UNITED STATES DEPARTMENT OF COMMERCE
WEATHER BUREAU
WASHINGTON

May 20, 1963

IN REPLY, PLEASE ADDRESS
CHIEF, U. S. WEATHER BUREAU
WASHINGTON 25, D. C.
AND REFER TO
C-3.1

MEMORANDUM

TO : Area and State Climatologists, NWRC, Field Aides (HC), Field Aides, River Forecast Centers, River District Offices, Regional Substation Management Units, and Area Hydrologic Engineers (with copies to Regional Administrative Offices, Agricultural Service Offices, and Agricultural Forecast Offices for information)

FROM : Director, Climatology

SUBJECT: Climatological Services Memorandum No. 98

1. CONFERENCE ON AGRICULTURAL METEOROLOGY: The conference held at Lakeland, Florida, April 4-5, was the fifth of a series sponsored by the American Meteorological Society. Spaced at approximate intervals of 18 months, previous meetings were held at Madison (spring 1957), New Haven (fall 1958), Kansas City (spring 1960), and St. Louis (fall 1961).

Mr. Keith Butson, Florida State Climatologist, acted as General Chairman of the conference. In close cooperation with Dr. John Gerber, University of Florida, and Warren Johnson, MIC at Lakeland, a very excellent meeting was arranged. The facilities at the Lakeland Civic Center are ideal for such activities. Not only the program but the social activities were obviously well planned. Wives and guests were most appreciative of the tours which were so ably conducted by Mesdames Johnson, Gerber and Butson.

A primary purpose from the beginning of the series has been to bring together meteorologists and research workers from many branches of agriculture for discussions of their common problems. To this end, the 1961 meeting at St. Louis was held jointly with the American Society of Agronomy. Among the agricultural specialties represented at these Conferences, either by individuals or through their organizations, are agronomy, agricultural engineering, ecology, agricultural economics, horticulture, and soil physics.

The Florida meeting was somewhat concentrated with 32 papers presented in a 2-day period. Following a pattern apparent in all five of the meetings, more than half of the papers referred directly to theoretical or practical problems of physics and chemistry in the biosphere. The "biosphere" may be defined as the 1 meter below and the 1 to 3 meters above the soil-atmosphere interface but would include 10 to 20 meters of atmosphere in the special case of forest meteorology. The plant environment consists mainly of the actual content and fluxes of energy, water, and carbon dioxide in the biosphere. The most frequent concern is with the availability and use of water. The temperature environment, almost equally important, is treated as part of the energy balance. Instrumentation, experimental design, the compromises required where experimental control is almost nonexistent, and treatment of

often voluminous data have called for much imagination, ingenuity, and hard work. The estimation of evapo-transpiration values for operational uses such as irrigation control has been attacked from every angle and much fundamental knowledge has been gained. The practical solutions are based either on crude empirical estimates based on temperature patterns or on less crude but still empirical estimates based on water loss from open pans or atmometers.

Other papers at this meeting dealt with climatology, general agricultural meteorology, data processing, and synoptic or meso-scale analysis. A number of papers were concerned with cold protection problems in subtropical areas such as Florida and California. Protection of citrus and other crops through the use of orchard heaters, wind machines, and water sprinklers is of tremendous importance in those areas. The Florida freeze of December 12-13, 1962, was the most severe on record in this century and became the subject of much discussion and comment. The fact that the Friday sessions covering this severe freeze were attended by at least a hundred growers and farm managers attests to the importance of practical agricultural meteorology in the Florida area.

As in each of the earlier meetings a substantial contribution to the success of the program can be credited to a delegation from Canada led by Dr. George Robertson of the Canada Department of Transport. Other papers at this meeting were based on work done in East Africa, Hawaii, and Trinidad. Regretably the papers from Barbados and Indonesia had to be cancelled.

The Conferences on agricultural meteorology have so far dealt almost exclusively with the problems of plants with only a few discussions concerning animals. Of course there should be considerable transfer of basic knowledge from plant to animal problems, particularly the facts concerning fluxes of water vapor and radiant energy. However, one must also conclude that the problems in animal bioclimatology at this period seem somewhat less important. The current deep involvement of plant scientists with micro-meteorology seems to be a marriage of necessity rather than a natural romance. Although much earlier work in plant breeding, fertilizers, plant pathology, and entomology could ignore the weather variables this omission must now exact a price. One researcher said, "We must analyze weather effects so that we can ignore them, i.e., correct our other results." The next step is to use such knowledge as a tool to increase production in quality or quantity or to reduce costs. It can be assumed that as the pressure increases to convert plant foodstuffs to animal proteins we can expect increasing research in the problems of animal biometeorology.

2. PRECIPITATION MEASUREMENTS BY RADAR: Ever since it was shown that certain types of radar do a good job of locating precipitating clouds, there has been widespread interest in quantitative precipitation estimates. As against the known limitations of conventional rain gages, the prospect of current rainfall measurements with coverage complete both in time and space is most attractive. Enthusiasm has been high and there have been predictions that rain gages would quickly become obsolete.

