

## Plotting v5 (1.26.16)

### Overview

The plotting utility is opened via the Window menu.

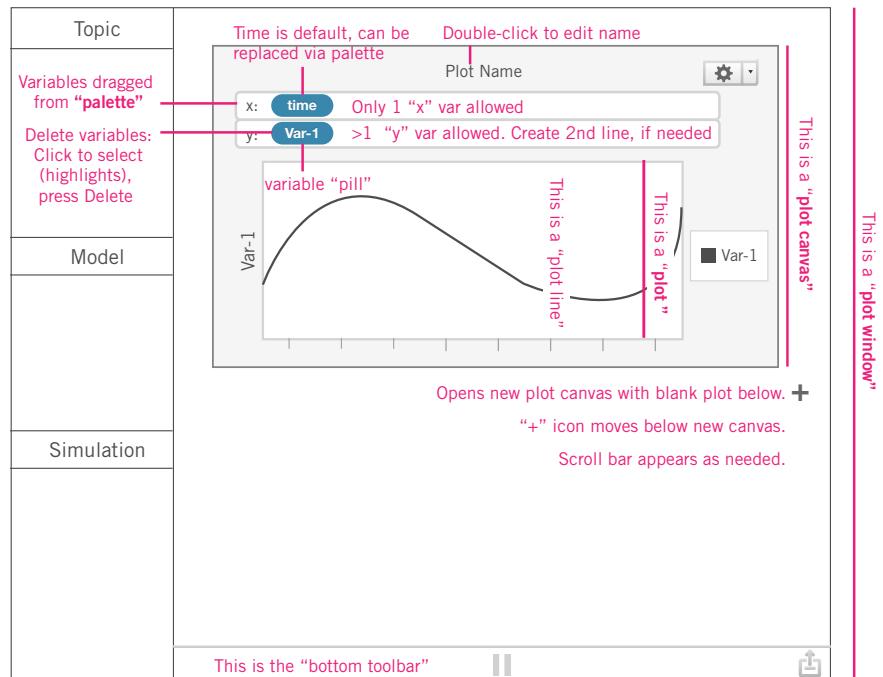
The plotting window first opens with a blank plot canvas and blank plot. Only "time" is prefilled as the "x" value. It can be deleted.

Variables are dragged from the left "palette" to the (x,y) fields on the canvas. If a variable is released above the blank plot, it populates as a "y" variable (see right). Only one "x" variable is allowed. **Error message if "time" is not deleted before user adds an "x" variable.**

Adding more than one variable to "y" creates multiple plots within the same plot canvas (see below).

Dragging one "y" variable onto another causes them to join into one long pill, with "Variables:" at the start of the name. When user drags a pill onto another, the destination pill highlights on hover. On release, the two pills are joined into one. The variables then appear in the same plot, on the same plot canvas (see bottom right).

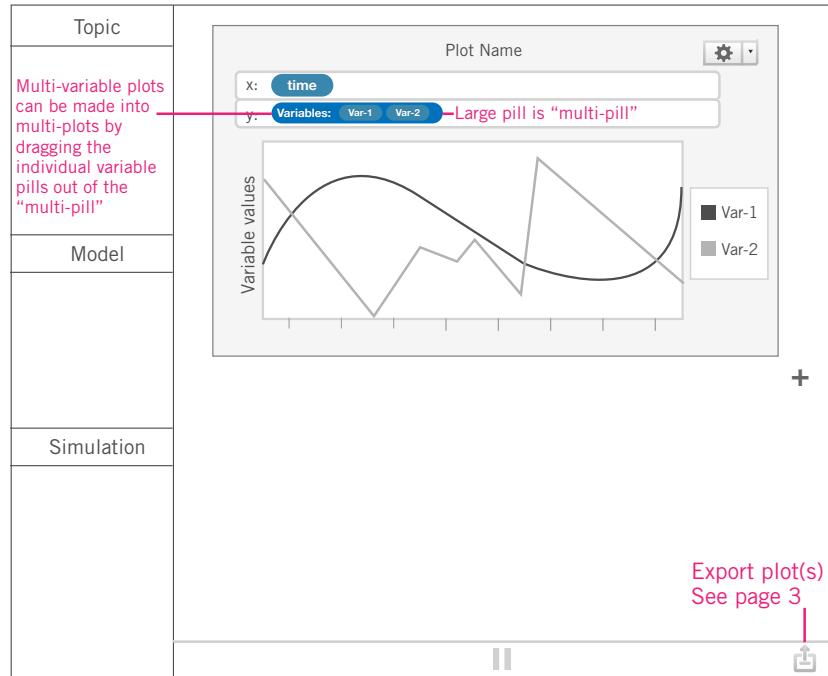
### Example of single plot (one plot, one "y" variable)



