Introduction to GIS and Hydrologic modeling using ArcView 3.x

Tutorial and case study for the
DIFPOLMINE CONFERENCE
Budapest 2005

1. Introduction to GIS

Using ArcView, beginner's guide.

- Opening shape and image data sources
- Zooming, panning
- Labeling themes
- Thematic mapping
- Spatial join
- Analysis
- Presentation

2. Hydrologic modeling

The study area is situated in Gyöngyösoroszi, Hungary, around the abadoned czink and plume mine.

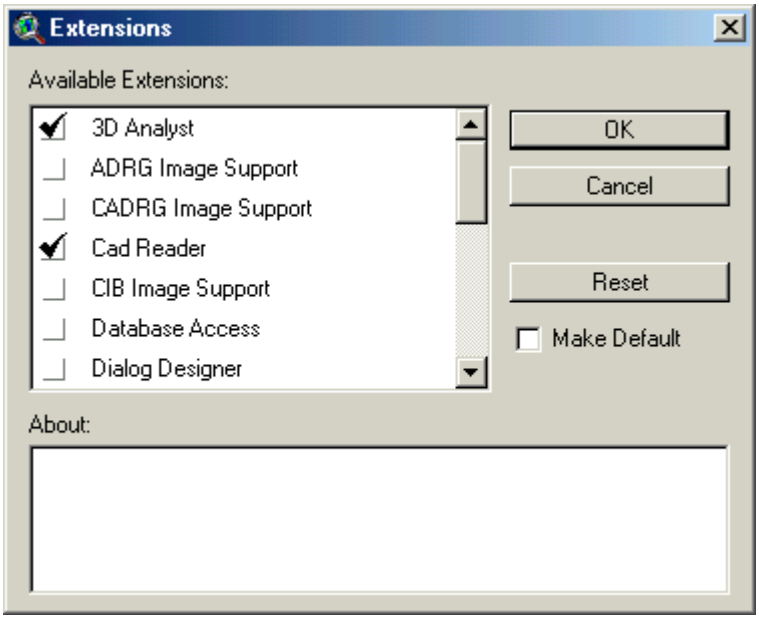
Data given

- Elevations, given in an AutoCAD DXF (Drawing eXchange File) as 3D contour lines,
- Land cover (CORINE), given in ESRI Shape file
- As, Zn, etc. measurements at sample points as an ascii file
- location of pit-heaps

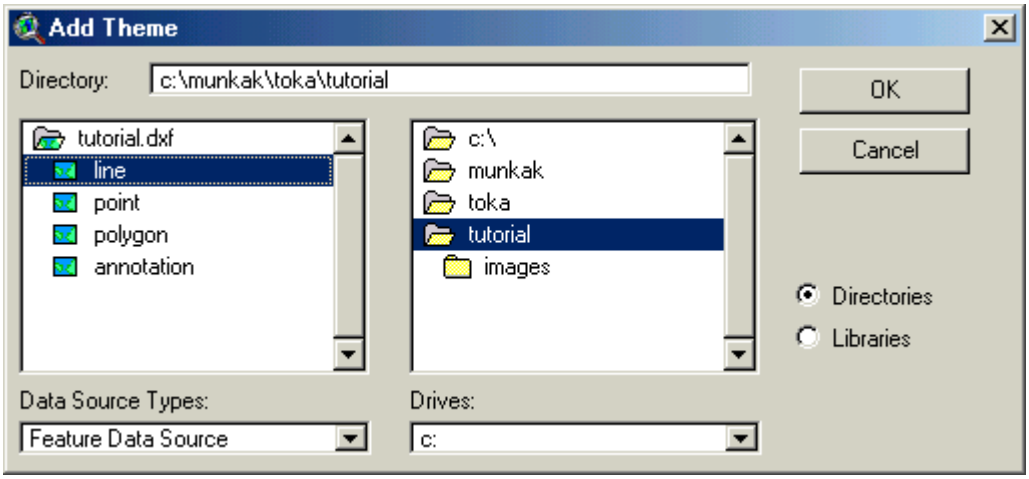
Creating the DTM

Start ArcView (Look for the icon on the desktop or select it from the Start/Programs/ESRI/ArcView GIS/ArcView GIS) and create a new project with a new view. Do not add data to the view at this moment.

Add CAD Reader, 3D Analyst and Spatial analyst extensions using the File/Extensions menu option. After loading the extensions some new menu title are shown (eg. Analysis, Surface).

