U.S. Climate Normals 1971-2000, Products

CLIM81 CLIMATOGRAPHY OF THE U.S. NO. 81: Monthly Station Normals
CLIM84 CLIMATOGRAPHY OF THE U.S. NO. 84: Daily Station Normals

Secondary Products
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CLIM20-01 CLIMATOGRAPHY OF THE U.S. NO. 20 - Supplement 1: Frost/Freeze Data
HCS 4-1;2 HISTORICAL CLIMATOLOGY SERIES 4-1, 4-2: Area-Weighted State, Regional, and National Monthly Temperature and Precipitation
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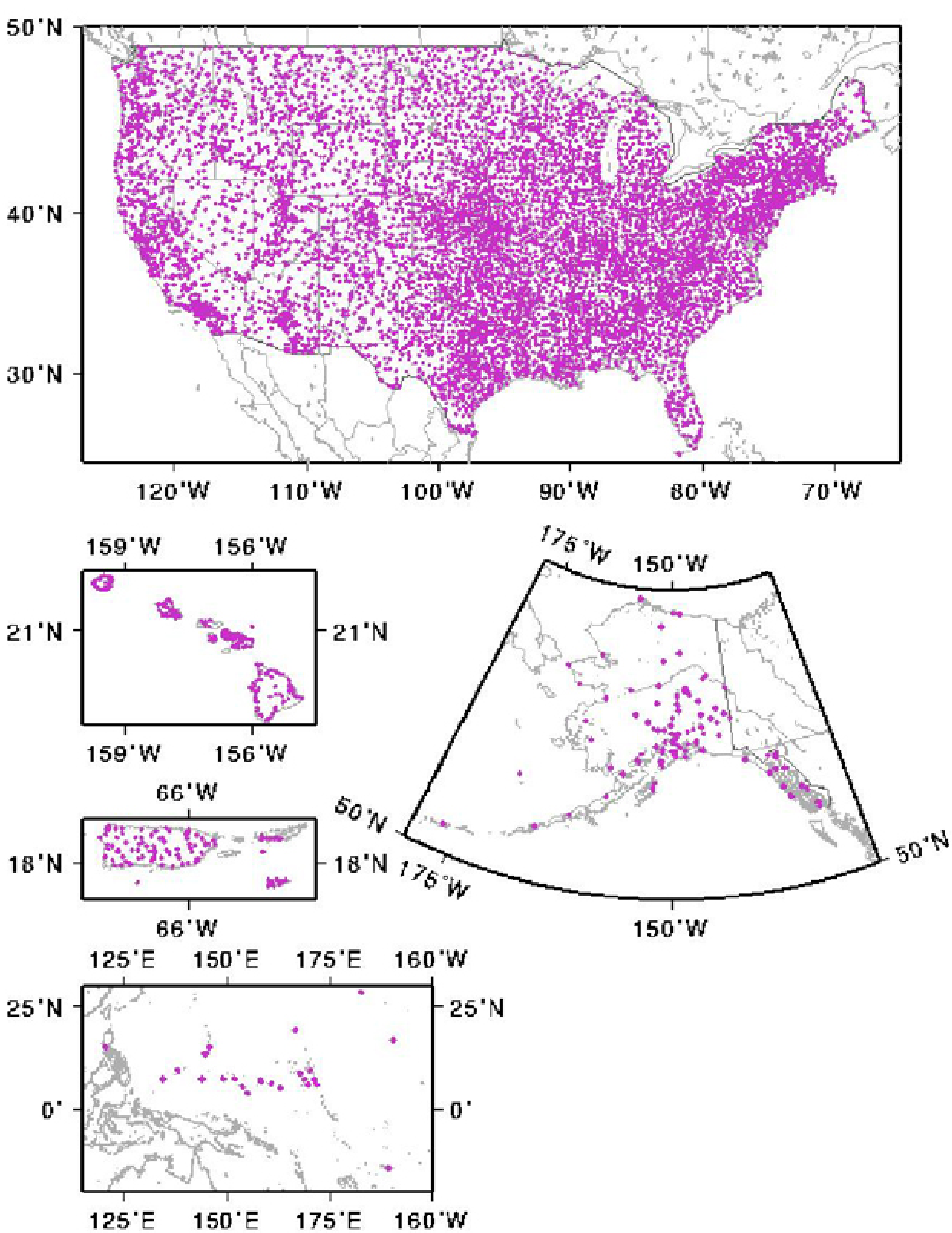
CLIMATOGRAPHY OF THE U.S. NO. 81

Monthly Station Normals

Description

This product includes normals of average monthly and annual maximum, minimum, and mean temperature (degrees F), monthly and annual total precipitation (inches), and heating and cooling degree days (base 65 degrees F) for individual locations for the 1971-2000 period. There are temperature, precipitation, and/or degree day data for 7937 stations. The locations represent sites that are part of the Cooperative Network, National Weather Service offices, and principal climatological stations in the 50 states, Puerto Rico, Virgin Islands, and Pacific Island locations. These locations are shown in Figure 1 for (from top to bottom) the contiguous United States, Hawaii, Alaska, Puerto Rico and the Virgin Islands, and Pacific Island locations.

