National Climatic Data Center

DATA DOCUMENTATION

FOR

DATA SET 9641 D (DSI-9641D)

DAILY STATION NORMALS OF TEMPERATURE, PRECIPITATION, AND HEATING AND COOLING DEGREE DAYS, 1971 - 2000

December 18, 2002

National Climatic Data Center
151 Patton Ave.
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1. Abstract: The climatological normals presented in this data set are based on monthly maximum, minimum, and mean temperature and monthly total precipitation records for each year in the 30-year period 1971-2000, inclusive (as well as separately computed monthly degree day totals). The monthly values are available in data set DOC/DSI-9641-C (*Climatography of the United States, No. 81* Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days, 1971-2000). Most stations were operating as of December 2000. In order to be included in the normals, a station had to have at least 10 years of monthly temperature data or 10 years of monthly precipitation data for each month in the period 1971-2000. In addition, a station had to be active since January 1, 1999 **OR** had to be included as a normals station in the 1961-1990 normals.

In 1989, the World Meteorological Organization (WMO) prescribed standards of data completeness for stations that were subsequently included in the 1961-1990 WMO Standard Normals (WMO, 1989). For full qualification, the thirty-year month-year sequential file had to have no more than three consecutive year-month values missing for a given month or no more than five overall values missing for a given month. Less than fully qualified stations were included in the standard normals if they had a minimum of 10 year-month values for each month. The requirement for a minimum of 10 years of monthly data in the 1971-2000 period assures that all stations minimally meet standard normals requirements articulated by WMO. Out of 7937 stations included in the 1971-2000 normals, approximately 5200 are fully qualified under the WMO guidelines, with the remaining meeting minimal requirements (except for selected supplemental ASOS stations).

Several adjustments were made to the data before the normals were calculated. These adjustments include estimating missing data, adjusting for time of observation bias, and adjusting for inhomogeneities.

Units used in this publication are degrees F for temperature and inches for precipitation. Heating and cooling degree day (base: 65 degrees F) normals are derived from the monthly normal temperatures using a modification of the technique developed by Thom (1954a, 1954b, 1966), or are computed directly from daily degree day values. Degree day normals have also been computed to other bases and are available in *Climatography of the United States, No. 81, Supplement No. 2* (Annual Degree Days to Selected Bases, 1971-2000) or in digital data set DOC/TD-9641-G.

1971-2000 DAILY STATION NORMALS

The daily values are not simple means of the observed daily values. They are interpolated form the much less variable monthly normals by use of the natural spline function. The procedure involved constructing a cumulative series of monthly sums from the monthly normals. The cumulative series was for a 24-month period (July, August,…, December, January,…,December, January,…, June), so that the interpolating function could adequately fit the end points in the annual series. This process was applied independently to all six elements. No normal values for February 29 are included; in common practice, the normal values for the 28th are used for the 29th in each leap year. Thus, for leap years, the February monthly total degree days or precipitation are calculated

by adding the daily value for the 28th to the monthly total. February temperature averages are likewise not adjusted for leap years. For most stations, the monthly heating and cooling degree day normals (base 65 degrees Fahrenheit) are derived from monthly normal temperature using an estimation technique developed by H.C.S. Thom. Spurious values of 1 are indicated by a -99 in this data set. Such values are designated as spurious because of their separation from the major rise and fall of non-zero degree day values over the course of a heating/cooling degree day season, yet their presence assures consistency between the monthly total and the sum of the daily total. For applications emphasizing accumulation and computations on a day-by-day basis, such spurious values should often be excluded.

Generally, the daily values should adhere to two rules. First, the sum of the maximum and minimum temperature divided by two (and rounded OR truncated) should equal the average temperature. Second, the functional relationship TAVG-65+HDD-CDD=0, where TAVG is the average temperature, HDD is the daily heating degree days, and CDD is the daily cooling degree days, should be valid. There can be exceptions to the latter rule (and there is flexibility in the first rule in allowing truncation or rounding) in order to assure that the arithmetic average or sum of the daily values is equivalent to the monthly values presented in data set DOC/TD-9641-C (*Climatography of the United States, No. 81* Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days, 1971-2000). In other words, values in this data set are subordinated to those found in the monthly normals.

