

June, 2006

Tutorial: Create map with multiple views and data layers using ArcMap GIS 9.0

This presentation demonstrates how to create a publication-quality map illustration consisting of three panes or 'views' of a single spatial data set using **ArcMap GIS version 9.0** on the Windows XP computing platform.

First, we will describe and illustrate the map production process using data from an NCEAS Associate's research project. Then, we will create a different map using a public-domain data set that the reader can download and use to practice the technique.

I. Producing Three-View Map

The map will contain four data layers: 1) a global-scale raster data set, generated with a spatial analysis model of ship traffic density around worldwide shipping ports. 2) A set of latitude/longitude coordinates of ship locations, 3) a polygon shape file containing world continent outlines, and 4) a polygon shape file containing the latitude/longitude grid lines at 30 degree intervals.

The map illustration contains a primary map and two smaller, inset maps: the first displays the worldwide study area; the inset maps display subsets of the study area (Western Europe and Southeast Asia). Here is an example:

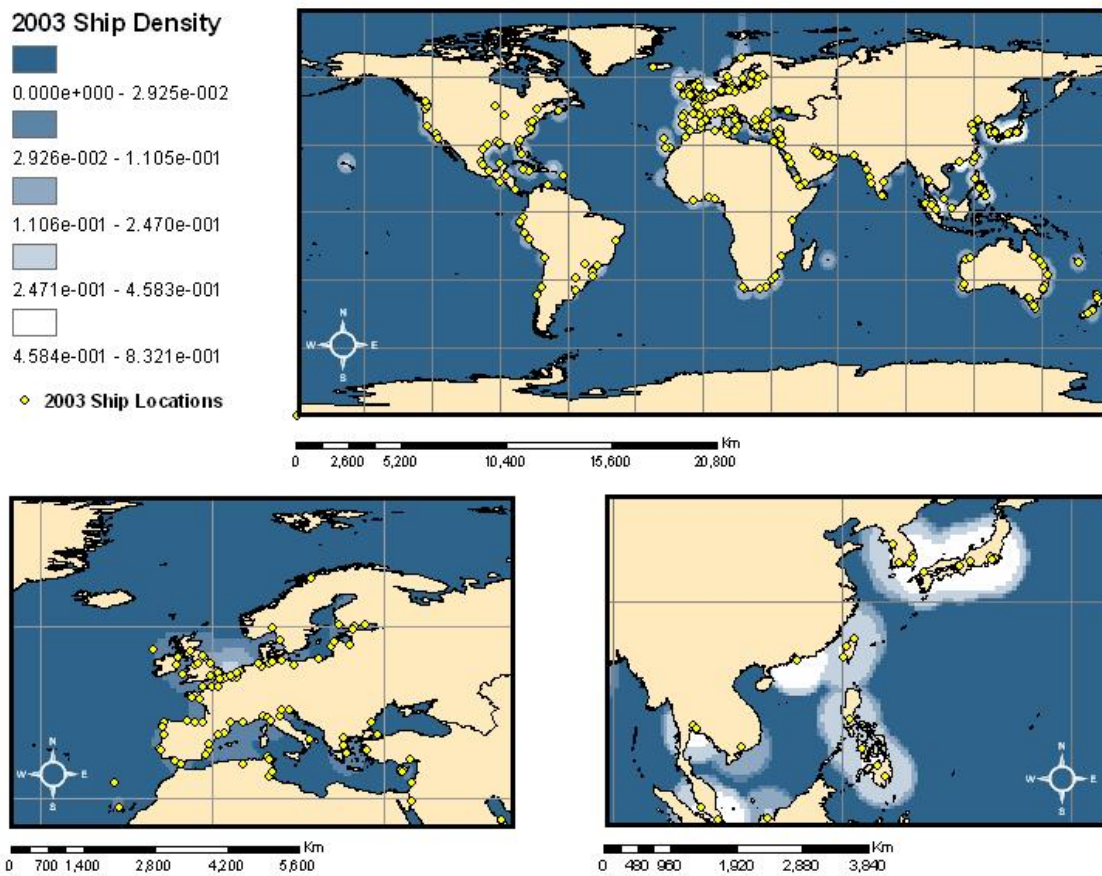


Figure 1: Sample 'Three-View' map

We will use **ArcMap GIS Version 9.0** in **Layout Mode** to create an ArcMap GIS **Map Document** that contains three Data Frames. Each frame will display a different subset (view) of the study area's four data layers, along with the appropriate map annotation. A single map legend, representing will be associated with the primary (global view) data frame. Be sure that you have the **Layout Toolbar** added to the ArcMap desktop:



To illustrate the process, we will construct the map in three phases, with the steps in each phase described separately below:

Phase 1: Create the empty Map Document and populate it with the four spatial data sets to create the primary (worldwide) map view.

Step 1: Start ArcMap, and create a new Map Document by selecting **File/New/Blank Document**. A blank document framework named layers will appear in the ArcMap workspace. Set the document view to Layout View (menu bar option **View/Layout View**). Layout View enables you to add and arrange multiple Data Frames to a map document, and to add map design elements, such as north arrows and scale bars, to the map document. The 'Layers' object in the map document **Table of Contents (TOC)** (left window) controls the primary map document Data Frame.

Right-click on **Layers**, select Properties, then the General tab. Change the name from **Layers** to **View 1**, and click the OK button. Right-click on the View 1 layer, select Add Data, navigate to the Windows folder containing the map data in this case a raster file named *kernald_ship3*, and add the primary raster data set to View 1. The raster image will appear in the workspace as a grey-scale image.

To assign a color map to the new data layer, right-click on the layer name, select **Properties...**, then the **Symbology** tab. To display the data set as a series of color-coded 'bins', select the **Classified** option from the text list on the left of the **Symbology** tab. Select a number of Classes (bins), then select a Color Ramp from the drop-down list.

