SnT 2025 8 SEPTEMBER ONLINE DAY 9 TO 12 SEPTEMBER AT HOFBURG PALACE, VIENNA & ONLINE
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

Bulletin of the Central and Eastern European Infrasound Network 2023-2024

Marcell Pásztor[1,2], István Bondár[3], Barbara Czecze[2], Daniela Ghica[4], Oleksandr Liashchuk[5], Ulrike Mitterbauer[6], Tereza Sindelarova[7]

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INTRODUCTION AND MAIN RESULTS

This study presents the biannual CEEIN bulletin for 2023–2024, building on our earlier work in regional infrasound monitoring. The bulletin reports both seismoacoustic events (such as quarry blasts) and infrasound-only observations (such as eruptions of Mount Etna and bolides). Seismoacoustic events are relocated with the iLoc algorithm to enhance spatial accuracy. By systematically compiling and analyzing these events, the CEEIN bulletin strengthens regional monitoring efforts and provides a dataset that can serve as a basis for future research.

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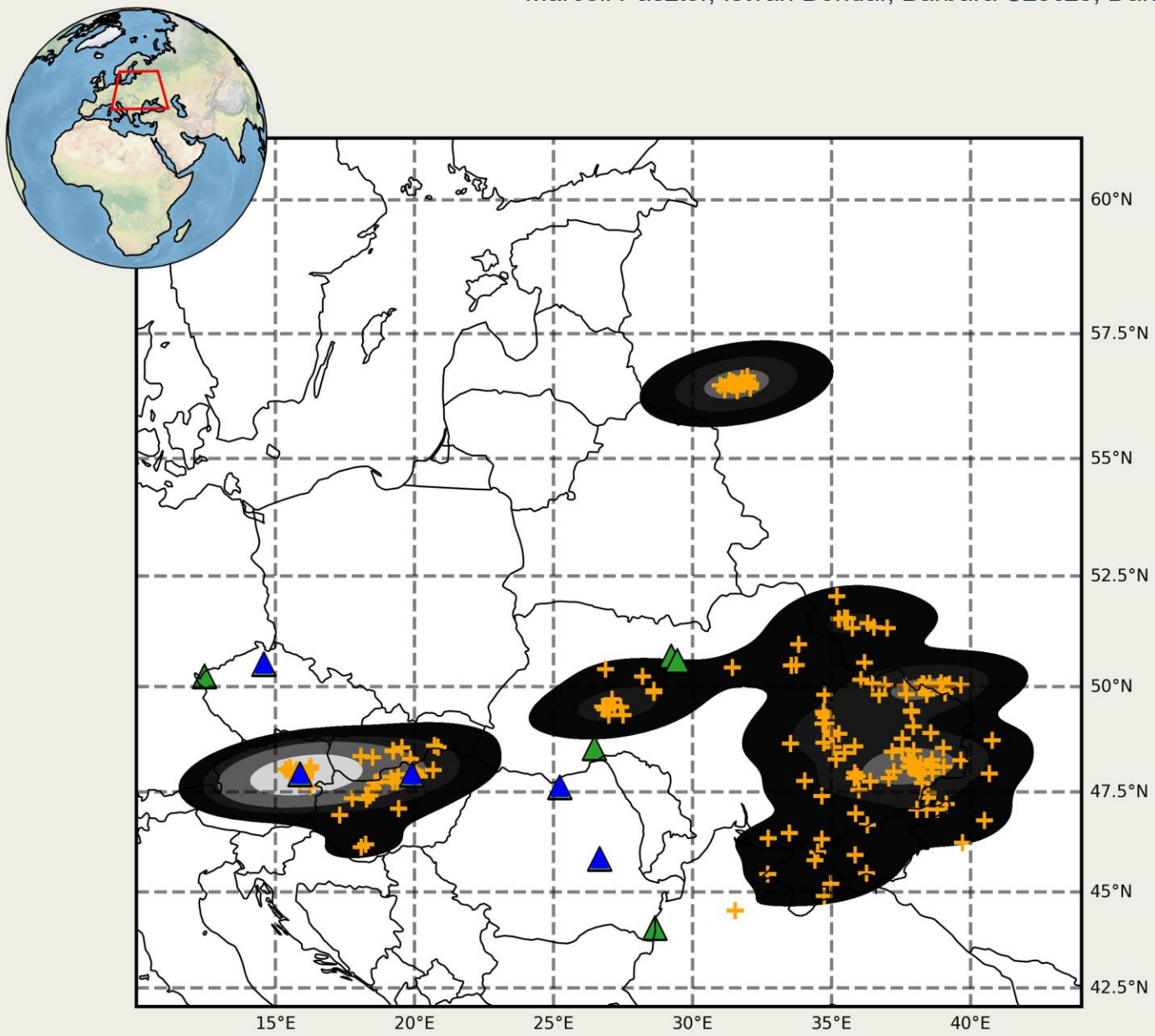