### Example of multi-plot (multiple "y" variables on separate plots)



### Example of multi-variable plot (more than one "y" variable on the same plot)



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### Settings



#### Settings

Clicking the gear icon on a plot canvas opens the settings for that plot canvas only.

*Pop out:* Pops plot canvas into own window. Palette goes along, but is auto-collapsed. Bottom toolbar goes along, too. Plus icon does not. This popped-out window doesn't have a white background like the regular "plot window"; the "plot" (and toolbar) occupies the whole window.

This new window can be made fullscreen using default fullscreen option in window. Popped out window now gets "⤷ Pop in" option in top right corner of window.

*Show grid:* Shows/hides grid lines on plot.

#### These options open in a separate dialog (*Future Feature*)

*Align start point:* If there is a plot with >1 sim runs plotting the same variable, this option aligns the start point of the previous runs to the start point of the current run (see bottom left for dialog layout). *This option is greyed out if the plot does not contain multiple runs of the same variable.*

*Apply log function:* Future feature

*Log to disk:* Future feature

#### These options do not open a separate dialog, but do ask for confirmation.

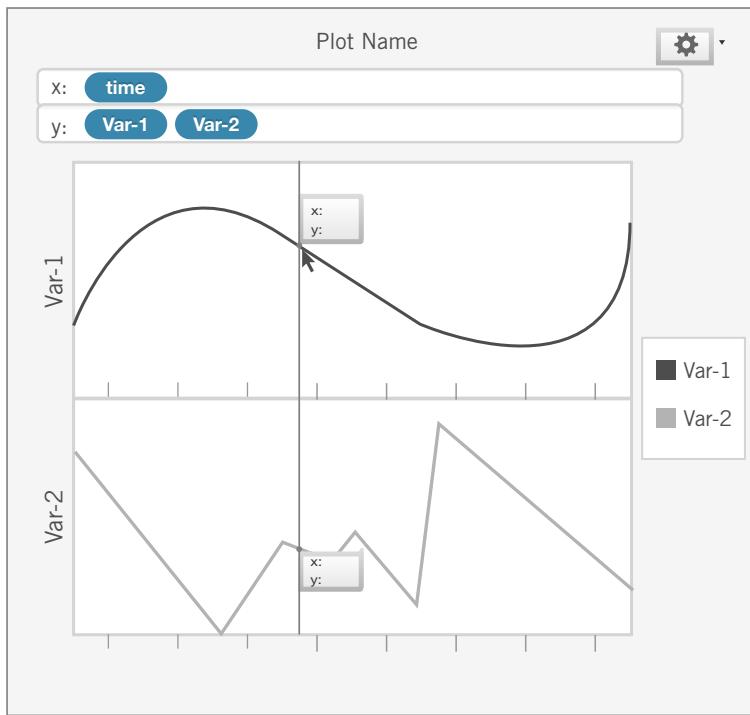
*Clear all fields:* Clear (x,y) variables and clear all plot(s) on canvas.

*Delete plot:* Deletes entire canvas. If it was the only canvas, clear all fields and lines, but leave blank plot.

