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Discrimination of earthquakes and nuclear and industrial explosions

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The report focuses on the problem of the discrimination of explosions and earthquakes based on spectral analysis of seismograms. For analysis we selected 10 nuclear explosions, 22 industrial explosions and 12 earthquakes. We tested different approaches: simple visual analysis of seismograms (the form of seismic trace, the polarity of P-wave first arrival, the presence of a surface wave, P/S and Pg/Lg ratios), filtering records by narrowband filter system in the range of 0.5 to 20 Hz, calculation of the Fourier spectra and spectral-temporal analysis. Analysis of explosion seismograms showed that the P/S and Pg/Lg ratios can vary greatly; for some events on the record clearly visible S-wave. The duration and amplitude of the surface wave also varies greatly for different explosions. The method of spectral analysis revealed that the explosions are characterized by a low-frequency radiation in comparison with earthquakes. Comparison of the Fourier spectra of earthquakes and explosions showed that, in general, the explosions are characterized more complex "cuted" spectra with peaks in the low frequencies. Spectrograms, showing the radiation intensity and the frequency distribution with respect to time, are significantly more informative. For earthquakes, radiation peaks locates at shear waves (4 to 25 Hz range), and its low-frequency component of the radiation decays rapidly with time. The second maximum of radiation corresponds to P-waves. For explosions, a different picture is observed - radiation peaks at P-waves (characterized by a wide range of frequencies – from 4 to 25 Hz), the intensity of the radiation of S-waves is much lower. Surface waves are very well defined. Explosions are characterized by more rapid attenuation of high-frequency component of radiation compared with earthquakes. The use of a variety of criteria of discrimination earthquakes and explosions showed that the most informative is the use of spectral-temporal analysis of seismograms.
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