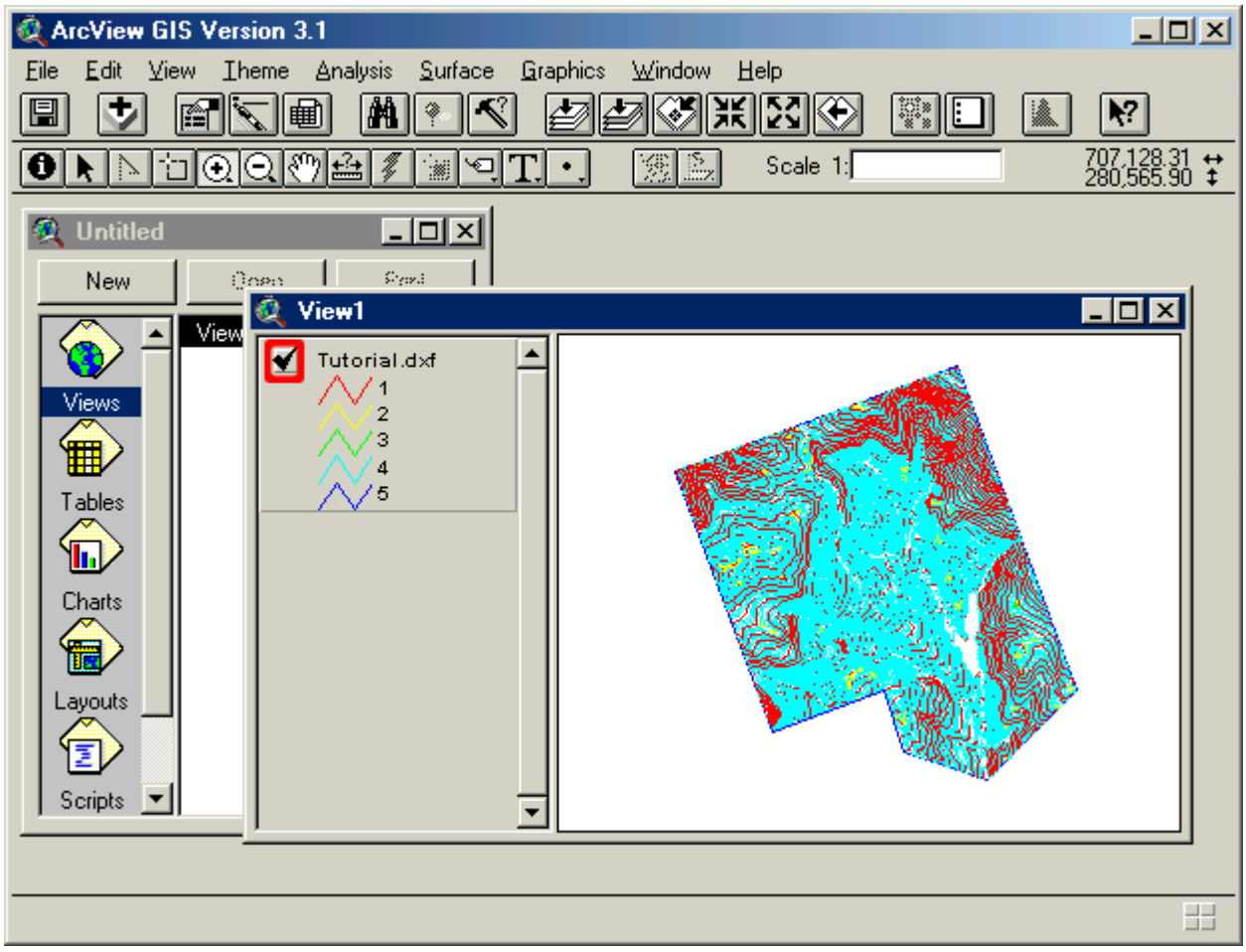


Now make the View active (click in the window titled by View1) and let's add a new Theme to the view clicking on the icon (or View/Add theme from the menu). Select the *tutorial.dxf* file. Please note that the drive and directory may be different on your machine.



