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QUARTERMASTER RESEARCH & DEVELOPMENT COMMAND

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TECHNICAL REPORT

EP-16

FC

VARIABILITY OF MONTHLY MEAN TEMPERATURE



QUARTERMASTER RESEARCH & DEVELOPMENT CENTER  
ENVIRONMENTAL PROTECTION DIVISION

JULY 1955

NATICK, MASSACHUSETTS

<p>AD-          Quartermaster Research and Development Center, Natick, Mass.          VARIABILITY OF MONTHLY MEAN TEMPERATURE, by Lois C. Anderson. July 1965, 43 p., illus. (Technical Report EP-16)</p> <p>Accession No.          Unclassified report</p> <p>A series of maps showing standard deviation of monthly mean temperature in the Northern Hemisphere is presented, together with a description of their construction and application. The maps indicate that variability of the monthly mean is greater in winter than in summer, and more marked in northern latitudes.</p>	<p>UNCLASSIFIED</p> <p>1. Temperature - Standard deviation          I. Anderson, Lois C.          II. Title          III. Series          IV. Clark U.</p>
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HEADQUARTERS QUARTERMASTER RESEARCH & DEVELOPMENT COMMAND  
Quartermaster Research & Development Center, US Army  
Natick, Massachusetts

ENVIRONMENTAL PROTECTION DIVISION

Technical Report  
EP-16

THE STANDARD DEVIATION AS A MEASURE OF  
VARIABILITY OF MONTHLY MEAN TEMPERATURE IN  
THE NORTHERN HEMISPHERE

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ENVIRONMENTAL RESEARCH BRANCH

Project Reference:  
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## FOREWORD

The Environmental Protection Division of the Quartermaster Research and Development Command is concerned with the impact of the total environment on the soldier in the performance of his mission.

Although extreme environmental conditions may be critical in specific instances, it is the usual range of conditions encountered that more often influences the success or failure of the individual soldier and the equipped team. Therefore, not only extreme but also ordinary conditions must be known for one to make correct military decisions involving temperature.

The temperature to be expected at a place is usually identified with the average temperature for the period of record. The full range of temperatures may be estimated from the extremes of record; however, this full range is composed of daily and seasonal variations within each year, as well as year-to-year differences. Consequently, it becomes important to know how well the average of the period of record represents conditions which may be expected in any one future year.

The year-to-year standard deviation of the monthly temperature mean was selected as the measure of variation, and hemispheric maps were prepared by Clark University under a research contract with the Office of The Quartermaster General. These maps are published here as the first generally available source of information on the amount of year-to-year variation in air temperature, suitable for use with information on average temperature for a variety of military and civil applications.

AUSTIN HENSCHEL, Ph.D.  
Acting Chief  
Environmental Protection Division

Approved:

A. STUART HUNTER, Ph.D.  
Scientific Director  
QM R&D Command

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#### ABSTRACT

A series of maps showing standard deviation of monthly mean temperature in the Northern Hemisphere is presented, together with a description of their construction and application. The maps indicate that variability of the monthly mean is greater in winter than in summer, and more marked in northern latitudes.

THE STANDARD DEVIATION AS A MEASURE OF  
VARIABILITY OF MONTHLY MEAN TEMPERATURE IN  
THE NORTHERN HEMISPHERE

1. Introduction

a. Background

As part of a program of contract studies for The Quartermaster General, the Graduate School of Geography of Clark University prepared a series of maps showing monthly temperature means and daily and yearly range of temperature. It was suggested that a study of variation from the long-term mean was the next logical step. A report<sup>1</sup> on the standard deviation of mean monthly temperature in North America was partly financed by the Office of The Quartermaster General. Subsequently, a contract was given to Clark University to widen the scope of the investigation to cover the entire Northern Hemisphere; the results are presented here.

b. Importance of deviations

Unusual months are most likely to have a disruptive effect on human activities in zones of intermediate temperatures, since, in very hot or very cold climates, deviation from the normal affects the severity, but not the general character, of the climatic stress on soldiers and equipment.

Summer<sup>1</sup> gives this illustration of variation: "At Havre, Montana, for example, the mean January temperature over a fifty-year period is 13° F., but there has been a January (1916) with a mean temperature of -13° F. ...and there has also been a January (1919) with a mean temperature of 34° F.... In the first instance, Havre had about the average January mean of Fairbanks, Alaska; in the latter instance, about that of Amarillo, Texas — two sharply contrasting localities climatically!"

Knowledge of the deviations from the long-period mean is important for both military and non-military activities. While the mean itself is valuable as a guide, the magnitude and frequency of occurrence of the deviations from that mean are of considerably more significance in estimating the environmental situation likely to obtain in any given area at any given time. Study of the maps presented here and detailed studies of smaller critical areas can tell the planner approximately what is the risk of unusual months in future years.

c. Standard deviation as a measure of variability

Validity of interpretation and of application of the maps depends primarily upon the soundness of the assumptions made in selecting standard deviation as the measure of dispersion of monthly temperature.

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The first assumption is that monthly temperatures follow the normal distribution. This is supported directly by U.S. Weather Bureau contract studies of temperature normals, as reported by Thom<sup>2</sup> and checked for about fifty stations by Bumer.<sup>3</sup> It is supported further, statistically, by the theorem that sample means\* tend to follow a normal distribution even when the population from which the samples were drawn is not clearly identified with the normal distribution.<sup>4,5</sup>

The second assumption is that monthly temperatures in successive years are independent in the probability sense. Bumer found no evidence to the contrary.

The third assumption, basic to most military climatology, is that no long-term temperature trend affects the applicability of past records.

The mean of the period of record is used as the estimate of the true mean of the population (which can never be known exactly, in this instance), and the standard deviation of the period of record as the estimate of the true standard deviation. As the number of years of record increases, the accuracy of the estimate increases.

If the assumption of normal distribution is correct, then the mean is a temperature characteristic which is independent of the standard deviation in the probability sense.<sup>6</sup> Since the estimates of true mean calculated for this study are not necessary for applications of the standard deviations as read from the maps, only the standard deviations are shown.\*\* Actually, means based on longer records in some cases and on the most recent data available might provide better estimates of the true long-period mean.

## 2. Construction of Maps

### a. Compilation of data

Ideally, the climatological record should cover the same period at all stations and should include sufficient stations located so as to give adequate representation: for all areas and for all combinations of climatic controls. In practice, this was impossible to achieve. However, data were gathered on 600 Northern Hemisphere stations selected to give as good coverage as possible (stations were few or nonexistent in such areas as the Near East, parts of Canada, the Greenland Plateau and the Sahara). Records were obtained from sources such as Clayton's "World Weather Records," and approximately 60 other sources corresponding generally to those indexed in the world-wide Climatic Data Cards of the U.S. Weather Bureau. No

\* Each monthly mean is considered the mean of a sample number of observations from the total population, i.e., 30 daily means or about 720 hourly observations.

\*\* See Appendix A.

observations prior to 1880 were used. The list of stations used in this study is presented in Appendix B, followed by a map showing their location in Appendix C. The length of record is given, and where the record is incomplete, this is indicated in a footnote.

b. Drawing of isopleths

After the standard deviations were computed, they were plotted on maps, and isopleths of equal standard deviation were drawn. The maps prepared by Sumner formed the basis for mapping North America, although new stations were added to give fuller coverage.

Study of certain areas revealed that mountain ranges act as a barrier to air masses that produce year-to-year variation in temperature; accordingly, isopleths were drawn to follow the trend of mountain ranges.

When records of short length and different periods in the same area did not fit the general pattern of nearby stations with longer records, standard deviation of the anomalous station was disregarded. Where few or no stations were available, the location of these isopleths was estimated from nearby isopleths. Conjectural isopleths are shown on the maps by broken lines.

Any interpretation of the maps should be made with these limitations in mind.

3. Precision of the Maps

Within the limitations noted, it is believed that standard deviation read from the maps will usually be within one Fahrenheit degree of the true standard deviation, although short record, high deviation, or lack of sufficient stations may cause the error of estimate to rise as high as 2 or 3 degrees.

Comparisons of the order of one degree or larger, with the exceptions noted, are reasonable. This should be sufficient for most applications, since the effects of temperature on equipment are usually not known more precisely than to 2 or 3 degrees.

4. Interpretation and Use of the Maps

a. Interpretation

Interpretation of the standard deviation read from the maps is based on the assumption that monthly temperature means follow the normal distribution, so that normal probability theory is applicable.

The most elementary interpretation is that in areas where the standard deviation is low, the probability of occurrence of an unusual month in any future year is low; where the standard deviation is high, the probability that any one monthly mean will depart considerably from the long-period mean is high. A more sophisticated interpretation is based on use of the maps, together with mean data and Table I (presented and described in the following paragraph). Some of the questions that can be answered by this material are:

(1) What range of temperature means may be expected in any given period of time?

(2) What values of temperature means are not likely to occur in a given period of time?

(3) How often is the mean temperature expected to equal or exceed a given value?

(4) How often, on the average, will the monthly mean be a specified temperature or lower?

(5) How often is the monthly mean expected to lie within a specified temperature range?

b. Description of Table I and general method

Figure 1 shows the percent of area bounded by the mean, represented as 0, and  $\pm 1, 2$  and 3 standard deviations. For example, this illustrates that the area bounded by the mean + 1 standard deviation includes 34.13% of the total area. The area from the mean -1 standard deviation to the mean + 1 standard deviation will therefore include  $34.13 + 34.13$ , or 68.26% of the total.

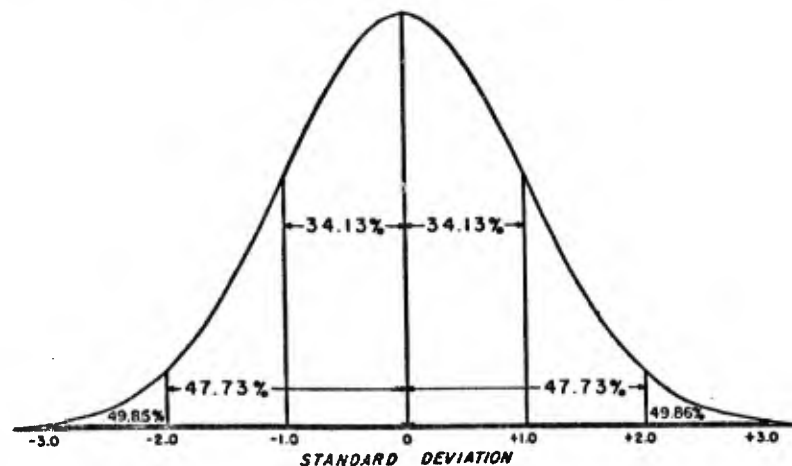


Figure 1: CUMULATIVE PERCENT OF AREA UNDER THE NORMAL PROBABILITY CURVE

Table I, which is a standard statistical table, shows the values shown in Figure 1, as well as others which may be useful. More complete tables of Area under the Normal Curve may be found in most texts on statistics.

**TABLE I: PERCENT OF AREA UNDER THE NORMAL CURVE BOUNDED BY THE MEAN PLUS OR MINUS THE STANDARD DEVIATION**

Proportion of Standard Deviation	Total Area Percent		0.5 Area Percent	
	<u>included</u>	<u>excluded</u>	<u>included</u>	<u>excluded</u>
.2	15.86	84.14	7.93	42.07
.4	31.08	68.92	15.54	34.46
.6	45.14	54.86	22.57	27.43
.8	57.62	42.38	28.81	21.19
1.0	68.26	31.74	34.13	15.87
1.1	72.86	27.14	36.43	13.57
1.2	76.98	23.02	38.49	11.51
1.3	80.64	19.36	40.32	9.68
1.4	83.84	16.16	41.92	8.08
1.5	86.64	13.36	43.32	6.68
1.6	89.04	10.96	44.52	5.48
1.7	91.08	8.92	45.54	4.46
1.8	92.82	7.18	46.41	3.59
1.9	94.26	5.74	47.13	2.87
2.0	95.46	4.54	47.73	2.27
2.2	97.22	2.78	48.51	1.39
2.4	98.36	1.64	49.18	0.82
2.6	99.06	0.94	49.53	0.47
2.8	99.48	0.52	49.74	0.26
3.0	99.73	0.27	49.865	0.135

Table I may be used to determine the area under the normal curve between any two values.\*

If the area to be computed includes the mean (e.g., mean - 1 standard deviation to mean + 1 standard deviation), the "Total Area, % included" column is used and we find the area to be 68.26%. If the question is what area lies outside the limits of mean - 1 standard deviation to mean + 1 standard deviation, reference is made to the "Total Area, % excluded" column, which shows an area of 31.74%.

If the problem considered deals with an area of which one limit is the mean (i.e., if the question involves only values above the mean or only values below the mean), then the "0.5 Area" columns are used. The area from the mean to + 1 standard deviation is read from the "% included" column: 34.13% of the total area. The area with values greater than the mean + 1 standard deviation may be read from the "% excluded" column to be: 15.87%.

### c. Specific applications

Havre, Montana, the example cited by Sumner,<sup>1</sup> may be used to illustrate the procedure in answering questions of the type given in Section 4a. Havre has a long-period January mean of 13°F. and (as shown in Figure 2) a standard deviation of about 10°F.

(1) What temperature range may be expected to include the January mean monthly temperature at Havre in three years out of four, on the average? The "Total Area, Percent Included" column of Table I shows that 76.98 percent of the area (a reasonably good approximation of three years out of four), is bounded by the mean  $\pm 1.2$  standard deviations. The mean of 13°F  $\pm 1.2$  times standard deviation of 10°F equals 13  $\pm 12$ , or the range from 1° to 25°F. Thus in three years out of four, the probability is that the January mean will be between 1° and 25°F.

(2) What monthly mean values are likely not to occur in 9 years out of 10, on the average, at Havre? The method used in answering question 1 may be used to find the range of means expected approximately 90 percent of the time, with the answer being stated that values above and below this range are not likely to occur. This gives an answer of 13°  $\pm 16$  = -3°F to 29°F for the range in 9 out of 10 January months, therefore, temperatures lower than -3°F or higher than 29°F are not likely.

\* It is suggested that this method be used to determine the probability of usual conditions with which we are concerned here, rather than that of extreme conditions (e.g., less frequent than one in 40), which are dealt with elsewhere.<sup>7,8</sup> It should also be emphasized that these maps are for application to areas and not to points, unless accompanied by a more detailed study of the particular point.

An alternative solution is to realize that the area of interest in the 1 year in 10 to be excluded. The "Total Area, Percent Excluded" column of Table I shows that 10.96 percent of the area (an approximation of 1 year in 10) lies outside the limits of the mean  $\pm 1.6$  standard deviations. Therefore approximately 1 January mean in 10 will be either below  $13^{\circ} - 16^{\circ}$  (i.e.  $-3^{\circ}\text{F}$ ) or above  $13^{\circ} + 16^{\circ}$  (i.e.  $29^{\circ}\text{F}$ ), which is the answer as stated above.

(3) What is the expectancy of a January mean temperature of  $32^{\circ}\text{F}$  or higher at Havre? Here the area to be considered is that excluded by

the mean plus  $\frac{\text{amount of deviation from the mean}}{\text{amount of standard deviation}}$  or mean  $+ \frac{32 - 13}{10} =$  mean

$+ 1.9$  standard deviations. Since only the area above the mean  $+ 1.9$  standard deviations is of concern, reference is made to the "0.5 Area Percent Excluded" column of Table I. The area lying beyond the mean  $+ 1.9$  standard deviations is 2.87 percent. Therefore, it may be concluded that in about 3 years out of 100, on the average, the January mean will equal or exceed  $32^{\circ}\text{F}$ .

