The Hungarian Seismo-Acoustic Bulletin

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Photography encouraged

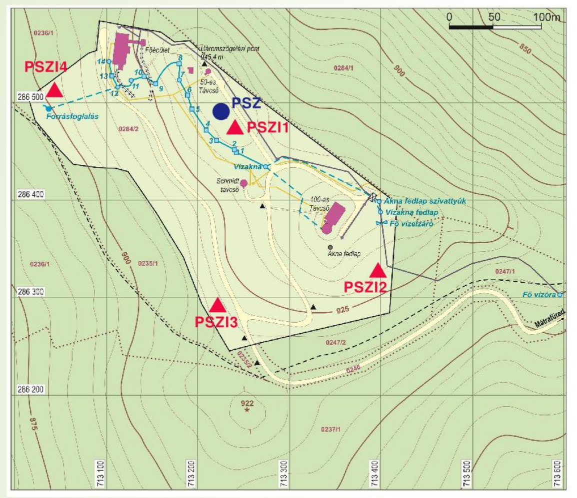
Introduction

The seismo-acoustic bulletin was compiled by the Kövesligethy Radó Seismological Observatory of the Hungarian Academy of Sciences. The bulletin combines infrasound data from the Central and East European Infrasound Network (CEEIN), the Comprehensive Nuclear-Test-Ban Treaty Organization International Monitoring System (IMS) infrasound stations with seismic data from the permanent stations of the Hungarian National Seismological Network and stations in the Central and East European Earthquake Research Network (CE3RN) as well as data from other permanent and temporary networks in the region. The Bulletin can be downloaded from http://infrasound.hu/index.php/en/hungarian-seismo-acoustic-bulletin

PSZI infrasound array

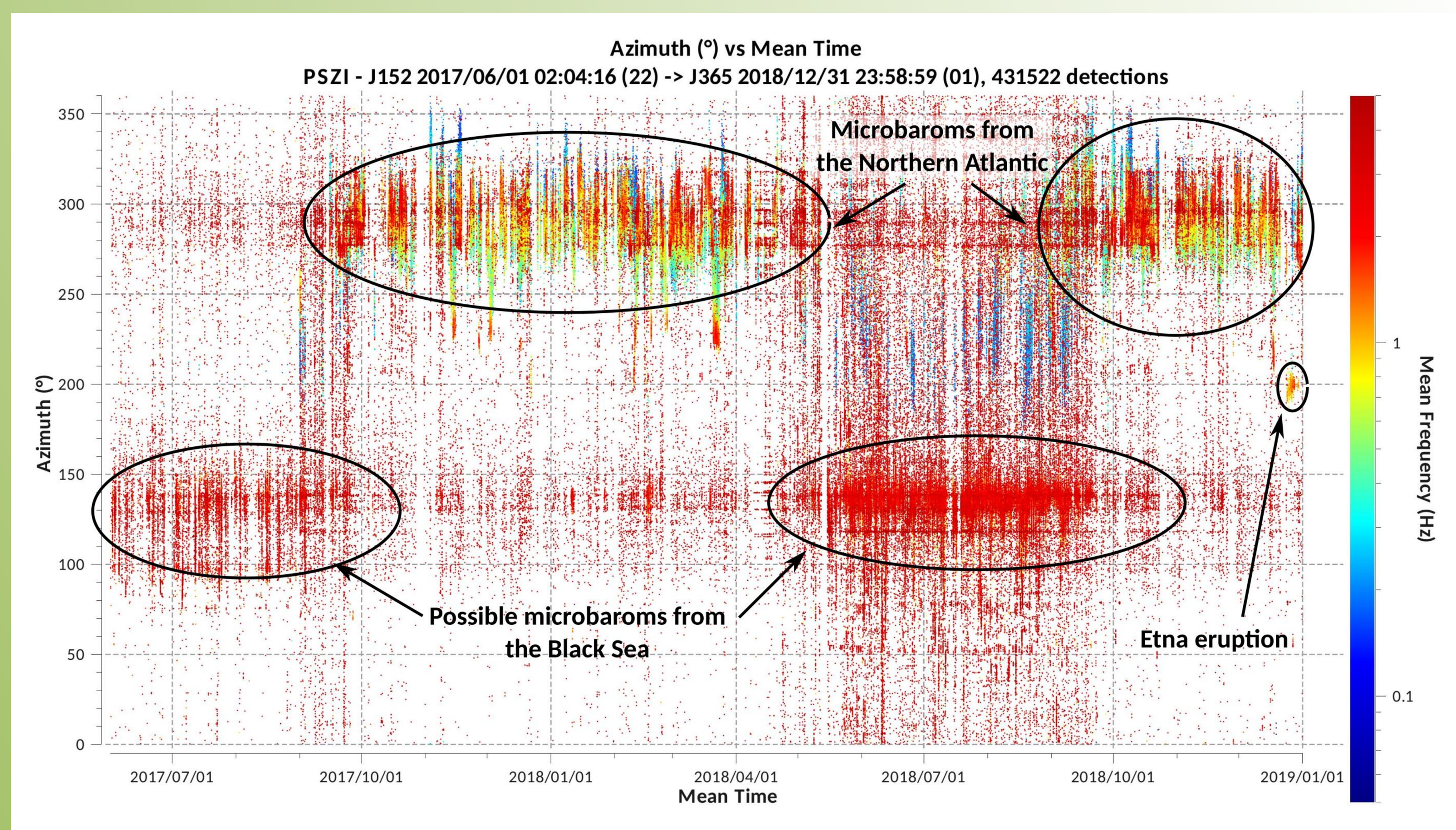
The Hungarian National Infrasound Network (HNIN, doi:10.14470/UA114590) was established by the Kövesligethy Radó Seismological Observatory, Research Centre for Astronomy and Earth Sciences of the Hungarian Academy of Sciences (MTA CSFK), Budapest, Hungary with the deployment of the Piszkés-tető (PSZI) infrasound array in 2017. The PSZI infrasound array is registered at the International Registry of Seismographic Stations, and the HNIN has the FDSN network code HN (https://geofon.gfz-potsdam.de/doi/network/HN).
The MTA CSFK has joined the Atmospheric dynamics Research InfraStructure in Europe (ARISE) project in 2016 (http://arise-project.eu/).

