NOAA Atlas NESDIS 56

RUSSIAN MARINE EXPEDITIONARY INVESTIGATIONS OF THE WORLD OCEAN

Silver Spring, MD
December 2002

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Environmental Satellite, Data, and Information Service

World Data Center for Oceanography, Silver Spring
International Ocean Atlas and Information Series, Volume 5
NOAA Atlas NESDIS 56

МОРСКИЕ ЭКСПЕДИЦИОННЫЕ НАУЧНЫЕ ИССЛЕДОВАНИЯ РОССИИ

Н.Н. Михайлов, Е.Д. Вязилов, В.И. Ломонов,
Н.С. Студёнов, М.З. Шаймарданов
(Всероссийский Научно-Исследовтельский Институт
Гидрометеорологической Информации/
Мировой Центр Данных - Б)

Под редакцией: Р. Татуско, С. Левитус
(NOAA/NESDIS/NODC/Ocean Climate Laboratory)

Обнинск – Silver Spring
Декабрь 2002

Федеральная Служба России по Гидрометеорологии и Мониторингу Окружающей Среды
Александр И. Бедритский, Председатель

Всероссийский Научно-Исследовательский Институт
Гидрометеорологической Информации
Марсель Шаймарданов, Директор

U.S. DEPARTMENT OF COMMERCE
Donald L. Evans, Secretary

National Oceanic and Atmospheric Administration
Vice Admiral Conrad C. Lautenbacher, Jr. USN (Ret.)
Under Secretary of Commerce for Oceans and Atmosphere

National Environmental Satellite, Data, and Information Service
Gregory W. Withee, Assistant Administrator

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N.N. Mikhailov, E.D. Vyazilov, V.I. Lomonov,
N.S. Studyonov, M.Z. Shaimardanov
(All-Russian Research Institute for Hydrometeorological Information/
World Data Center - B)

Edited by: R. Tatusko, S. Levitus
(NOAA/NESDIS/NODC/Ocean Climate Laboratory)

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Russian Federal Service for Hydrometeorology and Environmental Monitoring
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All-Russian Institute for Hydrometeorological Information
Marsel Shaimardanov, Director

U.S. DEPARTMENT OF COMMERCE
Donald L. Evans, Secretary

National Oceanic and Atmospheric Administration
Vice Admiral Conrad C. Lautenbacher, Jr. USN (Ret.)
Under Secretary of Commerce for Oceans and Atmosphere

National Environmental Satellite, Data, and Information Service
Gregory W. Withee, Assistant Administrator

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PREFACE

The World Data Centers for Oceanography in Silver Spring, Maryland, and in Obninsk, Russia, are just one component of a global network of centers that facilitate international exchange of data in a variety of scientific fields. These centers function under the guidance of the International Council of Scientific Unions (ICSU), which was established in 1957-58 during the International Geophysical Year (IGY).

This Atlas has been translated from the original Russian, which was published by the All-Russian Research Institute and can be obtained by going to http://www.oceaninfo.ru.

This Atlas is Volume 5 within the International Ocean Atlas and Information Series, and is being distributed internationally without restriction in accordance with the principles of the World Data Center system of the ICSU and the UNESCO Intergovernmental Oceanographic Commission. It is available on the Internet at http://www.nodc.noaa.gov/OC5/indprod.html, under International Ocean Atlas Series.

Sydney Levitus, Director
World Data Center for Oceanography
NOAA/NESDIS/NODC
Silver Spring, MD

Marsel Shairmardanov, Director
World Data Center for Oceanography
RIHMI
Obninsk, Kaluga Region, Russia

ACKNOWLEDGEMENTS

In memory of Russian oceanographer
Valeriy I. Kalatsky

The authors express sincere gratitude to the following individuals, who contributed to the preparation of this monograph: S.S. Lappo and V.A. Semenov for reviewing this monograph; V.A. Sobolev and E.A. Svischeva for translating the monograph from Russian to English; L.V. Kuznetsova, I.N. Lychagina, and M.B. Darkina, who assisted in the preparation of computer materials; A.Ya. Podvysotskaya, whose contribution to summarizing the oceanographic data is difficult to underestimate; WDC personnel in Obninsk, who collected pictures of Russian research vessels; Renee Tatusko and Sydney Levitus at the World Data Center for Oceanography in Silver Spring, Maryland, for editing the English translation; NOAA/NESDIS for publishing the English version of this monograph as part of International Ocean Atlas and Information Series; and Roger Colony, former Director of the Arctic Climate System Study (ACSYS) project office, who supported the production of the monograph.

The authors realize that the monograph may contain some inaccuracies and errors, for which they take full responsibility, but they hope that the information presented will be useful and that this work will be extended in the future. Readers are encouraged to send any comments, suggestions for additions, corrections, or requests for further information to the All-Russian Research Institute for Hydrometeorological Information, World Data Center for Oceanography, 6, Korolyov Street, Obninsk, Kaluga Region, 249020 Russia; e-mail: wdcb@meteo.ru; telephone: 7-095-255-2194; fax: 7-095-255-2225.

Russian Marine Expeditionary Investigations of the World Ocean

N.N. Mikhailov, E.D. Vyazilov, V.I. Lamonov, N.S. Studyonov, M.Z. Shairmardanov
(All-Russian Research Institute for Hydrometeorological Information)

Edited by: R. Tatusko, S. Levitus (NOAA/NESDIS/NODC/World Data Center for Oceanography, Silver Spring, MD)

ABSTRACT

The history of Russian oceanographic expeditionary research is very rich and full of numerous global-scale discoveries of great scientific importance. However, it is a very difficult task to introduce a comprehensive review of multidisciplinary marine investigations, which date back over 300 years. This publication is an endeavor to present the most important results of sea voyages and ocean expeditions performed by Russian seamen from the late 17th century up to the present. It is intended to familiarize the international oceanographic scientific communities as well as anyone interested in historical Russian marine exploration and the current state of expeditionary research. In particular, this monograph may be particularly useful for students and officers in navigation schools as more general information about Russia's marine expeditionary research is presented. This monograph presents information on the most famous expeditions and the results from these investigations, the national and international projects (programs) involving Russia, and the organizations contributing to research of the world oceans.

1. INTRODUCTION

Within the last 300 years, Russia has become a powerful maritime country, whose interest since the time of Peter the Great has been closely connected to both marine communications and the use of biological, mineral, and energy resources of the world ocean. At all times, Russian seamen – hydrographers, cartographers, oceanographers, biologists – were noted for their courage and willingness to sacrifice themselves. They were always persistent in attaining the identified goals and open for international cooperation. The names of outstanding seafarers became immortalized as they were given to numerous places on geographical maps of the globe as well as to modern Russian research vessels. The challenges of investigating the marine environment, including those of shipbuilding and the use of research vessels, were of considerable interest and importance to the Government at all times. Since the end of the 19th century, marine data has been made more available to meet the requirements of both the national economy and the obligations of the Russian Navy. These data include tables of tides; atlases of surface and deep-sea currents; charts of sea-ice conditions and drifting ice; vertical profiles of temperature, salinity, density, and velocity; fields of storm surges; information on the content of dissolved gases and pollutants in sea water; data on different aspects of ocean–atmosphere interaction; and other products of marine research. During the mid-to-late 20th century, both national and international scientific communities recognized the Soviet research fleet as the best in the world.

This monograph is divided into several time periods to illustrate the level of technical equipment, scientific knowledge, research programs, and data processing and analysis capabilities, which were typical for each period. Information is also provided on research vessels, many of which now belong to the former republics of the former USSR, such as Ukraine, Lithuania, etc. For the purpose of this monograph, however, the owners or institutional affiliation of the ships are provided at the time when the cruise commenced.

The All-Russian Research Institute of Hydrometeorological Information (RIHMI) – World Data Center (WDC) for Oceanography in Obninsk has made its data and publications available to facilitate the preparation of this work. The oceanographic data set archived in the Russian State Data Holding is unique. It contains a large amount of oceanographic data that has been collected since the end of the last century and which serves as a basis for theoretical and applied research and development. In addition to the documents provided by the WDC for the preparation of this monograph, other publications about Russia's oceanographic history and research efforts can be found in Appendix 5. This appendix also includes publications about the hydrology of some seas and the oceans as well as those dedicated to historical anniversaries of Russia and different scientific institutions, which describe the results of some specific expeditions. The most recent publication similar in effort to this monograph was edited in 1968 by K.K. Deryugin, and this work extends upon that effort as well as those of A.M. Muromtsev, M.I. Belov, and others.

Basic information on the types of ships, the period of operation, their geographical areas of operation, and the different types of observations conducted can be found in Appendix 1. Information about the most prominent national and international expeditions and projects (programs) is provided in Appendix 2. This includes the period of operation, the scientific mission or goal, geographical area of the expedition, data processing institution, data archive, participating countries, and types of observations conducted. The research vessels involved in various programs and projects are identified in Appendix 3 along with their ship number,

institutional affiliation (at the time of the expedition), and their start and finish dates. Appendix 4 is a listing of Russian and former USSR organizations, which took an active part in the study of the seas and oceans, and includes their addresses (some telephone and fax numbers as well as e-mail and Internet addresses are also provided) and the specific activities in which they were involved. A list of resources with information on marine expeditions can be found in Appendix 5, and a list of acronyms is provided in Appendix 6.

2. OUTSTANDING SEA VOYAGES AND EXPEDITIONS DURING THE 16TH-19TH CENTURIES

Of those ancient philosophers and great men who studied the world seas and oceans, Herodotus, Aristotle, Seneca, and Ptolemaeus were the first to summarize observations made by early pioneering seafarers, and they stated their belief that the Atlantic and the Indian Oceans were not separated. They also made reasonable hypotheses about the water cycle and sea water salinity; tides in the Persian Gulf and along the European coast of the Atlantic; the interconnection of high tides with the gravitational pull of the moon; and currents in the Bosporus, Dardanelles, and the Kerch Straits.

In the epoch of great geographical discoveries (mid-15th to mid-16th centuries), a considerable amount of information about the oceans was collected and analyzed, which substantiated the belief in Earth's sphericity and, hence, the existence of the Northeast Passage (the sea route to India). In addition, the outlines of inhabited continents were roughly determined, and vast areas of America and Asia were explored. This period was also characterized by the study of the geographical distribution of the world oceans. Among some of the most famous navigators and explorers of the 16th and 17th centuries were Christopher Columbus, Ferdinand Magellan, Vasco de Gama, Amerigo Vespucci, Francis Drake, Henry Hudson, and William Baffin.

Russian explorers also played an important role in the discovery and exploration of new lands during this period. They were the first to discover the Asian part of Arctic and the North Pacific. In 1581-1582, the Cossack leader Yermak Timofeyevich crossed the Urals, conquered the Tatar khanate of Siberia by defeating its leader, Kuchum, and paved the way for exploration of western Siberia. In 1601, the town of Mangazeya was established on the Taz River followed by Yakutsk, in 1628, on the Lena River. The Russians pushed onwards to discover the Sea of Okhotsk, and from 1639-1641, I. I. Moskvitin and M. Stadukin had surveyed the entire continental coast. By the middle of the 17th century, K. Kurochkin, I. Perfilyev, E. Khabarov, and other investigators had explored all the great rivers of Siberia including the Amur. At the same time, using small sail boats to investigate the northern coast of Asia, Russian seamen discovered the Taimyr, Yamal, and Chukotka peninsulas. Under the leadership of F. Popov and S. Dezhnyov, these seamen also successfully passed through the Bering Strait from the Arctic Ocean to the Pacific to prove that Asia and America were separated. Dezhnyov was the first European to sail through the Bering Strait. The Spitsbergen archipelago was discovered in the middle of the 16th century. In 1697, V.V. Atlasov became the first to explore Kamchatka and the northern Kurile Islands, but it wasn't until 1719 when I. Evreinov and F. Luzhin charted the northern Kuriles. The northwest Atlantic was further explored under the First Kamchatka Expedition, which took place from 1725-1730 under the command of V.I. Bering. Bering explored the eastern area of the Bering Sea and the Strait, which connects the Bering Sea with the Arctic Ocean. In 1732, I. Fyodorov and M. Gvozdev sailed east from Cape Dezhnyov, discovered Cape Prince of Wales, and explored the Alaskan coast in the vicinity of Nome, thereby becoming the first Europeans to see Alaska. The most outstanding discoveries were made during the Great Northern Expedition of 1733-1743, commanded by V. Bering, who has without question, no equal in the history of polar exploration. In 1740-1741, with V.I. Bering commanding the "St. Peter" and A.I. Chirikov commanding the "St. Paul," the open waters of the North Pacific were first explored. Bering and Chirikov also discovered the Commander and the Aleutian Islands as well as the northwestern coast of North America. As a result, many gaps

on the map of the North Atlantic were filled. In addition, Chirikov made the first attempt to measure ocean currents. In 1788-1789, G. Izmailov, D. Bocharov, and G. Sarychev went on to explore the northwestern coast of America.

Cartographic coastline surveys, hydrographic surveys of straits and river mouths, and identification of ice boundaries and tide occurrences are believed to be the basic scientific activities of early marine expeditions. But as more ships were equipped with oceanographic and meteorological instruments, investigations of the interconnections and regularities of the physical and chemical processes in the ocean received greater attention.

Deep-sea observations were initiated in 1803 during the first Russian expedition to circumnavigate the globe in the "Nadezhda" and the "Neva" under the command of I.F. Kruzenstern and Yu.F. Lisyansky, respectively. Extensive oceanographic observations, including water-temperature measurements, were performed by a Swiss member of the expedition, Johann Gorner. Gorner was the first to perform concurrent measurements at depths from the surface down to 360 meters using the Six's thermometer. The expedition also pioneered specific water-weight observations in the Pacific and Atlantic Oceans and in the Okhotsk, Japan, South China, and Baltic Seas. The oceanographic observations performed during this expedition resulted in some generalizations and conclusions about the marine environment. For example, Gorner pointed out the uneven distribution of water salinity, and he attributed enhanced salinity in the subtropics to high evaporation. In addition, he was the first to identify negative temperatures at some depth in the Sea of Okhotsk. Based on the observations made during this expedition, Kruzenstern compiled "The South Sea Atlas." Following the voyage of Kruzenstern and Lisyanski, deep-water temperature measurements became a "must" for numerous Russian and foreign expeditions.

The Russian-American Company, created in 1799, played a major role in the history of exploration of the North Pacific since frequent sea voyages supplied Russian settlements in North America with foodstuffs and other necessities. During these voyages, Russian seamen performed deep-sea measurements to investigate horizontal and vertical water temperatures and specific water-weight distribution.

From 1816-1818, the Russian expedition of the "Ryurik," under the command of O. Kotzebue, obtained water-temperature measurements at 27 stations in the Pacific and Indian Oceans down to depths of 549 m. At one of these stations, measurements were obtained as deep as 746 m. These measurements were used to refine the data on the vertical water-temperature distribution, which was obtained during the Kruzenstern expedition. Two years later, F.F. Bellinsgauzen and M.P. Lazarev led the first Russian expedition to reach the coast of Antarctica in the "Vostok" and "Mirny," respectively. This expedition, after successfully crossing the Atlantic Ocean and arriving at the Antarctic coast, made the first hydrometeorological observations in the coastal waters off Antarctica.

In 1820-1821, M.N. Vasilyev and G.S. Shishmarev, commanding the sloops "Otkrytie" and "Blagonamerenny," respectively, led an expedition to search for a route from the Pacific to the Atlantic Ocean via the Bering Strait. This expedition made astronomical and tidal observations and charted the northwestern coast of North America and nearby islands. While visiting Australia, the "Blagonamerenny" measured water temperature to a depth of 366 m in the Tasman Sea near Sydney. Water temperature measurements were also made in the vicinity of the Aleutian Islands.

In the course of the 1823-1826 expedition of the "Predpriyatie," commanded by O.E. Kotzebue, the physicist E. Lents made measurements of water temperature and specific water

weight, which are comparable in accuracy with data obtained during the first half of the 20th century. In 1845, Lents summarized all available data on water temperature and developed models of water circulation in the Atlantic and Pacific Oceans. Changes in water temperature from 2.44° to 2.24° at depths of 1780-1980 m led him to conclude that water temperature progressively decreases toward the ocean bottom. He also suggested that there should be a cold current with water temperature only slightly above zero, which flows from the poles to the equator. Based on surface water temperatures in the Okhotsk and the Japan Seas, as well as adjacent areas of the Pacific Oceans, the academician L.I. Schrenk developed a general model of surface currents for these regions. In total, from 1800-1872, 257 measurements of water temperature were made in the Atlantic at different depths, of which 81 were made by Russian scientists and navigators. The maximum depth at which measurements were obtained was 3779 m.

In parallel with water-temperature measurements in the middle of the18th century, Russian seafarers also made tidal observations in different parts of the ocean. The Russian explorer and geographer, F.P. Litke, attached much importance to the study of tides. To perform tidal observations on a regular basis, Litke came up with the idea of a self-recording "tide meter," designed under the supervision of Lents and installed on the Pacific coast in Novoarkhangelsk (now Sitka in Alaska). In 1844, Litke was the first to summarize tidal studies in the Pacific and Arctic Oceans and to produce a publication with tables and tidal charts.

The analysis of marine observations made in the first half of the 19th century led to expanded methods of expeditionary research in Russia. This involved the use of sailing and motor-sailing ships specially designed for marine research and equipped with meteorological and oceanographic instruments. At the turn of the century (1898), the icebreaker "Ermak" was built, which was the first of its kind. Future icebreakers played a vital part in the exploration of the Arctic and Antarctic seas. Expeditionary reports available for this period contain a considerable amount of data not only on the physical properties of water such as temperature, salinity, and density but also on ocean currents, air temperature, wind direction and velocity, and atmospheric pressure.

A major contribution to the study of the Pacific Ocean was made by Admiral S.O. Makarov, who was a brilliant and innovative naval architect, inventor, tactician, ship designer, and scientist. He made extensive observations of his own aboard the corvette, "Vityaz," in 1887-1888 and also summarized a large amount of the earlier observational data. His publication, "The Vityaz and the Pacific," was the first monograph on the hydrology of the greatest ocean of the Earth. In the Pacific, the "Vityaz" made 166 measurements of water temperature and specific water weight to a depth of 400 m; and at some stations, measurements were made to a depth of 800 m. From the data he obtained, Makarov prepared charts of water temperature and specific water-weight distributions at the surface as well as water-temperature distributions to a depth of 400 m. Based on these data, Makarov formulated important conclusions regarding the Pacific Ocean currents and prepared a definitive model of the surface currents in the north Atlantic Ocean.

In the 1870s through the 1880s, A.I. Voyeykov laid the foundation for the theory of monsoons, and O. Onatsevich investigated drift currents caused by monsoons affecting the Far East. L. Schrenk discovered some unique characteristics of water temperature and current distributions in the Far East seas. The concept of tidal currents in the China and Yellow Sea was refined by E. Mandel, who identified distinctive features of wind-drift currents induced by monsoon winds.

The Black and Azov Seas have been studied since 1871, the year in which the Sevastopol marine biological station was set up. The famous Russian scientists A. Kovalevski, N. Nasonov, and S. Zerhov worked at this station. In 1873, F. Wrangel led a hydrophysical expedition to the Black Sea in the schooner, "Ingul," during which the first water temperature and salinity data were obtained. Aboard the "Taman" during 1881-1882, Makarov performed current observations in the Bosporus Strait and was the first to discover the two-layer flow regime where the current flows from the Black Sea to the Sea of Marmora at the surface and in the opposite direction at the bottom. This discovery was of prime importance in understanding the unique water-structure formation of the Black Sea and, in general, developing a theory of the exchange of water through sea straits. Subsequently, this two-layer current flow was found to exist in many other straits. The first significant oceanographic investigation in different areas of the Black and Azov Seas were conducted by expeditions under the leadership of I. Shpindler and F. Wrangel in 1890-1891. At that time, the Black Sea was discovered to be a deep-sea trough (2244 m); and below 150 - 200 m, the water was found to be heavily saturated with hydrogen sulfide.

Investigations of the Caspian and Aral Seas began in the mid 1800s. From 1853-1856, Academician K.M. von Baer led the first large expedition to explore the Caspian Sea and, among other things, to solve the puzzle of the decline in sea level. In 1895, N.I. Andrusov conducted a comprehensive investigation of the Caspian Sea as did J.B. Spindler in 1897. During the latter expedition, a massive sea-salt deposit was discovered in the Kara-Bogaz-Gol Bay (in Turkmenistan), which turned out to be the largest in the world. The study of the Aral Sea was first undertaken by A.I.Butakov in an 1848 expedition to study the flora and fauna. At the turn of the 20th century, Academician L. Berg conducted additional studies. From 1899-1902 and again in 1906, Berg mounted large expeditions and collected valuable data on the hydrology, biology, and meteorology of the Aral Sea.

Russian explorations also took place in the Arctic and Pacific Oceans. In 1882, Russia and ten other countries participated in the First International Polar Year (IPY), which was promoted in order to obtain a set of simultaneous observations, extending over a long period of time, at various locations around the Arctic. Useful contributions to the exploration of the Pacific Ocean were made during the period 1888-1905 in an expedition of the research vessel "Albatross." This expedition conducted detailed deep-sea, biological, and water-temperature studies. Also worth noting is the expedition, "The Specific Survey of the Pacific," which took place from 1884-1908 under the direction of hydrographer M.E. Zhdanko. In addition to making sea-level observations, this expedition investigated currents in the Japan and Okhotsk Seas using drift bottles.

The results of marine research conducted in the 19th century were described by Yu. M. Shokalski in 1977 in his fundamental work, "Oceanography." Table 2.1 provides information on the most well known sea voyages and marine expeditions of Russia from 1648-1955. Because of the large number of expeditions carried out during the period 1956-1995, detailed information about the research vessels used and the programs and projects in which they were involved is provided in Appendix 3. The most important events in Russia's oceanographic history are listed in Table 2.2.

Table 2.1 The most well-known sea voyages and marine expeditions of Russia

Years	Expedition or Agency	Leaders	Ship Name	Geographical area of research
1648	Unknown	S. Dezhnyov	Unknown	Bering Strait
1716	Great Kamchatka duty	Unknown	Unknown	Far East seas
1725-1730	First Kamchatka Expedition	V.I.Bering, M.P.Shpanger, A.I.Chirikov	Fortuna, Saint Gabriel	"
1732–1740	First Marine Expedition	Unknown	Unknown	Ob River mouth
1733–1738	Ob expedition	Unknown	Unknown	"
1733–1743	Great Northern expedition	S.V.Muravyov, M.S.Pavlov	Expedition, Ob	Arctic seas
1736	"	S.G.Malygin, A.I.Skuratov	Unknown	Northern Sea Route
1737	"	S.G.Malygin	Unknown	Arctic seas
1738	"	V.M.Golovnin, A.I.Skuratov	Unknown	"
1734	"	D.L.Ovtsyn	Tobol	"
1735	"	V.V.Pronchischev, P.Lassinus	Yakutsk	"
1736	"	S.I.Cheluskin, I.Elagin, M.Petrov, D.V.Sterligov	Yakutsk	"
1737	"	Kh.P.Laptev, D.Ya.Laptev	Unknown	"
1738	"	M.P.Shpanberg	Archangel Michael Nadezhda	"
1740	"	F.A.Minin	Unknown	"
1740–1741	Second Kamchatka Expedition	V.I.Bering, A.I.Chirikov, V.A. Rtischev	St. Peter, St. Paul, Fortune, St. Gabriel	Far East seas
1768–1769	Unknown	F.Rozmyslov	Unknown	The New Land
1803–1806	Circumnavigation of the Earth	I.F.Krusenstern, Yu.F.Lisyanski	Nadezhda, Neva	World Ocean

Years	Expedition or Agency	Leaders	Ship Name	Geographical area of research
1807	Unknown	V.M.Golovnin	Diana	Shantarskie Islands, South Kuriles
1815–1818	Circumnavigation of the Earth	O.E.Kotzebue	Rurik	World Ocean
1817–1819	Unknown	V.M.Golovin	Kamchatka	World Ocean
1819–1822	"	G.S.Shishmarev	Blagonamerenny	"
1819–1821	"	F.F.Bellinsgauzen	Mirny, Vostok	Discovery of Antarctica
1821–1824	"	F.P.Litke	Novaya Zemlya	The New Land coast
1822–1825	Circumnavigation of the Earth	M.P.Lazarev	Cruiser	World Ocean
1823	Unknown	F.P.Litke	Craft	Arctic Ocean
1823–1826	Circumnavigation of the Earth	E.H.Lentz	Predpriyatie	World Ocean
1826–1829	"	F.P.Litke, M.N.Stanyukovich	Senyavin, Moller	"
1828–1830	"	V.S.Khromchenko	Helena	"
1831–1833	"	V.S.Khromchenko	America	"
1832–1833	Hydrographical expedition	P.K.Pakhtusov	Novaya Zemlya	Kara Sea
1834–1835	"	P.K.Pakhtusov	Krotov, Kozakov	"
1837	Unknown	K.M.Baer	Krotov	The New Land
1849–1855	Amur expedition	G.I.Nevelskoy	Baikal	Amur River mouth
1849–1858	Hydrographical investigations	A.Zarubin	Unknown	Arkhangelsk
1852–1855	Circumnavigation of the Earth	E.V.Putyatin	Pallada	Far East, Japan
1860–1862	Unknown	I.F.Krusenstern	Ermak, Embrio	Unknown
1862–1865	"	Yu.I.Koshelevski	Unknown	From Pechora River mouth to Yenisei River mouth
1865–1866	"	Unknown	Varyag, Nadezhda	Japan Sea, Pacific Ocean
1876–1877	Trade Assistance Society	Kh.Dal	Unknown	Ob River mouth

Years	Expedition or Agency	Leaders	Ship Name	Geographical area of research
1877	Unknown	Unknown	Severnoye siyanie	Yenisei River mouth
1877	"	M.K.Sidorov	Utrennyaya Zarya	Kara Sea
1878–1879	Unknown	A.E.Nordensheld	Vega	Arctic Seas
1880	Trade Assistance Society	A.M.Sibiryakov	Oskar Dixon	Ob and Yenisei River mouth
1886	Biological expedition	N.M.Knipovich	Unknown	Caspian Sea
1886–1894	Circumnavigation of the Earth	S.O.Makarov	Vityaz	World Ocean
1888	Unknown	Unknown	Naezdnik	Pacific Ocean
1891	"	"	Nakhimov	"
1890	"	"	Chernomorets	Black Sea
1891	"	"	Donets	"
1891	"	"	Zaporozhets	"
1893	Hydrographical Expedition of Ministry of Transport	Unknown	Naezdnik, Lieutenant Malygin Minusinsk, Lieutenant Ovtsyn	Arctic Seas
1893	Unknown	A.I.Vilkitski	Unknown	Arctic Ocean
1893	Yenisei expedition	D.Tsim, V.I.Semyonov	Unknown	Yenisei River mouth
1894	Unknown	Unknown	Selyanik	Atlantic Ocean
1894	Oceanographic studies	M.E.Zhdanko	Poryv	North-West Pacific
1894–1896	Hydrophysical expedition	A.I.Vilkitski	Unknown	Arctic Ocean, Yenisei and Ob river mouths
1895	The New Land expedition	O.Chernyshev	Unknown	The New Land
1895–1896	Unknown	S.O.Makarov	Unknown	La Perouse Strait
1896	Expedition of Academy of Sciences	B.Golitsyn	Unknown	The New Land
1897	Assignment of minister S.Yu.Vitte	S.O.Makarov	John of Kronshtadt	From Ob River mouth to Yenisei River mouth

Years	Expedition or Agency	Leaders	Ship Name	Geographical area of research
1898	Unknown	A.I.Varnek	Unknown	Yugorski Shar strait
1898–1901	Murmansk research-fishery expedition	N.M.Knipovich	Andrey Pervozvani	Unknown
1898–1904	Hydrographical expedition	Unknown	Pakhtusov	Arctic Seas
1899	Test navigation	S.O.Makarov	Ermak	Arctic, Spitsbergen archipelago
1900	Murmansk expedition	Unknown	Pomor	Unknown
1900–1902	Unknown	E.V.Toll	Zarya	Novosibirisrie islands
1900–1903	Russian Polar expedition	"	Unknown	Arctic Ocean
1901	Unknown	A.I.Varnek	Pakhtusov	"
1901	"	V.Veber	Ermak	"
1902- 1903	Biological expeditions	N.M.Knipovich	Unknown	Baltic Sea
1904	"	"	"	Caspian Sea
1904	Hydrographical expedition	Unknown	"	Arctic Ocean
1905	Unknown	"	Pakhtusov	Arctic Ocean
1905	Expedition of Minisry of Transport	"	Unknown	Yenisei River mouth
1907–1909	Military agency	"	Bakan	Unknown
1909	"	"	Saint Foka	Kolyma River mouth
1910	The New Land expedition	V.A.Rusanov	Dmitri Solunski	Arctic Seas
1910	Unknown	Yu.M.Shokalski	Michael Sars	North Atlantic
1911	Hydrographical expedition	Unknown	Pakhtusov	Unknown
1912	Expedition of Mail agency	"	Saint Vassian, John Bogoslov	"
1912	Unknown	G.L.Brusilov	Saint Ann	Arctic Seas
1912	Polar expedition	V.A.Rusanov	Hercules	Spitsbergen archipelago

