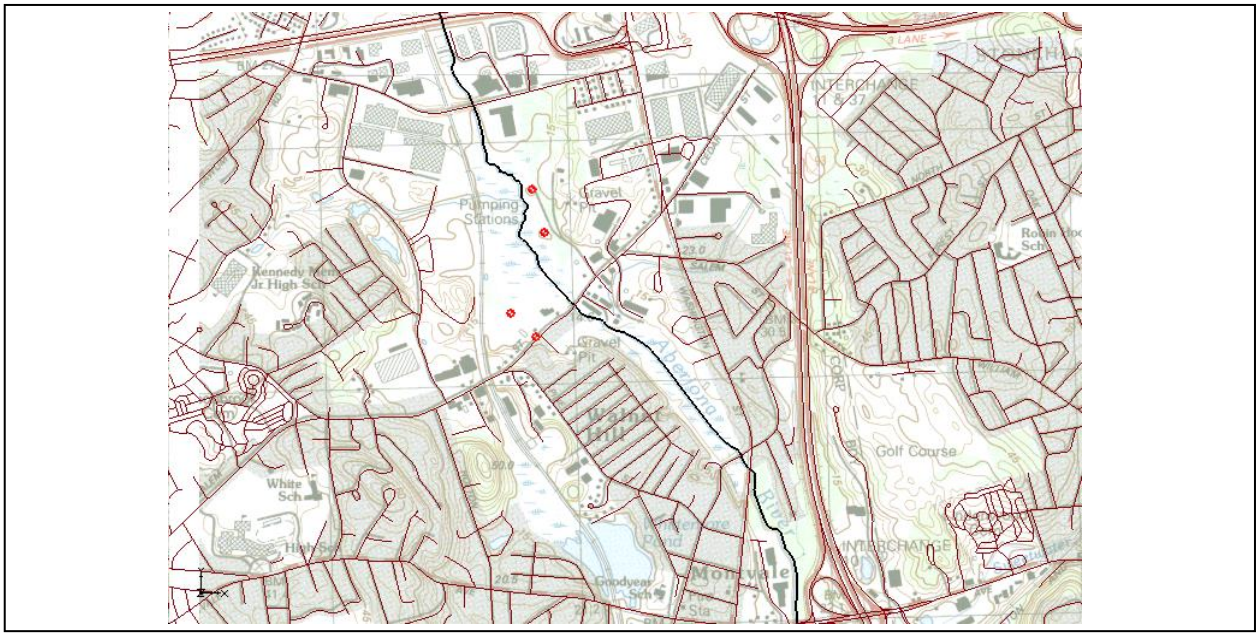
GMS

v. 10.3

GMS 10.3 Tutorial

Projections / Coordinate Systems

Working with map projections in GMS



Objectives

Learn how to work with projections in GMS, and how to combine data from different coordinate systems into the same GMS project.

Prerequisite Tutorials

- Feature Objects
- Rasters

Required Components

- Map
- GIS

Time

- 20–30 minutes

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1 Introduction

Coordinate systems and map projections provide information for locating data on the earth (georeferencing). There are two types of coordinate systems: geographic and projected.

A geographic coordinate system uses a three dimensional sphere to locate data on the Earth. Data in a geographic coordinate system is referenced using latitude and longitude. Latitude and longitude are angles measured from the Earth's center to a point on the Earth's surface.

A projected coordinate system is two dimensional based on a sphere or spheroid. Unlike a geographic coordinate system, projected coordinate systems have constant lengths, angles, and areas across the two dimensions.[1]

A PRJ file is a text file containing information describing the type coordinate system and other relevant data to position the related data on the Earth. This tutorial provides an overview of working with projected data in GMS through the following steps:

1. Importing a TIFF file and assigning a projection.
2. Learning about the Display Projection.
3. Importing a CAD file and assigning a different projection.
4. Learning about "Project on the fly".
5. Importing a shapefile with an associated projection.
6. Importing elevation data and edit points.
7. Creating a coverage and a 3D grid.