Figure 1
CLIM81 Station Locations


50°N
40°N
30°N
120°W
110°W
100°W
90°W
80°W
70°W
159°W
156°W
21°N
21°N
159°W
156°W
66°W
18°N
18°N
66°W
175°W
150°W
50°N
50°N
175°W
150°W
125°E
150°E
175°E
160°W
25°N
25°N
0°
0°
125°E
150°E
175°E
160°W

The monthly normals are published by state, with additional publications for Puerto Rico, Virgin Islands, and Pacific Islands (District of Columbia stations are included with Maryland). The data are arranged in four tables representing temperature, precipitation, heating degree days, and cooling degree days. The locations are listed alphabetically within each table. A station locator map and cross reference index (with station name, number, type, location, elevation, and flags) are included in the publication for each state.

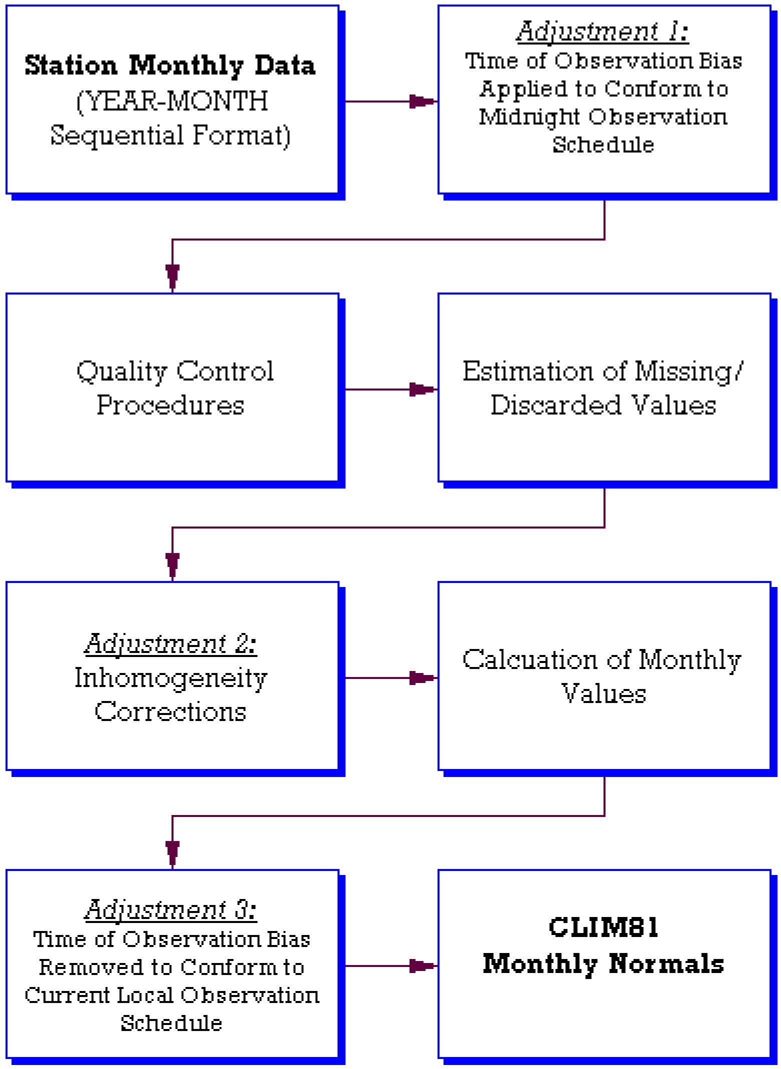
Computational Procedures

A. Adjustments to the Data

A climate normal is defined, by convention, as the arithmetic mean of a climatological element computed over three consecutive decades (WMO, 1989). Ideally, the data record for such a 30-year period should be free of any inconsistencies in observational practices (e.g., changes in station location, instrumentation, time of observation, etc.) and be serially complete (i.e. no missing values). When present, inconsistencies can lead to a non-climatic bias in one period of a station's record relative to another. In that case, the data record is said to be "inhomogeneous". Since records are frequently characterized by data inhomogeneities, statistical methods have been developed to identify and account for these data inhomogeneities. In the application of these methods, adjustments are made so that earlier periods in the data record more closely conform to the most recent period. Likewise, techniques have been developed to estimate values for missing observations. After such adjustments are made, the climate record is said to be "homogeneous" and serially complete. The climate normal can then be calculated simply as the average of the 30 values for each month observed over a normals period like 1971 to 2000. By using appropriately adjusted data records, where necessary, the 30-year mean value will more closely reflect the actual average climatic conditions at all stations.

