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CLIMATIC FREQUENCIES
FOR LOW LATITUDE STATIONS

for

Headquarters
Quartermaster Research and Engineering Command
U. S. Army
Natick, Massachusetts

Contract No. DA19-129-QM-1971 (OI 6064)
Project No. 7X83-01-008

FINAL REPORT

CLIMATIC FREQUENCIES FOR LOW LATITUDE STATIONS

Contract No. DA19-129-QM-1971 (OI 6064)

Project No. 7X83-01-008

January 1964

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Quartermaster Research and Engineering Command

U. S. Army

Natick, Massachusetts

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General Climatic Features

The purpose of the tables and figures presented ~~in this report~~ is to depict the temperature and humidity regimes in the zone between 35°N and 35°S. This area comprises the tropics and the equatorward portion of the temperate regions of middle latitudes.

In the tropics the most significant feature of the climate is that the daily range of temperature commonly exceeds the annual range. In middle and high latitudes the reverse situation prevails. For a description of the temperature and humidity regions in the tropics it is essential that data be available for every hour of the day.

In the higher latitudes of the 35°N - 35°S zone there is a significant seasonal variation of temperature and humidity, particularly over continental areas.

Selection of Basic Climatic Data

Prior to 1940 there were relatively few stations in the tropics which made regular meteorological observations, even four times a day. It has been necessary, therefore, to prepare the climatological summaries from data which have been taken for the most part since 1940.

An extensive data survey was undertaken by the National Weather Records Center. It developed that 24-hour a day observations were available for 107 suitable stations. In addition, 21 stations reported on a 6-to-14 times a day schedule. Since the observation times were distributed throughout the 24-hour day, it was considered that their data would be representative. Hence, the climatic survey has been based upon observations from more than 125 stations.

Many observing stations in the tropics have reported on a substantially less frequent schedule, e.g., one to four observations a day. Data from these sources have not been included but a suggested scheme for incorporating such data is described later.

Climatic summaries are ordinarily derived from a long period of meteorological observations. In this study an attempt was made to select a four-year period as the basic climatic unit. This relatively short length of time was dictated in part by the availability of data in a readily usable form. Even though a four-year period was desired, it was necessary to include 59 stations with a two-to-four year period, in order to arrive at the number of stations used. Since yearly variations of temperature and humidity in the tropics are not too pronounced, it was considered that these relatively short periods were adequate to depict frequencies of different temperature and humidity regimes.

Density of Climatic Data

The stations which are included in this climatic summary do not provide a uniform geographical distribution. There are two principal reasons for this lack of geographical coverage.

T. e majority of the countries in tropical latitudes fall within the category which has been defined as the under-developed areas. The meteorological networks are sparse and, as a consequence, there are vast regions such as the interior of Africa and South America where data have not been available on a 24-hour a day schedule. Existing stations within these two continents have provided data on a one-to-four times a day schedule A plan for simulating 24-hour a day conditions is discussed in the penultimate section of this report.

The other reason for the lack of data is the absence of established population centers in regions where the climate is unfavorable for human habitation. The extreme summer heat and aridity of the Sahara Desert area is an example of such a region.

Tropical Climates

Table 1 presents a highly idealized distribution of climate within the 35°S - 35°N zone.

35°N		
	Zone 4	Temperate
	Zone 3	Hot and Dry especially in summer
	Zone 2	Hot and Humid in summer Dry in winter
0°	Zone 1	Hot and Humid all year
	Zone 2	Hot and Humid in summer Dry in winter
	Zone 3	Hot and Dry especially in summer
	Zone 4	Temperate
35°S		

Table 1: An idealized latitudinal variation of climate

The transition from hot-humid weather near the equator to hot-dry conditions about 20° latitude and to temperate weather beyond 30° latitude occurs over all regions, but the latitudinal boundaries of the zones may vary considerably. For example, Zone 1 is narrower across South America and Africa than in the southeast Asia-Australia area. Also the desert area, Zone 3, extends from 12°N to 32°N over North Africa. Geographical differences are illustrated by Figure 1. In this Figure, Zones 1 and 2 have been combined. This diagram only attempts to present a broad classification of the climate in the tropical areas. Within each of the three subdivisions there are smaller areas where the climate is different from the broad classification. Such differences arise quite frequently from topographical variations.

Climatic data from six stations were processed in detail in order to depict the variety of climate within the 35°N - 35°S region. The diurnal variations of air temperature and dew-point temperature are presented in the Figures 2-5 for the months of January, April, July and October.

Belem and Kwajalein are representative of the vast area of hot-humid climate in the tropics. The most significant feature is the negligible seasonal variation. The increased diurnal variation of temperature at Belem can be attributed to the continental influence. In the interior of the continents a somewhat larger diurnal variation is to be expected. Isolated islands experience the small variability illustrated by Kwajalein.

Dharan and Marrakech are located in the hot-dry climatic zone. At Dharan the temperatures and dew-point temperatures are influenced by the proximity of the water area of the Persian Gulf. The large seasonal and diurnal variations at Marrakech are more representative of the desert areas. In the interior of the continents, such as the central Sahara, these variations are more extreme than those depicted by Marrakech. For example, temperatures well in excess of 100°F, and lower dew-point temperatures, are quite common in the summer-half of the year, as illustrated by the data from inland North African stations included in this report.

Gaya illustrates the temperature and humidity regime at a location which experiences dry winters and humid summers. Pronounced seasonal changes occur over southeast Asia as a consequence of the monsoon circulation. The monsoon is off-shore in winter and on-shore in summer so that July is hot and humid while January is relatively mild. Maximum temperatures are observed in spring (April). The Gaya data present a rather extreme example of the climate in Zone 2 of Table 1, with its pronounced difference between April and July.

Liuchow is a representative station in a more temperate regime with hot-humid summers and relatively mild winters.

The quality of the input data for the climatic summaries can be judged, in part, from the diurnal variations in Figures 2-5. Except for a few erratic night-time fluctuations at Liuchow the diurnal variations are smooth. Evidently there are few obviously erroneous reports in the punch card decks. Even with the questionable night-time fluctuations for

