0051
7	0.0586	0.0945	0.1461	0.0142	0.0012
8	0.0825	0.0564	0.1185	0.0048	0.0002
9	0.1033	0.0299	0.0855	0.0014	0.0000
10	0.1163	0.0143	0.0555	0.0004	
11	0.1190	0.0062	0.0327	0.0001	
12	0.1117	0.0025	0.0177	0.0000	
13	0.0967	0.0009	0.0088		
14	0.0778	0.0003	0.0041		
15	0.0584	0.0001	0.0018		
16	0.0411	0.0000	0.0007		
17	0.0272		0.0003		
18	0.0170		0.0001		
19	0.0101		0.0000		
20	0.0057				
21	0.0030				
22	0.0016				
23	0.0008				
24	0.0004				
25	0.0002				
26	0.0001				
27	0.0000				

Table 22. Comparison of surface air temperature and ENSO-related parametric values for different ENSO phase conditions.

Parameter	ENY(16)	LNY(15)	NY(35)	<ONI> >0.0(30)	<ONI> <0.0(31)
<AT>	9.42(0.65)	9.40(0.43)	9.55(0.51)	9.49(0.60)	9.44(0.45)
<ONI>	0.66(0.33)	-0.73(0.37)	-0.01(0.39)*	0.52(0.32)	-0.52(0.36)
<SOI>	-6.36(4.44)	7.88(4.51)	-0.66(5.05)	-5.71(3.94)	5.49(4.48)
<NAO>	0.08(0.34)	-0.15(0.35)	-0.02(0.39)*	0.02(0.36)	-0.07(0.38)
<PDO>	0.10(0.80)	-0.72(0.80)	0.01(0.75)	0.29(0.74)	-0.49(0.75)
<TNI>	-0.338(1.205)	0.337(1.060)	-0.349(1.081)	-0.374(1.380)	-0.025(0.878)
<MEI>	0.677(0.453)	-0.806(0.599)	0.121(0.584)*	0.671(0.429)	-0.573(0.465)
<GSSTEI>	0.197(0.126)	-0.067(0.200)	0.056(0.130)	0.188(0.110)	-0.047(0.146)
<JMASSTM>	26.34(0.41)	24.95(0.41)	25.57(0.39)#	26.15(0.43)	25.13(0.32)
<NTA>	0.071(0.292)	0.003(0.382)$	0.087(0.218)*	0.138(0.275)	-0.011(0.270)$
<CAR>	0.066(0.120)	-0.050(0.195)$	0.054(0.150)*	0.092(0.137)	-0.027(0.158)$
<QBO>	-2.00(7.06)	-0.67(8.86)	-5.51(7.75)%	-3.06(7.74)	-3.97(8.41)
<AMO>	-0.011(0.182)	-0.036(0.242)	0.019(0.172)%	0.019(0.192)	-0.026(0.196)
<AMM>	-0.64(2.10)	0.104(2.35)	0.52(1.56)%	0.08(2.14)	0.17(1.83)

* means no data for 1945-1949
# means no data for 1945-1948
$ means no data for 1950
% means no data for 1945-1947

Table 23. Poisson probability distributions for North Atlantic basin tropical cyclones based on yearly parametric values being either above (+) or below (–) long-term parametric averages.

A. <AT>

	"+"					"-"				
	NTC	NTS	NH	NMH	NUSLFH	NTC	NTS	NH	NMH	NUSLFH
r	(m = 12.69)	(m = 5.86)	(m = 6.83)	(m = 3.38)	(m = 2.10)	(m = 9.38)	(m = 3.68)	(m = 5.70)	(m = 2.19)	(m = 1.27)
0	0.0000	0.0029	0.0011	0.0340	0.1225	0.0001	0.0252	0.0033	0.1119	0.2808
1	0.0000	0.0167	0.0074	0.1151	0.2572	0.0008	0.0928	0.0191	0.2451	0.3567
2	0.0002	0.0409	0.0252	0.1945	0.2700	0.0037	0.1708	0.0544	0.2684	0.2265
3	0.0010	0.0956	0.0574	0.2191	0.1890	0.0116	0.2095	0.1033	0.1959	0.0959
4	0.0033	0.1401	0.0980	0.1852	0.0992	0.0272	0.1927	0.1472	0.1073	0.0304
5	0.0085	0.1642	0.1339	0.1252	0.0417	0.0511	0.1419	0.1678	0.0470	0.0077
6	0.0179	0.1604	0.1524	0.0705	0.0146	0.0798	0.0870	0.1594	0.0171	0.0016
7	0.0324	0.1342	0.1487	0.0340	0.0044	0.1070	0.0457	0.1298	0.0054	0.0003
8	0.0514	0.0983	0.1269	0.0144	0.0011	0.1254	0.0210	0.0925	0.0015	0.0000
9	0.0725	0.0640	0.0963	0.0054	0.0003	0.1307	0.0086	0.0586	0.0004	
10	0.0920	0.0375	0.0658	0.0018	0.0001	0.1226	0.0032	0.0334	0.0001	
11	0.1061	0.0200	0.0409	0.0006	0.0000	0.1046	0.0011	0.0173	0.0000	
12	0.1122	0.0098	0.0233	0.0002		0.0817	0.0003	0.0082		
13	0.1095	0.0044	0.0122	0.0000		0.0590	0.0001	0.0036		
14	0.0993	0.0018	0.0060			0.0395	0.0000	0.0015		
15	0.0840	0.0007	0.0027			0.0247		0.0006		
16	0.0666	0.0003	0.0012			0.0145		0.0002		
17	0.0497	0.0001	0.0005			0.0080		0.0001		
18	0.0351	0.0000	0.0002			0.0042		0.0000		
19	0.0234		0.0001			0.0021				
20	0.0149		0.0000			0.0010				
21	0.0090					0.0004				
22	0.0052					0.0002				
23	0.0029					0.0001				
24	0.0015					0.0000				
25	0.0008									
26	0.0004									
27	0.0002									
28	0.0001									
29	0.0000									

B. <ONI>

	"+"					"-"				
	NTC	NTS	NH	NMH	NUSLFH	NTC	NTS	NH	NMH	NUSLFH
r	(m = 10.57)	(m = 4.60)	(m = 5.97)	(m = 2.37)	(m = 1.50)	(m = 11.29)	(m = 4.71)	(m = 6.58)	(m = 3.06)	(m = 1.61)
0	0.0000	0.0101	0.0026	0.0935	0.2231	0.0000	0.0090	0.0014	0.0469	0.1999
1	0.0003	0.0462	0.0152	0.2215	0.3347	0.0001	0.0424	0.0091	0.1435	0.3218
2	0.0014	0.1063	0.0455	0.2625	0.2510	0.0008	0.0999	0.0300	0.2195	0.2591
3	0.0051	0.1631	0.0906	0.2074	0.1255	0.0030	0.1568	0.0659	0.2239	0.1390
4	0.0134	0.1875	0.1352	0.1229	0.0471	0.0085	0.1846	0.1084	0.1713	0.0560
5	0.0282	0.1725	0.1614	0.0582	0.0141	0.0191	0.1739	0.1427	0.1048	0.0180
6	0.0497	0.1323	0.1606	0.0230	0.0035	0.0359	0.1365	0.1564	0.0535	0.0048
7	0.0751	0.0869	0.1370	0.0078	0.0008	0.0580	0.0919	0.1471	0.0234	0.0011
8	0.0992	0.0500	0.1022	0.0023	0.0001	0.0818	0.0541	0.1210	0.0089	0.0002
9	0.1165	0.0255	0.0678	0.0006	0.0000	0.1026	0.0283	0.0884	0.0030	0.0000
10	0.1232	0.0118	0.0405	0.0001		0.1159	0.0133	0.0582	0.0009	
11	0.1184	0.0049	0.0220	0.0000		0.1189	0.0057	0.0348	0.0003	
12	0.1042	0.0019	0.0109			0.1119	0.0022	0.0191	0.0001	
13	0.0848	0.0007	0.0050			0.0972	0.0008	0.0097	0.0000	
14	0.0640	0.0002	0.0021			0.0784	0.0003	0.0045		
15	0.0451	0.0001	0.0009			0.0590	0.0001	0.0020		
16	0.0298	0.0000	0.0003			0.0416	0.0000	0.0008		
17	0.0185		0.0001			0.0276		0.0003		
18	0.0109		0.0000			0.0173		0.0001		
19	0.0061					0.0103		0.0000		
20	0.0032					0.0058				
21	0.0016					0.0031				
22	0.0008					0.0016				
23	0.0004					0.0008				
24	0.0002					0.0004				
25	0.0001					0.0002				
26	0.0000					0.0001				
27						0.0000				

Table 23. Poisson probability distributions for North Atlantic basin tropical cyclones based on yearly parametric values being either above (+) or below (–) long-term parametric averages (Continued).

C. <SOI>

	"+"					"-"				
	NTC	NTS	NH	NMH	NUSLFH	NTC	NTS	NH	NMH	NUSLFH
r	(m = 11.27)	(m = 4.67)	(m = 6.60)	(m = 3.13)	(m = 1.80)	(m = 10.47)	(m = 4.61)	(m = 5.86)	(m = 2.36)	(m = 1.50)
0	0.0000	0.0094	0.0014	0.0437	0.1653	0.0000	0.0100	0.0029	0.0944	0.2231
1	0.0001	0.0438	0.0090	0.1368	0.2975	0.0003	0.0459	0.0167	0.2228	0.3347
2	0.0008	0.1022	0.0296	0.2141	0.2678	0.0016	0.1057	0.0490	0.2629	0.2510
3	0.0030	0.1591	0.0652	0.2234	0.1607	0.0054	0.1625	0.0956	0.2068	0.1255
4	0.0086	0.1857	0.1076	0.1748	0.0723	0.0142	0.1873	0.1401	0.1220	0.0471
5	0.0193	0.1735	0.1420	0.1094	0.0260	0.0298	0.1727	0.1642	0.0576	0.0141
6	0.0363	0.1350	0.1562	0.0571	0.0078	0.0519	0.1327	0.1604	0.0227	0.0035
7	0.0584	0.0901	0.1472	0.0255	0.0020	0.0776	0.0874	0.1342	0.0076	0.0008
8	0.0823	0.0526	0.1215	0.0100	0.0005	0.1016	0.0503	0.0983	0.0023	0.0001
9	0.1031	0.0273	0.0891	0.0035	0.0001	0.1182	0.0258	0.0640	0.0006	0.0000
10	0.1161	0.0127	0.0588	0.0011	0.0000	0.1238	0.0119	0.0375	0.0001	
11	0.1190	0.0054	0.0353	0.0003		0.1178	0.0050	0.0200	0.0000	
12	0.1118	0.0021	0.0194	0.0001		0.1028	0.0019	0.0098		
13	0.0969	0.0008	0.0099	0.0000		0.0828	0.0007	0.0044		
14	0.0780	0.0003	0.0046			0.0619	0.0002	0.0018		
15	0.0586	0.0001	0.0020			0.0432	0.0001	0.0007		
16	0.0413	0.0000	0.0008			0.0283	0.0000	0.0003		
17	0.0274		0.0003			0.0174		0.0001		
18	0.0171		0.0001			0.0101		0.0000		
19	0.0102		0.0000			0.0056				
20	0.0057					0.0029				
21	0.0031					0.0015				
22	0.0016					0.0007				
23	0.0008					0.0003				
24	0.0004					0.0001				
25	0.0002					0.0000				
26	0.0001									
27	0.0000									

D. <NAO>

	"+"					"-"				
	NTC	NTS	NH	NMH	NUSLFH	NTC	NTS	NH	NMH	NUSLFH
r	(m = 10.46)	(m = 4.88)	(m = 5.58)	(m = 2.00)	(m = 1.54)	(m = 11.29)	(m = 4.49)	(m = 6.80)	(m = 3.26)	(m = 1.57)
0	0.0000	0.0076	0.0038	0.1353	0.2144	0.0000	0.0112	0.0011	0.0384	0.2080
1	0.0003	0.0371	0.0211	0.2707	0.3301	0.0001	0.0504	0.0076	0.1251	0.3266
2	0.0016	0.0905	0.0587	0.2707	0.2542	0.0008	0.1131	0.0258	0.2040	0.2564
3	0.0055	0.1471	0.1092	0.1804	0.1305	0.0030	0.1693	0.0584	0.2217	0.1342
4	0.0143	0.1795	0.1524	0.0902	0.0502	0.0085	0.1900	0.0992	0.1807	0.0527
5	0.0299	0.1752	0.1701	0.0361	0.0155	0.0191	0.1706	0.1349	0.1178	0.0165
6	0.0521	0.1425	0.1582	0.0120	0.0040	0.0359	0.1277	0.1529	0.0640	0.0043
7	0.0779	0.0993	0.1261	0.0034	0.0009	0.0580	0.0819	0.1486	0.0298	0.0010
8	0.1019	0.0606	0.0879	0.0009	0.0002	0.0818	0.0460	0.1263	0.0121	0.0002
9	0.1184	0.0329	0.0545	0.0002	0.0000	0.1026	0.0229	0.0954	0.0044	0.0000
10	0.1238	0.0160	0.0304	0.0000		0.1159	0.0103	0.0649	0.0014	
11	0.1178	0.0071	0.0154			0.1189	0.0042	0.0401	0.0004	
12	0.1026	0.0029	0.0072			0.1119	0.0016	0.0227	0.0001	
13	0.0826	0.0011	0.0031			0.0972	0.0005	0.0119	0.0000	
14	0.0617	0.0004	0.0012			0.0784	0.0002	0.0058		
15	0.0430	0.0001	0.0005			0.0590	0.0001	0.0026		
16	0.0281	0.0000	0.0002			0.0416	0.0000	0.0011		
17	0.0173		0.0001			0.0276		0.0004		
18	0.0101		0.0000			0.0173		0.0002		
19	0.0055					0.0103		0.0001		
20	0.0029					0.0058		0.0000		
21	0.0014					0.0031				
22	0.0007					0.0016				
23	0.0003					0.0008				
24	0.0001					0.0004				
25	0.0000					0.0002				
26						0.0001				
27						0.0000				

Table 23. Poisson probability distributions for North Atlantic basin tropical cyclones based on yearly parametric values being either above (+) or below (–) long-term parametric averages (Continued).

E. <PDO>

	"+"					"-"				
r	NTC (m = 10.82)	NTS (m = 4.86)	NH (m = 5.96)	NMH (m = 2.50)	NUSLFH (m = 1.79)	NTC (m = 10.84)	NTS (m = 4.47)	NH (m = 6.37)	NMH (m = 2.87)	NUSLFH (m = 1.53)
0	0.0000	0.0078	0.0026	0.0821	0.1670	0.0000	0.0114	0.0017	0.0567	0.2165
1	0.0002	0.0377	0.0154	0.2052	0.2989	0.0002	0.0512	0.0109	0.1627	0.3313
2	0.0012	0.0915	0.0458	0.2565	0.2675	0.0012	0.1144	0.0347	0.2335	0.2534
3	0.0042	0.1483	0.0910	0.2138	0.1596	0.0042	0.1704	0.0738	0.2234	0.1293
4	0.0114	0.1802	0.1356	0.1336	0.0714	0.0113	0.1904	0.1175	0.1603	0.0494
5	0.0247	0.1751	0.1617	0.0668	0.0256	0.0244	0.1702	0.1496	0.0920	0.0151
6	0.0446	0.1418	0.1606	0.0278	0.0076	0.0442	0.1268	0.1589	0.0440	0.0039
7	0.0689	0.0985	0.1367	0.0099	0.0020	0.0684	0.0810	0.1446	0.0180	0.0008
8	0.0932	0.0598	0.1019	0.0031	0.0004	0.0927	0.0453	0.1151	0.0065	0.0002
9	0.1120	0.0323	0.0675	0.0009	0.0001	0.1116	0.0225	0.0815	0.0021	0.0000
10	0.1212	0.0157	0.0402	0.0002	0.0000	0.1210	0.0100	0.0519	0.0006	
11	0.1192	0.0069	0.0218	0.0000		0.1192	0.0041	0.0301	0.0002	
12	0.1075	0.0028	0.0108			0.1077	0.0015	0.0160	0.0000	
13	0.0895	0.0011	0.0050			0.0898	0.0005	0.0078		
14	0.0691	0.0004	0.0021			0.0695	0.0002	0.0036		
15	0.0499	0.0001	0.0008			0.0503	0.0000	0.0015		
16	0.0337	0.0000	0.0003			0.0340		0.0006		
17	0.0215		0.0001			0.0217		0.0002		
18	0.0129		0.0000			0.0131		0.0001		
19	0.0073					0.0075		0.0000		
20	0.0040					0.0040				
21	0.0020					0.0021				
22	0.0010					0.0010				
23	0.0005					0.0005				
24	0.0002					0.0002				
25	0.0001					0.0001				
26	0.0000					0.0000				

F. <TNI>

	"+"					"-"				
r	NTC (m = 10.83)	NTS (m = 4.65)	NH (m = 6.17)	NMH (m = 3.04)	NUSLFH (m = 1.78)	NTC (m = 10.84)	NTS (m = 4.63)	NH (m = 6.21)	NMH (m = 2.53)	NUSLFH (m = 1.56)
0	0.0000	0.0096	0.0021	0.0478	0.1686	0.0000	0.0098	0.0020	0.0797	0.2101
1	0.0002	0.0445	0.0129	0.1454	0.3002	0.0002	0.0452	0.0125	0.2015	0.3278
2	0.0012	0.1034	0.0398	0.2210	0.2672	0.0012	0.1046	0.0387	0.2549	0.2557
3	0.0042	0.1602	0.0819	0.2240	0.1585	0.0042	0.1614	0.0802	0.2150	0.1330
4	0.0113	0.1863	0.1263	0.1702	0.0705	0.0113	0.1868	0.1245	0.1360	0.0519
5	0.0246	0.1732	0.1558	0.1035	0.0251	0.0224	0.1730	0.1546	0.0688	0.0162
6	0.0444	0.1343	0.1602	0.0524	0.0074	0.0442	0.1335	0.1600	0.0290	0.0042
7	0.0686	0.0892	0.1412	0.0228	0.0019	0.0684	0.0883	0.1420	0.0105	0.0009
8	0.0929	0.0518	0.1089	0.0087	0.0004	0.0927	0.0511	0.1102	0.0033	0.0002
9	0.1118	0.0268	0.0747	0.0029	0.0001	0.1116	0.0263	0.0760	0.0009	0.0000
10	0.1211	0.0125	0.0461	0.0009	0.0000	0.1210	0.0122	0.0472	0.0002	
11	0.1192	0.0053	0.0258	0.0002		0.1192	0.0051	0.0267	0.0001	
12	0.1076	0.0020	0.0133	0.0001		0.1077	0.0020	0.0138	0.0000	
13	0.0896	0.0007	0.0063	0.0000		0.0898	0.0007	0.0066		
14	0.0693	0.0002	0.0028			0.0695	0.0002	0.0029		
15	0.0501	0.0001	0.0011			0.0503	0.0001	0.0012		
16	0.0339	0.0000	0.0004			0.0340	0.0000	0.0005		
17	0.0216		0.0002			0.0217		0.0002		
18	0.0130		0.0001			0.0131		0.0001		
19	0.0074		0.0000			0.0075		0.0000		
20	0.0040					0.0040				
21	0.0021					0.0021				
22	0.0010					0.0010				
23	0.0005					0.0005				
24	0.0002					0.0002				
25	0.0001					0.0001				
26	0.0000					0.0000				

Table 23. Poisson probability distributions for North Atlantic basin tropical cyclones based on yearly parametric values being either above (+) or below (–) long-term parametric averages (Continued).

G. <MEI>

	"+"					"-"				
	NTC	NTS	NH	NMH	NUSLFH	NTC	NTS	NH	NMH	NUSLFH
r	(m = 10.98)	(m = 4.95)	(m = 6.02)	(m = 2.46)	(m = 1.56)	(m = 10.85)	(m = 4.05)	(m = 6.80)	(m = 3.25)	(m = 1.55)
0	0.0000	0.0071	0.0024	0.0854	0.2101	0.0000	0.0174	0.0011	0.0388	0.2122
1	0.0002	0.0351	0.0146	0.2102	0.3278	0.0002	0.0706	0.0076	0.1260	0.3290
2	0.0010	0.0868	0.0440	0.2585	0.2557	0.0011	0.1429	0.0258	0.2048	0.2550
3	0.0038	0.1432	0.0883	0.2120	0.1330	0.0041	0.1929	0.0584	0.2218	0.1317
4	0.0103	0.1772	0.1330	0.1304	0.0519	0.0112	0.1953	0.0992	0.1802	0.0510
5	0.0227	0.1754	0.1601	0.0641	0.0162	0.0243	0.1582	0.1349	0.1172	0.0158
6	0.0415	0.1447	0.1606	0.0263	0.0042	0.0440	0.1068	0.1529	0.0635	0.0041
7	0.0650	0.1023	0.1381	0.0092	0.0009	0.0682	0.0618	0.1486	0.0295	0.0009
8	0.0893	0.0633	0.1039	0.0028	0.0002	0.0924	0.0313	0.1263	0.0120	0.0002
9	0.1089	0.0348	0.0695	0.0008	0.0000	0.1114	0.0141	0.0954	0.0043	0.0000
10	0.1196	0.0172	0.0419	0.0002		0.1209	0.0057	0.0649	0.0014	
11	0.1194	0.0078	0.0229	0.0000		0.1193	0.0021	0.0401	0.0004	
12	0.1092	0.0032	0.0115			0.1078	0.0007	0.0227	0.0001	
13	0.0923	0.0012	0.0053			0.0900	0.0002	0.0119	0.0000	
14	0.0724	0.0004	0.0023			0.0697	0.0001	0.0058		
15	0.0530	0.0001	0.0009			0.0504	0.0000	0.0026		
16	0.0363	0.0000	0.0003			0.0342		0.0011		
17	0.0235		0.0001			0.0218		0.0004		
18	0.0143		0.0000			0.0132		0.0002		
19	0.0083					0.0075		0.0001		
20	0.0045					0.0041		0.0000		
21	0.0024					0.0021				
22	0.0012					0.0010				
23	0.0006					0.0005				
24	0.0003					0.0002				
25	0.0001					0.0001				
26	0.0000					0.0000				

H. <GSSTEI>

	"+"					"-"				
	NTC	NTS	NH	NMH	NUSLFH	NTC	NTS	NH	NMH	NUSLFH
r	(m = 10.78)	(m = 4.89)	(m = 5.89)	(m = 2.39)	(m = 1.61)	(m = 10.95)	(m = 4.05)	(m = 6.90)	(m = 3.45)	(m = 1.70)
0	0.0000	0.0075	0.0028	0.0916	0.1999	0.0000	0.0174	0.0010	0.0317	0.1827
1	0.0002	0.0368	0.0163	0.2190	0.3281	0.0002	0.0706	0.0070	0.1095	0.3106
2	0.0012	0.0899	0.0480	0.2617	0.2591	0.0011	0.1429	0.0240	0.1889	0.2640
3	0.0043	0.1466	0.0942	0.2085	0.1390	0.0038	0.1929	0.0552	0.2173	0.1496
4	0.0117	0.1792	0.1388	0.1246	0.0560	0.0105	0.1953	0.0952	0.1874	0.0636
5	0.0252	0.1753	0.1635	0.0595	0.0180	0.0230	0.1582	0.1314	0.1293	0.0216
6	0.0454	0.1428	0.1605	0.0237	0.0048	0.0420	0.1068	0.1511	0.0743	0.0061
7	0.0699	0.0998	0.1350	0.0081	0.0011	0.0658	0.0618	0.1489	0.0366	0.0015
8	0.0941	0.0610	0.0994	0.0024	0.0002	0.0900	0.0313	0.1284	0.0158	0.0003
9	0.1127	0.0331	0.0651	0.0006	0.0000	0.1095	0.0141	0.0985	0.0061	0.0001
10	0.1215	0.0162	0.0383	0.0002		0.1199	0.0057	0.0679	0.0021	0.0000
11	0.1191	0.0072	0.0205	0.0000		0.1194	0.0021	0.0426	0.0007	
12	0.1070	0.0029	0.0101			0.1089	0.0007	0.0245	0.0002	
13	0.0887	0.0011	0.0046			0.0917	0.0002	0.0130	0.0001	
14	0.0683	0.0004	0.0019			0.0718	0.0001	0.0064	0.0000	
15	0.0491	0.0001	0.0008			0.0524	0.0000	0.0029		
16	0.0331	0.0000	0.0003			0.0358		0.0013		
17	0.0210		0.0001			0.0231		0.0005		
18	0.0126		0.0000			0.0140		0.0002		
19	0.0071					0.0081		0.0001		
20	0.0038					0.0044		0.0000		
21	0.0020					0.0023				
22	0.0010					0.0012				
23	0.0005					0.0005				
24	0.0002					0.0002				
25	0.0001					0.0001				
26	0.0000					0.0000				

Table 23. Poisson probability distributions for North Atlantic basin tropical cyclones based on yearly parametric values being either above (+) or below (–) long-term parametric averages (Continued).

