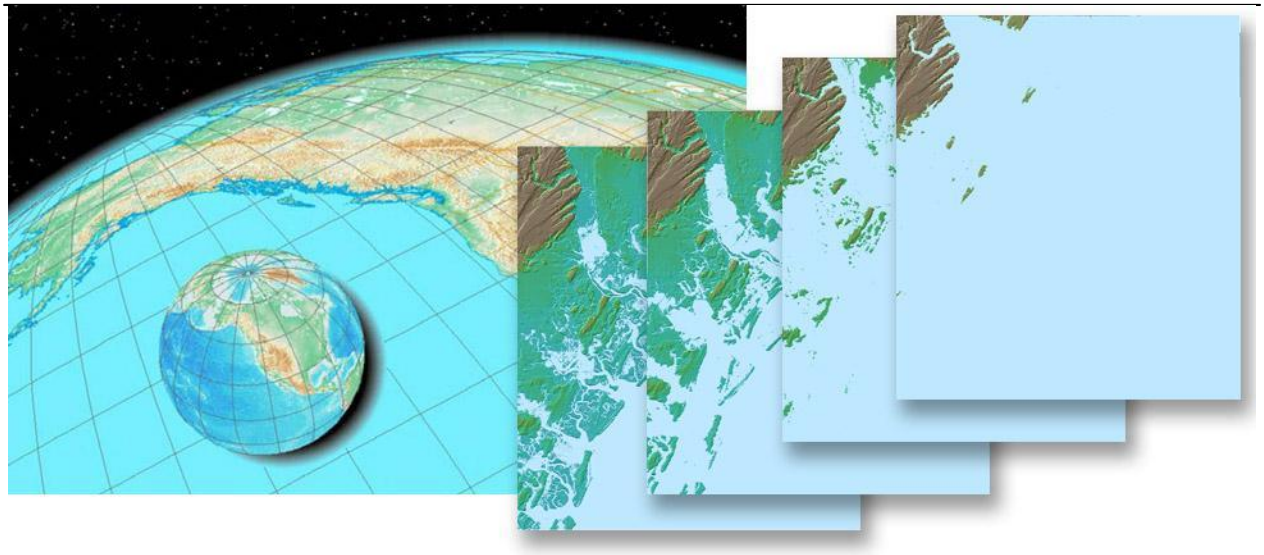
Exercise 5c: Estimating the impact of sea level rise in coastal areas of the United States

National Geophysical Data Center (NGDC)
ArcGIS Online

Due: Thursday, September 22 at the start of class.

Goal: Your goal is to analyze where the populations are that would be affected by sea level rise and to estimate how many people would be affected by rises of various magnitudes. In order to do this, you need to combine detailed census data with accurate topography in coastal regions. In this part of the exercise, you will download US Census Bureau data and prep both your bathy-topo DEM (downloaded in 5a) and the census data for analysis.

Turn in: Nothing, but I will know if you aren't done with this.



A cautionary note: In this part of the exercise, you will download quite a bit more data. Be sure to organize your folders and files carefully so that you identify things clearly and can find things easily.

World map graphic from http://mappingcenter.esri.com/index.cfm?fa=resources.gatewayPresentation "Making Beautiful Maps", 2010 presentation by Buckley, Akella, and Richards.

Important information about US Census data

US Census Bureau data consist of two components:

1) The first component is a set of shapefiles that define the geographic extent of legally defined statistical areas for the census. The smallest statistical unit is called a *census block*. Blocks are combined into *block groups*, block groups into *tracts*, and tracts into *counties*. Census blocks provide the highest level of detail. These shapefiles are redefined every year.
2) The second component is a set of data tables that contains the census demographic data. The US Census is taken every 10 years. The most recent census data were collected in 2010.

In order to use US Census Bureau data for analysis in ArcGIS, you usually need to **join** a census data table to the attribute table of the shapefile for the area of interest.

Because this can be a long and complicated process, we will use shapefiles that have been **pre-joined** with some census demographic data. But, before we do that, we will look at where the other census data are available from because it is a good source of lots of useful information.

US Census Bureau data consist of two components:

1) The first component is a set of shapefiles that define the geographic extent of legally defined statistical areas for the census. The smallest statistical unit is called a *census block*. Blocks are combined into *block groups*, block groups into *tracts*, and tracts into *counties*. Census blocks provide the highest level of detail. These shapefiles are simply outlines, and the attribute tables contain no actual demographic data. These shapefiles are redefined every year.
2) The second component is a set of data tables that contains the census demographic data. The US Census is taken every 10 years. The most recent census data were collected in 2010.

In order to use more detailed US Census Bureau data for analysis in ArcGIS, you need to **join** a census data table to the attribute table of the shapefile for the area of interest. We mostly don't have to deal with this, but I want you to look around the census data website.

Go to American FactFinder (http://factfinder2.census.gov) and look around the site. See what types of data are available and on what topics. Be sure to put information about it into your data source and website lists. I know it's kind of a confusing site, but it has some really useful data.

Fortunately for us this year, there is a subset of American FactFinder data available already connected with shapefiles. We'll be using that for class this week.

Part I. US TIGER Census Data from the government site

A. TIGER/Line shapefiles from the US Census Bureau

1. We're all going to download census data for the states overlapping with your DEM.
    a. Start a new ArcMap, and add your coastal bathy-topo DEM and the USA States layer and label the features. Does your DEM cover area in more than one state? If so, write down the states that your DEM touches.

