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Volcanic Tremor Analysis at Mt. Etna, Italy, from Remote Land and Offshore Seismic Stations opens new Frontiers in Volcano Seismology

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Mt. Etna is a basaltic volcano with persistent eruptive activity, located in southern Italy. Its frequent lava effusions in recent years (1999, 2001, 2002-2003, 2004-2005) have been the subject of several seismological studies, investigating the links between seismic signals and eruptive activity. Particularly the volcanic tremor - a signal continuously recorded at the local, permanent seismic network - has offered new insights into the volcano feeder. Here we propose a new study of tremor recorded by three remote very broadband seismic stations, two inland and one offshore (OBS), respectively. We focus our attention on the 2002 - 2003 lava effusion and its most energetic phases of eruptive activity, which were characterized by high tremor amplitude. The innovative approach is based on the integrated data analysis of tremor recorded at distances between 25 km and 65 km from the eruptive theatre, covering a range of periods from 1 s to 30 s hitherto never investigated on this volcano. In particular, we find a maximum energy content of the signal at the remote stations on 27 October, 2002, i.e., at the onset of the volcano unrest. Afterwards, shape and dominant frequencies of the spectrum at all the three sites are very similar in several time windows throughout the eruptive activity. The stations were operative under different geological conditions and azimuth, and had different instrumental equipment. This lead us to infer these effects of the signal as a source property. The use of the multiparameter station SN-1, including a very-broad-band OBS deployed in the Ionian sea 25 km east of the cost and about 50 km from Mt. Etna, additionally allows us to explore the characteristics of tremor at a depth of 2105 m below the sea level, bridging the gap between land and offshore records.