Climate-Smart Agriculture and Geospatial Applications

Training Module

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Introduction

This tutorial shows you how to use the ArcMap module to create a simple map. ArcMap is one of the modules in ArcGIS Desktop. You use ArcMap to create maps, query data, perform analysis, and most of the other basic GIS operations. ArcMap is the module that you will use most frequently. This tutorial may take 3-4 hours to complete.

Creating a Map with ArcMap

You will now learn the basics of using GIS data to explore an area and create a map.

Your efforts will be focused on Nepal.

Starting ArcMap, opening Arc Catalog, and adding data layers

To start ArcMap, choose **Start-All Programs – Applications - GIS Applications - ArcGIS 10.2 - ArcMap**

1. When the first dialog box comes up, highlight the option to start with a new blank map and press OK
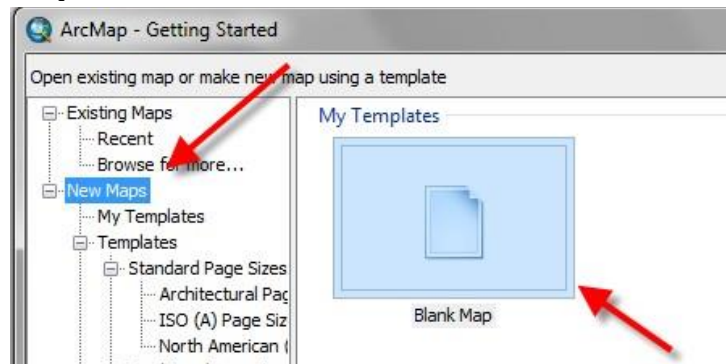
2. Go to **Customize** – click on **Toolbar**, and make sure that *Standard* and *Tools* are visible (have check marks next to them)

3. On the left side of the screen, you should see your *Table of Contents* area - right now it should only say "Layers". If you do not see this separate area, select Windows **- Table of Contents**.

4. Use the mouse to pass over each tool and see what it does.

5. Choose **Windows – ArcCatalog** to bring up the *ArcCatalog* window – ArcCatalog is like a file manager for GIS data – we'll talk more about it in the class.
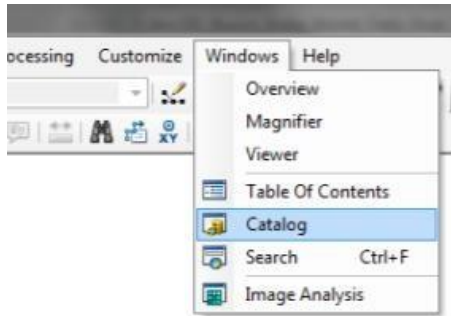
6. Click on the *Auto-Hide* icon (thumb-tack) to keep this Window visible
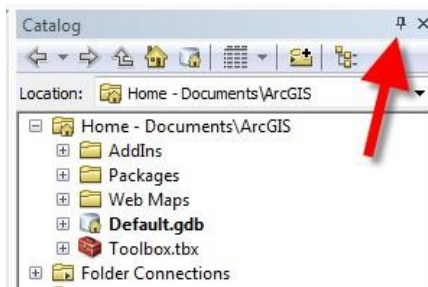
7. Right-click on *Folder Connections* and choose *Connect Folder*
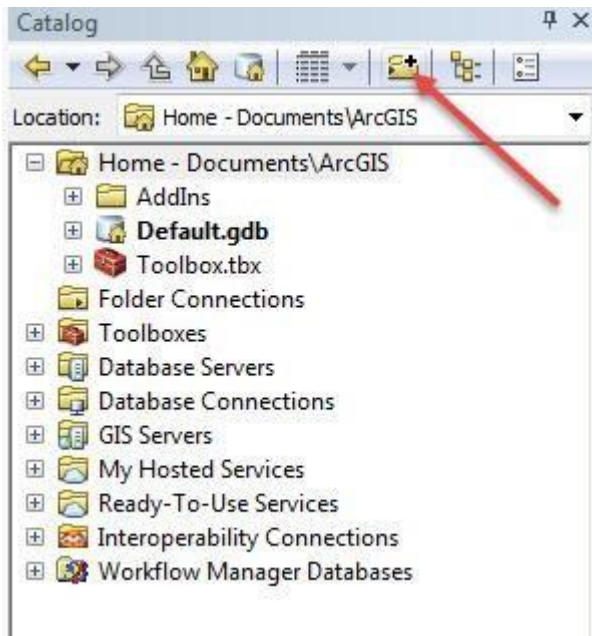
8. Highlight the GIS D/E drive and click OK

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9. Make a **folder connection to your D/E drive** as well - you will store your map file there later.

10. Using your new drive folder connection, navigate to **Map: Climate_smt_agri.** Click once on each file to highlight it, and drag the following data layers into the main ArcMap window (one at a time):

    a. Cities.shp

    b. Country.shp

    c. Rivers.shp

    d. Highway.shp
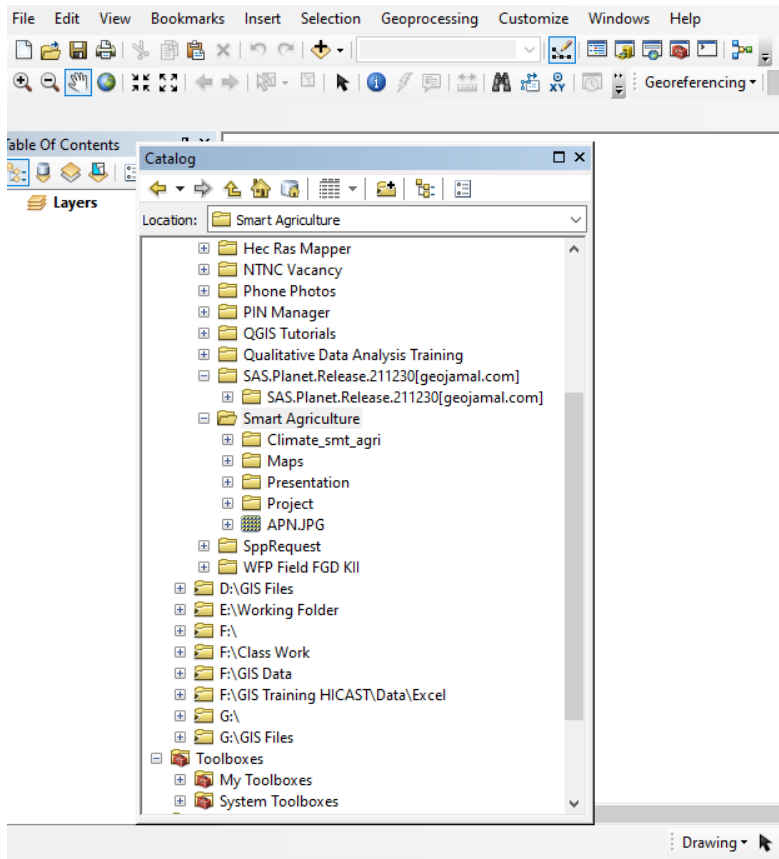
11. Uncheck **Climate_smt_agri** and in the *Table of Contents.* You can do so by clicking once on the box, located to the left of the file name.

12. Now you should have just the **rivers**, **cities**, and countries (**country**) drawn on the map.

Getting Around the Map

1. Zoom into a part of Nepal using the Zoom in tool. When using the zoom tool, you can click and drag a box around the area you would like to zoom in to. Use the *Zoom in,*

   Zoom Out, and *Pan* ( ) tools to move around the map, and the *Zoom to Full*

2. *Extent* tool to go back to the full view (in ArcGIS, you can place the cursor over each tool in the menu without clicking to see a description of what it does)

3. Try clicking on the *Identify* icon ( ) and then click on countries, rivers, or lakes. The Identify tool brings up information from the attribute table for each feature you click on.

4. Right-click on the *rivers* layer in the *Table of Contents* (be sure you right-click on the actual name and not the symbol) and then click on *Label Features* – this will label the rivers.

5. Name the map file *basemap1.mxd*. This action creates a *map file* (.mxd). A map file is a very small file that contains pointers to your data sets and remembers what you had up in your session. If you quit ArcMap at this point, the next time you start it, you can choose to start with this existing map file and it will automatically pop up all the data layers you added in your first session, with the layers turned on when you last saved the map file, and with the view of the data just as you left it. Thus, map files are easy ways to save work. But beware – map files do not actually contain data layers, they only have pointers to the data layers. If you copied your *basemap1.mxd* file and tried to open it on a home computer without the appropriate GIS data layers, an ArcMap session would start and list the data in the table of contents but nothing would appear because it would not be able to find the data it is pointing to.

6. Save your map file frequently and always save at the end of a session.

7. Navigate to the *D/E: datasets\Country\Nepal\Climate_smt_agri* folder and drag all the shape files in that folder into the ArcMap window
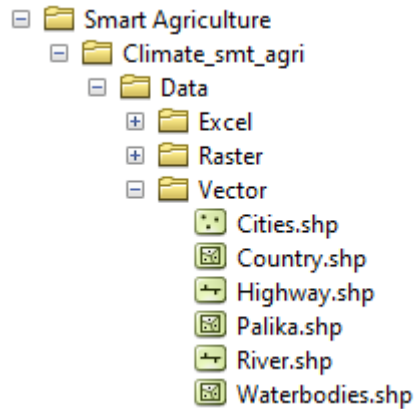
8. **Again**, the map will be messy. Zoom into Nepal so that it fills the map.

