Descriptions of PRISM Spatial Climate Datasets for the Conterminous United States

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The PRISM Climate Group works on a range of projects, some of which support the development of spatial climate datasets. The resulting array of datasets reflects the range of project goals, requiring differing station networks, modeling techniques, and spatial and temporal resolutions. Whenever possible, we offer these datasets to the public, either free of charge, or for a fee, depending on the size and difficulty of delivering the dataset and funding for the activity. In order for users to make informed decisions about which dataset is most appropriate for their needs, this document provides information on the PRISM spatial climate datasets currently available. We start with an overview of the array of PRISM datasets, then discuss each in turn. Summary tables are provided for quick reference.

It should be noted up front that these datasets are not static entities, but are in a constant state of change. New networks are being added on a regular basis to some datasets. Even those designed for long-term consistency experience changes due to improvements in data handling and quality control procedures. We will endeavor to keep this documentation current, but inconsistencies are bound to arise.

Overview

PRISM datasets provide estimates of three basic climate elements: precipitation (ppt), minimum temperature (tmin), maximum temperature (tmax), and dew point (tdmean). Two derived variables, mean temperature and vapor pressure, are sometimes included, depending on the dataset. Descriptions of the climate elements and derived variables are given in Table 1.

Table 1. Descriptions of climate elements available from PRISM datasets. Basic descriptions are for the daily time interval, with additional monthly time interval information given in brackets. Monthly station values are calculated from daily data.

Abbreviation	Type	Description
Ppt	Modeled climate element	Daily [monthly] total precipitation (rain+melted snow)
Tmax	Modeled climate element	Daily maximum temperature [averaged over all days in the month]
Tmin	Modeled climate element	Daily minimum temperature [averaged over all days in the month]
Tmean	Derived variable	Daily mean temperature, calculated as (tmax+tmin)/2
Tdmean	Modeled climate element	Daily mean dew point temperature [averaged over all days in the month]
Vpr	Derived variable	Vapor pressure, derived from tdmean and tmean

A summary of the PRISM datasets is given in Table 2. There are two main classes of PRISM datasets: long-term averages and time series. Long-term averages, or “normals,” abbreviated “Norm” in Table 2, are 30-year averages for periods with years ending in 0, such as 1961-90 and 1971-2000. A “71” represents a 1971-2000 climatological average, and “81” represents a 1981-2010 average. An “m” denotes that the dataset has a monthly time step.

Time series datasets are abbreviated with an "LT" or "AN" (Table 2). LT, which stands for long term, refers to time series focused on temporal consistency. AN, which stands for all networks, refers to time series focused on providing the best estimate possible, at the expense of temporal consistency. For time series datasets, a 71 or 81 refers to the start year of the climatology used in the CAI process (see Time Series Datasets section). A "71" means that the dataset is based on the 1971-2000 climatology, and "81" means that it is based on the 1981-2010 climatology. A "d" denotes a daily time step. An "m" denotes a monthly time step.

Table 2. Summary of the PRISM spatial climate datasets active as of August 2013. See Table 1 for descriptions of climate elements and derived variables.

Dataset	Time Period	Climate Elements	Time Step	Modeling Resolution	Output Resolution	Modeling Method	Date of Last Full Version
Long-Term Averages							
Norm71m	1971-2000	Ppt, tmin, tmax	Monthly, annual average	30 sec (~800m)	30 sec	DEM	July 2007
Norm81m	1981-2010	Ppt, tmin, tmax, tmean*	Monthly, annual average	30 sec	30 sec, 2.5 min (~4km)	DEM	July 2012
Time Series							
LT71m	Jan 1895 – Dec 2015	Ppt, tmin, tmax, tmean*, tdmean, vpr*	Monthly, annual time series	30 sec	30 sec	CAI (1971-2000)	July 2008
LT81m	Jan 1895 - ongoing	Ppt, tmin, tmax, tmean*	Monthly, annual time series	30 sec	30 sec	CAI (1981-2010)	August 2013
AN81m	Jan 1895 - ongoing	Ppt, tmin, tmax, tmean*	Monthly, annual time series	30 sec	30 sec, 2.5 min	CAI (1981-2010)	August 2013
AN81d	1 Jan 1981 - ongoing	Ppt, tmin, tmax, tmean*	Daily time series	30 sec	30 sec, 2.5 min	CAI (1981-2010); AHPS (ppt)	June 2013

* Element is not modeled directly with PRISM, but derived from other modeled elements.

