UNITED STATES DEPARTMENT OF COMMERCE
WEATHER BUREAU
WASHINGTON

July 25, 1960

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, Field Aides (HC), Field Aides, WRPCs, River Forecast Centers, River District Offices, and Area Engineers (with copies to Regional Offices for information)

FROM : Office of Climatology

SUBJECT : Climatological Services Memorandum No. 81

GENERAL

1. CLIMATIC INDICES IN USDA SCS SOIL SURVEY WORK: (The following was written by Marvin D. Magnuson, Northwest Area Climatologist) "In early 1960, the USDA, SCS, Western Technical Work-Planning Conference for Soil Survey adopted a recommendation to make evapotranspiration computations via Thornthwaite's method for their use in climate and soil classification. This informal technical group has been set up to assist in coordinating efforts in the 11 western States and Hawaii for improving their understanding of soils and to advance their methods of interpretation and publication procedures. Attendance to these meetings consists of the SCS State Soil Scientist, an Agricultural College Soil Specialist from each State plus some representation from other Federal Agencies, such as the Bureau of Reclamation, U. S. Forest Service and the Weather Bureau. A similar organization covers the midwest and the eastern portions of the country.

"For the Western Group, the basic tool for making these evapotranspiration computations is the nomogram and charts in the Palmer-Havens article in the April 1958 issue of Monthly Weather Review. (The nomogram of van Hylckama in Monthly Weather Review of March 1959 could also be used.) All SCS soil scientists in the 11 western States have been furnished copies of MWR for April 1958, as well as a manual of instruction for computations within their State. Arrangements have been completed with the SCS for the reprinting and enlarging the basic Palmer-Havens nomogram and charts. When these are available, a copy will be furnished to all State Climatologists.

"For this project, the initial computations are to be performed on the "normals" of temperature and precipitation. Thus, the following climatic indices are included: (1) the annual potential evapotranspiration (PE), (2) the PE for the frost-free season (several freeze levels), (3) the annual actual evapotranspiration (ET) for several levels of available water-holding capacity of the soil (AWC), and (4) the ET for the frost-free season (several freeze levels) for several AWC's. These indices can be used for classifying soil capability or crop potential. For example, the annual PE is an index for irrigated and frost-resistant crops, like barley. The index gives the maximum energy available to a crop in an irrigated economy. Thus, with irrigation, the temperature becomes the main limiting factor. Similarly, annual ET is an

index for dry-farmed and hardy crops (or range pasture). This index recognizes the limitation of both temperature and precipitation and gives the amount of energy available to a given plant in a normal year. The following table gives some of the overall variations of these indices:

	Helena, Mont.	Sacramento, Calif.	Honolulu, Hawaii	Seattle, Wash.	Aberdeen, Wash.
Precipitation (P)	13"	16"	22"	33"	85"
Ann. Pot. Evapo. (PE)	22"	33"	69"	26"	25"
Ann. Actual Evapo.(ET) (For AWC 4 in.)	13"	12"	22"	18"	24"

Other important information such as the amount of water deficit and water surplus is also determined from these computations. However, these latter indices must be considered as general estimates since using "normals", the water balance underestimates both the deficits and surpluses. For example, with the above data, the water surplus at Sacramento is estimated as 4 inches; at Aberdeen, Wash., 61 inches. Similarly the water deficiency is estimated as 21 inches and 1 inch respectively. If one had used daily values or monthly values (instead of monthly normals), both of these indices would have been larger since the normals balance out the departures that occur on a short term basis.

"The question has been occasionally raised as to why the selection of the Thornthwaite method rather than, say the Penman method or the Blaney-Criddle formula for the evapotranspiration computations. Essentially, the main reasons were (1) the availability of large amounts of basic data, and (2) the simplicity of the method (via the Palmer-Havens nomograms). Even if it is conceded that the Penman method might be more exact and theoretically correct, it still is quite impossible to make reasonable estimates of wind, sunshine and relative humidity for most areas in the west. (In addition, the whole 11 state area has only 37 sunshine recorders, whereas a comparable area elsewhere has twice that number!) Thus, in a way, the problem resolves down to the choice of using estimated data of fair quality in an exact formula or of using exact data in a less exact formula.