9. You **can** group the Nepal data layers all together. If they are no longer all highlighted, hold the CTRL key and click on each one in turn to highlight them. Assuming they are highlighted now, right-click on one of them and choosing *Group* as shown below:
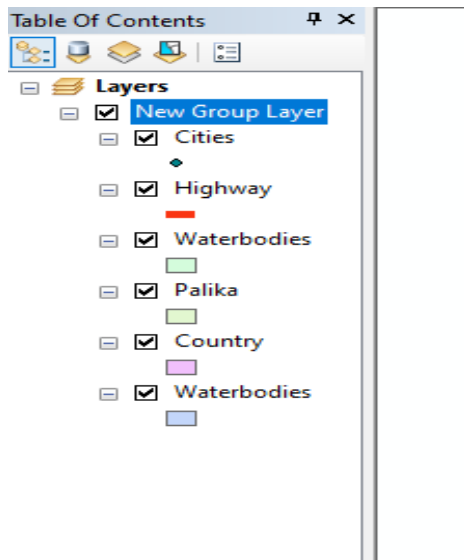
10. Rename the "New Group Layer" to *Nepal* as shown below:
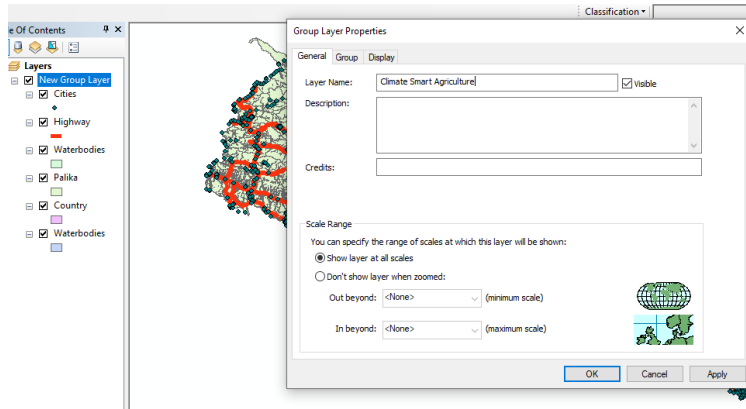
11. Perform the same grouping on the *Whole Nepal* data so that it is in its own group as shown here, then turn off the *Whole Nepal* data. If you click on the first and last datasets, while holding shift, all layers will get highlighted.
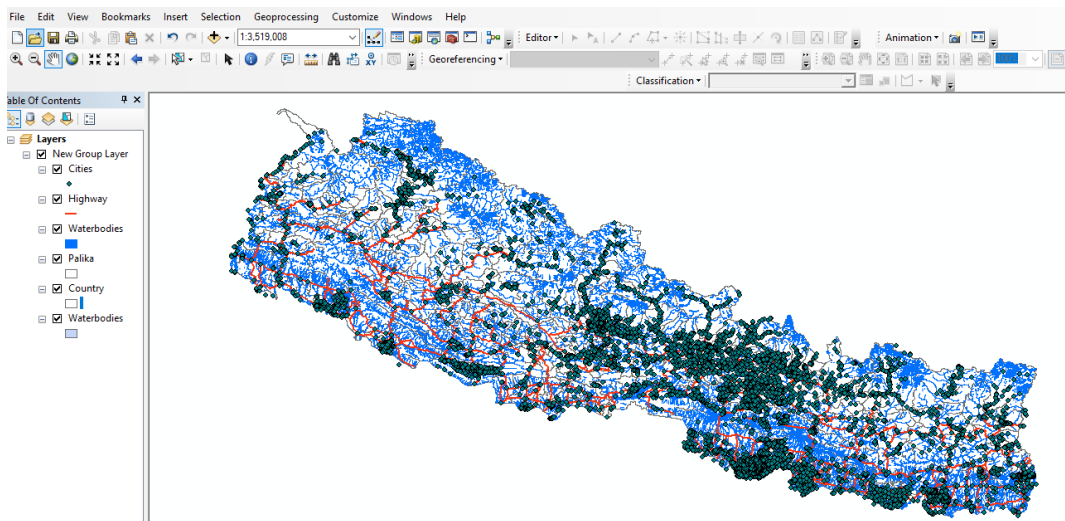
REMINDER: Save your mapfile frequently, and always save it at the end of a session! Global

Global Positioning System (GPS) and Its Application

The Global Positioning System (GPS) is a satellite-based navigation system that sends and receives radio signals. A GPS receiver acquires these signals and provides you with information. Using GPS technology, you can determine location, velocity and time, 24 hours a day in any weather conditions anywhere in the world for free. GPS, formally known as the NAVSTAR (Navigation Satellite Timing and Ranging) originally was developed for the military

purpose. Because of its popular navigation capabilities and because you can access GPS technology using small inexpensive equipment, the government made the system available for civilian use.
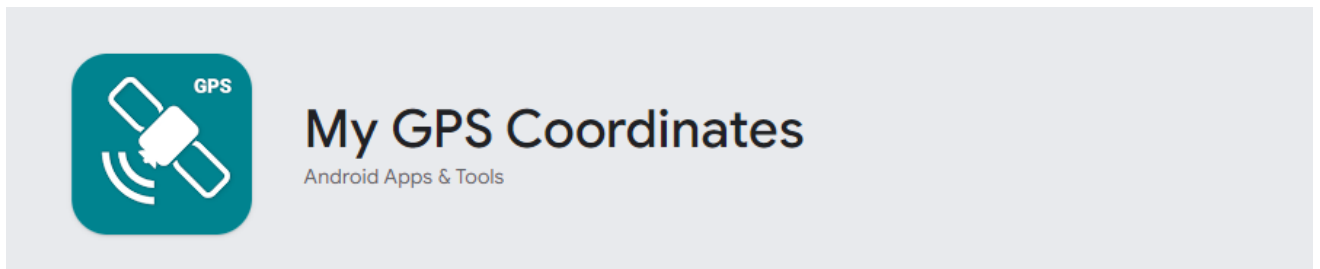
Find an app's data safety information
Go to play.google.com.
Browse or use the search bar to find an app.

Select an app.

Under "Data safety," you'll find a summary of the app's data safety practices.

For more detail, select See details.

Tip: The info in the Data safety section only applies to apps distributed on Google Play. You'll only find the Data safety section on Android 5 and up.

The Data safety section of an app listing lets developers describe how their apps collect, share, and handle different types of data. Developers explain their practices for:

Data collection: Developers describe the types of user data their app collects, how they use this data, and whether the collection of this data is optional. Data is generally considered "collected" when the developer uses their app to retrieve data off your device.

In some cases, developers do not need to disclose data as "collected" even if the data technically leaves your device (for example, when the data is only processed ephemerally). Learn more about these cases below.

Data sharing: Developers describe if their app shares your data with third parties and what types of data are shared. Data is generally considered "shared" when it is accessed by the app and transferred to a third party.

In some cases, developers do not need to disclose data as "shared" even if it's technically transferred to another party (for example, when you give your consent to transfer the data after the app explains how it will use the data, or when the data is shared with a developer's service provider). Learn more about these cases below.

Handling GPS and Google Earth Application

As of early 2015, Google Earth Pro, which used to be a $400 product, is now free. This is a powerful yet simple tool for viewing information geographically—whether it is viewing climate information, analysing change over time, seeing the world the same way you're used to seeing, or remembering routes taken while on vacation. In this tutorial you will learn how to create placemarks (points of interest), analyse elevation changes over the landscape, import images, utilize the built in library (3D buildings, weather, photo gallery, etc.), view historical imagery, navigate to a city with the directions module, import shape files, geocode addresses, and create a route.

If you are familiar with the standard Google Earth version, much of this tutorial will be review. There are however new and interesting features that are in the pro version that are quite useful that will be covered. The interface is shown in Figure below.
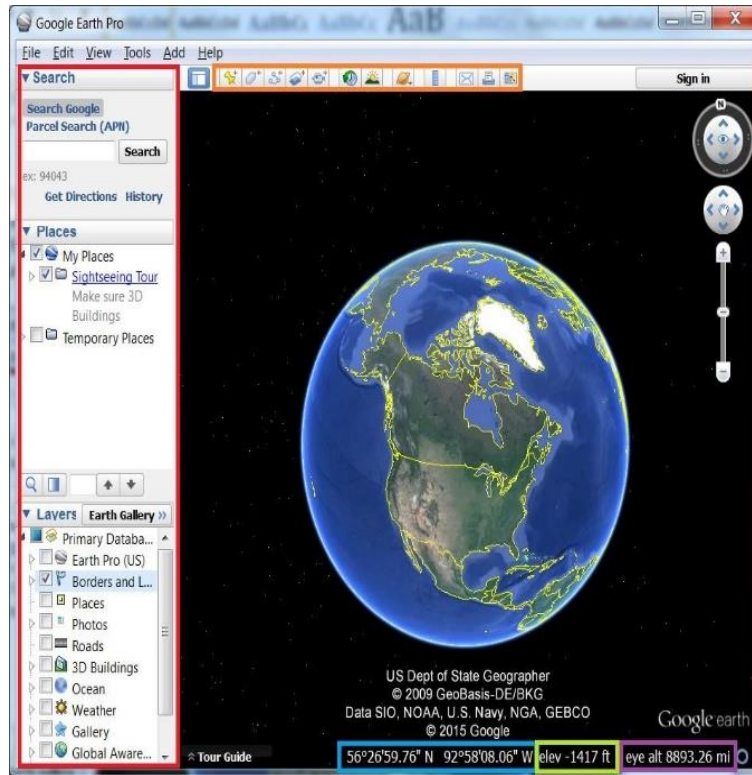
The **sidebar** on the left hand side of the screen contains a few different modules. At the top is the **Search** module which can be used to search for locations using various methods, such as latitude/longitude, cities, provinces/Provinces, nations, administrative boundaries and addresses. In the middle is the **Places** module where location information is saved and organized. At the bottom is the **Layers** module, which contains a variety of information, or layers, created by the Google Earth community that can be checked on and off for viewing purposes. Examples of these layers include photos, weather, labels, demographics (US only), and 3D buildings.

The **toolbar** at the top of the Google Earth interface gives access to a variety of features provided within Google Earth, including Placemarks, creating polygons, image overlays, historical imagery, and so forth.

The bottom of the screen provides helpful information such as the current **latitude and longitude** coordinates and **elevation** of where your cursor is pointing. Off to the right you can also find the **Eye altitude**, or the altitude that Google Earth is currently viewing the world from.

