PermaSim

User Guide
Version 1.22

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1. Introduction

PermaSim is an educational software that allows the user to view, interactively, changes to the ground thermal regime over a one-year period in communities in Nunavik. (See Fig. 1). The user can choose from among 13 towns built on permafrost (all except Kuujjuarapik), 5 soil types (rock, till, sand, clay and peat), 4 types of plant cover (tall shrubs, low shrubs, lichen, none) and levels of soil depth (1 to 5 m). The top graph shows air and soil temperatures over one year, depending on the selected preferences. The bottom table shows soil temperature changes in 2D for one year, based on depth. PermaSim also simulates snow cover and how snow affects soil temperature. The user can compare different soil types and vegetation covers for a selected town. PermaSim is based on studies conducted by students of the Cégep de Trois-Rivières and was developed by Samuel Loranger in collaboration with the Centre d'études nordiques, Université Laval, the Cégep de Trois-Rivières, the Université du Québec à Trois-Rivières, and Aboriginal Affairs and Northern Development Canada.

2. Minimum Requirements

To run PermaSim on a computer, the following minimum requirements must be met:

1. Operating system: Windows XP SP3, Vista SP1, 7, 8, 8.1
2. RAM memory: 256 Mo (Windows XP), 1 Go (Windows Vista, 7, 8, 8.1)
3. Graphics card: DirectX 9.0C with shaders 1.1 (shaders 2.0 recommended)
4. Screen: 1024x768 pixels resolution

Software:

- Microsoft Office Access 2000
- Microsoft .NET Framework 4
- Microsoft XNA Framework 4 (included with installation)

3. Installation

PermaSim installs automatically with the Install program file (setup_lng.exe).

4. Data Display

4.1. Monthly Table

The monthly table (Figure 1) is a representation of permafrost thermal regime in 2D over a one-year period depending on the depth and soil type. Each column of the table shows the evolution of soil temperatures over a month.

