

NOAA Technical Memorandum NWS WR-155



A RAININESS INDEX FOR THE ARIZONA MONSOON

Salt Lake City, Utah
July 1980

**U.S. DEPARTMENT OF
COMMERCE**

/ National Oceanic and
Atmospheric Administration

/ National Weather
Service

NOAA TECHNICAL MEMORANDA
National Weather Service, Western Region Subseries

The National Weather Service (NWS) Western Region (WR) Subseries provides an informal medium for the documentation and quick dissemination of results not appropriate, or not yet ready, for formal publication. The series is used to report on work in progress, to describe technical procedures and practices, or to relate progress to a limited audience. These Technical Memoranda will report on investigations devoted primarily to regional and local problems of interest mainly to personnel, and hence will not be widely distributed.

Papers 1 to 25 are in the former series, ESSA Technical Memoranda, Western Region Technical Memoranda (WRTM); papers 24 to 59 are in the former series, ESSA Technical Memoranda, Weather Bureau Technical Memoranda (WBTM). Beginning with 60, the papers are part of the series, NOAA Technical Memoranda NWS. Out-of-print memoranda are not listed (inclusive, 1-115).

Papers 2 to 22, except for 5 (revised edition), are available from the National Weather Service Western Region, Scientific Services Division, P. O. Box 11188, Federal Building, 125 South State Street, Salt Lake City, Utah 84147. Paper 5 (revised edition), and all others beginning with 25 are available from the National Technical Information Service, U. S. Department of Commerce, Sillis Building, 5285 Port Royal Road, Springfield, Virginia 22151. Prices vary for all paper copy; \$2.25 microfiche. Order by accession number shown in parentheses at end of each entry.

ESSA Technical Memoranda (WRTM)

- 2 Climatological Precipitation Probabilities. Compiled by Lucianne Miller, December 1965.
- 3 Western Region Pre- and Post-FP-3 Program, December 1, 1965, to February 20, 1966. Edward D. Diemer, March 1966.
- 5 Station Descriptions of Local Effects on Synoptic Weather Patterns. Philip Williams, Jr., April 1966 (revised November 1967, October 1969). (PB-17800)
- 7 Final Report on Precipitation Probability Test Programs. Edward D. Diemer, May 1966.
- 8 Interpreting the RAREP. Herbert P. Benner, May 1966 (revised January 1967).
- 11 Some Electrical Processes in the Atmosphere. J. Latham, June 1966.
- 17 A Digitalized Summary of Radar Echoes within 100 Miles of Sacramento, California. J. A. Youngberg and L. B. Overaas, December 1966.
- 18 Limitations of Selected Meteorological Data. December 1966.
- 21 An Objective Aid for Forecasting the End of East Winds in the Columbia Gorge, July through October. D. John Coparanis, April 1967.
- 22 Derivation of Radar Horizons in Mountainous Terrain. Roger G. Pappas, April 1967.

ESSA Technical Memoranda, Weather Bureau Technical Memoranda (WBTM)

- 25 Verification of Operational Probability of Precipitation Forecasts, April 1966-March 1967. W. W. Dickey, October 1967. (PB-176240)
- 26 A Study of Winds in the Lake Mead Recreation Area. R. P. Augulis, January 1968. (PB-177830)
- 28 Weather Extremes. R. J. Schmidli, April 1968 (revised July 1968). (PB-178928)
- 29 Small-Scale Analysis and Prediction. Philip Williams, Jr., May 1968. (PB-178425)
- 30 Numerical Weather Prediction and Synoptic Meteorology. Capt. Thomas D. Murphy, U.S.A.F., May 1968. (AD-673365)
- 31 Precipitation Detection Probabilities by Salt Lake ARTC Radars. Robert K. Belesky, July 1968. (PB-179084)
- 32 Probability Forecasting--A Problem Analysis with Reference to the Portland Fire Weather District. Harold S. Ayer, July 1968. (PB-179289)
- 35 Joint ESSA/FAA ARTC Radar Weather Surveillance Program. Herbert P. Benner and DeVon B. Smith, December 1968 (rev. June 1970). (AD-681857)
- 36 Temperature Trends in Sacramento--Another Heat Island. Anthony D. Lentini, February 1969. (PB-183055)
- 37 Disposal of Logging Residues without Damage to Air Quality. Owen P. Cramer, March 1969. (PB-183057)
- 38 Climate of Phoenix, Arizona. R. J. Schmidli, P. C. Kangleser, and R. S. Ingram, April 1969. (Rev. July 1971; May 1976.) (PB-184295)
- 39 Upper-Air Lows over Northwestern United States. A. L. Jacobson, April 1969. (PB-184296)
- 40 The Man-Machine Mix in Applied Weather Forecasting in the 1970s. L. W. Snellman, August 1969. (PB-185068)
- 42 Analysis of the Southern California, Santa Ana of January 15-17, 1966. Barry B. Aronovitch, August 1969. (PB-185670)
- 43 Forecasting Maximum Temperatures at Helena, Montana. David E. Olsen, October 1969. (PB-185762)
- 44 Estimated Return Periods for Short-Duration Precipitation in Arizona. Paul C. Kangleser, October 1969. (PB-187763)
- 46 Applications of the Net Radiometer to Short-Range Fog and Stratus Forecasting at Eugene, Oregon. L. Yee and E. Bates, December 1969. (PB-190476)
- 47 Statistical Analysis as a Flood Routing Tool. Robert J. C. Burnash, December 1969. (PB-188744)
- 48 Tsunami. Richard P. Augulis, February 1970. (PB-190157)
- 49 Predicting Precipitation Type. Robert J. C. Burnash and Floyd E. Hug, March 1970. (PB-190962)
- 50 Statistical Report on Aeroallergens (Pollens and Molds) Fort Huachuca, Arizona, 1969. Wayne S. Jonsson, April 1970. (PB-191743)
- 51 Western Region Sea State and Surf Forecaster's Manual. Gordon C. Shields and Gerald B. Burdwell, July 1970. (PB-193102)
- 52 Sacramento Weather Radar Climatology. R. G. Pappas and C. M. Veliquette, July 1970. (PB-193347)
- 54 A Refinement of the Vorticity Field to Delineate Areas of Significant Precipitation. Barry B. Aronovitch, August 1970.
- 55 Application of the SSARR Model to a Basin without Discharge Record. Vail Schermerhorn and Donald W. Kuehl, August 1970. (PB-194394)
- 56 Areal Coverage of Precipitation in Northwestern Utah. Philip Williams, Jr., and Werner J. Heck, Sept. 1970. (PB-194389)
- 57 Preliminary Report on Agricultural Field Burning vs. Atmospheric Visibility in the Willamette Valley of Oregon. Earl M. Bates and David O. Chilcote, September 1970. (PB-194710)
- 58 Air Pollution by Jet Aircraft at Seattle-Tacoma Airport. Wallace R. Donaldson, October 1970. (COM-71-00017)
- 59 Application of PE Model Forecast Parameters to Local-Area Forecasting. Leonard W. Snellman, Oct. 1970. (COM-71-00016)

NOAA Technical Memoranda (NWS WR)

- 60 An Aid for Forecasting the Minimum Temperature at Medford, Oregon. Arthur W. Fritz, October 1970. (COM-71-00120)
- 62 Forecasting the Catalina Eddy. Arthur L. Elchelberger, February 1971. (COM-71-00223)
- 63 700-mb Warm Air Advection as a Forecasting Tool for Montana and Northern Idaho. Norris E. Woerner, February 1971. (COM-71-00349)
- 64 Wind and Weather Regimes at Great Falls, Montana. Warren B. Price, March 1971.
- 66 A Preliminary Report on Correlation of ARTCC Radar Echoes and Precipitation. Wilbur K. Hall, June 1971. (COM-71-00829)
- 69 National Weather Service Support to Soaring Activities. Ellis Burton, August 1971. (COM-71-00956)
- 71 Western Region Synoptic Analysis-Problems and Methods. Philip Williams, Jr., February 1972. (COM-72-10433)
- 74 Thunderstorms and Hail Days Probabilities in Nevada. Clarence M. Sakamoto, April 1972. (COM-72-10554)
- 75 A Study of the Low Level Jet Stream of the San Joaquin Valley. Ronald A. Willis and Philip Williams, Jr., May 1972. (COM-72-10707)
- 76 Monthly Climatological Charts of the Behavior of Fog and Low Stratus at Los Angeles International Airport. Donald M. Gales, July 1972. (COM-72-11140)
- 77 A Study of Radar Echo Distribution in Arizona During July and August. John E. Hales, Jr., July 1972. (COM-72-11136)
- 78 Forecasting Precipitation at Bakersfield, California, Using Pressure Gradient Vectors. Earl T. Riddiough, July 1972. (COM-72-11146)
- 79 Climate of Stockton, California. Robert C. Nelson, July 1972. (COM-72-10920)
- 80 Estimation of Number of Days Above or Below Selected Temperatures. Clarence M. Sakamoto, October 1972. (COM-72-10021)
- 81 An Aid for Forecasting Summer Maximum Temperatures at Seattle, Washington. Edgar G. Johnson, Nov. 1972. (COM-73-10150)
- 82 Flash Flood Forecasting and Warning Program in the Western Region. Philip Williams, Jr., Chester L. Glenn, and Roland L. Raetz, December 1972. (Rev. March 1978.) (COM-73-10251)
- 83 A Comparison of Manual and Semiautomatic Methods of Digitizing Analog Wind Records. Glenn E. Resch, March 1973. (COM-73-10669)
- 84 Southwestern United States Summer Monsoon Source--Gulf of Mexico or Pacific Ocean? John E. Hales, Jr., March 1973. (COM-73-10769)
- 86 Conditional Probabilities for Sequences of Wet Days at Phoenix, Arizona. Paul C. Kangleser, June 1973. (COM-73-11264)
- 87 A Refinement of the Use of K-Values in Forecasting Thunderstorms in Washington and Oregon. Robert Y. G. Lee, June 1973. (COM-73-11276)
- 89 Objective Forecast of Precipitation over the Western Region of the United States. Julia N. Paegle and Larry P. Kieruff, September 1973. (COM-73-11946/3AS)
- 90 A Thunderstorm "Warm Wake" at Midland, Texas. Richard A. Wood, September 1973. (COM-73-11845/AS)
- 91 Arizona "Eddy" Tornadoes. Robert S. Ingram, October 1973. (COM-73-10465)

NOAA Technical Memorandum NWS WR-155

A RAININESS INDEX FOR THE ARIZONA MONSOON

John H. TenHarkel

National Weather Service Forecast Office
Phoenix, Arizona
July 1980

UNITED STATES
DEPARTMENT OF COMMERCE
Philip M. Klutznick, Secretary

NATIONAL OCEANIC AND
ATMOSPHERIC ADMINISTRATION
Richard A. Frank, Administrator

National Weather
Service
Richard E. Hallgren, Director



This Technical Memorandum has been reviewed and is approved for publication by Scientific Services Division, Western Region.

A handwritten signature in black ink, appearing to read "L. W. Snellman". The signature is written in a cursive style with a long, sweeping tail that extends to the right.