2. Element Names and Definitions:

Access Method and Sort for Archived Data

The data are archived in two files of fixed-length ASCII format.

File 1. 1971-2000 DAILY NORMALS INVENTORY
(9641D_1971-2000_NORM_CLIM84_DLY_STNMETA)
File 2. 1971-2000 DAILY STATION NORMALS
(9641D_1971-2000_NORM_CLIM84_DLY_STNNORM)

File 1. 1971-2000 DAILY NORMALS INVENTORY (9641D_1971-2000_NORM_CLIM84_DLY_STNMETA)

This file contains identification information about the stations for which 1971-2000 daily normals were calculated.

ELEMENT	WIDTH	POSITION
STATION COOPERATIVE I.D. NUMBER (CD NUMBER)	6	001-006
STATE ABBREVIATION	2	007-008
BLANK	1	009-009
STATION NAME	29	010-038
LATITUDE (DEGREES)	2	039-040
LATITUDE (MINUTES)	2	041-042
LATITUDE (HEMISPHERE: N=North, S=South)	1	043-043
BLANK	3	044-046
LONGITUDE (DEGREES)	3	047-049
LONGITUDE (MINUTES)	2	050-051
LONGITUDE (HEMISPHERE: N=North, S=South)	1	052-052

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BLANK	3	053-055
ELEVATION (in feet)	5	056-060

STATION COOPERATIVE I.D.: This 6-character station identifier (occasionally referred to as CD or Cooperative Number) is assigned by the National Climatic Data Center (POSITION 1-6). The first two digits refer to state code (Value 01 - 48, 50, 51, 66, 67 and 91). The next four digits refer to Cooperative Network Index Number (0001 - 9999) (Position 01-06).

STATE ABBREVIATION: The 2-letter U.S. Postal Service abbreviation for states. Territories are assigned the following abbreviations: PR=Puerto Rico, VI=U.S. Virgin Islands, and PI=Pacific Islands (U.S. Pacific Trust Territories) (Position 07-08).

STATION NAME: An alpha, numeric or combination of both characters which indicate the station's name. Distance/direction addendums generally indicate number of miles and cardinal direction from a U.S. Post Office or centralized location associated with a place (e.g., NORTHPORT 2 W = 2 miles west of Northport Post Office or town center). A number of abbreviations are common, including: STN=Station, AP=Airport, INTL=International, NATL=National, RGNL=Regional, METRO=Metropolitan, OBSY=Observatory, UNIV=University, MTN=Mountain, ST PK=State Park, IS=Island, PLT=Plant, EXP=Experiment, REF=Refuge, AFB=Air Force Base, MCAS=Marine Corps Air Station, NAS=Naval Air Station (Position 10-38).

LATITUDE: In degrees and minutes, with hemisphere indicator (Position 39-43).

LONGITUDE: In degrees and minutes, with hemisphere indicator (Position 47-52).

ELEVATION: In whole feet (Position 56-60).

File 2. 1971-2000 DAILY STATION NORMALS (9641D_1971-2000_NORM_CLIM84_DLY_STNNORM)

This file contains the 365 daily station normals by element. Values for February 29 (not included) should be assumed to be the same as February 28.

ELEMENT	WIDTH	POSITION
STATION COOPERATIVE I.D. NUMBER (CD NUMBER)	6	001- 006
ELEMENT CODE	1	007- 007
DAILY VALUE for January 1	3	008- 010
DAILY VALUE for January 2	3	011- 013
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DAILY VALUE for December 30	3	1097-1099
DAILY VALUE for December 31	3	1100-1102

ELEMENT CODES:

1 = Minimum Temperature
2 = Maximum Temperature
3 = Mean Temperature
4 = Heating Degree Days

5 = Cooling Degree Days
6 = Precipitation

UNITS: Temperature (degrees Fahrenheit) and degree day values are in whole units, while the precipitation values are in hundredths of an inchSee topic 4 "Description: Access Method and Sort for Archived Data".

