From Weather to Climate using Daymet

Explore the concepts of weather and climate using local weather data (North American only).

Weather to Climate: What's the Difference?

Weather is the mix of events (precipitation, humidity, temperature, etc.) that happen over a short period of time (minutes to months) in a specific location. **Climate** is the long-term pattern of weather in a particular area (often defined as the average weather over a 30 year period, which is called a **climate normal**).

Exploring Weather and Climate: Indentify a Research Question

The first step to beginning the research process is to identify a research question, which will help you to focus your study. Some suggestions are provided below. Keep a science journal throughout your investigation to record your question, data, results, and observations.

Daymet data is perfect for exploring both weather and climate because it is a long-term weather record.

Use the data to explore **weather** by investigating patterns within and over months, seasons, or years.

    For example:

- What is the variability in weather over the course of a month?
- What are the temperature maximums and minimums in June? October? February?
- What was the difference in precipitation between January of 2012 and January of 2013?

Use this data to explore the **climate** in your area by investigating the long-term weather patterns and calculating climate normals.

    For example:

- Is temperature increasing, decreasing, or staying the same over the entire time period?
- Is there difference in the climate normal at the beginning of the time period (average of the first 30 years of data) and the end of the time period (average of the last 30 years of data)?

Finding and Downloading Weather Data

Navigate to the Daymet Single Pixel Extraction page (http://daymet.ornl.gov/singlepixel.html)
Daymet uses computer software to extrapolate data from many daily meteorological observations to produce estimates of weather data over large regions.

Select Your Location and Data Variables

1. Enter the latitude and longitude of your location in the boxes below the map. If you do not know your latitude or longitude, use the Carbon Map tool or Google Maps to find them.

2. Choose the climate variable you wish to study. You can choose more than one by holding down the Ctrl (PC) or command (Mac) key as you click on the variable.
    a. TMAX = maximum daily temperature (°C)
    b. TMIN = minimum daily temperature (°C)
    c. DAYL = daylight period (sun/day)
    d. PRCP = daily total precipitation (mm/day)
    e. SRAD = shortwave solar radiation (W/m^2)
    f. SWE = snow water equivalent- amount of water contained in the snowpack (kg/m^2)
    g. VP = water vapor pressure (Pa)
3. Choose the years for which you would like data. We suggest choosing ALL.
4. Click 'Get Data.'

Download the Data

1. The data will now appear on a new page (*this may take a few minutes*).
2. Click on the 'Download Data' link.
3. The data will automatically download as a csv file [a file format readable by Excel] with a filename that is a series of 5 numbers, and then the date.

Prepare the Data

****A few steps to complete before you can analyze your data.*

1. Open the csv file in Excel.
2. Go to File → Save As, and save your data with a descriptive name, and as an Excel file (with the extensions .xls or .xlsx). This will allow you to create multiple worksheets within your file.
3. The first 7 rows are information about the location. Copy these rows and paste them into a new worksheet (click on the + tab at the bottom of the spreadsheet). Return to your original sheet and delete the now-blank rows so that the headers (year, yday, etc.) are in Row 1.
4. To convert the first two columns (date, yday–*day of year*) into the full date:
    a. Right-click on the year column, and insert a new column by choosing 'Insert.'
    b. In the new column, add the header 'Date.'
    c. In row 2, enter the formula: =DATE(B2, 1, C2) and hit Enter.
    d. Copy the formula down by selecting the corner of the cell, positioning the mouse over the lower right corner of the cell until the + cursor appears, then either double clicking or dragging down the column to the last row of data.
    e. Highlight and copy the entire DATE column, click on the top cell of the column (A1), and go to File → Paste Special. Choose Values and click Okay. This will make the column just values, and not an equation, so that you can manipulate it later.

Your data are now ready to use!

How to Start Analyzing your Data in Excel

**These are suggestions for steps you could take to begin your data analysis, only use the suggestions that you find useful to your study. Making simple graphs and exploring the averages, minimums and maximums of your dataset are good places to begin your investigation and a good way to become familiar with the data.

1. Keep the header row (row #1) visible as you scroll through the data:

1. Highlight Row 2.
2. From the menu, choose Window → Freeze Panes. Anything visible in the window above and to the left of that cell will remain visible as you scroll down the worksheet.

2. Making Averages, calculating climate normal's (average of 30 years of data):

1. In an empty cell, either below or to the right of your data, type '=**AVERAGE(**', highlight the column of data over the period you are interested in, then type ')'.
2. Hit return and the average value will appear in the cell.
3. For example, to calculate the temperature normal from 1980 to 2010, type:

   = AVERAGE(C2:C10950)

   Where C2 is the Max Temperature (tmax) for Jan 1, 1980, and C10950 is the Max Temperature (tmax) for Dec 31, 2009. (*Note: your dataset rows and columns may be different than this example*).

3. Finding Minimum and Maximum values:

1. Use the same instructions as in #2, but using the formulas:

   =MAX() or =MIN()

2. Highlight the data range you are interested in. Hit return and the cell will display the minimum or maximum value of that data.

4. Graphing one month of weather data:

1. Highlight one month of dates.
2. Hold down the command (Mac) or Ctrl (PC) button and highlight the values for the climate variable that correspond with those dates.
3. Click the 'Charts' tab, and click the 'X Y (Scatter)' option.
4. Choose a chart that connects the points with lines.
5. The chart will now appear on the spreadsheet. Use the Formatting Palette to add titles, change the colors, etc.
6. Follow the same steps to graph data for different months, or a longer time period. ***Note: Graphing the whole daily dataset will slow down the computer; shorter time periods are advisable.*

Student Climate Data. University of New Hampshire. 2014

5. Calculate yearly averages and graph a variable over time:
Note: This example uses tmax, but the instructions will work for any climate variable

1. Create a new sheet (Click on the + tab at the bottom) and label it "YearlyAverage."
2. Highlight and copy the Date and tmax column into Column A in the new sheet.
3. Label column C 'AveTmax.'
4. In C2, enter the formula, '=**AVERAGE(B2:B366)**' and hit Enter.
5. Copy the formula down by selecting the corner of the cell, positioning the mouse over the lower right corner of the cell until the + cursor appears, then either double clicking or dragging down the column to the last row of data.

1. Highlight and copy the AveTmax column, click on D1, go to Edit → Paste Special, choose 'Values' and click Okay. Delete column C.
2. Highlight **ALL** Columns of data, and go to Data Sort. Choose to sort by yday and then by year. Click 'Okay.'
3. To graph the yearly average temperature, highlight the year column and the AveTemp column *for the rows where yday equal 1*, and use the charts tab to create an XY Scatter plot.