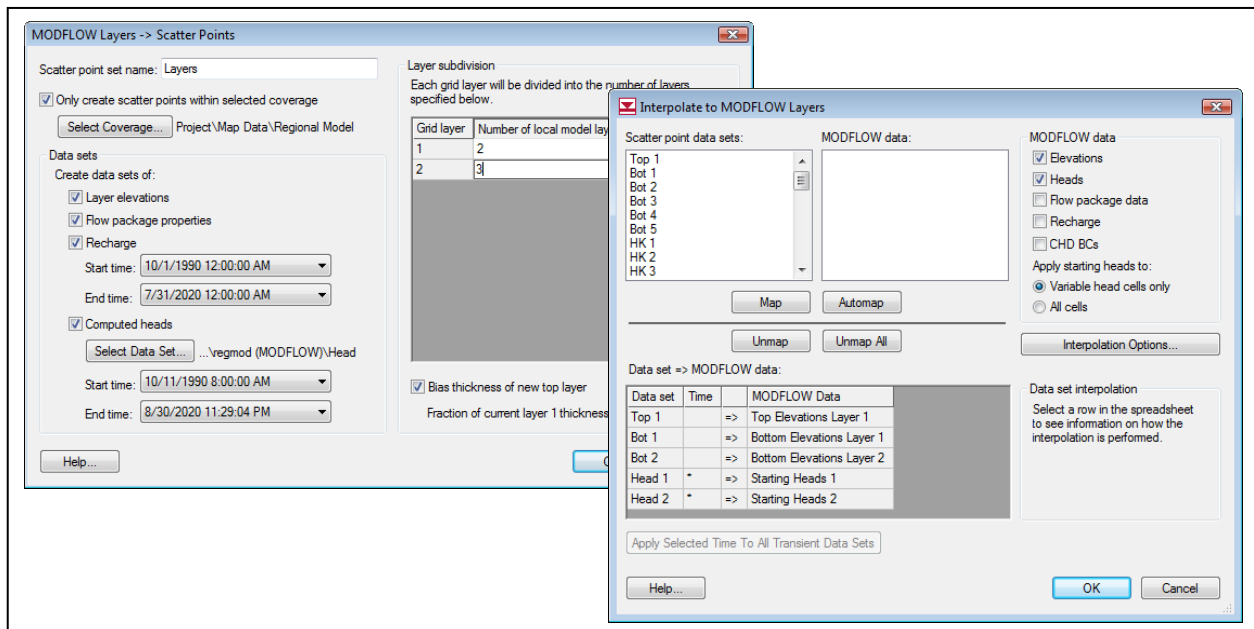*GMS 10.0 Tutorial*

MODFLOW – Regional to Local Model Conversion, Transient

Create a local model from a regional model using convenient tools provided in GMS

Objectives

Use the convenient tools provided in GMS to perform the steps involved in a typical regional to local model conversion. This tutorial uses a transient model. A steady state example is provided in the "MODFLOW – Regional to Local Model Conversion, Steady State" tutorial.

Prerequisite Tutorials

- MODFLOW – Regional to Local Model Conversion, Steady State.

Required Components

- Grid Module
- Geostatistics
- Map Module
- MODFLOW

Time

- 20-35 minutes

1 Introduction

The "MODFLOW – Regional to Local Model Conversion, Steady State" tutorial describes the basic regional-to-local conversion methods. The user should complete that tutorial prior to completing this one. This tutorial uses the same model as the one in the steady state tutorial with the exception that, in this tutorial, the model is transient. The background information and model description have been omitted from this tutorial because they can be found in the steady state tutorial.

1.1 Outline

Here are the steps of this tutorial:

1. Open a regional conceptual model.

2. Convert the layer data to a scatter point set.

3. Build a local conceptual model and create a 3D grid.

4. Map the conceptual model to a MODFLOW simulation.

5. Interpolate the layer data.

6. Run MODFLOW.

2 Getting Started

Do the following to get started:

1. If necessary, launch GMS.

2. If GMS is already running, select the *File* / **New** command to ensure that the program settings are restored to their default state.

