*Intergovernmental Oceanographic Commission*
*Russian State Hydrometeorological University*

*Baltic Floating University Facility*

With the participation of the UNESCO/IOC Chair in Remote Sensing and Modeling in Oceanography


**SUMMARY REPORT OF THE**

# BALTIC FLOATING UNIVERSITY CRUISES – 2007 and related activities

**IN THE FRAMEWORK OF THE TRAINING THROUGH RESEARCH PROGRAM OF IOC/TEMA**

**on board the research vessel "Professor Shtokman" and the sailing catamaran "Centaurus II"**

(July, 12 - July, 31, 2007)

**St. Petersburg, 2007**

## Summary

In the summer of 2007 the Russian State Hydrometeorological University (RSHU, St.-Petersburg) carried out the BFU-2007 two-ship operation co-sponsored by IOC. It included: (i) the 15th training-through-research cruise of the Baltic Floating University (BFU) programme also co-sponsored by the Special Sub-program "The investigation of the nature of the World ocean" of the Federal Target Program "The World Ocean", and by the state-owned company Sevmorgeo (July, 12-29), and (ii) a cruise of the sailing catamaran "Centaurus-II" in the Gulf of Finland (July, 18-31). Besides the research cruises, the BFU activity also included cultural and educational programs in Kaliningrad, Gdynya, Stockholm and St.-Petersburg.

a)

b)

Figure 1. R/V "Professor Shtokman" (a) and sailing catamaran "Centaurus-II" (b)

# The R/V “Professor Shtokman” cruise

Like it was the case in 2006, in 2007 the expedition was conducted onboard the research vessel “Professor Shtokman”, which belongs to the P.P. Shirshov Institute of Oceanology of the Russian Academy of Sciences (IO RAS). Participants, 27 in number, came from various institutions and backgrounds. Among members of the scientific crew were lecturers and researchers from the RSHU Faculty of Oceanography, experts from Sevmorgeo and Neftegazgeodezia Ltd, Zoological Institute of the Russian Academy of Sciences, the Atlantic Branch of IO RAS, and Moscow State University. Students and postgraduate students came from RSHU and universities of Russia, Spain, United Kingdom and Namibia (Appendix 1-1 and Fig. 2).


Figure 2. Cruise participants onboard the R/V “Professor Shtokman”

## Objectives of the cruise

Complex oceanographic, geological and ecological investigations in the Baltic Sea were carried out from July, 12 to July, 29. The main *research* direction was complex assessment of the present state and integrated sensitivity of macro-ecosystems in the Baltic Proper, the Bornholm and Arkona Deeps, the Gulf of Finland and the Kaliningrad Shelf, including the state of the marine environment (water masses, bottom sediments, meteorological situation) and biological communities (plankton, benthos and fish). The research cruise also provided new data for the oceanographic databanks of RSHU (www.rshu.ru).

*Education and training* tasks of the expedition included: lectures and seminars on environmental problems of the Baltic Sea; training of students in experimental research at sea and in data pre-processing; scientific guidance of the preparation of students' presentations of preliminary results based on acquired data; and a mid-cruise Seminar in Stockholm, Sweden.

Through the combination of the research, education and training efforts, during the cruise the TTR-approach was successfully fulfilled.

