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QUARTERMASTER RESEARCH & ENGINEERING COMMAND

U S ARMY

TECHNICAL REPORT

EP-116

Canal Zone Analogs VII

ANALOGS OF CANAL ZONE CLIMATE IN INDONESIA, THE PHILIPPINES, AND BORNEO

QUARTERMASTER RESEARCH & ENGINEERING CENTER

ENVIRONMENTAL PROTECTION RESEARCH DIVISION

JUNE 1959

NATICK, MASSACHUSETTS

HEADQUARTERS
QUARTERMASTER RESEARCH & ENGINEERING COMMAND, U.S. ARMY
OFFICE OF THE COMMANDING GENERAL
NATICK, MASSACHUSETTS

Major General Andrew T. McNamara
The Quartermaster General
Washington 25, D.C.

Dear General McNamara:

This report, "Analogs of Canal Zone Climate in Indonesia, the Philippines, and Borneo", is the seventh of a series of studies comparing the climates of tropical areas with the climate of the Canal Zone.

The report presents information for military planners and test personnel on the extent to which the climates of Balboa Heights and Cristobal in the Canal Zone resemble those of Indonesia, the Philippines, and Borneo. Thus it suggests the applicability to other tropical regions of the results of clothing and equipment tests conducted in the Canal Zone.

Sincerely yours,

C. G. Calloway

C. G. CALLOWAY
Major General, USA
Commanding

1 Incl
EP-116

HEADQUARTERS
QUARTERMASTER RESEARCH & ENGINEERING COMMAND, US ARMY
Quartermaster Research & Engineering Center
Natick, Massachusetts

ENVIRONMENTAL PROTECTION RESEARCH DIVISION

Technical Report
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Canal Zone Analogs VII

ANALOGS OF CANAL ZONE CLIMATE IN INDONESIA, THE PHILIPPINES, AND BORNEO

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Geographer

Regional Environments Research Branch

Prepared for the Environmental Analogs Project (8-97-10-004) U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Mississippi

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FOREWORD

A successful research, development, or training program requires knowledge of the extent of environmental representativeness of test sites and training areas. The Quartermaster Corps, at the request of the Corps of Engineers, Waterways Experiment Station, under a directive from the U. S. Army General Staff, is developing a generalized, comparative, climatic picture of the wet tropics throughout the world by a series of tropical analog studies. The series parallels two other completed series which presented comparisons between (1) Yuma Test Station and other desert regions of the Northern Hemisphere, and (2) Fort Greely, Alaska, and Fort [illegible] Hill, Canada, and other arctic and subarctic regions.

This is the seventh report of the tropical series. It compares the Canal Zone climate with that of Indonesia, the Philippines, and Borneo and, by so doing, provides a climatic reference for military planners and test personnel.

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Approved:

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ABSTRACT

The climate of Indonesia, the Philippines, and Borneo is compared with that of two localities in the Canal Zone: Balboa Heights, representing the drier, leeward, Pacific side of the Isthmus of Panama, and Cristobal, representing the wetter, windward, Atlantic side. Distribution of areas of analogy of pertinent climatic elements and combinations of these elements are shown on maps.

Regional temperature differences are insignificant within Indonesia, the Philippines, and Borneo. Areas at low and moderate altitudes are consistently analogous with the Canal Zone stations; those areas at higher altitudes are consistently too cool for analogy.

Precipitation differences are more marked. The larger land areas of the midtropical East Indies (Borneo, Malaya, and Sumatra) are wetter than the rest of the study area. Analogy with Cristobal with respect to mean annual precipitation is widespread in those areas. However, the areas are not analogous with respect to number of wet months because much of the area has no dry season. Islands not on the Equator and the smaller, equatorial islands east of Borneo show pronounced precipitation seasonality and have numerous areas analogous to the Canal Zone, due to local differences in exposure to monsoon winds which blow alternately from Asia and Australia.

Local dryness is common in the Lesser Sunda Islands. This regional tendency to dryness is caused by dry monsoon winds from Australia which prevail for a long period. As in the rest of the East Indies, the driest spots in the Lesser Sundas are lowlands sheltered from both monsoons by mountains. Areas of analogy with Cristobal for annual precipitation are much less extensive in the Lesser Sundas than elsewhere. Most parts of this island group have too few wet months for analogy with either Canal Zone station.

For mean cloudiness and windspeed of the wettest month, and relative humidity of the driest month, analogy appears widespread between the Canal Zone and much of the study area, but not enough data are available to draw firm conclusions.

ANALOGS OF CANAL ZONE CLIMATE IN INDONESIA, THE PHILIPPINES, AND BORNEO

1. Purpose and scope

This report is the seventh of a series comparing the climate of tropical regions with that of Cristobal and Balboa Heights, Canal Zone. These two stations were selected to represent respectively the climates of the Atlantic and Pacific portions of the Canal Zone. The environment of Cristobal is described in a previous report (Wiley and others, 1955).

No attempt has been made to provide a regional climatology of Indonesia, the Philippines, and Borneo. Instead, the method has been to select certain climatic elements that are considered particularly significant and, for each of these, to map the areas within the region considered closely analogous to either Balboa Heights or Cristobal. Some of the information presented on these maps of single climatic elements has been consolidated into two composite maps, one for each of the two Canal Zone stations, showing areas where there is a coincidence of analogy for two to four climatic elements.

2. Position and physical geography

This study covers most of the land areas between Asia and Australia, except New Guinea, extending from 11° S. to 19° N. and from 95° E. to 134° E. It includes the tip of the Malay Peninsula and thousands of islands, which range in size from approximately 1 to 280,000 square miles (Borneo). The Philippines, Moluccas, Celebes, and Sunda Islands are major archipelagos within the region (Fig. 2). The term "East Indies" is used in this study to refer to the region as a whole.

a. Topography

The East Indies are part of a great system of mountain ranges which rise from the sea between the Indian and Pacific Oceans. Northeast Borneo has a volcanic cone higher than 13,000 feet. The volcanic range which forms the Indian Ocean coast of the Sunda Islands has three summits more than 12,000 feet high; Celebes has two cones over 11,000 feet. Luzon, Mindanao, and western New Guinea each have peaks which exceed 9,000 feet.

Except for the high linear volcanic range of the Sunda Islands, the pattern of ranges which form the East Indies is intricate. Central Borneo, Celebes, Halmahera, and Mindanao each have places in which four or more of the various intertwined mountain ranges converge from different directions. Volcanic cones are a conspicuous part of the mountain landscape in most parts of the East Indies, especially in Java; however, few areas in Borneo have volcanoes.

East and northeast of Borneo the islands slope steeply into deep water in various gulfs. Lowlands in that sector of the East Indies are small and scattered, whereas western Borneo and northeastern Sumatra, facing shallower seas, have extensive lowlands. Lowlands near mountains in the East Indies are generally well-drained, but the broad lowlands of Sumatra and Borneo have poorly drained deltaic coasts.

b. Climate

The principal climatic controls in the East Indies are the monsoon winds which blow alternately from Asia and Australia. The monsoon air is initially dry but becomes moist, largely because of evaporation from the warm seas over which it moves. Sea surface temperatures are above 80° F. all year throughout the East Indies, except around the northernmost Philippines. The southeasterly flow of air from Australia during the southern winter brings little rainfall to the Lesser Sunda Islands. When it reaches western Java it is moist. It crosses the Equator over the Moluccas, Celebes, Borneo, and Sumatra and becomes a south or southwesterly flow, primarily because of the rotational effect of the earth. After passing over the Philippines it is drawn into the northern-summer monsoon flow toward eastern Asia.

During the northern winter a flow of initially cold, dry air from Asia, plus some moist air from the northeast trades, follows almost the same path in reverse across the East Indies toward Australia. Its course over water north of the East Indies is long enough so that it is warm and moist when it reaches the Philippines.

Thus, in the Philippines, as in most of the East Indies outside the Lesser Sunda group, both monsoons are rain bearers. Slopes which face one monsoon or the other, especially at high levels, have many months of heavy rain. Throughout the East Indies the drier stations are those which are sheltered from both monsoons by mountains; the inner coasts of the Philippine Archipelago are the best example. In the Lesser Sundas, the dryness of such stations is intensified by the seasonal dryness of the region as a whole. Seasonality of rainfall in most of the other islands of the region is largely a matter of difference in duration of the monsoons plus local shelter from one of the monsoons.

Also important to the precipitation regime is the migrating belt of converging air, sometimes referred to as the equatorial trough of barometric pressure (intertropical front). The influence of this aspect of the general circulation is felt most during the transition periods between monsoons. The brief periods of heavy rainfall which occur during the passage of the equatorial trough are especially important in areas sheltered from both monsoon winds by mountains.

In late summer, the Philippines are subject to typhoons which may bring large amounts of rainfall, especially along the east coast. Similar storms occasionally reach Timor, the southernmost of the Lesser Sunda Islands.

Unlike precipitation, regional temperature differences are slight; those that exist are almost entirely a function of altitude. There is widespread analogy of mean relative humidity and cloudiness, and only scattered analogy of mean windspeeds in the study area.

3. Climatic summary of the Canal Zone

The Pacific portion of the Canal Zone, represented by Balboa Heights, has a moderately humid, tropical climate with a relatively dry season of four months (Fig. 1). The difference in mean monthly temperatures of the warmest and coldest months is only 2F°, and the range from the highest mean daily maximum (March and April, 90°F) to the lowest mean daily minimum (February, 71°F) is only 19F°. The mean annual temperature of 79°F is typical of equatorial areas. Precipitation, averaging 70 inches annually, is markedly seasonal. Two months, February and March, have less than 1 inch of rainfall, and 5 months have more than 8 inches. The dry season begins in December and ends in April. Rainfall during the remaining months is more than 7 inches; October and November both have more than 10 inches. Relative humidity is high from June through November. Cloudiness is at a maximum from May through November, coinciding with the wet season; sky coverage averages about 8 tenths at Balboa Heights at that season. Windspeed, however, is greatest during the dry season; winds average 9 to 10 mph at Balboa Heights from January through April, but only about 5 to 6 mph in the other months. Southeastward toward the coast, there is a slight decrease in rainfall and an increase in temperature, as elevation drops to sea level from 118 at Balboa Heights. Rainfall increases to the northwest, averaging 88 inches at Gamboa and 117 inches at Monte Lirio.

The Atlantic portion of the Canal Zone, represented by Cristobal, has a wet-tropical climate (Fig. 1). The difference in mean temperatures of the warmest and coolest months is only 2F°, and the range from the highest mean daily maximum (April, May, June, September, and October, 86°F) to the lowest mean daily minimum (October and November, 75°F) is only 11F°. The mean annual temperature of 81°F is typical of equatorial areas. Precipitation averages 130 inches a year, and the monthly distribution is uneven. Although no month can be considered completely dry, 2 months have less than 2 inches of rainfall, while 8 months have more than 11 inches. The "dry" season at Cristobal begins in January (3.4 inches) and ends in April (4.1 inches). During the remaining months, average rainfall ranges from nearly 12, to more than 22 inches in November. Mean relative humidity is high in all months; the lowest mean value, 77 percent, occurs in both February and March. Cloud

cover is greatest in July, 8 tenths, and least in February, 5.5 tenths. Mean windspeed is greatest in February and March (nearly 15 mph) and least in September (about 6 mph).

4. Criteria and methods

a. Climatic elements selected for study

As in the previous studies of this series, temperature, precipitation, humidity, cloud cover, and windspeed were the climatic elements considered most important to military activities. It was assumed that test authorities are more interested in stress periods (e.g., hottest and wettest) and in annual fluctuations than in the data for specific calendar months; accordingly, the warmest, coldest, wettest, and driest months of the year at each station were selected for study. The following specific combinations of element and month were studied:

(1) Mean temperature of the warmest month
(2) Mean daily maximum temperature of the warmest month
(3) Mean temperature of the coldest month
(4) Mean daily minimum temperature of the coldest month
(5) Mean daily temperature range of the warmest month
(6) Mean annual precipitation
(7) Mean precipitation of the wettest month
(8) Number of wet months
(9) Relative humidity of the driest month
(10) Mean cloud cover of the wettest month
(11) Mean windspeed of the wettest month

b. "Analogous" and "semianalogous" ranges defined

Classes were established defining the ranges of values considered to be closely analogous to those for Balboa Heights and Cristobal. Fairly narrow limits of analogy were used in order to keep comparisons closely representative of the two reference stations. Table I lists the classes of analogy and semianalogy selected for each element. For temperature, a departure of 4 degrees from the mean at the Canal Zone station was allowed for each analogy class (except where a mean was taken for the two reference stations), and an additional 4 degrees for semianalogy. For precipitation, the mean annual rainfall of 70 inches at Balboa Heights is somewhat below that normally considered humid equatorial (supporting dense evergreen forest) for a locality with a dry season; therefore, in this tropical deciduous forest the limits of analogy were set at 55 to 85 inches, differentiating it from most of the evergreen rain forest areas, on the upper margin, and savanna areas, on the lower margin. Cristobal, which has a tropical evergreen rain forest type of climate, has a mean annual rainfall of 130 inches. Departures of up to 30 inches of mean annual rainfall were

considered analogous to Cristobal, and an additional 30 inches was considered semianalogous. Departures of 5 percent in mean relative humidity, 1 tenth in amount of cloudiness, and 2 mph in windspeed were selected as ranges of analogy for these elements.

c. Explanation of maps

Values are shown for each station, with degree of analogy indicated by a symbol. Isopleths were drawn to show zones of close analogy, and these zones are shaded. Areas of semianalogy were not shaded but were indicated by placing the appropriate symbol on the map and legend for stations having semianalogous conditions. From the separate maps showing analogous areas for each element, two composite maps were prepared (one for Balboa Heights and one for Cristobal), indicating regions where the following four single elements are analogous: mean temperature of the warmest month, mean temperature of the coldest month, mean annual precipitation, and number of wet months.

d. Limitations of data

The procedures as outlined have certain definite limitations in a climatic comparison of this sort. Foremost among these is the necessity often encountered in climatology, of interpolating climatic conditions in areas having few if any stations.

