RELMA
REGIONAL LAND MANAGEMENT UNIT

GIS Exercise
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Introduction to GIS and Digital Cartography using ArcExplorer

Requirements
This exercise requires a PC with Windows 95/98/2000, Windows NT, or later and the freeware ArcExplorer 2.0. To download and install ArcExplorer see appendix 1. The necessary data are available on the RELMA_GIS1.0 CD. Sources of internet available data are given in appendix 2, and in the document Spatial Data and Applications for Environmental Studies in Africa.

Objectives
This exercise will give an introduction to GIS and digital cartography using the ArcExplorer freeware. To illustrate the exercise different freely available data over Africa will be introduced. The objective of the exercise is that the students should gain basic insight into GIS and digital cartography including data types, scale, symbolizing, labelling and layout. After completing the exercise students should be able to create small-scale thematic maps.

Task
To pass the exercise a thematic map over Africa with major rivers and catchments, and population centers showing cities symbolised based on inhabitants should be handed in.

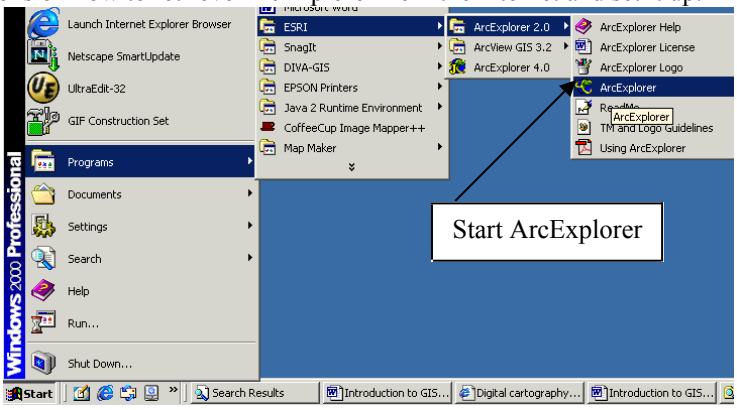
Start the GIS freeware ArcExplorer and add data

In this exercise we will use ArcExplorer  - a GIS freeware offered by ESRI (ArcExplorer is the free viewer of ArcView)– see appendix 1 for instructions on how to retrieve ArcExplorer from the internet and set it up.

If the ArcExplorer icon is not on your desktop you can find it via **"Start - Programs - Esri – ArcExplorer 2.0 – ArcExplorer".**

The source program is under **"C:\Program Files \Esri\ ArcExplorer2.0".**

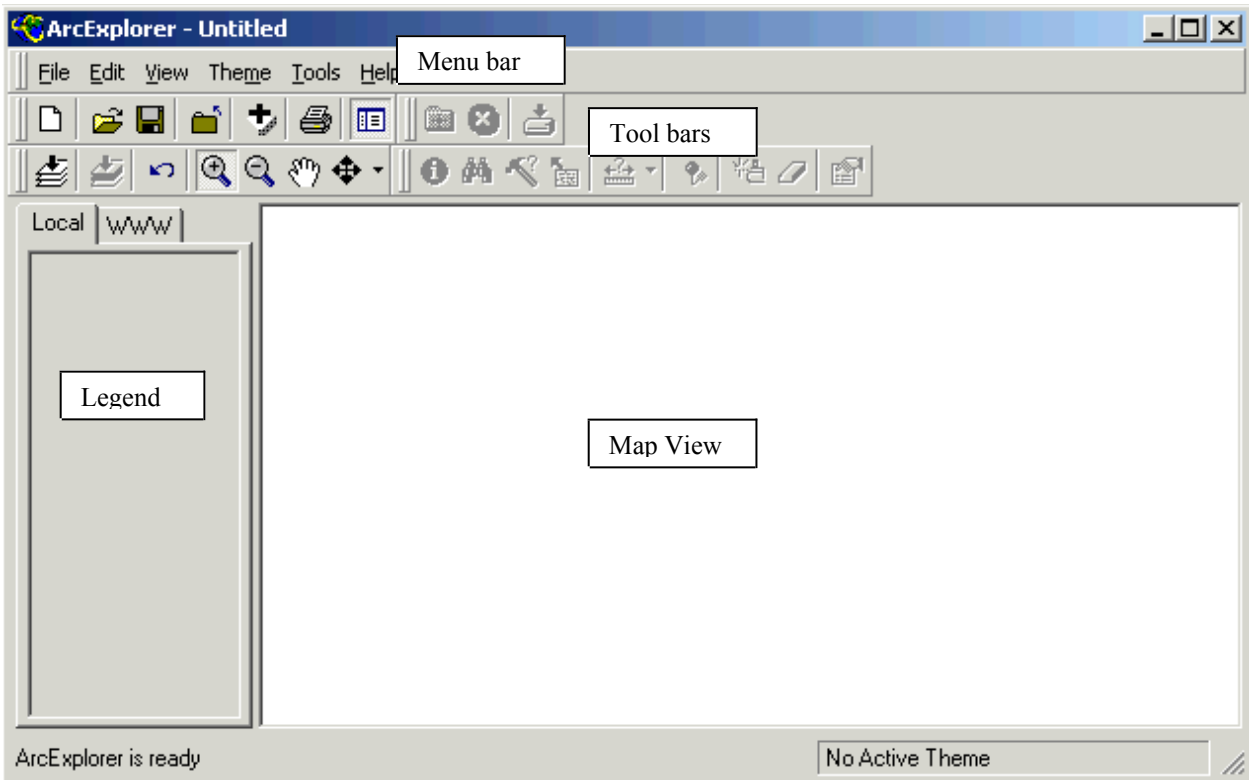
Start **ArcExplorer**.



