

MEMBER COUNTRY: UKRAINE
National Report to SCAR For year : 2019

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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						

Scientific Highlights

The study of climate change, in particular the impact of climate change on the course of natural processes in the Antarctic environment, including the dynamics of the oceans, sedimentation of marine and continental sediments, etc. is one of the priority areas of Antarctic research identified by the Scientific Committee on Antarctic Research (SCAR).

Therefore, in the reporting period in the field of **Geological and Geophysical Research** the reproduction of historical climatic data started in 2018 has been continued by studying bottom sediments selected in the Argentine archipelago during the season in the 24th UAE, which recorded stages of activation of glaciers and their reduction, changes in water temperature and the development of plankton. The latest data were collected using instrumental methods, in particular, using the georadar method; new data on the variability and stratigraphy of island glaciers were obtained. For the first time, the method of determining the surface volumes of island glaciers by using digital stereophotogrammetric acquisition and removal from UAVs was applied and the dynamics of their melting was investigated. The data obtained are an important component of climate change forecasting.

According to the results of research at geophysical and geodetic landfills in the vicinity of Akademik Vernadsky station, a number of new fundamental results on modern geodynamics of the earth's crust, which deserve attention not only in terms of forecasting geodynamic processes and climate change, but also in mineral prospecting in the region, were obtained.

For the first time, there were obtained data on the geological structure, mineral-petrographic features and ore content of magmatic formations of the small group of Wedel Islands, Wilhelm archipelago, located in the waters of Graham Coast 12 km from the Antarctic Akademik Vernadsky station, which until recently was a “white spot” on all existing geological maps. In 2019, during seasonal work in the 24th

UAE, field geological surveys were first conducted on these islands, which are the basic material for determining areas prospective for ore deposits and other minerals.

In the field of **Hydrometeorological Research**, a number of new fundamental results were obtained on long-term changes in the ozone layer associated with dynamic processes in the troposphere and stratosphere. The obtained quantitative characteristics of the asymmetry of Antarctic ozone and its seasonal changes can be useful for development of models of the ozone hole and predicting the future state of the Antarctic stratosphere.

Climate projections were developed in the Antarctic Peninsula region till the end of the 21st century, and temperature characteristics and humidity indices have been obtained. For the first time, a study of microclimatic conditions in the Antarctic Peninsula was conducted and a wide range of climatic indicators was obtained, some of which are non-standard and calculated for the possibilities of use in polar climates.

The obtained results can be used both to study the impact of microclimatic conditions on ecosystems of the region and for strategic planning of future scientific, logistic and tourism activities in the research area.

In the field of **Oceanographic Research**, according to the unique measuring system Ferry Box, the database of physicochemical parameters of the aquatic environment in the Atlantic sector of the Southern Ocean (CCAMLR statistical reporting area 48), launched in 2018, has been replenished. Based on these data, the variability of the Antarctic frontal zone is estimated and the structure of water masses in the study area is determined. It should be noted that Ukraine's experience in using the Ferry Box measuring system in the Southern Ocean during the 2018-2019 season is highly valued at the international level and is unique, as none of the countries has used such device complex in these waters. The obtained data are extremely important for predicting the seasonal variability of hydrological and hydrophysical fields of the Southern Ocean, determining the biological productivity and industrial significance of the studied region.

At the same time, according to the results of monitoring of oceanographic fields in the area of the Antarctic Akademik Vernadsky station (CCAMLR area 48.1), scientists modeled the seasonal variability of temperature, salinity, currents and ice cover of the Bellingshausen Sea and the Antarctic Peninsula shelf. It is shown that the synoptic variability of atmospheric processes significantly affects the short-period processes of ice transfer. The effects of bottom and coast topography, along with the distribution of heat and momentum fluxes and their variability over time, are an important factor in the formation of temperature and salinity fields and ice formation processes both on a large scale and in the coastal zone on the shelf.

Geospace Research. The problem of global warming is now one of the main challenges for humanity. The results of long-term observations on UAS of ultra-low-frequency Schumann signals from global thunderstorms have proved that thunderstorm activity and global temperature are clearly interconnected. Introduced at the UAS and in the Arctic, where there is no technogenic interference, Ukrainian systems for ultra-low-frequency monitoring of world thunderstorms and original signal processing methods developed by the Radio Astronomy Institute made it possible to track in 2019 more than 126,000 high-power lightnings and to study their distribution around the planet. In order to more accurately investigate thunderstorms for UAS, a new very-low-frequency complex was developed and tested, which is supposed to be commissioned at the station this year.

