The infrasound installation in Sardinia

Mariusz Suchenek

msuchenek@camk.edu.pl

Nicolaus Copernicus Astronomical Center

Polish Academy of Sciences

Thiessen Wineries, Maastricht, Netherlands, 23-26.01.2023

ASTROCENT

NICOLAUS COPERNICUS ASTRONOMICAL CENTER OF THE POLISH ACADEMY OF SCIENCES

European Funds Smart Growth

Republic of Poland

FNP Foundation for Polish Science

European Union European Regional Development Fund

The infrasound installation in Sardinia

- characterization of the infrasound field in the mine, a place similar to destination site for the telescope
- multipoint infrasound measurements
- more than 1 month of data
- infrasound are one of the components of the Newtonian noise

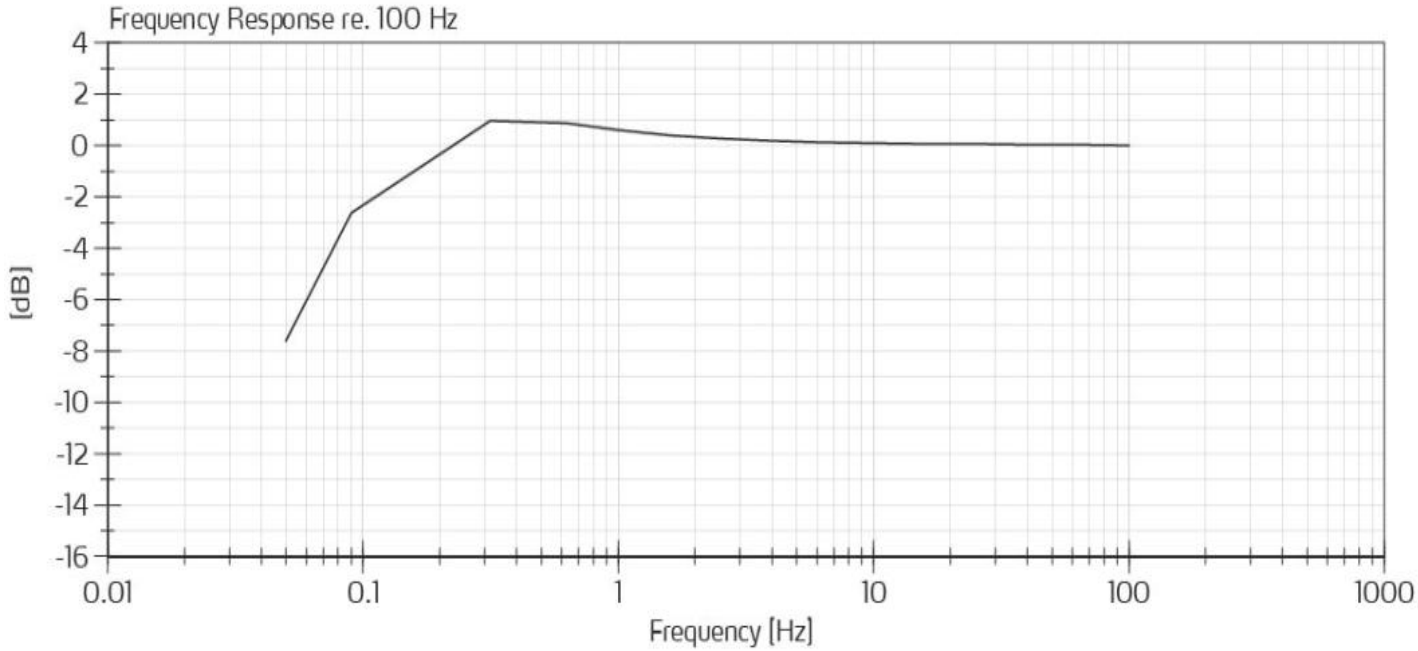
Two types of infrasound sensors (infrasound microphones):

- GRAS 47AC 1/2"
- developed by Astrocent

GRAS 47AC 1/2" CCP Infra-Sound Microphone Set

Condenser microphone set for infra-sound measurements in open acoustic fields

- frequency range: 0.09 Hz to 10 kHz
- dynamic range: 20 dB(A) to 148 dB
- sensitivity: 8 mV/Pa



https://www.grasacoustics.com/products/special-microphone/infra-sound-microphones/product/712-47ac

Infrasound microphones - Astrocent

- developed by Astrocent team
- low-cost infrasound microphone ~100 EU
- frequency range from 0.5 Hz to 120 Hz (AC47 Gras from 0.09 Hz to 20 kHz)
- sensitivity: 2.5 mV/Pa

Sos Enattos mine

The mine consists of tunnels with cavities

Cavities:

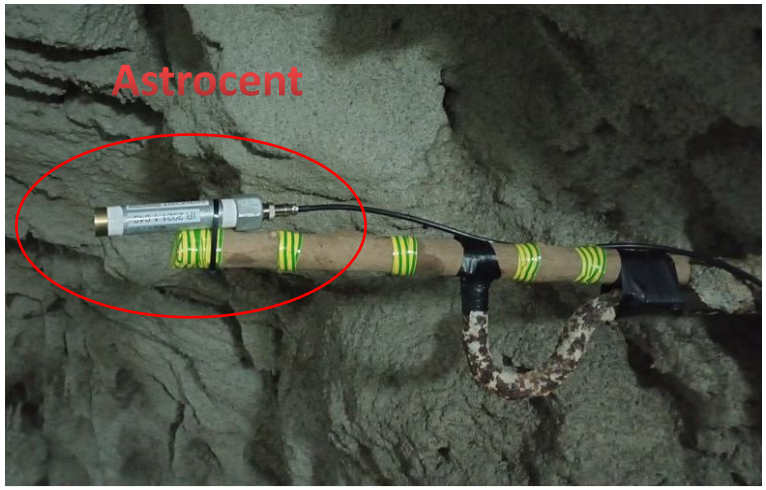
ST0 - Surface Station

- power supply from solar panels
- 1x GRAS 47AC 1/2", 1x microphone developed by Astrocent
- data synchronized by GPS, 1 pps signal (1 Hz)

