Drought Tools Users Manual

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Introduction

Drought Tools provides a graphical interface to drought and soil data calculated using the Palmer Drought Severity Index, Standardized Precipitation Index, Newhall Simulation Model, and Keetch Byram Drought Index. Drought Tools adds flexibility in input and visualization of results to the command-line programs on which it is based.

Creating Stations

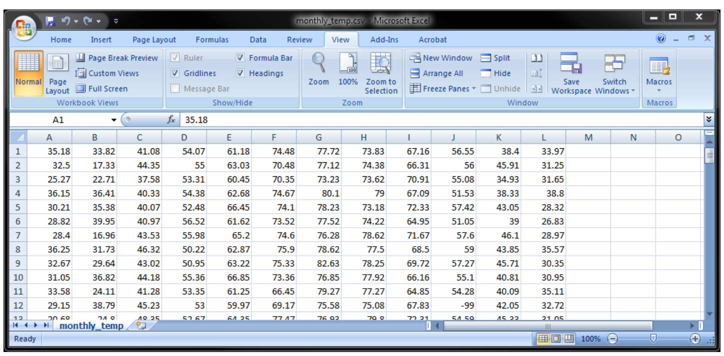
The following information is needed to create a new station:

- **Station Name and ID**
- **Latitude and Longitude** (in decimal degrees) – Locations are only available for the United States
- **Available Water Capacity** – AWC is the amount of water in the soil that is available for use by plants. AWC is very important to the calculations of the PDSI, so it is important to use the most accurate information available. The AWC of the nearest station to the location can be retrieved if the value for the location is unknown.

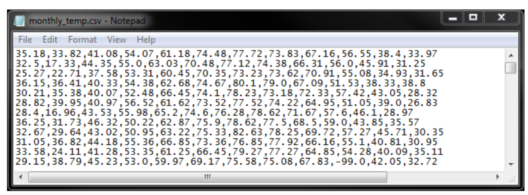
Adding Data to a Station

Station records can contain data about high temperature, average temperature, and precipitation. This data can be uploaded as .csv files or typed into the data grids manually. To add information by hand, select the High Temperature, Average Temperature, or Precipitation buttons at the top of the screen. Click Add Year to add a row to the grid. Once a year is added, click on a cell in that year's row on the grid to input data.

To import data from a file, click Upload Data file on the Station Information page or any of the data pages. Data files should be formatted as .csv (comma separated value) files. The first value of each row of the should be the year, followed by 12 values for monthly files, or 52 values for weekly files.



An example of a monthly temperature file in Excel.