Years	Expedition or Agency	Leaders	Ship Name	Geographical area of research
1912–1915	Research expedition	N.M.Knipovich	Unknown	Caspian Sea
1912–1914	Polar expedition	G.Ya. Sedov	Saint Foka	Arctic Ocean
1913	"	V.Rusanov	Hercules	Northern Sea Route
1913–1914	Unknown	Unknown	Nogaisk	Azov Sea
1898–1915	Hydrographical expedition	B.A.Vilkitski	Taimyr, Vaigach	Arctic Seas
1920–1923	Northern research-fishery expedition	R.L.Samoilovich	Delphin, Nadezhda, Sharlotta	Unknown
1921	1st expedition of Floating Research Marine Institute (Plavmornin)	I.I.Mesyatsev	Malygin (former Solovey Budimirovich)	White, Barents, Kara Seas
1921	Kara barter marine expedition	Unknown	Unknown	Ob and Yenisei River mouths
1922	Research expedition	"	Persei	Arctic Seas
1922	Unknown	"	Danilevski	Black Sea
1922	"	K.M.Derugin	Murman	White Sea
1922	Research expedition	N.M.Knipovich	Unknown	Black and Azov seas
1923	Unknown	Unknown	A.Sibiryakov	White Sea
1923	"	"	Valkiriya, Samorodok	Black Sea
1923–1932	Navy Directorate of Navigation and Oceanography (GUNIO)	"	Pervoye Maya	"
1923–1924	Unknown	"	Ingul	"
1924	"	"	White	"
1924–1925	GUNIO	"	Murman	Barents Sea
1924–1939	Unknown	L.A.Demin	Krasny Vympel	Far East Seas
1924–1946	GUNIO	Unknown	Polyarny	World Ocean
1925–1927	Unknown	"	Sukhum	Black Sea
1925–1928	GUNIO	"	Maxim Gorki	Caspian Sea

Years	Expedition or Agency	Leaders	Ship Name	Geographical area of research
1925–1929	Unknown	"	Lag	Black Sea
1925–1939	"	"	Hidrograph	Japan Sea
1925–1926	GUNIO	"	Beglitski	Black Sea
1926	Unknown	"	Muravei, Paltus	Amur and Ussuri Bays
1926	Unknown	Unknown	Dobrynya Nikitich	Peter Great Bay
1926	GUNIO	"	Lot	Black Sea
1926–1928	"	"	Vorovski	Japan Sea
1927	Unknown	V.V.Shuleikin	Transbalt	Odessa - Vladivostok
1927–1928	GUNIO	Unknown	Pakhtusov	White Sea
1928	Unknown	"	Briz	Caspian Sea
1928	"	P.L.Samoilovich	Krasin	Unknown
1928	GUNIO	Unknown	Krasnyi Vympel, Kazak Poyarkov, Yunyi Pioner	Japan Sea
1928	"	"	Zagraditel	Baltic Sea
1928	"	"	Priboi	Kara Sea
1928–1930	Unknown	"	Kulaz	Caspian Sea
1928–1929	"	"	Krasnovodsk	"
1929	"	"	Unknown	Baltic Sea
1929	"	N.M.Knipovich	Sosunov	Peter Great Bay
1929	"	O.Yu.Schmidt	G.Sedov, Malygin	Arctic Seas
1929	"	Unknown	Lomonosov	Franz Josef Land
1930	Arctic expedition	O.Yu.Schmidt	G.Sedov	Kara Sea
1930	Unknown	Unknown	Kaira, Meteor	White Sea, Umba River mouth
1930	"	K.A.Gomoyunov	Krasnyi yakut	Nevelski and Amur firths

Years	Expedition or Agency	Leaders	Ship Name	Geographical area of research
1930	"	Unknown	Delfin	Barents Sea
1926–1930	GUNIO	"	Krasnyi Vympel	Sea of Okhotsk
1930–1936	Expedition of Pacific Fishery Institute {PFI)	"	Rossinant	Japan and Bering Seas
1926-1935	Unknown	"	Pochin	Caspian Sea
1930–1936	Unknown	P.Yu.Schmidt	Plastun , Askold, Paltus	Unknown
1930–1936	Unknown	G.E.Ratmanov	Dalnevostochnik, Gagara, Plankton, Krasnoarmeets, Hidrograph, Pervoe Maya	Far East Seas
1926–1935	GUNIO	Unknown	A.Kovalevski , Danilevski, Tri Svyatitelya, Pereyaslavtsev	Black Sea
1930	"	"	Kolyma	East Siberian Sea
1930	"	"	Samoed	Baltic Sea
1930–1931	Unknown	"	Sextant	"
1931	Expedition of Arctic Institute	A.F.Laktionov	Lomonosov	Barents Sea, Franz Josef Land
1931	Unknown	Unknown	Bakhchisarai	Black Sea
1931	GUNIO	"	Kommuna	Baltic Sea
1931–1933	Unknown	"	Kafa	Black Sea
1931–1932	Caspian Plankton Research Expedition	N.M.Knipovich	Unknown	Caspian Sea
1932–1936	Arctic expedition	R.L.Samoilovich	Rusanov	Arctic
1932	Unknown	Unknown	Gagara	Sea of Okhotsk
1932	Expedition of Arctic Institute	N.V.Pinegin	Malygin	Franz Josef Land
1932	Unknown	Unknown	N. Knipovich	"

Years	Expedition or Agency	Leaders	Ship Name	Geographical area of research
1932	“	“	Sumeiz	Azov Sea
1932	“	“	Sovet	Sea of Okhotsk
1932–1971	Polar Scientific Research Institute of Fishery and Oceanography (PolarRIFO)	“	Taimyr	World Ocean
1932–1969	Unknown	“	Suchan	Chukchi Sea
1932–1949	Unknown	Unknown	N. Knipovich	North Atlantic
1932	1st one-season voyage	O.Yu.Schmidt	Sibiryakov	Northern Sea Route
1932–1939	Unknown	Unknown	“	“
1932	“	“	Korifei	Japan Sea
1932	“	“	Abkhazets	Black Sea
1932	State Hydrological Institute (SHI)	“	Severoid	Kara Sea
1932–1934	Unknown	“	Shoina	Black Sea
1932–1939	GUNIO	“	Seiner	World Ocean
1932–1936	Unknown	“	Propagandist	Black Sea
1932–1933	Unknown	“	Nekton	“
1932–1933	GUNIO	“	Priboi	Japan Sea
1932–1933	Hydrographical expedition	G.E.Ratmanov	Dalnevostochnik	Bering and Chukchi seas
1932	Unknown	Unknown	Krasnoarmeets	Bering Sea
1932–1934	“	“	Yakor	Black Sea
1933	Research-fishery expedition	V.K.Esipov	Arctica	Region of The New Land
1933	Oceanographic Expedition	V.V.Vashezerov	Nord	Unknown
1933	Hydrographical expedition	V.Yu.Vize	A.Sibiryakov	Northern part of Kara Sea

Years	Expedition or Agency	Leaders	Ship Name	Geographical area of research
1933	“	I..D.Protopopov	Voronov	Kara Strait
1933	“	M.M.Nikitin	Pakhtusov	“
1933	Unknown	Unknown	Chelyuskin	Arctic Ocean
1933	Hydrological expedition	S.D.Lappo	Pioner	Southeastern Laptev Sea
1933	Research-fishery expedition	V.D.Alexandrov	Unknown	The New Land
1933	One-season voyage	Unknown	Vancetti, Iskra	Murmansk, Vladivostok
1933–1934	Unknown	Unknown	Kurort	Black Sea
1929–1935	Ice observations	L.V.Antonov	Krasin	Kara and Laptev Seas
1933	Unknown	Unknown	Beluga	Black Sea
1933	“	“	Belukha	Kara Sea
1933–1938	“	“	Vydvizhenets	Black Sea
1933–1934	“	P.P.Karayanov	Sever	Unknown
1933–1934	Ice drift	O.Yu.Schmidt	Chelyuskin	Arctic seas
1934	Combined expedition of Arctic and Antarctic Scientific Research Institute (AARI)	R.L.Samoilovich	Georgi Sedov	Northeastern Kara Sea
1934–1954	Unknown	Unknown	Lebed	Sea of Okhotsk
1934	Hydrological expeditions	S.S.Ruzov, I.V.Maximov	Unknown	The New Land straits
1934	Unknown	Unknown	Persei	Greenland Sea, Spitsbergen archipelago
1934	1st submarine expedition	Unknown	submarines	Arctic
1934	One-season voyage	V.Yu.Vize	Fyodor Litke	Northern Sea Route
1934	Hydrological unit	Unknown	Temp	Tiksi Bay and Sogo Bay
1934	Unknown	S.I.Belov	Laptev	Khatanga Bay

Years	Expedition or Agency	Leaders	Ship Name	Geographical area of research
1934	Research-fishery expedition	V.K.Esipov	Unknown	The New Land
1934	Unknown	Unknown	Krasnyi Kaspi	Caspian Sea
1934	"	"	Krasnoarmeets	Unknown
1934	Hydrographical expedition	"	Unknown	Minin skerries
1934–1937	Unknown	"	Gimeinovets	Black Sea
1934–1935	"	"	Ermak	Japan Sea
1934–1935	Hydrological expedition	N.I.Evgenov	Krasin	Chukchi and East Siberian Seas
1934–1935	Biological-fishery unit	A.ARomanov	Unknown	Area between Lena and Khatanga Rivers
1934–1935	2nd Chukotka expedition	M.Ph.Zyablov	"	Krest Bay, Mechigmenskay Bay
1935	First High-Latitude expedition	G.A.Ushakov	Sadko	Arctic Ocean
1935	Hydrological expedition	I.A.Kireev	Malygin	Northeastern part of Kara Sea
1935	"	V.I.Vorobjev	Lomonosov, Bakan	The New Land straits
1935	Unknown	Unknown	Severoid-2	Yenisei and Pyasina Bays
1935	Hydrological expedition	D.S.Duplitski, G.E.Ratmanov	Krasin	Chukchi and East Siberian Seas
1935	Research-fishery expedition	N.I.Grigorjev	Vetluga	Barents Sea Islands
1935	Hydrological expedition	Unknown	Pakhtusov, Arctic	The New Land straits
1935	Investigation of river mouths	D.V.Belkov, M.M.Nikitin	Unknown	Siberian river mouths
1935	Unknown	Unknown	Anadyr, Ermak, Vancetti, Iskra	Vladivostok, Murmansk
1935	"	"	Vestnik, Vaindlo	Baltic Sea
1935–1936	AARI research-fishery expedition	V.N.Andreev	Unknown	Kara Sea, Yamal Peninsula
1935–1936	Hydrographical research	G.A.Avsuk	"	Bay of Marina Pronchischeva

Years	Expedition or Agency	Leaders	Ship Name	Geographical area of research
1935–1937	Hydrographical party	V.V.Potekhin	"	Along coast from Cape Schmidt to Komsomolskaya Bay
1936	Unknown	R.L.Samoilovich	Sadko	Unknown
1936	"	Unknown	Neptun	Sea of Okhotsk
1936	Hydrological expedition	P.M. Tsvetkin	Plyarnik, Arctik, Pakhtusov	Yugorski Shar Strait
1936–1940	Hydrological unit	B.A.Morzhev, K.A.Gomoyunov	Nerpa	Sections in Greenland Sea, southeastern part of Kara Sea
1936–1937	Unknown	Unknown	Glubina	Black Sea
1936	Ice observations	Unknown	Kapitan Pospelov, Kapitan Voronin	Arctic Seas
1936	Biological-fishery expedition	G.N.Toporkov	Kaira	Belushya Bay, Matochkin Shar Bay
1936	2nd High-Latitude expedition	R.L.Samoilovich	Sadko	Arctic Ocean
1936	Ice observations	Unknown	Litke	Unknown
1936	Unknown	"	Anadyr, Krasin	Murmansk. Vladivostok
1936	GUNIO	"	Nord	Japan Sea
1936–1938	Unknown	"	Sextant	Baltic Sea
1936	"	"	Vilsandi	"
1936–1940	"	"	Kaira	White Sea
1936–1938	"	"	Krasnyi Kaspi	Caspian Sea
1936–1941	"	"	Anastas	"
1936–1937	Hydrographical expedition	A.A.Braun, Ya.K.Smirnitski	Temp	Laptev strait
1936–1937	3rd Chukotka expedition	Yu.A.Odints	Unknown	Krest Bay
1936–1937	Hydrographical unit	S.I.Belov	Unknown	East Siberian Sea

Years	Expedition or Agency	Leaders	Ship Name	Geographical area of research
1936-1937	1st wintering hydrographical expedition	N.N.Alekseev	Toros	Nordensheld archipelago
1937	Ice patrol	D.M.Apollonov, K.A.Gomoyunov	Nerpa	Greenland and Kara Seas
1937	Hydrographical expedition	Unknown	Georgi Sedov	Northeastern part of Kara Sea
1937	Hydrological expedition	I.I.Lvov	Krasin	Chukchi and East Siberian Seas
1937	Unknown	Unknown	Smelyi	Black Sea
1937	"	"	Tourist	"
1937–1988	"	"	Typhoon	Azov Sea
1937–1938	"	"	Tavrida	Black Sea
1937–1938	"	"	Strela	"
1932–1937	SHI	Unknown	Lenin	Kara Sea
1937	Unknown	"	Litke	Arctic Ocean
1937	"	"	Yakov	Black Sea
1937–1952	"	"	West	Black and Azov Seas
1937	Hydrographical expedition	"	Georgi Sedov	Arctic Basin
1937	Hydrological unit	"	Mossovet	Unknown
1937	Unknown	"	Lebed	Sea of Okhotsk
1937	Ice observations	"	Ermak	Kara and Barents Seas
1937	Ice observations	"	Uritski	Unknown
1937	Unknown	"	Neiva	Japan Sea
1937–1941	"	"	Issledovatel	Barents Sea
1937	"	"	GS-273	Japan Sea
1937	"	"	Razvedchik, Ost	"
1937	"	"	Pioner	Black Sea
1937	"	"	Khenken	"
1937–1951	"	"	Chekist	Azov Sea
1937–1985	"	"	Gals	Black Sea

Years	Expedition or Agency	Leaders	Ship Name	Geographical area of research
1937–1938	"	"	Vl. Kochetov	"
1937–1938	Drifting station	I.D.Papanin	SP-1	Arctic Ocean
1937–1938	High-Latitude expedition	R.L.Samoilovich	Sadko, Ermak, Lenin	"
1937–1938	Unknown	Unknown	Amra	Black Sea
1937–1938	Ice drift	"	Malygin, G.Sedov, Sadko	Novosibirskie Islands and north
1938	Unknown	"	Vostok	Okhotsk Sea
1938	"	"	Persei	Atlantic
1938	Ice observations	"	Taimyr	Arctic Seas
1938	Unknown	"	Mys Kodosh	Black Sea
1938	1st spring ice patrol	K.K.Derugin	Nerpa	Kara Sea
1938	Ice patrol	V.T.Timofeev	Murmansk, Litke	Northeastern Kara Sea, Barents Sea, Vilkitski strait
1938	Unknown	Unknown	Vestnik	Baltic Sea
1938	"	"	Malvina	Black Sea
1938–1941	"	"	Meteor	Baltic Sea
1938	"	"	Gridino	White Sea
1938	Ice observations	"	Ermak	Arctic Seas
1938	"	"	Murmanets	Greenland Sea
1938	Unknown	"	Zyuid	Black Sea
1938–1939	Unknown	"	Papanin	"
1938–1939	Hydrographical expedition	V.A.Radzeevski	Toros	Nordensheld archipelago
1938–1939	Hydrographical unit	V.N.Smirnitski	Unknown	Tiksi Bay
1938–1939	Hydrographical expedition	A.I.Kosoi	Nord	Nordensheld archipelago
1938–1940	559-day drift	Unknown	G.Sedov	Arctic Basin

Years	Expedition or Agency	Leaders	Ship Name	Geographical area of research
1938–1940	Hydrographical expedition	P.A.Guschin	Unknown	Olenek Bay
1939	AARI expedition	Unknown	Sibiryakov	Norwegian and Greenland Seas
1939–1944	Unknown	"	Dezhnev	Northern part of Pacific Ocean
1939	Hydrographical expedition	Ya.K.Smirnitsky	Malygin	Dmitri Laptev Strait
1939	Hydrological unit	Unknown	Professor Vize	Chaunskaya Bay
1939	Ice patrol	"	Nerpa	Kara Sea
1939	Hydrographical unit	"	Murmanets	Islands of Arctic Ocean
1939	Unknown	"	Polyarnic	Japan Sea
1939	Hydrological expedition	"	Sadko	Kara Sea
1939	Ice observations	"	Uritski, Temp, Anadyr, Arkos	Arctic Seas
1939	Unknown	I.S.Samoilenko	Komsomolsk	Unknown
1939	Unknown	S.Z.Riekhakaine	Proletari	Unknown
1939	"	Unknown	Vilyui	Bering Sea
1939	"	"	Toporok , Belogorsk, Gaga, SRT-331	Japan Sea
1939–1941	"	"	Cheluskin	Black Sea
1939–1941	"	"	Korifei, Lebed	Japan Sea
1939	"	"	Kamchadal, Partizan	Unknown
1939–1940	"	"	GS-10	"
1939–1940	Hydrographical expedition	S.G.Karandashev	Papanin	Taimyr Bay
1939–1940	Hydrographical unit	V.P.Shevlyagin	Unknown	Khatanga Bay
1939–1940	AARI hydrological winter expedition	A.P.Kibalin	"	Laptev Strait
1940	Ice patrol	A.A.Kukharski	Smolny	Chukchi Sea

Years	Expedition or Agency	Leaders	Ship Name	Geographical area of research
1940	Unknown	Unknown	Pyatiletka	Caspian Sea
1940	Ice patrol	Ya.Ya.Gakkel	Shokalski	Barents and Laptev Seas
1940	Hydrographical expedition	Ya.K.Smirnitski	Malygin	Sannikov Strait
1940	Hydrographical unit	A.V.Nevski	Ost	Yanski Bay
1940	Unknown	Unknown	Alatyr, Revolutioner	Japan Sea
1940	AARI expedition	"	Sibiryakov	Kara Sea
1940	Research expedition	"	Nerpa	Unknown
1940	"	"	Minin	Yenisei Bay
1940	"	"	Litke	Unknown
1940	"	"	Sedov , Patrul, Anadyr	Kara Sea
1940	"	"	Ostashkov, Voyeikov, Albatros	Japan Sea
1940	Research expedition	Unknown	Mgla	Barents Sea
1940	"	"	Oka-1	Japan Sea
1940–1958	"	"	Val	Black Sea
1940–1941	"	"	Temp	Sannikov Strait, Little Lyakhovski Island
1940–1941	"	"	Shokalski	Barents and Laptev Seas
1941	"	"	Sadko	Unknown
1941	"	"	Volna	"
1941–1944	"	"	Smolny	Pacific Ocean
1941	"	"	Anadyr	Unknown
1941	"	"	Ayaks, Alatyr	Japan Sea
1941	PolarRIFO expedition	"	Masshtab	Barents Sea

Years	Expedition or Agency	Leaders	Ship Name	Geographical area of research
1941	Research expedition	"	Uglomer	Black Sea
1940–1941	"	"	Gydrolog	Caspian Sea
1941	"	"	Saturn	Okhotsk Sea
1941	"	"	Okhotsk , Chukcha	Bering Sea
1942	"	"	Sedov, Tsirkul	Kara Sea
1942	Ice patrol	"	Murmanets	"
1942	Research expedition	"	Temp	Bering Sea
1942	"	"	Geophysic	Japan Sea
1940–1942	"	"	Dalnevostochnik	Bering Sea
1942	"	"	Saner N-2	"
1942–1943	Complex hydrographical expedition	F.F.Baranov	Papanin, West	Khatanga Bay, Olenek River
1943	Ice patrol	Unknown	Smolny	Eastern Arctic
1943	Hydrographical unit	N.N.Kolodiev, Ya.P.Koblents	Vikhr	Uelen, Anadyr firth, Chaunskaya Bay
1943	Unknown	Unknown	GMK-027, BMB-22, Onuka	Okhotsk Sea
1943	"	"	Vityaz	Japan Sea
1943–1948	"	"	Hydrolog (former Kavasaki)	Okhotsk Sea
1944	Ice patrol	"	Smolny	Eastern Arctic
1944	Unknown	"	Kashalot	Okhotsk Sea
1944	"	"	Azimut	Japan Sea
1944–1950	"	"	Rynda	"
1944	"	"	Kapitan Voronin	"
1944–1948	"	"	Kashalot	Barents Sea

Years	Expedition or Agency	Leaders	Ship Name	Geographical area of research
1945–1952	“	“	Temp	Bering Sea
1946	“	“	Vestnik, Okhotsk, Ocean, BO-316, TSH-111	Okhotsk Sea
1946	“	“	Korifei	Japan Sea
1946	GUNIO	“	Severny Polus	“
1946–1947	Research expeditions	“	Sedov, Ayaks	“
1946–1948	“	“	Saratov	Barents Sea
1946	“	“	Kamchatsky, Yuzhny, Vesthik, Opukha, Krasny Vympel	Japan Sea
1946–1959	“	“	Slava	Antarctic Region
1947	“	“	Maitun	Okhotsk Sea
1947	“	“	Yuzhny	“
1947	“	“	K-59	“
1947	Research expeditions	Unknown	RS-13	Okhotsk Sea
1947	“	“	Bering	Northern part of Pacific Ocean
1947	“	“	EK-1, DS-3, Okhotsk, BO-318	Okhotsk Sea
1947	“	“	Tobol, Rynda	Japan Sea
1947–1949	“	“	Vjun	Azov Sea
1947–1948	“	“	Vilui	Okhotsk Sea
1947–1949	“	“	Issledovatel	Okhotsk and Japan Seas
1947–1948	“	“	Toporik	“
1948	“	“	Alatyr, G.Sedov	Japan Sea
1948–1950	“	“	Zvezda Kryma	“

Years	Expedition or Agency	Leaders	Ship Name	Geographical area of research
1948	“	“	Kapitan Voronin	Okhotsk and Japan Seas
1948	“	“	Kapitan Pospelov	“
1948–1982	“	“	Issledovatel	Bering Sea
1948–1969	“	“	V.Vorobjev	World Ocean
1948–1950	“	“	Hydrolog	Okhotsk and Japan Seas
1949	“	“	Persei Unknown2	Barents Sea
1949	“	“	Abrek	Okhotsk Sea
1949	“	“	Briz	Japan Sea
1949	“	“	Utes	Pacific Ocean
1949	“	“	Ametist, Balkhash	Japan Sea
1949	“	“	Bystry	Azov Sea
1949	“	“	Meridian	Barents Sea
1949–1961	“	“	Issledovatel	Black Sea
1949–1950	Research expeditions	Unknown	Kamchatsky	Japan Sea
1949–1950	“	“	Professor Soldatov	Okhotsk Sea
1949–1950	“	“	Toporok	Okhotsk and Bering Sea
1949–1958	“	“	Akvator	Unknown
1949–1979	IO RAS Research expeditions	“	Vityaz	World Ocean
1950	Research expeditions	“	Aisberg	North Atlantic
1950	“	“	Ayaks	Okhotsk Sea
1950	“	“	Ostryak	Bering Sea
1950	“	“	BTSCH-2, West	Okhotsk Sea
1950	“	“	Bystry	Japan Sea

Years	Expedition or Agency	Leaders	Ship Name	Geographical area of research
1950–1951	“	“	Krater	Unknown
1950–1954	“	“	Musson	“
1951–1952	“	“	Korablestroitel	“
1951	“	“	BCHS-614	Azov Sea
1951–1956	“	“	Vetromer	“
1952	“	“	Zarya	World Ocean
1949–1955	“	“	Professor Mesyatsev	“
1953–1955	“	“	Akademik Berg	“

Table 2.2 The most important events in oceanographic studies

Date	Event
20 Sept 1648	S.Dezhnov discovered the Bering Strait, which separated Asia from America.
14 Jan 1701	Peter the Great established the School of Mathematics and Navigation in Moscow.
17 Jan 1724	Peter the Great established the Admiralty - Collegium Archives, which was the beginning of the Navy State Central Archives (NSCA).
23 Dec 1724	Peter the Great launched the First Kamchatka Expedition (1725-1730).
28 Dec 1732	The Russian Admiralty organized the Great Northern Expedition (1733-1743).
04 June 1741	The Second Kamchatha Expedition (1733-1743).
26 July 1803	The first Russian circumnavigation of the Earth in the sloops "Nadezhda" and "Neva."
1815	I.F.Kruzenstern compiled "The South Sea Atlas."
16 Jan 1820	The expedition under F.F.Bellinsgauzen and M.P.Lazarev (1819-1821) discovered Antarctica.
1822	The hydrographic expedition under Lieutenent F.P. Litke reached the New Land.
1826	The circumnavigation of the Earth in the sloops "Senyavin" and "Moller" began.
01 Oct 1827	The Navy Hydrographic Service was established, which is now the Navy Directorate of Navigation and Oceanography (GUNIO).
1843	The Hydrographic Department produced the first published manual for marine hydrometeorological stations named "Manual on meteorological observations made at naval ports and on correction of a ship compass error."
30 May 1849	The Amur Expedition under J.I. Nevelskoi (1849-1855).
1864	The world`s first icebreaker was built in Russia.
1874	The Marine Department was established under the Main Geophysical Observatory (MGO).
1878	The Marine Observatory was established in Sevastopol.
1882-1883	The First International Polar Year (IPY).
24 May 1886	The circumnavigation of the Earth began under First Rank Captain S.O. Makarov in the Baltic Fleet corvette "Vityaz."
14 Aug 1912	The expedition under the senior lieutenant G.Ya.Sedov in the schooner "Saint martyr Foka" departed from Arkhangelsk.
21 Aug 1913	The expedition under B.A.Vilkitski discovered the Northern Land archipelago.

Date	Event
1914-1915	The first one-season voyage from east to west along the Northern Sea Route in the naval transport ships "Taimyr" and "Vaigach" was accomplished.
1915	The Pacific tidal annuals began publication.
1917	Yu.M.Shokalski published his fundamental work "Oceanography."
1919	The State Hydrological Institute (SHI) was established (Leningrad).
1920	The Northern Research-Fishery Expedition was mounted.
10 Mar 1921	The First Floating Marine Research Institute (PLAVMORNIN) was established. N.V.Roze was the first in the history of the Arctic exploration to make an ice forecast for the Kara Sea. The Weather Watch was set up to provide seamen with information on meteorological, hydrological, and ice conditions.
1924	The Northern Hydrographical Expedition was undertaken. The Pacific Research Institute of Fishery and Oceanography was established on the basis of the Pacific research-fishery Station.
1925	The Northern Research-Fishery Expedition was rearranged into the Northern Research Institute. Regular observations were resumed at the Kola meridian section. K.M. Derugin set up the research-fishery station in Vladivostok.
1923-1927	The Black Sea oceanographic expedition was undertaken. PLAVMORNIN merged with the Murmansk Marine Biological Station. The State Oceanographic Institute (SOI) was established.
1930	The Northern Research Institute was rearranged into the All-Union Arctic Institute (AAI).
15 July 1930	The Arctic Expedition in the "Georgi Sedov" began.
1931	Based on the integration of the All-Union Institute of Fishery and the SOI, the All-Union Scientific Research Institute for Fishery and Oceanography was established. The experimental base in Katsiveli (the Crimea) was set up to study wind waves.
28 July 1932	The first-ever one-season voyage began in the "Alexander Sibiryakov" along the Northern Sea Route.
17 Dec 1937	The Directorate of the Northern Sea Route (GLAVSEVMORPUT) was organized. Vize Island was discovered on the basis of analysis of the "Saint Ann" drift. Flights of the hydrological aircraft "USSK-N-2" to the Northern Land under the command of A.D. Alexeev and M.I. Kozlov were initiated to perform ice reconnaissance of the Kara Sea. Polar stations were opened on the cape of Cheluskin, Rudolf Island, in the Nordvick and Tiksi Bays, at the settlement of Barentsburg, and along the Khatanga and Kheta Rivers.

Date	Event
1933	V.V. Shuleikin published his monograph "Physics of the Sea," S.V. Bruevich published his monograph "Methods of chemical oceanography."
1932-1933	The Second Polar Year.
7 July 1934	The first issue of "Weather Bulletin" was published by GLAVSEVMORPUT Weather Watch.
31 July 1934	GLAVSEVMORPUT organized the Inter-Agency Burin of ice forecasts under the command of O.Yu. Schmidt.
1934	The polar Research Institute of Fishery and Oceanography was established in Murmansk.
1934-1935	Winter ice reconnaissance in the Vilkitski Strait was undertaken.
1 Mar 1935	The first Arctic navigational ice forecast was made.
6 July -28 Aug 1935	The first high-latitude expedition of GLAVSEVMORPUT in the icebreaker "Sadko" was undertaken.
1937	The first atmospheric high-latitude expedition was undertaken.
21 May 1937	The first drifting expedition "Severnyi Polus - 1" began. It opened a new chapter in ice studies of the Arctic Ocean.
1938	The following monographs were published: "Sea waters and ice" by N.N. Zubov, "Dynamics of the Sea" by V.A. Beryozkin, and "Hydrology of Seas and brackish waters" by N.M. Knipovich.
1939	The first research-operational groups under marine headquarters were organized. Strategic ice reconnaissance started in the Arctic Seas.
5 Aug -17 Oct 1940	The first-ever one-season voyage of the submarine (SCH-423) from Polyarnyi to Vladivostok along the Northern Sea Route was accomplished.
1941	The Institute of Oceanology was established on the basis of the laboratory of Oceanology of the USSR Academy of Sciences.
14 June 1943	The State Oceanographic Institute (SOI) was established on the basis of the Main Geophysical Observatory (MGO) marine department.
1946	L.F. Tutov was the first to propose that empirical formulae and plots should be used to determine wave parameters from preassigned values of wind speed and fetch.
1947	M.P.Morozov built the first open-sea wave recorder in Russia (VOM-47).
1946-1966	Marine annuals were published.
1948	The marine Hydrophysical institute of the USSR Academy of Sciences was established. The monograph "Hydrochemistry" was published.

