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Insights on the emplacement of a compound lava flow field documented by a time series of Lidar-derived DEMs

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The application of light detection and ranging (LIDAR) technology allows the production of high-resolution digital elevation models which are widely used in volcanological studies. Here we show a novel application of the airborne LIDAR technology which yields details of the volumetric rates and emplacement dynamics of an active lava flow field.
During November 17-18, 2006, an airborne Lidar survey has been carried out at Mt. Etna on the upper slopes of the Valle del Bove (East flank) where a compound lava flow field was emplacing. The survey flight was specifically planned as a series of crossings (about 15' apart) over the flow field to repeatedly acquire a number of strips (one at each crossing) of the evolving lava channels. From each strip, a high resolution Digital Elevation Model (DEM) has been independently derived obtaining a time series of DEMs representing the evolution of the compound lava flow field. We derived volume changes in each acquisition interval by DEM subtraction. The analysis of the obtained series of DEM differences clearly shows that the emplacement of flow units is characterized by pulses of lava moving along lava channels. Lava fluxes have been derived for several flow units. Volumes and velocities of different pulses are uneven, highlighting a complex non linear emplacement of compound lava flows. These results have been obtained owing to a substantial improvement of three technical aspects: (1) the correction for systematic errors in raw LIDAR data; (2) the DEM-to-DEM coregistration; and (3) the precise quantification of residual errors.