Alberta Climate Information Service (ACIS): Meteorological Normals Definitions

Additional information

A more complete overview of ACIS please refer to: http://agriculture.alberta.ca/acis/docs/Station-viewer-y2019_m03_d27

This document will explain:

1. Alberta Agriculture and Forestry's Disclaimer
2. How hourly, daily and monthly observations are handled and aggregated.
3. Meteorological elements
4. The data flagging scheme
5. How long term normals are derived
6. How various meteorological derivatives are computed (eg Dew Point Temperature)

For an overview of the methodology and data sources used for generating the interpolation data set used for the calculation of long term normal please refer to: http://agriculture.alberta.ca/acis/docs/Methodology-and-data-sources-for-interpolated-data-y2019_m03_d27.pdf

Long Term Normals (1961-2018)

Most of the stations that are available through ACIS do not have a long enough period of record to develop long term normal's, and of those that do, many have numerous missing observations within their period of record. This makes it difficult to compare normals and averages between stations at different locations. Thus, the long term normal's available here (1961-2018), are **estimates of the long term normal's** for each station, based on a gridded weather data product called the Alberta Climate Database http://agriculture.alberta.ca/acis/township-data-viewer.jsp. This database was created by interpolating the historical daily weather data for stations in Alberta as well as from neighboring provinces, to a grid that uses township centers as grid points. Note, since the township grid does not exist in the Mountain Parks, these stations do not have estimated normals. The interpolation scheme used a combination of the hybrid method of inverse-distance weighting and nearest station assignments (Shen et al, 2001). Basing the interpolation on township centers yields a manageable database with enough detail and without undue redundancy.

Daily weather data for each day from January 1, 1901 to December 31, 2018, was interpolated to the center point of each of the 6900 townships in Alberta. The interpolation for any given day was based only on those stations that reported weather values for that day. For each township center on each day, the closest eight stations within a 60 km radius for precipitation and 200 km radius for other elements, were used to inverse distance weight the value for the township. If no stations had data for a particular element within the 60 or 200 km radius, then the nearest station was used regardless of its distance from the township center. For the purposes of calculating the long term normal's given here, the period from 1961 to 2015 was chosen since, prior to 1961, station density was not sufficient to make meaningful regional and local weather related time series. Air temperature, wind speed, wind direction, solar radiation and humidity were inverse distance weighted using a linear weighting scheme. Precipitation was inverse distance weighted using the cube of the inverse distance, with the inverse distance monthly totals redistributed proportionally, relative to the nearest station with a complete monthly record. This resulted in more weighting to the nearest station and for precipitation, the redistribution of the monthly totals, imposed a more natural precipitation pattern.

Note that for all the interpolated elements, it is extremely important to realize that the interpolation scheme tends to "smooth" the data and as such, only approximates the extreme occurrences at each station. In addition, since the interpolation looks out to 60 km for precipitation and 200 km for other elements, there tends to be more estimation error where local variability for a particular element is high. This is particularly true for areas near the mountains or foot hills and/or where local elevation changes rapidly or large bodies of water are present.

Precipitation Ave. (mm)

- Daily Option: This is the average daily precipitation accumulated for the period ranging from 1961 to 2018.
- Monthly Option: This is the average monthly precipitation based on the period ranging from 1961 to 2018.

Air Temp. Ave (°C)

- Daily Option: The average daily air temperatures for the period ranging from 1961 to 2018.
- Monthly Option: The monthly average daily air temperature for the period ranging from 1961 to 2018.

Air Temp Ave. Max. (°C)

- Daily Option: The average maximum daily air temperature for the period 1961 to 2018
- Monthly Option: The monthly average maximum daily air temperature for the period ranging from 1961 to 2018.

Air Temp. Highest Max (°C)

- Daily Option: The estimated maximum daily air temperature for the period 1961 to 2018. Note that these are not record maximum station temperatures as these values were estimated using data from 1 or more nearby stations.
- Monthly Option: The estimated maximum daily air temperature that occurred during the month for the period 1961 to 2018. Note that these are not record maximum station temperatures as these values were estimated using data from one or more nearby stations.