[1] Information summarized from ESRI: http://webhelp.esri.com/arcgisdesktop/9.2/index.cfm?TopicName=projection_basics_the_gis_professional_needs_to_know

2 Getting Started

To begin the tutorial, do the following:

1. Launch GMS.
2. Select *File* | **New** to restore program settings to the default state.

3 Importing an Image

Start by importing an image of an area where the model will be built. The image was downloaded from the state of Massachusetts.

1. Click the **Open** button to bring up the *Open* dialog.
2. Navigate to the *Tutorials\Basics\Projections* folder.
3. Select "Images (*.tif, *.tiff;…)" from the *Files of type* drop-down.
4. Select "q233914.tif" and click **Open** to import the image and close the *Open* dialog.
5. Move the mouse around in the Graphics Window.

Notice that the lower right corner of the image is at x=233,000 and y=914,000 (which is where the file name "q233914" comes from). This image came with a TFW file (TIFF world file); the world file gives the location and size of the pixels in the image file. However, this image did not come with a PRJ (projection) file. Notice in the bottom right corner of the GMS window the text "No projection, Feet (U.S. Survey)" (Figure 1).

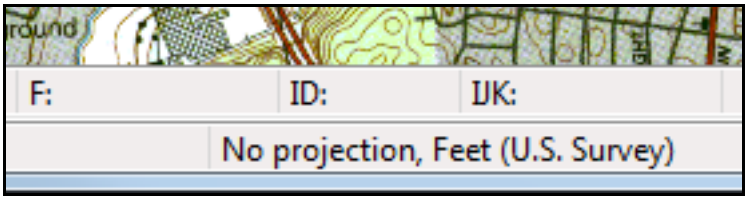

Figure 1 Projection information from GMS Window

No PRJ file was included with this image, so while GMS is able to read the world file and position the image at the correct coordinates, GMS is not able to georeference the location of the image. The projection of the image must be specified in order to georeferenced the image.

To set the projection in GMS:

1. Right-click "q233914.tif" in the Project Explorer and select *Projection* | **Projection…** to bring up the *Projection* dialog.

2. In the *Horizontal* section, select the **Global projection** radio button to bring up the *Select Projection* dialog. This dialog is used to select a projection and can also be used to export or import PRJ files.
3. Select "State Plane Coordinate System" from the *Projection* drop-down.
4. Select "Massachusetts Mainland (FIPS 2001)" from the *Zone* drop-down.
5. Select "NAD83" from the *Datum* drop-down.
6. Select "METERS" from the *Planar Units* drop-down.
7. Click **OK** to exit the *Select Projection* dialog.
8. Click **OK** to exit the *Projection* dialog.
9. Click **OK** at the prompt that explains that a projection file will be created.

A new PRJ file named "q233914.prj" is created in the same directory as the "q233914.tif" file. Any time this TIFF file is imported into GMS (or any GIS application) the PRJ file will also be imported and the image will be georeferenced.

Any time the projection is set on an image, shapefile, CAD file, or raster in GMS, a new PRJ file will be created to accompany the image file and any existing PRJ file will be overwritten.

10. Move the mouse around the Graphics Window.

Notice that the coordinates are the same as before but now the latitude and longitude are displayed as the mouse moves. The current projection, also called the "display projections", is visible in the bottom right corner of the GMS window (Figure 2).

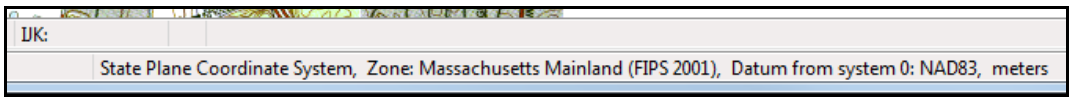

Figure 2 GMS Window with georeferenced data

When data which includes a PRJ file is imported GMS, it will set the display projection to match the information in the PRJ file. The display projection can be changed to any supported projection, though some projections are not compatible. For example, data in State Plane, Massachusetts Mainland will not display in the Philippines Grid.

The transparency of the image must now be changed so that the other data brought into the project will be easier to see.

To do this:

1. Right-click on "q233814.tif" in the Project Explorer and select **Transparency…** to bring up the *Layer Transparency* dialog.
2. Use the slider to set *Transparency* to "60%".
3. Click **OK** to exit the *Layer Transparency* dialog.