I. <JMASSTM>

	"+"					"-"				
	NTC	NTS	NH	NMH	NUSLFH	NTC	NTS	NH	NMH	NUSLFH
r	(m = 10.43)	(m = 4.60)	(m = 5.83)	(m = 2.33)	(m = 1.50)	(m = 11.47)	(m = 4.75)	(m = 6.72)	(m = 3.09)	(m = 1.66)
0	0.0000	0.0101	0.0029	0.0973	0.2231	0.0000	0.0087	0.0012	0.0455	0.1901
1	0.0003	0.0462	0.0171	0.2267	0.3347	0.0001	0.0411	0.0081	0.1406	0.3156
2	0.0016	0.1063	0.0499	0.2641	0.1095	0.0007	0.0976	0.0272	0.2172	0.2620
3	0.0056	0.1631	0.0970	0.2051	0.0547	0.0026	0.1545	0.0610	0.2237	0.1450
4	0.0146	0.1875	0.1414	0.1195	0.0205	0.0075	0.1835	0.1025	0.1728	0.0602
5	0.0304	0.1725	0.1649	0.0557	0.0062	0.0173	0.1743	0.1378	0.1068	0.0200
6	0.0528	0.1323	0.1602	0.0216	0.0015	0.0330	0.1380	0.1543	0.0550	0.0055
7	0.0787	0.0869	0.1334	0.0072	0.0003	0.0541	0.0937	0.1481	0.0243	0.0013
8	0.1026	0.0500	0.0973	0.0021	0.0001	0.0776	0.0556	0.1244	0.0094	0.0003
9	0.1189	0.0255	0.0630	0.0005	0.0000	0.0988	0.0293	0.0929	0.0032	0.0001
10	0.1240	0.0118	0.0367	0.0001		0.1134	0.0139	0.0624	0.0010	0.0000
11	0.1176	0.0049	0.0195	0.0000		0.1182	0.0060	0.0381	0.0003	
12	0.1022	0.0019	0.0095			0.1130	0.0024	0.0214	0.0001	
13	0.0820	0.0007	0.0042			0.0997	0.0009	0.0110	0.0000	
14	0.0611	0.0002	0.0018			0.0817	0.0003	0.0053		
15	0.0425	0.0001	0.0007			0.0625	0.0001	0.0024		
16	0.0277	0.0000	0.0003			0.0448	0.0000	0.0010		
17	0.0170		0.0001			0.0302		0.0004		
18	0.0098		0.0000			0.0193		0.0001		
19	0.0054					0.0116		0.0000		
20	0.0028					0.0067				
21	0.0014					0.0036				
22	0.0007					0.0019				
23	0.0003					0.0009				
24	0.0001					0.0005				
25	0.0000					0.0002				
26						0.0001				
27						0.0000				

J. <NTA>

	"+"					"-"				
	NTC	NTS	NH	NMH	NUSLFH	NTC	NTS	NH	NMH	NUSLFH
r	(m = 12.56)	(m = 5.35)	(m = 7.21)	(m = 3.41)	(m = 1.50)	(m = 8.73)	(m = 3.85)	(m = 4.88)	(m = 1.62)	(m = 1.58)
0	0.0000	0.0047	0.0007	0.0330	0.2231	0.0002	0.0213	0.0076	0.1979	0.2060
1	0.0000	0.0254	0.0053	0.1127	0.3347	0.0014	0.0819	0.0371	0.3206	0.3254
2	0.0003	0.0680	0.0192	0.1921	0.1095	0.0062	0.1577	0.0905	0.2597	0.2571
3	0.0012	0.1212	0.0462	0.2184	0.0547	0.0179	0.2024	0.1471	0.1402	0.1354
4	0.0036	0.1621	0.0832	0.1861	0.0205	0.0391	0.1948	0.1795	0.0568	0.0535
5	0.0091	0.1734	0.1200	0.1270	0.0062	0.0683	0.1500	0.1752	0.0184	0.0169
6	0.0191	0.1546	0.1442	0.0722	0.0015	0.0994	0.0962	0.1425	0.0050	0.0045
7	0.0343	0.1182	0.1485	0.0351	0.0003	0.1240	0.0529	0.0993	0.0011	0.0010
8	0.0539	0.0790	0.1339	0.0150	0.0001	0.1353	0.0255	0.0606	0.0002	0.0002
9	0.0752	0.0470	0.1072	0.0057	0.0000	0.1312	0.0109	0.0329	0.0000	0.0000
10	0.0945	0.0251	0.0773	0.0019		0.1145	0.0042	0.0160		
11	0.1079	0.0122	0.0507	0.0006		0.0909	0.0015	0.0071		
12	0.1129	0.0055	0.0305	0.0002		0.0661	0.0005	0.0029		
13	0.1091	0.0022	0.0169	0.0000		0.0444	0.0001	0.0011		
14	0.0979	0.0009	0.0087			0.0277	0.0000	0.0004		
15	0.0820	0.0003	0.0042			0.0161		0.0001		
16	0.0643	0.0001	0.0019			0.0088		0.0000		
17	0.0475	0.0000	0.0008			0.0045				
18	0.0332		0.0003			0.0022				
19	0.0219		0.0001			0.0010				
20	0.0138		0.0000			0.0004				
21	0.0082					0.0002				
22	0.0047					0.0001				
23	0.0026					0.0000				
24	0.0013									
25	0.0007									
26	0.0003									
27	0.0002									
28	0.0001									
29	0.0000									

Table 23. Poisson probability distributions for North Atlantic basin tropical cyclones based on yearly parametric values being either above (+) or below (–) long-term parametric averages (Continued).

K. <CAR>

	"+"					"-"				
	NTC	NTS	NH	NMH	NUSLFH	NTC	NTS	NH	NMH	NUSLFH
r	(m = 11.91)	(m = 5.25)	(m = 6.66)	(m = 3.00)	(m = 1.44)	(m = 9.75)	(m = 4.07)	(m = 5.68)	(m = 2.21)	(m = 1.64)
0	0.0000	0.0052	0.0013	0.0498	0.2369	0.0001	0.0171	0.0034	0.1097	0.1940
1	0.0001	0.0275	0.0085	0.1494	0.3412	0.0006	0.0695	0.0194	0.2424	0.3181
2	0.0005	0.0723	0.0284	0.2240	0.2456	0.0028	0.1414	0.0551	0.2679	0.2609
3	0.0019	0.1266	0.0631	0.2240	0.1179	0.0090	0.1919	0.1043	0.1973	0.1426
4	0.0056	0.1661	0.1050	0.1680	0.0424	0.0220	0.1952	0.1480	0.1090	0.0585
5	0.0134	0.1744	0.1399	0.1008	0.0122	0.0428	0.1589	0.1682	0.0482	0.0192
6	0.0266	0.1526	0.1553	0.0504	0.0029	0.0696	0.1078	0.1592	0.0178	0.0052
7	0.0453	0.1145	0.1477	0.0216	0.0006	0.0969	0.0627	0.1292	0.0056	0.0012
8	0.0675	0.0751	0.1230	0.0081	0.0001	0.1181	0.0319	0.0917	0.0015	0.0003
9	0.0893	0.0438	0.0910	0.0027	0.0000	0.1279	0.0144	0.0579	0.0004	0.0000
10	0.1064	0.0230	0.0606	0.0008		0.1247	0.0059	0.0329	0.0001	
11	0.1152	0.0110	0.0367	0.0002		0.1105	0.0022	0.0170	0.0000	
12	0.1143	0.0048	0.0204	0.0001		0.0898	0.0007	0.0080		
13	0.1047	0.0019	0.0104	0.0000		0.0674	0.0002	0.0035		
14	0.0891	0.0007	0.0050			0.0469	0.0001	0.0014		
15	0.0708	0.0003	0.0022			0.0305	0.0000	0.0005		
16	0.0527	0.0001	0.0009			0.0186		0.0002		
17	0.0369	0.0000	0.0004			0.0107		0.0001		
18	0.0244		0.0001			0.0058		0.0000		
19	0.0153		0.0000			0.0030				
20	0.0091					0.0014				
21	0.0052					0.0007				
22	0.0028					0.0003				
23	0.0014					0.0001				
24	0.0007					0.0000				
25	0.0003									
26	0.0002									
27	0.0001									
28	0.0000									

L. <QBO>

	"+"					"-"				
	NTC	NTS	NH	NMH	NUSLFH	NTC	NTS	NH	NMH	NUSLFH
r	(m = 11.36)	(m = 4.88)	(m = 6.48)	(m = 3.04)	(m = 1.80)	(m = 10.66)	(m = 4.50)	(m = 6.16)	(m = 2.55)	(m = 1.47)
0	0.0000	0.0076	0.0015	0.0478	0.1653	0.0000	0.0111	0.0021	0.0781	0.2299
1	0.0001	0.0371	0.0099	0.1454	0.2975	0.0003	0.0500	0.0130	0.1991	0.3380
2	0.0008	0.0905	0.0322	0.2210	0.2678	0.0013	0.1125	0.0401	0.2539	0.2484
3	0.0028	0.1471	0.0696	0.2240	0.1607	0.0047	0.1687	0.0823	0.2158	0.1217
4	0.0081	0.1795	0.1127	0.1702	0.0723	0.0126	0.1898	0.1267	0.1376	0.0447
5	0.0184	0.1752	0.1460	0.1035	0.0260	0.0269	0.1708	0.1561	0.0702	0.0132
6	0.0348	0.1425	0.1577	0.0524	0.0078	0.0478	0.1281	0.1603	0.0298	0.0032
7	0.0564	0.0993	0.1460	0.0228	0.0020	0.0728	0.0824	0.1411	0.0109	0.0007
8	0.0802	0.0606	0.1183	0.0087	0.0005	0.0970	0.0463	0.1086	0.0035	0.0001
9	0.1012	0.0329	0.0851	0.0029	0.0001	0.1149	0.0232	0.0743	0.0010	0.0000
10	0.1149	0.0160	0.0552	0.0009	0.0000	0.1225	0.0104	0.0458	0.0003	
11	0.1187	0.0071	0.0325	0.0002		0.1187	0.0043	0.0256	0.0001	
12	0.1124	0.0029	0.0176	0.0001		0.1055	0.0016	0.0132	0.0000	
13	0.0982	0.0011	0.0087	0.0000		0.0865	0.0006	0.0062		
14	0.0797	0.0004	0.0040			0.0659	0.0002	0.0027		
15	0.0603	0.0001	0.0017			0.0468	0.0001	0.0011		
16	0.0428	0.0000	0.0007			0.0312	0.0000	0.0004		
17	0.0286		0.0003			0.0196		0.0002		
18	0.0181		0.0001			0.0116		0.0001		
19	0.0108		0.0000			0.0065		0.0000		
20	0.0061					0.0035				
21	0.0033					0.0018				
22	0.0017					0.0009				
23	0.0008					0.0004				
24	0.0004					0.0002				
25	0.0002					0.0001				
26	0.0001					0.0000				
27	0.0000									

Table 23. Poisson probability distributions for North Atlantic basin tropical cyclones based on yearly parametric values being either above (+) or below (–) long-term parametric averages (Continued).

M. <AMO>

	"+"					"-"				
	NTC	NTS	NH	NMH	NUSLFH	NTC	NTS	NH	NMH	NUSLFH
r	(m = 12.36)	(m = 5.27)	(m = 7.09)	(m = 3.48)	(m = 1.79)	(m = 9.37)	(m = 3.97)	(m = 5.40)	(m = 1.93)	(m = 1.40)
0	0.0000	0.0051	0.0008	0.0308	0.1670	0.0001	0.0189	0.0045	0.1451	0.2466
1	0.0001	0.0271	0.0059	0.1072	0.2989	0.0008	0.0749	0.0244	0.2801	0.3452
2	0.0003	0.0714	0.0209	0.1865	0.2675	0.0037	0.1487	0.0659	0.2703	0.2417
3	0.0013	0.1255	0.0495	0.2164	0.1596	0.0117	0.1968	0.1185	0.1739	0.1128
4	0.0042	0.1653	0.0877	0.1883	0.0714	0.0274	0.1953	0.1600	0.0839	0.0395
5	0.0103	0.1742	0.1244	0.1310	0.0256	0.0513	0.1551	0.1728	0.0324	0.0111
6	0.0212	0.1530	0.1470	0.0760	0.0076	0.0801	0.1026	0.1555	0.0104	0.0026
7	0.0375	0.1152	0.1489	0.0378	0.0020	0.1073	0.0582	0.1200	0.0029	0.0005
8	0.0579	0.0759	0.1320	0.0164	0.0004	0.1256	0.0289	0.0810	0.0007	0.0001
9	0.0795	0.0444	0.1040	0.0064	0.0001	0.1308	0.0127	0.0486	0.0001	0.0000
10	0.0983	0.0234	0.0737	0.0022	0.0000	0.1225	0.0051	0.0262	0.0000	
11	0.1105	0.0112	0.0475	0.0007		0.1044	0.0018	0.0129		
12	0.1138	0.0049	0.0281	0.0002		0.0815	0.0006	0.0058		
13	0.1082	0.0020	0.0153	0.0001		0.0587	0.0002	0.0024		
14	0.0955	0.0008	0.0078	0.0000		0.0393	0.0001	0.0009		
15	0.0787	0.0003	0.0037			0.0246	0.0000	0.0003		
16	0.0608	0.0001	0.0016			0.0144		0.0001		
17	0.0442	0.0000	0.0007			0.0079		0.0000		
18	0.0303		0.0003			0.0041				
19	0.0197		0.0001			0.0020				
20	0.0122		0.0000			0.0010				
21	0.0072					0.0004				
22	0.0040					0.0002				
23	0.0022					0.0001				
24	0.0011					0.0000				
25	0.0006									
26	0.0003									
27	0.0001									
28	0.0000									

N. <AMM>

	"+"					"-"				
	NTC	NTS	NH	NMH	NUSLFH	NTC	NTS	NH	NMH	NUSLFH
r	(m = 12.40)	(m = 5.06)	(m = 7.34)	(m = 3.74)	(m = 1.77)	(m = 9.11)	(m = 4.14)	(m = 4.96)	(m = 1.50)	(m = 1.39)
0	0.0000	0.0063	0.0006	0.0238	0.1703	0.0001	0.0159	0.0070	0.2231	0.2491
1	0.0001	0.0321	0.0048	0.0888	0.3015	0.0010	0.0659	0.0348	0.3347	0.3462
2	0.0003	0.0812	0.0175	0.1661	0.2668	0.0046	0.1365	0.0863	0.2510	0.2406
3	0.0013	0.1370	0.0428	0.2071	0.1574	0.0139	0.1883	0.1426	0.1255	0.1115
4	0.0041	0.1733	0.0785	0.1936	0.0697	0.0317	0.1949	0.1769	0.0471	0.0387
5	0.0101	0.1754	0.1152	0.1448	0.0247	0.0578	0.1614	0.1754	0.0141	0.0108
6	0.0208	0.1479	0.1410	0.0903	0.0073	0.0878	0.1114	0.1450	0.0035	0.0025
7	0.0368	0.1069	0.1478	0.0482	0.0018	0.1142	0.0659	0.1028	0.0008	0.0005
8	0.0571	0.0676	0.1356	0.0226	0.0004	0.1301	0.0341	0.0637	0.0001	0.0001
9	0.0787	0.0380	0.1106	0.0094	0.0001	0.1317	0.0157	0.0351	0.0000	0.0000
10	0.0975	0.0192	0.0812	0.0035	0.0000	0.1199	0.0065	0.0174		
11	0.1100	0.0089	0.0542	0.0012		0.0993	0.0024	0.0079		
12	0.1136	0.0037	0.0331	0.0004		0.0754	0.0008	0.0032		
13	0.1084	0.0015	0.0187	0.0001		0.0528	0.0003	0.0012		
14	0.0960	0.0005	0.0098	0.0000		0.0344	0.0001	0.0004		
15	0.0794	0.0002	0.0048			0.0209	0.0000	0.0001		
16	0.0615	0.0001	0.0022			0.0119		0.0000		
17	0.0449	0.0000	0.0010			0.0064				
18	0.0309		0.0004			0.0032				
19	0.0202		0.0001			0.0015				
20	0.0125		0.0000			0.0007				
21	0.0074					0.0003				
22	0.0042					0.0001				
23	0.0022					0.0000				
24	0.0012									
25	0.0006									
26	0.0003									
27	0.0001									
28	0.0000									

Note: "+" means either above 0.0 or above the mean (<AT> and <JMASSTM)
"-" means either below 0.0 or below the mean (<AT> and <JMASSTM>

Table 24. Inferred linear regression equations using 10-yma parametric values for the intervals 1950–2005 and 1990–2005, arranged by *r* value.

A. NTC

1950-2005							1990-2005						
regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
-39.524 + 5.303<AT>	0.896	0.803	0.8	>99.9%	10.5	1.8	11.475 + 18.674<AMO>	0.991	0.982	0.3	>99.9%	12.7	2.1
10.140 + 12.711<NTA>	0.878	0.771	0.9	>99.9%	10.5	1.9	12.340 + 2.230<AMM>	0.991	0.982	0.3	>99.9%	12.7	2.1
10.290 + 14.209<CAR>	0.673	0.452	1.4	>99.9%	10.5	1.9	9.601 + 17.139<NTA>	0.990	0.981	0.3	>99.9%	12.7	2.1
10.815 + 8.137<AMO>	0.613	0.376	1.5	>99.9%	10.5	1.9	9.455 + 31.011<CAR>	0.979	0.958	0.4	>99.9%	12.7	2.1
10.624 + 0.891<AMM>	0.450	0.202	1.7	>99.9%	10.5	1.9	-76.962 + 9.104<AT>	0.971	0.943	0.6	>99.9%	12.7	2.1
10.090 - 2.586<TNI>	-0.441	0.194	1.6	>99.9%	10.5	1.8	15.323 + 1.157<SOI>	0.966	0.934	0.5	>99.9%	12.7	2.1
6.846 - 1.082<QBO>	-0.357	0.127	1.7	>99%	10.5	1.9	14.086 - 14.012<NAO>	-0.956	0.915	0.6	>99.9%	12.7	2.1
-82.360 + 3.624<JMASSTM>	0.348	0.121	1.8	>98%	10.5	1.9	17.474 - 43.336<GSSTEI>	-0.951	0.905	0.7	>99.9%	12.7	2.1
10.512 + 2.540<ONI>	0.221	0.049	1.9	<90%	10.5	1.9	15.966 - 10.177<MEI>	-0.945	0.893	0.7	>99.9%	12.7	2.1
10.481 + 0.637<MEI>	0.108	0.012	1.9	<90%	10.5	1.9	14.852 - 9.038<PDO>	-0.935	0.874	0.8	>99.9%	12.7	2.1
10.617 - 1.162<GSSTEI>	-0.058	0.003	1.8	<90%	10.5	1.8	15.451 - 17.302<ONI>	-0.893	0.798	1.0	>99.9%	12.7	2.1
10.549 + 0.137<PDO>	0.040	0.002	1.8	<90%	10.5	1.8	2.626 - 2.933<QBO>	-0.849	0.721	1.1	>99.9%	12.7	2.1
10.525 - 0.028<SOI>	-0.038	0.001	1.8	<90%	10.5	1.8	406.145 - 15.245<JMASSTM>	-0.540	0.291	1.8	>99.9%	12.7	2.1
10.541 - 0.160<NAO>	-0.014	0.000	1.9	<90%	10.5	1.9	12.212 - 1.085<TNI>	-0.161	0.026	2.1	<90%	12.7	2.1

B. NTS

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
-23.349 + 2.942<AT>	0.804	0.646	0.7	>99.9%	4.4	1.1	7.662 - 5.906<MEI>	-0.960	0.922	0.3	>99.9%	5.8	1.2
4.309 + 6.890<NTA>	0.797	0.635	0.7	>99.9%	4.5	1.1	7.253 + 0.656<SOI>	0.959	0.920	0.3	>99.9%	5.8	1.2
4.402 + 7.058<CAR>	0.559	0.313	1.0	>99.9%	4.5	1.1	4.072 + 9.368<NTA>	0.947	0.897	0.4	>99.9%	5.8	1.2
4.113 - 1.831<TNI>	-0.504	0.254	1.0	>99.9%	4.4	1.1	5.102 + 10.125<AMO>	0.940	0.884	0.4	>99.9%	5.8	1.2
-67.212 + 2.797<JMASSTM>	0.443	0.196	1.0	>99.9%	4.5	1.1	7.001 - 5.188<PDO>	-0.939	0.882	0.4	>99.9%	5.8	1.2
4.581 + 3.133<AMO>	0.388	0.150	1.1	>99.5%	4.5	1.1	5.571 + 1.207<AMM>	0.939	0.881	0.4	>99.9%	5.8	1.2
4.478 + 0.588<PDO>	0.280	0.079	1.1	>95%	4.4	1.1	4.022 + 16.667<CAR>	0.921	0.848	0.5	>99.9%	5.8	1.2
4.489 + 1.792<ONI>	0.259	0.067	1.1	>90%	4.5	1.1	8.361 - 23.551<GSSTEI>	-0.905	0.818	0.5	>99.9%	5.8	1.2
4.437 + 0.789<MEI>	0.222	0.049	1.1	<90%	4.5	1.1	-41.908 + 4.841<AT>	0.904	0.817	0.5	>99.9%	5.8	1.2
4.250 + 2.635<GSSTEI>	0.212	0.045	1.1	<90%	4.4	1.1	6.507 - 7.487<NAO>	-0.894	0.800	0.5	>99.9%	5.8	1.2
4.490 + 1.449<NAO>	0.206	0.043	1.1	<90%	4.5	1.1	7.310 - 9.707<ONI>	-0.877	0.769	0.6	>99.9%	5.8	1.2
4.390 - 0.093<SOI>	-0.202	0.041	1.1	<90%	4.4	1.1	-0.030 - 1.688<QBO>	-0.855	0.731	0.6	>99.9%	5.8	1.2
4.496 + 0.213<AMM>	0.176	0.031	1.1	<90%	4.5	1.1	260.502 - 9.871<JMASSTM>	-0.612	0.374	1.0	>98%	5.8	1.2
3.681 - 0.233<QBO>	-0.126	0.016	1.1	<90%	4.5	1.1	5.122 - 1.442<TNI>	-0.374	0.140	1.1	<90%	5.8	1.2