(4) How often, on the average, will the January mean temperature at Havre be  $0^{\circ}\text{F}$  or lower? This method is similar to that in question 3, since values in only one direction from the mean are pertinent to the problem. The "0.5 Area, Percent Excluded" column of Table I is used to

determine the percentage of area below the limit of the mean plus

$\frac{\text{amount of deviation which is mean plus } 0 - 13}{\text{standard deviation}}$  or mean  $- 1.3$  standard

deviations equals 9.68 percent of all cases. The general conclusion is that in about 1 year in 10 the January mean will be  $0^{\circ}\text{F}$  or lower.

(5) How often will the January mean temperature at Havre be between  $0^{\circ}$  and  $32^{\circ}\text{F}$ ? The same method is used to determine the proportions of the standard deviation which form the boundaries of the area, but this time the answer is the area included by these bounds; that is, the mean  $-1.3$  standard deviations and the mean  $+ 1.9$  standard deviations. These areas included are 40.32 percent and 47.13 percent, respectively. About 87.5 percent of the time, on the basis of normal probability theory, the January mean temperature at Havre will be between  $0^{\circ}$  and  $32^{\circ}\text{F}$ . On the average, 61 out of 70 years are expected to fall within this range.

d. Comparison of expected values with actual values

It is interesting to compare the expected values obtained above for Havre, Montana with actual recorded occurrences at Havre. (The expected values for Havre were based on standard deviation as read from the January map and on the long-period mean established by the U.S. Weather Bureau.)

Table II lists actual January mean temperatures for a 70-year period, taken from U.S. Weather Bureau records. (The mean and standard deviation for this period will be found to be  $14^{\circ}\text{F}$  and  $10.3\text{F}^{\circ}$ , respectively, if computed.)

TABLE II: JANUARY MEAN TEMPERATURE AT HAVRE, MONTANA FOR 70 YEARS  
 $^{\circ}$  ( $^{\circ}\text{F}$ )

34.1	26.6	22.4	20.2	17.0	13.4	11.2	8.3	4.4	0.4
28.8	26.2	22.2	19.4	16.8	13.4	11.0	7.2	3.8	-1.4
28.6	26.0	21.6	19.4	16.4	13.0	11.0	7.2	3.3	-2.8
27.7	25.5	21.6	18.8	16.2	11.9	10.8	7.0	2.6	-5.1
27.5	24.3	21.6	18.4	14.8	11.6	10.1	6.9	2.2	-8.0
27.3	24.3	20.8	18.3	14.2	11.4	10.0	6.4	1.6	-11.6
26.6	22.4	20.6	17.5	13.8	11.2	9.6	5.2	1.3	-13.3

(1) On a 70-year basis, the answer to question 1, Paragraph 4c, was that in about 52 years out of 70, the mean would be in the range from  $1^{\circ}$  to  $25^{\circ}\text{F}$ . Table II shows that the mean actually fell in this range for 52 years.

(2) The answer to question 2, converted to a 70-year basis, was that temperatures lower than  $-3^{\circ}\text{F}$  or higher than  $29^{\circ}\text{F}$  are not likely to occur in 63 out of 70 years. From Table II, it may be seen that these extremes did not occur in 65 years out of 70.

(3) The expected frequency of January mean temperatures of  $32^{\circ}\text{F}$  or higher at Havre was computed to be about 3 years out of 100 — or 2 in 70 years. Table II shows that in the recorded 70-year period this actually occurred once.

(4) The expectancy of a January mean of  $0^{\circ}\text{F}$  or lower was computed to be 1 in 10. Reference to the actual 70-year period, Table II, shows that this expected event did occur that number of times (or 7 in 70).

(5) On the average, according to computation, 61 out of 70 January monthly means may be expected to fall within the range of  $0^{\circ}$  and  $32^{\circ}\text{F}$ . During the 70-year period shown in Table II, 63 January monthly means fell within this range.

## 5. Summary and Conclusions

a. Maps of the variability of mean monthly temperature in the Northern Hemisphere are presented, accompanied by a brief description of their construction.

b. Examples of several applications are given. The theory on which these applications are based is that this method should yield an accurate estimate of expected temperatures within the limitations stated.

c. Comparison of expected with actual values for one station indicates that the estimate is reasonably accurate.

d. Some general conclusions that may be drawn from an examination of these maps are:

1) Departures from the long-period mean are larger in winter than in summer.

2) Departures from the mean are small in tropical regions.

3) Departures from the mean in high latitudes during winter are much larger in certain regions, such as the Yukon, than in others at the same latitude.

4) In regions where variation from year to year is high, military planners must evaluate the risk of deviation from the average in determining requirements imposed by these varying conditions.

## 6. Acknowledgments

Appreciation is expressed to Mr. William B. Anderson, Environmental Protection Division who reviewed the mathematics of the approach and the precision of the maps. The temperature data for Hære, Montana were compiled by Mr. Owen S. Parmele of the Statistical Office. The work of the Cartographic Section is acknowledged with gratitude. Special thanks are due to Major George C. Russell, Jr., and Dr. David H. Miller, Environmental Research Branch, for their advice and guidance.

## 7. References

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8. Lackey, E.E. A comparison of some graphic scales for determining temperature probabilities. (Ms rpt in files of EPD.) 1953.

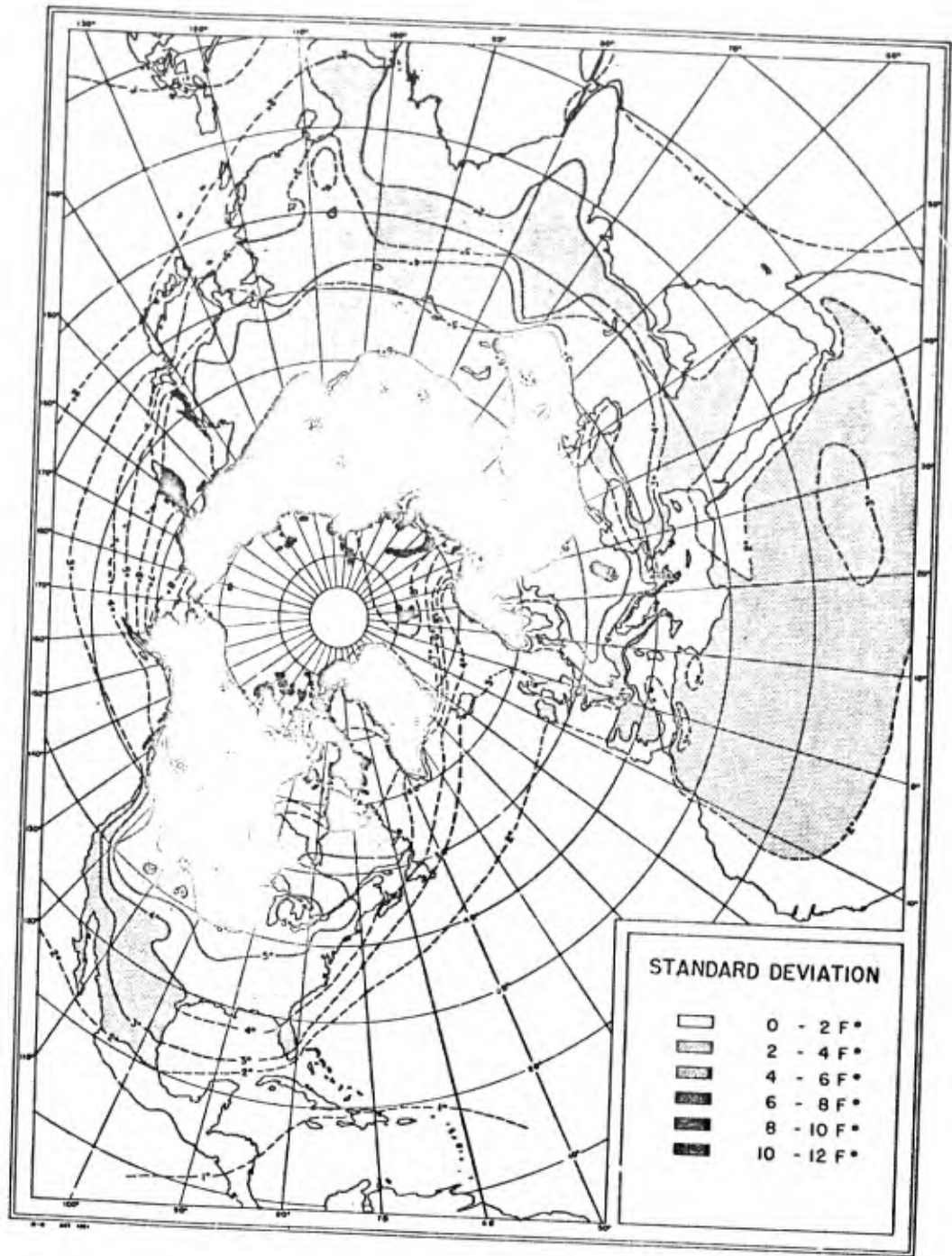


Figure 2. Temperature Variability, Northern Hemisphere, January.

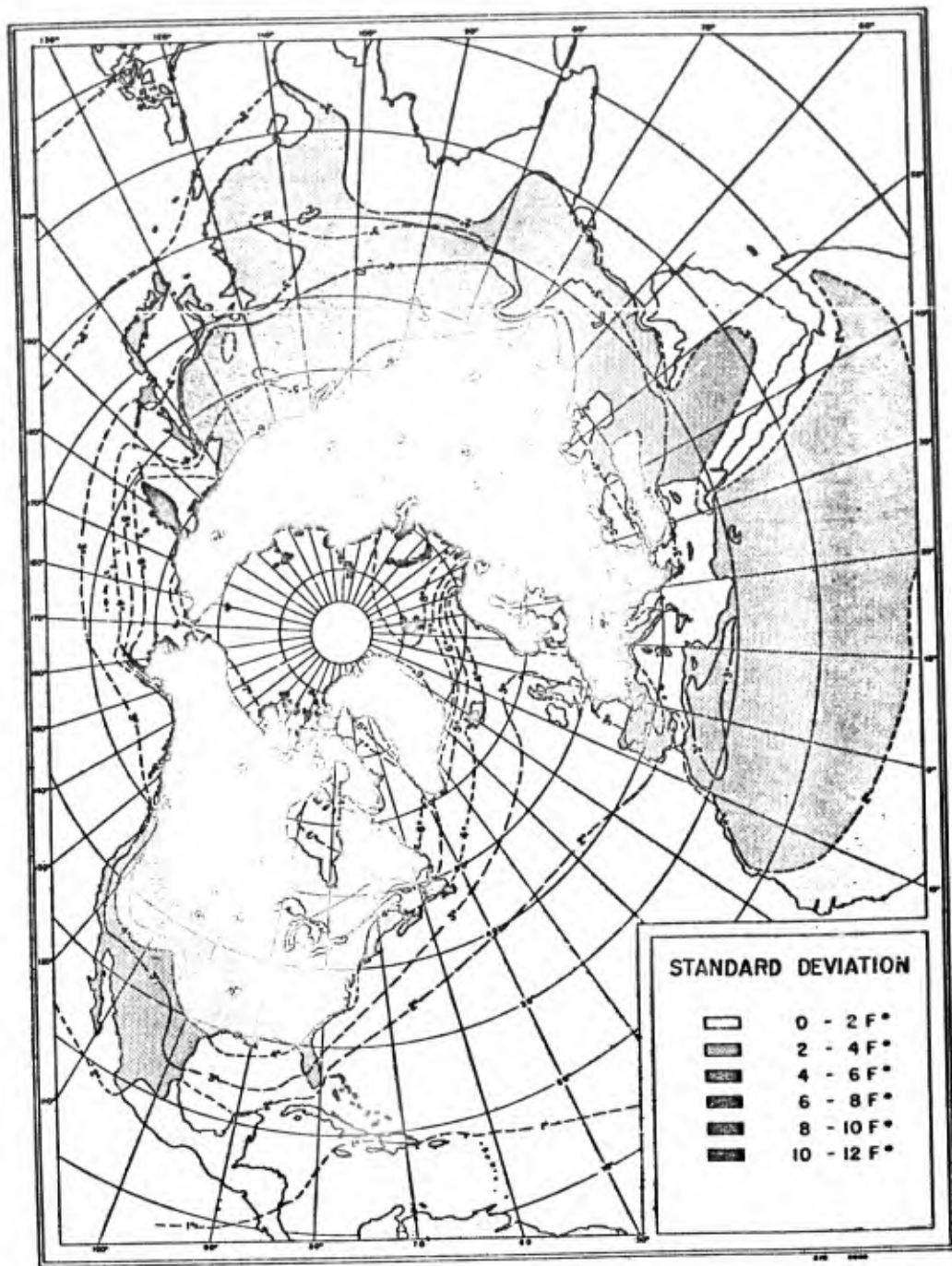


Figure 3. Temperature Variability, Northern Hemisphere, February.

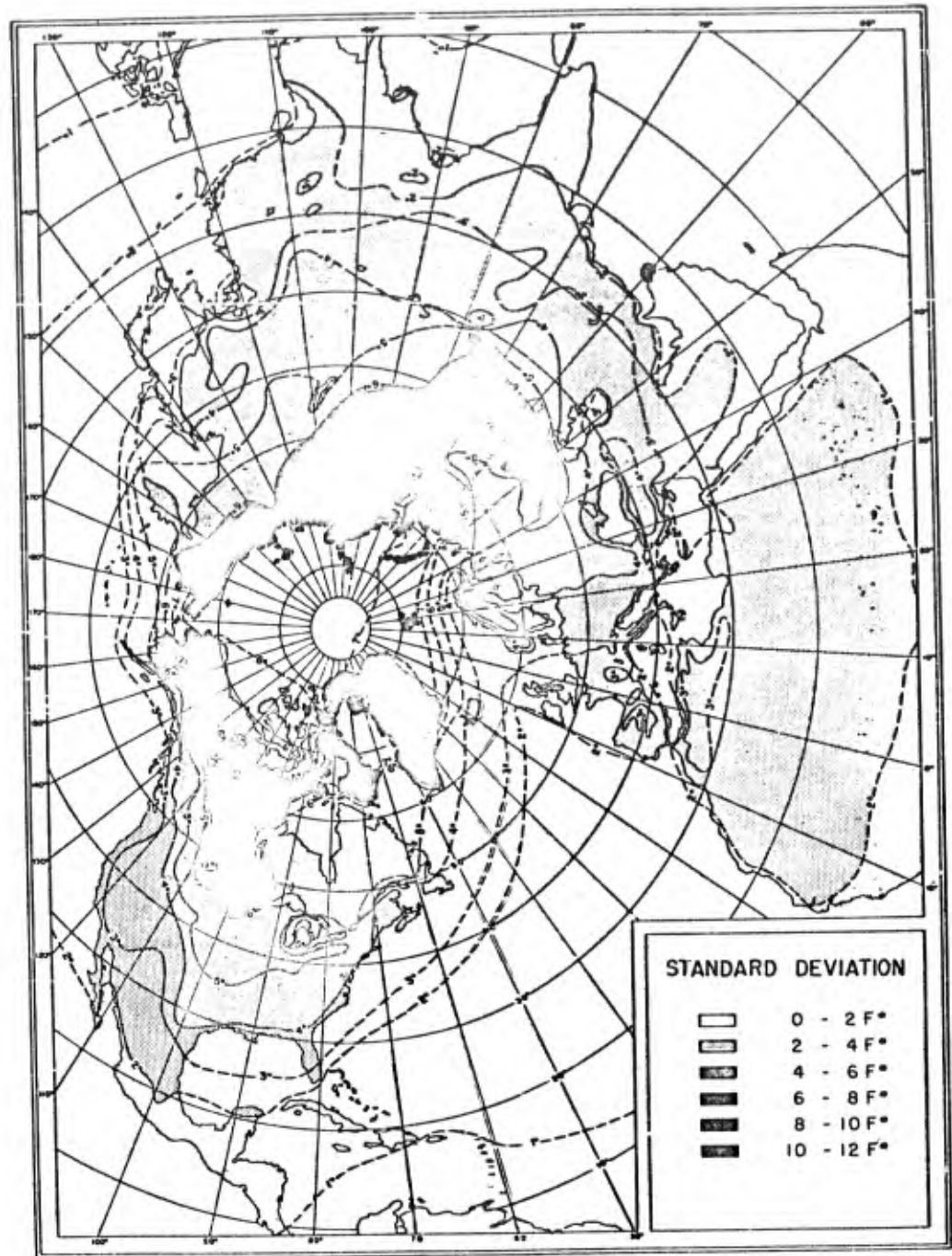


Figure 4. Temperature Variability, Northern Hemisphere, March.

