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Volcano deformation revealed by DInSAR measurements and stress transfer in the Lazufre area, Central Andes

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Synchronous deformations at neighbouring volcanoes are often observed, however, stress transfer processes between those are rarely assessed. Evaluating the stress transferred from one volcano to another may help to understand their possible relationship.
In this work, we analyse the ground deformation phenomena affecting the Lazufre volcanic area (Chilean-Argentinean border) through the SBAS-DInSAR technique. For the purpose, a set of 64 SAR images acquired by the European ENVISAT-ASAR satellite on descending orbits (track 282, frame 4118) is considered, and the mean deformation velocity map and the corresponding displacement time series are generated. Moreover, a filtering operation for removing possible atmospheric artefacts present in the DInSAR products is applied. To test whether atmospheric and topographic artefacts may affect the signal, we first compare the results with and without atmospheric filtering and, secondly, we analyze the possible effect of high topographic features (volcanic edifices). Since the atmospheric signals are highly correlated in space and poorly in time, the atmospheric components are filtered out through a cascade of a Spatial High-Pass (HP) and a Temporal Low-Pass (LP) step. Accordingly, the mean values of the retrieved deformation are preserved. The achieved results show that both the unfiltered and filtered deformation time-series, relevant to selected points in space, are similar and demonstrate that no significant variations on the deformation trend is introduced. It is also verified that no important spurious signals in the atmospheric-filtered deformation are correlated to high topographic features.
The data reveals inflation rates up to 3.2 cm/yr for the investigated period, affecting an area greater than 1800 km^2. At the NNW margin of this inflation, another smaller deformation is located on the Lastarria volcano, which shows persistent fumarolic activity. Both the large and small inflation signals can be explained by pressurized magmatic or hydrothermal sources located at about 13 km and 1 km depth, respectively. The DInSAR products hence suggest two sources that are simultaneously subject to pressure increase. To test a possible relationship, we use numerical modelling and estimate that the deep inflating source increases the tensile stress close to the shallow source up to 1 bar during the observation period. We therefore hypothesize that the deep inflating source may have disturbed the shallow one and triggered the observed deformation at Lastarria.