Getting Started with ArcGIS

(EXERCISE FOCUSES HYDROLOGY STUDENTS)

Introduction to Digital Elevation Model (DEM)

- Add dem or tiff
- Make a small polygon
- Extract tiff equal to poly (Spatial Analysis..Extraction ..Mask)
- Resample (0.0083333 deg)
- Fill
- Flowdir
- Sink
- Flow acc
- Map calculator: str=con(....>=10000, 1, 0)
- Stream to feature

How to Download DEM

- There are many internet sources for Downloading DEM. You can download this from http://srtm.csi.cgiar.org/ as shown in next Slide

- Under SRTM Content, click SRTM Data Search and Download on left side of the screen.

How to Download DEM

How to Download DEM

- The world map will be opened and the grids will be shown. Boundaries of almost every country can be seen clearly and hence one can download his/her area of interest. The next two slides explains selection of tile and the Map.....

SRTM Data Selection Options

Chinese users : 中国用户可通过中国科学院镜像站点下载

| 1. Select Server: | ◉ CGIAR-CSI (USA) | ○ HarvestChoice (USA) | ○ JRC (IT) | ○ King's College (UK) | ○ TelaScience (USA) |

| 2. Data selection method: | ◉ Multiple Selection | ○ Enable Mouse Drag | ○ Input Coordinates |

Many tiles can be selected at random locations. These selected tiles are listed in the results page for download.

| | ○ Decimal Degrees (ie 34.5, -100.5) | | ◉ Degrees: Minutes: Seconds (ie 34 30 00 N, 100 30 00 W) |

Longitude - min: [ ] max: [ ] Longitude - min: [ ] [ ] [ ] East ▾ max: [ ] [ ] [ ] East ▾

Latitude - min: [ ] max: [ ] Latitude - min: [ ] [ ] [ ] North ▾ max: [ ] [ ] [ ] North ▾

Longitute: 177.48 Latitude: 3.97 Tile X: 72 Tile Y: 12 [Mark Area] [Clear Area]

| 3. Select File Format: | ◉ GeoTiff | ○ ArcInfo ASCII | | [Click here to Begin Search >>] |
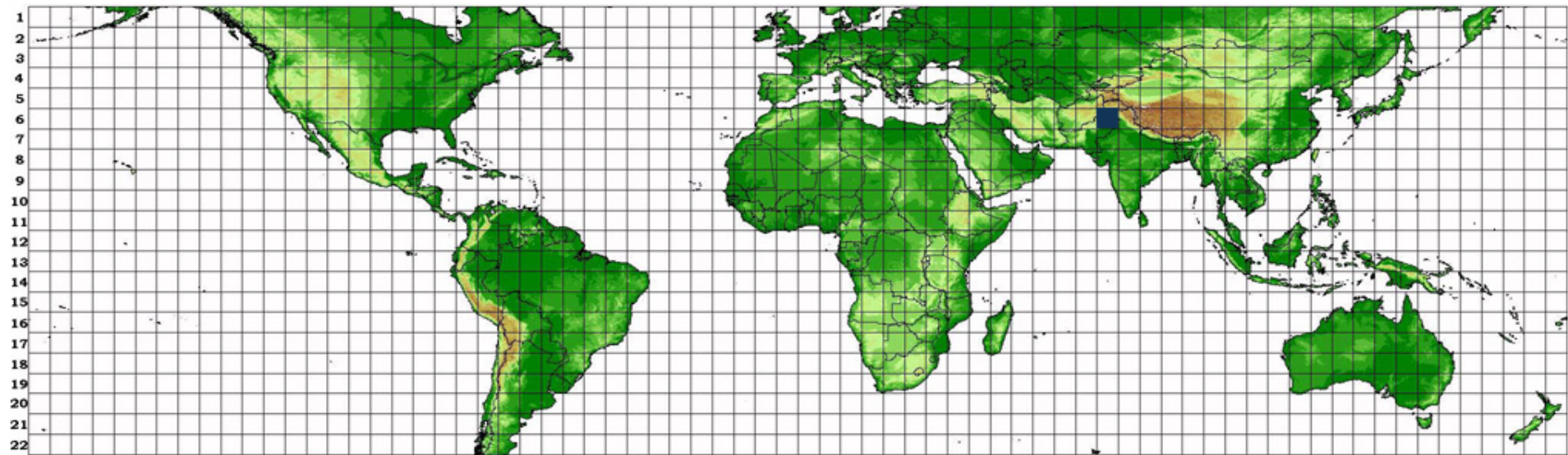
How to Download DEM

- The World map is divide in to a number of grids and as an example we have selected one tile from Pakistan. Now download preferences can be selected from the other portion (on the map above)
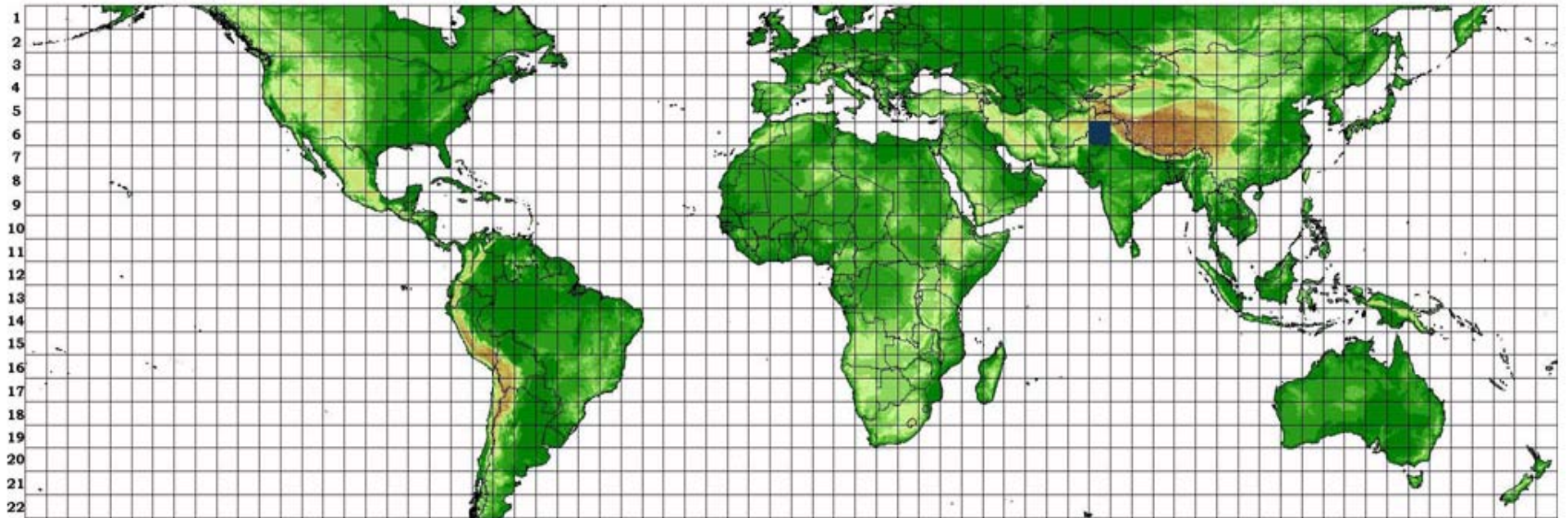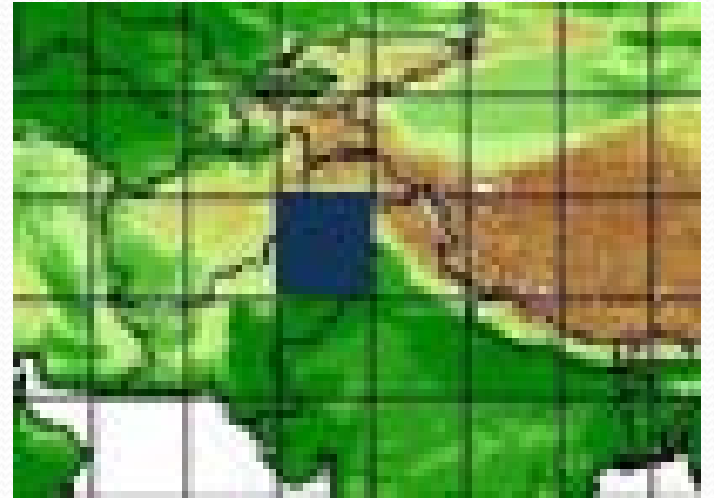
How to Download DEM

- The download preferences can be selected by the user him/her self. Here at the bottom we have selected the Geo Tiff format. After this click the off white portion mentioning "Click here to Begin Search". A new window will be opened....

How to Download DEM

- In this window the preview of the DEM image is shown with its location and some description. At the bottom data down load options are mentioned. Here we select first one i.e. Data Download (FTP)

Description	Location	Image
Product : SRTM 90m DEM version 4		
Data File Name : srtm_51_06.zip		
Mask File Name: srtm_mk_51_06.zip		
Latitude min: 30 N max: 35 N		
Longitude min: 70 E max: 75 E		
Center point : Latitude 32.50 N Longitude 72.50 E		

CSI Server :   Data Download (FTP)   Data Download (HTTP)   Data Mask Download (FTP)   Data Mask Download (HTTP)   ^TOP^

How to Download DEM

From here you can browse the data to the location where you want to save this file. Here we have browsed the file to USB as shown (Better to save data in the computer hard disk and not the external drives)
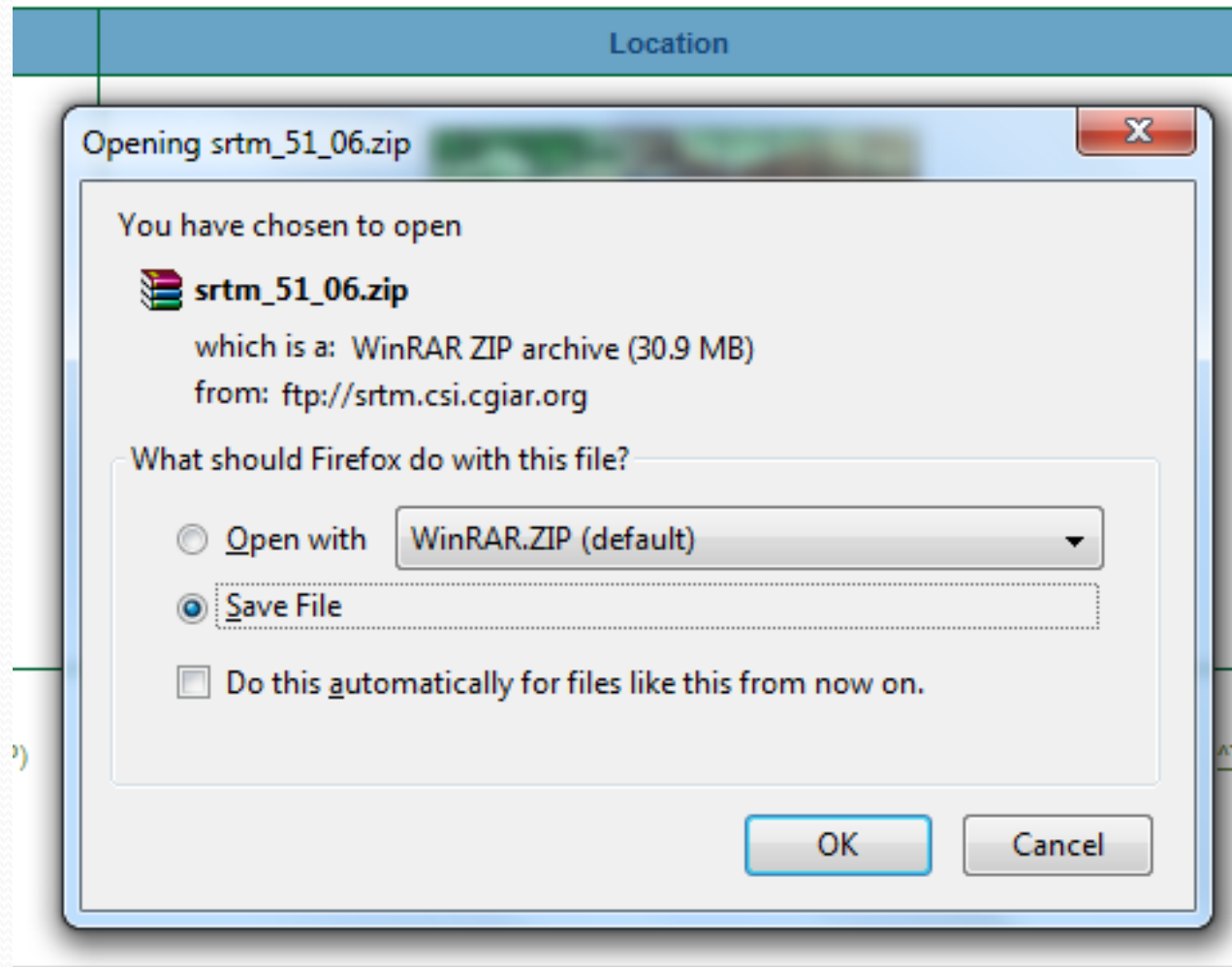
How to Download DEM

- The downloading will take some considerable time. Be patient……………………..
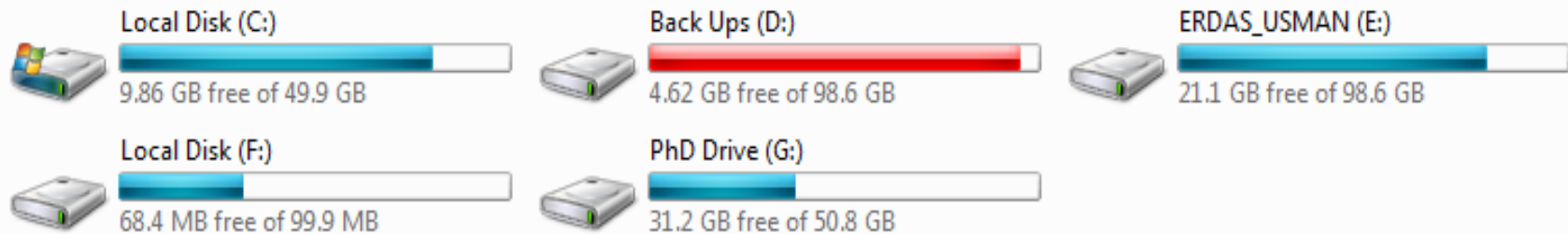
Getting Started with ArcGIS

- From the start menu of your PC you can find the icon of ArcMap or if a shortcut is available at the desktop you can double click to open ArcGIS
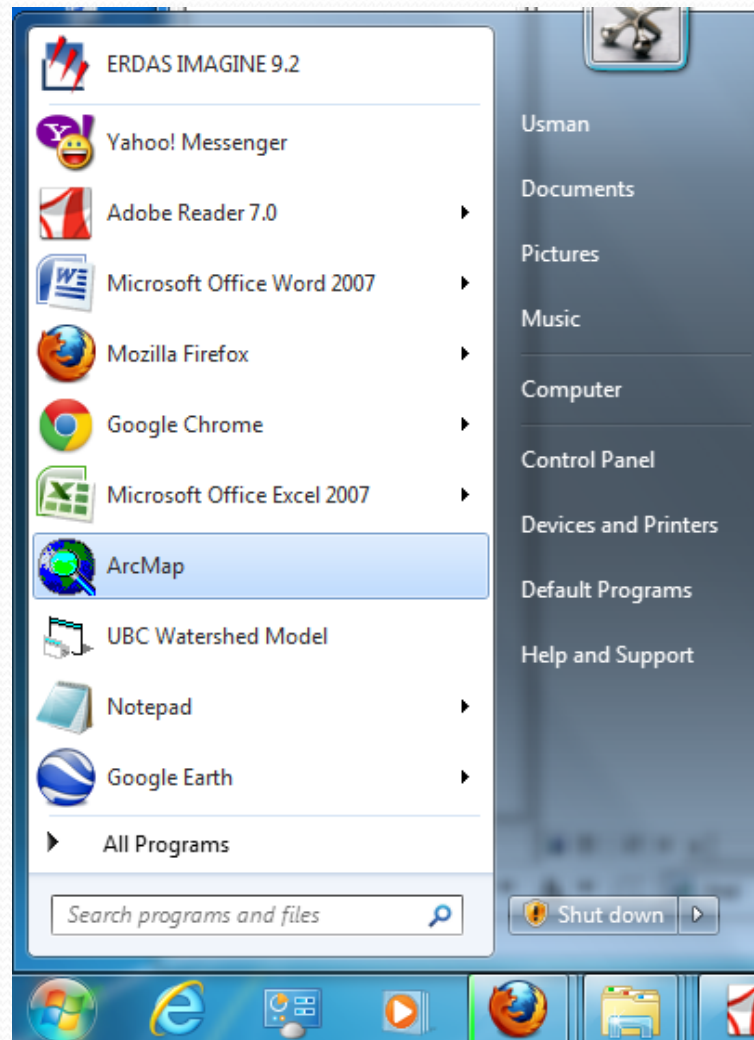
Getting Started with ArcGIS

- The following program will be opened as shown below. Since we are opening a new program so select the option as shown above "a new empty map"
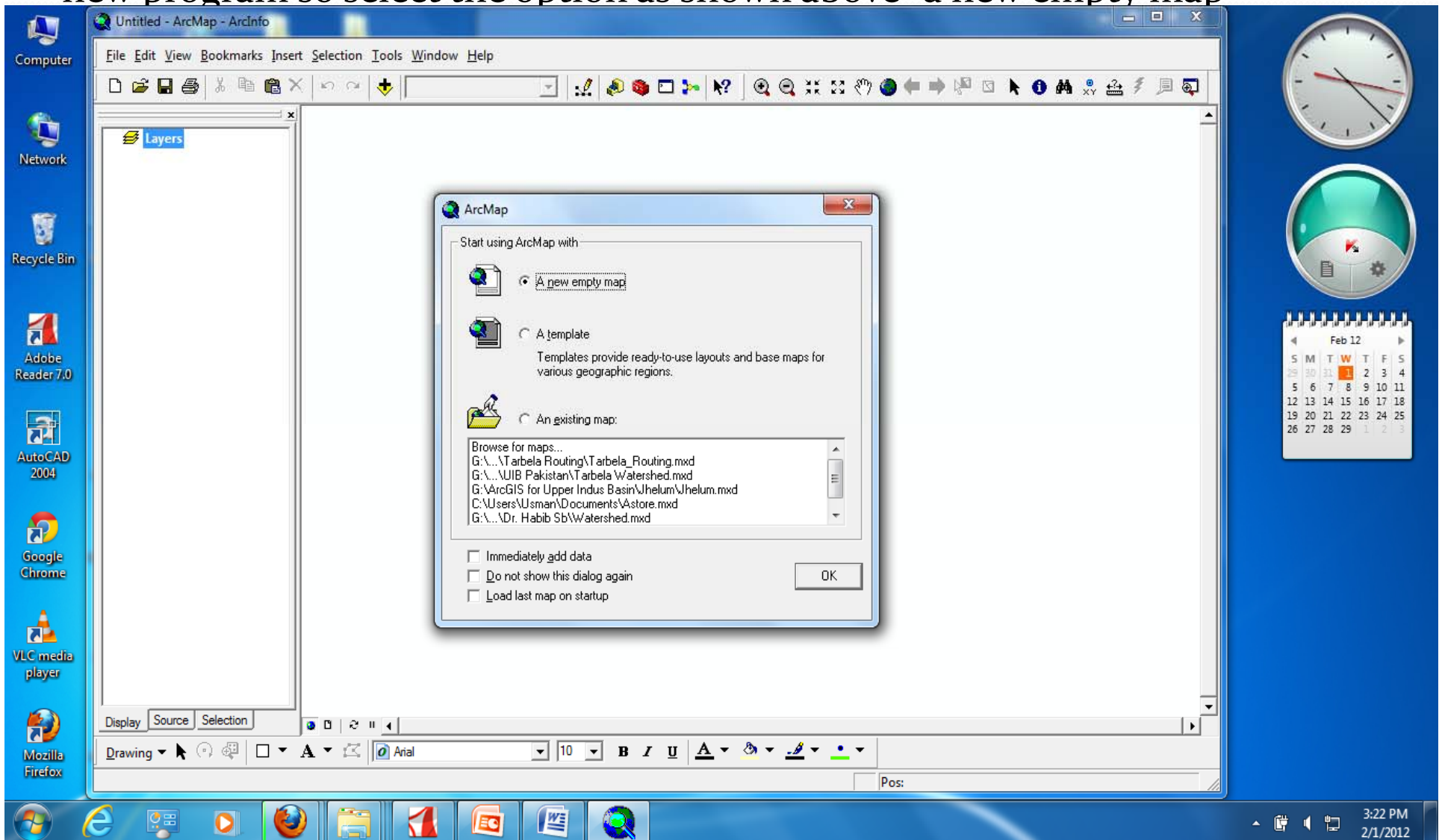
Adding Data to ArcGIS

- In the menu bar you can see the yellow and black icon with + sign. This is for "Adding Data". Click this to your downloaded DEM.........
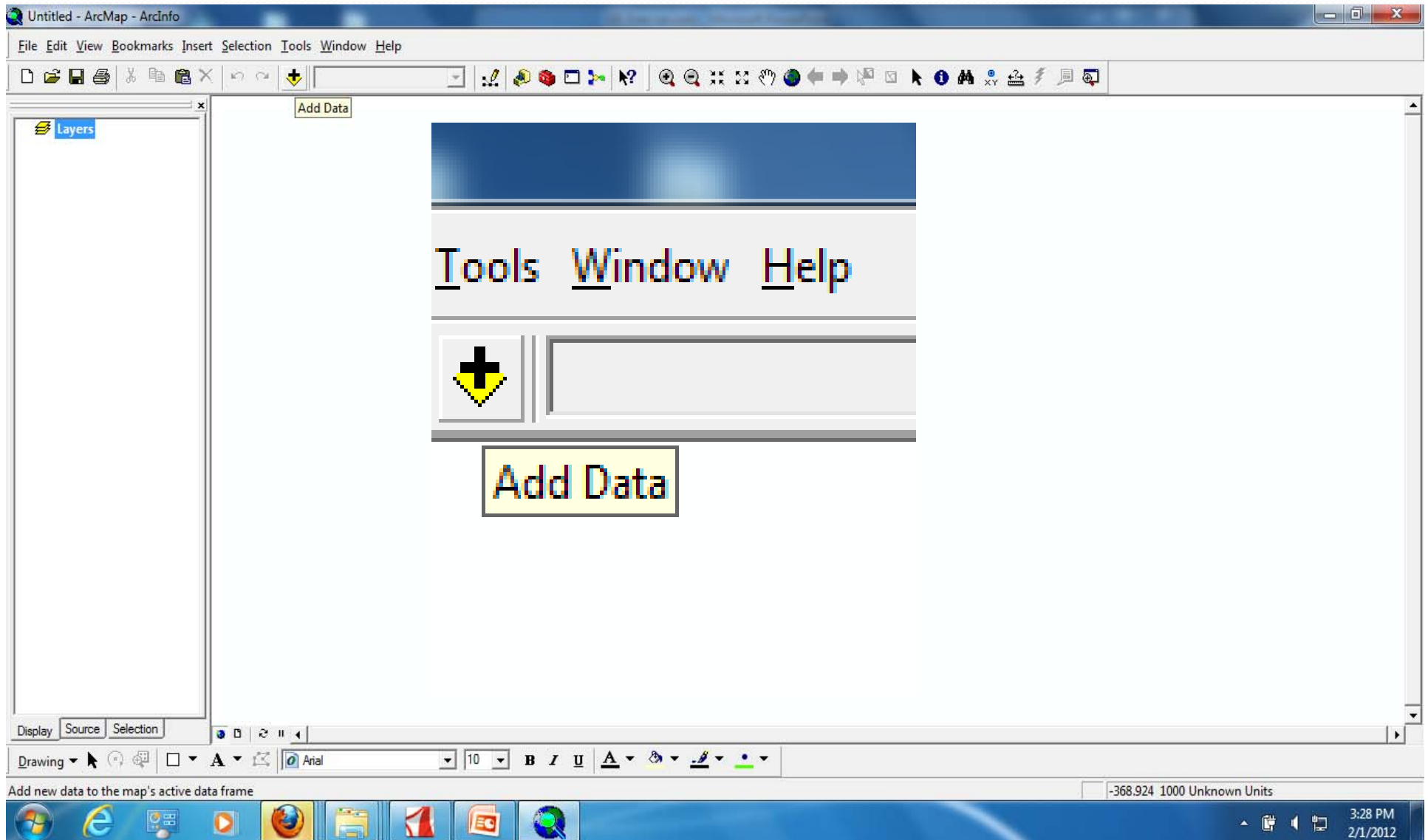
Adding Data to ArcGIS

The following opened window will help to browse the data
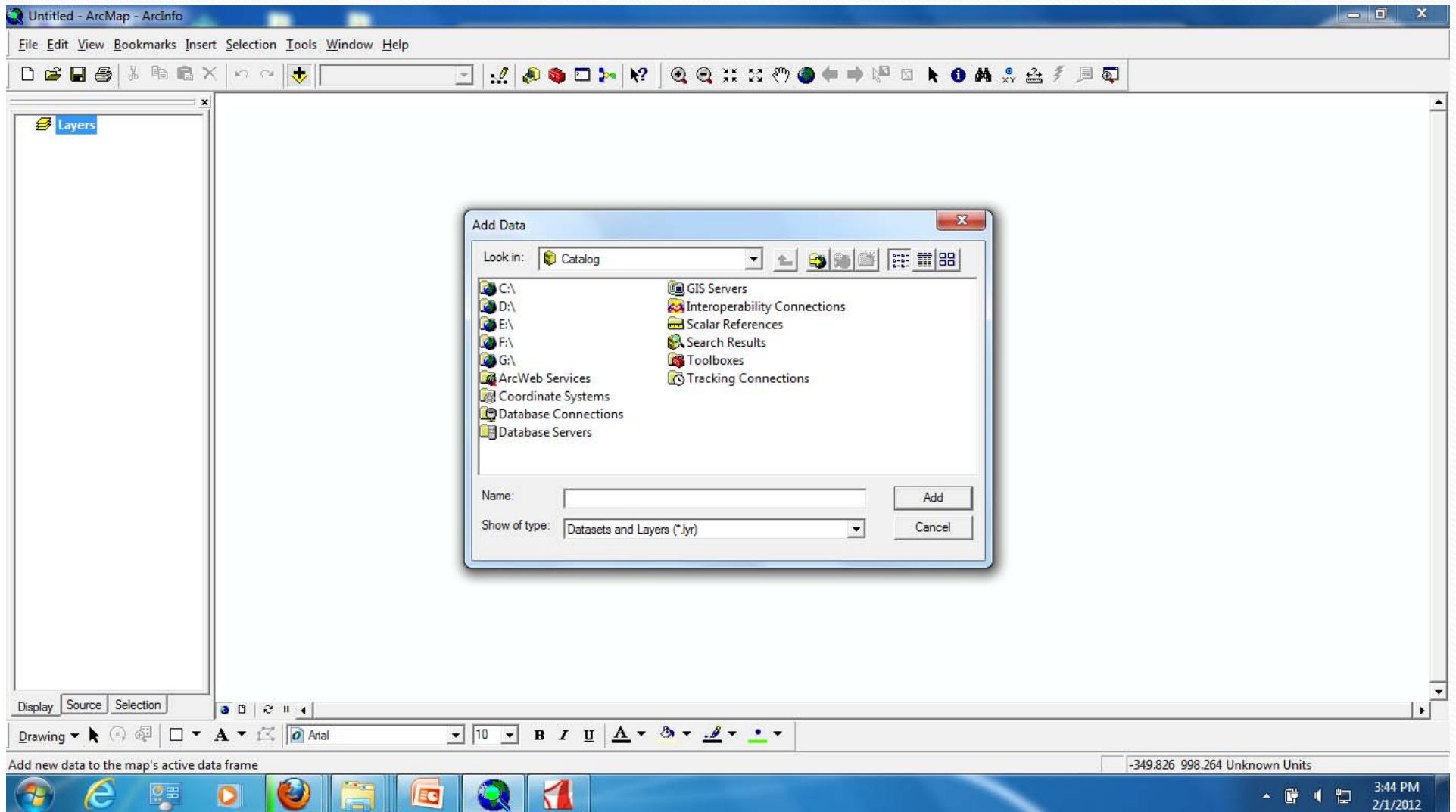
Adding Data to ArcGIS

- If the required data is at desktop so use the following icon to locate the file. otherwise it is simple if you put your data in any of the drives e.g. C, D,.......G etc
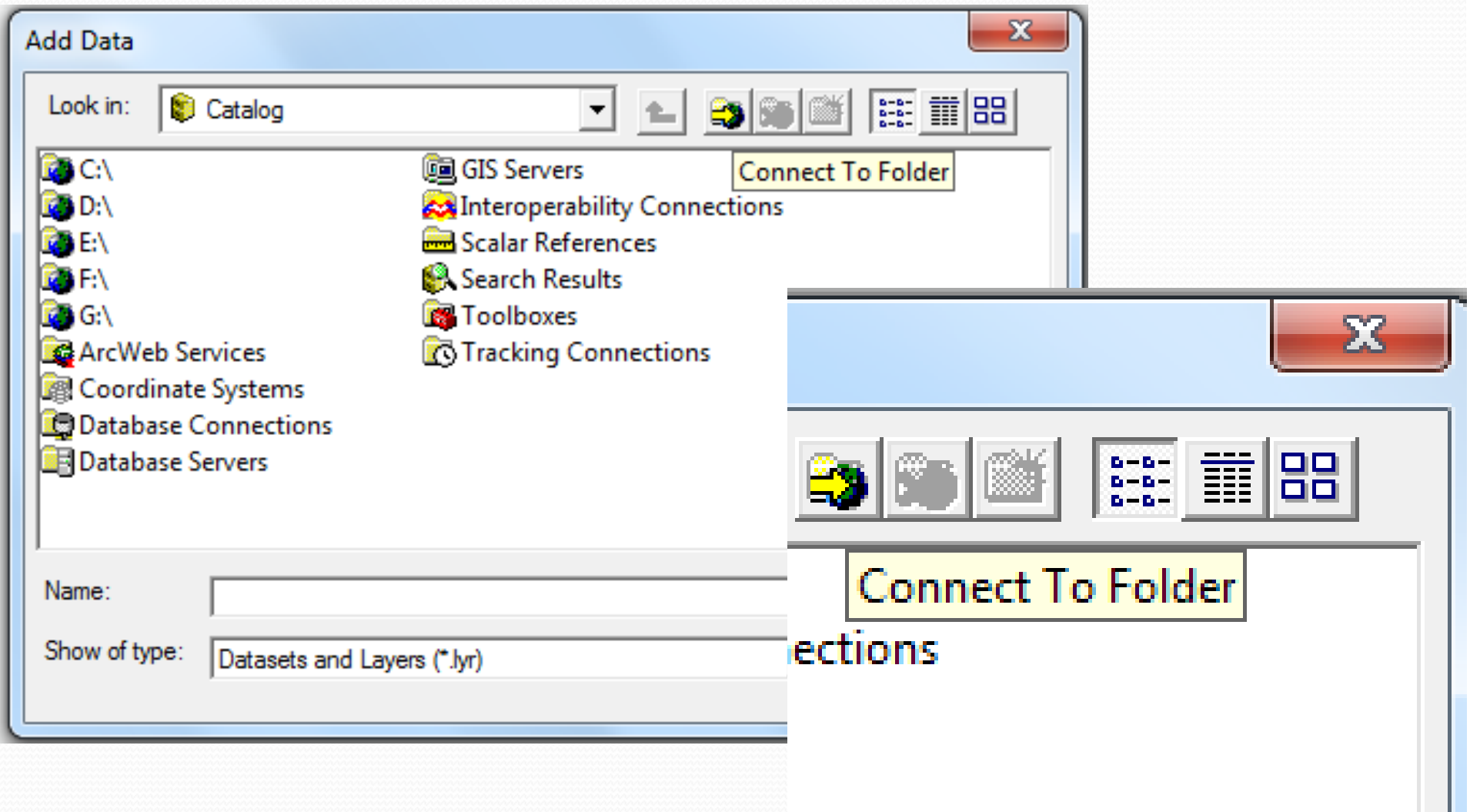
Adding Data to ArcGIS

