BEEHAVE Weather Tool Manual

1. Introduction

2. Loading Data
    a. Preset Weather Data
        i. Full Year
        ii. Monthly Average Data
    b. Input File
    c. Monthly Averages
    d. Freehand Draw

3. Selecting days
    a. Day, Week, Month, Season, Year
    b. Freehand Selection
    c. Range of Days

4. Altering Selection
    a. Adding Hours
    b. Adding Non-foraging Days
    c. Setting Selection to Value
    d. Setting Selection to Average
    e. Adding Hours to Selection

5. Saving and Output

6. Example

7. Modifications to BEEHAVE

1. Introduction

This tool is for creating customised weather files for use in the BEEHAVE model. In BEEHAVE weather effects are implemented simply as the number of hours in the day that are available for the bees to forage as the number of hours of sunlight on days when the maximum temperature exceeds 15°C.

To start the model press `Start`.

(WARNING: pressing Start will also delete all previously entered data.)

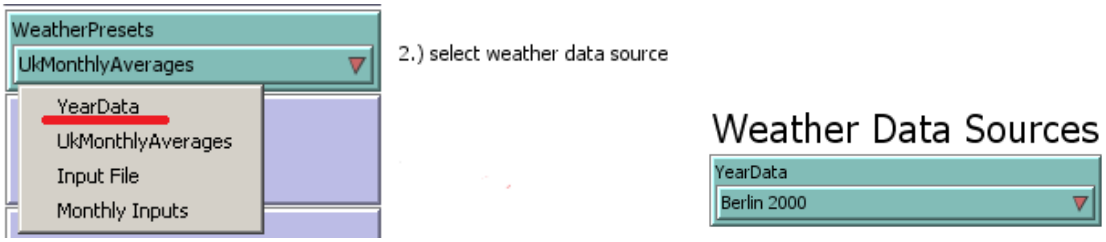
2. Loading Data

a) Preset weather data

The weather tool has multiple presets from which to choose to begin creating the weather file. These can be based on real gathered weather data or from user designated values.

i) Full Year

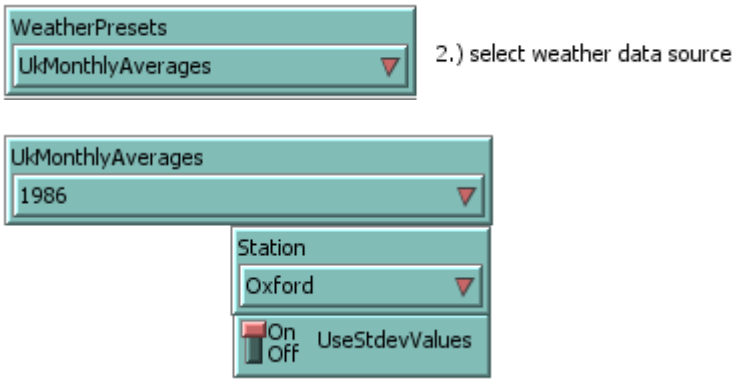
The weather tool contains all the weather data from within the BEEHAVE model as full year weather data. These are data from around Rothamsted Research in Hertfordshire, UK and Berlin, Germany.



This data is added into the tool by setting `WeatherPresets` to "YearData" and YearData to the desired dataset and then pressing `Load Weather`

ii) Monthly Average Data

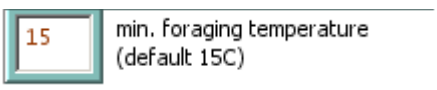
Monthly average data is based on UK data from weather stations in Camborne, Cornwall, UK and Oxford, Oxfordshire, UK from 1982 to 2013.



