GIS 4 Geomorphology

Geomorphometry of Mountain Landscapes & Upland Watersheds…a little Wildlife, too

Faceted Spurs: Wasatch Front

The Wasatch Mountains mark the boundary between two physiographic provinces: the Basin & Range and the Colorado Plateau. The western range front rises abruptly out of the valley for 100 miles between Logan and Pro The Wasatch is tectonically active today (Google: Intermountain Seismic Zone). Much work has been done over past few decades to understand the neotectonics of the range (Machette et al., 1992a,b; Schwartz & Coppersm 1984). Background reading is found in *Tectonic Geomorphology* by Burbank & Anderson (2012, Fig 4.16, p. 91) and references therein.

Here is a GIS exercise for Geoscience students. It asks pairs of students to measure the heights of triangular faceted spurs along the range, measure the range width at several locations, and create topographic swath prof from a DEM. The goal is to gather/generate a few new (if simple) data sets and work with them in different softw programs (Google Earth, ArcMap, Excel, Illustrator). I think it is important to become good at moving various typ of data between applications. Use each for what it does best/fastest/most intuitively, rather than doing everythin one program.

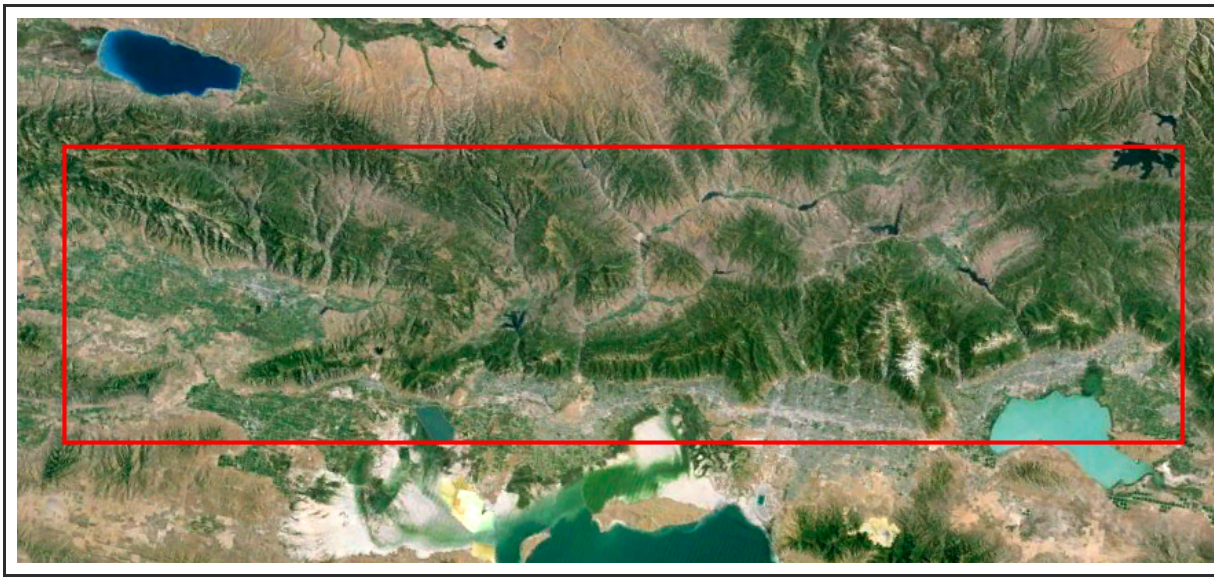
– In this lesson, you a.) determine the heights of faceted spurs along the Wasatch Front (apex elevations), b.) plc the x,y,z coordinates of each, c.) create topographic swath profiles along the range, d.) bring the data together i summary scatter chart figure (x = Northing, y = Elevation), including points for the spur heights and curves for th swath profiles (mean, max).

— Make elevation picks for tops of 3 faceted spurs in Google Earth.

– Create a new folder for this project.

– I have broken the Wasach Front, which runs north-south, into a number of segments. You will be assigned on segment. Segment breaks not provided here.

