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Detection of the Volcanic Deformation with Multi-Stack Persistent Scatterer Interferometry using TerraSAR-X Data

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Persistent Scatterer Interferometry (PSI) technology has been successfully applied in the urban area. But in volcanic area the situation is more complicated: 1) fast temporal decorrelation from the vegetation; 2) strong layover and shadowing effect from Radar side-looking geometry; 3) large height-dependent atmospheric effect from the hydrostatic and wet zenith delay (ZHD and ZWD).

In this research a test site Stromboli volcano in Italy is selected. In order to get the full coverage of the volcano, the object is acquired from four different acquisition geometries, two ascending and two descending orbits. After independent PSI processing the fusion of the multi-stack results is required. Thanks to the highly calibrated TerraSAR-X satellite the range and azimuth coordinates are within decimeter accuracy. In contrast, the offset in the elevation direction is usually several times more inaccurate. A fusion method using Iterative Closest Points (ICP) algorithm is developed to refine the elevation offsets of the geocoded results. A denser PS-DEM, updated from reference DEM, is combined from four stacks, as well as the deformation map of the whole volcano.

The factor of height-dependent atmospheric delay of each InSAR pair is calculated with two independent methods: integration of weather data provided from European Centre for Medium-Range Weather Forecasts ECMWF and linear fitting of the phase observations. The results are compared before and after the atmospheric corrections.

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