Application of ArcMap TOPAGNPS Tool

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Abstract

This report documents the step-by-step procedure for the application of ArcGIS (Version 8.2) TOPAGNPS tool developed recently by Huaguo Xiao. The application example for OR_Mission_Creek is adopted from the released package of AnnAGNPS (Version 3.2 Released November 29, 2002) by USDA. The results from the present application match the results from original released package. This tool can be applied to facilitate watershed-modeling work significantly.

1. Introduction

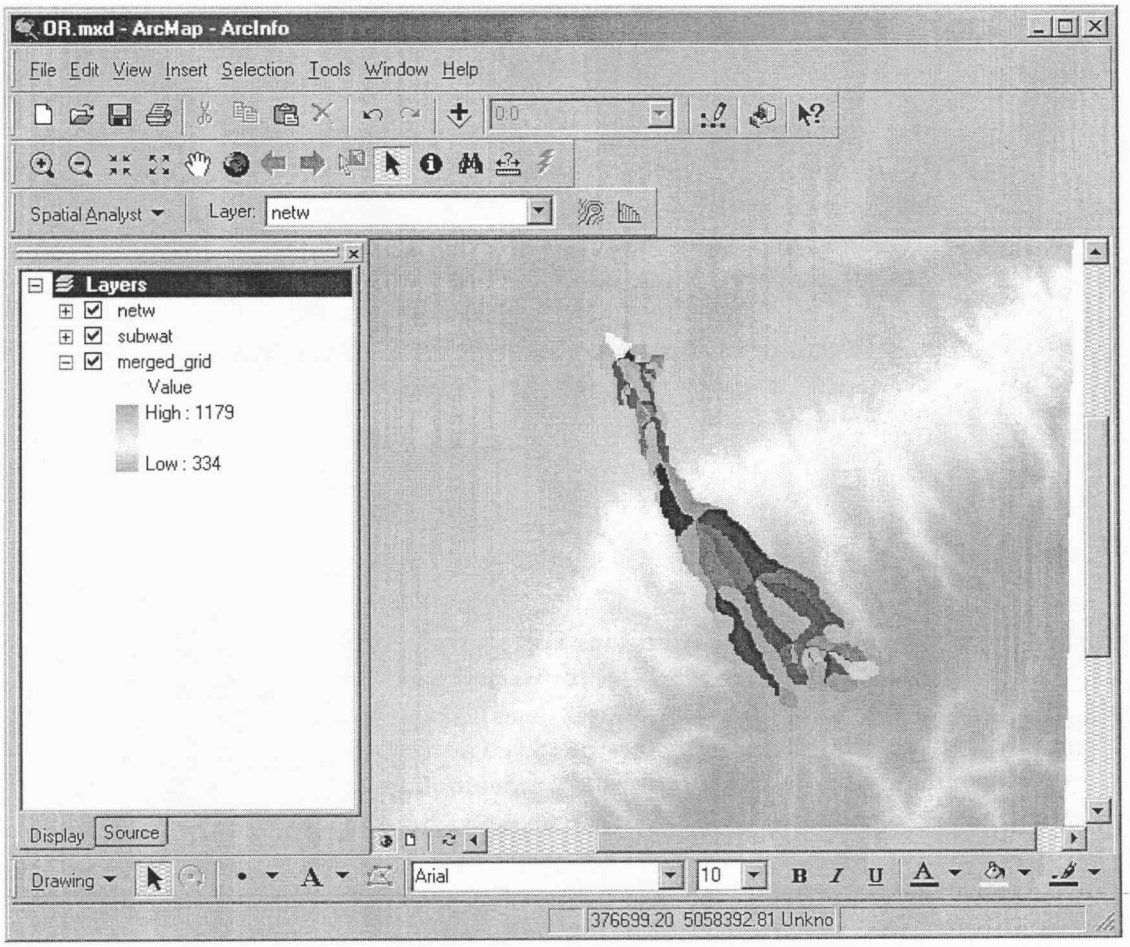
Both Topaz (TOpographic PArameteriZation) [1] and AnnAGNPS (AGricultural Non-Point Source Pollution Model) [2] models for watershed are very much involved in term of preparing and presenting input and output data. Data are usually in Geographic Information Systems (GIS) format and ArcGIS is a power tool for data processing. The interface developed by Huaguo Xiao recently provides handy and user-friendly tool for using both Topaz and AnnAGNPS models with ArcGIS 8.2. This report is prepared to offer a step-by-step approach for model user. It can be used as a user manual or a tutorial. This package, based on ArcGIS 8.2 and AnnAGNPS 3.2, is different from the one developed in 2001 [3] based on ArcView 3.3 and AnnAGNPS 2.2. The AnnAGNPS 3.2 fixed several bugs in AnnAGNPS 2.2 and improve many features.

In this report, a Digital Elevation Models (DEM) clip method, DEM processing, watershed delineation, and generation of TOPAGNPS input files are discussed and an

application example for Mission Creek watershed is shown. The dataset for Mission Creek watershed is part of the data in the AnnAGNPS released package and a comparison is made to show this ArcMap interface produces similar outputs as the AnnAGNPS released package.

2. OR_Mission_Creek data

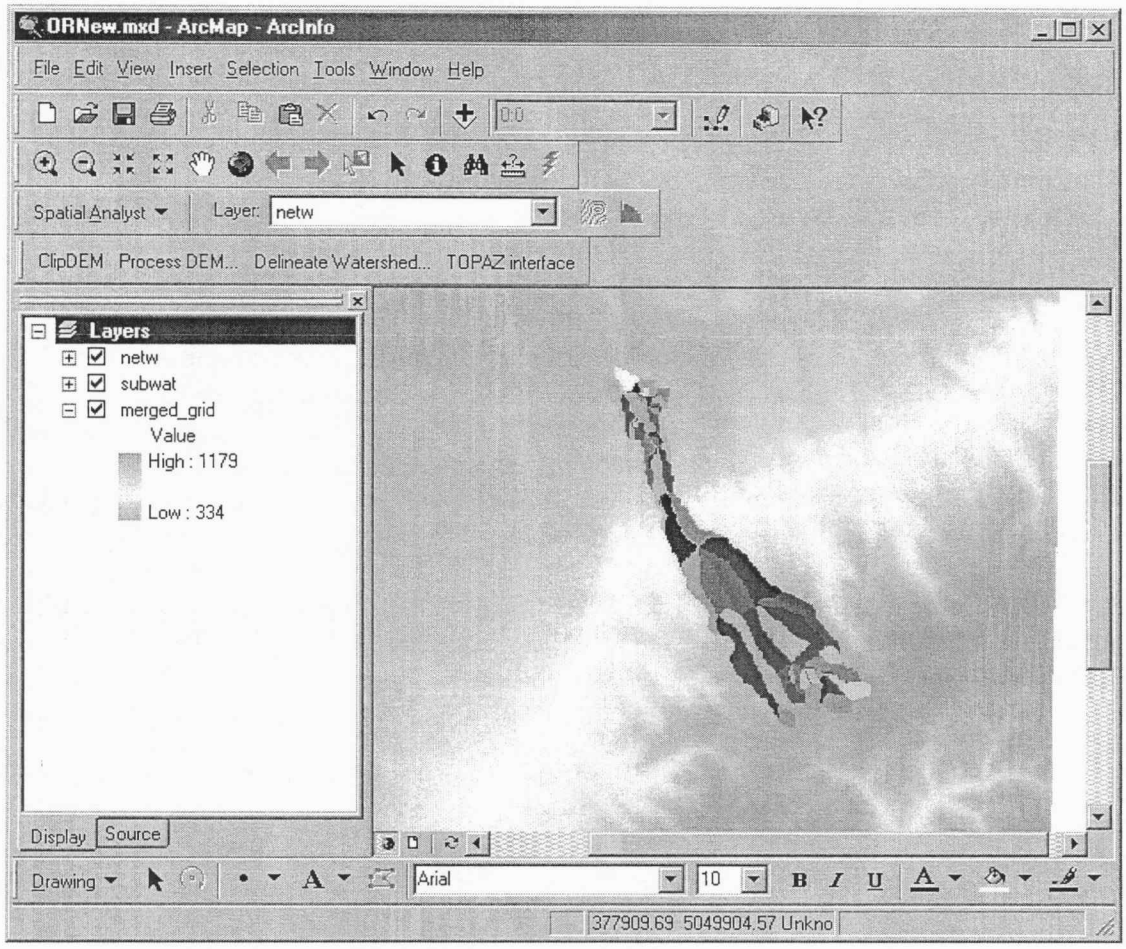
The following figure is the DEM, derived sub-watershed, and stream network for OR_Mission_Creek data. Data are taken from the directory AGNPS_Watershed_Studies\OR_Mission_Creek\4_ArcView_Datasets\TOPAGNPS_Files. The figure is saved as a file named OR.mxd. For the application of the ArcMap TOPAGNPS tool, make a copy of the directory OR_Mission_Creek as "Copy of OR_Mission_Creek". This directory will be used as a working directory. The same data set is used and the similar figures will be produced in this directory using the ArcGIS TOPAGNPS tool.



