

SIE 509 – Principles of GIS

Ex 07 – Terrain Analysis¹

Due: Nov. 9, 2017

Total Points: 42

Introduction:

In this lab you will use a digital elevation model (DEM) and a triangulated irregular network (TIN) to analyze the area in and around China Lake, Maine. China Lake is a shallow lake only a few miles from Messalonskee Lake, the latter of which has a serious invasive plant problem. In this lab you will see how 3D data can be used to model the bottom of China Lake, compute the volume under various conditions, and determine possible areas of invasive plant colonization. China Lake is also a bustling community, and in this lab you will see how 3D data can assist in assessing aesthetic impacts of certain types of development.

Procedures:

1. Download and extract the Ex_07 folder.
2. Start ArcCatalog.
3. Each of the 3 folders in Ex_07 contains a shapefile called contours. They all have the same name, which will create a problem when you merge them. Rename the files: *contours_CL*, *contours_V* and *contours_W* respectively.
4. Create a new polygon shapefile called *mask.shp*, having projected coordinates of UTM, Zone 19N, NAD_83.
5. Create a new personal geodatabase named China_Lake.
6. Import the DEM (medem10), DIRCLIP.TIF, depth_data.dbf and the three MarinaSite shapefiles into your geodatabase, keeping the names without the extensions.
7. Close ArcCatalog and open ArcMap to a new map.
8. Set your Environment variables (Workspace and Scratch Space).
9. From the Customize menu, select Extensions and verify that there is a check mark next to 3D Analyst and Spatial Analyst.
10. From the Customize menu, select Toolbars, and add the 3D Analyst Toolbar to your project.
11. Save your project.
12. Add medem10 to your project.
13. Examine the DEM of the China Lake area. The dark mass in the middle is China Lake. Zoom in to a light grey area until you can see individual pixels, use the Identify tool to see what information is displayed.

Q1. What do the two values represent (use Help if necessary)?

14. Right-click on the medem10 in the TOC.

Q2. Why is the attribute table “grayed out”?

¹ This lab was adapted from the Maine Department of Environmental Protection Training Materials – Terrain Analysis.

15. Look at the Properties of the DEM

Q3. What is the spatial reference for the DEM?

Q4. What units are used?

Q5. What is the resolution (cell size) of the DEM?

16. Use ArcToolbox->Data Management Tools->General->Merge to merge the three contour files to a single shapefile called *m_contours.shp* (feature class) and remove the three original contour files. (If you get an error message, try merging two at a time: contours_CL+contours_V->merge1; merge1+contours_W->m_contours).

17. Preview *m_contours.shp*. Zoom in to the shoreline and use the Identify tool on one of the contours.

Q6. What units are used for contour elevation?

18. Examine the properties of *m_contours.shp*

Q7. What is the spatial reference for *m_contours.shp*?

Q8. What are the units are used for the X,Y coordinates?

19. Add mask.shp to the project, and create a polygon the size and shape of the DEM.

20. Use this mask to clip *m_contours*, and save the clip in your geodatabase as contours. Remove the *mask* and *m_contours* shapefile from the project.

21. From ArcToolbox, go to 3D Analyst ->Data Management >TIN ->Create TIN. The output TIN is cl_TIN and the in_feature class is *contours*. Save the TIN in your Ex_07 folder.

22. Uncheck 'contours.shp' in the TOC.

23. From the cl_TIN Properties, select Symbology and uncheck Edges.

24. Zoom in near the shoreline of China Lake until you can clearly see the individual triangles that make up the TIN. Use the Identify tool and "click on" several places on a single triangle.

Q9. What information do you get from the TIN?

Q10. Which parameter(s) change along the face of a triangle?

Q11. What units are used for elevation?

25. Zoom to the full extent of your project. Locate a peak in the north-central part of the TIN and zoom in to the area around it.

Q12. Does the elevation change at different locations on the peak? Why or why not?

26. To change the symbology so that the lake appears blue, you need to manually adjust the classes. Use the Identify tool on the surface of China Lake to determine the elevation at the surface.

Q13. What is the elevation of China Lake?

27. Open the cl_TIN properties->Symbology dialog box.
- Select elevation.
 - Click on the 'Classify' button. Under the Break Values' window, change the smallest break value 198 and the next to the elevation you recorded plus 0.01. The 1 is added to the end so that the surface is included in this class.
 - Choose "Lake Blue" for the color of the lake, and an olive green for the lowest class.

Slope is often used as an indicator of soil stability and erosion potential. It can also be used to indicate the scenic value of a particular site. A typical classification used by Maine's Department of Environmental Protection is to look at slope in 3 classes: 0-25%, 25-40%, and greater than 40%. These categories are used to help define the scenic value of a particular site, but might also be used to identify slope areas prone to erosion and/or landslide risk.

28. Bring up cl_TIN Properties->Symbology again.
- Click on the 'Add' button below the 'Show' box and select 'Face slope with graduated color ramp', click 'Add' to add it to your symbology, then 'Dismiss' to make the dialog box go away.
 - Select Slope, then change the number of classes to 3 and click on the 'Classify' button.
 - Click the % button to change the break values from degrees to percent. Set the middle value as 40% value first, then set the lower break value with to a 25% slope. Click OK.
 - Adjust the labels to read "Less than 25%", "25%-40%" and "Greater than 40%" accordingly.
 - Uncheck Elevation.