A second limitation is that some elements, such as dew point, solar radiation, and visibility, which would have been valuable as indicators of climatic analogy, were not included in this study because of the limited amount of data available.

For certain elements the number of stations reporting does not provide a representative picture. Consequently, isopleths were not drawn for mean relative humidity for the driest month, mean cloudiness for the wettest month, or mean windspeed for the wettest month. The assumption has been made that Balboa Heights and Cristobal are representative of the Pacific and Atlantic portions of the Canal Zone. Values outside the limits of analogy or semianalogy were not analyzed, nor were combinations of climatic elements other than those involved in computing number of wet months.

The method of recording temperatures varies from country to country. Experience has shown that the difference between mean temperatures derived by these different ways is seldom more than 1 F° (Contreras Arias, 1942). Hours of observation of relative humidity, windspeed, and cloudiness vary widely throughout the study area.

5. Analysis of single-element maps

Individual maps showing analogous areas have been prepared for the climatic elements listed in paragraph 4a above, numbers 1 through 8. Maps of elements 9, 10, and 11 have been prepared showing only the values for individual stations, since the data were considered inadequate for delimiting analogous areas.

a. Mean temperature, warmest month (Fig. 3)

As indicated on Table I, Balboa Heights and Cristobal have almost the same mean temperature for the warmest month, 80° F. and 82° F. respectively. The map, therefore, shows only one zone of analogy, lying between the 77° F. and 85° F. isotherms. Analogous areas in the East Indies extend from sea level to approximately 2,000 feet. Significant local differences are not evident from available data.

b. Mean daily maximum temperature, warmest month (Fig. 4)

At Balboa Heights, the mean daily maximum temperature for the warmest month is 90° F.; at Cristobal, which has a less pronounced dry season, it is 86° F. Analogous areas are those which have temperatures within 4 F° of these means. The 82° to 90° F. range is analogous to Cristobal, the 86° to 94° F. range to Balboa Heights; the 86° to 90° F. range is analogous to both.

On Figure 4, the analogous zones are arranged altitudinally, Balboa Heights analogy at sea level, Cristobal analogy at high elevations, and dual analogy between the two. Although the boundaries shown are necessarily generalized, the lower limit of dual analogy is generally near 1,000 feet and the upper limit is 2,000 feet. The upper limit of Cristobal analogy is approximately 3,000 feet in most areas.

c. Mean temperature, coldest month (Fig. 5)

Balboa Heights and Cristobal have similar mean temperatures in their coldest months, 78° F. and 80° F. respectively. For simplicity, a single 8 F° zone of analogy centered on a mean of 79° F. (75° to 83° F.) is presented. As on the map for the warmest month (Fig. 3), analogy extends from sea level to roughly 2,000 feet. Since there is no apparent difference in the distribution of analogy on the two maps, the boundaries have been made almost identical.

d. Mean daily minimum temperature, coldest month (Fig. 6)

At Balboa Heights, the mean daily minimum temperature of the coldest month is 71° F.; at Cristobal it is 75° F. The 4 F° range of analogy used on both sides of each of these means extends analogy with Balboa

Heights to 67° F. and 75° F., and with Cristobal to 71° F. and 79° F. Stations with temperatures between 71° F. and 75° F. are analogous to both Canal Zone stations.

Two stations, Cuyo, Philippines, and Sarokka, Indonesia, on Figure 6 are analogous to Cristobal only. Dual analogy is the normal condition close to sea level except near mountains, where there is cooling by air drainage at night, in the season of least warmth. On mountainsides, Balboa Heights analogy extends from sea level up to an altitude generally near 2,000 feet. Higher levels are too cool for analogy.

e. Mean daily temperature range, warmest month (Fig. 7)

At Balboa Heights, the mean daily range of temperature in the warmest month is 16 F°; at Cristobal, with onshore marine winds, the range is only 8 F°. A range of 4 F° on either side of these means is considered analogous. The 12 F° isotherm therefore separates the two zones of analogy.

Balboa Heights analogy is the dominant condition throughout the East Indies. Ranges of less than 12 F°, analogous to Cristobal, occur at a few exposed coastal sites and on isolated heights. Ranges too high for analogy occur at certain stations sheltered from maritime influences.

f. Mean annual precipitation (Fig. 8)

At Balboa Heights, the mean annual precipitation is 70 inches; at Cristobal it is 130 inches. A 30-inch range on either side of the mean is considered analogous to Cristobal; a 15-inch range for Balboa Heights.

The rather complex distributions of Figure 8 deserve careful explanation because differences in precipitation amount and regime are the main causes of climatic contrasts among regions within the East Indies. (See also section 2b.)

Areas too dry for analogy are found only in the Lesser Sunda Islands, southern Celebes, and eastern Java. In that region, even slopes directly facing the southeast (Australian) monsoon are often analogous only to Balboa Heights. Such regional dryness is due to the fact that the southeast trades there are close to their source region in the deserts of Australia and prevail during a long season. Moist monsoon winds originating in the Northern Hemisphere, on the other hand, can reach the Lesser Sundas for only a short period when the equatorial trough of barometric pressure is in its southernmost position. Especially dry areas in the Lesser Sunda group are those which are either sheltered from both monsoons, or have too little relief to cause much precipitation. In the few areas of Cristobal analogy there are fairly high mountains.

Elsewhere in the East Indies, Balboa Heights analogy is the drier condition and exists mostly where stations are somewhat sheltered from one or both monsoons. The situation in the Philippines is the best illustration of this relationship. High mountains tend to be too wet for analogy; Cristobal analogy is an intermediate condition confined to the vicinity of mountains in the drier archipelagos (Philippines, Moluccas, Celebes) and extending over broad lowlands in the larger equatorial land masses of the East Indies (Borneo, Sumatra, southern Malaya).

g. Mean precipitation, wettest month (Fig. 9)

At Balboa Heights the mean precipitation of the wettest month is 11 inches; at Cristobal it is 22 inches. Analogy with Balboa Heights is from 8 to 14 inches and analogy with Cristobal from 15 to 29 inches.

Except that the dryness of the Lesser Sunda group is not as evident in Figure 9, the differences in distribution of analogy between Figures 8 and 9 are mostly local rather than regional in character, closely related to the exposure of particular places at the height of one monsoon or the other. At some places, the precipitation mapped occurs during the passage of the equatorial trough.

h. Number of wet months (Fig. 10)

In this series of analogs the term "wet month" is based on the Thornthwaite (1931) formula, having a base mean temperature of 68° and a mean monthly precipitation of 1.96 inches or more. Mean monthly precipitation for any given mean monthly temperature must be at least as high as the values indicated below in order to be called wet.

Mean monthly temperature (°F)	Mean monthly precipitation (in.)
95	2.88
90	2.71
85	2.54
80	2.37
75	2.20
70	2.03
68	1.96

Using the above definition, the areas of analogy for wet months are 8 to 10 wet months for Balboa Heights and 9 to 11 wet months for Cristobal.

Most of the equatorial East Indies have 12 wet months, according to the criteria used in this study, though many such stations nevertheless have strongly seasonal precipitation. The Lesser Sundas are mostly non-analogous because they have too many dry months; east Java and southern

Celebes are transitional zones with various degrees of analogy. The central and northern Philippines are mostly analogous; only the southern part of Mindanao and a narrow strip along the east coasts have 12 wet months. The immediate coast of northwestern Luzon has too many dry months for analogy, and the lowland of central Luzon is analogous to Balboa Heights. The rest of the archipelago is transitional between its southern and northern sections, having either tropical analogy or Cristobal analogy.

i. Relative humidity, driest month (Fig. 11)

The relative humidity of Balboa Heights is 75 percent in February, the month of least rainfall. The corresponding figure for Cristobal is 77 percent in February and March. Analogous stations are those at which the driest month has a mean humidity within 5 percent of one or the other of those means. Balboa Heights analogy thus extends from 70 to 80 percent and Cristobal analogy from 72 to 82 percent. No areas of analogy are mapped because of the sparsity of data and the difficulty of determining their comparability. The data shown indicate that analogy is widespread.

j. Mean cloudiness, wettest month (Fig. 12)

Balboa Heights and Cristobal both have about 8 tenths cloud cover in their wettest months. A range of 1 tenth on each side is considered analogous. No areas of analogy are drawn on the map because of sparsity of data, but inspection of the scattered stations shows that analogy is widespread.

k. Mean windspeed, wettest month (Fig. 13)

The mean windspeed of the wettest month at Cristobal is 8 mph. At Balboa Heights the corresponding figure is about 6 mph. A range of 2 mph on each side of each mean is considered analogous. Balboa Heights analogy thus extends from 4 to 8 mph and Cristobal analogy from 6 to 10 mph.

Although no areas of analogy are drawn on the map because of the lack of data, a number of widely dispersed analogous stations are shown.

6. Analysis of composite maps (Fig. 14 and 15)

Two maps, for Balboa Heights (Fig. 14) and Cristobal (Fig. 15), show the extent within the study area of composite analogy for the more important elements presented singly elsewhere. The elements for which areas of analogy are fully plotted on the composite maps are the mean temperatures of the warmest and coldest months, and mean annual precipitation. Because of the importance of seasonality of precipitation in the tropics, areas which are analogous for the number of wet months are also shown, but only

where they occur within areas analogous with respect to the other three elements. This is done because full presentation of a fourth element would make the maps difficult to read.

On Figures 14 and 15, thermal analogy is shown for the whole study area below approximately 2,000 feet. Only precipitation analogy is indicated above that level on the composite maps. Below 2,000 feet, areas of precipitation analogy show as areas of combined precipitation and thermal analogy. Thus, precipitation analogy plays the dominant role in determining regional differences. Areas that are analogous in terms of number of wet months as well as in terms of temperature and precipitation are considered to have climates resembling those of the Canal Zone. Many small areas of such analogy are found in the Philippines and Java, but there are few on the wetter islands. Other areas of Balboa Heights analogy occur on Bali, Lombok, and Timor in the Lesser Sunda Islands, in a strip across Malaya at the northern limit of the study area, and in southern Celebes. Additional areas of Cristobal analogy, all small, are to be found in southern Borneo, Celebes, and New Guinea.

7. Tables of monthly values

Tables II through IX show monthly and yearly means of climatic elements for 23 selected stations in the East Indies as well as for the two Canal Zone stations. These stations were chosen for length of reliable record and representativeness. In each table the mean values for the stations reveal certain characteristics of climate which are not shown on the maps. For example, a truer climatic picture is presented when one knows the length and time of occurrence of the dry seasons.

The stations given in the tables represent the following areas: Kuala Trenggan, the east coast of Malaya; Kualapana, its interior highlands; Singapore, its southern tip. Medan, in Sumatra, represents the coasts of the Strait of Malacca; Fort de Kock, the interior highlands of Sumatra; Padang, its west coast. Pontianak, Balikpapan, and Sandakan represent the west, east, and north coasts of Borneo respectively. Jakarta (Batavia), Pangrango, and Kajoemas are in Java, the first being on the north shore of its west end; the other two are highland stations, one western, the other eastern. Kupang represents the Lesser Sunda Islands; Makassa the southwest and Menado the northeast ends of Celebes; Amboina, the Moluccas; Puerto Princesa, Palawan. Cebu represents the central Philippine archipelago and Legaspi its east coast; Manila, the lowland of central Luzon; Baguio, its northern highlands; Zamboanga and Davao the southwest and southeast coasts of Mindanao respectively.