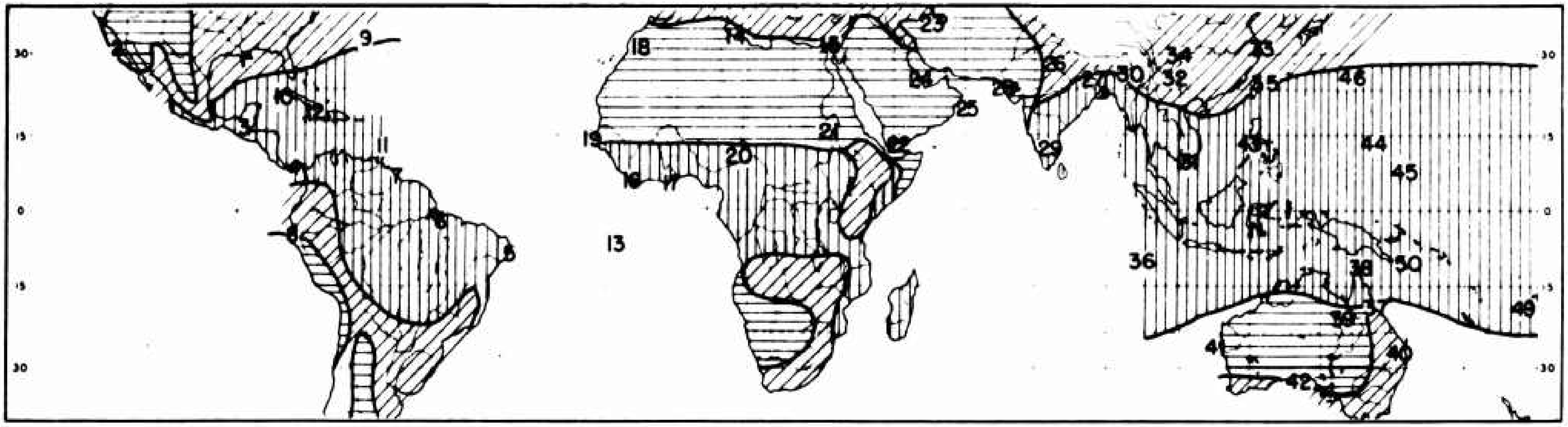

Fig. 1. Major climatic areas. ☰ hot and dry ||| hot and humid /// temperate. See list of stations for identification numbers.

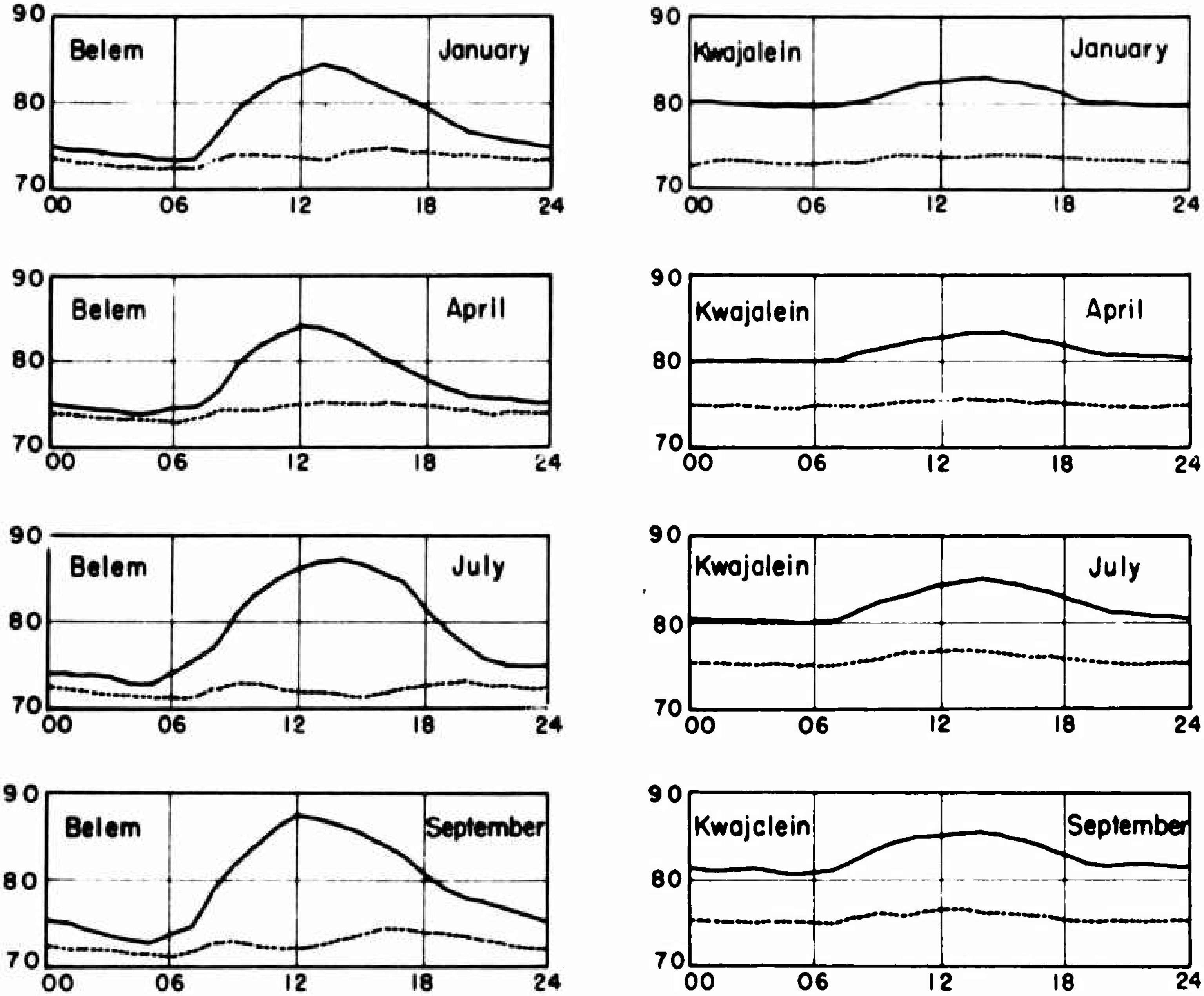

Fig. 2. Average diurnal variation of temperature (solid lines) and dew-point temperature (dashed lines) at Belem and Kwajalein, drawn for hourly mean temperatures.