The color scale that you see in the center of the Symbology dialog will be used as the map legend, so you will probably want to fine-tune it. To change the classification breaks, go to the **Classification** section of the dialog and set the number of classes. Click the **Classify** button to enter the class breaks that you wish to use in the legend. Back in the Symbology dialog, you can edit the legend **Labels** text by right-clicking the text you wish to modify.

It is possible to customize the color map selection. For example, to replace one of the colors in the map, double-click any color in the legend list, then by right-

clicking the selection in the drop-down list, and select a new color from the menu. You can modify the gradient or re-interpolate the entire color map by left-clicking the Select Scale option in the dropdown list, then Properties, to expose the **Edit Color Ramp** menu. Or, click on any of the color samples in the Symbol menu to modify (e.g., invert) the color ramp. To reverse the color scale, click on any color in the legend list, and select **Flip Colors**.

Step 2: Add the two base map layers: World Continent outlines, and the latitude/longitude grid.

Right-click on **View 1**, then click Add Data, then navigate to the folder containing the ESRI-provided map data sets. On the system used to produce these maps that location is:

c:/Program Files/ArcGIS/Bin/TemplateData/World

From this folder, select **continent.shp** (world continent outlines) and **WORLD30.shp** (latitude/longitude grid at 30 degree intervals), in this order. Note that the WORLD30 layer obscures the underlying layers. The polygons that comprise the lat/long grid are displayed with a filled color. To display only the grid lines, right click on the color patch next to the layer name, then select the No Data rectangle at the top of the color panel.

Next, add the global point locations shape file to the map by clicking **View 1 / Add Data**, navigating to the correct folder, and then selecting the text file containing the x/y point location. The filename is added to the TOC, but no points are displayed. To display the locations as symbols, right-click the point file name, then select **Display X/Y Data**. This is a good time to save the modified map document: select **File/Save**.

In ArcMap, map layers are displayed in reverse order of their position in the map document TOC: the last (bottom) entry is drawn first, the prior TOC entry is drawn 'on top' of it, and so forth until the first (top) TOC entry is drawn as the top map layer. For this map, the raster data should be drawn first, followed by the continent outlines, the point locations, and finally the latitude/longitude grid lines. Make sure that the Display tab at the bottom of the TOC window is set, then use the mouse to click/drag the TOC entries up and down to achieve this ordering.

Note that the latitude grid lines are stored as filled polygons, and that the polygon fill obscures the underlying layers. To expose the other map layers, change the fill color attribute of the polygons to 'transparent': Right-click on the WORLD30 layer, then select **Properties**, then the **Symbology** tab, then click the **Symbol** button, and select the **Hollow** color. From the **Options** section of this dialog, select a medium grey color for the grid lines.

Now, set the extent of the main map layer: highlight the map to set the focus, then use the Layout toolbar Map Extent tools (magnifying glass icons at left) to size the map to correct viewing extent.

Once you have added and set the display attributes for all of the data layers in View 1, use the **File/Page and Print Setup** menu to set the **Paper** and **Map Page Size** attributes to **Landscape**. Then the **Tools** toolbar to position the map within the data frame. Use the Zoom (magnifying glass, arrow icons) and Pan tools to bring the map to the correct size and center it in the data frame bounding rectangle. Experiment with both sets of tools to see how they work. The **Map Layout** toolbar tools control the size of the entire data frame; the **Tools** toolbar controls the size and position of the map layers within the active data frame. Adjust and position the View 1 data frame until your map document resembles **Figure 2**:

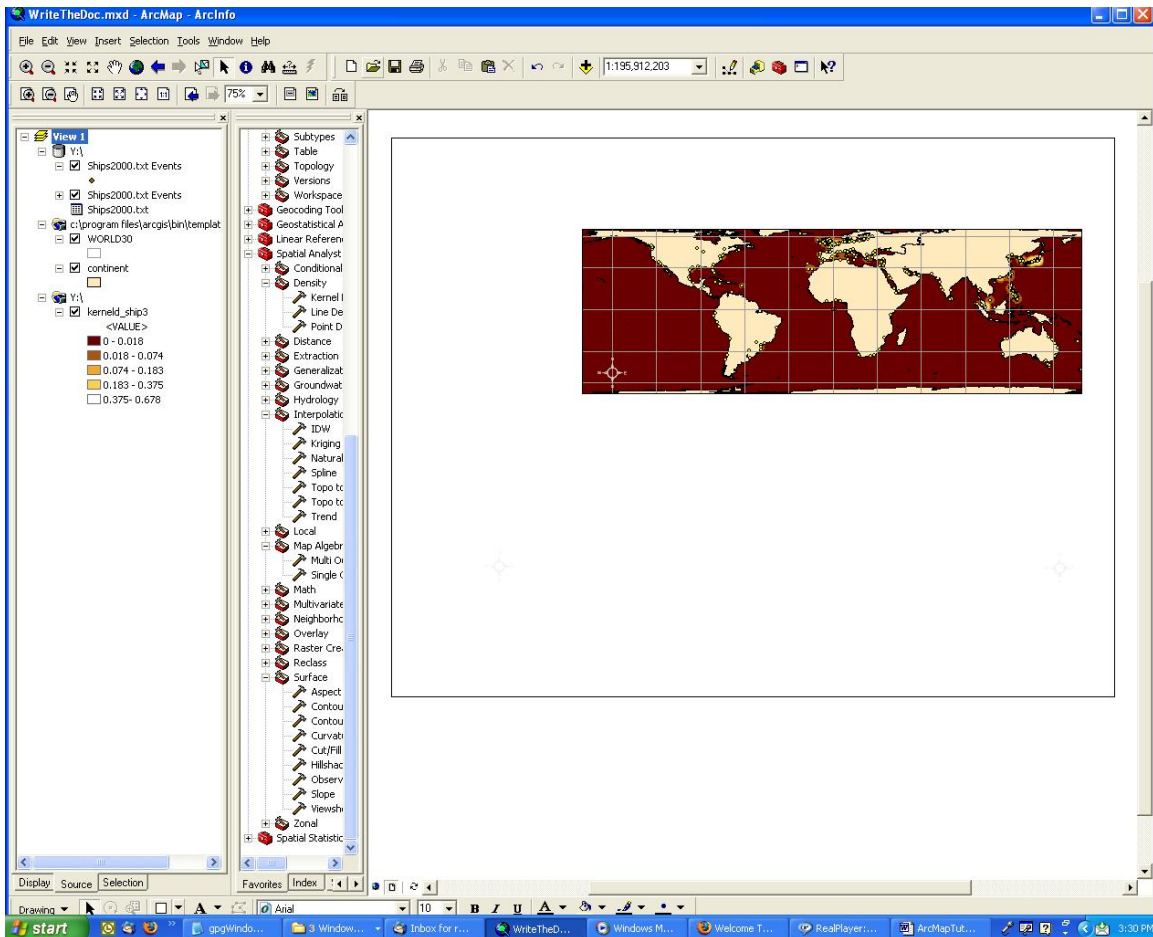


Figure 2

Phase 2: Add the two inset maps containing regional views to the map document by inserting two additional Data Frames.

Reminder: Be sure that the map view is set to **Layout View**.

Step 1: Adjust the primary data layer, View 1, inside the map document: Highlight View 1 in the TOC. Click the Map Layout toolbar Focus Data Frame icon in the tool bar, and click the globe icon in the Map Extent section of the toolbar to display the full extent of the raster dataset. To move the base map layer inside the map document, click and hold the dashed line surrounding the layer, then drag the layer to the desired place. In the present case, move the data set to the right to make room for the map legend.

Step 2: Add the two 'regional' views of the study area to the map document by adding two new data frames to the map document. On main menu bar, select **Insert / Data Frame**. A blank data frame appears on the map layout. Repeat **Phase 1, Steps 1 and 2** to populate the blank data frame with the four data layers. Use the layout Tools to position the new data frame in the main map document. Perform this operation twice to add two new data frames to the map:

Set the display extent of the new frames to the two regions of interest. Set the map document focus to the each of the new data frames by left-clicking the layer name in the TOC. Then use the **Map Extent** controls (**Zoom In/Zoom Out and Fixed Zoom In/Fixed Zoom Out**) in the **Tools** toolbar to select the desired sub-region of the worldwide map view (View 1). Use the Zoom In/Zoom out tools to draw and then adjust a stretch box around the region of interest. Use the Fixed Zoom In/Fixed Zoom Out tools to make the sub-region the correct size within the second data frame.

Then, using the **Properties/Symbology** dialog as shown in **Phase 1, Step 1**, assign the same color map to the View 2 raster image as you assigned to the View 1 image.

Right-click on Layers, select properties, then the General tab. Change the name of the new data frame from **New Data Frame** to **View 2**.

Repeat **Step 2** for the second region of interest, creating **View 3** in the map document TOC. Now, you have all three views displayed in the map. It will look something like **Figure 3**. Save the document.