3. Loading the ArcGIS TOAGNPS tool

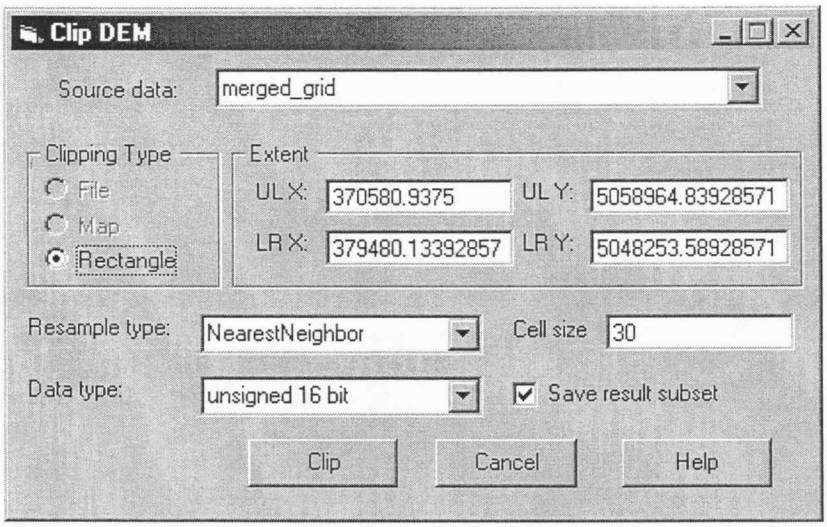
Open ArcMap and load the dll files into ArcMap. To use this interface, ArcGIS Spatial Analyst must be installed and licensed. To load the dll files, click Tools>customize...>Toolbars. After clicking on new, give a new name for the "toolbar name" field and choose untitled or normal.mxt (untitled is recommended) for the "save in" field. Now click Commands tag in the customize dialog. Then click "add from file..." button. Navigate to the dll file location and choose them. Click OK when messages show up and ask you if you like to add the objects. In the categories field, find the "DEMprocessing" and choose it. In the Commands field, click and drag all the commands to your new toolbar. For loading the TOPAGNPS, in the categories field, find the "TOPAGNPS" and choose it. In the Commands field, click and drag all the commands to your new toolbar. Finally click "Close" button to close the customize dialog and you will see the toolbar for TOPAGNPS show up.

Open the file OR.mxd from the newly created directory and save it as ORNew.mxd. We will use it as a working file and compare it with OR.mxd at the final step. The ArcGIS TOPAGNPS should show up like the following figure.

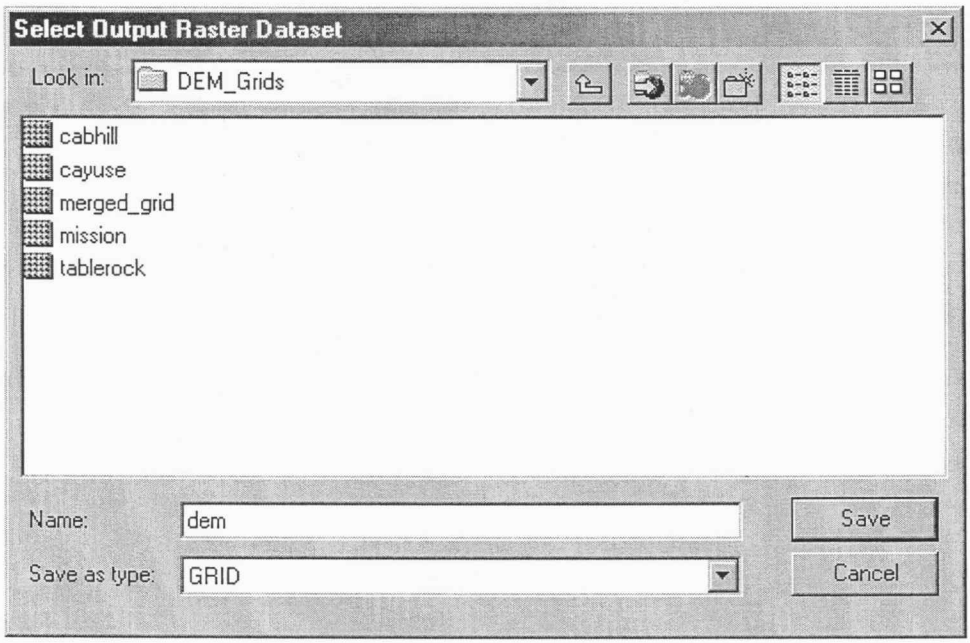


4. Clipping DEM

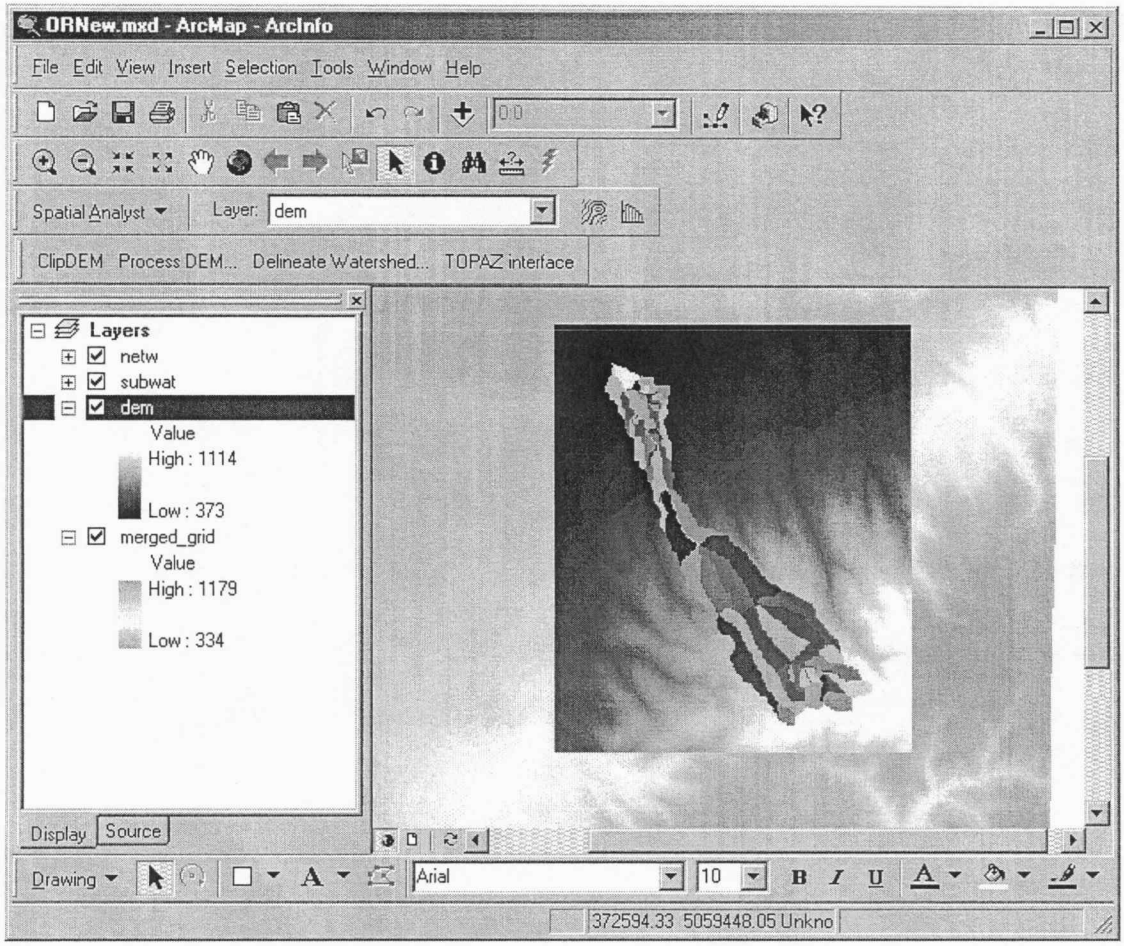
To reduce processing time, clip the DEM covering the watershed. Using rectangle drawing tool to draw a rectangle covering the watershed then click on the item ClipDEM. Fill the parameters in the panel looks like the following figure.



Click on Clip button and save it as a grid file named dem as the following figure.