L. W. Snellman, Chief
Scientific Services Division
Western Region Headquarters
Salt Lake City, Utah

CONTENTS

	<u>Page</u>
Figures	iv
I. Abstract	1
II. Background	1
III. Data	1
IV. Tables	2
V. Analysis	2
VI. Discussion	3
VII. Other Measure of Monsoon Activity	3
VIII. Comments, Suggestions for Research	4
IX. References	5
X. Appendix	11

FIGURES

	<u>Page</u>
Figure 1. Average July Precipitation and Stations Reporting July 1979	7
Figure 2. Average Daily Monsoon Index June 1 - September 30	8
Figure 3. Seasonal Average Monsoon Index	9
Figure 4. July Average Monsoon Index	9
Figure 5. Daily Deviations from Normal Curve (Figure 2) of Monsoon Index Values for 1900. Very dry year	10
Figure 6. Same as Figure 5, except for 1931. Very wet year	10
Figure 7. Same as Figure 5, except for 1979. Very dry year	10

A RAININESS INDEX FOR THE ARIZONA MONSOON

John H. TenHarkel
National Weather Service Forecast Office
Phoenix, Arizona

I. ABSTRACT

A raininess index is derived for Arizona for each summer day from 1897 through 1979. Mean values for each season and each date are tabulated, graphed and compared to other measures of monsoon activity. Column (date) means are used to derive a normal curve for the Arizona Monsoon. Some individual seasons are then compared to the normal curve.

II. BACKGROUND

Arizona's summer rainy season has been called a "Monsoon" because it coincides with a seasonal shift of the winds aloft (from west to southeast). Although rainfall is lighter and much less frequent than that of the Asian Monsoon, it is seasonal, and it does depend on a seasonal wind shift. The name "Arizona Monsoon" has been used locally for many years and will be used here.

Most attempts to document the Arizona Monsoon have employed data from a few individual stations having a long period of record. Time-frequency graphs from such records show great day to day and station to station variability in rainfall. They give an impression of randomness in both a spatial and temporal sense.

The experience of the author in operational forecasting at Phoenix is that there are large systematic variations in raininess, from one day to another, and also for periods of a week or more. However, attempts to understand and anticipate these changes have had little success.

Before such changes can be studied, they must be documented. An index of rainfall coverage is needed, which is not subject to chance occurrence at fixed locations, and which can be averaged over a long period of record.

Bryson and Lowry (1955) devised a raininess index that used all available rain reports including those from unpaid "cooperative" observers, about 200 at the time. A two-day running mean was taken to reduce second-day error, caused when some observers took their readings on the following day (morning). Reiter (1957) employed a similar index. These authors tabulated their index for only the first part (onset) of the rainy season, and for only a 30-year period of record.

The following tabulation is for the entire summer, June 1 through September 30, from 1897 to 1979 (see appendix).

III. DATA

Daily substation rainfall from the Arizona Section of "U.S. Climatological

Data" (or it's equivalent) were used to find a raininess index for each day. The index, hereafter, called the "Monsoon Index" or "M.I.", is defined as:

$$\text{M.I. (D)} = \frac{100 \times R}{N}$$

where N is the number of reporting stations having a complete record for the month and R is the number of stations reporting .01 inch or more of rain on a given day (D).

Values of M.I. were tabulated without any attempt to correct for second-day error. This type of error is discussed later.

The tabulation starts with 1897, the first year for which daily rainfall was included in the climatic data. At that time, there were 41 stations. There are now nearly 200.

The areal distribution of climatic stations has not changed very much. Since 1897, there has been a concentration of stations in the central and southeast sections. This roughly coincides with the region of maximum summer rainfall.

Figure 1 shows the distribution of stations in July 1979. Stations included in the tabulation are marked with a large black dot. The area that normally receives more than two inches of rain in July is shaded, the areas with over four inches are darkly shaded.

About one quarter of the state's area averages more than two inches of rain in July; and over one half (111 out of 188) of the reporting stations are within this area. Thus, the M.I. is weighted toward the area that normally has the most rainfall.

There is a close relationship between rainfall amount and areal coverage - for those years for which an average statewide rainfall was computed, the correlation between it and the average Monsoon Index is near 0.90 (slightly less in September).

IV. TABLES

The M.I. is tabulated by month; each row represents a year, each column a date. The average and standard deviation for each row (year) are shown on the right, and to the right of the September table, the seasonal average and standard deviation are shown. These are for the entire 122 days of the summer.

Rounded (Integer) averages for the columns are shown below (after 1979) for each day. These averages, along with standard deviation, and moment coefficients of skewness and kurtosis, are tabulated separately, in single precision (6-place) accuracy. (See Appendix.)

V. ANALYSIS

Daily (column) means are plotted in Figure 2. A normal curve was hand-fitted to the data points, then a polynomial fit was attempted. The equation:

$$M.I. = 28.34 + 0.02 x - 0.016 x_5 D^2 + 0.000085 x D^3 + 0.000003 x D^4 - 0.00000027 x D^5$$

explains 95.68% of the variance in M.I. Here, D is the day number, zero on August 1.

Figure 3 shows the individual season (Row) means for each year since 1897, and Figure 4 shows the monthly means for July, for comparison. Note the relatively small standard deviation, especially for the season totals.

Figures 5-7 compare individual seasons to the handfitted normal curve. The year 1900 (Figure 5) was very dry, the year 1931 (Figure 6) was very wet. The most recent year, 1979, is shown in Figure 7. Note the very high peak in early August, (August 12), a day of extensive flash flooding. Yet, the season was overall a very dry one.

VI. DISCUSSION

Much can be learned simply by visual inspection of the tables. Note that rainy periods of several days do occur in August, supposedly a wet month. There have been many "breaks" in the monsoon similar to those of August 1976 and 1977, which caused much comment and speculation about a "failure" of the monsoon.

Very high peaks (over 80% coverage) are more common after the end of July, and especially in September, when frontal type precipitation and also hurricanes sometimes occur.

Skewness of the daily samples is very large in June, and again in September, because of the high frequency of dry days (M.I.=0). Kurtosis, a measure of the "peak-ness" of a distribution, also is high. This is typical of an arid climate, which Arizona's certainly is, most of the time.

Near the peak monsoon period, late July, skewness approaches zero and kurtosis nears the value 3, approaching the values of a normal distribution. This is not characteristic of aridity.

VII. OTHER MEASURE OF MONSOON ACTIVITY

In recent years hourly ARTC radar maps have been composited for 12-hour periods, 0000-1200 GMT and 1200-0000 GMT, daily. These composite maps can be used to estimate how much of a geographic area has been subjected to rainfall, assuming all areas covered by a radar echo at least once in the 12-hour period had rain.

Unfortunately, until recently, no one had been keeping a record of these charts. They were collected at WSFO Phoenix for the summer of 1979, and rainfall coverage estimated using a template.

This gives us a fair estimate (subject to uneven radar coverage and infrequent reports) of the actual areal coverage of rainfall, with which we can try to correct the Monsoon Index for its "wrong day" error.

The following model was tested, using stepwise linear regression:

$$\text{adjusted M.I.} \cong \text{Radar Coverage (\%)} = B_0 + B_1 \times \text{M.I. (today)} + B_2 \times \text{M.I. (next day)} + B_3 \times \text{M.I. (yesterday)} + B_4 \times \text{M.I. (second day)}.$$

at the 5% confidence level, the only variables selected were the M.I. for "today" and "tomorrow", with the latter value having the greatest weight. The equation:

$$\text{Radar Coverage} = .184 + .296 \times \text{M.I. (today)} + .68 \times \text{M.I. (tomorrow)}$$

explained 86.2% of the variance in radar coverage.

An attempt was then made to screen in other predictors for individual stations having a record extending back to 1897. Parameters that would be available for use since that year include dewpoint, maximum and minimum temperature, rainfall and sky cover. The resulting equation:

$$\text{R.C.} = .254 \times \text{M.I. today} + .644 \times \text{M.I. tomorrow} + 1.45 \times [1/3 (\text{Sky cover PHX} + \text{Sky cover TUS} + \text{Sky cover INW})] - 0.16 \times (\text{PHX dewpoint at 000Z})$$

explained 88.04% of the variance in R.C. (Radar Coverage).

All of the single station variables were strongly dependent on Radar Coverage. It is likely that much of the unexplained variance in radar coverage is caused by incomplete radar coverage, and by too infrequent radar observations. Also, no attempt was made to "weight" the radar data toward the east central and southeast parts of Arizona, where the Monsoon Index is weighted.

Even so, the technique looks promising and another attempt will be made as soon as two or three more years of radar data are collected. If it is possible to reduce the variance by 90% or more, one could then eliminate most of the "second-day" observational error for the entire period of record (since 1897).

VIII. COMMENTS, SUGGESTIONS FOR RESEARCH

The monsoon rains in Arizona change character from great variability at start and finish to dependability near their peak. In addition, the rains are well known to be associated with southeast winds aloft. This implies the main cause of the monsoon is a seasonal shift in the mean circulation, which is subject to interruption early and late in summer.

One may speculate that these interruptions are caused by small scale waves, travelling in the westerlies, or in the easterlies, or both; or they may be caused by large-scale shifts in the latitude of the westerlies, or the east-west axis of the subtropical high.

Another (wetting) mechanism was postulated by Hales ("Surges of Maritime Tropical Air Northward Over the Gulf of California, 1971"). This "Gulf Surge" has proven easy to spot once it starts, but almost impossible to forecast.

In any case, too little is known about the circulation in the region south of Arizona. It obviously plays a vital role in the monsoon since the moisture bearing winds blow from the south or southeast.

So far, the only mean-circulation maps available are those prepared by Sadler (1975); 300 mb and 200-mb 10-year means. The monsoon peak coincides with the establishment of a 200-mb anticyclone over northwest Mexico, and the farthest northward retreat of the westerly jet. It also coincides with the maximum northward displacement of the northeast Trades. (See "The Upper Tropospheric Circulation Over the Global Tropics" Part 1, Page 9, upper right graph).

Similar mean charts should be prepared for the lower troposphere, in particular, for the surface - 600-mb layer analyzed by the National Hurricane Center since 1968. Composite maps should be prepared for several cases of peak monsoon activity, and also for several cases of abnormally low activity, to find out what circulation patterns are associated with these abnormalities.

Individual case studies can be made using NHC 200-mb and SFC-600-mb analyses, both available on micro-film from the Hurricane Center. The Monsoon Index records could be used to spot abnormalities to be investigated.

The index tables themselves can be studied in more detail. Has there been any significant change in the Monsoon over the 83-year period? What is the frequency of dry days, or days with more than 50% coverage, in July, or August? What is the probability of a sequence of, say, 3 dry days in a row, or more than one "wet" day in a week?

These are all ideas that should have been explored locally (at Phoenix) in the course of operational forecasting; but have not been, because of a lack of time and resources. Hopefully, more time and resources will become available, but meanwhile it is hoped that the historical data will be of use to others.

The index tables were printed and statistics generated using a TRS-80 micro-computer. The data are stored on a 5-inch mini-disc.

IX. REFERENCES

Reitar, Clayton H., "The Role of Precipitable Water Vapor in Arizona's Summer Rains", pp. 3,4. Institute of Atmospheric Physics, University of Arizona, 1957.