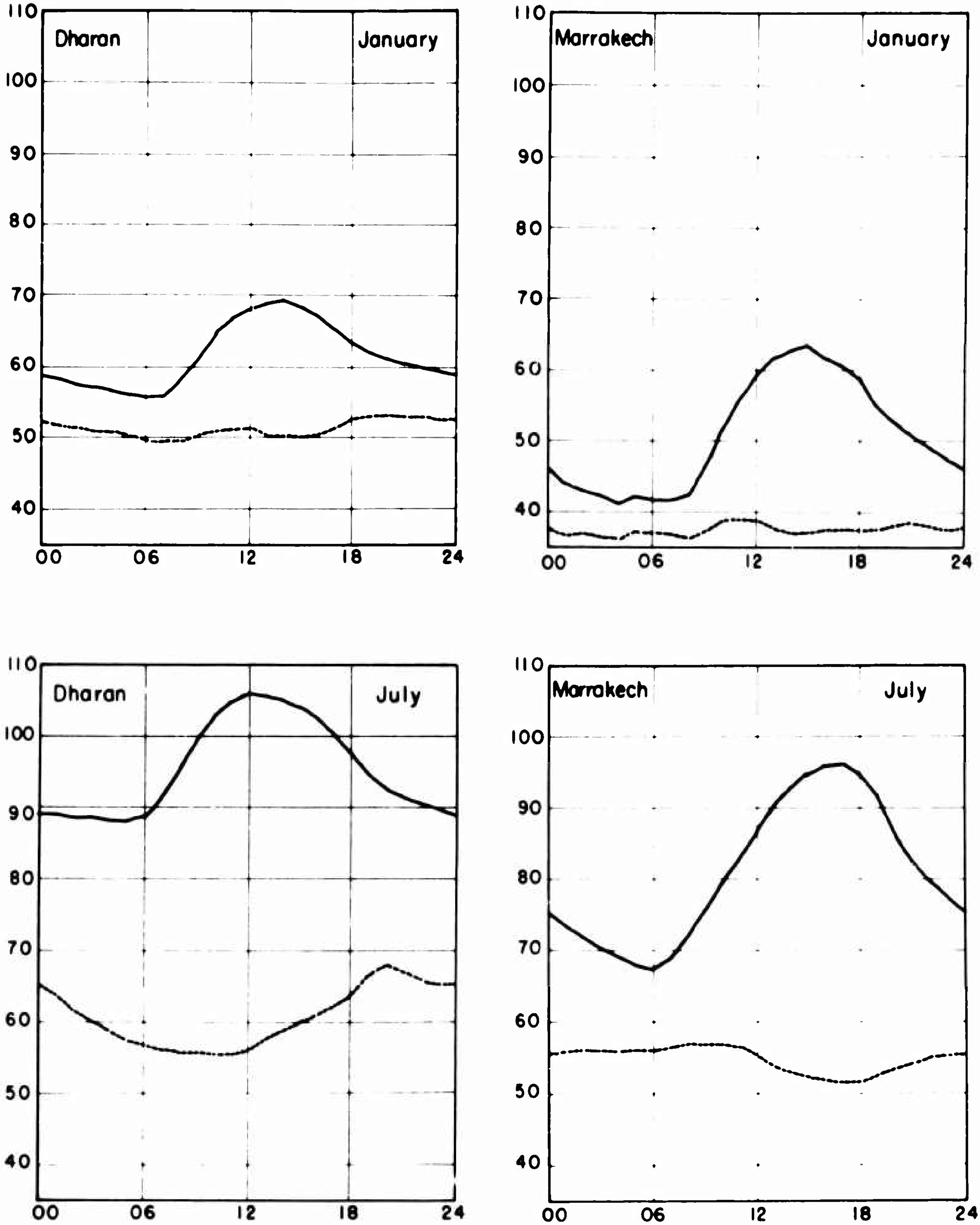

Fig. 3. Average diurnal variation of temperature (solid lines) and dew-point temperature (dashed lines) at Dharan and Marrakech, drawn for hourly mean temperatures.

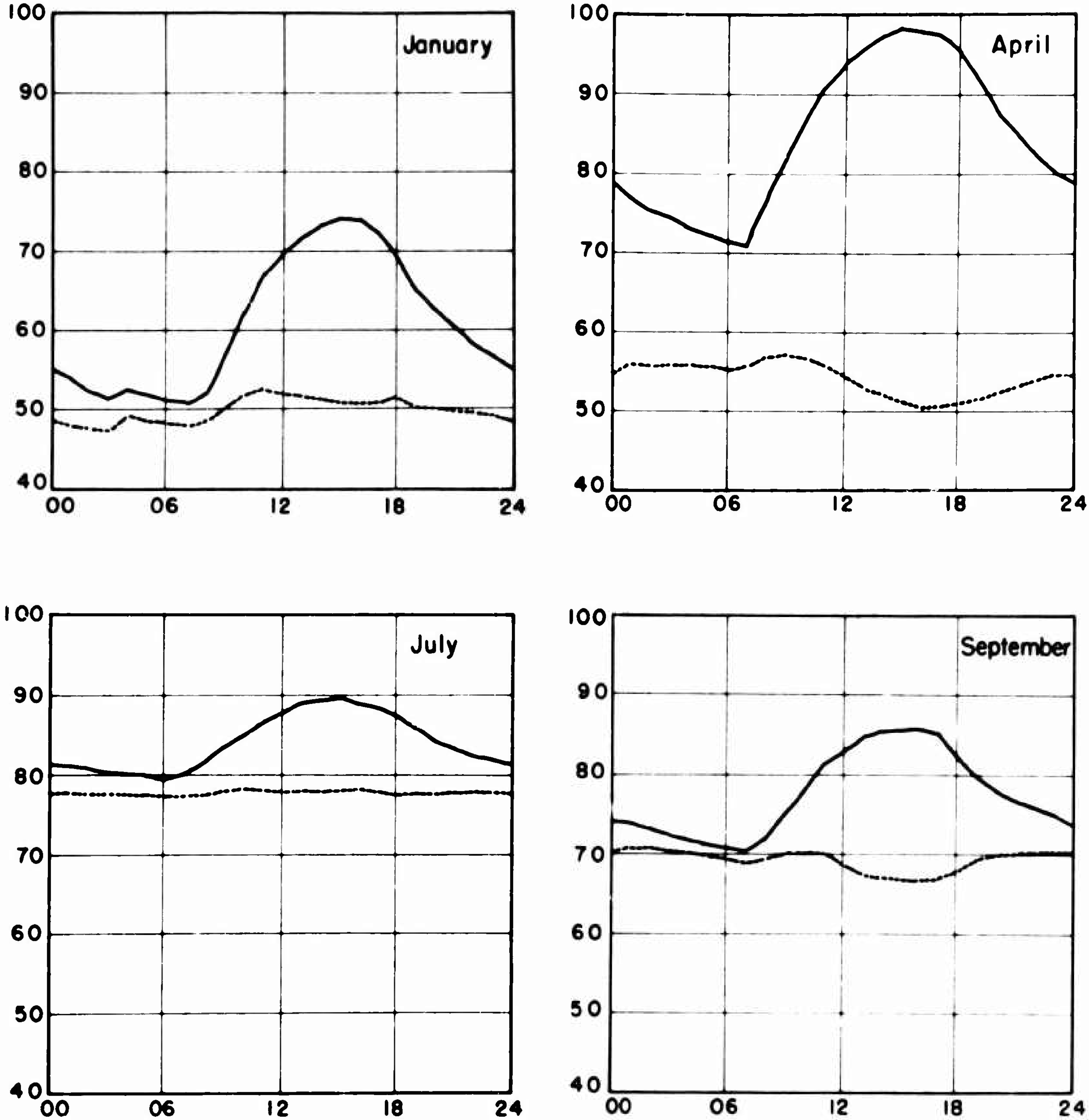

Fig. 4. Average diurnal variation of temperature (solid lines) and dew-point temperature (dashed lines) at Gaya, drawn for hourly mean temperatures.

