

# The Desertification of the Gobi Desert and Its Effect on Beijing

## I. Goal

Asses the rate of desertification of the Gobi desert, and determine, at its current rate, how long until it spans into Beijing, China's second largest city. I will do so using data stored in a variety of formats (shapefile, geodatabase feature classes, and raster .sid), obtained from various sources, such as the USGS, Encarta Encyclopedia, and the Nasa Zulu database.

## II. Problem

Even though the Gobi is distant from China's capital, Beijing, dunes are forming just 70 km from the city, and may be drifting south at 20-25 km a year, with conservative estimates saying 3 km a year. Despite massive spending by the Chinese government on land reclamation and replanting, China cannot keep up with the rapid expansion of the desert. Only 7% of Chinese land is viable farmland, and half of China's 617 largest cities face water deficits. Beijing is among the cities which will be most affected. By analyzing the obtained data, hopefully I will be able to answer, at its current rate of expansion, how long until the Gobi's borders reach Beijing? Furthermore, I can compare my results to current projections to gauge how accurate my approach is.

## III. Data

The Data used from my project was obtained by three sources:

1. The Lab 2: Map Projections and Coordinate Systems file, specifically the world30 file
2. A gif imaga of the Gobi desert from <http://images.encarta.msn.com/xrefmedia/aencmed/targets/maps/map/T028749A.gif>
3. MrSid files of landsat data from 1990 and 2000 from [Nasa Zulu website](#).

## IV. Procedure

The procedure involves the following general steps:

1. Create Map area of Mongolia and China
2. Geofrenence the gif image of the Gobi desert to a map of China and Mongolia to get an approximation of the perimeter of the Gobi;
3. Digitize a desert area polygon;
4. Mosaic individual .sid files into a single .sid file;

- Calculate the rate of desertification of the southwest corner of the Gobi from 1990 to 2000 by using spatial analysis.

**A. Create a Map Area of Mongolia and China**

- Open ArcMap and create a new, empty map.
- Load the Open ArcMap and create a new, empty map.
- Load the cntry94 feature class from the geodatabase Mapproj.mdb, found in the Lab 2 folder.
- Use the selection tool to highlight the countries of Mongolia and China
- Use the clip tool located in ArcToolBox under Coverage Tools, to extract the selected data. Save the new file under Mon\_Chin.