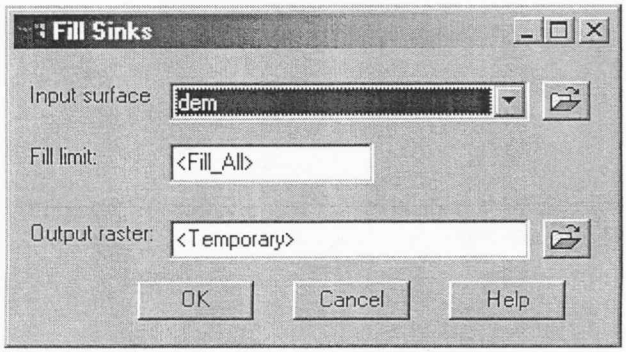
After deleting the rectangle, the ArcMap should looks like the following figure,

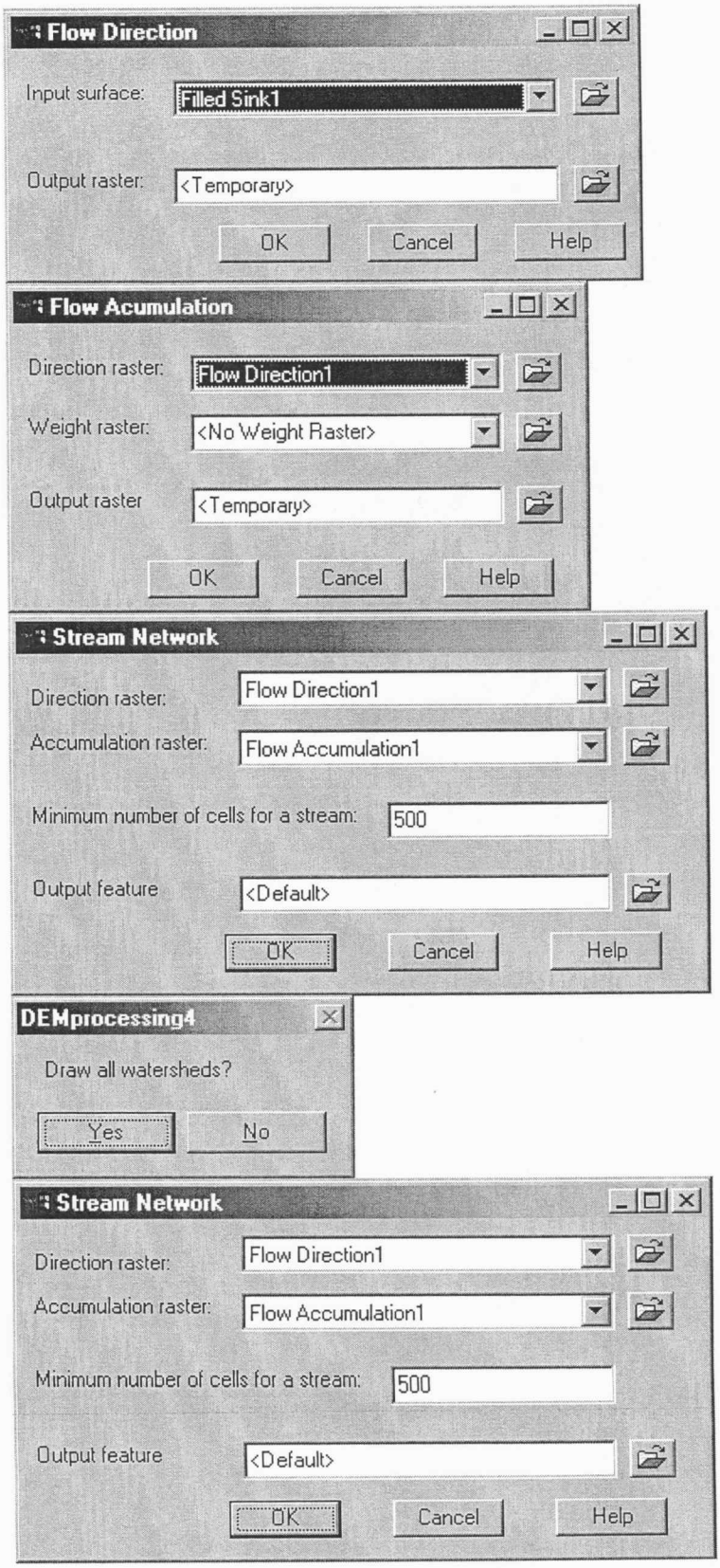


Now we complete the first step and we will be working on the Clipped DEM in black and white instead of the original DEM in color. It will save time for processing data.

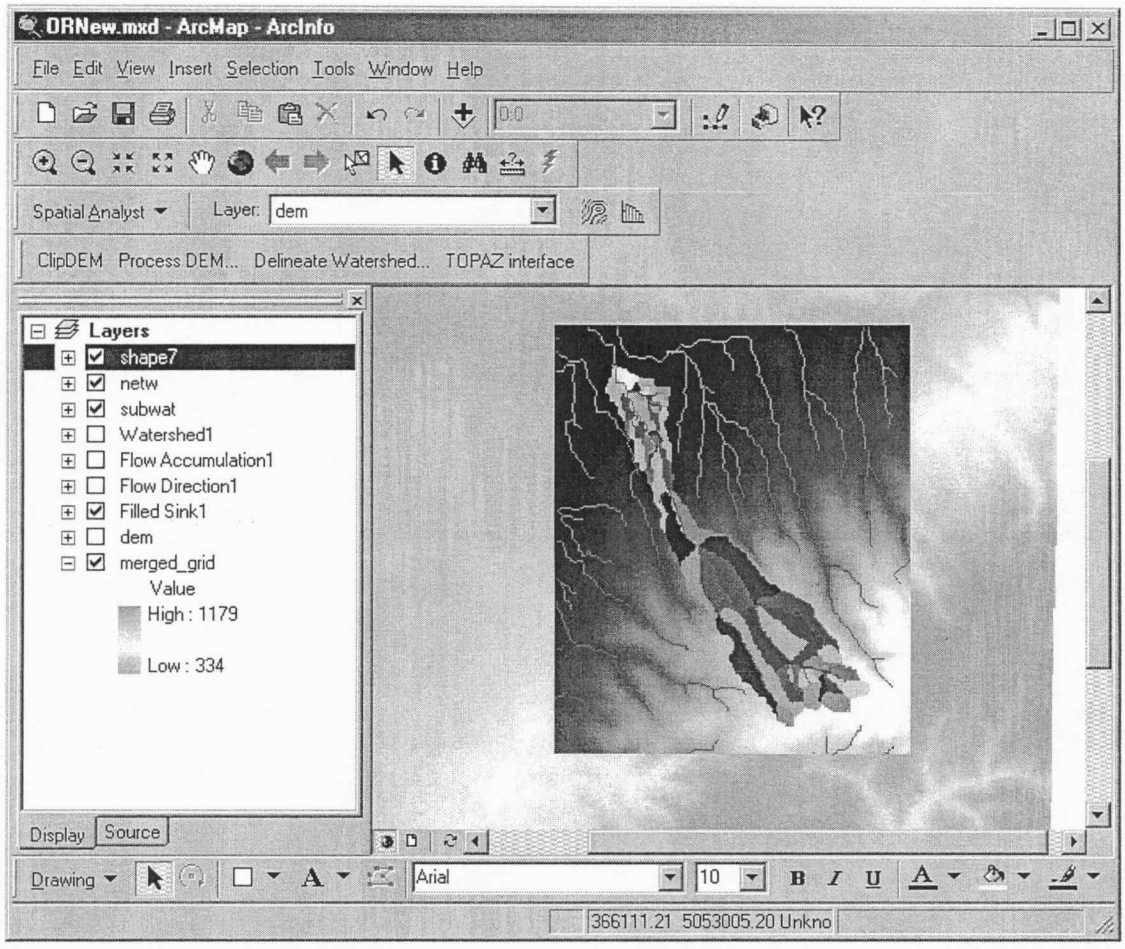
5. Processing DEM

This is an easy step. After making the dem layer active, click on item Processing DEM and Fill the following panels one by one with proper DEM and file names.