The main parts of the ArcExplorer interface are shown in the figure below. You will be presented with an empty project called Untitled. The Legend window contains two tabs (pages), one for Local themes (themes that are stored on your local computer or local area network) and one for WWW themes (themes stored on Web sites). In this exercise we will only use local data, to use WWW data your computer must be connected to the internet. An introduction on using internet data is given in the exercise Data Mining on Internet.

To get help on any topic just press F1, or search via help in the menu bar. You can also find the users manual (**Using ArcExplorer.pdf** or **Arcexplorer.pdf**) in the same folder as the program file. This manual can be read by using Adobe Acrobat reader (see appendix 1 for download of Adobe Acrobat).

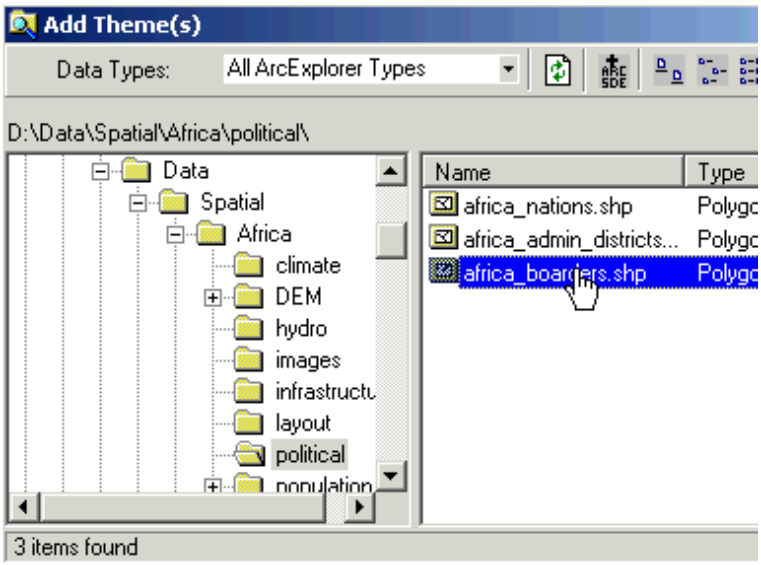
In the interface you will notice that some menu and tool items are gray (fuzzy) that means that they are not available at the moment. Many items require that you have some themes in the view, (a *theme* is a *maplayer* in GIS jargong) and some that you have at least one theme active (this will soon be clear to you).



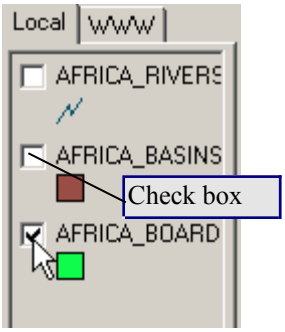
Save,  the ArcExplorer project, preferably in your home directory. Change the name into something logical. Remember to save the project frequently in case you should cause the program to crash or loose power supply.

We will start by adding some maps from the RELMA_GIS1.0 CD.

Press the Add Theme button,  , and go to the directory **…data/spatial/africa/political** and select **Africa_boarders.shp** by double clicking on it (or select it and click the Add Theme button). Also add the themes **Africa_basins.shp** and **Africa_rivers.shp** under **…data/spatial/africa/hydro** from the Add Theme(s) dialogue box.



The Legend window should now contain 3 themes, as shown to the right. The river theme is composed of lines, and the basin and boarder themes are polygons. Click in the Check box to the left of the AFRICA_BOARDERS theme. You should now see the map of African countries in the Map View. Also click the Check boxes of the river and the basin theme – note the difference between themes with lines and polygons. Use the Zoom In tool,  , to zoom in on Africa and the Zoom out tool,  to zoom out. With the Zoom In tool,  chosen click the left mouse button, do not release the button, and drag the window you want to zoom and then release the mouse button.



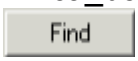
Use the Zoom to Full Extent button,  to return to the full view. If you just click in the view with the Zoom In tool active the position you clicked will be the center of the new display area after the zoom. Also try the Pan tools,  and  . Turn off the river and basin themes; we will only use them later in the exercise.

Select and Find Data

Note that several of the Tools are still fuzzy (i.e. inactive). Activate the AFRICA_BOARDERS theme by clicking on the label (not the Check box) and see how the active theme appears 'lifted'. Now also several of the tools will be activated and have a full color saturation.
We will now locate Uganda (or another country) in our view by using the Find tool,  . Click the find tool.

In the dialogue box

Enter Uganda under 1. select search type, set 2. Select a search type to Any part of Field, and 3. Choose which theme to search to Africa_boarders. The click the



button,
and select 4. Pick a feature to be Africa_boarders CNTRY_NAME. Then 5. Select the operation to perform, sequentially click the buttons