TABLE I: CLIMATIC ELEMENTS AND CLASSES OF ANALOGY

Station index	Balboa Heights			Cristobal		
	Value at B.H. (mean)	Analogous (range)	Semianalogous (range)	Value at Cris. (mean)	Analogous (range)	Semianalogous (range)
TEMPERATURE (°F)						
Mean, warmest month *	80	77-85	73-76 86-89	82	77-85	73-76 86-89
Mean daily maximum, warmest month	90	86-94	82-85 95-98	86	82-90	78-81 91-94
Mean coldest month *	78	75-83	71-74 84-87	80	75-83	71-74 84-87
Mean daily minimum coldest month	71	67-75	63-66 76-79	75	71-79	67-70 80-83
Mean daily range, warmest month	16	12-20	8-11 21-24	8	4-12	0-3 13-16
PRECIPITATION						
Mean annual (inches)	70	55-85	40-54 86-100	130	100-160	70-99 161-190
Mean, wettest month (inches)	11	8-14	5-7 15-17	22	15-29	8-14 30-36
Number of wet months	9	8-10	7 11	10	9-11	8 12
RELATIVE HUMIDITY (%)						
Mean, driest month	75	70-80	65-69 81-85	77	72-82	67-71 83-87
CLOUDINESS (tenths)						
Mean, wettest month	7.6	7.0-8.9	6.0-6.9 9.0-10.0	7.6	7.0-8.9	6.0-6.9 9.0-10.0
WINDSPEED (mph)						
Mean, wettest month	5.8	4-8	2-3 9-10	8	6-10	4-5 11-12

* See section 4b for explanation of ranges of analogy; sometimes a mean of the 2 reference station is used.

TABLE II: STATIONS USED IN TABLES OF MONTHLY VALUES

Stations	Elev. (ft)	Lat.	Long. (E)	Period of Record (Yrs) Temp	Precip.
Amboina Indonesia	10	3°42' S	128°10'	21	50
Baguio Philippine Is.	4,960	16°25' N	120°35'	23	36
BALBOA HEIGHTS Canal Zone	118	8°58' N	78°35' W	12-34	22-38
Balikpapan Indonesia	3	1°17' S	116°51'	7	45
Cebu Philippine Is.	30	10°18' N	123°54'	23	36
CRISTOBAL Canal Zone	36	9°25' N	79°52' W	7-32	8-60
Davao Philippine Is.	16	7°01' N	125°35'	10	34
Fort de Kock Indonesia	3,018	0°21' S	100°28'	8	45
Jakarta (Batavia) Indonesia	26	6°11' S	106°50'	55	50
Kajoemas Indonesia	3,051	7°57' S	114°09'	7	41
Kualapana (Fraser's Hill) Malaya	4,272	3°43' N	101°44'	9	9
Kuala Trenggan Malaya	105	5°20' N	103°08'	9	9
Kupang Indonesia	7	10°11' S	123°34'	21	50
Legaspi Philippine Is.	18	13°09' N	123°45'	23	36
Makassar Indonesia	13	5°08' S	119°24'	11	50
Manila Philippine Is.	47	14°35' N	120°59'	53	73
Medan Indonesia	82	3°35' N	98°40'	17	50
Menado Indonesia	30	1°30' N	124°50'	14	50
Padang Indonesia	10	0°56' S	100°22'	10	50
Pangrango Indonesia	9,918	6°45' S	106°58'	7	46
Pontianak Indonesia	10	0°01' S	109°20'	8	50
Puerto Princesa Phillipine Is.	44	9°44' N	118°38'	14	23
Sandakan British N. Borneo	104	5°50' N	118°07'	45	46
Singapore Malaya	10	1°19' N	103°52'	39	64
Zamboanga Philippine Is.	16	6°54' N	122°06'	23	36

TABLE XII: MEAN MONTHLY TEMPERATURE (°F)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
Amboina	82	82	82	80	80	78	77	77	78	80	81	82	80
Baguio	64	64	67	68	68	68	66	65	66	66	66	66	66
BALBOA HEIGHTS	78	79	80	80	79	79	79	79	79	78	78	78	79
Balikpapan	79	79	79	79	79	79	78	79	79	79	79	79	79
Cebu	79	79	80	82	83	82	82	82	81	81	81	80	81
CRISTOBAL	80	80	81	82	81	81	81	81	81	80	80	80	81
Davao	79	80	81	81	81	80	80	80	81	81	81	80	80
Fort de Kock	71	71	72	72	72	71	71	71	71	71	71	71	71
Jakarta (Batavia)	79	79	79	80	80	80	79	80	80	81	80	79	80
Kajoemas	68	68	69	69	69	69	68	69	71	72	71	69	69
Kualapana	64	66	66	69	69	69	68	68	68	68	67	65	67
Kuala Trenggan	77	78	80	81	82	82	81	81	81	80	78	78	80
Kupang	81	81	81	81	81	80	79	79	81	82	83	82	81
Legaspi	79	79	80	82	83	83	82	82	82	81	81	80	81
Makasser	79	79	79	80	80	79	78	78	78	79	80	79	79
Manila	78	78	81	83	84	83	82	81	81	81	79	78	81
Medan	77	78	79	80	80	80	79	78	78	78	77	77	78
Menado	79	79	79	80	80	80	80	81	81	80	80	80	80
Padang	79	80	80	80	80	80	79	79	79	79	79	79	79
Pangrango	47	48	48	49	50	49	48	48	48	47	47	47	48
Pontianak	80	82	81	82	82	82	82	82	81	81	81	80	81
Puerto Princesa	79	79	80	82	82	81	81	81	80	80	80	79	80
Sandakan	80	80	81	82	82	82	82	82	82	81	81	80	81
Singapore	79	80	81	81	82	82	81	81	81	81	81	80	81
Zamboanga	79	79	80	80	80	80	80	80	80	80	80	80	80

TABLE IV: MEAN DAILY MAXIMUM TEMPERATURE (°F)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
Amboina	88	88	88	86	84	82	81	81	83	85	87	88	85
Baguio	72	73	76	77	76	75	71	71	71	73	74	74	74
BALBOA HEIGHTS	88	89	90	90	87	86	87	87	86	85	85	87	87
Balikpapan	85	86	86	85	85	84	83	84	84	85	85	85	85
Cebu	85	85	86	88	89	88	87	88	87	87	87	86	87
CRISTOBAL	84	84	85	86	86	86	85	85	86	86	84	84	85
Davao	87	89	90	91	90	88	88	88	89	89	89	88	89
Fort de Kock	77	79	79	79	80	79	79	79	79	78	78	77	79
Jakarta (Batavia)	83	83	85	86	86	86	86	86	87	87	86	85	86
Kajoemas	72	72	73	75	75	75	75	76	78	80	78	74	75
Kualapana	70	72	73	74	75	75	74	74	74	73	72	70	73
Kuala Trenggan	83	85	87	89	90	89	88	89	88	86	84	83	87
Kupang	87	87	87	89	89	88	88	89	91	92	92	88	89
Leganpi	84	85	87	89	91	91	90	90	89	89	87	85	88
Makasser	84	84	85	86	87	86	86	86	86	87	86	84	86
Manila	86	88	91	93	93	90	88	87	87	88	87	86	89
Medan	85	87	88	89	89	89	89	89	88	86	86	85	87
Menado	85	85	85	86	87	87	87	89	89	88	87	86	87
Padang	87	87	88	87	88	88	87	87	86	86	86	86	87
Pangrango	52	54	54	56	57	57	57	57	57	56	54	51	55
Pontianak	86	88	88	88	89	89	89	89	88	88	87	86	88
Puerto Princesa	88	88	90	92	92	90	89	89	89	88	88	88	89
Sandakan	85	86	87	89	89	89	89	89	89	88	87	86	88
Singapore	86	88	88	88	89	89	88	87	87	87	87	87	87
Zamboanga	87	87	87	86	86	86	85	86	85	86	86	87	86

TABLE ": MEAN DAILY MINIMUM TEMPERATURE (°F)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
Amboina	76	76	76	75	75	74	73	73	74	74	75	76	75
Baguio	55	56	58	59	61	61	60	60	60	59	59	57	59
BALBOA HEIGHTS	72	71	72	74	74	74	74	74	7[illegible]	73	73	73	73
Balikpapan	73	73	73	73	74	74	73	74	74	74	73	73	73
Cebu	73	73	74	76	77	76	76	76	76	75	75	74	75
CRISTOBAL	76	77	77	78	77	76	77	76	76	75	76	77	76
Davao	71	71	71	72	73	73	72	72	72	72	72	72	72
Fort de Kock	64	64	64	65	65	65	63	63	64	64	65	65	64
Jakarta (Batavia)	74	74	74	74	74	74	73	73	73	74	74	74	74
Kajoemas	64	64	64	64	64	63	62	62	63	65	65	65	64
Kualapana	60	61	62	63	64	63	62	62	62	62	62	61	62
Kuala Trenggan	72	71	73	73	74	73	73	73	73	73	73	72	73
Kupang	75	75	74	72	72	71	70	70	71	72	74	75	73
Legaspi	73	72	74	75	75	75	75	75	74	74	74	74	74
Makasser	74	75	74	74	74	72	70	69	70	72	74	74	73
Manila	69	69	70	73	75	75	75	75	75	74	72	70	73
Medan	71	71	72	73	73	72	72	72	72	72	72	72	72
Menado	73	73	73	73	73	73	73	73	73	72	73	73	73
Padang	74	74	74	75	75	74	74	73	74	74	74	74	74
Pangrango	44	45	44	45	45	44	43	43	42	43	43	43	44
Pontianak	74	74	74	75	75	75	74	74	74	74	74	74	74
Puerto Princesa	70	69	70	72	72	72	72	72	72	72	72	71	71
Sandakan	74	74	75	76	76	75	75	75	75	75	75	74	75
Singapore	73	73	74	75	75	75	75	75	75	74	74	73	74
Zamboanga	72	72	72	74	74	74	74	74	74	73	73	73	73

TABLE VI: MEAN MONTHLY PRECIPITATION (INCHES)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
Amboina	5.0	4.7	5.3	11.0	20.3	25.1	23.7	15.8	9.5	6.1	4.5	5.2	136.1
Baguio	0.9	0.9	1.7	4.3	15.8	17.2	42.3	45.7	28.1	15.0	4.9	1.9	178.7
BALBOA HEIGHTS	1.0	0.6	0.7	2.9	8.0	8.4	7.3	7.8	8.2	10.2	10.5	4.7	70.3
Balikpapan	8.1	7.1	9.3	7.3	8.5	7.4	6.8	6.3	5.2	5.5	6.4	7.8	85.7
Cebu	4.2	2.9	2.0	1.7	4.5	6.4	7.3	5.6	6.9	7.7	6.4	5.0	60.6
CRISTOBAL	3.4	1.5	1.5	4.1	12.5	13.9	15.6	15.3	12.8	15.8	22.3	11.7	130.4
Davao	4.8	4.5	5.2	5.8	9.2	9.1	6.5	6.5	6.7	7.9	5.3	6.1	77.5
Fort de Kock	9.1	6.6	8.6	9.8	7.2	5.3	3.7	6.1	6.4	8.9	8.7	9.8	90.4
Jakarta (Batavia)	12.0	12.6	8.3	5.5	4.2	3.6	2.6	1.7	2.7	4.7	5.6	7.8	71.4
Kajoemas	18.8	17.6	18.1	8.6	5.8	2.5	1.6	0.6	0.5	1.9	7.9	10.3	99.4
Kualapana	12.0	7.0	10.4	11.6	9.5	5.4	3.3	6.2	6.1	11.7	12.2	10.4	105.9
Kuala Trenggan	9.2	3.4	7.3	4.6	4.7	5.1	6.2	7.0	5.8	14.8	27.2	24.7	120.0
Kupang	15.3	14.4	8.7	[illegible]	[illegible]	0.4	0.2	0.1	0.1	0.7	3.5	9.7	56.8
Legaspi	15.4	11.5	7.7	[illegible]	6.4	7.9	10.2	7.9	10.2	13.7	18.3	20.3	135.5
Makasser	27.0	21.1	16.7	[illegible]	3.5	2.9	1.4	0.4	0.5	1.7	7.0	23.9	112.2
Manila	1.0	0.5	0.7	1.2	5.1	9.9	17.0	16.6	14.4	7.7	5.6	2.5	82.1
Medan	5.4	3.6	4.1	5.2	6.9	5.2	5.3	7.0	8.3	10.2	9.7	9.0	79.9
Menado	18.3	14.0	12.0	7.8	6.3	6.4	4.7	3.8	3.4	4.8	8.6	14.6	104.8
Padang	13.8	10.2	12.8	14.3	12.4	12.1	10.9	13.7	16.0	19.5	20.4	18.9	174.3
Pangrango	18.5	19.7	15.0	12.2	7.8	3.9	2.2	4.8	5.8	9.6	15.9	18.2	133.5
Pontianak	11.2	8.3	9.9	11.2	11.0	8.8	6.7	8.3	8.6	14.7	15.7	13.3	128.3
Puerto Princesa	2.4	1.5	1.6	2.1	6.6	7.8	8.7	7.1	8.4	10.3	10.8	10.0	77.3
Sandakan	19.0	10.9	8.6	4.5	6.2	7.4	6.7	7.9	9.3	10.2	14.5	18.5	123.7
Singapore	9.9	6.8	7.6	7.4	6.2	6.8	6.7	7.7	7.0	8.2	10.0	10.1	95.0
Zamboenga	2.1	2.2	1.5	2.0	3.5	4.2	4.9	4.0	4.7	5.6	4.2	3.4	42.4

