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Interlevel Correlations of Temperature and Density, Surface to 60 km

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METEOROLOGY DIVISION PROJECT 6670
AIR FORCE GEOPHYSICS LABORATORY
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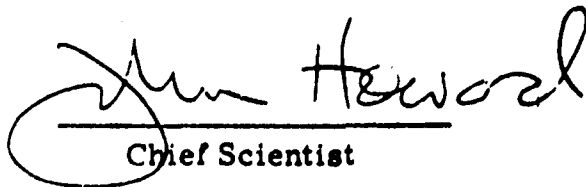
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→ distributions of vertical density and temperature gradients and the effects of day-to-day density variations on the trajectories of reentry vehicles. ↑

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Preface

The authors wish to take this opportunity to thank Mr. Karekin Agazarian who developed the computer programs for the computation of the statistical arrays and prepared them in "camera-ready" format. We also extend our thanks to Mrs. Helen Connell who typed several drafts of the text and tables.

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Interlevel Correlations of Temperature and Density, Surface to 60 km

1. INTRODUCTION

Geographical, seasonal, and day-to-day variations in the vertical distributions of atmospheric density and temperature must be considered in the design and operation of reentry vehicles. The atmospheric drag coefficients for a given vehicle are a function of the Mach number, which is directly related to ambient temperature. Variations in the distribution of atmospheric density affect the predicted deceleration and range of free-fall bombs and ballistic missiles that have high forward velocities. Thus, the purpose of this report is to develop statistical presentations that can be used to determine the influence of density and temperature distributions on the trajectories of reentry vehicles at altitudes between the surface and 60 km.

This work is part of a continuing effort to compile, analyze, and present information on the distribution of thermodynamic properties of the atmosphere in a form suitable for use in the design and operation of aerospace vehicles. An economical method of estimating the effect of density and temperature on reentry vehicles by the use of interlevel coefficients of correlation of density with density and temperature with temperature is described. A technique is also presented for obtaining estimates of these interlevel relationships in regions of sparse data.

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In evaluating the accuracy of a proposed missile system, estimates must be made of the effect of day-to-day variations in density on the impact point. The most direct approach to this problem is to calculate individual points of impact in each target area using a representative sample of observed density profiles from each region. This task could be time consuming, especially if several types of aerodynamic designs and various reentry angles are being investigated. A simpler approach is possible if the effect of density at each level is known to be independent or nearly independent of the effects at other levels, as it is believed to be in most cases. The required representative sample of soundings can then be summarized statistically and presented in an array so that only a simple arithmetical calculation is required to find the missile range and its standard deviation.

Arrays of means and standard deviations of density and temperature at 2-km intervals of altitude from the surface to 60 km, together with interlevel coefficients of correlation of density with density and temperature with temperature, are presented for the mid-season months at four locations. The same type of data are also presented for altitudes between 26 and 60 km at six additional locations. Both sets of data, ranging in latitude from 8° S to 64° N, are in a format that can be readily used to determine the integrated effect of density and temperature variations on the trajectories of reentry vehicles.

The integrated effect (E) of mean monthly density on the trajectory and impact point of a missile can be determined for a specific location by computer-simulated "flights" through mean monthly or seasonal density profiles, if the proper influence coefficients (c_i) for the missile at various levels are given:

$$E = \sum c_i \bar{\rho}_i . \quad (1)$$

where $\bar{\rho}_i$ is the mean monthly density at the i 'th level. The integrated standard deviation of the range, or deceleration due to day-to-day variations from the mean seasonal or monthly density profiles, can be obtained:

$$\sigma_{int}^2 = \sum_{ij} c_i \sigma_i R_{ij} c_j \sigma_j , \quad (2)$$

where σ_{int}^2 is the integrated variance for all layers being considered, c_i and c_j are influence coefficients at levels i and j , σ_i and σ_j are the standard deviations of density at levels i and j , and R_{ij} is the coefficient of correlation between densities at levels i and j .

Previous statistical presentations of the vertical density distributions suitable for reentry studies were prepared for levels up to 30 km from radiosonde observations by Cole and Court¹ and by Cole and Nee.² Investigations at altitudes above 30 km had been hampered by the lack of adequate data. Only during the past few years have sufficient observations become available from Meteorological Rocket Network (MRN) stations for such investigations.

2. DATA SOURCES AND ACCURACY

The statistical arrays of the means, standard deviations, and interlevel coefficients of correlation of density and temperature for altitudes up to 60 km are based on radiosonde and MRN observations taken at the 10 locations shown in Table 1. At four of these sites, radiosonde and rocketsonde observations taken within a few hours of each other were combined to provide individual density and temperature profiles from the surface to 60 km. Rocketsondes without accompanying radiosondes were used at the six remaining sites to develop statistical properties of the density and temperature distributions between 26 and 60 km. Only observations that were taken at least 3 days apart were used in an attempt to reduce the effects of persistence on the statistical properties of the elements being studied. It has been shown by Durst³ that the coefficients of correlation (R) for meteorological elements observed at various time intervals at levels between 5 and 20 km follow the law $R = e^{-aT}$, where a equals $6.9 \times 10^{-6} \text{ sec}^{-1}$ and T is measured in seconds. In a 3-day interval, the coefficients of correlation between observations are generally less than 0.2, approaching independence.

Temperatures were obtained at 2-km intervals of geopotential altitude below 30 km from individual radiosonde observations by linear interpolation between values at standard and significant pressure levels whose heights had been computed hypsometrically. Densities were interpolated logarithmically. Errors introduced by logarithmic interpolation of density are unimportant, generally < 1 percent at radiosonde heights.² The root-mean-square (rms) observational errors in radiosonde temperatures vary linearly with altitude from 1°K at the surface to from 2 to 5°K at 30 km, and the estimated rms errors in densities derived from these measurements range from 0.2 percent at the surface to 1.0 percent at 30 km.⁴

1. Cole, A. E., and Court, A. (1962) Density Distribution, Interlevel Correlations, and Variation with Winds, AFCRL-TR-62-815.
2. Cole, A. E., and Nee, P. F. (1965) Correlations of Temperature, Pressure, and Density to 30 km, AFCRL-TR-65-43, AD 612651.
3. Durst, B. A. (1954) Variation of Wind with Time and Distance, Geophysical Memoirs No. 93, British Meteorological Office.
4. Meteorological Group, Range Commanders Council (1977) Meteorological Data Error Estimates, Document 110-77, White Sands Missile Range, NM.

Temperatures and densities were obtained from MRN observations at geometric altitudes between 26 and 60 km. The estimated rms observational errors in rocketsonde temperatures vary linearly with altitude from 1.5°K at 25 km to 3.5°K at 70 km, and the rms errors in densities derived from rocketsonde measurements are estimated to vary from 1 percent at 30 km to 5 percent at 60 km.⁴

Table 1. Observational Sites

Station	Location	Altitudes	Period of Record
Ascension Island	8°S, 14°W	Surface to 60 km	1969-1976
Kwajalein	9°N, 168°E	Surface to 60 km	1969-1976
Wallops Island	38°N, 75°W	Surface to 60 km	1969-1976
Churchill	59°N, 94°W	Surface to 60 km	1969-1976
Fort Sherman	9°N, 80°W	26 to 60 km	1969-1976
Barking Sands	22°N, 160°W	26 to 60 km	1969-1976
Cape Kennedy	28°N, 80°W	26 to 60 km	1969-1976
White Sands	32°N, 106°W	26 to 60 km	1969-1976
Primrose Lake	55°N, 110°W	26 to 60 km	1969-1976
Poker Flats	64°N, 146°W	26 to 60 km	1969-1976

The observed rms variations (σ_o) around the monthly means contain the true rms variability due to changes in synoptic conditions (σ_T) and the rms observational error (σ_E). If the true variability and observational errors are assumed to be independent, the observed rms variability is given by:

$$\sigma_o = \sqrt{\sigma_T^2 + \sigma_E^2}. \quad (3)$$

Consequently, the effect of observational errors must be carefully evaluated to determine how much of the variability that is indicated by the uncorrected soundings is due to synoptic changes in weather patterns. These errors have less effect on the mean monthly values of temperature and density given in the appendices, because the rms error of the mean monthly values is equal to the rms value of the error of an observation divided by the square root of the number of independent observations used for computing the monthly means.

3. TEMPERATURE

Statistical arrays of mean monthly temperatures, standard deviations, and interlevel coefficients of correlation are given in Appendix A for altitudes up to 60 km. An indication of the variations in the vertical distributions of mean monthly temperatures with geographical location can be obtained from the temperature-altitude profiles for each of the four mid-season months shown in Figure 1 at Ascension Island (8S), Wallops Island (38N), and Churchill (59N). The most striking feature of these comparisons is seen at the two levels where the temperature profiles for the three locations converge or cross. The first such level occurs near 12 km; the second, between 22 and 26 km. Below 12 km, the temperature profiles tend to parallel each other, indicating that geographical differences in the mean monthly temperature-lapse rates in the troposphere are relatively small. Locations that have the warmest temperatures below 12 km have the coldest temperatures between 12 and 24 km. The largest geographical temperature variations occur at the surface in January, April, and October, and at 16 km in July. Above 24 km, the variability of the profiles with latitude is largest in October and January.

Seasonal changes in the temperature-altitude profile at each of the three locations are illustrated in Figure 2. Differences in mean monthly temperatures are largest at the surface and smallest near 12 km. The vertical temperature gradients in the troposphere are negative and remain relatively constant throughout the year. The mean monthly vertical gradients in the stratosphere are positive in all months at Ascension Island and Wallops Island; at Churchill, they are slightly negative or isothermal between 10 and 28 km in January, October, and April and slightly positive in July.

Standard deviations of the day-to-day variations around the mean monthly temperatures at levels between the surface and 60 km are tabulated in Appendix A and are plotted in Figure 3 for January and July at Ascension Island, Wallops Island, and Churchill. These variations, due to day-to-day changes in weather patterns, are largest in January and at high latitudes, whereas in July the variations are approximately the same at all latitudes. The magnitude of the seasonal difference in the standard deviations of temperature at these altitudes increases with latitude.

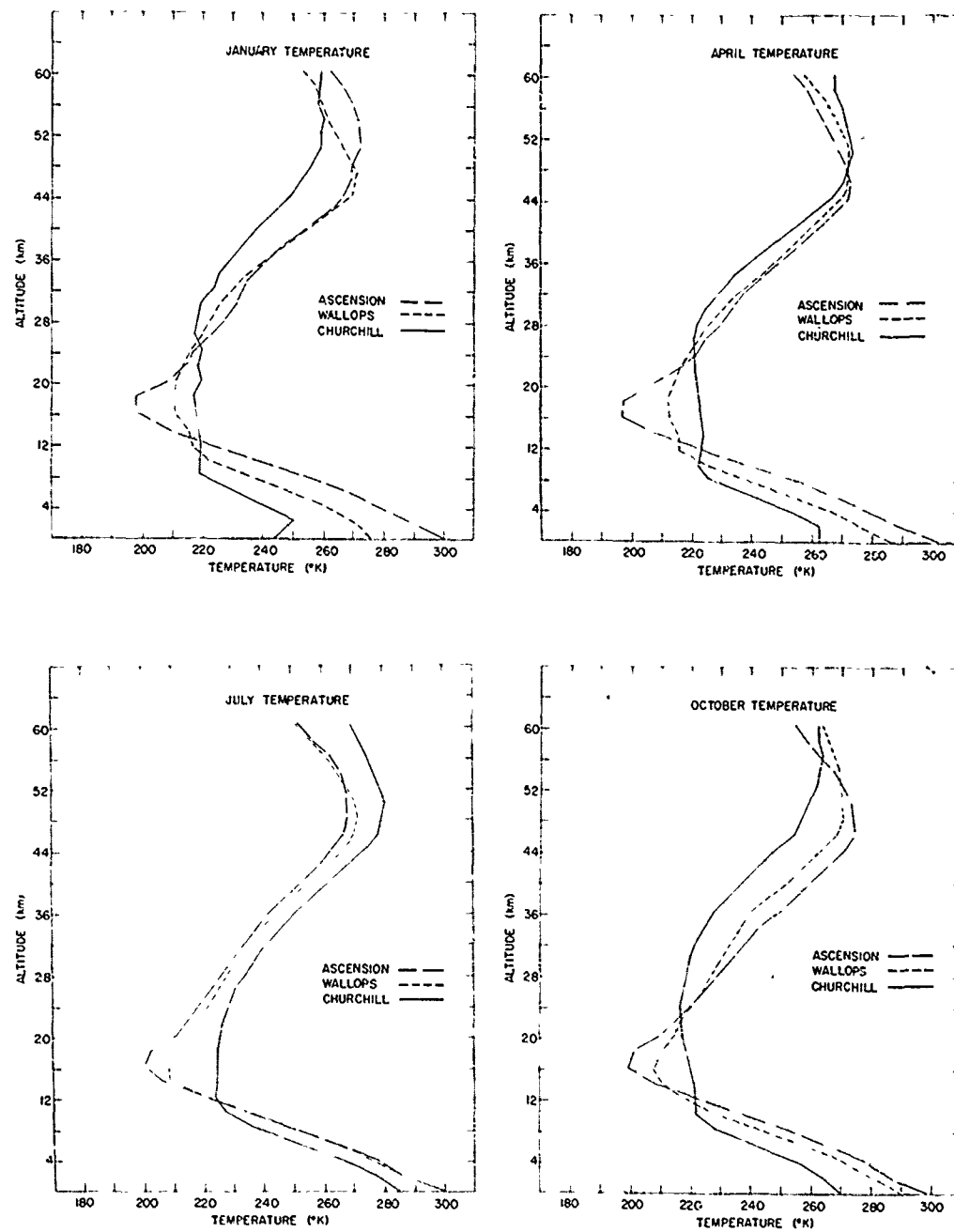


Figure 1. Latitudinal Changes in the Temperature-Altitude Profiles for the Mid-Season Months at Ascension Island, Wallops Island, and Churchill

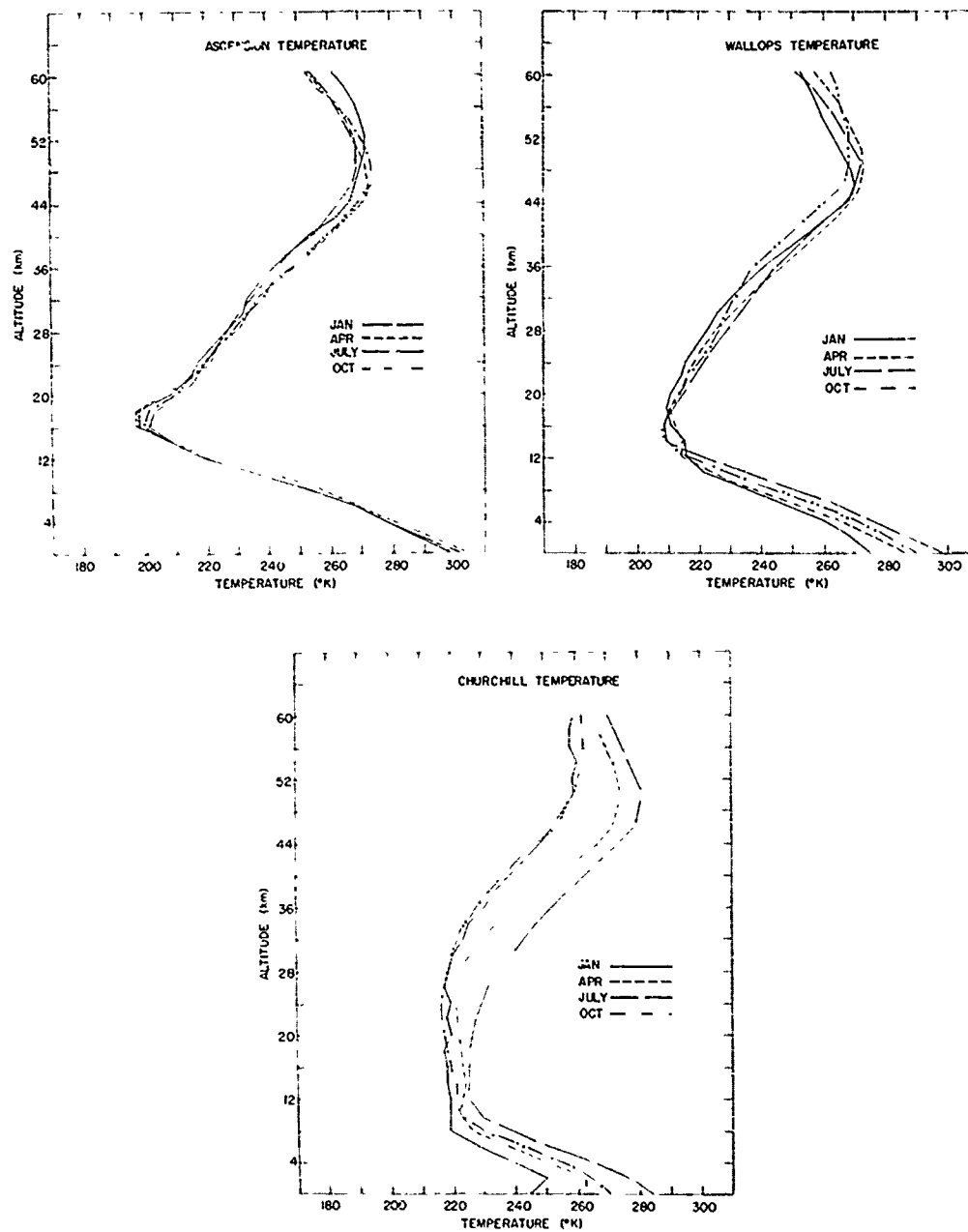


Figure 2. Seasonal Differences in the Temperature-Altitude Profiles at Ascension Island, Wallops Island, and Churchill

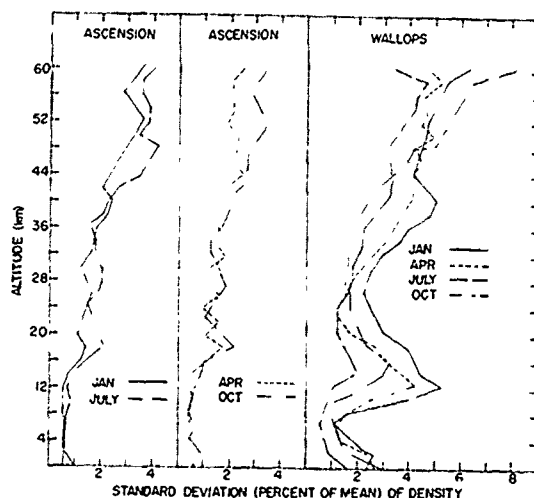


Figure 3. Day-to-Day Variability Around Mean Monthly Temperatures for January and July at Ascension Island, Wallops Island, and Churchill

The day-to-day variations around mean monthly densities are plotted vs altitude in Figure 6 as coefficients of variation ($100 \times \text{SD}/\text{mean}$) for the mid-season months at Ascension Island, Wallops Island, and Churchill. These variations increase markedly with latitude, particularly during winter. In July, however, they are essentially the same at all latitudes.

4. DENSITY

Arrays of mean monthly densities, standard deviations, and interlevel correlations for altitudes up to 60 km are given in Appendix B. The mean densities for each of the mid-season months at Ascension Island, Wallops Island, and Churchill are plotted versus altitude in Figure 4 as percentage departures from the U.S. Standard Atmosphere, 1976.⁵ The individual profiles cross or converge near 8 km and between 22 and 26 km. Both are levels of minimum density variability. There is an isopycnic level near 8 km at which mean monthly densities depart from standard by no more than 1 or 2 percent, regardless of location and season. However, between 22 and 26 km there is a marked seasonal variability, even though there is very little latitudinal variability.

Seasonal changes in the mean monthly density profiles at each of the three locations are shown in Figure 5. The minimum seasonal variability, 1 or 2 percent, occurs at 8 km and the maximum occurs above 60 km.

5. COESA (1976) U.S. Standard Atmosphere, 1976, GPO, Washington, D.C.

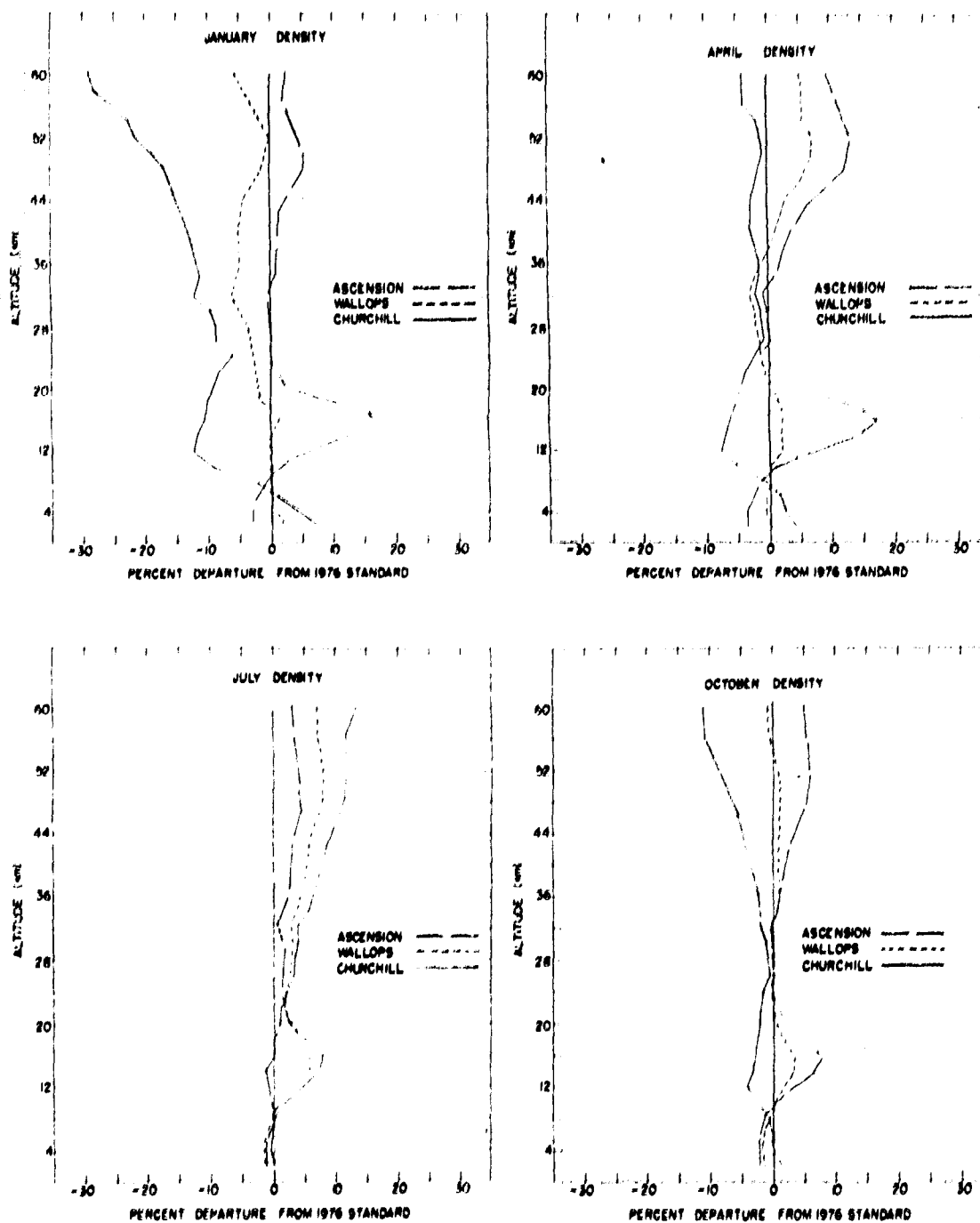


Figure 4. Latitudinal Changes in the Density-Altitude Profiles for the Mid-Season Months at Ascension Island, Wallops Island, and Churchill

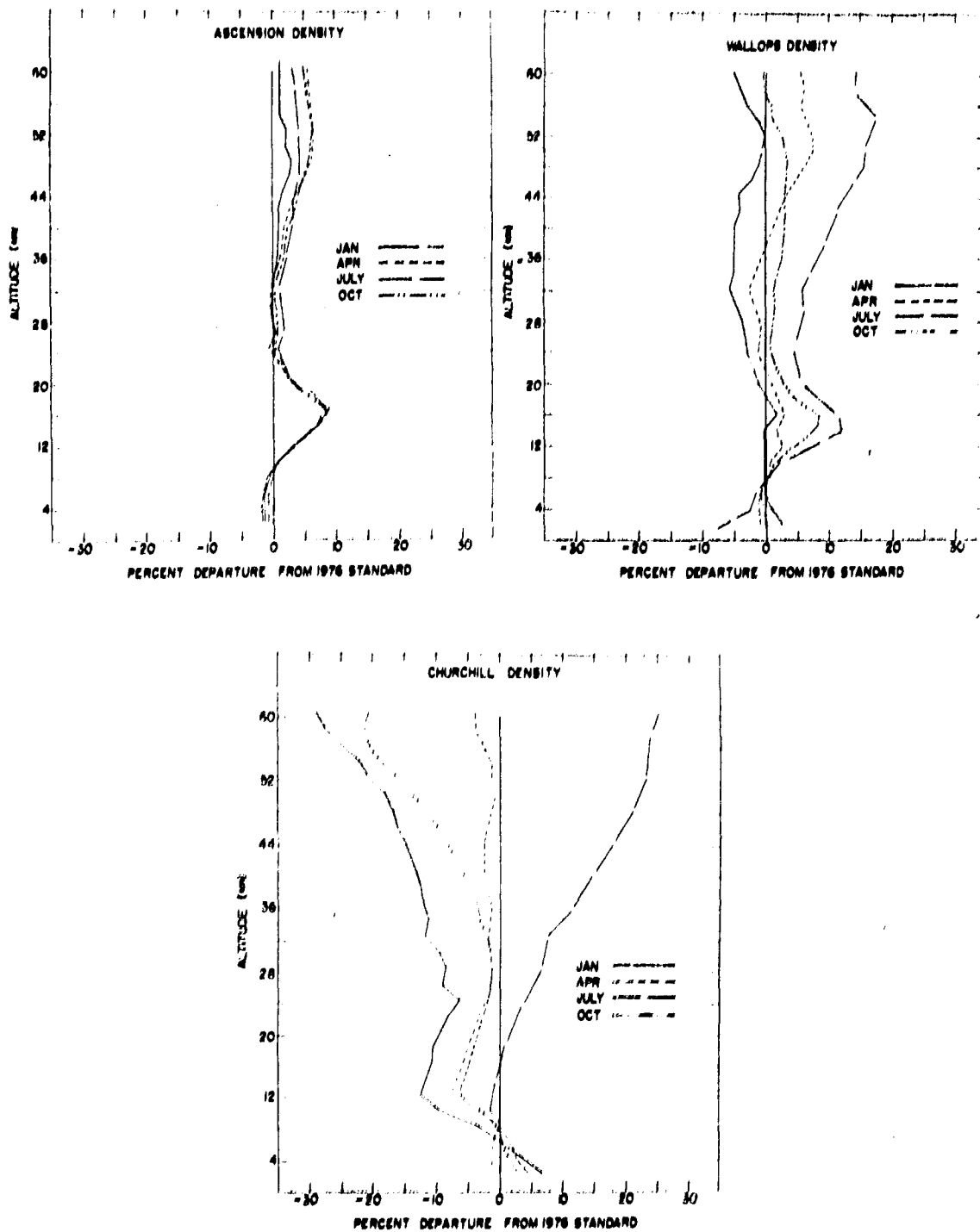


Figure 5. Seasonal Differences in the Density-Altitude Profiles at Ascension Island, Wallops Island, and Churchill

The day-to-day variations around mean monthly densities are plotted vs altitude in Figure 6 as coefficients of variation ($100 \times \text{SD} / \text{mean}$) for the mid-season months at Ascension Island, Wallops Island, and Churchill. These variations increase markedly with latitude, particularly during winter. In July, however, they are essentially the same at all latitudes.

