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LOCATED HORIZON VARIATION STUDY

FINAL REPORT

~~U.S. GOVERNMENT AGENCIES ONLY~~

January 1969

Prepared under Contract No. NAS 1-8102 by

HONEYWELL INC.

Aerospace Division

Minneapolis, Minnesota

for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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by L. G. Bradfield
G. D. Nelson

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FOREWORD

This report documents the Located Horizon Variation Study performed under National Aeronautics and Space Administration Contract NAS 1-8102 for Langley Research Center.

This study provides the basis for quantitative comparison and for extension of results obtained under NASA Contract NAS 1-6010, Horizon Definition Study. During the Horizon Definition Study, the concept of located horizon altitudes was introduced to provide analytical techniques analogous to horizon sensor mechanizations for deriving altitudes from horizon radiance profiles. Specifically, the current suty statistically compares variations in located horizon altitudes observed in the earlier study with similar variations observed from the use of a broader meteorological data base.

Variations in the located horizon altitudes are presented for the three-year period 1964 through 1967 as functions of time and latitude band. These data are analyzed and presented using analytical representations for two of the horizon sensor mechanization techniques.

Honeywell Inc., Aerospace Division, performed this study under the technical direction of Mr. J.C. Bates. The study was conducted during the period 20 May 1968 through 13 January 1969.

Gratitude is extended to NASA Langley Research Center for their technical guidance, under the program technical direction of Mr. L.S. Keafer and direct assistance from Messrs. J.A. Dodgen, H.J. Curfman, R.E. Davis, and T.B. McKee, and Mrs. R.I. Whitman.

CONTENTS

ILLUSTRATIONS

TABLES

LOCATED HORIZON VARIATION STUDY
FINAL REPORT

By L. G. Bradfield
G. D. Nelson

SUMMARY

The requirement for definition of the Earth's infrared horizon arises from the need for an improved attitude reference for space vehicles. An extensive analysis of this subject was made previously in the NASA Horizon Definition Study under contract NAS 1-6010. The present study evolved as a logical extension of that contract effort.

The purpose of this study was twofold:

1. To examine further the interpolation techniques used to generate meteorological data for use in computing horizon radiance profiles and to determine if these techniques introduced artificial variations in the located horizon altitudes.

2. To determine, by generating and analyzing data over a three-year time span, if there are significant located horizon altitude variations for a period longer than one year.

In this study, 697 horizon radiance profiles were generated for the years 1964, 1965, and 1966. The body of data used consisted of actual meteorological data from radiosondes and rocketsondes and of meteorological data interpolated in time and space from these sensor sources. Interpolation provided a data base with sufficient resolution to determine temporal and spatial frequency variations in located horizon altitudes.

Statistical comparisons of the located horizon altitudes were made between corresponding temporal and spatial subsets of the data. Study results showed that the interpolation techniques used to generate the meteorological data base did not significantly affect the accuracy of the study. The study also indicated that year-to-year variations occur at the high latitudes over North America and that variations in the equatorial regions show evidence of the quasi-biennial cycle.

INTRODUCTION

Horizon sensors have been employed for spacecraft local vertical determination for more than a decade, during which time spectral intervals ranging from the visual to the infrared were used. Early space flights indicated that a number of problems existed in this use of the horizon. The primary problem was the effect of clouds on horizon sensors operating in the infrared spectrum. Experiments to study this problem revealed that these clouds appeared as objects colder than Earth. However, since horizon sensors are conceptually simpler than other systems giving an Earth reference, studies were undertaken to determine a suitably stable spectral interval. These studies led to recognition of the inherent stability of the 14 to 16.28μ spectral interval.

To exploit the full potential of this region of the infrared spectrum an extensive experimental and analytical program to define the Earth's 15μ infrared horizon was undertaken by the NASA Langley Research Center. Experimental efforts consisted of four X-15 borne radiometer flights and two suborbital ballistic rocket probes (Project Scanner). From the latter effort, several hundred high-resolution horizon radiance profiles were obtained in August and December 1966. This experiment is the most significant of its type to date. Concurrent with this experimental effort, an analytical study was conducted by Honeywell Inc., Systems and Research Division, for Langley Research Center under contract NAS 1-6010. This Horizon Definition Study was conducted to determine the experimental requirements of a horizon definition measurement program. During the study, a large body of atmospheric data was acquired and studied using analytical techniques developed for that purpose. A highly accurate horizon profile synthesis model is the most significant of these techniques. This is the most comprehensive synthesis model existing for computing 15μ horizon radiance profiles. Results of this model were recently compared with horizon radiance profiles measured by Project Scanner and were shown to be within the accuracy of the experimental data (refs. 1 and 2).

During the Horizon Definition Study, considerable attention was focused on obtaining quantitative estimates of the variability of the Earth's 15μ horizon. Since limited experimental data were available, the synthesis of over 1000 horizon radiance profiles, based on interpolated atmospheric data, was required. The spatial and temporal variability of the 15μ horizon was determined from these data, and sampling requirements were deduced. For this analysis, "locator" processing was the basic technique (ref. 3). This analytical technique permitted the analysis of horizon profile variations on the basis of a single point on the profile, e.g., the altitude at which a fixed value of radiance occurs or the altitude at which the integral of radiance is fixed. A total of 88 such locator concepts was used, resulting in over 88 000 located altitudes. Computed statistics of these located altitudes provided a prediction of the horizon variability.

The Located Horizon Variation Study was undertaken to substantiate and extend the results of the located horizon analyses conducted during the Horizon Definition Study. Specifically, the present study verifies that variations in located horizons obtained from interpolated atmospheric data can also be obtained from an atmospheric data base composed of uninterpolated temperature and pressure data. Further, this study attempts to verify that these variations are essentially unchanged from year to year.

LOCATED HORIZON VARIATION STUDY

During the Horizon Defintion Study, an extensive investigation of factors affecting the variability of the Earth's 15μ infrared horizon was undertaken (ref. 4). Of several analytical techniques developed to analyze the effects of these factors, the "locator" concept proved to be the most useful, since variations observed in altitudes derived fromthe locator analysis relate directly to the factor-induced variations. Atmospheric data for the Horizon Definition Study were derived from a limited number of meteorological soundings made during the one-year period from April 1964 through March 1965. The limited number of available soundings did not provide the data base necessary for statistical analyses on horizon variations to be meaningful; therefore, interpolation of the meteorological data base in time, latitude, and longitude was used to develop the necessary data. This approach to the study of horizon variations and the use of only one year of data led to two basic questions.

1. Are there located variations of duration greater than one year?

2. Does space-time interpolation significantly affect the variations observed in located horizons?

The Located Horizon Variation Study was undertaken to develop a broader meteorological data base and a suitable analytical approach to answer these questions.

STUDY OBJECTIVE

The significance of answering the preceding questions becomes apparent when considering the extensive analysis (ref. 5) which was based on the Horizon Definition Study atmospheric data base. Verification of the data preparation method (and, by implication, of the analysis and conclusions) for that study provides the motivation for the objectives of this study. Thus, it is desirable to reformulate the objectives with emphasis on the method of data preparation for the current study.

The objectives of this study are to generate an atmospheric data base of sufficient quality and resolution and to develop an analytical approach to compare the spatial and temporal variations in located horizons derived from interpolated atmospheric data to those derived directly from rocketsonde and radiosonde data. In addition, the data period must be of sufficient duration to detect possible year-to-year variations. In the Horizon Definition Study, longitudinal variations were shown to be small compared to latitudinal and temporal variations. Therefore, for this study longitudinal variations were assumed to be negligible, with verification of this assumption as a secondary objective.

STUDY APPROACH

The approach taken to meet the objectives of this study was to perform direct comparative analyses of the located horizon altitude variations derived from interpolated atmospheric data with variations derived from actual radiosonde and rocketsonde data. Variations from both sets of data were compared over a three-year period. Critical steps in this approach were

- The generation of sets of horizon profiles from interpolated and actual data that are comparable in time and space
- The definition of methods for comparing the two sets of data
- The selection of locators to be compared
- The analysis and interpretation of the comparisons

For the first step, a large amount of the interpolated data was available in the form of horizon radiance profiles generated during the Horizon Definition Study (refs. 6 and 7). From this existing data base, 448 horizon radiance profiles were chosen. These profiles represented eight synoptic situations spanning April 1964 through February 1965, with each situation containing 56 profiles covering the northern hemisphere between longitudes 60°W and 160°W. For comparative purposes, all new data generated under this study were selected to correspond to the eight dates of these synoptic data.

These existing data and all new data were further structured by separating them into four latitude bands -- 0° to 20°N, 20°N to 35°N, 35°N to 55°N, and 55°N to 80°N. These latitude bands were selected on the basis of Meteorological Rocket Network (MRN) station density and on the density of the data available from each station. The resulting space-time cell structure provided the basis for the comparative analysis.

Each of the space-time cells was compared with a corresponding space-time cell by using the T and F tests for equal means and variances (refs. 8 and 9). The F-test statistically tests the hypothesis that two variances are equal. The test based on a comparison of the value σ_1^2 / σ_2^2 to its normally expected distribution. The T-test, which statistically tests the hypothesis that the means of two populations are equal, is based on a comparison of the difference in the means of two samples with the expected distribution of values. Both of these tests are described in detail later.

Detailed analyses and interpretations of the data were made on the basis of

- Variations within a latitude band for a three-year period
- Variations over the latitude bands for temporal subsets
- Differences in variations of the above sets due to choice of locator

Each of these elements in the study is discussed in detail later.

DATA SELECTION AND PREPARATION

Data selection and preparation for this study were conducted to ensure that the resulting data base had sufficient spatial and temporal resolution to adequately map located horizon variations. Further, the desire to examine the validity of the use of interpolated temperature and pressure data in horizon profile analysis imposed the additional constraint that real atmospheric data obtained directly from meteorological soundings be used for profile synthesis. These considerations led to the selection of 597 MRN soundings which provided the real atmospheric data for this study. From these 597 soundings, 585 were used directly in the horizon radiance profile synthesis. The remaining 12 soundings were used to provide interpolated data for two synoptic situations, each situation containing 56 interpolated profiles (Appendix A).

These atmospheric data, together with the corresponding synthesized 15μ horizon radiance profiles, were recorded and were transmitted to Langley Research Center. The compilation of these data is a significant by product of the Located Horizon Variation Study and results in the availability of these data for further study. This significance is strengthened by the considerable time span of the data (in excess of three years) and by recent comparison of these data to experimental data taken by Project Scanner (refs. 1 and 2).

DATA SELECTION

The raw atmospheric data for this study were compiled from the monthly data reports of the MRN (refs. 10 and 11). These reports were obtained for the period January 1964 through January 1967. Thus, for the analysis of temporal variations, data spanning three years were selected.

A second source of data for this study was the existing data base of horizon radiance profiles syntehsized during the Horizon Definition Study. Of the

1085 profiles available from the Horizon Definition Study, 448 profiles were selected for comparison with the profiles generated in this study. These profiles were synthesized for 56 grid points over North America at eight times during the period April 1964 through February 1965 to provide synoptic variability. All profiles are for the northern latitudes and 60°W to 160°W longitude. The dates and numbers (ref. 6) of these profiles are presented in Table 1. Each date has 56 profiles associated with it.

TABLE 1.- PROFILE NUMBERS AND DATES

Date	Profile numbers
4/8/64	1 - 56
6/3/64	57 - 112
8/12/64	113 - 168
10/21/64	169 - 224
11/13/64	225 - 280
12/9/64	281 - 336
1/20/65	337 - 392
2/10/65	393 - 448

The space-time cell structure necessary for statistical computations was completed by the selection of four latitude bands. These bands, from 0° to 20°, 20° to 35°, 35° to 55°, and 55° to 80°, each contain a sufficient number of grid points to provide a good statistical sample and at least one MRN station which reports temperature and pressure data in sufficient quantity. The 56 synoptic grid points and four latitude bands are presented in Figure 1. Also included in this figure are the MRN stations from which data were selected for use in this study.

This selection proceeded as follows from MRN reports a preliminary selection yielding approximately 2550 soundings was made according to the following criteria.

1. Temperature data must be available from 0 to at least 45 km.

2. Pressure data must be available from 0 to at least 30 km.

These criteria were used to minimize, as much as possible, the reliance on extrapolated data for use in horizon profile synthesis. From these soundings, 585 were selected to be used directly for profile synthesis Another 12 were selected to provide data for 112 interpolated synoptic profiles. This final selection was made by extending the space-time cells encompassing the Horizon Definition Study data to include January 1964 through January 1967. The final cell structure is presented in Figure 2. Here, for purposes of easy reference to computer outputs, the cells have been numbered. Also indicated are the dates, latitude bands, data source, and method of preparation for the cells. No soundings were available for the shaded cells.

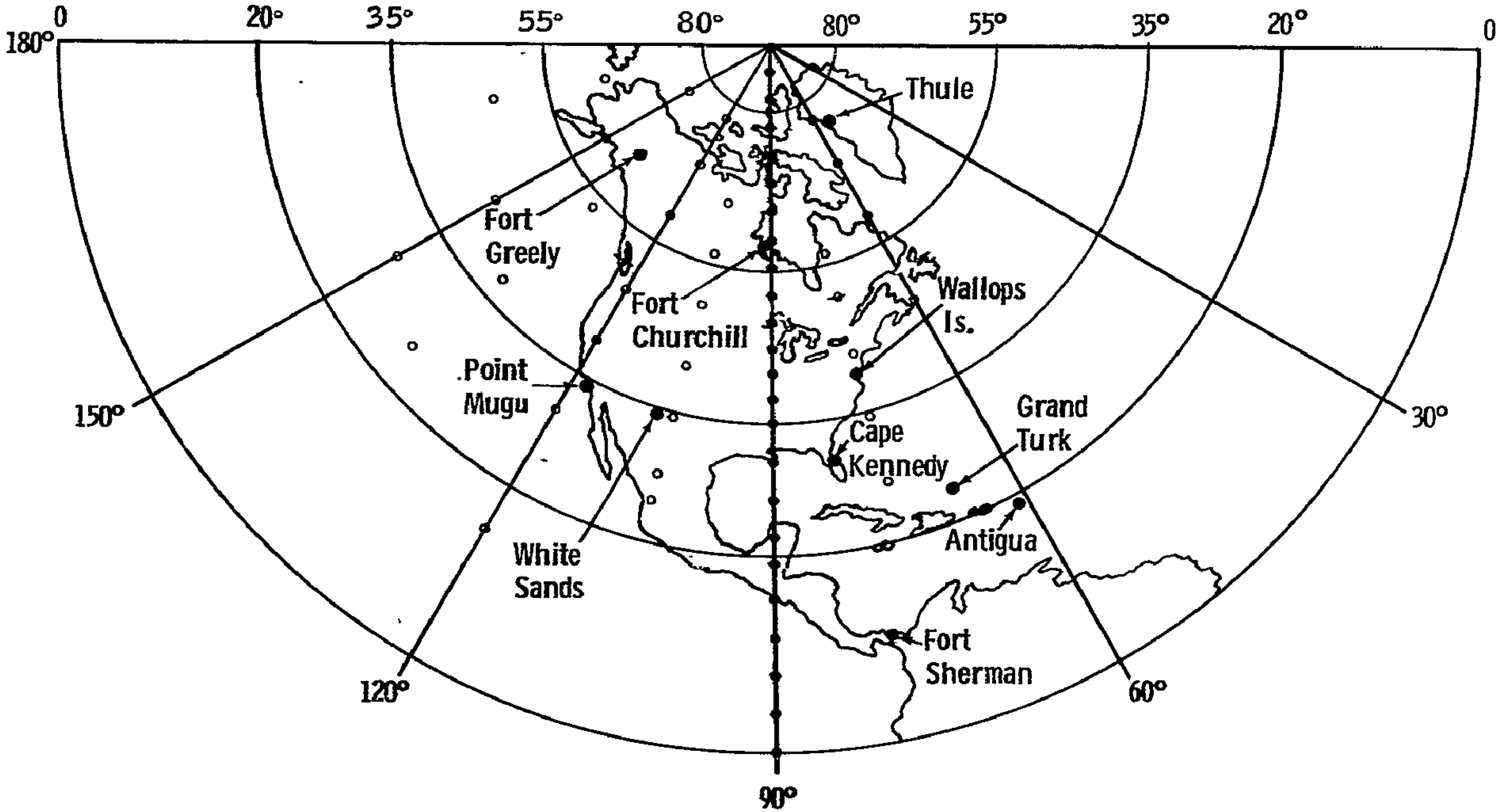

Figure 1. Location of Synoptic Grid Points, Latitude Bands, and MRN Stations

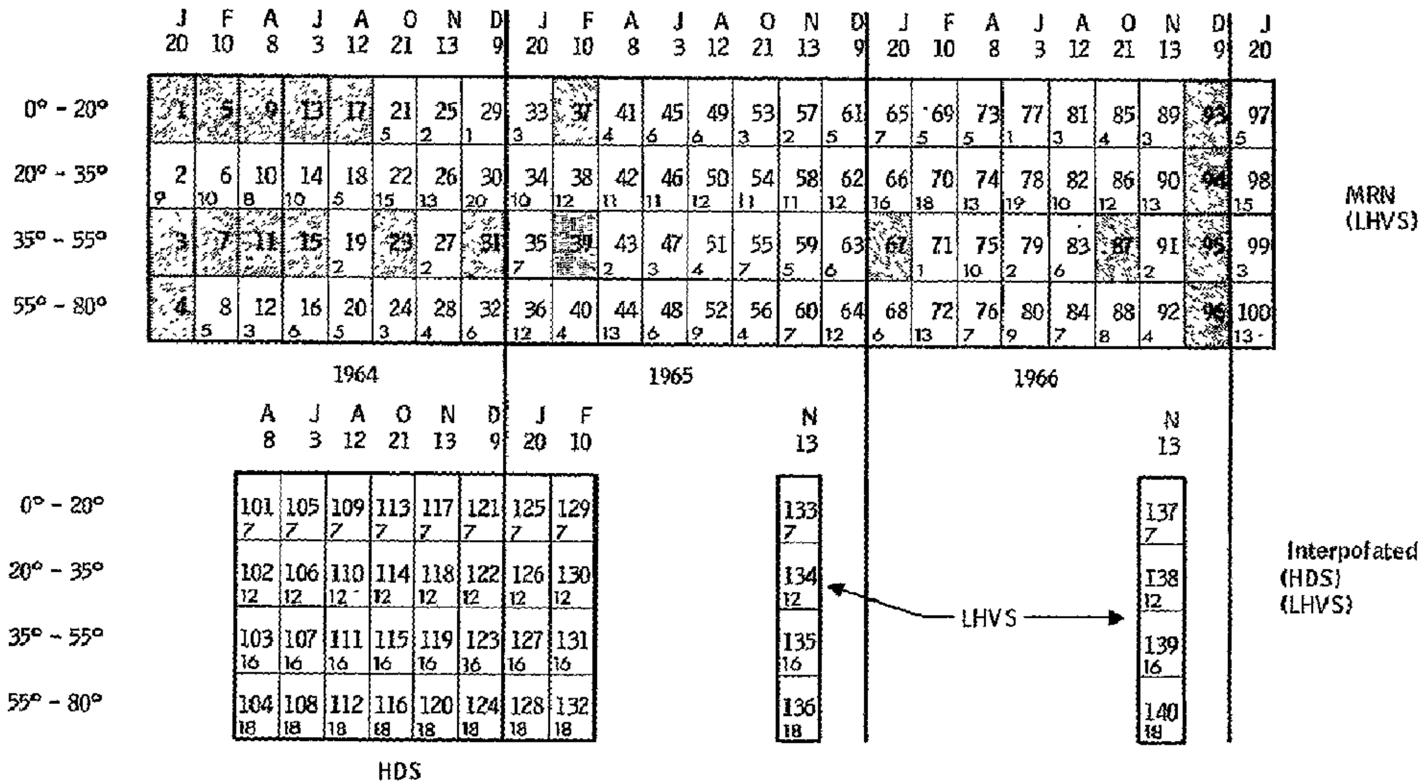

Figure 2. Basic Cell Structure

All soundings selected were picked to coincide with the chosen dates as closely as possible, preferably within ±2 days. Soundings tightly clustered in time at a particular station are desirable to compensate for instrument errors and local temperature varations. An extreme case of this is illustrated in Figure 3. This is a plot of two temperature measurements taken at Cape Kennedy on 9 November 1966. Although 15 minutes separate the soundings, there are significant temperature differences in the rocketsonde data. However, the available data did not always provide a sufficient number of soundings by this criterion. In some cases, it was necessary to select soundings over a 10-day period centered at the specified date, while in other cases, it was necessary to seek a new date near the defined date.

All soundings selected for direct profile synthesis are listed chronologically in Appendix A. Those used for interpolating for the two synoptic situations are listed in Table 2.

DATA PREPARATION

The primary atmospheric variables required for horizon profile synthesis are temperature and pressure for altitudes to 80 km. During the Horizon Definition Study, profiles of these variables were generated by an interpolation of actual data obtained from radiosonde and rocketsonde soundings. For this study, two approaches to generating these atmospheric profiles were used. The first approach, identical to the interpolation used in the Horizon Definition Study, was employed to produce 112 "synoptic" profiles. The second approach was to use only atmospheric data available from meteorological soundings. For both approaches, identical methods of extrapolation were used to provide high-altitude temperature and pressure data not available from soundings or interpolation.

The preparation of atmospheric data for the Horizon Definition Study (ref 4) can be summarized by considering three altitude ranges, 0 to 30 km, 30 to 60 km, and 60 to 90 km. In the 0 to 30 km range, all radiosonde information was gathered in the form of constant pressure charts (for the 850, 700, 500, 300, 200, 100, 50, 30, and 10 mb levels) containing lines of constant altitude and temperature. In the 30 to 60 km range, temperature data were obtained from MRN soundings. From these, constant-height charts were prepared at 3 km intervals to that temperature profiles could be obtained for any particular geographic location. Pressure profiles for both the 30 to 60 km and 60 to 90 km ranges were computed from the hydrostatic equation, with the 10 mb pressure at approximately 30 km used as a base. Manual extrapolation of temperature profiles to 90 km was achieved by the use of two sets, one for winter and one for summer, of standard temperature-versus-altitude curves for high altitudes (ref. 4). With the exception of manual extrapolation, these methods were also used during this study to generate the atmospheric profiles for the 112 synoptic cases. Extrapolation of temperature in this study was performed by the computer using the same procedure as the previous manual extrapolation.

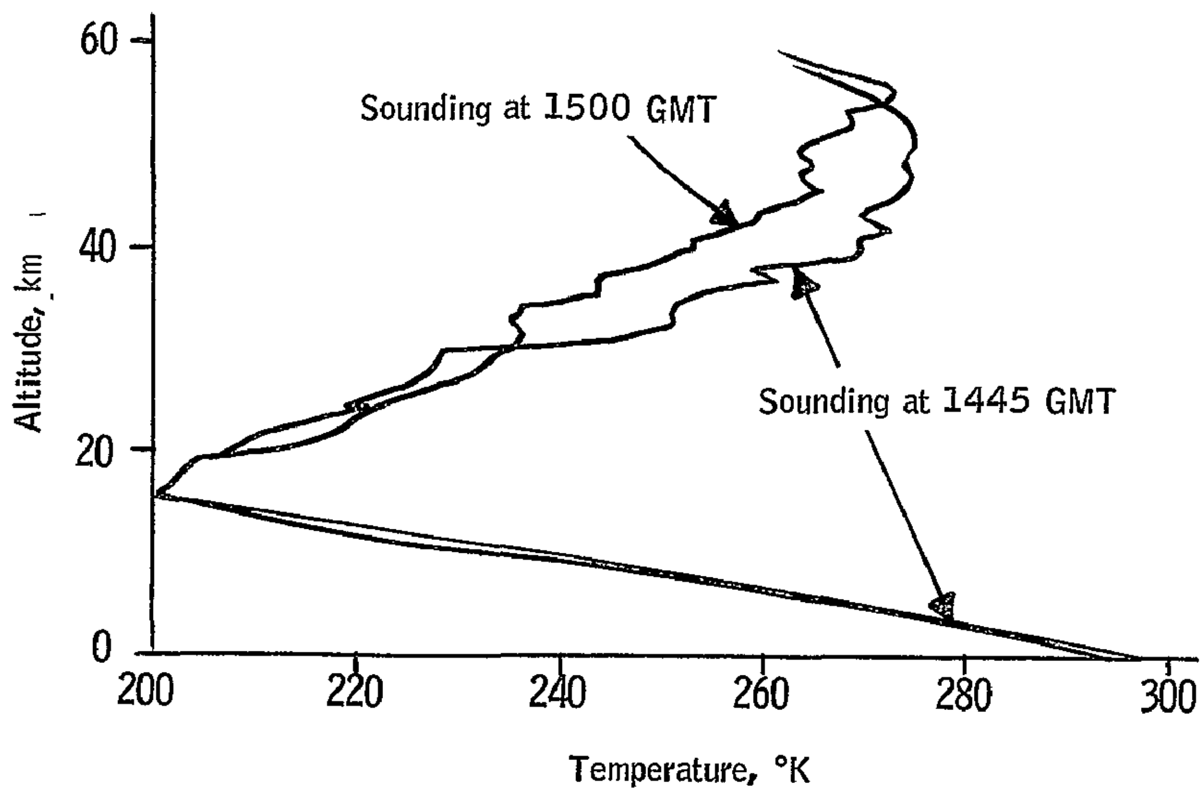

Figure 3 An Example of Temperature Variations Due to Local Weather Conditions

TABLE 2.- MRN ROCKET SOUNDINGS - SYNOPTIC DATA

Time Cell	Location	Date	Time GMT
13 November 1965	Ascension Island	12 November	1600
	Cape Kennedy	15 November	1600
	Grand Turk Island	12 November	1700
	Fort Greeley	11 November	1015
	Fort Mugu	15 November	1736
	Wallop Island	11 November	0440
13 November 1966	Ascension Island	14 November	1445
	Cape Kennedy	14 November	1900
	Fort Churchill	10 November	0233
	Fort Greeley	14 November	2001
	White Sands	11 November	0736

The constant-altitude charts used in this study for the 30 to 60 km altitude band are presented in Appendix B. These data were prepared for, and used exclusively for, this study. The constant-pressure charts used to interpolate atmospheric data from 850 mb to 10 mb are standard data charts.

No constant pressure, temperature, or altitude charts were used for the 585 profiles derived from atmospheric data. Rather, the data from the selected MRN soundings were used directly in profile synthesis. Both pressure and temperature profiles were extrapolated from the highest data point to 90 km, as described above.

Pressure extrapolation was performed using the hydrostatic equation. The base pressure was taken to be the recorded pressure nearest 30 km. This treatment makes maximum use of the available pressure data. Also, this treatment is consistent with the method used for extrapolation in the Horizon Definition Study, where the 10 mb pressure was used as the base.

Generally, the selected MRN soundings yielded temperature data terminating in the 45 to 60 km region. No interpolation was required in the recorded temperatures, since most temperatures were recorded 1.5 to 2.0 km apart. It is empahsized that both pressure and temperature profiles were prepared by making the best use of existing data. At high altitudes where the data were unavailable, extrapolation methods identical to those used in the Horizon Definition Study were employed.

A second consideration in the data preparation was the overlap region of radiosonde and rocketsonde data from the MRN soundings. Temperature data were given by the radiosonde from 0 to 30 km and by the rocketsonde from 20 to 50 km. Thus, there was an overlap of temperature data in the 20 to 30 km altitude region. However, the temperature data from the two sondes did not always agree in the overlap region. While the differences typically were 2°C, one sounding at Thule showed a difference of 14°C. These differences were due to three causes: (1) the time differences between radiosonde and rocketsonde data can be as much as 12 hours, (2) as the result of downwind motion of the radiosonde as it rises to 30 km, a difference in geographic position between the two sondes could occur; and (3) the different instrumentation used in the two sondes results in temperature data variations. The time and instrumentation differences were considered to be the most critical. For this study, rocketsonde data were used down to the lowest available altitude, as the rocketsonde was considered to be more accurate than the radiosonde.

LOCATORS

Two analytical approaches were employed during the Horizon Definition Study for the analysis of infrared horizon profile variability. The first of these was a technique called locator analysis (ref. 3). For this approach, several "locators" or functions which reduce a horizon profile to a single number (a "located horizon") were defined and analyzed. The second approach, profile analysis, was to consider the entire profile (ref. 12); statistical analyses and curve fitting were used in this approach. While profile analysis was useful in understanding horizon profile variability, the locator concept proved to be much more valuable for defining the data requirements of a horizon definition measurement program. This was the result of the direct relationship that exists between locator analysis and the mechanization of horizon sensors.

Each locator was defined as a function of the horizon radiance profile and simulated the operation of a horizon sensor, either conceptual or operational. Basically, locator analysis is the inverse of horizon profile synthesis. From the latter, radiance as a function of altitude is obtained, while, from the former, altitude is obtained as a function of radiance and, for some locators, as a function of input constants. For example, the altitude at which a fixed level of radiance is detected is a simple locator to compute and is easily interpreted. Since a locator reduced a horizon profile to a single number, locator analysis is particularly suitable for the statistical analysis of a large number of profiles.

From the results of the Horizon Definition Study, three major conclusions were drawn concerning locator analysis (ref. 5).

1. Locator L4, the integral of normalized radiance, has the greatest potential for local vertical determination (i.e., it is most stable over both space and time).

2. The stability of any locator technique is enhanced if input contants are selected so that the locator operates in regions above the troposphere.

3. Locators based on radiance or integrated radiance are more stable than those based on derivatives of the radiance.

Further, for the purposes of measurement data requirements determination, the limiting locators were determined to be the integral of normalized radiance and the fixed radiance locator. Consequently, the following four locators were chosen for the Located Horizon Variation Study from among the 30 locators available

1. Fixed radiance (L1) at threshold levels of
   2 W/m^2-sr and 3 W/m^2-sr

2. Normalized radiance (L2) with threshold levels of
   0.15, 0.5, and 0.9

3. Integrated radiance (L3) with threshold levels of
   4.5 km-W/m^2-sr and 20 km-W/m^2-sr

4. Integrated normalized radiance (L4) with threshold levels 2.5 km and 10.0 km.

Each of the above locators yields an altitude which corresponds to the threshold level. Mathematically, these locators are defined as follows

$$h\ (L1) \quad C_1 = N[\bar{L1}(C_1)]$$

$$h\ (L2) \quad C_2 = N[L2(C_2)]$$

$$h\ (L3) \cdot \quad C_3 = \int_{L3(C_3)}^{\infty} N(h)\, dh$$

$$h\ (L4) \quad C_4 = \frac{1}{N_{max}} \int_{L4(C_4)}^{\infty} N(h)\, dh$$

where

N = radiance

C_i = threshold constant

h = altitude

For this study, numerical solutions of the above equations were obtained by methods identical to those employed in the Horizon Definition Study. However, new computer routines were developed, since those previously used (ref. 13) were much more general than needed and were therefore not efficient for use in this study.

Trapezoidal integration and linear interpolation were used to compute the above locators. Thus, the above integrals are approximated by

$$\int_{h_j}^{\infty} N(h)\, dh \cong \sum_{i=j}^{n-1} \frac{N(h_i) + N(h_{i+1})}{2} (h_{i+1} - h_i)$$

for $j=1, 2, \cdots, n-1$. For all Located Horizon Variation Study work, h_n = 80 km and

$$\int_{80}^{\infty} N(h)\, dh \equiv 0.$$

These numerical methods were selected over higher-order approximation methods because they were used in the Horizon Definition Study. It is important for this study that identical techniques be employed, since different methods can be expected to produce biased results.

RADIANCE PROFILE SYNTHESIS

Horizon radiance profiles for the Located Horizon Variation Study were synthesized using a mathematical model identical to the one employed in the Horizon Definition Study. However, as with the routines used for locator computations, a new computer program was developed for profile synthesis. This program is a modification of the original (refs. 14 and 15) synthesis program and was developed for two reasons. First, the original program has a large number of options which were not used in this study. These were eliminated for the sake of efficiency. Second, the input/output capabilities of the program were modified to allow a smoother interface with other programs written for the Located Horizon Variation Study.

For completeness, a summary discussion (ref. 5) of the earlier model has been reproduced for this report

> Factors which affect horizon radiance profiles can be defined as either explicit or implicit. Explicit factors are those which relate directly to the input quantities in the radiative transfer equation. Temperature and pressure, for example, are explicit factors which exert an influence upon the magnitude and shape of the horizon radiance profile by means of their functional relationship with the Planck source function and the atmospheric transmissivity. Implicit factors, on the other hand, specify the conditions which are associated with an individual profile or group of profiles, including such factors as latitude, longitude, time of year, time of day, various atmospheric (or meteorological) conditions, and underlying topography.
>
> The radiance I(h), which effectively emanates from each tangent height h of the radiance profile, is the result of a double integration over the atmospheric optical path and the wavelength, plus a boundary condition integrated over the wavelength only. The form of the equation is
>
> $$I(h) = \int_{\Delta\lambda} B(\lambda, T_1)\ \tau(\lambda, u_1)\, d\lambda + \int_{\Delta\lambda} \int_{u_1}^{0} B(\lambda, T)\ \frac{\partial \tau}{\partial u}\, d\lambda\, du \qquad (1)$$
>
> To make best use of available tabulated data, this equation is integrated by parts to yield
>
> $$I(h) = \int_{\Delta\lambda} B[\lambda, T(u=0)]\, d\lambda + \int_{\Delta\lambda} \int_{u_1}^{0} \tau(u)\ \frac{\partial B(\lambda, T)}{\partial u}\, d\lambda\, du \qquad (1a)$$

where

$B(\lambda, T)$ = source function (in general including pseudo-sources such as solar scattering from stratospheric dust, clouds, and scattered earth-shine in addition to the primary Planck source function),

$\tau(u, \lambda)$ = spectral transmissivity of CO_2 (reflects choice of absorption model and effects due to pressue and Doppler broadening),

u = optical path,

λ = wavelength in the spectral interval $\Delta\lambda$ (including consideration of the filter spectral response when integrating over $\Delta\lambda$), and

T = temperature at the point specified by u

At each wavelength λ the spectral transmissivity τ is a function of temperature and pressure as well as optical path u. Temperature and pressure are specified by calculating an effective temperature T_e and an effective pressure p_e for each atmospheric optical path. All of the preceding parameters explicitly affect the radiance I(h) and, for convenience, are hereinafter referred to as explicit factors.

The two most prominent explicit factors in the foregoing equations are temperature and pressure. These factors exert influence on the magnitude and shape of the horizon radiance profile through the functions (such as atmospheric transmissivity or the derivative of the Planck function) which appear in the integrand of the radiation equation. However, by the barometric equation

$$p = p_o \quad \exp - \int_o^h \frac{Mg(h)}{RT(h)} \, dh \tag{2}$$

where g is gravitational acceleration, M is the molecular weight of air, and R is the universal gas constant, pressure is related to the temperature as a function of the altitude h. Hence, temperature as a function of altitude is the explicit factor to which the magnitude and shape of the radiance profile are most sensitive. This conclusion has two important ramifications. First, the most important inputs to the mathematical model for synthesizing radiance profiles are the empirically derived temperature profiles. Second, variations in both the magnitude and shape of the radiance profile are most likely due to changes in the factors which affect the temperature.

The specific model characteristics retained from this general model for profile synthesis in the Located Horizon Variation Study were:

a) Atmospheric refraction

b) Local thermal equilibrium

c) Doppler broadening

d) Plass CO_2 radiance model

e) Radiance from 615 cm^{-1} to 715 cm^{-1} spectral interval

f) Constant CO_2 mixing ratio of 3.14×10^{-4}

For both studies, identical mathematical and physical models were used for profile synthesis, and identical numerical methods were used for locator computations. This is an important detail since different methods could be expected to produce biased results.

There is, however, one facet of the synthesis procedure that was altered. All Wallops Island profiles were computed in the tangent-height range from 10 to 80 km, whereas all others, including the Horizon Definition Study profiles, were computed in the -30 km to 80 km range. This was decided midway in the study after an examination of a preliminary data set. The main concern was the effect that this would have on the locators L2 and L4, which require a peak radiance value. Since Wallops Island profiles characteristically possess a peak in the -30 to 10 km range, it was decided to use the -30 to 80 km range. Conversely, Fort Churchill and Fort Greely exhibit a limb darkening with the radiance approaching a maximum asymptotically with decreasing tangent height. Formerly for this case, the -30 km radiance level was used as the peak. However, the difference in radiance at this height and 10 km is less than $0.2\ W/m^2$-sr. Since this causes negligible changes in L2 and L4, the shortened tangent height ranges were used for these stations. All other stations exhibited peak radiance values in the range 10 to 20 km.

STATISTICAL COMPARISON OF LOCATED ALTITUDES

In this portion of the study, statistical tests were used to perform two basic sets of comparisons. The space-time cells described previously provided the basic structure for the comparisons, while the mean and variance of the located altitudes within each cell provided the statistics to be compared. The first set of comparisons was constructed to determine if located horizon variations of greater than one year exist. To do this, cell statistics were compared for similar cells on a year-to-year basis. Statistics derived from interpolated atmospheric data were not compared with statistics derived from raw atmospheric data for this determination. For example, cell 45 (June 1965, 0° to 20°, MRN data) was compared with cell 77 (June 1966, 0° to 20° MRN data), but not with cell 105 (June 1964, 0° to 20°, interpolated data) The second set of comparisons was structured to evaluate the effect of interpolation. For this, cells with similar dates, but with statistics derived from the different data bases, were compared. For example, cell 53 (November 1965, 0° to 20°, MRN data) was compared with cell 133 (November 1965, 0° to 20°, interpolated data). Cells with dissimilar dates were not compared.

Tests used to compare cell statistics are the T and F tests for equal means and variances (refs. 8 and 9). Each of these statistical tests is bounded by the assumption of a confidence interval (i.e., what confidence does one want in the answers resulting from applying the tests). Both tests may be performed at any confidence level. Because of the nature of the objectives of this study, a high-confidence level was desired, 95 percent was selected. This confidence interval is also the same as that used previously in the Horizon Definition Study (ref. 16).

The confidence level qualified the result of each comparison as follows. If the statistics (either the mean or variance) of two cells are tested for equality and the test is not passed, it is possible to conclude with 95 percent confidence that the statistics are unequal. However, the converse is not true. If the test is passed, it is only possible to conclude that the statistics may be equal. This point is clarified by a consideration of Figure 4, in which the standard deviations of the locator L4 (2.5) for the comparison of uninterpolated with interpolated data in the 55° to 80° latitude band are plotted. Along with each standard deviation, the 95 percent confidence limits are also plotted. These limits were determined so that it is possible to assert with 95 percent confidence that the true value of the standard deviation lies within the limits. Below each of the points plotted is the result of testing the two standard deviations for equality. Wherever the confidence limits overlap, the test is passed (indicated by a Yes). Conversely, wherever the limits fail to overlap, the test is not passed. The bands connecting the points were constructed to visually tie together the data for this particular method of data presentation. The bands should not be interpreted as providing information at intermediate dates.

While these plots were not developed for the other comparisons undertaken, two features that are generally true are noted. First, the confidence that is possible in the variance statistic is much lower (i.e., it has a much wider confidence limit) for the uninterpolated data than for the interpolated data. The consistently higher sample variances for the uninterpolated data are due largely to the small number of samples (three or four) available, versus 18 for the interpolated data. Second, the consistently smaller value of sample variance for the interpolated data has the possible smoothing effect of the interpolation on located horizon variations.

For this study, the test for equal variances is the more appropriate test to use. Reasons for this are (1) the variance test can be performed on the sample data with no assumption about the population means, but the tests for means assumes equal variances, and (2) for the purpose of determining sampling requirements for a measurement experiment, the variability of the

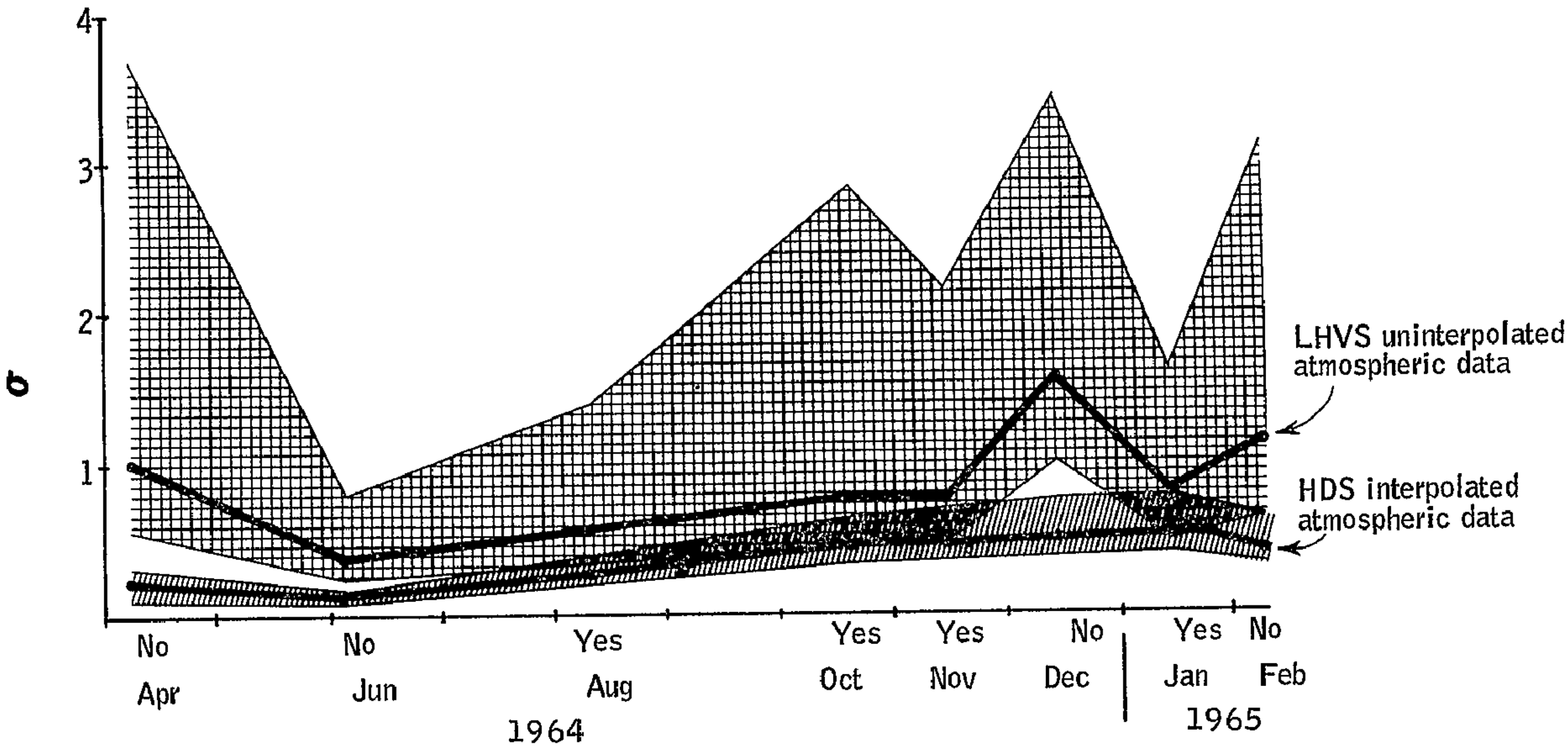

Figure 4. L4(2.5), 55°N to 80°N Comparisons with 95% Confidence Limits

phenomena to be measured is more critical than the mean value. It must be remembered, however, that the space-time mean of the located altitude population would be used directly for compensation in a horizon sensor. Therefore, the test for equal means was performed for each of the comparable space-time cells in the data

F-TEST FOR EQUAL VARIANCES - STATISTICAL BASIS

The F-test for equal variances is a method of comparing the variances of two populations by statistical inference from the variances of samples taken from the two populations. The test assumes that the two populations are normally distributed. The basis of the test is a comparison of the actual ratio of the sample variances with the theoretical distribution of that ratio.

The F-distribution is defined as the distribution of the ratio of two independent chi-square variables, each divided by its number of degrees of freedom. If σ_1^2 and σ_2^2 are the population variances, if S_1^2, S_2^2, n_1, and n_2 are the sample variances and sizes, and if the assumption of normal populations is made, then the quantity

$$R = \frac{S_1^2/\sigma_1^2}{S_2^2/\sigma_2^2}$$

has the F-distribution with $\upsilon_1 = n_1 - 1$ and $\upsilon_2 = n_2 - 1$ degrees of freedom.

Since we are testing for equality of the variances and have no way of determining actual population variances, we compute $R' = S_1^2/S_2^2$ for use in the actual test. If the variances of the populations are equal, then the quantity R' has the F-distribution with υ_1 and υ_2 degrees of freedom. An acceptance region is established such that, if $\sigma_1 = \sigma_2$, then the value of R' will be within the region 95 percent of the time (see Figure 5). This acceptance region may be expressed

$$F_{0.025}(\upsilon_1, \upsilon_2) < R' < F_{0.975}(\upsilon_1, \upsilon_2)$$

The identity $[F_\alpha(\upsilon_1, \upsilon_2) = 1/F_{1-\alpha}(\upsilon_2, \upsilon_1)]$ makes it possible to compute $F_{0.975}$ percentiles easily from $F_{0.025}$ percentiles to conserve computer memory. Thus, the test becomes

$$F_{0.025}(\nu_1, \nu_2) < R' < \frac{1}{F_{0.025}(\nu_2, \nu_1)}$$

The hypothesis that $\sigma_1 = \sigma_2$ is rejected if R' does not lie within the acceptance region. We are confident that R' will lie within the acceptance region 95 percent of the time if $\sigma_1 = \sigma_2$. In other words, the probability of a negative conclusion when $\sigma_1 = \sigma_2$ is 0.05.

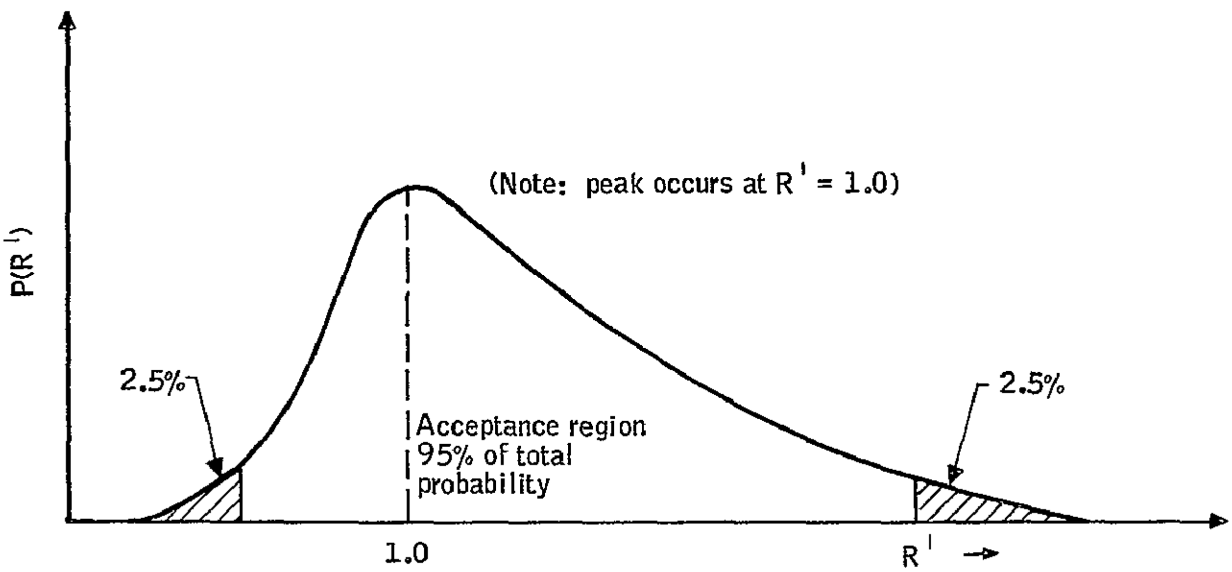

Figure 5. Probability Distribution of R'

The alternative to this hypothesis is $\sigma_1 \neq \sigma_2$. We would also like to know the probability for R' values within the acceptance region in this case (that is, what is the probability of a positive conclusion where indeed $\sigma_1 \neq \sigma_2$). We recall that $R = (S_1^2 \sigma_2^2)/(S_2^2 \sigma_1^2)$ is F-distributed even when $\sigma_1 \neq \sigma_2$. so that the probability function for R' is

$$P(R') = \frac{\sigma_2^2}{\sigma_1^2} P_f \left(R' \frac{\sigma_2^2}{\sigma_1^2} \right)$$

where

$P_f(R)$ is the probability function for R.

Using this probability function, we can compute the characteristic function

$$\beta\left(\nu_1,\ \nu_2,\ \frac{\sigma_1^2}{\sigma_2^2}\right),$$

which is the probability that the value of R' lies within the acceptance region.

$$\beta\left(\nu_1,\ \nu_2,\ \frac{\sigma_1^2}{\sigma_2^2}\right) = \int_{F_{0.025}(\nu_1,\nu_2)}^{\frac{1}{F_{0.025}(\nu_2,\nu_1)}} P_f(\nu_1, \nu_2)\left(R'\ \frac{\sigma_2^2}{\sigma_1^2}\right) dR'$$

This integration is shown graphically in Figure 6.

