Education evenings 2016

Practical introduction to groundwater modelling

Computer exercises
01 02 Introduction to ModelMuse

1

Purpose

The following exercise will

- ✓ get you acquainted with the ModelMuse user interface,
- ✓ and introduce you to data sets, model features and objects.

We will also have a brief look at

- ✓ formulas and functions

which can be used to define data sets or model features.

2

But first …

3

In ancient Greece and Rome,

the Muses were thought, by some, to provide the inspiration for music, poetry, and the arts. The composers, poets, and other artists, however, still had to do the hard work of tuning that inspiration into an actual work of art. **It would be great if ModelMuse could** do the same for modelers – **provide the key insight required to allow the system to be quickly and effectively modeled**. **ModelMuse** can not do that; it **is not smart enough**. What **it can** do is **take over** some of the mundane **parts of the modeling process and** make them much easier and faster. By doing so, ModelMuse **allows the modeler more time to think, to observe, to analyze, to experiment**, and to generate the needed inspiration.

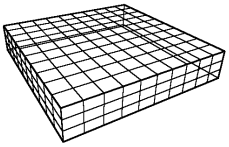
Richard B. Winston, ModelMuse author

Winston, R.B., 2009, ModelMuse-A graphical user interface for MODFLOW-2005 and PHAST: U.S. Geological Survey Techniques and Methods 6-A29, 52 p.

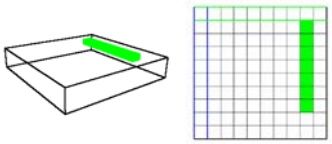
4

Data sets vs model features vs objects

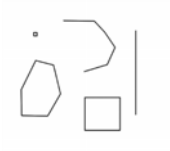
- ✓ Provide properties for every cell in the model grid, *e.g.* Kx, initial head, …
- ✓ Are set with a default formula
- ✓ Can be modified locally by objects



- ✓ Are only defined in certain locations, *e.g.* river, drain, fixed head, …
- ✓ Do not have default formulas
- ✓ Are defined by objects



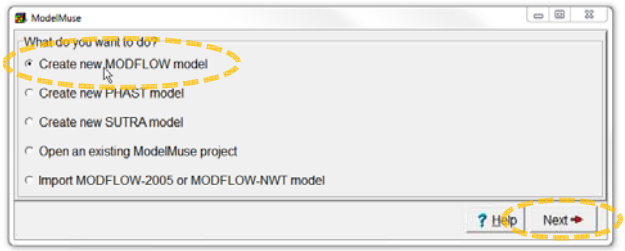
- ✓ Can be points, polylines, polygons, straight-lines or rectangles
- ✓ Can modify data sets locally
- ✓ Can define model features



5

Create new model

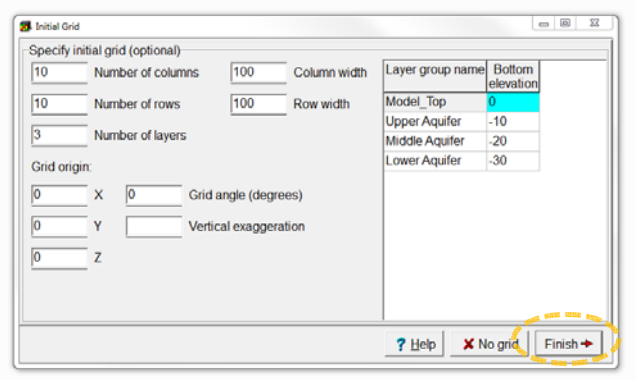
- ✓ Start ModelMuse by double-clicking on its icon.
- ✓ Choose **Create new MODFLOW model** and click **Next**.