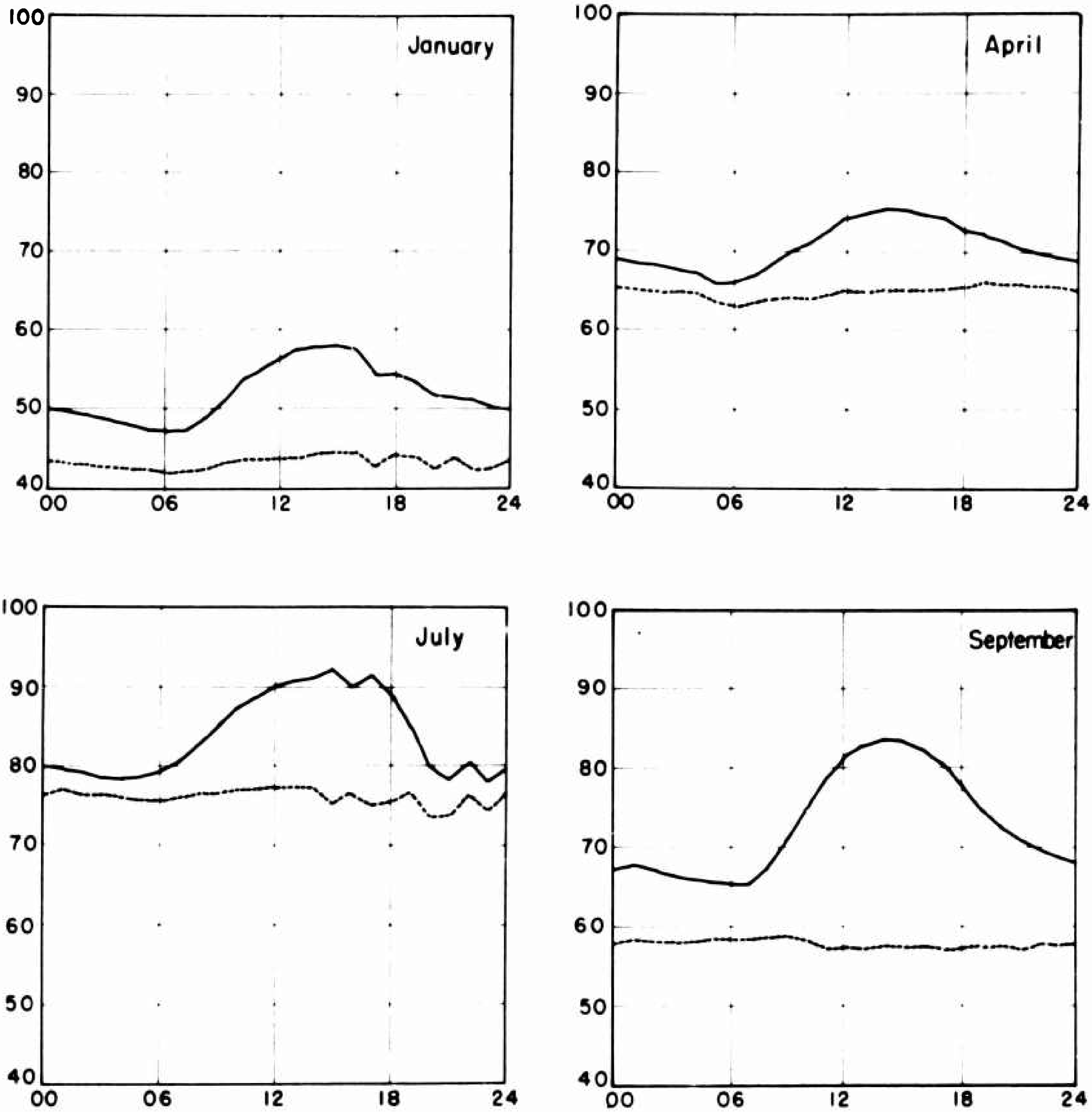

Fig 5. Average diurnal variation of temperature (solid lines) and dew-point temperature (dashed lines) at Liuchow, drawn for hourly mean temperatures.

Liuchow the departures from expected means are small and they should not significantly affect the frequency distributions.

Wind Regime

Table 2 shows the diurnal variation of wind speed for the six selected stations. Minimum speeds occur at night-time and during the early morning hours. Mid-afternoon is the usual time for the wind maxima. This diurnal variation of wind speed has been considered in arriving at the definition of a hot-humid climate.

Definition of Hot-Humid and Hot-Dry Regions

From the stations used, a sample of 50 was selected for extensive analysis. The list is presented in Table A and the locations of the stations are indicated in Figure 1. The frequency of occurrence of hot-humid and hot-dry conditions is presented in a separate table described below.

Many criteria may be suggested for defining what is meant by hot-humid or hot-dry weather. The temperature and humidity bounds which specify each category are, therefore, somewhat arbitrary. In this investigation the following definitions have been used:

Hot-humid: Dew-point temperature above 70°F.

Hot-dry: Air temperature above 75°F and the relative humidity below the range 30 to 40 per cent, see description of Table 8 below for details.

No air temperature criterion was used in the hot-humid classification. The specification of a lower limit to the temperature, such as 80°F would only have the effect of separating night from day, as illustrated by the diurnal variations at Belem. As far as personal reaction to a hot-humid climate is concerned, it is necessary to take cognizance of wind speed. Light winds or calm make the climate more oppressive. As shown in Table 2 the effect of high daytime temperatures is offset by an increase in wind speed. When the diurnal variation of wind is small so also is the

Table 2: Average maximum and minimum wind speeds (in m.p.h.) at selected stations.

Month	Minimum Speed	Minimum Time		Maximum Speed	Maximum Time
			Marrakech		
January	3.5	0900		5.7	1500
July	3.7	0900		10.7	2000
			Dharan		
January	5.3	2300		8.8	1500
July	3.8	2300		13.2	1500
			Belem		
January	2.0	0600		10.1	1500
July	3.0	0400		7.5	1400
			Kwajalein		
January	14.3	0400		15.1	0900
July	7.3	0600		8.3	1400
			Gaya		
January	3.0	2300		6.6	1500
July	5.9	0600		10.4	1500
			Liuchow		
January	3.8	2400		6.9	1300
July	1.2	0200		5.2	1400

diurnal variation of temperature, as illustrated by Kwajalein. It was considerations such as these which lead to the simple definition of a hot-humid regime based solely on dew-point temperature.

Definition of Comfort Index

Human reaction to hot weather is determined by a number of meteorological parameters, notably, temperature, humidity, wind-speed and sunshine. Such non-meteorological factors as clothing and degree of acclimatization affect the reaction of an individual to a hot climate.

Definitions have been proposed of "effective temperatures" or "comfort indices" to indicate the degree of comfort of the "average" person. In this report we have used the Temperature-Humidity Index (THI) proposed by the U.S. Weather Bureau.

THI = 0.55 (air temperature) + 0.2 (dew-point temperature) + 17.5*

The range of indices for the 50 representative stations are tabulated in this report. To quote the Weather Bureau, "When the Index reaches 75, at least half of the people will be uncomfortable; when it reaches 79, few if any will be comfortable." These criteria are arbitrary and will vary according to the individual, clothing, wind speeds, sunshine, etc. However, it can be concluded that stations with a high frequency of occurrence of high indices represent uncomfortable climates.

Influences of Topography

The numerous mountainous areas in the tropics have a profound influence upon the climate. The windward side of a mountain range will be wetter and, therefore, more humid than the lee side. The extremely heavy rainfall and humid summertime weather of northeast India can be attributed to the mountain influence during the southwest monsoon.