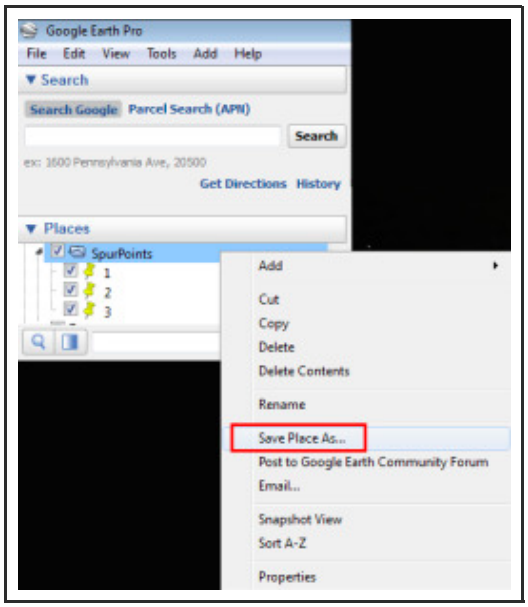
In Google Earth, create a Placemark at the apex of 25 faceted spurs (the first, most prominent apex above the range front slope break) along the Wasatch Front between the Utah-Idaho Stateline and Salem, UT. Name each Placemark consecutively from north to south.



— Google Earth image of the Wasatch Mountains front between UT-ID Stateline and Spanish Fork Canyon. North to the left. That's Bear Lake in the upper left corner, Utah Lake at the lower right, and a portion of Great Salt La peeks out along the bottom margin. The DEM you use for the Swath Profiles (later down in this lesson) should b cropped closer to the range front on both east and west sides. You might need two swaths due to the step-over break in the range between Brigham City and Ogden.

– Manually record the elevation of each point (Placemark) you place in an Excel spreadsheet. It helps if you tile Excel and Google Earth on the screen, so you can see both programs. Mouse over the apex point and read elevation which is shown in the lower right corner of Google Earth window. Save the spreadsheet as "SpurPts_SegmentA.xlsx" in your project folder.

– Save a .kmz containing all spur Placemarks (spurs.kmz).

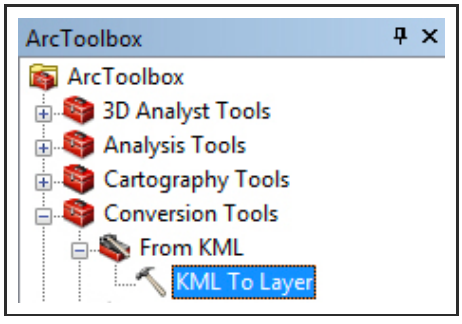


— In Google Earth, 1.) Create a New Folder called "SpurPoints", 2.) Create your Placemarks, 3.) Drag all your Placemarks into SpurPoints Folder, if they are not there already, 4.) Save Place As a .kmz to your project folder.

– Open ArcMap and save a new, blank map (SpurSwathProject.mxd) in your project folder.

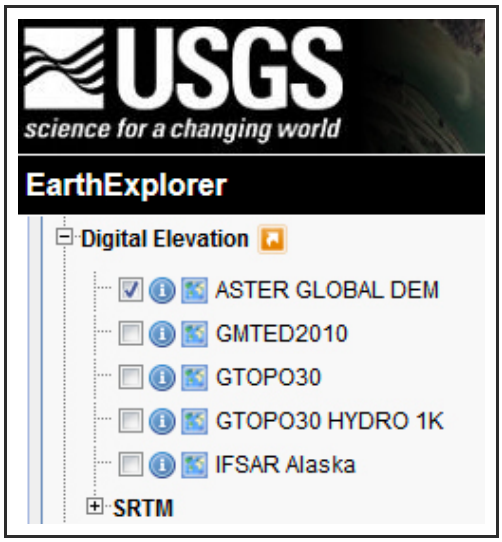
– Set the Data Frame coordinate system to PCS_NAD83_UTM Zone 12N and check that the Display Units is Meters (View > Data Frame Properties > CoordSys tab and General tab).

– Convert your .kmz to a shapefile (Conversion Tools > From KML tool).



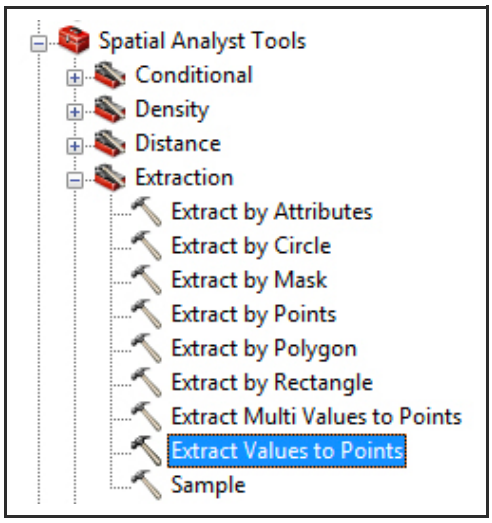
— Convert .kmz to shapefile with ArcToolbox > Conversion Tools.

