

MEMBER COUNTRY: UKRAINE
National Report to SCAR For year : 2018

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Activity	Contact Name	Address	Telephone	Fax	Email	web site
Scientific Research Program						
AAA 1) 2) 3) 4)						
AntEco 1) 2) 3) 4)						
AnT-ERA 1) 2) 3) 4)						
AntClim21 1) 2) 3) 4)						
PAIS 1) 2) 3) 4)						
SERCE 1) 2) 3) 4)						

Activity	Contact Name	Address	Telephone	Fax	Email	web site
Standing Committees						
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Other Groups (optional)						
SOOS						

During the reporting period, the State Institution National Antarctic Scientific Center of Ukraine conducted fundamental and applied research in accordance with the State Special-Purpose Research Program in Antarctica for 2011—2020.

The main directions of research - biological, medical-physiological, geological and geophysical, hydrometeorological, geospace, development and introduction of new technologies - were carried out using the primary data, materials and samples obtained during the 22nd (wintering) and 23rd (season) Ukrainian Antarctic Expeditions on the following topics:

Geological and Geophysical Research

1) **Investigation of variability and stratigraphy (stratification) of glaciers in the area of Antarctic Akademik Vernadsky station** (Project Manager – Volodymyr Bakhmutov, NASC, Leading Researcher of the Department of Geological and Geophysical Research, Doctor of Geological Sciences).

Object. Investigation of the structure of glaciers on Galindez, Winter and Skua Islands (Wilhelm archipelago, Antarctica) and observations of seasonal and long-term changes in their internal structure. The study of the glaciers was conducted using the VIY3-300 (300 MHz) and Zond 12-e (75 MHz) radars. The internal structure was investigated using VIY3-300 ground-penetrating radar, and Zond 12-e was mainly used to detect the boundary between ice and rock. **Results.** As a result of the processing and interpretation of ground-penetrating radar profiles obtained in the 23rd UAE, and their comparison with the results of the studies of the 22nd UAE, it was found that the structure of all the studied glaciers is similar. The number of layers extending over the area of the entire glacier ranges from 5 to 8 (depending on the thickness of the ice and the length of the glacier). Interlayers inside these layers are also sometimes distinguished. All glaciers are characterized by presence

of cracks, cavities and / or water channels in the last third along the glacier closer to the edge that reaches the ocean. A map-diagram of the slopes of the glacier layers was compiled. The annual and seasonal dynamics of the formation and development of fracturing on the glaciers of Galindez and Winter Islands is traced. **Conclusions.** Monitoring ground-penetrating radar surveys of island glaciers according to the chosen methodology are informative for the study of glacier stratification, detection of internal heterogeneities (cracks, voids, etc.) and study of the history of their development. When planning further ground-penetrating radar studies, it is recommended to increase the number of records during the year on the Winter and Skua Islands (up to 3-4 times a year) and on other islands of the Argentine Islands archipelago up to 2 times a year in order to track and predict their further changes. Continuation of these scientific observations is important because changes in the small cover of glaciers in Western Antarctica are indicators of global warming.

2) **Assessment of the mineral and raw materials base in the area of Antarctic Akademik Vernadsky station** (Project Manager – Volodymyr Bakhmutov, NASC, Leading Researcher of the Department of Geological and Geophysical Research, Doctor of Geological Sciences).

Object. Clarification of geological conditions of occurrence and the natural diversity of intrusive-magmatic formations in the area of Antarctic Akademik Vernadsky station, determination of their petrographic characteristics, mineral composition and potential ore bearing. Object of the study: intrusive-igneous rocks and associated mineral formations developed in the area of the Ukrainian Antarctic Akademik Vernadsky station on the islands of Berseloth, Barchans, Anagram and Petermann. **Methods:** petrographic studies of transparent thin sections in transmitted light using a polarizing microscope; mineralogical studies of polished sections in reflected light on a polarizing microscope with ore attachment; electron microscopic studies of transparently polished sections using a scanning electron microscope; electron-microprobe analysis of rock-forming and ore minerals; high-quality x-ray fluorescence analysis of the main and rare elements. **Results.** The authors made a systematic geological description of the most typical intrusive bodies of the region of Antarctic Akademik Vernadsky station: stratified gabbroid intrusions of Berselot and Anagram, Barchans-Forge granitoid massif, and post-granite basite dikes. The main petrographic representatives of intrusive rocks - gabbroids, granitoids, and dike formations – are characterized. As a result of studies, primary magmatic mineral parageneses in gabbroids of the Berselot Island are identified; phenomena of over-equilibrium and decomposition of solid solutions of Fe-Ti oxide-ore minerals gabbroids are recorded, their influence on determination of crystallization conditions and the performance of paleomagnetic studies is envisaged, mineralogical features of the tholeiitic series in young dyke formations in the UAS region are identified. In the course of research, thorite mineralization in granitoids of the Barchans Islands and chromite-magnetite mineralization of gabbroids of the Berselot Island was discovered. Based on the results of the work, recommendations and conclusions are given regarding the further application of the obtained data to solve problems aimed at clarifying the features of the geological structure of Western Antarctica and assessing its mineral resource potential.

3) **Maintenance of observations at magnetic observatory of the Arademir Vernadsky station, processing and analyzing data in accordance with the INTERMAGNET requirements for monitoring space weather and changes in the Earth's main magnetic field** (Project Manager – Volodymyr Bakhmutov, NASC, Leading Researcher of the Department of Geological and Geophysical Research, Doctor of Geological Sciences).

Object. Processing and comparative analysis of geomagnetic monitoring data obtained using the magnetometric complex at the geomagnetic observatory of the Antarctic Akademik Vernadsky station. **Methods.** Using statistical methods, the analysis of geomagnetic field

measurements in the area of the Akademik Vernadsky Antarctic station and their comparison with data from other geomagnetic observatories of the INTERMAGNET network were carried out. **Results.** It is established that the components of the magnetometric complex as separate individual autonomous devices (LEMI-008 variants No. 02 and No. 16, as well as the POS-1 scalar magnetometer) have high accuracy and sufficient stability. However, the magnetometric complex as a unit has poor accuracy and insufficient stability due to a number of factors, such as ambient temperature, power supply voltage, circuitry of electronics units, and the like. Modification of the hardware-software magnetometric complex is proposed; software for processing geomagnetic data is improved to present the results of studies to the international data network. Magnetometric digital data sets according to INTERMAGNET formats as well as data on changes in the Earth's main magnetic field and space weather have been prepared. **Conclusions.** The research results will be used to build analytical models of the Earth's geomagnetic field based on the results of five-year monitoring studies, determine the age course of the Earth's main magnetic field, study the upper atmosphere, near space, and space weather forecast.

4) **Geological Survey of the Argentine Islands and Antarctic Peninsula Bottom Area near Antarctic Akademik Vernadsky Station** (Project Manager – Petro Gozhyk, Institute of Geological Sciences, Director, Academician of the NAS of Ukraine).