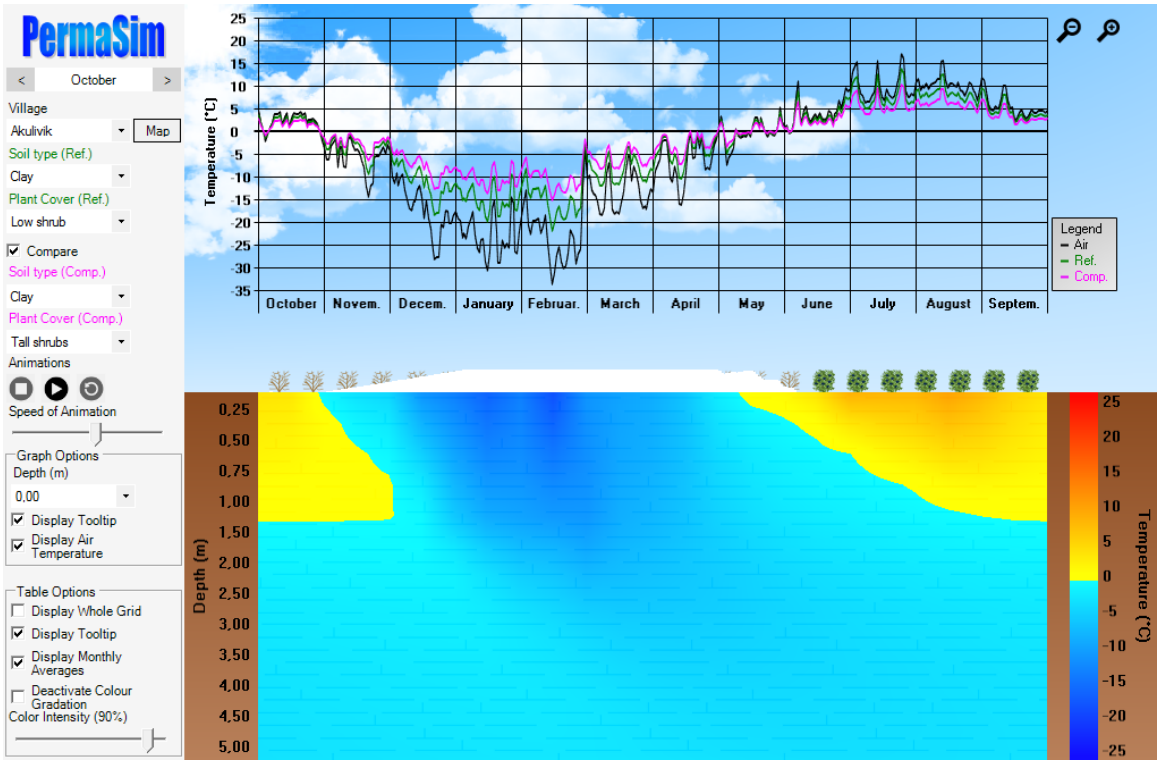


Figure 1: Monthly table

Data displayed on the **right section** of the window are composed of two elements: a graph and a soil table. The data displayed on the right section depend on the options selected in the **left section**.

4.2. Daily Table

The daily table (Figure 2) is a representation of the profile of the permafrost thermal regime over a one-year period depending on the depth and soil type. The temperature is represented by colours ranging from red to blue, identified in a legend to the right of the table. The curve shows the evolution of soil temperatures over a one-day period.

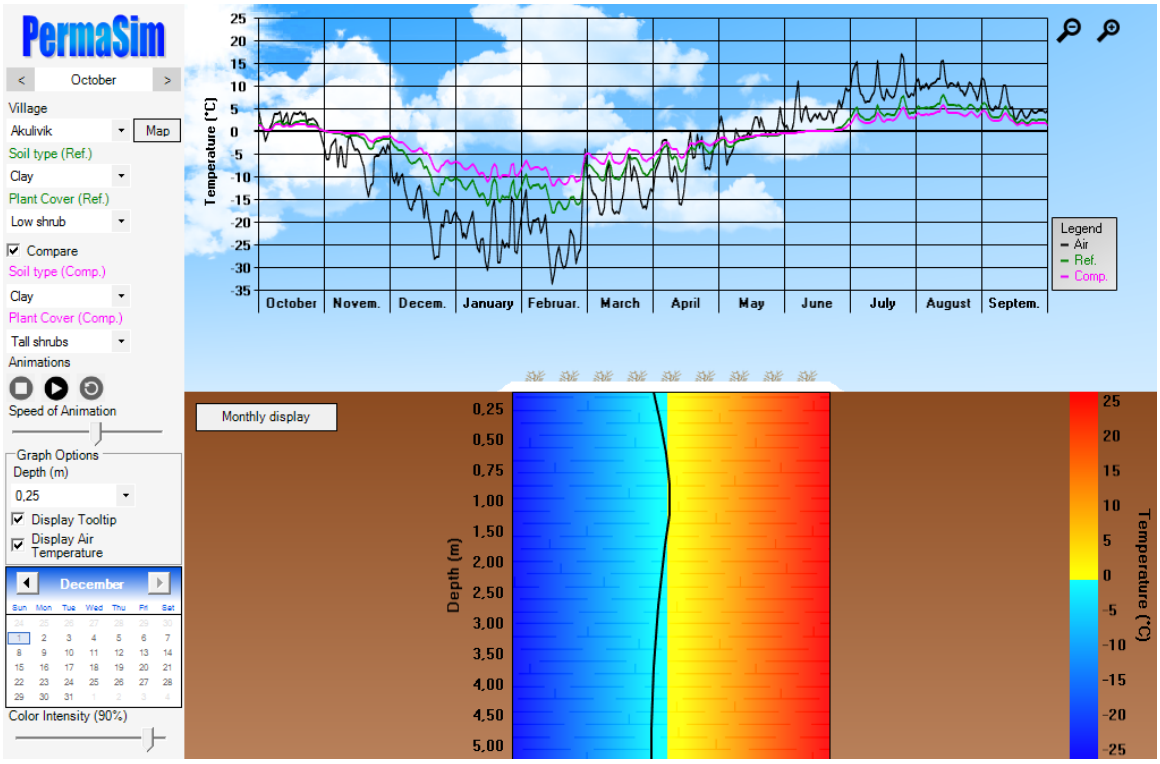


Figure 2: Daily table

4.3. Infrastructure

The infrastructure module (Figure 3) is a representation of the permafrost thermal regime depending on the fill layer above. The embankment (1 m thick) is represented by a gray layer above the natural ground.