Browse to the required folder where the data has been kept. As an example shown under PAKISTAN is the folder where we have saved the data.
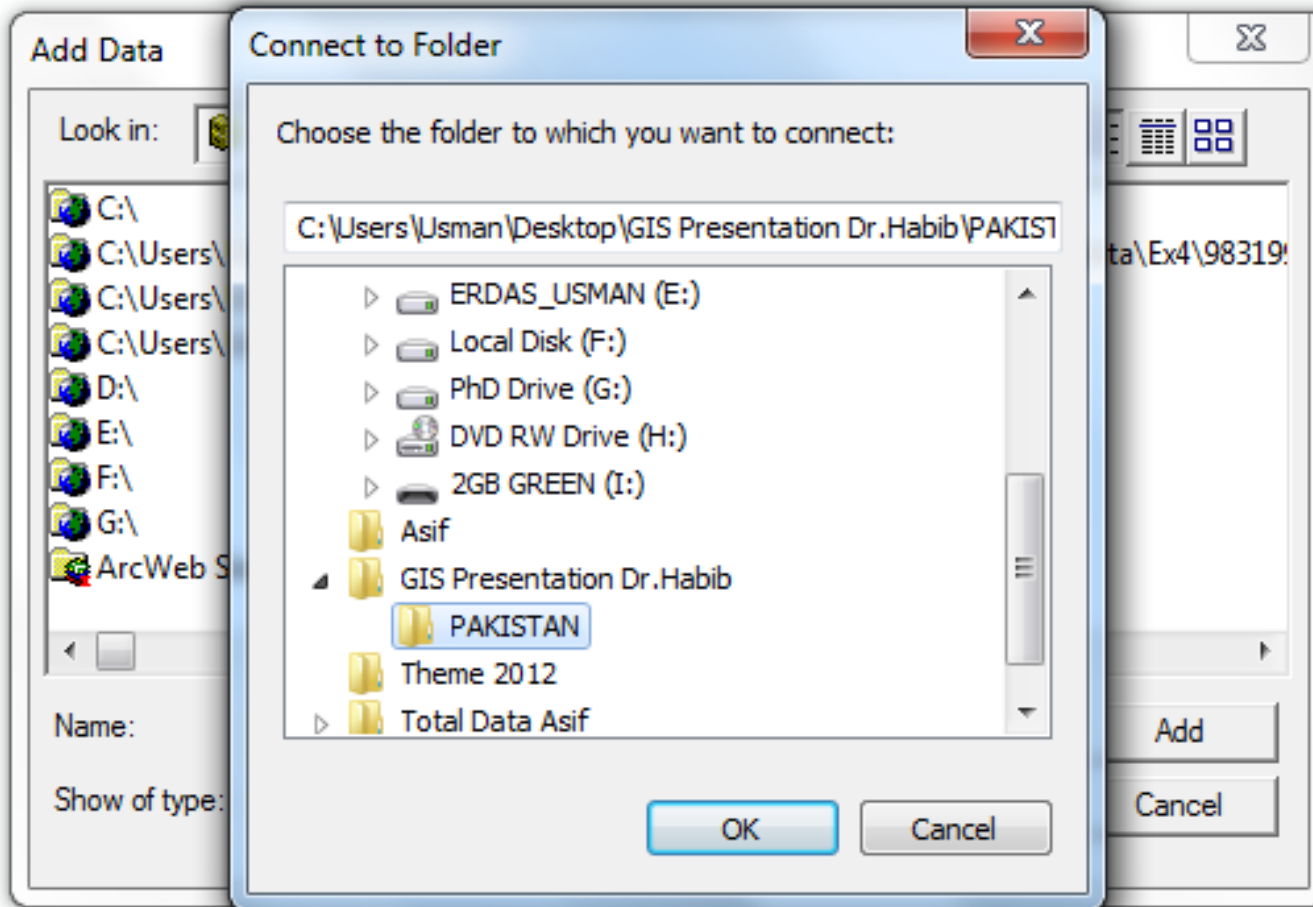
Adding Data to ArcGIS

- The file format .tif is your required file……. Double Click the file (say here mosaic_uib.tif).

- NOTE: This is already a Mosaic (means two or more downloaded tiles are combined together) File. Later in the exercise we will see how to mosaic tiles. First we will learn how to cut our area of interest……………….
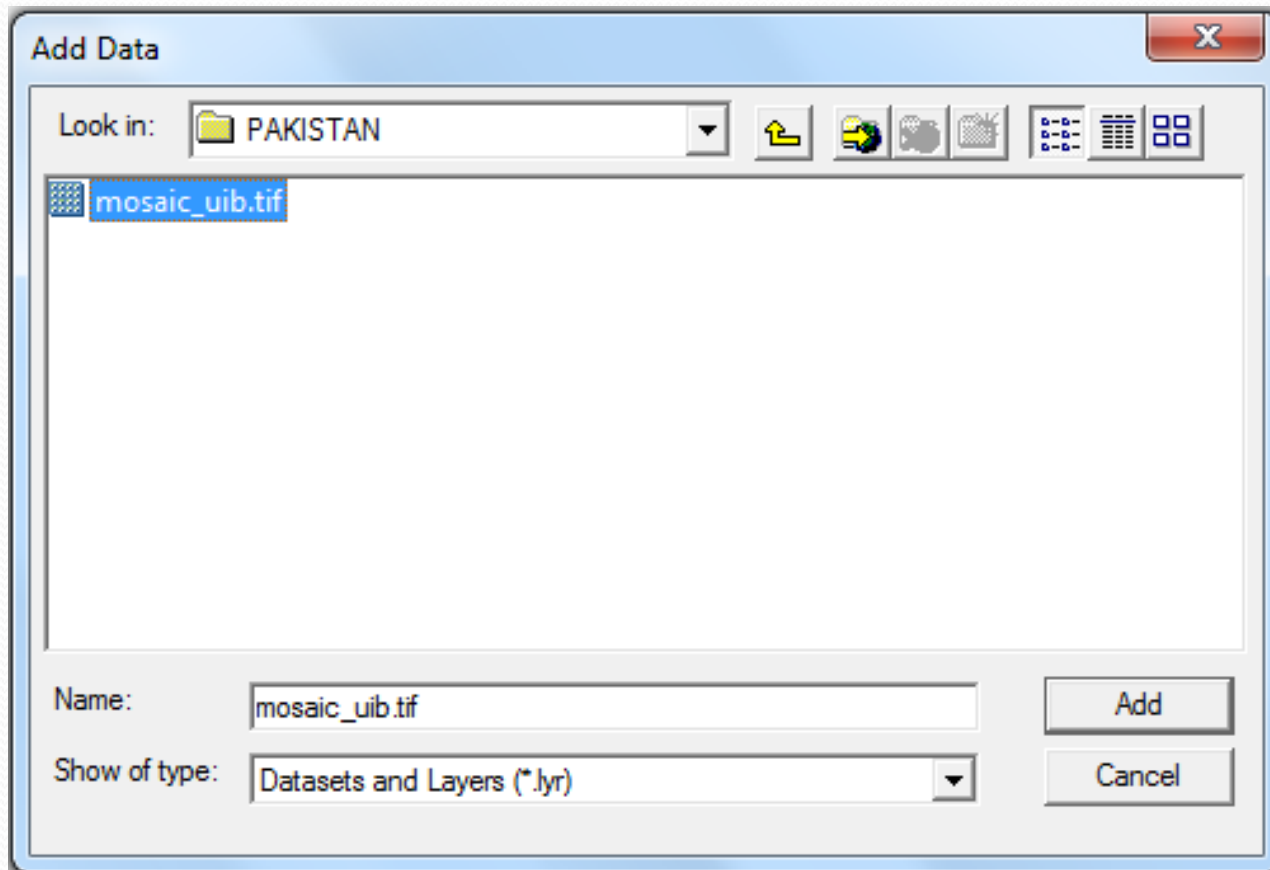
Adding Data to ArcGIS

Click yes for Pyramid Building. This will take a few moments……..
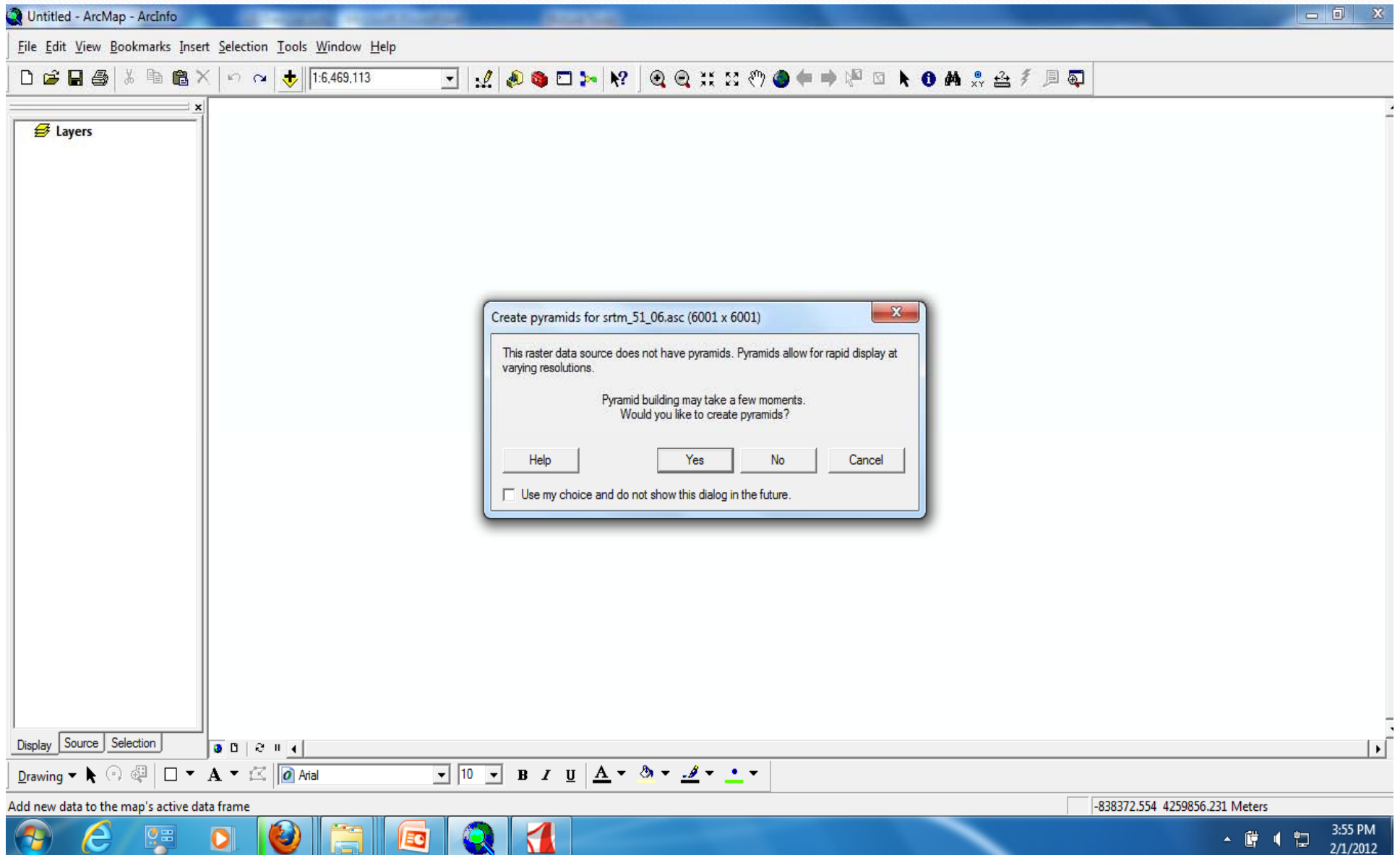
Adding Data to ArcGIS

- The following figure shows that the data has been added . This file has been added with the UTM as co ordinate system you can see at the bottom (extreme right) the coordinates are given in meters.
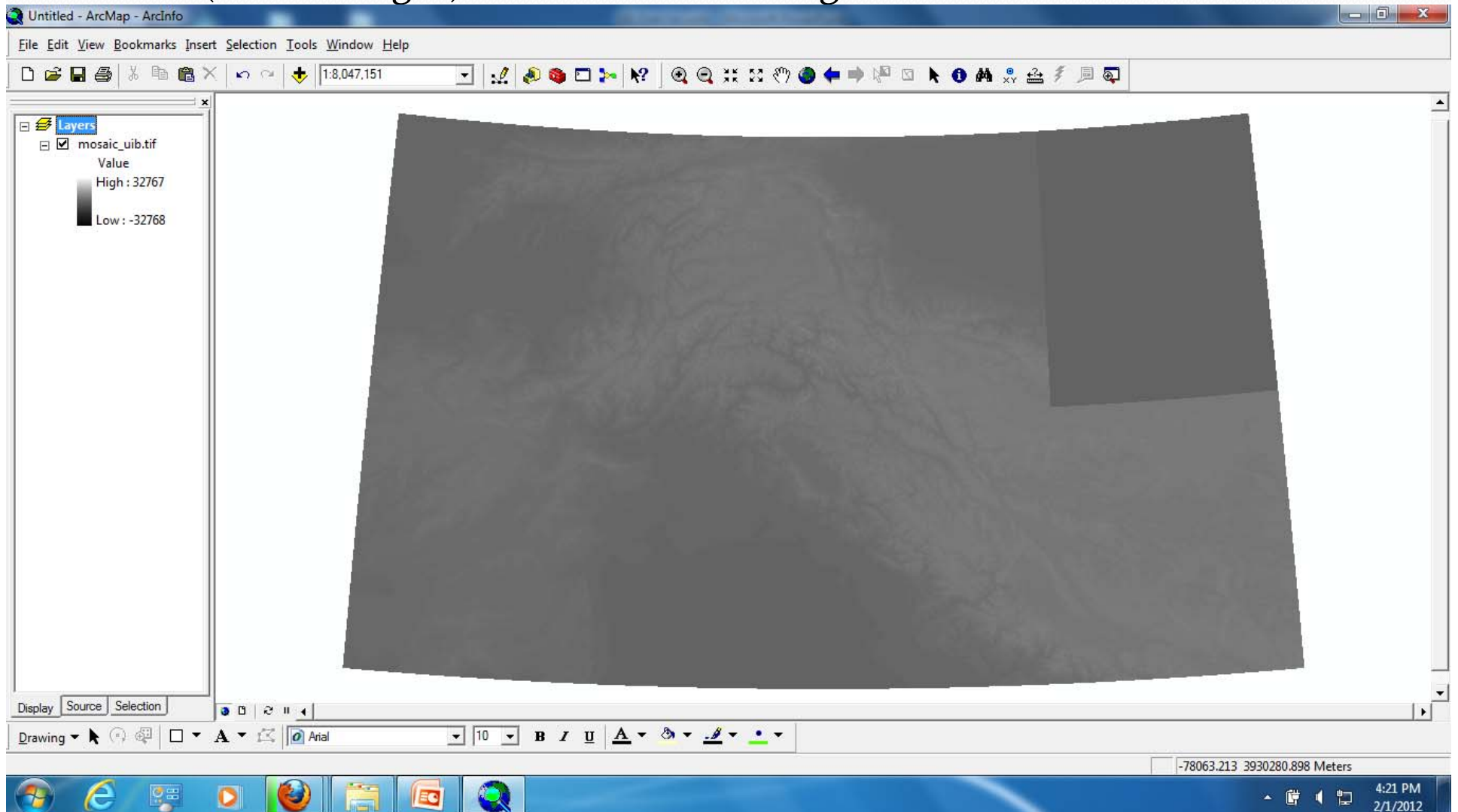
How to Change the co-ordinate Systems

If we want to change the co ordinate system from Projected Co ordinate systems to Geographic Co ordinate system just follow the steps as shown in the slides as..........Right Click the "Layers" there then go to "Properties"
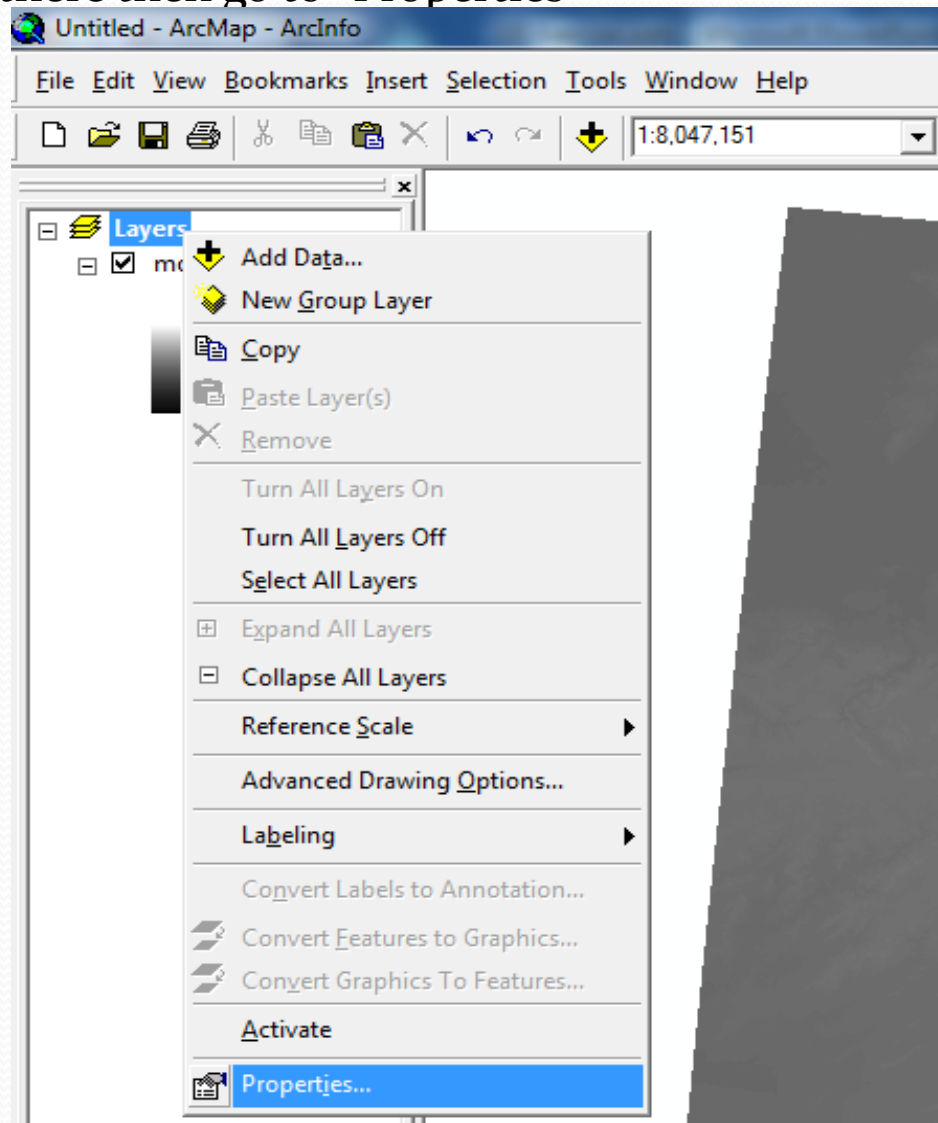
How to Change the co-ordinate Systems

A window will be opened showing....In co ordinate tab you can see the system is WGS_1984_UTM_Zone_43N. Follow the next slides to convert the system...
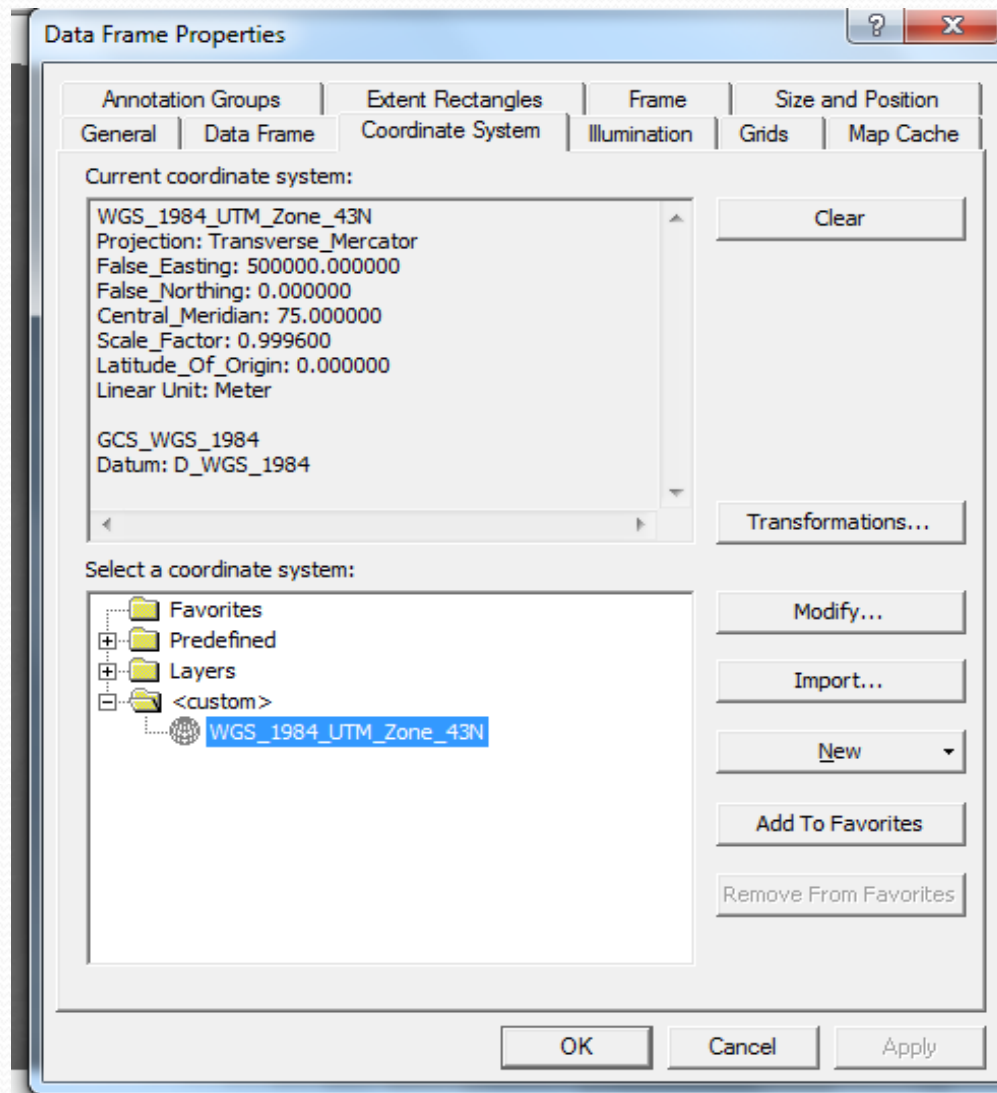
How to Change the co-ordinate Systems
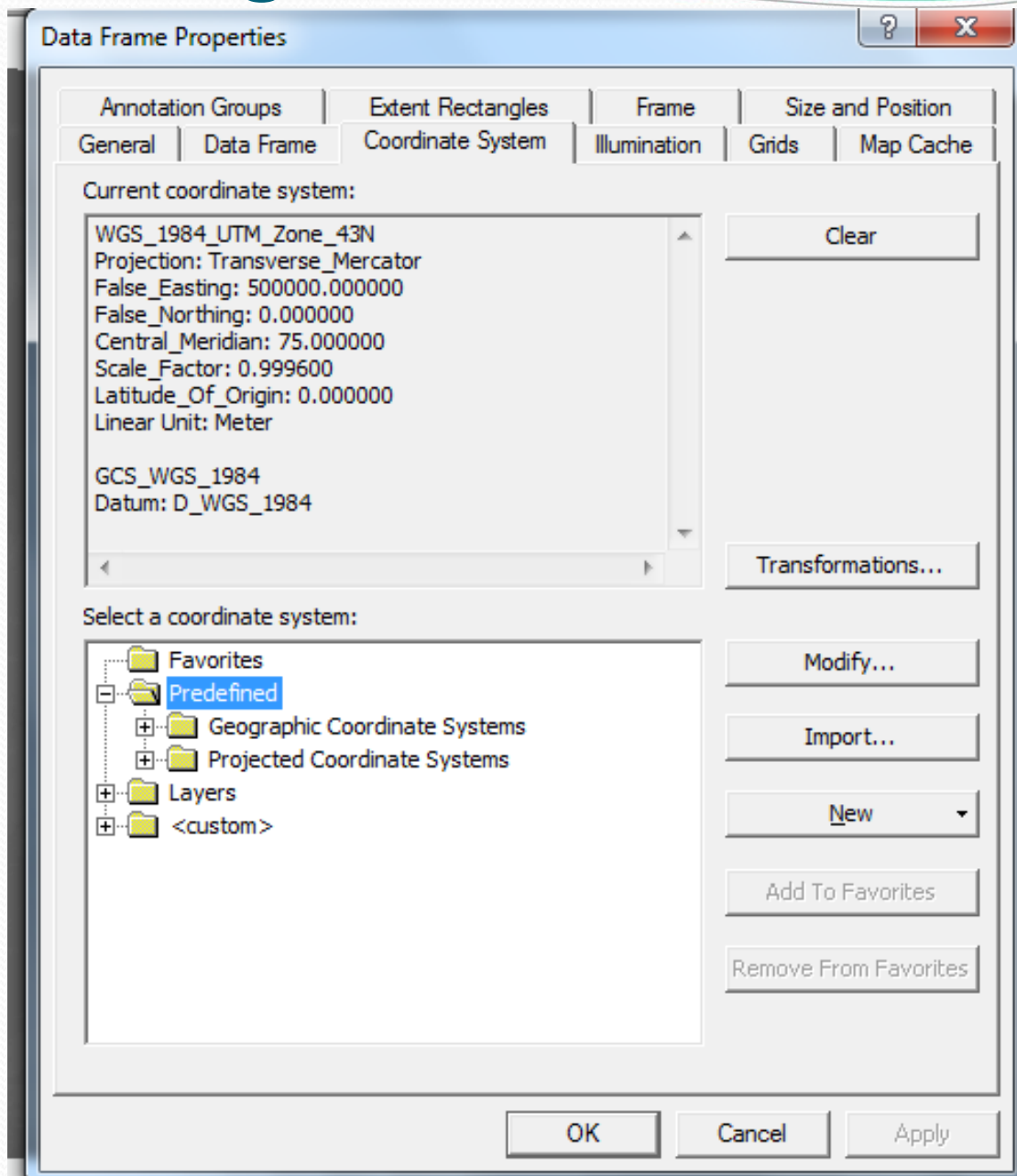
How to Change the co-ordinate Systems
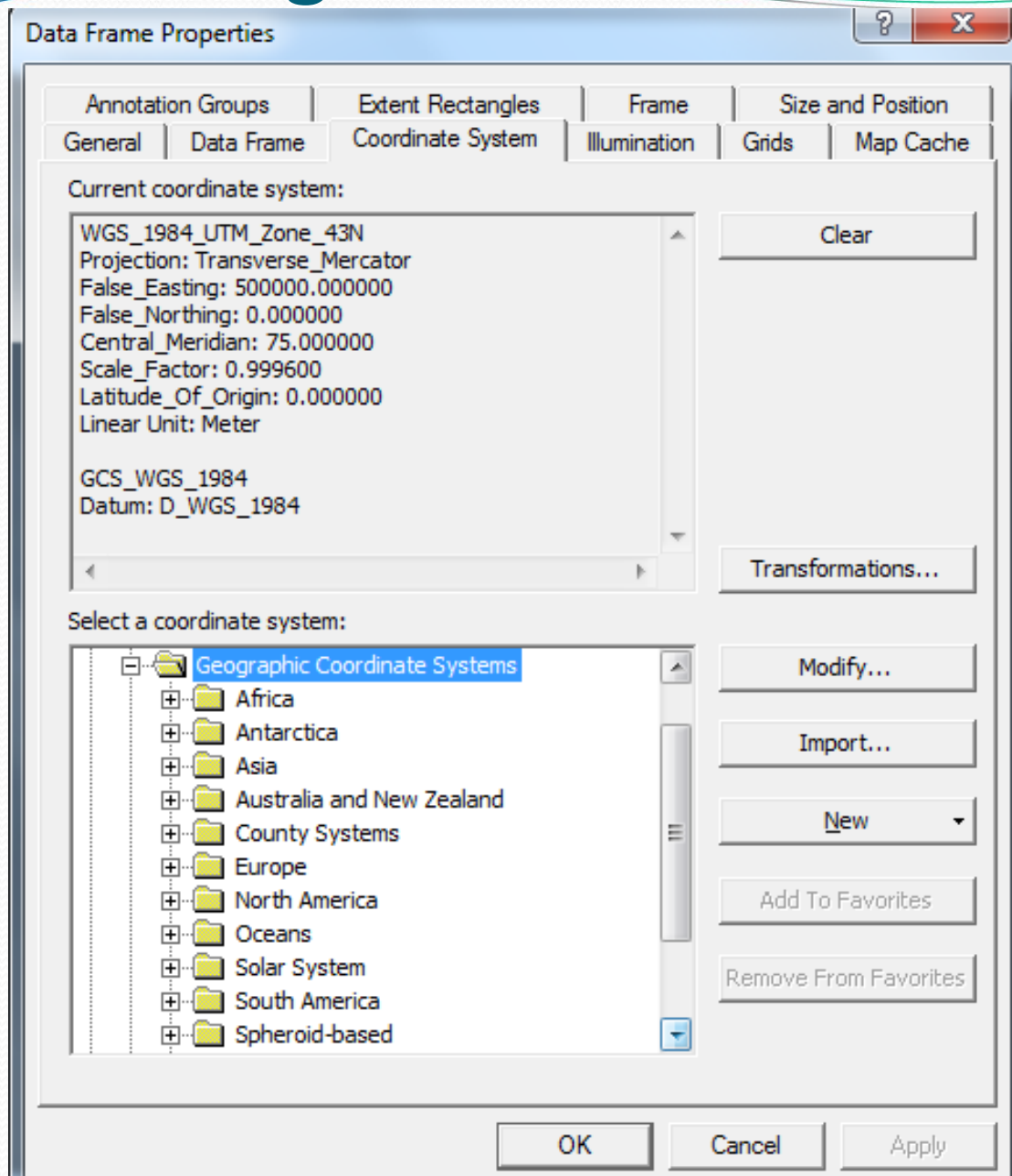
How to Change the co-ordinate Systems