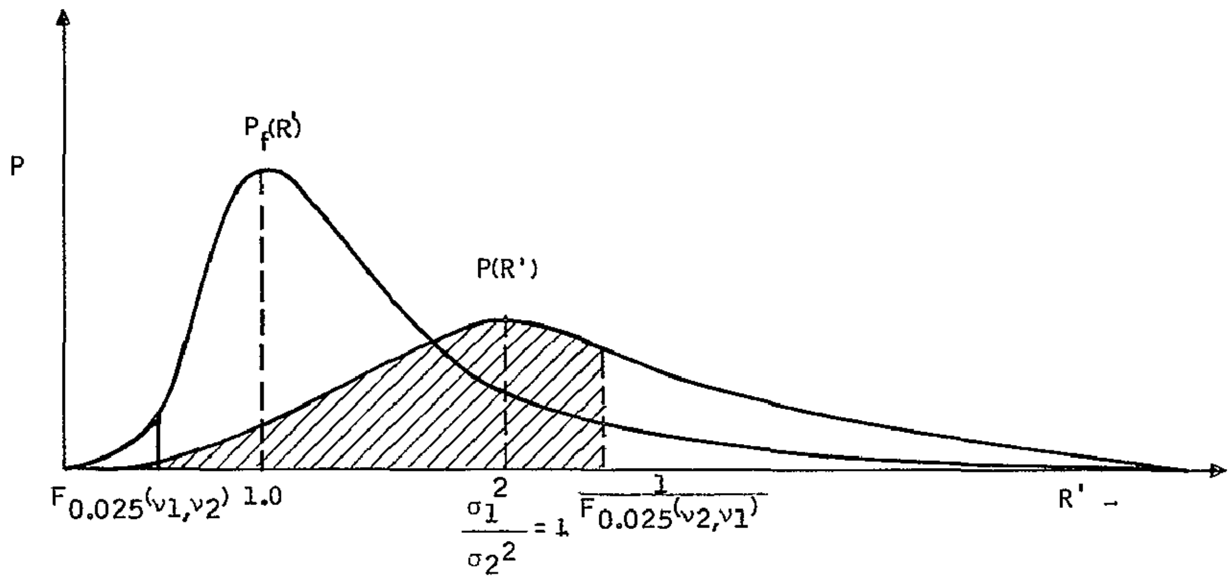

Figure 6. Graphical Representation of β

The characteristics function β reaches a maximum of 0.95 at $\sigma_1^2/\sigma_2^2 = 1$ and approaches zero as σ_1^2/σ_2^2 approaches either zero or infinity. In Figure 7, β is plotted for values of ν_1 and ν_2, β is approximately 0.50 at $\sigma_1^2/\sigma_2^2 = F_{0.025}(\nu_1, \nu_2)$ andat $\sigma_1^2/\sigma_2^2 = 1/F_{0.025}(\nu_2, \nu_1)$. At both

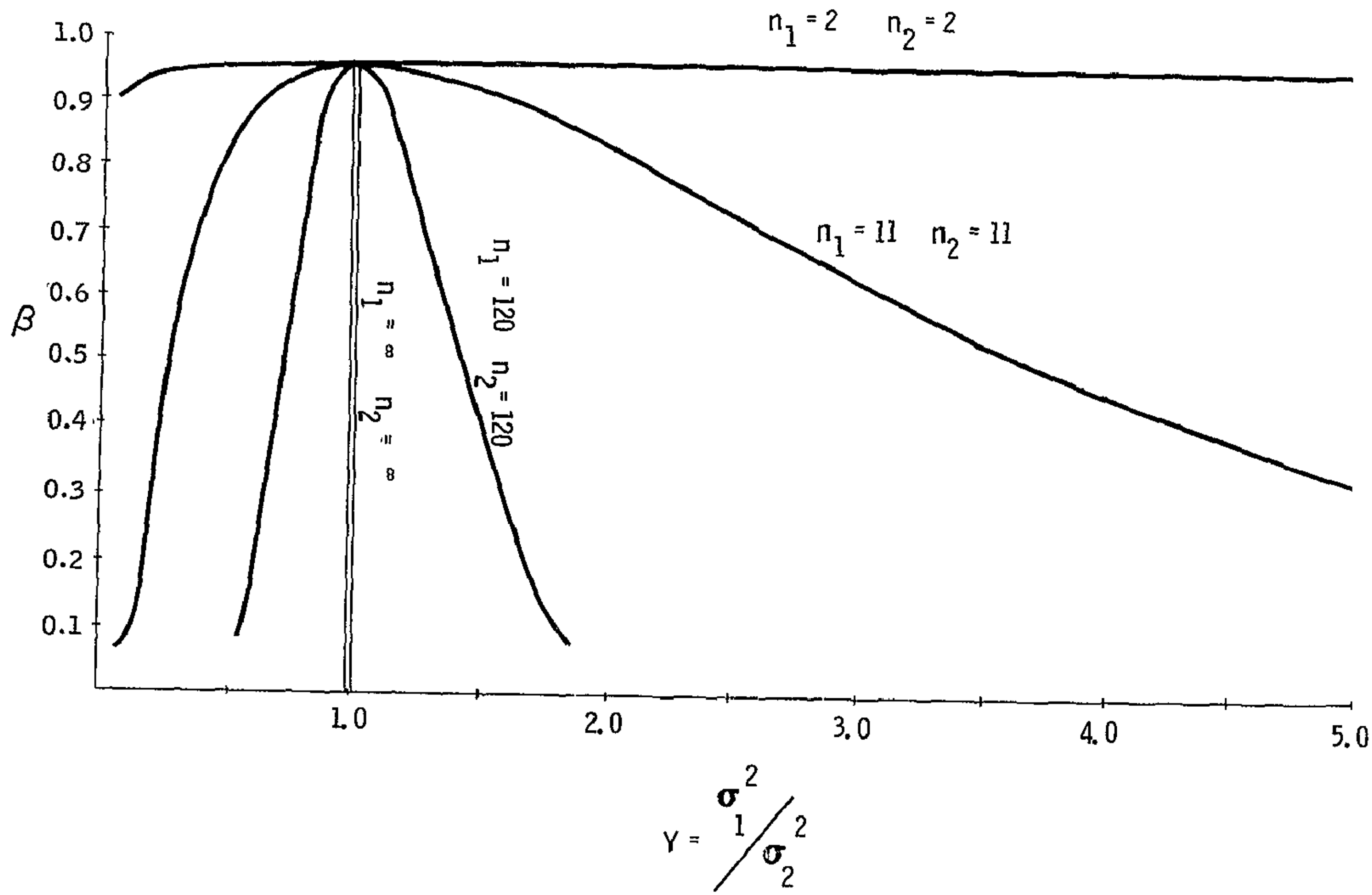

Figure 7. β Characteristic Function for F-test of Equal Variances, 0.05 Significance

$$\frac{\sigma_1^2}{\sigma_2^2} = F_{0.025}(\nu_1, \nu_2)\, F_{0.025}(\nu_2, \nu_1) \text{ and } \frac{\sigma_1^2}{\sigma_2^2} = \frac{1}{F_{0.025}(\nu_1, \nu_2)\, F_{0.025}(\nu_2, \nu_1)},$$

β is approximately 0.025. These approximations are useful in interpretation of the test as follows.

A "Yes" answer to test implies:

$$F_{0.025}(\nu_1, \nu_2) < \frac{\sigma_1^2}{\sigma_2^2} < \frac{1}{F_{0.025}(\nu_2, \nu_1)}$$ more than 50 percent of the time.

$$F_{0.025}(\nu_1, \nu_2)\, F_{0.025}(\nu_2, \nu_1) < \frac{\sigma_1^2}{\sigma_2^2} < \frac{1}{F_{0.025}(\nu_1, \nu_2)\, F_{0.025}(\nu_2, \nu_1)}$$

more than 97.5 percent of the time.

A "No" answer to test implies

$\sigma_1^2 / \sigma_2^2 \neq 1.0$ 95 percent of the time.

$$\frac{\sigma_1^2}{\sigma_2^2} > \frac{1}{F_{0.025}(\nu_2, \nu_1)} \quad \text{or} \quad \frac{\sigma_1^2}{\sigma_2^2} < F_{0.025}(\nu_1, \nu_2)$$ more than 50 percent of the time.

In summary, the F-test for equal variances compares the ratio $R' = S_1^2 / S_2^2$ with its expected range of values on the basis of the sample size. The test answers the question, "Are the variances σ_1^2 and σ_2^2 equal?" with either "Yes it is possible that $\sigma_1^2 = \sigma_2^2$" or "No, it is not probable that variances σ_1^2 and σ_2^2 could be equal." The test makes this judgment on the assumption that both populations are normally distributed. If the answer is no, the probability of being wrong is 0.05, but the probability of getting an incorrect yes answer is

$$\beta\left(\nu_1, \nu_2, \frac{\sigma_1^2}{\sigma_2^2}\right)$$

T-TEST FOR EQUAL MEANS - STATISTICAL BASIS

The T-test for equal means is a method of comparing the means of two populations by statistical inference from the means and variances of samples taken from the two populations. The test assumes that the two populations are normal and that their variances are identical. The validity of the test does not require that the variances of the two samples be identical. The basis of the test is a comparison of the actual difference in sample means with the theoretical distribution of that difference.

The T-distribution with ν degrees of freedom can be defined as that of a random variable symmetrically distributed about zero, whose square is a fraction in which the numerator and denominator are independent chi-square variables of 1 and ν degrees of freedom, respectively.

Let μ_1, μ_2, and σ be the population means and their common variance, and let $\overline{X}_1$, $\overline{X}_2$, S_1, S_2, n_1, and n_2, be the sample means, variances, and sizes, where sample 1 is taken from population 1 and sample 2 is taken from population 2. Then if population 1 and population 2 are normal, the quantities

$$W = \frac{[\overline{X}_1 - \overline{X}_2) - (\mu_1 - \mu_2)]^2}{\sigma^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}, \qquad Q = \frac{n_1 S_1{}^2 + n_2 S_2{}^2}{\sigma^2 (n_1 + n_2 - 2)}$$

are chi-square distributed with 1 and $(n_1 + n_2 - 2)$ degrees of freedom, respectively. Therefore, the quantity,

$$R = \sqrt{\frac{W}{Q}} = [(\overline{X}_1 - \overline{X}_2) - (\mu_1 - \mu_2)] \sqrt{\frac{n_1 n_2 (n_1 + n_2 - 2)}{(n_1 + n_2)(n_1 S_1{}^2 + n_2 S_2{}^2)}}$$

has the T-distribution. The probability function for R is well known and percentiles of the distribution are compiled in many tests. Since we are testing for the equality of μ_1 and μ_2, we will compute R', assuming that $\mu_1 = \mu_2$

$$R' = (\overline{X}_1 - \overline{X}_2)\sqrt{\frac{n_1 n_2 (n_1 + n_2 - 2)}{(n_1 + n_2)(n_1 S_1{}^2 + n_2 S_2{}^2)}}$$

An acceptance region is then established such that if $\mu_1 = \mu_2$; the probability is 0.95 that the value of R' will lie within that region. In other words, the probability of a negative conclusion when $\mu_1 = \mu_2$ is 0.05. This acceptance region is established by the inequality $t_{0.025}(\nu) < R' < t_{0.975}(\nu)$ or equivalently, $|R'| < t_{0.975}(\nu)$, since the distribution is summetric about zero. The acceptance region is shown graphically in Figure 8. In actual usage of the test, the region is expressed as,

$|\overline{X}_1 - \overline{X}_2| <$ LSD, where LSD is called the least significant difference and is defined by

$$\text{LSD} = t_{0.975}(\nu)\sqrt{\frac{(n_1 + n_2)(n_1 S_1^{\ 2} + n_2 S_2^{\ 2})}{n_1 n_2 (n_1 + n_2 - 2)}}$$

where $\nu = n_1 + n_2 - 2$.

The alternative to this hypothesis is $\mu_1 \neq \mu_2$. We would also like to know the probability for R' values within the acceptance region in this case. That is, what is the probability of a positive conclusion when indeed $\mu_1 \neq \mu_2$.

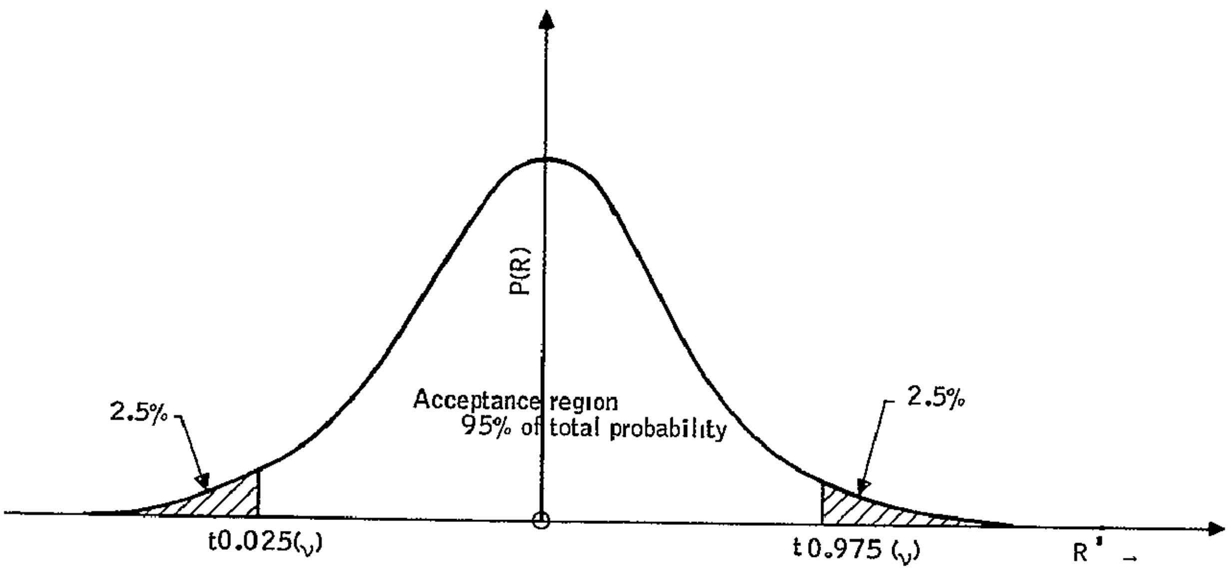

Figure 8. Probability Distribution of R

Recall that we calculated the value for R' on the assumption that $\mu_1 = \mu_2$. If the population means actually differ by an amount $\Delta\mu = |\mu_1 - \mu_2|$, then the probability function for R' will be shifted relative to that for R by an amount

$$Z = \Delta\mu \sqrt{\frac{n_1 n_2 (n_1 + n_2 - 2)}{(n_1 + n_2)(n_1 S_1^2 + n_2 S_2^2)}}$$

Using this shifted R' distribution, we can then compute the operating characteristic $\beta(\nu, Z)$, which is the probability that the value of R' lies in the acceptance region.

$$\beta(\nu, Z) = \int_{t_{0.025}(\nu)}^{t_{0.975}(\nu)} P_t(\nu, R-Z)\, dR$$

where $P_t(\nu, R)$ is the probability function for the T-distribution. This is shown graphically in Figure 9.

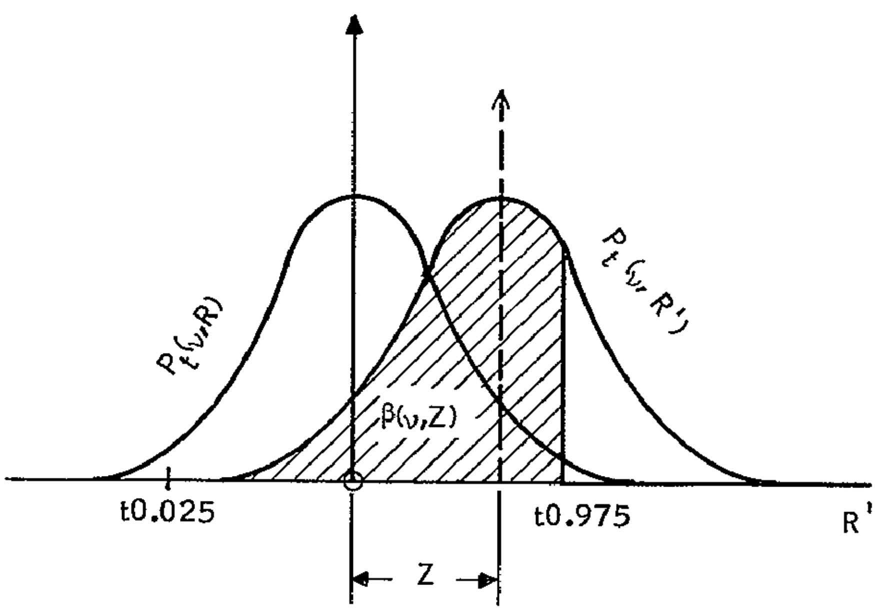

Figure 9. Graphical Representation of $\beta(\upsilon, R')$

The operating characteristic $\beta(\nu, Z)$ for the T-test is plotted for a few values of ν in Figure 10, β is approximately 0.50 at $Z = t(\nu)$ and approximately 0.025 at $Z = 2 \times t_{0.975}(\nu)$. Since $Z = t_{0.975}(\nu)$, 0.975 is equivalent to $\Delta\mu$ = LSD, we can interpret the results of the test as follows

A "Yes" answer to test:

		More than
$\lvert\bar{X}_1 - \bar{X}_2\rvert$ < LSD implies	$\Delta\mu$ < LSD	50 percent confidence
	or	
	$\Delta\mu$ < 2 LSD	97.5 percent confidence

A "No" answer to test:

		More than
$\lvert\bar{X}_1 - \bar{X}_2\rvert$ > LSD implies	$\Delta\mu > 0$	95 percent confidence
	or	
	$\Delta\mu$ > LSD	50 percent confidence

In summary, the T test for equal means compares the difference $\lvert\bar{X}_1 - \bar{X}_2\rvert$ with an expected maximum difference, LSD, which is adjusted according to the sample sizes.

The test answers the question, "Are the means μ_1, and μ_2 equal? with either "Yes, it is possible that means μ_1, and μ_2, are equal" or "No, it is not probable that means μ_1 and μ_2 are equal. The test makes this judgment on the assumption that the populations both have the same variance and are normal. If the answer is no, the probability of being incorrect is 0.05, but the probability of getting an incorrect yes answer is $\beta(\nu, Z)$.

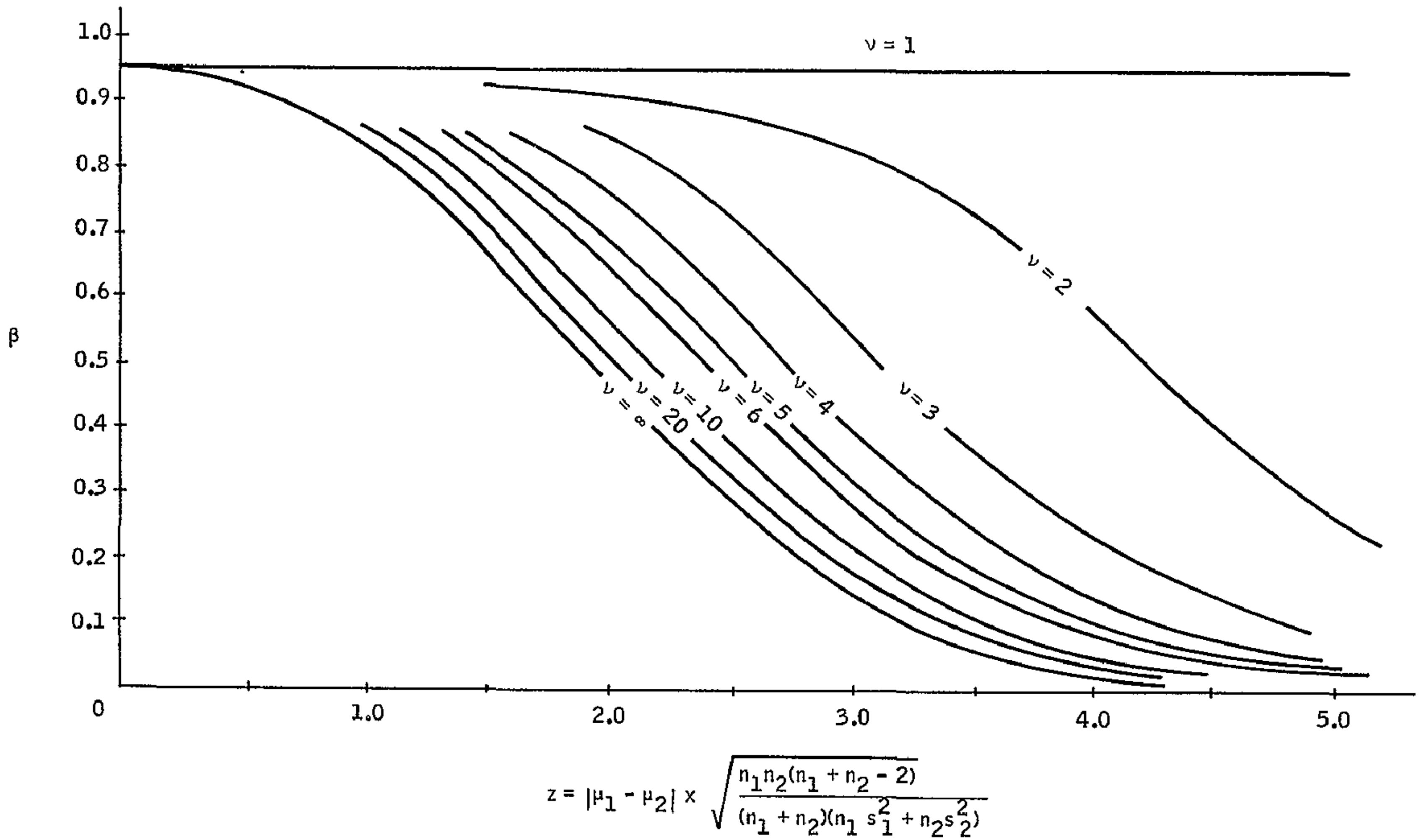

Figure 10. β Characteristic Function for F-Test of Equal Means, 0.05 Significance

DATA ANALYSIS

As discussed previously, this study was conducted to substantiate and extend the results of the previous Horizon Definition Study. This study extends the meteorological data base from a one-year (1964) to a full three-year period (1964, 1965, and 1966). Analyses of these data then permit a more accurate determination of deterministic variations occurring with a period longer than one year. Also, by comparing results derived from interpolated meteorological data with actual MRN rocketsonde data, the effects of synoptic interpolation may be better understood. Appendix C is a listing of all located horizon altitude data used in this study. Reference will be made in later discussions to individually located altitudes that are thought to be either representative or erroneous data.

ARE THERE VARIATIONS IN THE LOCATED HORIZON FROM YEAR TO YEAR?

To examine in detail the year-to-year variations in the infrared horizon, locator L1 (3.0) was chosen for this study because of its inherent susceptibility to temperature changes in the stratosphere (ref. 17). The results obtained will be shown to be in close agreement with a similar study, which had different objectives, performed by Keith W. Johnson and Melvyn E. Gelman and published in June 1968 (ref. 19). It will also be shown that the variations in the infrared horizon, indicated by this study, relate to observed meteorological phenomena.

The results of the statistical tests for the standard deviations for the three years' studies are presented in Figure 11. The key, as indicated on the figure, allows an evaluation of the statistical tests for all locators, at all latitude bands for each period studied. However, the detailed analysis will be focused on L1 (3.0); thus, the presentation for the statistical test for equal means is limited to that locator. For information purposes, the plots of mean and standard deviation for L4 (2.5) are shown in Appendix D.

The results of this portion of the study will be discussed separately for each of the latitude bands and for the standard deviations and means in each band.

Latitude Band - -55° N to 80° N

<u>Standard deviations</u>.--Referring to the L1 (3.0) data in Figure 11, it is apparent that the hypothesis of equal standard deviations from year to year is rejected in only two instances--August of 1965 versus August of 1966 and December of 1964 versus December of 1965. As discussed in the previous section, comparisons between actual and interpolated data were not made in

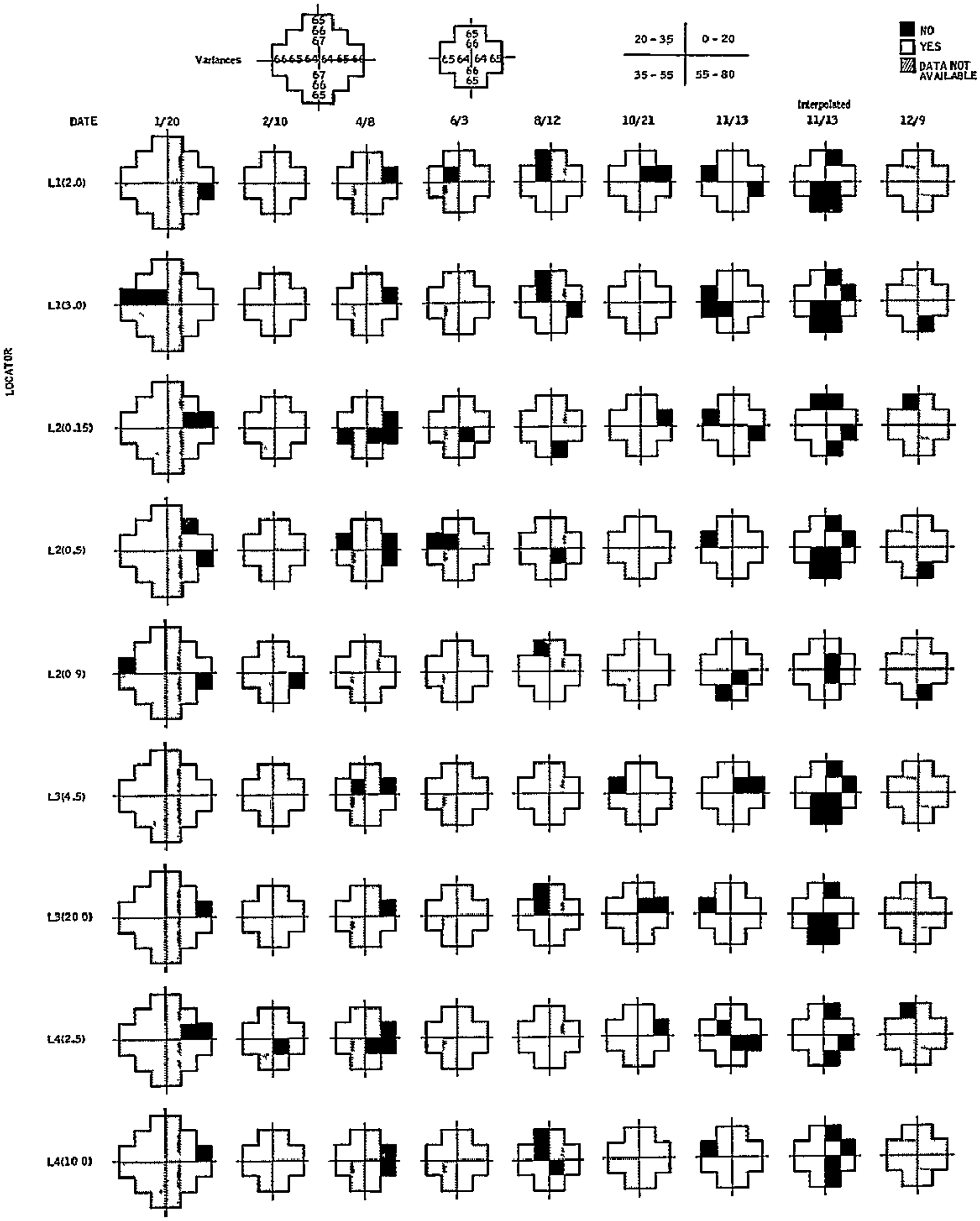

Figure 11. Statistical Test Results for Equal Variances

analyzing year-to-year variations. Therefore, the statistical data shown in Figure 11 for the November interpolated data are discussed later.

In Figure 12, the difference between the standard deviations for December 1964 and December 1965 is approximately 1.5 km. All data for the December 1964 analysis were taken from Fort Churchill and, with the exception of a single sample from Fort Greely, all December 1965 data were also from Fort Churchill. A study by Johnson and Gelman (ref. 18) shows that the months of November and December 1964 were periods of high stratospheric activity over the Fort Churchill area. This activity is shown in Figure 13, reprinted from ref. 18. Figure 13 shows that the temperature standard deviation for the 10 mb level in December 1964 was between 6° C and 7° C, whereas in 1965 it was approximately 4° C. Reference to Figure 15 indicates that the located altitude for L1 (3.0) in the November-December time is located at about the altitude of the 10 mb point (approximately 30 km).

The disagreement in standard deviation for August 1965 versus 1966, as shown in Figure 12, is attributed to the effects of longitudinal variation which were not taken into account in this study. The August samples for 1965 were totally from Fort Churchill and Fort Greely, but the samples for 1966 were limited to four from Fort Churchill and three from Thule. Again referring to Figure 13, the rapid rise in standard deviation beginning in August of 1966 can be seen at Thule, reaching a peak of about 5° C. In 1965, the low deviation of approximately 2° C at Fort Churchill can be seen as compared with approximately 4° C at Thule for the same period.

In general, the standard deviations for the three years sampled show close similarity from year to year. The effects of seasonal atmospheric activity at these northern latitudes are also evident as the standard deviation for L1 (3.0) increases from approximately 1 km in the summer months to as high as 4 km in the autumn changeover period.

Mean located altitude. --Although the standard deviations of the located altitudes during the sample periods seem to agree from year to year, relatively large differences occur when comparing the means. Figure 14 shows the statistical comparison of the located altitude mean for the space-time cells for L1 (3.0) only. Inequalities in the means occur in the months of January, April, August, October, and November.

It should also be remembered that the inequality of the standard deviations for the months of August and December invalidated the statistical tests for the means of those months (August 1965-1966 and December 1964-1965). All sample data for this study for the December 1964 and December 1965 months, except in a single sample from Fort Greely in December 1965, were taken from Fort Churchill. Later in this discussion, it will be shown that the means for these two months are indeed different. For the August data, the data sample for 1965 is taken from Fort Churchill and Fort Greely, and for 1966 the data sample is taken from Fort Churchill and Thule. The most probable cause of the August inequalities is the effects of longitudinal weighting.

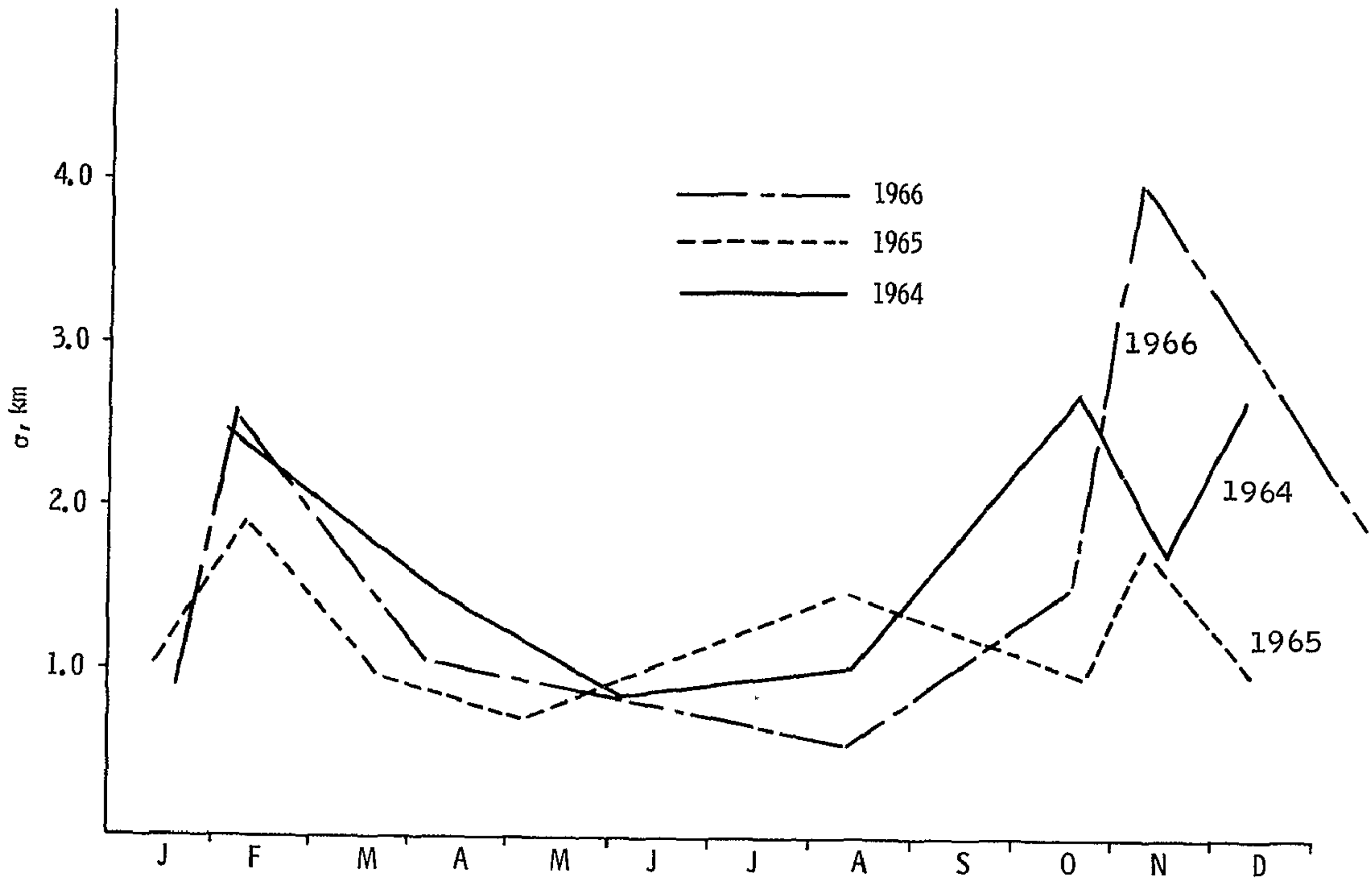

Figure 12. Standard Deviation for L1(3.0), Latitude Band 55°N to 80°N

a) 10-mb height b) 10-mb temperature

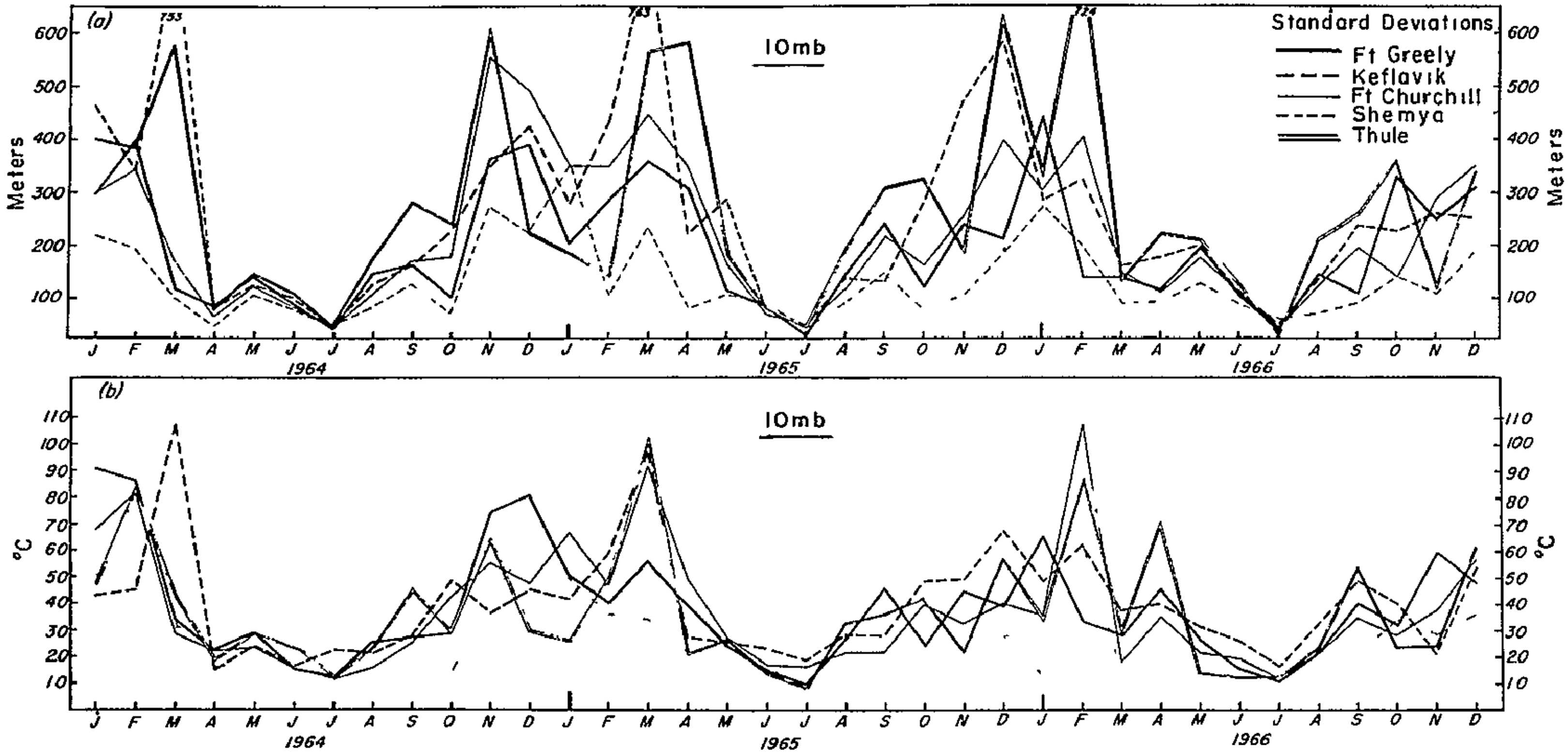

Figure 13. Standard Deviations at Stations Along High Altitude East-West Section, 10 mb height, 10 mb temperature (Ref. 18)

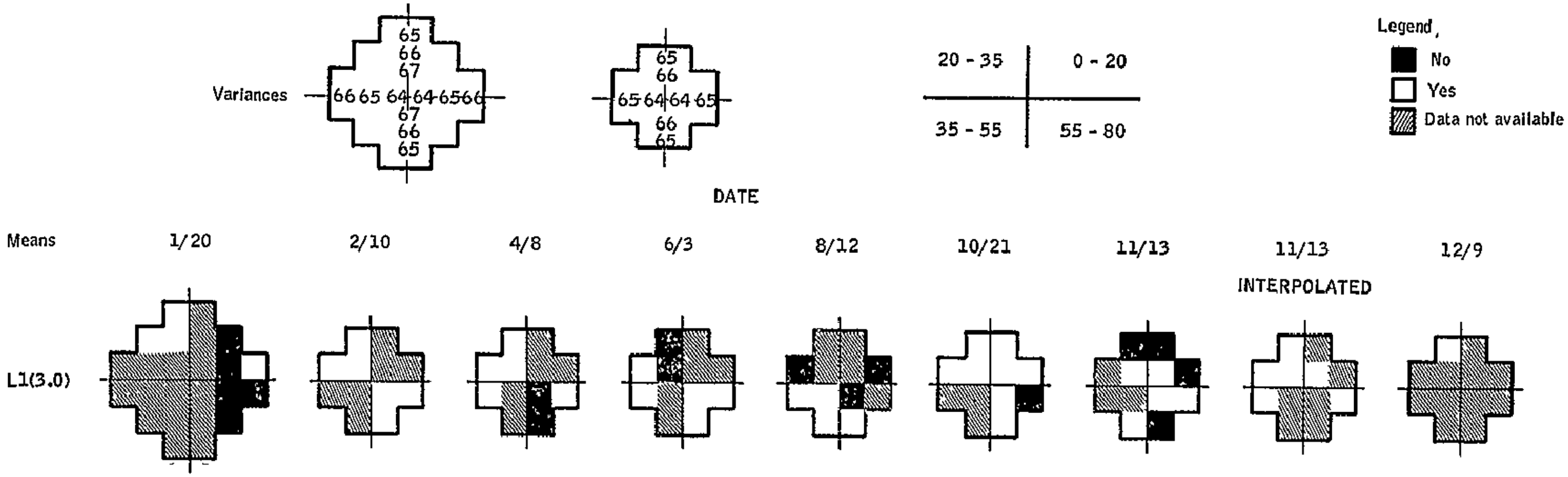

Figure 14. Statistical Test Results for Equal Means

Prior to examining the details of the variations in the mean located infrared horizon altitudes, a brief discussion of the atmospheric phenomena studied by Johnson and Gelman (ref. 18) will be presented. Because of the sensitivity of L1 (3.0) to the atmospheric variations at altitudes close to the 10 mb level, the Johnson and Gelman data lend insight into the variations in mean altitudes noted above. Johnson and Gelman, on a daily basis, evaluated the range of altitudes and temperatures associated with constant pressures of 50 mb and 10 mb for 1964, 1965, and 1966. Also, weekly values for 5 mb, 2 mb, and 0.5 mb altitudes and temperatures were analyzed for 1965 and 1966.

The conclusions of Johnson and Gelman show that, in the winter months in the high latitudes, sudden warmings of both major and minor proportions vary from year to year. The differences in height and temperature between all years studied occurred in the period from January to April. An example was given showing a difference in altitude and temperature of the 10 mb level of 2.7 km and 15°C between 1 April 1964 and 1 April 1967. The periods of high stratospheric activity during the study were found to be November 1964, December 1965, and February 1966. These conclusions will be examined in greater detail in the following discussions.

Figure 15 is a plot of the mean located altitude of L1 (3.0) for 1964, 1965, and 1966, and January 1967. The effects of midwinter warmings can clearly be seem when comparing January of 1967 with the years of 1966 and 1965. Although no reference was found in a literature search to a major warming in the stratosphere for 1967, it is believed that this difference in the infrared horizon (approximately 8.5 km between 1966 and 1967) was due to an event similar to that shown in Figure 16 (ref. 18), that occurred during January 1963. As can be seen from the figure, the temperature rose approximately 60°C at the 10 mb level. This is supported in ref. 19 which Winkler reports common average daily temperature levels over the United States of 16°C above normal for January of 1967, albeit at the 700 mb level.

The irregularity in the spring transition mentioned above can be seen in the shapes of the curves in both Figure 15 and Figure 16. Close agreement of the data shown in Figure 15 is believed to be coincidental because of the available data used in the study, since during these periods there are phenomena occurring that do not necessarily repeat from year to year, or even from one reporting station to another within the same year. For example, the spring "overshoot" reported in references 18 and 20, during which temperatures in the stratosphere rose in March to a higher level than was reached during the remainder of the summer, was not observed in this study because of the limited sample data available. This overshoot is shown in Figure 17 (from ref. 18). The overshoot occurred at Fort Churchill in March 1965 at the 10 mb level. The maximum temperature of the year was -29°C.

As mentioned earlier, the effects of the warming in November of 1964 and subsequent sudden cooling and the warming in December of 1965 are apparent in Figures 15 and 17. The warming of November 1964 produced a difference of about 4.5 km, between 1964 and 1965, in the located altitude.

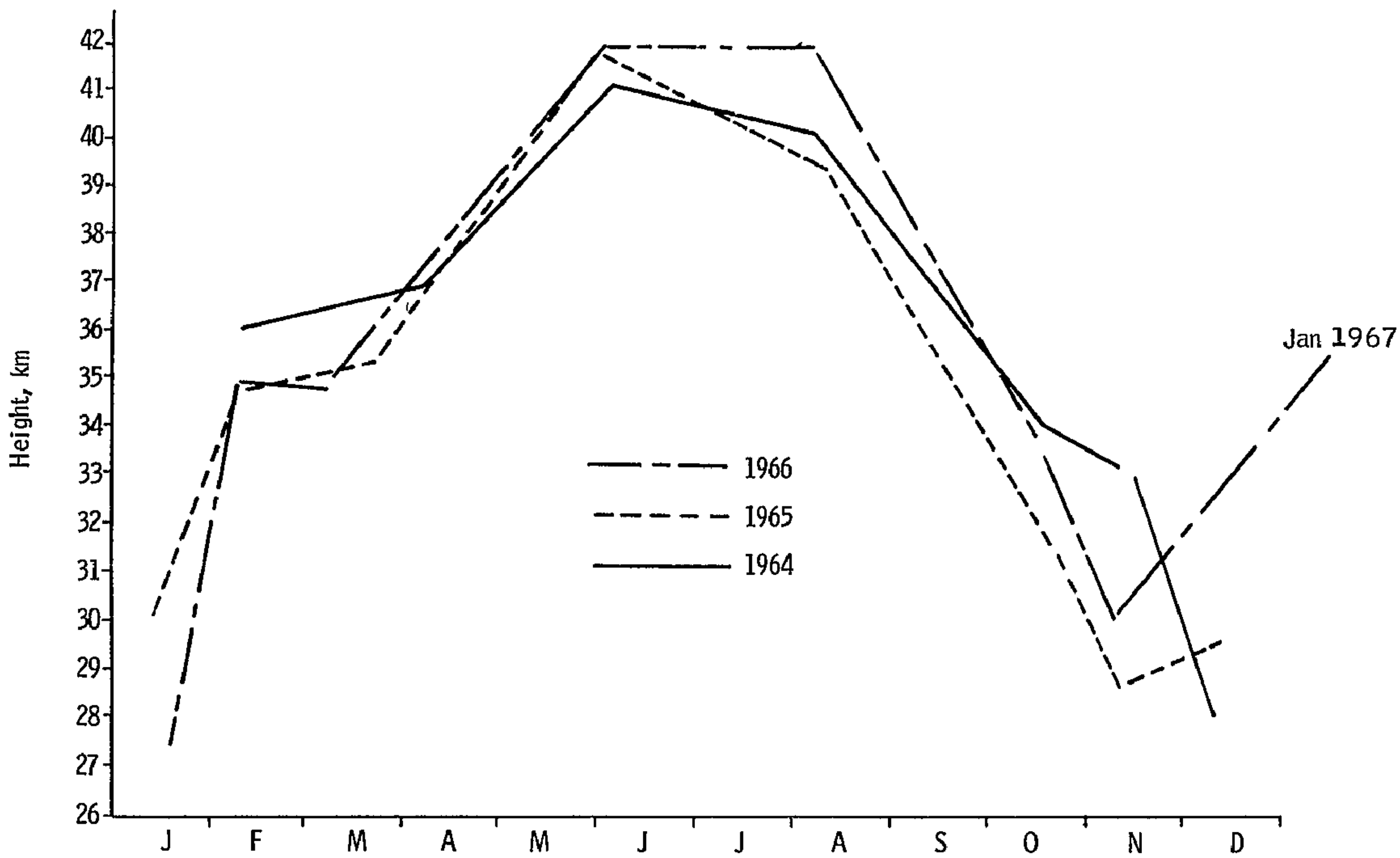

Figure 15. Locator L1(3.0) Means, MRN Data, Latitude Band 55°N to 80°N

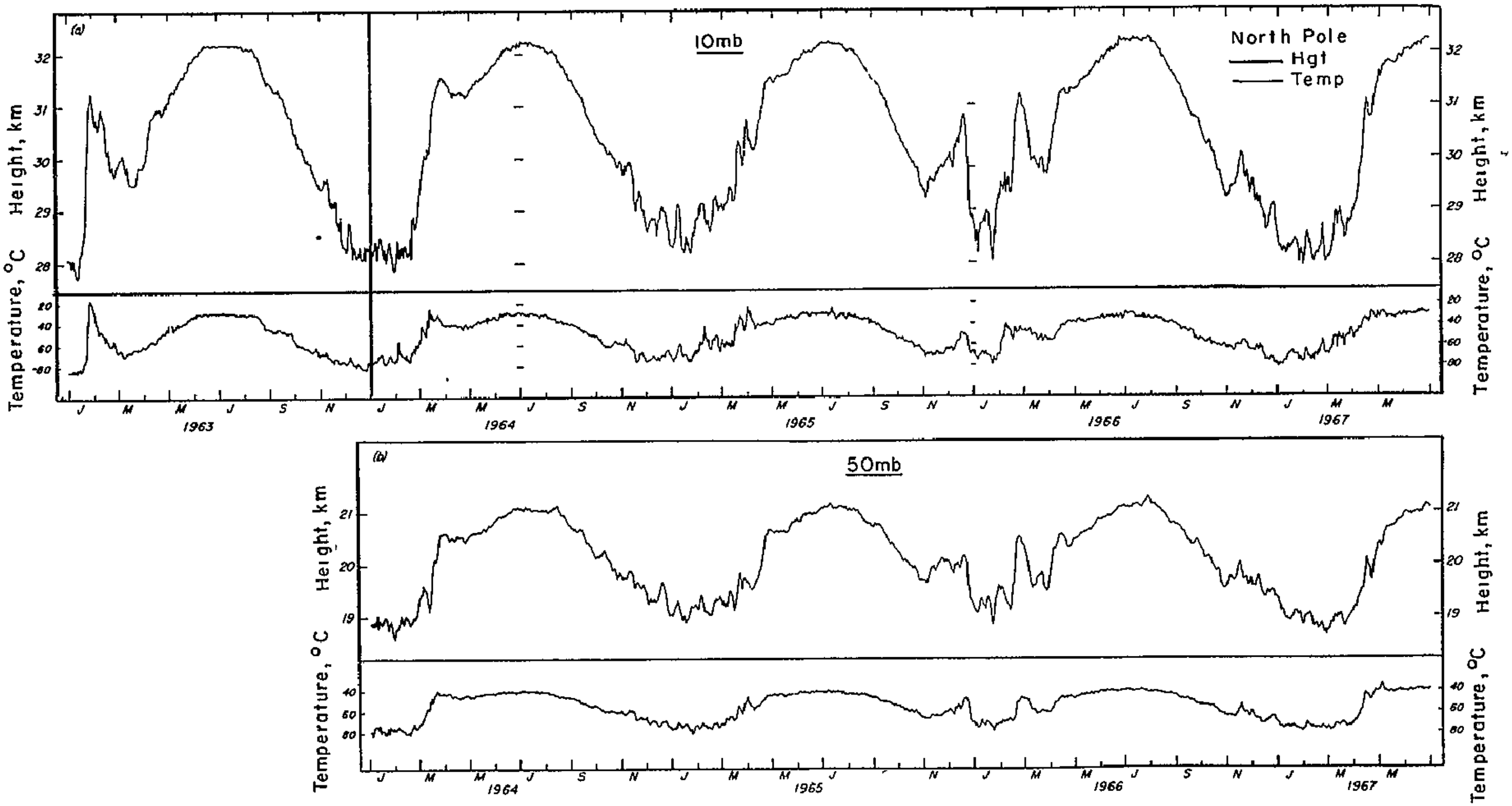

Figure 16. Time Sections of Height and Temperature at the North Pole, 10 mb Level (Ref. 18)

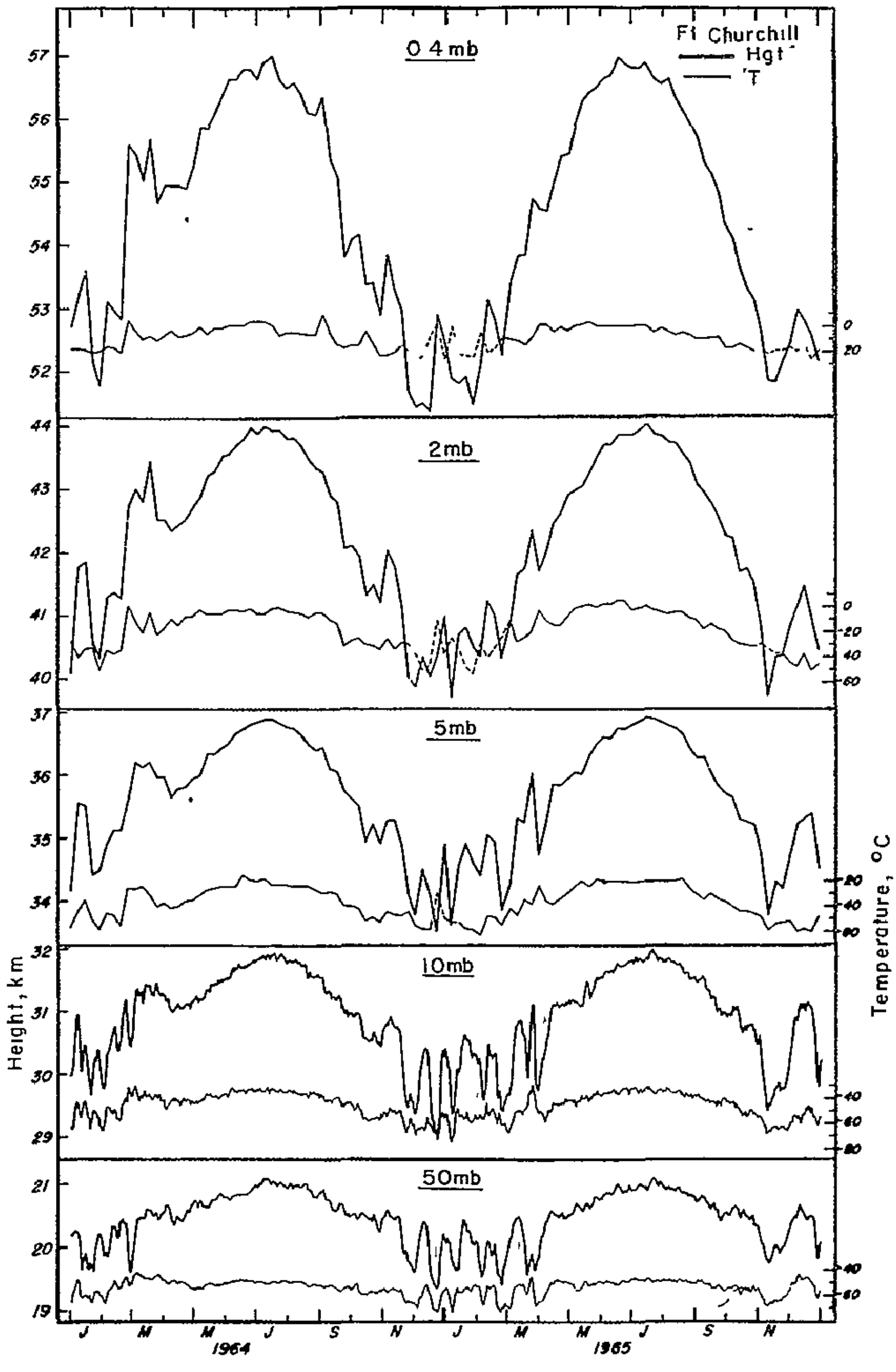

Figure 17. Time Sections of Height and Temperature at Churchill, Canada, 0.4, 2, 5, 10, and 50 mb levels (Ref. 18)

Each of the instances of inequality in the located altitude standard deviation comparison can be interpreted to be caused by meteorological activity occurring in one of the space-time cells. These local phenomena can be expected to show variations from year to year in the data in the high latitude regions, 55° N to 80° N. However, the magnitudes of these variations are shown in Figure 15 to be small with respect to the approximately 15 km seasonal variation. The one exception of January 1967 produces a year-to-year variation of over 50 percent of the seasonal variation.