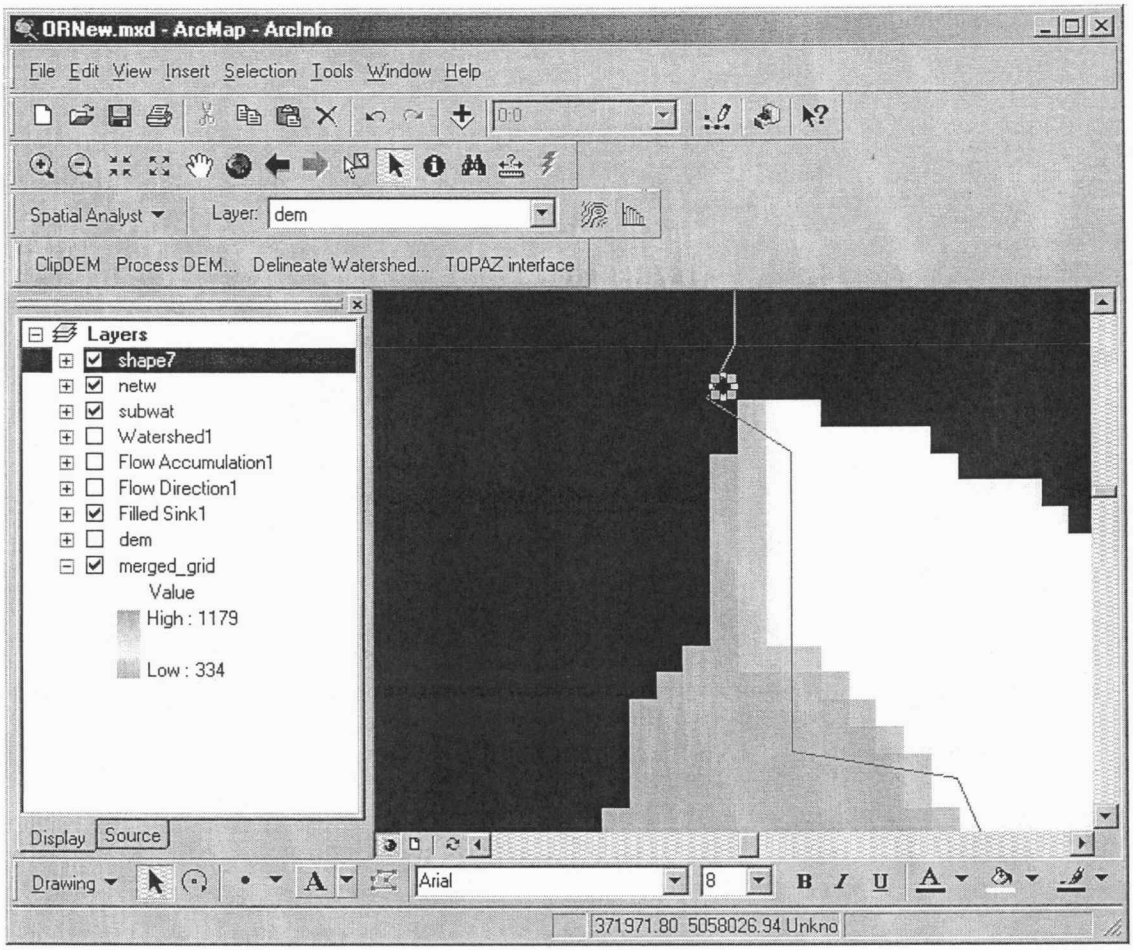

Flow Direction
Input surface:
Filled Sink1
Output raster:
<Temporary>
OK
Cancel
Help
Flow Acumulation
Direction raster:
Flow Direction1
Weight raster:
<No Weight Raster>
Output raster
<Temporary>
OK
Cancel
Help
Stream Network
Direction raster:
Flow Direction1
Accumulation raster:
Flow Accumulation1
Minimum number of cells for a stream:
500
Output feature
<Default>
OK
Cancel
Help
DEMprocessing4
Draw all watersheds?
Yes
No
Stream Network
Direction raster:
Flow Direction1
Accumulation raster:
Flow Accumulation1
Minimum number of cells for a stream:
500
Output feature
<Default>
OK
Cancel
Help

After rearranging the layers in ArcMap, the derived stream should show up as in the following figure.

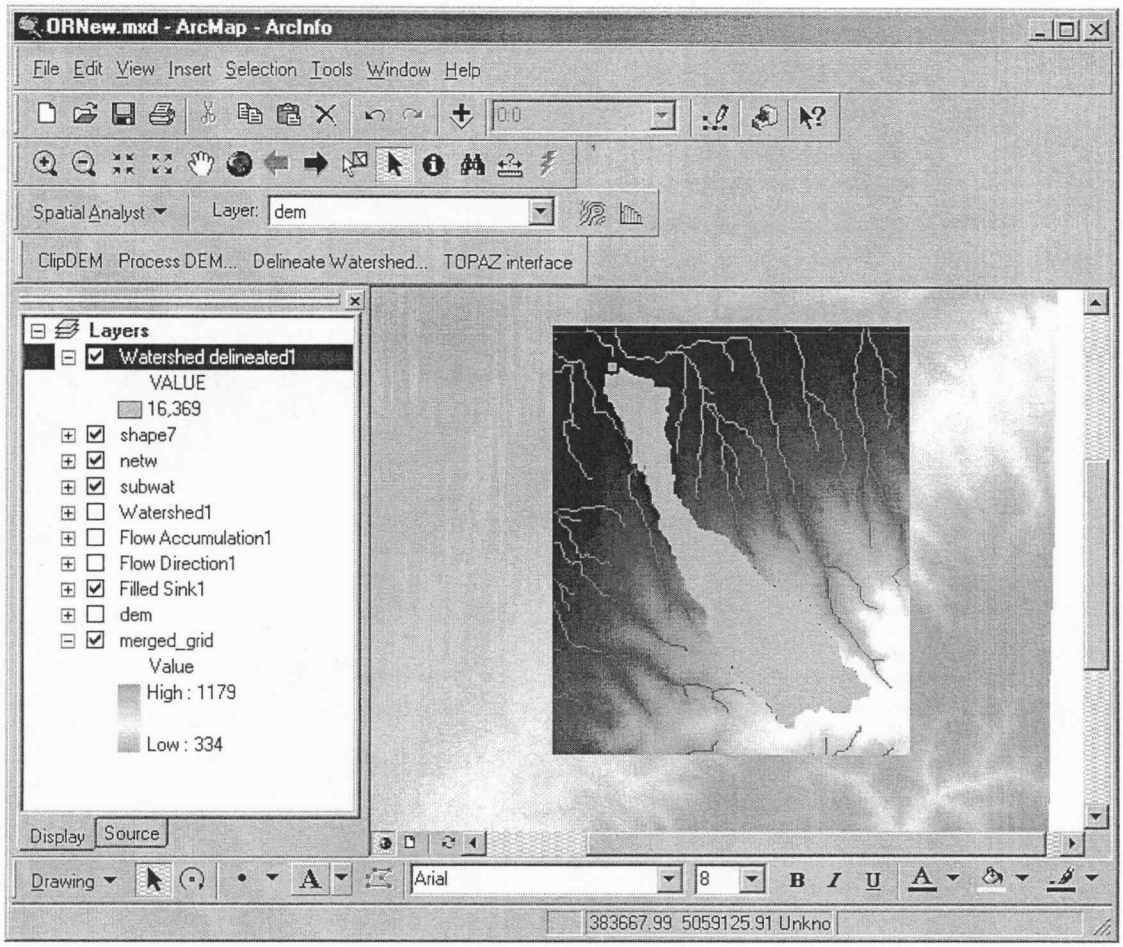


6. Delineating watershed

The key for this step is to locate the outlet for the watershed. Zoom in to the outlet area, using a point in drawing tool to define the outlet as the following figure,



Click on the item delineate watershed, the following figure will show up,

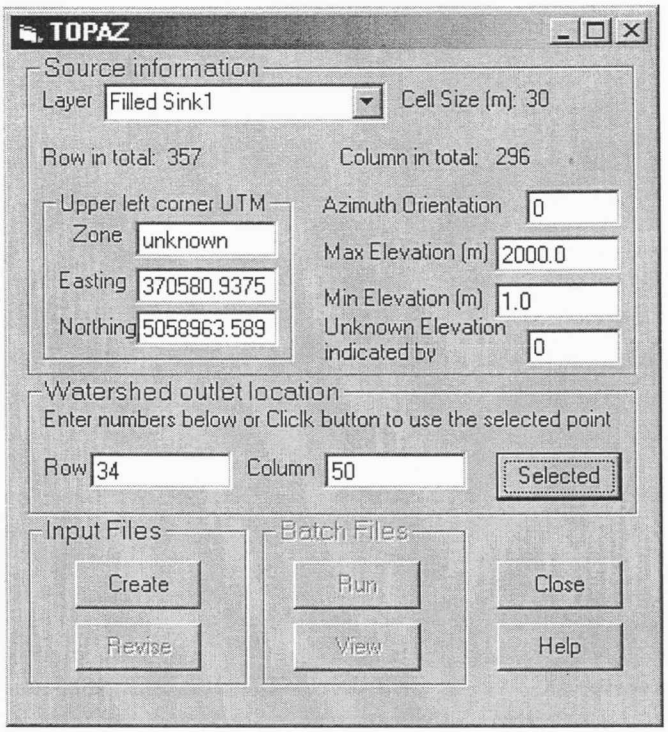


Here, you can see the delineated watershed overlays with the watershed from the original OR_Mission_Creek data. The watershed delineation has completed.

