

Projection Exercise

Part 2 of 1.963 Lab for 9/27/04

Introduction

In this exercise, you will work with projections, by re-projecting a grid dataset from one projection into another. You will create a map showing both projections together.

Projections - Every spatial dataset is projected in some manner, to transfer the geographic coordinates of latitude and longitude on the three-dimensional earth to X and Y coordinates on a flat piece of paper. When using a dataset, we need to know what projection it is in, so that it can be properly aligned with other datasets. All the data in a GIS data view must be in the same projection in order to line up properly with all the other datasets. In ArcGIS these tasks are often done in the background, so the user does not have to worry about them. ArcGIS will use the projection of the first dataset loaded to set the projection of the view. It will then re-project each dataset on the fly to match that projection, so long as the datasets have a projection defined. If not, it will guess at what projection the data is in.

Defining a Projection - When a dataset is first acquired, it may or may not have a projection defined. If not, the user must define the projection of the dataset. This can be done most easily with the "Define Projection Wizard" tools in the ArcToolbox. Defining a projection for a dataset does not change the dataset, it simply attaches projection information to the data. To check if a dataset has a projection defined, look at its metadata using ArcCatalog, or load it into a data view in ArcMap, and look at the Data Source information in the Layer Properties Dialog to find projection information.

Changing a Projection - To project a dataset from its present projection into another projection, the location of each point (vertex, grid-cell, etc.) in the dataset must be re-calculated. This is accomplished with the "Project Wizard" in the ArcToolbox.

Items to hand in

In this lab, you will create two maps. One map will show two different projections of the same data.

The other map will show the projected version with more data added.

Each map should contain the basic elements necessary in a professional map, including all of those elements discussed in the Layout lecture which are applicable.

Please print out your maps and hand them in at the beginning of the next class.

Data

For this lab you will download the necessary data from the web, as detailed in the instructions.

If there are problems with the software in the room, such as ArcToolbox crashing like it did last week.

Software

All of this exercise can be done in the ArcMap, ArcToolbox, and ArcCatalog modules of the ArcGIS Desktop.

Each application can be found in the Start menu, under: Start >> All Programs >> ArcGIS

Downloading a Dataset

For this exercise we will use elevation data from the National Elevation Dataset (NED). The NED is a collection of elevation data which covers the entire United States. It has been processed to correct discrepancies, fill holes, match the edges of source datasets, and fill slivers of missing data. More information on the NED can be found at <http://gisdata.usgs.net/NED/About.asp>.

In the past, elevation data was most often available as Digital Elevation Models (DEMs), split by USGS topo quad sheet. In order to see the elevation of a large area, one had to download numerous DEMs and perform combining procedures to stitch them together into a single DEM.

Today, that task has been eliminated since the NED is now available through "The National Map Seamless Data Distribution System" from the USGS. The website for this seamless national map is: <http://seamless.usgs.gov>. The National Map website makes available a number of datasets, as listed below. The seamless data distribution system allows users to select an area of the country or the world, and to download seamless data for that entire area as one dataset. The system allows for data delivery via free web downloads (with size restrictions), or via CD-ROM media (for a fee).

The National Map Seamless Data Distribution System data sets (as of 9/22/03)

- National Elevation Dataset (NED)
- National Land Cover Dataset (NLCD) 1992
- Shuttle Radar Topography Mission (SRTM)
- MODIS NDVI Direct Broadcast (7-day satellite image composites)

Now, let's download a dataset.

Go to The National Map website (<http://seamless.usgs.gov>), and click on the link to: **"View and Order Data Sets - United States Viewer"**.

An ArcIMS internet mapping site will open up (see image below), with a view of the United States, and the available NED and NLCD datasets shown. You can use the tools on the left to move around the map, zoom in and out, and select features like within ArcMap. On the right are two lists of data layers. The top one is download layers. The layers selected in this list will be downloaded when you select an area with one of the download tools. The bottom list is the visible layers list, and layers selected from this list will be visible in the viewer. In order to view changes in your selections, you must click the "Refresh Map" button at the bottom of the list (scroll down).

USGS

The National Map Seamless Data Distribution System Viewer Help

Move

Zoom

Select

Misc

Download

Current Active Layer
GNIS Names (text)

Download Layers

Raster

NED

1/3" NED

NLCD

SRTM 30m

SRTM 90m

Display Legend/Layers

Layer

Visible

Hi-Res Ortho Index

BTS Roads Index

NLCD Index

1/3" NED Index

0 1149mi

Welcome to the SDDS Raster Extraction Website

Tool selected = Zoom In

[U.S. Department of the Interior](#) || [U.S. Geological Survey](#) || [EROS Data Center](#)
 URL: <http://seamless.usgs.gov/index.htm> || Maintainer: webmapping@usgs.gov || Last Modified: Fri 02 May 2002

Use the tools to zoom-in and find an area that you are interested in, such as your home, where you like to vacation, or some place you have always wanted to visit. Try to choose an area that has some elevation differences... a flat floodplain won't be a very interesting elevation dataset. Also, if you can, pick an area with features that you will be able to recognize, so that you can see the effects of projection more clearly. The area should be somewhere around 10 to 25 miles on each side, since we don't want too big a dataset for this exercise. Note which state(s) you are getting data from.

Once you have found an area you like, make sure that the NED and NLCD are selected in the Download Layers list.

Use the "Select By Rectangle" Download tool  to select the area for which you want to download data.

When you release the button, a new window will appear, and after a moment of processing, you will get a SDDS Request Summary Page containing links to download your selected data. By default, your data should be in ArcGrid format. If you wanted to

change the format of your data, the format of the metadata, the datasets selected, or other options, you can use the Modify Data Request Button.

