Department of Higher Geodesy and Astronomy

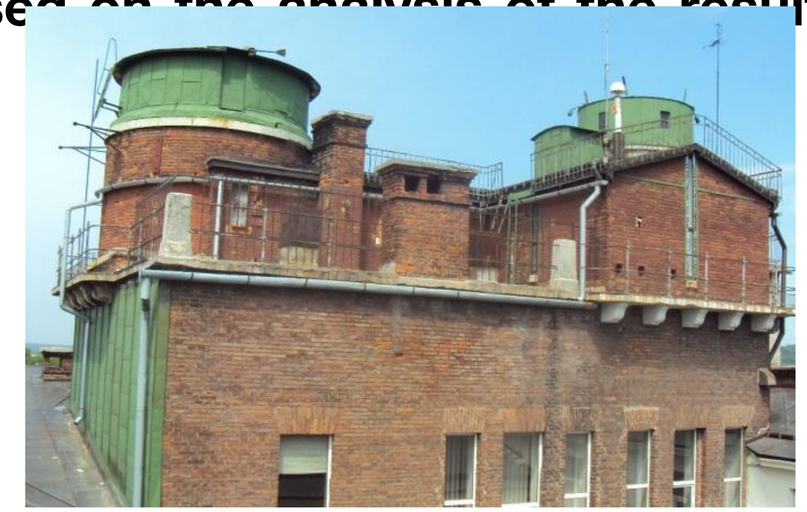
Institute of Geodesy

Lviv Polytechnic National University

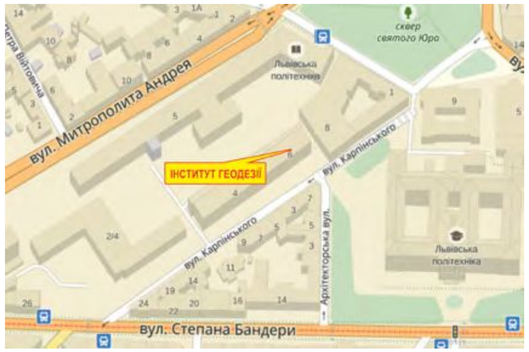
Liubov Yankiv-Vitkovska, Lviv, Ukraine

Department overview

- The **Department of Higher Geodesy and Astronomy** dates back to **June 18, 1871**, when the Department of Geodesy and Spherical Astronomy was founded at the Lviv Polytechnic National University. The department received its current name in 1974. Today, there are 16 employees
- The department has also 2 scientific laboratories and **Astronomical Observatory**
- The department trained bachelors and masters in the specialty "Space monitoring of the Earth" and specialization "Space geodesy" of the specialty "Geodesy" of the direction "Geodesy, cartography and land management".
- The main scientific direction of the department is **monitoring the physical surface of the Earth and its atmosphere based on the analysis of the results of modern ground and**