Green, Christine R., "Summer Rainy Days in Arizona", Institute of Atmosphere Physics, University of Arizona, 1963.

Bryson, Reid A., and Lowry, William P., "Synoptic Climatology of the Arizona Monsoon", Bulletin of the American Meteorological Society, 1955.

- Climatological Data:
- (A) U.S. Department of Agriculture, Weather Bureau, "Climate and Crop Service", June-Sept. Vol. 1897-1905.
 - (B) U.S. Department of Agriculture, Weather Bureau, "Climatological Report, Arizona Section", June-Sept. Vol. 1906-1913.
 - (C) U.S. Weather Service, "Climatological Data, National Summary", Vol. 18-83, No. 6-9 (June-Sept. 1914-1979).

Hales, John, "Surges of Maritime Tropical Air Northward Over the Gulf of California", Monthly Weather Review, 1971.

Sadler, James C., "The Upper Tropospheric Circulation Over the Global Tropics, Part I", p. 9., University of Hawaii, 1975.

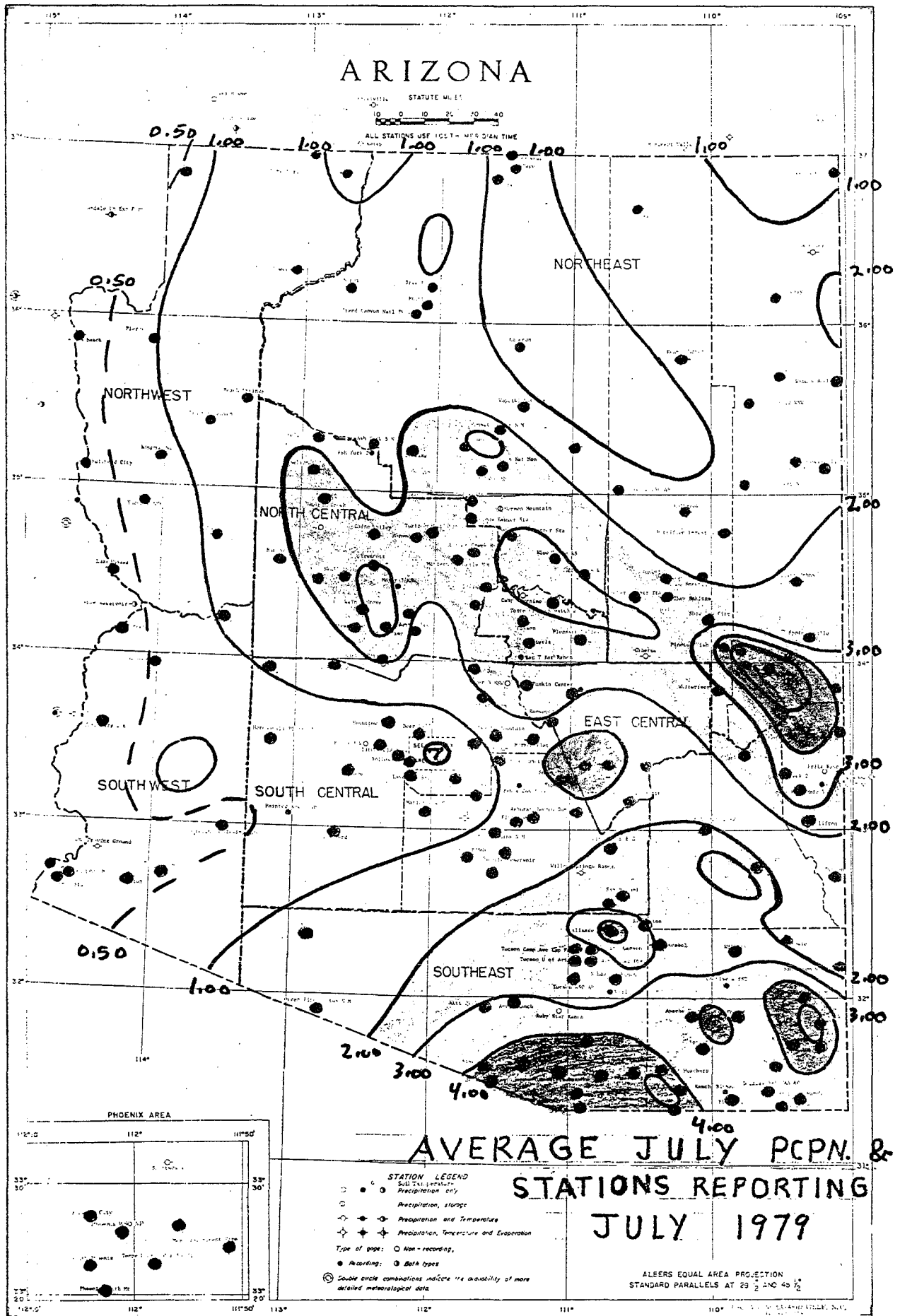


FIGURE 1

AVERAGE DAILY MONSOON INDEX JUNE 1 - SEPT 30

— HAND FITTED NORMAL CURVE
- - - POLYNOMIAL FIT

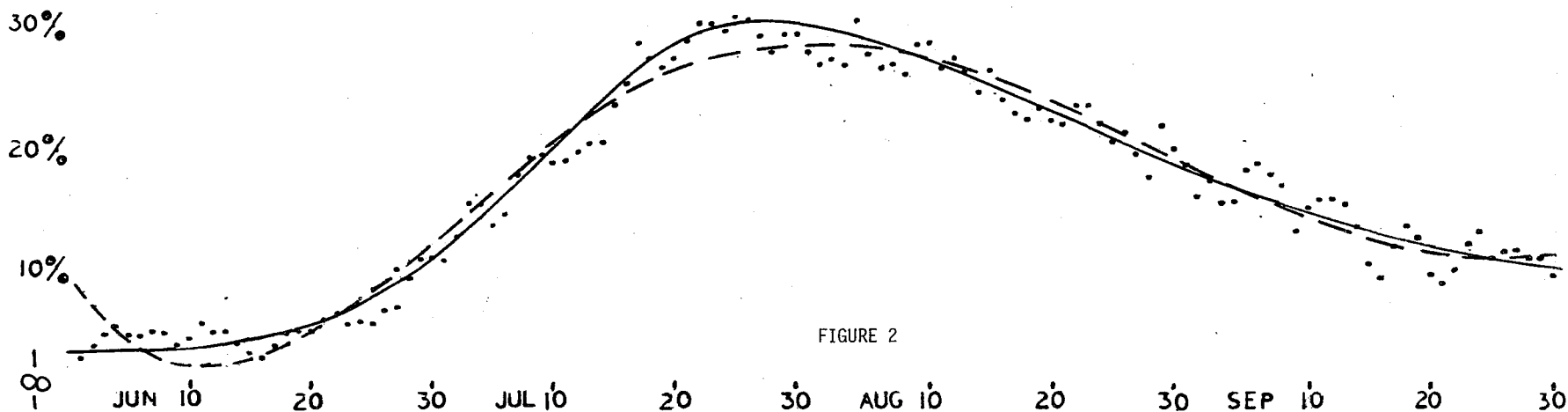
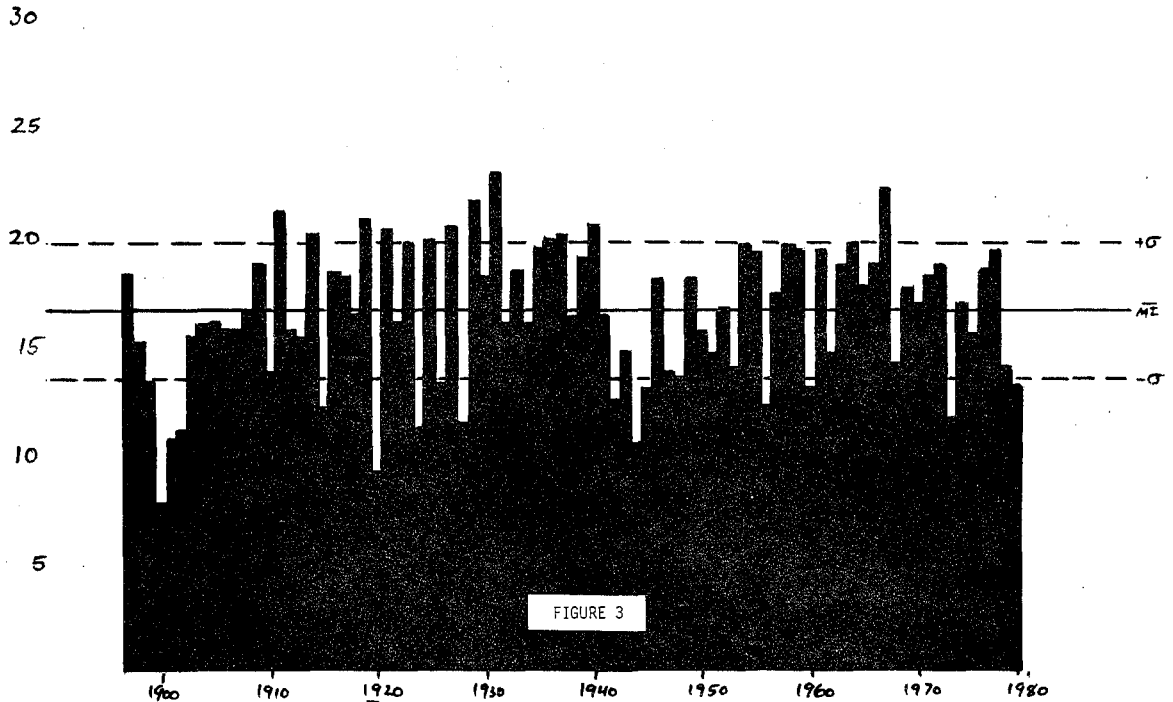