,

, and

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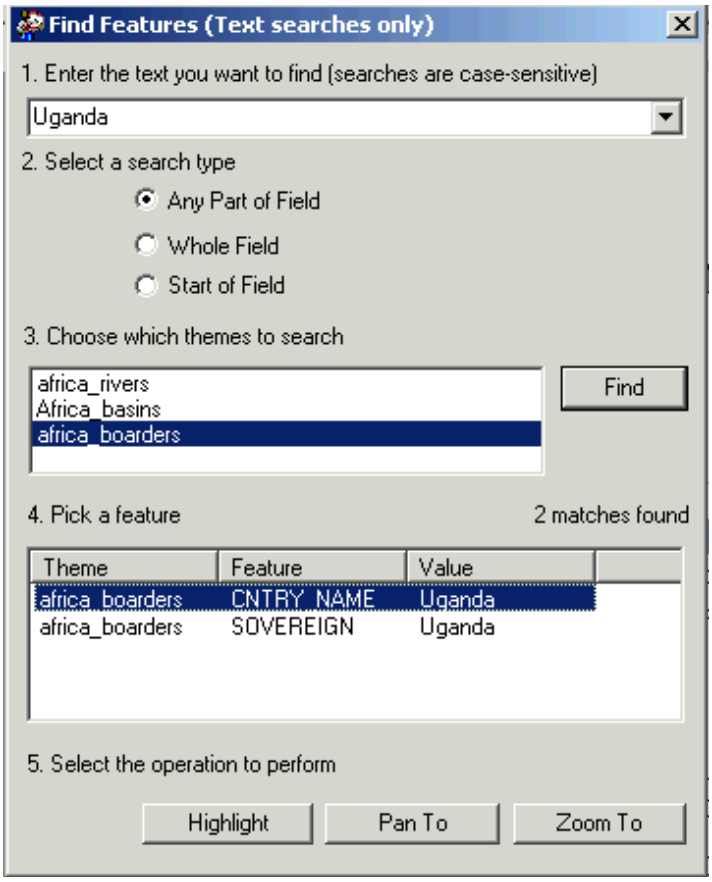
Uganda should appear in yellow in the Map View. Use the Clear Selection tool,

to deselect Uganda.



Querying data

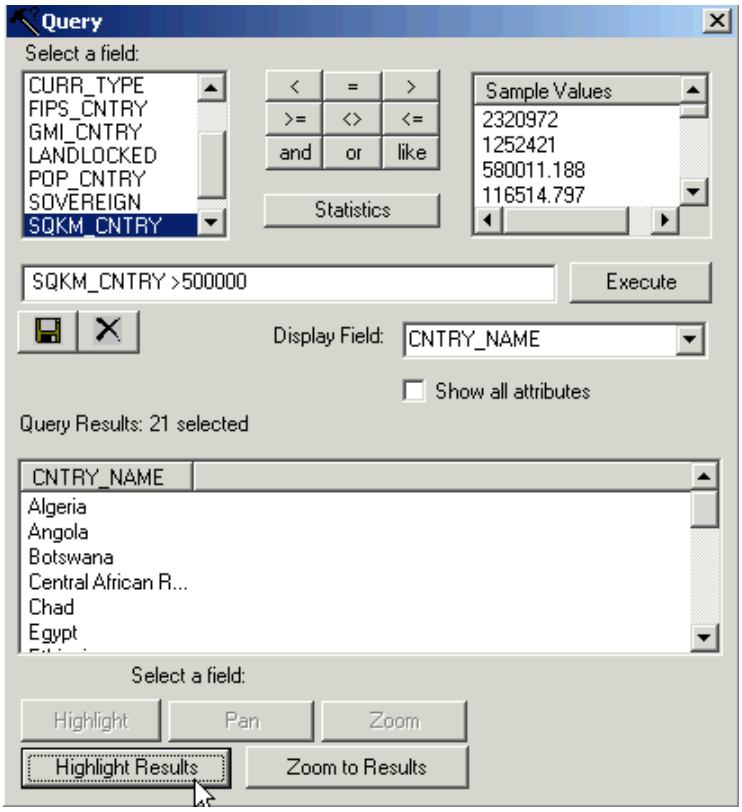
To see the database table for an individual country use the Information tool,

. Make sure that the theme Africa_boarders is active (i.e. elevated), point at any country and click the left mouse button. All the *fields* of the database for the selected country (a *record* in database jargon) are displayed.

Next we will try the Query Builder,

to see which African nations are larger than Sweden. The area of each country is given in square kilomters in the theme Africa_boarders.

Make sure Africa_boarders is the active theme and click the Query Builder,  . In the query dialogue box select SQKM_CNTRY as field then press the ">" sign and fill in 500000 (the area of Sweden in square kilometers) by hand in the query below (as to the right). Press Execute, and then Highlight Results. 21 African countries are larger than Sweden.



In the query builder you can also calculate summary statistics for numerical fields. Try it out for the area of countries. How many countries are there in Africa, and what is the average size of the countries in Africa? (The answer is 48 countries and 609474 km^2)

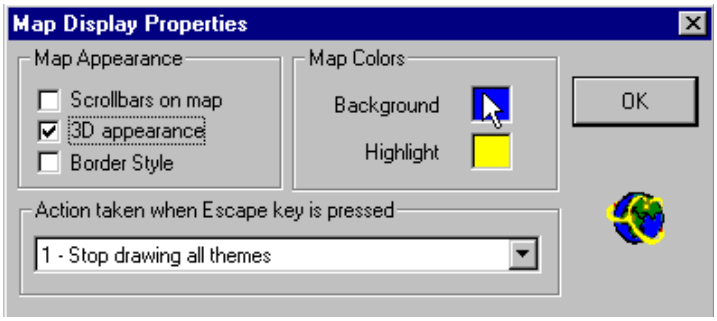
Next try to build a query to see which African countries are larger than Sweden but at the same time have less population (the population of Sweden is 9 million). The Query should look like this: SQKM_CNTRY > 500000 and POP_CNTRY < 9000000. How many countries fulfilled this Query?

To clear the classification press the Clear Selection tool,  .