"The Western Group also reviewed the P-E index. This index is often called the "precipitation effectiveness index" and is simply a complex ratio between monthly temperature and precipitation. This index was also developed by Thornthwaite but much earlier in 1931. (See CSM 78 and 71). For some time now, national SCS has been mentioning this P-E index as a guide for land capability classification. The criterion was to determine whether the P-E index was above or below 44. It is pertinent to mention that not much attention was given to this classification in the eastern portion of the U. S. since the entire area was above 44! (No area in a limited class.) At the same time, many workers in the west could not utilize the P-E index number since it was difficult to relate one area to another. Besides, identical values of the index could be obtained by various combinations of temperature and precipitation data. For the above reasons, the Western Group has now rejected the P-E index. In time, it is hoped that the National Plan for SCS will deemphasize this index and give its support to the more meaningful evapotranspiration computations.

"In the meantime, all State Climatologists should familiarize themselves with the Palmer-Havens nomograms and other work in the field of evapotranspiration. They should also maintain contact with the SCS and Agricultural School Soil Scientists and give whatever assistance and advice that may be needed in regard to the climatic section of the soil survey reports."

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The following comments on the above item are by Franklin Newhall and Dwight W. Swanson, SCS Climatologists.

"Mr. Magnuson has prepared an excellent critique on the position and work of the Committee on Climate of the Western Regional Work Planning Conference, Soil Survey, SCS, USDA, and of the related work going on in the Western states. His discussion covers material which was considered at the National Soil Survey Conference at St. Louis in April, 1960. Here the National Committee on Climate commended the work which has already been done in the west and strongly approved continuance of this research. The National Committee recommended that these modified potential evapotranspiration techniques be tried as widely as possible in the west and other regions of the United States. If wider trials bear out the early promise shown in the west, the results will undoubtedly be incorporated into a forthcoming soils memorandum.

"Magnuson's next-to-last paragraph mentions the rejection of the old P-E precipitation effectiveness concept by the Western group and raises the question as to why the SCS in Soils Memorandum #22 continues to suggest the use of P-E as an aid to land capability classification. The fact is that the P-E technique has, during the past 10 to 12 years, proved rather useful in the arid and semiarid lands of the Great Plains, in contrast to the lack of success in the arid and semiarid lands of the mountains and basins of the west. In the Great Plains much better results have been obtained with P-E than with other climatic expressions such as unadjusted total rainfall. During the past 4 to 6 years maps of P-E index have been prepared for all of the Great Plains, and using these maps jointly with soil maps, areas have been delimited in which the highest possible capability rating in any given area is controlled by the P-E values of the isolines bounding it.

"Concerning the suggestions regarding P-E index and the several arbitrary limits given in Soils Memorandum #22, we feel that the soil scientist, or the climatologist giving him material, is called upon to make few, if any, fresh computations of the P-E index for additional locations. There are three reasons for this. 1) In the west, where new techniques are being tried out, soil scientists have been given freedom to develop their own criteria applicable to their area. 2) In the east, precipitation effectiveness, if it is expressed as P-E, is not and probably could not be, applied to land capability classification. 3) In the only remaining part, the Great Plains, P-E has been a rather crude but generally useful tool and will remain in use until superseded by some better technique; here, however, P-E has already been widely mapped. We would regard the discussion of P-E in Soils Memorandum #22 chiefly as a rationale for using the available P-E maps in preparing land capability classifications on the Great Plains."

2. REPORT OF PAPERS PUBLISHED: The Advisory Committee for Climatology has recommended that more publicity be given to papers published by Weather Bureau climatologists. We therefore request that all State and Area Climatologists and all WRPC, NWRC, and Office of Climatology personnel report to us, in the future, any papers on meteorological or climatological subjects that are published, giving reference details. This should include state agricultural bulletins where the climatologist is author, co-author, or to which he contributed; monographs published under state, university or private auspices; signed articles published by newspapers or periodicals, etc.

This is in addition to reporting such papers by WB Form 5010 to Personnel Management Division for your personnel folder.

