SnT 2021
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

CTBTO
PREPARATORY COMMISSION

UKRAINIAN INFRASOUND NETWORK - CURRENT STATE AND SHORT-TERM PERSPECTIVE

Oleksandr Liashchuk , Leonid Kolesnykov, Yuriy Andrushchenko Evheniy Kariagin, Ivan Tolchonov ; Anatoliy Poichalo

Poster No. P3.1-618

POSTER

Main Centre of Special Monitoring, Gorodok, Ukraine

SnT 2021
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE
Poster No.: P3.1-618

UKRAINIAN INFRASOUND NETWORK - CURRENT STATE AND SHORT-TERM PERSPECTIVE

Oleksandr Liashchuk , Leonid Kolesnykov, Yuriy Andrushchenko Evheniy Kariagin, Ivan Tolchonov ; Anatoliy Poichalo

CTBTO PREPARATORY COMMISSION

ABOUT THE MAIN CENTER OF SPECIAL MONITORING

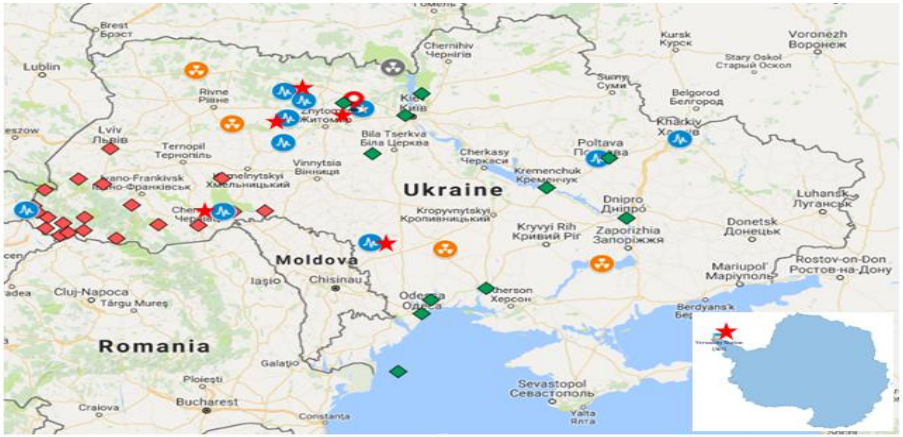
The MCSM is a branch of the National Space Facilities Control and Test Center of the State Space Agency of Ukraine.
Tasks of the MCSM:

- monitoring of the **nuclear tests** and monitoring of the compliance of the international treaties for non-proliferation and ban of the nuclear weapon

- monitoring of the **earthquakes and geophysical phenomena** on the territory of Ukraine and the Earth
- monitoring of the **radionuclide** contamination in the atmosphere

- **research** in geophysics
- providing information about the **geophysical** situation for the government and the scientific institutions

The map shows the National Network of Seismic Monitoring of Ukraine, the data of which is processed by MCSM. Infrasound stations are also included in this network (Observation sites where there are microbarographs marked with red stars).



Disclaimer: The views expressed on this poster are those of the author and do not necessarily reflect the view of the CTBTO

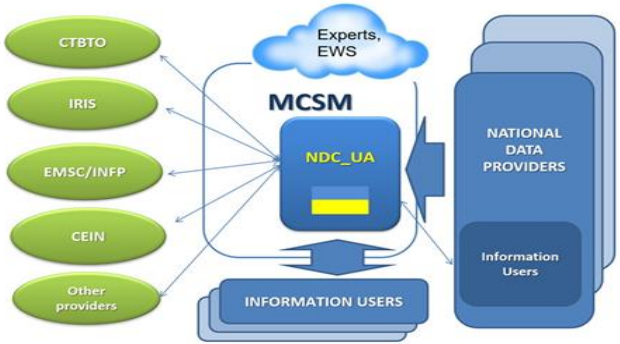
UKRAINIAN INFRASOUND NETWORK - CURRENT STATE AND SHORT-TERM PERSPECTIVE

Oleksandr Liashchuk , Leonid Kolesnykov, Yuriy Andrushchenko Evheniy Kariagin, Ivan Tolchonov ; Anatoliy Poichalo

