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ATLANTIC TROPICAL CYCLONE STATISTICS

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16. ABSTRACT

Statistical climatologies of North Atlantic, Caribbean and Gulf of Mexico tropical cyclones are presented. These are stratified according to season, geographical location, and selected time intervals. The statistics are derived by approximating the distribution of tropical cyclone movements by the bivariate normal distribution.

The applicability of the bivariate normal and bivariate "t" distributions in desbribing the tropical cyclone movements for the above areas is examined by performing Chi-square goodness of fit calculations for fourteen areas. In general, the bivariate "t" model provides a better fit to the data. For example, at the .05 level of significance, the bivariate "t" model is rejected in three of the fourteen areas, while the bivariate normal model is rejected in eight areas. Since the bivariate "t" distribution asymptotically approaches the bivariate normal distribution for large data samples, the difference may be attributed to limited data samples. It is concluded that the bivariate normal distribution, the general, provides a useful model for depicting the movements of tropical cyclones.

An accompanying publication provides tables which may be used to obtain probabilities that an existing tropical cyclone will be within a selected target area at the end of prescribed time intervals. These probabilities likewise may be computed by use of the Fortran IV program included in the present paper as an appendix.

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FOREWORD

This work was sponsored under Cross Service Order No. H76789 by the Aerospace Environment Division, Aero-Astrodynamics Laboratory, Marshall Space Flight Center, because the National Aeronautics and Space Administration maintains installations and conducts activities along the Atlantic and the Gulf of Mexico coastal regions--regions affected by tropical cyclones.

The size and complexity of many space vehicles make rapid movement impossible and demand lengthy on-pad checkout procedures. Thus, the vehicle and much ground support equipment must be maintained in a storm-vulnerable configuration for perhaps 30 days before launch.

Since this study should also find wide application in a number of meteorological organizations, it is being distributed to several offices in the National Weather Service, the Air Weather Service of USAF, and the Navy Weather Service.

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Introduction

The bivariate normal distribution has been used previously in the study of tropical storms and/or hurricanes by Haggard and others (1965), Haggard and others (1967), and Hope and Neumann (1968, 1969, 1970).

This distribution is discussed in numerous texts and technical papers relating to statistics. Appendix I provides references to some of the developmental work and reviews the theoretical basis for the distribution. Results of tests described in Appendix II indicate that distributions of tropical cyclone movement vectors when selectively stratified can be described by the bivariate normal model.

The purpose of this report is to summarize some of the information contained in observations of tropical cyclones to provide guides for forecasters and the many private and government organizations which are affected by these storms. The results presented in Appendix III are statistical climatologies of tropical cyclone movements stratified according to season (June-July; August; September; October; November-May), geographical location (five-degree latitude by five-degree longitude "squares"), and selected time intervals (12-, 24-, 36-, 48-, 72- and 96-hours).

Copies of bivariate probability tables and applications by Groenewoud and others (1967) are being distributed with this report. These, along with the statistical climatologies indicated above, allow the user to make probability statements concerning future storm movements for planning

or decision making purposes. Appendix IV provides the Fortran IV - IBM 360/65 program which easily was adapted for use on the CDC 6600 and RCA Spectra 70/45 computers to provide tropical cyclone strike probabilities which will appear in a second paper. The procedures and material presented here should not replace present forecasting techniques but should be used as a source of additional information.

Data Source

The statistics presented here are based on data taken from the NOAA, EDS, National Climatic Center's Card Deck 993 (Tropical Cyclone Deck). The preparation of this deck was funded by the Commander, Naval Weather Service Command, Washington, D. C. The data are, for the most part, taken from the charts of North Atlantic Tropical Cyclones presented by Cry and others (1959) and Cry (1965). A complete description of this deck is available in a reference manual available at the National Climatic Center. The period of record used here is 1899-1969. This deck contains the latitude and longitude positions (in degrees to tenths) of storm centers at 00Z and 12Z. All movement vectors were calculated using the positions at these times. Only storms classified as a "tropical storm" or "hurricane" (winds $\geq$ 34 knots) and originating in the North Atlantic Ocean were treated. These will be referred to as "tropical cyclones." Movements for the periods when these storms were classified as "tropical depressions" or were extratropical are not included.

Computation of Statistics

(a) Stratifications

The data were stratified according to time and location of occurrence.

The year was divided into five seasons: June-July; August; September; October; and November-May. This classification separates periods which tend to exhibit different characteristics in storm movement or in the geographical location of storm development. Geographical stratification was achieved by dividing the North Atlantic and adjacent areas into separate five-degree latitude by five-degree longitude areas or "squares."

Figure 1 shows these squares and illustrates the scheme used to identify them. The three or four digit number plotted in each square gives the coordinates of the southwest corner of the square. The last two digits, when multiplied by five, give the longitude in degrees. The preceding digits give the latitude in degrees. For example, the four digit number 1010 indicates the area between 10 and 15 degrees north latitude and 45 and 50 degrees west longitude. That is, 10°N and 50°W locates the southwest corner of the square.

(b) Coordinate Transformations

The latitude-longitude positions of the storm centers were transformed into positions in the orthogonal I,J grid system currently used at the NOAA, NWS, National Meteorological Center. This grid consists of a square grid superimposed on a polar stereographic projection of the Northern Hemisphere. The transformation equations are:

$$I = B[\sin(\lambda')] + 24$$

$$J = B[\cos(\lambda')] + 26$$

where

$$\lambda' = (\lambda + 100)(\pi/180)$$

$$\phi' = (\phi)(\pi/180)$$

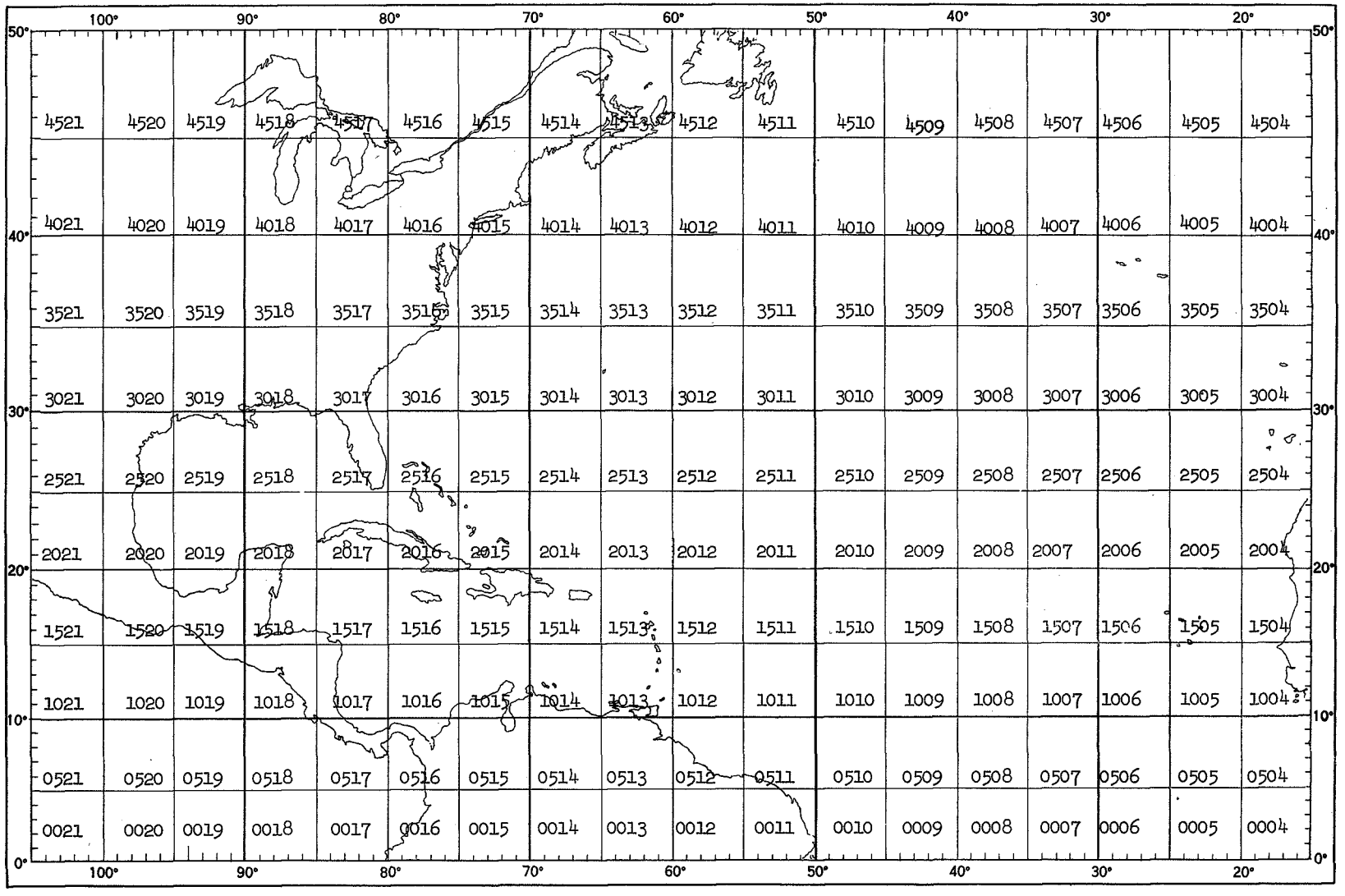

Figure 1 Mercator projection of the tropical North Atlantic and adjacent areas showing the positions and identification scheme for the five degree latitude by five degree longitude "squares".

λ = longitude (degrees)

ϕ = latitude (degrees)

$B = 31.2043\ [\cos(\phi')/(1 + \sin(\phi'))]$

This grid eliminates the curvature effects present in a latitude-longitude system.

Figure 2 shows the I,J grid overlaid on a polar stereographic map of the North Atlantic Ocean and surrounding area. The following table gives the approximate distance equivalent to one grid length for various latitudes.

Latitude	One Grid Length (Kilometers)
10°N	241
20°N	273
30°N	308
40°N	334

Conversion from grid intervals to kilometers.

(c) Computations

Movement vectors in terms of (I,J) coordinates were compiled for elapsed times of 12, 24, 36, 48, 72 and 96 hours. All the movement vectors originating in a given square were translated such that the initial positions were moved to the center of the square. The bivariate statistics were computed for the stratifications indicated previously by utilizing the machine program, Winds Aloft Summary (1963).

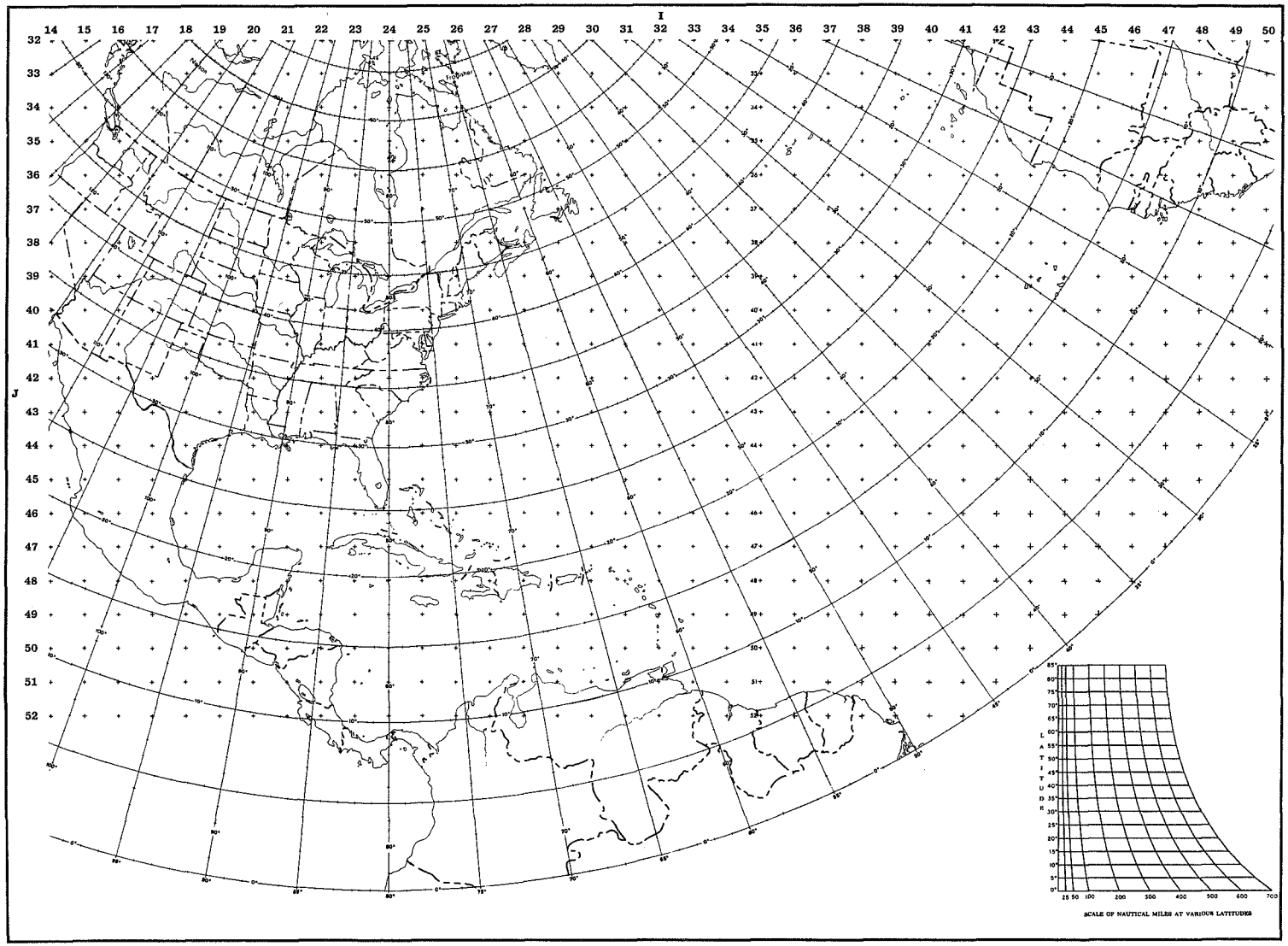

Figure 2 Polar stereographic projection of the North Atlantic and adjacent areas with an overlay of the NMC I, J Grid System

The pertinent statistics, including both polar and component forms of the means, are listed in Appendix III. These are:

(1) Resultant direction of storm movement (degrees) - (θ)

(2) Magnitude of the resultant storm movement - (D_r)

(3) and (4) Means of the components of storm movement - ($\overline{\Delta I}$ and $\overline{\Delta J}$)

(5) and (6) Standard deviations along the major and minor axes of the distribution - (s_a and s_b). These are called SIGX and SIGY in the tables and example applications by Groenewoud, Hoaglin, Vitalis and Crutcher (op. cit.).

(7) The angle of rotation measured counterclockwise from the I axis - (ψ)

(8) The number of observations - (n)

These parameters were computed from the following expressions:

$$\theta = \text{Arctan} \sum_{i=1}^{n} \Delta I_i / \sum_{i=1}^{n} \Delta J_i$$

$$D_r = \sqrt{\left[\left(\sum_{i=1}^{n} \Delta I_i\right)^2 + \left(\sum_{i=1}^{n} \Delta J_i\right)^2\right]/n^2}$$

$$\overline{\Delta I} = \left(\sum_{i=1}^{n} \Delta I_i\right)/n$$

$$\overline{\Delta J} = \left(\sum_{i=1}^{n} \Delta J_i\right)/n$$

$$s_a = \sqrt{K_1}$$

$$s_b = \sqrt{K_2}$$

$$\psi = 1/2 \text{ Arctan } [2r_{\Delta I \Delta J} s_{\Delta I} s_{\Delta J} / (s_{\Delta I}^2 - s_{\Delta J}^2)]$$

where

(a) $\Delta I = I_o - I_f$ and $\Delta J = J_f - J_o$ where the subscripts o and f indicate the initial and final positions, respectively. (Note the reversal of I_o and I_f in the formulation of ΔI. This modification makes the signs of the components agree with the standard meteorological coordinate system.)

(b) $$s_{\Delta I} = \left[\left(\sum_{i=1}^{n} \Delta I^2 \right)/n\text{-}1 \right) - \left(\left(\sum_{i=1}^{n} \Delta I \right)^2 / n(n\text{-}1) \right) \right]^{\frac{1}{2}}$$

($s_{\Delta I}$ is the standard deviation along the I axis)

(c) $$s_{\Delta J} = \left[\left(\sum_{i=1}^{n} \Delta J^2 \right)/n\text{-}1 \right) - \left(\left(\sum_{i=1}^{n} \Delta J \right)^2 / n(n\text{-}1) \right) \right]^{\frac{1}{2}}$$

($s_{\Delta J}$ is the standard deviation along the J axis)

(d) $$r_{\Delta I \Delta J} = \left[\left(n \left(\sum_{i=1}^{n} \Delta I_i \Delta J_i \right) \right) - \left(\sum_{i=1}^{n} \Delta I_i \right) \left(\sum_{i=1}^{n} \Delta J_i \right) \right] / n(n\text{-}1) s_{\Delta I} s_{\Delta J}$$

($r_{\Delta I \Delta J}$ is the correlation coefficient of the I and J components)

(e) K_1 and K_2, the eigenvalues, are the roots of the determinant

$$\begin{vmatrix} s_{\Delta I}^2 - K & s_{\Delta I} s_{\Delta J} r_{\Delta I \Delta J} \\ s_{\Delta I} s_{\Delta J} r_{\Delta I \Delta J} & s_{\Delta J}^2 - K \end{vmatrix} \equiv 0$$

with K_1 being the larger.

The determinant expanded is

$$(s_{\Delta I}^2 - K)(s_{\Delta J}^2 - K) - s_{\Delta I}^2 s_{\Delta J}^2 r_{\Delta I \Delta J}^2 = 0$$

or

$$K = \left[(s_{\Delta I}^2 + s_{\Delta J}^2) \pm \sqrt{(s_{\Delta I}^2 + s_{\Delta J}^2)^2 - 4 s_{\Delta I}^2 s_{\Delta J}^2 (1 - r_{\Delta I \Delta J}^2)} \right] / 2$$

Examples

Appendix III contains a listing of the bivariate statistics needed to define the distribution of storm movements. Here, each page contains the movement statistics for two squares. All seasons and time intervals are included except for cases with less than five observations.

Figure 3 illustrates how the statistics are used to construct probability ellipses. Here, Square 2518 (the north central Gulf area) is considered. The data show the end point of the 24-hour movements when all originate at the center of the square. The season is September.

The statistics computed from these data are: - (see page III-27)

$$n = 73$$

$$\overline{\Delta I} = -.20$$

$$\overline{\Delta J} = -.93$$

$$s_a = 1.08$$

$$s_b = .65$$

$$\psi = 3.5^\circ$$

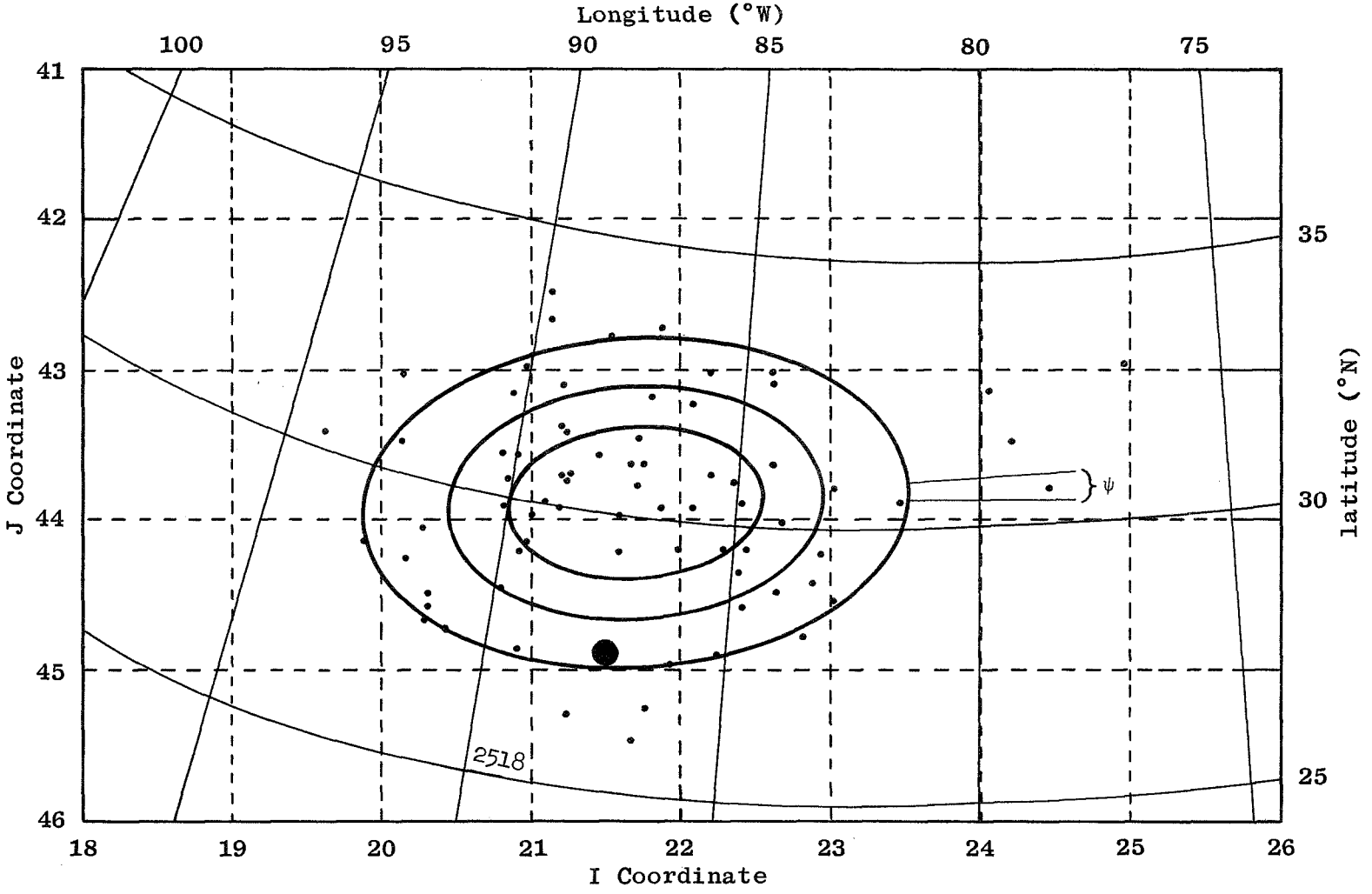

Figure 3 Twenty-four hour movements (1899-1969) for tropical cyclones initially located within square 2518. All initial positions were translated to the center of the square. The positions after 24 hours relative to this "common origin" are indicated. Ellipses for the .25, .50 and .75 probability levels are shown.

The probability ellipses are constructed through the following steps. Since the statistics were computed in the I,J coordinate system, this system must be used in the steps indicated.

(1) Locate the mean of the movements.

(2) Construct an I,J coordinate system such that the origin coincides with the mean.

(3) Rotate this coordinate system counterclockwise from the I-axis through the angle ψ.

(4) Select the probability value desired.

(5) Select the appropriate multiplier from Figure 4.

(6) Multiply s_a and s_b (the standard deviation along the major and minor axis) by this multiplier.

(7) Let these distances define the length of the semi-major and semi-minor axis.

(8) Construct the ellipse described by these distances.

In Figure 3 the .25, .50 and .75 probability ellipses are drawn. The mean movement vector, along with the size, shape and orientation of the probability ellipses, gives a clear picture of how the storm movements are distributed. Here the data indicate a large variation in the direction of movement. The probability ellipses relate the same information by the east-west orientation of the major axis.

Additional Publications and Future Work

This is the first of a series of publications dealing with tropical storm movement statistics and strike probabilities. The proposed

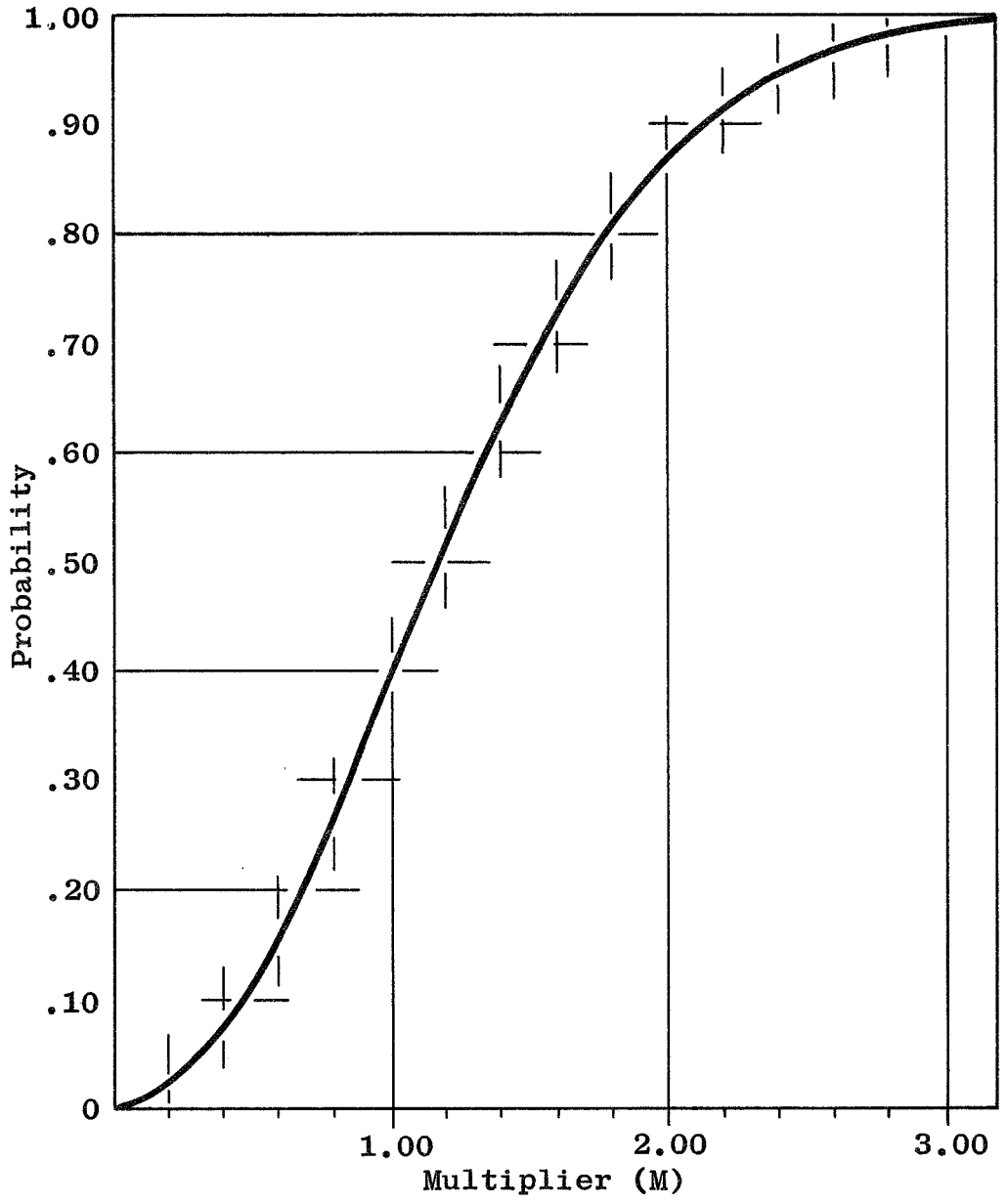

Figure 4 Radii for various probability ellipses. The major and minor axes are given by $\sigma_a(M)$ and $\sigma_b(M)$. For example, the multiplier (M) for a .50 probability ellipse is 1.18. (Adapted from National Weather Records Center, Winds Aloft Summary, 1963).

titles and sponsoring agencies for these future publications are as follows:

(1) Atlantic Tropical Cyclone Strike Probabilities (For Selected Stations and the Month of September) - Aerospace Environment Division, Aero-Astrodynamics Laboratory, Marshall Space Flight Center, NASA, Huntsville, Alabama.

(2) Atlantic Tropical Cyclone Strike Probabilities, (Volume I, 24-Hour Movements; Volume II, 48-Hour Movements; Volume III, 72-Hour Movements) - Commander, Naval Weather Service Command, Washington, D. C.

(3) Atlantic Tropical Cyclone Mean Vector Charts - Commander, Naval Weather Service Command, Washington, D. C.

Future work may be extended to:

(a) Use of Hotelling's "T^2" test to delineate areas of similar or dissimilar storm movement in time and space.

(b) Development of a theoretical model to permit use of prior conditions.

(c) Development of classification and discrimination or clustering techniques to isolate homogeneous time-space groups. This will be an extension to (a) above.

Summary

The bivariate normal distribution is used as a model to describe the movements of tropical cyclones for stated periods from specified positions (see Appendix II). Due to the small number of cases, the distributions are described better by the bivariate t-distribution. As the

bivariate normal distribution is approximated by the bivariate "t" with an increasing number of observations, it is assumed that the bivariate normal distribution model can be used to compute valid movement statistics and strike probabilities.

The bivariate statistics of tropical cyclone movements are computed and presented. Sample sizes range from 5 to almost 100. Obviously, more confidence should be placed in those statistics which are based on the larger sample sizes. Strike probabilities may be computed by the user from tables which accompany this paper as a separate publication or by means of an electronic computer program included as an appendix.

Acknowledgments

Acknowledgment is made to Dr. S. Kaufman and Mr. C. Groenewoud of Cornell Aeronautical Laboratory for permission to use their Fortran IV program to compute the strike probabilities. The cooperation of the National Weather Service's Computer Division for help in the actual computing of the probabilities is acknowledged also.

The author expresses his appreciation for the significant contributions made by the following personnel of the National Climatic Center: Messrs. Frank Quinlan and Glenn O'Kelley developed the necessary computer programs; Messrs. Danny Fulbright and Grant Goodge performed much of the work connected with the testing of models; Mr. Ray Hoxit provided editorial assistance; Mr. Robert Courtney performed the necessary drafting; and Mrs. Margaret Larabee typed the manuscript.

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APPENDIX I. THE BIVARIATE NORMAL DISTRIBUTION

Bravais (1846) provides the first extension from the univariate to bivariate distribution. Maxwell (1859), Bertrand (1888), Pearson (1900), and Strutt (1919) provide further extensions, and Bartlett (1934) discusses vector representations in samples. The following discussion is taken in part from Crutcher (1959).