TABLE VII: MEAN CLOUDINESS (tenths of sky covered)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
Amboina	4.6	4.7	4.2	4.9	5.3	7.1	7.8	6.9	6.2	4.8	3.5	3.5	5.2
Baguio	5.2	5.4	5.3	5.9	7.0	7.4	8.6	8.9	8.4	7.1	5.5	5.2	6.7
BALBOA HEIGHTS	4.8	4.8	5.0	6.3	7.6	8.0	7.6	7.7	7.7	7.7	7.6	6.3	6.8
Balikpapan*	---	---	---	---	---	---	---	---	---	---	---	---	---
Cebu	6.1	5.8	5.2	4.8	5.6	6.6	7.3	6.9	7.2	6.7	6.2	6.4	6.2
CRISTOBAL	5.9	5.5	5.8	6.4	7.8	7.9	8.0	7.6	7.1	7.4	7.6	6.8	7.0
Davao	6.4	5.2	5.2	6.1	6.0	6.4	6.4	6.2	6.2	6.2	6.4	6.7	6.1
Fort de Kock*	---	---	---	---	---	---	---	---	---	---	---	---	---
Jakarta (Batavia)	7.9	7.9	7.1	6.4	5.8	5.5	4.9	4.9	5.2	6.0	7.1	7.7	6.4
Kajoemas*	---	---	---	---	---	---	---	---	---	---	---	---	---
Kualapasa	8.3	7.5	8.0	8.2	7.7	7.6	7.4	7.6	7.9	8.3	8.5	8.6	8.0
Kuala Trenggan	7.0	5.3	5.9	5.8	6.6	6.6	7.0	6.5	7.4	8.0	7.7	7.8	6.8
Kupang*	---	---	---	---	---	---	---	---	---	---	---	---	---
Legaspi	5.6	5.4	4.4	3.4	4.2	5.1	6.4	6.0	6.4	5.7	5.8	6.0	5.4
Makasser*	---	---	---	---	---	---	---	---	---	---	---	---	---
Manila	5.5	4.9	4.5	4.0	5.7	7.0	7.8	7.8	7.5	6.7	6.4	6.2	6.2
Medan	6.0	4.0	4.0	4.0	4.0	3.0	3.0	4.0	4.0	5.0	5.0	5.0	4.0
Menado	5.0	5.0	4.8	3.2	3.6	3.4	2.7	2.1	3.0	3.6	3.6	3.8	3.7
Padang	4.0	3.0	3.0	3.0	2.0	3.0	3.0	3.0	4.0	4.0	4.0	4.0	3.0
Pangrango*	---	---	---	---	---	---	---	---	---	---	---	---	---
Pontianak*	---	---	---	---	---	---	---	---	---	---	---	---	---
Puerto Princesa	6.4	6.2	6.2	5.9	7.3	8.1	8.3	8.1	8.0	7.7	7.6	7.3	7.3
Sandakan	6.0	4.6	4.0	3.9	3.9	4.4	4.7	4.9	5.3	4.3	5.4	5.3	4.7
Singapore	5.8	5.1	4.9	5.1	5.2	5.4	5.2	5.4	5.4	5.6	6.2	6.2	5.5
Zamboanga	6.6	6.3	6.1	6.2	7.0	7.5	7.8	7.6	7.7	7.5	7.2	6.7	7.0

*No data available

TABLE VIII: MEAN RELATIVE HUMIDITY (PERCENT)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
Amboina	80	79	80	84	86	86	85	83	84	83	82	80	83
Baguio	81	81	81	83	87	88	92	94	93	88	81	80	86
BALBOA HEIGHTS	78	75	73	77	85	87	86	87	87	88	83	84	83
Balikpapan	89	88	89	90	90	89	88	86	84	86	88	87	88
Cebu	76	75	73	73	75	76	77	76	77	78	78	78	76
CRISTOBAL	78	77	77	79	83	85	86	86	85	85	86	82	82
Davao	82	82	81	80	82	84	84	84	83	82	84	84	83
Fort de Kock	82	80	80	81	80	79	78	80	81	82	82	82	81
Jakarta (Batavia)	88	88	88	85	84	84	81	79	78	80	83	85	84
Kajoemas	88	88	86	80	80	76	72	69	65	65	75	80	77
Kuala[illegible]	95	91	91	91	89	87	87	88	87	90	93	94	90
Kuala Trenggan	85	84	83	84	83	84	86	86	87	89	90	89	86
Kupang	81	81	81	71	68	65	62	59	60	65	69	78	70
Legaspi	82	81	80	78	79	81	82	82	83	83	83	84	82
Makasser	86	84	85	83	82	79	76	72	70	75	81	85	80
Manila	78	74	71	70	75	81	85	85	86	84	83	81	80
Medan	85	83	82	82	83	82	81	82	84	86	86	86	83
Menado	91	89	86	89	88	85	79	76	78	81	88	90	85
Padang	79	79	79	80	79	77	77	77	80	81	81	81	79
Pangrango	94	92	93	89	82	79	70	72	76	85	91	92	84
Pontianak	86	86	87	88	87	87	86	85	86	87	89	89	87
Puerto Princesa	80	79	79	78	82	83	82	82	82	84	84	83	82
Sandakan	82	81	79	77	78	79	78	78	78	79	81	82	79
Singapore	82	79	79	81	80	80	79	79	79	80	82	83	80
Zamboanga	83	83	82	84	85	83	86	84	86	86	86	84	84

TABLE IX: MEAN WINDSPEED (mph)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
Amboina*	---	---	---	---	---	---	---	---	---	---	---	---	---
Baguio	8.8	8.8	8.6	8.1	8.1	8.8	11.2	12.1	9.3	7.7	8.6	8.9	9.1
BALBOA HEIGHTS	6.8	10.1	10.3	8.8	6.1	5.4	5.9	5.9	5.6	6.3	5.8	6.4	7.1
Balikpapan*	---	---	---	---	---	---	---	---	---	---	---	---	---
Cebu	8.0	7.8	8.0	7.3	6.3	6.5	8.8	9.2	7.7	6.8	6.8	7.2	7.5
CRISTOBAL	14.1	14.8	14.8	12.5	8.0	6.6	8.1	7.9	6.1	6.6	8.0	11.8	9.9
Davao	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Fort de Kock*	---	---	---	---	---	---	---	---	---	---	---	---	---
Jakarta (Batavia)	2.5	2.5	2.5	2.5	2.5	2.2	2.5	2.9	2.9	2.7	2.5	2.5	2.6
Kajoenas*	---	---	---	---	---	---	---	---	---	---	---	---	---
Kualapana*	---	---	---	---	---	---	---	---	---	---	---	---	---
Kuala Trenggan*	---	---	---	---	---	---	---	---	---	---	---	---	---
Kupang*	---	---	---	---	---	---	---	---	---	---	---	---	---
Legaspi	7.6	7.3	6.9	6.2	4.5	4.3	5.8	6.0	5.5	5.6	6.6	7.5	6.2
Makasser	4.0	3.4	2.9	2.5	2.2	2.5	2.7	3.4	3.4	3.8	3.1	3.4	3.1
Manila	4.0	4.7	5.3	5.7	5.5	5.6	7.0	7.6	6.4	4.2	3.9	3.7	5.3
Medan	2.9	2.9	2.9	3.1	2.9	2.9	2.9	2.9	2.9	2.5	2.7	2.9	2.9
Menado*	---	---	---	---	---	---	---	---	---	---	---	---	---
Padang*	---	---	---	---	---	---	---	---	---	---	---	---	---
Pangrango*	---	---	---	---	---	---	---	---	---	---	---	---	---
Pontianak*	---	---	---	---	---	---	---	---	---	---	---	---	---
Puerto Princesa	3.5	3.5	3.5	3.5	2.3	2.3	3.5	2.3	2.3	2.3	3.5	2.3	2.9
Sandakan*	---	---	---	---	---	---	---	---	---	---	---	---	---
Singapore*	---	---	---	---	---	---	---	---	---	---	---	---	---
Zamboanga	4.1	4.4	4.8	4.8	4.7	4.6	5.8	5.5	5.8	5.5	5.0	4.0	4.9

*No data available

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9. Acknowledgments

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10. Maps

Figure	
2	Station Locations
3	Mean Temperature, Warmest Month
4	Mean Daily Maximum Temperature, Warmest Month
5	Mean Temperature, Coldest Month
6	Mean Daily Minimum Temperature, Coldest Month
7	Mean Daily Temperature Range, Warmest Month
8	Mean Annual Precipitation
9	Mean Monthly Precipitation, Wettest Month
10	Number of Wet Months
11	Relative Humidity, Driest Month
12	Mean Cloudiness, Wettest Month
13	Mean Wind Speed, Wettest Month
14	Composite of Analogous Areas - Balboa Heights
15	Composite of Analogous Areas - Cristobal