3   Reading in the Regional Model

The first step in the model conversion process is to build a regional model. Since the focus of this tutorial is primarily on the conversion process, the user will read in a previously constructed model.

1. Select the **Open** 📂 button.

2. Locate the file entitled *Tutorials\MODFLOW\reg2loc*.

3. Select the file entitled "regmod.gpr."

4. Click **Open.**

The user is now viewing the top layer of the two-layer model. The user may wish to use the arrow buttons in the *Tool Palette* to view the bottom layer. The wells are located in the bottom layer. When finished, return to the top layer.

This model was constructed using the conceptual model approach. The boundary of the local site is indicated with a red rectangle.

The imported project includes the solution for the regional model. The user should see contours of computed head.

4   Converting the Layer Data to a Scatter Point Set

The first step in converting the regional model to a local model is to convert the MODFLOW layer data to a 2D scatter point set.

1. Select the "3D Grid Data" 🔲 folder in the Project Explorer.

2. Select the *Grid* / **MODFLOW Layers → 2D Scatter Points** command to open the *MODFLOW Layers → Scatter Points* dialog.

3. Change the *Scatter point set name* to "Regional Data."

4. Toggle on *Only create scatter points within selected coverage*.

5. Click the **Select Coverage**… button.

6. In the *Select Coverage* dialog, select the *Scatter points* coverage under *Regional Model*. (It may be necessary to expand the "Regional Model" item.)

7. Click **OK**.

8. Toggle on *Bias thickness of new top layer*.

9. In the spreadsheet on the right, change the *Number of local model layers* for grid layer 1 to "2" and grid layer 2 to "3."

10. Toggle on the following options:

    - *Layer Elevations*

    - *Flow package properties*

    - *Recharge*

    - *Computed heads*

11. Click the **Select Dataset …** button to open the *Select Dataset* dialog.

12. Select the "Head" dataset under "regmod (MODFLOW)" item.

13. Click **OK**.
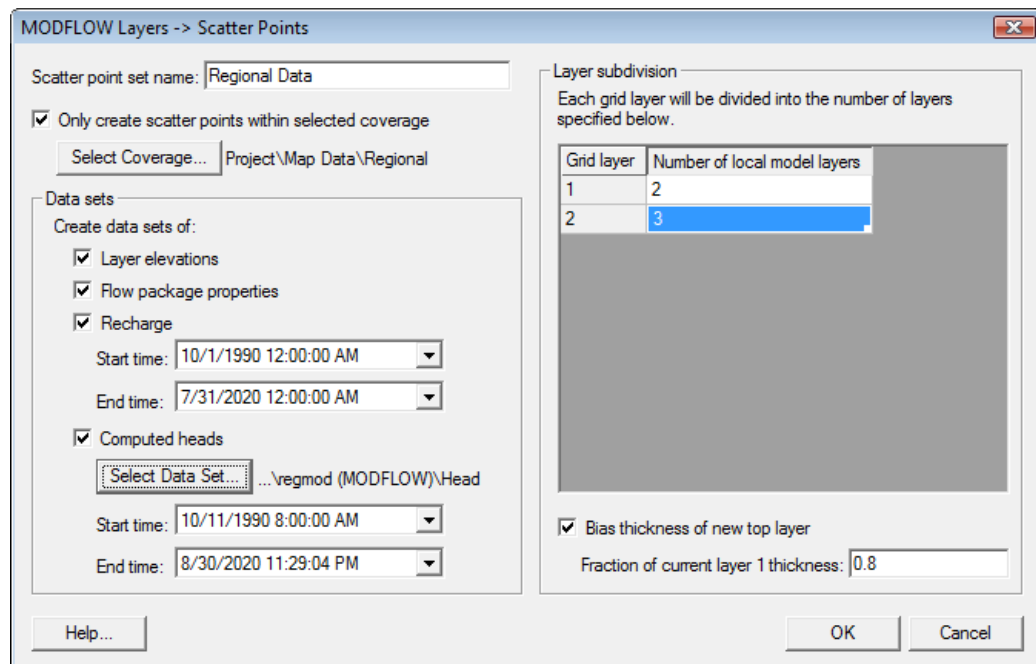
The dialog should look like this.

Figure 1   MODFLOW Layers → Scatter Points dialog

14. Select the **OK** button to exit to the dialog.

The user should see a set of scatter points appear at the location of the cell centroids. This scatter point set has a dataset for the computed heads, recharge, hydraulic conductivity, and the top and bottom elevations of the model layers.