– Acquire a 30m DEM for the Wasatch Front from EarthExplorer (earthexplorer.usgs.gov) and add it to your map (see DEM Data Sources lesson). I prefer the ASTER data. Unzip the compressed folder, if necessary. Make sure store the file(s) in your project folder.



— ASTER DEM data is available from the EarthExplorer website. Create a login, which is good for all USGS sites.

– Extract the DEM elevation values to your spur points (Extract Values to Points). These will appear in a new fielc the attribute table for your points (Field = RASTERVALU).

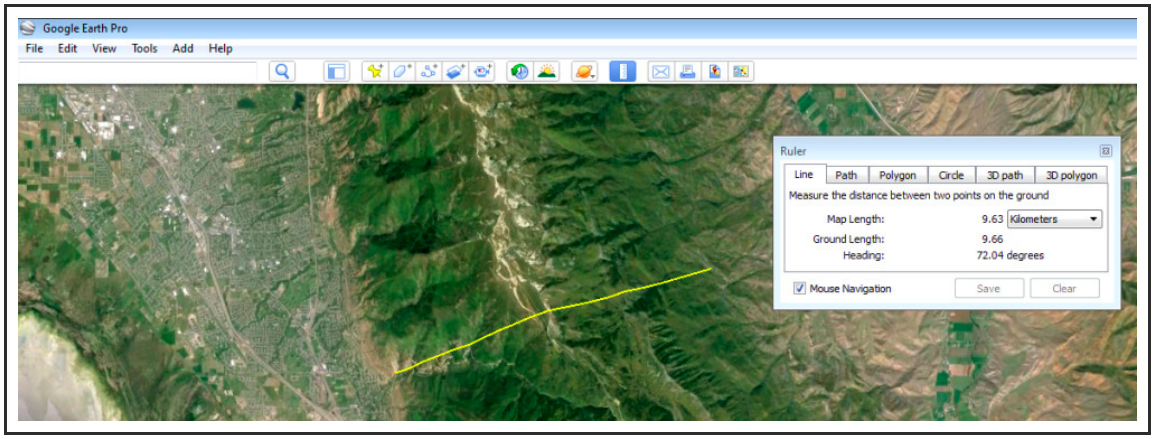


— Extract the raster values (elevations)

from the DEM to the corresponding point locations (spur points) using Spatial Analyst > Extraction Tools.

– Recreate this field in Field Calculator. Be sure to specify the data type correctly. Rename it “DEM_Elev”. Delete RASTERVALU field.

– Measure the width of the range (perpendicular across range) using the Ruler in Google Earth at the following locations. You kind of have to eyeball these measurements.



— Use the Ruler tool in Google Earth to measure the cross-range width (km) at locations given below. You could modify the locations or change the number of them if you like.

Record the cross-range widths for each of the following locations in your spreadsheet.

UT-ID Stateline
Smithfield
Logan
Hyrum
McKenzie Mtn
Perry
Willard
South Willard
North Ogden
Ogden
South Weber
Farmington
Bountiful
Salt Lake City
Summit Park
Park City
Granite

Draper
Alpine
Pleasant Grove
Orem
Provo
Springville
Salem

– Export the spur points attribute table to a .dbf to your project folder.

– Open Excel. Choose SHOW ALL FILES (not Show All Excel Files). Navigate to and open your .dbf (not the .cp .xml files). Save the spreadsheet as an .xlsx in your project folder.

– Plot the on the same chart a.) the spur points, b.) the Max swath profile curve, and c.) the Mean swath profile curve.

– Add the range width series data to your chart on a secondary y-axis.

– Copy and paste completed chart into Illustrator and create a better looking chart. Clean up/remove any Clippi Masks, Compound Paths, and/or Groupings.

– Add arrows and labels for about 10 geographic locations to give geographic context (cities, major highways, l streams, ski areas, prominent summits, etc.).

– Add fault segment information from Machette et al. (1992), too, if you prefer.