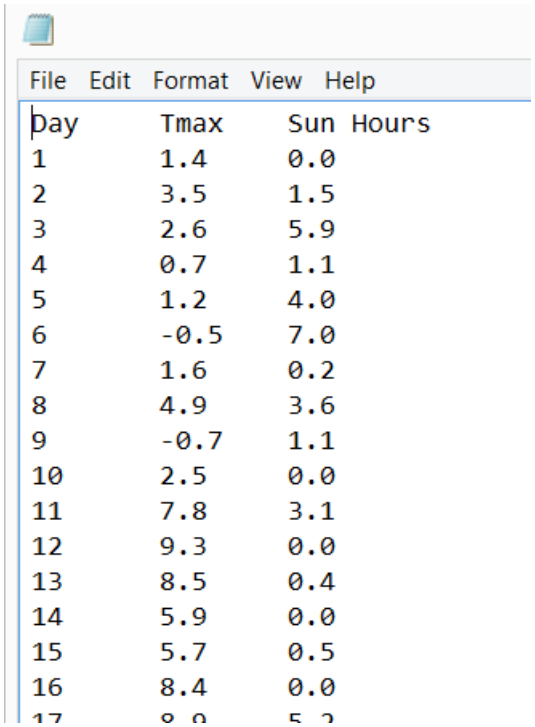
This data is added into the tool by setting `WeatherPresets` to "UKMonthlyAverages", `UKMonthlyAverages` to the desired year and Station to the desired location and then pressing `Load Weather`

There is then the option to use standard deviations for each month of the year to add in some randomness, this is based on the full-year weather data from Rothamsted in 2009, the weather data used in BEEHAVE's default scenario.

This data will be effected by altering the threshold maximum temperature required for foraging as outlined below.

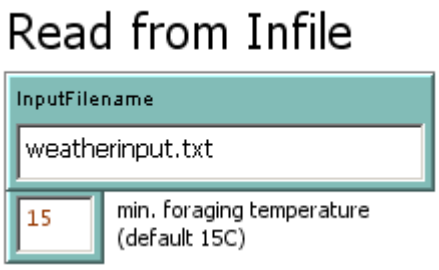


b) Input File



Data can be loaded into the tool from an input file, shown here in Windows Notepad, but could be made with Microsoft Excel or similar for easier input.

The input file consists of three columns: the day number, maximum temperature on that day and hours of sunlight on that day. These are required to have column headers as the tool removes the first row and to be tab-delimited.



To import the input file data, set `InputFilename` to the filename of the input file and then pressing `Load Weather` For greater customisation it is also possible to set the threshold maximum daily temperature for foraging.

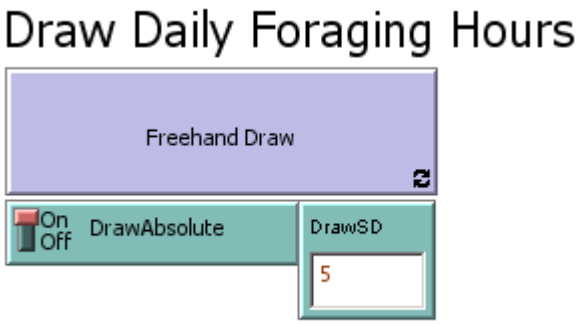
c) Monthly Averages

For simple input, there are input boxes for each month allowing you to set the mean and standard deviation for the hour to forage in each month.

To add this data set `WeatherPresets` to "Monthly Inputs" and press `Load Weather`

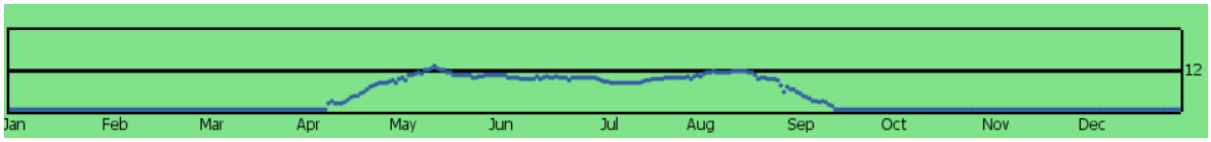
d) Freehand Draw

Finally, there is the ability to draw the desired data onto the graph for very quick data entry.