The result should resemble figure 1

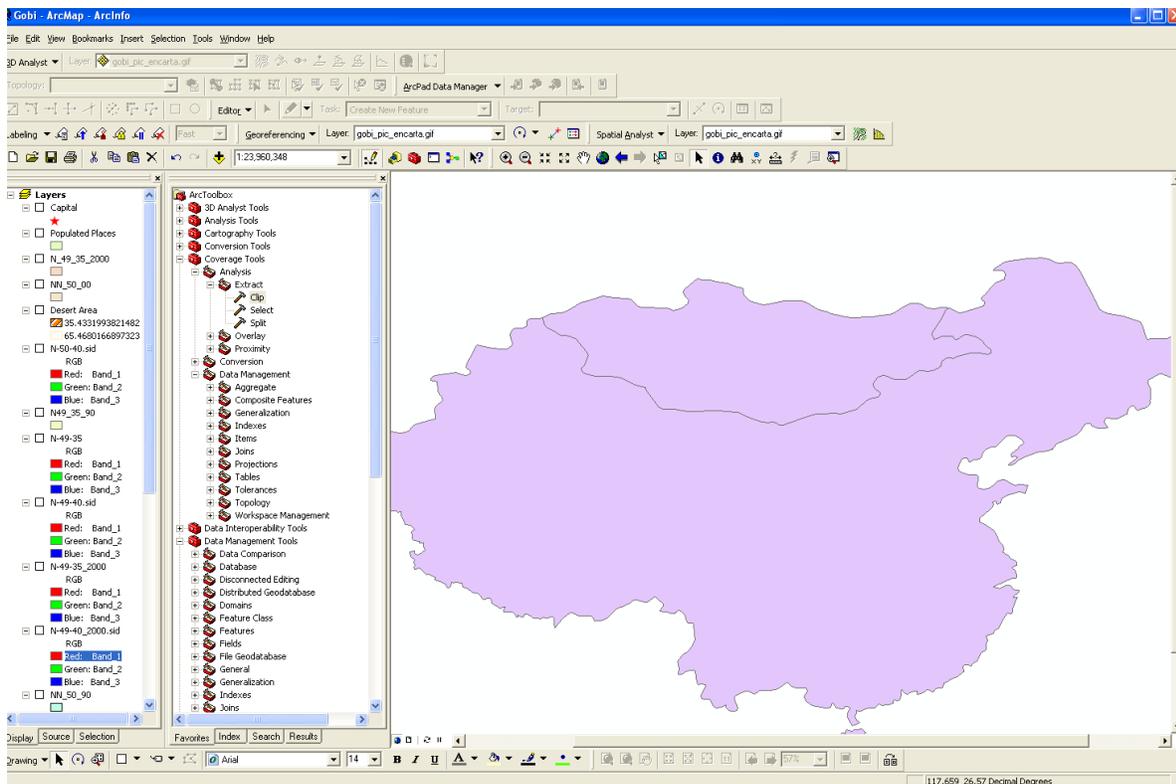


Figure 1- clipped countries from world map

**B. Georeferencing**

- Load the .gif file of the Gobi desert into ArcMap. Establish the spatial reference of the photo as
- Open the "view link table"
- Use the add control points tool to pick 3-5 points where the .gif image will link up to the map of Mongolia and China. Zoom into the .gif image layer first and pick the first point, then zoom

into the Mon\_Chin layer and pick the second point lines up with the first point picked on the .gif image. Continue this process until the maps line up appropriately.

4. Save the links in the Project/my\_data folder.
5. Rectify the new georeferenced map, using nearest neighbor resampling, and a cell size of 1, in the spatial reference data frame GCS\_North\_American\_1983.