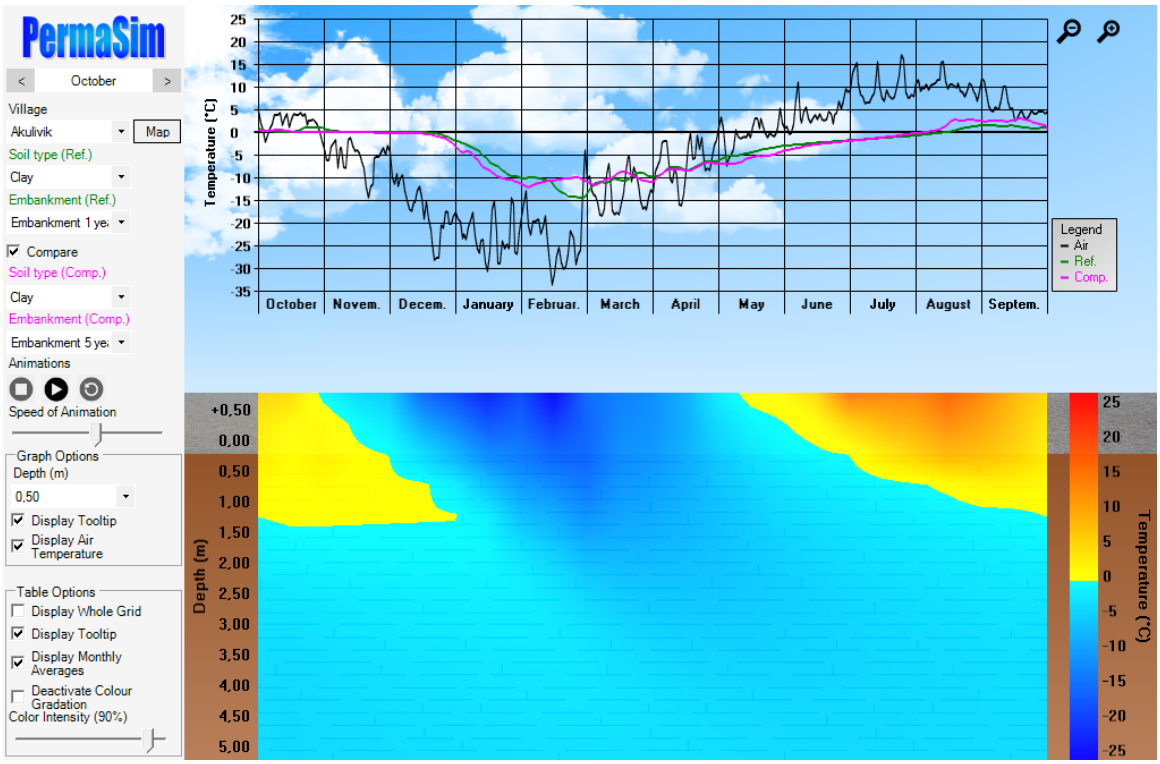


Figure 3: Infrastructure module

4.4. Right Section

4.4.1. The Graph

The graph is located in the upper part of the screen's right section. Data are presented as a curve. The graph displays air temperature and soil temperature (Ref.) according to the selected depth (0m by default). The graph also shows the comparison curve (Comp.) when the "Compare" function is activated.

Air temperature is shown as a black curve. The curves representing soil temperature (Ref.) and comparison (Comp.) are represented by colours ranging from red to blue. The red-yellow colours represent positive temperatures (T°C > 0.01°), whereas the green-blue colours represent negative temperatures (T°C < 0°). The reference and comparison curves can be distinguished by colours identified in a legend to the right of the graph.