5   Building the Local Conceptual Model

The simplest way to build the local model is to create a conceptual model in the *Map* module. To do this, the user will create a new conceptual model.

1. Right-click on the "Map Data" folder in the Project Explorer.

2. Select **New Conceptual Model** command.

3. Change the name to "Local Model."

4. Select **OK**.

5.1   Creating a New Coverage

Next, create a new source/sink coverage.

1. Right-click on "Local Model" item in the Project Explorer.

2. Select the **New Coverage** command to open the *Coverage Setup* dialog.

3. Change the *Coverage name* to "local ss."

4. In the *Sources/Sinks/BCs* list, turn on *Layer Range* and *Specified Head (CHD)*.

5. Change the *Default layer range* to be "1" to "5."

6. Select the **OK** button.

5.2   Creating the Boundary Arcs

Next, create the boundary arcs. First, it is necessary to zoom in on the local site model:

1. Select the **Zoom** tool.

2. Drag a box around the local site boundary (the red rectangle).

3. Select the "local ss" coverage in the Project Explorer to make it the active coverage.

Create the boundaries as follows:

4. Select the **Create Arc** tool.

5. Create one arc to form a rectangle on top of (or close to) the red rectangle in Figure 2. If the red rectangle isn't visible, the user needs to toggle on "Annotation Data" in Project Explorer.
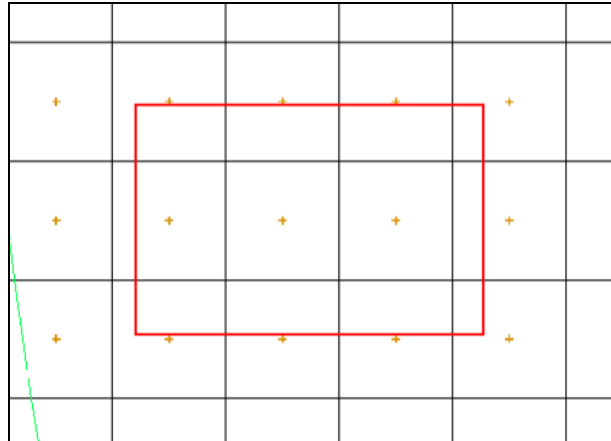
Figure 2   Arcs to be created on boundary of local model

5.3   Building the Polygon

Next, use the arcs to build a polygon defining the model domain.

1. Select the *Feature Objects* / **Build Polygons** command.

5.4   Marking the Specified Head Arcs

The next step is to mark the specified head boundaries.

1. Select the **Select Arcs** tool.

2. Select the boundary arc of the model.

3. Select the **Properties** button to open the *Attribute Table* dialog.

4. In the spreadsheet change the *Type* to "spec. head (CHD)."

5. Select the **OK** button.

6   Creating the Local MODFLOW Model

It is now possible to convert the conceptual model to a grid model. First, the user will create a new grid frame that fits the local model.

1. In the Project Explorer, right-click on the empty space.

2. From the pop-up menu, select the *New* / **Grid Frame** command.

3. Right-click on the *Grid Frame* in the Project Explorer.

4. Select the **Fit to Active Coverage** command from the pop-up menu.

5. If desired, the user can use **Grid Frame** tool to position the grid frame to better match the local grid boundary.

6.1   Creating the Grid

Next, create the grid.

1. In the Project Explorer, right-click on the *Grid Frame* and select the *Map To* / **3D Grid** command.

2. Select **OK** twice to confirm deletion of the existing grid and the MODFLOW data.

3. In the *Create Finite Difference Grid* dialog, enter "60" for the number of cells in the *X-Dimension*.

4. Then enter "40" for the number of cells in the *Y-Dimension*.

5. Enter "5" for the number of cells in the *Z-Dimension*.

6. Select **OK** to create the grid.

The user should see a grid appear. The user can zoom in to examine the grid.