- Under Geographic Co ordinate System select World
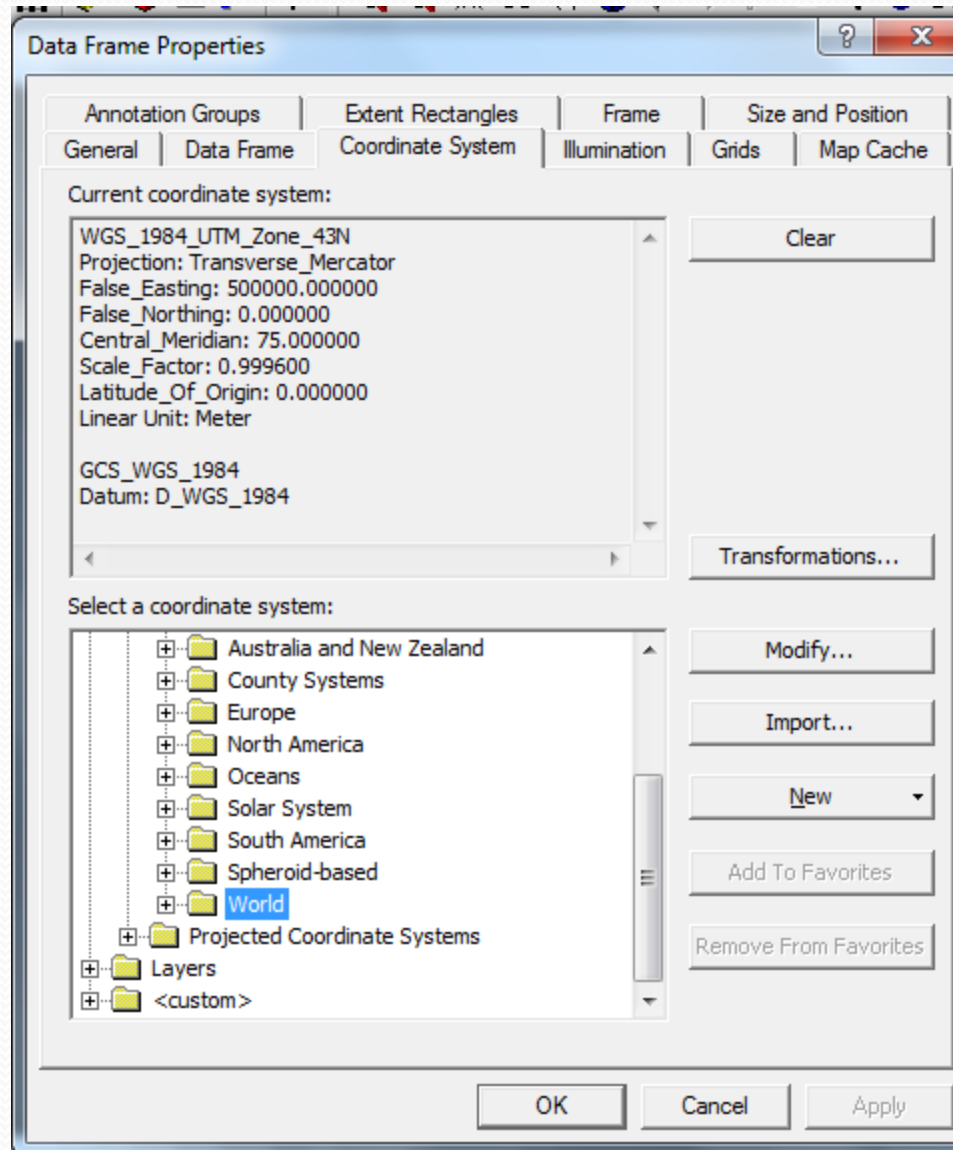
How to Change the co-ordinate Systems

Further select WGS 1984
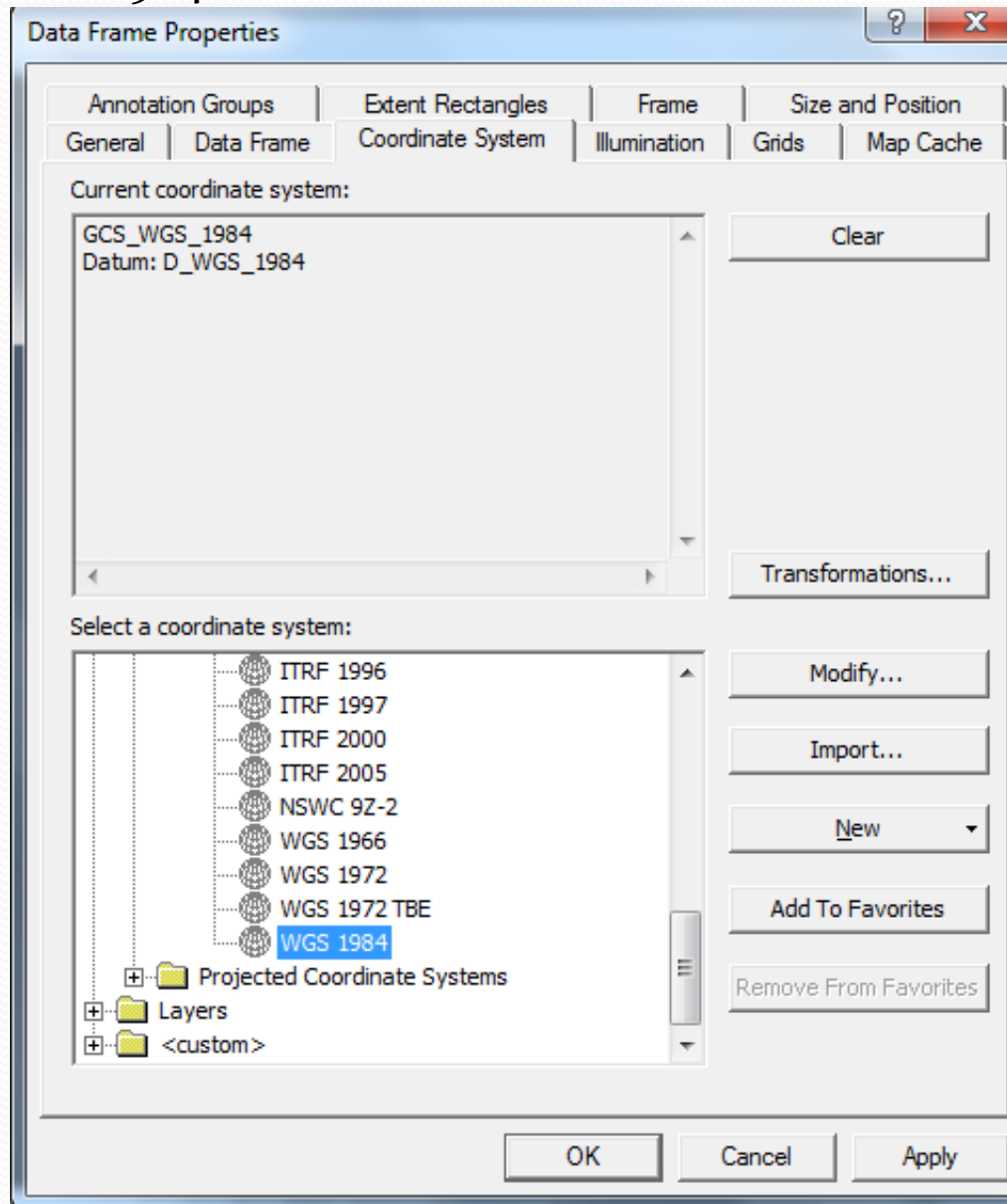
How to Change the co-ordinate Systems

- Now the Co ordinates have been changed and at the bottom (extreme right) the decimal degree is appeared (Longitudes and Latitudes)
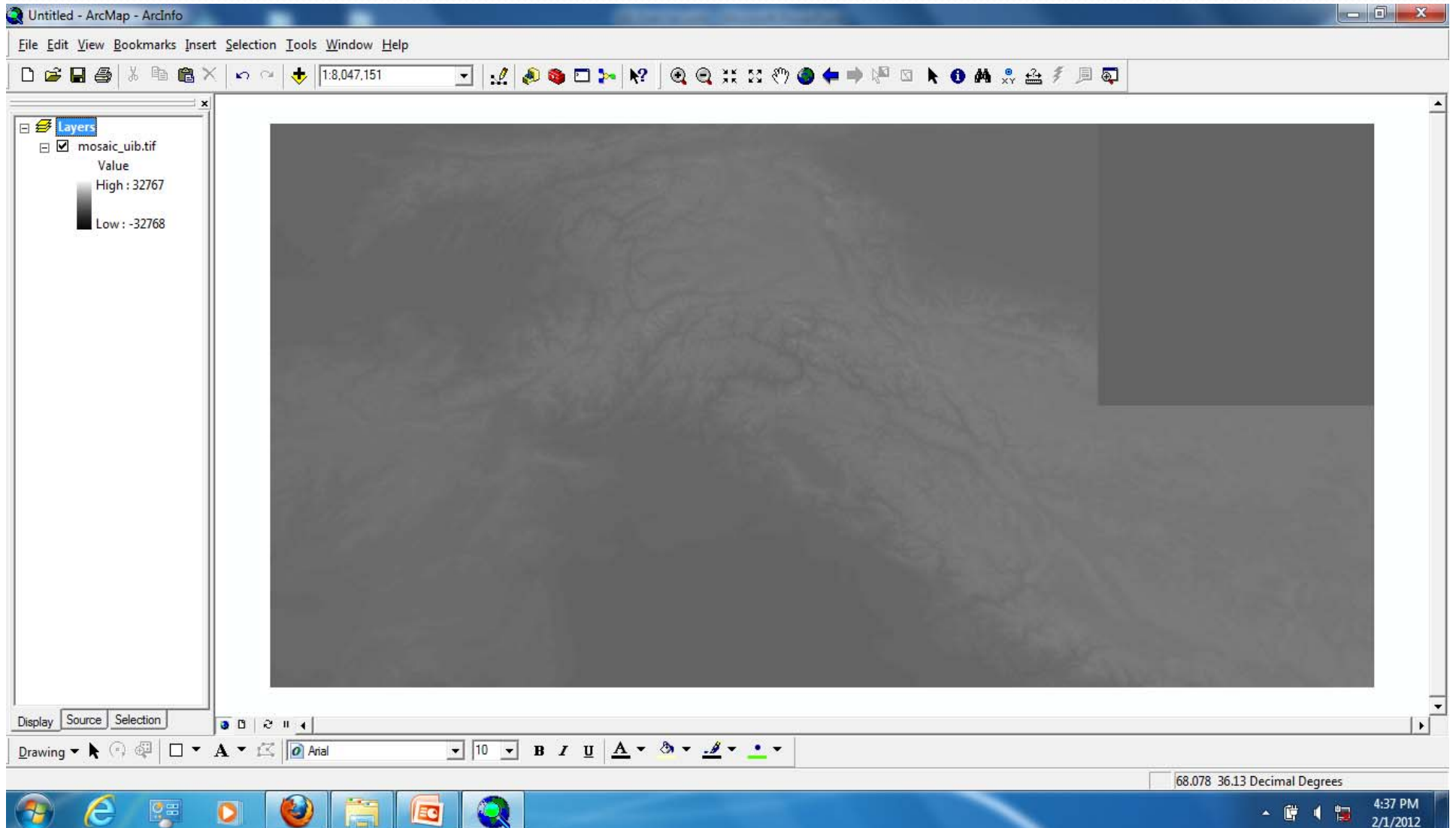
How to Cut or Extract DEM

- The data added is showing huge area. Normally even a tile downloaded is huge very big for if our area of interest is a small watershed. Therefore it is good practice to cut the area of interest so that the analysis can be performed only on the required area and not the whole tile or tiles....

- For this we have to make a shape file of the area which we want to cut

- One should know approximately his/her area of interest. Knowing the approximate co ordinates of your area will help much in this regard.....

- Following steps can be followed to cut DEM

How to Cut or Extract DEM
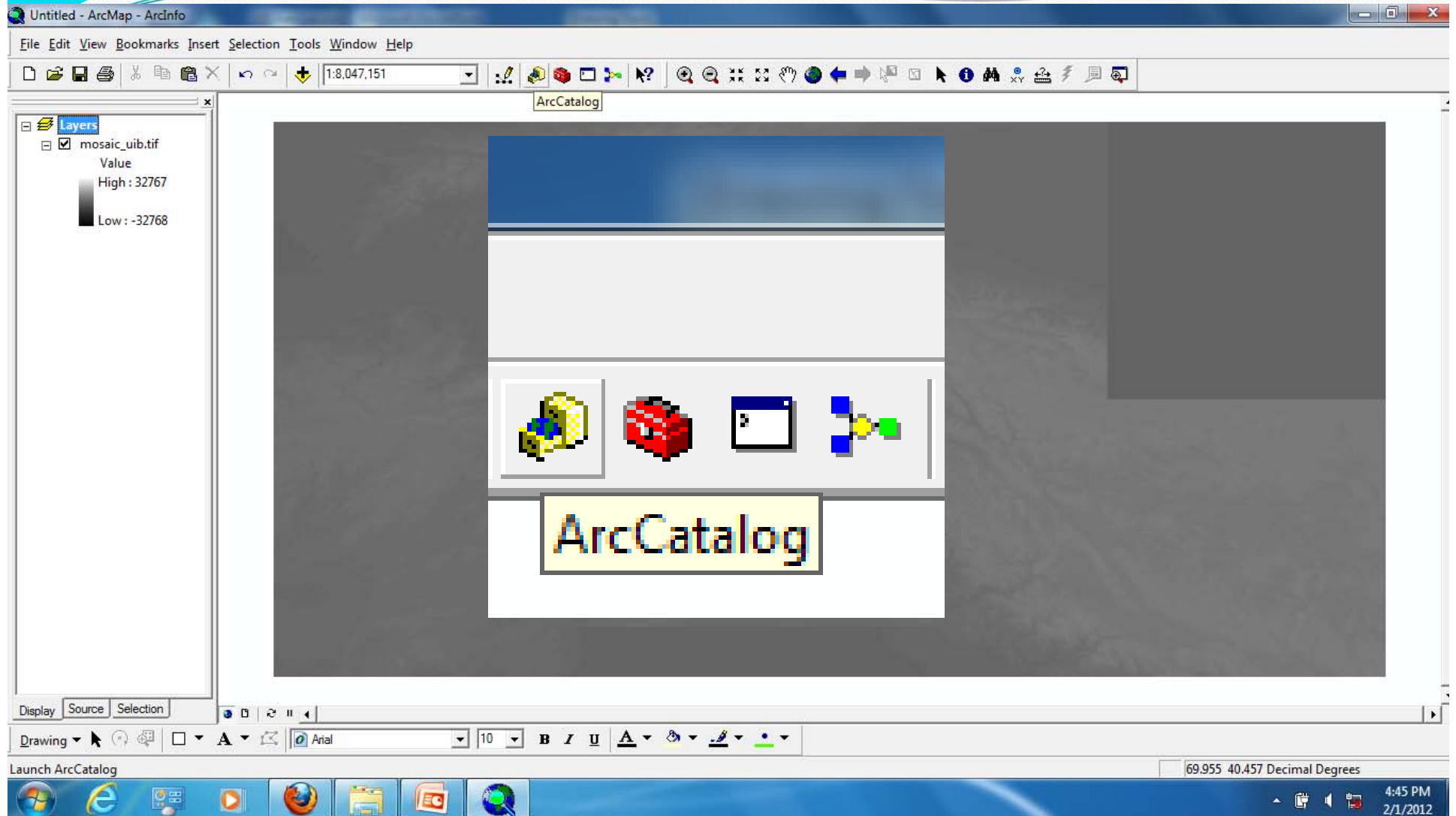
Use of Arc Catalog

A new window will be opened. From here one can browse the folder where shape file is desired to save.
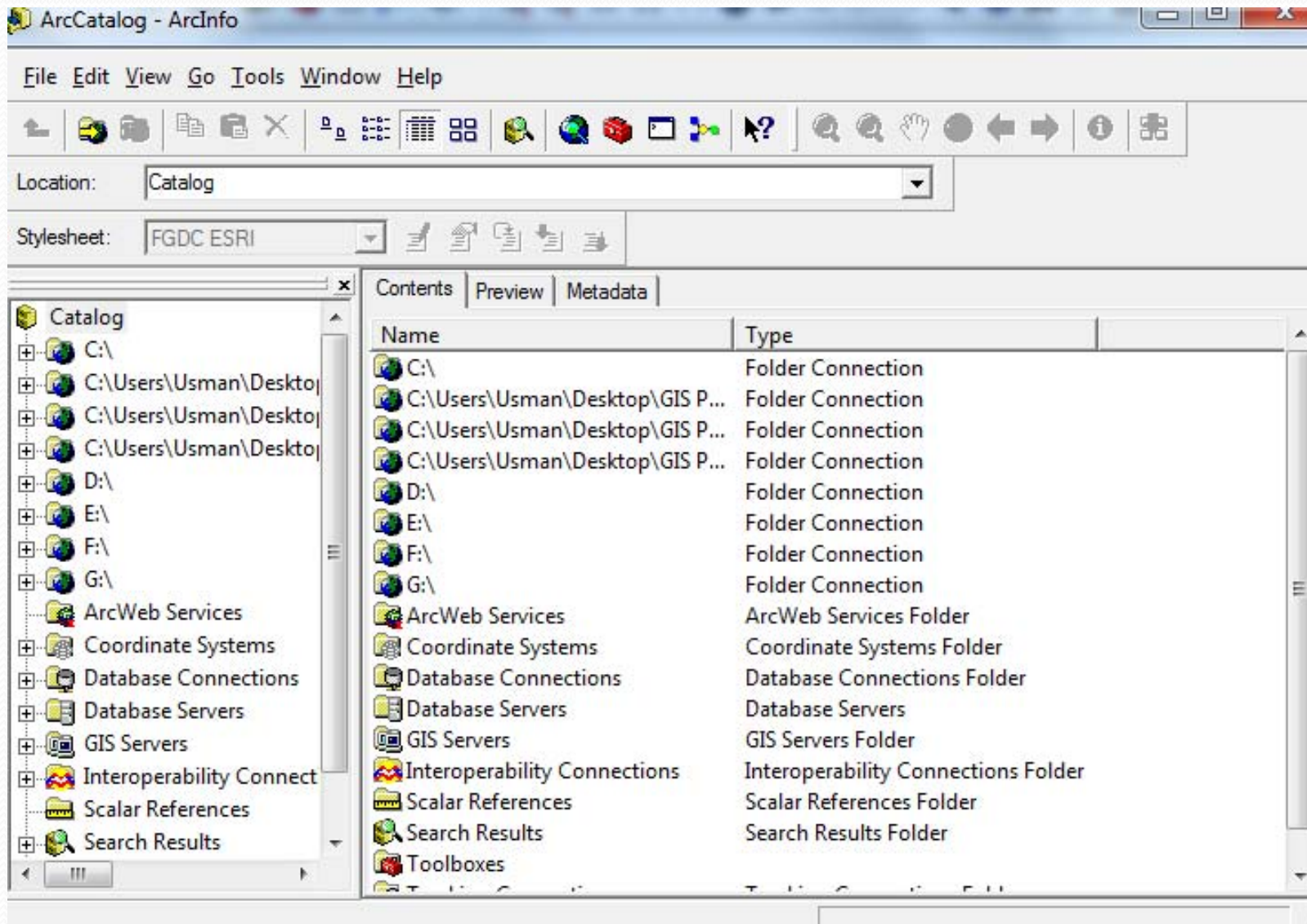
Use of Arc Catalog

We have selected the same folder in which the original DEM was placed as shown
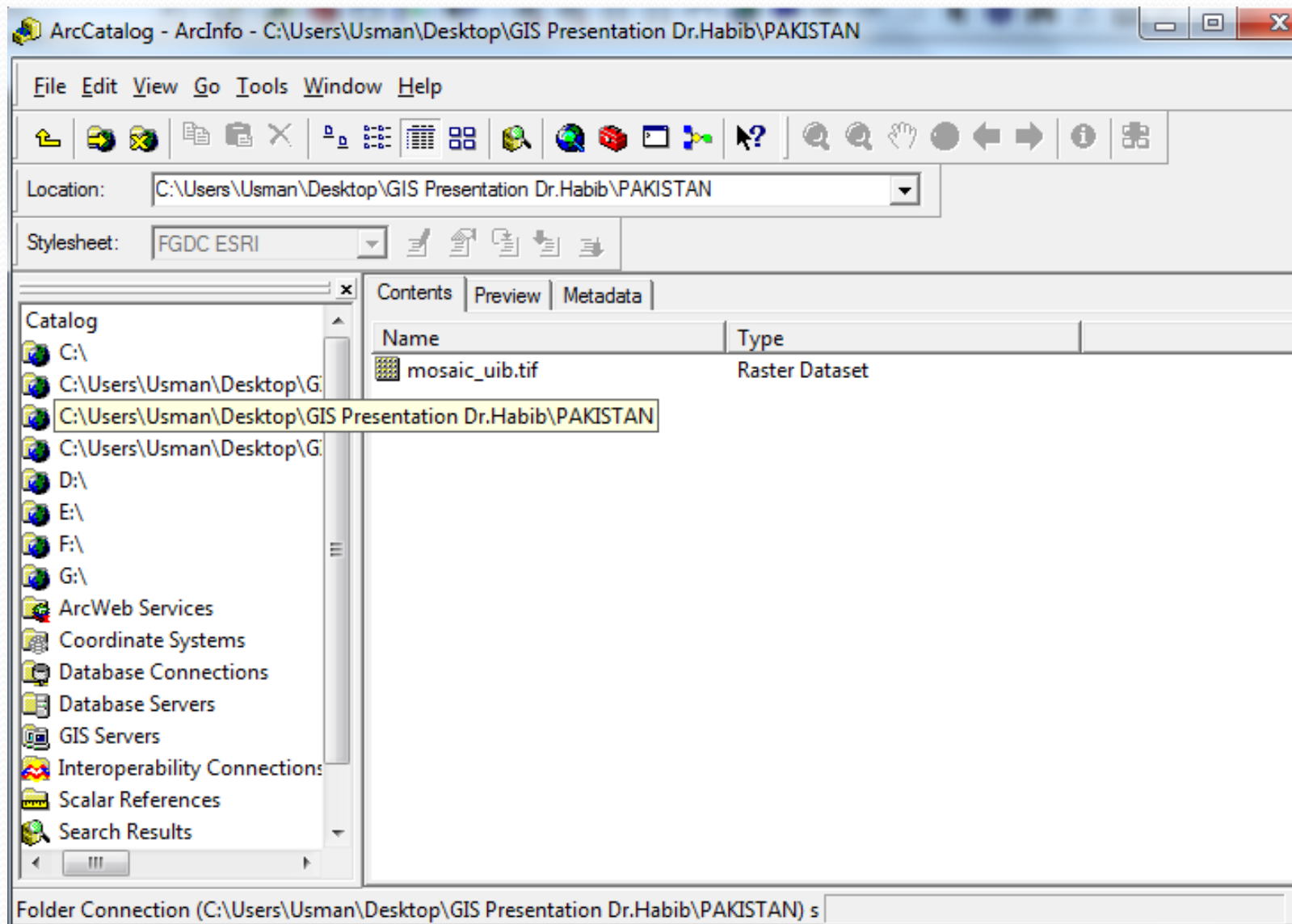
Shape File

After selecting the folder, follow the steps as
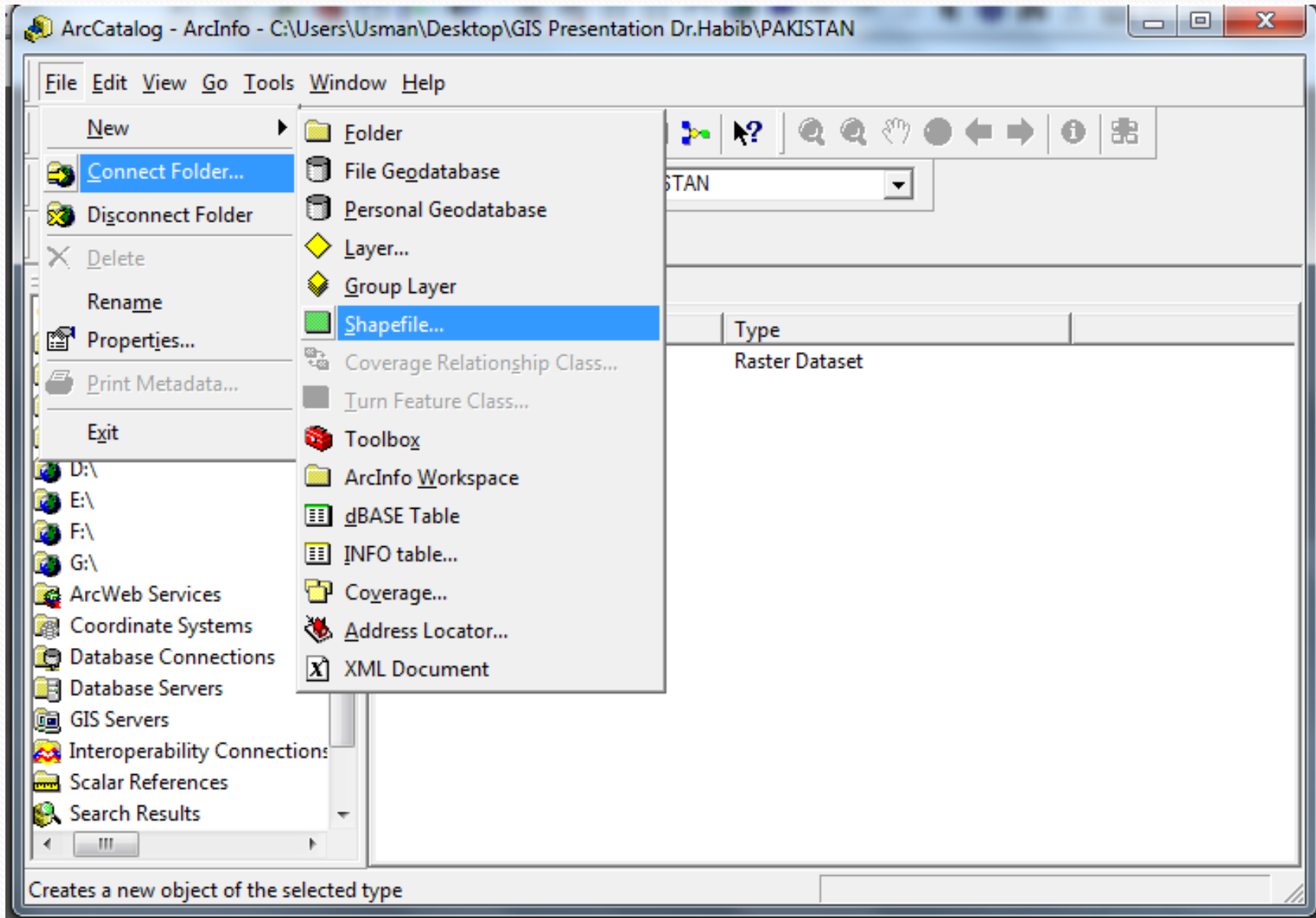
Shape File

