



SMS 13.3 Tutorial

Projections / Coordinate Systems

Working with map projections in SMS



Objectives

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

Prerequisite Tutorials

- Overview
- Rasters

Required Components

- SMS Core

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 SMS through the following steps:

- Importing a TIFF file and assigning a projection.
- Learning about the Display Projection.
- Importing a CAD file and assigning a different projection.
- Learning about "Project on the fly".
- Importing a shapefile with an associated projection.
- Importing elevation data and editing points.

2 Getting Started

To begin the tutorial, do the following:


1. If SMS is already open, select **File / New** to restore program settings to the default state. If SMS is not open, skip to step 3.
2. If asked to save data, click **No**.
3. Launch SMS.

¹ Information summarized from ESRI:

http://webhelp.esri.com/arcgisdesktop/9.2/index.cfm?TopicName=projection_basics_the_gis_professional_needs_to_know

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 **Open**  to bring up the *Open* dialog.
2. Select “TIFF Image Files (*.tif, *.tiff)” from the *Files of type* drop-down.
3. Browse to the *Data Files* folder for this tutorial and select “q233914.tif”.
4. 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) that gives the location and size of the pixels in the image file. However, this image did not come with a PRJ (projection) file.

SMS was able to position the image at the correct coordinates using the data in the TFW file. However, SMS is not able to georeference the location of the image because no PRJ file was included. The projection of the image must be specified in order to georeference the image.

3.1 Setting the Projection

To set the projection in SMS:

1. Right-click on “ q233914.tif” and select *Projection | Projection...* to bring up the *Projection* dialog.
2. In the *Horizontal* section, select *Global projection* to bring up the *Horizontal Projection* dialog. If the dialog does not automatically appear, click **Set Projection...** to bring it up.

This dialog is used to select a projection and can also be used to export or import PRJ files.

3. Enter “1983 Meters Massachusetts” in the *Filter strings* edit field.
4. Select the “NAD 1983 StatePlane Massachusetts FIPS 2001 (Meters)” item from the list.
5. Click **OK** to exit the *Horizontal Projection* dialog.
6. Click **OK** to exit the *Projection* dialog.
7. Click **OK** at the prompt that explains that a new TIFF file will be created.
8. Click **Save** from the *Save As* dialog to save the new TIFF file.

A new TIFF file named “q233914_exported.tif” is created in the same directory as the “q233914.tif” file. The projection information is saved inside the new TIFF file. Any time this TIFF file is imported into SMS (or any GIS application) the image will be georeferenced.



Any time the projection is set on an image, a new image will be exported from SMS with the projection information stored in that image.


9. Move the mouse around the Graphics Window and notice the coordinates are the same as before.

When data which includes projection information is imported SMS, it will set the display projection to match the information in the 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.

3.2 Setting Transparency

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 “ q233914_exported.tif” 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.

The project should appear similar to Figure 1.

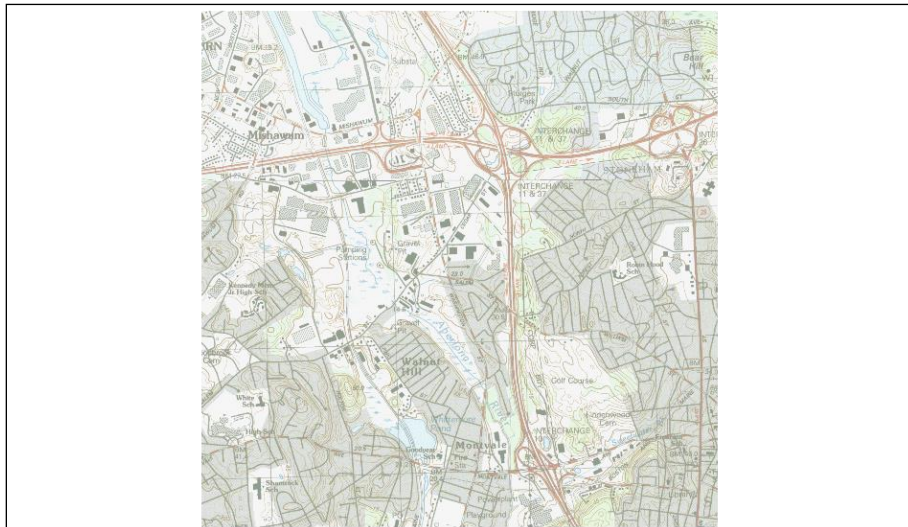



Figure 1 Map image with 60% transparency applied

4 Importing a CAD File

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

1. Click **Open**  to bring up the *Open* dialog.
2. Select “AutoCAD Files (*.dwg, *.dxf)” from the *Files of type* drop-down.
3. Select “roads.dwg” and click **Open** to import the file and close the *Open* dialog.

The CAD data is not visible because it is not georeferenced.

4. Right-click on the “roads.dwg” CAD file and select **Zoom To Extents**.

The Graphics Window should appear similar to Figure 2.



Figure 2 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:

5. Right-click on “roads.dwg” and select *Projection* | **Projection...** to bring up the *Projection* dialog.
6. In the *Horizontal* section, select *Global projection* and click **Set Projection...** to bring up the *Horizontal Projection* dialog.

Instead of searching the tree for the correct projection, enter the EPSG code to assign a geographic projection to the CAD data.

7. Select the **EPSG code...** button to open the *Projection from EPSG code* dialog.
8. Enter “4269” as the *New EPSG code*.
9. Click **OK** to exit the *Projection from EPSG code* dialog.
10. Click **OK** to exit the *Horizontal Projection* dialog.
11. Click **OK** to exit the *Projection – Project\CAD Data\roads.dwg* dialog.
12. Click **OK** at the prompt that explains that a projection file will be created.
13. **Frame**  the project.

