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Identification of seismic events at Mikhnevo small-aperture array by wavelet methods

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Small-aperture seismic array Mikhnevo (MHVAR) in the Moscow region performs continuous monitoring of the central part of East European Platform since 2004. The list of more than 2000 events per year consists of regional and teleseismic earthquakes and industrial explosions from quarries at distances from 50 to 700 km with magnitudes M>0.5. More than 1000 quarry blasts were recorded by MHVAR in 2015. One fourth of them (249) correspond to the sources situated within 100 km distance from the array. Part of them with magnitudes M=1.8-2.5 (Novogurovsky, R=59 km, z=208, and Parsukovsky, R=62 km, z=222) are well identified by P arrivals and located with BEAM-f and F-K methods. The problem arises with event identification in a group of quarries with close epicentral distances (Afanasyevsky, R=67 km, z=60; Schurovsky, R=73 km, z=79; Golutvinsky, R=64 km, z=81; Panshinsky R=71 km, z=67), producing explosions with magnitudes M=0.9-1.6. These events with similar waveforms are poorly classified by traditional approaches also owing to small (±5 degrees) azimuth resolution of the standard software. In this study, the wavelet analysis approach was applied to separate 60 events, primarily attributed to a single group. Master signals for each quarry were designed using the smoothed envelope of the main coefficients of decomposition by the Haar wavelet for a typical event from the quarry. Two-minute samples of analyzed waveforms under study were decomposed by Haar wavelet, and averaged envelopes of coefficients were compared to master signals. Correlation coefficients over C=0.8 were obtained in case of events belonging to a definite group. Fourteen events out of 60 primarily selected were excluded and relocated. The rest were definitely attributed to one of the four quarries. Wavelet analysis proved to be the most effective for identification in case of poorly visually recognized events, contaminated by noise, from closely situated sources.
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