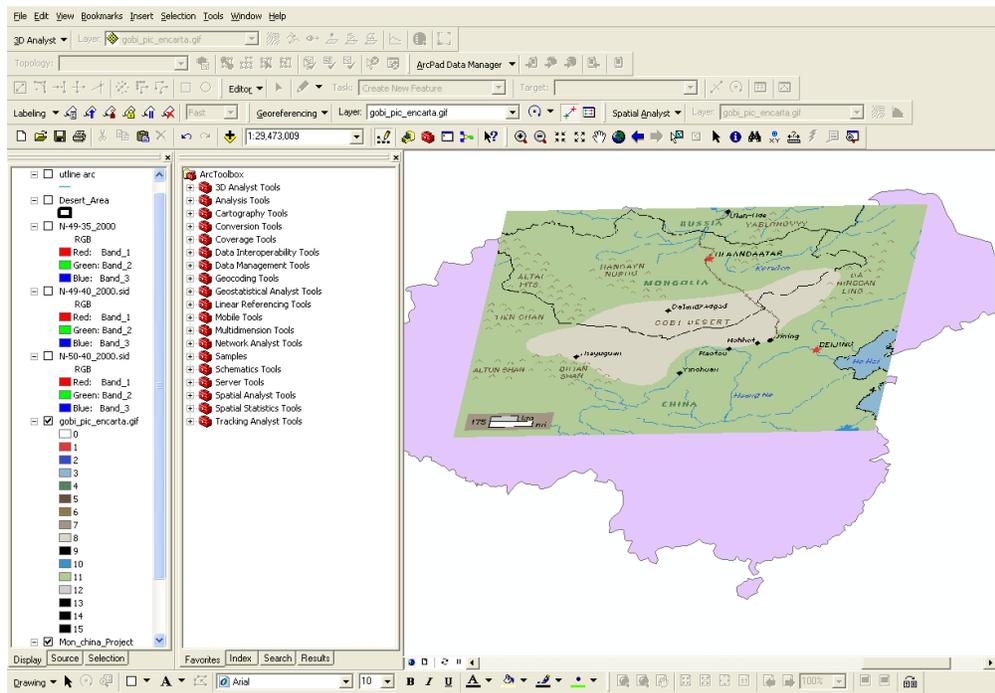


Figure 2-Rectified Georeferenced Map

### C. Create a Personal Geodatabase

1. We will want to create a personal geodatabase to create feature classes in.
2. Within ArcCatalog, browse to the project folder, right-click on the folder, select “New”, then Personal Geodatabase.
3. Name the new Geodatabase “Gobiproj.mdb”

### D. Create a Feature Dataset

1. Within ArcCatalog, browse to the project folder, right-click on the Gobiproj geodatabase, select “New”, then “Feature Dataset”.
2. Name the new Feature Dataset “Gobi” and click the “next” button to bring up the Spatial Reference Properties window.
3. Because we will be mainly working in UTM 49N, Browse to Projected Coordinate System>UTM>WGS\_1984> WGS\_1984 UTM 49N.prj and select, then click “Next”.
4. Accept all defaults and click “Finish”