NOTE: Closing the plot window using the default X also triggers a confirmation dialog.

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### Interactions (1 of 3)



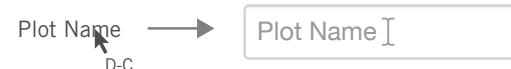
#### Plot line hover (See left)

Hovering the mouse over a segment of plot line causes a vertical line to appear along the height of the plot, at the hover point. Where the line intersects the plot line(s) a small dot and box appear with the (x,y) values of that point. The box corner is attached to the dot.

Move mouse off the plot line to clear boxes.

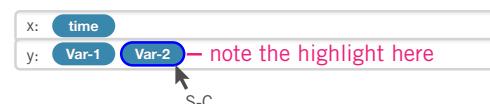
#### Rename plot

Double-click the plot name to change the name. Press Enter to save new name.



#### Delete variables

Single-click on a variable pill to select it. Press Delete to delete it.



#### Zoom in/out on plot

Use the scroll wheel to zoom in and out on the plot. The zoom only impacts the plot over which the user is hovering.

The (x,y) axes update to reflect zoom, and a clickable zoom box appears in the top right corner of the plot during zoom and for a few seconds after the zoom (See below).

- 120% + | Reset

#### Edit variable names

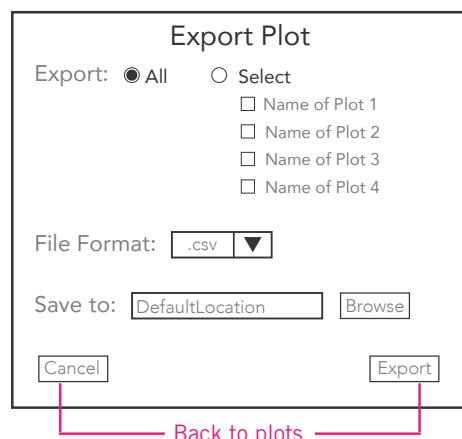
Double-clicking into a pill makes the variable names editable. Pressing "Enter" or clicking out of the pill saves the edit.

The default label ("Variables", below) on a multi-pill is not editable.

Variables: Var-2-1 Var-2-2

### Export Plot(s) (See below)

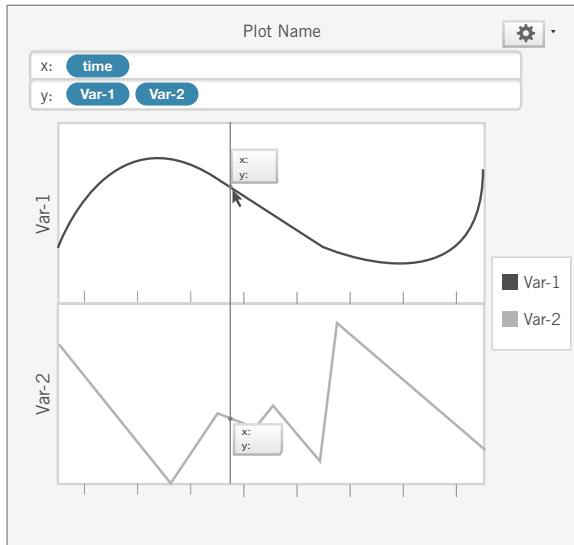
This dialog opens when the Export button is clicked in the bottom toolbar.



Back to plots

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### Interactions (2 of 3)



#### Calculate the difference between two points

Hover over a point on a plot line. The  $(x_1, y_1)$  callouts appear.

Click to “lock in” that selection.

