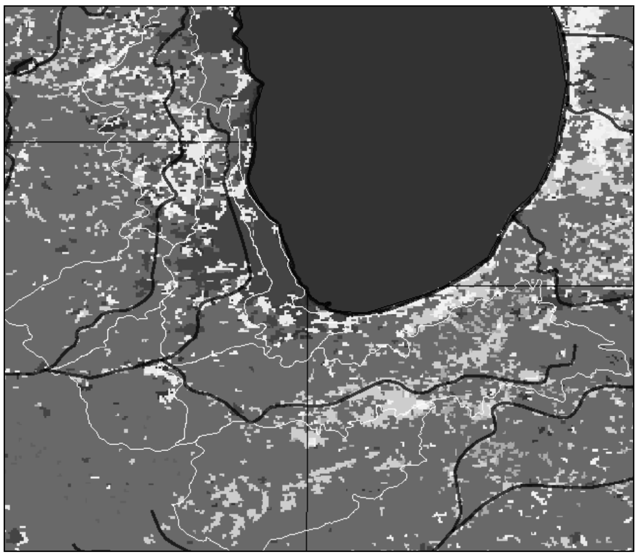
Lab 1: Landuse and Hydrology, learning ArcGIS10

The following lab exercises are designed to give you experience using ArcMap in order to visualize and analyze datasets that are relevant to important geomorphological/ hydrological questions. In addition to improving your technical proficiency, you will also be developing and applying your understandings of watershed units, flow pathways, natural variability, and hydrographs. We will address the question of how landcover changes can influence watershed hydrology.



Specifically, you will be exploring a case study of how landcover has changed in two watersheds in the upper Midwest—the Des Plaines River and the Kankakee River. In class we will discuss the many variables that affect stream discharge. The many variables make it challenging to isolate the role of a single variable (e.g., landcover change). One method that geologists use is to substitute space for time. In this way, variables like topography, stream order, climate, and lithology are as comparable as possible, while a single variable like landcover, has changed in a quantifiable way.

To help you set up this fair comparison, you will be guided through four sets of activities in ArcMap. Each lab session has specific deliverables that are an essential component of a final 2-page lab report that will summarize what these data sets and analyses reveal about the influence of landcover changes on watershed hydrology.

ACTIVITY	DELIVERABLE
I. Acquiring/Visualizing Data in ArcMap	*Presentation Quality Map of Region*
II. Manipulating Data in ArcMap	*Table 1: Summary Stats for Hydrology*
III. Grid Calculation	*Table 2: Summary Stats for Landcover*
IV. Time Series Analysis	*Hydrograph Interpretations*

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I. ACQUIRING/VISUALIZING DATA

The first step in doing any GIS analysis is finding the relevant datasets and bringing them into your GIS software. While there is a lot of freely available data on the internet, it is often distributed at different resolutions, over different time intervals, and/or formatted in different file types -- always an important consideration.

In geomorphology, one fundamental dataset you often need is a digital elevation model (DEM). DEMs are continuous grids that represent elevation by assigning an average (or central) elevation value to each pixel. Since these models have been interpolated in different ways and have a finite resolution, it important to understand the strengths and weaknesses of DEMs derived from different sources. Fortunately, there are two sources that provide extensive international (~90m) and full national (~30m) grids, respectively:

http://srtm.csi.cgiar.org/ http://seamless.usgs.gov/

In class, we will go through the steps required for downloading your own data from the USGS Seamless Server. These steps (and much more) are documented in great detail on the following webpage:

http://arrowsmith362.asu.edu/Lectures/Lecture3/Geomorph_09_06_2006/DEM_data.htm

For the sake of time, we have downloaded all the data files you need in advance. How you access data for this lab will depend on your computing setup (instructions on course website). However, all data is located within the folder: \Project_1\arcmap\

As a class:

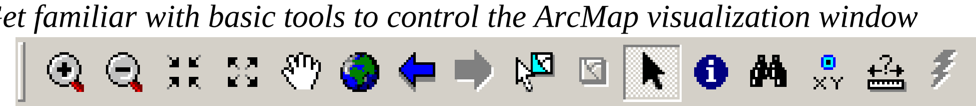
1. *Create a work directory on your M: drive (MyFiles). In a web browser, go to MyASU, click on MyFiles (wait). Create a folder to work in. I suggest creating a glg362 folder and within that a lab1 folder, but use what you like.*

2. *Start ArcMap and Open chi_area.mxd (ArcGIS Project – saves all settings)*

3. *Save AS name_chi_area.mxd on your M: drive under glg362/lab1 to create a copy where you can save your changes and your work.*

4. If nothing appears, double click on each of the red exclamation points by data layers in the Layers list (left hand column) – this is called "repairing the links", navigate to the source file for each: upperillinois is the watershed boundary so is in \Project_1\arcmap\watersheds; dp_gages and ka_gages are river gaging stations so are in \Project_1\arcmap\gages. Once repaired, click the Save button (*do this often as you work*).

5. *Get familiar with basic tools to control the ArcMap visualization window*



Make sure you find the Ruler tool – you will need it later.

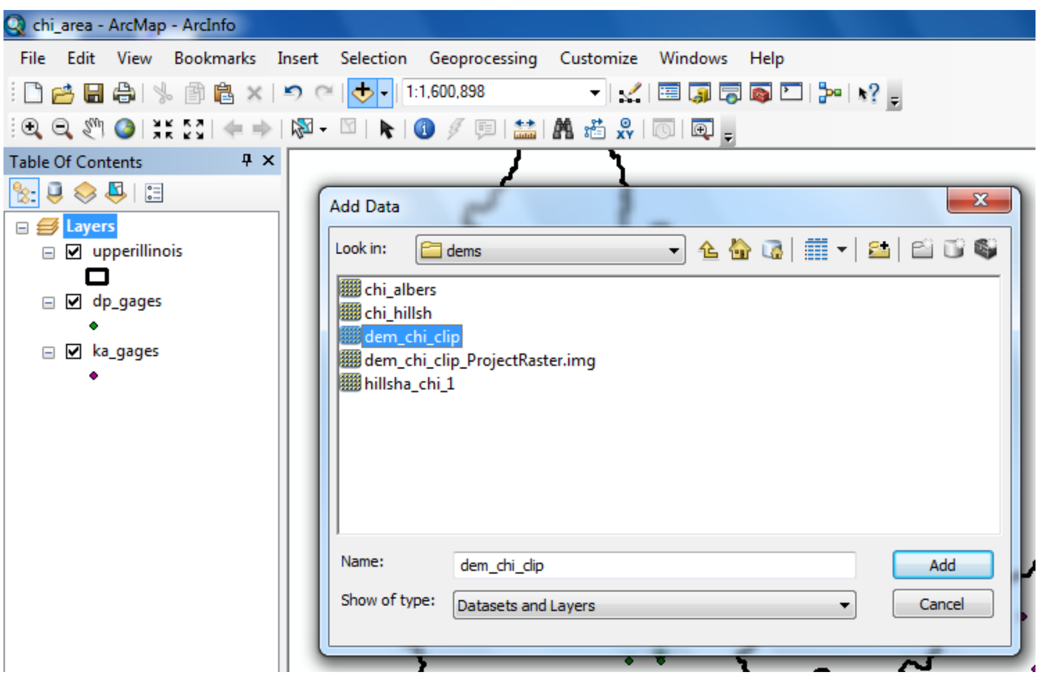
6. *Open an attribute table (right click on layer of interest in the Layers column on left). The attribute table for dp_gages is shown below as an example:*