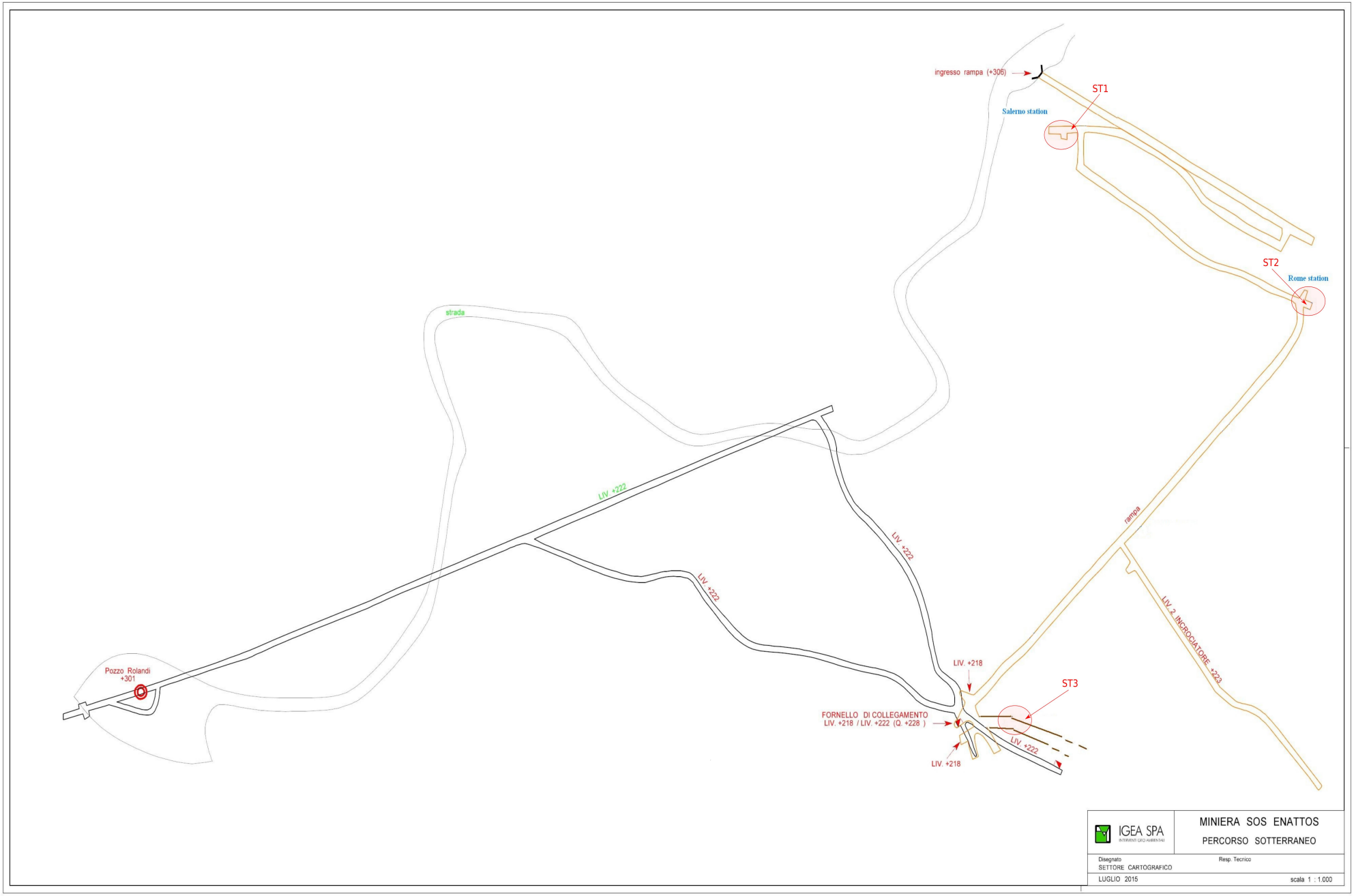
Stations

ST1, ST3 - in every station 3x infrasound microphones

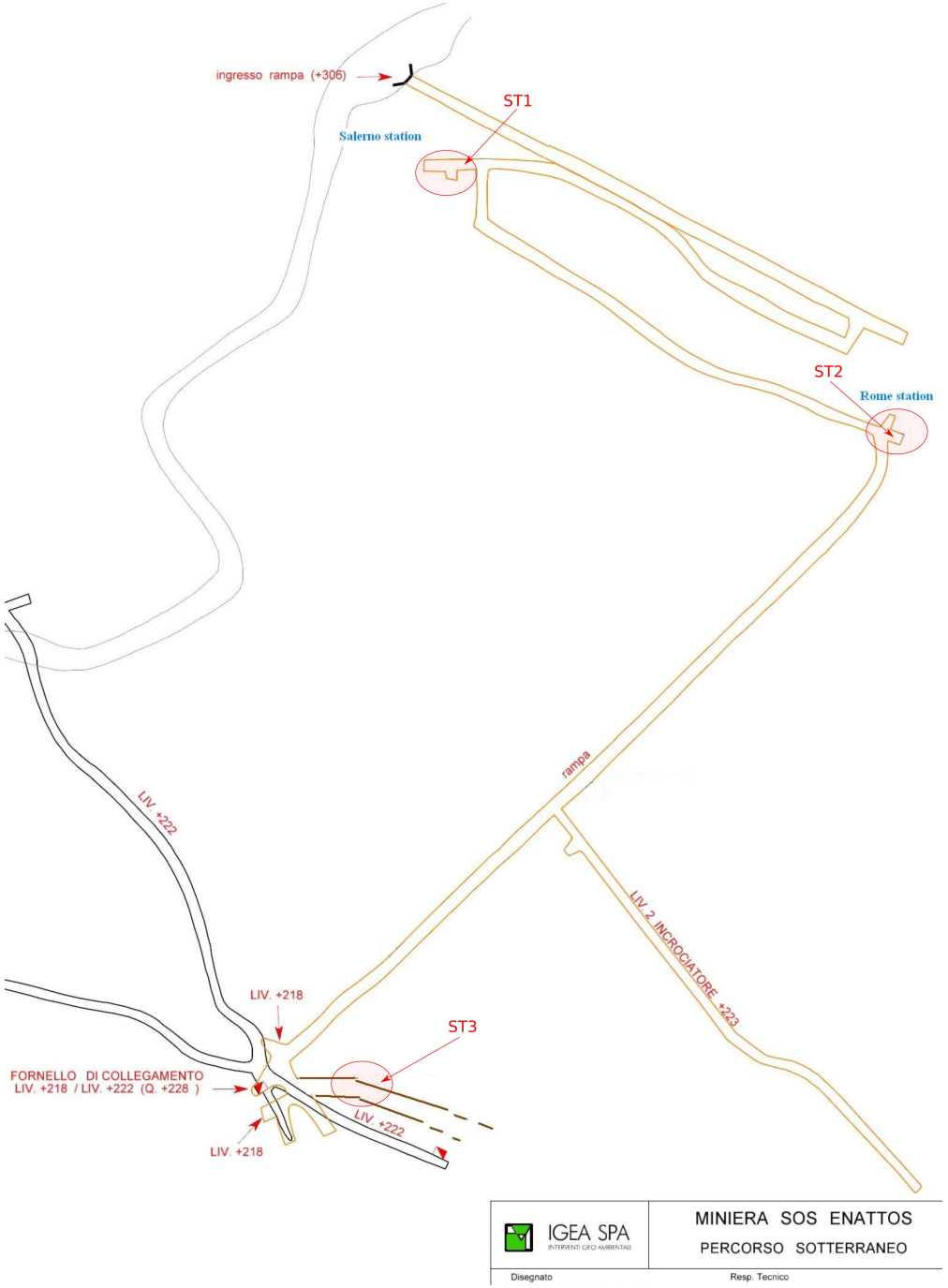
- data synchronized by NTP serwer via Internet
- 1x Gras, 1x Astrocent microphone (inside the cavity)
- 1x Astrocent (outside the cavity)