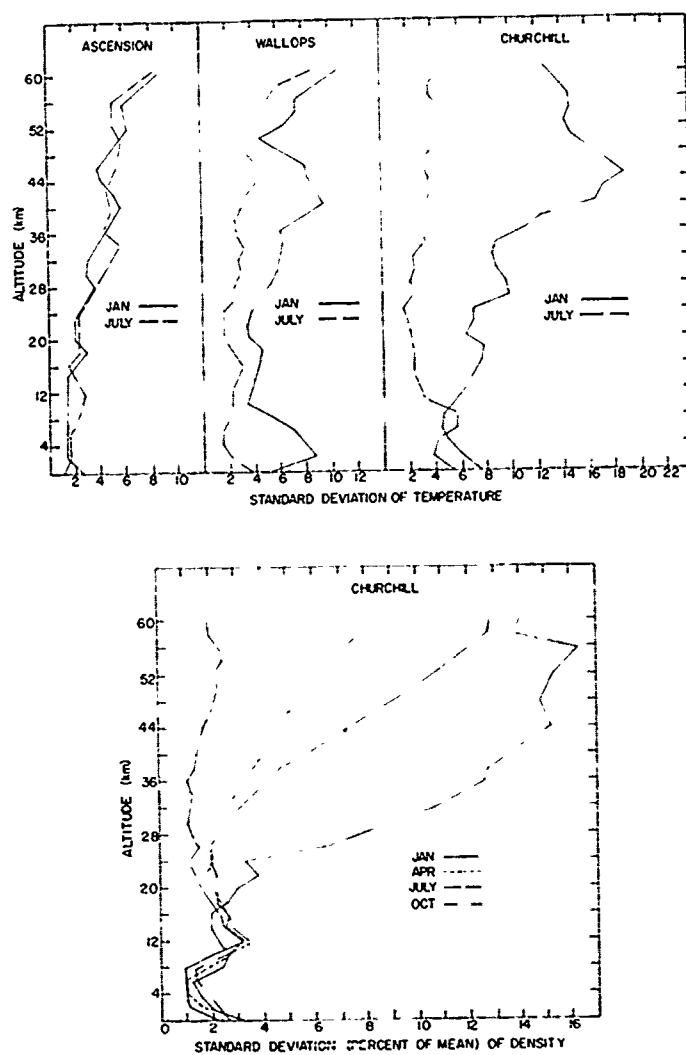


Figure 6. Day-to-Day Variability Around Mean Monthly Density for the Mid-Season Months at Ascension Island, Wallops Island, and Churchill

5. INTERLEVEL CORRELATION

The manner in which the correlation between densities at two levels decreases (or decays) with increasing separation between the levels is an example of the general problem of correlation decay. Similar correlation decay is found for most meteorological elements as the horizontal or vertical distance between the points of observation or the time interval between observations increases. As yet, no fully satisfactory description of the decay rate, based on fundamental properties or assumptions, is available. Consequently, many empirical models that are valid for specific elements over restrictive ranges have been proposed.

Profiles of coefficients of correlation, R , of surface density with density at other altitudes are shown in Figure 7 for each of the mid-season months at Kwajalein, Wallops Island, and Churchill. During all four seasons and at all three locations the correlation between surface density and density at other altitudes decreases rapidly as the vertical distance between levels increases, approaching zero by 8 or 10 km. The correlation then generally remains near zero or slightly negative at altitudes between 10 and 60 km. The low correlation between the surface density and the density at levels between 10 and 60 km indicates that very little information on deviations from the mean monthly density profiles between 10 and 60 km can be obtained from observations of surface density.

Profiles of coefficients of correlation of the density at 26 km with density at higher altitudes up to 60 km are shown for each of the mid-season months for locations in the tropics (Figure 8), middle latitudes (Figure 9), and high latitudes (Figure 10). These figures indicate that at middle and high latitudes the interlevel density correlations above 26 km decay more rapidly in winter than in the other seasons, and that seasonal variations in the decay rates in the tropics are relatively small. In April, July, and October the 26-km densities at most locations are positively correlated with the densities at nearly all levels between 25 and 60 km. At several stations, data on which to base these profiles of interlevel correlations were not available for all four mid-season months. As a result the April profile for Ascension Island is not shown in Figure 8, and the Primrose Lake and Poker Flats profiles for July and October, respectively, are not shown in Figure 10.

Profiles of coefficients of correlation, R , of surface temperatures with temperatures at other altitudes are shown in Figure 11 for each of the mid-season months at Ascension Island, Kwajalein, Wallops Island, and Churchill. At most locations, the correlation between surface temperatures and temperatures at other altitudes decreases rapidly with increasing altitude, reaching a minimum or becoming negative between 12 and 16 km and then remaining near zero, plus or minus 0.3, from 20 to 60 km. There is a pronounced negative correlation between the surface temperature at Wallops Island and temperatures at altitudes between 10 and 20 km. Values of -0.4 to -0.6 occur at these levels in January, April, and October.

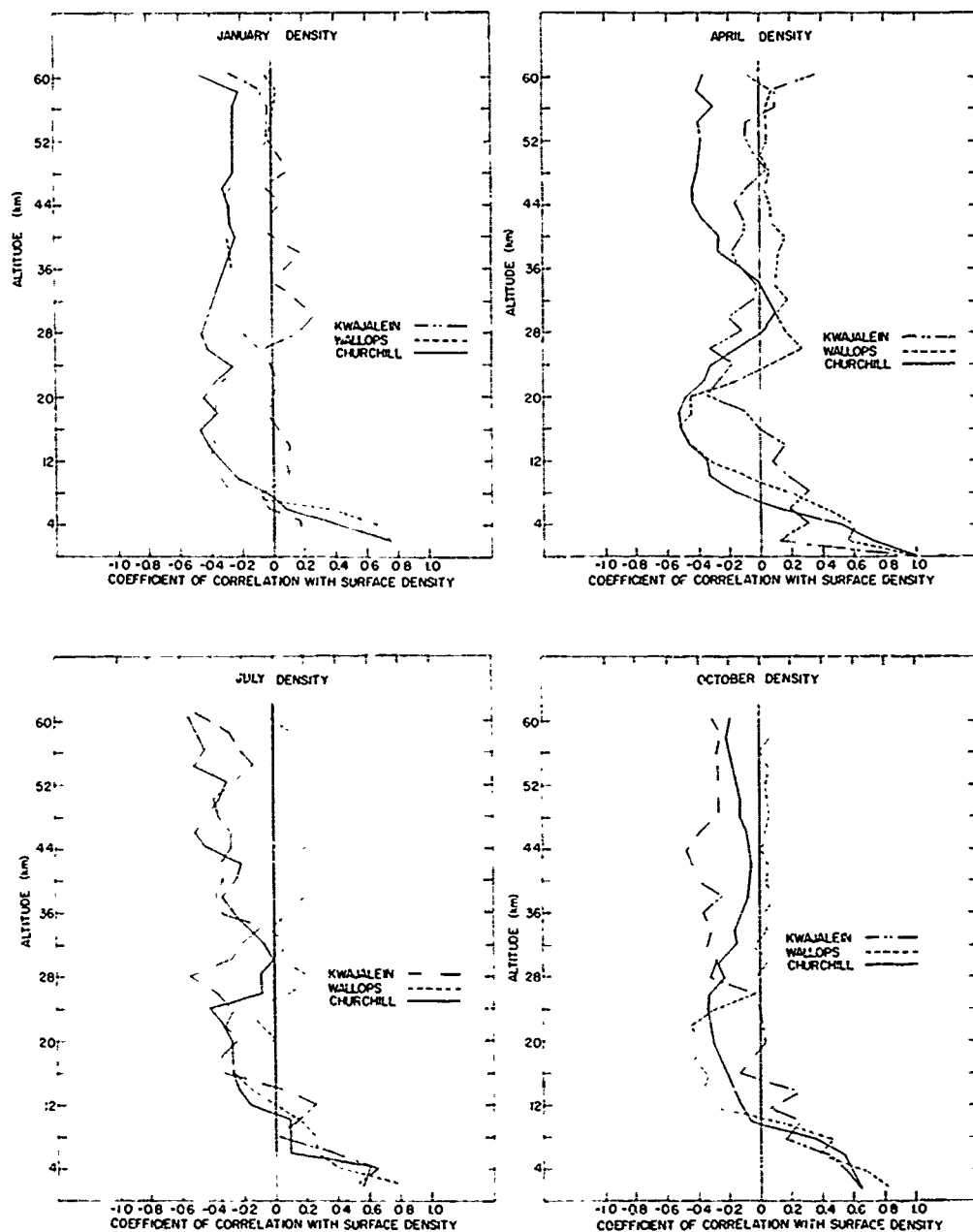


Figure 7. Vertical Profiles of Interlevel Coefficients of Correlation of Surface Density With Density at Other Altitudes up to 60 km for the Mid-Season Months at Kwajalein, Wallops Island, and Churchill

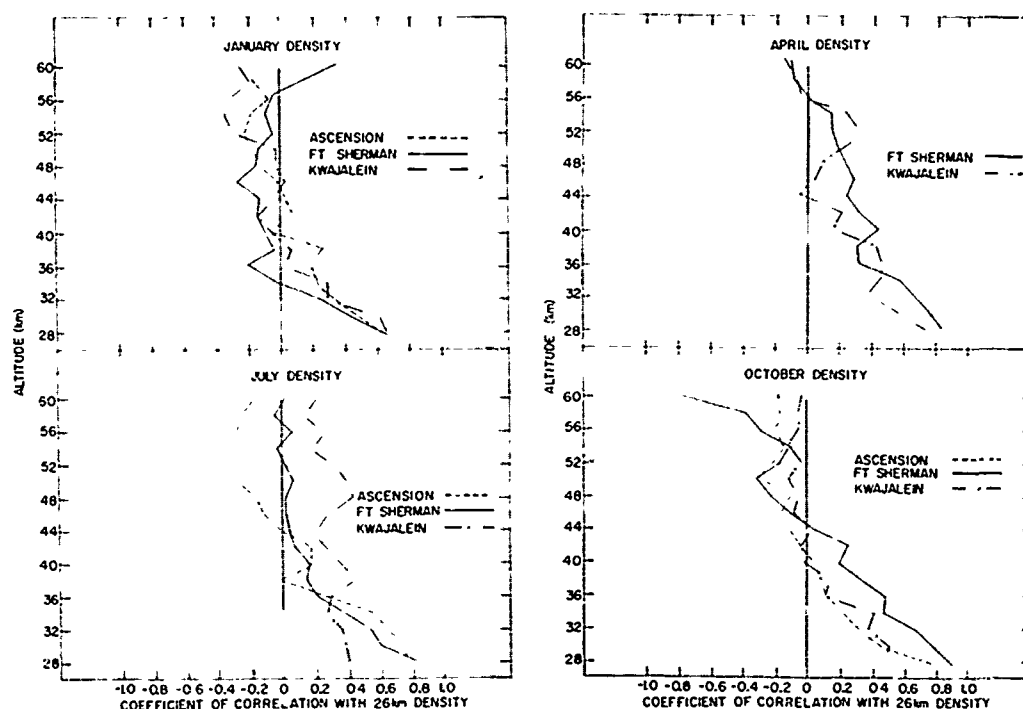


Figure 8. Vertical Profiles of Interlevel Coefficients of Correlation of Density at 26 km With Density at Higher Altitudes up to 60 km for the Mid-Season Months at Ascension Island, Fort Sherman, and Kwajalein

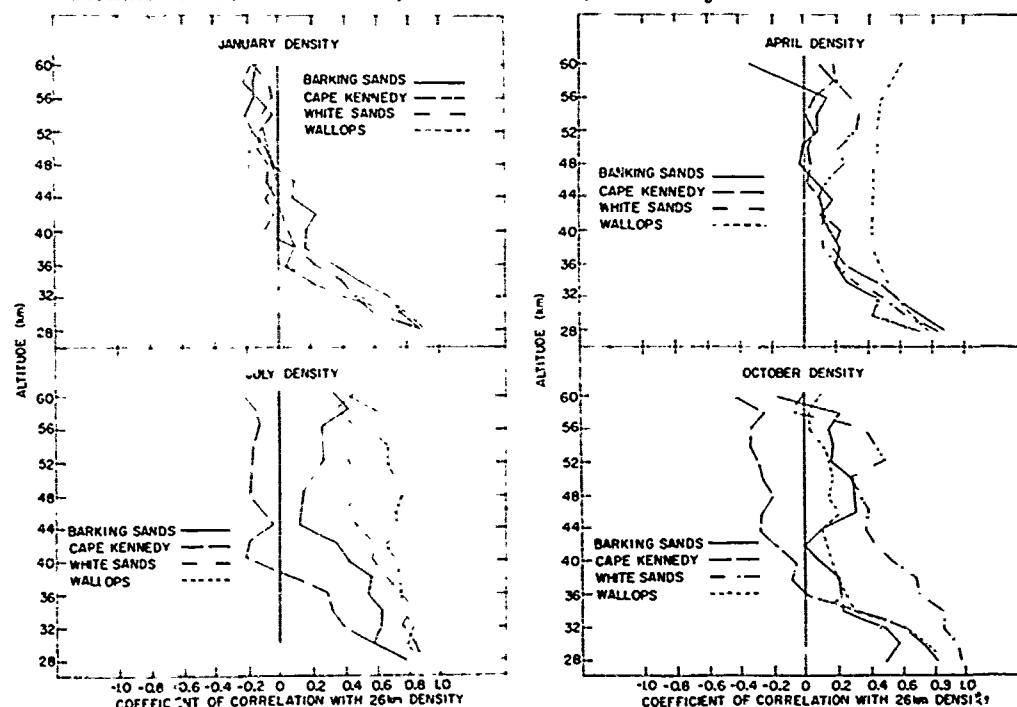


Figure 9. Vertical Profiles of Interlevel Coefficients of Correlation of Density at 26 km With Density at Higher Altitudes up to 60 km for the Mid-Season Months at Barking Sands, Cape Kennedy, White Sands, and Wallops Island

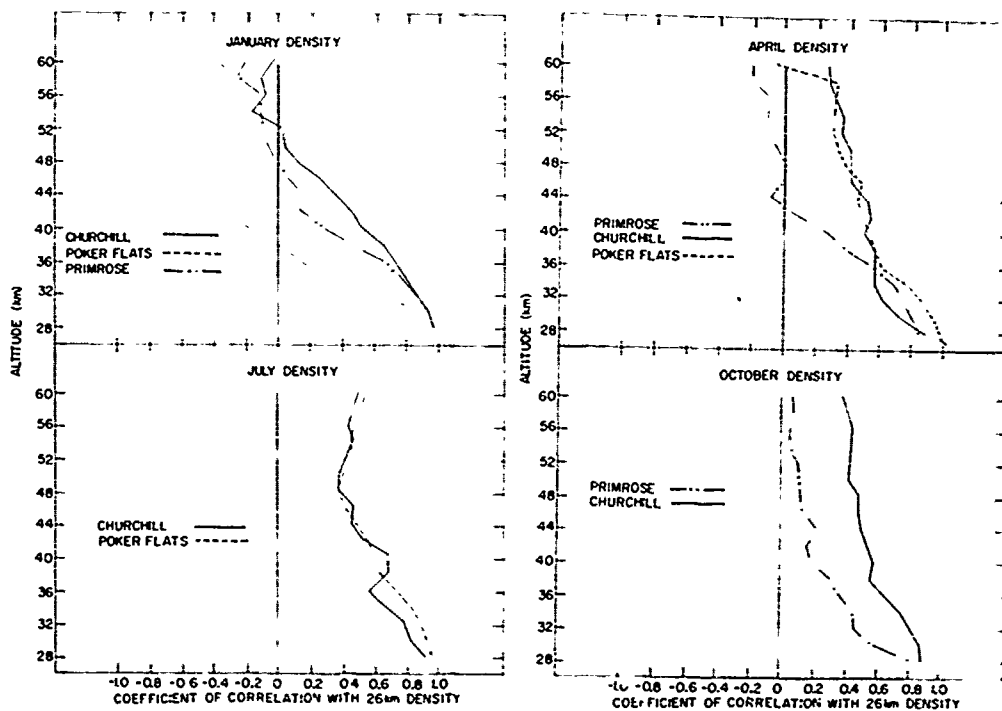


Figure 10. Vertical Profiles of Interlevel Coefficients of Correlation of Density at 26 km With Density at Higher Altitudes up to 60 km for the Mid-Season Months at Primrose Lake, Churchill, and Poker Flats

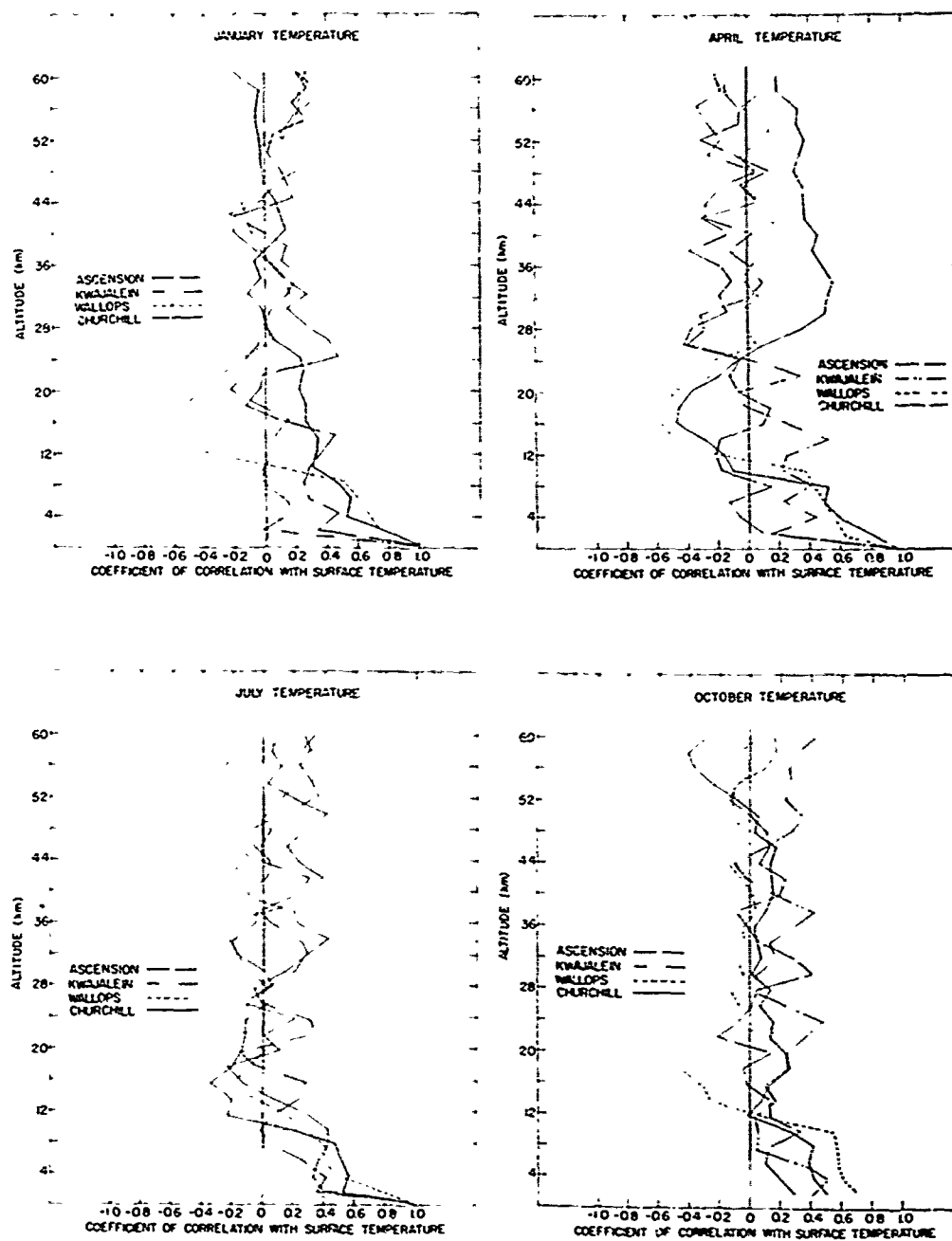


Figure 11. Vertical Profiles of Interlevel Coefficients of Correlation of Surface Temperature With Temperature at Other Altitudes up to 60 km for the Mid-Season Months at Ascension Island, Kwajalein, Wallops Island, and Churchill

Individual profiles of the correlations between temperatures at 26 km and those at other altitudes between 26 and 60 km are plotted in Figures 12, 13, and 14 for locations at low, middle, and high latitudes, respectively. The July profile for Primrose Lake is not shown in Figure 14 because only seven observations were available for the development of the interlevel correlations. The rate of decay of the interlevel correlations with increasing vertical separation between levels is approximately the same at all latitudes in July, and positive correlation exists between the values at 26 km and those of other altitudes up to 60 km. In January the rates of decay at middle and high latitudes are considerably greater than those in the tropics, and, except in the tropics, negative correlations occur at most locations when levels are separated by more than 13 to 20 km.

The individual arrays of interlevel correlations of temperatures and densities from 26 to 60 km, given in Appendices A and B for locations in tropical areas (Ascension Island, Fort Sherman, and Kwajalein), were combined to produce one set each of temperature and density matrices, Tables 2 and 3 respectively, for tropical areas. This same procedure was followed for middle latitudes (Barking Sands, Cape Kennedy, White Sands, and Wallops Island), Tables 4 and 5, and for high latitudes (Primrose Lake, Churchill, and Poker Flats), Tables 6 and 7. Combining the individual arrays increased the sample size and smoothed out many of the irregularities found in the profiles of R that are based on values from one station. The combined or average R-values of density are plotted at 2-km intervals between altitudes of 26 and 60 km, using semi-log coordinates (Figures 15, 16, and 17) for low, middle, and high latitudes, respectively. R-values of temperature are presented in the same manner in Figures 18, 19, and 20. The 26-km level was selected as the lower limit because it is near the top of observed radiosonde temperature and density profiles that are taken on a routine basis in most areas of the world. Consequently, temperatures and densities observed by radiosondes at 26 km can be used with the interlevel correlations of temperatures and densities shown in Tables 2 through 7 to extrapolate these elements to higher altitudes.

