

**Expedition "North Pole 2022-23"**  
**on board the research expedition vessel (REV) "Akademik Tryoshnikov"**  
**(August 2022 - July 2023)**

The Russian Federation is preparing a large-scale research project for implementation in the Central Arctic. It is planned to conduct the scientific expedition on board the AARI REV "Akademik Tryoshnikov" within the period from August 2022 till July 2023.

AARI is the organizer and coordinator of the expedition scientific program. The Institute as a recognized leader in polar science has a unique experience in conducting marine and land-based scientific expeditions in the Arctic and Antarctic. The organization of a drifting station using the REV "Akademik Tryoshnikov" as a base platform is a continuation of Russia's consistent efforts to support the Arctic research. Starting from the first drifting station "North Pole-1" (1937), the Soviet Union and then the Russian Federation, gained great experience in conducting scientific expeditions in the Central Arctic Basin from drifting ice.

The logistic plan for organization and implementation of the expedition is shown in Figure 1.

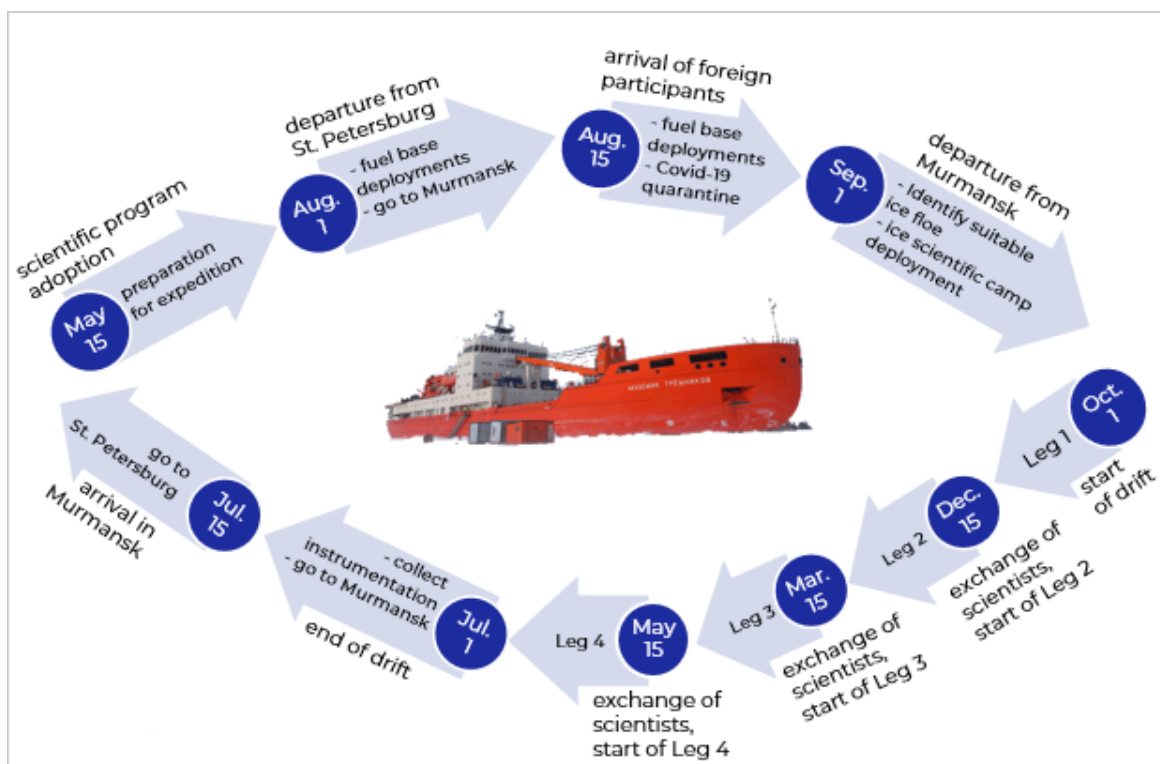


Figure 1 – Implementation plan

After the preparation stage approximately in early October 2022 the vessel will enter into drifting ice in the region to the north (northeast) of the Novosibirsk Islands, be fixed in drifting ice and start free drifting with the surrounding ice fields. Presumably, floating in Transarctic Drift, the vessel will pass through a near polar region and reach the Fram Strait, where the expedition will finish. The planned drift is shown in Figure 2.