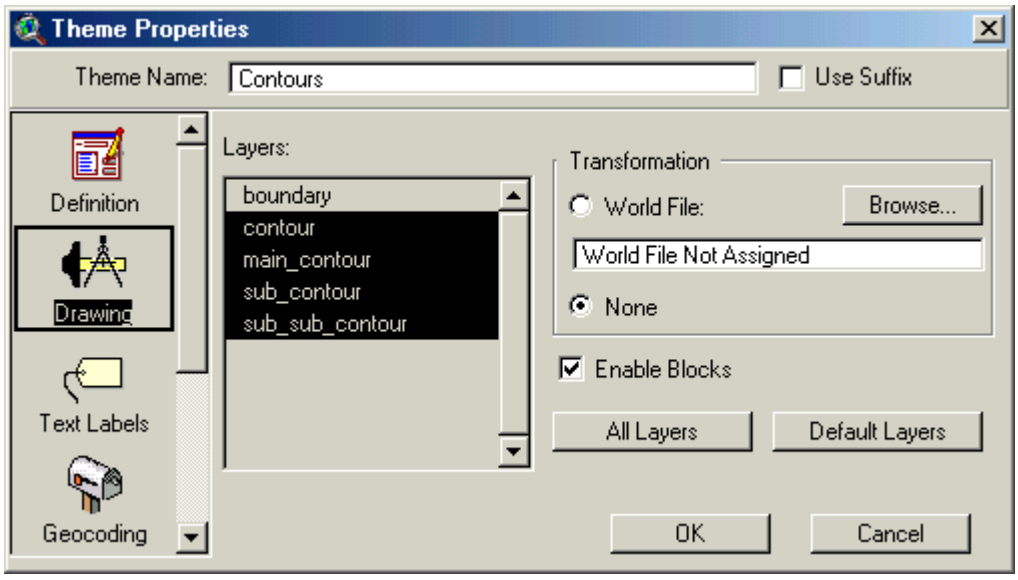
Turn on the new theme in the View clicking on the checkbox of the *tutorial.dxf*. This is the north part of

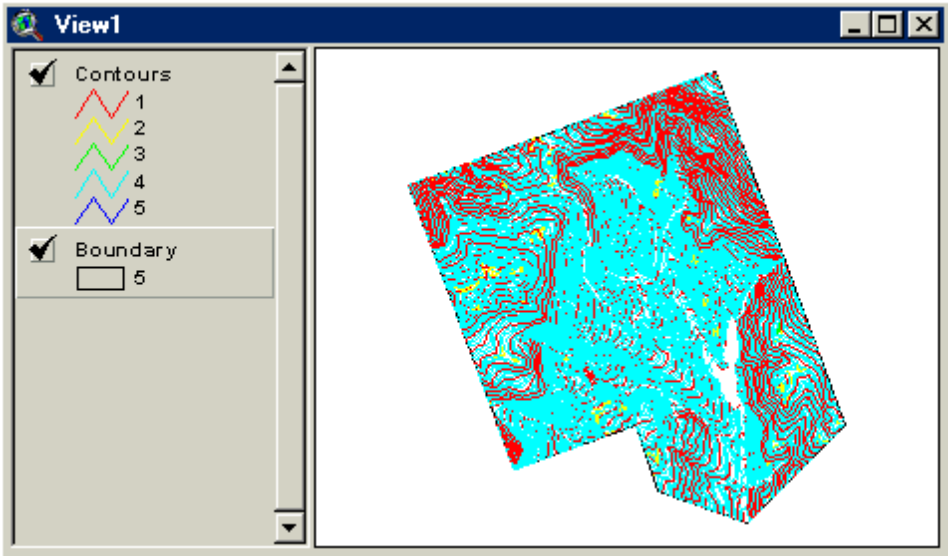
Toka valley.



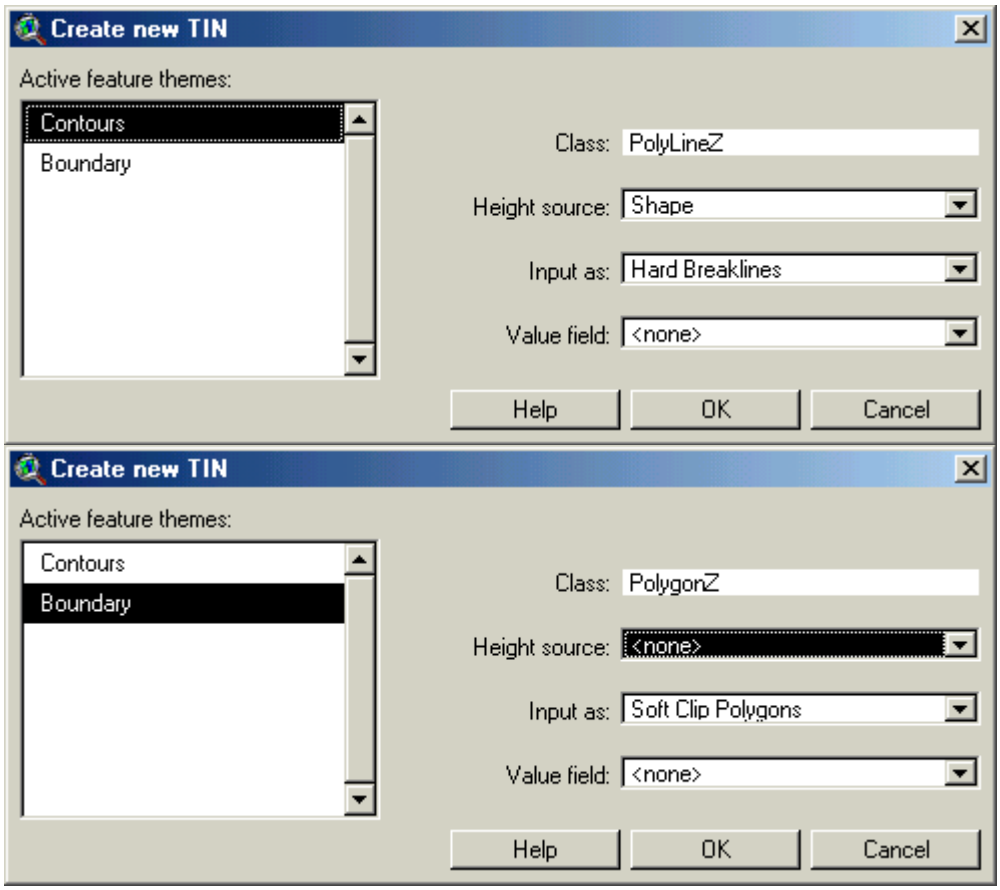
Now we shell create a continuous surface from contour lines. Before we start this job we have to separate two different type of information given by the dxf file. It contains contour lines and the boundary of the study area. We should have two themes one for the contour lines and an other for the boundary. Make tutorial.dxf the active theme clicking on the name of the theme, then select Theme/Properties from the menu. Select the **Drawing** icon from the left side list. Deselect **boundary** layer, hold down Shift key and click on the **boundary** in the list. Change the name of the theme to **Contours**.