6

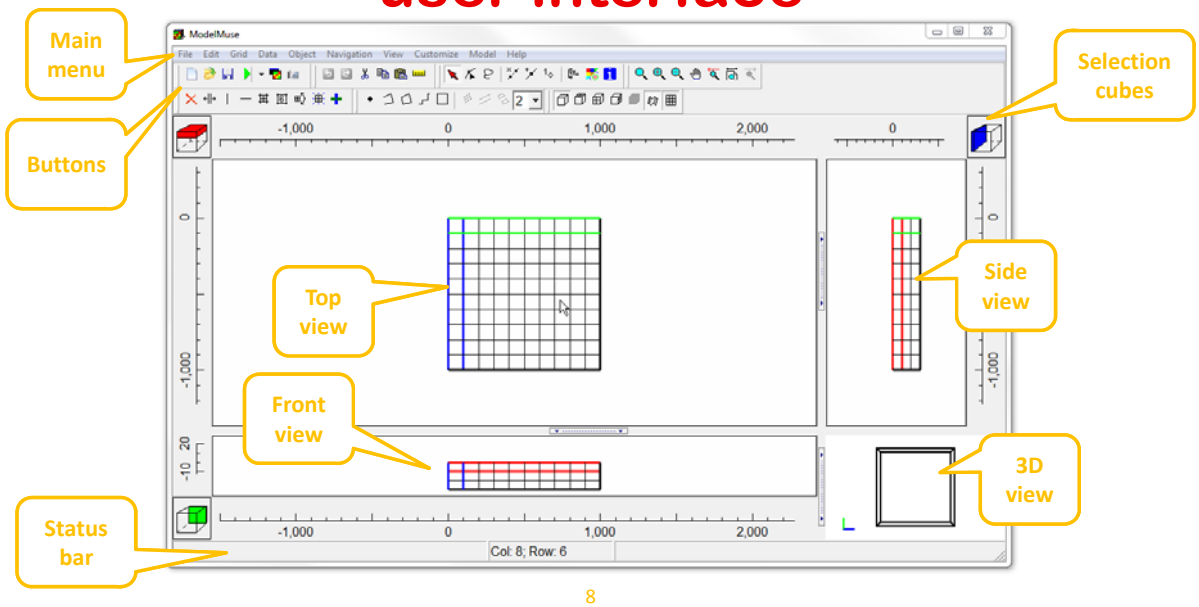
Accept default grid settings

✓ Click **Finish**.



7

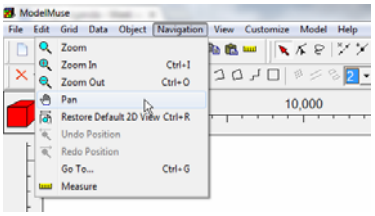
Explore the ModelMuse user interface

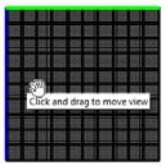


8

Navigate the grid (1/3)

- ✓ Select **Navigation|Pan** and hold the mouse over the grid.
- ✓ Then drag with the mouse. The grid should move with the mouse.
- ✓ Note that there is a toolbar button with the same image as the image in the menu. Any menu item with an image has a matching tool bar button.





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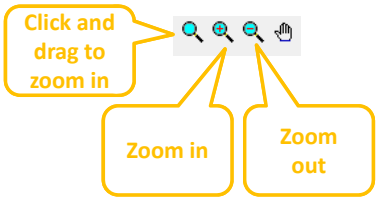
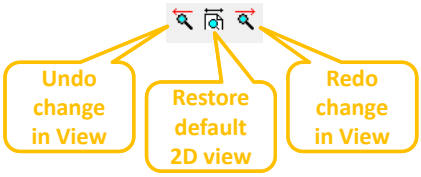
Navigate the grid (2/3)

- ✓ Hold the mouse over the grid and roll the scroll wheel on the mouse, the model should zoom in and out.
- ✓ Click the **Undo change in View** button repeatedly until you get back to the original view or just click the **Restore default 2D view** button.





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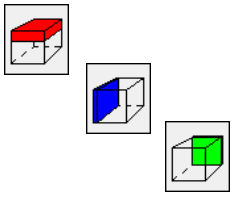
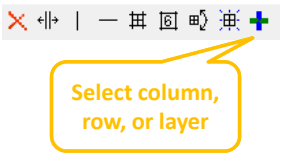
Navigate the grid (3/3)

- ✓ Click or scroll the mouse wheel on the selection cubes to change the shown layer, column, or row.
- ✓ Alternatively, select two of the three at once, using the **Select column, row, or layer** button.





