Improved location estimates of volcanic tremor with a multi-level cross-correlation approach

Ka Lok Li (1), Hamzeh Sadeghisorkhani (1), Ólafur Gudmundsson (1), Roland Roberts (1), Giulia Sgattoni (1,2,3)

(1) Department of Earth Sciences, Uppsala University, Uppsala, Sweden, (2) Department of Biological, Geological and Environmental Sciences, University of Bologna, Bologna, Italy, (3) Institute of Earth Sciences, Science Institute, University of Iceland, Reykjavik, Iceland

Earth processes in volcanic areas often produce complex seismic signals which lack a clear onset. For such signals one cannot use first-arrival picks to locate a source, as is commonly done for earthquake locations. Over the last decade inter-station cross correlation has become a popular approach for the analysis of seismic noise. In particular, the technique is used to assess the spatial distribution of ambient noise sources. We introduce an extension of the cross-correlation method for source location. This extension, which can be viewed as a simple example of a family of techniques based on higher-order cross correlation, involves a back projection of products of cross correlations from station pairs. This process helps to suppress effects of correlated, spurious signals and uncorrelated noise and, therefore, gives an improved location estimate. We present synthetic test examples of the method and use volcanic tremor from Katla volcano, Iceland, in July 2011 as a real-data example.