Date	Event
1949	Stationary observations from ocean weather ships were organized.
1950	The Far East Scientific Research Institute was established. The first volume of the marine atlas was published.
1951	The Azov-Black Sea Scientific Research Institute of Fishery and Oceanography (now the South Scientific Research Institute of Fishery and Oceanography). The institute of Biology of Southern Seas was established.
1953	The monograph "Basics of Hydrochemistry" was published.
1954	"Manual on works at standard hydrological sections and marine hydrological surveys" was published. It later became "Manual on works in seas and oceans" (1966, 1977).
1956	The Arctic Scientific Research institute was renamed the Arctic and Antarctic Scientific Research Institute. Scientific research studies in Antarctica began. The Marine Hydrophysical Institute of the Ukrainian Academy of Sciences (MHI of UAS) was established in Sevastopol.
1957	World Data Center (WDCs) A and B "Oceanography" were established in Washington, D.C., and Moscow. Since 1990, WDC-B has been located in Obninsk (RIHMI-WDC). Expeditionary research began in the RV "M.Lomonosov," owned by MHI of UAS.
1957-1958	The International Geophysical Year (IGY).
1958	The first voyage of the submarine "Severyanka." A.M.Muromtsev published his monograph "Basic features of the Pacific Ocean hydrology."
1959	The MHI expedition discovered the Atlantic equatorial countercurrent (the Lomonosov current). A.M.Muromtsev published his monograph "Basic features of the Indian Ocean hydrology."
15 Sept 1959	Delivery trials of the world's first atomic icebreaker "Lenin."
1959-1960	The expedition of the Institute of Oceanology of the Russian Academy of Sciences, which discovered the equatorial countercurrent in the Indian Ocean (the Tarreev Current).
1960	Intergovernmental Oceanographic Commission (IOC) of UNESCO was established.
1961	A submarine mounting ridge more than 4000 km long was revealed in the Atlantic Ocean. The world's first Atlas of Antarctica was compiled. The Odessa Branch of the Institute of the Biology of Southern Seas was established.

Date	Event
17 July 1962	The submarine "Leninski Komsomol" reached the North Pole.
1963	Muromtsev published his monograph "Basic features of the Atlantic Ocean hydrology."
1964	The Oceanographic Data Center was organized under the Main Directorate of Hydrometeorological Service. It served as the centralized system for collection of punch card data and data sets.
1966	The monograph "Chemistry of the Ocean" was published. The world's first underwater circumnavigation of the Earth was undertaken by Soviet atomic submarines.
1968	The Odessa branch of the State Oceanographic Institute was established.
1970	The expedition "Poligon-70" discovered synoptically produced eddies in the ocean. The State Committee for Science and Technology (SCST) adopted the resolution on the development of a system of specialized oceanographic data centers.
1960-1970	The International Decade of the Ocean Exploration.
1970-1980	The Global Atmospheric Research Program (GARP) was carried out, which included such experiments as TROPEX-72, GATE, FGGE and others.
1971	All-Russia Scientific Research Institute of Hydrometeorological Information-World Data Center (RIHMI-WDC) was established in Obninsk.
1972	Tropical Experiment (TROPEX-72).
1973	The Pacific Oceanological Institute of the Russian Academy of Sciences (Far East Branch) was established. Regular studies of marine environmental pollution began. The marine network of the Joint State Environmental Observing System was set up. The Sevastopol Branch of the State Oceanographic Institute was established on the basis of the Black and Azov Seas Observatory.
1974	The SCST Scientific Council, which was working on the problem "Exploration of Seas and use of marine resources," established the Interagency Commission on Oceanographic Information for the collection, storage, automated processing, and exchange of data. The Navy Scientific Research Center was established. The USSR participated in the GARP Atlantic Tropical Experiment.
1974-1990	Polar Experiment (South, North)
1975	ODC of RIHMI-WDC produced deep-sea square-by-square data set on magnetic tapes on the second generation mainframe computers (M-222, Minsk-32).

Date	Event
1976	The first edition of "Cruise Summary Report" appeared.
1977	The First Oceanological Congress (Moscow). The data base for coastal hydrometeorological observations was initiated.
17 Aug 77	The North Pole voyage of the atomic icebreaker "Arctica" under the command of A.N. Chilingarov began.
1979	The USSR participated in the First GARP Global Experiment.
1980	NODC produced the first deep-sea cruise-by-cruise data set on magnetic tapes on third generation mainframe computers (Computers of Unified Series.)
1981-1995	"The USSR Seas" project under the leadership of F.S.Tersiev
1982	The Second Oceanological Congress
02 Dec 1982	Antarctic expedition in the Navy hydrographic research vessels "Admiral Vladimirski" and "Faddey Bellinsgauzen."
1979-1983	The first large-scale computer calculations were made to prepare a set of statistical atlases for the Pacific and Atlantic Oceans (temperature, salinity, density, sound velocity, conductivity, and others). The Yu.M. Shokalski prize of the USSR Roshydromet was awarded to the team of people who prepared these atlases: Shirshov Institute of Oceanology - V.N. Stepanov, L.I. Galerkin, S.G. Panfilova, A.D. Sherbinin; RIHMI-WDC - V.I. Lomanov, L.A. Golovanova, S.A. Oleinikov, V.P. Kutko).
1985	Large areas of elevated temperature and salinity were revealed in the Atlantic Ocean. Oceanographic databases, "Oceanography," were created and put into operation in NODC and other institutions.
1985-1995	The USSR participated in TOGA.
1986	Oceanographic databases were put into industrial operation in RIHMI-WDC and other Roshydromet centers. Technology of oceanographic data entry onto magnetic tapes was developed. Technology of oceanographic data collection from computer-equipped vessels was introduced. Development of State Automated System of Oceanographic Information Collection, Storage, Exchange and Processing (SASOI) began. A database of RV cruises performed by all agencies of the USSR and other countries (28,000) was created.
1987	The Third Oceanographic Congress.
1988	The monograph "Oceanographic databases" and the reference manual "Data bases about the Oceanography of the Seas of the USSR" were produced.

Date	Event
1989	"Manual for Preparation of Scientific Report from Expeditionary Investigations of the World Ocean: Physical Oceanography" was published.
1990	NODC produced the third version of square-to-square water bottle data set comprising more than two million oceanographic stations. Joint (ODC of RINMI-WDC and the Navy) bathythermograph database was created.
1991	Technology of obtaining grid point climatic characteristics was developed.
1992	E-mail was introduced. Ocean surface temperature database was created on the basis of satellite observation.
1993-1997	Russia participated in Global Ocean Data Archaeology and Rescue Project (GODAR).
1994	World Data Center-B "Sea ice" was established in Russia (AARI).
1995	PC oceanography database and data collection and primary processing system were developed. Technology of oceanographic data collection on diskettes was introduced.
1996	Report of Russian NODC, "Information Resources of the World Ocean environment," was produced.
1996-1997	New information technologies were applied in NODC (local computational network, GIS, CD recording system, commercial database management systems).
1997	The concept of the Federal Target Program, "The World Ocean," with the subprogram, "Creation of the unified information system for the World Ocean State" (as a key element), was adopted by the Decree of the Russian Federation President of January 17, 1997, and the Resolution of the Russian Federation Government of February 22, 1997.

The Bark “G. Sedov”

3. MARINE EXPEDITIONARY RESEARCH IN THE 20TH CENTURY

3.1 First half of the 20th century

During the first half of the 20th century, marine research in Russia was predominantly conducted in the adjacent and interior seas. This was due to foreign policy and economic reasons. Expedition cruises were first made in converted ships and then in specially built ships equipped with instruments to record air temperature, pressure and humidity, wind speed and wind direction, sea water temperature, salinity and gas content at different depths, and surface and deep currents. Hydrochemical research on the world oceans rapidly expanded.

An important aspect during this period was the establishment of regular oceanographic and marine meteorological observations at the same stations along hydrological sections and at island and coastal stations. Using these observations, statistical analysis revealed cause-and-effect relationships between physical, chemical, and biological processes in the sea and, based on these relationships, marine hydrological forecasts were developed.

Traditional ship observations were supplemented with data from drifting ice stations and aircraft observations. Pilot-balloon and radiosonde observations of wind, air pressure, air temperature, and humidity also began, with measurements taken at different altitudes above sea level. Oceanographic observational data was proving useful for fishing, hunting, and navigational activities as well as for naval operations.

A lack of precise and easy-to-use instruments, the short duration of ship cruises, and bad conditions of living onboard made it extremely difficult to conduct large-scale comprehensive oceanographic research campaigns. However, these drawbacks were substantially offset by the devotion to science and an extremely thorough and deep analysis of the observations that were obtained. This was epitomized in the research by many prominent marine scientists of that time, such as N.M. Knipovich, S.O. Makarov, B.V. Davydov, L.S. Berg, K.M. Deryugin, Yu.M. Shokalsky, Yu.V. Vize, V.A. Beryozkin, N.N. Zubov, V.V. Shuleikin, and others.

Prior to World War II, Russian scientists and sailors undertook many cruises and expeditions to explore the Arctic for both scientific and economic purposes. As early as the late 19th to early 20th centuries, scientist and admiral S.O.Makarov was the first in the history of Arctic exploration to reach 81° 28' N. He is also noted as the first to make oceanographic observations in the vicinity of Spitsbergen, Franz Josef Land, and Novaya Zemlya from the world's first powerful icebreaker, Ermak, which was built according to his specifications. In 1914-1915, the hydrographic expedition commanded by B.A.Vilkitsky carried out a one-season voyage along the northern sea route from east to west in the icebreakers "Taimyr" and "Vaigach." One of the most dramatic geographical discoveries of the 20th century -- the islands of Severnaya Zemlya -- was made during this cruise.

Immediately after Russia's Civil War, research in the Arctic resumed and expanded rapidly. During these years, many of Russia's maritime research institutions were established and which continue to exist today. For example, in 1920, the Northern Commercial Research Expedition (NCRE), an organization established within the Supreme Council of the National Economy, established the Arctic and Antarctic Research Institute (AARI) in St. Petersburg. AARI became actively involved in the study of hydrometeorological conditions along sailing routes and in the fishing and hunting regions from the Kola Peninsula to Novaya Zemlya. Regular observations of currents and ice drifts began in the Kara and Yugorski Shar Straits. In 1921, the NCRE consisted of 23 groups totaling about 400 people. The first director of the

NCRE was R. Samoilovich, a strong champion of investigations in the Arctic. The scientific advisory group for the NCRE consisted of the following prominent scientists: President of the Russian Academy of Sciences, A. Karpinsky; academician A. Fersman; and professors N. Knipovich, K. Deryugin, Yu. Shokalsky, and L. Berg. The Arctic Governmental Commission and the Main Agency for the Northern Sea Route were established in 1928 and 1932, respectively, to organize regular and coordinated research in the Arctic. To explore the possibility of regular navigation along the northern sea route, expeditions were undertaken in the icebreakers "Sibiryakov" and "Chelyuskin" and the icecutter "Litke" along with high-latitude expeditions on the icebreakers "Sadko" and "G. Sedov."

Also in St. Petersburg, the State Hydrological Institute (SHI) was created in 1919 and included a Marine Department. In Murmansk, the Floating Marine Scientific Institute (Plavmornin) was established in 1921, which later became the foundation for the Polar Research Institute of Marine Fisheries and Oceanography (PINRO). In 1922, Plavmornin, under the leadership of professor I. Mesyatsev, became the owner of the "Persey," a ship specially designed for conducting research in the Arctic and adapted to sailing under ice conditions. It was destined to play a leading role in Arctic research. Having made about 100 voyages in the Greenland, Norwegian, Barents, White, and Kara Seas, the "Persey" became a research school for hundreds of students from educational institutions in St. Petersburg, Moscow, Arkhangelsk, and other cities. Many of the students who graduated from these institutes went on to become well-known scientists.

The city and port of Arkhangelsk, which has been a significant sea and river port in Russia since antiquity, occupies a special place in the history of the Russian sea fleet. It was in this city that Peter the Great created the first Russian shipyard and a sea fortress toward the end of the 17th century. The port served all polar ships heading out to conduct research in the Arctic Ocean and which, ultimately, traversed the Northern Sea Route. During 1941-1944, major military cargoes arrived in the USSR through this port. Severodvinsk, a satellite city of Arkhangelsk, is now a large center for building military and other specialized ships.

The Russian Hydrometeorological Service, established in 1836, provided ships with information on weather, hydrological, and ice conditions. In 1917, after an 11-year disruption, observations by PINRO were resumed along the "Kola Meridian." The Murmansk Marine Biological Institute (MBI), with help from the SHI, began to make regular observations along this meridian in 1921. These data are considered to be the longest and most complete series of oceanographic measurements ever obtained. In the same year, the first forecast of ice cover for the Kara Sea was provided by N. Roze. Beginning in 1922, as part of an expedition headed by K. Deryugin, the SHI, the Navy Directorate of Navigation and Oceanography (GUNIO), and Plavmornin started systematic research on hydrological conditions in the White Sea.

A radically new stage in the development of Arctic research began in the 1930s. The Institute for the North was reorganized into the All-Union Arctic Institute; the State Oceanographic Institute and the All-Union Institute for Marine and Fish Industry merged to form the All-Union Research Institute for Fishery and Oceanography (RIFO). During 1932-1933, the Second International Polar Year (IPY) gave another impulse to Arctic research. A network of polar stations was created on the coasts and islands of the Arctic seas. Fifteen major integrated oceanographic expeditions were mounted during this period. In particular, significant scientific results were derived from the GUNIO expedition, commanded by the polar hydrographer A. Lavrov and academician V. Shuleikin. Having first measured the amount of heat received by the ice surface in the Kara Sea from direct and incident radiation by using a solarigraph onboard the

R/V "Taimyr," the scientists calculated all the components of the energy balance in the Kara Sea and revealed a large heat deficit. This deficit could be offset only by the deep warm current from the Atlantic Ocean, which was subsequently supported by observations from the icebreaker "Sadko" and the drifting ice station "North Pole-1." Extremely important conclusions were made by V. Vize and V. Beryozkin concerning the presence of northern islands in the Kara Sea that had not yet been discovered.

One of the most brilliant episodes in the history of Arctic research is represented by the drifting ice station "The North Pole-1 (NP1)" in 1937-1938. During the ten months that NP1 drifted in the Arctic Ocean, four brave men -- I. Papanin, P. Shirshov, E. Fyodorov, and E. Krenkel -- obtained valuable information on the hydrology of the central Arctic, drifting ice fields, and bottom topography. Upper-air meteorological observations resulted in a new understanding of the atmospheric structure in the Arctic region. Subsequently, beginning in 1954 and ending in 1991, drifting stations operated continuously in the central Arctic. Starting in 1957, aircraft high-latitude expeditions of the "Sever" and regular marine expeditions aboard the "Ledovyi Patrul" began to collect ice and hydrometeorological information and to make this data rapidly available for use in making marine forecasts in the Arctic region. This data also was used to describe the hydrometeorological conditions of the Arctic in order to provide navigational guidance to pilots and for the preparation of atlases of currents, which were of considerable importance for the promotion of the Northern fleet and for escorting the allied convoys along the northern sea route during World War II. Among the leaders and participants of numerous pre-war Arctic expeditions were O. Schmidt, V. Shuleikin, N. Zubov, V. Vize, V. Bogorov, V. Beryozkin, G. Ushakov, A. Laktionov, N. Yevgenov, V. Buinitsky, I. Kireev, and many others.

Oceanographic operations in the Far Eastern seas and along the Pacific coast of Kamchatka began with expeditions commanded by V. Brazhnikov, P. Schmidt (1899-1903), and V. Soldatov (1907-1918). Beginning in 1908, a Pacific hydrographic expedition, led by the well-known hydrographer B. Davydov, started conducting observations. In 1915, V. Stakhevich compiled the first summary of available data on the tides in the northwestern Pacific by using the results of the expedition commanded by M. Zhdanko. Since that time, the GUNIO issues annual reports of tides in the Pacific, thoroughly studies ice conditions, and makes depth measurements. In 1923, based on the results of the hydrographic expedition in the Pacific Ocean, B. Davydov issued a pilot report, "The Sea of Okhotsk and the Eastern Coast of Kamchatka with Karaginsky Island Included," which received wide recognition.

During the period 1925-1933, oceanographic and hydrobiological research in the Sea of Japan and the Bering and Chukchi Seas was conducted by the Pacific Scientific Research Fisheries Center (TINRO) and the Far East Research Geophysical Institute. The data obtained during this hydrographic expedition, commanded by N. Tarasov, P. Ushakov, L. Rudovits, and L. Dyomin, were used to issue numerous marine maps and atlases.

Starting in 1932, oceanographic measurements in the Far East seas were performed as part of a Pacific expedition consisting of research teams from the SHI and TINRO. The leader of this expedition was K. Deryugin. Vessels involved in this effort included the trawlers "Dalnevostochnik" and "Blyukher" and the motor-sailing schooner "Rossinant," all of which were converted for use as research vessels. The data obtained during this two-year effort were the most comprehensive not only for the Far East seas but also throughout the entire Pacific basin. These observations provided valuable information that were used to better understand the nature of the Far East waters and fishery development. From these observations, it was possible

to determine the main features of water circulation and heat balance and to identify populations and migration routes of commercial fish. In particular, N. Belinsky and G. Ratmanov contributed much to the research of the Sea of Japan and the Chukchi Sea from 1934-1936.

Early in the 20th century, of primary importance in studying the Baltic Sea were hydrological and ice observations made by S. Makarov aboard the icebreaker "Ermak" (1901) and hydrological and hydrobiological observations by N. Knipovich and S. Pavlovich on the carrying vessels "Opasnyi" and "Kompas" (1908). From 1909-1911, I. Shpindler pursued research in Nevskaya Bay in connection with the construction of a sewage system in St. Petersburg. In 1920-1921, an expedition commanded by K. Deryugin studied hydrological and hydrobiological conditions in the Gulf of Finland with four ships (Oryol, Meridian, Almukantarat, and Polius). In 1928, the Hydrometeorological Bureau made synchronous observations in Nevskaya and Luzhskaya Bays, and the marine department of the SHI performed research at the same locations in the Gulf of Finland on the "Nerpa" and "Liliya" in summer and on the ice in winter.

During the period 1931-1940, the Marine Observatory in Kronstadt sent Vs. Beryozkin, Vl. Beryozkin, and G.Ul to lead a hydrographic expedition in the Gulf of Finland. Comprehensive oceanographic and marine meteorological observations were performed aboard the hydrographic ships "Astronom," "Samoyed," "Kommuna," "Trefem," Kursant," "Vest," and "Ost." The resulting analysis of the distribution and relationship between the parameters of hydrological and meteorological conditions was of vital importance in providing hydrometeorological support to the Baltic fleet during World War II.

N. Knipovich, Yu. Shokalsky, and V. Shuleikin made significant contributions to oceanographic research in the Black Sea soon after the civil war. During 1922-1927, Knipovich led an integrated research-fishery expedition to the Azov and Black Seas aboard the ships "Sukhum" and "Besstrashnyi." The results from this expedition provided a fundamental understanding of basin ichthyology. From 1924-1928, the oceanographic expedition commanded by Yu. Shokalsky, E. Skvortsov, V. Nikitin, and V. Snezhinsky studied the vertical structure of water and flow conditions in the Black Sea. All in all, the expedition obtained data from more than 1,000 oceanographic stations, drilled 700 cores of soil from the sea floor, and conducted comprehensive biological research. In 1932, V. Shuleikin was the first to make an oceanographic survey of the eastern Black Sea in the ship "Gidrograf." The expedition studied, in detail, the penetration of cold waters in the intermediate layer and found that they originated in winter in the shallow-water area of the northwestern part of the sea. Internal waves at the interface between water layers of different density were also first detected and measured. Based on the data from this expedition, A. Dobrovolsky compiled a dynamic map of currents. In 1933, in the Crimea, V. Beryozkin discovered a wave basin to study the development of wind waves.

Starting in 1936, the Azov Research Institute for Fishery Problems (AzNIRKH) began making two or three surveys annually using the ships "Danilevsky" and "Akademik Zernov" in the Azov-Black Sea basin. In addition to the study of hydrological conditions, these ships were used to search for fish in the Sea of Azov, which was the most important fishery basin in the country during the 1930s and 1940s. Numerous pre-war expeditions were largely uncoordinated, which substantially reduced the understanding of hydrological and hydrobiological processes in the basins of the two seas.

As for the Caspian Sea, marine research in the first half of the 20th century began with a special expedition led by N. Knipovich, during which a large amount of hydrobiological and hydrological data were collected. In 1918, expedition research was conducted in the delta of the

Volga River and the adjacent portion of the Caspian Sea, which was a peculiar kind of gate through which oil, chemical raw materials, and valuable species of acipenserids (sturgeons) arrived in Russia. In 1921-22, the hydrological conditions of the Kara-Bogaz-Gol Bay were studied during an expedition under the command of Academician N. Kurchatov. In the early 1930s, N. Knipovich mounted an integrated fishery expedition to study the water area of the Caspian Sea and the Gulf of Komsomolets. Beginning in 1932, research fishery expeditions of the Caspian Research Institute for Fishery Problems (CaspNIRKH) started collecting data in the Caspian Sea and, beginning in 1933, the Hydrometeorological Service also conducted expeditions. These expeditions focused on the northern section of the Caspian Sea, and investigations were conducted to examine issues such as hydrological conditions for spawning, supplies of commercial fish, and feeding mechanisms.

In the 1930s, expeditions of Russian and foreign researchers made it possible to compile distribution maps of salinity over the surface of the Indian and Pacific Oceans.

3.2 Second Half of the 20th Century

With the advent of World War II (1939-1945), Russia's position as a world power was substantially strengthened, and its geopolitical and economic interests were expanded and modified considerably. Navy ships put out to the seas, both domestic and foreign; marine freight transportation rapidly developed between Russia and other countries from nearly all continents; and regions of commercial fisheries, including those for whaling purposes, began to be extensively explored. Soon after the war, a decision was made to perform a wide range of marine research. This included the following: sea surface and deep currents, tidal and storm surge, density distribution, sound conductivity and sound velocity, wave conditions, standing and drifting ice and icebergs, chemical composition of water and bottom sediments, presence and concentration of phytoplankton and zooplankton, spawning and feeding regions, as well as migration routes of fish, whales and crustacea.

The knowledge acquired by the second half of the 20th century greatly enhanced the scientific community's understanding of the ocean's impact on the Earth's climate system. In order to reveal major regularities and cause-effect relationships in the Earth's climate system, it was necessary to measure, on a global scale, the quantitative indices and direction of heating rates as well as water and gas exchange between the atmosphere and the ocean. In the last quarter of the 20th century, a vital issue was the investigation of man-made pollution of the world ocean and the possibility of its self-purification. Marine ore mining as well as marine oil and gas exploration and development were added to the more conventional kinds of economic activity in the sea. And, finally, Russian marine scientists have continued to resolve one of the crucial challenges of the present time - a study of the seas and oceans in order to tap into their energy and to manage biological and mineral resources.

The Russian government responded aggressively to the needs of research for technical support. A research fleet was rapidly expanded; and during the 1960s-1980s, it was one of the most advanced in the world. Educational institutions began to provide training for marine researchers in different specializations. Among these are Moscow, Leningrad and the Far East State University; Leningrad and Odessa Hydrometeorological Institutes; Leningrad Engineering Marine Academy; and others.

3.2.1 Development of expedition research on the World Ocean from 1946-1956

In the latter part of the 20th century, Russian marine scientific institutions received more than 20 specially built expedition vessels, including the first-class research vessels "Vityaz," "Mikhail Lomonosov," "Polius," "Yu.M.Shokalsky," "Akademik Korolyov," "Professor Vize," "Sergei Vavilov," "Akademik Knipovich" and the icebreakers "Lena," "Ob" and others. Search and fishery-reconnaissance vessels, making both hydrobiological and oceanographic observations, had also increased in number.

The suite of instruments was complemented by bathythermographs, electromagnetic current meters, self-contained bottom-depth gauges, remote sensing technology (meteorological rockets and modified radiosondes), plankton nets, bottom sweeps, echo sounders, and radars. This substantially increased the number and quality of oceanographic observations made during expeditions. It became possible to make measurements on meridional and latitudinal hydrological sections throughout the entire ocean, to measure the vertical distribution of temperature and current velocity, to establish self-contained buoy stations for prolonged measurements of currents at different depths, to measure tidal heights in the open sea, to perform regular temperature-wind soundings of the atmosphere above the ocean, to take hydrobiological and soil samples, and to construct thousand-mile profiles of the sea bottom at the stations. In addition, the accuracy in determining the coordinates of oceanographic stations was improved.

Standardization of observational methods was made from the very beginning of oceanographic observations. In 1843, the hydrographic department published the first manual intended for marine hydrometeorological stations, "The Manual for Making Meteorological Observations in Military Ports and for Correcting Errors of Ship Compasses." However, after the first issue of "The Manual for the Operations on Standard Hydrological Sections and Marine Hydrological Surveys" had been published in 1954, this manual became the definitive guide used by all the departments and institutions conducting marine observations. The Manual presented topics such as how to organize expedition operations in the open ocean; appropriate techniques for taking measurements of sea-water temperature, salinity, transparency, and color at the surface and within the water column; and observational methods for currents, waves, and underwater light transmittance. The Manual also described observational instruments, apparatus, accessory equipment, and other devices applied by modern oceanographic ships. A number of methodological materials for hydrochemical, wave, ice and ship hydrometeorological observations were issued at that time. Since that time, observations from expedition vessels have become a standard element of the state observational network.

The first post-war oceanographic investigations were conducted in 1946 by the staff of the State Oceanographic Institute (SOI) and All-Union Research Institute for Marine Fisheries and Oceanography (now the Russian Federal Research Institute of Fisheries and Oceanography, VNIRO). Three vessels were utilized: in the Indian Ocean, the "Aniva;" and in the southern polar region, the whaling vessels "Slava" (from1947) and "Sovetskaya Ukraina." Since 1949, oceanographic observations have been made from specialized research vessels. For instance, an expedition of the "Vityaz," sponsored by the Academy of Sciences, began operating in the northwest Pacific. Previously, the Vityaz had been involved in research in both the Far East seas and the open ocean.

In 1951, the Navy Hydrographic Agency (now the Head Department of Navigation and Oceanography, GUNIO) conducted oceanographic research in the north Atlantic Ocean and the Norwegian, Greenland and Barents Seas in the expedition vessel "Ekvator," which contained

four research laboratories and first-class instruments. From 1952-1955, in a northern hydrographic expedition commanded by E. Kvartalnov and V. Altshuler, GUNIO conducted comprehensive hydrographic observations of tides and currents as well as precise measurements of bottom topography were made in the eastern section of the Barents Sea, including the straits of Kara Gate and Matochkin Shar. A large body of data on hydrology and water dynamics obtained from these expeditions was used to compile helpful manuals concerning surface and undersea navigation and to improve the operating efficiency of naval ships and special facilities in oceanic regions of most importance for Russia. GUNIO's expedition vessels were particularly active during the IGY from 1957-1959. These operations, in addition to the hydrographic ships "Ekvator" and "Stvor," involved the world's largest sailing vessels "G. Sedov" and "Kruzenstern." These ships, along with the "Mikhail Lomonosov," the research vessel of the Marine Hydrophysical Institute of the Ukrainian Academy of Sciences, collaborated in an interagency Atlantic Expedition commanded by V. Shuleikin.

The investigations conducted aboard these ships made it possible to advance the development of a theory for calculating wind-wave elements, and they were useful in revealing significant features of heat fluxes in the Atlantic. In addition, the investigations led to a better understanding of the formation of storms off the African coasts in summer and enabled further study to determine if these characteristics were similar to the formation of storms during the summer in the Black Sea. Of special utility were the monthly measurements of currents at several depths in the vicinity of the Rockol Bank, which showed, for the first time, the temporal patterns in current velocity and direction.

In 1960, the Oceanographic Commission of the USSR Academy of Sciences adopted a program of research in the Atlantic Ocean, which was devoted to the study of ocean dynamics. As part of this program, three interagency expeditions took place from 1960-1965. These expeditions involved the following research vessels: from GUNIO, the "G. Sedov," "Stvor," "Polius," "Nikolay Zubov," and "Kruzenshtern;" from the Marine Hydrophysical Institute, the "Mikhail Lomonosov;" from the Northwestern and Murmansk departments of the Hydrometeorological Service, the "Okeanograf" and "Aisberg;" two trawlers of the PINRO and the Baltic Research Institute for Fishery and Oceanography (now AtlantNIRO); and the "Bataisk" from the Leningrad Hydrometeorological Institute. The largest of them, "Mikhail Lomonosov" and "Polius," had a displacement of 6000 tons and 16-18 laboratories. These ships performed annual hydrological and hydrochemical surveys, current measurements at buoy stations, and standard marine meteorological and heat-balance observations in the North Atlantic, from the tropics to Spitsbergen and Franz Josef Land. The data obtained from these expeditions showed that the Gulf Stream current was more intensive in winter than in summer, and the current also exhibited semi-annual variations, which had a significant effect on atmospheric patterns affecting Europe. The atmosphere-hydrosphere interaction was further explored in the Soviet program, "Sections," and within a number of international programs. This interaction continues to be a main area of research for present-day ocean physics.

Of primary importance in furthering research in the Atlantic Ocean from 1957-1966 was the ownership of the R/V "Mikhail Lomonosov" by the MHI of the USSR Academy of Sciences (which is now the Ukrainian Academy of Sciences). Even in the first cruise (November-December 1957) in the northeastern Atlantic, observations showed that during the fall-winter period, the ocean layer was well mixed up to 700 m, with water advected in by the Gulf Stream, while the bottom layers were much colder (with negative temperatures) due to water originating in the Norwegian and Greenland Seas. Over the course of the next 17 cruises, significant

scientific results were obtained and a number of vital discoveries were made. Among these was the discovery of the relationship between the processes occurring in the north Atlantic waters and the atmospheric circulation in the Northern Hemisphere. Summaries of data obtained from1957-1959 were used to study the atmosphere over the north Atlantic and its interaction with the underlying surface of the ocean. These summaries were successfully applied by many countries to make forecasts in support of marine fisheries and navigation. In addition, a hydrological section along the meridian of 30° West, extending from Greenland to the southern tropics and which crossed all major jets of the Atlantic currents, made it possible to obtain new data on the Gulf Stream, Antilles, North Atlantic, Equatorial, and Canary currents.