The methodology used to address inhomogeneity and missing data value problems stations is described in Figure 2. As with all automated quality control and statistical adjustment techniques, only those data errors and inhomogeneities falling outside defined statistical limits can be identified and appropriately addressed. In addition, even the best procedures can occasionally apply corrections where none are required or misidentify the exact year of a discontinuity. In the 1971-2000 monthly normals calculations, the sequential year-month data were adjusted to conform to a common midnight-to-midnight observation schedule. This is necessary since changes in observation time also can lead to non-climatic biases in a station's record. The data were then quality controlled to identify suspect observations and missing or erroneous values were estimated. Finally, the serially complete data series were adjusted for non-climatic inhomogeneities. In the 1971-2000 normals, all stations were processed through the same procedures, whereas in the 1961-1990 normals only NWS First Order stations were evaluated for inhomogeneities. Each of the steps in the data processing procedures used in the 1971-2000 normals calculations is described briefly below.

Figure 2
CLIM81 Processing Steps (Temperature)



In order to effectively compare records among various stations, the time of observation bias, if present, must be removed. While the practice at all NWS First Order stations is to use the calendar day (midnight recording time) for daily summaries, Cooperative Network Station observers record observations once per day summarizing the preceding 24-hour period ending generally in the local morning or evening hours. Observations based on observation times other than midnight can exhibit a bias relative to those based on a midnight observation time (see e.g., Baker, 1975). Moreover, observation times at any one station may change during a station's history resulting in a potential inhomogeneity at that station. To produce records that reflect a consistent observational schedule, the technique developed by Karl et al. (1986) was used to adjust the monthly maximum and minimum temperature observations to conform to observations recorded on a midnight-to-midnight schedule. However, no time of observation bias adjustments were applied to stations in Alaska, Hawaii, or the U.S. possessions since no model for adjustment presently exists for these regions.

All monthly temperature averages and precipitation totals were cross-checked against archived daily observations to ensure internal consistency. In addition, each monthly observation was evaluated using an adaptation of the quality control procedures described by Peterson et al.(1998). In this approach, observations at each station are expressed as a departure from the long-term monthly mean. Then, monthly anomalies at a candidate station are compared with the anomalies observed at neighboring stations. Where anomalies at the candidate disagree substantially with those of its neighbors, the observations at the candidate are flagged as suspect and an estimate for the candidate is calculated from neighboring observations (see below). If the original observation and the estimate differ by a wide margin (standardized using the observed frequency distribution at the station), the original is discarded in favor of the estimate. Very few observations were eliminated based on the quality control evaluation.

To produce a serially complete data set, missing or discarded temperature and precipitation observations were replaced using the observed relationship between a candidate's monthly observations and those of up to 20 neighboring stations whose observations exhibited the highest correlation with those at the candidate site. Monthly estimates are calculated using the climatological relationship between candidate and neighbor as well as a weighting function based on the neighbor's correlation with the candidate. For temperature estimates, neighboring stations were drawn from the pool of stations found in the U.S. Historical Climatology Network (USHCN; Karl et al. 1990) whereas for precipitation estimates, all available stations were potentially used as neighbors in order to maximize station density for estimating the more spatially variable precipitation values.

Peterson and Easterling (1994) and Easterling and Peterson (1995) outline the method that was used to adjust for temperature inhomogeneities. This technique involves comparing the record of the candidate station with a reference series generated from neighboring data. The reference series is reconstructed using a weighted average of first difference observations (the difference from one year to the next) for neighboring stations with the with the highest correlation with the candidate. The underlying assumption behind this methodology is that temperatures over a region have similar tendencies in variation. For example, a cold winter followed by a warm winter usually occurs simultaneously for a candidate and its neighbors. If this assumption is violated, the potential discontinuity is evaluated for statistical significance. Where significant discontinuities are detected, the difference in average annual temperatures before and after the inhomogeneity is applied to adjust the mean of the earlier block with the mean of the latter block of data. Such an evaluation requires a minimum of five years between discontinuities. Consequently, if multiple changes occur within five years or if a change occurs very near the end of the normals period (e.g. after 1995), the discontinuity may not be detectable using this methodology.