4.4.2. Soil Table

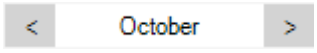
The soil table is located in the lower part of the screen's right section. The table presents the evolution of soil temperature in 2D over a one-year period according to soil type and depth. The temperature is represented by colours ranging from red to blue, identified in a legend to the right of the table. The red-yellow colours represent positive temperatures (T°C > 0.01°), whereas the green-blue colours represent negative temperatures (T°C < 0°).

The plants placed above the soil table represent the plant cover type selected (tall shrubs, low shrubs, lichen, or none). It is also possible to observe the evolution of snow cover during an annual cycle. The background shows soil type, more or less visible depending on the intensity of the colour.

4.5. Left Section

4.5.1. Start Month

To change the start month displayed in the graph and soil table, click on the arrows located at each side of the month. By default, the start month is October.



4.5.2. Village

A village can be selected in the scroll-down "Village" menu or by clicking on the "Map" button on the right side of the scroll-down menu. A map of Nunavik (Northern Quebec) will appear in the right section of the window (Figure 4). To select, click on the village's name. The map can be hidden by clicking once again on the "Map" button, or on the X at the top right corner of the map. If more than one map is available, it is possible to alternate between them via the menu that will appear at the top right corner of the map. It is possible to switch between the different maps available via the scroll-down menu displayed in the top right corner of the map.

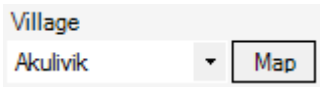
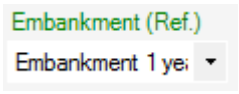


Figure 4: "Map" Function for selecting a town.

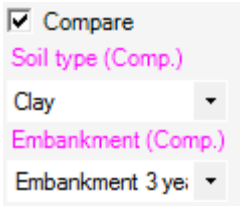
4.5.3. Soil Type, Plant Cover and Embankment

Soil type, plant cover and embankment (Infrastructure) can be changed in the scroll-down menus of the left section.



4.5.4. Comparison

The comparison function compares two types of soil and plant cover for the selected village. The function displays an additional curve in the graph (Comp.), which can be compared with the reference curve (Ref.). This function can be activated or deactivated in the "Compare" box.



4.5.5. Animations

Animations present gradual, rather than instantaneous, annual changes in air and soil temperatures.

When the "Activate Animations" box is ticked, any change to the displayed data options will appear progressively once the animation starts.

4.5.5.1. To Start the Animation

To start the animation, click on the icon. Once the animation is started, all program options, except for the animation options, are deactivated. The options are reactivated automatically when the animation ends.

4.5.5.2. To Pause the Animation

To pause the animation, click on the icon. This icon appears when the animation is playing and allows the viewer to stop the video without losing any progression made. By clicking on the icon, the animation continues its progression where it had stopped.

4.5.5.3. To Stop the Animation

Clicking on the icon will stop the animation, whether running or paused. The data will then be displayed in full before the end of the animation.

4.5.5.4. To Start the Animation Again

To return to the beginning of the animation without stopping it, click on the  icon while the animation is running or paused.

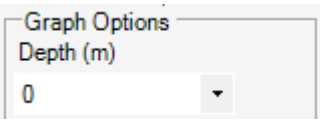
4.5.5.5. Speed of the Animation

The speed can be modified anytime on the "Speed of animation" bar, even while the animation is running.

4.5.6. Graph Options

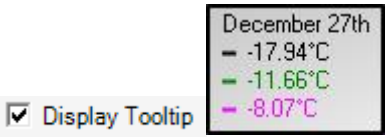
4.5.6.1. Depth

Depth of soil temperature curves can be modified in the scroll-down menu "Depth (m)." This function is useful when comparing temperatures at varying depths (0 to 5m).



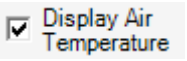
4.5.6.2. Tooltip

The tooltip displays the exact temperature of each curve for the date pointed at by the mouse cursor. This function can be activated or deactivated in the "Display Tooltip" box.