Long-Term Average ("Normals") Datasets

The normals are baseline datasets describing average monthly and annual conditions over the most recent three full decades, and are our most popular datasets (Table 3). The most recent PRISM normals are for the period 1981-2010. Long-term average datasets are modeled with PRISM using a digital elevation model (DEM) as the predictor grid. The normals are also used in the interpolation of the time series datasets (see CAI discussion in the Time Series Datasets section). Given their importance, the normals are carefully developed and subjected to extensive peer review. A description of the PRISM modeling system, the process used to create the 1971-2000

normals, and an uncertainty analysis is available from Daly et al. (2008).[1] The 1981-2010 normals were prepared using similar methods to those used in the 1971-2000 normals, but with additional station networks.

Table 3. Summary of the station data used in the PRISM normals datasets. Descriptions of the station networks are given in appendix Table A1.

Data Sources	Norm71m	Norm81m
Tmax, tmin	AGRIMET, ASOS/ISH, CDEC, COOP, EC, HJA, MEXICO, RAWS, SNOTEL, UPPERAIR (GGUAS), WBAN, WRCC	AGRIMET, ASOS/ISH, CDEC, COOP, EC, HJA, MEXICO, RAWS, SNOTEL, UPPERAIR (NN) , WBAN, WRCC
Ppt	AGRIMET, CDEC, COOP, EC, HJA, NVDWR, RAWS, SNOTEL, SNOWCOURSE, STORAGE, WBAN, WRCC	AGRIMET, CDEC, COCORAHS, COOP, EC, HDSC, HJA, MN, NDSWC, NVDWR, OKMESONET, RAWS, SFWMD, SNOTEL, SNOWCOURSE, STORAGE, USLTER, WBAN, WRCC

Norm71m

Climate elements: tmin, tmax, ppt

Units and scaling: tmin, tmax (deg C*100), ppt (mm*100); all values are integers

Description: Monthly 30-year "normal" dataset covering the conterminous US, averaged over the period 1971-2000. Interpolation method for all elements uses a DEM (digital elevation model) as the predictor grid. This dataset was heavily peer reviewed, and is freely available on the PRISM website.

Status: Most recent Norm71m analysis completed July 2007; Norm71m has been superseded by Norm81m

Availability: 800m version (only) available until Fall of 2014 from the old PRISM website (follow links from http://prism.oregonstate.edu)

Caveats: Norm71m cannot be compared directly to Norm81m to assess climatic changes between the two periods. Station networks and data were not consistent between the two datasets. Each time the normals are created, we try to include new and better sources of data so that the product continues to reflect the state of knowledge regarding climatic values and spatial patterns. Dataset uses all stations, regardless of time of observation, which means that stations with morning observation times could exhibit cool biases for tmin, and stations with afternoon observation times could exhibit warm biases for tmax.

Norm81m

Climate elements: tmin, tmax, tmean (derived), ppt

Units and scaling: tmin, tmax, tmean (deg C), ppt (mm); all values are floating point

Description: Monthly 30-year "normal" dataset covering the conterminous US, averaged over the period 1981-2010. Interpolation method for all elements uses a DEM (digital elevation model) as the predictor grid. This dataset was heavily peer reviewed, and is freely available on the PRISM website.

[1] Daly, C., Halbleib, M., Smith, J.I., Gibson, W.P., Doggett, M.K., Taylor, G.H., Curtis, J., and Pasteris, P.A. 2008. Physiographically-sensitive mapping of temperature and precipitation across the conterminous United States. *International Journal of Climatology*, 28: 2031-2064.

Status: Most recent Norm81m analysis completed July 2012

Availability: 800m and 4km versions available at http://prism.oregonstate.edu

Caveats: Same as Norm71m

Time Series Datasets

The long-term average datasets discussed above are modeled with PRISM using a DEM as the predictor grid. In contrast, the time series datasets are modeled using a method called climatologically-aided interpolation (CAI). In CAI, the long-term average datasets serve as the predictor grids. The idea behind CAI is that the best first guess of the spatial pattern of climatic conditions for a given month or day is the long-term average pattern. CAI is robust to wide variations in station data density, which is necessary when modeling century-long time series.