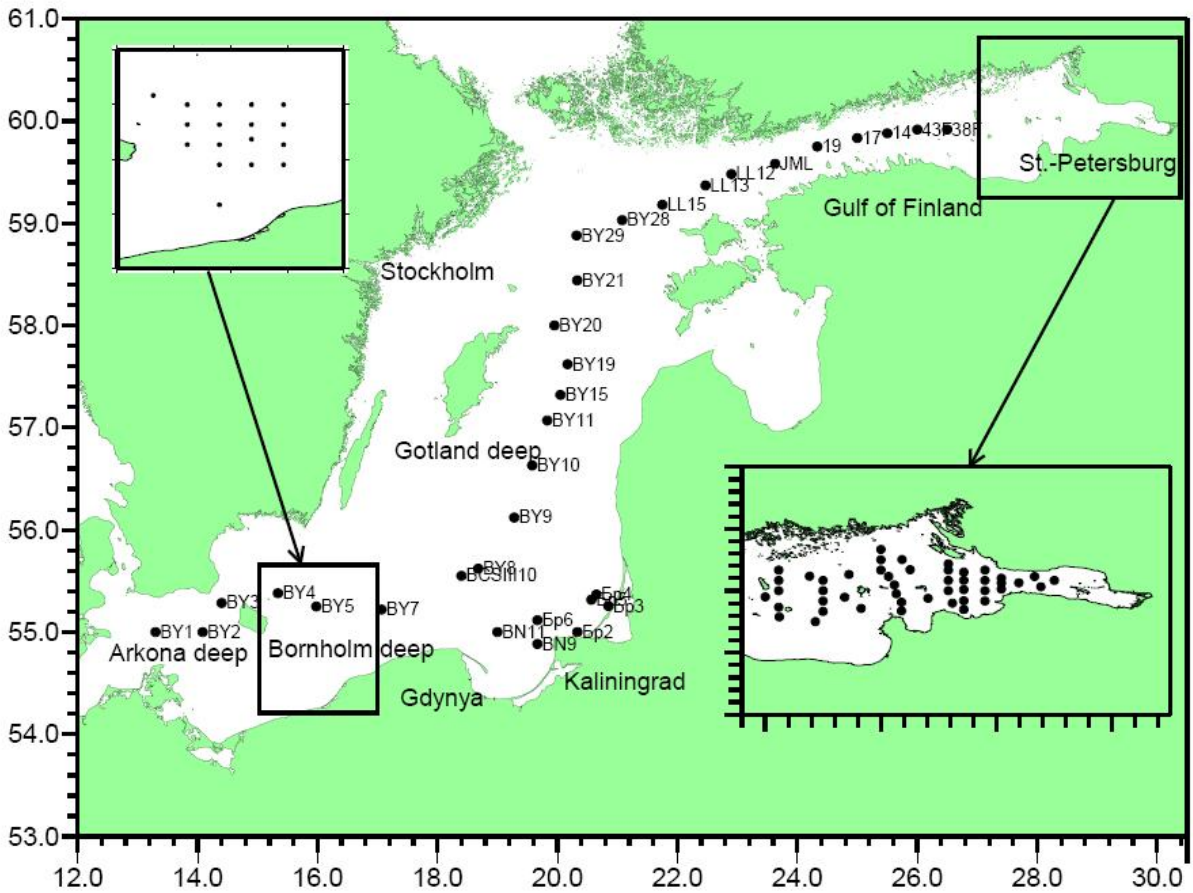


Figure 3. Map of the region and stations taken.

## Leg 1: on the Kaliningrad shelf

The first group of the cruise participants arrived from St.-Petersburg to Kaliningrad on July, 7, delivering to the R/V “Professor Shtokman” all the equipment required for the work at sea. Two other groups of researchers arrived in the period from 8 to 10 of July. Preparation of laboratories for the field research began. The international student team arrived on July, 11. The students took part in the preparations for the cruise. During their free time the students and researchers were able to see the places of interest in Kaliningrad, including the Museum of the World Ocean and the Central Cathedral with a memorial grave of a famous philosopher Immanuel Kant (Fig. 4).

Figure 4. Ships making part of the Museum of the World Ocean, and the Cathedral (on the back) in the city of Kaliningrad

The cruise started from the Kaliningrad harbor on July 12. The work on the Kaliningrad Shelf, near the working oil platforms, began immediately, with taking geological, oceanographic, hydrochemical and biological samples (Fig. 5). Between the stations students discussed environmental problems of the Baltic Sea - a basin, isolated from the Atlantic Ocean and containing brackish waters.

Figure 5. Routine work on a complex oceanographic station (from left: taking samples of bottom sediments; work with sampling bottles; teaching students to take water samples; work in a chemistry lab)

Poland was the first country to be visited. In the port of Gdynya the last participant – a student from Plymouth University, UK, joined the team. Head of the Expedition, Dr. Tatiana Eremina, met with professor of the University of Gdansk Natalia Gorska for discussion of perspectives of collaboration between Gdansk University and RSHU in organizing the monitoring of the marine environment. During the stay in Gdynya students and teachers visited the coastal resort area, tested seafood and observed a memorial of the famous Polish-American story writer Joseph Konrad. On July 14 the R/V “Professor Shtokman” left Gdynya for the planned research in the Baltic Proper and the Bornholm Deep.