The methodology employed to generate the 1971-2000 normals is not the same as in previous normals calculations. For example, in the calculation of the previous normals no attempt was made to adjust Cooperative Network observer data records for inhomogeneities other than those associated with the time of observation bias. Therefore, serial year-monthly data for overlapping periods between normals (e.g., for the 20 years in common between the 1961-90 and 1971-2000 normals) will not necessarily be identical.

The following white paper (United States Climate Normals, 1971-2000: Inhomogeneity Adjustment Methodology) [PDF] is available regarding procedures for adjusting station data to account for inhomogeneities due to changes in station locations, instrumentation, time of observation, surrounding environment, observing practice, sensor drift, etc. The purpose of such adjustments is to produce a time series and normals statistics that are representative of the observing practices as of the end of the normals period (December 2000), since these are the conditions under which future observations will likely be compared.

B. Element Computations

The monthly normals for maximum and minimum temperature and precipitation are computed simply by averaging the appropriate 30 values from the 1971-2000 record. The monthly average temperature normals are computed by averaging the corresponding maximum and minimum normals. The annual temperature normals were calculated by taking the average of the 12 monthly normals. The annual precipitation normals were calculated by adding the 12 monthly normals. Note that monthly precipitation totals less than 0.005 inch are shown as zero, and that precipitation includes rain and the liquid equivalent of frozen and freezing precipitation (*e.g.*, snow, sleet, freezing rain, and hail).

Degree day normals were computed in two ways. The following white paper (United States Climate Normals, 1971-2000: Degree Day Computation Methodology) [PDF] is available regarding the two-tiered approach to computing degree day normals. For stations that are not first-order NWS locations, the rational conversion formulae developed by Thom (1954, 1966) was modified by using a daily spline-fit assessment of mean and standard deviations of average temperature. The Thom methodology allows the adjusted mean temperature normals and their standard deviations to be converted to degree day normals with uniform consistency. The modification eliminates an artificial month-by-month 'step' in the data output. In some cases this procedure will yield a small number of degree days for months when degree days may not otherwise be expected. This results from statistical considerations of the formulae. The annual degree day normals were calculated by adding the corresponding monthly degree day normals.

Based on the input of the climate research community and energy groups, NCDC is computing monthly degree day totals DIRECTLY from daily average temperature values for first-order sites for the 1971-2000 period. Stations with serially complete records were included in this approach, and are listed (see Degree Day Table) and with an asterisk '*` in the HDD/CDD section of the CLIM81 PDF publication.

NCDC advocates use of the newly computed monthly normals over the sum of the daily normals for degree days in climate applications. The daily normals are a useful tool in monitoring day-to-day climate and are internally consistent, but the monthly normals better represent the observational record.

Digital Data Archive

CLIM81 data are archived by the National Climatic Data Center under data set DOC 9641-C (CLIM81 1971-2000). Normals. This archive includes a variety of statistics associated with the monthly station data for minimum, maximum, mean temperature, total precipitation, and heating/cooling degree days, including those shown in Table 1.

Table 1
CLIM81 Statistics for the 1971-2000 Normals in DOC 9641-C

CODE	Data Description	CODE	Data Description
01	No Data	11	1990-2000 Standard Deviation
02	No Data	12	1990-2000 Median
03	Number of Estimated Values in Normals Period	13	Maximum Monthly Value in Normal Period
04	1971-2000 Normal	14	Year of Occurrence of Maximum Value
05	1971-2000 Standard Deviation	15	Minimum Monthly Values in Normal Period
06	1971-2000 Median	16	Year of Occurrence of Minimum Value
07	1980-2000 Mean	17	Precipitation 10th Percentile
08	1980-2000 Standard Deviation	18	Precipitation 90th Percentile
09	1980-2000 Median	19	Time of Observation Adjustment Factor
10	1990-2000 Mean		

CLIMATOGRAPHY OF THE U. S. NO. 84

Daily Station Normals

Description

This product includes daily 1971-2000 normal maximum, minimum, and mean temperature (degrees F), heating and cooling degree days (base 65 degrees F), and precipitation (inches) for selected cooperative and First-Order stations. Monthly, seasonal, and annual normals of these elements are also presented. Monthly and annual precipitation probabilities and quintiles are also included. The data are published by station.

The daily normals are derived by statistically fitting smooth curves through monthly values; daily data were ***not*** used to compute daily normals. As a result, the published values reflect smooth transitions between seasons. The typical daily random patterns usually associated with precipitation are not exhibited; however, the precipitation normals may be used to compute average amounts accumulated over time intervals.