Historical Imagery

Historical Imagery can be a very useful tool when utilized in the right circumstance. It enables the user to analyses change in the landscape overtime. For example, we can use the historical imagery to view the progress of development of Birendranager, Surkhet
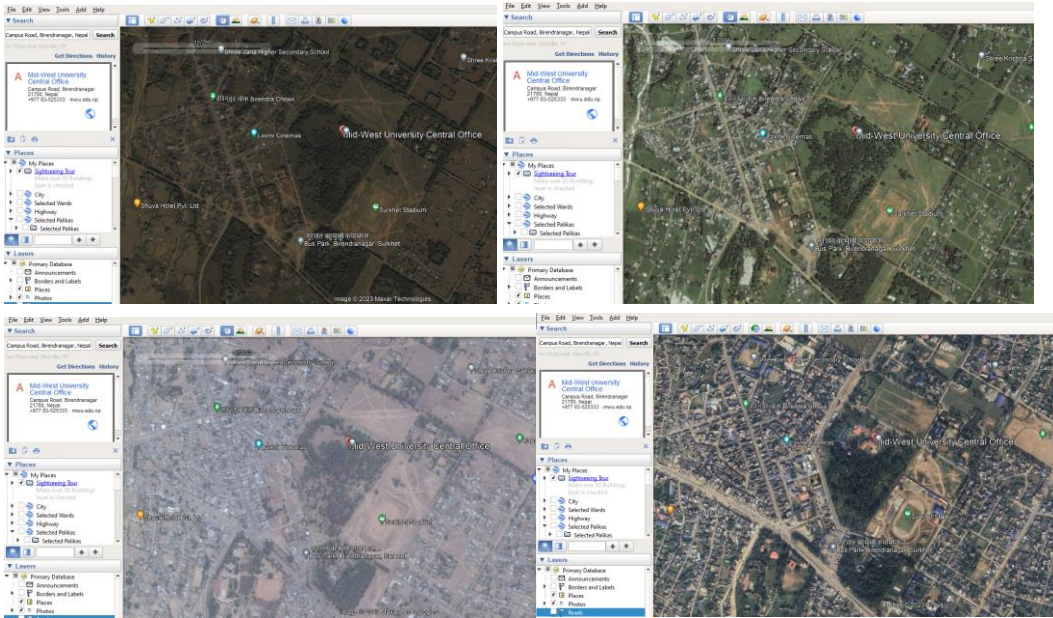
Creating a Placemark Convert to KML File

Place marks have a variety of uses in Google Earth but essentially represent Points of Interest you can refer back to after. For example, they can be used to show where a Hotel is located. The name of the placemark could be "Mid-West University, Surkhet", this information can be displayed when the Place mark is selected.
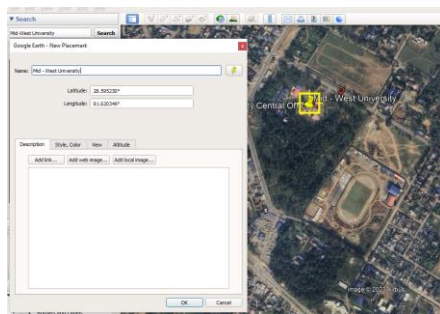
For more about google earth please flow this link below.
http://www.google.com/earth/outreach/tutorials/kmltours.html
http://support.google.com/earth/bin/answer.py?hl=en&answer=176674
http://googleearthdesign.blogspot.ca/2009/08/creating

Setting a Coordinate System for the Data Frame

The rest of this tutorial focuses on Nepal, so we are going to set a coordinate system that better maps Nepal. This will also ensure that any spatial queries you do will perform correctly.

1. Click on the **View** menu and choose **Data Frame Properties**

2. Click on the **Coordinate System** tab

3. In the coordinate system dialog box, you will see information in the bottom panel for the current coordinate system (GCS_WGS_1984). We want to change this.

4. Scroll down and click on **Projected Coordinate Systems**, then **UTM** then on **WGS 1984**, then **Northern Hemisphere**, and finally on **WGS 1984 UTM Zone 44N and WGS 1984 UTM Zone 45N** as shown below and then **OK**:
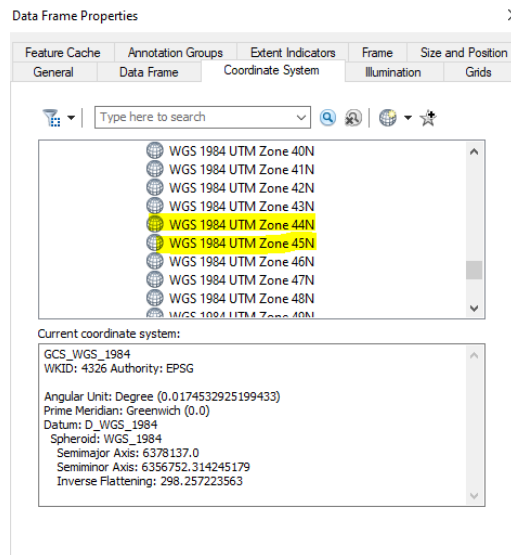
If you zoom out to the world at this point, you will see that this severely distorts the rest of the world. But it's a great way to show Nepal!

Zoom back to whole Nepal when you're ready.

In the next section of the tutorial, you will learn how to organize your data layers' properties to start bringing some coherence to the map. To clean up the map, uncheck all the layers except for the *roads, cities, district,* and *provicne* layers.

You will also learn how to color the data layers to start making a more interesting and readable map.

Defining the General and Symbology Properties for a Layer

In this section of the tutorial, you will learn how to organize your data layers' properties to start bringing some coherence to the map.

Assigning proper layer names

First, you need to give the data layers' better names than what they have (e.g., *Districts, Municipalities* should say "*Palikas"*)

Assigning proper colors

Your map would be a lot better if the district layer were not blocking the Province layer, etc. We want the Province boundaries to show up on top of the District boundaries.

1. Right-click on the *Province* layer and bring up the Properties dialog box again.

2. Click on the *Symbology* tab

3. To change the color of the layer, click on the colored box under Symbol - this should bring up the *Symbol Selector* box.
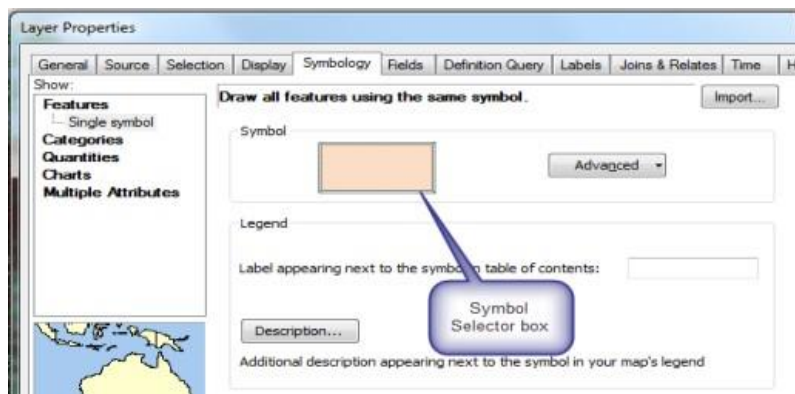
4. Click on the small colored box next to *Fill Color*, to see colors to choose from – choose **No color** for the Provinces' fill.
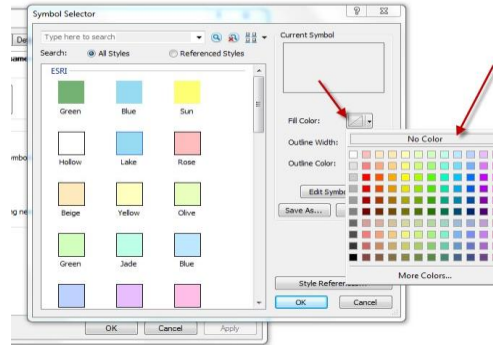
5. Make the outline width 2.00.

6. Press OK when you are finished, and OK again to return to your map.

7. Drag the *Province* layer to the top of the Nepal group in Table of Contents. Now that it is hollow you can see the layers below.

8. Color the *District* layer beige and give it a 1.0 gray outline width as show below:
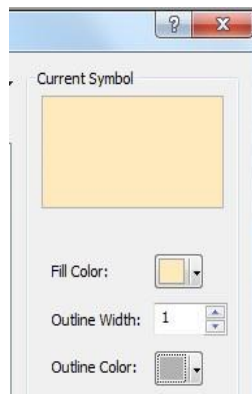
9. Using what you have learned, give appropriate colors to your other layers.

10. When finished, choose **File – Save** again. Now your basemap1.mxd file will remember all the colors and names you assigned. It's starting to look better…

Drawing a layer based on an attribute value (land use codes)

Some of your layers would look better if you could distinguish between types of features in the same layer. The *Province* layer, for example, shows Nepal's sates boundaries but doesn't give us more information when drawn with a single color. You can use an attribute field to symbolize your data to reflect the field values.

1. If it's not already on, turn on the PROVINCE layer.

2. *Right-click* on the PROVINCE layer and choose *Open Attribute Table*:
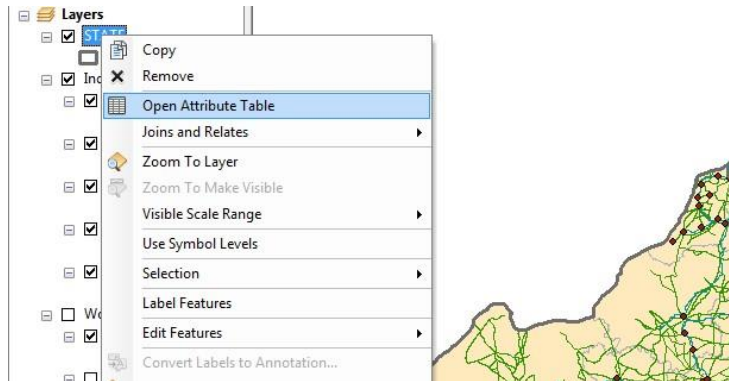
In the Climate_agri_smt folder, there is a subfolder called Raster. Open up this folder using your Windows File Manager (not ArcCatalog).

Go to *D/E: Codes folder Description*, and take a look at the color code.pdf to see what the abbreviations in the attribute table columns mean.
 Let's say we wanted to visualize the population of cultivators. We see that the column (field) name for this data item is *Mutton*, *pork and other* is in the field,

Right click on the Province layer, and click Properties. Click on the *Symbology* tab, and select Quantities – Graduated Colors on the left. Fill out the form as you see below:
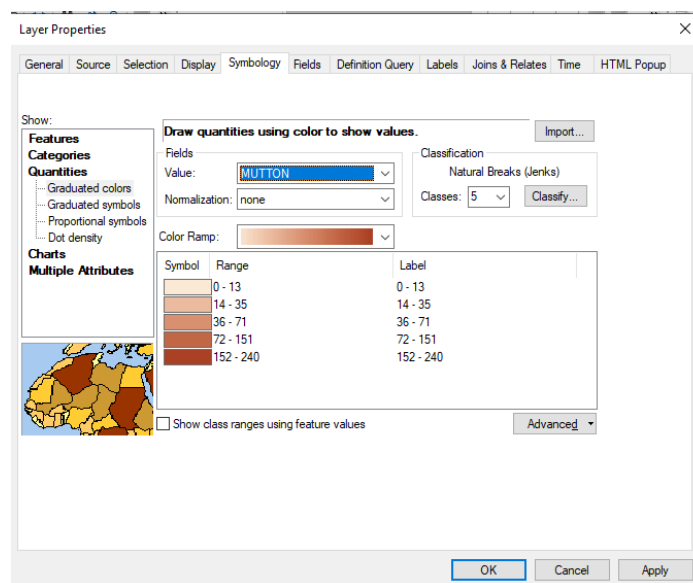
Notice that the options in the Value dropdown are the row headings you saw in the attribute table.