Click on the "**Download**" link next to the NED dataset. When the data is extracted, select "**Save**" and save the Zip file it to a new directory

Find the file you downloaded using "My Computer" or "Windows Explorer", and right-click it to open the context menu. Select **7-Zip >> Extract Files**, and extract the files to your Lab4 folder. (it may automatically create a directory with the file name, which is fine).

Before closing the window with the SDDS Request Summary Page, download and extract the NLCD data set in the same way.

Examine the Data

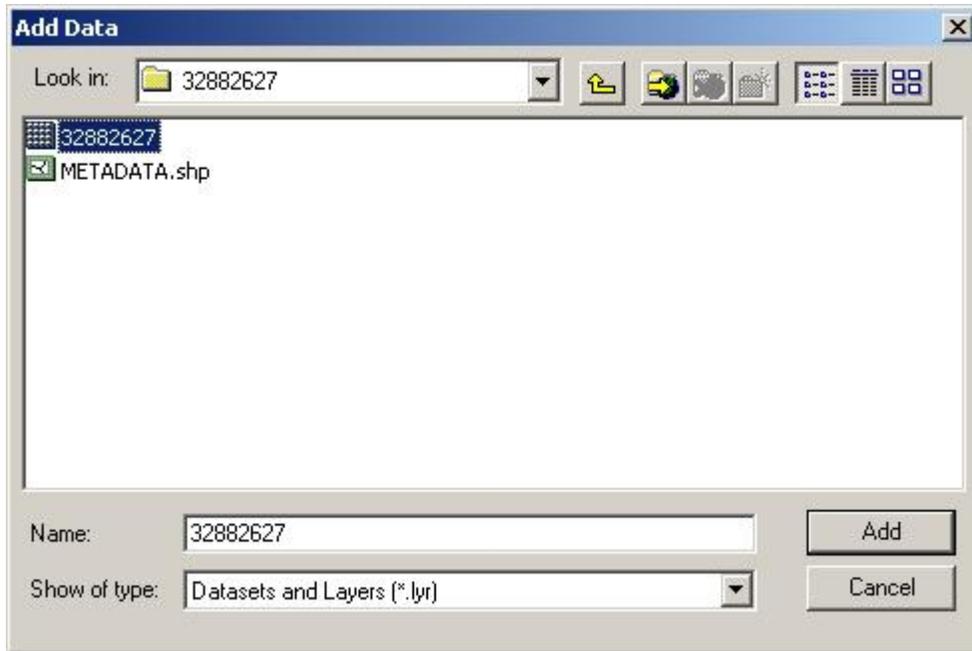
Open ArcCatalog and navigate to your newly downloaded NED dataset. You will see a grid (the actual data) and a shapefile called METADATA. This file contains polygons depicting the original DEMs from which your dataset was assembled.

Select the grid dataset and click the Metadata tab to view the metadata for the NED grid. Find the section on projections and coordinate systems. What projection is it in?

Close ArcCatalog and open **ArcMap** with a new, empty map.

Before loading any data, view the **Data Frame Properties** (under the View menu). Go to the **Coordinate System** tab. Under Current coordinate system, It should say "No Projection", indicating that no projection is defined for the data view. Close the Data Frame Properties Dialog.

Now, open the Add Data dialog and add in the NED dataset you downloaded.