## Leg 2: in the Baltic Sea

During one week, from July 14 until July 20, the students worked in laboratories, attended lectures and seminars of Prof. Dr. Alexander Rybalko and Prof. Dr. Michael Shilin, participated in discussions of the preliminary results of the cruise (Fig. 6).

Figure 6. Professor Dr. Alexander Rybalko leads a shipboard seminar

The second chief of master, Valerij Nikitin, organized and guided an excursion for the students through the vessel's rooms and cabins and briefed them on the navigation rules (Fig. 7).

Figure 7. The second-chief of master, Valerij Nikitin, explains to the students the navigation rules.

From July, 14 till July, 20 the research was conducted in the Bornholm Deep and the Baltic Proper, including monitoring of the World War II chemical weapon disposal sites. On the completion of this work the vessel headed for the port of Stockholm, Sweden. On the way to Stockholm students prepared their presentations for the traditional mid-cruise Seminar, with the help of and in consultation with Dr. Tatiana Eremina, Dr. Alexander Averkiev, Prof. Dr. Alexander Rybalko and Dr. Roman Vankevich**.**

## Mid-cruise seminar in Stockholm

On July 20, during the stay in Stockholm, a mid-cruise Seminar was held onboard the R/V "Professor Shtokman". The Head of the Expedition, Dr. Tatiana Eremina, opened the Seminar with the welcome words to the participants and guests. The guest of the Seminar, acting member of the International Ecotourism Society, Viktoria Grigorieva spoke about the problems and perspectives of sustainable tourism development on islands in the Baltic Sea. The students presented preliminary research results and spoke about their work at home universities (Figs. 8 and 9). After the discussion Prof. Dr. Michael Shilin concluded the Seminar, speaking about the integrative function of the Marine Science, and necessity to use during the cruise the interdisciplinary approach. Overall, eight presentations were made at the Seminar.

After the Seminar students visited the city of Stockholm and could fully admire the old "Baltic" style of its architecture, Swedish food and the charm of the *Gamlastan* – a historical center of the city.

After the three-day stay in Stockholm the research vessel sailed off to conduct further research in the central part of the Baltic Sea and in the Gulf of Finland.

Figure 8. Mid-cruise Seminar in Stockholm onboard the R/V “Professor Shtokman” - students from Spain making their presentation

## Leg 3: in the Gulf of Finland

45 stations were planned in the Gulf of Finland, with the research polygon starting near the Gogland Island (fig.9) on the border of Russian waters and up to Kronshtadt – an island at the entrance to the Neva Bay. The weather favored the intensive scientific work, and on July, 29, at 5 a.m. the last station was completed. In the early evening of July, 29, with all the research and educational tasks successfully fulfilled, the R/V “Professor Shtokman” reached St.-Petersburg, and the cruise successfully ended. The participants left the vessel on July, 30.

Figure 9. Gogland Island – the biggest island in the Gulf of Finland.

## Preliminary scientific results

The total duration of the cruise was 18 days. 91 complex oceanographic stations were made during the time of the field work, including 29 geoecological stations with the sampling of bottom sediments and near-bottom water. Half of the stations were located in the Eastern Gulf of Finland.

For acquiring the information about the status of marine ecosystems a method of research polygons developed by the Russian oceanographer Vladimir Shtokman in 1960-1979 was used. The information about the status of the environment was collected on three polygons, located in the Bornholm Deep, the Kaliningrad Shelf and the Gulf of Finland, and on the standard long-term HELCOM transect. Such characteristics like water temperature, salinity, density, transparency, contents of dissolved oxygen, phosphates, nitrates, nitrites, silicates, pH and the total alkalinity were measured. Hydrophysical data was received with the use of the CTD-probe “Hydrobios”. The comparative analysis of the content of the dissolved oxygen in near-bottom

water, redox-potential in water and in bottom sediments was carried out. In addition, the presence/absence of the hydrosulphide $H_2S$ in the near-bottom layer and the concentration of oil products in the surface water were controlled. For the toxicological analysis fish, bottom sediments and water from the near-bottom layer and from the surface were sampled. For studying biological processes, the concentration of the chlorophyll "a", the intensity of the primary production, the biochemical oxygen demand $BOD_5$, the distribution of the phytoplankton, zooplankton, benthos, seiston and suspended organic matter were analyzed. For understanding biochemical processes, the intensity of the biogenic sedimentation of the suspended organic material was measured.