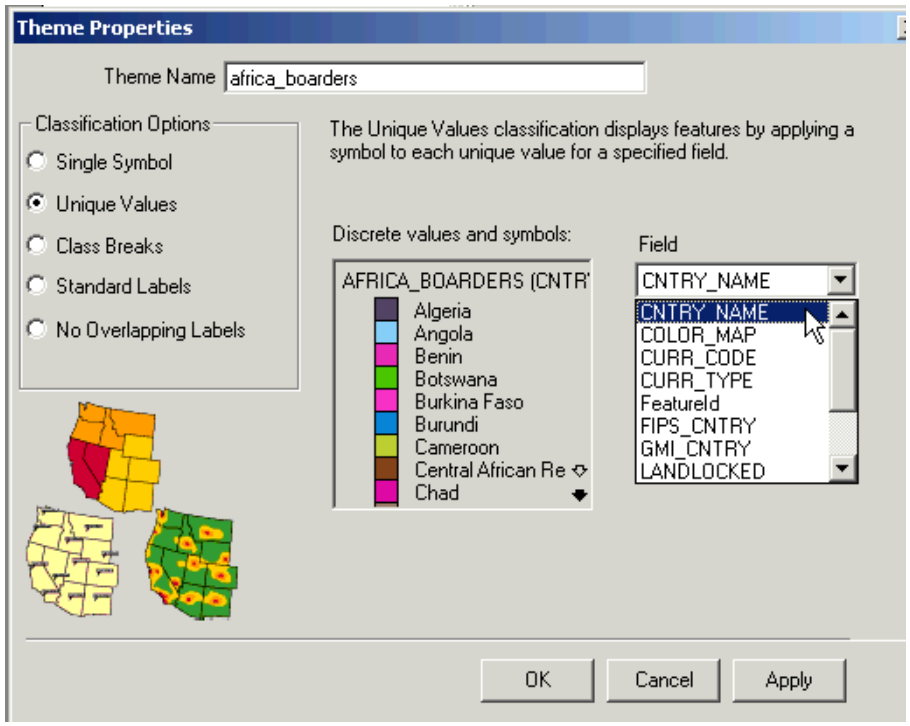
Symbolizing data

Use the Zoom to Full Extent button,  to get the view of the whole of Africa. As you can see all countries have the same color. We shall now symbolize the map and the countries by putting different colors to them.

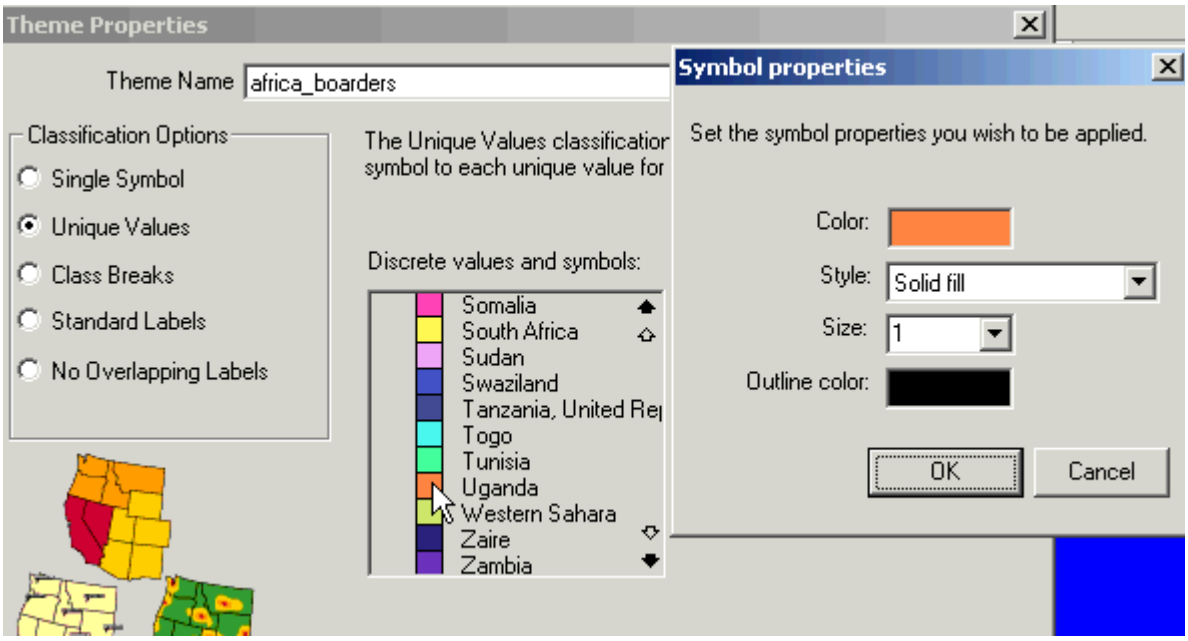
To set a background color and other map display properties press View in the menu bar and then Map Display Properties. You can add scrollbars and make the map appear 3D and change the color of the Background (the sea in our case) and Highlight (when you query the data the result is highlighted in this color – yellow is default). Click OK when finished.