4 Importing a CAD File

To import a CAD file with the roads in the study area, do the following:

1. Select the **Open** button to bring up the *Open* dialog.
2. Select "DWG/DXF Files (*.dwg, *.dxf)" from the *Files of type* drop-down..
3. Select "roads.dwg" and click the **Open** button to import the file and close the *Open* dialog.

After importing the CAD file, the Graphics Window should appear as in Figure 3.

Figure 3 Imported CAD data

Notice that the background image has disappeared. By moving the mouse around in the Graphics Window, the displayed coordinates vary from (-71.15, 42.46) to (-71.09, 42.52), and the latitude/longitude values have changed.

Because there was no PRJ file associated with this CAD file, the data is drawn at the coordinates specified in the file. A projection for the CAD data must be specified so that it will be drawn in the correct location. This particular file has coordinates in latitude/longitude.

To set the projection:

1. Right-click on "roads.dwg" in the Project Explorer and select *Projection* | **Projection** to bring up the *Projection* dialog.
2. In the *Horizontal* section, select *Global projection* and click the **Set Projection…** button to bring up the *Select Projection* dialog.
3. Select "Geographic (Latitude/Longitude)" from the *Projection* drop-down.
4. Select "NAD83" from the *Datum* drop-down.

5. Select "ARC DEGREES" from the *Planar Units* drop-down.
6. Click **OK** to exit the *Select Projection* dialog.
7. Click **OK** to exit the *Projection* dialog.
8. Click **OK** at the prompt that explains that a projection file will be created.
9. Right-click on "roads.dwg" in the Project Explorer and select **Zoom to Extents**.

The image should now be visible behind the CAD data (Figure 4). Even though the CAD data is in a different projection from the display projection, it is positioned in the correct location. The CAD data is "projected on the fly", which involves transforming the coordinates of the CAD data from latitude and longitude to State Plane meters.

Items with a projection different from the display projection are "projected on the fly" so that they are positioned correctly.

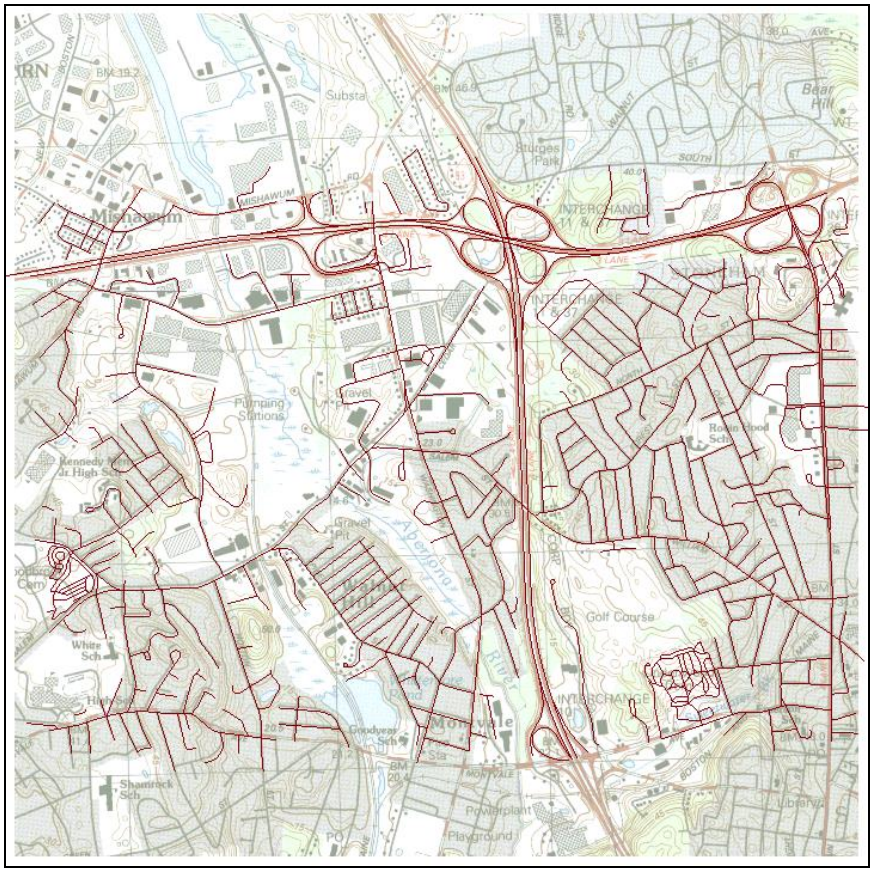

Figure 4 CAD correctly positioned after specifying the projection

If the CAD file had initially had an associated PRJ file, then the data would have already been correctly positioned in the current display projection.