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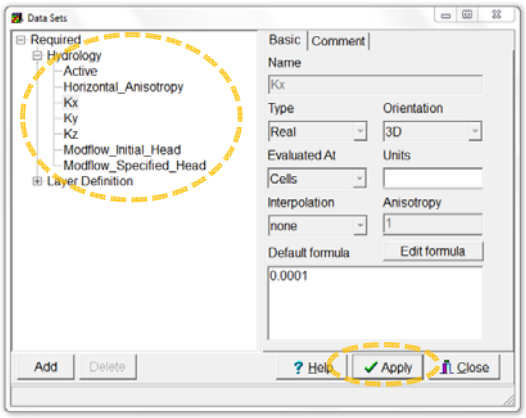
Check data set default formulas

- ✓ Select **Data|Edit Data Sets…**,
- ✓ expand **Required|Hydrology**, and
- ✓ check the default values of **Active**, **Horizontal_Anisotropy**, **Kx**, **Ky**, **Kz**, **Modflow_Initial_Head**, and **Modflow_Specified_Head**.
- ✓ Click **Close** to close the **Data Sets** dialog box.



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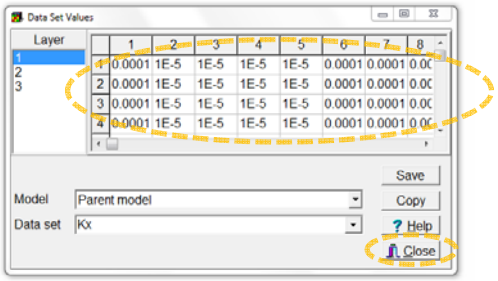
Display data set values

- ✓ Select **Data|Display Data Set Values**.
- ✓ Select **Data Sets|Required|Hydrology|Kx**,
- ✓ and check if the values correspond to the default **Kx** formula.
- ✓ Press **Close** to close the **Data Set Values** dialog box.



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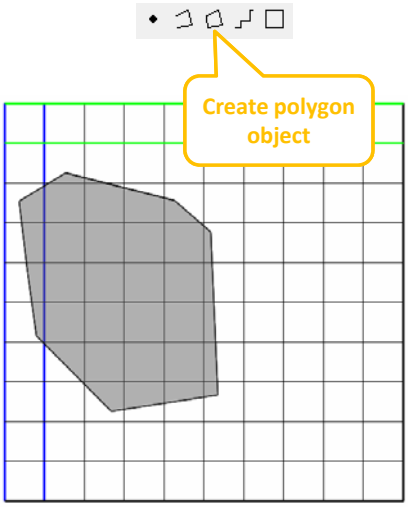
Create object to modify data set

- ✓ Change the selected layer to layer 1 if layer 1 is not already the selected layer.
- ✓ Select **Object|Create|Polygon**, or use the corresponding button.
- ✓ Click on the top view of the model to start drawing a polygon. Have the polygon surround part of the grid.
- ✓ When you are finished, double-click and the **Object Properties** dialog box will appear.



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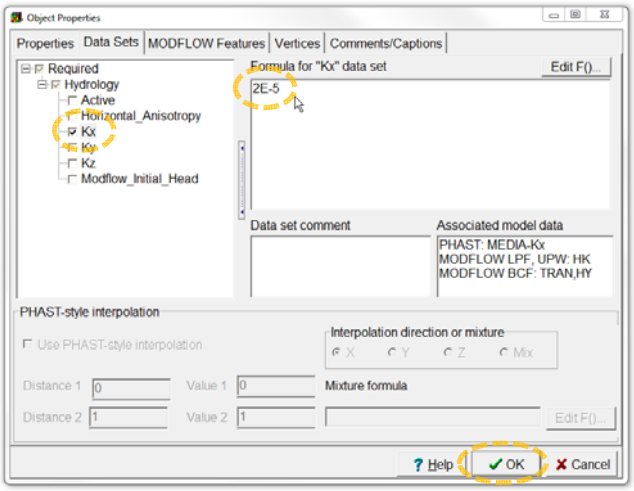
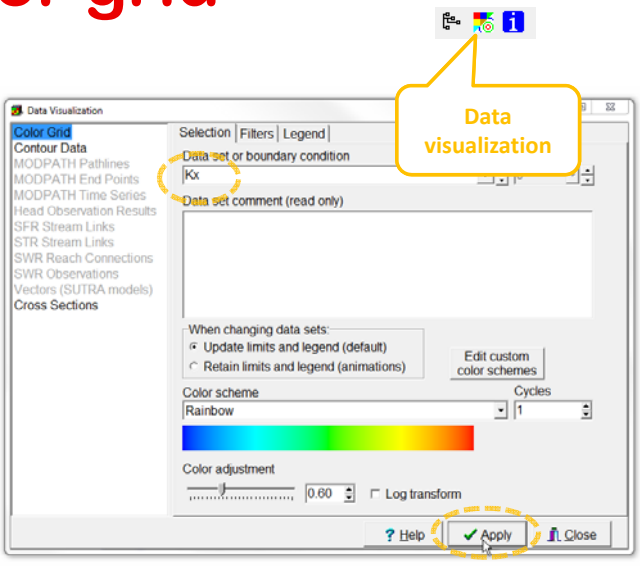
Set object Kx formula