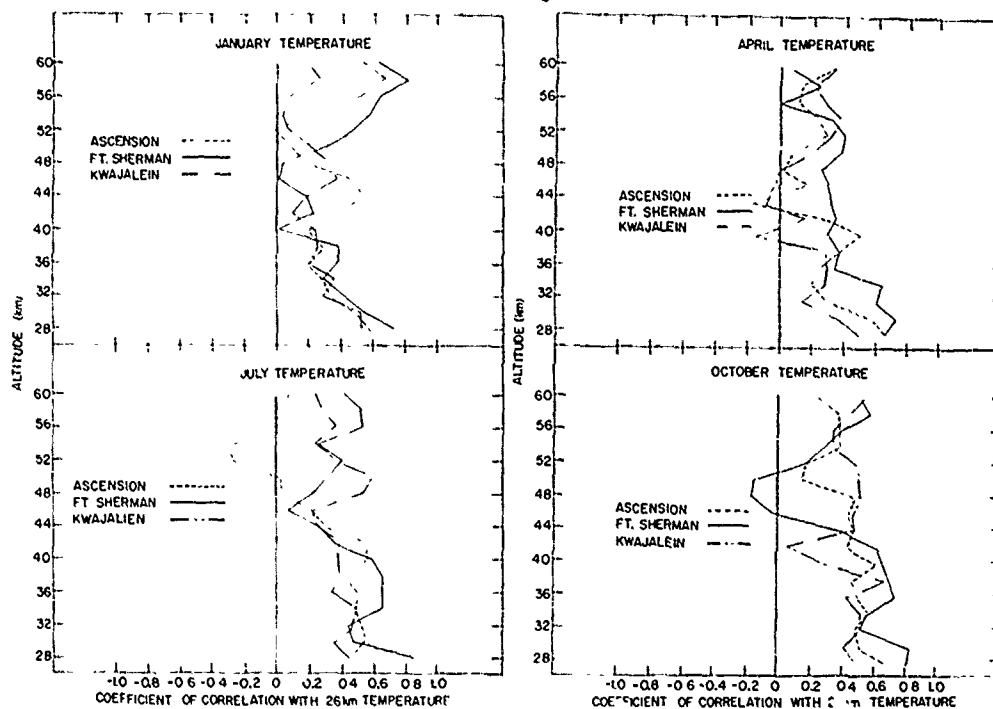


Figure 12. Vertical Profiles of Interlevel Coefficients of Correlation of Temperature at 26 km With Temperature at Higher Altitudes up to 60 km for the Mid-Season Months at Ascension Island, Fort Sherman, and Kwajalein

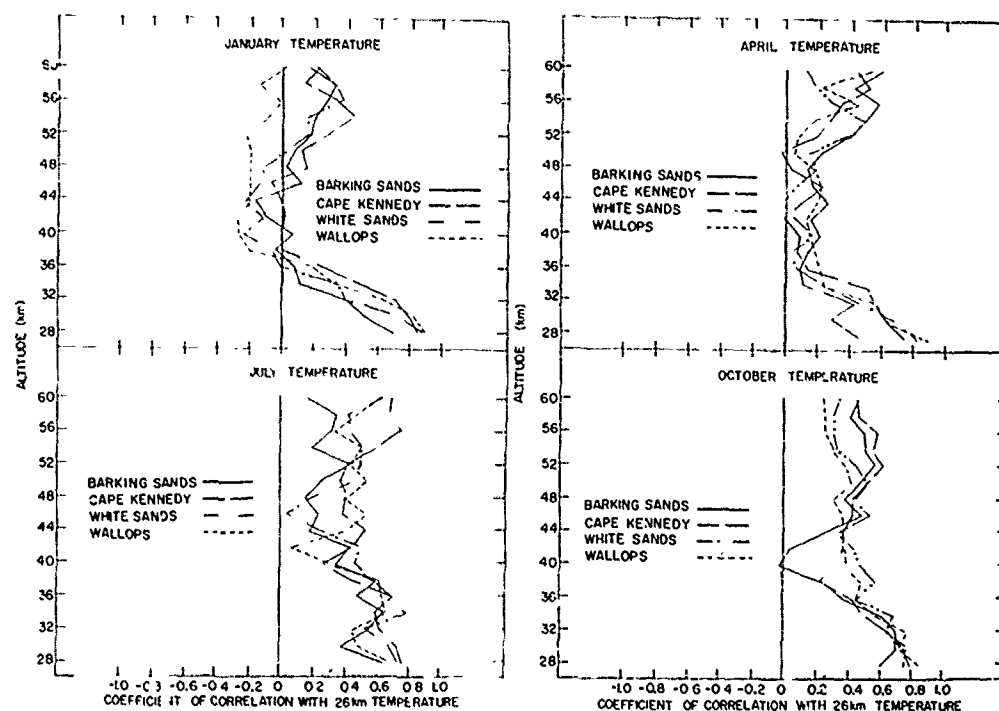


Figure 13. Vertical Profiles of Interlevel Coefficients of Correlation of Temperature at 26 km With Temperature at Higher Altitudes up to 60 km for the Mid-Season Months at Barking Sands, Cape Kennedy, White Sands, and Wallops Island

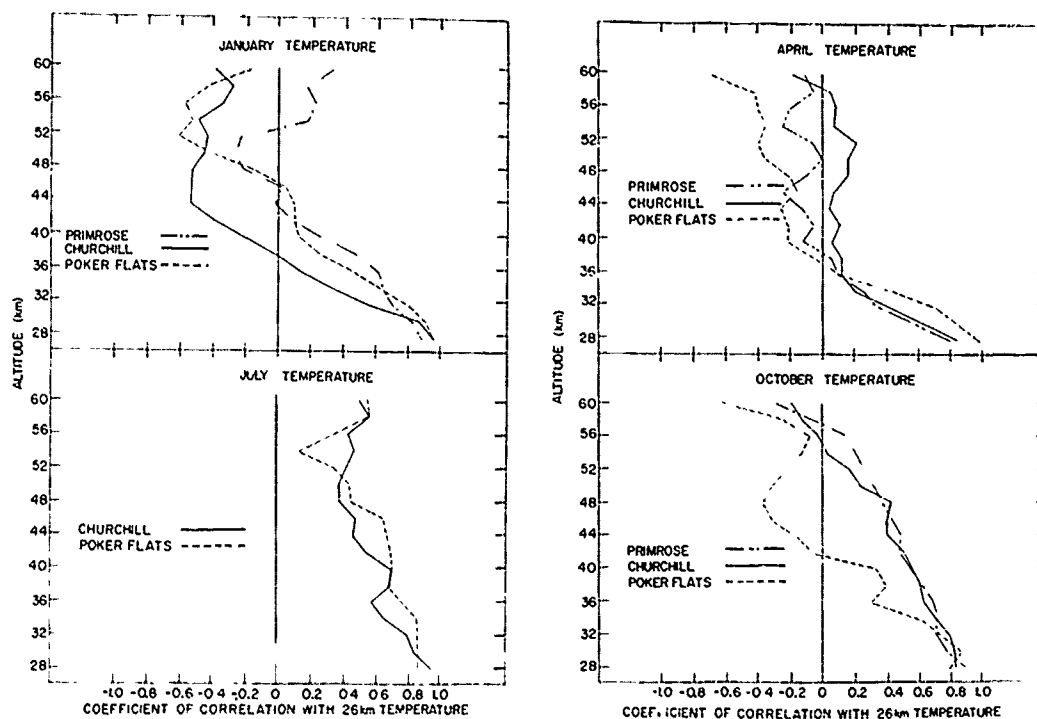


Figure 14. Vertical Profiles of Interlevel Coefficients of Correlation of Temperature at 26 km With Temperature at Higher Altitudes up to 60 km for the Mid-Season Months at Primrose Lake, Churchill, and Poker Flats

Table 2a. Average January Interlevel Correlations of Temperature for the Tropics

km	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
28	59																
30	50	61															
32	37	36	56														
34	29	22	36	54													
36	25	26	41	50	62												
38	29	19	44	37	46	60											
40	14	18	25	12	36	32	58										
42	21	32	36	23	38	38	48	65									
44	25	18	31	19	45	28	42	40	64								
46	28	01	37	32	40	33	37	17	29	55							
48	18	12	29	32	44	33	38	25	28	40	58						
50	20	17	19	13	30	16	20	15	14	24	16	55					
52	17	24	23	20	26	16	19	07	07	16	02	35	68				
54	27	25	16	18	15	14	13	00	01	05	-06	18	39	68			
56	40	32	31	22	15	19	17	12	11	09	00	09	28	48	70		
58	57	48	47	33	21	21	30	13	14	18	14	11	34	49	61	78	
60	46	38	36	23	16	24	31	09	19	16	06	-07	26	49	62	64	84

Table 2b. Average April Interlevel Correlations of Temperature for the Tropics

km	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
28	59																
30	54	61															
32	33	38	64														
34	36	30	39	52													
36	28	28	24	32	63												
38	33	16	32	30	44	58											
40	21	11	24	29	25	16	50										
42	26	22	12	14	28	13	07	32									
44	02	16	17	22	23	17	-10	-04	36								
46	14	05	18	30	32	32	26	17	10	24							
48	08	05	24	38	42	44	33	17	04	11	57						
50	21	10	21	33	35	43	41	21	00	13	20	50					
52	33	21	29	40	45	53	50	28	20	14	19	35	65				
54	31	28	38	37	58	52	43	28	19	13	25	35	43	67			
56	13	17	35	32	41	41	39	25	20	27	30	31	23	51	73		
58	20	23	36	34	47	51	46	31	28	26	22	35	35	56	73	88	
60	25	25	28	30	28	39	46	35	32	15	19	38	33	57	58	66	85

Table 2c. Average July Interlevel Correlations of Temperature for the Tropics

km	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
28	57																
30	45	56															
32	47	43	64														
34	53	43	55	75													
36	49	36	49	56	74												
38	47	34	33	47	56	60											
40	50	42	41	47	49	46	58										
42	42	36	41	47	45	33	43	59									
44	26	23	30	32	28	23	20	12	47								
46	15	13	27	27	22	21	14	01	11	5							
48	26	11	27	17	19	19	09	07	34	28	34						
50	32	16	13	10	18	15	14	04	05	11	22	74					
52	20	14	10	03	15	04	16	00	12	14	14	41	63				
54	10	10	17	10	11	00	06	11	10	17	23	30	31	73			
56	27	21	24	21	19	15	15	15	13	20	18	44	38	54	74		
58	29	16	28	22	18	19	16	07	06	13	36	50	46	49	54	83	
60	24	20	13	18	10	11	15	15	22	21	24	18	42	51	54	70	84

Table 2d. Average October Interlevel Correlations of Temperature for the Tropics

km	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
28	67																
30	59	66															
32	52	61	71														
34	55	52	56	67													
36	56	54	47	57	55												
38	61	46	41	47	46	58											
40	52	48	46	41	48	42	57										
42	37	39	34	29	32	38	33	62									
44	44	36	29	41	29	37	33	37	47								
46	28	22	21	35	28	36	25	17	24	58							
48	27	29	32	42	32	30	15	13	14	37	63						
50	15	34	17	35	25	33	17	11	15	30	44	68					
52	26	30	15	18	20	23	17	18	20	17	13	29	56				
54	32	33	23	29	27	25	17	29	22	21	20	27	33	77			
56	36	36	25	30	16	34	25	29	22	18	29	28	34	59	81		
58	44	39	29	36	26	37	35	27	26	24	34	28	34	54	66	84	
60	41	44	25	33	44	35	31	23	30	32	47	41	51	50	54	65	82

* Multiply tabular values by 0.01 to obtain correlation coefficients.

Table 3a. Average January Interlevel Correlations of Density for the Tropics

km	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
28	65																
30	51	56															
32	30	33	63														
34	17	18	43	62													
36	01	13	37	47	61												
38	11	09	33	43	48	61											
40	-13	-04	09	16	35	44	65										
42	-06	09	17	24	34	48	57	77									
44	-03	02	17	27	40	43	53	64	83								
46	-07	-07	19	31	31	41	44	48	65	84							
48	-09	-02	09	30	29	36	39	47	59	75	83						
50	-10	-04	05	21	23	22	28	47	56	69	79						
52	-18	-05	01	17	13	32	31	45	61	72	72	74	85				
54	-20	-14	-08	14	03	26	29	44	60	68	71	68	72	90			
56	-14	-17	-11	11	02	24	25	44	58	62	66	58	60	79	90		
58	02	-05	-07	11	01	21	34	42	60	67	67	54	57	78	87	92	
60	-26	-25	-21	00	00	42	36	42	64	66	70	60	52	79	86	85	92

Table 3b. Average April Interlevel Correlations of Density for the Tropics

km	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
28	70																
30	57	68															
32	40	51	72														
34	29	35	48	70													
36	23	32	37	59	77												
38	20	20	40	55	59	68											
40	18	27	40	58	48	47	72										
42	08	23	26	47	51	49	50	74									
44	-04	18	28	46	46	54	50	64	78								
46	-04	03	20	46	44	50	56	63	66	81							
48	-03	08	25	47	46	53	58	63	64	74	85						
50	03	13	25	44	46	55	65	70	66	76	80	89					
52	06	15	26	46	49	59	65	67	67	73	73	79	91				
54	02	17	28	42	38	50	57	64	65	75	78	80	85	89			
56	-14	00	18	33	31	34	47	59	59	71	70	69	73	73	85		
58	-16	03	14	31	30	35	51	61	61	67	68	69	73	72	80	92	
60	-10	15	09	35	32	40	53	69	67	64	65	72	76	76	52	77	89

Table 3c. Average July Interlevel Correlations of Density for the Tropics

km	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
28	66																
30	45	63															
32	51	41	54														
34	40	37	44	62													
36	22	20	23	32	55												
38	19	14	06	16	33	62											
40	21	13	05	09	21	54	66										
42	17	18	11	14	28	59	65	81									
44	08	12	04	08	24	60	59	67	85								
46	05	11	07	07	22	56	59	65	77	92							
48	09	05	01	02	24	54	53	66	72	81	86						
50	06	05	-07	-02	16	50	53	66	73	78	79	90					
52	03	01	-06	-03	14	19	58	70	76	77	79	82	91				
54	-03	-03	-08	-01	10	49	77	73	77	78	78	75	82	92			
56	01	-01	-12	-01	08	19	55	73	76	78	78	81	84	91			
58	-03	02	-02	06	11	46	50	65	71	69	74	75	76	76	79	93	
60	02	11	15	05	15	53	60	72	60	73	70	73	72	74	78	87	91

Table 3d. Average October Interlevel Correlations of Density for the Tropics

km	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
28	72																
30	45	58															
32	46	59	52														
34	37	38	31	63													
36	25	29	22	50	69												
38	19	16	13	41	60	69											
40	08	17	15	36	64	60	71										
42	06	21	14	42	64	66	66	86									
44	-02	07	08	38	58	62	63	73	82								
46	-11	-02	-03	30	55	60	61	69	78	88							
48	-13	00	-01	27	48	54	60	69	72	81	89						
50	-23	-02	-04	21	50	55	58	73	74	77	80	87					
52	-14	-01	-05	18	52	54	62	71	74	76	82	86	89				
54	-12	-01	-06	19	52	55	63	74	77	78	84	85	86	95			
56	-18	-06	-02	14	46	52	63	71	73	75	84	83	86	92	96		
58	-21	-04	-01	17	47	50	62	68	72	75	85	82	84	90	91	95	
60	-34	-21	-15	01	20	29	44	31	33	61	79	77	68	82	84	90	95

* Multiply tabular values by 0.01 to obtain correlation coefficients.

Table 4a. Average January Interlevel Correlations of Temperature for Middle Latitudes

km	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
28	80																
30	66	79															
32	51	59	75														
34	29	43	58	76													
36	10	23	36	53	71												
38	-10	-02	04	22	42	73											
40	-12	00	01	14	36	50	75										
42	-14	-04	02	07	25	36	56	73									
44	-13	-06	-03	06	16	23	44	55	74								
46	-09	00	-02	-01	04	13	35	42	51	75							
48	-05	02	00	04	10	21	30	38	49	56	71						
50	00	05	10	10	13	20	25	26	32	38	48	75					
52	09	18	16	11	12	16	19	16	13	11	19	33	64				
54	17	30	21	23	21	28	18	08	03	00	00	05	26	69			
56	24	34	17	22	21	17	08	02	00	06	07	07	16	48	80		
58	16	24	10	05	03	04	-01	00	06	10	17	18	33	48	69	82	
60	15	19	10	02	00	01	09	-09	02	07	12	17	35	38	49	59	85

Table 4b. Average April Interlevel Correlations of Temperature for Middle Latitudes

km	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
28	72																
30	58	73															
32	51	56	69														
34	29	39	53	68													
36	14	16	33	47	63												
38	12	08	18	33	40	72											
40	17	06	08	21	26	33	55										
42	10	00	-04	-03	-04	06	28	56									
44	14	10	00	-05	-04	-02	16	37	68								
46	17	06	00	-08	-05	00	18	25	35	62							
48	14	01	-05	-07	-04	-02	14	28	30	42	67						
50	10	03	02	04	00	01	20	43	35	45	50	64					
52	26	11	06	05	02	01	18	39	45	50	43	42	71				
54	34	22	20	22	15	13	27	40	41	46	42	39	55	75			
56	41	22	23	27	23	19	31	40	40	46	42	38	41	55	80		
58	33	24	22	25	20	16	24	41	42	48	31	24	36	51	70	81	
60	41	31	23	25	12	13	19	35	32	34	31	24	38	53	66	67	81

Table 4c. Average July Interlevel Correlations of Temperature for Middle Latitudes

km	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
28	70																
30	58	70															
32	52	55	66														
34	46	61	58	69													
36	40	58	50	54	68												
38	54	62	47	46	51	56											
40	32	43	38	45	38	35	57										
42	34	38	48	54	46	43	31	56									
44	32	41	44	44	41	36	27	17	52								
46	28	34	39	30	34	28	21	04	23	71							
48	27	36	39	43	37	31	21	08	22	42	61						
50	39	44	46	50	50	40	31	23	29	27	33	76					
52	44	47	43	47	49	44	33	27	31	22	17	43	73				
54	43	46	42	46	50	48	36	33	32	20	12	26	54	84			
56	44	45	33	40	45	52	40	30	26	23	12	13	33	57	82		
58	46	44	28	28	48	47	34	24	22	29	23	20	28	48	70	86	
60	52	55	39	28	58	54	41	24	24	34	33	25	32	42	58	72	89

Table 4d. Average October Interlevel Correlations of Temperature for Middle Latitudes

km	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
28	76																
30	75	76															
32	70	72	84														
34	61	58	65	78													
36	44	46	54	63	70												
38	40	42	45	57	65	74											
40	29	35	32	42	51	61	72										
42	31	36	37	40	48	52	60	66									
44	34	36	33	39	43	42	53	46	67								
46	46	44	39	42	48	50	56	50	61	76							
48	40	42	36	40	43	48	46	48	52	56	79						
50	49	44	44	44	48	45	46	43	48	50	66	83					
52	51	40	48	46	47	47	46	36	47	52	68	69	77				
54	43	37	42	38	42	44	37	27	41	47	62	60	64	85			
56	42	36	41	35	40	40	34	20	36	45	54	53	56	72	33		
58	36	40	43	37	40	48	42	30	40	43	58	57	58	67	78	88	
60	38	44	47	43	43	49	44	34	43	50	58	53	60	64	75	80	

* Multiply tabular values by 0.01 to obtain correlation coefficients.

Table 5a. Average January Interlevel Correlations of Density for Middle Latitudes

km	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
28	84																
30	89	81															
32	48	57	71														
34	30	42	57	80													
36	14	25	41	62	81												
38	-05	04	19	45	68	86											
40	-14	-02	12	32	58	66	82										
42	-01	02	16	29	50	58	69	83									
44	-08	-06	06	21	37	44	56	68	85								
46	-06	09	-02	10	22	34	44	56	70	88							
48	-09	-12	-06	05	17	28	34	45	63	76	89						
50	-12	-17	-06	03	10	19	24	33	49	65	79	90					
52	-17	-19	-11	-04	05	18	18	25	38	54	67	76	91				
54	-18	-17	-14	-02	03	09	11	17	32	48	59	67	80	90			
56	-14	-18	-17	-02	05	07	09	17	32	52	62	69	77	83	94		
58	-19	-24	-14	-02	02	14	18	24	46	62	71	77	85	83	89	93	
60	-25	-29	-19	-09	03	14	19	32	51	65	72	75	83	82	86	88	96

Table 5b. Average April Interlevel Correlations of Density for Middle Latitudes

km	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
28	78																
30	59	73															
32	52	57	73														
34	37	47	62	78													
36	28	34	54	68	84												
38	23	29	44	58	74	89											
40	23	27	34	49	65	71	80										
42	18	23	29	39	54	65	76	81									
44	19	25	29	37	54	62	71	78	90								
46	17	20	27	37	54	62	71	75	80	90							
48	17	21	29	39	55	60	67	74	75	84	93						
50	17	22	32	43	56	61	68	74	75	82	88	93					
52	23	26	32	42	56	60	65	71	75	80	84	85	92				
54	22	25	33	44	56	62	65	68	72	78	83	84	88	93			
56	25	25	35	46	57	64	66	69	75	80	81	82	88	94			
58	21	26	33	43	56	60	60	65	70	73	77	78	81	87	80	92	
60	13	15	26	44	52	59	54	56	57	61	74	77	81	86	87	84	92

Table 5c. Average July Interlevel Correlations of Density for Middle Latitudes

km	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
28	85																
30	72	79															
32	66	66	78														
34	64	66	67	75													
36	59	61	64	69	81												
38	51	60	61	68	73	86											
40	38	49	56	63	65	70	83										
42	35	39	54	63	66	74	73	83									
44	31	35	47	54	61	67	68	66	83								
46	28	30	45	51	61	66	69	66	78	93							
48	27	30	45	56	62	70	70	70	81	82	89						
50	29	33	46	56	63	71	72	73	79	74	80	93					
52	28	31	42	51	60	68	70	73	77	70	74	84	91				
54	30	32	41	49	59	70	72	74	78	71	73	79	87	95			
56	27	31	34	41	55	68	69	69	72	72	74	79	83	91			
58	30	31	35	45	62	68	72	72	74	79	78	74	77	81	86	94	
60	21	26	36	44	61	68	73	73	74	73	78	74	77	78	83	89	94

Table 5d. Average October Interlevel Correlations of Density for Middle Latitudes

km	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
28	76																
30	74	73															
32	60	61	75														
34	40	42	54	76													
36	28	36	46	64	74												
38	24	24	35	60	72	80											
40	17	28	30	45	60	72	84										
42	09	19	24	35	48	61	74	87									
44	07	14	17	31	41	52	67	77	86								
46	15	20	21	33	42	53	65	77	83	89							
48	13	19	21	34	42	53	63	78	80	82	92						
50	12	15	22	33	38	48	60	76	79	81	87	94					
52	12	13	23	32	36	47	60	72	77	80	87	88	93				
54	09	10	20	29	34	43	54	68	74	79	83	84	90	96			
56	05	09	17	26	33	40	52	66	71	76	79	82	88	92	96		
58	-03	06	15	25	33	42	56	70	75	73	77	83	87	88	91	94	
60	-14	-06	08	22	26	31	50	65	68	73	69	74	84	83	85	88	90

* Multiply tabular values by 0.01 to obtain correlation coefficients.

Table 6a. Average January Interlevel Correlations of Temperature for High Latitudes

km	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
28	83*																
30	87	94															
32	69	80	90														
34	53	67	77	92													
36	40	54	64	83	92												
38	24	38	48	69	83	92											
40	07	20	29	53	70	82	93										
42	-07	10	18	43	62	74	87	93									
44	-15	-02	06	30	49	63	78	84	91								
46	-15	-03	01	23	42	55	70	78	83	93							
48	-29	-23	-19	03	20	32	51	60	68	83	89						
50	-37	-32	-31	-15	02	15	36	45	54	70	76	92					
52	-42	-45	-47	-35	-19	-07	09	18	25	44	54	74	89				
54	-27	-37	-44	-44	-35	-26	-17	-09	-06	09	25	40	61	84			
56	-22	-37	-43	-49	-46	-41	-33	-27	-25	-12	03	20	40	68	89		
58	-18	-31	-40	-52	-54	-55	-48	-46	-44	-37	-27	-10	12	43	72	92	
60	-07	-22	-31	-45	-52	-56	-49	-54	-53	-45	-32	-19	-01	23	53	74	91

Table 6b. Average April Interlevel Correlations of Temperature for High Latitudes

km	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
28	85*																
30	68	84															
32	48	67	88														
34	29	49	71	89													
36	10	29	47	71	83												
38	04	17	37	46	76	92											
40	-09	05	24	50	69	85	92										
42	-06	04	17	43	63	77	83	92									
44	-12	03	15	40	58	74	82	89	93								
46	-11	06	19	44	60	75	81	88	88	90							
48	-05	04	17	43	56	72	78	84	85	83	88						
50	-07	-01	09	33	49	62	70	78	81	82	81	92					
52	-08	-01	06	29	44	56	63	72	74	77	78	84	91				
54	-18	-08	00	23	39	50	57	64	67	69	73	77	80	88			
56	-17	-09	01	23	39	47	51	58	59	59	62	69	72	81	91		
58	-14	-09	-04	19	25	42	44	54	61	59	62	68	74	79	82	89	
60	-33	-30	-19	03	20	28	29	43	48	41	47	50	62	61	62	75	87

Table 6c. Average July Interlevel Correlations of Temperature for High Latitudes

km	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
28	88*																
30	72	7.															
32	72	68	79														
34	64	60	75	85													
36	57	54	75	74	76												
38	67	58	62	80	72	75											
40	47	48	54	70	73	65	72										
42	38	41	52	64	73	45	53	76									
44	49	45	44	48	51	48	47	43	50								
46	37	31	40	45	54	48	51	56	54	74							
48	47	43	51	56	68	67	67	68	50	40	56						
50	46	42	57	73	62	69	67	58	37	35	32	84					
52	40	35	45	71	59	64	64	58	39	37	32	76	94				
54	38	31	15	53	42	40	54	43	30	19	18	62	70	82			
56	42	40	32	59	53	56	56	54	32	22	22	71	76	87	89		
58	57	55	47	71	57	50	63	57	33	34	32	65	72	80	81	88	
60	46	47	32	61	49	41	57	56	30	38	36	65	67	73	70	80	91

Table 6d. Average October Interlevel Correlations of Temperature for High Latitudes

km	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
28	85*																
30	82	89															
32	75	80	93														
34	67	73	85	92													
36	54	64	76	85	89												
38	51	60	71	80	85	87											
40	49	53	64	74	77	79	93										
42	31	38	44	56	66	69	82	86									
44	24	32	37	51	62	65	77	80	91								
46	16	25	23	39	48	52	63	64	82	88							
48	13	23	22	34	44	49	57	58	73	81	92						
50	08	15	15	24	33	32	47	51	67	71	79	87					
52	07	09	09	17	29	21	41	48	63	65	71	77	91				
54	03	08	08	20	27	23	33	39	48	48	56	59	69	81			
56	02	-01	-01	09	14	12	22	31	37	35	39	47	53	67	82		
58	-15	-11	-12	-03	03	09	14	16	21	28	32	41	46	56	71	89	
60	-37	05	-28	-30	-13	-06	-30	-28	15	17	28	33	37	50	62	85	

* Multiply tabular values by 0.01 to obtain correlation coefficients.