In 1960, the R/V "Mikhail Lomonosov" was the first vessel to conduct research on the Gulf Stream in winter. The highest transparency in the world ocean, 64.5, was measured in the Sargasso Sea. In the summer of 1960, a deep equatorial countercurrent was found near the western boundary of the Gulf of Guinea; this was subsequently given the name of Lomonosov. This current represents one of the principal components of circulation in the entire Atlantic Ocean: it is about 300 km wide, has a velocity of 4 knots, and transports water at a rate of 35 million $m^3 s^{-1}$. In 1962, in cooperation with two ships from the Ministry for Fisheries, the "Olonets" and "Zvezda," an expedition of the R/V "Mikhail Lomonosov" succeeded in setting a buoy station at a depth of 6800 m. The observed velocities of deep currents at this station verified that, counter to what was previously understood, it takes substantially less than 300 years for deep waters to mix with surface waters. This fact was subsequently used to support the arguments that deep-water regions must not be used for the burial of radioactive wastes whose half-life is approximately 150 years.

In 1963-64, the "Mikhail Lomonosov" was actively involved in the international expedition, "Equalant," which made magnetometric surveys, observations of currents, chemical and radiochemical observations. During its 18th cruise, the "Mikhail Lomonosov" transmitted via radio the observations of currents to the coastal center, the Institute for Cybernetics of the Ukranian Academy of Sciences, which subsequently processed the data. For ten years, the expeditions of the "Mikhail Lomonosov" collected extensive data, which made it possible to study many physical, chemical, and biological processes occurring in the ocean and atmosphere. Some of the scientific leaders of the expeditions worth noting are A. Kolesnikov, G. Ponomarenko, A. Ivanov, V. Lednyov, V. Agenorov, S. Voita, N. Khanaichenko, B. Nelepo, and A. Metalnikov. The expeditions involved representatives of the Institute of Oceanology of the Academy of Sciences, Institute for Biology of the Southern Seas, Institute for Cybernetics, State Oceanographic Institute, All-Union Research Institute for Fishery and Oceanography, Arctic and Antarctic Research Institute, and Leningrad Hydrometeorological Institute, as well as many foreign institutions and their scientists.

A valuable contribution to research of the Atlantic Ocean was made by the scientific-training ship "Bataisk" in the 1960s. This ship was a good school for students of many specialities related to the marine environment. From 1960 to 1996, this "floating institute" made 35 cruises to the north Atlantic Ocean and the White, Barents, Greenland, Norwegian, Baltic, Mediterranean, and North Seas. Much attention was given to the study of tidal currents, internal waves, variability of heat balance, and the influence of currents on the position of the ice edge. The expeditions were generally led by the professorial staff and researchers from educational institutions and colleges.

Of considerable value are specialized hydrophysical observations made in the Atlantic Ocean by the R/Vs "Sergei Vavilov" and "Piotr Lebedev," owned by the Acoustic Institute.

Both ships had five laboratories to study hydroacoustics, electronics, hydrology, hydrobiology, and hydrochemistry. Working almost simultaneously in nearby regions and using automated recordings of hydrophysical parameters, these ships obtained extremely accurate measurements. Observations of the dynamic characteristics of ocean waters were made by direct measurements with current meters and also by hydroacoustic measurements of noise across a wide range of frequencies under different states of the ocean and in a variety of weather conditions.

Also important in the advancement of research in the north Atlantic Ocean, as well as the Barents, Norwegian, and Greenland Seas, were expeditions of research vessels of PINRO ("Persey-2," "Sevastopol," "Tunetz," "Professor Mesyatsev," "Akademik Berg," "Akademik Knipovich") and fishery reconnaissance ships. The "Persey-2," converted in 1949 from a steam trawler and named in memory of the "Persey," was the first vessel in the Soviet research fleet, over many years of voyages in the Barents, Greenland and Norwegian Seas, to have collected research materials of such volume and scientific-fishery significance to be comparable with those obtained by many of the larger present-day research vessels.

In the summer 1960, the "Persey-2," commanded by M. Adrov, and eight other research vessels from Germany, Norway, Great Britain, and Iceland were involved in an expedition sponsored by the International Council for the Exploration of the Sea (ICES), which took place in the Norwegian and Greenland Seas and adjacent regions of the north Atlantic Ocean. The expedition made three complete oceanographic surveys of the Faroe-Iceland basin. After processing the collected data, it was found that cold deep waters of the Norwegian Sea penetrate into the north Atlantic through most of the basin's extent; and the resulting vertical circulation produces conditions favorable for the development of zooplankton, the major food source for fish in the Norwegian and Barents Seas. The international oceanographic survey of the northwestern Atlantic in the spring and summer 1963 involved expedition ships of PINRO ("Akademik Knipovich" and "Topseda") and ships from Germany, Canada, France, Norway, Great Britain, Denmark, and Iceland. The objective of this expedition was to determine the conditions most favorable to the development of larvae and young fish of various species in order to solve the problems of fishery management.

During 1964-66, the Hydrometeorological Service ships "Aisberg" and "Okeanograf," deployed numerous buoy stations in the north Atlantic, from the Faroe and Shetland Islands to the Rockol Bank, using Alekseev current meters. As a result, the two-layer current was found in the Faroe-Shetland strait: in the upper layer as deep as 400-600 m, a northward flowing current; and at greater depths, a southward flowing current. These data were in a good correlation with the observations obtained from the R/V "Mikhail Lomonosov." In 1967, for 55 days, these ships conducted observations of currents to a depth of 1 km in the deep-sea trough southwest of the Faroe-Shetland basin. Continuous measurements of currents for such a long period, and to such a great depth, were the first to be made in the history of world-ocean research.

Long-term joint operations of expedition ships of PINRO in the Barents and Norwegian Seas exemplify interagency coordination of marine research. The results of these efforts prove that successful exploration of the ocean's biological resources depends greatly on the development of many sciences, primarily hydrometeorology, hydrochemistry, hydrobiology, and ichthyology.

Post-war oceanographic research in the Pacific Ocean began in 1949 when the R/V "Vityaz," named after two historically well-known Russian oceanographers, arrived in Vladivostok. The "Vityaz" became the flagship of the Soviet Pacific research fleet, which it held for more than 20 years. It had an endurance cruise of 18.5 thousand miles, supported 18 research

laboratories, and was able to make observations as deep as 11 km. Some of the expeditions of the "Vityaz," organized by the Institute of Oceanology, involved 43 agencies and institutions. These included the Far East Research Institute of Hydrometeorological Information (Far East RIHMI), Pacific Research Institute for Fishery and Oceanography (TINRO), GUNIO, and Maritime Hydromet.

In 1952, an interagency Far East expedition was mounted, led by V. Timonov. The expedition made simultaneous instrumental observations of currents in the Kuril Straits from four ships ("Vityaz," "Gidrolog," "Plastun," and "Dalnevostochnik"), and the data acquired were of great scientific significance. The data showed that one of the main hydrological features of that region was the high velocity of water exchanged between the Sea of Okhotsk and the Pacific Ocean through the straights, a velocity up to six knots, which represented serious danger to surface and underwater navigation.

The "Vityaz" also obtained valuable data in other oceanographic expeditions. In the spring of 1954, the "Vityaz" and five research vessels from different agencies made three oceanographic surveys in the Sea of Japan for ten-day intervals. These surveys provided valuable information about the heat-accumulation processes in the active sea layer. In April-May 1957, the "Vityaz" was the first to make extended time series of deep-sea observations at two locations and while anchored: to a depth of 7690 m in the area of the Kuroshio current and to a depth of 9600 m in the Kuril-Kamchatka trench. The "Vityaz" also played a large part in studying deep-sea trenches in the Pacific Ocean. In 1953, the correct depth was determined for the Kuril-Kamchatka trench -- 10542 m. For many years, the depth was considered to be 8512 m, which was measured by the U.S. ship "Tuscarora" in 1874. During 1957-1958, the "Vityaz" also investigated some of the other large deep-sea trenches: Idzu-Bonin, Mariana, Ryukyu, Tonga, Kermadec, Aleutian, Philippine, Bougainville, and Palau. In 1957, the maximum depth of the Mariana Trench, found near Guam Island, was discovered to be 11034 m; it was previously taken to be 10843 m. Depth measurements in deep-sea trenches were made along with current observations, soil sampling, bottom photography, and an accounting of biological activity. Such comprehensive data from the "Vityaz" cruises, with some measurements exceeding 2 km, were comparable to those of the well-known major foreign expeditions during 1949-1957 as well as the cruises of prominent Danish and English scientists in the "Altares," "Halathea," and "Challenger-2."

These extensive observations were subsequently used by Russian scientists to make essential discoveries in the deep trenches. For instance, Professor A. Ivanov from Leningrad State University discovered a new type of species, pogonophora, inhabiting the ocean at a depth of about 10 km. The photography of bottom topography in the northern and central Pacific revealed vast areas of the ocean bottom covered with ferromanganese nodules (as much as 10 kg m^{-2}). In addition, a study of deep-sea trenches showed that an intensive exchange occurs between the surface and deep waters. Based on this fact, V. Bocharov and M. Krin deemed it inappropriate to bury radioactive wastes in ocean trenches.

The research vessels "Vityaz," "Okean," "Val," "Zhemchug," "Pervenets," and "Ob" participated in Pacific research expeditions as part of the International Geophysical Year (IGY) during 1957-1958. These cruises covered the Bering Sea, portions of the Kuroshio Current, and western, northern, central and Antarctic parts of the Pacific. Joint efforts of researchers from Russia, the USA, Japan, Canada, France, Indonesia, Australia, and other countries resulted in the solution of some of the major problems in physical oceanography. In particular, the Pacific equatorial countercurrent (the Cromwell Current) was found to have a discharge of more than 40

million m^3 s^{-1}, which is approximately equal to the discharge of the Gulf Stream. The observations made in the "Vityaz" in 1958 showed that eddies, with a diameter of more than 100 miles, form at the boundaries of the Cromwell Current; and eddies in the southern tropical front had a clockwise rotation while those in the northern tropical front were counterclockwise.

In 1958, the "Vityaz" and the "Ob" made measurements along a longitudinal section from the Bering Strait to the Antarctic coast, and they were the first to give a comprehensive account of the latitudinal variation of the physical, chemical, and biological processes in the ocean. In 1961, V. Kort, the leader of the expedition aboard the "Vityaz," was the first to construct a theory of deep currents in the central part of the ocean based on deep-sea instrumental measurements.

In 1959-1960, the R/Vs "Yu.M. Shokalsky" and "A.I. Voeikov" (Far East RIHMI), which logged more than 15 thousand miles, embarked on expedition research in the Far East seas and the North Pacific. These vessels were designed to support a wide range of research in oceanography, meteorology, aerology, and geophysics. These ships were the first in the history of marine research to apply meteorological rockets for upper-air soundings.

Beginning in 1965, a program of international research to investigate the Kuroshio Current was conducted, and one of the first expeditions to this region was undertaken by the R/Vs "Yu.M. Shokalsky," "Zhemchug," and "Uliana Gromova" under the leadership of A. Muromtsev. The following year, five ships ("Yu.M. Shokalsky," "Vityaz," "A.I. Voeikov," "Orlik," and "Gennady Nevelskoi") made surveys of the Kuroshio Current in the summer and winter seasons; and the following year, these ships made surveys of the current in spring, summer, fall and winter. The data from these research efforts provided detailed information about the annual and long-term variations within the Kuroshio Current and showed a relationship between its course and weather changes occurring in the Russian Far East.

Oceanographic, aerometeorological, hydrometeorological, and ichthyological observations made by the "Yu.M. Shokalsky" and "A.I. Voeikov" in the Kuril-Hokkaido region and near the Aleutians were of great value in making weather forecasts and providing safe navigation in these biologically rich regions. Of great importance to advancing an understanding of the biological resources of the Pacific were the cruises of the "Vityaz" in 1966 and the "Akademik Berg" (TINRO) in 1964-68. These ships made valuable observations of bacteria inhabiting the sea bottom, which were actively involved in transforming the organic matter, deposited on the bottom, to mineral substance.

Along with large research vessels, such as those discussed above and others, much of the oceanographic and hydrobiological research in the Pacific Ocean, the Sea of Japan, the Sea of Okhotsk, and the Bering Sea during the period 1948-68 was performed by small expedition ships of the Far East RIHMI and TINRO. These were largely represented by medium fish trawlers ("Gidrolog," "Dalnevostochnik," "Priboy," "Zarnitza," "Pelamida," "Zhemchug," "Orlik," "Virokan," "Pervenets," and "Alazeya"). This minor research fleet had two objectives: (1) to make long-term continuous observations at standard sections in order to determine variations of major hydrophysical parameters (temperature, salinity, transparency, chemical composition of sea water, currents, and waves) and for the purpose of investigating climate variability; and (2) to compare these data with other data on zoo- and phytoplankton and migration of fish shoals, whales, and invertebrate.

Regular investigations in the Indian Ocean began in 1959 with the six-month expedition in the "Vityaz" led by V. Bocharov and again the next year under the command of P. Bezrukov. In 1955-1959, the R/V "Ob" made measurements on two oceanographic sections in the southern

region of the Indian Ocean; the first section extended from the Antarctic to the Bay of Bengal and the second from the Antarctic to the Red Sea. During 1959-1962, the R/Vs "Yu.M. Shokalsky" and "A.I. Voeikov" (Far East RIHMI) made voyages in the Indian Ocean. These expeditions, undertaken in the Red Sea during the winter period, detected large year-to-year variations in temperature and oxygen content. In his calculations, N. Kucherov found that a mean daily heat loss at the ocean surface in 1959 was 2.5 times higher than that in 1960 (685 and 275 cal cm^{-2} day^{-1}, respectively). The water in the Gulf of Aden proved to be characterized by a very low oxygen concentration, lower than 1 ml l^{-1} in a depth range of 200 - 1500 m.

There were other expeditions in the Indian Ocean throughout the 1960s. In 1962, the "Vityaz" conducted expedition research in this area during the summer monsoon. Previously, no country had done oceanographic research in the Indian Ocean during the summer because of severe meteorological conditions. Over three years, numerous observations were made throughout this vast region, from Australia to South Africa and from the Asian coasts to 40° S. Major research tasks in this region consisted of studying atmospheric and oceanographic conditions, establishing zones of oceanographic fronts, determining heat balance and water exchange, determining concentrations of chemical elements and water radioactivity, etc. Self-contained buoy stations, which were capable of making measurements over a long period of time, were first deployed in the ocean in order to record current velocity and direction at different depths. A great contribution to the Indian Ocean research was made by the Azov-Black Sea Research Institute for Fishery and Oceanography (AzNIRKH) and VNIRO. To study fish supplies in the Indian Ocean, AzNIRKH mounted a scientific-search expedition in the R/V "Vladimir Vorobjyov" in the northwest section of the Indian Ocean in 1961 and 1962. Research investigating the influence of hydrological conditions on the behavior of different species of fish showed that concentrations of commercial fish stocks are produced only under very specific water temperature and oxygen content. In 1963-1964, two research vessels of the medium fish-trawler type (MFT), the "Marlin" and "Chernomor," and two large research vessels, the "Nauka" and "Lesnoi," – all four owned by AzNIRKH – were deployed to the Indian Ocean to conduct oceanographic, hydrobiological, and ichthyological investigations. The research-fishery vessel "Akademik Knipovich" (VNIRO), which was put into operation in 1965, contributed much to the development of research on the Indian Ocean. In the history of world shipbuilding, this was the first vessel that had a displacement of 3800 tons, supported 13 laboratories, and was equipped with special acoustic devices, under-water photography cameras, plankton nets, hundreds of powerful multi-colored electric lamps, and other instruments. A research fishery expedition conducted on the "Akademik Knipovich" in the Southern Ocean found that the Antarctic waters, adjacent to the south Atlantic and western Indian Oceans, are characterized by high biological productivity. In 1966, an expedition of the R/V "Mikhail Lomonosov" was undertaken in the Indian Ocean, the Red and Arabian Seas, and the Gulf of Aden. Based on the depth measurements in the Gulf of Aden, drastic changes in bottom topography were revealed, with depths increasing from 200 to 5000 m. Geophysicists hypothesized (subsequently confirmed) that active submarine volcanoes existed at the boundary between the ocean and the Red Sea. In 1967, the "Vityaz" made prolonged and continuous measurements of all hydrophysical parameters at different depths in a small region of the tropical Indian Ocean representing a peculiar kind of natural laboratory. The results of geophysical observations and depth measurements obtained by the R/Vs "Ob," "Vityaz," "Mikhail Lomonosov," and "Akademik Kurchatov" from 1955-1962 radically changed the understanding of bottom topography in the Indian Ocean. Numerous ravines, canyons, mountain peaks, troughs and

mountain ridges that were given the names of Russian scientists and research vessels soon made their appearance on maps. Vast areas of ferromanganese nodules, similar in chemical composition to those in the Pacific, were also found at the bottom of the central region of the Indian Ocean.

Of great scientific value and applied interest was determining the features of the monsoon current covering the whole area of the Indian Ocean north of 5° S and the deep-sea countercurrent running below. The salinity distribution at the equator was found to depend largely on the influence by high-salinity waters in the Arabian Sea as well as freshened waters in the Bay of Bengal. In addition, expedition ships have collected a large body of valuable data on biological productivity of the Indian Ocean and revealed regions that were most promising for fishery development. Mutually beneficial contacts were established between scientists from the USSR and scientists from India, Indonesia, Ceylon, Australia, Burma, and other countries of the Indian Ocean basin. These contacts advanced a mutual understanding in solving crucial problems of international research.

Research in the southern polar region research started in 1946. Every year, scientists participated in cruises of whaling vessels such as the tenders "Slava," "Sovetskaya Rossiya," "Sovetskaya Ukraina," and "Yury Dolgoruky." During the period 1946-1970, the scientific-search ships of these flotillas had collected extensive material on oceanographic, aerometeorological, and hydrobiological observations that helped resolve problems concerning the development of the whaling industry as well as some oceanographic and climatological questions. These data improved the ability to forecast hydrometeorological processes in the Northern Hemisphere and on a global scale.

Oceanographers and hydrobiologists, working collaboratively with whalers, solved the complicated fishery problem of detecting ocean regions with large groups of whales. These scientists also were able to study the physical processes occurring in the Antarctic waters, affecting the flora and fauna. Current measurements at self-contained buoy stations in the southern polar oceans showed that two rings of ocean currents existed. The outer ring, i.e. the Great Eastern Drift, crosses the southern regions of the Atlantic, Indian and Pacific Oceans; has a mean width of 1580 km and a mean depth of 2370 m; is 7.5 times greater than the Gulf Stream in water transport; and is, thus, the largest ocean current. The penetration of the Atlantic waters into the Pacific implies that a general circulation of the World Ocean waters exists, but is has more of a background nature, which in most regions, is overlapped by more distinct currents.

Additional oceanographic and meteorological discoveries were made in the mid 1900s in the Southern Ocean. For instance, a study of the ocean circulation in the Antarctic waters showed that deep and bottom waters originated in this region, which then spread throughout the entire World Ocean. Yu. Makerov, participating in one of the first cruises of the tender "Slava," classified the waters of the southern polar basin into three major categories: surface water with large temperature gradients; bottom water representing a layer of 2500 m thick with negative temperatures; and an upper deep-water layer. V. Nazarov and V. Rzheplinsky, both from SOI, found that in the region of intensive ice melt, the height of storm waves is considerably lower than that in other regions, although wind speed was the same. They accurately interpreted this phenomenon by deducing that much of the wind energy is taken by internal waves at the interface between waters of normal salinity and freshened waters. In addition, scientists found that some of the islands plotted on maps of the Southern Ocean, which were generated many years previously, no longer existed. From a distance, huge icebergs that were covered with silt and stones and, therefore, having a dark earthen color, were inadvertently mistaken for islands.

Similar phenomena were also observed in the Arctic. As for the atmosphere, T. Tauber analyzed synoptic maps and determined the regions of incipient cyclones in the high latitudes of the Southern Hemisphere. The analysis of cyclone recurrence maps and mean monthly air pressure maps, obtained in the Antarctic regions, showed that Antarctic cyclones mate with anticyclones in the southern subtropical belt of the eastern regions of the Atlantic, Indian and Pacific Oceans. In 1956, based on ten years' worth of observations, the SOI's staff prepared a monograph, "Antarctica," whose first part was devoted to climate and weather and the second part to hydrological conditions in the Antarctic waters. This was the first monograph of its kind in the history of polar research.

In 1957, during the IGY, the USSR studied the Antarctic region between 80° and 105° E. In order to conduct oceanographic research in the Antarctic waters as well as deliver supplies and instrumentation to the Antarctic coast, which were required for establishing and ensuring the operation of coastal and inner-land stations, the identical and powerful icebreakers "Ob" and "Lena" were deployed. These vessels had a displacement of more than 12 thousand tons; supported eight research laboratories; included facilities for launching meteorological and aerological instruments; and contained aircraft and helicopter platforms to perform aerial ice reconnaissance and transport operations. The first expedition, led by V. Kort, headed to the Antarctic coasts in the "Ob" and "Lena." In 1957, a second Antarctic expedition utilized the same ships in the Southern Ocean. The "Ob" made measurements along meridional hydrological sections in the Indian Ocean sector of the Southern Ocean, and the "Lena" studied the coasts of the continent. In 1959, an oceanographic expedition in the "Ob" studied the waters of the Southern Ocean along three sections: from Cape Town to station Mirnyi; along coastal waters from station Mirnyi to station Lazarev; and from station Lazarev back to Cape Town.

In late 1967, the 13th Antarctic expedition headed to the Southern Ocean in the "Ob," "Professor Vize," "Faddeiy Bellinsgauzen," and "Boris Davidov." The new R/V "Professor Vize" (AARI), commanded by Academician E. Fyodorov, conducted oceanographic, marine aerometeorological, and geophysical research over a large area of the Antarctic waters and carried out tests of new equipment and instruments. The three other research vessels of this expedition, under general command of A. Treshnikov, were devoted to oceanographic studies of the Bellinsgauzen and Weddell Seas, which were covered with floating ice and icebergs.

In the decade following the IGY, further Antarctic expeditions successfully completed a significant amount of research in marine aerometeorology, oceanography, geophysics, biology, hydrography, and marine geology. In addition, it may be noted that during the 100 years preceding IGY, about 2 thousand oceanographic stations had been involved in research throughout the Southern Ocean and a similar number during 1956-68, with almost half accomplished by the R/Vs "Ob" and "Lena." On their journeys to the Antarctic coasts and back, these ships made measurements along numerous meridional sections crossing the Indian Ocean and the South Pacific, which included the following: 30 thousand miles of currents were measured by electromagnetic technique; 155 thousand miles were covered by depth sounder measurements; regular observations were made of icebergs, waves, and water temperature; and a collection of flora and fauna were acquired along with many samples of bottom sediments.

These and many other observations provided the basis for the world's first comprehensive "Atlas of Antarctica" jointly compiled by AARI, MSU, Institute of Geophysics of RAS (Russian Academy of Sciences), SOI, Research Institute for Arctic Geology, GUNIO, the Ministry of Marine Fleet, and other organizations. The first volume of the Atlas included cartographic materials and, the second, scientific papers on the Antarctic nature.

The materials of Russian and foreign expeditions undertaken in the 19th and first half of the 20th centuries made it possible to analyze both horizontal and vertical spatial and temporal variability of temperature, salinity, and density over much of the world ocean's area. In the late 1940s, Russian scientists investigated hydrological conditions in the oceans based on data summaries. The most significant results of these investigations are given in A. Muromtsev's monographs and atlases of the Atlantic, Pacific, and Indian Oceans as well as in A. Dobrovolsky's papers on the classification of water masses. In the mid 1970s, all collected and digitized observations from Russian and foreign research vessels were classified and processed by the staff of the Institute of Oceanology of RAS and in the U.S. by the National Oceanic and Atmospheric Administration's (NOAA) National Oceanographic Data Center (NODC). The processing and analysis results are summarized in the series, "Atlases of Hydrophysical Parameters of the World Ocean" (temperature, salinity, density, sound velocity, electric conductivity, Vaisala-Brent frequency, and quasi-homogeneous layer).

3.2.2 Period of national and international projects and programs for comprehensive World Ocean research

By the early 1970s, the number of Soviet research vessels and their capacity for taking extended cruises had reached the point where oceanographic research could be conducted on a regular basis, both regionally and globally. Research vessels put into operation in succeeding years were generally built for special-purpose groups, such as the weather ships "Musson," "Passat," "Poryv," "Shkval," "E. Krenkel;" the satellite-tracking ships "Kosmonat Yu. Gagarin," "Kosmonat V. Komarov;" the general-purpose ships "Akademik Mstislav Keldysh," "Akademik Fyodorov," the new "Vityaz;" the research icebreaker "Otto Schmidt;" the self-contained submersible vehicle "Sever;" the submarines "Vega" and "Severyanka," and others. The number of research vessels with respect to agencies, institutions, and republics of the former USSR is presented in Table 3.1 and the information on these vessels is given in Appendix 1.

Table 3.1 Number of expedition ships with respect to agencies, institutions and republics of the former USSR

Republic	Agency	Institution	Number of Ships
Azerbaijan	Hydrometeorological Service		7
Georgia	Hydrometeorological Service		5
Latvia	Hydrometeorological Service		4
"	Committee for Fishery	BRIF	8
"	Geology	RIMG	2
Lithuania	Hydrometeorological Service		7
Russia	Hydrometeorological Service	AARI	17
"	"	Amderma Hydromet	1
"	"	SHI	4
"	"	Far East Hydromet	1
"	"	Far East RIHMI	28
"	"	Kamchatka Hydromet	8

Republic	Agency	Institution	Number of Ships
"	"	Murmansk Hydromet	52
"	"	Kolyma Hydromet	6
"	"	St-Petersburg SOI	1
"	"	Maritime Hydromet	9
"	"	Sakhalin Hydromet	33
"	"	Northern Hydromet	10
"	"	North Caucasia Hydromet	24
"	"	Northwestern Hydromet	7
"	"	Tiksi Hydromet	3
"	Russian Academy of Sciences	AI	2
"	"	IV	1
"	"	IWP	1
"	"	IO	11
"	"	MMBI	1
"	"	Sakhalin CRI	5
"	"	POI, Far East Branch	7
"	Committee for Fishery	AtlantNIRO	56
"	"	VNIRO	3
"	"	WESTFISHREC	42
"	"	PINRO	75
"	"	SakhNIRO	1
"	"	TINRO	88
"	"	PBFS	4
"	Ministry of Defense	GUNIO	97
"	Ministry of Education	RSHMI	2
"	"	Moscow State University	3
Uzbekistan	Hydrometeorological Service		2
Ukraine	Academy of Sciences	IBSS	3
	"	MHI	4
	Hydrometeorological Service	Odessa SOI	9
	"	Sevastopol SOI (now Marine Division of Ukrainian RIHMI)	53
	"	Ukrainian Hydromet	33
	Committee for Fishery	South RIFO	31
	"	South Fish Search	26
Estonia	Hydrometeorological Service		8
	Academy of Sciences	ITPE	1
Unknown			32

The instrument capabilities had also been enhanced with (1) sounding bathometers measuring temperature and salinity to an accuracy of 0.001° C and 0.001%, respectively (developed by the Central Design Office of Hydrometeorological Instruments); (2) automated digital current and water temperature meters (AARI); (3) towered sounders produced by

"Nyrok," which measured the vertical distribution and horizontal variability of water temperature, and (4) new CTD technology, "Istok," which measured the electric conductivity of water while a ship was moored (by IO of RAS and MHI of Ukrainian AS). These low-inertia instruments, which measured the micropulsation of water temperature, electric conductivity, and currents, were useful in developing a quantitative understanding of heat and mass exchange as well as momentum transfer both at the interface between the atmosphere and the ocean and within the water column itself.

Stand-alone instruments were no longer necessary and began to be integrated into a ship's observational platform. When computers were installed on the research vessels, these observational platforms were unified into a totally automated measuring system. The automation of field measurements of meteorological and oceanographic parameters contributed to the solution of two vital problems facing sea expeditions by the mid-1980s: real-time computer display of measurements as tables and plots, on which instantaneous analysis could be used for making decisions in order to adjust the schedule of observations; and preparation of scientific and technical reports about the expedition directly en route.

The world scientific community, having become aware of the substantially increased capabilities of Russian oceanographers, invited them to participate in international projects to further understand the oceans and foreign seas, primarily to make oceanographic and aerometeorological observations. In most cases, this was adequate for the scientific and economic interests of Russia. The Soviet scientists participated in some international projects to provide scientific and methodical assistance to other countries and to uphold the international reputation of Russia.