35° N to 55° N

Standard deviations.--From Figure 18, the standard deviations in located altitude for L1 (3.0) are different at the 95 percent confidence level only in November. As indicated in Appendix A, all of the data in this latitude band are from Wallops Island. The two data samples, taken one week apart from this station in November 1966, show a standard deviation of only 0.015 km. This is not representative of the true variations at this station in November, as is shown by the larger standard deviations, and agreement, evidenced in November 1964 and November 1965. This low standard deviation is a result of the very small sample and of the meteorological similarity of the data.

Figure 18 graphically presents the standard deviations in located altitudes for L1 (3.0) for this latitude band. All of the standard deviations are seen to be less than 2 km.

Means of located altitude.--Figures 14 and 19 show the stability of the infrared horizon from year to year according to the samples available in the 35° N to 55° N latitude band. Note that no samples were available for February 1965, therefore, no true comparison can be made in Figure 19 between Februaries in the sample years.

Again, all data available for this latitude band were taken from Wallops Island, which is at 38° N latitude and which is probably not representative of the 35° N to 55° N latitude band in total. As indicated in ref. 18, a warm band exists at 30° N in the stratosphere and, hence, creates a stability near that latitude which is not typical of the entire 20° of latitude in this 35° N to 55° N band.

The warming in January 1967 is again quite obvious.

Although only two points were available for 1964, it can be seen that the mean located horizon for the samples were the same from year to year except for the isolated warming in January 1967, which is 2.5 km higher than in 1966. Compared with the seasonal variation, this is again greater than 50 percent of the total--2.5 km versus a seasonal variation of 4.5 km.

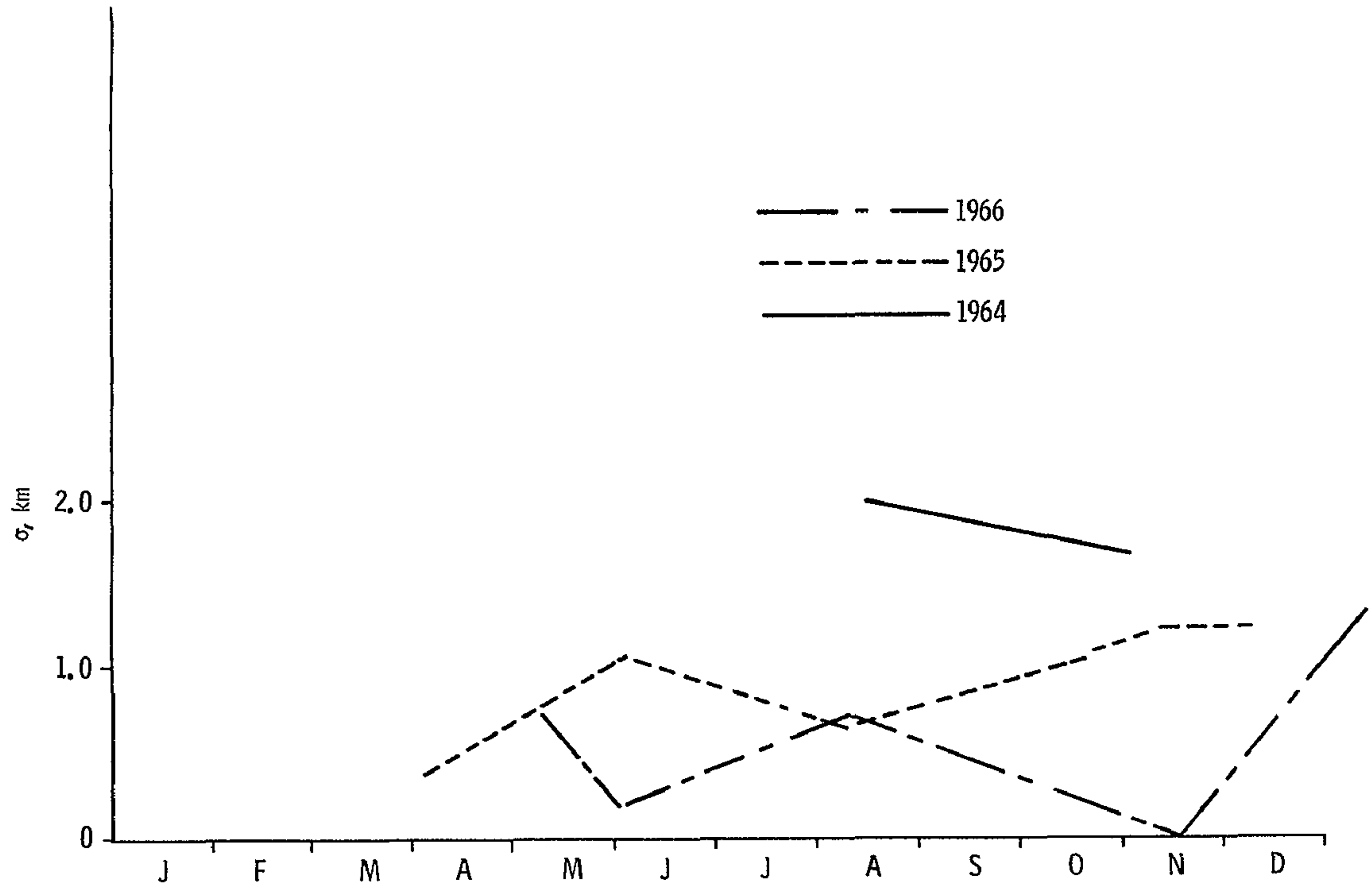

Figure 18. Standard Deviations for L1(3.0), MRN Data, Latitude Band 35°N to 55°N

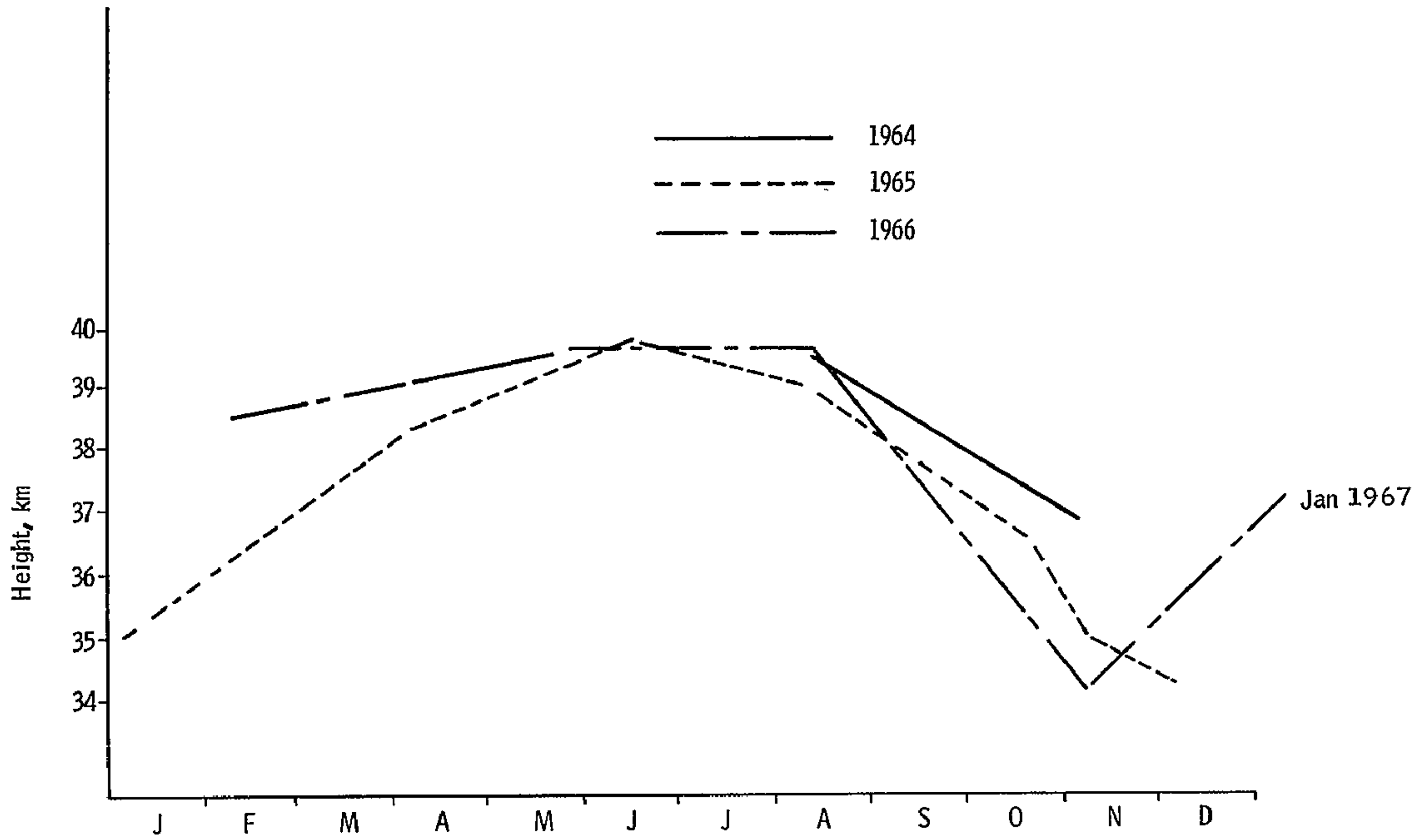

Figure 19. Locator L1(3.0) Means, MRN Data, Latitude Band 35°N to 55°N

20° N to 35° N

Standard Deviations. --Figures 11 and 20 show the three-year sample period standard deviations for the 20° N to 35° N latitude band, again for L1 (3. 0). From Figure 11, the statistical test for equal variances in the space-time cells indicates inequalities when comparing January 1967 with January in 1964, 1964, and 1966, August 1964 with August 1965 and 1966, and November 1965 with November 1966.

Except for the August comparison, Figure 20 shows that the standard deviations are within 1 km on a comparative basis. In analyzing the conditions on the August sample dates, no meteorological phenomena were found that would cause such a high standard deviation in August 1964. However, of the five data samples for that date (reference Appendix A), two of the Point Mugu profiles exhibited extremely high-temperature regions in the upper stratosphere, causing the located altitude for those cases to be approximately 4 km higher than any other observed.

No reason could be found to a priori exclude these rocketsonde data from the sample set; therefore, the standard deviation for August 1964 must be considered in light of these data. The influence of either instrument error or data handling techniques for the raw meteorological data possibly caused this anomaly.

The inequality in standard deviations for the January comparison is illustrated in Figure 20. Standard deviations for January 1964, 1965, and 1966 compare; however the standard deviation for January 1967 is lower. After examining the sample data, Januaries for 1964, 1965, and 1966 indicate longitudinal effects when the sample data are grouped according to station. The standard deviation of each of the stations being smaller than the standard deviation of the stations as representing the latitude band, the mean located altitude for the station-to-station analysis indicates longitudinal effects.

January 1967 data exhibited the same station-to-station standard deviation magnitudes, but indicated a weakening of the longitudinal gradients. The mean indicated altitude of the Cape Kennedy data fell to approximately the same value at those of Point Mugu and White Sands. As discussed earlier, no detailed information could be found concerning the lower stratospheric temperatures over the North American continent for January 1967; however, the effect of this is evidenced in the data in this study. With the weakening of longitudinal gradients in January 1967 came the reduction in standard deviation for the latitude band, as indicated in Figure 20.

For the standard deviation inequality indicated in Figure 11 for November 1965 to 1966, examination of the located altitude data again indicates a strong longitudinal gradient existing for November 1966. The data from Point Mugu and for White Sands indicate a low standard deviation with a definite reduction in the located altitude for those stations. The attendant increase in standard deviation results from this gradient.

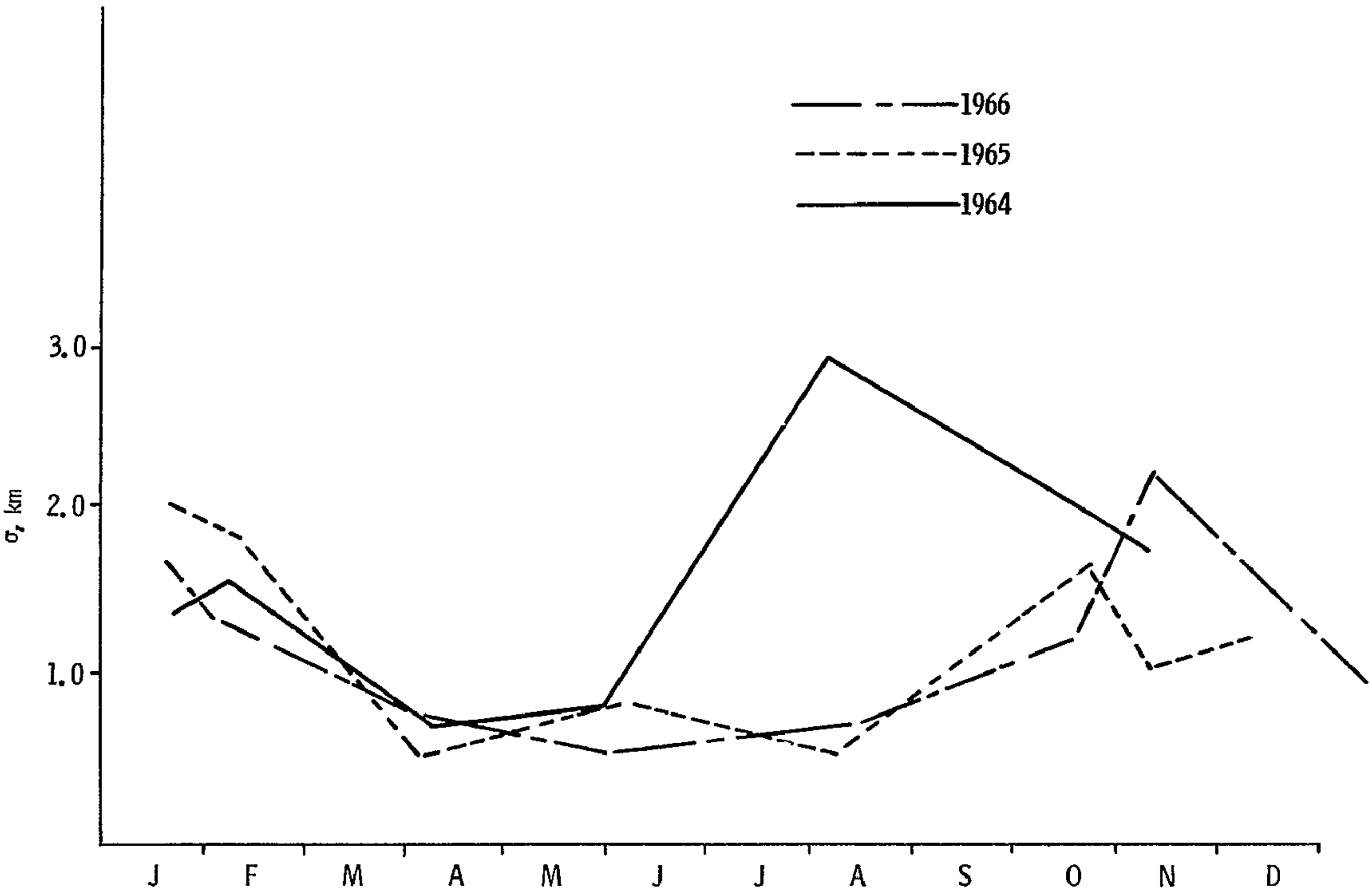

Figure 20. Standard Deviation for L1(3.0) MRN Data,
Latitude Band 20°N to 35°N

Mean located altitude. --Figures 14 and 21 show the results of the statistical tests for mean located altitudes and the mean located altitudes for the space-time cells in the study sample. The "no" comparison answers in Figure 14 for January, August, and November comparisons were briefly discussed in the previous section. Figure 21 graphically illustrates the increase and decrease of the mean located altitude for the latitude band caused by the station-to-station gradients existing.

In the comparison of June 1964 with June 1965 and June 1966, the data show that the western half of the latitude band (i.e., Point Mugu and White Sands) had a cooler stratosphere than was evidenced in these locations in June 1965 and June 1966. The data from the three June periods compare well at the Cape Kennedy and Grand Turk stations. Comparison of the White Sands and Point Mugu data between June 1965 and June 1966 also shows very close agreement. However, as indicated, the June 1964 data in the western regions show a decrease in the located altitude mean of approximately 1 km to 1.5 km.

The seasonal variations in this latitude band are again dominant, with this change being approximately 4 km and with the maximum difference in the means for any single temporal comparison being less than 2 km.

Latitude Band 0° N to 20° N

Standard deviations. --Only a single MRN station was available for the 0° N to 20° N latitude band, Antigua at 17° N. A plot of the standard deviations is shown in Figure 22. Only two sample data points were available from Antigua in 1966--in October and in November.

The standard deviations are quite low, less than 1 km, for all points in Figure 22, except for the April 1965 case. Reference to Figure 11 shows the inequality in standard deviations for the April 1965 to April 1966 comparison. Analyzing the individual data samples for these two space-time cells shows a single located altitude in April 1965, out of the four samples, that has a value approximately 4 km higher than the others in either April 1965 or April 1966. The other eight samples in these cases show an extremely low standard deviation.

It must be concluded that this anomaly is caused either by an instrument error when taking the meteorological data or by a short-term meteorological change. The available data samples on either side of this sample do not show this anomalous effect.

Mean located altitude. --Figures 14 and 23 present the statistical comparison of the located altitude means for each space-time cell and, graphically, the located means, respectively. Figure 14 shows that the tests for equal means of the sample data fail when comparing (1) January 1965 with either January 1966 or January 1967, (2) August 1965 with August 1966, and (3) November 1965 with either November of 1964 or 1966.

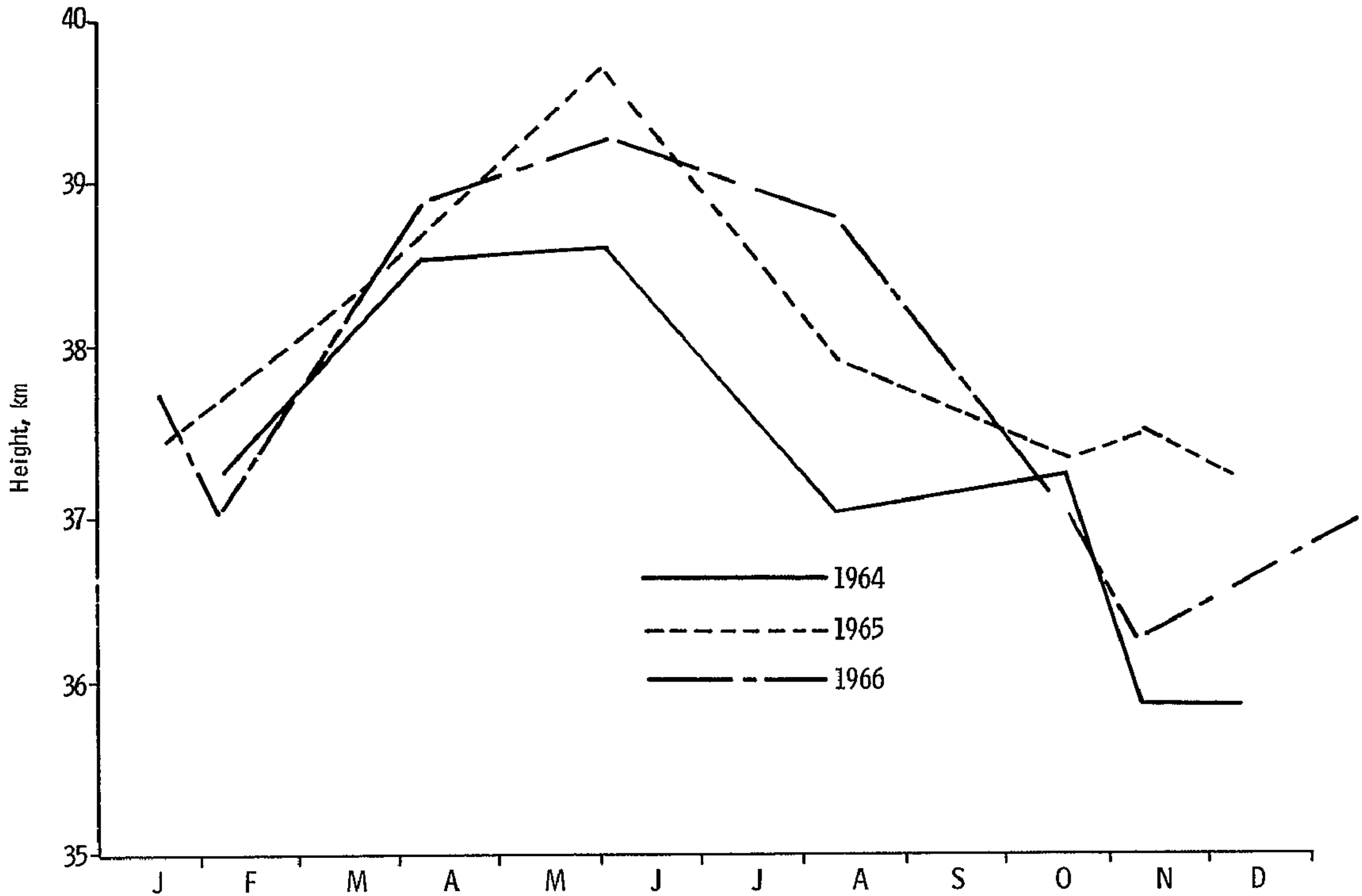

Figure 21 Locator L1(3.0) Means, MRN Data, 20°N to 35°N

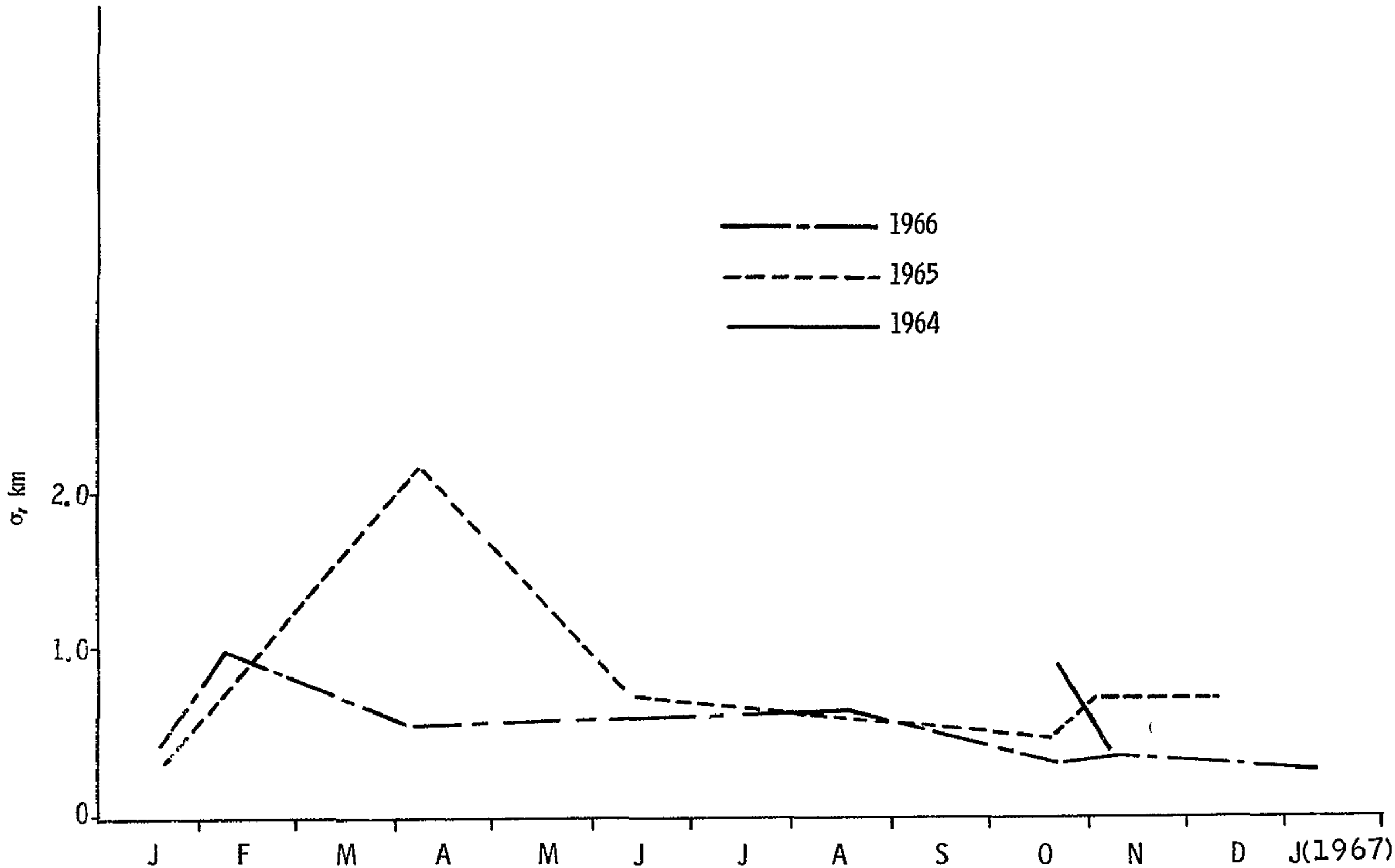

Figure 22. Standard Deviation for L1(3 0) MRN Data, Latitude Band 0° to 20°N

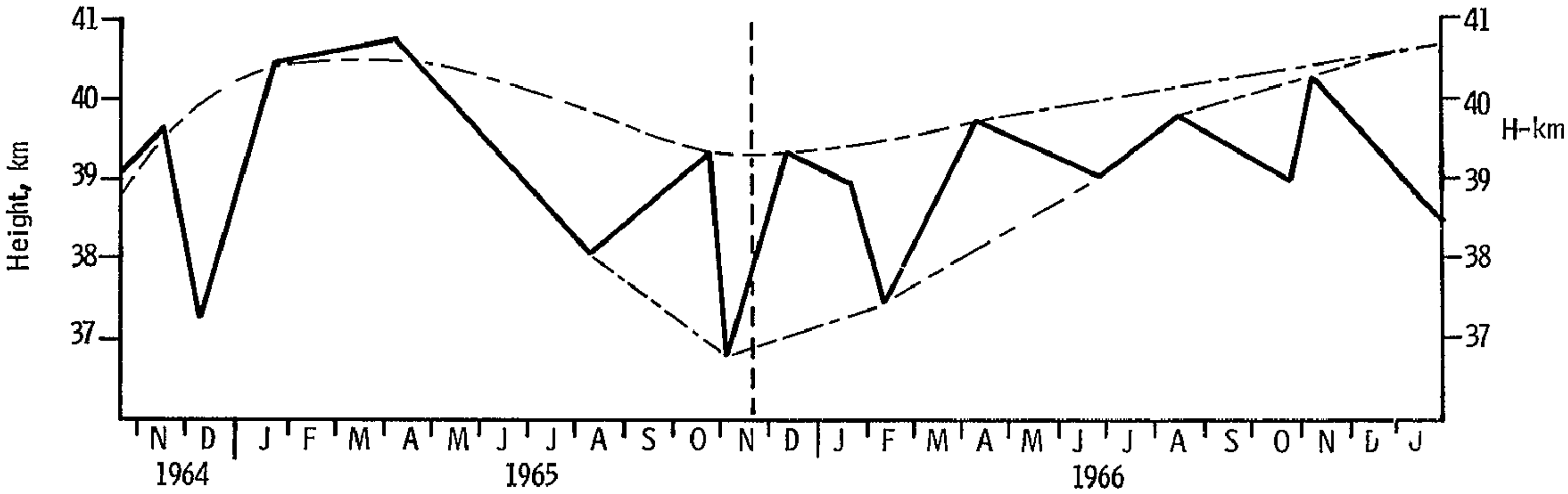

Figure 23. Locator L1(3 0) Means, MRN Data, Latitude Band 0°N to 20°N

Figure 22 showed the extremely low standard deviations occurring in all Januaries sampled, with Figure 23 showing the higher mean located altitude in January 1964. Available data samples taken over a three-day period during this month show a mean located altitude 1 km to 1.5 km higher than either of the other two Januaries. This indicates that meteorological changes rather than measurement instrument errors produced this effect.

A similar effect is noted for the August space-cell comparison. The sample data available indicate a definite shift in the located altitude means between August 1965 and 1966.

The November 1965 comparison with November 1964 and 1966 again exhibits the same phenomenon, a reduction in the located altitude mean for November 1965. On the basis that there are at least two samples per space-time cell, an atmospheric change between the cells is indicated.

In Figure 23, dashed lines were drawn to indicate a possible curve fitting of the points of located altitude means. Taking the extreme points on these curves, the means of the samples have a 4 km peak-to-peak variation. The dominent effect of seasonal variations, as indicated in the 20° N to 35° N, 35° N to 55° N, and 55° N to 80° N latitude band, is not evidenced in this 0° N to 20° N band.

Although sufficient data are not available to be conclusive, it is postulated that the located altitudes of the infrared horizon profiles vary such that the effects of the quasi-biennial cycle in the tropics is evidenced. This phenomenon has long been under study by atmospheric scientists and was referenced in the Horizon Definition Study (ref. 21). The temperature structure of the quasi-biennial cycle, as observed by R. J. Reed (ref. 22) and used by Kaichi Maeda (ref. 23), is presented in Figure 24.

The similarity of the possible curve fits to the data shown in Figure 23 with the data in Figure 24 strongly indicates the effect of this 26-month cycle on the sample data in the 0°N to 20°N latitude band.

DOES INTERPOLATION OF TEMPERATURE DATA INTRODUCE ARTIFICIAL VARIATIONS IN LOCATED ALTITUDE STATISTICS?

To determine whether synoptic mapping interpolation has any effect on the statistics of located horizon altitudes, profiles were generated for 1964 from actual MRN data coincident with the dates used previously in the Horizon Definition Study. Also, new synoptic data were created for November 1965 and November 1966 to compare interpolated and MRN data over these space-time cells.

Meaningful statistical comparisons of the actual versus interpolated data were limited to the 20° N to 35° N and 55° N to 80° N latitude bands because of

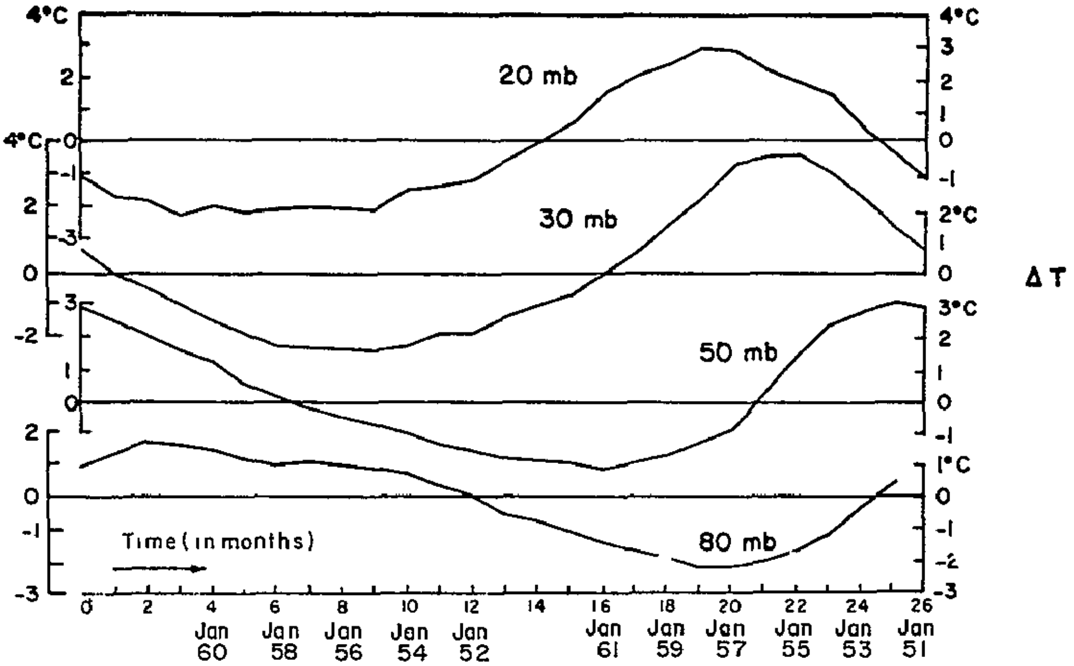

Figure 24. 26-Month Variations of Stratospheric Temperature in Tropical Regions (Ref. 23)

insufficient data being available for the other bands. These data are shown in Figures 25 through 28. All of the statistical data comparisons for the space-time cells are shown in Figure 29.

In the 55° N to 80° N latitude band, Figure 29 shows that standard deviations between the MRN and interpolated data are unequal in the months of June and November 1964 and in January 1965. In all cases of comparing interpolated data with real MRN data in this latitude band, 18 samples from the interpolated data were used. In contrast to this, the available data (Appendix A) ranged from a minimum of three samples to a maximum of only seven samples. As described in the section on statistical tests, the comparison of standard deviations is sample size-dependent and is therefore extremely difficult to interpret intuitively.

In general, however, in the 55° N to 85° N latitude band, the agreement in the shapes of the curves is quite good, the major apparent disagreement being in October 1964. The MRN data showed a 1.5 km higher standard deviation than did the interpolated data. This type of disagreement could be expected as a result of the local character of the MRN samples as opposed to the generalized coverage of the full latitude band of the interpolated data. Longitudinal averaging of the band will be discussed further in the detailed comparison of the MRN versus interpolated data for November 1964, 1965, and 1966.

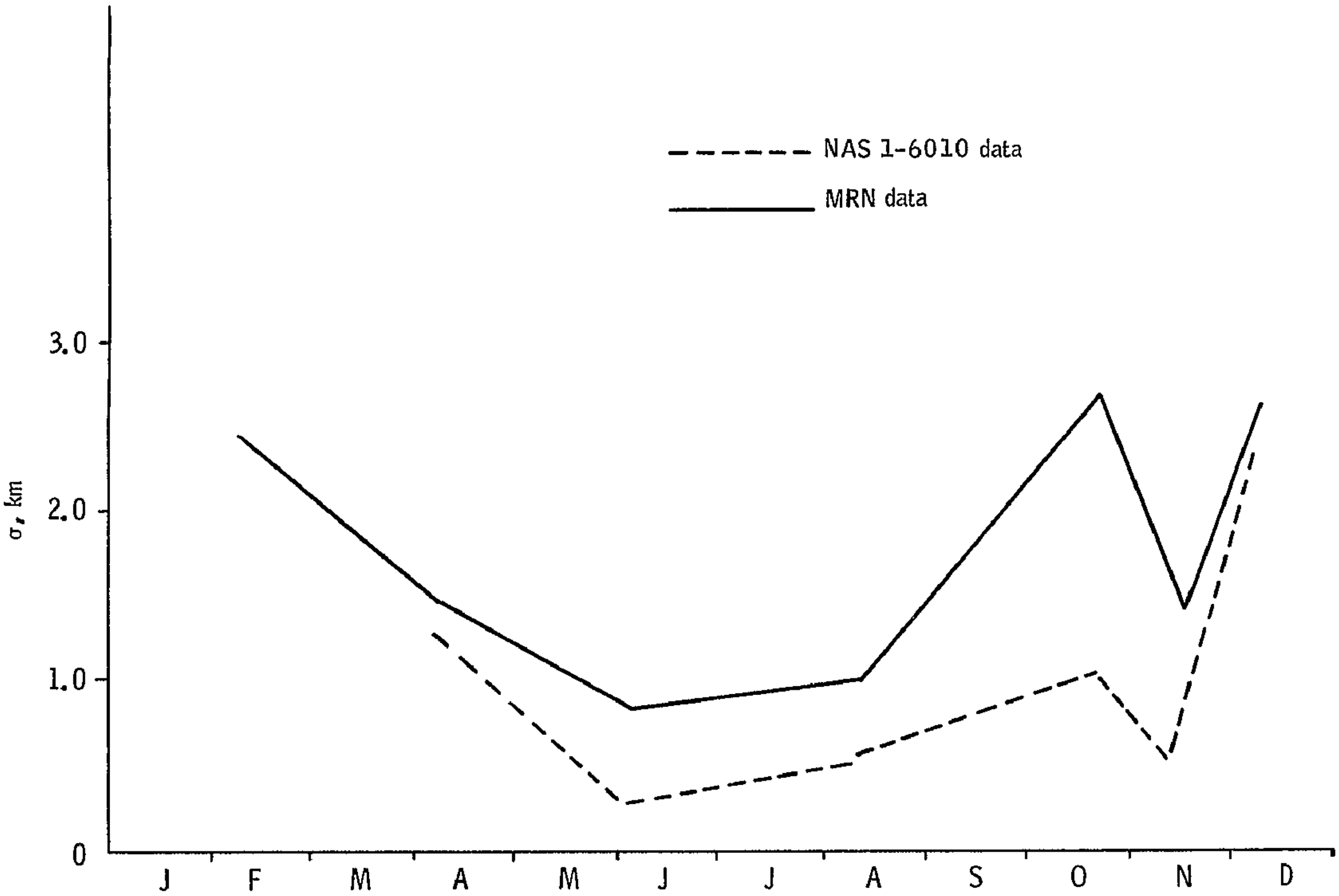

Figure 25 Standard Deviation for L1(3.0) NAS 1-6010 Versus MRN Data, Latitude Band 55°N to 80°N

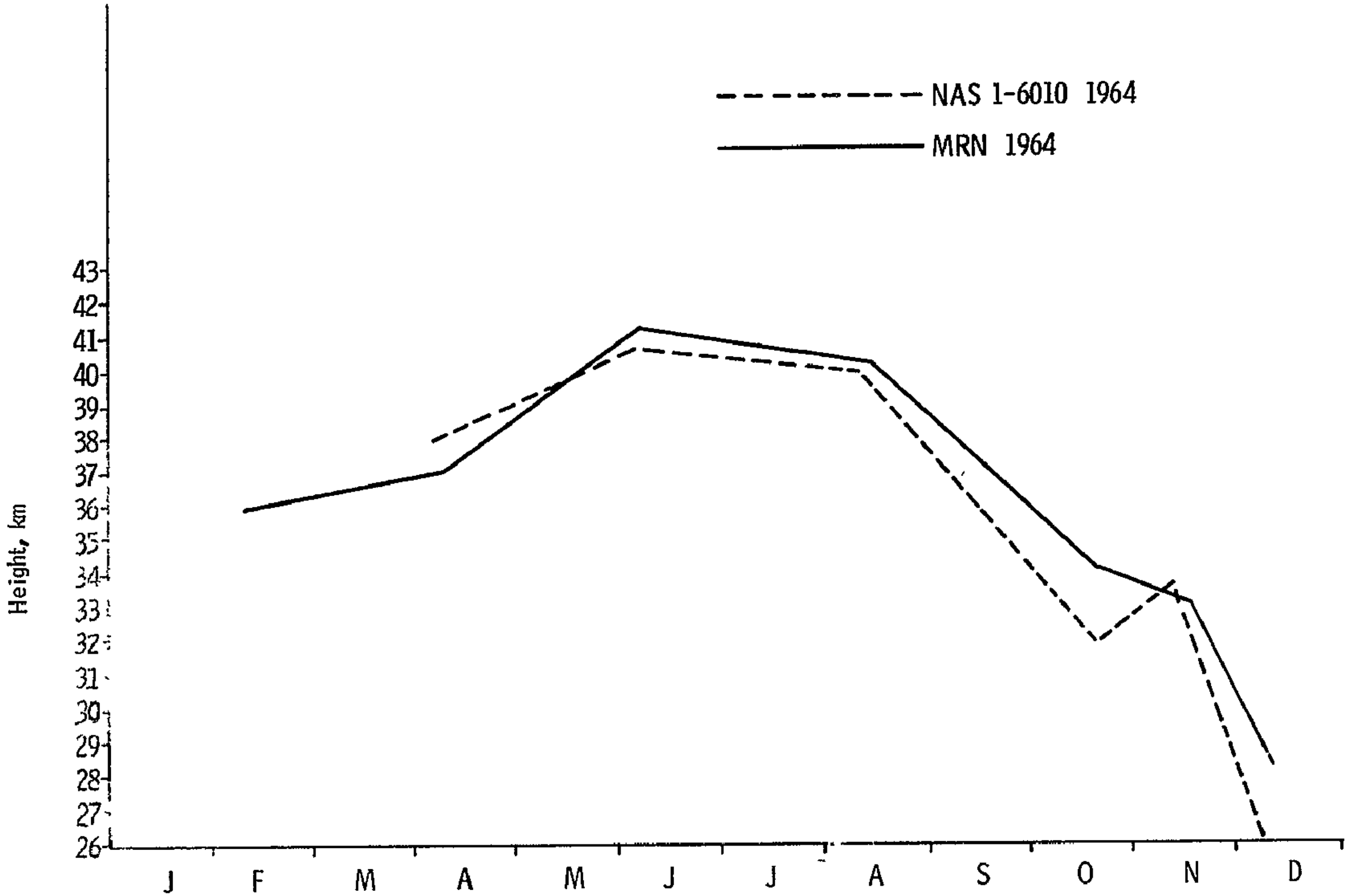

Figure 26. Locator L1(3.0) Means, Latitude Band 55°N to 80°N

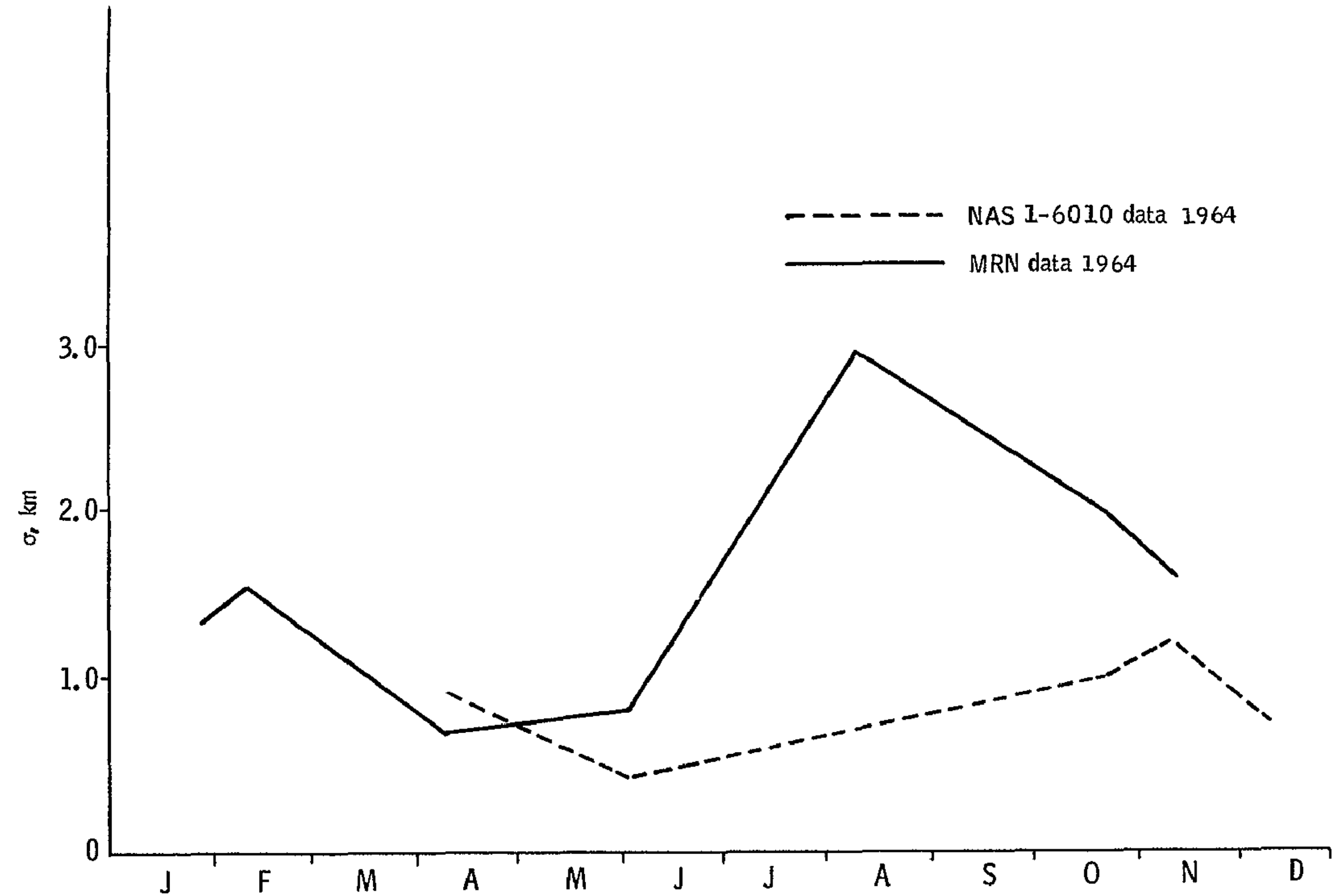

Figure 27 Standard Deviation for L1(3 0) NAS 1-6010 Versus MRN Data, Latitude Band 20°N to 35°N