The Piszkés-tető infrasound array is located in Northern Hungary, in the Mátra Mountains, at approximately 930 m above sea level. It consists of four elements and has an aperture of approximately 300 m. Each element of the array is equipped with a SeismoWave MB3d microbarometer with a built-in digitizer. The central element of the infrasound array (PSZI1) is co-located with a permanent broadband seismological station.
For data acquisition SeisComp3 and for infrasound data processing the DTKPMCC (Cansi, 1995) are used. Both programs are found in the CTBTO NDC-in-a-Box software package. The seismo-acoustic and infrasound-only events are located with iLoc (Bondár et al., 2018), the successor of the International Seismological Centre (ISC) location algorithm Bondár and Storchak, 2011;
Waveforms are collected in real-time at the GEOFON European Integrated Data Archive (EIDA) node.



Map of the PSZI array. Red triangles mark the infrasound sensors, the blue circle is the broadband seismological station PSZ.

The PSZI array detects continuous and transient infrasound signals from several different sources. These sources include microbaroms, quarry blasts and accidental explosions, thunderstorms and bolides. Figure 4 shows that during winter time – from mid-September to April – microbaroms are continuously detectable from the North Atlantic Ocean. In the summer period signals are detected from South-East direction in the frequency range of 1-2 Hz, presumably originating from the Black sea.