Sardinia - Sos Enattos Mine

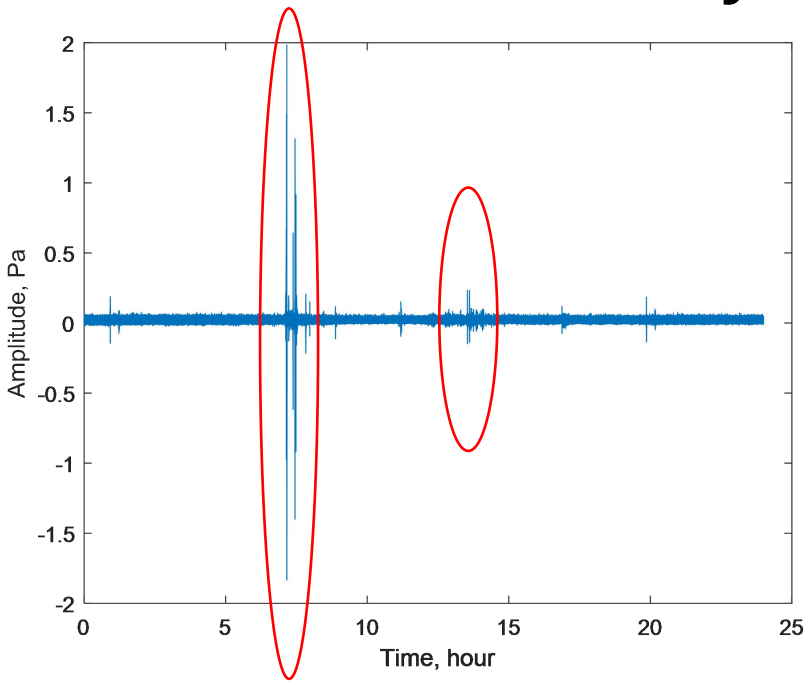


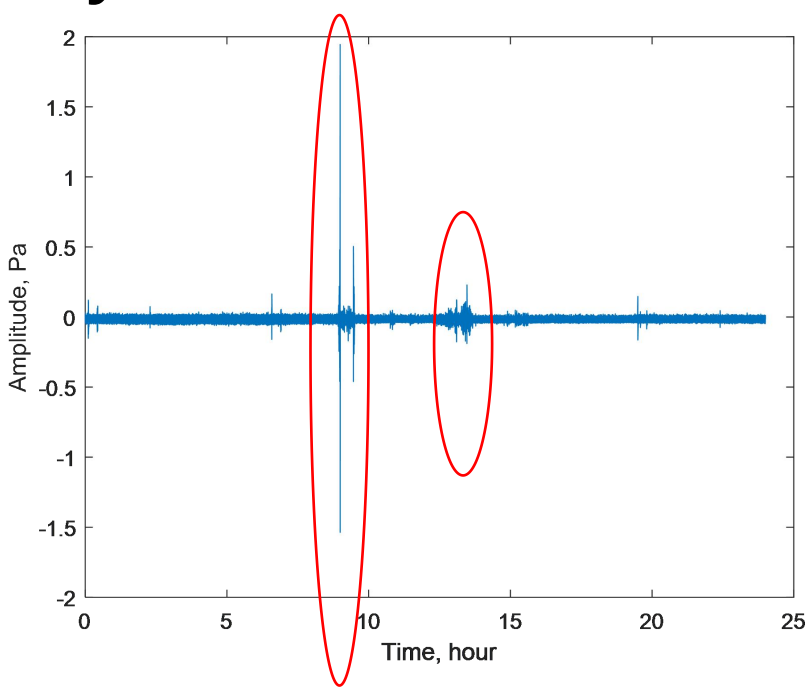
Sardinia - Sos Enattos Mine



