

## **U.S. Monthly Gridded Precipitation and Temperature Climate Normals: 1991-2020, 2006-2020, and 1901-2000**

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### **Abstract**

A 1/24 degree by 1/24 degree (~5 km) gridded data set consisting of monthly precipitation and temperature values for the conterminous U.S. was published as part of generating new division climate normals (Vose et al 2014). The underlying data set is nClimGrid, and this is based on a set of station anomalies observed in any given month interpolated spatially using climate guidance and reconstructed into whole values. The resulting monthly grids are the equivalent of homogenous temperature and serially complete precipitation records. Therefore, a simple 30-year average of monthly grids from 1991-2020 yields directly the set of gridded conventional climate normals, 2006-2020 yields 15-year climate normals, and 1901-2000 yields the 20<sup>th</sup> Century Baseline. Monthly gridded climate normals are calculated for total precipitation, and maximum, minimum and average temperature.

Vose, R. S., S. Applequist, M. Squire, I. Durre, M. Menne, C. N. Willams Jr., C. Fenimore, K. Gleason, and D. Arndt, 2014: Improved Historical Temperature and Precipitation Time Series for U.S. Climate Divisions. *J. Appl. Meteor. Climatol.*, **53**, 1232-1251.  
<https://doi.org/10.1175/JAMC-D-13-0248.1>

[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 gridded normals are from the monthly version of nClimGrid, from June 2021. 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 for each time period is a set of four files in NetCDF format:

tavg-1991\_2020-monthly-normals-v1.0.nc  
tmax-1991\_2020-monthly-normals-v1.0.nc  
tmin-1991\_2020-monthly-normals-v1.0.nc  
prcp-1991\_2020-monthly-normals-v1.0.nc

Naming patterns are similar for 2006-2020 and 1901-2000.

### **Primary Variables in Each NetCDF**

Monthly Normal: mlytavg\_norm, mlytmax\_norm, mlytmin\_norm, mlyprcp\_norm

Monthly Standard Deviation: mlytavg\_std, mlytmax\_std, mlytmin\_std, mlyprcp\_std

Monthly # of Years: mlytavg\_flag, mlytmax\_flag, mlytmin\_flag, mlyprcp\_flag

Seasonal Normal: seastavg\_norm, seastmax\_norm, seastmin\_norm, seasprcp\_norm

Seasonal Standard Deviation: seastavg\_std, seastmax\_std, seastmin\_std, seasprcp\_std

Seasonal # of Years: seastavg\_flag, seastmax\_flag, seastmin\_flag, seasprcp\_flag

[Note: Seasons are 1 = DJF, 2 = MAM, 3 = JJA, 4 = SON]

Annual Normal: anntavg\_norm, anntmax\_norm, anntmin\_norm, annprcp\_norm

Annual Standard Deviation: anntavg\_std, anntmax\_std, anntmin\_std, annprcp\_std