Object. Detailing the topographic and structural-tectonic features of the shelf and the mainland of the Antarctic Peninsula in the area of Antarctic Akademik Vernadsky Station based on the use of satellite observations, modern ground and sea data, and tomographic modeling technologies. Study of the granulometric, mineralogical composition of rocks, X-ray structural analysis of rock-forming minerals, distribution and accumulation of heavy elements in ecosystem components, study of the taxonomic composition of organic residues, ecological and paleobiogeographic analysis of their complexes, characterization of processes of sedimentation and paleoclimatic reconstructions based on the obtained data. **Methods.** Expeditionary marine geological and mapping and survey works, which included sampling of marine bottom sediments with a column-type sampler on board Zodiac inflatable boat, application of computer-software equipment complexes and high-precision GPS observations; analysis of cartographic material and electronic databases of bathymetric and hypsometric data according to GIS technology programs, use of radioisotope dating methods. Analysis, interpretation and generalization of materials were carried out using the following methods: electron microscopic examination of the mineralogical composition of marine bottom sediments; analysis of particle size distribution of rocks; X-ray diffraction studies of rock-forming minerals; ultrasonic disintegration of rocks for micro-paleontological analysis; investigation of organic residues in light and electron microscopes; facial analysis of diatom complexes; photographing organic residues using light and electron microscopes. **Results.** The current state of geological researches of Quaternary bottom sediments on the western shelf of the Antarctic Peninsula is analyzed, the general characteristic of bottom sediments of the study area, granulometric composition of sediments, elemental composition and X-ray structural features of the main rock-forming minerals of the bottom sediments selected in the Argentine Islands archipelago during the 23rd UAE season, composition of organic sediment residues, as well as cartography of bottom configuration of individual sections of the studied water area using data from previous Ukrainian and British expeditions are obtained. For the analysis of multifactorial processes it is extremely important to study the effects of climate change, both on the natural environment and the level of the World Ocean, and on the accumulation of marine and continental sediments mass. That is why, the paper focuses on the study of bottom sediments of the inter-island waters adjacent to the Antarctic Akademik Vernadsky station, since it is in marine sediments that the stages of activation of outlet glaciers and their reduction, changes of water temperature and the development of planktonic and benthic microorganisms, primarily of diatoms as the main flint-skeletal component of biogenic sedimentation in the region, were recorded. **Results and Conclusions.** In parallel with diverse comprehensive lithological and mineralogical studies of layers of sedimentary material and with analysis of the organic residues contained in

them, it is worth studying the ice thickness of the Galindez Island, the aeolian material contained in it, organic residues and the composition of the air gases included into the ice of the pre-technogenic era.

5) **Investigation of the modern geodynamics of the Earth's crust at geophysical and geodetic test sites in the area of the Antarctic Akademik Vernadsky station** (Project Manager – Kornilyi Tretiak, National University Lviv Polytechnic, Director of the Institute of Geodesy, Doctor of Technical Sciences,).

Object. Investigation and differentiation of modern kinematics of tectonic plates in the area of the Antarctic Akademik Vernadsky station, as well as changes of surface volumes of island glaciers of the Antarctic coast on the materials obtained in Ukrainian Antarctic expeditions. The object of study is the crust and island glaciers in the area of the Antarctic Akademik Vernadsky station. The subject of the study is the movements of the earth's crust and the parameters of its deformation in the area of the Antarctic Akademik Vernadsky station; change in surface volumes of island glaciers near the station. **Methods.** Based on the results of determining the coordinates by global navigation satellite systems made at a geodetic test site near the Antarctic Akademik Vernadsky station during the season of the 23rd UAE, the influence of regional movements of the Earth's crust (within the Antarctic Peninsula) on the local geodynamics of the Argentine Islands archipelago is investigated. **Results.** Parameters of horizontal displacements of the points of the geodynamic test side of the Argentine Islands archipelago are calculated, and maps of their distribution for four periods of study are constructed (2003-2005; 2005-2014; 2014-2018 and 2003-2018). Using algorithms for determining the parameters of the deformations of the Earth's surface in 3D and 2D space, the elements of the strain rate tensor of the points of the geodynamic test site of the Argentine Islands archipelago are calculated for all periods of the study. To clarify the mechanism of the geological-tectonic model of the Earth's crust movements and the deformation field parameters of the territory of the geodynamic test side of the Argentinean Islands, based on an analysis of previous studies, maps and diagrams of the distribution of dilatation velocities for all periods of the study were calculated and constructed. It is revealed that the deformation processes on the territory of the geodynamic test side of the Argentine Islands archipelago have a pulsating alternating character. The use of ground-based laser scanning made it possible to verify and confirm the accuracy of the digital stereo-photogrammetric method for determining the volume of island glaciers. Based on the obtained materials of ground-based laser scanning and ground-based digital surveying, 3d models of island glacier outputs on the Galindez and Winter islands were built. By the joint processing of ground-based laser scanning and ground-based digital surveys performed during the season of the 23rd UAE and previous Antarctic expeditions, changes in the surface volumes of the outputs of island glaciers on the Galindez and Winter islands were determined. **Conclusions.** The results of studies of regional movements of the Earth's crust of the Argentinean Islands archipelago are suitable for further structural analysis and prediction of the geodynamic processes of the Antarctic Peninsula and Antarctica as a whole. According to the results of study of the dynamics of glaciers, both island and continental, valuable information is obtained for predicting climate change not only in the research area, but throughout the globe.

6) **Investigation of spatio-temporal tectonomagnetic and magnetovariational anomalies at a geophysical test site in the region of Antarctic Akademik Vernadsky station** (Project Manager – Valentyn Maksymchuk, Director of the Carpathian Branch of S.I. Subbotin Institute of Geophysics NAS of Ukraine, Doctor of Physical and Mathematical Sciences)

Object. Detection of anomalous effects related to the modern dynamics of the earth's crust of the western slope of the Antarctic Peninsula, according to magnetovariational and tectonomagnetic observations in the area of Antarctic Akademik Vernadsky Station. Object of study is the modern geodynamics of the earth's crust of the Antarctic Peninsula western slope. **Methods.** The studies used the data of

tectonomagnetic observations at the geodynamic test site for the period of 1998-2017 (11 observation cycles) with a total volume of 1024 MB, magnetovariational observations at the AIA magnetic observatory for the period of 2000-2018 (value of the full vector and X, Y, Z components) with a total volume of 40960 MB, as well as data from other Antarctic observatories. The original complexes of programs and techniques for conducting and interpreting tectonomagnetic observations, which are based on conducting synchronous geomagnetic observations using proton magnetometers and are widely used at geodynamic test sites in seismic zones of different countries to study earthquake predictors, as well as the technique of magnetovariational monitoring observations are used in the work. **Results.** An interpretation model of tectonomagnetic anomalies is constructed using data on the magnetic properties of rocks of the research area. When processing the series of magnetovariational observations, we used author's programs for processing magnetotelluric data, which make it possible to calculate the components of the Wiese vectors for variations of different periods. Interpretation of spatio-temporal tectonomagnetic and magnetovariational anomalies was carried out. The conclusion is made about the relationship of spatial-temporal anomalies with seismicity and modern movements of the earth's crust of the Antarctic Peninsula. **Conclusions.** The results obtained allowed us to estimate the intensity of variations of tectonic stresses in the Earth's crust of the Antarctic Peninsula. Active tectonic faults found in the area of the island Three Little Pigs and Penola Strait are worthy of consideration in terms of mineral exploration.