A vector distribution is said to be normal if the probability density has a maximum at some point and falls off in all directions as

$$f(x,y) = \exp\left(-\tfrac{1}{2}Q\right) \tag{1}$$

where Q is distributed as χ^2 with ν degrees of freedom for the ν-dimensional distribution. For the 2-dimensional distribution

$$Q = [1/(1-\rho_{xy}^2)]\left[[(X-\mu_x)^2/\sigma_x^2]-[2\rho_{xy}(X-\mu_x)(Y-\mu_y)/\sigma_x\sigma_y]+[Y-\mu_y)^2/\sigma_y^2]\right] \tag{2}$$

and is distributed as χ^2 with 2 degrees of freedom. χ^2 may be used to replace Q. The probability that a point lies inside the ellipse for a specified χ^2 is then $F(\chi^2<\chi^2_p) = P$. For a given probability P, χ^2_p can be determined. Then $\sqrt{\chi^2_p}$ or χ_p becomes the vector radius to determine the probability ellipse contour corresponding to probability P.

Eq. 1 then represents a bivariate normal distribution where ν is 2, X and Y are orthogonal components, μ_x and μ_y are the respective means of the components, σ_x and σ_y are the standard deviations of the respective components, and ρ_{xy} is the correlation between the components.

If ρ_{xy} equals 1, the distribution is a degenerate bivariate distribution which is not encountered in practice. The opposite extreme occurs when the variances σ_x^2 and σ_y^2 are equal and ρ_{xy} equals zero. The expression (1) reduces to $\exp(-R^2/\sigma_v^2)$ where

$$R^2 = (X-\mu_x)^2 + (Y-\mu_y)^2 \text{ and } 2\sigma_x^2 = 2\sigma_y^2 = \sigma_v^2$$

The distribution is then circular. These two form the limits of the distribution, that is, the straight line and the circular. Since the correlation between components is often zero, the circular form frequently will be encountered.

Now, if w_x^2 equals $(X-\mu_x)^2/\sigma_x^2$ and w_y^2 equals $(Y-\mu_y)^2/\sigma_y^2$, expression (1) reduces to

$$f(x,y) = \exp\{-[1/2(1-\rho_{xy}^2)][w_x^2-2\rho_{xy}w_xw_y+w_y^2]\} \quad (3)$$

and if ρ_{xy} is zero reduces to

$$f(x,y) = \exp\{-1/2[w_x^2 + w_y^2]\} \quad (4)$$

Letting $w^2 = w_x^2 + w_y^2$, Eq. (4) becomes

$$f(x,y) = \exp(-w^2/2) \quad (5)$$

which is the familiar central Rayleigh (Strutt) distribution (1919) if only distribution of the magnitudes is considered and the vector mean is zero.

If the distribution is elliptical, then ρ_{xy} may be significantly different from zero. In this case the axes may be rotated through the angle ψ to a new axes along which the components are not correlated.

The values for the components in the new coordinate system may be obtained from Equations (6a) and (6b).

$$X' = X \sin \psi + Y \cos \psi \tag{6a}$$

$$Y' = Y \sin \psi - X \cos \psi \tag{6b}$$

while the means may be expressed as

$$\overline{X}' = \overline{X} \sin \psi + \overline{Y} \cos \psi \tag{6c}$$

$$\overline{Y}' = \overline{Y} \sin \psi - \overline{X} \cos \psi \tag{6d}$$

Here ψ (measured counterclockwise from the positive X axis) is given as

$$\psi = (1/2) \text{ Arctan } [2\rho_{xy}\sigma_x\sigma_y/(\sigma_x^2-\sigma_y^2)]$$

Standardization of the new variates X' and Y' provides Equation (5) as Equation (7)

$$f(x,y) = \exp (-(w')^2/2) \tag{7}$$

and is a measure of the standardized resultant of the X' and Y' components. Thus, the mean of a normal vector distribution coincides with the point of maximum probability. In standardized form, the probability is proportional to $\exp [-(w^2/2)]$.

Expression (1) is completely defined by five parameters: two means (μ_x and μ_y), the two variances (σ_x^2 and σ_y^2), and the correlation coefficient (ρ_{xy}). Moreover, these parameters define the probability density as a function only of the vector variable.

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APPENDIX II. DETERMINATION OF MODEL FIT

A. Determination of Fit to the Bivariate Normal Distribution.

This section describes the testing of the validity of the assumption that tropical cyclone movement distributions are bivariate normal. Crutcher (1957, 1958) made this assumption in work on extra-tropical cyclones. Here the assumption was supported by the demonstration that the component distributions in themselves were distributed normally. Though this is a necessary condition, i.e., that the marginal distributions be distributed normally, it is not a sufficient condition. It may be inferred from Hald's (1952) suggestion (page 602) that a two-dimensional χ^2 test may be made. This was the basis for the assumption of bivariate normality for wind distributions as used by Crutcher (1959). The reasonableness of this assumption is evident when the expected frequencies are compared with observed frequencies.

Though it may be advisable at times to go to the uncorrelated forms for purposes of this test, the general case in which the correlation is not zero may be used. This is Q or χ^2 obtained from expression (1) in Appendix I. It is repeated here.

$$\chi^2 = [1/(1-r_{xy}^2)]\left[[(X-\overline{X})^2/s_x^2]-[2r_{xy}(X-\overline{X})(Y-\overline{Y})/s_x s_y]+[(Y-\overline{Y})^2/s_y^2]\right] \qquad (1)$$

where the sample estimates of the parameters replace the population parameters.

Now, the use of the normal distribution implies that a relatively large number of observations was available. This is not always the case in

tropical cyclone data stratified by season and by five-degree latitude by five-degree longitude squares. Therefore, the bivariate *t*-distribution model was investigated also.

B. Determination of Fit to the Bivariate Student *t*-Distribution.

The rationale here is that if the tropical cyclone movements are bivariate *t* and as the bivariate *t* asymptotically approaches the bivariate normal, the non-rejection of the *t*-distribution would permit the assumption of bivariate normality in the computation of storm strike or target strike probabilities. The multivariate *t*-distribution also approaches the multivariate normal distribution asymptotically just as in the univariate and the bivariate cases. The multivariate form is indicated for the *t*-distribution by Krishnaiah and others (1969), Steffens (1968), John (1961), and others. Let $x_1, x_2, x_3, \ldots, x_\nu$ be distributed jointly as a ν-variate normal with zero means, common unknown variance σ^2, and known correlation matrix $\Omega = (\rho_{ij})$. Let $\nu s^2/\sigma^2$ be a chi-square variate with ν degrees of freedom distributed independently of $x_1, x_2, x_3, \ldots, x_\nu$. Then the joint distribution of $t_1, t_2, t_3, \ldots, t_\nu$ where $t_i = x_i/s$ is known to be a central ν-variate *t*-distribution, Dunn and Massey (1965).

Let random variables x,y have a bivariate normal distribution with means μ_1, μ_2 and variances σ_1^2, σ_2^2, respectively, then $\nu s_x^2/\sigma_1^2$ and $\nu s_y^2/\sigma_2^2$ both are independent of x,y and have a χ^2 distribution with ν degrees of freedom where s_x^2 and s_y^2 are estimates of σ_1^2 and σ_2^2, respectively. It follows that $t_i = (x_i - \mu_i)/s_i$, where $\bar{x}_i$ replaces μ_i and i = 1,2 and each

has a Student t-distribution. The joint density function following Steffens (1968) is

$$f(t_1,t_2) = (1/2\pi)\left[1 + (t_1^2/\nu) + (t_2^2/\nu)\right]^{-(\nu+2)/2} \qquad (2)$$

Probabilities associated with this function may be evaluated for ν degrees of freedom and various values of t using the tables developed by Steffens (op. cit.). Critical values of t also have been tabulated by degrees of freedom. Values of t for a given probability level are determined by interpolation using the values of Steffens' Integral I_1 and his tabular data. The expression

$$I_1 = (1 - P)/4 \qquad (3)$$

where P = probability level, gives the proper value to use in determining t when values of I_1 have been plotted against t. For example, using a probability of .40 and 75 degrees of freedom

$$I_1 = (1 - .40)/4 = .15 \qquad (4)$$

and interpolation in Steffens' tables yields a value for $t_1 = t_2 = .904$.

C. Testing of Models for Tropical Cyclone Movement

Figure II-1 shows ten geographic five-degree latitude by five-degree longitude squares in the southern North Atlantic and Gulf of Mexico areas. These areas were selected to test the bivariate normal and t-distribution function models for the 12-hour tropical cyclone movements during September for the period 1899-1969. The selected geographic areas are shown in black.

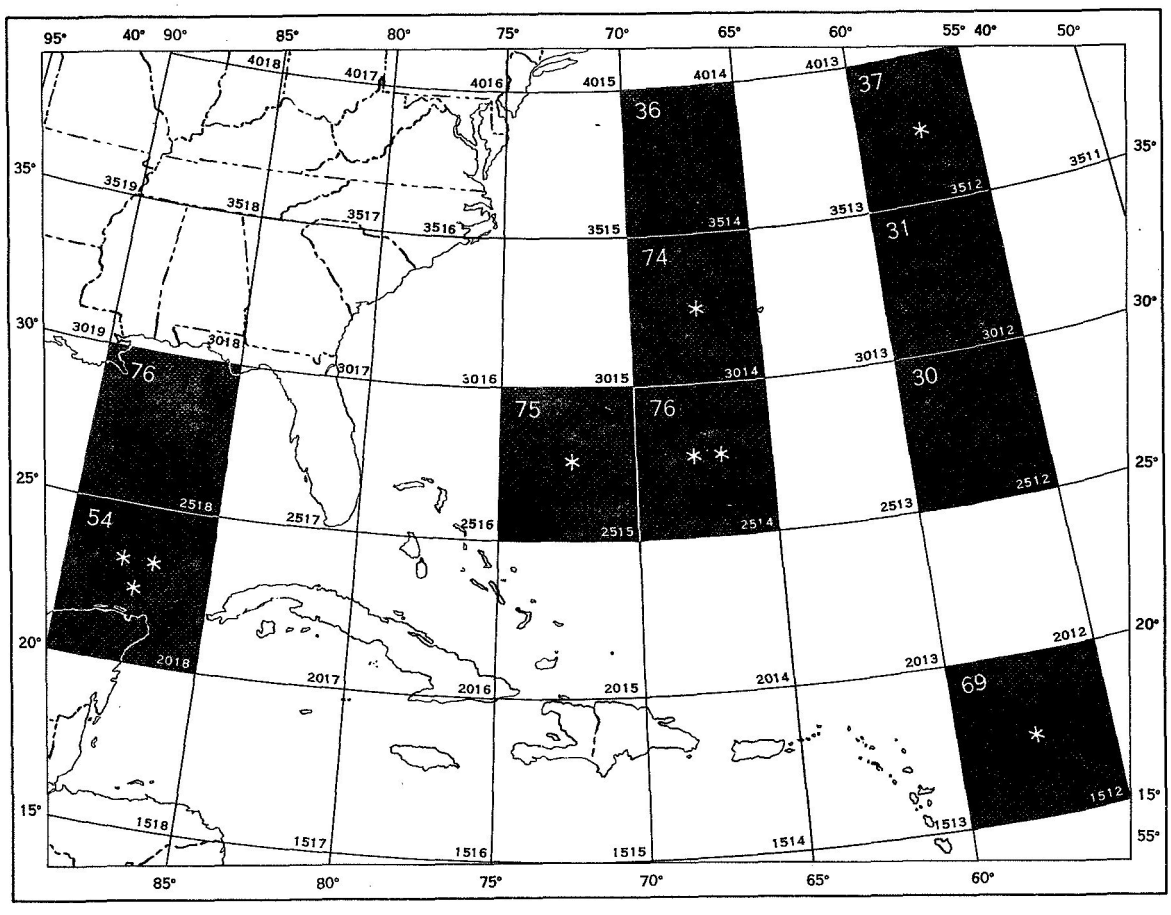

Figure II—1 Tests of null hypotheses for the bivariate normal and bivariate t-distribution for 12-hour movements of tropical cyclones during the month of September. The geographic areas are shown in black. The number of tropical cyclone movements is shown in the upper left corner of each square. A single asterisk or double asterisk indicates rejection of the null hypothesis for the bivariate normal and the bivariate t-distribution respectively. The rejection level of $\alpha = 0.05$ involved 4 degrees of freedom as ten equiprobability intervals were selected as class intervals. Period of Record 1899-1969.

A standard model was used for testing all squares, i.e., random variables $\Delta I, \Delta J$ were standardized resulting in means 0 and variances 1. A rotation of axis was performed to remove correlation. By definition of the t variate, these standardized random variables have a joint distribution which is the bivariate t-distribution.

A χ^2 test of goodness of fit was made for each of the bivariate normal and bivariate t-distributions. For more details the reader is referred to Crutcher and Falls (1971). The general procedure is the following. The distribution is set up with ten shells, each shell holding, theoretically, ten percent of the volume. The shells may be rectangular, square, elliptical or circular. Availability of polar tables for the normal distribution and the availability of rectangular tables for the t-distribution permits the use of elliptical cylindrical shells for the first and square cylindrical shells for the second. The expected frequencies for each shell then are n/10 and may be expressed as E_i. An actual count of the end points of the observed vectors falling inside each shell then is made. This may be expressed as O_i. The difference, $(O_i - E_i)$, is squared and the square is divided by E_i. This is done for each shell and the ten quotients are added. This is expressed as

$$X^2 = \sum_{i=1}^{10} \left[(O_i - E_i)^2 / E_i \right] \qquad (5)$$

The quantity X^2 is distributed as χ^2, Pearson (1900). The bivariate frequency surface is fitted with two means, two variances, one correlation, and a fixed volume, causing a loss of six degrees of freedom. As there

are ten shells and six degrees of freedom are lost, X^2 is distributed as χ^2 with four degrees of freedom.

Figure II-2 shows equiprobability ellipses and rectangles of 0.40 and 0.50 for the normal and *t*-distribution, respectively. The September 12-hour cyclone movements are indicated by the dots from the intersection of the I,J coordinates at the center of the Square 2512. With 30 tropical cyclone movements and ten shells, three dots are expected in each shell. There are two in the elliptical shell and two in the rectangular shell where boundaries are 0.40 and 0.50 probability rectangles. The contribution of each shell to X^2 for each distribution is $(3-2)^2/3$ or 0.333. This is done for all ten elliptical shells or rectangular shells, then the total X^2 is found for each case. This then is compared against the appropriate decision criteria for $\alpha = 0.05$ with four degrees of freedom.

The null hypothesis H_o: $\chi^2 \leq \chi^2_{(\alpha,4)}$ was tested against the alternate hypothesis H_a: $\chi^2 > \chi^2_{(\alpha,4)}$ where $\alpha = 0.05$. Here $\chi^2_{(\alpha,4)}$ is 9.488. When the χ^2 statistic obtained is less than $\chi^2_{(\alpha,4)}$, the null hypothesis that the bivariate normal distribution shows a reasonable fit to the actual data distribution is not rejected.

Table II-1 gives the results of the testing of the null hypothesis for the two distributions. An asterisk denotes rejection of the null hypothesis for the bivariate normal distribution, while a double asterisk indicates rejection of the null hypothesis for the bivariate *t*-distribution. The bivariate normal distribution model is rejected five times, while the bivariate *t*-distribution is rejected twice out of ten. The asterisks are shown also on Figure II-1.

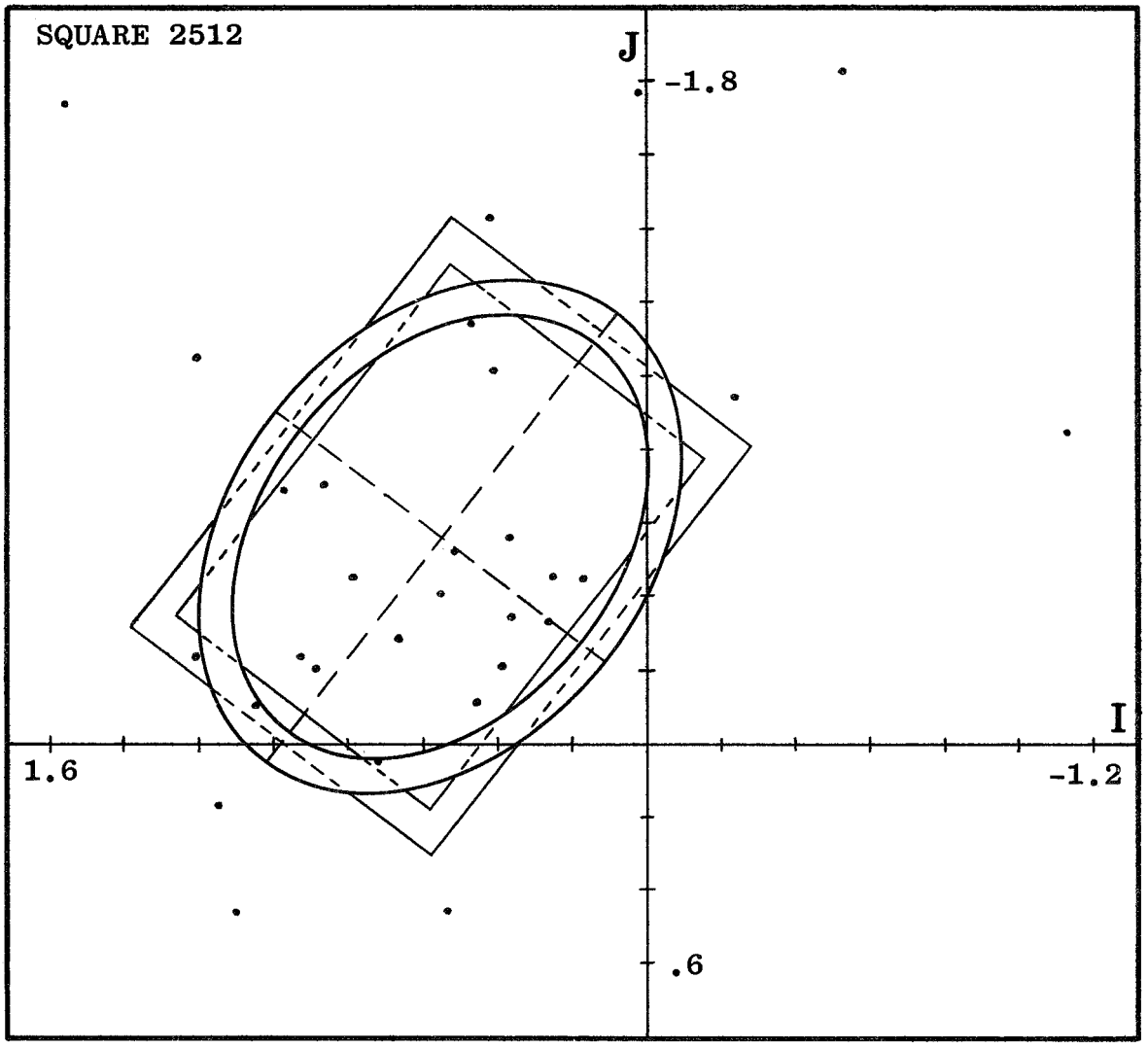

Figure II—2 Distribution of tropical cyclone 12-hr movements for September, years 1899-1969 in the I, J grid system. The .40 and .50 probability ellipses and rectangles for the bivariate normal and the bivariate Student t-distribution respectively are shown. The probability of a tropical cyclone occurring within the bands defined by the ellipses or the rectangles is .10. The number of movements is 30.

Both models are rejected in the Square 2018 just north of Yucatan and between Yucatan and Cuba. Examination of the data indicates some bimodality which is evident when the five-degree square is broken down into two and one-half degree squares. Tropical cyclones, if in the northern part, tend to move north, while those in the southern part tend to move west.

In Square 2514 the slow moving storm of September 18-21, 1964, contributed greatly to X^2 due to several movements in the 0.30 to 0.40 probability band. Though the following is conjecture, this could be due to estimates of movement being equalized by the analyst over several periods.

Table II-1. Chi-square (χ^2) test for fit of tropical cyclone 12-hour movements during September. Period 1899-1969, $\alpha = 0.05$, degrees of freedom = 4, critical value of $\chi^2_{(\alpha,4)} = 9.488$.

Square	No. of Obs.	χ^2 Bivariate normal (rejected*)	χ^2 Bivariate "t" (rejected**)
1512	69	14.91 *	5.93
2018	54	15.60 *	14.52 **
2512	30	8.00	9.33
2514	76	6.37	16.89 **
2515	75	11.00 *	7.27
2518	76	3.47	8.21
3012	31	7.38	8.68
3014	74	11.68 *	4.92
3512	37	13.43 *	8.14
3514	36	5.67	6.22

Table II-2 gives the results of testing the same null hypothesis for selected samples for time intervals greater than twelve hours. Here data from all seasons except November-May are used. The bivariate normal model is rejected in three of the four cases, while the bivariate "t" model is rejected only once. In general, these results agree with those indicated by Table II-1.

Table II-2. Chi-square (χ^2) test for fit of selected samples of tropical cyclone movements for time intervals greater than 12 hours. Period 1899-1969, $\alpha = 0.05$, degrees of freedom = 4, critical value of $\chi^2_{(\alpha,4)} = 9.488$.

Square	Time (Hrs)	Season	No. of Obs.	χ^2 Bivariate Normal (rejected*)	χ^2 Bivariate "t" (rejected**)
2518	24	June-July	37	5.43	4.35
3015	36	September	54	15.99 *	8.96
1516	48	October	44	15.09 *	21.91 **
2015	72	August	39	11.51 *	5.36

Table II-3 provides the approximate probabilities that the computed χ^2 values given in Tables II-1 and II-2 would be exceeded by chance. Here, for example, the probability level <.05 indicates less than .05 but greater than or equal to .02, while <.50 indicates less than .50 but greater than or equal to .40.

Inspection of Table II-3 shows that if the null hypothesis is tested at the .10 level of significance, the number of squares accepted by the

Table II-3. Probability levels indicating the likelihood that the computed χ^2 values provided in Tables II-1 and II-2 would be exceeded by chance.

Square	Time (Hrs)	Season	No. of Obs.	χ^2 Bivariate Normal	Prob. Level	χ^2 Bivariate "t"	Prob. Level
1512	12	September	69	14.91	<.01	5.93	<.30
2018	12	September	54	15.60	<.01	14.52	<.01
2512	12	September	30	8.00	<.10	9.33	<.10
2514	12	September	76	6.37	<.20	16.89	<.01
2515	12	September	75	11.00	<.05	7.27	<.20
2518	12	September	76	3.47	<.50	8.21	<.10
3012	12	September	31	7.38	<.20	8.68	<.10
3014	12	September	74	11.68	<.02	4.92	<.30
3512	12	September	37	13.43	<.01	8.14	<.10
3514	12	September	36	5.67	<.30	6.22	<.20
2518	24	June-July	37	5.43	<.30	4.35	<.40
3015	36	September	54	15.99	<.01	8.96	<.10
1516	48	October	44	15.09	<.01	21.91	<.01
2015	72	August	39	11.51	<.02	5.36	<.30

bivariate normal model would be comparable to the number accepted by the bivariate "t" model. In general, however, the bivariate t-distribution provides a better fit to the data. As the bivariate t-distribution is asymptotic to the bivariate normal distribution, the difference between the two models can be largely attributed to the limited amount of data.

In a few squares, topography and/or certain preferred patterns in the general circulation may result in a heterogeneous sample within a five-degree square. Further stratification could have eliminated the problem of heterogeneity but would reduce the sample size, hence reduce the significance of the resulting statistics.

The information presented here is considered to be substantive that the hypothesis is valid though it is admitted that the χ^2 test is not a powerful test. Since the Kolmogorov-Smirnov Test is not applicable to the multivariate case, other tests are being devised and will be published in the paper being prepared by Crutcher and Falls (op. cit.).

The assumption then is made that the tropical cyclone movements may be described by the bivariate normal distribution. To the extent that these assumptions may not be quite valid, the tropical cyclone movement statistics and strike probabilities will be in error. However, these are expected to be an improved approximation to future storm movements over those implied by empirical probabilities.

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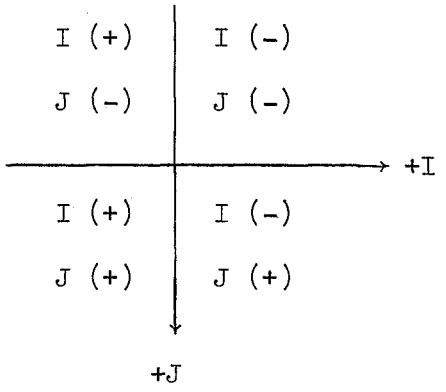
APPENDIX III. BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS (1899-1969), (I,J) COORDINATES

Explanation

The "5 DEG ID" indicates the square location (see Figure 1). All distances are given in units of one grid length in the I,J grid. The parameters are identified by the abbreviations in the left column and are defined in the text (pages 7-9). The signs of the component movements are as follows:



For stratification with less than 5 observations, the statistics were not computed. For these cases, zeroes are listed for all parameters except the number of observations.

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 1005 LAT= 10-15N LON= 20- 25W SEASON= SEPTEMBER

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	219.2	220.4	221.3	222.6	225.5	230.7
RESULT DIST	0.896	1.751	2.624	3.486	5.260	7.016
MEAN I COMP	0.566	1.134	1.733	2.360	3.749	5.431
MEAN J COMP	0.694	1.334	1.970	2.566	3.690	4.441
STD DEV MAJ	0.193	0.355	0.542	0.670	1.014	2.318
STD DEV MIN	0.097	0.158	0.191	0.222	0.428	0.730
ANG OF ROT	87.7	71.7	66.4	63.3	87.8	91.6
NUM OF OBS	7	7	7	7	7	7

5DEG ID= 1006 LAT= 10-15N LON= 25- 30W SEASON= AUGUST

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	223.7	225.5	227.1	228.7	232.9	237.4
RESULT DIST	1.385	2.782	4.228	5.580	8.295	10.511
MEAN I COMP	0.957	1.986	3.099	4.192	6.614	8.856
MEAN J COMP	1.001	1.949	2.877	3.683	5.006	5.662
STD DEV MAJ	0.330	0.647	0.928	1.185	1.944	2.346
STD DEV MIN	0.113	0.217	0.317	0.418	0.660	1.218
ANG OF ROT	45.6	43.1	40.0	38.9	30.9	27.7
NUM OF OBS	9	9	9	9	9	9

SEASON= SEPTEMBER

RESULT DIR	233.9	235.3	237.9	240.5	244.7	248.0
RESULT DIST	0.737	1.468	2.198	2.908	4.418	5.749
MEAN I COMP	0.595	1.207	1.861	2.533	3.994	5.332
MEAN J COMP	0.435	0.836	1.169	1.430	1.888	2.150
STD DEV MAJ	0.387	0.779	1.175	1.585	2.461	3.201
STD DEV MIN	0.172	0.336	0.569	0.771	1.330	1.796
ANG OF ROT	67.0	66.8	64.7	69.0	67.6	63.0
NUM OF OBS	15	15	15	15	15	15

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 1007 LAT= 10-15N LON= 30- 35W SEASON= AUGUST

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	229.5	230.8	232.5	234.4	238.4	242.5
RESULT DIST	1.343	2.702	3.936	5.252	7.636	9.712
MEAN I COMP	1.022	2.095	3.121	4.268	6.507	8.615
MEAN J COMP	0.872	1.707	2.399	3.060	3.996	4.484
STD DEV MAJ	0.276	0.581	0.856	1.254	1.851	2.124
STD DEV MIN	0.109	0.203	0.291	0.418	0.719	1.493
ANG OF ROT	34.6	34.5	31.5	28.2	19.1	6.3
NUM OF OBS	10	10	10	10	10	10

SEASON= SEPTEMBER

RESULT DIR	234.9	238.2	240.5	242.9	248.9	256.7
RESULT DIST	0.911	1.849	2.713	3.610	5.287	6.800
MEAN I COMP	0.745	1.571	2.361	3.215	4.933	6.617
MEAN J COMP	0.524	0.975	1.337	1.642	1.902	1.565
STD DEV MAJ	0.312	0.646	1.045	1.433	2.135	2.996
STD DEV MIN	0.160	0.328	0.496	0.875	1.571	2.074
ANG OF ROT	165.7	142.7	124.4	120.0	109.3	108.3
NUM OF OBS	13	13	13	13	13	13

5DEG ID= 1008 LAT= 10-15N LON= 35- 40W SEASON= AUGUST

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	235.7	238.2	241.6	244.9	250.4	256.2
RESULT DIST	1.119	2.187	3.301	4.394	6.417	8.602
MEAN I COMP	0.924	1.859	2.903	3.979	6.045	8.354
MEAN J COMP	0.631	1.151	1.571	1.865	2.154	2.049
STD DEV MAJ	0.382	0.681	1.003	1.289	1.929	2.729
STD DEV MIN	0.116	0.276	0.510	0.821	1.456	1.634
ANG OF ROT	36.0	32.8	35.2	40.1	72.7	87.1
NUM OF OBS	14	14	14	14	14	14

SEASON= SEPTEMBER

RESULT DIR	246.0	248.5	250.8	253.0	258.6	264.9
RESULT DIST	0.978	1.905	2.780	3.689	5.318	6.842
MEAN I COMP	0.893	1.773	2.626	3.528	5.213	6.816
MEAN J COMP	0.397	0.697	0.914	1.077	1.051	0.605
STD DEV MAJ	0.377	0.720	1.088	1.483	2.168	2.855
STD DEV MIN	0.277	0.519	0.723	0.884	1.237	1.508
ANG OF ROT	51.0	49.7	47.9	45.2	50.2	56.8
NUM OF OBS	18	18	18	18	18	18

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 1009 LAT= 10-15N LON= 40- 45W SEASON= AUGUST

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	247.3	249.8	252.6	256.0	261.7	266.6
RESULT DIST	1.172	2.359	3.480	4.547	6.789	8.771
MEAN I COMP	1.081	2.214	3.320	4.411	6.718	8.756
MEAN J COMP	0.452	0.814	1.043	1.104	0.983	0.518
STD DEV MAJ	0.393	0.838	1.271	1.641	2.300	2.971
STD DEV MIN	0.207	0.377	0.590	0.749	1.043	1.289
ANG OF ROT	75.3	70.5	68.1	74.6	79.7	73.7
NUM OF OBS	14	14	14	14	14	14