Annual # of Years: anntavg\_flag, anntmax\_flag, anntmin\_flag, annprcp\_flag

### **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-monthly-normals-v1.0.nc***

```
netcdf nClimGrid_tavg-1991_2020-monthly-normals-v1.0 {
```

```
dimensions:
```

```
    lon = 1385 ;
```

```
    lat = 596 ;
```

```
    time = 12 ;
```

```
    seasons = 4 ;
```

```
variables:
```

```
    float lon(lon) ;
```

```
        lon:long_name = "longitude" ;
```

```
        lon:standard_name = "longitude" ;
```

```
        lon:units = "degrees_east" ;
```

```
        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" ;
```

```
    float lat(lat) ;
```

```
        lat:long_name = "Latitude" ;
```

```
        lat:standard_name = "Latitude" ;
```

```
        lat:units = "degrees_north" ;
```

```
        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" ;
```

```

int time(time) ;
    time:long_name = "Time, month of the year" ;
    time:standard_name = "time" ;
    time:calendar = "gregorian" ;
    time:units = "months" ;
    time:axis = "T" ;
    time:comment = "A month is defined between 1 and 12" ;
int seasons(seasons) ;
    seasons:long_name = "Seasons, season of the year" ;
    seasons:standard_name = "time" ;
    seasons:calendar = "gregorian" ;
    seasons:units = "months" ;
    seasons:axis = "K" ;
    seasons:comment = "A season is defined between 1 and 4" ;
float mlytavg_norm(time, lat, lon) ;
    mlytavg_norm:long_name = "Monthly mean temperature normals from monthly
averages" ;
    mlytavg_norm:standard_name = "air_temperature" ;
    mlytavg_norm:units = "degree_Celsius" ;
    mlytavg_norm:_FillValue = -9999.f ;
    mlytavg_norm:valid_min = "-100.f" ;
    mlytavg_norm:valid_max = "100.f" ;
    mlytavg_norm:comment = "Values should be rounded to the nearest tenth" ;
    mlytavg_norm:least_significant_digit = "1L" ;
float mlytavg_std(time, lat, lon) ;
    mlytavg_std:long_name = "Standard deviation of monthly mean temperature
values of all input years for a given month" ;
    mlytavg_std:standard_name = "standard_deviation" ;
    mlytavg_std:units = "degree_Celsius" ;
    mlytavg_std:_FillValue = -9999.f ;
    mlytavg_std:valid_min = "0.f" ;
    mlytavg_std:valid_max = "100.f" ;
    mlytavg_std:comment = "Values should be rounded to the nearest tenth" ;
    mlytavg_std:least_significant_digit = "1L" ;
float mlytavg_min(time, lat, lon) ;
    mlytavg_min:long_name = "Minimum temperature of monthly mean temperature
values of all input years for a given month" ;
    mlytavg_min:standard_name = "air_temperature" ;
    mlytavg_min:units = "degree_Celsius" ;
    mlytavg_min:_FillValue = -9999.f ;
    mlytavg_min:valid_min = "-100.f" ;
    mlytavg_min:valid_max = "100.f" ;
    mlytavg_min:comment = "Values should be rounded to the nearest tenth" ;
    mlytavg_min:least_significant_digit = "1L" ;

```

```

float mlytavg_max(time, lat, lon) ;
    mlytavg_max:long_name = "Maximum temperature of monthly mean temperature
values of all input years for a given month" ;
    mlytavg_max:standard_name = "air_temperature" ;
    mlytavg_max:units = "degree_Celsius" ;
    mlytavg_max:_FillValue = -9999.f ;
    mlytavg_max:valid_min = "-100.f" ;
    mlytavg_max:valid_max = "100.f" ;
    mlytavg_max:comment = "Values should be rounded to the nearest tenth" ;
    mlytavg_max:least_significant_digit = "1L" ;
float mlytavg_flag(time, lat, lon) ;
    mlytavg_flag:long_name = "Number of years used to calculate monthly mean
temperature normals" ;
    mlytavg_flag:standard_name = "air_temperature" ;
    mlytavg_flag:units = "number of months" ;
    mlytavg_flag:valid_min = "0.f" ;
    mlytavg_flag:valid_max = "30.f" ;
    mlytavg_flag:comment = "Values should be rounded to the nearest tenth" ;
    mlytavg_flag:least_significant_digit = "1L" ;
float seastavg_norm(seasons, lat, lon) ;
    seastavg_norm:long_name = "Seasonal mean temperature normals (WSSF)
from monthly normals" ;
    seastavg_norm:standard_name = "air_temperature" ;
    seastavg_norm:units = "degree_Celsius" ;
    seastavg_norm:_FillValue = -9999.f ;
    seastavg_norm:valid_min = "-100.f" ;
    seastavg_norm:valid_max = "100.f" ;
    seastavg_norm:comment = "Values should be rounded to the nearest tenth" ;
    seastavg_norm:least_significant_digit = "1L" ;
float seastavg_std(seasons, lat, lon) ;
    seastavg_std:long_name = "Standard deviation of all input monthly mean
temperature normal values" ;
    seastavg_std:standard_name = "standard_deviation" ;
    seastavg_std:units = "degree_Celsius" ;
    seastavg_std:_FillValue = -9999.f ;
    seastavg_std:valid_min = "0.f" ;
    seastavg_std:valid_max = "100.f" ;
    seastavg_std:comment = "Values should be rounded to the nearest tenth" ;
    seastavg_std:least_significant_digit = "1L" ;
float seastavg_min(seasons, lat, lon) ;
    seastavg_min:long_name = "Minimum values of all input monthly mean
temperature normal values" ;
    seastavg_min:standard_name = "air_temperature" ;
    seastavg_min:units = "degree_Celsius" ;