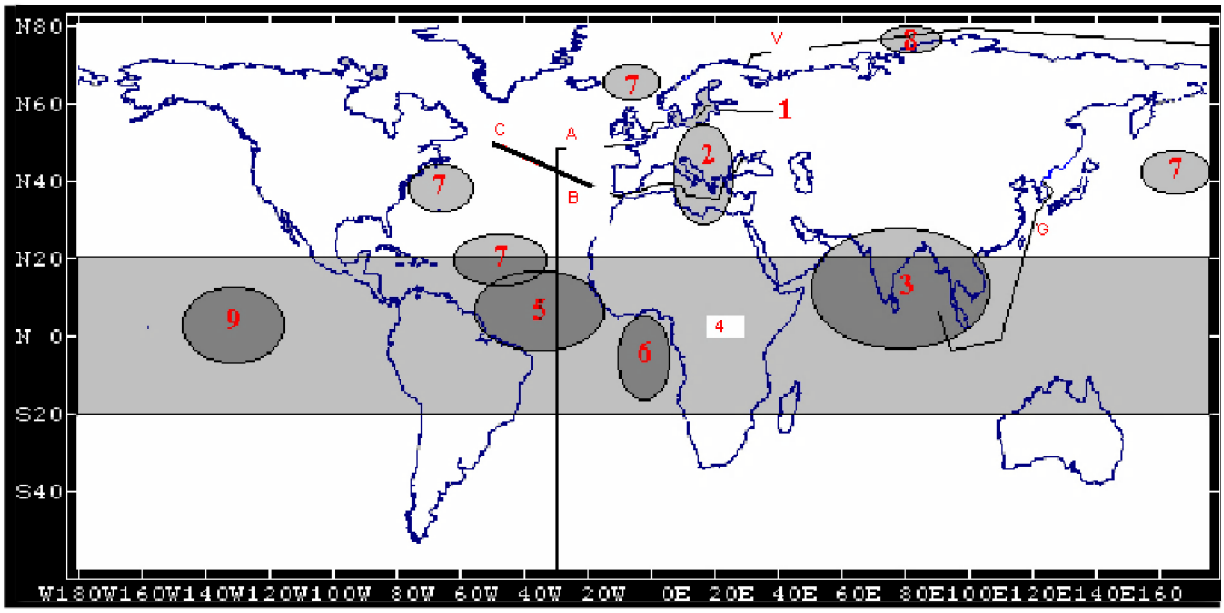


Figure 3.1 A map of regions where major national and international projects were conducted; typical R/V cruises (1 – "Baltics", 2 – ALPEX, 3 – Monsoon, 4 – TOGA, 5 – GATE, 6 – MONEX, 7 – SECTIONS, 8 – Kara Experiment, 9 – Abissal; C – OSP, A – AARI, B – SOI, V – Murmansk Hydromet, G – Far East RIHMI)

However, beyond the international scientific and technical cooperation, the research institutes of the Academy of Sciences and Roshydromet concentrated most of their attention on national projects of marine research as well as on scientific support for the Navy and activities devoted to the application of marine resources. During a span of 25 years, from 1970-1994, Soviet research vessels had conducted expedition observations for 54 oceanographic research projects, 13 of these being international in scope. Figure 3.1 shows a map of the regions where major national and international projects were implemented. These projects involved more than 1100 R/V cruises (not including the cruises in inland and border seas) of which 190 were part of international programs and more than 900 for national projects. International and national projects are listed in Table 3.2. Information about these projects is given in Appendix 2, and the information on the cruises involved in Appendix 3.

Table 3.2 International global and regional projects of marine research

Name of project/program	Acronym
Global Projects	
First International Polar Year	IPY-1
Second International Polar Year	IPY-2
International Decade of Ocean Exploration	IDOE
Global Atmospheric Research Program	GARP
First GARP Global Experiment	FGGE
Joint U.S.-Soviet Mid-Ocean Dynamics Experiment	POLYMODE
Biological Investigations of Marine Antarctic Systems and Stocks	BIOMASS
First Dynamic Response and Kinematics Experiment	FDRAKE
International Geophysical Year	IGY
Tropical Ocean and Global Atmosphere	TOGA
World Ocean Circulation Experiment	WOCE
Climate: Long-Range Investigation, Mapping and Prediction Study	CLIMAP
Marine Pollution Monitoring System	MARPOLMON
Global Investigation of Pollution in the Marine Environment	GIPME
Geochemical Ocean Sections Study	GEOSECS
Regional Projects	
International Indian Ocean Expedition	IIOE
Caribbean Sea and Adjacent Regions	CSAR
Cooperative Investigations of the Northeastern Central Atlantic	CINECA
GARP Atlantic Tropical Experiment	GATE
Alpine Experiment	ALPEX
Baltic Open Sea Experiment	BOSEX
Mediterranean Alpine Experiment	MEDALPEX
Joint Exploration of the Mediterranean Sea	JEMS
Cooperative Study of the Kuroshio and Adjacent Regions	CSK
Coastal Upwelling Ecosystems Analysis	CUEA
International Southern Ocean Studies	ISOS
The Baltic Sea	-
IOC Subcommission on the Western Pacific	WESTPAC
International Antarctic Glaciological Project	IAGP

Name of project/program	Acronym
Regional Study of the Phenomenon known as “El Nino”	ERFEN
Kuroshio Applied Research	KAR
Fladen Ground Experiment	FLEX'76
Joint Air-Sea Interaction Experiment	JASIN
Joint North Sea Data Acquisition Project	JONSDAP
East Asia Tectonics and Resources Exploration Program	EATREP
Great Northern Expedition	-
Second Kamchatka Expedition	-
Northern Research Fishery Expedition	-
Northern Hydrographic Expedition	-
Black Sea Oceanographic Expedition	-
Aircraft High-Latitude Expedition	-
Drifting Stations “North Pole”	NP
Antarctic research	-
Investigations in the Southern Polar Region	-

The period of 1977-1986 exhibited a peak of marine research when, on an annual basis, 16 to 20 projects involved expedition observations in the Pacific, Atlantic, Indian, Arctic, and Southern Oceans and the largest seas. The amount of data obtained from 1970-1996 from oceanographic, marine aerometeorological, hydrochemical (including radiochemical), ice, biological, hydroacoustic, marine geological, gravimetric and magnetic observations was approximately equal to that for all previous years of oceanographic research combined. A map of Russian expeditions in 1979, typical of those conducted during the 1970s and 1980s, is shown in Figure 3.2.

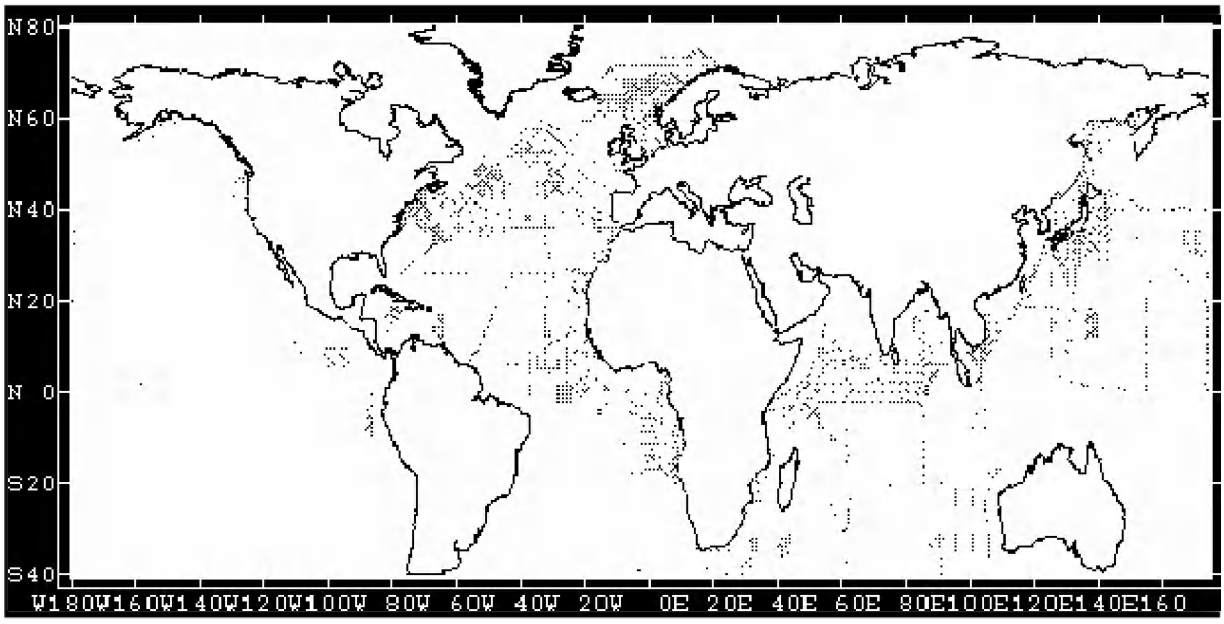


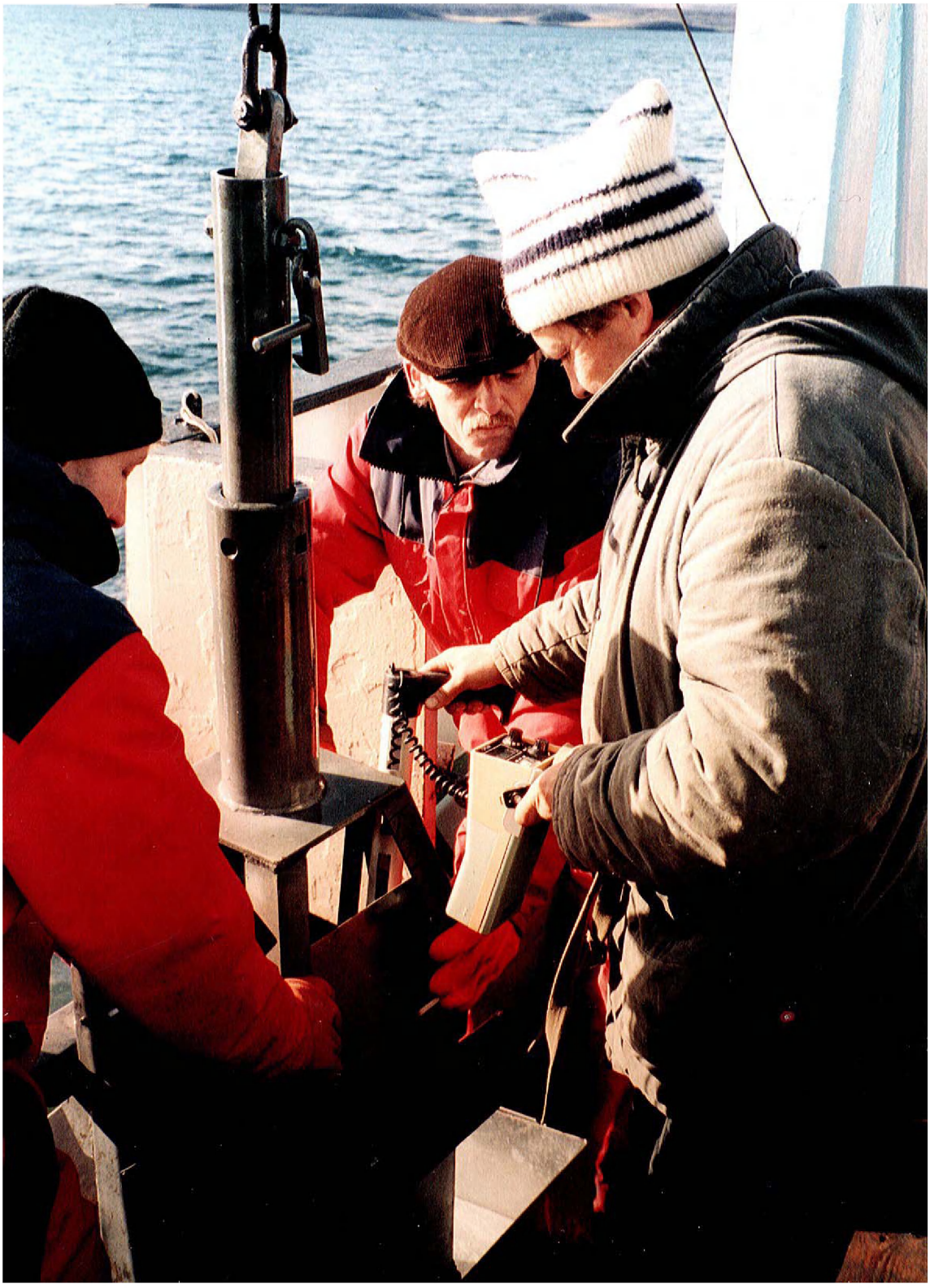
Figure 3.2 A map of Russian expeditions in 1979.

Expedition observations were conducted by research vessels concurrently with regional and global networks of ground- and space-based observational platforms in accordance with agreed-upon programs; the data obtained from some of these projects are considered unique in terms of diversity. It should be emphasized that, as a result of the enormous joint efforts of the Oceanographic Committee and scientists and experts of the State Committee for Hydrometeorology, Russian Academy of Sciences, GUNIO, Ministry of Fishery, and Ministry of Geology, many observations made by foreign participants in international marine research programs have been obtained under the auspices of international data exchange agreements.

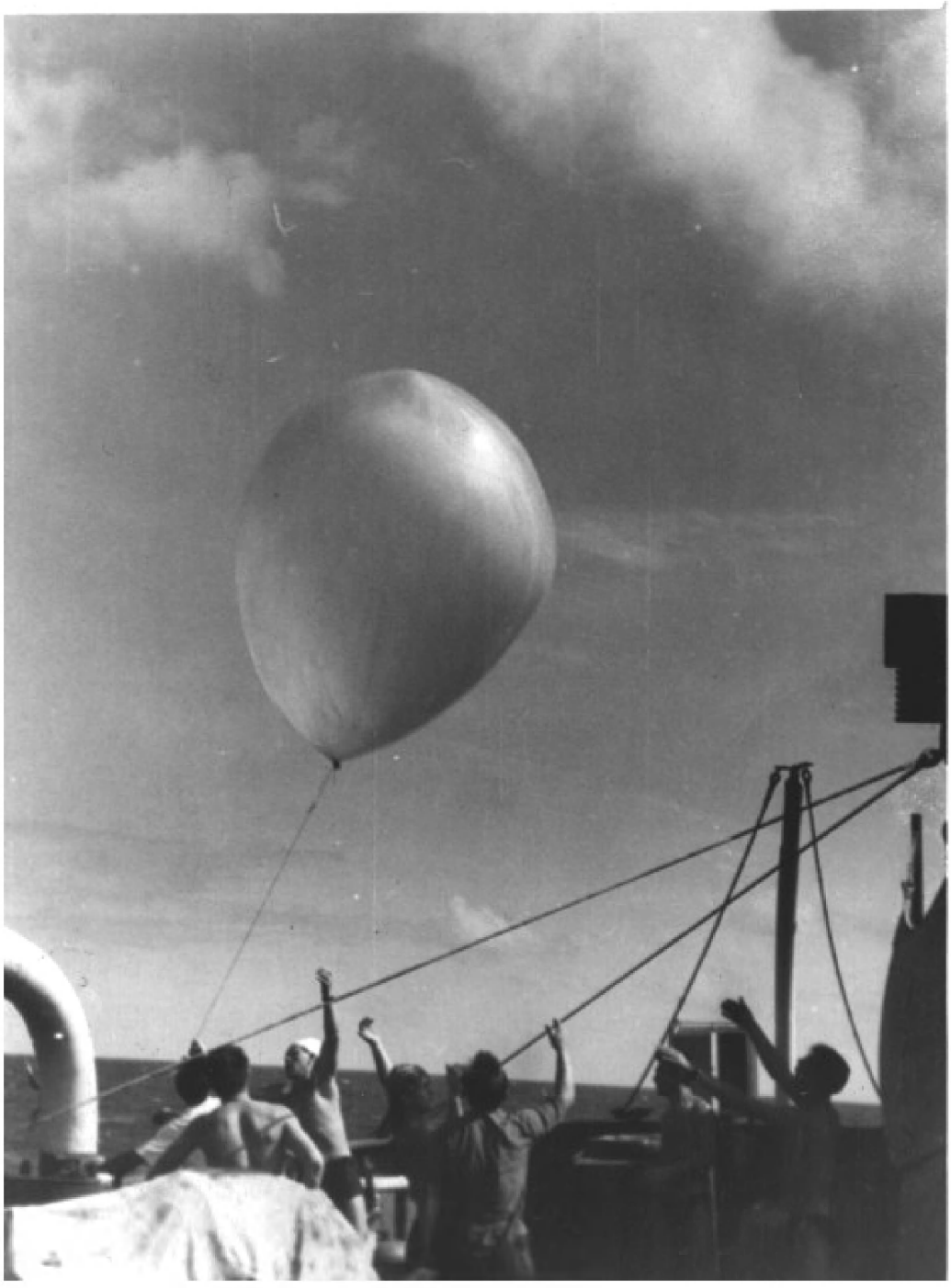
During the period 1970-1973, four long-term national projects were implemented: "Quasi-two-year cycle" (QC), "BREEZE," "Monsoon," and "Southern cycle." In the 12 years of the QC project, 7 research vessels from the Far East RIHMI performed 43 expedition cruises in the Pacific and Indian Oceans. The main objective of the project was to study the quasi-two-year cycle of atmospheric circulation in the equatorial stratosphere over the Pacific and Indian Oceans and the impact of these cycles on the weather in extratropical latitudes. An important distinguishing feature of observations made during these expeditions was aerological and rocket soundings of the atmosphere to heights of more than 30 km from the vessels' launching platforms, as seen in Figure 3.3. These data are even more valuable since no radiosonde or rocket meteorological observations were made by research vessels of other countries. Concurrent with the radiosonde launchings, oceanographic observations to a depth of 2 km depth were conducted, which made it possible to obtain complete profiles of thermodynamic conditions in the two interacting media -- the atmosphere and ocean. The QC investigations determined the duration and characterized the variability in different phases of the quasi two-year cycles of circulation in the stratosphere. These cause-and-effect relationships were used by the Hydrometeorological Center and Far East RIHMI to develop procedures for long- and short-range weather forecasts for the Far East. The characteristics of the energy balance at the ocean surface during a storm, particularly turbulent heat losses, and the sinking of heat deep into the ocean as a result of the storm were first obtained from the QC cruises based on field measurements. B. Chuchkalov was the scientific leader of this project.

Figure 3.3 Launching a meteorological rocket from a research vessel

Determining water radioactivity (SPA “Typhoon)



Setting a self-contained buoy station equipped with a current meter



Launching a radiosonde from a research vessel

Water sampling for pollution evaluation

During this same period, investigations for a national "Water and Heat Exchange" program were conducted to study water and heat transport in the northwestern Pacific. From 1970-1972, 6 research vessels from the Far East RIHMI participated in the program and logged more than 20 cruises performing repeat oceanographic surveys east of Kamchatka, along the Kuril and Japan Islands in the Kuroshio zone. The oceanographic survey data were used to derive the velocities of water transported with the Kuroshio Current (30-50 million $m^3 s^{-1}$), the Kuril Current (15-30 million $m^3 s^{-1}$), and the Kamchatka Current (5-15 million $m^3 s^{-1}$). They were also used to determine the heat transported within the Kuroshio Current (500-700 Gcal s^{-1}). This information has greatly contributed to climate research.

The "Breeze" project involved 10 medium and small research vessels of the Far East RIHMI, which participated in 26 cruises during 1971-78 and performed seasonal oceanographic surveys at strictly fixed dates.

The expedition cruises for the "Southern cycle" program involved two large research vessels of MHI and IBSS, which performed five seasonal surveys in the Antarctic waters over a period of six years. The results of these observations supplemented the available data used to construct dynamical maps of currents in the Southern Ocean.

Two Soviet-Indian expeditions in 1973 and 1977 were conducted under the "Monsoon" project. In both years, up to four research vessels from the Far East RIHMI conducted synchronous spring-summer oceanographic surveys in the Arabian Sea and equatorial Indian Ocean. Hourly meteorological observations, six-hour upper-air soundings and ocean current, temperature, and salinity observations made it possible to obtain a number of important results concerning the peculiarities of monsoonal flow in a steady and unsteady state as well as to calculate heat and water vapor fluxes, etc. In addition to the direct use of the data in research, they were also used in the development and planning of the international Monsoon Experiment (MONEX) in the summer and winter of 1978-79, which was, in effect, a subprogram of the First GARP (Global Atmospheric Research Program) Global Experiment (FGGE).

In 1972, a national Tropical Experiment (TROPEX-72) project was implemented in the Atlantic, which involved six research vessels of AARI, Southern Branch of IO RAS, Odessa SOI, and GUNIO. M. Petrosyants was the lead scientist for this program. TROPEX-72 was unique in terms of the equipment involved and the application of comprehensive and diversified observational procedures. The organizational and scientific experience gained in the course of this project was successfully applied by Soviet scientists in the planning of subsequent international projects, such as the GARP Atlantic Tropical Experiment (GATE), FGGE, Mid-Ocean Dynamics Experiment (POLYMODE), etc. In addition, TROPEX-72 was the first project to implement data management during the course of the expedition.

In the late 1960s and early 1970s, prominent Soviet scientists participated in working groups of the World Meteorological Organization (WMO) and the International Oceanographic Committee (IOC) to plan activities under GARP, the predecessor to the World Climate Research Program (WCRP), which was established in 1979. This was one of the largest research programs in the post-war years consisting of several major experiments: GATE, FGGE, Monsoon, MONEX, Barbados Oceanographic Meteorological Experiment (BOMEX), and the Mediterranean Alpine Experiment (MEDALPEX). In addition, under the sponsorship of GARP, a number of regional monsoon experiments were carried out, such as the West Africa Monsoon Experiment (WAMEX), the Alpine Experiment (ALPEX), the Ocean Topography Experiment (TOPEX), and others. It should be noted that the GARP findings have not been completely

analyzed and will be useful in ongoing efforts to evaluate and develop regional and global models to enhance forecasting capabilities.

From 1974-1976, Soviet research vessels participated in expeditions under the auspices of two international and four national programs. Observations were made in the tropical Atlantic as part of GATE; North Pacific ("Typhoon," "Plyos," "Shelf"); North Atlantic, Norwegian and Greenland Seas, and Antarctic waters (Polar Experiment or POLEX); and the Baltic Sea (Baltic Open Sea Experiment or BOSEX).

In particular, TROPEX-72 served as a rehearsal for Soviet participation in GATE, which took place in 1974. GATE was the largest international field study ever undertaken up to that time, and the project utilized a method of a moving polygon, in which five research vessels were arranged in an envelope and synchronously shifted along strictly specified longitudinal meridians to make three-dimensional measurements of the ocean and atmosphere. The observations of the ships within the moving polygons were complemented by current measurements at self-contained buoy stations, aircraft observations, and satellite observations. The 1974 GATE program involved 11 countries: Brazil, Canada, France, West Germany, Mexico, The Netherlands, Portugal, the USSR, Great Britain, the USA, and Venezuela. From April to December of that year, 13 large and medium research vessels from the Far East RIHMI, Odessa SOI, AARI, MHI, IO RAS, and GUNIO made hydrological, hydrochemical, aerometeorological, current, cloud, and precipitation observations in the tropical Atlantic. In addition, research aircraft and satellite observations supplemented those made on the ships. The purpose of GATE was to understand the tropical atmosphere and its role in the global circulation of the atmosphere. So far this project represents the best example of standardization of observational procedures, data verification, and data digitization in a unified format.

An international pilot project, Marine Pollution Monitoring System (MARPOLMON), sponsored by the IOC to study the effects of oil pollution, was carried out by the USSR, Japan, and the USA from 1976 to 1987. This project involved 22 research vessels of the Far East RIHMI, Odessa SOI, Murmansk Hydromet, Navy GUNIO, and Northwestern Hydromet, which conducted 48 cruises in the North Pacific and in the Philippine, Coral, Solomon, Japan, East China, Bismarck, Caribbean, and Mediterranean Seas in all seasons. In addition, nearly 2500 Soviet merchant ships from different ministries and agencies contributed to the project. Along with standard oceanographic and marine aerometeorological observations, a large number of measurements on oil-clot concentrations as well as the density and extent of oil spills on the sea surface were obtained, which were based on the procedures specially developed by SOI and its Odessa branch. Quantitative indicators of oil pollution were determined along the main navigation routes within the regions of study, and capabilities and mechanisms for water self-purification in fishery regions were studied. This effort established the need for a new kind of production-scientific activity -- monitoring of pollution in the world ocean. As a result, discussions were initiated within high levels of governments in most of the world's coastal countries to consider the problem of pollution in the marine environment and water purification efforts.

The most prolonged national project, the Polar Experiment (POLEX), started in 1974 and consisted of two subprograms: Polar Experiment - Northern Hemisphere (POLEX-North) and Polar Experiment - Southern Hemisphere (POLEX-South). Over the course of its 25-year history, and under the scientific leadership of A. Treshnikov and B. Krutskikh, POLEX involved 18 research vessels from AARI, Murmansk Hydromet, Far East RIHMI, Odessa SOI, and RSHMI; and these ships participated in 122 cruises in both the northern and southern polar

latitudes of the world ocean. In the course of the POLEX cruises, the circulations of surface and deep waters were studied and observations were made of water, energy, and heat exchange between the Atlantic and Arctic Oceans as well as between the atmosphere and ocean in the Antarctic regions.

Major results of this research are described in numerous selected works by AARI and Far East RIHMI. Specifically, temporal and spatial variabilities of the sea-surface heat balance components in the central North Pacific were first evaluated from direct observations. The contribution of latent heat by the freezing of sea water and ice melt to the ocean-atmosphere energy balance in the Arctic basin was also studied. The expedition observations conducted in the Southern Ocean (POLEX-South) from 1977 to 1990 have been, up to now, the most comprehensive and prolonged series of oceanographic and aerometeorological observations in this region. In addition, the surveys resulted in the installation of numerous automatic buoy stations (ABSs). These ABSs, exposed to extremely harsh weather conditions, were capable of taking measurements up to a depth of 4000 m (some of which worked continuously for 7-10 months). The data from the expeditions as well as from the buoy stations were used to compile maps of temperature and salinity distribution in the Southern Ocean, to determine characteristics and areas of distribution of major water masses, and to compile maps of surface and deep currents. These investigations validated the Antarctic waters as an independent part of the world ocean, now called the Southern Ocean, and determined its geographical boundaries. Cyclone frequency and trajectory, ice drift, and propagation and nature of tides were also determined. The arguments about the structure of the Antarctic Circumpolar Current (ACC) were settled: measurements verified that the ACC has a mono-directional flow whose width varies between 300 and 1300 miles and with a mean water transport in the Drake Strait of 110 million $m^3 s^{-1}$. Also during this period, under a bilateral agreement, Russian and U.S. scientists participated in POLEX-South to update oceanographic databases held within both countries. Such cooperation exemplified a fruitful international collaborative effort in world-ocean scientific research. In addition, students and teachers from RIHMI also participated in the cruises, and this significantly enhanced the training of young scientists in oceanographic and meteorological specialties.

In 1978, expedition observations began in the Pacific Ocean under the framework of a 12-year project called "Typhoon." In the course of 23 cruises carried out during four summer-fall periods, scientists from the Far East RIHMI investigated the origination and conditions for the development of Pacific typhoons and deep tropical cyclones as well as their tracks. The leader of the Project was V. Ivanov. Research within this project was comprehensive from the very beginning: along with participants from SPA "Typhoon" (Institute of Experimental Meteorology) and Far East RIHMI, the expedition cruises and subsequent data processing involved scientists from six institutes of the State Committee for Hydrometeorology, nine institutes of the USSR Academy of Sciences, the Ministry of Higher Education as well as representatives of the Meteorological Institute in Cuba and the Geophysical Service in the Philippines. The observations established a direct relationship between sea-surface temperature (SST) and high heat storage (thermal potential) in the upper 100-m water layer associated with typhoon formation and intensity. The formation of a "thermal trace" along the typhoon trajectory was revealed, the parameters of the trace were studied, and the quantity of water and heat given to the typhoon by the upper-ocean layer was calculated. A dynamic structure of the trace showed a cyclonic eddy in the oceanic zone that was exposed to the typhoon, and this provided an answer to the question about the origin of this element of ocean circulation, which is of great scientific and applied interest.

An international project to do comprehensive research on the Baltic Sea -- the Baltic Open Sea Experiment (BOSEX) -- was carried out from 1976 to1988. The experiment involved Sweden, West Germany, Denmark, Finland, East Germany, and Poland. As for the USSR, the ITPE's research vessel participated in BOSEX with the implementation of eight cruises in the Baltic Sea in the spring-summer-fall period to study synoptic variability of hydrophysical and hydrochemical fields.

A joint U.S.-Soviet Mid-Ocean Dynamics Experiment (POLYMODE) was carried out in 1977-1978 within the framework of the International Decade of Ocean Exploration (IDOE). Over the course of 13 expedition cruises, 8 research vessels from MHI, Southern Branch of IO RAS, AI, GUNIO and Odessa SOI made measurements of current characteristics in the North Atlantic in both warm and cold seasons to study the oceanic circulation and its interaction with atmospheric processes. On the Soviet side, the leader of this project was V. Kort.

As part of POLYMODE, the Soviet side implemented a subprogram, the Synoptic and Dynamic Experiment (SDE), which was implemented in the Sargasso Sea on the periphery of the zone of the Gulf Stream countercurrent. The basis for the SDE was to conduct observations of the current at 19 Autonomous Buoy Stations (ABSs), which were located at points of a polygon of equilateral triangles with center at 29° N, 70° W, each having a spatial distance of 39 miles. ABSs were located inside the polygon of 5° latitude and 12° longitude, within which oceanographic surveys were performed using a very dense grid of STD and temperature soundings of the ocean (400 measurement points in one survey). The observations within the polygon throughout the year produced pictures of 13 eddy formations of synoptic scale (transverse dimensions are 50 - 80 km) in the 100- to 1400-m layer with a current velocity up to 60 cm s^{-1}. All the eddies moved in a general westward direction with velocities of 6 km per day. Higher temperatures were observed within the eddies -- 2.5° to 3.5° C higher than in the surrounding waters at the same depth. Establishing the existence of synoptic-scale eddy formations in the constant-temperature field contributed much to improving procedures for analyzing oceanic circulation and developing a formation mechanism and structure of the main thermocline. High values of the energy parameters of synoptic eddies made it possible to characterize them as elements of macroturbulence.

During the period 1977-1980, Soviet research vessels had conducted expedition observations for eight national and four international projects. Of these, the international projects, FGGE and WESTPAC, and national projects, SECTIONS and "The Seas of the USSR," were the largest in the scope of investigations. The FGGE was somewhat similar to IGY in that it involved 23 countries, including Brazil, Great Britain, the USSR, the USA, West Germany, Mexico, The Netherlands, Canada, France, and Portugal. The experiment was preceded by careful preliminary planning, which took into account the experience gained from GATE and other international projects. The USSR contribution to the FGGE oceanographic investigations was represented by 26 cruises in the tropical Atlantic, Pacific, and Indian Oceans undertaken by 14 major and medium research vessels from the Far East RIHMI, AARI, Odessa SOI, Southern Branch of IO RAS, MHI, GUNIO, and Sakhalin Hydromet. All the objectives identified in the FGGE program were fulfilled, i.e. current observations as well as hydrological, hydrochemical, marine aerometeorological, geological and geophysical observations. As in GATE, all observational data were put on standard magnetic tapes. Owing to the active participation of Russian research vessels and scientists in the FGGE expeditions and working committees for planning and data management, the World Data Center B (Obninsk) received observation materials from all the countries involved in the project, including 28,000 profile

measurements of the vertical thermohaline structure in the upper ocean layer taken by expendable bathythermographs (XBTs), which were not used on the Soviet research vessels. Scientific results of FGGE are described in numerous proceedings of research institutes of the State Committee for Hydrometeorology and Soviet and Ukrainian Academies of Sciences.