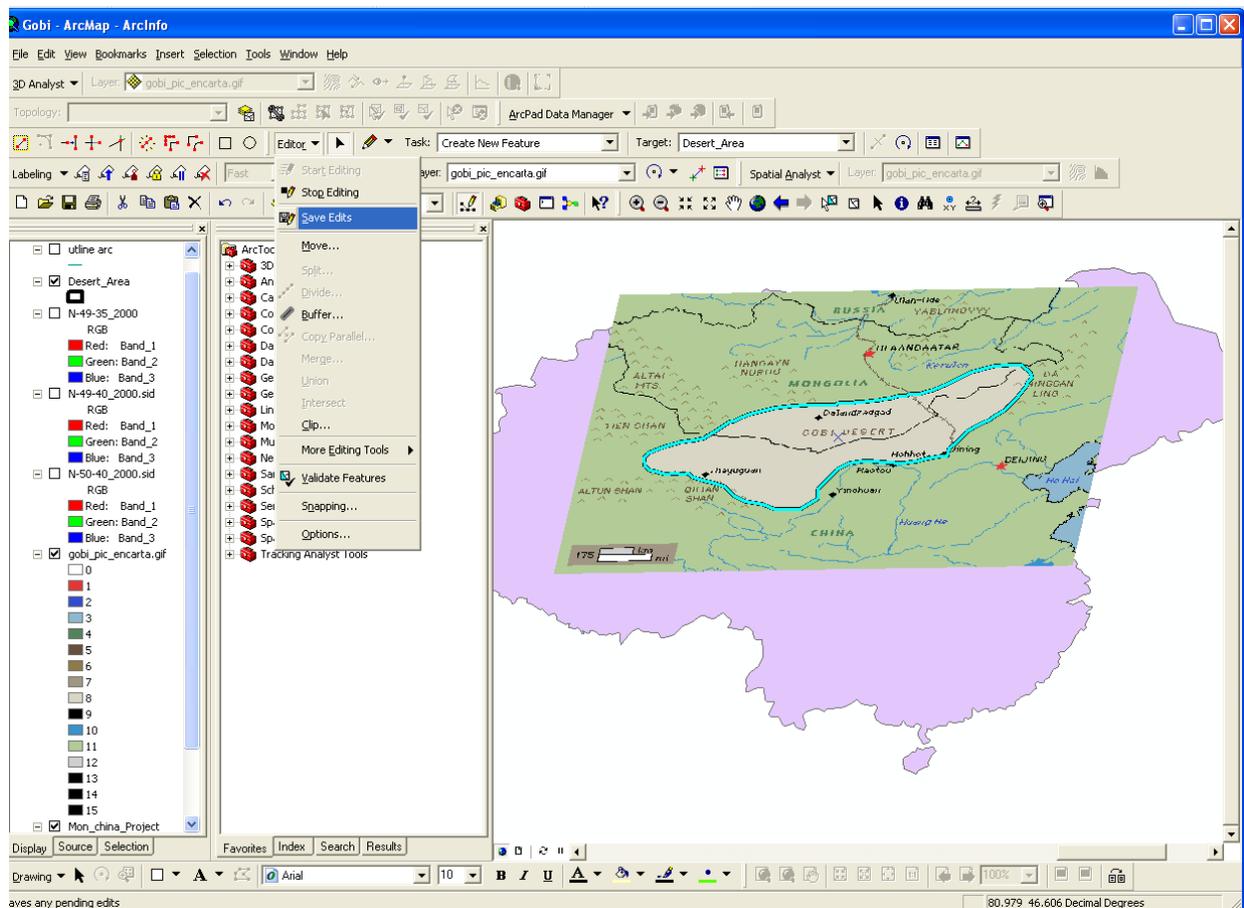
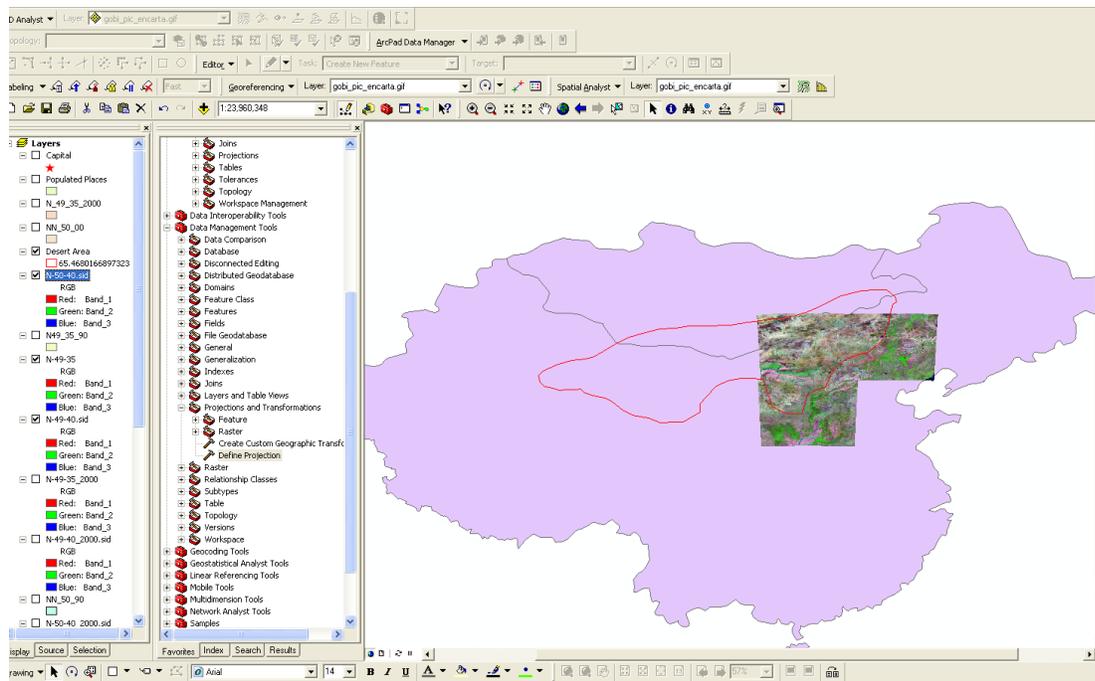


Figure 4-Saving the edits made for the newly created polygon

- g. Click “Save Edits” on the editor toolbar
  - h. Click “Stop Editing” on the editor toolbar
  - i. Change the symbology of the polygon to “No Fill”, with a bright red outline 1 point wide.
- G. Using Satellite Images to Determine How Far the Gobi has Expanded in the Southeast corner, during 1990-2000.**
1. Upload the 6 MrSid files obtained from the [Nasa Zulu website](#) into ArcMap.
  2. Set the spatial reference for each of the files by going into ArcToolBox, Data Management Tools, Projections and Transformations, Raster, and then click on Define Projection.
  3. Set the Spatial Reference according to the UTM zone the data is located in. WGS\_1984\_UTM 49N for the data located in UTM Zone 49N, and WGS\_1984\_UTM 50N for the data located in UTM Zone 50N.
  4. Check the boxes so only the 3 MrSid files containing the satellite images from 1990, and the gobi desert outline is displayed, like in figure 5.