Click the Shape file Icon and select the followings as asked in the window. You can also change the name of the shape file e.g. we are making the name of the file "exercise" and do not forget to assign the co ordinate system (from "Edit tab" and then click "Select") similar to that in which you are working now............
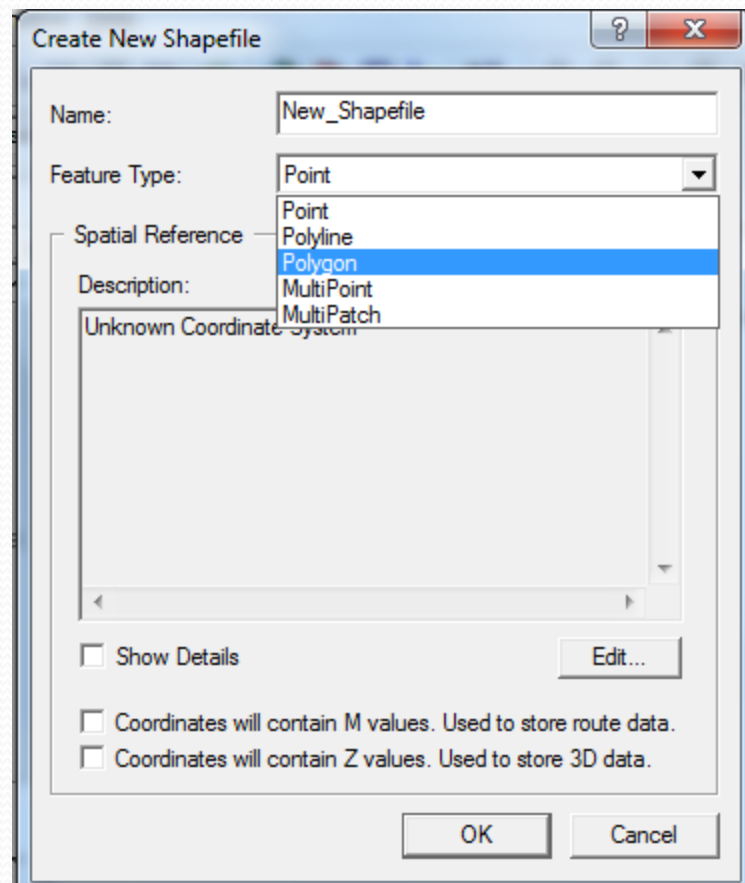
Shape File
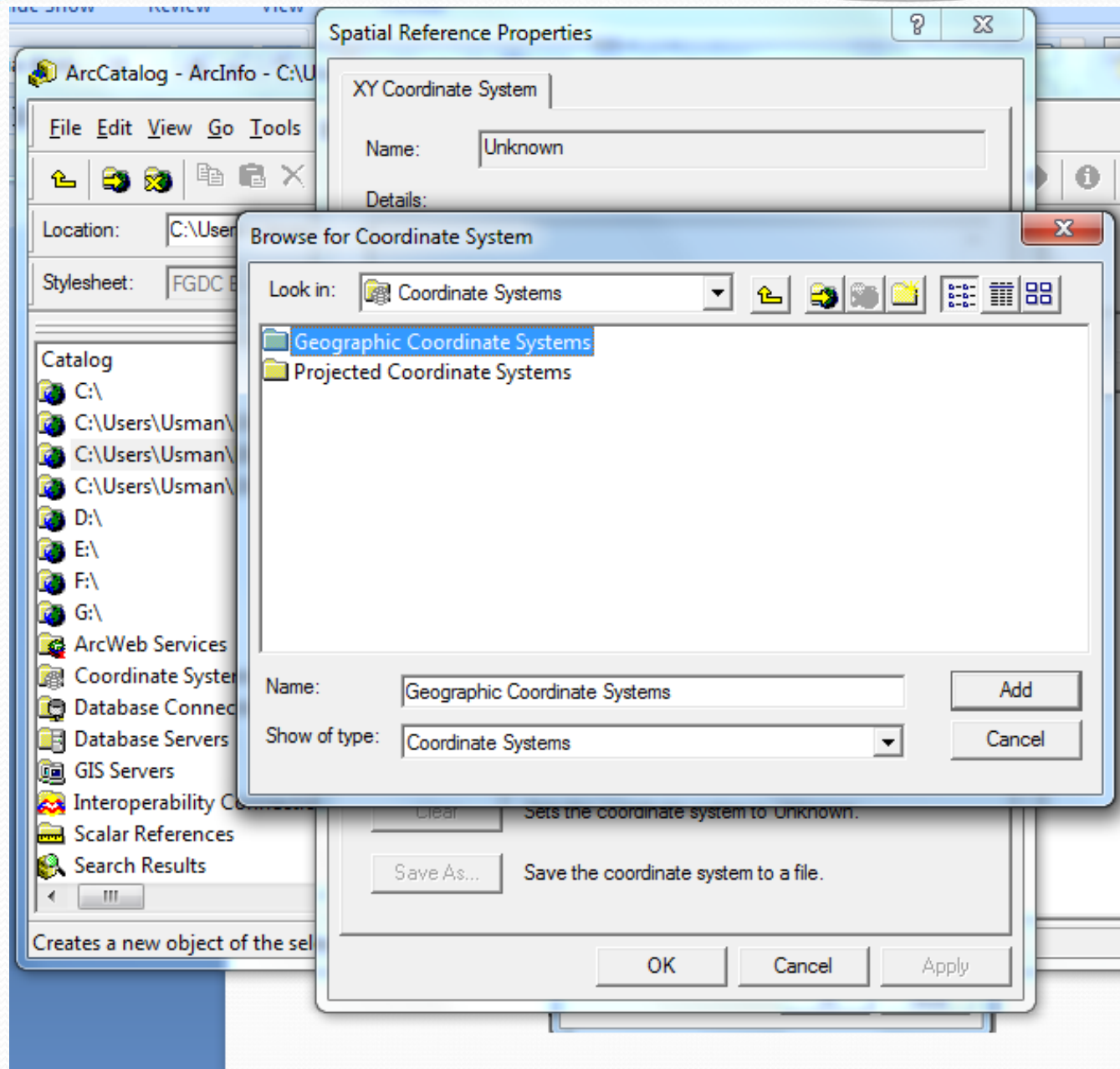
Shape File
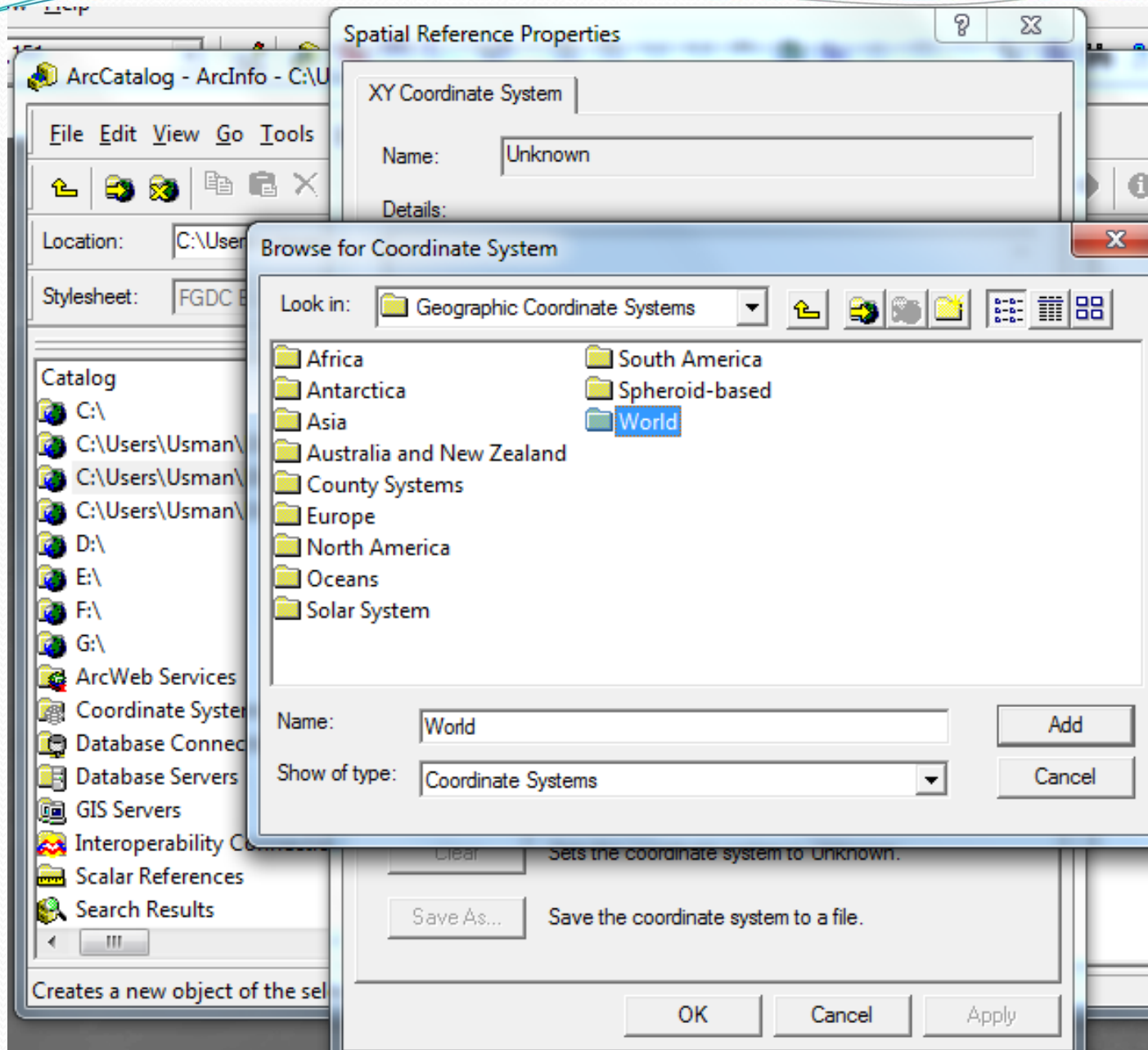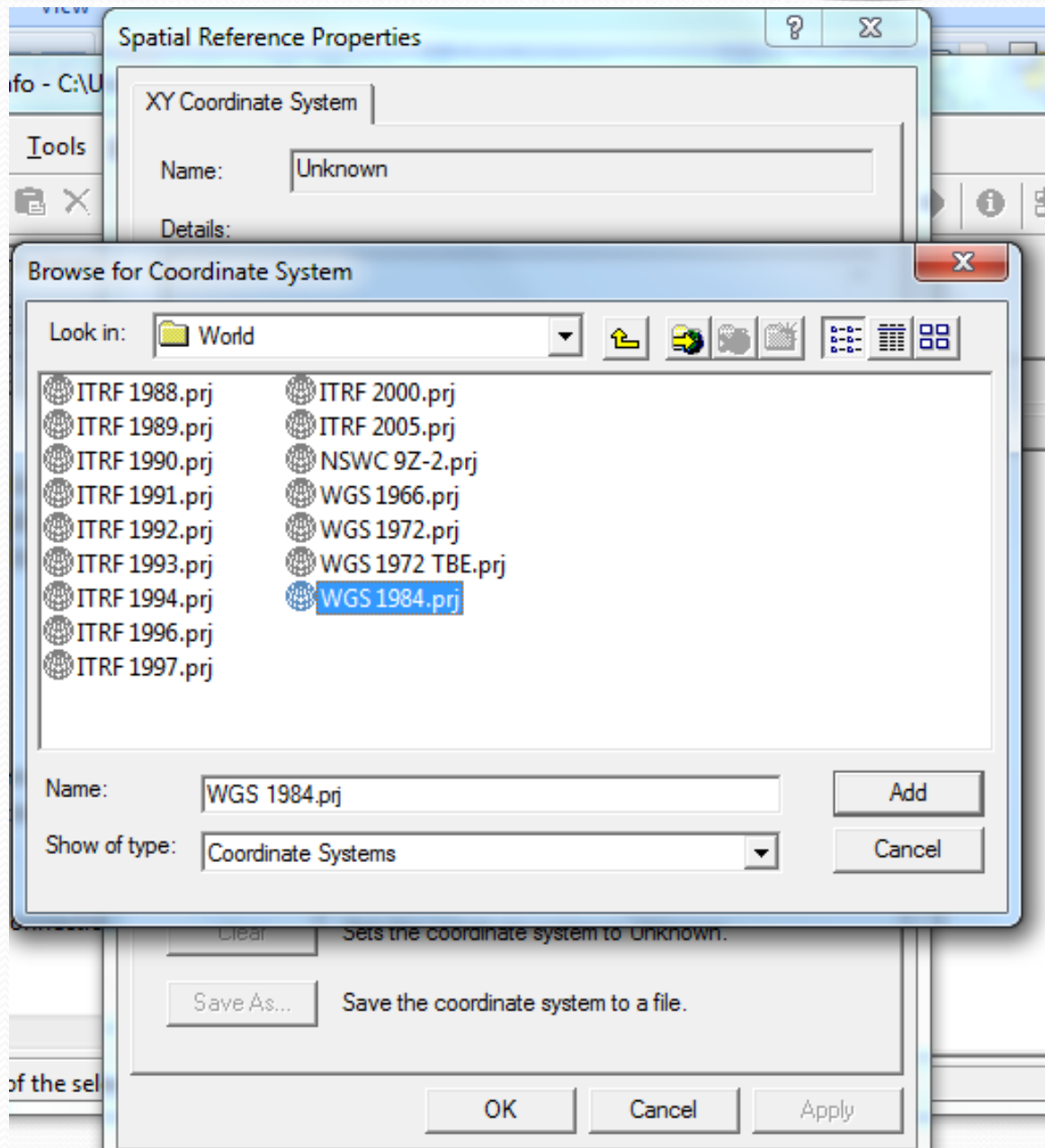
Shape File

Shape File

Finally Click Apply and OK. Click OK to other open Windows as well. Now you can see in Arc Catalog window a new green icon has been added. You have successfully added a Shape File. You can close the Arc Catlog
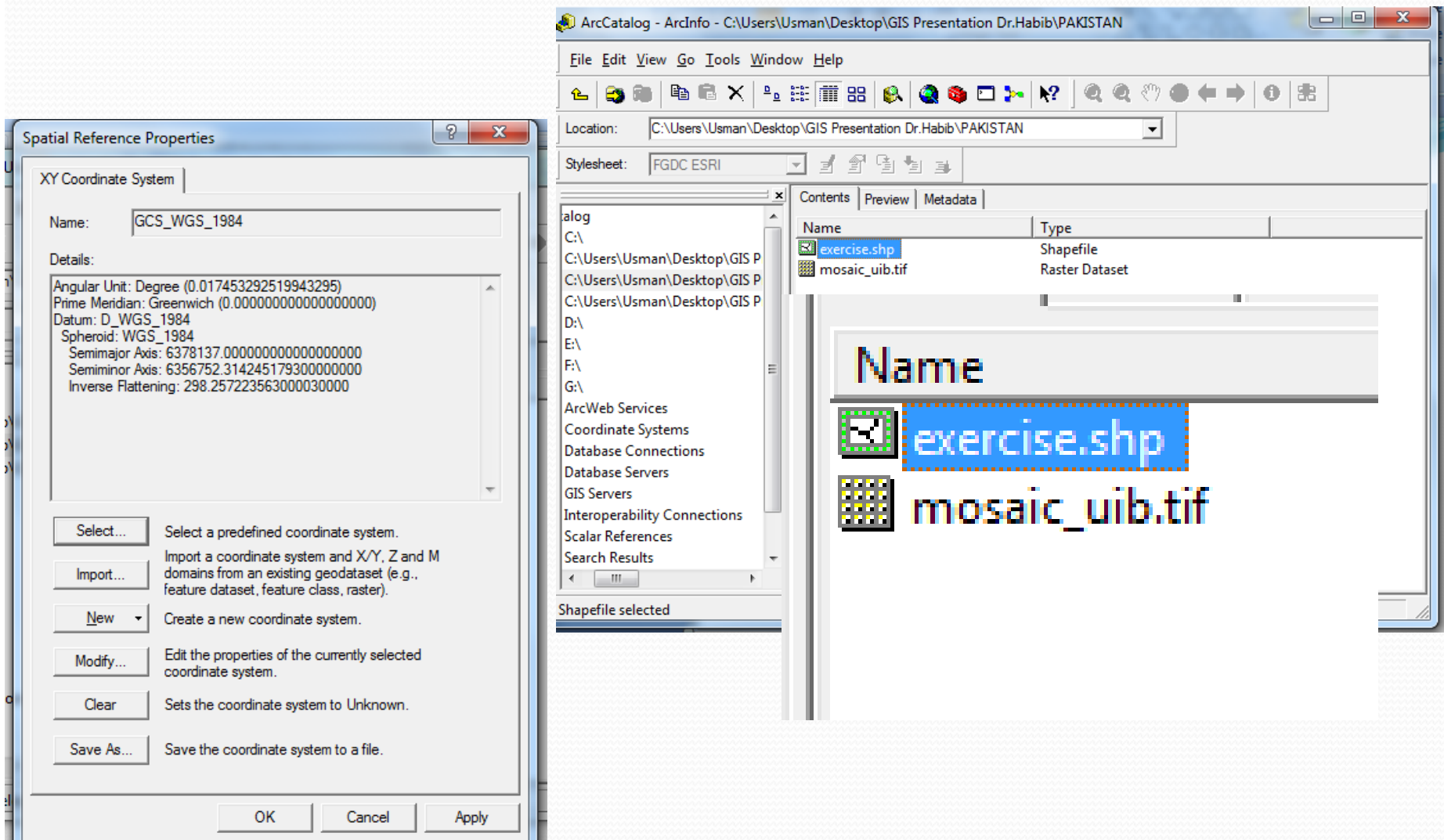
Editing a Shape File

Again using the "Add Data Icon" , brows to the shape file and add. By adding the shape file under the Layers a layer will be added naming "exercise"

Tools Window Help

1:8,047,151

Add Data

Look in: PAKISTAN

exercise.shp
mosaic_uib.tif

Name:

Show of type: Datasets and Layers (*.lyr)

Add

Cancel

Layers
  exercise

  mosaic_uib.tif
    Value
    High : 32767

    Low : -32768
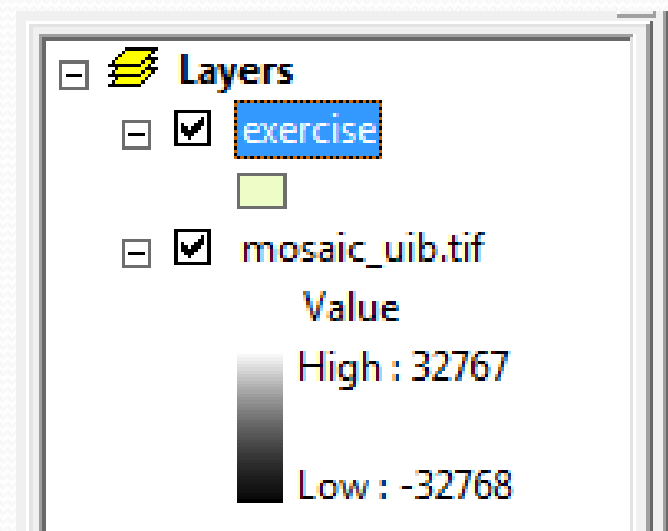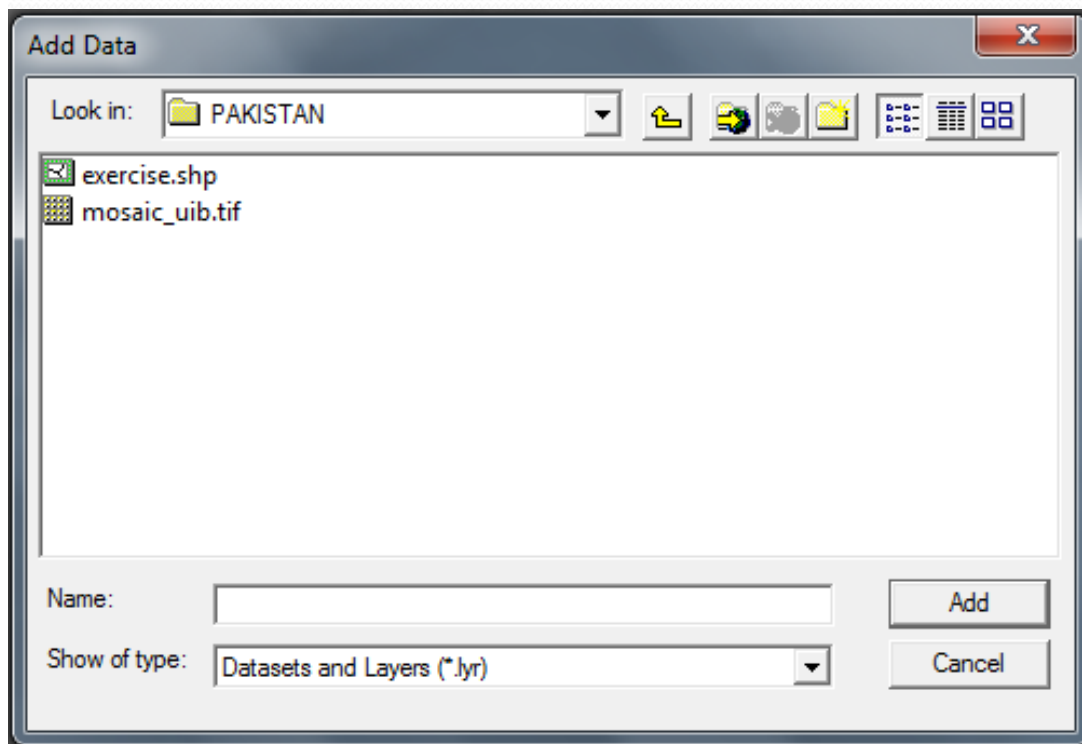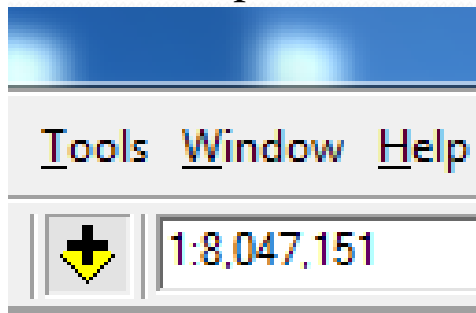
Editing a Shape File

We need to work in "Editor" now. If the editor is activated that fine if not just on the menu bar of ArcGIS a right click will show the follwing... from this list check the Editor as well as Arc Hydro tools..................
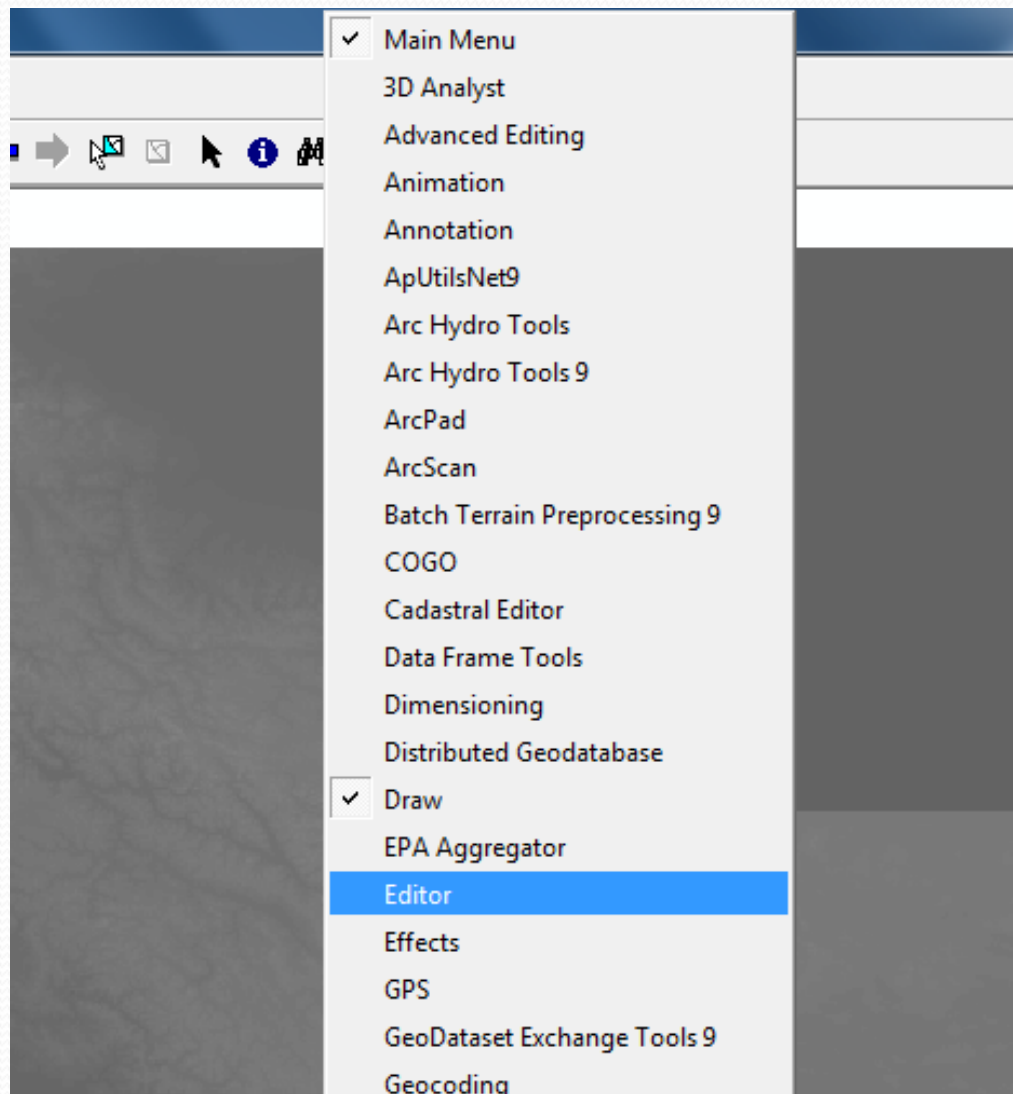
Editing a Shape File

- Just to show the change in the modified menu bar and old one please have a look as shown
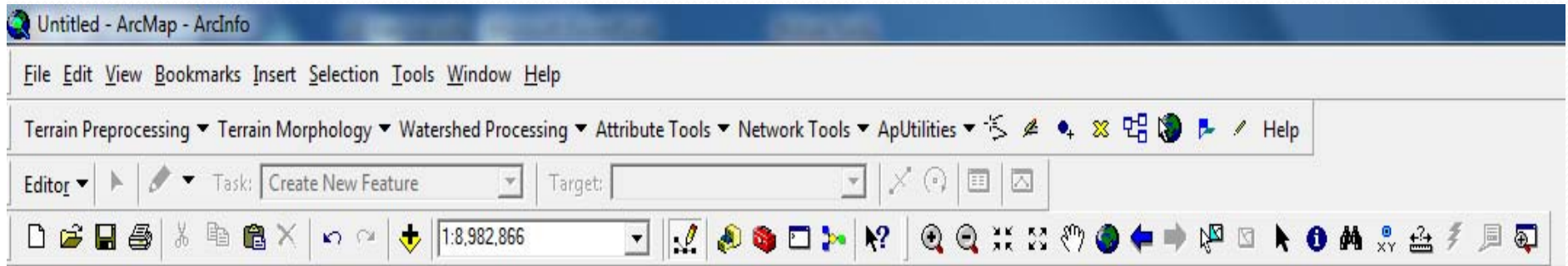
- Modified

- Previous

Editing a Shape File

- Just click on the layer "exercise" before starting editing. And then click on Editor and then Start Editing in the menu bar.
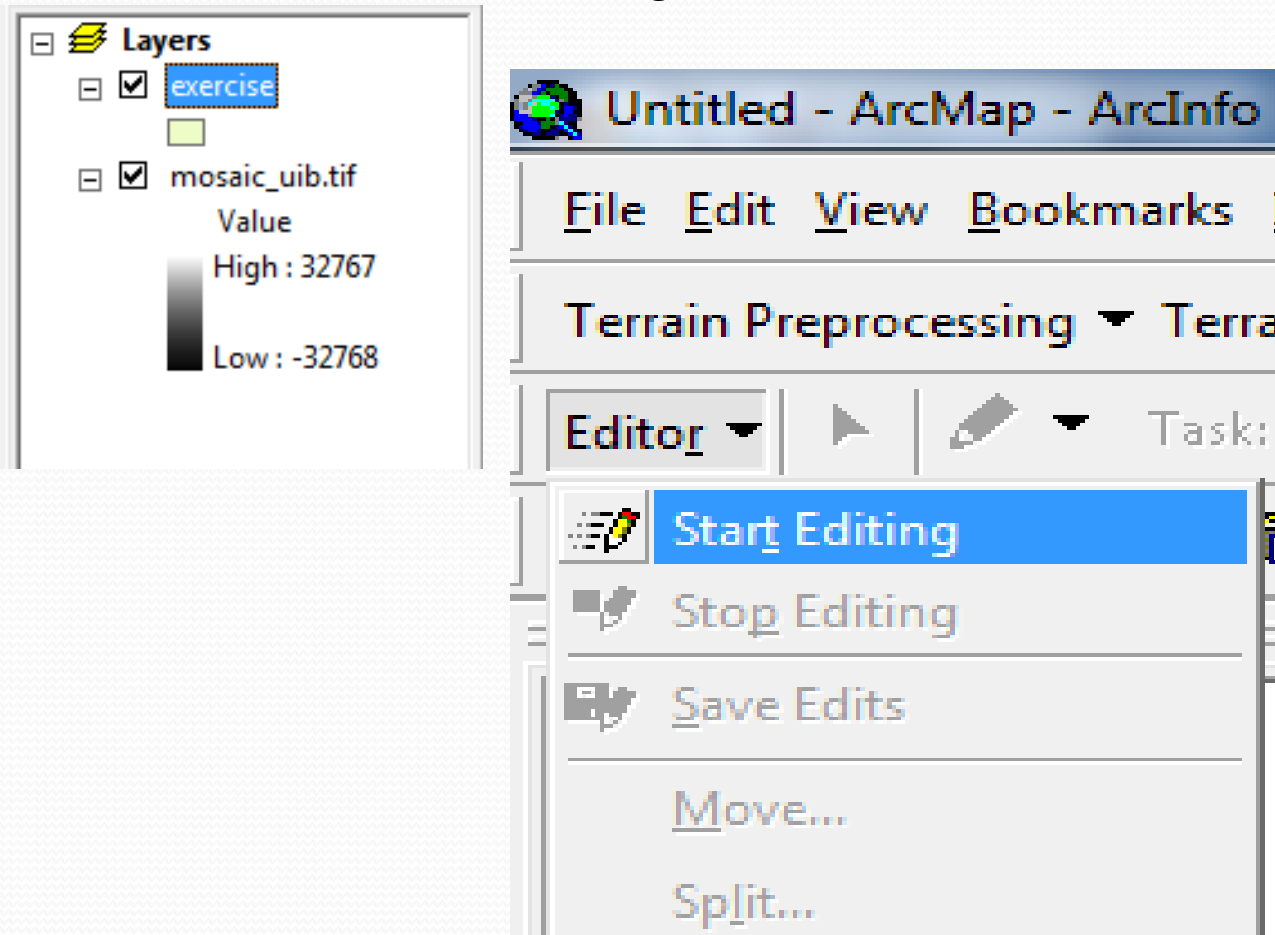
Editing a Shape File

From the menu bar select the "Sketch Tool". An icon can be seen on ArcMap window as shown. Simple Clicks will help to identify your area of interest. Do not forget to close the polygon by double clicking the first point from where u started your work.
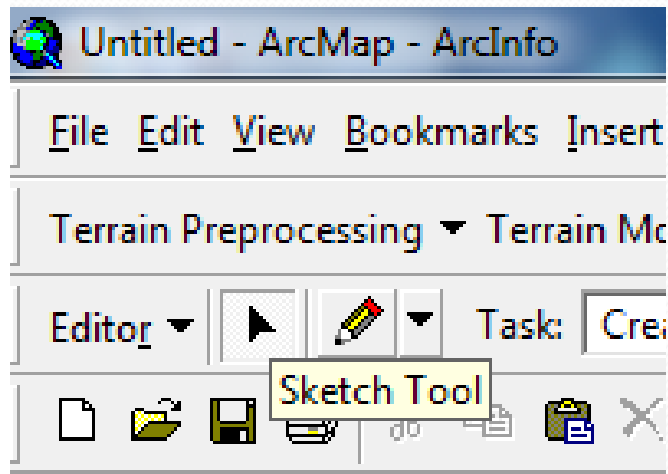
Editing a Shape File