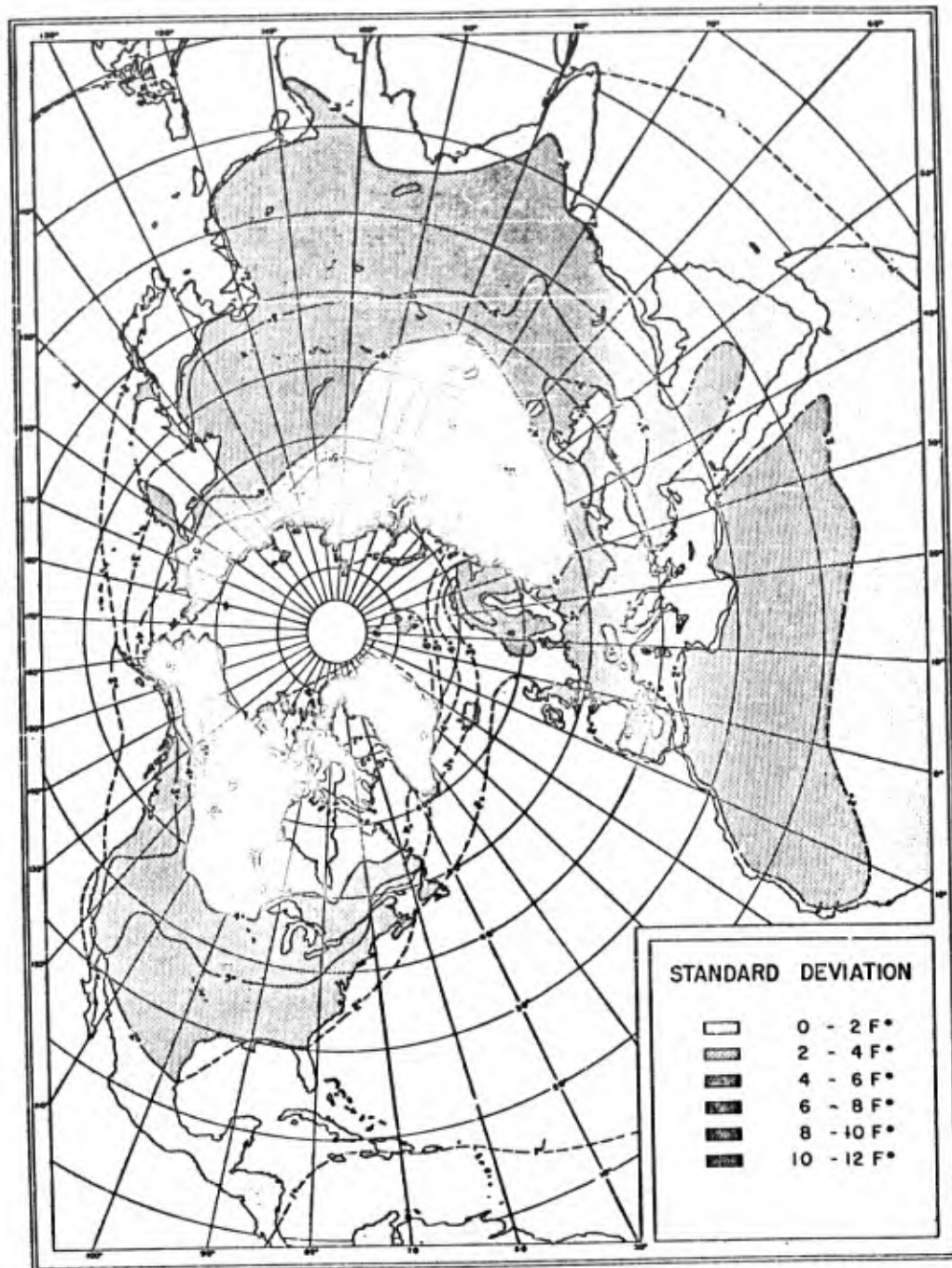


Figure 5. Temperature Variability, Northern Hemisphere, April.

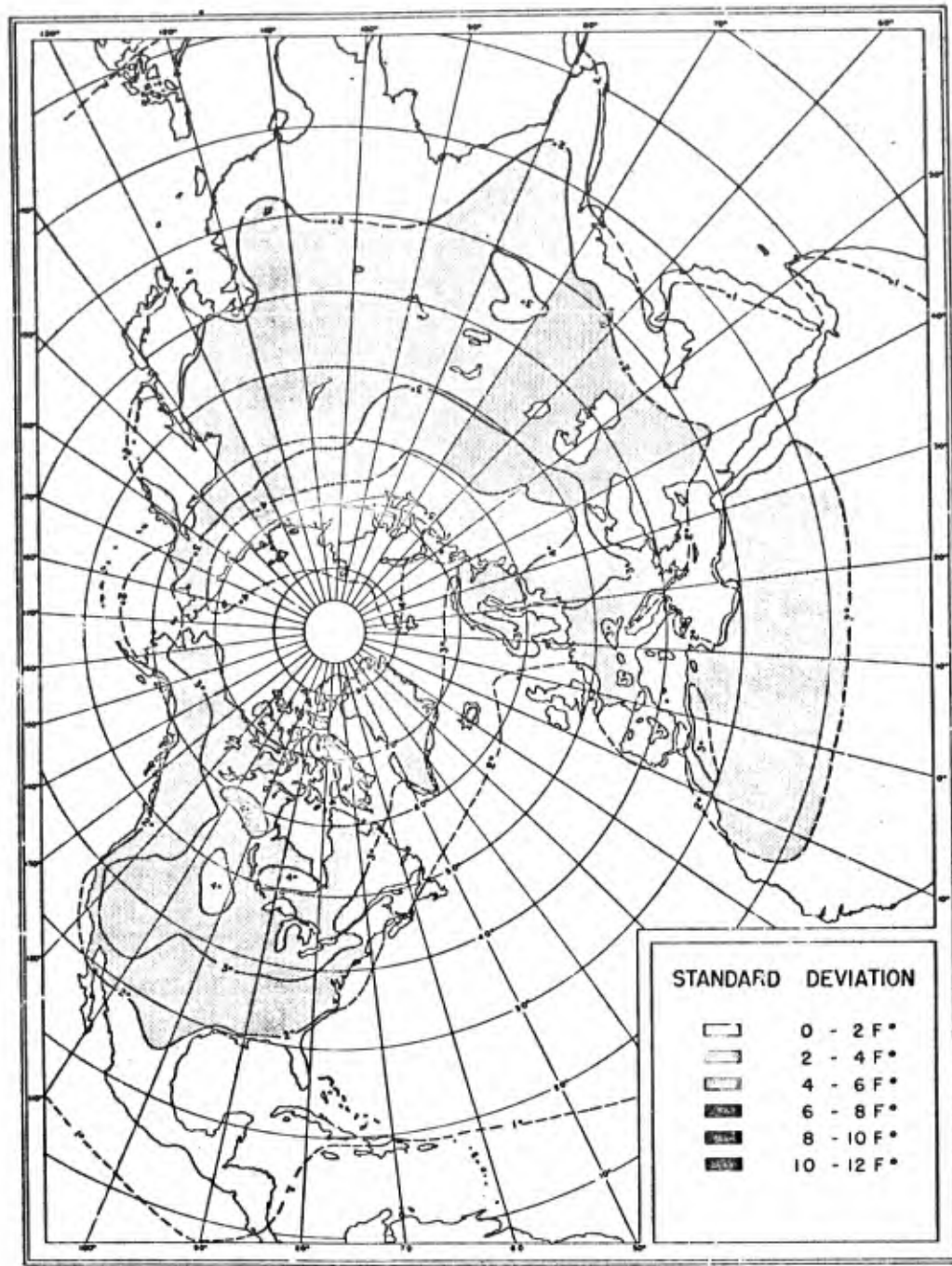


Figure 6. Temperature Variability, Northern Hemisphere, May.

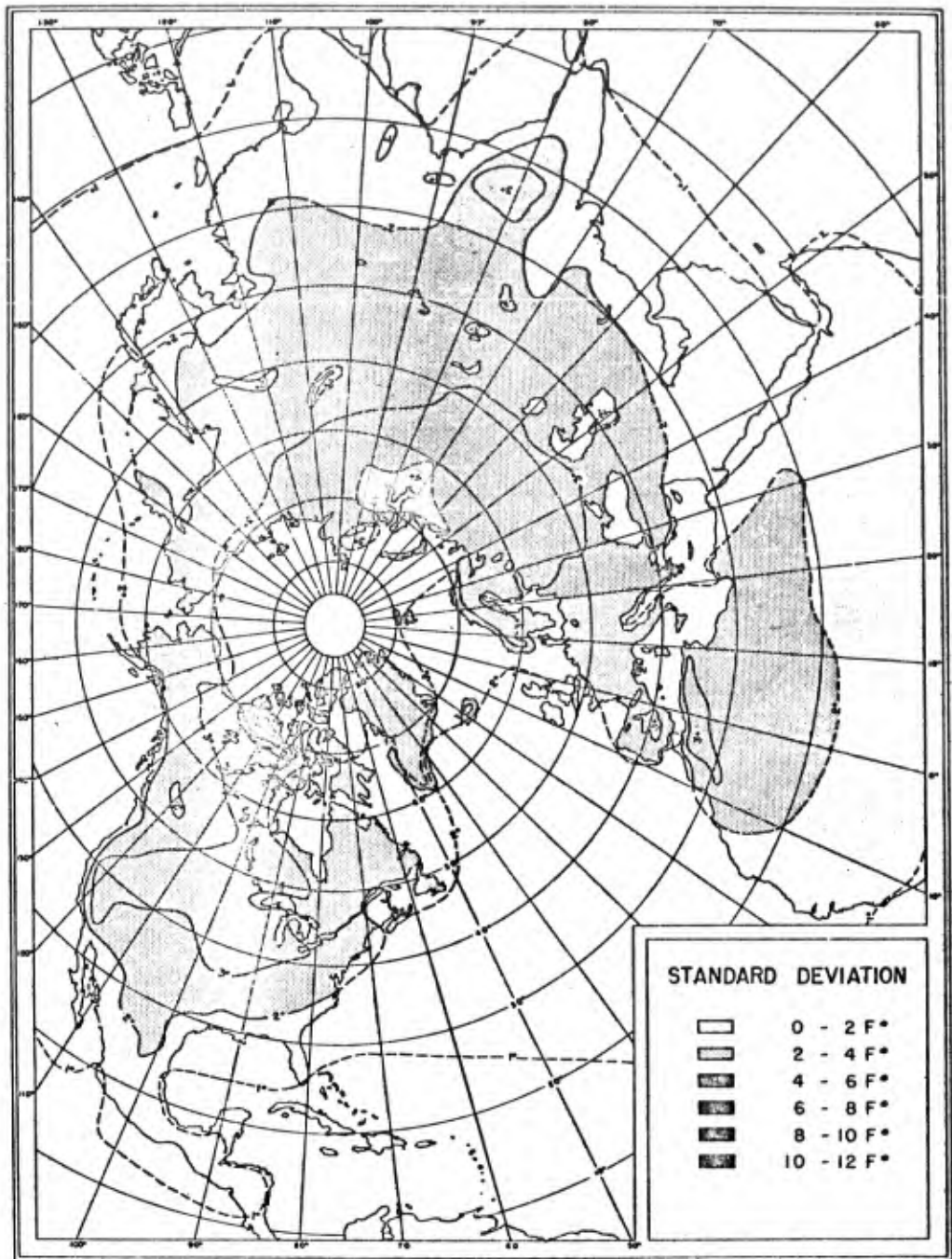


Figure 7. Temperature Variability, Northern Hemisphere, June.

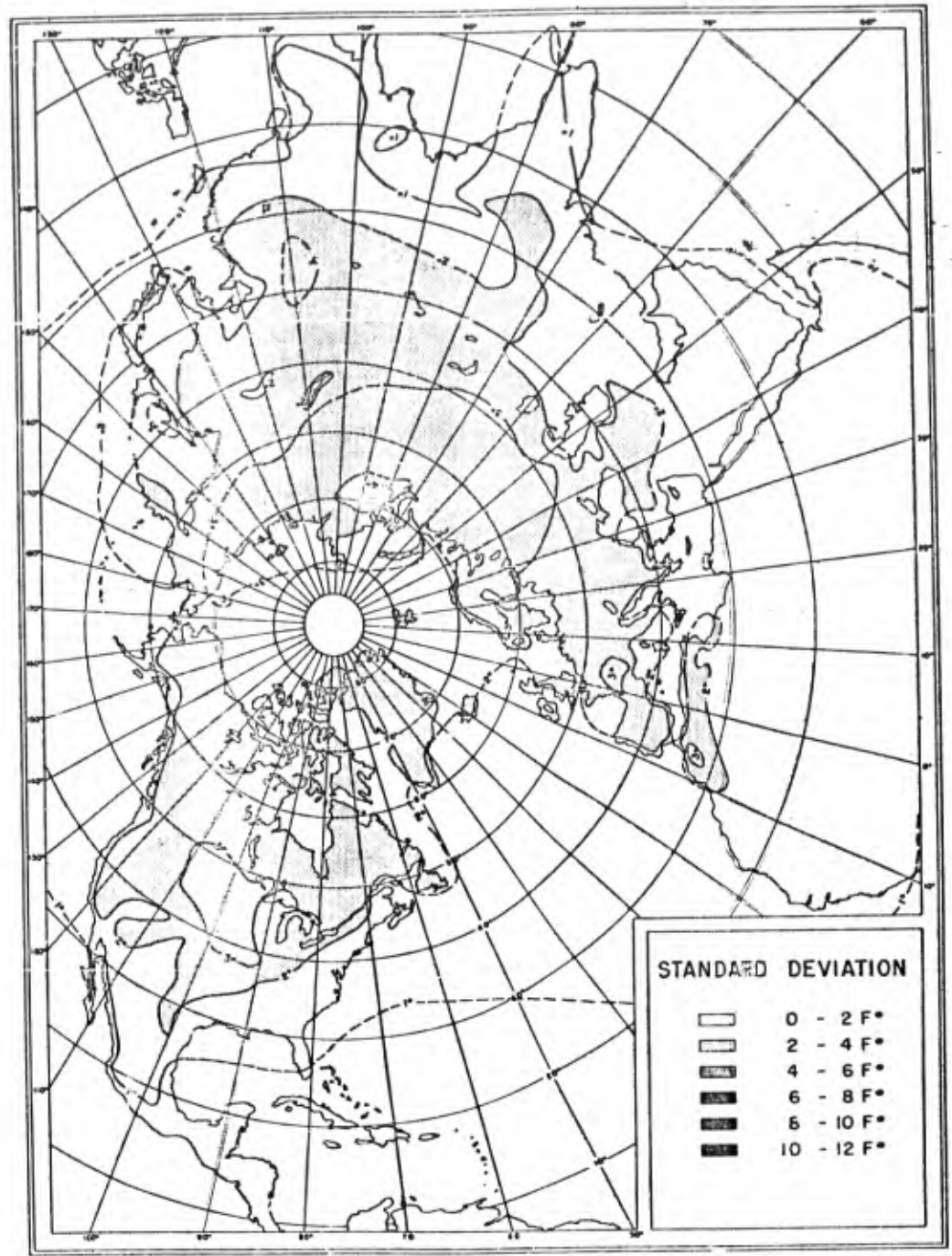


Figure 8. Temperature Variability, Northern Hemisphere, July.