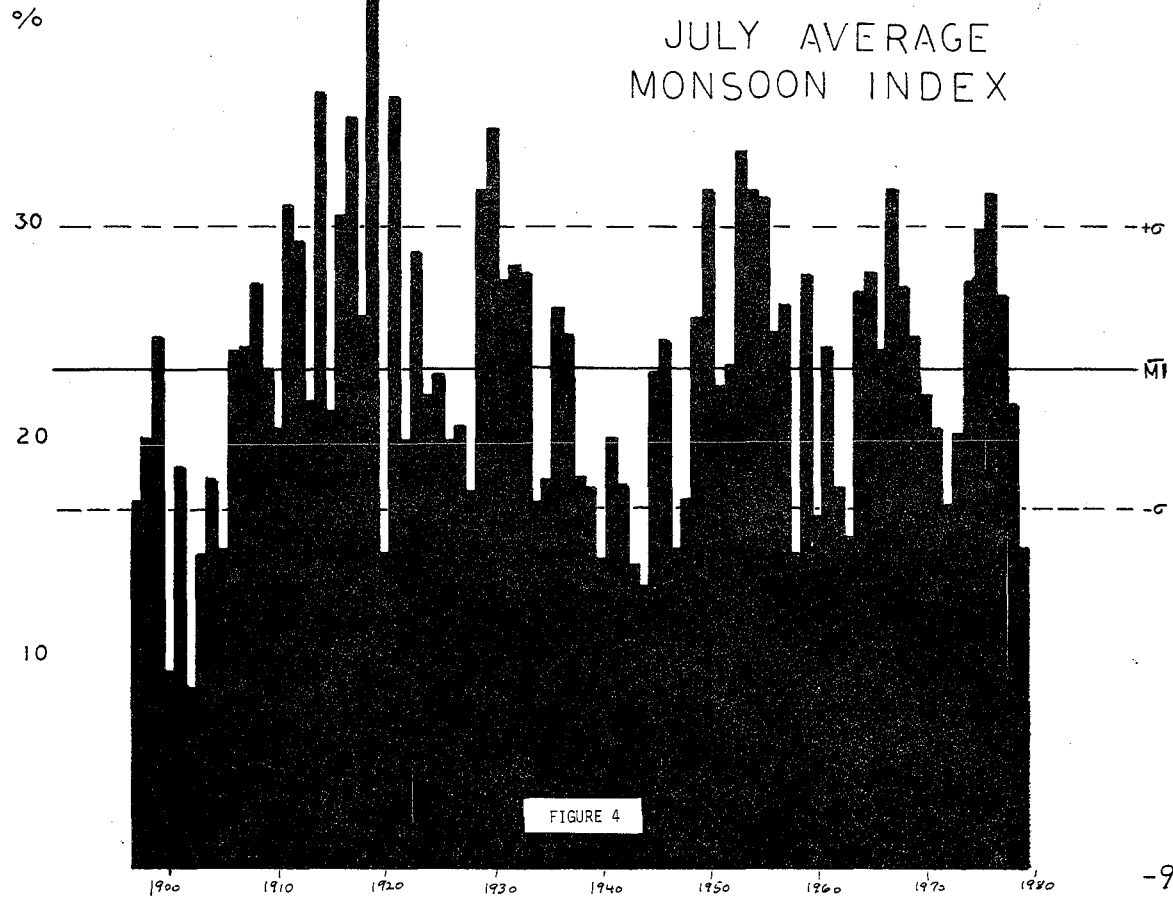
FIGURE 2

90

SEASONAL AVERAGE MONSOON INDEX



JULY AVERAGE MONSOON INDEX



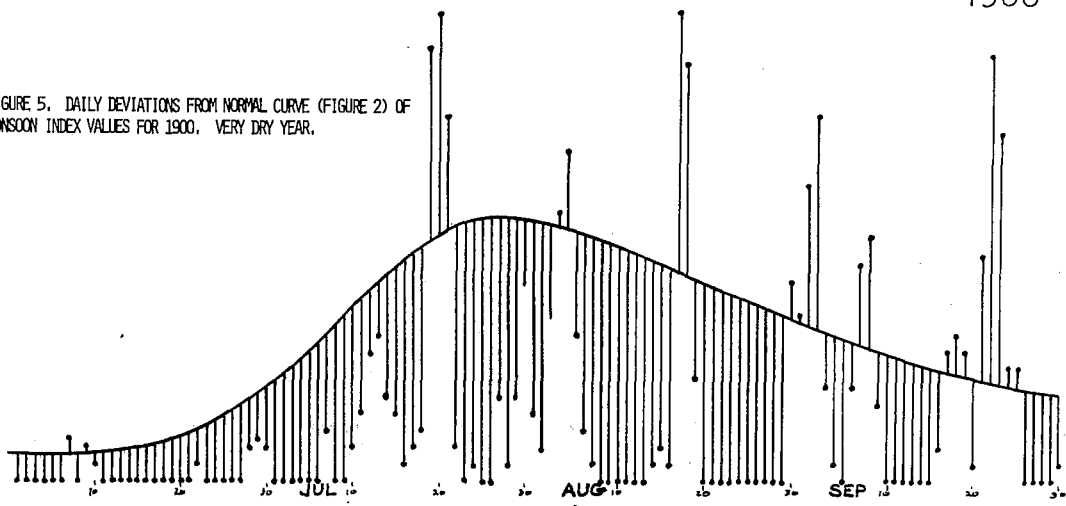
%

1900

50

FIGURE 5. DAILY DEVIATIONS FROM NORMAL CURVE (FIGURE 2) OF MONSOON INDEX VALUES FOR 1900. VERY DRY YEAR.

30



%

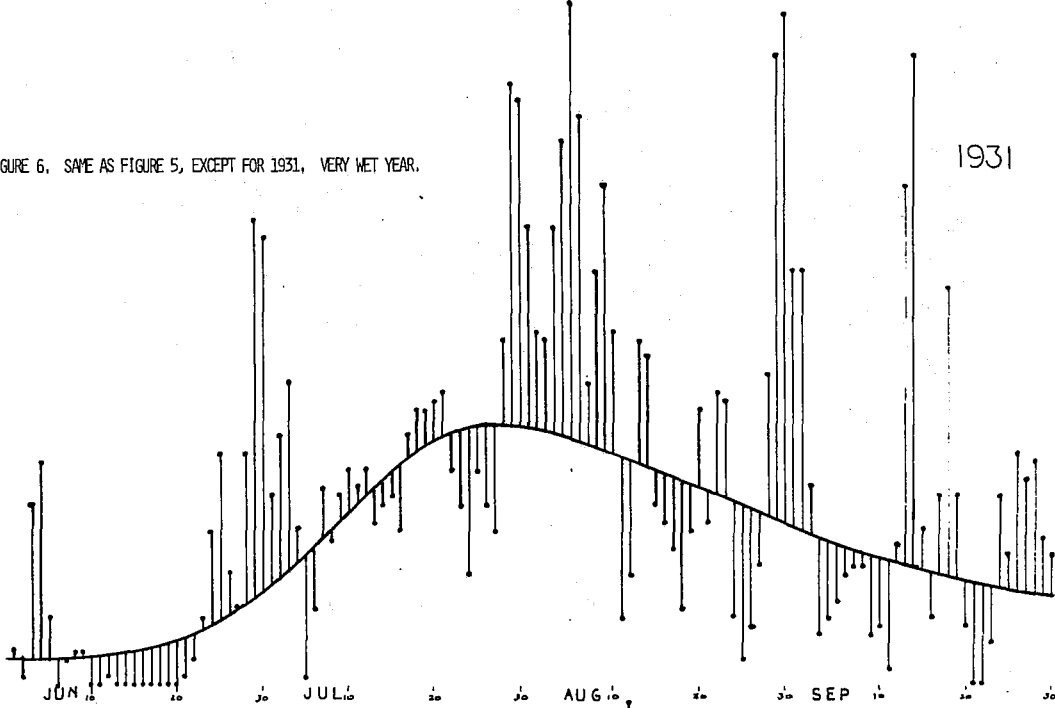
7

FIGURE 6. SAME AS FIGURE 5, EXCEPT FOR 1931, VERY WET YEAR.

1931

5

3



%

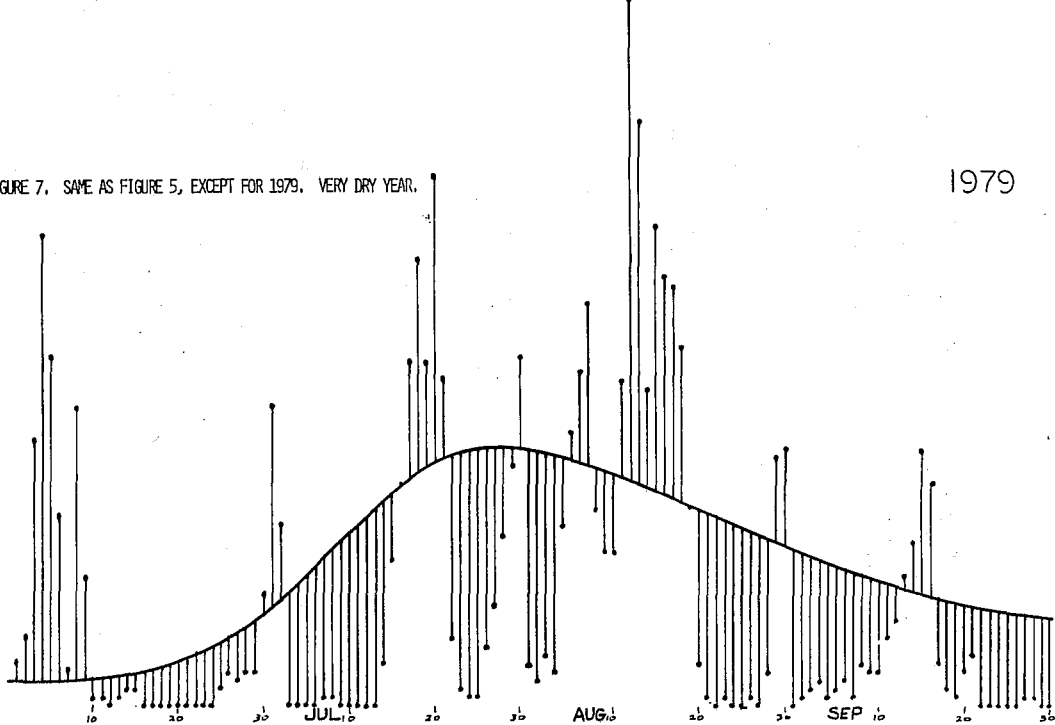
70

FIGURE 7. SAME AS FIGURE 5, EXCEPT FOR 1979. VERY DRY YEAR.

1979

50

30



X. APPENDIX - 1897-1979 DATA TABULATIONS

1. DAILY MONSOON INDEX VALUES BY MONTH (JUNE THROUGH SEPTEMBER).
2. MEANS, STANDARD DEVIATIONS, SKEWNESS AND KURTOSIS OF DAILY MONSOON INDEX DATA.

