Week 8 Cookbook:
Review and Reflection

Week 8 Overview

8.1) Review and Reflection
8.2) Making Intelligent Maps: The map sheet as a blank canvas
8.3) Making Intelligent Maps: Base layers and analysis layers
8.4) ArcGIS Online: a great source for base layers (and web mapping)
8.5) Making Intelligent Maps: Legends!

Now we have spent 8 weeks learning GIS together...what have we learned?

Basic GIS, to me, is all about making meaningful and intelligent maps – we know how to do that. Now all we need are some GIS data (Weeks 9, 10), some analysis tools (Week 11) and we are ready for Projects 2 and 3 later on this semester.

This week we will slow-down a bit reviewing the material, catching-up with some of the assignments, and reflecting on the big-picture context of what we have accomplished so far. But, there is also some cool new stuff this week: ArcGIS Online.

Consider printing this cookbook for your convenience
8.1) Review and Reflection: Looking Back and Looking Ahead

It is useful here to remind ourselves of the overarching learning goals for this class (from the syllabus):

1) **Knowledge**
   Geospatial concepts and analysis using GIS tools (ArcGIS 9.3) and GIS data sources.

2) **Skills and Critical Thinking**
   Application of geospatial concepts, analysis, and GIS tools.
   Intellectual inquiry and effective communication.

3) **Perspective**
   Space, spatial patterns, and spatial relationships as global organizing concepts.

Course Organization

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**Weeks 1 to 7**
- What is GIS?
- Web Mapping using Google Maps
- How to use ArcGIS
- Making meaningful choropleth maps

**Week 8**
- Review and Reflection
- Intelligent maps with data frames, graphs, tables, text, etc.
- Base layers and analysis layers
- ArcGIS Online
- Legends

**Weeks 9, 10**
- How to get GIS data: Online sources
- Creating GIS data: digitizing

**Week 11**
- An Introduction to Spatial Analysis
- More in GARP 0344

**Weeks 12 to 14**
- MassGIS Project: A Landuse Change Analysis

**Week 15**
- “Final” Project: Zoning in Westfield and Holyoke
8.2) Making Intelligent Maps: The map sheet as a blank canvas

To me, the map sheet starts as an empty canvas (or poster boards) on which you display the results of your GIS analysis. You can present these results in a variety of complementary ways, including maps (i.e. data frames), graphs, tables, text, and photographs. An intelligent map combines all of the above so that the GIS analysis is presented professionally, accurately, comprehensively, and visually-pleasing.

**Map Sheet**
That’s the actual piece of paper that the map will be printed on. The size of the map obviously impacts the size and number of your data frames, graphs, tables, text, etc. Common sheet paper sizes are: 8.5 by 11 inches, 18 by 24 inches, and 24 by 36 inches. In addition, larger color printers print using rolls of paper, typically 3 feet wide.

**Data Frames**
Your map sheet will typically show a series of data frames – each showing a map consisting of a series of map layers containing your GIS analysis. One data frame may be contain an overview/location map, whereas other data frames show the actual data.

**Graphs**
Often, it is easier and better to illustrate the relationship between variables as graphs, for example line graphs, scatter plots, bar graphs, pie charts, etc. It is usually best to create these graphs in MS Excel and copy them into your map. This is especially useful if you are showing and quantifying the correlation between two variables.

**Tables**
Often, it is useful to summarize your data or results as a table (= data arranged as rows and columns). It is usually best to create the table in MS Excel and copy it into your map. In some cases you may include the actual data mapped in the data frames as a table.

**Text**
Don’t forget to use text to convey information. An intelligent map typically includes a few paragraphs of text to explain your GIS analysis.

**Photographs**
Photographs can be very useful to illustrate an important aspect of your GIS analysis.

All these items can be arranged on your map sheet (using the guidelines) to create a final map that presents your GIS analysis professionally, accurately, comprehensively, and visually-pleasing. We will practice this approach in the two remaining projects this semester (MassGIS Project and Zoning Project).

**Example: 2003 Residential Energy Consumption of the U.S.**

This map (shown below) contains four data frames showing choropleth maps. The table in the center of the map sheet lists the underlying data for each state and the graph compares energy consumption with CO2 emissions (per state). The text describes the overall GIS analysis, the methodology, and the results.

- Note: This map is not ‘perfect’ (no map ever is) – but illustrates how you can combine the various techniques to convey information in an intelligent map.
- Many more examples can be viewed in the hallway outside of Bates 022.
Example: 2003 Residential Energy Consumption of the U.S.

8.3) Making Intelligent Maps: Base layers and analysis layers

Very frequently, a data frame contains one (or more) analysis layers shown on top of one (or more) base layers.

Analysis Layers(s)
- ‘Active’ data layers that show your GIS analysis, for example your choropleth map.

Base Layer(s)
- Static background data that provides spatial context without distracting from the GIS analysis shown in the analysis layers.
- Here we are often using satellite images, aerial photographs, roads, and town lines.

In other words: Your analysis layers show your creativity and intelligence in GIS analysis, whereas the base layers are only supposed to look good and show where the analysis layers are located in space.
Example 1

The map sheet in 18 by 24 inches and contains just one data frame. This is a simple trail map, so we did not include any graphs or tables. Text is included to provide some information about Stanley Park and the trail network. We also did not include photographs to give us as much room as possible on the map sheet for the data frame.

