

# Shorelines: Mapping and Elevation Measurement

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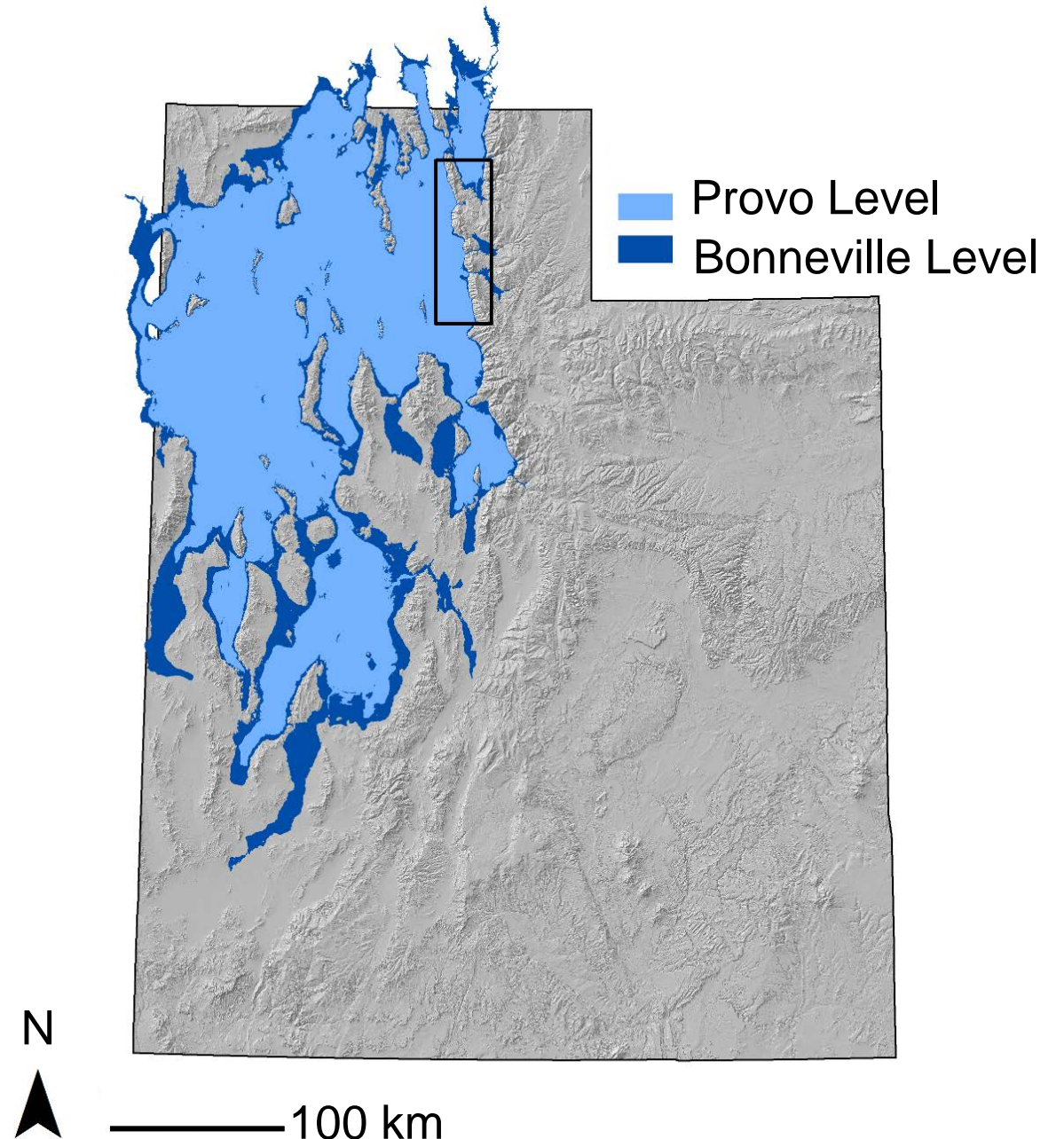
U.S. Bureau of Reclamation

Seismology, Geomorphology, and Geophysics Group

Lakewood, CO

# Lake Bonneville

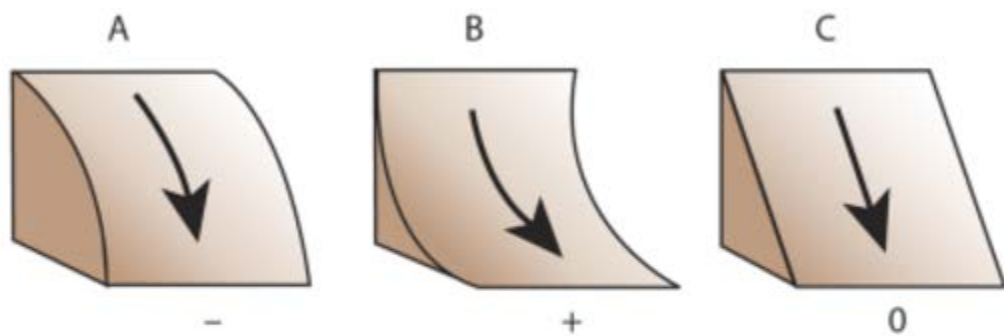
- Largest Pleistocene pluvial lake in the Great Basin
- Major shorelines are laterally continuous and well time-constrained
- Shorelines preserve a record of surface deformation:
  - tectonic deformation
  - isostatic rebound



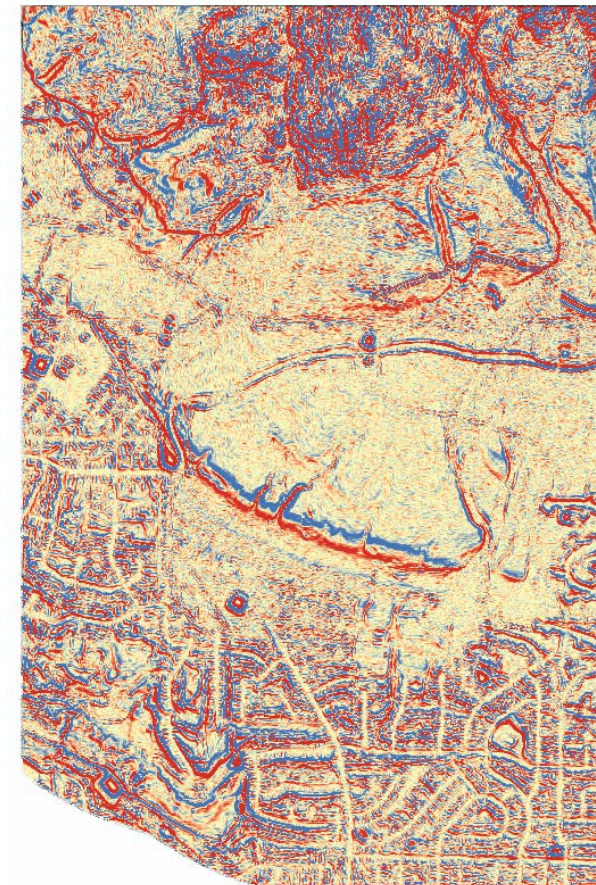
Shapefiles provided by Ken Adams (Adams and Bills, 2016)

