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Identification of activity regimes by unsupervised pattern classification of volcanic tremor data. Case studies from Mt. Etna.

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The monitoring of the seismic background signal – commonly referred to as volcanic tremor - has become a key tool for volcanic surveillance, particularly when field surveys are unsafe and/or visual observations are hampered by bad weather conditions. Indeed, it could be demonstrated that changes in the state of activity of the volcano show up in the volcanic tremor signature, such as amplitude and frequency content. Hence, the analysis of the characteristics of volcanic tremor leads us to pass from a mere monoparametric vision of the data to a multivariate one, which can be tackled with modern concepts of multivariate statistics. For this aim we present a recently developed software package which combines various concepts of unsupervised classification, in particular cluster analysis and Kohonen maps. Unsupervised classification is based on a suitable definition of similarity between patterns rather than on a-priori knowledge of their class membership. It aims at the identification of heterogeneities within a multivariate data set, thus permitting to focalize critical periods where significant changes in signal characteristics are encountered. The application of the software is demonstrated on sample sets derived from Mt. Etna during eruptions in 2001, 2006 and 2007-8.