## Network-Based Detection and Classification of Seismovolcanic Tremors: Example From the Klyuchevskoy Volcanic Group in Kamchatka

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We develop a network-based method for detecting and classifying seismovolcanic tremors. The proposed approach exploits the coherence of tremor signals across the network that is estimated from the array covariance matrix. The method is applied to four and a half years of continuous seismic data recorded by 19 permanent seismic stations in the vicinity of the Klyuchevskoy volcanic group in Kamchatka, where five volcanoes were erupting during the considered time period. We compute and analyze daily covariance matrices together with their eigenvalues and eigenvectors. As a first step, most coherent signals corresponding to dominating tremor sources are detected based on the width of the covariance matrix eigenvalues distribution. Thus, volcanic tremors of the two volcanoes known as most active during the considered period, Klyuchevskoy and Tolbachik, are efficiently detected. As a next step, we consider the daily array covariance matrix's first eigenvector. Our main hypothesis is that these eigenvectors represent the principal components of the daily seismic wavefield and, for days with tremor activity, characterize dominant tremor sources. Those daily first eigenvectors, which can be used as network-based fingerprints of tremor sources, are then grouped into clusters using correlation coefficient as a measure of the vector similarity. As a result, we identify seven clusters associated with different periods of activity of four volcanoes: Tolbachik, Klyuchevskoy, Shiveluch, and Kizimen. The developed method does not require a priori knowledge and is fully automatic; and the database of the network-based tremor fingerprints can be continuously enriched with newly available data. In a final step, we use compute time domain cross-correlations from the first eigenvectors and use their move-outs to locate the position of the tremors ources.