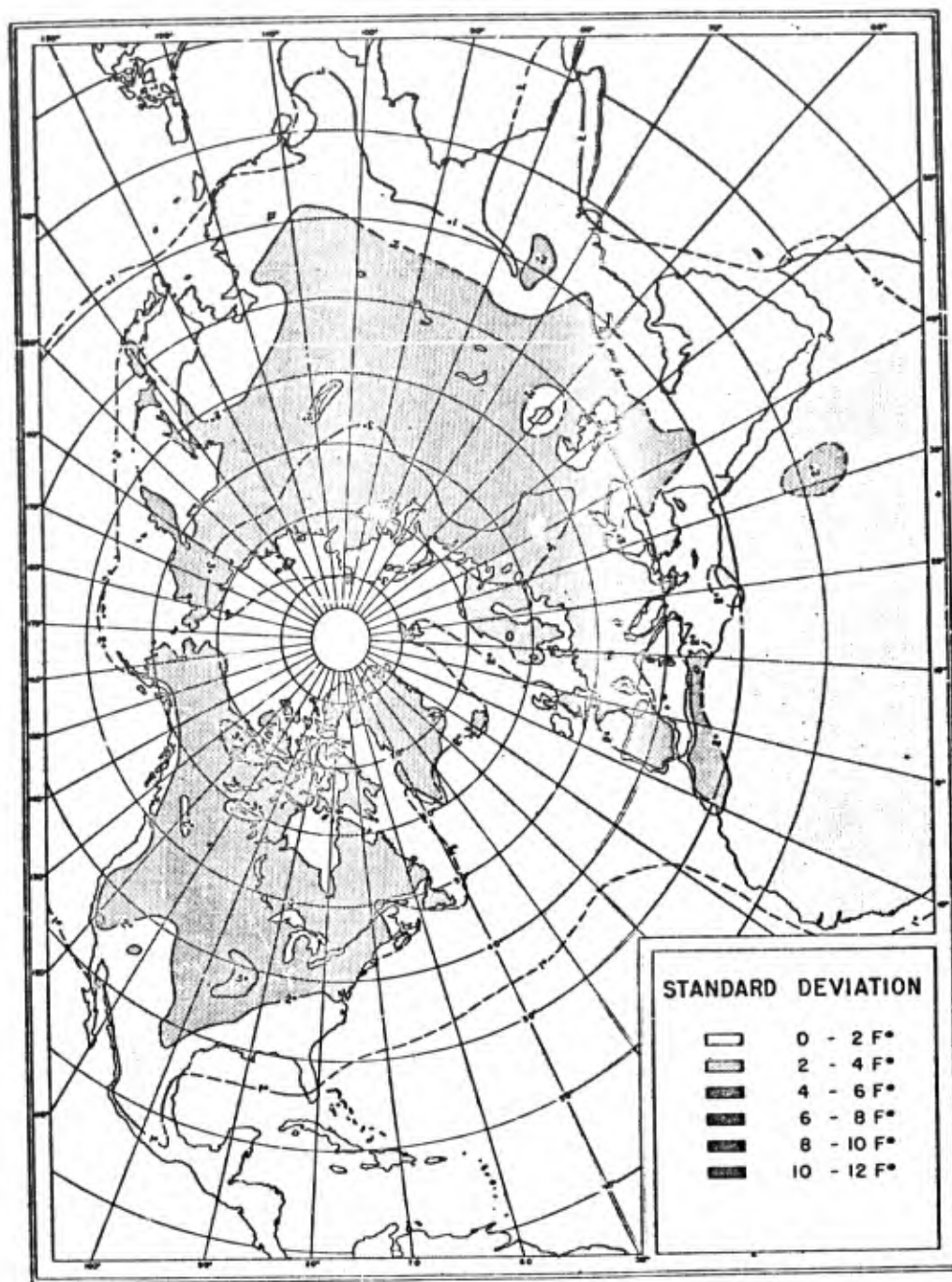


Figure 9. Temperature Variability, Northern Hemisphere, August.

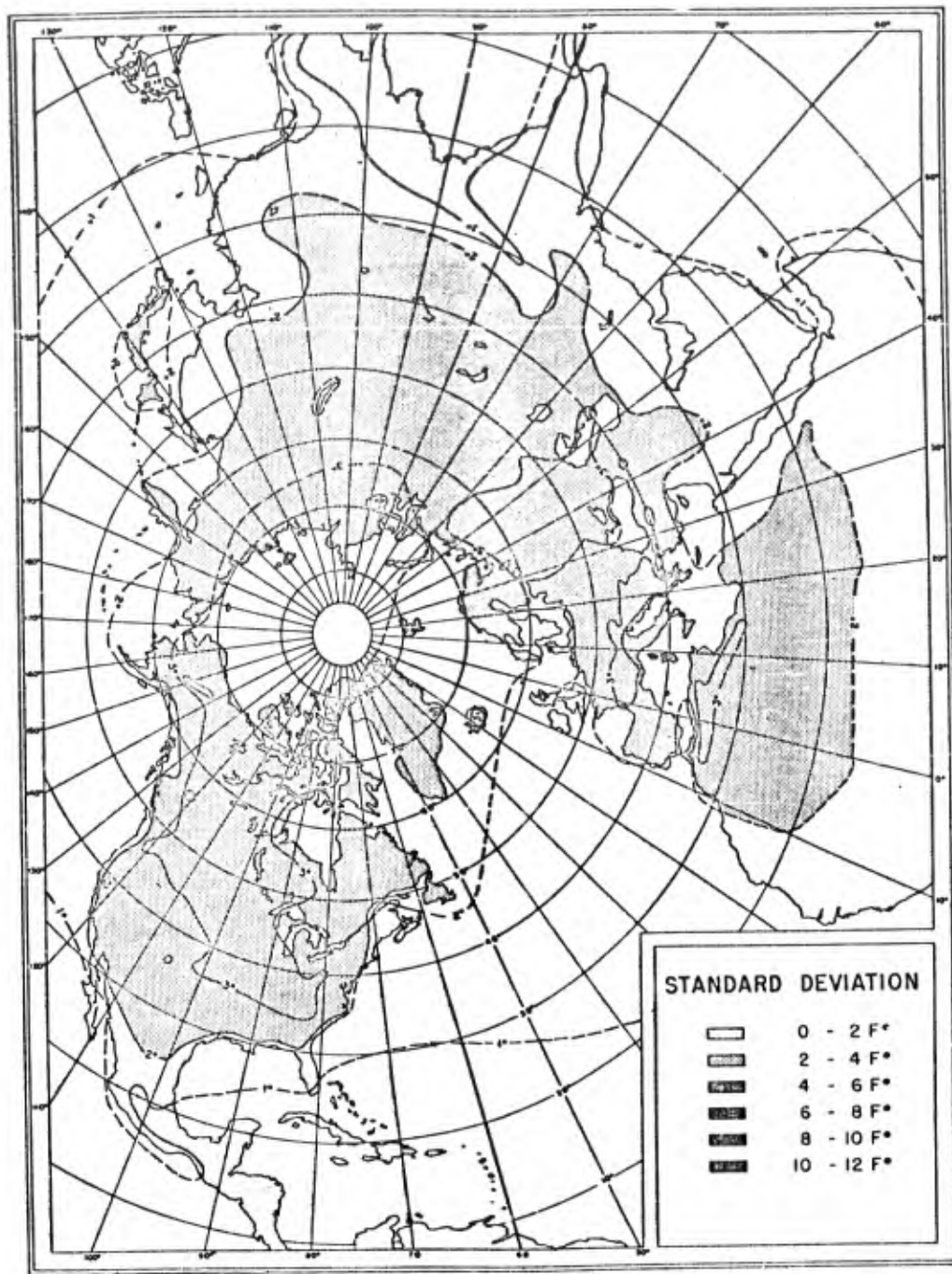


Figure 10. Temperature Variability, Northern Hemisphere, September.

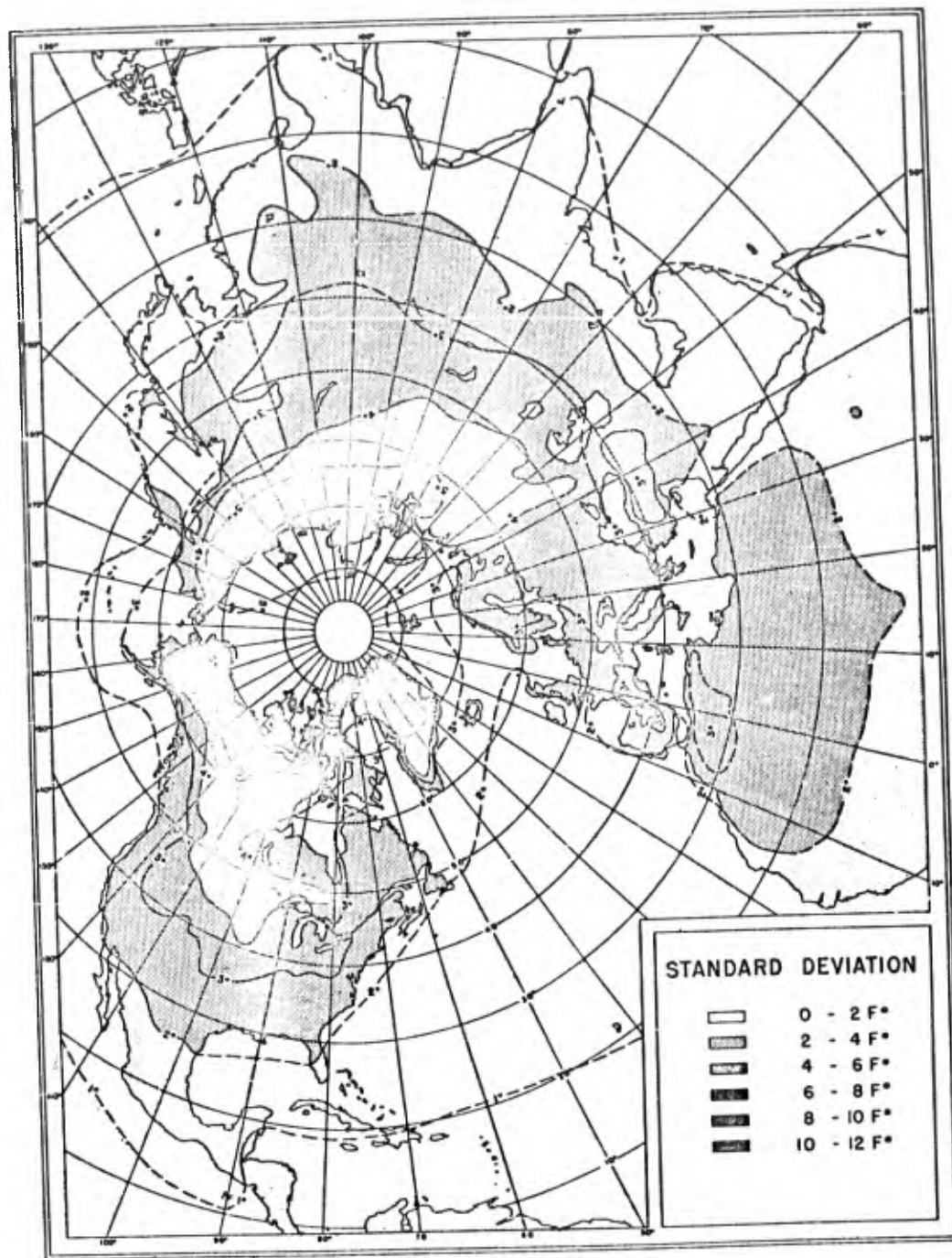


Figure 11. Temperature Variability, Northern Hemisphere, October.

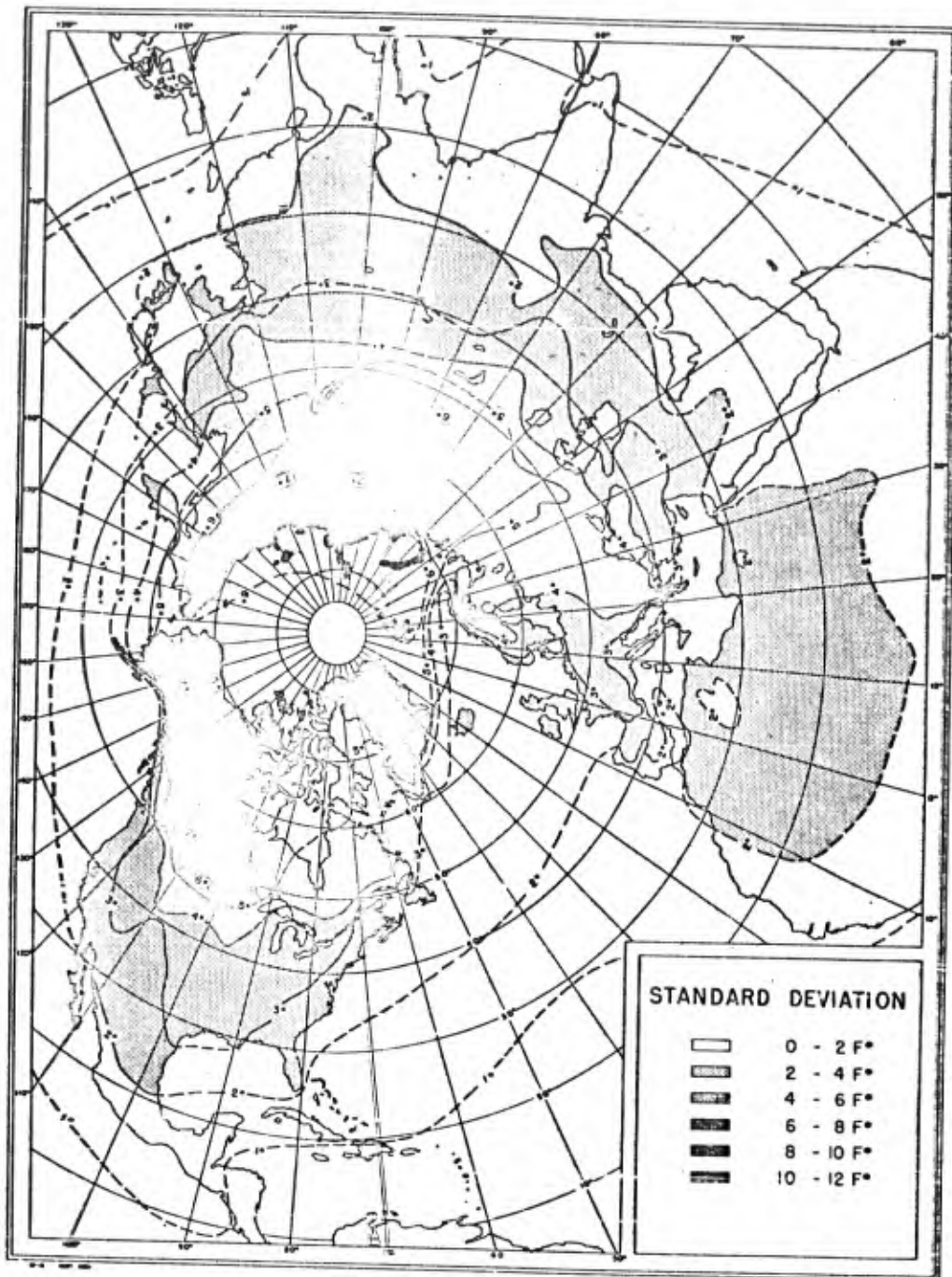


Figure 12. Temperature Variability, Northern Hemisphere, November.