Attributes of dp_gages

FID	Shape	Latitude	Longitude	coord_acy_	dec_coord_	site_no	huc_cd	station_nm
0	Point	42.489186	-87.926466	S	NAD83	5527800	7120004	DES PLAINES RIVER AT RUSSELL, IL
1	Point	42.444189	-87.991742	U	NAD83	5527940	7120004	TEMPEL FARMS DITCH NEAR OLD MILL CREEK, IL
2	Point	42.41528	-87.969169	S	NAD83	5527950	7120004	MILL CREEK AT OLD MILL CREEK, IL
3	Point	42.344164	-87.93833	S	NAD83	5528000	7120004	DES PLAINES RIVER NEAR GURNEE, IL
4	Point	42.306134	-87.968691	U	NAD83	5528030	7120004	BULL CREEK NEAR LIBERTYVILLE, IL
5	Point	42.291964	-87.928406	U	NAD83	5528040	7120004	TERRE FAIRE DITCH AT LIBERTYVILLE, IL
6	Point	42.209446	-87.955003	S	NAD83	5528230	7120004	INDIAN CREEK AT PRAIRIE VIEW, IL
7	Point	42.175025	-87.970624	U	NAD83	5528475	7120004	GREEN LAKE DITCH AT BUFFALO GROVE, IL
8	Point	42.151942	-87.957776	S	NAD83	5528500	7120004	BUFFALO CREEK NEAR WHEELING, IL
9	Point	[illegible]	[illegible]	S	NAD83	[illegible]	[illegible]	[illegible]

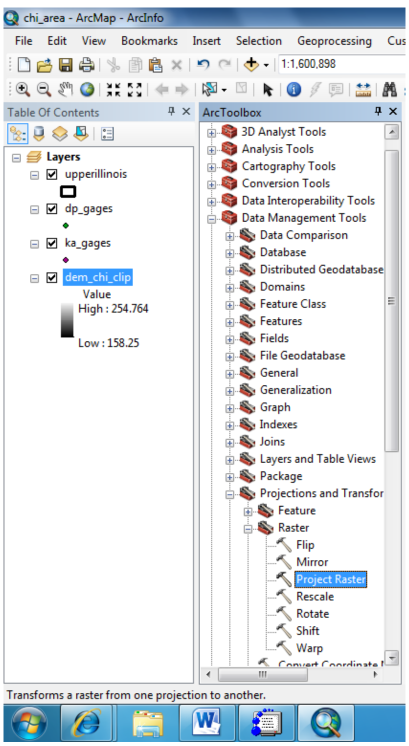
After examining the table, close it (you will learn to use this data later on).

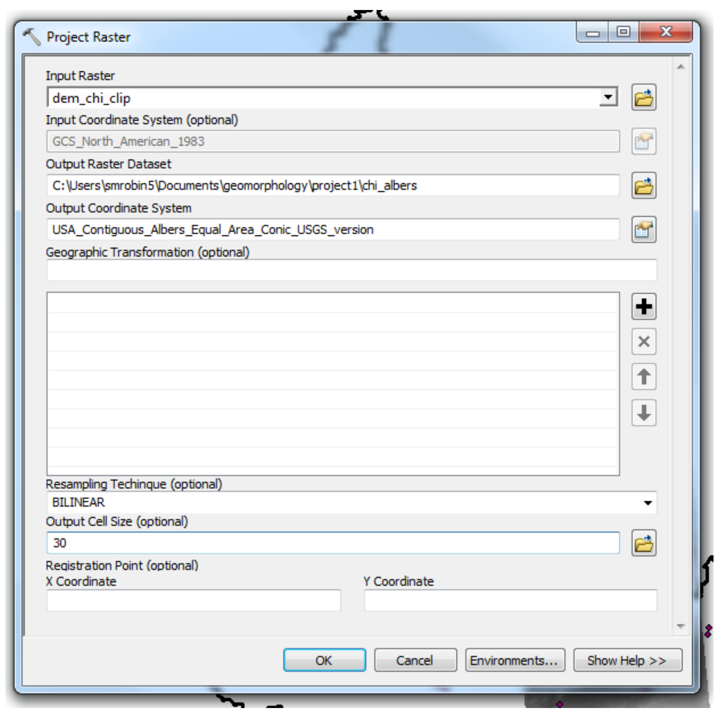
7. *Bring in the downloaded DEM (\Project_1\arcmap\dems\dem_chi_clip): Click the Add Data button – a Plus Sign on a Yellow Diamond (middle of main tool bar)*



8. *Use ArcToolbox to project data: Click the red toolbox icon, navigate to and double click:* Data Management Tools/Projections and Transformations/Raster/Project Raster.