- ✓ Switch to the **Data Sets** tab.
- ✓ Expand **Required|Hydrology** and check the check box for the **Kx** data set.
- ✓ Change the formula for **Kx** to 2E-5 and then click **OK** to close the dialog box.

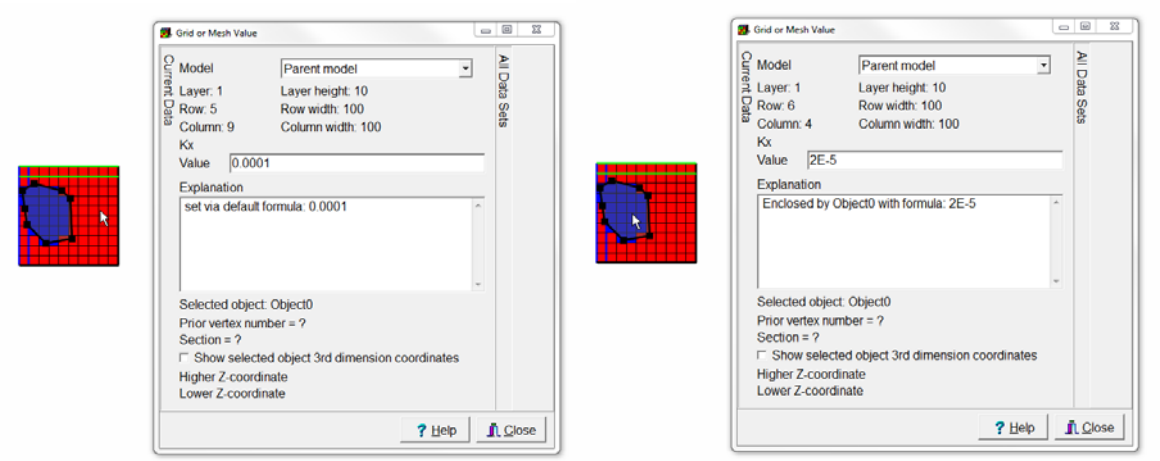


Color grid

- ✓ Select **Data|Data Visualization…** or use the corresponding button,
- ✓ select the **Kx** data set and
- ✓ click **Apply**.
- ✓ Select **Data|Show Grid Or Mesh Values** and move the cursor over the grid to see what the different colors represent.



This is what you should get



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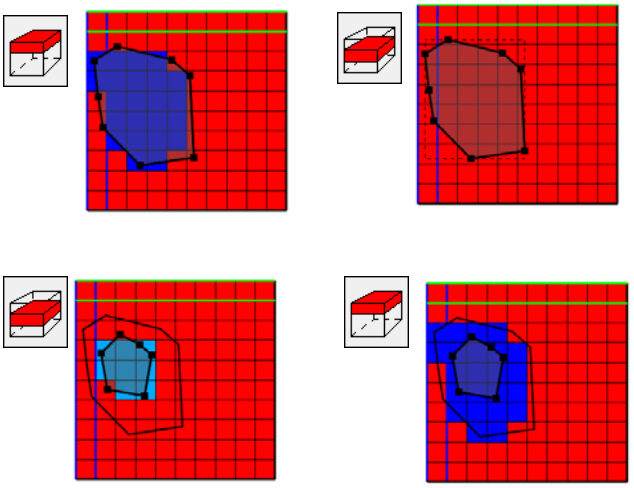
Create object in layer 2

- ✓ Locate the cube with the red square that indicates the selected layer. Click on the cube below the red square to change the selected layer to layer 2. Did the object you drew before affect Kx on layer 2?
- ✓ Draw another polygon and use this one to set Kx inside the polygon to 3E-5. Did this polygon affect the values of Kx in layer 2? Did it affect the values of Kx on layer 1?