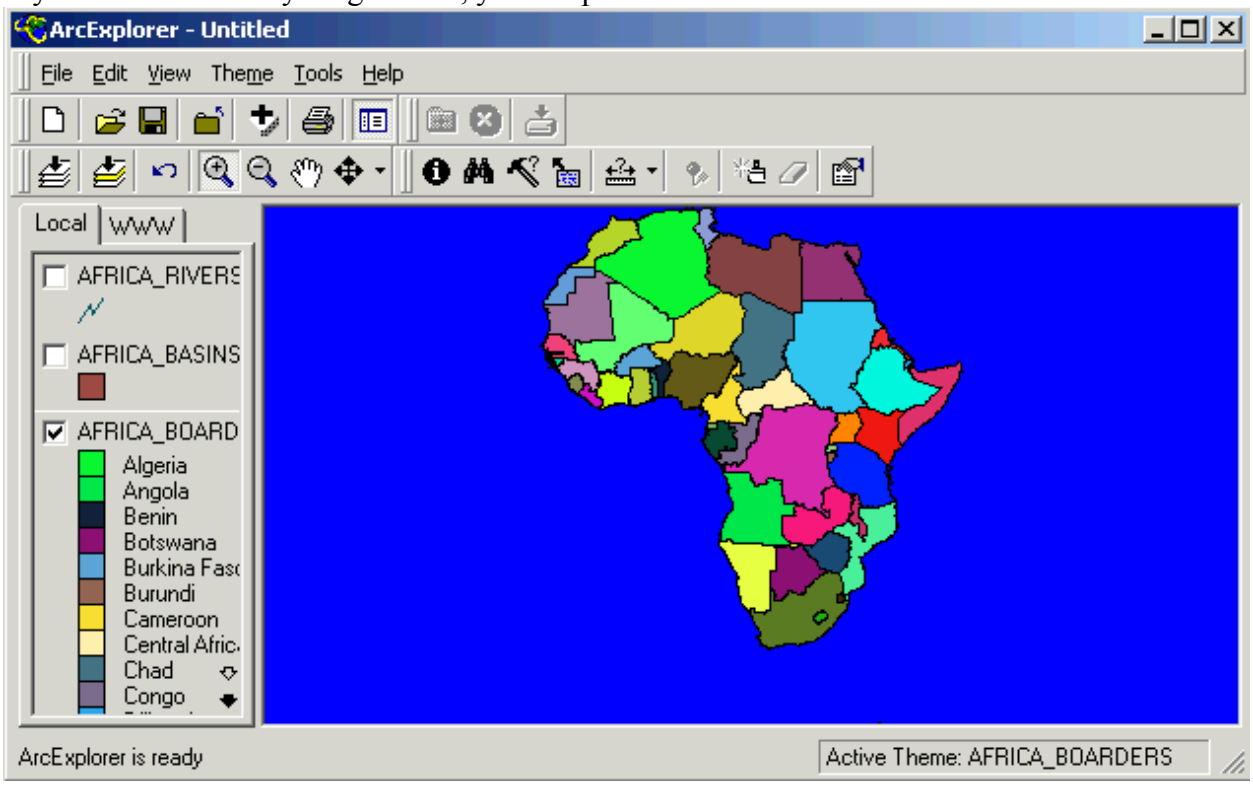
Make the theme AFRICA_BOARDERS active. Open the Theme Properties dialogue box, either via the Theme properties button,  , or double click a theme's name in the legend. Set Classification option to be Unique value and Field to NAME. Press Apply. Also try the Remove Outline option in the Theme Properties dialogue box. If you want to remove thematic classification from the active theme press  Clear Thematic Classification button.



To change the individual color (or other symbol) for a particular record first open the Theme Properties box, simply click an attribute and than select Color, Style and Size.
You can set individual colors, style and size of each attribute by clicking on them. Try changing the color of Uganda as shown below. To get to Uganda in the Discrete Values and Symbols menu you have to use the scroll tools,  to get to down to 'U' in the alphabet. Remember to press APPLY to activate your symbolizing.



If you have done everything correct, your map should now look like below.



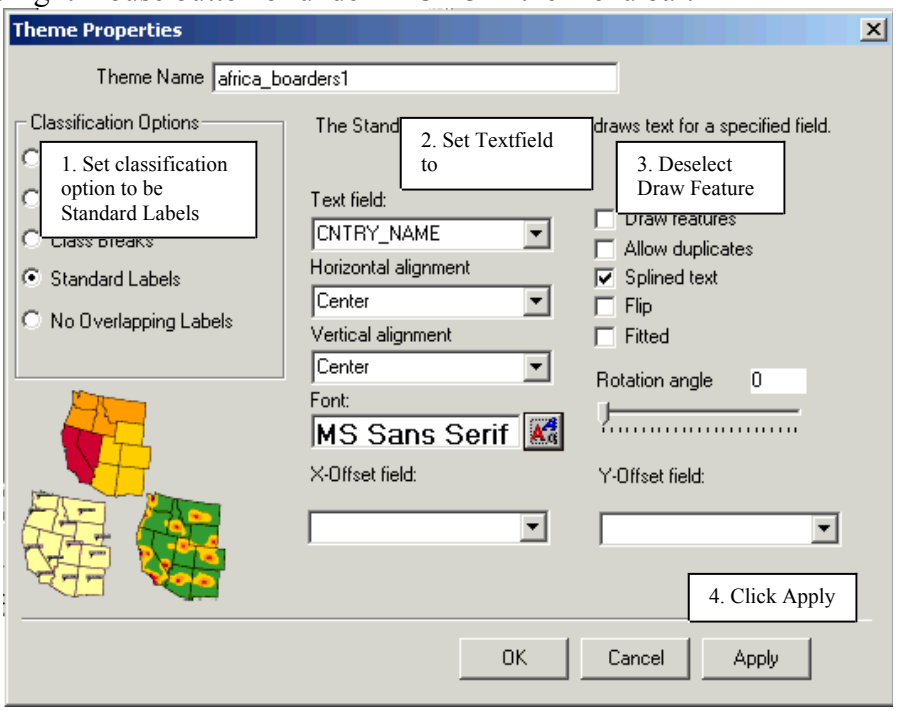
Labeling maps

To label a polygon map in ArcExplorer you have to add a duplicate copy of the theme. Use the Add theme button,  , and add a second copy of the AFRICA_BOARDERS theme. Put the