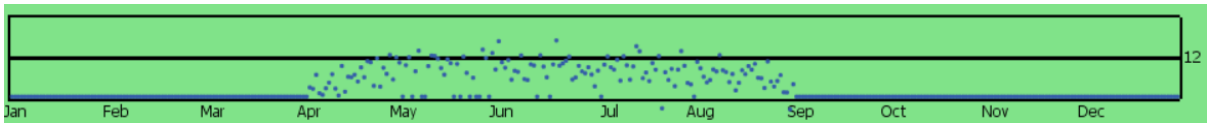


When pressed `Freehand Draw` will remain black, and you can draw the desired data onto the graph with the mouse. If `DrawAbsolute` is set to on, then the data will be entered as drawn, if it is off, then the data will vbe added randomly around the location of the mouse with standard deviation as set in `DrawSD`.

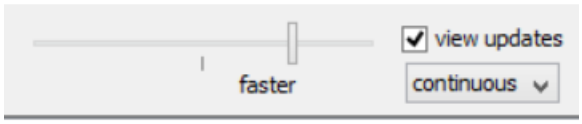
`DrawAbsolute` on



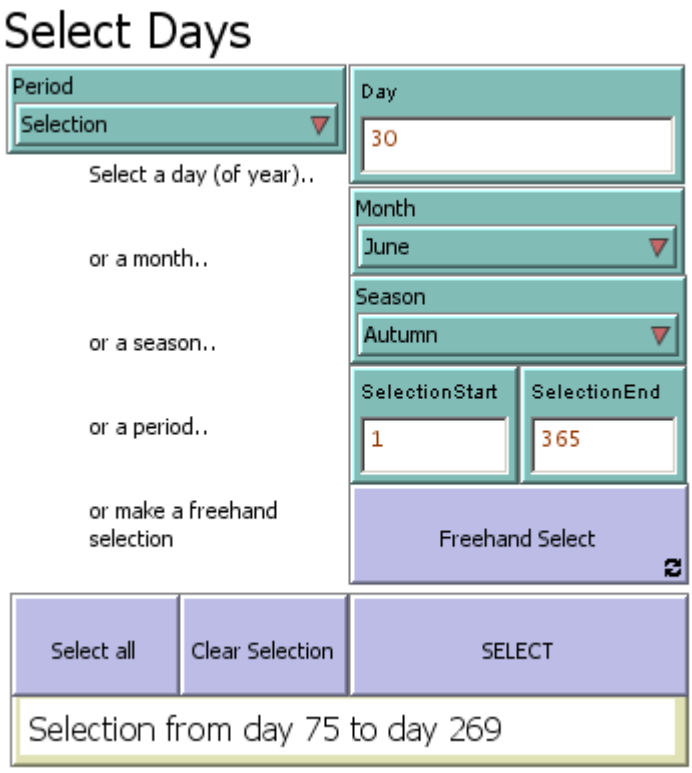
`DrawAbsolute` off `DrawSD` 3



Data will need to be drawn slowly, to ensure NetLogo detects the mouse location correctly. To help this, ensure the model speed slider is set half way between the centre and fastest setting.



3. Selecting Days



a) Day,Week, Month, Season, Year.

To select a certain day:

Set `Period` to "Day", set `Day` to the day of choice and press `SELECT`

To select a certain week:

Set `Period` to "Week", set `Day` to the start day of the desired week and press `SELECT`

To select a certain month:

Set `Period` to "Month", set `Month` to the desired Month and press `SELECT`

To select a certain season:

Set `Period` to "Season" ,set `Season` to the desired season and press `SELECT`

To select the entire year:

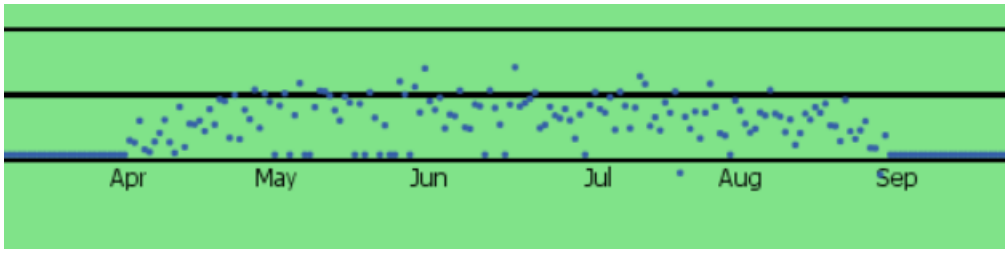
Set `Period` to "Year" and press `SELECT`

The selected days should turn red in the graph and are ready to be edited.

