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Morphometry and parameter assessment of scoria cones fields: a DEM-based morphometric approach

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Cinder cones are relatively small but common volcanic features that form by the eruption of low-viscosity, generally basaltic magma during strombolian or hawaiian eruptions. Often they appear in volcanic fields, providing geomorphic evidence of a particular eruptive behaviour. Also, when a big number of scoria cones are scattered over a large area, it means that there the magma can find several different ways to reach the Earth's surface. These facts as well as the time-space distribution of the cones have important implications toward the understanding of local geological settings, and have substantial inferences for hazard assessment.

The recent availability of freely downloadable topographic data increases the efficiency and precision of the collection of morphometric parameters of scoria cones. Various digital elevation models (DEMs) at different resolution can nowadays be found on the internet: the Shuttle Radar Topography Mission DEMs (SRTM; http://www2.jpl.nasa.gov/srtm); the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Global Digital Elevation Model (GDEM; http://www.gdem.aster.ersdac.or.jp); the USGS National Elevation Dataset (NED; http://seamless.usgs.gov); TINITALY DEMs (http://kharita.rm.ingv.it); etc.

Measurements of scoria cone characteristics using DEMs engage errors that are dependent on the DEM resolution and accuracy. The SRTM DEM was discarded because of the too low resolution. Obviously, the errors involved in scoria cone morphometry are also dependent on the cone dimensions. In this work we measured the discrepancies of the widely used morphometric parameters (V, H,Wco, and H/Wco) between DEMs from different sources (LIDAR = 2 m, TINITALY = 10 m, NED $\sim$ 10 m, ASTER $\sim$ 30 m) as a function of scoria cone volume, in order to assess the precision of these free available DEMs. As a result, we identified cone volume values, depending on resolution, beyond which the morphometric and volumetric measurements are reliable.

Based on this assessment, scoria cones have been selected having well defined circular boundaries, no breaching, and being separated from the surrounding terrain by an abrupt change in slope. Using the created data base, cone height (Hco), cone width or basal diameter (Wco), and cone volume (V) have been calculated and compared for hundreds of cones, belonging to 32 cone field disseminated over the world. Some of the studied fields are well known, but for most of them we provide the first systematic results of scoria cone morphometry.