4.5.6.3. Display Air Temperature

The air temperature curves are likely to interfere with other curves in the graph and reduce its readability, especially during comparisons. This particular curve can be hidden or displayed using the "Display Air Temperature" box.

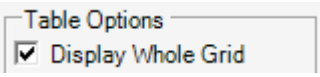


4.5.7. Soil Table Options

4.5.7.1. Display Whole Grid

By default, the cells of the soil table are displayed according to the position of the mouse cursor (the indicated cell is emphasized, the squares of the column and row pointed are displayed and, if the option is activated, the monthly average appears in the pointed

square). All cells can be displayed at once by activating the "Display Whole Grid" function. The same goes for the monthly averages (if the option is activated) (Figure 3).



When the whole grid is displayed, it is preferable to deactivate the colour gradation so the graph is easy to read (see section "Deactivate Colour Gradation") (Figure 5). This way, each cell is represented by one colour only.

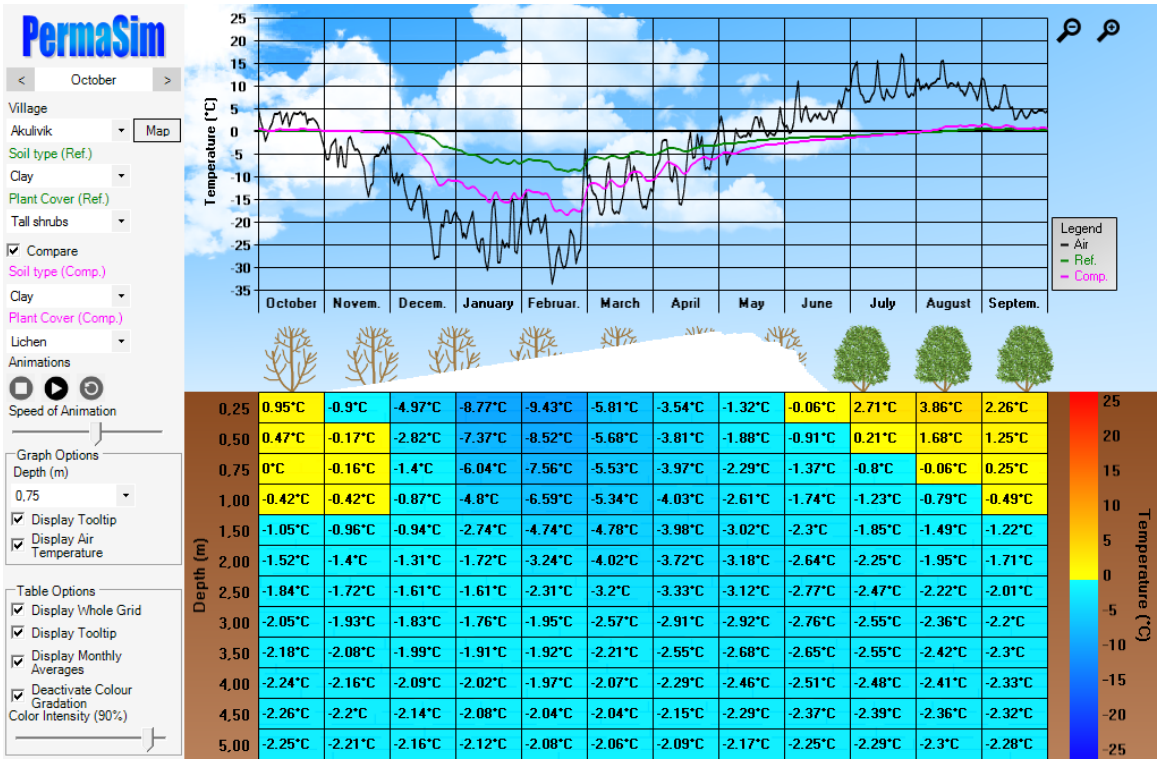
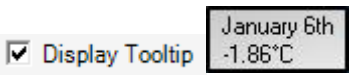


Figure 5: Functions "Display Whole Grid" and "Deactivate Colour Gradation" in the table's options.