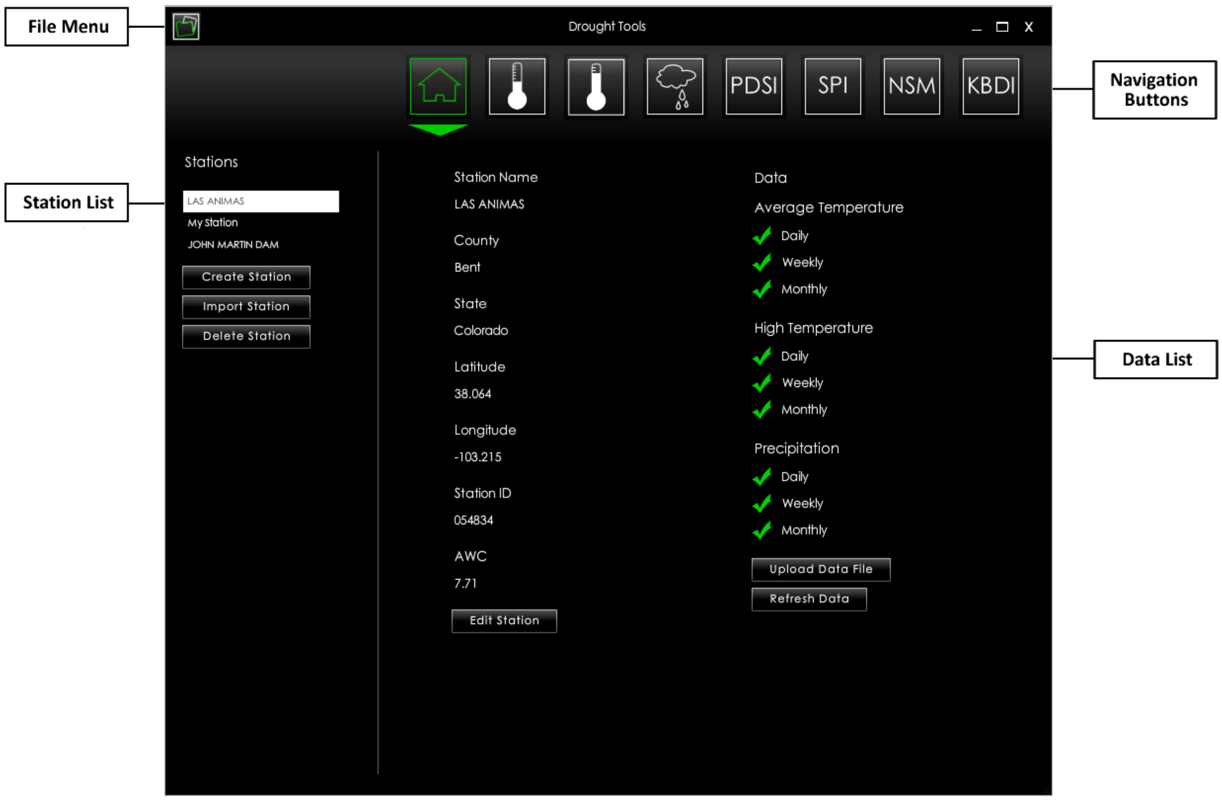


The same file in Notepad.

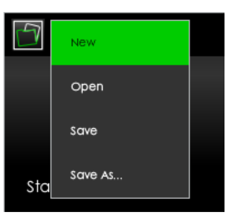
Importing Stations

Data can be imported for an existing station from the GreenLeaf Project by clicking on Import Station, on the left side of the screen. Stations can be browsed by location or searched for by name. All available monthly and weekly data will be included in the import, as will daily data starting in 1970.

Station Data

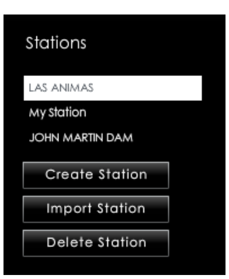


File Menu



Lists of stations and the information and data for those stations can be saved as Drought Tool Data (.dtd) files. Use the file menu to save and access those files.

Station List



The station list shows all the stations in the current workspace. Click on a station name to select that station and display its data. Remove a station from the list by selecting it and clicking Delete Station. New stations can be adding using the Create Station and Import Station buttons.

Navigation Buttons

Use the navigation buttons to select a data page. The PDSI, SPI, NSM, and KBDI will only be enabled when the data needed to run each index is present.

Data List

This shows a checklist of data for each station. In this case, the green check marks indicate that the selected station has data for all possible data sets. Click Upload Data File to replace the data for one of the sets with new information from a .csv file. The Refresh Data button is only available for stations imported from the GreenLeaf Project. Clicking it will replace all saved data for that station with the latest data from GreenLeaf.

A third button, not shown, is also present under certain circumstances: Calculate Missing From Daily. This appears when daily data has been uploaded, but monthly and/or weekly data for that data type is not present. Clicking Calculate Missing From Daily will create monthly and/or weekly data based on the daily data but will not replace data that was already present.

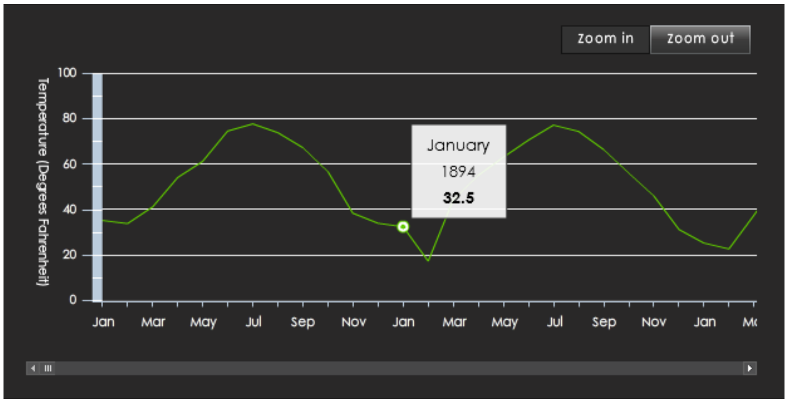
Temperature and Precipitation

The high temperature*, average temperature**, and precipitation pages display data in a grid and line chart. Click on the Monthly, Weekly, or Daily buttons above the grid to view data for another period. Data in the grid can be edited by clicking on a cell and changing its contents. The line chart has two zoom levels to show a closer view of points in large datasets.

* High temperature values are based on daily highs. Weekly or monthly high temperature refers to the average of all daily high temperatures for a given period, not the highest temperature value of that period.

** Average temperature values are the mean values between daily highs and lows (ex., if the high for a given day were 100 and the low were 50, the average would be 75). Weekly or monthly average temperature refers to the average of all mean daily values for a given period.

Precipitation data for Las Animas station.



View details about a point by mousing over it.

Palmer Drought Severity Index

The PDSI was developed as a standard way to quantify the severity of drought conditions. W. C. Palmer published his method in the 1965 paper “Meteorological Drought” for the Office of Climatology of the U.S. Weather Bureau. Since then, the PDSI has become one of the most widely used drought assessment tools. The federal government and many state governments rely on the PDSI to trigger drought relief programs.