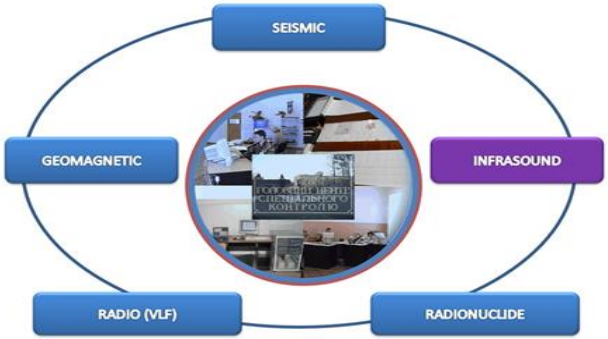
ABOUT THE MAIN CENTER OF SPECIAL MONITORING

Main Center of Special Monitoring (MCSM) serves as the National Data Center of the National system of seismic observations and improve the safety of the population living in earthquake-prone regions, the National Data Center of the International Monitoring System of the Comprehensive Test Ban Treaty and carry out control technical means for seismic and radiation environment and provides infrasonic, geomagnetic and radio research.

NATIONAL DATA CENTER



TECHNOLOGIES OF GEOPHYSICAL MONITORING IN MCSM



All data is sent to the National Data Center in real time. Then they are processed and archived. Organized **operational duty 24/7**, the duty analyst processes the data within **30 minutes**. For remote experts, there is a **Cloud service**. The processed information about events is immediately transmitted to state agencies for decision making and response.

The data format is miniSEED and CSS3.0. Processing Software - Geotool, SeisComP, PMCC

UKRAINIAN INFRASOUND NETWORK - CURRENT STATE AND SHORT-TERM PERSPECTIVE

Oleksandr Liashchuk , Leonid Kolesnykov, Yuriy Andrushchenko Evheniy Kariagin, Ivan Tolchonov ; Anatoliy Poichalo

Infrasound observation sites with one microbarograph (current time)

Microbarographs from the Soviet K-304 acoustic station (0.03-10 Hz, +/- 50 Pa) are currently used in combination with a 24-bit digitizer. Wind-Noise Reduction System 'conical tube'.

4 Chaparral Model 64 VX microbarographs were purchased. Now it's arrived at the Vernadsky station, where they are planned to be installed during the current year. For testing, the aperture will be 150 meters.

Microbarographs are installed in settlements for training; it is currently impractical to establish arrays.

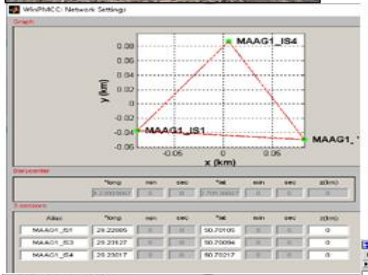
UKRAINIAN INFRASOUND NETWORK - CURRENT STATE AND SHORT-TERM PERSPECTIVE

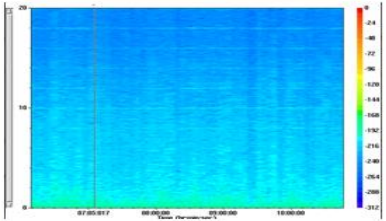
Poster No.: P3.1-618

Oleksandr Liashchuk , Leonid Kolesnykov, Yuriy Andrushchenko Evheniy Kariagin, Ivan Tolchonov ; Anatoliy Poichalo

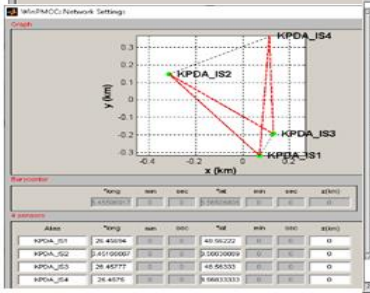
CTBTO PREPARATORY COMMISSION

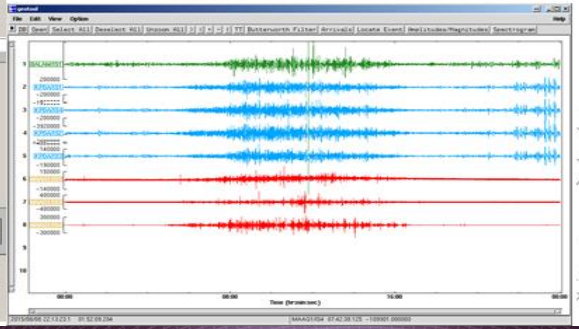
Infrasound Arrays (current time)





K304 microbarographs are combined into infrasound arrays (KPDA and MAAG1). Some of the problems are harmonics in the spectrum that are caused by obsolete power supplies. Now there is a replacement of these blocks. However, events are recorded and processed.