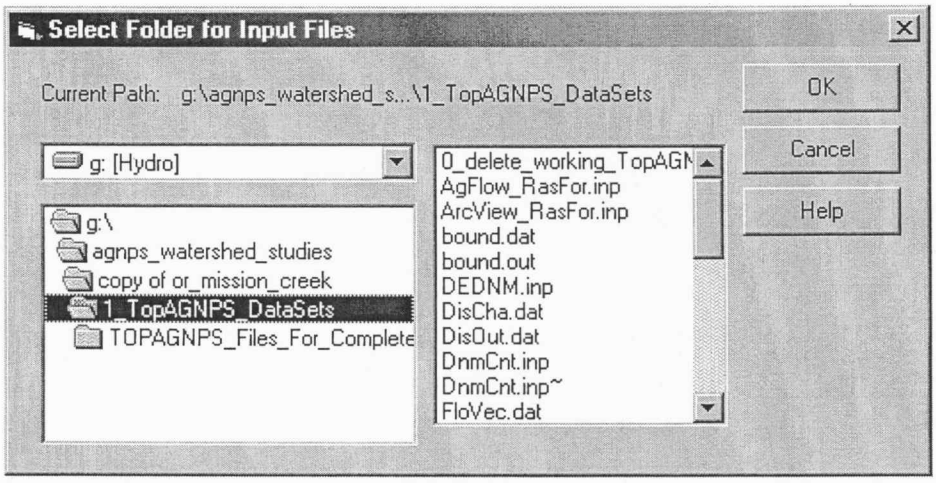
7. Topaz interface

This is an important step. It will generate the TOPAGNPS input file and run the TOPAGNPS. The results from TOPAGNPS can be added into the ArcMap for visualization and the output files can be used directly as geomorphologic part of the AnnAGNPS input.

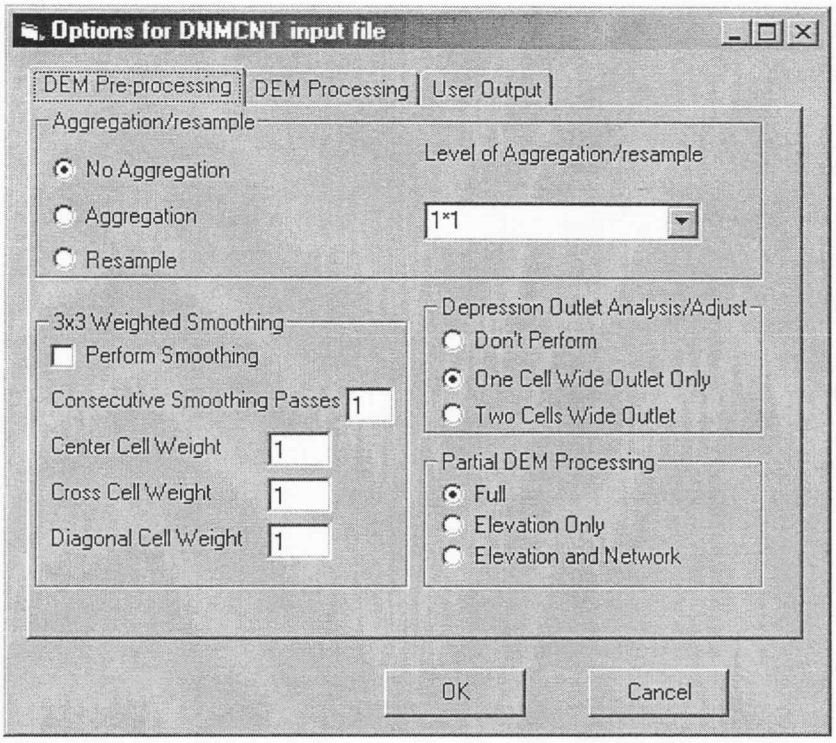
To start working, click on item Topaz interface, fill in the name of layer (DEM here) and parameters, and click on select, as shown in the following figure,



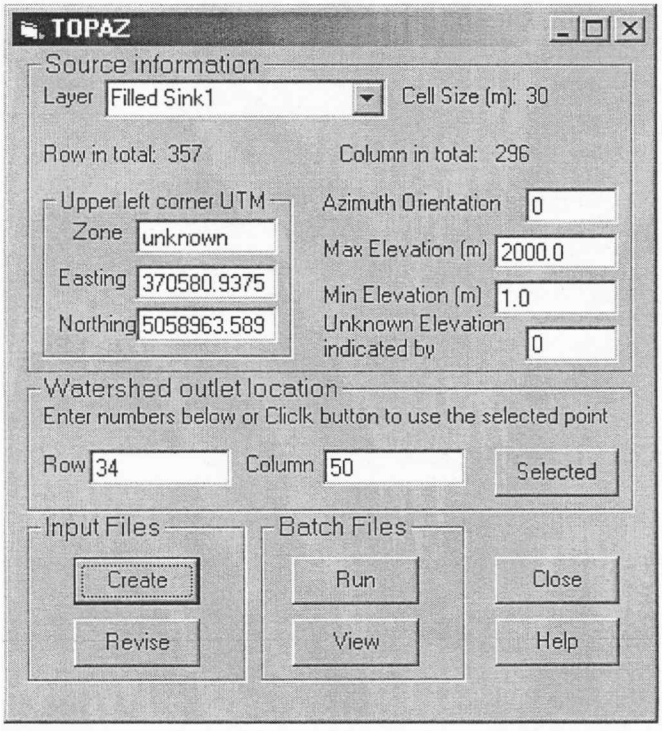
Click on Create button and navigate to the directory to save the TOPAGNPS input data,



Adjust parameters if necessary in the following panels. For demonstration purpose, the default values are used for this example.

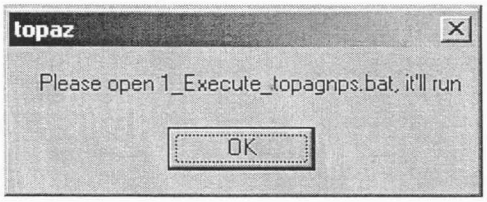


After clicking on OK, the Topaz panel will show up like the following

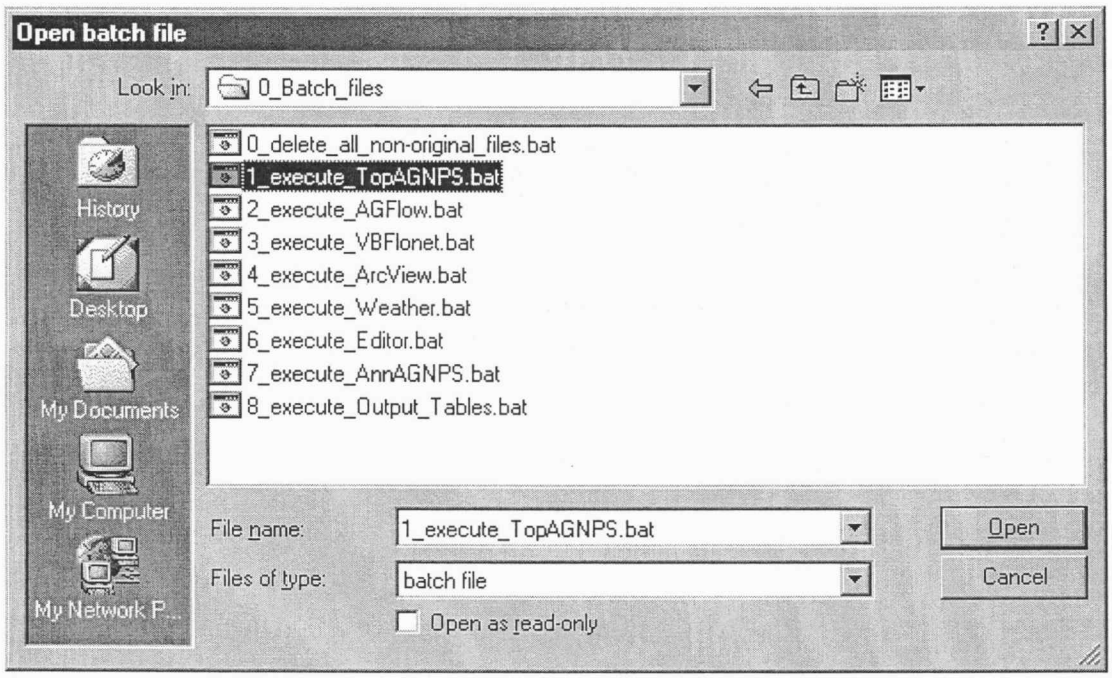


Now the TOPAGNPS input files have been generated and you are ready to run TOPAGNPS within ArcMAP.

