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# DEM-based model for reconstructing volcano's morphology from primary volcanic landforms

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Volumes of magma intruded in and emitted by volcanoes through time can be estimated by reconstruction of volcano's morphology and time sequence. Classical approaches for quantifying magma volumes on active volcanoes are based on the difference between pre- and post-eruption digital elevation models (DEM), but this kind of approach needs the pre-eruptive surfaces to be available. For old and eroded volcanoes these surfaces are poorly constrained. However, because the geometrical form of many volcanic edifices exhibits a remarkable symmetry we propose, here, a new approach using primary volcanic landforms in order to estimate the amount of the both erupted and eroded material and to locate eruptive centers.

A large fraction of composite volcanoes have near constant slope on their flanks and a form that is concave upwards near their summits. But many phenomena can lead to non-symetrical edifices and complex morphologies can result, for example from parasitic centers of volcanism on the flanks, from alternation of short effusive and explosive construction phases, from flank or caldera collapses, or from glacial and other types of erosion.

In this study we propose that, on the first order approximation, complex morphologies can be modeled by piling regular cones. In this model, cones centers and slopes are derived by fitting primary volcanic landform with a linear function :elevation=f(distance from center). Such an approach allows to estimate both errors on location of the eruptive center and on the volume of the resulting cones. This model can then be used for quantifying volume of erupted and eroded material, and for quantifying catastrophic events as giant landslides or flank collapse.

This approach is tested on four different active volcanoes : Mount Mayon (Philippines), Mount Fuji (Japan), Mount Etna (Sicily) and Mount Teide (Canary Island) to estimate errors in volume between modeled and actual edifices. It is then used on volcanoes of La Réunion hotspot to reconstruct the Piton des Neiges and Piton de la Fournaise volcanoes at its different stages of growing.