*Figure 5- Gobi Desert Perimeter Outline and 1990 Satellite Images*

5. The edge of Gobi Desert Outline doesn't quite match up with outline of the desert seen in the satellite images. This is ok! The first outline was just to give us a rough idea of the desert's location, now we can edit the polygon in the Southeast corner to match up with the desert image in the 1990 satellite photos.
    - a. From the editing toolbar menu, click "Start Editing"
    - b. On the toolbar set Target to the file you will digitize to (Desert\_Area)
    - c. On the toolbar, Choose task- "Modify Feature"
    - d. From here you will be able to drag, delete, or add new vertexes until the southeast corner of the polygon matches up with the desert perimeter in the satellite photos.
    - e. Click "save edits"
    - f. Click "stop editing"
- H. Determine the Newly Expanded Perimeter of 2000**
1. Click the boxes on the TOC bar so now only the MrSid files featuring satellite images taken in 2000 and the desert outline are present.
  2. It's apparent that there has been some significant growth from 1990 to 2000, so we will want to create a new feature on the Desert\_Area to display this change.

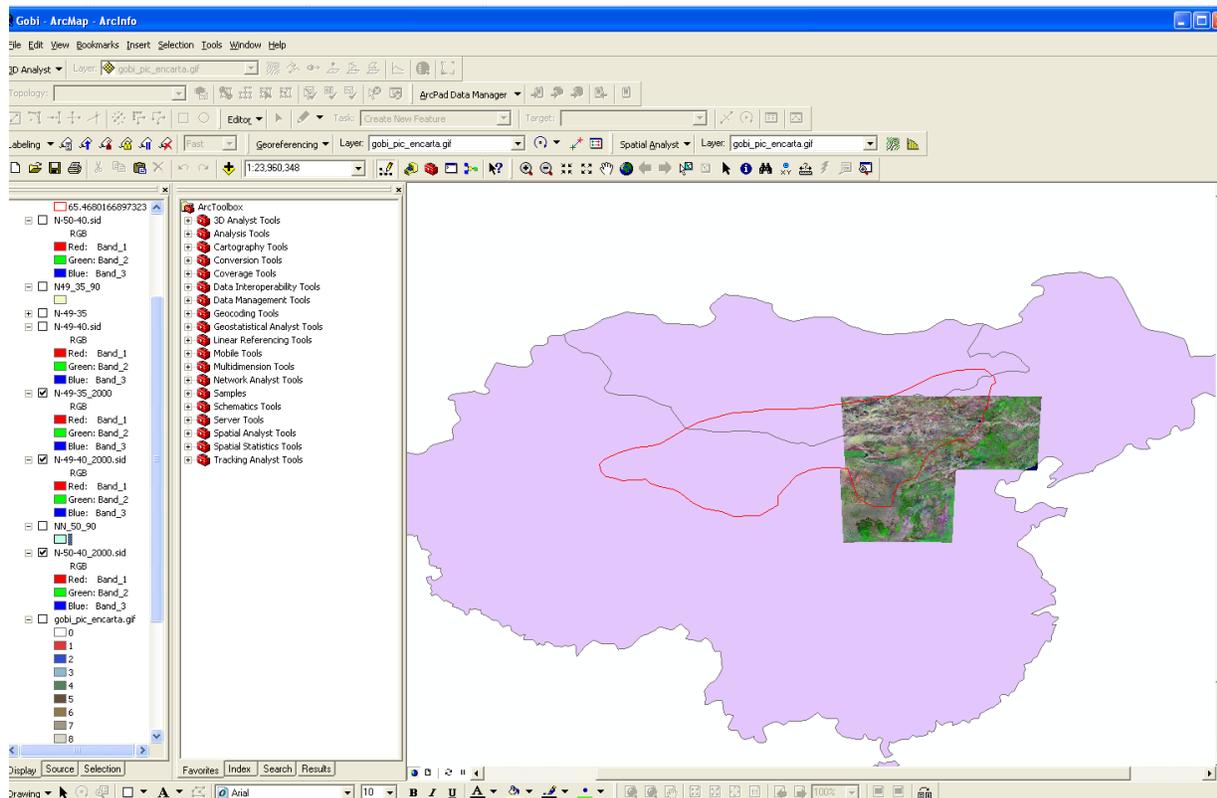


Figure 6- Gobi desert perimeter from 1990 compared with satellite images of Gobi in 2000

3. To create this new feature, we will want to go back into the editor toolbar.
  - a. From the editing toolbar menu, click “Start Editing”
  - b. On the toolbar set Target to the file you will digitize to (Desert\_Area)
  - c. On the toolbar, Choose task- “Create New Feature”
  - d. Select Tool-Pencil
  - e. Begin outlining the new extended perimeter in the Southeast corner of the Gobi desert featured on the map .
  - f. Finish sketch, save edits, stop editing. The new polygon should resemble figure 7.

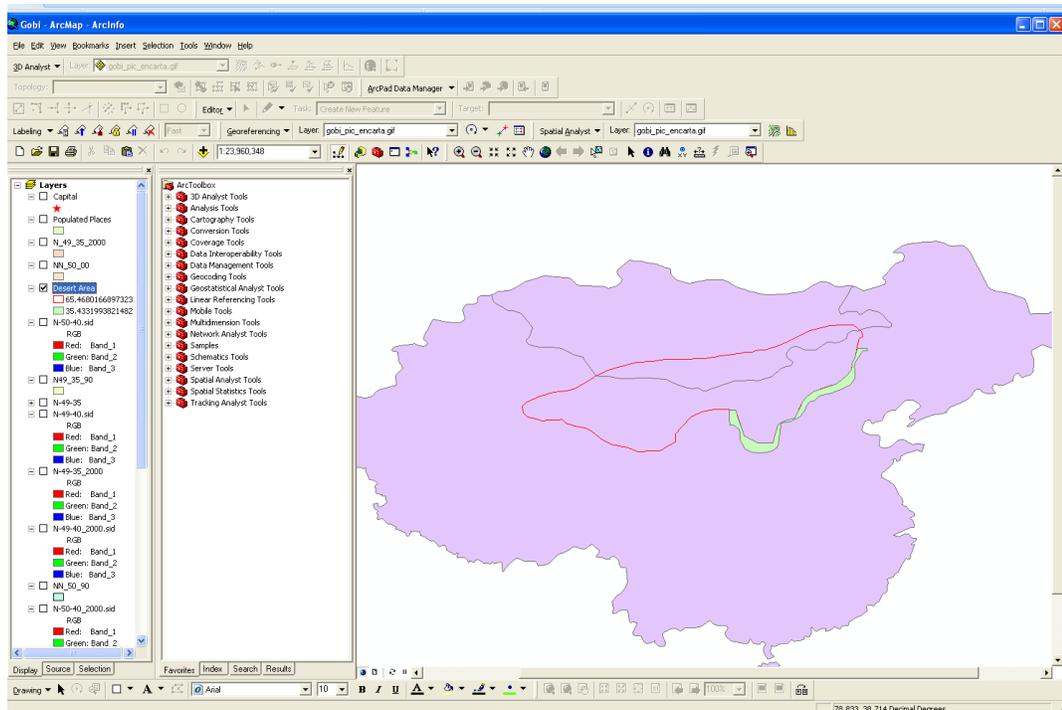


Figure 7- Polygon displaying new expansion

## I. Determining the Total Amount of Perimeter Expansion in the Southeast Corner of the Gobi

1. In order to determine the total amount of perimeter expansion, we can use the attribute table of the Desert\_Area polygon .