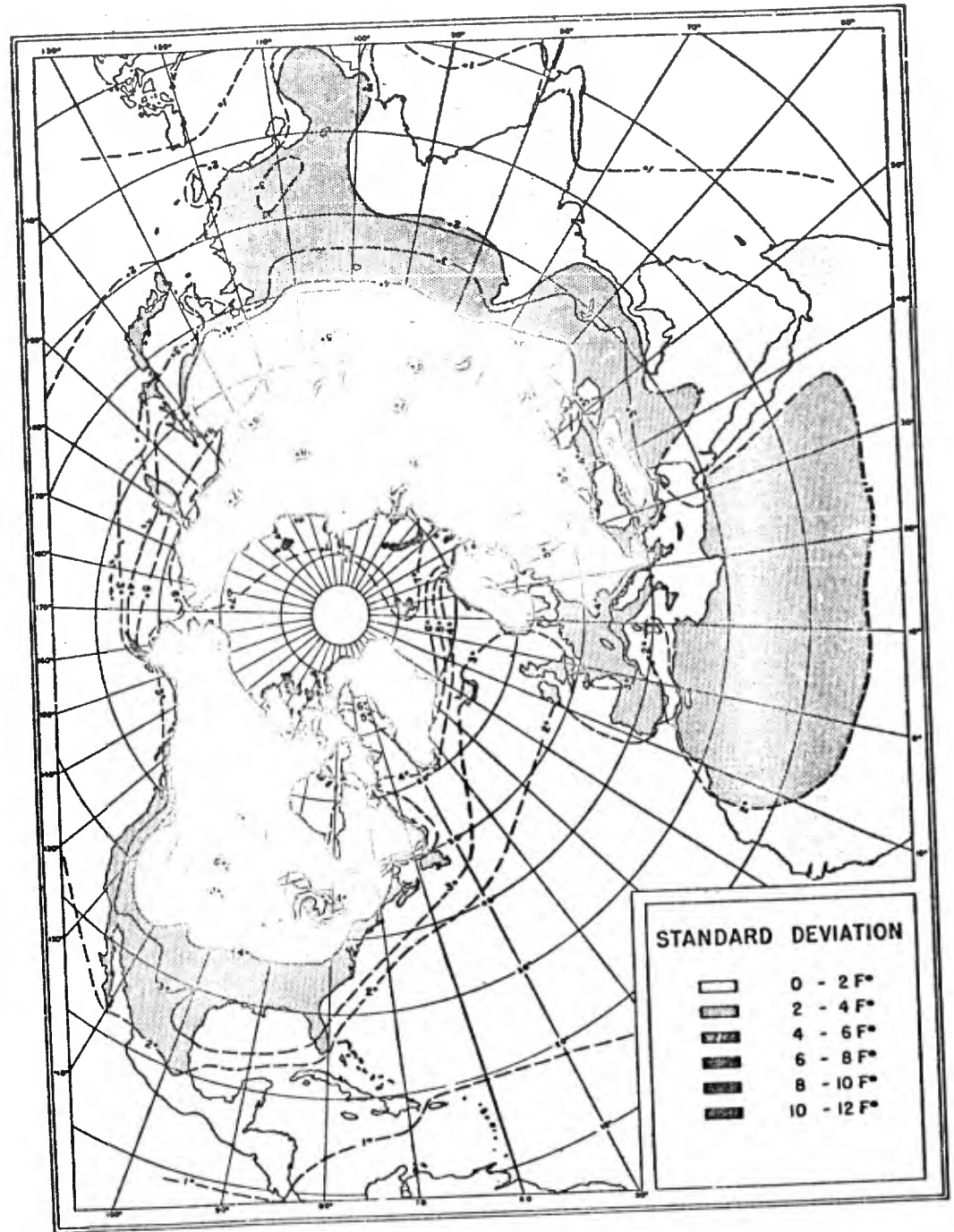


Figure 13. Temperature Variability, Northern Hemisphere, December.

## APPENDIX B

## NORTH AMERICA

<u>Station No.</u>	<u>Station Name</u>	<u>Elev. (Ft.)</u>	<u>Period of Record</u>	<u>No. of Years</u>
100	Point Barrow, Alaska	23	1921-1940	20
101	Pond Inlet, Canada	16	1921-1945*	22
102	Upernavik, Greenland	59	1887-1936	50
103	Nome, Alaska	23	1906-1947	42
104	Holy Cross, Alaska	50	1914-1945	32
105	Allakaket, Alaska	1,000	1923-1945	23
106	Tanana, Alaska	220	1903-1940	38
107	Anchorage, Alaska	118	1915-1945	31
108	Fairbanks, Alaska	500	1904-1945	42
109	Valdez, Alaska	25	1909-1940*	24
110	Fort Yukon, Alaska	400	1920-1945	26
111	Eagle, Alaska	834	1906-1933	28
112	Kennicott, Alaska	2,003	1920-1945	26
113	Dawson, Canada	1,062	1898-1945	48
114	Aklavik, Canada	30	1931-1940	10**
115	Fort Good Hope, Canada	214	1908-1945	38
116	Fort Simpson, Canada	415	1897-1945*	47
117	Hay River, Canada	529	1896-1945	50
118	Coppermine, Canada	13	1930-1945	16
119	Chesterfield Inlet, Canada	13	1921-1945	25
120	Nottingham Island, Canada	54	1931-1940	10**
121	Lake Harbour, Canada	54	1909-1945*	29
122	Resolution Island, Canada	127	1931-1940	10**
123	Godthaab, Greenland	66	1887-1936	50
124	Jakobshavn, Greenland	102	1892-1940	49
125	Ivigtut, Greenland	82	1892-1940	49
126	Nanortalik, Greenland	23	1916-1941	26
127	Angmagssalik, Greenland	95	1896-1940	45
128	Dutch Harbor, Alaska	50	1905-1940	36
129	Juneau, Alaska	80	1900-1945*	45
130	Atlin, Canada	2,240	1905-1945	41
131	Prince Rupert, Canada	170	1913-1945	33
132	Bella Coola, Canada	10	1896-1945*	49
133	New Hazelton, Canada	1,150	1914-1945	32
134	Prince George, Canada	2,218	1912-1945	34

\* not all years used

\*\* not all months used

<u>Station No.</u>	<u>Station Name</u>	<u>Elev. (Ft.)</u>	<u>Period of Record</u>	<u>No. of Years</u>
135	Barkerville, Canada	4,180	1890-1940*	50
136	Kamloops, Canada	1,193	1896-1945	50
137	Fort St. John, Canada	2,275	1910-1945*	25
138	Beaverlodge, Canada	2,500	1913-1945	33
139	Jasper, Canada	3,480	1914-1945	32
140	Banff, Canada	4,521	1896-1945	50
141	Calgary, Canada	3,540	1891-1940	50
142	Fort Vermilion, Canada	950	1908-1945	38
143	Edmonton, Canada	2,219	1891-1940	50
144	Fort Chipewyan, Canada	656	1896-1945	50
145	McMurray, Canada	840	1908-1945*	35
146	Fond-du-Lac, Canada	700	1905-1938*	33
147	Prince Albert, Canada	1,414	1896-1945	50
148	Regina, Canada	1,884	1896-1945	50
149	The Pas, Canada	894	1910-1945	36
150	Sioux Lookout, Canada	1,227	1914-1945	32
151	Fort Hope, Canada	1,100	1898-1922	25
152	Moose Factory, Canada	34	1896-1945	50
153	Port Harrison, Canada	66	1921-1945*	24
154	Mistassini Post, Canada	1,255	1915-1940	26
155	Harrington Harbour, Canada	25	1912-1945	34
156	Belle Isle, Canada	426	1912-1945*	27
157	Victoria, Canada	230	1891-1940	50
158	Vancouver, Canada	45	1898-1945	48
159	Seattle, U.S.A.	14	1896-1945	50
160	Salem, U.S.A.	130	1896-1945	50
161	Eugene, U.S.A.	449	1897-1947*	50
162	Medford, U.S.A.	1,425	1911-1946	36
163	Eureka, U.S.A.	64	1890-1939	50
164	Redding, U.S.A.	590	1894-1943	50
165	Yakima, U.S.A.	1,070	1909-1938	30
166	Spokane, U.S.A.	1,943	1896-1945	50
167	Baker, U.S.A.	3,471	1896-1945	50
168	Winnemucca, U.S.A.	4,344	1896-1945	50
169	Boise, U.S.A.	2,842	1895-1936	42

\* not all years used

<u>Station No.</u>	<u>Station Name</u>	<u>Elev. (Ft.)</u>	<u>Period of Record</u>	<u>No. of Years</u>
170	Cranbrook, Canada	3,013	1901-1945*	42
171	Missoula, U.S.A.	3,225	1896-1945	50
172	Butte, U.S.A.	5,530	1896-1945	50
173	Pocatello, U.S.A.	4,477	1899-1946	48
174	Salt Lake City, U.S.A.	4,222	1896-1945	50
175	Lethbridge, Canada	3,018	1908-1945*	37
176	Great Falls, U.S.A.	3,654	1896-1945	50
177	Helena, U.S.A.	3,893	1896-1945	50
178	Havre, U.S.A.	2,505	1896-1945	50
179	Lander, U.S.A.	5,372	1896-1945	50
180	Sheridan, U.S.A.	3,912	1896-1945	50
181	Williston, U.S.A.	1,875	1890-1939	50
182	Rapid City, U.S.A.	3,251	1896-1945	50
183	Cheyenne, U.S.A.	6,023	1896-1945	50
184	Bismarck, U.S.A.	1,674	1896-1945	50
185	Valentine, U.S.A.	2,593	1895-1944	50
186	North Platte, U.S.A.	2,841	1896-1945	50
187	Winnipeg, Canada	785	1891-1940	50
188	Devils Lake, U.S.A.	1,473	1905-1945	41
189	Lincoln, U.S.A.	1,189	1896-1945	50
190	Duluth, U.S.A.	1,133	1896-1945	50
191	Minneapolis, U.S.A.	913	1896-1945	50
192	Des Moines, U.S.A.	861	1896-1945	50
193	Burlington, U.S.A.	694	1898-1947	50
194	Springfield, U.S.A.	644	1896-1945	50
195	Marquette, U.S.A.	734	1898-1947	50
196	Green Bay, U.S.A.	617	1898-1947	50
197	Milwaukee, U.S.A.	681	1896-1945	50
198	Chicago, U.S.A.	824	1896-1945	50
199	Kapuskasing, Canada	752	1918-1945	28
200	Sault Sainte Marie, U.S.A.	721	1896-1945	50
201	Alpena, U.S.A.	609	1896-1945	50
202	Grand Rapids, U.S.A.	707	1898-1947	50
203	Lansing, U.S.A.	863	1898-1947	50
204	Detroit, U.S.A.	730	1896-1945	50

\* not all years used

<u>Station No.</u>	<u>Station Name</u>	<u>Elev. (Ft.)</u>	<u>Period of Record</u>	<u>No. of Years</u>
205	Fort Wayne, U.S.A.	856	1911-1943	33
206	Cleveland, U.S.A.	787	1896-1945	50
207	Amos, Canada	990	1913-1945	33
208	Haileybury, Canada	707	1896-1945*	43
209	Toronto, Canada	379	1891-1940	50
210	Buffalo, U.S.A.	600	1898-1947	50
211	Pittsburgh, U.S.A.	842	1896-1945	50
212	Ottawa, Canada	339	1896-1945	50
213	Syracuse, U.S.A.	419	1902-1947	46
214	Harrisburg, U.S.A.	361	1896-1945	50
215	Binghanton, U.S.A.	871	1896-1945	50
216	Philadelphia, U.S.A.	156	1896-1945	50
217	Quebec, Canada	296	1896-1945	50
218	Burlington, U.S.A.	404	1896-1945	50
219	Albany, U.S.A.	277	1896-1945	50
220	New York, U.S.A.	10	1896-1945	50
221	Concord, U.S.A.	350	1896-1945	50
222	Boston, U.S.A.	124	1896-1945	50
223	Hartford, U.S.A.	15	1905-1947	43
224	Father Point, Canada	20	1896-1945	50
225	Saint John, Canada	119	1896-1945	50
226	South West Point, Canada	24	1891-1940	50
227	Halifax, Canada	83	1896-1945	50
228	Charlottetown, Canada	45	1891-1940	50
229	Cape Race, Canada	99	1920-1945	26
230	San Francisco, U.S.A.	206	1896-1945	50
231	Sacramento, U.S.A.	71	1896-1945	50
232	Reno, U.S.A.	4,397	1896-1945	50
233	Bakersfield, U.S.A.	404	1896-1945	50
234	Los Angeles, U.S.A.	361	1896-1945	50
235	Modena, U.S.A.	5,479	1901-1939	39
236	Flagstaff, U.S.A.	6,907	1896-1945	50
237	Phoenix, U.S.A.	1,108	1896-1945	50
238	Grand Junction, U.S.A.	4,602	1896-1945	50
239	Santa Fe, U.S.A.	7,013	1896-1945	50