7) Geomagnetic field-climate: cause-effect relations in changing some of the atmospheric parameters in the Antarctic and Arctic regions (Project Manager – Volodymyr Bakhmutov, NASC, Leading Researcher of the Department of Geological and Geophysical Research, Doctor of Geological Sciences)

Object. Creation of a model of influence of geophysical factors on the air temperature in Antarctica and the Arctic, which would reasonably explain the dynamics of long-term temperature changes in the polar regions of the Northern and Southern Hemispheres. The object of the study are the factors influencing the changes in ground temperature in Antarctica and the Arctic, the subject is the spatial-temporal structure and cause-effect relations of different geophysical parameters that can affect the surface air temperature in the polar regions of the Northern and Southern Hemispheres. **Methods.** In this work methods of analyzing time series based on the standard Statistica, Excel packages, as well as the Surfer package for building maps are used. **Results.** Based on the comparison of observations from polar geomagnetic and meteorological stations at high and middle latitudes of both hemispheres, the dynamics of age-related variations of the Earth's magnetic as a result of changes in global temperature was studied; maps and graphs of these parameters were constructed. A cause-and-effect chain of the Earth's magnetic field, galactic cosmic rays, ozone variations and the amount of water vapor in the upper troposphere / lower stratosphere is traced, which ultimately leads to a change in the radiation balance of our planet and, as a result, to changes in surface temperature and climate. The proposed model of the mechanism explains the influence of the geomagnetic field on the climate through tropopause processes. It is based on the modulation of particles charged by a geomagnetic field and their influence on ozone balance near the tropopause. Both ozone destruction by cosmic rays and its formation in the lower stratosphere are taken into account in two different ways: in the autocatalytic cycle of ozone production initiated by particles of galactic cosmic rays (for Northern Hemisphere) and as a result of ozone "self-healing" effect initiated by solar energetic particles (for Southern hemisphere). The model explains one of the paradoxes of the modern climate - simultaneous warming in the west and a decrease in temperature in the east and in the center of Antarctica, as well as the region of elevated and lowered temperatures in the polar and middle latitudes of the Northern hemisphere. **Conclusions.** For the first time, a chain of causal relationships has been constructed as the basis for a physical mechanism that takes into account the influence of variations in the Earth's main magnetic field as one of the determining factors of spatial distribution and variations in surface temperature in the Polar Regions of the Southern and Northern hemispheres. The results can be used to create climate models that can predict future climate changes and further study the relationship of the geomagnetic field and climate at

different time intervals and in individual regions.

Hydro-Meteorological and Oceanographic research

8) Building of ensemble long-term weather forecast and climate change for the Antarctic Peninsula and adjacent marine basins

(Project Manager – Svitlana Krakovska, Senior Researcher of the Department of Atmospheric Physics, Candidate of Physical and Mathematical Sciences)

Object. Development of ensemble methods of long-term and climatic forecasts of basic meteorological values for Antarctic Akademik Vernadsky station area and the Antarctic Peninsula as a whole. The problem of long-term weather forecasts is solved by the **methods** of statistical processing of the calculation results of the NCEP-CFSv2 model and Web programming using data averaging and smoothing algorithms. Climatic projections of changes in surface air temperature by the end of the XXI century are also obtained using methods of statistical data processing of 93 calculations of 10 models of the general circulation of the atmosphere and oceans for the three socio-economic scenarios of the IPCC. **Results.** An interactive visualization system for long-term weather forecasts was developed and implemented on the NASC official website uac.gov.ua/wf/longrange_ua.html. The system automatically updates predicted information according to the criteria of optimal perception and computational capabilities. According to the results of the climate forecast, the obtained linear trend coefficients for three scenarios (from 0.15 to 0.29 ° C / 10 years) and the projection of the average annual air temperature until the middle and the end of the XXI century were obtained. **Conclusions.** The obtained ensemble long-term weather forecast for the area of the Antarctic Akademik Vernadsky station and the Antarctic Peninsula as a whole is the most up-to-date, but needs further real-time approbation and testing with possible subsequent correction of errors, expansion of parameters and improvement of the visualization system for forecast data. The obtained projections of changes in the temperature regime in the middle and end of the XXI century can be used, in particular, to predict ecosystem changes in the Antarctic Peninsula region, the impact on other geophysical parameters, long-term logistics planning and station maintenance, etc.

9) Long-term changes in atmospheric circulation and climate in the Southern Hemisphere and the Antarctic Peninsula area

(Project Manager – Vazira Martazinova, Doctor of Physical and Mathematical Sciences, Ukrainian Hydrometeorological Institute of the State Service of Emergences of Ukraine and NAS of Ukraine).

Object. To study the current state and changes in the climate system of Antarctica and the regional climate of the Antarctic Peninsula during global warming, to study the features of the seasonal ozone hole, to show the role of Ukrainian Antarctic station in identifying the ozone anomaly. The object of the study is a large-scale atmospheric circulation over the South Polar Region and regional circulation over the Antarctic Peninsula. Observational data at Antarctic Akademik Vernadsky station (daily average values for the entire period of the station's operation): meteorological parameters (temperature), total ozone concentration, Earth's magnetic field variations (three components each), as well as materials from international databases were used in research. **Results.** A comparative assessment of the current climate in the Antarctic Peninsula has been made. A long-term change in atmospheric circulation in the low, middle troposphere and low stratosphere of the Southern Hemisphere, with special attention to the period of development of the ozone anomaly during the polar spring is analyzed. A significant degree of tropospheric-stratospheric relations is shown; the dependence of the variability of weather conditions and climate of the Antarctic Peninsula on the phenomenon of El Niño-Southern Oscillation was marked. The modern nature of synoptic processes that determine anomalous weather conditions over the West Antarctica sector and the Antarctic Peninsula is revealed. The classification of total ozone (TO) over the Faraday /

Vernadsky station for the period of 1972-2017 was obtained. It was revealed that the influence of the ozone hole on the TO over the station has begun in 1990 and continues to the present. The connection between the circumpolar vortex and the position of the ozone hole during the polar spring is shown. An assumption was made that in the next few years an increase in the total ozone over the Akademik Vernadsky station and a decrease in the ozone layer depletion over the Southern Hemisphere should be expected. **Conclusions.** The obtained results are at the level of world analogues, scientific novelty lies in a comprehensive analysis of the Antarctic climate system, using data from ground-based observations, as well as the structure of the troposphere and low stratosphere, studies of both large-scale and regional circulation, the relations with the El Niño-Southern Oscillation. Knowledge of the current state of the ozone hole and its relationship with El Niño and the atmospheric circulation of the Southern Hemisphere make it possible to make a climate forecast for the next 30-50 years.

10) Monitoring of physics and chemical parameters of the Southern Ocean fields, accumulation and transport of pollutants in Antarctic marine and terrestrial ecosystems (Project Manager – Viktor Komorin, NASC, Leading Researcher of the Department of Geological and Geophysical Sciences, PhD in geographical sciences).