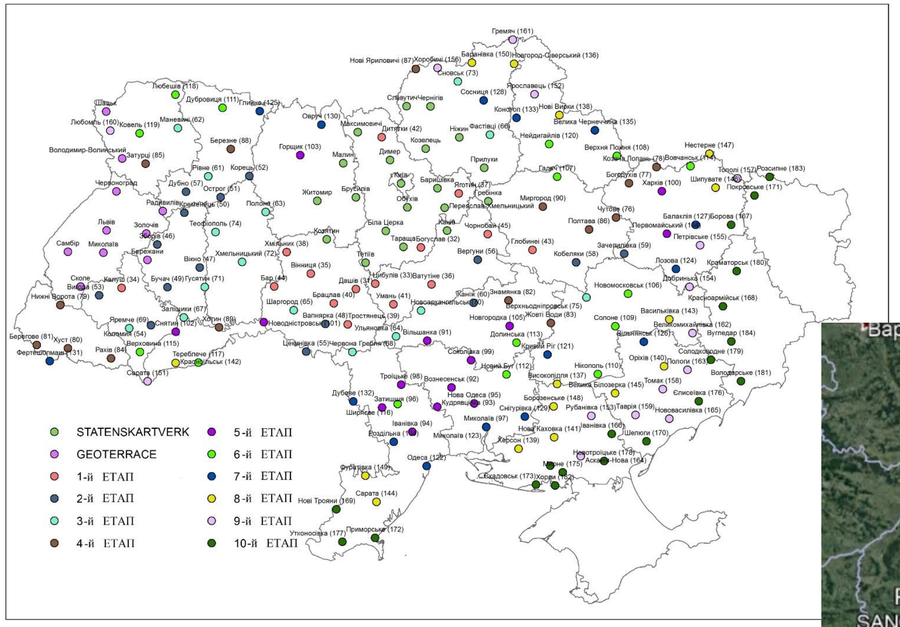
Department overview

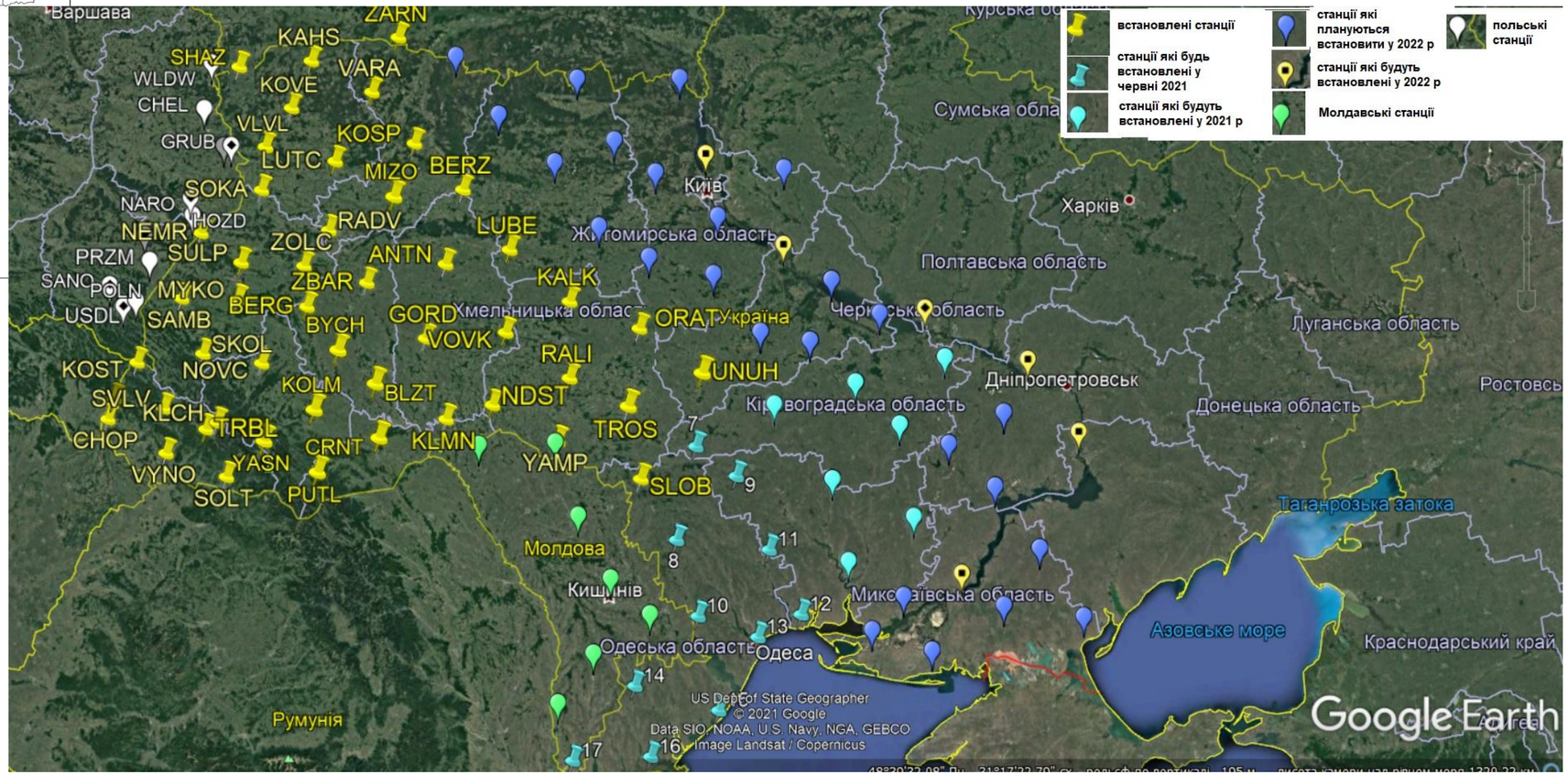


Creation of the Institute of Geodesy began
on January 24, 1945.
Teaching geodesy began in Lviv Polytechnic in 1844,
teaching of astronomy began in 1871 by Professor
Dominic Zbrozhek
the first head of the department and the first head of the
Astronomical Observatory

Development of GNSS networks

We perform the design, optimization and construction of the active GNSS stations network on the territory of Ukraine
GeoTerrace GNSS station network (76 stations as of December 2022)

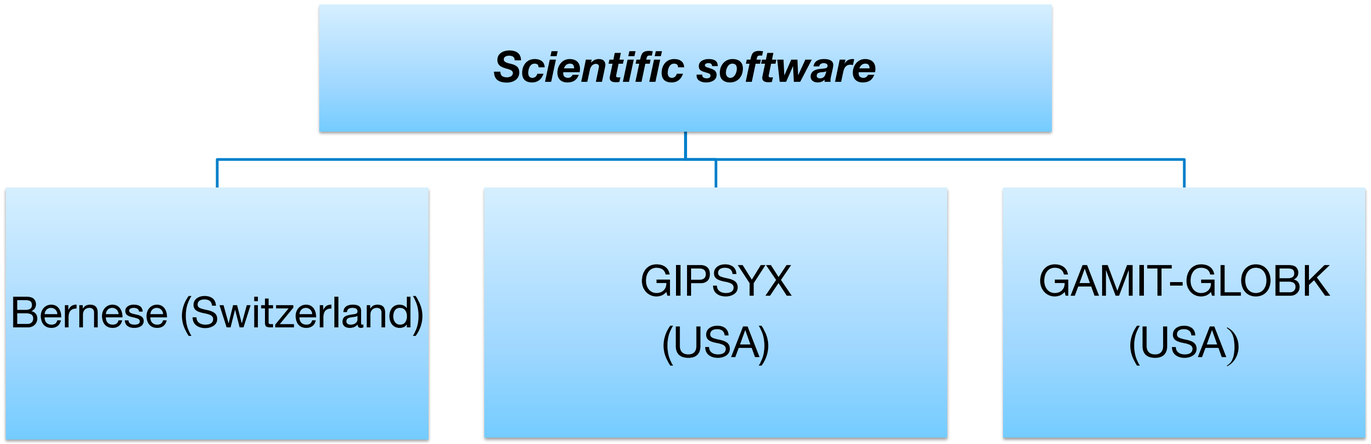




This project is carried out by the state order of the Ministry of Education and Culture of Ukraine

Development of GNSS networks

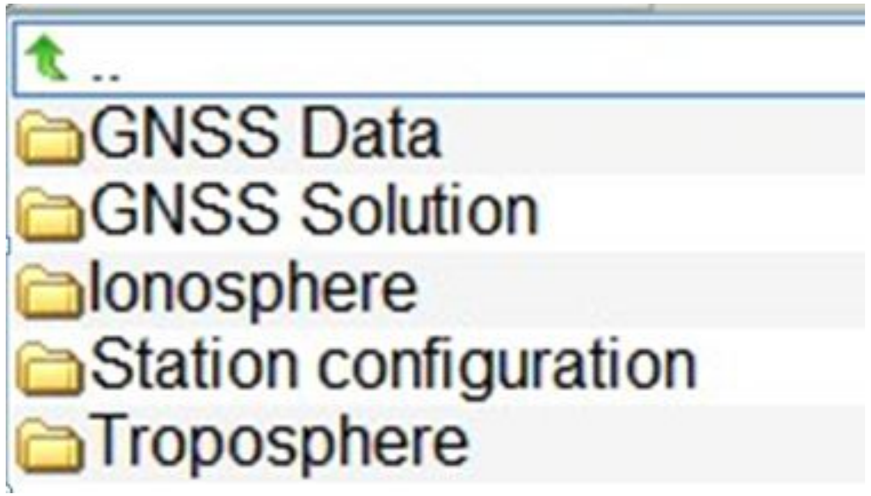
Processing of observations from the network of reference GNSS stations



Processing of GNSS observations is carried out in specialized scientific software.
Department of Higher Geodesy and Astronomy have a licence for three such software:

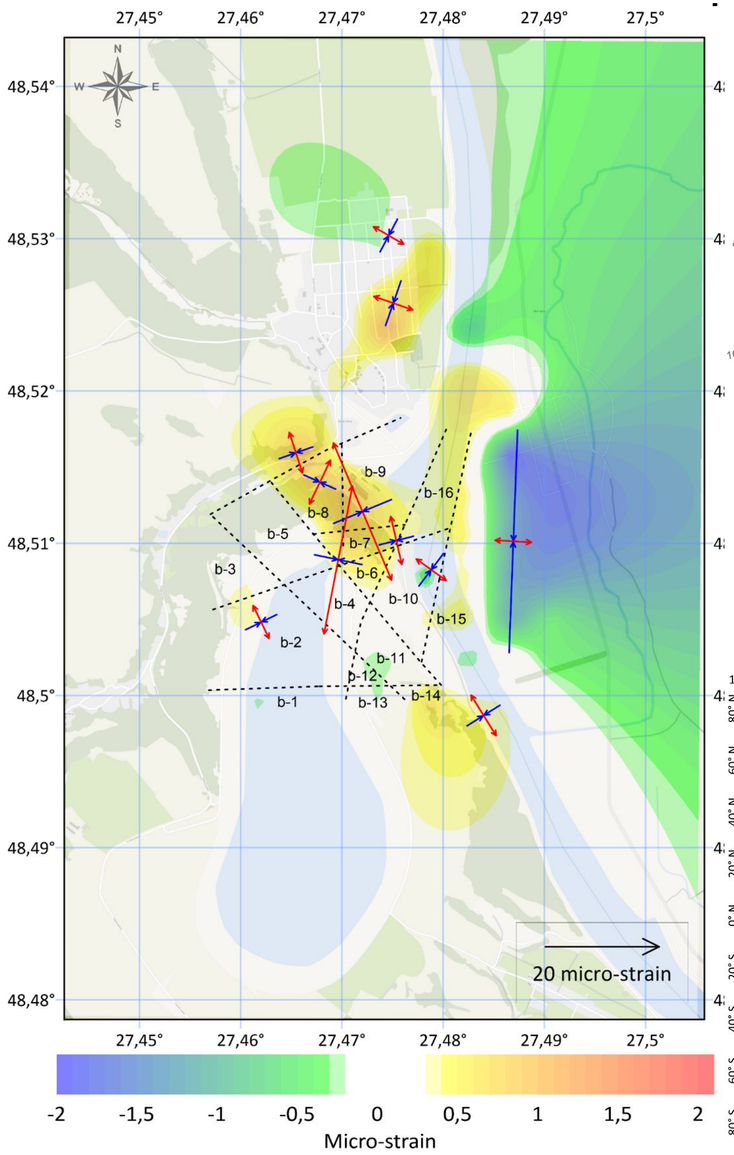
GNSS POST-PROCESSED PRODUCTS

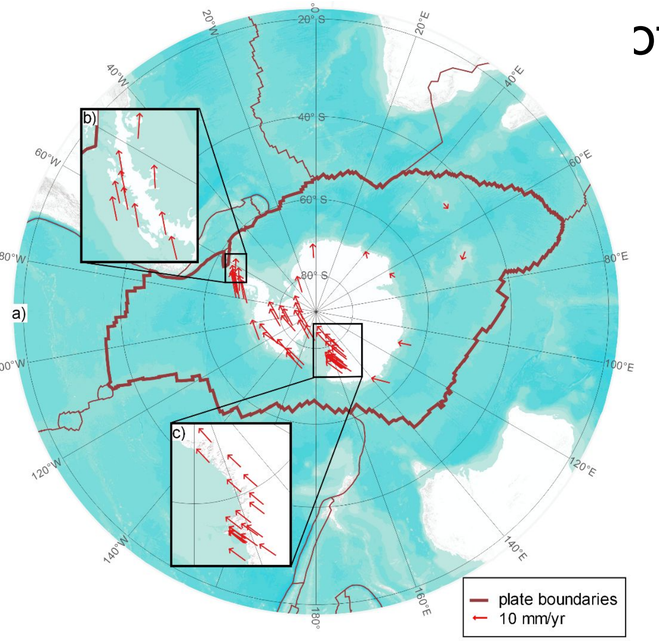
- **Daily/Weekly Combined Positions** From GIPSYX and GAMIT-GLOBK software
- **Tropospheric Delays**
- **Ionosphere products** containing ionosphere vertical total electron content

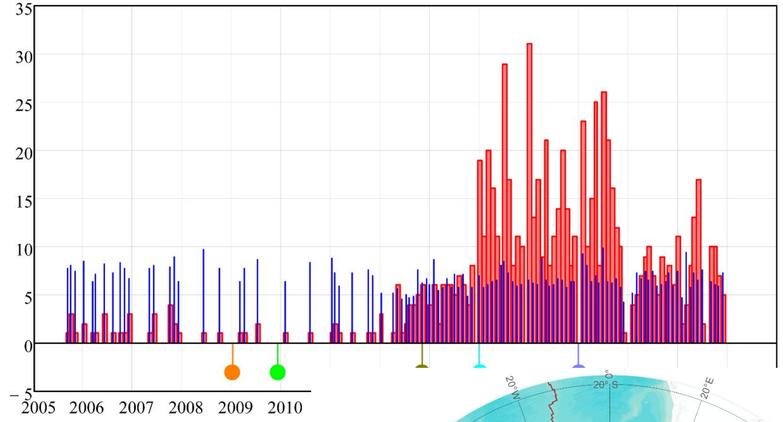


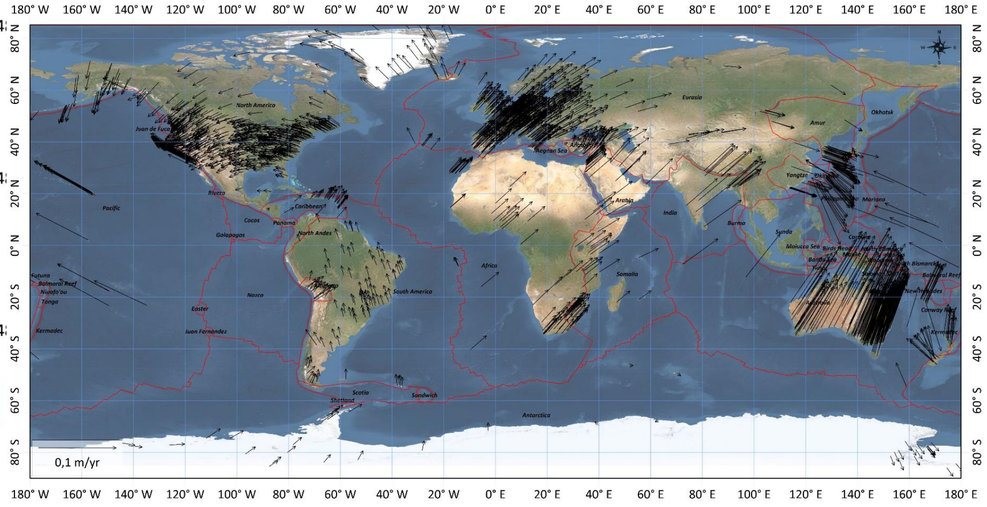
Geodynamics

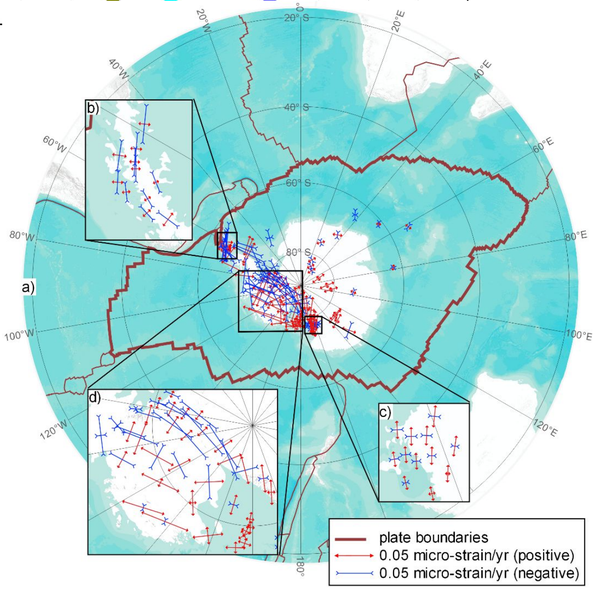
We perform research of local, regional and global geodynamic processes based on GNSS measurement data (in the Carpathian region, Ukraine, Europe, and Antarctica) as wel as of the tectonic plate)