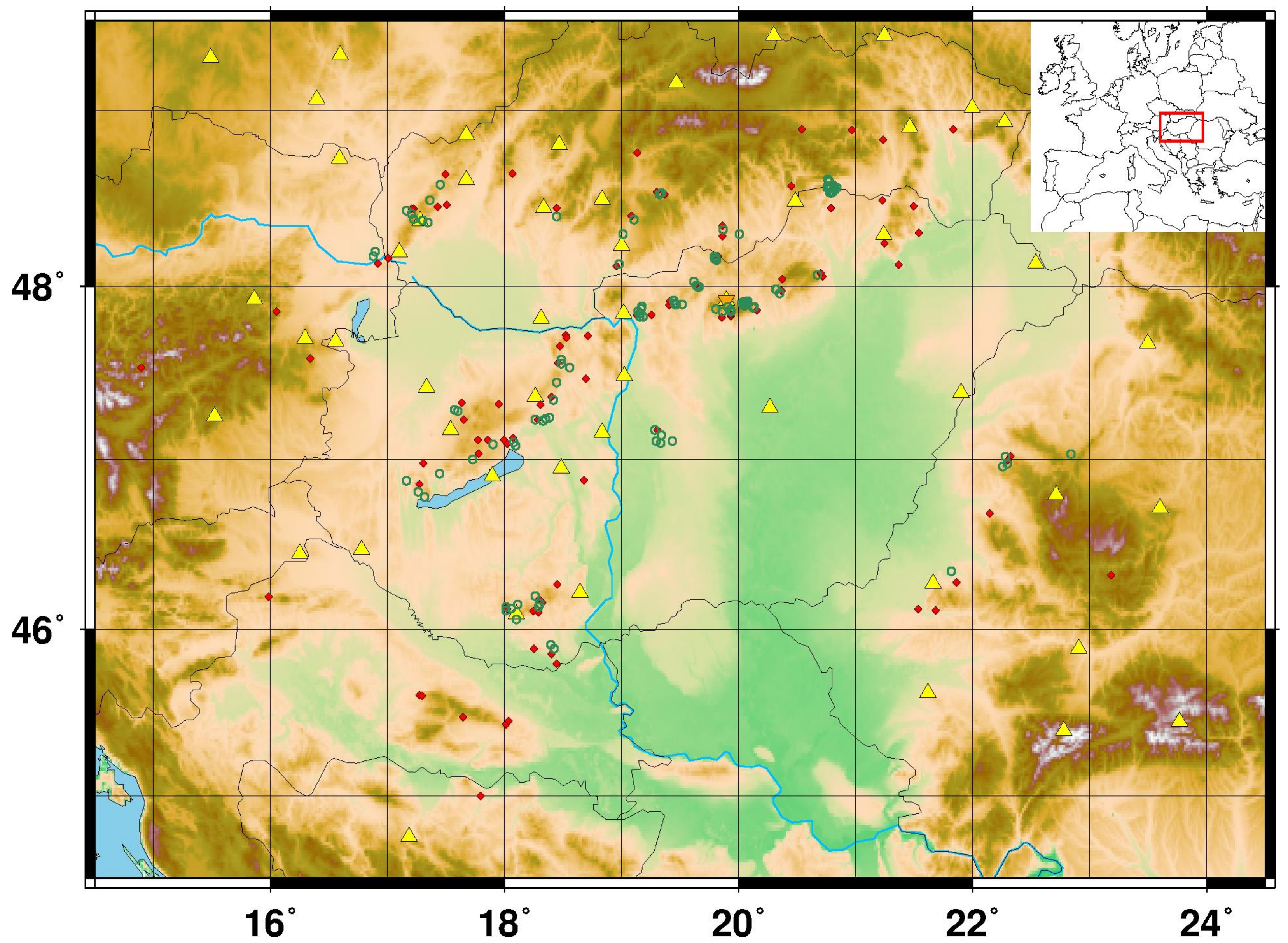


Infrasound detections of PSZI between 2017/06/01 and 2018/12/31. The detections were made by the PMCC method and are shown as a function of time and back-azimuth, color-coded by frequency. The figure was made by DTK-DIVA, part of the NDC-in-a-box software package.

Seismo-acoustic events

Anthropogenic events constitute some 50% of the recorded seismicity in the region. Hence, it is important to discriminate explosions from natural earthquakes in order to study natural seismicity and produce reliable seismic hazard estimates.

Between the operational start date of the PSZI array (2017-06-01) and 2018-12-31 the Hungarian National Seismological Network recorded the seismic signals of more than 1200 explosions, most of them originating from known surface quarries in Hungary, Slovakia, Austria and Romania. Approximately 25% of these explosions were also recorded by the PSZI infrasound array. Many, but not all, mines regularly send confirmation of their explosions to the MTA CSFK Kövesligethy Radó Seismological Observatory. These events serve as ground truth, and in the bulletin the author BUD_GT indicates the GT coordinates, while the author ILOC stands for the seismo-acoustic location of the events. The magnitude range of the events is between M0.5-2.5.



Infrasound (inverted orange triangles) and seismic stations (yellow triangles) contributing to the Hungarian Seismo-Acoustic Bulletin. Known quarry and mine locations are shown as red diamonds, green circles indicate the seismo-acoustic locations of quarry blasts.