Now add the tutorial.dxf file again to the project but select polygon after clicking on the icon left to the *tutorial.dxf*. Change the properties of the new theme similar to the contours theme but now select only the boundary layer from the list and change the name to **boundary**. Finally change the order of the themes. Click on the name of **boundary** theme and drag it below then **Contours** theme.



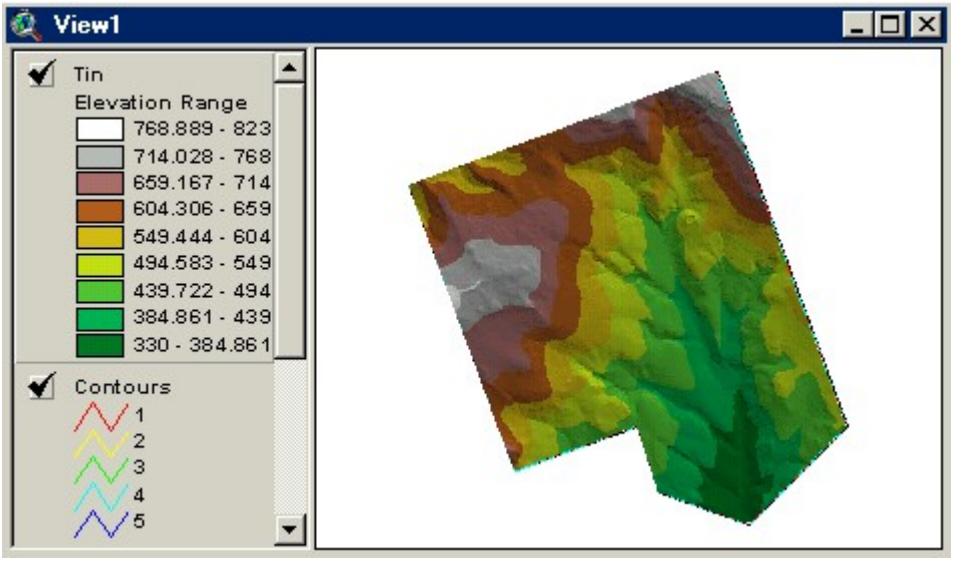


Now the data are ready to create the DTM. Make both theme active, click on the name of Contours then Shift click on the name of Boundary theme. Select Surface/Create TIN from Features from the menu. Set up the two themes properties as follows.

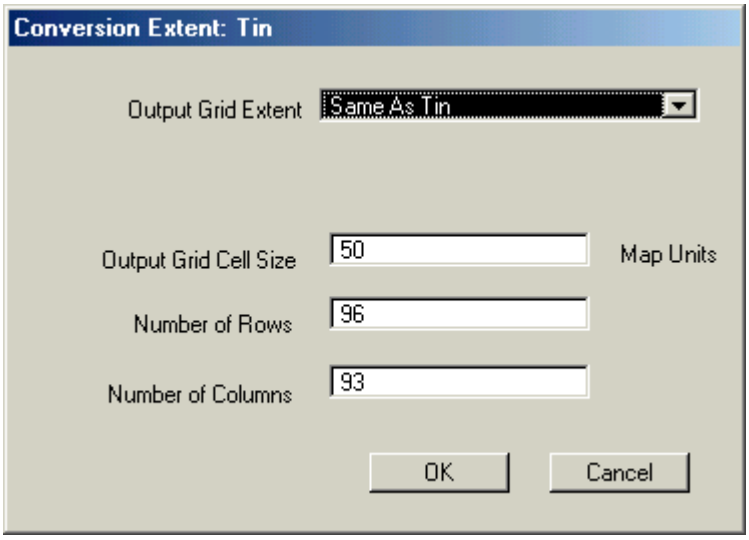


Finally accept the default name and folder for the TIN.