The Central and Eastern European Infrasound Network

The Central and Eastern European Infrasound Network (CEEIN) was established in 2018 through a collaboration of research institutes from Hungary, Austria, the Czech Republic, and Romania. In 2019, Ukraine joined the network, further extending its reach. Within CEEIN, researchers work together to identify shared infrasound sources both within and beyond the network, carry out seismoacoustic investigations, and distinguish between natural and human-made events. Bondár et al. (2022) demonstrated that CEEIN significantly improves infrasound detection capabilities across Europe. CEEIN data can be accessed on the website on the right.

Recently, a large labelled infrasound dataset was published for Machine Learning studies (Pásztor et al., 2025, P3.5-643 at SnT 2025).The recorded events—such as quarry blasts, sonic booms, war activity in Ukraine and bolides—are reported in the biannual CEEIN bulletin (Bondár et al., 2022). The draft of the bulletin is presented here.

We are motivated by the need for bulletins which can serve as a base for further scientific studies and civilan applications (see e.g., Pilger at al., 2018; Bondár et al., 2022; Park et al., 2024).

CEEIN website

Bondár et al., 2022

Pásztor et al., 2025

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Method

Our method can be summarized in the following steps:

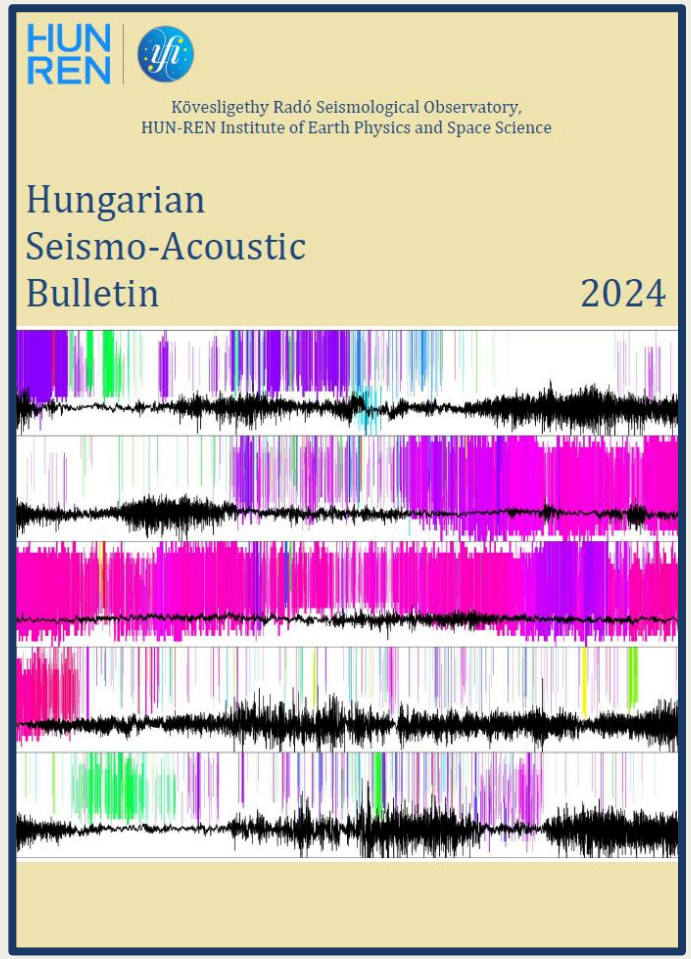
- **Collect ground truth events**, which typically includes, quarry blasts, bolides, earthquakes, sonic booms and recently, war activity in Ukraine
- **Associate detections to the events** at the CEEIN arrays. For this step, arrival times is estimated with a constant 300 m/s and +/- 10 minutes, relative to the estimated arrival time and +/- 10 ° azimuth range with respect to the expected direction is investigated manually.
- Those events are selected, the have **at least 2 CEEIN infrasound phases** recorded.
- Lastly, **relocation process** is performed for the seismoacoustic events using the iLoc (Bondár and Storchak, 2011) software.