Acknowledgements

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AZ NKFI ALAPBÓL MEGVALÓSULÓ PROGRAM

References

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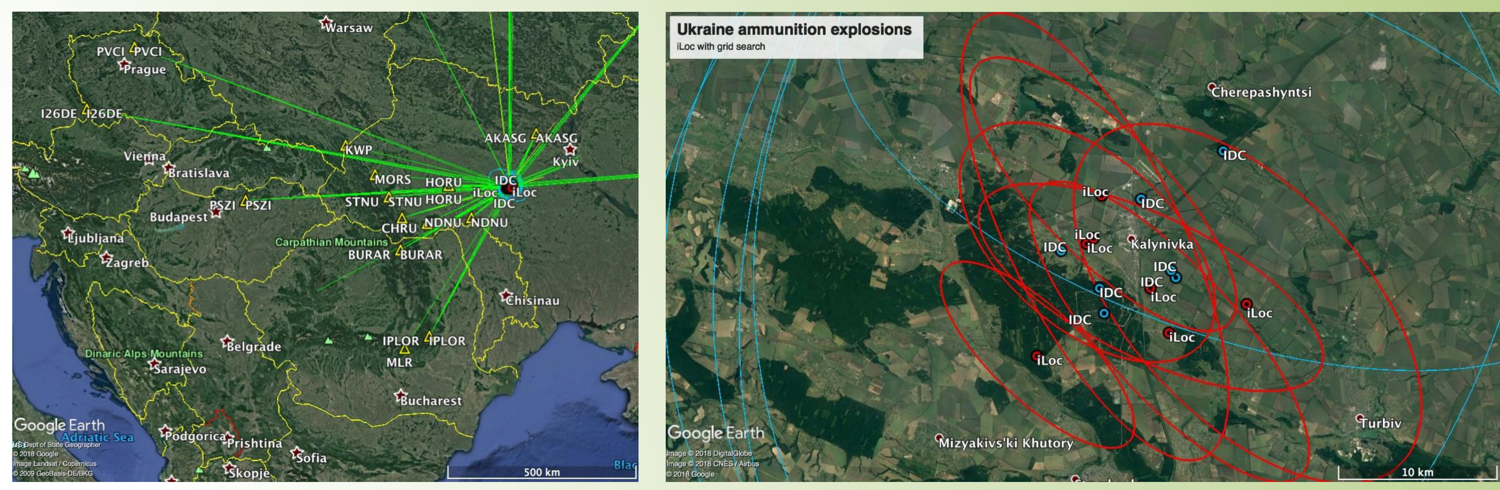
Ammunition Storage Explosions in Kalynivka, Ukraine, September 2017

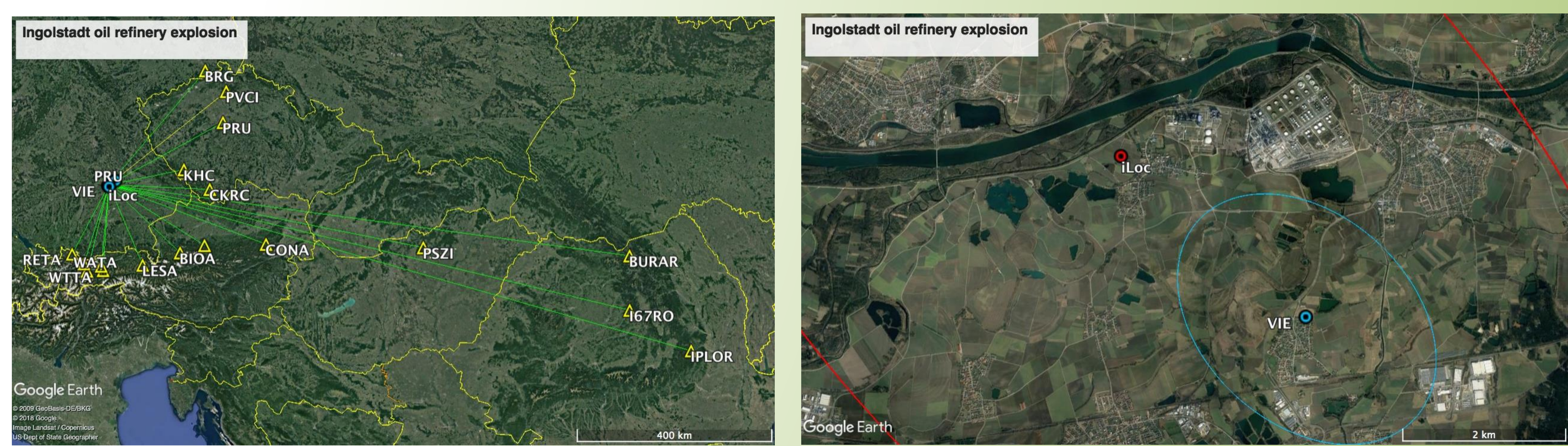
Accidental successive explosions occurred between 26 and 27 September 2017 at a military ammunition depot in central Ukraine, near Kalynivka, in Vinnytska region. 7 event locations related to this deflagration were reported in the IDC LEB bulletins. Four of the CEEIN stations (located within the distance range of 300 to 1000 km from the blasts' site) have detected infrasound signals which could be associated to the Kalynivka explosions. The seismic signals generated by the explosion were recorded by several seismological stations in Ukraine and Romania. The seismic and infrasound detections combined with the IMS data were used to relocate the event with the iLoc location algorithm.