SEASON= SEPTEMBER

RESULT DIR	254.3	256.8	260.8	265.4	273.8	280.0
RESULT DIST	1.004	1.971	2.853	3.679	5.237	6.734
MEAN I COMP	0.966	1.919	2.817	3.667	5.226	6.633
MEAN J COMP	0.272	0.450	0.456	0.297	-0.343	-1.167
STD DEV MAJ	0.338	0.675	0.964	1.291	1.935	2.692
STD DEV MIN	0.209	0.422	0.694	1.018	1.551	1.889
ANG OF ROT	27.2	25.5	25.9	25.9	67.0	70.9
NUM OF OBS	19	19	19	19	19	19

5DEG ID= 1010 LAT= 10-15N LON= 45- 50W SEASON= AUGUST

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	246.3	249.2	252.2	255.0	260.9	266.5
RESULT DIST	1.326	2.566	3.744	4.961	7.322	9.443
MEAN I COMP	1.215	2.399	3.565	4.791	7.231	9.425
MEAN J COMP	0.532	0.909	1.146	1.288	1.156	0.571
STD DEV MAJ	0.400	0.790	1.074	1.405	2.010	2.489
STD DEV MIN	0.306	0.568	0.800	0.969	1.173	1.473
ANG OF ROT	42.4	36.3	48.2	52.4	58.2	57.5
NUM OF OBS	15	15	15	15	15	15

SEASON= SEPTEMBER

RESULT DIR	263.5	267.0	269.8	272.3	276.0	279.5
RESULT DIST	1.059	2.116	3.133	4.075	5.661	7.115
MEAN I COMP	1.052	2.113	3.133	4.071	5.630	7.018
MEAN J COMP	0.120	0.111	0.010	-0.161	-0.589	-1.170
STD DEV MAJ	0.436	0.888	1.269	1.524	1.951	2.271
STD DEV MIN	0.202	0.400	0.633	0.971	1.568	2.055
ANG OF ROT	8.5	0.6	0.5	179.9	177.3	37.9
NUM OF OBS	22	22	22	22	22	21

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 1011 LAT= 10-15N LON= 50- 55W SEASON= AUGUST

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	253.4	255.8	258.4	261.9	268.5	274.5
RESULT DIST	1.310	2.662	3.983	5.237	7.583	9.349
MEAN I COMP	1.255	2.580	3.901	5.185	7.581	9.320
MEAN J COMP	0.375	0.655	0.802	0.742	0.192	-0.740
STD DEV MAJ	0.330	0.555	0.773	1.027	1.542	2.582
STD DEV MIN	0.162	0.358	0.540	0.756	1.355	1.603
ANG OF ROT	14.2	14.6	22.3	23.2	54.1	64.3
NUM OF OBS	16	16	16	15	15	15

SEASON= SEPTEMBER

RESULT DIR	262.5	265.6	268.2	271.0	275.5	277.0
RESULT DIST	1.046	2.125	3.060	3.834	5.354	7.055
MEAN I COMP	1.037	2.119	3.059	3.834	5.329	7.003
MEAN J COMP	0.137	0.161	0.095	-0.067	-0.511	-0.854
STD DEV MAJ	0.390	0.752	0.990	1.210	1.528	1.563
STD DEV MIN	0.288	0.523	0.712	0.849	0.987	1.196
ANG OF ROT	5.3	12.0	12.4	10.5	18.0	26.0
NUM OF OBS	15	15	15	14	13	12

5DEG ID= 1012 LAT= 10-15N LON= 55- 60W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	267.2	271.6	274.1	274.8	276.9	279.5
RESULT DIST	1.164	2.198	3.165	4.013	5.463	6.584
MEAN I COMP	1.162	2.197	3.157	3.999	5.423	6.494
MEAN J COMP	0.057	-0.062	-0.227	-0.338	-0.659	-1.081
STD DEV MAJ	0.406	0.609	0.859	1.209	2.070	2.570
STD DEV MIN	0.268	0.496	0.637	0.738	0.942	1.151
ANG OF ROT	14.6	11.3	11.0	15.5	4.9	2.2
NUM OF OBS	9	9	9	9	9	9

SEASON= AUGUST

RESULT DIR	267.4	268.5	270.7	273.1	277.3	282.2
RESULT DIST	1.163	2.369	3.637	4.641	6.806	8.551
MEAN I COMP	1.162	2.368	3.637	4.634	6.750	8.359
MEAN J COMP	0.053	0.060	-0.043	-0.253	-0.868	-1.804
STD DEV MAJ	0.417	0.742	1.146	1.349	2.038	2.521
STD DEV MIN	0.234	0.389	0.473	0.598	0.865	0.795
ANG OF ROT	22.0	30.9	29.1	29.9	24.9	27.4
NUM OF OBS	25	25	24	23	20	17

SEASON= SEPTEMBER

RESULT DIR	259.1	260.9	263.2	265.6	270.0	275.4
RESULT DIST	1.057	1.994	2.945	3.917	5.698	7.188
MEAN I COMP	1.038	1.969	2.925	3.905	5.698	7.157
MEAN J COMP	0.200	0.314	0.351	0.301	0.001	-0.675
STD DEV MAJ	0.324	0.524	0.685	0.871	1.354	1.984
STD DEV MIN	0.302	0.475	0.640	0.853	0.967	1.166
ANG OF ROT	161.5	103.1	133.4	128.8	65.3	53.9
NUM OF OBS	23	22	20	19	17	15

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 1013 LAT= 10-15N LON= 60- 65W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	270.8	270.1	270.3	271.6	275.4	280.0
RESULT DIST	1.127	2.192	3.173	4.144	6.031	7.240
MEAN I COMP	1.127	2.192	3.173	4.142	6.005	7.131
MEAN J COMP	-0.017	-0.005	-0.017	-0.118	-0.563	-1.252
STD DEV MAJ	0.395	0.813	1.186	1.609	2.263	2.761
STD DEV MIN	0.243	0.372	0.449	0.538	1.019	1.569
ANG OF ROT	174.0	179.1	1.7	179.3	173.8	170.3
NUM OF OBS	12	12	12	12	12	11

SEASON= AUGUST

RESULT DIR	267.2	269.5	271.5	273.4	277.8	281.2
RESULT DIST	1.168	2.271	3.364	4.469	6.431	8.180
MEAN I COMP	1.167	2.270	3.363	4.461	6.372	8.024
MEAN J COMP	0.058	0.020	-0.086	-0.265	-0.869	-1.586
STD DEV MAJ	0.307	0.654	0.989	1.353	1.668	2.013
STD DEV MIN	0.203	0.348	0.461	0.615	0.850	1.078
ANG OF ROT	7.2	179.3	173.6	169.4	152.6	138.5
NUM OF OBS	21	21	21	21	20	20

SEASON= SEPTEMBER

RESULT DIR	264.0	266.4	268.4	270.2	273.0	275.1
RESULT DIST	0.962	1.912	2.798	3.625	5.174	6.663
MEAN I COMP	0.956	1.909	2.797	3.625	5.167	6.636
MEAN J COMP	0.100	0.120	0.077	-0.012	-0.272	-0.592
STD DEV MAJ	0.355	0.648	0.943	1.126	1.593	2.056
STD DEV MIN	0.151	0.265	0.434	0.601	0.884	1.271
ANG OF ROT	17.4	12.2	12.1	15.6	22.2	14.1
NUM OF OBS	28	27	27	26	24	22

SEASON= OCTOBER

RESULT DIR	269.3	271.9	275.6	279.9	288.9	298.3
RESULT DIST	0.846	1.662	2.383	3.059	4.253	5.381
MEAN I COMP	0.846	1.661	2.372	3.013	4.023	4.738
MEAN J COMP	0.010	-0.055	-0.233	-0.524	-1.377	-2.551
STD DEV MAJ	0.280	0.579	0.939	1.341	2.172	2.909
STD DEV MIN	0.186	0.348	0.462	0.538	0.809	1.112
ANG OF ROT	31.9	39.8	44.3	44.6	43.5	44.6
NUM OF OBS	15	15	15	15	15	15

5DEG ID= 1014 LAT= 10-15N LON= 65- 70W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	270.0	272.6	275.1	276.5	281.4	287.1
RESULT DIST	1.205	2.288	3.326	4.314	6.084	7.443
MEAN I COMP	1.205	2.286	3.313	4.286	5.964	7.114
MEAN J COMP	0.000	-0.105	-0.298	-0.492	-1.200	-2.187
STD DEV MAJ	0.374	0.651	0.910	1.158	1.643	1.894
STD DEV MIN	0.220	0.385	0.537	0.728	0.963	1.441
ANG OF ROT	9.5	7.9	174.6	172.3	175.7	168.0
NUM OF OBS	10	10	10	10	10	9

SEASON= AUGUST

RESULT DIR	272.8	274.5	276.4	278.2	282.5	288.9
RESULT DIST	1.003	1.992	3.000	3.996	5.522	7.134
MEAN I COMP	1.002	1.986	2.981	3.955	5.391	6.751
MEAN J COMP	-0.049	-0.157	-0.333	-0.567	-1.196	-2.306
STD DEV MAJ	0.467	0.847	1.270	1.636	2.055	2.557
STD DEV MIN	0.158	0.291	0.457	0.618	0.884	1.233
ANG OF ROT	177.9	171.4	167.4	163.8	149.6	142.0
NUM OF OBS	19	19	19	19	17	15

SEASON= SEPTEMBER

RESULT DIR	266.8	268.0	269.2	270.2	273.2	277.4
RESULT DIST	0.988	1.882	2.822	3.779	5.556	7.363
MEAN I COMP	0.986	1.881	2.822	3.779	5.547	7.301
MEAN J COMP	0.056	0.067	0.038	-0.011	-0.314	-0.949
STD DEV MAJ	0.315	0.500	0.709	0.987	1.563	1.862
STD DEV MIN	0.173	0.254	0.279	0.309	0.546	0.944
ANG OF ROT	0.8	172.2	165.7	161.2	154.2	148.1
NUM OF OBS	17	17	17	17	16	16

SEASON= OCTOBER

RESULT DIR	275.8	279.9	285.0	290.1	300.4	311.0
RESULT DIST	0.789	1.449	2.052	2.655	3.829	4.904
MEAN I COMP	0.785	1.428	1.981	2.494	3.304	3.700
MEAN J COMP	-0.080	-0.249	-0.532	-0.911	-1.935	-3.219
STD DEV MAJ	0.327	0.717	1.098	1.501	2.249	3.369
STD DEV MIN	0.158	0.243	0.413	0.599	0.973	1.483
ANG OF ROT	33.8	40.3	42.3	48.7	58.8	74.8
NUM OF OBS	8	8	8	8	8	8

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 1015 LAT= 10-15N LON= 70- 75W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	279.5	280.8	282.2	284.8	290.4	297.2
RESULT DIST	1.165	2.339	3.427	4.448	6.016	7.309
MEAN I COMP	1.149	2.297	3.350	4.301	5.637	6.498
MEAN J COMP	-0.193	-0.440	-0.723	-1.134	-2.102	-3.346
STD DEV MAJ	0.246	0.445	0.574	0.743	1.202	1.408
STD DEV MIN	0.118	0.288	0.452	0.382	0.374	0.267
ANG OF ROT	1.6	175.9	10.7	27.0	41.0	40.5
NUM OF OBS	7	7	7	7	6	5

SEASON= AUGUST

RESULT DIR	276.6	279.0	280.4	283.7	0.0	0.0
RESULT DIST	1.333	2.663	3.573	4.210	0.000	0.000
MEAN I COMP	1.324	2.630	3.515	4.090	0.000	0.000
MEAN J COMP	-0.154	-0.416	-0.643	-0.998	0.000	0.000
STD DEV MAJ	0.386	0.801	1.214	1.340	0.000	0.000
STD DEV MIN	0.121	0.259	0.382	0.312	0.000	0.000
ANG OF ROT	168.6	167.0	161.1	141.4	0.0	0.0
NUM OF OBS	7	7	6	5	4	3

SEASON= SEPTEMBER

RESULT DIR	266.9	268.1	270.9	275.5	282.9	288.6
RESULT DIST	0.790	1.621	2.448	3.290	4.989	6.386
MEAN I COMP	0.789	1.620	2.447	3.275	4.864	6.054
MEAN J COMP	0.043	0.054	-0.039	-0.316	-1.111	-2.034
STD DEV MAJ	0.245	0.474	0.660	1.017	1.601	2.348
STD DEV MIN	0.115	0.226	0.438	0.692	1.068	1.258
ANG OF ROT	168.0	170.9	162.6	154.0	168.3	179.2
NUM OF OBS	15	15	15	14	14	14

5DEG ID= 1016 LAT= 10-15N LON= 75- 80W SEASON= SEPTEMBER

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	278.2	284.2	288.9	292.0	300.1	313.5
RESULT DIST	0.704	1.512	2.308	3.022	4.434	5.391
MEAN I COMP	0.696	1.465	2.184	2.801	3.838	3.912
MEAN J COMP	-0.100	-0.371	-0.748	-1.134	-2.221	-3.708
STD DEV MAJ	0.312	0.664	1.030	1.461	2.427	3.450
STD DEV MIN	0.184	0.461	0.692	0.821	1.149	1.144
ANG OF ROT	34.9	25.6	22.9	22.4	23.3	25.4
NUM OF OBS	17	17	17	17	15	12

SEASON= OCTOBER

RESULT DIR	11.6	11.0	11.2	8.0	7.4	10.9
RESULT DIST	0.328	0.711	1.177	1.671	2.844	4.299
MEAN I COMP	-0.066	-0.136	-0.229	-0.232	-0.364	-0.815
MEAN J COMP	-0.322	-0.698	-1.155	-1.655	-2.821	-4.221
STD DEV MAJ	0.347	0.670	0.930	1.242	1.859	2.927
STD DEV MIN	0.172	0.319	0.459	0.605	0.939	1.259
ANG OF ROT	15.7	16.8	18.2	22.1	32.4	50.0
NUM OF OBS	25	25	24	24	23	22

SEASON= NOVEMBER-MAY

RESULT DIR	321.0	328.4	335.9	349.4	7.4	10.1
RESULT DIST	0.337	0.752	1.205	1.707	2.543	3.040
MEAN I COMP	0.212	0.393	0.492	0.314	-0.327	-0.533
MEAN J COMP	-0.262	-0.641	-1.100	-1.678	-2.522	-2.992
STD DEV MAJ	0.496	1.049	1.671	2.256	3.266	3.370
STD DEV MIN	0.222	0.504	0.714	0.883	1.006	1.047
ANG OF ROT	6.8	0.1	179.8	177.9	2.7	5.6
NUM OF OBS	18	18	18	17	16	12

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 1017 LAT= 10-15N LON= 80- 85W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	323.9	328.0	329.8	331.5	335.1	336.5
RESULT DIST	0.597	1.242	1.900	2.535	3.868	5.325
MEAN I COMP	0.352	0.659	0.957	1.209	1.631	2.127
MEAN J COMP	-0.482	-1.053	-1.641	-2.228	-3.507	-4.882
STD DEV MAJ	0.194	0.364	0.572	0.814	1.238	1.658
STD DEV MIN	0.164	0.298	0.360	0.425	0.664	0.855
ANG OF ROT	167.1	36.4	48.5	54.7	47.5	33.4
NUM OF OBS	10	10	10	10	10	10

5DEG ID= 1506 LAT= 15-20N LON= 25- 30W SEASON= SEPTEMBER

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	242.5	243.6	244.4	243.7	244.4	245.8
RESULT DIST	0.602	1.238	1.890	2.733	4.879	8.310
MEAN I COMP	0.534	1.109	1.704	2.451	4.401	7.582
MEAN J COMP	0.278	0.551	0.817	1.209	2.106	3.402
STD DEV MAJ	0.524	0.984	1.377	1.799	2.514	1.629
STD DEV MIN	0.093	0.165	0.259	0.375	0.754	0.502
ANG OF ROT	60.3	56.7	53.9	51.1	46.8	106.4
NUM OF OBS	10	10	10	9	7	5

SEASON= SEPTEMBER

RESULT DIR	309.6	310.0	309.3	311.3	327.4	342.4
RESULT DIST	0.790	1.534	2.228	2.925	4.109	5.234
MEAN I COMP	0.608	1.175	1.725	2.197	2.216	1.580
MEAN J COMP	-0.504	-0.986	-1.411	-1.931	-3.460	-4.990
STD DEV MAJ	0.461	0.758	1.090	1.469	1.938	1.264
STD DEV MIN	0.260	0.380	0.401	0.559	0.780	1.156
ANG OF ROT	12.9	19.9	19.6	16.0	2.0	151.9
NUM OF OBS	11	11	11	10	7	6

SEASON= OCTOBER

RESULT DIR	333.9	338.8	344.2	346.3	346.4	354.2
RESULT DIST	0.384	0.809	1.294	1.794	2.711	3.692
MEAN I COMP	0.169	0.292	0.352	0.426	0.636	0.373
MEAN J COMP	-0.345	-0.754	-1.245	-1.743	-2.635	-3.673
STD DEV MAJ	0.282	0.497	0.581	0.651	0.727	1.228
STD DEV MIN	0.149	0.275	0.361	0.390	0.622	0.678
ANG OF ROT	54.4	51.2	69.4	87.7	98.7	33.8
NUM OF OBS	36	33	30	28	27	26

SEASON= NOVEMBER-MAY

RESULT DIR	333.8	345.4	354.9	355.8	11.4	25.1
RESULT DIST	0.227	0.523	0.846	1.136	1.675	2.707
MEAN I COMP	0.100	0.132	0.075	0.083	-0.332	-1.147
MEAN J COMP	-0.204	-0.506	-0.842	-1.133	-1.642	-2.451
STD DEV MAJ	0.391	0.738	0.992	1.182	1.544	2.221
STD DEV MIN	0.304	0.568	0.699	0.831	1.188	1.436
ANG OF ROT	159.5	137.9	122.1	112.7	79.5	34.8
NUM OF OBS	25	24	23	23	19	15

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 1507 LAT= 15-20N LON= 30- 35W SEASON= SEPTEMBER

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	253.0	254.6	254.7	256.1	260.6	262.0
RESULT DIST	0.804	1.650	2.568	3.426	5.048	6.743
MEAN I COMP	0.769	1.591	2.477	3.326	4.980	6.677
MEAN J COMP	0.234	0.438	0.676	0.821	0.824	0.939
STD DEV MAJ	0.572	1.141	1.698	2.222	3.202	3.768
STD DEV MIN	0.252	0.418	0.469	0.609	0.926	1.151
ANG OF ROT	76.0	76.0	73.4	69.1	63.4	57.9
NUM OF OBS	16	15	14	14	14	13

5DEG ID= 1508 LAT= 15-20N LON= 35- 40W SEASON= AUGUST

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	234.9	237.1	239.8	242.1	246.1	251.0
RESULT DIST	1.379	2.659	3.979	5.204	7.430	9.402
MEAN I COMP	1.129	2.233	3.439	4.597	6.793	8.887
MEAN J COMP	0.793	1.444	2.001	2.439	3.010	3.067
STD DEV MAJ	0.615	0.846	1.206	1.628	2.132	2.439
STD DEV MIN	0.117	0.276	0.473	0.571	0.866	1.361
ANG OF ROT	33.0	35.4	33.7	31.0	29.7	25.0
NUM OF OBS	7	7	7	7	7	7

SEASON= SEPTEMBER

RESULT DIR	248.5	249.9	252.8	255.9	261.3	270.0
RESULT DIST	1.000	1.988	3.030	4.015	5.936	7.367
MEAN I COMP	0.930	1.867	2.894	3.894	5.869	7.367
MEAN J COMP	0.367	0.683	0.898	0.978	0.893	-0.006
STD DEV MAJ	0.288	0.582	0.909	1.291	2.104	2.580
STD DEV MIN	0.190	0.356	0.598	0.802	1.207	1.576
ANG OF ROT	62.9	67.7	65.0	73.5	80.7	74.2
NUM OF OBS	21	21	21	21	21	19

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 1509 LAT= 15-20N LON= 40- 45W SEASON= AUGUST

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	242.4	245.4	247.0	249.2	255.4	261.4
RESULT DIST	1.215	2.480	3.667	4.788	7.048	9.038
MEAN I COMP	1.077	2.254	3.376	4.474	6.820	8.936
MEAN J COMP	0.563	1.032	1.433	1.703	1.779	1.354
STD DEV MAJ	0.350	0.793	1.203	1.499	2.138	2.371
STD DEV MIN	0.134	0.302	0.516	0.730	1.468	2.238
ANG OF ROT	25.8	19.7	22.8	25.2	18.5	3.8
NUM OF OBS	9	9	9	9	9	9

5DEG ID= 1510 LAT= 15-20N LON= 45- 50W SEASON= AUGUST

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	261.7	264.7	267.3	270.1	275.9	283.3
RESULT DIST	1.102	2.174	3.217	4.261	6.136	7.341
MEAN I COMP	1.091	2.165	3.213	4.261	6.103	7.145
MEAN J COMP	0.159	0.200	0.151	-0.006	-0.635	-1.684
STD DEV MAJ	0.527	1.003	1.362	1.686	2.394	3.310
STD DEV MIN	0.334	0.583	0.780	1.017	1.389	1.510
ANG OF ROT	57.1	64.6	71.0	73.2	69.6	64.2
NUM OF OBS	26	26	26	26	26	26

SEASON= SEPTEMBER

RESULT DIR	252.0	254.6	258.2	262.3	274.0	280.0
RESULT DIST	1.004	2.000	2.990	3.908	5.551	6.590
MEAN I COMP	0.955	1.929	2.927	3.873	5.537	6.490
MEAN J COMP	0.310	0.530	0.610	0.520	-0.385	-1.146
STD DEV MAJ	0.351	0.709	1.042	1.364	2.090	3.050
STD DEV MIN	0.244	0.460	0.747	1.056	1.490	1.546
ANG OF ROT	35.7	45.6	52.6	55.4	83.9	78.6
NUM OF OBS	30	30	30	29	27	25

SEASON= SEPTEMBER

RESULT DIR	264.2	268.0	271.4	275.0	280.5	283.9
RESULT DIST	0.899	1.741	2.502	3.287	4.715	6.202
MEAN I COMP	0.895	1.740	2.501	3.274	4.636	6.021
MEAN J COMP	0.091	0.060	-0.062	-0.286	-0.859	-1.488
STD DEV MAJ	0.342	0.659	0.927	1.242	1.864	2.406
STD DEV MIN	0.283	0.552	0.755	0.936	1.240	1.483
ANG OF ROT	42.4	59.8	65.7	73.8	73.6	72.6
NUM OF OBS	47	47	46	46	45	43

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 1511 LAT= 15-20N LON= 50- 55W SEASON= AUGUST

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	264.4	267.6	270.7	272.7	277.0	282.7
RESULT DIST	1.132	2.155	3.252	4.247	5.880	6.912
MEAN I COMP	1.126	2.153	3.251	4.242	5.836	6.743
MEAN J COMP	0.111	0.089	-0.037	-0.202	-0.720	-1.518
STD DEV MAJ	0.464	0.754	1.000	1.202	1.677	2.403
STD DEV MIN	0.239	0.419	0.660	0.832	1.132	1.264
ANG OF ROT	48.7	57.4	61.3	62.1	62.4	56.7
NUM OF OBS	23	23	23	23	23	23

SEASON= SEPTEMBER

RESULT DIR	268.3	269.8	272.3	274.5	278.8	284.4
RESULT DIST	0.858	1.625	2.408	3.159	4.725	6.051
MEAN I COMP	0.858	1.625	2.406	3.149	4.669	5.860
MEAN J COMP	0.025	0.005	-0.097	-0.249	-0.722	-1.509
STD DEV MAJ	0.406	0.700	1.096	1.476	2.337	3.152
STD DEV MIN	0.304	0.580	0.801	0.972	1.336	1.516
ANG OF ROT	5.2	47.2	59.4	62.2	59.1	56.5
NUM OF OBS	57	57	56	55	51	49

5DEG ID= 1512 LAT= 15-20N LON= 55- 60W SEASON= AUGUST

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	265.4	268.8	272.1	275.0	281.2	288.2
RESULT DIST	1.037	2.067	3.017	3.917	5.478	6.731
MEAN I COMP	1.034	2.067	3.015	3.902	5.374	6.393
MEAN J COMP	0.083	0.044	-0.111	-0.338	-1.061	-2.105
STD DEV MAJ	0.398	0.761	1.088	1.369	2.014	3.246
STD DEV MIN	0.235	0.482	0.724	1.006	1.357	1.458
ANG OF ROT	28.6	26.2	23.6	26.3	46.3	50.8
NUM OF OBS	49	49	49	49	47	46

SEASON= SEPTEMBER

RESULT DIR	274.4	277.2	279.7	282.4	287.7	295.2
RESULT DIST	0.781	1.582	2.355	3.119	4.536	5.740
MEAN I COMP	0.778	1.569	2.321	3.047	4.321	5.192
MEAN J COMP	-0.060	-0.199	-0.397	-0.668	-1.382	-2.448
STD DEV MAJ	0.365	0.730	1.097	1.483	2.241	3.182
STD DEV MIN	0.216	0.390	0.558	0.731	0.953	1.178
ANG OF ROT	29.8	31.3	32.5	34.1	38.0	42.3
NUM OF OBS	69	68	67	66	66	66

SEASON= OCTOBER

RESULT DIR	271.4	266.0	261.3	0.0	0.0	0.0
RESULT DIST	0.690	1.586	2.737	0.000	0.000	0.000
MEAN I COMP	0.690	1.582	2.706	0.000	0.000	0.000
MEAN J COMP	-0.017	0.112	0.414	0.000	0.000	0.000
STD DEV MAJ	0.614	1.217	1.518	0.000	0.000	0.000
STD DEV MIN	0.273	0.697	1.278	0.000	0.000	0.000
ANG OF ROT	47.4	47.1	60.4	0.0	0.0	0.0
NUM OF OBS	7	6	5	4	4	4

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 1513 LAT= 15-20N LON= 60- 65W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	278.4	281.9	284.9	288.3	296.0	302.0
RESULT DIST	1.042	1.981	2.910	3.894	5.541	6.536
MEAN I COMP	1.031	1.938	2.812	3.698	4.980	5.544
MEAN J COMP	-0.152	-0.409	-0.749	-1.220	-2.429	-3.462
STD DEV MAJ	0.297	0.561	0.722	0.858	1.392	2.260
STD DEV MIN	0.212	0.372	0.548	0.739	1.143	1.223
ANG OF ROT	1.3	4.0	9.4	18.2	58.0	44.9
NUM OF OBS	12	12	12	12	11	11

SEASON= AUGUST

RESULT DIR	273.4	276.4	280.2	283.5	289.0	290.8
RESULT DIST	1.057	2.018	2.905	3.746	5.145	6.237
MEAN I COMP	1.056	2.006	2.859	3.643	4.866	5.829
MEAN J COMP	-0.062	-0.226	-0.517	-0.872	-1.673	-2.220
STD DEV MAJ	0.401	0.698	0.903	1.199	1.899	2.179
STD DEV MIN	0.230	0.442	0.679	0.872	1.278	1.148
ANG OF ROT	18.8	17.4	19.2	20.2	35.3	18.6
NUM OF OBS	52	50	47	45	44	41

SEASON= SEPTEMBER

RESULT DIR	275.9	277.9	279.8	282.1	288.0	293.9
RESULT DIST	0.918	1.795	2.625	3.367	4.593	5.665
MEAN I COMP	0.913	1.778	2.587	3.292	4.368	5.179
MEAN J COMP	-0.095	-0.247	-0.445	-0.705	-1.419	-2.296
STD DEV MAJ	0.334	0.600	0.878	1.211	2.075	3.230
STD DEV MIN	0.199	0.415	0.567	0.714	0.860	1.143
ANG OF ROT	41.0	42.0	43.8	47.8	41.2	36.8
NUM OF OBS	61	61	60	60	58	54

SEASON= OCTOBER

RESULT DIR	291.7	299.5	306.4	313.5	327.7	340.7
RESULT DIST	0.546	1.128	1.781	2.461	3.792	5.570
MEAN I COMP	0.508	0.982	1.434	1.785	2.024	1.845
MEAN J COMP	-0.202	-0.555	-1.056	-1.694	-3.207	-5.255
STD DEV MAJ	0.534	1.020	1.405	1.823	2.779	3.865
STD DEV MIN	0.341	0.680	1.032	1.221	1.641	1.595
ANG OF ROT	30.9	35.8	49.6	60.3	61.9	53.6
NUM OF OBS	17	17	16	15	13	11

SEASON= NOVEMBER-MAY

RESULT DIR	203.3	200.7	199.4	203.1	0.0	0.0
RESULT DIST	0.546	1.020	1.394	1.836	0.000	0.000
MEAN I COMP	0.216	0.361	0.464	0.722	0.000	0.000
MEAN J COMP	0.502	0.954	1.315	1.688	0.000	0.000
STD DEV MAJ	0.379	0.683	1.010	1.269	0.000	0.000
STD DEV MIN	0.157	0.269	0.348	0.369	0.000	0.000
ANG OF ROT	20.6	14.5	13.9	7.4	0.0	0.0
NUM OF OBS	10	9	8	6	4	2

5DEG ID= 1514 LAT= 15-20N LON= 65- 70W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	283.6	285.4	288.1	291.9	299.9	306.3
RESULT DIST	0.954	2.028	3.065	3.912	4.986	5.828
MEAN I COMP	0.928	1.955	2.913	3.628	4.322	4.695
MEAN J COMP	-0.224	-0.539	-0.954	-1.462	-2.486	-3.452
STD DEV MAJ	0.375	0.840	1.364	1.761	2.532	2.856
STD DEV MIN	0.303	0.633	0.901	1.152	1.370	1.382
ANG OF ROT	17.6	22.5	20.1	26.5	32.9	30.7
NUM OF OBS	13	13	13	13	12	11

SEASON= AUGUST

RESULT DIR	277.2	280.6	283.2	285.4	289.3	293.1
RESULT DIST	1.022	2.070	3.015	3.852	5.236	6.450
MEAN I COMP	1.014	2.035	2.936	3.715	4.941	5.932
MEAN J COMP	-0.128	-0.381	-0.687	-1.020	-1.734	-2.533
STD DEV MAJ	0.342	0.664	0.965	1.237	1.750	2.267
STD DEV MIN	0.234	0.478	0.637	0.796	1.043	1.307
ANG OF ROT	10.1	2.8	0.6	2.0	10.9	14.8
NUM OF OBS	43	41	41	41	40	38

