The first infrasound array in Hungary

Csenge CZANIK, István BONDÁR

Kövesligethy Radó Seismological Observatory, Geodetic and Geophysical Institute,Research Centre for Astronomy and Earth Sciences, Hungarian Academy of Sciences
czanik@seismology.hu, bondar@seismology.hu

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Introduction

The first Hungarian experimental infrasound array started operation in May 2017.

Hungary is characterized by moderate seismicity where more than a third of the seismically recorded events are anthropogenic events, such as quarry blasts and mine explosions. Hence, to study the natural seismicity of the country and produce reliable seismic hazard estimates, it is important to identify and separate natural events from anthropogenic ones. Explosions not only generate seismic waves, but the shock wave propagates to large distances in the atmosphere in the form of infrasound waves. The infrasound array in Piszkés-tető was intentionally designed so that it is co-located with a seismic station. Combined with well-established seismic discrimination techniques, the infrasound records will help us to routinely distinguish earthquakes (that typically do not generate infrasound) from explosions (that do).

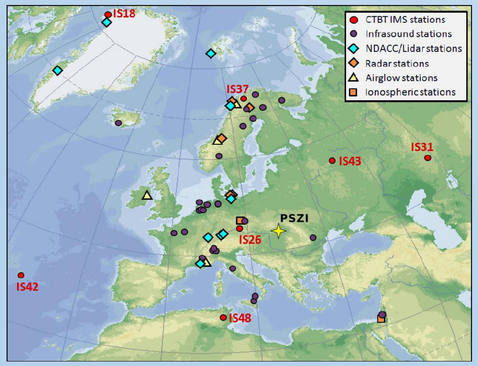


Fig.1: The map of the ARISE and IMS infrasound network. Yellow star shows the location of PSZI array (modified after [1])

Hungary joined the Atmospheric Research InfraStructure in Europe (ARISE) in 2016, when the Geodetic and Geophysical Institute of the Hungarian Academy of Sciences has won national funding for the deployment of the first Hungarian infrasound station. The ARISE project is a collaboration of more than 25 European universities and research institutes and aims to provide a new atmosphere model with a high spatio-temporal resolution by integrating different techniques - including infrasound. The ARISE infrasound network consists of the CTBTO IMS network and several European experimental infrasound arrays. In the Eastern-European region the ARISE network is sparse, hence the Piszkés-tető array will improve the coverage of the infrasound network in the region.

The PSZI array

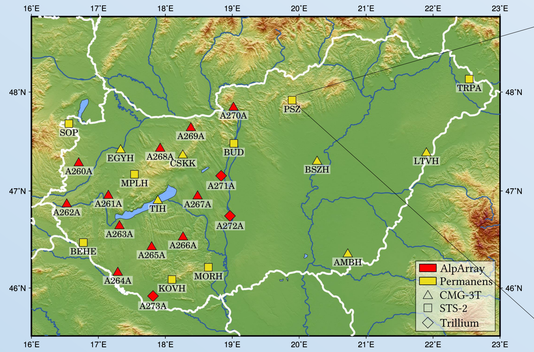


Fig.2: The Hungarian National Seismological Network

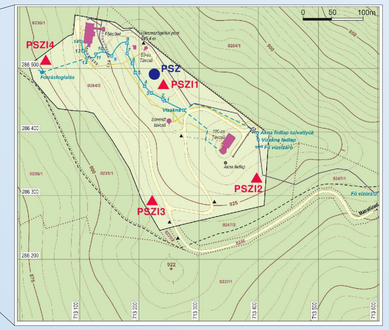
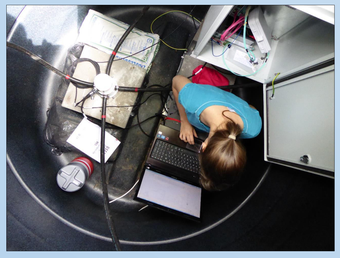


Fig.3: The map of the PSZI array. Red triangles show the array elements. Blue circle shows the PSZ permanent seismological station.

- The Piszkés-tető infrasound array is located in Northern Hungary, in the Mátra Mountains, at approximately 930 m asl.
- The array consists of 4 elements and has an aperture of approximately 300 m.
- Each element of the array is equipped with a SeismoWave MB3d microbarometer with built-in digitizer.
- All the instrumentation is placed in a waterproof plastic container.
- The station site is covered with forest that helps to reduce environmental noise.
- For further noise reduction the sensors are equipped with a star array wind-noise filtering system made of porous hoses.
- The data is forwarded real-time, and collected with SeisComp3 in the data centre of the Kövesligethy Radó Seismological Observatory.
- The central element of the infrasound array (PSZI1) is co-located with a permanent broadband seismological station.
- For data processing we will use the CTBTO NDC-in-a-box software package that includes PMCC [2].
- The waveform data will be available on GEOFON from September 2017.



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References

[1] www.arise-project.eu
[2] Cansi, Y. (1995): An automatci seismic event processing for detection and location: The P.M.C.C. method; Geophysical Research Letters, vol. 22, No. 9, pages 102 1-1024

Seismo-acoustic events

The PSZ seismological station regularly detects signals from the surrounding quarry blasts. We expect to detect also infrasound signal from these explosions. The infrasound recordings will be analysed jointly with the data of the PSZ seismological station to develop an automated method for the discrimination of earthquakes and explosions.

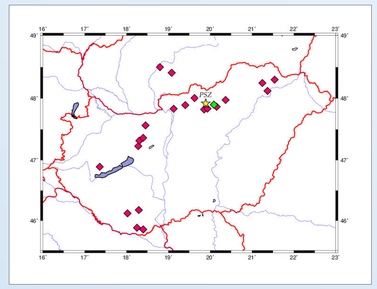


Fig.5: The red diamonds show the locations of the known mines in Hungary and in the vicinity of PSZI array. The Recsk mine is highlighted with green.

Noise spectra

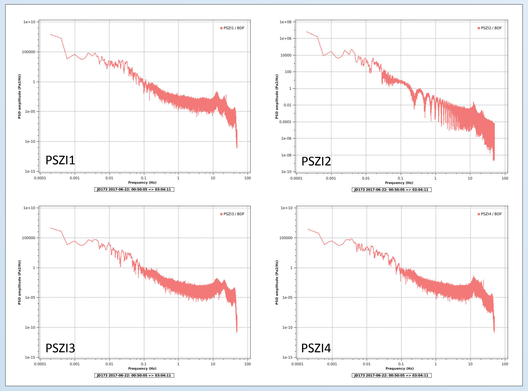
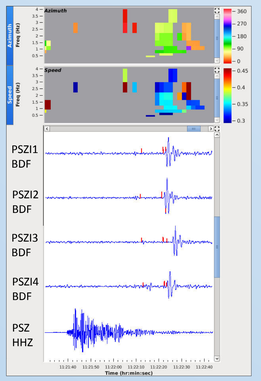


Fig.6.: Noise spectra of the sensors

First observations



In the first month of the operation of the PSZI array we already managed to record the direct infrasound arrivals of several blasts from the Recsk mine (green diamond on Fig. 5).

Fig.6.: Signal of a reported quarry blast recorded by PSZI infrasound array and PSZ seismological station; and PMCC detections