U.S. Daily Gridded Precipitation and Temperature Climate Normals for 1991-2020

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Abstract

The U.S. Daily Gridded Climate Normals Datasets are derived from the nClimGrid Daily Dataset (Durre et al. 2022) produced by the NOAA National Centers for Environmental Information (NOAA NCEI). Thin-plate smoothing splines were used to transform an extensive set of station temperature and precipitation values into grids at a high spatial resolution of 1/24° latitude/longitude, or approximately 5 km. The variables available as daily gridded normals include daily maximum, minimum, and mean temperatures and daily, month-to-date, and year-to-date precipitation totals. The values for each individual grid cell change smoothly from day-to-day through the application of the same methods used to generate daily normals for observation stations. The averages of all daily gridded temperature normals are constrained by a harmonic fit to equal the monthly gridded normals (Arguez et al. 2013). A moving window averaging technique is used to generate smooth daily gridded precipitation normals which are then also adjusted by month so that the sum of the days would equal the monthly gridded normals (Durre et al. 2012). The internal consistency between the daily and monthly gridded climate normals is a key advantage to the approaches used here.

Each of the six variables is reported in an individual netCDF file with 366 or 365 calendar day grids, depending on the variable. Feb 29 values are not available for month-to-date or year-to-date precipitation totals.

Arguez, A., and S. Applequist, 2013: A Harmonic Approach for Calculating Daily Temperature Normals Constrained by Homogenized Monthly Temperature Normals. Journal of Atmospheric and Oceanic Technology, **30**, 1259–1265. https://doi.org/10.1175/JTECH-D-12-00195.1.

Durre, I., A. Arguez, C. Schreck III, M. F. Squires, and R. S. Vose, 2022: Daily High-Resolution Temperature and Precipitation Fields for the Contiguous United States from 1951 to Present. Journal of Atmospheric and Oceanic Technology (in press). https://doi.org/10.1175/JTECH-D-22-0024.1.

Durre, I., M. F. Squires, R. S. Vose, X. Yin, A. Arguez, and S. Applequist, 2012: NOAA's 1981–2010 U.S. Climate Normals: Monthly Precipitation, Snowfall, and Snow Depth. Journal of Applied Meteorology and Climatology, **52**, 2377- 2395. https://doi.org/10.1175/JAMC-D-13-051.1.

[For further information about these U.S. Climate Normals, visit the Gridded Normals tab at:

https://www.ncei.noaa.gov/products/land-based-station/us-climate-normals]

Inputs

The input data used to generate the 1991-2020 normals are from the version of nClimGrid-Daily timestamped on July 29, 2022. The latest version of the data can be found here: https://www.ncei.noaa.gov/thredds/catalog/data-in-development/nclimgrid/catalog.html

Data Files

The final product is a set of six files in NetCDF format:

tavg-1991_2020-daily-normals-v1.0.nc

tmax-1991_2020-daily-normals-v1.0.nc

tmin-1991_2020-daily-normals-v1.0.nc

prcp-1991_2020-daily-normals-v1.0.nc

m2dprcp-1991_2020-daily-normals-v1.0.nc

y2dprcp-1991_2020-daily-normals-v1.0.nc

Primary Variables in Each NetCDF

dlytavg - daily temperature average for 366 calendar days, including Feb 29

dlytmax - daily temperature maximum for 366 calendar days, including Feb 29

dlytmin - daily temperature minimum for 366 calendar days, including Feb 29

dlyprcp - daily precipitation total for 366 calendar days, including Feb 29

m2dprcp - month-to-date precipitation total for 365 calendar days

y2dprcp - year-to-date precipitation total for 365 calendar days

Data Structure

A description of one of the resulting *.nc files is below; all files are similar in form.