1. Press OK when finished.

The resulting map is interesting. We certainly see the Provinces with larger numbers of cultivators. What Provinces have the largest numbers? (Hint: use the *Identify* tool -)

2. Go back to the *Province Layer Properties* and to the *Symbology* tab, and in the box for *Normalization*, choose the field, *Pork* – when you use this Normalize function, it simply divides the top value by the normalization value, so in this case *Mutton/Pork*:
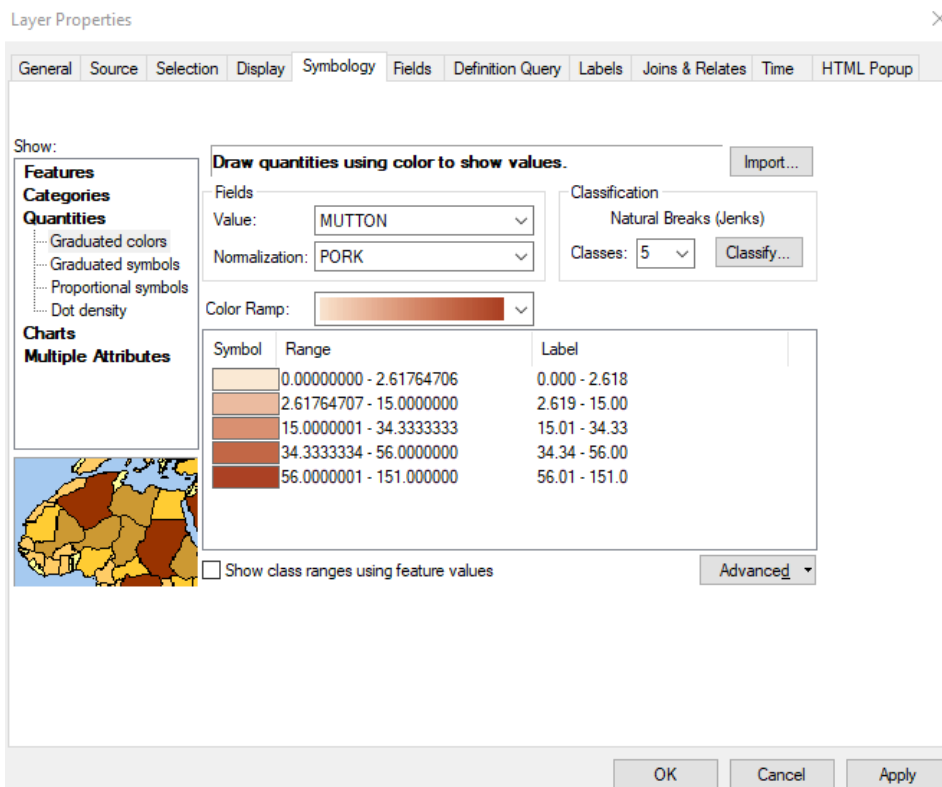
3. Press OK.

Try making the same map (fraction of workers who are cultivators) by Districts.
You may have to drag one on top of the other to see them.

Using the Select by Location function

In the last section, we sorted the table by district to select out towns. But there is another way to query data in ArcGIS – we can use a selection query.

1. Turn your *Cities* layer

2. Turn on the *district* layer again

3. Click on *Selection* in the Tools menu and then choose **Select by Locations**
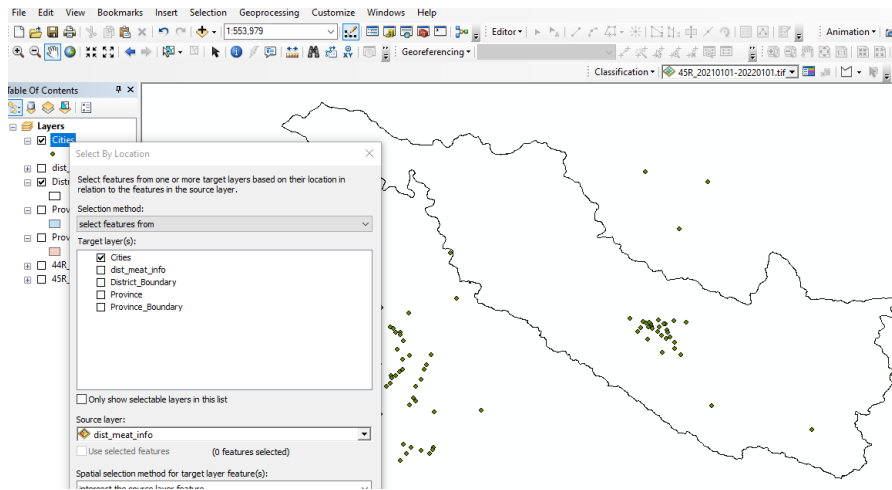
Labeling a layer based on an attribute field

You can label features based on attribute values. Let's label the Provinces.

1. Right-click on the *districts* (or if you renamed it before) layer and choose *Label Features*. Note that the names for some Provinces are repeated – that's because the Province may have islands or other non-contiguous sections that are represented twice in the database, and so get double names.

2. To get rid of the double names, right-click on the District layer, access its Properties and click on the Labels tab.

3. Click on *Placement Properties* and then on *Remove duplicate labels* as shown below:
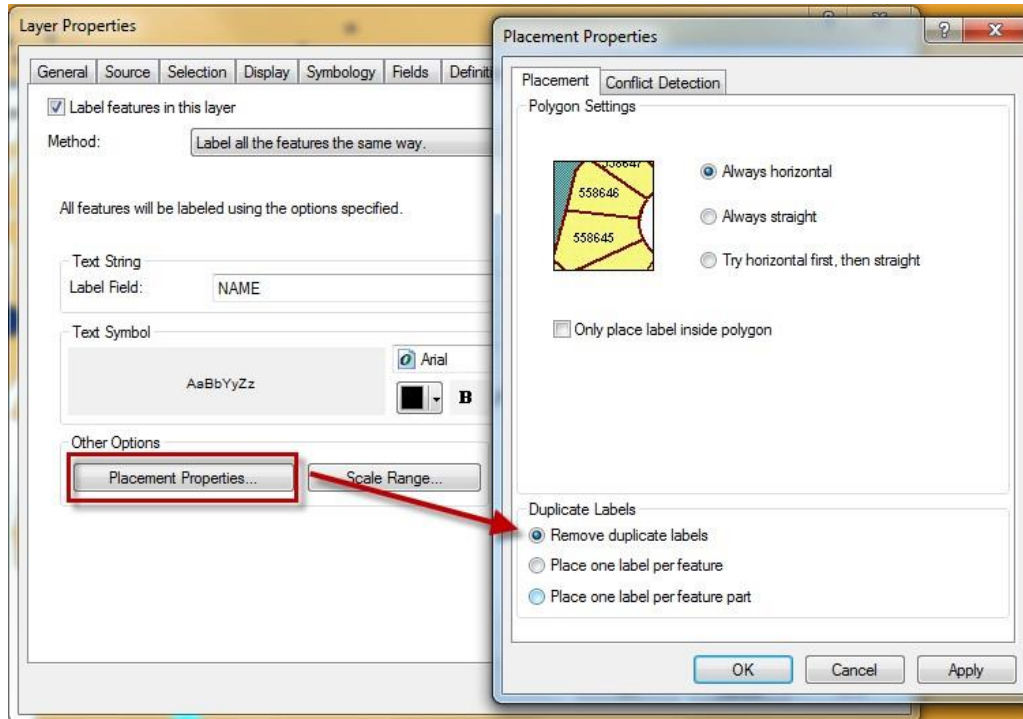
4. Save your map file.

Changing the formatting of labels

Let's say you want to have the *Province* names stand out more on the map. We can do this by changing the label's format.

1. Right click on the *District* layer name and choose *Properties*.

2. Click on the *Labels* tab.

3. Make sure that the *Label* field says *Name*.

4. You can choose the font, size and color of your labels by clicking on the *Symbol...* button – try making them *bold with 10pt font*.
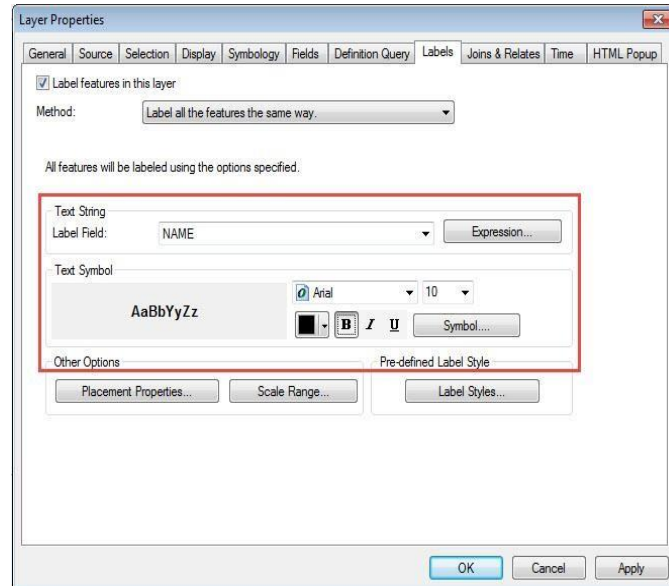
5. When you are done, return to your map. If needed, clear the previously made selection using the *Clear selection* tool.

6. If you don't like the results, adjust the label format again as you wish. Check out some of the predefined label styles.

Using Data from ArcGIS Online

Increasingly, ESRI other agencies are setting up online GIS data servers that you can access from ArcGIS. We're going to use one of these services now.

