ES407 Senior Seminar Independent Project Instructions
Newberry Volcano Project

Becker – Cone Drainage Density Experiment

Objective: to explore using the Lidar bare-earth elevation models to examine a select set of cinder cones for drainage density patterns as indicators of cone age.

(1) Test Quads: Lava Cast Forest + Lava Butte bare earth Lidar models
(2) Work with Taylor to select 20 cones with a range of morphologies
(3) Download / use existing cone map polygons, polygon IDs and clip boxes (see taylor)
(4) Clip the selected 20 cones from the lidar Lidar DEM's using clip boxes, keyed to existing polygon IDs
(5) Create slope map (degrees) for each clipped cone DEM respectively
(6) Create hillshade model (use default settings) for each clipped cone
(7) Examine each cone slope map and hillshade model, identify gullying or stream incision.
(8) Create polyline feature class for those cones with incision, heads-up digitize channel center lines, in attribute table of channels include poly-ID, length of channel line in meters
(9) Create summary/results spreadsheet with results including cone ID, absence or presence of incision, relative degree of incision? (N/A, low, moderate, high), no. of gullies, sum of total stream lengths, cone polygon area, drainage density for each cone = sum of stream lengths / cone polygon area.

NOTE: work through steps 1-9 above completely for 10 of the 20 cones first, see how it goes / how long it takes. If logistically feasible, repeat steps 1-9 on the remaining half of the selected 20-cone population.

Slides for presentation: (1) a bullet summary slide of purpose / methods explored, why is this important with respect to newberry cinder cone work? (2) two slides with example hillshade model, slope model, and stream-line overlay for several style cones across the population (3) a results and conclusion slide with bullets summarizing findings, suggestions for future work on this topic?

Vreeland - Modified Two-Point Alignment Analysis

Objective: to re-evaluate the two-point cone alignment method for Newberry cinder cone patterns, comparing recent methodology of Cebria et al. (2011) to Lutz (1986).

(1) Use existing Newberry cinder cone GIS coverages to explore the methods of Cebria et al., 2011, specifically using the "minimum distance" threshold approach.
(2) GIS approach: use newberry single cinder cone point layers (site-wide, north half, south half), calculate the line lengths and azimuths for all combinations of points, break subsets of population into groups according to line lengths.
(3) Apply Cebria technique to both actual newberry data, and to 30 random cone distribution patterns (available from Taylor), determine significance interval using Lutz methodology. Determine which actual Newberry orientations are "stochastic" or random, and which are systematic and non-related (i.e. related to structural control).
(4) Separate analysis into zones: all Newberry, north half only, south half only.

(5) Compared significant orientations from Cebria technique, to fault orientations (Walker Rim, Brothers, Tumalo), provide comparison in form of rose diagrams for each combination of data.

Slides for presentation: (1) a bullet summary slide of purpose / methods explored, why is this important with respect to newberry cinder cone work? (2) a methodology / overview bullet slide comparing the Cebria vs. Lutz two-point techniques (how are the same/different), (3) 1 results slides showing the existing findings of Taylor using the Lutz method, and results of Vreeland application of Cebria techniques, (4) one slide using rose diagrams comparing significant cone alignments from both Lutz and Cebria methods, to fault orientations from Walker Rim, Brothers, Tumalo (borrow existing slide from Taylor work and modify, suggestions for future work on this topic?

Fletcher - Test of Newberry Glacial Hypothesis

Objective: to test the Newberry glacial ice cap hypothesis via quality analysis of Lidar-based landform models in the caldera zone.