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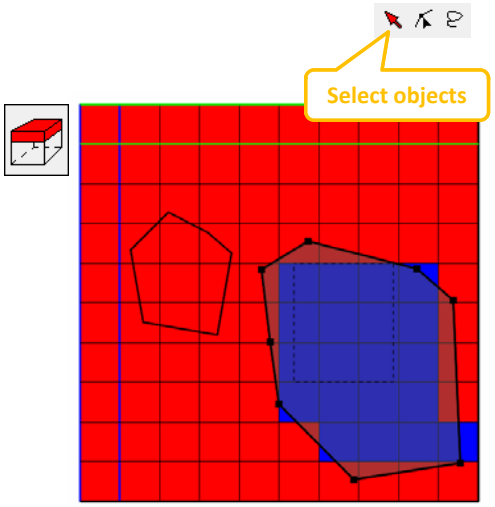
Move objects

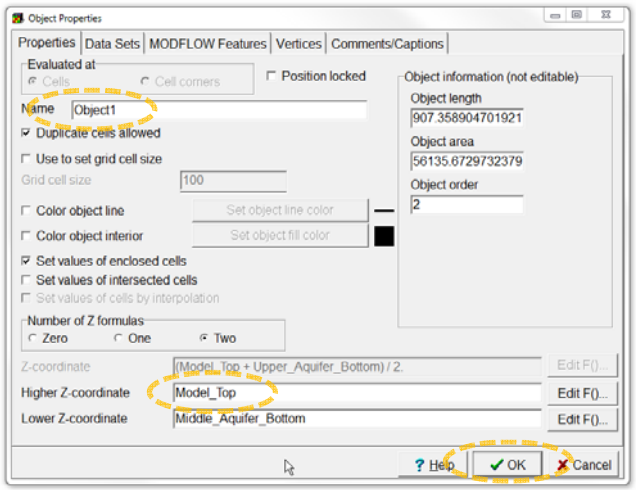
- ✓ Select **Object|Select Objects** or use the corresponding button,
- ✓ and click on one of the objects that sets the value of Kx to select that object.
- ✓ Click on the object again but hold the mouse down and drag the object to a new position. How did moving the object affect Kx?



19

Change Z-coordinates

- ✓ Double click on the second object to open the **Object Properties** dialog box.
- ✓ Change the formulas for the **Higher Z-coordinate** and **Lower Z-coordinate** so that they are "Model_Top" and "Middle_Aquifer_Bottom" respectively.
- ✓ Click **OK** to close the dialog box. How does this change affect Kx?



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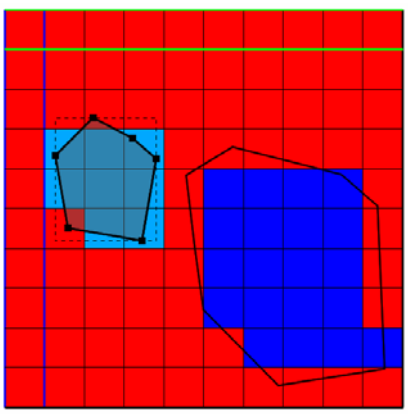
This is what you should get



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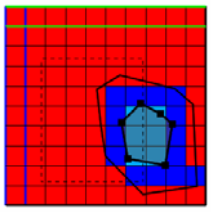
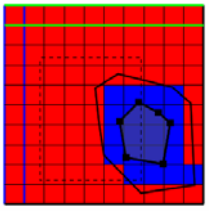
Change object order (1/2)

- ✓ Drag one of the objects so that it overlaps with the other object. What is the value of Kx in the area of overlap?
- ✓ Select the second of the two objects. Then right-click and select **To Back**. How does this affect the value of Kx in the area of overlap between the two objects?

