Accessing Climate Trends and Data
US Historical Climatology Network-- and PRISM

I. US Historical Climatology Network Excel Template (USHCN Stations)

Excel Template for Station-Specific Historical Precipitation and Temperature Data
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The U.S. Fish and Wildlife Service, Pacific Region, has developed an Excel spreadsheet linear regression application that charts climate trends from the 20th Century to the present using United States Historical Climatology Network data. This allows you to choose an observation station and produce 18 charts of annual and seasonal temperature and precipitation trends. Follow the step-by-step instructions, below. (Requires use of Microsoft Excel software and an Internet connection.)

One station does not make a regional trend. If you have more than one station near your area of interest, we recommend creating Excel files for all of them. Compare trends and averages from more than one site. If you observe the same trend at more than one site, it is more credible.

Please note that linear regressions are very sensitive to outliers or extreme values, the length of record used, and the starting and ending data points. For example, cooler than average temperatures during recent years in the Pacific Northwest at some of the stations result in negative (cooling) the trends for the 30-year period from 1981-2010. This is an artifact of the linear regression and the relatively short record examined. Nonparametric trend tests are less sensitive to outliers and starting/ending values and we prefer using these for trend tests but these are not available in Excel. As a result, be careful in choosing start/end dates and interpreting these trends. They are meant to provide a reconnaissance level analysis for station data and more in-depth research is warranted on regional trends, longer term trends, and an understanding of inter-annual variability caused by the El Nino Southern Oscillation (ENSO) and other oscillations.

Description:The United States Historical Climatology Network (USHCN) is a high-quality data set of daily and monthly records of basic meteorological variables from 1218 observing stations across the 48 conterminous United States (network excludes AK and HI). The data have been corrected to remove biases or heterogeneities from non-climatic effects such as urbanization or other landscape changes, station moves, and instrument and time of observation changes. Daily data include observations of maximum and minimum temperature, precipitation amount, snowfall amount, and snow depth; monthly data consist of monthly-averaged maximum, minimum, and mean temperature and total monthly precipitation. Most of these stations are U.S. Cooperative Observing Network stations located generally in rural locations, while some are National Weather Service First-Order stations that are often located in more urbanized environments.

USHCN stations were chosen to provide a key baseline data set for monitoring U.S. climate. The USHCN has been developed over the years at the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC) to assist in the detection of regional climate change. It has been widely used in analyzing U.S. climate. Stations were selected using a number of criteria including length of record, percent of missing data, number of station moves and other station changes that may affect data homogeneity, and resulting network spatial coverage. Missing data have been estimated based on a weighted average of values from highly correlated neighboring stations. Each of the 1218 stations in the USHCN has a complete record of monthly temperature and precipitation from 1895 to 2010.

The Excel template file that has been developed is populated with the 1925 to 2010 time series of monthly precipitation and temperature data from a selected USHCN station. The template uses total monthly precipitation and average monthly maximum, mean, and minimum daily temperatures for a given USHNC station for the period 1925 to 2010. Statistics are calculated to summarize the monthly precipitation and temperature data on a seasonal basis (water year, cool season – that's Oct-Mar – winter, spring, summer, and fall). The 1925 to 2010 period was selected based on a compromise between a desire to examine the record as far back as possible and the knowledge that the further back one goes, the data are based on fewer stations and may be more questionable. The 1925 starting date also completely captures the long 20-year warm phase of the Pacific Decadal Oscillation that occurred from 1925 to 1944. For purposes of examining 30-year averages and linear trends in time, I used the period 1981 to 2010, figuring that the "average climate" and any relevant trends in time are best represented by looking at the last 30 years rather than the entire period of record.

Directions: Open the web site for USHCN map and data access:
http://cdiac.ornl.gov/epubs/ndp/ushcn/ushcn_map_interface.html

The mapper at the web site above is used to locate USHCN stations that are close to your area of interest. After the data are input, a macro in the template will sort the data, update the plots and chart titles, and calculate seasonal statistics and trends. The file is then ready to associate with a station (by renaming the file as directed below). Because every USHCN station has a complete and consistent data set, it's easy to develop a macro to automate the processing.