Object. To initiate a system of long-term standardized observations of the physicochemical parameters of the aquatic environment in the Atlantic Sector of the Southern Ocean (CCAMLR Statistical Area 48) and introduce a system for monitoring the spread of polluting chemicals in the coastal marine and terrestrial ecosystems of the Argentine group of islands of the Wilhelm Archipelago (Galindez Island and adjacent islands). **Methods.** A series of automatic measurements of the physicochemical parameters of the aquatic environment in the Atlantic sector of the Southern Ocean (CCAMLR Statistical Area 48) was launched during the seasonal maritime expedition under the 23rd UAE 2018 using the autonomous FerryBox system manufactured by 4H-JENA engineering GmbH (Germany) installed on board the marine vessel More Sodruzhestva, engaged in regular fishing activities in the abovementioned area. The vertical structure of water masses was determined using the SBE 37SM STD measuring complex. The main seawater indicators (physical, chemical and several biological) were continuously determined throughout the vessel's route. **Results.** The spatial distribution of temperature and salinity of the water along the movement of the vessel according to the data of the FerryBox system has been charted. A database of variability of oceanographic fields of the South Atlantic and Antarctica has been formed. The paper also defines the tasks and methods of their solution for the study of the distribution of polluting chemicals in different components of ecosystems: seawater, soil, atmosphere, sediments, tissues of living organisms of different trophic levels and taxonomic groups (shellfish, crustaceans, fish, seabirds, and marine mammals), etc. Since Antarctica is a region geographically remote from the major sources of anthropogenic pollution, the focus is on monitoring the content of persistent pollutants with a long lifetime in the environment, such as heavy metals, persistent organic pollutants and microplastic particles. A methodology of sampling, sample preparation and analysis of samples of environmental components for the fulfillment of the tasks has been developed. **Conclusions.** The system introduced for monitoring of the physicochemical parameters of the South Ocean fields, the accumulation and transport of pollutants in the Antarctic marine and terrestrial ecosystems will allow to move to a new level of knowledge about the effects of climate change on the ocean and will fundamentally improve the forecasting of the ecological state and biological productivity of the waters of the Southern Ocean. In addition, data on the content of pollutants in various components of the Antarctic ecosystems provide important information on the degree of anthropogenic pollution in general and are necessary for understanding the processes of transformation of pollutants in the environment.

11) Investigation of processes of spatial-temporal variability of currents in the Bellingshausen Sea and modeling of zones of rising and lowering of waters on the sea shelf (Project Manager – Volodymyr Maderych, Doctor of Physical and Mathematical Sciences, Institute of Problems of Mathematical Machines and Systems NAS of Ukraine)

Object. Investigation of the processes of spatial-temporal variability of currents in the Bellingshausen Sea using a high-resolution numerical hydrodynamic model within the shelf of the Bellingshausen Sea and the calculation of shelf waters rising and lowering zones to assess areas of increased biological productivity. The object of study is a stratified aquatic environment, the Bellingshausen Sea. **Methods.** Numerical modeling techniques have been used in the studies, including the use of a three-dimensional baroclinic model with unstructured finite SCHISM elements. For comparison with calculations, oceanographic observation data including data on sea level, temperature, salinity, transparency, sea water density obtained in the 22nd UAE, as well as data from previous expeditions were used to calibrate and validate the numerical model along with satellite data observations and regional studies of other expeditions. **Results.** A numerical baroclinic circulation model with an unstructured grid, which has a high resolution on the shelf of the Antarctic Peninsula, is built and adapted to the Bellingshausen Sea. A comparison of calculations was made with the available observational data in the eastern part of the Bellingshausen Sea and on the shelf of the Antarctic Peninsula, including observation data at Antarctic Akademik Vernadsky station. The calculations of the circulation and divergence of water masses during the Antarctic summer and the estimation of rising and lowering zones of shelf waters of the Antarctic Peninsula were obtained. **Conclusions.** A high-resolution model of the eastern part of the Bellingshausen Sea and the shelf of the Antarctic Peninsula was first constructed. The proposed model differs from well-known calculations (Smith, Dinniman, 2002; Dinniman, Klinck, 2004) in that the use of a model with an unstructured grid makes it possible to simulate a wide range of different-scale processes in the ocean and on the shelf. The calculated areas of rising and lowering shelf waters can be used to assess areas of increased biological productivity of the Southern Ocean.

Geospace research

12) Comparative analysis of ionosphere vertical sounding data obtained at Antarctic Akademik Vernadsky station using the IPS-42 ionosonde and a prototype of a new digital ionosonde (Project Manager – Andriy Zalizovsky, NASC, Senior Researcher of the Department of Geological and Geophysical Sciences, Doctor of physical and mathematical sciences).

Object. To investigate seasonal-daily variations of ionosphere parameters above Antarctic Akademik Vernadsky station using the new method of averaged (median) altitude-time diagrams, as well as to perform a comparative analysis of the ionospheric vertical sounding (IVS) obtained using the IPS-42 ionosonde and a model of a new digital ionosonde. **Results.** New methods for processing and presenting of data from modern systems of high-frequency diagnostics of the ionosphere at Antarctic Akademik Vernadsky station were developed, tested and brought to practical implementation. It is shown that the developed methods of averaged (median) altitude-time diagrams are suitable for diagnosing the speed of movement of regular ionospheric layers and for evaluating changes in the behavior of sporadic E layers. The value of the diagrams is that they reflect the altitude-time behavior of the ionosphere at the observation point per month on a single figure. Comparative analysis of vertical ionospheric sounding data obtained at Antarctic Akademik Vernadsky station using the IPS-42 ionosonde and a model of a new digital ionosonde showed the suitability of the latter for ionospheric diagnostics for the purpose of space weather monitoring. The developed methods of constructing the median frequency-altitude diagrams are included in the standard IVS data processing at the Antarctic Akademik Vernadsky station. **Conclusions.** New methods of HF measurements data processing make it possible to significantly expand the diagnostic capabilities of

HF sounding complexes installed at UAS in recent years with the assistance of the Radio Astronomy Institute of the National Academy of Sciences of Ukraine. The introduction of averaged altitude-time diagrams to visualize data from both traditional and coherent IVS allows obtaining more complete information about regular variations in the state of the ionosphere above Antarctic Akademik Vernadsky station.

13) Investigation of near-Earth plasma inhomogeneities over the Antarctic Peninsula based on monitoring of high-frequency signals (HF) at Akademik Vernadsky and Palmer Antarctic stations (Project Manager – Oleksandr Koloskov, NASC, Senior Researcher of the Department of Geological and Geophysical sciences, Doctor of physical and mathematical sciences).

Object. Study the parameters of ionospheric inhomogeneities characterizing the state of space weather in the Antarctic Peninsula region by processing high-frequency monitoring data. **Methods.** The research tools were UAS-Palmer coherent sounding systems and the installation of ionosphere vertical sounding (IVS) on UAS. The approach to research problems was to analyze the daily, monthly, and seasonal distributions of the characteristics of the HF signals and the ionosphere over the UAS and at the UAS-Palmer route. Spectral methods and wavelet analysis of monitoring measurements were applied for data processing. **Results.** The processing results have shown that the wavelet analysis can reliably identify moving ionospheric inhomogeneities (MII). Statistical processing showed that for each month of the year it is possible to distinguish time intervals of the most probable occurrence of MII and to evaluate their characteristic periods. In addition, data for the same months of 2016 and 2017 are found to be very similar, which confirms the presence of stable seasonal dependences of MII parameters. **Conclusions.** Obtained results are important for identifying the mechanisms of excitation of near-Earth plasma inhomogeneities over the Antarctic Peninsula. The works performed are valuable in terms of the complete integration of new geospace diagnostic complexes into the structure of the electromagnetic observatory at the Akademik Vernadsky Antarctic station.