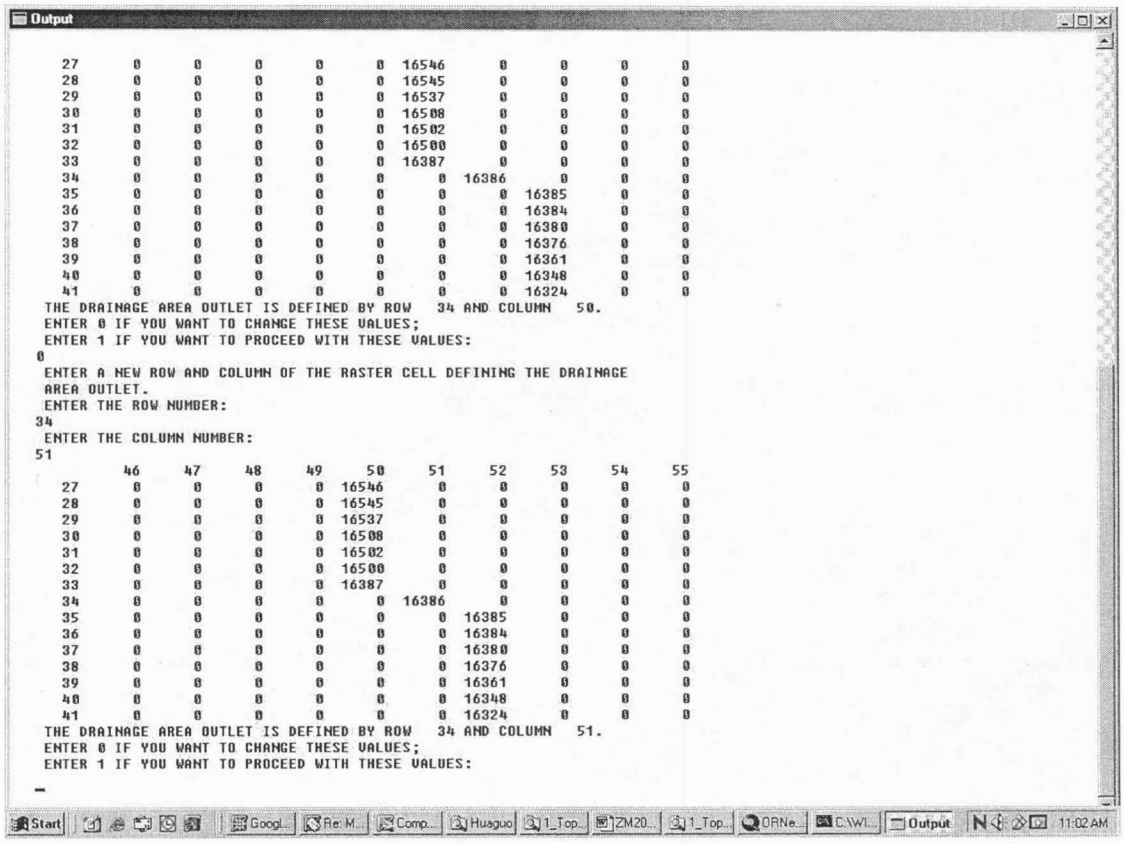
Click on the Run button,



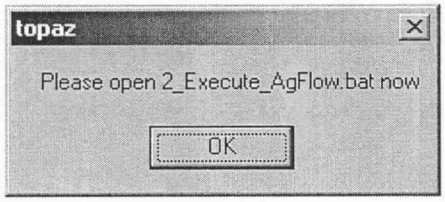
Click on OK and navigate to where the executable file is

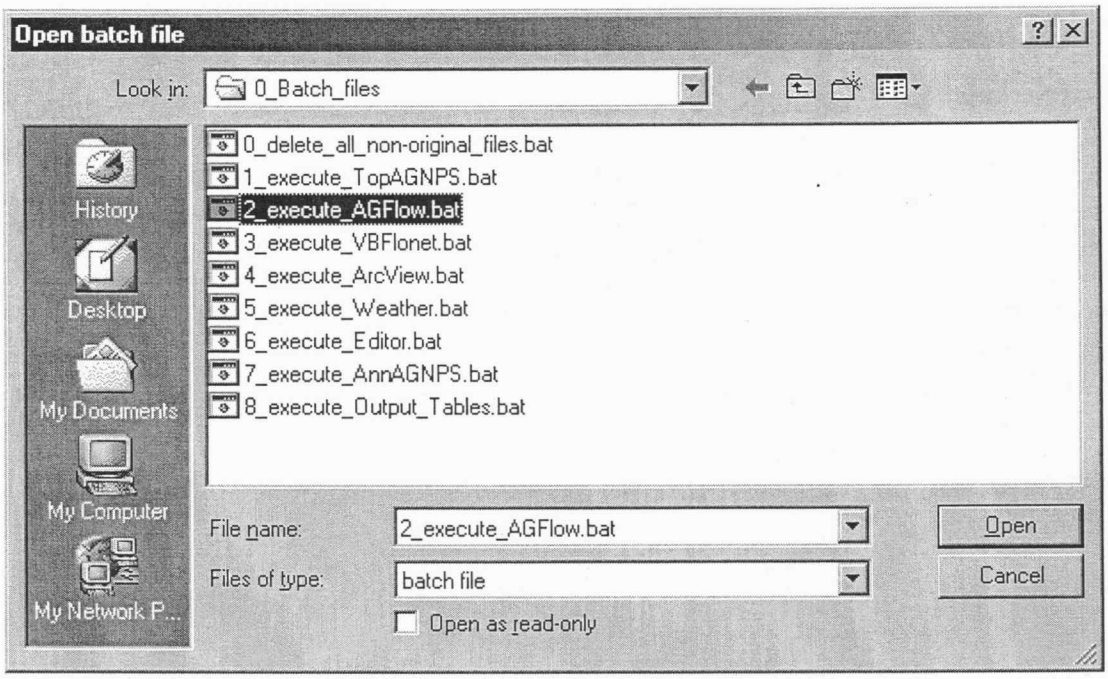


Click on Open and you will see the TOPAGNPS is running as shown in the following figure,

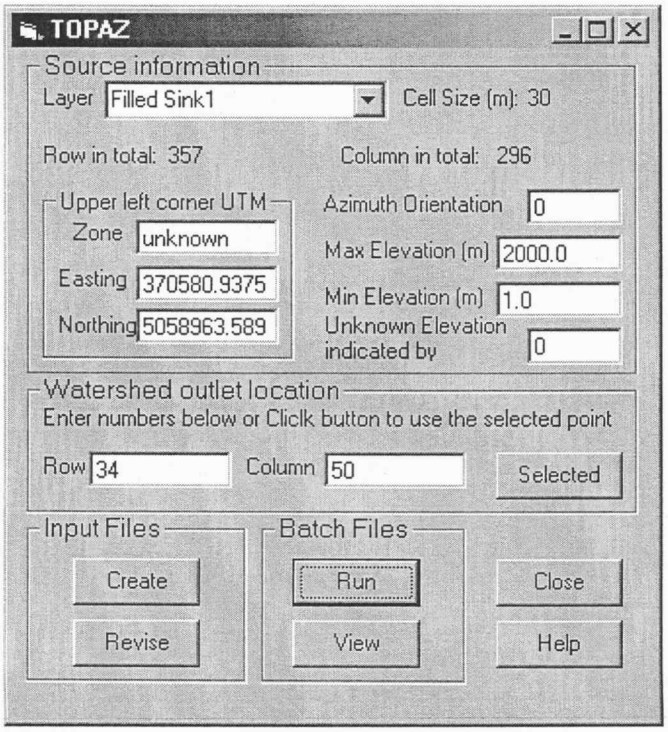


After Topaz run, activate the AgFlow and navigate to where the executable file for AgFlow is,