SEASON= SEPTEMBER

RESULT DIR	280.0	282.9	286.0	288.4	291.4	297.9
RESULT DIST	0.848	1.627	2.319	2.992	4.175	4.974
MEAN I COMP	0.835	1.586	2.228	2.839	3.887	4.398
MEAN J COMP	-0.147	-0.364	-0.640	-0.944	-1.523	-2.324
STD DEV MAJ	0.381	0.708	1.048	1.407	2.260	3.201
STD DEV MIN	0.212	0.336	0.513	0.675	1.018	1.187
ANG OF ROT	36.6	38.2	39.7	41.8	36.3	35.5
NUM OF OBS	56	54	52	49	44	42

SEASON= OCTOBER

RESULT DIR	309.9	317.7	323.2	328.7	341.5	350.1
RESULT DIST	0.887	1.799	2.721	3.723	5.830	6.962
MEAN I COMP	0.681	1.210	1.631	1.936	1.848	1.202
MEAN J COMP	-0.568	-1.331	-2.178	-3.180	-5.529	-6.858
STD DEV MAJ	0.422	0.876	1.441	1.887	2.668	3.138
STD DEV MIN	0.201	0.286	0.253	0.365	1.218	1.566
ANG OF ROT	44.5	53.2	50.6	51.9	61.2	50.7
NUM OF OBS	12	12	12	12	12	9

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5DEG ID= 1515 LAT= 15-20N LON= 70- 75W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	274.6	277.3	281.1	283.4	0.0	0.0
RESULT DIST	1.336	2.565	3.514	4.457	0.000	0.000
MEAN I COMP	1.332	2.544	3.448	4.336	0.000	0.000
MEAN J COMP	-0.106	-0.324	-0.676	-1.030	0.000	0.000
STD DEV MAJ	0.398	0.755	0.846	1.198	0.000	0.000
STD DEV MIN	0.234	0.414	0.267	0.325	0.000	0.000
ANG OF ROT	35.0	14.8	36.0	32.7	0.0	0.0
NUM OF OBS	5	5	5	5	4	3
SEASON= AUGUST						
RESULT DIR	281.7	283.6	285.6	288.2	292.8	296.1
RESULT DIST	1.102	2.147	3.071	3.913	5.550	6.815
MEAN I COMP	1.079	2.087	2.958	3.717	5.114	6.120
MEAN J COMP	-0.223	-0.505	-0.827	-1.223	-2.155	-2.997
STD DEV MAJ	0.396	0.720	0.979	1.184	1.561	1.833
STD DEV MIN	0.173	0.313	0.492	0.708	1.145	1.351
ANG OF ROT	163.4	158.2	157.1	155.7	152.6	177.7
NUM OF OBS	31	31	31	31	30	27
SEASON= SEPTEMBER						
RESULT DIR	277.6	279.3	280.9	281.7	287.3	292.5
RESULT DIST	0.940	1.761	2.585	3.328	4.600	5.676
MEAN I COMP	0.932	1.738	2.538	3.258	4.392	5.245
MEAN J COMP	-0.124	-0.283	-0.491	-0.677	-1.369	-2.170
STD DEV MAJ	0.292	0.605	0.837	1.083	1.559	2.257
STD DEV MIN	0.216	0.451	0.694	0.706	0.899	1.128
ANG OF ROT	1.6	5.3	10.0	0.7	10.2	10.6
NUM OF OBS	37	36	34	33	33	33
SEASON= OCTOBER						
RESULT DIR	332.0	334.8	338.0	340.2	340.2	333.4
RESULT DIST	0.572	1.159	1.805	2.500	3.876	4.727
MEAN I COMP	0.269	0.493	0.675	0.849	1.314	2.118
MEAN J COMP	-0.505	-1.049	-1.674	-2.351	-3.647	-4.226
STD DEV MAJ	0.648	1.248	1.865	2.594	3.933	4.108
STD DEV MIN	0.191	0.339	0.556	0.818	1.481	2.209
ANG OF ROT	23.7	27.9	36.2	43.3	51.7	78.7
NUM OF OBS	14	14	14	14	13	11
SEASON= NOVEMBER-MAY						
RESULT DIR	25.3	26.0	26.0	27.4	0.0	0.0
RESULT DIST	0.945	1.880	2.663	3.264	0.000	0.000
MEAN I COMP	-0.404	-0.824	-1.166	-1.502	0.000	0.000
MEAN J COMP	-0.854	-1.690	-2.394	-2.898	0.000	0.000
STD DEV MAJ	0.896	1.681	2.395	3.001	0.000	0.000
STD DEV MIN	0.200	0.335	0.578	0.858	0.000	0.000
ANG OF ROT	176.0	176.5	179.2	4.8	0.0	0.0
NUM OF OBS	5	5	5	5	3	2

5DEG ID= 1516 LAT= 15-20N LON= 75- 80W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	300.2	303.8	305.0	309.2	308.4	319.2
RESULT DIST	0.639	1.272	2.054	2.808	4.704	5.941
MEAN I COMP	0.553	1.057	1.683	2.176	3.687	3.879
MEAN J COMP	-0.321	-0.707	-1.177	-1.775	-2.921	-4.500
STD DEV MAJ	0.647	1.101	1.584	1.894	2.102	1.532
STD DEV MIN	0.112	0.238	0.436	0.638	1.062	0.420
ANG OF ROT	178.8	179.0	179.5	176.8	8.1	20.2
NUM OF OBS	16	15	14	12	10	7
SEASON= AUGUST						
RESULT DIR	287.0	289.7	292.3	294.4	297.8	302.4
RESULT DIST	1.034	1.926	2.829	3.670	5.086	6.014
MEAN I COMP	0.989	1.814	2.618	3.341	4.497	5.077
MEAN J COMP	-0.302	-0.648	-1.072	-1.519	-2.376	-3.223
STD DEV MAJ	0.381	0.593	0.783	0.963	1.423	1.862
STD DEV MIN	0.160	0.319	0.507	0.738	1.090	1.072
ANG OF ROT	169.0	170.4	176.7	3.4	23.3	32.4
NUM OF OBS	34	33	33	33	31	25
SEASON= SEPTEMBER						
RESULT DIR	288.2	292.2	295.8	298.7	305.7	319.8
RESULT DIST	0.825	1.617	2.329	2.959	4.133	4.970
MEAN I COMP	0.784	1.497	2.098	2.595	3.354	3.208
MEAN J COMP	-0.258	-0.612	-1.012	-1.421	-2.414	-3.797
STD DEV MAJ	0.388	0.746	1.104	1.486	2.490	3.452
STD DEV MIN	0.250	0.478	0.684	0.834	1.088	0.991
ANG OF ROT	16.3	16.1	19.7	23.1	25.8	33.1
NUM OF OBS	46	45	45	45	44	35
SEASON= OCTOBER						
RESULT DIR	332.2	333.4	329.2	331.2	330.8	338.4
RESULT DIST	0.336	0.693	1.054	1.394	2.056	2.673
MEAN I COMP	0.157	0.310	0.540	0.671	1.003	0.983
MEAN J COMP	-0.297	-0.620	-0.905	-1.222	-1.795	-2.486
STD DEV MAJ	0.478	0.897	1.162	1.554	2.099	2.600
STD DEV MIN	0.210	0.406	0.629	0.844	1.224	1.359
ANG OF ROT	16.3	25.2	31.3	34.9	42.3	43.2
NUM OF OBS	45	45	44	44	43	39
SEASON= NOVEMBER-MAY						
RESULT DIR	4.7	10.1	16.1	21.7	25.6	26.5
RESULT DIST	0.266	0.560	0.877	1.284	2.148	3.503
MEAN I COMP	-0.022	-0.098	-0.244	-0.475	-0.928	-1.563
MEAN J COMP	-0.265	-0.551	-0.842	-1.193	-1.937	-3.135
STD DEV MAJ	0.368	0.661	0.889	1.102	1.510	2.304
STD DEV MIN	0.246	0.466	0.582	0.615	0.700	1.020
ANG OF ROT	128.1	109.1	84.7	67.1	56.3	58.9
NUM OF OBS	21	21	21	21	19	16

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5DEG ID= 1517 LAT= 15-20N LON= 80- 85W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	315.9	317.4	322.9	327.0	334.5	339.6
RESULT DIST	0.681	1.397	2.088	2.834	4.202	5.092
MEAN I COMP	0.474	0.945	1.259	1.543	1.808	1.774
MEAN J COMP	-0.489	-1.029	-1.665	-2.377	-3.793	-4.773
STD DEV MAJ	0.381	0.769	1.086	1.379	1.795	2.550
STD DEV MIN	0.223	0.443	0.600	0.684	0.671	0.879
ANG OF ROT	8.4	17.5	19.7	22.2	21.1	18.2
NUM OF OBS	30	30	28	27	25	21

SEASON= AUGUST

RESULT DIR	296.7	298.1	300.5	302.2	307.5	310.7
RESULT DIST	0.924	1.825	2.702	3.505	4.792	5.936
MEAN I COMP	0.826	1.610	2.327	2.965	3.803	4.499
MEAN J COMP	-0.415	-0.859	-1.373	-1.870	-2.915	-3.871
STD DEV MAJ	0.288	0.496	0.699	0.906	1.267	1.681
STD DEV MIN	0.171	0.351	0.546	0.767	0.974	0.869
ANG OF ROT	172.6	172.9	177.0	8.1	14.1	55.6
NUM OF OBS	31	31	30	29	22	16

SEASON= SEPTEMBER

RESULT DIR	305.5	308.8	313.5	320.1	333.2	344.4
RESULT DIST	0.675	1.283	1.858	2.435	3.421	4.570
MEAN I COMP	0.550	1.000	1.347	1.564	1.543	1.230
MEAN J COMP	-0.392	-0.803	-1.279	-1.867	-3.053	-4.402
STD DEV MAJ	0.395	0.767	1.163	1.539	2.226	2.869
STD DEV MIN	0.269	0.492	0.678	0.846	0.967	1.329
ANG OF ROT	15.4	20.8	22.6	21.9	24.8	23.3
NUM OF OBS	56	56	53	50	44	41

SEASON= OCTOBER

RESULT DIR	329.3	334.4	340.8	346.4	3.5	10.1
RESULT DIST	0.391	0.768	1.162	1.599	2.684	3.895
MEAN I COMP	0.200	0.332	0.381	0.376	-0.162	-0.684
MEAN J COMP	-0.336	-0.693	-1.097	-1.554	-2.679	-3.834
STD DEV MAJ	0.392	0.822	1.238	1.537	1.911	2.725
STD DEV MIN	0.275	0.482	0.643	0.762	0.984	1.259
ANG OF ROT	16.9	19.2	21.7	25.9	30.6	32.8
NUM OF OBS	93	92	90	86	77	73

SEASON= NOVEMBER-MAY

RESULT DIR	332.5	343.3	355.3	7.0	14.6	23.6
RESULT DIST	0.460	0.878	1.324	1.941	3.232	5.096
MEAN I COMP	0.212	0.253	0.107	-0.238	-0.813	-2.040
MEAN J COMP	-0.408	-0.841	-1.320	-1.926	-3.128	-4.670
STD DEV MAJ	0.563	0.978	1.492	2.103	3.315	4.483
STD DEV MIN	0.363	0.820	1.180	1.345	1.546	1.457
ANG OF ROT	113.0	85.9	53.9	39.0	40.5	46.4
NUM OF OBS	26	25	23	20	18	16

5DEG ID= 1518 LAT= 15-20N LON= 85- 90W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	312.9	313.7	315.6	318.8	325.1	336.2
RESULT DIST	0.542	1.083	1.562	1.975	2.676	3.025
MEAN I COMP	0.397	0.782	1.093	1.300	1.533	1.219
MEAN J COMP	-0.369	-0.748	-1.115	-1.487	-2.194	-2.768
STD DEV MAJ	0.394	0.707	0.961	1.239	1.669	1.710
STD DEV MIN	0.267	0.620	0.895	1.051	1.205	1.369
ANG OF ROT	30.0	43.3	106.9	117.0	142.7	165.7
NUM OF OBS	27	26	25	24	22	19

SEASON= AUGUST

RESULT DIR	294.8	299.6	298.1	296.5	0.0	0.0
RESULT DIST	0.826	1.757	2.546	3.313	0.000	0.000
MEAN I COMP	0.750	1.529	2.246	2.965	0.000	0.000
MEAN J COMP	-0.346	-0.867	-1.199	-1.478	0.000	0.000
STD DEV MAJ	0.248	0.468	0.494	0.538	0.000	0.000
STD DEV MIN	0.201	0.152	0.075	0.198	0.000	0.000
ANG OF ROT	163.2	155.6	157.8	160.8	0.0	0.0
NUM OF OBS	8	7	7	6	2	0

SEASON= SEPTEMBER

RESULT DIR	300.0	308.2	312.4	318.4	327.4	328.4
RESULT DIST	0.631	1.283	2.036	2.591	3.672	4.725
MEAN I COMP	0.546	1.008	1.504	1.720	1.979	2.474
MEAN J COMP	-0.316	-0.793	-1.372	-1.937	-3.094	-4.026
STD DEV MAJ	0.422	0.791	1.088	1.567	2.220	2.285
STD DEV MIN	0.242	0.497	0.760	0.991	0.975	0.895
ANG OF ROT	177.2	178.4	3.0	25.9	47.3	67.4
NUM OF OBS	36	31	29	24	16	8

SEASON= OCTOBER

RESULT DIR	307.7	319.7	336.4	354.7	11.4	20.7
RESULT DIST	0.448	0.889	1.331	1.847	3.159	4.470
MEAN I COMP	0.354	0.575	0.532	0.172	-0.623	-1.584
MEAN J COMP	-0.274	-0.678	-1.220	-1.839	-3.097	-4.181
STD DEV MAJ	0.465	0.928	1.363	1.636	2.338	3.309
STD DEV MIN	0.266	0.460	0.600	0.718	0.884	1.414
ANG OF ROT	17.4	17.0	19.1	28.8	40.6	28.1
NUM OF OBS	25	23	21	19	18	17

SEASON= NOVEMBER-MAY

RESULT DIR	315.4	314.8	0.0	0.0	0.0	0.0
RESULT DIST	0.550	1.150	0.000	0.000	0.000	0.000
MEAN I COMP	0.387	0.816	0.000	0.000	0.000	0.000
MEAN J COMP	-0.392	-0.810	0.000	0.000	0.000	0.000
STD DEV MAJ	0.454	0.704	0.000	0.000	0.000	0.000
STD DEV MIN	0.090	0.116	0.000	0.000	0.000	0.000
ANG OF ROT	29.0	28.3	0.0	0.0	0.0	0.0
NUM OF OBS	6	5	4	3	1	0

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5DEG ID= 1519 LAT= 15-20N LON= 90- 95W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	308.4	317.5	324.4	333.2	343.0	347.3
RESULT DIST	0.549	0.965	1.483	1.884	2.599	3.438
MEAN I COMP	0.430	0.651	0.864	0.850	0.758	0.756
MEAN J COMP	-0.341	-0.711	-1.206	-1.682	-2.486	-3.354
STD DEV MAJ	0.463	0.746	1.054	1.247	0.704	0.626
STD DEV MIN	0.122	0.250	0.308	0.326	0.353	0.418
ANG OF ROT	127.1	154.1	173.3	179.2	179.6	72.9
NUM OF OBS	8	7	7	6	5	5

5DEG ID= 2007 LAT= 20-25N LON= 30- 35W SEASON= SEPTEMBER

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	324.0	326.6	328.7	330.3	338.9	0.0
RESULT DIST	0.620	1.213	1.748	2.192	2.523	0.000
MEAN I COMP	0.364	0.667	0.909	1.087	0.908	0.000
MEAN J COMP	-0.501	-1.013	-1.493	-1.903	-2.354	0.000
STD DEV MAJ	0.165	0.335	0.516	0.691	1.153	0.000
STD DEV MIN	0.046	0.100	0.097	0.087	0.044	0.000
ANG OF ROT	145.5	137.9	142.8	146.6	151.2	0.0
NUM OF OBS	7	7	7	7	5	4

SEASON= SEPTEMBER

RESULT DIR	287.9	303.1	352.6	0.0	0.0	0.0
RESULT DIST	0.581	1.039	1.327	0.000	0.000	0.000
MEAN I COMP	0.553	0.870	0.172	0.000	0.000	0.000
MEAN J COMP	-0.179	-0.568	-1.316	0.000	0.000	0.000
STD DEV MAJ	0.564	1.051	1.417	0.000	0.000	0.000
STD DEV MIN	0.471	0.908	0.407	0.000	0.000	0.000
ANG OF ROT	133.7	8.9	7.4	0.0	0.0	0.0
NUM OF OBS	14	10	5	4	4	1

SEASON= OCTOBER

RESULT DIR	321.2	336.6	348.5	355.7	8.7	19.1
RESULT DIST	0.274	0.684	1.069	1.569	2.796	4.126
MEAN I COMP	0.172	0.271	0.213	0.117	-0.422	-1.351
MEAN J COMP	-0.214	-0.628	-1.047	-1.565	-2.764	-3.899
STD DEV MAJ	0.310	0.555	0.663	0.829	1.122	1.144
STD DEV MIN	0.253	0.309	0.482	0.743	1.018	0.935
ANG OF ROT	138.9	158.4	131.3	102.6	56.0	52.2
NUM OF OBS	18	15	14	14	14	14

SEASON= NOVEMBER-MAY

RESULT DIR	314.1	0.0	0.0	0.0	0.0	0.0
RESULT DIST	0.092	0.000	0.000	0.000	0.000	0.000
MEAN I COMP	0.066	0.000	0.000	0.000	0.000	0.000
MEAN J COMP	-0.064	0.000	0.000	0.000	0.000	0.000
STD DEV MAJ	0.277	0.000	0.000	0.000	0.000	0.000
STD DEV MIN	0.062	0.000	0.000	0.000	0.000	0.000
ANG OF ROT	109.3	0.0	0.0	0.0	0.0	0.0
NUM OF OBS	5	3	2	0	0	0

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 2009 LAT= 20-25N LON= 40- 45W SEASON= SEPTEMBER

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	283.9	288.9	292.6	294.9	300.1	310.9
RESULT DIST	1.075	2.276	3.357	4.109	4.969	5.273
MEAN I COMP	1.043	2.153	3.098	3.728	4.298	3.983
MEAN J COMP	-0.258	-0.738	-1.292	-1.728	-2.493	-3.455
STD DEV MAJ	0.560	1.118	1.504	1.666	1.873	2.263
STD DEV MIN	0.127	0.213	0.232	0.348	0.379	0.535
ANG OF ROT	71.8	73.0	69.8	63.4	46.4	32.9
NUM OF OBS	6	6	6	6	6	6

5DEG ID= 2010 LAT= 20-25N LON= 45- 50W SEASON= SEPTEMBER

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	295.9	298.3	300.1	306.0	316.2	312.9
RESULT DIST	0.857	1.914	2.891	3.762	5.199	6.188
MEAN I COMP	0.771	1.684	2.501	3.043	3.601	4.532
MEAN J COMP	-0.374	-0.909	-1.450	-2.213	-3.751	-4.213
STD DEV MAJ	0.523	1.084	1.602	2.284	3.676	4.942
STD DEV MIN	0.372	0.792	0.946	1.220	0.865	0.782
ANG OF ROT	56.4	56.2	49.0	52.3	66.3	69.6
NUM OF OBS	16	16	15	14	12	9

SEASON= OCTOBER

RESULT DIR	279.9	282.6	288.2	295.6	0.0	0.0
RESULT DIST	0.609	1.141	1.648	2.200	0.000	0.000
MEAN I COMP	0.600	1.113	1.565	1.983	0.000	0.000
MEAN J COMP	-0.105	-0.248	-0.515	-0.952	0.000	0.000
STD DEV MAJ	0.301	0.719	1.352	2.089	0.000	0.000
STD DEV MIN	0.228	0.302	0.441	0.685	0.000	0.000
ANG OF ROT	38.4	48.0	50.6	51.6	0.0	0.0
NUM OF OBS	6	6	6	6	4	3

SEASON= NOVEMBER-MAY

RESULT DIR	277.6	275.6	276.1	279.6	295.0	312.0
RESULT DIST	0.668	1.375	1.921	2.324	2.669	3.219
MEAN I COMP	0.662	1.368	1.910	2.292	2.418	2.394
MEAN J COMP	-0.088	-0.134	-0.204	-0.386	-1.130	-2.152
STD DEV MAJ	0.388	0.745	1.037	1.152	1.495	2.209
STD DEV MIN	0.237	0.428	0.499	0.592	0.556	0.315
ANG OF ROT	11.7	179.5	167.8	146.2	86.7	69.4
NUM OF OBS	5	5	5	5	5	5

SEASON= NOVEMBER-MAY

RESULT DIR	318.8	313.6	309.7	306.7	313.1	0.0
RESULT DIST	0.382	0.868	1.323	1.672	2.512	0.000
MEAN I COMP	0.251	0.629	1.019	1.340	1.833	0.000
MEAN J COMP	-0.287	-0.599	-0.844	-1.000	-1.717	0.000
STD DEV MAJ	0.913	1.774	2.381	2.899	4.092	0.000
STD DEV MIN	0.300	0.432	0.414	0.270	0.528	0.000
ANG OF ROT	57.8	70.0	72.9	72.2	70.7	0.0
NUM OF OBS	7	7	7	7	6	4

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 2011 LAT= 20-25N LON= 50- 55W SEASON= AUGUST

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	289.1	290.5	294.0	298.0	310.6	319.5
RESULT DIST	0.984	1.928	2.848	3.569	4.495	5.421
MEAN I COMP	0.930	1.805	2.601	3.151	3.411	3.521
MEAN J COMP	-0.321	-0.676	-1.160	-1.676	-2.927	-4.121
STD DEV MAJ	0.300	0.511	0.748	0.962	1.723	3.306
STD DEV MIN	0.154	0.168	0.206	0.412	0.843	1.137
ANG OF ROT	136.3	131.3	122.9	111.3	79.6	66.8
NUM OF OBS	8	8	8	8	8	7

SEASON= SEPTEMBER

RESULT DIR	289.7	294.2	300.0	305.0	311.5	314.2
RESULT DIST	0.804	1.609	2.328	2.972	4.276	5.383
MEAN I COMP	0.757	1.468	2.016	2.434	3.202	3.858
MEAN J COMP	-0.271	-0.661	-1.164	-1.706	-2.833	-3.753
STD DEV MAJ	0.513	0.941	1.429	1.952	3.069	3.504
STD DEV MIN	0.345	0.692	0.948	1.075	1.202	1.484
ANG OF ROT	36.5	50.0	62.3	66.3	65.4	64.3
NUM OF OBS	34	34	34	34	33	30

SEASON= OCTOBER

RESULT DIR	266.8	275.3	287.3	294.5	308.6	0.0
RESULT DIST	0.755	1.410	2.094	2.851	4.101	0.000
MEAN I COMP	0.754	1.404	2.000	2.594	3.205	0.000
MEAN J COMP	0.042	-0.130	-0.621	-1.182	-2.558	0.000
STD DEV MAJ	0.339	0.630	0.852	1.085	1.235	0.000
STD DEV MIN	0.259	0.412	0.328	0.399	0.550	0.000
ANG OF ROT	71.7	80.1	110.3	104.9	89.5	0.0
NUM OF OBS	11	10	9	9	6	3

SEASON= NOVEMBER-MAY

RESULT DIR	275.5	278.7	302.5	328.5	0.0	0.0
RESULT DIST	0.315	0.713	1.038	1.626	0.000	0.000
MEAN I COMP	0.314	0.705	0.875	0.848	0.000	0.000
MEAN J COMP	-0.030	-0.108	-0.558	-1.387	0.000	0.000
STD DEV MAJ	0.750	1.429	2.486	3.784	0.000	0.000
STD DEV MIN	0.260	0.429	0.624	0.569	0.000	0.000
ANG OF ROT	51.1	49.7	58.1	64.8	0.0	0.0
NUM OF OBS	10	10	8	6	4	4

5DEG ID= 2012 LAT= 20-25N LON= 55- 60W SEASON= AUGUST

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	294.1	297.9	302.5	308.8	318.8	327.2
RESULT DIST	0.670	1.330	1.943	2.560	3.717	5.119
MEAN I COMP	0.611	1.175	1.639	1.997	2.447	2.777
MEAN J COMP	-0.274	-0.623	-1.044	-1.603	-2.797	-4.300
STD DEV MAJ	0.377	0.688	0.934	1.145	1.908	3.064
STD DEV MIN	0.159	0.387	0.678	0.998	1.187	1.052
ANG OF ROT	165.4	164.9	171.8	7.4	64.6	70.4
NUM OF OBS	23	23	23	23	22	21

SEASON= SEPTEMBER

RESULT DIR	285.9	291.8	296.4	301.4	309.5	310.6
RESULT DIST	0.718	1.421	2.131	2.838	4.300	5.492
MEAN I COMP	0.690	1.319	1.908	2.422	3.316	4.168
MEAN J COMP	-0.197	-0.528	-0.947	-1.480	-2.737	-3.576
STD DEV MAJ	0.412	0.846	1.278	1.792	2.912	3.318
STD DEV MIN	0.298	0.583	0.781	0.915	1.216	1.573
ANG OF ROT	23.3	46.0	54.0	57.5	63.1	58.9
NUM OF OBS	49	47	47	46	42	34

SEASON= OCTOBER

RESULT DIR	287.3	295.1	306.6	316.7	341.2	0.0
RESULT DIST	0.652	1.301	2.081	2.821	4.245	0.000
MEAN I COMP	0.622	1.178	1.670	1.934	1.370	0.000
MEAN J COMP	-0.194	-0.552	-1.242	-2.054	-4.018	0.000
STD DEV MAJ	0.131	0.289	0.755	0.884	1.281	0.000
STD DEV MIN	0.053	0.168	0.129	0.391	0.799	0.000
ANG OF ROT	8.0	133.3	107.8	108.6	179.2	0.0
NUM OF OBS	5	5	5	5	5	3

SEASON= NOVEMBER-MAY

RESULT DIR	281.1	292.1	276.6	270.1	272.4	266.2
RESULT DIST	0.392	0.710	1.265	1.840	2.761	3.003
MEAN I COMP	0.384	0.658	1.257	1.840	2.758	2.996
MEAN J COMP	-0.076	-0.267	-0.145	-0.002	-0.117	0.198
STD DEV MAJ	0.523	1.284	1.581	1.670	2.330	2.899
STD DEV MIN	0.167	0.250	0.263	0.356	0.648	0.596
ANG OF ROT	60.3	63.9	68.9	75.3	86.3	101.0
NUM OF OBS	7	6	6	6	6	5

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5DEG ID= 2013 LAT= 20-25N LON= 60- 65W SEASON= AUGUST

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	291.0	294.2	297.6	302.6	312.7	326.7
RESULT DIST	0.828	1.587	2.311	2.878	3.948	4.995
MEAN I COMP	0.772	1.447	2.048	2.425	2.901	2.743
MEAN J COMP	-0.297	-0.652	-1.072	-1.549	-2.678	-4.174
STD DEV MAJ	0.402	0.702	1.016	1.121	1.779	3.303
STD DEV MIN	0.161	0.301	0.516	0.701	1.244	1.326
ANG OF ROT	179.0	176.7	166.0	148.5	79.3	58.1
NUM OF OBS	29	29	29	28	28	27

SEASON= SEPTEMBER

RESULT DIR	295.8	301.5	307.4	313.7	324.5	322.8
RESULT DIST	0.723	1.427	2.080	2.644	3.730	4.691
MEAN I COMP	0.651	1.217	1.652	1.910	2.164	2.833
MEAN J COMP	-0.315	-0.745	-1.263	-1.828	-3.037	-3.739
STD DEV MAJ	0.362	0.761	1.235	1.771	2.791	3.187
STD DEV MIN	0.266	0.504	0.721	0.903	1.240	1.818
ANG OF ROT	27.6	34.9	37.0	38.3	37.6	35.2
NUM OF OBS	73	73	73	71	66	57

SEASON= OCTOBER

RESULT DIR	311.3	316.3	323.9	332.7	348.0	356.3
RESULT DIST	0.689	1.361	1.857	2.263	3.523	5.299
MEAN I COMP	0.518	0.940	1.095	1.036	0.732	0.340
MEAN J COMP	-0.455	-0.984	-1.500	-2.012	-3.446	-5.288
STD DEV MAJ	0.532	1.002	1.437	2.002	3.274	4.065
STD DEV MIN	0.198	0.384	0.520	0.588	1.054	2.116
ANG OF ROT	38.5	36.8	34.5	32.3	30.1	36.8
NUM OF OBS	17	16	15	14	14	13

SEASON= NOVEMBER-MAY

RESULT DIR	301.3	282.9	285.9	286.8	0.0	0.0
RESULT DIST	0.341	1.009	1.379	1.749	0.000	0.000
MEAN I COMP	0.291	0.983	1.327	1.675	0.000	0.000
MEAN J COMP	-0.177	-0.225	-0.377	-0.505	0.000	0.000
STD DEV MAJ	0.817	1.695	2.419	3.022	0.000	0.000
STD DEV MIN	0.598	0.333	0.909	1.515	0.000	0.000
ANG OF ROT	125.2	116.2	111.6	108.1	0.0	0.0
NUM OF OBS	7	6	6	6	4	2

5DEG ID= 2014 LAT= 20-25N LON= 65- 70W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	301.6	307.1	310.5	314.5	319.4	323.1
RESULT DIST	0.782	1.425	2.024	2.637	3.686	4.468
MEAN I COMP	0.666	1.137	1.539	1.881	2.399	2.684
MEAN J COMP	-0.410	-0.859	-1.315	-1.847	-2.799	-3.572
STD DEV MAJ	0.438	0.798	1.057	1.248	1.553	1.518
STD DEV MIN	0.210	0.342	0.498	0.677	0.733	0.619
ANG OF ROT	143.6	135.6	119.5	103.6	79.6	59.2
NUM OF OBS	9	8	8	8	8	8

SEASON= AUGUST

RESULT DIR	298.8	302.2	307.0	310.6	315.3	322.0
RESULT DIST	0.774	1.465	2.062	2.633	3.568	4.392
MEAN I COMP	0.678	1.239	1.647	1.999	2.512	2.705
MEAN J COMP	-0.373	-0.781	-1.240	-1.714	-2.535	-3.460
STD DEV MAJ	0.406	0.748	1.157	1.715	2.648	3.263
STD DEV MIN	0.273	0.574	0.803	1.037	1.208	1.208
ANG OF ROT	146.4	124.8	91.4	71.2	56.1	46.4
NUM OF OBS	46	46	45	45	42	40

