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Automated realtime detection of mining induced seismicity in the Ruhr coal mining district, Germany, using master waveforms

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The exploitation of the subsurface by mining, geothermal or petroleum production causes seismic events in the surrounding areas. Shallow focal depths can lead to perceptible ground motions in densely populated areas and in rare cases to damages even for small events (magnitude smaller than 3.5). Thus, the monitoring of this kind of activities is necessary and increasingly requested by governmental agencies. A reliable detection and localisation of small events generally requires a dense and therefore expensive local seismic station network.
At the end of 2014 and beginning of 2015, a dense seismic network of 12 stations was set up as a test case in the area of the black coal mine Prosper-Haniel in the Ruhr district, Germany. This network was capable of detecting almost 400 events within 4 weeks. A cluster analysis identified 135 events of magnitude -0.7 or higher, which could be located. This cluster analysis was also used to construct master events for running a real-time single-station cross-correlation detector in the Seiscomp3 software. The results of the real-time cross-correlation detector are compared to the results of the cluster analysis with respect to the number, magnitudes and locations of the events. This two-step monitoring of the source area provides a cost efficient way for long term monitoring of the mining activity.