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# Developing methodology for scoria cone morphometry processing

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Over the past decades it has become more and more common that digital terrain models (DTMs) of different landforms are studied using GIS tools in addition to field surveys. With the development of data acquisition instrumentation, we can get more accurate and realistic representation of the surface in increasing resolution using different measurement techniques (drone, satellite, etc.). On the other hand, the rapidly growing amount of data requires higher automation of the processing. In extraction of geomorphometric parameters the batch processing of DTM derivatives is getting more and more common.
Owing to their beauty and relative geometric simplicity, frequent targets of geomorphometric analyses are the scoria cones. From a geological point of view monogenetic scoria cones are static forms. These very simple, mostly conical, rounded volcanic edifices can be examined relatively easily. Our study areas were the San Francisco Volcanic Field (USA), the Chaîne des Puys (France) and the central-eastern part of the Sierra Chichinautzin (Mexico). We had different resolution DTMs (30 m, 0.5 m and 5 m horizontal resolution, respectively) representing different number of cones (313 pcs, 26 pcs and 152 pcs, resp.).
We created a workflow through which any scoria cone area's edifices can be tested automatically in the same way. The input can be various: maps, DTMs, auxiliary info (e.g., shapefiles), and all of them give the baseline for the processing. The first processing step in the extraction of a few summary tables, followed by the computation of the most basic DTM derivatives to describe scoria cones (e.g., relief, slope, aspect). From these basics, we extracted more sophisticated parameters, images and diagrams. In our method an important step is to perform polar coordinate transformation (PCT), a one-to-one mapping of the original Cartesian coordinates (X, Y in meters) to radial distance (m) and azimuth (°) values.
PCT images are used to detect asymmetrical shape components of the scoria cones. An essential step in that asymmetry study is to calculate various average values and find radial or other outliers that enhance asymmetric features of the cones. The applied technique allows to define new derivatives of volcano-geomorphological parameters.
The morphometric characterisation of the cones is an intermediate product as we intend to deduce conclusions concerning the age or age ranges of the groups created via the processing. Finally, Mann–Whitney test is performed in order to verify the statistical robustness of groupings based on the morphometric properties and the age ranges. In successful case a relationship can be established between morphometry and ages. The processing chain can be applied independently of the input data resolution and type.
With the help of our processing methodology we have standardized and mostly automatized the processing, for a later worldwide comparison in mind. We speculate that in the near future a processing will be possible, no matter which volcanic area is involved, how many scoria cones are there or what resolution DTM is available from the area, and a deeper analysis of the cones will be feasible.