Ground Truth sources

Several sources of ground truth information are used. List of quarry blasts in Hungary and neighboring countries are provided by a seismic analyst at the Kövesligethy Radó Seismological Observatory. Some events are confirmed by the authorities as well, while the rest remain suspected quarry blasts. These are annually reported in the Hungarian Seismo-Acoustic Bulletin (HSAB) and serve as the core to the CEEIN bulletins as well.

Earthquakes and war activity in Ukraine is taken from the bulletins of the International Seismological Centre (https://www.isc.ac.uk/iscbulletin/search/bulletin/).

Bolides were compared to the dataset provided by the International Meteor Organization (https://fireball.imo.net/members/imo_view/browse_events).



HSABs can be found at: seismology.hu/index.php/en/infrasound/hungarian-seismo-acoustic-bulletin

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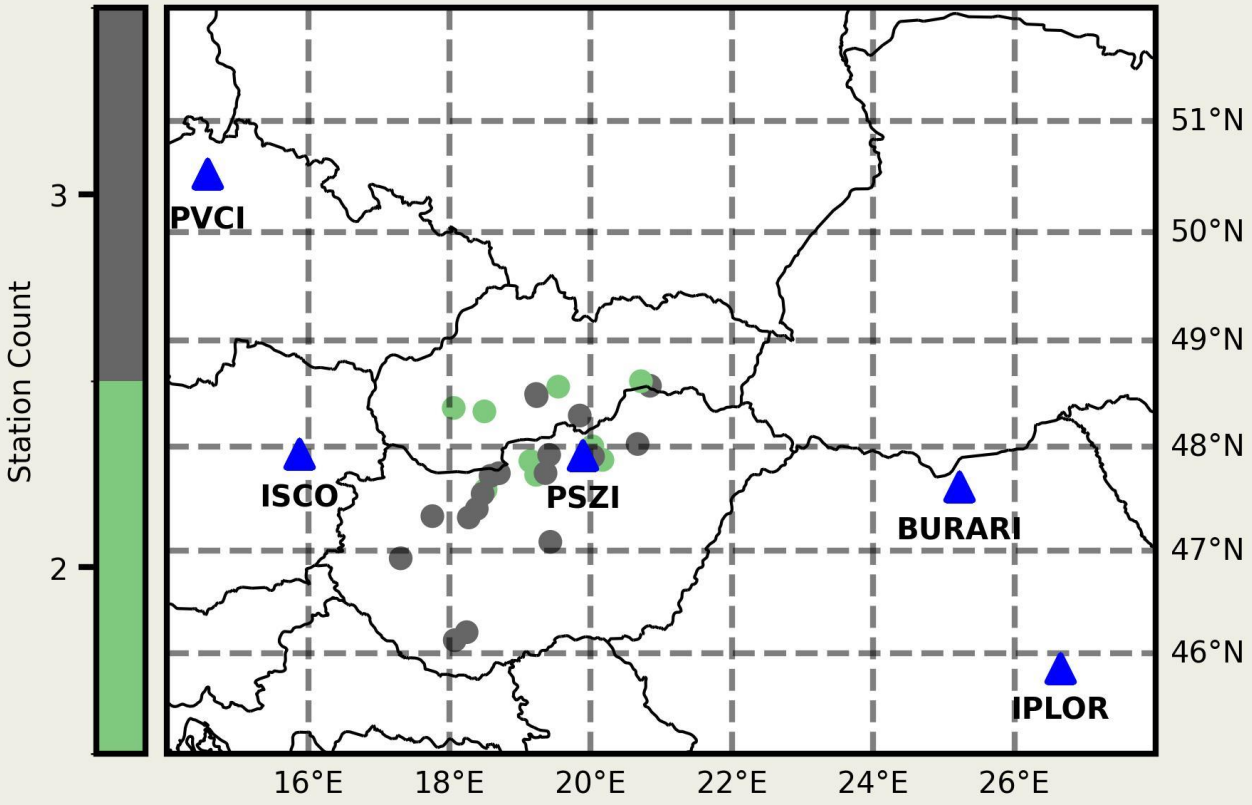
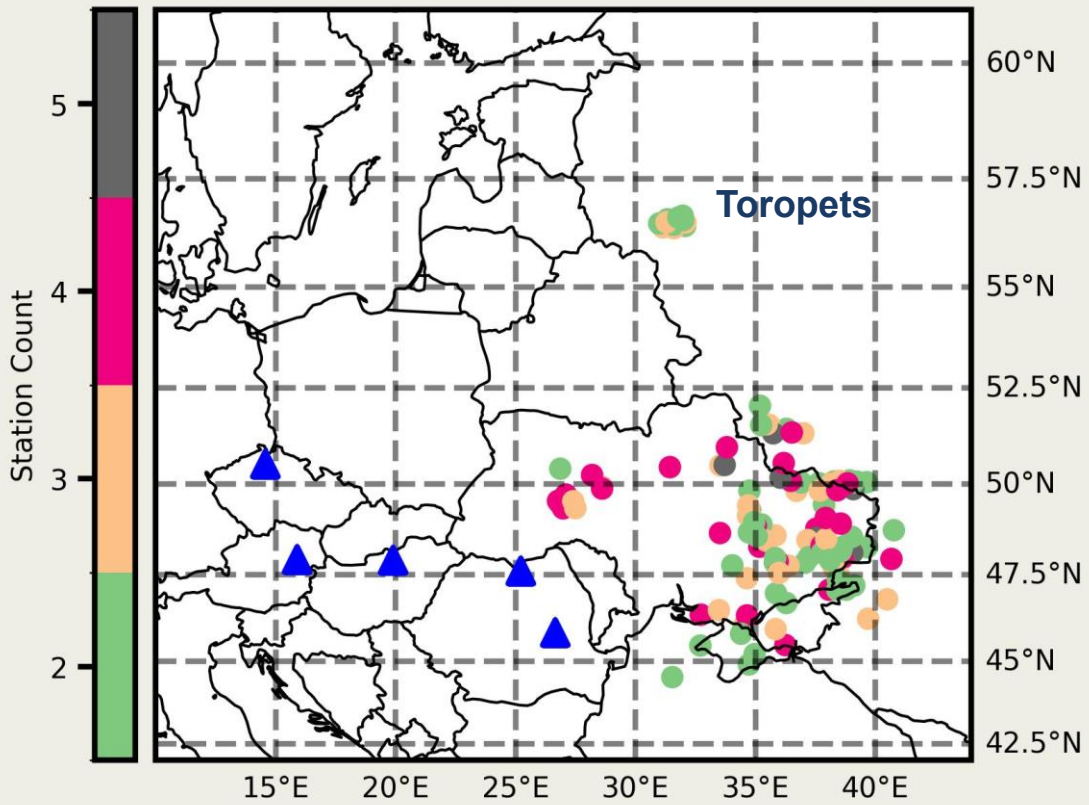
Quarry blasts from HSAB



In total, 36 quarry blasts were relocated from the HSABs in 2023 and 2024 with the addition of infrasound phases from one or the other CEEIN station(s) besides PSZI.