14) Research of geocosmic processes by analyzing the monitoring data of the electromagnetic environment of the Earth at Antarctic Akademik Vernadsky station (Project Manager – Oleksandr Koloskov, Institute of Radio Astronomy of the NAS of Ukraine, Leading Researcher, Doctor of physical and mathematical sciences).

Object. The study of geospace processes and their interaction with energy flows from above the Sun and from below from the surface of the Earth and the troposphere, which form the state of space weather. Object of study: space weather, the structural components of which are the ionosphere and the Earth's magnetosphere. The working hypothesis for research is the presence of a significant influence of processes at the Earth's surface and in the troposphere on the characteristics of the ionosphere and the state of space weather. The approach to solving the research objectives is to compare the geospace data obtained in the Antarctic Peninsula region, in particular at the Antarctic Akademik Vernadsky station, with the characteristics of near-surface and tropospheric processes in order to identify their relationship to confirm the working hypothesis. To test the effectiveness of the developed and improved methods, computer modeling and statistical analysis methods were used. Physical interpretation of the obtained results was carried out using modern geophysical models. **Results.** By coherent processing and analysis of data of synchronous monitoring of signals at spatially located points of the global ultra-low frequency (ULF) interferometer (in Antarctica - Galindez Island, Antarctic Akademik Vernadsky station and the Arctic - Svalbard) the study of ultrastrong lightning discharges as manifestations of planetary thunderstorm activity was carried out. Mapping of the discharges and analysis of their distribution depending on the season, time of day, geographical coordinates, and threshold for selecting events by energy was conducted. It is shown that the proposed system is suitable for tracking short-term events (high-power lightning discharges) as well as for monitoring of long-term seasonal and interannual changes in world thunderstorm activity. A model of linkage between the land temperature and the global thunderstorm activity has been developed, within which the linkage between the parameters of the Schumann resonances and the continental temperature of thunderstorm

sources has been investigated. On the example of the African continent, a high level of correlation of the surface temperature and the intensity of the Schumann signal is shown. A functional diagram of a very low-frequency (VLF) complex for monitoring of thunderstorm activity and the lower ionosphere has been developed. The requirements for the design parameters of the antennas and the receiving part of the complex intended for installation at the Antarctic Akademik Vernadsky station are identified and justified. **Results.** Within the research work the processing techniques are developed, tested and brought to practical implementation and the data of the global VLF interferometer are presented. The VLF complex proposed by the authors of the work will make it possible to take the bearings of ultrastrong discharges with greater accuracy than LF measurements allow.

15) Study of the global ionospheric effects of strong geospace storms occurred during the 22nd Ukrainian Antarctic Expedition 2017-2018. (Project Manager – Dmytro Kotov, , Institute of the Ionosphere of the National Technical University “Kharkiv Polytechnic Institute”, PhD in Physics and Mathematics).

Object. A study of the manifestations of strong geospace storms in variations of electron concentration in the Southern and Northern hemispheres using the Akademik Vernadsky Antarctic station ion probe and incoherent scattering radar and ion probe located in Ukraine.

Research Methods: radiophysical methods of vertical sounding and incoherent scattering; obtaining information on electron concentration variations by solving the inverse problem of radiophysics; geophysical interpretation of results using the physical model of the ionosphere. The object of study is the concentration of electrons in the ionosphere. **Results.** For the Antarctic station region, the ionospheric storm was found to be positive both during daytime hours (~ 35% increase of concentration in NmF2 ionization maximum) and at night (~ 100% increase in NmF2). It is concluded that the increase in electron concentration during the geospace storm over Antarctica can be explained by the increase in the height of the ionization maximum. **Results.** The results of the work can be used for basic research of solar-terrestrial communications and the near-Earth environment, as well as for solving applied problems of radio wave propagation in near-Earth space.

16) Investigation of long-term changes in the ozone hole parameters and their relationship with a large-scale atmospheric circulation (Project Manager – Gennady Milinevsky, NASC, Senior Researcher of the Department of geological and geophysical research, Doctor of physical and mathematical sciences).

Object. Investigation of atmospheric dynamics and climate trends. Object of study: atmospheric dynamics and climatic trends, ozone hole over Antarctica. Subject of study: the relationship between dynamic processes in the atmosphere, the troposphere and the parameters of the ozone hole. **Methods:** terrestrial and satellite measurements, statistical analysis. **Results.** Changes in the zonal asymmetry of Antarctic ozone and regional climate changes in the Southern Hemisphere are investigated. It is shown that there are statistically significant relations between changes in the structure of quasi-stationary atmospheric waves over the Antarctic region and in the distribution of atmospheric parameters in the Southern Hemisphere. A methodology of estimation of the probable evolution of the ozone hole, which is consistent with the observed data, has been developed. Long-term changes were revealed in the stability of the wave chain and, accordingly, in the intensity of the Pacific tropical impact on the climate of the Antarctic Peninsula. **Conclusions.** The results obtained make it possible to supplement the current understanding of the nature of long-term changes in the ozone hole, parameters of the troposphere and stratosphere, in particular, the temperature regime in the region of the Antarctic Peninsula. The relationships in ozone variations over the Antarctic Peninsula and surface temperature in the tropics of the Pacific Ocean sector, and the variations in surface temperatures in the Antarctic Peninsula with tropical thermal anomalies in the Pacific Ocean have been studied. The nature of changes in the parameters of the ozone hole and planetary waves has been established based on available observations and the evolution of asymmetry in the distribution of ozone over the Antarctic has been determined.

Biological research

17) **Six-year dynamics of the composite latent index of the adaptability of *Deschampsia Antarctica* population, Galindez Island (Maritime Antarctica)** (Project Manager – Iryna Kozeretska, NASC, Senior Researcher of the Department of medical and biological research, Doctor of biological sciences).

Object. To describe the dynamics of complex adaptability of *Deschampsia antarctica* E. Desv., Galindez Island, Argentine Islands, Maritime Antarctica over six Antarctic summer seasons. **Results.** A study and analysis of plant morphometric parameters was carried out, and the electrophoretic spectra of protective and reserve proteins of *D. antarctica* plant seeds of six populations of Galindez Island in the 2017/2018 season were analyzed. Based on a number of statistical methods, united by the name "expert statistical method for constructing a composed latent indicator of the effectiveness of an object's functioning," a composed latent adaptability indicator (CLAI) for six populations of Galindez Island in the 2017/2018 season has been analyzed. CLAI values for the last season were added to the previously obtained five-year dynamics of six populations. Trends of the six-year dynamics of the composed latent adaptability indicator for six populations were obtained. **Conclusions.** An analysis of these results suggests that the continuation of the dynamics is likely to show the oscillatory form of the trend of CLAI (third degree polynomial) with a different period and phase of oscillation of each studied population. The obtained trends of the six-year dynamics of CLAI of *D. antarctica* in Galindez Island confirm our assumption about the individuality of changes in this integral indicator not only depending on the place of growth, but also depending on the conditions of a particular season. Further monitoring will make it possible to build the population dynamics of CLAI, the forecast accuracy of which for each population will increase with an increase in the number of points of dynamics, which creates additional opportunities for finding their dependence on locally measured climatic indicators.

18) **The effect of ultraviolet A on the growth and biosynthetic activity of *Deschampsia Antarctica* plants *in vitro*** (Project Manager – Oksana Poronnik, NASC Researcher. PhD in Biology).