5 Importing a Shapefile

A shapefile of the Aberjona River will now be imported. This shapefile uses a different projection than the display projection.

To import the shapefile:

1. Click the **Open** button to bring up the *Open* dialog.
2. Select "Shapefiles (*shp)" from the *Files of type* drop-down.
3. Select "AberjonaRiver_Clip.shp" and click **Open** to import the file and close the *Open* dialog.

The Graphics Window should appear as in Figure 5.

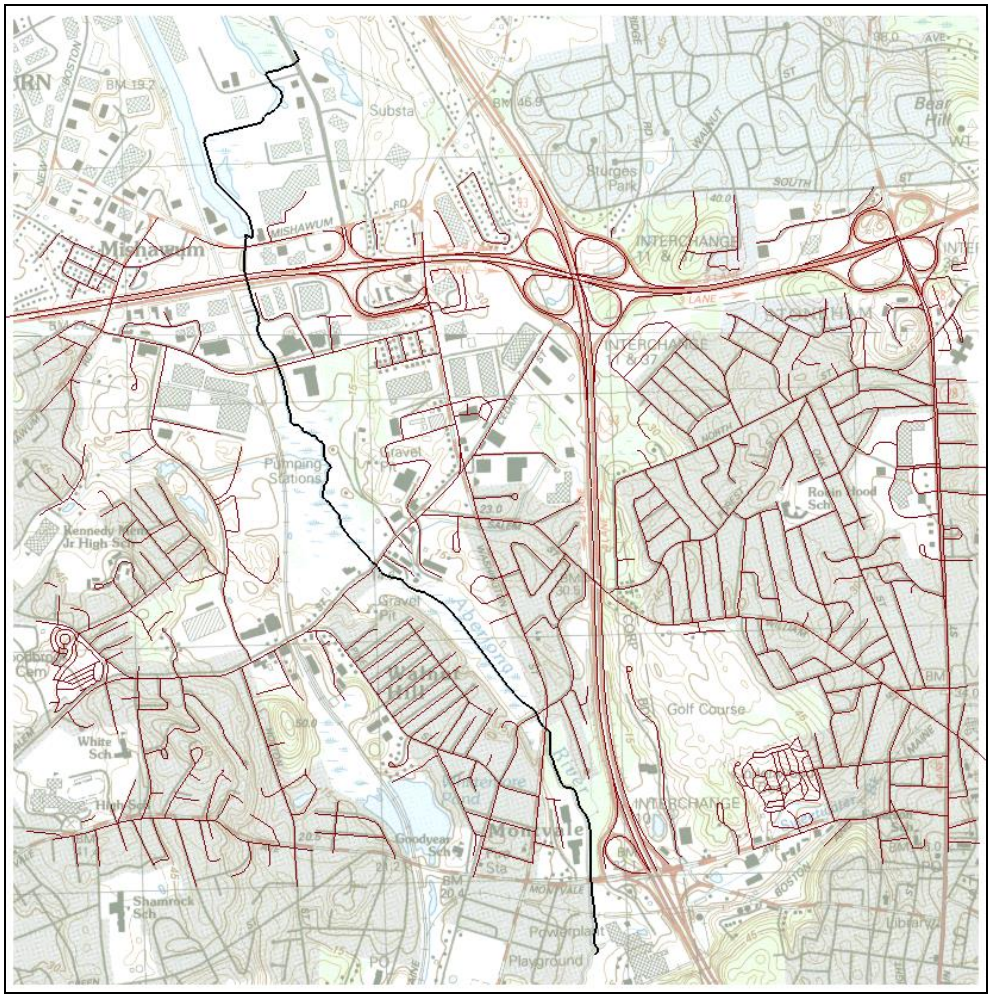

Figure 5 Aberjona River shapefile

4. Right-click on "AberjonaRiver_Clip.shp" in the Project Explorer and select *Projection* | **Projection…** to bring up the *Projection* dialog.