There are two types of time series datasets: those created to provide the best possible estimates at a given time step, and those created with long-term consistency in mind. Table 4 lists the station networks used in each type of time series dataset. A more detailed description of the station data networks used is given in Appendix A. Time series datasets providing the best possible estimates, abbreviated "AN" (all networks), use all of the station networks and data sources ingested by the PRISM Climate Group. Time series datasets focusing on long-term consistency, abbreviated "LT" (long term), may not use all available station networks, but instead focus on networks that have been in existence for at least twenty years. The goal of the LT datasets is to provide better temporal consistency than the AN datasets. However, even the LT datasets are not currently suitable for calculating multi-decadal climate trends. Although longer-term networks are used, grids still contain non-climatic variations due to station equipment and location changes, stations openings and closings, and varying observation times.

LT71m

Climate elements: tmin, tmax, tmean (derived), tdmean, ppt, vpr (derived)

Units and scaling: tmin, tmax, tmean, tdmean (C*100), ppt (mm*100), vpr (Pa); all values are integers

Description: Monthly dataset covering the conterminous US, starting on January 1895 and ending on the most recently completed month. Emphasis is on long-term consistency, and uses only station networks having at least some stations with ≥ 20 years of data. Interpolation method for all elements is CAI, using 1971-2000 monthly climatologies as the predictor grids. This dataset has been available for several years for a fee.

Status: The most recent re-analysis was done in July 2008 (full period of record), and updated with new data for subsequent months. LT71m is a legacy product, and has been superseded by LT81m for tmin, tmax, and ppt. LT81m versions of tdmean and vpr are expected in 2014. New users are encouraged to use LT81m whenever possible, and current users of LT71m should migrate to LT81m as soon as is practical. LT71m will be updated monthly through December 2015, at which time it will be decommissioned. No further re-analyses of LT71m are anticipated.

Availability: 800m dataset available for a fee; contact prism_orders@nacse.org

Caveats: Dataset should not be used to calculate multi-decadal climate trends. Although longer-term networks are used, grids still contain non-climatic variations due to station equipment and location changes, station openings and closings, and varying observation times.

Table 4. Summary of the PRISM time series datasets. Methodological details are provided in the Time Series Datasets section. Descriptions and time histories of the station networks are given in appendix Tables A1-A4.

	AN81m	AN81d	LT71m/LT81m
Focus	Best estimate	Best estimate	Temporal consistency
Data Sources	All stations included, regardless of observation time	All stations included, but with time of observation constraint	Only "long-term" networks having at least some stations with ≥ 20 years of data included. All stations included, regardless of observation time.
Tmax, tmin	AGRIMET, ASOS/ISH, CDEC, COOP, EC, HJA, MEXICO, RAWS, SNOTEL, WBAN, WRCC	Same as AN81m, except non-PRISM Day observations are excluded	*LT81m:* AGRIMET, ASOS/ISH, CDEC, COOP, EC, HJA, MEXICO, RAWS, SNOTEL, WBAN, WRCC *LT71m*: AGRIMET, ASOS/ISH, COOP, EC, SNOTEL, WBAN, WRCC
Tdmean	None	None	*LT71m only*: AGRIMET, ASOS/ISH, COOP, HJA, RAWS, WBAN
Ppt	AGRIMET, ASOS/ISH, CDEC, COCORAHS, COOP, EC, HDSC, HJA, HYD, MEXICO, MN, NDSWC, RAWS, SFWMD, SNOTEL, WBAN, WRCC	Same as AN81m, except non-PRISM Day observations are re-apportioned Also: AHPS RADAR Stage 2 and 4 grids	*LT81m*: AGRIMET, CDEC, COOP, EC, HJA, MEXICO, MN, NDSWC, RAWS, SNOTEL, WBAN *LT71m*: AGRIMET, COOP, RAWS, SNOTEL, WBAN
None can be used safely to calculate multi-decadal climate trends			

LT81m

Climate elements: tmin, tmax, tmean (derived), ppt

Units and scaling: tmin, tmax, tmean (deg C), ppt (mm); all values are floating point

Description: Monthly dataset covering the conterminous US, starting on January 1895 and ending on the most recently completed month. Emphasis is on long-term consistency, and uses only station networks having at least some stations with ≥ 20 years of data. Interpolation method for all elements is CAI, using 1981-2010 monthly climatologies as the predictor grids. This is an updated version of LT71m.