C. NH

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
5.831 + 5.821<NTA>	0.866	0.750	0.4	>99.9%	6.0	0.9	-35.054 + 4.264<AT>	0.980	0.961	0.1	>99.9%	6.9	1.0
-16.177 + 2.360<AT>	0.821	0.674	0.5	>99.9%	6.1	0.9	6.769 + 1.023<AMM>	0.979	0.959	0.2	>99.9%	6.9	1.0
6.231 + 4.987<AMO>	0.791	0.626	0.5	>99.9%	6.0	0.9	6.373 + 8.549<AMO>	0.978	0.956	0.2	>99.9%	6.9	1.0
5.888 + 7.151<CAR>	0.729	0.531	0.6	>99.9%	6.0	0.9	5.433 + 14.344<CAR>	0.976	0.952	0.2	>99.9	6.9	1.0
6.126 + 0.675<AMM>	0.718	0.515	0.6	>99.9%	6.0	0.9	5.529 + 7.771<NTA>	0.968	0.936	0.3	>99.9%	6.9	1.0
3.178 - 0.845<QBO>	-0.587	0.344	0.7	>99.9%	6.0	0.9	7.580 - 6.525<NAO>	-0.960	0.921	0.3	>99.9%	6.9	1.0
6.362 - 3.758<GSSTEI>	-0.385	0.149	0.8	>99.5%	6.1	0.9	9.114 - 19.785<GSSTEI>	-0.936	0.876	0.3	>99.9%	6.9	1.0
6.051 - 1.609<NAO>	-0.296	0.087	0.8	>95%	6.0	0.9	8.069 + 0.501<SOI>	0.902	0.813	0.4	>99.9%	6.9	1.0
6.069 - 0.447<PDO>	-0.271	0.074	0.8	>95%	6.1	0.9	7.850 - 3.850<PDO>	-0.858	0.737	0.5	>99.9%	6.9	1.0
5.973 - 0.762<TNI>	-0.267	0.071	0.9	>95%	6.1	0.9	8.305 - 4.271<MEI>	-0.855	0.731	0.5	>99.9%	6.9	1.0
6.133 + 0.064<SOI>	0.177	0.031	0.9	<90%	6.1	0.9	8.142 - 7.594<ONI>	-0.845	0.714	0.5	>99.9%	6.9	1.0
-15.485 + 0.840<JMASSTM>	0.171	0.029	0.9	<90%	6.0	0.9	2.657 - 1.246<QBO>	-0.777	0.604	0.6	>99.9%	6.9	1.0
6.021 + 0.713<ONI>	0.133	0.018	0.9	<90%	6.0	0.9	145.643 - 5.375<JMASSTM>	-0.410	0.168	0.9	<90%	6.9	1.0
6.043 - 0.152<MEI>	-0.055	0.003	0.9	<90%	6.0	0.9	7.090 + 0.357<TNI>	0.114	0.013	1.0	<90%	6.9	1.0

D. NMH

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
2.707 + 5.678<AMO>	0.940	0.884	0.3	>99.9%	2.5	0.8	2.860 + 0.844<AMM>	0.982	0.965	0.2	>99.9%	3.0	0.8
2.595 + 0.845<AMM>	0.937	0.879	0.3	>99.9%	2.5	0.8	2.534 + 7.054<AMO>	0.980	0.960	0.2	>99.9%	3.0	0.8
2.305 + 7.119<CAR>	0.808	0.652	0.5	>99.9%	2.4	0.8	1.833 + 6.434<NTA>	0.973	0.947	0.2	>99.9%	3.0	0.8
2.290 + 4.478<NTA>	0.741	0.550	0.5	>99.9%	2.4	0.8	3.535 - 5.448<NAO>	-0.973	0.947	0.2	>99.9%	3.0	0.8
-0.786 - 0.967<QBO>	-0.701	0.491	0.6	>99.9%	2.5	0.8	-31.299 + 3.482<AT>	0.972	0.946	0.2	>99.9%	3.0	0.8
3.025 - 6.423<GSSTEI>	-0.660	0.436	0.7	>99.9%	2.6	0.9	1.765 + 11.761<CAR>	0.972	0.944	0.2	>99.9%	3.0	0.8
-14.637 + 1.824<AT>	0.636	0.405	0.7	>99.9%	2.6	0.9	4.809 - 16.458<GSSTEI>	-0.946	0.894	0.3	>99.9%	3.0	0.8
2.493 - 2.682<NAO>	-0.539	0.291	0.7	>99.9%	2.5	0.8	3.969 + 0.429<SOI>	0.938	0.880	0.3	>99.9%	3.0	0.8
2.521 - 0.790<PDO>	-0.481	0.232	0.8	>99.9%	2.6	0.9	4.170 - 3.658<MEI>	-0.889	0.791	0.4	>99.9%	3.0	0.8
2.642 + 0.130<SOI>	0.363	0.132	0.8	>99%	2.6	0.9	3.773 - 3.265<PDO>	-0.884	0.782	0.4	>99.9%	3.0	0.8
2.509 - 0.566<MEI>	-0.225	0.051	0.8	<90%	2.5	0.8	4.027 - 6.486<ONI>	-0.877	0.768	0.4	>99.9%	3.0	0.8
2.544 - 0.238<TNI>	-0.084	0.007	0.9	<90%	2.6	0.9	-0.588 - 1.044<QBO>	-0.791	0.626	0.5	>99.9%	3.0	0.8
8.849 - 0.248<JMASSTM>	-0.054	0.003	0.8	<90%	2.5	0.8	130.404 - 4.937<JMASSTM>	-0.458	0.209	0.7	>90%	3.0	0.8
2.457 + 0.001<ONI>	0.000	0.000	0.8	<90%	2.5	0.8	3.070 + 0.171<TNI>	0.066	0.004	0.8	<90%	3.0	0.8

Table 24. Inferred linear regression equations using 10-yma parametric values for the intervals 1950–2005 and 1990–2005, arranged by *r* value (Continued).

E. NUSLFH

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
1.619 + 1.896<AMO>	0.788	0.621	0.2	>99.9%	1.6	0.3	1.598 + 0.408<AMM>	0.904	0.817	0.2	>99.9%	1.7	0.4
1.475 + 2.650<CAR>	0.721	0.520	0.2	>99.9%	1.5	0.3	1.100 + 3.116<NTA>	0.897	0.805	0.2	>99.9%	1.7	0.4
1.475 + 1.782<NTA>	0.707	0.501	0.2	>99.9%	1.5	0.3	1.441 + 3.393<AMO>	0.897	0.805	0.2	>99.9%	1.7	0.4
1.578 + 0.249<AMM>	0.693	0.481	0.2	>99.9%	1.6	0.3	1.068 + 5.693<CAR>	0.896	0.802	0.2	>99.9%	1.7	0.4
-4.069 + 0.600<AT>	0.501	0.251	0.3	>99.9%	1.6	0.4	-14.518 + 1.643<AT>	0.873	0.764	0.2	>99.9%	1.7	0.4
0.745 - 0.237<QBO>	-0.432	0.186	0.3	>99.8%	1.6	0.3	2.511 - 7.694<GSSTEI>	-0.842	0.708	0.2	>99.9%	1.7	0.4
1.710 - 1.715<GSSTEI>	-0.422	0.178	0.3	>99.8%	1.6	0.4	2.123 + 0.201<SOI>	0.830	0.688	0.2	>99.9%	1.7	0.4
1.547 - 0.564<NAO>	-0.274	0.075	0.3	>90%	1.5	0.3	2.222 - 1.740<MEI>	-0.805	0.649	0.3	>99.9%	1.7	0.4
1.578 - 0.183<PDO>	-0.266	0.071	0.4	>95%	1.6	0.4	1.898 - 2.367<NAO>	-0.805	0.648	0.3	>99.9%	1.7	0.4
1.541 - 0.297<TNI>	-0.250	0.063	0.4	>90%	1.6	0.4	2.018 - 1.487<PDO>	-0.767	0.588	0.3	>99.9%	1.7	0.4
1.605 + 0.028<SOI>	0.184	0.034	0.4	<90%	1.6	0.4	2.107 - 2.790<ONI>	-0.718	0.515	0.3	>99.8%	1.7	0.4
1.535 + 0.334<ONI>	0.165	0.027	0.3	<90%	1.5	0.3	0.103 - 0.454<QBO>	-0.656	0.430	0.3	>99.5%	1.7	0.4
-3.290 + 0.189<JMASSTM>	0.102	0.010	0.3	<90%	1.5	0.3	63.596 - 2.400<JMASSTM>	-0.423	0.179	0.4	<90%	1.7	0.4
1.542 - 0.032<MEI>	-0.030	0.001	0.3	<90%	1.5	0.3	1.542 - 0.272<TNI>	-0.201	0.040	0.4	<90%	1.7	0.4

F. <N. LAT>

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
22.202 - 10.784<AMO>	-0.871	0.758	0.9	>99.9%	22.6	1.7	21.034 - 0.543<TNI>	-0.512	0.262	0.3	>95%	21.3	0.3
22.992 - 15.199<CAR>	-0.826	0.682	0.9	>99.9%	22.7	1.7	21.103 + 0.954<NTA>	0.350	0.123	0.3	<90%	21.3	0.3
22.448 - 1.253<AMM>	-0.677	0.459	1.3	>99.9%	22.6	1.7	21.256 + 0.122<AMM>	0.344	0.118	0.3	<90%	21.3	0.3
23.009 - 7.910<NTA>	-0.621	0.385	1.3	>99.9%	22.7	1.7	21.209 + 1.017<AMO>	0.343	0.118	0.3	<90%	21.3	0.3
55.380 - 3.493<AT>	-0.586	0.343	1.5	>99.9%	22.4	1.8	21.098 + 1.691<CAR>	0.339	0.115	0.3	<90%	21.3	0.3
22.727 - 4.944<ONI>	-0.484	0.235	1.5	>99.9%	22.7	1.7	21.398 - 0.514<PDO>	-0.338	0.114	0.3	<90%	21.3	0.3
21.888 + 7.563<GSSTEI>	0.374	0.140	1.7	>99.5%	22.4	1.8	21.445 - 0.529<MEI>	-0.313	0.098	0.3	<90%	21.3	0.3
26.094 + 1.033<QBO>	0.365	0.133	1.6	>99%	22.6	1.7	16.819 + 0.452<AT>	0.307	0.094	0.5	<90%	21.3	0.3
22.693 + 1.694<TNI>	0.288	0.083	1.7	>95%	22.4	1.8	21.517 - 2.195<GSSTEI>	-0.306	0.094	0.3	<90%	21.3	0.3
88.163 - 2.557<JMASSTM>	-0.270	0.073	1.7	>90%	22.6	1.7	21.402 + 0.056<SOI>	0.297	0.089	0.3	<90%	21.3	0.3
22.778 - 1.163<MEI>	-0.222	0.049	1.6	<90%	22.7	1.7	21.325 - 0.501<NAO>	-0.218	0.047	0.3	<90%	21.3	0.3
22.455 + 0.611<PDO>	0.179	0.032	1.8	<90%	22.4	1.8	20.900 - 0.109<QBO>	-0.201	0.040	0.4	<90%	21.3	0.3
22.659 + 0.853<NAO>	0.082	0.007	1.7	<90%	22.7	1.7	21.361 - 0.539<ONI>	-0.177	0.031	0.3	<90%	21.3	0.3
22.422 + 0.038<SOI>	0.051	0.003	1.8	<90%	22.4	1.8	33.832 - 0.487<JMASSTM>	-0.110	0.012	0.6	<90%	21.3	0.3

G. <W. LONG>

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
64.659 - 10.544<ONI>	-0.808	0.653	1.3	>99.9%	64.5	2.1	64.503 - 19.231<GSSTEI>	-0.811	0.657	0.6	>99.9%	62.4	1.1
65.771 + 5.620<TNI>	0.780	0.608	1.4	>99.9%	64.8	2.2	62.976 - 5.986<NAO>	-0.785	0.616	0.7	>99.9%	62.4	1.1
280.957 - 8.440<JMASSTM>	-0.704	0.495	1.3	>99.9%	64.6	2.2	61.033 + 12.905<CAR>	0.782	0.612	0.7	>99.9%	62.4	1.1
65.071 + 0.633<SOI>	0.697	0.485	1.6	>99.9%	64.8	2.2	61.889 + 7.541<AMO>	0.768	0.590	0.7	>99.9%	62.4	1.1
65.942 - 16.728<GSSTEI>	-0.679	0.461	1.6	>99.9%	64.8	2.2	63.601 - 7.656<ONI>	-0.759	0.576	0.7	>99.9%	62.4	1.1
64.936 - 4.308<MEI>	-0.643	0.414	1.7	>99.9%	64.5	2.1	26.828 + 3.610<AT>	0.740	0.547	0.9	>99.8%	62.4	1.1
64.610 - 2.311<PDO>	-0.555	0.308	1.9	>99.9%	64.8	2.2	62.246 + 0.853<AMM>	0.728	0.530	0.8	>99.8%	62.4	1.1
64.746 - 8.660<NTA>	-0.542	0.294	1.8	>99.9%	64.5	2.1	63.407 + 0.451<SOI>	0.724	0.524	0.7	>99.9%	62.4	1.1
64.630 - 6.704<NAO>	-0.506	0.255	1.9	>99.9%	64.5	2.1	61.227 + 6.397<NTA>	0.710	0.504	0.8	>99.5%	62.4	1.1
95.969 - 3.302<AT>	-0.454	0.206	2.0	>99.9%	64.8	2.2	63.618 - 3.847<MEI>	-0.686	0.471	0.8	>99.5%	62.4	1.1
64.659 - 10.527<CAR>	-0.452	0.204	1.9	>99.8%	64.5	2.1	63.118 - 3.088<PDO>	-0.613	0.376	0.9	>98%	62.4	1.1
62.381 - 0.661<QBO>	-0.187	0.035	2.1	<90%	64.6	2.2	59.549 - 0.825<QBO>	-0.459	0.210	1.0	>90%	62.4	1.1
64.557 - 2.386<AMO>	-0.154	0.024	2.2	<90%	64.6	2.2	63.040 + 1.483<TNI>	0.422	0.178	1.0	<90%	62.4	1.1
64.668 + 0.322<AMM>	0.139	0.019	2.2	<90%	64.6	2.2	218.429 - 6.046<JMASSTM>	-0.411	0.169	0.4	>99.8%	62.4	1.1

H. PWS

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
126.561 + 5.075<AMM>	0.934	0.872	1.8	>99.9%	126.1	5.1	126.128 + 5.848<AMM>	0.970	0.941	1.4	>99.9%	127.1	5.5
127.072 + 29.275<AMO>	0.804	0.647	3.1	>99.9%	126.1	5.1	118.986 + 44.727<NTA>	0.965	0.930	1.5	>99.9%	127.1	5.5
129.106 - 39.033<GSSTEI>	-0.678	0.460	3.8	>99.9%	126.4	5.2	123.905 + 48.299<AMO>	0.956	0.915	1.7	>99.9%	127.1	5.5
124.958 + 34.955<CAR>	0.658	0.433	3.6	>99.9%	125.6	4.8	-106.946 + 23.763<AT>	0.946	0.895	1.7	>99.9%	127.1	5.5
107.847 - 5.340<QBO>	-0.642	0.412	3.9	>99.9%	126.1	5.1	118.684 + 80.163<CAR>	0.944	0.892	1.9	>99.9%	127.1	5.5
126.003 - 18.887<NAO>	-0.627	0.393	3.8	>99.9%	125.7	4.9	133.689 + 2.919<SOI>	0.910	0.828	2.3	>99.9%	127.1	5.5
124.954 + 19.849<NTA>	0.545	0.297	4.1	>99.9%	125.6	4.8	139.122 - 109.378<GSSTEI>	-0.896	0.803	2.5	>99.9%	127.1	5.5
126.062 - 4.617<PDO>	-0.475	0.226	4.6	>99.9%	126.4	5.2	135.287 - 25.598<MEI>	-0.887	0.787	2.6	>99.9%	127.1	5.5
59.456 + 7.095<AT>	0.418	0.175	4.7	>99.8%	126.4	5.2	130.512 - 34.771<NAO>	-0.886	0.785	2.6	>99.9%	127.1	5.5
126.811 + 0.866<SOI>	0.408	0.166	4.8	>99.8%	126.4	5.2	132.327 - 22.075<PDO>	-0.852	0.726	3.0	>99.9%	127.1	5.5
126.160 - 4.484<MEI>	-0.294	0.087	4.7	>95%	125.7	4.9	133.817 - 42.420<ONI>	-0.817	0.668	3.3	>99.9%	127.1	5.5
247.288 - 4.734<JMASSTM>	-0.170	0.029	4.9	<90%	125.9	5.0	101.416 - 7.471<QBO>	-0.807	0.652	3.4	>99.9%	127.1	5.5
125.801 - 4.721ONI>	-0.159	0.025	4.9	<90%	125.7	4.9	1119.706 - 38.463<JMASSTM>	-0.508	0.258	5.0	>95%	127.1	5.5
126.438 + 0.003<TNI>	0.000	0.000	5.2	<90%	126.4	5.2	125.429 - 3.664<TNI>	-0.203	0.041	5.6	<90%	127.1	5.5

Table 24. Inferred linear regression equations using 10-yma parametric values for the intervals 1950–2005 and 1990–2005, arranged by *r* value (Continued).

I. <PWS>

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
74.498 - 18.817<NAO>	-0.830	0.689	2.1	>99.9%	74.2	3.7	11.450 + 6.214<AT>	0.830	0.690	0.7	>99.9%	72.6	1.6
77.376 - 36.587<GSSTEI>	-0.808	0.653	2.4	>99.9%	74.9	4.1	70.487 + 20.592<CAR>	0.814	0.663	1.0	>99.9%	72.6	1.6
74.799 + 3.154<AMM>	0.767	0.589	2.5	>99.9%	74.5	3.8	71.847 + 12.115<AMO>	0.805	0.649	1.0	>99.9%	72.6	1.6
74.416 - 5.585<PDO>	-0.730	0.534	2.8	>99.9%	74.9	4.1	72.408 + 1.443<AMM>	0.803	0.646	1.0	>99.9%	72.6	1.6
60.991 - 3.956<QBO>	-0.629	0.396	3.0	>99.9%	74.5	3.8	73.562 - 9.306<NAO>	-0.796	0.633	1.0	>99.9%	72.6	1.6
75.312 + 1.013<SOI>	0.607	0.368	3.3	>99.9%	74.9	4.1	75.824 - 28.888<GSSTEI>	-0.794	0.631	1.0	>99.9%	72.6	1.6
74.864 - 6.741<MEI>	-0.588	0.346	3.0	>99.9%	74.5	3.8	70.718 + 10.638<NTA>	0.770	0.593	1.1	>99.9%	72.6	1.6
370.880 - 11.568<JMASSTM>	-0.561	0.315	3.2	>99.9%	74.9	4.1	74.316 - 10.530<ONI>	-0.681	0.464	1.2	>99.5%	72.6	1.6
75.007 + 14.957<AMO>	0.543	0.295	3.3	>99.9%	74.3	3.7	74.107 + 0.647<SOI>	0.677	0.458	1.3	>99.5%	72.6	1.6
74.349 - 9.320<ONI>	-0.418	0.174	3.4	>99.5%	74.2	3.7	73.794 - 4.845<PDO>	-0.628	0.394	1.3	>99%	72.6	1.6
75.581 + 4.079<TNI>	0.308	0.095	3.9	>95%	74.2	3.7	74.338 - 5.288<MEI>	-0.615	0.379	1.3	>98%	72.6	1.6
73.926 + 8.956<CAR>	0.229	0.052	3.5	<90%	74.1	3.5	67.773 - 1.417<QBO>	-0.514	0.264	1.5	>95%	72.6	1.6
80.051 - 0.548<AT>	-0.041	0.002	4.1	<90%	74.9	4.1	73.749 + 2.503<TNI>	0.465	0.216	1.5	>90%	72.6	1.6
74.107 - 0.591<NTA>	-0.022	0.000	3.6	<90%	74.1	3.5	213.880 - 5.473<JMASSTM>	-0.243	0.059	1.8	<90%	72.6	1.6

J. ACE

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
106.277 + 177.876<AMO>	0.902	0.814	12.0	>99.9%	100.3	27.5	80.959 + 416.370<CAR>	0.972	0.944	6.8	>99.9%	124.4	27.8
93.299 + 179.914<NTA>	0.850	0.723	14.8	>99.9%	99.1	27.8	108.307 + 247.300<AMO>	0.970	0.941	7.0	>99.9%	124.4	27.8
102.571 + 24.484<AMM>	0.832	0.692	15.4	>99.9%	100.3	27.5	119.756 + 29.524<AMM>	0.970	0.941	7.0	>99.9%	124.4	27.8
94.505 + 252.072<CAR>	0.817	0.667	16.2	>99.9%	99.1	27.8	-1079.381 + 122.247<AT>	0.964	0.930	7.6	>99.9%	124.4	27.8
-570.937 + 71.213<AT>	0.798	0.636	16.5	>99.9%	101.4	27.2	83.835 + 225.059<NTA>	0.961	0.924	7.9	>99.9%	124.4	27.8
0.550 - 29.197<QBO>	-0.648	0.420	21.1	>99.9%	100.3	27.5	143.116 - 187.897<NAO>	-0.948	0.899	9.1	>99.9%	124.4	27.8
100.331 - 70.823<NAO>	-0.414	0.171	25.4	>99.9%	99.4	27.6	187.039 - 567.434<GSSTEI>	-0.921	0.848	11.2	>99.9%	124.4	27.8
109.501 - 118.846<GSSTEI>	-0.392	0.154	25.2	>99.5%	101.4	27.2	157.787 + 14.673<SOI>	0.906	0.821	12.2	>99.9%	124.4	27.8
96.263 - 29.541<TNI>	-0.333	0.111	25.8	>98%	101.4	27.2	164.613 - 124.920<MEI>	-0.858	0.736	14.8	>99.9%	124.4	27.8
100.046 - 16.445<PDO>	-0.321	0.103	26.0	>98%	101.4	27.2	159.422 - 219.474<ONI>	-0.838	0.702	15.7	>99.9%	124.4	27.8
102.284 + 2.104<SOI>	0.188	0.035	26.9	<90%	101.4	27.2	150.290 - 108.256<PDO>	-0.828	0.686	16.2	>99.9%	124.4	27.8
99.062 + 27.302<ONI>	0.162	0.026	27.6	<90%	99.4	27.6	4.935 - 34.823<QBO>	-0.746	0.556	19.2	>99.9%	124.4	27.8
-350.612 + 17.571<JMASSTM>	0.114	0.013	27.7	<90%	99.8	27.6	4401.083 - 165.709<JMASSTM>	-0.434	0.188	26.0	>90%	124.4	27.8
100.182 - 8.796<MEI>	-0.102	0.010	27.8	<90%	99.4	27.6	128.405 + 8.918<TNI>	0.098	0.010	28.7	<90%	124.4	27.8