War activity in Ukraine



In total, 136 events from the ISC bulletins were relocated in 2023 and 2024 with the addition of infrasound phases from two to five CEEIN stations.

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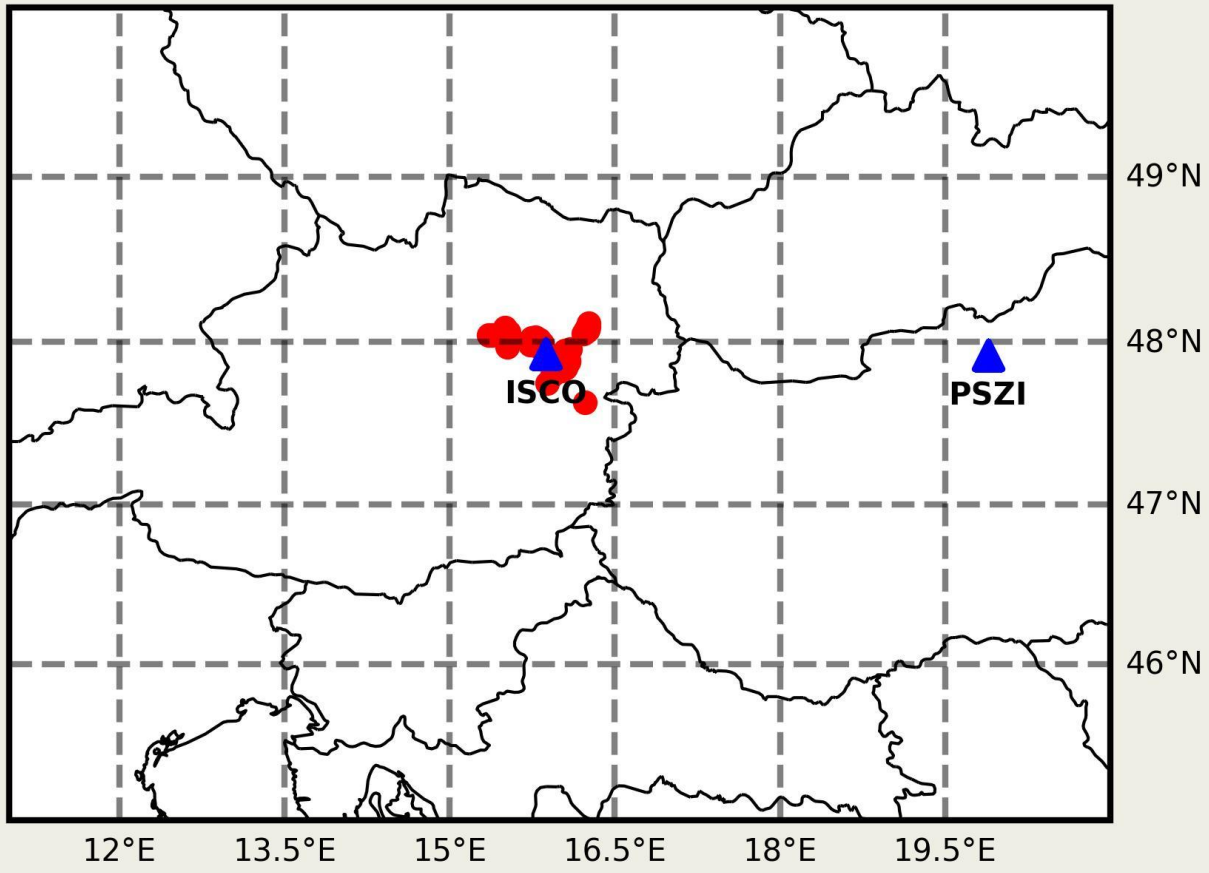
Mining activity near ISCO



Etna eruptions

CEEIN stations regularly detect activity of the Etna volcano in Sicily, Italy, especially PSZI, IPLOR and BURARI. Etna is located at about 180° azimuth relative to ISCO and PVCI, making it uncommon to detect eruptions. A detailed, detection list can be accessed at the CEEIN dataset (Pásztor et al., 2025), here we give a brief overview on the dates when detections were associated to Etna.