# Locating and Mapping Shorelines

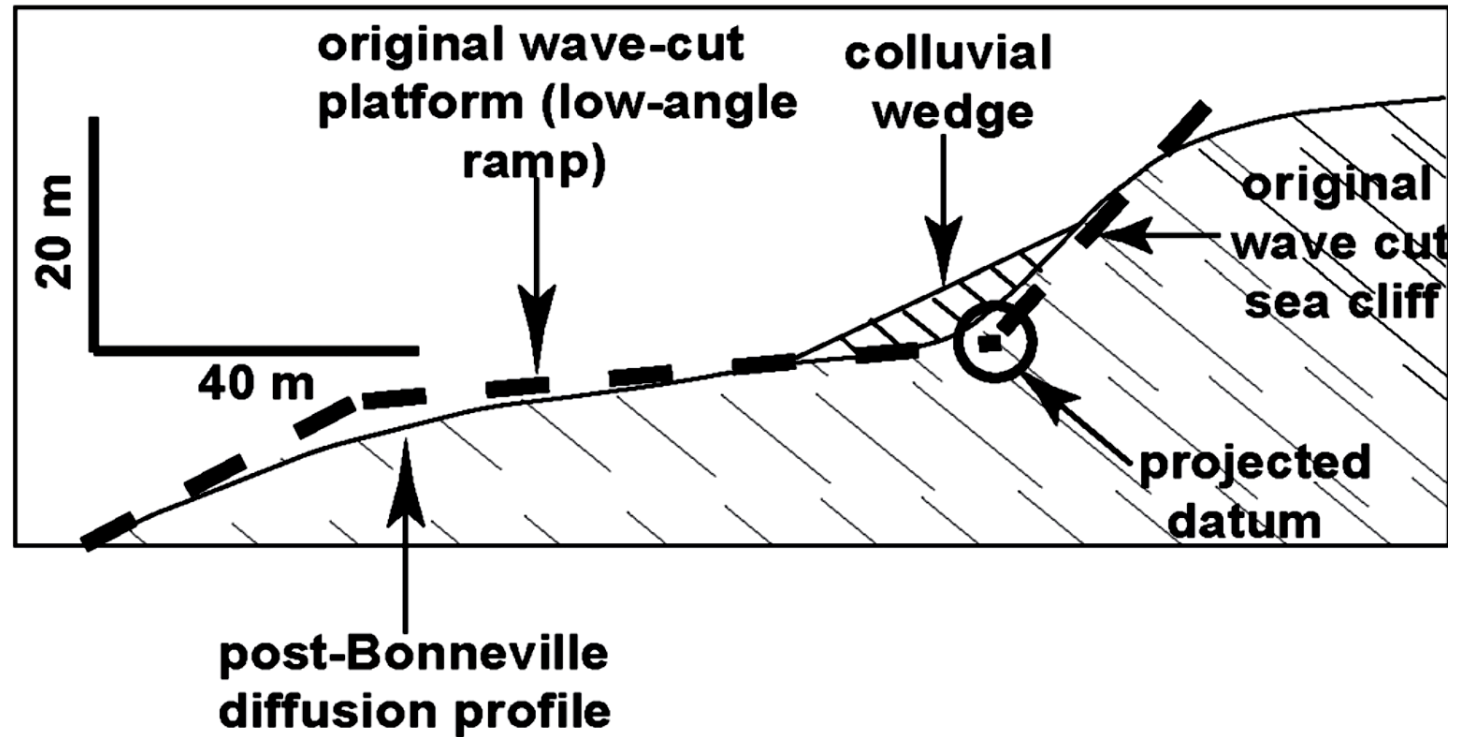
- Slopeshades vs. Hillshades
- Curvature