Status: The most recent re-analysis was completed in August 2013 (full period of record), and updated with new data for subsequent months. This product supersedes LT71m for tmin, tmax, and ppt. LT81m versions of tdmean and vpr are expected in 2014. New users are encouraged to use LT81m whenever possible, and current users of LT71m should migrate to LT81m as soon as is practical. LT71m will be updated monthly through December 2015, at which time it will be decommissioned.

Availability: 800m dataset available for a fee; contact prism_orders@nacse.org

Caveats: Dataset should not be used to calculate multi-decadal climate trends. Although longer-term networks are used, grids still contain non-climatic variations due to station equipment and location changes, station openings and closings, and varying observation times.

AN81m

Climate elements: tmin, tmax, tmean (derived), ppt

Units and scaling: tmin, tmax, tmean (deg C), ppt (mm); all values are floating point

Description: Monthly dataset covering the conterminous US, starting on January 1895 and ending on the most recently completed month. Emphasis is on arriving at the best estimate, regardless of temporal consistency, and uses all station networks ingested by the PRISM Group. Interpolation method for all elements is CAI, using 1981-2010 monthly climatologies as the predictor grids. This is an updated version of the free data posted to prism.oregonstate.edu.

Status: The most recent re-analysis was completed in August 2013 (full period of record), and updated with new data for subsequent months. New station networks are being added to this dataset on a regular basis, which means Table 4 may be out of date for the most recent months. However, historical data from new networks are not incorporated until a new version of AN81m is developed. This product supersedes the free data posted to prism.oregonstate.edu. AN81m versions of tdmean and vpr are expected in 2014.

Availability: 4km version available at http://prism.oregonstate.edu. 800m dataset available for a fee; contact prism_orders@nacse.org

Caveats: Dataset should not be used to calculate multi-decadal climate trends. Grids may contain non-climatic variations due to station equipment and location changes, openings and closings, and varying observation times, and the use of relatively short-term networks.

AN81d

Climate elements: tmin, tmax, tmean (derived), ppt

Units and scaling: tmin, tmax, tmean (deg C), ppt (mm); all values are floating point

Description: Daily dataset covering the conterminous US, starting on 1 January 1981 and ending on the most recent day. Interpolation method for tmin and tmax is CAI, using 1981-2010 monthly climatologies as the predictor grids. For ppt, CAI, using 1981-2010 monthly climatologies as the predictor grids, is applied in the western US (Rockies westward), and, starting on 1 January 2002, a combination of CAI and RADAR versions is used in the central and eastern US. The RADAR version is created using the National Weather Service Stage 2 unbiased (ST2un) and 4 (ST4) 4km gridded radar products from the Advanced Hydrometeorological Prediction System (AHPS). On a pixel-by-pixel basis, a "besting" process compares the R^2 values from the PRISM regressions of climate vs. station ppt (CAI) and ST2un vs. station ppt (RADAR). ST2un, rather than ST4, is used to estimate the predictive power of RADAR, because ST2un does not have individual station observations incorporated, which makes for a fairer comparison to CAI than ST4, which has many stations assimilated into the grid estimates. Based on this comparison, a RADAR weighting factor (0-1) is calculated. The weighting factor is then applied to the ST4 AHPS grid, when averaging it with the CAI grid, to form a hybrid estimate.

Station data used in AN81d are screened for adherence to a "PRISM day" criterion. A PRISM day is defined as 1200 UTC-1200 UTC (e.g., 7 AM-7AM EST), which is the same as the AHPS day definition. Once-per day observation times must fall within +/- 4 hours of the PRISM day to be included in the AN81d tmax and tmin

datasets. Stations without reported observation times in the NCDC GHCN-D database are currently assumed to adhere to the PRISM day criterion. For ppt, non-PRISM day observations are included in AN81d, but the daily values are re-apportioned (if necessary) on an event basis to mimic the relative variations of nearby PRISM-day observations. Multi-day accumulations are also re-apportioned on an event basis to mimic the relative variations of nearby PRISM-day observations. The dataset uses a day-ending naming convention, e.g., a day ending at 1200 UTC on 1 January is labeled 1 January.