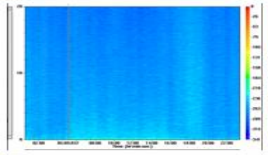


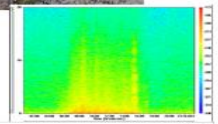


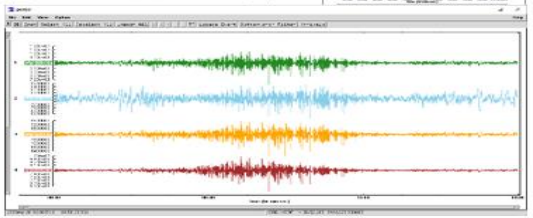
UKRAINIAN INFRASOUND NETWORK - CURRENT STATE AND SHORT-TERM PERSPECTIVE

Oleksandr Liashchuk , Leonid Kolesnykov, Yuriy Andrushchenko Evheniy Kariagin, Ivan Tolchonov ; Anatoliy Poichalo

DIGITAL MICROBAROMETER







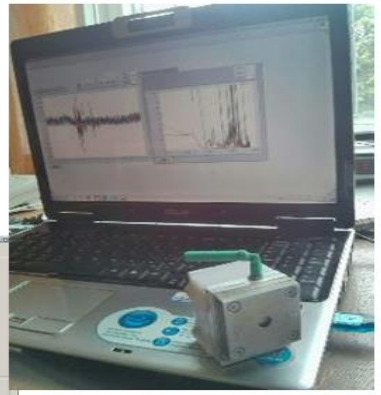
Frequency Range	Hz	0,001 - 15
Sensitivity in range 0,01 – 10 Гц	mV/Pa	not less than 20 (-1% +1%)
Power	V	220 / 12 V
Dynamic range of the input signal	dB	not less than 120
Maximum pressure level (relative)	Pa	± 100
Output		differential
Noise level	mPa (mkV)	≤1 (≤20 mkV)
Signal gain		5, 10, 50, 100
Noise reduction system volume	sm^3	60-100
Noise reduction system inputs	pcs.	4
Weight	kg	Up to 5
ADC channels	pcs.	1
bit ADC	pcs.	24
ADC quantization rate	Hz	10, 20, 40, 80
Voltage measurement range	V	±10
Analog output	pcs.	1

16 digital condenser microbarographs released in 2019. Data is transmitted using the SeedLink protocol and stored in miniSEED format. A 4-channel multiplexer or Ethernet connection is used to collect data. Now preparing sites for their placement in the form of infrasound arrays. The images show the appearance of microbarographs and an example of recording.

UKRAINIAN INFRASOUND NETWORK - CURRENT STATE AND SHORT-TERM PERSPECTIVE

Oleksandr Liashchuk , Leonid Kolesnykov, Yuriy Andrushchenko Evheniy Kariagin, Ivan Tolchonov ; Anatoliy Poichalo

Infrasound microphone



Example of recording an infrasound signal from a mining blast

A low-cost optical-based infrasound sensor has been developed. Prototypes were made for connecting using wires, as well as wireless using Wi-Fi.
Each sensor has a microcontroller with a 12-bit ADC (we can install any other) Fs=100 Hz. Sensors are connected in series. For the experiment, a small-aperture array of 5 sensors was installed near to the array on the K-304 microbarographs. The test array recorded all industrial explosions within a radius of 20 km.

UKRAINIAN INFRASOUND NETWORK - CURRENT STATE AND SHORT-TERM PERSPECTIVE

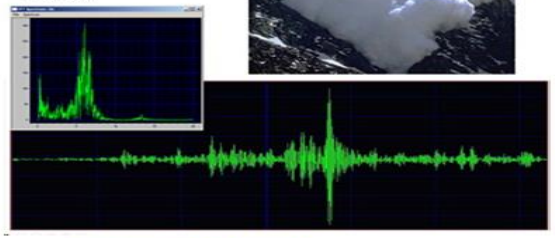
Poster No.: P3.1-618

Oleksandr Liashchuk , Leonid Kolesnykov, Yuriy Andrushchenko Evheniy Kariagin, Ivan Tolchonov ; Anatoliy Poichalo