K. NSD

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
50.000 + 82.294<NTA>	0.925	0.855	4.5	>99.9%	52.6	11.7	64.174 + 12.421<AMM>	0.992	0.984	1.5	>99.9%	66.1	11.4
-260.554 + 33.214<AT>	0.907	0.823	4.7	>99.9%	53.0	11.1	48.942 + 95.342<NTA>	0.990	0.981	1.7	>99.9%	66.1	11.4
50.845 + 99.081<CAR>	0.763	0.582	7.7	>99.9%	52.6	11.7	59.376 + 103.742<AMO>	0.989	0.979	1.7	>99.9%	66.1	11.4
54.842 + 60.767<AMO>	0.743	0.552	7.7	>99.9%	52.8	11.4	47.993 + 173.817<CAR>	0.986	0.973	1.9	>99.9%	66.1	11.4
53.461 + 7.147<AMM>	0.585	0.343	9.3	>99.9%	52.8	11.4	74.071 - 79.756<NAO>	-0.979	0.958	2.4	>99.9%	66.1	11.4
22.712 - 8.806<QBO>	-0.471	0.222	10.2	>99.9%	52.8	11.4	-434.189 + 50.808<AT>	0.974	0.949	2.7	>99.9%	66.1	11.4
50.133 - 16.648<TNI>	-0.458	0.210	10.0	>99.9%	53.0	11.1	80.378 + 6.263<SOI>	0.940	0.884	4.0	>99.9%	66.1	11.4
52.394 + 20.557<ONI>	0.291	0.085	11.2	>95%	52.6	11.6	92.146 - 235.694<GSSTEI>	-0.930	0.865	4.4	>99.9%	66.1	11.4
54.210 - 17.492<GSSTEI>	-0.141	0.020	11.1	<90%	53.0	11.1	83.377 - 53.586<MEI>	-0.895	0.800	5.3	>99.9%	66.1	11.4
52.749 - 8.952<NAO>	-0.125	0.016	11.6	<90%	52.6	11.6	77.547 - 47.756<PDO>	-0.888	0.789	5.5	>99.9%	66.1	11.4
52.306 + 3.492<MEI>	0.096	0.009	11.7	<90%	52.6	11.6	81.000 - 93.202<ONI>	-0.865	0.748	5.9	>99.9%	66.1	11.4
61.777 - 0.350<JMASSTM>	-0.087	0.008	11.6	<90%	52.7	11.5	12.253 - 15.703<QBO>	-0.817	0.668	6.8	>99.9%	66.1	11.4
52.888 - 1.545<PDO>	-0.074	0.005	11.2	<90%	53.0	11.1	1869.885- 69.890<JMASSTM>	-0.445	0.198	10.6	>90%	66.1	11.4
52.995 - 0.045<SOI>	-0.010	0.000	11.3	<90%	53.0	11.1	66.105 - 0.091<TNI>	-0.002	0.000	11.8	<90%	66.1	11.4

L. ACE/NSD

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
1.850 + 0.230<AMM>	0.884	0.781	0.1	>99.9%	1.8	0.2	1.566 + 2.219<CAR>	0.951	0.905	0.04	>99.9%	1.8	0.2
1.834 - 1.165<NAO>	-0.780	0.609	0.1	>99.9%	1.8	0.2	1.712 + 1.316<AMO>	0.949	0.900	0.04	>99.9%	1.8	0.2
1.873 + 1.301<AMO>	0.747	0.558	0.2	>99.9%	1.8	0.2	1.773 + 0.157<AMM>	0.946	0.894	0.04	>99.9%	1.8	0.2
0.905 - 0.271<QBO>	-0.681	0.464	0.2	>99.9%	1.8	0.2	-4.584 + 0.648<AT>	0.939	0.882	0.1	>99.9%	1.8	0.2
1.959 - 1.743<GSSTEI>	-0.648	0.420	0.2	>99.9%	1.8	0.2	1.582 + 1.193<NTA>	0.936	0.877	0.1	>99.9%	1.8	0.2
1.817 - 0.279<PDO>	-0.614	0.377	0.2	>99.9%	1.8	0.2	1.895 - 0.985<NAO>	-0.913	0.834	0.1	>99.9%	1.8	0.2
1.787 + 1.334<CAR>	0.504	0.254	0.2	>99.9%	1.8	0.2	2.133 - 3.043<GSSTEI>	-0.907	0.823	0.1	>99.9%	1.8	0.2
1.861 + 0.048<SOI>	0.479	0.229	0.2	>99.9%	1.8	0.2	1.977 + 0.079<SOI>	0.897	0.805	0.1	>99.9%	1.8	0.2
1.850 - 0.348<MEI>	-0.461	0.213	0.2	>99.9%	1.8	0.2	2.016 - 0.678<MEI>	-0.856	0.733	0.1	>99.9%	1.8	0.2
14.932 - 0.511<JMASSTM>	-0.378	0.143	0.2	>99.8%	1.8	0.2	1.986 - 1.182<ONI>	-0.829	0.687	0.1	>99.9%	1.8	0.2
1.795 + 0.511<NTA>	0.282	0.080	0.2	>95%	1.8	0.2	1.931 - 0.561<PDO>	-0.788	0.622	0.1	>99.9%	1.8	0.2
0.210 + 0.173<AT>	0.218	0.047	0.2	>90%	1.8	0.2	1.184 - 0.179<QBO>	-0.704	0.495	0.1	>99.8%	1.8	0.2
1.821 - 0.310<ONI>	-0.211	0.044	0.2	<90%	1.8	0.2	27.519 - 0.997<JMASSTM>	-0.479	0.230	0.2	<90%	1.8	0.2
1.842 + 0.012<TNI>	0.015	0.000	0.2	<90%	1.8	0.2	1.815 + 0.039<TNI>	0.079	0.006	0.2	<90%	1.8	0.2

Table 24. Inferred linear regression equations using 10-yma parametric values for the intervals 1950–2005 and 1990–2005, arranged by *r* value (Continued).

M. HISACE

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
32.711 + 6.994<AMM>	0.895	0.802	3.3	>99.9%	32.1	7.3	33.237 + 5.357<AMM>	0.965	0.931	1.4	>99.9%	34.1	5.1
33.514 + 43.239<AMO>	0.827	0.683	4.1	>99.9%	32.1	7.3	-183.772 + 22.123<AT>	0.956	0.915	1.6	>99.9%	34.1	5.1
1.396 - 8.976<QBO>	-0.751	0.564	4.9	>99.9%	32.1	7.3	26.726 + 40.797<NTA>	0.955	0.913	1.6	>99.9%	34.1	5.1
32.237 - 32.616<NAO>	-0.720	0.519	5.1	>99.9%	31.8	7.3	31.203 + 44.205<AMO>	0.951	0.904	1.6	>99.9%	34.1	5.1
30.754 + 49.071<CAR>	0.605	0.366	5.9	>99.9%	31.6	7.3	26.357 + 74.017<CAR>	0.947	0.897	1.7	>99.9%	34.1	5.1
31.680 - 8.070<PDO>	-0.595	0.354	5.8	>99.9%	32.3	7.3	37.442 - 33.752<NAO>	-0.934	0.872	1.9	>99.9%	34.1	5.1
35.512 - 46.462<GSSTEI>	-0.579	0.335	5.9	>99.9%	32.3	7.2	40.106 + 2.648<SOI>	0.896	0.804	2.3	>99.9%	34.1	5.1
30.782 + 26.831<NTA>	0.483	0.233	6.5	>99.8%	31.6	7.3	45.105 - 99.876<GSSTEI>	-0.888	0.789	2.4	>99.9%	34.1	5.1
-66.771 + 10.498<AT>	0.443	0.197	6.5	>99.5%	32.3	7.2	41.226 - 22.201<MEI>	-0.836	0.698	2.9	>99.9%	34.1	5.1
32.878 + 1.258<SOI>	0.425	0.181	6.6	>99.5%	32.3	7.2	38.715 - 19.382<PDO>	-0.813	0.660	3.1	>99.9%	34.1	5.1
32.647 - 9.249<MEI>	-0.404	0.163	6.8	>99%	31.8	7.3	40.193 - 38.307<ONI>	-0.802	0.642	3.1	>99.9%	34.1	5.1
300.049 - 10.459<JMASSTM>	-0.257	0.066	7.1	>90%	31.9	7.3	12.352 - 6.334<QBO>	-0.743	0.552	3.5	>99.9%	34.1	5.1
31.697 - 3.688<TNI>	-0.157	0.025	7.2	<90%	32.3	7.2	740.302 - 27.364<JMASSTM>	-0.393	0.154	4.8	<90%	34.1	5.1
31.842 - 4.061<ONI>	-0.091	0.008	7.4	<90%	31.8	7.3	34.676 + 1.324<TNI>	0.080	0.006	5.2	<90%	34.1	5.1

N. LISNSD

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
6.427 - 1.506<QBO>	-0.703	0.494	1.0	>99.9%	11.6	1.3	13.076 - 6.637<NAO>	-0.918	0.844	0.4	>99.9%	12.4	1.0
11.779 + 6.104<AMO>	0.651	0.424	1.0	>99.9%	11.6	1.3	11.862 + 8.498<AMO>	0.914	0.836	0.4	>99.9%	12.4	1.0
11.654 + 0.854<AMM>	0.610	0.372	1.0	>99.9%	11.6	1.3	10.925 + 14.279<CAR>	0.914	0.835	0.4	>99.9%	12.4	1.0
11.388 + 6.012<NTA>	0.588	0.345	1.1	>99.9%	11.6	1.3	14.669 - 20.447<GSSTEI>	-0.907	0.823	0.4	>99.9%	12.4	1.0
-11.545 + 2.446<AT>	0.581	0.338	1.0	>99.9%	11.5	1.3	12.258 + 0.998<AMM>	0.899	0.809	0.5	>99.9%	12.4	1.0
11.638 - 4.451<NAO>	-0.539	0.291	1.1	>99.9%	11.6	1.3	-28.447 + 4.150<AT>	0.897	0.805	0.4	>99.9%	12.4	1.0
11.444 + 7.557<CAR>	0.506	0.256	1.2	>99.8%	11.6	1.3	13.608 + 0.525<SOI>	0.888	0.789	0.5	>99.9%	12.4	1.0
11.460 - 1.038<PDO>	-0.431	0.186	1.2	>99.5%	11.5	1.3	11.049 + 7.580<NTA>	0.888	0.788	0.5	>99.9%	12.4	1.0
11.711 - 1.445<MEI>	-0.347	0.120	1.3	>95%	11.6	1.3	13.723 - 8.200<ONI>	-0.858	0.737	0.5	>99.9%	12.4	1.0
11.607 + 0.145<SOI>	0.276	0.076	1.2	>90%	11.5	1.3	13.848 - 4.452<MEI>	-0.838	0.703	0.6	>99.9%	12.4	1.0
11.752 - 3.037<GSSTEI>	-0.213	0.045	1.3	<90%	11.5	1.3	13.299 - 3.698<PDO>	-0.775	0.601	0.7	>99.9%	12.4	1.0
36.786 - 0.984<JMASSTM>	-0.134	0.018	1.4	<90%	11.6	1.3	8.347 - 1.186<QBO>	-0.696	0.485	0.7	>99.5%	12.4	1.0
11.543 - 0.038<TNI>	-0.049	0.002	1.2	<90%	11.5	1.3	186.627 - 6.750<JMASSTM>	-0.485	0.235	0.9	>95%	12.4	1.0
11.577 + 0.116<ONI>	0.014	0.000	1.3	<90%	11.6	1.3	12.740 + 0.728<TNI>	0.219	0.048	1.0	<90%	12.4	1.0

O. <NSD>

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
4.974 + 2.040<AMO>	0.728	0.530	0.3	>99.9%	4.9	0.4	4.809 + 2.740<CAR>	0.818	0.669	0.1	>99.9%	5.1	0.2
4.933 + 0.292<AMM>	0.698	0.487	0.3	>99.9%	4.9	0.4	5.221 - 1.266<NAO>	-0.817	0.668	0.1	>99.9%	5.1	0.2
3.397 - 0.442<QBO>	-0.690	0.476	0.3	>99.9%	4.9	0.4	-2.770 + 0.799<AT>	0.805	0.649	0.1	>99.9%	5.1	0.2
4.830 + 1.701<NTA>	0.572	0.327	0.3	>99.9%	4.9	0.4	5.065 + 0.191<AMM>	0.803	0.644	0.1	>99.9%	5.1	0.2
4.840 + 2.483<CAR>	0.572	0.327	0.3	>99.9%	4.9	0.4	4.992 + 1.590<AMO>	0.797	0.636	0.1	>99.9%	5.1	0.2
4.905 - 1.245<NAO>	-0.518	0.268	0.3	>99.9%	4.9	0.4	4.835 + 1.443<NTA>	0.788	0.621	0.1	>99.9%	5.1	0.2
4.900 - 0.371<PDO>	-0.499	0.249	0.3	>99.9%	4.9	0.4	5.476 - 3.452<GSSTEI>	-0.716	0.513	0.2	>99.5%	5.1	0.2
-0.703 + 0.597<AT>	0.460	0.211	0.3	>99.9%	4.9	0.4	5.290 + 0.086<SOI>	0.676	0.457	0.2	>99%	5.1	0.2
5.045 - 1.682<GSSTEI>	-0.382	0.146	0.4	>99.5%	4.9	0.4	5.301 - 1.290<ONI>	-0.630	0.397	0.2	>99%	5.1	0.2
4.859 - 0.411<TNI>	-0.319	0.102	0.4	>98%	4.9	0.4	5.311 - 0.669<MEI>	-0.587	0.345	0.2	>98%	5.1	0.2
4.948 + 0.040<SOI>	0.245	0.060	0.4	>90%	4.9	0.4	5.235 - 0.584<PDO>	-0.571	0.326	0.2	>95%	5.1	0.2
4.911 - 0.240<MEI>	-0.198	0.039	0.4	<90%	4.9	0.4	4.404 - 0.202<QBO>	-0.552	0.305	0.2	>98%	5.1	0.2
4.884 + 0.424<ONI>	0.179	0.032	0.4	<90%	4.9	0.4	5.235 + 0.314<TNI>	0.440	0.194	0.2	>90%	5.1	0.2
7.817 - 0.114<JMASSTM>	-0.053	0.003	0.4	<90%	4.9	0.4	17.614 - 0.485<JMASSTM>	-0.162	0.026	0.2	<90%	5.1	0.2

P. NHD

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
25.337 + 35.391<AMO>	0.823	0.678	3.4	>99.9%	24.1	6.0	-141.327 + 17.197<AT>	0.842	0.709	2.5	>99.9%	28.0	4.5
24.659 + 5.195<AMM>	0.807	0.651	3.6	>99.9%	24.1	6.0	30.646 - 26.371<NAO>	-0.826	0.683	2.6	>99.9%	28.0	4.5
0.008 - 7.066<QBO>	-0.719	0.518	4.2	>99.9%	24.1	6.0	22.128 + 56.463<CAR>	0.818	0.669	2.7	>99.9%	28.0	4.5
23.024 44.410<CAR>	0.664	0.442	4.6	>99.9%	23.8	6.0	25.860 + 33.179<AMO>	0.808	0.653	2.7	>99.9%	28.0	4.5
22.866 + 29.990<NTA>	0.655	0.429	4.6	>99.9%	23.8	6.0	27.243 + 4.049<AMM>	0.807	0.652	2.7	>99.9%	28.0	4.5
-86.586 + 11.759<AT>	0.600	0.360	4.8	>99.9%	24.4	6.0	22.631 + 29.896<NTA>	0.793	0.629	2.8	>99.9%	28.0	4.5
24.188 - 20.468<NAO>	-0.552	0.304	5.1	>99.9%	23.9	6.0	36.391 - 75.835<GSSTEI>	-0.764	0.584	3.0	>99.9%	28.0	4.5
24.188 - 20.468<PDO>	-0.552	0.304	5.1	>99.9%	23.9	6.0	32.156 + 1.818<SOI>	0.697	0.486	3.3	>99.5%	28.0	4.5
26.490 - 30.120<GSSTEI>	-0.453	0.205	5.4	>99.9%	24.4	6.0	32.455 - 27.795<ONI>	-0.659	0.434	3.5	>99%	28.0	4.5
24.718 + 0.665<SOI>	0.271	0.073	5.8	>90%	24.4	6.0	31.136 - 13.029<PDO>	-0.619	0.383	3.6	>99%	28.0	4.5
23.623 - 4.657<TNI>	-0.239	0.057	5.8	>90%	24.4	6.0	32.669 - 14.443<MEI>	-0.616	0.379	3.7	>98%	28.0	4.5
24.296 - 4.184<MEI>	-0.223	0.050	5.9	<90%	23.9	6.0	13.666 - 4.184<QBO>	-0.556	0.309	3.9	>95%	28.0	4.5
23.864 + 4.125<ONI>	0.113	0.013	6.0	<90%	23.9	6.0	31.095 + 6.913<TNI>	0.471	0.221	4.1	>90%	28.0	4.5
62.757 - 1.511<JMASSTM>	-0.045	0.002	6.1	<90%	24.0	6.0	336.823 - 11.965<JMASSTM>	-0.195	0.038	4.5	<90%	28.0	4.5

Table 24. Inferred linear regression equations using 10-yma parametric values for the intervals 1950–2005 and 1990–2005, arranged by *r* value (Continued).

Q. NMHD

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
6.489 + 19.751<AMO>	0.948	0.899	0.9	>99.9%	5.8	2.9	6.893 + 2.517<AMM>	0.982	0.965	0.5	>99.9%	7.3	2.3
6.094 + 2.911<AMM>	0.937	0.877	1.0	>99.9%	5.8	2.9	3.825 + 19.222<NTA>	0.975	0.951	0.5	>99.9%	7.3	2.3
5.172 + 25.644<CAR>	0.801	0.642	1.7	>99.9%	5.6	2.9	5.930 + 20.890<AMO>	0.973	0.948	0.6	>99.9%	7.3	2.3
5.158 + 14.930<NTA>	0.681	0.463	2.1	>99.9%	5.6	2.9	3.641 + 34.973<CAR>	0.970	0.940	0.6	>99.9%	7.3	2.3
-5.167 - 3.217<QBO>	-0.677	0.458	2.2	>99.9%	5.8	2.9	-94.067 + 10.293<AT>	0.964	0.930	0.6	>99.9%	7.3	2.3
-48.973 + 5.820<AT>	0.612	0.374	2.3	>99.9%	6.0	2.9	8.846 - 15.627<NAO>	-0.937	0.878	0.8	>99.9%	7.3	2.3
5.830 - 9.980<NAO>	-0.559	0.312	2.4	>99.9%	5.7	2.9	10.141 + 1.253<SOI>	0.919	0.845	1.0	>99.9%	7.3	2.3
7.146 - 17.219<GSSTEI>	-0.534	0.285	2.5	>99.9%	6.0	2.9	12.517 - 47.353<GSSTEI>	-0.913	0.833	1.0	>99.9%	7.3	2.3
5.777 - 2.372<PDO>	-0.435	0.189	2.6	>99.9%	6.0	2.9	10.730 - 10.688<MEI>	-0.872	0.760	1.2	>99.9%	7.3	2.3
6.115 + 0.338<SOI>	0.284	0.080	2.8	>95%	6.0	2.9	9.492 - 9.209<PDO>	-0.837	0.700	1.3	>99.9%	7.3	2.3
5.583 - 2.234<TNI>	-0.237	0.056	2.8	>90%	6.0	2.9	10.203 - 18.261<ONI>	-0.828	0.686	1.4	>99.9%	7.3	2.3
5.869 - 1.895<MEI>	-0.210	0.044	2.9	<90%	5.7	2.9	-3.059 - 3.016<QBO>	-0.767	0.588	1.6	>99.9%	7.3	2.3
5.635 + 0.002<JMASSTM>	0.203	0.041	2.8	>90%	5.8	2.9	378.974 - 14.402<JMASSTM>	-0.448	0.201	2.2	>90%	7.3	2.3
5.680 + 1.255<ONI>	0.071	0.005	2.9	<90%	5.7	2.9	7.252 - 0.093<TNI>	-0.012	0.000	2.5	<90%	7.3	2.3

R. NTCA

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
113.422 + 177.771<AMO>	0.932	0.868	9.8	>99.9%	107.4	26.6	124.505 + 28.160<AMM>	0.986	0.972	4.5	>99.9%	129.0	26.1
109.773 + 25.040<AMM>	0.879	0.772	12.8	>99.9%	107.4	26.6	113.660 + 234.713<AMO>	0.981	0.963	5.2	>99.9%	129.0	26.1
100.496 + 167.377<NTA>	0.828	0.686	15.1	>99.9%	105.9	26.6	90.221 + 214.776<NTA>	0.978	0.956	5.7	>99.9%	129.0	26.1
101.472 + 242.574<CAR>	0.823	0.677	15.3	>99.9%	105.9	26.6	87.938 + 392.933<CAR>	0.977	0.955	5.7	>99.9%	129.0	26.1
-524.199 + 67.082<AT>	0.769	0.591	16.1	>99.9%	108.8	26.5	-1014.082 + 116.076<AT>	0.976	0.952	5.9	>99.9%	129.0	26.1
6.309 - 29.604<QBO>	-0.679	0.461	19.7	>99.9%	107.4	26.6	146.773 - 179.102<NAO>	-0.963	0.928	7.3	>99.9%	129.0	26.1
118.531 - 142.406<GSSTEI>	-0.481	0.231	23.5	>99.9%	108.8	26.5	188.412 - 538.806<GSSTEI>	-0.932	0.868	9.8	>99.9%	129.0	26.1
107.300 - 74.492<NAO>	-0.454	0.206	23.9	>99.9%	106.3	26.5	160.912 + 14.054<SOI>	0.925	0.855	10.3	>99.9%	129.0	26.1
107.262 - 18.887<PDO>	-0.378	0.143	24.8	>99.5%	108.8	26.5	167.490 - 119.773<MEI>	-0.876	0.768	13.0	>99.9%	129.0	26.1
104.613 - 24.167<TNI>	-0.279	0.078	25.7	>95%	108.8	26.5	154.231 - 105.783<PDO>	-0.862	0.743	13.7	>99.9%	129.0	26.1
109.944 + 2.663<SOI>	0.244	0.060	26.0	>90%	108.8	26.5	162.407 - 209.767<ONI>	-0.853	0.728	14.1	>99.9%	129.0	26.1
107.374 - 11.757<MEI>	-0.142	0.020	26.5	<90%	106.3	26.5	11.100 - 34.347<QBO>	-0.784	0.614	16.8	>99.9%	129.0	26.1
106.076 + 19.046<ONI>	0.118	0.014	26.6	<90%	106.3	26.5	4192.737 - 157.461<JMASSTM>	-0.439	0.193	24.3	>90%	129.0	26.1
-137.004 + 9.513<JMASSTM>	0.064	0.004	26.8	<90%	106.9	26.6	131.034 + 4.635<TNI>	0.054	0.003	27.0	<90%	129.0	26.1

