CALCULATION OF MONTHLY AND ANNUAL 30-YEAR STANDARD NORMALS

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I.   PURPOSE

The purpose of this document is to establish general procedures to be used for the calculation of the WMO monthly and annual 30 year (1961-1990 and following periods) standard and provisional normals and to suggest other climatic descriptors. These procedures were produced for use by all countries, and will be produced and distributed as a computer application and written document. However, all countries may use this information but certain procedures may be difficult to implement without the use of computers.

II.   BACKGROUND

The International Meteorological Committee in 1872 decided to compile mean values over a uniform period in order to assure comparability between data collected at various stations. The outgrowth of this was the recommendation for calculation of 30 year normals for stations. As stated in WMO Technical Regulation No. 49, Vol. 1, Section B "Each Member should establish and periodically revise normals for stations whose climatological data are distributed on the Global Telecommunications System in accordance with the provisions of Annex II (Manual on Codes, Volume 1) and forward these normals to the Secretariat". The initial period was determined to be 1901-1930. Succeeding periods were decided to be at 30-year intervals (i.e. 1931-1960, 1961-1990). However, many WMO members have been updating their 30-year normals at the completion of each decade. This was recommended in 1956 and noted in Technical Note No. 84. The WMO regulations require the calculations only each 30-year period. The WMO guidelines and regulations provide little guidance on "how to" calculate the 30-year normals; "how to" handle missing data; "how to" handle periods of data that contain obviously erroneous data; or "how much" data is required for a 30-year normal verses provisional normals. This paper is intended to provide a procedure with generalized rules and data completeness or quality indicators to be used in the calculation of the 30-year normals and to provide suggested ancillary data descriptors that will help to better describe the climate in statistical terms. These procedures are presented as practical advice only and are not considered to be the "best or only" methods of calculating normals.

III. STANDARD NORMALS AND PROVISIONAL NORMALS

Climate data are often more useful when they are compared with standard or normal values. The Technical Regulations define normals as "period averages computed for a uniform and relatively long period comprising at least three consecutive ten-year periods" and climatological standard normals as "averages of climatological data computed for consecutive periods of 30 years as follows: 1 January 1901 to 31 December 1930, 1 January 1931 to 31 December 1960, etc." In the case of stations for which the most recent climatological standard normal is not available (either because the station has not been in operation for the period of 30 years or for some other reason), provisional normals should be calculated. Provisional normals are

short-period means based on observations extending over a period of at least ten years. The concept of "normals calculation" is extended in this document to include an analysis of data homogeneity and the calculation of other climate descriptors. This extension is based on WMO Tech Note 84.

IV.   DATA EXAMINATION

It is assumed that routine hourly, daily and monthly quality control has been performed on the data as suggested in the WMO/TD-No. 111, WCP-85, Guidelines on the Quality Control of Surface Climatological Data. Climatological quality control (i.e. homogeneity) investigation and data inspection over a long period should also be performed. The following paragraphs recommend steps to analyze data homogeneity and identify heterogeneities (ref. WMO Guide to Climatological Practices). Suggested procedures to examine data homogeneity are:

1.   Examine the data for trends, shifts (step functions), spurious data values, other data problems and evidence of data heterogeneity. Techniques include:

    a.   Basic data descriptions e.g. frequency counts, means, medians, standard deviations, variances, extremes, and percentiles.

    b.   Graphical analysis e.g. histograms, time series displays and areal comparisons.

    c.   Nonparametric tests e.g. runs, sign, trend and serial correlation. The significance level should be .95.

2.   Examine the data for heterogeneities by analyzing the results of the techniques listed above for identifying the cause of non-climatic discontinuities and variations. Potential non-climatic heterogeneities are:

    a.   Station/sensor relocation e.g. horizontal and/or vertical movement of some or all of the station sensors to a new location.

    b.   Instrument effects e.g. drift, calibration, maintenance and new/replacement instruments.

    c.   Environmental effects e.g. vegetation changes, building effects on airflow and land use changes.

    d.   Systematic observer bias and observing/coding changes.

After the data have been examined, it is necessary to decide if heterogeneity exists and if the cause is climatic or non-climatic. Reasons for the decision should be documented. Data should be classified as: