Growing Degree Day Tool: Details Behind the Data

Gridded Minimum and Maximum Temperature

The gridded minimum and maximum temperature data for the U2U 12-state area are downloaded from the ACIS site at: http://builder.rcc-acis.org/. The GridData tab is used. The Grid id is NRCC Interpolated (1). The elements downloaded are mint and maxt.

An example of a curl command that is used to download the data for the U2U area is:

curl -o output.txt --data 'params={"bbox":"-104.38,34.75,-80.37,49.76","sdate":"20100501","edate":"20100501","grid":"1","elems":"maxt,mint","meta":"ll,elev","output":"json"}' http://data.rcc-acis.org/GridData.

This commands defines the area used, the date range, the elements to be downloaded and the metadata to be downloaded with the data. Note that the metadata was just download one time to get the latitude and longitude for the data. The lat-long will not change for the rest of the data.

The data values for minimum and maximum temperature are integer values.

The method used for creating the gridded data on the ACIS site from the point station data is called "Natural Neighbor". References for this provided by Bill Noon of the Northeast Regional Climate Center, Cornell University are: http://en.wikipedia.org/wiki/Natural_neighbor and http://interpolate3d.googlecode.com/files/Report.pdf. The gridded data are in a geographic (lat-long) projection with a vertical and horizontal sampling interval of 0.0416666667 degrees. This translates to a pixel size of around 4600 meters or 3 miles. An image for the defined U2U area contains 362 lines and 579 columns.

Gridded Growing Degree Day Data

The gridded minimum and maximum data are then used to create the growing degree data files using the 86/50 method. The GDDs for a given day are computed as:

[MIN(MAX(minTemp,50), 86) + MIN(MAX(maxTemp,50), 86)]/2 – 50

for each day of the year. The accumulated GDD file with one layer for each day of the year is computed as:

Day 1 = sum of GDDs for day 1.
Day 2 = sum of GDDs for day 1 and 2,
Day 3 = sum of GDDs for day 1, 2 and 3, etc.

The computation for GDDs for the day and summation for accumulated GDD is done as a float. The final number stored in the accumulated GDD file for each day of the year is converted to a 16-bit integer value.

Accumulated GDD GeoTIFF files were created for each year from 1981 to 2012. Each file contains 365 or 366 layers with each layer representing a day of the year.

GeoTIFF files were also created for the average, median, minimum and maximum accumulated GDDs for the 30-year period from 1981-2010.

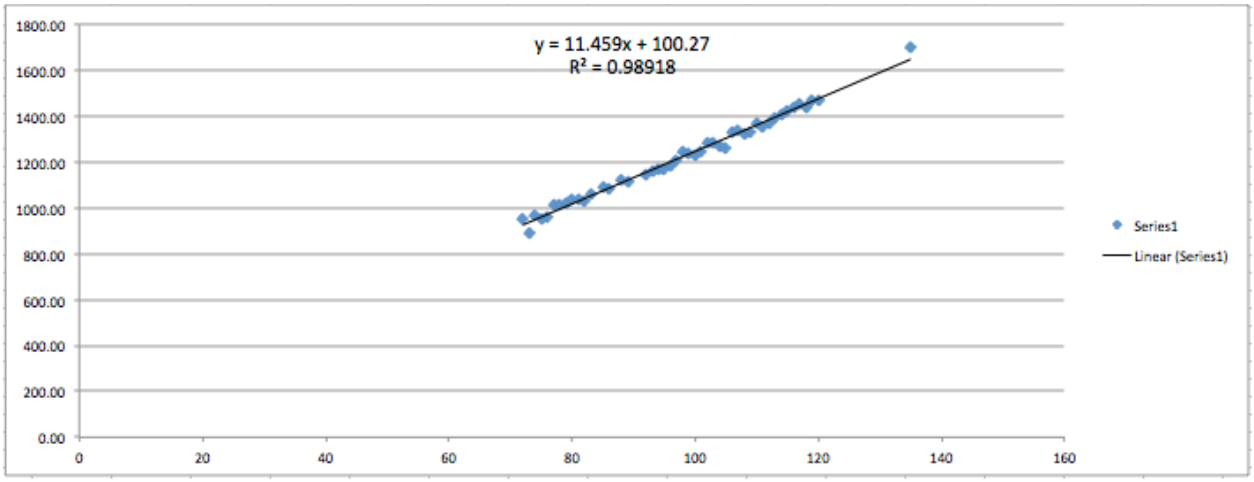
Note that the data for day 366 for leap years is just left off. The days are compared starting with day 1 of the year and going forward.

Current Year Growing Degree Day Data

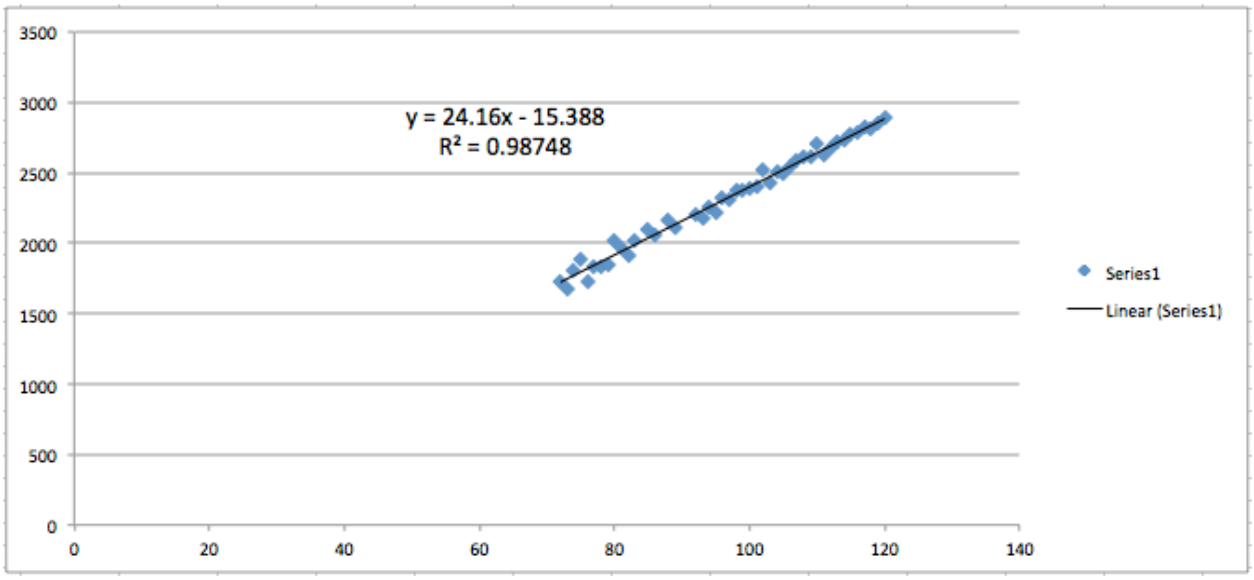
A script is used to download year-to-date growing degree data; the script is run just after midnight each day to keep the current year GDDs up to date. All of the data for the year is download each time the script is run. This will make allowances for any updates in prior data in the year to be taken into account. This process takes 1-2 hours to run.

Calculation of Silking and Black Layer Dates

Ray Massey of Missouri provide an analysis and algorithms to use to determine the Silking and Black Layer dates based on accumulated GDDs since planting and the maturity days for the corn hybrid. The analysis was based on data he had on around 550 Pioneer hybrids. His analysis as is illustrated in the figure below relates accumulated GDDs from planting to silking against maturity days.



The figure below illustrates the relationship of accumulated GDDs from planting to black layer against maturity days.



The equations in the figures are being used to define the location of the lines for silking and black layer on the GDD graph.

Projected Current Year GDDs

The projected GDDs used for the current year are based on the 30-year average. The assumption is made that the GDDs will continue to accumulate from the last date of known accumulated GDDs for the year as has occurred in the 30-year average. The variation around the projected GDDs is based on the 30-year variation in accumulated GDDs from the start of the projected period.

The overall process for the Development of the Growing Degree Day tool is:

- Download the minimum and maximum temperature from the ACIS web site for the U2U area for the years 1981 through 2012.

- Generate the accumulated growing degree days for the year from the minimum and maximum temperature data using the 86/50 method.

- Create a geotiff file for each year with 365 layers in the file with each layer representing a different day of the year. (Note that the 366th day for leap years is ignored; there is usually very few GDDs for the last day of the year for the area.) Do this for the growing degree day data and the minimum temperature data.

- Create 30-year (1981-2010) average and median geotiff files for the growing degree day data.

- Create last and first temperature threshold day-of-year geotiff files for each year and threshold temp from 25 through 35 degrees from the minimum temperature data. Create 30-year average first and last temperature threshold day-of year geotiff file for each threshold temp from 25 through 35 degrees.

- Create (and run) script to automatically create the current year data file as the year progresses.

- Three geotiff files in band interleaved by pixel (BIP) format are used for input to the tool:
    - 30-year average, 30-year median, yearly from 1981 – 2012.
    - Day of year file with average, and yearly last and first temp thresholds for 25-35 degrees.
    - 2013 GDD file which is updated periodically.

- The growing degree day tool has a map page to allow the user to select the location for the graph and a graph page which displays the GDD data for that location.

- The verification process for the data were to obtain a plot of the min and max minimum temperature for the entire site for each day of the year. These plots illustrated a few times when the min or max minimum temperature spiked significantly during the summer for some days compared to other days around the spike. The images of the minimum temperature data were reviewed for these days. Most times a very dark area (or a very bright) area would appear in the image indicating some bad input temperature for the gridding process. This procedure was also followed for the maximum temperature. Bill Noon was notified about these potential problems. Currently only a few problems exist in single areas for 1 or 2 days in 1983, 1993, 1996, 1998, 2010 and 2012.