STATION COOPERATIVE I.D.: This 6-character station identifier (occasionally referred to as CD or Cooperative Number) is assigned by the National Climatic Data Center (POSITION 1-6). The first two digits refer to state code (Value 01 - 48, 50, 51, 66, 67 and 91). The next four digits refer to Cooperative Network Index Number (0001 - 9999) (Position 01-06).

ELEMENT CODE: Refers to Minimum/Maximum/Mean Temperature, Degree Day, or Precipitation (Position 7).

DAILY VALUE: Data values for individual day, January 1 through December 31 (365 days, leap year date of February 29 NOT included). A value of -99 represents a degree day value greater than 0 but less than 1. The temperature (degrees Fahrenheit) and degree day values are in whole units, while the precipitation values are in hundredths of an inch (Positions 08-1102).

3. Start Date: 19710101

4. Stop Date: 20001231

5. Coverage: **T**he USA, including the 50 states and possessions (Puerto Rico, Virgin Islands, and Pacific Islands).

a. Southernmost Latitude: 15S
b. Northernmost Latitude: 72N
c. Westernmost Longitude: 64W
d. Easternmost Longitude: 121E

6. How to Order Data:

Ask NCDC's Climate Services about the cost of obtaining this data set.
Phone: 828-271-4800
FAX: 828-271-4876
E-mail: **NCDC.Orders@noaa.gov**

7. Archiving Data Center:

National Climatic Data Center
Federal Building
151 Patton Avenue
Asheville, NC 28801-5001
Phone: (828) 271-4800.

8. Technical Contact:

National Climatic Data Center
Federal Building
151 Patton Avenue
Asheville, NC 28801-5001
Phone: (828) 271-4800.

9. Known Uncorrected Problems: None.

10. Quality Statement: The monthly data that were input to the examination and adjustment algorithms had undergone range, climatology, and allowed value checks at the NCDC's Data Operations Branch. Preparation of the normals sequential values was conducted using statistical assessments by NCDC's Scientific Services Division.

11. Essential Companion Datasets: *Climatography of the United States, No. 81* Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days, 1971-2000

12. References:

Greville, T.N.E., 1967: "Spline functions, interpolation, and numerical quadrature," MATHEMATICAL METHODS OF DIGITAL COMPUTERS, Volume 2 (edited by A. Ralston and H.S. Wilf). John Wiley and Sons, Inc., New York.

Karl, T. R., G. Kukla, and J. Gavin. 1984. "Decreasing diurnal temperature range in the United States and Canada from 1941 through 1980." JOURNAL OF CLIMATE AND APPLIED METEOROLOGY, vol. 23, pp. 1489-1504.

Karl, T. R., C. N. Williams, Jr., P. J. Young, and W. M. Wendland. 1986. "A model to estimate the time of observation bias associated with monthly mean maximum, minimum and mean temperatures for the United States." JOURNAL OF CLIMATE AND APPLIED METEOROLOGY, vol. 25, pp. 145-160.

Karl, T. R., and C. N. Williams, Jr. 1987. "An approach to adjusting climatological time series for discontinuous inhomogeneities." JOURNAL OF CLIMATE AND APPLIED METEOROLOGY, vol. 26, pp. 1744-1763.

Karl, T. R., H. F. Diaz, and G. Kukla. 1988. "Urbanization: Its detection and effect in the United States climate record." JOURNAL OF CLIMATE, vol. 1. pp. 1099-1123.

Thom, H.C.S., 1954a: "The rational relationship between heating degree days and temperature." MONTHLY WEATHER REVIEW, vol. 82, pp. 1-6.

Thom, H.C.S., 1954b: "Normal degree days below any base." MONTHLY WEATHER REVIEW, vol. 82, pp. 111-115.

Thom, H.C.S., 1966: "Normal degree days above any base by the universal truncation coefficient." MONTHLY WEATHER REVIEW, vol. 94, pp. 461-465.