The PDSI actually uses a supply and demand model for the amount of moisture in the soil. The value of the PDSI is reflective of the how the soil moisture compares with normal conditions. A given PDSI value is a combination of the current conditions and the previous PDSI value, so the PDSI reflects the progression of trends. A single PDSI value is not representative of just the current conditions, but also of recent conditions.

Palmer defined the scale at the left for the PDSI. The categories run from mild to moderate to severe to extreme. The normal range of PDSI values is from -0.50 to +0.50. Any PDSI values above +4.00 or below -4.00 fall into the extreme category of wet spell or drought.

Palmer decided that the severity of a droughts effects is proportional to the relative change in climate. For example, if a climate that usually has very slight deviations from the normal experiences a moderate dry period, the effects would be quite dramatic. On the other hand, a very dry period would be needed in a climate that is used to large variations to produce equally dramatic effects. So the effects of a drought can be approximated by simply quantifying the unusualness of the climate conditions.

Running the PDSI requires data for temperature, precipitation, and average temperature. Thirty years of temperature and precipitation is needed to calculate valid results. Drought Tools will calculate both weekly and monthly values if the necessary data is present.

Palmer wanted a single methodology that could be used in any climate that was accurately representative of how the drought conditions affect that local climate. In other words, a PDSI of -4.0 in Western Texas should be similar to a PDSI of -4.0 in coastal Washington, even though coastal Washington will, even in its driest years, receive several times more rain than Western Texas. The procedure he developed involves calculating the moisture deficit or surplus and then weighting that value according to several factors of the historical behavior of the local climate. Successfully weighting the value should mean that it is representative of the severity of the conditions for the local climate.

Standardized Precipitation Index

The SPI quantifies deficit or excess moisture conditions at a location for a specific time interval. The value computed represents the number of standard deviations the measured precipitation for the interval deviates from the normalized mean of all intervals of the same length in the climate record. The NADSS implementation of the SPI quantifies wet and dry spells for 1-104 week or 1- 24 month intervals.

Running the SPI requires 30 years of precipitation data to calculate valid results. Drought Tools will calculate both weekly and monthly values if the necessary data is present.

Values	Classification	Time in Category	Frequency of Event
2.00 or more	Extremely wet		
1.50 to 1.99	Very wet		
1.00 to 1.49	Moderately wet		
-0.99 to 0.99	Near normal	~33%	1 in 3 years
-1.00 to -1.49	Moderately dry	~10%	1 in 10 years
-1.50 to -1.99	Severely dry	~4.5%	1 in 20 years
-2.00 or less	Extremely dry	~2.5%	1 in 50 years

Newhall Simulation Model

The NSM was designed to run on monthly normals for precipitation and temperature. The process involves running time-sequence monthly climate data against daily moisture status data, and then summarizing the results according to the rules of soil moisture and temperature regimes, thus classifying the site.

Running the NSM requires monthly data for precipitation and temperature. Data is displayed in a grid, and detailed information for each year's data can be viewed by clicking on a row in the grid.

Keetch Byram Drought Index

The KBDI was developed as a way to quantify the severity of drought conditions and the risk of wildfire. John J. Keetch and George M. Byram published this method in the 1968 paper “A Drought Index for Forest Fire Control” for the journal of the United States Department of Agriculture. Since then, the KBDI has been used by a number of organizations, including the United States Fire Service, for assessing the possible danger of wildfires in drought conditions.

Running the KBDI requires 30 years of daily precipitation and high temperature data. The index value of the KBDI is reflective of the how the soil moisture compares with saturated, normal, conditions. A given KBDI value is a combination of the current conditions and the previous KBDI value, so the KBDI also reflects the progression of trends, whether it is a drought or a wet spell. A single KBDI value is not representative of just the current conditions, but also of recent conditions.

Keetch and Byram defined the scale at the left for the KBDI. The categories run from low to moderate to high to extreme. The KBDI ranges from 0 to 800. The value is an estimation of the soil moisture deficiency, measured in hundredths of an inch, 0 being no drought conditions in the soil, 800 being completely devoid of water. This scale is based on a rationalization made by Keetch and Byram that a soil layer with an eight inch depth was reasonable for most areas needing to assess their wildfire risk.

The motive behind the development of the KBDI was to create a standard tool for quantifying the risk of wildfire. Keetch and Byram concluded that this risk was proportional to the relative soil moisture content. For example, if a climate that usually has very slight deviations from the normal experiences a moderate dry period, the effects would be quite dramatic. On the other hand, a very dry period, with high temperatures, would be needed in a climate that is used to large variations to produce equally dramatic effects. The calculation of today's KBDI is also dependent on the previous day's KBDI, making the KBDI reflect trends in the climate. The risk of wildfire can be approximated by simply quantifying the unusualness of the climate conditions. The KBDI is designed to work in almost all climates across the United States, reflecting drought conditions across those areas.