Infrasound signal - 24 hours

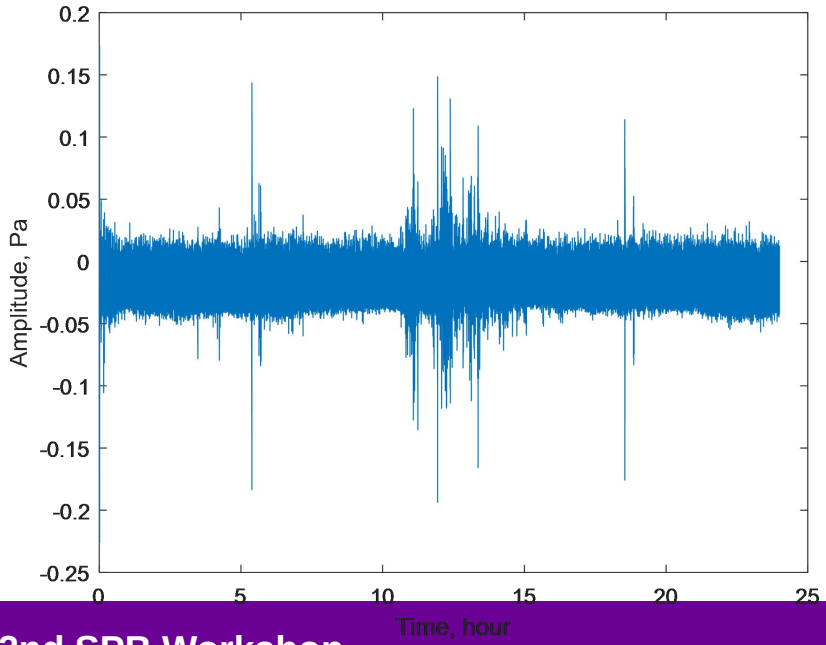
01.12.2022 day by day 21.12.2022





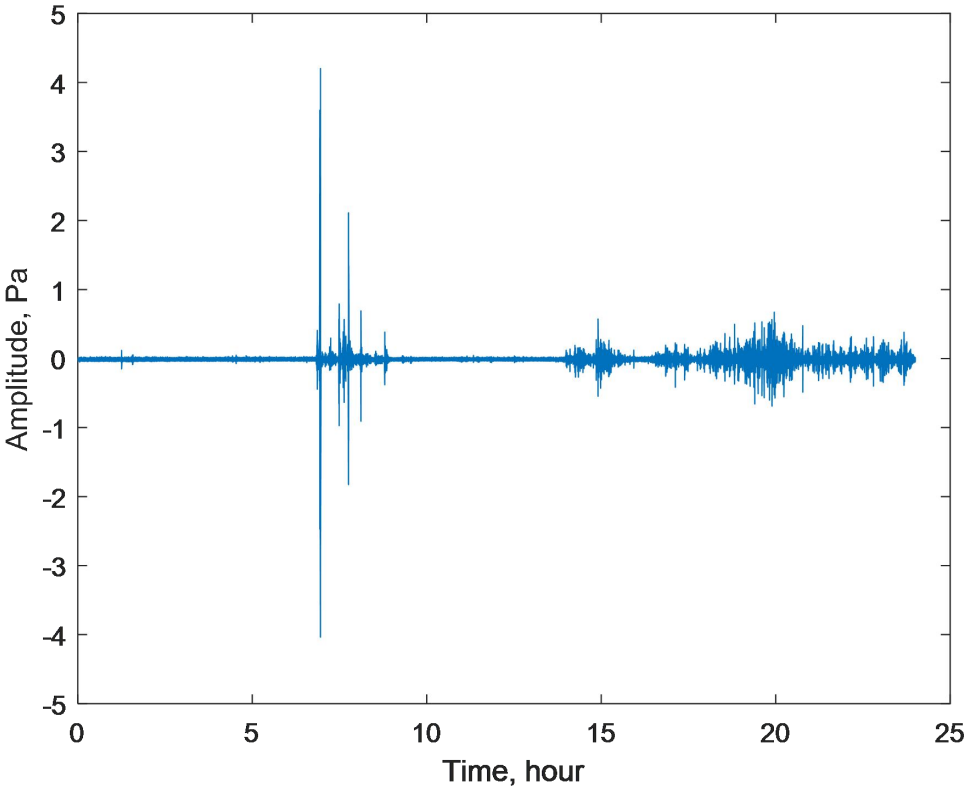
glitches in signal?