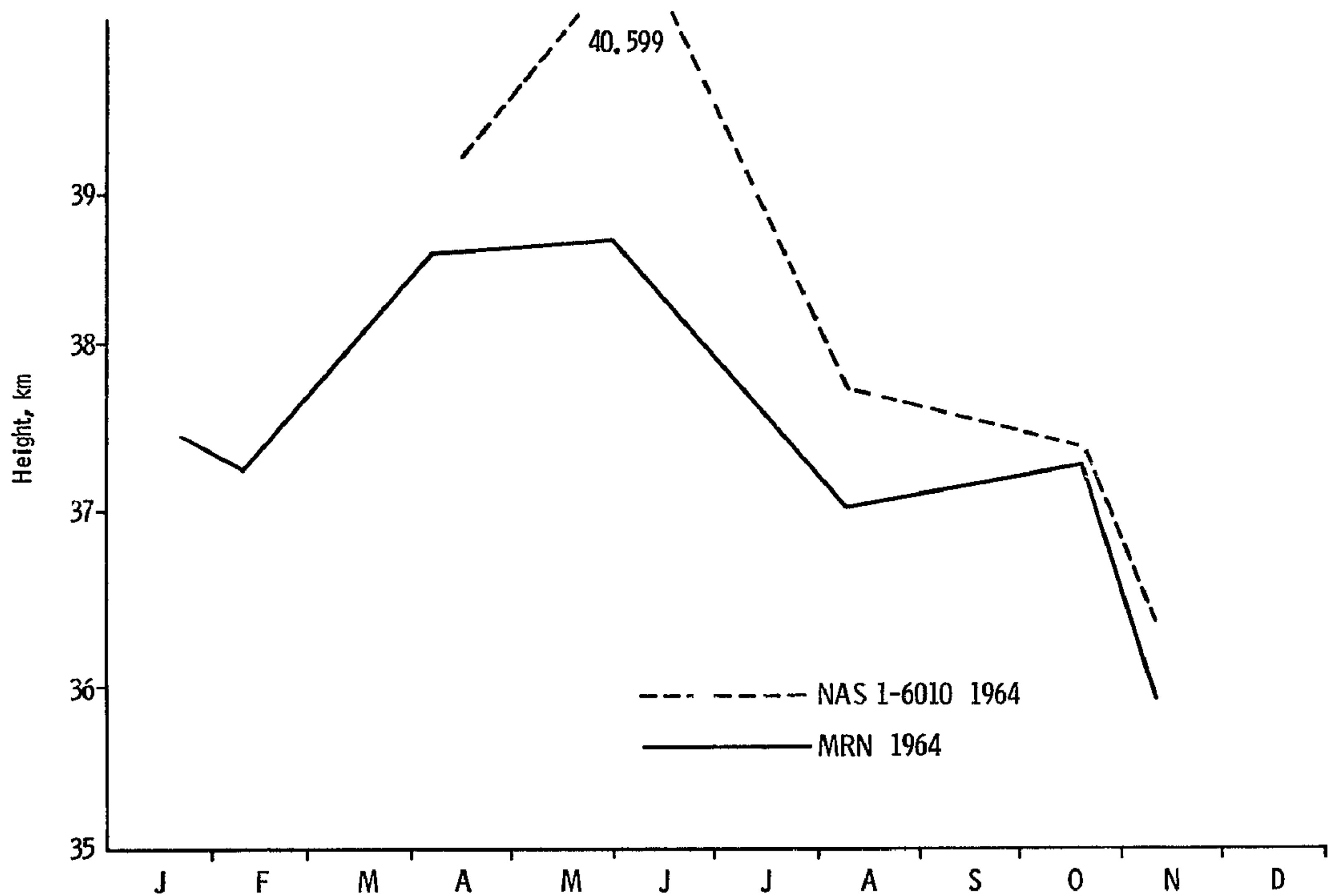

Figure 28. Locator L1(3.0) Means, Latitude Band 20°N to 35°N

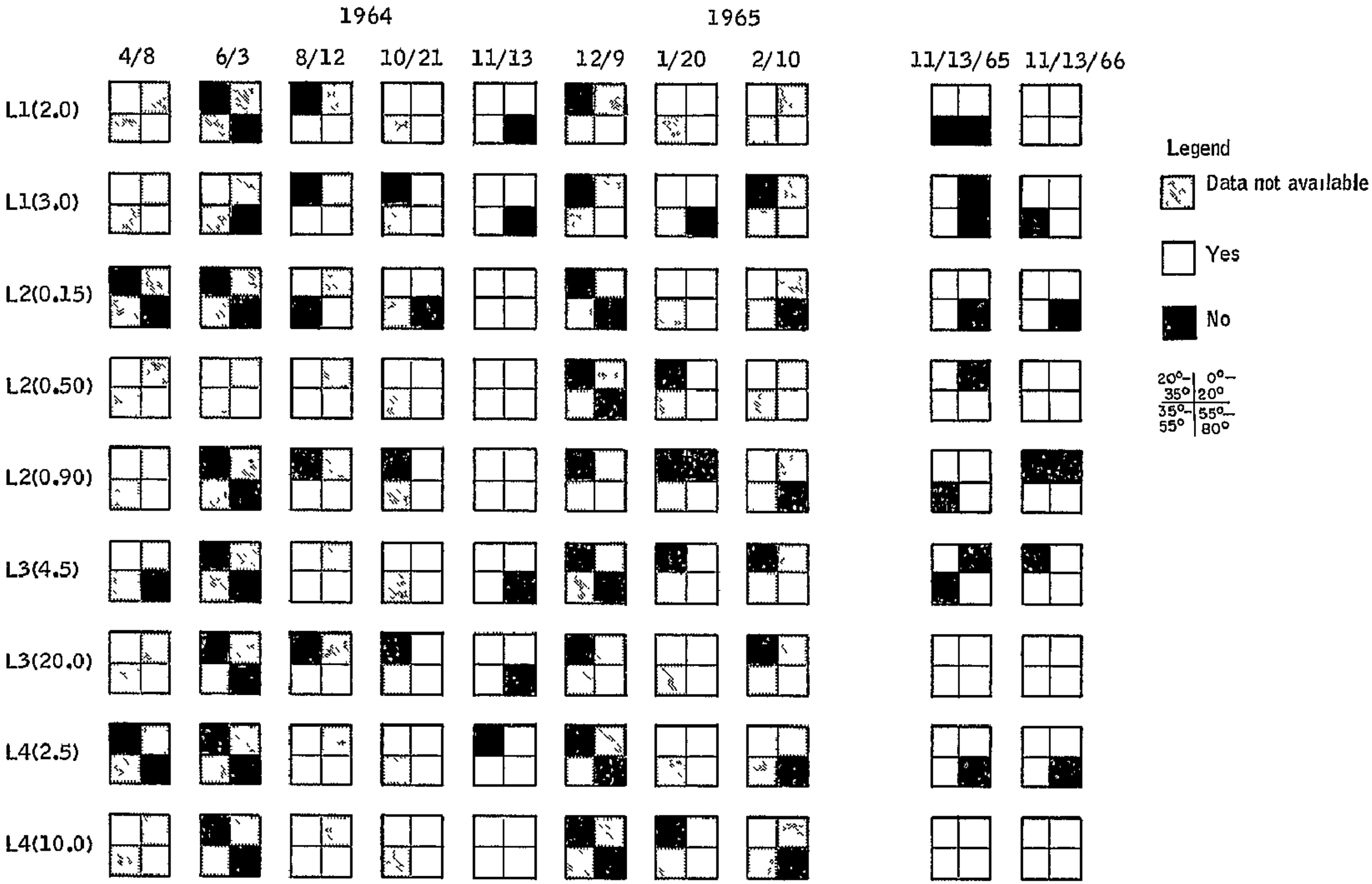

Figure 29. Statistical Comparisons of Variances for Interpolated versus Uninterpolated Data

It is apparent that interpolation of meteorological data had very little effect on the located altitude means (Figure 26).

For the 20° N to 35° N latitude band, the standard deviations agree well, except for the August comparison. The MRN data standard deviation magnitude was discussed previously in the MRN-to-MRN comparison section (20° N to 35° N). This isolated instance is believed to be caused by errors in the data and not by any atmospheric conditions.

The same effect is believed to have caused the apparent anomaly for the June comparison of the means (Figure 28).

SYNOPTIC MAPS

To examine the comparison between interpolated and real atmospheric data in more detail, synoptic maps were created for the months of November 1965 and 1966. These maps are presented in Appendix B. The results from the synoptic mapping are presented in Table 3 for L1 (3.0). As can be seen from the table, the MRN and the interpolated data agree in most instances within less than a kilometer, except at the high latitudes. In the high latitudes, longitudinal effects become quite strong. It is believed that this accounts for the differences, since the MRN data are limited to two stations. This would indicate that, as a representation of the total latitude band, the interpolated data are superior to the limited MRN data.

To examine the differences in detail, a look at the synoptic maps presented in Appendix B at the 39 km level shows reasons for the variations indicated in Table 3.

13 November 1965

From Table 3, it can be seen that the interpolated data show an indicated mean altitude 2.9 km lower than the MRN data for the 35° to 55° N band. The synoptic map shows that at 39 km the temperature is rapidly decreasing in a northward direction--from -30° at Wallops Island to about -50° at the northern boundary of the band. Since all MRN data available were from Wallops Island at 38° N, the interpolated data better represent the mean and standard deviation for the band.

Also noted is that the 55° N to 80° N shows a 3.9 km lower located altitude mean for the interpolated data. The synoptic map shows that the MRN data taken from Fort Churchill and Fort Greely were on isopleths of -45° and -50°, whereas the interpolated data took into account the cold air mass at -60° centered over Greenland. Since no MRN data were available for Thule, it is concluded that the interpolated data again is more representative of the band.

TABLE 3. - INTERPOLATED AND MRN DATA RESULTS

Latitude, °N	Interpolated MRN, mean and σ, km	MRN, mean and σ, km
13 November 1965		
0 to 20	38.2275	36.7876
	0.0873	0.7733
20 to 35	36.7789	37.5723
	0.9353	1.0634
35 to 55	32.1987	35.1025
	2.2479	1.2123
55 to 80	24.7745	28.6747
	3.2313	1.7867
13 November 1966		
0 to 20	38.937	40.2980
	0.5453	0.2682
20 to 35	35.1031	36.2895
	1.358	2.3362
35 to 55	30.9826	34.2286
	2.715	0.0155
55 to 80	27.5932	30.1649
	3.92	3.9651
13 November 1964		
0 to 20	38.1204	39.8841
	1.2323	0.5186
20 to 35	36.3737	35.9294
	1.2395	1.6068
35 to 55	35.0669	36.9358
	0.6284	1.6694
55 to 80	33.5597	33.0136
	0.5676	1.6927

13 November 1966

Again examining in detail the interpolated versus MRN data from Table 3 and the synoptic map for 39 km, the warm cell of -10° centered close to Antigua causes the MRN data (which is all from Antigua) to be 1.4 km higher than the interpolated data. The decrease to -15° over the remainder of the 0° to 20° N latitude band is better represented by the interpolated data.

The same effect is seen in the 35° to 55° N band. The MRN data taken at Wallops Island at this level indicate -35° C, whereas the interpolated data account for the northward decrease, to -50° C over the total band.

In conclusion, the interpolated data differ from the MRN data only in isolated cased, and, conversely, the MRN data differ from what is considered to be the true case in a similar manner. The important features (which were used to determine data requirements during the Horizon Definition Study), shapes and magnitudes of the means and standard deviations for seasonal and latitudinal effects, were preserved by the interpolated data.

RESULTS AND CONCLUSIONS

Results of this study have shown that the 15 μ infrared horizon varies from year to year. The exact magnitude of this variation depends on the latitudinal region, with the greatest temporal change occurring in the northern latitudes. On the basis of the data available for this study, the changes apparent in the high-latitude bands are caused by midwinter warmings in the stratosphere and by the instabilities of the transition seasons of spring and fall. Not observed during this study because of lack of data is the phenomena of "spring-overshoot" (ref. 18), which occurs in some years and not in others. There is evidence that the year-to-year changes in the tropical latitudes are caused by the quasi-biennial variation in wind and temperature in the atmosphere at a period of between 21 and 28 months.

Available data also indicated that longitudinal gradients exist in all latitude bands. Analysis of the MRN data at each station in a latitude band indicates this phenomenon in almost all cases. In the analysis of interpolated versus uninterpolated data, the interpolated data are believed to be more representative of the total latitudinal band because longitudinal effects are included in these data.

This study has also shown that there are both advantages and disadvantages to using either interpolated or uninterpolated meteorological data. The lack of actual meteorological data from MRN radiosondes and rocketsondes restricts the conclusions that can be drawn directly from this data source, since there are insufficient space-time data for accurate statistical testing. Interpolation of the data via synoptic mapping provides the necessary data base, but has some dependence on the interpolation of large scale information by the meteorologist.

The conclusions of the study indicate that there are indeed variations with periods longer than one year and that interpolation of the meteorological data does preserve the essential character of infrared horizon variations. However, an initial premise of this study, that no longitudinal variations, was shown to be incorrect.

To advance further the results of both this study and the Horizon Definition Study, it is apparent that actual measurements must be conducted with sufficient spatial and temporal frequency to permit high-resolution studies. Additionally, these experimental data must necessarily be as error free as possible.

APPENDIX A
DATA SELECTION

APPENDIX A - DATA SELECTION (continued)

Date	0 to 20°N	20 to 35°N				35 to 55°N	55 to 80°N		Total
	Antigua	Cape Kennedy	Point Mugu	White Sands	Grand Turk	Wallops Island	Fort Churchill	Fort Greely	
8/12/64		8/5 8/12	8/5 8/12 8/19			8/12 8/18	8/8 8/12 8/19 8/21	8/5	
Total		2	3			2	4	1	12
10/21/64	10/12 10/23 10/26 10/27 10/28	10/9 10/12 10/23 10/26 10/29 10/30	10/21	10/14 10/21 10/22 10/28 10/29	10/16 10/19 10/28		10/16 10/21	10/28	
Total	5	6	1	5	3		2	1	23
11/13/64	11/11 11/16	11/6 11/10 11/12 11/20	11/4 11/18	11/4 11/5 11/13 11/18 11/19 11/19 11/20		11/5 11/6	11/11 11/16 11/25	11/12	
Total	2	4	2	7		2	3	1	21
12/9/64	12/9	12/6 12/7 12/8 12/9 12/9 12/10	12/4 12/8 12/9 12/11 12/16 12/16 12/18 12/18	12/5 12/9 12/15 12/16	12/9 12/10		12/4 12/9 12/11 12/14 12/16 12/21		
Total	1	6	8	4	2		6		27

APPENDIX A - DATA SELECTION

Date	0 to 20°N	20 to 35°N				35 to 55°N	55 to 80°N		Total
	Antigua	Cape Kennedy	Point Mugu	White Sands	Grand Turk	Wallops Island	Fort Churchill	Fort Greely	
1/20/64		1/22 1/24 1/25 1/26		1/13 1/17 1/20 1/24 1/27					
Total		4		5					9
2/10/64		2/5 2/12 2/13	2/5	2/8 2/8 2/8 2/9 2/10 2/17				2/3 2/4 2/7 2/12 2/19	
Total		3	1	6				5	15
4/8/64		4/1 4/1 4/8 4/10 4/20		4/9 4/13 4/15				4/1 4/8 4/15	
Total		5		3				3	11
6/3/64		5/25 5/26 5/26 5/28	5/27 6/3	5/25 6/1 6/3 6/13			5/20 6/3 6/19	6/3 6/5 6/11	
Total		4	2	4			3	3	16

APPENDIX A - DATA SELECTION (continued)

Date	0 to 20°N	20 to 35°N				35 to 55°N	55 to 80°N		Total
	Antigua	Cape Kennedy	Point Mugu	White Sands	Grand Turk	Wallops Island	Fort Churchill	Fort Greely	
1/20/65	1/19 1/20 1/22	1/19 1/20 1/20 1/20 1/22 1/25	1/15 1/20 1/21	1/20			1/8 1/13 1/20 1/27	1/6 1/19 1/22	
Total	3	6	3	1			4	3	20
2/10/65		2/1 2/8 2/11 2/11 2/14 2/16 2/17 2/20	2/9 2/17	2/3	2/10		2/5 2/8 2/10 2/12		
Total		8	2	1	1		4		16
4/8/65	4/2 4/5 4/7 4/14	4/7 4/7 4/8 4/8 4/8 4/9 4/12 4/12	4/6		4/7 4/9	4/1 4/14	3/17 3/19 3/23 3/24 3/25	3/20 3/21 3/22 3/22 3/22 3/23 3/24 3/25	
Total	4	8	1		2	2	5	8	30

APPENDIX A - DATA SELECTION (continued)

Date	0 to 20°N	20 to 35°N				35 to 55°N	55 to 80°N		Total
	Antigua	Cape Kennedy	Point Mugu	White Sands	Grand Turk	Wallops Island	Fort Churchill	Fort Greely	
6/3/65	5/28 6/9 6/11 6/14 6/16 6/25	6/3 6/4 6/7	6/2 6/4 6/7	5/27 5/28 6/2	6/4 6/7	5/27 6/27 6/30	5/26 5/28 5/31 6/2	6/2 6/9	
Total	6	3	3	3	2	3	4	2	26
8/12/65	8/4 8/6 8/9 8/11 8/13 8/20	8/6 8/9 8/13 8/16	8/9 8/11 8/16	8/7 8/11 8/16	8/13	8/7 8/8 8/13 8/18	8/7 8/7 8/8 8/8 8/11 8/16	8/12 8/13 8/16	
Total	6	5	3	3	1	4	6	3	31
10/21/65	10/22 10/25 10/27	10/18 10/20 10/22 10/26	10/20 10/27	10/15 10/21 10/25	10/25 10/27	10/13 10/20 10/23 10/25 10/26 10/27 10/29	10/23	10/14 10/26 10/29	
Total	3	4	2	3	2	7	1	3	25
11/13/65	11/1 11/3	11/9 11/10 11/12 11/15 11/17	11/9 11/15	11/6	11/10 11/12 11/15	11/4 11/8 11/10 11/11 11/19	11/8 11/9 11/10 11/15	11/10 11/11 11/17	
Total	2	5	2	1	3	5	4	3	25

APPENDIX A - DATA SELECTION (continued)

Date	0 to 20°N	20 to 35°N				35 to 55°N	55 to 80°N		Total
	Antigua	Cape Kennedy	Point Mugu	White Sands	Grand Turk	Wallops Island	Fort Churchill	Fort Greely	
12/9/65	11/29 12/8 12/15 12/17 12/20	12/13 12/4 12/8 12/10 12/13 12/15 12/16 12/18	12/8 12/6	12/3 12/8		12/1 12/2 12/8 12/9 12/15 12/16	12/3 12/8 12/9 12/10 12/11 12/12 12/14 12/14 12/16 12/18 12/18	12/10	
Total	5	8	2	2		6	11	1	35
1/20/66	1/12 1/14 1/17 1/19 1/24 1/26 1/28	1/14 1/17 1/18 1/19 1/21 1/24	1/19 1/24	1/19 1/21 1/26	1/14 1/17 1/19 1/21 1/26		1/14 1/17 1/24	1/16 1/17 1/20	
Total	7	6	2	3	5		3	3	29
2/10/66	2/2 2/7 2/9 2/9 2/10	2/9 2/10 2/11 2/14 2/16	2/3 2/4 2/8 2/10	2/2 2/3 2/4 2/9 2/10 2/14 2/18	2/4 2/7	2/10	2/5 2/9 2/10	2/5 2/6 2/8 2/10 2/11 2/14 2/15 2/16	
Total	5	5	4	7	2	1	3	8	35

APPENDIX A - DATA SELECTION (Continued)

Date	0 to 20°N	20 to 35°N				33 to 55°N	55 to 80°N			Total
	Antigua	Cape Kennedy	Point Mugu	White Sands	Grand Turk	Wallops Island	Fort Churchill	Fort Greely	Thule	
4/8/66	3/28 4/1 4/6 4/13 4/15	4/5 4/6 4/7 4/8	4/6 4/13	4/7 4/13	4/4 4/6 4/8 4/11 4/13	5/10 5/10 5/11 5/11 5/11 5/11 5/11 5/11 5/11 5/11		4/4 4/6 4/7 4/8 4/11 4/12 4/14		
Total	5	4	2	2	5	10		7		35
6/3/66	6/22	6/1 6/3 6/6 6/7	5/26 5/31 6/2 6/3 6/6 6/7 6/8 6/9 6/10	5/26 5/27 6/2 6/2 6/8	6/3	6/1 6/3	5/30 6/3 6/6 6/8	5/31 6/3 6/5	6/1 6/2	
Total	1	4	9	5	1	2	4	3	2	31
8/12/66	8/10 8/19 8/22	8/9 8/10 8/11 8/12 8/15	8/9 8/11 8/12 8/15	8/12		8/7 8/7 8/12 8/17 8/18 8/19	8/7 8/7 8/10 8/18		8/8 8/9 8/15	
Total	3	5	4	1		6	4		3	26

APPENDIX A - DATA SELECTION (concluded)

Date	0 to 20°N		20 to 35°N				35 to 55°N	55 to 80°N		Total
	Antigua	Fort Sherman	Cape Kennedy	Point Mugu	White Sands	Grand Turk	Wallops Island	Fort Churchill	Fort Greely	
10/21/66	10/21 10/24 10/26 10/28		10/19 10/20 10/24 10/25	10/19 10/20 10/21	10/19 10/20 10/21	10/19 10/21		10/17 10/19 10/20 10/24	10/17 10/19 10/24 10/26	
Total	4		4	3	3	2		4	4	24
11/13/66	11/4 11/7 11/16		11/9 11/9 11/10 11/11 11/14 11/15 11/16	11/10 11/14 11/15	11/11 11/8	11/15	11/9 11/16	11/8 11/10	11/10 11/14	
Total	3		7	3	2	1	2	2	2	22
1/20/67	1/23 1/13	1/16 1/23 1/25	1/16 1/17 1/18 1/18 1/19 1/20 1/23 1/24	1/16 1/17 1/19 1/20 1/23	1/18 1/23		1/18 1/31 2/1	1/16 1/17 1/18 1/19 1/20 1/23 1/24 1/25	1/16 1/19 1/20 1/23 1/25	
Total	2	3	8	5	2		3	8	5	36

APPENDIX B

DERIVATION OF TEMPERATURE AND PRESSURE DATA FOR SYNOPTIC CASES

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APPENDIX B

DERIVATION OF TEMPERATURE AND PRESSURE DATA FOR SYNOPTIC CASES

LOWER LEVELS

For levels below 30 km, upper air charts prepared by the U.S. Weather Bureau and the Free University of Berlin, Germany, were used to obtain temperature and pressure-altitude information. Temperature and altitude data were picked off via interpolation between plotted isotherms and isopleths of altitude for each of the 56 grid points accommodated in the model. These data were then entered on the data coding sheets.

UPPER LEVELS

For altitudes above 30 km, charts were drawn at 3 km intervals from 33 km to 60 km. The charts were prepared from weather data obtained by rocketsondes launched over the western half of the northern hemisphere. These data were obtained from the Meteorological Rocketsonde Data published by the U.S. Government. The data were plotted on charts, and isobars and isotherms were drawn. Values were then obtained at the same 56 grid points as in the case of the lower levels, again by interpolation.

In preparing the charts, data were plotted for the time most closely approaching that of the dates specified, November 13 of 1965 and 1966. In addition, where available, data up to four days before and after the target day were plotted to aid in awareness of changes occurring and to spot occasional large errors appearing in the rocket data. Knowing the changes helps to "zero in" on the conditions that prevailed on the target date.

To assure that no gross errors appeared in the charts, the patterns obtained were checked against the patterns obtained by the Upper Air Branch, NMC, ESSA, in their 5, 2, and 0.4-millibar charts. In the case of the 13 November, 1966 data, no serious discrepencies in the pattern existed, while in the 13 November, 1965 data, a gross error did appear over Alaska due to an extremely large error in the rocket data from Fort Greely, Alaska. The magnitude of the error was ascertained by personal communication with Mr. Gelman and others of the Upper Air Branch, who prepared the 5, 2, and 0.4 millibar charts. The charts that were prepared were adjusted accordingly.