CLIMATIC SUMMARY

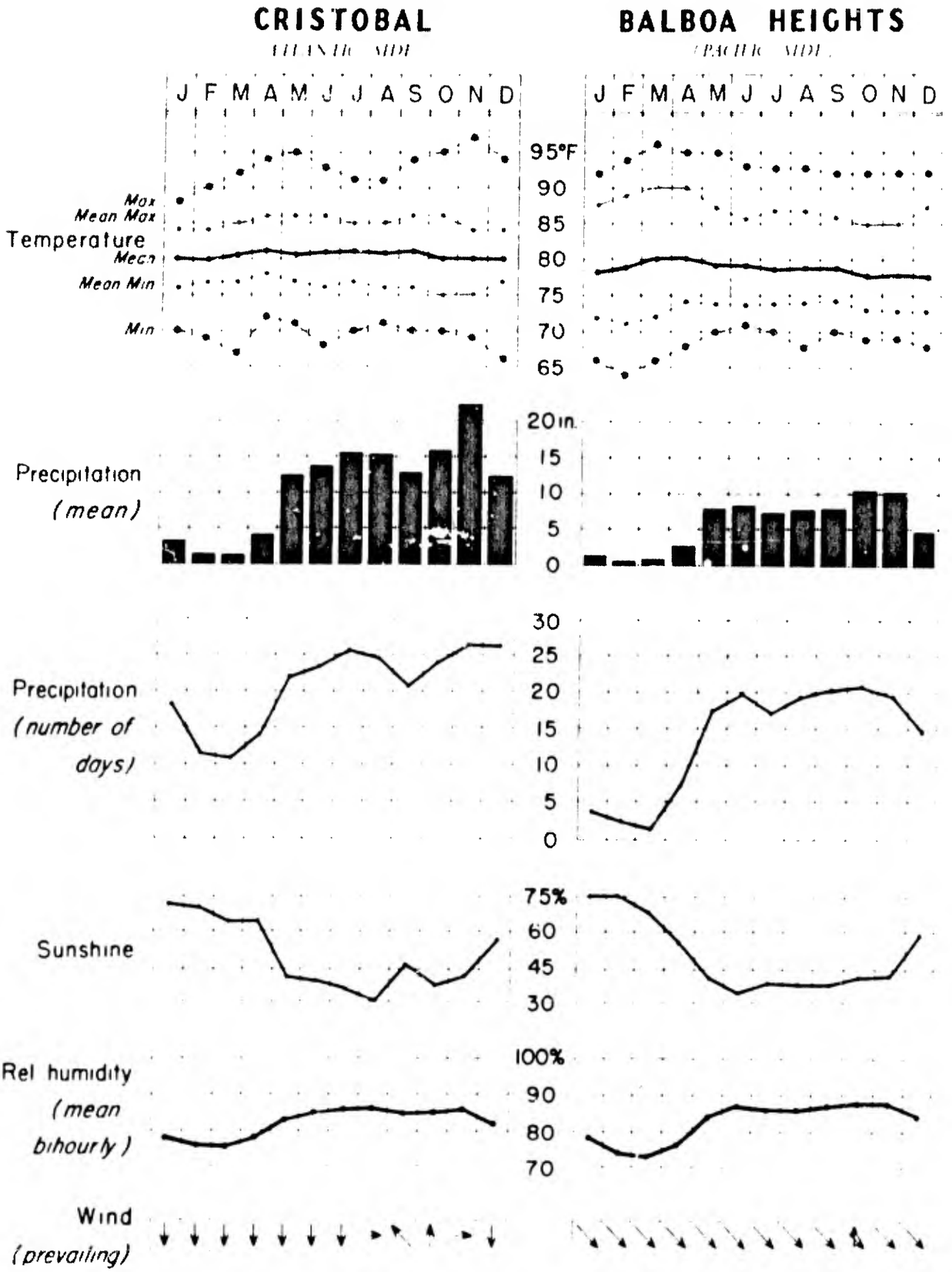
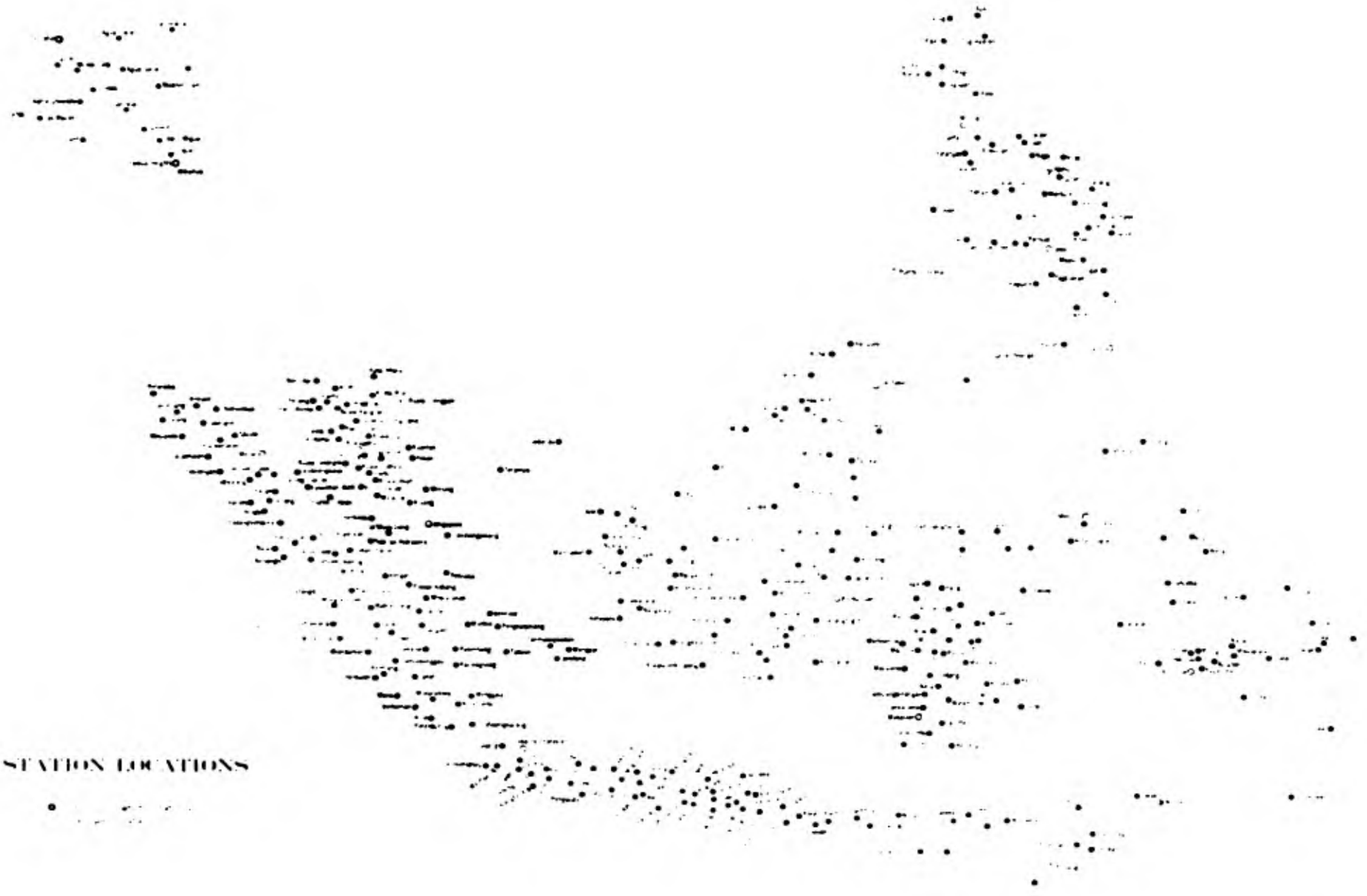
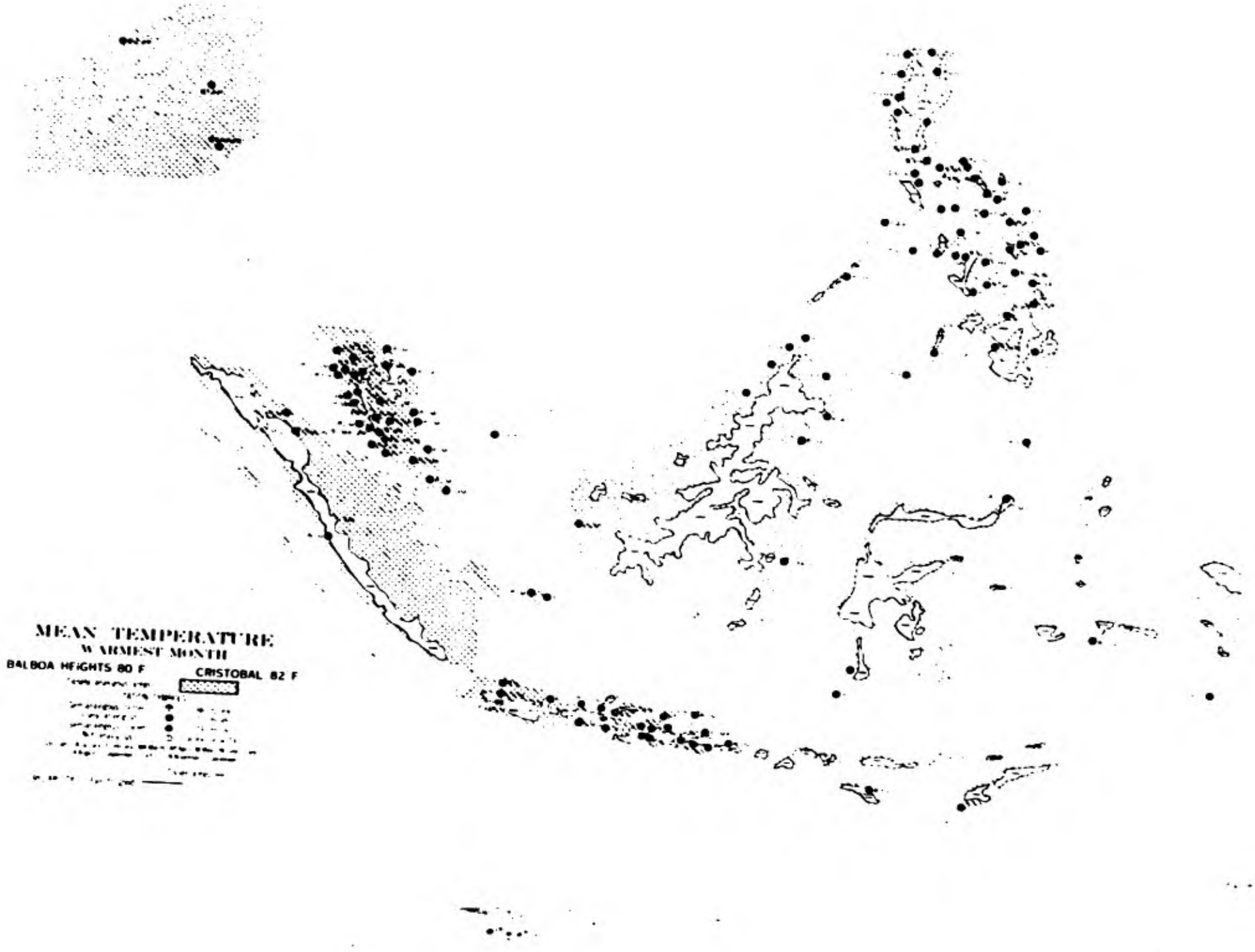
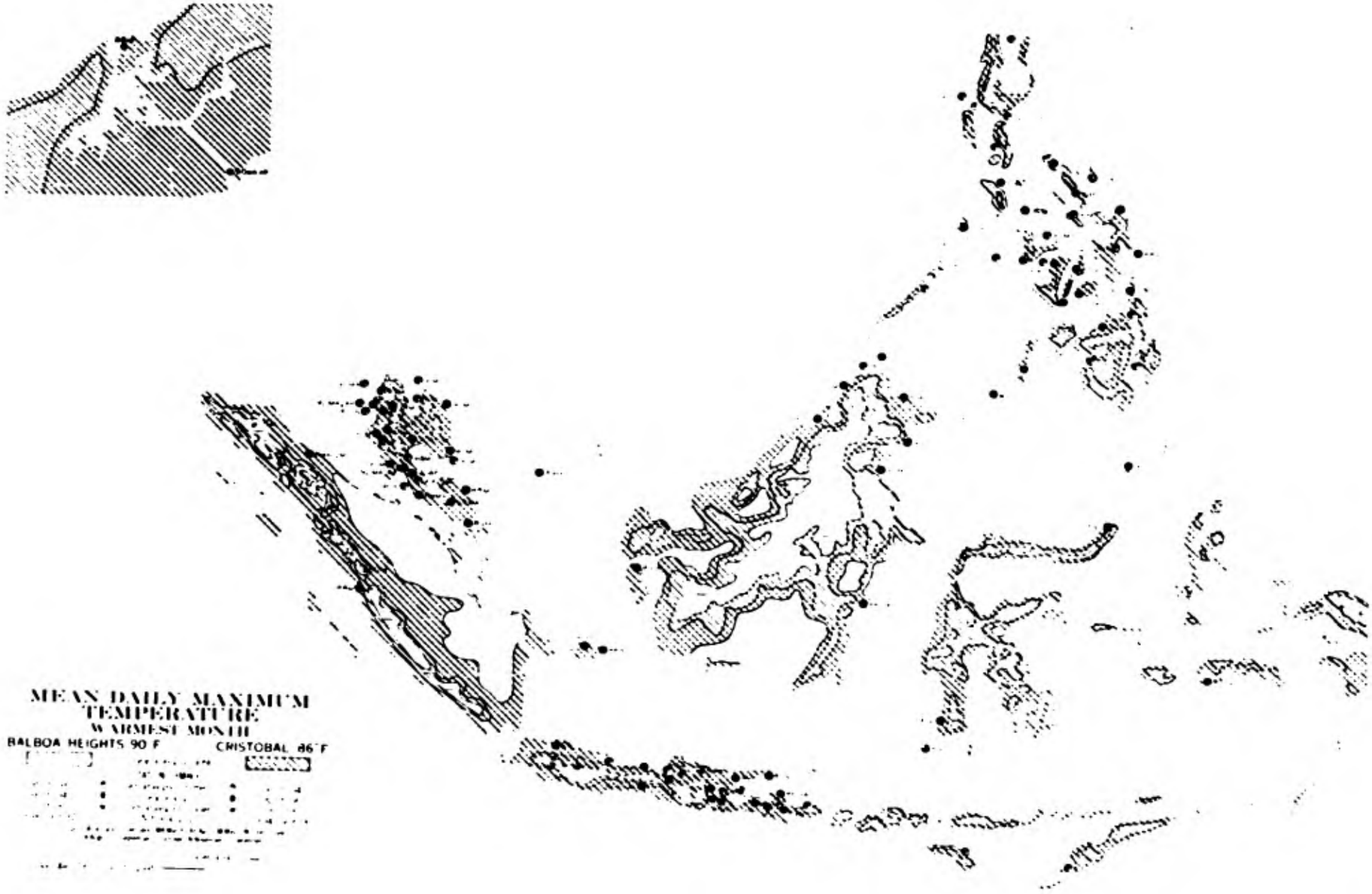
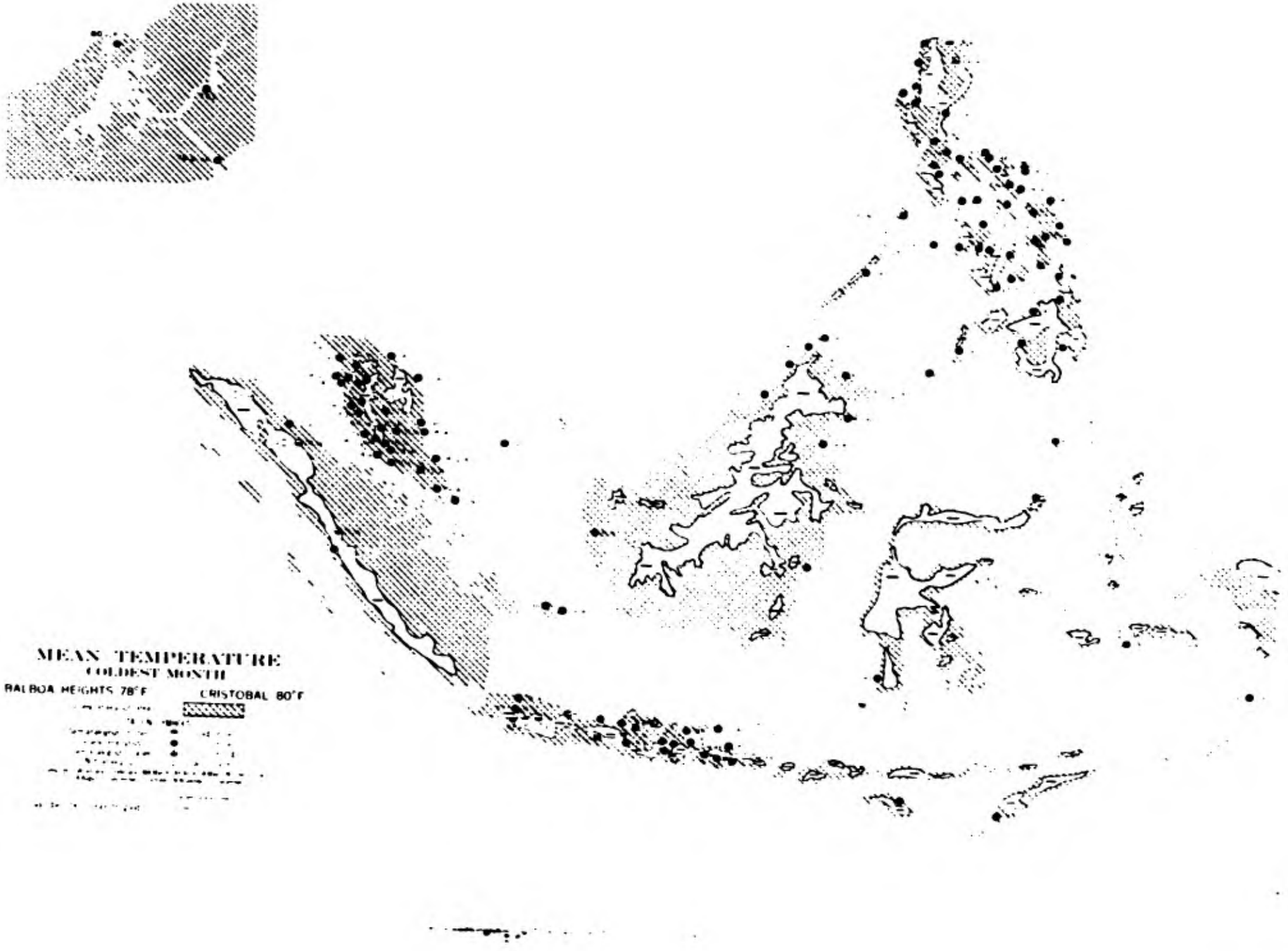