Air Temp Ave. Min (°C).

- Daily Option: The average minimum daily air temperature for the period 1961 to 2018
- Monthly Option: The average monthly minimum daily air temperature for the period ranging from 1961 to 2018

Air Temp. Lowest Min. (°C)

- Daily Option: The estimated minimum daily air temperature for the period 1961 to 2014. Note that these are not record minimum station temperatures as these values were estimated using data from 1 or more nearby stations.
- Daily Option: The estimated minimum daily air temperature that occurred during the month for the period 1961 to 2018. Note that these are not record minimum station temperatures as these values were estimated using data from one or more nearby stations.

Growing Degree Days

Daily Option: Average daily accumulated growing degree days from the period 1961 to 2018
Monthly Option: Average monthly accumulated growing degree days from the period 1961 to 2018.

Growing degree days are a heat index that relates the development of plants, insects, and disease organisms to ambient air temperature. ACIS will compute them anytime between April 15 and Oct 15. Before April 15 and After Oct 15 they are assumed to be 0. Users can set the start date for the calculation by selecting a start date and end the calculation by selecting an end date. If the weather station experiences frost, the average growing degree days will still continue to accumulate, but will be 0 on the frost date. This gives the user full control to over local frost conditions and does not force and end to the computation. In the event that a frost date is unknown, simply plot the minimum temperature along with the growing degree days and then manually determine the frost date and then readjust the end date accordingly. Growing Degree Days are provided for a variety of base temperatures, and they are computed on a daily basis using the following equations:

$$\text{Growing Degree days (0)} = \left(\frac{\text{Tmax} + \text{Tmin}}{2}\right) - 0,\ \mathit{If}\ \ \mathit{negative} = 0$$

$$\text{Growing Degree days (2)} = \left(\frac{\text{Tmax} + \text{Tmin}}{2}\right) - 2,\ \mathit{If}\ \ \mathit{negative} = 0$$

$$\text{Growing Degree days (5)} = \left(\frac{\text{Tmax} + \text{Tmin}}{2}\right) - 5,\ \mathit{If}\ \ \mathit{negative} = 0$$

Where:

Tmax = Maximum daily temperature (°C)
Tmin = Minimum daily temperature (°C)

Corn Heat Units

Daily Option: Average daily accumulated corn heat units from the period 1961 to 2018
Monthly Option: Average monthly accumulated corn heat units from the period 1961 to 2018.

Corn heat units are similar to growing degree days and are temperature-based units that are related to the rate of development of corn. ACIS will compute them anytime between April 15 and Oct 15. Before April 15 and After Oct 15 they are assumed to be 0. Users can set the start date for the calculation by selecting a start date and end the calculation by selecting an end date. If the weather station experiences frost, the average corn heat units will still continue to accumulate, but will be 0 on the frost date. This gives the user full control to over local frost conditions and does not force and end to the computation. In the event that a frost date is unknown, simply plot the minimum temperature along with the corn heat units and then manually determine the frost date and then readjust the end date accordingly. Note that for the each year during the period of record (1961-2014) corn heat units **started** accumulating after April 15 of each year, only after three consecutive days where average daily air temperatures are >= 12.8 (°C) and they were zero prior to this day. They are computed on a daily basing using the following equations:

$$\text{Corn Heat Units} = \frac{CHUX + CHUY}{2}$$

Where:

$$\text{CHUX} = 1.8 \times (\text{Tmin - 4.4}),\ \mathit{If}\ \ \mathit{negative} = 0$$

$$\text{CHUX} = 3.33 \times (\text{Tmax - 10}) - 0.084 \times (\text{Tmax - 10})^2,\ \mathit{If}\ \ \mathit{negative} = 0$$

Tmax = Maximum Daily temperature (°C)
Tmin = Minimum daily temperature (°C)

after the selected start date, corn heat units will **begin** accumulating only after three consecutive days where average daily air temperatures are >= 12.8 2 (°C) and they are zero prior to this day.