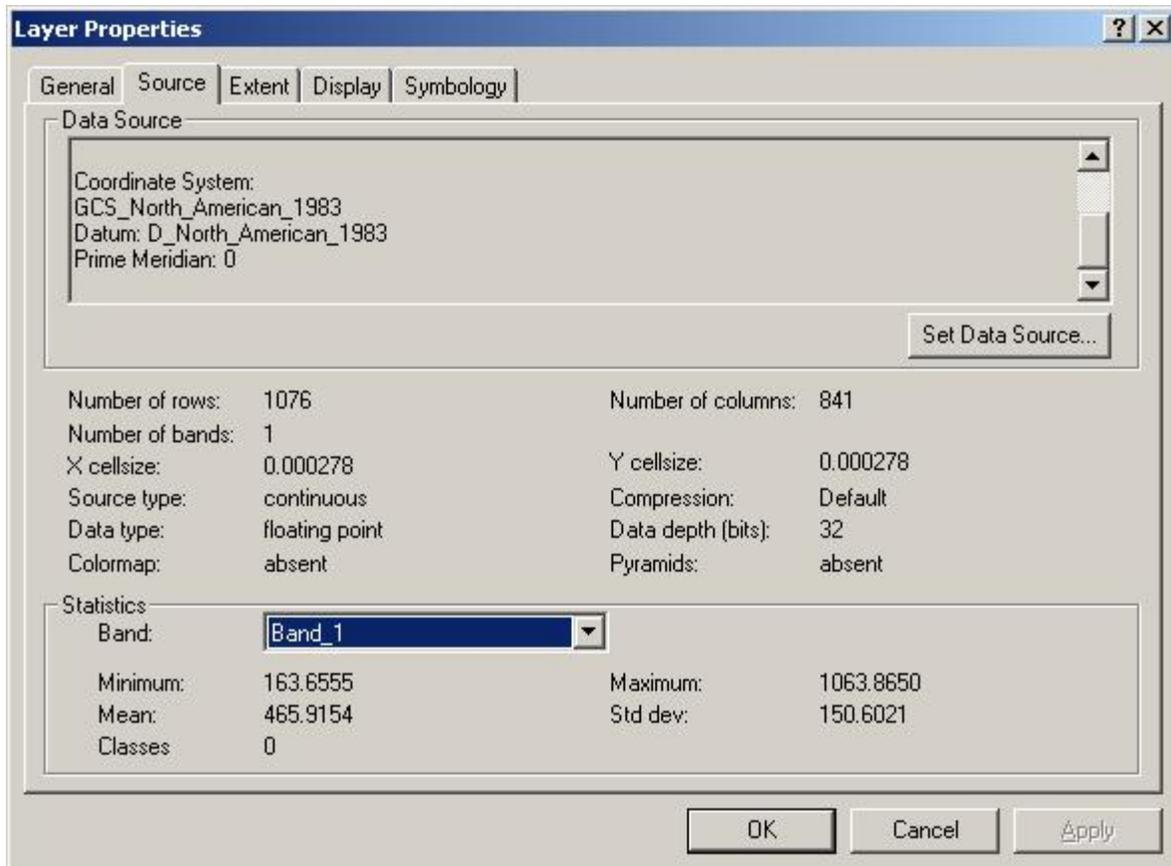


The dataset should appear on the Layers list.

Go to the new dataset's **Layer Properties** dialog (Right-click its name and select Properties from the context menu).

Go to the Source tab and scroll down the top box titled "Data Source" to see the **Coordinate System** information.

The Coordinate system should show up as "GCS_North_American_1983", as shown below:



Since there is no further projection information, this indicates that the data is in the simplest type of Latitude/Longitude projection, the "Geographic Coordinate System" (GCS). The Datum used is the North American, 1983 datum (NAD83), which is pretty standard today, although some datasets are still in the older 1927 datum (NAD27).

Close the Layer Properties Dialog and go to the Data Frame Properties dialog again. Look at the Coordinate System information again, and note that the Data Frame view has been set to GCS_North_American_1983, to match the data. Close the Data Frame Properties dialog.

Don't forget to Save your work.

Project the Data

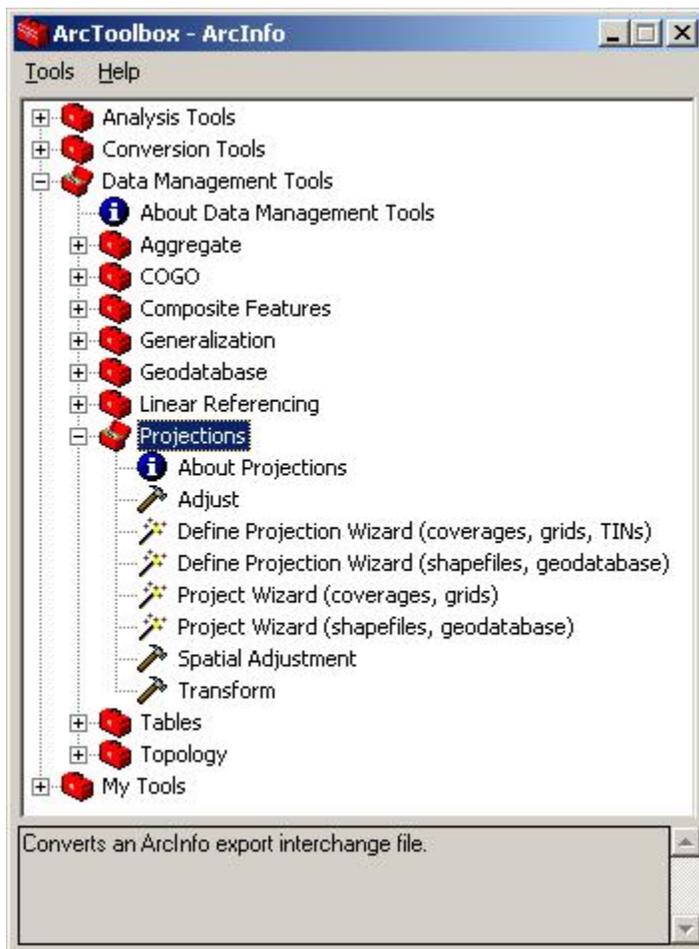
Next, we will re-project the data into a new projection.

Open the **ArcToolbox** from the Start Menu, or from within ArcCatalog.

Since you have found that the dataset you downloaded already has a projection defined (GCS - NAD83), you do not need to define a projection, but can simply project it into another projection of your choosing.

Side Note: If you ever come across a dataset that has no projection defined, it is likely that it may be in a GCS projection. Try defining it as GCS, and lay it over some data of a known projection in the same geographic region and see how it lines up. Datasets with no projection defined might also be in a State Plane projection, especially if they are state level or smaller data, so try that next.

In ArcToolbox, go to **Data Management Tools >> Projections** and look at the available tools. There should be two Define Projection Wizards, one for coverages and grids, and one for shapefiles and geodatabases. There should be Projection Wizards for the same two types of data. There may also be other tools for projection adjustment and transformation, etc.