2. Go to http://www.census.gov/geo/maps-data/data/tiger-data.html to get the TIGER shapefiles for your state or states.
    a. Click 2010 Census "Population and Housing Unit Counts -- Blocks"
    b. Select your state. Click "Go."
    c. Move your file to your logically organized spot and unzip it.
    d. You will need to repeat these steps for all the states you have.

3. Launch ArcCatalog, and preview your shapefiles. Be sure to use both the **Geography** tab (bottom of ArcCatalog Preview window) and the **Table** tab. What GCS do your shapefiles have?

Part II. Projecting all your data sets into the same projected coordinate system

As part of the homework download, you should have chosen **Define Projection** and selected a **Geographic** Coordinate System for your bathy-topo DEM. Ditto for the census data. **If, instead, you defined a PROJECTED coordinate system, you did the wrong thing.** Before you do anything else, you need to go back, start with the original files without a spatial reference, and Define a GCS, rather than a PCS. Why is a GCS the right choice?

So, now all of your data sets should be in geographic coordinate systems. Because you will want to make a hillshade of your DEM, you'll need to project the DEM. **And it's best practice to have all your layers in the same projected coordinate system before you start doing analyses, rather than having ArcMap project on the fly.**

1. Start a new folder at the top level of your sea level folder so that you can collect all your projected data sets into one folder for easy use.
2. Project all data sets to NAD83 UTM XXN, using a UTM converter online to pick the correct UTM zone for your coastal area. If a geographic transformation is needed, be sure to choose the correct transformation using your datum transformation handout (in Course Overview on Blackboard). **Be sure to save these projected files with names that let you know that they are projected, and be sure to save them in your top level working folder.**
    a. Use the search tool to find the right tools.
    b. Which tool did you choose to project your DEM? Why? Don't forget that you need to choose the correct resampling technique. (Hint: it isn't the default. If you need to know which one to choose, look in lab 1).

    c. Which tool did you use to project your merged counties file, and why?

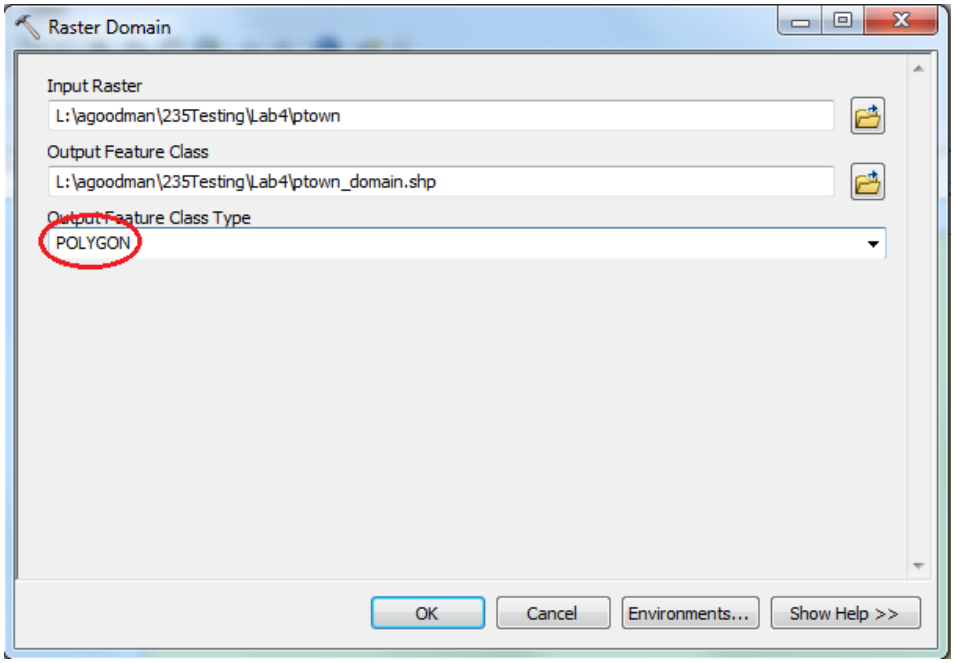
3. Make a hillshade of your bathy-topo to make sure everything is hunky-dory. **If you got a "molten metal" hillshade, what do you need to do to fix the problem?**

Part III. Getting your shapefiles down to a manageable size

Your census block shapefiles are made out of many, many tiny polygons. This would take a long, long time to load in ArcMap. To save time, we will clip them down so that we are only loading census blocks for the area that we care about.

1. We are only interested in the area that is covered by your DEM. You will need to use the **Clip (Analysis)** tool to cut your census block shapefile down to the size. Find the Clip tool. Does it want you to input vector or raster datasets?

2. Since the tool we want won't accept our DEM as an input, we need to make a polygon that is the same shape and size as the "footprint" of the DEM. Turn on the 3D Analyst extension. Search for "Raster Domain." Input your projected DEM. Set the output feature class type to POLYGON.



3. Preview the resulting polygon. A rectangle! Just like you wanted.
4. Open up the Clip tool again. Input your projected census blocks, as "Input features," your new rectangle as "Clip features," and come up with a name for the output.

5. Clipping might take some time.

6. Repeat step 4 with another state if your DEM overlaps multiple states.
7. Open up ArcMap. Add your DEM, your hillshade, and your census blocks. Does everything look right? If you should have to go back and re-do something, delete the offending files that you don't need so that you don't wind up with a whole passel of files that you can't distinguish from each other.

8. Make sure that you have all your data sets, plus an mxd file with your DEM and census blocks ready for lab on Thursday.