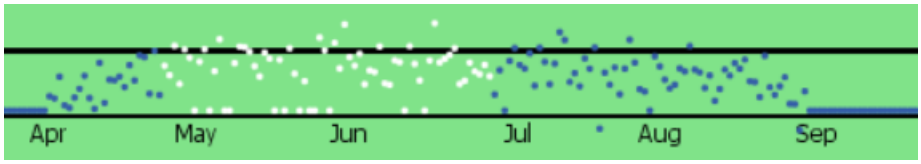
b) Freehand Selection

Press `Freehand Select`, the button should turn black and remain black.

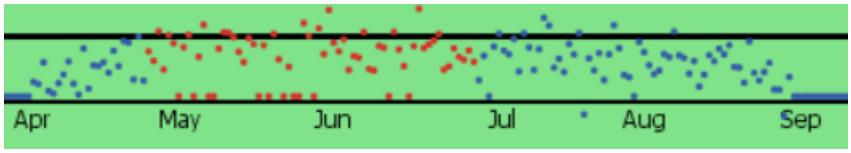
Click and drag across the selected days on the graph.



The selected days should turn white



And will turn red when the mouse button is released, indicating that they are selected



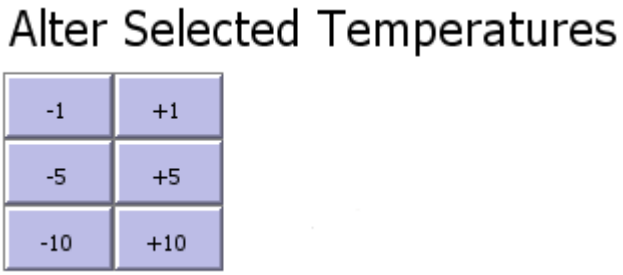
they are then ready to be edited, the selected days will be shown in the output box in the selection tools

c) Range of Days

To select a range of days by their number, enter the first day of the selection in `SelectionStart`, the last day in `SelectionEnd` and press `SELECT`. The selection will turn red on the graph to show that the days are ready to be edited.

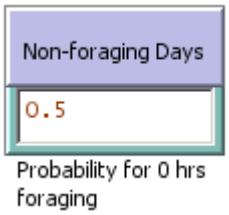
4. Altering Selection

a) Adding Hours



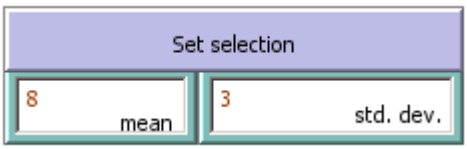
Once a selection is made, you can add or subtract foraging hours using the `+1`, `+5`, `+10`, `−1`, `−5`, `−10` buttons. If any day's value is above 24 or below 0, it is set to 24 or 0 respectively.

b) Adding non-foraging days



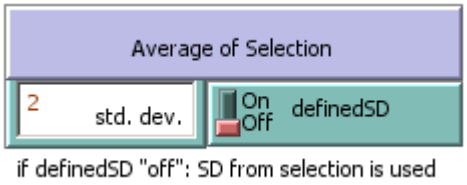
By pressing the button `Non-foraging Days` hours of foraging for selected days is set to 0 hours with the given probability.

c) Setting Selection to Value



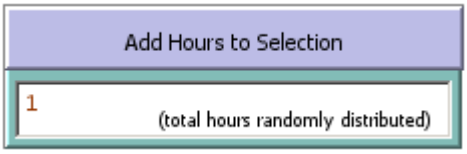
To set the selection to a certain value, or to random values around a set mean. Enter the desired mean into the box marked “mean” and the desired standard deviation into the box marked “std. dev.”, and press `Set selection` a standard deviation of 0 will set all days to the mean.