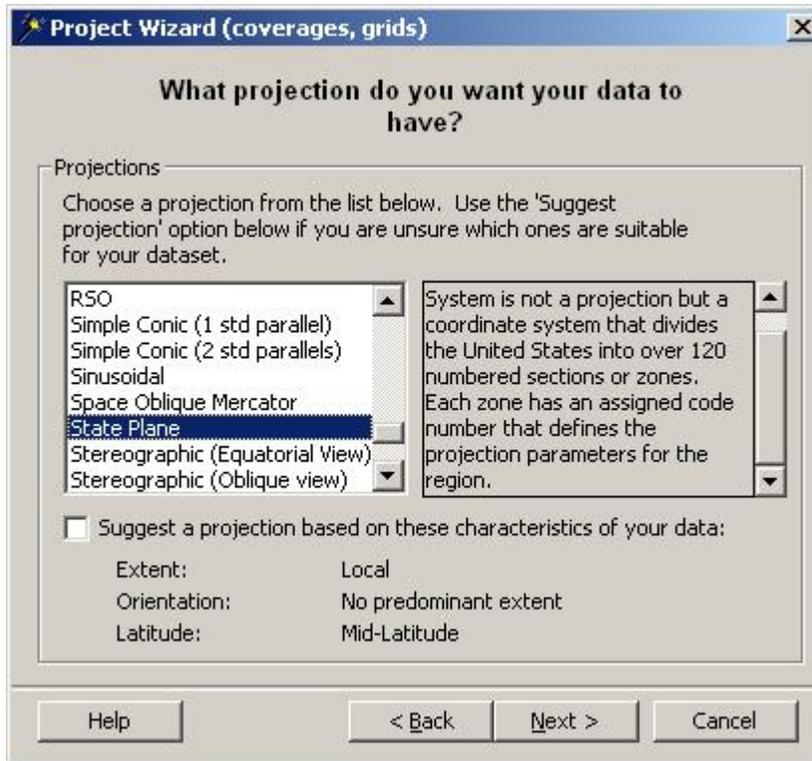
Since we want to re-project a grid with a projection already defined, select "**Project Wizard (coverages, grids)**" and double-click on it to open the wizard.

In the first window, select "**Project my data to a specified coordinate system**" and click Next to continue.

In the next window, use the browse button to find and select your NED dataset. Once opened, the "Coordinate System Parameters" box should confirm the projection information we just found.



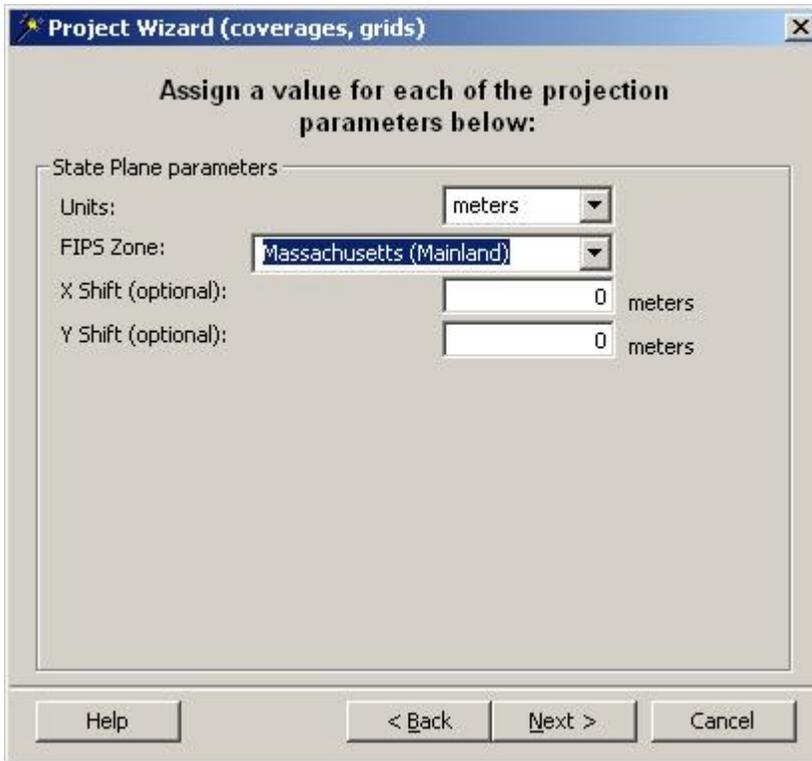
Click Next and in the following window, scroll through the available projections. By clicking on each, you can view a brief description.



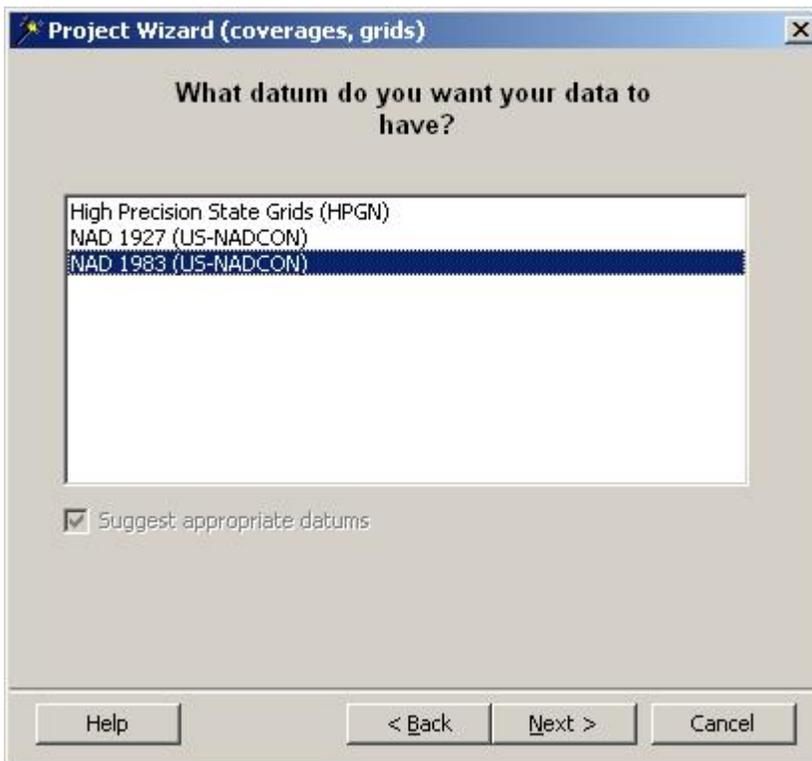
Select the **State Plane** projection system. The description notes that "State Plane" is not strictly a projection itself, but rather a code system dividing the US into regions (mostly by state), each of which has its own projection, optimized to each region. Click Next to continue.