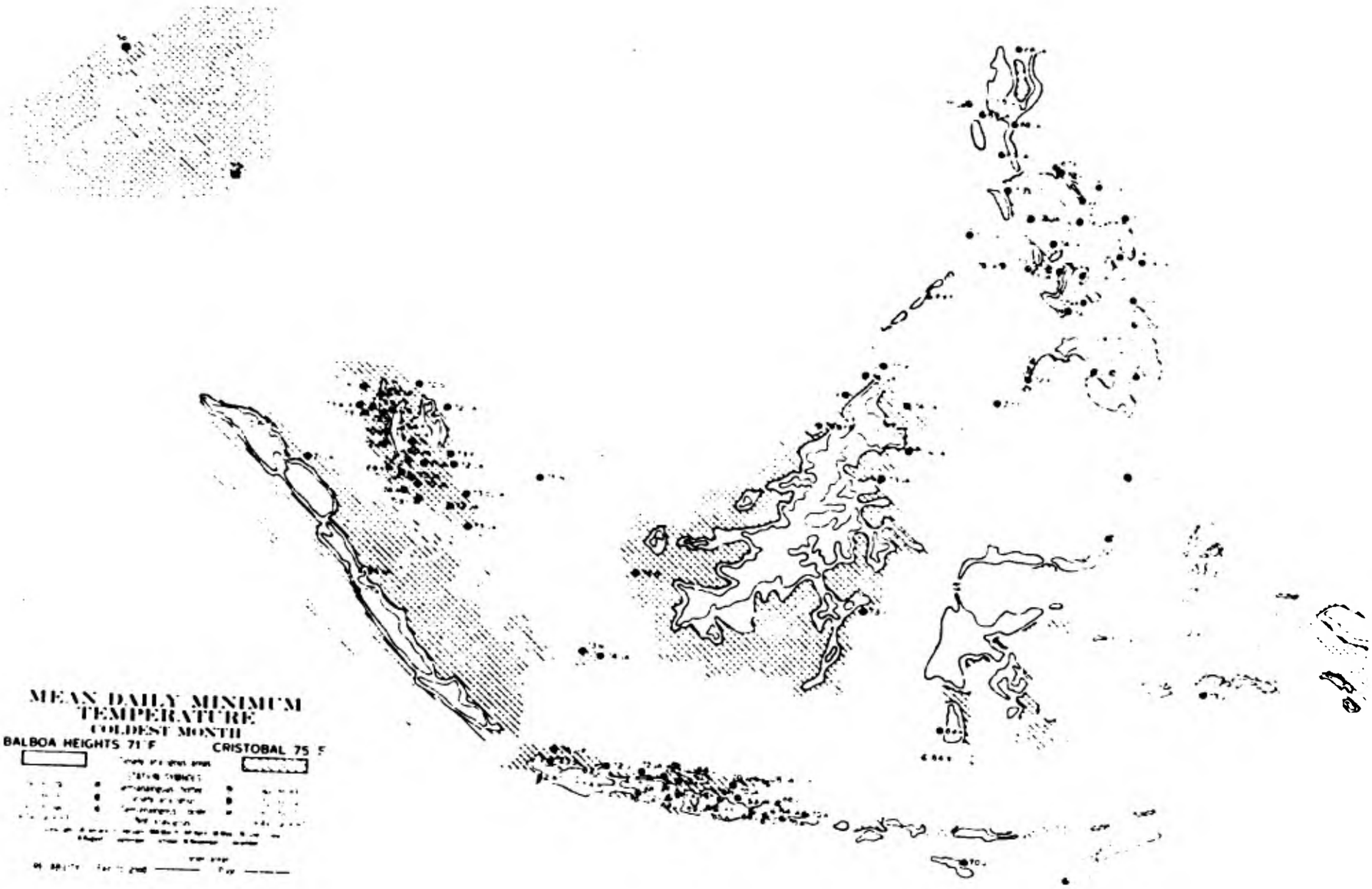
Figure 1

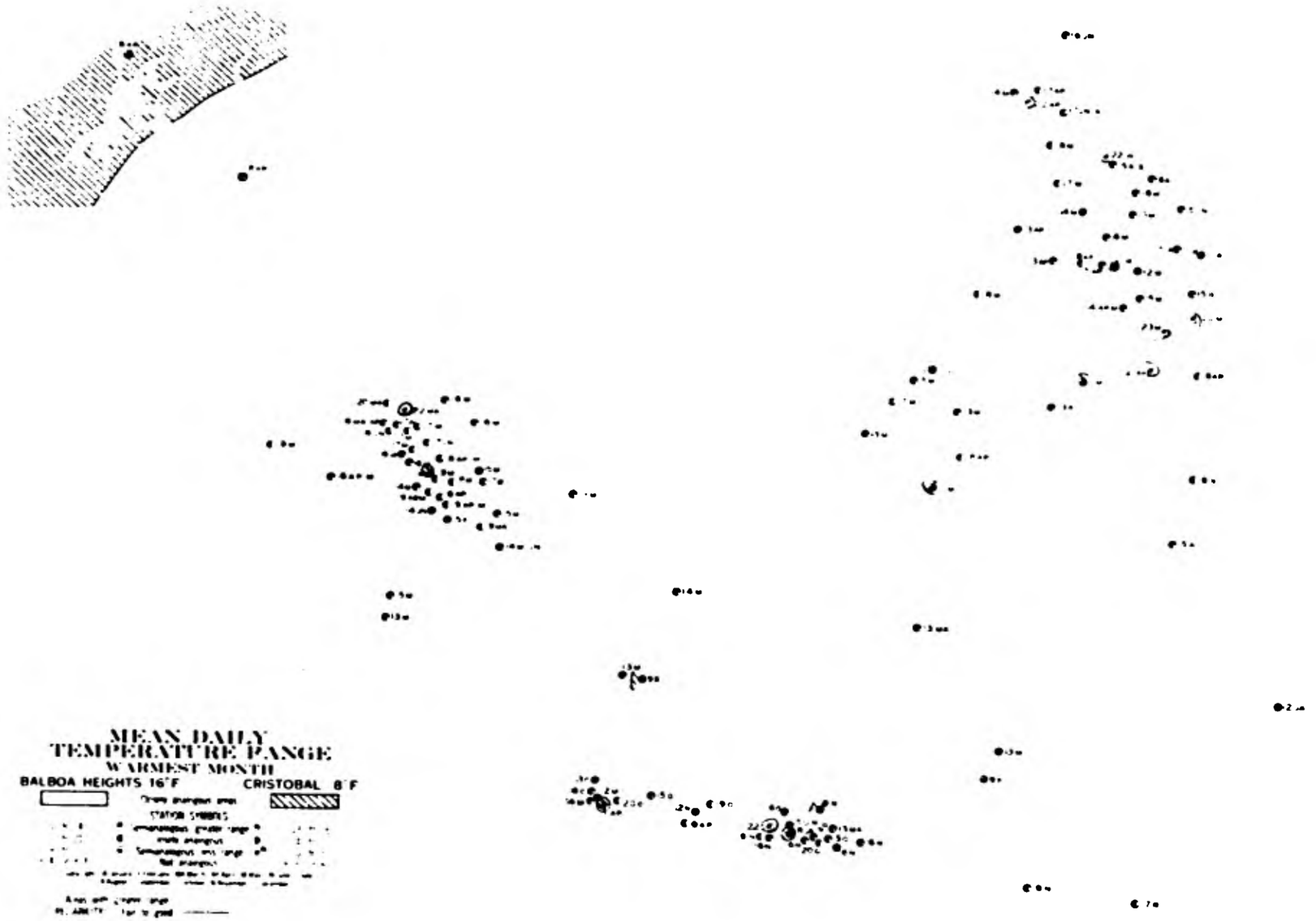

STATION LOCATIONS


MEAN TEMPERATURE
WARMEST MONTH
BALBOA HEIGHTS 80 F
CRISTOBAL 82 F


MEAN DAILY MAXIMUM
TEMPERATURE
WARMEST MONTH
BALBOA HEIGHTS 90 F
CRISTOBAL 86 F


MEAN TEMPERATURE
COLDEST MONTH
BALBOA HEIGHTS 78°F
CRISTOBAL 80°F


MEAN DAILY MINIMUM
TEMPERATURE
COLDEST MONTH