Computational Procedures

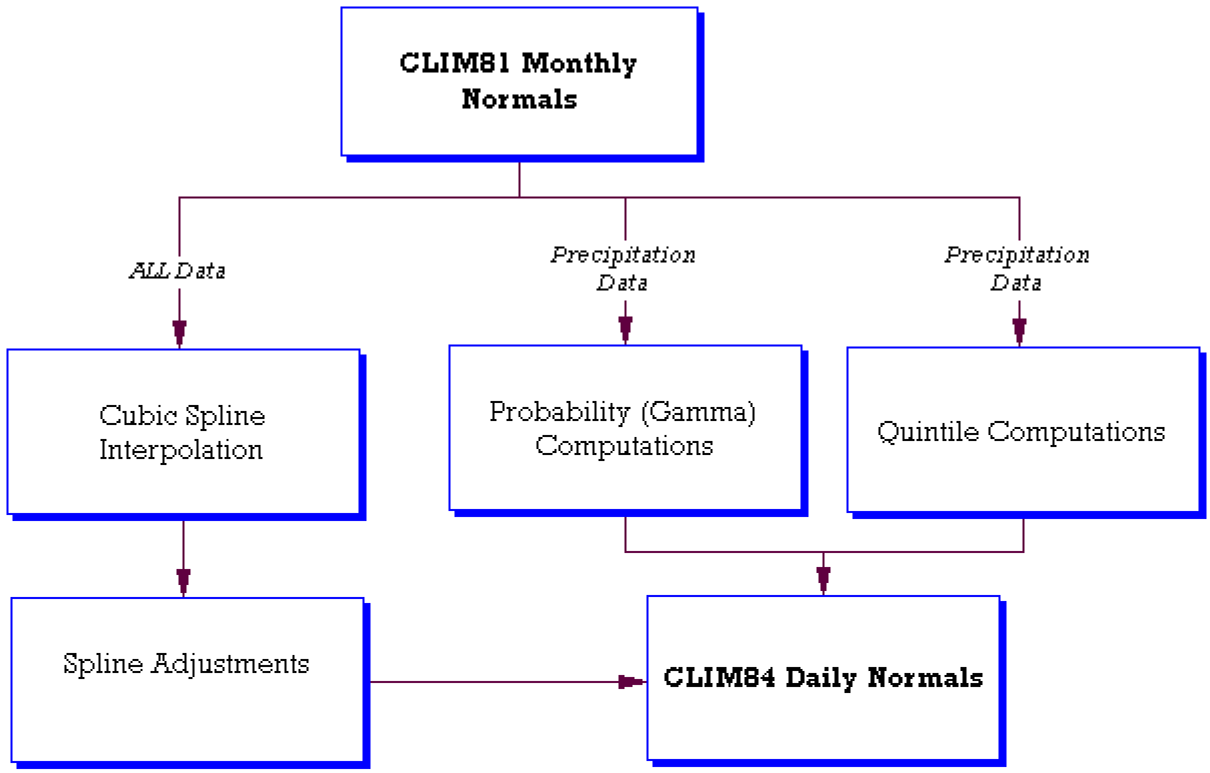
A. Spline-Fit Daily Normals

Daily normals of maximum, minimum, and mean temperatures, heating and cooling degree days, and precipitation were prepared for selected stations by interpolating between the monthly normal values. The interpolation scheme was a cubic spline fit through the monthly values. Each element was interpolated independently from the other elements. The procedure is described by Greville (1967).

The series of daily values of an element resulting from the cubic spline yields a smooth curve throughout the year without requiring the use of daily data. Another property of this technique is that the average of the daily temperatures in a month equals the monthly normal and that the total of the daily precipitation or degree days in a month equals the monthly normal. In order to eliminate discontinuities between December 31 and January 1, the spline interpolation was performed on a series of 24 monthly values. This extended series was created by appending July-December normals before January and January-June normals after December. This process is applied independently to all six climatological elements. February 29 is assigned the same value as February 28.

Since each element was interpolated independently, the daily series of temperatures and degree days were adjusted using software to remove spurious inflection points caused by rounding and to ensure adherence to functional relationships among the elements. The software interrogated the data for climatologically reasonable inflection points, daily consistency between elements, monthly consistency between daily and monthly values by element, and adherence of temperature and degree day values to the formula $T - 65 + H - C = 0$, where T = mean temperature, H = heating degree days, and C = cooling degree days. Collectively, the processing steps for CLIM84 are shown in Figure 3.

Figure 3
CLIM84 Processing Steps



Daily precipitation normals were published as generated by the cubic spline interpolation. The smooth curve through a month does not represent a climatologically reasonable distribution. The spreading of the monthly precipitation by the spline over all the days in a month is useful for accumulating amounts over specified time intervals. A climatologically reasonable normal precipitation, based on daily data, for any one date would be much different from the published normals.