DAILY MONSOON INDEX VALUES BY MONTH (JUNE THROUGH SEPTEMBER)

MONSOON INDEX FOR JULY UNCORRECTED % STATIONS REPORTING RAIN >= .01 INCH

YEAR	DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	AVG.	STD. DEV.
1897		14	00	00	00	00	07	33	67	23	28	33	02	02	02	05	14	19	37	05	07	21	56	19	00	12	07	16	28	28	16	30	17.1	16.61
1898		27	22	27	69	51	41	14	06	31	35	14	18	18	27	47	37	12	00	02	06	08	08	09	09	09	04	16	14	12	14	19.9	16.08	
1899		04	02	05	09	11	16	18	11	37	44	32	33	33	28	25	37	39	44	53	23	32	19	18	40	23	18	21	18	14	21	35	24.6	12.96
1900		00	00	00	00	00	00	06	00	00	04	08	15	17	10	08	02	04	06	50	54	42	04	00	02	00	10	02	10	23	08	9.2	14.41	
1901		00	02	00	00	00	00	00	00	14	04	02	04	02	02	06	06	06	14	31	33	33	45	53	49	43	47	45	63	39	25	18.5	20.44	
1902		05	00	00	00	00	00	00	00	16	07	09	05	09	31	31	18	11	04	13	24	20	13	24	09	04	04	00	02	00	02	8.4	9.51	
1903		00	00	00	00	02	08	18	14	18	14	08	24	18	30	74	28	02	02	04	36	26	36	34	14	28	10	04	00	00	00	14.6	16.52	
1904		00	00	00	00	00	00	02	05	03	00	00	00	02	14	12	09	07	03	24	43	50	40	45	26	50	57	21	22	48	50	24	18.0	19.83
1905		00	00	00	00	00	00	00	00	02	25	27	27	15	02	00	02	05	15	15	23	13	07	12	23	35	43	43	55	42	27	14.8	16.22	
1906		01	00	37	41	34	24	30	16	27	31	11	33	41	23	59	29	07	03	06	14	23	23	10	16	39	56	40	19	14	11	26	24.0	15.09
1907		00	02	08	09	12	11	09	35	24	14	12	21	40	17	08	03	08	17	30	26	38	44	65	79	64	23	08	03	21	51	44	24.1	20.44
1908		01	00	01	00	01	03	23	17	30	30	25	36	41	52	57	55	52	32	10	03	19	38	32	32	52	41	51	49	14	29	13	27.1	18.96
1909		26	23	31	40	16	04	01	00	00	00	00	00	00	04	13	21	52	68	69	40	40	60	48	51	57	34	00	01	03	13	23.1	23.49	
1910		00	00	01	10	01	00	01	08	07	06	15	50	76	26	46	29	10	10	01	14	53	44	24	26	31	36	39	21	35	11	20.4	19.58	
1911		82	61	20	11	11	25	29	12	24	40	39	30	23	31	22	40	52	30	57	55	55	20	11	37	27	52	37	17	02	00	00	30.7	19.6
1912		01	01	02	04	00	00	00	00	05	08	41	64	37	18	31	47	48	45	35	39	49	41	67	45	52	40	60	57	52	10	29.0	23.32	
1913		00	00	01	01	02	13	21	19	22	13	03	08	21	29	27	49	49	68	66	62	78	32	05	03	02	00	00	14	21	43	21.7	23.38	
1914		42	59	68	52	09	08	16	32	59	24	20	33	47	54	46	25	32	37	23	41	28	13	23	39	47	48	45	39	46	34	21	35.8	15.32
1915		05	10	11	03	00	00	00	00	00	09	32	14	02	07	04	18	18	27	34	48	59	62	49	68	65	46	29	04	02	02	21.2	22.31	
1916		00	00	00	01	03	13	42	40	56	65	47	42	25	21	23	21	16	16	27	26	22	36	33	26	57	59	50	45	40	34	50	30.2	18.82
1917		24	31	36	24	29	10	14	26	36	33	28	23	16	30	25	19	22	33	32	52	36	36	49	47	44	76	44	53	72	42	33	34.7	15.03
1918		33	27	42	18	34	30	33	57	53	41	51	61	21	09	11	08	06	20	22	33	27	19	12	26	05	01	04	11	11	32	34	25.5	16.3
1919		45	56	40	31	49	53	57	41	33	44	60	64	60	68	78	68	76	57	22	16	24	08	07	06	22	56	38	19	15	56	41.2	21.85	
1920		06	04	01	00	00	00	00	00	02	00	03	11	13	26	25	10	07	04	18	43	48	28	21	22	31	33	34	11	26	28	14.7	14.28	
1921		00	01	30	22	03	00	15	16	36	34	36	47	44	49	38	28	35	21	31	34	28	37	43	53	60	55	57	52	47	72	79	35.6	19.96
1922		01	01	04	00	12	21	24	19	11	02	00	02	06	02	08	26	39	31	44	50	26	04	06	19	30	42	30	08	24	58	63	19.8	18.14
1923		00	00	01	03	31	39	44	31	11	10	18	55	65	55	39	10	13	23	20	36	66	73	43	32	06	16	30	14	30	31	39	28.5	20.28
1924		29	30	36	44	24	33	57	41	35	31	11	01	01	06	23	22	15	16	05	01	00	11	17	34	38	41	30	14	12	18	21.8	15.22	
1925		37	45	55	33	07	01	04	12	16	13	09	08	19	14	13	08	05	19	14	21	26	19	11	20	40	34	40	36	52	37	43	22.9	15.19
1926		19	21	33	25	17	09	00	02	03	26	20	04	07	08	22	19	00	03	20	20	27	22	38	40	55	62	29	17	15	30	19.8	15.29	
1927		00	08	28	51	32	36	45	47	18	11	10	11	04	00	00	00	02	11	26	09	19	14	30	43	45	39	29	24	16	08	19	20.5	15.82
1928		00	00	00	01	04	01	02	00	01	08	06	10	32	36	38	43	40	34	32	24	16	08	06	00	17	20	26	19	21	40	58	17.5	16.5
1929		04	09	10	10	05	05	04	14	35	37	38	31	33	33	49	37	26	30	34	39	43	22	34	66	54	39	43	40	56	54	31.3	16.83	
1930		02	07	08	04	12	13	37	68	74	56	57	44	34	29	33	32	22	38	41	53	49	39	21	24	26	38	51	44	31	34	40	34.2	18.04
1931		22	29	35	18	01	09	23	17	22	25	23	25	19	21	22	18	29	32	32	33	34	25	21	13	25	21	18	40	70	68	53	27.2	14.62
1932		65	57	19	01	04	18	24	43	31	24	16	22	21	18	38	27	13	20	07	11	06	05	24	28	36	47	44	56	64	46	26	27.8	17.82
1933		03	06	11	34	48	45	40	25	19	17	20	39	32	29	41	41	50	26	18	15	41	30	49	30	07	15	21	32	35	16	16	27.5	13.41
1934		23	31	39	21	06	00	04	04	01	01	04	05	03	04	11	24	18	26	54	54	25	13	14	08	18	17	17	33	15	16	17.0	14.16	
1935		00	00	00	00	01	00	01	05	10	13	25	21	26	27	23	09	37	57	51	34	09	10	05	00	01	17	31	37	30	39	39	18.0	16.81
1936		01	01	07	11	11	04	26	60	57	52	23	00	01	05	08	12	22	27	43	24	23	30	32	19	55	59	36	36	39	34	44	25.9	18.9
1937		11	15	37	43	42	46	45	52	55	64	56	13	02	01	03	07	05	05	04	13	19	20	27	15	24	27	29	47	24	09	07	24.7	18.88
1938		04	01	00	00	00	00	01	01	03	07	31	51	22	09	26	44	39	20	30	14	20	21	28	16	25	28	31	49	25	09	07	18.1	15.33
1939		13	35	36	12	00	00	01	18	13	07	01	00	00	12	07	14	06	13	10	15	27	47	38	22	28	37	46	38	20	12	17	17.6	14.29
1940		00	00	00	01	00	01	00	03	04	09	06	06	10	14	31	55	55	19	01	13	10	13	30	46	48	26	10	14	13	04	04	14.4	16.7
1941		00	00	00	08	16	13	23	32	21	10	13	09	13	19	20	19	56	50	43	25	16	25	59	64	45	15	04	01	00	00	20.0	18.77	
1942		19	20	19	13	02	05	07	06	06	02	01	01	09	34	56	63	31	09	04	10	20	19	09	17	28	16	23	30	36	16	21	17.8	14.96
1943		05	01	00	00	01	08	14	11	09	01	03	11	25	25	13	04	03	11	34	47	18	03	03	09	16	21	25	19	30	28	38	14.1	12.45
1944		15	27	36	12	07	05	06	15	07	01	00	00	00	01	02	02	15	24	26	32	36	36											

DAILY MONSOON INDEX VALUES BY MONTH (JUNE THROUGH SEPTEMBER)

