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Variations in eruptive activity at Mount Etna in 2007-2008: state transitions revealed by pattern classification of volcanic tremor data

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Eruptive activity at Mount Etna in 2007-2008 consisted of 7 episodes of lava fountaining and periodic Strombolian activity at the summit, followed by an eruption on the upper east flank that started on 13 May 2008 and is continuing as of January 2009. The lava fountains originated from the Southeast Crater, the youngest of Etna's four summit craters, and showed a shift in the main locus of activity from the summit of the Southeast Crater cone to a new vent on its lower eastern flank. The three lava fountaining episodes from the new vent in September and November 2007 and May 2008 were unusually long-lived (up to 10 hours, compared to <1 h during most of the previous episodes from the Southeast Crater), and produced some of the longest lava flows (6.2 km) ever erupted from an Etnean summit vent. Volcanic tremor data recorded during the same period by the seismic network of the Istituto Nazionale di Geofisica e Vulcanologia (Sezione di Catania) showed significant variations related to the changes in the eruptive activity.
We explore the application of a new software, which combines various methods of pattern classification based on unsupervised learning, and which is used to detect state transitions in volcanic tremor data collected throughout the aforementioned eruptive episodes. Particular attention is devoted to transitions from pre-eruptive to eruptive activity, such as the onset of Strombolian activity, often heralding episodes of lava fountaining. We investigate possible differences in the regimes of seismic radiation prior to summit (Strombolian or lava fountaining) and flank activity (opening of fissures, short-lived lava fountaining, lava flow emission), and compare these to changes in the patterns of eruptive activity based on field and other visual observations.