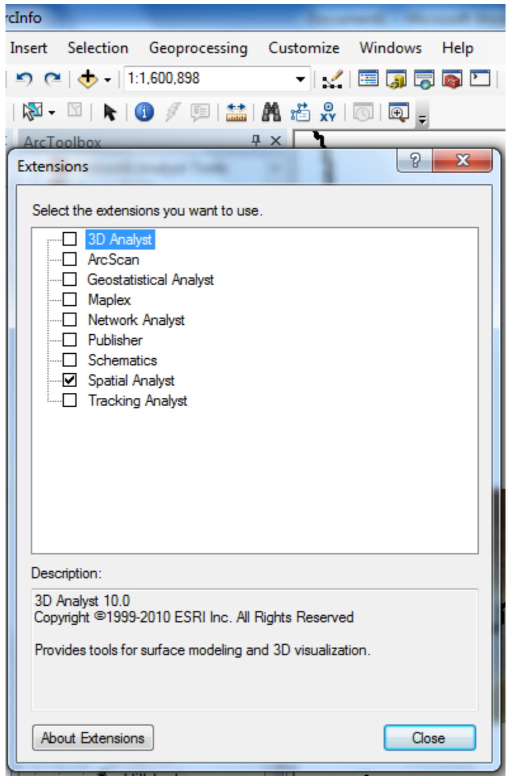
   For Input Raster choose dem_chi_clip *from the pull-down menu. For Output Raster Browse to your* glg362/lab1 *folder on your M: drive, and save as* chi_clip_albers (NOT chi_albers – that file already exists and we will use it shortly), or use the default name if you wish. *For Output coordinate system click the "edit" button at right. In the Spatial Reference Properties Dialog box click the* Select *button, then navigate to* Projected Coordinate Systems/Continental/North America/USA Contiguous Albers Equal Area Conic USGS.prj. *Click Add. Then click OK in the Spatial Reference Properties Dialog box. Back in the Project Raster Dialog box, scroll down to find the* ***Resampling Technique*** *field and use the pull-down menu to choose* **Bilinear**. *(The default Nearest Neighbor often produces artifacts in the projected DEM). Click OK and sit back – it will take a couple minutes.*





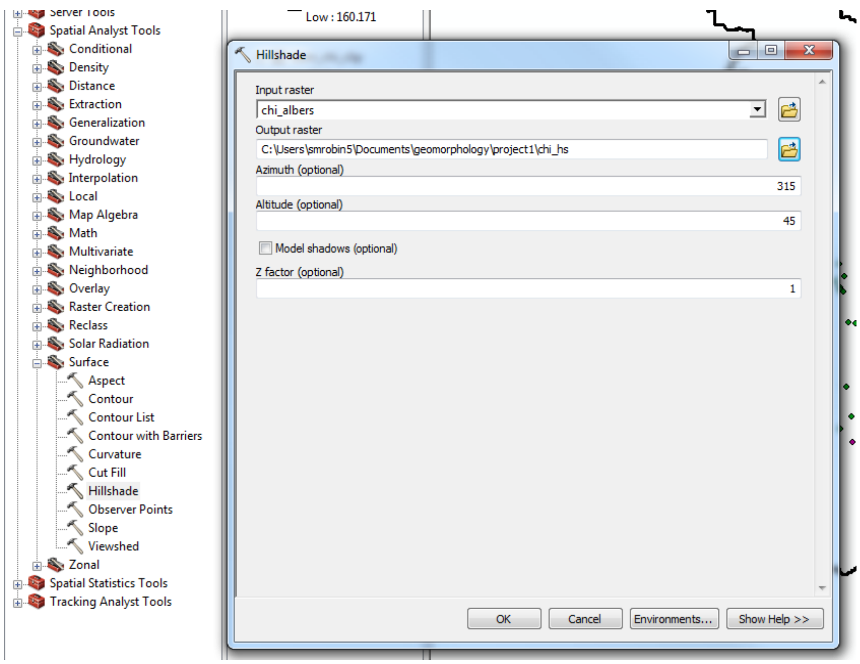
9. *Check the Coordinate System of the Data Frame. This is important because although you just projected this data into an Albers Equal-Area projection, Arc tries to be "helpful" by "projecting on the fly" so no matter what projection you set in a given layer, all will be projected for display only, to the Coordinate System of the Data Frame. In the Main Menu, navigate to View/Data Frame Properties. In the Data Frame Properties Dialog box check that NAD_1983_Albers is listed as the current coordinate system. If it is not, select it from the browse window and click OK.*