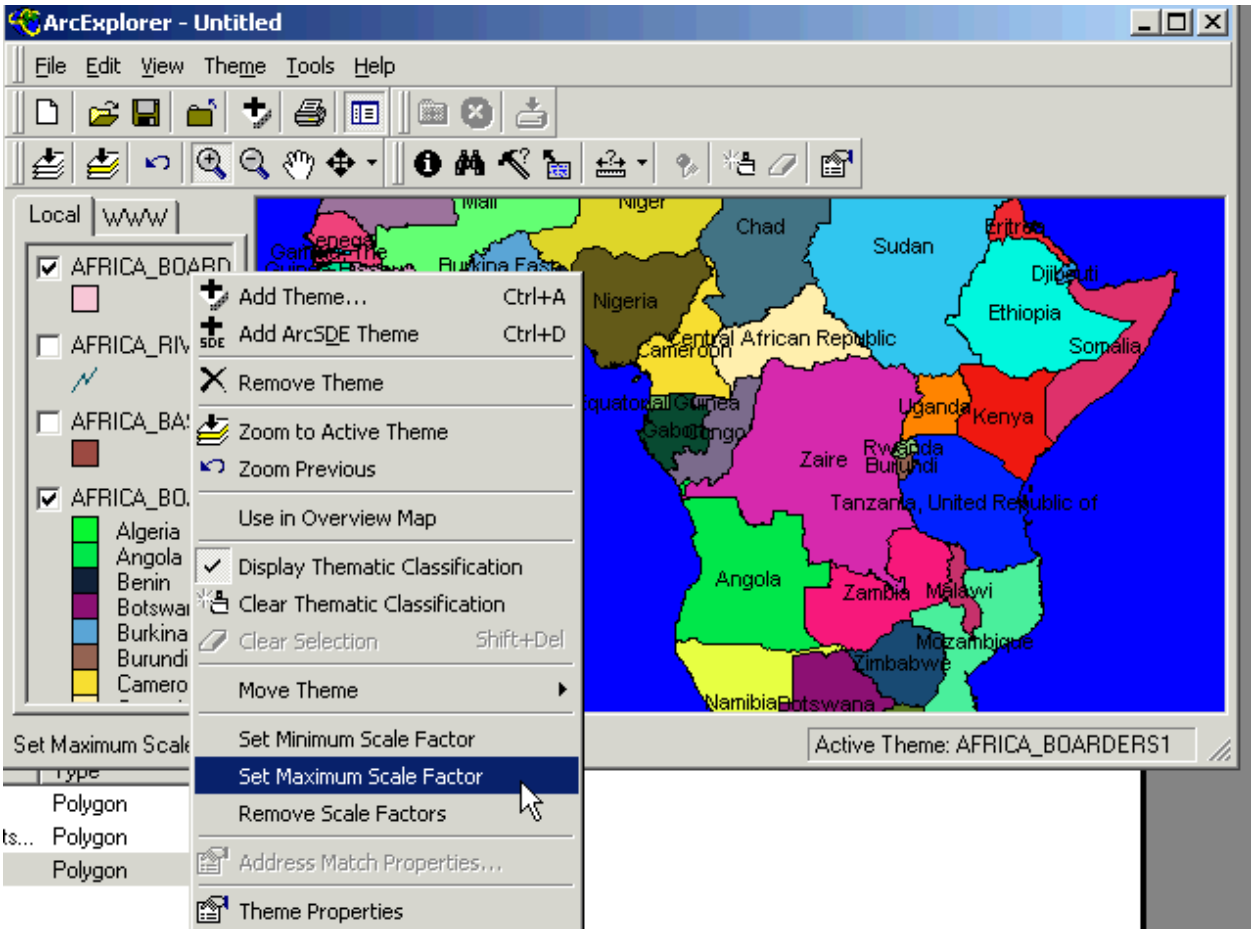
new theme highest up in the Legend (grab it by holding down the left mouse button and slide it to the top of the legend).

Open the Theme Properties dialogue for this second AFRICA_BOARDERS theme – either by double clicking, through the right mouse button or under Theme in the menu bar.

In the Theme Properties dialogue set Classification Options to be Standard Labels. New labels and edit boxes will appear. Select NAME as Text field and deselect Draw features. You can also change the Font. Press Apply and then OK. Your map should now have name labels for countries in Africa



As you will see when you display the whole African continent the name labels are too large; it is difficult to read the names as well as distinguish which name belongs to which country. To improve the layout of the map you can decide a scale above or below which the name labels will not be displayed. First zoom the map of Africa so that you can conveniently read the labels and associate them with a particular country. Activate the theme and press the right mouse button, in the pop-up menu (see next page) select the option Set Maximum Scale Factor. Zoom to Full Extent,  – and *voila* no name labels - if you zoom in they will reappear.

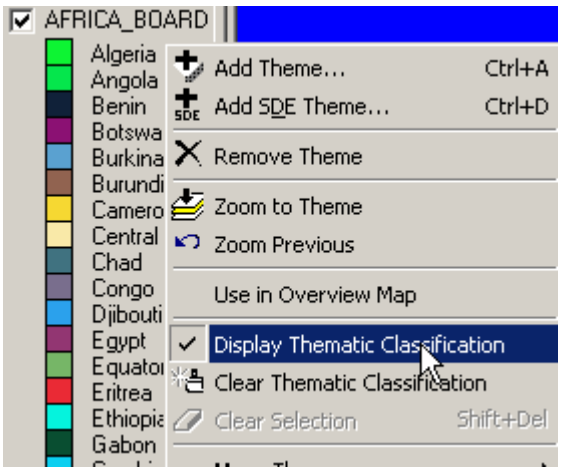


To enlarge your View you can use the Toggle Legend button,  . Try it.

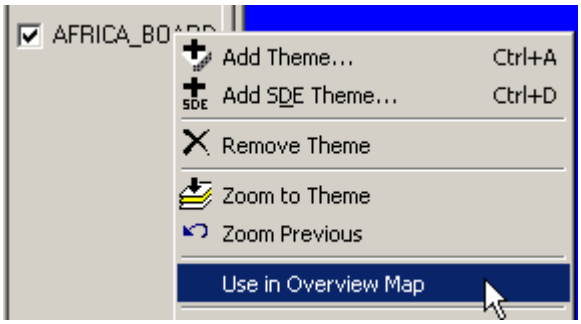
Zoom to Full Extent. If you followed the instructions no labeling should be seen. You should now add a tool that allows you to use the mouse for displaying selected properties of a theme. Make sure the visible AFRICA_BOARDERS theme is active (the copy of this theme symbolizing colors). Click the Map tips tool,  , to display the Map Tips dialog. Select CNTRY_NAME in the list and click OK. When you move the cursor in the view the name of the country where you slide the cursor will be shown in a little box. Hands on your heart - how many African countries do you really know?

