Infrasonic and seismic signals from earthquakes and explosions observed with Plostina seismo-acoustic array

D. Ghica and C. Ionescu

National Institute for Earth Physics, National Data Center, Bucharest, Romania (daniela@infp.ro, +4021 4930053)

Plostina seismo-acoustic array has been recently deployed by the National Institute for Earth Physics in the central part of Romania, near the Vrancea epicentral area. The array has a 2.5 km aperture and consists of 7 seismic sites (PLOR) and 7 collocated infrasound instruments (IPLOR). The array is being used to assess the importance of collocated seismic and acoustic sensors for the purposes of (1) seismic monitoring of the local and regional events, and (2) acoustic measurement, consisting of detection of the infrasound events (explosions, mine and quarry blasts, earthquakes, aircraft etc.).

This paper focuses on characterization of infrasonic and seismic signals from the earthquakes and explosions (accidental and mining type). Two Vrancea earthquakes with magnitude above 5.0 were selected to this study: one occurred on 1st of May 2011 (MD = 5.3, h = 146 km), and the other one, on 4th October 2011 (MD = 5.2, h = 142 km). The infrasonic signals from the earthquakes have the appearance of the vertical component of seismic signals. Because the mechanism of the infrasonic wave formation is the coupling of seismic waves with the atmosphere, trace velocity values for such signals are compatible with the characteristics of the various seismic phases observed with PLOR array. The study evaluates and characterizes, as well, infrasound and seismic data recorded from the explosion caused by the military accident produced at Evangelos Florakis Naval Base, in Cyprus, on 11th July 2011. Additionally, seismo-acoustic signals presumed to be related to strong mine and quarry blasts were investigated. Ground truth of mine observations provides validation of this interpretation.

The combined seismo-acoustic analysis uses two types of detectors for signal identification: one is the automatic detector DFX-PMCC, applied for infrasound detection and characterization, while the other one, which is used for seismic data, is based on array processing techniques (beamforming and frequency-wave number analysis).

Spectrograms of the recorded infrasonic and seismic data were examined, showing that an earthquake produces acoustic signals with a high energy in the 1 to 5 Hz frequency range, while, for the explosion, this range lays below 0.6 Hz.

Using the combined analysis of the seismic and acoustic data, Plostina array can greatly enhance the event detection and localization in the region. The analysis can be, as well, particularly important in identifying sources of industrial explosion, and therefore, in monitoring of the hazard created both by earthquakes and anthropogenic sources of pollution (chemical factories, nuclear and power plants, refineries, mines).