Profile curvature

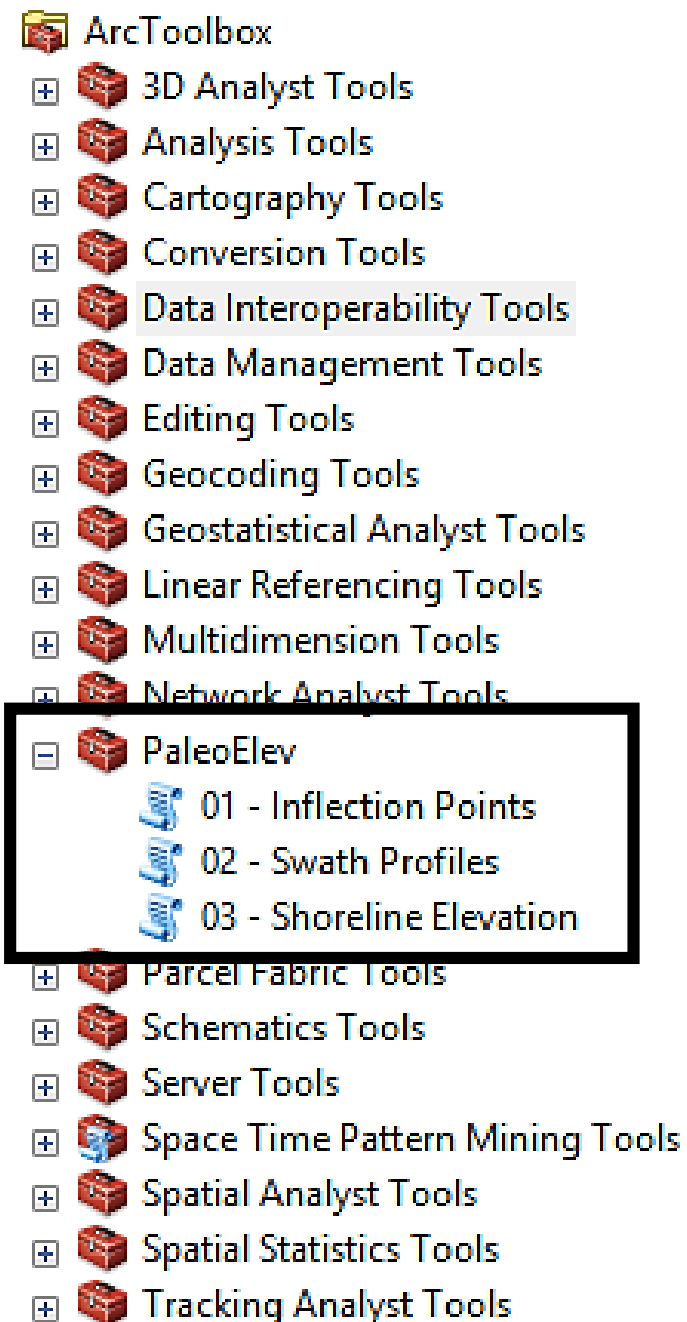


- **Paleoelevation:** the elevation of the shoreline at the time of formation

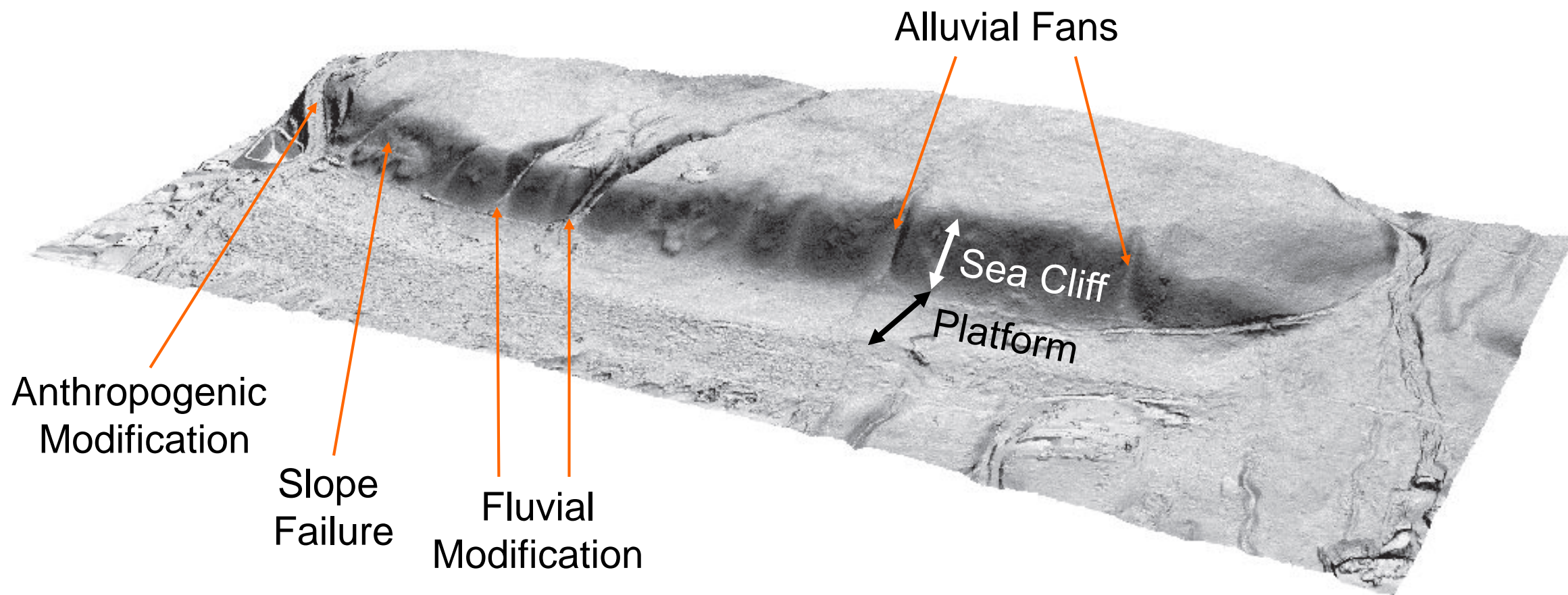


# The PaleoElev Tool

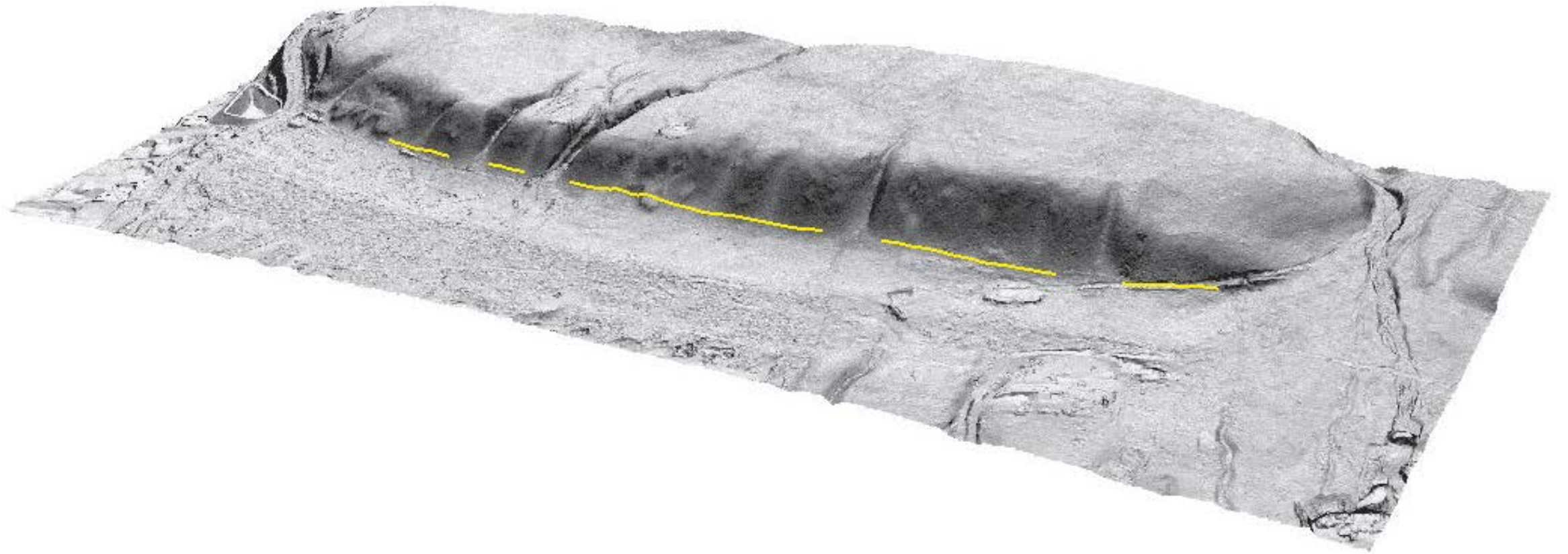
- Goals:
- Automate measurement of shoreline paleoelevation.
- Analyze swaths instead of profiles (taking into account an entire surface)
- Written using the Python 2.7 IDLE