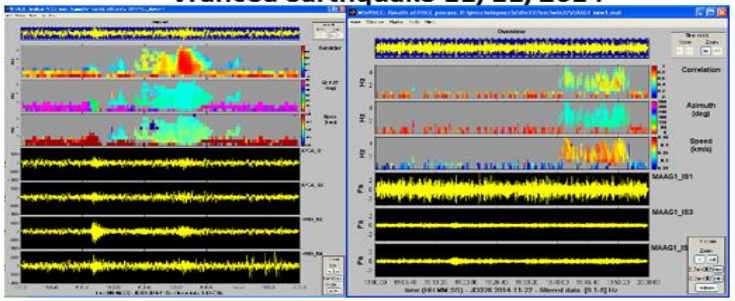
Registration examples. Natural phenomena

Avalanches

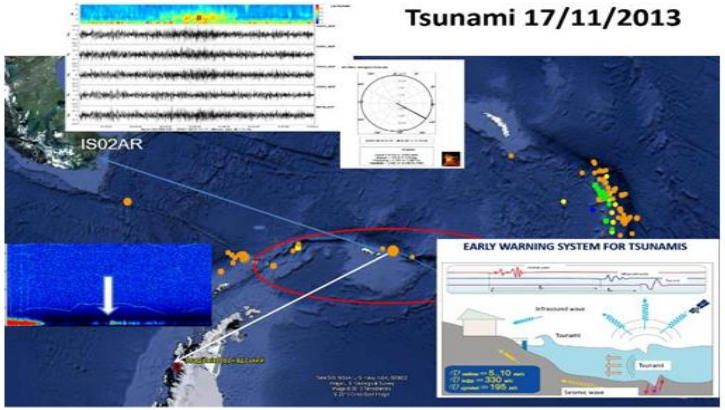
Signal from the avalanche
04/12/16
time 15:15
Estimated distance to the source
~ 10-15 km



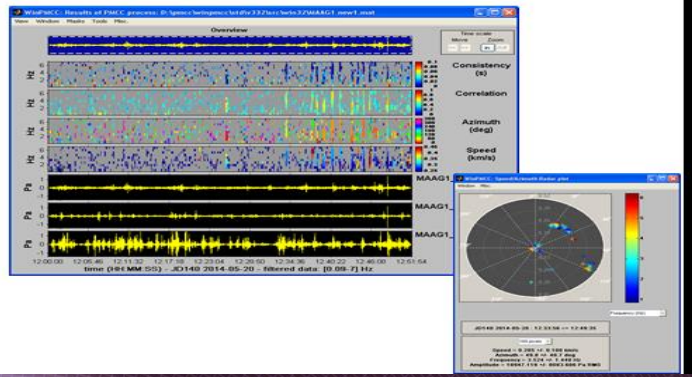
Vrancea earthquake 11/11/2014



Tsunami 17/11/2013



Thunderstorm



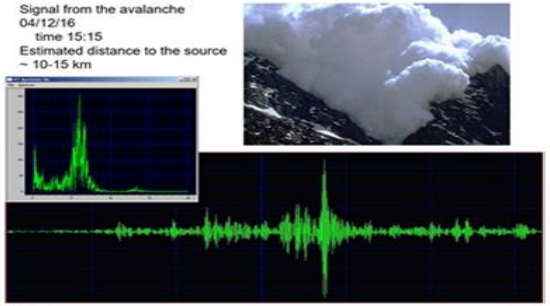
UKRAINIAN INFRASOUND NETWORK - CURRENT STATE AND SHORT-TERM PERSPECTIVE

Oleksandr Liashchuk , Leonid Kolesnykov, Yuriy Andrushchenko Evheniy Kariagin, Ivan Tolchonov ; Anatoliy Poichalo

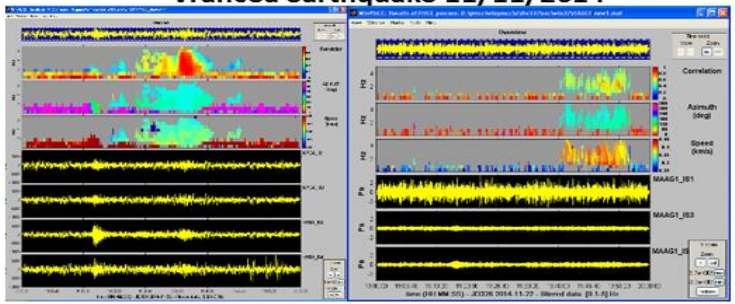
Registration examples. Natural phenomena