SEASON= SEPTEMBER

RESULT DIR	297.2	303.2	310.1	316.6	327.0	338.1
RESULT DIST	0.677	1.315	1.900	2.441	3.551	4.552
MEAN I COMP	0.602	1.100	1.454	1.677	1.932	1.700
MEAN J COMP	-0.309	-0.720	-1.222	-1.774	-2.979	-4.223
STD DEV MAJ	0.348	0.685	1.079	1.548	2.633	3.626
STD DEV MIN	0.267	0.515	0.704	0.876	1.340	1.187
ANG OF ROT	13.2	33.0	39.1	39.9	42.4	46.8
NUM OF OBS	80	80	80	79	74	66

SEASON= OCTOBER

RESULT DIR	341.0	350.4	356.0	356.4	1.7	6.7
RESULT DIST	0.770	1.644	2.691	3.487	4.848	7.331
MEAN I COMP	0.251	0.274	0.186	0.222	-0.140	-0.856
MEAN J COMP	-0.728	-1.621	-2.685	-3.480	-4.846	-7.281
STD DEV MAJ	0.731	1.526	2.352	2.672	2.783	3.269
STD DEV MIN	0.314	0.509	0.778	1.186	1.168	1.533
ANG OF ROT	50.7	51.1	50.8	50.3	25.6	35.2
NUM OF OBS	14	14	14	13	11	11

SEASON= NOVEMBER-MAY

RESULT DIR	31.2	26.1	23.6	24.1	0.0	0.0
RESULT DIST	0.813	1.512	2.757	3.767	0.000	0.000
MEAN I COMP	-0.421	-0.665	-1.103	-1.537	0.000	0.000
MEAN J COMP	-0.695	-1.357	-2.527	-3.439	0.000	0.000
STD DEV MAJ	0.658	1.343	1.788	2.834	0.000	0.000
STD DEV MIN	0.438	0.614	0.421	0.493	0.000	0.000
ANG OF ROT	66.8	54.6	35.6	39.0	0.0	0.0
NUM OF OBS	8	8	7	7	3	2

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5DEG ID= 2015 LAT= 20-25N LON= 70- 75W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	308.4	313.8	319.1	323.3	328.9	335.7
RESULT DIST	0.825	1.592	2.238	2.764	3.540	4.169
MEAN I COMP	0.647	1.148	1.466	1.652	1.827	1.712
MEAN J COMP	-0.512	-1.102	-1.691	-2.216	-3.032	-3.801
STD DEV MAJ	0.263	0.563	0.890	1.225	1.801	2.893
STD DEV MIN	0.209	0.367	0.496	0.538	0.652	0.737
ANG OF ROT	87.7	72.8	56.4	51.1	40.0	30.7
NUM OF OBS	16	16	16	16	16	16

SEASON= AUGUST

RESULT DIR	296.4	299.4	300.8	303.2	308.7	317.0
RESULT DIST	0.708	1.309	1.885	2.386	3.246	4.141
MEAN I COMP	0.634	1.141	1.619	1.996	2.534	2.826
MEAN J COMP	-0.315	-0.643	-0.965	-1.308	-2.028	-3.027
STD DEV MAJ	0.338	0.578	0.801	1.080	1.524	2.612
STD DEV MIN	0.285	0.477	0.620	0.721	0.879	1.022
ANG OF ROT	146.3	51.7	47.1	49.5	40.5	38.7
NUM OF OBS	43	42	41	40	39	36

SEASON= SEPTEMBER

RESULT DIR	307.0	309.5	312.6	318.0	331.6	345.1
RESULT DIST	0.655	1.267	1.807	2.285	3.002	3.958
MEAN I COMP	0.523	0.978	1.329	1.529	1.427	1.021
MEAN J COMP	-0.394	-0.806	-1.224	-1.698	-2.641	-3.824
STD DEV MAJ	0.329	0.674	1.111	1.628	2.801	3.769
STD DEV MIN	0.253	0.440	0.580	0.721	0.946	1.243
ANG OF ROT	44.6	40.0	35.1	35.8	38.4	40.2
NUM OF OBS	70	68	66	66	64	64

SEASON= OCTOBER

RESULT DIR	355.4	353.4	355.5	358.4	5.1	9.1
RESULT DIST	0.779	1.569	2.490	3.564	5.622	7.157
MEAN I COMP	0.063	0.179	0.194	0.101	-0.498	-1.138
MEAN J COMP	-0.776	-1.559	-2.483	-3.563	-5.599	-7.066
STD DEV MAJ	0.728	1.397	2.020	2.454	2.764	3.638
STD DEV MIN	0.256	0.464	0.727	1.123	2.113	2.351
ANG OF ROT	20.4	18.4	17.9	19.8	30.7	61.6
NUM OF OBS	24	22	21	20	17	13

SEASON= NOVEMBER-MAY

RESULT DIR	24.6	22.6	20.8	18.5	21.5	12.4
RESULT DIST	0.522	1.338	1.926	2.378	3.872	4.419
MEAN I COMP	-0.217	-0.515	-0.684	-0.754	-1.418	-0.950
MEAN J COMP	-0.475	-1.235	-1.801	-2.255	-3.603	-4.316
STD DEV MAJ	0.737	1.485	2.204	2.903	4.845	6.137
STD DEV MIN	0.518	0.831	0.883	1.037	0.720	0.162
ANG OF ROT	8.9	10.1	18.8	26.3	37.3	35.6
NUM OF OBS	13	12	11	10	9	5

5DEG ID= 2016 LAT= 20-25N LON= 75- 80W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	288.2	295.6	302.9	310.6	327.1	338.3
RESULT DIST	0.508	1.023	1.524	1.978	2.892	3.792
MEAN I COMP	0.483	0.923	1.279	1.502	1.571	1.404
MEAN J COMP	-0.159	-0.442	-0.828	-1.287	-2.428	-3.522
STD DEV MAJ	0.166	0.277	0.461	0.754	1.681	2.874
STD DEV MIN	0.094	0.169	0.315	0.384	0.353	0.293
ANG OF ROT	141.1	99.2	57.9	34.7	21.8	16.1
NUM OF OBS	10	10	10	10	10	9

SEASON= AUGUST

RESULT DIR	313.0	318.7	321.2	324.0	327.1	333.5
RESULT DIST	0.736	1.345	1.932	2.452	3.543	4.406
MEAN I COMP	0.539	0.887	1.212	1.442	1.925	1.965
MEAN J COMP	-0.502	-1.011	-1.505	-1.983	-2.974	-3.943
STD DEV MAJ	0.298	0.453	0.596	0.764	1.089	1.405
STD DEV MIN	0.160	0.285	0.377	0.477	0.679	0.833
ANG OF ROT	36.1	36.2	34.4	29.0	20.6	13.8
NUM OF OBS	15	15	14	13	13	13

SEASON= SEPTEMBER

RESULT DIR	302.4	305.8	310.2	315.5	327.3	340.0
RESULT DIST	0.555	1.102	1.613	2.082	3.062	4.198
MEAN I COMP	0.468	0.893	1.232	1.458	1.656	1.435
MEAN J COMP	-0.297	-0.645	-1.041	-1.486	-2.576	-3.945
STD DEV MAJ	0.430	0.832	1.190	1.579	2.466	3.709
STD DEV MIN	0.180	0.346	0.506	0.629	0.856	1.225
ANG OF ROT	16.9	17.3	21.1	24.6	26.1	31.4
NUM OF OBS	39	39	39	39	38	37

SEASON= OCTOBER

RESULT DIR	11.8	12.9	14.8	17.7	22.3	21.1
RESULT DIST	0.478	1.015	1.578	2.076	2.988	4.151
MEAN I COMP	-0.098	-0.227	-0.404	-0.631	-1.134	-1.496
MEAN J COMP	-0.467	-0.989	-1.525	-1.978	-2.765	-3.873
STD DEV MAJ	0.464	0.841	1.207	1.529	2.505	3.715
STD DEV MIN	0.344	0.678	0.949	1.104	1.079	1.344
ANG OF ROT	22.4	18.4	24.0	34.8	48.0	51.1
NUM OF OBS	36	36	36	34	29	27

SEASON= NOVEMBER-MAY

RESULT DIR	11.1	17.3	18.1	20.2	28.1	31.1
RESULT DIST	0.376	0.746	1.132	1.706	3.021	3.968
MEAN I COMP	-0.073	-0.222	-0.352	-0.589	-1.425	-2.048
MEAN J COMP	-0.369	-0.713	-1.076	-1.601	-2.664	-3.398
STD DEV MAJ	0.707	1.427	2.129	2.790	4.284	4.692
STD DEV MIN	0.273	0.502	0.749	0.910	1.326	1.255
ANG OF ROT	36.9	40.9	44.1	44.3	42.2	34.9
NUM OF OBS	23	23	22	20	13	12

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 2017 LAT= 20-25N LON= 80- 85W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	340.5	343.0	346.1	348.0	355.5	3.6
RESULT DIST	0.581	1.087	1.574	2.026	2.824	3.596
MEAN I COMP	0.194	0.318	0.379	0.422	0.223	-0.227
MEAN J COMP	-0.548	-1.040	-1.528	-1.981	-2.816	-3.589
STD DEV MAJ	0.405	0.682	1.027	1.420	2.087	2.899
STD DEV MIN	0.307	0.588	0.821	0.958	1.151	1.237
ANG OF ROT	13.3	29.1	25.3	20.8	19.1	14.6
NUM OF OBS	27	27	27	27	23	15

SEASON= AUGUST

RESULT DIR	316.1	319.2	322.1	322.8	323.2	330.2
RESULT DIST	0.692	1.356	1.994	2.619	3.633	4.439
MEAN I COMP	0.480	0.887	1.225	1.585	2.178	2.204
MEAN J COMP	-0.498	-1.026	-1.573	-2.085	-2.908	-3.853
STD DEV MAJ	0.394	0.790	1.117	1.296	1.448	1.762
STD DEV MIN	0.246	0.492	0.726	0.944	1.111	1.122
ANG OF ROT	7.3	176.0	176.1	176.5	21.8	31.1
NUM OF OBS	26	26	26	24	20	18

SEASON= SEPTEMBER

RESULT DIR	325.7	329.1	332.6	336.2	345.8	3.8
RESULT DIST	0.548	1.089	1.624	2.166	3.120	4.367
MEAN I COMP	0.309	0.559	0.748	0.874	0.768	-0.291
MEAN J COMP	-0.453	-0.934	-1.442	-1.982	-3.024	-4.357
STD DEV MAJ	0.375	0.765	1.202	1.665	2.648	3.795
STD DEV MIN	0.243	0.422	0.584	0.745	1.199	1.626
ANG OF ROT	18.9	18.7	20.2	21.4	28.5	33.5
NUM OF OBS	52	52	52	52	51	39

SEASON= OCTOBER

RESULT DIR	14.6	20.5	24.4	27.2	29.0	28.5
RESULT DIST	0.511	1.090	1.721	2.410	3.872	5.260
MEAN I COMP	-0.129	-0.381	-0.712	-1.102	-1.878	-2.510
MEAN J COMP	-0.495	-1.021	-1.567	-2.144	-3.386	-4.623
STD DEV MAJ	0.454	0.987	1.563	2.171	3.226	4.179
STD DEV MIN	0.221	0.454	0.673	0.865	1.163	1.506
ANG OF ROT	35.0	30.9	29.1	28.9	30.3	34.3
NUM OF OBS	69	69	68	67	59	47

SEASON= NOVEMBER-MAY

RESULT DIR	5.7	3.1	1.9	0.1	359.8	13.7
RESULT DIST	0.282	0.821	1.802	2.470	2.334	3.459
MEAN I COMP	-0.028	-0.044	-0.061	-0.005	0.009	-0.822
MEAN J COMP	-0.281	-0.820	-1.801	-2.470	-2.334	-3.360
STD DEV MAJ	0.975	1.804	2.751	3.474	3.850	6.193
STD DEV MIN	0.150	0.284	0.247	0.453	1.154	0.995
ANG OF ROT	46.1	47.6	48.4	52.9	54.8	54.8
NUM OF OBS	10	9	8	8	7	6

5DEG ID= 2018 LAT= 20-25N LON= 85- 90W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	327.0	328.0	330.1	334.9	350.9	9.7
RESULT DIST	0.576	1.158	1.611	1.996	2.462	3.047
MEAN I COMP	0.313	0.614	0.803	0.847	0.389	-0.516
MEAN J COMP	-0.483	-0.982	-1.396	-1.807	-2.431	-3.003
STD DEV MAJ	0.356	0.698	1.084	1.534	2.401	2.336
STD DEV MIN	0.316	0.623	0.857	1.043	1.276	1.078
ANG OF ROT	144.4	172.2	169.7	175.1	15.7	29.5
NUM OF OBS	39	39	37	35	26	18

SEASON= AUGUST

RESULT DIR	309.3	309.9	310.2	312.3	318.7	339.9
RESULT DIST	0.761	1.468	2.074	2.559	3.328	3.822
MEAN I COMP	0.589	1.126	1.584	1.891	2.197	1.313
MEAN J COMP	-0.482	-0.942	-1.339	-1.723	-2.500	-3.589
STD DEV MAJ	0.299	0.527	0.771	0.990	1.671	1.874
STD DEV MIN	0.245	0.511	0.705	0.876	0.963	0.548
ANG OF ROT	138.4	103.2	163.6	177.5	36.4	24.7
NUM OF OBS	41	40	37	34	27	12

SEASON= SEPTEMBER

RESULT DIR	322.6	325.6	329.8	334.1	349.3	355.9
RESULT DIST	0.611	1.187	1.675	2.128	3.083	4.026
MEAN I COMP	0.371	0.671	0.842	0.929	0.573	0.289
MEAN J COMP	-0.486	-0.979	-1.448	-1.914	-3.029	-4.015
STD DEV MAJ	0.400	0.887	1.412	1.727	2.408	2.619
STD DEV MIN	0.272	0.495	0.755	1.009	1.338	1.308
ANG OF ROT	47.7	43.4	40.9	36.9	28.0	37.3
NUM OF OBS	54	54	54	51	37	23

SEASON= OCTOBER

RESULT DIR	330.3	338.2	348.4	0.7	17.1	28.8
RESULT DIST	0.379	0.772	1.126	1.574	2.454	4.155
MEAN I COMP	0.188	0.286	0.226	-0.020	-0.722	-2.003
MEAN J COMP	-0.329	-0.717	-1.103	-1.574	-2.345	-3.640
STD DEV MAJ	0.455	0.963	1.609	2.364	3.830	4.944
STD DEV MIN	0.239	0.418	0.557	0.718	1.059	1.625
ANG OF ROT	41.6	34.7	31.1	29.6	27.3	28.0
NUM OF OBS	39	39	38	36	31	23

SEASON= NOVEMBER-MAY

RESULT DIR	23.4	26.6	0.0	0.0	0.0	0.0
RESULT DIST	0.746	1.496	0.000	0.000	0.000	0.000
MEAN I COMP	-0.297	-0.670	0.000	0.000	0.000	0.000
MEAN J COMP	-0.685	-1.338	0.000	0.000	0.000	0.000
STD DEV MAJ	1.092	2.386	0.000	0.000	0.000	0.000
STD DEV MIN	0.233	0.277	0.000	0.000	0.000	0.000
ANG OF ROT	31.1	37.5	0.0	0.0	0.0	0.0
NUM OF OBS	6	5	4	4	2	1

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 2019 LAT= 20-25N LON= 90- 95W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	331.6	338.1	345.5	357.1	22.1	29.7
RESULT DIST	0.505	1.019	1.464	1.886	2.924	3.686
MEAN I COMP	0.240	0.379	0.366	0.096	-1.100	-1.827
MEAN J COMP	-0.444	-0.946	-1.417	-1.884	-2.709	-3.201
STD DEV MAJ	0.360	0.672	0.974	1.296	2.017	2.485
STD DEV MIN	0.268	0.538	0.843	1.077	1.152	1.059
ANG OF ROT	171.9	168.8	1.0	28.3	38.8	29.6
NUM OF OBS	38	37	34	30	22	18

SEASON= AUGUST

RESULT DIR	303.5	303.9	306.2	309.7	0.0	0.0
RESULT DIST	0.698	1.272	1.804	2.130	0.000	0.000
MEAN I COMP	0.582	1.056	1.456	1.640	0.000	0.000
MEAN J COMP	-0.386	-0.709	-1.064	-1.359	0.000	0.000
STD DEV MAJ	0.308	0.522	0.828	1.105	0.000	0.000
STD DEV MIN	0.237	0.482	0.665	0.734	0.000	0.000
ANG OF ROT	155.1	122.8	98.9	65.4	0.0	0.0
NUM OF OBS	36	33	26	16	3	1

SEASON= SEPTEMBER

RESULT DIR	339.6	345.2	354.9	5.1	23.7	32.8
RESULT DIST	0.433	0.850	1.254	1.680	2.234	2.908
MEAN I COMP	0.151	0.217	0.111	-0.151	-0.898	-1.575
MEAN J COMP	-0.406	-0.822	-1.249	-1.673	-2.045	-2.445
STD DEV MAJ	0.472	0.890	1.348	1.806	1.709	2.192
STD DEV MIN	0.303	0.516	0.672	0.926	1.436	1.022
ANG OF ROT	8.0	13.1	14.2	14.7	30.5	178.1
NUM OF OBS	47	45	41	36	22	16

SEASON= OCTOBER

RESULT DIR	1.0	8.7	14.5	15.2	27.8	40.1
RESULT DIST	0.440	0.964	1.698	2.282	3.490	4.952
MEAN I COMP	-0.008	-0.145	-0.424	-0.600	-1.625	-3.188
MEAN J COMP	-0.440	-0.953	-1.644	-2.202	-3.088	-3.789
STD DEV MAJ	0.520	1.132	1.704	1.772	2.389	2.894
STD DEV MIN	0.244	0.483	0.743	1.033	1.370	1.158
ANG OF ROT	24.3	28.9	33.5	44.3	40.8	40.3
NUM OF OBS	43	42	39	36	27	19

SEASON= NOVEMBER-MAY

RESULT DIR	303.0	278.5	0.0	0.0	0.0	0.0
RESULT DIST	0.068	0.125	0.000	0.000	0.000	0.000
MEAN I COMP	0.057	0.123	0.000	0.000	0.000	0.000
MEAN J COMP	-0.037	-0.018	0.000	0.000	0.000	0.000
STD DEV MAJ	0.485	0.724	0.000	0.000	0.000	0.000
STD DEV MIN	0.321	0.394	0.000	0.000	0.000	0.000
ANG OF ROT	101.4	56.6	0.0	0.0	0.0	0.0
NUM OF OBS	7	6	4	3	2	1

5DEG ID= 2020 LAT= 20-25N LON= 95-100W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	328.2	350.0	358.2	12.4	13.7	17.4
RESULT DIST	0.489	1.037	1.526	1.973	3.183	4.522
MEAN I COMP	0.258	0.179	0.047	-0.422	-0.755	-1.352
MEAN J COMP	-0.416	-1.021	-1.525	-1.927	-3.093	-4.315
STD DEV MAJ	0.415	0.772	1.058	1.535	0.590	0.469
STD DEV MIN	0.294	0.314	0.529	0.245	0.260	0.317
ANG OF ROT	78.5	90.8	74.3	51.3	38.6	135.0
NUM OF OBS	21	15	13	10	8	6

SEASON= AUGUST

RESULT DIR	295.5	309.2	329.1	0.0	0.0	0.0
RESULT DIST	0.491	0.861	1.194	0.000	0.000	0.000
MEAN I COMP	0.443	0.667	0.614	0.000	0.000	0.000
MEAN J COMP	-0.211	-0.545	-1.024	0.000	0.000	0.000
STD DEV MAJ	0.410	0.794	1.209	0.000	0.000	0.000
STD DEV MIN	0.185	0.297	0.520	0.000	0.000	0.000
ANG OF ROT	64.7	63.9	61.4	0.0	0.0	0.0
NUM OF OBS	21	11	5	2	2	2

SEASON= SEPTEMBER

RESULT DIR	294.5	301.7	306.6	0.0	0.0	0.0
RESULT DIST	0.385	0.687	0.644	0.000	0.000	0.000
MEAN I COMP	0.350	0.585	0.517	0.000	0.000	0.000
MEAN J COMP	-0.160	-0.361	-0.384	0.000	0.000	0.000
STD DEV MAJ	0.398	0.813	1.202	0.000	0.000	0.000
STD DEV MIN	0.178	0.313	0.297	0.000	0.000	0.000
ANG OF ROT	103.8	101.9	95.0	0.0	0.0	0.0
NUM OF OBS	24	14	7	4	1	0

SEASON= OCTOBER

RESULT DIR	313.2	332.3	355.9	0.0	0.0	0.0
RESULT DIST	0.440	0.841	1.299	0.000	0.000	0.000
MEAN I COMP	0.321	0.391	0.094	0.000	0.000	0.000
MEAN J COMP	-0.301	-0.744	-1.296	0.000	0.000	0.000
STD DEV MAJ	0.515	1.328	1.968	0.000	0.000	0.000
STD DEV MIN	0.134	0.250	0.438	0.000	0.000	0.000
ANG OF ROT	50.9	43.3	36.0	0.0	0.0	0.0
NUM OF OBS	9	7	5	3	2	1

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5DEG ID= 2507 LAT= 25-30N LON= 30- 35W SEASON= SEPTEMBER

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	296.0	278.5	257.3	237.5	237.0	237.4
RESULT DIST	0.224	0.448	0.751	1.247	2.671	4.019
MEAN I COMP	0.201	0.443	0.732	1.051	2.239	3.385
MEAN J COMP	-0.098	-0.066	0.166	0.670	1.456	2.166
STD DEV MAJ	0.515	0.998	1.516	1.920	2.110	1.650
STD DEV MIN	0.317	0.556	0.752	0.710	0.760	0.416
ANG OF ROT	68.3	58.1	48.5	39.3	28.2	22.9
NUM OF OBS	10	10	9	8	8	8

5DEG ID= 2508 LAT= 25-30N LON= 35- 40W SEASON= SEPTEMBER

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	248.2	247.8	247.2	245.3	244.0	250.2
RESULT DIST	0.696	1.434	2.142	2.721	3.082	2.716
MEAN I COMP	0.646	1.327	1.974	2.471	2.770	2.555
MEAN J COMP	0.259	0.543	0.830	1.139	1.351	0.922
STD DEV MAJ	0.366	0.586	0.564	0.567	1.097	1.645
STD DEV MIN	0.089	0.118	0.274	0.311	0.426	0.509
ANG OF ROT	17.9	13.1	8.2	150.4	9.9	28.9
NUM OF OBS	7	7	7	7	7	6

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 2509 LAT= 25-30N LON= 40- 45W SEASON= SEPTEMBER

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	300.0	312.6	329.3	335.6	336.2	341.9
RESULT DIST	0.503	0.936	1.367	1.993	2.816	3.572
MEAN I COMP	0.436	0.689	0.698	0.824	1.136	1.112
MEAN J COMP	-0.251	-0.633	-1.176	-1.815	-2.577	-3.395
STD DEV MAJ	0.777	1.697	2.608	3.258	3.783	4.381
STD DEV MIN	0.352	0.688	0.881	1.111	1.237	1.264
ANG OF ROT	70.7	69.7	69.4	72.3	72.2	66.5
NUM OF OBS	14	14	14	14	12	10

SEASON= OCTOBER

RESULT DIR	317.6	333.5	346.4	349.8	358.0	6.7
RESULT DIST	0.442	1.015	1.564	2.042	3.541	4.958
MEAN I COMP	0.298	0.453	0.369	0.360	0.123	-0.580
MEAN J COMP	-0.326	-0.908	-1.520	-2.010	-3.539	-4.924
STD DEV MAJ	0.625	1.132	1.306	1.658	2.711	2.870
STD DEV MIN	0.253	0.499	0.771	0.732	0.402	1.045
ANG OF ROT	37.9	40.5	59.1	73.3	82.0	65.6
NUM OF OBS	14	13	11	9	7	5

5DEG ID= 2510 LAT= 25-30N LON= 45- 50W SEASON= SEPTEMBER

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	331.6	333.4	336.9	343.4	358.2	359.7
RESULT DIST	0.512	0.899	1.311	1.853	3.371	5.562
MEAN I COMP	0.244	0.402	0.514	0.531	0.105	0.030
MEAN J COMP	-0.450	-0.804	-1.206	-1.775	-3.369	-5.562
STD DEV MAJ	0.609	0.898	1.313	1.707	2.397	3.230
STD DEV MIN	0.491	0.793	1.019	1.171	1.243	1.523
ANG OF ROT	133.6	6.2	43.5	45.1	38.6	43.7
NUM OF OBS	16	15	14	12	10	10

SEASON= OCTOBER

RESULT DIR	18.2	4.2	359.7	5.1	2.4	0.0
RESULT DIST	0.202	0.563	0.935	1.394	1.664	0.000
MEAN I COMP	-0.063	-0.041	0.004	-0.123	-0.069	0.000
MEAN J COMP	-0.192	-0.562	-0.935	-1.388	-1.663	0.000
STD DEV MAJ	0.588	1.124	1.509	1.994	2.885	0.000
STD DEV MIN	0.475	0.901	1.284	1.324	1.217	0.000
ANG OF ROT	74.0	85.2	51.2	50.3	38.7	0.0
NUM OF OBS	13	13	12	11	7	3

SEASON= NOVEMBER-MAY

RESULT DIR	341.4	348.8	354.0	357.6	359.5	358.0
RESULT DIST	0.499	1.061	1.728	2.580	4.047	5.473
MEAN I COMP	0.159	0.206	0.181	0.109	0.037	0.192
MEAN J COMP	-0.473	-1.041	-1.718	-2.578	-4.047	-5.470
STD DEV MAJ	0.885	1.301	1.590	1.820	2.249	2.173
STD DEV MIN	0.423	0.687	0.788	0.871	0.894	0.742
ANG OF ROT	71.9	72.9	77.3	77.2	78.3	80.7
NUM OF OBS	10	10	10	10	9	6

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 2511 LAT= 25-30N LON= 50- 55W SEASON= AUGUST

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	279.0	282.2	287.6	295.5	313.7	330.2
RESULT DIST	0.879	1.570	2.147	2.707	3.804	4.119
MEAN I COMP	0.868	1.534	2.046	2.444	2.750	2.044
MEAN J COMP	-0.138	-0.332	-0.650	-1.164	-2.628	-3.576
STD DEV MAJ	0.479	0.933	1.517	2.382	4.550	6.580
STD DEV MIN	0.240	0.349	0.446	0.529	0.827	0.807
ANG OF ROT	85.6	84.0	77.5	70.8	66.4	53.4
NUM OF OBS	5	5	5	5	5	5

SEASON= SEPTEMBER

RESULT DIR	315.6	320.5	323.2	325.5	327.5	339.3
RESULT DIST	0.703	1.383	2.137	2.909	3.959	4.835
MEAN I COMP	0.491	0.880	1.280	1.648	2.127	1.711
MEAN J COMP	-0.502	-1.067	-1.712	-2.397	-3.340	-4.522
STD DEV MAJ	0.500	1.021	1.575	2.092	2.581	3.328
STD DEV MIN	0.336	0.572	0.804	1.055	1.342	1.844
ANG OF ROT	67.9	63.6	62.3	62.1	48.7	53.6
NUM OF OBS	32	32	31	29	23	20

SEASON= OCTOBER

RESULT DIR	249.6	266.0	268.5	254.6	0.0	0.0
RESULT DIST	0.181	0.483	0.842	1.008	0.000	0.000
MEAN I COMP	0.170	0.482	0.842	0.972	0.000	0.000
MEAN J COMP	0.063	0.033	0.022	0.268	0.000	0.000
STD DEV MAJ	0.591	1.228	1.751	2.226	0.000	0.000
STD DEV MIN	0.515	1.026	1.180	1.255	0.000	0.000
ANG OF ROT	172.6	151.8	118.0	89.9	0.0	0.0
NUM OF OBS	6	6	6	5	4	2

SEASON= NOVEMBER-MAY

RESULT DIR	302.4	317.6	337.3	357.3	0.0	0.0
RESULT DIST	0.399	0.682	1.104	1.670	0.000	0.000
MEAN I COMP	0.337	0.460	0.427	0.078	0.000	0.000
MEAN J COMP	-0.213	-0.503	-1.018	-1.668	0.000	0.000
STD DEV MAJ	0.469	0.925	1.238	1.423	0.000	0.000
STD DEV MIN	0.141	0.170	0.224	0.283	0.000	0.000
ANG OF ROT	50.5	39.0	29.2	24.3	0.0	0.0
NUM OF OBS	6	6	6	5	2	1

5DEG ID= 2512 LAT= 25-30N LON= 55- 60W SEASON= AUGUST

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	297.1	301.3	301.3	291.9	279.9	277.7
RESULT DIST	0.681	1.296	1.726	2.069	2.982	3.731
MEAN I COMP	0.606	1.108	1.475	1.920	2.937	3.698
MEAN J COMP	-0.310	-0.673	-0.897	-0.772	-0.515	-0.502
STD DEV MAJ	0.504	1.054	1.533	1.820	2.119	2.245
STD DEV MIN	0.258	0.468	0.731	0.837	0.865	1.303
ANG OF ROT	80.3	67.3	59.7	51.4	36.3	25.6
NUM OF OBS	10	10	10	9	8	8

SEASON= SEPTEMBER

RESULT DIR	315.8	323.4	332.2	334.0	342.1	350.5
RESULT DIST	0.783	1.508	2.192	2.827	3.623	4.599
MEAN I COMP	0.546	0.900	1.022	1.239	1.111	0.758
MEAN J COMP	-0.561	-1.210	-1.939	-2.541	-3.448	-4.537
STD DEV MAJ	0.660	1.301	1.934	2.450	3.318	3.865
STD DEV MIN	0.473	0.815	1.094	1.402	1.833	2.122
ANG OF ROT	52.4	56.1	54.1	58.8	68.7	64.4
NUM OF OBS	30	30	30	28	25	23

SEASON= OCTOBER

RESULT DIR	318.5	336.2	352.1	2.0	15.4	0.0
RESULT DIST	0.560	1.171	1.886	2.652	5.523	0.000
MEAN I COMP	0.371	0.473	0.258	-0.091	-1.467	0.000
MEAN J COMP	-0.419	-1.071	-1.868	-2.650	-5.324	0.000
STD DEV MAJ	0.569	1.143	1.646	2.305	2.681	0.000
STD DEV MIN	0.344	0.802	1.216	1.440	1.456	0.000
ANG OF ROT	0.5	25.4	46.6	72.3	76.6	0.0
NUM OF OBS	12	11	10	9	7	3