# Example Analysis – Bonneville Shoreline



# Inflection Points Script



# Inflection Points Script – Single Swath

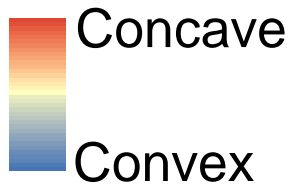


5 m x 5 m

10 m x 10 m

15 m x 15 m

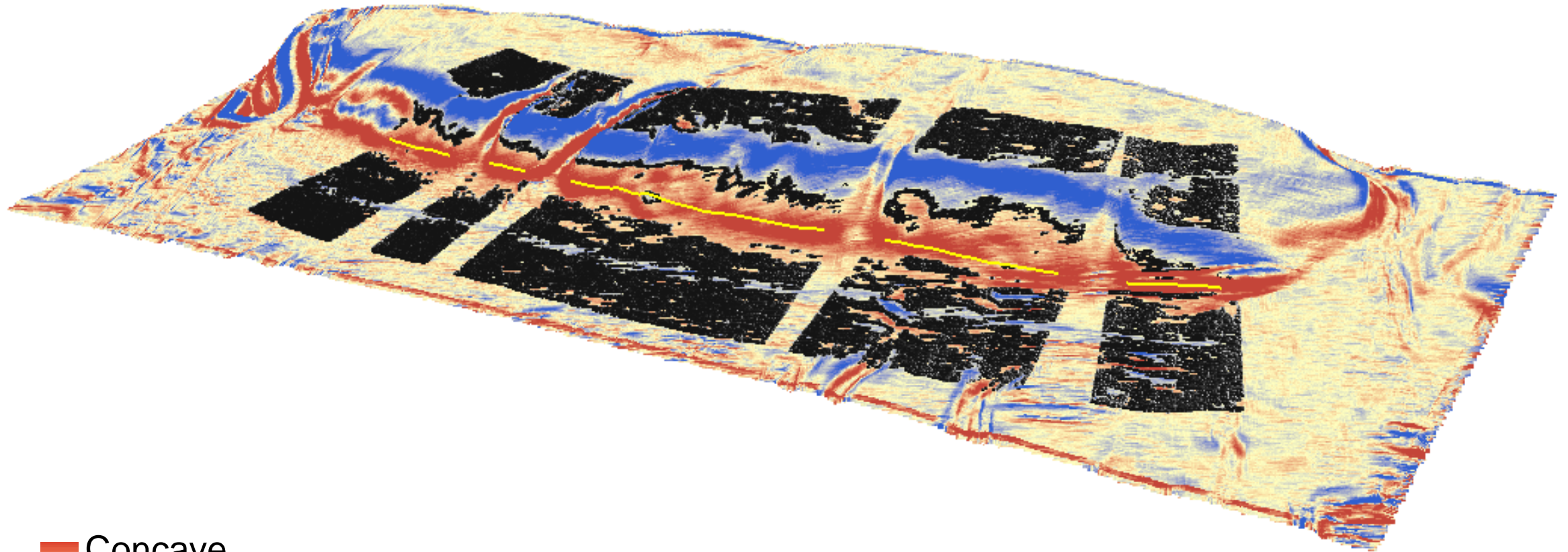
20 m x 20 m



• Inflection Point

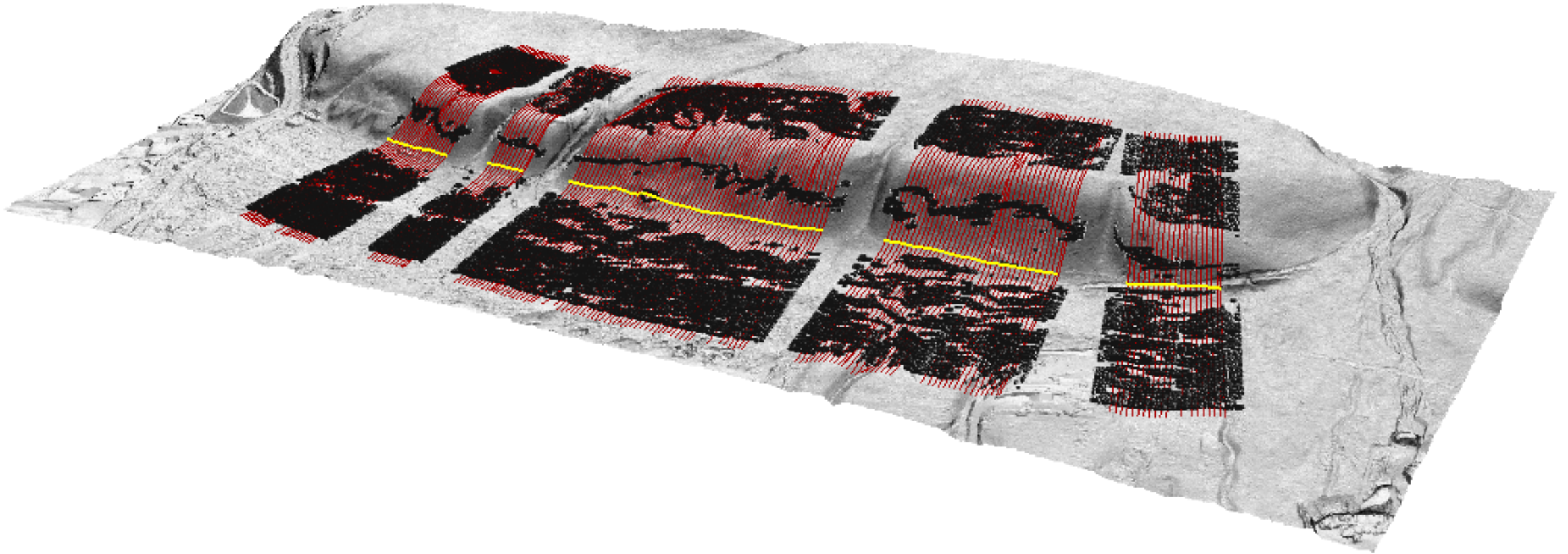


# Inflection Points Script - Output

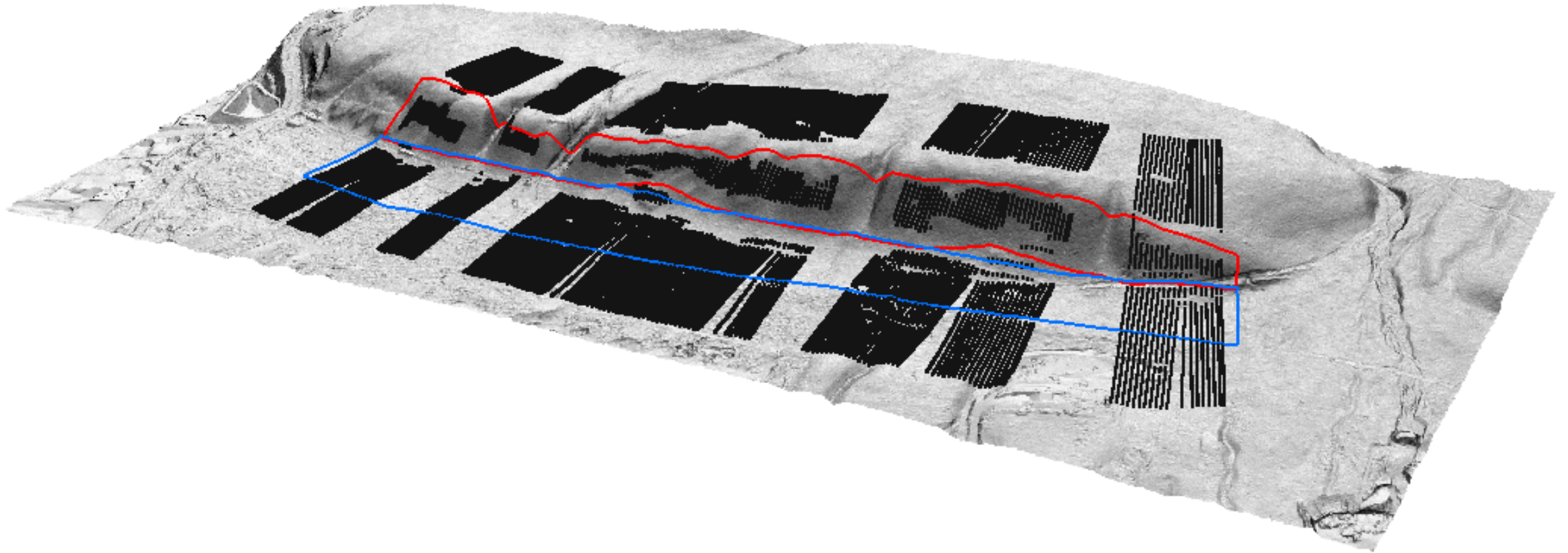


Concave  
Convex

# Swath Profiles Script

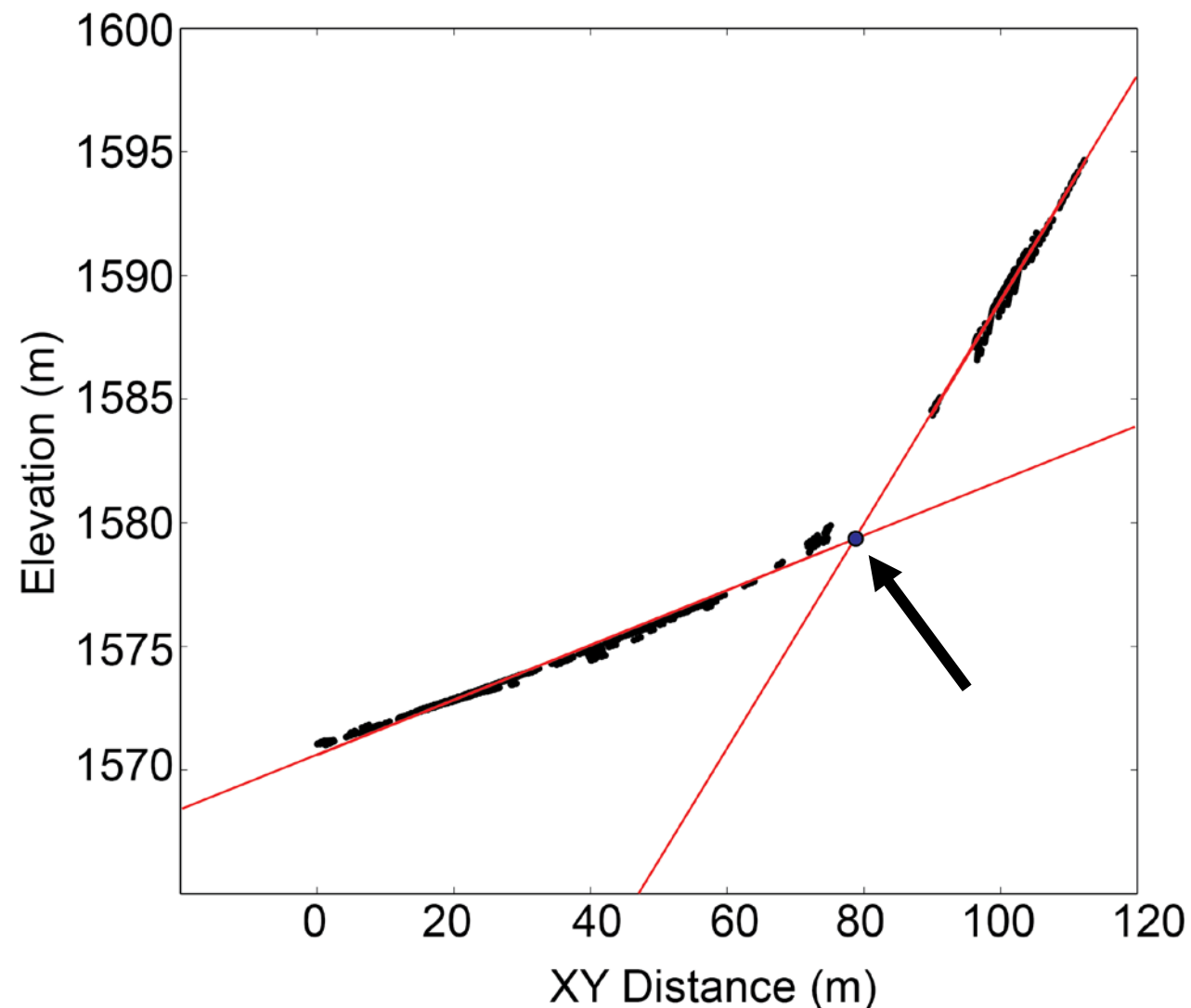


# Shoreline Elevations Script



# Shoreline Elevations Script – Single Swath

- Requires minimum of 2 inflection points on both the sea cliff and platform surfaces