1. Click on **File – Add Data – Basemap**.
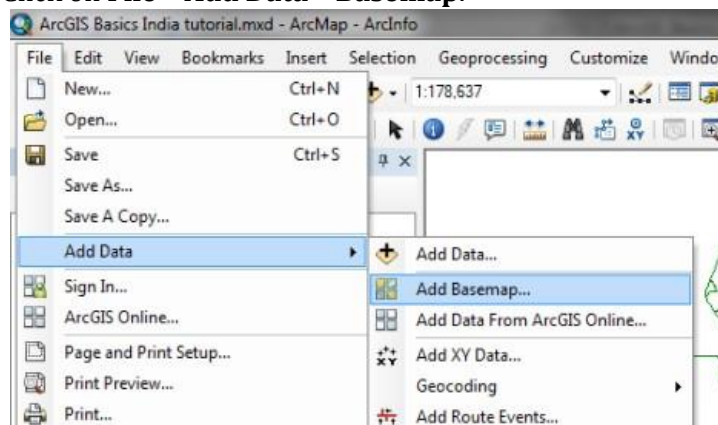
2. Choose **Imagery** from the list. It will take a while to draw. You may have to turn off layers that are overlaying it to see it.
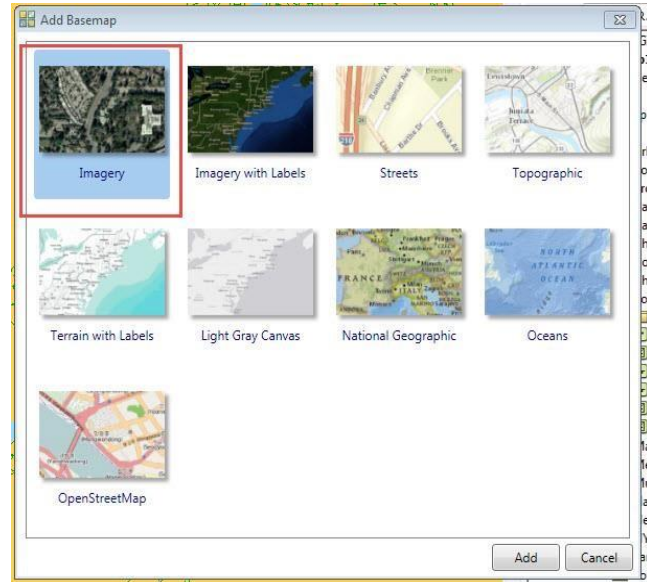
3. Go to File – Add Data from ArcGIS Online. Search the **World Topographic Map** layer from ArcGIS online. Click **Add**/ This is a set up to provide a nice shaded relief background for mapping. This will be more interesting if you are mapping the mountainous part of Nepal – try zooming to that region (north).

4. Move the **World Topographic Map** layer to the top of your *Table of Contents*.

5. Right click on this layer to open the *Group Layer Properties* window, and click the *Display* tab. This allows you to change the transparency of the layer. Set the transparency to 50%. This provides a nice shaded relief background for mapping.

6. To remove a data set you don't want, right click on the data layer main name (e.g., *Basemap*) and choose *Remove*.

7. If you don't remove it, turn off the imagery for now. It makes drawing very slow.

Note that there are many other data sets available on ArcGIS Online.

Measuring Distance and Area and Drawing a Map to Scale

Measuring distances and areas

1. Click on the **Measure** tool in the *Tools* toolbar.

2. Click somewhere on the map to start a measuring line. Drag the line somewhere else and click again. You will see two measurements reported in the Measurement window. The first, *segment*, gives the distance (in *meters*) of the line you just drew. The second, *Length*, gives the total distance. Click on a third point in the map. You will see the new segment distance plus the total distance of both segments. Double-click on the map or choose a different tool to stop measuring.

If you want to measure in a different unit, click on the little black triangle as shown below and select a new distance unit:
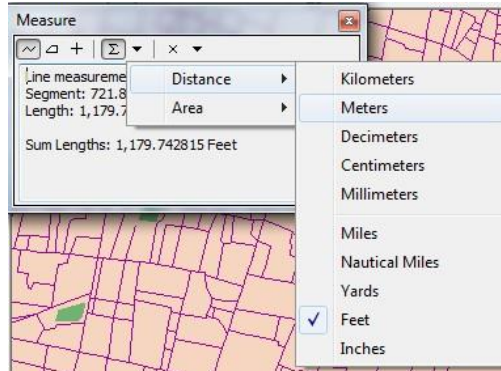
Try calculating the area in acres of a park in Surkhet (Go to Surkhet and zoom to help guide you) – use the polygon tool in the *Measure* tool as shown below and set the area units to acres:
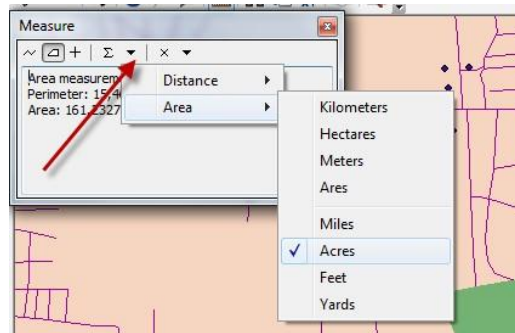
We'll learn a better way to do this later.

Drawing a map at a set scale

Many professional map users expect printed maps to be at a standardized scale. USGS topographic maps are printed at 1:100,000 scale (1 inch on the map equals 100,000 inches in the real world or about 1.58 miles) and at 1: 24,000 scale for example (1 inch on the map equals 24,000 inches in the real world, or 2000 feet or about 0.38 miles). In ArcGIS you can scale your map to any scale, but you are also offered standard scales from which to choose.

1. Set the scale of your map to 1:10,000:
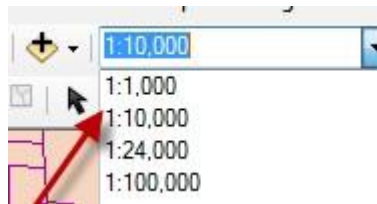
This is very "large scale" map (lots of detail, small area displayed) so it would work well for a map of downtown Surkhet but not for a map of a Province or the entire country.

2. Experiment with some of the other map scales. Which scale would be good for a map of downtown Surkhet? You can also type in a scale yourself (you only have to type the denominator, e.g., 450,000, with or without commas).

3. Try typing in 100,000 in the scale box – this creates a map at 1: 450,000 scale (1 inch on the map equals 450,000 inches in the real world) and you can have a map of Surkhet

Creating a layout for printing or graphic export

You create a layout when you want to actually create a map for printing or inclusion in another document. It is a view of your data, much like viewing the page layout when you are working in a word processing software. You should use the layout view when you are ready to create a map – do all the preliminary work and analysis in the data frame view (where you have been up to now in this tutorial).

In this tutorial, you can create a map of all or any part of Nepal you like – we provide the graphic above of the Surkhet Distrct as an example.

When you create a map, you should include the map itself, plus a title, a legend, a scale, and a north arrow. You should also provide the name of the cartographer (you), a date, and acknowledgements of data sources.

It is important in a map not to include too much information. You would not want a map that includes all the data layers you have in your ArcMap session from this tutorial. It would be much better to do several maps.

You may also include other elements on your map – for example, more explanatory text, charts, tables, photos, or other images.

Note that you can also have more than one data frame on a layout – for example, you can have a small locational reference map (as in the map above) or an inset map to show an area in more detail. See the next section (*Adding a data frame to show two or more maps on a layout*) for instructions about how to do this.

To do all this, you will move into *Layout View*. *Layout View* is much like viewing the page layout when you are working with word processing software. You should do all the preliminary work and analysis in the *Data Frame View* (where you have been up to now in this tutorial), then move into *Layout View* only when you are ready to create a map

For detailed information about layouts, go to the main menu and click Help – *ArcGIS Desktop Help. Then, in the contents bar, click on Mapping – Working with ArcMap – Using Page Layouts*

Setting up a map layout

1. Before you start a map layout, it is important to think through what you want to do and how you want your map to look. What do you want to show? How large do you want your final map to be? Portrait or landscape orientation? Do you need space for additional text or graphics? This tutorial example will assume a printer paper size (8x11 inch) map but often you are making map for publications where they must be smaller, or for Powerpoint where they need to be a certain size (e.g., 7.5x10 inches), or for posters where they may be much larger than 8x11.

2. In ArcMap, choose **View – Layout View** from the main menu.

3. The view changes to show your data frame on a page layout and a new toolbar appears – the *Layout* toolbar

4. The first thing you should do is to set up your Page properties. Choose **File – Page and Print Setup**

5. In the *Page Setup* dialog box, make sure that the page size is set to *Letter*. Also check either *Portrait* or *Landscape* (which would be better for the map you want to create? The example map is in *Portrait* orientation). Press OK to return to the map.

Moving around in the page and data frame

It is very important to understand the difference between the **Layout** toolbar and the regular (data frame) **Tools** toolbar. They share similar tools (zoom in and out, pan) but the **layout tools** work on the layout as if you were zooming in and out of the *paper itself* (There is paper in the icon), while the same tools on the **Tools** toolbar work on the data inside the data frame (e.g., zoom into Kolkata). You will get confused occasionally, but once you get the hang of the two toolbars, you will be off and running. For now, experiment with both to see what happens.

The Tools Toolbar	**The Layout Toolbar**
Use these to navigate within the *data frame* on your map (e.g., you want the data frame to be slightly more zoomed into Surkhet, or you need to pan the data frame to the north).	The 1:1 tool is particularly useful to see what the map features and text looks like at actual print size. The Zoom to Whole Page tool will take you back to the entire page view.

Resizing and moving the data frame

You will always need to re-size things in your map, especially the data frame itself which contains the map image. In this case we are moving and resizing our data frame so that it fills the 4/5ths of our page. We'll then put a title, legend, and other map requirements in the blank space along the bottom of the page:

Moving and re-sizing in ArcMap works similarly to most other programs where you use graphics. The key is selecting the element first. The steps for this are on the next page.

1. To resize and move the data frame, use the **Select Elements** pointer ![pointer] to select the frame first.
2. Use the small grab points on the corners and sides to resize
3. Click and drag with the cursor anywhere over the data frame to move it.

Inserting a title, north arrow, and legend

These are all usually required elements on a map. You access them by going to the **Insert** item on the *main menu* bar. You can read more about these by going to **Help** - *ArcGIS Desktop Help.* Then, in the contents bar, click *Professional Library – Mapping and Visualization – Page Layouts*

Use the ***Insert*** menu function to insert the required map elements.

Insert Scale Bar

The scale bar you select will be in the *Display* units of your data frame (e.g., decimal degrees). If you want a different unit, double-click on the scale bar. In the *Scale Units tab*, select a different *Division Unit*.

