Automatic post processing algorithm for passive seismic monitoring data

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Abstract. The problem of monitoring of different types of seismic events - geoacoustic precursors of earthquakes, industrial and field explosions, places fragments fall of separating parts of rockets-carriers, etc. is one of the key in the modern ecology of the environment. The peculiarity of this kind of monitoring is that it is mobile seismic groups, which should be based in the proposed area of occurrence of events [Avrorov, 2010].

One of the most important steps for solving the problems connected with the detection and identification of recorded data from passive sensors in mobile seismic array (MSA). The task of determining the nature of the source and its' coordinates lies in the basis of direction, referred to as the geoacoustic location. Using a new approach (not by location) by neural classification we will demonstrate usability of algorithm which based on quantitative parameters of signal.

Main idea. The increase on the demand for Passive Seismic especially in the domains of exploration and production has most recently become a challenging field of opportunity. The method based on uncontrolled sources, requires an understanding and analysis of what we call passive events in a careful manner, so as not to be misinterpreted leading to a possible damage of its credibility [Kapotas et al., 2006]. The problem of earthquake occurrence in platform territories, in spite of numerous examples of such seismic events, remains still unsolved in many aspects. This problem is particularly important for densely populated southern European Russia [Ulomov, 2007]. Another objective of seismic monitoring is to detect and locate underground nuclear explosions agreed with Comprehensive Nuclear-Test-Ban Treaty (CTBT) verification regime.

Modern seismological monitoring of the EEP is carried out by the Geophysical Survey of Russian Academy of Sciences (GS RAS) in close contact with different regional organizations, including academic and university research units. The objective of this presentation is to look at one of the methodologies that benefit from passive sources, and justify its use with case studies from MSA "Mikhnevo". The targets of MSA are the low-magnitude events (M > 1.5-4.5). The data of the Mikhnevo 3-C station from the GEOFON network are added to these observations for some earthquakes. MSA "Mikhnevo" is situated in a quiet area which is located about 80 km to the south of Moscow [Sanina et al., 2011].

Reviewing datasets we can observe some different seismic events. They could have nature from: natural hazard (landslides, earthquakes etc.) or anthropogenic activity (mining exploration, munitions disposal etc.). We need to produce an automatic algorithm which can indicate a seismic event nature. After this procedure operator will use results for next processing (such seismic event location). There are few programs in the world, but our interest is to create this algorithm for MSA "Mikhnevo", because we should consider territorial features (depth of the sediment layers, body wave velocities etc.). The seismic channel of MSA "Mikhnevo" is based on a SM3-KV short-period seismometer, widely used. The low-frequency acoustic/seismic background noise (between 0.5-10 Hz), which is actively emitted by the earth, lies near the central frequency of wanted signal (4-8 Hz – P-waves, 2-3 Hz – S-waves, 0.5-0.8 Hz – Surface waves). This is of particular importance in passive seismic systems where STA/LTA algorithms require an input signal. Typical casing failure events have large relative amplitude, a P/S ratio close to unity. Then we estimate P/S ratios, Hilbert transform, signal lasting and Fourrier spectra – these are waveform "portraits".

We provide an application *CASE (Classification Algorithm for Seismic Events)* employing Matlab 6.1. *CASE* can make solutions like an expert system providing an interpretator choice. Neural algorithms are the most powerful for classification and identification. The complex database includes waveform "portraits" (2004-2013 years) is used for network training.

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