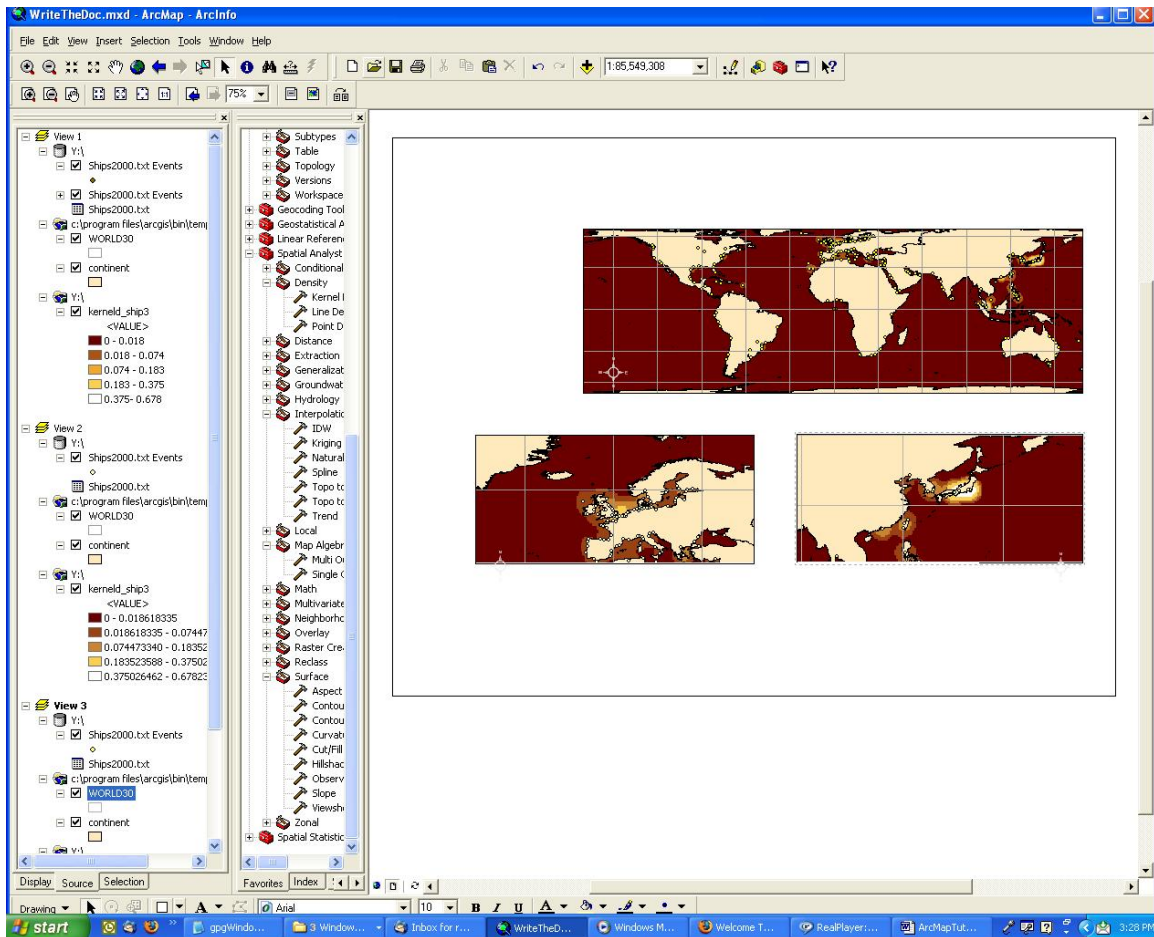


Figure 3

Phase 3: Add the finishing touches to the map: Title, legend, scale bars, and north arrows. Export the map image to publication format.

Note: If you have not already done so, adjust the **Properties/Symbology** for the raster image in each map view so that all three images use the same color map.

Step 1: Add a legend to the map. Activate **View 1** the map document's primary data frame. Select the raster image, then select **Properties/Symbology** to review and edit if necessary the color legend label text. Then, select **Insert/Legend** to start the **Legend Wizard**. Select the layers that should appear in the legend: Use the raster image and the ship event layers for this legend. Click the Next button, to fine-tune the legend title. Click the Next button again, to design the various legend elements. In the selected elements box, double-click the raster image name to bring up the Legend Item Selector. Click the item layout that you would like to use, then press the OK button, then the Apply button. To position the legend block within the map document, right-click the block and use the mouse to change its position.

Step 2: Add the north arrow and scale bars to each of the three map views: Select **Insert/North Arrow**, then double-click the desired north arrow, and it will appear inside a stretch box on the map document. Use the 'handles' on the box to correctly size the symbol. Double-click the north arrow to display the North Arrow Properties dialog, and set the color and any other desired display property. To place the same north arrow on the second two views, right-click the arrow, then Copy it into the clipboard, then paste it on to the other two views.

Use a similar procedure (Insert/Scale Bar) to add the desired scale bar to the lower-left corner of each map view.

At the end of Phase 3, your map should resemble **Figure 4**:

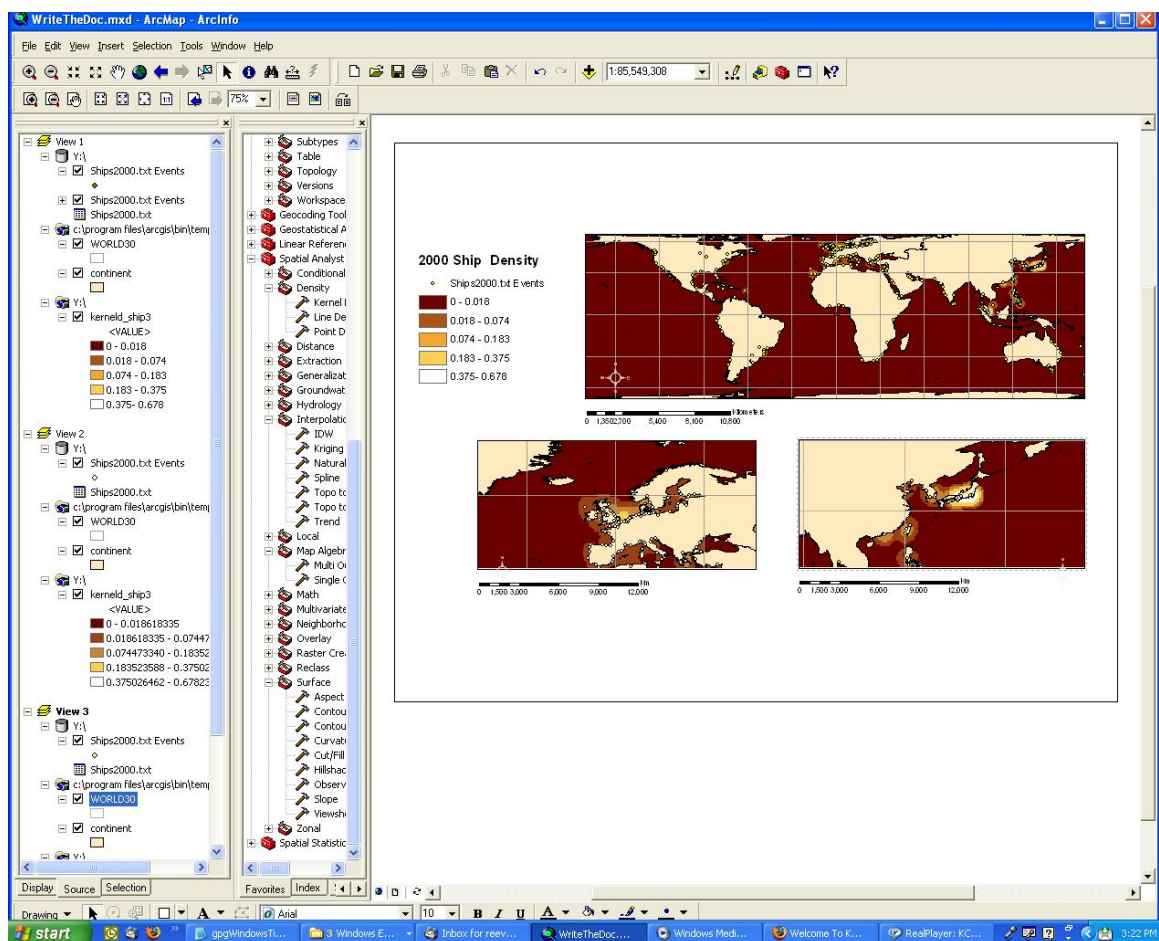


Figure 4

Step 3: Export the map documents to TIFF files for inclusion in a publication. Select **File/Export Map...** option, then select **TIFF (.tif)** as the output format.