Another global problem is changes in space weather. Storms in geospace have a negative impact on human well-being, can disable satellites and significantly disrupt GPS navigation and communication systems. Space weather reflects the state of the ionosphere, which should be studied in Antarctica, where there is no anthropogenic activity, and the geospace is the closest to the Earth's surface. Regular annual changes in the concentration and velocity of plasma in the ionosphere were studied with the help of a new digital ionosonde developed by the Radio Astronomy Institute. The complex of RF sensing UAS - Palmer allowed studying the characteristics of ionospheric waves. The use of wavelet

analysis revealed a steady recurrence from year to year of the time of existence and periods of ionospheric waves, which is very important for the identification of the mechanisms of wave excitation.

The obtained results are of great scientific importance, since they implement new methods for diagnosing the ionosphere parameters and allow organizing global monitoring of high-power lightning electrical discharges in the atmosphere of the entire planet using exclusively national diagnostic tools.

Biological Research was noted by an integrated approach to the study of terrestrial and marine ecosystems at all hierarchical levels of the organization of a living organism (viruses, microorganisms, lichens, mosses, vascular plants, invertebrates and vertebrates).

New data on the biodiversity of marine ecosystems, in particular, the species richness of zooplankton organisms of the Southern Ocean in the area of scientific and economic interests of Ukraine - CCAMLR 48 were obtained. At the same time, a program of monitoring studies of the state of the marine ecosystem in the area of the Antarctic Akademik Vernadsky station was introduced to determine the impact of climate change on the biological and hydrochemical parameters of the marine ecosystem in the waters of Galindez Island (Argentine Islands). New data on biodiversity and population structure of background species of benthic groups' representatives in the waters of Argentine Islands have been obtained.

The structure and functions of terrestrial and coastal ecosystems of the Antarctic region were studied, and the stocks of rare organisms and organisms with valuable properties were estimated. New molecular genetic research methods were introduced for research.

Thus, new data were obtained on the genetic diversity and genetic structure of vascular plant populations of terrestrial ecosystems of Western Antarctica, namely, *Deschampsia antarctica* E. Desv. – a unique indicator species of Antarctic terrestrial ecosystems, and *Colobanthus quitensis* (Kunth) Bartl. The obtained data allow to clarify the historical aspects of the development of terrestrial ecosystems of the region, as well as to predict their future.

Started in 2018 systematic molecular genetic study of the microbiomes of the rhizosphere of Antarctic plants, in particular, the study of the taxonomic composition of the microbiota using the metagenomic sequencing, which will determine the mechanisms of adaptation of microorganisms to extreme conditions, their influence on the biogeochemical cycles of elements, the contribution of microorganisms to the ability of plants to survive under the extreme conditions of Antarctica, as well as to identify changes in microbial communities under conditions climate change was extended.

Research has been carried out in the field of bioprospecting – the study of living organisms in terms of their commercial value as resources of valuable compounds and genes for biotechnology.

For the first time, using genomic and metabolic profiling, it was found that individual strains of micromycetes isolated from the rhizosphere of *Deschampsia antarctica* E. Desv. are potential producers of antibiotic compounds that can inhibit the growth of multi-resistant strains of pathogenic bacteria and fungi and therefore may be promising for use in medical practice.

The collection of technologically promising strains of microorganisms has been replenished with 10 new strains of metal-resistant bacteria isolated from different substrates of Antarctica, which can be promising for use in environmental technologies.

Deposit certificates of four strains of microorganisms in the Depository of Microorganisms of the Zabolotnyi Institute of Microbiology and Virology NAS of Ukraine were obtained.

It is worth noting that Ukraine, as a Consultative Party to the Antarctic Treaty, fulfills its international obligations to ensure environmental protection in the research area.

Thus, in order to harmonize the use of all available protection and management tools based on the ecosystem approach, the Ukrainian part in the reporting year justified the concept of creating a Antarctic Specially Protected Area, which includes the Argentine islands, adjacent

islands and coastal oases of the Antarctic Peninsula in accordance with the requirements of the Protocol on Environmental Protection to the Antarctic Treaty.

The proposed protected area will consist of terrestrial and marine components. In particular, the marine component was created on the basis of four marine biogeographic landfills in the inter-island waters of the central group of the Argentine islands, which were founded by Ukrainian scientists and systematically investigated during seasonal and year-round Ukrainian Antarctic expeditions during 2011-2019.

In October 2019, the Scientific Committee of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) approved the marine component proposed by the Ukrainian delegation as one of the monitoring areas of the large-scale Marine Protected Area proposed by Argentina and Chile for integrated conservation of marine ecosystems in the West Antarctica.

In May 2020, it is planned to complete the preparation of the Management Plan for this protected area and submit it to the Committee for Environmental Protection, the deliberative body of the Consultative Meeting of the Member States of the Antarctic Treaty.

In the field of **Medical and Physiological Research** the results important for improvement of a methodology for selection of winterers, clarifying the mechanisms of human adaptation to extreme conditions of Antarctica are obtained.

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