Display overview map and add image theme

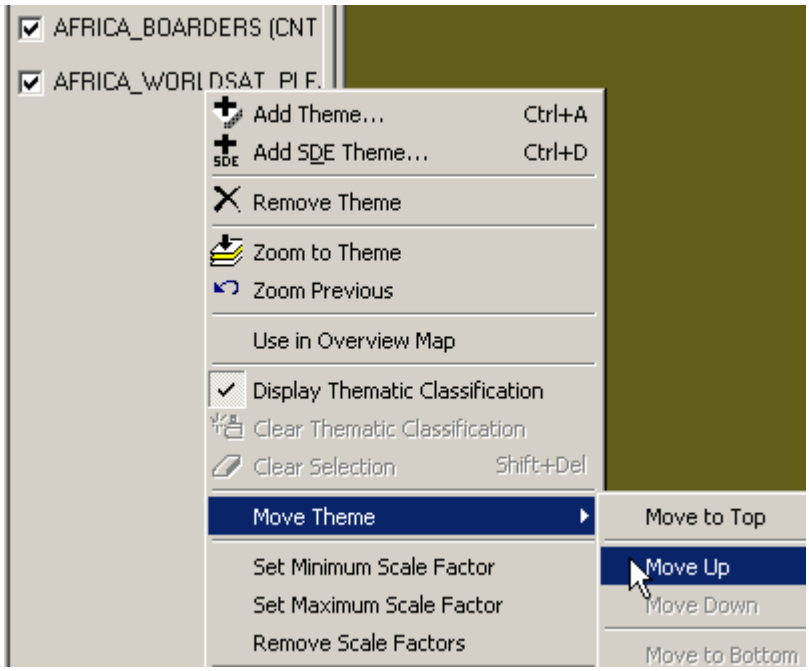
Before adding an overview map and another Theme you need to hide the legend of the AFRICA_BOARDERS map. This you do by pointing the cursor to the AFRICA_BOUNDARIES theme, click the right mouse button and deselect Display Thematic Classification in the pop-up menu. There is now enough space to have a better overview of the Legend and the content in the Map View.



You shall now define the AFRICA_BOARDERS as an Overview Map. Again point at the AFRICA_BOARDERS theme in the Legend and click the right mouse button. Then select Use in Overview Map from the pop-up menu. You should now have a small overview map under the Legend. If you zoom in to the Map View, the area in the Map View will be shown in the Overview map.



ArcExplorer can display georeferenced images as backdrops. Use the Add Theme button,  and navigate to the directory **… data/spatial/africa/images** and add the image **Africa_Worldsat_Pleasing.tif**. Move the new theme to above the AFRICA_BOUNDARIES theme in the Legend. You can either use the mouse to drag and drop it, or use the pop-up menu by clicking the right mouse button while pointing at the theme to move it up or down in the Legend.

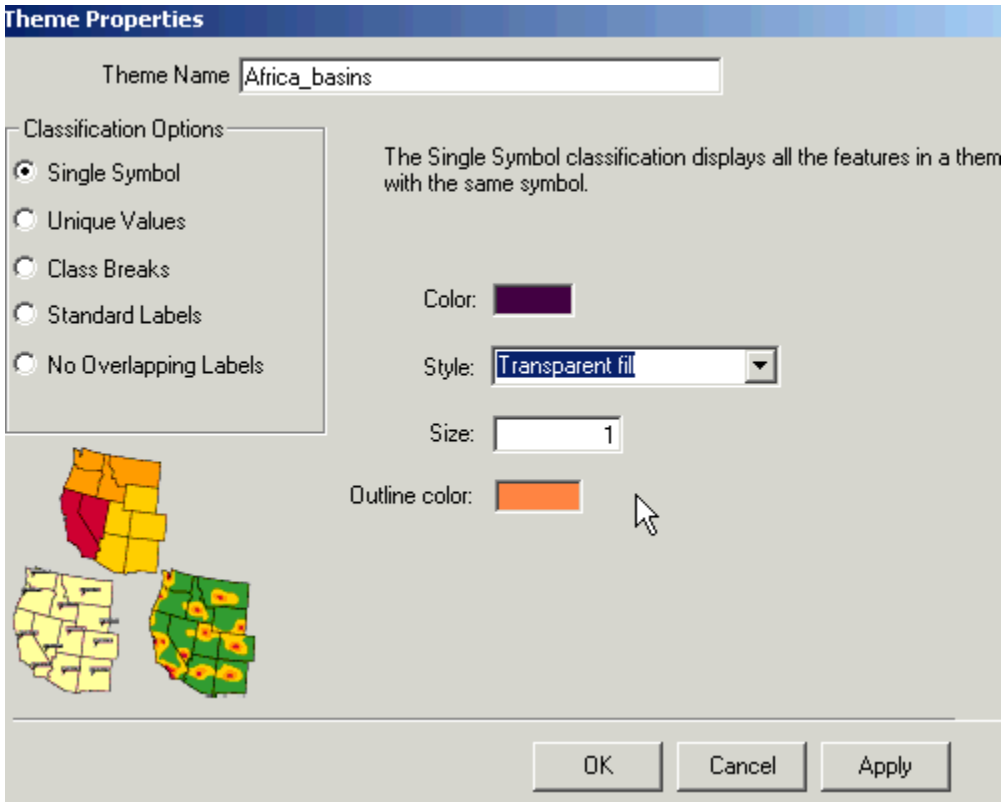


Make the image theme the active theme (it should appear raised) and use the Zoom to Active Theme tool,  . Change the active theme to be the AFRICA-BOARDERS theme that you used for setting the MapTips and move the cursor over the Map View – the name of the countries will be displayed despite that you do not see them.