Table 7a. Average January Interlevel Correlations of Density for High Latitudes

km	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
28	96*																
30	92	97															
32	86	94	97														
34	78	89	93	98													
36	72	84	88	94	98												
38	61	74	80	86	92	96											
40	49	65	72	79	86	92	97										
42	41	58	65	72	80	87	93	97									
44	37	52	60	66	74	81	90	93	98								
46	30	45	52	58	66	73	82	87	93	97							
48	22	37	43	50	57	65	75	81	89	94	98						
50	14	28	35	40	47	55	66	73	82	88	94	98					
52	10	24	32	38	44	53	60	71	78	86	91	95					
54	01	15	22	23	29	36	51	53	64	73	81	90	96	95			
56	03	12	20	19	23	28	37	46	58	67	78	87	93	93	99		
58	04	01	15	15	20	26	16	46	58	65	76	84	90	91	96	99	
60	01	12	19	19	24	27	33	45	57	62	69	77	83	85	91	94	98

Table 7b. Average April Interlevel Correlations of Density for High Latitudes

km	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
28	92																
30	83	93															
32	76	87	94														
34	69	80	85	94													
36	59	69	76	84	93												
38	53	60	65	73	84	93											
40	45	52	54	64	76	88	95										
42	39	41	42	48	63	75	86	93									
44	32	34	34	37	50	64	77	84	95								
46	31	33	32	33	44	58	70	78	88	95							
48	28	27	25	25	35	49	63	72	84	92	97						
50	24	21	19	19	27	41	54	64	79	89	94	98					
52	18	15	13	10	19	33	47	57	74	86	93	96	98				
54	19	16	14	09	18	31	44	52	70	83	91	95	97	99			
56	17	14	11	07	14	26	38	46	64	78	87	93	95	96	99		
58	12	06	04	02	06	20	33	42	62	78	85	90	94	97	97	98	
60	00	05	03	02	11	26	39	49	65	76	86	90	93	93	96	97	99

Table 7c. Average July Interlevel Correlations of Density for High Latitudes

km	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
28	94*																
30	88	90															
32	81	88	86														
34	71	80	82	94													
36	51	61	66	88	80												
38	46	59	52	76	72	83											
40	42	54	44	68	68	74	88										
42	26	42	38	64	64	68	78	88									
44	13	28	26	54	55	70	74	80	92								
46	11	25	22	52	52	72	78	77	80	92							
48	07	20	20	50	51	73	72	74	76	85	94						
50	05	20	25	49	45	65	68	66	70	78	92	92					
52	06	15	19	44	42	62	68	68	75	80	90	88	96				
54	08	18	18	48	44	67	74	72	79	84	85	88	91	96			
56	00	10	10	42	44	65	72	75	82	88	90	88	85	87	96		
58	08	12	10	40	45	60	62	72	82	91	88	83	76	80	89	96	
60	06	15	10	36	42	62	62	71	83	92	90	83	73	73	87	96	99

Table 7d. Average October Interlevel Correlations of Density for High Latitudes

km	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
28	84																
30	73	90															
32	64	80	92														
34	60	73	86	94													
36	51	65	76	87	93												
38	44	55	69	83	91	96											
40	38	48	63	79	85	92	97										
42	36	44	59	75	82	91	95	98									
44	36	42	55	71	78	89	93	95	98								
46	31	38	50	66	72	83	90	93	96	98							
48	31	37	50	64	70	81	87	91	94	97	98						
50	26	33	45	59	66	78	84	88	92	95	97	99					
52	27	34	45	59	65	76	82	86	90	94	96	98	99				
54	25	33	44	56	61	74	78	83	87	91	94	97	98	98			
56	25	32	43	55	58	71	76	81	85	89	92	95	97	98	99		
58	25	34	43	56	59	71	77	83	87	90	93	96	97	98	98	99	
60	24	35	43	54	60	70	77	82	85	89	92	95	96	96	97	98	99

* Multiply tabular values by 0.01 to obtain correlation coefficients.

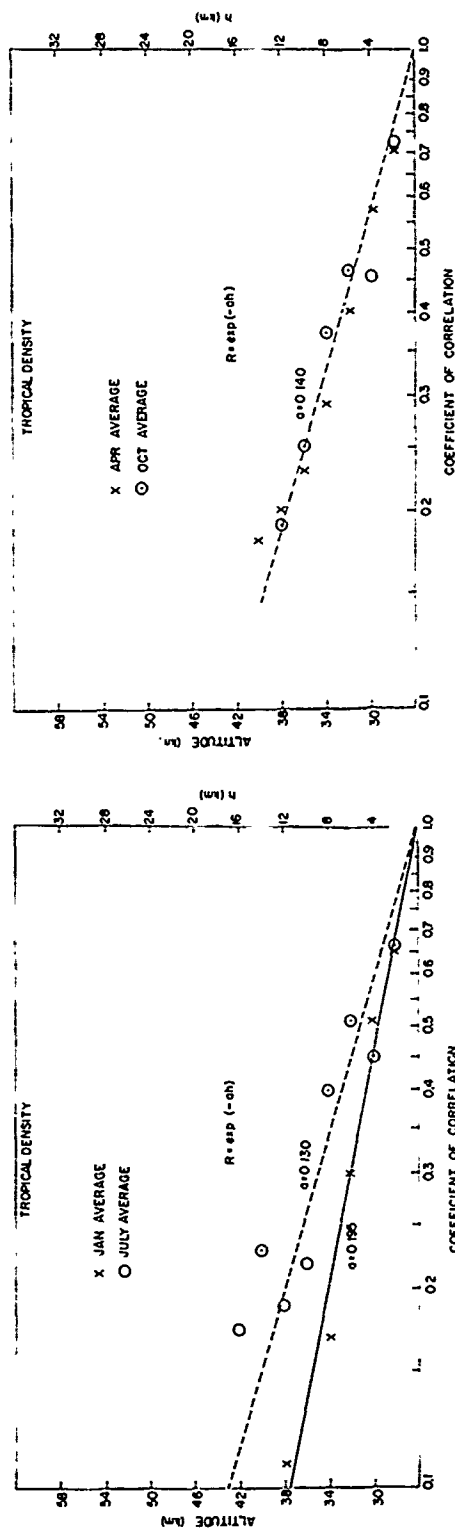


Figure 15. Interlevel Coefficients of Correlation of Density at 26 km With Density at Higher Altitudes for the Mid-Season Months in the Tropics

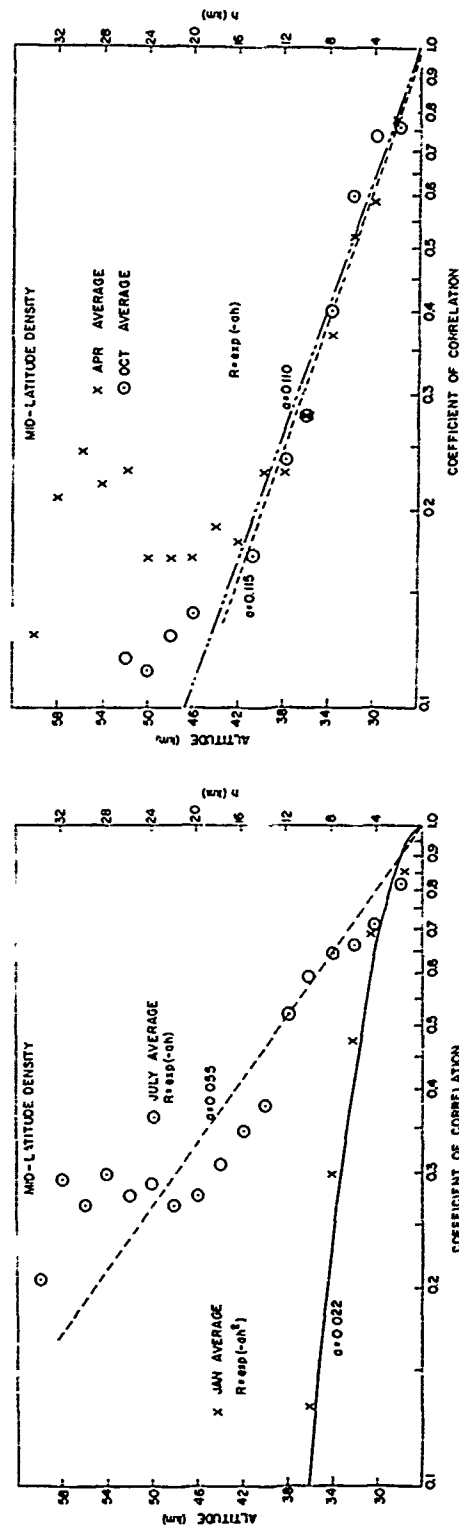


Figure 16. Interlevel Coefficients of Correlation of Density at 26 km With Density at Higher Altitudes for the Mid-Season Months in Middle Latitudes

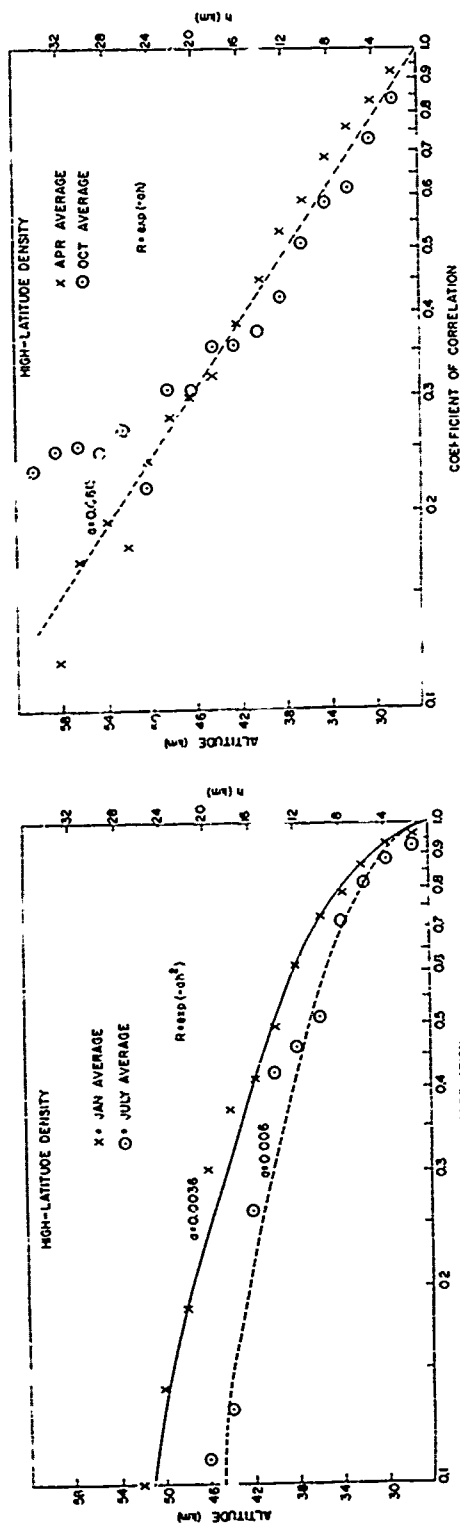


Figure 17. Interlevel Coefficients of Correlation of Density at 26 km With Density at Higher Altitudes for the Mid-Season Months in High Latitudes

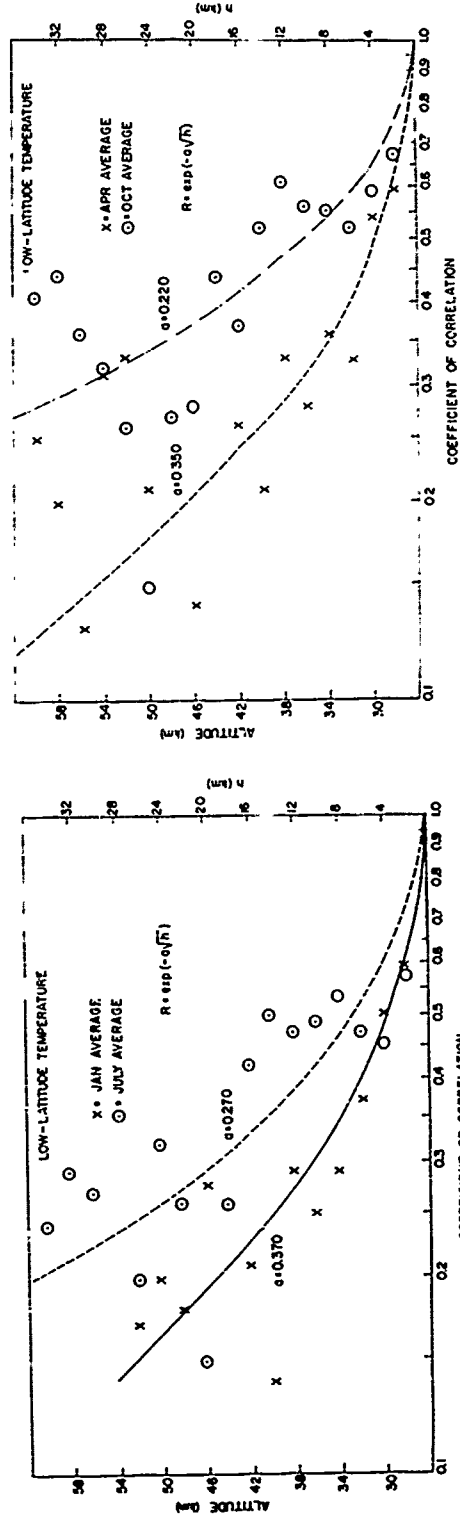


Figure 18. Interlevel Coefficients of Correlations of Temperature at 26 km With Temperature at Higher Altitudes for the Mid-Season Months in the Tropics

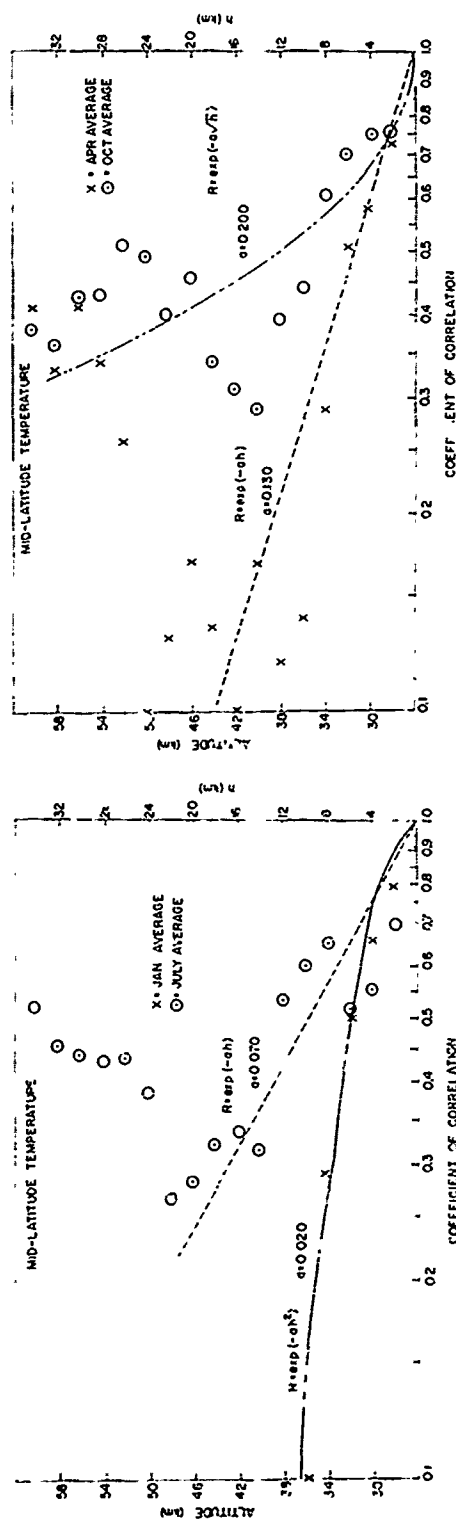


Figure 19. Interlevel Coefficients of Correlations of Temperature at 26 km With Temperature at Higher Altitudes for the Mid-Season Months in Middle Latitudes

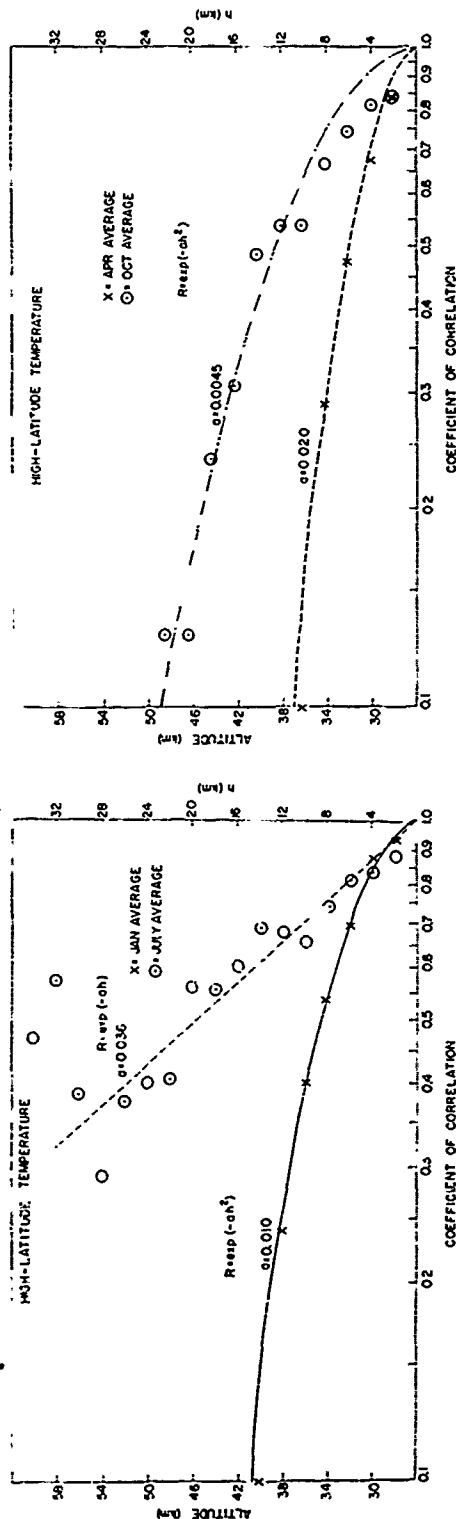


Figure 20. Interlevel Coefficients of Correlations of Temperature at 26 km With Temperature at Higher Altitudes for the Mid-Season Months in High Latitudes

The decay of the interlevel correlations of both temperatures and densities between values at 26 km and those at higher altitudes, Figures 15 through 20, can be defined by a simple expression of the type:

$$R = \exp (-ah) , \quad (4)$$

where a is a constant and h is the vertical separation in kilometers. However, several of the curves were better defined by modified versions of the same expression:

$$R = \exp (-ah^2) \quad (5)$$

and

$$R = \exp (-a\sqrt{h}) . \quad (6)$$

It was found that the value of the constant " a " in these equations, which are generally valid for thicknesses of 12 to 20 km, changed with season and latitude, as shown in Table 8 and in Figures 15 through 20.

Table 8. Seasonal and Latitudinal Changes in " a " (used for defining correlation decay)

	Density		
	High Latitude	Middle Latitude	Low Latitude
Jan	$0.0036h^2$	$0.022h^2$	$0.195h$
Apr	$0.060h$	$0.115h$	$0.140h$
July	$0.006h^2$	$0.055h$	$0.130h$
Oct	$0.060h$	$0.110h$	$0.140h$
	Temperature		
	High Latitude	Middle Latitude	Low Latitude
Jan	$0.010h^2$	$0.020h^2$	$0.370\sqrt{h}$
Apr	$0.020h^2$	$0.130h$	$0.350\sqrt{h}$
July	$0.036h$	$0.070h$	$0.270\sqrt{h}$
Oct	$0.0045h^2$	$0.20\sqrt{h}$	$0.220\sqrt{h}$

If density observations on a specific day extend only to an altitude of 26 km, the usual peak altitude of a radiosonde, an estimated density profile can be obtained from 28 to 60 km by using the appropriate monthly means, standard deviations, and interlevel correlations in the general expression:

$$\hat{\rho}_2 = \bar{\rho}_2 + R \frac{\sigma_2}{\sigma_1} (\rho_1 - \bar{\rho}_1), \quad (7)$$

where $\hat{\rho}_2$ is the estimated density at the desired level, ρ_1 is the density at the lower level, $\bar{\rho}_2$ is the density at the upper level, σ_1 is the standard deviation of ρ_1 , σ_2 is the standard deviation of ρ_2 , and R is the coefficient of correlation of density between the two levels.

The effect of density on the trajectory and impact point of a missile can be estimated through use of Eqs. (1) and (2). The mean effect, E , can be determined from Eq. (1) for a particular location or region, using the mean monthly densities from the appropriate array in Appendix B and the influence coefficients for a given missile at the various levels of interest. The standard deviation around the mean monthly effects of density due to day-to-day variations in the density profile can be estimated from Eq. (2). An arithmetic example, given in Appendix C, illustrates the use of Eqs. (1) and (2) along with the statistical arrays from Appendix B.

6. VERTICAL DENSITY GRADIENTS

The largest changes of density with altitude occur in layers that have a low base temperature and a large positive vertical temperature gradient. Consequently, the largest mean monthly vertical density gradients below 30 km occur in the layer immediately above the tropical tropopause where temperatures increase rapidly with altitude from tropospheric and stratospheric minima near 190°K. Vehicles descending through this region would encounter a 44- to 51-percent increase in density through a 2-km layer (Tables B1 and B2). The largest density gradients above 30 km within the stratosphere and lower mesosphere generally occur between 30 and 40 km in arctic and subarctic regions in January, when temperatures are lowest near 30 km and increase with altitude up to 45 or 50 km. This can be even more significant in winter during a "stratospheric warming" in which the temperature in the lower stratosphere decreases while the temperature in the upper stratosphere increases by 30 or 40°K.⁶

6. Kantor, A. J., and Cole, A. E. (1977) Monthly 90° N Atmospheres and High-Latitude Warm and Cold Winter Stratosphere/Mesosphere, AFGL-TR-77-0289, AD A051421.

Mean monthly vertical density gradients for 2-km increments of altitude may be extracted from the statistical arrays given for 10 locations in Appendix B. More importantly, the variance of density gradients associated with the day-to-day variations in synoptic weather conditions can be estimated (from the appropriate means, standard deviations, and coefficients of correlation) using the fundamental relationship:

$$\hat{\sigma}^2 = \sigma_1^2 + \sigma_2^2 - 2 R \sigma_1 \sigma_2 , \quad (8)$$

where σ_1^2 is the mean monthly density variance at level 1, σ_2^2 is the variance at level 2, R is the coefficient of correlation of density between values at levels 1 and 2, and $\hat{\sigma}^2$ is the estimated variance around the mean monthly gradient between these levels. A sample computation for Churchill in January is given in Appendix D for a vertical density gradient that is equalled or exceeded 2.5 percent of the time.

References

1. Cole, A. E., and Court, A. (1962) Density Distribution, Interlevel Correlations, and Variation with Winds, AFCRI-TR-62-815.
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3. Durst, B. A. (1954) Variation of Wind with Time and Distance, Geophysical Memoirs No. 93, British Meteorological Office.
4. Meteorological Group, Range Commanders Council (1977) Meteorological Data Error Estimates, Document 110-77, White Sands Missile Range, NM.
5. COESA (1976) U.S. Standard Atmosphere, 1976, GPO, Washington, D.C.
6. Kantor, A. J., and Cole, A. E. (1977) Monthly 90°N Atmospheres and High-Latitude Warm and Cold Winter Stratosphere/Mesosphere, AFGL-TR-77-0289, AD A051421.