Steps:
Open the Excel file called USHCN_Data_1925-2010_template.xls. Go to the USHCN data access web site http://cdiac.ornl.gov/epubs/ndp/ushcn/ushcn_map_interface.html

On the web site, map the stations in your state of interest, zoom in on them, and select the station you want to download data from. You will get a pop-up with some information about the station as well as links to the data.

First, record the station information in the template file. Create a station label consisting of "Station Number and Location" and put it in the appropriate cell in the template (cell

G1). The information in this cell will automatically update all the chart titles for all the charts. Then, place the latitude, longitude (note this is negative in sign), and elevation (m) in cells J5:J7 (the file will automatically calculate the elevation conversion to feet). You may find it quickest to just write these in but you can select them and "copy and paste" the information directly from the pop-up associated with the station on the mapper. I don't do anything more with this information at this point but it's easy to keep track of it now if we use it later.

Next, go to "**Get monthly data**" which is an option on the pop-up associated with each station on the mapper. This will open a new web page. Select **Create a download file of monthly data** which is an option under **Available download files titled "Write a comma-separated file of monthly data to a download area,"** which takes you to toward the bottom of the page. In the section, select Precipitation (PRECIP), Minimum Temperature (TMIN), Mean Temperature (TMEAN), Maximum Temperature (TMAX) (but don't select the flags), and change the beginning year to 1924 (so we get Oct-Dec of WY 1925) and end year to 2010 if it's not there already. Then hit **submit and** you will get a link to a .csv file. Click on the link, choose open the file and select and copy all the data (*a quick way to select all the data on this page is "Control A". After selecting all data, hit control C or the copy command to copy. There's really not a need to copy the 1st line (source) since it doesn't vary with stations but it's easiest just to select all and copy and paste it into the template.*) Place the cursor in the template spreadsheet in cell A3 and paste (control V or paste in the Edit menu). It is important to place the data in the exact cell (A3) so that all the sums/averages in the following columns are computed correctly. We find that it works best to close the .csv file after you copy it before continuing to work in the spreadsheet.

Run macro (push "control w" to run the macro – for newer version of Excel, you will need to enable macros for this file. To enable the macros using excel 2007: Find the Office symbol in the top left and click on it. Then under prepare, choose properties. A window will open allowing access to enable macros. Under Excel 2010, go to Developer and Macro Security). The macro does the following steps (it does these steps very fast and ends up with the cursor at the data for the SOI winter pcp/temp charts – if you don't see the anything happen and you don't end up here after pushing "control w", the macro didn't run):

1) Selects and copies L4:AO1048, pastes these beginning in cell AQ4 (as values), sorts these data (by pcp/temp values), deletes the blanks rows consisting of years only (below – not really necessary, just cleans the spreadsheet up), and then resorts the remaining data (chronologically by year). End up with total pcp (and % of normal too), and avg, min, max temp summaries for each year by WY, O-M, and 4 seasons.

2) Selects and copies B669:D1048 and F669:F1048 (monthly pcp and avg temp for years 1981 to 2010 – 30-yr normals) – in 2 steps - pastes these beginning in cell BX5, sorts these data (by month). Monthly means are automatically

computed to the right of these columns and then linked to summaries beginning in cell CD4 for the plots.

3) Selects and copies BS32:BS90 (O-M % of avg pcp) and BU32:BU90 (avg temp) from 1952 to 2010 into cells beginning with CN5 and CO5, respectively, for plots of O-M pcp v SOI and O-M temp v Jun-Nov SOI and v Oct-Mar PDO. This is the end of the macro steps.