For some dates at most locations the published degree days are shown by an asterisk. The symbol represents a value of less than one degree day, but more than zero degree days. It is used to smooth through aperiodic oscillations of zeroes and ones that are climatologically unreasonable. For example, if a station has 17, 15, and 18 normal heating degree days in June, July, and August, respectively, it is not possible to distribute the 15 July degree days evenly throughout the month using integer values (zeroes and ones) without creating unrealistic oscillations through the 3-month period. The use of fractional degree days (asterisks) does allow for a smooth transition from June through July to August.

There are several reasons for using a cubic spline fit of the monthly normals instead of averaging the daily data. First, simply averaging the observed daily values would result in a daily normal curve that has considerable variability from day to day (Guttman and Plantico, 1987), yielding an annual temperature cycle that would be considerably jagged or ragged. This climatological raggedness could result in daily normals that trend in the opposite direction from what is expected. For example, an autumn daily normal temperature could be considerably warmer than one from several days earlier, or a spring daily normal temperature could be considerably cooler than one from several days earlier. Using a cubic spline fit of the monthly normals eliminates this raggedness from the daily normals curve. Furthermore, a complete and homogeneous (*i.e.*, no change in location, instrumentation, exposure, or observation practices) data set is necessary for the analysis to be accurate. There are very few stations that have complete and homogeneous daily records. Any change of the types indicated above would introduce a nonclimatic effect which would make the data inhomogeneous. The techniques for estimating missing daily data and adjusting daily data for inhomogeneities are complex and, for some stations, are difficult to apply. However, the estimation and adjustment techniques for monthly data are not as complex or troublesome. Hence, the official daily normals are based on monthly normals, which incorporate CLIM81 inhomogeneity adjustments.

B. Precipitation Probabilities and Quintiles:

A secondary part of the CLIM84 product is the monthly precipitation totals that correspond to the indicated probability levels. The probability levels are based on the 1971-2000 sequential monthly precipitation and are explained below. The historical precipitation data are the serially complete values (including estimated values) that were also used to compute the monthly normals (*i.e*., CLIM81).

When historical climate data are accumulated and examined, they generally follow a certain pattern called a statistical distribution. For example, if 30 years of June temperature data were assembled and examined, the data would display a pattern that consisted of most of the Junes having temperatures close to the normal or average value, a few Junes having very warm temperatures, and a few Junes having very cold temperatures. This kind of statistical pattern is called a Gaussian distribution and theoretically takes the form of a bell-shaped curve. Temperature data are more likely to follow a Gaussian distribution than precipitation data. This is because precipitation is zero bounded.

When historical precipitation data are examined, most of the values will be close to the middle of the distribution, but some values will be considerably higher than the middle range. On the low end of the scale, however, the smallest values will never be less than zero. In particularly dry (*e.g.*, desert) regions, the pattern can be drastically skewed to the left-hand side of the scale, with most of the values being near zero and a few very wet values spread far to the right. This kind of pattern can be fit by a Gamma distribution. Once the statistical distribution is identified, the statistical properties of the distribution can be used to estimate the probabilities that certain values will occur, and which values can be expected at certain probability levels. For summarization purposes, the probability levels desired can be preselected at certain individual levels or at regular intervals.

The Gamma distribution is used to estimate the precipitation probability and quintile values. The probability table shows the amount of precipitation expected at 15 probability (PROB) levels (0.005, 0.01, 0.05, 0.10, 0.20, 0.30, 0.40, 0.50, 0.60, 0.70, 0.80, 0.90, 0.95, 0.99, and 0.995) for each month of the year and for the annual total. For example, if 1.77 inches corresponds to the 0.20 probability level, that means that, on average, 2 out of 10 years will have 1.77 inches or less of precipitation in that month. It also means that, on average, 8 out of 10 years will have more than 1.77 inches of precipitation in that month.

The second table shows the expected precipitation values at the five quintile levels (LVL): 1 (0-20%); 2 (20-40%); 3 (40-60%); 4 (60-80%); 5 (80-100%) for each of the twelve months and for the year. For example, if 2.91 and 4.07 inches are the bounds for the second quintile, then a monthly total precipitation amount for that month falling in the range 2.91 to 4.07 would be classified as a second quintile precipitation amount and the month would be considered relatively dry. The first line (LVL 0 <) in this table shows the *minimum* precipitation value derived from the historical record. Quintile level 0 would be used if a future precipitation observation is less than the 1971-2000 minimum. The last line (LVL 6>) shows the *maximum* precipitation value. Level 6 would be used if the observed precipitation value is more than the 1971-2000 maximum. The quintile table is used primarily in National Weather Service operations for composition of information that is transmitted in CLIMAT messages and published in the Monthly Climatic Data for the World publication.