- Currently no  $R^2$  parameter
  - Possibility for outliers





# Takeaways:

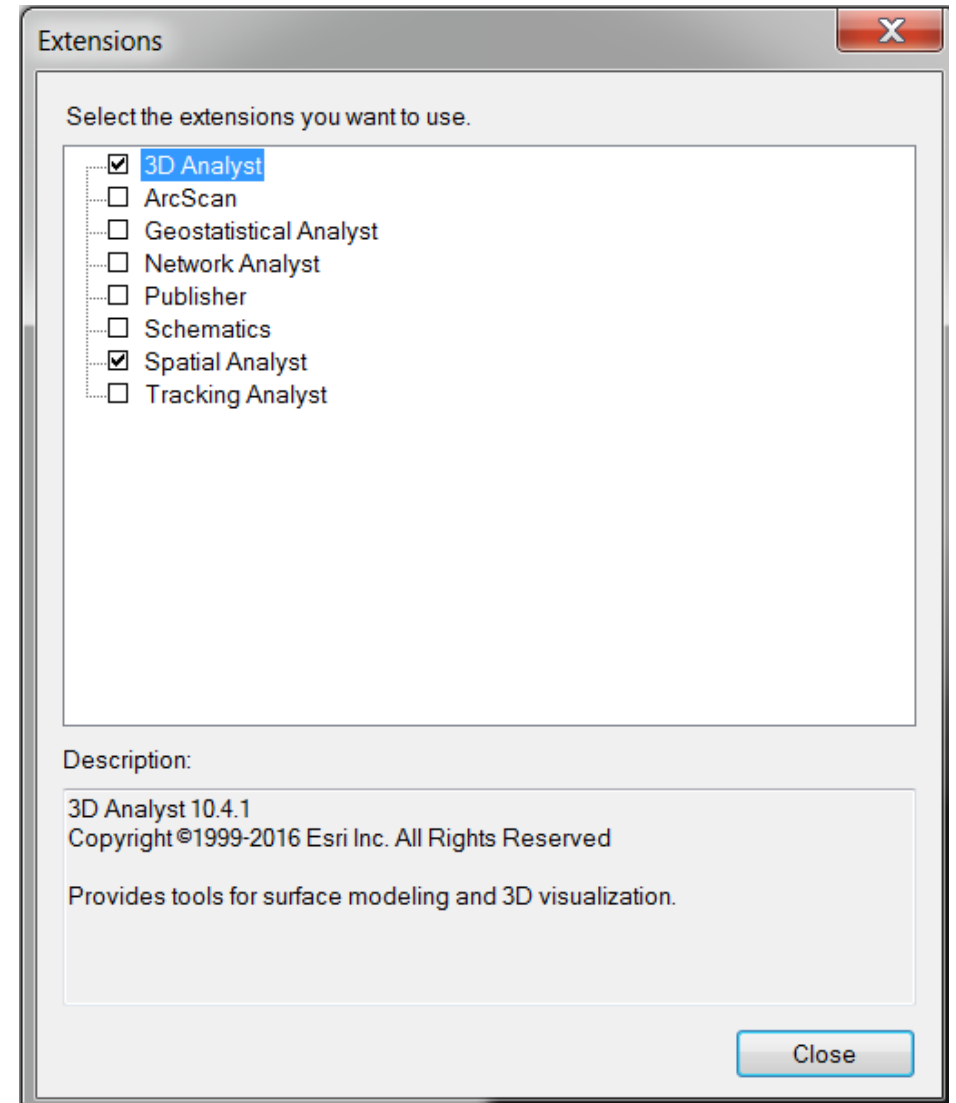
- Use multiple lidar derivatives (not just hillshades) to help identify geomorphic features
- Using swath profiles instead of traditional 2D profiles takes into account an entire surface feature, which is a better overall representation of the feature

# Demo for Curvature Rasters

# Setup


- Extensions:
  - You need Spatial/3D Analyst
  - Go to Customize → Extensions at the top of ArcMap
  - Check boxes for “3D Analyst” and “Spatial Analyst”
- Toolbar:
  - You need 3D Analyst
  - Go to Customize → Toolbars and click “3D Analyst” to turn it on

