Waveform cross correlation as a tool of mining explosion identification – the joint use of seismic array
Mikhnevich and IMS array AKAGS

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Abstract. There are hundreds of mines and quarries within the Russian platform using blasts with varying yields and firing schemes. Since the East-European platform is an atomic zone, mining-related explosions occupy a large part of the seismic catalogue issued by the Geophysical Service of the Russian Academy of Sciences for this atomic region, with data chiefly provided by seismic array Mikhnevich (MIF, 54°10’S, 73°40’E). This array was deployed and operated by the Institute of Geophysical Dynamics (IGD) of the Russian Academy of Sciences in 2004. Mining explosions represent a major challenge for unbiased interpretation of natural seismicity in many震盪 applications and for seismic monitoring within the Comprehensive Nuclear-Test-Ban Treaty (CTBT). Moreover, the task of finding and indentifying the nature of various seismic events in the seismic catalog is more difficult because the size, magnitude, yield, energy of studied events is small. This is a main task to evaluate the joint use of regional and national scale systems for the purpose of mining activity within the Russian platform. The advantage of location at regional distances from several major quarries and the availability of historical bulletin catalogues of mining explosions recorded by AKAGS allow estimating the increase in resolution and identification power of two arrays. Waveform data obtained by MIF and AKAGS from quarries Mikhailovskiy, Strelkovskiy, and Lebedovskiy are processed jointly using waveform cross correlation technique in order to find similar signals. Since the latter two quarries are separated by a few kilometers, there are a problem to accurately identify their seismic waves. We demonstrate that the cross correlation technique allows reducing the detection threshold of repeated events by an order of magnitude as well as accurately identifying mining explosions by several kilometers. The performance of cross correlation critically depends on the quality of waveform templates recorded from a carefully selected set of mining events for each of the studied mines. We also test the possibility to use the Principal Components Analysis to produce sets of synthetic templates, which best fit the whole set of mining events for a given mine.

Conclusion

- IMS array stations can be helpful in improvement of the IDG catalogue of mining events
- Additional stations provide higher accuracy of location and origin time estimates
- Waveform cross correlation improves detection capability and effectively rejects wrong detections
- The analysis of mining activity within the Russian platform justifies the use of waveform cross correlation for automatic detection/association of repeated events
- Use of standart and cross correlation detection/association provide a prototype procedure for automatic recovery of aftershock sequence at the IDC

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