Appendix A

Interlevel Coefficients of Correlation of Temperature
for Altitudes up to 60 km

Table A1. Ascension Island—Correlation of January Temperatures (°K) From Surface to 60 km

KM	KM KILOMETERS ABOVE SEA LEVEL																													
	MEAN AVERAGE OF OBSERVED VALUES																													
	STOV STANDARD DEVIATION OF VALUES TIMES 10																													
	N NUMBER OF VALUES AT EACH ALTITUDE																													
0.079	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
MEAN	287	278	266	253	237	221	207	198	188	208	214	217	222	227	231	233	237	242	248	254	262	266	268	269	271	271	270	268	265	261
STOV	10	14	11	12	13	13	13	17	23	22	23	23	28	35	28	30	36	41	50	57	51	41	39	50	56	63	57	59	78	80
N	41	41	41	41	41	41	41	41	41	41	41	41	41	40	40	41	41	41	41	41	41	41	41	40	40	40	39	38	32	30
4	37	14	55																											
6	20	20	18	30																										
8	25	16	32	44	65																									
10	37	43	28	13	28	44																								
12	35	33	20	14	24	35	60																							
14	32	24	19	19	22	20	20	21																						
16	29	24	17	14	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	
18	27	22	15	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
20	24	19	14	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
22	21	16	11	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
24	18	13	8	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
26	15	10	6	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
28	12	8	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
30	9	6	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
32	7	4	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
34	5	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
36	4	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
38	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
40	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
42	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
44	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
46	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
48	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
50	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
52	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
54	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
56	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
58	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
60	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table A1. Ascension Island—Correlation of July Temperatures (°K) From Surface to 60 km (Cont)

KM	KM										KILOMETERS ABOVE SEA LEVEL										MEAN AVERAGE OF OBSERVED VALUES										STDEV STANDARD DEVIATION OF VALUES TIMES 10										N										NUMBER OF VALUES AT EACH 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KM	0.00	2	4	5	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	60																													
MEAN	30.1	28.6	27.9	26.7	25.5	24.1	22.4	20.8	19.5	19.2	20.6	21.2	21.7	22.1	22.5	22.8	23.2	23.7	24.2	24.7	25.3	25.7	26.2	26.7	27.1	27.2	27.2	27.1	26.8	26.5	26.3																												
STDEV	1.4	1.3	1.3	1.4	1.4	1.4	1.5	1.6	1.5	1.6	2.8	2.6	2.3	3.0	2.7	3.0	3.6	3.6	3.7	4.2	4.2	3.8	4.2	4.8	6.3	6.4	5.1	4.1	4.4	4.9	5.6																												
N	42	42	42	42	42	42	42	42	42	42	42	42	42	41	40	41	42	42	42	42	42	42	42	42	42	42	42	42	41	38	34																												
2	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
4	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
5	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
8	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
10	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
12	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
14	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
16	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
18	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
20	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
22	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
24	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
26	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
28	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
30	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
32	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
34	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
36	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
38	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
40	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
42	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
44	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
46	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
48	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
50	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
52	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
54	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
56	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
58	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													
60	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13																													

Table A2. Kwajalein—Correlation of April Temperatures (°K) From Surface to 60 km (Cont)

KM	KM KILOMETERS ABOVE SEA LEVEL																													
	MEAN AVERAGE OF OBSERVED VALUES																													
	STOV STANDARD DEVIATION OF VALUES TIMES 10																													
	N NUMBER OF VALUES AT EACH ALTITUDE																													
KM	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
MEAN	289	279	267	255	240	224	207	195	195	206	214	220	223	229	233	236	242	248	256	262	267	269	271	272	271	270	267	265	260	255
STOV	14	9	11	13	12	13	14	14	15	27	23	22	19	28	34	32	26	30	36	42	39	36	39	35	36	37	44	42	57	69
N	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	22
2	17	48																												
4	16	22	62																											
6	42	12	48	68																										
10	23	13	53	64	67																									
12	27	16	64	56	58	71																								
14	53	22	54	54	62	71	16																							
16	25	4	61	33	33	17	16	3																						
20	6	3	16	1	11	7	8	19	26																					
22	35	6	19	14	38	26	18	33	0	13	25	19																		
24	1	24	23	5	27	25	19	25	8	13	11	13	6																	
26	39	23	29	5	5	9	9	11	9	20	20	13	6	48																
30	1	6	5	12	12	11	13	20	4	2	2	7	8	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
32	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
34	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
36	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
38	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
40	2	9	12	27	31	32	0	24	16	5	2	20	42	16	30	12	3	12	19	51										
42	29	15	6	21	12	10	17	16	14	14	0	29	14	15	10	1	2	24	10	12	37									
44	10	10	4	19	10	19	6	5	1	2	8	27	17	9	34	1	25	31	36	13	20									
46	4	12	1	19	19	19	8	5	1	10	10	10	10	10	10	10	10	10	10	10										
48	27	35	50	34	29	42	32	43	17	10	13	15	27	20	12	23	24	30	35	47	19	7	22	6	43					
50	16	4	23	0	21	16	3	15	10	4	27	33	15	31	25	26	15	39	40	52	36	31	32	25	73	76				
52	54	23	24	11	24	11	10	14	5	5	27	22	15	38	49	49	30	64	52	52	36	31	32	25	52	52	52	25	52	
54	54	23	24	11	24	11	10	14	5	5	27	22	15	38	49	49	30	64	52	52	36	31	32	25	52	52	52	30	52	88
56	54	23	24	11	24	11	10	14	5	5	27	22	15	38	49	49	30	64	52	52	36	31	32	25	52	52	52	30	52	88
58	54	23	24	11	24	11	10	14	5	5	27	22	15	38	49	49	30	64	52	52	36	31	32	25	52	52	52	30	52	88
60	54	23	24	11	24	11	10	14	5	5	27	22	15	38	49	49	30	64	52	52	36	31	32	25	52	52	52	30	52	88
68	23	19	19	25	20	3	4	2	10	26	8	23	46	34	28	43	35	30	45	47	46	51	42	28	46	39	56	65	77	90

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

(Cont)

TO OBTAIN CORRELATION COEFFICIENTS

(Cont)

***** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS**

Table A3. Wallops Island—Correlation of January Temperatures (°K) From Surface to 60 km

[illegible]

♦♦ MULTIPLY TABLE VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

60 km

* * * MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table A3. Wallops Island—Correlation of July Temperatures (°K) From Surface to 60 km (Cont)

KM	KM										KILOMETERS ABOVE SEA LEVEL										MEAN										AVERAGE OF OBSERVED VALUES										STDEV										STANDARD DEVIATION OF VALUES TIMES 10										N										NUMBER OF VALUES AT EACH ALTITUDE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			

(Cont)

• MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table A4. Churchill—Correlation of January Temperatures (°K) From Surface to 60 km

[illegible]

→ MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table A4. Churchill—Correlation of April Temperatures (°F) From Surface to 60 km

•• MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

(Cont)

**** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS**

(Cont)

•• MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table A5. Ft. Sherman—Correlation of January Temperatures (°K) From 26 km to 60 km

		KM KILOMETERS ABOVE SEA LEVEL										MEAN AVERAGE OF OBSERVED VALUES										STOW STANDARD DEVIATION OF VALUES TIMES 10										N NUMBER OF VALUES AT EACH ALTITUDE									
		26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60			26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60		
MEAN	224	226	229	234	238	244	250	256	261	264	267	270	274	276	274	271	267	265			267	270	274	276	274	271	267	265													
STOW	47	43	47	50	63	54	58	49	50	50	49	52	51	50	48	59	89	72			50	52	51	50	48	59	89	72													
N	29	30	31	31	31	31	31	31	31	31	31	31	31	31	31	30	26	19	14			31	31	31	31	30	26	19	14												
28	71	**																																							
30	53	64																																							
32	50	55	79																																						
34	27	34	76																																						
36	37	36	77	76																																					
38	37	27	74	64	53	76																																			
40	0	21	47	21	44	49	57																																		
42	21	28	67	48	55	65	61	64																																	
44	16	-12	37	48	52	50	50	52	53																																
46	3	44	49	51	53	46	36	36	47	50	65																														
50	32	39	38	17	36	3	13	17	17	27	7	26																													
52	48	46	24	32	23	7	20	8	2	17	-8	9	52																												
54	38	42	12	36	11	15	20	-15	-9	-12	-13	-14	11	67																											
56	84	76	53	57	29	24	57	14	30	19	-14	-14	22	37	83																										
60	64	76	54	46	9	33	60	17	34	6	-31	-67	1	40	75	85	89																								

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table A5. Ft. Sherman—Correlation of April Temperatures (°K) From 26 km to 60 km (Cont)

	KM KILOMETERS ABOVE SEA LEVEL																	
	MEAN AVERAGE OF OBSERVED VALUES																	
	STOV STANDARD DEVIATION OF VALUES TIMES 10																	
	N NUMBER OF VALUES AT EACH ALTITUDE																	
KM	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
MEAN	223	227	232	236	242	248	253	259	265	270	272	272	272	270	268	266	261	257
STOV	37	37	39	32	37	46	45	45	39	34	38	38	37	38	36	43	46	48
N	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	27	21	18
28	64	**																
30	71	66																
32	59	64	77															
34	52	54	64	74														
36	33	38	43	46	51	73												
38	29	9	27	36	40	29	50											
40	34	14	6	9	10	6	-6	15										
42	31	24	35	32	13	-6	-19	37	-13									
44	30	26	31	29	29	34	38	43	-9	-4	67							
46	25	38	30	42	50	65	55	43	-1	-4	23	62						
48	37	40	29	40	51	63	52	38	-1	-4	23	62						
50	39	38	32	39	43	58	55	23	3	-18	15	49	61					
52	32	30	14	13	17	45	43	35	13	-18	10	20	25	41				
54	-1	19	15	1	11	48	42	23	10	-3	23	30	-9	20	64			
56	24	34	28	9	36	66	49	21	19	10	-1	33	39	42	66	82		
58	8	32	14	6	16	39	38	9	10	-7	24	54	41	45	39	52	75	

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table A5. Ft. Sherman—Correlation of July Temperatures (°K) From 26 km to 60 km (Cont)

		KM KILOMETERS ABOVE SEA LEVEL																	
		MEAN AVERAGE OF OBSERVED VALUES																	
		STOW STANDARD DEVIATION OF VALUES TIMES 10																	
		N NUMBER OF VALUES AT EACH ALTITUDE																	
KM		26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
MEAN		222	226	231	234	237	241	246	252	257	262	265	267	267	267	264	263	261	255
STDEV		39	42	57	46	52	53	50	61	57	46	46	44	60	65	62	52	75	88
N		29	32	32	32	32	32	32	32	32	32	32	32	32	32	32	29	24	17
28	84 **																		
30	46	56																	
32	43	46	71																
34	67	60	63	73															
36	64	51	49	50	69	70													
40	59	56	48	33	50	35	64												
42	34	40	40	44	60	23	44	67											
44	27	28	32	23	23	20	20	20	23										
46	21	15	27	17	12	15	15	1	1	28									
50	32	23	30	16	19	20	27	20	-11	-4	-19	65							
52	40	35	24	24	32	15	34	39	21	-14	-16	36	60						
54	26	26	24	34	26	18	28	21	16	-3	14	5	63						
56	32	44	28	32	25	28	38	21	15	-8	26	31	12	50					
58																			
60	42	52	34	33	6	10	30	23	8	-15	-2	20	27	68	55	65	84		

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table A5. Ft. Sherman—Correlation of October Temperatures (°K) From 26 km to 60 km (Cont)

KM	KM KILOMETERS ABOVE SEA LEVEL																	
	MEAN AVERAGE OF OBSERVED VALUES																	
	STOV STANDARD DEVIATION OF VALUES TIMES 10																	
	N NUMBER OF VALUES AT EACH ALTITUDE																	
	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
MEAN	224	230	234	239	244	248	252	258	264	268	271	271	271	270	267	263	260	256
STOV	57	55	51	44	40	40	48	49	44	50	43	36	41	44	48	59	66	75
N	22	22	23	23	23	23	23	23	23	23	23	23	23	23	23	23	22	19
20	82	**																
30	83	84																
32	53	70	79	74	75	65												
34	70	77	77	50	57													
36	70	70	63															
40	66	64	53	42	52	63	75											
42	62	63	51	26	45	54	43	73										
44	39	55	34	36	29	45	46	61	53									
46	-17	11	8	10	13	18	10	12	14	64	67							
50	-16	15	-3	12	7	6	-10	-19	7	29	52	80						
52	15	24	19	16	11	23	8	10	29	15	9	15	47					
54	20	36	32	40	23	37	22	24	17	15	6	15	19	15	27			
56	37	33	29	33	5	39	28	18	14	15	17	15	15	39	86			
58	55	53	44	39	24	51	45	19	10	15	17	15	15	59	69	86		
60	49	69	42	43	70	55	51	14	28	51	77	51	49	36	53	60	71	

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table A6. Barking Sands—Correlation of January Temperatures (°K) From 26 km to 60 km

KM	KM KILOMETERS ABOVE SEA LEVEL																	
	MEAN AVERAGE OF OBSERVED VALUES																	
	STDEV STANDARD DEVIATION OF VALUES TIMES 10																	
	N NUMBER OF VALUES AT EACH ALTITUDE																	
	26	20	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
MEAN	220	225	228	233	236	241	247	254	261	266	270	269	268	265	264	262	261	258
STDEV	33	39	36	45	51	52	51	65	67	68	64	56	68	68	62	70	55	55
N	47	47	47	47	47	47	47	47	47	47	47	47	47	47	44	42	42	38
28	67	**																
30	50	69																
32	38	64	79															
34	0	47	57	73														
36	5	27	29	51	65													
38	-6	13	4	33	43	72												
40	6	24	23	44	48	55	66											
42	-12	6	26	35	41	43	40	69										
44	-16	8	20	30	36	38	39	48	59									
46	10	28	33	34	36	37	38	44	54	73	55							
50	6	13	32	17	20	15	13	28	47	42	42	75						
52	16	39	40	19	19	9	10	20	17	13	22	34	58					
54	17	46	36	32	27	20	28	10	13	22	36	-21	-8	58				
56	32	58	48	22	20	9	12	12	-1	18	35	-10	27	-6	77			
60	16	32	27	24	27	3	-13	-6	5	28	20	27	42	33	31	39	71	

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table A6. Barking Sands--Correlation of April Temperatures (°K) From 26 km to 60 km (Cont)

		KM KILOMETERS ABOVE SEA LEVEL																	
		MEAN AVERAGE OF OBSERVED VALUES																	
		STDV STANDARD DEVIATION OF VALUES TIMES .8																	
		N NUMBER OF VALUES AT EACH ALTITUDE																	
KM		26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
MEAN	224	229	233	238	243	247	251	256	261	265	266	265	269	268	265	261	258	254	
STDV	26	28	29	31	30	34	36	36	42	39	29	39	37	29	39	49	51	48	
N	42	43	43	43	43	43	43	43	43	43	43	42	42	42	42	42	36	26	
28	47	**																	
30	31	53																	
32	45	41	47																
34	12	35	37	55															
36	10	31	33	20	46														
38	15	31	20	26	32	74													
40	22	20	26	11	24	17	31												
42	16	29	34	4	3	3	10	47											
44	26	46	49	14	10	18	13	33	67										
46	17	28	42	27	16	19	20	17	21	54									
48	14	30	30	25	5	3	6	12	36	54									
50	22	9	34	16	13	3	7	28	14	27	32	74							
52	39	26	29	21	27	1	8	13	41	39	39	63							
54	47	43	45	55	36	21	10	17	41	39	39	63							
56	51	43	45	55	36	21	10	17	41	39	39	63							
58	42	39	43	53	33	13	8	16	37	50	50	27	23	52	88	74			
60	59	56	40	64	32	-4	-11	24	38	48	47	54	42	59	72	66	83		

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table A6. Barking Sands—Correlation of July Temperatures (°K) From 26 km to 60 km (Cont)

		KM KILOMETERS ABOVE SEA LEVEL																			
		MEAN AVERAGE OF OBSERVED VALUES																			
		STOV STANDARD DEVIATION OF VALUES TIMES 10																			
		N NUMBER OF VALUES AT EACH ALTITUDE																			
KM		26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60		
MEAN	225	228	231	234	238	242	247	253	259	263	265	267	265	263	261	258	255	252			
STOV	21	24	27	24	22	33	33	38	31	37	41	39	35	40	43	56	75	83			
N	41	44	44	44	44	44	44	44	44	44	44	44	44	44	44	43	39	32	20		
28	63	**																			
30	37	64																			
32	53	51	59																		
34	63	50	47	74																	
36	47	50	37	52	60																
38	58	66	41	47	52	65															
40	32	50	23	33	23	50	73														
42	41	31	20	56	46	39	37	40													
44	17	37	49	44	44	25	13	12	19												
46	22	35	40	45	46	29	5	-11	14	67	62										
50	24	43	49	56	58	38	23	5	29	24	38	77									
52	42	47	50	52	44	36	36	24	37	22	26	43	70								
54	32	52	52	42	33	34	34	36	37	32	38	43	50	79							
56	10	52	37	27	41	34	46	21	26	25	34	38	26	39	70						
58	15	42	34	17	54	34	57	9	5	46	60	23	34	25	57	72	92				

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table A6. Barking Sands—Correlation of October Temperatures (°K) From 26 km to 60 km (Cont)

		KM KILOMETERS ABOVE SEA LEVEL										MEAN AVERAGE OF OBSERVED VALUES										STDEV STANDARD DEVIATION OF VALUES TIMES 10										N NUMBER OF VALUES AT EACH ALTITUDE									
		26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60			26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60		
MEAN	224	227	230	235	238	242	247	254	259	265	266	269	268	266	263	261	258	254			STDEV	25	31	42	37	41	42	43	37	45	48	44	49	41	42	42	48	54	45		
N	44	46	46	47	47	47	47	47	47	47	47	47	47	47	46	45	44	38	24			40	42	34	36	38	40	42	44	46	48	50	52	54	56	58	60				
26	51	**																																							
30	72	70																																							
42	71	65	83																																						
44	82	53	62	83																																					
46	25	37	22	41	58	58																																			
48	-2	-5	5	14	21	30	51																																		
50	4	6	19	8	16	20	28	42																																	
52	27	14	13	19	28	36	31	12	50																																
54	39	39	30	33	42	41	32	28	41	63	72																														
56	48	40	42	45	61	32	39	30	49	34	55	78																													
58	57	33	48	50	53	47	45	26	45	34	71	61	66																												
60	51	48	44	38	46	51	35	10	36	23	55	37	41	77																											

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table A7. Cape Kennedy—Correlation of January Temperatures (°K) From 26 km to 60 km

		KM KILOMETERS ABOVE SEA LEVEL																	
		MEAN AVERAGE OF OBSERVED VALUES																	
		STDEV STANDARD DEVIATION OF VALUES TIMES 10																	
		N NUMBER OF VALUES AT EACH ALTITUDE																	
KM		26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
MEAN	220	224	226	232	236	241	247	255	263	269	271	270	267	264	261	260	259	257	
STDEV	36	52	57	49	53	67	72	66	71	64	60	61	48	55	57	61	61	73	
N	41	42	43	43	43	43	43	43	43	43	43	43	43	43	43	42	41	37	32
28	81	**																	
30	77	88																	
32	68	65	55																
34	44	56	43	35	59														
36	22	42	35	19	43	81													
38	-2	23	19	19	43	81													
40	-2	26	15	12	44	45	63												
42	0	34	18	14	26	22	50	62											
44	-3	21	13	11	22	22	38	55	71										
46	13	37	24	14	14	12	19	21	28	68	70								
50	11	30	29	-2	-4	12	16	5	0	17	44	71							
52	28	36	42	11	6	20	15	14	-6	-1	7	17	63						
54	43	32	25	14	30	30	13	13	-1	1	-15	15	31	54					
56	14	16	13	1	4	19	6	13	25	20	-1	22	46	44	78	79			
60	22	22	29	-11	4	19	-1	-8	22	6	-8	2	34	40	61	57	84		

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table A7. Cape Kennedy--Correlation of April Temperatures (°K) from 26 km to 60 km (Cont)

KM	KILOMETERS ABOVE SEA LEVEL																	
	MEAN AVERAGE OF OBSERVED VALUES																	
	STDEV STANDARD DEVIATION OF VALUES TIMES 10																	
	N NUMBER OF VALUES AT EACH ALTITUDE																	
KM	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
MEAN	224	229	233	237	242	246	252	256	261	265	269	270	270	268	266	264	260	256
STDEV	28	34	17	39	39	38	35	28	36	33	28	30	32	26	38	47	52	60
N	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	44	41	35
28	76	**																
30	65	76																
32	56	56	79															
34	53	52	59	71														
36	13	22	27	43	54		74											
38	8	17	23	39	36													
40	10	-8	3	42	35	33	46											
42	1	-20	27	-7	-10	-16	-10	41										
44	34	-9	-3	-1	-1	-16	-12	20	55									
46	34	2	-10	-2	-1	-11	-5	19	19	45								
50	-2	-3	-8	8	10	-2	12	58	34	34	33	42						
52	12	9	5	35	5	-4	19	62	47	41	20	19	77					
54	36	19	20	34	25	39	29	69	38	39	2	-11	29	52	79			
56	51	38	40	49	20	21	24	50	30	39	2	-11	29	52	79			
60	43	29	27	37	15	28	37	55	32	22	6	-5	34	54	68	65	62	

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table A7. Cape Kennedy—Correlation of July Temperatures (°K) From 26 km to 60 km (Cont)

		KM KILOMETERS ABOVE SEA LEVEL																	
		MEAN AVERAGE OF OBSERVED VALUES																	
		STDV STANDARE DEVIATION OF VALUES TIMES 10																	
		N NUMBER OF VALUES AT EACH ALTITUDE																	
KM		26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
MEAN	22.5	22.9	23.2	23.6	24.0	24.4	25.0	25.5	26.0	26.4	26.6	26.7	26.6	26.3	26.1	25.7	25.4	25.1	
STDV	3.1	2.9	3.0	3.7	2.7	3.8	3.8	4.4	3.7	4.4	5.1	4.9	4.9	5.6	6.2	7.1	8.9	10.3	
N	4.8	4.9	4.9	4.9	4.8	4.8	4.8	4.8	4.0	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.8	4.4	3.6
2.0	75	**																	
3.0	72	64																	
3.2	60	45	67																
3.4	56	55	50	68															
3.6	68	56	57	67	46	51													
4.0	25	4.1	35	33	27	11	31												
4.2	4.3	4.8	55	59	44	41	22	55											
4.4	4.3	4.8	52	51	45	34	35	-1.6	40	75									
4.6	3.8	3.0	4.0	4.3	2.8	3.4	2.2	0	1.7	75									
4.8	3.9	3.2	4.7	5.7	4.4	5.3	3.7		25	48	75								
5.0	3.6	4.1	4.3	6.1	5.7	5.5	4.2	1.8	3.8	2.6	3.2	73							
5.2	4.1	4.6	5.3	5.4	6.0	5.2	3.9	2.8	3.9	2.0	5	4.0	81						
5.4	4.2	4.2	5.3	5.0	6.4	5.6	4.1	3.8	5.2	2.4	-4	1.8	51	80					
5.6	4.3	4.2	5.3	5.0	6.5	6.6	4.0	2.7	4.2	3.3	9	2.0	3.7	5.9	82				
5.8	6.6	4.8	4.7	4.4	6.1	5.2	3.4	2.8	3.1	3.3	1.6	1.3	2.0	4.0	68	90			
6.0	6.8	5.0	4.5	3.7	5.5	5.5	3.9	3.3	2.7	2.1	1.8	1.5	1.4	2.6	5.2	7.8	8.9		

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table A7. Cape Kennedy—Correlation of October Temperatures (°K) From 26 km to 60 km (Cont)

KM	KILOMETERS ABOVE SEA LEVEL									
	MEAN AVERAGE OF OBSERVED VALUES									
	STDEV STANDARD DEVIATION OF VALUES TIMES 10									
	N NUMBER OF VALUES AT 10 KM ALTITUDE									
26	28	30	32	34	36	38	40	42	44	46
28	28	30	32	34	36	38	40	42	44	46
30	28	30	32	34	36	38	40	42	44	46
32	28	30	32	34	36	38	40	42	44	46
34	28	30	32	34	36	38	40	42	44	46
36	28	30	32	34	36	38	40	42	44	46
38	28	30	32	34	36	38	40	42	44	46
40	28	30	32	34	36	38	40	42	44	46
42	28	30	32	34	36	38	40	42	44	46
44	28	30	32	34	36	38	40	42	44	46
46	28	30	32	34	36	38	40	42	44	46
48	28	30	32	34	36	38	40	42	44	46
50	28	30	32	34	36	38	40	42	44	46
52	28	30	32	34	36	38	40	42	44	46
54	28	30	32	34	36	38	40	42	44	46
56	28	30	32	34	36	38	40	42	44	46
58	28	30	32	34	36	38	40	42	44	46
60	28	30	32	34	36	38	40	42	44	46

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table A8. White Sands—Correlation of January Temperatures (°K) From 26 km to 60 km

KM	KM KILOMETERS ABOVE SEA LEVEL														
	MEAN AVERAGE OF OBSERVED VALUES														
	STDEV STANDARD DEVIATION OF VALUES TIMES 10														
	N NUMBER OF VALUES AT EACH ALTITUDE														
26	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54
28	86	**													
30	58	75													
32	35	45	81												
34	33	39	78	88											
36	29	41	77	68	78										
38	25	16	2	13	34	52	60								
40	14	17	27	5	29	35	64	81							
42	24	33	22	11	19	44	74	69							
44	16	26	27	20	8	13	31	45	59	61	74				
46	13	25	26	10	2	23	31	45	59	61	74				
50	2	2	6	8	15	21	25	31	40	44	45	72			
52	15	13	6	4	0	4	3	1	10	7	15	38	68		
54	14	26	2	4	5	7	10	7	5	8	10	15	25	73	
56	36	37	5	11	12	17	23	13	15	13	13	27	49	58	84
58	32	37	5	11	12	17	23	13	15	13	13	27	49	58	81
60	21	27	10	18	25	27	35	30	21	25	4	3	22	42	47

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table A8. White Sands—Correlation of April Temperatures (°K) From 26 km to 60 km (Cont)

	KM										KILOMETERS ABOVE SEA LEVEL									
	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60		
MEAN	222	226	230	235	242	247	251	258	263	267	269	270	270	269	266	263	260	257		
STOV	36	40	41	39	42	40	41	47	51	45	47	37	33	35	42	42	53	54		
N	40	50	51	51	51	51	51	51	51	51	51	51	51	51	51	50	48	43		
28	82	**																		
30	70	80																		
32	48	56	70																	
34	26	39	54	69																
36	9	17	45	54	74															
38	4	-3	13	28	44	66														
40	18	4	10	19	24	38	68													
42	6	-13	-12	-13	-13	6	40	65												
44	-2	-11	-21	-27	-23	-7	24	39	64											
46	7	-9	-20	-29	-18	0	29	29	47	81	67									
48	19	-6	-14	-22	-16	-5	18	18	39	58										
50	14	-1	-7	-23	-12	-5	10	25	38	64	71	65								
52	38	5	-7	-21	-20	-13	11	17	32	50	53	62	76							
54	47	20	3	-1	-15	11	14	27	39	51	47	71	79							
56	28	7	1	-11	-9	14	21	28	33	54	44	56	57	78						
58	17	5	-3	-11	-9	31	37	38	34	48	36	52	41	65	86					
60	11	2	3	-10	-10	5	21	25	23	14	30	11	38	32	55	62	74			

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table A8. White Sands—Correlation of July Temperatures (°K) From 26 km to 60 km (Cont)

		KM KILOMETERS ABOVE SEA LEVEL																	
		MEAN AVERAGE OF OBSERVED VALUES																	
		STOV STANDARD DEVIATION OF VALUES TIMES 10																	
		N NUMBER OF VALUES AT EACH ALTITUDE																	
KM		25	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
MEAN	225	229	233	237	240	245	250	255	261	265	268	269	268	266	266	263	260	256	252
STOV	24	33	36	34	43	41	47	51	49	40	35	42	43	52	61	64	71	74	
N	38	43	44	44	44	44	44	44	44	44	44	44	44	44	44	43	42	39	35
28	72	**																	
30	67	76																	
32	51	63	66																
34	77	73	65	70															
36	67	61	50	66	68	65													
38	55	60	50	66	57														
40	45	59	56	68	54	49	74												
42	48	51	49	51	54	61	46	58											
44	23	39	37	19	26	48	27	22	78										
46	12	17	23	-11	15	10	1	11	17	60									
48	17	25	22	13	15	10	1	11	17	17	41								
50	44	37	33	30	34	27	16	28	16	9	12	76							
52	49	47	28	36	39	47	32	34	17	14	7	47	74	58					
54	49	40	23	27	35	47	35	27	19	17	14	14	17	57	88				
56	43	28	19	12	30	55	36	18	17	22	28	26	28	55	74	89			
58	41	33	20	4	33	53	34	13	25	22	28	26	26	55	74	89			
60	62	49	27	2	46	48	39	19	32	30	30	27	15	38	34	50	79		