During the last 10 years a great amount of research has been directed toward this problem. The question of what the radar sees has involved the physics of radar reflectivity and the effects of scattering and attenuation. The energy reflected by water drops is extremely sensitive to changes in drop size while rainfall drop size depends on the physics and dynamics of clouds. Basic research has been aimed at the precipitation process itself as well as the behavior of radar. The goal has been to measure the radar return over each small area and to convert these values objectively into rainfall rates. The question of what happens to rain in falling from the level of detection through varying depths of moist or dry air to the ground has received somewhat less attention.

As the complexity of the direct approach became apparent, several workers looked toward other means of relating radar to rainfall. Photographic overlays of the PPI scope or hand tabulations can show the location and duration of radar echoes while changes in gain settings show the relative intensity of echoes. (Echo intensity is directly but not uniquely related to rainfall rate.) The echo counts per unit area are related to surface rainfall in conventional gages. By stratifying precipitation situations into several groups such as warm front rain, snow, scattered showers, thunderstorms, squall lines, etc., it is possible to improve the reliability of the relationships. At this time, it appears that for ranges of about 15 to 60 miles using the WSR-57 radar calibrated for the particular area and for the type of weather it is now possible to estimate rainfall with an accuracy of plus or minus 15 - 30% through the careful use of such techniques. While this is very definite progress, it is safe to say that basic networks of raingages must be continued for climatological purposes for many years to come.

A precipitation integrator has been built by the Stanford research group and installed at the WB experimental radar facility at Norman, Oklahoma. This will automatically analyze for location, intensity, and duration all radar echoes for a 141 point grid over a 200-mile diameter circle around the WSR-57 radar. The data are converted to equivalent rainfall rates, stored on punched tape, displayed on counters, and may be transmitted on teletype lines. During the next few months the data collected will be matched with recording rain gage records.

At various WB offices the current radar reports are being used operationally to confirm the location of heavier rainfall areas and to study their movement, growth, and decay. Rainfall rates are judged very subjectively and tied to raingage reports received by telephone or teletype. Used in this manner the radar is a very helpful tool in flash flood situations. Thus at Akron-Canton, Ohio, a special flood-warning project employs the Decca radar at WBAS, dense networks of rain gages organized on a community basis and reporting by telephone, and a community-action type of warning distribution.

3. CLIMATOLOGICAL SUMMARIES FOR SCS SOIL SURVEYS: Samuel King, of the University of Missouri Computer Center, has developed a 1620 program for preparing climatological summaries from the 1009 cards for SCS Soil Surveys. If any State Climatologist with access to a 1620 desires a copy of this program we will furnish it.

4. SPACING OF CLIMATOLOGICAL SUBSTATIONS: The following memo was written in explanation of criteria for spacing of climatological substations:

"Before the policy for the network of climatological stations was adopted, some study was made of the sampling error for the mean density of one gauge per 600 sq. miles. Since temperature was known to be less variable than precipitation, the latter maximized the sampling error and was therefore used as a criterion. Further, the shortest period for which areal averaging was to be regularly done was one week. This was for agricultural purposes where a statewide uniformly-spaced network was desirable. Sampling for hydrologic purposes was specifically left out of this plan since precipitation was the main interest, and it was anticipated that such networks would be superimposed on the climatological network to fit specific drainage basin situations. The uniformly-spaced temperature measurements would be, however, suitable for all purposes.

"The studies of precipitation network sampling error gave a relative standard error (RSE) (coefficient of variation) of 10% for the 600 mile density. In sampling practice of this general character, it is usually desirable to have a 5% RSE. Since halving the RSE would require doubling the network density, we had to be satisfied with 10%. For your purpose, we have calculated the ratio of the RSE for one day to that for a week, and have found it to be 0.239. This would mean that the RSE for a day with the standard network is about 24%. To reduce this to a desirable value, say 6%, would require that the network density be reduced by $(1/4)^2$ or 1/16. This gives a gauge about every 40 sq. miles."

5. COMMEMORATIVE POSTAGE STAMP: Re CSM 92-8, 93-8, and 94-5. The Stamp Advisory Committee of the Post Office Department has rejected our suggestion for a commemorative postage stamp on the sesqui-centennial of the May 2, 1814 order of Dr. Tilton establishing an official meteorological network.