7. Select the **Zoom** tool.

8. Drag a box around the grid.

6.2   Creating a New MODFLOW Model

Next, inactivate the exterior cells.

1. Select the "3D Grid Data" folder in the Project Explorer.

2. Select the *MODFLOW* | **New Simulation** command.

3. In the *MODFLOW Global / Basic Package* dialog, select **Packages** button.

4. In the *MODFLOW Packages* dialog, toggle on CHD1 - *Time var. spec. head* and RCH1 - *Recharge*.

5. Select **OK** to return to *MODFLOW Global/Basic Package* dialog.

6. Switch model type to *Transient*.

7. Select the **Stress periods** button.

8. Make sure the *Use dates/times* option is turned on.

9. Change the *Number of stress periods* to "7."

10. Enter the following times and number of time steps for the stress periods:

	Start	*Num time steps*
1	**4/15/1991 12:00:00 AM**	**3**
2	**4/20/1991 12:00:00 AM**	**4**
3	**4/30/1991 12:00:00 AM**	**6**
4	**5/20/1991 12:00:00 AM**	**10**
5	**7/19/1991 12:00:00 AM**	**20**
6	**10/17/1991 12:00:00 AM**	**30**
7	**4/15/1992 12:00:00 AM**	**40**
End	**12/1/1993 12:00:00 AM**	

11. Select the **OK** button to exit the *Stress Periods* dialog.

12. Select the **OK** button to exit the *MODFLOW Global/Basic Package* dialog.

6.3   Inactivating Cells

1. Select the "Map Data" folder in the Project Explorer.

2. Select the *Feature Objects* | **Activate Cells in Coverage(s)** command from the menu.

If the arcs match the grid boundary closely, the user may not see any cells inactivated. If, however, the grid extends significantly beyond the arcs, some cells will be inactivated.

6.4   Mapping the Properties

Next, convert the MODFLOW data to the grid.

1. Right-click on the "Local Model" conceptual model in the Project Explorer.

2. Select the *Map to* | **MODFLOW/MODPATH** from the menu.

3. Select **OK** at the prompt to map *All applicable coverages*.

7   Interpolating the Layer Data

The final step in the conversion process is to interpolate the regional data from the scatter points to the MODFLOW layer arrays.

1. Right-click on the "Regional Data" *s*catter set in the Project Explorer.

2. Select the *Interpolate To* | **MODFLOW Layers** command to open the *Interpolate to MODFLOW Layers* dialog.

3. Toggle on the following options:

   - *Flow package data*

   - *Recharge*

   - *CHD BCs*.

4. Click the **Automap** button. GMS will automatically map datasets to MODFLOW layers.

5. Select the **OK** button.

It will take a few moments for GMS to interpolate from the scatter points to the MODFLOW arrays. Now that the user is done using the scatter points, turn them off to make it easier to see the grid.

6. Uncheck the box in the Project Explorer next to the "2D Scatter Data" folder.

8   Saving and Running the Local Model

It is now possible to save the MODFLOW model and run the simulation.

1. Select the "3D Grid Data" folder in the Project Explorer.

2. Select the *File |* **Save As** command.

3. Change the project name to "locmod."

4. Click the **Save** button.

To run MODFLOW:

5. Select the *MODFLOW |* **Run MODFLOW** command.

6. When the simulation is finished, select the **Close** button.

The user should see a set of head contours that closely resemble the head contours from the regional model. At this point, the local flow model is complete and the injection and extraction wells could be added for the pump and treat simulations.

9   Conclusion

This concludes the "MODFLOW – Regional to Local Model Conversion, Transient" tutorial. Here are the key concepts in this tutorial:

- The *Grid* | **MODFLOW Layers → 2D Scatter Points** command converts the MODFLOW elevation, flow package properties, recharge, and computed heads data into scatter points.

- The basic steps for conducting a regional-to-local model conversion in GMS are as follows:

    1. Generate the regional model and compute a solution.

    2. Use the **MODFLOW Layers → 2D Scatter Points** command to create the scatter point set with the layer and head data from the regional model.

    3. Create the 3D grid for the local scale model.

    4. Interpolate the heads and layer data values from the scatter points to the MODFLOW layer arrays for the local scale model.