** MULTIPLY TABULAF VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table A8. White Sands—Correlation of October Temperatures (°K) From 26 km to 60 km (Cont)

		KM KILOMETERS ABOVE SEA LEVEL																	
		MEAN AVERAGE OF OBSERVED VALUES																	
		STDV STANDARD DEVIATION OF VALUES TIMES 10																	
		N NUMBER OF VALUES AT EACH ALTITUDE																	
KM		26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
MEAN	224	227	229	231	236	239	244	250	256	262	266	267	268	266	263	261	258	255	
STDV	34	37	37	44	51	52	50	47	42	44	40	39	43	47	51	57	65	67	
N		44	47	49	49	49	49	49	49	49	49	49	49	48	46	45	44	38	36
28	77	**																	
30	78		81																
32	65		78	80															
34	70		85	88	81														
36	74		89	92	86	74													
38	59		62	61	66	70	86												
40	48		52	46	57	60	75	78											
42	49		49	44	54	61	65	71	54										
44	35		42	36	47	50	51	54	53	71									
46	34		50	46	47	57	64	68	63	70	79								
48	45		44	42	45	55	60	55	55	62	62	80							
50	53	34	45	40	52	48	49	34	48	49	63	72							
52	46	29	44	41	51	41	41	26	37	46	58	68	82						
54	34	24	37	35	48	43	35	23	25	35	52	66	75	98					
56	32	23	44	31	45	35	27	5	16	24	42	59	71	81	88				
58	31	36	54	42	48	47	42	18	27	26	49	60	70	74	82	94			
60	35	38	57	49	56	60	48	27	34	35	53	64	73	77	82	87	93		

** MULTIPLY TABLE VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table A9. Primrose Lake—Correlation of January Temperatures (°K) From 26 km to 60 km

KM	KILOMETERS ABOVE SEA LEVEL										N	STDEV	MEAN	STANDARD DEVIATION OF VALUES TIMES 10										NUMBER OF VALUES AT EACH ALTITUDE
	AVERAGE OF OBSERVED VALUES																							
	AVERAGE OF OBSERVED VALUES																							
	AVERAGE OF OBSERVED VALUES																							
26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60							
223	223	224	225	228	229	231	235	238	241	245	250	251	252	250	251	249								
61	61	78	88	99	107	106	116	108	124	113	133	129	119	100	131	156	178							
20	21	21	21	21	21	21	21	21	21	21	21	21	21	21	16	17	16							
88	**																							
30																								
32																								
34																								
36																								
40																								
42																								
44																								
46																								
50																								
52																								
54																								
56																								
58																								
60																								

* * * MULTIPLY TABLE VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table A9. Primrose Lake—Correlation of April Temperatures (°K) From 26 km to 60 km (Cont)

KM	KM KILOMETERS ABOVE SEA LEVEL																
	MEAN AVERAGE OF OBSERVED VALUES																
	STDEV STANDARD DEVIATION OF VALUES TIMES 10																
	N NUMBER OF VALUES AT EACH ALTITUDE																
KM	25	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	60
MEAN	221	223	226	231	235	241	247	254	260	266	270	272	272	272	271	270	267
STDEV	20	30	37	50	52	60	63	77	68	63	57	54	51	48	49	56	57
N	32	32	32	32	32	32	32	32	32	32	31	31	31	30	30	26	21
28	78	**															
30	50	82															
32	35	62	85	91	91												
34	25	49	70	70	84	91											
36	9	31	59	70	84	91											
38	5	21	46	70	84	91											
40	-12	8	30	61	76	86	93										
42	-6	6	21	52	70	77	84	90									
44	-13	6	20	49	63	70	79	86	91								
46	-25	-2	15	50	63	75	82	90	96	90							
48	-10	-2	10	54	66	74	83	87	83	77	85						
50	0	-1	7	38	58	66	76	81	80	74	75	91					
52	-7	-2	3	36	52	56	69	74	72	73	75	86	90				
54	-25	-16	3	36	52	56	67	69	65	65	74	78	72	81			
56	-20	-11	-1	32	49	46	50	55	53	44	57	73	63	67	71	82	
58	-6	-5	-1	28	43	36	44	54	62	56	60	75	71	67	71	82	
60	-11	-10	-9	14	25	25	20	30	36	13	34	51	48	28	38	50	76

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table A9. Primrose Lake—Correlation of October Temperatures (°K) From 26 km to 60 km (Cont)

KM	KM KILOMETERS ABOVE SEA LEVEL																	
	MEAN AVERAGE OF OBSERVED VALUES																	
	STDEV STANDARD DEVIATION OF VALUES TIMES 10																	
	N NUMBER OF VALUES AT EACH ALTITUDE																	
KM	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
MEAN	210	219	220	222	225	229	233	238	244	248	253	257	259	259	259	259	257	256
STDEV	46	51	52	56	59	63	65	70	73	71	64	64	61	64	69	65	63	72
N	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	31	26
28	91	**																
30	70	91																
32	71	86	95															
34	71	79	82	94														
36	69	78	86	87	89	92												
40	56	64	72	80	81	83	91											
42	48	52	63	71	72	81	83	90										
44	49	43	55	62	68	77	81	85	93									
46	42	45	52	58	59	65	74	76	86	87								
48	36	36	43	48	53	55	68	74	79	84	89							
50	32	35	40	49	48	48	63	72	77	79	84	91						
52	25	25	31	40	39	32	52	63	67	71	80	89	94					
54	20	26	29	39	28	26	40	54	51	52	61	67	70	80				
56	15	13	15	23	10	17	32	26	25	24	36	42	57	90				
58	-8	1	-4	4	-14	-14	-4	9	-2	3	0	12	16	33	71	86		
60	-28	-12	-17	-9	-23	-18	-8	4	-4	-1	-5	0	4	10	54	61	85	

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table A10. Poker Flats—Correlation of January Temperatures (°K) From 26 km to 60 km (Cont)

	KM KILMETERS ABOVE SEA LEVEL																	
	MEAN AVERAGE OF OBSERVED VALUES																	
	STDV STANDARD DEVIATION OF VALUES TIMES 10																	
	N NUMBER OF VALUES AT EACH ALTITUDE																	
KM	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
MEAN	224	224	225	225	227	229	231	233	235	238	240	245	247	249	250	250	257	257
STDV	96	99	100	110	120	133	146	137	151	150	146	138	120	101	110	130	137	136
N	31	32	32	32	32	32	32	32	32	32	32	32	31	31	28	27	22	16
28	96	**																
30	92	96																
32	81	87	93															
34	63	70	78	93														
36	45	53	64	84	95													
38	26	36	46	69	88	95												
40	13	23	33	57	80	88	97											
42	10	21	30	51	75	81	92	95										
44	10	23	33	52	73	81	88	92	95									
46	-14	-3	6	21	40	48	59	68	80	82	89							
50	-41	-30	-24	-9	11	22	37	51	63	65	73	92						
52	-60	-60	-60	-54	-38	-26	-10	8	19	22	31	55	83					
54	-52	-58	-60	-67	-63	-50	-33	-18	-3	-12	-18	31	56	80				
56	-56	-67	-66	-77	-70	-63	-43	-28	-13	-3	-18	14	49	80	93			
58	-43	-52	-53	-73	-62	-50	-38	-23	-8	-7	-69	-5	-25	20	66	88		
60	-16	-124	-32	-95	-69	-83	-64	-44	-28	-10	-89	-82	-65	-30	19	54	88	

** MULTIPLY TABULAR VALUES BY 0.81 TO OBTAIN CORRELATION COEFFICIENTS

Table A10. Poker Flats—Correlation of April Temperatures (°K) From 26 km to 60 km (Cont)

KM	KILOMETERS ABOVE SEA LEVEL																	
	MEAN AVERAGE OF OBSERVED VALUES																	
	STOV STANDARD DEVIATION OF VALUES TIMES 10																	
	N NUMBER OF VALUES AT EACH ALTITUDE																	
KM	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
MEAN	225	226	228	231	235	240	246	252	259	264	269	271	272	272	273	271	268	265
STOV	45	47	50	52	58	59	66	78	82	79	66	67	66	67	53	57	67	76
N	34	34	34	35	35	35	35	35	35	35	35	35	35	35	34	31	26	15
28	95	**																
30	83	92																
32	70	80	90															
34	43	55	67	88														
36	10	10	20	52	66	93												
38	-6	4	12	39	60													
40	-22	-12	2	32	57	84	91											
42	-26	-19	-3	27	52	76	83	92										
44	-26	-19	-12	17	43	74	82	88	95									
46	-16	-15	-8	30	59	74	77	86	89	88								
48	-21	-11	-2	22	42	70	72	77	82	86	89							
50	-37	-27	-18	9	34	56	65	75	82	88	84	93						
52	-39	-29	-21	1	25	51	57	69	76	84	84	84	91					
54	-36	-29	-25	-3	24	44	50	59	65	71	77	77	83	91				
56	-40	-31	-17	3	31	46	50	62	65	66	70	64	72	90	94			
58	-42	-29	-17	9	31	50	51	58	63	65	69	61	72	92	93			
60	-69	-64	-48	-19	12	28	31	51	58	53	54	43	66	79	82	88	91	

** MULTIPLY TABULAR VALUES BY 0.011 TO OBTAIN CORRELATION COEFFICIENTS

Table A10. Poker Flats—Correlation of July Temperatures (°K) From 26 km to 60 km (Cont)

		KM KILOMETERS ABOVE SEA LEVEL																			
		MEAN AVERAGE OF OBSERVED VALUES																			
		STDEV STANDARD DEVIATION OF VALUES TIMES 10																			
		N NUMBER OF VALUES AT EACH ALTITUDE																			
KM		26	28	30	32	34	36	40	42	44	46	48	50	52	54	56	58	60			
MEAN	232	235	239	243	248	253	258	264	270	275	279	281	281	280	275	276	272	270			
STDEV	26	26	32	36	31	37	43	49	38	37	30	31	68	80	84	83	57	38			
N	27	28	28	29	29	29	29	29	29	29	29	29	29	29	28	25	20	19	15		
28	84	**																			
30	84	86																			
32	84	82	87																		
34	84	77	80	89																	
36	75	60	82	87	82																
38	67	58	71	85	81	86															
40	69	61	71	83	82	85	95														
42	68	68	64	74	74	71	70	78													
44	65	69	67	76	73	73	73	73	59	82											
46	64	59	64	74	73	73	76	80	50	23											
48	44	37	50	64	59	61	72	69	32	-29	-20	79									
50	43	38	54	63	46	61	72	69	32	-29	-20	79									
52	33	21	26	61	48	58	72	67	33	-28	-26	71	93								
54	12	7	2	38	58	64	71	66	33	-38	-33	71	90	98							
56	57	47	48	74	60	57	70	65	41	-8	-5	66	68	73	96						
58																					
60	43	32	18	64	62	49	53	54	42	-1	12	55	57	57	59	69	85				

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Appendix B

Interlevel Coefficients of Correlation of Density for
Altitudes up to 60 km

Table B1. Ascension Island—Correlation of January Density (kg m^{-3}) From Surface to 60 km

[illegible]

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

•• MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B1. Ascension Island—Correlation of April Density (kg m^{-3}) From Surface to 60 km (Cont)

		KILOMETERS ABOVE SEA LEVEL																													
		MEAN AVERAGE OF OBSERVED VALUES																													
		STDEV STANDARD DEVIATION OF VALUES																													
		IN PERCENT OF MEAN TIMES 10																													
		N NUMBER OF VALUES AT EACH ALTITUDE																													
KM		2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
MEAN	1163	973	790	642	519	419	334	261	195	130	930	652	463	344	269	183	135	996	143	551	415	316	242	188	148	116	911	714	559	437	339
STDEV	6	4	3	4	3	5	4	5	9	18	11	14	9	14	11	12	17	14	16	15	15	18	25	20	23	24	20	22	21	25	
N	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	28	26	20
2	15	30	55	18																											
4	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
6	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
10	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
12	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
14	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
16	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
18	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
20	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
22	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
24	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
26	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
28	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
30	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
32	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
34	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
36	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
38	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
40	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
42	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
44	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
46	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
48	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
50	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
52	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
54	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
56	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
58	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
60	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10
 ** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B1. Ascension Island—Correlation of July Density (kg m^{-3}) From Surface to 60 km (Cont)

		KM KILOMETERS ABOVE SEA LEVEL												MEAN AVERAGE OF OBSERVED VALUES												STDEV STANDARD DEVIATION OF VALUES IN PERCENT OF MEAN TIMES 10												N NUMBER OF VALUES AT EACH ALTITUDE											
KM		2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60																		
MEAN	1177	985	794	645	522	420	334	259	191	134	928	661	475	352	257	188	138	102	757	563	421	317	241	185	143	111	869	682	536	422	328																		
STDEV	9	5	4	4	5	7	6	9	15	21	18	16	14	19	20	19	17	17	16	20	22	27	35	37	41	34	36	38	36	40	46																		
N	45	45	45	45	45	45	45	45	45	45	44	42	38	44	44	44	44	44	44	44	44	44	44	44	44	43	43	43	43	42	36																		
2	46	51	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48																		
4	40	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35																		
6	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36																		
8	13	1	-8	-3	25																																												
10	13	1	-8	-3	25																																												
12	12	1	-8	-3	25																																												
14	12	1	-8	-3	25																																												
16	12	1	-8	-3	25																																												
18	12	1	-8	-3	25																																												
20	12	1	-8	-3	25																																												
22	12	1	-8	-3	25																																												
24	12	1	-8	-3	25																																												
26	12	1	-8	-3	25																																												
28	12	1	-8	-3	25																																												
30	12	1	-8	-3	25																																												
32	12	1	-8	-3	25																																												
34	12	1	-8	-3	25																																												
36	12	1	-8	-3	25																																												
38	12	1	-8	-3	25																																												
40	12	1	-8	-3	25																																												
42	12	1	-8	-3	25																																												
44	12	1	-8	-3	25																																												
46	12	1	-8	-3	25																																												
48	12	1	-8	-3	25																																												
50	12	1	-8	-3	25																																												
52	12	1	-8	-3	25																																												
54	12	1	-8	-3	25																																												
56	12	1	-8	-3	25																																												
58	12	1	-8	-3	25																																												
60	12	1	-8	-3	25																																												

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

** MULTIPLY TAEULAF VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B1. Ascension Island—Correlation of October Density (kg m^{-3}) From Surface to 60 km (Cont)

KM	KILOMETERS ABOVE SEA LEVEL																														
	MEAN AVERAGE OF OBSERVED VALUES																														
	STDEV STANDARD DEVIATION OF VALUES																														
	IN PERCENT OF MEAN TIMES 10																														
N NUMBER OF VALUES AT EACH ALTITUDE																															
KM	0.79	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
*MEAN	1179	978	792	643	520	420	334	260	193	135	930	659	470	347	252	185	136	101	745	558	420	318	243	188	147	115	908	716	563	441	343
STDEV	5	8	4	5	3	4	5	8	9	21	16	10	13	17	16	14	12	13	17	19	19	24	26	26	27	32	34	32	29	30	34
N	47	47	47	47	47	47	47	47	47	47	47	47	46	46	46	47	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
2	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
4	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
6	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
8	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
10	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
12	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
14	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
16	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
18	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
20	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
22	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
24	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
26	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
30	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
32	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
34	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
36	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
40	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
42	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
44	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
46	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
50	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
52	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
54	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
56	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
58	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
60	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B2. Kwajalein—Correlation of January Density (kg m^{-3}) From Surface to 60 km

		KM KILOMETERS ABOVE SEA LEVEL												MEAN AVERAGE OF OBSERVED VALUES												STDEV STANDARD DEVIATION OF VALUES IN PERCENT OF MEAN TIMES 10												N NUMBER OF VALUES AT EACH ALTITUDE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
KM	.COR	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	60																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
*MEAN 1167	969	786	639	516	416	332	261	199	141	934	654	454	342	248	182	133	930	725	533	401	303	230	175	134	105	818	643	544	397	314																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
STDEV 15	5	4	4	5	4	5	5	5	10	28	15	13	12	10	15	15	17	18	16	18	21	20	23	28	22	28	28	33	34	37	37																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
N	44	42	42	42	42	42	42	42	42	42	42	42	41	40	41	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
2	17	37	22	14	74	49	29	52	30	45	31	41	37	66	21	61	57	51	48	52	51	55	70	72	70	67	62	58	54	50	45	40	36	32	28	24	20	16	12	8	4	2	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	

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• MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

*** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B2. Kwajalein—Correlation of October Density (kg m^{-3}) From Surface to 60 km (Cont)

		KM KILOMETERS ABOVE SEA LEVEL																													
		MEAN AVERAGE OF OBSERVED VALUES																													
		STDEV STANDARD DEVIATION OF VALUES																													
		IN PERCENT OF MEAN TIMES 10																													
		N NUMBER OF VALUES AT EACH ALTITUDE																													
KM		2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
*MEAN	1157	969	789	643	518	417	334	262	196	137	940	659	469	343	250	183	135	100	743	552	417	317	244	189	149	114	892	701	554	436	340
STDEV	5	3	3	4	4	4	5	6	10	13	13	11	11	12	13	15	14	15	18	18	21	26	24	23	23	26	31	34	35	35	35
N	40	40	40	40	40	40	40	40	40	40	40	40	40	40	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	38	33
2	62	72	76	66																											
4	55	51	44																												
6	15																														
10	24	41	52	59	70																										
12	5	27	36	49	53	31																									
14	12	15	19	27	37	32	12																								
16	19	16	22	31	41	38	28	13	25																						
18	1	23	28	36	45	54	44	31	24	34																					
20	30	1	15	12	2	1	15	15	15	15	10	27	4	55																	
22	30	1	15	12	2	1	15	15	15	15	10	27	4	55																	
24	30	1	15	12	2	1	15	15	15	15	10	27	4	55																	
26	30	1	15	12	2	1	15	15	15	15	10	27	4	55																	
28	30	1	15	12	2	1	15	15	15	15	10	27	4	55																	
30	30	1	15	12	2	1	15	15	15	15	10	27	4	55																	
32	30	1	15	12	2	1	15	15	15	15	10	27	4	55																	
34	30	1	15	12	2	1	15	15	15	15	10	27	4	55																	
36	30	1	15	12	2	1	15	15	15	15	10	27	4	55																	
38	30	1	15	12	2	1	15	15	15	15	10	27	4	55																	
40	30	1	15	12	2	1	15	15	15	15	10	27	4	55																	
42	30	1	15	12	2	1	15	15	15	15	10	27	4	55																	
44	30	1	15	12	2	1	15	15	15	15	10	27	4	55																	
46	30	1	15	12	2	1	15	15	15	15	10	27	4	55																	
48	30	1	15	12	2	1	15	15	15	15	10	27	4	55																	
50	30	1	15	12	2	1	15	15	15	15	10	27	4	55																	
52	30	1	15	12	2	1	15	15	15	15	10	27	4	55																	
54	30	1	15	12	2	1	15	15	15	15	10	27	4	55																	
56	30	1	15	12	2	1	15	15	15	15	10	27	4	55																	
58	30	1	15	12	2	1	15	15	15	15	10	27	4	55																	
60	30	1	15	12	2	1	15	15	15	15	10	27	4	55																	

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

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* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

**** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS**

Table B3. Wallops Island—Correlation of July Density (kg m^{-3}) From Surface to 60 km (Cont)

		KM KILOMETERS ABOVE SEA LEVEL												MEAN AVERAGE OF OBSERVED VALUES												STDEV STANDARD DEVIATION OF VALUES IN PERCENT OF MEAN TIMES 10												N NUMBER OF VALUES AT EACH ALTITUDE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
	KM	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10
 ** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B3. Wallops Island—Correlation of October Density (kg m^{-3}) From Surface to 60 km (Cont)

		KM KILOMETERS ABOVE SEA LEVEL																													
		MEAN AVERAGE OF OBSERVED VALUES																													
		STDV STANDARD DEVIATION OF VALUES IN PERCENT OF MEAN TIMES 10																													
		N NUMBER OF VALUES AT EACH ALTITUDE																													
KM		2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
MEAN	1229	908	806	651	526	420	328	245	179	127	908	652	470	345	253	186	137	101	747	551	410	307	232	176	136	106	823	643	505	395	309
STDV	27	15	11	11	9	10	22	30	33	26	20	17	16	16	16	18	17	21	25	27	34	39	41	49	52	54	57	61	63	65	83
N	43	44	44	44	44	44	44	44	44	43	42	42	41	44	44	43	43	43	43	43	43	43	43	43	43	43	43	43	39	35	26
2	80	85	50	60	63																										
4	90	52	52	52	52																										
6	13	7	24	36	73																										
10	13	7	24	36	73																										
12	13	7	24	36	73																										
14	13	7	24	36	73																										
16	13	7	24	36	73																										
20	41	43	41	17	0	15	33	73	86	54																					
22	45	43	19	22	14	11	34	64	81	91	77	77	76	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	
24	45	43	19	22	14	11	34	64	81	91	77	77	76	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	
26	45	43	19	22	14	11	34	64	81	91	77	77	76	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	
30	45	43	19	22	14	11	34	64	81	91	77	77	76	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	
32	45	43	19	22	14	11	34	64	81	91	77	77	76	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	
34	45	43	19	22	14	11	34	64	81	91	77	77	76	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	
36	45	43	19	22	14	11	34	64	81	91	77	77	76	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	
38	45	43	19	22	14	11	34	64	81	91	77	77	76	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	
40	45	43	19	22	14	11	34	64	81	91	77	77	76	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	
42	45	43	19	22	14	11	34	64	81	91	77	77	76	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	
44	45	43	19	22	14	11	34	64	81	91	77	77	76	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	
46	45	43	19	22	14	11	34	64	81	91	77	77	76	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	
48	45	43	19	22	14	11	34	64	81	91	77	77	76	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	
50	45	43	19	22	14	11	34	64	81	91	77	77	76	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	
52	45	43	19	22	14	11	34	64	81	91	77	77	76	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	
54	45	43	19	22	14	11	34	64	81	91	77	77	76	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	
56	45	43	19	22	14	11	34	64	81	91	77	77	76	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	
58	45	43	19	22	14	11	34	64	81	91	77	77	76	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	
60	45	43	19	22	14	11	34	64	81	91	77	77	76	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

** MULTIPLY TABULAR VALUES BY 0.051 TO OBTAIN CORRELATION COEFFICIENTS

Table B4. Churchill – Correlation of January Density (kg m^{-3}) From Surface to 60 km

[illegible]

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

*** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

(Cont)

