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Advancing the Analysis of Volcano-seismic Signals on Etna using Rotational Sensor Data

Eva P. S. Eibl[1], Martina Rosskopf[2], Mariangela Sciotto[3], Giuseppe Di Grazia[3], Gilda Currenti[3], Philippe Jousset[4], Frank Krüger[1], and Michael Weber[4]

[1]University of Potsdam, Germany (eva.ps.eibl@hotmail.com)
[2]ETH, Switzerland
[3]INGV, Catania, Italy
[4]GFZ, Potsdam, Germany

Etna volcano in Italy is one of the most active volcanoes in Europe. We recorded the volcanic activity including degassing and vigorous strombolian activity using a seismometer and a rotational sensor in August to September 2019. We test the newly developed rotational sensor in the field in comparison to the broadband seismometer and seismic-network-based locations using the INGV network. We demonstrate that a single rotational sensor co-located with a seismometer can be used to identify specific seismic wave types, to estimate the back azimuth of wave arrivals and the local seismic phase velocities.

Using the rotational sensor, we easily detected the dominant SH-type waves composing volcanic tremor during weak volcanic activity and the recorded VLP/ LP events. Changes in the composition of the tremor wavefield caused by the onset of vigorous volcanic activity are obvious and can be detected in near real-time if data is streamed. We discuss the changes in the wavefield composition from SH-type waves to a mixed wavefield in the context of the volcanic activity, the back azimuth of the signals and associated phase velocities. Our findings are consistent with observations by INGV and hence the rotational sensor reliably enlarges our sensor portfolio in volcanic environments. In fact, wavefield and ground properties can be derived using just one sensor instead of a sensor network, which makes experiments in remote areas cheaper and easier to maintain. In addition, you can observe phenomena that otherwise go unnoticed, like near vent block rotation.