CLIMATOGRAPHY OF THE U. S. NO. 85

Monthly Divisional Normals & Standard Deviations

Description

This product includes normals and standard deviations for the five 30-year periods and the 70-year period between 1931-2000 for each division in a state. A division represents a region within a state that is, as nearly as possible, climatically homogeneous. Some areas, however, may experience rather extreme variations within a division (*e.g.*, the Rocky Mountain states). The divisions have been established to satisfy researchers in hydrology, agriculture, energy supply, *etc.*, who require data averaged over an area of a state rather than for a point (station).

The normals and standard deviations include values for each of the 12 calendar months and an annual value. The divisional data are displayed by name and number for a state or island. The states and islands include the contiguous United States, Alaska, Puerto Rico, and the Virgin Islands, and are arranged alphabetically. Hawaii is not included because the varied topography and locations of the observing stations do not allow for the establishment of homogeneous divisions. The data elements include mean temperature (degrees F), precipitation (inches), and heating and cooling degree days (base 65 degrees F).

Computational Procedures

Climatic divisions are regions within each state that have been determined to be reasonably climatically homogeneous. The maximum number of divisions in each state is 10. Monthly divisional average temperature and total precipitation data are derived using data from all stations reporting both temperature and precipitation within a climatological division. The number of reporting stations within a division varies from month to month and year to year.

Monthly temperature normals and 70-year averages for a division are computed by adding the yearly values for a given month and then dividing by the number of years in the period. The annual normal and 70-year average are computed by adding all of the monthly normal or long-term average values and then dividing by 12. Consequently, if an annual normal were computed by averaging annual values obtained for each year in the period (by adding the corresponding 12 monthly values and then dividing by 12), it may be slightly different from the average of the 12 monthly normals because of rounding differences. Precipitation normals and 60-year averages are computed in a similar manner, except that the annual values are the totals of the 12 monthly values.

Sequential monthly degree days are derived using procedures developed by Thom (1954, 1966). This technique utilizes the historical monthly average temperature and its corresponding standard deviation (over some "standardizing period") to compute degree days. The procedure for the computation of the divisional degree day normals involves the following three steps:

1. Calculate the standard deviations of the temperatures for each of the 12 calendar months over the standardizing period;
2. Use the Thom technique to compute the heating and cooling degree days for every month for every year in the period 1931-2000; and
3. Calculate the 30-year normals and 70-year (1931-2000) averages of the degree days using the procedure discussed above.

CLIMATOGRAPHY OF THE U. S. NO. 20

Monthly Station Climate Summaries

Description

This product provides climate data from selected sites included in CLIM81, as well as statistics that have not been published elsewhere. The climatological data included in the CLIM20 make this publication the most appropriate summary for agricultural applications.

The following link contains a detailed description of the summaries
Monthly Station Climate Summaries Documentation

CLIMATOGRAPHY OF THE U. S. NO. 81

Supplement Number 1, Monthly Precipitation Probabilities

A probability value is the frequency of occurrence of a quantity (say, a certain precipitation amount) over a given time period. For example, if the quantity has an annual probability of 0.1, then it would be expected to occur on average once out of every ten years, or 3 times out of every 30 years, *etc*. It can also be thought of in a predictive sense to mean that, in any given year, there is a ten percent chance (0.1 probability) that the quantity will occur. In this product, probabilities are applied to monthly and annual precipitation amounts. The sequential year-month values of monthly (and annual) precipitation, which were used to compute the monthly normals in the Climatography of the United States No. 81 product, were used in the preparation of this Supplement.

The Supplement No. 1 publication presents the monthly and annual precipitation values (in inches) corresponding to three probability levels: 0.10, 0.50, and 0.90. The stations are listed alphabetically. There is a separate volume of this publication for each state.

Monthly and annual precipitation probabilities are also available on microfiche and in digital format. The values are summarized in two tables. The first table shows the amount of precipitation expected at 15 probability levels (0.005, 0.01, 0.05, 0.10, 0.20, 0.30, 0.40, 0.50, 0.60, 0.70, 0.80, 0.90, 0.95, 0.99, and 0.995) for each month of the year and for the annual total. The second table shows the expected precipitation values at the five quintile levels:

First Quintile: 0-20%
Second Quintile: 20-40%
Third Quintile: 40-60%

Fourth Quintile: 60-80%
Fifth Quintile: 80-100%

The probability tables in this product are determined by fitting the 1971-2000 historical monthly precipitation to a Gamma distribution (Crutcher *et al.*, 1977; Crutcher and Joiner, 1978). The process was performed with the historical data for each of the twelve months and separately with the annual values to produce 13 sets of probability values for each station.