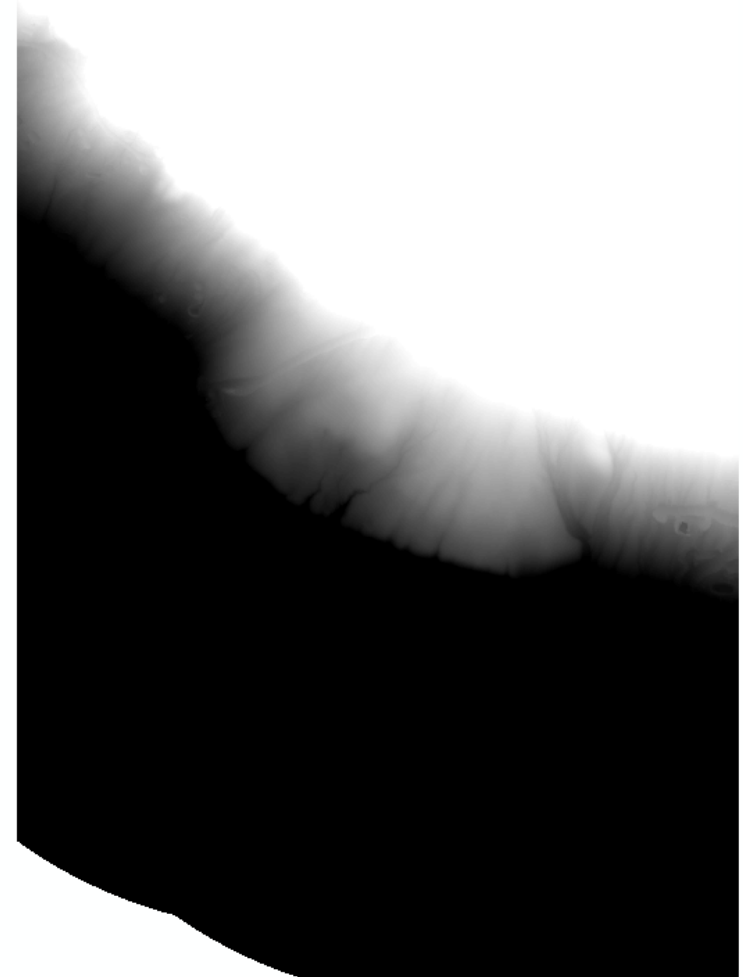
Customize → Extensions GUI





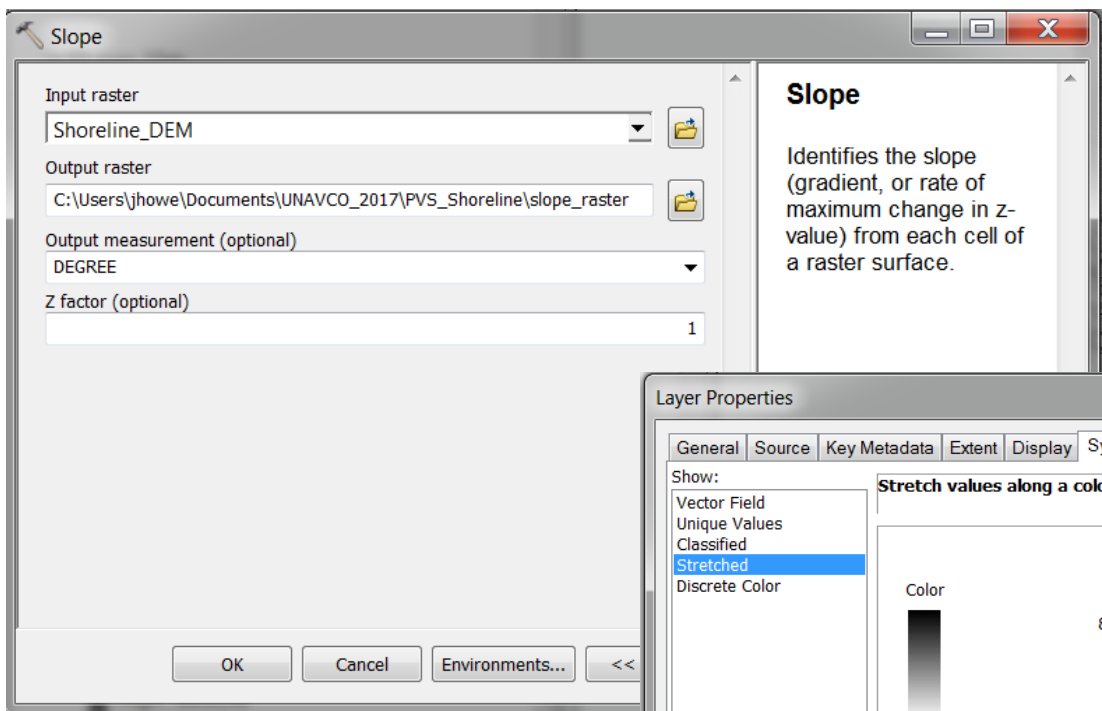
# Load a lidar DEM and create rasters

- Use ArcCatalog or the “Add Data” button  at the top of ArcMap to load “Shoreline\_DEM.tif”
- Create slope raster using the Slope Arc Tool
- Create curvature using Focal Statistics and Curvature Arc Tools