Avalanches

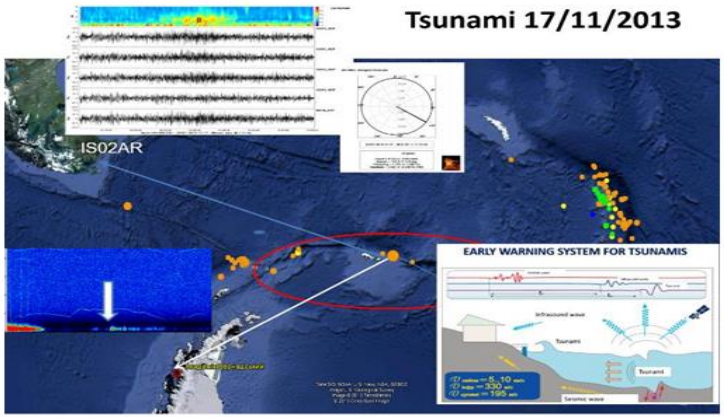
Signal from the avalanche
04/12/16
time 15:15
Estimated distance to the source
~ 10-15 km



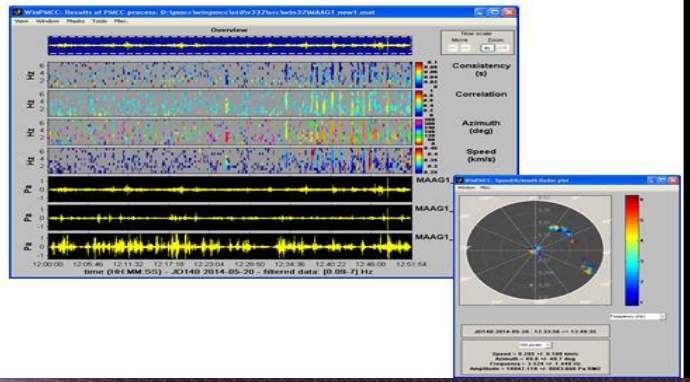
Vrancea earthquake 11/11/2014



Tsunami 17/11/2013



Thunderstorm

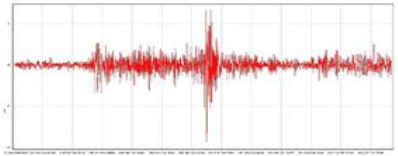


UKRAINIAN INFRASOUND NETWORK - CURRENT STATE AND SHORT-TERM PERSPECTIVE

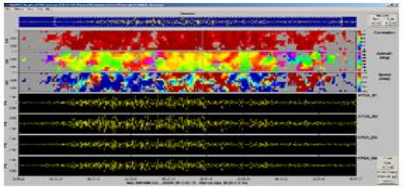
Oleksandr Liashchuk , Leonid Kolesnykov, Yuriy Andrushchenko Evheniy Kariagin, Ivan Tolchonov ; Anatoliy Poichalo

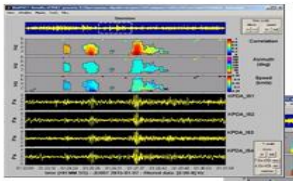
Registration examples. Bolides

Meteorite explosion over Antarctica 2004

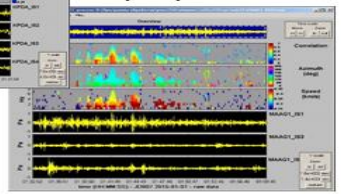


Chelyabinsk meteorite 02/15/2013

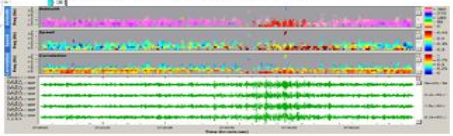


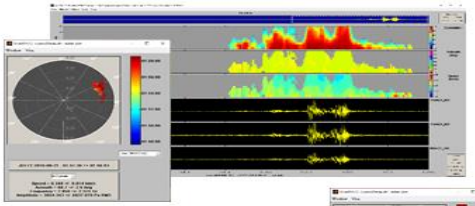


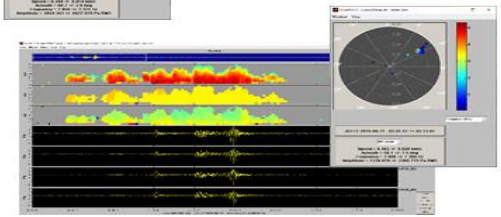
Registration of the Romanian meteorite 01/07/2015