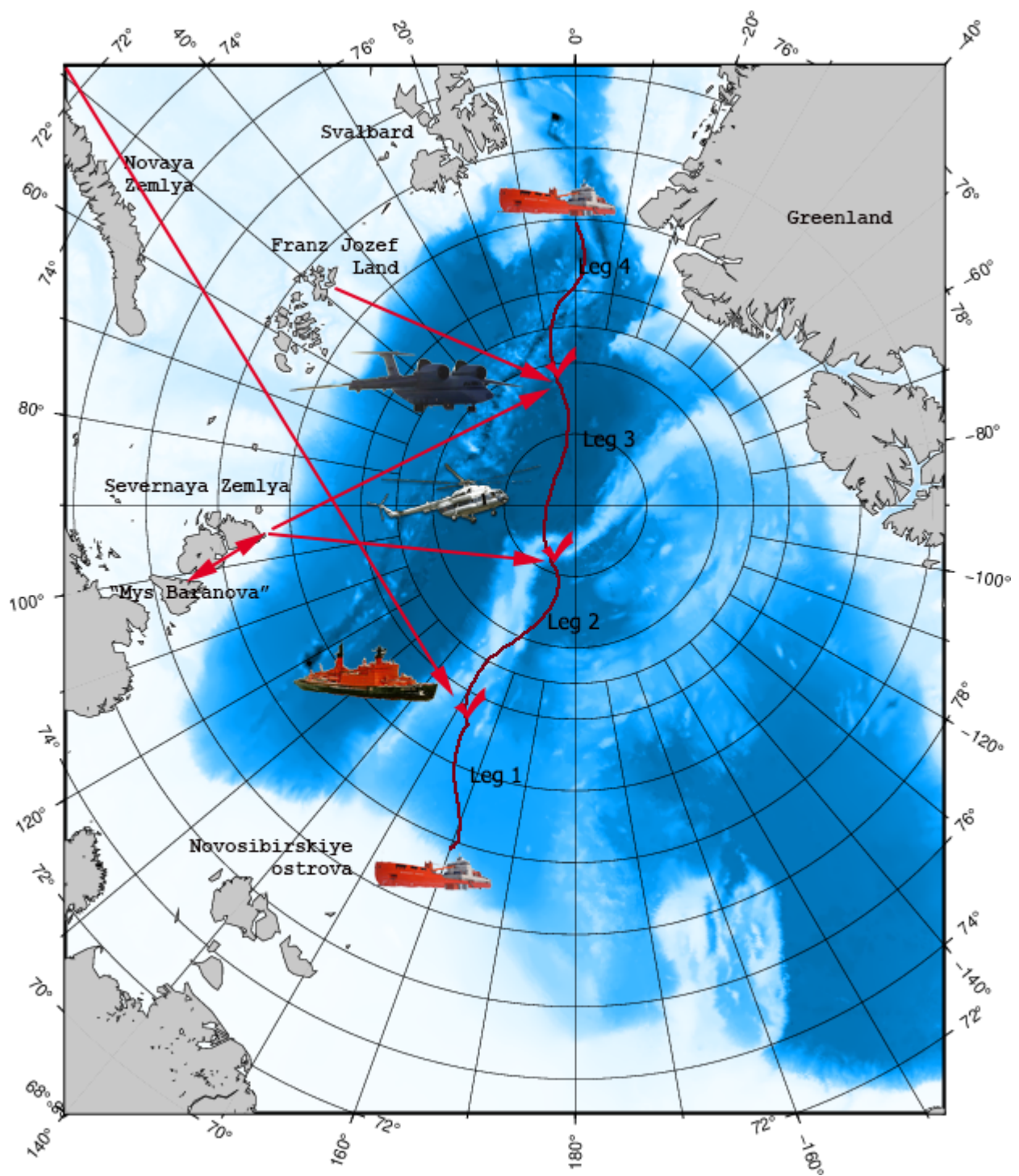


Figure 2 – Planned drift

During the drift the scientists will carry out a wide range complex research (meteorological, oceanographic, ice, geophysical, geological, chemical, hydrobiological and medical (Figure 3)) from board the REV "Akademik Tryoshnikov".