Insert Legend

There are lots of ways to improve your legend. For starters, let's say we're creating a map of Larger Cities in Nepal. We want the legend and map to focus on large cities. We have features in the background as in the example map, but everyone knows what that is, it doesn't have to be identified in the legend. To control what goes on the legend:

1. Choose **Insert – Legend** from the main menu
2. Adjust what is in the legend so that only Large Cities is there by following the graphic on the next page. You may need to select *Large Cities* from the **Map Layers** box, and then use the arrow to manually add it.
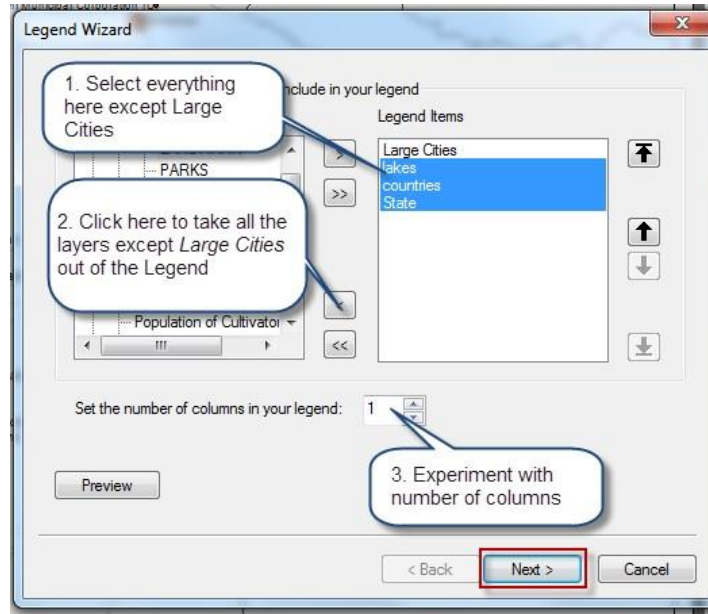
3. Once is ready, click on the **Next** tab

4. Then, you can modify the legend. For example, in the *Legend Title*, you can tell it NOT to show the word "Legend" by erasing or you can change that word to something else.
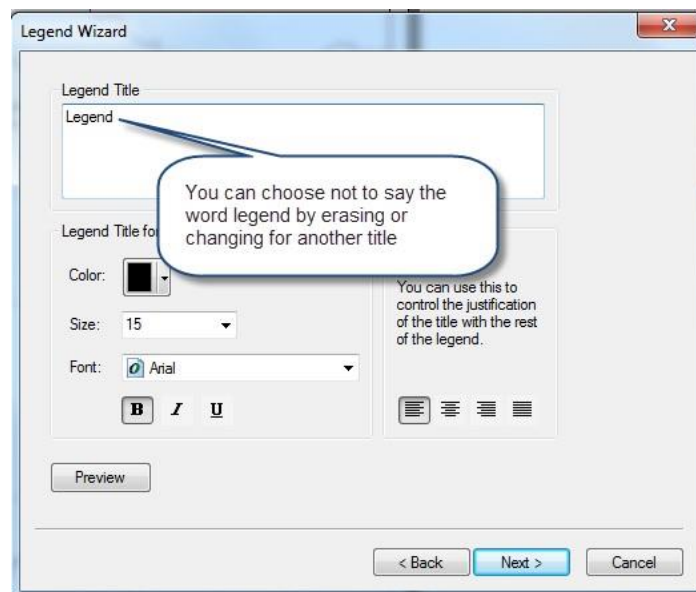
5. You can adjust all the attributes in each window, as desired. When you click **Finish**, the legend will appear. You can drag to put in the location you want it. Note: make sure *Large Cities* is checked in the Table of Contents, or else the legend will be blank.

6. Double click on the legend to access and modify its properties.

7. Go the **Items** tab, then click on **Style**:

Try out different styles and preview how they will look:

Press OK, and OK again. If the map goes back to one column and you want two, double-click on the *Legend* again and under the *Items* tab, type in 2 for *columns* Insert Legend

Selecting Elements

Remember, you always have to select an element before you can move, resize, or change its properties. Use the select pointer icon ![pointer] on the *Tools* Toolbars. You can select more than one element by holding down the CTRL key as you click on each element.

Modifying an element after insertion

You can usually modify an element after you have inserted it by selecting it and then double clicking on it. The relevant dialog box will appear for that element (e.g., title, legend, scale bar).

Inserting text

To put in a title, your name as the cartographer, and any other information, use the **Insert - Text function**. Remember also to include a date. You should also have a data source - note that the data comes from the Tufts GIS M Drive.

Add more text for any more descriptions or explanation of your map.

You can change font properties on selected text by right-clicking on the selected text and choosing Properties

Inserting a Picture

Note that you can also insert images into the data frame.

Deleting and trying again

If modifying an existing element doesn't work, remember that you can always select an item and delete it if you don't like it. Select it using the select pointer, and press *delete*. Especially useful if your legend gets messed up - just delete and insert a new legend again to start fresh.

Saving map files under different names

Once you have created one map in a layout you like, you can save your map file (File – Save As) to be the name of that map (e.g., Larger Cities Nepal). You can then use the same layout but change some of the visible features and save as a new map name (e.g., Nepal Cultivators).

This allows you to make maps fast once you have a good layout, and it allows you to make maps of the same area at the same scale, but showing different layers of information.

Choose **File-Save As** and save the map file to an appropriate new name.

Adding a second data frame to show an inset map

You can add a second (or more) data frames to your ArcMap session. Only one data frame will appear at a time in the data frame view (right-click on the data frame name and choose Activate to see the data frame you want). But in the layout, all the data frames will appear. This can be handy for putting in a small "locator" map. See the following graphic:
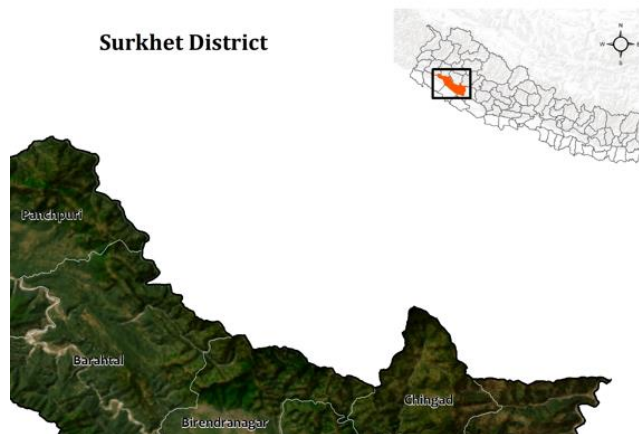
Before you begin this section, use what you learned above to create a map zoomed in either to Surkhet or to Nepal showing a variable from the census by Ward (if you are focusing on Surkhet) or by Province if you are focusing on the country.

Adding a second data frame for a locator map

Multiple data frames can get a little tricky, and will take some practice. Play with them some, and remember to save map files frequently under different names in case you mess up and want to return to a previous view. In this example, we'll use a new data frame to insert a locator map.

1. In *Layout View*, choose **Insert - Data Frame** from the top main menu – a *new data frame* box appears in your layout. You'll see *the New Data Frame* listed in the table of contents:


2. Move and resize the *new data frame* box so it is in the location you want it – here we are taking it to the bottom right corner of our layout:

3. You can add data to this data frame just as you did to the first one, or in the *Table of Contents*, you can drag a layer from the first frame to the second. Try dragging the *Countries* layer from the original data frame down to the *New Data Frame* and turn it on

4. Drag the *Province* layer (in your Nepal group layer) down as well, or drag it from the ArcCatalog window – D/E: datasets\Climate_smt_agri. If you add it from ArcCatalog, you should also take time to zoom into Nepal.

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5. Make sure to drag the Province boundaries above the Countries. Countries should be white with a gray outline.

6. Set the PROVINCE fill color however you wish with no outline so you will highlight Nepal boundaries.

7. In the *table of contents*, right-click on **New Data Frame** and choose **Properties**

8. Click on the **Frame** tab and change the *Background* color to blue – this will make the water appear blue.
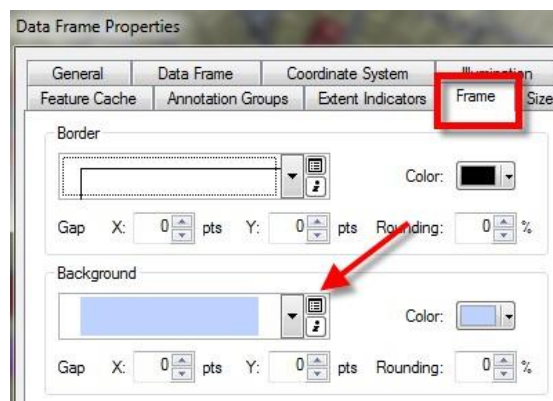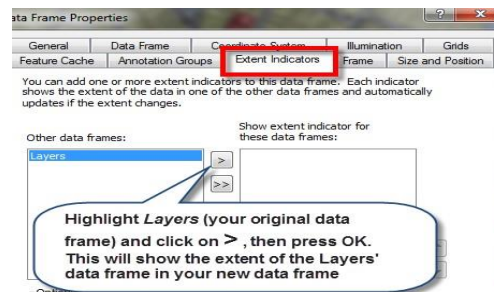

9. Press OK to see the results. Save your map file!

Setting up locator map boundary box

Finally, we're going to show a boundary box on our *Locator Map*.

1. Right-click on the *new data frame* to get its *Properties* dialog box back.

2. Click on *Extent Indicators* tab and follow the instructions below, then press OK:

Note that the extent of your main map will be outlined in the smaller map; if you do not like the extent of the box that you just created, use the pan and zoom tools on your larger map to adjust.

If all this was successful, save your map file! Otherwise delete and try again.

Work as necessary on your layout to make it show what you want it to show – some census variable for Surkhet or for a Province by District or Sub-district, with the location shown on the locator map.

Printing or exporting your map

You can print directly from ArcMap or you can export to a digital graphic format like .pdf. Printing works just like any other Windows program, so we won't cover that here, but feel free to print your map. We will talk more about printing options and good resolution in class.

The ability to **export** to a digital format is very useful. If exporting to an image, remember to set your page size to the appropriate dimensions - this may mean custom dimensions, e.g., a small image to fit on a computer screen, a powerpoint presentation, a web site, or word document. When creating a layout for digital export, you should think ahead about what size you want your final image and lay out the map accordingly, and be sure to use font sizes that are readable at the final map size.

1. When you have your layout the way you want it, choose **File – Export Map**
2. In the *Export* dialog box that appears, navigate to your tutorial folder and give the image a name.
3. For *Save as Type*, choose a format - we recommend **.gif or .pdf** because they come out well and are readable across a variety of platforms. The only problem with PDF formats is that they do not recognize all text fonts, so stay simple with your font types - e.g., Arial or Times New Roman.
4. **Before you export,** adjust resolution under the **Options** area. Digital images meant to be seen on a computer screen do not need high resolution. 96 or 150 should be fine depending on image size, 300 should be the maximum.
5. Press **Export** when you are ready to go - the process will take a minute.
6. Check your results by navigating to the folder outside of ArcGIS and opening the graphic - if not pleased, experiment with different resolutions and compare file sizes.