Closing on the initial point will make the polygon as shown. Making a shape file like this should ensure that the study area lies within this boundary
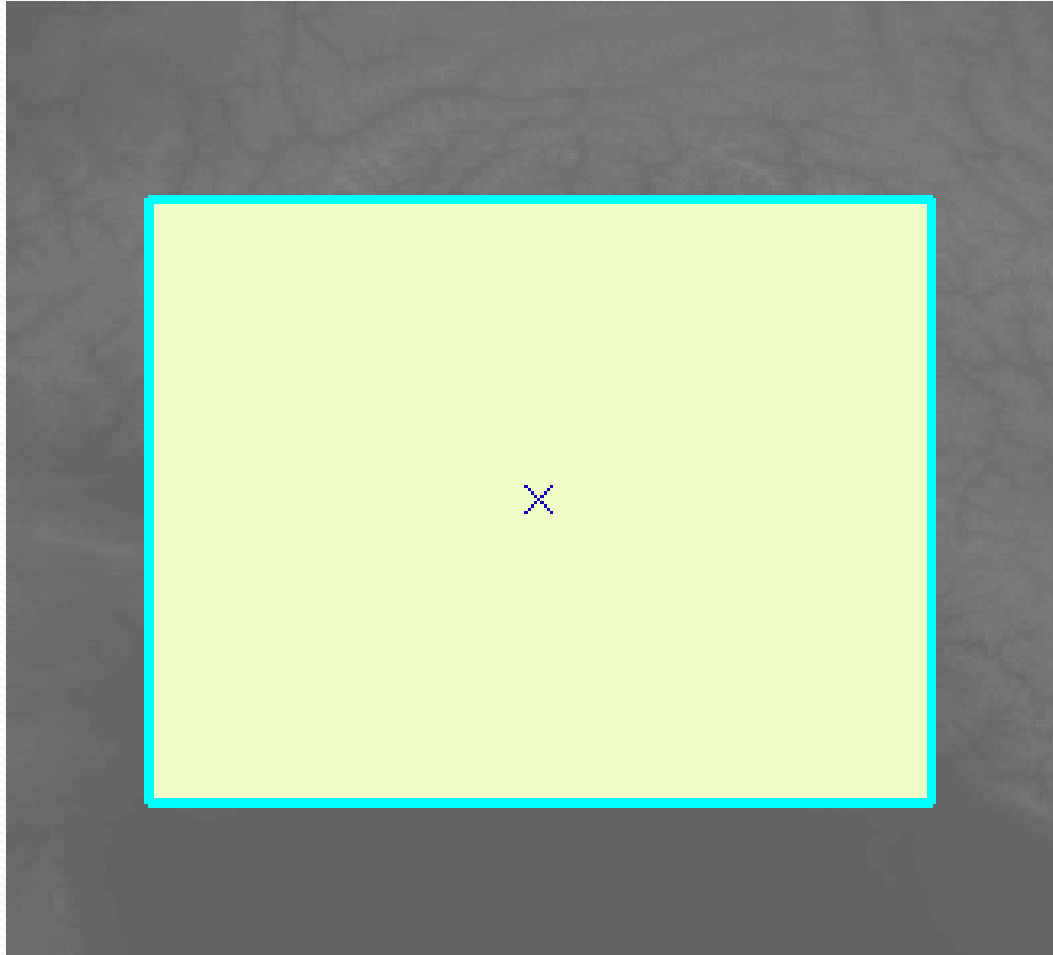
Editing a Shape File

- After defining the shape file as in previous slide click on the Editor and there Save Edits. After saving the edits made again click the Editor and click Stop Editing as shown.
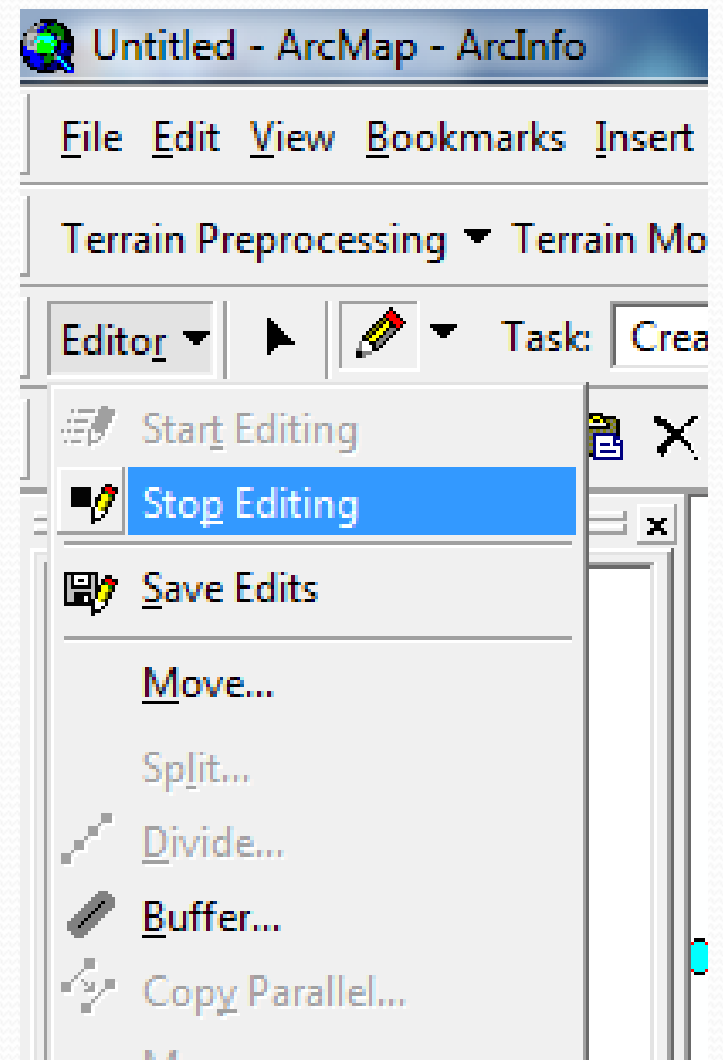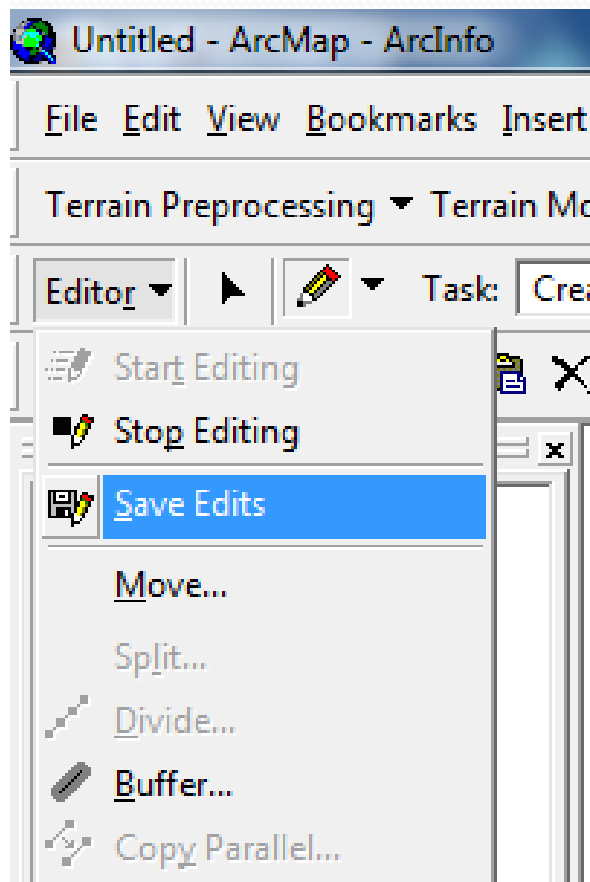
Extracting DEM

- Use the following icon to Open Arc Tool Box Window as shown

Show/Hide ArcToolbox Window
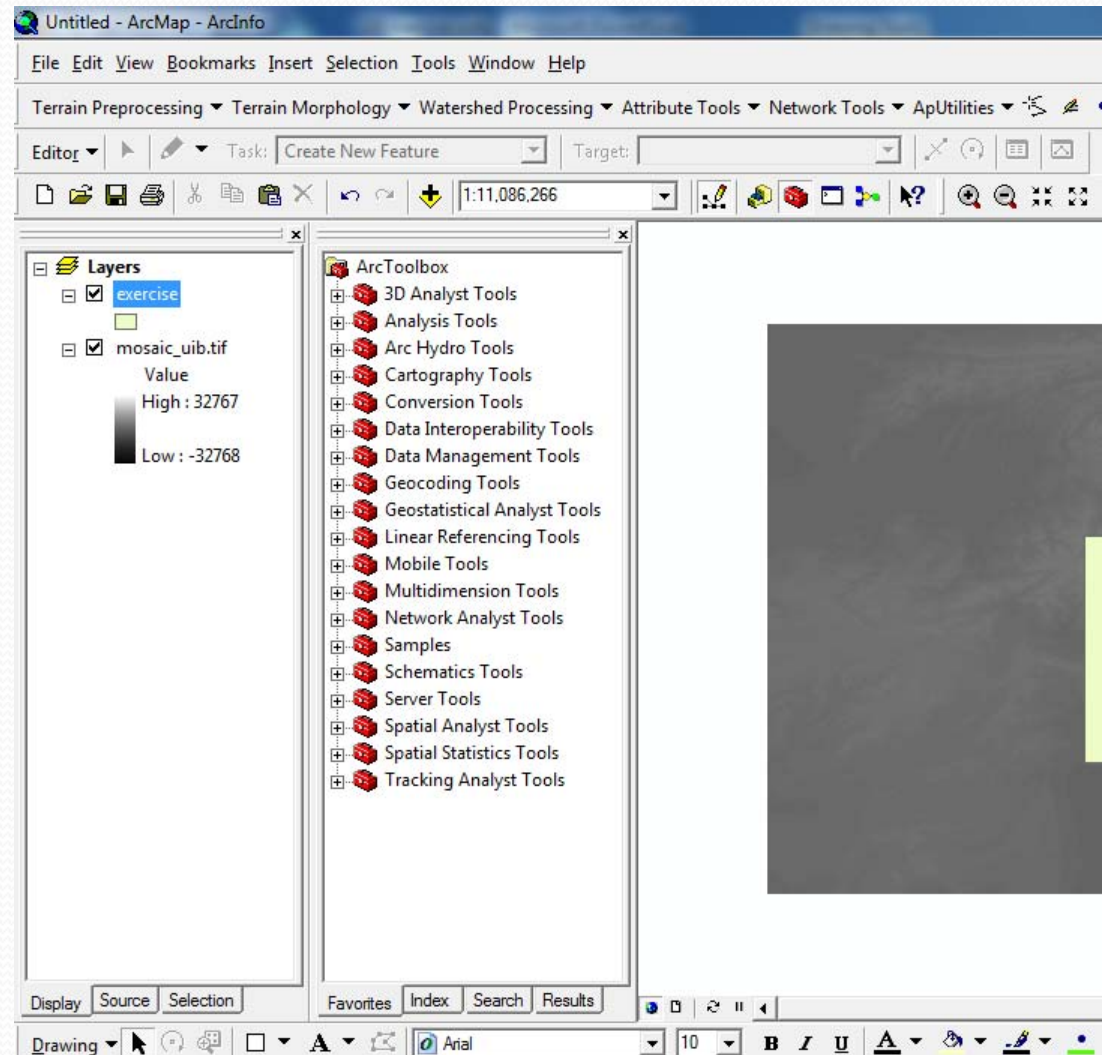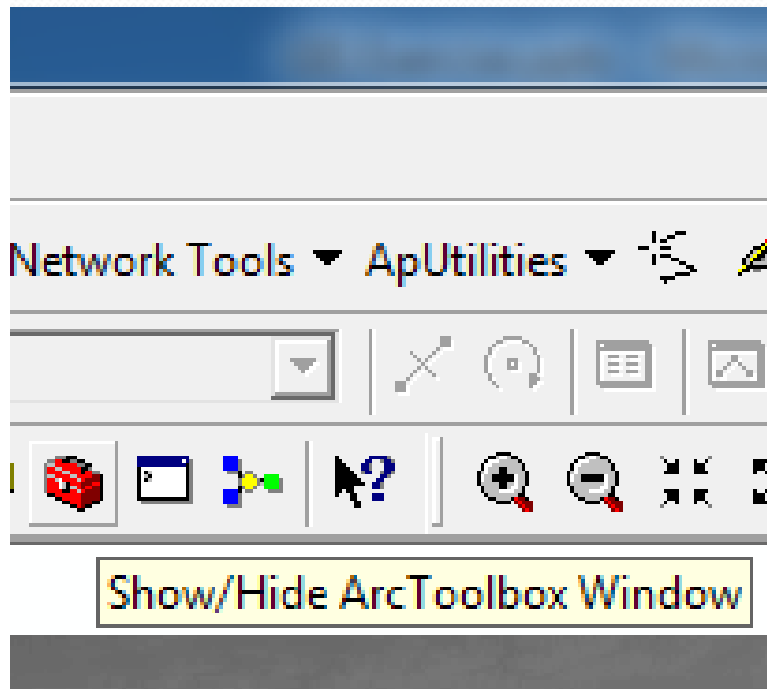
Extracting DEM

From the Arc Tool Box. Go to Spatial Analyst Tool then Extraction then double click Extract by Mask as shown
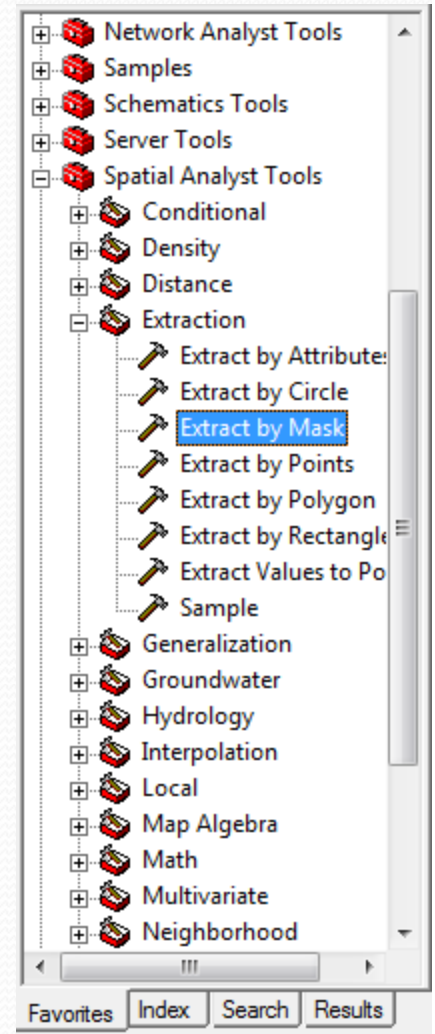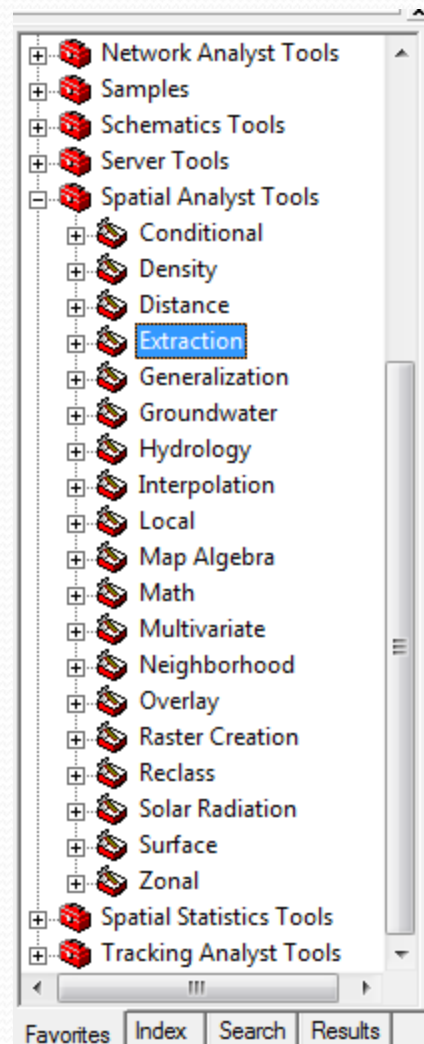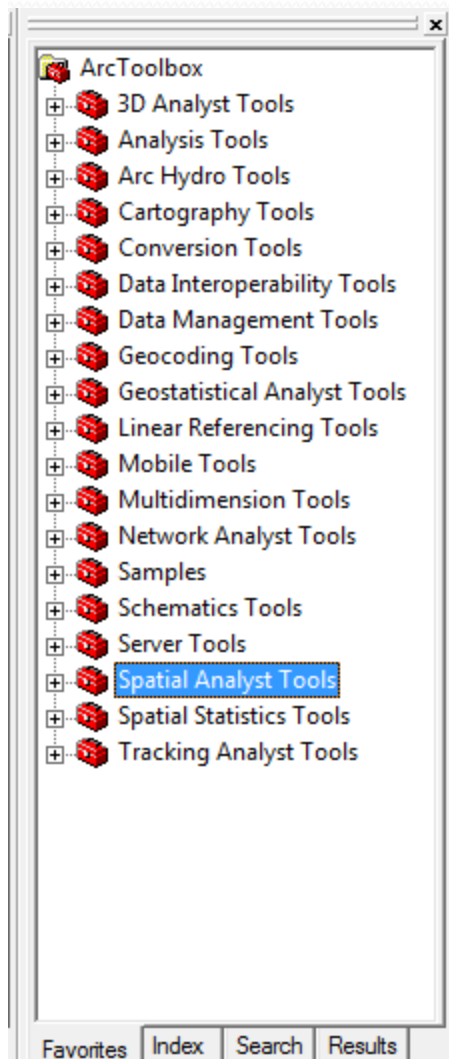
Extracting DEM

The following window will be opened. Here the input raster will be the mosaic_uib.tiff and the mask data will be the shape file "exercise". The respective data can be browsed by using the icons of the folders as shown. The final Output Raster 's name and location will be generated automatically that can be changed as desired.
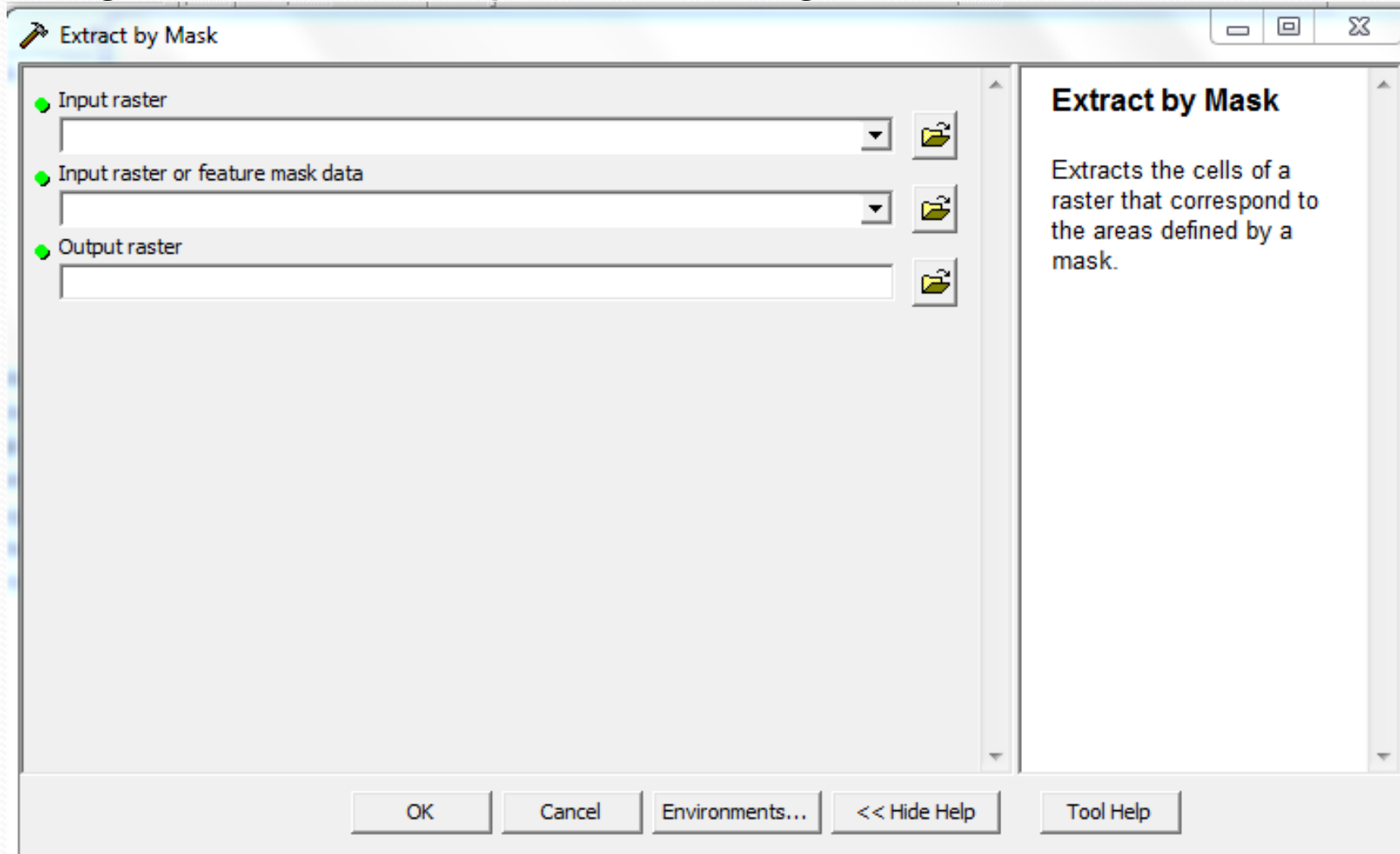
Extracting DEM

Click OK
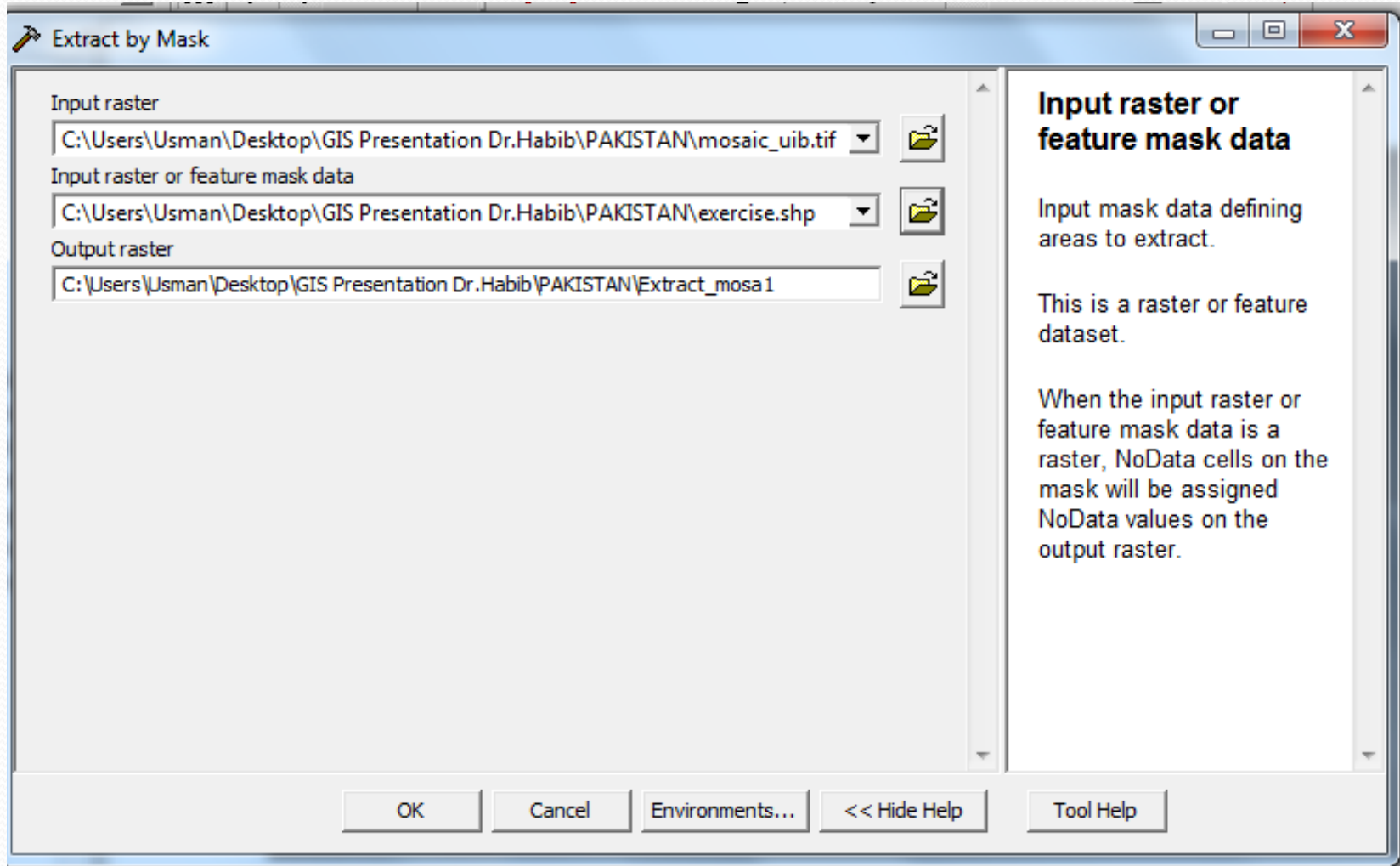
Extracting DEM

- A new Raster Layer has been added under Layers as shown here named Extract_mosa1
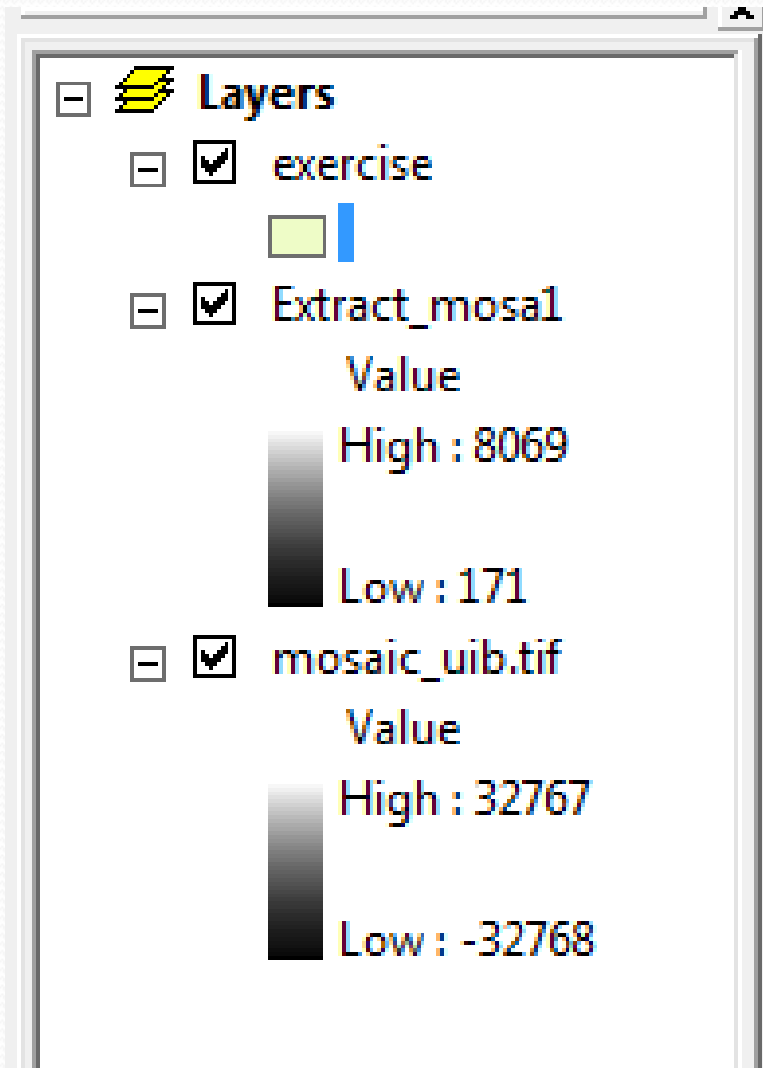
Extracting DEM

Un check all the layers except Extract_mosa1, to see only the extracted DEM
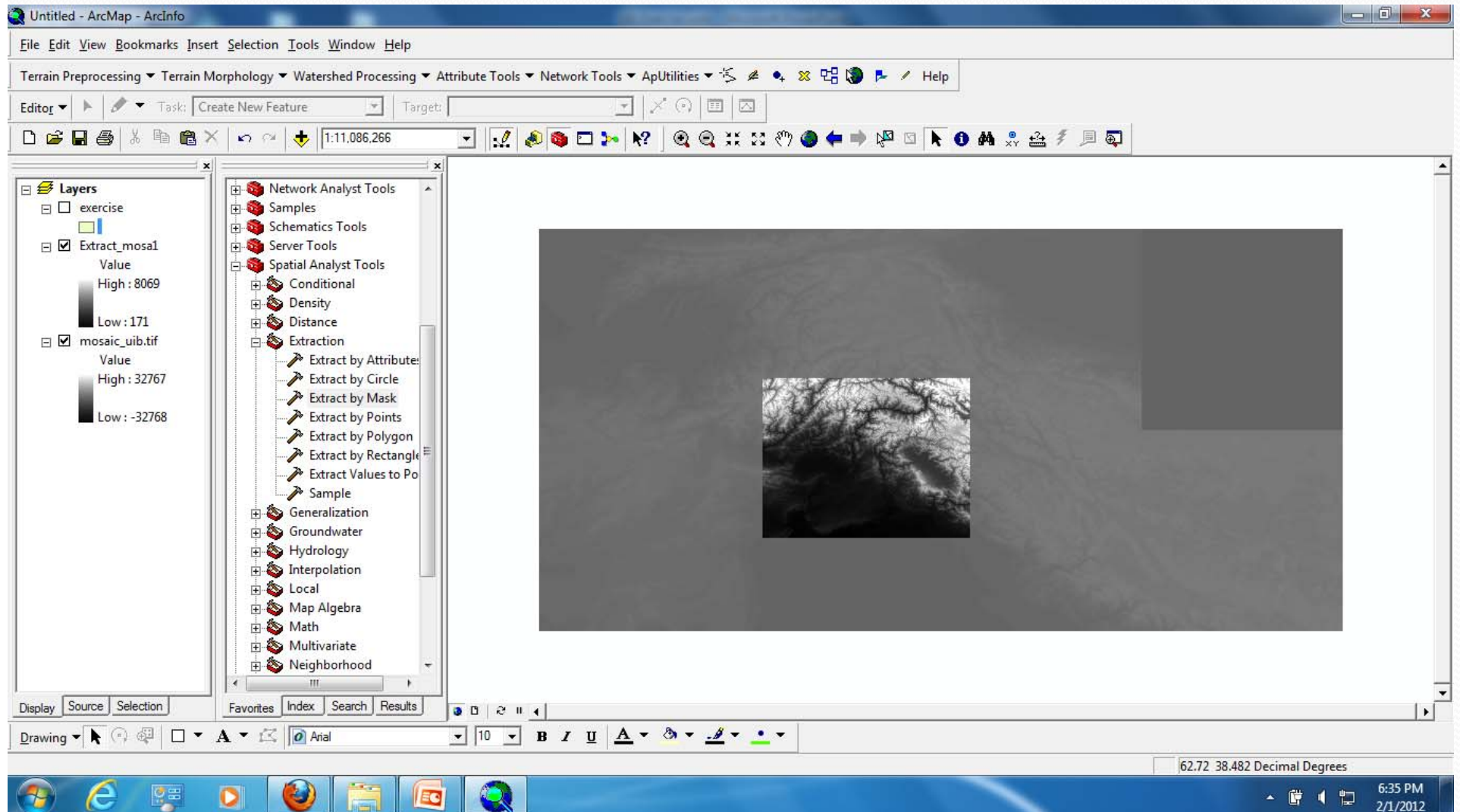
Extracting DEM