YEAR	MONSOON INDEX FOR AUGUST																															AVG.	STD. DEV.	
	DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30			31
1897	50	64	39	14	11	30	36	27	39	39	45	50	39	39	32	14	02	09	23	18	09	07	05	14	39	50	09	05	00	07	18	25.3	17.51	
1898	14	20	31	45	47	14	20	14	16	10	06	06	06	08	25	20	18	24	20	33	45	59	51	24	43	63	39	20	24	49	63	28.3	17.4	
1899	46	59	17	02	20	15	19	22	14	05	08	00	00	03	39	07	02	00	00	03	05	05	00	03	02	10	17	32	14	08	12.2	14.59		
1900	04	19	31	38	17	06	02	00	00	00	00	00	00	02	04	02	54	48	12	00	00	00	00	00	00	00	00	00	23	19	9.1	15.1		
1901	30	30	48	52	30	02	04	10	28	32	34	46	44	26	20	22	36	20	10	00	02	00	06	04	02	08	14	20	32	14	02	20.3	15.73	
1902	08	17	13	42	23	34	30	53	42	26	19	51	38	00	04	15	02	02	06	04	15	53	47	42	34	02	17	04	19	02	00	21.4	17.74	
1903	00	02	02	13	19	42	38	45	57	28	28	19	23	21	08	13	15	17	21	15	12	15	23	25	23	17	10	21	15	17	19.9	12.41		
1904	27	25	31	40	40	42	18	20	38	36	15	20	49	22	44	65	55	29	29	18	36	58	47	38	18	27	40	48	47	24	16	34.0	13.19	
1905	23	18	07	15	11	15	31	46	36	48	16	10	07	16	20	21	08	10	13	21	30	30	31	43	30	43	30	07	13	26	18	22.4	12.13	
1906	80	14	12	20	18	33	55	29	23	36	17	09	06	38	45	35	67	68	58	17	00	00	00	00	00	00	21	42	48	23	15	24	31.8	23.35
1907	32	51	52	15	08	06	06	14	17	18	09	23	31	22	28	26	25	55	43	58	45	23	20	22	29	40	29	17	63	32	03	27.8	16.25	
1908	23	52	46	30	19	14	33	39	25	35	28	16	30	26	17	39	45	41	30	19	25	17	06	20	64	28	04	00	14	25	20	26.8	14.03	
1909	36	30	30	31	58	29	29	42	53	35	42	30	26	58	78	52	40	42	14	09	10	14	36	34	17	05	21	31	45	71	49	35.4	17.46	
1910	16	29	33	05	03	00	23	24	41	42	33	18	01	03	14	15	18	30	38	05	10	23	21	34	11	27	21	36	64	33	07	21.9	14.76	
1911	00	01	00	00	00	05	08	32	42	21	26	21	24	19	20	17	14	20	33	63	58	26	12	46	50	49	10	06	01	02	00	20.2	18.63	
1912	04	05	14	11	05	02	01	00	00	09	18	41	44	32	11	19	11	15	16	08	07	11	38	25	27	25	67	49	32	49	38	20.5	17.29	
1913	35	24	21	09	26	36	27	34	23	60	43	28	13	08	03	00	01	15	29	24	14	19	14	32	41	33	19	21	16	29	37	23.7	13.24	
1914	12	19	15	26	41	26	25	15	17	04	08	13	17	17	05	32	19	13	15	42	40	27	26	28	21	04	26	61	38	08	21.5	13.1		
1915	02	02	11	14	45	23	11	01	00	01	07	08	21	20	22	14	06	02	00	01	15	25	11	18	30	44	40	29	22	17	00	14.9	13.09	
1916	24	25	22	37	33	27	16	21	12	15	27	66	58	66	46	36	10	01	02	03	02	18	59	52	38	39	15	23	54	30	10	28.6	19.18	
1917	23	50	43	41	23	13	12	25	18	28	45	51	24	15	20	09	00	00	00	01	02	07	26	23	21	09	00	01	02	04	18.0	15.57		
1918	20	11	16	43	35	72	57	42	52	44	11	22	41	14	00	01	01	00	00	01	16	20	10	03	09	14	06	04	03	06	22	19.2	19.44	
1919	66	51	18	01	04	05	17	18	09	06	10	11	07	10	38	50	23	09	13	13	01	06	11	13	23	35	10	06	13	23	57	18.6	17.07	
1920	25	43	37	13	17	22	17	22	36	26	24	51	21	11	32	16	37	49	16	08	07	17	46	38	03	00	00	00	00	00	00	20.9	15.64	
1921	33	03	25	35	24	36	30	40	32	29	18	16	34	34	44	26	11	29	56	72	79	37	49	31	34	15	15	23	33	44	47	33.4	16.15	
1922	44	21	04	06	02	08	19	46	74	43	17	10	14	21	41	50	42	61	32	33	37	34	33	01	03	04	18	11	04	04	23	24.2	19.19	
1923	14	10	23	17	23	20	22	31	67	66	68	66	36	37	39	45	48	29	36	39	15	07	23	39	47	34	10	13	30	36	54	33.7	17.7	
1924	18	19	34	24	07	03	07	05	11	17	29	26	06	07	01	01	03	00	00	00	00	03	11	08	05	06	06	15	20	28	29	11.3	10.3	
1925	16	07	09	33	45	42	31	27	43	35	19	07	01	06	06	10	30	33	19	19	14	27	42	42	52	35	31	31	22	42	60	27.0	15.2	
1926	15	19	19	21	36	33	49	19	10	18	13	25	29	31	39	32	12	00	00	00	01	01	01	00	00	01	05	05	01	01	14.1	14.34		
1927	46	29	28	63	35	19	17	08	07	17	28	35	34	26	43	30	12	34	37	13	18	22	12	33	38	50	51	49	34	09	10	28.6	14.56	
1928	49	55	14	02	00	01	01	01	04	19	39	41	35	30	25	15	07	03	03	06	27	47	38	25	34	17	28	42	14	15	09	20.8	16.66	
1929	39	48	48	65	35	22	32	54	47	57	42	29	26	27	24	28	37	18	09	08	18	36	28	23	36	32	39	18	07	18	17	31.0	14.38	
1930	44	35	18	48	21	42	63	71	43	48	52	19	06	08	03	01	00	00	01	02	08	20	25	10	10	08	06	10	27	10	07	21.5	20.33	
1931	41	40	53	63	79	66	35	48	58	41	08	13	04	08	21	09	16	09	18	32	19	34	33	08	03	07	14	36	73	78	48	35.2	22.01	
1932	11	04	05	17	23	20	14	29	50	31	02	01	02	10	20	06	14	25	29	31	29	19	36	33	36	57	41	15	03	00	19.8	15.24		
1933	26	21	15	20	27	45	39	33	20	19	09	03	09	17	07	21	22	24	48	41	30	21	09	09	34	20	06	03	13	06	13	20.3	12.3	
1934	10	13	37	62	23	14	43	43	27	27	30	45	44	22	21	22	29	39	28	22	47	50	35	31	36	46	51	47	48	39	29	34.2	12.65	
1935	45	49	36	21	28	35	53	39	25	20	40	36	51	63	77	52	10	08	12	18	28	45	75	74	36	22	12	30	31	42	49	37.5	18.76	
1936	56	37	44	61	30	35	33	51	57	38	24	30	26	31	24	12	35	48	40	35	15	02	00	00	20	28	09	22	26	19	20	29.3	16	
1937	13	25	32	39	59	37	52	42	20	15	31	48	65	37	05	00	00	00	00	00	02	20	34	37	37	22	15	18	31	34	71	27.1	19.87	
1938	13	02	04	18	11	29	31	11	15	20	08	23	24	40	37	27	39	32	27	25	33	30	49	29	15	19	28	31	20	31	38	24.5	11.15	
1939	28	56	54	55	57	72	58	21	20	32	22	06	22	26	23	17	22	21	23	16	15	32	37	20	27	33	36	46	28	08	02	30.3	17.22	
1940	12	16	26	40	30	19	21	09	10	15	28	24	39	40	23	12	16	38	37	31	32	37	47	70	56	12	00	00	03	08	27	25.1	16.36	
1941	01	04	22	56	38	40	57	42	63	67	15	05	16	58	57	43	29	06	04	12	11	15	08	06	01	01	00	08	43	35	09	24.9	22.06	
1942	52	34	32	36	62	49	32	27	35	38	12	07	15	16	20	19	21	16	17	10	14	23	28	17	09	06	02	01	01	00	21.7	15.45		
1943	57	62	63	32	14	21	35	22	41	36	30	21	23	37	57	36	06	11	06	08	12	09	13	35	27	14	13	21	38	20	07	26.7	16.77	
1944	03	02	00	01	08	12	27	65	48	29	04	10	09	10	13	20	18	31	36	11	03	01	18	18	02	01	01	00	00	00	13.0	15.64		
1945	41	46	30	2																														

DAILY MONSOON INDEX VALUES BY MONTH (JUNE THROUGH SEPTEMBER)

MONSOON INDEX FOR SEPTEMBER																																	UNCORRECTED % STATIONS REPORTING RAIN >= .01 INCH		
DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	AUG.	STD. DEV.	Avg.		
5TD. DEV.																																			
YEAR																																			
1897	48	48	00	14	39	34	36	36	29	50	73	32	27	07	07	18	18	09	64	52	20	07	25	48	23	11	07	34	16	16	28.1	18.5	18.27	15.14	
1898	24	06	02	00	06	20	31	14	04	16	06	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	4.3	8.23	15.08	4.45	
1899	02	04	04	06	20	33	28	48	22	09	11	02	02	19	07	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	7.2	12.01	13.34	6.66	
1900	34	42	11	02	00	11	25	28	09	00	00	00	00	00	00	04	15	17	15	02	26	49	40	13	13	00	00	00	00	00	11.9	14.58	7.79	8.81	
1901	00	02	04	02	00	02	00	03	05	38	11	04	00	00	00	00	00	00	02	00	00	00	00	00	00	00	00	00	00	00	2.9	7.11	10.66	3.7	
1902	00	02	06	40	02	06	20	06	06	30	10	20	22	26	60	18	02	16	24	42	12	02	00	00	02	00	04	00	00	00	12.6	15.13	11.15	9.2	
1903	21	04	06	15	54	35	19	15	12	10	10	00	00	00	00	00	00	02	00	10	17	23	19	38	23	19	94	81	06	29	18.7	22.86	15.42	13.81	
1904	02	07	30	14	00	02	02	07	20	04	13	43	21	29	18	09	04	02	00	02	05	09	05	00	02	00	00	00	00	00	8.5	10.74	15.94	6.41	
1905	19	47	61	50	32	15	21	15	02	02	02	00	00	03	06	08	02	00	00	00	13	31	50	55	65	10	10	66	56	00	21.4	23.27	16.04	14.67	
1906	00	08	03	00	00	01	07	08	00	00	01	00	10	30	17	06	00	00	00	00	00	00	04	32	25	11	08	66	03	01	6.0	8.94	15.71	5.09	
1907	03	05	35	28	22	09	03	03	02	00	02	03	14	20	12	11	17	02	00	00	03	00	00	00	02	00	00	00	00	00	7.4	11.75	15.70	6.58	
1908	13	21	09	00	13	63	65	38	16	00	04	00	01	00	00	00	00	00	00	06	01	01	04	46	09	06	00	00	00	10.6	18.33	16.60	10.08		
1909	18	10	18	74	78	49	10	05	12	15	14	05	00	00	00	00	00	01	00	00	00	00	04	27	24	24	03	00	00	13.0	20.54	18.71	11.53		
1910	04	11	24	07	00	00	00	01	03	01	03	19	23	12	04	03	05	15	19	09	09	00	01	01	11	00	03	00	00	6.4	7.28	13.74	4.51		
1911	08	11	19	20	06	01	03	09	19	15	34	76	56	44	16	13	18	33	27	09	11	05	00	03	16	48	35	39	65	63	23.9	21.05	21.13	14.6	
1912	25	17	00	02	01	00	00	01	05	00	01	05	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	4.0	9.6	15.70	5		
1913	47	37	08	21	40	51	30	11	09	07	07	11	05	11	04	00	00	00	00	00	00	00	00	00	00	00	00	00	00	12.4	14.98	15.36	9.08		
1914	01	01	03	03	11	07	06	08	15	22	36	11	05	03	12	27	06	05	09	12	18	08	00	00	00	02	27	27	28	13	10.9	9.95	20.12	6.77	
1915	11	36	20	01	00	00	00	00	01	00	01	00	09	12	03	03	28	20	16	09	08	02	04	31	29	01	01	00	00	8.2	10.91	12.11	6.41		
1916	11	07	07	22	26	11	20	72	68	25	07	01	01	02	14	14	08	09	05	08	09	01	01	00	02	05	03	01	11	29	13.9	17.98	16.25	10.22	
1917	06	07	02	08	17	34	27	18	19	52	48	45	38	00	02	12	06	17	41	53	31	17	02	00	00	00	01	04	21	17.6	17.49	18.06	11.46		
1918	23	41	45	20	03	00	05	03	09	06	04	00	01	00	00	00	02	10	02	08	05	08	03	00	00	00	00	00	00	6.6	11.41	16.38	6.27		
1919	25	17	05	05	14	52	67	74	15	02	07	22	20	16	02	00	00	07	21	14	00	04	04	06	58	73	19	06	00	18.6	22.51	20.68	13.65		
1920	02	02	06	38	52	29	29	04	00	00	02	01	22	26	21	36	33	09	04	06	13	05	01	00	01	00	00	01	08	02	11.8	14.53	14.28	8.70	
1921	19	02	00	00	00	00	00	00	01	15	05	00	01	06	08	00	00	02	01	00	00	05	13	06	00	01	03	15	15	6.2	11.79	20.27	6.36		
1922	25	63	27	11	17	17	14	08	19	08	07	01	02	01	01	10	02	12	17	11	06	01	00	02	04	08	23	16	01	00	11.1	12.61	15.99	7.88	
1923	35	16	11	11	17	19	04	07	06	17	17	46	28	35	25	22	49	44	07	01	01	06	20	01	01	01	04	00	00	15.0	14.6	19.69	7.93		
1924	13	16	24	38	26	09	06	20	41	39	28	00	00	00	03	10	02	00	00	00	00	00	00	00	00	00	00	00	00	9.2	13.41	11.20	7.67		
1925	30	51	39	15	07	05	03	00	01	00	00	08	05	01	03	40	67	53	08	01	01	01	01	01	00	00	00	00	00	13.8	22.08	19.75	12.35		
1926	03	19	14	05	01	24	68	29	10	13	27	13	04	06	15	10	00	01	00	01	03	04	03	10	26	72	57	20	06	01	15.5	19.16	13.25	11.35	
1927	14	03	03	09	17	49	65	26	22	20	37	79	38	06	06	42	51	20	15	06	08	21	40	10	01	00	00	00	01	20.4	20.66	20.40	13.5		
1928	07	04	12	22	15	03	01	09	10	01	01	00	00	00	00	00	00	00	00	00	05	01	00	00	15	56	21	01	00	6.2	11.45	11.46	6.21		
1929	19	56	65	56	45	04	01	02	02	08	25	05	08	00	08	08	52	54	33	36	29	34	41	29	24	07	00	04	02	21.8	20.94	21.53	13.92		
1930	17	06	05	10	26	49	63	27	01	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	8.8	16.15	18.09	8.77		
1931	48	23	06	08	10	13	14	14	06	07	02	16	58	73	18	08	22	46	22	07	00	05	22	15	27	24	26	17	15	19.1	17.1	22.87	11.78		
1932	00	00	00	01	01	01	03	00	00	03	05	03	02	04	04	02	01	01	02	08	17	19	47	29	21	09	07	36	46	33	10.2	14.19	16.01	8.22	
1933	10	16	11	03	01	01	24	73	49	51	27	14	11	16	08	02	22	41	22	38	31	02	00	00	00	00	02	02	16	22	17.2	18.32	18.40	11.64	
1934	05	00	00	00	14	20	22	15	02	01	04	08	00	00	00	14	12	03	04	03	00	37	59	15	01	00	00	00	00	8.0	13.08	15.98	7.27		
1935	57	38	12	24	11	09	12	07	00	00	00	00	00	00	01	00	00	14	26	32	17	31	52	83	48	39	40	18	05	00	19.3	21.02	19.43	13.24	
1936	36	47	18	04	02	01	11	11	26	70	41	54	29	02	00	01	11	31	36	26	33	14	01	03	02	09	12	03	00	18.2	19.04	19.80	12.19		
1937	58	40	11	10	38	46	33	17	07	18	21	12	19	10	02	02	00	02	16	37	46	27	06	01	00	01	10	52	44	19.6	17.89	20.01	12.19		
1938	43	38	47	33	19	36	21	03	13	48	26	04	04	03	09	24	05	07	04	01	01	02	05	03	02	00	00	01	01	04	13.6	15.73	16.27	7.68	
1939	48	06	34	64	64	65	69	38	31	40	63	62	53	11	07	10	13	12	13	16	03	00	02	24	48	40	02	00	01	00	26.5	29.56	18.95	16.6	
1940	55	57	53	12	19	36	25	13	10	20	61	64	29	13	02	00	86	79	29	04	19	35	18	04	05	08	22	56	63	37	31.8	23.88	20.47	18.03	
1941	04	04	01	01	00	04	05	01	00	00	02	21	66	46	14	03	22	39	06	09	10	27	04	00	00	00	15	76	41	02	14.1	20.25	16.32	11.64	
1942	00	03	27	23	43	29	34	00	01	31	45	16	19	10	03	00	01	13	21	05	01	02	01	00	00	00	00	00	00	9.7	13.57	12.46	7.86		
1943	01	00	08																																