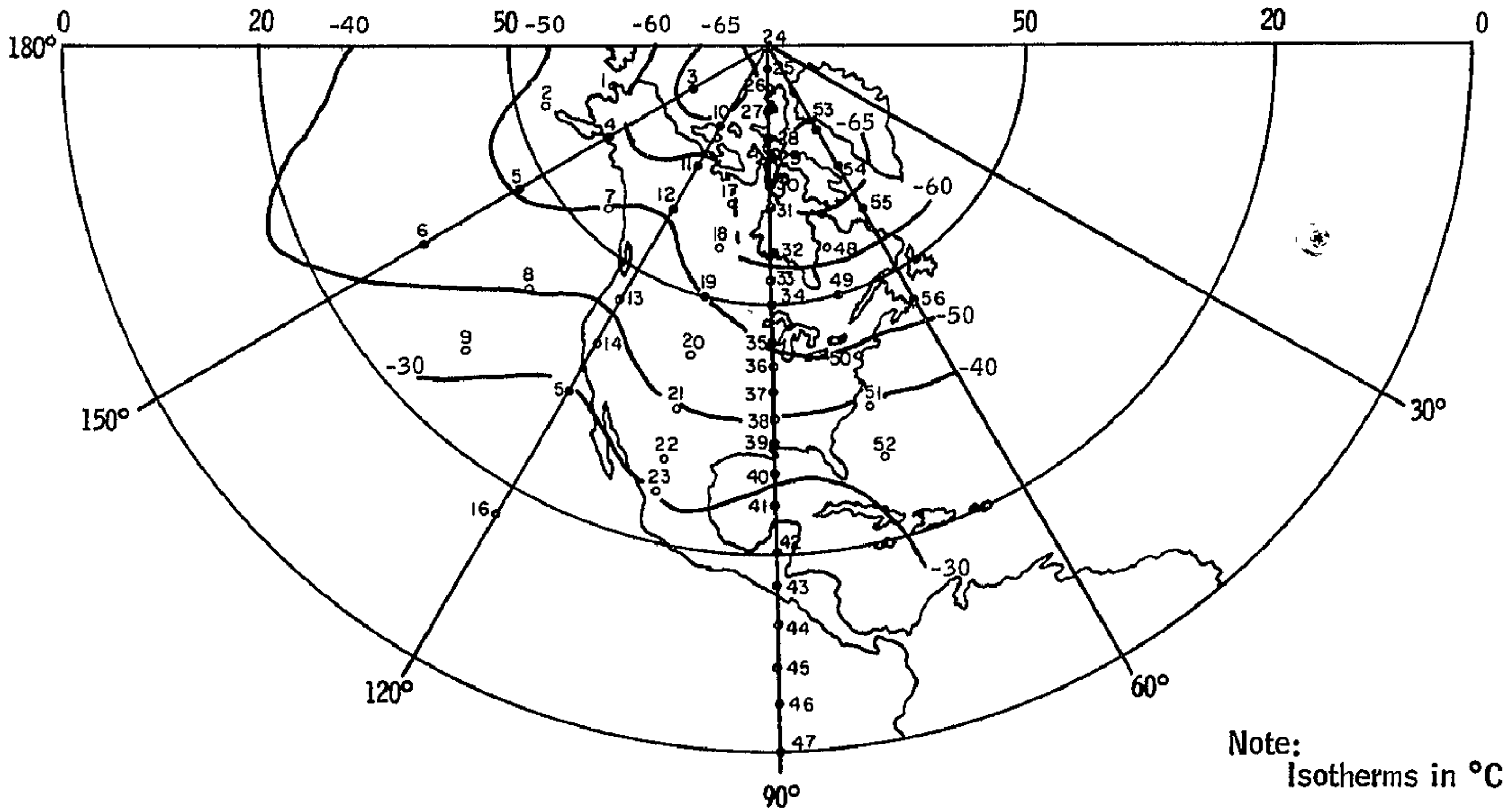

Figure B1. Constant Altitude - Synoptic Temperature Map, 13 November 1965, 33 km

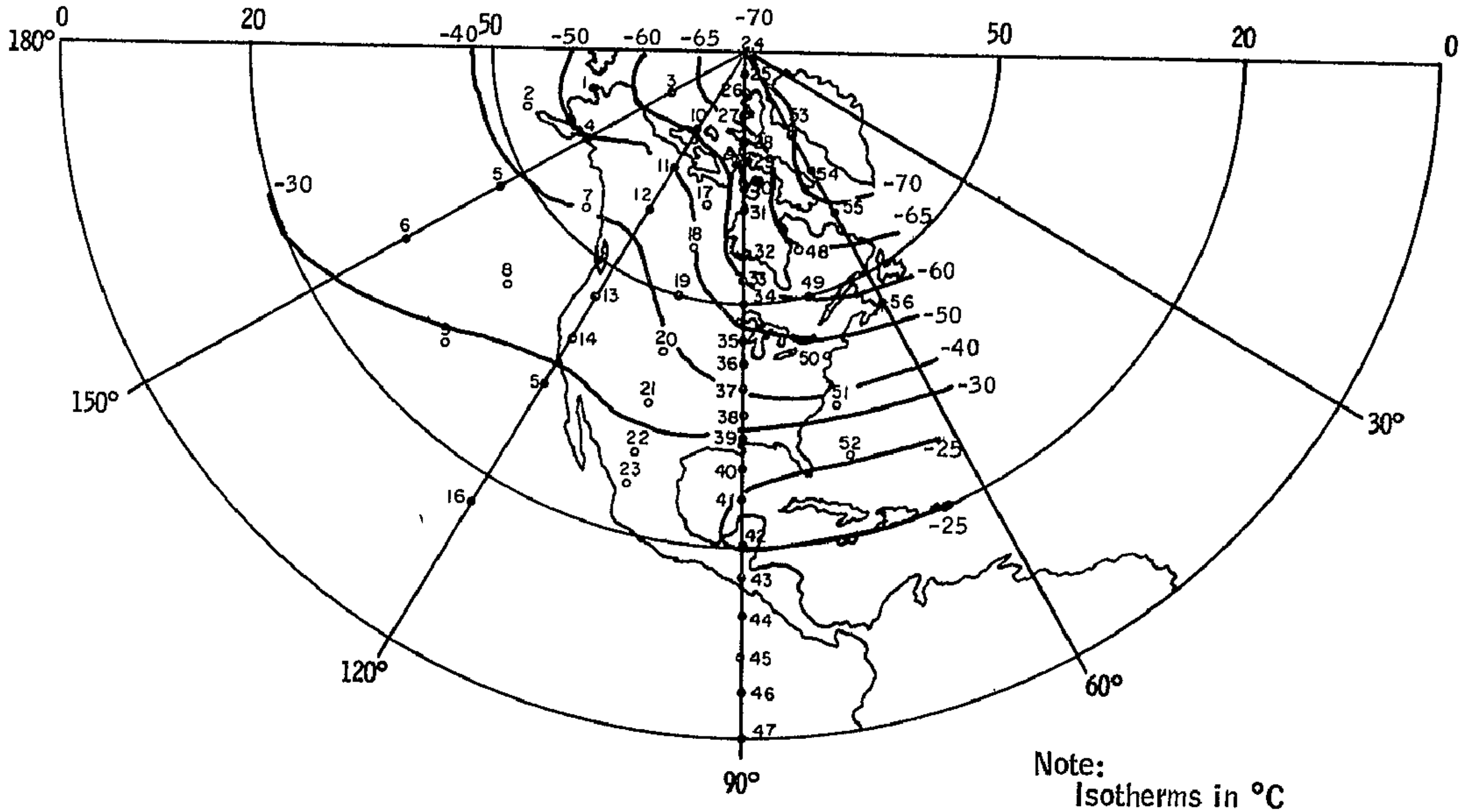

Figure B2. Constant Altitude, Synoptic Temperature Map, 13 November 1965, 36 km

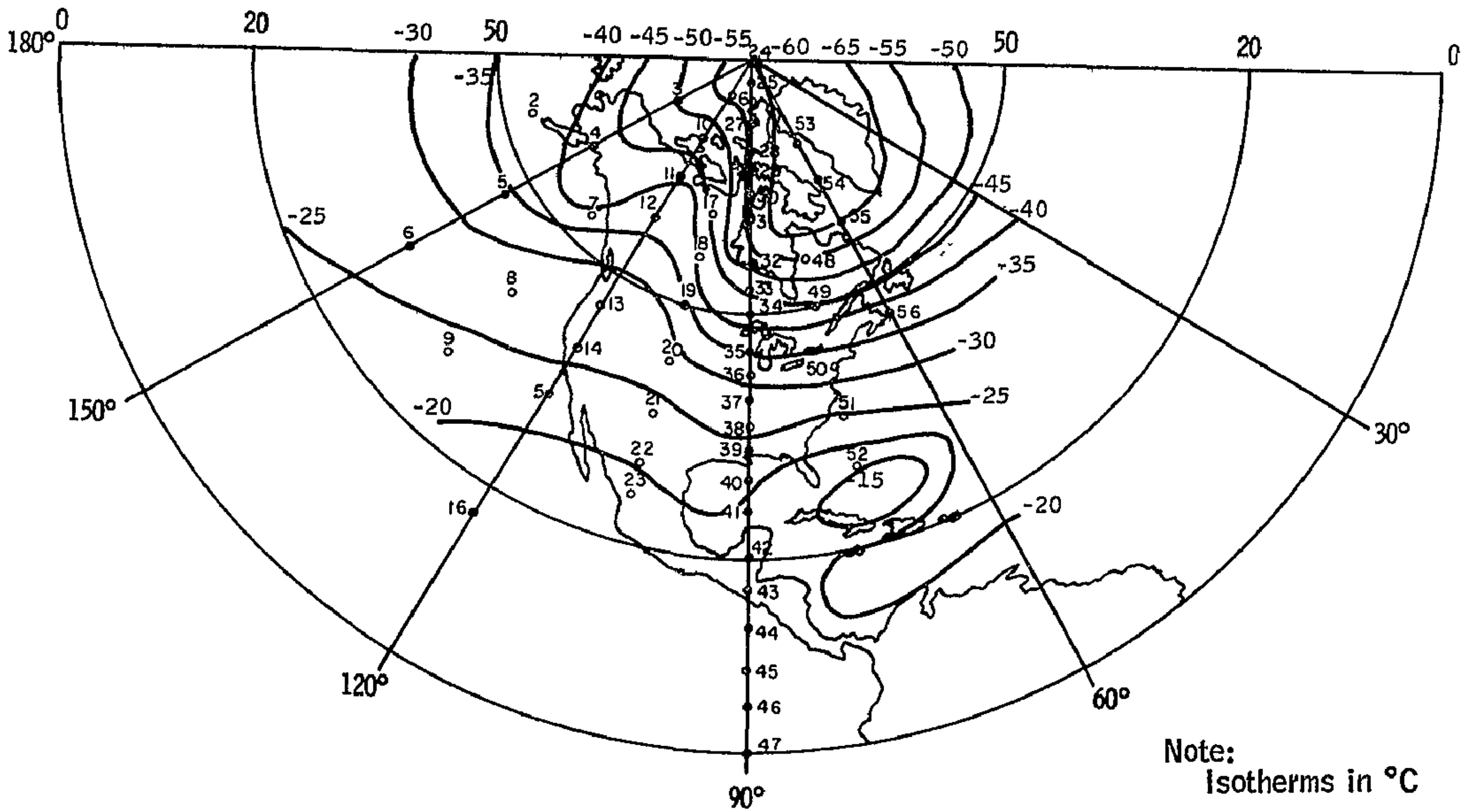

Figure B3. Constant Altitude, Synoptic Temperature Map, 13 November 1965, 39 km

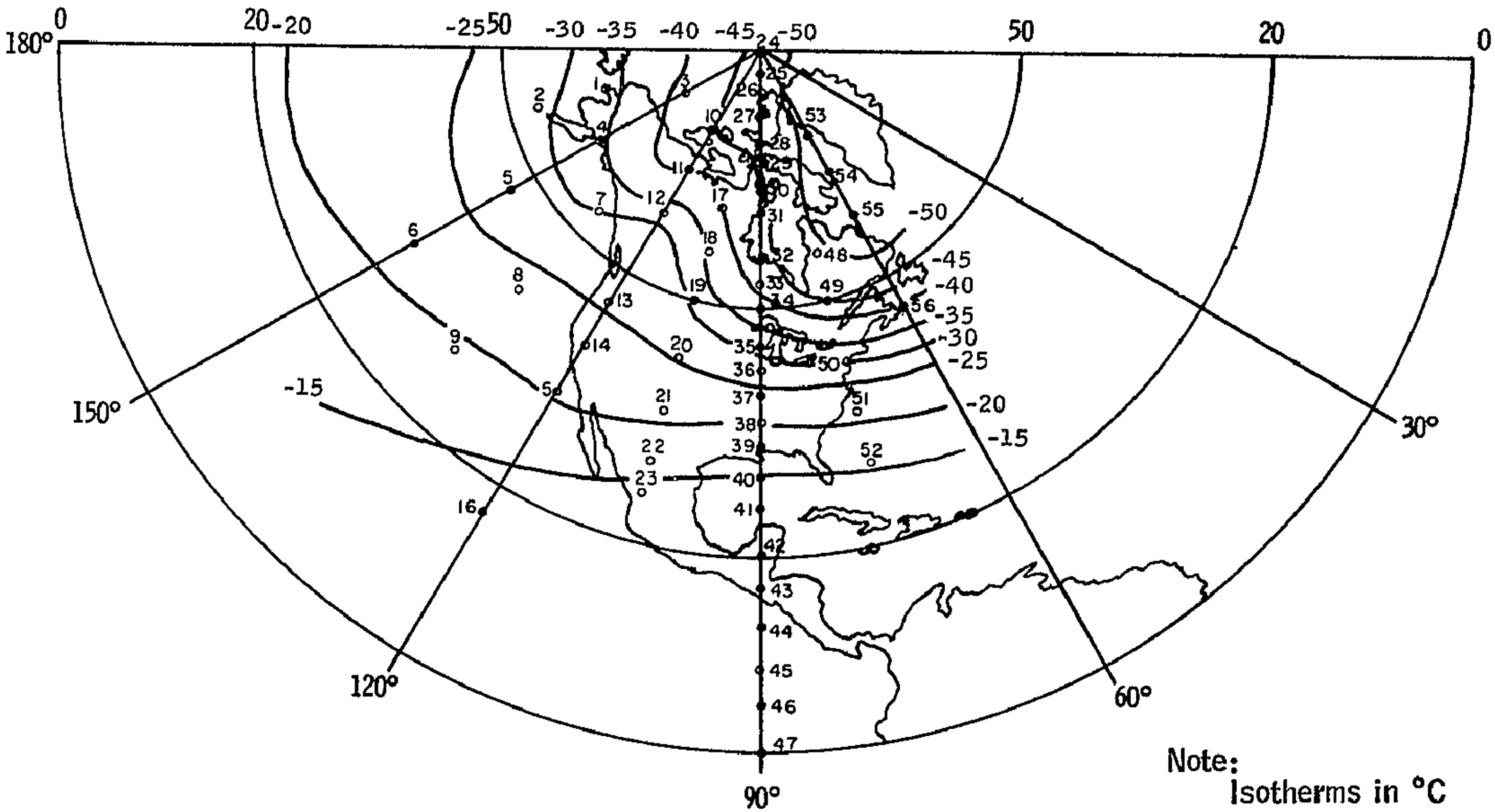

Figure B4. Constant Altitude, Synoptic Temperature Map, 13 November 1965, 42 km

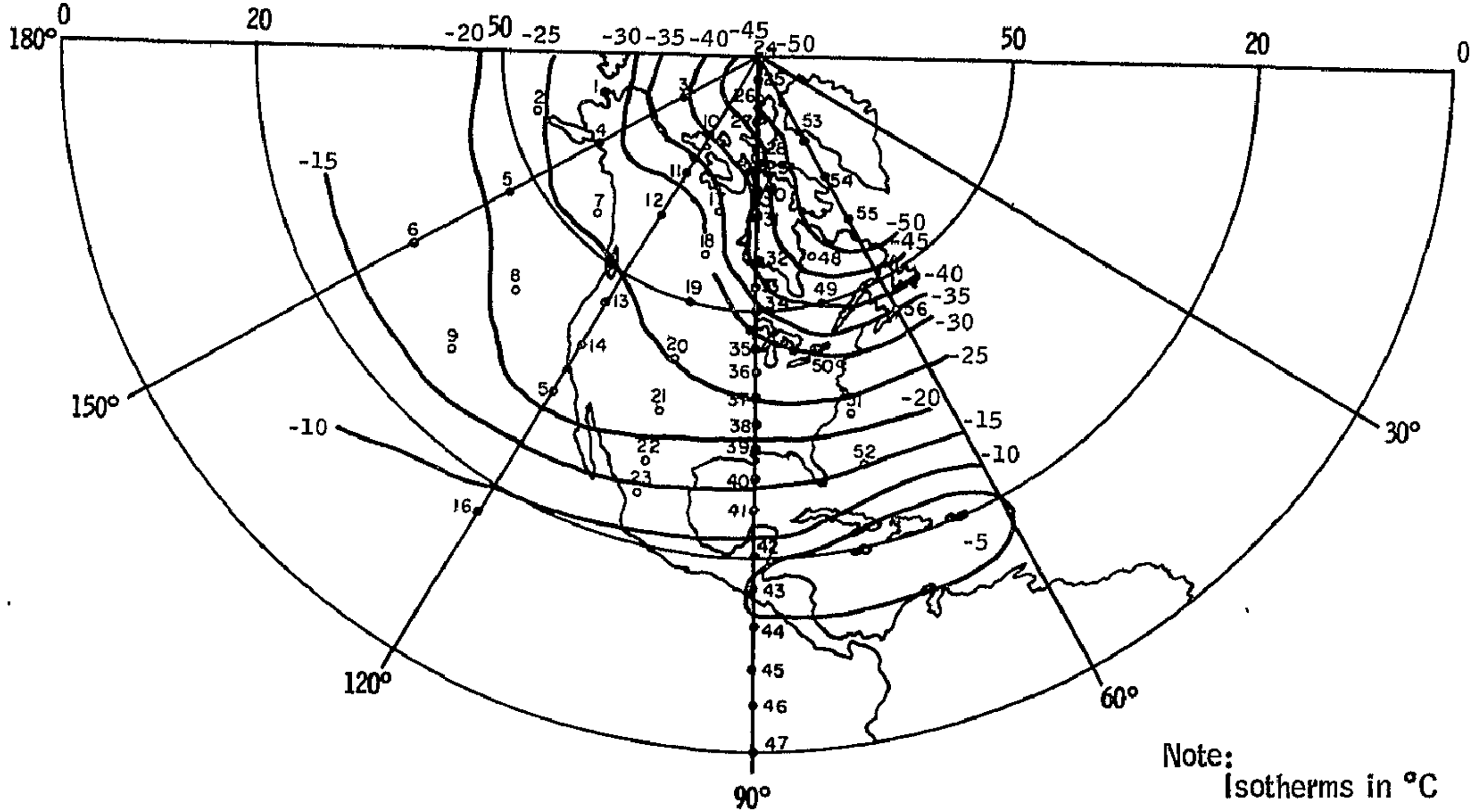

Figure B5. Constant Altitude, Synoptic Temperature Map,
13 November 1965, 45 km

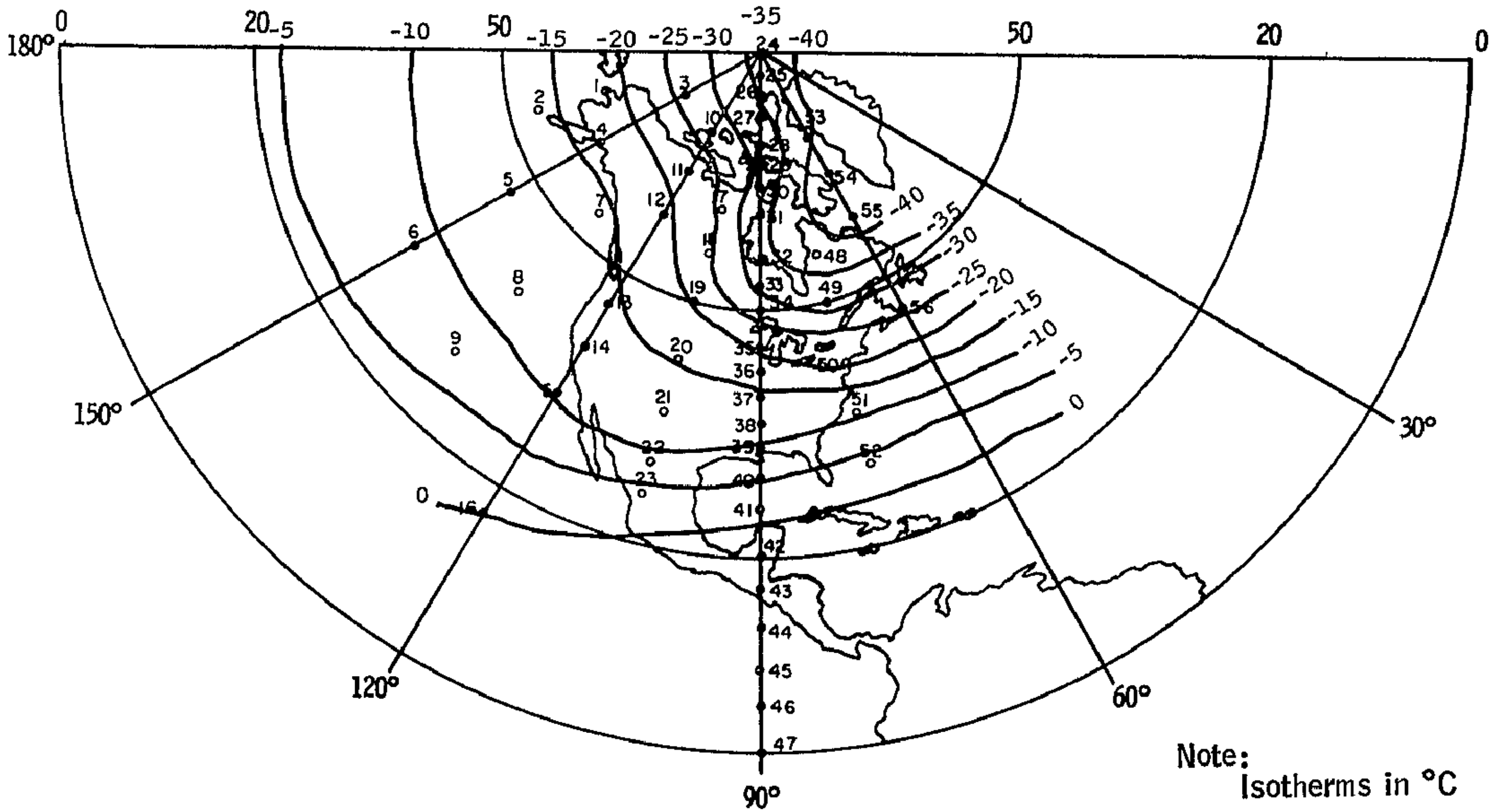

Figure B6. Constant Altitude, Synoptic Temperature Map,
13 November 1965, 48 km

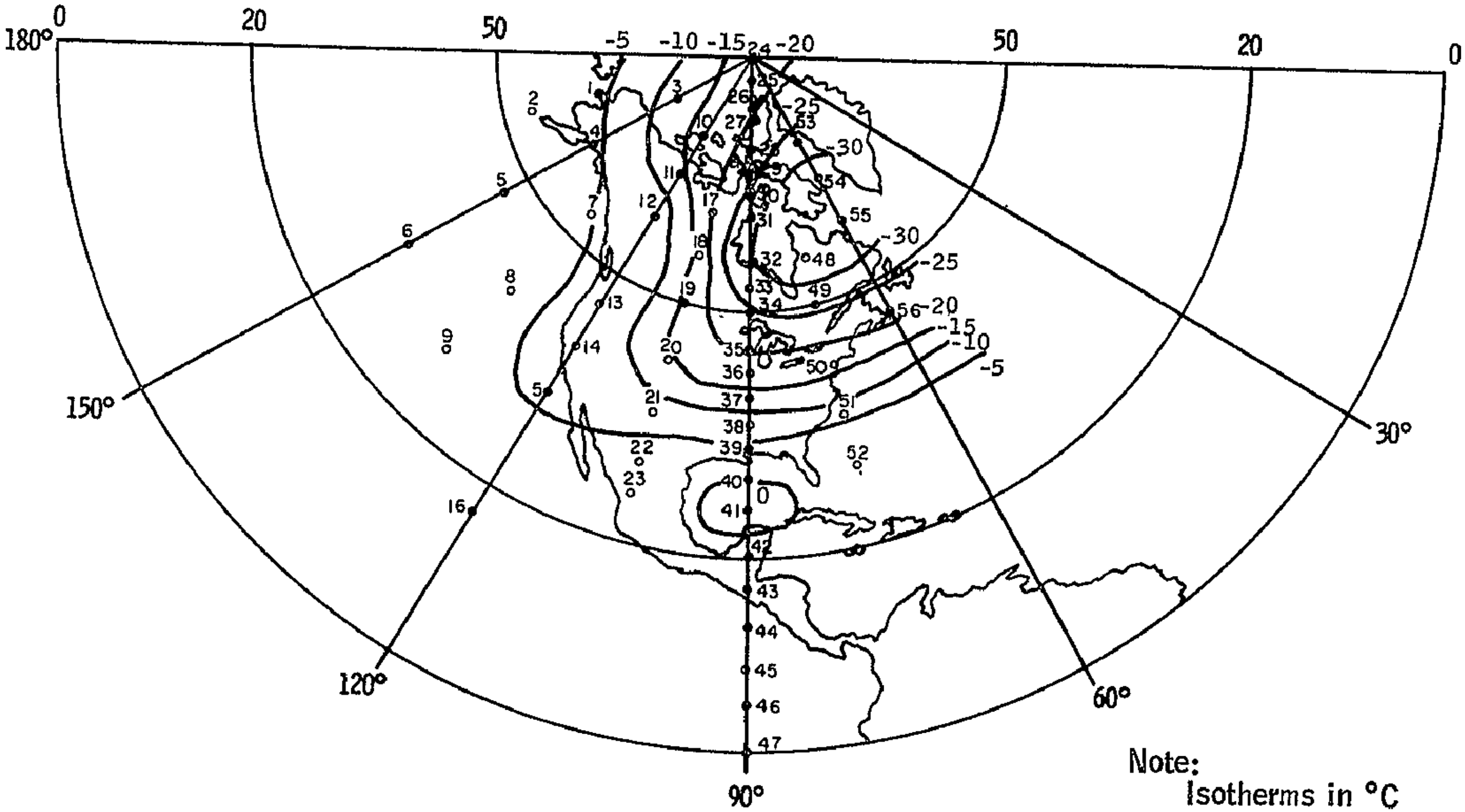

Figure B7. Constant Altitude, Synoptic Temperature Map, 13 November 1965, 51 km

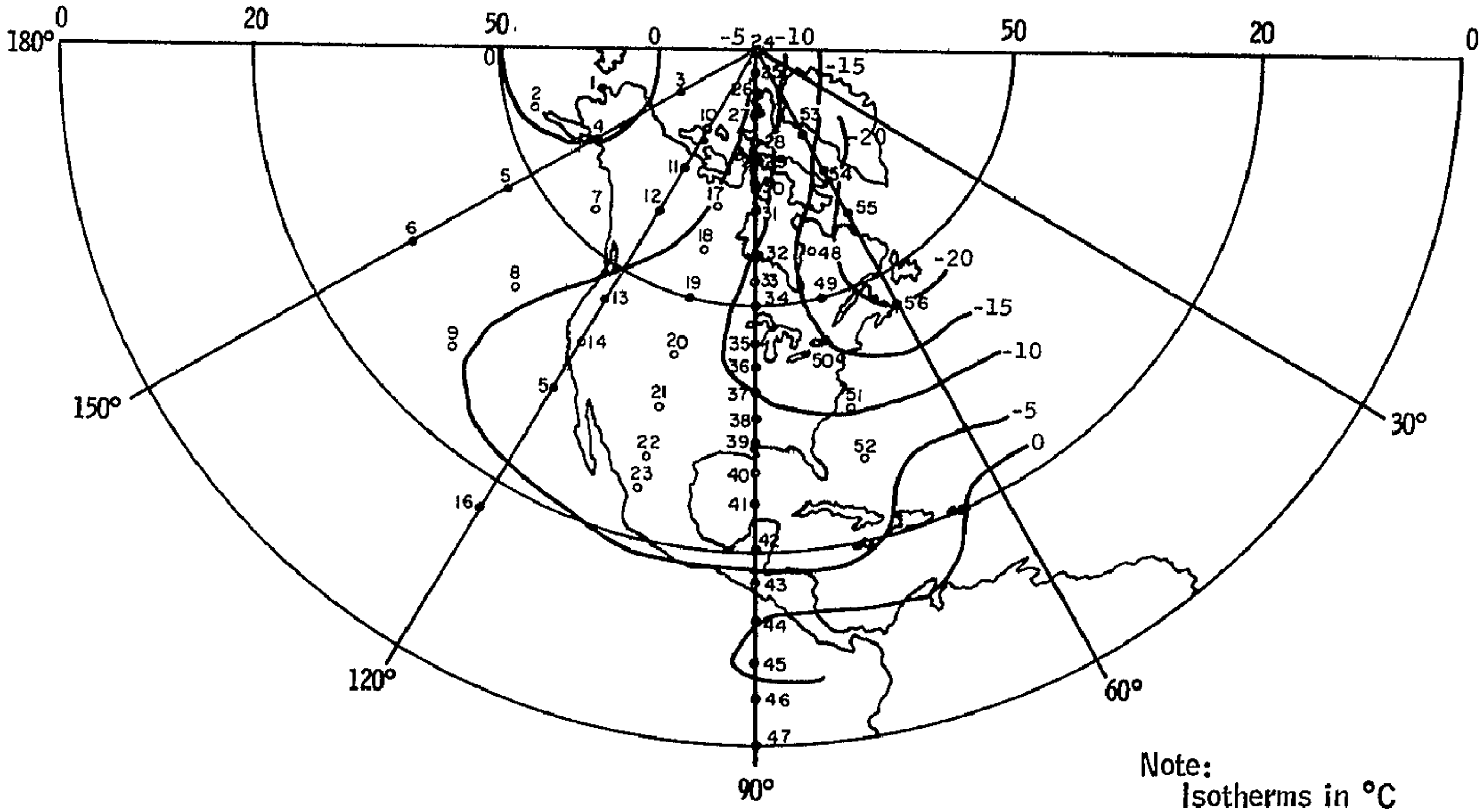

Figure B8. Constant Altitude, Synoptic Temperature Map,
13 November 1965, 54 km

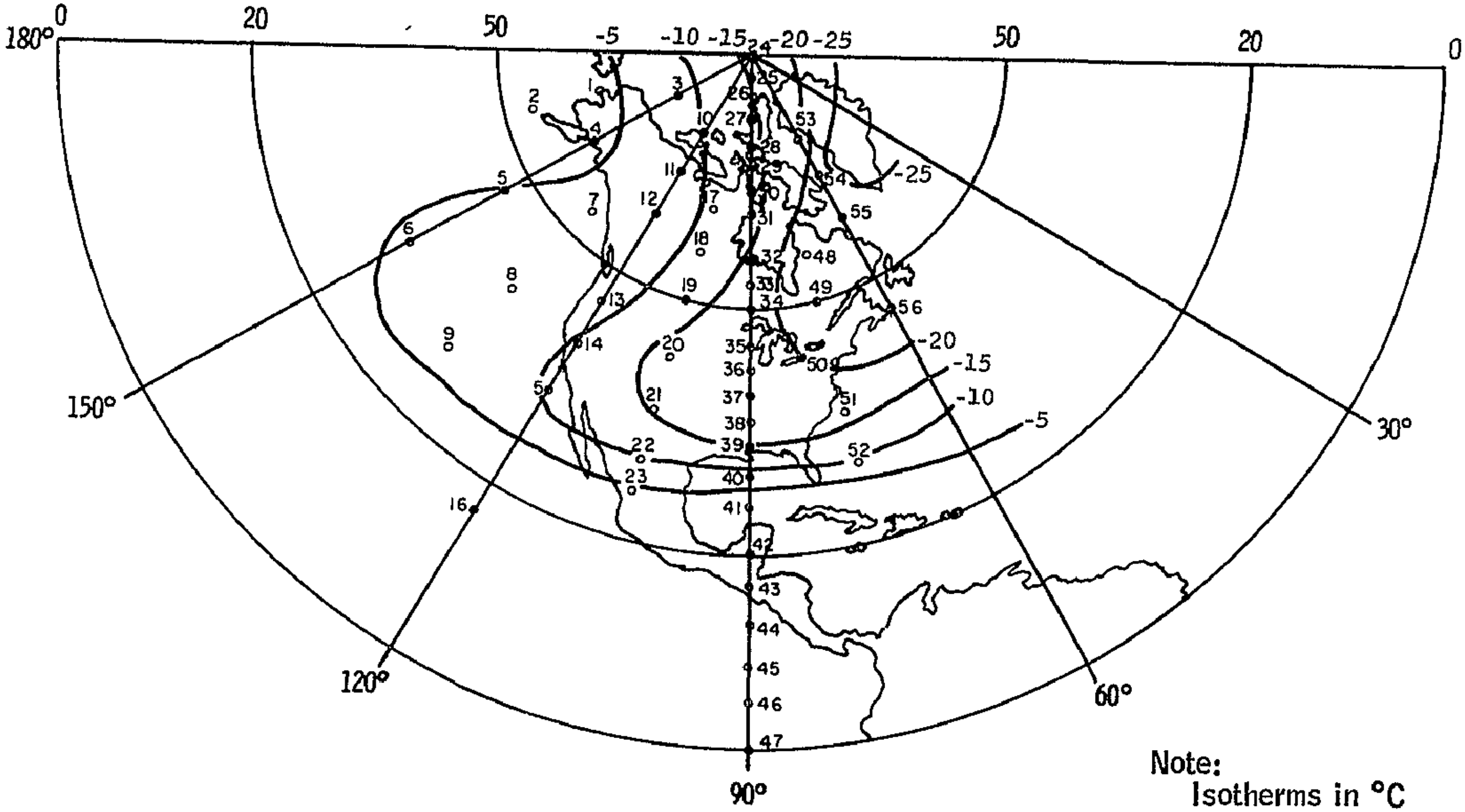

Figure B9. Constant Altitude, Synoptic Temperature Map, 13 November 1965, 57 km

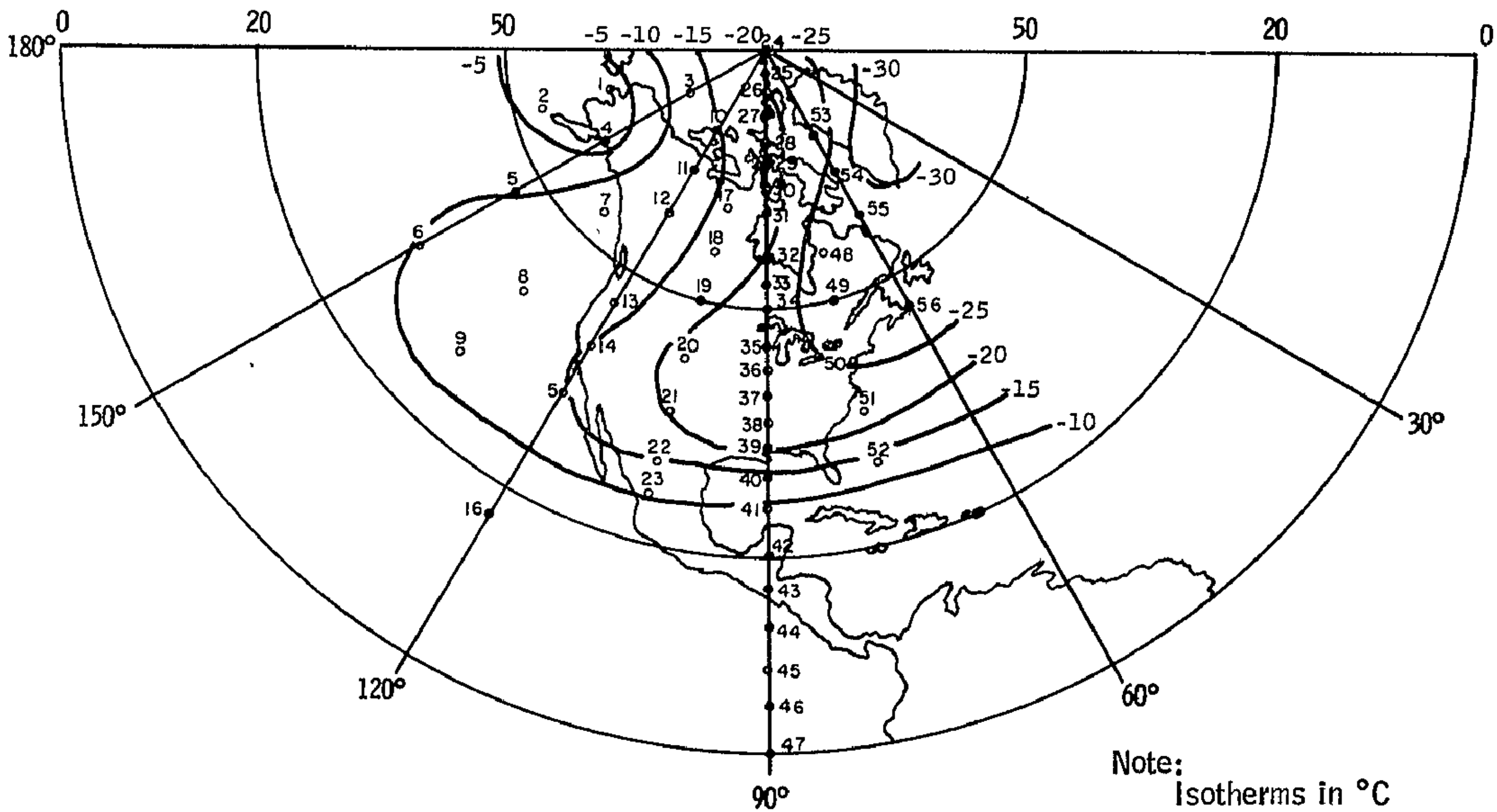

Figure B10. Constant Altitude, Synoptic Temperature Map
13 November 1965, 60 km

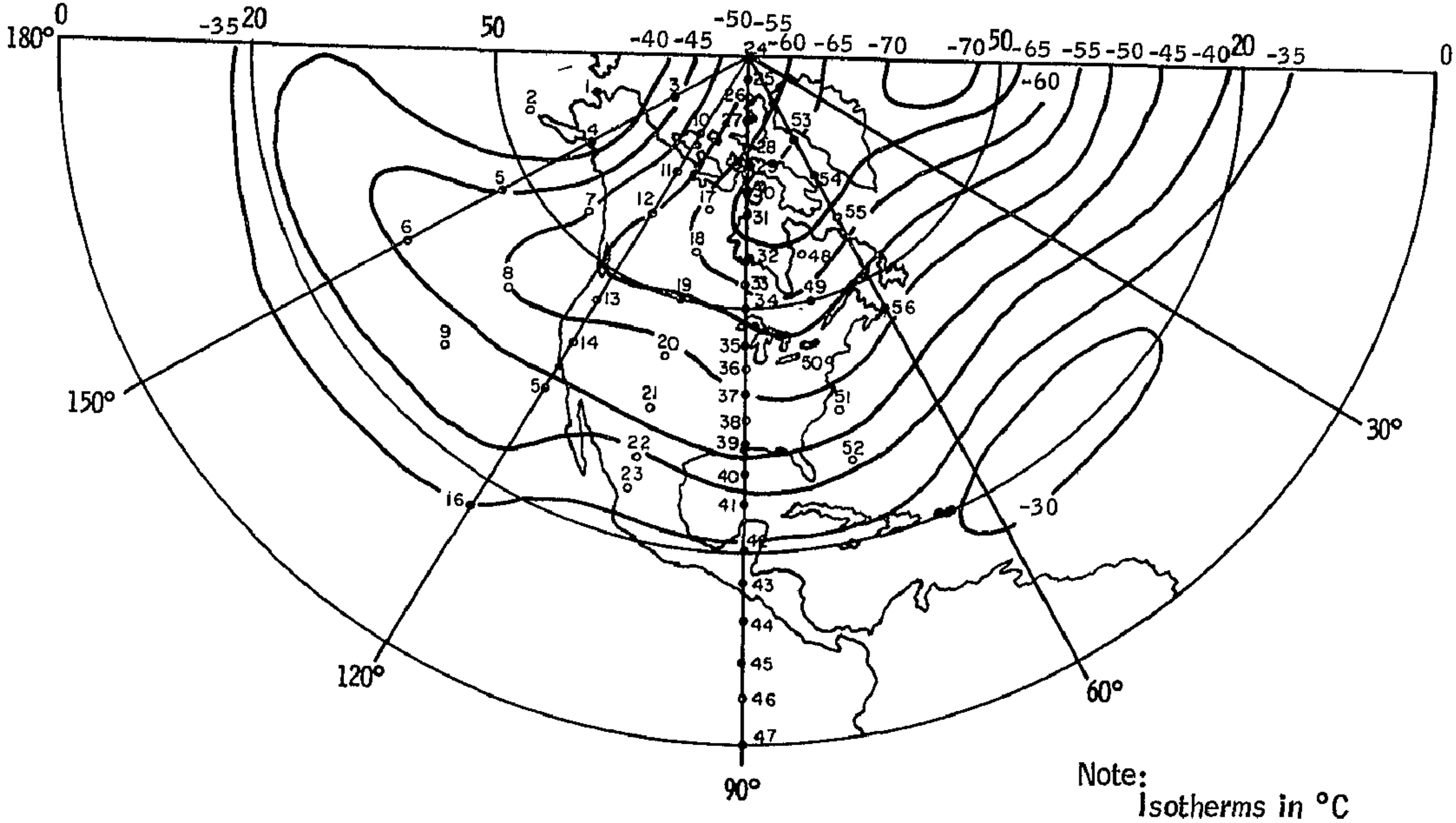

Figure B11. Constant Altitude, Synoptic Temperature Map, 13 November 1966, 33 km

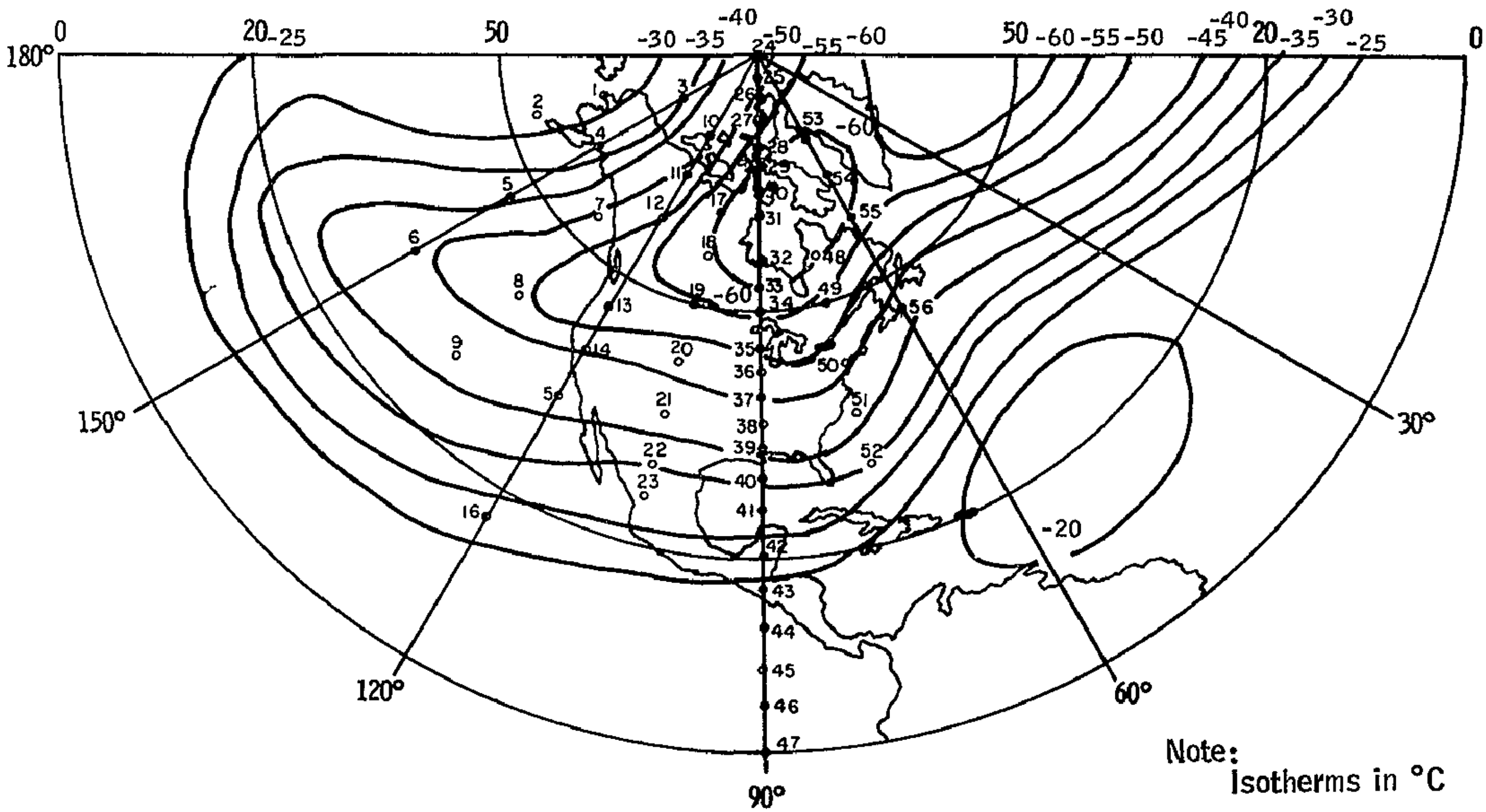

Table B12. Constant Altitude, Synoptic Temperature Map,
13 November 1966, 36 km

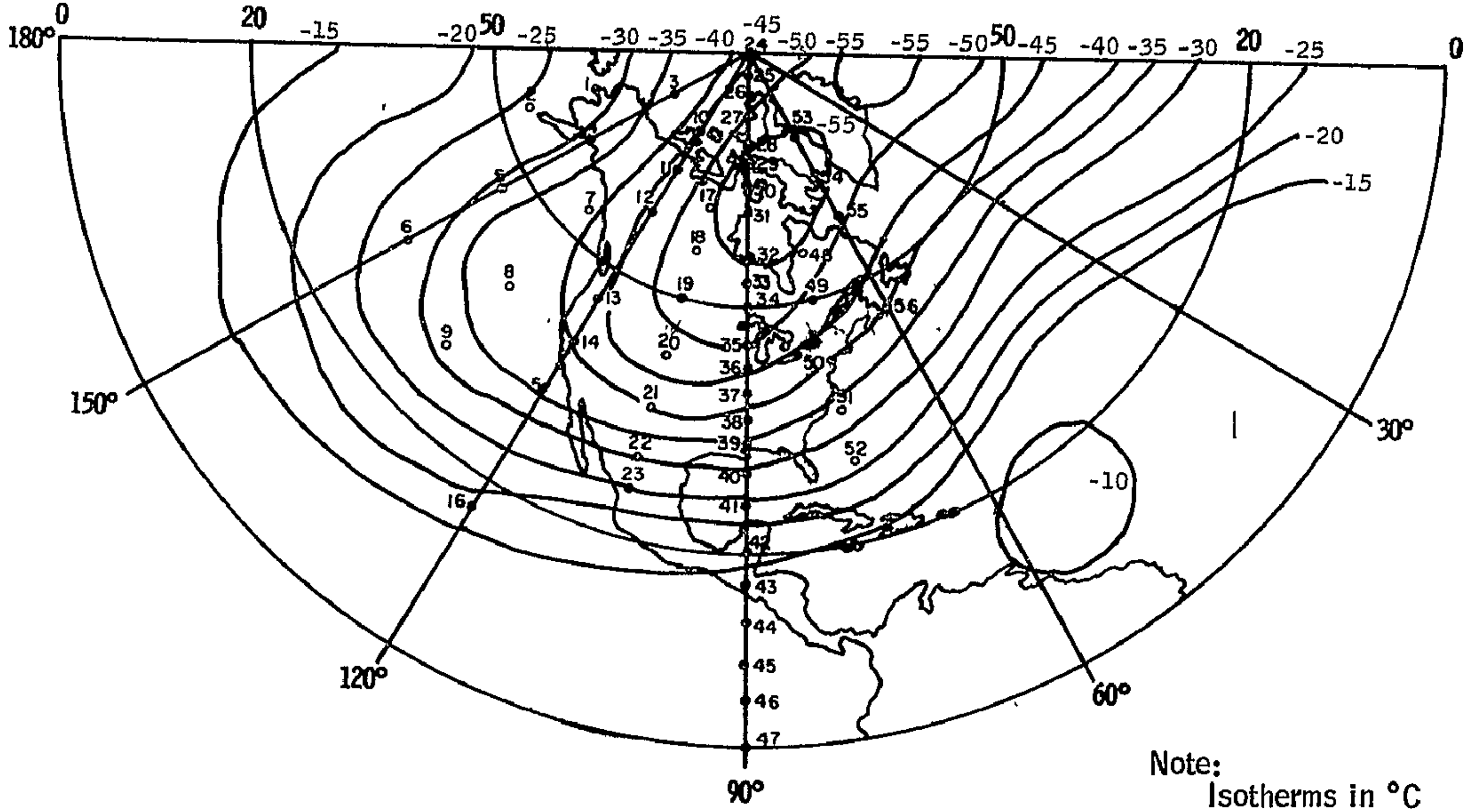

Figure B13. Constant Altitude, Synoptic Temperature Map, 13 November 1966, 39 km

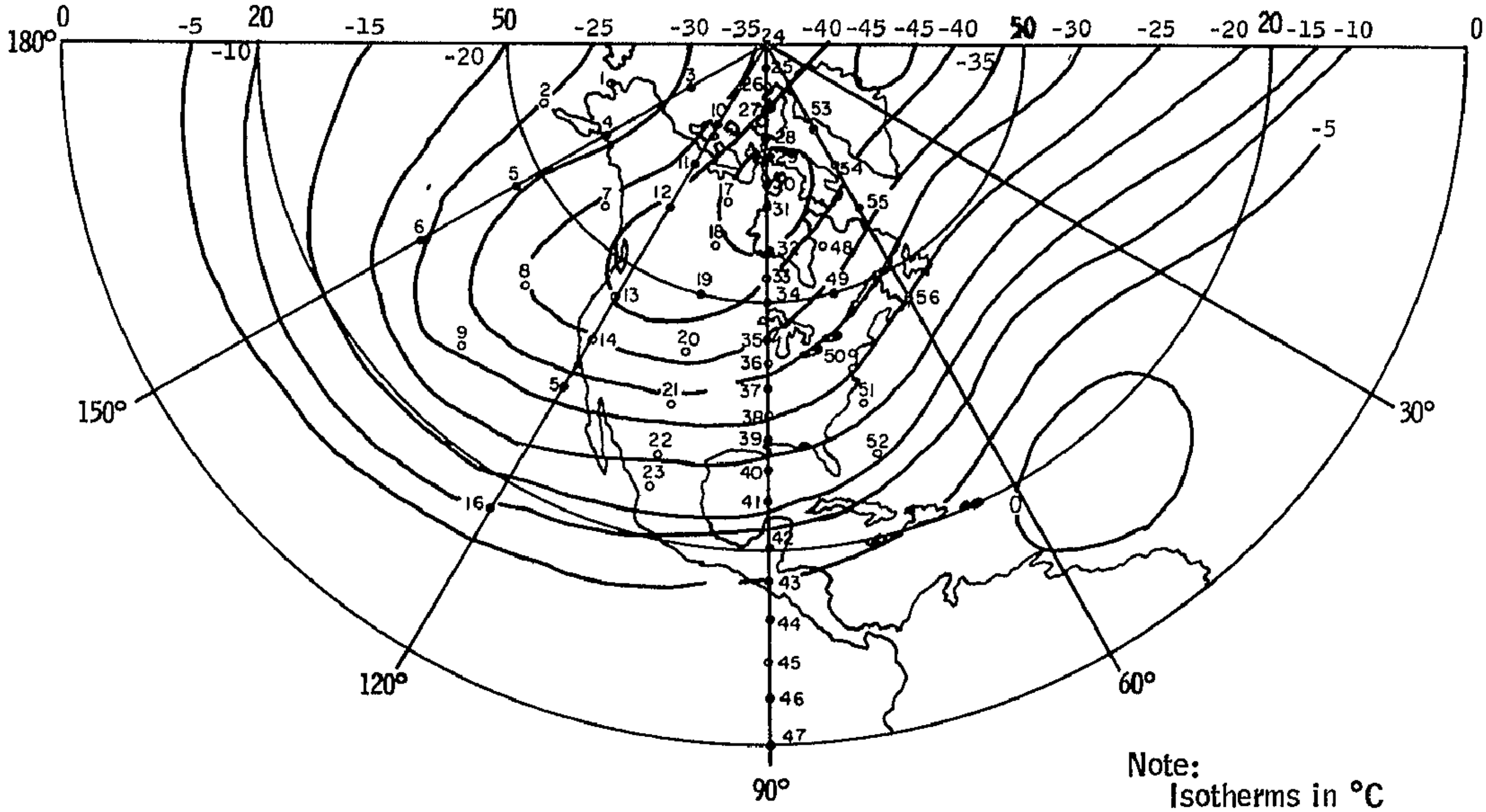

Figure B14 Constant Altitude, Synoptic Temperature Map, 13 November 1966, 42 km

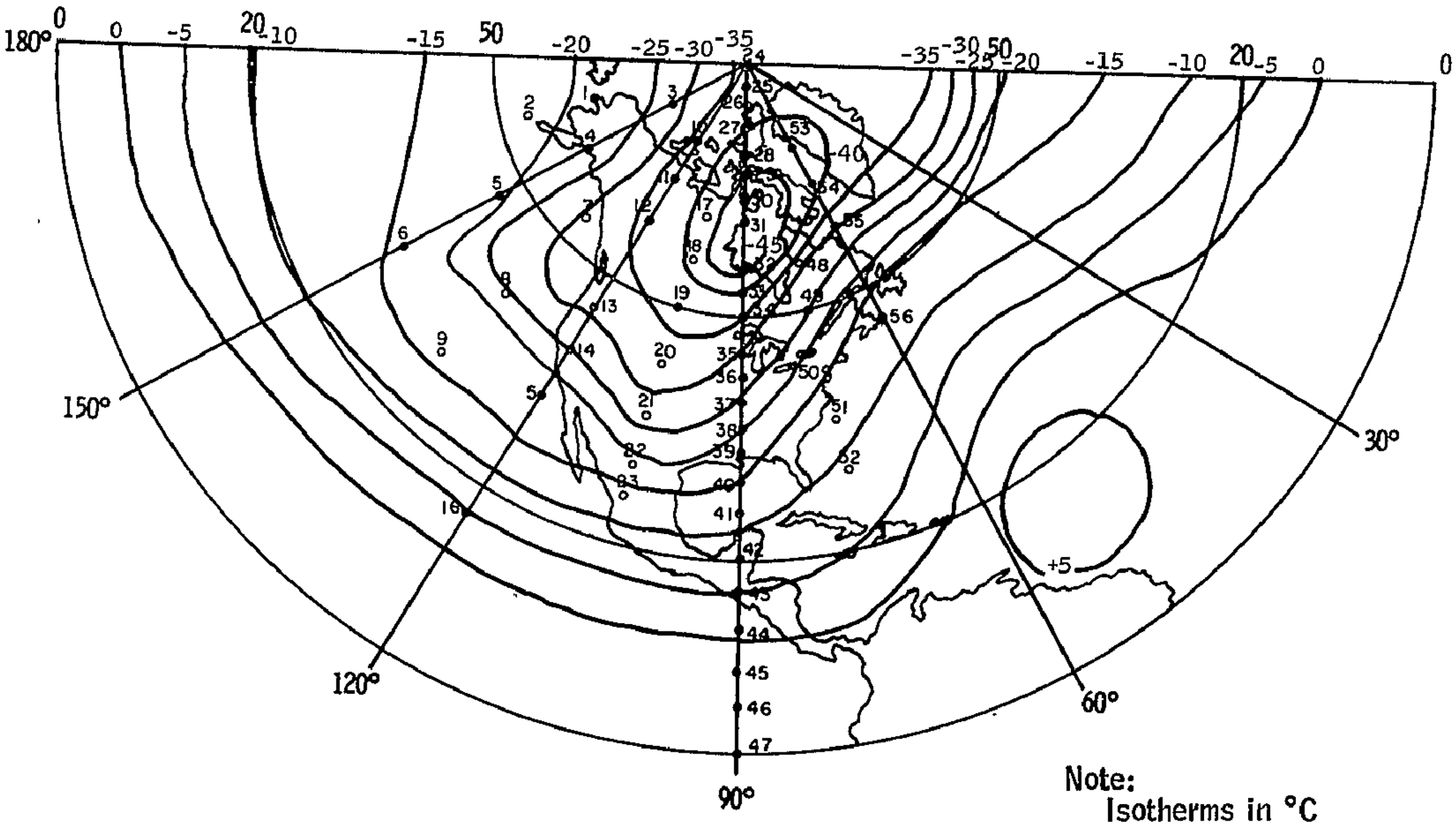

Figure B15. Constant Altitude, Synoptic Temperature Map, 13 November 1966, 45 km

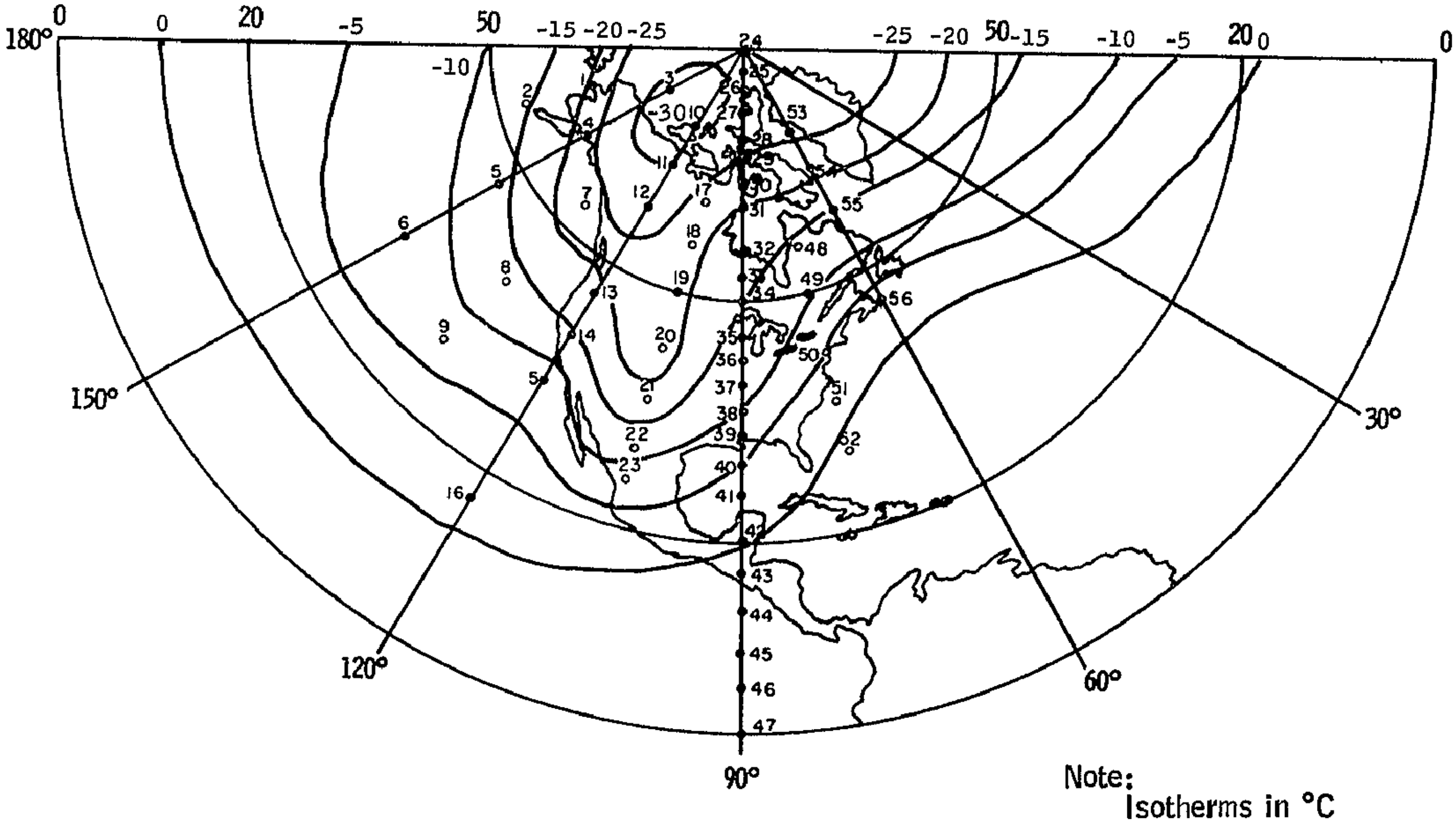

Figure B16. Constant Altitude, Synoptic Temperature Map, 13 November 1966, 48 km

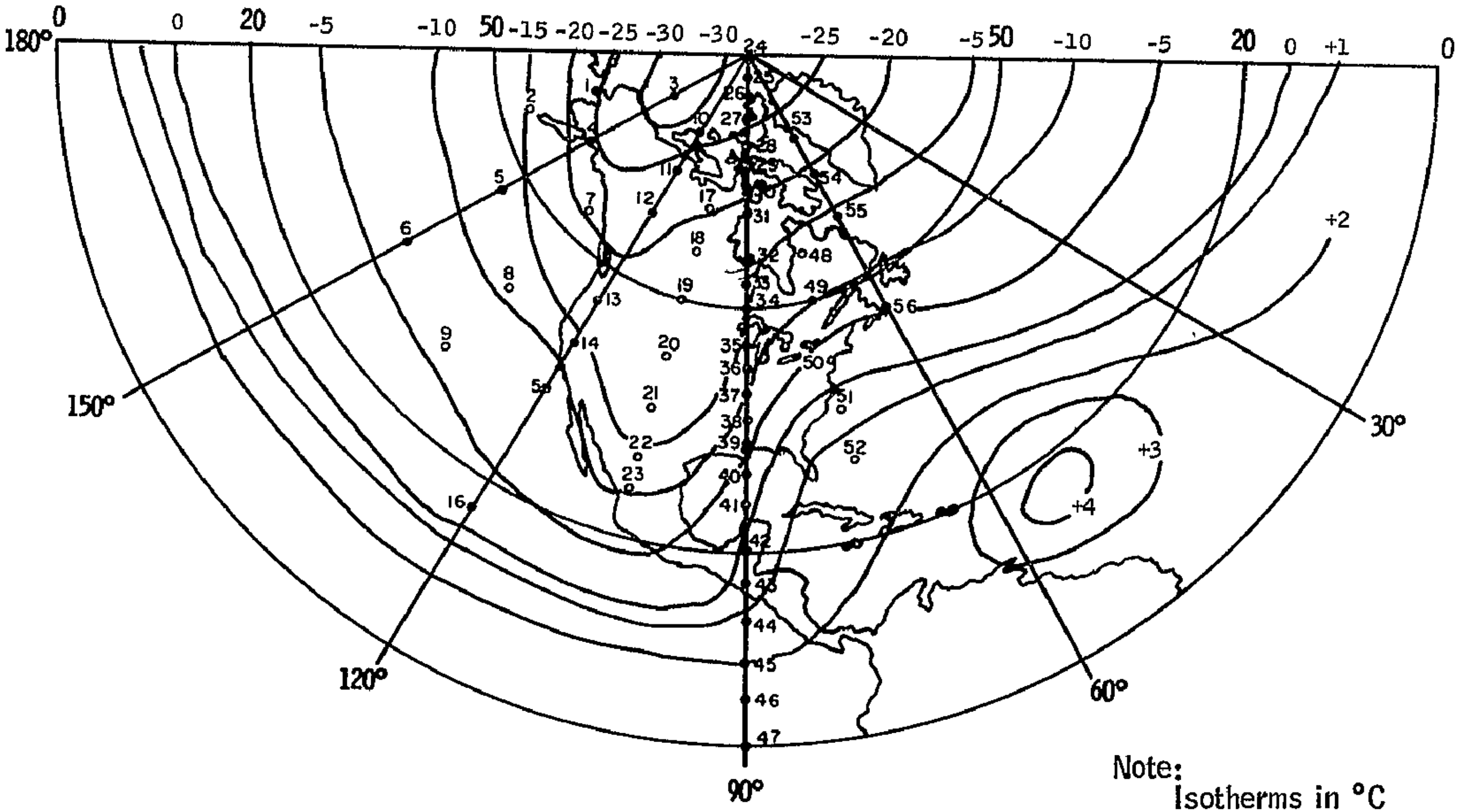

Figure B17 Constant Altitude, Synoptic Temperature Map, 13 November 1966, 51 km

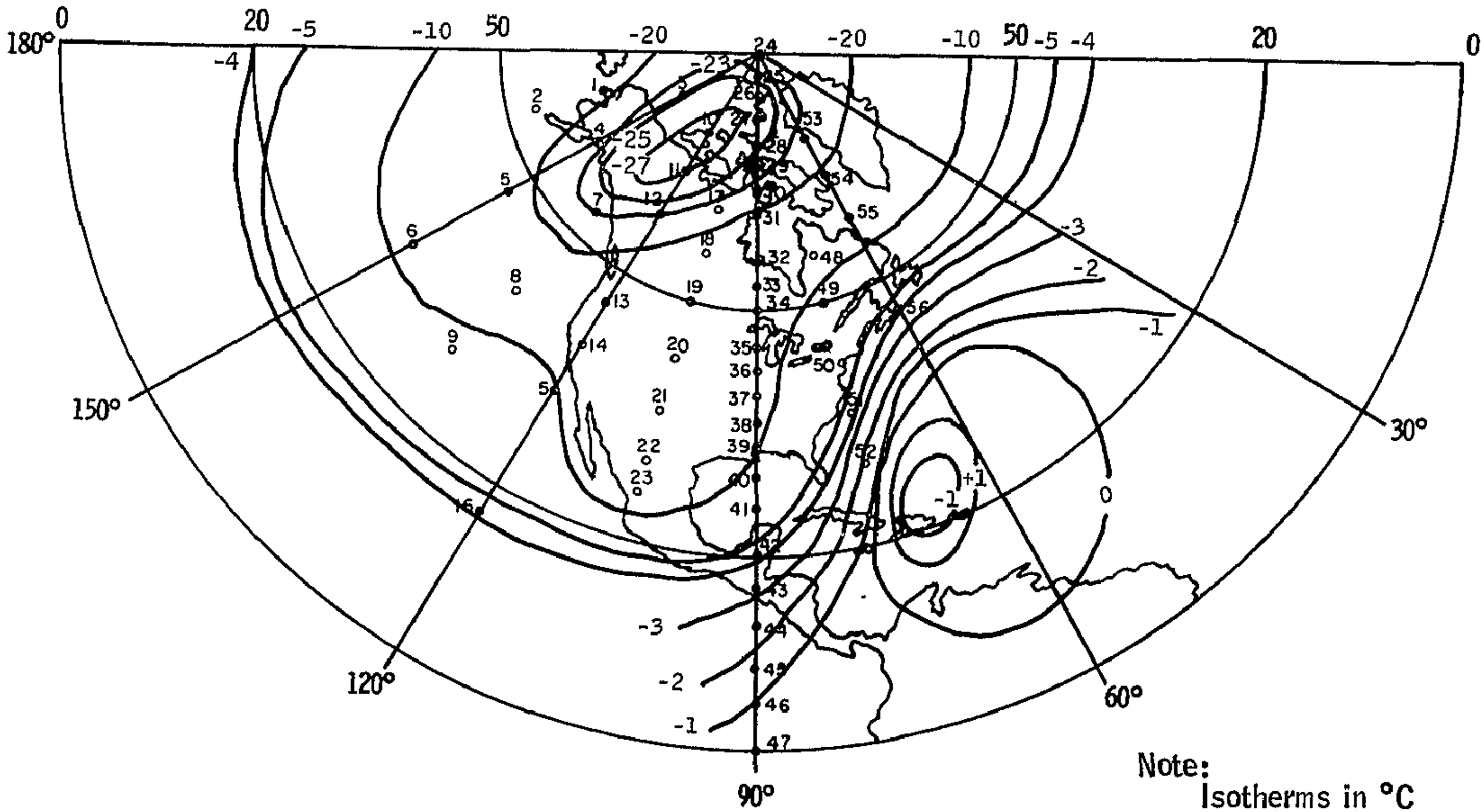

Figure B18 Constant Altitude, Synoptic Temperature Map, 13 November 1966, 54 km

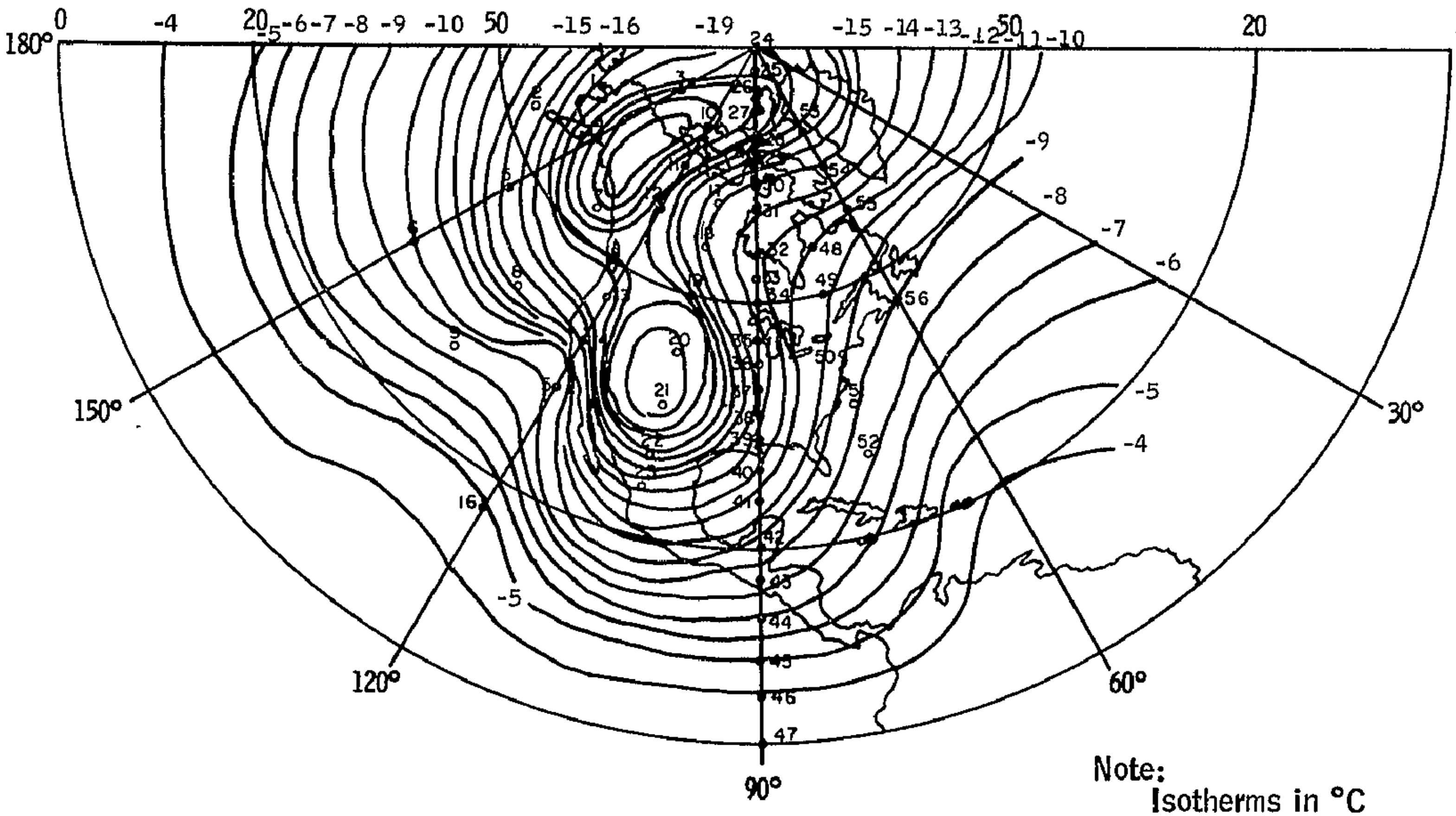

Figure B19. Constant Altitude, Synoptic Temperature Map,
13 November 1966, 57 km

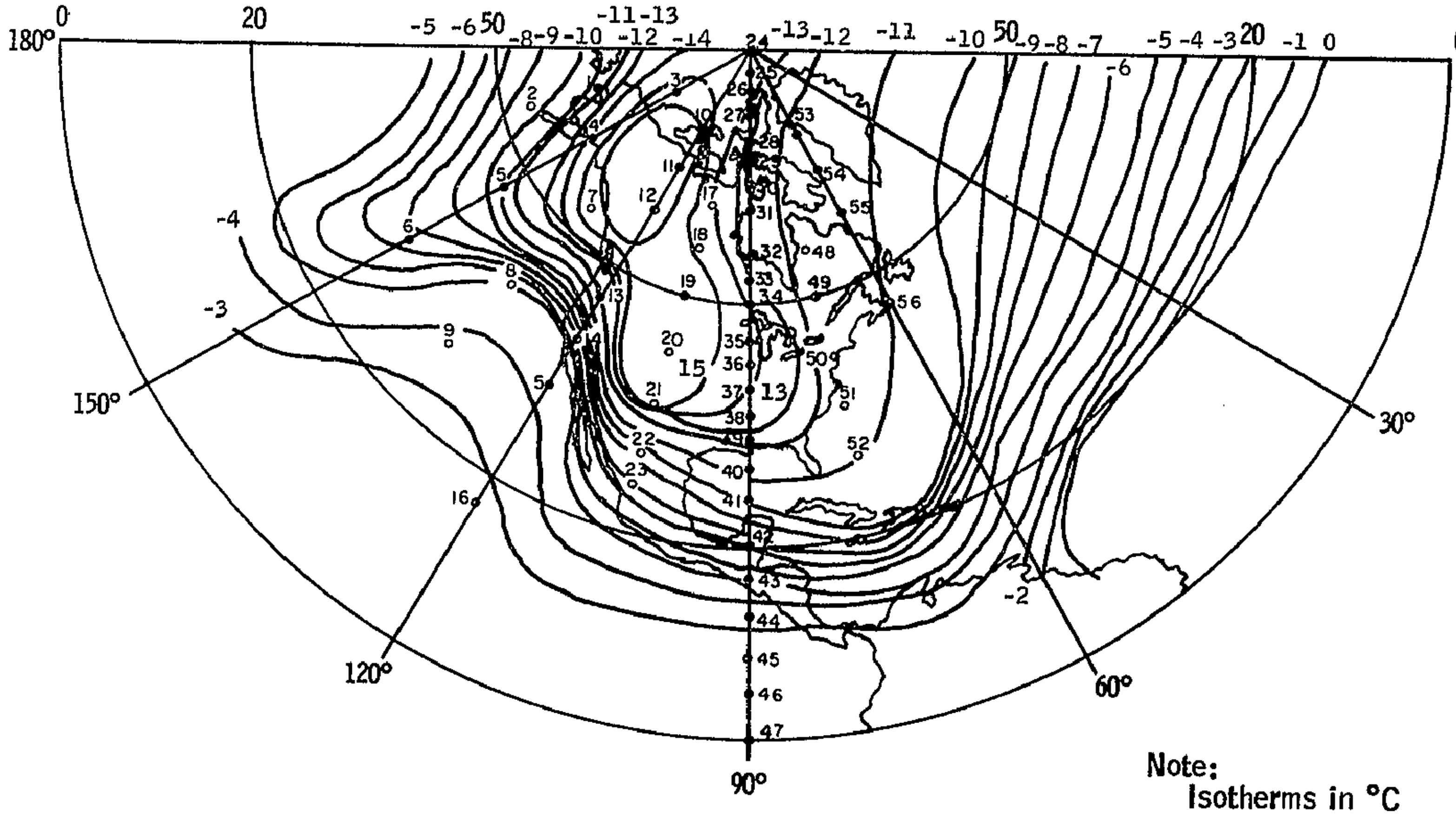

Figure B20. Constant Altitude, Synoptic Temperature Map, 13 November 1966, 60 km

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APPENDIX C
LOCATED ALTITUDES

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APPENDIX C

LOCATED ALTITUDE

The following computer run lists the locations, dates of atmospheric soundings, and located altitudes used in the Located Horizon Variation Study. In the left-hand pages, the first column shows a unique number which was assigned to the soundings. The second column shows either the name of the site where the sounding was obtained or, in the case of synoptic profiles, the number assigned to the grid point at which the interpolations were made. The last three columns are the date that the sounding was taken, the north latitude, and the west longitude of the sounding location or grid point. In the right-hand pages, the located altitudes with corresponding profile number are tabulated.