- a. Open the “attributes” window of the Desert\_Area polygon. Click the options tab on the lower right-hand corner of the window. Click “add field”. Label the field “Area”, and select “long integer” as the type. Right-click on the “area” tab, and choose “Calculate Geometry”. Under “Property”, select “Area”, and make sure the coordinate system is set to the coordinate system of the data source. Under unites select “square kilometers”, and hit OK. Do the same for the “Perimeter” tab, setting the “property to “perimeter” and the “units” to “kilometers.”

- b. This displays that over 10 years the Gobi's Southeast corner has expanded 153 km. Giving us a rate of 15.3 km/yr.

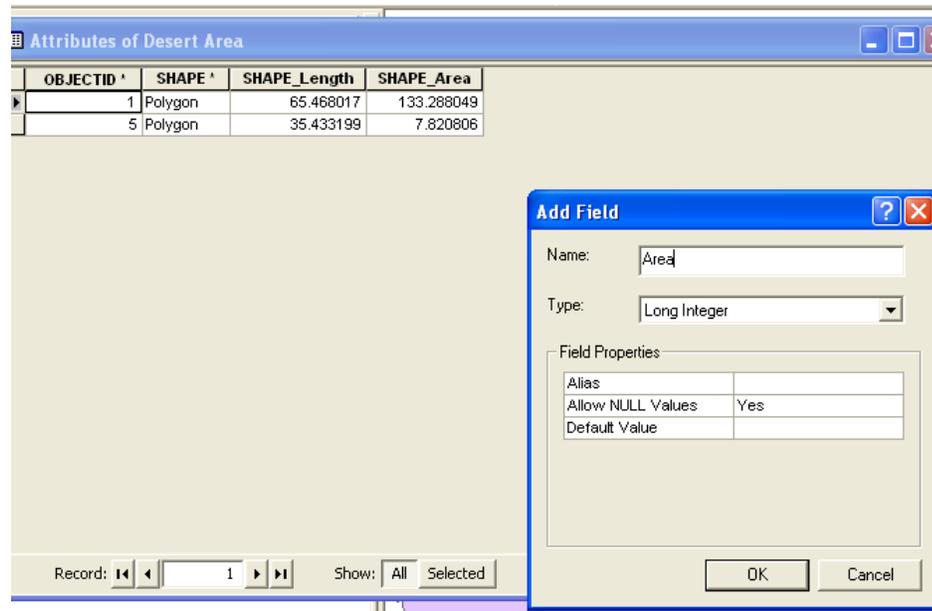
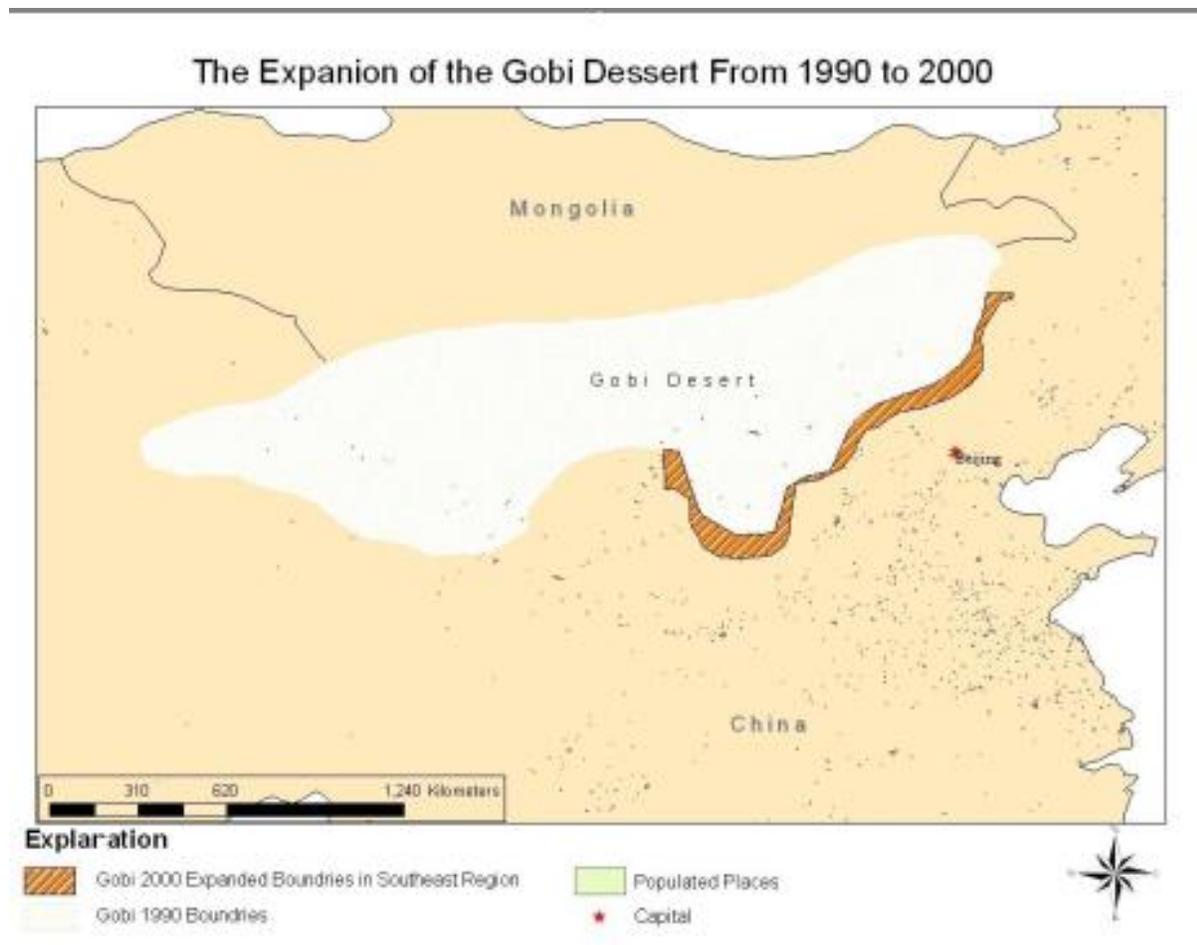