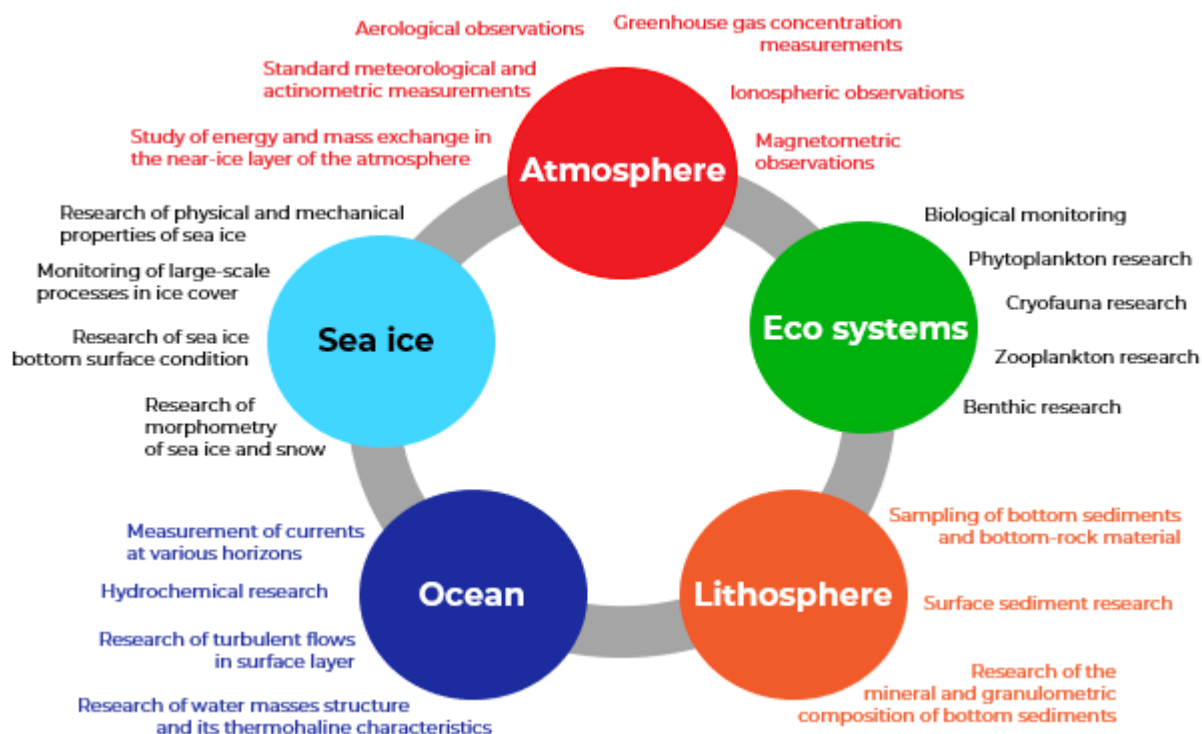


Figure 3 – Main directions of complex research at a drifting station

One of the main tasks of the expedition is to study the processes in environment due to global climatic changes. It is known that the Arctic is warming faster than on average on Earth. It is critically important for the Arctic states to forecast and prepare for the Arctic warming impact, as well as to use possible economic benefits, associated with warming in the region.

Special attention will be paid to the Arctic environment monitoring. During the drift the samples of water, snow, ice, precipitation, atmospheric air will be regularly collected to analyze the content of pollutants. The composition of studied environmental components and the list of indicators determined in them comply with the recommendations of the Arctic Monitoring and Assessment Program (AMAP) of the Arctic Council.

The research will be carried out on board the vessel, at ice-based scientific camp and at additional points to reach which one may using helicopters based on the vessel. On the adjacent ice within a radius of several tens of kilometers from the vessel, it is planned to install autonomous measuring systems to be a basis of the expedition's observation network.

The expedition members consists of 140 people, the crew - 60, the expedition team - 80 people, including the crews and maintenance stuff of helicopters.

Three expedition members' rotations by an icebreaker and aircrafts are planned in December 2022, March and May 2023.

Representatives from 30 Russian research institutions and universities will take part in the expedition.

The AARI as organizer of the "North Pole 2022-2023" expedition invites the research institutions of the member-states of the Arctic Council to participate in the expedition to strengthen and develop international scientific cooperation. AARI is ready to provide up to 10 places at a time for researchers from these states.

The main platform of the drifting station, the REV "Akademik Treshnikov", is appropriated for a wide range of associated and special research work in ocean, including in the Arctic and Antarctic waters (Figure 4).