Composing a thematic map

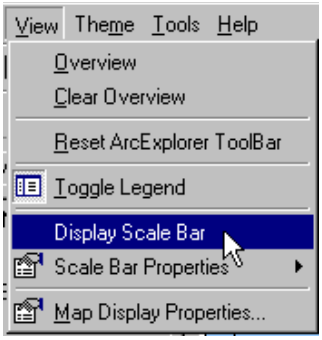
We shall now have a look at the drainage system of Africa. Click the Check box for the AFRICA_BASINS theme.

This theme shows the major catchments of the African continent. But we only want to see the boundaries so that we can see the satellite image as a backdrop. Open the Theme Properties dialogue and set Style to Transparent Fill and Outline color to orange. Click Apply.



In the same way click the Check box for the AFRICA_RIVERS Theme. Change rivers to a blue color and line width to be 2 in the Theme Properties dialogue.

Set the scale and scale units



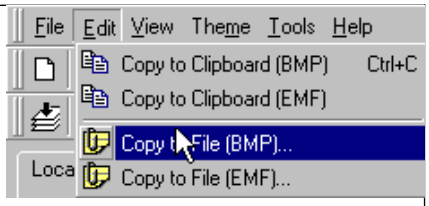
A scale bar is obligatory for a map. Thus you must add one. This you do under View in the menu bar as shown to the right. To change the scale bar to display kilometers and be in centimeter units change the Scale Bar Properties (also found under View in the menu). Map units are decimal degree so you must not change them, set Scale Units to kilometers and Screen Units to centimeters You also need to set measure units to be able to interactively calculate distances in the map. This is done under Tools in the menu. Set the Measure units,  to be kilometers and see how far the distance is between Egypt and South Africa (should be approximately 6 000 km). On the map view, click and drag a line representing the distance you wish to measure.

You should now have a thematic map of Africa showing rivers and major watersheds against a satellite image backdrop.

Your turn

To complete the exercise you should put the national boundaries on top of the map (in black) and add a theme showing major African cities (found in the file **AFRICA_CITIES** in the directory **…data/spatial/africa/infrastructure**). The city theme is composed of point data. Try to symbolize the cities according to number of inhabitants, as done in the example on next page.

When you are satisfied with your cartographic product it is time to transfer to another media. Either print it,  , if you are connected to a printer. Or export the map as a bitmap –found under Edit in the menu bar as shown to the right.
If the map is only built from vectordata copy it to EMF format, **Copy to File [EMF].** If the map contains images copy it to BMP format, **Copy to File [BMP].**



AFRICA – major drainage system and population centers

Appendix 1: How to get ArcExplorer from the internet

Use a web-browser (Netscape, Internet explorer) and navigate to ESRI´s homepage (http://www.esri.com) and to the page with free resources (in the blue field to the left, you have to scroll down get to Free Resources), select ArcExplorer (you should then be transferred to the site http://www.esri.com/software/arcexplorer/index.html). Read about ArcExplorer and then press Download (version 2.0 is the latest at the time of writing this instruction). You should then be transferred to the page http://www.esri.com/software/arcexplorer/aedownload.html. Download the file **ae2seup.exe**, also download the User Guide, **arcexplorer.pdf**.

Close all windows applications that are running on your PC and install ArcExplorer by executing the program **ae2setup.exe** (the program that you downloaded). To be able to install ArcExplorer you must have administrative rights on the computer you are using – if you do not have that you must ask your system administrator to help you. To install and run ArcExplorer the user should have full access (read and write) to the archive C:\Esri\ (not only for installation – also for running). When you install the ArcExplorer the default path for installation is "**Program files\ ESRI\ArcExplorer**". It is recommended that you accept that.

If you get stuck or do not understand a command, please refer to the User Guide that you downloaded (**arcexplorer.pdf**). This document is in pdf format, which you can read using Adobe acrobate reader. If you do not have acrobat reader on your computer you can download it from http://www.adobe.com/. Installation is done in a similar manner as the ArcExplorer installation described above.

Appendix 2: Free data from the internet used in this exercise

Most of the data used in this exercise is freely available from the internet. Most of it you can find via ESRIs (the supplier of ArcExplorer and ArcView) home page www.esri.com Their own main data can be found at ArcData online - http://www.esri.com/data/online/index.html. Other data suppliers can be found under the page http://www.esri.com/data/index.html, especially the data hound is useful for finding thematic data over specified regions -http://nt1.esri.com/scripts/production/esri/marketing/datahound/main.cfm.

For more comprehensive information on data available over the internet see the document Spatial Data and Applications for Environmental Studies in Africa. The exercise GIS Data Mining on Internet introduces using ArcExplorer for direct linking to map resources on the internet. It also includes examples of how to find and download other datasets, including Digital Chart of the World (DCW), which is a comprehensive dataset with global coverage. DCW data covering the RELMA countries (Uganda, Ethiopia, Eritrea, Tanzania, Kenya and Zambia) is available on the RELMA_GIS1.0 CD (under **…data/spatial/DCW**). To import the DCW to ArcExplorer you must use special software (Import71), which is also supplied on the RELMA_GIS1.0 CD. It is however not trivial to import this data, but you can find the instructions in the exercise Data Mining on Internet.