Callouts and vertical line remain in-place as cursor moves to next point. (See left)

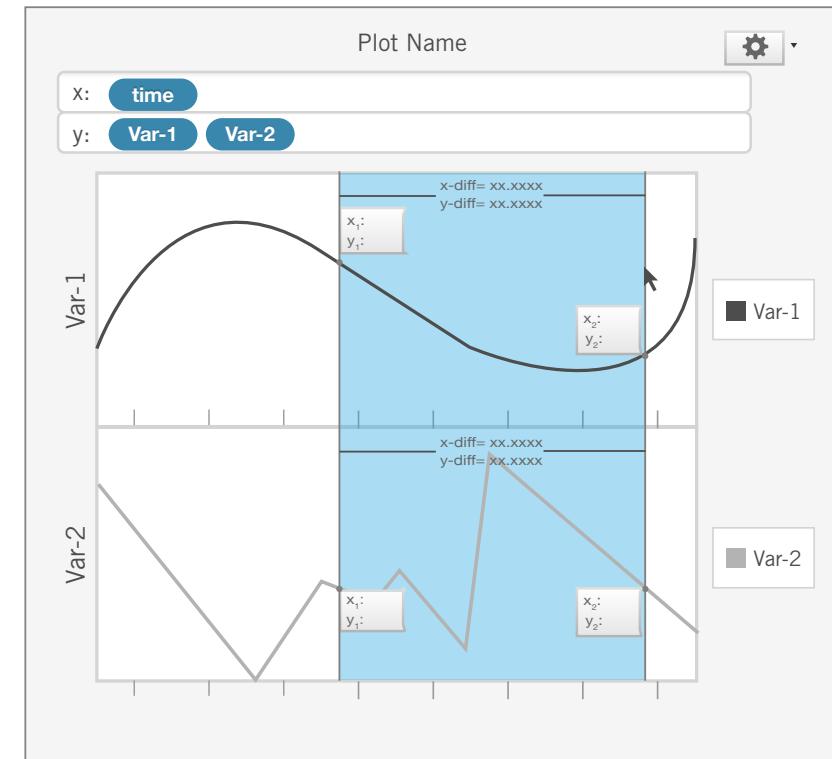
Drag mouse in either direction. The space between the cursor and the vertical line fills in/highlights and a second vertical line appears, attached to the cursor. As the second vertical line passes over the plot lines, callouts appear at the intersection points with the line  $(x_2, y_2)$ .

As the cursor moves, the difference between  $(x_1, y_1)$  and  $(x_2, y_2)$  updates along the top of the plot. **We may need to add a white background in case the numbers overlap with the line(s).**

Clicking a second time “freezes” the highlighting/numbers, and cursor movements no longer affect the highlighted area.

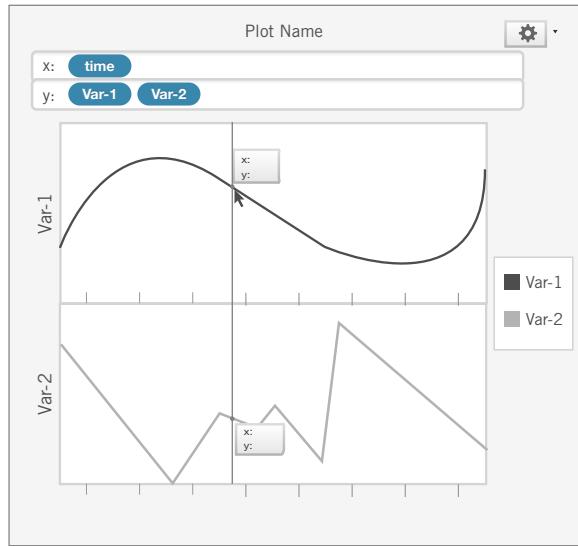
The user can zoom in/out during this process (see previous page for details).

Press Escape to clear.