Figure 4 – REV "Akademik Tryoshnikov"

The vessel is equipped with lifting devices, cargo and refrigerated holds, bulk tanks. The vessel has a helicopter complex, which provides the operation of two helicopters. Crew members and expedition team are accommodated at comfortable cabins. The vessel is equipped with a medical unit, which includes an operating room, a dental office, an isolator, etc. A gym, showers and sauna are at everybody's disposal for relaxation. One may connect a personal computer to the ship's local network from each cabin and laboratory. A satellite television system is installed to watch television programs.

To carry out research work the vessel is equipped with 11 laboratories with modern instruments and four mobile laboratories, five research winches with girder cranes, A-frame.

A detailed description of research equipment is presented below.

### **Oceanographic complex**

The oceanographic complex consists of deck equipment, two adjoining laboratories on the upper deck and a laboratory on the first deck near the A-frame.

#### Deck equipment

In the stern part of the first deck there is a A-frame and two cable (six ton) winches for operation through the A-frame (Figure 5). Drum capacity 6000 m, rope 12 mm in diameter. Winches and A-frame are designed to work with various towed devices, as well as to work with dredges, soil intake pipes, bottom grab.

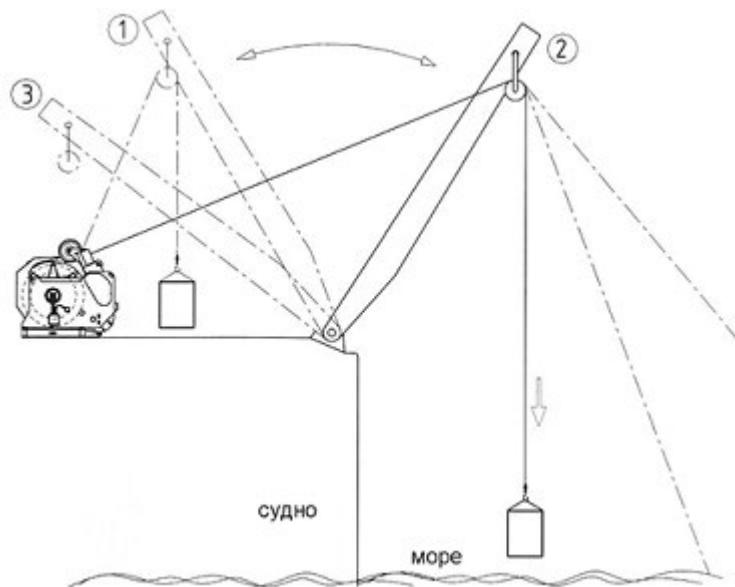


Figure 5 – Scheme of operation of stern winches 60 kN with a A-frame

On the deck superstructure of the second tier, two cable winches are installed on the starboard and portside to carry out the hydrobiological and oceanographic work with plankton nets, autonomous CTD profilers, and other small-sized devices (Figure 6). The drum capacity is 2000 m of steel cable with a diameter of 5 mm.

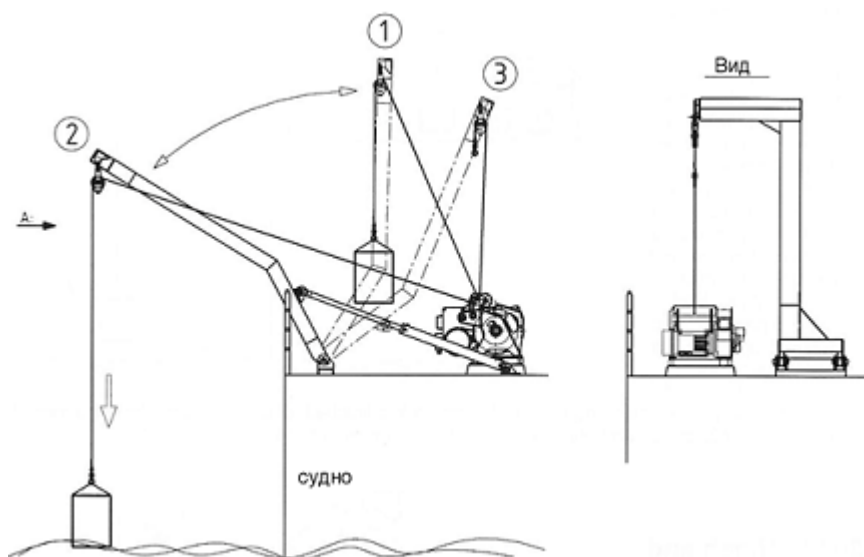


Figure 6 - Scheme of operation of bow winches 15 kN with a crane beam

Cable-rope winch 30 kN (Figure 7) is installed on the portside of the upper deck and is designed to work with the SBE-911plus profiler with CTD and dissolved oxygen sensors with a sampling section (rosette) SBE 32 Carousel Water Sampler with 24 bottles of 10 liters each.

