

IMPROVING A STUDENT'S GLOBAL VIEW

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ABSTRACT

It is legend that many students in the United States' colleges and universities do not know where anything is located. This paper reports on how ArcReader along with the Global GIS database is being used to improve the geographic knowledge of students taking World Regional Geography at Kutztown University. Specifically, this paper discusses how the regional databases were developed, how students may use the various data layers to investigate the spatial relationships among the layers, and how students have responded to the use of ArcReader as a learning tool.

PURPOSE OF THE STUDY

Since 1988 when the disappointing results of the National Geographic Survey were announced, additional surveys have shown that geographic literacy as improved only slightly [RoperAWS, 2002]. What is more disturbing than students not knowing where a country is located on map nor understanding the importance of spatial relationships, are the reports of corporate problems associated with geographic illiteracy.

Insensitive computer programmers with little knowledge of geography have cost the giant Microsoft company hundreds of millions of dollars in lost business and led hapless company employees to be arrested by offended governments.

The problem has damaged the company's reputation and the "trust rating," which is seen as key to keeping the company competitive, has dropped, a senior Microsoft executive revealed yesterday at the International Geographers Conference in Glasgow [Brown, 2004].

Microsoft has instituted geography classes so that its staff might avoid blunders such as not including Jammu-Kashmir within India, games within which Moslems convert churches into mosques, making Kurdistan a separate country from Turkey, or Taiwan as an independent country [Brown, 2004].

Having taught at the college level for over twenty-four years, I have come to the conclusion that the lack of geographic literacy may be more the fault of the method of instruction rather than the lack of interest in the topic of geography. Typically our introductory courses are large lecture classes in which students get very little hands-on experience in working with geographic data and discovering the underlying relationships between spatial distributions. This paper reports on how ArcReader and Global GIS databases are being used to improve the geographic knowledge of students taking World Regional Geography at Kutztown University. Specifically, this paper discusses how the regional databases were developed, how students may use the various data layers to investigate the spatial relationships among the layers; and how students have responded to the use of ArcReader as a learning tool.

DEVELOPMENT OF THE REGIONAL DATABASES

The original impetus to create regional GIS databases was for me to be able to produce a set of maps for place name and feature identification. The base maps would be used by students in my World Regional Geography classes at Kutztown University. I had found that most of the maps provided by textbook publishers were too simplified and were often missing features that I felt were important in understanding the geography of a region. The maps produced from the regional databases are the students' introduction to a region since when we begin to study a region I distribute a set of features the students are responsible for being able to locate on a map. These features always include the countries within the region, rivers, water bodies, land bodies, mountains and uplands. Depending upon the region, the set may also include capitals and major cities. The maps are printed on 11 by 17 inch paper, which gives the students sufficient space to write notes and annotate the features. Same sizes of maps are used in the examinations that are given at the conclusion of each region. An example of one of these maps is found in Figure 1.

The United States Geological Survey, USGS, began in 2000 to publish the various regional *Global GIS Databases* as part of their digital data series [Hearn, 2000]. Seven regional CD-ROMs covering the planet were released over the next several years. In 2003 *Global GIS, A Digital Atlas of the Planet Earth* in DVD format was developed by the USGS covering the entire planet and published by the American Geological Institute [Hearn, 2003]. There are several advantages to using these data sets, such as having a single source from which to extract data and well-defined metadata for each of the layers. The foremost reason I chose to use these data sets was the availability of data layers beyond the typical country boundaries, rivers, and capitals. The basic map layers within Global GIS databases are listed in Table 1. Using these additional data layers I was able to produce a variety of thematic maps for a region. The maps could be printed onto transparencies or displayed directly with a computer and data projector in the classroom.

Table 1. Global GIS Data Layers

Country Political Boundaries	Digital Shaded Relief Map
Elevation	Slope
Hydrology (Streams, Spring, Wells)	Locations of Cities and Towns
Airfields	Roads
Railroads	Utility Lines
Population Density	Geology
Ecological Regions	Historical Seismicity
Volcanoes	Ore Deposits
Oil and Gas Fields	Climate Data
Land Cover	Vegetation Index
Light at Night	MODIS Satellite Images

Regional study areas were defined as a set of rectangular boxes using latitude and longitude, see Figure 2. It was decided that the base geographic coordinate system would be based on the WGS-1984 datum because of its increased accuracy. Data for each of the study areas was

extracted from the Global GIS database and saved in a set of personal geodatabases. Several sets of features had to be projected from North American Datum 1927 to WGS 1984. Once this was completed, all feature data sets within a region were then projected into an Albers Equal-Area Conic projection centered on the region. This projection was also applied to raster data files for each region and the 30-arc second resolution was converted to 1 kilometer for all raster data sets.