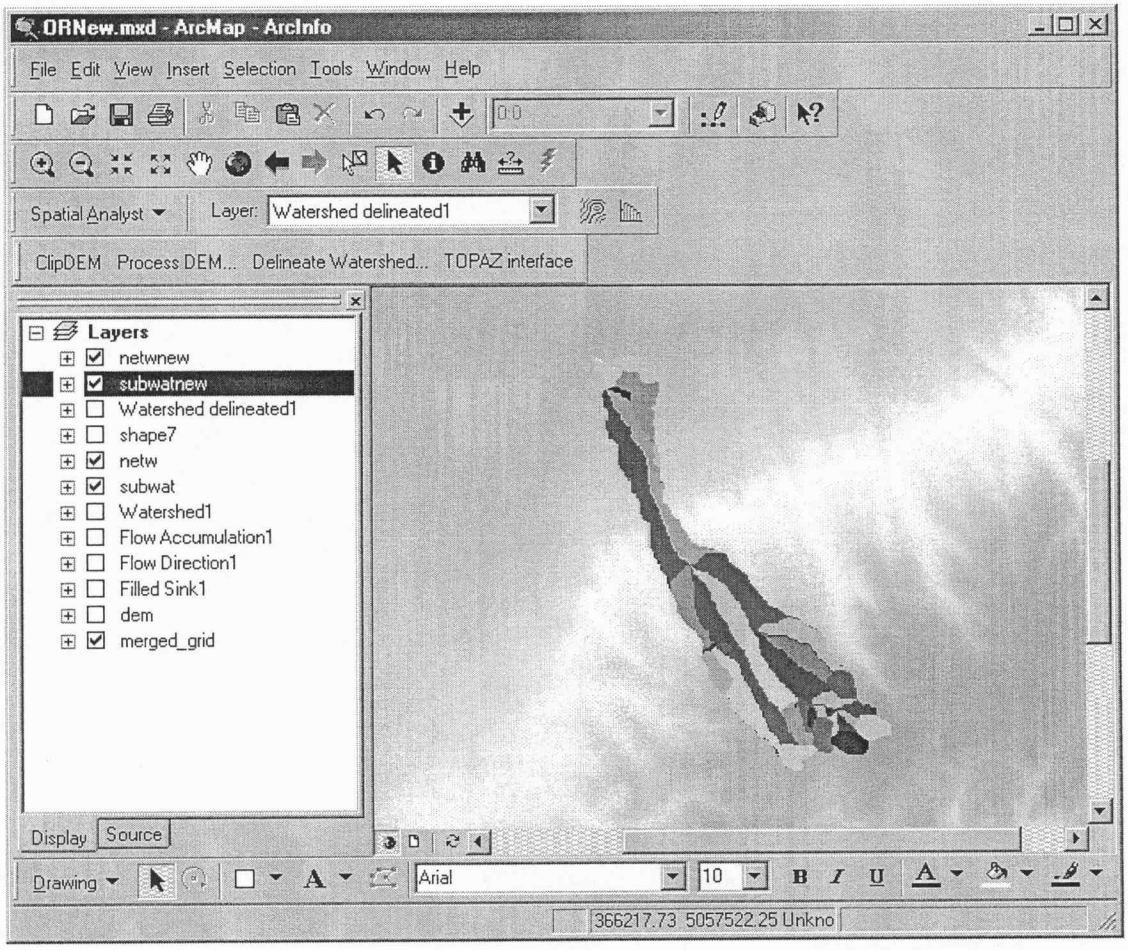
After AgFlow run, click on the Close button in the following panel



The TOPAGNPS job is done. Now it is a time to add results generated from TOPAGNPS into ArcMap for visualization.

8. Visualization of derived watershed and stream network

The output files are in ascii format and should be converted into grid format before adding to ArcMap. ArcToolbox can be used for the conversion. Unfortunately, ArcToolbox doesn't allow directory name with space so the directory name should be changed from "Copy of OR_Mission_Creek" to "Copy_of_OR_Mission_Creek". (Using _ to replace space). Here, two files, subwta.arc and netw.arc are converted into subwtanew and netwnew grid files and they are added into the ArcMap in the following. You can see now the results are similar to the original results for the OR_Mission_Creek dataset.



9. Application to Hillsdale watershed, Kansas

Another application is presented here to provide an alternative for process Dem data. The Hillsdale watershed is chosen because water quality is a concerned issue there.

Sometime, the item clip DEM is not working properly for unknown reason. This package used "Clip raster with a Rectangle", a sample tool of ArcObjects and has the same problem as the sample tool. As an alternative, the following article from ESRI web site can be used to clip DEM with ArcMap.

Summary
This article shows how to clip a raster based on a shapefile.

Procedure

1) Start ArcCatalog.
2) Right-click folder and select New > Shapefile.
3) Name your shapefile and specify:

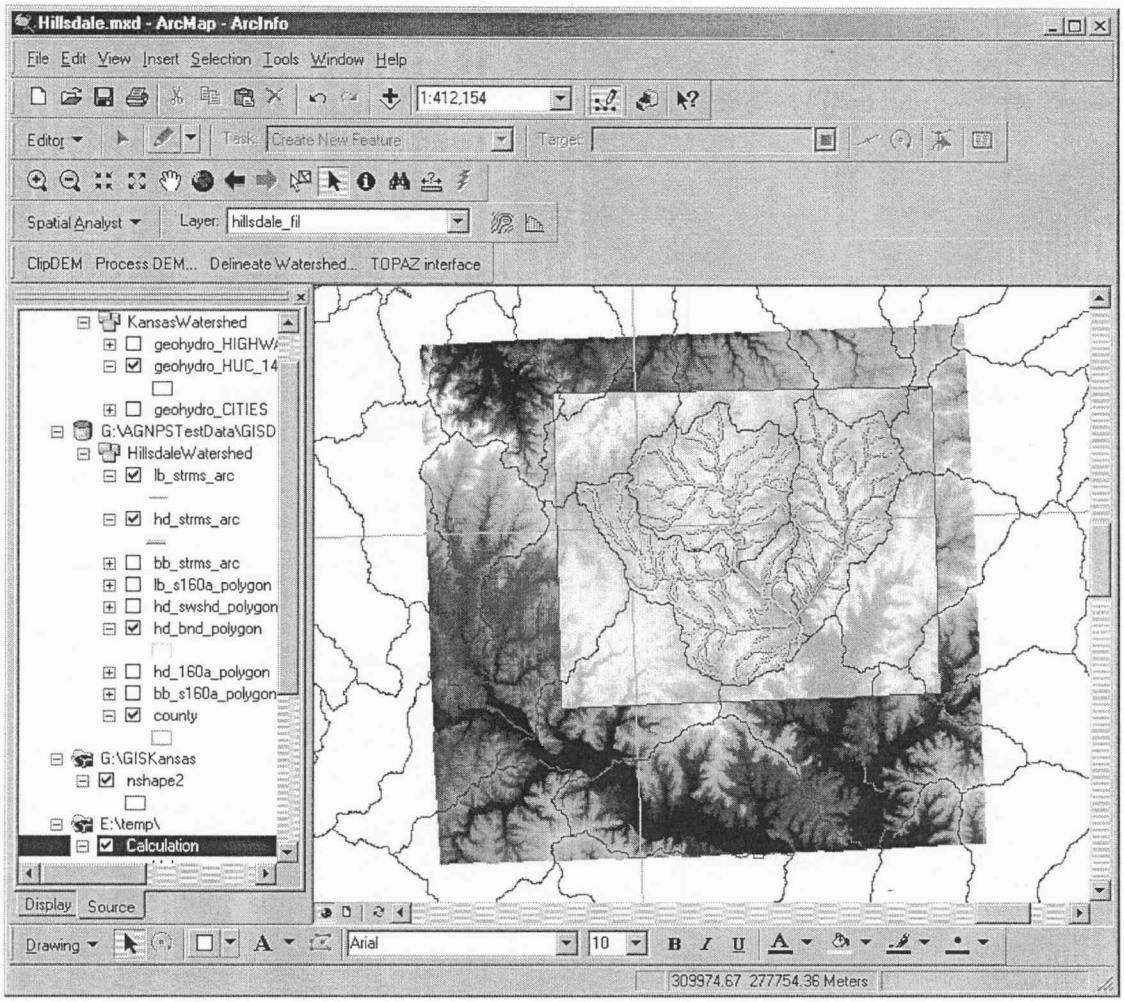
   a. Feature Type = Polygon
   b. Spatial Reference is Optional

4) Start ArcMap.
5) Add the shapefile layer and raster layer.
6) Click Editor > Start Editing and specify:

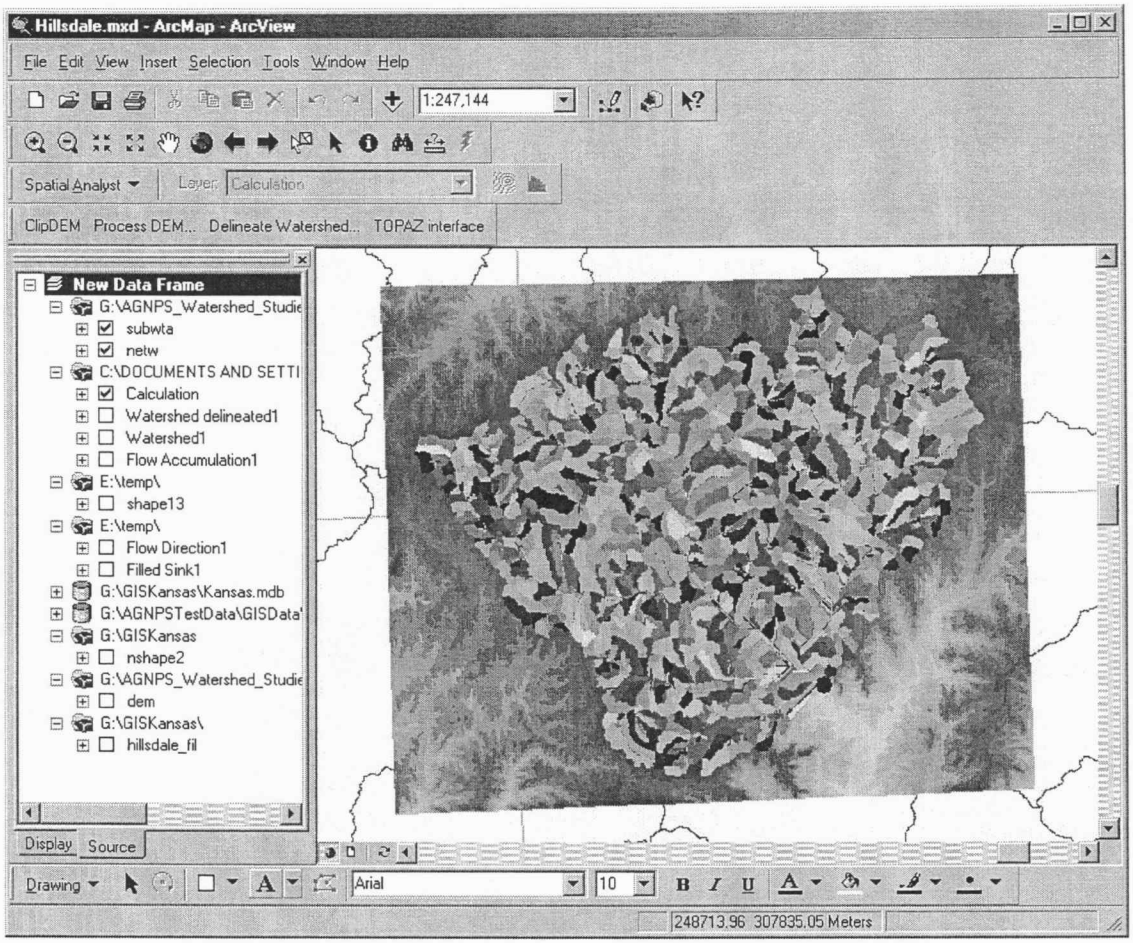
   A. Task = Create New Feature
   B. Target = Shapefile

7) Select the Create New Feature tool.
8) Draw a polygon around the area of the raster you want to clip.
9) Stop editing and save your edits.
10) Select Options in the dropdown menu of Spatial Analyst.
11) Switch to the General tab and specify Analysis Mask = Shapefile.
12) Switch to the Extent tab and specify Analysis Extent = Shapefile.
13) Select Raster Calculator in the Spatial Analyst dropdown menu.
14) Double-click the raster under layers.
15) Evaluate.

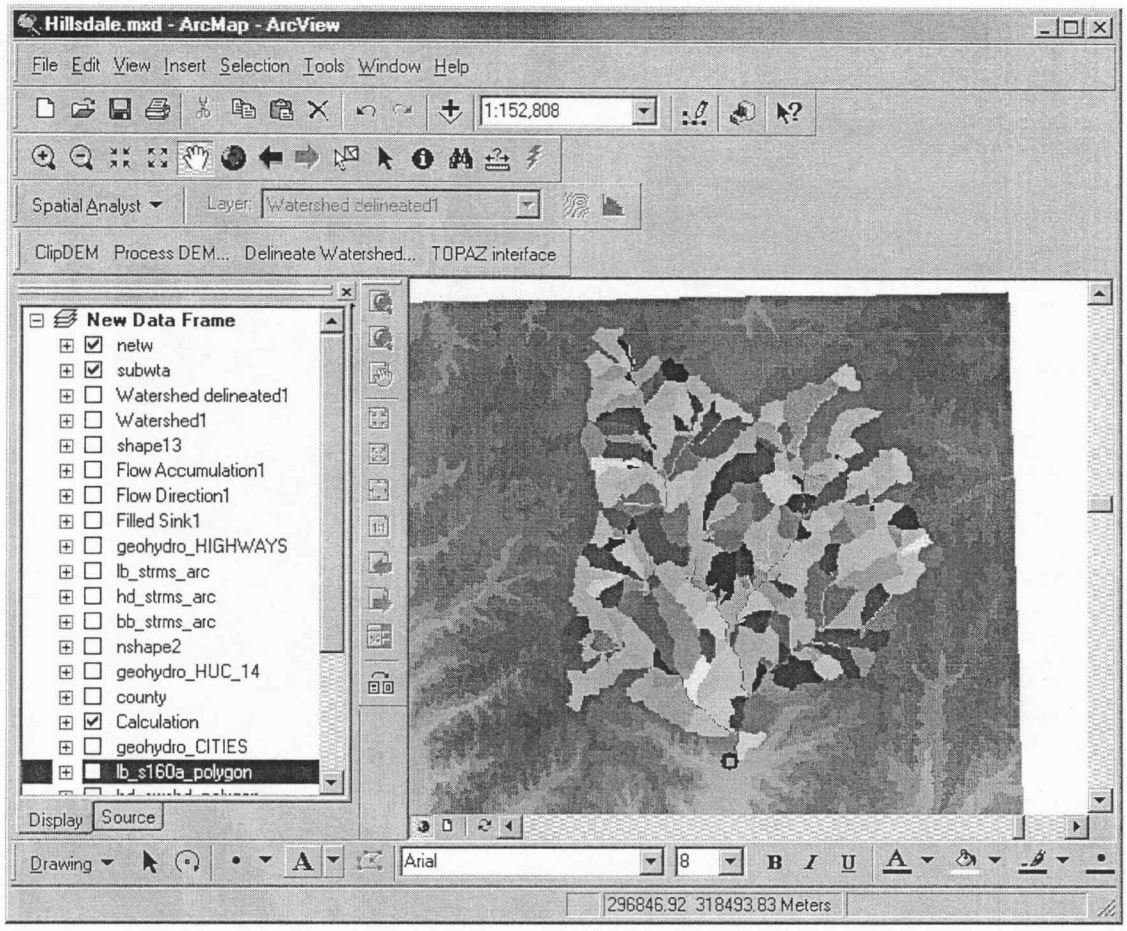
The following figure shows the result after clipping DEM using the method described above for Hillsdale watershed.



After going through the steps described in the previous (5-8) sections, the result from TOPAGNPS is shown in the following. It is recommended to use integer number for DEM values instead of floating number for saving space. For that, the DEM in floating number must be converted into integer number before the step for the generation of the TOPAGNPS input file.



Little Bull watershed as part of Hillsdale watershed is derived with the same approach and displayed in the following.



10. Final Remark

The report provides a step-by-step procedure for application of ArcGIS TOPAGNPS tool developed by Huaguo Xiao. Although there may be other alternatives, we believe this is the first ArcMap TOPAGNPS Tool released to public. The purpose of our work is to provide a handy and user-friendly tool for people who are working for protecting water resources and water quality in our living environment.

Acknowledgments

Appreciation is expressed to Dr. Ming-Shu Tsou and Girmay Misgna for discussions on this issue.

References:

[1] Garbrecht, J., and L. W. Martz. 1999. TOPAZ: An Automated Digital Landscape Analysis Tool for Topographic Evaluation, Drainage Identification, Watershed Segmentation and Subcatchment Parameterization; TOPAZ Overview. U.S. Department of Agriculture, Agricultural Research Service, Grazinglands Research Laboratory, El Reno, Oklahoma, USA, ARS Publication No. GRL 99-1, 26 pp., April 1999.

[2] Bingner, R. L., F.D. Theurer, R.G.Cronshey, R.W.Darden. 2001. AGNPS 2001 Web Site. *Internet* at http://www.sedlab.olemiss.edu/AGNPS.html

[3] M. Tsou, G. Misgna, X. Zhan, S. Wang, D. G. Huggins, S. Liu, and C. Volkman. Modeling procedures for using AnnAgnps Arcview extension. Open-File Report 2001-57, Kansas Geological Survey, December 2001.