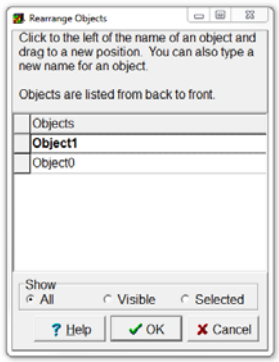




22

Change object order (2/2)

- ✓ Note that object order can also be modified by selecting **Object | Edit | Rearrange Objects**...



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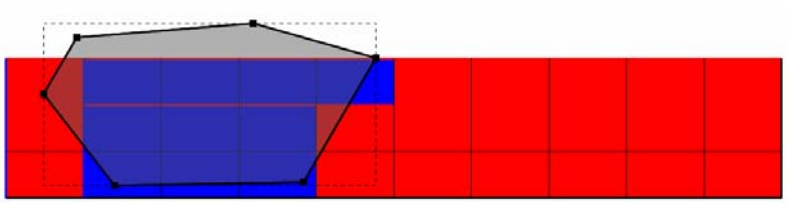
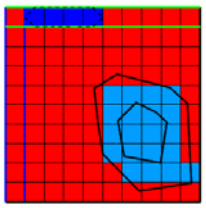
Add a front view object (1/2)

- ✓ Try drawing a polygon on the front view of the model.
- ✓ Use this object to set Kx to 1E-5.





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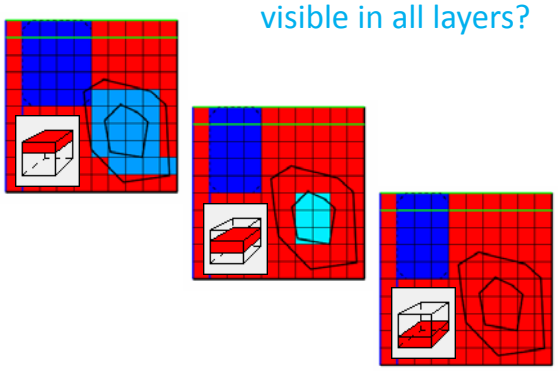
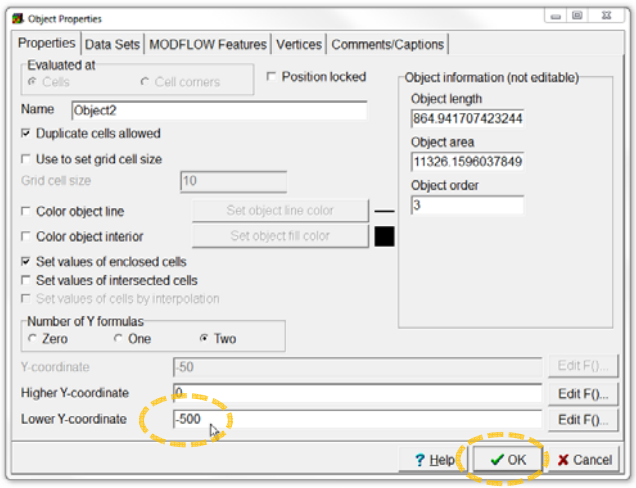
Add a front view object (2/2)

- ✓ Modify the Lower Y-coordinate to -500 in the **Object Properties** dialog box.
- ✓ Then press **OK**. Are the effects visible in all layers?





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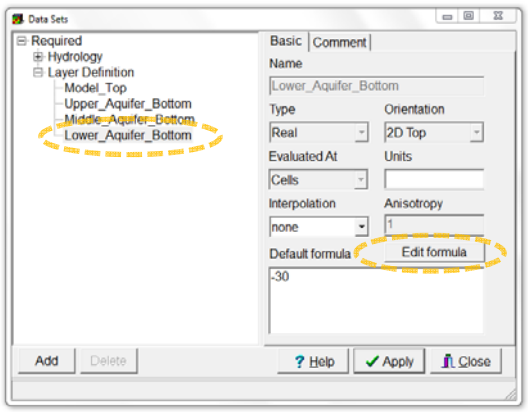
Use formula to change data set (1/2)

- ✓ Select **Data|Edit Data Sets…**,
- ✓ and expand **Required|Layer Definition**.
- ✓ Select the **Lower_Aquifer_Bottom**.
- ✓ The default formula is -30. Click the **Edit formula** button to open the **Formula Editor**.



