I. Description - Hourly Normals

The 1991-2020 U.S. Climate Normals are conventional 30-year normals of many weather and climate variables. Normals are organized into hourly, daily, monthly, seasonal and annual normals. This document describes the elements of the hourly normals. These observations are compiled from many surface weather station records, predominantly from National Weather Service and Federal Aviation Administration stations at airports and other important offices. These records were merged and then subjected to a suite of quality assurance reviews at NOAA's National Centers for Environmental Information (NCEI).

The 1991-2020 U.S. hourly normals provide a suite of descriptive statistics based on hourly observations at more than 460 stations from across the United States and its Pacific and Caribbean territories. Statistics are provided as 30-year averages, frequencies of occurrence, and percentiles for each hour and day of the year. These products are useful in examination of the diurnal change of a particular variable.

For temperature, dew point and mean sea level pressure an average hourly value as well as a 10th and 90th percentile of hourly values is given. For heating and cooling degree hours, an average hourly value isgiven using a 65 °F base. Average hourly values are also given for heat index and wind chill. Cloud cover statistics include percent frequency of clear, few, scattered, broken and overcast conditions. Wind statistics include prevailing and secondary wind direction and percent frequency, average wind speed, percentage of calm winds and mean wind vector direction and magnitude.

The statistics are computed from the Integrated Surface Dataset (Lite Version) compiled at NCEI (http://www.ncdc.noaa.gov/oa/climate/isd/index.php?name=isd-lite). Each hourly normal is computed based on 450 possible values. This is the aggregation of the value for a date and hour, plus and minus 7 days, over each of 30 years. 80% data availability is required for each calculation. If fewer than 360 valid values are present, the output is missing. No normals are computed for February 29, but data for February 29 is included in the 15-day window for leap years. The hourly normals are provided in local standard time.

II. Format/Element (Value) Definitions

(Note: the term 'element' is used throughout this document and refers to an individual meteorological / climatological measurement or statistical value such as temperature, dew point, wind, etc.)

A. Initial section

Each record represents all selected elements available for a given station-day. The initial section of each record is ordered as follows with the following definitions:

STATION ID (11 characters) is the station identification code. Please see for a complete station metadata record the NCEI Historical Observing Metadata Repository at https://www.ncdc.noaa.gov/homr/.

STATION_NAME (max 50 characters) is the name of the station (usually city/airport name).

GEOGRAPHIC_LOCATION is the latitude (decimal degrees w/northern hemisphere values > 0, southern hemisphere values < 0), longitude (decimal degrees w/western hemisphere values < 0, eastern hemisphere values > 0) and elevation above mean sea level.

DATE is the month, day, and hour in a 24-hour clock (e.g., 18:00:00 means 6:00 PM local standard time).

B. **Elements (values) and flags (attributes)**

Following this initial section of the record, all selected elements and flags are given in the following order:

1st Element, Measurement Flag, Completeness Flag, Number of Years, 2nd Element, Meaurement Flag, Completeness Flag, Number of Years, 3rd Element…etc., for all elements selected.

Elements/values are defined in Table 2 below. Please note only elements selected by user will appear inthe specific output.

Measurement Flag (Attribute) is defined in **Table 1** below

Completeness Flag (Attribute) is defined in **Table 1** below

Flags accompany every Normals value and indicate certain measurement conditions (if necessary only, blank otherwise) and the completeness of the data record used to compute each value, accounting for methodological differences for different product classes. The flag options are described in **Table 1** below. Flags relevant to the calculation of hourly normals are included here.

Table 1

Measurement Flags:

M = Missing
X = Nonzero value has rounded to zero

Completeness Flags:

S = standard (no more than 80% of values missing)

Blank = the data value is reported as a special missing value such as -9999 when other values in the column are available.

Table 2 (Elements/Values)

hly-cldh-normal	Cooling degree hours
hly-clod-pctclr	Clouds clear percentage
hly-clod-pctfew	Clouds few percentage
hly-clod-pctsct	Clouds scattered percentage
hly-clod-pctbkn	Clouds broken percentage
hly-clod-pctovc	Clouds overcast percentage
hly-dewp-10pctl	Dew point 10th percentile
hly-dewp-90pctl	Dew point 90th percentile
hly-dewp-normal	Dew point mean
hly-hidx-normal	Heat index mean
hly-htdh-normal	Heating degree hours
hly-pres-10pctl	Sea level pressure 10th percentile
hly-pres-90pctl	Sea level pressure 90th percentile
hly-pres-normal	Sea level pressure mean
hly-temp-10pctl	Temperature 10th percentile
hly-temp-90pctl	Temperature 90th percentile
hly-temp-normal	Temperature mean
hly-wchl-normal	Wind chill mean
hly-wind- 1stdir	Prevailing wind direction (1-8)
hly-wind- 1stpct	Prevailing wind percentage
hly-wind- 2nddir	Secondary wind direction (1-8)
hly-wind- 2ndpct	Secondary wind percentage
hly-wind- avgspd	Average wind speed
hly-wind- pctclm	Percentage calm
hly-wind- vctdir	Mean wind vector direction
hly-wind- vctspd	Mean wind vector magnitude