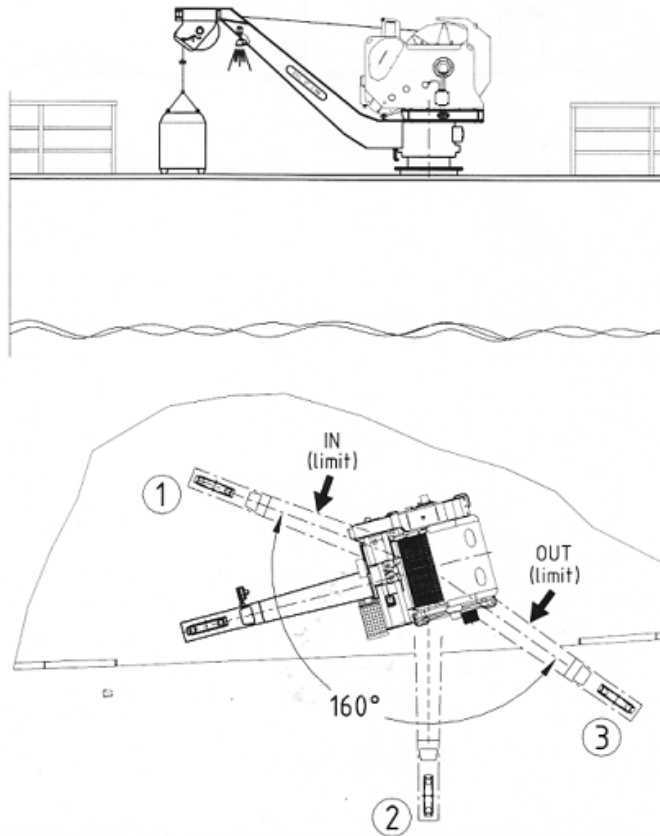


Figure 7 - Scheme of operation of a cable-rope winch 30 KN with a rotary crane

### **Laboratory rooms**

Oceanographic laboratory is located on the upper deck and is equipped with on-board CTD-profiler unit, XBT on-board unit, recording unit of the "Aqualine" system, SBE19 plus V2 profiler and computers for information processing.

Oceanographic wet laboratory is located on the upper deck. There is an exit from "wet" laboratory to the deck to the winch. There are entrances to adjoining oceanographic, hydrochemical and ecological laboratories. "Wet" laboratory is equipped with a complex "Aqualine" for continuous analysis of the surface layer of seawater with sensors for CTD, transparency, chlorophyll, dissolved oxygen, pH, as well as two bidistillers and other auxiliary instruments.

The hydrological laboratory is located on the first deck and is designed to work with various samples of water, soil, ice samples, etc. The laboratory is equipped with a 12 cubic meter freezer for storing ice samples. The freezing temperature is  $-20^{\circ}\text{C}$ .

### **Meteosynoptic complex**

The meteosynoptic complex consists of meteorological laboratory, laboratory for receiving and processing satellite meteorological information and special deck equipment. Automated meteorological station MAWS-420 was installed at the meteorological laboratory. Dartcom station was installed at the other laboratory to receive and process the satellite meteorological information.

Deck equipment consists of the following instruments:

- atmospheric pressure sensor PTB220 - 2 units;
- air temperature and humidity sensor HMP45D - 2 units;
- wind speed and wind direction sensors WS425 - 2 units;
- long-wave radiation sensor CUV3 - 2 units;
- solar radiation sensors CM 6B - 3 units;
- ceilometer for cloud base height measurements - CL31;
- horizontal visibility sensor - DRD12;
- surface water temperature and salinity sensors AA3919;



Two sets of temperature and humidity sensors installed on two jib cranes (at portside and starboard) and equipped with radiation protection.

Weather station monitors are installed in the following rooms:

- navigational cabin;
- flight control post;
- hydrographic laboratory;
- oceanographic laboratory;
- hydrological lab on the first deck;
- hydrochemical laboratory;
- radio cabin;
- hydroacoustic laboratory.