5. Note the projection is "UTM, Zone: 18 (78°W - 72°W - Northern Hemisphere), NAD83, feet", which was imported from the PRJ file associated with the shapefile. This allowed GMS to place the shapefile in the correct location. Select **Cancel** to exit the *Projection* dialog.

If a file is imported GMS, and the file has an associated PRJ, then the projection is imported with the file.

6 Importing Elevation Data

Next, import surface elevations into the project from a text file by doing the following:

1. Select the **Open** button to bring up the *Open* dialog.
2. Select "Text Files (*.txt, *.csv)" from the *Files of type* drop-down.
3. Select "elev.txt" and click **Open** to close the *Open* dialog and open the *Text Import Wizard – Step 1 of 2* dialog.
4. Below the *File import options* section, toggle on *Heading row*.
5. Click the **Next >** button to bring up the *Text Import Wizard – Step 2 of 2* dialog.
6. Click the **Finish** button to close the *Text Import Wizard – Step 2 of 2* dialog.

The background image and the CAD data will disappear and a small square should be visible in the Graphics Window. As with the CAD data, the elevation data is in a different projection than the display projection.

To set the projection to make the scatter set display correctly, do the following

1. Right-click on "elev" in the Project Explorer and select *Projection* | **Projection** to bring up the *Projection* dialog.
2. In the *Horizontal* section, select *Global projection* and click on the **Set Projection…** button to bring up the *Select Projection* dialog.
3. Click the **Load From File…** button to bring up the *Open* dialog.
4. Browse to the *Tutorials\Basics\Projections* directory and select "elev.prj".
5. Click **Open** to close the *Open* dialog.
6. Click **OK** to close the *Select Projection* dialog.
7. Click **OK** to close the *Projection* dialog.
8. Select "elev" in the Project Explorer and click the **Frame** macro.
9. Click the **Display Options** macro to bring up the *Display Options* dialog.
10. Select "2D Scatter Data" from the list on the left.

11. On the *2D Scatter Point Set* tab, click on the color selector button to the right of "elev" in the list below the *Contours* checkbox. This brings up the *Symbol Attributes* dialog.
12. Enter "2" in the *Size* field and click **OK** to close the *Symbol Attributes* dialog.
13. Click **OK** to close the *Display Options* dialog.

The Graphics Window should appear as in Figure 6.