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### Interactions (3 of 3)



#### Plotting the same variable(s) over multiple simulation runs

##### Scenario:

1. The user runs a simulation while recording two variables in a multi-plot setup (see top left).

2. The user stops simulation and resets it.

3. The user starts simulation again.

The plotting utility should behave as follows:

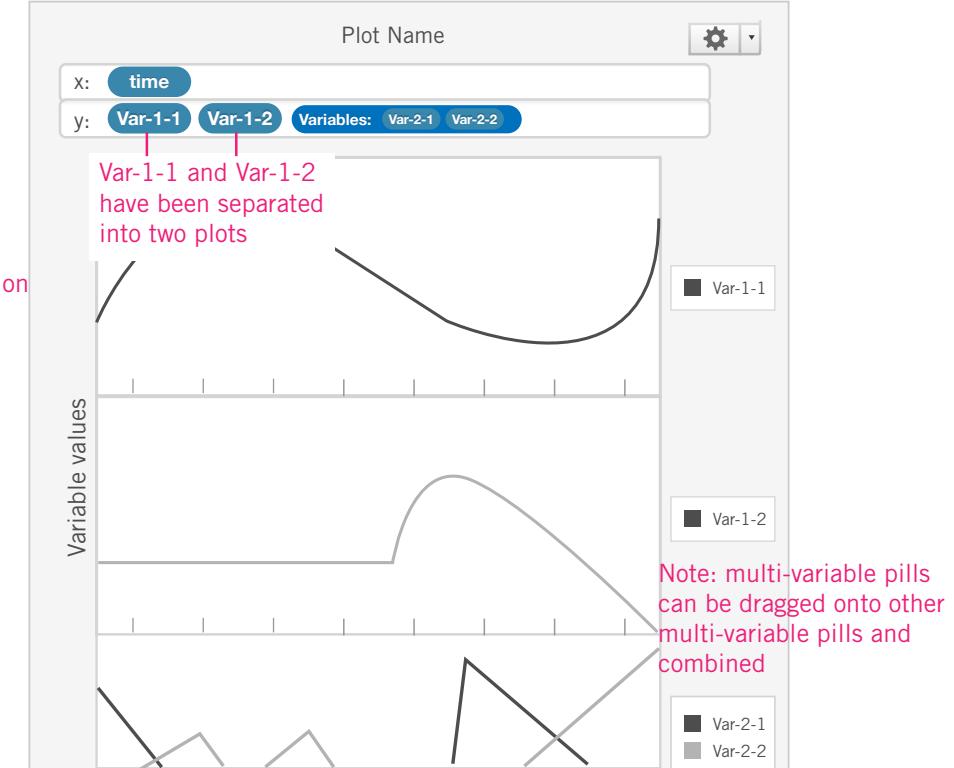
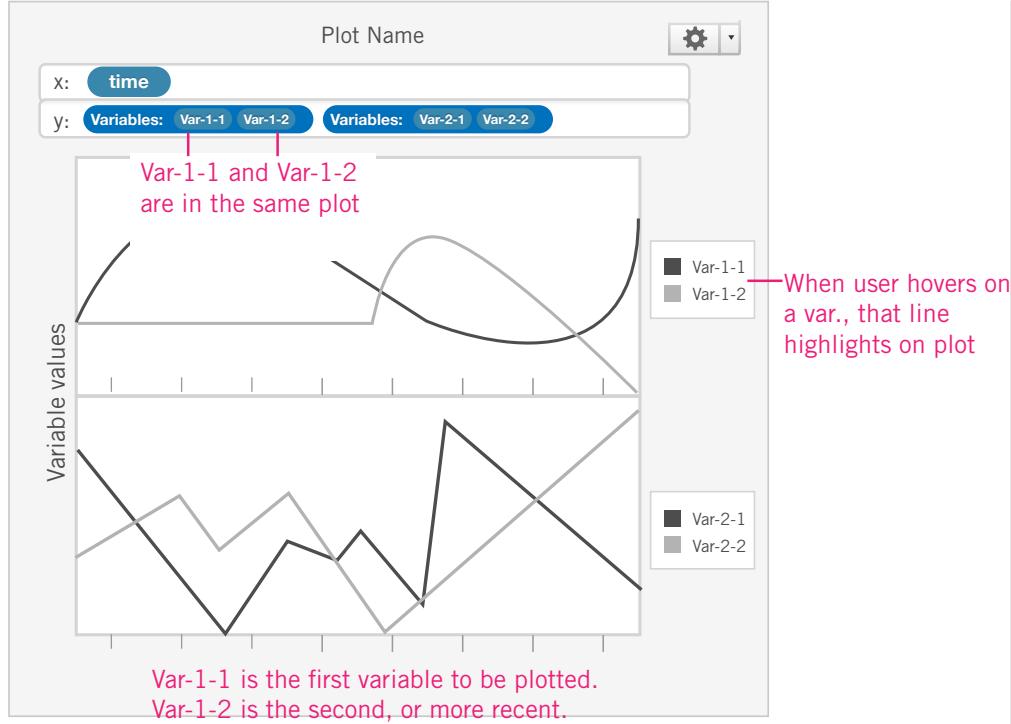
1. The plot to the left is created.