II. Practice Technique using Public Domain-available data set

To conclude the tutorial we will construct a second, similar map using four publicly-available Arc Map GIS coverage files. Three of the data files are included in the default installation of **Arc Map GIS Version 9.0**. Assuming that your Arc Map GIS was installed in the folder **C:/Program Files**, the files and their locations are:

C:\Program Files\ArcGIS\Bin\TemplateData\World\WORLD30.shp: Lat/Long grid

C:\Program Files\ArcGIS\ArcGlobeData\country.shp: World country outlines

C:\Program Files\ArcGIS\Bin\TemplateData\World\City.shp: World city locations

The fourth file is a global-scale raster land cover classification image that can be downloaded through the following Web site (34 megabyte .zip file):

<http://www-gvm.jrc.it/glc2000/Products/fullproduct.asp>

You will need to log in to the site (creating an account is straightforward). Then, proceed to the Download page and obtain the Global product in ESRI format. The file is named: **glc2000_v1_1_grid.zip**. Should you encounter difficulties obtaining this file, please contact the author of this tutorial (reeves@nceas.ucsb.edu) to obtain it.

Let's complete the phases described in Section I of this tutorial. First, create an empty Arc Map **.mxd** document and populate it with the three data files. Your document should resemble **Figure 5** (next page), with the data layers arranged in the order shown in the Map Table of Contents:

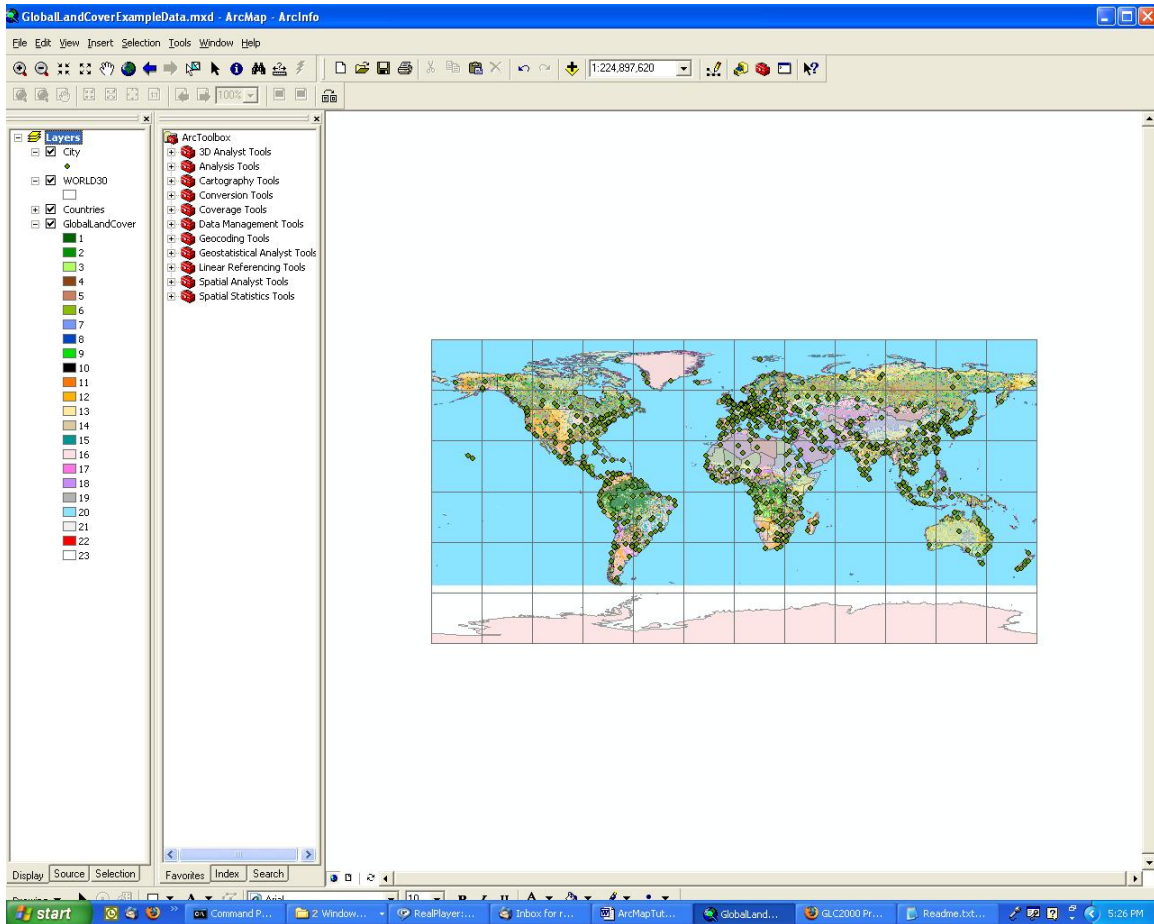


Figure 5

Note that there is no land cover information for Antarctica, thus the raster map does not extend to the bottom of the page. We will correct for this by creating three sub-image views of our data for the final map document. Double-click on the first map layer 'Layers' name in the Map TOC and rename it **View 1**. Select **View/Layout View**.