There were only two real problems that I encountered with the Global GIS databases. The first was with coordinate values of the precipitation and temperature data. These data sets consisted of point files with information on monthly, seasonal, and annual precipitation, and monthly temperatures. These point data sets as they came off the Global GIS databases were geo-registered based on an original 30-minute grid system with coordinate values in the lower left hand corner of each grid cell. To be used ArcGIS, the coordinate of each point had to be shifted 15-minutes east and north. Fortunately, these values were record in the dBase attribute files. These files were brought in as X-Y Event tables and converted to a geodatabase feature class. The second major problem was the erroneous boundary between Armenia and Azerbaijan in the data files which had to be corrected.

The most tedious task in creating the regional databases was a manual editing process to select and extract the major rivers of a region. The process I used was to add a field to the attributes. The value of this field would indicate whether a stream as a polygon or a line would be kept or discarded. In Figure 3, a small portion of the Paraná River system in southern Brazil shows those features that will be kept in red and those to be discarded in grey.

STUDENT INTERFACE

With the release of ArcReader and Map Publisher by ESRI and the expansion of computer server/network capabilities on the Kutztown campus, I realized that it might be possible for the students to have a 'hands-on' experience that would enhance their understanding of spatial distributions and relationships. There are several advantages with using ArcReader. First, there are no costs for using the product. Second, it can be loaded on any number of computers on campus. Third, and probably most importantly, users are limited to the number of actions that they may take in viewing any region. I wanted the students to be able to access the maps but not give them the 'power' to change the maps or data. Within ArcReader, students can turn on or off the visibility of layers, zoom in and out, pan the map, search on attributes, use bookmarks, calculate distances, and use hyperlinks.

The layers and feature classes listed in Table 2 are available for the students to view for each region. Figure 4 shows the ArcReader interface for Africa South of the Sahara.

Table 2. World Regional Data Layers

Economic Layers	Geophysical Layers
Mines - points	Climate Stations - points
Ore Deposits - points	Faults
Oil and Gas Fields - points	Volcanoes - points
	Earthquakes - points
Hydrology Layers	Geologic Provinces
Rivers - arcs	Geologic Age
Rivers - polygons	Ecological Regions
Water Bodies – polygons	
Spring and Wells - points	Precipitation Layers
	Monthly Average Precipitation - points
Transportation Layers	Annual Average Precipitation - points
Airfields – points	
Railroads – arcs	Temperature Layers
Roads - arcs	Monthly Average Temperature – points
Social Layers	Pennsylvania – polygon
Capitals – points	Elevation Profiles - arcs
Major Cities – points	Image Points - points
Urban Areas – polygons	Boundary Lines - arcs
Boundary Lines - arcs	Land Bodies – open polygons
Countries – polygons	Graticule - arcs
Administrative Units – polygons	Study Area - polygon
Land Bodies - polygons	
	Raster Layers
	Land Cover
	Population Density
	MODIS Satellite Image
	Shaded Relief Model

The symbolism and order of the layers within the table of contents is standardized across all the regional databases. The order within the Table of Contents was largely determined by feature type: point, arc, or polygon. Two feature classes, Boundary Lines and Land Bodies, are repeated outside of the Social Layers which allows them to appear as overlays on the Raster Layers without hiding them. Symbolization is based on standard ESRI symbol sets and is found in the original Global GIS ArcView interface.

Two hyperlinked feature classes were created and added to the regions. Elevation Profiles were created using the profile function within 3D-Analyst and the projected topographic database from the original Global GIS databases, see Figure 5.

The second hyperlinked feature class is Image Points. When an Image Point is selected, it is hyperlinked to photographs or graphics from that area within the region, see Figure 6. Most of the images have been pulled off the Internet and the original URLs for the photographs or graphics are listed in the attribute file of the Image Points.

Please note the inclusion of a polygon of the state of Pennsylvania which has been translated to the center of the region and projected at the same scale as the region under study. Since most of the students at the University are from Pennsylvania, this allows them to get a sense of the size of the region. Figures 7 and 8 show two examples of the type of maps the students can see and interact.

