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Flank stability analysis at Lastarria volcano (northern Chile): insights from rock failure criterion and InSAR observations

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Andesitic volcanic edifices are often affected by instability phenomena, which may lead to devastating flank collapses that produce debris avalanches travelling over long distances. Lastarria is an active volcano located in the northern part of Chile that shows a strong and persistent fumarolic activity. During the past 105 years this volcanic complex displays a clear northward migration of the activity, associated with several flank collapses. Among them, the youngest has a maximum length of 8 km long, and involves a volume estimated of around 0.1 km3. Differential radar interferometry (DInSAR) data, spanning from 2003 to 2008, shows the presence of localized lenticular deformation features on the western flank of the volcano, which might be interpreted as slow landslide motions. Over time, the displacement signal shows a linear trend, with mean velocity of 1cm/yr along the satellite line-of-sight (LOS).

In this work, we use DInSAR data, Landsat multispectral images, as well as field observations to classify the different ground composition at the volcano surface and to assess the possible mechanisms driving the flank collapses at Lastarria. Using estimates of material characteristics and precise DEM, we then compute slope stability models following the Mohr-Coulomb criterion. Our results show that the presence of a persistent hydrothermal system may lead to non-negligible effects on the potential occurrence of future flank movements at the Lastarria volcano.