Left panel: Regional seismic and infrasound station that recorded the Kalynivka, Ukraine ammunition storage explosions. Right panel: Seismo-acoustic event locations. IDC REB locations and error ellipses are shown in blue, iLoc locations using both IMS and regional data are shown in red. Green rectangle indicates the ammunition storage site.

Explosion in Ingolstadt, Germany, September 1, 2018

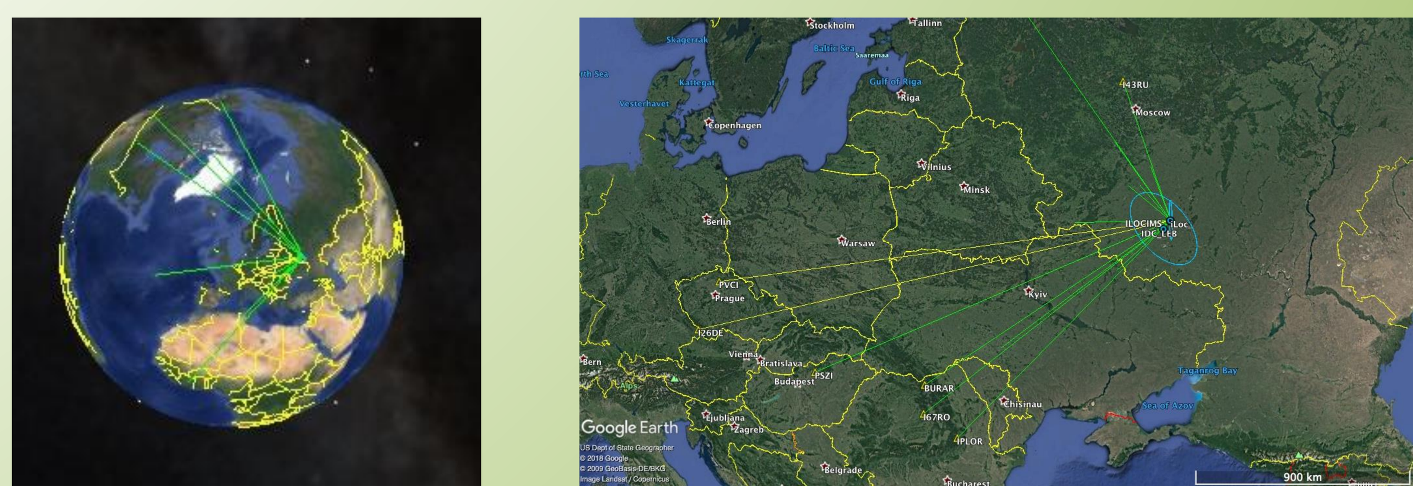
On 1 September 2018 an explosion occurred in an oil refinery near Ingolstadt, Southern Germany. The explosion produced infrasound signals that were detected by 5 CEEIN stations. The event was relocated using seismic arrivals reported to the ISC (as of 2019-03-05) and infrasound detections from the CEEIN stations.



Left panel: Regional seismic and infrasound station that recorded the Ingolstadt, Germany oil refinery explosion. Right panel: Seismo-acoustic event locations. ZAMG, Austria location and error ellipse are shown in blue, the iLoc location is indicated in red. Green rectangle indicates the oil refinery site.

Bolide over Russia, June 21, 2018

On 21 June, 2018 a large bolide exploded over Western Russia. The event was detected by 10 IMS infrasound stations and 5 CEEIN stations. The event was relocated using IMS and CEEIN detections.



Infrasound network that recorded the Russian fireball. Right panel: Event locations by the IDCand iLoc.