*U.S. Weather Bureau Publication, revised August 1960.

Elevation also affects the temperature regime because, in the mean, temperature decreases with height. The influence of elevations on temperature can be illustrated by comparing the average temperatures at Quito (elevation 9,350 ft.) and Belem (elevation 79 ft.). Both stations are very close to the equator. The yearly mean temperature is 54°F at Quito and 80°F at Belem. On the average the mean temperature decreases 2-1/2°F to 3°F per 1000 feet of elevation. Regions at high elevations in the tropics thus experience milder climates than adjacent low-lying areas.

Suggested Method of Simulating Frequency Distributions

In this report frequency distributions have been presented for more than 125 stations which took round-the-clock observations. As noted earlier the geographical coverage is incomplete, particularly in South America and Africa. However, there are many stations in these areas which have made four or fewer observations a day. The purpose of this section is to suggest a method of simulating the 24-hour frequency distribution for a station which takes only a few observations a day.

Consider a station with three observations a day which is located in the hot-humid zone of Figure 1. Depending upon its specific location the frequency distribution of temperature and dew-point temperature should be similar to that of Kwajalein, Belem or Gaya. Suppose the location indicates a climate like that of Gaya (hot-humid summer, dry winter). The mean monthly temperatures and dew-point temperatures can be compared with those at the same local times at Gaya. Suppose in January it is noted that the station is x°F warmer on the average and has dew-point temperatures which are y°F higher on the average than Gaya. The hypothetical 24-hour distribution of temperature and dew-point temperature for the station is then obtained by adjusting the January data for Gaya by increasing Gaya's temperatures by x°F and the dew-point temperatures by y°F. A similar procedure is followed for the other months of the year. In this manner an estimate can be obtained of the actual 24-hour temperature and humidity regime at a station which has taken only a few observations a day.

The success of such a method depends upon the extent to which the master station (Gaya) is an analogue of the station with few reports. No two stations are climatologically identical so that this proposed procedure contains an inherent error. The error may be minimized by having hourly mean temperatures for a number of master stations.

The simulation technique is proposed only as a stop-gap measure until 24-hour a day observations become available for the blind areas.

Comments

This investigation has been hampered by the lack of 24-hour observations in many areas. Also the length of record is short at those stations which have taken 24-hour observations. A more representative coverage of the climatic features of the 35°N to 35°S must await the availability of more extensive data.

Source Data

Two distinct types of data were used in this study. One type consisted of original data cards procured from the National Weather Records Center in Asheville, N.C. The most suitable data available were selected by the Center as the result of a special survey conducted for this study. The remaining data were taken directly from bivariate frequency distributions of temperature and dew point furnished by the U.S. Army Natick Laboratory. Except for minor editing, the data appear as they were furnished.

Original source data appeared on standard 80 column punched cards in a wide variety of formats, codes, and units. The cards were reduced to a uniform format, decoded, and translated to a uniform set of units, namely degrees Fahrenheit, local times, and dew-point readings when necessary. The data processing was done on an IBM 1401/7090 Computer System. All results were automatically printed through the IBM 1401.

Tables

The following tables for all stations were prepared:

Table 3: Bivariate Frequency of Temperature vs. Dew Point

Table 4: Cumulative Frequency of Air Temperature with Associated Conditional Dew Point Mean

Table 5: Cumulative Frequency of Air Temperature

Table 6: Cumulative Frequency of Dew Point Temperature

Table 7: Cumulative Frequency of the Comfort Index

Table 8: Frequency of Hot-humid and Hot-dry Weather

Table 3

The temperature classes are designated across the top of the table by their mid-class mark with the exceptions that the first interval, say T1, which denotes all temperatures less than or equal to T1 while the last interval, say TN, denotes all temperatures greater than TN. All other class marks, T, denote that class of temperatures which are greater than T-1° and less than or equal to T + 1°. The convention was adopted so that the number of temperature intervals could be limited to 30.

The dew point classes are all uniformly 2° wide and also labeled by their midpoints. The class called TD denotes the class of dew points which are greater than TD-1° and less than or equal to TD + 1°. No attempt was made to constrain the table in the number of dew point classes. However, classes which contained no observations were suppressed.

The marginal totals are given rounded to the nearest tenth of one per cent which is the unit in which the entrees to the main table are given. The grand total may differ from 100.0 per cent because of round-off error.

Table 4

This table was produced essentially to aid in the preparation of an atlas. Two entries appear under each month and opposite a temperature level. The entry on the left is the frequency in per cent of occurrence of observations having air temperatures greater than or equal to the temperature level while the entry on the right is the average of the dew points of these observations. This average is rounded to the nearest degree.

Table 5

This table is similar to Table 4 except that the conditional dew point means have been suppressed.

Table 6

The frequency of occurrence of observations having dew points greater than or equal to the level at the left is reported rounded to the nearest per cent.

Table 7

A calculation, described above, was effected to give the comfort index. The frequency of occurrence of this index greater than or equal to the level headed by THI is given rounded to the nearest per cent.

Table 8

The criterion for hot humid weather has been given above. For hot dry, the criterion was modified so that the following conditions were required to exist: the temperature was required to be greater than 75° and the dew point less than or equal to 54°, or temperature greater than 90° and dew point less than or equal to 62°, or temperature greater than 100° and dew point less than or equal to 68°. The frequency of occurrence is reported rounded to the nearest per cent.

Stations Used

Table A is a complete list of stations used in the study. Latitude and longitude, elevation in feet above sea level and frequency and period of record of data from which the tables were prepared are listed. The select fifty stations are denoted in the column headed by "Select." The number in this column is used to refer to Figure 1.

TABLE A
COMPLETE LIST OF STATIONS

Station	Latitude	Longitude	Elevation	Ob.	Hrs.	Record Period	Select (1)	Source Used (2)
Abadan, Iran	30°22'N	48°14'E	9 ft.	24		Dec 43-Dec 45		C
Accra, Gold Coast Africa	05°36'N	00°10'W		24		Sep 42-Aug 45	17	S
Adana, Turkey	37°00'N	35°26'E	265 ft.	24		58- 62		C
Albuquerque, N.M.	35°03'N	106°37'W	5314 ft.	24		58- 62		
Allahabad, India, Bamrauli	25°26'N	81°50'E	322 ft.	24		Jun 42-Dec 42		C
						Nov 43-Jul 44		
						Jun 45-Sep 45		
				13		Jan 43-Jun 43		
				11		Jul 43-Oct 43		
Ambon, Indonesia	03°44'S	128°11'E	10 ft.		09	Aug 49		S
						Dec 49-Dec 53		
					15	Jan 49-May 49		
						Jul 49-Jul 50		
						Dec 50-Dec 53		
Ascension Is. AAFB	07°58'S	14°24'W	260 ft.	24		58- 62	13	C

(1) Indicates station was one of fifty for which complete analysis was done, see Figure 1.
(2) "S" indicates data from a summary previously prepared, "C" indicates cards were used.