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 2513 LAT= 25-30N LON= 60- 65W SEASON= AUGUST

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	320.0	326.3	332.1	336.8	343.3	348.6
RESULT DIST	0.554	1.047	1.630	2.381	3.957	5.200
MEAN I COMP	0.356	0.582	0.762	0.938	1.137	1.024
MEAN J COMP	-0.424	-0.871	-1.441	-2.188	-3.790	-5.099
STD DEV MAJ	0.458	0.991	1.627	2.310	3.409	4.338
STD DEV MIN	0.295	0.450	0.542	0.749	1.115	1.749
ANG OF ROT	46.9	47.3	47.4	50.1	47.8	40.8
NUM OF OBS	25	25	25	25	24	21

5DEG ID= 2514 LAT= 25-30N LON= 65- 70W SEASON= AUGUST

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	315.6	323.9	334.2	345.3	352.7	351.1
RESULT DIST	0.616	1.200	1.806	2.544	4.331	5.340
MEAN I COMP	0.432	0.707	0.787	0.647	0.551	0.828
MEAN J COMP	-0.440	-0.969	-1.625	-2.460	-4.296	-5.275
STD DEV MAJ	0.443	0.991	1.651	2.422	3.655	4.070
STD DEV MIN	0.341	0.645	0.855	0.992	1.116	1.293
ANG OF ROT	32.2	38.6	41.4	45.9	55.6	56.9
NUM OF OBS	26	26	26	26	24	19

SEASON= SEPTEMBER

RESULT DIR	327.1	333.4	338.7	341.1	346.5	346.1
RESULT DIST	0.522	1.094	1.749	2.318	3.706	4.358
MEAN I COMP	0.284	0.490	0.635	0.751	0.867	1.049
MEAN J COMP	-0.438	-0.978	-1.630	-2.193	-3.604	-4.230
STD DEV MAJ	0.514	1.004	1.516	1.921	2.952	3.519
STD DEV MIN	0.314	0.558	0.801	1.024	1.468	1.835
ANG OF ROT	36.0	40.2	46.5	49.0	65.9	69.8
NUM OF OBS	41	39	37	35	31	25

SEASON= SEPTEMBER

RESULT DIR	334.4	341.3	346.9	350.2	353.1	1.0
RESULT DIST	0.529	1.070	1.661	2.314	3.601	4.820
MEAN I COMP	0.228	0.343	0.377	0.393	0.430	-0.084
MEAN J COMP	-0.477	-1.013	-1.617	-2.281	-3.575	-4.819
STD DEV MAJ	0.457	0.993	1.605	2.237	3.182	3.711
STD DEV MIN	0.280	0.503	0.709	0.909	1.295	1.494
ANG OF ROT	34.0	36.0	37.6	39.5	44.7	45.5
NUM OF OBS	76	75	73	70	62	54

SEASON= OCTOBER

RESULT DIR	11.1	12.3	10.2	11.6	11.7	29.1
RESULT DIST	0.577	1.187	1.815	2.668	3.391	2.996
MEAN I COMP	-0.111	-0.253	-0.322	-0.537	-0.687	-1.458
MEAN J COMP	-0.567	-1.160	-1.786	-2.613	-3.321	-2.617
STD DEV MAJ	0.718	1.315	1.788	2.496	3.486	2.665
STD DEV MIN	0.469	0.921	1.331	1.664	2.408	1.998
ANG OF ROT	28.4	27.3	46.8	52.6	73.3	100.7
NUM OF OBS	26	26	25	24	18	13

SEASON= OCTOBER

RESULT DIR	19.8	18.8	18.2	17.4	18.8	19.3
RESULT DIST	0.710	1.498	2.203	2.851	4.520	4.536
MEAN I COMP	-0.241	-0.483	-0.688	-0.855	-1.456	-1.501
MEAN J COMP	-0.668	-1.418	-2.093	-2.720	-4.279	-4.280
STD DEV MAJ	0.640	1.310	1.748	2.129	2.878	2.855
STD DEV MIN	0.420	0.880	1.353	1.579	1.555	1.589
ANG OF ROT	39.1	49.9	51.1	54.1	70.0	55.5
NUM OF OBS	47	45	44	42	28	15

SEASON= NOVEMBER-MAY

RESULT DIR	348.3	356.6	2.4	354.0	7.0	15.6
RESULT DIST	0.549	1.223	2.009	2.224	3.608	3.942
MEAN I COMP	0.111	0.073	-0.086	0.233	-0.437	-1.062
MEAN J COMP	-0.537	-1.221	-2.007	-2.212	-3.581	-3.797
STD DEV MAJ	0.725	1.484	2.227	1.924	2.275	3.689
STD DEV MIN	0.246	0.414	0.460	0.432	0.354	0.450
ANG OF ROT	47.1	44.7	44.1	45.9	43.7	52.6
NUM OF OBS	12	12	12	10	8	6

SEASON= NOVEMBER-MAY

RESULT DIR	339.3	334.7	333.3	349.3	16.1	299.8
RESULT DIST	0.343	0.704	1.010	1.507	1.720	0.281
MEAN I COMP	0.121	0.301	0.454	0.281	-0.478	0.244
MEAN J COMP	-0.321	-0.636	-0.902	-1.481	-1.652	-0.140
STD DEV MAJ	0.686	1.133	1.539	2.156	3.180	3.728
STD DEV MIN	0.416	0.799	1.068	1.312	0.937	0.653
ANG OF ROT	37.3	37.8	57.8	61.7	57.8	78.1
NUM OF OBS	20	19	17	13	8	5

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5DEG ID= 2515 LAT= 25-30N LON= 70- 75W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	330.4	336.4	340.1	341.9	347.5	349.3
RESULT DIST	0.730	1.302	1.863	2.365	3.222	4.291
MEAN I COMP	0.361	0.522	0.635	0.735	0.698	0.795
MEAN J COMP	-0.635	-1.193	-1.752	-2.248	-3.145	-4.216
STD DEV MAJ	0.348	0.698	1.018	1.375	2.545	3.811
STD DEV MIN	0.299	0.391	0.537	0.653	0.714	0.985
ANG OF ROT	49.9	39.4	37.5	31.4	25.2	31.8
NUM OF OBS	13	13	13	13	13	11

SEASON= AUGUST

RESULT DIR	323.5	327.9	335.3	344.1	355.7	3.2
RESULT DIST	0.589	1.157	1.699	2.268	3.239	4.764
MEAN I COMP	0.351	0.615	0.709	0.621	0.245	-0.268
MEAN J COMP	-0.474	-0.980	-1.544	-2.181	-3.229	-4.757
STD DEV MAJ	0.407	0.779	1.226	1.745	2.603	3.624
STD DEV MIN	0.244	0.476	0.633	0.745	0.907	0.933
ANG OF ROT	28.7	40.3	47.3	47.5	39.7	43.4
NUM OF OBS	40	39	39	39	33	30

SEASON= SEPTEMBER

RESULT DIR	348.2	352.8	356.5	1.1	11.1	11.9
RESULT DIST	0.544	1.138	1.800	2.495	4.061	5.140
MEAN I COMP	0.111	0.144	0.109	-0.048	-0.780	-1.061
MEAN J COMP	-0.533	-1.129	-1.797	-2.495	-3.986	-5.029
STD DEV MAJ	0.490	0.992	1.549	2.166	3.481	4.134
STD DEV MIN	0.352	0.679	0.983	1.193	1.230	1.377
ANG OF ROT	36.5	47.4	49.6	47.2	46.1	44.4
NUM OF OBS	75	73	71	69	64	51

SEASON= OCTOBER

RESULT DIR	25.2	20.0	21.3	26.0	25.2	17.9
RESULT DIST	0.568	1.158	1.842	2.768	4.178	5.033
MEAN I COMP	-0.242	-0.395	-0.670	-1.213	-1.778	-1.550
MEAN J COMP	-0.514	-1.088	-1.715	-2.488	-3.781	-4.788
STD DEV MAJ	0.740	1.365	1.753	1.933	2.569	3.103
STD DEV MIN	0.397	0.761	1.251	1.682	1.956	2.257
ANG OF ROT	21.2	17.2	15.7	10.9	34.2	50.4
NUM OF OBS	41	39	34	29	25	19

SEASON= NOVEMBER-MAY

RESULT DIR	14.0	23.1	40.0	48.1	47.0	0.0
RESULT DIST	0.405	0.962	1.902	3.056	4.512	0.000
MEAN I COMP	-0.098	-0.378	-1.223	-2.273	-3.298	0.000
MEAN J COMP	-0.393	-0.885	-1.457	-2.042	-3.078	0.000
STD DEV MAJ	0.617	1.350	2.029	2.774	2.558	0.000
STD DEV MIN	0.534	0.990	1.259	1.425	2.157	0.000
ANG OF ROT	93.6	97.3	103.2	82.6	40.7	0.0
NUM OF OBS	18	14	11	9	6	4

5DEG ID= 2516 LAT= 25-30N LON= 75- 80W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	338.9	337.8	324.0	322.5	325.0	350.8
RESULT DIST	0.326	0.680	0.983	1.328	2.011	2.564
MEAN I COMP	0.117	0.257	0.578	0.808	1.153	0.411
MEAN J COMP	-0.304	-0.630	-0.795	-1.054	-1.648	-2.531
STD DEV MAJ	0.547	0.990	0.982	1.225	2.028	3.068
STD DEV MIN	0.279	0.539	0.754	0.907	1.081	1.185
ANG OF ROT	28.2	34.4	20.1	18.2	13.8	25.9
NUM OF OBS	25	25	24	24	23	18

SEASON= AUGUST

RESULT DIR	332.7	335.7	341.8	347.7	2.2	11.7
RESULT DIST	0.436	0.907	1.390	1.902	3.248	4.797
MEAN I COMP	0.200	0.373	0.434	0.405	-0.124	-0.973
MEAN J COMP	-0.387	-0.827	-1.320	-1.858	-3.245	-4.698
STD DEV MAJ	0.328	0.643	1.005	1.459	2.663	3.795
STD DEV MIN	0.209	0.418	0.603	0.711	0.892	1.329
ANG OF ROT	176.5	9.3	22.1	29.8	36.6	37.1
NUM OF OBS	63	63	62	59	54	46

SEASON= SEPTEMBER

RESULT DIR	341.2	348.8	356.6	1.8	358.2	359.9
RESULT DIST	0.366	0.781	1.308	1.905	2.817	3.785
MEAN I COMP	0.118	0.151	0.077	-0.058	0.090	0.006
MEAN J COMP	-0.347	-0.766	-1.306	-1.904	-2.816	-3.785
STD DEV MAJ	0.548	1.191	1.894	2.603	3.346	4.002
STD DEV MIN	0.367	0.695	0.988	1.219	1.662	1.787
ANG OF ROT	25.0	33.6	39.0	41.8	43.6	45.8
NUM OF OBS	71	71	70	67	58	48

SEASON= OCTOBER

RESULT DIR	26.3	28.6	29.8	30.3	28.0	33.1
RESULT DIST	0.704	1.375	1.994	2.515	3.291	4.734
MEAN I COMP	-0.311	-0.659	-0.990	-1.269	-1.544	-2.583
MEAN J COMP	-0.631	-1.207	-1.731	-2.172	-2.907	-3.967
STD DEV MAJ	0.681	1.337	1.864	2.377	3.413	4.846
STD DEV MIN	0.408	0.827	1.289	1.604	1.854	1.806
ANG OF ROT	9.9	16.8	26.6	37.9	48.6	44.4
NUM OF OBS	51	49	46	42	37	26

SEASON= NOVEMBER-MAY

RESULT DIR	21.7	13.5	12.3	7.0	17.8	13.6
RESULT DIST	0.399	0.849	1.381	1.408	2.615	2.278
MEAN I COMP	-0.147	-0.199	-0.294	-0.172	-0.800	-0.534
MEAN J COMP	-0.371	-0.825	-1.349	-1.398	-2.490	-2.214
STD DEV MAJ	0.809	1.569	2.295	2.576	3.950	2.978
STD DEV MIN	0.263	0.636	0.896	1.138	1.318	0.313
ANG OF ROT	68.4	66.3	62.1	52.8	47.3	34.6
NUM OF OBS	15	15	15	13	13	9

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5DEG ID= 2517 LAT= 25-30N LON= 80- 85W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	8.4	10.0	9.0	7.1	9.0	11.4
RESULT DIST	0.463	0.962	1.436	1.856	2.755	3.186
MEAN I COMP	-0.068	-0.167	-0.225	-0.228	-0.433	-0.632
MEAN J COMP	-0.458	-0.947	-1.418	-1.842	-2.720	-3.123
STD DEV MAJ	0.545	1.146	1.698	2.061	2.919	3.533
STD DEV MIN	0.282	0.436	0.511	0.571	0.759	0.884
ANG OF ROT	2.5	13.1	18.1	19.5	25.6	26.5
NUM OF OBS	33	33	33	30	22	17

SEASON= AUGUST

RESULT DIR	320.3	324.8	325.8	331.6	347.0	349.4
RESULT DIST	0.498	0.985	1.494	1.919	2.744	3.309
MEAN I COMP	0.318	0.568	0.839	0.912	0.616	0.607
MEAN J COMP	-0.383	-0.805	-1.236	-1.688	-2.674	-3.253
STD DEV MAJ	0.338	0.620	0.939	1.412	2.573	3.552
STD DEV MIN	0.207	0.396	0.519	0.617	0.850	0.997
ANG OF ROT	3.2	17.2	35.6	36.9	42.2	45.9
NUM OF OBS	35	32	29	29	28	22

SEASON= SEPTEMBER

RESULT DIR	352.1	350.0	356.3	1.6	10.0	18.3
RESULT DIST	0.496	1.054	1.655	2.293	3.704	5.077
MEAN I COMP	0.068	0.184	0.105	-0.063	-0.644	-1.592
MEAN J COMP	-0.492	-1.038	-1.652	-2.292	-3.648	-4.821
STD DEV MAJ	0.587	1.051	1.615	2.165	3.498	4.716
STD DEV MIN	0.290	0.544	0.815	1.062	1.385	1.068
ANG OF ROT	12.7	17.9	22.8	29.8	33.3	28.3
NUM OF OBS	53	50	50	48	41	24

SEASON= OCTOBER

RESULT DIR	35.4	37.8	41.6	42.7	46.7	46.7
RESULT DIST	0.659	1.431	2.358	3.260	6.000	6.833
MEAN I COMP	-0.382	-0.878	-1.564	-2.212	-4.369	-4.973
MEAN J COMP	-0.537	-1.131	-1.764	-2.395	-4.113	-4.686
STD DEV MAJ	0.578	1.206	1.733	2.205	2.604	3.343
STD DEV MIN	0.413	0.726	0.926	1.149	1.689	2.293
ANG OF ROT	9.5	15.4	20.3	21.7	55.4	65.6
NUM OF OBS	36	36	34	33	23	14

SEASON= NOVEMBER-MAY

RESULT DIR	2.6	4.8	7.2	11.9	0.0	0.0
RESULT DIST	0.587	1.288	1.918	2.279	0.000	0.000
MEAN I COMP	-0.027	-0.107	-0.240	-0.468	0.000	0.000
MEAN J COMP	-0.587	-1.283	-1.903	-2.230	0.000	0.000
STD DEV MAJ	0.960	1.379	1.712	2.210	0.000	0.000
STD DEV MIN	0.167	0.376	0.457	0.683	0.000	0.000
ANG OF ROT	31.3	33.5	34.9	35.2	0.0	0.0
NUM OF OBS	6	6	6	5	4	0

5DEG ID= 2518 LAT= 25-30N LON= 85- 90W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	3.0	7.2	8.0	8.9	18.7	28.4
RESULT DIST	0.453	0.857	1.216	1.590	2.319	3.179
MEAN I COMP	-0.023	-0.107	-0.169	-0.246	-0.744	-1.513
MEAN J COMP	-0.452	-0.850	-1.204	-1.571	-2.196	-2.796
STD DEV MAJ	0.533	1.147	1.772	2.548	3.587	4.326
STD DEV MIN	0.264	0.452	0.539	0.547	0.690	0.982
ANG OF ROT	18.8	13.4	12.9	14.5	15.5	16.3
NUM OF OBS	40	37	32	25	14	7

SEASON= AUGUST

RESULT DIR	327.5	328.0	329.2	330.2	343.2	8.1
RESULT DIST	0.509	1.021	1.481	1.868	2.315	2.939
MEAN I COMP	0.273	0.541	0.759	0.928	0.669	-0.412
MEAN J COMP	-0.429	-0.867	-1.272	-1.621	-2.217	-2.910
STD DEV MAJ	0.362	0.696	1.024	1.344	2.085	3.169
STD DEV MIN	0.242	0.441	0.570	0.624	0.911	1.037
ANG OF ROT	40.0	38.4	39.1	38.9	22.7	14.7
NUM OF OBS	32	32	32	29	24	15

SEASON= SEPTEMBER

RESULT DIR	3.5	12.3	12.4	16.1	21.8	34.0
RESULT DIST	0.480	0.957	1.442	2.025	2.855	4.165
MEAN I COMP	-0.029	-0.204	-0.310	-0.560	-1.062	-2.329
MEAN J COMP	-0.479	-0.935	-1.409	-1.946	-2.650	-3.454
STD DEV MAJ	0.549	1.078	1.472	2.031	2.682	3.727
STD DEV MIN	0.354	0.648	0.963	1.217	1.453	1.656
ANG OF ROT	4.2	3.5	6.7	15.8	25.5	28.3
NUM OF OBS	76	73	64	55	28	14

SEASON= OCTOBER

RESULT DIR	28.0	28.3	29.7	40.3	41.7	39.0
RESULT DIST	0.518	1.049	1.313	1.588	2.445	3.837
MEAN I COMP	-0.243	-0.497	-0.650	-1.028	-1.627	-2.416
MEAN J COMP	-0.457	-0.923	-1.140	-1.211	-1.824	-2.981
STD DEV MAJ	0.713	1.401	1.826	2.681	4.248	5.616
STD DEV MIN	0.450	0.883	1.169	1.193	1.397	1.870
ANG OF ROT	23.1	35.9	35.0	37.4	31.9	47.9
NUM OF OBS	35	32	25	19	14	9

SEASON= NOVEMBER-MAY

RESULT DIR	342.9	358.6	0.0	0.0	0.0	0.0
RESULT DIST	0.368	0.482	0.000	0.000	0.000	0.000
MEAN I COMP	0.108	0.012	0.000	0.000	0.000	0.000
MEAN J COMP	-0.352	-0.482	0.000	0.000	0.000	0.000
STD DEV MAJ	0.616	1.009	0.000	0.000	0.000	0.000
STD DEV MIN	0.238	0.213	0.000	0.000	0.000	0.000
ANG OF ROT	146.0	152.5	0.0	0.0	0.0	0.0
NUM OF OBS	5	5	4	3	2	2

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 2519 LAT= 25-30N LON= 90- 95W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	332.2	336.2	353.2	9.0	46.7	46.8
RESULT DIST	0.538	1.027	1.484	2.007	4.297	5.433
MEAN I COMP	0.251	0.415	0.175	-0.314	-3.126	-3.964
MEAN J COMP	-0.476	-0.939	-1.474	-1.982	-2.948	-3.716
STD DEV MAJ	0.424	0.992	1.800	2.407	2.984	3.386
STD DEV MIN	0.231	0.490	0.628	0.753	0.687	0.935
ANG OF ROT	30.3	26.9	21.9	18.4	12.7	7.2
NUM OF OBS	44	42	33	24	11	8

SEASON= AUGUST

RESULT DIR	318.2	316.4	320.6	323.2	337.8	338.4
RESULT DIST	0.480	0.876	1.167	1.400	1.693	1.558
MEAN I COMP	0.320	0.605	0.740	0.838	0.639	0.574
MEAN J COMP	-0.358	-0.634	-0.902	-1.121	-1.568	-1.448
STD DEV MAJ	0.380	0.676	0.918	1.143	1.363	2.333
STD DEV MIN	0.196	0.376	0.499	0.558	0.593	0.967
ANG OF ROT	97.7	94.2	75.7	76.0	77.2	67.1
NUM OF OBS	38	37	34	27	17	10

SEASON= SEPTEMBER

RESULT DIR	1.8	6.8	13.5	22.3	33.7	44.0
RESULT DIST	0.394	0.785	1.171	1.502	2.366	4.272
MEAN I COMP	-0.013	-0.093	-0.274	-0.570	-1.312	-2.967
MEAN J COMP	-0.394	-0.780	-1.139	-1.390	-1.969	-3.074
STD DEV MAJ	0.463	0.958	1.450	1.738	2.782	4.525
STD DEV MIN	0.284	0.612	0.943	1.121	1.429	1.240
ANG OF ROT	13.7	22.7	28.5	35.5	42.1	46.4
NUM OF OBS	73	66	54	43	32	18

SEASON= OCTOBER

RESULT DIR	18.1	34.8	46.0	57.0	57.3	0.0
RESULT DIST	0.346	0.708	1.185	2.041	4.020	0.000
MEAN I COMP	-0.107	-0.404	-0.852	-1.711	-3.383	0.000
MEAN J COMP	-0.329	-0.581	-0.823	-1.113	-2.171	0.000
STD DEV MAJ	0.541	1.039	1.431	1.557	2.490	0.000
STD DEV MIN	0.375	0.672	1.011	1.014	0.825	0.000
ANG OF ROT	30.6	35.6	33.7	25.7	42.3	0.0
NUM OF OBS	26	24	21	17	10	3

SEASON= NOVEMBER-MAY

RESULT DIR	31.5	39.0	47.9	54.4	63.0	0.0
RESULT DIST	0.516	1.163	1.896	2.695	4.603	0.000
MEAN I COMP	-0.270	-0.732	-1.406	-2.192	-4.102	0.000
MEAN J COMP	-0.440	-0.904	-1.272	-1.568	-2.088	0.000
STD DEV MAJ	0.300	0.544	0.971	1.337	1.872	0.000
STD DEV MIN	0.052	0.055	0.146	0.148	0.230	0.000
ANG OF ROT	22.9	11.4	177.5	0.0	11.4	0.0
NUM OF OBS	5	5	5	5	5	1

5DEG ID= 2520 LAT= 25-30N LON= 95-100W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	341.1	2.1	18.5	20.7	23.0	33.0
RESULT DIST	0.508	0.970	1.555	2.133	2.954	3.934
MEAN I COMP	0.164	-0.036	-0.494	-0.754	-1.153	-2.144
MEAN J COMP	-0.481	-0.969	-1.474	-1.995	-2.720	-3.299
STD DEV MAJ	0.377	0.654	0.682	0.771	1.038	1.319
STD DEV MIN	0.261	0.405	0.331	0.453	0.739	0.566
ANG OF ROT	23.1	30.7	59.3	76.3	106.6	103.4
NUM OF OBS	28	19	15	13	10	7

SEASON= AUGUST

RESULT DIR	315.3	329.0	342.8	322.8	350.2	0.0
RESULT DIST	0.295	0.295	0.203	0.252	0.225	0.000
MEAN I COMP	0.207	0.152	0.060	0.153	0.038	0.000
MEAN J COMP	-0.210	-0.253	-0.194	-0.201	-0.222	0.000
STD DEV MAJ	0.416	0.686	0.995	1.344	2.355	0.000
STD DEV MIN	0.275	0.416	0.331	0.440	0.595	0.000
ANG OF ROT	118.8	84.6	70.6	65.9	57.2	0.0
NUM OF OBS	20	15	12	11	6	2

SEASON= SEPTEMBER

RESULT DIR	337.3	9.6	35.0	38.2	0.0	0.0
RESULT DIST	0.359	0.711	1.496	2.001	0.000	0.000
MEAN I COMP	0.138	-0.119	-0.858	-1.238	0.000	0.000
MEAN J COMP	-0.331	-0.701	-1.225	-1.573	0.000	0.000
STD DEV MAJ	0.375	0.969	1.700	1.938	0.000	0.000
STD DEV MIN	0.324	0.546	0.561	0.606	0.000	0.000
ANG OF ROT	49.1	41.8	46.6	46.7	0.0	0.0
NUM OF OBS	18	14	11	8	3	2

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 3008 LAT= 30-35N LON= 35- 40W SEASON= SEPTEMBER

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	19.6	16.0	7.9	3.3	0.0	0.0
RESULT DIST	1.357	2.852	4.125	4.852	0.000	0.000
MEAN I COMP	-0.456	-0.784	-0.566	-0.282	0.000	0.000
MEAN J COMP	-1.278	-2.742	-4.086	-4.844	0.000	0.000
STD DEV MAJ	0.692	1.161	1.634	1.617	0.000	0.000
STD DEV MIN	0.142	0.260	0.607	0.933	0.000	0.000
ANG OF ROT	92.6	91.8	115.7	129.7	0.0	0.0
NUM OF OBS	5	5	5	5	4	2

SEASON= OCTOBER

RESULT DIR	25.5	4.9	355.0	339.5	324.0	289.8
RESULT DIST	0.403	0.841	1.355	1.659	1.339	2.036
MEAN I COMP	-0.173	-0.071	0.119	0.580	0.786	1.916
MEAN J COMP	-0.363	-0.838	-1.350	-1.554	-1.084	-0.690
STD DEV MAJ	0.800	1.663	2.644	3.065	3.428	3.502
STD DEV MIN	0.410	0.572	0.528	1.152	0.961	1.433
ANG OF ROT	60.0	77.2	79.1	85.4	47.9	44.1
NUM OF OBS	9	9	9	9	8	5

5DEG ID= 3009 LAT= 30-35N LON= 40- 45W SEASON= SEPTEMBER

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	350.4	359.6	3.3	5.8	11.9	6.8
RESULT DIST	0.313	0.714	1.270	1.886	3.167	3.449
MEAN I COMP	0.052	0.005	-0.072	-0.192	-0.655	-0.410
MEAN J COMP	-0.308	-0.714	-1.268	-1.876	-3.099	-3.424
STD DEV MAJ	0.484	0.930	1.488	2.030	2.907	3.071
STD DEV MIN	0.346	0.514	0.616	0.684	0.797	0.926
ANG OF ROT	48.4	58.7	67.5	72.1	76.1	78.5
NUM OF OBS	21	21	21	21	19	16

SEASON= OCTOBER

RESULT DIR	323.3	318.9	307.0	296.1	249.9	218.3
RESULT DIST	0.248	0.684	1.032	1.399	1.299	1.491
MEAN I COMP	0.148	0.449	0.824	1.257	1.220	0.924
MEAN J COMP	-0.199	-0.515	-0.622	-0.614	0.447	1.170
STD DEV MAJ	0.617	1.257	1.638	1.769	1.882	0.917
STD DEV MIN	0.388	0.835	1.181	1.613	1.202	0.412
ANG OF ROT	60.3	68.2	57.9	68.8	153.5	51.9
NUM OF OBS	11	11	10	9	6	5

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 3010 LAT= 30-35N LON= 45- 50W SEASON= SEPTEMBER

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	344.6	351.9	357.5	357.6	350.1	347.2
RESULT DIST	0.467	0.779	1.222	1.638	2.999	4.498
MEAN I COMP	0.124	0.110	0.054	0.068	0.517	0.994
MEAN J COMP	-0.451	-0.772	-1.221	-1.636	-2.955	-4.387
STD DEV MAJ	0.537	1.106	1.762	2.600	4.501	5.779
STD DEV MIN	0.326	0.412	0.600	0.685	0.797	1.001
ANG OF ROT	37.5	48.4	50.6	54.9	63.5	74.2
NUM OF OBS	13	12	11	11	11	7

SEASON= OCTOBER

RESULT DIR	326.9	320.4	12.5	121.3	20.5	349.8
RESULT DIST	0.411	0.558	0.066	0.501	0.771	1.433
MEAN I COMP	0.224	0.356	-0.014	-0.428	-0.270	0.254
MEAN J COMP	-0.344	-0.430	-0.064	0.260	-0.722	-1.410
STD DEV MAJ	0.626	1.306	1.523	1.620	1.235	1.353
STD DEV MIN	0.544	0.827	1.127	0.703	0.946	0.563
ANG OF ROT	134.8	126.2	106.3	50.5	28.5	147.3
NUM OF OBS	10	9	7	6	6	5

5DEG ID= 3011 LAT= 30-35N LON= 50- 55W SEASON= SEPTEMBER

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	17.9	18.1	15.9	20.1	19.9	14.6
RESULT DIST	0.604	1.333	2.136	2.927	5.505	6.692
MEAN I COMP	-0.186	-0.415	-0.585	-1.005	-1.871	-1.686
MEAN J COMP	-0.575	-1.267	-2.054	-2.749	-5.177	-6.476
STD DEV MAJ	0.654	1.355	1.898	2.278	2.779	3.338
STD DEV MIN	0.570	1.119	1.522	1.703	1.045	0.736
ANG OF ROT	75.7	76.2	84.6	64.7	37.9	59.2
NUM OF OBS	15	13	12	10	7	5

SEASON= OCTOBER

RESULT DIR	46.9	36.2	28.3	26.0	58.4	94.9
RESULT DIST	0.375	0.792	1.260	1.464	0.675	0.485
MEAN I COMP	-0.274	-0.468	-0.597	-0.642	-0.575	-0.483
MEAN J COMP	-0.257	-0.639	-1.109	-1.316	-0.354	0.042
STD DEV MAJ	0.796	1.645	2.518	3.224	3.262	3.558
STD DEV MIN	0.320	0.616	0.869	1.071	1.173	1.165
ANG OF ROT	72.2	77.8	82.0	85.0	83.4	73.5
NUM OF OBS	18	18	18	17	14	13

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 3012 LAT= 30-35N LON= 55- 60W SEASON= AUGUST

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	0.8	352.5	352.1	351.9	2.8	354.9
RESULT DIST	0.648	1.442	2.488	2.732	2.818	2.719
MEAN I COMP	-0.009	0.189	0.340	0.386	-0.138	0.240
MEAN J COMP	-0.648	-1.430	-2.465	-2.704	-2.815	-2.708
STD DEV MAJ	0.666	1.687	2.863	3.647	4.809	4.980
STD DEV MIN	0.362	0.446	0.315	0.459	0.650	0.145
ANG OF ROT	69.4	81.9	81.7	77.6	56.6	51.4
NUM OF OBS	9	8	8	7	6	5