In the *southern part of the Baltic Sea* (Kaliningrad Shelf, Bornholm and Arkona Deeps, and the southern part of the HELCOM transect) the regime of temperature and salinity was slightly different from that of last years. The difference from the average conditions is that the upper mixed layer had the temperature 4-5 $^0$ C lower, and the cold intermediate layer as well as the near-bottom layer had the temperature – 2-3 $^0$ C higher than the mean annual values. The low temperatures in the upper layer are due to cold and rainy decades in the end of June – beginning of July in the Kaliningrad area and Southern Baltic. The increase of temperature of intermediate layer is caused by mild winter of 2006 - 2007. The absence of visible intrusions on temperature and salinity profiles shows the absence of the North Sea water inflows.

The results of the geoecological observations on the Kaliningrad shelf near the Kravtsovskoe oilfield show the stable situation in the geoenvironment. Preliminary data show that the geological environment is slightly exposed to alterations influenced by anthropogenic factors. The general improvement of the geoecological situation seems to be closely connected to natural hydrological processes. However, the low redox-potential at stations near the oil platform D-6 was fixed. At the shallow stations the geoecological situation was favorable.

In the Bornholm Deep the relative improvement of the geoecological situation on the slopes, connected to the occurrence of oxygen and zones of oxide deposits, was fixed. The conditions of deep anaerobic sedimentation were distributed only in the central part of the Bornholm Deep. Negative values of redox-potential essentially exceeded the absolute values at the stations of the Kaliningrad shelf. It creates favorable conditions for migration of chemical components, including products of decomposition of the dumped chemical weapons. The received data shows, that there are objective preconditions for migration of chemical components, including arsenic, on slopes of the Deep –this can be stimulated by the expense of cyclic change of redox-potential in the top layers of bottom sediments. In general, the geological environment in the Bornholm Deep seems to be unstable.

In the *central part of the Baltic Proper* on the HELCOM transect the vertical distribution of temperature and salinity is in accordance with mean climatic conditions and shows the stable temperature stratification. The upper mixed layer is less evident (according to the temperature values) due to the active cyclonic activity, and the temperature of the cold bottom layer is slightly higher than its mean values, which is caused by mild winter last year.

In the *Gulf of Finland* the lithological-geochemical section from Krasnogorsk road up to the mouth of the Gulf Finland was made. The data of the express - analysis allows allocating of zones of intensive accumulation of sedimentary material to which the maximal accumulation of toxic substances is connected. In the Eastern Gulf of Finland near the Neva estuary a general deterioration of the environmental situation is observed, which is indirectly confirmed by reduction of Eh.

On all the polygons, the intensity of the photosynthesis has changed from 0,1 to 0,4 g C /$m^3$ in the day. In the open parts of the Sea the intensity was not higher than 0,2 g C /$m^3$ in the day. It has increased in the shallow parts of the Gulf of Finland, but was lower than in 2006 because of the intensive hydrotechnical work, dredging and decreasing of the water transparency in the Eastern part of the Gulf and in the Neva Bay. The maximum value of primary production was registered in the shallow part of the Kaliningrad shelf.

The benthic communities in all of the studied areas were extremely poor, with exception of some stations in the shallow parts of the Kaliningrad shelf and the Gulf of Finland. The maximal biomass of benthos was found in the Kaliningrad shelf, where the bottom settlements of Bivalvian mollusks *Mytilus rossulus* and *Macoma balthica* are developed.

