GMS TUTORIALS

GIS Module

The GIS module can be used to display data from a GIS database directly in GMS without having to convert that data to GMS data types. Native GMS data such as grids and boreholes can be displayed along with the GIS data. The GIS module can also be used to select a portion of the GIS data and convert it to GMS data types to be used in constructing a groundwater model. Currently the GIS module can only be used for steady state data.

If you have a license of ArcObjects® installed on your computer, many features available in ESRI® software (such as ArcMap®) become available in GMS. If you do not have a license of ArcObjects® installed, you can still use the GIS module, but many features will not be available. You can still import and display shapefiles and convert them to GMS feature objects. For a full list of the features available in the different modes, refer to the GMS Help.

This tutorial will introduce you to the GIS module. There are two parts to the tutorial. The first part shows the features available to you if you don't have a license of ArcObjects® installed on your computer. The second part shows the features available if you do. You will not be able to complete the second part if you do not have a license of ArcObjects® installed on your computer.

1.1 Outline

This is what you will do:

1. Open a shapefile.
2. View the attribute table.
3. Convert the shapefile to scatter points.
4. Enable ArcObjects and read in some layers and shapefiles.

5. Convert the shapefile to feature objects.

1.2 Required Modules/Interfaces

You will need the following components enabled to complete this tutorial:

- Map, GIS

You can see if these components are enabled by selecting the *File | Register* command.

2 Part 1 - Without ESRI® ArcObjects®

We will import a point shapefile containing well data. Then we will create scatter points from the shapefile points. Next we will create a GMS MODFLOW conceptual model in the Map module, and create a coverage with well attributes. Then we will convert the shapefile to GMS wells that we could use to help build a model. This will illustrate how GIS data can be imported and converted to GMS data.

3 Getting Started

If you have not yet done so, launch GMS. If you have already been using GMS, you may wish to select the *File | New* command to ensure the program settings are restored to the default state.

4 Reading the Shapefile

The first step is to read the shapefile.

1. Select the *Open* button .
2. Locate and open the directory entitled: **tutfiles\GIS\gismodule**
3. In the *Open* dialog, change the *Files of type* to **Shapefiles (*.shp)**.
4. Select the file entitled **arcmap.shp** and select the *Open* button.

5 Viewing the Shapefile

You should now see a number of points displayed on the screen. These are the wells in the shapefile.

1. Select the *GIS Layers* Folder in the *Project Explorer*.
2. In the *Project Explorer*, expand the *GIS Layers* folder if necessary.

Notice the **arcmap.shp** object in the Project Explorer. This is the shapefile we just opened.

Without ESRI® ArcObjects®, we have only a limited set of options for displaying the shapefile.

3. Select the *Display Options* button.
4. Click on the button displaying the point symbol style.
5. Change the point radius and color. Click *OK* to exit all dialogs.

Notice that the point color has changed.

6 Viewing the Attribute Table

The shapefile we opened has a number of attributes associated with each point. Let's take a look at them.

1. In the *Project Explorer*, right-click on the **arcmap.shp** object.
2. Select the *Attribute Table* command from the pop-up menu.
3. Resize the dialog by dragging the bottom right corner out so you can see more of the data.

There are number of attributes (columns) associated with each point. Notice the data is not editable.

4. Click *OK* to exit the dialog.

7 Converting the Shapefile to 2D Scatter Points

Now we will convert the GIS data to 2D scatter points that we can use to perform interpolations.

1. In the *Project Explorer*, right-click on the **arcmap.shp** object.
2. Select the *Convert to 2D Scatter Points* command from the pop-up menu.

You should see some new symbols appear on the screen. These are the new 2D scatter points.

3. If necessary, expand the *2D Scatter Data* folder.

Notice the **arcmap.shp** 2D scatter point set that we just created.

4. Expand the **arcmap.shp** data set .

Notice that GMS automatically created a data set from each numeric attribute in the attribute table. You could use this procedure to create scatter points and then interpolate from the scatter points to a grid. If you had water level information for each point, for example, you could create a starting head data set for your model.