Status: The most recent re-analysis was done in June 2013 (full period of record). This dataset is updated daily, and may include new station networks.

Availability: 4km version available at http://prism.oregonstate.edu; 800m dataset not yet available to the public

Caveats: Dataset should not be used to calculate multi-decadal climate trends. Grids may contain non-climatic variations due to station equipment and location changes, openings and closings, and the use of RADAR data for ppt starting in 2002. Screening stations for adherence to a "PRISM day" criterion does help to minimize time of observation bias. However, the downside is that this results in the exclusion of a large percentage of stations from the analysis, especially early in the record. For example, in 1981, non-PRISM day COOP stations outnumbered PRISM day stations by about 2 to 1. The two groups were about equal in size in 1990. By 2010, PRISM day COOP stations outnumbered non-PRISM day stations by about 3 to 1.

Appendices

Table A1. Descriptions of Station Networks Used in PRISM Spatial Climate Datasets

Table A2. History of station networks used in PRISM monthly time series datasets: Tmax/Tmin

Table A3. History of station networks used in PRISM monthly time series datasets: Precipitation

Table A4. History of station networks used in PRISM monthly time series datasets: Tdmean

Table A1. Descriptions of station networks used in PRISM spatial climate datasets

		Dataset Usage		
Network	**Description**	**Tmax, Tmin**	**Ppt**	**Tdmean**
AGRIMET	Bureau of Reclamation Agricultural Weather Network	All	All	LT71m
ASOS/ISH	Automated Surface Observing System and related networks (e.g., AWOS), and Integrated Surface Hourly network *Notes*: ASOS network began installation in 1996, with poor instrumentation for measuring snowfall. Therefore, ppt data are used during May-Sep only. Future versions will make exceptions for the installation of ASOS all-weather gauges.	All	Rainfall only (see notes) AN81m AN81d	LT71m
CDEC	California Data Exchange Center *Notes*: A collection of stations from various networks operating in California.	Norm71m Norm81m LT81m AN81m	Norm71m Norm81m LT81m AN81m	NA
COCORAHS	Community Collaborative Rain, Hail and Snow Network *Notes*: Currently the largest ppt observing network in the US.	NA	Norm81m AN81m AN81d	NA
COOP	National Weather Service Cooperative Observer Program *Notes*: These stations are part of the GHCN-D database. COOP is the longest-running climate network in the US.	All	All	LT71m
EC	Environment Canada	All	All except LT71m	NA
HDSC	NOAA Hydrometeorological Design Studies Center *Notes*: A collection of ppt stations in California used by HDSC and PRISM to produce the NOAA Atlas 14 ppt frequency maps. Period of record ends in 2010.	NA	Norm81m AN81m	NA
HJA	HJ Andrews Experimental Forest, Oregon, NSF Long Term Ecological Research Site (LTER); benchmark sites, reference stands, cold air transects *Notes*: Data lag time is currently longer than 6 months, which is our cutoff for operational inclusion; this means that at present, HJA data can be included only when new versions of the datasets are created.	All, except LT71m Exceptions: Tmin only at reference stands, thermograph sites, and cold air transects Cold air transects used in AN81 datasets only	All, except LT71m	LT71m