Any time this DWG file is imported into SMS (or any GIS application), the CAD data will be georeferenced.



Any time the projection is set on a CAD file or shape file, a new PRJ file will be created to go with the original file and any existing PRJ file will be overwritten.

The map image should now be visible behind the CAD data (Figure 3). 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 3 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.

When opening the *Horizontal Projection* dialog, notice that a list of recently used projections is shown. This can be useful when assigning the same projections to multiple objects. Likewise, frequently used projections can be saved by right-clicking on the projection and selecting **Add to Favorites** which will then show the projection under the favorite projections folder.

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 **Open**  to bring up the *Open* dialog.
2. Select “AberjonaRiver_Clip.shp” and click **Open** to import the file and close the *Open* dialog.

The Graphics Window should appear similar to Figure 4.



Figure 4 Aberjona River shapefile overlaying the map image and CAD data



3. Right-click on “ AberjonaRiver_Clip.shp” in the Project Explorer and select **Set Layer Projection...** to bring up the *Projection* dialog.
4. Note the projection is “NAD_1983_2011_UTM_Zone_18N” with units of “Foot_US”, which was imported from the PRJ file associated with the shapefile. This allowed SMS to place the shapefile in the correct location.
5. Select **Cancel** to exit the *Projection* dialog.



If a file is imported into SMS and has an associated PRJ file, the projection is imported with the file.

6 Importing Elevation Data

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

1. Click **Open**  to bring up the *Open* dialog.
2. Select “elev.txt” and click **Open** to exit the *Open* dialog and bring up the *Text Import Wizard* dialog.
3. Click **Next** to go to the *Step 2 of 2* page of the *Text Import Wizard* dialog.
4. Click **Finish** to close the *Text Import Wizard* dialog.
5. Click **OK** at the prompt that says that a projection must be specified for the imported data to bring up the *Projection – Project\Scatter Data\elev* dialog.
6. Click on **Set Projection...** to bring up the *Horizontal Projection* dialog.
7. Click **.prj file...** to bring up the *Open* dialog.
8. Browse to the *Data Files* directory for this tutorial and select “elev.prj”.
9. Click **Open** to exit the *Open* dialog.
10. Click **OK** to close the *Horizontal Projection* dialog.
11. Click **OK** to close the *Projection* dialog.
12. **Frame**  the project.

The Graphics Window should appear similar to Figure 5.

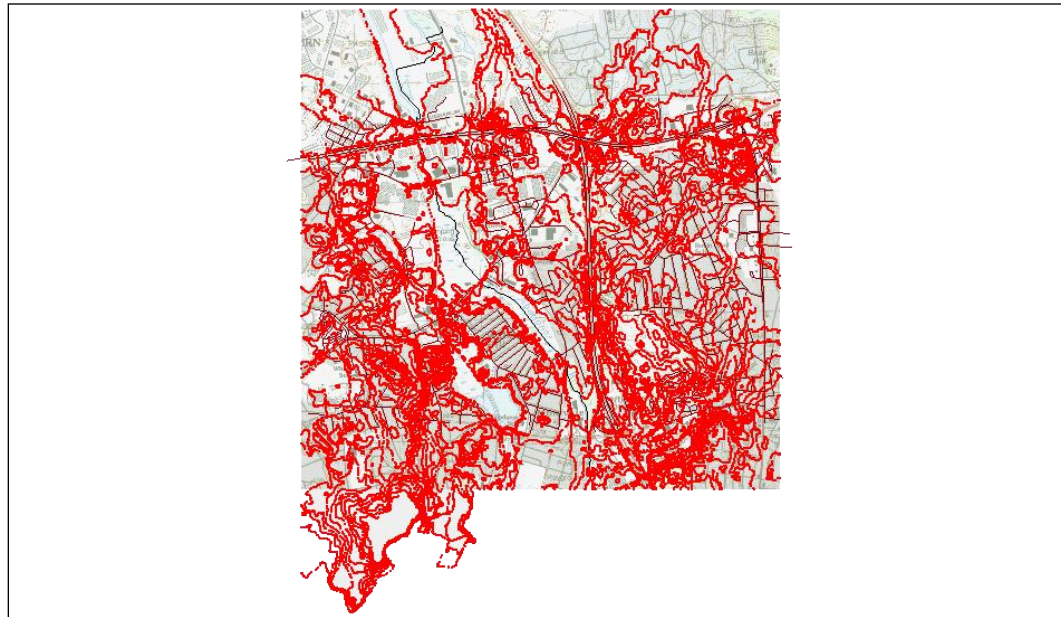





Figure 5 Imported elevation data

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. Click **Yes**.

SMS may take a few moments to change the display projection.

5. Press the *Delete* key again to delete the selected point.
6. When asked to confirm deletion of the scatter vertex, click **Yes**.




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 on “ Map Data” in the Project Explorer and select **New Coverage** to bring up the *New Setup* dialog.

2. Select *Generic* | **Mesh Generator** as the *Coverage Type* and click **OK** to exit the *Coverage Setup* dialog.
3. Right-click on “ Mesh Generator” and select **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 SMS project, the projection of the new item will be set to match the display projection.

8 Conclusion

This concludes the “Projections / Coordinates Systems” tutorial. The following key topics were discussed in this tutorial:

- SMS supports many different projections.
- SMS has a user-defined display projection.
- An item’s projection can be specified in SMS and a PRJ file will be created or overwritten.
- All georeferenced data in an SMS project is drawn in the display projection; this requires “projecting on the fly”.
- To edit an item in a SMS project, the item’s projection must match the display projection.
- Newly created items in a SMS project are assigned the display projection by default.