Profiles synthesized from uninterpolated atmospheric data have been assigned the numbers 1 through 585. Those profiles synthesized from interpolated atmospheric data have been assigned the numbers 1086 through 1197, since these profiles are an extension of the 1085 profiles derived during the Horizon Definition Study.

PROFILE NO.	LOCATION	DATE	LATITUDE	LONGITUDE
1	ANTIGUA	1/ 19/ 65	17.15	61.78
2	ANTIGUA	1/ 20/ 65	17.15	61.78
3	ANTIGUA	1/ 22/ 65	17.15	61.78
4	CAPE KENNEDY	1/ 19/ 65	28.45	80.53
5	CAPE KENNEDY	1/ 20/ 65	28.45	80.53
6	CAPE KENNEDY	1/ 20/ 65	28.45	80.53
7	CAPE KENNEDY	1/ 20/ 65	28.45	80.53
8	CAPE KENNEDY	1/ 22/ 65	28.45	80.53
9	CAPE KENNEDY	1/ 25/ 65	28.45	80.53
10	FORT CHURCHILL	1/ 8/ 65	58.73	93.82
11	FORT CHURCHILL	1/ 13/ 65	58.73	93.82
12	FORT CHURCHILL	1/ 20/ 65	58.73	93.82
13	FORT GREELY	1/ 19/ 65	64.00	145.75
14	FORT GREELY	1/ 22/ 65	64.00	145.75
15	POINT MUGU, CAL.	1/ 15/ 65	34.12	119.12
16	POINT MUGU, CAL.	1/ 20/ 65	34.12	119.12
17	POINT MUGU, CAL.	1/ 21/ 65	34.12	119.12
18	WHITE SANDS	1/ 20/ 65	32.38	106.48
19	FORT CHURCHILL	1/ 27/ 65	58.73	93.82
20	FORT GREELY	1/ 6/ 65	64.00	145.75
21	ANTIGUA	1/ 14/ 66	17.15	61.78
22	ANTIGUA	1/ 17/ 66	17.15	61.78
23	ANTIGUA	1/ 19/ 66	17.15	61.78
24	ANTIGUA	1/ 24/ 66	17.15	61.78
25	ANTIGUA	1/ 26/ 66	17.15	61.78
26	ASCENSION IS.	1/ 14/ 66	-7.98	14.25
27	ASCENSION IS.	1/ 24/ 66	-7.98	14.25
28	ASCENSION IS.	1/ 26/ 66	-7.98	14.25
29	CAPE KENNEDY	1/ 14/ 66	28.45	80.53
30	CAPE KENNEDY	1/ 17/ 66	28.45	80.53
31	CAPE KENNEDY	1/ 18/ 66	28.45	80.53
32	CAPE KENNEDY	1/ 19/ 66	28.45	80.53
33	CAPE KENNEDY	1/ 21/ 66	28.45	80.53
34	CAPE KENNEDY	1/ 24/ 66	28.45	80.53
35	GRAND TURK IS.	1/ 14/ 66	21.43	71.14
36	GRAND TURK IS.	1/ 17/ 66	21.43	71.14
37	GRAND TURK IS.	1/ 19/ 66	21.43	71.14
38	GRAND TURK IS.	1/ 21/ 66	21.43	71.14
39	GRAND TURK IS.	1/ 26/ 66	21.43	71.14
40	FORT CHURCHILL	1/ 14/ 66	58.73	93.82
41	FORT CHURCHILL	1/ 17/ 66	58.73	93.82
42	FORT CHURCHILL	1/ 24/ 66	58.73	93.82
43	FORT GREELY	1/ 16/ 66	64.00	145.75
44	FORT GREELY	1/ 17/ 66	64.00	145.75
45	FORT GREELY	1/ 20/ 66	64.00	145.75
46	BARKING SANDS	1/ 19/ 66	22.03	159.78
47	POINT MUGU, CAL.	1/ 19/ 66	34.12	119.12
48	POINT MUGU, CAL.	1/ 24/ 66	34.12	119.12
49	WHITE SANDS	1/ 19/ 66	32.38	106.48
50	WHITE SANDS	1/ 21/ 66	32.38	106.48

PROFILE NO.	L1(2.0)	L1(3.0)	L2(.15)	L2(.50)	L2(.90)	L3(4.5)	L3(20.0)	L4(2.5)	L4(10.)
1	44.84	40.09	52.49	40.73	28.72	53.46	42.92	45.67	32.25
2	45.55	40.70	52.42	40.71	29.51	53.70	43.37	45.64	32.30
3	46.14	40.65	53.47	40.79	29.86	54.16	44.04	46.47	32.63
4	43.82	38.28	51.27	39.89	27.59	53.29	41.87	45.00	31.37
5	43.96	39.27	51.52	40.91	28.20	53.76	42.05	45.22	31.94
6	44.06	39.47	52.02	40.68	28.35	54.10	42.39	45.57	32.22
7	43.60	39.07	51.53	40.45	28.21	52.89	41.71	44.87	31.64
8	44.01	39.03	51.69	40.21	28.74	52.78	42.00	44.93	31.75
9	43.85	38.88	51.65	39.95	29.69	53.39	42.03	45.03	31.76
10	37.10	30.41	47.91	35.83	21.59	49.75	36.85	42.30	28.01
11	37.35	30.54	48.05	34.45	22.30	49.36	36.93	41.76	27.18
12	34.40	28.76	47.89	32.77	21.13	48.92	35.34	41.14	25.85
13	35.98	30.72	49.90	33.65	22.73	50.68	37.40	42.64	26.88
14	35.30	28.90	48.48	32.99	21.07	50.05	36.19	41.88	26.21
15	40.71	34.26	49.79	36.42	25.63	50.88	39.61	43.50	29.37
16	42.83	36.59	51.87	38.87	27.90	52.44	41.42	45.13	31.22
17	41.86	35.40	50.59	37.83	26.51	51.49	40.44	44.12	30.15
18	40.93	34.52	50.64	37.90	25.41	51.39	39.89	44.04	29.96
19	33.92	28.80	46.67	31.96	20.73	51.55	35.69	41.54	25.28
20	35.94	31.34	46.79	33.06	23.12	49.78	36.39	40.65	25.96
21	44.34	39.45	51.44	39.76	30.56	53.13	42.38	44.89	31.78
22	44.07	38.90	52.24	40.29	29.47	53.37	42.38	45.53	32.12
23	43.93	38.45	51.75	40.33	29.19	52.80	41.98	45.18	31.78
24	44.15	39.39	52.06	40.36	28.63	53.47	42.48	45.43	31.91
25	43.68	38.99	51.72	40.31	28.07	52.94	41.97	45.23	31.83
26	44.51	39.00	51.77	40.49	28.42	53.00	42.37	45.37	31.86
27	45.12	39.72	53.18	40.77	28.39	54.26	43.52	46.55	32.75
28	44.10	38.60	52.45	40.15	28.45	53.06	42.37	45.70	32.03
29	42.61	37.54	50.21	38.87	29.92	52.18	40.86	43.94	30.71
30	42.35	38.05	51.08	39.62	29.03	52.55	40.98	44.54	31.30
31	42.17	37.94	50.01	39.25	28.59	51.93	40.52	43.92	31.00
32	42.77	38.24	50.45	39.35	29.23	52.20	41.02	44.10	31.02
33	43.62	38.97	50.63	39.74	29.82	51.98	41.52	44.21	31.27
34	43.48	37.98	51.63	39.36	28.51	53.29	41.94	45.10	31.43
35	42.95	37.81	51.23	39.40	28.86	52.60	41.35	44.61	31.29
36	43.28	37.97	50.75	40.08	29.31	51.98	41.22	44.47	31.48
37	43.36	38.49	51.13	39.98	28.84	52.27	41.38	44.53	31.48
38	44.27	39.64	51.35	39.82	29.82	52.88	42.32	44.75	31.55
39	43.42	38.56	51.55	40.20	28.00	52.49	41.70	44.89	31.45
40	33.35	26.77	49.75	32.01	20.00	51.12	36.23	43.15	25.95
41	33.85	27.55	48.00	32.59	20.50	49.26	35.37	41.61	25.90
42	33.98	26.91	50.03	32.59	20.19	50.52	36.78	43.15	26.44
43	32.85	28.05	46.96	31.04	21.09	50.61	35.18	41.32	24.75
44	33.07	28.17	46.76	31.21	21.16	49.33	34.59	40.31	24.67
45	32.63	25.89	46.91	31.61	20.24	50.75	34.36	41.71	24.86
46	40.37	33.41	51.46	38.09	26.00	51.75	39.91	44.78	30.57
47	41.40	36.11	50.74	38.44	24.34	52.03	40.09	44.24	30.44
48	41.88	36.22	50.58	38.43	25.58	52.64	40.78	44.18	30.10
49	45.93	41.12	53.41	41.12	30.92	54.20	43.97	46.30	32.98
50	40.32	35.99	49.05	37.20	25.06	51.25	39.30	42.97	29.72

PROFILE NO.	LOCATION	DATE	LATITUDE	LONGITUDE
51	WHITE SANDS	1/ 26/ 66	32.38	106.48
52	ANTIGUA	1/ 12/ 66	17.15	61.78
53	ANTIGUA	1/ 28/ 66	17.15	61.78
54	WALLOPS ISLAND	1/ 5/ 65	37.84	75.46
55	ANTIGUA	1/ 23/ 67	17.15	61.78
56	ANTIGUA	1/ 13/ 67	17.15	61.78
57	FORT SHERMAN	1/ 16/ 67	9.33	79.98
58	FORT SHERMAN	1/ 23/ 67	9.33	79.98
59	FORT SHERMAN	1/ 25/ 67	9.33	79.98
60	CAPE KENNEDY	1/ 16/ 67	28.45	80.53
61	CAPE KENNEDY	1/ 17/ 67	28.45	80.53
62	POINT MUGU, CAL.	1/ 19/ 67	34.12	119.12
63	POINT MUGU, CAL.	1/ 20/ 67	34.12	119.12
64	POINT MUGU, CAL.	1/ 23/ 67	34.12	119.12
65	WHITE SANDS	1/ 18/ 67	32.38	106.48
66	WHITE SANDS	1/ 23/ 67	32.38	106.48
67	FORT CHURCHILL	1/ 16/ 67	58.73	93.82
68	FORT CHURCHILL	1/ 17/ 67	58.73	93.82
69	FORT CHURCHILL	1/ 18/ 67	58.73	93.82
70	FORT CHURCHILL	1/ 19/ 67	58.73	93.82
71	FORT CHURCHILL	1/ 20/ 67	58.73	93.82
72	FORT CHURCHILL	1/ 23/ 67	58.73	93.82
73	FORT CHURCHILL	1/ 24/ 67	58.73	93.82
74	FORT CHURCHILL	1/ 25/ 67	58.73	93.82
75	FORT GREELY	1/ 16/ 67	64.00	145.75
76	FORT GREELY	1/ 19/ 67	64.00	145.75
77	FORT GREELY	1/ 20/ 67	64.00	145.75
78	FORT GREELY	1/ 23/ 67	64.00	145.75
79	FORT GREELY	1/ 25/ 67	64.00	145.75
80	POINT MUGU, CAL.	1/ 17/ 67	34.12	119.12
81	POINT MUGU, CAL.	1/ 16/ 67	34.12	119.12
82	CAPE KENNEDY	1/ 18/ 67	28.45	80.53
83	CAPE KENNEDY	1/ 18/ 67	28.45	80.53
84	CAPE KENNEDY	1/ 19/ 67	28.45	80.53
85	CAPE KENNEDY	1/ 20/ 67	28.45	80.53
86	CAPE KENNEDY	1/ 23/ 67	28.45	80.53
87	CAPE KENNEDY	1/ 24/ 67	28.45	80.53
88	FORT CHURCHILL	6/ 2/ 65	58.73	93.82
89	FORT GREELY	6/ 7/ 65	64.00	145.75
90	FORT GREELY	6/ 9/ 65	64.00	145.75
91	ANTIGUA	8/ 4/ 65	17.15	61.78
92	ANTIGUA	8/ 6/ 65	17.15	61.78
93	ANTIGUA	8/ 9/ 65	17.15	61.78
94	ANTIGUA	8/ 11/ 65	17.15	61.78
95	ANTIGUA	8/ 13/ 65	17.15	61.78
96	ANTIGUA	8/ 20/ 65	17.15	61.78
97	ANTIGUA	10/ 22/ 65	17.15	61.78
98	ANTIGUA	10/ 25/ 65	17.15	61.78
99	ANTIGUA	10/ 27/ 65	17.15	61.78
100	ANTIGUA	11/ 1/ 65	17.15	61.78

PROFILE NO.	L1(2.0)	L1(3.0)	L2(.15)	L2(.50)	L2(.90)	L3(4.5)	L3(20.0)	L4(2.5)	L4(10.)
51	42.81	37.67	51.30	38.66	27.32	53.24	41.51	44.59	30.85
52	43.27	38.53	51.18	39.90	29.44	52.38	41.48	44.55	31.39
53	43.58	38.25	51.86	40.27	27.49	52.92	41.85	45.41	31.92
54	42.49	34.96	51.61	38.64	24.28	52.04	41.01	44.88	30.54
55	43.89	38.34	51.55	39.98	28.63	52.61	41.88	44.93	31.70
56	43.65	38.81	51.70	39.50	29.41	53.24	42.05	44.83	31.40
57	43.16	38.86	51.47	39.87	28.55	52.58	41.59	44.76	31.63
58	43.53	38.64	51.59	39.83	27.94	52.70	41.83	44.88	31.54
59	43.76	39.04	51.61	40.09	29.07	52.93	41.98	44.92	31.67
60	43.10	37.03	51.45	39.28	27.25	52.46	41.49	44.93	31.21
61	43.05	37.44	50.92	39.50	27.39	51.96	41.16	44.39	31.08
62	41.82	36.44	50.45	37.64	26.89	51.71	40.52	43.91	30.16
63	40.77	35.62	49.29	37.20	26.31	51.16	39.45	42.95	29.43
64	41.54	36.05	49.91	37.29	25.90	51.79	40.35	43.57	29.56
65	42.00	36.98	50.67	38.60	27.15	51.81	40.67	44.10	30.68
66	41.91	36.27	50.13	38.17	26.40	51.16	40.28	43.60	30.02
67	42.09	38.34	48.70	40.15	25.46	49.88	39.52	42.63	30.72
68	41.71	38.16	48.39	39.23	27.83	50.23	39.32	42.29	30.68
69	41.03	36.43	49.86	38.88	26.84	50.63	39.39	43.35	30.49
70	40.89	36.39	47.85	38.45	25.40	49.39	38.61	41.93	29.52
71	39.49	35.58	46.64	37.04	26.28	50.20	37.70	41.22	28.80
72	37.97	33.89	45.92	35.59	24.17	48.68	36.32	40.10	27.20
73	37.68	32.53	47.26	35.24	23.71	48.86	36.41	40.52	27.17
74	41.78	37.24	46.91	40.00	23.32	49.35	38.72	42.05	30.20
75	40.24	36.02	47.29	36.67	25.30	49.93	38.45	41.18	28.20
76	39.95	35.35	47.35	35.56	24.63	50.53	38.57	41.16	27.69
77	39.20	34.56	46.32	34.97	23.66	49.88	37.68	40.42	27.02
78	39.01	34.03	46.91	34.84	24.02	51.20	38.02	41.23	27.24
79	37.23	32.97	48.56	34.66	23.23	50.63	37.58	41.91	27.08
80	43.52	38.71	50.65	39.21	27.50	52.96	41.67	44.36	31.08
81	42.30	36.55	51.14	38.46	26.53	52.52	41.19	44.72	30.73
82	42.11	36.77	50.05	38.87	27.30	51.19	40.16	43.74	30.58
83	42.95	37.71	50.99	39.46	27.71	52.00	41.12	44.33	31.00
84	42.43	36.92	50.79	38.62	28.14	51.71	40.78	44.06	30.53
85	41.90	36.42	50.51	38.69	27.94	51.33	40.44	44.13	30.65
86	43.25	37.98	50.79	39.56	28.58	51.98	41.27	44.42	31.20
87	44.44	38.54	52.22	40.62	28.31	53.03	42.39	45.47	31.95
88	46.55	42.38	52.27	40.82	28.90	53.92	44.10	45.39	32.25
89	47.05	42.56	53.41	40.53	26.40	55.45	45.12	46.33	32.36
90	46.38	41.65	51.72	39.91	26.48	54.45	44.05	45.34	31.74
91	44.25	38.69	51.64	39.35	28.42	52.70	42.20	44.85	31.30
92	43.71	38.74	51.44	39.35	28.08	52.56	41.87	44.64	31.20
93	43.20	37.73	51.51	38.93	27.69	52.34	41.57	44.74	31.27
94	43.71	38.40	51.63	39.34	27.92	52.51	41.80	44.75	31.22
95	42.49	37.37	51.23	39.09	27.62	52.12	41.00	44.38	30.84
96	42.75	37.57	50.68	38.57	28.35	51.96	41.04	44.02	30.67
97	43.84	38.78	51.88	39.74	27.94	53.13	42.19	45.00	31.50
98	44.00	39.80	51.88	40.62	27.77	52.92	42.24	45.12	31.88
99	43.31	39.51	50.23	39.72	29.28	52.09	41.31	43.69	31.04
100	41.49	36.24	49.96	38.15	26.51	51.19	39.95	43.44	29.94

PROFILE NO.	LOCATION	DATE	LATITUDE	LONGITUDE
101	ANTIGUA	12/ 8/ 65	17.15	61.78
102	ANTIGUA	12/ 15/ 65	17.15	61.78
103	ANTIGUA	12/ 17/ 65	17.15	61.78
104	ANTIGUA	12/ 20/ 65	17.15	61.78
105	CAPE KENNEDY	8/ 6/ 65	28.45	80.53
106	CAPE KENNEDY	8/ 9/ 65	28.45	80.53
107	CAPE KENNEDY	8/ 13/ 65	28.45	80.53
108	CAPE KENNEDY	8/ 16/ 65	28.45	80.53
109	CAPE KENNEDY	8/ 18/ 65	28.45	80.53
110	POINT MUGU, CAL.	8/ 9/ 65	34.12	119.12
111	POINT MUGU, CAL.	8/ 11/ 65	34.12	119.12
112	POINT MUGU, CAL.	8/ 16/ 65	34.12	119.12
113	WHITE SANDS	8/ 7/ 65	32.38	106.48
114	WHITE SANDS	8/ 11/ 65	32.38	106.48
115	GRAND TURK IS.	8/ 13/ 65	21.43	71.14
116	FORT CHURCHILL	8/ 7/ 65	58.73	93.82
117	FORT CHURCHILL	8/ 7/ 65	58.73	93.82
118	FORT CHURCHILL	8/ 8/ 65	58.73	93.82
119	FORT CHURCHILL	8/ 8/ 65	58.73	93.82
120	FORT CHURCHILL	8/ 11/ 65	58.73	93.82
121	FORT CHURCHILL	8/ 16/ 65	58.73	93.82
122	FORT GREELY	8/ 12/ 65	64.00	145.75
123	FORT GREELY	8/ 13/ 65	64.00	145.75
124	FORT GREELY	8/ 16/ 65	64.00	145.75
125	ANTIGUA	4/ 1/ 66	17.15	61.78
126	ANTIGUA	3/ 28/ 66	17.15	61.78
127	ANTIGUA	4/ 6/ 66	17.15	61.78
128	ANTIGUA	4/ 13/ 66	17.15	61.78
129	ANTIGUA	4/ 15/ 66	17.15	61.78
130	CAPE KENNEDY	4/ 5/ 66	28.45	80.53
131	CAPE KENNEDY	4/ 6/ 66	28.45	80.53
132	CAPE KENNEDY	4/ 7/ 66	28.45	80.53
133	CAPE KENNEDY	4/ 8/ 66	28.45	80.53
134	POINT MUGU, CAL.	4/ 6/ 66	34.12	119.12
135	POINT MUGU, CAL.	4/ 13/ 66	34.12	119.12
136	WHITE SANDS	4/ 7/ 66	32.38	106.48
137	WHITE SANDS	4/ 13/ 66	32.38	106.48
138	GRAND TURK IS.	4/ 4/ 66	21.43	71.14
139	GRAND TURK IS.	4/ 6/ 66	21.43	71.14
140	GRAND TURK IS.	4/ 8/ 66	21.43	71.14
141	GRAND TURK IS.	4/ 11/ 66	21.43	71.14
142	GRAND TURK IS.	11/ 15/ 65	21.43	71.14
143	FORT CHURCHILL	11/ 8/ 65	58.73	93.82
144	FORT CHURCHILL	11/ 9/ 65	58.73	93.82
145	FORT CHURCHILL	11/ 10/ 65	58.73	93.82
146	FORT CHURCHILL	11/ 15/ 65	58.73	93.82
147	FORT GREELY	11/ 10/ 65	64.00	145.75
148	FORT GREELY	11/ 11/ 65	64.00	145.75
149	FORT GREELY	11/ 17/ 65	64.00	145.75
150	ANTIGUA	11/ 29/ 65	17.15	61.78

PROFILE NO.	L1(2.0)	L1(3.0)	L2(.15)	L2(.50)	L2(.90)	L3(4.5)	L3(20.0)	L4(2.5)	L4(10.)
101	43.52	39.17	51.65	39.84	29.41	52.84	41.94	44.94	31.90
102	44.26	39.90	52.17	40.72	30.22	53.20	42.47	45.38	32.29
103	42.85	38.00	51.56	39.75	28.25	52.87	41.44	44.93	31.58
104	44.09	39.83	51.97	40.35	30.54	53.26	42.50	45.16	31.98
105	43.32	38.27	51.13	38.98	28.06	52.36	41.68	44.49	30.97
106	42.09	36.67	50.09	37.96	27.04	51.97	40.57	43.85	30.21
107	43.06	38.07	50.94	39.05	27.51	52.12	41.28	44.24	30.86
108	43.03	37.92	50.98	38.65	27.71	52.49	41.47	44.35	30.79
109	41.91	37.34	50.28	38.81	26.78	51.82	40.48	43.83	30.52
110	43.01	38.34	49.85	38.89	28.06	52.32	40.98	43.60	30.53
111	43.53	38.28	50.76	38.75	28.16	52.52	41.62	44.28	30.93
112	43.51	37.86	50.66	38.83	27.39	52.26	41.46	44.23	30.81
113	42.48	38.13	50.47	39.36	27.32	51.59	40.68	43.69	30.60
114	43.42	37.54	52.55	39.05	27.22	53.48	42.34	45.77	31.57
115	43.18	38.72	51.19	39.57	28.54	52.37	41.55	44.37	30.98
116	45.76	40.82	51.97	39.10	27.10	54.51	43.85	45.29	31.31
117	45.55	40.85	52.22	39.47	26.86	54.31	43.74	45.36	31.48
118	44.43	39.66	51.36	38.99	26.04	53.05	42.45	44.45	30.72
119	44.97	40.15	51.55	39.22	26.86	53.83	43.12	44.87	31.08
120	45.47	41.02	51.73	39.71	26.85	54.03	43.45	45.07	31.42
121	45.26	40.48	51.71	39.28	26.05	53.60	43.24	44.86	31.10
122	43.79	38.57	51.45	39.08	25.00	52.91	42.09	44.75	30.88
123	43.73	37.95	51.50	38.42	25.30	53.13	42.16	44.78	30.64
124	42.78	36.96	51.51	38.04	24.76	53.10	41.66	44.77	30.37
125	44.03	39.65	51.76	39.99	29.68	53.24	42.38	44.95	31.57
126	43.66	38.73	51.37	39.62	28.75	52.61	41.75	44.72	31.56
127	44.55	39.87	51.73	39.91	29.19	53.30	42.66	45.01	31.67
128	44.46	39.90	51.39	40.00	29.01	53.02	42.41	44.75	31.60
129	44.85	40.30	51.31	40.06	31.27	53.44	42.74	44.84	32.02
130	43.93	39.58	51.64	39.64	28.34	53.20	42.42	44.87	31.38
131	42.85	38.15	51.11	39.04	28.34	52.44	41.37	44.41	30.95
132	43.19	38.70	51.33	39.45	28.20	52.75	41.69	44.55	31.05
133	43.65	38.45	51.26	38.91	28.65	52.59	41.87	44.55	31.05
134	42.95	37.97	51.11	38.74	28.65	53.19	41.58	44.55	30.85
135	43.22	38.31	50.73	38.70	28.09	53.10	41.63	44.30	30.75
136	43.35	37.84	50.68	38.18	27.91	53.00	41.70	44.30	30.55
137	44.28	39.76	51.18	39.29	29.20	53.23	42.45	44.52	31.25
138	43.81	38.81	51.54	39.43	29.06	53.07	42.05	44.82	31.49
139	43.79	38.76	51.71	39.44	29.43	53.10	42.09	44.99	31.67
140	44.04	39.69	51.58	39.87	29.83	53.35	42.38	44.88	31.70
141	44.40	40.07	51.68	40.34	29.24	53.16	42.49	44.98	31.82
142	42.82	37.82	51.14	39.04	27.61	52.98	41.56	44.73	31.17
143	35.20	27.22	50.49	35.23	20.86	51.99	37.30	44.73	28.66
144	36.51	29.59	50.10	35.96	21.11	50.27	37.39	43.63	28.86
145	34.47	25.70	47.84	34.90	20.70	48.30	35.05	41.83	27.12
146	37.51	30.16	50.62	36.40	21.68	50.63	37.68	43.66	28.76
147	35.51	28.88	50.64	34.10	21.84	51.76	37.51	44.00	27.76
148	35.63	28.27	51.48	34.38	21.27	51.87	37.78	44.40	28.00
149	35.73	30.90	46.92	33.27	22.65	49.06	35.99	40.49	26.00
150	43.52	38.83	51.41	39.86	29.00	52.95	41.85	44.78	31.53

PROFILE NO.	LOCATION	DATE	LATITUDE	LONGITUDE
151	CAPE KENNEDY	10/ 18/ 65	28.45	80.53
152	CAPE KENNEDY	10/ 20/ 65	28.45	80.53
153	CAPE KENNEDY	10/ 22/ 65	28.45	80.53
154	CAPE KENNEDY	10/ 26/ 65	28.45	80.53
155	POINT MUGU, CAL.	10/ 20/ 65	34.12	119.12
156	POINT MUGU, CAL.	10/ 27/ 65	34.12	119.12
157	WHITE SANDS	10/ 15/ 65	32.38	106.48
158	WHITE SANDS	10/ 21/ 65	32.38	106.48
159	WHITE SANDS	10/ 25/ 65	32.38	106.48
160	GRAND TURK IS.	10/ 25/ 65	21.43	71.14
161	GRAND TURK IS.	10/ 27/ 65	21.43	71.14
162	FORT CHURCHILL	10/ 23/ 65	58.73	93.82
163	FORT GREELY	10/ 14/ 65	64.00	145.75
164	FORT GREELY	10/ 26/ 65	64.00	145.75
165	FORT GREELY	10/ 29/ 65	64.00	145.75
166	ANTIGUA	11/ 4/ 66	17.15	61.78
167	ANTIGUA	11/ 7/ 66	17.15	61.78
168	ANTIGUA	11/ 16/ 66	17.15	61.78
169	CAPE KENNEDY	11/ 9/ 66	28.45	80.53
170	CAPE KENNEDY	11/ 9/ 66	28.45	80.53
171	CAPE KENNEDY	11/ 10/ 66	28.45	80.53
172	CAPE KENNEDY	11/ 11/ 66	28.45	80.53
173	CAPE KENNEDY	11/ 14/ 66	28.45	80.53
174	CAPE KENNEDY	11/ 15/ 66	28.45	80.53
175	CAPE KENNEDY	11/ 16/ 66	28.45	80.53
176	POINT MUGU, CAL.	11/ 10/ 66	34.12	119.12
177	POINT MUGU, CAL.	11/ 14/ 66	34.12	119.12
178	POINT MUGU, CAL.	11/ 15/ 66	34.12	119.12
179	WHITE SANDS	11/ 11/ 66	32.38	106.48
180	WHITE SANDS	11/ 8/ 66	32.38	106.48
181	GRAND TURK IS.	11/ 15/ 66	21.43	71.14
182	FORT CHURCHILL	11/ 8/ 66	58.73	93.82
183	FORT CHURCHILL	11/ 10/ 66	58.73	93.82
184	FORT GREELY	11/ 10/ 66	64.00	145.75
185	FORT GREELY	11/ 14/ 66	64.00	145.75
186	FORT CHURCHILL	3/ 17/ 65	58.73	93.82
187	FORT CHURCHILL	3/ 19/ 65	58.73	93.82
188	FORT CHURCHILL	3/ 23/ 65	58.73	93.82
189	FORT CHURCHILL	3/ 24/ 65	58.73	93.82
190	FORT CHURCHILL	3/ 25/ 65	58.73	93.82
191	FORT GREELY	3/ 20/ 65	64.00	145.75
192	FORT GREELY	3/ 21/ 65	64.00	145.75
193	FORT GREELY	3/ 22/ 65	64.00	145.75
194	FORT GREELY	3/ 22/ 65	64.00	145.75
195	FORT GREELY	3/ 22/ 65	64.00	145.75
196	FORT GREELY	3/ 23/ 65	64.00	145.75
197	FORT GREELY	3/ 24/ 65	64.00	145.75
198	FORT GREELY	3/ 25/ 65	64.00	145.75
199	CAPE KENNEDY	6/ 3/ 65	28.45	80.53
200	ANTIGUA	4/ 2/ 65	17.15	61.78

PROFILE NO.	L1(2.0)	L1(3.0)	L2(.15)	L2(.50)	L2(.90)	L3(4.5)	L3(20.0)	L4(2.5)	L4(10.)
151	44.45	39.54	51.87	39.82	29.09	53.29	42.61	45.09	31.55
152	43.02	38.15	51.31	39.32	28.20	52.51	41.41	44.52	31.06
153	43.62	38.13	51.87	39.61	27.30	53.18	42.05	45.20	31.28
154	43.60	38.73	51.31	39.79	27.42	52.51	41.70	44.60	31.19
155	41.71	35.77	51.77	38.53	26.11	52.38	40.66	44.66	30.54
156	42.09	36.44	51.49	38.44	26.61	51.97	41.02	44.66	30.63
157	38.56	33.64	47.37	36.39	25.78	49.44	37.35	41.53	28.19
158	42.60	36.94	51.43	39.03	26.13	51.96	41.08	44.62	30.77
159	42.55	36.63	51.49	38.70	26.17	52.95	41.37	44.94	30.82
160	43.92	38.96	51.49	39.90	28.55	52.73	42.00	44.73	31.32
161	43.04	38.41	51.33	39.46	27.48	52.49	41.57	44.67	31.30
162	38.22	32.95	49.26	35.51	24.19	50.85	38.19	42.64	28.06
163	37.49	30.68	49.58	34.24	21.66	50.59	38.24	42.90	27.39
164	37.22	31.26	48.09	35.10	22.77	49.14	36.70	41.49	27.20
165	37.27	31.38	48.52	35.05	22.14	49.90	37.27	41.95	27.21
166	44.79	40.16	52.19	40.61	28.34	53.44	42.84	45.37	31.92
167	44.44	39.91	52.08	40.03	28.73	53.51	42.72	45.15	31.83
168	45.07	40.83	51.73	40.73	30.02	53.56	42.95	45.15	32.17
169	44.48	40.33	51.57	40.55	31.32	53.13	42.47	44.91	32.16
170	42.63	37.52	50.89	38.53	27.88	52.76	41.23	44.28	30.51
171	42.57	37.37	51.11	38.46	28.25	52.49	41.28	44.37	30.63
172	40.50	35.23	50.90	37.34	26.80	51.82	40.04	44.03	29.81
173	43.25	37.34	52.06	39.06	27.48	52.86	41.92	45.24	31.11
174	42.30	36.38	50.98	38.54	27.39	51.90	40.84	44.37	30.56
175	44.22	38.44	51.48	38.95	28.13	52.93	42.26	44.86	31.14
176	40.97	35.56	50.81	37.44	26.98	51.97	40.21	44.14	30.08
177	39.38	33.40	50.43	36.69	26.08	51.99	39.39	44.16	29.51
178	39.45	33.83	50.05	36.96	26.04	51.01	39.09	43.61	29.44
179	38.78	33.45	48.93	36.04	26.29	50.56	38.35	42.52	28.44
180	39.48	33.58	49.66	36.41	26.06	50.83	38.78	43.16	28.97
181	43.73	39.33	51.61	40.04	28.28	52.99	42.06	44.86	31.51
182	34.13	27.49	47.77	32.88	20.58	49.28	35.12	41.50	25.98
183	33.04	26.37	48.16	32.42	20.04	49.11	34.69	41.58	25.71
184	36.97	31.87	48.18	33.96	22.68	51.05	37.62	41.93	26.74
185	39.52	34.93	47.44	35.66	23.90	51.32	38.55	41.69	27.75
186	40.95	36.27	50.33	37.00	23.99	53.23	40.61	43.86	29.40
187	41.21	35.30	50.55	37.05	25.44	52.02	40.36	43.82	29.51
188	41.45	36.51	48.91	33.95	25.19	54.48	41.42	43.09	27.52
189	41.95	36.36	49.01	34.24	24.88	52.25	40.78	42.43	27.55
190	41.22	35.70	48.75	35.29	25.47	51.56	39.94	42.24	27.80
191	40.50	35.01	49.22	36.14	24.87	51.27	39.53	42.77	28.51
192	40.30	35.31	50.09	36.22	24.58	52.68	40.28	43.66	28.99
193	39.98	34.89	50.65	36.26	24.64	52.40	40.08	43.76	28.91
194	39.29	34.02	48.91	35.97	24.09	50.91	38.66	42.39	28.20
195	39.56	34.56	48.87	35.79	24.15	51.11	38.81	42.36	28.24
196	41.78	35.76	50.77	37.14	24.83	52.78	40.91	44.15	29.52
197	41.80	36.56	50.87	37.29	24.45	53.15	41.21	44.31	29.65
198	38.85	33.46	49.30	35.66	23.75	51.05	38.44	42.70	28.22
199	43.62	38.82	51.33	39.02	28.12	52.95	42.04	44.59	30.99
200	43.99	39.07	51.88	40.00	28.72	53.01	42.24	45.11	31.71

PROFILE NO.	LOCATION	DATE	LATITUDE	LONGITUDE
201	ANTIGUA	4/ 5/ 65	17.15	61.78
202	ANTIGUA	4/ 7/ 65	17.15	61.78
203	ANTIGUA	4/ 14/ 65	17.15	61.78
204	CAPE KENNEDY	4/ 7/ 65	28.45	80.53
205	CAPE KENNEDY	4/ 7/ 65	28.45	80.53
206	CAPE KENNEDY	4/ 8/ 65	28.45	80.53
207	CAPE KENNEDY	4/ 8/ 65	28.45	80.53
208	FORT CHURCHILL	11/ 13/ 64	58.73	93.82
209	CAPE KENNEDY	4/ 9/ 65	28.45	80.53
210	CAPE KENNEDY	4/ 12/ 65	28.45	80.53
211	CAPE KENNEDY	4/ 12/ 65	28.45	80.53
212	POINT MUGU, CAL.	4/ 6/ 65	34.12	119.12
213	GRAND TURK IS.	4/ 7/ 65	21.43	71.14
214	WHITE SANDS	6/ 2/ 65	32.38	106.48
215	GRAND TURK IS.	6/ 4/ 65	21.43	71.14
216	GRAND TURK IS.	6/ 7/ 65	21.43	71.14
217	ANTIGUA	8/ 10/ 66	17.15	61.78
218	ANTIGUA	8/ 19/ 66	17.15	61.78
219	ANTIGUA	8/ 22/ 66	17.15	61.78
220	CAPE KENNEDY	8/ 9/ 66	28.45	80.53
221	CAPE KENNEDY	8/ 10/ 66	28.45	80.53
222	CAPE KENNEDY	8/ 11/ 66	28.45	80.53
223	CAPE KENNEDY	8/ 12/ 66	28.45	80.53
224	CAPE KENNEDY	8/ 15/ 66	28.45	80.53
225	GRAND TURK IS.	8/ 13/ 66	21.43	71.14
226	FORT GREELY	4/ 4/ 66	64.00	145.75
227	FORT GREELY	4/ 6/ 66	64.00	145.75
228	FORT GREELY	4/ 7/ 66	64.00	145.75
229	FORT GREELY	4/ 8/ 66	64.00	145.75
230	FORT GREELY	4/ 11/ 66	64.00	145.75
231	FORT GREELY	4/ 12/ 66	64.00	145.75
232	FORT GREELY	4/ 14/ 66	64.00	145.75
233	CAPE KENNEDY	12/ 3/ 65	28.45	80.53
234	CAPE KENNEDY	12/ 4/ 65	28.45	80.53
235	CAPE KENNEDY	12/ 8/ 65	28.45	80.53
236	CAPE KENNEDY	12/ 10/ 65	28.45	80.53
237	CAPE KENNEDY	12/ 13/ 65	28.45	80.53
238	CAPE KENNEDY	12/ 15/ 65	28.45	80.53
239	CAPE KENNEDY	12/ 16/ 65	28.45	80.53
240	CAPE KENNEDY	12/ 18/ 65	28.45	80.53
241	POINT MUGU, CAL.	12/ 8/ 65	34.12	119.12
242	POINT MUGU, CAL.	12/ 6/ 65	34.12	119.12
243	WHITE SANDS	12/ 3/ 65	32.38	106.48
244	WHITE SANDS	12/ 8/ 65	32.38	106.48
245	FORT CHURCHILL	12/ 3/ 65	58.73	93.82
246	FORT CHURCHILL	12/ 8/ 65	58.73	93.82
247	FORT CHURCHILL	12/ 9/ 65	58.73	93.82
248	FORT CHURCHILL	12/ 10/ 65	58.73	93.82
249	FORT CHURCHILL	12/ 11/ 65	58.73	93.82
250	FORT CHURCHILL	12/ 12/ 65	58.73	93.82

PROFILE NO.	L1(2.0)	L1(3.0)	L2(.15)	L2(.50)	L2(.90)	L3(4.5)	L3(20.0)	L4(2.5)	L4(10.)
201	48.04	43.85	53.71	42.47	32.07	55.57	45.62	46.95	34.14
202	44.18	39.44	52.28	40.01	28.93	53.40	42.56	45.27	31.66
203	44.43	40.76	51.54	40.80	28.55	53.27	42.55	44.88	32.12
204	43.21	38.59	51.15	39.24	29.02	52.92	41.69	44.54	31.24
205	43.49	38.57	51.09	39.58	28.58	52.43	41.65	44.51	31.26
206	43.85	39.12	51.74	39.78	29.11	53.34	42.23	44.99	31.72
207	42.78	37.74	51.29	39.17	28.26	52.53	41.28	44.59	31.14
208	39.62	33.89	49.91	36.47	23.05	51.18	39.31	43.39	28.75
209	43.02	38.26	50.61	38.95	27.54	52.49	41.30	44.04	30.67
210	43.41	38.65	51.23	39.60	28.03	53.19	41.87	44.76	31.30
211	43.60	38.93	51.13	39.62	28.37	53.13	41.91	44.64	31.32
212	43.60	39.11	50.72	39.04	29.13	53.01	41.88	44.20	30.92
213	44.09	38.69	51.70	39.48	28.52	52.96	42.27	45.05	31.47
214	44.62	39.91	52.46	40.09	27.71	53.58	42.92	45.37	31.77
215	44.64	40.05	51.98	40.42	28.38	53.08	42.64	45.12	31.87
216	44.53	39.47	51.67	39.81	28.05	52.80	42.41	44.86	31.52
217	44.57	39.25	51.52	39.01	30.23	53.01	42.55	44.76	31.25
218	44.59	40.50	51.62	40.01	29.60	53.57	42.82	44.86	31.72
219	44.08	39.62	50.95	39.74	28.15	52.63	41.95	44.31	31.33
220	43.90	39.61	50.69	39.61	30.06	52.28	41.79	44.02	31.36
221	43.81	39.69	50.47	39.63	28.61	52.19	41.69	43.88	31.13
222	43.14	38.75	50.60	39.35	28.20	52.25	41.37	44.07	30.84
223	43.01	37.58	50.68	38.77	27.13	51.94	41.16	43.94	30.59
224	43.28	37.95	50.80	38.77	27.32	52.20	41.34	44.25	30.80
225	44.27	39.32	52.03	40.26	28.76	53.36	42.47	45.29	31.94
226	40.65	33.99	50.73	37.05	22.54	51.85	39.98	44.03	29.33
227	40.28	33.98	50.94	37.31	23.30	52.03	39.96	44.27	29.50
228	40.75	33.80	51.17	36.90	23.17	52.44	40.22	44.48	29.59
229	40.47	34.18	50.41	36.74	23.31	51.47	39.73	43.77	29.29
230	41.26	35.87	50.98	37.65	23.52	52.82	40.71	44.33	29.86
231	41.62	35.05	51.05	37.40	22.51	52.77	40.81	44.51	29.75
232	42.48	36.41	51.15	37.98	23.38	53.08	41.36	44.67	30.23
233	42.39	37.45	50.82	38.88	26.44	51.90	40.89	44.30	30.90
234	42.51	37.92	51.10	39.49	27.25	52.25	40.96	44.44	31.25
235	43.05	36.40	51.95	39.44	25.91	52.54	41.59	45.52	31.57
236	42.93	37.65	51.70	40.06	27.08	52.61	41.33	45.06	31.66
237	44.13	39.29	51.80	40.80	27.60	52.61	42.09	45.30	32.27
238	43.30	37.79	52.75	40.69	27.57	52.84	41.92	45.78	32.15
239	43.31	38.87	52.03	40.53	28.20	52.63	41.76	45.39	32.31
240	41.46	37.33	51.48	39.07	27.74	51.99	40.80	44.75	31.13
241	39.85	34.76	50.12	37.46	25.50	51.17	39.09	43.39	29.55
242	40.43	35.59	51.35	38.15	27.06	52.26	40.03	44.51	30.52
243	41.52	36.69	50.43	38.99	27.15	51.88	40.11	44.01	30.72
244	42.88	37.75	51.97	38.45	26.30	54.36	42.24	45.37	30.96
245	38.28	32.18	48.35	34.60	22.01	50.54	37.76	42.06	27.43
246	35.56	29.93	48.60	31.85	21.87	49.90	37.33	41.98	26.08
247	34.57	29.52	48.15	31.35	21.97	50.94	36.68	41.85	25.42
248	34.99	29.01	47.07	31.73	21.50	49.60	35.53	40.47	25.04
249	32.89	28.09	43.23	30.23	20.78	45.95	32.53	37.00	22.58
250	35.06	29.58	46.18	32.24	22.02	49.46	35.54	40.54	25.41

PROFILE NO.	LOCATION	DATE	LATITUDE	LONGITUDE
251	FORT CHURCHILL	12/ 14/ 65	58.73	93.82
252	FORT CHURCHILL	12/ 14/ 65	58.73	93.82
253	FORT CHURCHILL	12/ 16/ 65	58.73	93.82
254	FORT CHURCHILL	12/ 18/ 65	58.73	93.82
255	FORT CHURCHILL	12/ 18/ 65	58.73	93.82
256	FORT GREELY	12/ 10/ 65	64.00	145.75
257	CAPE KENNEDY	11/ 9/ 65	28.45	80.53
258	CAPE KENNEDY	11/ 10/ 65	28.45	80.53
259	CAPE KENNEDY	11/ 12/ 65	28.45	80.53
260	CAPE KENNEDY	11/ 15/ 65	28.45	80.53
261	CAPE KENNEDY	11/ 17/ 65	28.45	80.53
262	POINT MUGU, CAL.	11/ 9/ 65	34.12	119.12
263	POINT MUGU, CAL.	11/ 15/ 65	34.12	119.12
264	WHITE SANDS	11/ 6/ 65	32.38	106.48
265	GRAND TURK IS.	11/ 10/ 65	21.43	71.14
266	GRAND TURK IS.	11/ 12/ 65	21.43	71.14
267	GRAND TURK IS.	4/ 9/ 65	21.43	71.14
268	ANTIGUA	5/ 28/ 65	17.15	61.78
269	WHITE SANDS	5/ 27/ 65	32.38	106.48
270	WHITE SANDS	5/ 28/ 65	32.38	106.48
271	FORT CHURCHILL	5/ 26/ 65	58.73	93.82
272	FORT CHURCHILL	5/ 28/ 65	58.73	93.82
273	FORT CHURCHILL	5/ 31/ 65	58.73	93.82
274	ANTIGUA	6/ 9/ 65	17.15	61.78
275	ANTIGUA	6/ 11/ 65	17.15	61.78
276	ANTIGUA	6/ 14/ 65	17.15	61.78
277	ANTIGUA	6/ 16/ 65	17.15	61.78
278	ANTIGUA	6/ 25/ 65	17.15	61.78
279	CAPE KENNEDY	6/ 4/ 65	28.45	80.53
280	CAPE KENNEDY	6/ 7/ 65	28.45	80.53
281	POINT MUGU, CAL.	6/ 2/ 65	34.12	119.12
282	POINT MUGU, CAL.	6/ 4/ 65	34.12	119.12
283	POINT MUGU, CAL.	8/ 9/ 66	34.12	119.12
284	POINT MUGU, CAL.	8/ 11/ 66	34.12	119.12
285	POINT MUGU, CAL.	8/ 12/ 66	34.12	119.12
286	POINT MUGU, CAL.	8/ 15/ 66	34.12	119.12
287	WHITE SANDS	8/ 12/ 66	32.38	106.48
288	FORT CHURCHILL	8/ 7/ 66	58.73	93.82
289	FORT CHURCHILL	8/ 7/ 66	58.73	93.82
290	FORT CHURCHILL	8/ 10/ 66	58.73	93.82
291	FORT CHURCHILL	8/ 18/ 66	58.73	93.82
292	THULE, GREENLAND	8/ 8/ 66	76.55	68.82
293	THULE, GREENLAND	8/ 9/ 66	76.55	68.82
294	THULE, GREENLAND	8/ 15/ 66	76.55	68.82
295	WALLOPS ISLAND	6/ 27/ 65	37.84	75.48
296	WALLOPS ISLAND	6/ 30/ 65	37.84	75.48
297	WALLOPS ISLAND	8/ 18/ 65	37.84	75.48
298	WALLOPS ISLAND	8/ 13/ 65	37.84	75.48
299	WALLOPS ISLAND	8/ 7/ 65	37.84	75.48
300	WALLOPS ISLAND	8/ 8/ 65	37.84	75.48

