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Quantitative estimation of topographical change caused by 1986 eruption at Izu-Oshima

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The 1986 eruption at Izu-Oshima produced three types of lava flow (LA, LB, and LC) from different craters. In order to test the algorism for a numerical simulation of lava flow in the near future, we made a digital elevation model (DEM) of Izu-oshima before eruption and measure the topographical change by subtracting a DEM before eruption from that after eruption. The post-eruption DEM has already been published as ”Digital Map 10m Grid (Elevation of active Volcanos) ” by The Geospatial Information Authority of Japan (GSI). On the other hand, there is no published pre-eruption DEM. We digitized a topographical map (paper map) published in 1981. We made a digitizing assist software with Processing language and digitize the shape of contour lines of the topographical map. Then the data was resampled into 1 m mesh DEM with kriging method by a mesh resampling software that we made with IDL language. Kriging is a group of geostatistical techniques to interpolate the value of a random field, based on a stochastic model of the spatial dependence quantified by the variogram. To estimate an amount of shift between the pre-eruption DEM and the post-eruption DEM, we searched for shift-parameters for the match by shifting the area of post-eruption DEM at eastern caldera, which is not topographically affected by eruption, ranging +-50 m horizontally with 1 m intervals and +-30 m vertically with 0.1 m intervals and checked the difference between the pre- and post- eruption DEMs at the area. When we shifted the post-eruption DEM 29 m to the South, 31 m to the West, and 0.8 m downward, the average of absolute difference of elevations took minimum value 2.09 m. Because the value does not match the amount of shift by plate sliding, it requires consideration. Using the matched DEMs and a boundary shape of Lava A interpreted by Google Map’s satellite image we estimated the volume of Lava A by multiplying grid area (10 m x 10 m) and the difference of elevation between the DEMs and obtained the value 6.6 x 10^5 m^3. The estimated volume is a little larger than the value (5.5 x 10^5 m^3) estimated by Nagaoka (1988) and that (2.3 x 10^5 m^3) by Endo et al. (1988). We estimated also the amount of deposition by Lava B and a scoria cone and obtained the value 38 m maximum. We found a new landslide at Kengamine and confirmed it by Google Map’s satellite image interpretation.

Keywords: lava flow, topographical change, DEM