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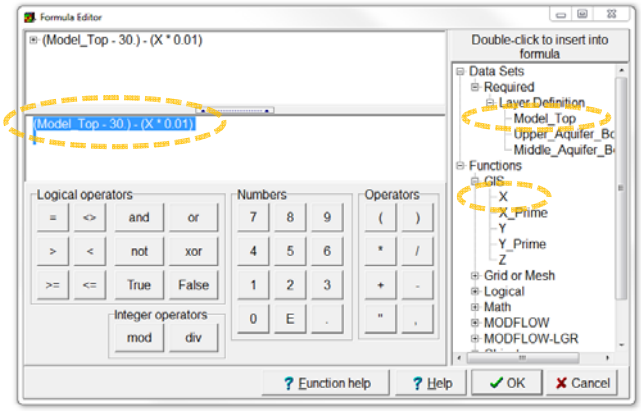
Use formula to change data set (2/2)

- ✓ On the right, expand **Data Sets|Required|Layer Definition**, and
- ✓ **Functions|GIS**, and
- ✓ double-click on the **Model_Top** data set and **X** function to insert these into the formula.
- ✓ In the edit window in the middle of the left side of the dialog box, change the formula to "(Model_Top – 30) – (X*0.01)".



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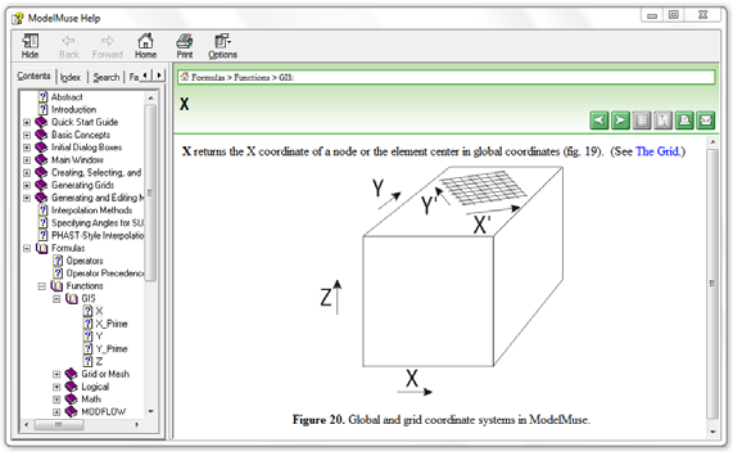
Check function help

- ✓ Before closing the **Formula Editor**, select function **X** again.
- ✓ Then click on the **? Function Help** button. This will display the help for the selected function.



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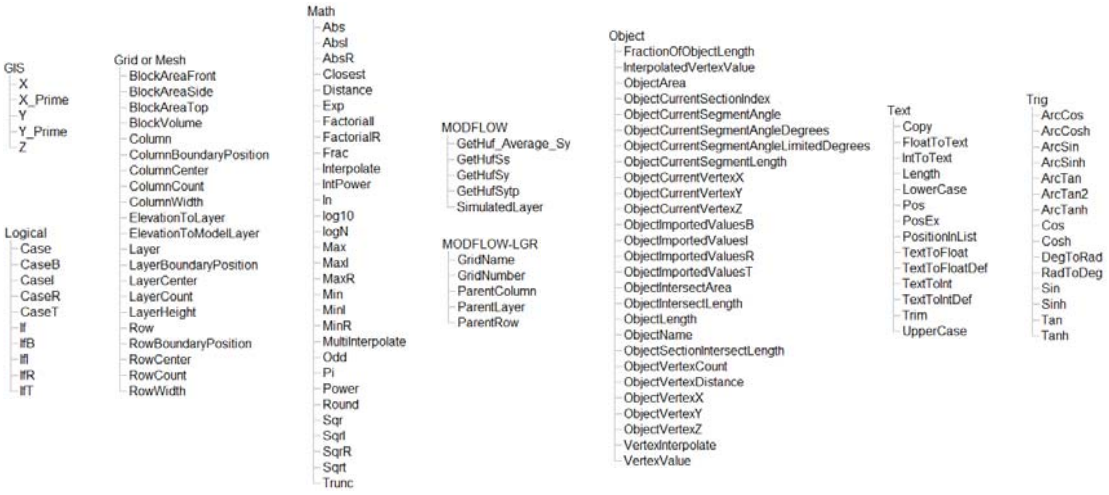
All available Functions



