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Automatic location of long-period events on Tenerife (Canary Islands) through the seismic network covariance matrix analysis

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The long-period volcanic seismicity, composed of long-period events and volcanic tremors, constitutes an important attribute of volcanic unrest. Its detection and characterization is therefore a key aspect of volcano monitoring and eruption forecasting. In the present work, a method based on the seismic network covariance matrix, the equivalent in the frequency domain of the cross-correlation matrix, is used to automatically detect and locate long-period events on the island of Tenerife. We analyze seismic data continuously recorded by the Red Sísmica Canaria, a permanent monitoring network composed of 15 broadband stations operated by INVOLCAN in Tenerife. The method is based on the analysis of eigenvalues and eigenvectors of the network covariance matrix.
First, the width of the network covariance matrix eigenvalues distribution is used to detect different episodes of long-period events. Then, the first eigenvector of the covariance matrix corresponding to each episode is extracted. Our main hypothesis is that, by representing the principal component of the recorded wavefield, this first eigenvector characterizes the dominant long-period event excluding the information related to the noise. Sources of long-period events are finally located using the cross-correlation moveout information of those first eigenvectors. The obtained locations are successfully compared with locations from a standard approach based on manual phase picking. Conversely to this latter traditional approach, the developed location method has the advantage of not requiring a priori knowledge, to be fully automatic and to be adapted to emergent seismo-volcanic signals such as volcanic tremors.