This is our area of interest OR the Extracted Area.
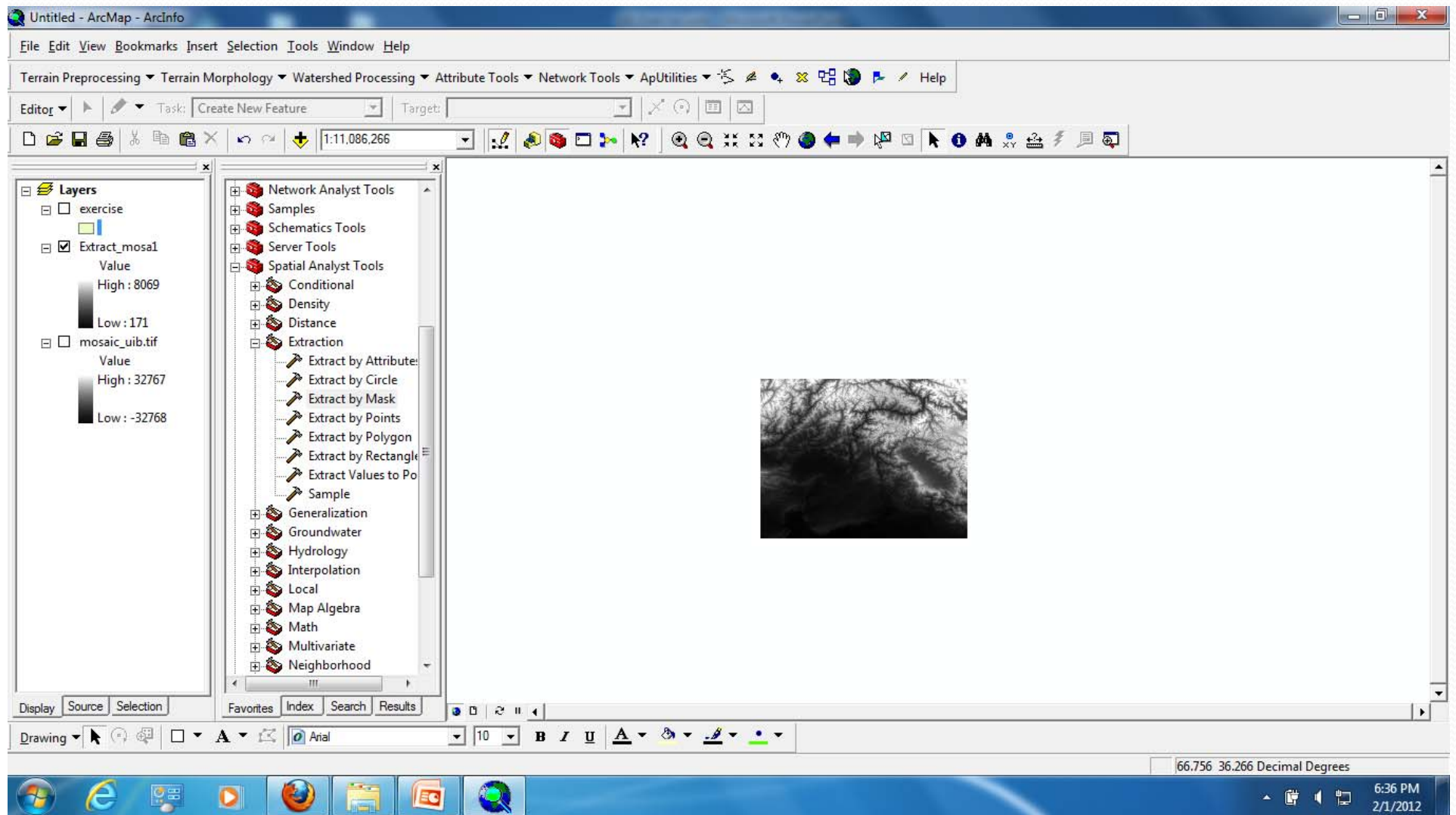
River Network Generation

- By using the Arch Hydro tools River networks can be generated. Following steps are involved

- Terrain Processing
  - Filling the Sinks
  - Flow Directions
  - Flow Accumulation
  - Stream Definition
  - Stream Segmentation
  - Catchment Grid Delineation
  - Catchment Polygon Processing
  - Drainage line Processing
  - Adjoint Catchment Processing
  - Drainage Point Processing

- Note
  - From here onwards all the processing will be performed on the extracted DEM i.e. Extract_mosa1. Students should follow their own data and they can use their own names given to the outputs……..

River Network Generation

- Before proceeding to next step save the work. If we will not save now it will be appeared automatically before we can perform the step of filling the sinks as the following prompt will appear on the screen. So save your file according to your will first. (Better to save the file in the same folder of your project where rest of the files are placed). Click the save icon as shown

Fill Sinks ☒

Please save the ArcMap document before continuing.

OK

Untitled - ArcMap - ArcInfo

File Edit View Bookmarks Insert

Terrain Preprocessing ▼ Terrain Mor

Editor ▼ ▶ ◆ ▼ Task: Creat

Save (Ctrl+S) ☒

Layers
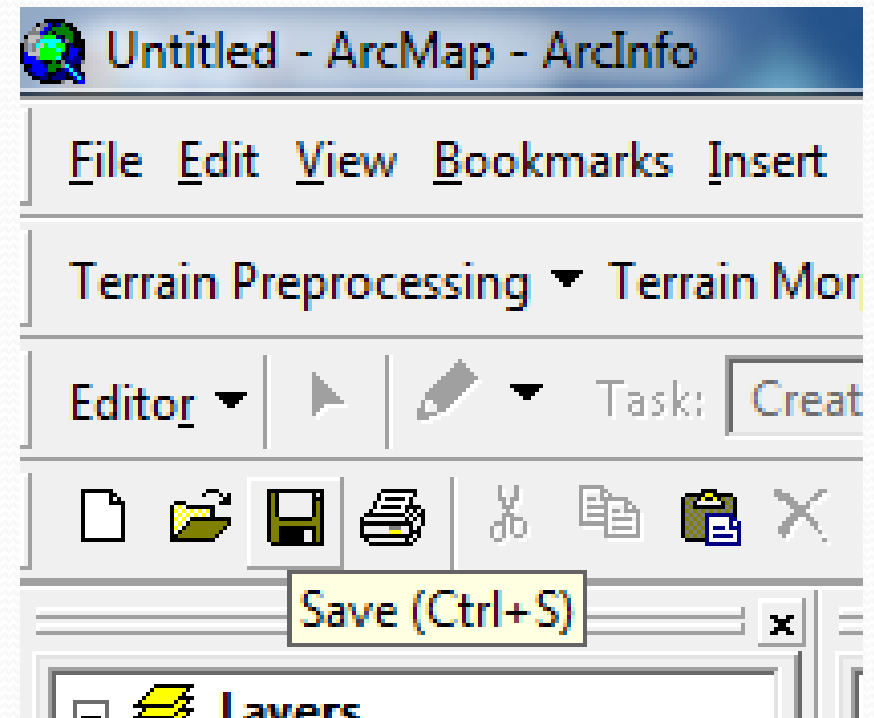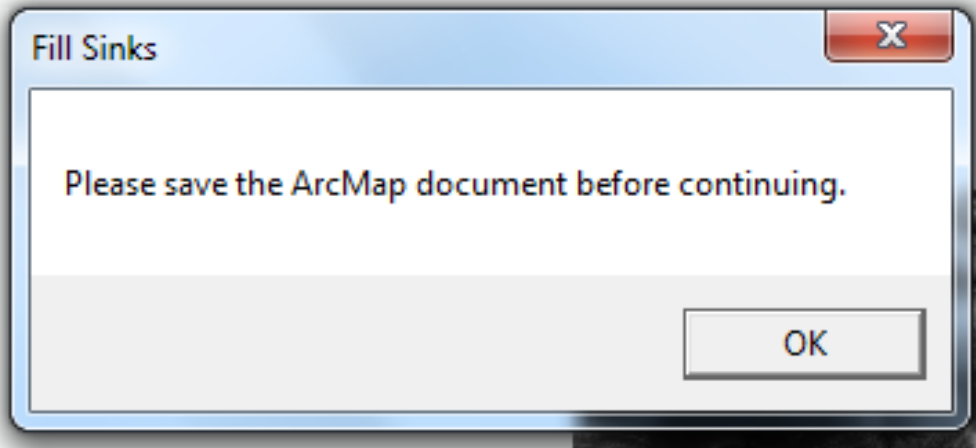
River Network Generation

Following will appear and you can browse to the location where you want to save the file. You must change the File name according to your will.
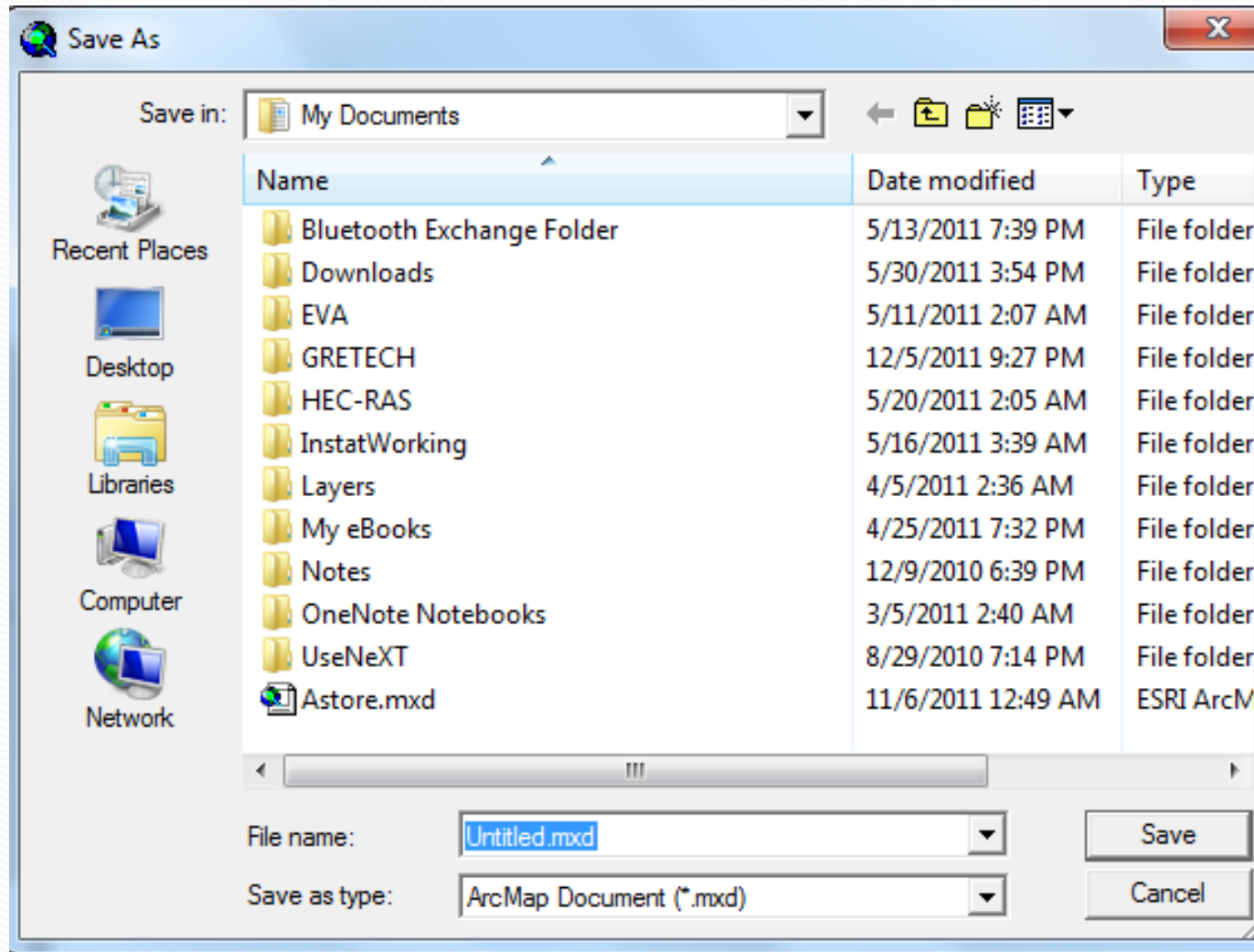
River Network Generation

- Here the file is given name PAKISTAN.mxd and it is browsed to desktop then GIS presentation Dr. Habib (Folder) and then PAKISTAN (Folder) as shown
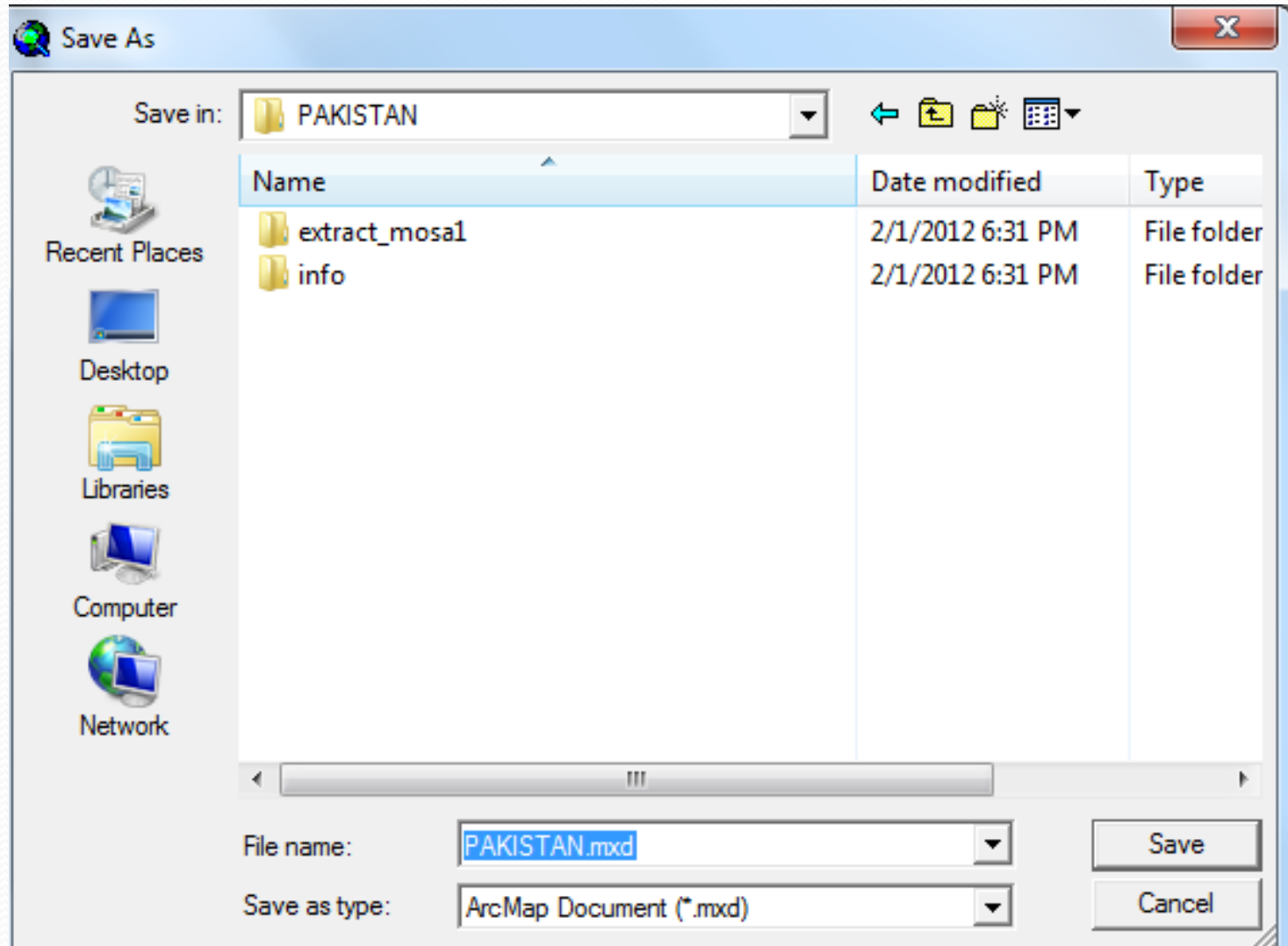
Fill Sinks

Now using the applications of Arc Hydro Tools perform fill sinks as shown
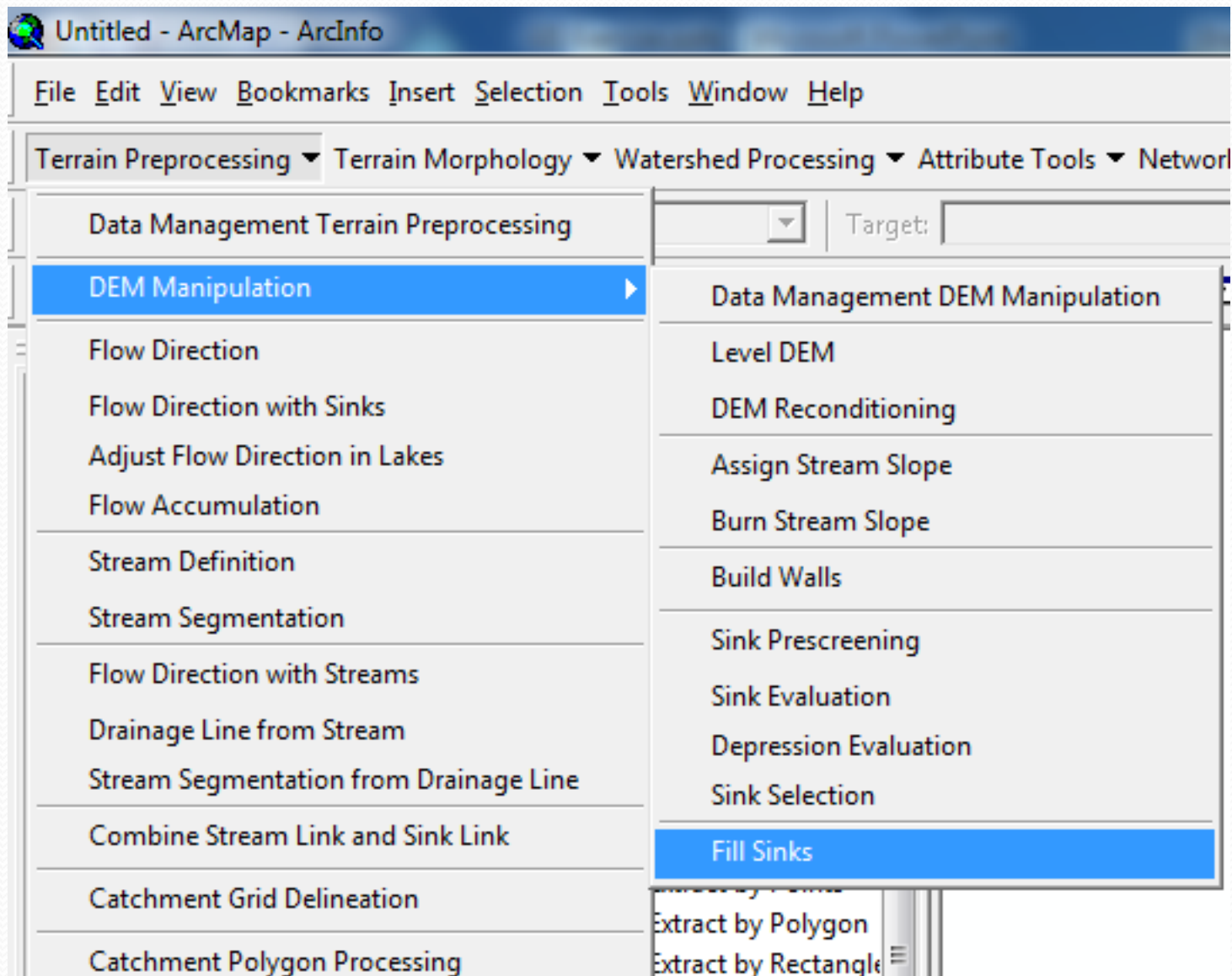
Fill Sinks

- Following window will be opened. Be sure about the right DEM to proceed further. Click OK. This will add a new Hydro DEM layer named Fill. As an example it shown here. In the similar manner all the formed layers will be added. Each time a layer formed will be added.
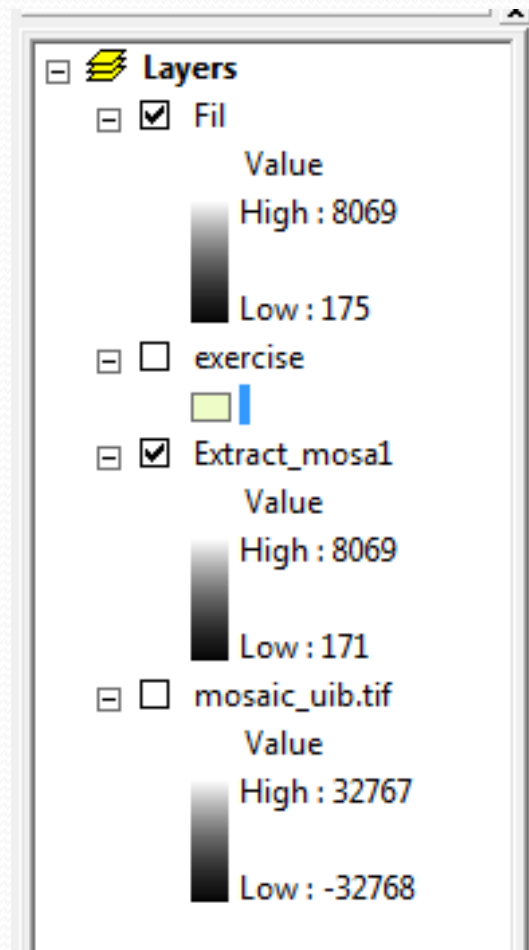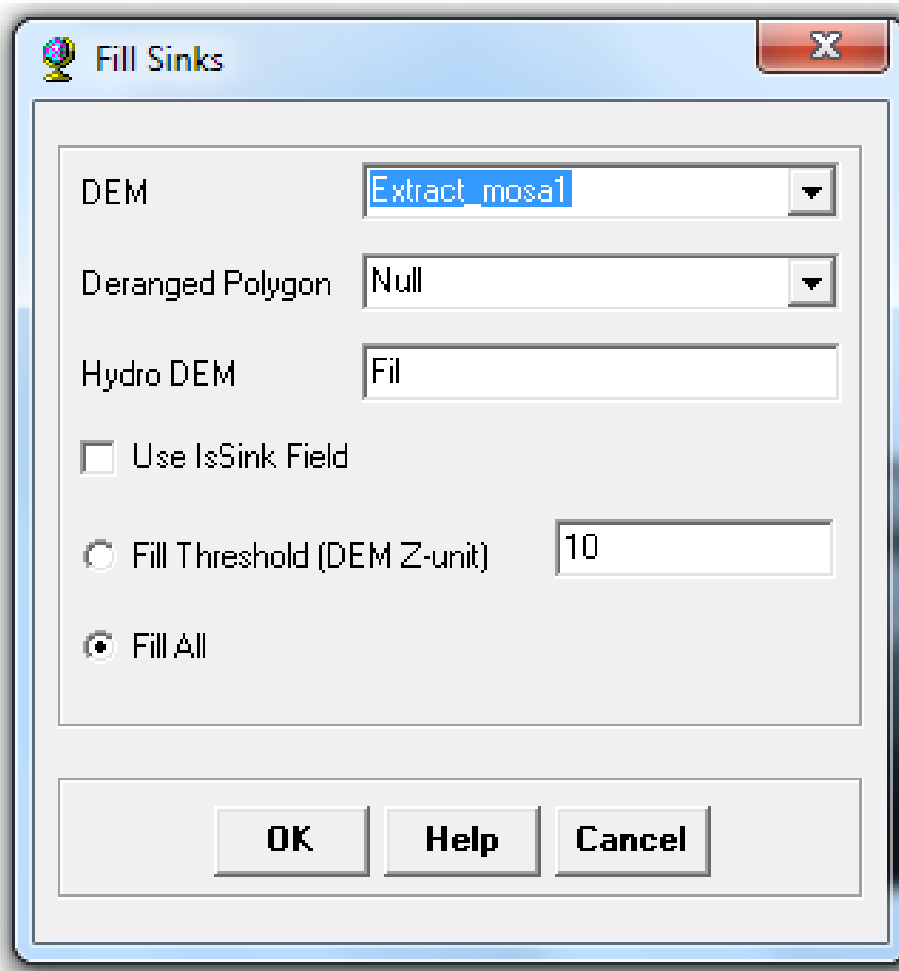
Flow Direction

- Follow the steps

- Click OK
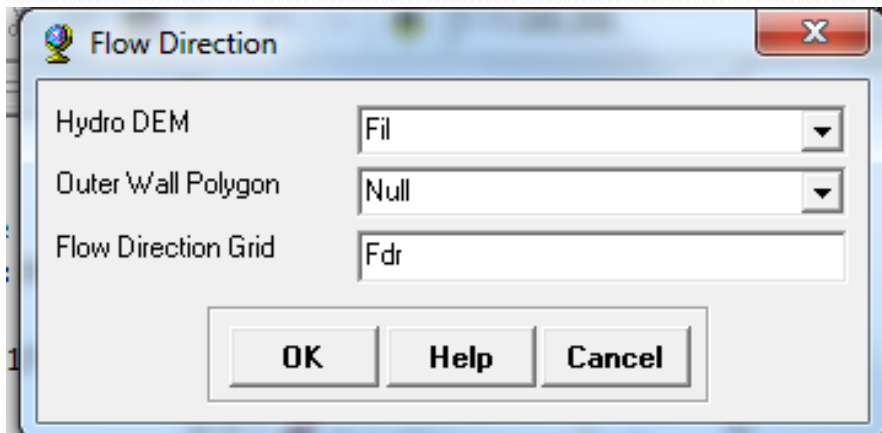
Flow Directions Formed

Flow Accumulation

PAKISTAN.mxd - ArcMap - ArcInfo

File Edit View Bookmarks Insert Selection Tool

Terrain Preprocessing ▼ Terrain Morphology ▼ Wat

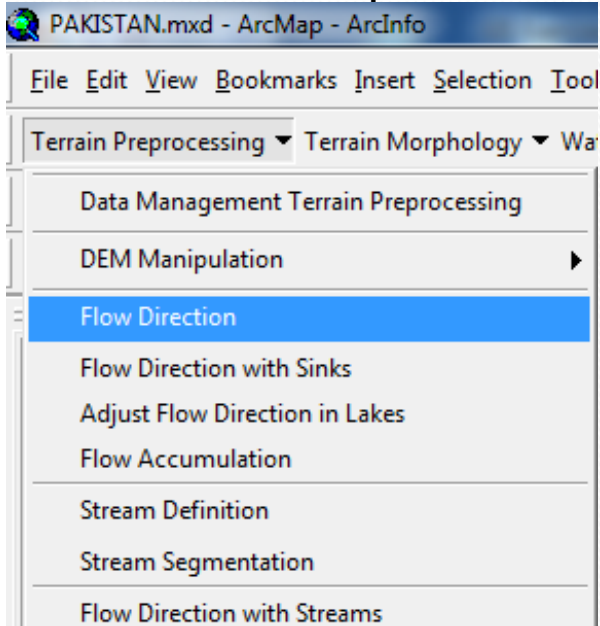| Data Management Terrain Preprocessing | |
DEM Manipulation	▶
Flow Direction	
Flow Direction with Sinks	
Adjust Flow Direction in Lakes	
Flow Accumulation	
Stream Definition	
Stream Segmentation	
Flow Direction with Streams	
Drainage Line from Stream	
Stream Segmentation from Drainage Line	