2. Plotting stops.

3. Once simulation is started again, we create two multi-pills. The first multi-pill contains the first and the current runs of Variable 1. The second multi-pill contains the first and current runs of Variable 2 (see bottom left).

4. The runs for each individual variable display in the same plot.

5. If the user wants the plot lines to appear in separate plots, she can drag a pill out of the multi-pill and into an empty spot in the "y" field (see below).



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## Colors

Line Colors (colorblind-safe)



## Picking colors for plot lines

If...

1. There are multiple plots with 1 variable on each: Use the darkest color, each from a different color group.

2. There are multiple plots with >1 variable on each: Use a different color group for each variable. Depending on the number of plots, color groups may be used more than once across multiple plots.

3. If there is only one multi-pill group on a plot (e.g., ), use a single color group with patterns.



\*\*\*\*\*

4. If there are multiple multi-pill groups on a plot (e.g., and ), use a single color group for each multi-variable group (e.g., all var-1 lines are shades of purple, and all var-2 lines shades of blue). After the three colors from a color group are taken, make the lines patterned, and start over from the darkest color. In a multi-pill, limit the number of lines/runs to 6:



Variables: Var-1-1 Var-1-2



Variables: Var-2-1 Var-2-2

Axes Color  
R: 179  
G: 179  
B: 179

Plot Background Color  
R: 242  
G: 244  
B: 247

## Example of lines on a plot with many variables



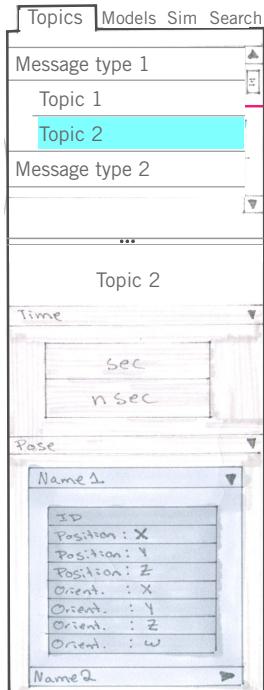
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### Palette

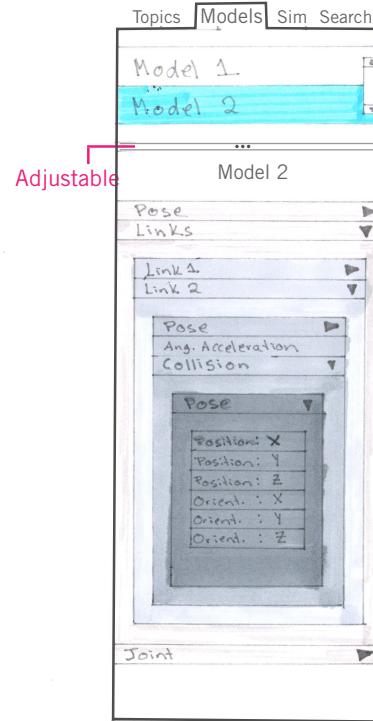
The Palette is divided into tabs (Topics, Model, Sim), and into the top pane and bottom pane.

