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Detection of quasi-static displacement components of LP seismic sources near the volcanic summit

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Seismic long-period (LP) events are still not completely understood, but widely accepted source models involve fluids and fluid-driven resonance processes. Due to the difficulties related to installing seismometers in summit regions of volcanoes, the observations of volcanic seismicity are usually performed at distances not closer than 1-2 km from the hypocentre of a seismic event.
Observations from high-density network experiments on different volcanoes lead to a new model proposed by Bean et al. (Nature Geoscience, January 2014). Therein LP events are explained as a consequence of a brittle-ductile failure occurring under the low-stress conditions in the shallow volcanic edifice, rather than fluid-driven resonance. One consequence of this model is a static displacement associated with these LP events. Unfortunately, the expected amplitude of the static shift is only several micrometres, i.e. not detectable by typical deformation measurements. Therefore, we try to develop methods for using seismometers as static shift detecting sensors.
Our current inability to recover the full spectrum of recorded displacement results in a band-limited representation of the true process derived from moment-tensor inversions. If the actual source process is of a broadband character, our narrow-band results can be quite misleading.
In this study we are focusing on quasi-static displacements we observed on seismometer data from Turrialba Volcano (Costa Rica) and Mt Etna (Italy). These appear as ramp-like signals on displacement traces of LP events, most commonly on all three seismometer components, and have a magnitude of a few micrometres. Laboratory tests confirm that the seismometers used in our field experiments can indeed measure step-like signals, but they also show that long period noise can be a problem when trying to interpret these. Normal high pass filters suitable to remove this noise cannot be applied without losing the signal we are interested in. Therefore special attention has to be paid to the processing steps preceding the interpretation of data. In order to constrain the data and test the applied methods, we compare field data and laboratory data with numerical simulations.
Considering the full broadband spectrum of the recorded displacements may shed new light on the long period part of the source process.