17.12.2022

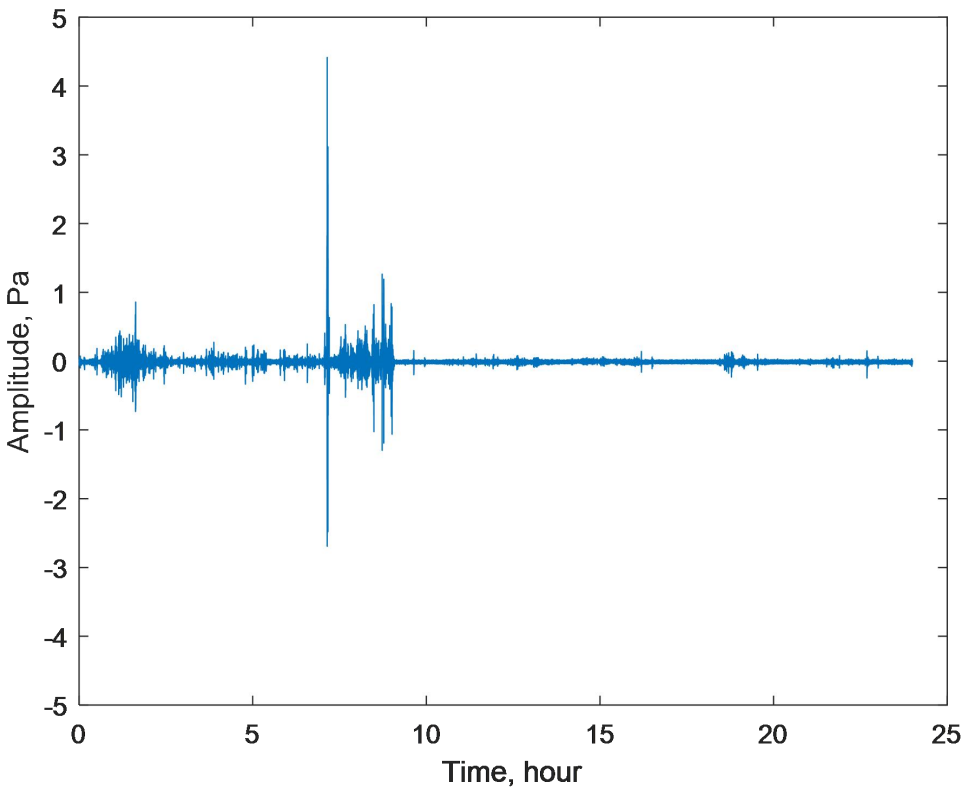


Interferences

15.12.2022



16.12.2022



Power spectrum & coherence

Power spectrum

$$S_{xx,f} = \frac{2dt^2}{T} X_f X_f^*$$

$$S_{xy,f} = \frac{2dt^2}{T} X_f Y_f^*$$

X, Y - spectrum of signal

T - total time of recording

dt - samplig time

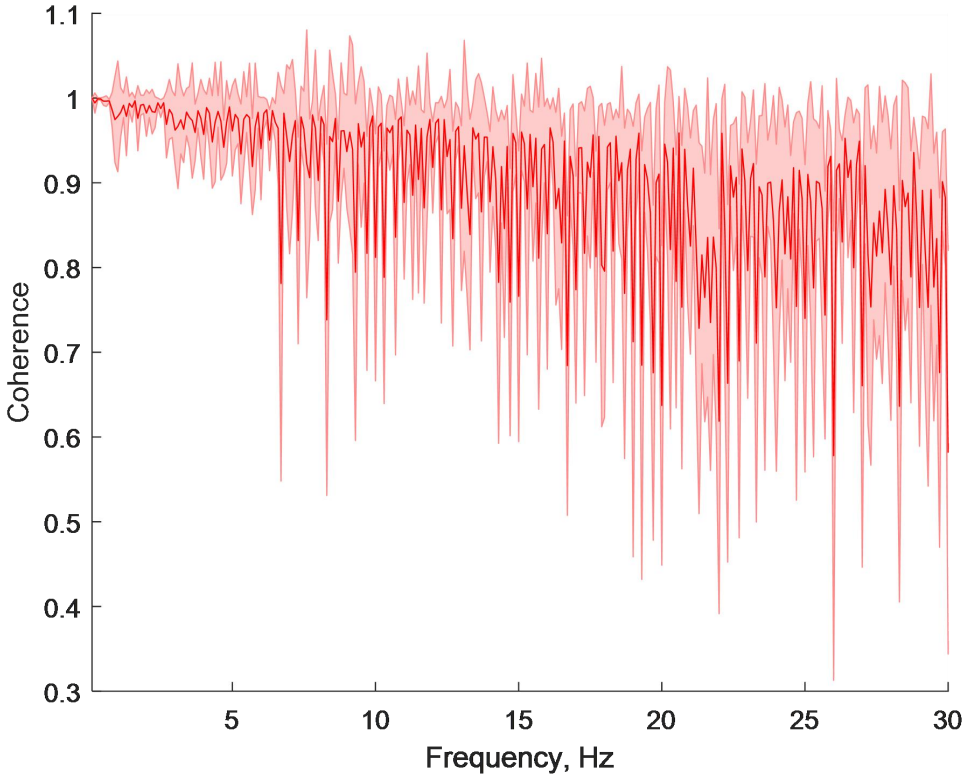
Coherence