PROFILE NO.	L1(2.0)	L1(3.0)	L2(.15)	L2(.50)	L2(.90)	L3(4.5)	L3(20.0)	L4(2.5)	L4(10.)
251	33.39	28.46	45.12	31.17	21.90	47.91	34.25	39.44	24.47
252	33.96	28.76	46.39	31.79	21.92	49.41	35.38	40.59	25.13
253	35.43	30.16	47.15	32.06	22.20	49.51	36.64	41.01	25.73
254	34.81	30.20	46.73	32.04	22.17	51.04	36.30	41.15	25.49
255	34.27	30.07	45.70	32.03	22.20	48.00	34.66	39.33	24.73
256	35.11	29.82	48.46	31.70	22.46	50.15	37.63	42.05	25.91
257	42.17	38.09	50.48	38.97	27.58	52.08	40.86	43.94	30.71
258	42.46	38.19	51.01	39.10	27.61	52.18	41.04	44.17	30.77
259	42.08	37.96	50.74	38.80	28.11	52.17	40.81	43.95	30.62
260	41.91	37.53	50.65	38.41	28.60	51.82	40.59	43.69	30.36
261	41.29	36.75	50.49	37.95	29.22	52.17	40.36	43.78	30.17
262	41.26	36.02	50.29	38.56	25.96	52.33	40.24	44.27	30.51
263	40.97	36.57	50.31	38.08	26.40	51.87	39.87	43.59	30.11
264	41.82	36.24	50.22	39.00	26.12	51.69	40.20	43.89	30.33
265	43.31	39.31	51.13	39.86	29.38	53.22	41.84	44.69	31.55
266	43.26	38.82	51.43	39.46	28.93	52.98	41.86	44.78	31.43
267	43.68	38.91	51.95	39.91	28.28	53.26	42.17	45.14	31.64
268	44.73	40.38	51.66	40.41	28.81	52.98	42.60	44.89	31.71
269	44.11	39.23	52.22	39.84	28.13	53.77	42.65	45.38	31.61
270	45.33	40.76	52.79	41.12	29.03	53.49	43.27	45.79	32.42
271	46.05	41.43	52.17	40.41	27.74	54.19	43.86	45.44	32.03
272	45.50	40.53	52.06	39.60	26.83	53.99	43.52	45.24	31.41
273	46.18	41.67	52.15	40.42	27.41	54.48	44.00	45.48	31.95
274	43.83	38.83	51.64	39.64	28.67	52.88	42.03	44.82	31.50
275	44.17	39.19	51.61	39.70	28.80	53.00	42.23	44.88	31.54
276	45.39	40.11	52.43	40.24	28.67	53.37	43.19	45.53	32.22
277	43.77	38.28	51.52	39.61	28.59	52.40	41.78	44.76	31.35
278	43.90	39.51	51.43	40.04	28.04	53.21	42.17	44.80	31.44
279	43.36	38.14	52.03	38.96	26.93	53.68	42.38	45.40	31.26
280	44.81	40.17	52.06	40.54	28.67	53.06	42.73	45.25	32.02
281	44.30	39.58	51.40	39.72	27.49	53.30	42.40	44.80	31.40
282	46.07	41.23	52.35	40.43	29.74	53.80	43.80	45.57	32.30
283	44.34	39.69	51.06	39.75	28.67	52.51	42.11	44.44	31.40
284	44.05	38.86	50.81	39.02	28.39	52.61	41.93	44.31	30.96
285	43.96	38.64	51.55	38.99	27.65	53.77	42.47	45.09	31.17
286	43.50	38.39	51.39	39.33	27.73	53.03	41.80	44.74	31.15
287	44.01	39.18	51.73	39.53	28.58	53.35	42.40	44.95	31.37
288	45.29	41.02	52.10	39.91	27.31	54.28	43.57	45.23	31.52
289	45.75	41.68	51.92	40.31	27.82	54.48	43.73	45.25	31.79
290	46.46	42.23	52.52	40.66	29.77	54.36	44.20	45.51	32.28
291	45.87	41.70	52.40	40.08	27.27	54.69	44.00	45.58	31.89
292	46.72	42.49	52.17	40.42	27.35	54.29	44.39	45.32	31.97
293	46.97	42.29	53.07	40.19	27.31	55.14	44.90	45.95	32.10
294	46.42	42.02	52.25	39.96	27.61	54.17	44.20	45.28	31.66
295	43.46	39.39	51.09	39.96	29.01	52.44	41.70	44.38	31.41
296	45.25	40.98	51.78	40.48	28.30	53.29	43.01	44.97	31.86
297	45.53	39.84	52.55	40.29	27.72	53.36	43.24	45.68	32.14
298	43.59	38.56	50.45	39.05	27.29	52.15	41.43	43.92	30.66
299	44.74	39.24	53.50	39.76	27.63	54.02	43.35	46.08	31.93
300	44.09	38.41	51.42	39.28	27.54	52.58	42.00	44.69	31.09

PROFILE NO.	LOCATION	DATE	LATITUDE	LONGITUDE
301	WALLOPS ISLAND	12/ 1/ 65	37.84	75.48
302	WALLOPS ISLAND	12/ 2/ 65	37.84	75.48
303	WALLOPS ISLAND	12/ 8/ 65	37.84	75.48
304	WALLOPS ISLAND	12/ 9/ 65	37.84	75.48
305	WALLOPS ISLAND	12/ 15/ 65	37.84	75.48
306	WALLOPS ISLAND	12/ 16/ 65	37.84	75.48
307	WALLOPS ISLAND	11/ 4/ 65	37.84	75.48
308	WALLOPS ISLAND	11/ 8/ 65	37.84	75.48
309	WALLOPS ISLAND	11/ 11/ 65	37.84	75.48
310	WALLOPS ISLAND	11/ 10/ 65	37.84	75.48
311	WALLOPS ISLAND	11/ 19/ 65	37.84	75.48
312	WALLOPS ISLAND	10/ 13/ 65	37.84	75.48
313	WALLOPS ISLAND	10/ 20/ 65	37.84	75.48
314	WALLOPS ISLAND	10/ 23/ 65	37.84	75.48
315	WALLOPS ISLAND	10/ 25/ 65	37.84	75.48
316	WALLOPS ISLAND	10/ 26/ 65	37.84	75.48
317	WALLOPS ISLAND	10/ 27/ 65	37.84	75.48
318	WALLOPS ISLAND	10/ 29/ 65	37.84	75.48
319	WALLOPS ISLAND	4/ 1/ 65	37.84	75.48
320	WALLOPS ISLAND	4/ 14/ 65	37.84	75.48
321	WALLOPS ISLAND	5/ 27/ 65	37.84	75.48
322	WALLOPS ISLAND	1/ 18/ 67	37.84	75.48
323	WALLOPS ISLAND	2/ 1/ 67	37.84	75.48
324	WALLOPS ISLAND	1/ 31/ 67	37.84	75.48
325	ANTIGUA	11/ 3/ 65	17.15	61.78
326	WHITE SANDS	2/ 3/ 65	32.38	106.48
327	CAPE KENNEDY	2/ 1/ 65	28.45	80.53
328	CAPE KENNEDY	2/ 8/ 65	28.45	80.53
329	CAPE KENNEDY	2/ 14/ 65	28.45	80.53
330	CAPE KENNEDY	2/ 11/ 65	28.45	80.53
331	CAPE KENNEDY	2/ 16/ 65	28.45	80.53
332	CAPE KENNEDY	2/ 11/ 65	28.45	80.53
333	CAPE KENNEDY	2/ 17/ 65	28.45	80.53
334	CAPE KENNEDY	2/ 20/ 65	28.45	80.53
335	GRAND TURK IS.	2/ 10/ 65	21.43	71.14
336	POINT MUGU, CAL.	2/ 9/ 65	34.12	119.12
337	POINT MUGU, CAL.	2/ 17/ 65	34.12	119.12
338	FORT CHURCHILL	2/ 5/ 65	58.73	93.82
339	FORT CHURCHILL	2/ 8/ 65	58.73	93.82
340	FORT CHURCHILL	2/ 10/ 65	58.73	93.82
341	FORT CHURCHILL	2/ 12/ 65	58.73	93.82
342	ANTIGUA	2/ 2/ 66	17.15	61.78
343	ANTIGUA	2/ 7/ 66	17.15	61.78
344	ANTIGUA	2/ 9/ 66	17.15	61.78
345	ANTIGUA	2/ 9/ 66	17.15	61.78
346	ANTIGUA	2/ 10/ 66	17.15	61.78
347	GRAND TURK IS.	2/ 4/ 66	21.43	71.14
348	GRAND TURK IS.	2/ 7/ 66	21.43	71.14
349	POINT MUGU, CAL.	2/ 3/ 66	34.12	119.12
350	POINT MUGU, CAL.	2/ 4/ 66	34.12	119.12

PROFILE NO.	L1(2.0)	L1(3.0)	L2(.15)	L2(.50)	L2(.90)	L3(4.5)	L3(20.0)	L4(2.5)	L4(10.)
301	41.31	34.69	50.99	37.62	24.65	52.11	40.32	44.25	29.97
302	39.58	34.61	50.26	37.17	24.54	51.28	39.35	43.89	29.73
303	39.65	32.35	51.77	37.21	23.47	52.22	40.11	45.11	30.02
304	40.23	33.47	49.93	38.02	24.11	50.96	38.98	43.63	29.71
305	42.75	35.96	50.78	39.89	24.46	51.40	40.71	44.60	31.14
306	42.29	35.03	52.92	39.85	24.35	52.56	41.54	46.06	31.82
307	42.05	36.75	50.74	38.23	25.96	51.98	40.71	44.03	30.18
308	40.45	33.62	49.58	36.52	26.11	51.32	39.40	43.27	28.94
309	40.31	34.25	49.61	37.14	25.50	51.17	39.19	43.09	28.99
310	41.07	35.50	50.20	37.61	25.83	51.49	40.03	43.59	29.43
311	40.81	35.39	51.06	37.51	25.95	51.84	40.54	44.39	30.10
312	43.22	37.76	51.32	38.85	25.70	52.32	41.58	44.49	30.57
313	41.54	35.57	51.67	38.45	27.13	52.03	40.69	44.56	30.43
314	43.07	36.97	51.80	39.25	26.72	52.32	41.53	44.88	30.95
315	43.60	38.13	52.06	38.99	26.56	53.33	42.25	45.18	31.03
316	42.14	35.64	51.19	38.30	25.67	51.79	40.79	44.39	30.31
317	41.47	35.47	51.23	38.09	25.50	51.84	40.39	44.27	30.09
318	43.03	36.79	51.82	38.63	25.90	52.49	41.57	44.91	30.80
319	42.81	38.02	50.77	38.91	25.86	52.23	41.20	44.14	30.73
320	43.11	38.54	50.76	39.30	27.56	52.36	41.32	44.03	30.95
321	44.46	38.89	51.57	38.91	27.25	53.17	42.47	44.76	31.38
322	40.29	35.74	49.98	37.83	25.66	51.23	39.41	43.45	29.77
323	44.08	37.91	51.62	40.78	26.22	52.79	41.91	45.26	31.72
324	44.01	38.13	51.36	40.06	25.77	52.17	41.76	44.87	31.44
325	42.05	37.33	50.45	38.75	26.99	52.33	40.73	44.02	30.48
326	39.31	32.83	50.43	36.32	25.23	51.36	39.18	43.91	29.23
327	43.65	39.08	51.21	39.59	28.69	53.69	42.14	44.87	31.09
328	43.69	38.71	50.98	40.20	29.08	52.33	41.57	44.40	31.25
329	42.85	36.91	51.47	39.15	27.69	53.15	41.48	45.11	31.21
330	44.49	39.50	51.88	40.26	29.58	53.14	42.51	45.15	31.64
331	43.94	38.30	52.04	40.30	27.17	52.80	42.02	45.32	31.75
332	43.36	37.72	51.47	39.57	28.41	52.63	41.59	44.70	31.07
333	43.39	38.32	51.83	40.16	27.81	53.22	41.86	45.20	31.57
334	43.61	39.08	50.88	40.01	28.02	52.88	41.64	44.50	31.36
335	43.37	37.49	51.61	39.40	27.71	52.66	41.62	44.78	30.99
336	42.16	37.21	49.98	38.86	26.41	51.60	40.47	43.76	30.44
337	43.57	39.10	50.66	40.58	27.64	51.97	41.29	44.29	31.82
338	40.08	34.65	51.80	37.05	25.52	52.87	40.51	44.94	29.95
339	42.04	36.82	50.24	37.95	29.33	51.68	40.52	43.64	30.36
340	37.34	32.25	49.22	34.15	22.66	50.62	37.90	42.46	27.29
341	40.02	34.98	49.86	36.66	22.47	51.79	39.53	43.31	29.02
342	43.32	37.51	52.14	39.17	28.83	52.86	41.87	45.31	31.49
343	42.88	37.87	51.39	39.98	28.07	52.18	41.21	44.74	31.53
344	41.80	36.28	51.07	38.83	27.98	51.75	40.47	44.46	30.91
345	43.94	38.83	52.94	40.27	28.83	53.53	42.56	45.87	32.28
346	42.66	36.51	50.93	39.17	27.79	51.79	40.72	44.36	30.94
347	42.99	37.17	51.79	39.75	28.31	52.97	41.53	45.15	31.48
348	42.78	37.70	51.12	39.74	27.67	52.00	41.06	44.59	31.25
349	40.91	35.41	52.34	36.06	25.58	52.43	40.95	45.37	30.95
350	40.31	34.21	51.65	37.63	25.09	51.97	40.11	44.68	30.16

PROFILE NO.	LOCATION	DATE	LATITUDE	LONGITUDE
351	POINT MUGU, CAL.	2/ 8/ 66	34.12	119.12
352	POINT MUGU, CAL.	2/ 10/ 66	34.12	119.12
353	WHITE SANDS	2/ 2/ 66	32.38	106.48
354	WHITE SANDS	2/ 3/ 66	32.38	106.48
355	WHITE SANDS	2/ 4/ 66	32.38	106.48
356	WHITE SANDS	2/ 9/ 66	32.38	106.48
357	WHITE SANDS	2/ 10/ 66	32.38	106.48
358	WHITE SANDS	2/ 14/ 66	32.38	106.48
359	WHITE SANDS	2/ 18/ 66	32.38	106.48
360	CAPE KENNEDY	2/ 9/ 66	28.45	80.53
361	CAPE KENNEDY	2/ 10/ 66	28.45	80.53
362	CAPE KENNEDY	2/ 11/ 66	28.45	80.53
363	CAPE KENNEDY	2/ 14/ 66	28.45	80.53
364	CAPE KENNEDY	2/ 16/ 66	28.45	80.53
365	FORT CHURCHILL	2/ 5/ 66	58.73	93.82
366	FORT CHURCHILL	2/ 9/ 66	58.73	93.82
367	FORT CHURCHILL	2/ 10/ 66	58.73	93.82
368	FORT GREELY	2/ 5/ 66	64.00	145.75
369	FORT GREELY	2/ 6/ 66	64.00	145.75
370	FORT GREELY	2/ 8/ 66	64.00	145.75
371	FORT GREELY	2/ 10/ 66	64.00	145.75
372	FORT GREELY	2/ 11/ 66	64.00	145.75
373	FORT GREELY	2/ 14/ 66	64.00	145.75
374	FORT GREELY	2/ 15/ 66	64.00	145.75
375	FORT GREELY	2/ 16/ 66	64.00	145.75
376	WHITE SANDS	10/ 20/ 66	32.38	106.48
377	WHITE SANDS	10/ 21/ 66	32.38	106.48
378	POINT MUGU, CAL.	10/ 19/ 66	34.12	119.12
379	POINT MUGU, CAL.	10/ 20/ 66	34.12	119.12
380	POINT MUGU, CAL.	10/ 21/ 66	34.12	119.12
381	FORT CHURCHILL	10/ 17/ 66	58.73	93.82
382	FORT CHURCHILL	10/ 19/ 66	58.73	93.82
383	FORT CHURCHILL	10/ 20/ 66	58.73	93.82
384	FORT CHURCHILL	10/ 24/ 66	58.73	93.82
385	FORT GREELY	10/ 17/ 66	64.00	145.75
386	FORT GREELY	10/ 19/ 66	64.00	145.75
387	FORT GREELY	10/ 24/ 66	64.00	145.75
388	FORT GREELY	10/ 26/ 66	64.00	145.75
389	WHITE SANDS	5/ 26/ 66	32.38	106.48
390	WHITE SANDS	6/ 2/ 66	32.38	106.48
391	WHITE SANDS	6/ 8/ 66	32.38	106.48
392	WHITE SANDS	5/ 27/ 66	32.38	106.48
393	CAPE KENNEDY	6/ 1/ 66	28.45	80.53
394	CAPE KENNEDY	6/ 7/ 66	28.45	80.53
395	CAPE KENNEDY	6/ 3/ 66	28.45	80.53
396	GRAND TURK IS.	6/ 3/ 66	21.43	71.14
397	FORT CHURCHILL	6/ 3/ 66	58.73	93.82
398	FORT CHURCHILL	6/ 6/ 66	58.73	93.82
399	FORT CHURCHILL	6/ 8/ 66	58.73	93.82
400	FORT CHURCHILL	5/ 30/ 66	58.73	93.82

PROFILE No.	L1(2.0)	L1(3.0)	L2(.15)	L2(.50)	L2(.90)	L3(4.5)	L3(20.0)	L4(2.5)	L4(10.)
351	41.69	35.47	49.96	38.46	23.95	51.45	40.05	43.43	29.60
352	41.69	36.79	50.33	38.74	25.06	51.48	40.04	43.51	30.23
353	42.09	36.84	51.73	39.40	25.49	52.48	41.19	45.08	31.34
354	41.95	35.93	50.78	37.99	25.03	51.67	40.47	44.17	30.44
355	40.71	35.28	50.57	38.07	25.15	51.10	39.58	43.86	30.15
356	42.93	38.54	50.99	39.11	25.24	53.41	41.58	44.41	30.82
357	42.76	38.07	50.55	38.85	25.35	52.16	41.12	43.94	30.89
358	42.44	37.96	50.69	38.94	27.15	52.55	41.00	44.20	30.89
359	42.09	37.62	50.15	38.28	28.04	52.41	40.74	43.72	30.21
360	42.67	37.56	50.97	39.31	28.33	52.03	40.97	44.37	31.11
361	44.17	38.83	52.77	41.42	28.54	53.12	42.37	46.02	32.81
362	42.39	37.55	50.93	39.63	27.21	51.84	40.78	44.43	31.13
363	42.91	38.89	51.45	40.17	29.78	52.73	41.40	44.61	31.59
364	42.04	37.16	51.15	38.96	27.56	51.95	40.76	44.51	31.03
365	42.03	30.86	53.36	39.17	21.48	52.47	41.48	46.35	31.41
366	43.62	38.03	51.62	39.73	24.67	52.38	41.84	44.95	31.11
367	42.25	35.51	50.98	37.54	23.78	55.71	41.67	45.48	30.36
368	37.14	32.63	44.60	34.03	23.42	48.99	35.92	39.37	25.95
369	42.18	38.72	49.92	38.87	24.07	52.72	40.86	43.43	30.08
370	41.61	36.62	49.10	36.30	25.91	52.41	40.49	42.81	28.84
371	40.92	36.12	48.88	35.81	24.33	52.29	40.05	42.47	28.20
372	40.20	35.99	48.01	35.78	24.62	51.48	39.25	41.69	27.91
373	37.52	33.51	47.27	35.17	24.25	49.72	36.71	40.63	26.91
374	37.10	32.73	46.63	34.35	23.87	49.66	36.65	40.46	26.59
375	37.31	32.48	46.88	34.03	23.60	50.38	37.01	40.94	26.63
376	40.97	36.15	50.55	37.79	26.90	51.76	40.02	43.69	29.93
377	40.31	34.99	49.10	36.77	26.67	50.95	39.20	42.88	29.18
378	41.91	36.47	51.08	38.01	27.28	52.21	40.88	44.32	30.38
379	42.04	36.57	51.19	37.56	26.64	52.35	41.07	44.38	30.18
380	41.12	35.87	50.95	37.83	26.42	52.14	40.39	44.10	29.96
381	40.26	34.21	51.92	36.43	23.64	52.11	40.39	44.50	29.37
382	40.47	34.29	50.34	36.33	23.65	51.70	39.86	43.58	28.93
383	40.12	34.49	49.41	36.35	23.98	50.85	39.23	42.78	28.61
384	38.36	33.30	48.83	36.07	23.86	50.33	37.76	42.12	28.01
385	40.90	34.53	49.77	37.27	23.60	51.77	39.59	43.34	29.21
386	39.30	33.37	50.46	36.55	23.62	51.57	39.02	43.50	28.94
387	36.82	30.11	48.79	33.65	21.13	49.72	36.98	41.63	26.39
388	39.85	34.67	49.60	36.60	22.82	51.64	39.26	43.15	28.80
389	44.16	39.55	51.15	39.55	28.11	52.62	42.10	44.37	31.16
390	44.40	39.20	52.50	39.77	28.17	54.42	43.04	45.86	32.03
391	44.55	39.75	51.01	39.63	27.96	52.73	42.28	44.44	31.33
392	44.70	39.38	52.13	39.50	27.87	53.15	42.83	45.22	31.53
393	44.40	39.37	51.58	39.73	28.08	52.76	42.34	44.80	31.47
394	44.75	39.80	51.19	39.80	28.85	52.75	42.39	44.59	31.50
395	44.49	39.10	51.79	39.59	28.73	52.92	42.48	44.99	31.54
396	43.45	38.20	51.40	38.85	28.12	52.51	41.78	44.57	30.99
397	45.80	41.72	52.23	40.32	27.14	54.70	44.00	45.61	32.07
398	45.64	40.90	52.12	39.94	26.95	54.22	43.65	45.41	31.74
399	45.90	41.15	51.93	39.84	27.22	53.83	43.62	45.12	31.69
400	45.74	40.99	51.97	40.01	27.64	54.30	43.67	45.41	31.85

PROFILE NO.	LOCATION	DATE	LATITUDE	LONGITUDE
401	FORT GREELY	5/ 31/ 66	64.00	145.75
402	FORT GREELY	6/ 5/ 66	64.00	145.75
403	THULE, GREENLAND	6/ 1/ 66	76.55	68.82
404	ANTIGUA	6/ 22/ 66	17.15	61.78
405	POINT MUGU, CAL.	6/ 7/ 66	34.12	119.12
406	POINT MUGU, CAL.	6/ 2/ 66	34.12	119.12
407	POINT MUGU, CAL.	6/ 8/ 66	34.12	119.12
408	POINT MUGU, CAL.	5/ 26/ 66	34.12	119.12
409	POINT MUGU, CAL.	6/ 3/ 66	34.12	119.12
410	POINT MUGU, CAL.	6/ 9/ 66	34.12	119.12
411	POINT MUGU, CAL.	5/ 31/ 66	34.12	119.12
412	POINT MUGU, CAL.	6/ 6/ 66	34.12	119.12
413	POINT MUGU, CAL.	6/ 10/ 66	34.12	119.12
414	WHITE SANDS	6/ 2/ 66	32.38	106.48
415	CAPE KENNEDY	6/ 6/ 66	28.45	80.53
416	THULE, GREENLAND	6/ 2/ 66	76.55	68.82
417	ANTIGUA	10/ 21/ 66	17.15	61.78
418	ANTIGUA	10/ 24/ 66	17.15	61.78
419	ANTIGUA	10/ 26/ 66	17.15	61.78
420	ANTIGUA	10/ 28/ 66	17.15	61.78
421	CAPE KENNEDY	10/ 19/ 66	28.45	80.53
422	CAPE KENNEDY	10/ 20/ 66	28.45	80.53
423	CAPE KENNEDY	10/ 24/ 66	28.45	80.53
424	CAPE KENNEDY	10/ 25/ 66	28.45	80.53
425	GRAND TURK IS.	10/ 19/ 66	21.43	71.14
426	GRAND TURK IS.	10/ 21/ 66	21.43	71.14
427	WALLOPS ISLAND	5/ 10/ 66	37.84	75.48
428	WALLOPS ISLAND	5/ 10/ 66	37.84	75.48
429	WALLOPS ISLAND	5/ 11/ 66	37.84	75.48
430	WALLOPS ISLAND	5/ 11/ 66	37.84	75.48
431	WALLOPS ISLAND	5/ 11/ 66	37.84	75.48
432	WALLOPS ISLAND	5/ 11/ 66	37.84	75.48
433	WALLOPS ISLAND	5/ 11/ 66	37.84	75.48
434	WALLOPS ISLAND	5/ 11/ 66	37.84	75.48
435	WALLOPS ISLAND	5/ 11/ 66	37.84	75.48
436	WALLOPS ISLAND	5/ 11/ 66	37.84	75.48
437	WALLOPS ISLAND	8/ 19/ 66	37.84	75.48
438	WALLOPS ISLAND	11/ 9/ 66	37.84	75.48
439	WALLOPS ISLAND	11/ 16/ 66	37.84	75.48
440	WALLOPS ISLAND	8/ 18/ 66	37.84	75.48
441	WALLOPS ISLAND	8/ 17/ 66	37.84	75.48
442	WALLOPS ISLAND	8/ 12/ 66	37.84	75.48
443	WALLOPS ISLAND	8/ 7/ 66	37.84	75.48
444	WALLOPS ISLAND	8/ 7/ 66	37.84	75.48
445	WALLOPS ISLAND	6/ 1/ 66	37.84	75.48
446	WALLOPS ISLAND	6/ 3/ 66	37.84	75.48
447	WALLOPS ISLAND	2/ 10/ 66	37.84	75.48
448	WHITE SANDS	8/ 16/ 65	32.38	106.48
449	WHITE SANDS	10/ 19/ 66	32.38	106.48
450	POINT MUGU, CAL.	6/ 7/ 65	34.12	119.12

PROFILE NO.	L1(2.0)	L1(3.0)	L2(.15)	L2(.50)	L2(.90)	L3(4.5)	L3(20.0)	L4(2.5)	L4(10.)
401	45.78	41.27	52.08	40.12	27.50	54.55	43.79	45.47	31.89
402	45.97	41.69	52.26	40.58	27.14	54.29	43.84	45.49	32.07
403	47.22	43.11	52.07	40.84	28.93	54.45	44.67	45.19	32.21
404	43.42	39.04	50.97	39.44	28.16	52.45	41.60	44.19	31.03
405	44.24	39.53	51.13	39.59	28.34	53.02	42.33	44.67	31.40
406	43.58	38.94	51.36	39.41	27.82	52.95	41.93	44.57	31.04
407	43.85	39.64	51.23	39.51	27.72	53.04	42.16	44.44	31.06
408	43.51	38.44	50.96	39.06	27.17	52.22	41.56	44.23	30.85
409	44.52	40.04	51.34	39.97	28.82	53.28	42.55	44.81	31.61
410	44.34	39.79	51.56	39.70	29.52	53.16	42.51	44.78	31.56
411	44.27	40.08	51.15	39.92	27.98	53.27	42.39	44.60	31.36
412	44.28	39.37	51.53	39.59	28.40	52.86	42.26	44.75	31.37
413	43.15	38.09	51.04	38.98	27.62	52.87	41.63	44.54	30.94
414	44.30	39.52	51.90	39.80	28.71	53.52	42.63	45.18	31.69
415	43.69	38.98	51.49	39.71	27.81	52.57	41.93	44.73	31.33
416	47.39	43.10	52.69	40.50	27.39	55.39	45.19	45.89	32.27
417	44.24	39.53	51.73	40.32	28.23	52.72	42.21	44.96	31.76
418	44.14	38.53	51.69	39.40	28.32	53.03	42.25	44.99	31.43
419	44.06	39.08	51.92	39.66	28.33	53.12	42.34	45.08	31.45
420	44.13	38.81	51.47	39.53	29.72	52.75	42.13	44.81	31.39
421	42.48	37.38	51.39	38.93	27.40	52.41	41.27	44.70	30.96
422	43.53	38.39	51.40	39.16	27.73	52.50	41.78	44.62	31.15
423	43.07	37.38	51.13	38.82	28.46	52.01	41.17	44.35	30.94
424	42.97	37.37	51.50	38.48	28.53	52.70	41.66	44.73	30.85
425	44.92	39.66	51.85	39.63	29.52	53.09	42.81	45.08	31.73
426	43.33	38.41	51.23	39.36	28.03	52.30	41.53	44.51	31.09
427	44.63	40.44	51.64	40.28	28.21	53.00	42.66	44.83	31.80
428	44.69	40.18	51.85	40.27	28.81	53.03	42.62	44.93	31.67
429	43.74	39.07	51.24	39.62	27.24	52.48	41.82	44.50	31.19
430	43.31	39.05	50.75	39.68	27.43	52.14	41.41	44.11	31.07
431	43.48	38.64	51.77	39.44	28.02	53.62	42.08	45.11	31.47
432	43.15	38.17	51.36	39.84	29.26	52.08	41.32	44.68	31.60
433	44.59	39.65	51.77	39.90	27.18	52.92	42.55	44.95	31.67
434	44.10	39.67	51.89	39.89	27.92	53.51	42.56	45.08	31.71
435	43.90	39.44	50.91	39.60	27.27	52.53	41.88	44.29	31.12
436	44.51	39.97	51.64	40.12	27.82	52.95	42.46	44.82	31.72
437	43.94	39.45	50.94	39.45	28.39	52.95	42.09	44.44	31.19
438	40.52	34.24	50.80	36.71	26.46	51.64	39.95	44.17	29.78
439	40.70	34.22	51.25	37.45	25.13	51.71	40.18	44.49	30.02
440	44.42	40.16	50.49	39.89	27.19	52.18	41.95	43.95	31.07
441	44.29	39.24	51.33	39.79	27.45	52.67	42.16	44.66	31.30
442	44.23	39.01	51.46	39.18	27.60	52.85	42.25	44.67	31.06
443	45.61	40.66	52.71	40.00	28.19	53.83	43.61	45.65	31.99
444	42.92	38.57	51.05	39.29	27.40	52.40	41.34	44.19	30.84
445	44.87	39.43	51.75	39.58	27.71	52.98	42.65	44.96	31.50
446	44.61	39.71	52.40	39.79	28.97	53.38	42.87	45.31	31.84
447	43.06	38.54	51.90	39.32	27.37	52.97	41.92	45.02	31.39
448	43.35	38.81	51.06	39.31	27.53	52.19	41.55	44.15	30.82
449	42.23	36.67	50.81	38.11	26.91	52.23	40.94	44.26	30.36
450	44.61	40.10	51.81	40.36	27.82	52.99	42.51	44.93	31.74

PROFILE NO.	LOCATION	DATE	LATITUDE	LONGITUDE
451	FORT GREELY	6/ 3/ 66	64.00	145.75
452	CAPE KENNEDY	1/ 22/ 64	28.45	80.53
453	CAPE KENNEDY	1/ 24/ 64	28.45	80.53
454	CAPE KENNEDY	1/ 25/ 64	28.45	80.53
455	CAPE KENNEDY	1/ 26/ 64	28.45	80.53
456	WHITE SANDS	1/ 13/ 64	32.38	106.48
457	WHITE SANDS	1/ 17/ 64	32.38	106.48
458	WHITE SANDS	1/ 20/ 64	32.38	106.48
459	WHITE SANDS	1/ 24/ 64	32.38	106.48
460	WHITE SANDS	1/ 27/ 64	32.38	106.48
461	CAPE KENNEDY	2/ 5/ 64	28.45	80.53
462	CAPE KENNEDY	2/ 12/ 64	28.45	80.53
463	CAPE KENNEDY	2/ 13/ 64	28.45	80.53
464	FORT GREELY	2/ 3/ 64	64.00	145.75
465	FORT GREELY	2/ 4/ 64	64.00	145.75
466	FORT GREELY	2/ 7/ 64	64.00	145.75
467	FORT GREELY	2/ 12/ 64	64.00	145.75
468	FORT GREELY	2/ 19/ 64	64.00	145.75
469	POINT MUGU, CAL.	2/ 5/ 64	34.12	119.12
470	WHITE SANDS	2/ 8/ 64	32.38	106.48
471	WHITE SANDS	2/ 8/ 64	32.38	106.48
472	WHITE SANDS	2/ 8/ 64	32.38	106.48
473	WHITE SANDS	2/ 7/ 64	32.38	106.48
474	WHITE SANDS	2/ 10/ 64	32.38	106.48
475	WHITE SANDS	2/ 17/ 64	32.38	106.48
476	CAPE KENNEDY	4/ 1/ 64	28.45	80.53
477	CAPE KENNEDY	4/ 1/ 64	28.45	80.53
478	CAPE KENNEDY	4/ 8/ 64	28.45	80.53
479	CAPE KENNEDY	4/ 10/ 64	28.45	80.53
480	CAPE KENNEDY	4/ 20/ 64	28.45	80.53
481	FORT GREELY	4/ 1/ 64	64.00	145.75
482	FORT GREELY	4/ 8/ 64	64.00	145.75
483	FORT GREELY	4/ 15/ 64	64.00	145.75
484	WHITE SANDS	4/ 9/ 64	32.38	106.48
485	WHITE SANDS	4/ 13/ 64	32.38	106.48
486	WHITE SANDS	4/ 15/ 64	32.38	106.48
487	CAPE KENNEDY	5/ 25/ 64	28.45	80.53
488	CAPE KENNEDY	5/ 26/ 64	28.45	80.53
489	CAPE KENNEDY	5/ 26/ 64	28.45	80.53
490	CAPE KENNEDY	5/ 28/ 64	28.45	80.53
491	POINT MUGU, CAL.	5/ 27/ 64	34.12	119.12
492	POINT MUGU, CAL.	6/ 3/ 64	34.12	119.12
493	FORT GREELY	6/ 3/ 64	64.00	145.75
494	FORT GREELY	6/ 5/ 64	64.00	145.75
495	FORT GREELY	6/ 11/ 64	64.00	145.75
496	WHITE SANDS	5/ 25/ 64	32.38	106.48
497	WHITE SANDS	6/ 1/ 64	32.38	106.48
498	WHITE SANDS	6/ 3/ 64	32.38	106.48
499	WHITE SANDS	6/ 13/ 64	32.38	106.48
500	ANTIGUA	11/ 11/ 64	17.15	61.78

PROFILE NO.	L1(2.0)	L1(3.0)	L2(.15)	L2(.50)	L2(.90)	L3(4.5)	L3(20.0)	L4(2.5)	L4(10.)
451	46.15	41.70	52.58	40.79	26.55	54.32	44.01	45.72	32.24
452	44.12	39.01	51.38	40.36	28.25	52.59	41.95	44.89	31.83
453	43.19	37.64	51.38	39.30	28.63	52.51	41.59	44.83	31.40
454	42.71	37.06	51.06	38.85	28.80	52.72	41.14	44.54	31.04
455	42.69	37.82	51.13	39.25	28.12	52.23	41.17	44.45	31.02
456	40.83	35.42	49.81	37.74	25.67	51.34	39.73	43.38	29.53
457	42.01	38.54	48.85	39.11	27.14	51.54	40.17	42.61	29.83
458	41.36	36.03	50.35	38.37	26.02	51.61	40.04	43.78	30.00
459	44.83	39.47	52.39	40.08	27.07	53.48	42.97	45.54	31.72
460	42.88	36.34	51.87	38.82	25.81	52.70	41.36	44.91	30.84
461	43.18	38.07	50.73	39.04	30.15	52.29	41.33	44.13	31.04
462	43.42	39.04	50.75	39.65	27.00	52.75	41.57	44.22	31.10
463	43.80	39.59	50.40	40.67	28.58	52.51	41.37	44.33	32.03
464	42.71	37.95	49.40	36.83	25.59	52.19	41.11	42.80	28.87
465	42.32	37.05	47.99	36.23	24.80	51.98	40.53	42.15	28.61
466	40.80	35.75	49.88	35.90	24.98	52.24	40.31	43.07	28.57
467	37.70	31.81	47.58	34.14	22.35	50.25	37.39	41.52	26.80
468	40.83	36.95	48.01	36.46	25.17	52.57	40.07	42.31	28.58
469	44.21	38.38	52.92	39.27	27.96	54.98	43.14	46.16	31.81
470	42.15	36.42	50.40	37.80	26.83	52.46	40.64	44.05	30.28
471	41.01	36.10	49.68	37.30	26.14	52.12	40.18	43.59	29.71
472	41.89	36.03	51.03	37.57	26.27	53.17	41.23	44.61	30.15
473	39.42	34.35	49.47	36.54	26.18	51.00	38.70	42.91	29.02
474	42.98	37.30	50.81	38.86	27.08	52.09	41.11	44.24	30.69
475	42.78	37.26	50.39	38.82	25.50	52.43	41.10	44.23	30.60
476	43.71	39.13	51.28	39.85	28.95	52.51	41.86	44.63	31.38
477	44.35	39.42	52.29	39.80	29.31	53.71	42.77	45.44	31.87
478	43.28	37.92	51.69	39.66	28.95	52.65	41.74	44.97	31.38
479	43.23	38.33	51.86	39.28	28.99	53.37	42.03	45.16	31.38
480	44.06	38.85	51.27	39.46	28.88	52.75	42.03	44.68	31.19
481	42.11	35.61	50.26	35.96	23.22	53.73	41.24	44.07	28.94
482	42.19	36.79	53.62	37.60	23.53	54.81	42.63	46.04	30.29
483	44.13	38.54	51.61	38.39	24.50	53.22	42.37	44.66	30.55
484	43.27	37.87	51.34	39.09	28.06	52.38	41.45	44.56	31.13
485	43.13	37.71	51.32	39.23	26.68	52.56	41.50	44.70	31.08
486	44.16	39.29	52.23	40.39	28.06	53.82	42.57	45.71	32.13
487	42.89	38.02	51.20	38.95	27.48	52.46	41.35	44.32	30.84
488	44.41	39.76	51.55	40.13	28.27	52.80	42.32	44.77	31.51
489	44.49	39.30	51.42	39.60	28.70	52.86	42.35	44.81	31.53
490	42.14	37.49	50.12	38.35	27.41	51.68	40.50	43.44	30.14
491	43.35	38.29	50.45	38.69	27.83	52.13	41.36	43.83	30.59
492	49.53	45.78	54.58	44.10	31.41	55.45	46.51	47.59	35.08
493	44.33	40.29	53.57	39.53	26.01	55.46	43.77	45.99	31.55
494	46.79	41.61	52.63	40.85	26.36	54.34	44.37	45.88	32.34
495	45.01	41.01	51.55	40.03	27.11	54.67	43.77	45.54	31.66
496	42.78	37.85	51.60	39.31	27.20	52.85	41.42	44.83	31.19
497	44.11	38.68	52.11	39.17	26.81	53.24	42.47	45.21	31.38
498	44.17	38.78	51.85	39.52	27.62	53.29	42.21	44.92	31.39
499	44.51	39.72	51.60	40.00	26.87	53.41	42.48	44.86	31.42
500	44.62	39.52	51.96	40.04	29.02	53.19	42.64	45.24	31.84

PROFILE NO.	LOCATION	DATE	LATITUDE	LONGITUDE
501	ANTIGUA	11/ 16/ 64	17.15	61.78
502	CAPE KENNEDY	11/ 6/ 64	28.45	80.53
503	CAPE KENNEDY	11/ 10/ 64	28.45	80.53
504	CAPE KENNEDY	11/ 12/ 64	28.45	80.53
505	CAPE KENNEDY	11/ 20/ 64	28.45	80.53
506	CAPE KENNEDY	4/ 8/ 65	28.45	80.53
507	FORT CHURCHILL	11/ 16/ 64	58.73	93.82
508	FORT CHURCHILL	11/ 25/ 64	58.73	93.82
509	FORT GREELY	11/ 12/ 64	64.00	145.75
510	POINT MUGU, CAL.	11/ 4/ 64	34.12	119.12
511	POINT MUGU, CAL.	11/ 18/ 64	34.12	119.12
512	WALLOPS ISLAND	11/ 5/ 64	37.84	75.48
513	WALLOPS ISLAND	11/ 6/ 64	37.84	75.48
514	WHITE SANDS	11/ 4/ 64	32.38	106.48
515	WHITE SANDS	11/ 5/ 64	32.38	106.48
516	WHITE SANDS	11/ 13/ 64	32.38	106.48
517	WHITE SANDS	11/ 18/ 64	32.38	106.48
518	WHITE SANDS	11/ 19/ 64	32.38	106.48
519	WHITE SANDS	11/ 16/ 64	32.38	106.48
520	WHITE SANDS	11/ 20/ 64	32.38	106.48
521	ANTIGUA	12/ 9/ 64	17.15	61.78
522	CAPE KENNEDY	12/ 6/ 64	28.45	80.53
523	CAPE KENNEDY	12/ 7/ 64	28.45	80.53
524	CAPE KENNEDY	12/ 8/ 64	28.45	80.53
525	CAPE KENNEDY	12/ 9/ 64	28.45	80.53
526	CAPE KENNEDY	12/ 9/ 64	28.45	80.53
527	CAPE KENNEDY	12/ 10/ 64	28.45	80.53
528	GRAND TURK IS.	12/ 9/ 64	21.43	71.14
529	GRAND TURK IS.	12/ 10/ 64	21.43	71.14
530	FORT CHURCHILL	12/ 4/ 64	58.73	93.82
531	FORT CHURCHILL	12/ 9/ 64	58.73	93.82
532	FORT CHURCHILL	12/ 11/ 64	58.73	93.82
533	FORT CHURCHILL	12/ 14/ 64	58.73	93.82
534	FORT CHURCHILL	12/ 16/ 64	58.73	93.82
535	FORT CHURCHILL	12/ 21/ 64	58.73	93.82
536	POINT MUGU, CAL.	12/ 4/ 64	34.12	119.12
537	POINT MUGU, CAL.	12/ 8/ 64	34.12	119.12
538	POINT MUGU, CAL.	12/ 9/ 64	34.12	119.12
539	POINT MUGU, CAL.	12/ 11/ 64	34.12	119.12
540	POINT MUGU, CAL.	12/ 16/ 64	34.12	119.12
541	POINT MUGU, CAL.	12/ 16/ 64	34.12	119.12
542	POINT MUGU, CAL.	12/ 18/ 64	34.12	119.12
543	POINT MUGU, CAL.	12/ 18/ 64	34.12	119.12
544	WHITE SANDS	12/ 5/ 64	32.38	106.48
545	WHITE SANDS	12/ 9/ 64	32.38	106.48
546	WHITE SANDS	12/ 15/ 64	32.38	106.48
547	WHITE SANDS	12/ 16/ 64	32.38	106.48
548	CAPE KENNEDY	8/ 5/ 64	28.45	80.53
549	CAPE KENNEDY	8/ 12/ 64	28.45	80.53
550	FORT CHURCHILL	8/ 8/ 64	58.73	93.82

PROFILE NO.	L1(2.0)	L1(3.0)	L2(.15)	L2(.50)	L2(.90)	L3(4.5)	L3(20.0)	L4(2.5)	L4(10.)
501	45.33	40.25	53.10	40.78	28.91	53.83	43.51	46.12	32.47
502	42.23	35.93	51.10	38.56	26.66	51.93	40.78	44.41	30.47
503	43.74	38.24	51.77	39.82	28.07	52.78	41.95	45.04	31.39
504	43.10	37.34	51.20	39.56	27.77	52.15	41.39	44.78	31.21
505	43.69	38.20	51.92	40.10	27.19	52.79	41.94	45.11	31.49
506	43.08	38.20	51.06	39.19	28.83	52.83	41.49	44.46	31.18
507	38.61	32.63	50.28	34.97	22.93	52.17	39.20	43.82	28.47
508	37.77	31.55	48.23	35.39	23.55	49.56	37.26	42.14	27.91
509	40.36	34.86	49.50	35.79	23.90	51.44	39.55	42.65	28.22
510	41.46	36.07	50.19	37.74	26.99	51.60	40.32	43.87	30.07
511	40.30	34.32	50.95	37.55	25.18	52.15	39.96	44.50	30.02
512	41.71	35.76	50.72	38.47	25.82	51.68	40.41	44.12	30.24
513	43.38	38.12	51.56	39.64	27.32	52.57	41.68	44.83	31.21
514	39.98	33.60	50.40	37.42	25.93	51.25	39.28	43.90	29.76
515	43.15	38.31	51.83	39.43	28.44	52.99	41.82	44.92	31.31
516	41.77	35.55	50.65	38.16	25.58	51.73	40.45	44.23	30.22
517	41.13	34.86	50.83	37.60	26.37	51.43	40.24	44.32	30.23
518	41.55	35.25	50.44	37.57	26.41	51.63	40.32	44.13	30.09
519	42.34	34.98	51.29	38.56	26.63	51.94	40.85	44.67	30.56
520	42.30	34.44	51.20	39.36	27.09	51.59	40.67	44.77	30.82
521	42.73	37.27	50.78	38.89	28.05	52.10	41.05	44.19	30.66
522	40.40	35.35	49.45	37.14	28.18	51.03	39.38	43.14	29.49
523	41.12	35.13	50.04	36.86	28.07	51.37	40.01	43.56	29.56
524	41.05	35.10	50.19	37.05	27.71	51.27	39.94	43.65	29.72
525	39.65	34.68	50.23	36.41	27.34	51.44	39.52	43.54	29.29
526	43.63	37.35	50.82	38.02	28.91	52.43	41.62	44.31	30.51
527	41.88	36.06	50.96	38.48	27.88	51.82	40.58	44.35	30.57
528	42.44	36.62	51.50	38.38	28.10	52.30	41.23	44.74	30.76
529	44.62	38.77	52.39	39.95	28.77	53.26	42.67	45.58	31.86
530	34.08	25.89	46.60	34.56	20.47	47.46	34.04	40.88	26.64
531	34.45	27.46	48.41	33.26	20.75	49.76	35.72	42.13	26.42
532	33.15	26.31	48.67	31.86	20.56	49.82	35.26	42.12	25.59
533	36.12	28.96	50.13	33.72	20.83	51.45	37.83	43.64	27.55
534	34.46	27.71	49.25	33.52	21.41	51.73	36.15	43.19	26.77
535	40.18	33.28	51.75	38.91	23.56	52.22	40.09	45.37	30.98
536	43.55	37.73	51.78	39.02	28.13	53.43	42.17	45.21	31.14
537	45.48	40.19	55.06	41.04	28.75	55.71	44.53	47.57	33.11
538	41.05	35.09	52.53	37.37	27.25	53.64	41.57	45.68	30.50
539	45.78	38.11	53.60	41.14	27.67	53.69	43.59	46.68	32.64
540	41.26	34.11	50.64	37.69	25.79	51.59	40.22	44.04	29.59
541	40.81	33.43	50.64	37.12	25.89	51.44	39.98	44.04	29.43
542	44.06	33.26	51.56	38.55	24.89	52.83	41.73	45.23	30.39
543	41.02	32.70	50.33	36.34	25.39	51.30	39.85	43.76	29.08
544	40.13	34.82	48.87	36.32	26.51	50.96	39.12	42.79	28.96
545	39.40	33.98	49.68	36.13	26.49	51.06	39.00	43.16	28.95
546	44.66	37.41	53.44	39.47	26.57	53.88	42.98	46.34	31.93
547	44.58	38.87	53.43	41.25	26.36	53.81	42.94	46.08	32.02
548	43.51	38.45	51.11	39.36	28.27	52.38	41.64	44.35	31.00
549	39.74	33.63	50.29	37.77	24.24	50.67	38.83	43.53	29.57
550	44.30	39.63	50.83	38.96	26.48	52.97	42.40	44.29	30.74

PROFILE NO.	LOCATION	DATE	LATITUDE	LONGITUDE
551	FORT CHURCHILL	8/ 12/ 64	58.73	93.82
552	FORT CHURCHILL	8/ 19/ 64	58.73	93.82
553	FORT CHURCHILL	8/ 21/ 64	58.73	93.82
554	FORT CHURCHILL	5/ 20/ 64	58.73	93.82
555	FORT CHURCHILL	6/ 3/ 64	58.73	93.82
556	FORT CHURCHILL	6/ 19/ 64	58.73	93.82
557	FORT GREELY	8/ 5/ 64	64.00	145.75
558	POINT MUGU, CAL.	8/ 5/ 64	34.12	119.12
559	POINT MUGU, CAL.	8/ 12/ 64	34.12	119.12
560	POINT MUGU, CAL.	8/ 19/ 64	34.12	119.12
561	WALLOPS ISLAND	8/ 12/ 64	37.84	75.48
562	WALLOPS ISLAND	8/ 18/ 64	37.84	75.48
563	ANTIGUA	10/ 12/ 64	17.15	61.78
564	ANTIGUA	10/ 23/ 64	17.15	61.78
565	ANTIGUA	10/ 26/ 64	17.15	61.78
566	ANTIGUA	10/ 27/ 64	17.15	61.78
567	ANTIGUA	10/ 28/ 64	17.15	61.78
568	CAPE KENNEDY	10/ 9/ 64	28.45	80.53
569	CAPE KENNEDY	10/ 12/ 64	28.45	80.53
570	CAPE KENNEDY	10/ 23/ 64	28.45	80.53
571	CAPE KENNEDY	10/ 26/ 64	28.45	80.53
572	CAPE KENNEDY	10/ 29/ 64	28.45	80.53
573	CAPE KENNEDY	10/ 30/ 64	28.45	80.53
574	GRAND TURK IS.	10/ 16/ 64	21.43	71.14
575	GRAND TURK IS.	10/ 19/ 64	21.43	71.14
576	GRAND TURK IS.	10/ 28/ 64	21.43	71.14
577	FORT CHURCHILL	10/ 16/ 64	58.73	93.82
578	FORT CHURCHILL	10/ 21/ 64	58.73	93.82
579	FORT GREELY	10/ 28/ 64	64.00	145.75
580	POINT MUGU, CAL.	10/ 21/ 64	34.12	119.12
581	WHITE SANDS	10/ 14/ 64	32.38	106.48
582	WHITE SANDS	10/ 21/ 64	32.38	106.48
583	WHITE SANDS	10/ 22/ 64	32.38	106.48
584	WHITE SANDS	10/ 28/ 64	32.38	106.48
585	WHITE SANDS	10/ 29/ 64	32.38	106.48