STUDENTS RESPONSES AND FEEDBACK

While no formal survey has been conducted among the students in my World Regional Geography classes, the informal feedback has been generally positive. This is especially true in the summer session of the class that I taught in May 2005. Enrollment was sufficiently small that the entire class of thirteen could fit in our twenty-seat lab. The students found locating rivers easier when they are color-coded. Several commented on the fact that they like being able to zoom in on a feature in the MODIS satellite image and then compare the area's population density to the physical geography. They liked the ability to turn on the earthquake feature class and see how it related to volcanoes and mountains systems. The use of ArcReader and the regional databases has created much more interaction in class and questions from the students based on the spatial distributions they are viewing. It is a hopeful sign!

FURTHER DEVELOPMENTS

While I will be continuing to incorporate more photos and graphics as hyperlinks, the major focus my use of ArcReader as a learning tool will be the addition of thematic maps as a layer. Specifically, I would like to include maps of agricultural land use, physiographic density, and international trade, see Figure 9.

Figure 1. East Asia

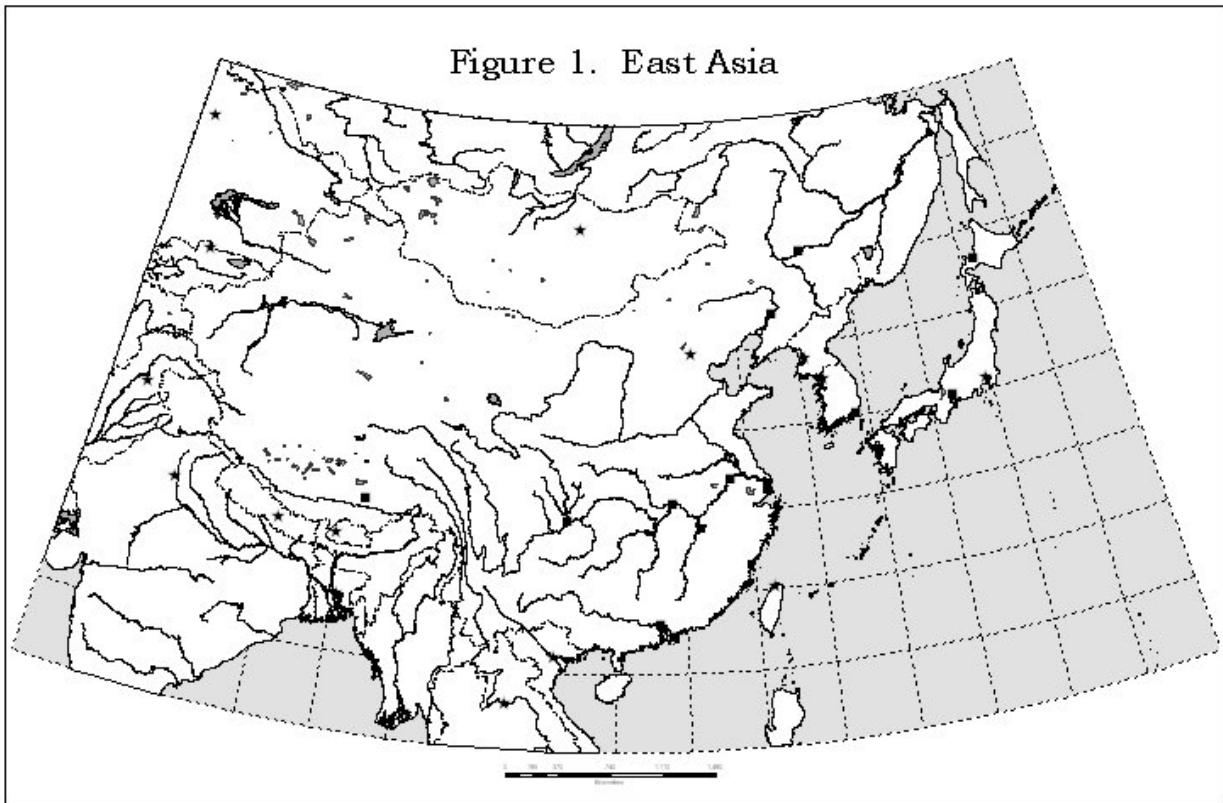