SEASON= SEPTEMBER

RESULT DIR	355.2	356.8	358.7	3.9	9.8	13.0
RESULT DIST	0.754	1.412	2.089	2.764	4.010	5.408
MEAN I COMP	0.064	0.079	0.048	-0.189	-0.681	-1.218
MEAN J COMP	-0.751	-1.410	-2.088	-2.758	-3.952	-5.269
STD DEV MAJ	0.655	1.204	1.649	1.993	2.709	3.525
STD DEV MIN	0.370	0.749	1.183	1.470	1.833	1.795
ANG OF ROT	44.1	37.0	35.0	33.2	70.5	72.3
NUM OF OBS	31	30	29	28	23	14

SEASON= OCTOBER

RESULT DIR	38.3	36.2	34.1	35.7	51.2	70.3
RESULT DIST	1.011	2.082	3.279	3.603	3.103	2.900
MEAN I COMP	-0.627	-1.229	-1.837	-2.103	-2.420	-2.730
MEAN J COMP	-0.793	-1.681	-2.716	-2.926	-1.943	-0.978
STD DEV MAJ	0.531	1.147	2.079	2.554	2.338	1.677
STD DEV MIN	0.449	0.777	0.952	1.190	1.210	1.091
ANG OF ROT	16.4	66.7	75.0	79.7	76.5	50.1
NUM OF OBS	17	15	12	10	7	6

5DEG ID= 3013 LAT= 30-35N LON= 60- 65W SEASON= AUGUST

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	18.4	16.2	15.2	11.1	5.6	12.7
RESULT DIST	0.871	1.846	2.516	3.290	4.894	3.229
MEAN I COMP	-0.275	-0.515	-0.658	-0.634	-0.474	-0.710
MEAN J COMP	-0.826	-1.772	-2.429	-3.229	-4.871	-3.150
STD DEV MAJ	0.524	0.999	1.386	1.852	3.026	2.543
STD DEV MIN	0.425	0.692	0.961	1.445	2.266	0.719
ANG OF ROT	57.0	53.1	51.0	40.5	95.1	169.3
NUM OF OBS	13	12	9	8	7	5

SEASON= SEPTEMBER

RESULT DIR	7.8	10.5	11.9	12.9	10.5	9.7
RESULT DIST	0.629	1.330	1.959	2.459	2.285	2.842
MEAN I COMP	-0.085	-0.243	-0.405	-0.548	-0.415	-0.479
MEAN J COMP	-0.623	-1.307	-1.917	-2.397	-2.247	-2.802
STD DEV MAJ	0.687	1.447	2.230	2.966	3.010	3.736
STD DEV MIN	0.349	0.613	0.881	1.019	1.218	1.410
ANG OF ROT	62.3	62.1	64.2	67.8	63.3	55.9
NUM OF OBS	50	48	46	44	36	30

SEASON= OCTOBER

RESULT DIR	11.1	9.3	7.9	1.9	353.4	24.0
RESULT DIST	0.695	1.334	1.959	2.402	2.444	4.037
MEAN I COMP	-0.134	-0.215	-0.269	-0.078	0.279	-1.642
MEAN J COMP	-0.682	-1.316	-1.940	-2.401	-2.428	-3.688
STD DEV MAJ	0.854	1.537	2.410	3.364	4.712	4.188
STD DEV MIN	0.508	0.998	1.473	1.731	2.379	2.524
ANG OF ROT	44.4	43.4	49.2	50.5	50.3	38.3
NUM OF OBS	28	27	24	20	13	8

SEASON= NOVEMBER-MAY

RESULT DIR	18.6	19.9	0.0	0.0	0.0	0.0
RESULT DIST	0.820	1.510	0.000	0.000	0.000	0.000
MEAN I COMP	-0.262	-0.514	0.000	0.000	0.000	0.000
MEAN J COMP	-0.777	-1.420	0.000	0.000	0.000	0.000
STD DEV MAJ	1.059	2.397	0.000	0.000	0.000	0.000
STD DEV MIN	0.161	0.340	0.000	0.000	0.000	0.000
ANG OF ROT	72.1	68.3	0.0	0.0	0.0	0.0
NUM OF OBS	6	5	4	4	2	0

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5DEG ID= 3014 LAT= 30-35N LON= 65- 70W SEASON= AUGUST

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	6.0	10.5	13.3	12.8	17.6	25.6
RESULT DIST	0.755	1.703	2.787	3.548	5.047	6.407
MEAN I COMP	-0.079	-0.311	-0.640	-0.784	-1.522	-2.764
MEAN J COMP	-0.750	-1.674	-2.713	-3.460	-4.812	-5.780
STD DEV MAJ	0.645	1.284	1.989	2.657	4.174	5.776
STD DEV MIN	0.305	0.566	0.776	1.045	1.288	1.118
ANG OF ROT	47.3	46.4	45.7	42.2	32.9	28.2
NUM OF OBS	23	23	22	18	13	8

SEASON= SEPTEMBER

RESULT DIR	13.7	16.1	15.4	14.6	17.7	23.0
RESULT DIST	0.689	1.464	2.240	3.042	4.631	4.739
MEAN I COMP	-0.164	-0.406	-0.595	-0.766	-1.408	-1.854
MEAN J COMP	-0.670	-1.406	-2.159	-2.944	-4.411	-4.361
STD DEV MAJ	0.614	1.278	1.969	2.614	3.194	2.778
STD DEV MIN	0.357	0.685	0.929	1.201	1.772	1.386
ANG OF ROT	42.6	45.4	47.7	50.9	57.8	47.7
NUM OF OBS	74	72	65	59	47	27

SEASON= OCTOBER

RESULT DIR	7.9	10.9	16.5	18.9	25.0	31.8
RESULT DIST	0.726	1.531	2.352	3.099	5.204	7.259
MEAN I COMP	-0.100	-0.290	-0.669	-1.003	-2.203	-3.822
MEAN J COMP	-0.719	-1.503	-2.254	-2.932	-4.715	-6.171
STD DEV MAJ	0.782	1.483	2.269	3.151	3.710	4.230
STD DEV MIN	0.455	0.884	1.069	1.372	2.113	3.103
ANG OF ROT	49.7	54.9	51.0	51.3	68.9	98.1
NUM OF OBS	38	36	34	29	20	12

SEASON= NOVEMBER-MAY

RESULT DIR	353.1	357.8	347.1	345.0	0.0	0.0
RESULT DIST	0.385	0.590	0.479	0.257	0.000	0.000
MEAN I COMP	0.046	0.022	0.107	0.067	0.000	0.000
MEAN J COMP	-0.382	-0.590	-0.467	-0.248	0.000	0.000
STD DEV MAJ	0.460	1.153	2.293	3.353	0.000	0.000
STD DEV MIN	0.252	0.512	0.759	0.939	0.000	0.000
ANG OF ROT	30.0	57.2	61.7	62.3	0.0	0.0
NUM OF OBS	11	9	7	6	3	1

5DEG ID= 3015 LAT= 30-35N LON= 70- 75W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	29.7	31.7	35.7	38.6	42.0	0.0
RESULT DIST	0.639	1.269	1.994	3.000	4.571	0.000
MEAN I COMP	-0.317	-0.666	-1.165	-1.872	-3.056	0.000
MEAN J COMP	-0.555	-1.079	-1.618	-2.344	-3.399	0.000
STD DEV MAJ	0.380	0.816	1.319	1.920	3.200	0.000
STD DEV MIN	0.145	0.282	0.560	1.010	1.521	0.000
ANG OF ROT	6.4	7.6	15.1	25.6	31.6	0.0
NUM OF OBS	17	17	17	17	11	2

SEASON= AUGUST

RESULT DIR	356.3	4.7	9.3	13.3	17.9	3.6
RESULT DIST	0.643	1.423	2.330	3.198	4.831	4.912
MEAN I COMP	0.041	-0.115	-0.375	-0.733	-1.488	-0.312
MEAN J COMP	-0.642	-1.418	-2.299	-3.113	-4.596	-4.902
STD DEV MAJ	0.686	1.547	2.432	2.997	3.636	4.122
STD DEV MIN	0.325	0.568	0.755	1.128	1.567	0.914
ANG OF ROT	51.2	48.2	48.1	47.2	45.1	50.6
NUM OF OBS	29	28	25	23	17	8

SEASON= SEPTEMBER

RESULT DIR	3.6	9.6	14.6	17.6	25.6	28.4
RESULT DIST	0.575	1.294	2.132	3.032	5.061	7.004
MEAN I COMP	-0.036	-0.215	-0.538	-0.917	-2.189	-3.334
MEAN J COMP	-0.574	-1.276	-2.063	-2.890	-4.563	-6.159
STD DEV MAJ	0.536	1.107	1.639	1.994	2.519	3.128
STD DEV MIN	0.279	0.534	0.783	0.971	1.096	1.313
ANG OF ROT	33.2	35.3	34.1	35.4	47.1	70.6
NUM OF OBS	54	54	54	51	36	26

SEASON= OCTOBER

RESULT DIR	19.2	22.8	27.0	29.9	32.4	33.5
RESULT DIST	0.290	0.603	1.018	1.547	2.769	3.245
MEAN I COMP	-0.096	-0.234	-0.463	-0.771	-1.483	-1.791
MEAN J COMP	-0.274	-0.556	-0.907	-1.340	-2.338	-2.706
STD DEV MAJ	0.663	1.328	2.047	2.775	4.387	5.157
STD DEV MIN	0.367	0.625	0.874	1.016	1.367	1.397
ANG OF ROT	52.6	50.4	51.6	51.5	51.1	52.5
NUM OF OBS	54	53	47	41	34	24

SEASON= NOVEMBER-MAY

RESULT DIR	15.1	15.7	30.4	35.9	267.3	311.3
RESULT DIST	0.623	0.732	1.144	1.543	0.128	0.694
MEAN I COMP	-0.162	-0.198	-0.578	-0.905	0.128	0.522
MEAN J COMP	-0.601	-0.705	-0.987	-1.250	0.006	-0.458
STD DEV MAJ	0.959	1.918	3.134	4.317	3.086	4.338
STD DEV MIN	0.497	0.430	0.419	0.377	0.318	0.321
ANG OF ROT	56.1	55.5	56.2	56.1	56.4	49.0
NUM OF OBS	8	6	6	6	5	5

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5DEG ID= 3016 LAT= 30-35N LON= 75- 80W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	31.8	31.5	32.4	34.5	43.9	42.2
RESULT DIST	0.624	1.241	1.930	2.708	4.211	5.961
MEAN I COMP	-0.329	-0.648	-1.034	-1.533	-2.920	-4.003
MEAN J COMP	-0.530	-1.059	-1.630	-2.232	-3.035	-4.418
STD DEV MAJ	0.744	1.274	1.595	1.749	1.604	2.047
STD DEV MIN	0.309	0.627	0.987	1.301	1.062	1.388
ANG OF ROT	41.9	43.0	44.5	43.7	30.9	38.8
NUM OF OBS	35	34	32	30	24	17

SEASON= AUGUST

RESULT DIR	7.1	14.2	19.5	21.9	21.7	26.6
RESULT DIST	0.604	1.320	2.145	3.033	4.475	4.916
MEAN I COMP	-0.074	-0.324	-0.716	-1.132	-1.652	-2.202
MEAN J COMP	-0.600	-1.279	-2.022	-2.813	-4.159	-4.395
STD DEV MAJ	0.468	1.046	1.697	2.364	3.299	3.828
STD DEV MIN	0.251	0.508	0.654	0.780	1.226	1.793
ANG OF ROT	53.3	48.5	43.7	44.4	49.3	55.8
NUM OF OBS	47	47	45	42	33	19

SEASON= SEPTEMBER

RESULT DIR	15.4	22.2	27.3	32.9	32.5	32.8
RESULT DIST	0.832	1.922	3.379	5.208	7.513	9.398
MEAN I COMP	-0.222	-0.725	-1.551	-2.828	-4.032	-5.096
MEAN J COMP	-0.802	-1.780	-3.002	-4.373	-6.339	-7.897
STD DEV MAJ	0.684	1.374	1.940	2.273	2.451	2.933
STD DEV MIN	0.349	0.694	1.088	1.286	0.961	1.594
ANG OF ROT	35.5	42.4	56.4	73.0	92.0	89.7
NUM OF OBS	42	39	32	24	14	12

SEASON= OCTOBER

RESULT DIR	24.6	34.4	35.8	39.1	42.3	41.5
RESULT DIST	0.432	1.034	1.566	2.145	4.559	7.468
MEAN I COMP	-0.180	-0.584	-0.916	-1.353	-3.069	-4.949
MEAN J COMP	-0.392	-0.854	-1.271	-1.665	-3.371	-5.592
STD DEV MAJ	0.763	1.470	2.137	2.659	3.633	4.921
STD DEV MIN	0.466	0.882	1.083	1.255	1.655	1.671
ANG OF ROT	53.1	59.0	53.9	54.0	60.7	56.3
NUM OF OBS	41	37	36	34	25	17

SEASON= NOVEMBER-MAY

RESULT DIR	40.6	50.2	50.6	62.5	109.8	0.0
RESULT DIST	0.336	0.674	0.577	0.702	0.189	0.000
MEAN I COMP	-0.219	-0.518	-0.446	-0.623	-0.178	0.000
MEAN J COMP	-0.255	-0.431	-0.366	-0.324	0.064	0.000
STD DEV MAJ	0.713	1.422	1.958	2.353	3.671	0.000
STD DEV MIN	0.347	0.625	0.299	0.330	0.323	0.000
ANG OF ROT	60.1	60.1	64.3	56.5	39.2	0.0
NUM OF OBS	8	8	7	7	5	4

5DEG ID= 3017 LAT= 30-35N LON= 80- 85W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	37.6	40.1	41.6	39.7	45.3	52.3
RESULT DIST	0.658	1.272	1.939	2.603	3.897	3.715
MEAN I COMP	-0.401	-0.818	-1.300	-1.664	-2.769	-2.938
MEAN J COMP	-0.521	-0.973	-1.466	-2.002	-2.743	-2.273
STD DEV MAJ	0.669	1.217	1.828	2.429	2.218	2.259
STD DEV MIN	0.219	0.569	1.063	1.784	2.143	1.235
ANG OF ROT	13.4	14.8	16.4	20.3	171.4	153.5
NUM OF OBS	15	13	12	11	8	6

SEASON= AUGUST

RESULT DIR	6.7	19.1	27.8	30.9	32.3	0.0
RESULT DIST	0.521	1.216	2.134	3.101	5.177	0.000
MEAN I COMP	-0.061	-0.398	-0.995	-1.592	-2.763	0.000
MEAN J COMP	-0.518	-1.149	-1.888	-2.661	-4.378	0.000
STD DEV MAJ	0.415	0.958	1.650	2.268	4.314	0.000
STD DEV MIN	0.233	0.389	0.596	0.793	0.456	0.000
ANG OF ROT	40.4	37.2	42.9	52.9	56.3	0.0
NUM OF OBS	19	17	16	14	6	1

SEASON= SEPTEMBER

RESULT DIR	27.5	27.0	30.9	35.1	46.7	43.9
RESULT DIST	0.595	1.248	2.054	3.132	7.542	9.299
MEAN I COMP	-0.275	-0.566	-1.056	-1.803	-5.489	-6.453
MEAN J COMP	-0.528	-1.112	-1.761	-2.561	-5.173	-6.696
STD DEV MAJ	0.667	1.295	2.010	2.959	3.248	3.713
STD DEV MIN	0.340	0.562	0.760	0.903	0.531	0.667
ANG OF ROT	15.4	21.9	25.3	28.3	43.9	54.7
NUM OF OBS	24	22	22	20	12	7

SEASON= OCTOBER

RESULT DIR	26.0	48.8	55.8	57.9	64.4	86.2
RESULT DIST	0.458	1.021	1.894	3.397	4.781	5.626
MEAN I COMP	-0.201	-0.769	-1.567	-2.878	-4.311	-5.613
MEAN J COMP	-0.412	-0.673	-1.065	-1.804	-2.068	-0.373
STD DEV MAJ	0.672	1.246	1.757	2.334	3.342	1.586
STD DEV MIN	0.411	0.633	0.907	0.856	1.110	0.627
ANG OF ROT	20.0	40.7	50.5	71.2	79.4	65.7
NUM OF OBS	16	14	13	10	8	6

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5DEG ID= 3018 LAT= 30-35N LON= 85- 90W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	15.8	30.2	0.0	0.0	0.0	0.0
RESULT DIST	0.639	1.045	0.000	0.000	0.000	0.000
MEAN I COMP	-0.174	-0.526	0.000	0.000	0.000	0.000
MEAN J COMP	-0.614	-0.903	0.000	0.000	0.000	0.000
STD DEV MAJ	0.788	1.596	0.000	0.000	0.000	0.000
STD DEV MIN	0.335	0.524	0.000	0.000	0.000	0.000
ANG OF ROT	179.2	8.9	0.0	0.0	0.0	0.0
NUM OF OBS	9	7	4	4	1	1

SEASON= AUGUST

RESULT DIR	348.4	356.5	4.5	19.2	0.0	0.0
RESULT DIST	0.519	1.052	1.381	1.744	0.000	0.000
MEAN I COMP	0.104	0.064	-0.109	-0.575	0.000	0.000
MEAN J COMP	-0.509	-1.050	-1.377	-1.647	0.000	0.000
STD DEV MAJ	0.238	0.584	0.971	1.636	0.000	0.000
STD DEV MIN	0.086	0.228	0.337	0.575	0.000	0.000
ANG OF ROT	65.1	45.7	24.6	5.4	0.0	0.0
NUM OF OBS	9	8	7	6	2	2

SEASON= SEPTEMBER

RESULT DIR	27.0	27.5	31.1	34.4	0.0	0.0
RESULT DIST	0.423	0.932	1.666	2.573	0.000	0.000
MEAN I COMP	-0.192	-0.430	-0.860	-1.455	0.000	0.000
MEAN J COMP	-0.377	-0.827	-1.427	-2.122	0.000	0.000
STD DEV MAJ	0.511	1.104	1.491	1.207	0.000	0.000
STD DEV MIN	0.253	0.534	0.747	0.877	0.000	0.000
ANG OF ROT	6.9	10.4	12.7	142.6	0.0	0.0
NUM OF OBS	27	24	19	11	3	3

SEASON= OCTOBER

RESULT DIR	20.8	0.0	0.0	0.0	0.0	0.0
RESULT DIST	1.008	0.000	0.000	0.000	0.000	0.000
MEAN I COMP	-0.358	0.000	0.000	0.000	0.000	0.000
MEAN J COMP	-0.942	0.000	0.000	0.000	0.000	0.000
STD DEV MAJ	0.613	0.000	0.000	0.000	0.000	0.000
STD DEV MIN	0.261	0.000	0.000	0.000	0.000	0.000
ANG OF ROT	90.0	0.0	0.0	0.0	0.0	0.0
NUM OF OBS	5	2	2	1	1	0

5DEG ID= 3019 LAT= 30-35N LON= 90- 95W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	45.0	54.5	66.7	68.1	65.3	0.0
RESULT DIST	0.737	1.580	1.952	2.569	3.626	0.000
MEAN I COMP	-0.521	-1.286	-1.793	-2.384	-3.296	0.000
MEAN J COMP	-0.521	-0.918	-0.771	-0.957	-1.513	0.000
STD DEV MAJ	0.577	1.432	1.506	1.921	2.779	0.000
STD DEV MIN	0.411	0.643	0.400	0.329	0.639	0.000
ANG OF ROT	18.9	22.3	29.1	28.3	23.8	0.0
NUM OF OBS	9	9	7	7	7	3

SEASON= AUGUST

RESULT DIR	325.4	338.1	9.1	0.0	0.0	0.0
RESULT DIST	0.561	1.065	1.685	0.000	0.000	0.000
MEAN I COMP	0.319	0.397	-0.268	0.000	0.000	0.000
MEAN J COMP	-0.461	-0.989	-1.664	0.000	0.000	0.000
STD DEV MAJ	0.296	0.690	1.061	0.000	0.000	0.000
STD DEV MIN	0.126	0.261	0.383	0.000	0.000	0.000
ANG OF ROT	21.1	23.0	19.5	0.0	0.0	0.0
NUM OF OBS	8	7	5	4	0	0

SEASON= SEPTEMBER

RESULT DIR	0.7	20.2	0.0	0.0	0.0	0.0
RESULT DIST	0.797	1.905	0.000	0.000	0.000	0.000
MEAN I COMP	-0.010	-0.657	0.000	0.000	0.000	0.000
MEAN J COMP	-0.797	-1.789	0.000	0.000	0.000	0.000
STD DEV MAJ	0.680	1.481	0.000	0.000	0.000	0.000
STD DEV MIN	0.381	0.825	0.000	0.000	0.000	0.000
ANG OF ROT	38.0	39.5	0.0	0.0	0.0	0.0
NUM OF OBS	12	7	4	2	0	0

SEASON= OCTOBER

RESULT DIR	34.8	33.3	0.0	0.0	0.0	0.0
RESULT DIST	0.802	1.685	0.000	0.000	0.000	0.000
MEAN I COMP	-0.458	-0.926	0.000	0.000	0.000	0.000
MEAN J COMP	-0.658	-1.408	0.000	0.000	0.000	0.000
STD DEV MAJ	0.401	0.673	0.000	0.000	0.000	0.000
STD DEV MIN	0.166	0.371	0.000	0.000	0.000	0.000
ANG OF ROT	123.0	114.6	0.0	0.0	0.0	0.0
NUM OF OBS	5	5	3	2	0	0

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5DEG ID= 3020 LAT= 30-35N LON= 95-100W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	26.7	25.0	0.0	0.0	0.0	0.0
RESULT DIST	0.625	1.129	0.000	0.000	0.000	0.000
MEAN I COMP	-0.281	-0.477	0.000	0.000	0.000	0.000
MEAN J COMP	-0.559	-1.023	0.000	0.000	0.000	0.000
STD DEV MAJ	0.275	0.515	0.000	0.000	0.000	0.000
STD DEV MIN	0.153	0.371	0.000	0.000	0.000	0.000
ANG OF ROT	39.9	58.8	0.0	0.0	0.0	0.0
NUM OF OBS	7	6	4	4	2	0

5DEG ID= 3506 LAT= 35-40N LON= 25- 30W SEASON= SEPTEMBER

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	19.2	16.0	17.4	13.2	0.0	0.0
RESULT DIST	0.575	0.910	1.186	1.632	0.000	0.000
MEAN I COMP	-0.189	-0.251	-0.354	-0.373	0.000	0.000
MEAN J COMP	-0.543	-0.874	-1.131	-1.588	0.000	0.000
STD DEV MAJ	0.978	1.655	2.242	2.948	0.000	0.000
STD DEV MIN	0.244	0.572	0.859	1.043	0.000	0.000
ANG OF ROT	104.5	114.4	116.8	114.9	0.0	0.0
NUM OF OBS	7	7	7	6	2	1

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 3508 LAT= 35-40N LON= 35- 40W SEASON= SEPTEMBER

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	3.9	3.2	3.9	4.8	0.0	0.0
RESULT DIST	1.303	3.023	4.527	5.822	0.000	0.000
MEAN I COMP	-0.088	-0.170	-0.308	-0.486	0.000	0.000
MEAN J COMP	-1.300	-3.018	-4.517	-5.802	0.000	0.000
STD DEV MAJ	0.644	1.196	1.167	2.482	0.000	0.000
STD DEV MIN	0.239	0.392	1.030	0.740	0.000	0.000
ANG OF ROT	35.9	46.2	117.3	141.0	0.0	0.0
NUM OF OBS	6	6	6	5	0	0

5DEG ID= 3509 LAT= 35-40N LON= 40- 45W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	339.7	343.6	344.5	343.7	339.4	0.0
RESULT DIST	0.352	0.813	1.347	1.856	2.894	0.000
MEAN I COMP	0.122	0.230	0.360	0.520	1.020	0.000
MEAN J COMP	-0.330	-0.780	-1.298	-1.782	-2.708	0.000
STD DEV MAJ	0.351	0.515	0.504	0.470	0.387	0.000
STD DEV MIN	0.118	0.118	0.156	0.216	0.178	0.000
ANG OF ROT	73.6	74.5	72.9	88.2	117.7	0.0
NUM OF OBS	5	5	5	5	5	4

SEASON= SEPTEMBER

RESULT DIR	35.9	29.6	22.3	13.0	350.1	0.0
RESULT DIST	0.494	0.879	1.293	1.997	1.597	0.000
MEAN I COMP	-0.290	-0.434	-0.490	-0.449	0.273	0.000
MEAN J COMP	-0.400	-0.765	-1.197	-1.946	-1.573	0.000
STD DEV MAJ	0.451	1.074	2.090	3.367	4.139	0.000
STD DEV MIN	0.250	0.501	0.748	0.843	0.790	0.000
ANG OF ROT	46.7	62.9	71.0	80.6	91.4	0.0
NUM OF OBS	14	11	9	8	6	3

SEASON= OCTOBER

RESULT DIR	21.6	5.0	0.0	0.0	0.0	0.0
RESULT DIST	0.977	1.389	0.000	0.000	0.000	0.000
MEAN I COMP	-0.360	-0.120	0.000	0.000	0.000	0.000
MEAN J COMP	-0.908	-1.384	0.000	0.000	0.000	0.000
STD DEV MAJ	1.244	2.416	0.000	0.000	0.000	0.000
STD DEV MIN	0.556	1.652	0.000	0.000	0.000	0.000
ANG OF ROT	72.8	101.2	0.0	0.0	0.0	0.0
NUM OF OBS	6	5	4	4	3	1

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 3510 LAT= 35-40N LON= 45- 50W SEASON= SEPTEMBER

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	32.9	27.4	15.7	0.0	0.0	0.0
RESULT DIST	0.699	1.225	1.745	0.000	0.000	0.000
MEAN I COMP	-0.380	-0.564	-0.473	0.000	0.000	0.000
MEAN J COMP	-0.587	-1.088	-1.680	0.000	0.000	0.000
STD DEV MAJ	0.840	1.597	2.437	0.000	0.000	0.000
STD DEV MIN	0.391	0.744	1.002	0.000	0.000	0.000
ANG OF ROT	39.2	44.3	53.9	0.0	0.0	0.0
NUM OF OBS	10	10	9	4	1	0

SEASON= OCTOBER

RESULT DIR	359.7	5.0	353.8	0.3	339.6	336.5
RESULT DIST	0.867	1.689	1.700	1.163	0.969	1.411
MEAN I COMP	0.004	-0.147	0.184	-0.006	0.338	0.562
MEAN J COMP	-0.867	-1.683	-1.690	-1.163	-0.908	-1.294
STD DEV MAJ	0.910	1.923	2.246	0.655	0.524	0.416
STD DEV MIN	0.477	0.521	0.222	0.183	0.148	0.210
ANG OF ROT	68.0	72.4	94.4	67.6	63.9	76.4
NUM OF OBS	12	10	8	7	5	5

5DEG ID= 3511 LAT= 35-40N LON= 50- 55W SEASON= AUGUST

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	9.9	11.7	15.2	13.5	9.1	0.0
RESULT DIST	0.685	1.418	1.948	2.902	2.493	0.000
MEAN I COMP	-0.118	-0.287	-0.511	-0.675	-0.394	0.000
MEAN J COMP	-0.675	-1.388	-1.880	-2.822	-2.461	0.000
STD DEV MAJ	0.868	1.746	2.494	3.650	4.949	0.000
STD DEV MIN	0.336	0.664	0.981	1.403	0.567	0.000
ANG OF ROT	89.5	83.3	75.4	76.1	78.4	0.0
NUM OF OBS	16	16	15	15	7	3

SEASON= SEPTEMBER

RESULT DIR	18.7	15.6	18.8	18.8	9.2	0.0
RESULT DIST	0.749	1.707	3.230	4.524	9.032	0.000
MEAN I COMP	-0.241	-0.460	-1.042	-1.457	-1.440	0.000
MEAN J COMP	-0.709	-1.643	-3.057	-4.283	-8.916	0.000
STD DEV MAJ	0.777	1.546	2.090	2.208	2.204	0.000
STD DEV MIN	0.420	0.845	1.148	0.850	1.012	0.000
ANG OF ROT	59.8	67.5	81.3	109.3	97.5	0.0
NUM OF OBS	20	18	14	11	5	1

SEASON= NOVEMBER-MAY

RESULT DIR	47.7	0.0	0.0	0.0	0.0	0.0
RESULT DIST	0.767	0.000	0.000	0.000	0.000	0.000
MEAN I COMP	-0.568	0.000	0.000	0.000	0.000	0.000
MEAN J COMP	-0.516	0.000	0.000	0.000	0.000	0.000
STD DEV MAJ	0.353	0.000	0.000	0.000	0.000	0.000
STD DEV MIN	0.100	0.000	0.000	0.000	0.000	0.000
ANG OF ROT	41.7	0.0	0.0	0.0	0.0	0.0
NUM OF OBS	5	4	2	1	0	0

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 3512 LAT= 35-40N LON= 55- 60W SEASON= AUGUST

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	14.7	15.1	17.6	19.7	44.5	61.0
RESULT DIST	1.040	1.884	2.592	3.145	2.438	1.115
MEAN I COMP	-0.263	-0.491	-0.785	-1.058	-1.709	-0.976
MEAN J COMP	-1.006	-1.819	-2.470	-2.962	-1.739	-0.540
STD DEV MAJ	0.551	1.096	1.571	2.220	3.421	0.864
STD DEV MIN	0.335	0.687	1.111	1.548	0.247	0.178
ANG OF ROT	98.6	110.4	105.0	92.3	56.3	59.2
NUM OF OBS	12	11	11	11	7	5

SEASON= SEPTEMBER

RESULT DIR	18.2	19.7	22.5	25.0	27.4	31.0
RESULT DIST	0.924	1.972	2.876	3.929	5.872	9.194
MEAN I COMP	-0.289	-0.666	-1.100	-1.662	-2.707	-4.737
MEAN J COMP	-0.877	-1.856	-2.657	-3.561	-5.211	-7.880
STD DEV MAJ	0.761	1.387	2.000	2.513	2.204	1.563
STD DEV MIN	0.440	0.846	1.189	1.380	1.653	1.041
ANG OF ROT	66.3	73.7	80.5	87.1	99.6	126.3
NUM OF OBS	37	34	29	25	15	7

SEASON= OCTOBER

RESULT DIR	25.1	25.3	24.3	0.0	0.0	0.0
RESULT DIST	1.544	3.527	5.193	0.000	0.000	0.000
MEAN I COMP	-0.654	-1.508	-2.140	0.000	0.000	0.000
MEAN J COMP	-1.399	-3.188	-4.732	0.000	0.000	0.000
STD DEV MAJ	0.748	1.404	1.973	0.000	0.000	0.000
STD DEV MIN	0.544	0.955	1.221	0.000	0.000	0.000
ANG OF ROT	84.5	129.8	138.6	0.0	0.0	0.0
NUM OF OBS	8	6	6	2	1	0