Flow Accumulation

□ 🗁 **Layers**
  □ ☑ Fac
      Value
      High : 14785296

      Low : 0

□ 🗁 **Layers**
  □ ☑ Fac
      Value
      High : 1478529€

      Low : 0

Flow Accumulation

Flow Direction Grid   Fdr

Flow Accumulation Grid   Fac

OK   Help   Cancel

Flow Accumulation After Inverted Ramp

Flow Accumulation

- Zooming in the Inverted Ramp
- The flow accumulation Lines can be observed

PAKISTAN.mxd - ArcMap - ArcInfo

File   Edit   View   Bookmarks   Insert   Selection   Tool

Terrain Preprocessing ▼   Terrain Morphology ▼   Wa

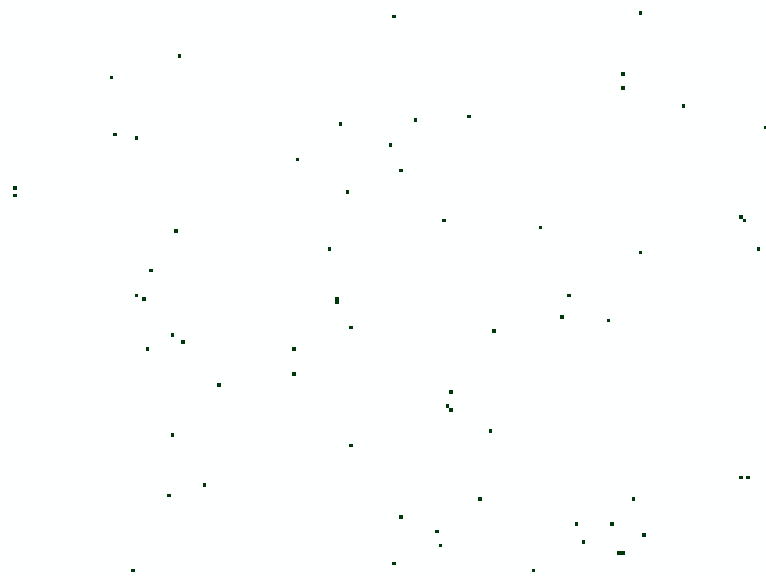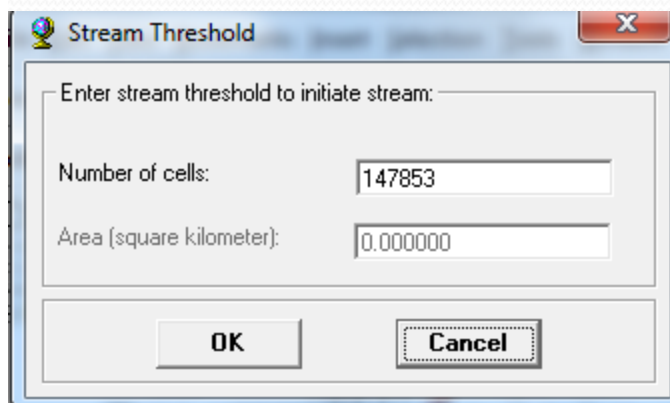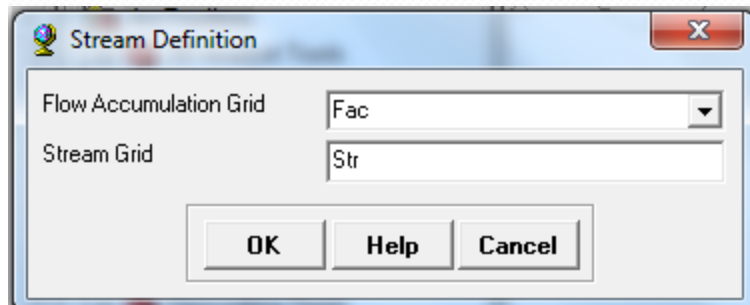Data Management Terrain Preprocessing

DEM Manipulation   ▶

Flow Direction

Flow Direction with Sinks

Adjust Flow Direction in Lakes

Flow Accumulation

Stream Definition

Stream Segmentation

Flow Direction with Streams

Stream Definition

Flow Accumulation Grid   Fac

Stream Grid   Str

OK   Help   Cancel

Stream Threshold

Enter stream threshold to initiate stream:

Number of cells: 147853

Area (square kilometer):   0.000000

OK   Cancel

- After defining the Stream Definition

Stream Segmentation a Step Towards River network Generation

PAKISTAN.mxd - ArcMap - ArcInfo

File Edit View Bookmarks Insert Selection Tool

Terrain Preprocessing ▼ Terrain Morphology ▼ Wa

- Data Management Terrain Preprocessing
- DEM Manipulation ▶
- Flow Direction
- Flow Direction with Sinks
- Adjust Flow Direction in Lakes
- Flow Accumulation
- Stream Definition
- **Stream Segmentation**
- Flow Direction with Streams
- Drainage Line from Stream

Stream Segmentation

Flow Direction Grid	Fdr
Stream Grid	Str
Sink Watershed Grid	Null
Sink Link Grid	Null
Stream Link Grid	StrLnk

OK   Help   Cancel

- Stream Segmentation

Catchment Grid Delineation

- Catchment Grid Delineation Layer Generated

Catchment Polygon Processing

- Catchment Polygon Processing

Drainage Line Processing

PAKISTAN.mxd - ArcMap - ArcInfo

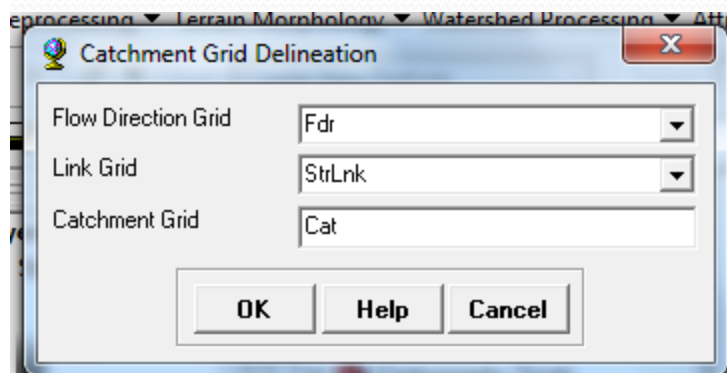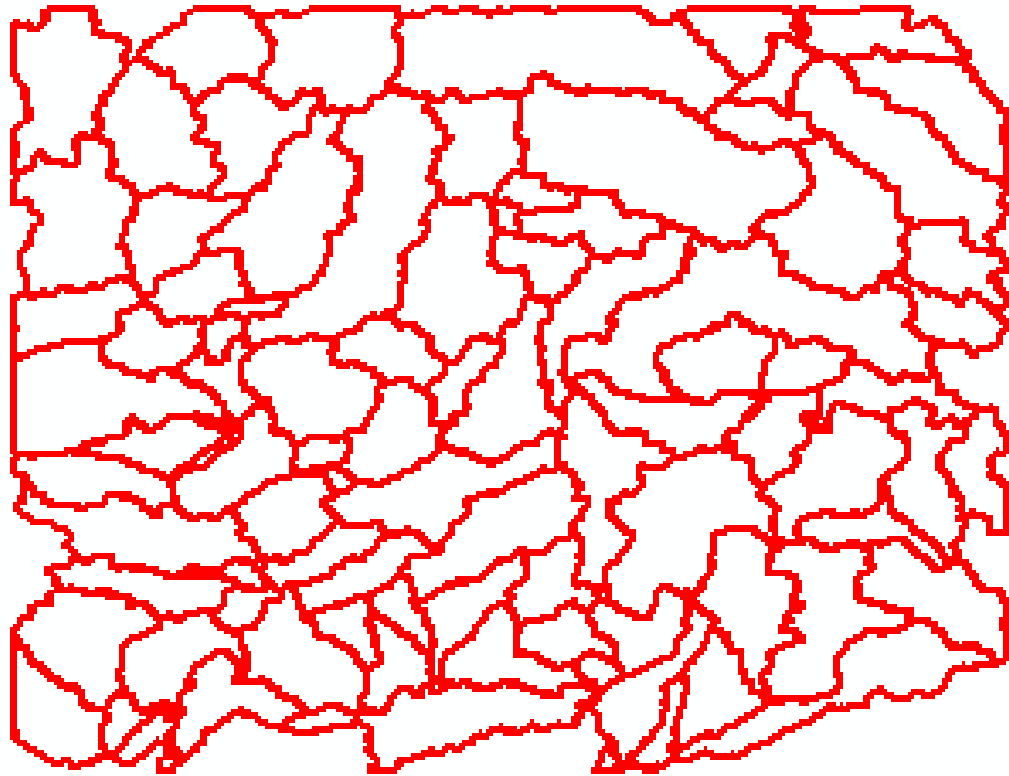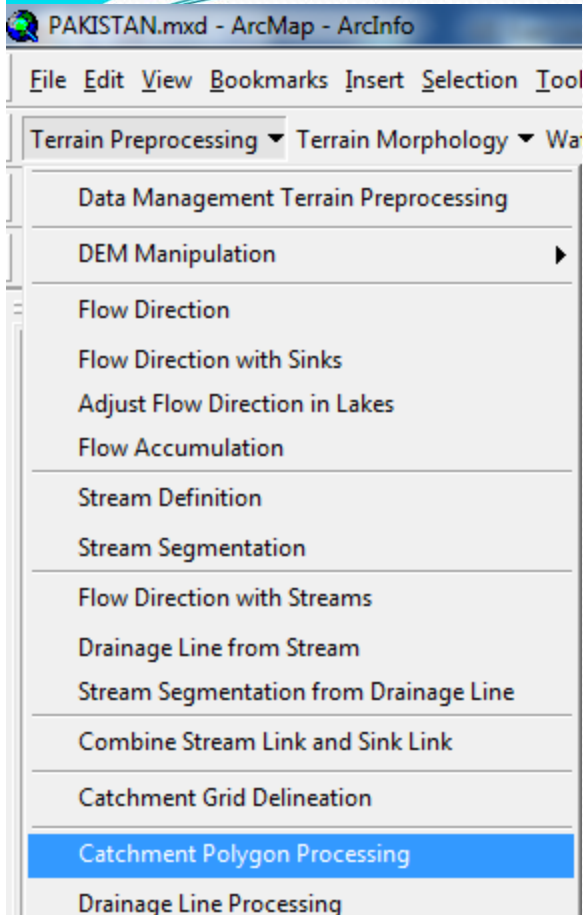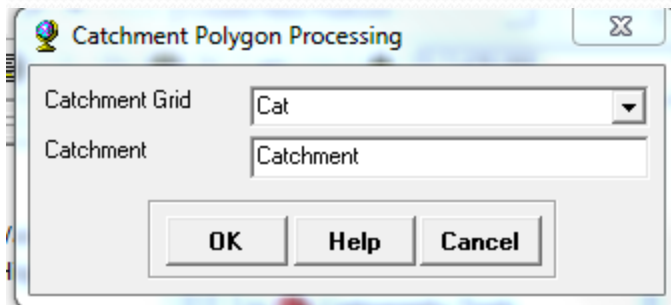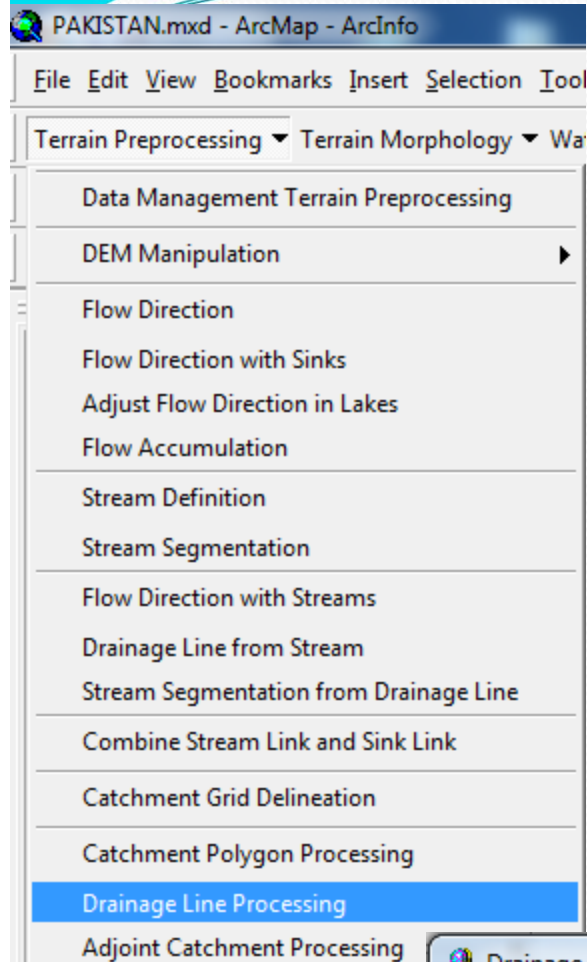File Edit View Bookmarks Insert Selection Tool

Terrain Preprocessing ▼ Terrain Morphology ▼ Wa

- Data Management Terrain Preprocessing
- DEM Manipulation   ▶
- Flow Direction
- Flow Direction with Sinks
- Adjust Flow Direction in Lakes
- Flow Accumulation
- Stream Definition
- Stream Segmentation
- Flow Direction with Streams
- Drainage Line from Stream
- Stream Segmentation from Drainage Line
- Combine Stream Link and Sink Link
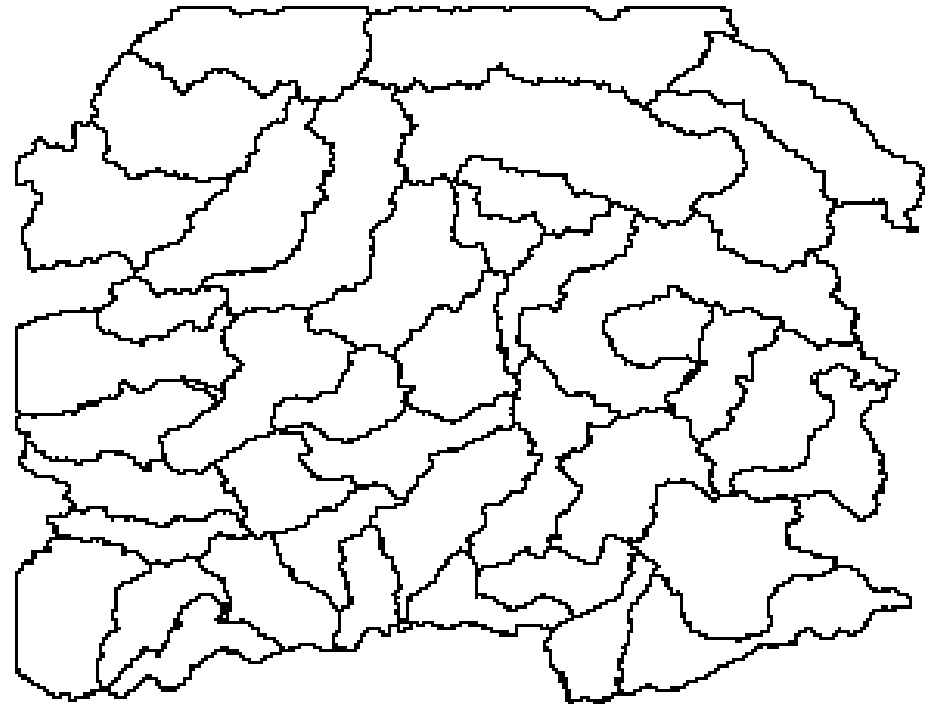- Catchment Grid Delineation
- Catchment Polygon Processing
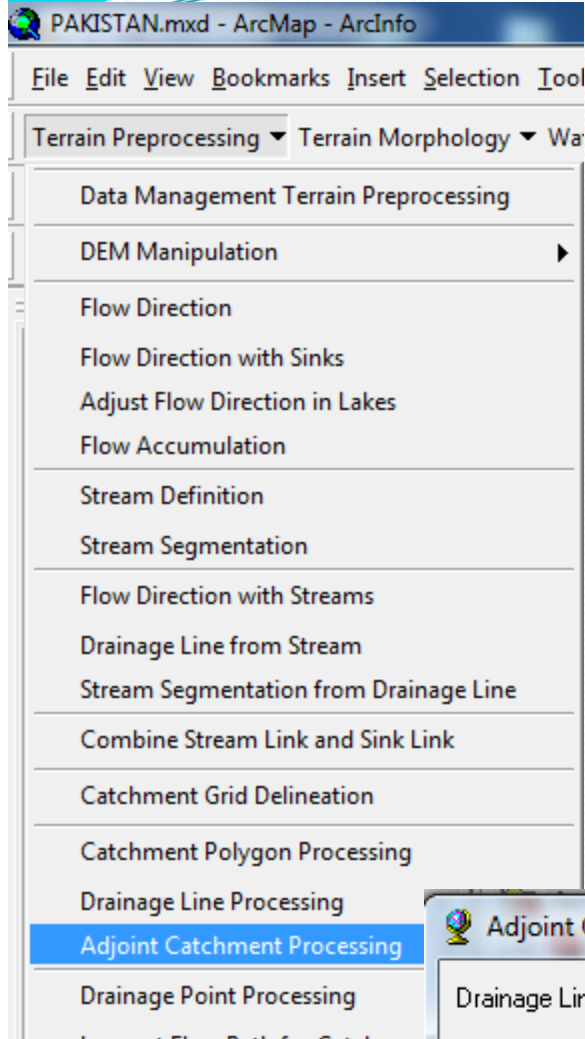- Drainage Line Processing
- Adjoint Catchment Processing

Drainage Line Processing

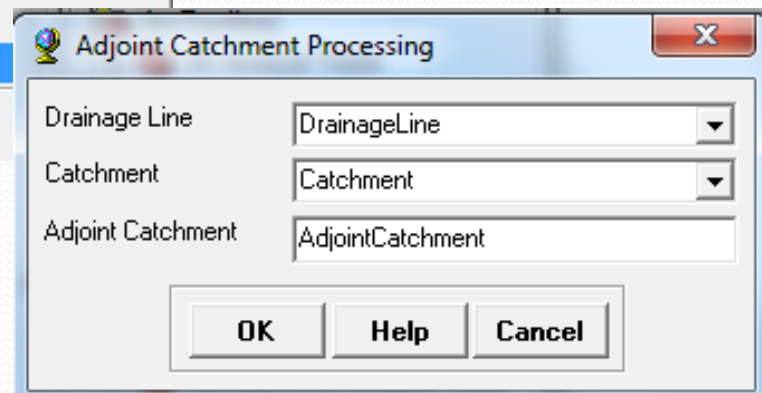| Stream Link Grid | StrLnk |
| Flow Direction Grid | Fdr |
| Drainage Line | DrainageLine |

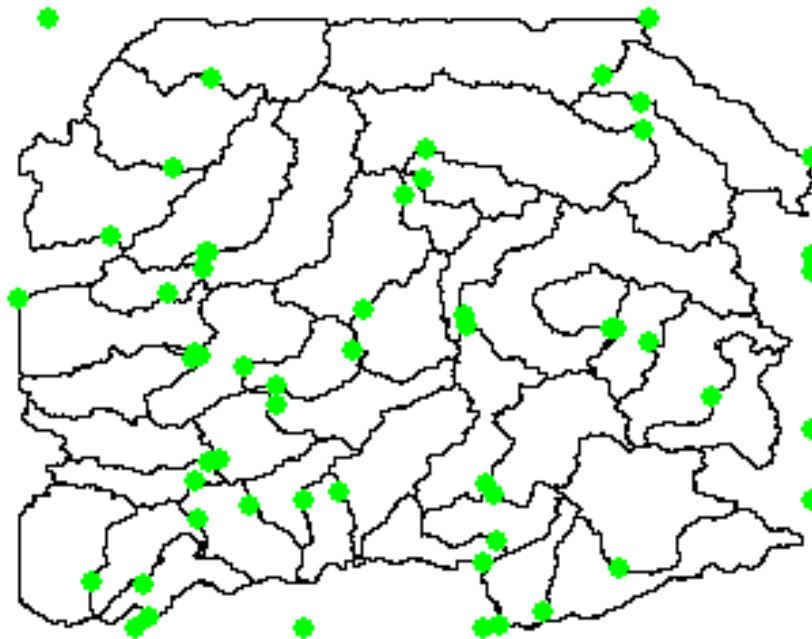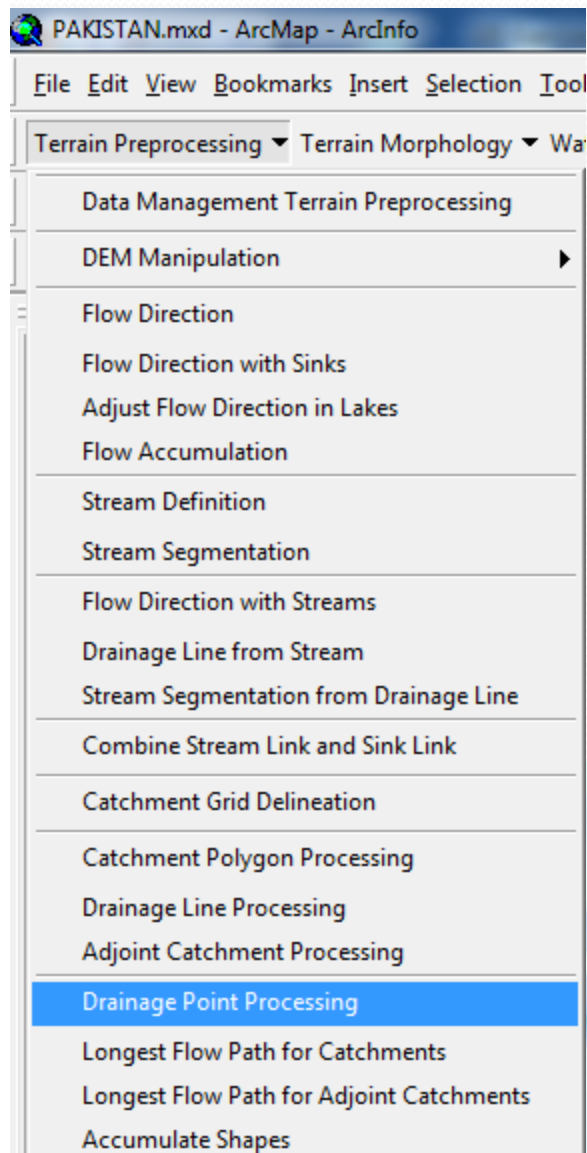OK   Help   Cancel

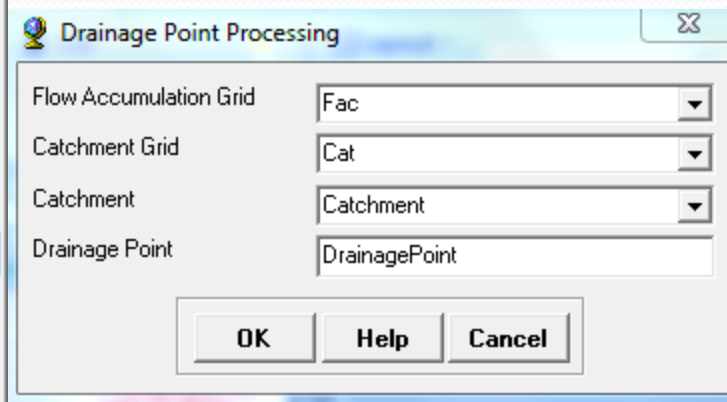- Drainage Line Processing

Adjoint Catchment Processing

- Adjoint Catchment Processing Layer

Drainage Point Processing (Not a necessary step for Our Exercise)
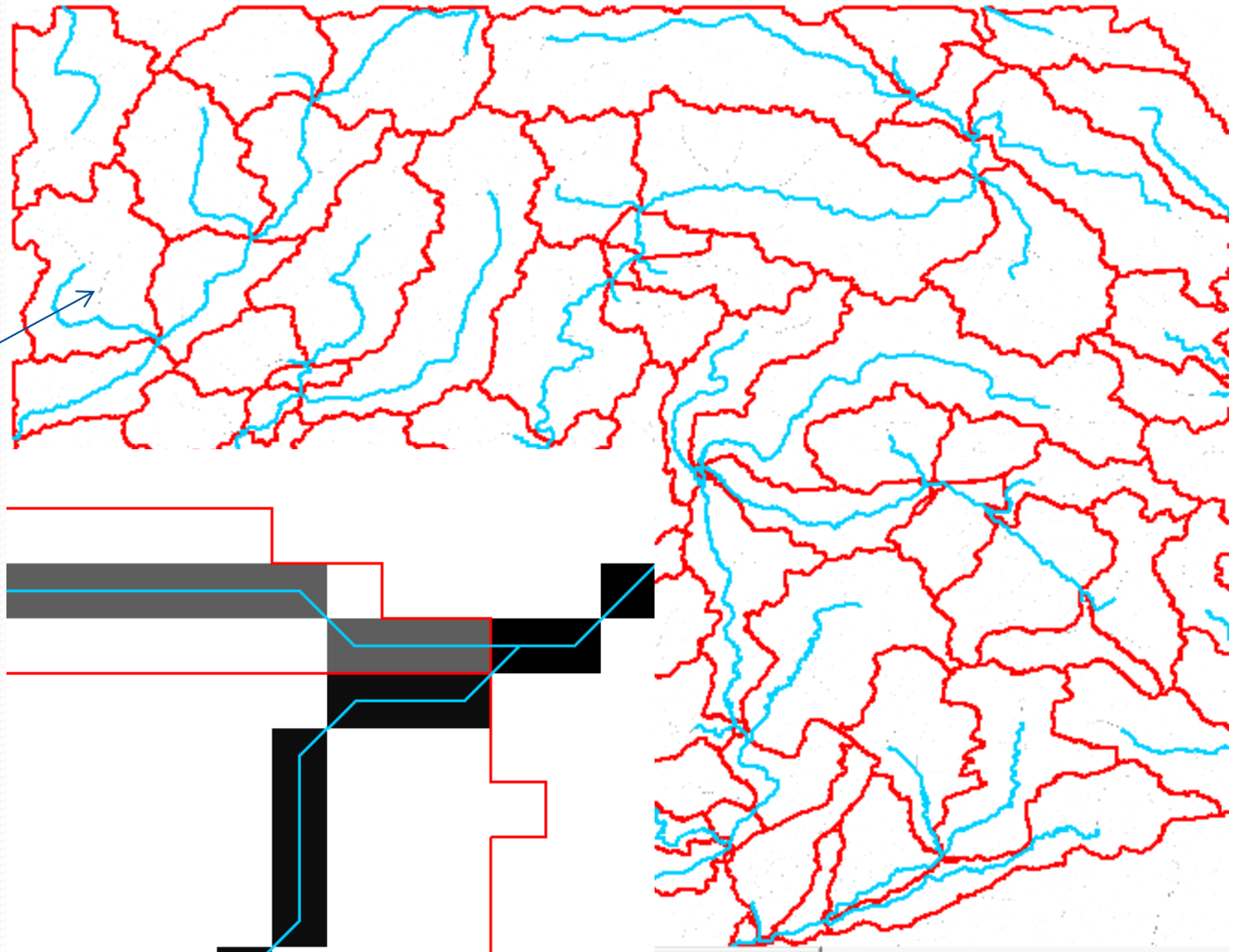

- Drainage Point Processing

Watershed Processing
Batch Watershed Delineation

- Before proceeding to this step first arrange your display so that
 - Fac
  - Catchment and
  - Drainage Line

Layers are visible as shown

- Focus on these Black Spots too. They are showing Flow Accumulations "Fac". (Zoomed Image is also shown, explained in next slide)
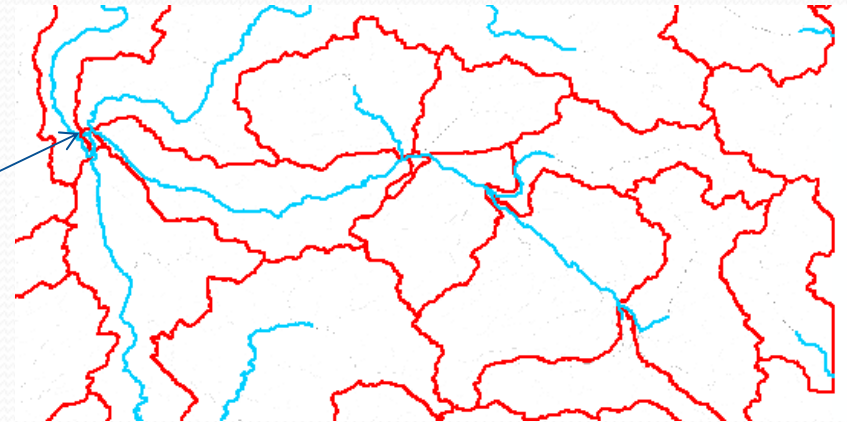
Batch Watershed Delineation

- Zooming in the three layers at any point the following should be visible. In the following figure red boundary is for catchment, blue lines are for river and the black portions are showing the flow accumulations. The purpose of zooming in is that even a single grid is visible and the point where we want to delineate water shed should easily be known .
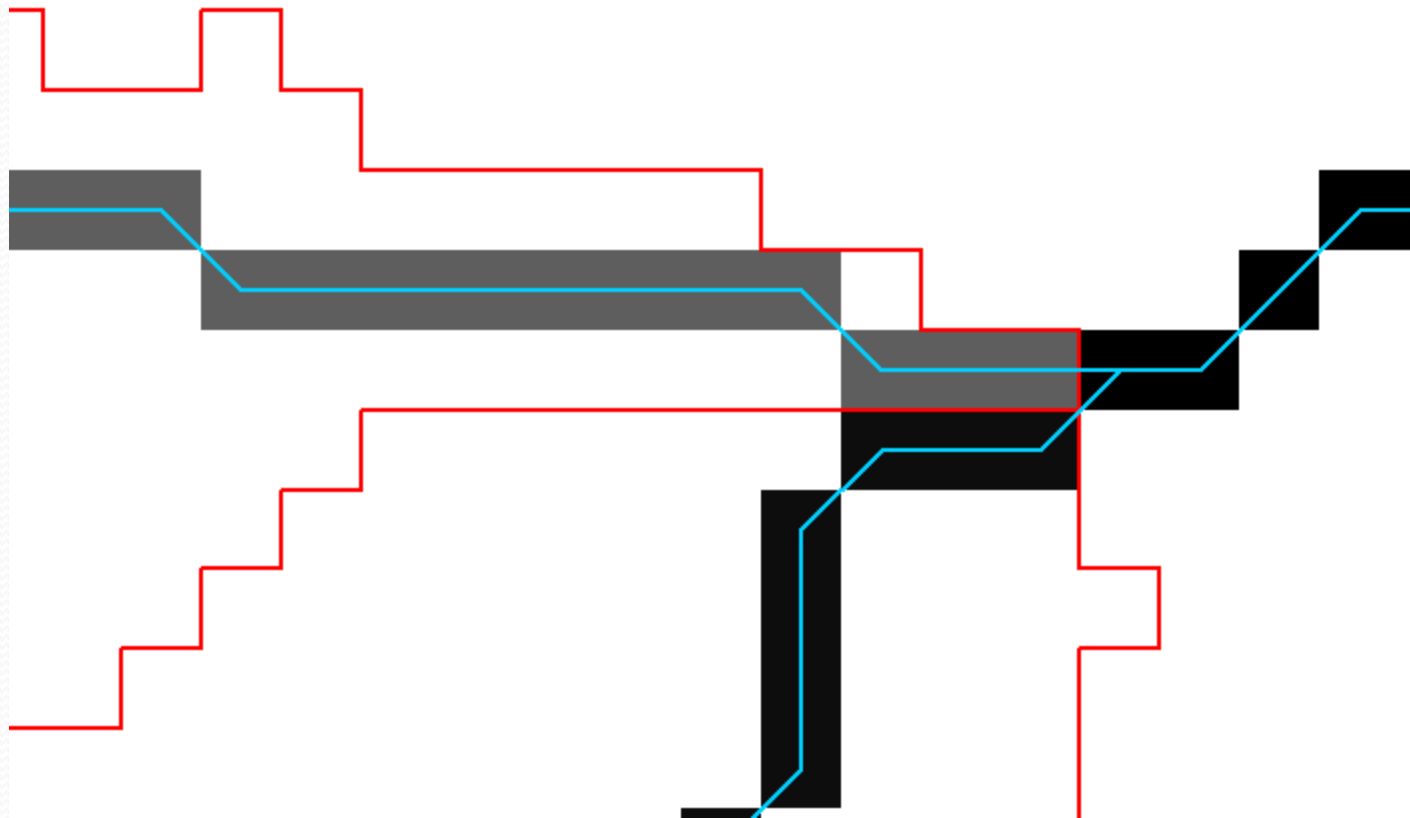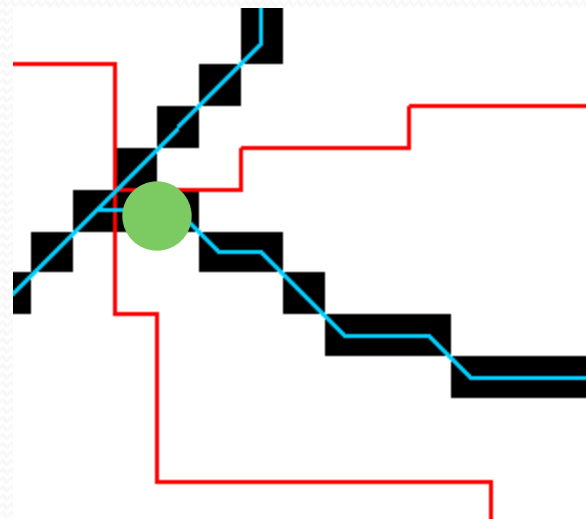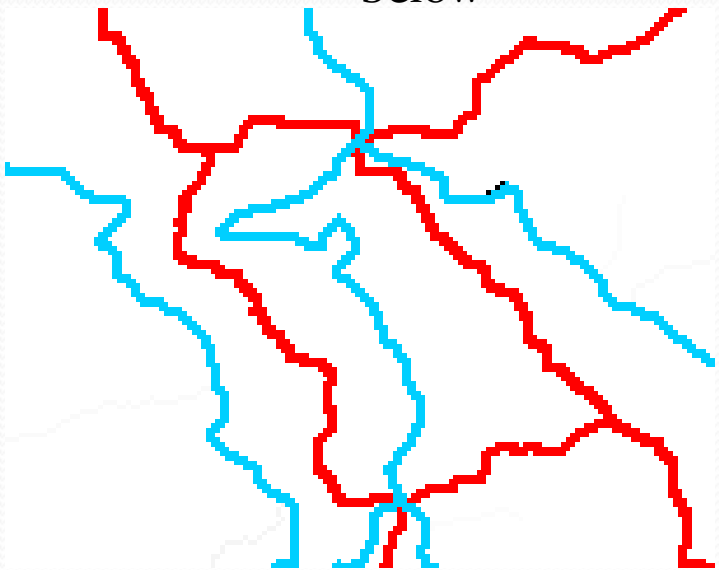
Batch Watershed Delineation
(Selecting an Arbitrary Point to Delineate watershed)