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That's the basics. Now practice what you have learned by creating several maps of Nepal, a region within districts, palika and many others.

Remote Sensing

"Remote sensing is the science (and to some extent, art) of acquiring information about the Earth's surface without actually being in contact with it. This is done by sensing and recording reflected or emitted energy and processing, analyzing, and applying that information." In much of remote sensing, the process involves an interaction between incident radiation and the targets of interest. This is exemplified by the use of imaging systems where the following seven elements are involved. Note, however that remote sensing also involves the sensing of emitted energy and the use of non-imaging sensors.

© CCRS / CCT
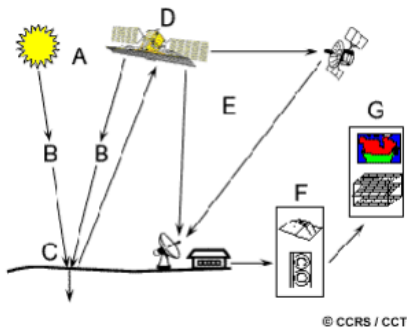
With the ArcGIS Spatial Analyst extension, the Multivariate toolset provides tools for both supervised and unsupervised classification. The Image Classification toolbar provides a user-friendly environment for creating training samples and signature files used in supervised classification. The Maximum Likelihood Classification tool is the main classification method. A signature file, which identifies the classes and their statistics, is a required input to this tool. For supervised classification, the signature file is created using training samples through the Image Classification toolbar. For unsupervised classification, the signature file is created by running a clustering tool. Spatial Analyst also provides tools for post-classification processing,

such as filtering and boundary cleaning. The detailed steps of the image classification workflow are illustrated in the following chart.
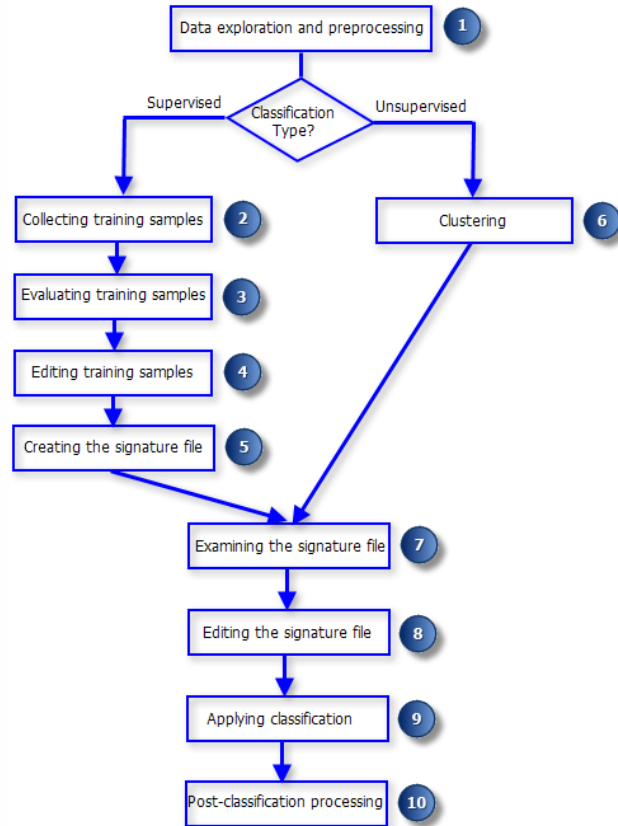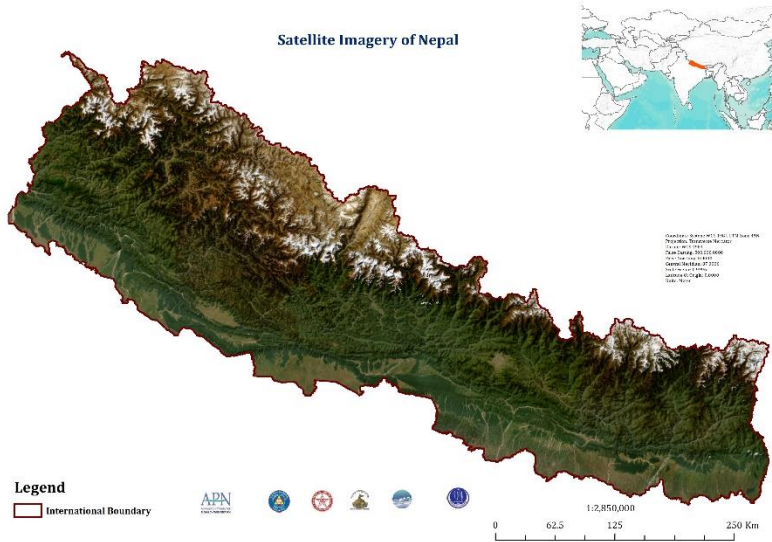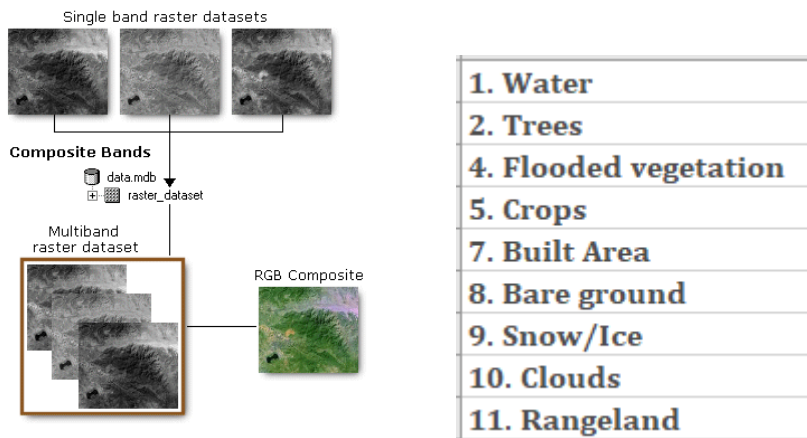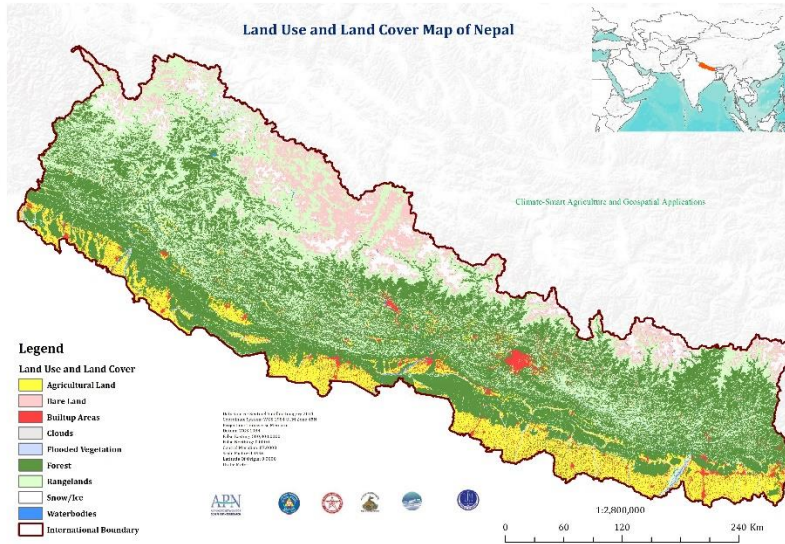

Image classification workflow

Image classification refers to the task of extracting information classes from a multiband raster image. The resulting raster from image classification can be used to create thematic maps. Depending on the interaction between the analyst and the computer during classification, there are two types of classification: supervised and unsupervised.

Satellite Imagery of Nepal

Supervised classification uses the spectral signatures obtained from training samples to classify an image. With the assistance of the Image Classification toolbar, you can easily create training samples to represent the classes you want to extract. You can also easily create a signature file from the training samples, which is then used by the multivariate classification tools to classify the image.

1. Water
2. Trees
4. Flooded vegetation
5. Crops
7. Built Area
8. Bare ground
9. Snow/Ice
10. Clouds
11. Rangeland

Land Use and Land Cover Map of Nepal

Legend

Land Use and Land Cover
- Agricultural Land
- Bare Land
- Builtup Areas
- Clouds
- Flooded Vegetation
- Forest
- Rangelands
- Snow/Ice
- Waterbodies
- International Boundary

1:2,800,000

0   60   120   240 Km

Extraction by Masking

- The Extraction tools allow you to extract a subset of cells from a raster by either the cells' attributes or their spatial location. You can also obtain the cell values for specific locations as an attribute in a point feature class or as a table.

- Extracting cells by the geometry of their spatial location requires that groups of cells meeting a criterion of falling within or outside a specified geometric shape (Extract by Circle, Extract by Polygon, Extract by Rectangle).

- The Mask environment is used to identify those cell locations that will be included when performing an analysis. All input cells that fall outside the mask are assigned the No Data value in the result. A mask can be a raster or a feature dataset.
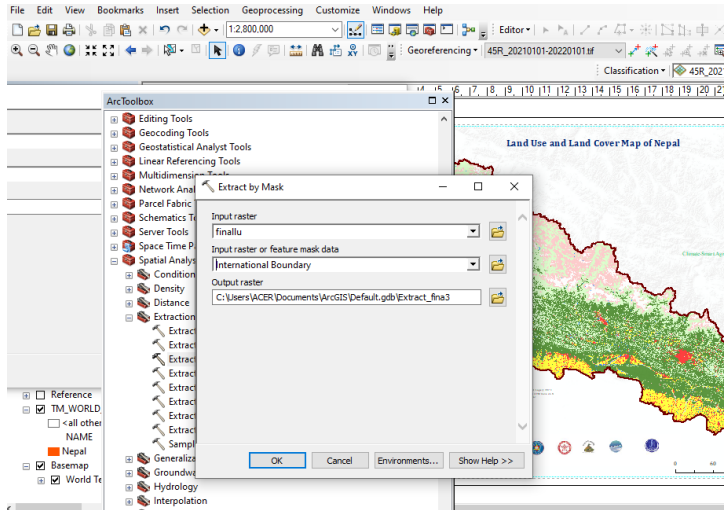
- For most Spatial Analyst tools, when a Mask environment is specified, it will be applied to the inputs before performing the analysis. However, for some other tools, such as the Interpolation tools, the mask will be applied only to the output after the analysis has been performed.
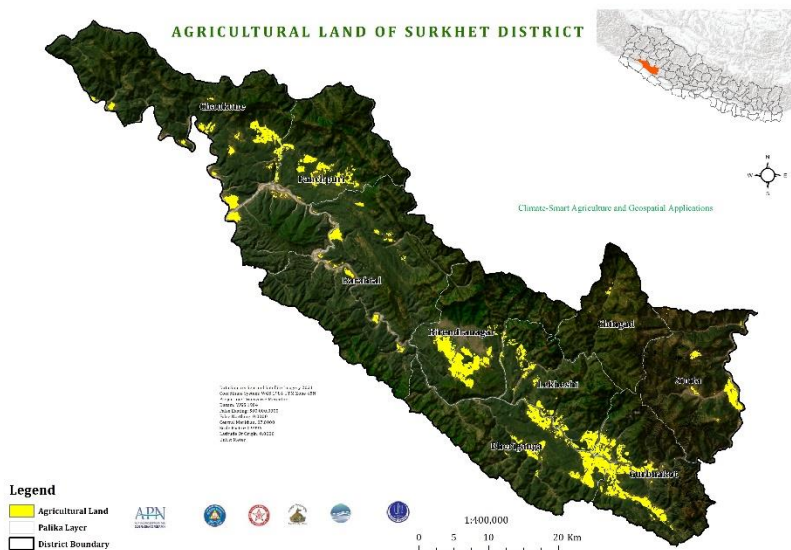
Crop Suitability Analysis using GIS and Climatic Data (Entropy Modelling)