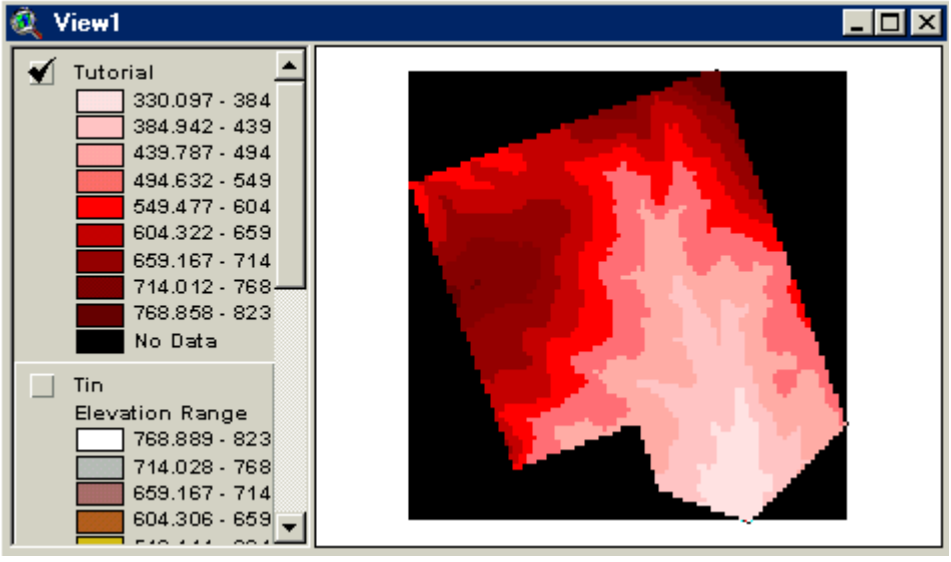
We have created an Digital Terrain Model (DTM) which consists of triangles. A new theme has been added to our view, turn on this new theme. It may take several seconds to display the theme. Now we can get elevation data for any point. Select the DTM theme in the View clicking on the name, then choose the "i" (identify) tool from the tool bar. Clicking in the map you get the elevation at that point. The created TIN contains 194756 triangles 97798 nodes (check Theme properties).



Lest's simplify DTM converting it to a Grid. Select Theme/Convert to Grid from the menu and after setting the location and name of the grid, set the parameters as follows. You must set first the resolution and then select the output grid extent and the number of rows, columns are recalculated. Finally add the new grid to our view.



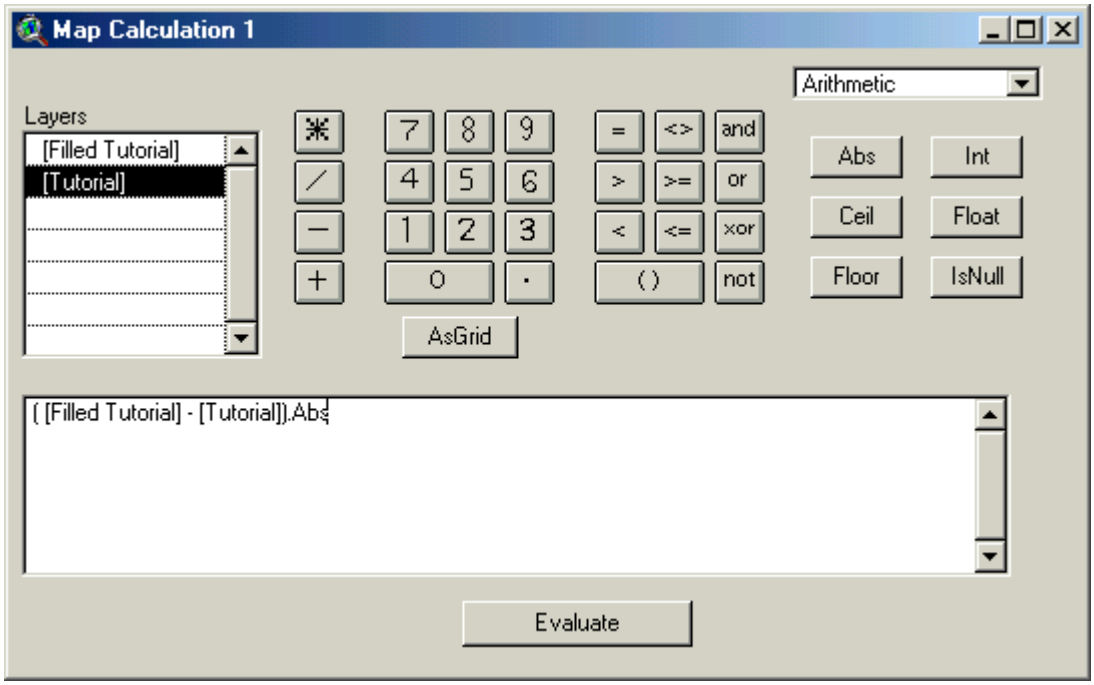
Turn on the Tutorial grid. We get a rectangular area, black cells outside the boundary. The legend call them "No Data". The grid boundary must be rectangular, but cells can be assigned to "No Data" value.