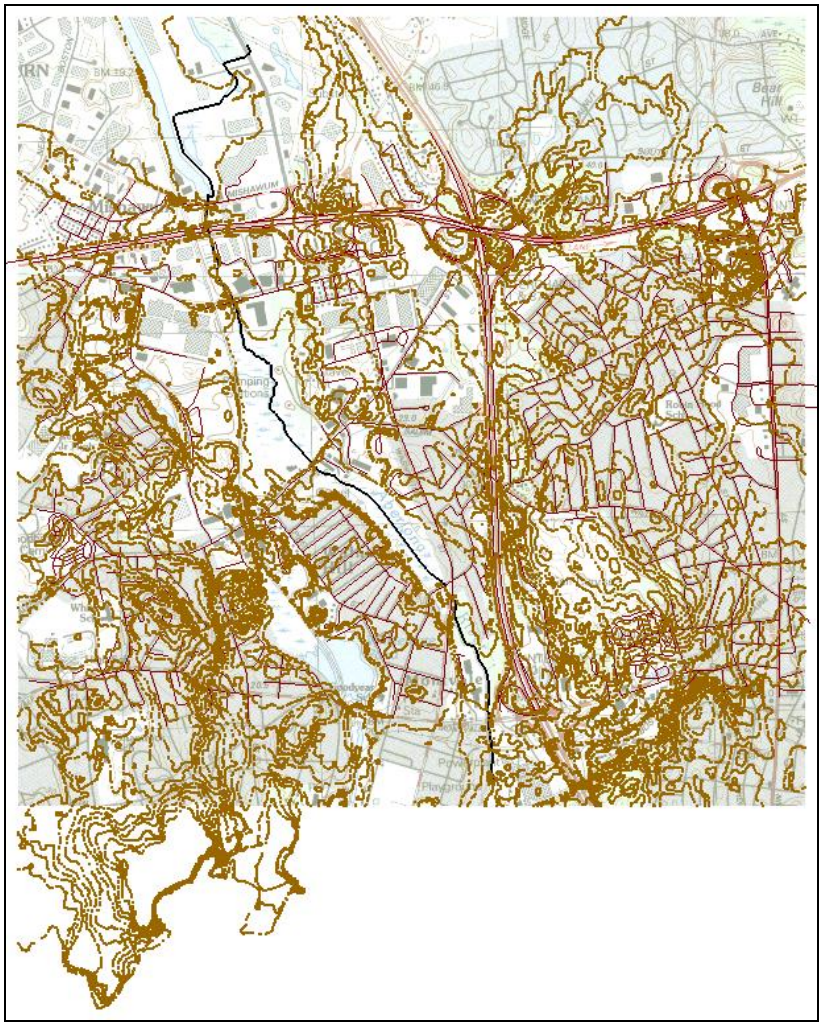

Figure 6 Imported elevation data

6.1 Editing the Scatter Points

The elevations that are in the project can be edited as follows:

1. Select "elev" in the Project Explorer to make it active.
2. Using the **Select Scatter Point** tool, select one of the scatter points in the Graphics Window by clicking on it.

3. Press the *Delete* key to delete the selected point. A prompt appears that explains that the projection of the "elev" scatter set does not match the display projection. In order to edit the points, the scatter set's projection must be the same as the display projection.
4. Select **Yes** at the prompt to change the display projection to match that of the "elev" scatter set projection.
5. **Frame** the project.
6. Press the *Delete* key again to delete the selected point.

An item in a project can be edited only if its projection matches the display projection.

7 Creating a Coverage

A coverage can be created by doing the following:

1. Right-click in a blank space in the Project Explorer and select *New* | **Coverage…** to bring up the *Coverage Setup* dialog.
2. Click **OK** to accept the default settings and exit the *Coverage Setup* dialog.
3. Right-click on "new coverage" and select *Projection* | **Projection…** to bring up the *Projection* dialog.
4. Notice that the projection for this coverage is the same as the Display Projection. Click **OK** to exit the *Projection* dialog.

When a new item is created in a GMS project, the projection of the new item will be set to match the Display Projection.

8 Creating a 3D Grid

MODFLOW simulations are common components of GMS projects. Some versions of MODFLOW use a structured grid for computations. 2D and 3D grids and grid frames in GMS are not "projected on the fly" because they must retain their rectilinear shape and cannot be warped.

Therefore, when a grid is created in a GMS project, the grid will be set to use the display projection; as long as the grid is part of the project, the display projection cannot be different than the grid's projection.

To create the 3D grid, do the following:

1. Right-click in a blank space in the Project Explorer and select *New* | **3D Grid…** to bring up the *Create Finite Difference Grid* dialog.

2. Click **OK** to accept the defaults and exit the *Create Finite Difference Grid* dialog. A grid will appear over the other items in the Graphics Window.
3. Right-click on "grid" in the Project Explorer and select *Projection* | **Projection…** to bring up the *Projection* dialog.
4. Notice that the projection for this grid is the same as the Display Projection. Click **OK** to exit the *Projection* dialog.
5. Right-click on "AberjonaRiver_Clip.shp" in the Project Explorer and select *Projection* | **Set As Display Projection**.
6. A dialog appears explaining that the display projection must match the grid projection. Click **OK** to close the dialog.

If a grid is included in a project, the display projection must match the grid's projection.

9 Conclusion

This concludes the "GMS Projections / Coordinates Systems" tutorial. The following items were discussed in the tutorial:

- GMS supports many different projections.
- GMS has a user-defined display projection.
- An item's projection can be specified in GMS and a PRJ file will be created or overwritten.
- All georeferenced data in a GMS project is drawn in the display projection; this requires "Projecting on the fly".
- Newly created items in a GMS project are assigned the display projection by default.
- To edit an item in a GMS project, the item's projection must match the display projection.
- If a grid is included in a GMS project then the display projection must match the grid's projection.