# Summer 2007 training-through-research cruise of the Sailing Catamaran "Centaurus II" in the Eastern Gulf of Finland (Remote Sensing experiment of the UNESCO-IOC Chair in Remote Sensing and Modeling in Oceanography, - RSHU)

The 2007 cruise of the sailing catamaran "Centaurus II" was carried out in the Eastern part of the Gulf of Finland on 18-31 of July (Fig.10). This programme is being held every summer from 1993, making possible to teach students in oceanographic measurements and the comparison of data from past years taken in the same region. Four crew members, four RSHU professors, two scientists from the Zoological Institute (RAS), and nine students (four from Russia, two from Spain and three from Colombia) were participants of this expedition (Appendix 1-2, Fig. 11). Complex oceanographic survey began on July, 18 and continued on July, 21, after two days of waiting for favorable weather conditions in St.-Petersburg waters. Students guided by the RSHU professors participated in investigations and all kinds of work. The second stage of the survey ended on July, 24 at the central part of the Gulf of Finland due to the bad forecast, with six stations left for a third stage, finished on July, 31 in the Gulf of Vyborg.

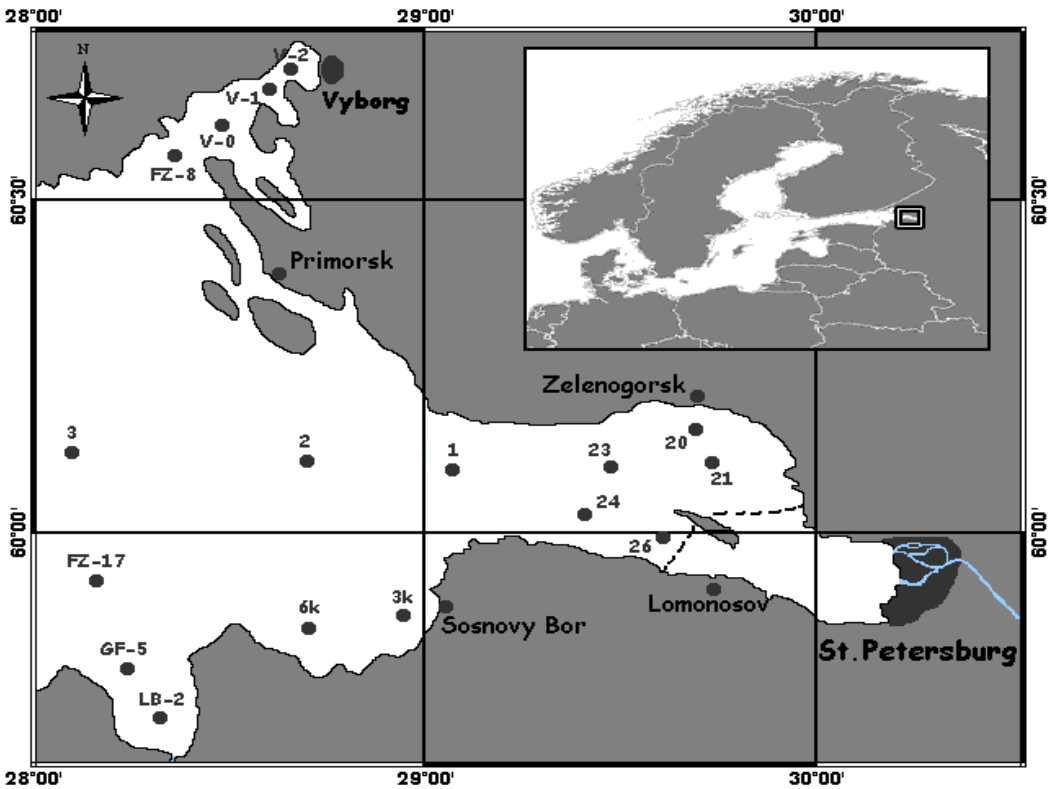


Figure 10. Map of the region with stations

Oceanographic, meteorological, hydrochemical and some biological data were taken at the 22 complex stations in the Eastern Gulf of Finland. Parallel with all these measurements, a Sea & Sun Technology GmbH CTD was used to register detailed vertical profiles of temperature and salinity and transparency of the water (using the Secchi disc) at nine stations at the same time when satellites AQUA and TERRA passed over the region, in order to carry out a future validation of the different algorithms for the calculation of sea surface characteristics. The Aqua MODIS data were used to obtain nighttime and daytime SST; the appropriate bands were 20, 31 and 32 (3.660-3.840 μm, 10.780-11.280 μm, and 11.770-12.270 μm respectively). Students prepared few examples of the preliminary comparison between the remote sensed and *in situ* data of SST and sea color. This research was carried out within the programme of the UNESCO Remote Sensing Division and projects of the UNESCO-IOC Chair in Remote Sensing and Modeling in Oceanography (RSMO) at RSHU. The MODIS products and algorithms used for the Gulf of Finland were received for the cloudiness free conditions on July, 18, 22 and 23. A new UNESCO BILKO module was prepared during the cruise, using the MODIS data. Preparation of remote sensed data, its interpretation and preliminary comparison with *in situ* data were made with assistance of the RSMO staff.