Once you have added and set the display attributes for all of the data layers in View 1, use the **File/Page and Print Setup** menu to set the **Paper** and **Map Page Size** attributes to **Landscape**. Then the **Tools** toolbar: (picture here) to position the map within the data frame. Use the Zoom (magnifying glass, arrow icons) and Pan tools to bring the map to the correct size and center it in the data frame bounding rectangle. Experiment with both sets of tools to see how they work. The **Map Layout** toolbar tools control the size of the entire data frame; the **Tools** toolbar controls the size and position of the map layers within the active data frame. Use the instructions from **Phase 2, Step 1**, (above) to adjust and position the View 1 data frame until your map document resembles **Figure 6** (next page):

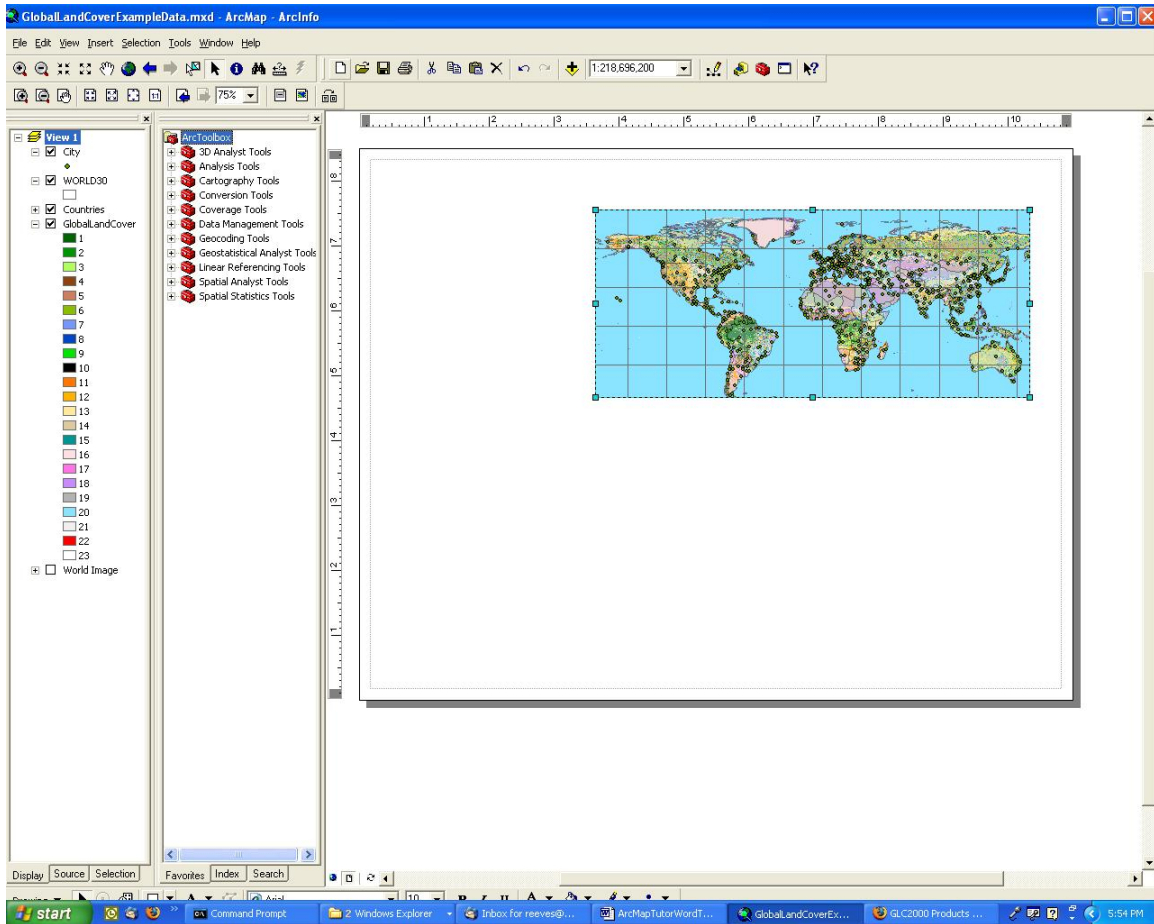


Figure 6

Use the instructions from **Phase 2, Steps 1 and 2** to add two 'regional' study area views to the map document by adding two new data frames to the map document. Name them View 2 and View 3. At the end of this process your map document should resemble Figure 7. Note that we have left extra space on the left-hand edge of the map document to accommodate the map legend.