The resulting data of measurements quantifying the exchange of heat, chemical components, energy and water between the sea, atmosphere, and land in the tropical regions at different temporal and spatial resolutions as well as increased computer capabilities enhanced mathematical modeling of the thermodynamic processes, which contributed toward ongoing research efforts to improve long-range weather forecasts and to better understand short-term climate variability. Specifically, the high-density instrumental observations, afforded by the polygon method along sections in the tropical North Atlantic during intensive two-month observational periods in summer and winter seasons, made it possible to characterize the parameters of the annual variation in water temperature and salinity in the upper 1000-m ocean layer, estimate the latitudinal advective heat transport, and describe the temporal variability of temperature and salinity in the main thermocline. In the western part of the Lomonosov Current, observations were conducted by ABSs within special polygons, each having a spatial separation of five miles (using the schemes "snail" and "comb"). These observations revealed high-salinity and high-temperature water lenses 15-30 km in diameter and 30 m thick in the 50-100 m layer. New and vital results were also obtained in the Pacific and Indian Oceans.

Regional experiments sponsored by the IOC on the western pacific (WESTPAC) were held from 1979-1987 and involved the USSR, Japan, and Australia. Target research areas were the northern and northwestern Pacific, Sea of Okhotsk, Sea of Japan, East China Sea, South China Sea, and Inland Sea. In these areas, 10 research vessels from the Far East RIHMI, POI, and Sakhalin CRI carried out oceanographic, biological, marine meteorological, and geological/geophysical observations in the course of 19 expedition cruises. The Soviet part of this project was led by V. Fedorei.

The ten-year national project "Tsunami" was initiated in 1978. In the framework of this project, four medium research vessels from the Far East RIHMI and Sakhalin Hydromet carried out ten expedition cruises in the northwestern Pacific and Far East seas where standard and special oceanographic observations were made in the spring and fall seasons.

Two seven-year projects began in 1979: the international project, Investigations of the Caribbean Sea (IOCARIBE), and the national Monsoon Experiment (MONEX). In IOCARIBE, which involved the USA, the USSR, and other countries, biological and oceanographic observations were made during seven winter and spring expedition cruises by three major research vessels of MHI of the Ukrainian Academy of Sciences. The MONEX activity program for 1978-1979, in which five Far East RIHMI research vessels participated, was split into two phases: Summer MONEX and Winter MONEX. The Soviet expedition in Summer MONEX was commanded by B.Chuchkalov. Summer MONEX was equipped with diverse platforms for observations: research vessels, aircrafts, satellites, coastal meteorological and aerological stations, observation towers, sondes, and rockets. The scientific goals of MONEX were to study the peculiarities of monsoons on global and regional scales, their heat sources, mechanisms of monsoon development, termination of monsoons, interaction of monsoons with other forms of atmospheric circulation in the Southern Hemisphere and at temperate latitudes of the Northern Hemisphere, interaction with stratospheric circulation, and improving numerical modeling and forecasts. Scientists from the Far East RIHMI and SPA "Typhoon" studied the conditions and mechanisms of the evolution of the summer and winter monsoon in the Indian Ocean.

Expedition cruises in Summer and Winter MONEX were completed about the time of the first and second special observation periods of FGGE; consequently, the MONEX observational data were put on magnetic tapes in the FGGE format. This made the results of the scientific analysis of the data obtained in other FGGE regions highly comparable, which was helpful in realizing the goals of MONEX. Comprehensive and comparable observations made it possible to obtain new and unique data on the global-scale atmospheric circulation and its regional peculiarities in the Indian Ocean, which is of great importance for research efforts within the World Meteorological Organization's (WMO's) World Weather Watch program as well as to the national weather services of India and other countries in the Indian Ocean basin.

The investigations conducted in the energetically active zones of the world ocean from 1979-1990 as part of the SECTIONS program proved to be a unique in national and international oceanographic research. The program involved 94 research vessels from 19 institutions of the State Committee for Hydrometeorology, Academy of Sciences, Ministry of Fishery, and Navy GUNIO, which, collectively, carried out 490 cruises. During these cruises, continuous and extensive observations were conducted throughout the year on sections and within polygons in energetically active zones in the tropical and subtropical Atlantic and Pacific Oceans, in the Gulf Stream and Kuroshio zones, the Faeroe-Shetland Strait, and the Norwegian Sea. The main objective of SECTIONS consisted of studying the contribution of the ocean to short-term climate variations. The principal targets of the study were represented by energetically active ocean zones (EAOZ), i.e. zones of maximum impact by oceans on climatic fluctuations in the atmosphere. The national program, SECTIONS did encourage and, to some extent, require the involvement of research vessels from other countries. The concept of the program, including its objectives and immediate tasks, was the subject of extensive discussion by the scientific community during the planning phase in 1980-81. The expedition cruises began in 1981. The objectives were identified as follows:

- to study the main climatic factors in the atmosphere and ocean in order to better understand short-term climate variations for specific regions of the Northern Hemisphere by using primarily the data from field measurements in the EAOZ;
- to study the formation of anomalous values of oceanographic parameters in the EAOZ in the tropical and northern Atlantic and Pacific by using a four-dimensional analysis of observational data;
- to study the temporal variability of major characteristics of the ocean and atmosphere in the EAOZ and develop climatic models to simulate the annual variation in heat content in the upper active ocean layer;
- to study, on a regional basis, the interaction between the atmosphere, EAOZ, and continental land off the eastern Asian coasts.

To achieve these goals, the following measurements were made by research vessels: water temperature, salinity, and content of individual chemical elements in the ocean to a depth of 2 km; air temperature, humidity, cloudiness, wind speed, atmospheric pressure, and precipitation in the boundary layer; air temperature, humidity and velocity vector in the free atmosphere to a height of 30 km; incoming atmospheric solar radiation and a vertical distribution of heat fluxes in the atmosphere and ocean. Again, special aircraft and satellite observations were conducted. Observational data from weather ships and research vessels involved in other international and national projects were used. The SECTIONS program leaned heavily on the experience previously gained from GATE, POLEX, FGGE, Monsoon, Typhoon, and other

international programs. In addition, the SECTIONS program called for observational data management as a distinct activity.

The analysis of observations and recommendations for enhancing the program were made by a Scientific Advisory Council whose members represented the institutes involved in the program. Consequently, the program obligated scientific resources and expedition facilities from nearly each institution with an oceanographic focus, which had been the core of Russian marine research for ten years. The results of the analysis and processing of data were regularly published in a special series of proceedings of the All-Union Institute of Scientific and Technical Information and in the proceedings of research institutes involved in SECTIONS. The data, recorded on magnetic tapes, have been used for large-scale theoretical and applied research of the ocean as well as for studying the global climate system.

The icebreaker "Otto Schmidt" greatly facilitated oceanographic research in the Arctic seas. The AARI and Murmansk Hydromet implemented the national project, the Kara Sea Experiment (KAREX, 1979-1994), in the course of which four research vessels, including the "Otto Schmidt," carried out nine expeditions in the Kara Sea in the fall-winter seasons. The observations conducted made it possible to better understand the beginning and intensity of ice formation along the northern sea route and in the mouths of Siberian rivers in the western Arctic, to study heat fluxes during ice formation, and to specify the trajectory of ice drift. The resulting data greatly contributed in the improvement of forecasts of ice conditions in the western Arctic. It should also be noted that aircraft and drifting ice stations played a large part in research efforts in the Russian Arctic during the latter half of the 20th century. However, in the years preceding the experiment in the Kara Sea, a number of outstanding cruises, in terms of their scientific significance, were carried out by merchant and Navy ships. Among these are the one-season high-latitude voyages of the nuclear-powered icebreaker, "Lenin," together with the icebreaker "Vladivostok" (1971); cruises of the nuclear-powered icebreakers "Arctika" and "Rossia" to the North Pole (1977); the under-ice voyage of the K-3 nuclear-powered submarine, which was the first Soviet submarine to reach the North Pole (17 July, 1962); and the voyage of the electrically driven motorship, "Kapitan Myshevsky," piloted by the nuclear-powered icebreaker, "Sibir." Among the many who made significant contributions to Arctic research were I. Maksimov, M. Somov, E. Tolstikov, A. Treshnikov, P. Gordienko, N. Kornilov, Yu. Konstantiniv, N. Romanov, P. Morozov, A. Chireikin, N. Blinov, and L. Bulatov.

Two ten-year international projects, the Baltic Experiment (BALTEX) and the Marine Pollution Monitoring system (MARPOLMON), and one two-year international project, Mediterranean Alpine Experiment (MEDALPEX), were initiated in the early 1980s. BALTEX was the largest of the Baltic Sea research programs in that it involved all Baltic states - Denmark, Sweden, West Germany, the USSR, Finland, Poland, and East Germany. Russian participation involved eight medium and small research vessels from the AARI, Lithuanian Hydromet, Estonian Institute for Thermal Electrophysics, RSHMI, and Odessa SOI, which collectively carried out 44 cruises in all the seasons of the year. The aim of the program was to conduct comprehensive research on the ecosystem of the Baltic Sea. Oceanographic and meteorological observations were complemented by extensive biological observations. The nature, extent, and concentrations of pollutants were also determined. The results of data analyses were regularly discussed during meetings with high-level policy makers, in which recommendations and strategies were elaborated to assist governmental institutions of the Baltic states to reduce pollution that was having an impact on fishery quotas.

The IOC MARPOLMON program, aimed at monitoring marine pollution in parts of the world ocean, involved nearly all IOC member states. Ships and coastal monitoring stations collected data on oil residue in the ocean as well as obtained samples of water for oil clots. These observations were carried out over the vast water areas of the Pacific and its seas – the Caribbean, Baltic, and Mediterranean Seas – as well as along major navigation routes and in the regions of marine oil production.

The MEDALPEX program involved Spain, Italy, the USSR, Yugoslavia, France, Turkey, and Belgium. MEDALPEX involved four Russian research vessels from Odessa SOI, GUNIO, and IBSS. Four cruises in the winter-spring and fall seasons were carried out within the program. Hydrological, hydrochemical, meteorological and biological observations were conducted in order to obtain quantitative values of the sea-air interaction in the central Mediterranean and in the Tyrrhenian, Ligurian, and Adriatic Seas. The data were used to compile the "Atlas of the Mediterranean Sea" (1984), which was produced by the Regional Data Center for Cooperative Exploration of the Mediterranean (a component of the NODC).

A significant contribution to research on the Pacific Ocean was made by two one-year national projects, CENP'80 (Comprehensive Explorations in the Northwestern Pacific-1980) and CEPI (Complex Expeditions in the Pacific and Indian Oceans, 1982). CENP'80 involved seven research vessels from the Far East RIHMI, and V. Pokudov was the program manager. The objectives of the project were: 1) to obtain a quantitative estimate of heat and mass transport of currents in tropical latitudes of the western Pacific to temperate latitudes; 2) to study the evolution and vertical structure of the summer Asian monsoon in order to develop a numerical model of the development of the monsoon circulation; 3) to study the characteristics of the life cycle and path of typhoons; and 4) to quantify the ocean-atmosphere large-scale thermal interaction. These objectives were achieved by implementing six subprograms: "Kuroshio," "Macroeddy," "Stationary Polygon," "Typhoon," and "Fine Structure." The scientific objectives of CENP'80 were too ambitious for a one-year project, but the data obtained were, nonetheless, quite impressive and valuable, especially regarding the individual parameters studied. Two large-scale hydrobiological surveys, three microsurveys, and two stationary polygons were carried out in the course of this project, involving 3 thousand oceanographic stations and soundings, 944 radiosonde launchings, 97 thermosound soundings, 657 water samples treated for an isotope-inferred indication of water and nutrient balances, and current observations made at five ABSs. CENP'80 provided quantitative information of the water heat content and the location of hydrobiological fronts, which were revealed by studying large (warm and cold) eddies in the meandering zone of the Kuroshio. The characteristics of the supertyphoon "Winnie" in 1983, whose pressure at the center dropped below 890 hPa, were measured along with its impact on the upper-ocean layer. The observations confirmed the existence of a countercurrent at depths of 300 - 1000 m under the southern periphery of the northern trade current. The investigation into cyclogenesis abnormalities in the northwestern Pacific was of great importance for predicting weather conditions in the Russian Far East, for understanding the water circulation mechanism in the Far East seas, and for estimating biological productivity in one of the richest fishery regions of the world ocean.

The CEPI'82 project involved 8 research vessels from the Far East RIHMI, which carried out 13 expeditions in the Pacific and Indian Oceans in the spring, summer, and fall seasons of 1982. It was a logical extension of the earlier investigations by this institute, such as "Water and Heat Exchange," "Monsoon," MONEX, and CENP'80. The main goal of the CEPI program was to obtain comprehensive data to study the ocean-atmosphere interaction during the origin and

evolution of the Indian Ocean and Asian monsoons and tropical cyclones (typhoons) from May to September and from September to January when summer hydrological processes give way to winter processes. The observations conducted as part of CEPI'82 were used in a number of interrelated programs: "Thermal abnormality of energetically active regions in the Pacific and Indian Oceans," "Water circulation," "Atmospheric processes and their connection with water thermodynamics," "Macroeddy," and "Stationary polygon."

The CEPI'82 program was the largest in the history of combined research on the Pacific and Indian Oceans with respect to geographic coverage, the number of the ships involved, observations conducted, and the scope of scientific problems solved from one-year observations. During the spring-summer and fall-winter periods, three research vessels in the Indian Ocean and five research vessels in the Pacific conducted 8716 meteorological observations, 3447 measurements at oceanographic stations, 1569 aerological soundings, and 752 actinometric measurements. In addition, 40 meteorological rockets were launched, 5 ABSs were set, 221 satellite images were utilized, and 227 surface weather maps were compiled. The observations identified a number of distinctive qualities in hydrometeorological conditions in the area under study, including a one-month delay in the "explosion" of the southwestern monsoon. The observations also determined velocities of water and heat transport with the southern trade current in the Indian Ocean, the Kuroshio Current and countercurrent, the northern trade current, and the subtropical countercurrent in the Pacific Ocean. Using the observational results, maps were compiled of the location of the centers of baric systems in the Indian Ocean and on the heat budget at the surface of the Pacific and Indian Oceans in the spring-summer and fall-winter seasons. Origin sites, characteristics, and trajectories of 11 summer typhoons occurring in 1982 were identified, and a map was compiled of the distribution of stratification of sound velocity in the northwestern Pacific.

Several national programs were launched during the 1980s. The long-term national Barents Sea Experiment (BAREX), which focused on the North, Norwegian, Greenland, and Barents Seas, was initiated in 1984. In the period 1987-90, oceanographic surveys continued in the Barents Sea under a different program, called the Barents project. For the two projects combined, 7 major research vessels from Murmansk Hydromet, WESTFISHREC Company, and AARI carried out 20 cruises in all seasons of the year. The two programs were led by Yu. Sustavov. The programs concentrated much attention on the study of the relationship between hydrological-hydrochemical conditions, biological productivity, and migration of commercial fish. From 1985-1988, the national project, "Kosmos" (Space), was conducted, where two major research vessels, belonging to MHI, carried out seven cruises in the Atlantic in all seasons of the year. And, finally, a significant contribution to research efforts on the inland and marginal Russian seas was made under the auspices of the program, "The USSR Seas" (1981-1990), which involved 40 institutions of the Hydrometeorological Service, Ministry of Fishery, Academy of Sciences, and others. The program was led by F. Terziev. Within the framework of this program, small and medium research vessels from the Far East RIHMI, Odessa SOI, and Sakhalin, Lithuanian, Murmansk and Northern Hydrometeorological Services carried out hundreds of cruises in the spring, summer, and fall seasons over both ice-free and ice-covered water areas. A time series of observations on sections in the Baltic Sea exemplifies the amassment of data on the seasonal variability of hydrological conditions in the Russian seas. There were 455 stations in the Baltic Sea where oceanographic and meteorological observations were made once per season for five years and more. In addition, the data acquired under the "Seas" program was summarized and analyzed in numerous general-purpose historical reference

monographs, manuals, atlases, catalogs, and other materials prepared for special requests. Among those particularly worth noting are the monographs, "Hydrometeorology and Hydrochemistry of Seas: the Aral Sea, the Sea of Azov, the White, Baltic, Barents, Caspian and Black Seas, and the Sea of Okhotsk" and "Present-day Climate Change in the Caspian Sea." Furthermore, the data were used to provide forecasts of marine pollution and to develop methods of water accounting for inland and semi-closed seas.

Specific single-discipline marine research was also conducted under programs, such as "Shelf," "Dumping," "Wind Waves," "The Environment," "Mouths," "Digma," and others. From 1968-1992, more than 400 cruises took place using small and medium research vessels from the SOI (and its branches) and regional branches of the Roshydromet, each with an objective to obtain data addressing a special need.

Russian research vessels greatly contributed to the operation of observation systems at Ocean Weather Stations (OWS). A network of these stations was established in the late 1940s. At first, the network was intended for aviation purposes; and before 1975, the stations had been operated by the International Civil Aviation Organization (ICAO) in cooperation with the International Association for the Physical Sciences of the Ocean (IAPSO) and International Council for the Exploration of the Sea (ICES). However, starting in 1975, the observations at the stations were conducted under the auspices of the WMO. A total of 13 stations were operating in the North Atlantic and 8 stations in the Pacific, and the network involved research vessels from Norway, France, The Netherlands, Great Britain, the USA, the USSR, Sweden, Japan, and Canada. From 1 July 1975 to 13 May 1990, SOI's research vessels had carried out 171 expedition cruises at OWS "C" (Charlie) (52° 41' N, 35° 38' W). Here 35,750 oceanographic, 24,070 aerological soundings, and 158,697 meteorological measurements were taken. These allowed fairly reliable statistical calculations to be made to obtain characteristics of the temporal variability of the ocean-atmosphere interaction processes. Since 1946, when Ocean Weather Stations went into operation, a unique time series was produced on the variability of hydrometeorological and oceanographic parameters in the open ocean.. These data are now available from RIHMI-WDC (Obninsk). Unfortunately, to the regret of oceanographers around the world, the OWSs ceased to operate in the late 1980s as a result of the high costs of maintenance.

In 1985, the Tropical Ocean-Global Atmosphere (TOGA) program began, under the auspices of the World Climate Research Program (WCRP), and focused on obtaining data to investigate the interannual variability in the tropical oceans and global atmosphere. The main objectives of TOGA were to study characteristics of the ocean-atmosphere interaction and to evaluate large-scale climate variations in the tropical oceans and global atmosphere (i.e. El Niño, monsoon variability in Asia and Africa, droughts in Africa and South America, and other unfavorable phenomena). Russian involvement in the program was managed by S.Lappo. The World Ocean Circulation Experiment (WOCE), also a component of the WCRP, was launched in 1990. The main objective of this program is to better understand and predict the variability of ocean circulation, its effect on gas storage, and how it interacts with the atmosphere. The program was set up to address 12 objectives, with major field programs undertaken from 1990-97. Analysis and modeling efforts are expected to continue possibly into 2005. Russia's participation in the field program included monthly hydrological soundings for the entire water column at 12 specially selected points in the Atlantic and 8 points in the Pacific. In the past ten years Russian oceanographers have taken an active part in the International Geosphere-Biosphere Program (IGBP), World Climate Research Program, etc.

Most typical for the 1980s were one- and two-year marine research projects , such as "Vertical," "Abyssal," "Wave," Patchiness Experiment, "Krill," GSEPM (Governmental Service for Environmental Pollution Monitoring), SAGAPE (Soviet-American Gas-Aerosol Pacific Experiment), "Maritime Territory," "Start," "Geomorphology," etc. Among the one-year projects, worth noting are the following: "Triangle," "Hurricane," and "Front." In the national project, "Polynia," two research vessels from the IO RAS and AARI were deployed in the high-latitude waters of the Southern Hemisphere, one of which, the Mikhail Somov, was under polar night conditions for more than two months. There were some projects, in which no Russian research vessels were involved but included the participation of Russian scientists to ensure high-quality observations. Among these are Biological Investigations of Marine Antarctic Systems and Stocks (BIOMASS), First Dynamic Response and Kinematics Experiment (FDRAKE), Joint Exploration of the Mediterranean Sea (JEMS), Cooperative Study of the Kuroshio and Adjacent Regions (CSK), Cooperative Investigations of the Northeaster Central Atlantic (CINECA), WOCE, Mid-Ocean Dynamics Experiment-1 (MODE-1), and others.

Since the early 1990s, the extent of Soviet oceanographic research has been reduced drastically, and the State Environmental Data Holding (within the RIHMI, Obninsk) no longer receives observational data from research vessels of Lithuania, Latvia, Estonia, and Azerbaijan. Nevertheless, in spite of the financial difficulties, Russian oceanographers, marine meteorologists, aerologists, and hydrochemists continue to conduct research on the oceans and seas. During 1991-96, the Russian NODC received hundreds of reports on national and foreign R/V cruises, which took place during these years.

3.3 Organizations engaged actively in studies of oceans and seas

In the latter half of the 20th century, more than 70 Russian institutions (information on these institutions is provided in Appendix 4) were involved in the planning, coordination, and execution of various programs, providing both technical and instrumental support as well as training technicians, students, and scientists to conduct oceanographic research. The most active among these institutions were those of the Academy of Sciences, State Committee for Hydrometeorology (Roshydromet), Ministry of Fisheries (now the Fishery Agency at the Ministry of Agriculture), Ministry of Defense, and Ministry of Geology (now the Russian Committee for Natural Resources). With respect to the objectives of research concerning the world ocean and the conduct of expedition cruises, marine institutions and related organizations may be classified into several groups:

- Group 1 includes the Shirshov Institute of Oceanology of the RAS and its regional branches, which conduct comprehensive investigations of the physical, chemical, biological, and geological processes in the seas and oceans.
- Group 2 includes institutions which specialize in a particular field of research. For example, the Murmansk Marine Biological Institute of the Kola Branch of RAS specializes in marine biology of the northern seas; the Zoological Institute of the RAS in marine biology; the Acoustic Institute of the RAS in ocean acoustics; and the Institute of Biology of the Southern Seas of the Ukrainian AS in marine biology.
- Group 3 consists of specialized ministry-supported institutes, which are engaged in solving scientific and applied-research problems that are mission oriented: VNIRO, PINRO, AtlantNIRO and TINRO (Ministry of Fishery); AARI, SOI, Far East RIHMI, IAG and IEM

(Roshydromet); Research Center of GUNIO (Ministry of Defense); hydrometeorological centers of fleets; and others.

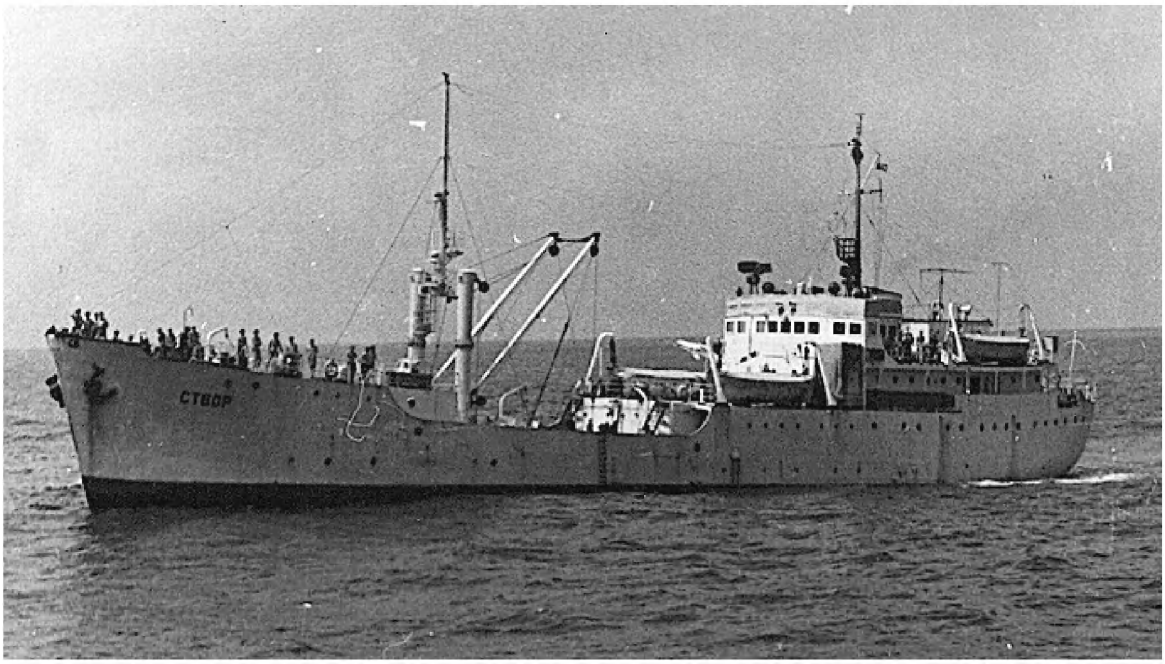
- Group 4, the largest one, comprises production enterprises and organizations engaged primarily in observations and oceanographic data acquisition. Regional administrations of the Roshydromet and marine fishery services belong to this group.
- Group 5 consists of educational institutions: Russian State Hydrometeorological Institute; Moscow State University (faculty of Geography); St. Petersburg State University (faculty of Geography); Makarov Marine Engineering Academy (faculties of the Arctic and Hydrography). Specialists in major fields of oceanology are trained at these educational institutions. Top-quality experts receive further training in post-graduate courses in educational and research institutions.

Enormous contributions to further understanding world oceanographic research were made by the following institutions: Far East RIHMI, AARI, SOI, Odessa SOI, Atlantic Branch of IO RAS, POI, MHI, TINRO, AtlantNIRO, PINRO, GUNIO (developers of the system of international oceanographic and marine meteorological data exchange), AI RAS (largest owners of research vessels), IO RAS, MSU, IEM, RIHMI-WDC, SOI, St. Petersburg SOI, MGO, VNIRO, IBSS, RSHMI (developers of national and international projects for oceanographic research), maritime, northwestern, northern, Sakhalin, and Lithuanian hydrometeorological services, Sevastopol SOI, MMBI (executors of standard observations to study Russian seas and coastal waters); the USSR Oceanographic Committee, and the Russian Hydrometeorological Center.

During the past two decades, individual branches and institutes of Roshydromet, IGCE, SOI, IAG, Institute of Geophysics of RAS, and other organizations have conducted comprehensive national and cooperative international research on world ocean pollution; more than 1300 R/V cruises were conducted for these research efforts. As a result of this research, Russia became one of the leading participants in the international monitoring efforts of marine pollution.

Marine research in Russia is now coordinated by the Scientific Council for Studies of Oceans and Seas and Application of their Resources (under the Ministry of Science of the Russian Federation). Of great importance in coordinating the efforts of different countries in world ocean research is the activity of international organizations. The International Council for the Exploration of the Sea (ICES), established in 1902 in Copenhagen, was among the first organizations of this kind that brought together European countries of the northeastern Atlantic basin and adjacent seas. The Intergovernmental Oceanographic Commission (IOC) was founded in 1960 under the auspices of UNESCO. The IOC working committees, in collaboration with WMO, ICSU, and other marine-related scientific councils and unions, are now coordinating and organizing international scientific and technical collaborative efforts to address various research needs for the world ocean and to develop operational services and sound application principles.