Object. To investigate the effect of ultraviolet A on the growth and biosynthetic activity of *Deschampsia Antarctica* plants *in vitro*. **Results.** It was found that there is a significant increase in the number of all photosynthetic pigments during additional UV-A irradiation of *D. antarctica* Desv plants *in vitro*. However, the most productive was the triploid Y-66. The content of chlorophylls A and B in the leaves of this plant has tripled, and the content of carotenoids increased 3.5 times. The plant of this genotype has more powerful photoprotection. Additional UV-A irradiation caused a slight increase in the content of flavonoid glycosides in *Deschampsia Antarctica* plants with triploid genotype Y66 and diploid plants S22 and R35. A decrease in the number of glucosides of flavonoids in a diploid plant *Deschampsia Antarctica* G / D12-2a was recorded. Such a different reaction can be explained by the fact that for plants G / D12-2a originating from Galindez Island (monitoring site D12), such a dose of UV-A may not be significant. **Conclusions.** The obtained results allow us to understand some of the adaptive responses of *D. antarctica* Desv. to UV radiation and can be used in biotechnology to obtain practically valuable compounds.

19) **Comparative metagenomic study of the microbiota of *Deschampsia antarctica* (Poaceae) rhizosphere in the vicinity of Antarctic Akademik Vernadsky and Palmer stations** (Project Manager – Ievgeniia Prekrasna, Senior Researcher of the Scientific and Organizational Department. PhD in Biology).

Object. The study of the taxonomic composition of the microbiota of *D. antarctica* rhizosphere in the region of Antarctic Akademik Vernadsky and Palmer stations using metagenomic sequencing. The object of the study is the microbiome of the rhizosphere *Deschampsia*

antarctica, selected at the Antarctic Akademik Vernadsky and Palmer stations (maritime Antarctica) during the season in the 23rd Ukrainian Antarctic Expedition. **Results.** A protocol for sampling of *D. antarctica* rhizosphere was developed for further molecular genetic analysis of the microbiome. Different temperature regimes and preservative solutions for storage and transportation of soil and rhizosphere samples for molecular genetic analysis have been analyzed. DNA was isolated for metagenomic sequencing on the Illumina MiSeq platform. The processing and preparation of *D. antarctica* rhizosphere samples for metagenomic sequencing of the bacterial marker 16S rRNA was performed. The obtained DNA was sent to Molecular Research MrDNA for metagenomic sequencing on the Illumina MiSeq platform. Based on the results of sequencing, the taxonomic composition of microbial rhizosphere communities from different populations of *D. antarctica* will be evaluated. **Conclusions.** Systematic implementation of molecular genetic studies of the microbiome of Antarctic plants rhizosphere, in particular *D. antarctica*, will allow to determine the mechanisms of adaptation of microorganisms to extreme conditions, their impact on the biogeochemical cycles of the elements (carbon, nitrogen, sulfur), the contribution of microorganisms to the ability of plants to survive in extreme Antarctic conditions, and to detect changes in microbial communities under the climate change.

20) Study of the properties of actinomycetes of rhizosphere of *Deschampsia antarctica* E. Desv. from Galindez Island (Antarctica) (Project Manager – Ivan Parnikoza, Head of the Department of Medical and Biological Research, PhD in Biology).

Object. The study of the antagonistic, phytostimulatory, enzymatic properties of actinomycetes isolated from the rhizosphere of *Deschampsia antarctica* E. Desv. (Galindez Island, Wilhelm Archipelago, Antarctica). **Results.** Among the isolates tested there we found strains, which have significant growth retardation (5–7 days) compared with isolates previously isolated from the Crimean Peninsula biotopes. The ability of isolated strains of actinomycetes to inhibit the growth of a wide range of gram-positive, gram-negative bacteria, yeast and mycelial fungi has been investigated. A number of strains have been identified that suppress only one test culture, some of them are antagonists of 2 or more infectious agents. It is noteworthy that among the studied isolates, strains with a very high level of antagonistic activity against individual test cultures, in particular *Pseudomonas savastanoi* pv. *phaseolicola*, *Xantomonas campestris* pv. *Campestris*. Their activity index (the ratio of the diameter of the growth inhibition zone of the culture test to the diameter of the colony of actinomycetes) ranged from 15 to 32, which is 1.5 - 3 times higher than the maximum activity indices of actinomycetes strains isolated from the Crimean Peninsula. Phytostimulatory properties of Antarctic actinomycetes were investigated. 11 strains capable of synthesizing indolilocytic acid in concentrations from 210 to 625 µg / ml were identified. At the same time, the lack of ability of the investigated isolates to grow on appropriate diagnostic environment made it impossible to identify strains capable of solubilizing phosphorus compounds or synthesizing siderophores. Future research plans to modify the environments to detect such strains. The studied isolates showed the ability to synthesize enzymes. In particular, 75% of actinomycete strains were capable of synthesizing amylolytic enzymes, 28% of strains showed proteinolytic, and 14% showed lipolytic activity. **Conclusions.** The data obtained indicate that some strains of actinobacteria inhabiting biotopes with extremely low temperatures differ in slow growth rates in nutrient media. It also affects the onset of their synthesis of secondary metabolites, in particular antibiotics. Nevertheless, individual strains of actinobacteria from the rhizosphere of *D. antarctica* E. Desv., taking into account the level and spectrum of their antagonistic activity, are considered promising for the chemical analysis of their secondary metabolites and screening of new biologically active compounds. Strains with a high level of biosynthesis of indolilocytic acid can be promising for the creation of biologics-phytostimulants.

21) Study of patterns of synthesis and absorption of greenhouse gases by Antarctic ecosystems (Project Manager – Ivan Parnikoza, Head of the Department of Medical and Biological Research, PhD in Biology).

Object. Assessment of the intensity of CO² emissions from different types of coastal Antarctic soils and determination of the mineralization potential of these soils in the context of global climate change. **Results.** The last decade has been recognized as the warmest in the history of meteorological observations, and in 2010, 2013, 2015 and 2016 the historical maximums were exceeded. One of the regions with the largest temperature increases is the Coastal Antarctica. Lack of reliable information on the composition and properties of the organic matter of the soils of the region, their mineralization potential and the intensity of respiratory gas exchange makes it impossible to forecast the state of biogeocenoses for a long time, and therefore implement measures for their conservation. Based on the analysis of the literature, it has been established that in the coastal Antarctic region, only spot studies of in situ respiratory gas exchange studies have been conducted, and all of these studies are concentrated on King George Island. Soils under *D. antarctica* show high rates of carbon dioxide release into the atmosphere - from 1.5 to more than 4 μmol CO₂ m² s⁻¹, which is commensurate with the respiration of soils under meadow vegetation in the temperate climate zone. It was found that the lowest soil respiration intensity of 0.8-1.35 μmol of CO₂ m² s⁻¹ is confined to acidic soils (pH 5.0-5.4) formed on mosses, but for pH 6.5-7, CO₂ emissions increase 1.5-2 times. It was established that the studied soil of the Galindez Island has an inherent high content of easily oxidizable organic compounds - from 4 to more than 12 mg g⁻¹ (by Carbon content), while low values of this indicator were found in soils with a high content of calcium carbonate in the form of mollusk shells. In general, the studied soil is characterized by a high mineralization potential, indicating their vulnerability to global climate change. **Conclusions.** The practical value of the work lies in the substantiation of informative criteria for assessing the state of terrestrial ecosystems of the Coastal Antarctic, among which are soil respiration, ecosystem respiration and the content of labile soil organic matter. Their application will make it possible to predict the response of ecosystems to climate change and implement measures for the conservation, adaptation and protection of these ecosystems.

