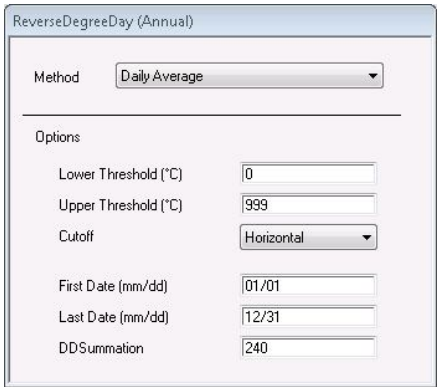
Documentation of Reverse Degree-Day Model

A part of this documentation about degree-day (DD) was took from:
http://www.ipm.ucdavis.edu/WEATHER/ddmoreinfo.html

1. Introduction

Degree-day is a unit combining time and temperature, used to measure the development of an organism from one point to another in its life cycle.

2. Input parameters:



1- Method

- **Average**: The average method is the most common used degree-day method because of is simplicity. The Average method uses a daily minimum and maximum temperatures and subtracted lower threshold.

DD = Max(0, (Tmin+Tmax)/2 - Lower Threshold);

- **Average (Limited to thresholds)**: This method calculates degree-days using the daily minimum and maximum temperatures. Maximum temperatures above the upper threshold are set as being equal to the upper threshold and minimum temperatures below the lower threshold are set as being equal to the lower threshold.

Tn = Max(Tmin, Lower Threshold);
Tx = Min(Tmax, Upper Threshold);
DD = Max(0, (Tn+Tx)/2 - Lower Threshold);

- **Single Triangle**: One method of simulating a temperature curve for a 24-hour period. One triangle is fitted to the minimum and maximum temperatures for a day, in the assumption that temperatures are symmetrical around the maximum temperature. Degree-day calculations are based on the area under the curve and between the thresholds.

- **Double Triangle**: One method of simulating a temperature curve for a 24-hour period. Two triangles are fit to the minimum and maximum temperatures for a day and the minimum temperature for the next day. Degree-day calculations are based on the area under the curve and between the threshold(s).

- **Single Sine**: One method of simulating a temperature curve for a 24-hour period. A sine curve is fitted to the minimum and maximum temperatures for a day, in the assumption that temperatures are symmetrical around the maximum temperature. Degree-day calculations are based on the area under the curve and between the threshold(s).

- **Double Sine**: One method of simulating a temperature curve for a 24-hour period. Two sine curves are fit to the minimum and maximum temperatures for a day and the minimum temperature for the next day. Degree-day calculations are based on the area under the curve and between the threshold(s).

- **Modified Allen Sine Wave (1976)**: The original equation from: Allen, J. C. 1976. A modified sine wave method for calculating degree days. Environ. Entomol. 5:388-396.

- **From hourly temperature**: Compute degree-day from BioSIM internal hourly temperature. Only this method is available for hourly model.

2- Lower threshold

The temperature below which development stops.

3- Upper threshold

The temperature above which the rate of growth or development begins to decrease or stop as determined by the cutoff method.

4- Cutoff

- **Horizontal**: A modification, in relation to the upper threshold, to the degree-day calculation method. A horizontal cutoff assumes that development continues at a constant rate at temperatures above the upper threshold.

- **Intermediate**: A modification, in relation to the upper threshold, to the degree-day calculation method. An intermediate cutoff assumes that development slows as temperatures increase above the upper threshold.

- **Vertical**: A modification, in relation to the upper threshold, to the degree-day calculation method. A vertical cutoff assumes that development does not occur at temperatures above the upper threshold.

5- First Date

Date (mm/dd) to begin compute DD. Before first date, output will be missing.

6- Last Date

Date (mm/dd) to end compute DD. After last date, output will be missing.

7- DDSummation

Cumulative degree-day summation to reach.

3. Output

1- Annual

- Julian day when cumulative degree-day is reach.

2- Overall Years

- Mean of Julian day when cumulative degree-day is reach.
- Standard deviation of Julian day.
- Number of years.

4. Reference

Allen, J. C. 1976. A Modified Sine Wave Method for Calculating Degree-Days. Environmental Entomology. 5(3):388-396.

Sine and double sine calculation was inspirited from FORTRAN source here: http://www.ipm.ucdavis.edu/WEATHER/ddroutines.html