PROFILE NO.	L1(2.0)	L1(3.0)	L2(.15)	L2(.50)	L2(.90)	L3(4.5)	L3(20.0)	L4(2.5)	L4(10.)
551	44.76	40.17	51.46	39.36	26.00	53.61	42.86	44.72	31.09
552	45.73	41.06	52.19	40.31	27.71	54.33	43.75	45.59	32.20
553	46.17	41.28	52.48	40.37	28.44	53.75	43.79	45.57	32.15
554	45.56	40.43	52.65	39.96	26.17	54.66	43.75	45.81	31.79
555	46.15	41.40	52.10	40.23	26.98	53.71	43.74	45.22	31.79
556	46.73	42.60	53.31	40.63	27.53	55.66	45.01	46.26	32.58
557	44.58	38.82	52.69	38.23	25.26	53.69	43.08	45.18	30.74
558	47.58	42.25	54.53	40.75	28.70	55.45	45.45	47.07	32.98
559	44.29	38.93	51.61	39.49	27.66	52.94	42.33	44.96	31.55
560	47.30	43.07	55.14	41.97	28.78	55.50	45.69	47.55	33.68
561	43.09	37.77	50.64	38.41	27.25	52.14	41.27	43.99	30.49
562	45.42	40.59	52.64	40.16	26.31	54.36	43.66	45.74	32.00
563	44.16	39.40	51.61	40.26	28.37	52.86	42.16	44.96	31.71
564	44.83	40.10	51.50	40.32	29.10	53.22	42.68	45.05	31.77
565	45.05	39.90	51.88	40.28	28.49	52.97	42.79	45.22	31.92
566	43.71	37.98	51.08	39.30	27.94	51.95	41.56	44.56	31.26
567	43.53	38.41	50.55	39.45	28.57	52.09	41.38	44.20	30.95
568	42.80	37.70	50.59	38.56	27.64	51.87	40.96	43.95	30.61
569	44.32	39.59	51.41	39.42	28.74	52.91	42.34	44.54	31.04
570	43.44	38.81	50.65	39.57	27.88	51.50	41.37	44.23	31.29
571	44.02	38.17	51.82	40.13	27.43	52.47	41.96	45.02	31.34
572	44.08	38.60	51.77	39.78	27.07	52.53	42.03	44.96	31.34
573	43.60	38.74	50.91	39.14	28.67	52.36	41.67	44.20	30.93
574	44.33	39.43	52.21	39.98	29.40	53.69	42.75	45.48	31.80
575	44.32	39.47	52.35	40.57	28.19	53.10	42.49	45.50	32.20
576	43.52	37.01	50.98	38.95	27.50	51.90	41.28	44.40	30.89
577	39.22	32.02	51.72	36.47	22.06	52.24	39.78	44.64	29.33
578	39.07	33.05	50.33	35.98	23.09	51.70	39.16	43.76	28.88
579	42.44	37.13	49.60	37.32	23.40	51.88	40.67	43.12	29.19
580	43.38	36.15	51.87	39.58	26.67	52.49	41.55	45.10	31.22
581	41.23	35.82	50.68	37.72	26.06	51.87	40.31	44.10	30.07
582	43.33	37.21	51.32	39.42	27.52	52.38	41.48	44.88	31.20
583	41.66	35.19	50.47	38.23	26.96	50.74	40.07	43.85	30.17
584	39.23	33.12	50.11	36.96	25.46	50.70	38.66	43.58	29.45
585	40.72	34.40	50.74	38.37	27.02	51.65	40.01	44.43	30.33

PROFILE NO.,	GRID POINT	DATE	LATITUDE	LONGITUDE
1086	1	11/ 13/ 66	63.75	165.00
1087	2	11/ 13/ 66	52.50	165.00
1088	3	11/ 13/ 66	75.00	150.00
1089	4	11/ 13/ 66	60.00	150.00
1090	5	11/ 13/ 66	45.00	150.00
1091	6	11/ 13/ 66	30.00	150.00
1092	7	11/ 13/ 66	52.50	135.00
1093	8	11/ 13/ 66	37.50	135.00
1094	9	11/ 13/ 66	26.25	135.00
1095	10	11/ 13/ 66	75.00	120.00
1096	11	11/ 13/ 66	67.50	120.00
1097	12	11/ 13/ 66	60.00	120.00
1098	13	11/ 13/ 66	45.00	120.00
1099	14	11/ 13/ 66	37.50	120.00
1100	15	11/ 13/ 66	30.00	120.00
1101	16	11/ 13/ 66	15.00	120.00
1102	17	11/ 13/ 66	63.75	105.00
1103	18	11/ 13/ 66	56.75	105.00
1104	19	11/ 13/ 66	48.75	105.00
1105	20	11/ 13/ 66	41.25	105.00
1106	21	11/ 13/ 66	33.75	105.00
1107	22	11/ 13/ 66	26.25	105.00
1108	23	11/ 13/ 66	22.50	105.00
1109	24	11/ 13/ 66	90.00	.00
1110	25	11/ 13/ 66	86.25	90.00
1111	26	11/ 13/ 66	82.50	90.00
1112	27	11/ 13/ 66	78.75	90.00
1113	28	11/ 13/ 66	75.00	90.00
1114	29	11/ 13/ 66	71.25	90.00
1115	30	11/ 13/ 66	67.50	90.00
1116	31	11/ 13/ 66	63.75	90.00
1117	32	11/ 13/ 66	56.25	90.00
1118	33	11/ 13/ 66	52.50	90.00
1119	34	11/ 13/ 66	48.75	90.00
1120	35	11/ 13/ 66	45.00	90.00
1121	36	11/ 13/ 66	41.25	90.00
1122	37	11/ 13/ 66	37.50	90.00
1123	38	11/ 13/ 66	33.75	90.00
1124	39	11/ 13/ 66	30.00	90.00
1125	40	11/ 13/ 66	26.25	90.00
1126	41	11/ 13/ 66	22.50	90.00
1127	42	11/ 13/ 66	18.75	90.00
1128	43	11/ 13/ 66	15.00	90.00
1129	44	11/ 13/ 66	11.25	90.00
1130	45	11/ 13/ 66	7.50	90.00
1131	46	11/ 13/ 66	3.75	90.00
1132	47	11/ 13/ 66	.00	90.00
1133	48	11/ 13/ 66	56.25	75.00
1134	49	11/ 13/ 66	48.75	75.00
1135	50	11/ 13/ 66	41.25	75.00

PROFILE NO.	L1(2.0)	L1(3.0)	L2(.15)	L2(.50)	L2(.90)	L3(4.5)	L3(20.0)	L4(2.5)	L4(10.)
1086	40.21	35.82	48.04	36.45	23.83	51.51	39.11	42.11	28.34
1087	40.97	36.48	49.09	36.93	24.75	51.95	39.95	42.81	28.90
1088	37.93	32.92	46.83	35.31	23.00	50.10	37.15	41.17	27.04
1089	39.64	34.91	47.90	35.92	23.53	51.05	38.65	41.91	27.96
1090	39.88	34.41	49.36	36.38	24.77	51.38	39.19	42.96	28.66
1091	40.29	34.06	50.19	37.12	26.00	51.59	39.58	43.68	29.33
1092	37.92	32.24	47.82	34.54	22.68	50.26	37.50	41.59	27.10
1093	38.47	32.28	49.82	35.79	24.89	51.14	38.45	43.35	28.62
1094	40.36	34.41	50.81	37.45	26.56	51.96	39.92	44.27	29.90
1095	36.07	30.13	46.65	34.03	22.47	49.15	35.84	40.80	26.29
1096	36.06	30.30	46.84	33.74	22.36	49.35	35.99	40.87	26.23
1097	35.89	30.16	47.22	33.48	22.03	49.50	36.08	41.06	26.21
1098	36.48	30.85	48.69	34.54	23.26	50.06	36.90	42.26	27.40
1099	38.05	32.41	49.64	35.82	24.74	50.98	38.18	43.23	28.58
1100	39.98	34.13	50.47	36.96	26.10	51.81	39.65	44.01	29.57
1101	43.31	38.35	51.45	39.64	27.69	53.04	41.73	44.89	31.41
1102	33.14	27.14	47.33	32.43	21.54	48.61	34.31	40.94	25.53
1103	33.68	27.50	47.82	32.64	21.37	49.00	34.90	41.29	25.77
1104	34.88	28.87	48.20	33.64	22.01	49.42	35.73	41.70	26.50
1105	36.56	31.14	48.64	35.08	23.61	49.83	36.77	42.23	27.67
1106	38.56	33.20	49.12	36.13	25.48	50.64	38.19	42.74	28.61
1107	40.98	36.24	49.85	37.79	26.77	51.71	39.81	43.56	30.02
1108	41.69	36.53	50.28	38.35	27.00	52.05	40.40	43.94	30.30
1109	36.79	30.26	48.31	35.87	23.14	49.96	36.62	42.44	28.08
1110	36.33	29.86	48.20	35.54	22.91	49.77	36.35	42.32	27.88
1111	35.67	29.27	48.09	35.07	22.42	49.51	35.94	42.13	27.56
1112	33.42	26.66	46.81	33.28	21.03	48.09	34.06	40.84	25.94
1113	32.49	25.69	46.92	32.70	20.73	47.86	33.39	40.74	25.52
1114	31.93	25.12	47.08	32.30	20.54	47.85	33.22	40.75	25.35
1115	31.46	24.60	47.26	31.94	20.30	47.84	33.03	40.76	25.16
1116	31.33	24.40	47.43	31.68	20.18	47.95	33.05	40.77	24.96
1117	32.36	25.30	48.19	32.35	20.47	48.59	34.00	41.40	25.55
1118	33.31	26.29	48.53	32.85	20.50	49.05	34.91	41.84	26.04
1119	32.97	26.35	47.65	32.33	20.67	48.43	34.21	40.98	25.34
1120	35.74	29.44	49.28	34.67	22.25	49.90	36.68	42.72	27.55
1121	37.00	30.54	49.70	35.55	23.33	50.35	37.54	43.16	28.25
1122	38.04	32.14	49.89	36.04	24.29	50.77	38.28	43.36	28.74
1123	39.45	33.50	50.13	36.62	24.84	51.19	39.09	43.58	29.14
1124	40.57	34.69	50.62	37.52	26.15	51.55	39.76	44.00	29.85
1125	41.58	36.52	50.85	38.19	26.89	51.94	40.48	44.23	30.48
1126	42.08	36.82	51.13	38.81	27.02	52.16	40.84	44.48	30.71
1127	42.88	38.05	51.32	39.58	27.44	52.54	41.37	44.70	31.24
1128	43.44	38.87	51.48	40.09	27.80	52.86	41.78	44.87	31.65
1129	43.80	39.16	51.61	40.29	27.92	53.05	42.02	45.03	31.87
1130	44.02	39.30	51.73	40.41	28.02	53.16	42.19	45.17	31.99
1131	44.13	39.39	51.81	40.47	27.94	53.25	42.29	45.25	32.06
1132	44.22	39.45	51.89	40.48	27.90	53.37	42.39	45.32	32.09
1133	32.67	25.05	48.86	32.91	19.97	48.91	34.77	42.23	26.30
1134	35.28	28.01	49.61	34.37	20.66	49.92	36.74	43.02	27.50
1135	38.69	32.04	50.71	36.52	23.71	51.12	38.96	44.05	29.25

PROFILE NO.,	GRID POINT	DATE	LATITUDE	LONGITUDE
1136	51	11/ 13/ 66	33.75	75.00
1137	52	11/ 13/ 66	26.25	75.00
1138	53	11/ 13/ 66	75.00	60.00
1139	54	11/ 13/ 66	67.50	60.00
1140	55	11/ 13/ 66	60.00	60.00
1141	56	11/ 13/ 66	45.00	60.00
1142	1	11/ 13/ 65	63.75	165.00
1143	2	11/ 13/ 65	52.50	165.00
1144	3	11/ 13/ 65	75.00	150.00
1145	4	11/ 13/ 65	60.00	150.00
1146	5	11/ 13/ 65	45.00	150.00
1147	6	11/ 13/ 65	30.00	150.00
1148	7	11/ 13/ 65	52.50	135.00
1149	8	11/ 13/ 65	37.50	135.00
1150	9	11/ 13/ 65	26.25	135.00
1151	10	11/ 13/ 65	75.00	120.00
1152	11	11/ 13/ 65	67.50	120.00
1153	12	11/ 13/ 65	60.00	120.00
1154	13	11/ 13/ 65	45.00	120.00
1155	14	11/ 13/ 65	37.50	120.00
1156	15	11/ 13/ 65	30.00	120.00
1157	16	11/ 13/ 65	15.00	120.00
1158	17	11/ 13/ 65	63.75	105.00
1159	18	11/ 13/ 65	56.75	105.00
1160	19	11/ 13/ 65	48.75	105.00
1161	20	11/ 13/ 65	41.25	105.00
1162	21	11/ 13/ 65	33.75	105.00
1163	22	11/ 13/ 65	26.25	105.00
1164	23	11/ 13/ 65	22.50	105.00
1165	24	11/ 13/ 65	90.00	.00
1166	25	11/ 13/ 65	86.25	90.00
1167	26	11/ 13/ 65	82.50	90.00
1168	27	11/ 13/ 65	78.75	90.00
1169	28	11/ 13/ 65	75.00	90.00
1170	29	11/ 13/ 65	71.25	90.00
1171	30	11/ 13/ 65	67.50	90.00
1172	31	11/ 13/ 65	63.75	90.00
1173	32	11/ 13/ 65	56.25	90.00
1174	33	11/ 13/ 65	52.50	90.00
1175	34	11/ 13/ 65	48.75	90.00
1176	35	11/ 13/ 65	45.00	90.00
1177	36	11/ 13/ 65	41.25	90.00
1178	37	11/ 13/ 65	37.50	90.00
1179	38	11/ 13/ 65	33.75	90.00
1180	39	11/ 13/ 65	30.00	90.00
1181	40	11/ 13/ 65	26.25	90.00
1182	41	11/ 13/ 65	22.50	90.00
1183	42	11/ 13/ 65	18.75	90.00
1184	43	11/ 13/ 65	15.00	90.00
1185	44	11/ 13/ 65	11.25	90.00

PROFILE NO.	L1(2.0)	L1(3.0)	L2(.15)	L2(.50)	L2(.90)	L3(4.5)	L3(20.0)	L4(2.5)	L4(10.)
1136	40.83	34.40	51.17	37.59	25.61	51.74	40.18	44.45	30.02
1137	42.44	36.73	51.44	38.74	27.22	52.35	41.18	44.75	30.81
1138	31.57	23.13	47.20	32.54	19.57	47.72	33.08	41.00	25.53
1139	31.25	22.74	47.91	32.38	19.17	48.04	33.41	41.50	25.60
1140	33.23	25.11	49.05	33.49	19.92	49.09	35.20	42.51	26.75
1141	38.70	32.22	50.82	37.15	23.25	51.08	38.92	44.27	29.72
1142	37.46	30.60	50.17	34.04	21.70	51.46	38.25	43.24	27.50
1143	38.93	32.47	50.87	36.12	23.39	51.89	39.16	43.99	28.88
1144	32.88	26.23	48.77	32.53	20.32	49.53	35.13	42.15	26.21
1145	37.19	30.01	50.48	35.09	22.07	51.23	37.99	43.57	28.00
1146	39.56	33.72	50.81	37.01	24.13	51.69	39.35	43.96	29.35
1147	40.90	35.70	51.00	37.95	26.01	52.06	40.18	44.23	30.16
1148	37.99	31.99	50.53	36.54	22.48	51.03	38.21	43.67	28.95
1149	40.22	35.11	50.68	37.73	24.41	51.60	39.52	43.87	29.88
1150	41.23	36.37	50.94	38.36	26.66	52.05	40.29	44.22	30.55
1151	32.30	24.57	48.17	32.97	20.17	48.74	34.12	41.83	26.21
1152	34.91	26.71	49.05	34.91	20.68	49.52	35.69	42.56	27.42
1153	36.84	28.94	50.00	36.43	21.75	50.12	36.90	43.26	28.66
1154	39.22	33.93	50.27	37.55	22.80	50.99	38.56	43.54	29.59
1155	40.02	35.30	50.40	37.77	25.78	51.49	39.31	43.68	29.90
1156	41.22	36.59	50.63	38.24	27.11	51.91	40.18	43.86	30.36
1157	42.71	37.94	51.27	39.31	28.10	52.70	41.35	44.72	31.34
1158	33.85	25.47	48.38	34.51	20.44	48.87	34.80	42.17	27.08
1159	35.82	28.42	48.84	35.42	21.87	49.59	36.10	42.50	27.75
1160	37.36	30.94	49.07	36.12	22.80	49.79	37.00	42.58	28.33
1161	39.32	33.71	49.53	37.19	24.67	50.74	38.44	43.02	29.12
1162	40.83	35.94	50.15	37.93	26.22	51.47	39.70	43.45	29.80
1163	41.84	37.26	50.83	38.72	27.30	52.11	40.63	44.10	30.66
1164	42.35	37.72	51.10	38.99	28.09	52.60	41.12	44.48	30.99
1165	30.98	23.03	46.52	32.03	20.00	47.78	32.40	40.80	25.05
1166	30.71	22.49	46.59	32.10	20.03	47.69	32.23	40.85	25.09
1167	30.59	21.90	46.60	32.20	19.80	47.55	32.15	40.82	25.15
1168	30.68	21.79	46.70	32.36	19.71	47.55	32.26	40.89	25.29
1169	30.75	21.82	46.90	32.49	19.77	47.53	32.39	41.02	25.45
1170	30.79	21.59	47.01	32.64	19.65	47.53	32.47	41.13	25.59
1171	30.88	21.83	46.93	32.65	19.69	47.52	32.52	41.09	25.61
1172	31.23	22.60	46.67	32.69	20.02	47.59	32.64	41.00	25.68
1173	32.38	25.45	46.75	32.85	20.60	48.09	33.49	41.01	25.85
1174	33.43	27.60	47.47	33.16	21.34	48.65	34.57	41.32	26.30
1175	35.04	29.54	47.68	34.06	22.19	49.18	35.68	41.62	26.96
1176	37.67	31.57	48.62	35.09	23.41	50.00	37.33	42.23	27.79
1177	38.99	32.86	48.89	35.91	24.57	50.57	38.18	42.47	28.29
1178	40.02	34.29	49.44	36.79	25.44	51.07	38.99	42.89	28.89
1179	40.95	35.84	50.04	37.63	26.27	51.48	39.77	43.34	29.59
1180	41.58	36.79	50.43	38.11	27.28	51.74	40.30	43.65	30.11
1181	42.31	37.62	50.98	38.71	28.25	52.32	41.01	44.22	30.74
1182	42.80	38.06	51.28	38.99	28.98	52.73	41.50	44.60	31.12
1183	43.08	38.33	51.30	39.27	29.26	52.83	41.65	44.72	31.35
1184	43.34	38.28	51.46	39.48	28.95	52.85	41.74	44.89	31.56
1185	43.29	38.27	51.65	39.48	28.67	52.92	41.78	44.97	31.58

PROFILE NO.,	GRID POINT	DATE	LATITUDE	LONGITUDE
1186	45	11/ 13/ 65	7.50	90.00
1187	46	11/ 13/ 65	3.75	90.00
1188	47	11/ 13/ 65	.00	90.00
1189	48	11/ 13/ 65	56.25	75.00
1190	49	11/ 13/ 65	48.75	75.00
1191	50	11/ 13/ 65	41.25	75.00
1192	51	11/ 13/ 65	33.75	75.00
1193	52	11/ 13/ 65	26.25	75.00
1194	53	11/ 13/ 65	75.00	60.00
1195	54	11/ 13/ 65	67.50	60.00
1196	55	11/ 13/ 65	60.00	60.00
1197	56	11/ 13/ 65	45.00	60.00

PROFILE NO.	L1(2.0)	L1(3.0)	L2(.15)	L2(.50)	L2(.90)	L3(4.5)	L3(20.0)	L4(2.5)	L4(10.)
1186	43.26	38.28	51.66	39.46	28.52	52.92	41.78	44.96	31.56
1187	43.23	38.25	51.59	39.45	28.51	52.88	41.74	44.93	31.54
1188	43.21	38.24	51.58	39.45	28.50	52.87	41.72	44.92	31.52
1189	31.52	23.65	45.76	32.45	20.19	47.16	32.34	40.25	25.20
1190	34.03	28.49	47.14	33.25	22.13	48.69	34.87	41.04	26.26
1191	38.76	32.53	48.94	35.71	24.34	50.36	37.97	42.42	28.17
1192	40.81	35.46	50.11	37.81	26.17	51.40	39.67	43.43	29.65
1193	42.32	37.99	50.90	39.08	28.19	52.34	40.99	44.25	30.92
1194	29.21	19.42	45.44	31.86	18.71	46.51	31.06	40.18	24.55
1195	30.07	22.01	44.93	31.47	19.55	46.56	31.25	39.78	24.41
1196	31.39	24.84	45.08	31.92	20.65	47.18	32.09	39.88	24.80
1197	37.00	31.14	47.92	33.94	23.88	49.79	36.87	41.59	26.99

APPENDIX D
LOCATOR L4 (2. 5)

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APPENDIX D

LOCATOR L4 (2. 5)

INTRODUCTION

This appendix contains the plots of mean and standard deviation for L4 (2 5) resulting from this study.

GENERAL DISCUSSION

As would be expected and was demonstrated in the Horizon Definition Study contract, L4 (2. 5) is a more stable locator than L1 (3. 0) and, hence, the phenomena which caused the variations is not as distinguishable. However, the general shapes for the means and standard deviations are similar The characteristic high standard deviations in the winter and transition seasons in the high latitudes are apparent in Figures D1 and D2. Extremely stable conditions are shown for the 35°N to 55°N and 20°N to 35°N bands in Figures D3 through D6. It will be noted that, for this locator in these two bands, the standard deviations at times exceeds the total seasonal range of the means

Also to be noted is the apparent quasi-biennial oscillation again in Figure D8. Although not as pronounced as for L1 (3. 0), the variation in the means appears out of phase from year to year. The plot of the curve for 1966 is almost exactly opposite to what would be expected for a seasonal swing - cooling from January to June and then warming until November.

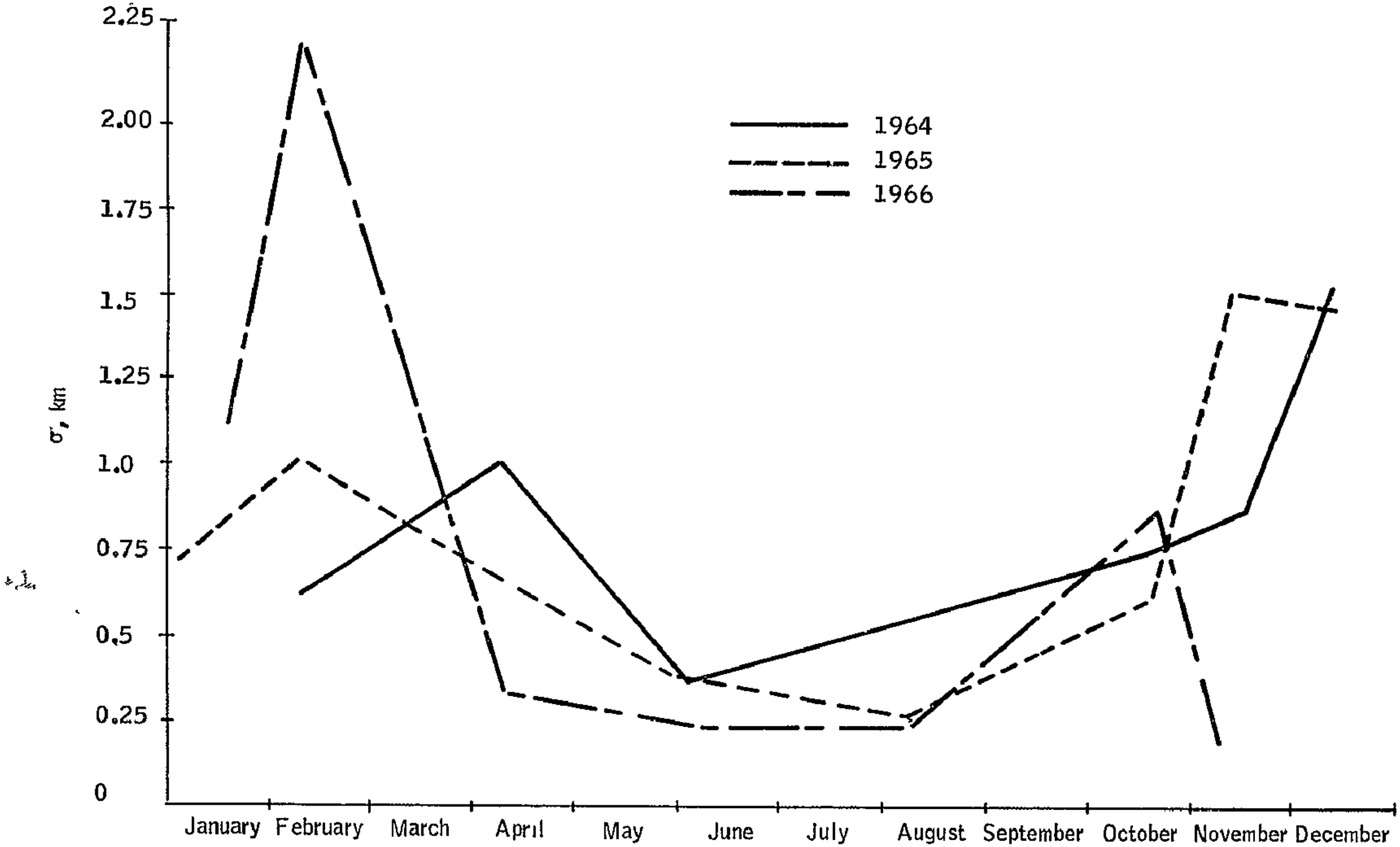

Figure D1. Standard Deviation for L4 (2.5), Latitude Band 55°N to 80°N

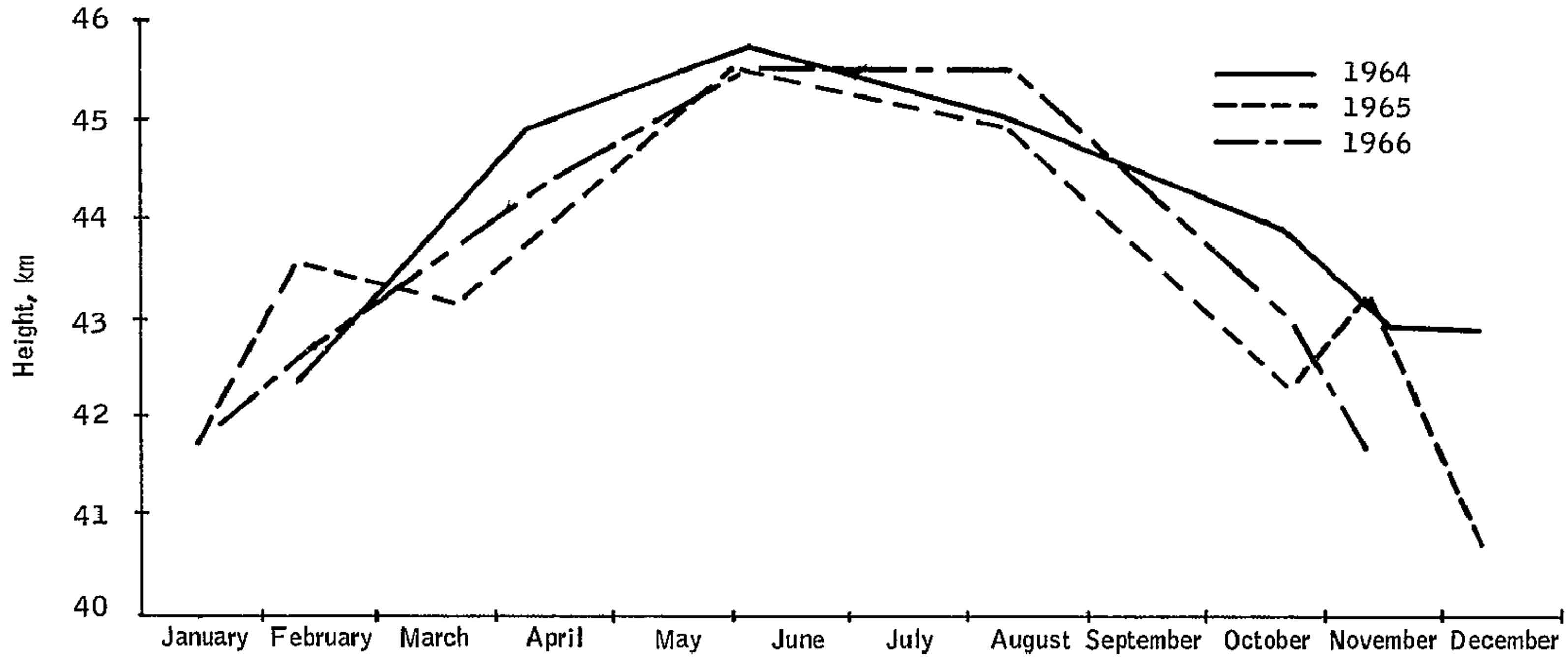

Figure D2. Locator L4 (2 5) Means, MRN Data, Latitude Band
55°N to 80°N

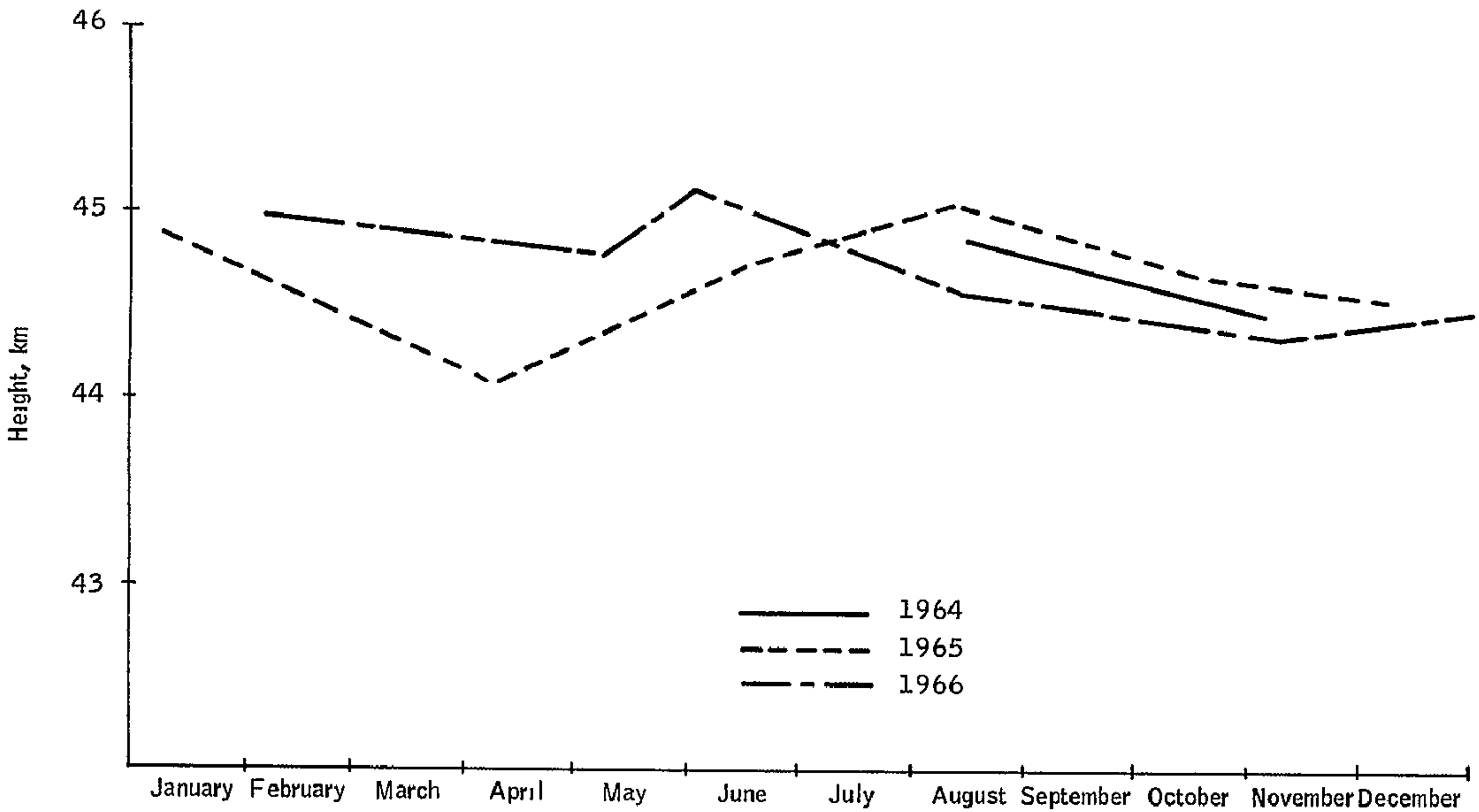

Figure D3. Locator L4 (2.5) Means, MRN Data, Latitude Band 35°N to 53°N

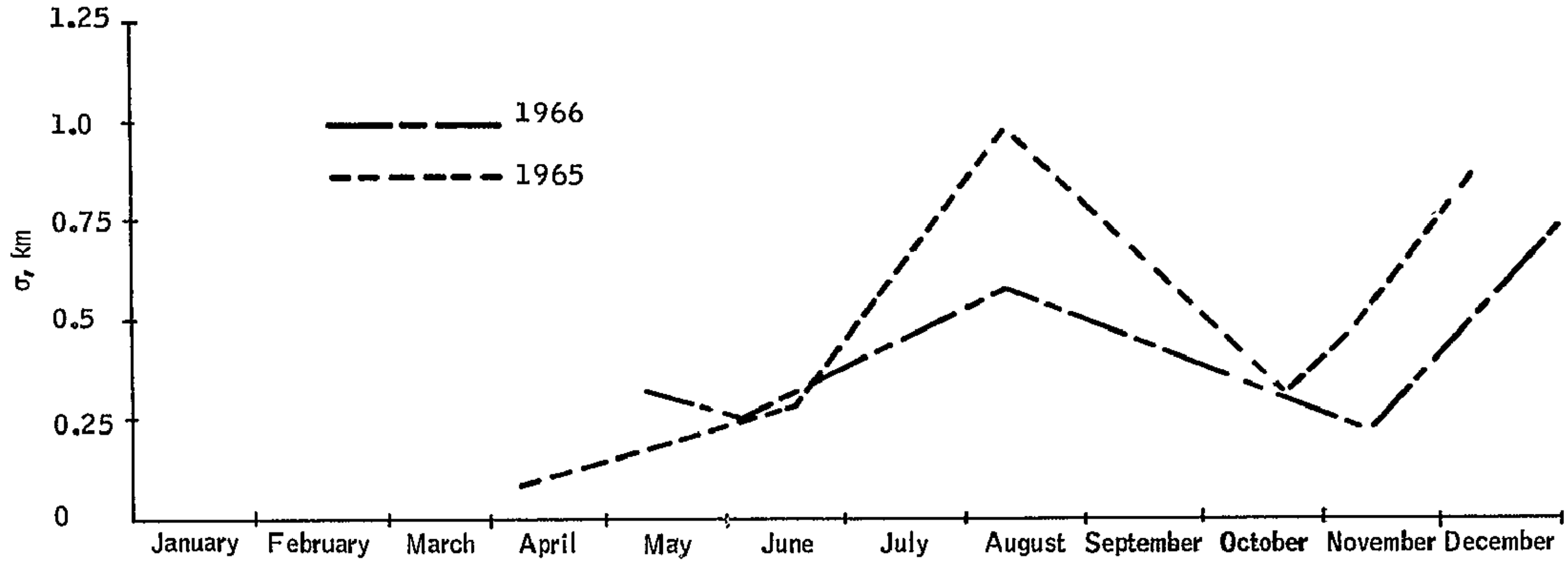

Figure D4. Standard Deviation for L4 (2.5), Latitude Band 35°N to 55°N

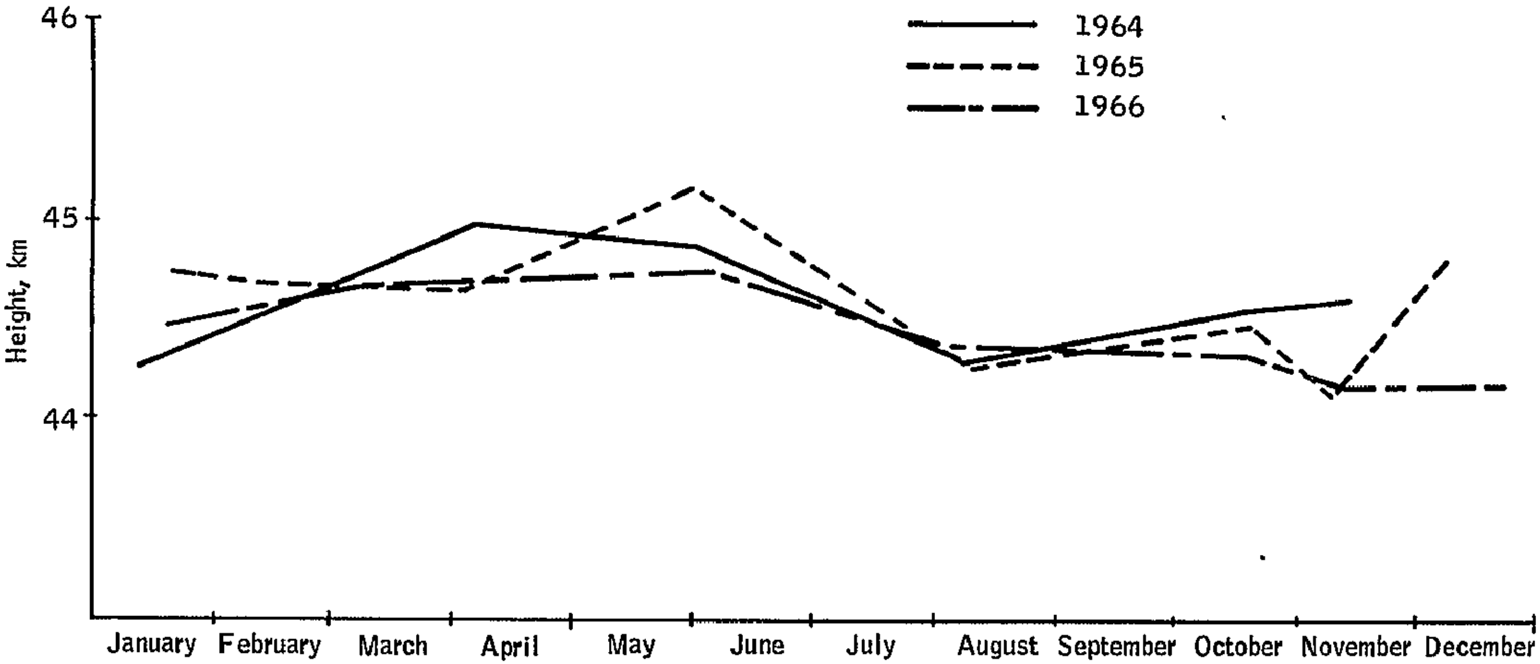

Figure D5. Locator L4 (2.5) Means, MRN Data, Latitude Band 20°N to 35°N

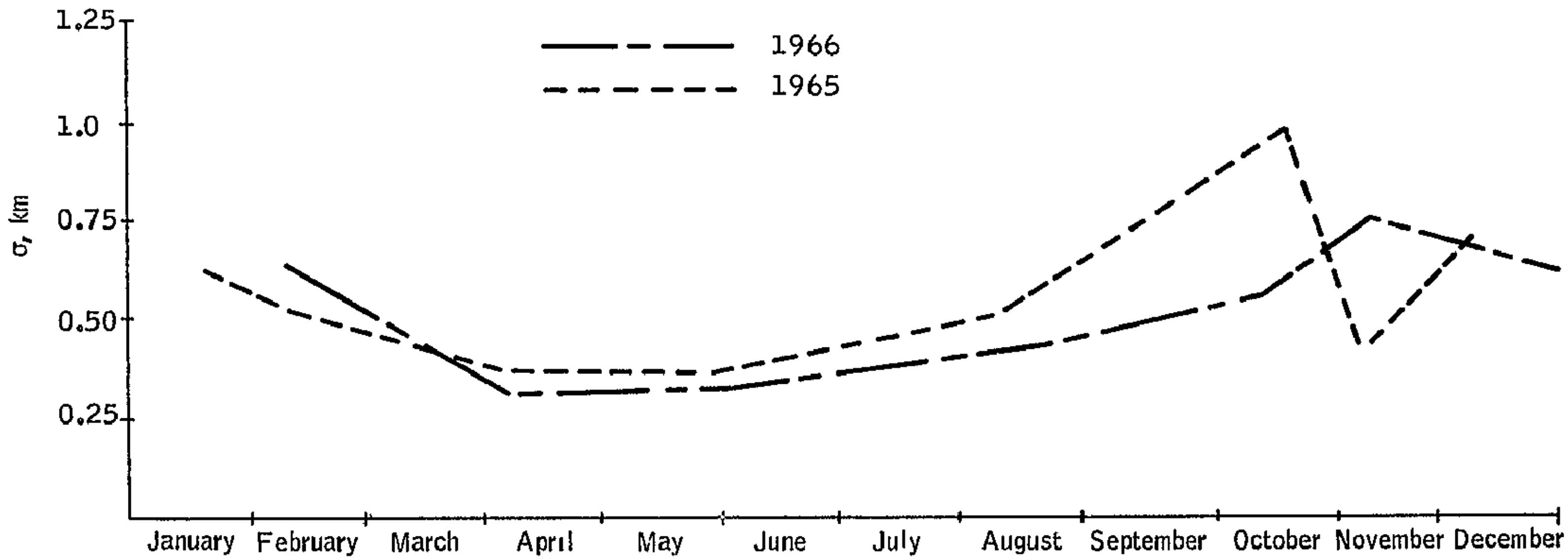

Figure D6. Standard Deviation for L4 (2.5), Latitude Band 20°N to 35°N

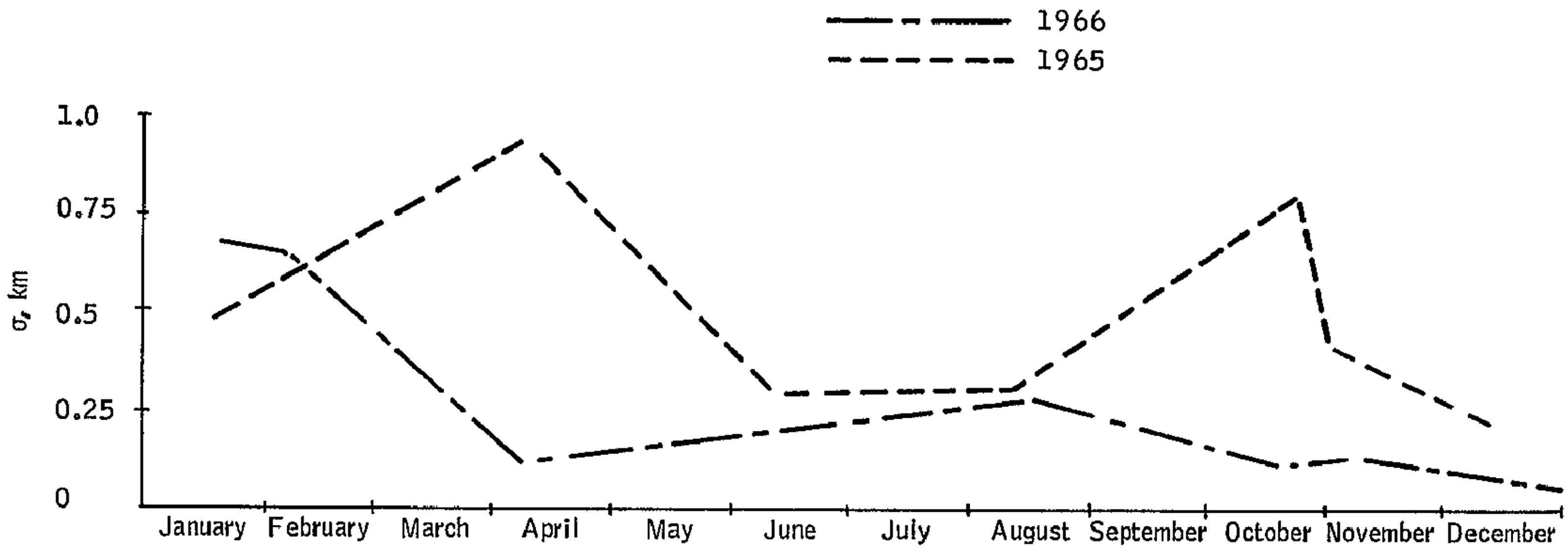

Figure D7. Standard Deviation for L4 (2.5), Latitude Band 0° to 20°N

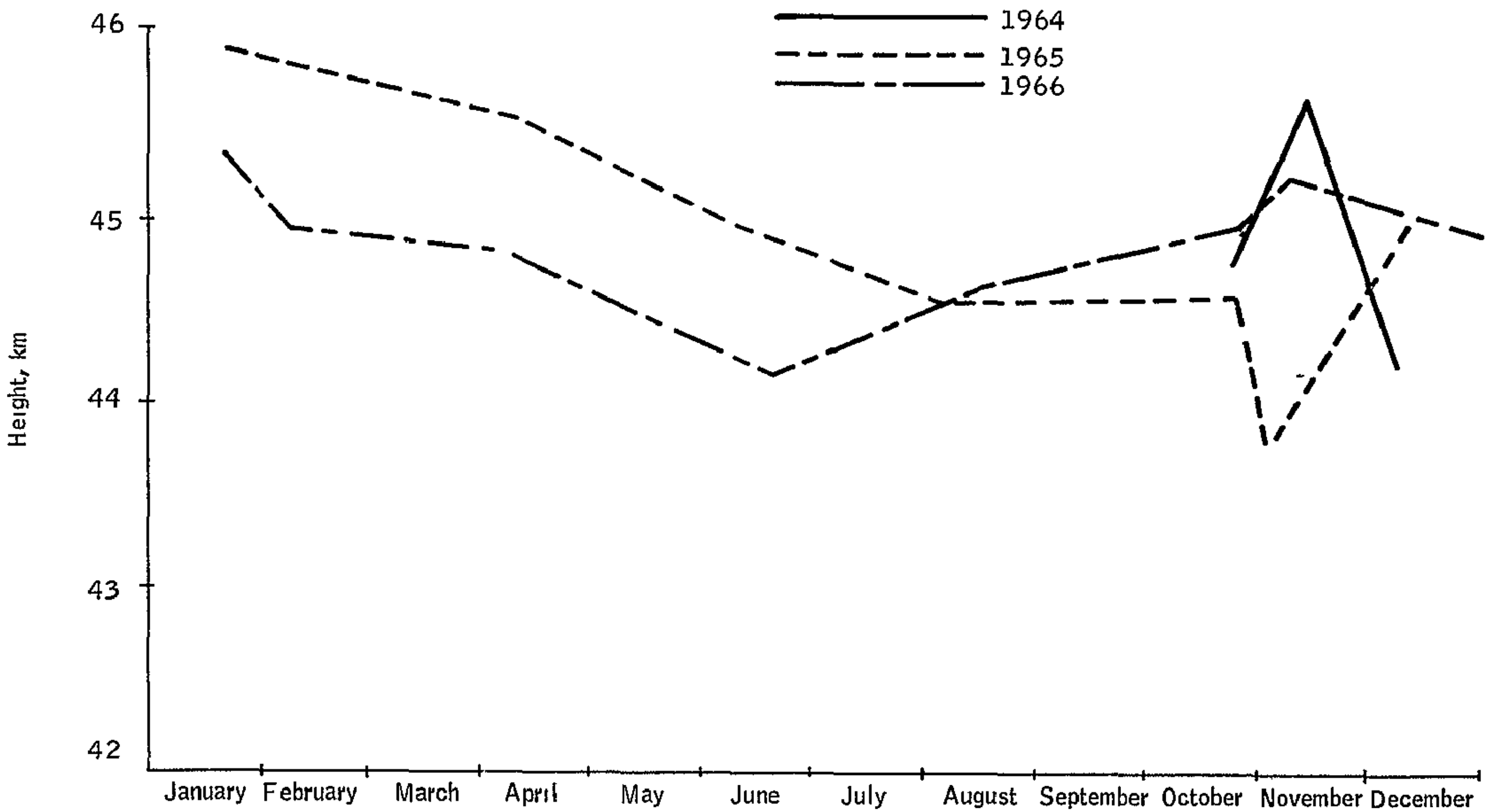

Figure D8. Locator L4 (2.5) Means, MRN Data, Latitude Band 0° to 20°N

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