10. *Turn on Spatial Analyst (Step 1: select the check box by Spatial Analyst under Tools>>Extensions)*

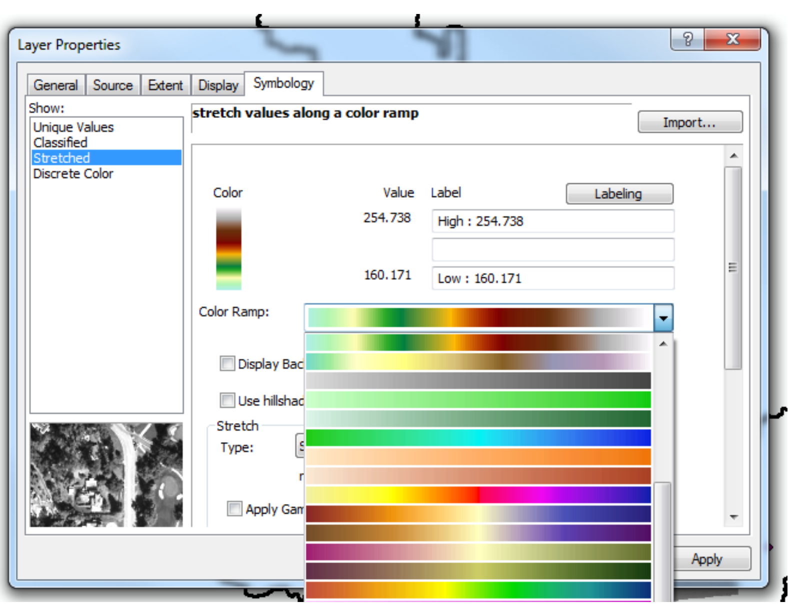


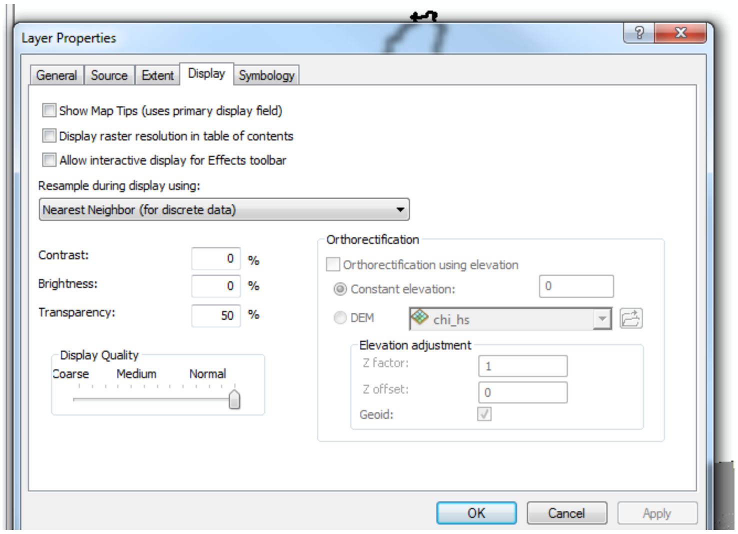
11. *Step 2: You'd think that would be enough to get the Spatial Analyst up and running. But in fact this just activates the Extension and makes it possible to turn it on. To actually turn in on you can Right Click on any grey space on the toolbar and select Spatial Analyst from the pop-up menu. A floating Spatial Analyst toolbar will appear. You can add this to your toolbar by dragging and dropping it into place. Click SAVE. From now on Spatial Analyst should appear on your toolbar whenever you open ArcMap.*

12. *Use ArcToolbox to create a hillshade of your* projected *dem (chi_clip_albers) (save to M: drive): double click Spatial Analyst Tools/ Surface/ Raster/ Hillshade. For Input Raster choose* chi_clip_albers *from the pull-down menu. For Output Raster, browse to your* glg362/lab1 *folder on your M: drive, and save as a name like* chi_clip_hs.