Figure 2. Regional Study Areas

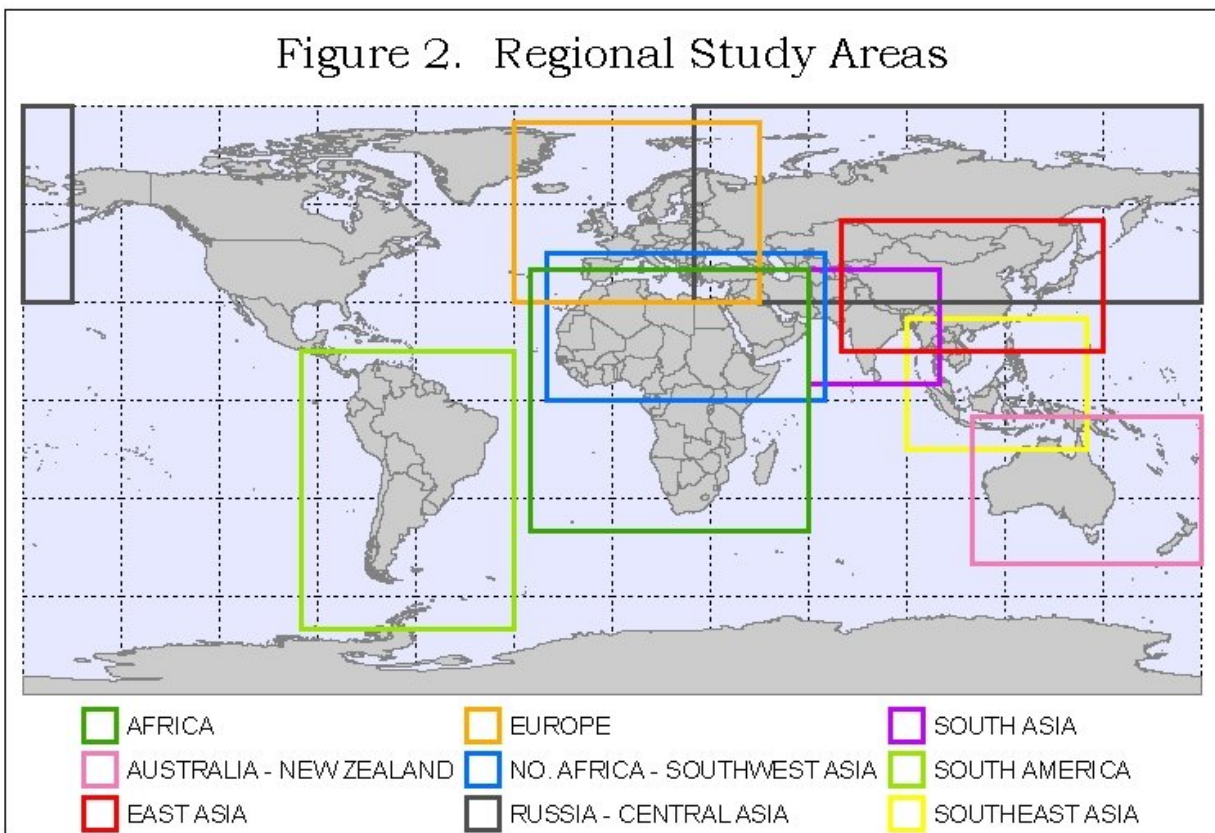


Figure 3. River Editing

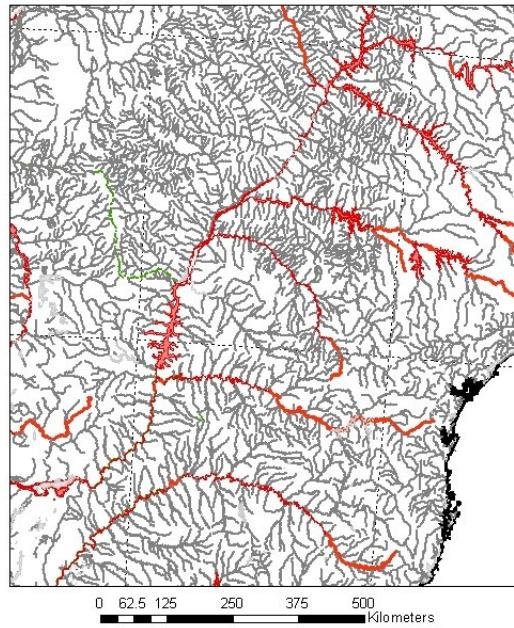


Figure 4. ArcReader Interface

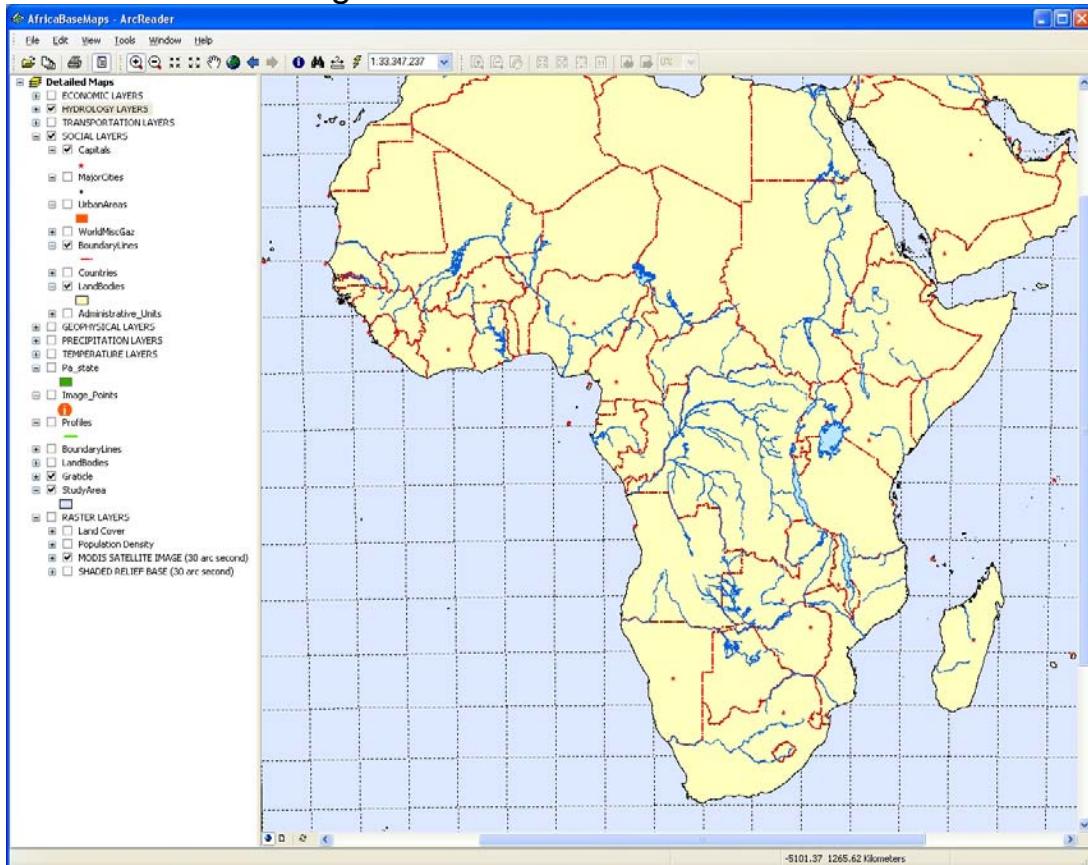


Figure 5. Elevation Profile

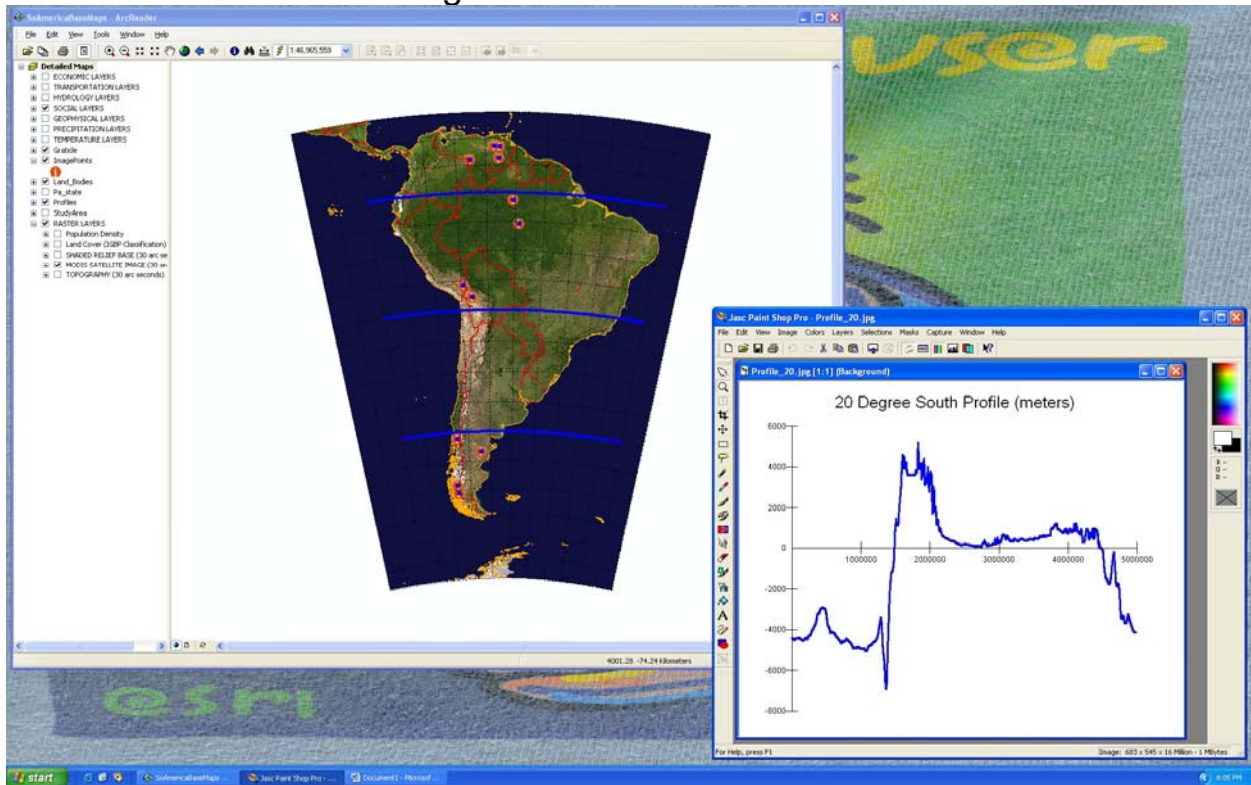


Figure 6. Hyperlinked Graphics