NAME	KILOMETERS ABOVE SEA LEVEL	AVERAGE OF OBSERVED VALUES	STANDARD DEVIATION OF VALUES IN PERCENT OF MEAN TIMES 10	NUMBER OF VALUES AT EACH ALTITUDE
1	0	1.0	0.5	10
2	10	1.5	0.8	15
3	20	2.0	1.0	20
4	30	2.5	1.2	25
5	40	3.0	1.5	30
6	50	3.5	1.8	35
7	60	4.0	2.0	40
8	70	4.5	2.2	45
9	80	5.0	2.5	50
10	90	5.5	2.8	55
11	100	6.0	3.0	60
12	110	6.5	3.2	65
13	120	7.0	3.5	70
14	130	7.5	3.8	75
15	140	8.0	4.0	80
16	150	8.5	4.2	85
17	160	9.0	4.5	90
18	170	9.5	4.8	95
19	180	10.0	5.0	100
20	190	10.5	5.2	105
21	200	11.0	5.5	110
22	210	11.5	5.8	115
23	220	12.0	6.0	120
24	230	12.5	6.2	125
25	240	13.0	6.5	130
26	250	13.5	6.8	135
27	260	14.0	7.0	140
28	270	14.5	7.2	145
29	280	15.0	7.5	150
30	290	15.5	7.8	155
31	300	16.0	8.0	160
32	310	16.5	8.2	165
33	320	17.0	8.5	170
34	330	17.5	8.8	175
35	340	18.0	9.0	180
36	350	18.5	9.2	185
37	360	19.0	9.5	190
38	370	19.5	9.8	195
39	380	20.0	10.0	200
40	390	20.5	10.2	205
41	400	21.0	10.5	210
42	410	21.5	10.8	215
43	420	22.0	11.0	220
44	430	22.5	11.2	225
45	440	23.0	11.5	230
46	450	23.5	11.8	235
47	460	24.0	12.0	240
48	470	24.5	12.2	245
49	480	25.0	12.5	250
50	490	25.5	12.8	255
51	500	26.0	13.0	260
52	510	26.5	13.2	265
53	520	27.0	13.5	270
54	530	27.5	13.8	275
55	540	28.0	14.0	280
56	550	28.5	14.2	285
57	560	29.0	14.5	290
58	570	29.5	14.8	295
59	580	30.0	15.0	300
60	590	30.5	15.2	305
61	600	31.0	15.5	310
62	610	31.5	15.8	315
63	620	32.0	16.0	320
64	630	32.5	16.2	325
65	640	33.0	16.5	330
66	650	33.5	16.8	335
67	660	34.0	17.0	340
68	670	34.5	17.2	345
69	680	35.0	17.5	350
70	690	35.5	17.8	355
71	700	36.0	18.0	360
72	710	36.5	18.2	365
73	720	37.0	18.5	370
74	730	37.5	18.8	375
75	740	38.0	19.0	380
76	750	38.5	19.2	385
77	760	39.0	19.5	390
78	770	39.5	19.8	395
79	780	40.0	20.0	400
80	790	40.5	20.2	405
81	800	41.0	20.5	410
82	810	41.5	20.8	415
83	820	42.0	21.0	420
84	830	42.5	21.2	425
85	840	43.0	21.5	430
86	850	43.5	21.8	435
87	860	44.0	22.0	440
88	870	44.5	22.2	445
89	880	45.0	22.5	450
90	890	45.5	22.8	455
91	900	46.0	23.0	460
92	910	46.5	23.2	465
93	920	47.0	23.5	470
94	930	47.5	23.8	475
95	940	48.0	24.0	480
96	950	48.5	24.2	485
97	960	49.0	24.5	490
98	970	49.5	24.8	495
99	980	50.0	25.0	500
100	990	50.5	25.2	505
101	1000	51.0	25.5	510
102	1010	51.5	25.8	515
103	1020	52.0	26.0	520
104	1030	52.5	26.2	525
105	1040	53.0	26.5	530
106	1050	53.5	26.8	535
107	1060	54.0	27.0	540
108	1070	54.5	27.2	545
109	1080	55.0	27.5	550
110	1090	55.5	27.8	555
111	1100	56.0	28.0	560
112	1110	56.5	28.2	565
113	1120	57.0	28.5	570
114	1130	57.5	28.8	575
115	1140	58.0	29.0	580
116	1150	58.5	29.2	585
117	1160	59.0	29.5	590
118	1170	59.5	29.8	595
119	1180	60.0	30.0	600
120	1190	60.5	30.2	605
121	1200	61.0	30.5	610
122	1210	61.5	30.8	615
123	1220	62.0	31.0	620
124	1230	62.5	31.2	625
125	1240	63.0	31.5	630
126	1250	63.5	31.8	635
127	1260	64.0	32.0	640
128	1270	64.5	32.2	645
129	1280	65.0	32.5	650
130	1290	65.5	32.8	655
131	1300	66.0	33.0	660
132	1310	66.5	33.2	665
133	1320	67.0	33.5	670
134	1330	67.5	33.8	675
135	1340	68.0	34.0	680
136	1350	68.5	34.2	685
137	1360	69.0	34.5	690
138	1370	69.5	34.8	695
139	1380	70.0	35.0	700
140	1390	70.5	35.2	705
141	1400	71.0	35.5	710
142	1410	71.5	35.8	715
143	1420	72.0	36.0	720
144	1430	72.5	36.2	725
145	1440	73.0	36.5	730
146	1450	73.5	36.8	735
147	1460	74.0	37.0	740
148	1470	74.5	37.2	745
149	1480	75.0	37.5	750
150	1490	75.5	37.8	755
151	1500	76.0	38.0	760
152	1510	76.5	38.2	765
153	1520	77.0	38.5	770
154	1530	77.5	38.8	775
155	1540	78.0	39.0	780
156	1550	78.5	39.2	785
157	1560	79.0	39.5	790
158	1570	79.5	39.8	795
159	1580	80.0	40.0	800
160	1590	80.5	40.2	805
161	1600	81.0	40.5	810
162	1610	81.5	40.8	815
163	1620	82.0	41.0	820
164	1630	82.5	41.2	825
165	1640	83.0	41.5	830
166	1650	83.5	41.8	835
167	1660	84.0	42.0	840
168	1670	84.5	42.2	845
169	1680	85.0	42.5	850
170	1690	85.5	42.8	855
171	1700	86.0	43.0	860
172	1710	86.5	43.2	865
173	1720	87.0	43.5	870
174	1730	87.5	43.8	875
175	1740	88.0	44.0	880
176	1750	88.5	44.2	885
177	1760	89.0	44.5	890
178	1770	89.5	44.8	895
179	1780	90.0	45.0	900
180	1790	90.5	45.2	905
181	1800	91.0	45.5	910
182	1810	91.5	45.8	915
183	1820	92.0	46.0	920
184	1830	92.5	46.2	925
185	1840	93.0	46.5	930
186	1850	93.5	46.8	935
187	1860	94.0	47.0	940
188	1870	94.5	47.2	945
189	1880	95.0	47.5	950
190	1890	95.5	47.8	955
191	1900	96.0	48.0	960
192	1910	96.5	48.2	965
193	1920	97.0	48.5	970
194	1930	97.5	48.8	975
195	1940	98.0	49.0	980
196	1950	98.5	49.2	985
197	1960	99.0	49.5	990
198	1970	99.5	49.8	995
199	1980	100.0	50.0	1000
200	1990	100.5	50.2	1005
201	2000	101.0	50.5	1010
202	2010	101.5	50.8	1015
203	2020	102.0	51.0	1020
204	2030	102.5	51.2	1025
205	2040	103.0	51.5	1030
206	2050	103.5	51.8	1035
207	2060	104.0	52.0	1040
208	2070	104.5	52.2	1045
209	2080	105.0	52.5	1050
210	2090	105.5	52.8	1055
211	2100	106.0	53.0	1060
212	2110	106.5	53.2	1065
213	2120	107.0	53.5	1070
214	2130	107.5	53.8	1075
215	2140	108.0	54.0	1080
216	2150	108.5	54.2	1085
217	2160	109.0	54.5	1090
218	2170	109.5	54.8	1095
219	2180	110.0	55.0	1100
220	2190	110.5	55.2	1105
221	2200	111.0	55.5	1110
222	2210	111.5	55.8	1115
223	2220	112.0	56.0	1120
224	2230	112.5	56.2	1125
225	2240	113.0	56.5	1130
226	2250	113.5	56.8	1135
227	2260	114.0	57.0	1140
228	2270	114.5	57.2	1145
229	2280	115.0	57.5	1150
230	2290	115.5	57.8	1155
231	2300	116.0	58.0	1160
232	2310	116.5	58.2	1165
233	2320	117.0	58.5	1170
234	2330	117.5	58.8	1175
235	2340	118.0	59.0	1180
236	2350	118.5	59.2	1185
237	2360	119.0	59.5	1190
238	2370	119.5	59.8	1195
239	2380	120.0	60.0	1200
240	2390	120.5	60.2	1205
241	2400	121.0	60.5	1210
242	2410	121.5	60.8	1215
243	2420	122.0	61.0	1220
244	2430	122.5	61.2	1225
245	2440	123.0	61.5	1230
246	2450	123.5	61.8	1235
247	2460	124.0	62.0	1240
248	2470	124.5	62.2	1245
249	2480	125.0	62.5	1250
250	2490	125.5	62.8	1255
251	2500	126.0	63.0	1260
252	2510	126.5	63.2	1265
253	2520	127.0	63.5	1270
254	2530	127.5	63.8	1275
255	2540	128.0	64.0	1280
256	2550	128.5	64.2	1285
257	2560	129.0	64.5	1290
258	2570	129.5	64.8	1295
259	2580	130.0	65.0	1300
260	2590	130.5	65.2	1305
261	2600	131.0	65.5	1310
262	2610	131.5	65.8	1315
263	2620	132.0	66.0	1320
264	2630	132.5	66.2	1325
265	2640	133.0	66.5	1330
266	2650			

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

• MULTIPLY TABLE VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B4. Churchill—Correlation of July Density (kg m^{-3}) From Surface to 60 km (Cont)

KM	KM KILOMETERS ABOVE SEA LEVEL																														
	MEAN AVERAGE OF OBSERVED VALUES																														
	STDEV STANDARD DEVIATION OF VALUES IN PERCENT OF MEAN TIMES 10																														
	N NUMBER OF VALUES AT EACH ALTITUDE																														
.035	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	
MEAN	999	810	554	525	409	306	224	166	122	901	662	487	362	267	197	146	109	813	610	460	349	267	206	161	126	992	765	620	+92	395	
STDEV	21	12	11	10	19	39	24	22	20	16	14	12	15	13	12	12	13	11	14	15	16	18	21	22	23	23	25	27	29	32	
N	20	20	20	20	20	20	20	20	20	20	27	27	20	20	20	20	20	20	20	20	20	20	20	20	20	20	26	25	25	20	19
2	55	75	89																												
4	39	43	61	70																											
6																															
10	8	-32	-14	-17	29																										
12	17	-44	-56	-34	69																										
14	-17	-56	-34	69																											
16	-29	-56	-34	69																											
20	-20	-72	-60	-54	-33	44	71	87	93	50																					
22	-13	-22	-33	-27	-29	39	39	75	86	91	55	90																			
24	-12	-22	-33	-27	-29	39	39	75	86	91	55	90																			
26	-10	-22	-33	-27	-29	39	39	75	86	91	55	90																			
28	-9	-22	-33	-27	-29	39	39	75	86	91	55	90																			
30	-1	-33	-27	-29	-33	44	71	87	93	50																					
32	7	-20	-33	-27	-29	39	39	75	86	91	55	90																			
34	-10	-22	-33	-27	-29	39	39	75	86	91	55	90																			
36	-10	-22	-33	-27	-29	39	39	75	86	91	55	90																			
38	-10	-22	-33	-27	-29	39	39	75	86	91	55	90																			
40	-25	-19	-32	-42	-37	-6	6	16	25	25	25	27	25	22	22	36	15	48	45	52	78										
42	-24	-19	-32	-42	-37	-6	6	16	25	25	25	27	25	22	22	36	15	48	45	52	78										
44	-24	-19	-32	-42	-37	-6	6	16	25	25	25	27	25	22	22	36	15	48	45	52	78										
46	-24	-19	-32	-42	-37	-6	6	16	25	25	25	27	25	22	22	36	15	48	45	52	78										
50	-35	-7	-10	-10	-24	-30	-11	-12	-12	-14	-17	-14	-2	-23	-12	-7	33	23	51	51	50	60	70	79	89						
52	-35	-7	-10	-10	-24	-30	-11	-12	-12	-14	-17	-14	-2	-23	-12	-7	33	23	51	51	50	60	70	79	89						
54	-35	-7	-10	-10	-24	-30	-11	-12	-12	-14	-17	-14	-2	-23	-12	-7	33	23	51	51	50	60	70	79	89						
56	-35	-7	-10	-10	-24	-30	-11	-12	-12	-14	-17	-14	-2	-23	-12	-7	33	23	51	51	50	60	70	79	89						
60	-66	-11	-29	-36	-39	-27	17	22	17	22	17	22	17	22	17	22	17	22	17	22	17	22	17	22	17	22	17	22	17	22	19

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

(Cont)

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10
* MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B5. Ft. Sherman—Correlation of January Density (kg m^{-3}) From 26 km to 60 km

		KM KILOMETERS ABOVE SEA LEVEL																		
		MEAN AVERAGE OF OBSERVED VALUES																		
		STDEV STANDARD DEVIATION OF VALUES																		
		IN PERCENT OF MEAN TIMES 10																		
		N NUMBER OF VALUES AT EACH ALTITUDE																		
KM		26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	
*MEAN		337	246	180	132	96	71	53	39	30	23	17	13	10	8	6	5	4	3	
STDEV		20	17	20	21	27	24	30	33	34	45	44	44	53	54	51	53	41	42	
N		21	22	22	22	22	22	22	22	22	22	22	22	22	21	21	20	15	10	
28		67	**																	
30		42	58																	
32		26	54	78																
34		2	38	69	41															
36		19	15	47	51	84														
38		1	20	37	54	50														
40		36	4	2	20	43	68	77												
42		12	17	13	36	46	74	76	86											
44		12	15	10	39	49	66	79	88	94										
46		24	12	7	40	46	75	79	83	89	92									
48		14	11	4	39	40	65	74	82	86	91	94								
50		11	6	13	18	29	30	40	70	64	70	70	79							
52		1	12	18	26	17	46	62	74	79	84	82	87	82						
54		4	13	13	28	12	50	61	65	76	79	82	82	86	96					
56		4	1	16	20	8	42	52	61	75	77	77	79	84	94	97				
58		16	17	20	0	3	29	66	63	72	76	62	67	50	91	95	95			
60		38	13	45	31	29	63	7	68	86	71	74	74	28	80	92	93	92		

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B5. Ft. Sherman—Correlation of April Density (kg m^{-3}) From 26 km to 60 km (Cont)

KM	KILOMETERS ABOVE SEA LEVEL																	
	MEAN AVERAGE OF OBSERVED VALUES																	
	STDEV STANDARD DEVIATION OF VALUES																	
	IN PERCENT OF MEAN TIMES 10																	
N NUMBER OF VALUES AT EACH ALTITUDE																		
KM	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
MEAN	341	248	161	133	982	728	545	418	309	236	182	143	112	877	690	549	434	342
STDEV	22	23	19	20	22	27	26	35	40	36	39	36	30	30	43	36	35	39
N	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	25	21	10
20	87	**																
30	76	80																
32	66	76	83															
34	58	68	86															
36	31	47	54	69	74	85												
40	44	54	63	77	74	74	87											
42	33	46	50	64	65	69	73	84										
44	35	44	52	63	63	63	72	85										
46	27	48	53	69	70	73	83	85										
50	19	50	67	68	77	85	83	86	90	92								
52	15	36	44	60	63	72	81	79	86	88								
54	15	38	44	57	53	70	81	81	89	93								
56	12	38	44	57	53	70	81	81	89	93								
58	9	25	31	43	42	58	67	74	83	86								
60	5	35	42	54	44	53	74	82	86	88								

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

** MULTIPLY TABULAR VALUE BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B5. Ft. Sherman—Correlation of July Density (kg m^{-3}) From 26 km to 60 km (Cont)

KM	KM KILOMETERS ABOVE SEA LEVEL																	
	MEAN AVERAGE OF OBSERVED VALUES																	
	STDEV STANDARD DEVIATION OF VALUES																	
	IN PERCENT OF MEAN TIMES 10																	
N NUMBER OF VALUES AT EACH ALTITUDE																		
KM	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
*MEAN	34.9	25.4	18.6	13.7	10.2	7.52	5.52	4.20	3.17	2.40	1.84	1.42	1.10	.859	.676	.529	.417	.328
STDEV	16.20	24.20	24.20	22.22	22.22	26.34	37.44	49.50	50.50	50.50	46.42	41.50	35.50	29.50	24.50	19.50	14.50	10.50
N	22	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	19	14
28	84	**																
30	59	64																
32	53	47	64															
34	20	34	12	75														
36	14	20	12	45	67													
40	15	18	4	17	40	54	82											
42	8	19	10	35	67	97	85	86										
44	4	14	22	50	74	74	74	67	84	95								
46	2	11	22	26	47	67	74	71	72	91								
48	2	11	22	26	47	67	74	71	72	91								
50	6	9	1	26	42	67	73	73	71	82	84	95						
52	13	2	15	23	42	60	81	70	78	84	90	97	91	92				
54	13	11	12	23	42	60	81	70	78	84	90	97	91	92				
56	13	11	12	23	42	60	81	70	78	84	90	97	91	92				
58	13	11	12	23	42	60	81	70	78	84	90	97	91	92				
60	2	6	18	28	45	60	84	83	88	81	78	75	71	79	84	91	92	

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10
 ** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B5. Ft. Sherman—Correlation of October Density (kg m^{-3}) From 26 km to 60 km (Cont)

	KM KILOMETERS ABOVE SEA LEVEL																	
	MEAN AVERAGE OF OBSERVED VALUES																	
	STOV STANDARD DEVIATION OF VALUES																	
	IN PERCENT OF MEAN TIMES 10																	
N NUMBER OF VALUES AT EACH ALTITUDE																		
KM	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
MEAN	335	243	180	131	974	728	547	412	310	237	182	143	112	875	688	544	428	334
STOV	32	35	31	29	21	29	26	29	31	39	50	46	44	51	54	56	47	44
N	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	11	9
24	91	**																
30	38	40																
32	68	78	44															
34	40	63	36	91	97	82												
36	49	54	52	74	77													
40	20	29	19	73	85	80	40											
42	25	40	13	70	99	91	73	88	89									
44	44	50	14	56	68	78	73	75	81	93								
46	-10	-2	-4	51	67	68	67	74	78	92	96							
50	-31	-9	10	41	65	56	50	79	75	82	78	89						
52	-17	0	-1	45	67	66	65	72	70	80	95	93	83	97				
54	-22	-14	5	47	73	71	72	75	73	80	92	93	85	95	99			
56	-36	-17		52	60	61	66	68	67	81	93	94	85	96	95	96		
60	-79	-73	-51	-42	-39	-14	2	-53	-57	35	81	74	36	78	86	95	95	

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

** MULTIPLY TABULATED VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B6. Barking Sands--Correlation of January Density (kg m^{-3}) From 26 km to 60 km

	KM	KILOMETERS ABOVE SEA LEVEL																
		MEAN AVERAGE OF OBSERVED VALUES																
		STDEV STANDARD DEVIATION OF VALUES IN PERCENT OF MEAN TIMES 10																
		N NUMBER OF VALUES AT EACH ALTITUDE																
	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
MEAN	342	240	181	132	979	721	535	390	297	224	174	136	106	834	649	506	392	306
STDEV	20	23	25	28	29	30	29	27	35	37	35	35	38	37	43	43	45	50
N	47	47	47	47	47	47	47	47	47	47	47	47	47	44	42	42	38	26
28	84	**																
30	73	81																
32	67	79	89															
34	47	64	78	87	79													
36	32	42	55	65	65	85												
40	16	21	42	50	61	68	78											
42	22	24	55	51	61	62	66	79										
44	9	4	24	37	48	49	63	61	81									
46	-4	-11	14	19	23	36	47	42	66	84								
48	-9	-16	11	4	12	26	31	28	57	64	78	90						
50	-10	-14	0	-1	6	23	30	20	40	51	63	73	82					
52	-11	-14	-3	6	13	22	30	12	29	43	56	60	63	84				
54	-11	-14	-1	8	17	23	31	12	32	54	65	74	79	84	92			
56	-17	-16	-5	13	20	28	41	29	55	69	74	74	79	78	88	90		
60	-15	-3	16	23	28	34	44	34	60	70	72	75	80	79	85	85	96	

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B6. Barking Sands—Correlation of April Density (kg m^{-3}) From 26 km to 60 km (Cont)

KM	KM KILOMETERS ABOVE SEA LEVEL																	
	MEAN AVERAGE OF OBSERVED VALUES																	
	STDEV STANDARD DEVIATION OF VALUES IN PERCENT OF MEAN TIMES 10																	
	N NUMBER OF VALUES AT EACH ALTITUDE																	
KM	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
MEAN	343	249	182	134	994	742	557	418	316	241	186	144	112	876	608	541	424	331
STDEV	14	14	14	14	17	18	17	20	21	20	23	25	25	25	24	24	28	30
N	41	43	43	43	43	43	43	43	43	43	42	42	42	42	42	41	35	25
23	70	**																
30	41	61																
32	45	46	56															
34	26	46	50	60														
36	19	37	43	44	73													
38	21	37	43	40	65	85												
40	17	23	30	21	49	51	61											
42	10	26	31	132	36	46	54	74										
44	18	31	36	122	47	53	55	81	81									
46	7	14	20	27	53	53	55	62	79	88								
48	-3	1	19	27	41	41	44	54	71									
50	-1	2	20	28	49	46	51	58	55	67	84	91						
52	8	14	18	30	50	50	52	53	60	68	73	75	87	93				
54	14	14	14	14	32	32	35	46	61	68	72	76	82	88	91			
56	14	14	14	14	35	35	37	45	61	68	72	76	82	88	91	85		
58	14	14	14	14	35	35	37	45	61	68	72	76	82	88	91	85		
60	-35	-20	-10	36	48	49	42	45	44	45	81	75	75	85	84	79	89	

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B6. Barking Sands--Correlation of July Density (kg m^{-3}) From 26 km to 60 km (Cont)

	KM KILOMETERS ABOVE SEA LEVEL															
	MEAN AVERAGE OF OBSERVED VALUES															
	STDEV STANDARD DEVIATION OF VALUES															
	IN PERCENT OF MEAN TIMES 10															
	N NUMBER OF VALUES AT EACH ALTITUDE															
24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56
MEAN	354	259	190	140	104	77	572	427	321	244	187	145	113	805	490	538
STDEV	13	14	14	15	16	19	20	23	24	26	25	27	27	29	31	33
N	41	44	44	44	44	44	44	44	44	44	44	44	44	44	43	39
28	82	**														
30	60	79														
32	64	68	76													
34	65	64	66	85												
36	55	63	63	74	76											
38	57	66	63	73	70	82										
40	44	56	57	72	62	78	89									
42	35	32	50	52	63	67	70	78								
44	11	22	41	52	53	57	58	58	83							
46	11	24	45	44	52	50	53	58	76	88						
48	12	20	39	51	46	57	55	62	80	82	86					
50	18	24	40	52	49	60	63	67	79	74	77	93				
52	35	37	51	45	59	67	67	73	76	70	70	82	92			
54	32	37	47	47	53	75	69	77	77	71	72	73	80	93		
56	34	35	40	47	57	67	73	73	77	69	58	62	70	83	80	89
58	40	43	42	52	59	63	76	73	68	67	69	55	76	76	85	89
60	31	45	46	51	67	71	79	78	73	77	84	75	78	77	89	91

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B6. Barking Sands—Correlation of October Density (kg m^{-3}) From 26 km to 60 km (Cont)

KM	KM KILOMETERS ABOVE SEA LEVEL										
	MEAN AVERAGE OF OBSERVED VALUES										
	STOV STANDARD DEVIATION OF VALUES IN PERCENT OF MEAN TIMES 10										
	N NUMBER OF VALUES AT EACH ALTITUDE										
26	28	30	32	34	36	38	40	42	44	46	48
28	30	32	34	36	38	40	42	44	46	48	50
30	32	34	36	38	40	42	44	46	48	50	52
32	34	36	38	40	42	44	46	48	50	52	54
34	36	38	40	42	44	46	48	50	52	54	56
36	38	40	42	44	46	48	50	52	54	56	58
38	40	42	44	46	48	50	52	54	56	58	60
40	42	44	46	48	50	52	54	56	58	60	
42	44	46	48	50	52	54	56	58	60		
44	46	48	50	52	54	56	58	60			
46	48	50	52	54	56	58	60				
48	50	52	54	56	58	60					
50	52	54	56	58	60						
52	54	56	58	60							
54	56	58	60								
56	58	60									
58	60										
60											

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B7. Cape Kennedy—Correlation of January Density (kg m^{-3}) From 26 km to 60 km

KM	KM										KILOMETERS ABOVE SEA LEVEL									
	MEAN										AVERAGE OF OBSERVED VALUES									
	STDEV										STANDARD DEVIATION OF VALUES IN PERCENT OF MEAN TIMES 10									
	N										NUMBER OF VALUES AT EACH ALTITUDE									
	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60		
*MEAN	340	246	179	131	965	711	527	390	291	221	171	134	105	830	649	504	391	302		
	-4	-4	-4	-4	-4	-5	-5	-5	-5	-5	-5	-5	-5	-5	-6	-6	-6	-6		
STDEV	20	21	21	21	21	26	30	35	35	39	38	39	34	35	37	35	38	42	44	
N	30	30	39	39	39	39	39	39	39	39	39	39	39	39	39	38	37	34	30	
26	83	**																		
30	73	84																		
32	36	39	31	66																
34	16	25	22	47	62	84														
36	3	14	20	36	62	84														
38	-21	-11	5	36	62	84														
40	-19	-13	-4	25	53	47	72													
42	0	-5	14	32	50	45	45	82												
44	-9	-9	-1	20	20	21	47	63	84											
46	-8	-9	-1	14	22	13	35	55	74	89										
48																				
50	-14	-17	-6	20	20	20	39	54	51	60	81	87								
52	-13	-17	-3	10	16	16	30	47	41	55	64	64	91	97						
54	-14	-17	-3	10	16	16	30	47	41	55	64	64	91	97						
56	-12	-18	-10	10	16	16	30	47	41	55	64	64	91	97						
58	-12	-18	-10	10	16	16	30	47	41	55	64	64	91	97						
60	-10	-24	-3	14	26	23	33	57	62	63	67	57	72	73	79	81	92			

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 1:

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B7. Cape Kennedy—Correlation of April Density (kg m^{-3}) From 26 km to 60 km (Cont)

		KM KILOMETERS ABOVE SEA LEVEL																
		MEAN AVERAGE OF OBSERVED VALUES																
		STDEV STANDARD DEVIATION OF VALUES																
		IN PERCENT OF MEAN TIMES 10																
		N NUMBER OF VALUES AT EACH ALTITUDE																
KM		26	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
MEAN	343	249	183	135	997	742	553	417	315	240	184	143	112	874	603	537	421	330
STDEV	18	16	14	10	22	26	26	27	32	30	27	28	26	25	23	23	23	27
N	44	45	45	45	45	45	45	45	45	45	45	45	45	45	45	44	41	35
20	65	**																
30	71	72																
32	57	51	75															
34	55	51	75	79														
36	55	51	75	56	83													
38	55	51	75	56	74	89												
40	21	20	27	55	71	74	86											
42	12	9	11	34	53	55	79	91										
44	19	9	11	34	53	55	79	91	93									
46	11	11	11	11	11	11	11	11	11	94								
48	11	11	11	11	11	11	11	11	11	94								
50	2	11	15	33	55	63	76	89	83	86	85	88						
52	6	11	15	33	55	63	76	89	83	86	85	88	94					
54	19	20	21	21	21	21	21	21	21	21	21	21	21	94	98	98	87	
56	19	20	21	21	21	21	21	21	21	21	21	21	21	94	98	98	87	
60	10	5	22	24	39	61	63	64	61	59	66	66	71	76	78	72	87	

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

** MULTIPLY TABULAR VALUES BY 6.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B7. Cape Kennedy—Correlation of July Density (kg m^{-3}) From 26 km to 60 km (Cont)