- As an Example we are focusing on the following area to Delineate Water shed

- Zoomed in Portion of the Pointed Area is shown as below

- Further Zoom highlights the Fac, Drainage line and the catchment. Consider Our Point of interest is encircled Green as shown which is an Arbitrary Point

Batch Watershed Delineation

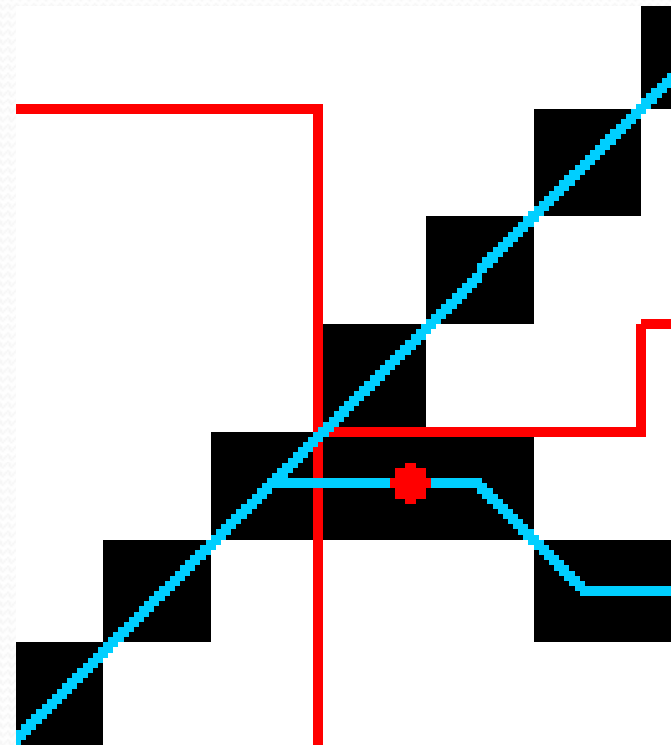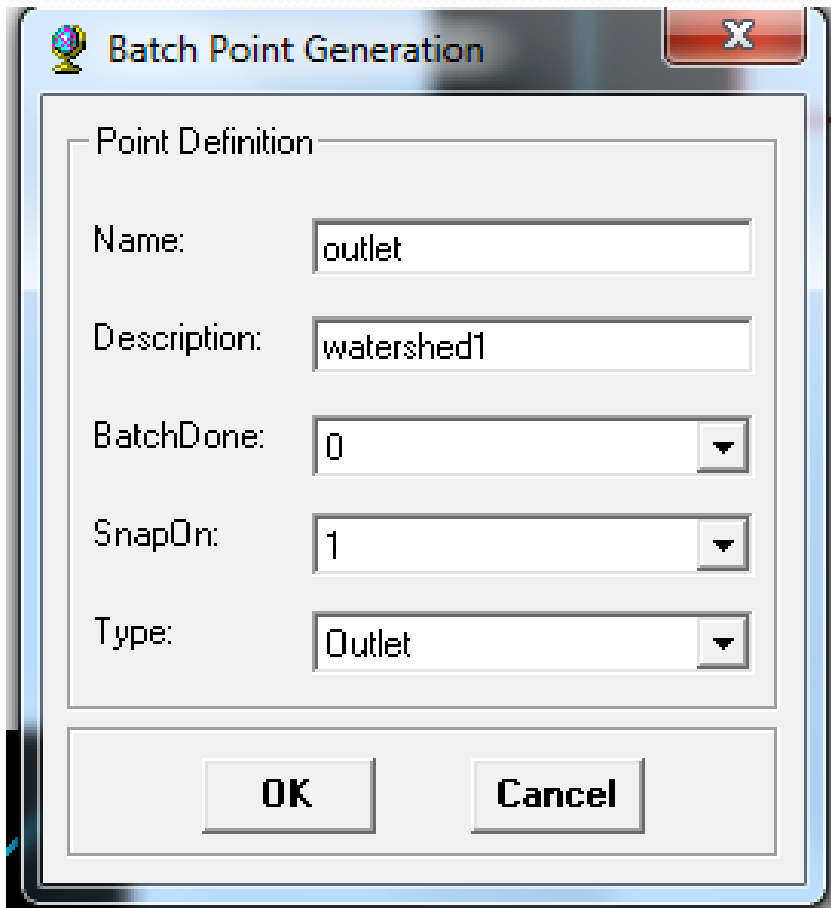(Selecting an Arbitrary Point to Delineate watershed)

- Using the Menu bar of Arc Hydro Tools, Select the icon of Batch Watershed Delineation as shown . Curser will turn in to + sign. Click the grid from where we desire to delineate the watershed. The following window will appear. Click OK
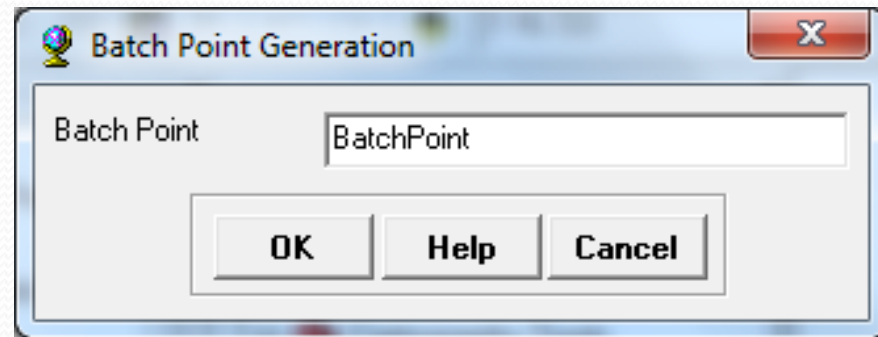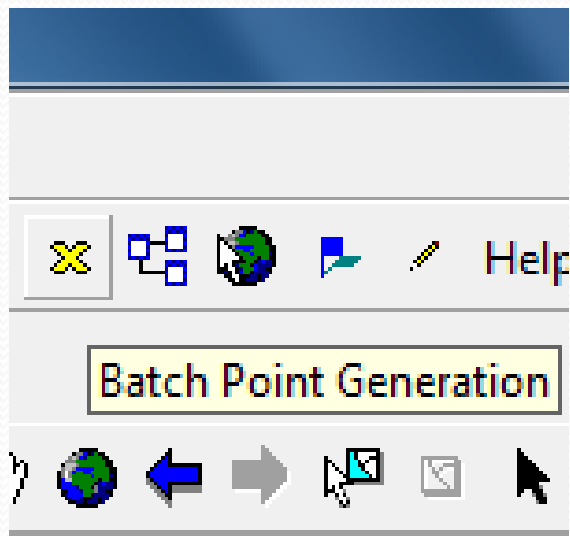
Batch Watershed Delineation
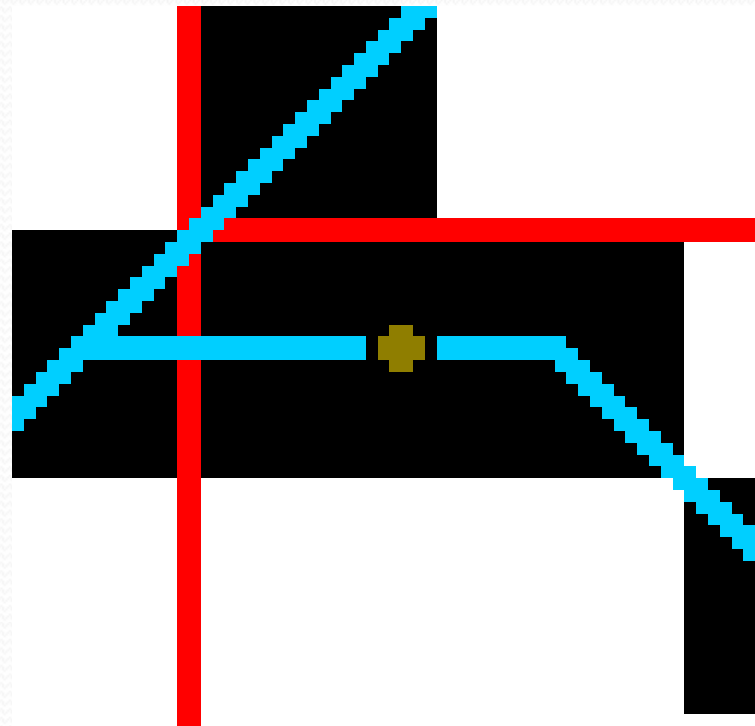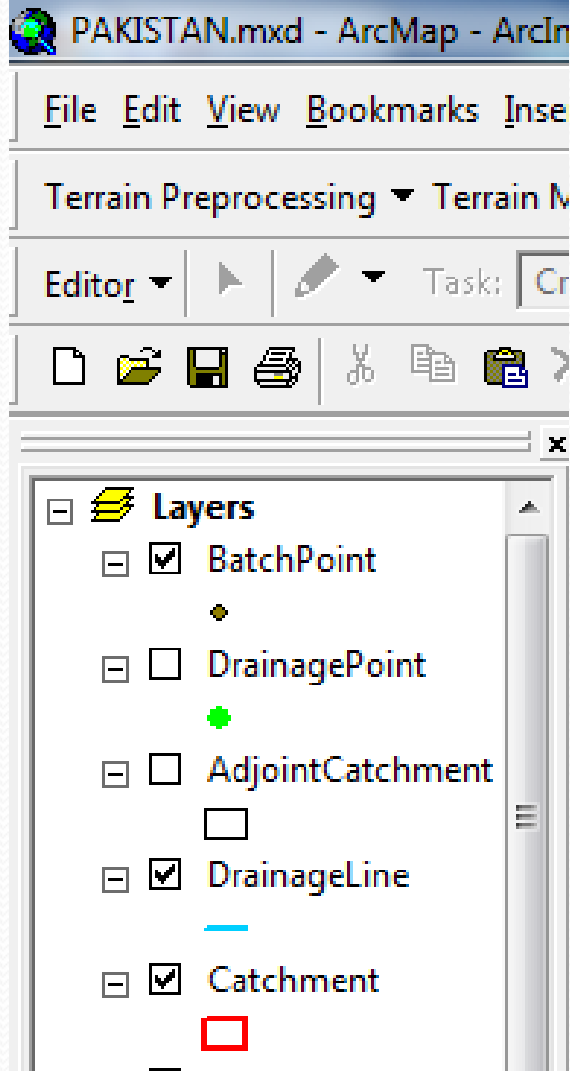## (Selecting an Arbitrary Point to Delineate watershed)

- On clicking at the required grid a dot will be highlighted on the same grid as shown with another window will be prompted. In the Name Tab type outlet and use description tab to describe this watershed e.g. we use Watershed 1 . Click OK

Batch Watershed Delineation
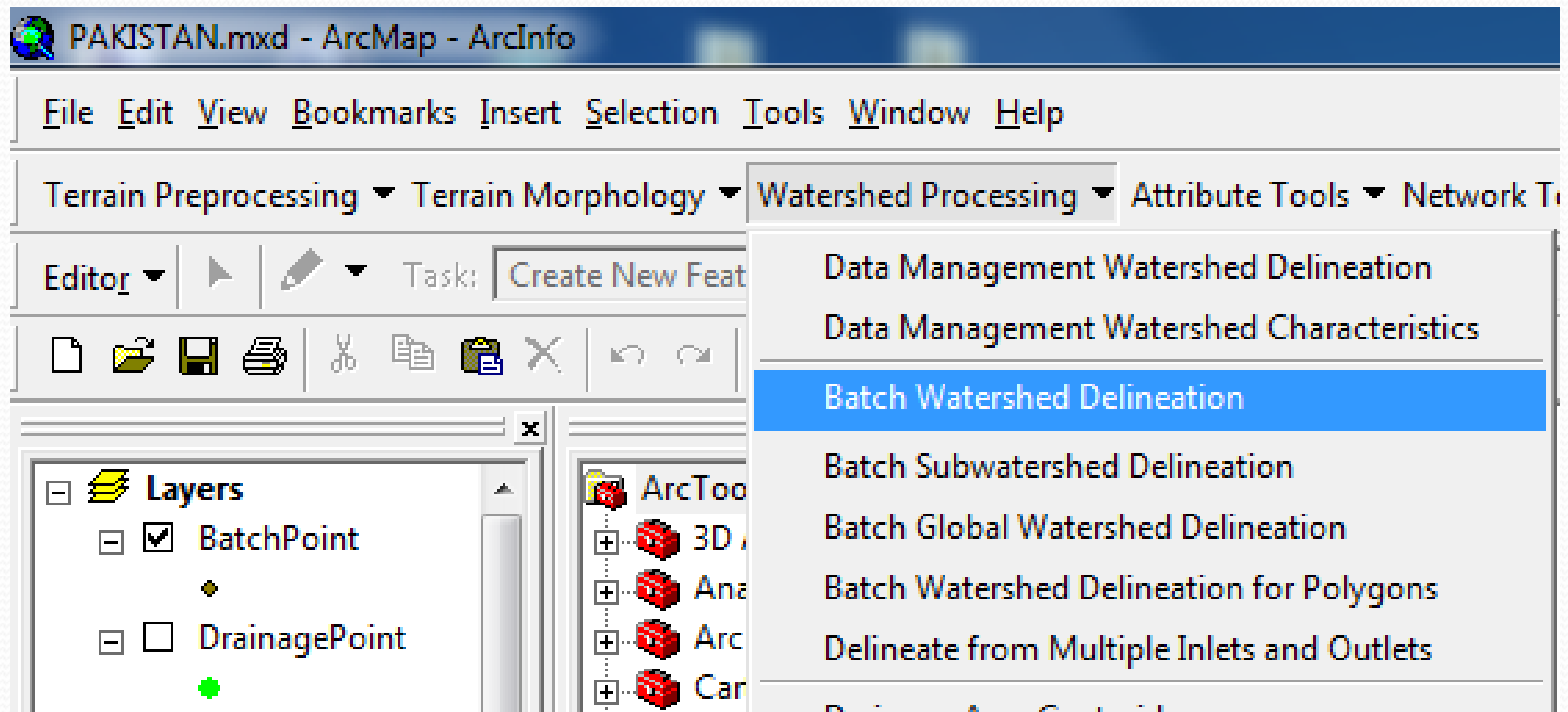## (Selecting an Arbitrary Point to Delineate watershed)

- The red dot will be changed to a minor dot and in fact a layer named BatchPoint has been added in the ArcMap now.

Batch Watershed Delineation
(Selecting an Arbitrary Point to Delineate watershed)

- Follow the steps

Batch Watershed Delineation

(Selecting an Arbitrary Point to Delineate watershed)

- The following window will be opened. Do not forget to mention Fdr for Flow Direction Grid, Str for Stream Grid, Catchment to Catchment, BatchPoint to Batch Point, Watershed20 (Or the selected name of your choice) to Watershed and WatershedPoint20 (Or the selected name of your choice) to Watershed Point as shown and click OK
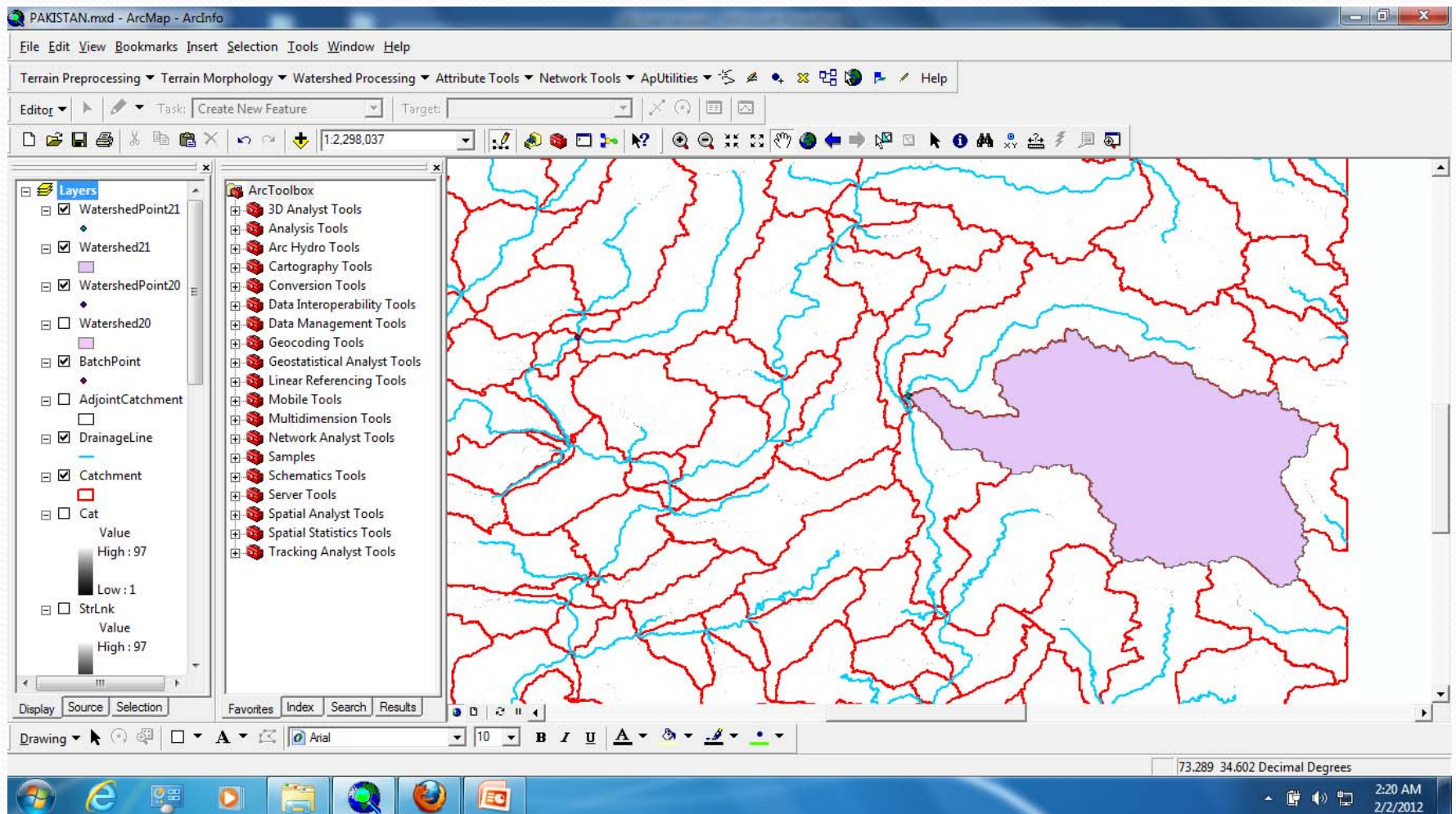
Batch Watershed Delineation
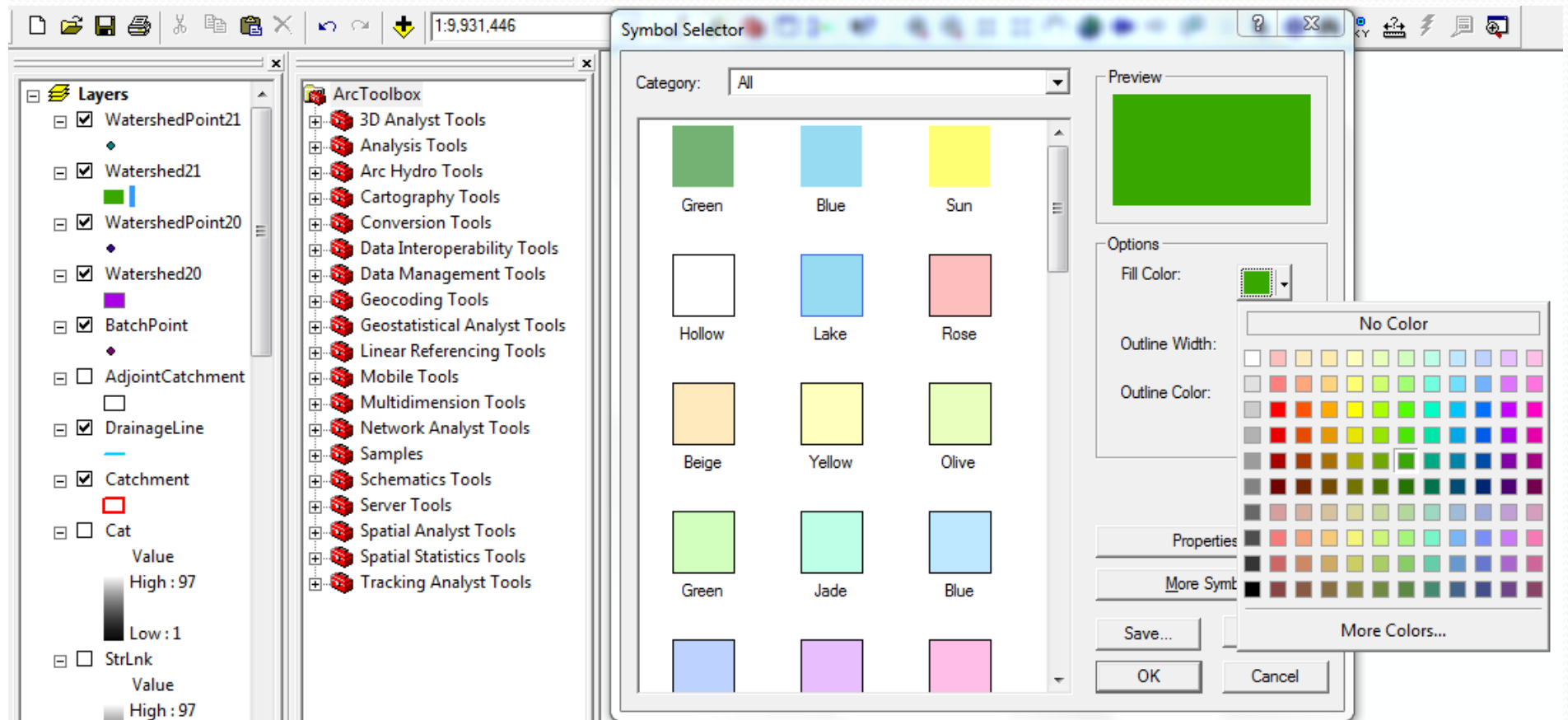## (Selecting an Arbitrary Point to Delineate watershed)

- Clicking the OK will generate the watershed from the point where the Batch point was located. In the similar manner by changing the name of Outlet (say Outlet2, Outlet3 etc describing different watersheds) a number of watersheds can be delineated.
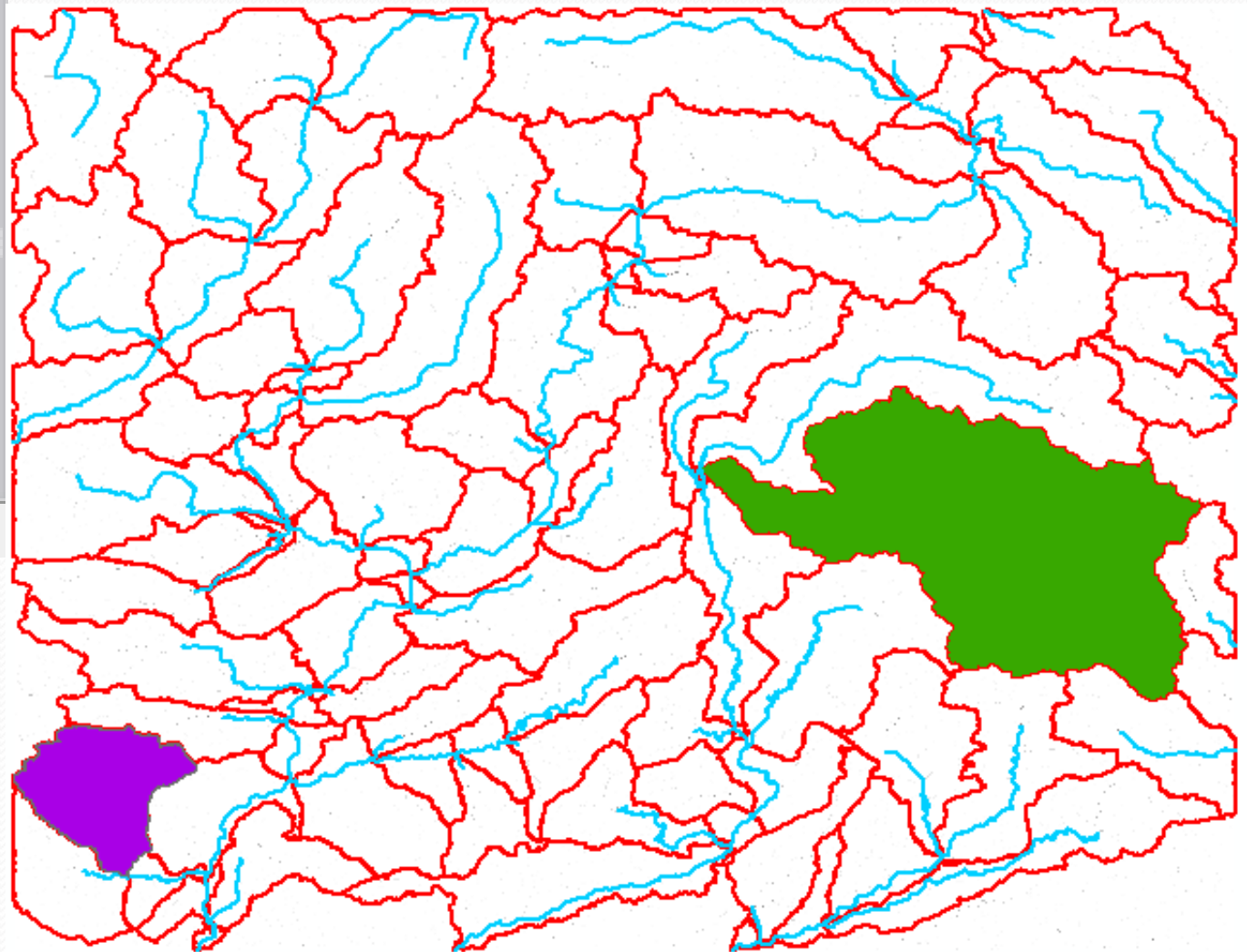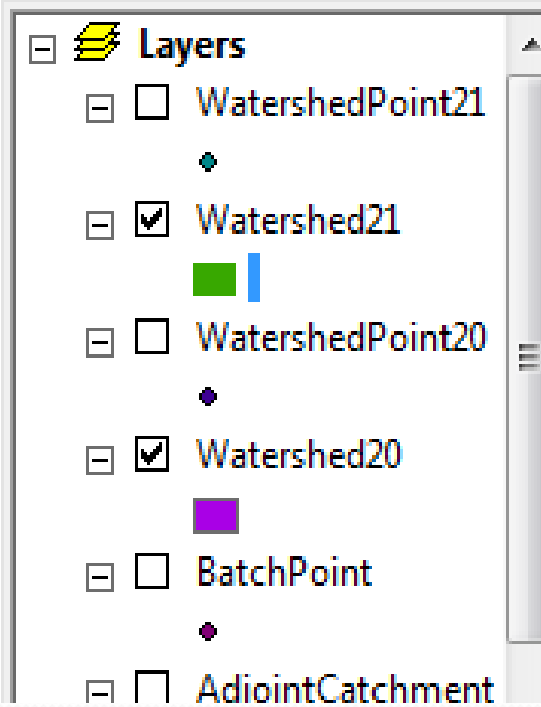
Batch Watershed Delineation
(Selecting an Arbitrary Point to Delineate watershed)

- In the example shown we have delineated watershed 20 and watershed 21 as shown in the layers. The color scheme can be changed by left clicking the watershed icon and the following window will be opened.

Batch Watershed Delineation
(Selecting an Arbitrary Point to Delineate watershed)

Batch Watershed Delineation
(Selecting an Arbitrary Point to Delineate watershed)