Station	Latitude	Longitude	Elevation	Ob.	Hrs.	Record Period	Select (1)	Source Used (2)
Atar, Maurintania AAB	20°28'N	13°02'W	771 ft.	24		Apr 43-Sep 45		C
Bangalore, India	12°58'N	77°35'E	3022 ft.	24		Sep 42-Dec 45	29	S
Belem, Brazil	01°28'S	48°27'W	79 ft.	24		Oct 42-Apr 46 Jun 46-Oct 46	6	S
Bengasi, Libya	32°02'N	20°03'E	25 ft.	24		Nov 43-Dec 45		C
Bombay, India, Santa Cruz	19°05'N	72°53'E	30 ft.	24		Jun 44-Dec 45		C
Burrwood, La.	28°59'N	89°22'W	9 ft.	24		58- 62	1	C
Cairo, Egypt, Payne Field	30°02'N	31°15'E	381 ft.	24		Nov 43-Nov 46	15	S
Calcutta Dum Dum, India	22°38'N	88°28'E	19 ft.	24		Sep 43-Dec 45		C
Camaguey, Cuba	21°24'N	77°55'W	350 ft.	24		Jul 42-Jun 45		S
Canton, Phoenix Is.	02°49'S	171°43'W	12 ft.	24		Jan 43-Oct 46 (less Mar 43)		S
Cape Hatteras, N.C.	35°16'N	75°33'W	25 ft.	24		58- 62		C
Carnarvon, Australia	24°53'S	113°40'E	14 ft.	7	00, 03, 06, 19, 12, 15, 18, 24	Jan 54-Dec 57	41	C

Station	Latitude	Longitude	Elevation	Ob.	Hrs.	Record Period	Select (1)	Source Used (2)
Chabua, India	27°30'N	95°07'E		24		Jul 42-Apr 46	30	S
Chengtu, China	30°15'N	104°02'E	1577 ft.	24		Jan 44-Dec 45	34	C
Chiangmai, Thailand	18°47'N	98°59'E	1030 ft.		01, 04, 22,	May 50-Dec 52		S
					07, 10, 16	Jan 48-Dec 52		
					13	Dec 46		
						Jan 48-Nov 49		
						Jan 50-Dec 52		
					19	Nov 46-Dec 46		
						Jan 48-Oct 49		
						Jan 50-Dec 52		
Chihkiang, China	27°27'N	109°38'E	872 ft.	24		Feb 45-Dec 45		C
				13		Oct 43-Jan 45		
				24		Jan 46-Jul 47		
Chinhae, Korea AB	35°10'N	128°50'E		24		Jan 52-Jun 54		S
						Jul 55-Dec 57		
Christmas Island, Line Is. Casady Fld.	01°59'N	157°21'W	19 ft.	24		Mar 43	47	S
						Oct 43-Feb 46		
						Apr 56-Sep 48		
Cloncurry, Australia	21°14'S	140°30'E	616 ft.	24		Oct 42-Nov 44	39	C
Coco Solo, Canal Zone	09°22'N	79°55'W	8 ft.	24		Feb 51-Apr 51	4	S
						Jan 52-Jan 53		
						May 53-Dec 56		

Station	Latitude	Longitude	Elevation	Ob.	Hrs.	Record Period	Select (1)	Source Used (2)
Cocos Is., Indian Ocean	12°11'S	96°50'E	26 ft.	8	00, 03, 06, 09, 12, 15, 18, 21	Feb 52-Feb 56 (less Jan 56)	36	C
Darwin, Australia	12°26'S	130°52'E	88 ft.	14	02, 03, 05, 06, 08, 09, 11, 12, 14, 15, 17, 18, 20, 21	Jan 54-Dec 57		C
Dakar, Senegal, Eknes Fld.	14°43'N	17°14'W	73 ft.	24		Apr 43-May 44	19	C
Dharan, Saudi Arabia	26°17'N	50°09'E		24		Sep 53-Aug 58	24	S
Dobodura, Papua, Horandu	05°00'S	145°00'E	20 ft.	24		Nov 42-Oct 44 Dec 44-Aug 45		S
Doroud Iran, Camp Gillies	33°28'N	49°03'E	4621 ft.	24 17		Dec 43-Apr 45 May 45-Dec 45		C
El Fasher, Anglo Egypt Sudan	13°38'N	25°21'E	2398 ft.	24		Apr 43-May 45		C
Eniwetok Atoll, Marshall Is.	11°21'N	162°15'E	11 ft.	24		Dec 52-Feb 53 Sep 53-Nov 56 Mar 57-Aug 58		S
Ensenada, Baja Cal.	31°51'N	116°38'W	26 ft.		01, 04, 07, 10, 13, 16, 19, 22	Jun 49-Aug 53	2	S

Station	Latitude	Longitude	Elevation	Ob.	Hrs.	Record Period	Select (1)	Source Used (2)
Espiritu Santo, New Hebrides	15°31'S	167°13'E	187 ft.	24		Jan 43-Feb 46 Apr 46-Jan 47		S
Fall River, New Guinea, Gurney St.	10°19'S	150°31'E	30 ft.	24		Aug 42-Jul 45	50	S
Flamingo Hill, Mayaguana	22°23'N	73°00'W	28 ft.	24		Jan 55-Nov 55 Jan 56-Feb 57		S
Forrest, Australia	30°50'S	128°06'E	515 ft.	8	00, 03, 06, 09, 12, 15, 17, 18, 24	Jan 54-Dec 57	42	C
Galapagos Is., Ecuador	0°0'	89°00'W	36 ft.	24		Nov 42-Apr 46 May 47-Oct 48		S
Gaya, India	24°45'N	84°57'E	371 ft.	24		Nov 42-Jan 46	27	S
Georgetown, Brit. Guiana, Atkinson AFB	06°48'N	58°10'W	7 ft.	24		May 44-Apr 49	7	S
Goldrock Creek, Grand Bahama	26°37'N	78°20'W	10 ft.	24		Dec 51 Mar 52-Nov 55 Jan 56-Feb 57		S
Grand Turk Is.	21°30'N	71°08'W	11 ft.	24		Nov 54-Feb 57		S
Guadalcanal, Solomon Is.	09°26'S	160°03'E	200 ft.	24		Oct 43-Nov 43 Jan 44-Dec 46 Dec 47-Sep 49		S