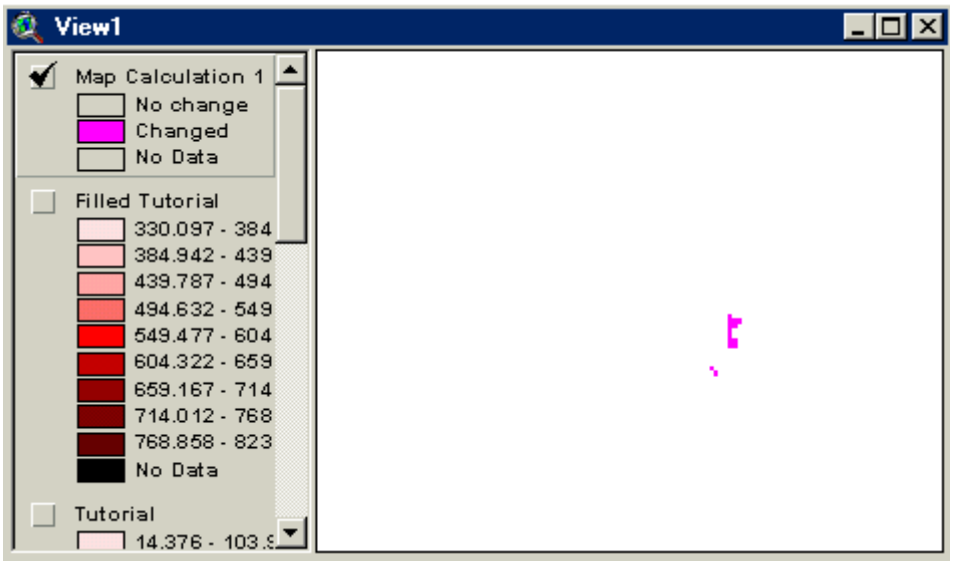
We have to remove sinks from the DTM for hyrologic modeling. Let's load the Hydrologic modeling

extension similar to Spatial analyst extension (File/Extensions) Make the DTM theme active and select Hydro/Fill sinks from the menu. You get an another grid with sinks filled (Filled tutorial).

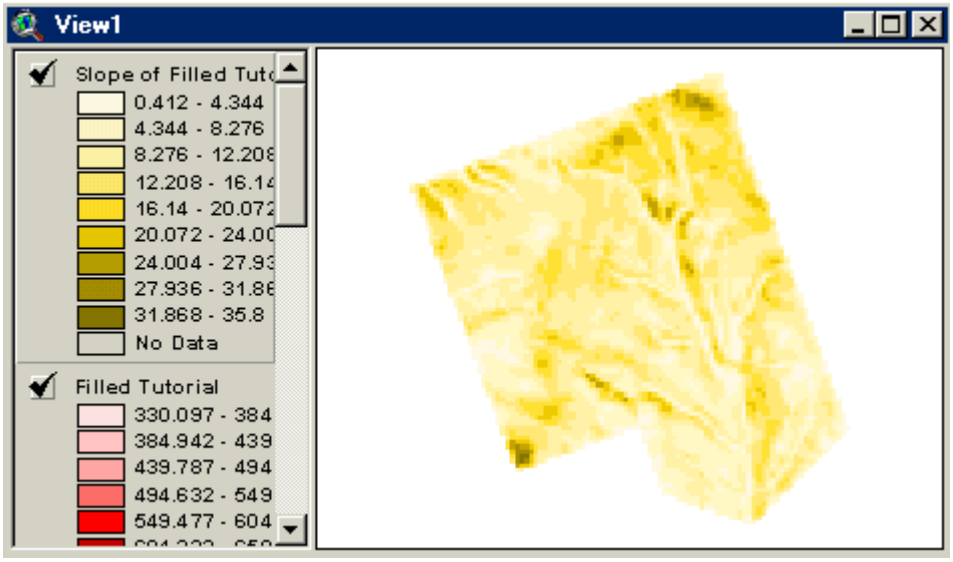
Let's try to find the areas where sinks were filled. Select **Analysis/Map calculator** from the menu. Add the formula to calculate the absolute value of height differences. Evaluating the differences between the cells of the two grids we found that there were sinks at two small areas. You allways have to check for sinks before starting hydrologic modelling.