Note that an installation program may run if this is the first time that this application has been run on the machine you are using.

In the next window, select the parameters for your projection. Leave the **units** as **meters**. For the **FIPS Zone**, select the **state** (and appropriate region if applicable) that dominates the data you downloaded. In the sample below, I selected "Massachusetts (mainland)" since my data is from western Massachusetts. Leave the X and Y Shift at zero. Click Next to continue.



In the following window, select the datum to use. The datums available will depend on the FIPs zone selected, but should include "NAD 1983". Select this and click Next to continue.



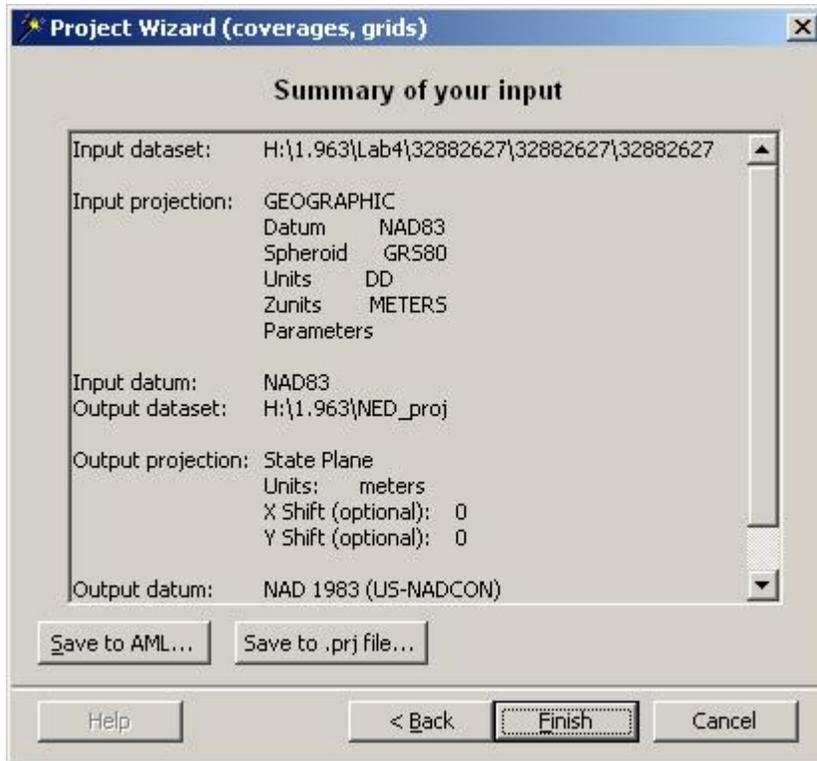
In the next window, use the browse button to navigate to the director where you want to **save your new projected dataset** (your Lab4 folder), give the new dataset a **name** (such as NED_proj), and click on Save to enter the output location into the wizard. In that window, leave the other selections at their default settings, and click Next to continue.

You should change the resampling method to CUBIC in this form!



The screenshot shows a dialog box titled "Project Wizard (coverages, grids)" with a close button (X) in the top right corner. The main heading is "Specify an output dataset." Below this, there is a "Dataset:" label followed by a text input field containing "H:\1.963\Lab4\NED_proj" and a small browse button icon to its right. A "Grid settings" section is enclosed in a rounded rectangle and contains the following options: "Resampling method:" with three radio buttons: "Nearest" (selected), "Bilinear", and "Cubic"; a checkbox labeled "Project will calculate a cellsize. Would you rather specify your own?" which is unchecked, with a "Cell size:" input field and the unit "meters" below it; and another checkbox labeled "Anchor grid origin to existing grid?" which is unchecked, with "X origin:" and "Y origin:" input fields below it. At the bottom of the dialog, there are four buttons: "Help", "< Back", "Next >", and "Cancel".

In the final window, review the **summary** of your settings. If anything looks wrong, go back and correct it.



When all is ready, click **Finish** to run the wizard.

Wait for the "Processing..." window to close. Your data has been projected and a new dataset created. You can now return to ArcMap.

Add New Data

In ArcMap, you will need to create a second data frame to display data in another projection.

First, change the name of your existing Data Frame, which should be "Layers" by default.

- Right-Click on the "Layers" name in your layers list
- Select **Properties** from the context menu
- Select the **General** tab
- Change the **name** to GCS (the name of the projection used in that data frame)
- Click **OK** to apply your changes.