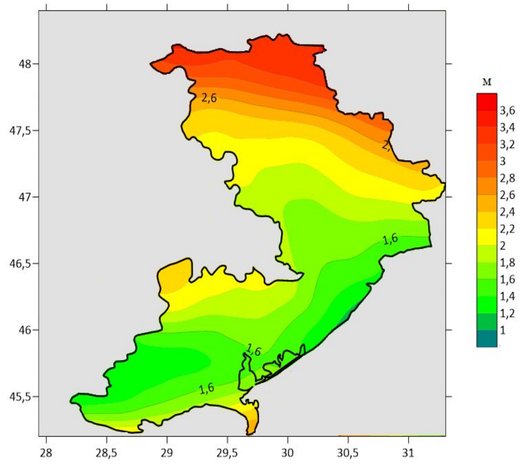


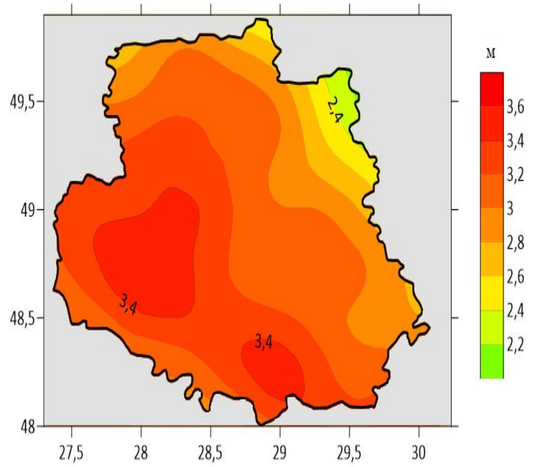


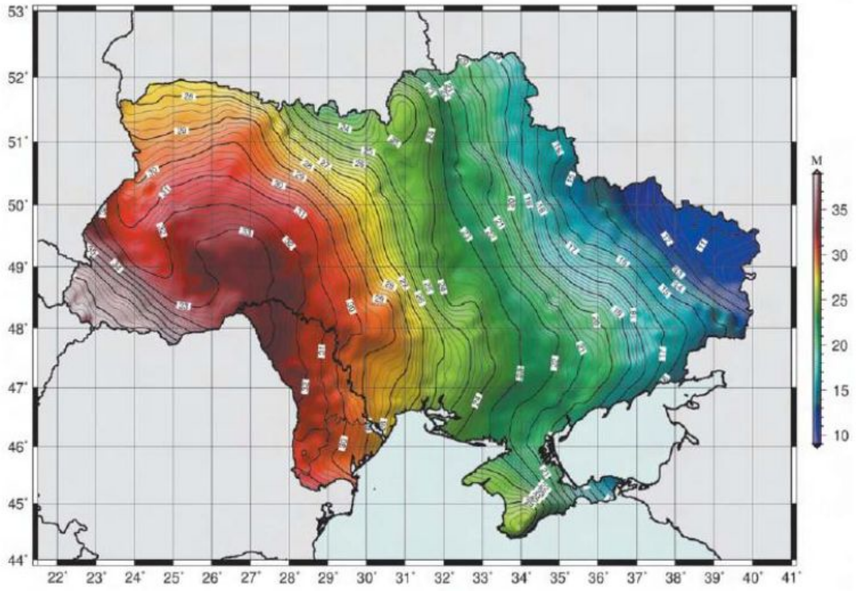




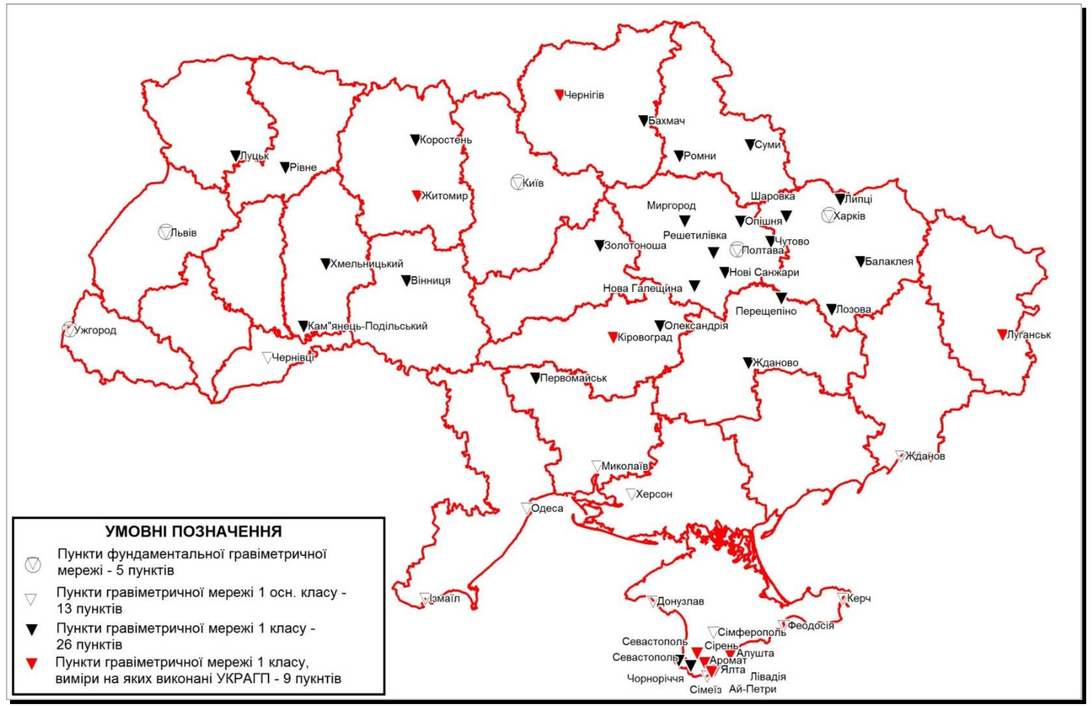
Determination of the Earth's gravitational field



