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Numerical modeling of sector collapses of volcanic edifices

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Debris avalanches evolving from collapses of volcanic edifices are frequent and destructive events, being a part of natural evolution of volcanoes and often involving volumes up to two orders of magnitude larger than non-volcanic rock and debris avalanches.

Due to the remoteness of the places were they occur, these events generally lack a detailed description and, in most cases, pre-event topography is not available.

We replicate the motion and spreading of several of the best known collapses (Socompa, Chile; St.Helens, Washington; Iliamna, Alaska; Montserrat, Lesser Antilles) by means of the numerical code DAN-3D. We derived the topographic data from the Space Radar Topography Mission (SRTM), while the back analyses and the sliding surface reconstructions are based on the literature available and on published geomorphic evidence. The correct identification of the sliding surface and of the detached volume geometry is critical to the success of the analyses, perhaps equally so as the analytical model itself. The movement is often transitional, evolving from dry debris avalanche to a lahar an this also represents a challenge for modelling. The selected

cases are among the most studied volcanic collapses and their spreading has been previously replicated with different codes and rheologies (Frictional, Pouliquen, etc). The cases vary with respect to their volumes, triggering factors, and materials.

The purposes of the work are: (i) to validate the capability of the model at replicating debris avalanches in volcanic environments, and to evaluate the extent to which the spreading process can be captured even when the initial data are uncertain and low in detail; (ii) to verify whether some similarity can be identified among the volcanic debris avalanches investigated despite the variety of conditions in which they occurred; (iii) to verify the predictive capability of the frictional rheology against other rheologies and the Voellmy rheology in particular, which is commonly preferred to replicate non-volcanic debris and rock avalanches in the presence of water-saturated material.