



InSAR, GPS, triangulation and EDM combination in a 3D velocity field: Insight from Arenal volcano

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Geodetic techniques provide useful information to detect and assess geophysical processes occurring at volcanoes. When the deformation signal is large, standard analyses and modelling can be carried out. However, when surface movements are subtle and several processes occur simultaneously, stochastic and multi-techniques assessment is required. Here we present a methodology that combines GPS, triangulation, trilateration and InSAR in a 3D velocity surface without any prior specific source assumption. The methodology is in 5 steps: design of the geodetic monitoring network, acquisition and post-processing of deformation observations, spatial integration, time series computation and finally spatial and temporal measurement integration. We apply this methodology to Arenal volcano in Costa Rica and provide an unprecedented insight of the volcano's deformation. The most significant improvements of this method are the reduction of campaign logistics, the unambiguous detection of the outliers, an increase in accuracy, a 3D velocity field accounting for all techniques and measurements. Although, the methodology is applied to GPS, triangulation, trilateration and INSAR geodetic networks with a steady motion, it has the potential to be extended to other geodetic techniques and where transient deformations are ongoing. The described methodology can be applied in volcano monitoring worldwide.