Let's reclassify the difference grid. We need only 3 values, changed, not changed, no data. Open the legend editor for this theme and press the classify button. Reduce the number of classes to two. Then edit the Value and Label columns. Value 0, label No change for the first class, value 0.001 - 10, label Changed for the second class. Change the color of the classes double clicking on the rectangles in the Symbol column.

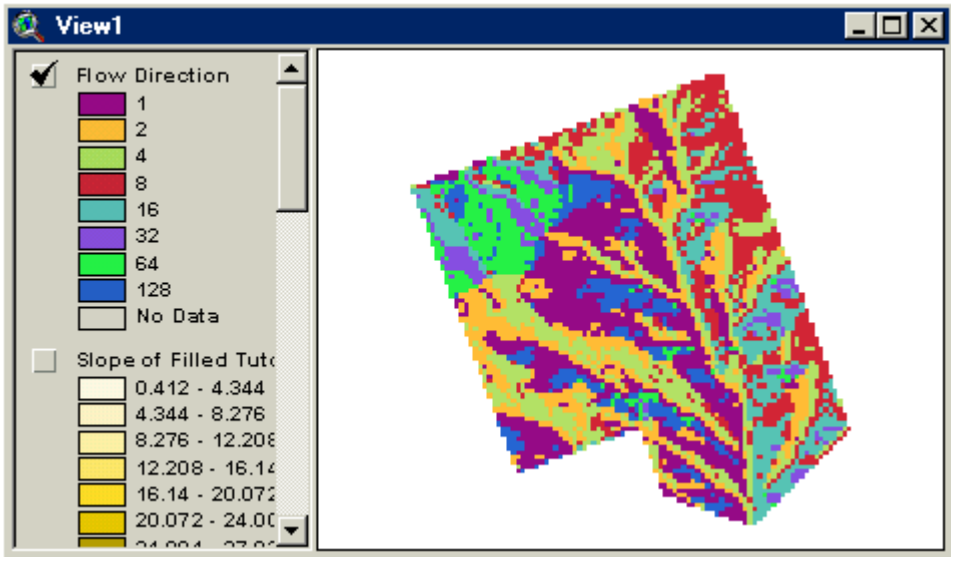


Lest's derive slopes from the DTM. Make the Filled Tutorial the active theme and Select **Surface/Derive** slope from the menu. We get another grid, the values are a slope in degree.

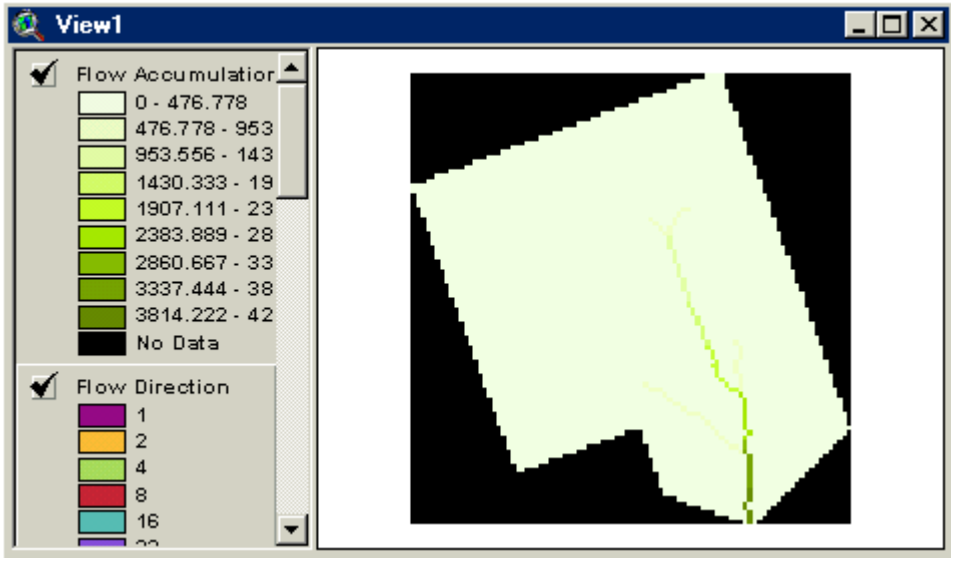


Let's generate a flow directions grid from the Filled Tutorial grid. This grid shows the on surface water flow direction from one cell to one of the eight neighboring cells. Make the Filled Tutorial the active theme and select **Hydro/Flow Direction** from the menu. Directions are coded

