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## Downprint and upprint of landforms from DEM: the case of the volcanic Acores islands.

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Present terrestrial landforms result from hydrogeomorphological processes during geological times that could be deciphered with DEM with specific algorithms. DEM could be considered as a "footprint" with two folds: the "downprint" referring to a tessellation of catchment basins organized according to lowest points and the "upprint" as a topographical splitting in relation to highest points. Specific algorithms allow the extraction of both "prints" that must be analyzed with ad hoc geostatistical methods. For the downprint, various algorithms have been developed since the 1980ties to extract of catchments according to the steepest descent downstream lines (I.e. D8 method or variant of it); for the upprint, the previous algorithms must be modified to fit with the specific topological properties of steepest ascent morphological lines with stepwise iterations to delineate humps, hills and mountain ranges of embedded (or enshrined?) magnitudes.

This geomorphometrical approach is applied to DEM SRTM 1 arc second (About 30 meters resolution) on the Sao Miguel and the Pico volcanic islands for comparison purposes. The results pinpoint the valuable contribution of the combined geostatistical analysis of both downprint and upprint to unravel the intricate patterns of hydrological and lithological entities so to say Steepest descent hydrological units (SDHU) and Steepest ascent morphological units (SAMU).

The SDHU delineated from DEM correspond to catchment basins and specific algorithms are implemented in many GIS for hydrological and other types of modeling. This is not the case for SAMU which need to be explained; each unit will be called "massif" and refers to all steepest ascent lines converging to one and only one summit for elementary SAMU (order 0) and the limits between them are related to thalwegs and saddle points; at higher orders, the progressive merging of the elementary massifs creates hierarchical sets (orders 1 to n) of larger massifs with several summits. The result delineates morphological units such as major volcanic mountains and also smaller adventives volcanoes in the case of both islands of San Miguel and Pico. SAMU are then mostly related to lithological and tectonic features and are complementary to SDHU which are hydrological functional units.

The comparative geostatistical analysis (area-number Korcak method) of SDHU and SAMU of the two islands suggests that they have different downprints and upprints despite that there are in the same morphotectonic and climatologic contexts. The discrepancies between the two islands may be because the volcanic geology of San Miguel is older than the one of the island of Pico.

### References:

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