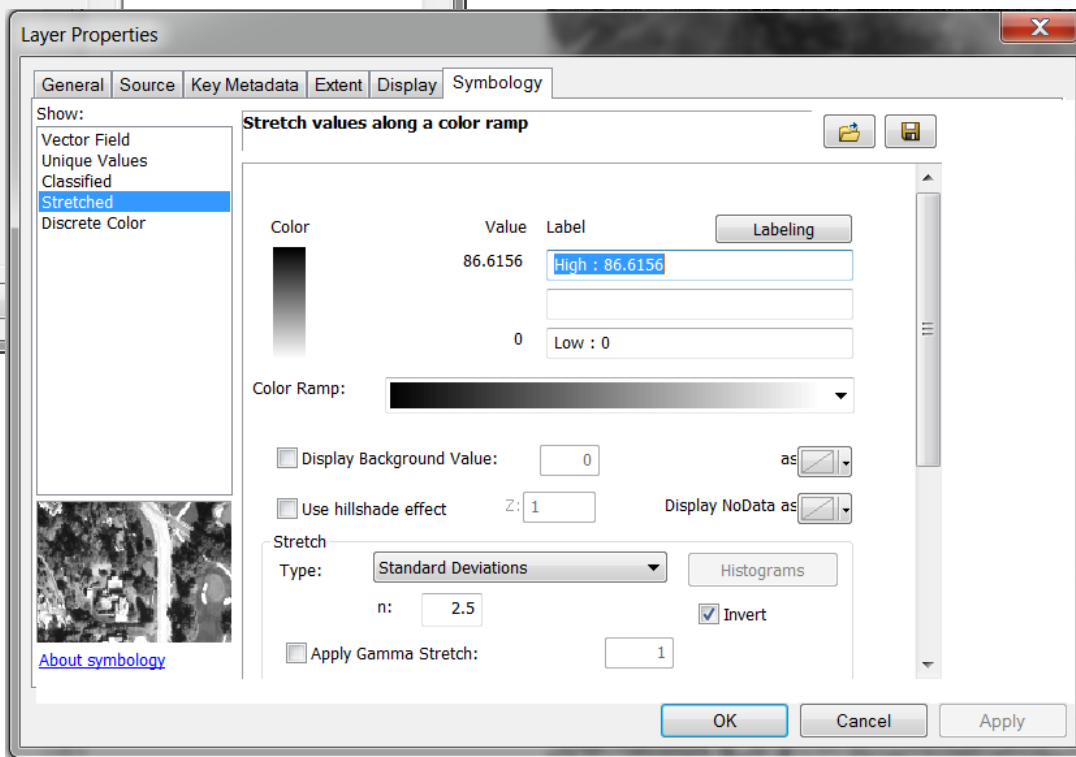
Shoreline\_DEM.tif loaded into ArcMap

# Create a Slope Raster



Input Parameters

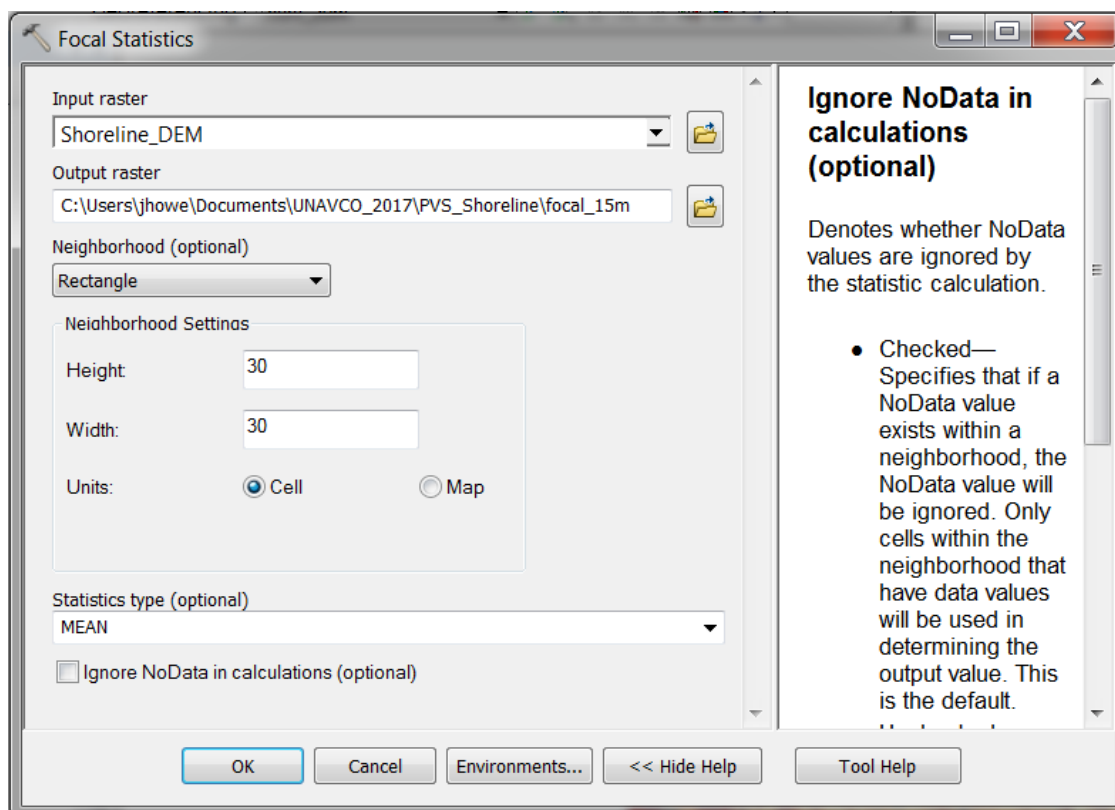
Symbology Parameters



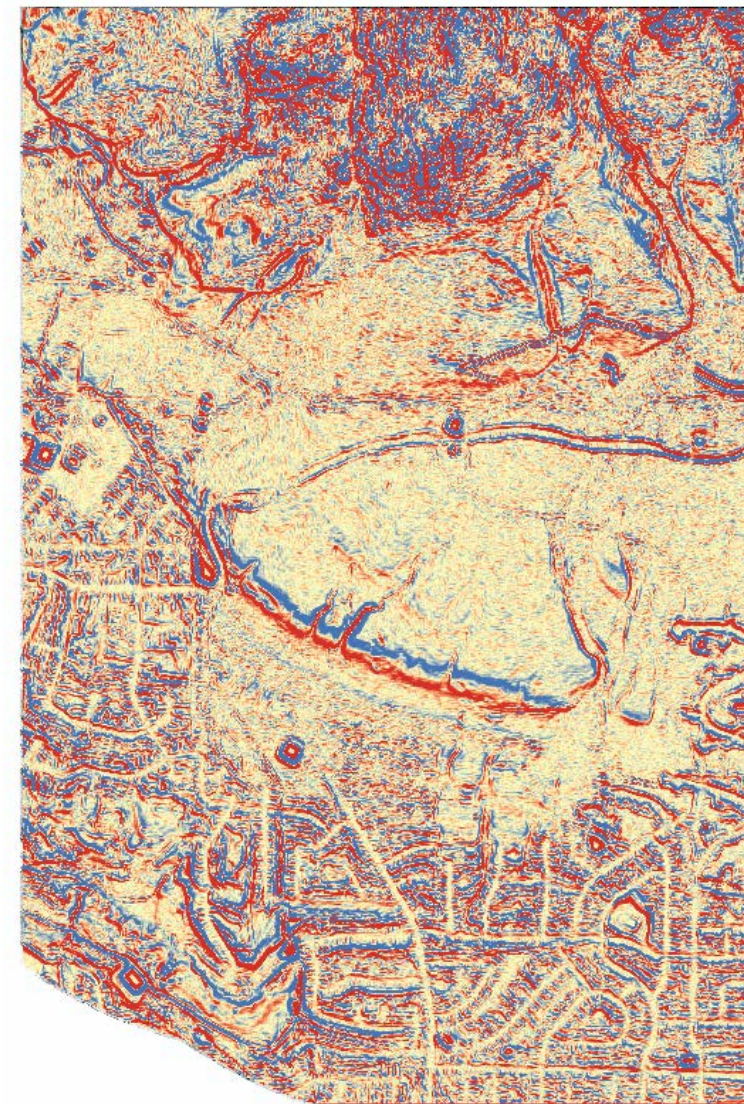
Slope Raster viewed in ArcMap

# Create a Curvature Raster

- Step 1: Focal Statistics



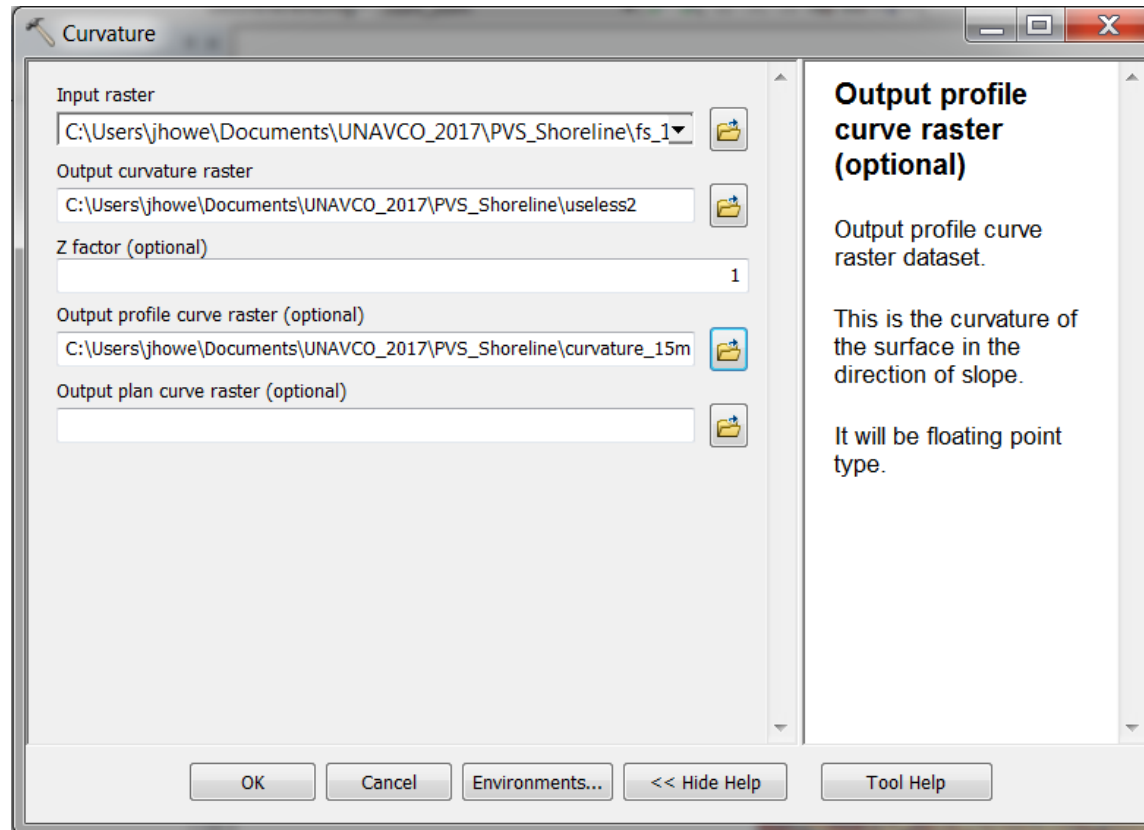
Input Parameters