3. LISTING OF HIGHEST AND LOWEST TEMPERATURES BY STATES: The Domestic Area Section is revising the 4-page leaflet "Record Highest Temperature and Record Lowest Temperature" which included values for each month and each state through December 1955. The revision is planned as a 1961 Letter Supplement. Each State Climatologist should advise this office as to the number of copies he is likely to need in one year's time. Copies of the old publication are still available.

Copies of the new tabulations of extreme temperatures, which will be based on all published data, will be forwarded to the respective State Climatologists for review or verification prior to their publication. Since the Domestic Area Section plans to keep current on these extremes, it is also requested that individual State Climatologists notify that office whenever record temperatures are equalled or exceeded.

The Domestic Area Section is gradually assembling information on unusual temperature conditions in each state; some of these appear in L.S. 5821. The Section would appreciate additional material of this type which appears to be unusual or significant.

4. CROP-WEATHER REPORTS THROWN OUT THE WINDOW: The Agricultural Statistician in Charge at Fargo, North Dakota reports that, in order to make an extremely tight TV schedule, his office releases the Weekly Weather and Crop material promptly at the appointed time by throwing it out of the office window to a TV station employee waiting in his car in the alley below. Within a few minutes the story is on at least 5 North Dakota TV stations.

5. TIME SPENT BY SUBSTATION OBSERVERS: (Re: Item 8, CSM #79). Additional reports on time spent by observers are now available. For 334 unpaid observers the figures average 4.5 hours per month per observer on observations and 3.3 hours on activities such as furnishing information or answering queries on the weather.

For 156 paid observers the corresponding figures are 5.0 hours on observations and 1.8 on other weather related activities.

6. NEW STATE CLIMATOLOGISTS: Mr. R. W. Harms has entered on duty at Champaign as State Climatologist for Illinois, replacing Mr. L. A. Joos, who now heads the Field Liaison Section, Climatic Field Service Branch, Office of

Climatology.

Mr. A. V. Hardy of the Raleigh WBAS has been designated as State Climatologist for North Carolina.

Mr. Robert Orton of WBAS Amarillo has been selected as State Climatologist for Texas, replacing the late Mr. R. D. Blood. Mr. Orton plans to enter on duty at Austin during the latter part of August.

Mr. John D. Alyea, former Field Aide (HC) in Iowa, is now Wyoming State Climatologist, located at Cheyenne.

7. TECHNICAL PAPER NO. 20. TORNADO OCCURRENCES IN THE UNITED STATES: The above Technical Paper, first issued in 1952 has been expanded from 43 to 71 pages and copies of the revision are being distributed to all stations.

8. THE COOPERATIVE WEATHER OBSERVER: The above publication, first issued in 1951, has been revised and sent to the Government Printing Office for printing.

9. AWARDS FOR SUBSTATION OBSERVERS: Seven Jefferson and 30 Holm awards were approved for 1960. Certificates have been distributed to supervising offices and many of them have been presented to the observers. Much favorable publicity resulted.

10. ACTIVITY REPORTS: State Climatologists are reminded that their non-periodic activity reports are our primary source of information about the field programs. Please continue to let us have these reports.

11. CSM INDEX: An index covering CSMs 71 through 80 has been issued.

12. PUBLICATIONS SENT TO STATE AND AREA CLIMATOLOGISTS AND WRPCs SINCE CSM #80:

Distribution of Extreme Winds in the United States by H.C.S. Thom, Journal of the Structural Division, Proceedings of the American Society of Civil Engineers, Volume 86, No. ST 4, April 1960.

A Practical Method of Determining Evapotranspiration from Temperature and Rainfall, by L. T. Pierce, reprinted from Transactions of the ASAE, Vol. 3, No. 1.

A Comparison of Evapotranspiration as Estimated by the Heat Budget and Measured by the Water Balance, University of Missouri, Dept. of Soils, Columbia, Missouri, June 1960.

R. W. Schloemer
for H. E. Landsberg
Director, Office of Climatology

GUIDE TO CLIMATOLOGICAL SERVICES MEMORANDUM NO. 81