Station	Latitude	Longitude	Elevation	Ob.	Hrs.	Record Period	Select (1)	Source Used (2)
Guam, Marianas, Anderson AFB	13°31'N	144°49'E	67 ft.	24		Sep 53-Aug 58	44	S
Guantanamo Bay	19°54'N	75°09'W		24		Jan 52-Dec 56	12	S
Guatemala City, Guatemala	14°35'N	90°32'W	4901 ft.	24		Feb 42-Jan 46	3	S
Hankow, China	30°35'N	114°15'E	120 ft.	24		Oct 45-Dec 45		C
Hanoi, Indochina	21°03'N	105°52'E	23 ft.		01	Jul 51-Sep 54		S
					04	Jan 50-Jun 50		
						Aug 50-Apr 51		
						Jul 51-May 53		
						Jul 53-Sep 54		
						Nov 54-Dec 54		
					07, 13	Oct 49		
						Jan 50-Sep 54		
					19	Nov 54-Dec 54		
					10	Jul 51-Mar 52		
						May 52-Sep 54		
						Nov 54-Dec 54		
					16	Jul 51-Sep 54		
						Nov 54-Dec 54		
					22	Mar 53-Sep 54		
Hoang sa, Viet Nam	16°33'N	111°37'E	20 ft.	7	00	Nov 52-Oct 56		C
					03, 06, 09	Jan 52-Dec 55		
					12			
					15	Apr 53-Dec 55 (less Jun 54)		

Station	Latitude	Longitude	Elevation	Ob.	Hrs.	Record Period	Select (1)	Source Used (2)
					18	Apr 53-Dec 55		
					21	Apr 52-Dec 55 (less Jun 54)		
Hong Kong, China	22°18'N	114°10'E		24		Oct 29-Dec 32 Jan 37-Sep 38		S
Honolulu, Oahu, T.H., Hick Fld.	21°20'N	157°57'W	15 ft.	24		Aug 44-Jul 48	48	S
Horn Is. Australia	10°36'S	142°18'E	40 ft.	24		Aug 42-Sep 44	38	C
*Ipswich, Australia, Amberly Fld.	27°36'S	152°43'E	87 ft.	24		Mar 43-Jul 45	40	C
Istanbul, Turkey	40°28'N	28°49'E		24		Jan 50-Dec 54		S
Iwo Jima, Volcano Is.	24°47'N	141°20'E	348 ft.	24		Sep 53-Aug 58	46	S
Jacksonville, Fla.	30°25'N	81°38'W	39 ft.	24		58- 62		C
Johnston Is., AFB	16°44'N	169°31'W	8 ft.	24		Nov 51-Oct 56		S
Kagoshima, Japan	31°36'N	130°33'E	18 ft.	24		Jan 50-Dec 52		S
Karachi, Pakistan	22°48'N	66°59'E	13 ft.	24		May 42-May 46	28	S

*Missing observations for January, February, November, December

Station	Latitude	Longitude	Elevation	Ob.	Hrs.	Record Period	Select (1)	Source Used (2)
Khartoum, A. E. Sudan, Wadi Seidna	15°50'N	32°32'E	1261 ft.	24		Nov 42-Jul 45	21	C
Kingston, Jamaica BWI, Vernam Fld.	17°56'N	76°47'W	24 ft.	24		Oct 44-Sep 49		S
Koepang, Indonesia	10°11'S	123°40'E	7 ft.		08 14	Jan 49-Dec 53 May 49 Jul 49-Dec 53		S
Kunming, China AAB	25°02'N	102°43'E	6213 ft.	24		Dec 42-Nov 45 Jul 46-Dec 46 Jan 47-Nov 47 Jan 48-Mar 48	32	S
Kwajalein Atoll, Marshall Is.	08°43'N	167°44'E	10 ft.	24		Mar 45-Jun 45 Mar 46-May 46 Jul 47-Feb 48 Apr 48-Feb 50 Apr 50-Apr 52	45	S
Lalmanirhat, Pakistan	25°53'N	89°29'E		24		Jul 43-Mar 46		S
Lanchow, China (Liuchow)	36°03'N	103°41'E			05, 14, 20	Jan 34-Oct 35 Dec 36 Jan 40-Dec 42		S
Laoag, Luzon, P. I.	18°11'N	120°32'E	14 ft.	24 13 24		Apr 45-Dec 45 Jan 46-Feb 46 Mar 46-Aug 46 Nov 46-Apr 47		C

Station	Latitude	Longitude	Elevation	Ob	Hrs.	Record Period	Select (1)	Source Used (2)
LaSenia, Algeria AAB	35°39'N	00°38'W		24		Nov 42-Dec 45		S
Maiduguri, Nigeria	11°51'N	13°05'E	1162 ft.	24		May 43-Jun 45	20	S
Maison Blanche, Algeria	36°45'N	13°11'W		24		Apr 43-Jan 46		S
Managua, Nicaragua, Las Mercedes	12°08'N	86°12'W	178 ft.	24		Oct 42-Jan 46 Apr 46-May 46		S
Manila, P.I.	14°35'N	120°59'E		24		Jan 35-Dec 38	43	S
Masira Is., Arabia	20°39'N	58°54'E	53 ft.	24 15		Jun 43-Jun 45 May 43	25	S
Marrakech	31°39'	[illegible]		24		Jan 43-Jan 46	15	S
Marshall, Liberia Roberts Fld.	06°08'N	10°22'W	75 ft.	24		Jul 42-Aug 46 Oct 46-Mar 47	16	S
Manado, Indonesia	01°30'N	124°50'E	10 ft.		08 14	Jan 49-Dec 53 Jan 49-May 49 Jul 49-Dec 53		S
Merauke, Neth., New Guinea	08°29'S	140°25'E	10 ft.	24		Nov 42-Sep 45		S
Monclova, Coahuila	26°45'N	101°25'W	223 ft.		02, 05, 08, 11, 14, 17, 20, 23	Jan 49-Sep 53		S

Station	Latitude	Longitude	Elevation	Ob.	Hrs.	Record Period	Select (1)	Source Used (2)
Nandi, Fiji Is. AAB	17°45'S	177°27'E	51 ft.	24		Apr 42-May 46	49	S
Nanking, China	32°05'N	118°45'E		24		Sep 45-Aug 48		S
Natal, Brazil, Parnamirim Fld.	05°46'S	35°12'W	26 ft.	24		Aug 43-Apr 46 Jun 46-Sep 46		S
New Delhi, India, Willingden	28°35'N	77°12'E	760 ft.	24		Jul 42-Feb 46	28	S
Nha Trang, Indochina	12°15'N	109°12'E	20 ft.		01	Feb 53-Jun 55		S
					04	May 50-Apr 51 Sep 51-May 53 Jul 53-Jun 55		
					07	Nov 51-Oct 56		
					10	Apr 50 Jun 50-Dec 50 Feb 51-Mar 51 May 51 Jul 51-Jun 55		
					13	Jul 50-Jun 55		
					16	Jun 50 Aug 50-Oct 50 Dec 50-Apr 51 Jul 51-Jun 55		
					19	Jul 50-Jun 55		
Oklahoma City, Okla. Will Rogers Fld.	35°24'N	97°36'W	1304 ft.	24		58- 62		C
Okinawa, Ryuku Is.	26°35'N	128°00'E		24		Sep 53-Aug 58		S