(*Note: The summaries could be done with pivot tables instead of the way I'm computing things here – I just wasn't sure how to get a macro to do a pivot table*)

All the plots, trendlines, and statistics should update themselves. You will need to check the titles and especially check/adjust the scales of the y axes on some of the plots to make sure you are plotting all the data. We have a few recommendations for the y axes scales below (see notes). The linear trendlines are only applied to the last 30 years. Because applying a linear trend to data over the entire period of record may or may not be appropriate depending on the site, we have limited the trendline to a 30-year period. It's also consistent with the 30-year averages that are computed and plotted. The plots also present the total change in precipitation or temperature over the 30-year period, calculated using the slope of the linear trendline (*see cautionary note on this above*). The precipitation change is calculated as a percent change from the initial value in 1981 while the temperature change is just an absolute change over the 30 year period.

Last, rename and save the worksheet – to rename, we suggest replacing "template" in the name with 2-letter State_Station name (for example, USHCN_data_1925-2010_WA_Centralia.xls)

Notes:

To scale the y axis on an Excel plot, just double click on the numbers on the axis and you will get the Format Axis box with axis options to set minimum and maximum values. Scaling y axis for time series plots (the monthly mean pcp and temp plots, the WY and O-M pcp time series plots, the O-M pcp and O-M temp v SOI plots are autoscaled – you'll need to adjust scales and ranges of all the other plots). You'll probably have to adjust the O-M temp and O-M pcp v SOI and v PDO scales too, because they keep starting from zero (on mine anyway). For each station, we suggest using a fairly consistent vertical scale between seasons for time series plots so the variability and trends don't appear to be different between seasons just because of scale differences. And we suggest using a fairly narrow range (but consistent) for the temperature data so that any trends are more apparent. If you don't want to bother with this, then change the axis option to autoscale the vertical axis in the template file before you begin. The vertical axis used on pcp time series plots is autoscaled. The vertical axis used for temperature time series plots is a range anywhere from 30F to 50F, depending on the range of the temperature data, which varies with site. The optimum vertical scale ranges for time series plots may differ for different parts of the country.

II. PRISM-- Available on ClimateWizard.org

The Parameter-elevation Regressions on Independent Slopes Model (PRISM) is a method developed by Oregon State University researchers for generating gridded estimates of historic precipitation and temperature at monthly and daily time steps (Daly 2002; Daly et al. 2008; http://www.prism.oregonstate.edu/). The method interpolates between point data from thousands of weather stations using a digital elevation model (DEM) and many other geographic data sets. The gridded estimates account for spatial variations in climate caused by elevation, terrain orientation, effectiveness of terrain as a barrier to flow, coastal proximity, moisture availability, atmospheric inversions, and topographic position (valley, mid-slope, ridge). Because of the complete geographic coverage, PRISM can provide estimates of climate data for remote areas where there is often little or no data available. PRISM does not provide projections of future climate, just estimates of past and current climate at a very fine resolution.

Monthly time series data from 1895 to the present are available with a 4-km resolution for any point in the conterminous U.S. To obtain this data, go to the internet map server on the PRISM webpage and select latitude and longitude of the desired point. Thirty-year average monthly temperature and precipitation based on the period 1971-2000 are available at an 800-m resolution for any point in the conterminous U.S and the Pacific Islands. These averages are referred to as "800-m normals" on the PRISM webpage.

This is now also available on the Climate Wizard-- http://www.climatewizard.org/ --a web tool that enables technical and non-technical audiences alike to access leading climate change trends (and model outputs) and visualize those data anywhere on Earth. This web-based program allows the user to choose a state or country and access climate trends for the past 50 years (and to project what future changes are predicted to occur in a given area). This can be selected from the home page and viewed as rate of change per year. You can also view the statistical significance of the data geographically (mapped p-values.)

Finally, you can also customize the time period and/or the geographic area by selecting "ClimateWizard Custom Analysis" (home page under "resources," top right portion of the page—or go here: http://climatewizardcustom.org/). This portion of the Wizard has a number of additional analysis functions including monthly, seasonal and annual data series, etc.