\* not all years used

<u>Station No.</u>	<u>Station Name</u>	<u>Elev. (Ft.)</u>	<u>Period of Record</u>	<u>No. of Years</u>
240	Albuquerque, U.S.A.	5,310	1896-1945	50
241	Roswell, U.S.A.	3,578	1896-1945	50
242	El Paso, U.S.A.	3,762	1896-1945	50
243	Denver, U.S.A.	5,292	1896-1945	50
244	Pueblo, U.S.A.	4,799	1896-1945	50
245	Amarillo, U.S.A.	3,676	1896-1945	50
246	Abilene, U.S.A.	1,738	1891-1940	50
247	Wichita, U.S.A.	1,377	1896-1945	50
248	Tulsa, U.S.A.	700	1905-1945	41
249	Oklahoma City, U.S.A.	1,247	1896-1945	50
250	Fort Worth, U.S.A.	670	1896-1945	50
251	Palestine, U.S.A.	510	1896-1945	50
252	Kansas City, U.S.A.	741	1896-1945	50
253	Springfield, U.S.A.	1,302	1896-1945	50
254	Little Rock, U.S.A.	257	1896-1945	50
255	Shreveport, U.S.A.	249	1396-1945	50
256	Saint Louis, U.S.A.	567	1896-1945	50
257	Cairo, U.S.A.	356	1896-1945	50
258	Memphis, U.S.A.	271	1891-1940	50
259	Meridian, U.S.A.	375	1896-1945	50
260	Mobile, U.S.A.	84	1896-1945	50
261	Indianapolis, U.S.A.	822	1896-1945	50
262	Evansville, U.S.A.	431	1897-1946	50
263	Nashville, U.S.A.	654	1891-1940	50
264	Birmingham, U.S.A.	701	1896-1945	50
265	Montgomery, U.S.A.	240	1896-1945	50
266	Tallahassee, U.S.A.	68	1895-1944	50**
267	Columbus, U.S.A.	918	1896-1945	50
268	Cincinnati, U.S.A.	761	1896-1945	50**
269	Louisville, U.S.A.	525	1896-1945	50
270	Chattanooga, U.S.A.	762	1896-1945	50
271	Atlanta, U.S.A.	975	1896-1945	50
272	Jacksonville, U.S.A.	18	1896-1945	50**
273	Elkins, U.S.A.	1,963	1899-1943	45
274	Charlotte, U.S.A.	779	1896-1945	50

\*\* not all months used

<u>Station No.</u>	<u>Station Name</u>	<u>Elev. (Ft.)</u>	<u>Period of Record</u>	<u>No. of Years</u>
275	Augusta, U.S.A.	180	1896-1945	50**
276	Richmond, U.S.A.	144	1896-1945	50
277	Columbia, U.S.A.	351	1896-1945	50
278	Charleston, U.S.A.	48	1896-1945	50
279	Hatteras, U.S.A.	11	1891-1940	50
280	Hamilton, Bermuda	151	1891-1940	50
281	Honolulu, T.H.I.#	38	1891-1940	50
282	Guaymas, Mexico	13	1922-1942*	18
283	Chihuahua, Mexico	4,669	1918-1942*	17
284	Mazatlán, Mexico	256	1921-1942	22
285	Ciudad Lerdo, Mexico	3,740	1924-1943*	18
286	Del Rio, U.S.A.	952	1906-1943	38
287	Monterrey, Mexico	1,732	1896-1939*	38
288	León, Mexico	5,935	1891-1942*	50
289	Guanajuato, Mexico	6,683	1916-1943*	26
290	San Antonio, U.S.A.	701	1896-1945	50
291	Brownsville, U.S.A.	38	1896-1945	50
292	Tampico, Mexico	59	1924-1943*	19
293	New Orleans, U.S.A.	51	1896-1945	50
294	Mérida, Mexico	72	1895-1942*	44
295	Havana, Cuba	79	1891-1940	50
296	Key West, U.S.A.	16	1896-1945	50
297	Miami, U.S.A.	83	1896-1945	50
298	Colima, Mexico	1,621	1918-1942*	24
299	Mexico, Mexico	7,411	1886-1940*	50
300	Puebla, Mexico	7,054	1884-1942*	52
301	Oaxaca, Mexico	5,128	1922-1942	21
302	Salina Cruz, Mexico	184	1910-1942*	29
303	Veracruz, Mexico	52	1917-1943*	22
304	Port-au-Prince, Haiti	121	1891-1940	50
305	San Juan, Puerto Rico	82	1898-1940	43

\* not all years used  
\*\* not all months used  
# not shown on map

## EUROPE

Station No.	Station Name	Elev. (Ft.)	Period of Record	No. of Years
400	Green Harbour, Spitzbergen	35	1911-1930	20
401	Vardø, Norway	46	1904-1947	44
402	Akurevri, Iceland	23	1924-1943	20
403	Grímsstadhir, Iceland	1,263	1924-1943	20
404	Bodø, Norway	67	1891-1940	50
405	Tromsø, Norway	147	1904-1947	44
406	Stensele, Sweden	1,076	1901-1948	48**
407	Gällivare, Sweden	1,198	1904-1948	45**
408	Kiruna, Sweden	1,657	1901-1948	48
409	Siččajavrre, Norway	1,312	1914-1947	34
410	Haparanda, Sweden	30	1891-1940	50
411	Oulu, Finland	33	1881-1936*	50
412	Karasjok, Norway	420	1904-1947	44
413	Inari, Finland	489	1907-1936*	25
414	Reykjavík, Iceland	16	1924-1943	20
415	Berufjördhur, Iceland	59	1890-1940	51
416	Bergen, Norway	57	1904-1947	44
417	Opstryn, Norway	673	1915-1947	33**
418	Dovre, Norway	2,113	1898-1947	50
419	Granheim, Norway	1,276	1898-1947	50
420	Lillehammer, Norway	741	1904-1947	44
421	Trondheim, Norway	194	1904-1947	44
422	Nordli, Norway	1,339	1922-1947	26
423	Storlien, Sweden	1,975	1901-1948	48
424	Kogens Grube, Norway	2,808	1896-1933	38
425	Roros, Norway	2,067	1904-1947	44
426	Särna, Sweden	1,512	1901-1940	40
427	Sveg, Sweden	1,191	1901-1948	48
428	Östersund, Sweden	1,083	1901-1948	48**
429	Falun, Sweden	400	1901-1948	48**
430	Härnösand, Sweden	29	1901-1948	48
431	Vaasa, Finland	33	1882-1936*	50
432	Tampere, Finland	276	1881-1936*	51
433	Helsinki, Finland	38	1891-1936	46
434	Sortavala, U.S.S.R.	52	1881-1931*	44

\* not all years used

\*\* not all months used

<u>Station No.</u>	<u>Station Name</u>	<u>Elev. (Ft.)</u>	<u>Period of Record</u>	<u>No. of Years</u>
435	Stornoway, Scotland	79	##	**
436	Oban, Scotland	229	1909-1948	40**
437	Paisley, Scotland	##	1911-1948*	36
438	Braemar, Scotland	1,119	1909-1948*	38
439	Banff, Scotland	##	1914-1948	35**
440	Aberdeen, Scotland	46	1891-1940	50
441	Dundee, Scotland	200	1906-1948*	41**
442	Svandalsflona, Norway	3,478	1922-1947	26
443	Dalen, Norway	338	1904-1947	44
444	Mandal, Norway	43	1904-1947	44
445	Borbjerg, Denmark	135	1895-1947*	48
446	Grinsted Plantage, Denmark	125	1895-1947*	48
447	Oslo, Norway	82	1891-1940	50
448	Gaardbo Gaard, Denmark	26	1895-1942	48
449	Odense, Denmark	49	1895-1947*	48
450	Laesø, Denmark	13	1895-1947*	48
451	Göteborg, Sweden	54	1901-1948	48**
452	Copenhagen, Denmark	16	1891-1940	50
453	Karlstad, Sweden	173	1901-1948	48**
454	Jönköping, Sweden	321	1901-1948	48
455	Kristianstad, Sweden	19	1901-1948	48
456	Uppsala, Sweden	79	1891-1940	50
457	Hangö, Sweden	23	1881-1936*	51
458	Riga, Latvia	43	1881-1930	50
459	Sovetsk, U.S.S.R.	36	1881-1930	50**
460	Valencia Island, Ireland	30	1893-1940	48
461	Armagh, Northern Ireland	203	1909-1948	40**
462	Birr Castle, Ireland	174	1909-1940	32**
463	Dublin, Ireland	154	1909-1937	29**
464	Falmouth, England	167	1900-1948	49**
465	Welshpool, Wales	254	1909-1948*	38**
466	Swansea, Wales	27	1905-1948*	41**
467	Hoylake, England	30	1905-1948	44**
468	Nottingham, England	82	1905-1948*	41
469	Bath, England	66	1905-1948*	41**

\* not all years used  
\*\* not all months used  
## data missing

Station No.	Station Name	Elev. (Ft.)	Period of Record	No. of Years
470	Southampton, England	52	1905-1948*	41**
471	Hull, England	13	1905-1948*	41
472	Greenwich, England	148	1891-1940	50
473	Dunkirk, France	23	1887-1934	48
474	Utrecht, Holland	10	1897-1944	48
475	Emden, Germany	20	1881-1930	50**
476	Kassel, Germany	669	1881-1930	50**
477	Frankfurt am Main, Germany	335	1889-1938	50
478	Hannover, Germany	197	1889-1938	50**
479	Kiel, Germany	155	1881-1930	50**
480	Berlin, Germany	115	1889-1938	50
481	Dresden, Germany	390	1881-1938	58**
482	Koslin, Germany	135	1881-1938	58**
483	Breslau, Germany	482	1889-1938	50
484	Kaliningrad, U.S.S.R.	10	1889-1938	50
485	Warsaw, Poland	397	1888-1937	50
486	Wilno, U.S.S.R.	446	1883-1937*	55
487	Brest, France	89	1887-1935	49
488	Nantes, France	135	1885-1934	50
489	Cherbourg, France	59	1897-1936	40
490	Moulins, France	732	1888-1934*	44
491	Paris, France	161	1885-1934	50
492	Besançon, France	1,020	1888-1934	47
493	Lyon, France	571	##	**
494	Grenoble, France	709	1888-1934*	41**
495	Stuttgart, Germany	883	1881-1930	50**
496	Zürich, Switzerland	1,617	1891-1940	50
497	Säntis, Switzerland	8,202	1883-1947	65
498	Zermatt, Switzerland	5,282	1898-1947	50
499	Great Saint Bernard Pass, Switzerland	8,130	1898-1947	50
500	Friedrichshafen, Germany	1,339	1881-1930	50**
501	Saint Gotthard Pass, Switzerland	6,873	1902-1947	46
502	Lugano, Switzerland	902	1898-1947	50**
503	Milan, Italy	483	1887-1936	50
504	Munich, Germany	1,736	1881-1930	50**

\* not all years used  
\*\* not all months used  
## data missing

Station No.	Station Name	Elev. (Ft.)	Period of Record	No. of Years
505	Liberec, Czechoslovakia	1,099	1915-1947*	30**
506	Salzburg, Austria	1,424	1895-1947*	51
507	Sonnblick, Austria	10,190	1888-1937	50
508	Venice, Italy	69	1911-1942	32
509	Vienna, Austria	663	1890-1939	50
510	Graz, Austria	1,129	1895-1947*	50
511	Klagenfurt, Austria	1,473	1895-1947*	51
512	Obir, Austria	6,706	1888-1937	50
513	Mašun, Yugoslavia	3,291	1889-1916	28
514	Pécs, Hungary	499	1888-1939*	47
515	Budapest, Hungary	371	1888-1939*	50
516	L'vov, U.S.S.R.	978	1889-1937	49
517	Debrecen, Hungary	423	1888-1939*	50
518	Szeged, Hungary	295	1888-1939*	50
519	Sibiu, Rumania	1,375	1890-1940*	50
520	Chernovtsy, U.S.S.R.	738	1880-1940*	56
521	Sulina, Rumania	7	1891-1940	50
522	Valladolid, Spain	2,346	1899-1947*	42
523	Burgos, Spain	2,822	1899-1947*	42
524	Pic du Midi d'ossau, France	9,380	##	##
525	Madrid, Spain	2,188	1881-1930	50
526	Bordeaux, France	243	1894-1936	43
527	Toulouse, France	636	1888-1936	49
528	Perpignan, France	105	1888-1936	49
529	Montagne de l'Aigoual, France	5,098	1900-1934	35
530	Marseille, France	246	1881-1930	50
531	Genoa, Italy	177	1911-1942	32
532	Sassari, Sardinia	735	1884-1930	47
533	Bologna, Italy	279	1911-1942	32
534	Florence, Italy	240	1911-1942	32
535	Rome, Italy	164	1881-1930	50
536	Naples, Italy	489	1901-1942	42
537	Lesina, Italy	66	1880-1918	39
538	Shkodër, Albania	30	1888-1915	28
539	Belgrade, Yugoslavia	453	1888-1930*	41

\* not all years used

\*\* not all months used

## data missing

<u>Station No.</u>	<u>Station Name</u>	<u>Elev. (Ft.)</u>	<u>Period of Record</u>	<u>No. of Years</u>
540	Sofia, Bulgaria	1,804	1909-1940*	29
541	Thessaloniki, Greece	7	1899-1937*	38
542	Pleven, Bulgaria	410	1899-1937*	38
543	Bucharest, Rumania	276	1891-1940	50
544	Lisbon, Portugal	335	1891-1940	50
545	Seville, Spain	98	1899-1949*	42
546	Gibraltar, Gibraltar	52	1890-1939	50
547	Ciudad Real, Spain	2,083	1904-1949*	38
548	Valencia, Spain	79	1899-1949*	42
549	Palermo, Sicily	236	##	##
550	Catania, Sicily	4	1892-1930	39**
551	Athens, Greece	351	1895-1930	36

\* not all years used  
 \*\* not all months used  
 ## data missing

## ASIA

Station No.	Station Name	Elev. (Ft.)	Period of Record	No. of Years
600	Malyye Karmakuly, U.S.S.R.	49	1896-1940*	41
601	Vaygach, U.S.S.R.	62	1921-1939	19
602	Dikson, U.S.S.R.	43	1921-1940	20
603	Archangel, U.S.S.R.	20	1891-1940*	44
604	Ust'-Tsil'ma, U.S.S.R.	82	1896-1940*	41
605	Oksino, U.S.S.R.	43	1899-1926	28
606	Berezovo, U.S.S.R.	131	1886-1940*	44
607	Salekhard, U.S.S.R.	79	1882-1915	34
608	Surgut, U.S.S.R.	131	1891-1940*	46
609	Dudinka, U.S.S.R.	66	1906-1925	20
610	Turukhansk, U.S.S.R.	131	1886-1940*	43
611	Olekminsk, U.S.S.R.	499	1901-1940*	30
612	Yakutsk, U.S.S.R.	322	1891-1940*	49
613	Verkhoyansk, U.S.S.R.	328	1885-1940*	49
614	Markovo, U.S.S.R.	85	1894-1919*	25
615	Anadyr', U.S.S.R.	75	1899-1935*	27
616	Minsk, U.S.S.R.	738	1889-1915	27
617	Leningrad, U.S.S.R.	20	1891-1940*	45
618	Moscow, U.S.S.R.	548	1891-1940*	45
619	Korenevo, U.S.S.R.	505	1891-1915	25
620	Kiev, U.S.S.R.	600	1881-1925	45
621	Khar'kov, U.S.S.R.	492	1892-1915	24
622	Voronezh, U.S.S.R.	400	1880-1928	49
623	Nikol'skoye, U.S.S.R.	630	1881-1930*	45
624	Zemetchino, U.S.S.R.	427	1888-1933	46
625	Ul'yanovsk, U.S.S.R.	554	1880-1915*	34
626	Kazan', U.S.S.R.	278	1891-1940*	45
627	Kirov, U.S.S.R.	594	1880-1915	36
628	Malouzensk, U.S.S.R.	128	1882-1931	50
629	Buguruslan, U.S.S.R.	230	1897-1936	40
630	Pery, U.S.S.R.	535	1886-1930	45
631	Chkalov, U.S.S.R.	374	1891-1940*	45
632	Sverdlovsk, U.S.S.R.	922	1891-1940*	45
633	Tobol'sk, U.S.S.R.	354	1889-1940*	45
634	Omsk, U.S.S.R.	289	1887-1940*	46