Figure 11. Participants of the summer 2007 cruise onboard the Sailing Catamaran "Centaurus II"

Preliminary analysis of *in situ* measurements shows very homogeneous superficial and bottom layers, and very well defined thermo- and halocline from 10 to 22 meters. The atmospheric conditions have a very clear influence on the vertical structure; during the preceding days of the 2007 survey, very strong winds produced intense vertical mixing, increasing the thickness of the surface layer in both temperature and salinity in comparison with 2006. At the deeper stations the oxygen concentration (%) is higher at the sub-superficial layer that could be explained by oxygen consumption by phytoplankton and zooplankton. The Secchi disc depth was changed from 3,2 m in the western part of the region to 0,3 m due to intense offshore works increasing the concentration of suspended material in the Neva Bay.

During the periods between stages of the cruise students studied the UNESCO BILKO image-processing software designed for training purposes. They have learned to read the Level 1B and 3 image formats for the TERRA and AQUA sensors commonly used at sea and in coastal remote sensing.

The new materials prepared during the 2007 cruise accompany the software and provide an approach to image processing and analysis for the Gulf of Finland. In this new module prepared during the period of the cruise, this is done using data from MODIS sensors.

During the cruise various lectures and seminars took place where professors and students made their presentations on different subjects related to the research in the Gulf of Finland.

## Post cruise program

After the cruise the students from both “Centaurus” and “Shtokman” cruises participated in a cultural program in St.-Petersburg that included sightseeing around the city and visits to the city museums.

On July, 31 the Post-cruise Seminar took place at the RSHU for experience exchange between the teams of the R/V "Professor Shtokman" and the catamaran. The Seminar facilitators were Dr. Tatyana Eremina and Dr. Vitalij Sychev. Students made the presentations of the results of both cruises and discussed them afterwards. (Fig. 12).

## Conclusions

A specificity of the Baltic Floating University programme is the use, in parallel, of two research platforms. The RV “Professor Shtokman” conducted a survey in the Baltic Sea, whereas the sailing catamaran “Centaurus-II” explored the shallowest parts of the Gulf of Finland. Combining the results obtained onboard both ships it is possible to get a more detailed picture of the state of the marine environment.

During these cruises students acquire skills in various oceanographic measurements.

In 2007 students from Russia, Spain, Colombia, Namibia and UK were trained in:

- taking samples of the sea water with Niskin bottles and using various types of hydrochemical analysis in the shipboard lab;
- taking samples of sediments with the use of various instruments and examining the sediments onboard;
- taking hydrobiological samples and using various techniques of their treatment;
- data processing and analysis.

In 2007 one training module in remote sensing (BILKO) has been created based on the in-situ data collected during the cruise.

Scientific results of the cruises contribute to the students’ presentations at the mid-cruise and post-cruise Seminars and their reports on the present state of the Baltic Sea. The data collected is used by the students in their research in their home universities, and serves as the basis of Master theses for many of them. Also, students have a possibility to publish the results of their research in the annual issue of the BFU Bulletin.

Figure 12. Post-cruise seminar in RSHU. Left: Dr.Vitaliy Sychev talking about the satellite observations in the Gulf of Finland; right: a Columbian student making his presentation.