This tutorial gives a basic introduction to use of the MaxEnt program for maximum entropy modelling of species' geographic distributions, written by Steven Phillips, Miro Dudik and Rob Schapire, with support from AT&T Labs-Research, Princeton University, and the Center for

Biodiversity and Conservation, American Museum of Natural History. For more details on the theory behind maximum entropy modeling as well as a description of the data used and the main types of statistical analysis used.

Getting started Crop Suitability Analysis

The software consists of a jar file, maxent.jar, which can be used on any computer running Java version 1.4 or later. Maxent can be downloaded, along with associated literature, from

http://biodiversityinformatics.amnh.org/open_source/maxent/; the Java runtime environment can be obtained from java.sun.com/javase/downloads. If you are using Microsoft Windows (as we assume here), you should also download the file maxent.bat, and save it in the same directory as maxent.jar. The website has a file called "readme.txt", which contains instructions for installing the program on your computer.

Firing up

If you are using Microsoft Windows, simply click on the file maxent.bat. Otherwise, enter "java - mx512m -jar maxent.jar" in a command shell (where "512" can be replaced by the megabytes of memory you want made available to the program). The following screen will appear:
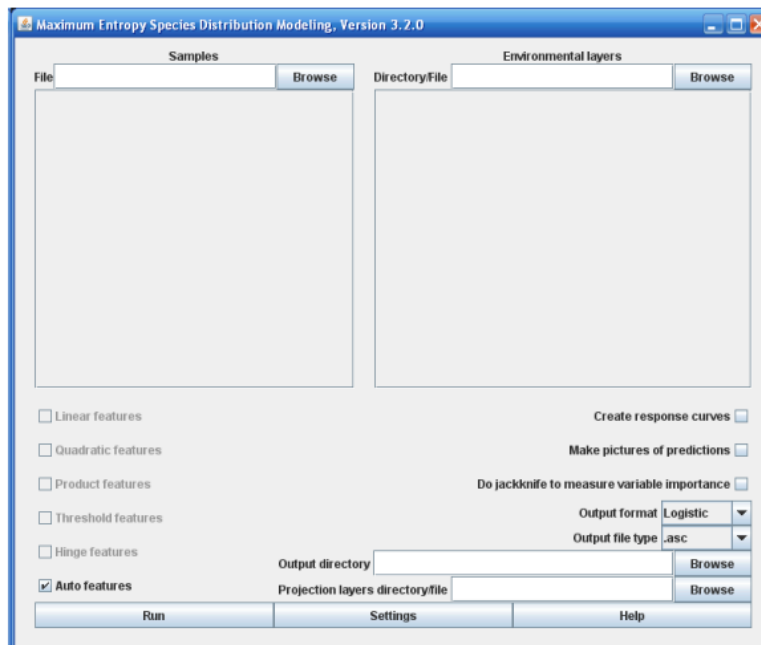
To perform a run, you need to supply a file containing presence localities ("samples"), a directory containing environmental variables, and an output directory. In our case, the presence localities are in the file "samples.csv", the environmental layers are in the directory

"layers", and the outputs are going to go in the directory "outputs". You can enter these locations by hand, or browse for them. While browsing for the environmental variables, remember that you are looking for the directory that contains them – you don't need to browse down to the files in the directory.
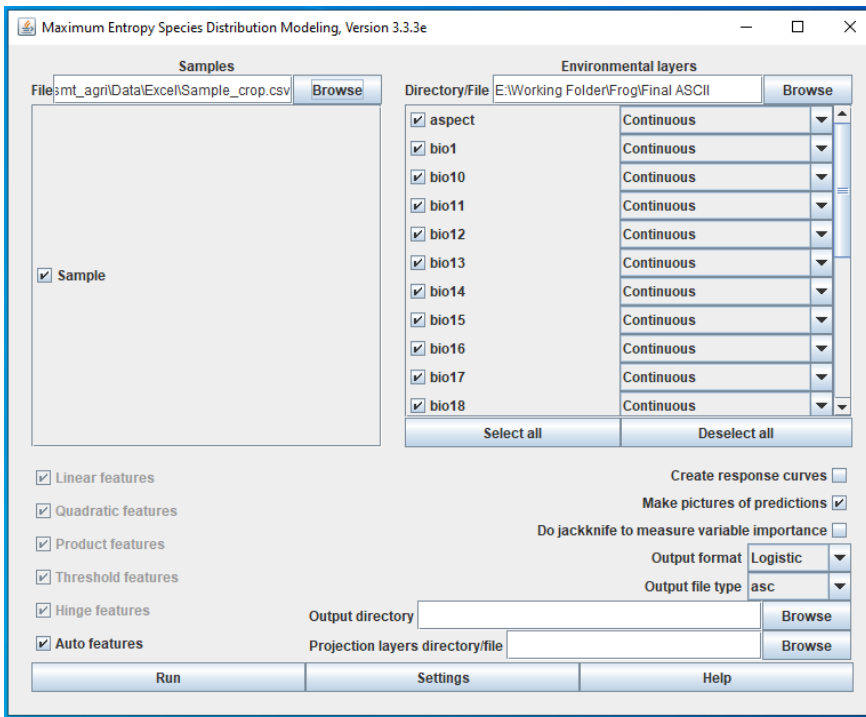
To see what other (more interesting) output there can be in bradpus.html, we will turn on a couple of options and rerun the model. Press the "Make pictures of predictions" button, then click on "Settings", and type "25" in the "Random test percentage" entry. Then, press the "Run" button again. After the run completes, the file bradypus.html contains a picture like this: The image uses colors to indicate predicted probability that conditions are suitable, with red indicating high probability of suitable conditions for the species, green indicating conditions typical of those where the species is found, and lighter shades of blue indicating low predicted probability of suitable conditions. For sample crop, we see that suitable conditions are predicted to be highly probable throughout Nepal. The file pointed to is an image file (.png) that you can just click on (in Windows) or open in most image processing software. If you want to copy these images, or want to open them with other software, you will find the .png files in the directory called "plots" that has been created as an output during the run.

Pictures of the model

This is a representation of the Maxent model for N._annandalii. Warmer colors show areas with better predicted conditions. dots show test locations. Click on the image for a full-size version.
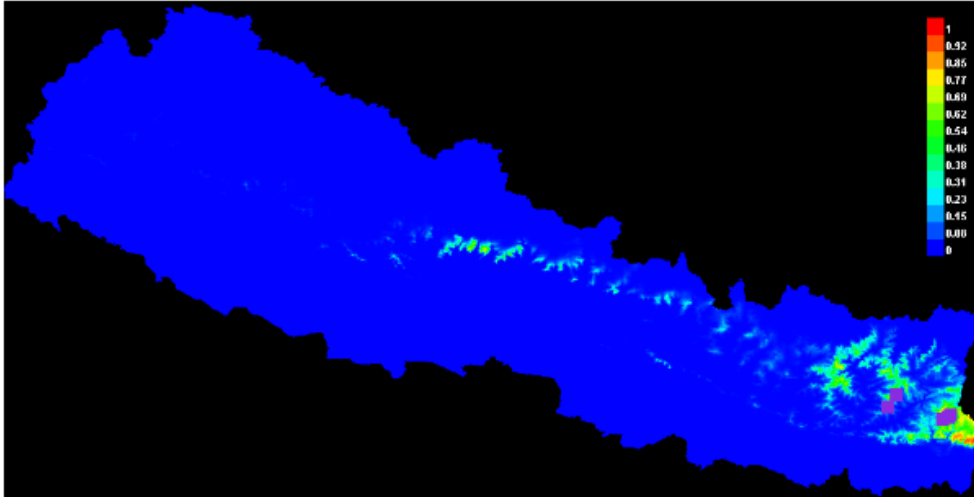
For more details, go through the link below.

LinC3_SpeciesDistModeling_Ex.pdf (amnh.org)

Hands on exercise on operating SMART agriculture NCFD Nepal application in android mobile (किसानको लागि फलफुलको माग तथा आपुर्ति वासलात)

एनसीएफडी नेपाल भनेको फलफूल विकास केन्द्र (एनसीएफडी), कीर्तिपुर, काठमाडौं, नेपाल अन्तर्गत निर्मित मोबाइल अनुप्रयोग हो। यो अनुप्रयोग नेपाल सरकार, कृषि र पशुधन विकास मन्त्रालय, कृषि विभाग, फल विकास राष्ट्रिय केन्द्र (NCFD) को एकमात्र सम्पत्ति हो र यो निः शुल्क सार्वजनिक सेवाको लागि लक्षित हो।

यस अनुप्रयोगले फल बिरुवा र बिरुवा वितरणको समग्र अनुगमन र व्यवस्थापनको लागि लक्षित गर्दछ। यो फलफूल बिरुवा र बिरुवाहरू सम्पूर्ण नेपालमा माग र आपूर्तिको केन्द्रिय डाटाबेस व्यवस्थापनको लागि योजना बनाईएको छ।

Hand on Exercise

Agricultural Product Mapping

Crop Loss Estimation Mapping

The End