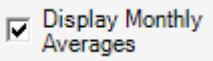
4.5.7.2. Tooltip

The tooltip shows the exact soil temperature for the day and the depth indicated by the mouse cursor. It can be activated or deactivated in the "Display Tooltip" box.



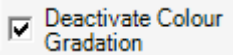
4.5.7.3. Display Monthly Averages

This option can be activated or deactivated in the "Display Monthly Averages" box. When activated, the soil's monthly average temperature is displayed in the table's cell when the mouse cursor is pointed at the cell. The monthly average temperature can also be displayed in all cells when the option "Display Whole Grid" is activated.



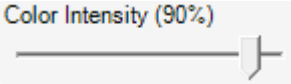
4.5.7.4. Deactivate Colour Gradation

By default, soil temperature colours are displayed in the graph in gradation. The colour gradation helps highlight approximate changes in soil temperatures according to the time of year and depth of soil. This option can be deactivated so that one temperature is displayed per cell, thus facilitating the readability of the table when the "Display Whole Grid" option is activated, and/or to improve performance on some computers (Figure 3).



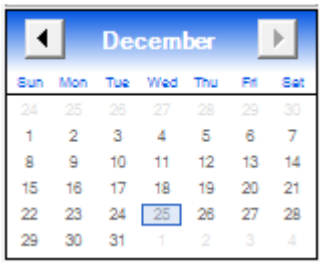
4.5.7.5. Colour Intensity

The default value of the "Colour Intensity" function is 90%. The more intense the colour, the more distinct the tone of the colour compared to the soil table's background. For instance, background patterns are not visible if the intensity is at 100%. A low intensity means a less distinct colour tone, which makes it more difficult to differentiate between the colours.



4.5.7.6. Date selection

In the **daily table** option, the date can be selected by using the calendar displayed in the lower left corner of the window.



5. Menu bar

5.1. Configuration Settings

5.1.1. Language

The menu allows the user to choose the display language (French or English).

5.1.2. Clouds

The clouds in the graph display are generated randomly. The user can select the speed of the animation.

5.1.2.1. Regenerate

Use this option to generate new clouds as many times as is necessary.

5.1.2.2. Animate

When selected, this option makes the clouds in the background move across the sky. New clouds are automatically and constantly generated.

5.1.2.3. Cloud Speed

Use the “Cloud Speed” button to change cloud speed when the “Animate” option is activated. Three speed options are available: slow, medium, and fast.

5.1.3. Automatic Save

Automatically save settings by clicking on “Auto Save.” Once the “Auto Save” function has been activated, the option “Save Settings” will no longer be displayed on the Menu Bar. However, it should be noted that when “Auto Save” is activated, program performance may be affected.

5.1.4. Number of Mouths Displayed

By default, the entire year is displayed on the graph and on the soil table. However, the user can choose to display fewer than 12 months.

To modify the number of months to be displayed, click on “Settings” in the Menu Bar and then select the number of months in the scroll-down menu “Number of Months Displayed.” Or, use the zoom icons at the top right corner of the graph to obtain the same result.

5.1.5. Graph

By default, the graph curves are shown by plain colours (green and pink). The “Graphic” option is used to represent temperature curves by colours ranging from red to blue, identified in a legend to the right of the table. The curves are also differentiated by two symbols: triangle (Ref.) and square (Comp.) (Figure 6).