BALBOA HEIGHTS 71°F
CRISTOBAL 75°F


MEAN DAILY
TEMPERATURE RANGE
WARMEST MONTH
BALBOA HEIGHTS 16°F
CRISTOBAL 8°F


MEAN ANNUAL
PRECIPITATION
BALBOA HEIGHTS
70 INCHES
CRISTOBAL
130 INCHES

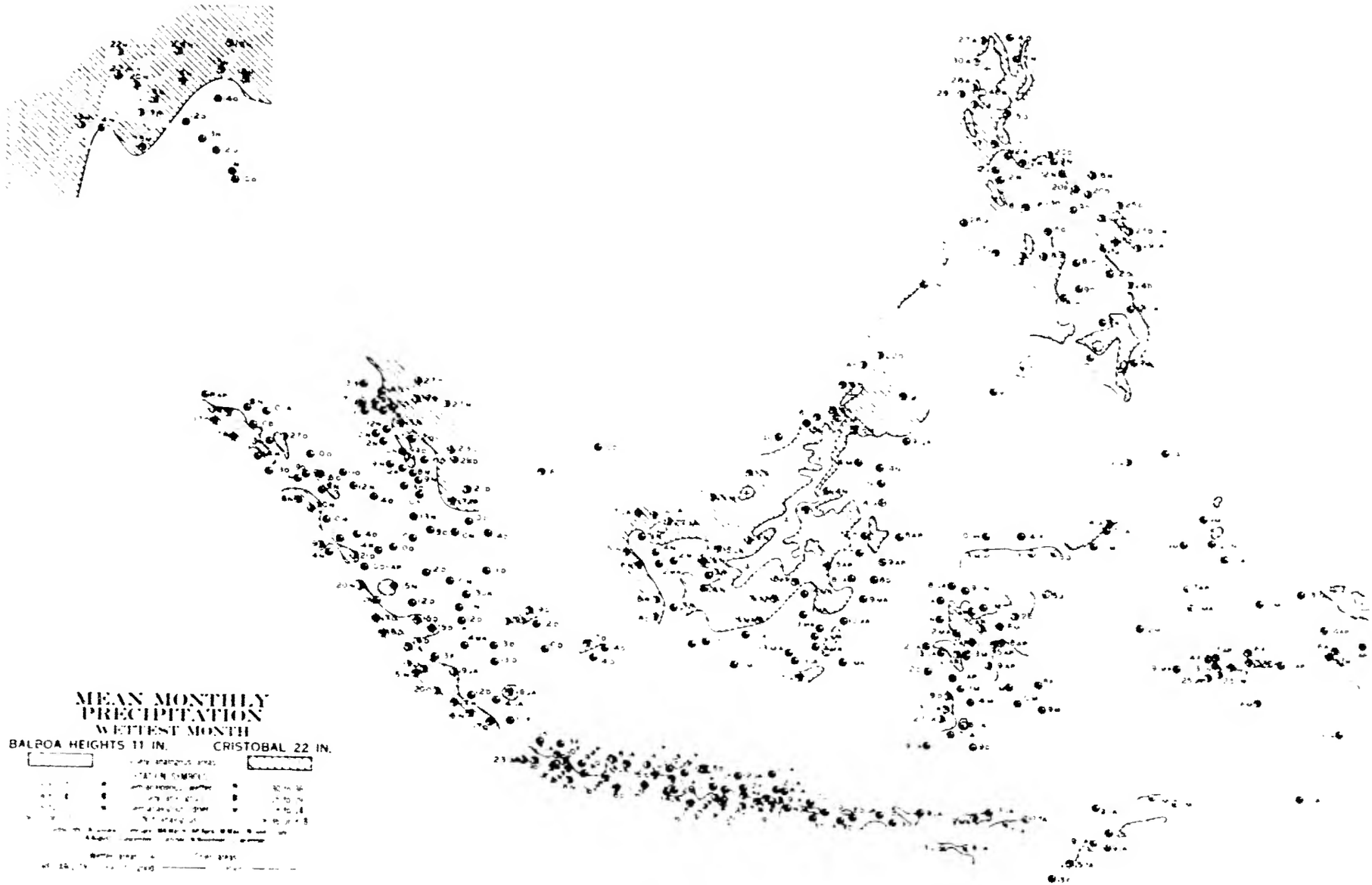
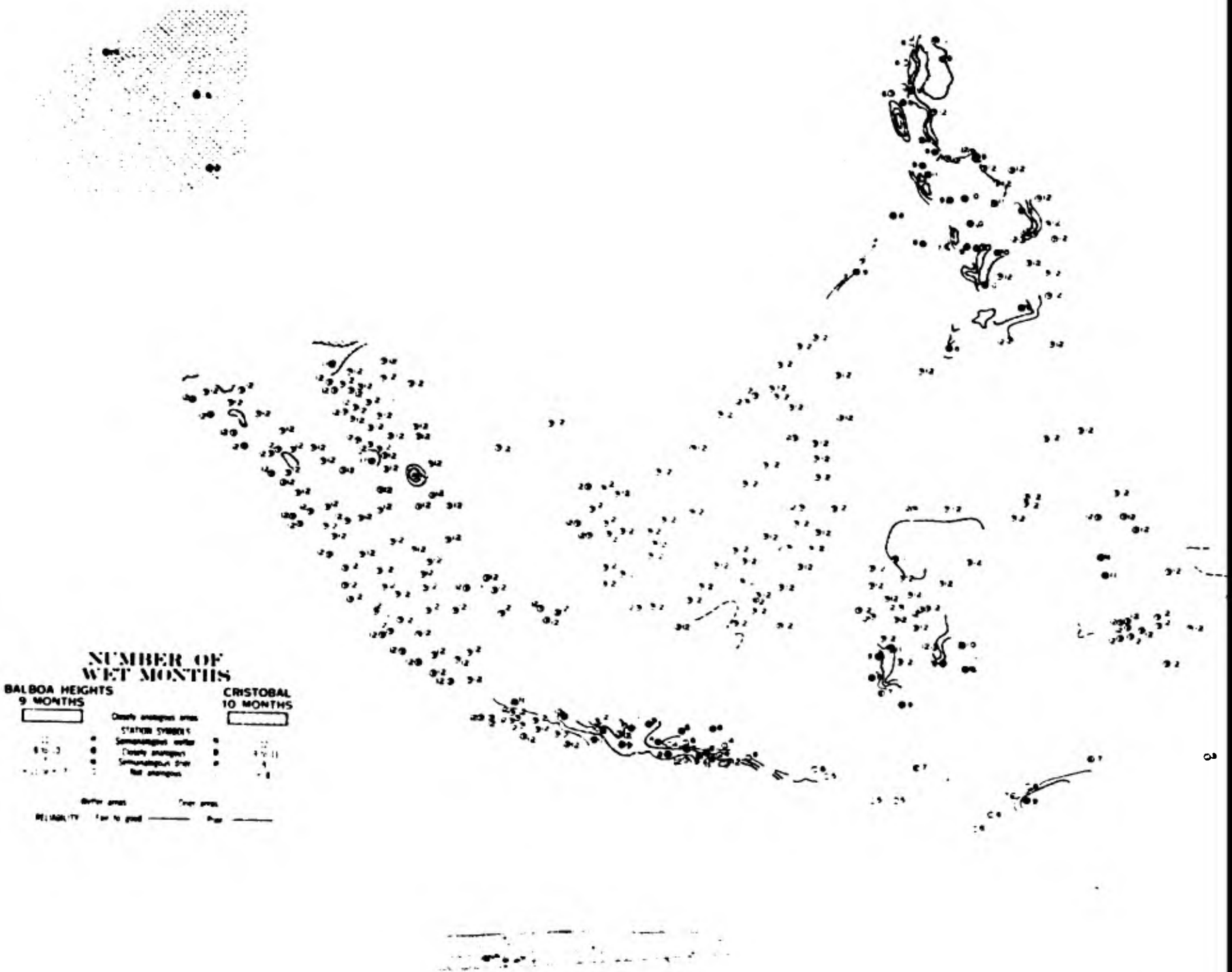
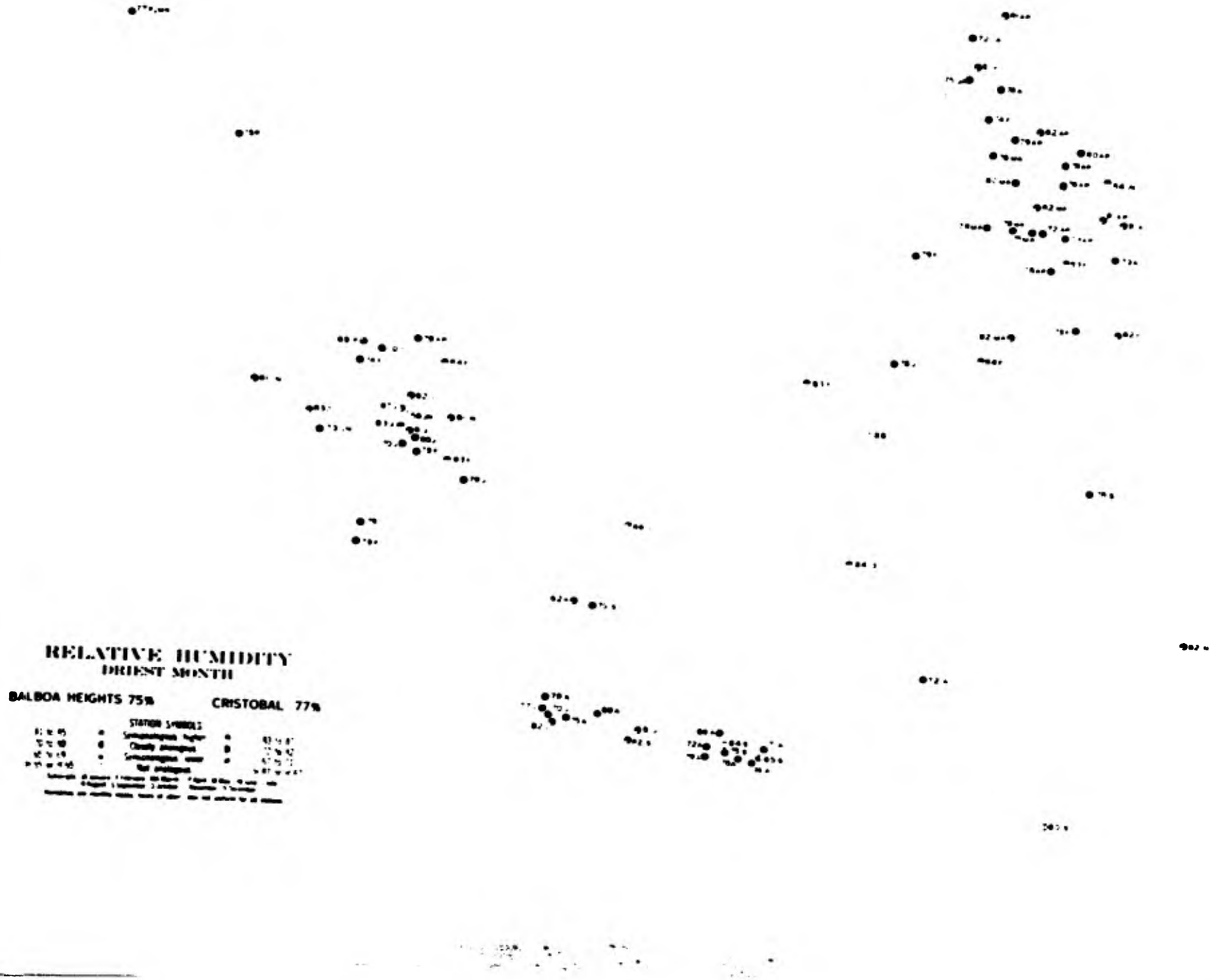
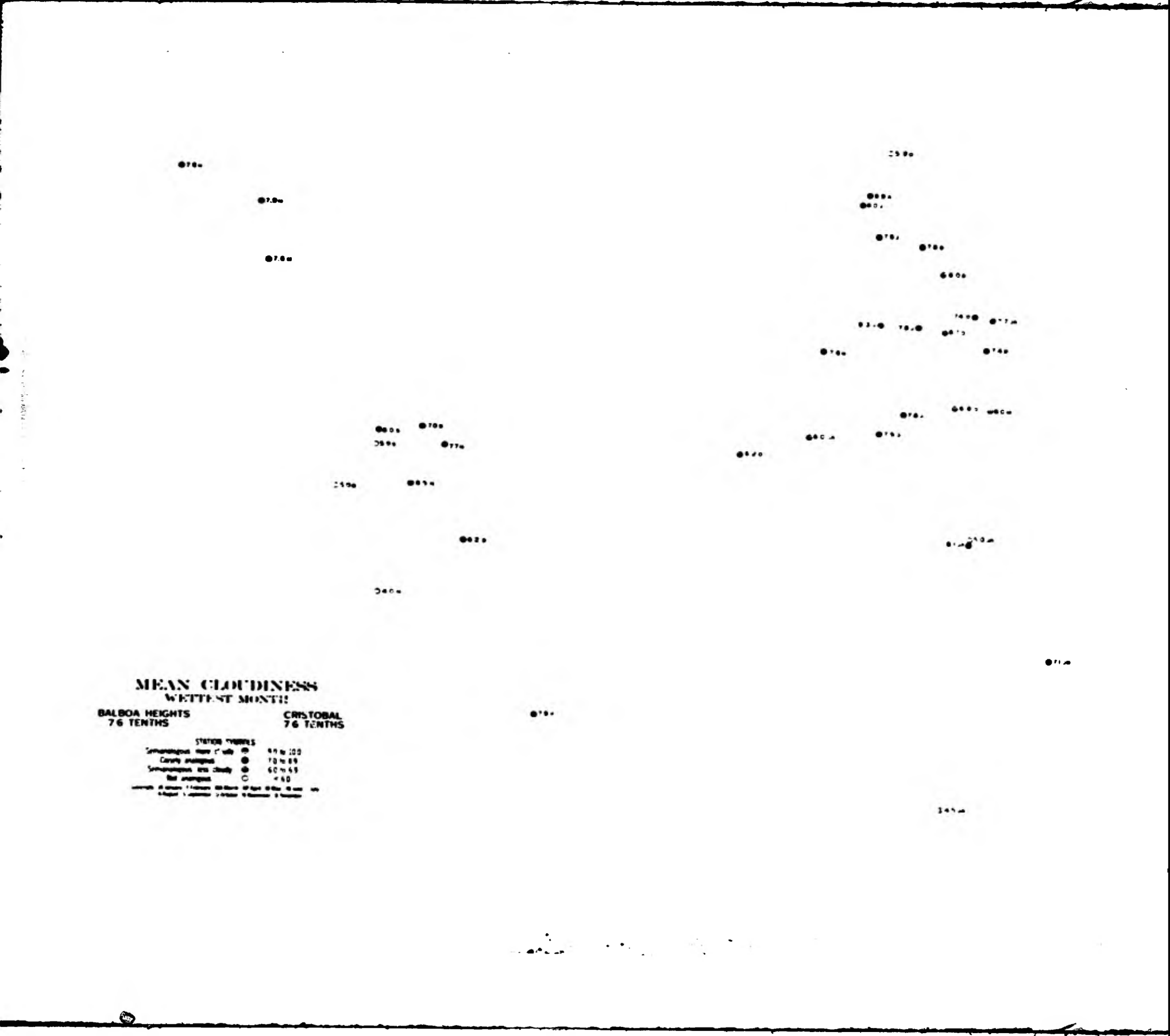
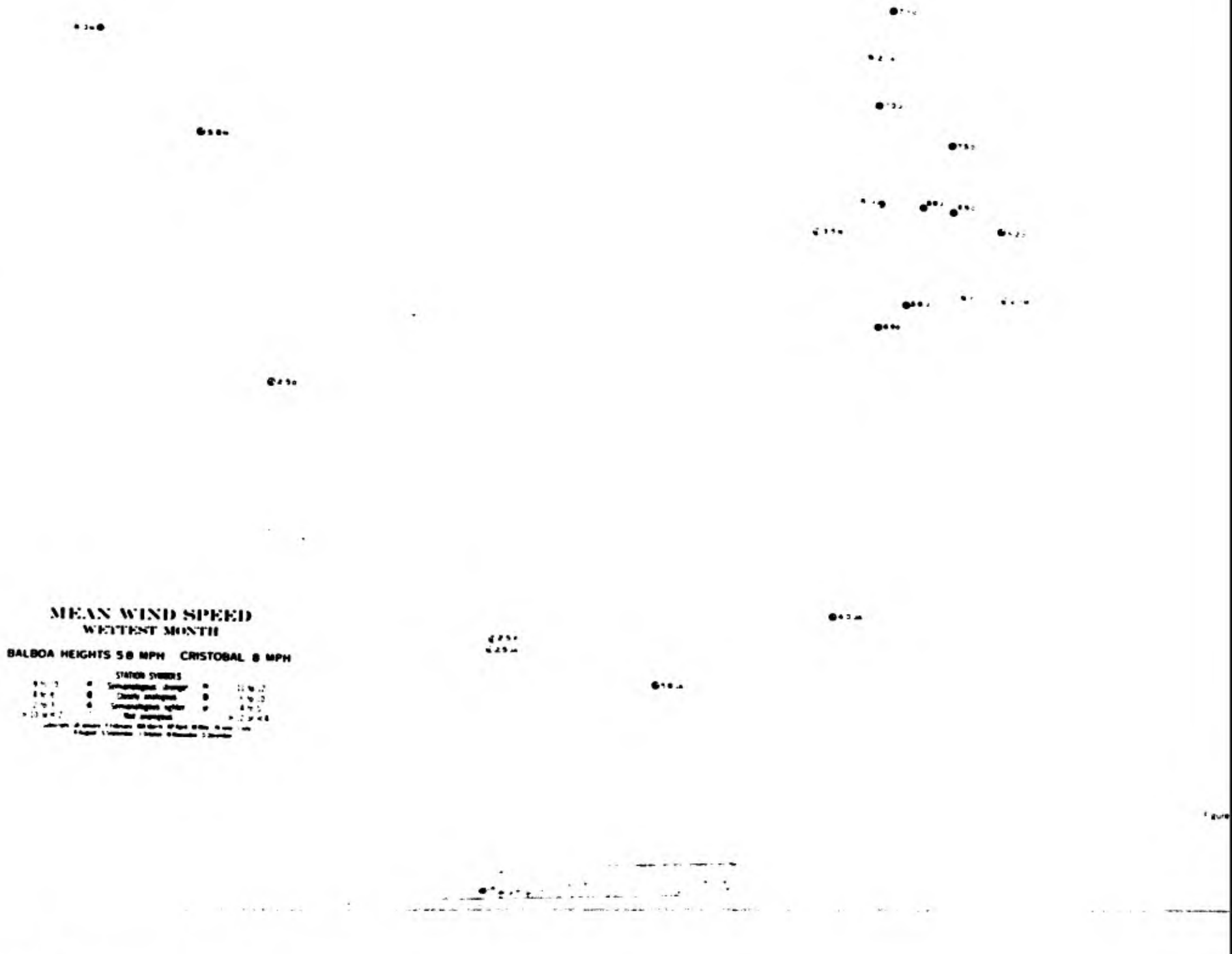