6. DECENNIAL CENSUS OF U. S. CLIMATE 1960 PROGRAM: The following is a report of the status of this program as of March 31, 1963:

I. CLINO (Monthly normals of sea-level pressure and temperature, and quintile values of precipitation, based on 1931-1960 period)

57 stations	completed in FY 1962, published by WMO

II. Climatography of the U. S. No. 81 series:a. Monthly normals of temperature, precipitation, and heating degree days (adjusted to latest location of instruments) for period 1931-1960

318 First Order Stations	completed in FY 1962

b. Monthly normals of temperature and precipitation, for period 1931-1960

3334 Substations and 359 Climatological Divisions	completed in FY 1962
45 sections	published in FY 1962

III. Climatography of the U. S. No. 82 series - Summaries of Hourly Observations (5-year and 10-year Recaps)

Summaries are planned for selected First Order Stations	Completed and published: 41 In process of printing : 30 In preparation this FY : 32

IV. Climatography of the U. S. No. 83 series - Monthly Heating Degree Day Normals, for period 1931-1960

2070 Substations	completed in FY 1963
Plus 318 First Order Stations	Publication: separates (by states) printed in FY 1963 assembled sets being printed

V. Climatography of the U. S. No. 84 series - Daily Normals of Temperature and Heating Degree Days

318 First Order Stations	Completed in FY 1963 Publication: in progress

VI. Climatography of the U. S. No. 85 series - Monthly Averages for State Climatic Divisions, 1931-1960. A listing of monthly and annual averages of temperature and precipitation for the period 1931-1960 for each climatic division.

359 Climatic Divisions	Completed in FY 1963 Publication: in progress

VII. Mid-Month Normals for Extended Forecast Branch

320 First Order and Second Order Stations	Completed in FY 1963

VIII. World Weather Records, 1951-1960

Background work and pilot project completed.
1951-1960 data punched for all stations.
Initial letters written to 109 foreign meteorological services.
Approximately 1/2 of required listings have been prepared by NWRC.
U. S. Delegation to Congress IV briefed and furnished supplementary material.
Completion scheduled for June 1964.

IX. Climatography of the U. S. No. 86 series - Climatic Summary of the United States - Supplement for 1951-1960 (Bulletin W Supplement)

Monthly long-term means of evaporation have been calculated for all qualifying stations.
Completion of the project is scheduled for June 1964.

7. KENTUCKY STATE CLIMATOLOGIST: Mr. A. B. Elam, Jr., formerly of the NWRC, has been selected as the first full-time Kentucky State Climatologist.

He is located on the campus of the University of Kentucky at Lexington. His address is: Weather Bureau State Climatologist, Agronomy Department, Agricultural Experiment Station, University of Kentucky, Lexington, Kentucky.

8. RSMU MEETING: The first meeting of the Chiefs of the four Regional Substation Management Units was held in the Central Office March 4-8. The group met at Suitland on March 5 and mutual problems were discussed with members of the Office of Climatology, O&SF Division, and Mr. G. E. Stegall of the NWRC.

9. STATE WEEKLY WEATHER AND CROP BULLETIN: Each State Climatologist is asked to send us two copies of an early representative issue of the state Weekly Weather and Crop Bulletin for the 1963 season, marked for C-3.1. Also each State Climatologist is asked to report to us the approximate number of Weather Bureau man-hours that are spent weekly in the preparation of the state bulletin and the size of the mailing list.

10. PRE-ADDRESSED CROP CARDS (WB FORM 612-1): Where there would be a considerable saving in labor, WB Form 612-1, The Weekly Weather Report, can be pre-addressed by the Central Office. Those State Climatologists desiring this service should send a card to this office with the address to be printed. Three to four weeks should be allowed for return of the finished job.

11. BOUND VOLUMES OF CLIMATOLOGICAL DATA BY STATES FOR PERIOD 1957-1961: These have now been bound and are being distributed to the respective State Climatologists. In three cases (California, New England, and Texas), due to the thickness of 5 years' issues of CD, two volumes are required for binding.

12. DAYS WITH ONE INCH OR MORE OF SNOW ON GROUND: Effective with data for January 1963 the number of days with one inch or more of snow on the ground will be published in the July issue of Climatological Data for all sections except Florida, the West Indies, Puerto Rico and the Virgin Islands, Hawaii and the Pacific.

13. PRICE QUOTATIONS: Occasionally a State Climatologist or MIC is asked about the cost of furnishing services from the NWRC. These may range from simple requests for basic data to a request for comprehensive machine summaries.

Since there are many variables that may affect the cost of a particular job it should be made quite clear to a prospective customer that any ball park cost estimates given to him are highly tentative. Wherever possible it would be best to avoid any indication that guidance furnished really represents any valid cost estimate.

14. PUBLICATIONS DISTRIBUTED TO STATE AND AREA CLIMATOLOGISTS SINCE CSM #97:
"Report on Conference on a Program of Research in Atmospheric Sciences and Weather Modification". South Dakota School of Mines and Technology.

"History of Weather Bureau Precipitation Measurements", No. 3.082 in the Key to Meteorological Records Documentation Series, by J. H. Hagarty, Office of Climatology.

"Those Other Weathermen", reprinted from the February 1963 Kiwanis Magazine.

"Extremes of Snowfall in the United States" by David M. Ludlum, reprinted from Volume 15, No. 6, December 1962 issue of Weatherwise.

"Meteorological Drought". Wayne C. Palmer, Office of Climatology.

H. E. Landsberg

GUIDE TO CLIMATOLOGICAL SERVICES
MEMORANDUM NO. 98

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