We won't do anything more with the scatter points, so we'll delete them now.

5. In the *Project Explorer* right-Click on the *2D Scatter Data* Folder and select *Delete* from the pop-up menu.

Now we will convert the GIS data to GMS feature objects that we could use to build a conceptual model. First we must create a default conceptual model and coverage with the appropriate attributes.

7.1 Creating the Conceptual Model

1. In the *Project Explorer* right-click on the empty space and then, from the pop-up menu, select the *New* | *Conceptual Model* command.

2. Change the *Name* to **Model1**.

3. Make sure the *Model* is set to **MODFLOW** and click *OK*.

4. In the *Project Explorer*, right click on the **Model1** Conceptual Model and select the *New Coverage* command from the pop-up menu.

5. Rename the new coverage **coverage1**.

6. Select the *Wells* option in the list of *Sources/Sinks/BCs* and click *OK*.

7.2 Mapping the GIS Data

1. Select the *GIS Layers* Folder in the *Project Explorer*

2. Select the *GIS* | *Shapes* → *Feature Objects* command.

3. Click *Yes* to confirm that we want to use all visible shapes.

At this point, the *GIS to Feature Objects Wizard* appears.

4. Click *Next*.

5. In the WELLNAME column, change the mapping to **Name**.

6. In the PUMPRATE column, change the mapping to **Flow rate**.

7. Click *Next*.

8. Click *Finish*.

Feature points now exist in the same location as the GIS points, but since they're in the same locations, you probably won't notice any difference in the display.

9. Uncheck the **arcmap.shp** object in the *Project Explorer*.

10. In the *Project Explorer*, right-click on **coverage1** and select the *Attribute Table* command from the pop-up menu.

This dialog shows the properties of all the feature points in the coverage. Notice that the names and flow rates were transferred from the GIS attributes, just like we specified. However, the points are all of type NONE. We need to make them wells.

11. Find the spreadsheet cell corresponding to the *All* row and the *Type* column. Change the type to *Well*. Since this is the *All* row, all of the points are changed to wells.

12. Click *OK*.

7.3 Part 1 Conclusion

At this point we have well points that we could use as we further construct a MODFLOW conceptual model. This topic is further discussed in the tutorial entitled *MODFLOW – Conceptual Model Approach* and will not be discussed further here.

8 Part 2 - With ESRI® ArcObjects®

If you have a license of ArcObjects® installed on your computer or on your network, you can proceed through part 2 of this tutorial If you have ESRI® software like ArcGIS® installed then you should have a license of ArcObjects® available. If you don't know if you have a license of ArcObjects®, the tutorial will show you how you can tell.

Many more features in the GIS module are available if you have a license of ArcObjects®. This part of the tutorial introduces those features.

9 Enabling ArcObjects

We will delete everything we have done so far and enable ArcObjects

1. Select the *New* button .

2. Select *No* at the prompt to save changes.

3. Switch to the *GIS module* .

4. Select the *GIS* | *Enable ArcObjects* menu command.

If a check mark appears next to the menu command you have a license of ArcObjects installed on your computer, and you can continue with the tutorial.

10 Reading the Data

The first step is to read the required data

1. Select the *GIS* | *Add Data* command.
2. Locate and open the directory entitled: **tutfiles\GIS\gismodule**
3. Select the files entitled **streams.shp, Ndavis.tif.lyr, Sdavis.tiff.lyr and recharge.shp, area_interest.shp**.
4. Select the *Add* button.

11 Viewing the Shapefile

The display order of the different layers is controlled by the order of the items in the Project Explorer. We will now arrange the data so that it can be viewed easily.

1. In the *Project Explorer*, expand the *GIS Layers* folder if necessary.
2. In the *Project Explorer,* right-click on the *area_interest* shapefile and select the *Zoom To Layer* command.
3. In the *Project Explorer* arrange the items in the order shown in the figure below (Figure 11-1) to adjust the display order in the *Graphics Window*.