Station	Latitude	Longitude	Elevation	Ob.	Hrs.	Record Period	Select (1)	Source Used (2)
Paramaribo, Surinam, Zandery Fld.	05°50'N	55°09'W	13 ft.	24		Sep 42-Jan 46 Jun 46-Feb 47		S
Penrhyn, Cook Is.	09°01'S	158°03'W	5 ft.	24		Aug 43-Aug 44 Oct 44-Jun 46		S
Poembut, New Caledonia, Plaines De Gaiaes Fld.	21°16'S	164°55'E	30 ft.	24		Nov 42-Nov 45		S
Recife, Brazil, Ibura Fld.	08°10'S	34°51'W	97 ft.	24		Aug 43-Jul 46	5	S
Rockhampton, Australia	23°24'S	150°30'E	44 ft.	24		May 43-Sep 45		C
Saigon, Indochina	10°49'N	106°40'E	36 ft.		01	Jan 51-Feb 51 Jul 51-Dec 52 Feb 53-Jun 55	31	S
					04	Jan 51-Feb 51 Jul 51-Dec 52 Feb 53-May 53 Jul 53-Jun 55		
					07	Nov 51-Oct 56		
					10	Apr 51 Jul 51-Sep 51 Nov 51 Mar 52 May 52-Jun 55		
					16	Feb 51 Apr 51 Jun 51-Jun 55		
					22	Apr 53-Jun 55		

Station	Latitude	Longitude	Elevation	Ob.	Hrs.	Record Period	Select (1)	Source Used (2)
St. George, Bermuda BWI, Kindley AFB	32°41'N	64°55'W	158 ft.	24		Jul 53-Jun 58	9	S
St. Lucia, BWI, Beane AFB	13°45'N	60°57'W	26 ft.	24		May 44-Apr 46 Jun 46-May 49	11	S
Salala, Arabia	17°03'N	54°06'E	55 ft.	24		Apr 43-May 45		C
San Antonio, Cuba, Batista AAB	22°53'N	82°32'W		24		Apr 43-May 46	10	S
Salinas, Ecuador	02°12'S	80°58'W	26 ft.	24		Apr 42-Jan 46		S
San Jose, Guat.	13°56'N	90°49'W	4 ft.	24		Aug 42-Jan 46 Apr 46-Jul 46		S
San Juan, P.R.	18°28'N	66°07'W	82 ft.	24		Jan 52-Dec 56		S
San Luis, Brazil, Tirirical Fld.	02°32'S	44°17'W		24		May 43-Apr 46 Jun 46-Aug 46		S
San Salvador Is.	13°43'N	89°09'W	2290 ft.	24		Mar 55-Nov 55 Jan 56-Feb 57		S
Santa Maria, Cal	34°[illegible]'N	120°28'W	259 ft.	24		58- 62		C
Shanghai, China	31°15'N	121°30'E	23 ft.	24		Jan 32-Dec 36	33	S
Sheikh Othman, (Aden Prot.)	12°52'N	44°58'E	33 ft.	24		Apr 43-Jun 45	22	C
Shionomisaki, Japan	33°27'N	135°46'E		24		Jul 49-Dec 52		S

Station	Latitude	Longitude	Elevation	Ob.	Hrs.	Record Period	Select (1)	Source Used (2)
Sian, China	34°15'N	108°55'E			03, 06, 09, 12, 15, 18, 21	Jan 40-Dec 42		S
Sidi Slimane, Fr. Morocco	34°10'N	05°55'W		24		Jan 53-Dec 57		S
Soto LaMarina	23°46'N	98°12'W	59 ft.		02 05, 11, 17, 23, 08, 14, 20	Jul 52-Sep 52 Nov 52-May 53 Jul 53-Sep 53 Nov 49-Sep 53 Jul 52-Sep 53		S
*Suichwan, China	26°25'N	114°30'E	440 ft.	24 12 14		Mar 44-Jun 44 Dec 44-Jan 45 Oct 43-Feb 44 Jan 46-Feb 46		C
Sydney, Australia, Mascot Fld.	33°57'S	151°12'E	14 ft.	16	00, 03, 06, 09, 12, 15, 18, 21, 24	Jan 54-Dec 57 Sep 43-Aug 45 (less Dec 43) Feb 44		C
Taihoku, Formosa	25°00'N	121°30'E	31 ft.	24		Jan 28-Dec 32	35	S
Talara, Peru	04°34'S	81°15'W	249 ft.	24		Nov 42-Nov 46 Apr 47-Sep 47	8	S

*Missing observations for July, August, September

Station	Latitude	Longitude	Elevation	Ob.	Hrs.	Record Period	Select (1)	Source Used (2)
Tehran, Iran, Mehralad	35°40'	51°25'	3850 ft.	24		Jan 51-Dec 55 Jan 52-Dec 52	23	S
Temosachic, Chihiahua	28°57'N	107°50'W			02, 05, 08, 11, 14, 17, 20, 23	Jan 49-Dec 51		S
Terceira, Azores, Lajes Fld.	38°40'N	27°20'W	3356 ft.	24		Jul 53-Jun 58		S
Tezpur, India	26°43'N	92°48'E	259 ft.	24		May 43-Sep 45		C
Tindouf, Algeria	27°41'N	08°09'W	1453 ft	24		Mar 43-Jun 45		C
Torreon, Coahuila	24°34'N	103°25'W	3773 ft.		02, 14	May 49-Aug 49 Feb 52-Sep 53		S
					05, 11, 17, 23	Jan 49-Sep 53		
					08, 20	Jul 52-Sep 53		
Townsville, Australia, Garbutt, Fld.	19°15'S	146°46'E	1[illegible] ft.	24		Jan 43-Sep 45 (less Nov 44)	37	S
Trinidad, BWI	10°36'N	61°12'W	67 ft.	24		Jan 45-Dec 49		S
Tripoli, Libya, Wheelers Fld.	32°54'N	13°17'E		24		Jan 53-Dec 57	14	S

Station	Latitude	Longitude	Elevation	Ob.	Hrs.	Record Period	Select (1)	Source Used (2)
Tsingtao, China, (U.S. Navy)	36°11'N	120°23'E	45 ft.	24 13 18 15 16		Jan 46-Apr 46 May 46-Aug 46 Apr 47-Jun 47 Jul 47-Oct 47 Nov 47-Mar 48		C
Vientiane, Laos, Vien Chen	17°57'N	102°34'E	558 ft.	8	00 03 06, 09, 12 15 18 21	Nov 52-Oct 56 Jan 52-Dec 55 Jan 52-Dec 55 Apr 53-Dec 55 Mar 53-Dec 55 Jan 52-Dec 55 (less Jun 53)		C
Villa Ahumada, Chihuahua	30°37'N	106°31'W	3940 ft.		02 05, 08, 11 14 17 20 23	Jan 49-Jan 50 Mar 50-Oct 50 Jan 49-Oct 51 Nov 51 Jan 49-Nov 50 Jan 49-Aug 51		S
Willemstad, Curacao	12°06'N	68°55'W	75 ft.	24		Sep 42-Jan 46		S
Zamboanga, Phillipine Is.	06°54'N	122°04'E	20 ft.	7	00, 03, 06, 09, 12, 18, 15	Jan 52-Dec 55 (less Jun 55) Apr 52-Dec 55 (less Jun 55)		