Geophysical Research Abstracts
Vol. 14, EGU2012-13174, 2012
EGU General Assembly 2012

Unsupervised clustering of seismic events in an On-Site-Inspection scenario

B. Sick and M. Joswig
Institute of Geophysics, University of Stuttgart, Stuttgart, Germany (benjamin.sick@geophys.uni-stuttgart.de)

During an On-site Inspection (OSI) it is essential to get a fast overview of recorded seismic signal classes to evaluate the local seismicity and in particular to investigate on suspicious events eventually representing aftershocks from an underground nuclear explosion (UNE). Very short and weak seismic events (M_L -2) of just a few seconds duration and a-priori unknown event characteristics with low-SNR, possibly masked by politically motivated interfering noise need to be detected in an inspection area of 1000 square kilometers. To meet that challenge the seismic aftershock monitoring system (SAMS) of OSI comprises of up to 50 seismic mini-arrays displaying all data in a special form of spectrograms, the four-traces super-sonograms. They rise any temporary signal energy from stationary background noise and enable visual rating of array-wide signal coherency. Currently, all data must be analyzed manually during the following day by a team of max. eight inspectors who also must maintain the stations and assemble the data. No automatic detection algorithms are in use yet because of the highly political importance of every (missed) detection. A first attempt to utilize the power of automated processing could be to support the inspectors in getting a fast overview of those possible noise sources and seismicity patterns that repeat over time. We base our approach on the same super-sonograms that proved valuable for the visual, human inspection and apply two methods of unsupervised learning. Both, Self-Organizing Maps (SOM) and Principal Component Analysis (PCA) investigate if clustering of signal types is existent and can create clusters without any prior knowledge of signal types. Superior to PCA, the SOM creates a 2-D map of representatives arranged by proximity of features, giving us a synoptic and topological overview of the acquired seismic signals. PCA, on the other hand, allows for feature extraction and tests on the necessary dimensionality for signal type differentiation and an insight on the most significant signal features used for this distinction.