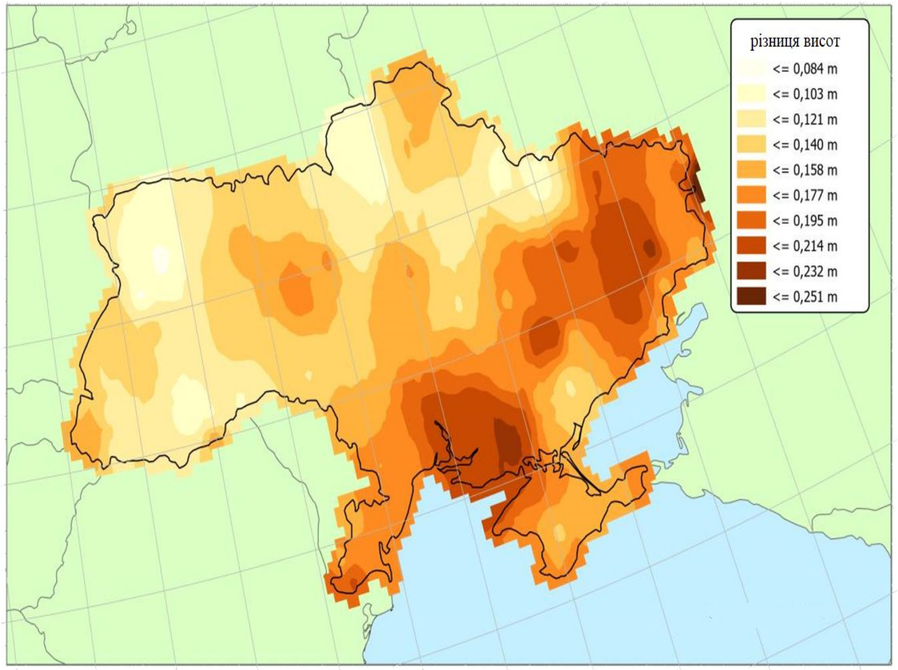




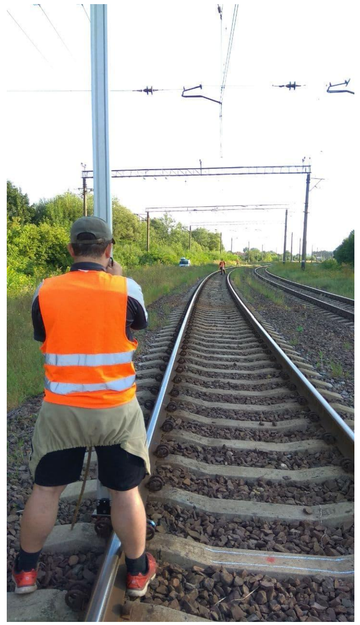
The construction of high-precision regional geoid models for determining gravity-dependent heights by satellite methods is in progress.
A project to modernize the gravimetric network of Ukraine has been developed.



Unification of the Ukrainian and European height systems



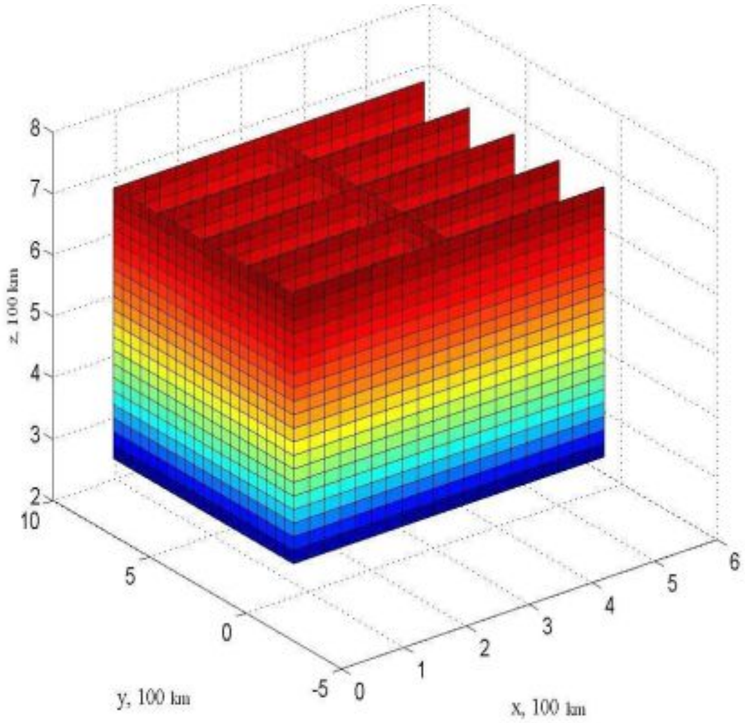
To integrate the Ukrainian height system into European, work on implementing and balancing high-precision levelling between Ukrainian and Polish height points is being carried out.



Study of atmospheric influence on GNSS radio signal transmission

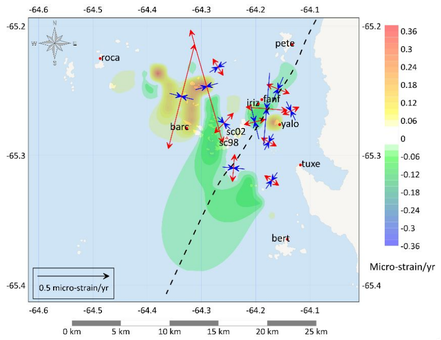
We perform research on improving model for determining the hydrostatic component of the zenith tropospheric delay and analysis of vertical profiles of the main meteorological variables obtained by the method of radio occultation (e.g. as part of the implementation of the CICERO project, Oslo)

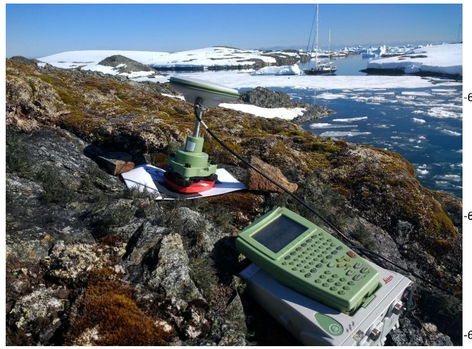
We research the use of active reference GNSS stations networks to establish the numerical characteristics of the Earth's ionosphere and to create an effective technology for monitoring the ionosphere on a regional scale.