$$K_{xy,f} = \frac{| < S_{xy,f} > |}{\sqrt{< S_{xx,f} >< S_{yy,f} >}}$$

Coherence ST3

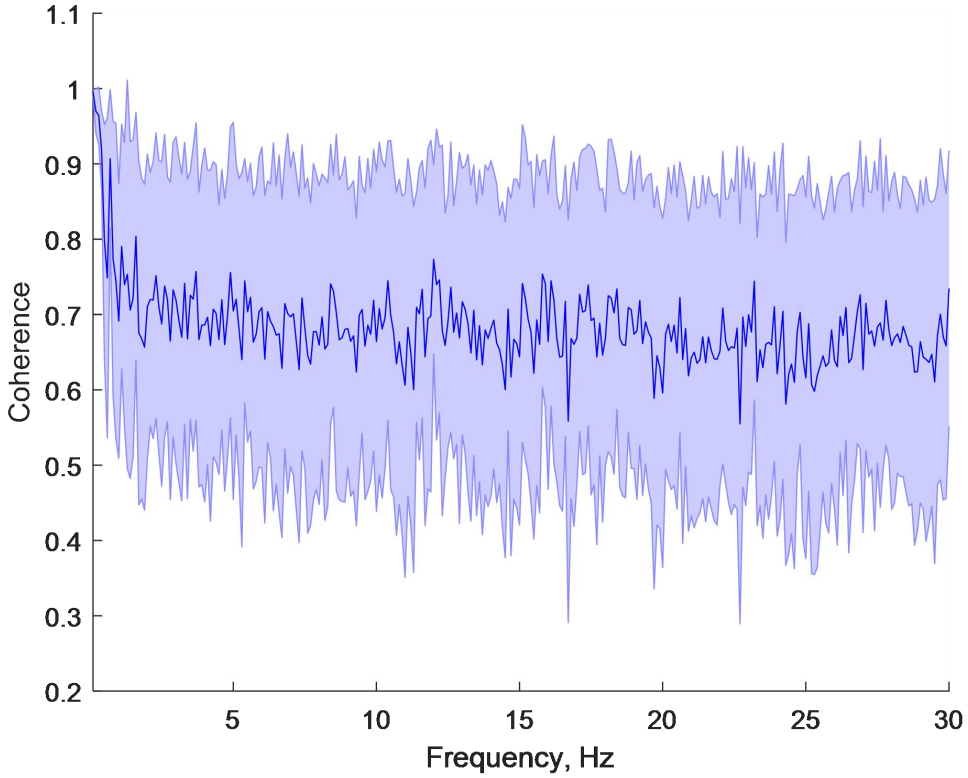
Inside cavity microphones

Gras-Astrocent



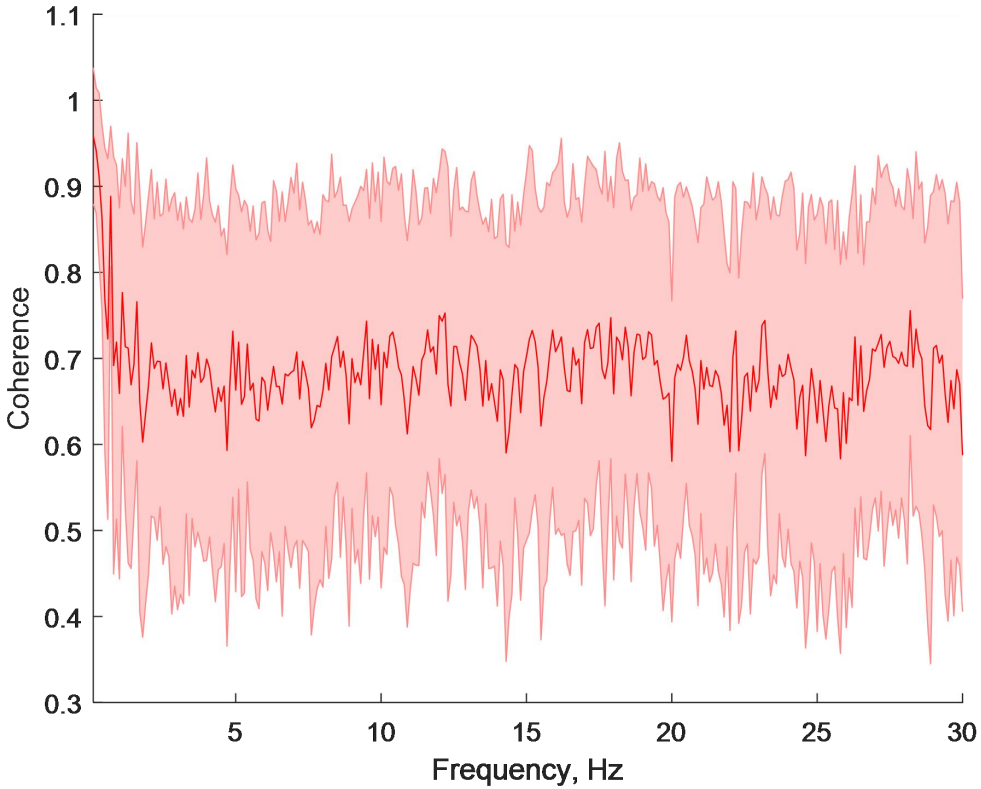
Inside and outside cavity

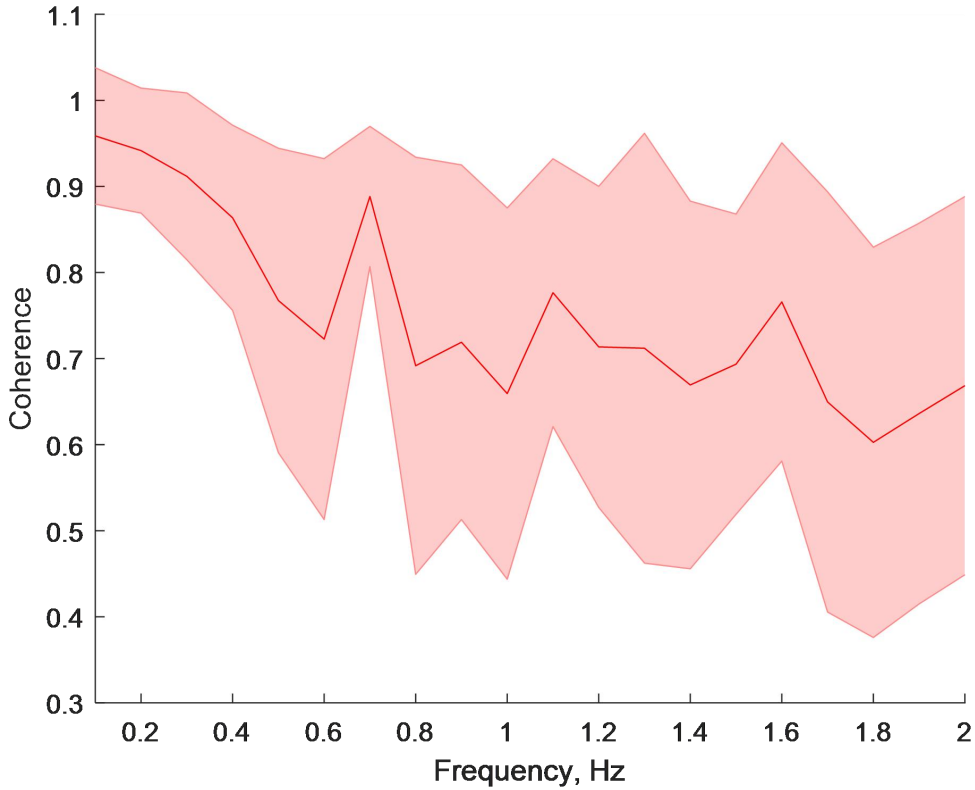
Astrocent-Astrocent



Coherence ST1 (inside) & ST3 (inside)