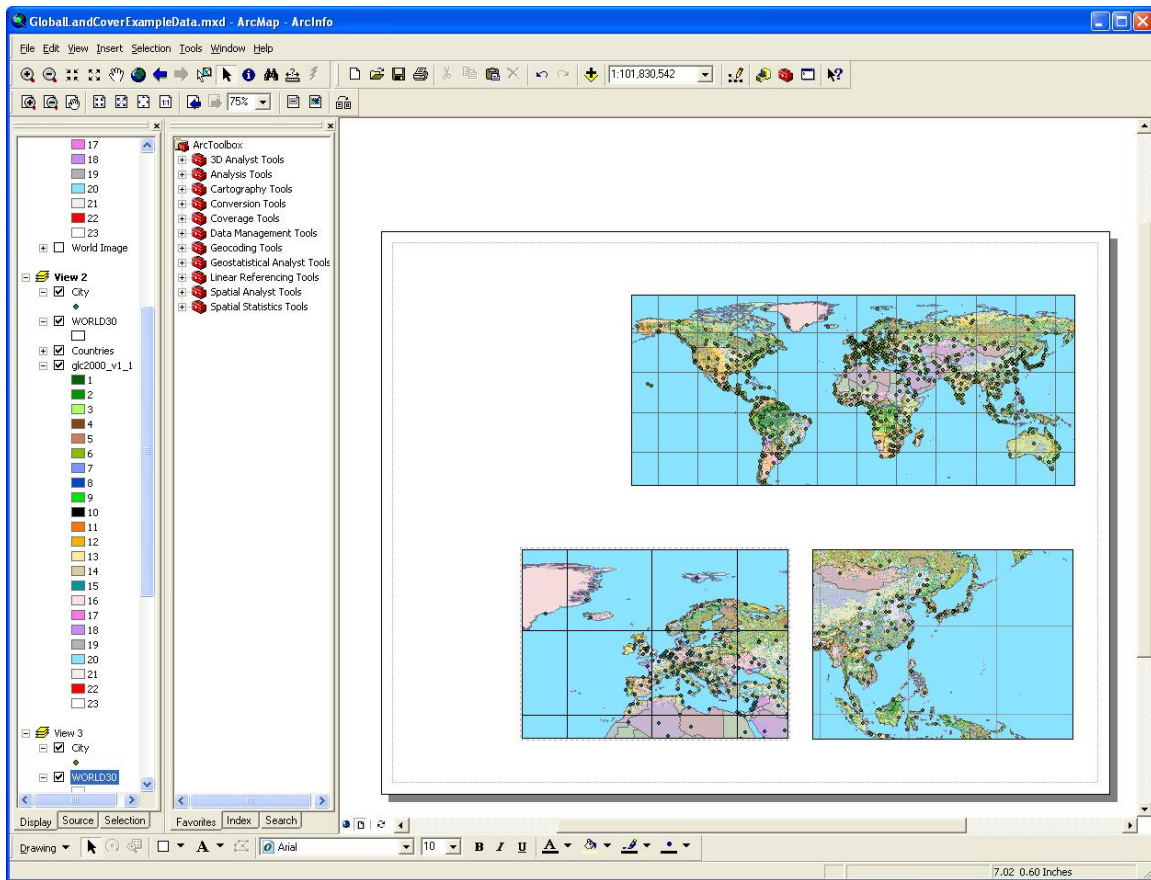


Figure 7

Next, add the map legend, scale bars, and north arrows: repeat **Phase 3, Steps 1 and 2**. Note that the legend for this land cover map layer uses a different scale to represent 23 discrete land cover categories in the layer. The legend will extend down the left edge of the map document.

Before creating the legend, you have the option of replacing the numbers next to the colors with more meaningful land cover labels derived from the following table:

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GLC Global Class (according to LCCS terminology)	
1.	Tree Cover, broadleaved, evergreen <i>LCCS >15% tree cover, tree height >3m</i> (Examples of sub-classes at regional level* : <i>closed > 40% tree cover; open 15-40% tree cover)</i>
2.	Tree Cover, broadleaved, deciduous, closed
3.	Tree Cover, broadleaved, deciduous, open <i>(open 15-40% tree cover)</i>
4.	Tree Cover, needle-leaved, evergreen
5.	Tree Cover, needle-leaved, deciduous
6.	Tree Cover, mixed leaf type
7.	Tree Cover, regularly flooded, fresh water (& brackish)
8.	Tree Cover, regularly flooded, saline water, (daily variation of water level)
9.	Mosaic: Tree cover / Other natural vegetation
10.	Tree Cover, burnt
11.	Shrub Cover, closed-open, evergreen (Examples of sub-classes at reg. level *: (i) sparse tree layer)
12.	Shrub Cover, closed-open, deciduous (Examples of sub-classes at reg. level *: (i) sparse tree layer)
13.	Herbaceous Cover, closed-open (Examples of sub-classes at regional level* : (i) natural, (ii) pasture, (iii) sparse trees or shrubs)
14.	Sparse Herbaceous or sparse Shrub Cover
15.	Regularly flooded Shrub and/or Herbaceous Cover
16.	Cultivated and managed areas (Examples of sub-classes at reg. level* : (i) terrestrial; (ii) aquatic (=flooded during cultivation), and under terrestrial: (iii) tree crop & shrubs (perennial), (iv) herbaceous crops (annual), non-irrigated, (v) herbaceous crops (annual), irrigated)
17.	Mosaic: Cropland / Tree Cover / Other natural vegetation
18.	Mosaic: Cropland / Shrub or Grass Cover
19.	Bare Areas
20.	Water Bodies (natural & artificial)
21.	Snow and Ice (natural & artificial)
22.	Artificial surfaces and associated areas

do

select **View 1** as the active view. Right-click the **GlobalLandCover** layer, then select **Properties** to expose the **Layer Properties** menu (Figure 8). Choose the **Symbology** tab, then *Show: Unique Values* from the left-side list. This view enables you to edit the legend elements. Under the label column, right-click any number to edit/replace the value with another character string.