S. <AT>

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
9.372 + 2.198<NTA>	0.898	0.807	0.1	>99.9%	9.4	0.3	9.810 + 0.236<AMM>	0.982	0.965	0.05	>99.9%	9.85	0.22
9.389 + 2.960<CAR>	0.829	0.687	0.2	>99.9%	9.4	0.3	0.719 + 1.969<AMO>	0.979	0.959	0.05	>99.9%	9.85	0.22
9.500 + 1.713<AMO>	0.764	0.584	0.2	>99.9%	9.4	0.3	9.524 + 1.793<NTA>	0.971	0.943	0.05	>99.9%	9.85	0.22
9.458 + 0.168<AMM>	0.502	0.252	0.3	>99.9%	9.4	0.3	9.5047 + 3.2825<CAR>	0.971	0.943	0.05	>99.9%	9.85	0.22
-11.683 + 0.824<JMASSTM>	0.468	0.219	0.3	>99.8%	9.4	0.3	10.353 - 4.584<GSSTEI>	-0.943	0.890	0.09	>99.9%	9.85	0.22
9.362 - 0.454<TNI>	-0.458	0.210	0.3	>99.9%	9.4	0.3	9.994 - 1.473<NAO>	-0.942	0.888	0.09	>99.9%	9.85	0.22
9.433 + 0.794<ONI>	0.408	0.167	0.3	>99.5%	9.4	0.3	10.071 - 0.936<PDO>	-0.908	0.824	0.09	>99.9%	9.85	0.22
8.960 - 0.141<QBO>	-0.276	0.076	0.3	>90%	9.4	0.3	10.110 + 0.116<SOI>	0.904	0.818	0.15	>99.9%	9.85	0.22
9.418 + 0.260<MEI>	0.261	0.068	0.3	>90%	9.4	0.3	10.172 - 1.008<MEI>	-0.878	0.770	0.09	>99.9%	9.85	0.22
9.430 - 0.024<SOI>	-0.195	0.038	0.3	<90%	9.4	0.3	10.125 - 1.739<ONI>	-0.842	0.709	0.11	>99.9%	9.85	0.22
9.447 + 0.079<PDO>	0.137	0.019	0.3	<90%	9.4	0.3	8.840 - 0.294<QBO>	-0.797	0.635	0.05	>99.9%	9.85	0.22
9.439 + 0.205<NAO>	0.104	0.011	0.3	<90%	9.4	0.3	43.929 - 1.321<JMASSTM>	-0.438	0.192	0.41	<90%	9.85	0.22
9.449 - 0.120<GSSTEI>	-0.035	0.001	0.3	<90%	9.4	0.3	9.850 + 0.006<TNI>	0.008	0.000	0.23	<90%	9.85	0.22

T. <ONI>

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
-0.032 - 0.063<SOI>	-0.923	0.852	0.1	>99.9%	0.0	0.2	-0.013 + 0.535<MEI>	0.963	0.927	0.03	>99.9%	0.16	0.11
-21.410 + 0.835<JMASSTM>	0.909	0.827	0.1	>99.9%	0.0	0.2	-0.088 + 2.240<GSSTEI>	0.952	0.907	0.03	>99.9%	0.16	0.11
-0.031 + 0.460<MEI>	0.897	0.804	0.1	>99.9%	0.0	0.2	0.028 - 0.058<SOI>	-0.935	0.875	0.04	>99.9%	0.16	0.11
-0.143 + 1.781<GSSTEI>	0.775	0.601	0.1	>99.9%	0.0	0.2	0.051 + 0.456<PDO>	0.913	0.833	0.04	>99.9%	0.16	0.11
0.013 + 0.242<PDO>	0.735	0.541	0.1	>99.9%	0.0	0.2	0.216 - 0.863<AMO>	-0.887	0.787	0.05	>99.9%	0.16	0.11
0.003 + 0.634<NAO>	0.624	0.389	0.1	>99.9%	0.0	0.2	0.307 - 1.413<CAR>	-0.864	0.747	0.06	>99.9%	0.16	0.11
-0.052 - 0.319<TNI>	-0.599	0.358	0.1	>99.9%	0.0	0.2	0.175 - 0.099<AMM>	-0.856	0.732	0.06	>99.9%	0.16	0.11
0.003 + 0.904<CAR>	0.499	0.249	0.1	>99.9%	0.0	0.2	4.171 - 0.407<AT>	-0.842	0.709	0.05	>99.9%	0.16	0.11
0.008 + 0.533<NTA>	0.431	0.186	0.1	>99.8%	0.0	0.2	0.090 + 0.627<NAO>	0.834	0.696	0.06	>99.9%	0.16	0.11
-1.973 + 0.210<AT>	0.408	0.167	0.2	>99.5%	0.0	0.2	0.660 + 0.146<QBO>	0.818	0.669	0.06	>99.9%	0.16	0.11
0.368 + 0.102<QBO>	0.369	0.136	0.2	>95%	0.0	0.2	-28.707 + 1.118<JMASSTM>	0.767	0.589	0.09	>99.5%	0.16	0.11
0.022 + 0.272<AMO>	0.229	0.053	0.2	<90%	0.0	0.2	0.223 - 0.296<NTA>	-0.438	0.192	0.10	>90%	0.16	0.11
0.010 - 0.013<AMM>	-0.071	0.005	0.2	<90%	0.0	0.2	0.174 + 0.033<TNI>	0.095	0.009	0.11	<90%	0.16	0.11

Table 24. Inferred linear regression equations using 10-yma parametric values for the intervals 1950–2005 and 1990–2005, arranged by *r* value (Continued).

U. <SOI>

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
-0.009 - 7.351<MEI>	-0.982	0.964	0.5	>99.9%	-0.7	2.4	0.547 - 8.767<MEI>	-0.975	0.951	0.4	>99.9%	-2.3	1.7
-0.532 - 13.468<ONI>	-0.923	0.852	0.9	>99.9%	-0.7	2.4	-3.247 + 14.938<AMO>	0.949	0.901	0.6	>99.9%	-2.3	1.7
316.459 - 12.369<JMASSTM>	-0.922	0.850	0.9	>99.9%	-0.6	2.4	-4.732 + 13.633<NTA>	0.943	0.890	0.6	>99.9%	-2.3	1.7
-0.770 - 4.166<PDO>	-0.910	0.828	1.0	>99.9%	-0.4	2.4	1.679 - 35.819<GSSTEI>	-0.941	0.886	0.6	>99.9%	-2.3	1.7
1.106 - 22.491<GSSTEI>	-0.829	0.688	1.4	>99.9%	-0.4	2.4	-2.553 + 1.766<AMM>	0.940	0.883	0.6	>99.9%	-2.3	1.7
-0.531 - 11.379<NAO>	-0.768	0.590	1.5	>99.9%	-0.7	2.4	-1.133 - 11.471<NAO>	-0.938	0.879	0.6	>99.9%	-2.3	1.7
-9.045 - 2.481<QBO>	-0.626	0.392	1.9	>99.9%	-0.6	2.4	0.139 - 15.131<ONI>	-0.935	0.875	0.6	>99.9%	-2.3	1.7
0.181 + 3.535<TNI>	0.446	0.199	2.2	>99.9%	-0.4	2.4	-4.839 + 24.578<CAR>	0.929	0.863	0.7	>99.9%	-2.3	1.7
-0.572 - 8.989<CAR>	-0.339	0.115	2.3	>98%	-0.8	2.4	-0.492 - 7.459<<PDO>	-0.924	0.854	0.7	>99.9%	-2.3	1.7
-0.493 + 0.825<AMM>	0.318	0.101	2.3	>98%	-0.6	2.4	-71.999 + 7.081<AT>	0.904	0.818	0.8	>99.9%	-2.3	1.7
-0.554 - 5.639<NTA>	-0.310	0.096	2.3	>95%	-0.7	2.4	-10.540 - 2.409<QBO>	-0.835	0.698	1.0	>99.9%	-2.3	1.7
14.265 - 1.557<AT>	-0.195	0.038	2.4	<90%	-0.4	2.4	386.298 - 15.056<JMASSTM>	-0.640	0.410	1.4	>99.9%	-2.3	1.7
-0.532 + 1.116<AMO>	0.064	0.004	2.4	<90%	-0.6	2.4	-2.759 - 1.095<TNI>	-0.194	0.038	1.7	<90%	-2.3	1.7

V. <NAO>

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
0.016 + 0.271<PDO>	0.836	0.698	0.1	>99.9%	0.0	0.2	0.181 - 1.251<AMO>	-0.973	0.946	0.03	>99.9%	0.10	0.14
-0.024 + 0.407<MEI>	0.805	0.648	0.1	>99.9%	0.0	0.2	0.306 - 1.146<NTA>	-0.970	0.941	0.04	>99.9%	0.10	0.14
0.737 + 0.214<QBO>	0.778	0.605	0.1	>99.9%	0.0	0.2	0.318 - 2.094<CAR>	-0.968	0.938	0.04	>99.9%	0.10	0.14
-0.022 - 0.052<SOI>	-0.768	0.590	0.1	>99.9%	0.0	0.2	0.123 - 0.149<AMM>	-0.968	0.937	0.04	>99.9%	0.10	0.14
-0.129 + 1.651<GSSTEI>	0.730	0.532	0.1	>99.9%	0.0	0.2	6.037 - 0.603<AT>	-0.942	0.888	0.05	>99.9%	0.10	0.14
-16.140 + 0.630<JMASSTM>	0.697	0.485	0.1	>99.9%	0.0	0.2	-0.075 - 0.077<SOI>	-0.938	0.879	0.05	>99.9%	0.10	0.14
-0.003 - 0.119<AMM>	-0.677	0.459	0.1	>99.9%	0.0	0.2	-0.218 + 2.879<GSSTEI>	0.926	0.857	0.06	>99.9%	0.10	0.14
0.007 + 0.614<ONI>	0.624	0.389	0.1	>99.9%	0.0	0.2	-0.044 + 0.599<PDO>	0.908	0.825	0.06	>99.9%	0.10	0.14
-0.003 - 0.407<AMO>	-0.348	0.121	0.2	>98%	0.0	0.2	-0.109 + 0.649<MEI>	0.884	0.781	0.07	>99.9%	0.10	0.14
-0.005 - 0.093<TNI>	-0.178	0.032	0.2	<90%	0.0	0.2	-0.081 + 1.148<ONI>	0.881	0.776	0.07	>99.9%	0.10	0.14
-0.483 + 0.053<AT>	0.104	0.011	0.2	<90%	0.0	0.2	-20.115 + 0.783<JMASSTM>	0.406	0.165	0.14	<90%	0.10	0.14
0.019 - 0.090<CAR>	-0.051	0.003	0.2	<90%	0.0	0.2	0.141 + 0.014<QBO>	0.179	0.032	0.14	<90%	0.10	0.14
0.017 + 0.007<NTA>	0.006	0.000	0.2	<90%	0.0	0.2	0.091 - 0.020<TNI>	-0.043	0.002	0.15	<90%	0.10	0.14

W. <PDO>

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
-0.144 + 1.479<MEI>	0.949	0.901	0.2	>99.9%	-0.01	0.5	-0.250 + 4.429<GSSTEI>	0.940	0.883	0.08	>99.9%	0.24	0.21
-0.167 - 0.199<SOI>	-0.910	0.828	0.2	>99.9%	-0.1	0.5	-0.098 + 1.047<MEI>	0.940	0.883	0.08	>99.9%	0.24	0.21
-63.025 + 2.458<JMASSTM>	0.876	0.767	0.2	>99.9%	-0.02	0.5	-0.021 - 0.114<SOI>	-0.924	0.854	0.09	>99.9%	0.24	0.21
-0.423 + 5.005<GSSTEI>	0.845	0.714	0.3	>99.9%	-0.1	0.5	0.356 - 1.796<AMO>	-0.921	0.848	0.09	>99.9%	0.24	0.21
-0.043 + 2.577<NAO>	0.836	0.698	0.3	>99.9%	-0.01	0.5	-0.053 + 1.829<ONI>	0.913	0.833	0.09	>99.9%	0.24	0.21
2.144 + 0.639<QBO>	0.761	0.579	0.3	>99.9%	-0.04	0.5	0.102 + 1.377<NAO>	0.908	0.825	0.09	>99.9%	0.24	0.21
-0.033 + 2.232<ONI>	0.735	0.541	0.3	>99.9%	-0.01	0.5	8.906 - 0.880<AT>	-0.908	0.824	0.09	>99.9%	0.24	0.21
-0.060 - 0.230<AMM>	-0.420	0.176	0.5	>99.8%	-0.04	0.5	0.272 - 0.210<AMM>	-0.904	0.818	0.09	>99.9%	0.24	0.21
-0.167 - 0.492<TNI>	-0.283	0.080	0.5	>95%	-0.1	0.5	0.530 - 1.615<NTA>	-0.902	0.814	0.10	>99.9%	0.24	0.21
-0.022 + 1.401<CAR>	0.255	0.065	0.5	>90%	0.00	0.5	0.547 - 2.950<CAR>	-0.900	0.810	0.10	>99.9%	0.24	0.21
-0.025 + 0.905<NTA>	0.240	0.058	0.5	>90%	0.00	0.5	1.243 + 0.293<QBO>	0.819	0.671	0.13	>99.9%	0.24	0.21
-0.062 - 0.689<AMO>	-0.187	0.035	0.5	<90%	-0.04	0.5	-43.884 + 1.710<JMASSTM>	0.585	0.343	0.17	>98%	0.24	0.21
-2.344 + 0.240<AT>	0.137	0.019	1.1	<90%	-0.1	0.5	0.299 + 0.137<TNI>	0.196	0.038	0.22	<90%	0.24	0.21

X. <TNI>

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
-0.161 - 1.406<NTA>	-0.604	0.364	0.2	>99.9%	-0.2	0.3	-44.873 + 1.721<JMASSTM>	0.411	0.169	0.28	<90%	-0.44	0.31
-0.186 - 1.122<ONI>	-0.599	0.358	0.2	>99.9%	-0.2	0.3	-0.587 + 0.446<MEI>	0.279	0.078	0.30	<90%	-0.44	0.31
-0.174 - 1.765<CAR>	-0.519	0.270	0.3	>99.9%	-0.2	0.3	-0.511 + 0.281<PDO>	0.196	0.038	0.31	<90%	-0.44	0.31
4.185 - 0.462<AT>	-0.458	0.210	0.3	>99.9%	-0.2	0.3	-0.523 - 0.035<SOI>	-0.194	0.038	0.31	<90%	-0.44	0.31
-0.149 + 0.056<SOI>	0.446	0.199	0.3	>99.9%	-0.2	0.3	-0.395 - 0.270<NTA>	-0.105	0.011	0.31	<90%	-0.44	0.31
-0.071 - 1.494<GSSTEI>	-0.437	0.191	0.3	>99.9%	-0.2	0.3	-0.488 + 0.273<ONI>	0.095	0.009	0.31	<90%	-0.44	0.31
18.697 - 0.737<JMASSTM>	-0.428	0.183	0.3	>99.8%	-0.2	0.3	-0.441 - 0.022<AMM>	-0.067	0.005	0.31	<90%	-0.44	0.31
-0.210 - 0.749<AMO>	-0.336	0.113	0.3	>98%	-0.2	0.3	-0.434 - 0.155<AMO>	-0.056	0.003	0.32	<90%	-0.44	0.31
-0.170 - 0.317<MEI>	-0.330	0.109	0.3	>98%	-0.2	0.3	-0.488 - 0.015<QBO>	-0.055	0.003	0.32	<90%	-0.44	0.31
-0.186 - 0.162<PDO>	-0.281	0.079	0.3	>95%	-0.2	0.3	-0.435 - 0.093<NAO>	-0.043	0.002	0.32	<90%	-0.44	0.31
-0.195 - 0.338<NAO>	-0.178	0.032	0.3	<90%	-0.2	0.3	-0.430 - 0.139<CAR>	-0.030	0.001	0.32	<90%	-0.44	0.31
-0.188 - 0.042<AMM>	-0.125	0.016	0.3	<90%	-0.2	0.3	-0.452 + 0.073<GSSTEI>	0.011	0.000	0.32	<90%	-0.44	0.31
-0.030 + 0.045<QBO>	0.089	0.008	0.3	<90%	-0.2	0.3	-0.557 + 0.011<AT>	0.008	0.000	0.31	<90%	-0.44	0.31

Table 24. Inferred linear regression equations using 10-yma parametric values for the intervals 1950–2005 and 1990–2005, arranged by *r* value (Continued).

Y. <MEI>

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
0.002 - 0.131<SOI>	-0.982	0.960	0.1	>99.9%	0.1	0.3	0.075 - 0.108<SOI>	-0.975	0.951	0.05	>99.9%	0.32	0.19
-43.767 + 1.711<JMASSTM>	0.956	0.914	0.1	>99.9%	0.1	0.3	0.045 + 1.732<ONI>	0.963	0.927	0.06	>99.9%	0.32	0.19
0.097 + 0.609<PDO>	0.949	0.901	0.1	>99.9%	0.1	0.3	-0.120 + 4.007<GSSTEI>	0.947	0.897	0.06	>99.9%	0.32	0.19
0.072 + 1.747<ONI>	0.897	0.804	0.1	>99.9%	0.1	0.3	0.120 + 0.844<PDO>	0.940	0.883	0.07	>99.9%	0.32	0.19
-0.234 + 3.773<GSSTEI>	0.843	0.710	0.2	>99.9%	0.1	0.3	0.427 - 1.609<AMO>	-0.919	0.844	0.08	>99.9%	0.32	0.19
0.070 + 1.593<NAO>	0.805	0.648	0.2	>99.9%	0.1	0.3	0.582 - 1.446<NTA>	-0.899	0.809	0.09	>99.9%	0.32	0.19
1.253 + 0.344<QBO>	0.631	0.398	0.3	>99.9%	0.1	0.3	o.351 - 0.188<AMM>	-0.899	0.808	0.09	>99.9%	0.32	0.19
0.075 + 1.298<CAR>	0.367	0.135	0.3	>99%	0.1	0.3	0.597 - 2.637<CAR>	-0.896	0.803	0.09	>99.9%	0.32	0.19
0.072 + 0.848<NTA>	0.350	0.122	0.3	>98%	0.1	0.3	0.202 + 1.202<NAO>	0.884	0.781	0.09	>99.9%	0.32	0.19
0.024 - 0.343<TNI>	-0.330	0.109	0.3	>98%	0.1	0.3	7.846 - 0.764<AT>	-0.878	0.770	0.09	>99.9%	0.32	0.19
0.078 - 0.097<AMM>	-0.280	0.078	0.3	>95%	0.1	0.3	1.234 + 0.266<QBO>	0.829	0.687	0.11	>99.9%	0.32	0.19
-2.379 + 0.262<AT>	0.261	0.068	0.3	>90%	0.1	0.3	-51.201 + 1.996<JMASSTM>	0.761	0.579	0.14	>99.8%	0.32	0.19
0.092 - 0.002<AMO>	-0.001	0.000	0.3	<90%	0.1	0.3	0.399 + 0.175<TNI>	0.279	0.078	0.19	<90%	0.32	0.19

Z. <GSSTEI>

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
0.080 + 0.143<PDO>	0.845	0.714	0.05	>99.9%	0.1	0.1	0.136 - 0.396<AMO>	-0.957	0.915	0.01	>99.9%	0.11	0.05
0.069 + 0.188<MEI>	0.843	0.710	0.04	>99.9%	0.1	0.1	0.046 + 0.405<ONI>	0.952	0.907	0.01	>99.9%	0.11	0.05
0.055 - 0.031<SOI>	-0.829	0.688	0.05	>99.9%	0.1	0.1	0.038 + 0.224<MEI>	0.947	0.897	0.02	>99.9%	0.11	0.05
0.083 + 0.337<ONI>	0.775	0.601	0.05	>99.9%	0.1	0.1	2.021 - 0.194<AT>	-0.943	0.890	0.01	>99.9%	0.11	0.05
-8.204 + 0.323<JMASSTM>	0.768	0.590	0.05	>99.9%	0.1	0.1	0.054 - 0.025<SOI>	-0.941	0.886	0.01	>99.9%	0.11	0.05
0.082 + 0.322<NAO>	0.730	0.532	0.05	>99.9%	0.1	0.1	0.179 - 0.654<CAR>	-0.941	0.886	0.01	>99.9%	0.11	0.05
0.366 + 0.084<QBO>	0.642	0.412	0.1	>99.9%	0.1	0.1	0.063 + 0.199<PDO>	0.940	0.883	0.02	>99.9%	0.11	0.05
0.074 - 0.049<AMM>	-0.576	0.332	0.1	>99.9%	0.1	0.1	0.118 - 0.046<AMM>	-0.933	0.870	0.02	>99.9%	0.11	0.05
0.046 - 0.128<TNI>	-0.437	0.191	0.1	>99.9%	0.1	0.1	0.081 + 0.298<NAO>	0.926	0.857	0.02	>99.9%	0.11	0.05
0.071 - 0.227<AMO>	-0.395	0.156	0.1	>99.5%	0.1	0.1	0.173 - 0.349<NTA>	-0.919	0.843	0.02	>99.9%	0.11	0.05
0.087 + 0.067<NTA>	0.129	0.017	0.1	<90%	0.1	0.1	0.313 + 0.059<QBO>	0.781	0.610	0.03	>99.9%	0.11	0.05
0.089 + 0.028<CAR>	0.037	0.001	0.1	<90%	0.1	0.1	-9.977 + 0.391<JMASSTM>	0.631	0.398	0.03	>99.5%	0.11	0.05
0.167 - 0.010<AT>	-0.035	0.001	0.1	<90%	0.1	0.1	0.111 + 0.002<TNI>	0.011	0.000	0.05	<90%	0.11	0.05

AA. <JMASSTM>

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
25.5897 + 0.5340<MEI>	0.956	0.914	0.05	>99.9%	25.6	0.2	25.7243 + 0.5262<ONI>	0.767	0.589	0.1	>90%	25.8	0.1
25.5915 - 0.0687<SOI>	-0.922	0.850	0.1	>99.9%	25.6	0.2	25.7148 + 0.2902<MEI>	0.761	0.579	0.05	>99.9%	25.8	0.1
25.6276 + 0.9899<ONI>	0.909	0.827	0.1	>99.9%	25.6	0.2	25.7466 - 0.0271<SOI>	-0.639	0.408	0.04	>99.9%	25.8	0.1
25.6415 + 0.3120<PDO>	0.876	0.767	0.1	>99.9%	25.6	0.2	25.696 + 1.017<GSSTEI>	0.631	0.398	0.04	>99.9%	25.8	0.1
25.484 + 1.825<GSSTEI>	0.768	0.590	0.1	>99.9%	25.6	0.2	25.760 + 0.200<PDO>	0.585	0.343	0.1	<90%	25.8	0.1
25.628 + 0.770<NAO>	0.697	0.485	0.3	>99.5%	25.6	0.2	26.0285 + 0.0642<QBO>	0.525	0.276	0.05	>98%	25.8	0.1
25.617 + 0.777<NTA>	0.572	0.327	0.2	>99.9%	25.6	0.2	25.829 - 0.326<AMO>	-0.488	0.238	0.1	<90%	25.8	0.1
25.623 + 1.067<CAR>	0.538	0.290	0.1	>99.9%	25.6	0.2	25.861 - 0.507<CAR>	-0.452	0.204	0.1	<90%	25.8	0.1
23.121 + 0.266<AT>	0.468	0.219	0.3	>99.8%	25.6	0.2	25.8137 - 0.0353<AMM>	-0.444	0.197	0.1	<90%	25.8	0.1
26.111 + 0.141<QBO>	0.465	0.217	0.3	>95%	25.6	0.2	27.241 - 0.146<AT>	-0.438	0.192	0.4	<90%	25.8	0.1
25.587 - 0.248<TNI>	-0.428	0.183	0.2	>99.5%	25.6	0.2	25.856 - 0.266<NTA>	-0.434	0.188	0.1	<90%	25.8	0.1
25.642 + 0.195<AMO>	0.151	0.023	0.2	<90%	25.6	0.2	25.8517 + 0.0982<TNI>	0.411	0.169	0.1	<90%	25.8	0.1
25.632 - 0.026<AMM>	-0.132	0.017	0.1	<90%	25.6	0.2	25.787 + 0.211<NAO>	0.406	0.165	0.1	<90%	25.8	0.1

BB. <NTA>

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
0.008 + 1.327<CAR>	0.910	0.827	0.1	>99.9%	0.03	0.1	0.160 + 0.130<AMM>	0.997	0.995	0.001	>99.9%	0.18	0.12
-3.434 + 0.367<AT>	0.898	0.807	0.1	>99.9%	0.03	0.1	0.110 + 1.079<AMO>	0.991	0.981	0.02	>99.9%	0.18	0.12
0.067 + 0.789<AMO>	0.821	0.674	0.1	>99.9%	0.03	0.1	-0.008 + 1.803<CAR>	0.985	0.970	0.02	>99.9%	0.18	0.12
0.048 + 0.091<AMM>	0.629	0.396	0.1	>99.9%	0.03	0.1	-5.000 + 0.526<AT>	0.971	0.943	0.03	>99.9%	0.18	0.12
-0.021 - 0.259<TNI>	-0.604	0.364	0.1	>99.9%	0.03	0.1	0.262 - 0.821<NAO>	-0.970	0.941	0.03	>99.9%	0.18	0.12
-10.769 + 0.421<JMASSTM>	0.572	0.327	0.1	>99.9%	0.03	0.1	0.329 + 0.065<SOI>	0.943	0.890	0.04	>99.9%	0.18	0.12
0.023 + 0.349<ONI>	0.431	0.186	0.1	>99.8%	0.03	0.1	0.447 - 2.417<GSSTEI>	-0.918	0.843	0.05	>99.9%	0.18	0.12
0.018 + 0.144<MEI>	0.350	0.122	0.1	>98%	0.03	0.1	0.301 - 0.504<PDO>	-0.902	0.814	0.05	>99.9%	0.18	0.12
-0.216 - 0.074<QBO>	-0.329	0.108	0.1	>98%	0.03	0.1	0.360 - 0.559<MEI>	-0.899	0.809	0.05	>99.9%	0.18	0.12
0.020 - 0.017<SOI>	-0.310	0.096	0.1	>95%	0.03	0.1	0.332 - 0.948<ONI>	-0.847	0.718	0.06	>99.9%	0.18	0.12
0.032 + 0.064<PDO>	0.240	0.058	0.1	>90%	0.03	0.1	-0.395 - 0.168<QBO>	-0.840	0.705	0.06	>99.9%	0.18	0.12
0.010 + 0.248<GSSTEI>	0.129	0.017	0.1	<90%	0.03	0.1	18.456 - 0.708<JMASSTM>	-0.434	0.188	0.11	>90%	0.18	0.12
0.032 + 0.005<NAO>	0.006	0.000	0.1	<90%	0.03	0.1	0.162 - 0.041<TNI>	-0.105	0.011	0.12	<90%	0.18	0.12

Table 24. Inferred linear regression equations using 10-yma parametric values for the intervals 1950–2005 and 1990–2005, arranged by *r* value (Continued).

CC. <CAR>

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
0.045 + 0.610<AMO>	0.926	0.858	0.03	>99.9%	0.02	0.1	0.066 + 0.593<AMO>	0.996	0.992	0.001	>99.9%	0.10	0.06
-0.0019 + 0.6233<NTA>	0.910	0.827	0.04	>99.9%	0.02	0.1	0.093 + 0.070<AMM>	0.985	0.971	0.01	>99.9%	0.10	0.06
-2.173 + 0.232<AT>	0.829	0.687	0.1	>99.9%	0.02	0.1	0.007 + 0.538<NTA>	0.985	0.970	0.01	>99.9%	0.10	0.06
0.031 + 0.074<AMM>	0.745	0.555	0.1	>99.9%	0.02	0.1	-2.726 + 0.287<AT>	0.971	0.943	0.03	>99.9%	0.10	0.06
-6.943 + 0.271<JMASSTM>	0.538	0.290	0.1	>99.9%	0.02	0.1	0.149 - 0.448<NAO>	-0.968	0.938	0.02	>99.9%	0.10	0.06
-0.013 - 0.153<TNI>	-0.519	0.270	0.1	>99.9%	0.02	0.1	0.254 - 1.353<GSSTEI>	-0.941	0.886	0.02	>99.9%	0.10	0.06
0.013 + 0.275<ONI>	0.499	0.249	0.1	>99.9%	0.02	0.1	0.184 + 0.035<SOI>	0.929	0.863	0.03	>99.9%	0.10	0.06
0.008 + 0.104<MEI>	0.367	0.135	0.1	>99%	0.02	0.1	0.170 - 0.275<PDO>	-0.900	0.810	0.03	>99.9%	0.10	0.06
0.009 - 0.013<SOI>	-0.339	0.115	0.1	>98%	0.02	0.1	0.202 - 0.305<MEI>	-0.896	0.803	0.03	>99.9%	0.10	0.06
-0.118 - 0.040<QBO>	-0.262	0.069	0.1	>90%	0.02	0.1	0.189 - 0.528<ONI>	-0.864	0.747	0.03	>99.9%	0.10	0.06
0.018 + 0.046<PDO>	0.255	0.065	0.1	>90%	0.02	0.1	-0.190 - 0.086<QBO>	-0.786	0.618	0.04	>99.9%	0.10	0.06
-0.051 - 1.396<NAO>	-0.051	0.003	0.1	>99.9%	0.02	0.1	10.492 - 0.403<JMASSTM>	-0.452	0.204	0.07	<90%	0.10	0.06
0.014 + 0.049<GSSTEI>	0.037	0.001	0.1	<90%	0.02	0.1	0.102 - 0.006<TNI>	-0.030	0.001	0.07	<90%	0.10	0.06

DD. <QBO>

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
-3.414 + 2.825<NAO>	0.778	0.605	0.4	>99.9%	-3.4	0.6	-2.672 - 4.209<NTA>	-0.840	0.705	0.34	>99.9%	-3.43	0.60
-3.381 + 0.906<PDO>	0.761	0.579	0.4	>99.9%	-3.4	0.6	-4.090 - 0.290<SOI>	-0.835	0.698	0.34	>99.9%	-3.43	0.60
-3.458 - 0.459<AMM>	-0.702	0.492	0.4	>99.9%	-3.4	0.6	-3.346 - 0.543<AMM>	-0.833	0.694	0.34	>99.9%	-3.43	0.60
-3.802 + 4.900<GSSTEI>	0.642	0.412	0.5	>99.9%	-3.4	0.6	-4.263 + 2.584<MEI>	0.829	0.687	0.34	>99.9%	-3.43	0.60
-3.482 + 1.158<MEI>	0.631	0.398	0.5	>99.9%	-3.4	0.6	-3.799 + 3.563<NAO>	0.823	0.677	0.35	>99.9%	-3.43	0.60
-3.505 - 0.158<SOI>	0.626	0.392	0.5	>99.9%	-3.4	0.6	-3.979 + 2.293<PDO>	0.819	0.671	0.36	>99.9%	-3.43	0.60
-3.497 - 2.433<AMO>	-0.556	0.309	0.5	>99.9%	-3.4	0.6	-3.140 - 4.469<AMO>	-0.819	0.671	0.36	>99.9%	-3.43	0.60
-42.903 + 1.541<JMASSTM>	0.465	0.217	0.5	>99.9%	-3.4	0.6	-4.163 + 4.586<ONI>	0.818	0.669	0.35	>99.9%	-3.43	0.60
-3.406 + 1.328<ONI>	0.369	0.136	0.6	>99%	-3.4	0.6	17.868 - 2.163<AT>	-0.797	0.635	0.37	>99.9%	-3.43	0.60
-3.317 - 1.468<NTA>	-0.329	0.108	0.6	>98%	-3.4	0.6	-2.679 - 7.210<CAR>	-0.786	0.618	0.38	>99.9%	-3.43	0.60
1.667 - 0.538<AT>	-0.276	0.076	0.6	>95%	-3.4	0.6	-4.568 + 10.300<GSSTEI>	0.781	0.610	0.39	>99.9%	-3.43	0.60
-3.333 - 1.706<CAR>	-0.262	0.069	0.6	>90%	-3.4	0.6	-114.204 + 4.292<JMASSTM>	0.525	0.276	0.51	>95%	-3.43	0.60
-3.330 + 0.213<TNI>	0.089	0.008	0.7	<90%	-3.4	0.7	-3.222 + 0.472<TNI>	0.242	0.058	0.60	<90%	-3.43	0.60

EE. <AMO>

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
-0.069 + 1.407<CAR>	0.926	0.858	0.05	>99.9%	-0.04	0.1	-0.110 + 1.674<CAR>	0.996	0.992	0.01	>99.9%	0.07	0.11
-0.021 + 0.134<AMM>	0.897	0.805	0.06	>99.9%	-0.03	0.1	0.046 + 0.119<AMM>	0.993	0.986	0.01	>99.9%	0.07	0.11
-0.071 + 0.855<NTA>	0.821	0.674	0.1	>99.9%	-0.04	0.1	-0.099 + 0.910<NTA>	0.991	0.981	0.02	>99.9%	0.07	0.11
-3.252 + 0.341<AT>	0.764	0.584	0.1	>99.9%	-0.03	0.1	-4.731 + 0.487<AT>	0.979	0.959	0.02	>99.9%	0.07	0.11
-0.467 - 0.127<QBO>	-0.556	0.309	0.1	>99.9%	-0.03	0.1	0.140 - 0.756<NAO>	-0.973	0.946	0.03	>99.9%	0.07	0.11
0.021 - 0.689<GSSTEI>	-0.395	0.156	0.1	>99.5%	-0.03	0.1	0.320 - 2.312<GSSTEI>	-0.957	0.915	0.03	>99.9%	0.07	0.11
-0.036 - 0.298<NAO>	-0.348	0.121	0.1	>98%	-0.04	0.1	0.202 + 0.060<SOI>	0.949	0.901	0.04	>99.9%	0.07	0.11
-0.062 - 0.151<TNI>	-0.336	0.113	0.1	>98%	-0.03	0.1	0.178 - 0.472<PDO>	-0.921	0.848	0.04	>99.9%	0.07	0.11
-0.042 + 0.193<ONI>	0.229	0.053	0.1	<90%	-0.04	0.1	0.234 - 0.525<MEI>	-0.919	0.844	0.04	>99.9%	0.07	0.11
-0.036 - 0.051<PDO>	-0.187	0.035	0.1	<90%	-0.03	0.1	0.211 - 0.912<ONI>	-0.887	0.787	0.05	>99.9%	0.07	0.11
-3.041 + 0.117<JMASSTM>	0.151	0.023	0.1	<90%	-0.04	0.1	-0.450 - 0.150<QBO>	-0.819	0.671	0.07	>99.9%	0.07	0.11
-0.032 + 0.004<SOI>	0.064	0.004	0.1	<90%	-0.03	0.1	18.929 - 0.731<JMASSTM>	-0.488	0.238	0.10	>90%	0.07	0.11
-0.040 - 0.000<MEI>	-0.001	0.000	0.1	<90%	-0.04	0.1	0.056 - 0.020<TNI>	-0.056	0.003	0.11	<90%	0.07	0.11

FF. <AMM>

regression equation	r	rxr	se	cl	mean	sd	regression equation	r	rxr	se	cl	mean	sd
0.109 + 6.008<AMO>	0.897	0.805	0.4	>99.9%	-0.1	0.9	-1.225 + 7.671<NTA>	0.997	0.995	0.07	>99.9%	0.16	0.91
-0.306 + 7.486<CAR>	0.745	0.555	0.6	>99.9%	-0.2	0.9	-0.384 + 8.316<AMO>	0.993	0.986	0.11	>99.9%	0.16	0.91
-3.761 - 1.074<QBO>	-0.702	0.492	0.7	>99.9%	-0.1	0.9	-1.290 + 13.873<CAR>	0.985	0.971	0.12	>99.9%	0.16	0.91
-0.090 - 3.851<NAO>	-0.677	0.459	0.7	>99.9%	-0.1	0.9	-40.138 + 4.092<AT>	0.982	0.965	0.18	>99.9%	0.16	0.91
-0.309 + 4.332<NTA>	0.629	0.396	0.7	>99.9%	-0.2	0.9	0.785 - 6.302<NAO>	-0.968	0.937	0.24	>99.9%	0.16	0.91
0.436 - 6.724<GSSTEI>	-0.576	0.332	0.8	>99.9%	-0.1	0.9	1.295 + 0.500<SOI>	0.940	0.883	0.32	>99.9%	0.16	0.91
-14.251 + 1.499<AT>	0.502	0.252	0.8	>99.9%	-0.1	0.9	2.243 - 18.890<GSSTEI>	-0.933	0.870	0.34	>99.9%	0.16	0.91
-0.123 - 0.765<PDO>	-0.420	0.176	0.9	>99.8%	-0.1	0.9	1.086 - 3.885<PDO>	-0.904	0.818	0.40	>99.9%	0.16	0.91
-0.024 + 0.123<SOI>	0.318	0.101	0.9	>95%	-0.1	0.9	1.541 - 4.300<MEI>	-0.899	0.808	0.42	>99.9%	0.16	0.91
-0.068 - 0.805<MEI>	-0.280	0.078	0.9	>95%	-0.1	0.9	1.333 - 7.366<ONI>	-0.856	0.732	0.49	>99.9%	0.16	0.91
17.444 - 0.685<JMASSTM>	-0.132	0.017	0.9	<90%	-0.1	0.9	-4.229 - 1.279<QBO>	-0.833	0.694	0.52	>99.9%	0.16	0.91
-0.163 - 0.375<TNI>	-0.125	0.016	0.9	<90%	-0.1	0.9	143.820 - 5.567<JMASSTM>	-0.444	0.197	0.85	>90%	0.16	0.91
-0.147 - 0.396<ONI>	-0.071	0.005	0.9	<90%	-0.2	0.9	0.069 - 0.202<TNI>	-0.067	0.005	0.94	<90%	0.16	0.91

Table 25. Listing of North Atlantic basin tropical cyclones for the year 2011.

						Genesis Location									
Year	SNBR	Name	Class.	FSD	LSD	N. Lat	W. Long.	Group	PWS	LP	ACE	NSD	NHD	NMHD	USLFH
2011	1447	Arlene	TS	06/28	06/30	20.7	93.5	1	55	993	1.9	2.25	-	-	
	1448	Bret	TS	07/18	07/21	27.5	78.1	3	60	995	3.3	4.00	-	-	
	1449	Cindy	TS	07/20	07/22	33.4	57.0	5	60	994	2.3	2.50	-	-	
	1450	Don	TS	07/27	07/30	22.0	86.7	1	45	997	1.6	2.50	-	-	
	1451	Emily	TS	08/02	08/07	14.9	61.4	2	45	1003	2.3	3.25	-	-	
	1452	Franklin	TS	08/13	08/13	37.6	61.1	3	40	1004	0.3	0.50	-	-	
	1453	Gert	TS	08/14	08/16	27.7	62.3	3	55	1000	1.9	2.25	-	-	
	1454	Harvey	TS	08/19	08/22	15.9	83.4	2	55	994	1.5	2.00	-	-	
	1455	Irene	MH	08/21	08/28	15.0	59.0	4	105	942	18.8	8.00	6.25	0.50	NC1
	1456	Jose	TS	08/27	08/28	27.9	63.4	3	40	1006	0.8	1.50	-	-	
	1457	Katia	MH	08/30	09/10	11.0	29.6	4	120	942	27.0	11.50	9.50	1.25	
	1458	Unnamed	TS	09/01	09/02	37.4	63.7	3	40	1002	0.8	1.50	-	-	
	1459	Lee	TS	09/02	09/05	27.2	91.4	1	50	986	1.8	2.75	-	-	
	1460	Maria	H	09/07	09/16	11.9	37.5	4	70	983	9.2	9.00	1.00	-	
	1461	Nate	H	09/07	09/11	20.3	92.9	1	65	994	4.4	4.50	0.50	-	
	1462	Ophelia	MH	09/21	10/03	12.5	39.7	4	120	940	18.7	9.75	3.50	2.00	
	1463	Philippe	H	09/24	10/08	11.1	26.1	4	80	976	15.9	13.75	2.50	-	
	1464	Rina	MH	10/24	10/28	16.0	81.9	2	100	966	10.1	4.75	2.75	0.75	
	1465	Sean	TS	11/08	11/11	27.7	69.8	3	55	982	3.7	3.75	-	-	

Summary: NTC = 19, NTS = 12, NH = 7, NMH = 4, NUSLFH = 1, PWS = 120, <PWS> = 66.3, LP = 940, <LP> = 984.2, <N. Lat.> = 22.0, <W. Long.> = 65.2, <ACE> = 6.6, Sum ACE = 126.3, <NSD> = 4.74, Sum NSD = 90.00, Sum NHD = 26.00, Sum NMHD = 4.50, NTCA = 145.0%, ACE/NSD = 1.39, HISACE = 27.0, LISNSD = 13.75

Table 26. The 34 strongest tropical cyclones, ranked by PWS (135–165 kt) from earliest to latest.

Storm Name	PWS	LP	ISACE	ISNSD	Group	Onset Mo
Camille 1969*	165	905	23.5	6.00	1	AUG
Allen 1980*	165	899	51.0	9.50	4	AUG
Dog 1950	160	-	62.6	12.50	4	AUG
Gilbert 1988	160	888	32.8	8.00	2	SEP
Wilma 2005*	160	882	38.9	8.75	2	OCT
Mitch 1998	155	905	35.9	10.75	2	OCT
Rita 2005*	155	897	25.1	6.50	3	SEP
Janet 1955	150	914	38.1	8.75	4	SEP
Carla 1961*	150	931	30.0	8.00	2	SEP
Anita 1977	150	926	12.8	4.00	1	AUG
David 1979*	150	924	44.0	11.50	4	AUG
Andrew 1992*	150	922	26.5	9.75	4	AUG
Katrina 2005*	150	902	20.0	6.00	3	AUG
Dean 2007	150	907	35.2	8.50	4	AUG
Felix 2007	150	930	18.0	4.25	4	SEP
Isabel 2003*	145	915	63.3	13.25	4	SEP
Ivan 2004*	145	910	70.4	14.75	4	SEP
Unnamed 1947*	140	947	62.6	16.25	4	SEP
Easy 1951	140	-	37.1	9.75	4	SEP
Cleo 1958	140	948	32.0	9.00	4	AUG
Donna 1960*	140	932	64.6	13.75	4	AUG
Ethel 1960*	140	981	5.3	2.25	1	SEP
Hattie 1961	140	920	21.7	5.00	2	OCT
Beulah 1967*	140	923	47.9	15.00	2	SEP
Edith 1971*	140	943	16.4	9.75	2	SEP
Hugo 1989*	140	918	42.7	11.25	4	SEP
Emily 2005	140	929	32.9	9.25	4	JUL
Carrie 1957	135	945	62.6	19.50	4	SEP
Cleo 1964*	135	950	37.7	13.25	4	AUG
Betsy 1965*	135	941	47.0	12.75	2	AUG
Georges 1998*	135	937	39.4	13.00	4	SEP
Floyd 1999*	135	921	29.4	9.25	4	SEP
Lenny 1999	135	933	19.9	6.75	2	NOV
Igor 2010	135	924	41.9	12.25	4	SEP

* means USLFH

Table 27. Frequency distribution of PWS.

Year	35-44	45-54	55-64	65-74	75-84	85-94	95-104	105-114	115-124	125-134	135-144	145-154	155-164	165+	Total	Comment
1945	1	4	1			2	1		2						11	
1946	3				1	1			1						6	
1947	2	2		1	1		1	1			1				9	Unnamed
1948	1	2		2				2	2						9	
1949	2	4		1		2	1	1	1	1					13	
1950		1	1		1		3	4	2				1		13	Dog
1951		2		2			4		1		1				10	Easy
1952		1			1	1	1	2		1					7	
1953	2	2	4	1			2	2		1					14	
1954	1	1	1	3		3		1	1						11	
1955	1		2		1	2	1	3		1		1			12	Janet
1956		2	2	1	1			1	1						8	
1957	1	2	2	1						1	1				8	Carrie
1958		2	1		2		1	1	2		1				10	Cleo
1959		3	1	4	1			1	1						11	
1960	2	1			1	1					2				7	Donna, Ethel
1961	1		2	1			1	2	1	1	1	1			11	Carla, Hattie
1962	1		1		1	2									5	
1963		2		2		2	1	1		1					9	
1964	2	3	1				1	1	1	2	1				12	Cleo
1965		2		1	1	1					1				6	Betsy
1966		4		3	1			2		1					11	
1967		2			4		1				1				8	Beulah
1968		1	2	4	1										8	
1969	1	2	3	2	3	2	2	2						1	18	Camille
1970		1	4	2		1		2							10	
1971		1	6	1	3		1				1				13	Edith
1972	1		3	1	1	1									7	
1973	1		3	1	2		1								8	
1974		4	3	1			2			1					11	
1975		1	2		1	1	2	1	1						9	
1976	2	2		1	1	2	1	1							10	
1977		1		3	1							1			6	Anita
1978	1	5	1	1	1	1			2						12	
1979	1	2	2		1	1			1			1			9	David
1980		1	1	3	1	3	1							1	11	Allen
1981		3	2	1	2	1	1	1	1						12	
1982			4		1			1							6	
1983			1	2			1								4	
1984	1	5	2	2	1	1		1							13	
1985		1	3	1	3			2		1					11	
1986		2		1	2	1									6	
1987	1	3		2				1							7	
1988	2	3	2	2						2			1		12	Gilbert
1989		3	1	1	2	2				1	1				11	Hugo
1990	2	1	3	3	3	1		1							14	
1991	1	3		1		1	1		1						8	
1992		1	2		1		2					1			7	Andrew
1993	2	2		2		1	1								8	
1994		2	2	1	1		1								7	
1995	2	2	4	2	2		4		2	1					19	
1996	2	1	1	3			3	1	1	1					13	
1997	4	1		2				1							8	
1998	1	1	2	1	2	4	1				1		1		14	Georges, Mitch
1999	1	3				2	1		1	2	2				12	Floyd, Lenny
2000	3	2	2	2	2	1		1	2						15	
2001	1	2	3	3	1	1	1	1	1	1					15	
2002	2	5	1		1	1		1		1					12	
2003	2	3	4	2	1	1		1		1		1			16	Isabel
2004	1	4	1	2			1	2		3		1			15	Ivan
2005	3	5	5	4	3	1	2			1	1	1	2		28	Emily, Katrina, Rita, Wilma
2006		3	2	1	2			2							10	
2007	4	5		3	1							2			15	Dean, Felix
2008	2	1	5		2	1		1	1	3					16	
2009	1	4	1			1		1	1						9	
2010	3	2	2	1	2	4		1	2	1	1				19	Igor
Total	68	136	104	88	68	54	49	51	33	30	17	10	5	2	715	

Table 28. Frequency distribution of ISACE.