CLIMATOGRAPHY OF THE U. S. NO. 81

Supplement Number 2, Annual Degree Days to Selected Bases

This product presents annual heating degree day normals to the following bases (in degrees F): 65, 60, 57, 55, 50, 45, and 40, and annual cooling degree day normals to the following bases (also in degrees F): 70, 65, 60, 57, 55, 50, and 45. The values were computed for all Climatography of the United States No. 81 temperature stations and are summarized alphabetically by state within each state or territory.

Monthly and annual degree day normals are available on microfiche and in digital format. The heating degree day normals are to the following bases: 70, 65, 60, 57, 55, 50, 45, 43, 40, 35, 32, and 30. The cooling degree day normals are to the following bases: 80, 75, 70, 65, 60, 57, 55, 50, 45, 43, 40, and 32.

CLIMATOGRAPHY OF THE U. S. NO. 20

Supplement Number 1, Freeze/Frost Data

This product contains freeze/frost-related information for several thousand observation sites within the United States for which a serially-complete daily maximum/minimum temperature observation data set had been edited and validated by NCDC.

The main contents of this publication are freeze/frost probability tables for each station, listed by state. The tables contain the dates of probable first and last occurrence, during the year beginning August 1 and ending July 31, of freeze-related temperatures; probable durations (in days) where the temperature exceeds certain freeze-related values; and the probability of experiencing a given temperature, or less, during the year period August 1 through July 31. For the fall and spring dates of occurrence, and freeze-free period, probabilities are given for three temperatures (36, 32, and 28 degrees F) at three probability levels (10, 50, and 90 percent). A series of maps present calendar data related to the probability of occurrence of freeze at two temperature thresholds.

Extended tables of freeze/frost data, which contain the dates for probabilities of 0.1 through 0.9 in increments of 0.1 versus temperature thresholds of 36, 32, 28, 24, 20, and 16 degrees F, are available on magnetic tape or on microfiche (by state) for all of the sites given in the publication.

HISTORICAL CLIMATOLOGY SERIES 4-1 and 4-2

State, Regional, and National Monthly and Annual Temperature; State, Regional, and National Monthly and Annual Precipitation (Weighted by Area)

Description

Each month, averages of temperature and precipitation are calculated for U.S. Climate Divisions by simple averaging of data from all stations within the division that record both temperature and precipitation. A division represents a region within a state that is climatically quasi-homogeneous or, in some cases, a semi-homogeneous dranage basin (as described by CLIM85).

The average monthly temperature and precipitation for a state are derived from the divisional values by weighting each division by its percentage of the total state area, including the 48 contiguous states, Alaska, Hawaii, Puerto Rico, and the Virgin Islands. The District of Columbia is treated as part of Maryland.

Procedure

The nation was divided into nine census divisions as defined and used by the Census Bureau. The divisions and states they comprise are as follows:

NORTHEAST REGION
New England Division: Maine, New Hampshire, Vermont, Massachusettes, Rhode Island, Connecticut
Middle Atlantic Division: New York, New Jersey, Pennsylvania
MIDWEST REGION
East North Central Division: Ohio, Indiana, Illinois, Michigan, Wisconsin
West North Central Division: Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas
SOUTH REGION
South Atlantic Division: Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida
East South Central Division: Kentucky, Tennessee, Alabama, Mississippi
West South Central Division: Arkansas, Louisiana, Oklahoma, Texas
WEST REGION
Mountain Division: Montana, Idaho, Wyoming, Colorado, New Mexico,

Arizona, Utah, Nevada
Pacific Division: Washington, Oregon, California, Alaska, Hawaii

The areal weights used to produce monthly and regional temperatures are also shown. These weights were obtained by dividing the area of each state by the total regional area. A particular regional monthly temperature value was obtained by multiplying the corresponding state temperature within a region by the appropriate weight and adding all of the products. Annual values were obtained by taking the average of the monthly values. Monthly and annual temperatures for the nine census divisions are presented in tables following the weights.

The national temperatures were devised by serially weighting the temperature values for the nine census divisions. The national value, therefore, covers only the contiguous United States.

HISTORICAL CLIMATOLOGY SERIES 5-1 and 5-2

State, Regional, and National Monthly and Seasonal Heating Degree Days; State, Regional, and National Monthly and Seasonal Cooling Degree Days, (Weighted by Population)

Description

The population weights for U.S. Climate Divisions are computed from the 2000 Census county and metropolitan populations in that division. Divisional population totals are summed from 2000 county totals for counties residing completely within a given division. For counties residing in more than one division, 2000 county populations are divided proportionally by overlaying the climate divisions on a one-kilometer squared population database based on the 1990 census and provided by the Socioeconomic Data Application Center (SEDAC). Approximately 25%, or about 800 out of 3200 counties, require division in this manner. Once divisional totals are determined, their proportion in the context of the state, division, region, and nation are determined.

Citing the Article

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