\* not all years used

Station No.	Station Name	Elev. (Ft.)	Period of Record	No. of Years
635	Akmolinsk, U.S.S.R.	1,138	1891-1940*	44
636	Tomsk, U.S.S.R.	399	1891-1940*	45
637	Barnaul, U.S.S.R.	517	1891-1940*	45
638	Minusinsk, U.S.S.R.	817	1891-1940*	45
639	Yeniseysk, U.S.S.R.	262	1886-1940*	50
640	Irkutsk, U.S.S.R.	1,532	1891-1940	50
641	Kirensk, U.S.S.R.	842	1892-1940*	47
642	Chita, U.S.S.R.	2,231	1890-1940*	47
643	Nerchinskiy Zavod, U.S.S.R.	2,034	1891-1940*	40
644	Blagoveshchensk, U.S.S.R.	459	1901-1940	40
645	Okhotsk, U.S.S.R.	20	1912-1940*	24
646	Nikolayevsk-na-Amure, U.S.S.R.	107	1891-1940*	45
647	Petropavlovsk, U.S.S.R.	335	1890-1940*	44
648	Edirne, Turkey	154	1927-1946*	19
649	Istanbul, Turkey	131	1927-1946*	19
650	Bursa, Turkey	394	1929-1946*	17
651	Odessa, U.S.S.R.	141	1881-1931*	50
652	Sinferopol', U.S.S.R.	732	1887-1915	29
653	Yalta, U.S.S.R.	13	1880-1915	36
654	Novorossiysk, U.S.S.R.	121	1891-1940*	44
655	Stavropol', U.S.S.R.	1,886	1880-1917	38
656	Batumi, U.S.S.R.	10	1882-1928	47
657	Kars, Turkey	5,742	1931-1946*	15
658	Tiflis, U.S.S.R.	1,325	1891-1940*	45
659	Stalingrad, U.S.S.R.	138	1891-1924	34
660	Astrakhan', U.S.S.R.	-45	1891-1940*	45
661	Baku, U.S.S.R.	-52	1880-1917	38
662	Gur'yev, U.S.S.R.	-72	1881-1915*	33
663	Fort Shevchenko, U.S.S.R.	-79	1891-1940*	45
664	Krasnovodsk, U.S.S.R.	-49	1891-1940*	44
665	Turtkul', U.S.S.R.	308	1880-1915	36
666	Kazalinsk, U.S.S.R.	207	1886-1940*	50
667	Turgay, U.S.S.R.	407	1900-1940*	30
668	Tashkent, U.S.S.R.	1,569	1891-1940*	45
669	Alma-Ata, U.S.S.R.	2,782	1891-1940*	45

\* not all years used

Station No.	Station Name	Elev. (Ft.)	Period of Record	No. of Years
670	Naryn, U.S.S.R.	6,713	1885-1940*	51
671	Kuei-sui, China	3,396	1915-1921	7
672	Lu-pin, China	2,134	1909-1928	20
673	Hailar, China	1,997	1909-1928	20
674	Ch'i-ch'i-ha-erh, China	490	1909-1928	20
675	Huai-te, China	699	1915-1935	21
676	Mukden, China	141	1906-1935*	24
677	Ying-K'au, China	10	1907-1932	26
678	Harbin, China	505	1909-1928	20
679	I-lan, China	328	1914-1935	22
680	Kirin, China	689	1916-1928	13
681	Tyokotin, Korea	1,027	1909-1928	20
682	Söngjin, Korea	13	1906-1936	31
683	Vladivostok, U.S.S.R.	446	1891-1940*	45
684	Shikuka, Japan	13	1908-1932	25
685	Ochiai, Japan	22	1908-1936	29
686	Maoka, Japan	89	1908-1932	25
687	Asahigawa, Japan	371	1888-1932*	44
688	Sapporo, Japan	59	1885-1932*	47
689	Nemuro, Japan	89	1886-1935	50
690	Aomori, Japan	14	1885-1932*	47
691	Izmir, Turkey	240	1927-1946*	19
692	Ankara, Turkey	2,910	1926-1946*	20
693	Konya, Turkey	3,363	1929-1946*	17
694	Isparta, Turkey	3,346	1930-1946*	16
695	Adana, Turkey	82	1930-1946*	16
696	Beirut, Lebanon	111	1891-1940	50
697	Baghdad, Iraq	125	1895-1940*	37
698	Lenkoran', U.S.S.R.	-62	1882-1927*	44
699	Teheran, Iran	4,002	1895-1935*	39
700	Isfahan, Iran	5,817	1895-1939*	43
701	Meshed, Iran	3,104	1905-1940*	35
702	Quetta, Pakistan	5,490	1891-1940	50
703	Kābul, Afghanistan	5,895	1895-1919	25
704	Peshāwar, Pakistan	1,110	1895-1939	45

\* not all years used

<u>Station No.</u>	<u>Station Name</u>	<u>Elev. (Ft.)</u>	<u>Period of Record</u>	<u>No. of Years</u>
705	Multān, Pakistan	420	1895-1938*	42
706	Kashgar, China	4,255	1895-1945*	51
707	Gilgit, Jammu and Kashmir	4,890	1895-1939	45
708	Skardu, Jammu and Kashmir	7,505	1896-1939	44
709	Srinagar, Jammu and Kashmir	5,204	1895-1939	45
710	Leh, Jammu and Kashmir	11,503	1891-1940	50
711	Lahore, Pakistan	702	1891-1940	50
712	Simla, India	7,232	1891-1940	50
713	Tsinan, China	177	1919-1935	17**
714	Sian, China	1,198	1921-1935	15
715	Ch'ing-yūan, China	73	1913-1935	23
716	T'ai-yūan, China	2,641	1916-1935	20
717	Hankow, China	85	1906-1938	33
718	Peiping, China	140	1910-1935*	24
719	Nanking, China	223	1905-1935	31
720	Dairen, China	315	1907-1932	26
721	Tsingtao, China	258	1900-1935*	34
722	Shanghai, China	23	1891-1940	50
723	Yongamp'o, Korea	17	1904-1935	32
724	Inch'ŏn, Korea	222	1905-1936	32
725	Mokp'o, Korea	108	1904-1935	32
726	Pusan, Korea	44	1904-1935	32
727	Nagasaki, Japan	436	1886-1935	50
728	Miyazaki, Japan	28	1885-1932*	47
729	Okayama, Japan	31	1891-1932*	41**
730	Kōchi, Japan	138	1885-1932*	47
731	Kyōto, Japan	161	1886-1935	50
732	Ōsaka, Japan	26	1885-1932*	47**
733	Kanazawa, Japan	94	1885-1932*	47
734	Gifu, Japan	47	1885-1932*	47
735	Hamamatsu, Japan	98	1885-1932*	47
736	Akita, Japan	32	1885-1932*	47
737	Miyako, Japan	98	1886-1935	50
738	Yamagata, Japan	510	1889-1932*	43
739	Tokyo, Japan	70	1886-1935	50

\* not all years used  
\*\* not all months used

Station No.	Station Name	Elev. (Ft.)	Period of Record	No. of Years
740	Aṭ Ṭūr, Egypt	6	1914-1932	19**
741	Bushire, Iran	14	1891-1940	50
742	Jāsk, Iran	13	1893-1940	48
743	Kalāt, Pakistan	6,616	1895-1940*	34
744	Hyderābād, Pakistan	96	1881-1930	50
745	Karāchi, Pakistan	13	1881-1940	60
746	Bikaner, India	771	1895-1938*	42
747	Jodhpur, India	782	1896-1938*	41
748	Jaipur, India	1,431	1881-1930	50
749	Nāgpur, India	1,017	1891-1940	50
750	Bareilly, India	568	1895-1939	45
751	Allahābād, India	309	1891-1940	50
752	Rānchī, India	2,128	1895-1938*	42**
753	Angul, India	455	1906-1938	33**
754	Darjeeling, India	7,409	1895-1939	45
755	Dinājpur, Pakistan	123	1895-1939	45
756	Berhampore, India	67	1895-1938*	42**
757	Calcutta, India	22	1891-1940	50
758	Shillong, India	4,920	1902-1940	39
759	Cherrapunji, India	4,309	1903-1939	37
760	Akyab, Burma	20	1891-1940	50
761	Dibrugarh, India	348	1901-1939	39
762	Sibsāgar, India	333	1895-1939	45
763	Bhamo, Burma	381	1895-1940	46
764	Minbu, Burma	165	1895-1940	46
765	Lashio, Burma	2,751	1895-1940	46
766	Maymyo, Burma	3,545	1900-1940	41
767	Yamethin, Burma	657	1895-1940	46
768	T'eng-ch'ung, China	5,358	1916-1935	20
769	K'un-ming, China	6,211	1916-1935	20
770	Chungking, China	712	1924-1935	12
771	Kuei-yang, China	3,527	1920-1935	16
772	Nan-ning, China	285	1922-1935	14
773	Mon Cay, Indochina	30	1907-1930	24
774	Phu Lien, Indochina	379	1907-1930	24

\* not all years used  
\*\* not all months used

<u>Station No.</u>	<u>Station Name</u>	<u>Elev. (Ft.)</u>	<u>Period of Record</u>	<u>No. of Years</u>
775	Ch'ang-sha, China	197	1924-1935	12
776	Hong Kong, China	108	1891-1940	50
777	Foochow, China	66	1905-1935	31
778	Wenchow, China	14	1924-1935	12
779	T'ai-pel, Formosa	31	1897-1932	36
780	Naha, Okinawa	34	1891-1935	45
781	Aden, Arabia	94	1886-1936	51
782	Bombay, India	37	1891-1940	50
783	Hyderābād, India	1,690	1895-1939	45
784	Bangalore, India	3,021	1891-1940	50
785	Madras, India	22	1891-1940	50
786	Waltair, India	38	1888-1940	53
787	Port Blair, India	59	1891-1940	50
788	Rangoon, Burma	18	1891-1940	50
789	Toungoo, Burma	183	1895-1940	46
790	Bangkok, Siam	7	1905-1931	27
791	Battambang, Indochina	52	1928-1939	12
792	Luang Prabang, Indochina	1,148	1928-1942*	14
793	Hue, Indochina	20	1907-1942*	29
794	Kontum, Indochina	1,159	1929-1939	11
795	Nha Trang, Indochina	10	1907-1930	24
796	Saigon, Indochina	36	1907-1930	24
797	Manila, Philippine Islands	47	1887-1940	54
798	Aparri, Philippine Islands	17	1903-1940	38
799	Iliolo, Philippine Islands	21	1903-1940	38
800	Legaspi, Philippine Islands	18	1903-1940	38
801	Cochin, India	9	1891-1940	50
802	Colombo, Ceylon	24	1891-1940	50
803	Trincomalee, Ceylon	99	1891-1940	50
804	Singapore, Singapore #	10	1911-1939	29
805	Sandakan, North Borneo #	5	1886-1939*	36

\* not all years used  
# not shown on map

## AFRICA

<u>Station No.</u>	<u>Station Name</u>	<u>Elev. (Ft.)</u>	<u>Period of Record</u>	<u>No. of Years</u>
900	Ponta Delgada, Azores	120	1894-1940	47
901	Funchal, Madeira Islands	82	1891-1940	50
902	Mogador, Morocco	16	1914-1940*	26
903	Casablanca, Morocco	164	1909-1940	32
904	Settat, Morocco	1,214	1909-1940	32
905	Marrakech, Morocco	1,509	1911-1940	30
906	Meknès, Morocco	1,772	1913-1939	27
907	Oujda, Morocco	1,821	1917-1940*	22
908	Orleansville, Algeria	344	1905-1942	38**
909	Garyville, Algeria	4,281	1905-1947*	37
910	Algiers, Algeria	1,122	1894-1938	45
911	Fort National, Algeria	3,051	1905-1940*	35
912	Biskra, Algeria	407	1910-1947	38
913	El Oued, Algeria	262	1904-1947*	40
914	Sétif, Algeria	3,350	1909-1939	31
915	Tebessa, Algeria	2,658	1906-1947	42
916	Metlaoui, Tunisia	735	1905-1939*	33
917	Tunis, Tunisia	105	1905-1939*	33
918	Sfax, Tunisia	26	1905-1939*	33
919	Tripoli, Libya	52	1905-1941	37
920	El Azizia, Libya	518	1913-1941*	26
921	Bengasi, Libya	82	1914-1941	28
922	Derna, Libya	16	1913-1940	28
923	Alexandria, Egypt	105	1891-1940	50
924	Siwa, Egypt	49	1912-1943*	27
925	Helwân, Egypt	379	1904-1940	37
926	Wâdi Halfa, Anglo-Egyptian Sudan	412	1904-1943*	39
927	Bathurst, Gambia	6	1910-1952*	21
928	Sokoto, Nigeria	1,158	1910-1932	23
929	Maiduguri, Nigeria	1,184	1910-1929	20**
930	El Fâsher, Anglo-Egyptian Sudan	2,395	1918-1939	22
931	Khartoum, Anglo-Egyptian Sudan	1,280	1901-1940	40
932	El Obeid, Anglo-Egyptian Sudan	1,847	1904-1939	36
933	Er Roseires, Anglo-Egyptian Sudan	1,532	1905-1939	35
934	Kassala, Anglo-Egyptian Sudan	1,657	1904-1939	36