Year	0.1-9.9	10.0-19.9	20.0-29.9	30.0-39.9	40.0-49.9	50.0-59.9	60.0-69.9	70.0+	Total	Comment
1945	9	1	1						11	
1946	6								6	
1947	5	3					1		9	Unnamed
1948	5	2	1	1					9	
1949	9	3	1						13	
1950	4	5	2	1			1		13	Dog
1951	4	4	1	1					10	
1952	3	3	1						7	
1953	11	2	1						14	
1954	7	3			1				11	Hazel
1955	5	2	3	1	1				12	Connie
1956	6	1	1						8	
1957	7						1		8	Carrie
1958	4	5		1					10	
1959	9		1	1					11	
1960	6						1		7	Donna
1961	4	1	3	2		1			11	Esther
1962	3	2							5	
1963	5	2	1		1				9	Flora
1964	7	1	1	3					12	
1965	4		1		1				6	Betsy
1966	7	2			1	1			11	Faith, Inez
1967	4	2	1		1				8	Beulah
1968	7	1							8	
1969	13	2	2	1					18	
1970	10								10	
1971	11	1			1				13	Ginger
1972	6		1						7	
1973	7	1							8	
1974	9	1	1						11	
1975	5	4							9	
1976	7	2		1					10	
1977	5	1							6	
1978	9	3							12	
1979	6	1	1		1				9	David
1980	8	1		1		1			11	Allen
1981	7	4	1						12	
1982	5	1							6	
1983	4								4	
1984	9	4							13	
1985	8	2	1						11	
1986	5	1							6	
1987	5	2							7	
1988	9		1	2					12	
1989	7	2		1	1				11	Hugo
1990	11	2	1						14	
1991	7	1							8	
1992	4	1	2						7	
1993	7		1						8	
1994	6	1							7	
1995	11	3	4			1			19	Luis
1996	7	2	3		1				13	Edouard
1997	7		1						8	
1998	9	1	2	2					14	
1999	4	4	3		1				12	Gert
2000	12	1	1	1					15	
2001	10	4	1						15	
2002	9	3							12	
2003	13		1		1		1		16	Fabian, Isabel
2004	7	4	2		1			1	15	Frances, Ivan
2005	19	5	2	2					28	
2006	8		2						10	
2007	13	1		1					15	
2008	12	2	1	1					16	
2009	8		1						9	
2010	14	2	2		1				19	Igor
Total	494	115	58	24	14	4	5	1	715	

Table 29. Frequency distribution of ISNSD.

Year	0.1-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0	5.1-6.0	6.1-7.0	7.1-8.0	8.1-9.0	9.1-10.0	10.1+	Total	Comment
1945		1	5	2	1		1	1				11	
1946	1	1	4									6	
1947	1	1	1		2			3			1	9	Unnamed
1948		2	1	1		2	1				2	9	Unnamed, unnamed
1949		2	2	2	1	1	4		1			13	
1950			2	1		2	2	1	1	2	2	13	Charlie, Dog
1951		1		1	2	2	2		1	1		10	
1952		1			2		2	1	1			7	
1953		1	2	5	3		1	1			1	14	Alice
1954		3	1	1	1	2	1	1			1	11	Hazel
1955		1	1	1	1	1	1	1	2		3	12	Connie, Diane, Ione
1956		3	1	1	1	1				1		8	
1957		3	2	1	1						1	8	Carrie
1958		2			1	2	3	1	1			10	
1959	2	2	3	1	1				1		1	11	Hannah
1960	1	2	1	1		1					1	7	Donna
1961		2	1	1	2			1	1	1	2	11	Debbie, Esther
1962			1	2		1	1					5	
1963		1	1	2	1	1	1				2	9	Flora, Ginny
1964	1	2	2	1	2						4	12	Cleo, Dora, Ethel, Gladys
1965		2			2						2	6	Betsy, Carol
1966	1	3	1	1		1		2			2	11	Faith, Inez
1967		2	1		1				1		3	8	Beulah, Chloe, Heidi
1968	1		1	2	2	1		1				8	
1969	1	4	1	2	2	4	1			1	2	18	Debbie, Inga
1970	1	3	2	2	1			1				10	
1971		6	3		1			1		1	1	13	Ginger
1972		2	1	1		1	1		1			7	
1973		1		3	1		1	1	1			8	
1974	1	1	3	1	3	1				1		11	
1975	1		3			1	1	1	2			9	
1976		2	2	1	1	1	2				1	10	Emmy
1977	1	1	2	2								6	
1978	2	2	2	2	1	1	1			1		12	
1979		4	1	1					1		2	9	David, Frederic
1980	1	1	1		2	3		1		1	1	11	Frances
1981	1	2	1	1	1		2	1	2		1	12	Emily
1982		3	1		1		1					6	
1983			2	2								4	
1984	3	1	2	1	1		1	1		1	2	13	Josephine, Lili
1985		1	4	1		3		1		1		11	
1986		1	3			1		1				6	
1987	1			3		1		1			1	7	Arlene
1988	3	3	2		1			1			2	12	Helene, Joan
1989		2	2	1	1			1	1	1	2	11	Gabrielle, Hugo
1990	1	1	2	2	2	2	1		1	1	1	14	Isidore
1991		3	2	2			1					8	
1992		1		3		1				1	1	7	Bonnie
1993	1	1	3	1	1						1	8	Emily
1994	1	3				1	1			1		7	
1995	1	2	3	1	2	2	1			4	3	19	Felix, Iris, Luis
1996	1	2		2	1		2		2		3	13	Edouard, Fran, Lili
1997		3	3		1						1	8	Erika
1998	2		2	1	2		1	1		1	4	14	Bonnie, Danielle, Georges, Mitch
1999	1		1	1	2	1	1	1		1	3	12	Cindy, Dennis, Gert
2000	1	3	2	3	1	2	1			1	1	15	Alberto
2001		3	3	2	2	2		1	1		1	15	Erin
2002	1	3	3	1		1			1	1	1	12	Kyle
2003	2	1	4	2	2				2		3	16	Fabian, Isabel, Kate
2004		4	1	2	2		1		1		4	15	Frances, Ivan, Jeanne Lisa
2005	6	3	3	1	1	5	2	2	2	2	1	28	Ophelia
2006	1		2	2	1			2		1	1	10	Helene
2007	5	3	3	1	1	1			1			15	
2008	1	3		5	2			1	1	1	2	16	Bertha, Ike
2009	1	4	1		2				1			9	
2010	2	4		3	4	1		1	2		2	19	Earl, Igor
Total	52	125	110	86	73	54	43	35	33	28	76	715	

Table 30. Frequency distribution of ISNHD.

Year	0.0	0.1-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0	5.1-6.0	6.1-7.0	7.1-8.0	8.1-9.0	9.1-10.0	10.1+	Total	Comment
1945	6		3		1	1							11	
1946	3		2	1									6	
1947	4		1	1		2						1	9	unnamed
1948	3	1	1			1	2					1	9	unnamed
1949	6		2	3		1		1					13	
1950	2		1	2	2	2		1	2			1	13	Dog
1951	2	1	1	1	1		2		1	1			10	
1952	1	2			1	2			1				7	
1953	8	1		2	2		1						14	
1954	3	2	1		1	3					1		11	
1955	3	1	1				3	2	2				12	
1956	4	1	1	1					1				8	
1957	5	1		1								1	8	Carrie
1958	3		2			3	1		1				10	
1959	4	3	2						1		1		11	
1960	3	1	1		1							1	7	Donna
1961	3	1			2	1	1			1	2		11	
1962	2		1			2							5	
1963	2		2		2		1			1		1	9	Flora
1964	6			1	1					2	1	1	12	Gladys
1965	2			2								2	6	Betsy, Carol
1966	4	1	1		2	1						2	11	Faith, Inez
1967	2	1	1				1	1				2	8	Beulah, Chloe
1968	3	1	2	1		1							8	
1969	6	2	3	3	2					1		1	18	Inga
1970	5	2	2	1									10	
1971	7	1	3		1							1	13	Ginger
1972	4		2		1								7	
1973	4	1		2		1							8	
1974	7		1	1		1	1						11	
1975	3		3		2				1				9	
1976	4	1		2	1		1				1		10	
1977	1	3	1		1								6	
1978	7		2	1	1	1							12	
1979	3	3			1			1		1			9	
1980	2	1	2	2	1		1		1			1	11	Frances
1981	5	2		2	1		1	1					12	
1982	4	1					1						6	
1983	1	1	2										4	
1984	8	1		1	1	1		1					13	
1985	4	2	2			1	1	1					11	
1986	2	2	1						1				6	
1987	4	1	2										7	
1988	7	2				1		1		1			12	
1989	4	2	1			1	1			1	1		11	
1990	6	2	1	2	1				1	1			14	
1991	4	1	1	1	1								8	
1992	3		1		1	1	1						7	
1993	4	2	1						1				8	
1994	4	1	1			1							7	
1995	8	1		4		1			2	1	1	1	19	Luis
1996	4	3			1		1	1	1		1	1	13	Edouard
1997	5	1	1						1				8	
1998	4	2	1	1	1		1	2			1	1	14	Georges
1999	4			2	1	1	2	1			1		12	
2000	7	1		4	1				1			1	15	Alberto
2001	6	3		2	2	1	1						15	
2002	8	1	1		2								12	
2003	9	3		1			1				1	1	16	Isabel
2004	6	2		1	2			2				2	15	Frances, Ivan
2005	13	3	2	2	3	3		1	1				28	
2006	5	1	1	1					1	1			10	
2007	9	4		1				1					15	
2008	8	1	2	2	1				1		1		16	
2009	6			2				1					9	
2010	7	2	4	2	1		1	1			1		19	
Total	306	80	70	59	47	35	27	20	22	12	14	23	715	

Table 31. Frequency distribution of ISNMHD.

Year	0.0	0.1-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0	5.1-6.0	6.1-7.0	7.1-8.0	8.1-9.0	9.1-10.0	Total	Comment
1945	8	1	1	1								11	
1946	5	1										6	
1947	7	1						1				9	
1948	5	1	2		1							9	
1949	10	1	1		1							13	
1950	5	4	1	1	1			1				13	
1951	5	3		1	1							10	
1952	4		2		1							7	
1953	10	2	1	1								14	
1954	9			1				1				11	
1955	6	1	2	1		1	1					12	
1956	6		2									8	
1957	6	1					1					8	
1958	5	1	3		1							10	
1959	9		1	1								11	
1960	5	1									1	7	Donna
1961	4		2	2	1	1				1		11	
1962	4	1										5	
1963	7	1						1				9	
1964	6	1	1	2	2							12	
1965	5								1			6	
1966	8	1	1					1				11	
1967	7						1					8	
1968	8											8	
1969	13	3		1	1							18	
1970	8	2										10	
1971	12	1										13	
1972	7											7	
1973	7	1										8	
1974	9		1	1								11	
1975	6	2	1									9	
1976	8	2										10	
1977	5	1										6	
1978	10	1		1								12	
1979	7		1			1						9	
1980	9	1						1				11	
1981	9	1	2									12	
1982	5		1									6	
1983	3	1										4	
1984	12	1										13	
1985	8	1	2									11	
1986	6											6	
1987	6	1										7	
1988	9		1	1		1						12	
1989	9					1	1					11	
1990	13	1										14	
1991	6	2										8	
1992	6				1							7	
1993	7	1										8	
1994	7											7	
1995	14	3	1						1			19	
1996	7	3	2						1			13	
1997	7			1								8	
1998	11		1		2							14	
1999	7		3	1			1					12	
2000	12	1	1	1								15	
2001	11	3	1									15	
2002	10		2									12	
2003	13		1						2			16	
2004	9	3			1			1			1	15	Ivan
2005	21	2		2	1	2						28	
2006	8	1	1									10	
2007	13		1		1							15	
2008	11	3	1			1						16	
2009	7	1		1								9	
2010	14	2	1		1	1						19	
Total	536	67	45	21	17	9	5	7	5	1	2	715	

Table 32. Frequency distribution of onset location N. LAT.

Year	5.0-9.9	10.0-14.9	15.0-19.9	20.0-24.9	25.0-29.9	30.0-34.9	35.0-39.9	40.0+	Total	Comment
1945		2	7	1	1				11	
1946			1	3	2				6	
1947		2	4	2	1				9	
1948		2	4	2	1				9	
1949		2	6	3	2				13	
1950		1	6	4	2				13	
1951		4	2	1	2	1			10	
1952		1	5	1					7	
1953		3	3	8					14	
1954		2	1	5	2	1			11	
1955		2	7	1	2				12	
1956		1		5	2				8	
1957		1		4	3				8	
1958		3	3	3	1				10	
1959		1		4	4	2			11	
1960		2		4		1			7	
1961		4	3	1	1	2			11	
1962			2	1	1	1			5	
1963		3	3		1	2			9	
1964		3	2	3	1	3			12	
1965		1	1	2	1	1			6	
1966		3	3	3		1	1		11	
1967		2	1	4	1				8	
1968			2	1	1	3	1		8	
1969		5	2	2	4	3	2		18	
1970		1	1	4	2	1	1		10	
1971		4	1		4	2	1	1	13	Unnamed
1972				1	1	3	2		7	
1973		2	1	2	1	1	1		8	
1974		2	2	1	1	3	2		11	
1975		1	1	2		4		1	9	ST2
1976		1	1	1	5	2			10	
1977			1		2	2	1		6	
1978		3	1	3	3	1	1		12	
1979		3	1	3	1		1		9	
1980		3	2	1	1	2	2		11	
1981		2	5		2	1	2		12	
1982		1		2	3				6	
1983					3	1			4	
1984		3	1	3	2	2	2		13	
1985		1	1	4	2	2	1		11	
1986		1		2	2	1			6	
1987		2	2	1	2				7	
1988		5	1	2	2		1	1	12	Alberto
1989		3	4	2	2				11	
1990	1	4	4	2	1		2		14	
1991		1		1	4		2		8	
1992		1		1	2	3			7	
1993		3	1		3	1			8	
1994		4		2	1				7	
1995		6	5	4	3	1			19	
1996		7	4		1	1			13	
1997		1		1	2	4			8	
1998		6	2	2	3	1			14	
1999		5	4	1	2				12	
2000		4	3	4	2	2			15	
2001		4	3		6	2			15	
2002	1	1	1		3	5	1		12	
2003		4	2	4	4	2			16	
2004	1	6	1	2	1	4			15	
2005		5	5	7	7	3	1		28	
2006		3	2	2	1	1		1	10	Unnamed
2007		5	2	2	2	2	2		15	
2008		4	7	2	1	1	1		16	
2009		4	2	1	1		1		9	
2010	1	9	4	4	1				19	
Total	4	175	146	144	128	82	32	4	715	

Table 33. Frequency distribution of onset location W. LONG.

Year	10.0-19.9	20.0-29.9	30.0-39.9	40.0-49.9	50.0-59.9	60.0-69.9	70.0-79.9	80.0-89.9	90.0-99.9	Total
1945					3	1	1	4	2	11
1946							3	2	1	6
1947		1				1	3	3	1	9
1948	1				2	1	2	1	2	9
1949			1	2	1	4	1	3	1	13
1950		1		3	4			4	1	13
1951		1	1	1	2		2	2	1	10
1952					4	1		2		7
1953			2	1	2	2	3	3	1	14
1954				2	2	2	2		3	11
1955			2	2	3	1	1	2	1	12
1956				1			3	1	3	8
1957		1				2		3	2	8
1958		1		2	2	2	1	1	1	10
1959				1	2		3	3	2	11
1960		1				2	1	1	2	7
1961		1	1	2	1	1	2	2	1	11
1962		1		1		1	2			5
1963				2	5		1		1	9
1964		1	1	3	1	1	1	3	1	12
1965			1		2	1		1	1	6
1966		1		2	5	1		1	1	11
1967	1		1	1	1	2	1		1	8
1968			1			2	2	2	1	8
1969			2	3	2		6	5		18
1970				1	1	1	2	5		10
1971				1	2	3	5	1	1	13
1972				1	2		3	1		7
1973		1	1			2	2	2		8
1974					2	3	5	1		11
1975			1	3		1	3		1	9
1976				2	3	1	1	3		10
1977						2	1	3		6
1978			1	3	1	3	1		3	12
1979			2	1	1	2			3	9
1980		3	1	2		2		2	1	11
1981			1	2	1	5	1	2		12
1982		1				1	1	2	1	6
1983						1	2		1	4
1984		1		1	3	4	3		1	13
1985		1				3	3	3	1	11
1986					2	1	2	1		6
1987		2	1		1		1	1	1	7
1988	1		1	1	2	2		3	2	12
1989		3	1	2	1			1	3	11
1990		1	3	3	3	1	1	2		14
1991			1		2	1	3	1		8
1992			1	1	1	2	2			7
1993			1	1	1	3		1	1	8
1994			1	2		1		3		7
1995		1	3	2	4	1	3	3	2	19
1996		1	3	1	1	1	1	4	1	13
1997				1		3	3		1	8
1998	1	1	4	1	1	1	1		4	14
1999		1	1	1	3		2	3	1	12
2000		2	1	2	2		4	3	1	15
2001			1	2	3	5		3	1	15
2002			1		3		5	2	1	12
2003			3	2	1	3	2	2	3	16
2004		1	4	1	1	4	2	1	1	15
2005		2	1	5	2	5	6	3	4	28
2006		1	1	1	3	2	1	1		10
2007		1	2	2	1	2	3	1	3	15
2008		2	2	1	1	4	1	4	1	16
2009		2	2		2		1	2		9
2010		3	3	2	1	2	2	5	1	19
Total	4	41	62	80	102	106	120	124	76	715

REFERENCES

1. "Glossary of NHC Terms," National Weather Service, National Hurricane Center, <http://www.nhc.noaa.gov/aboutgloss.shtml>, accessed May 2012.

2. "Saffir-Simpson Hurricane Wind Scale," National Weather Service, National Hurricane Center, <http://www.nhc.noaa.gov/aboutsshws.php>, accessed May 2012.

3. Blake, E.S.; Landsea, C.W.; and Gibney, E.J.: "The Deadliest, Costliest, and Most Intense United States Tropical Cyclones from 1851 to 2010 (and Other Frequently Requested Hurricane Facts), NOAA Technical Memorandum NWS NHC-6, NOAA/NWS/ NHC, Miami, FL, 47 pp., August 2011.

4. "Index of/data/hurdat," National Weather Service, National Hurricane Center, <http://www.nhc.noaa.gov/data/hurdat/>, accessed May 2012.

5. "Storms Before the 1900's," Hurricanes: Science and Society, University of Rhonde Island, <http://www.hurricanescience.org/history/storms/pre1900s/1502/>, accessed May 2012.

6. Landsea, C.W.: "Comment on 'Changes in the Rates of North Atlantic Major Hurricane Activity during the 20th Century'," *Geophys. Res. Lett.*, Vol. 28, p. L2871, 2001.

7. Landsea, C.W.: "Counting Atlantic Tropical Cyclones Back to 1900," *Eos*, Vol. 88, p. 197, 2007.

8. Landsea, C.W.: "A Climatology of Intense (or Major) Atlantic Hurricanes," *Mon. Weath. Rev.*, Vol. 121, p. 1703, 1993.

9. Landsea, C.W.; Nicholls, N.; and Gray, W.M.: "Downward Trends in the Frequency of Intense Atlantic Hurricanes during the Past Five Decades," *Geophys. Res. Lett.*, Vol. 23, p. L1697, 1996.

10. "Tropical Cyclone Names," National Weather Service, National Hurricane Center, <http://www.nhc.noaa.gov/aboutnames.shtml>, accessed May 2012.

11. Ochoa, G.; Hoffman, J.; and Tin, T.: *Climate: The Force That Shapes Our World and the Future of Life on Earth*, Rodale Intern. Ltd., London, UK, p. 216, 2005.

12. Goldenberg, S.B.; Landsea, C.W.; Mestas-Nuñez, A.M.; and Gray, W.M.: "The Recent Increase in Atlantic Hurricane Activity: Causes and Implications," *Science*, Vol. 293, p. 474, 2001.

13. Landsea, C.W.; Pielke, R.A.; Mestas-Nuñez, A.M.; and Knaff, J.A.: Atlantic Basin Hurricanes: Indices of Climatic Changes," *Clim. Change*, Vol. 42, p. 89, 1999.

14. Emanuel, K.: "Increasing Destructiveness of Tropical Cyclones over the Past 30 Years," *Nature*, Vol. 436, p. 686, 2005.

15. Pielke, R.A., Jr.; Landsea, C.; Mayfield, M.; et al.: "Hurricanes and Global Warming," *Bull. Amer. Meteor. Soc.*, Vol. 86, p. 1571, 2005.

16. Landsea, C.W.: "Meteorology: Hurricanes and Global Warming," *Nature*, Vol. 438, p. E11, 2005.

17. Klotzbach, P.J.: "Trends in Global Tropical Cyclone Activity over the Past Twenty Years (1986–2005)," *Geophys. Res. Lett.*, Vol. 33, p. L10805, 2006.

18. Holland, G.J.; and Webster, P.J.: "Heightened Tropical Cyclone Activity in the North Atlantic: Natural or Climatic Trend," *Phil. Trans. R. Soc. A.*, Vol. 365, p. 2695, 2007.

19. Knutson, T.R.; McBride, J.L.; Chan, J.; et al.: "Tropical Cyclones and Climate Change," *Nature GeoSci.*, Vol. 3, p. 157, 2010.

20. Wilson, R.M.: "Comment on 'Downward Trends in the Frequency of Intense Atlantic Hurricanes during the Past Five Decades' by C.W. Landsea et al.," *Geophys. Res. Lett.*, Vol. 24, p. L2203, 1997.

21. Wilson, R.M.: "Deciphering the Long-Term Trend of Atlantic Basin Intense Hurricanes: More Activity versus Less Active during the Present Epoch," *NASA/TP—1998–209003*, Marshall Space Flight Center, AL, 16 pp., December 1998.

22. Wilson, R.M.: "Statistical Aspects of ENSO Events (1950–1997) and the El Niño-Atlantic Intense Hurricane Activity Relationship," *NASA/TP—1998–209005*, Marshall Space Flight Center, AL, 24 pp., December 1998.

23. Wilson, R.M.: "Statistical Aspects of Major (Intense) Hurricanes in the Atlantic Basin during the Past 49 Hurricane Seasons (1950–1998): Implications for the Current Season," *Geophys. Res. Lett.*, Vol. 26, p. L2957, 1999.

24. Wilson, R.M.: "Decadal Trends of Atlantic Basin Tropical Cyclones (1950–1999)," *NASA/TP—2001–210991*, Marshall Space Flight Center, AL, 32 pp., May 2001.

25. Wilson, R.M.: "Statistical Aspects of the North Atlantic Basin Tropical Cyclones: Trends, Natural Variability, and Global Warming," *NASA/TP—2007–214905*, Marshall Space Flight Center, 60 pp., May 2007.

26. Wilson, R.M.: “An Estimate of North Atlantic Basin Tropical Cyclone Activity for 2008,” *NASA/TP—2008–215471*, Marshall Space Flight Center, AL, 38 pp., August 2008.

27. Wilson, R.M.: “An Extended Forecast of the Frequencies of North Atlantic Basin Tropical Cyclone Activity for 2009,” *NASA/TP—2009–215741*, Marshall Space Flight Center, AL, 52 pp., March 2009.