- The main analysis layer is the colored lines showing the trails that we mapped using GPS. This is essentially a choropleth map where the color of each line represents a trail characteristic, here its name. There is also a second analysis point layer showing important points.

- The base layer is an aerial photograph from 2005 – without it we would just see a bunch of colored lines printed on white paper. But, the aerial photograph is ‘static’ – I just downloaded it from a website – I did not perform any GIS analysis with it.

This map is intelligent and meaningful because it combines analysis layers with base layers.
Example 2

This is an example of the Pittsburgh school map – a classic point choropleth map where the size of the symbols (here: circles) is a function of the characteristic of the feature.

1 map sheet (size 8.5 by 11 inches) with 3 data frames.

1 analysis layer = the point layer showing the schools as a function of student enrollment.

1 base layer = the neighborhood lines.

Without the base layer…the analysis layer would just be a bunch of points floating in space.

Without the analysis layer…the base layer is just a boring wire frame map without any real content.

Together: they make an intelligent and meaningful map.

8.4) ArcGIS Online: a great source for base layers (and web mapping)

ArcGIS Online is a service provided by ESRI. ArcGIS Online is not ‘free’ – rather included in the purchase price for ArcGIS 9.3.

ArcGIS Online has essentially two parts:

1. ArcGIS Online is a web mapping application where you can create and share maps (requires a free account).

2. ArcGIS Online provides great base layer data that that you can embed into your own maps via the internet. In this case you do not download a huge file to your computer. Instead, the base layer data resides on a GIS server and is linked to your map.
Websites

Main website:  http://www.arcgisonline.com/home/
Help and resources:  http://resources.esri.com/arcgisonlineservices/
Great tutorial  http://www.arcgisonline.com/help/content/videos/intro/agol_intro.htm

8.4.1) Using base layer data from ArcGIS Online

This is a great way to use base layer data – just embed the data from ArcGIS Online. This saves space on your computer. But, you are dependent on a fast internet connection for your maps.

Just follow along step-by-step in ArcMap. There is also a multi-part Jing in the Week 8 folder.

1. Create a week8 folder on your flash drive.
2. Start ArcCatalog and ArcMap.
3. Create a folder connection to your week8 folder creates in Step 1.
4. Save your blank map into your week8 folder after you have confirmed that relative pathnames is checked.

That’s the prep work that you need to do each time you start a GIS map.

5. Goto File – Add Data From ArcGIS Online. This opens the ArcGIS Online website.
6. Click on Description below the World Imagery to learn more about the data layer.
7. Click on the World Imagery link to embed this online data in your local map.

You get a dialog box asking you if you want to open or save this layer file.
If you select Open, then the file is immediately opened in ArcMap.
If you select Save you download a small layer file that you need to open manually.
If Open does not work…use the Save option!

8. Select Open and the World Imagery is added to your map as a map layer.

This is very high-quality imagery, so try zooming into Westfield State College or the Eiffel Tower in Paris. Note that you can also activate data layers such as boundaries or transportation.

One note of caution: The data are transferred to your computer via the Internet, so you need to be patient at times. Do not open more than a few base layers at a time!

Other great base layers

World Street Map  Great detail!
US Topo Maps  Great detail!
US Demographics
US Weather Radar
World Topographic Maps
9. Spend some time exploring the different base layer options, both for the U.S and also for the rest of the world.

10. Remove all base layers, except for World Street Map and zoom-into Pittsburgh.

11. Add the Schools.shp and Neighborhoods.shp shapefiles that you used for the Pittsburgh Schools assignment. Read the Geographic Coordinate System Warning and hit Close. Make the neighborhoods hollow. Make the size of the circles a function of enrollment.

12. Switch to Layout View and add all the required map elements.

13. Export as JPG image and save your map into the week8 folder.

Now you have a choropleth map of schools in Pittsburgh (= the analysis layer), displayed on top of a road map that also shows shaded relief (= the base layer). The analysis layer is located on your computer, but the base layer is served via the Internet from ArcGIS Online.

8.4.2) Web Mapping with ArcGIS Online

ArcGIS Online includes a very sophisticated web mapping application with many high-quality data layers. Anyone can make a web map, but you need a free ESRI account to save your map and share it with others.

There is a Jing in the Week 8 folder that shows some of the web mapping tools of ArcGIS Online.
8.5) Making Intelligent Maps: Legends

Good legends are the key to a good map…In other words: Bad legend = bad map.

A few general comments:

1. In ArcGIS the legends are dynamically-linked to the map. What does that mean? It means that your legend changes automatically when you change your map. In the example above, if Sarah would change the color from yellow to red, or change the classification – those changes would automatically change the legend.

2. The Legend Wizard in ArcGIS does a reasonable job creating useful legends, but you should always fine-tune your legends afterwards. Things to consider:

   Layout: vertical or horizontal layout, title, border, background, etc.
   Content: all layers? selected layers? units? labels?

3. If you use physical data in your map (for example elevation, temperature, etc.) then you legend has to include the units of measurement (feet, meters, °F, etc.).

There is a multi-part Jing in the Week 8 folder that shows you a few more ways to make better legends. Just follow along in ArcMap as you watch the Jings.