MEAN MONTHLY
PRECIPITATION
WETTEST MONTH
BALBOA HEIGHTS 11 IN.
CRISTOBAL 22 IN.

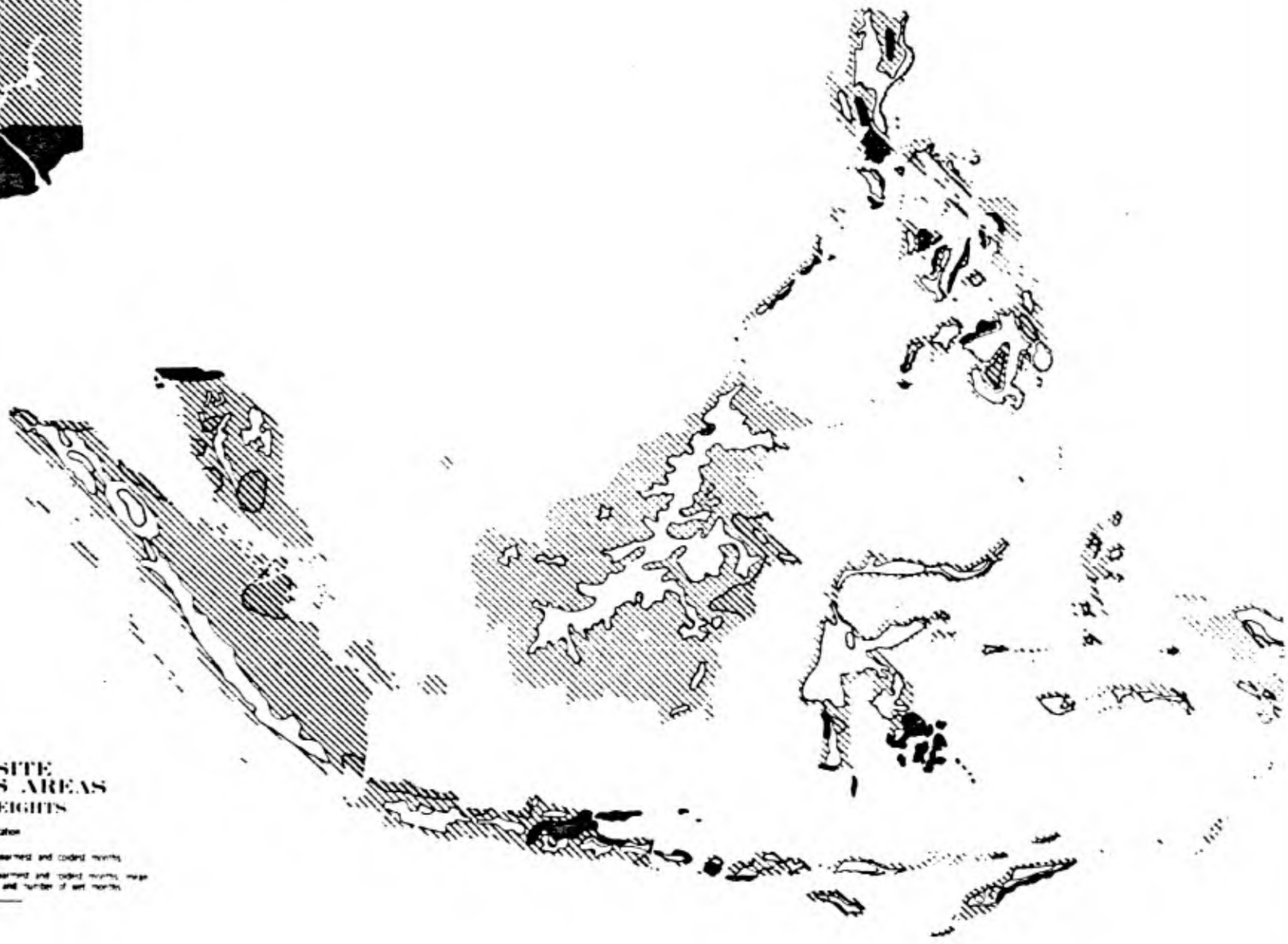
Figure 9


NUMBER OF
WET MONTHS
BALBOA HEIGHTS
9 MONTHS
CRISTOBAL
10 MONTHS


RELATIVE HUMIDITY
DRIEST MONTH
BALBOA HEIGHTS 75%
CRISTOBAL 77%
STATION SYMBOLS


MEAN CLOUDINESS
WETTEST MONTH
BALBOA HEIGHTS
76 TENTHS
CRISTOBAL
76 TENTHS


MEAN WIND SPEED
WETTEST MONTH
BALBOA HEIGHTS 5 8 MPH CRISTOBAL 8 MPH
STATION SYMBOLS



COMPOSITE ANALOGOUS AREAS

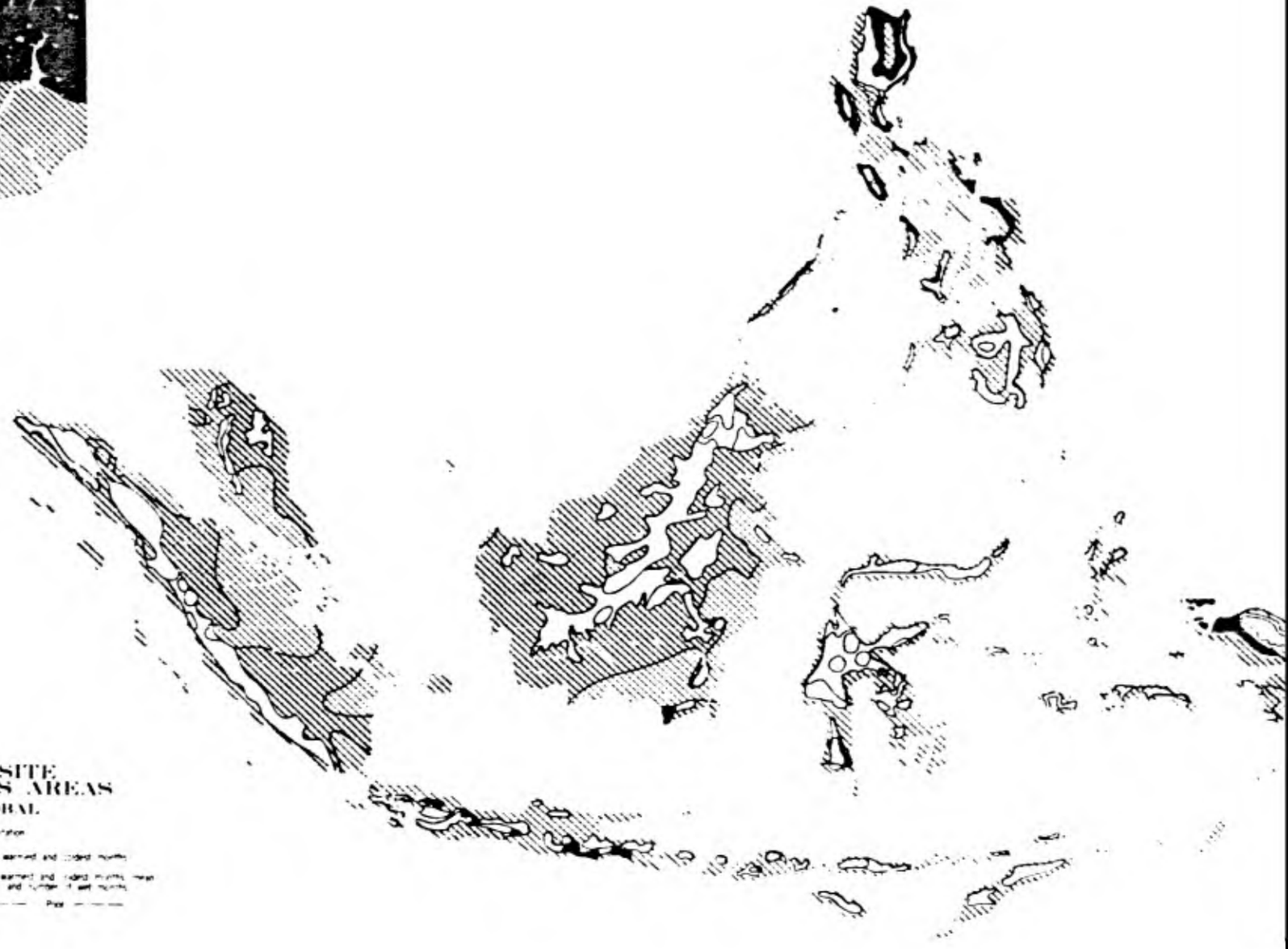
BALBOA HEIGHTS

Mean annual precipitation

Mean temperatures warmest and coldest months

Mean temperatures warmest and coldest months, mean annual precipitation and number of wet months

RELIABILITY: Fair to good


COMPOSITE
ANALOGOUS AREAS
CRISTOBAL