CLIMATOGRAPHY OF THE UNITED STATES NO. 81: MONTHLY STATION NORMALS OF TEMPERATURE, PRECIPITATION, AND HEATING AND COOLING DEGREE DAYS, 1971-2000. National Climatic Data Center, Asheville, NC.

CLIMATOGRAPHY OF THE UNITED STATES NO. 84: DAILY NORMALS OF TEMPERATURE, PRECIPITATION AND HEATING AND COOLING DEGREE DAYS, 1971-2000. National Climatic Data Center, Asheville, NC.

ENVIRONMENTAL INFORMATION SUMMARY C-23: "1971-2000 Climatic Normals". National Climatic Data Center, Asheville, NC.

ENVIRONMENTAL INFORMATION SUMMARY C-28: "Climatography of the United States No. 84: Daily Normals and Precipitation Probabilities". National Climatic Data Center, Asheville, NC.

Appendix 1, Sensor Name and Operating Principles:

Minimum Temperature; Maximum Temperature

In the beginning years of this data set, liquid-in-glass thermometers were used to measure these elements. This thermometer is a liquid-filled, U-shaped capillary tube with reservoirs at each end. Two floating indicators to mark the highest and lowest temperature that occurred between resetting times. Resetting is supposed to be done every 24 hours at the same clock time.

For approximately 400 stations in this data set (First-Order Stations), temperature values were observed hourly from hygro-thermometers that are part of the Automated Surface Observing System (ASOS). Prior to ASOS, hygrothermometers were used back to the universal installation of hygro-thermometers in the 1960's, when hourly temperatures were observed with psychrometers and thermographs.

Precipitation

The instrument generally in use for this data set was the 8 inch Standard Rain Gauge. Daily precipitation was measured visually to the nearest .01 inch. Occasionally stations used non-standard gauges (4 inch/plastic).

For approximately 400 stations in this data set (First-Order Stations), precipitation was observed hourly from one of two types of recording rain gauges:

Weighing Rain Gauge (pre-ASOS)

The gauge records the weight of a precipitation-collecting bucket via a spring mechanism, connected to a pen, that records on a paper chart. Records precipitation to a hundredth of an inch (0.01").

Tipping Bucket Rain Gauge

The gauge records the number of times in a 5-minute period that a small collecting bucket that holds one hundredth of an inch (0.01") of water is filled, tips over, and empties. The recorded number of tips is telemetered to a collection site.

Appendix B. Additional Station Information

Station Location Accuracy:

Location accuracy is to the nearest minute of Latitude/Longitude. Elevation accuracy varies from the nearest foot to nearest Topographic Map Contour interval.

Station Observation Schedule:

The observation schedule varied with station. Some stations (Cooperative Stations) made once-daily readings of daily (24-hour) maximum and minimum temperature and total precipitation in the morning, some in the afternoon, some in the evening, and some at midnight. Other stations (First-Order Stations) had more frequent (hourly) observation schedules and reported daily (24-hour) maximum and minimum temperature and total precipitation on a midnight-to-midnight (calendar) basis.

Station Data Time Averaging:

1971-2000 DAILY STATION NORMALS ALL ELEMENTS FILE

The data values in this data set spline-fit daily values from the 30-year averages of monthly mean maximum temperature, monthly mean minimum temperature, monthly mean temperature, monthly total degree days, and monthly total precipitation.

Network Participation:

The Cooperative Observer Network was used for this data set, which is comprised of U.S. stations primarily staffed by "cooperative" observers. The vast majority of these observers are volunteers (non-paid, private individuals) for the National Weather Service (NWS). The cooperative stations are augmented by professionally operated NWS stations, also part of the Cooperative Observer Network and located predominantly at airports.

Geographical Distribution:

There were 7937 stations overall (measuring temperature and/or precipitation), of which 5556 recorded temperature. The geographic distribution varied, being least dense in the western U.S., mountainous, and desert areas. Station density over island locations varied considerably.

Elevation Statement:

Most of the stations had elevations below 1000 meters above sea level. The minimum elevation is -60 meters and the maximum is 3300 meters.