ncdump -h nClimGrid_tavg-1991_2020-daily-normals-v1.0.nc

```
netcdf tavg-1991_2020-daily-normals-v1.0 {dimensions:
      time = UNLIMITED ; // (366 currently)
      lon = 1385 ;
      lat = 596 ;
variables:
      int64 time(time) ;
```

```
            time:long_name = "Time, day of leap year" ;
            time:standard_name = "time" ;
            time:calendar = "gregorian" ;
            time:units = "days" ;
            time:axis = "T" ;
            time:comment = "A day is defined between 1 and 366" ;
      float lon(lon) ;
            lon:_FillValue = NaNf ;
            lon:units = "degrees_east" ;
            lon:standard_name = "longitude" ;
            lon:long_name = "longitude" ;
            lon:axis = "X" ;
            lon:valid_min = "-124.6875f" ;
            lon:valid_max = "-67.02084f" ;
            lon:comment = "Resolution is 1/24 degree, equivalent to 4.63
km at the Equator, and ranging from 4.21 km at the southern boundary of
24.5625 deg. N to 3.02 km at 49.3542 deg. N" ;
      float lat(lat) ;
            lat:_FillValue = NaNf ;
            lat:units = "degrees_north" ;
            lat:standard_name = "latitude" ;
            lat:long_name = "latitude" ;
            lat:axis = "Y" ;
            lat:valid_min = "24.56253f" ;
            lat:valid_max = "49.3542f" ;
            lat:comment = "Resolution is 1/24 degree, equivalent to 4.63
km at the Equator, and ranging from 4.21 km at the southern boundary of
24.5625 deg. N to 3.02 km at 49.3542 deg. N" ;
      float dlytavg_norm(time, lat, lon) ;
            dlytavg_norm:_FillValue = -9999.f ;
            dlytavg_norm:long_name = "Average Temperature normals from
daily averages" ;
            dlytavg_norm:standard_name = "air_temperature" ;
            dlytavg_norm:units = "degree_Celsius" ;
            dlytavg_norm:valid_min = "-100.f" ;
            dlytavg_norm:valid_max = "100.f" ;
            dlytavg_norm:coordinates = "time lat lon" ;
            dlytavg_norm:comment = "Values should be rounded to the
nearest tenth" ;
            dlytavg_norm:least_significant_digit = "1L" ;

// global attributes:
            :date_created = "2022-07-29 14:04:43.218048" ;
            :date_modified = "2022-07-29 14:04:43.218072" ;
            :Conventions = "CF-1.6, ACDD-1.3" ;
            :ncei_template_version = "NCEI_NetCDF_Grid_Template_v2.0" ;
            :title = "1991-2020 Normals" ;
            :naming_authority = "gov.noaa.ncei" ;
            :standard_name_vocabulary = "Standard Name Table v35" ;
            :institution = "National Centers for Environmental Information
(NCEI)" ;
            :summary = "1991-2020 Normals" ;
            :license = "no restrictitons" ;
            :creator_name = "Point of contact: NCEI, Asheville, NC, USA" ;
```

```
            :creator_url = "https://www.ncei.noaa.gov" ;
            :publisher_name = "https://www.ncei.noaa.gov" ;
            :publisher_url = "https://www.ncei.noaa.gov" ;
            :geospatial_lat_min = "24.5625f" ;
            :geospatial_lat_max = "49.35417f" ;
            :geospatial_lon_min = "-124.6875f" ;
            :geospatial_lon_max = "-67.02084f" ;
            :geospatial_lat_units = "degrees_north" ;
            :geospatial_lon_units = "degrees_east" ;
            :geospatial_vertical_min = "surface" ;
            :geospatial_vertical_max = "surface" ;
            :time_coverage_resolution = "1 day" ;
            :program = "NCEI Climatic Science and Services Division
(CSSD)" ;
            :geospatial_lat_resolution = "0.04167 degree" ;
            :geospatial_lon_resolutioin = "0.04167 degree" ;
            :platform = "station" ;
            :references = "nClimGrid Monthly (Vose et al. 2014),
https://doi.org/10.1175/JAMC-D-13-0248.1" ;
}
```