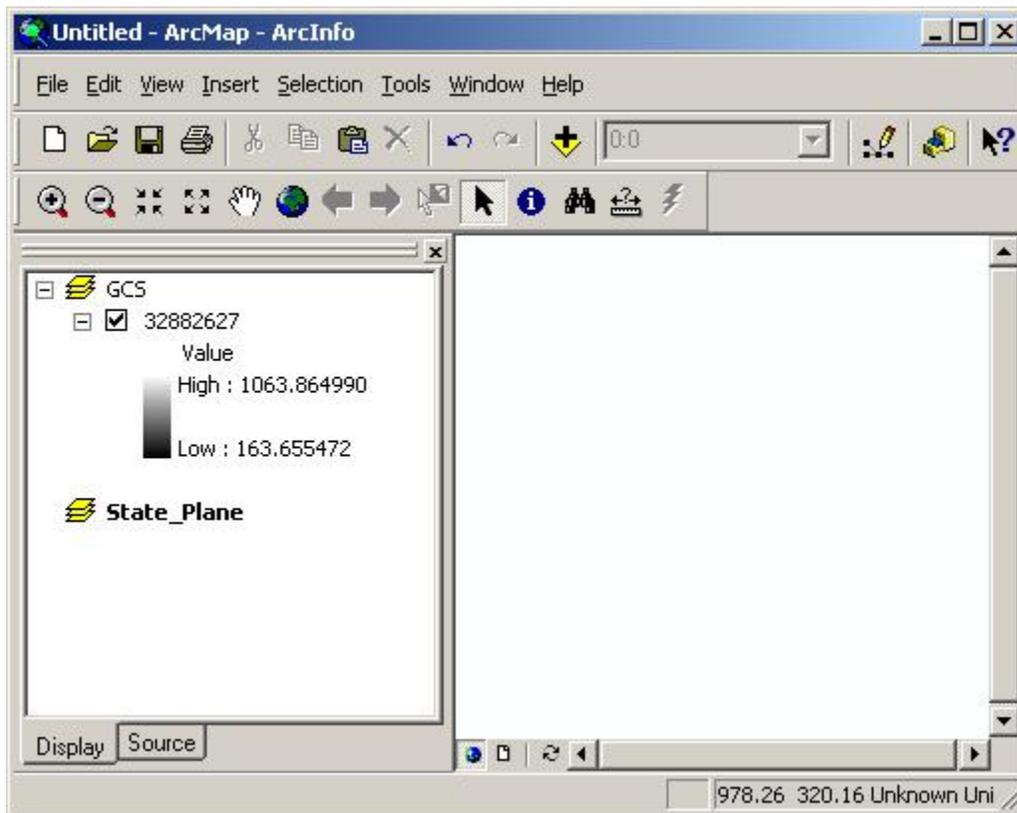
Now, create a new Data Frame:

- From the **Insert** menu, select **Data Frame**
- A new data frame appears in your layers list, titled "**New Data Frame**"
- Right-click on it and select **Properties**

- Go to the **General** tab
- Change the **name** to "State_Plane"
- Click **OK** to apply your changes.

Note that the new data frame is automatically "Activated", but in order to switch between data frames for future operations, you have to "Activate" the data frame before working with it. To do this, right click on the data frame name in the layers list, and select "Activate" from the menu. Activating one data frame de-activates all others.

When your new data frame is activated, the data in your first data frame (GCS) is not visible, as shown below:

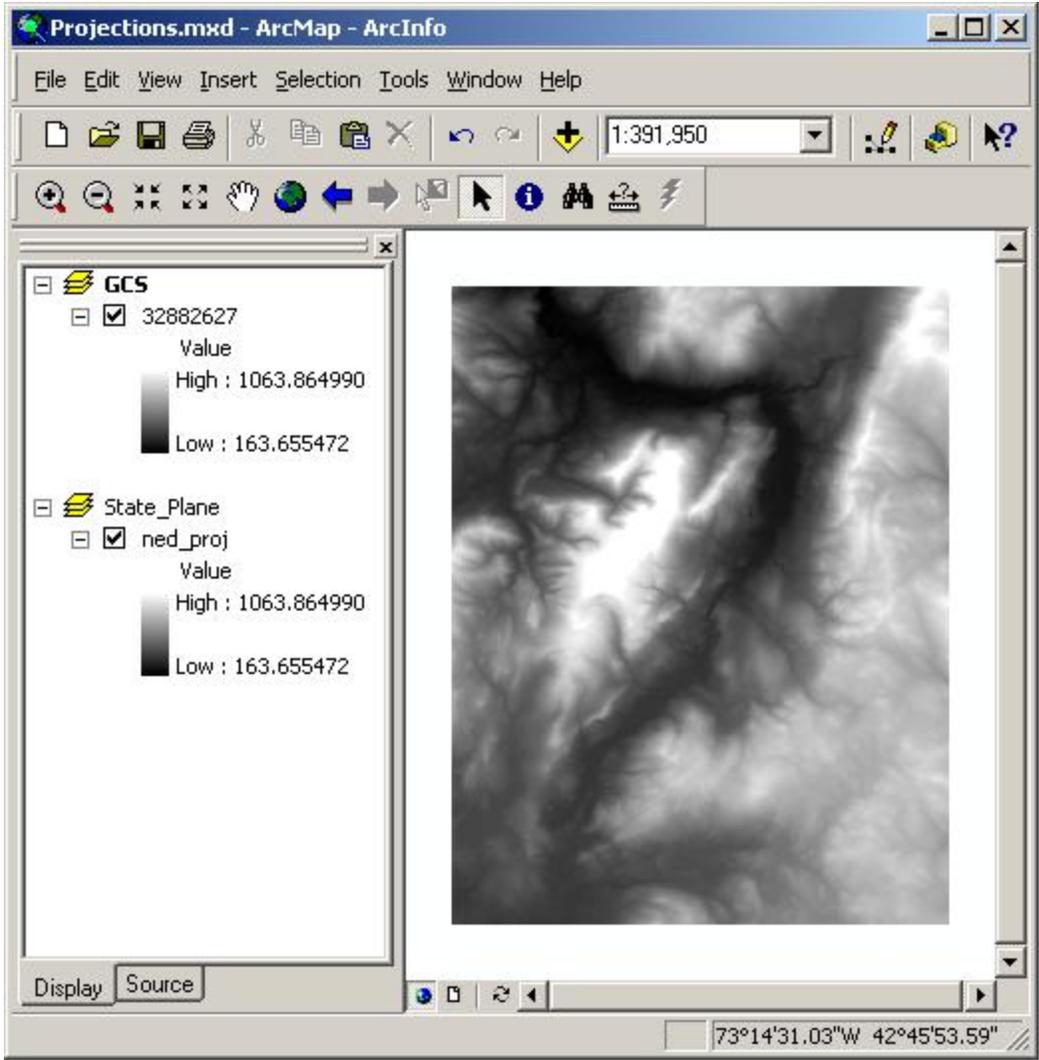


With your new "State_Plane" data frame activated, go to Data Frame Properties (View menu), and note that under the Coordinate System tab, no projection information is set.