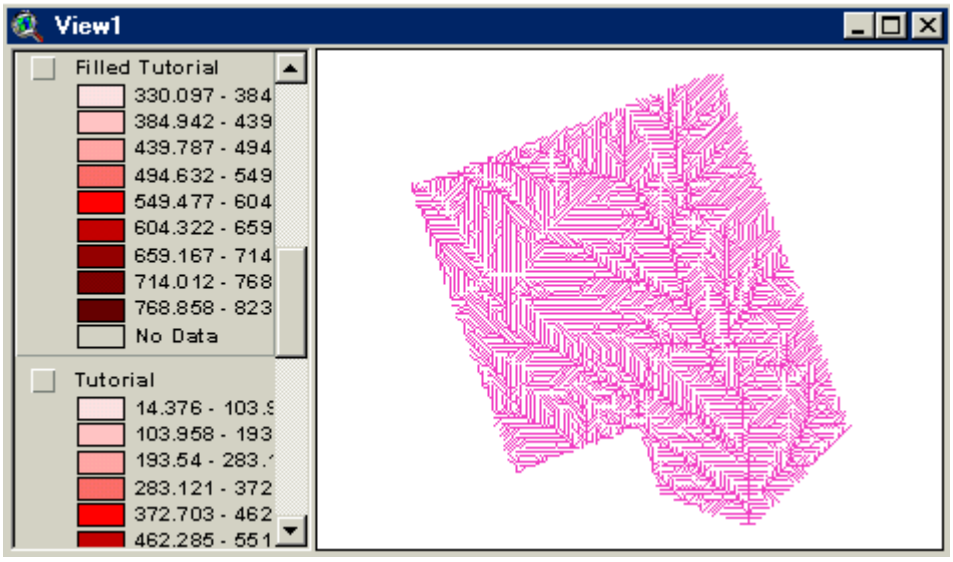
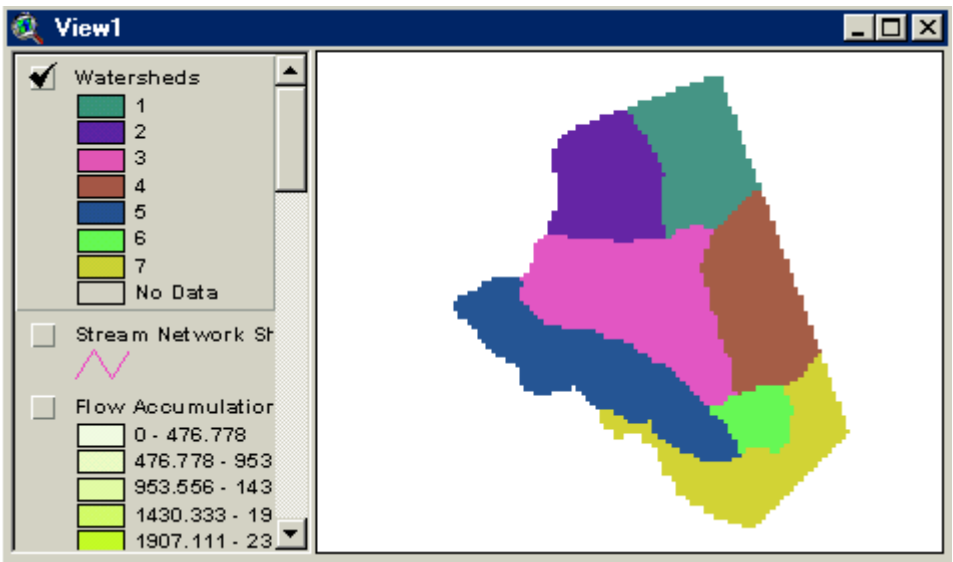
- 1 - East
- 2 - Southeast
- 4 - South
- 8 - Southwest
- 16 - West
- 32 - Northwest
- 64 - North
- 128 - Northeast



Now we will use flow directions to find the creeks, streams. We can accumulate flow directions, the number of cells from which water flows to a cell are counted during the accumulation. Make the Flow Direction theme the active theme and select **Hydro/Flow Accumulation** from the menu. We get the Toka creek.



We can find the stream network as lines too. Make the Filled Tutorian theme the active theme and select **Hydro/Stream Network as Line Shape** from the menu. Enter 50 for the minimum number of cells for a stream network and select Flow Directions theme from the list.



Let's try to find the watersheds. Make the Flow Accumulation theme the active theme and select **Hydro/Watershed** menu. Enter 500 for the minimal number of cells for a watershed and select Flow direction theme for the direction grid theme.