Figure 13. Participants of BFU-2007 students and teachers meeting the RSHU Rector Lev Karlin (in the front row)

Appendix 1

# List of Participants in the BFU-2007 cruises

1. Participants in the R/V "Professor Shtokman" cruise

| Name | Position | Institution |
|---|---|---|
| Researchers: | | |
| EREMINA Tatiana | Dr., Chief Scientist | RSHU, St.-Petersburg |
| AVERKIEV Alexander | Dr., Deputy Chief Scientist | RSHU, St.-Petersburg |
| DRONOV Denis | Biologist | Atlantic Branch IO RAS, Kaliningrad |
| FOKIN Denis | Geologist | Sevmorgeo, Russia |
| GUSTOEV Dmitry | Hydrologist | RSHU, St.-Petersburg |
| ISAEV Alexey | Hydrologist | RSHU, St.-Petersburg |
| KUDRYAVTSEVA Elena | Biologist | Atlantic Branch IO RAS, Kaliningrad |
| LAKHOV Tagir | Hydrologist | RSHU, St.-Petersburg |
| MAXIMOV Alexey | Dr., Biologist | Zoological Institute, RAS, St.-Petersburg |
| MORACHEVSKY Andrey | Dr., Hydrologist | RSHU, St.-Petersburg |
| RUSINA Larisa | Head, Chemistry lab | RSHU, St.-Petersburg |
| RYBALKO Alexander | Prof., Dr., Head of geology team | Sevmorgeo, Russia |
| SCHERBAKOV Yury | Head, Hydrology team | RSHU, St.-Petersburg |
| SHILIN Mikhail | Prof., Dr., Head, Biology team | RSHU, St.-Petersburg |
| STONT Zhanna | Dr., Meteorologist | Atlantic Branch IO RAS, Kaliningrad |
| VANKEVICH Roman | Dr., Data manager | RSHU, St.-Petersburg |
| VILENKIN Sergey | Head, Data management team | RSHU, St.-Petersburg |
| *Students:* | | |
| ERSHOVA Alexandra | PhD student, chemist | RSHU, St.-Petersburg |
| FLECHA SAURA Susana | Student | University of Cadiz, Spain |
| HERNANDO MORALES Victor | Student | University of Cadiz, Spain |
| KOCHETKOVA Ekaterina | Student | RSHU, St.-Petersburg |
| LOPEZ COMI Comi | Student | University of Cadiz, Spain |
| MAIER Gerald | Student | University of Plymouth, UK |
| MOROZOV Leonid | Student | RSHU, St.-Petersburg |
| NANGOLO Job | Student | RSHU, Namibia |
| SOFYINA Ekaterina | PhD student, chemist | RSHU, St.-Petersburg |

| Name | Position | Institution |
|---|---|---|
| TKACHENKO Nikolay | PhD student, hydrologist | RSHU, St.-Petersburg |

2. Participants in the sailing catamaran “Centaurus-II” cruise

| Name | Position | Institution |
|---|---|---|
| *Researchers:* | | |
| SYCHEV Vitaliy | Dr., Chief scientist | RSHU, St.-Petersburg |
| BASHKINA Galina | Chief of the field practice | RSHU, St.-Petersburg |
| GOLUBKOV Sergey | Dr., Researcher | Zoological Institute, RAS, St.-Petersburg |
| GOLUBKOV Mikhail | Researcher | Zoological Institute, RAS, St.-Petersburg |
| KHAIMINA Olga | Senior researcher | RSHU, St.-Petersburg |
| KOROVIN Anatoliy | Senior researcher | RSHU, St.-Petersburg |
| VINOGRADOV Sergey | Head, Data management | RSHU, St.-Petersburg |
| *Students:* | | |
| CACERES LEON Richard Humberto | Student | University of Bogota, Colombia |
| HERNANDEZ DECKERS Daniel | Student | University of Bogota, Colombia |
| DROZDOVA Karina | Student | RSHU, St.-Petersburg |
| GARCIA FUENTES Ana | Student | University of Cadiz, Spain |
| KOVIN Andrey | Student | RSHU, St.-Petersburg |
| KOZLOV Igor | Student | RSHU, St.-Petersburg |
| KURILO Alexander | Student | RSHU, St.-Petersburg |
| LEVACHEVA Natalia | Student | RSHU, St.-Petersburg |
| LOPEZ LOPEZ Lucia | Student | University of Cadiz, Spain |
| MORENO RINCON Juan Leonardo | Student | University of Bogota, Colombia |
| SIPYAGINA Ekaterina | Student | RSHU, St.-Petersburg |