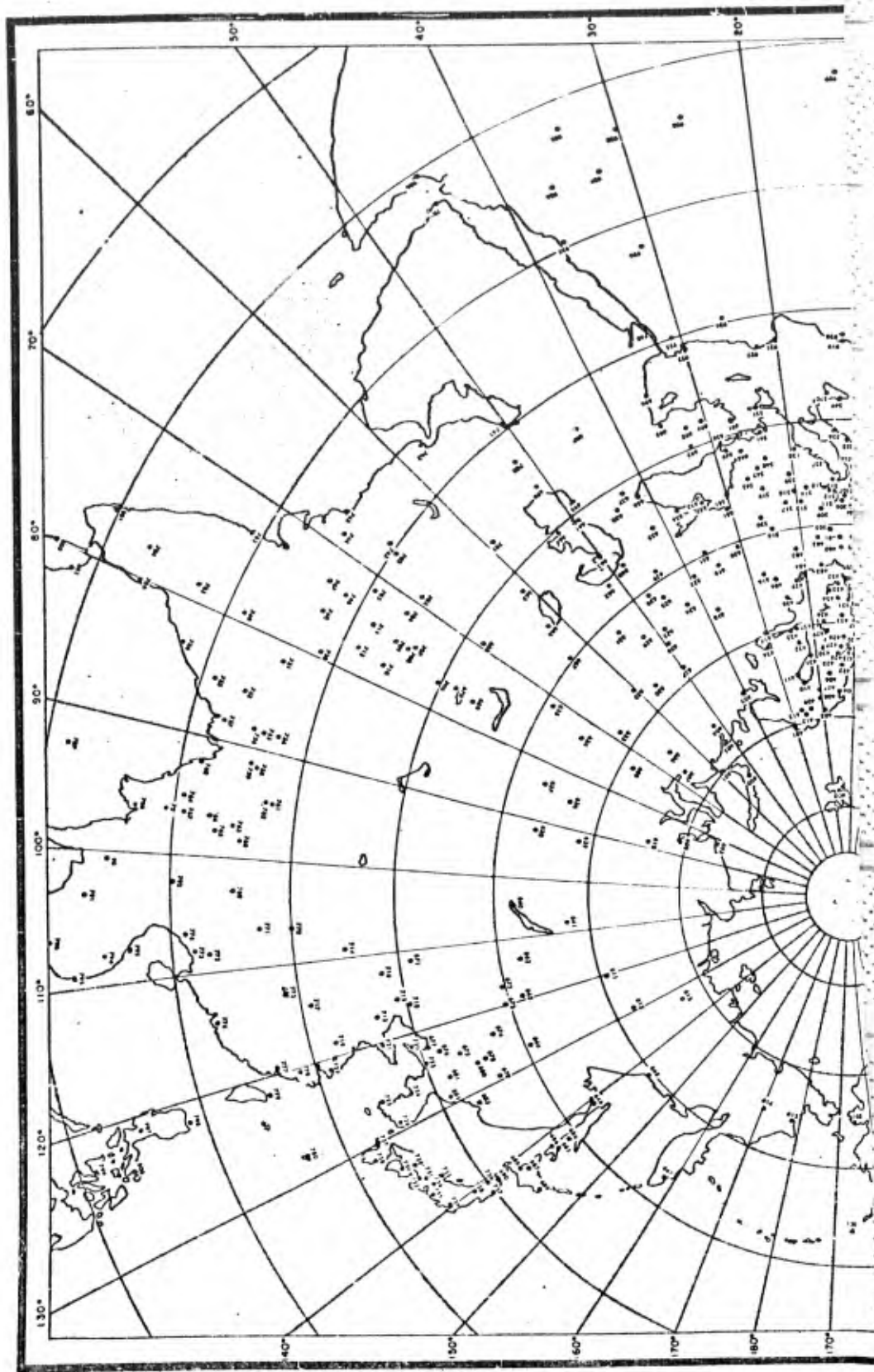
\*not all years used

\*\*not all months used

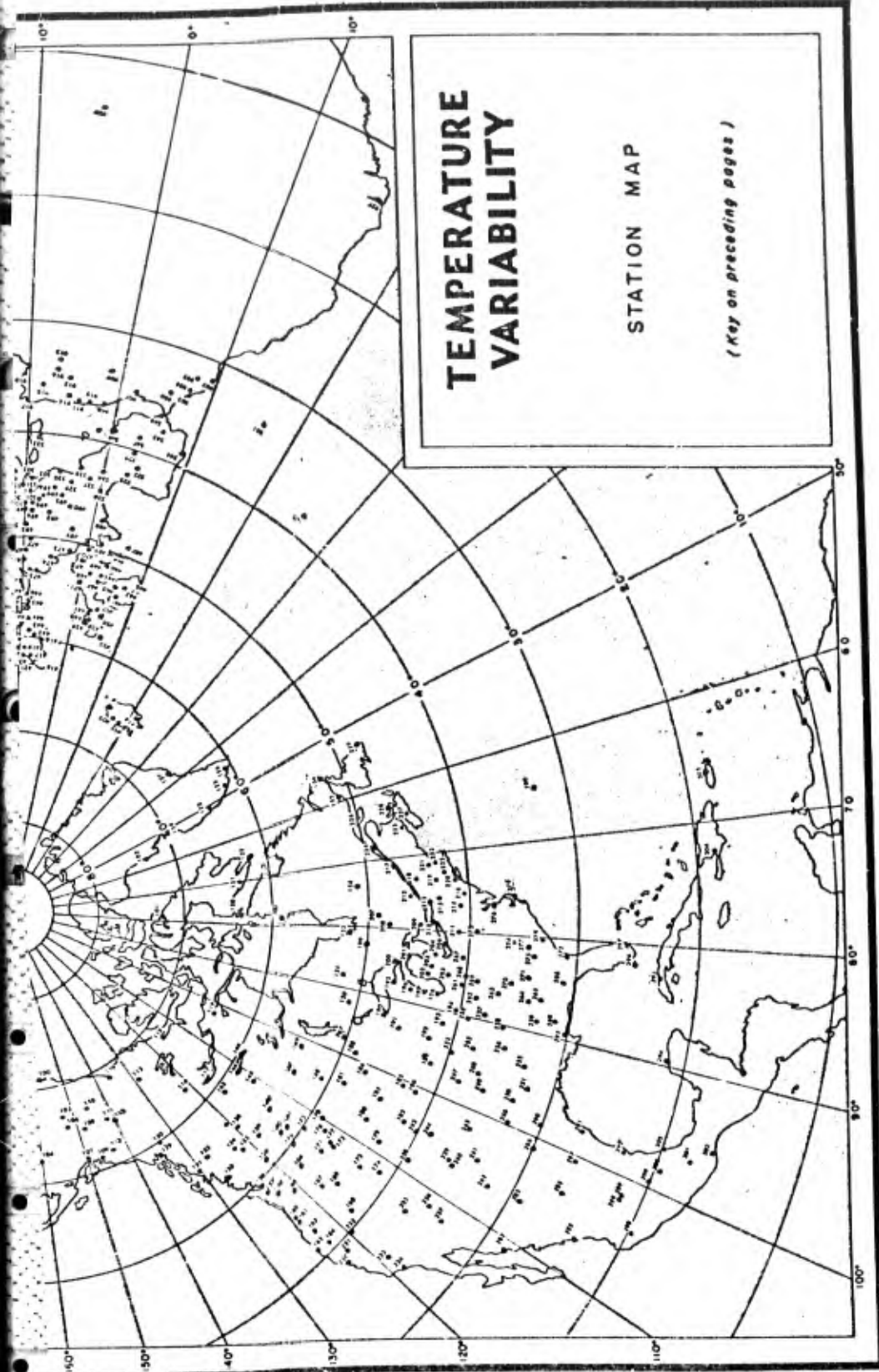
<u>Station No.</u>	<u>Station Name</u>	<u>Elev. (Ft.)</u>	<u>Period of Record</u>	<u>No. of Years</u>
935	Port Sudan, Anglo-Egyptian Sudan	18	1905-1939	35
936	Berbera, British Somaliland	31	1914-1932	19**
937	Lagos, Nigeria #	22	1892-1930	39
938	Lokoja, Nigeria #	320	1908-1938	31
939	Wau, Anglo-Egyptian Sudan #	1,437	1904-1939	36
940	Entebbe, Uganda #	3,842	1901-1930	30

\*\* not all months used

# not shown on map



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**TEMPERATURE  
VARIABILITY**

STATION MAP

*(Key on preceding pages)*

APPENDIX C  
42

M-44 DEC 1953

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Denver, Colorado  
(1 - Dr. Friedman, 1 - Dr. Grossman)
- 3 Armed Forces Institute of Pathology  
Washington 25, D.C. Med. Procurement Agency  
Chief, Armed Services Med. Procurement Agency  
B. Sells Bld., Brooklyn 1, N.Y.  
(Attn: Property Officer, Direct Req. BUD)
- 1 Chief of Staff of the Army, Wash. 25, D.C.  
(Attn: Research & Development)
- 3 Commanding Officer  
Transportation Res & Dev Command  
Ft. Belts, Virginia

CONTINENTAL ARMY COMMAND

- 1 C.G. Continental Army Command  
Ft. Monmouth, Virginia
- 1 President  
CONARC Board No. 1, Ft. Sill, Okla.
- 1 President  
CONARC Board No. 2, Ft. Knox, Ky.
- 1 President  
CONARC Board No. 3, Ft. Benning, Ga.
- 1 President  
CONARC Board No. 4, Ft. Bliss, Texas
- 1 President  
CONARC Board No. 5, Ft. Bragg, N.C.
- 1 Commanding General  
USA Alaska, APO 942  
Seattle, Washington  
(Attn: Arctic Test Branch  
Big Delta, Alaska)

AIR FORCE

- 2 Department of Air Force  
Hqtrs., USAF, Wash. 25, D.C.  
(1 - Attn: DC/S Material, 1 - Attn: DC/S  
Development)
- 1 Commander  
Air University, Maxwell AF Base, Ala.
- 1 Commandant  
USAF School of Aviation Medicine  
Randolph Air Force Base  
Randolph Field, Texas
- 1 Commander  
Arctic Air Medical Laboratory  
APO 731, Seattle, Washington
- 1 Commander  
Air Res & Dev Command  
PO Box 3395, Baltimore, Md.

NAVY

- 1 Director  
Naval Research Laboratory  
Arlington Hall, Washington 25, D.C.

NAVY

- 1 Chief of Bureau for Research  
Research & Development Division  
Navy Bureau of Ordnance  
Main Navy  
Washington 25, D.C.

- 1 Naval Medical Research Institute  
National Naval Med. Res. Center  
Bethesda, Md.

DOARDS AND COMMITTEES

- 1 Army Committee on Environment  
Office Assistant Chief of Staff, G-4  
Pentagon Bldg., Wash. 25, D.C.
- 1 Army Committee on Res. & Robot Control  
Office Assistant Chief of Staff, G-4  
Pentagon Bldg., Washington 25, D.C.
- 1 Army Research Committee  
Office Assistant Chief of Staff, G-4  
Pentagon Bldg., Wash. 25, D.C.

MISCELLANEOUS

- 1 The Army Library  
Pentagon Bldg.  
Washington 25, D.C.
- 1 Commandant  
National War College  
Ft. Meade, Wash. 25, D.C.
- 1 Commandant  
Command & General Staff School  
Ft. Leavenworth, Kansas
- 1 Commandant  
U.S. Military Academy  
West Point, New York
- 1 National Research Council  
2101 Constitution Ave.  
Washington 25, D.C.  
(Attn: Advisory Board on QM Research and  
Development)
- 3 Armed Services Technical Information Agency  
Document Service Center  
Knott Bldg.  
Dayton 2, Ohio  
(Attn: DDC-3B)

**DISSEMINATION LIST**

**ARMY QUARTERMASTER CORPS**

- 15 The Quartermaster General  
Department of the Army  
Washington 25, D.C.
- 2 Commanding General  
Philadelphia GM Depot  
2800 South 20th Street  
Philadelphia, Pa.
- 3 *Commandant*  
GM Food & Container Institute  
Chicago GM Depot  
1819 W. Pershing St., Chicago, Ill.
- 1 Commanding General  
GM Textile Institute, Attn: GM Library  
GM Textile Institute  
P.O. Box 100  
P.O. Lees, Virginia
- 2 Commanding Officer  
GM R&D Field Evaluation Agency  
P.O. Lees, Virginia
- 1 GM Liaison Officer, MCLAGH  
Wright-Patterson AF Base  
Dayton, Ohio
- 1 USGI, Technical Representative  
Firestore of Inter Service  
221 Wallington Street  
Ottawa, Canada
- 6 GAC Representative  
Officer Group No. 1  
U.S. Army, c/o U.S. Army 100, PFO  
New York, New York
- 1 Commandant  
The GM School, P.O. Lees, Va.
- 2 Ambitious Branch  
Office of Naval Research  
Bldg T-3, Wash. 25, D.C.
- 2 Assistant Chief of Staff, G-4  
Attn: Research & Development Division
- 1 Assistant Chief of Staff, G-1
- 1 Assistant Chief of Staff, G-3, Operations

**TECHNICAL SERVICES**

- 2 Commanding General  
The Engineer Center  
Ft. Belvoir, Va.
- 3 Commanding General  
Research & Eng. Command  
Army Chemical Center, Md.  
(1 - CO, Chem Corps Engr Agency,  
1 - CO, Chem Corps Med. Lab., J-Tech  
Library)
- 1 Chief of Ordnance, Dept. of the Army  
Wash. 25, D.C. Attn: Chief, R&D Div.
- 4 Commanding General  
Aberdeen Proving Ground, Aberdeen, Md.
- 2 Chief Signal Officer  
Dept. of the Army Wash 25, D.C.  
(1 - Sig CG-M, 1 - Sig CG-CA)
- 1 Commanding Officer  
Signal Corps Engr. Lab.,  
Ft. Monmouth, N.J.

**TECHNICAL SERVICES**

- 2 The Surgeon General  
Main Bldg, Wash. 25, D.C.
- 1 (1-Res & Dev Div, J-Tech, Liaison Off)  
The Armed Forces Medical Library  
7th & Independence Ave., S.W.  
Washington 25, D.C.
- 3 Commanding Officer  
Army Med. Off. Lab., Ft. Knox, Ky.
- 3 *Commandant*  
GM Medicine Branch  
Ft. Belvoir, Va.
- 1 (1 - Dr. Friedman, 1 - Dr. Grossman)  
Armed Forces Institute of Pathology  
Washington 25, D.C.
- 1 Chief, Armed Services Med. Procurement Agency  
814 1/2 St., Brooklyn 1, N.Y.  
(Attn: Property Officer, Marked: Req. DUSD  
#13)
- 1 Chief of Transportation  
Department of L.S. Army, Wash. 25, D.C.  
(Attn: Research & Development)
- 2 Commanding Officer  
Transportation Res & Dev Command  
Ft. Meade, Virginia
- CONTINENTAL ARMY COMMAND
- 1 C.O. Continental Army Command  
Ft. Monroe, Virginia
- 1 President  
COMUSC Board No. 1, Ft. Sill, Okla.
- 1 President  
COMUSC Board No. 2, Ft. Knox, Ky.
- 1 President  
COMUSC Board No. 3, Ft. Benning, Ga.
- 1 President  
COMUSC Board No. 4, Ft. Bliss, Texas
- 1 President  
COMUSC Board No. 5, Ft. Bragg, N.C.
- 1 Commanding General  
USA Alaska, APO 942  
Seattle, Washington  
(Attn: Arctic Development Branch  
Sig Corps, Alaska)

**AIR FORCE**

- 2 Department of Air Force  
Matters, USAF, Wash. 25, D.C.  
(1-Attn: DC/S Material, 1-Attn: DC/R  
Development)
- 1 Commander  
Air University, Maxwell AF Base, Ala.
- 1 Commandant  
USAF School of Aviation Medicine  
Randolph Air Force Base  
Randolph AFB, Texas
- 1 Commander  
Arctic Air Medical Laboratory  
APO 731, Seattle, Washington
- 1 Commander  
Air Res & Dev Command  
PO Box 1399, Baltimore, Md.

**NAVY**

- 1 Director  
Naval Research Laboratory  
4th & Chesapeake St., S.W.  
Washington, 25, D.C.

**NAVY**

- 1 Chief of Bureau for Research  
Research & Development Division  
Navy Bureau of Ordnance  
Main Navy  
Washington 25, D.C.
- 1 Naval Medical Research Institute  
National Naval Med. Res. Center  
Bethesda, Md.
- BOARDS AND COMMITTEES
- 1 Army Committee on Environment  
Office Assistant Chief of Staff, G-4  
Pentagon Bldg., Wash. 25, D.C.
- 1 Army Committee on Insect & Rodent Control  
Office Assistant Chief of Staff, G-4  
Pentagon Bldg., Washington 25, D.C.
- 1 Army Research Committee  
Office Assistant Chief of Staff, G-4  
Pentagon Bldg., Wash. 25, D.C.

**MISCELLANEOUS**

- 1 The Army Library  
Pentagon Bldg.  
Washington 25, D.C.
- 1 Commandant  
National War College  
Ft. McNeil, Wash. 25, D.C.
- 1 Commandant  
Command & General Staff School  
Ft. Leavenworth, Kansas
- 1 Commandant  
U.S. Military Academy  
West Point, New York
- 1 National Research Council  
2101 Constitution Ave.  
Washington 25, D.C.  
(Attn: Advisory Board on GM Research and  
Development)
- 5 Armed Services Technical Information Agency  
Document Services Center  
Scott Bldg.  
Dayton 2, Ohio  
(Attn: DDC-60)