MEANS, STANDARD DEVIATIONS, SKEWNESS AND KURTOSIS OF DAILY MONSOON INDEX DATA.

MEAN	S.D.	DEVIATION	SKEWNESS	KURTOSIS
2.53012	8.04308	4.71337	26.7165	AUG 1
2.53012	8.04308	4.71337	26.7165	AUG 2
3.6506	10.4956	3.88229	18.3122	AUG 3
4.59036	10.1224	3.99377	16.4114	AUG 4
5.08434	11.5567	2.90281	10.8771	AUG 5
4.42169	9.51779	3.09366	13.94632	AUG 6
4.39739	9.6493	3.50144	18.1259	AUG 7
4.77108	11.5867	3.92948	21.7488	AUG 8
4.62651	11.6428	3.2038	13.112	AUG 9
3.6288	8.31358	2.745	10.1136	AUG 10
4.0241	9.19023	3.19023	13.2392	AUG 11
5.14458	10.9394	3.14858	13.7236	AUG 12
4.63855	10.7665	2.97152	11.7406	AUG 13
4.75904	12.6082	3.95199	19.9873	AUG 14
3.68675	8.61922	2.79149	10.4707	AUG 15
2.84157	7.65413	4.14928	21.8245	AUG 16
2.62651	6.95504	3.38478	14.837	AUG 17
3.50602	8.23048	3.21427	14.0304	AUG 18
4.53012	11.5445	3.51082	16.5436	AUG 19
4.81228	10.1827	2.74003	10.2504	AUG 20
5.77108	12.1237	2.55176	8.61475	AUG 21
6.15643	12.1188	2.57041	9.45394	AUG 22
5.22822	9.73837	2.76717	11.8137	AUG 23
5.0241	7.7725	2.44394	7.44394	AUG 24
6.4064	10.4056	3.51277	18.52287	AUG 25
6.4064	12.7205	10.4781	10.4781	AUG 26
6.78313	13.4526	9.38417	9.38417	AUG 27
7.06224	15.4765	2.39631	9.49693	AUG 28
10.747	15.5323	1.75125	5.6303	AUG 29
10.8916	15.23	1.61613	4.88972	AUG 30
12.506	16.0172	2.88877	9.49857	AUG 31
12.506	16.0172	2.88877	9.49857	SEP 1
15.1494	17.0731	1.60288	3.12398	SEP 2
15.1494	17.0731	1.60288	3.12398	SEP 3
15.656	14.9478	1.34961	4.18943	SEP 4
15.656	14.9478	1.34961	4.18943	SEP 5
15.656	14.9478	1.34961	4.18943	SEP 6
17.3332	18.785	1.33312	3.2693	SEP 7
17.3332	18.785	1.33312	3.2693	SEP 8
17.3332	18.785	1.33312	3.2693	SEP 9
17.3332	18.785	1.33312	3.2693	SEP 10
17.3332	18.785	1.33312	3.2693	SEP 11
17.3332	18.785	1.33312	3.2693	SEP 12
17.3332	18.785	1.33312	3.2693	SEP 13
17.3332	18.785	1.33312	3.2693	SEP 14
17.3332	18.785	1.33312	3.2693	SEP 15
17.3332	18.785	1.33312	3.2693	SEP 16
17.3332	18.785	1.33312	3.2693	SEP 17
17.3332	18.785	1.33312	3.2693	SEP 18
17.3332	18.785	1.33312	3.2693	SEP 19
17.3332	18.785	1.33312	3.2693	SEP 20
17.3332	18.785	1.33312	3.2693	SEP 21
17.3332	18.785	1.33312	3.2693	SEP 22
17.3332	18.785	1.33312	3.2693	SEP 23
17.3332	18.785	1.33312	3.2693	SEP 24
17.3332	18.785	1.33312	3.2693	SEP 25
17.3332	18.785	1.33312	3.2693	SEP 26
17.3332	18.785	1.33312	3.2693	SEP 27
17.3332	18.785	1.33312	3.2693	SEP 28
17.3332	18.785	1.33312	3.2693	SEP 29
17.3332	18.785	1.33312	3.2693	SEP 30
17.3332	18.785	1.33312	3.2693	SEP 31
17.3332	18.785	1.33312	3.2693	OCT 1
17.3332	18.785	1.33312	3.2693	OCT 2
17.3332	18.785	1.33312	3.2693	OCT 3
17.3332	18.785	1.33312	3.2693	OCT 4
17.3332	18.785	1.33312	3.2693	OCT 5
17.3332	18.785	1.33312	3.2693	OCT 6
17.3332	18.785	1.33312	3.2693	OCT 7
17.3332	18.785	1.33312	3.2693	OCT 8
17.3332	18.785	1.33312	3.2693	OCT 9
17.3332	18.785	1.33312	3.2693	OCT 10
17.3332	18.785	1.33312	3.2693	OCT 11
17.3332	18.785	1.33312	3.2693	OCT 12
17.3332	18.785	1.33312	3.2693	OCT 13
17.3332	18.785	1.33312	3.2693	OCT 14
17.3332	18.785	1.33312	3.2693	OCT 15
17.3332	18.785	1.33312	3.2693	OCT 16
17.3332	18.785	1.33312	3.2693	OCT 17
17.3332	18.785	1.33312	3.2693	OCT 18
17.3332	18.785	1.33312	3.2693	OCT 19
17.3332	18.785	1.33312	3.2693	OCT 20
17.3332	18.785	1.33312	3.2693	OCT 21
17.3332	18.785	1.33312	3.2693	OCT 22
17.3332	18.785	1.33312	3.2693	OCT 23
17.3332	18.785	1.33312	3.2693	OCT 24
17.3332	18.785	1.33312	3.2693	OCT 25
17.3332	18.785	1.33312	3.2693	OCT 26
17.3332	18.785	1.33312	3.2693	OCT 27
17.3332	18.785	1.33312	3.2693	OCT 28
17.3332	18.785	1.33312	3.2693	OCT 29
17.3332	18.785	1.33312	3.2693	OCT 30
17.3332	18.785	1.33312	3.2693	OCT 31
17.3332	18.785	1.33312	3.2693	NOV 1
17.3332	18.785	1.33312	3.2693	NOV 2
17.3332	18.785	1.33312	3.2693	NOV 3
17.3332	18.785	1.33312	3.2693	NOV 4
17.3332	18.785	1.33312	3.2693	NOV 5
17.3332	18.785	1.33312	3.2693	NOV 6
17.3332	18.785	1.33312	3.2693	NOV 7
17.3332	18.785	1.33312	3.2693	NOV 8
17.3332	18.785	1.33312	3.2693	NOV 9
17.3332	18.785	1.33312	3.2693	NOV 10
17.3332	18.785	1.33312	3.2693	NOV 11
17.3332	18.785	1.33312	3.2693	NOV 12
17.3332	18.785	1.33312	3.2693	NOV 13
17.3332	18.785	1.33312	3.2693	NOV 14
17.3332	18.785	1.33312	3.2693	NOV 15
17.3332	18.785	1.33312	3.2693	NOV 16
17.3332	18.785	1.33312	3.2693	NOV 17
17.3332	18.785	1.33312	3.2693	NOV 18
17.3332	18.785	1.33312	3.2693	NOV 19
17.3332	18.785	1.33312	3.2693	NOV 20
17.3332	18.785	1.33312	3.2693	NOV 21
17.3332	18.785	1.33312	3.2693	NOV 22
17.3332	18.785	1.33312	3.2693	NOV 23
17.3332	18.785	1.33312	3.2693	NOV 24
17.3332	18.785	1.33312	3.2693	NOV 25
17.3332	18.785	1.33312	3.2693	NOV 26
17.3332	18.785	1.33312	3.2693	NOV 27
17.3332	18.785	1.33312	3.2693	NOV 28
17.3332	18.785	1.33312	3.2693	NOV 29
17.3332	18.785	1.33312	3.2693	NOV 30
17.3332	18.785	1.33312	3.2693	NOV 31
17.3332	18.785	1.33312	3.2693	DEC 1
17.3332	18.785	1.33312	3.2693	DEC 2
17.3332	18.785	1.33312	3.2693	DEC 3
17.3332	18.785	1.33312	3.2693	DEC 4
17.3332	18.785	1.33312	3.2693	DEC 5
17.3332	18.785	1.33312	3.2693	DEC 6
17.3332	18.785	1.33312	3.2693	DEC 7
17.3332	18.785	1.33312	3.2693	DEC 8
17.3332	18.785	1.33312	3.2693	DEC 9
17.3332	18.785	1.33312	3.2693	DEC 10
17.3332	18.785	1.33312	3.2693	DEC 11
17.3332	18.785	1.33312	3.2693	DEC 12
17.3332	18.785	1.33312	3.2693	DEC 13
17.3332	18.785	1.33312	3.2693	DEC 14
17.3332	18.785	1.33312	3.2693	DEC 15
17.3332	18.785	1.33312	3.2693	DEC 16
17.3332	18.785	1.33312	3.2693	DEC 17
17.3332	18.785	1.33312	3.2693	DEC 18
17.3332	18.785	1.33312	3.2693	DEC 19
17.3332	18.785	1.33312	3.2693	DEC 20
17.3332	18.785	1.33312	3.2693	DEC 21
17.3332	18.785	1.33312	3.2693	DEC 22
17.3332	18.785	1.33312	3.2693	DEC 23
17.3332	18.785	1.33312	3.2693	DEC 24
17.3332	18.785	1.33312	3.2693	DEC 25
17.3332	18.785	1.33312	3.2693	DEC 26
17.3332	18.785	1.33312	3.2693	DEC 27
17.3332	18.785	1.33312	3.2693	DEC 28
17.3332	18.785	1.33312	3.2693	DEC 29
17.3332	18.785	1.33312	3.2693	DEC 30
17.3332	18.785	1.33312	3.2693	DEC 31