d) Setting Selection to Average



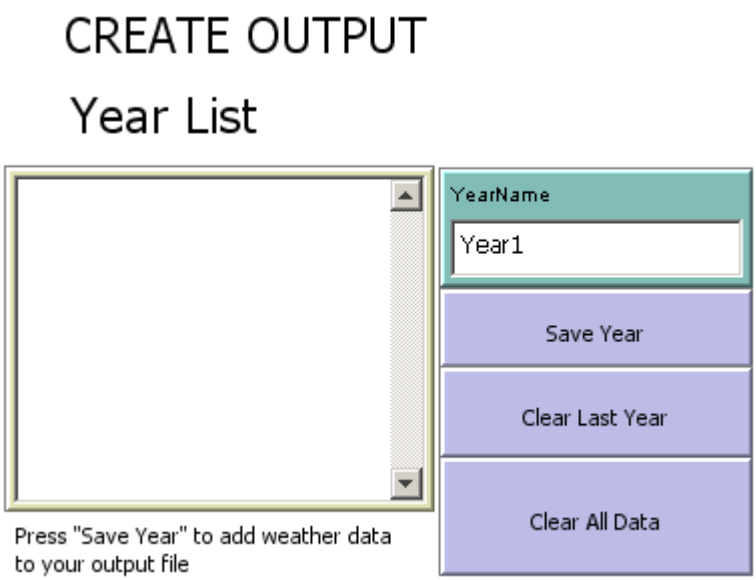
Pressing `Average of Selection` will set the values in each month to that month’s mean. If `definedSD` is set to on, the value in the box marked std.dev will be used as the standard deviation, if it is set to off, the standard deviation of the data for each month will be used.

e) Adding hours to selection



To add a certain number of hours distributed randomly within the selection, enter the number of hours to add (if negative they will be subtracted) and press `Add to Selection`

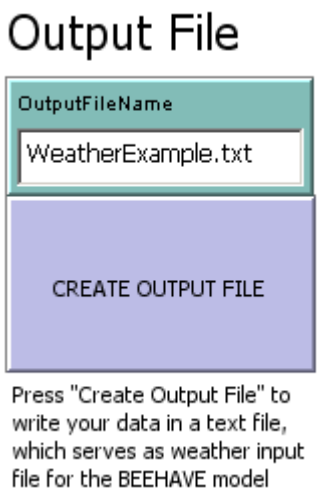
5. Saving and Output



Once the year data is to your satisfaction, enter a nickname for that data in `YearName` and press `Save Year`. You will be prompted for confirmation, if this is given, this will add that year to "Year List"

Once you have all the years you want in "Year List" enter the desired name of the output file in `OutputFileName` and press `CREATE OUTPUT FILE.` This saves the multi-year data to be used by BEEHAVE.

You can also delete the previous year if a mistake was made or all data if necessary.



6. Example

a) Loading full year data and improving a selection

- Press Start
- Set WeatherPresets to “YearData”
- Set YearData to “Rothamsted 2009”
- Press Load Weather
  - The data should appear ad blue dots in the graph

Now let’s make each day in autumn have one more hour of foraging time

- Set Period to “Season”
- Set Season to “Autumn”
- Press SELECT
  - The days in Autumn should show in red
- Press +1
  - The days highlighted should move up by one hour
- Set YearName to “Roth2009_AutumnPlusOne
- Press Save Year
- Set OutputFileName to “ModifiedRoth2009.txt”
- Press CREATE OUTPUT FILE

The output file is now created and ready for use.

7. Modifications required to original Beehave (2013)

To make the Beehave (2013) version compatible with the weather tool, some small modifications need to be made. These changes are **not required** for the new Beehave_BeeMapp (2015) version!

To the interface:

In the chooser `Weather` add the option "Weather File"

Add the input `WeatherFile` as a string input

To the Code

Add `WeatherDataList` to the globals.

In ParameterizationProc add:

```
if Weather = "Weather File"
[
      set WeatherDataList []
       file-open WeatherFile
       while [not file-at-end?]
       [
              set WeatherDataList lput read-from-string(file-
              read-line) WeatherDataList
       ]

       file-close
]
```

In Foraging_PeriodREP add:

```
if Weather = "Weather File"
[
    let year_no ceiling (ticks / 365)
    set foragingPeriod_s item (day - 1) ( item ( year_no mod
    length(WeatherDataList)) WeatherDataList) * 3600
]
```