22) **Investigation of penguin breeding colonies, chronology and breeding success in the CCAMLR 48.1 subarea using the CEMP Camera Network** (Project Manager – Igor Dykyy, Senior Researcher of the Department of Medical and Biological Research, PhD in Biology, Assistant Professor).

Object. The study of quantitative and qualitative changes in ecosystems under the influence of climatic factors, in particular the impact on nesting behavior, nutrition and breeding of penguins as key species of the Antarctic ecosystem. **Results.** Digital information with a total volume of more than 23 GB was processed and 33,107 photographs taken with automatic cameras during the summer season and winter of the 22nd UAE were studied. The received data were transformed into the CEMP protocol format, which were transmitted to CCAMLR. A systematic database on breeding behavior of *P. papua* and *P. adeliae* penguins in the Argentine Islands archipelago and Petermann Island region (West Antarctica) was completed, in particular their reproductive history and reproductive success of the population. It was found that the success of *P. papua* breeding in the model area of Petermann Island is the maximum in the summer season 2017/2018 and is 100%, unlike the 2015/2016 season (77%), when at the beginning of penguins laying were adverse weather conditions. The success of *P. papua* breeding, which, according to a comparative analysis, is also higher in the summer season of 2017/2018 (95%) than in previous seasons (70% and 77%), which is probably due primarily to the food supply, the presence of krill in the area of Peterman Island was studied. **Conclusions.** The results of a study of the nesting behavior of *P. papua* and *P. adeliae* penguins along with other data of observations of the ecosystem of the Antarctic Peninsula region will help to forecast the reaction of rare seabird species to future changes in the Antarctic environment. This will further develop real mechanisms for combating the effects of global warming on the planet and preserving the Antarctic environment, which is an urgent task of the transnational level. The results will be taken into account by the CCAMLR Committee when granting quotas and extending the trigger level of krill fishing in the CAMLR 48.1 subarea for domestic fishing companies.

23) **Hydroacoustic and biological survey of underwater biogeographic landfills of the Argentine Islands water area. Substantiation of creation of the Meek Channel marine biogeographic landfill** (Project Manager – Andriy Utevskiy, Leading Researcher of the Department of Medical and Biological Research, PhD in Biology, Assistant Professor).

Object. Investigate benthic ecosystems, their abiotic and biotic components; evaluate the uniqueness of their species diversity and underwater landscape in order to create the Meek Channel Marine Biogeographic Landfill. When fulfilling field works, hydroacoustic methods were used to study the bottom topography of the Argentinean waters using the side-scan echo sounder chart plotter and CHIRP-technology for signal processing and imaging of underwater landscapes to obtain primary hydroacoustic data. Diving, underwater photography and videography were used for biological samples collection and visual examination. In the cameral stage of work, GARMIN cloud technologies were used for processing primary hydroacoustic data, as well as ArcGIS, ReefMaster, GPS TrackEditor software packages. **Results.** Three-dimensional refined images of the mesorelief of the bottom of the Argentinean waters were obtained and their descriptions were created. A digital model of the bottom topography has been built, which allows calculating the slope angles of the banks of the channels, stratification of the topography and predicting the accumulation of bottom sediments and the formation of soft soils. The composition of the Meek Channel benthic fauna, the picture of its aggregate distribution and its relation to the morphology of the bottom mesorelief have been determined. The substantiation and description of the new Meek Channel biogeographic landfill have been developed. The results of molecular-genetic barcoding of selected groups of invertebrates are included in the molecular-genetic base, which made it possible to substantiate the isolation of a new deep-sea species (1433 m) of a fish leech from the Ross Sea. **Conclusions.** The results of the study are important for understanding the biological diversity and phylogeny of marine fauna, bottom landscapes, mechanisms for the formation of terrestrial ecosystems and their interaction with marine ecosystems, the creation of cartographic works of the waters of the of Argentine Islands and adjacent waters, as well as atlases of marine and land ecosystems. Based on the results of the studies, the materials for the national report of Ukraine in CCAMLR - WG-EMM-18/32 are presented.

24) **Biodiversity of the virobiota of microorganisms and flora of the Argentine Islands** (Project Manager – Iryna Budzanivska, Educational-Scientific Center "Institute of Biology and Medicine" Taras Shevchenko National University of Kyiv, Head of Department of Virology, D. Sci.in Virology, Professor).

Object. To study the diversity of bacterial viruses and higher plants isolated from different biotopes of the Antarctic Peninsula, moss and root soil (rhizosphere) of higher Antarctic plants. Conduct molecular genetic screening of vascular plants for revealing the presence of plant viruses. To create the collection of bacteriophages. Object of study: bacteriophages, plant viruses isolated from root soil and vascular plants obtained from Ukrainian Antarctic expeditions. **Results.** Isolates of phages to sensitive bacteria of moss and basal soils of higher Antarctic plants were isolated from samples of moss and soil obtained during wintering of the 22nd UAE and season of the 23rd UAE. According to the results of electron microscopic studies, the morphological and structural organization of bacteriophages was studied. The isolated phages are assigned to different taxonomic groups according to the characteristics of their structure: to the family *Siphoviridae*, *B1-B2* morphotypes, order *Caudovirales*; to the *Myoviridae* family, *A1* morphotype, order *Caudovirales*. A description of the diversity of bacteriophages indicating their taxonomic diversity in the terrestrial biotopes of the Argentine Islands archipelago in Antarctica and has been made and a collection based on their characteristics has been created. A cDNA library was obtained from pre-isolated total plants RNA using random primers for molecular biological screening of Antarctica vascular plants for the presence of plant viruses. *Deschampsia antarctica* plants were screened for the most common plant viruses from different genera, namely *Tobamovirus*, *Potyvirus* and *Emaravirus*. The polymerase chain reaction method revealed that the plants contained a virus that normally infects cereals - HPWMOV (*Emaravirus*). **Conclusions.** The results of the analysis of Antarctic

samples on the presence and number of plant bacteriophages, their morphological diversity and nature of interaction in the virus – host system should help to clarify the nature of the adaptation processes occurring in bacteriophages under the influence of extreme environmental conditions and determine their resistance to harsh physical and chemical factors of the Antarctic region.

25) The study of adaptability and genetic polymorphism of *Deschampsia antarctica* (Poaceae) under conditions of variation of marine Antarctic microclimate (Project Manager – Viktor Kunakh, Institute of Molecular Biology and Genetics NAS of Ukraine, Head of Department of genetics of cell populations, D.Sci in Biology, Professor, NAS of Ukraine Corresponding Member).