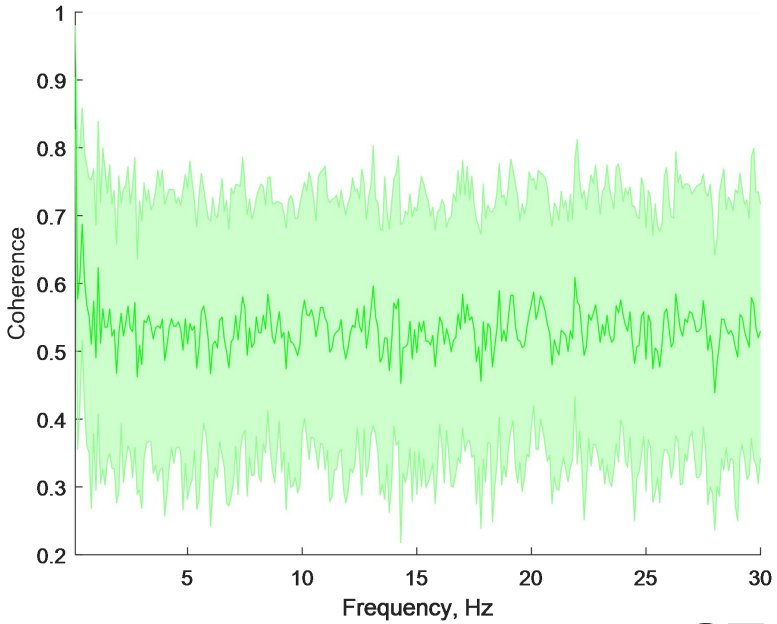
ST1 & ST3 Gras

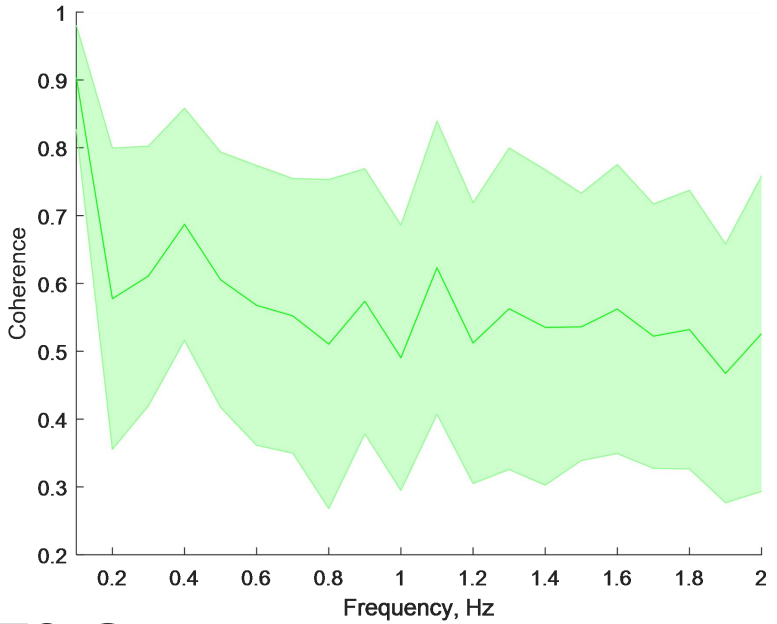




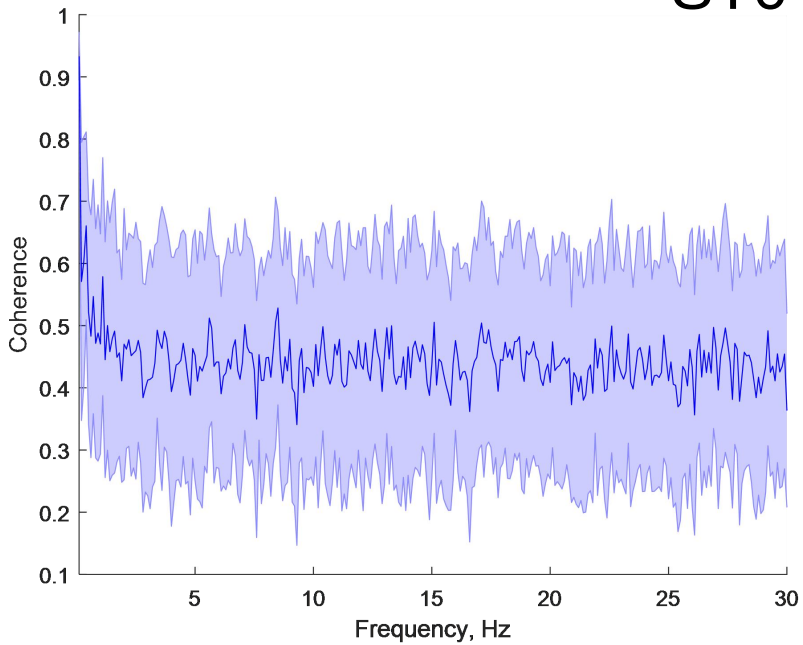
Coherence ST0 (outside) & ST1/3 (inside)

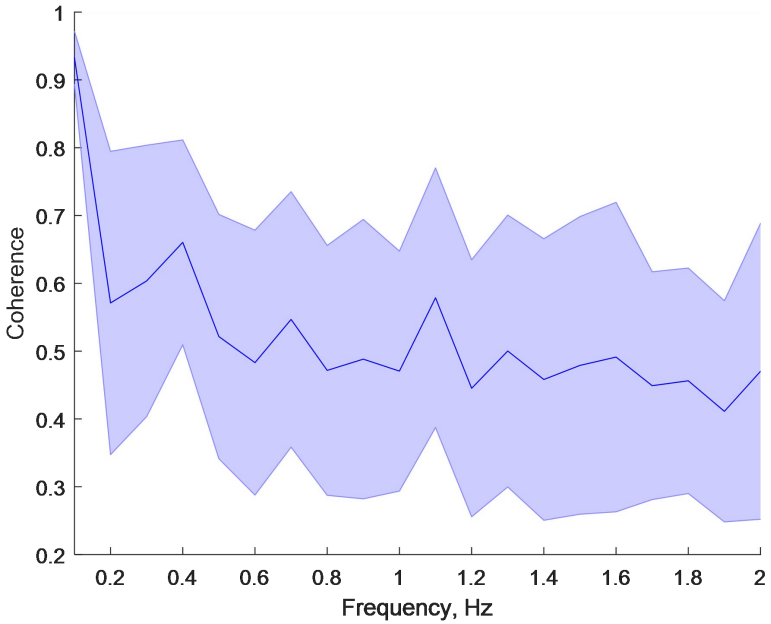
ST0 & ST1 Gras





ST0 & ST3 Gras





Conclusions

- distributed infrasound measurements
- very high coherence between microphones below 0.6 Hz

Thank you for your attention

Mariusz Suchenek msuchenek@camk.edu.pl

ASTROCENT
NICOLAUS COPERNICUS ASTRONOMICAL CENTER OF THE POLISH ACADEMY OF SCIENCES
Dark Wave
European Funds Smart Growth
Republic of Poland
FNP Foundation for Polish Science
European Union European Regional Development Fund