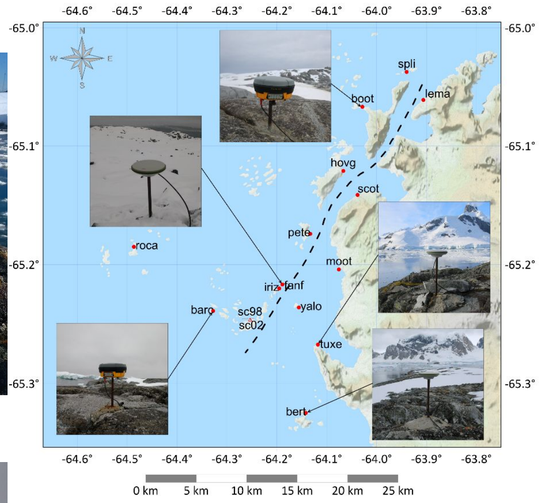


Antarctic research

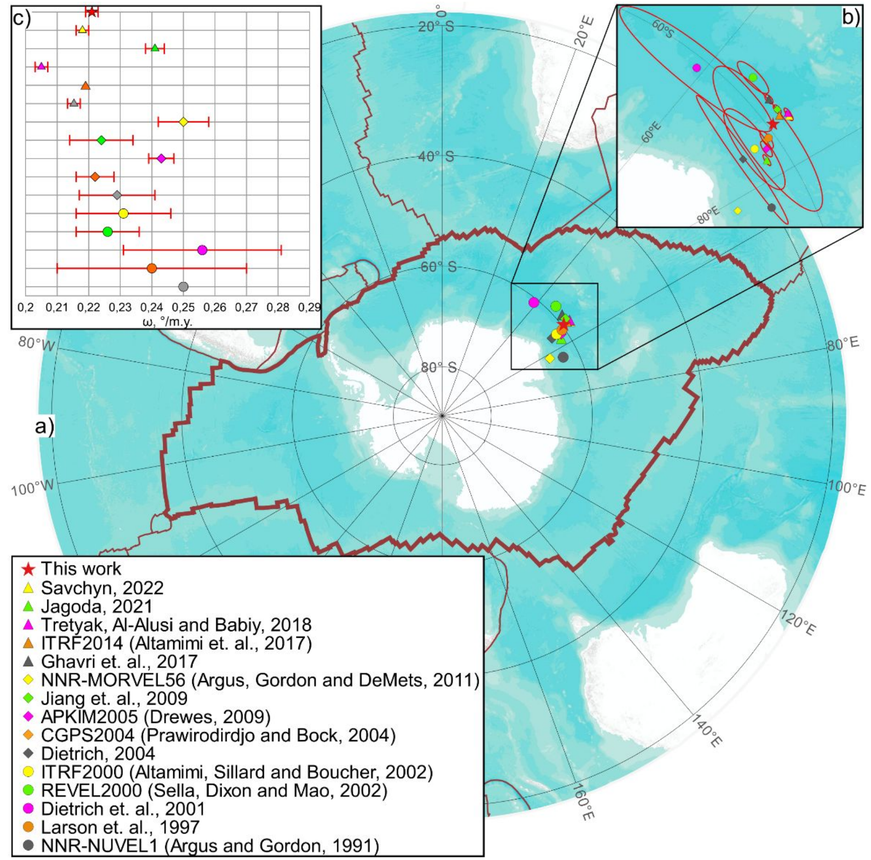
Employees of the department took part in 6 seasonal Ukrainian Antarctic expeditions, where a GNSS station was installed, and a geodynamic test site was laid. Glaciers are being monitored. GNSS measurements are carried out to study local geodynamic processes. Mapping of the surrounding territories is being performed.



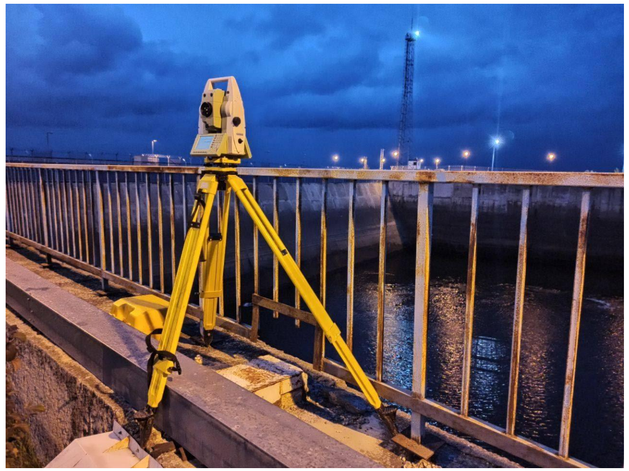




It is carried out as part of a targeted scientific research program in Antarctica



Engineering monitoring



We make monitoring of large engineering objects by GNSS and linear angular methods, as well as high-precision leveling methods (mainly hydroelectric power plants and nuclear power plants).

GNSS and linear-angular measurements are performed:

Dniester HPP 2002-2022

Terel-Rika HPP 2010-2022

Leveling is performed:

Rivne NPP 1986-2022

Zaporizhzhia NPP 2021

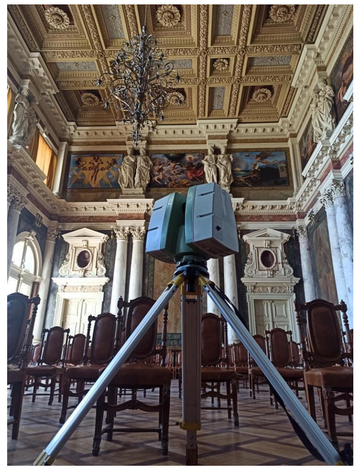
Dniester HPP-1 2022

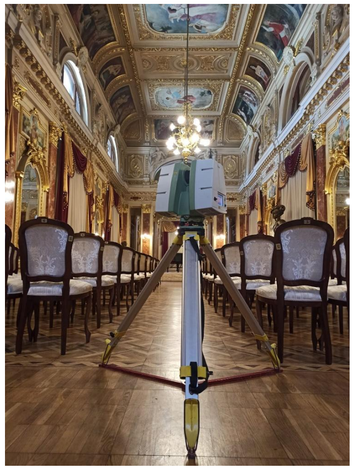
Dniester HPP-2 2022

Dnistrovsk HPP 2022

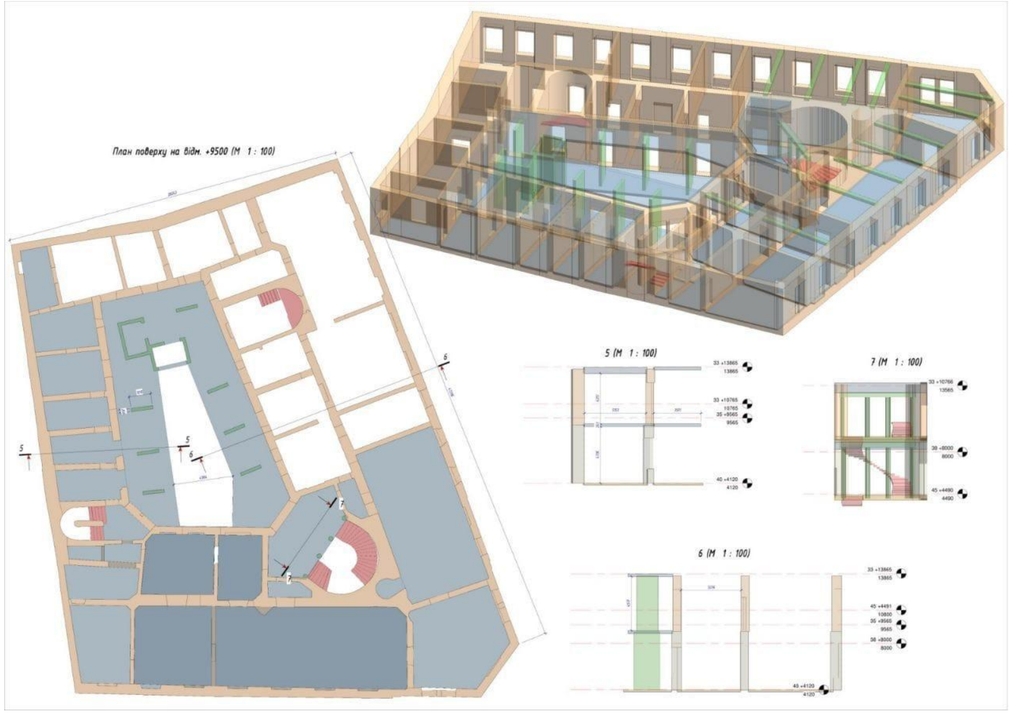
Digitization

Digitization of more than 100 objects of cultural heritage by the methods of terrestrial laser scanning and stereophotogrammetry is performed

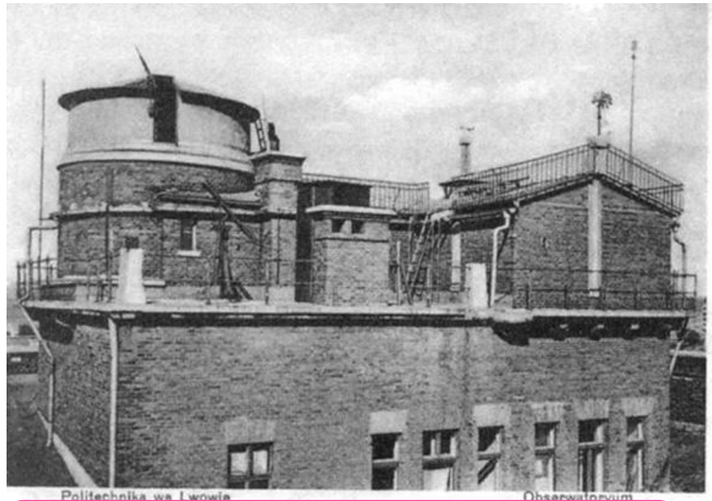




It was carried out as part of the projects:
Tempus GIDEC-GIS technology for sustainable development in Eastern neighbouring countries
AURA – Auralisation of acoustic heritage sites using Augmented and Virtual Reality
Regional program for the preservation of wooden sacred architecture monuments of the Lviv region



Astronomical observatory

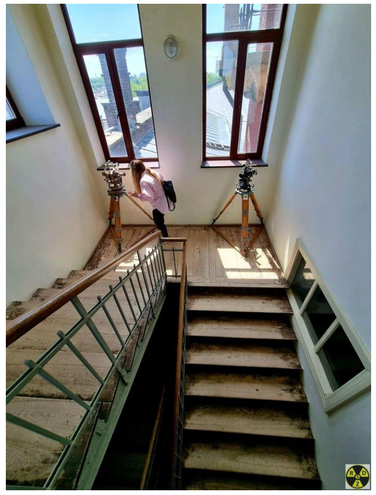


Our Observatory 1913

Our Observatory 2025

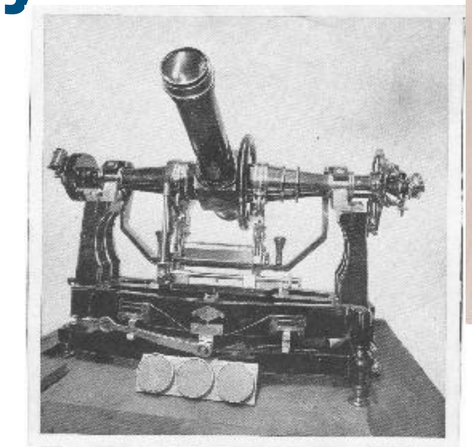
Astronomical Observatory was founded on November 15, 1877, is located in the city of Lviv at an altitude of 340 meters above sea level.

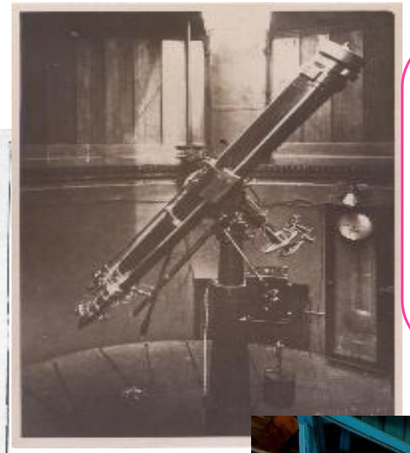
We have preserved unique instruments from the 19th century, but they need protection

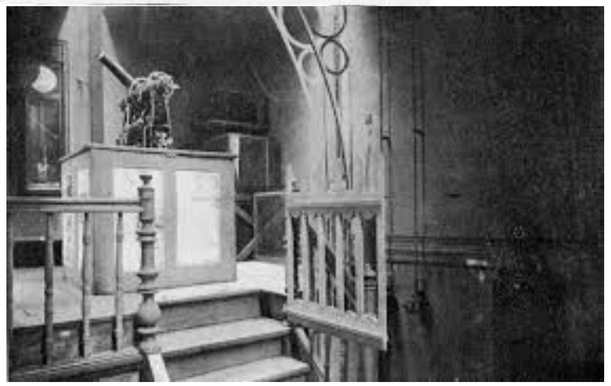


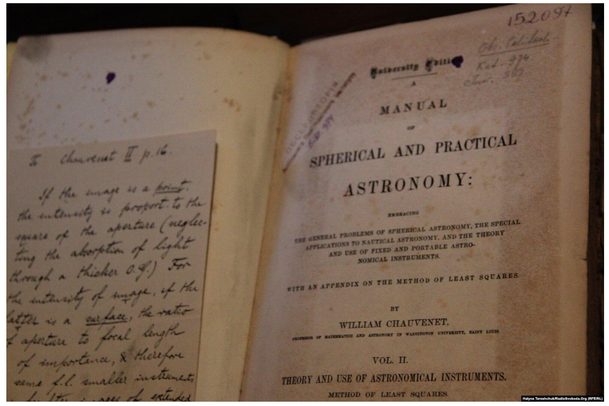
Astronomical observatory

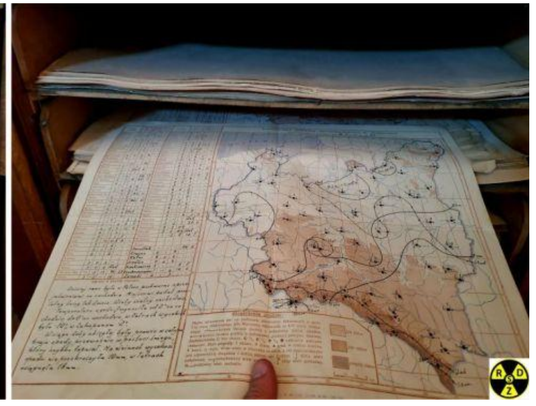
At the AO we demonstrate ancient instruments and simultaneously conduct training for students