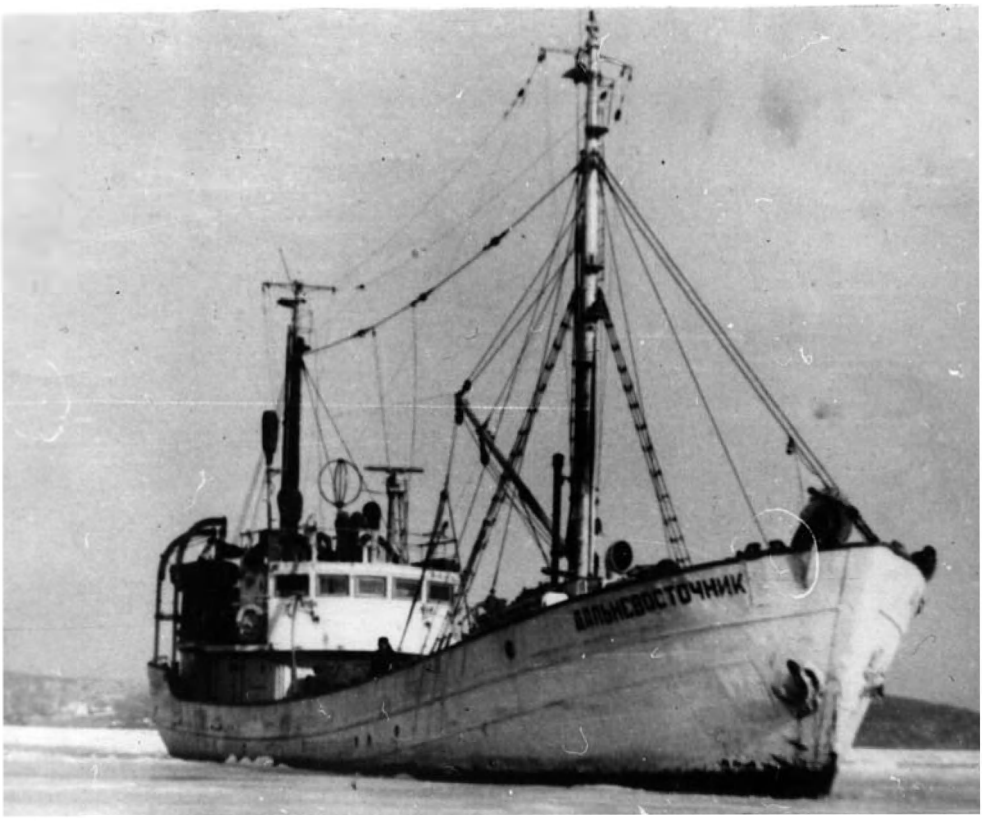
R/V Ixtiolog



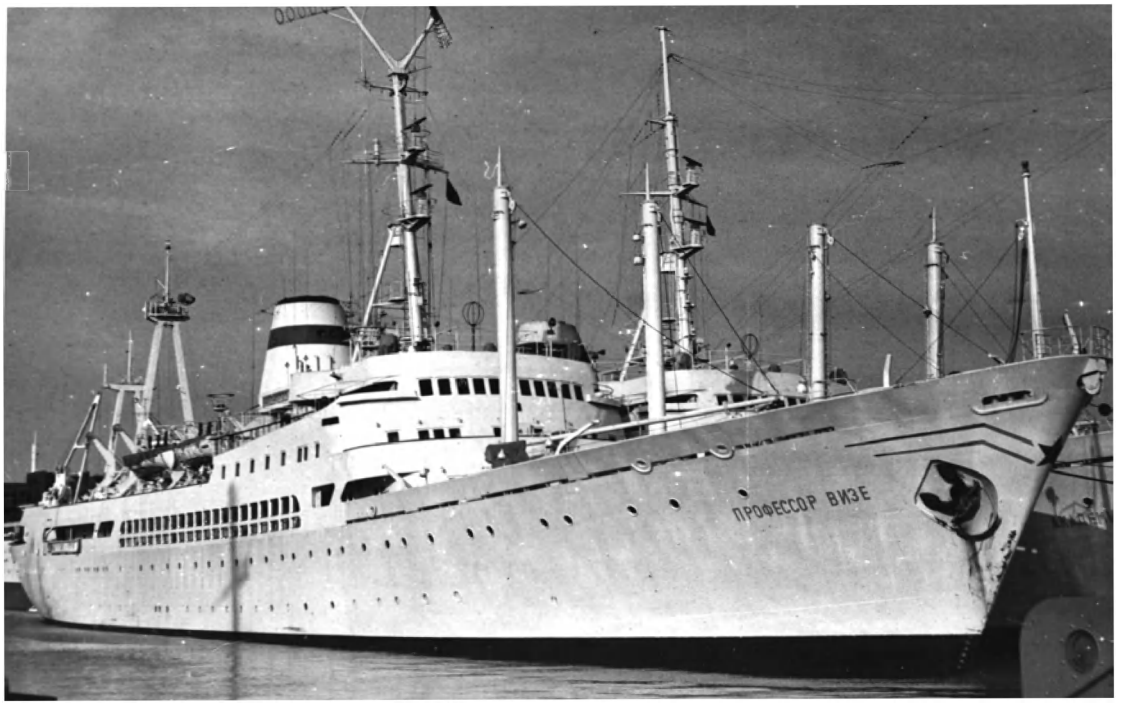
Survey ship, Stvor (Navy GUNIO)

R/V Neringa (Hydrometeorological Service of Estonia)

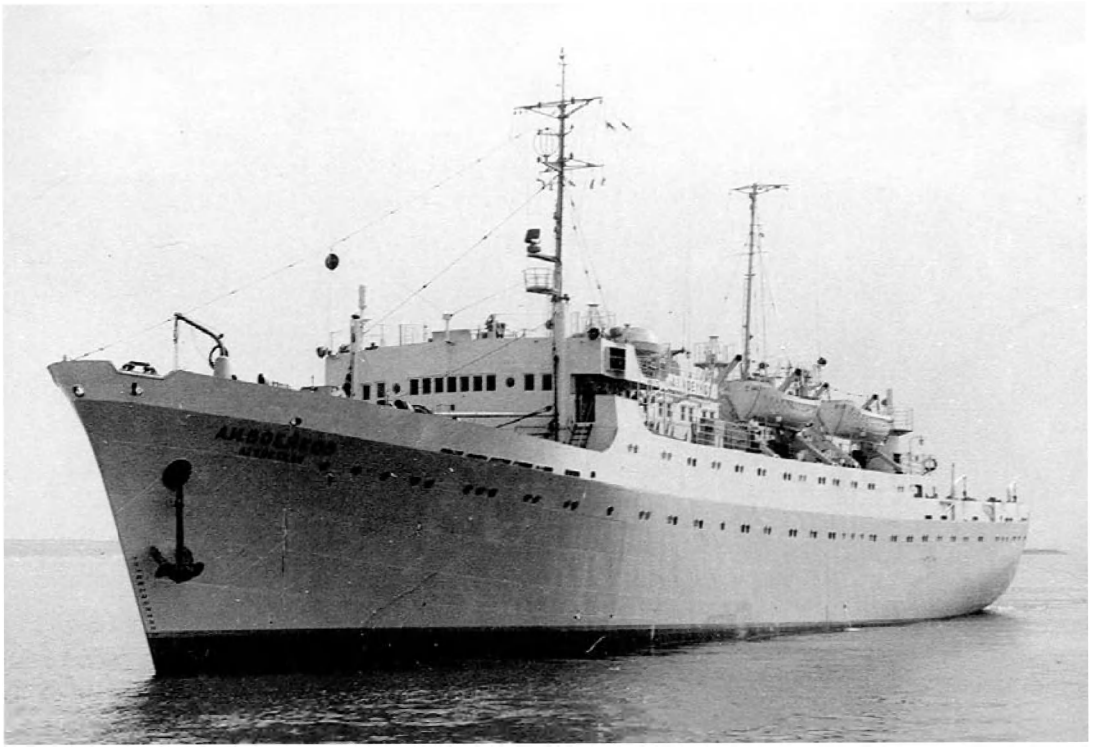
Medium fish trawler, Akademik Knipovich (PINRO)



R/V Dalnevostochnik (Maritime Hydromet)

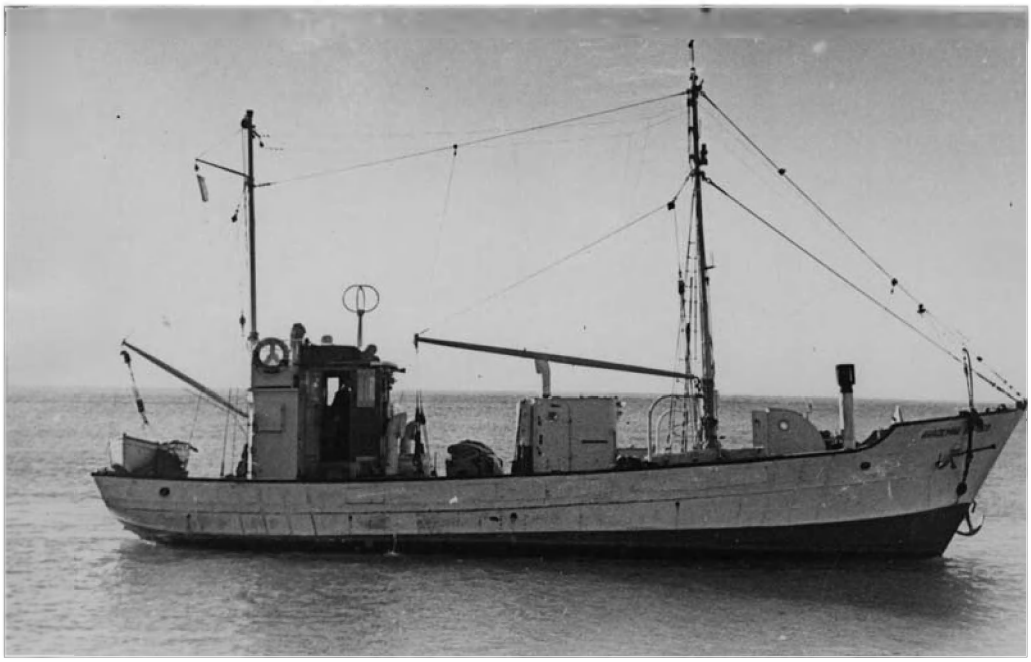


R/V Professor Vize, built in 1968 (AARI)



R/V A.I. Voeikov (Far East RIHMI)

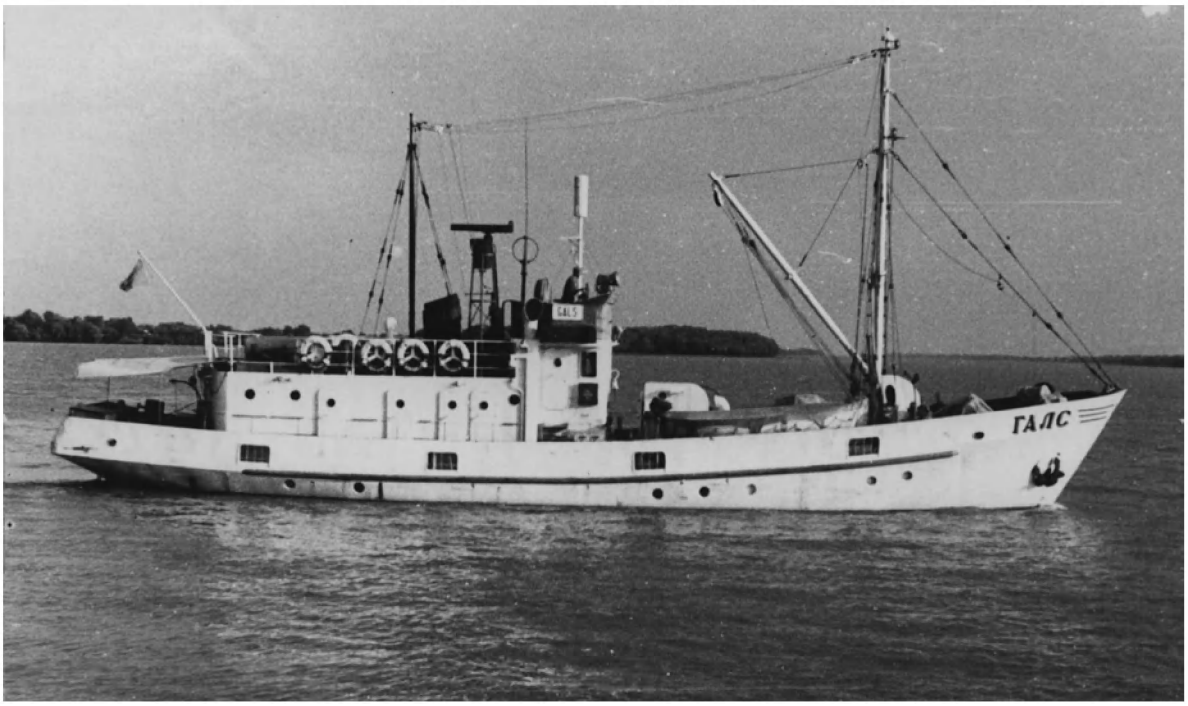
R/V Sevastopol (PINRO)



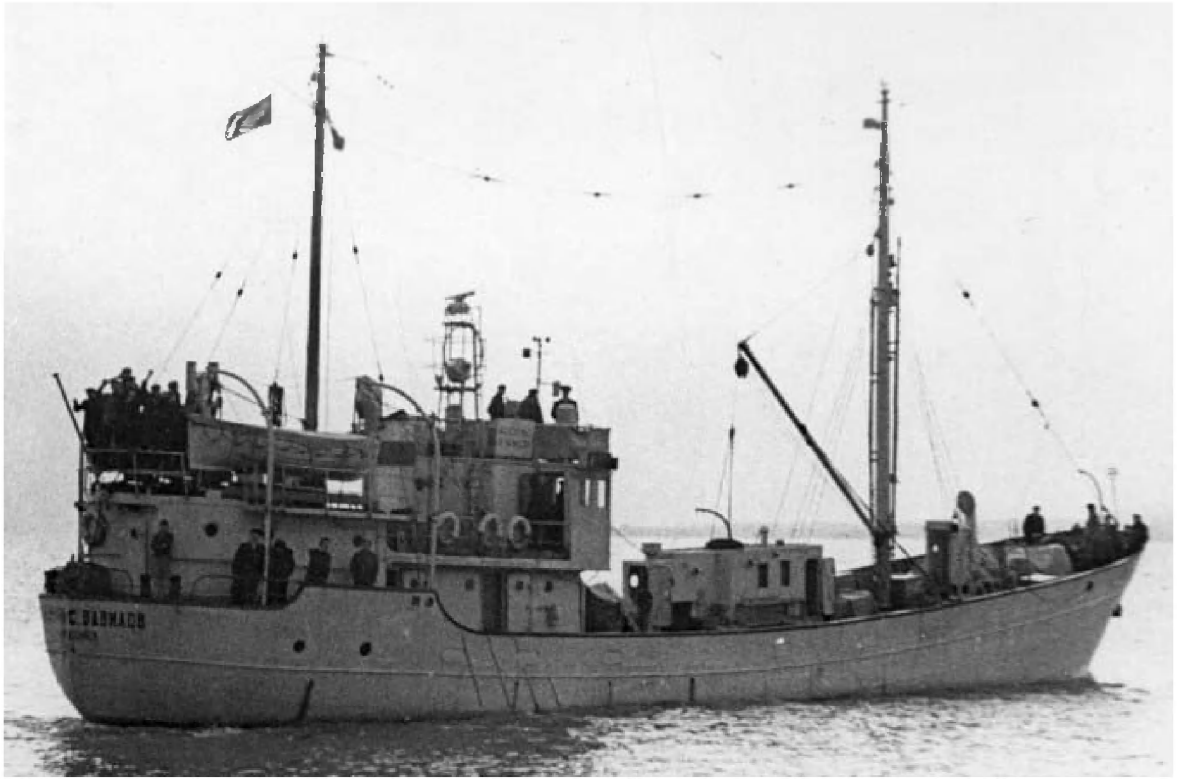
R/V Akademik Shirshov (Far East Hydrometeorological Institute)

R/V Vladimir Obruchev (Ministry of Geology)

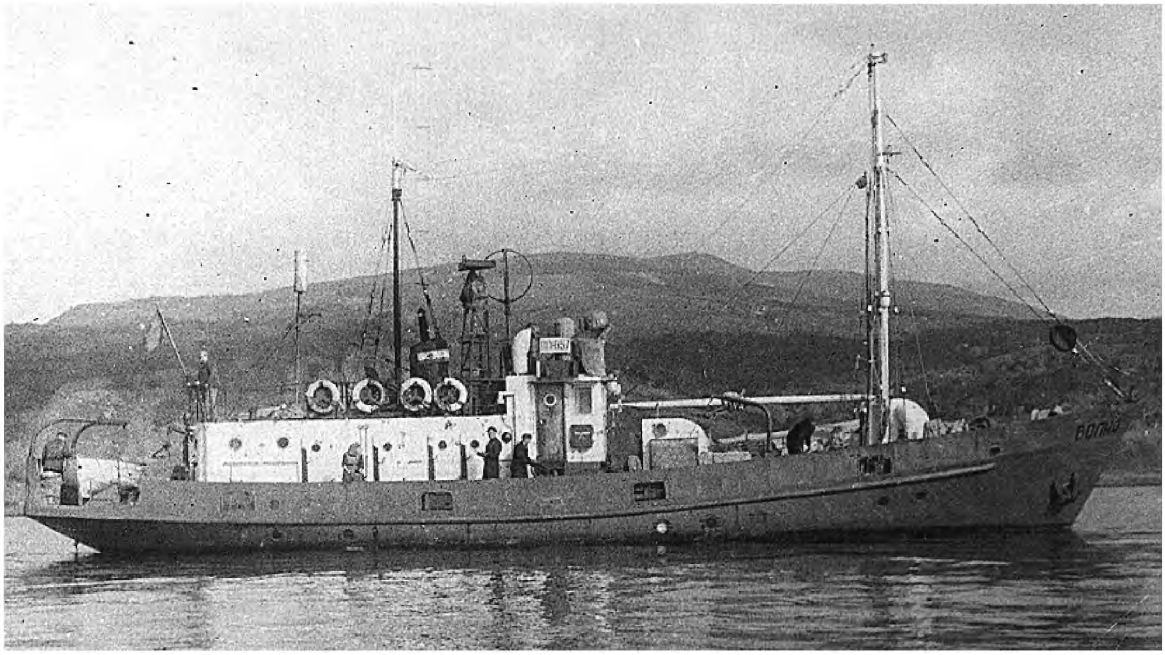
R/V Voskhod, built in 1953 (Murmansk Hydromet)



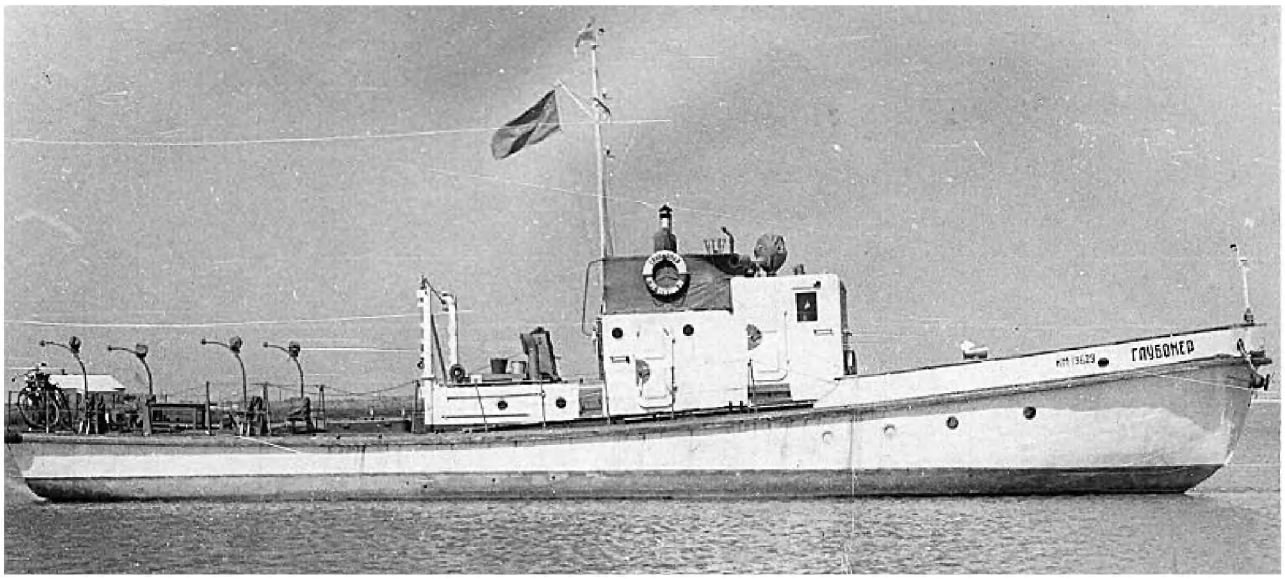
R/V Gals, built in 1963 (Ukrainian Hydromet)



R/V Sergei Vavilov

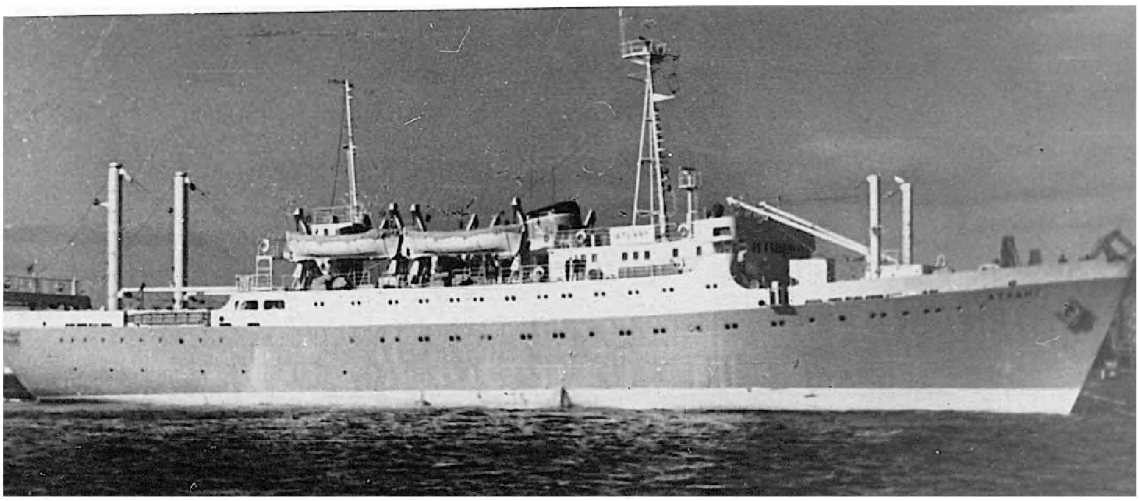


R/V Volna (Kamchatka Hydromet)



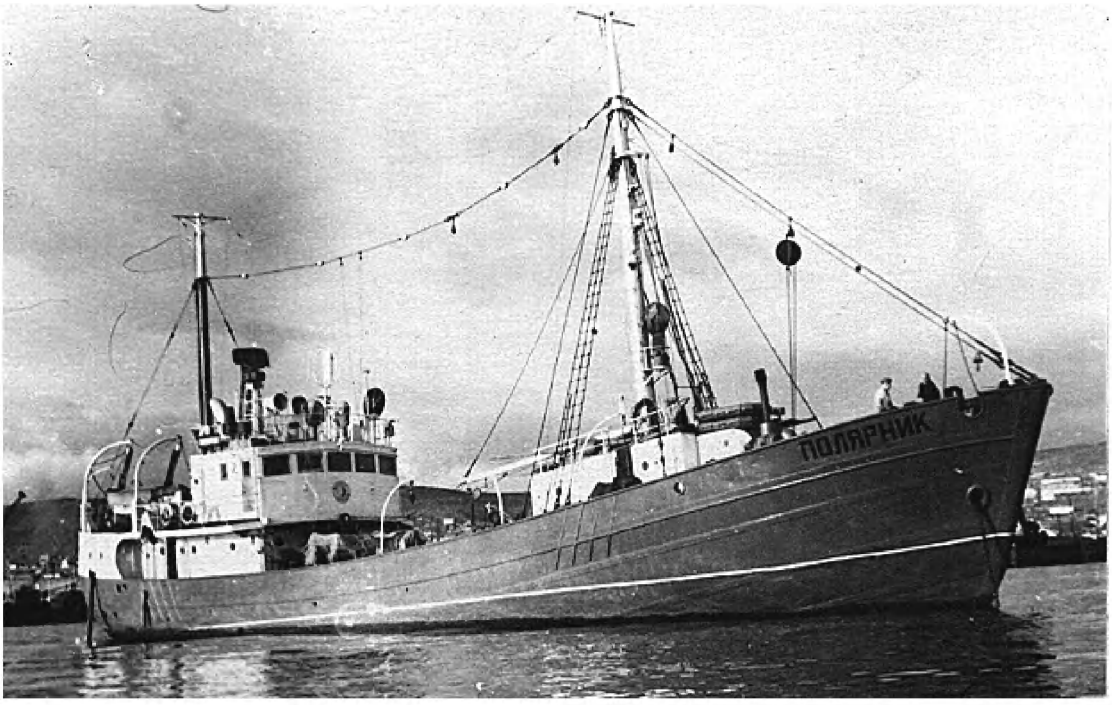
R/V Glubomer (North Caucasian Hydromet)

R/V I.D. Cherskiy



Major freezer fish trawler, Atlant (AtlantNIRO)

R/V Akademik Mstislav Keldysh (IO of RAS)



R/V Polyarnik (Murmansk Hydromet)

R/V Akademik Boris Petrov (built in 1984)

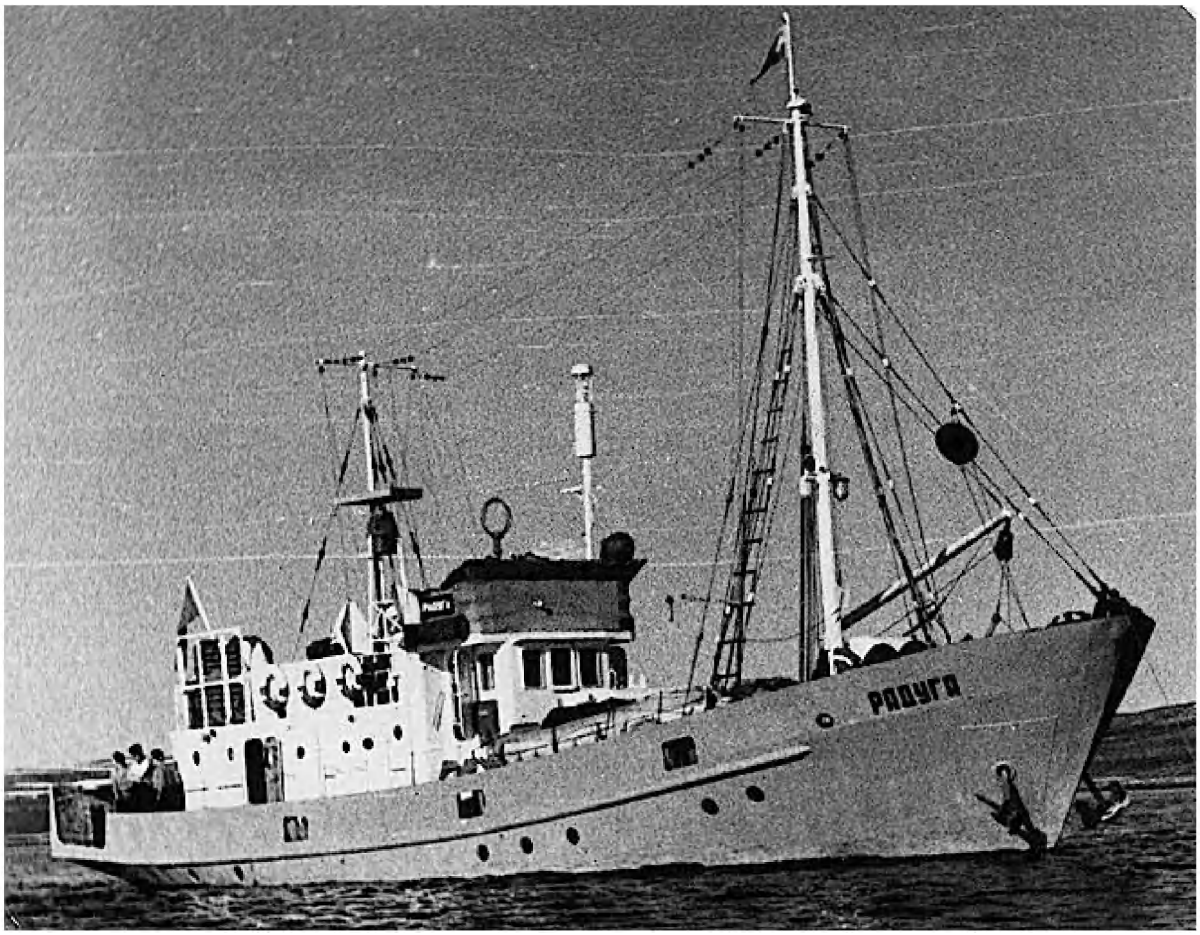
Nuclear-powered vessel, Lenin

Nuclear-powered icebreaker, Sibir, at the North Pole (1987)

Medium seine boat, Cyclon (Northwestern Hydromet, built in 1962)

R/V Priboi (Dunay Observatory, Hydrometeorological Service of Ukraine; built in 1961)

R/V Priliv (Far East Research Institute of Hydrometeorological Information, built in 1969)



R/V Raduga (Northwestern Hydromet)

4. OCEANOGRAPHIC EXPEDITION DATA COLLECTION, PROCESSING, ACCUMULATION, AND USE

4.1 Oceanographic data collection

Depending on the data-collection procedures, purpose, and time period of application, observations are classified as either real-time data or delayed-mode data. Data that are transmitted to a processing center soon after the time of the observation are considered real-time data. Real-time data are mainly used to prepare forecasts and to keep users informed on current meteorological and hydrological conditions in different regions of the world ocean. When they are used in an operational application, the real-time data is then considered to be delayed-mode data. Such data provide the basis for the study of different-scale variability of hydro-meteorological and hydro-chemical parameters and are used to prepare a wide range of atlases, manuals, guides, and other publications required for research and practical needs.

Collection of real-time oceanographic data began in the mid 1970s, when the Integrated Global Ocean Services System (IGOSS) was set up under the aegis of the IOC and the WMO. The Hydrometeorological Center of Roshydromet (Moscow) and RIHMI-WDC of Roshydromet (Obninsk) are the main centers in Russia for IGOSS real-time data collection and dissemination. The Hydrometeorological Center receives data from communication channels and performs quality control and computer processing necessary for operational application. Once the data are released, they are used to make weather forecasts and to predict hydro-meteorological conditions of the marine environment. In RIHMI-WDC, IGOSS information received via the Global Telecommunication System (GTS) in the form of BATHY, TESAC, DRIBU, BUOY and SHIP messages is quality controlled, processed, and put on archive media for long-term storage and subsequent use in requests by different agencies.

The collection, processing, and use of delayed-mode oceanographic data have been performed since the beginning of the 20th century. Until the mid 1960s, data taken at oceanographic stations were manually transferred from ship's logs to special tables either aboard the vessel or after it returned to port. The tables were further supplemented with comments, which were compiled into RV cruise reports and maintained in the libraries of ship owners. The data required for preparation of marine generalized products were processed manually.

In 1964, a Resolution adopted by the USSR government initiated the establishment of a centralized system of obtaining data from expeditions. In accordance with this Resolution, all R/V cruise data were to be registered and archived at the Russian National Oceanographic Data Center (in Obninsk), which was organized under the Main Directorate of the Soviet Hydrometeorological Service. At a later date, the archived data were distributed by discipline; and by the early 1970s, the centralized system acquired its modern form.