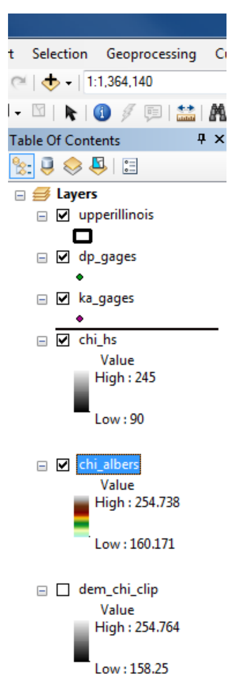


13. *Change symbology (of chi_clip_albers): Double click the layer in the Layers list column at left OR right click and select Properties. Select Symbology tab to select a Colorramp you like, amd the Display tab to Set 50% Transparent*

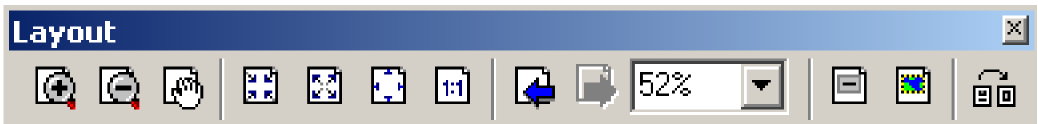




14. *Change order of layers (drag and drop in layer list) – move the transparent* chi_clip_albers *elevation layer so that it is above the* chi_clip_hs *hillshade layer in the Layers list. This allows you to see the hillshading (hills, valleys) and have the map color-coded by elevation. Zoom in to see your map – the zoom tool is in the Tools toolbar – this may be floating to the side of your arcmap window – you can dock this to the main window either horizontally with other toolbars or vertically on the bar beside the Layers Menu (my personal preference). IF you see a strange hatch pattern dicing up the hillshade, then in the project raster step (8) you forgot to set Resampling to Bilinear – go back and repeat that step.*



15. *Switch to Layout View (in main menu: View/Layout View). The Layout View toolbar will appear (see below) – special zoom tools for layout view. Again you can dock this to the main window. To add a scale bar, compass rose, and legend for the DEM go to Main Menu: Insert. These elements can be re-sized and moved around, and there are many options for their appearances. Try some options.*



All the above we did with a small piece clipped out of the DEM of the study area, so to maximize computing speed. Now on your own, do the following with the prepared datasets:

1. *Add projected elevation data (*..\Project_1\arcmap\chi_albers*) for the entire watershed (previously projected)*

2. *Add hillshade (*..\Project_1\arcmap\chi_hillsh*) for the entire watershed (previously computed)*

3. *Make a nice looking map of the region (e.g. organize the layers, adjust the symbology settings for the DEM, hillshade, and watershed boundaries, add a compass rose, legend, and scale bar)*

Finally:

Export a copy of your site map to your glg362/lab1 folder on your M:\ drive (.tiff or .jpg is fine)

File→Export Map→Save

Be Sure to Save your Arc project before closing, if you didn't do it before, save with unique name on your M:\ drive home space

File→Save As→"yourname_project1"(whatever name works for you)

The Next Lab exercise Picks up from here – so you will want to save this for future use. The beauty of using MyApps and the MyFiles M:drive, is that you can access your work from any networked computer at ASU. WiFi connections should be fine as the hard work is mostly done on fast connections between the App server and the M: drive data server.

***Deliverable**: The Exported Map*. Either print (color) and hand in your map, or email as pdf or jpg attachment by the due date. This map will be one of the figures in your final report on Lab 1.