HYD	Advanced Hydrologic Prediction Service River Forecast Centers *Notes*: Selected stations from a combination of many different networks. Stations available from networks for which we have direct feeds are excluded (difficulties identifying the source networks in HYD produce occasional duplications).	NA	AN81m AN81d	NA
MEXICO	Global Historical Climate Network – Mexico *Notes*: These stations are part of the GHCN-D database	Norm81m AN81m AN81d LT81m	Norm81m AN81m AN81d	NA
MN	Minnesota Climatology Working Group	NA	Norm81m AN81m AN81d LT81m	NA
NDBC	National Data Buoy Center *Notes*: Used to characterize coastal air temperature	Norm81m	NA	NA
NDSWC	North Dakota State Water Commission	NA	Norm81m LT81m AN81m AN81d	NA
NVDWR	Nevada Division of Water Resources *Notes*: Collection of ppt gauges in western Nevada.	NA	Norm71m Norm81m	NA
OKMESO-NET	Oklahoma Mesonet	Norm81m	Norm81m	NA
RAWS	U.S. Forest Service and Bureau of Land Management Remote Automated Weather Stations *Notes*: Unheated tipping bucket rain gauges are not suited for measuring snowfall. Therefore, ppt data are used during May-Sep only. Very little RAWS ppt data was used in Norm81m due to increased concerns over data quality (low ppt).	All, except AN71m	Rainfall only (see notes) All	LT71m
SFWMD	South Florida Water Management District	NA	Norm81m AN81m AN81d	NA
SNOTEL	Natural Resources Conservation Service Snowpack Telemetry *Notes*: The main high elevation network in western mountains.	All	All	NA
STORAGE	Miscellaneous Long-Term Precipitation Storage Gage Stations *Notes*: Storage gauges from various agencies in remote areas of the western US that are checked monthly to yearly.	NA	Norm71m Norm81m	NA
UPPERAIR	National Centers for Environmental Prediction/National Center for Atmospheric Research	Norm71m (GGUAS)	NA	NA

	Notes: GGUAS is the Gridded Global Upper Air Statistics dataset, and NN is the NCAR/NCEP reanalysis dataset. Used to represent mean temperatures at high elevations in free-air topographic positions.	Norm81m (NN)		
USLTER	Selected stations from NSF Long Term Ecological Research Sites: Hubbard Brook, Coweeta, Sevietta, Niwot Ridge	NA	Norm81m	NA
WBAN	Weather Bureau, Army, Navy *Notes*: These stations are part of the GHCN-D database. In 1996, many WBAN stations converted to ASOS instrumentation. Therefore, ppt is subjected to ASOS rules to exclude snowfall (see ASOS notes).	All	Rainfall only (see notes) All	LT71m
WRCC	Western Regional Climate Center	All	All	NA
SNOW-COURSE	Natural Resources Conservation Service Snow Course *Notes*: An algorithm was developed to relate April 1 snow water equivalent at the snow courses to winter ppt. Useful in remote mountain areas lacking actual ppt measurements.	NA	Norm71m Norm81m	NA

Table A2. History of station networks used in PRISM monthly time series datasets: Tmax/Tmin.

	AN81m, LT81m and LT71m
	AN81m and LT81m
	AN81m only

	Decade Ending Year												
Network	**1900**	**1910**	**1920**	**1930**	**1940**	**1950**	**1960**	**1970**	**1980**	**1990**	**2000**	**2010**	**2020**
AGRIMET													
ASOS/ISH													
CDEC													
COCORAHS													
COOP													
EC													
HDSC													
HJA													
HYD													
MEXICO													
MN													
NDBC													
NDSWC													
NVDWR													
OKMESONET													
RAWS													
SFWMD													
SNOTEL													
SNOWCOURSE													
STORAGE													
UPPERAIR													
USLTER													
WBAN													
WRCC													

Table A3. History of station networks used in PRISM monthly time series datasets: Precipitation.

	AN81m, LT81m and LT71m
	AN81m and LT81m
	AN81m only

Network	Decade Ending Year												
	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000	2010	2020
AGRIMET													
ASOS/ISH													
CDEC													
COCORAHS													
COOP													
EC													
HDSC													
HJA													
HYD													
MEXICO													
MN													
NDBC													
NDSWC													
NVDWR													
OKMESONET													
RAWS													
SFWMD													
SNOTEL													
SNOWCOURSE													
STORAGE													
UPPERAIR													
USLTER													
WBAN													
WRCC													

Table A4. History of station networks used in PRISM monthly time series datasets: Tdmean.

LT71m

Network	Decade Ending Year												
	1900	**1910**	**1920**	**1930**	**1940**	**1950**	**1960**	**1970**	**1980**	**1990**	**2000**	**2010**	**2020**
AGRIMET													
ASOS/ISH													
CDEC													
COCORAHS													
COOP													
EC													
HDSC													
HJA													
HYD													
MEXICO													
MN													
NDBC													
NDSWC													
NVDWR													
OKMESONET													
RAWS													
SFWMD													
SNOTEL													
SNOWCOURSE													
STORAGE													
UPPERAIR													
USLTER													
WBAN													
WRCC													