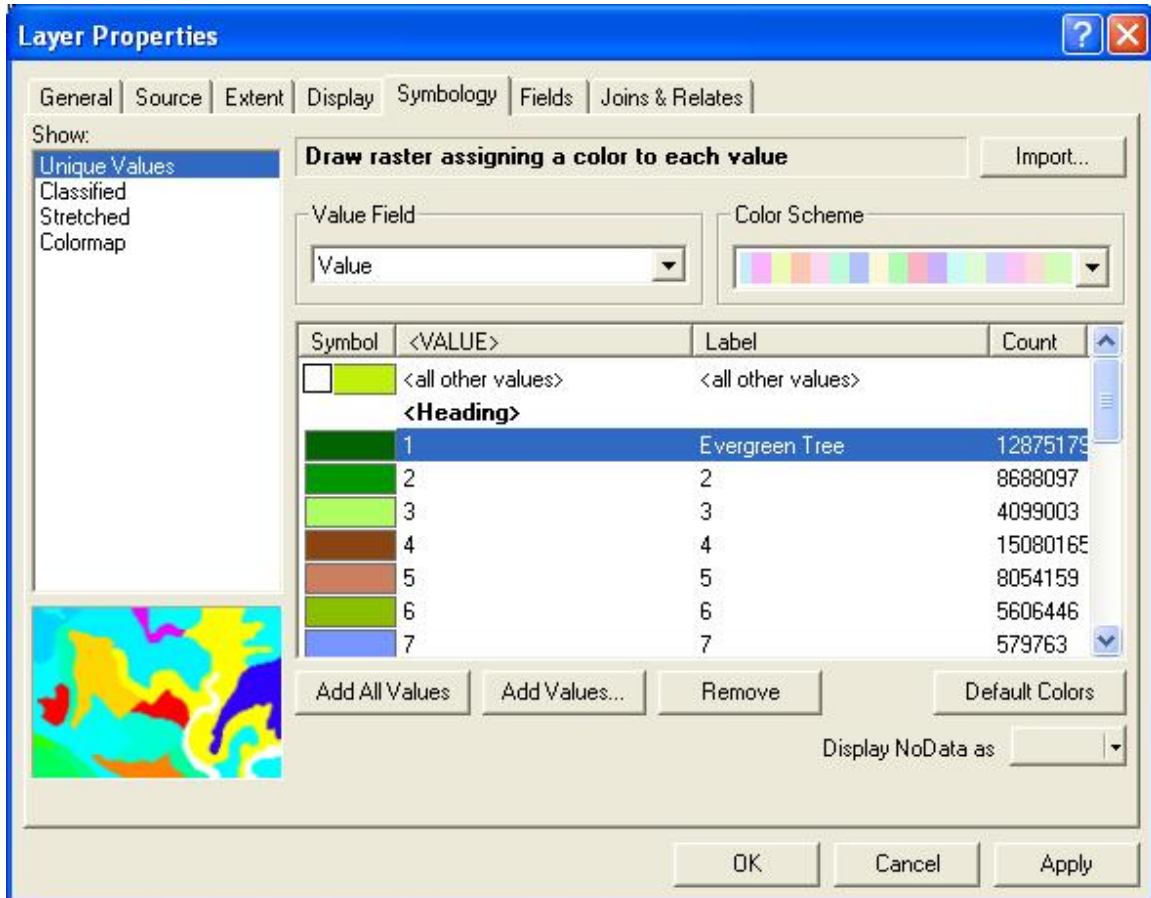


Figure 8

After modifying the labels in the TOC, Use the **Legend Wizard (Insert/Legend)** to create and place a legend in the map document. If desired, repeat **Phase 3, Step 3** to add scale bars and north arrows to the three map views. Your map should resemble **Figure 9**. Note that the legend shows an alternate label set added using the Layer Properties menu.

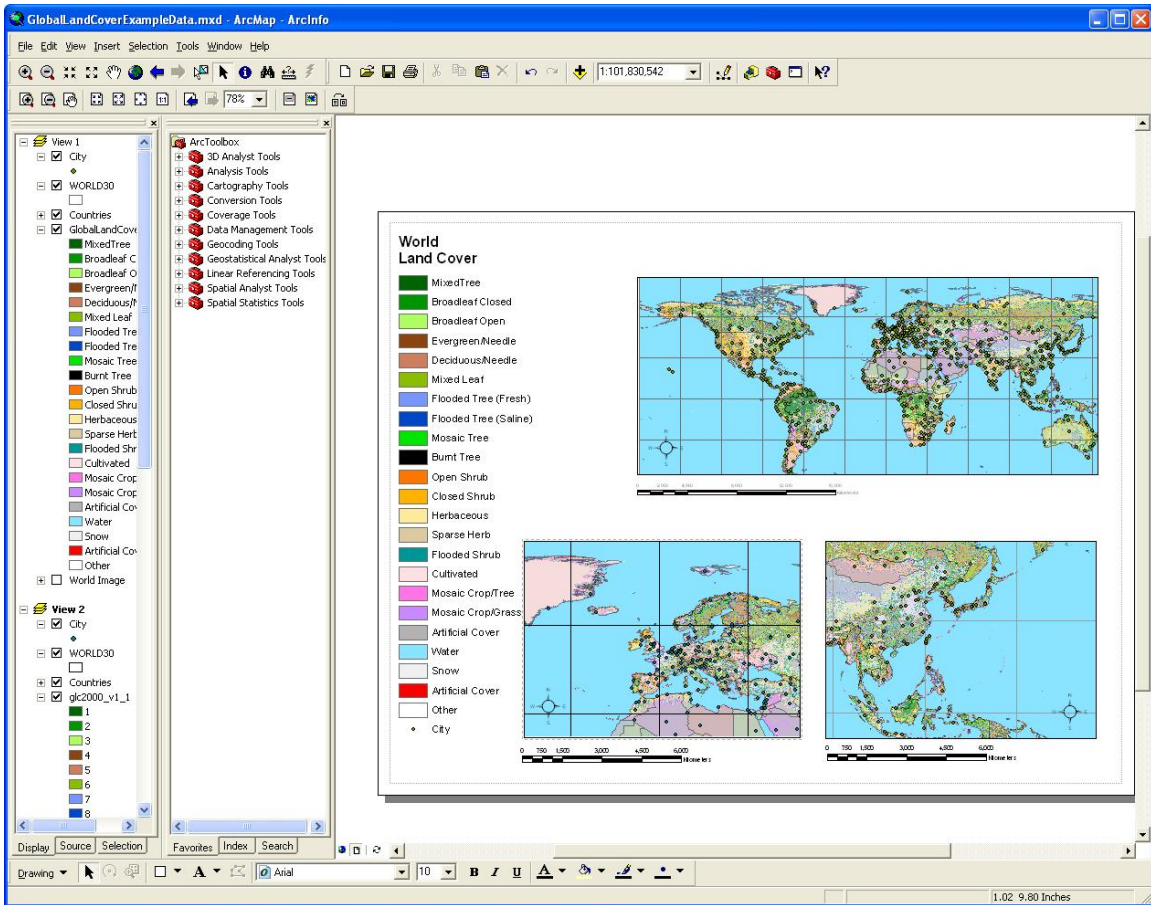


Figure 9

III. Conclusion

This tutorial has presented a collection of ArcMap GIS map production techniques which be applied to a range of map design projects.