Object. The study of the features of the distribution of genetic polymorphism in populations of *Deschampsia antarctica* - an indicator cereal of the Antarctic terrestrial ecosystems depending on microclimate conditions. Object of the study - Indicator Antarctic Cereal *Deschampsia antarctica* (Poaceae) along the west coast of the Antarctic Peninsula. The main task is to evaluate and determine the features of the distribution of genetic polymorphism in populations of *Deschampsia antarctica* from different regions of the Maritime Antarctica using molecular genetic analysis methods. **Results.** To study the genetic polymorphism and genetic structure of *Deschampsia antarctica* populations in the context of the distribution of the species in Antarctica, 93 species plants from 9 island populations located in three remote areas of marine Antarctica were analyzed using ISSR and IRAP markers. The data obtained indicate a relatively low genetic diversity of the species in the Maritime Antarctica, which is consistent with data for *D. antarctica* populations from this part of the range obtained earlier by the executors of this research or published by other authors. **Conclusions.** The studied populations differ in the level of genetic diversity, although, in general, populations from the South Shetland Islands region have a slightly higher level of intra-population polymorphism compared to populations from the Wilhelm Archipelago. A significant part of the interpopulation differences in the composition of total genetic heterogeneity according to AMOVA indicates a limited exchange of genetic material between island populations. Together with the results of the analysis of the genetic structure of *D. antarctica*, this may also indicate the existence of several relatively independent sources of distribution of the species in the West Antarctica region.

26) Impact of seabirds on the formation and evolution of coastal Antarctic soils (Project Manager – Nataliia Zaimenko, M.M. Gryshko Botanic Garden NAS of Ukraine, Director, Head of Department of Allelopathy, Leading Researcher, D.Sci in Biology, Professor, NAS of Ukraine Corresponding Member).

Object. Clarification of the influence of Antarctic organisms on the formation of vector flows of biogenic elements and the intensity of greenhouse gas emissions from various types of soils of Coastal Antarctica in the context of global climate change. The object of study is the soil carbon reservoir and the flows that form it. The systematic analytical approach is used in which the soil is considered as an open system formed under the influence of a number of external and internal factors. **Results.** The identification of possible direct and indirect impacts of birds on the vector flows of chemical elements in coastal Antarctic ecosystems, quantitative assessment of the flows of major macroelements from the ocean to the land of guano and seabirds' feathers. Quantitative estimation of flows of basic trace elements, including heavy metals, from the ocean to the land of guano and feathers of seabirds was made; the content of labile organic matter in the main types of coastal Antarctic soils as an important source of greenhouse gases was evaluated. It was found that the relative content of water-soluble carbohydrates in the studied samples of initial soils was from 33 to 50 percent of the total pool of organic substances extracted with cold water. This indicates a significant vulnerability of these soils to global climatic changes, which can lead to a sharp increase in the rate of destruction of this most labile fraction of soil organic matter. A scheme of vector flows of biogenic elements from the ocean to land consisting of guano and feathers of *Pygoscelis papua*

and *Pygoscelis adeliae* was built. **Conclusions.** The research results should be used to initiate stationary long-term monitoring of biogeochemical flows of matter within the Coastal Antarctica, which will allow a long-term assessment of the quantitative and qualitative impact of global climate change on them.

27) **Producers of biologically active substances and technologically promising strains of Antarctic microorganisms** (Project Manager – Tatiana Beregova, Taras Shevchenko National University of Kyiv, Head of Research Laboratory of Pharmacology and Experimental Pathology, D.Sci in Biology, Professor).

Object. Search and description of Antarctic microorganisms - producers of biologically active compounds and substantiation of the prospects for their use. **Results.** Using Antarctic rock, soil and lichen samples obtained during the 22nd UAE wintering and season of the 23rd UAE from areas of extreme influence of the rigid hard physical and chemical factors of Antarctica, the cultures of microorganisms (filamentous fungi, yeast, bacteria) were isolated and their cultural-morphological and physiological-biochemical characteristics, indicating their ability to synthesize BAS were described. The existing collection of technologically advanced strains of microorganisms is replenished with new types (strains) of microorganisms - potential producers of BAS. To implement the procedure for depositing strains of microorganisms, passports for three strains were developed - active producers of BAS, previously isolated from the samples of the 18th - 21st UAE: bacteria *Bacillus subtilis* FCKU 537; *Sphingobacterium thalpophilum* FCKU 534 and yeast *Rhodotorula rubra* FCKU 561. Certificate of the deposit of these strains - producers of BAS in the Depository of D.K. Zabolotnyi Institute of Microbiology and Virology NAS of Ukraine and Conclusions on the study of their virulence with a view to their further patenting and use in biotechnology and medicine have been received. **Conclusions.** The results of the analysis of Antarctic samples on the presence of microorganisms - potential producers of BAS will help to clarify the nature of adaptation processes that occur in microorganisms under the influence of extreme environmental conditions and cause their resistance to harsh physical and chemical factors of the Antarctic region. Isolated Antarctic microorganisms that exhibit antimicrobial and antifungal properties (including spore-forming bacteria) can be patented for use as biotechnological agents in medicine, in agricultural production, in environmental technologies. In particular, such micro-organisms can serve as a basis for the development of biotechnological remedies in agricultural production, which will significantly reduce the volume of use of ineffective chemicals in agriculture and their negative environmental impact. The high level of profitability of producing BAS of Antarctic microorganisms can be ensured by using industry waste as nutrient media for the cultivation of BAS producing organisms, in particular biologically active lipids.

Medical and physiological research

28) **Comprehensive medical and psychophysiological examination of wintering members and determination of biomedical indicators of suitability for work in the conditions of the Antarctic expedition at Akademik Vernadsky station** (Project Manager – Ievgen Moiseienko, Leading Researcher of the Department of Medical and Biological Research, D.Sci in Medicine).

Object. To study the adaptive changes in the regulation of the circulatory function of the members of the Antarctic expedition, to determine new indicators for assessing and monitoring the state of health and to give recommendations on the prevention of cardiovascular diseases of the members of the expedition at Vernadsky station.

Data from a comprehensive examination of the circulatory system and psychophysiological functions using EEG, testing, ECG, rheovasography, bicycle ergometry, blood pressure measurement, magnetocardiography, blood biochemical parameters and monitoring of

adaptive restructuring of blood function methods of the members of the 21st – 23rd UAE at the stage of their selection and after the expeditions are completed, as well as monitoring of their health and morbidity at Vernadsky station during the winter are used in the study. **Results.** The most sensitive to the negative influence of extreme factors were determined indicators of the psychophysiological status of winterers, which made it possible to pathogenetically substantiate the choice of a complex of effective diagnostics technologies based on the development of adapted methods of psychophysiological examination and the definition of new criteria of psychophysiological and psychological prognosis. New data were obtained on the adaptation mechanisms of the circulatory system of Antarctic expedition's participants during a long stay in Antarctica, in particular, on the features of adaptive restructuring of the autonomic regulation of the heart in dynamics during the year of their stay in Antarctica. **Results.** As a result, a new biomedical complex was developed, which includes a wide range of examination methods, and the diagnosis is based on the determination of personalized psychophysiological characteristics and individual characteristics of polychrome preference (testing), assessment of the state of central regulation mechanisms (electroencephalography and cephalography), diagnosing of mitochondrial dysfunction (electron microscopy) and HIF-1 α gene polymorphism (PCR method) and automated data analysis system (hardware-software complex). **Conclusions.** The research results are important for elucidation of new mechanisms of human adaptation to the extreme conditions of Antarctica, improving the methods of selection wintering members, controlling adaptive restructuring of body functions and preventing the occurrence of pathology during wintering at Vernadsky station.

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