III. Additional Information

A. Units

Degrees Fahrenheit to the nearest tenth (or Celsius if user specifies metric output option) for maximum, minimum, and average air temperatures, dew point, heat index, wind chill, and heating and cooling degree hour normals and standard deviations, e.g., 70.3.

Inches of mercury for mean sea level pressure normals in customary units or hectopascals in metric units, e.g., 29.92 inches or 1013.3 hPa.

Tenths of percent for prevailing and secondary wind direction percentages, e.g., 29.9%.

Prevailing and secondary wind directions can take on 8 values:
   1=N, 2=NE, 3=E, 4=SE, 5=S, 6=SW, 7=W, 8=NW.

Miles per hour or meters per second depending on user specification of metric or standard output for wind speeds and vector magnitudes, to the nearest tenth.

Whole degrees for mean vector wind directions.

B.   Special values

-9999: missing or insufficient data (*.csv data)
blank: missing or insufficient data (pdf only)

C.   Quality Control

The following conditions will cause a value to be flagged as invalid prior to the computation of normals:
   1. Any value exceeding the world record for that variable.
   2. Streaks of constant values longer than 24, 48, 72, and 24 hours for temperature, dew point,mean sea level pressure, and wind speed respectively.
   3. Mean sea level pressures that exhibit "wrap-around" values where, for example, values more than 1059 hPa are recorded as 960 hPa.
   4. A dew point value exceeds the temperature value. Both are flagged as invalid.
   5. Within a 450-observation sample, temperature and dew point values outside 7 standard deviations of the mean value are removed. This process iterates up to 10 times until there are no values outside the 14 standard deviations range.

D.   Derived variables

Heat index was computed using the traditional National Weather Service method (https://www.wpc.ncep.noaa.gov/html/heatindex_equation.shtml). Wind chill was computed when the temperature was less than 50 °F and the wind speed was greater than or equal to 3 mph. The wind chill value is set equal to the temperature if these conditions are not met.

Wind normals are comprised of the following:
   1.   The average speed of all wind speed values.
   2.   The frequency of winds less than or equal to 3 mph/1.3 m/s.
   3.   The direction and magnitude of the mean wind vector. These are computed by first decomposing the wind observation into u and v components. The average of each component is computed. A mean wind vector is then assembled from the average components.
   4.   For winds greater than 3 mph, each is counted in a 45° wide directional bin centered on 0, 45, 90, …, 315 degrees. Counts in these bins are rescaled to account for a bias introduced by wind directions being even multiples of 10. The identity of the two bins with the highest counts, along with their overall frequencies, is provided.

5. Cloud frequencies in categories clear, few, scattered, broken, and overcast. These are computed from valid observation values from 0 to 8 inclusive representing eighths of sky coverage. An obvious observational preference was noticed to reporting values 0, 2, 4, 7, and 8. We therefore included anyreports of 1, 3, 5, and 6 with the next higher category.
6. Cooling degree hour normals were computed by subtracting 65 from each valid temperature in the sample of 450. Positive differences were summed and divided by the number of valid values. Heating degree hour normals were computed in a similar manner.

E.   Summary

1991-2020 U.S. Climate Normals averages, percentiles, and frequencies of occurrence of the above at the hourly time scale are available at more than 460 locations in the U.S. and its territories. The recommended use of these products is in examination of the diurnal change of a particular variable and how that change may shift over the annual cycle. For daily, monthly, and seasonal values, please use the normals products created for those timescales.

For more detailed information, view complete documentation of normals calculations are at:
https://www.ncei.noaa.gov/data/normals-hourly/1991-2020/doc/Normals_Calculation_Methodology_2020.pdf

For information on reading archive and access *.csv file versions of normals:
https://www.ncei.noaa.gov/data/normals-hourly/1991-2020/doc/Readme_By-Variable_By-Station_Normals_Files.txt