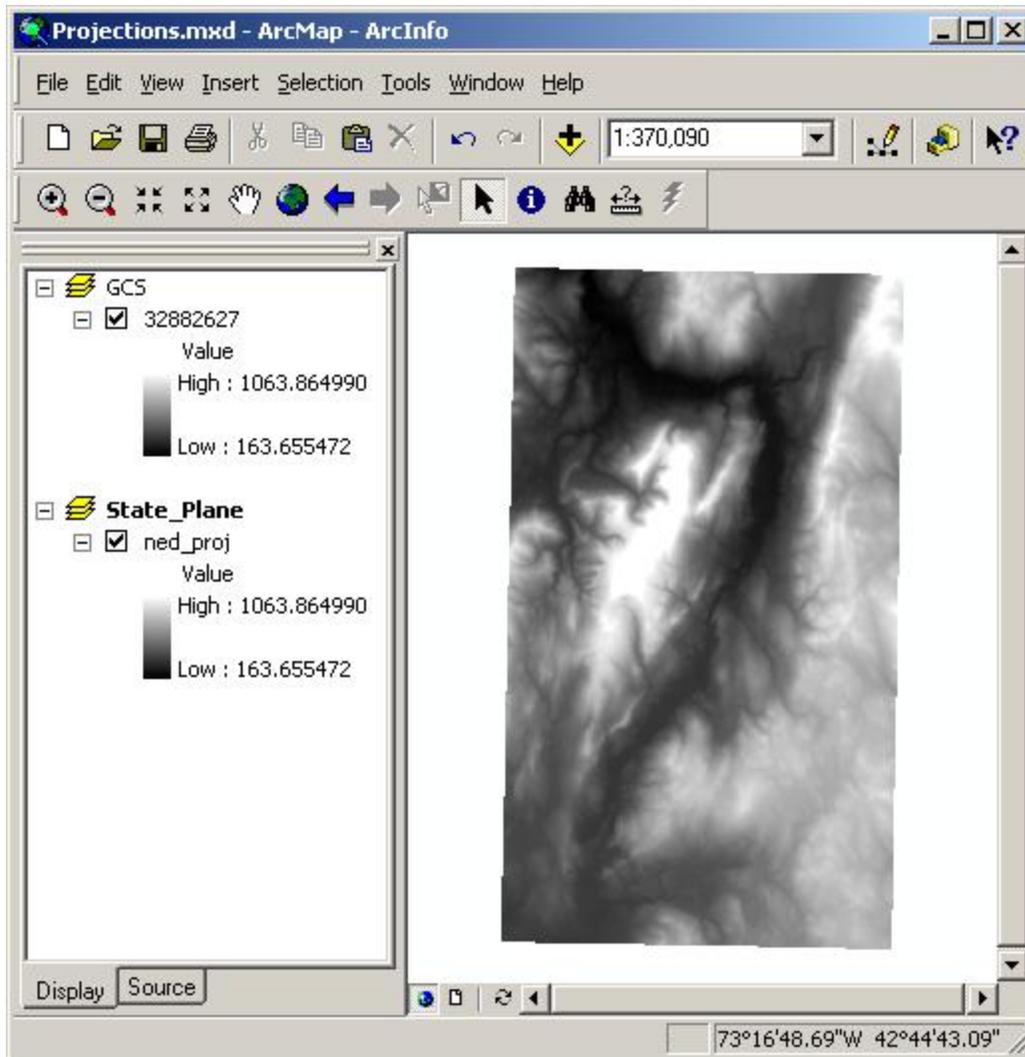
Add your newly projected data set to this new Data Frame using the Add Data dialog.

Notice how the data may seem stretched or skewed. This is the effect of the projection. Below are the data views of the two datasets that were used in creating this lab.

Geographic Coordinate System:



State Plane:



Make a Map

Use the layout skills you learned last week to create a map of your two projections.

Since you now have two data frames, it will be a little tricky at first. When you first go to Layout view, ArcMap will assume that one of the data frames is the primary and that the other is an overview map. It will make one fill the page, and the other small in the middle. Since we want the two maps side-by-side, you must re-arrange the data frames on the layout.