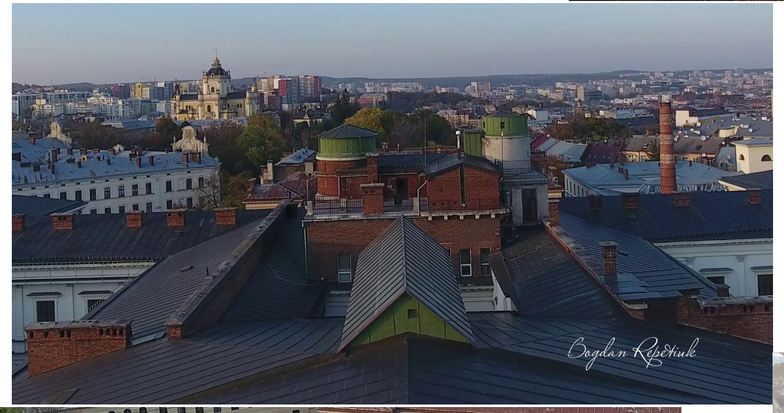






Astronomical observatory

For a long time, the department had an astronomical observatory. Today, it can be viewed from a historical perspective. We are working on creating the Astronomical Observatory museum, which will combine museum exhibits with modern astronomical instruments. It can become one of the good locations for conducting practices and astronomical summer school for students and all interested parties



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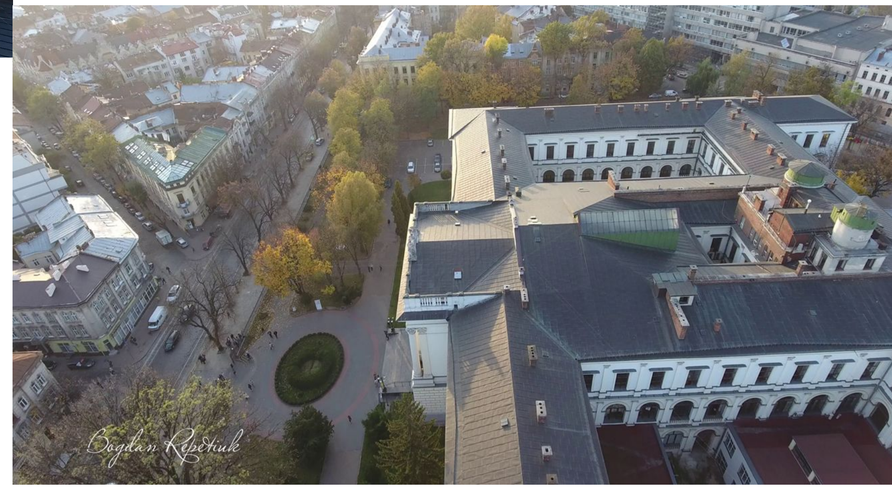
https://youtu.be/r7C_8hxxaPU



Pre-war teaching, research capacity and international role

- **Scientific activity** at the department is provided by 4 professors, 6 associate professors, 1 senior lecturer and 1 assistant, 4 laboratory workers

- **Scientific research**: Taking into account the influence of geophysical factors on changes in the Earth's gravitational field; Research on the accuracy and efficiency of GNSS technologies; Modern problems of geodetic astronomy; Research on the Earth's atmosphere based on GNSS measurements; Geodetic monitoring of deformations of engineering structures; Research on geodynamics and modern movements of the Earth's crust.
- **As of 2024**, the department has 40 bachelor's degrees, 10 master's degrees in space geodesy, and 10 master's degrees in space monitoring of the Earth, 3 PhD students in Earth Sciences. As of 2022, the department has 19 bachelor's degrees, 34 master's degrees in space geodesy, and 14 master's degrees in space monitoring of the Earth

- **New educational program !!! Geoconsulting and Earth Monitoring** «Earth Sciences»,bachelors (15 students 2024 year) and master’s degrees and **Geoanalytics** bachelor’s study (Interdisciplinary) (2025) Earth Sciences / Computer Science

- **Studying in european universities dual diploma programs**: Warsaw University of Technology (Poland), Neubrandenburg University of Applied Sciences (Germany), Lublin University of Life Sciences (Poland), Świętokrzyskie University of Technology (Poland)

Impact of the war

- Due to the war, most classes are online, some teachers, students, and graduate students are at war, the Ministry of Education and Science made changes to the curricula, introduced a 3-credit course "Military Training for Male Students" - the number of hours for students increased accordingly
- The stress caused by the war has led to a decrease in student activity
- Students, teachers are engaged in volunteer work - this also distracts from studying and reduces the level of learning - interruptions in learning;
- Infrastructure was damaged – dormitories, apartments of teachers and students living in Lviv were affected by the explosions.
- Frequent air alarms require interruption of lectures - the quality of practical laboratory classes is deteriorating
- Increase in online/distance learning, all online conferences - this is a loss of opportunities for sharing experience, internships and practical training are complicated
- Interruption of international cooperation – inability of male teachers, students and postgraduates to participate in international academic mobility. The war made it impossible for international partners to arrive. Only online lectures and visits by professors are possible

Current status and priority needs

- Deterioration in the quality of teaching and scientific research due to the problems of war
- The university provides psychological assistance for teachers and students, if necessary, material assistance (teachers and students), and material support is provided for students of preferential categories
- What is needed most: Funding for mobility for teachers and students **- reconstruction of one lab and Astronomical Observatory premises**, because this is the preservation of the historical and cultural heritage of Eastern Europe, due to the war, funding and the process of reconstruction of Astronomical Observatory, and restoration of ancient equipment**, preservation of unique books** from the astronomical library are limited.
- Gaps in funding, technical infrastructure and human resources

Strategic vision and collaboration opportunities

Our vision for recovery and development for the next 3-5 years:

- Reconstruction of the astronomical observatory and space monitoring laboratory, restoration of unique ancient devices and astronomical instruments, digitization of unique astronomical books

- Modernization of modern instrumentation (telescope for educational purposes, computing center-server), modern software

- Potential areas of cooperation- Horizont Europe, Erasmus +, Erasmus Capacity Building, Nawa

- Participation in international academic cooperation, training, joint teaching, joint scientific research, writing articles, exchange of experience in the educational field, exchange of personnel

We believe in victory and are grateful for the support and WELCOME to Lviv!

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