Q14. What is the dominant slope?

29. Next Add 'Face aspect with graduated color ramp.

Q15. What is the dominant aspect (If you can't tell just by looking, look at the frequency distribution Properties->Symbology->Classify)?

30. Turn off the aspect symbology and turn on the elevation symbology. Pan to a hill in the north-central part of your TIN and set your scale to 1:36000. You should be able to see all of the hill in your view.

The data frame uses false illumination to trick your eyes into perceiving relief in 3-D. It does this by computing the location of a light source (the Sun) in three dimensions, then shading areas that would fall into the shadows. You can manipulate these settings and the contrast.

31. Right-click on 'Layers' in the TOC and select Properties->Illumination. Exaggerate the shading by setting the contrast to 10.

The azimuth is the angle from which the Sun shines, and the altitude is its height (in degrees) above the horizon. The current azimuth setting is for 315 degrees, a bearing which would never occur in Maine.

32. Drag the 'little Sun' around 180 degrees and look at the effect. The hills appear inverted; i.e., as if there were a hole in the hill.
 - a. Move the 'little Sun' back to its original position and reset the contrast to 3.
 - b. Add the 'DRGCLIP.TIF' to your project and drag it above your TIN in the TOC.
 - c. Bring up the image's properties and select the 'Display' tab. Set the transparency to 50%, then check the results.
 - d. Uncheck the 'DIRCLIP.TIF' in the TOC.

You are going to modify your TIN, during the process, you will be creating several temporary files.

33. Add the *depth_data* to your project. All of the data in this file EXCEPT for the last column are in meters.

34. Create an Event Theme (File->Add Data->Add XY Date) from *depth_data.dbf*.
 - a. The X-Field is POINT_X and the Y-Field is POINT_Y.
 - b. The Z-Field is Elev_f (elevation in feet).
 - c. Edit the Spatial Reference System if necessary.

35. Export the data as a feature class called depth.

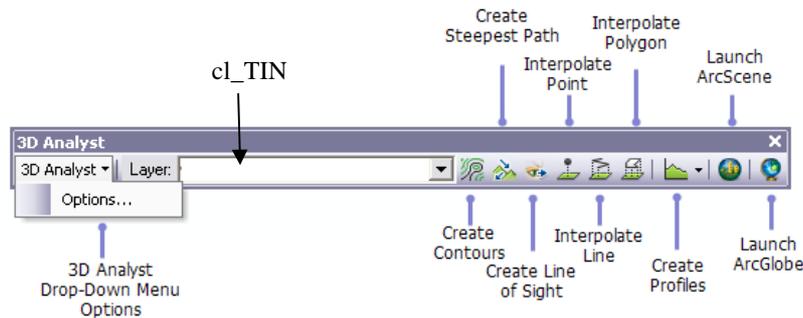
36. From the ArcToolbox->3-D Analyst menu select Data Management->TIN ->Edit TIN.

- a. The 'input TIN' is cl_TIN
- b. The in_feature_class is depth, be sure to set the "height_field" to ELEV_F.

37. The lake is now shown in 3D rather than as a flat surface. Variable water milfoil (*Myriophyllum heterophyllum*) is an invasive aquatic plant creeping into Maine's lakes. It is generally found in water that is less than 15 feet deep. Management of this plant includes inspecting boats, identifying likely points of entry, removal of plants, adding barriers to growth, use of herbicides, and using volunteers to patrol potential

milfoil habitat. China Lake is currently not infected, but it is only 9 miles away from Messalonskee Lake, which is heavily infested.

38. Find a place around the shoreline where the depth is roughly 15 feet.
 - a. Create an appropriate query (careful, this is tricky)
 - b. Use the Create Contours button on the 3D Analyst toolbar to create a contour line showing the limits of the potential habitat for this plant on your cl_TIN.



- Make it a bright color with a thickness of 2, by clicking on the line to bring up the properties dialog box.
 - d. Remove the depth feature from your project.

Q16. Think about the contour lines. Are they GIS data? Why or why not?



39. Using the skills you have already learned, create and print a layout showing the area of potential milfoil infestation in China Lake.

The Viewshed tool gives a simple representation of what is visible from an observation point to a target point. It should be noted that these lines are limited by the terrain data in use. 1:24,000 TINs are coarse data sets, and will not display the higher levels of terrain visibility that you would see if you visited a certain place. Also, they don't take into account trees, buildings, and other obstructions to visibility that you might encounter at a given site. They can, however, be used to get some general idea about what areas would be visible from a given site, as long as the user understands they are not a substitute for field visits.

A developer wants to build a marina on China Lake, and has submitted 3 possible locations. The first goal is to see if the site is visible from designated scenic areas. It is your job to answer that question.

40. Add the three proposed marina sites to your project, and change the symbology so that they are clearly visible.

41. From ArcToolBox-> 3-D Analyst->Visibility->Viewshed.

- a. The Input raster is medem10.
- b. The input point is MarinaSite1

The output is View1

42. Repeat with the outer two sites.

Q17. Which of the proposed sites do you think provide the best view along the length of the lake?

Deliverables:

Your report sheet with answers to 17 questions (2 Points Each), and a layout (8 Points) showing the areas of China Lake susceptible to milfoil.