NOAA Technical Memoranda NWSNR: (Continued)

- 92 Smoke Management in the Willamette Valley. Earl M. Bates, May 1974. (COM-74-11277/AS)
- 93 An Operational Evaluation of 500-mb Type Regression Equations. Alexander E. MacDonald, June 1974. (COM-74-11407/AS)
- 94 Conditional Probability of Visibility Less than One-Half Mile in Radiation Fog at Fresno, California. John D. Thomas, August 1974. (COM-74-11555/AS)
- 96 Map Type Precipitation Probabilities for the Western Region. Glenn E. Rasch and Alexander E. MacDonald, February 1975. (COM-75-10428/AS)
- 97 Eastern Pacific Cut-off Low of April 21-28, 1974. William J. Alder and George R. Miller, January 1976. (PB-250-711/AS)
- 98 Study on a Significant Precipitation Episode in Western United States. Ira S. Brenner, April 1976. (COM-75-10719/AS)
- 99 A Study of Flash Flood Susceptibility--A Basin in Southern Arizona. Gerald Williams, August 1975. (COM-75-11360/AS)
- 102 A Set of Rules for Forecasting Temperatures in Napa and Sonoma Counties. Wesley L. Tuft, October 1975. (PB-246-902/AS)
- 103 Application of the National Weather Service Flash-flood Program in the Western Region. Gerald Williams, January 1976. (PB-253-053/AS)
- 104 Objective Aids for Forecasting Minimum Temperatures at Reno, Nevada, During the Summer Months. Christopher D. Hill, January 1976. (PB-252-866/AS)
- 105 Forecasting the Mono Wind. Charles P. Ruscha, Jr., February 1976. (PB-254-650)
- 106 Use of MOS Forecast Parameters in Temperature Forecasting. John C. Plankinton, Jr., March 1976. (PB-254-649)
- 107 Map Types as Aids in Using MOS PoPs in Western United States. Ira S. Brenner, August 1976. (PB-259-594)
- 108 Other Kinds of Wind Shear. Christopher D. Hill, August 1976. (PB-260-437/AS)
- 109 Forecasting North Winds in the Upper Sacramento Valley and Adjoining Forests. Christopher E. Fontana, Sept. 1976. (PB-273-677/AS)
- 110 Cool Inflow as a Weakening Influence on Eastern Pacific Tropical Cyclones. William J. Denney, November 1976. (PB-264-655/AS)
- 112 The MAN/MOS Program. Alexander E. MacDonald, February 1977. (PB-265-941/AS)
- 113 Winter Season Minimum Temperature Formula for Bakersfield, California, Using Multiple Regression. Michael J. Oard, February 1977. (PB-273-694/AS)
- 114 Tropical Cyclone Kathleen. James R. Fors, February 1977. (PB-273-676/AS)
- 116 A Study of Wind Gusts on Lake Mead. Bradley Colman, April 1977. (PB-268-847)
- 117 The Relative Frequency of Cumulonimbus Clouds at the Nevada Test Site as a Function of K-value. R. F. Quiring, April 1977. (PB-272-831)
- 118 Moisture Distribution Modification by Upward Vertical Motion. Ira S. Brenner, April 1977. (PB-268-740)
- 119 Relative Frequency of Occurrence of Warm Season Echo Activity as a Function of Stability Indices Computed from the Yucca Flat, Nevada, Rawinsonde. Darryl Randerson, June 1977. (PB-271-290/AS)
- 121 Climatological Prediction of Cumulonimbus Clouds in the Vicinity of the Yucca Flat Weather Station. R. F. Quiring, June 1977. (PB-271-704/AS)
- 122 A Method for Transforming Temperature Distribution to Normality. Morris S. Webb, Jr., June 1977. (PB-271-742/AS)
- 124 Statistical Guidance for Prediction of Eastern North Pacific Tropical Cyclone Motion - Part I. Charles J. Neumann and Preston W. Leftwich, August 1977. (PB-272-661)
- 125 Statistical Guidance on the Prediction of Eastern North Pacific Tropical Cyclone Motion - Part II. Preston W. Leftwich and Charles J. Neumann, August 1977. (PB-273-155/AS)
- 127 Development of a Probability Equation for Winter-Type Precipitation Patterns in Great Falls, Montana. Kenneth B. Mielke, February 1978. (PB-281-387/AS)
- 128 Hand Calculator Program to Compute Parcel Thermal Dynamics. Dan Gudge, April 1978. (PB-283-080/AS)
- 129 Fire Whirls. David W. Goens, May 1978. (PB-283-866/AS)
- 130 Flash-Flood Procedure. Ralph C. Hatch and Gerald Williams, May 1978. (PB-286-014/AS)
- 131 Automated Fire-Weather Forecasts. Mark A. Moliner and David E. Olsen, September 1978. (PB-289-916/AS)
- 132 Estimates of the Effects of Terrain Blocking on the Los Angeles WSR-74C Weather Radar. R. G. Pappas, R. Y. Lee, and B. W. Finke, October 1978. (PB289767/AS)
- 133 Spectral Techniques in Ocean Wave Forecasting. John A. Jannuzzi, October 1978. (PB291317/AS)
- 134 Solar Radiation. John A. Jannuzzi, November 1978. (PB291195/AS)
- 135 Application of a Spectrum Analyzer in Forecasting Ocean Swell in Southern California Coastal Waters. Lawrence P. Kierulff, January 1979. (PB292716/AS)
- 136 Basic Hydrologic Principles. Thomas L. Dietrich, January 1979. (PB292247/AS)
- 137 LFM 24-Hour Prediction of Eastern Pacific Cyclones Refined by Satellite Images. John R. Zimmerman and Charles P. Ruscha, Jr., January 1979. (PB294324/AS)
- 138 A Simple Analysis/Diagnosis System for Real Time Evaluation of Vertical Motion. Scott Heflick and James R. Fors, February 1979. (PB294216/AS)
- 139 Aids for Forecasting Minimum Temperature in the Wenatchee Frost District. Robert S. Robinson, April 1979. (PB296339/AS)
- 140 Influence of Cloudiness on Summertime Temperatures in the Eastern Washington Fire Weather District. James Holcomb, April 1979. (PB298674/AS)
- 141 Comparison of LFM and MFM Precipitation Guidance for Nevada During Doreen. Christopher Hill, April 1979. (PB296613/AS)
- 142 The Usefulness of Data from Mountaintop Fire Lookout Stations in Determining Atmospheric Stability. Jonathan W. Corey, April 1979. (PB298699/AS)
- 143 The Depth of the Marine Layer at San Diego as Related to Subsequent Cool Season Precipitation Episodes in Arizona. Ira S. Brenner, May 1979. (PB298817/AS)
- 144 Arizona Cool Season Climatological Surface Wind and Pressure Gradient Study. Ira S. Brenner, May 1979. (PB298900/AS)
- 145 On the Use of Solar Radiation and Temperature Models to Estimate the Snap Bean Maturity Date in the Willamette Valley. Earl M. Bates, August 1979
- 146 The BART Experiment. Morris S. Webb, October 1979. (PB80155112)
- 147 Occurrence and Distribution of Flash Floods in the Western Region. Thomas L. Dietrich, December 1979.
- 148 A Real-Time Radar Interface for AFOS. Mark Mathewson, January 1980.
- 149 Misinterpretations of Precipitation Probability Forecasts. Allan H. Murphy, Sarah Lichtenstein, Baruch Fischhoff, and Robert L. Winkler, February 1980.
- 150 Annual Data and Verification Tabulation - Eastern and Central North Pacific Tropical Storms and Hurricanes 1979. Emil B. Gunther and Staff, EPHC, April 1980.
- 151 NMC Model Performance in the Northeast Pacific. James E. Overland, PMEL-ERL, April 1980.
- 152 Climate of Salt Lake City, Utah. Wilbur E. Figgins, June 1980.
- 153 An Automatic Lightning Detection System in Northern California. James A. Rea and Chris E. Fontana, June 1980.
- 154 Regression Equation for the Peak Wind Gust 6 to 12 Hours in Advance at Great Falls During Strong Downslope Wind Storms. Michael J. Oard, July 1980.

NOAA SCIENTIFIC AND TECHNICAL PUBLICATIONS

The National Oceanic and Atmospheric Administration was established as part of the Department of Commerce on October 3, 1970. The mission responsibilities of NOAA are to assess the socioeconomic impact of natural and technological changes in the environment and to monitor and predict the state of the solid Earth, the oceans and their living resources, the atmosphere, and the space environment of the Earth.

The major components of NOAA regularly produce various types of scientific and technical information in the following kinds of publications:

PROFESSIONAL PAPERS — Important definitive research results, major techniques, and special investigations.

CONTRACT AND GRANT REPORTS — Reports prepared by contractors or grantees under NOAA sponsorship.

ATLAS — Presentation of analyzed data generally in the form of maps showing distribution of rainfall, chemical and physical conditions of oceans and atmosphere, distribution of fishes and marine mammals, ionospheric conditions, etc.

TECHNICAL SERVICE PUBLICATIONS — Reports containing data, observations, instructions, etc. A partial listing includes data serials; prediction and outlook periodicals; technical manuals, training papers, planning reports, and information serials; and miscellaneous technical publications.

TECHNICAL REPORTS — Journal quality with extensive details, mathematical developments, or data listings.

TECHNICAL MEMORANDUMS — Reports of preliminary, partial, or negative research or technology results, interim instructions, and the like.



Information on availability of NOAA publications can be obtained from:

**ENVIRONMENTAL SCIENCE INFORMATION CENTER (D822)
ENVIRONMENTAL DATA AND INFORMATION SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE**

**6009 Executive Boulevard
Rockville, MD 20852**