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Geomorphometric analysis of the scoria cones of the San Francisco Volcanic Field using polar coordinate transformation

Fanni Vörös (1), Zsófia Koma (2), Dávid Karátson (3), Balázs Székely (2,4)

(1) Institute of Geosciences, Eötvös University, Budapest, Hungary (fannivrs@gmail.com), (2) Department of Geophysics and Space Science, Eötvös University, Budapest, Hungary, (3) Department of Physical Geography, Eötvös University, Budapest, Hungary, (4) Interdisciplinary Ecological Centre, TU Bergakademie Freiberg, Freiberg, Germany

Scoria cones are often studied using geomorphometric and traditional GIS methods, e.g. aspect, slope histograms, area, cone height/width ratio. In order to enhance the non-symmetric shape components in contrast to the conical forms, we used a new approach in our research: the polar coordinate transformation (PCT) introduced by Székely & Karátson (2004). The study area is the classic cluster of scoria cones at the San Francisco Volcanic Field (SFVF) encompassing roughly 600 scoria cones as well as the San Francisco stratovolcano. Our goal is to analyse the even slight asymmetric shape of the scoria cones, and to generalize our findings.

The area is a well-studied volcanic field, with a great number of available geological and geomorphological information, so comparing our PCT results with the data in literature is feasible.

Polar coordinate transformation, being a one-to-one transformation, maps the original Cartesian coordinates (X, Y in meters) to radial distance (m) and azimuth (°) values. Our inputs were digitized polygons.

We created images in the transformed coordinate system that clearly show the asymmetrical shape of the scoria cones. This asymmetry is found to be related to some extent to denudation, and to the age of the volcanic edifice that correlates with differential erosion. However, original asymmetries related to formation (e.g. rifting, emplacement on slope, eruption variations etc.) are also reasonable. The applied technique allows to define new derivatives of volcano-geomorphological parameters.

The resultant scoria cone patterns have been manually categorized, however, the results are suitable for automated classification which is our next purpose.

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Székely, B. & Karátson, D. (2004): DEM-based morphometry as a tool for reconstructing primary volcanic landforms: examples from the Börzsöny Mountains, Hungary, Geomorphology 63:25-37.