28. Wilson, R.M.: “North Atlantic Basin Tropical Cyclone Activity in Relation to Temperature and Decadal-Length Oscillation Patterns,” *NASA/TP—2009–215796*, Marshall Space Flight Center, AL, 84 pp., June 2009.

29. Wilson, R.M.: “An Estimate of the North Atlantic Basin Tropical Cyclone Activity for the 2010 Hurricane Season,” *NASA/TP—2010–216429*, Marshall Space Flight Center, AL, 44 pp., May 2010.

30. Wilson, R.M.: “An Estimate of the North Atlantic Basin Tropical Cyclone Activity for the 2011 Hurricane Season,” *NASA/TP—2011–216466*, Marshall Space Flight Center, AL, 78 pp., June 2011.

31. Lapin, L.L.: *Statistics for Modern Business Decisions*, 2nd Ed., Harcourt Brace Jovanovich, Inc., New York, p. 486, 1978.

32. McElroy, E.E.: *Applied Business Statistics*, 2nd Ed., Holden-Day Inc., San Francisco, p. 174, 1979.

33. Lapin, L.L.: *Statistics for Modern Business Decisions*, 2nd Ed., Harcourt Brace Jovanovich, Inc., New York, p. 626, 1978.

34. Wilson, R.M.: “An Examination of the Hadley Sea-Surface Temperature Time Series for the Niño 3.4 Region,” *NASA/TP—2010–216432*, Marshall Space Flight Center, AL, 94 pp., May 2010.

35. Gray, W.M.: “Atlantic Seasonal Hurricane Frequency. Part I.: El Niño and 30 mb Quasi-Biennial Oscillation Influences,” *Mon. Wea. Rev.*, Vol. 112, p. 1649, 1984.

36. Goldenberg, S.B.; and Shapiro, L.J.: “Physical Mechanisms for the Association of El Niño and West African Rainfall with Atlantic Major Hurricane Activity,” *J. Climate*, Vol. 9, p. 1169, 1996.

37. O’Brien, J.J.; Richards, T.S.; and Davis, A.C.: “The Effect of El Niño on U.S. Landfalling Hurricanes,” *Bull. Amer. Meteor. Soc.*, Vol. 77, p. 773, 1996.

38. Bove, M.C.; Elsner, J.B.; Landsea, C.W.; et al.: “Effect of El Niño on U.S. Landfalling Hurricanes,” *Bull. Amer. Meteor. Soc.*, Vol. 79, p. 2477, 1998.

39. Pielke, R.A., Jr.; and Landsea, C.W.: "La Niña, El Niño, and Atlantic Hurricane Damages in the United States," *Bull. Amer. Meteor. Soc.*, Vol. 80, p. 2027, 1999.

40. Glantz, M.H.: *Currents of Change: Impacts of El Niño and La Niña on Climate and Society*, Cambridge University Press, Cambridge, 252 pp., 2001.

41. Butler, C.J.: "Maximum and Minimum Temperatures at Armagh Observatory, 1844–1992, and the Length of the Sunspot Cycle," *Solar Phys.*, Vol. 152, p. 35, 1994.

42. Butler, C.J.; and Johnston, D.J.: "The Link between the Solar Dynamo and Climate – The Evidence from a Long Mean Air Temperature Series from Northern Ireland," *Irish Astron J.*, Vol. 21, p. 251, 1994.

43. Butler, C.J.; and Johnston, D.J.: "A Provisional Long Mean Air Temperature Series for Armagh Observatory," *J. Atmos. Terr. Phys.*, Vol. 58, p. 1657, 1996.

44. Wilson, R.M.: "Evidence for Solar-Cycle Forcing and Secular Variation in the Armagh Observatory Temperature Record (1844–1992)," *J. Geophys. Res.*, Vol. 103, p. 11,159, 1998.

45. Coughlin, A.D.S.; and Butler, C.J.: "Is Urban Spread Affecting the Mean Temperature at Armagh Observatory," *Irish Astron. J.*, Vol. 25, p. 125, 1998.

46. Butler, C.J.; Garcia Suárez, A.M.; Coughlin, A.D.S.; and Morrell, C.: "Air Temperatures at Armagh Observatory, Northern Ireland, from 1796 to 2002," *J. Climatol.*, Vol. 25, p. 1055, 2005.

47. Wilson, R.M.; and Hathaway, D.H.: "Examination of the Armagh Observatory Annual Mean Temperature Record, 1844–2004," *NASA/TP—2006–214434*, Marshall Space Flight Center, AL, 24 pp., July 2006.

48. Butler, C.J.; and Garcia Suárez, A.M.: "Trends and Cycles in Long Irish Meteorological Series," *Biol. Environ: Proc. Roy. Irish Acad.*, Vol. 107, p. 157, 2008.

49. "Calibrated Data," Armagh Observatory Meteorology Data Bank, <http://climate.arm.ac.uk/calibrated.html>, accessed May 2012.

50. "Monthly Records," Armagh Observatory Meteorology Data Bank, <http://climate.arm.ac.uk/scan.html>, accessed May 2012.

51. "Cold & Warm Episodes by Season," National Weather Service, <http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ensoyears.shtml>, accessed May 2012.

52. "Forecasts," National Oceanic and Atmospheric Administration, <http://www.elnino.noaa.gov/forecast.html>, accessed May 2012.

53. "S.O.I. (Southern Oscillation Index) Archives – 1876 to Present," Australian Government Bureau of Meteorology, <http://reg.bom.gov.au/climate/current/soihtm1.shtml>, accessed May 2012.

54. "Pacific Remains Close to El Niño Thresholds," Australian Government Bureau of Meteorology, <http://reg.bom.gov.au/climate/enso/>, accessed May 2012.

55. Hurrell, J.W.; Kushnir, Y.; and Visbeck, M.: "The North Atlantic Oscillation," *Science*, Vol. 291, p. 603, 2001.

56. Visbeck, M.H.; Hurrell, J.W.; Polvani, L.; and Cullen, H.M.: "The North Atlantic Oscillation: Past, Present, and Future," *PNAS*, Vol. 98, p. 12,876, 2001.

57. Hurrell, J.W.; Kushnir, Y.; Ottersen, G.; and Visbeck, M.: "An Overview of the North Atlantic Oscillation," in *The North Atlantic Oscillation, Climatic Significance and Environmental Impact*, *AGU Geophys. Monogr.*, J.W. Hurrell, Y. Kushnir, G. Ottersen, and M. Visbeck (eds.), Vol. 134, p. 1, 2003.

58. Hurrell, J.W.; and Deser, C.: "North Atlantic Climate Variability: The Role of the North Atlantic Oscillation," *J. Marine Sys.*, Vol. 78, p. 28, 2009.

59. "North Atlantic Oscillation (NAO)," National Weather Service, <http://www.cpc.ncep.noaa.gov/products/precip/CWlink/pna/nao.shtml>, accessed May 2012.

60. Mantua, N.J.; Hare, S.R.; Zhang, Y.; et al.: "A Pacific Interdecadal Climate Oscillation with Impacts on Salmon Production," *Bull. Amer. Meteor. Soc.*, Vol. 78, p. 1069, 1997.

61. Minobe, S.: "A 50-70 Year Climatic Oscillation over the North Pacific and North America," *Geophys. Res. Lett.*, Vol. 24, p. L683, 1997.

62. Zhang, Y.; Wallace, J.M.; and Battisti, D.S.: "ENSO-Like Interdecadal Variability: 1900–93," *J. Climate*, Vol. 10, p. 1004, 1997.

63. Gershunov, A.; and Barnett, T.P.: "Interdecadal Modulation of ENSO Teleconnections," *Bull Amer. Meteor. Soc.*, Vol. 79, p. 2715, 1998.

64. McCabe, G.J.; and Dettinger, M.D.: "Decadal Variations in the Strength of ENSO Teleconnections with Precipitation in the Western United States," *Intern. J. Climatol.*, Vol. 19, p. 1399, 1999.

65. Nigam, S.; Barlow, M.; and Berbery, E.H.: "Analysis Links Pacific Decadal Variability to Drought and Streamflow in the United States," *Eos Trans. AGU*, Vol. 80, p. 621, 1999.

66. Bond, N.A.; and Harrison, D.E.: "The Pacific Decadal Oscillation, Air-Sea Interaction and Central Pacific Winter Atmospheric Regimes," *Geophys. Res. Lett.*, Vol. 27, p. L731, 2000.

67. Mantua, N.J.; and Hare, S.R.: "The Pacific Decadal Oscillation," *J. Oceanogr.*, Vol. 58, p. 35, 2002.

68. MacDonald, G.M.; and Case, R.A.: "Variations in the Pacific Decadal Oscillation over the Past Millennium," *Geophys. Res. Lett.*, Vol. 32, p. L08703, 2005.

69. "PDO INDEX," Joint Institute for the Study of the Atmosphere and Ocean, University of Washington, <http://jisao.washington.edu/pdo/PDO.latest>, accessed May 2012.

70. Trenberth, K.E.; and Stepaniak, D.P.: "Indices of El Niño Evolution," *J. Climate*, Vol. 14, p. 1697, 2001.

71. "Indices of El Niño Evolution," Earth System Research Laboratory, <http://www.esrl.noaa.gov/psd/gcos_wgsp/Timeseries/Data/tni.long.data>, accessed May 2012.

72. Wolter, K; and Timlin, M.S.: "Monitoring ENSO in COADS with a Seasonally Adjusted Principal Component Index," in *Proceedings of the 17th Climate Diagnostic Workshop*, Norman, OK, p. 52, 1993.

73. Wolter, K.; and Timlin, M.S.: "Measuring the Strength of ENSO Events: How Does 1997/98 Rank?" *Weather*, Vol. 53, p. 315, 1998.

74. Wolter, K.; and Timlin, M.S.: "El Niño/Southern Oscillation Behaviour since 1871 as Diagnosed in an Extended Multivariate ENSO Index (MEI.ext)," *Intern. J. Climatol.*, Vol. 31, p. 1074, 2011.

75. "MEI Timeseries, 1950–2012," Earth System Research Laboratory, <http://www.esrl.noaa.gov/psd/data/correlation/mei.data>, accessed May 2012.

76. "Global-SST ENSO Index, 1817–February 2011," Joint Institute for the Study of the Amosphere and Ocean, University of Washington, <http://jisao,washington.edu/data/globalsstenso/> accessed May 2012.

77. Penland, C.; and Matrosova, L.: "Prediction of Tropical Atlantic Sea Surface Temperatures using Linear Inverse Modeling," *J. Climate*, Vol. 11, p. 483, 1998.

78. Penland, C.; and Matrosova, L.: "Studies of El Niño and Interdecadal Variability in Tropical Sea Surface Temperatures using a Nonnormal Filter," *J. Climate*, Vol. 19, p. 5796, 2006.

79. Hastenrath, S.: "Dipoles, Temperature, Gradients, and Tropical Climate Anomalies," *Bull. Amer. Meteor. Soc.*, Vol. 83, p. 735, 2002.

80. "North Tropical Atlantic (NTA) Index, 1951–2010," Earth System Research Laboratory, <http://www.esrl.noaa.gov/psd/data/correlation/NTA.data>, accessed May 2012.

81. Giannini, A.; Kushnir, Y.; and Cane, M.A.: "Interannual Variability of Caribbean Rainfall, ENSO, and the Atlantic Ocean," *J. Climate*, Vol. 13, p. 297, 2000.

82. Peterson, T.C.; Taylor, M.A.; Demeritte, R.; et al.: "Recent Changes in Climate Extremes in the Caribbean Region," *J. Geophys. Res.*, Vol. 107, p. 4601, 2002.

83. "Carribbean (CAR) Index, 1951–2010," Earth System Research Laboratory, <http://www.esrl.noaa.gov/psd/data/correlation/CAR.data>, accessed May 2012.

84. Hamilton, K.: "Observations of Tropical Stratospheric Winds before World War II," *Bull. Amer. Meteor. Soc.,* Vol. 79, p. 1367, 1998.

85. Baldwin, M.P.; Gray, L.J.; Dunkerton, T.J.; et al.: "The Quasi-Biennial Oscillation," *Rev. Geophys.*, Vol. 39, p. 179, 2001.

86. Mazzarella, A.; and Giuliacci, A.: "On the Dominance of 28-Month Harmonic in the Equatorial-Stratospheric-Wind Quasi Biennial Oscillation," *The Open Atmos. Sci. J.*, Vol. 4, p. 53, 2010.

87. Mazzarella, A.; Giuliacci, A.; and Liritzis, I.: "QBO of the Equatorial-Stratospheric Winds Revisited: New Methods to Verify the Dominance of 28-Month Cycle," *Intern. J. Oceans Clim. Sys.*, Vol. 2, p. 19, 2011.

88. "QBO, 1948–2012," Earth System Research Laboratory, <http://www.esrl.noaa.gov/psd/data/correlation/qbo.data>, accessed May 2012.

89. "Monthly Atmospheric & SST Indices," National Weather Service Climate Prediction Center, <http://www.cpc.ncep.noaa.gov/data/indices/>, accessed May 2012.

90. Schlesinger, M.E.; and Ramankutty, N.: "An Oscillation in the Global Climate System of Period 65-70 Years," *Nature*, Vol. 367, p. 723, 1994.

91. Andronova, N.G.; and Schlesinger, M.E.: "Causes of Global Temperature Changes during the 19^{th} and 20^{th} Centuries," *Geophys. Res. Lett.*, Vol. 27, p. L2137, 2000.

92. Delworth, T.L.; and Mann, M.E.: "Observed and Simulated Multidecadal Variability in the Northern Hemisphere," *Clim. Dyn.*, Vol. 16, p. 661, 2000.

93. Kerr, R.A.: "A North Atlantic Climate Pacemaker for the Centuries," *Science*, Vol. 288, p. 1984, 2000.

94. Enfield, D.B; Mestas-Nuñez, A.M.; and Trimble, P.J.: "The Atlantic Multidecadal Oscillation and Its Relationship to Rainfall and River Flows in the Continental U.S.," *Geophys. Res. Lett.*, Vol. 28, p. L2077, 2001.

95. Gray, S.T.; Graumlich, L.J.; Betancourt, J.L.; and Pederson, G.T.: "A Tree-Ring Reconstruction of the Atlantic Multidecadal Oscillation since 1567 A.D.," *Geophys. Res. Lett.*, Vol. 31, p. L12205, 2004.

96. Kerr, R.A.: "Atlantic Climate Pacemaker for Millennia Past, Decades Hence?" *Science*, Vol. 309, p. 41, 2005.

97. Zhang, R.; and Delworth, T.L.: "Impact of Atlantic Multidecadal Oscillations on India/Sahel Rainfall Atlantic Hurricanes," *Geophys. Res. Lett.*, Vol. 33, p. L17712, 2006.

98. Dijkstra, H.A.; Raa, L.A. te; Schmeits, M.; and Gerrits, J.: "On the Physics of the Atlantic Multidecadal Oscillation," *Ocean Dyn.*, Vol. 56, p. 36, 2006.

99. Klotzbach, P.J.; and Gray, W.M.: "Multidecadal Variability in North Atlantic Tropical Cyclone Activity," *J. Climate*, Vol. 21, p. 3929, 2008.

100. Grossmann, I.; and Klotzbach, P.J.: "A Review of North Atlantic Modes of Natural Variability and Their Driving Mechanisms," *J. Geophys. Res.*, Vol. 114, p. D24107, 2009.

101. Broecker, W.S.: "The Great Ocean Conveyor," *Oceanography*, Vol. 4, p. 79, 1991.

102. Kaplan, A.; Cane, M.A.; Kushnir, Y.; et al.: "Analyses of Global Sea Surface Temperature 1856–1991," *J. Geophys. Res.*, Vol. 103, p. 18,567, 1998.

103. Poore, R.Z.; De Long, K.L.; Richey, J.N.; and Quinn, T.M: "Evidence of Multidecadal Climate Variability and the Atlantic Multidecadal Oscillation from a Gulf of Mexico Sea-Surface Temperature-Proxy Record," *Geo-Mar. Lett.*, Vol. 29, p. 477, 2009.

104. Poore, R.Z.; Quinn, T.; Richey, J.; and Smith, J.L.: "Cycles of Hurricane Landfalls on the Eastern United States Linked to Changes in Atlantic Sea-Surface Temperatures," G.S Farris, G.J. Smith, M.P. Crane, et al. (eds.), in *Science and the Storms—the USGS Response to the Hurricanes of 2005*, U.S. Geological Survey Circular 1306, Reston, VA, p. 7, 2007.

105. "AMO, 1948–2012," Earth System Research Laboratory, <http://www.esrl.noaa.gov/psd/data/correlation/amon.us.data>, accessed May 2012.

106. "Climate Timeseries: AMO (Atlantic Multidecadal Oscillation) Index," Earth System Research Laboratory, <http://esrl.noaa.gov/psd/data/timeseries/AMO>, accessed May 2012.

107. Chylek, P.: and Lesins, G.: "Multidecadal Variability of Atlantic Hurricane Activity: 1851–2007," *J. Geophys. Res.*, Vol. 113, p. D22106, 2008.

108. Chiang, J.C.H.; and Vimont, D.J.: "Analogous Pacific and Atlantic Meridional Modes of Tropical Atmosphere-Ocean Variability," *J. Climate*, Vol. 17, p. 4143, 2004.

109. Vimont, D.J.; and Kossin, J.P.: "The Atlantic Meridional Mode and Hurricane Activity," *Geophys. Res. Lett.*, Vol. 34, p. L07709, 2007.

110. Kossin, J.P.; and Vimont, D.J.: "A More General Framework for Understanding Atlantic Hurricane Variability and Trends," *Bull. Amer. Meteor. Soc.*, Vol. 88, p. 1767, 2007.

111. Chylek, P.; and Lesins, G.: "Multidecadal Variability of Atlantic Hurricane Activity: 1851-2007," *J. Geophys. Res.*, Vol. 113, p. D22106, 2008.

112. Dailey, P.S.; Zuba, G.; Ljung, G.: et al.: "On the Relationship between North Atlantic Sea Surface Temperatures and U.S. Hurricane Landfall Risk," *J. Appl. Meteor. Climatol.*, Vol. 48, p. 111, 2009.

113. Kossin, J.P.; Camargo, S.; and Sitkowski, M.: "Climate Modulation of North Atlantic Hurricane Tracks," *J. Climate*, Vol. 23, p. 3057, 2010.

114. "Monthly Climate Timeseries: Atlantic Meridional Mode (AMM) SST Index," Earth System Research Laboratory, <http://www.esrl.noaa.gov/psd/data/timeseries/monthly/AMM>, accessed May 2012.

115. "SST AMM, 1948–2012," Earth System Research Laboratory, <http://www.esrl.noaa.gov/psd/data/timeseries/monthly/AMM/ammsst.data>, accessed May 2012.

116. Everitt, B.S.: *The Analysis of Contingency Tables*, John Wiley and Sons, New York, p. 12, 1977.

117. Camargo, S.J.; Barnston, A.G.; Klotzbach, P.J.; and Landsea, C.W.: "Seasonal Tropical Cyclone Forecasts," *WWO Bull.*, Vol. 56, p. 297, 2007.

118. Kotzbach, P.J.: "Recent Developments in Statistical Prediction of Seasonal Atlantic Basin Tropical Cyclone Activity," *Tellus*, Vol. 59A, p. 511, 2007.

119. Klotzbach, P.J.; and Gray, W.M.: "Twenty-Five Years of Atlantic Basin Seasonal Hurricane Forecasts (1984–2008)," *Geophys. Res. Lett.*, Vol. 36, p. L09711, 2009.

120. Klotzbach, P.J.; and Gray, W.M.: "Extended Range Forecast of Atlantic Seasonal Hurricane Activity and Landfall-Strike Probability for 2011," Colorado State University, Fort Collins, CO, <http://typhoon.atmos.colostate.edu/forecasts/>, accessed April 2011.

121. Saunders, M.; and Lea, A.: "Extended Range Forecast for Atlantic Hurricane Activity in 2011," U. College London, UK, <http://tropicalstormrisk.com/>, accessed March 2011.

122. Cangialosi, J.P.; and Franklin, J.L.: "2011 National Hurricane Center Forecast Verification Report," National Hurricane Center, Miami, FL, 76 pp., March 2012, <http://www.nhc.noaa.gov/pastall.shtml#tcr>, accessed May 2012.

123. Klotzbach, P.J.; and Gray, W.M.: "Summary of 2011 Atlantic Tropical Cyclone Activity and Verification of Author's Seasonal and Two-Week Forecasts," Colorado State University, Fort Collins, CO, <http://typhoon.atmos.colostate.edu/forecasts>, accessed May 2012.

124. Saunders, M.; and Lea, A.: "Summary of 2011 Atlantic Tropical Cyclone Season and Verification of Author's Seasonal Forecasts," U. College London, UK, <http://tropicalstormrisk.com/>, accessed May 2012.

125. "'Irene' Retired from List of Atlantic Basin Storm Names," National Oceanic and Atmospheric Administration, <http://www.noaanews.noaa.gov/stories2012/20120413_irene.html>, accessed May 2012.

126. Klotzbach, P.J.; and Gray, W.M.: "Extended Range Forecast of Atlantic Seasonal Hurricane Activity and Landfall-Strike Probability for 2012," Colorado State University, Fort Collins, CO, <http://typhoon.atmos.colostate.edu/forecasts/>, accessed May 2012.

127. "Seasonal Range Forecast," European Centre for Medium-Range Weather Forecasts, <http://ecmwf.int./products/forecasts/d/charts/seasonal/forecast/seasonal_range_forecast/>, accessed May 2012.

128. Saunders, M.; and Lea, A.: "April Forecast Update for Atlantic Hurricane Activity in 2012," U. College London, UK, <http://tropicalstormrisk.com/>, accessed May 2012.

129. Elsner, J.B.; Kossin, J.P.; and Jagger, T.H.: "The Increasing Intensity of the Strongest Tropical Cyclones," *Nature*, Vol. 455, p. 92, 2008.

130. "The NOAA Annual Greenhouse Gas Index (AGGI)," Earth System Research Laboratory, <http://www.esrl.noaa.gov/gmd/aggi/> accessed May 2012.

131. Wilson, R.M.: "Solar Cycle and Anthropogenic Forcing of Surface air Temperature at Armagh Observatory, North Ireland," *NASA/TP—2010–216375*, Marshall Space Flight Center, AL, 28 pp., March 2010.

132. "NOAA Predicts a Near-Normal 2012 Atlantic Hurricane Season," National Oceanic and Atmospheric Administration, <http://www.noaanews.noaa.gov/stories2012/20120524_atlantic_hurricane_season.html>, accessed May 2012.

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14. ABSTRACT
Examined are statistical aspects of the 715 tropical cyclones that formed in the North Atlantic basin during the interval 1945–2010. These 715 tropical cyclones include 306 storms that attained only tropical storm strength, 409 hurricanes, 179 major or intense hurricanes, and 108 storms that struck the US coastline as hurricanes. Comparisons made using 10-yma values between tropical cyclone parametric values and surface air and ENSO-related parametric values indicate strong correlations to exist, in particular, against the Armagh Observatory (Northern Ireland) surface air temperature, the AMO index, the AMM index, and the NAO index, in addition to the ONI and QBO indices. Also examined are the decadal variations of the tropical cyclone parametric values and a look ahead towards the 2012 hurricane season and beyond.

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