5DEG ID= 3513 LAT= 35-40N LON= 60- 65W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	59.9	53.2	49.1	0.0	0.0	0.0
RESULT DIST	0.894	1.796	2.305	0.000	0.000	0.000
MEAN I COMP	-0.774	-1.439	-1.741	0.000	0.000	0.000
MEAN J COMP	-0.449	-1.075	-1.510	0.000	0.000	0.000
STD DEV MAJ	0.587	1.010	1.032	0.000	0.000	0.000
STD DEV MIN	0.210	0.440	0.561	0.000	0.000	0.000
ANG OF ROT	34.6	41.8	32.1	0.0	0.0	0.0
NUM OF OBS	8	8	7	4	0	0

SEASON= AUGUST

RESULT DIR	36.9	30.9	26.2	27.2	0.0	0.0
RESULT DIST	1.736	3.238	4.553	5.325	0.000	0.000
MEAN I COMP	-1.041	-1.663	-2.013	-2.430	0.000	0.000
MEAN J COMP	-1.389	-2.778	-4.083	-4.738	0.000	0.000
STD DEV MAJ	0.670	0.821	1.203	1.811	0.000	0.000
STD DEV MIN	0.292	0.638	0.941	0.992	0.000	0.000
ANG OF ROT	41.3	33.3	157.6	174.7	0.0	0.0
NUM OF OBS	7	6	6	5	2	0

SEASON= SEPTEMBER

RESULT DIR	28.8	25.8	24.8	22.4	16.8	12.5
RESULT DIST	0.722	1.448	2.167	2.865	2.501	3.173
MEAN I COMP	-0.348	-0.630	-0.908	-1.092	-0.723	-0.685
MEAN J COMP	-0.633	-1.303	-1.967	-2.648	-2.395	-3.098
STD DEV MAJ	0.816	1.618	2.290	3.008	3.079	4.520
STD DEV MIN	0.389	0.710	0.869	1.281	2.157	2.514
ANG OF ROT	52.9	57.4	60.5	63.1	55.3	65.2
NUM OF OBS	40	38	36	32	19	13

SEASON= OCTOBER

RESULT DIR	21.4	22.7	26.7	30.6	48.0	0.0
RESULT DIST	1.219	2.596	3.537	4.881	7.612	0.000
MEAN I COMP	-0.445	-1.001	-1.588	-2.488	-5.656	0.000
MEAN J COMP	-1.135	-2.396	-3.160	-4.200	-5.094	0.000
STD DEV MAJ	0.744	1.638	2.556	2.790	2.929	0.000
STD DEV MIN	0.507	1.052	1.483	2.203	0.978	0.000
ANG OF ROT	48.3	49.5	39.0	43.5	157.6	0.0
NUM OF OBS	19	18	15	12	5	4

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 3514 LAT= 35-40N LON= 65- 70W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	38.1	37.7	50.1	46.9	0.0	0.0
RESULT DIST	1.043	1.961	2.513	3.079	0.000	0.000
MEAN I COMP	-0.644	-1.200	-1.929	-2.248	0.000	0.000
MEAN J COMP	-0.821	-1.551	-1.611	-2.103	0.000	0.000
STD DEV MAJ	0.898	1.619	1.144	1.324	0.000	0.000
STD DEV MIN	0.204	0.651	0.846	0.530	0.000	0.000
ANG OF ROT	99.2	106.1	65.4	91.0	0.0	0.0
NUM OF OBS	8	8	7	6	2	0

SEASON= AUGUST

RESULT DIR	32.6	37.0	42.2	43.9	0.0	0.0
RESULT DIST	1.700	3.457	5.030	6.688	0.000	0.000
MEAN I COMP	-0.917	-2.081	-3.378	-4.640	0.000	0.000
MEAN J COMP	-1.432	-2.760	-3.727	-4.816	0.000	0.000
STD DEV MAJ	0.536	0.992	1.280	1.621	0.000	0.000
STD DEV MIN	0.449	0.766	1.016	1.379	0.000	0.000
ANG OF ROT	144.9	29.7	142.3	103.1	0.0	0.0
NUM OF OBS	10	10	6	5	1	0

SEASON= SEPTEMBER

RESULT DIR	24.7	26.2	23.6	23.1	25.3	16.1
RESULT DIST	0.918	1.932	2.721	3.509	4.261	4.659
MEAN I COMP	-0.383	-0.853	-1.091	-1.378	-1.819	-1.295
MEAN J COMP	-0.835	-1.733	-2.493	-3.227	-3.853	-4.475
STD DEV MAJ	0.865	1.690	2.386	3.003	4.448	6.530
STD DEV MIN	0.453	0.853	1.073	1.148	1.372	1.281
ANG OF ROT	50.5	49.8	53.8	55.0	58.7	64.1
NUM OF OBS	36	34	30	29	21	11

SEASON= OCTOBER

RESULT DIR	28.5	32.8	34.4	32.4	0.0	0.0
RESULT DIST	1.344	2.639	4.463	6.059	0.000	0.000
MEAN I COMP	-0.641	-1.430	-2.525	-3.244	0.000	0.000
MEAN J COMP	-1.181	-2.217	-3.681	-5.117	0.000	0.000
STD DEV MAJ	0.709	1.514	2.026	2.546	0.000	0.000
STD DEV MIN	0.465	0.658	1.038	1.455	0.000	0.000
ANG OF ROT	10.7	17.4	35.4	58.1	0.0	0.0
NUM OF OBS	14	12	11	11	2	1

SEASON= NOVEMBER-MAY

RESULT DIR	44.7	36.2	0.0	0.0	0.0	0.0
RESULT DIST	0.566	1.180	0.000	0.000	0.000	0.000
MEAN I COMP	-0.398	-0.698	0.000	0.000	0.000	0.000
MEAN J COMP	-0.402	-0.952	0.000	0.000	0.000	0.000
STD DEV MAJ	0.387	0.530	0.000	0.000	0.000	0.000
STD DEV MIN	0.065	0.140	0.000	0.000	0.000	0.000
ANG OF ROT	167.5	178.2	0.0	0.0	0.0	0.0
NUM OF OBS	5	5	4	2	0	0

5DEG ID= 3515 LAT= 35-40N LON= 70- 75W SEASON= JUNE-JULY

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	34.2	25.8	27.3	45.2	0.0	0.0
RESULT DIST	0.699	1.652	2.614	2.333	0.000	0.000
MEAN I COMP	-0.393	-0.719	-1.200	-1.655	0.000	0.000
MEAN J COMP	-0.578	-1.487	-2.322	-1.645	0.000	0.000
STD DEV MAJ	0.516	1.221	1.977	1.974	0.000	0.000
STD DEV MIN	0.377	0.556	0.941	0.947	0.000	0.000
ANG OF ROT	57.2	71.9	81.4	55.3	0.0	0.0
NUM OF OBS	12	11	10	6	4	3

SEASON= AUGUST

RESULT DIR	44.0	45.7	43.3	44.6	58.5	66.8
RESULT DIST	1.168	2.474	3.707	4.752	5.251	6.233
MEAN I COMP	-0.812	-1.772	-2.543	-3.339	-4.480	-5.728
MEAN J COMP	-0.840	-1.727	-2.698	-3.381	-2.740	-2.457
STD DEV MAJ	0.511	1.046	1.560	2.161	3.074	2.794
STD DEV MIN	0.386	0.663	1.062	1.341	1.189	1.337
ANG OF ROT	47.7	46.1	61.8	76.0	72.3	45.9
NUM OF OBS	21	20	19	15	7	6

SEASON= SEPTEMBER

RESULT DIR	27.7	27.0	31.7	38.0	42.0	43.9
RESULT DIST	0.951	2.131	3.219	4.036	5.423	6.593
MEAN I COMP	-0.442	-0.968	-1.689	-2.483	-3.626	-4.573
MEAN J COMP	-0.842	-1.899	-2.740	-3.181	-4.033	-4.750
STD DEV MAJ	0.690	1.523	2.134	2.634	3.370	4.226
STD DEV MIN	0.433	0.954	1.246	1.291	1.703	2.054
ANG OF ROT	51.6	59.6	62.1	72.6	68.0	54.7
NUM OF OBS	35	34	31	23	17	12

SEASON= OCTOBER

RESULT DIR	35.8	35.3	0.0	0.0	0.0	0.0
RESULT DIST	1.082	2.535	0.000	0.000	0.000	0.000
MEAN I COMP	-0.633	-1.466	0.000	0.000	0.000	0.000
MEAN J COMP	-0.877	-2.068	0.000	0.000	0.000	0.000
STD DEV MAJ	0.714	1.333	0.000	0.000	0.000	0.000
STD DEV MIN	0.417	0.724	0.000	0.000	0.000	0.000
ANG OF ROT	21.0	88.5	0.0	0.0	0.0	0.0
NUM OF OBS	6	5	3	3	2	0

SEASON= NOVEMBER-MAY

RESULT DIR	71.7	69.5	61.7	56.6	0.0	0.0
RESULT DIST	0.382	0.909	1.581	2.250	0.000	0.000
MEAN I COMP	-0.363	-0.852	-1.392	-1.878	0.000	0.000
MEAN J COMP	-0.120	-0.318	-0.750	-1.240	0.000	0.000
STD DEV MAJ	0.200	0.515	0.813	0.991	0.000	0.000
STD DEV MIN	0.091	0.165	0.240	0.354	0.000	0.000
ANG OF ROT	178.6	180.0	179.9	0.4	0.0	0.0
NUM OF OBS	7	6	5	5	3	0

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 3516 LAT= 35-40N LON= 75- 80W SEASON= AUGUST

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	14.5	20.0	25.0	33.3	50.9	0.0
RESULT DIST	0.732	1.422	1.932	2.507	4.409	0.000
MEAN I COMP	-0.183	-0.485	-0.816	-1.377	-3.422	0.000
MEAN J COMP	-0.709	-1.336	-1.751	-2.096	-2.780	0.000
STD DEV MAJ	0.466	0.981	1.404	1.558	1.818	0.000
STD DEV MIN	0.348	0.515	0.556	0.579	1.068	0.000
ANG OF ROT	172.8	164.5	167.7	165.8	14.4	0.0
NUM OF OBS	12	11	11	9	6	3

5DEG ID= 4010 LAT= 40-45N LON= 45- 50W SEASON= SEPTEMBER

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	15.5	18.7	0.0	0.0	0.0	0.0
RESULT DIST	1.649	3.696	0.000	0.000	0.000	0.000
MEAN I COMP	-0.440	-1.187	0.000	0.000	0.000	0.000
MEAN J COMP	-1.589	-3.500	0.000	0.000	0.000	0.000
STD DEV MAJ	0.586	1.395	0.000	0.000	0.000	0.000
STD DEV MIN	0.418	0.501	0.000	0.000	0.000	0.000
ANG OF ROT	123.4	114.7	0.0	0.0	0.0	0.0
NUM OF OBS	8	6	4	3	2	1

SEASON= SEPTEMBER

RESULT DIR	39.6	46.2	49.7	47.4	39.5	32.7
RESULT DIST	1.088	2.354	4.150	5.844	8.773	9.986
MEAN I COMP	-0.694	-1.698	-3.165	-4.302	-5.575	-5.392
MEAN J COMP	-0.838	-1.630	-2.685	-3.956	-6.773	-8.405
STD DEV MAJ	0.783	1.589	2.464	3.317	2.047	1.702
STD DEV MIN	0.488	0.809	0.803	0.958	1.108	1.122
ANG OF ROT	42.1	38.5	49.0	54.1	41.6	32.4
NUM OF OBS	15	12	10	9	6	6

SEASON= OCTOBER

RESULT DIR	23.7	0.0	0.0	0.0	0.0	0.0
RESULT DIST	1.385	0.000	0.000	0.000	0.000	0.000
MEAN I COMP	-0.556	0.000	0.000	0.000	0.000	0.000
MEAN J COMP	-1.268	0.000	0.000	0.000	0.000	0.000
STD DEV MAJ	0.509	0.000	0.000	0.000	0.000	0.000
STD DEV MIN	0.353	0.000	0.000	0.000	0.000	0.000
ANG OF ROT	57.8	0.0	0.0	0.0	0.0	0.0
NUM OF OBS	5	4	2	1	1	1

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 4011 LAT= 40-45N LON= 50- 55W SEASON= SEPTEMBER

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	19.0	15.8	19.1	18.9	0.0	0.0
RESULT DIST	1.449	2.931	4.101	5.292	0.000	0.000
MEAN I COMP	-0.471	-0.798	-1.341	-1.718	0.000	0.000
MEAN J COMP	-1.370	-2.820	-3.875	-5.005	0.000	0.000
STD DEV MAJ	0.839	1.658	2.104	2.226	0.000	0.000
STD DEV MIN	0.525	1.023	1.041	1.091	0.000	0.000
ANG OF ROT	64.8	84.1	114.5	122.1	0.0	0.0
NUM OF OBS	12	11	8	6	2	2

5DEG ID= 4012 LAT= 40-45N LON= 55- 60W SEASON= SEPTEMBER

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	19.6	19.8	15.9	0.0	0.0	0.0
RESULT DIST	1.587	3.186	4.345	0.000	0.000	0.000
MEAN I COMP	-0.531	-1.082	-1.194	0.000	0.000	0.000
MEAN J COMP	-1.496	-2.997	-4.178	0.000	0.000	0.000
STD DEV MAJ	0.755	1.677	2.627	0.000	0.000	0.000
STD DEV MIN	0.398	0.803	1.267	0.000	0.000	0.000
ANG OF ROT	90.0	108.7	110.9	0.0	0.0	0.0
NUM OF OBS	7	6	5	2	1	1

BIVARIATE STATISTICS OF NORTH ATLANTIC TROPICAL CYCLONE MOVEMENTS(1899-1969) (I,J) COORDINATES

5DEG ID= 4013 LAT= 40-45N LON= 60- 65W SEASON= SEPTEMBER

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	29.5	0.0	0.0	0.0	0.0	0.0
RESULT DIST	1.814	0.000	0.000	0.000	0.000	0.000
MEAN I COMP	-0.893	0.000	0.000	0.000	0.000	0.000
MEAN J COMP	-1.578	0.000	0.000	0.000	0.000	0.000
STD DEV MAJ	0.677	0.000	0.000	0.000	0.000	0.000
STD DEV MIN	0.481	0.000	0.000	0.000	0.000	0.000
ANG OF ROT	38.9	0.0	0.0	0.0	0.0	0.0
NUM OF OBS	6	4	3	1	1	1

5DEG ID= 4014 LAT= 40-45N LON= 65- 70W SEASON= AUGUST

	12 HOUR	24 HOUR	36 HOUR	48 HOUR	72 HOUR	96 HOUR
RESULT DIR	43.5	32.8	0.0	0.0	0.0	0.0
RESULT DIST	1.021	1.950	0.000	0.000	0.000	0.000
MEAN I COMP	-0.702	-1.055	0.000	0.000	0.000	0.000
MEAN J COMP	-0.741	-1.640	0.000	0.000	0.000	0.000
STD DEV MAJ	0.572	1.380	0.000	0.000	0.000	0.000
STD DEV MIN	0.245	0.729	0.000	0.000	0.000	0.000
ANG OF ROT	62.5	92.6	0.0	0.0	0.0	0.0
NUM OF OBS	10	8	4	2	2	1

SEASON= SEPTEMBER

RESULT DIR	23.8	35.1	39.6	38.0	0.0	0.0
RESULT DIST	1.289	2.300	3.102	3.784	0.000	0.000
MEAN I COMP	-0.520	-1.323	-1.978	-2.330	0.000	0.000
MEAN J COMP	-1.180	-1.882	-2.390	-2.982	0.000	0.000
STD DEV MAJ	0.762	1.575	2.629	3.274	0.000	0.000
STD DEV MIN	0.539	1.008	1.379	1.805	0.000	0.000
ANG OF ROT	125.0	87.2	81.4	79.3	0.0	0.0
NUM OF OBS	8	6	5	5	3	3

SEASON= OCTOBER

RESULT DIR	353.7	0.0	0.0	0.0	0.0	0.0
RESULT DIST	0.803	0.000	0.000	0.000	0.000	0.000
MEAN I COMP	0.088	0.000	0.000	0.000	0.000	0.000
MEAN J COMP	-0.798	0.000	0.000	0.000	0.000	0.000
STD DEV MAJ	0.688	0.000	0.000	0.000	0.000	0.000
STD DEV MIN	0.439	0.000	0.000	0.000	0.000	0.000
ANG OF ROT	71.2	0.0	0.0	0.0	0.0	0.0
NUM OF OBS	6	4	2	0	0	0

APPENDIX IV

Program to integrate the bivariate normal distribution over an offset circle.

The following program represents a variable increment numerical integration method as applied to the integral of an elliptic bivariate normal density over an offset circle. It was developed and programmed by Dr. S. Kaufman and C. Groenewoud of Cornell Aeronautical Laboratory, Inc. It is reproduced here with the permission of the authors. Persons wishing to use the program should try to reproduce two test cases before applying it to other situations. These test cases are:

	Test Case I	Test Case II
SIGX	= 2	10.0
SIGY	= 1.6	2.0
CH	= 7.0	5.0
CK	= 3.2	7.0
R	= 5.64	17.5
P	= 0.11884	0.84203

```
      PROGRAM BINOC
      DIMENSION VO(15),G(5,5,15),S(4)
 1001 FORMAT (5F10.3)
 1002 FORMAT (2X,6H SIGX ,2X,6H SIGY ,2X,6H   H  ,2X,6H   K  ,2X,6H   R
     * ,2X,6H PROB )
 1004 FORMAT (I10,E10.2)
 1005 FORMAT (5F8.3,F8.5)
 1006 FORMAT (3E10.2)
 1007 FORMAT (2X,5HS(1)=F6.4,2X,5HS(2)=F6.4,2X,5HS(3)=F6.4,2X,5HS(4)=F6.
     *4,2X,2HP=F6.4     )
 1008 FORMAT(2X,5E15.8)
 1009 FORMAT(2X,15HSOMEBODY GOOFED)
 2001 FORMAT (2X,2HM=I2,4X,2HI=I2,2E15.8)
 2002 FORMAT (6E15.5)
 2003 FORMAT (2X,2HVV10F6.2)
 2004 FORMAT (2X,3HIA=I2,3X,3HIB=I2,3X,3HF4=E15.8,3X,5HDELX=E15.8)
 2005 FORMAT(2X,3HIA=I2,2X,3HIB=I2,2X,5HINDX=I2,2X,6HINDX2=I2,2X,4HINO=I
     *2/)
 2006 FORMAT(2X,5HIPOS=I2,2X,5HSIGX=F4.1,2X,5HSIGY=F4.1,2X,3HCH=F4.1,2X,
     *3HCK=F4.1//)
 2007 FORMAT(2X,//)
 2008 FORMAT(1H1)
      DO 4 KKK=1,11
      DO 3 III=1,3
    3 READ (5,1006) (G(III,JJJ,KKK),JJJ=1,3)
    4 CONTINUE
      CONST=10.**8
      RT2=SQRT(2.0)
      CRTPI=0.3989422804
      READ  (5,1004) IPRINT,ERR
      READ (5,1004) NCASE
      DO 700 ICASE =1,NCASE
      READ (5,1001) SIGX,SIGY,CH,CK,R
      WRITE(6,2008)
      DO 10  I=1,4
      S(I)=0
   10 CONTINUE
      R2=R*R
      RR2=R/RT2
      IPOS=1
   14 GO TO (15,16,15,16),IPOS
   15 BOTTOM = (CK+RR2)/SIGY
      TOP = (CK+R)/SIGY
      GO TO 20
   16 BOTTOM= (CK-R)/SIGY
      TOP = (CK-RR2)/SIGY
   20 SR=SIGX/RR2
```

```
      ELL=SIGX/SIGY
      INO=1
      RADM45=R2-(4.5*SIGY+CK)**2
      RADM30=R2-(3.0*SIGY+CK)**2
      RAD30 =R2-(3.0*SIGY-CK)**2
      RAD45 =R2-(4.5*SIGY-CK)**2
      WRITE (6,2006) IPOS,SIGX,SIGY,CH,CK
      VO(1)=(-4.5)
      VO(2)=(-3.0)
      VO(3)= 3.0
      VO(4)= 4.5
      VO(5)= CONST
      M=5
      V5=(CH-RR2)/SIGX
      VA=V5
      GO TO 80
   30 V6=(CH+RR2)/SIGX
      VA=V6
      GO TO 80
   31 IF(RADM45) 32,33,33
   32 M=M+2
      GO TO 40
   33 IF(BOTTOM.GT.(-4.5)) GO TO 32
      IF(TOP.LT.(-4.5)) GO TO 32
      S45 = SQRT(RADM45)
      V7 =(CH+S45)/SIGX
      VA = V7
      GO TO 80
   34 V8=(CH-S45)/SIGX
      VA=V8
      GO TO 80
   40 IF(RADM30) 41,42,42
   41 M=M+2
      GO TO 50
   42 IF(BOTTOM.GT.(-3.0)) GO TO 41
      IF(TOP.LT.(-3.0)) GO TO 41
      S30=SQRT(RADM30)
      V9=(CH+S30)/SIGX
      VA=V9
      GO TO 80
   43 V10=(CH-S30)/SIGX
      VA=V10
      GO TO 80
   50 IF(RAD30) 51,52,52
   51 M=M+2
      GO TO 60
   52 IF(BOTTOM.GT.3.0) GO TO 51
      IF(TOP.LT.3.0) GO TO 51
```

```
      T30=SQRT(RAD30)
      V11=(CH+T30)/SIGX
      VA=V11
      GO TO 80
   53 V12=(CH-T30)/SIGX
      VA=V12
      GO TO 80
   60 IF(RAD45) 61,62,62
   61 IF(IPRINT.EQ.1) GO TO 64
      GO TO 85
   62 IF(BOTTOM.GT.3.0) GO TO 61
      IF(TOP.LT.3.0) GO TO 61
      T45=SQRT(RAD45)
      V13=(CH+T45)/SIGX
      VA=V13
      GO TO 80
   63 V14=(CH-T45)/SIGX
      VA=V14
      GO TO 80
   64 WRITE(6,1008) (VO(JJ),JJ=1,15)
      GO TO 85
   80 I=1
      MM=M+1
      MMM=M+2
   81 VOV=VO(I)
      IF(VA.LT.VOV) GO TO 82
      IF(I.EQ.MM) GO TO 84
      I=I+1
      GO TO 81
   82 MI=M-I+1
      DO 83  II=1,MI
      MIMM=MMM-II
      MIM=MM-II
      VO(MIMM) = VO(MIM)
   83 CONTINUE
      VO(I)=VA
      M=M+1
      GO TO (84,84,84,84,84,30,31,34,40,43,50,53,60,63,61),M
   84 WRITE (6,1009)
      STOP
   85 X=V5
      VB=X
      GO TO 180
   86 CALL ELIPSE (IPOS,SIGX,SIGY,CH,CK,R,X,W)
   87 CALL AB(X,W,IA,IB)
   88 A=G(IA,IB,1)
      B=G(IA,IB,2)*SR +G(IA,IB,3)
      C1= G(IA,IB,4)*SR +G(IA,IB,5)
```

```
      C =C1*SR + G(IA,IB,6)
      D1=G(IA,IB,7) *SR + G(IA,IB,8)
      D2=D1*SR +G(IA,IB,9)
      D =D2*SR +G(IA,IB,10)
      E= G(IA,IB,11)
      F1= A*ELL +B
      F2= F1*ELL+C
      F3= F2*ELL+D
      F4= F3*ELL+E
      DELX=((360.0*ERR*SR)/F4)**0.25
      WRITE (6,2004) IA,IB,F4,DELX
   90 X2=X+DELX
      VB=X2
      GO TO 182
   91 IF(INDX.EQ.INDX2) GO TO 92
      INO = 0
      X2 = VO(INDX)
   92 CALL ELIPSE (IPOS,SIGX,SIGY,CH,CK,R,X2,W2)
      X1=(X+X2)/2.0
      CALL ELIPSE (IPOS,SIGX,SIGY,CH,CK,R,X1,W1)
      CALL NOR (W,PHI)
      Y=(X*X)/2.0
      QA= PHI *EXP(-Y)
      CALL NOR (W1,PHI)
      Y=(X1*X1)/2.0
      QB=4.0*PHI*EXP(-Y)
      CALL NOR (W2,PHI)
      Y=(X2*X2)/2.0
      QC = PHI *EXP(-Y)
      Q=((X2-X)/6.0)*(QA+QB+QC)*CRTPI
      S(IPOS)= S(IPOS)+Q
      X=X2
      W=W2
      IF(X.GE.V6) GO TO 200
      IF(INO.EQ.0) GO TO 93
      GO TO 90
   93 INDX=INDX+1
      INO = 1
      XDX=X+.001
      CALL ELIPSE (IPOS,SIGX,SIGY,CH,CK,R,XDX,WDW)
      CALL AB(XDX,WDW,IA,IB)
      GO TO 88
  180 J=1
 1800 VOV=VO(J)
      IF(VB.LT.VOV) GO TO 181
      IF(J.EQ.15) GO TO 84
      J=J+1
      GO TO 1800
```

```
  181 INDX=J
      GO TO 86
  182 J=1
 1820 VOV=VO(J)
      IF(VB.LT.VOV) GO TO 183
      IF(J.EQ.15) GO TO 84
      J=J+1
      GO TO 1820
  183 INDX2=J
      GO TO 91
  200 GO TO (300,400,500,600),IPOS
  300 IPOS=IPOS+1
      GO TO 14
  400 IPOS=IPOS+1
      AAA =SIGX
      SIGX=SIGY
      SIGY=AAA
      BBB =CH
      CH = CK
      CK = BBB
      GO TO 14
  500 IPOS = IPOS + 1
      GO TO 14
  600 Z1=(CH+RR2)/SIGX
      Z2=(CH-RR2)/SIGX
      Z3=(CK+RR2)/SIGY
      Z4=(CK-RR2)/SIGY
      CALL NOR (Z1,AA1)
      CALL NOR (Z2,AA2)
      CALL NOR (Z3,AA3)
      CALL NOR (Z4,AA4)
      P=(AA1-AA2)*(AA3-AA4)
      PROB= S(1)-S(2)+S(3)-S(4)-P
      WRITE(6,2007)
      WRITE (6,1007) S(1),S(2),S(3),S(4),P
      WRITE(6,2007)
      WRITE(6,1002)
      WRITE (6,1005) SIGY,SIGX,CK,CH,R,PROB
C     INTERCHANGES IN ABOVE STATEMENT ARE INTENTIONAL. SEE 400-500.
  700 CONTINUE
      STOP
      END


      SUBROUTINE ELIPSE (N,SIGX,SIGY,CH,CK,R,X,W)
      RAD2=R**2-(X*SIGX-CH)**2
      RAD=SQRT(RAD2)
      GO TO (10,20,10,20),N
   10 W= (CK+RAD)/SIGY
      GO TO 30
   20 W= (CK-RAD)/SIGY
   30 RETURN
      END
```

```
      SUBROUTINE AB(Q1,Q2,I,J)
      Q3=ABS(Q1)
      Q4=ABS(Q2)
      IF(Q3.GT.4.5) GO TO 11
      IF(Q3.GT.3.0) GO TO 10
      I=1
      GO TO 12
   10 I=2
      GO TO 12
   11 I=3
   12 IF(Q4.GT.4.5) GO TO 14
      IF(Q4.GT.3.0) GO TO 13
      J=1
      RETURN
   13 J=2
      RETURN
   14 J=3
   15 RETURN
      END


      SUBROUTINE NOR(X,PHI)
      IF(X) 20,45,30
   20 Y=ABS(X)
      I=0
      GO TO 40
   30 I=1
      Y=X
   40 IF(Y.GT.10.0) GO TO 42
      B1= 0.319381530
      B2=(-0.356563782)
      B3= 1.781477937
      B4=(-1.821255978)
      B5= 1.330274429
      P = .2316419
      T=1.0/(1.0+P*Y)
      A1= B5*T + B4
      A2= A1*T + B3
      A3= A2*T + B2
      A4= A3*T + B1
      A5= A4*T
      X2=(Y*Y)/2.0
      C = .3989422804
      Z = C * EXP(-X2)
      GO TO 44
   42 Z=0.
   44 IF (I.EQ.1) GO TO 50
      PHI=Z*A5
      RETURN
   45 PHI=0.5
      RETURN
   50 PHI=1.0-Z*A5
   60 RETURN
      END
```

```
C      PERMANENT DATA CARDS
    2.2E-01    3.3E-02    4.0E-04
    3.0E-03    4.0E-04    5.0E-06
    1.1E-05    1.7E-06    2.0E-08
    1.9E-00    1.8E-01    1.8E-03
    2.4E-02    2.2E-03    2.2E-05
    1.0E-04    9.0E-06    9.0E-08
    4.0E-01    3.6E-01    3.6E-04
    1.5E-02    1.4E-03    1.4E-05
    1.0E-04    8.5E-06    9.0E-08
    3.6E-00    1.3E-01    1.8E-03
    4.5E-02    1.7E-03    2.3E-05
    1.8E-04    6.5E-06    9.0E-08
    1.6E-00    5.6E-02    3.8E-04
    5.6E-02    2.1E-03    1.4E-05
    3.8E-04    1.4E-05    9.0E-08
    6.0E-01    2.2E-02    1.5E-04
    5.4E-02    2.0E-03    1.3E-05
    5.4E-04    2.0E-05    1.3E-07
    5.8E-00    7.2E-02    2.9E-04
    7.2E-02    9.0E-04    3.6E-06
    2.9E-04    3.6E-06    2.0E-08
    2.4E-00    3.0E-02    1.2E-04
    8.7E-02    1.1E-03    4.3E-06
    1.2E-03    1.5E-05    6.0E-08
    1.9E-00    2.4E-02    1.0E-04
    1.8E-01    2.2E-03    9.0E-06
    1.8E-03    2.2E-05    9.0E-08
    8.8E-01    1.1E-02    4.4E-05
    1.3E-01    1.6E-03    6.5E-06
    1.6E-03    2.0E-05    8.0E-08
    1.2E-00    1.2E-00    1.2E-00
    1.4E-01    1.4E-01    1.4E-01
    3.1E-03    3.1E-03    3.1E-03

C      INPUT AND SPECIFICATION CARDS
         0    1.0E-06
         2
     2.000      1.600      7.000      3.200      5.640
    10.000      2.000      5.000      7.000     17.500
```

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