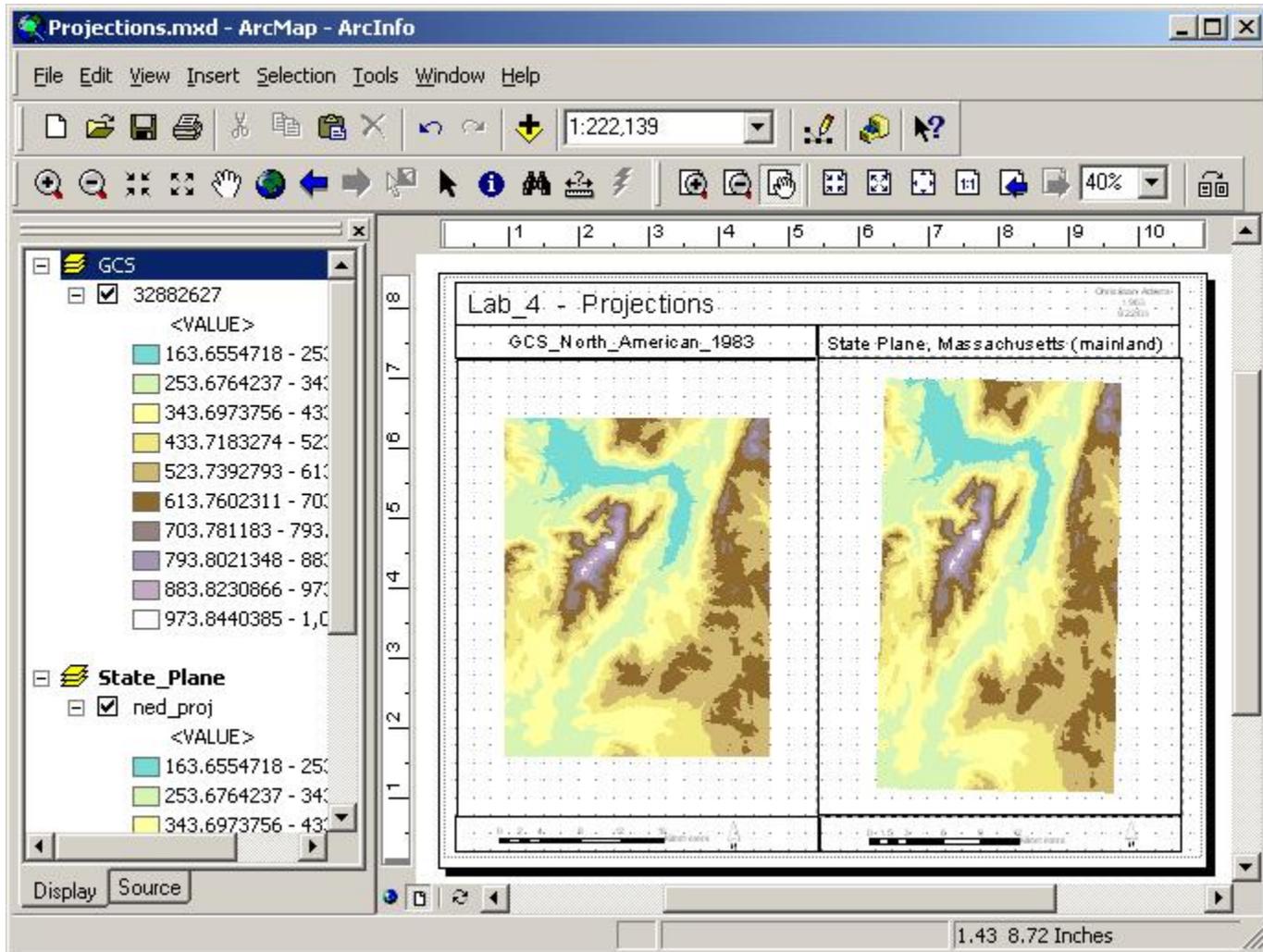
- Switch to Layout view (View menu)
- First, go to Page Setup (File Menu) and set your page settings (size, orientation, etc.)

- Now, use the select elements (black arrow) tool  to grab each of the data frames, resize them, and move them so they both have their own space on the page: side by side, or one above the other, depending on your data and on your page orientation.

Place a title over each data view, and add the regular map elements, such as the north arrow, descriptive text, etc.

Add a scale bar to each of the data frames, but be careful! When creating a scale bar, ArcMap creates the scale bar for the data frame that is currently activated. In Layout view, it is easy to switch the activation of the data frames. Simply use the select elements (black arrow) tool to select the frame in the view, and it is activated. Activate on data frame, create a scale bar for it, and then activate the other and create another scale bar. Adjust the scale bar properties so that the units are the same for both scale bars, and so both are an appropriate unit for the scale at which you are viewing your data. (i.e. don't use feet if you are viewing several miles of data).

Below is an example of how you might lay out your map. This is a quick example I threw together. I expect yours to be better planned and more carefully laid out than this. Be creative, but make it look good.



Line everything up nicely, make the important parts stand out, and make it look professional. Imagine that it will be published in a magazine... how would you want it to look with your name on it!

Include a brief description of the area you are looking at, and of course your name and the date.

Save your project and **print** out the map you created, to hand in.

A Second Map:

Now that you have all the skills to project and layout data, you will do the same thing with the land cover data (NLCD) that you downloaded. It should go quickly, since you have done all this before.

Open a new ArcMap project, and add the projected NED data to the view. Create a hillshade layer from the NED data.

Project the NLCD data set you downloaded into the appropriate state_plane projection (should be the same as your NED data). Add this projected dataset to your view. Make the land cover data semi-transparent and lay it over the hillshade, for a 3-D effect like in the online viewer (turn off the NED layer).

The NLCD layer contains codes (the cell values) which represent Land Cover Classes. Find out what these are and use them to label your data, so that the legend depicts the actual land cover classes. You can edit the values by going to the layer's symbology properties, and clicking on the number in the Value column, which you can edit. Save the dataset as a Layer File when you are done, so that you can use the classifications again later, if you want to.

Use this view to lay out a nice map of the area. Be sure to note what area it is, and what projection it is in. Save and Print this out to hand in as well.

For extra practice (not required), make another view for an overview (location) map, showing the state you chose, and where the data you downloaded is located (to orient the reader), and include this on the map.

Deliverables:

Please hand in a copy of each of the two layouts you did, the dual view with both projections of the NED data, and the single view of the projected NLCD data. Make sure they are nicely printed, report quality maps. Either color or black and white are fine, but if it's in black and white, be sure to use colors that convert well.

Due at the beginning of the next class, Wednesday September 29th.

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