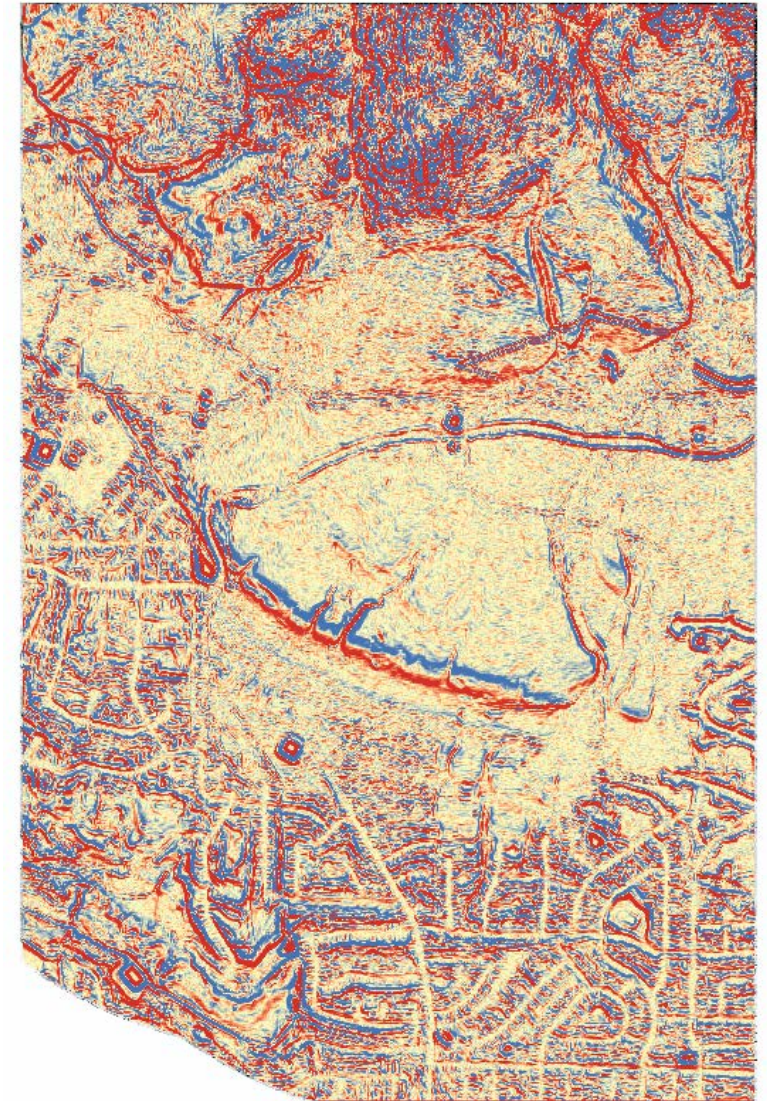
Curvature Raster viewed in ArcMap

# Create a Curvature Raster

- Step 2: Curvature



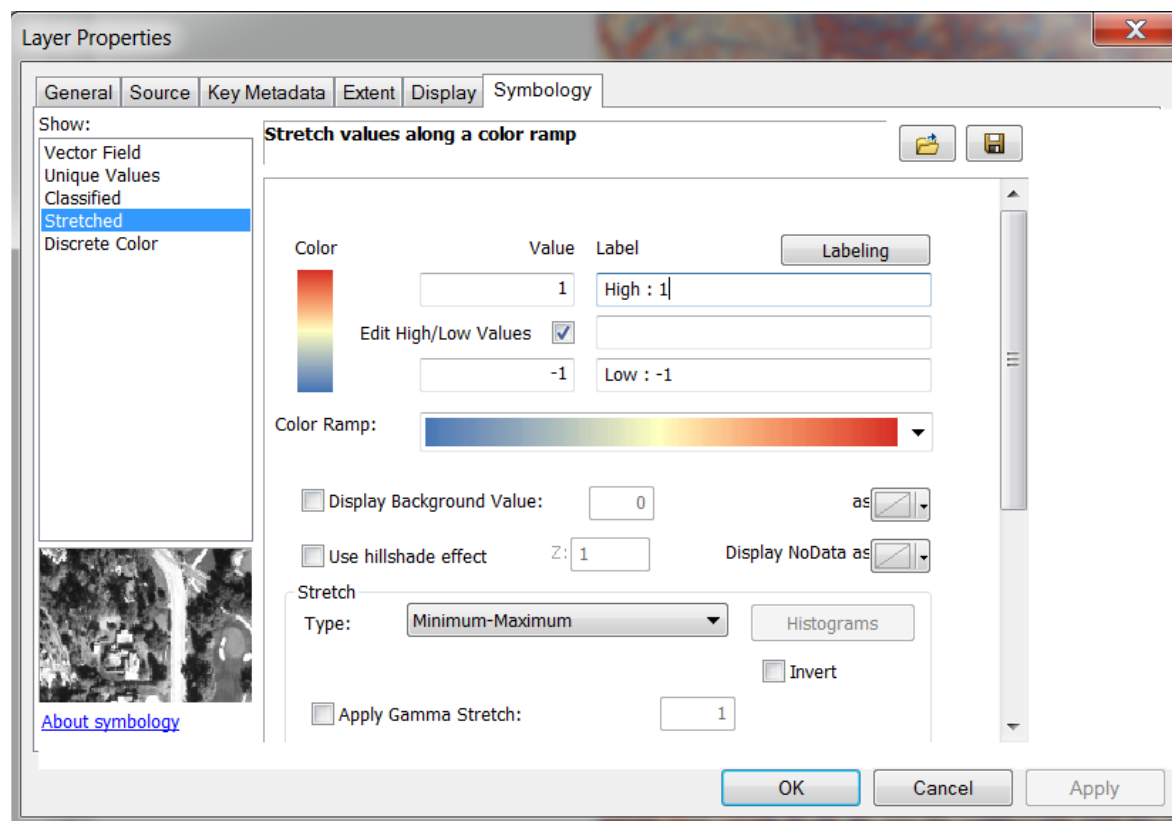
Input Parameters



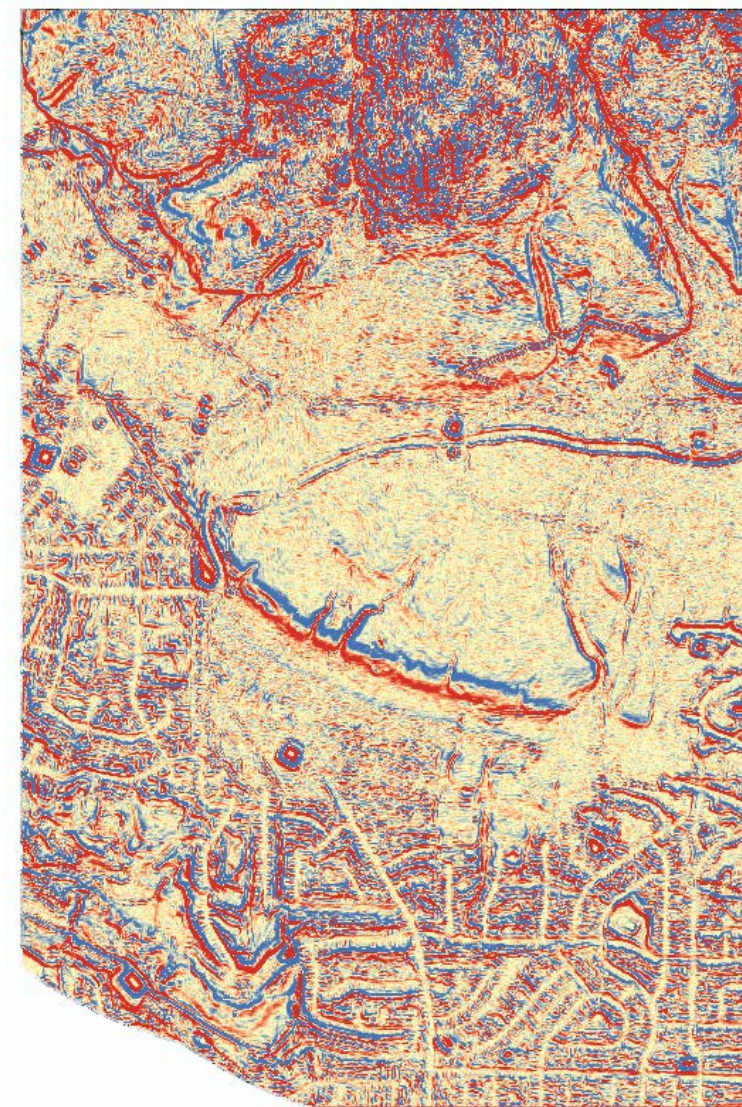
Curvature Raster viewed in ArcMap

# Create a Curvature Raster

- Step 2: Curvature



Symbology Parameters



Curvature Raster viewed in ArcMap