The top pane displays lists of options that cannot be added to the plot. The bottom pane is dynamic, changing based on the selection in the top pane.

Variables are dragged from the bottom pane to the plots.



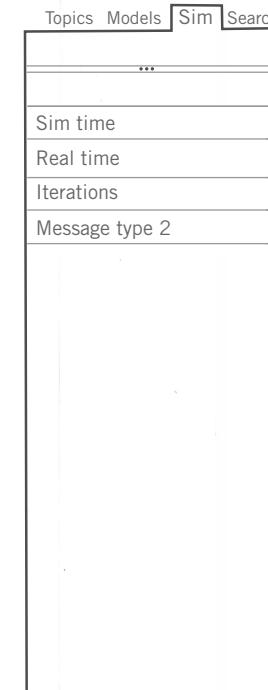
Topics organized like in Topic Viewer.  
Clicking a topic reveals its details in the bottom pane.  
Stretch goal: let users drag topics from Topic Viewer into plot canvas



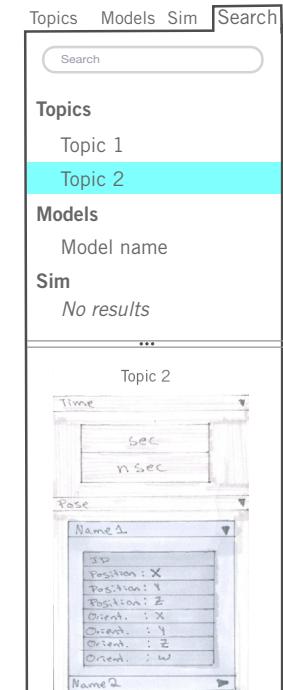
The sections in the bottom pane become darker the "deeper" the section.

Top Pane

Bottom Pane



Topics Models Sim Search



Search filters down and categorizes results into Topics, Models, Sim

Results remain until user clears search field

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### Future Features

#### Align start point

This option is available (not greyed out) in Settings when a single plot is plotting multiple runs of the same variable.

Align variables

If you are plotting the same variable across multiple simulation runs, you can select a starting point from one of the runs and align the other runs so that the starting points line up.

First, pick the variable(s) you want to align, then pick which run should be the baseline:

Select the variables you would like to align:

Var-1  
Use this variable as the baseline:  
 Var-1-1  
 Var-1-2

Var-2  
Use this variable as the baseline:  
 Var-2-1  
 Var-2-2

[Cancel](#) [Save](#)

This example shows a plot with two different variables. There may be only one variable to choose from, or more than two.

Unchecking a box clears the corresponding radio button selections. If this is done, the plots become un-aligned.

Bonus: only make the radio buttons appear if that variable's checkbox is ticked.

Change to "this variable" if there's only 1

#### Display timestamp data

When hovering over a line, show in the popup the time that the message was received or generated from the gzserver

#### Load data from CSV

Support loading a CSV file to compare against a new run

#### Save plot configurations

Support saving a file with the user's plot customizations

#### Support auto-complete in (x,y) fields

Users can add variables to the (x,y) fields by clicking into the field, typing, pressing tab to auto-complete, and pressing Enter to lock the variable in as a pill.

### Customize plot appearance

- Set the (x,y) ranges as predefined, or set them to expand with the plot
- Set how the current values appear: in the middle; does the plot compress as the data grows?, etc.
- Set plot aspect ratio
- Set grid interval

### Zoom via rectangle

Click-drag-release draws a rectangle across the plot and zooms into that area. As in Scroll Zoom, the visual below appears in the top right corner of the plot.

- 120% + | Reset

### Expand/collapse plots

Add an option to expand a multi-variable plot into a multi-plot, and collapse again.

### Checkboxes to toggle variables on/off

Add a checkbox next to each variable in the legend to toggle the data stream on/off.

### Support multiple Export options

On Export page, offer multiple options such as .png, PDF, etc.