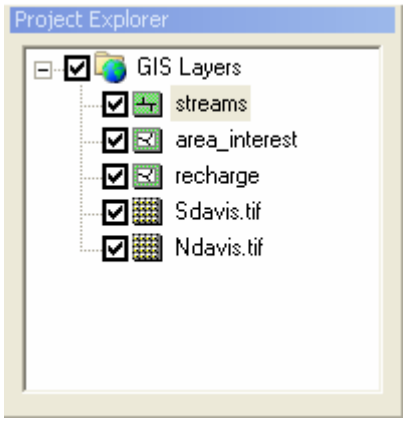

Figure 11-1 GIS display order

With ESRI® ArcObjects®, we have an expanded set of options for display. First we will change the display of the stream layer.

4. In the *Project Explorer,* right-click on the *streams* shapefile and select the *Properties* command.

5. Select the *Symbology* tab.

6. Select the button in the *Symbol* section.

7. Select the **River** type from the *Symbol* selector and select *OK*.

8. Select *OK* to exit the properties dialog.

To better see the background images we will now increase the transparency of the recharge layer, and we turn off the fill color for the area of interest layer.

9. In the *Project Explorer,* right-click on the *recharge* shapefile and select the *Set Layer Transparency* command.

10. Change the transparency to 50 % and hit OK.

11. In the *Project Explorer,* right-click on the *area_interset* shapefile and select the *Properties* command.

12. Select the *Symbology* tab.

13. Select the button in the *Symbol* section.

14. Select the **Hollow** type and change the *Outline Color* to **Red**.

15. Select *OK* twice to exit both dialogs.

12 Converting the Shapefile to Feature Objects

Now we will convert the GIS data to GMS feature objects that we could use to build a conceptual model. First we must create a default conceptual model and coverages with the appropriate attributes.

12.1 Creating the Conceptual Model

1. In the *Project Explorer* right-click on the empty space and then, from the pop-up menu, select the *New | Conceptual Model* command.

2. Change the *Name* to **Model1**.

3. Make sure the *Model* is set to **MODFLOW** and click *OK*.

4. In the *Project Explorer*, right click on the **Model1** Conceptual Model and select the *New Coverage* command from the pop-up menu.

5. Rename the new coverage to **Rivers**.

6. Select the *River* option in the list of *Sources/Sinks/BCs* and Click *OK*.

7. In the *Project Explorer*, right click on the **Model1** Conceptual Model and select the *New Coverage* command from the pop-up menu again.

8. Rename the new coverage to **Recharge**.

9. Select the *Recharge rate* option in the list of *Areal Properties* and click *OK*.

12.2 Mapping the GIS Data

We will first map the *streams* shapefile to the *Rivers* coverage. We will only Map objects that are within the area of interest by selecting items to map by their location.