```

```

    seastavg_min:_FillValue = -9999.f ;
    seastavg_min:valid_min = "-100.f" ;
    seastavg_min:valid_max = "100.f" ;
    seastavg_min:comment = "Values should be rounded to the nearest tenth" ;
    seastavg_min:least_significant_digit = "1L" ;
float seastavg_max(seasons, lat, lon) ;
    seastavg_max:long_name = "Maximum values of all input monthly mean
temperature normal values" ;
    seastavg_max:standard_name = "air_temperature" ;
    seastavg_max:units = "degree_Celsius" ;
    seastavg_max:_FillValue = -9999.f ;
    seastavg_max:valid_min = "-100.f" ;
    seastavg_max:valid_max = "100.f" ;
    seastavg_max:comment = "Values should be rounded to the nearest tenth" ;
    seastavg_max:least_significant_digit = "1L" ;
float seastavg_flag(seasons, lat, lon) ;
    seastavg_flag:long_name = "Number of months used to calculate seasonal mean
temperature normals" ;
    seastavg_flag:standard_name = "air_temperature" ;
    seastavg_flag:units = "number of months" ;
    seastavg_flag:valid_min = "0.f" ;
    seastavg_flag:valid_max = "3.f" ;
    seastavg_flag:comment = "Values should be rounded to the nearest tenth" ;
    seastavg_flag:least_significant_digit = "1L" ;
float anntavg_norm(lat, lon) ;
    anntavg_norm:long_name = "Annual mean temperature normals from monthly
normals" ;
    anntavg_norm:standard_name = "air_temperature" ;
    anntavg_norm:units = "degree_Celsius" ;
    anntavg_norm:_FillValue = -9999.f ;
    anntavg_norm:valid_min = "-100.f" ;
    anntavg_norm:valid_max = "100.f" ;
    anntavg_norm:comment = "Values should be rounded to the nearest tenth" ;
    anntavg_norm:least_significant_digit = "1L" ;
float anntavg_std(lat, lon) ;
    anntavg_std:long_name = "Standard deviation of monthly mean temperature
normals" ;
    anntavg_std:standard_name = "standard_deviation" ;
    anntavg_std:units = "degree_Celsius" ;
    anntavg_std:_FillValue = -9999.f ;
    anntavg_std:valid_min = "0.f" ;
    anntavg_std:valid_max = "100.f" ;
    anntavg_std:comment = "Values should be rounded to the nearest tenth" ;
    anntavg_std:least_significant_digit = "1L" ;

```

```

float anntavg_min(lat, lon) ;
    anntavg_min:long_name = "Minimum values of monthly mean temperature
normals" ;
    anntavg_min:standard_name = "air_temperature" ;
    anntavg_min:units = "degree_Celsius" ;
    anntavg_min:_FillValue = -9999.f ;
    anntavg_min:valid_min = "-100.f" ;
    anntavg_min:valid_max = "100.f" ;
    anntavg_min:comment = "Values should be rounded to the nearest tenth" ;
    anntavg_min:least_significant_digit = "1L" ;
float anntavg_max(lat, lon) ;
    anntavg_max:long_name = "Maximum values of monthly mean temperature
normals" ;
    anntavg_max:standard_name = "air_temperature" ;
    anntavg_max:units = "degree_Celsius" ;
    anntavg_max:_FillValue = -9999.f ;
    anntavg_max:valid_min = "-100.f" ;
    anntavg_max:valid_max = "100.f" ;
    anntavg_max:comment = "Values should be rounded to the nearest tenth" ;
    anntavg_max:least_significant_digit = "1L" ;
float anntavg_flag(lat, lon) ;
    anntavg_flag:long_name = "Number of months used to calculate annual mean
temperature normals" ;
    anntavg_flag:standard_name = "air_temperature" ;
    anntavg_flag:units = "number of months" ;
    anntavg_flag:valid_min = "0.f" ;
    anntavg_flag:valid_max = "12.f" ;
    anntavg_flag:comment = "Values should be rounded to the nearest tenth" ;
    anntavg_flag:least_significant_digit = "1L" ;

// global attributes:
:date_created = "2021-09-16 08:30:01" ;
:date_modified = "2021-09-16 08:30:01" ;
: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 month" ;
:program = "Center for Weather and Climate/Climate Science Branch/Dataset
Section" ;
:geospatial_lat_resolution = "0.04167 degree" ;
:geospatial_lon_resolution = "0.04167 degree" ;
:platform = "station" ;
:references = "GHCN-Monthly Version 4 (Menne et al. 2018),
https://www.ncei.noaa.gov/products/land-based-station/global-historical-climatology-network-
monthly" ;
}
```