Date	PSZI	PVCI	ISCO	IPLOR	BURARI
2023-05-21	✓	X	X	X	X
2023-11-12	✓	X	X	X	X
2024-04-05	✓	X	X	✓	✓
2024-04-06	✓	X	✓	✓	✓

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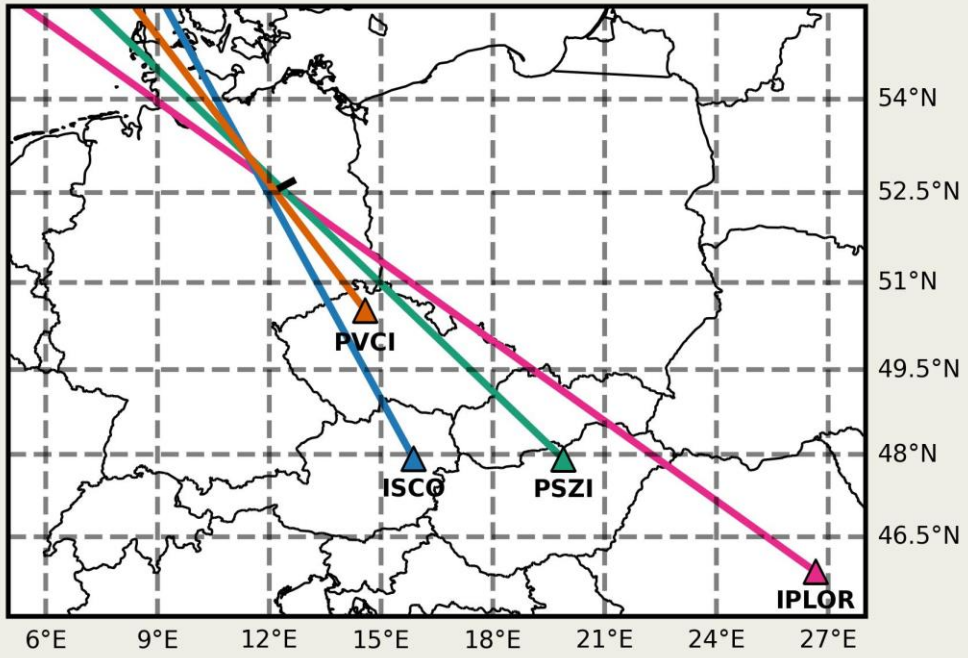
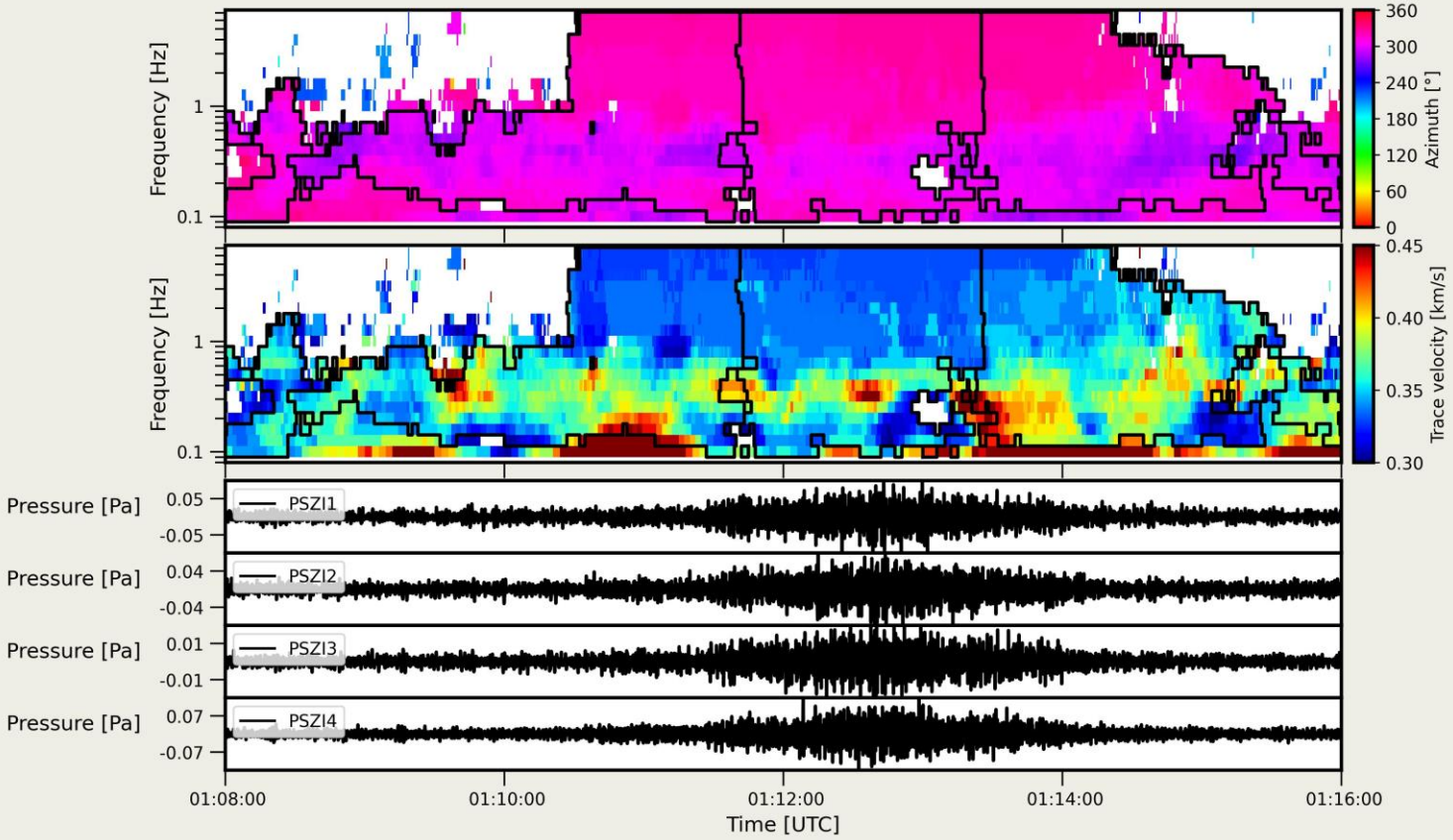
Bolides