(1) Test Quads: East Lake bare earth elevation model.
(2) Digitize glacial ice cap polygon for whole Newberry region as published by Donnelly-Nolan et al., 2011 (digitize whole figure, not just East Lake area)
(3) Digitize erratic locations from Donnelly-Nolan et al., 2011
(4) Build hillshade and slope map (degrees) for East Lake quad using bare earth lidar.
(5) Compare erratic-mapped cones vs. non-erratic cones in terms of morphology (relief, slope), use existing Taylor data for quantitative information
(6) See taylor for polygon coverage of single-cone areas and poly IDs and for related morphometric data.
(7) Examine the caldera zone for glacial landforms (cirque basins, moraine ridges, note: check north facing slopes for cirques or bowl-shaped features, how do they compare to south-facing slopes?)

Slides for presentation: (1) a bullet summary slide of purpose, concept/hypothesis of the “glacial model” and why it’s relevant to newberry cinder cone work, (2) a methodology / over slide showing techniques used in analysis, example Lidar models, (3) a slide/figure comparing / showing specific cone elevation images, erratic locations, and any suspected glacial landforms detected, (4) a slide summarizing results of analysis, whether the glacial hypothesis is supported /refuted, why? and suggestions for future analysis of this problem.

Dana - Flow Margin Mapping Experiment

Objective: to explore developing a methodology for mapping lava flow margins of different ages, as related to Newberry cinder cones.

(1) Test Quads: Lava Cast Forest + Lava Butte bare earth Lidar models; use adjacent quads as needed for young flows that extend off the maps.
(2) Clip quads / DEMs as needed to increase processing efficiency.
(3) Create slope maps (degrees) and hillshades for DEMs to use in mapping flow margins.
(4) Experiment with slope classification breaks; stepwise adjust and process to determine optimal slopes breaks that might identify “young’ and “old” flow margins based on slope

angle and flow-top morphology (young = jagged and steep fronts with primary flow structure, old = smooth and gentle sloping fronts with loss of primary flow structure).

(5) Create a polyline feature class and heads-up digitize flow margins. Attribute each line based on slope-break analysis above, and identify them qualitatively as “young”, “middle aged”, and “old”.

(6) Visually and qualitatively analyze the relative ages of flow margins using morphology and appearance of cross-cutting relations between flow margins, and with / around cinder cones.

Slides for presentation: (1) a bullet summary slide of purpose / methods explored, why is this important with respect to newberry cinder cone work? (2) two slides with example hillshade model, slope model, and flow margins polyline overlays for the two test quads (3) a results and conclusion slide with bullets summarizing findings and suggestions for future work on this topic?

Dziekan - Cone-Volume Methodology Comparison

Objective: to compare cone-volume estimation techniques using the USGS 10-m DEMs vs. new Lidar bare-earth elevation models.

(1) Test Quads: Lava Cast Forest + Lava Butte bare earth Lidar models
(2) Work with Taylor to select 20 cones with a range of morphologies / sizes
(3) Download / use existing cone map polygons, polygon IDs and clip boxes (see taylor)
(4) Clip the selected 20 cones from the lidar Lidar DEM’s using clip boxes, keyed to existing polygon IDs
(5) Create slope map (degrees) for each clipped cone DEM respectively
(6) Create hillshade model (use default settings) for each clipped cone
(7) Digitize new cone polygon boundaries around each cinder cone base / margin.
(8) Clip out the cone center elevations from the respective DEMs using the cone polygons.
(9) Export raster grid of donut, import into surfer, re-interpolate cone-elevations with cone removed.
(10) Use map algebra to subtract the cone-removed surface, from the original cone surface, and determine volume.
(11) Create summary/results spreadsheet with results including cone ID, cone volume calculated by Taylor from 10-m DEM, cone volume calculated by Dziekan from lidar DEM.

NOTE: work through steps 1-9 above completely for 10 of the 20 cones first, see how it goes / how long it takes. If logistically feasible, repeat steps 1-9 on the remaining half of the selected 20-cone population.

Slides for presentation: (1) a bullet summary slide of purpose / methods explored, why is this important with respect to newberry cinder cone work? (2) two slides with example hillshade model, slope model, and cone volume methodology (see existing taylor slide show) (3) a results and conclusion slide with bullets summarizing findings, suggestions for future work on this topic?