Discrimination of earthquakes and quarry explosions in Hungary using waveform cross-correlation and dendrogram analysis

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The seismicity of the Pannonian Basin can be described as moderate. Due to the increased sensitivity of the seismological instruments, we are able to register natural and artificial microseismic events. In seismology, discrimination of the anthropogenic and naturally occurred events is a universal problem. Nearly one-third of the Hungarian earthquakes are anthropogenic; quarry explosions, and mine blasts. Hence the earthquake catalogue may contain unidentified explosions that make geological interpretation more difficult. In order to make the Hungarian National Seismological Bulletin more accurate, it is necessary to recognize and classify these anthropogenic events.

The data has been provided by the Hungarian National Seismological Network and the neighboring countries, and registered between 2000 and 2016. First, we performed a hierarchical cluster analysis to obtain event clusters based on the spatial distances between the earthquakes, then we quantified the similarity between the waveforms in each cluster with the cross-correlation technique. Through this step, we created the P, SV, SH correlation matrices at different stations. Then we repeated the cluster analysis, but this time we used the correlation coefficient as distance metrics. Examining the shape of the resulting dendrogram, it is clear that certain subclusters are well separated. In these subclusters, the coordinates of the events are close to the mines, where explosive quarrying takes place.

With this technique, we are able to identify explosions that were listed as earthquakes in the catalogue. Now we have the opportunity to automatically remove probable blasts from the catalogue and review the recent tectonic movements in the Pannonian Basin.