Using the station "Dartcom" it is possible receive and process information both in visible and infrared ranges from all NOAA satellites in HRPT mode, with a resolution of 1.1 km, and information from MetOp-A and Feng Yun satellites ID in AHRPT mode as well. It is also possible to receive information from geostationary satellites Meteosat-9, GOES-East, GOES-West, MTSAT with a resolution of 4 km in LRIT mode, when there are no polar orbiting satellites in sight. In this mode information about the temperature of the sea surface, the temperature and height of the upper cloud layer, as well as the temperature of the earth's surface is transmitted from satellites.

#### **Vessel condition monitoring station**

The station includes a complex for measuring global and local ice loads on the vessel's hull and a complex for measuring loads on the rudder group of National Instruments. Strain gauges (126 units) are located in various places on the vessel's hull and connected to the data collection and processing station, which is located in the laboratory for monitoring ice loads on the first deck.

#### **Ice research complex**

The complex consists of telemetry station for automatic recording of ice cover along the route of the vessel, high-resolution marine video surveillance device for ice and icebergs in the visible and infrared spectra, ice research laboratory with a freezer of minus 20 ° C, with a volume of 12 cubic meters, equipment for ice core sampling, other auxiliary equipment for studying the physical properties of ice.

Auxiliary equipment consists of:

- band and circular saw for cutting cores;
- weight density meter;
- snow rail;
- ice gauge rail;
- motorized drill complete with augers, diameters 40, 150, 200, 220, 250 mm;
- analytical weigher;
- electronic weigher.

#### **Hydroacoustic complex**

The complex consists of multi-beam echo sounder SeaBeam 3020 "ELAC Nautic" to study the bottom topography at depths from 50 to 6000 m; single-beam dual-frequency echo sounder Hydro Star 4900 (12 kHz, 200 kHz); bottom sediment profiler SES-2000, penetration depth is 100 m, Doppler current profiler meters Teledyne OSII75S with range of current velocity measurements to depths of about 300-500 m.

All instruments are located at hydroacoustic and hydrographic laboratories. Emitting and receiving vibrators are installed in the vessel bottom and are protected from ice by special protection.

The complex software provides the possibility of continuous recording, accumulation and processing of information.

### **Hydrochemical laboratory**

The following instruments are installed at hydrochemical laboratory:

- seven-channel auto-analyzer with a sampler for 120 samples; determined elements: ammonium, nitrates, nitrites, silicates, phosphates, total nitrogen, total phosphorus;
- salt meter Autosal 8400;
- spectrophotometer UV-1800 for measure nitrites, nitrates and phosphates;
- auxiliary equipment required for sample preparation and analysis.

### **Ecological laboratory**

The following devices are installed at ecological laboratory:

- spectrophotometer UV-1800, determination of nitrites, nitrates, phosphates.
- auxiliary equipment for sample preparation and analysis, consisting of:
  - microwave,
  - dry oven,
  - pull out drobe,
  - laminar flow box,
  - circulating ultrathermostat,
  - titrator,
  - centrifuge,
  - ball mill,
  - mill for grinding filters,
  - shaker,
  - magnetic stirrer.
  - electrothermal decomposition system.

### **Container laboratories**

There are four removable laboratories in 20-foot containers, which are supplied with electricity, cold and hot water, the ship's local network, and telephone connection. These laboratories are equipped with the necessary laboratory furniture, lighting, heating. There are dedicated instrument cable outlets that can be installed on the open deck. Laboratories are designed to carry out various types of work, and can be equipped with the equipment of the Customer of the work.

In addition to the above equipment, there are device for determining the content of carbon dioxide in the air OPTOGAZ-500 and a sea towed magnetometer SeaSpy-1000 on board the vessel.

### **Ice-based camp infrastructure**

At ice-based camp near the vessel the additional research measuring and laboratory complexes are located.

Rooms for laboratory complexes, demountable panel houses (internal size: 2.4 x 4.8 m) are heated by electric heaters or a diesel oven. Different types of tents may be used to carry out short-term works.

The ice-based camp infrastructure facilities are powered by a cable line from the vessel or autonomous power generators.

There are snowmobiles (trailed sleds) to move on drifting ice.

It is planned to organize work of research groups at a long distance (about 50 km) from the vessel using a helicopter.

It is planned to build an ice runway near the icebreaker for aircraft An-74 type. Heavy tractor will be used.

The high-latitude drifting expedition in 2022-23 will focus to research the global climate change and environmental protection. These goals are among the priorities that Russia has identified for itself during its chairmanship in the Arctic Council.

To obtain information about the expedition and to discuss the possible participation of foreign scientists, please contact the AARI.