		KM KILOMETERS ABOVE SEA LEVEL																
		MEAN AVERAGE OF OBSERVED VALUES																
		STDEV STANDARD DEVIATION OF VALUES IN PERCENT OF MEAN TIMES 10																
		N NUMBER OF VALUES AT EACH ALTITUDE																
KM		26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	60
MEAN		357	260	192	141	105	77	57	43	32	24	19	16	11	9	7	5	3
STDEV		17	13	13	14	14	17	19	22	19	20	26	26	27	28	31	34	44
N		44	45	45	45	44	44	44	44	44	44	44	44	44	44	44	42	31
28	79 **																	
30	68	62																
32	46	36	70															
34	38	30	51	52														
36	8	34	37	24	77	67												
40	-21	6	23	15	37	35	59											
42	-19	-3	30	20	46	56	53	72										
44	-15	-7	24	20	47	52	51	39										
46	-17	-11	19	32	50	53	54	65	90									
48	-11	-12	24	30	54	64	60	74	84									
50	-19	-2	27	30	57	64	60	61	74	50	61	86						
52	-19	-3	24	19	52	55	54	63	70	43	49	73	92					
54	-17	-7	21	14	46	53	47	61	67	67	68	68	76	86				
56	-15	-12	1	-6	46	53	47	61	67	67	68	68	68	80	93			
58	-17	-12	1	-6	46	53	47	61	67	67	68	68	68	80	93			
60	-25	-5	12	12	37	43	57	63	61	53	63	59	59	62	72	86	92	

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10
 ** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B7. Cape Kennedy—Correlation of October Density (kg m^{-3}) From 26 km to 60 km (Cont)

		KM KILMETERS ABOVE SEA LEVEL																	
		MEAN AVERAGE OF OBSERVED VALUES																	
		STDEV STANDARD DEVIATION OF VALUES																	
		IN PERCENT OF MEAN TIMES 10																	
		N NUMBER OF VALUES AT EACH ALTITUDE																	
KM		26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
*MEAN		347	254	186	138	102	752	559	417	313	237	162	140	109	857	673	525	410	321
		-4	-4	-4	-4	-4	-5	-5	-5	-5	-5	-5	-5	-5	-6	-6	-6	-6	-6
STDEV		16	16	17	16	19	21	24	25	25	28	32	33	33	31	33	37	38	44
N		44	44	44	45	45	45	45	45	45	45	45	45	45	45	45	44	37	32
28	82	**																	
30	74	73																	
32	49	64	75																
34	25	17	23	56															
36	-9	17	15	44	59	76													
40	-7	13	6	31	55	65	81												
42	-20	-4	-5	19	40	56	74	80											
44	-29	-15	-12	11	24	38	52	72	80	91									
46	-20	-15	-11	10	22	42	53	73	75	85	94								
50	-27	-12	-7	10	22	40	49	70	73	83	91	95							
52	-30	-21	-8	5	18	35	47	64	72	80	88	87	92						
54	-35	-29	-14	0	15	30	43	60	73	82	87	84	83	87	92				
56	-34	-23	-11	-4	10	27	38	57	68	71	81	83	87	85	86	95			
58	-26	-10	-12	6	24	36	58	72	79	74	83	87	85	87	85	86	91		
60	-45	-30	-27	-2	22	36	59	63	71	72	79	82	86	84	87	91	95		

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

** MULTIPLY TABLE VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B8. White Sands—Correlation of January Density (kg m^{-3}) From 26 km to 60 km

	KM KILMETERS ABOVE SEA LEVEL																		
	MEAN AVERAGE OF OBSERVED VALUES																		
	STOV STANDARD DEVIATION OF VALUES IN PERCENT OF MEAN TIMES 10																		
	N NUMBER OF VALUES AT EACH ALTITUDE																		
KM	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	
*MEAN	338	247	180	131	965	708	522	306	289	218	168	131	103	810	633	494	383	295	
	-4	-4	-4	-4	-5	-5	-5	-5	-5	-5	-5	-5	-5	-6	-6	-6	-6	-6	
STOV	22	19	25	28	29	34	41	42	42	42	48	46	48	53	55	59	62	69	
N	43	47	50	50	50	50	50	50	50	50	50	50	50	50	49	46	43	37	
28	83	**																	
30	56	78																	
32	47	56	84																
34	37	50	69	83															
36	19	32	49	64	86														
38	6	17	23	45	74	85													
40	-11	-4	-1	18	53	69	82												
42	-5	-8	-12	6	36	54	62	83											
44	-10	-11	-13	-25	-14	27	32	41	51	61	71	81	91						
46	-3	-13	-25	-13	5	27	15	41	66	81	91								
48	-4	-10	-25	-13	5	27	15	41	66	81	91								
50	-7	-8	-22	-14	-5	12	1	23	47	69	80	92							
52	-11	-16	-29	-23	-18	0	-9	12	38	61	75	86	96						
54	-11	-12	-26	-26	-16	0	-8	12	34	54	70	81	91	95					
56	-7	-12	-27	-25	-15	-2	-12	18	31	56	69	79	89	91	93				
58	-7	-12	-27	-25	-15	-2	-12	13	36	63	76	82	89	91	92	96			
60	-17	-21	-32	-32	-22	1	-12	16	40	67	79	83	88	90	89	92	98		

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B8. White Sands--Correlation of April Density (kg m^{-3}) From 26 km to 60 km (Cont)

		KM KILOMETERS ABOVE SEA LEVEL										MEAN AVERAGE OF OBSERVED VALUES										STDEV STANDARD DEVIATION OF VALUES IN PERCENT OF MEAN TIMES 10										N NUMBER OF VALUES AT EACH ALTITUDE									
		26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60			26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60		
*MEAN		345	250	183	134	98	72	54	40	30	23	18	14	11	8	6	5	4	3			345	250	183	134	98	72	54	40	30	23	18	14	11	8	6	5	4	3		
		-4	-4	-4	-4	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5			-4	-4	-4	-4	-4	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5				
STDEV		17	17	17	17	23	25	29	31	34	38	38	38	36	39	39	41	41	46			17	17	17	17	23	25	29	31	34	38	38	36	39	39	41	41	46			
N		40	50	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	43			40	50	51	51	51	51	51	51	51	51	51	51	51	51	51	43				
28		82	**																																						
30		59	73																																						
32		45	54	76																																					
34		20	42	61	82																																				
36		20	31	61	75	87																																			
38		11	19	42	65	75	90																																		
40		10	15	31	55	64	70	80																																	
42		12	16	31	48	58	74	84	87																																
44		18	16	26	44	58	70	78	79	90																															
46		14	20	29	43	55	71	77	75	84	96																														
48		25	28	39	51	59	69	72	72	81	89	93																													
50		20	26	37	50	56	66	70	71	79	88	91	95																												
52		32	35	42	51	52	63	65	67	75	82	85	93	96																											
54		32	38	43	53	55	64	67	70	74	80	85	91	96	97																										
56		20	31	43	54	57	67	70	70	72	77	82	87	92	94	96																									
58		10	31	44	50	53	63	60	61	63	76	75	83	88	90	91	92	94																							

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B8. White Sands--Correlation of July Density (kg m^{-3}) From 26 km to 60 km (Cont)

		KM KILOMETERS ABOVE SEA LEVEL																	
		MEAN AVERAGE OF OBSERVED VALUES																	
		STDEV STANDARD DEVIATION OF VALUES IN PERCENT OF MEAN TIMES 10																	
		N NUMBER OF VALUES AT EACH ALTITUDE																	
KM		26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
*MEAN		361	264	193	142	106	744	505	430	330	222	137	150	117	919	719	561	430	343
		-4	-4	-4	-4	-4	-5	-5	-5	-5	-5	-5	-5	-5	-6	-6	-6	-6	-6
STDEV		24	22	21	20	20	25	29	32	34	42	40	47	44	43	47	47	45	51
N		36	41	42	42	42	42	42	42	42	42	42	42	42	42	41	40	37	33
28	89	**																	
30	86	87																	
32	77	77	79																
34	82	75	76	81															
36	75	68	69	77	80														
38	66	65	69	83	75	86													
40	57	60	67	78	73	77	89												
42	58	53	62	69	72	81	79	46											
44	47	46	56	61	67	73	76	82	94										
46	42	40	51	58	65	74	74	80	87	96									
48	44	41	51	63	67	70	73	79	82	89	95								
50	46	41	52	64	68	70	73	78	86	92	98								
52	41	36	43	61	64	70	72	74	75	84	88	90	94						
54	46	39	46	64	64	76	76	74	79	87	89	85	86	90	97				
56	46	36	47	58	64	70	76	73	84	90	92	85	86	86	92	97			
58	35	26	34	56	61	73	76	70	84	87	89	81	80	80	86	91	97		
60	44	36	42	59	62	71	79	73	85	87	87	80	80	80	87	87	95		

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

** MULTIPLY TABLE VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B8. White Sands—Correlation of October Density (kg m^{-3}) From 26 km to 60 km (Cont)

		KILOMETERS ABOVE SEA LEVEL																	
		MEAN AVERAGE OF OBSERVED VALUES																	
		STDEV STANDARD DEVIATION OF VALUES IN PERCENT OF MEAN TIMES 10																	
		N NUMBER OF VALUES AT EACH ALTITUDE																	
KM		26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
*MEAN		344	252	186	137	100	745	552	411	307	232	177	137	106	827	649	506	396	310
		-4	-4	-4	-4	-4	-5	-5	-5	-5	-5	-5	-5	-5	-6	-6	-6	-6	-6
STDEV		33	31	30	29	30	33	34	36	39	43	44	46	50	49	52	53	56	52
N		44	47	49	49	49	49	49	49	49	49	49	49	48	48	45	45	44	38
28	95	**																	
30	92	93																	
32	84	89	91																
34	84	83	83	90															
36	69	70	77	79	83	92													
40	52	56	65	69	74	84	91												
42	42	47	57	60	66	75	86	92											
44	37	41	52	55	60	69	80	88	94										
46	38	40	51	52	59	70	82	89	94	96									
48	32	34	48	48	56	65	77	86	93	97									
50	27	28	43	42	49	57	71	80	89	90	95	98							
52	46	46	55	55	62	69	73	81	86	89	94	97	98						
54	42	42	43	51	52	60	68	71	81	83	88	91	94	95	97	99			
56	36	37	43	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
58	-10	5	25	34	43	45	45	45	45	45	45	45	45	45	45	45	45	45	45
60	-1	11	25	31	38	44	44	44	44	44	44	44	44	44	44	44	44	44	44

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B9. Primrose Lake—Correlation of January Density (kg m^{-3}) From 26 km to 60 km

	KM	KM KILOMETERS ABOVE SEA LEVEL																
		MEAN AVERAGE OF OBSERVED VALUES																
		STDEV STANDARD DEVIATION OF VALUES IN PERCENT OF MEAN TIMES 10																
		N NUMBER OF VALUES AT EACH ALTITUDE																
	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
*MEAN	325	239	175	129	94	70	51	30	20	21	15	11	89	679	522	403	306	247
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
STDEV	43	45	48	55	54	54	64	72	81	92	98	114	116	123	135	140	148	113
N	20	21	21	21	21	21	21	21	21	21	21	21	21	21	21	18	17	12
28	94	**																
30	90	97																
32	83	92	95															
34	74	87	90	98														
36	64	80	81	90	96	92												
38	42	60	64	74	82													
40	27	51	55	66	75	87	95											
42	13	37	42	51	64	78	89	94										
44	11	30	37	48	57	71	88	99	97									
46	7	24	30	40	49	63	78	94	92	96								
48	-1	14	21	31	39	54	72	88	93	98								
50	-7	8	14	23	31	46	64	71	85	90	95							
52	-10	2	10	15	23	35	51	59	75	80	90	95	98					
54	-12	-4	0	12	20	32	48	64	71	84	91	96	98	99				
56	-25	-10	-11	-12	-8	0	13	27	51	55	71	81	95	95	98			
58	-20	-10	-3	-4	-4	-2	17	25	50	57	73	78	84	86	92	98		
60																		

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B9. Primrose Lake--Correlation of April Density (kg m^{-3}) From 26 km to 60 km (Cont)

KM	K4 KILOMETERS ABOVE SEA LEVEL										NUMBER OF VALUES AT EACH ALTITUDE									
	MEAN AVERAGE OF OBSERVED VALUES										STDEV STANDARD DEVIATION OF VALUES IN PERCENT OF MEAN TIMES 10									
26	26	26	30	32	34	36	36	40	42	44	46	48	50	52	54	56	58	60		
MEAN	343	251	183	133	979	718	538	394	296	223	171	133	104	60	634	497	391	306		
STDEV	16	17	23	28	28	30	29	32	32	33	38	42	47	49	53	56	52	63		
N	32	32	32	32	32	32	32	32	32	32	32	31	31	31	30	30	30	26	21	
28	87	**																		
30	81	92																		
32	77	91	93																	
34	70	83	84																	
36	58	71	75	84																
38	41	51	56	66	80	90														
40	30	41	44	57	73	85	95													
42	13	15	19	27	47	61	77	87												
44	7	12	16	23	33	41	50	57	67	71	77	85	96							
46	3	6	9	13	19	25	30	36	46	57	66	77	89	96						
50	-1	-9	-8	-12	2	18	36	46	71	86	91	97								
52	-11	-17	-14	-20	-6	5	28	39	65	85	91	96	96							
54	-10	-15	-10	-16	-8	8	26	35	63	82	89	94	95	98						
56	-17	-16	-13	-21	-9	3	19	29	57	77	86	93	94	97	98					
58	-20	-26	-26	-33	-22	-8	14	25	57	81	85	88	91	94	95	96				
60	-21	-23	-24	-25	-15	9	26	38	61	77	85	87	90	90	91	93	99			

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B9. Primrose Lake—Correlation of October Density (kg m^{-3}) From 26 km to 60 km (Cont)

		KM KILOMETERS ABOVE SEA LEVEL																	
		MEAN AVERAGE OF OBSERVED VALUES																	
		STDEV STANDARD DEVIATION OF VALUES																	
		IN PERCENT OF MEAN TIMES 10																	
		N NUMBER OF VALUES AT EACH ALTITUDE																	
KM		26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
*MEAN	344	251	183	134	97	710	521	383	282	211	158	119	914	702	542	419	326	253	
	-4	-4	-4	-4	-4	-5	-5	-5	-5	-5	-5	-5	-5	-6	-6	-6	-6	-6	
STDEV	16	17	21	26	31	36	42	47	54	64	71	76	81	87	91	100	102	110	
N	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	31	26	23
28	81	**																	
30	58	85																	
32	46	73	92																
34	44	64	85	93															
36	37	57	75	86	91														
38	31	48	70	84	91	95													
40	19	37	59	78	83	90	96												
42	12	33	56	74	80	88	90	94	97										
44	22	35	53	71	77	88	92	94	95	97									
46	14	31	49	66	71	82	89	92	94	97	98								
48	14	30	48	65	69	80	87	91	94	97	98								
50	12	28	45	62	65	77	84	89	92	95	98	99							
52	11	27	44	61	64	75	82	87	90	94	97	98	99						
54	7	23	39	56	58	71	78	83	87	91	94	96	97	98					
56	9	27	41	57	55	66	73	81	84	88	91	93	95	96	97	98	99		
58																			
60	8	27	42	58	56	67	74	82	85	87	92	94	95	95	96	97	99		

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B10. Poker Flats—Correlation of January Density (kg m^{-3}) From 26 km to 60 km

		KM KILMETERS ABOVE SEA LEVEL																		
		MEAN AVERAGE OF OBSERVED VALUES																		
		STDEV STANDARD DEVIATION OF VALUES																		
		IN PERCENT OF MEAN TIMES 10																		
		N NUMBER OF VALUES AT EACH ALTITUDE																		
KM		26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	
*MEAN		326	240	177	131	963	711	525	309	208	214	160	119	896	659	510	394	295	230	
		-4	-4	-4	-4	-5	-5	-5	-5	-5	-5	-5	-5	-6	-6	-6	-6	-6	-6	
STDEV		41	49	57	69	84	95	106	115	120	125	134	154	172	176	182	193	216	220	
N		31	32	32	32	32	32	32	32	32	32	32	32	31	31	28	27	22	16	12
28	95	**																		
30	91	96																		
32	85	93	97																	
34	70	82	89	94																
36	64	77	84	89	96															
40	50	65	73	79	89	93	97													
42	44	60	67	73	84	88	94	98												
44	35	40	48	55	66	73	82	91	98											
46	12	30	36	45	57	65	75	86	90	95	98									
50	3	21	30	36	49	58	69	81	85	91	95	99								
52	2	24	29	37	45	54	65	70	77	81	85	88								
54	-17	3	13	17	23	29	39	49	63	67	78	83	87	88						
56	-11	10	21	22	32	38	48	60	66	77	84	88	93	95	99					
60	-1	17	24	25	37	40	49	59	63	73	80	83	90	84	96	98	100			

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

** MULTIPLY TABULAR VALUES BY 3.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B10. Poker Flats—Correlation of April Density (kg m^{-3}) From 26 km to 60 km (Cont)

		KM KILOMETERS ABOVE SEA LEVEL																	
		MEAN AVERAGE OF OBSERVED VALUES																	
		STDEV STANDARD DEVIATION OF VALUES IN PERCENT OF MEAN TIMES 10																	
		N NUMBER OF VALUES AT EACH ALTITUDE																	
KM		26	29	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
*MEAN	344	253	186	137	101	738	546	407	304	230	175	135	105	820	642	505	396	310	
	-4	-4	-4	-4	-4	-5	-5	-5	-5	-5	-5	-5	-5	-5	-6	-6	-6	-6	
STDEV	40	43	45	46	50	55	56	57	57	55	56	56	61	64	67	63	69	70	
N	34	34	34	35	35	35	35	35	35	35	35	35	35	35	34	31	26	20	15
20	98	**																	
30	94	97																	
32	87	91	97																
34	78	81	91	97															
36	67	70	79	84	90	98													
38	59	67	75	84	90	98													
40	53	61	72	81	88	95	98												
42	51	58	68	77	84	90	94	97											
44	46	53	62	68	76	84	89	92	97										
46	48	54	62	68	75	84	89	92	95	97									
48	39	44	52	55	60	67	73	78	85	93	97								
50	33	38	46	47	52	59	66	72	80	89	95	98							
52	30	34	41	41	45	52	59	65	74	84	93	95	98						
54	29	32	37	38	40	46	53	59	65	74	84	93	95	98	99				
56	31	34	37	37	38	40	46	53	59	65	74	84	93	95	98	99			
58	27	31	33	33	34	39	41	53	67	78	87	93	95	98	99				
60	-6	9	17	15	24	28	37	40	52	63	80	87	92	92	97	98	99		

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B10. Poker Flats—Correlation of October Density (kg m^{-3}) From 26 km to 60 km (Cont)

KM	KILOMETERS ABOVE SEA LEVEL																				
	MEAN AVERAGE OF OBSERVED VALUES																				
	STDEV STANDARD DEVIATION OF VALUES																				
	IN PERCENT OF MEAN TIMES 10																				
N NUMBER OF VALUES AT EACH ALTITUDE																					
KM	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60			
MEAN	365	269	199	147	110	815	618	466	154	271	209	163	129	101	797	628	499	393	-6	-6	
STDEV	22	24	23	29	28	25	26	30	39	45	45	43	42	45	46	53	64	80			
N	27	28	28	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	15	15	
28	96	**																			
30	92	97																			
32	89	94	94																		
34	92	97	97																		
36	73	91	84	93																	
38	63	72	74	88	91	95															
40	61	71	72	88	92	95	98														
42	56	67	69	86	92	92	96	98													
44	59	69	69	86	88	88	89	92	96												
46	47	52	55	72	79	86	89	90	91	96											
48	37	48	53	72	79	86	89	90	91	96											
50	40	51	56	64	67	79	84	83	79	84	95										
52	44	50	57	66	70	81	87	85	82	81	84	97	95	97							
54	43	50	54	67	76	86	89	89	83	84	90	97	96	97	96						
56	45	53	61	78	87	87	84	69	94	96	98	98	90	90	86	95					
60	55	62	66	80	88	83	83	88	95	99	98	90	71	71	85	95	100				

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Table B10. Poker Flats—Correlation of July Density (kg m^{-3}) From 26 km to 60 km (Cont)

	KM KILOMETERS ABOVE SEA LEVEL																		
	MEAN AVERAGE OF OBSERVED VALUES																		
	STOV STANDARD DEVIATION OF VALUES IN PERCENT OF MEAN TIMES 10																		
	N NUMBER OF VALUES AT EACH ALTITUDE																		
KM	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	
*MEAN	327	340	176	130	95	69	115	380	201	200	155	117	80	67	52	41	30	23	
	114	114	114	114	115	115	115	115	115	115	115	115	115	115	115	115	115	115	
STOV	112	112	115	122	124	127	125	123	131	132	141	145	144	144	149	78	77	84	
N	23	23	23	23	23	23	23	23	23	23	22	20	20	19	18	17	12	5	
28	100	**																	
30	99	100																	
32	99	99	100																
34	99	99	99	100															
36	99	99	99	99	100														
38	95	96	96	98	99	100													
40	94	95	96	98	99	99	100												
42	91	93	93	95	97	98	99	99											
44	91	93	93	95	97	98	99	99	99										
46	91	93	93	95	97	98	99	99	99	99									
48	91	93	93	95	97	98	99	99	99	99	100								
50	89	91	92	97	95	97	97	98	98	98	98	99							
52	89	91	91	93	95	96	96	96	97	97	97	98	98	99					
54	93	94	94	94	95	96	96	96	97	97	97	98	98	99					
56	99	73	73	72	72	82	83	83	84	87	87	87	87	87	87	87	87	87	
58	77	81	79	80	82	85	85	85	84	87	87	87	87	87	87	87	87	87	
60	98	98	98	96	91	91	92	91	86	91	85	86	87	82	86	89	96		

* MULTIPLY MEAN BY INDICATED NEGATIVE POWER OF 10

** MULTIPLY TABULAR VALUES BY 0.01 TO OBTAIN CORRELATION COEFFICIENTS

Appendix C

Sample Calculation for Estimating the Effect of Density on a Reentry Vehicle

The computations provided in this appendix illustrate how to estimate the effect that the mean monthly density and its day-to-day variations around the mean have on the trajectory of a reentry vehicle passing through the region between 11 and 5 km at Wallops Island in January.

For the purposes of this simplified example, the following influence coefficients for the vehicle have been assumed, such that a density of 1 kg m^{-3} at a specific altitude will have the indicated retarding effect through a 2-km layer of the atmosphere:

Layer (km)	Influence ($\text{m}(\text{kg m}^{-3})^{-1}$)
11 - 9	800
9 - 7	400
7 - 5	200

The average distance short of a vacuum trajectory is the sum of the effects due to the mean monthly density at each level, as determined from Eq. (1) in the introduction to the main text:

Level (km)	Wallops Density (kg/m ³)		Influence (m (kg m ⁻³) ⁻¹)		Distance (m)
10	0.411	×	800	=	329
8	0.524	×	400	=	210
6	0.658	×	200	=	<u>132</u>
Average distance short of trajectory					= 671 m

The integrated standard deviation of the deceleration due to day-to-day variations in the density profile is determined from Eq. (2) using standard deviations of density at levels 10, 8, and 6 km and coefficients of correlation between these levels as indicated in the array for Wallops Island, January, in Appendix B.

Coefficient of Correlation		Standard Deviation	Influence	Standard Deviation	Influence	Distance
		$(1.44 \times 10^{-2})^2$	×	800		= 133
		$(7.86 \times 10^{-3})^2$	×	400		= 10
		$(6.58 \times 10^{-3})^2$	×	200		= 2
2×0.86	×	1.44×10^{-2}	×	800	×	7.86×10^{-3} × 400 = 62
2×-0.09	×	1.44×10^{-2}	×	800	×	6.58×10^{-3} × 200 = - 3
2×0.25	×	7.86×10^{-3}	×	400	×	6.58×10^{-3} × 200 = <u>2</u>
Total						= 206 m ²

$$\therefore \sigma^2 = 206 \text{ m}^2, \sigma = 14.4 \text{ m}, \text{ and } 2\sigma = 29 \text{ m}.$$

Based on an assumption of a normal distribution of atmospheric density, the range of the missile will vary by less than 30 m from the mean monthly impact point 95 percent of the time. If the aim point takes into consideration the mean monthly density profile, the variations in the impact point due to day-to-day variations in the density profile will be within ± 30 m of the target 95 percent of the time.

Appendix D

Sample Calculation for Estimating an Extreme Vertical Density Gradient

The following is an illustration of how to estimate an extreme vertical density gradient that may be encountered by an aerospace vehicle.

The answer to the question "What is the vertical density gradient that will be equalled or exceeded 2.5 percent of the time between 40 and 42 km near Churchill in January?", may be obtained by using the following expression taken from Eq. (8):

$$\hat{\sigma} = \sqrt{\sigma_1^2 + \sigma_2^2 - 2 R \sigma_1 \sigma_2}, \quad (D1)$$

where σ_1^2 is the mean monthly density variance at level 1 (40 km), σ_2^2 is the variance at level 2 (42 km), R is the coefficient of correlation of density between values at 40 and 42 km, and σ is the standard deviation around the mean monthly gradient between these levels. From Appendix B for Churchill in January,

$$\sigma_{40} = 13.8 \text{ percent of } 3.47 \times 10^{-3} \text{ or } 4.79 \times 10^{-3} \text{ kg m}^{-3}$$

$$\sigma_{42} = 14.4 \text{ percent of } 2.56 \times 10^{-3} \text{ or } 3.69 \times 10^{-3} \text{ kg m}^{-3}$$

$$\text{Mean monthly diff} = 0.91 \times 10^{-3} \text{ or } 9.10 \times 10^{-4} \text{ kg m}^{-3}$$

$$R = 0.98.$$

From Eq. (D1),

$$\hat{\sigma} = 1.39 \times 10^{-4} \text{ kg m}^{-3} \text{ or } 2\hat{\sigma} = 2.78 \times 10^{-4} \text{ kg m}^{-3}$$

$$\text{Mean diff} = 9.10 \times 10^{-4} \text{ kg m}^{-3}$$

$$\text{Value exceeded 2.5 percent of time} = 11.88 \times 10^{-4} \text{ kg m}^{-3}.$$

Consequently, an ascending vehicle will encounter $\frac{11.88 \times 10^{-4}}{4.75 \times 10^{-4}}$ percent

decrease in density, while a descending vehicle will encounter $\frac{11.88 \times 10^{-4}}{2.56 \times 10^{-3}}$,

a 46 percent increase in density between 40 and 42 km near Churchill in January.

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