Frost Probabilities

Daily option: The estimated probability of getting a frost **after** a given date in the spring or **before** given date in the fall.

The frost probabilities presented here are based upon interpolated station data from the 1961 to 2018 period, representing 48 years of observations. It is important to realize that they are generalizations based on interpolated station data. Local variations will exist and be largely dependent on landscape characteristics that affect air drainage and day time heating. Therefore, the frost probabilities presented here should only be used as a general guide.

Frost probabilities can be generated for various frost thresholds ranging from 0 °C to – 5 ° C. For example, in the spring, after what date is there a 50% chance of receiving frost? Using Figure 1, we can see that for Busby AGCM this date is May 15Th. Similarly, in the fall, on what date is there a 25% chance that frost will have occurred? Using Figure 1, we can see that for Busby AGCM that date is September 9th.

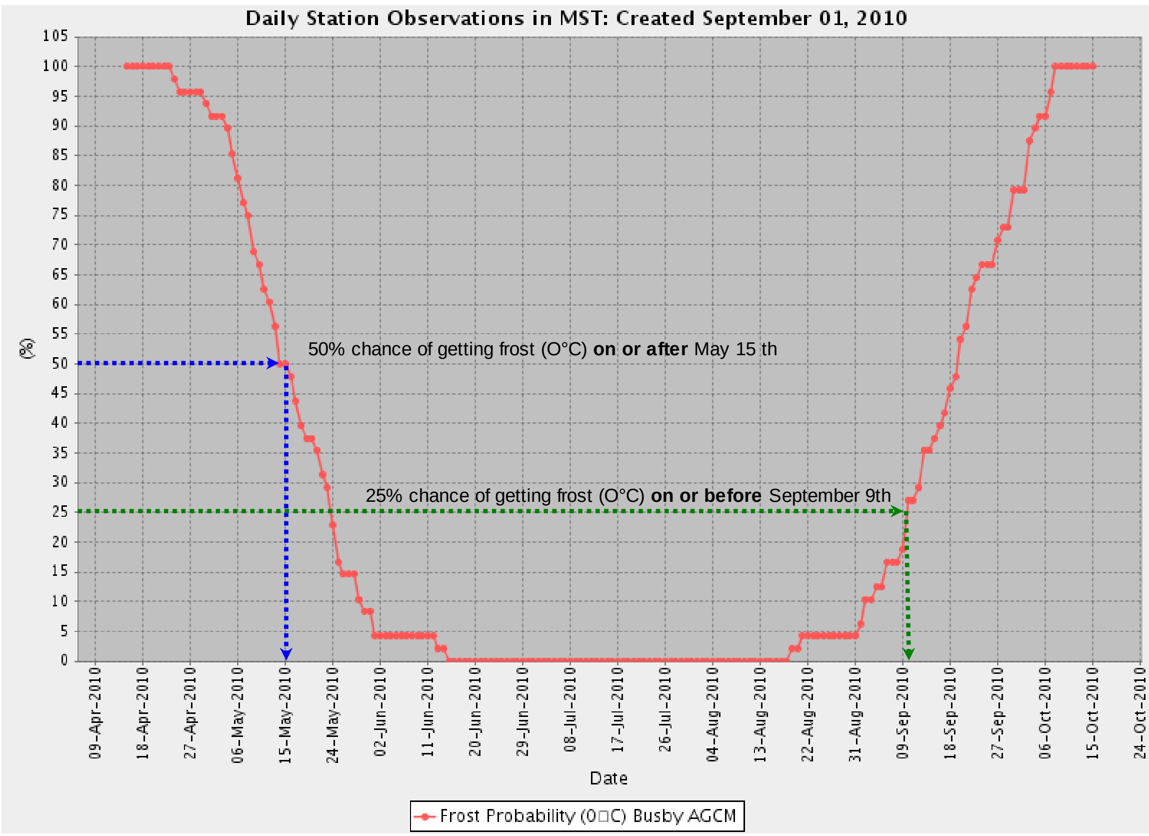

Figure 1. Probability of getting spring or fall frosts, for Busby AGCM, using 0 °C as the definition for frost