1. In the *Project Explorer* select the *Rivers* coverage to make it the active coverage.

2. Select the *GIS Layers* Folder in the *Project Explorer*

3. Select the *Selection* | *Select by Location* menu command.

4. Make sure the dialog matches the following figure (Figure 12-1) and select *Apply*.

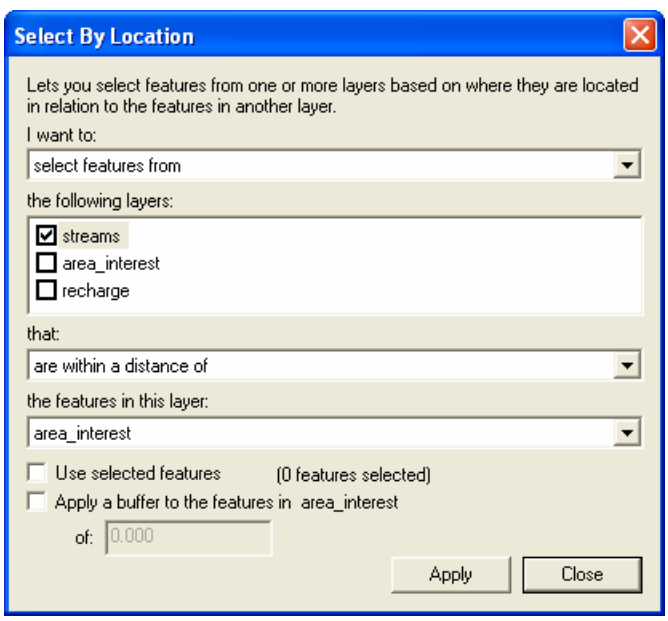

Figure 12-1 Select streams features by location

5. Click *Close*.

6. Select the *GIS* | *ArcObjects* → *Feature Objects* command.

At this point, the *GIS to Feature Objects Wizard* appears.

7. Click *Next*.
8. In the TYPE column, change the mapping to **Type**.
9. In the NAME column, change the mapping to **Name**.
10. Click *Next*.
11. Click *Finish*.

Feature arcs now exist that represent the rivers in the same location as the GIS arcs. We will now map the *recharge* shapefile to the *Recharge* coverage.

12. In the *Project Explorer* Select the *Recharge* coverage to make it the active coverage.
13. Select the *GIS Layers* Folder in the *Project Explorer*
14. Select the *Selection* | *Select by Location* command.
15. Make sure the dialog matches the following figure (Figure 12-2) and select *Apply*.

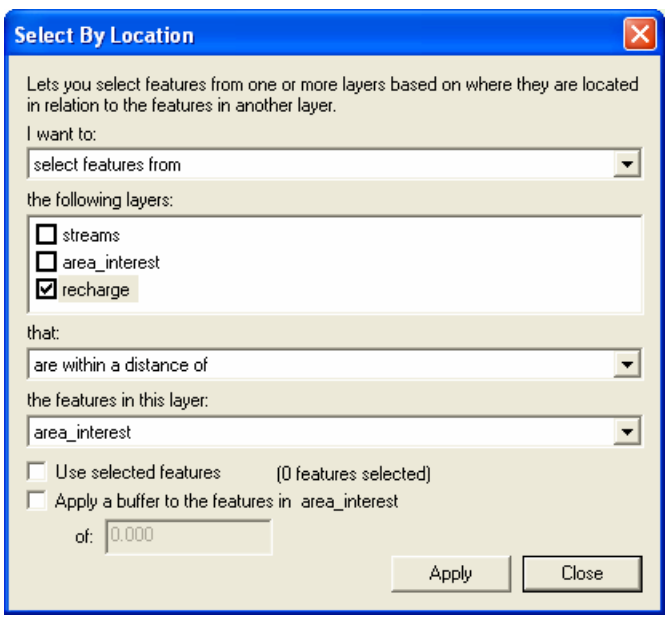

Figure 12-2 Select recharge features by location

16. Click *Close*.
17. Select the *GIS* | *ArcObjects* → *Feature Objects* command.

At this point, the *GIS to Feature Objects Wizard* appears.

18. Click *Next*.

19. In the RECH_RATE column, change the mapping to **Recharge rate**.

20. Click *Next*.

21. Click *Finish*.

Feature polygons now exist in the same location as the GIS polygons.

22. Uncheck the **GIS layers** folder in the *Project Explorer*.

23. In the *Project Explorer*, right-click on **Recharge** and select the *Attribute Table* command from the pop-up menu.

24. Change the *Feature type* to **Polygons**.

This dialog shows the properties of all the feature polygons in the coverage. Notice that the recharge rates were transferred from the GIS attributes, just like we specified.

25. Click *OK*.

At this point we have river arcs and recharge polygons that we could use as we further construct a MODFLOW conceptual model. This topic is further discussed in the tutorial entitled *MODFLOW – Conceptual Model Approach* and will not be discussed further here.

13 Conclusion

This concludes the tutorial. Here are the things that you should have learned in this tutorial:

- You can import ArcView Shapefiles into GMS without having a license of ArcView on your computer.
- You can convert Shapefile data to GMS scatter points or feature objects.
- If you have a license of ArcObjects installed, you can use a lot of powerful GIS tools provided by ESRI directly in GMS.