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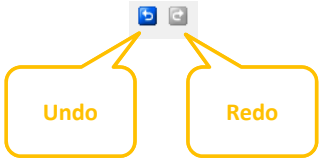
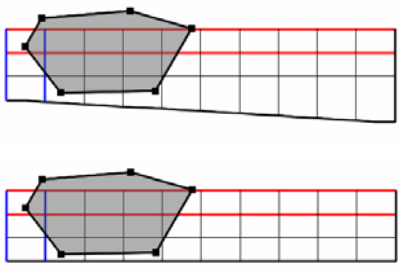
Check lower layer elevation

- ✓ Press **OK** and **Apply** to modify the **Aquifer_Bottom** formula.
- ✓ ModelMuse has undo and redo buttons. After closing the **Formula Editor** and the **Data sets** dialog box, try clicking them and check the elevation of the lower layer in the front view pane to see if it changed.





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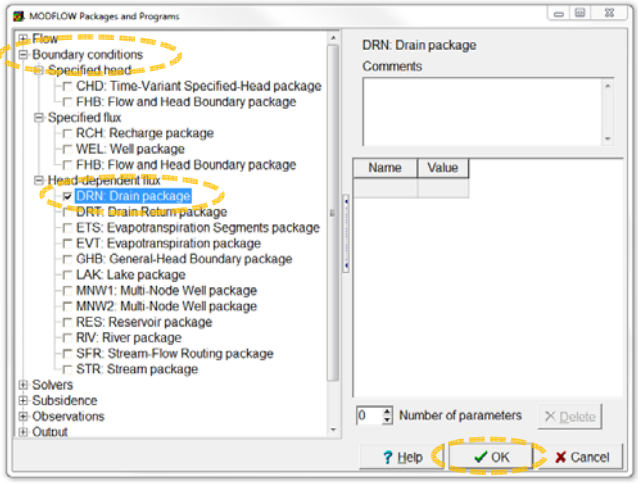
Create object to add model feature (1/2)

- ✓ Model features can only be added after activating additional packages.
- ✓ Select **Model|MODFLOW Packages and Programs…**, and
- ✓ have a look at some of the possibilities by expanding **Boundary conditions**.
- ✓ Check one of the packages, and press **OK**.



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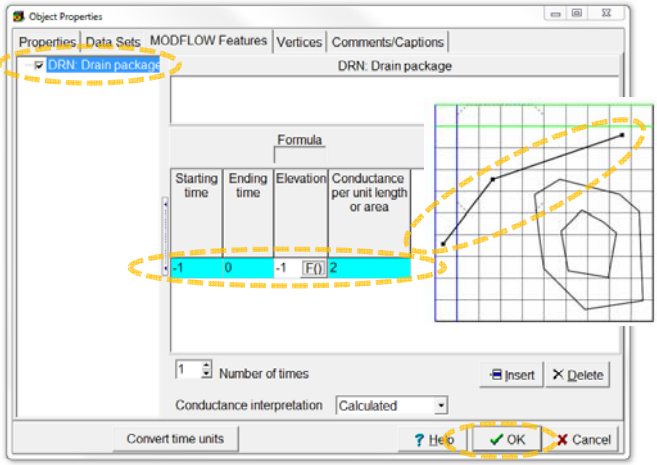
Create object to add model feature (2/2)

- ✓ Now draw another object on the grid.
- ✓ In the **Object Properties** dialog box, go to the **MODFLOW Features** tab, and select the package you just activated.
- ✓ Fill in the required feature properties, and press **OK** to add the model feature.



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Find more information in

- ✓the ModelMuse manual
- ✓the ModelMuse videos
- ✓the ModelMuse help

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BELGIUM

Education evenings 2016

Practical introduction to groundwater modelling

Computer exercises
01 02 Introduction to ModelMuse

Questions? Found an error?
Please contact B. Rogiers at brogiers@sckcen.be.

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