Meteorite explosion over the Bering Sea 12/18/2018







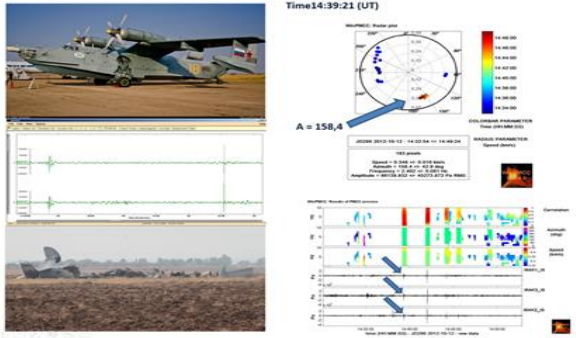
Infrasound signals from a car explosion in the Russian Federation near Lipetsk 06/21/2018

UKRAINIAN INFRASOUND NETWORK - CURRENT STATE AND SHORT-TERM PERSPECTIVE

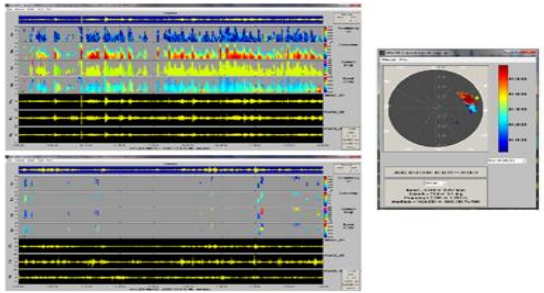
Oleksandr Liashchuk , Leonid Kolesnykov, Yuriy Andrushchenko Evheniy Kariagin, Ivan Tolchonov ; Anatoliy Poichalo

Registration examples. Technogenic explosions

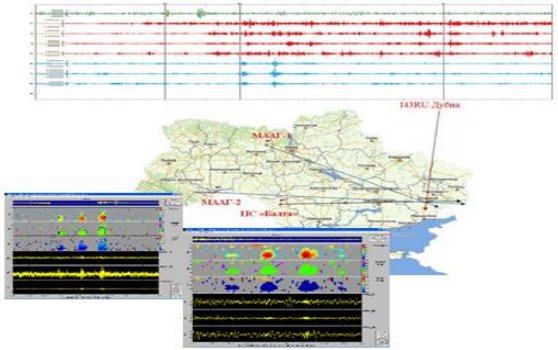
The crash of the Be-12 seaplane near Kacha in Crimea on October 14, 2012



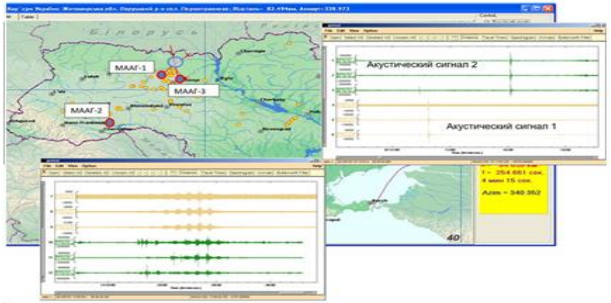
Registration of explosions at the military arsenal near the city of Ichnia 09/10/2018



The explosion of Donetsk. June 16, 2015



Registration of a mining explosion in a quarry



UKRAINIAN INFRASOUND NETWORK - CURRENT STATE AND SHORT-TERM PERSPECTIVE

Oleksandr Liashchuk , Leonid Kolesnykov, Yuriy Andrushchenko Evheniy Kariagin, Ivan Tolchonov ; Anatoliy Poichalo

CONCLUSIONS

Planned sensor upgrades are currently ongoing. It is also planned to install infrasound systems in the east and south of Ukraine. An array was installed in Antarctica (Vernadsky station). In addition, to register large-scale processes in the atmosphere, a pilot installation of microbarographs at the nodes of the seismic group PS45 is planned this year. In this case, the distance between the elements of the infrasonic array will be about 3-4 kilometers.

We hope that our efforts will culminate in the creation of a modern national infrasound network and that Ukraine will cease to be a “blank spot” for the European scientific community.

Infrasound technologies, which are developing at the national level, are an important part of the provisions of the CTBTO Treaty. By developing the national network, Ukraine contributes to the improvement of monitoring.