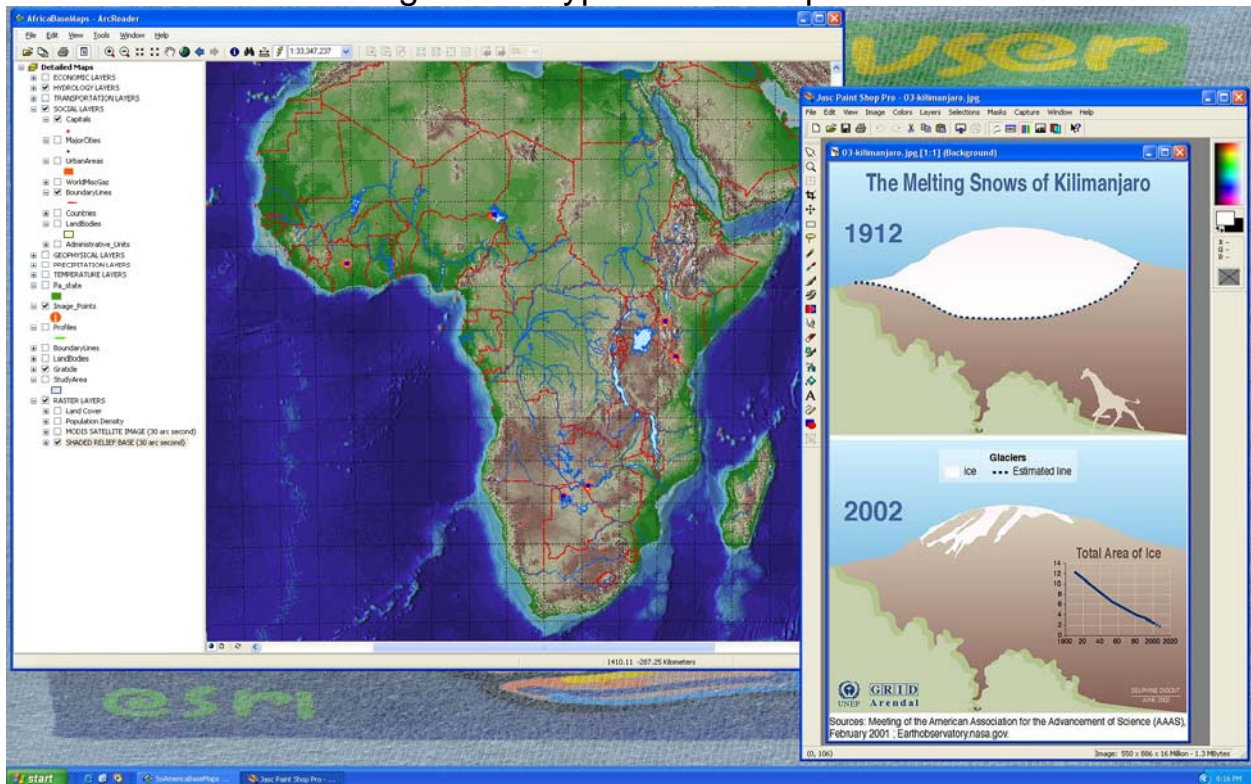


Figure 7. Taklamakan Desert of East Asia

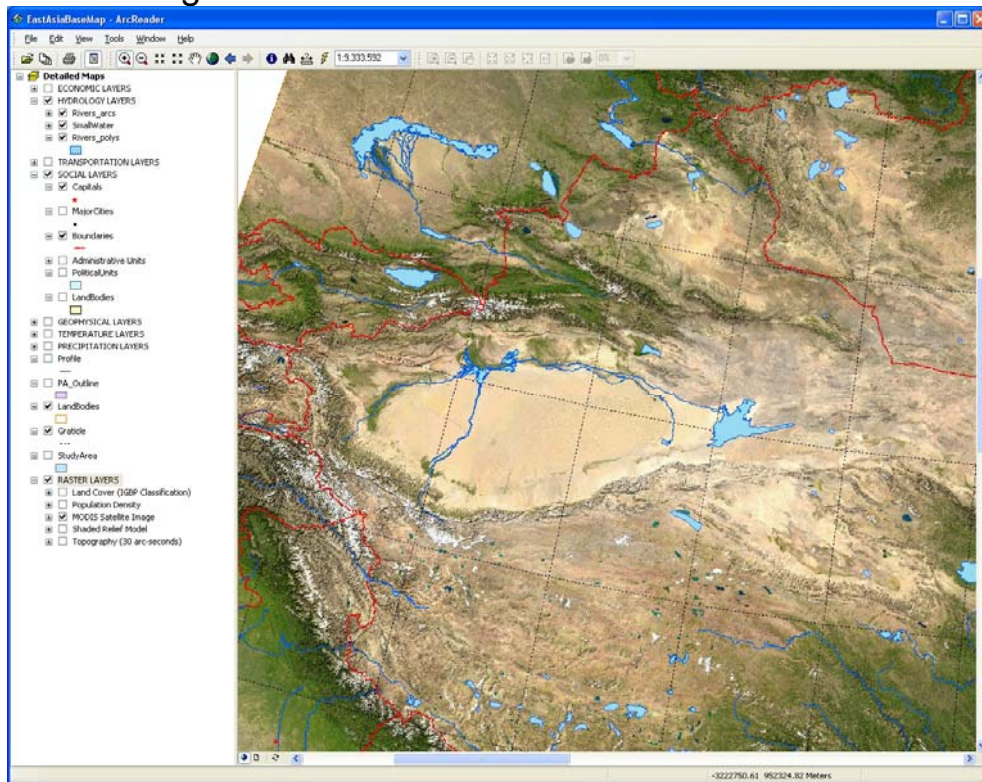


Figure 8. Earthquakes between 1973 and 2000

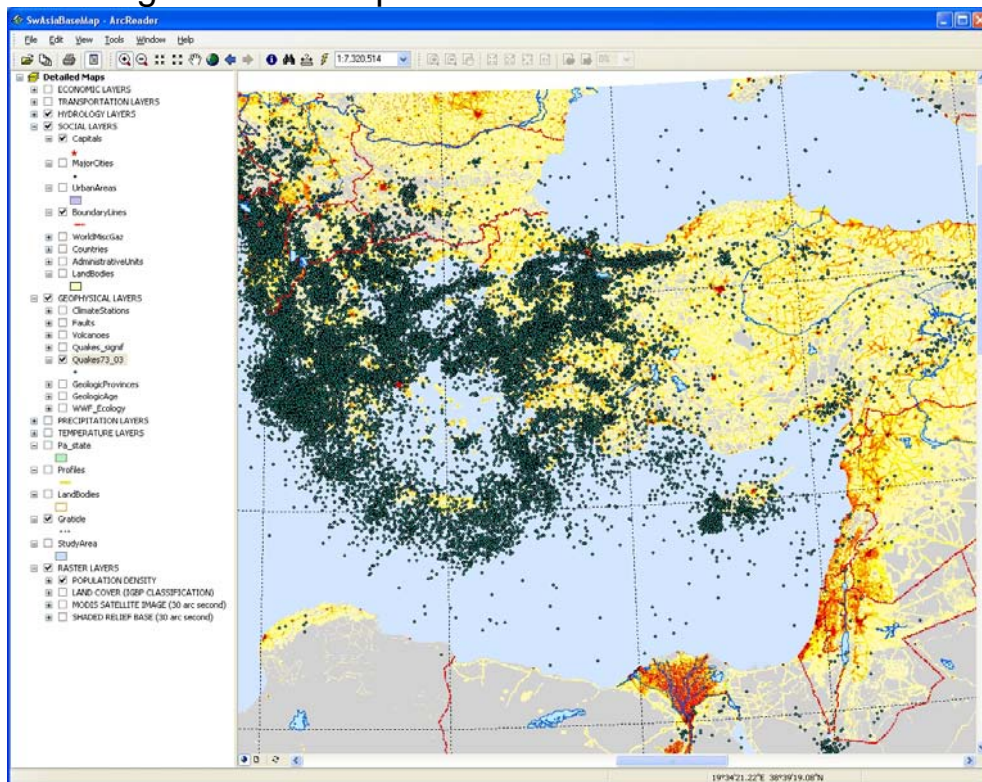
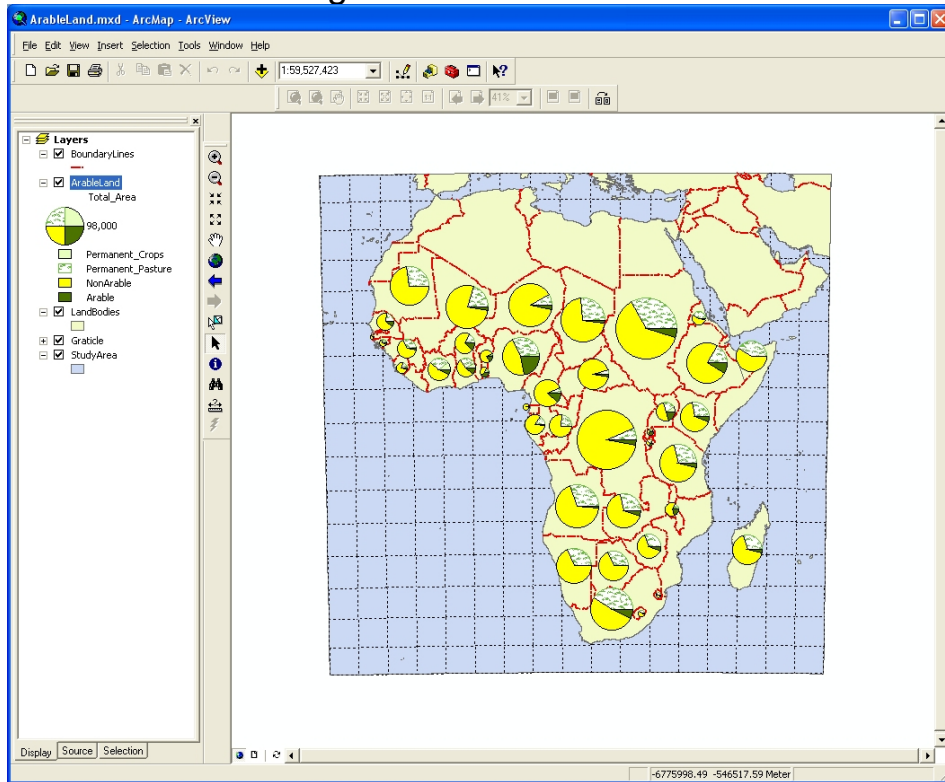


Figure 9. Arable Land



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