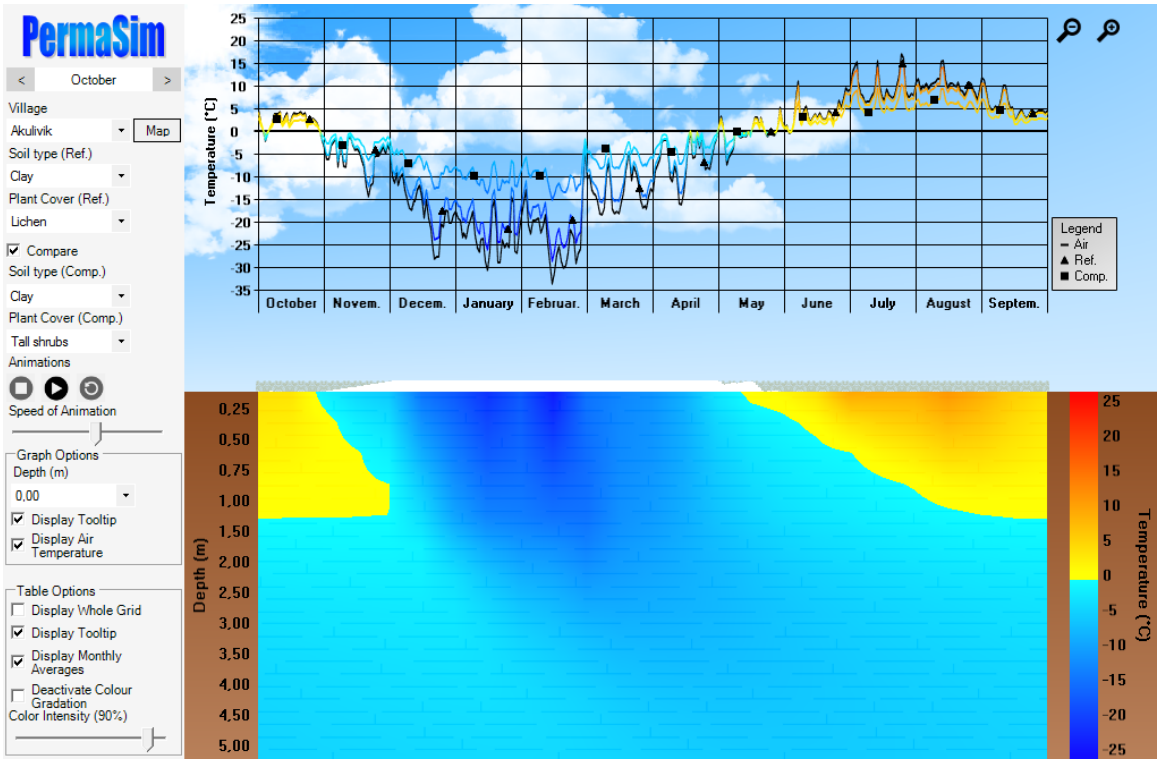


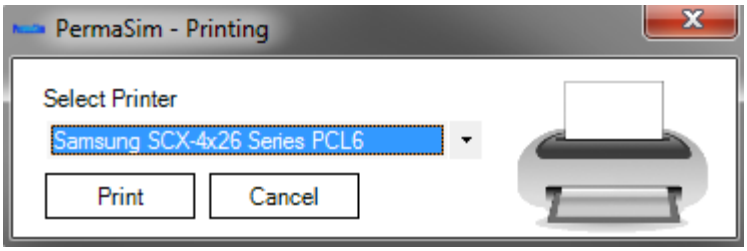
Figure 6: Temperature curves represented by colours ranging from red to blue and symbols.

5.2. Save

The “Save” function saves (as a .png file) a screenshot of a PermaSim window on the computer or on a USB key. This function is very useful to compare soil temperature results according to different soil types, plant covers and depths.

5.3. Print

Use the “Print” button in the Menu Bar to print a screenshot of a PermaSim window. In the Print window, select the desired printer and click on “Print.”



5.4. Save User Settings

Use the "Save Settings" function to save the current program settings (language, town, soil type, etc.) the next time PermaSim is run. Settings changes can also be saved automatically (see "Auto Save"). If the "Auto Save" function has been activated, the option "Save Settings" will no longer be displayed on the Menu Bar.

5.5. Help

The "Help" function gives access to two support tools: the User Manual and the program's presentation video.

5.6. About Us

The "About Us" function provides a description of the PermaSim program and the version installed on the computer. This window also gives access to the "Read Me" file.