Figure 8- Adding a field to the attribute table

#### J. Making the Map

1. Symbolize the desert area appropriately.
  - a. Right click on Desert\_Area in the TOC, click properties, symbology tab, and use the sand symbol for the 1990 Gobi outline, and banded orange for the 2000 Gobi Expansion.
2. Create labels
  - a. Use the text box tool to create label for the Countries of Mongolia and China, the City of Beijing, and the Gobi Desert.
3. Display populated Areas of China

Load the shapefile obtained by the [Geo Community Website](#), containing polygons of China's populated areas. Symbolize green.
4. Add a title, legend, scale, and North Arrow to your Map.



*Figure 9- Final Map*

## V. Conclusion

By examining satellite data, it was determined that the Gobi is expanding approximately 15.3 km/year. This is concurrent with current reports of the Gobi's rate of expansion. At this rate, China's capitol city will be on the edge of the Gobi within 6-8 years, and many populated cities in between will be consumed by the desert's sands. Many Chinese officials believe that the idea of Beijing being swallowed by the Gobi in a few years is "Silly", but according to the satellite data, if China does not taken drastic action, mass amounts of people will be displaced, and thirst and famine will be widespread.

## VI. Problems

1. The MrSid files obtained from the Nasa Zulu site, were much too large for the computer to handle, causing ArcMap, and the computer its self to crash frequently. I was also unable to use any of the tools in the spatial analyses toolbox. This called for multiple changes in my project.
2. Unknown if this problem is related to the large size of the MrSid files, but an Admin error, preventing me from creating any files during certain times of the day.