CEEIN stations regularly detect bolides. Overall, in 2023 and 2024 46 bolides are present in the bulletin. These were not relocated with iLoc, because of insufficient number of observations, however, some bigger events could be relocated for instance by cross-bearing. On the left a bolide over Germany (near Berlin) is shown on 2024-01-21, represented by its trajectory (black line), earlier investigated by Christoph Pilger & Patrick Hupe (EGU 2025). Colored lines show the observed azimuths at four CEEIN stations. The event has the ID 423-2024 in the IMO database. The figure on the right show the PMCC results of the bolide. Note, that the microbaroms coming from the same directions has an influence on the calculated parameters.





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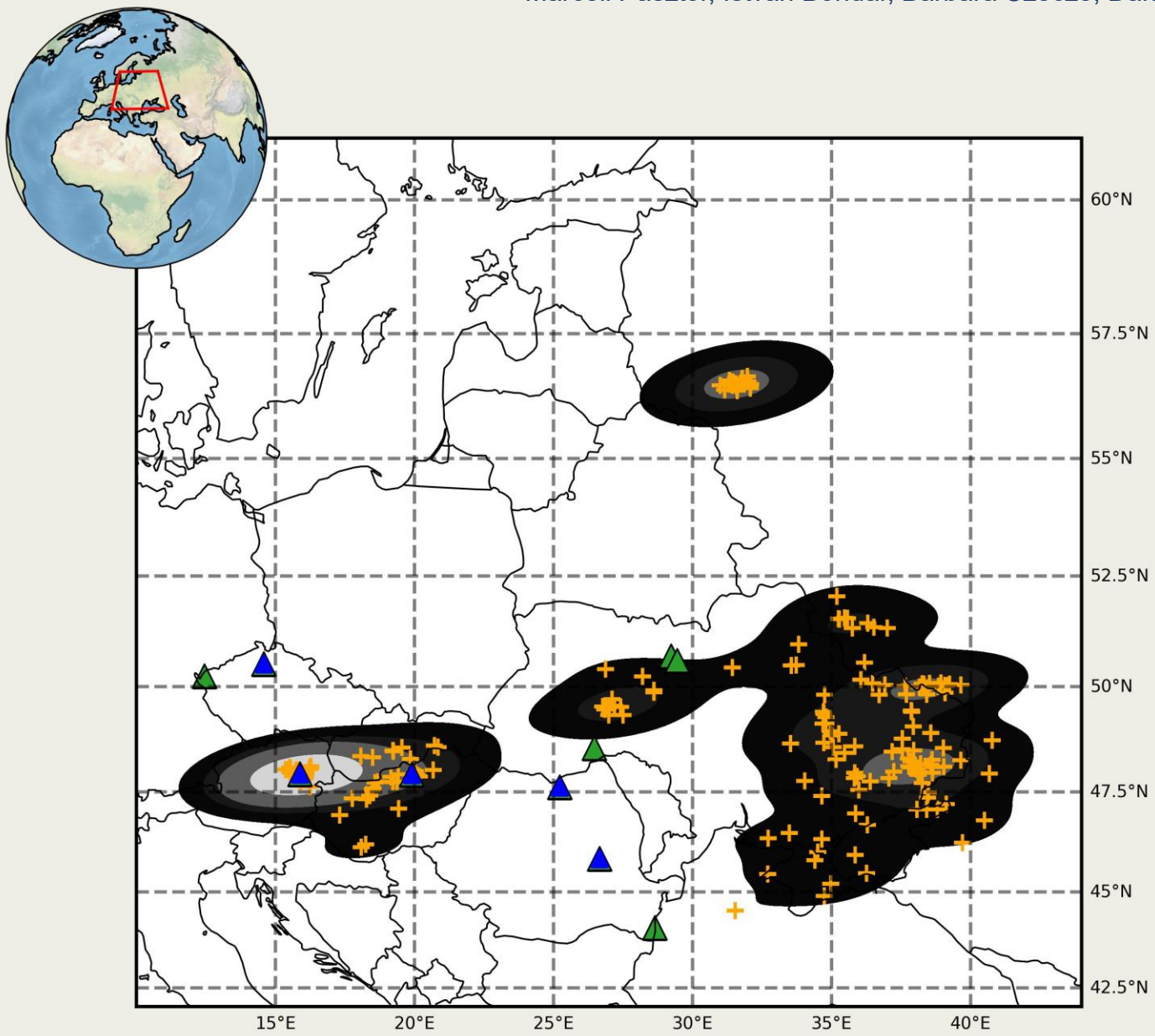

Conclusions

CEEIN is a dense network spanning over five countries in Europe. It has shown good capabilities to detect seismoacoustic and infrasound only events as well. Also, CEEIN data can further increase accuracy of event locations.

Our biannual bulletin can be accessed on the CEEIN website: https://www.ceein.eu/index.php?opt=bulletins. Please not that the release presented here is not yet accessible. We plan to publish it with and ISSN number later this year.

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