Standardization of delayed-mode data collection began when unified tables (TGM-3 forms) of deep-sea hydrological and hydrochemical observations were brought into use. In the mid 1960s, a program was initiated to put oceanographic data on punch cards and process them with analog instruments and mainframe computers of the first generation. In 1976, RIHMI-WDC produced "The Model of an R/V cruise: Scientific-Technical Report." A second edition of this document was published in 1989 in the form of a guide, which provided information on how to prepare an expedition report. This guide standardizes the documentation of data on paper and machine-readable media and provides the basis for comparison of data collected by R/Vs of different agencies. The guide also provides information on how data is obtained, systematized,

stored, and processed. For international projects, the guide serves to enhance inter-comparisons of instruments, which are used by participating countries, as well as the data that is collected before the results are included into specialized data bases. The second edition of another document, "The Guide to Work Performed in the Seas and Oceans," published in 1967 by the SOI, was a step forward in standardizing the methodology of oceanographic observations.

Depending on research needs and availability of platforms, standard observations were made from moving, drifting, and moored ships, both surface and underwater; shore-fast and drifting ice; moored and drifting buoys; aircraft and helicopters; and unmanned satellites. Basic types of ocean observations in the latter half of the 20th century have included: continuous oceanographic and aero-meteorological observations made at weather stations and lightships located in fixed points; surveys made by regular or irregular networks of oceanographic and aero-meteorological stations; moving observational polygons or synchronous observations performed at sections; monitoring of ocean eddies; and regular observations made at the same sections during all seasons.

Observational data on physical oceanography, marine hydrometeorology, and marine pollution as well as measurements obtained by satellites contribute to the Russian State Holding. These data are archived and maintained within RIHMI-WDC, which is co-located with the National Oceanographic Data Center. Data collected by the Navy are maintained in the Research Center of the Head Department of Navigation and Oceanography (RC of GUNIO, St. Petersburg). Ocean-drilling and geological data are managed by the World Data Center of Marine Geology and Geophysics (WDD-MGG, Gelendzhik), and marine biological data are stored in the Russian Federal Research Institute of Marine Fisheries and Oceanography (VNIRO, Moscow). These specialized data centers provide a firm basis for the collection, registration, management, and reliable storage of multi-disciplinary oceanographic data collected in the course of expeditionary exploration of the ocean.

Hand in hand with the development of computer facilities and the rapid improvement of observational instrumentation, the technology of data collection and processing was also changing. In the 1980s, computer rooms were set up on most of large research vessels. This allowed immediate processing and analysis of the data on the ship, and the data was then stored on magnetic tapes for future use. Since that time, a distinction has been made between large and medium computer-equipped vessels and small ships with respect to data-handling requirements. Large and medium vessels began to perform primary processing of the data at sea and then, after return to port, the data was submitted to one of the above-mentioned specialized centers on magnetic tapes in a prescribed format. Data collected by small ships were still processed by the data centers. However, in recent years, personal computers have gained wide acceptance in the collection and processing of data and have made it possible to submit observational data on computer-compatible media from all types of ships.

Large-scale computer-based processing of aero-meteorological and oceanographic information was initiated as part of the TROPEX-72 project, when observations were operationally entered on punch tapes. This program proved to be a good opportunity for Russian scientists and other specialists to gain valuable experience and contribute to the advancement of oceanographic and atmospheric research in the capacity of highly qualified researchers and international-scale project managers.

In the framework of the GATE project (1974), data collected by different countries were, for the first time, entered on magnetic tapes (more than 700) in a unified format and quality controlled using agreed algorithms. A sound data management plan contributed to the success of

the overall goals of the GATE project. Since 1974, all large-scale projects have required similar data-management plans.

From 1981-1985, AARI, Odessa SOI, Far East RIHMI, MGO, and RIHMI-WDC deployed the newest technology for collecting oceanographic data by equipping R/Vs with first- and second-generation mainframe computers. These high-speed computer systems were utilized to collect data on a variety of parameters, such as deep-sea profiles, hydrology, hydrochemistry, currents, CTDs, and ship aero-meteorology. These new technologies were eventually made available to more than 30 ships of all agencies, which resulted in the release of observational data to users within 1-3 months upon completion of a cruise (compared to 6-8 months using former technologies). In addition, expeditionary observations became less time consuming, and the data were immediately accessible to researchers right at sea. Finally, computer-based data processing was of fundamental importance for furthering sustainable development of marine science.

Oceanographic Data Banks (ODBs) took the automization of data processing a step further. Established in the late 1970s, the ODBs were put into operation in the data centers of different agencies. In 1985, a set of guiding principles, established by the ODBs and adopted by an interagency commission, was put into regular operation and applied to program such as "Oceanography – the World Ocean," "Seas," and "Sections." The ODBs mandated the following basic requirements: maintain a close relationship with institutions collecting the data; enact data quality-control procedures and ensure that data sets are updated; continuously improve software and hardware capabilities. It soon became apparent that similar data banks were needed in other agencies, in recognition of their missions and regional foci: WDC-MGG – geology and geophysics; VNIRO – hydrobiology; RC of GUNIO – oceanographic data collected by the Navy; and other marine institutions of the USSR (POI, Far East branch of RAS; SOI; Far East RIHMI; AARI; OI of RAS; and MHI, AS of the Ukraine). Introduction of these ODBs considerably reduced the time necessary to service user requests.

In 1986, the unified State Automated System of Oceanographic Information (SASOI) for the collection, storage, processing, and dissemination of data was initiated as part of the State Comprehensive Program, "The World Ocean." The goal of SASOI was to considerably increase both the quality and completeness of the data and to enhance a more expeditious delivery of the data and associated products to governmental, military, and civilian organizations. As part of their participation in the SASOI, the specialized data centers of Roshydromet, the Navy, the Committee for Fisheries, and the Committee for Natural Resources, with the assistance of ship owners, were tasked with three objectives: (1) develop a highly effective automated subsystem of oceanographic data collection; (2) develop and automate the maintenance of the state archive of data on physical oceanography, marine biology, marine geology and geophysics; and (3) develop software tools for processing the data and to facilitate the delivery of the data and other products to users upon request. During 1986-1991, these objectives were achieved with the advent of mainframe computers. Within the last five years, all oceanographic data processing procedures have been implemented using modern PCs.

At present, NODC has, for the most part, accomplished the development of PC software tools required to acquire, maintain and process oceanographic data. Functionally these tools are divided into three groups: (1) software tools for the maintenance and query of reference informational databases; (2) software tools for oceanographic data collection, primary processing, and entry on PC-compatible media; and (3) software tools for preparing secondary products from hydro-meteorological and oceanographic data. The first group of software tools is

applied to support the NODC reference oceanographic data bases utilizing FoxBASE and FoxPro database management systems (DBMS). The other two groups of software tools make up the Information-Reference System (IRS "Oceanography") and are applied to ensure a variety of operations required to build, maintain and use marine environmental data bases. These operations range from viewing initial tables and plots to prepare and display various products for a specific sea or ocean area, including grid-point characteristics. In order to improve the efficiency in the management, processing, and dissemination of oceanographic informational products, the NODC has updated its capabilities and now regularly uses advanced instrumental tools and information technologies such as MapInfo and Arc Info GIS, Paradox and Oracle DBMS, the Internet, and CD-ROMs.

International exchange plays an important part in oceanographic data collection and acquisition. The World Data Center System was initiated in 1957 during the time of the International Geophysical Year (IGY) and became a program of the IOC/International Oceanographic Data Exchange (IODE) system in 1961. The IODE system now comprises three World Data Centers (WDCs) for Oceanography (Silver Spring, Maryland; Obninsk, Russia; and Tianjin, China) and more than 60 National Oceanographic Data Centers (NODCs). The fundamental principles and responsibilities of the IODE system are set out in the Manual on International Oceanographic Data Exchange. Using the Manual, WDCs acquire, store, and disseminate oceanographic data collected from national and international programs conducting research on the world ocean. The WDCs for Oceanography are collocated with, and operated by, the National Oceanographic Data Centers (NODCs), which provide the resources and facilities to support the international data exchange activities. In Russia, the WDC for Oceanography is housed within the Roshydromet All-Russian Research Institute for Hydrometeorological Information (RIHMI).

4.2 Data accumulation and systematization

Expeditionary data are received by oceanographic data centers of different agencies and by ship owners. Since more than 150 Russian organizations have been involved in expeditionary research since the early 1900s, it is difficult to estimate the total amount of data that has been collected. Therefore, estimates provided here (such as Table 4.1) are based on data that are archived in the centers.

At present, the NODC has received more than 30 thousand reports of cruises performed by Russian R/Vs during the period 1885–1995. Data catalogues prepared by the NODC have been compared with data holdings in other marine organizations, and it can be said with confidence that since the beginning of 1996, the completeness of data archived at the NODC is not less than 80%. Hence, the characteristics of the NODC oceanographic database, discussed below, adequately depict the general pattern of long-term expedition research performed by Russian oceanographic institutes with the exception of the Arctic Ocean data, most of which are held in AARI in St. Petersburg. Figure 4.1 shows the distribution of oceanographic cruises conducted in the key periods of Russian expeditionary research. As can be seen in this figure, the greatest number of expeditions performed both in the World Ocean and in the inland seas of Russia took place during the period 1976 - 1985.

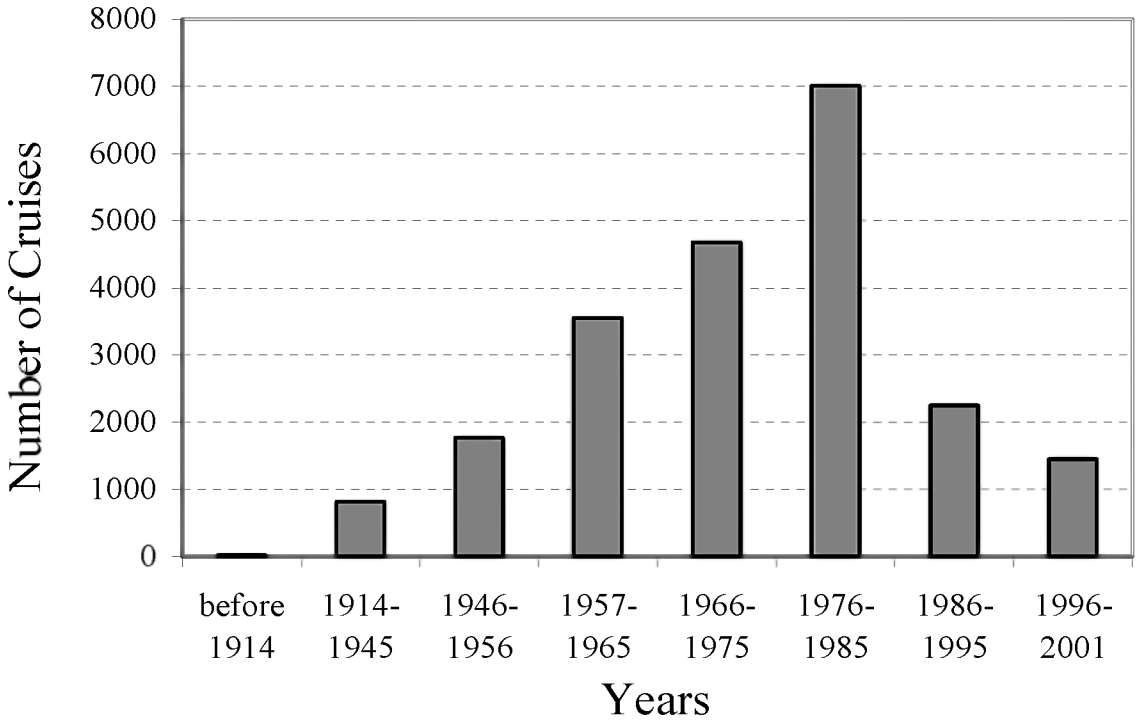


Figure 4.1. Number of Russian R/V cruises performed in key periods of expeditionary research in both the world ocean and in Russian seas

Table 4.1 and Figure 4.2 show the number of expeditions performed by different Russian agencies. It is clear that Roshydromet, the Fishery Committee, the Navy, and the Academy of Science are the main contributors to the exploration of seas and oceans. Among Roshydromet institutions, the greatest contribution was made by the Far East RIHMI, AARI, SOI (Odessa branch), Murmansk Hydromet, Maritime Hydromet, Northwestern Hydromet, and Sakhalin Hydromet.

Table 4.1. The number of reports containing oceanographic data submitted by agencies of Russia and former Republics of the USSR

Agency	Temperature salinity	Bathy-thermograph	Currents	Hydro-chemistry	Chemical pollution	Total
AS of the Ukraine	198	20	41	86	13	224
AS of Estonia	51	-	3	3	13	58
RAS	316	20	17	147	4	350
GUNIO	671	321	134	150	6	770
HMS of Azerbaijan	3796	3	51	29	12	3807
HMS of Georgia	146	-	4	20	18	146
HMS of Latvia	217	-	9	32	29	220
HMS of Lithuania	732	2	54	106	52	732
Roshydromet	9536	735	917	1464	640	9804

Agency	Temperature salinity	Bathy-thermograph	Currents	Hydro-chemistry	Chemical pollution	Total
HMS of Usbekistan	14	-	10	-	-	14
HMS of the Ukraine	922	6	70	166	37	926
HMS of Kazakhstan	49	-	-	-	-	49
HMS of Estonia	114	5	64	42	21	124
Fishery Committee	2492	728	26	1048	15	2706
Fishery Ministry of the Ukraine	408	89	3	246	1	410
Ministry of Natural Resources	7	-	-	-	-	7
Ministry of Education	30	3	1	20	1	30
WDC-B	10570	567	166	3425	36	11022
Unknown	10	-	1	-	1	10
Total	30279	2449	1571	6984	899	31409

Note: Information about the former Republics of the USSR is provided up to 1992.

Figure 4.2 Distribution of oceanographic data collected by different marine agencies of the Russian Federation (data collected by former Republics of the USSR before 1992 are included) in the period of 1976-1996 (a number of scientific reports on RV cruises). Data are held in the State Holding of RIHMI-WDC

The different categories and amounts of oceanographic data archived in the State Holding of RIHMI – WDC is shown in Figure 4.3. This is calculated for data received through 2001. The greatest percentage of data is *in situ* temperature and salinity measured at various depths. As large oceanic R/Vs were built and modern equipment was developed, additional marine environmental parameters were measured. It is safe to say that by 1980, the Russian research fleet was sufficiently equipped to make all basic aerometeorological, hydrological, and hydrochemical observations in the world ocean. The small amount of data collected by sounding instruments is reflective of the problems that Russian engineering had to face in developing such specialized oceanographic instruments. The distribution of Russian oceanographic data (oceanographic station, bathythermographs, and CTD data) archived in NODC over different regions of the world ocean is shown in Table 4.2. It is worth noting that nearly half of the total amount of data represents the world ocean located between 60° north and south latitudes. In particular, the north and central Atlantic enjoys the best data coverage. More than half a million deep-sea, bathythermograph (BT), and CTD soundings were made in this region. As for the Russian seas, the greatest amount of data was collected for the Baltic, Barents, and Japan Seas.

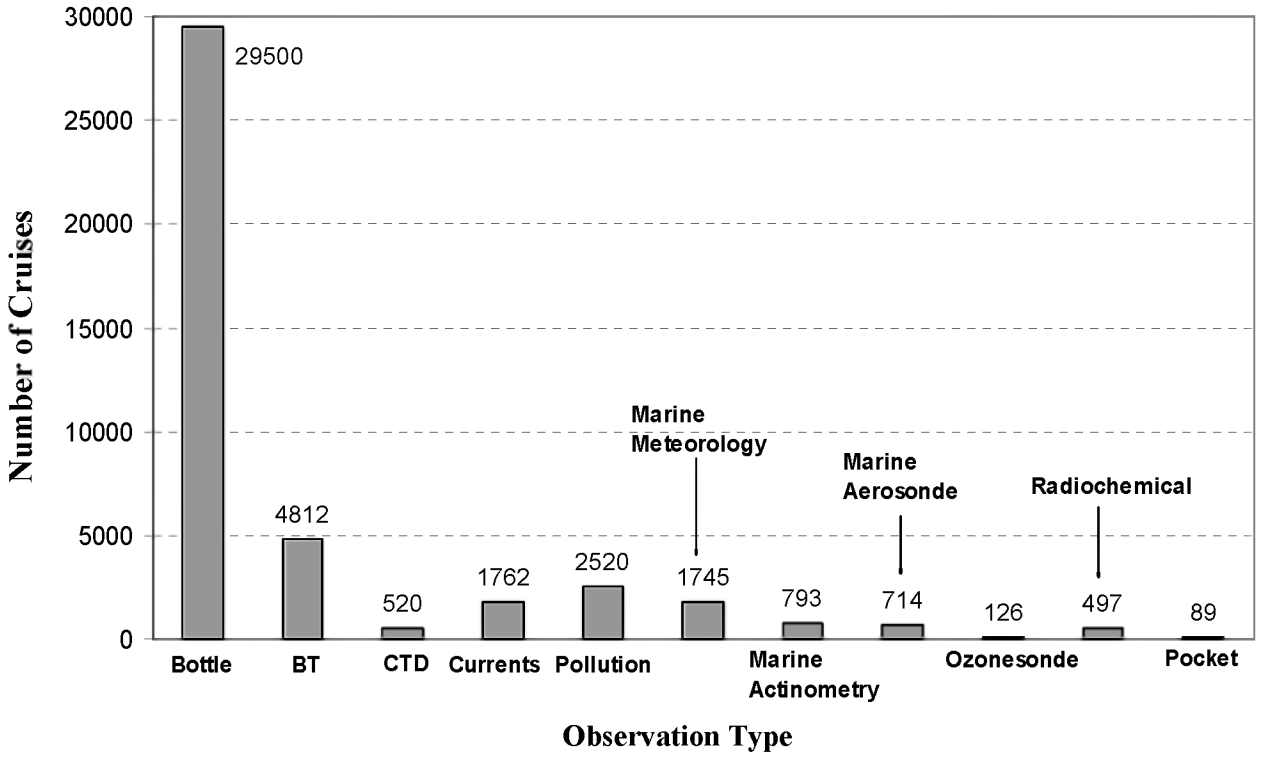


Figure 4.3. Distribution of oceanographic data held in the State Holding (RIHMI-WDC) by type of observations.

Table 4.2 Distribution of oceanographic data by basic regions of the World Ocean

Sea, Ocean	Russia (the USSR)		Other Countries	
	Cruises	Stations	Cruises	Stations
The Azov Sea	593	33600	3	100
The Aral Sea	51	1500	-	-
The Baltic Sea	4067	269800	558	15800
The Barents Sea	2491	120700	22	6
The White Sea	919	47300	-	-
The Bering Sea	320	16500	54	2700
The East Siberian Sea	54	5600	1	15
The Kara Sea	197	14400	2	30
The Caspian Sea	4035	50400	-	-
The Laptev Sea	419	12600	-	-
The Sea of Okhotsk	800	68500	32	640
The Black Sea	1659	94500	42	840
The Sea of Chukotsk	72	11000	6	120
The Japan Sea	2244	106000	671	20130
The Arctic Sea	110	159400	57	1710
The Pacific Ocean	6467	444000	4189	4900
The Atlantic Ocean	5484	647600	2865	100000
The Indian Ocean	815	86300	284	8520
The South Ocean	71	7421	70	7000

Figures 4.4, 4.5, 4.6, and 4.7 show the distribution of oceanographic stations in the Atlantic, North Pacific, and Indian Oceans as well as the Black and Azov Seas since 1900, respectively. Table 4.2 identifies the distribution of oceanographic data according to the region of the world ocean; this data is accessible to any user. About 60 % of foreign data was received through the International Oceanographic Data Exchange (IODE) program. Nonetheless, it should be pointed out that Russia made a sizeable contribution to the international oceanographic data set (Figure 4.8) and has submitted to the World Data Centers more than 180,000 oceanographic stations and 350,000 BT soundings. Along with the USA, Canada, and Japan, Russia is a major IODE contributor.

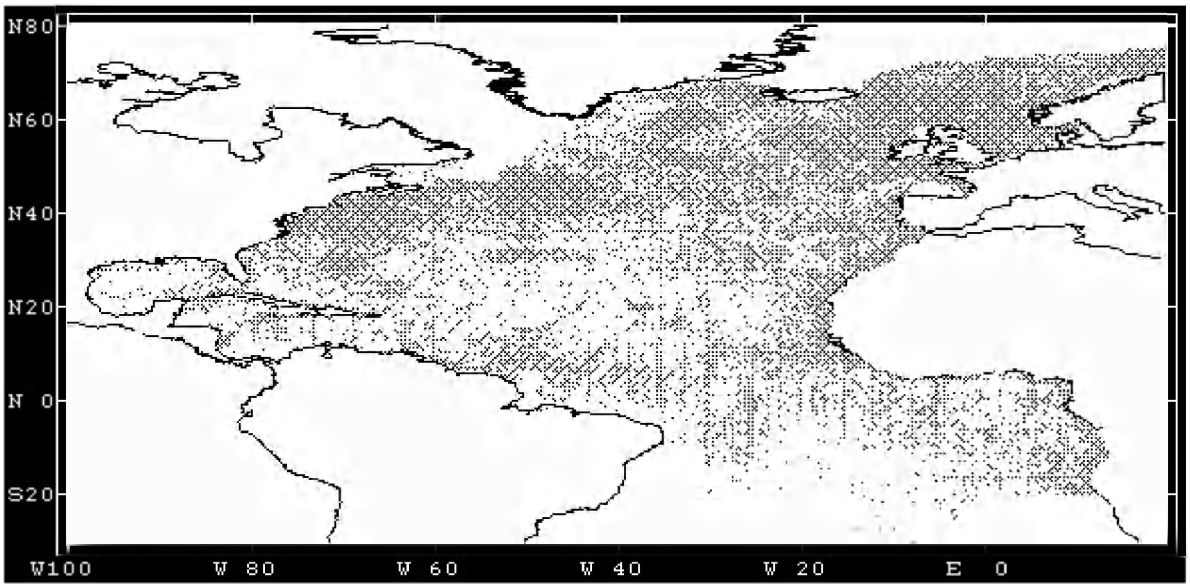


Figure 4.4 Distribution of R/V oceanographic stations since 1900 for the North and Central Atlantic.

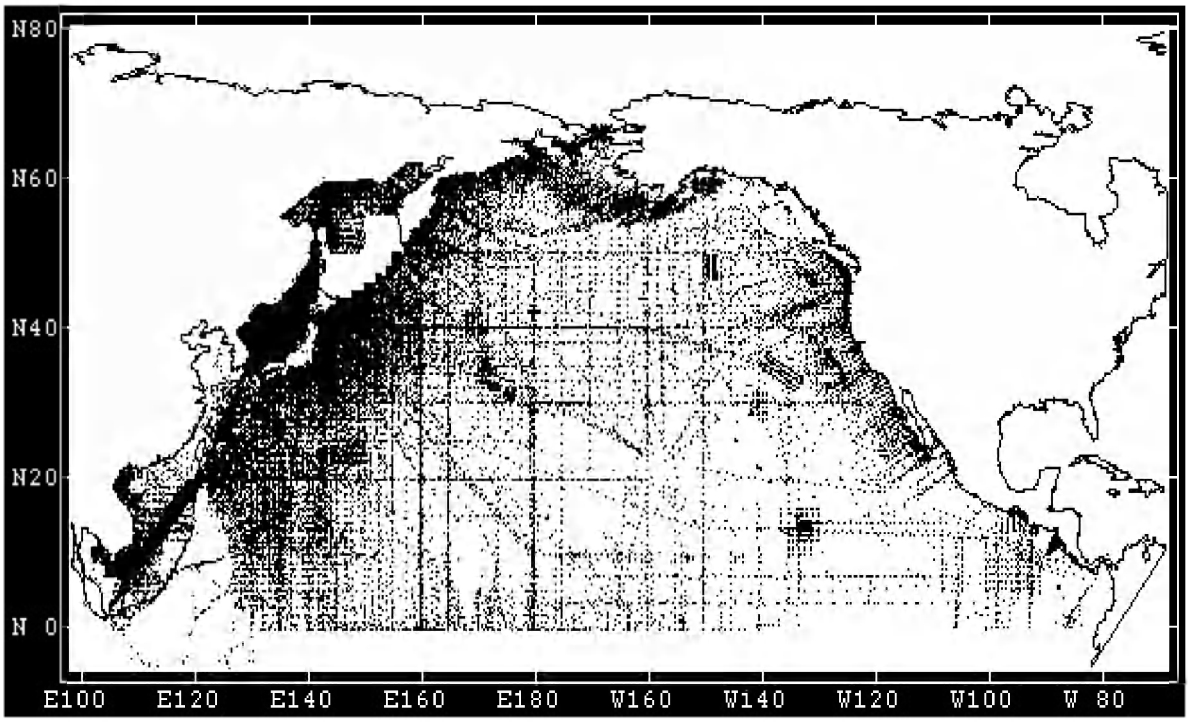


Figure 4.5 Distribution of R/V oceanographic stations since 1900 for the North Pacific.

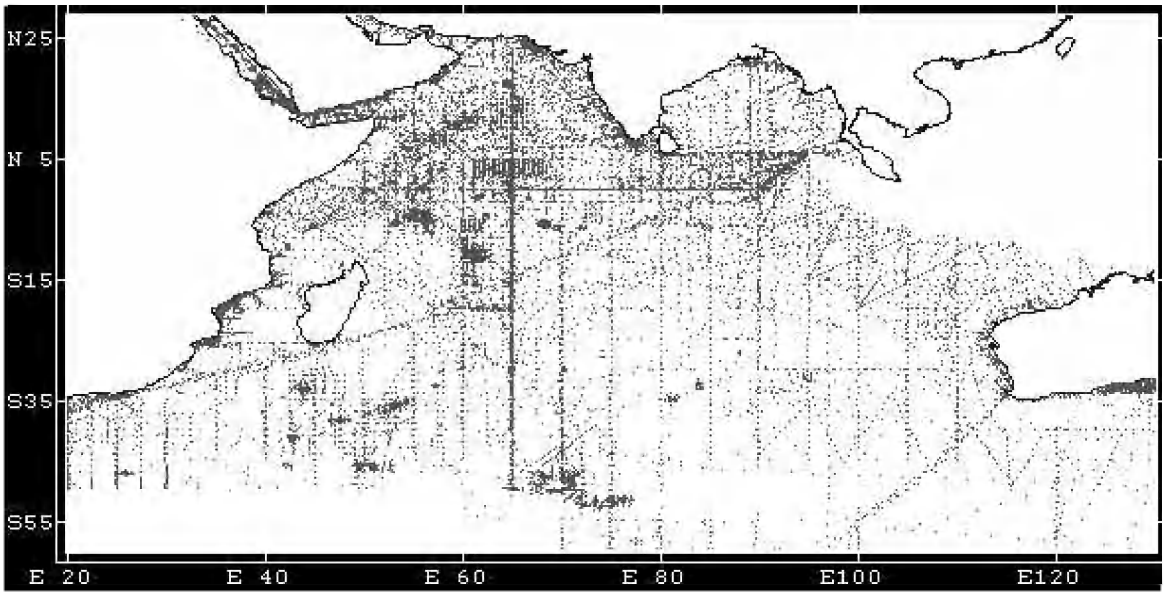


Figure 4.6 Distribution of R/V oceanographic stations since 1900 for the Indian Ocean.

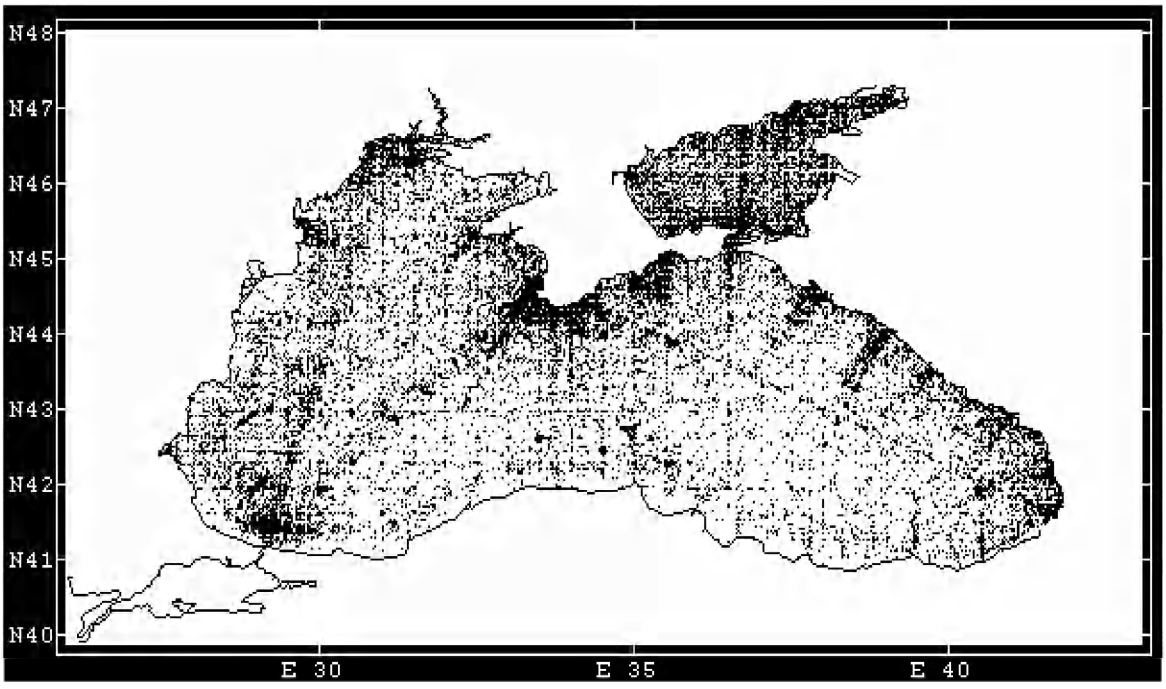


Figure 4.7 Distribution of R/V oceanographic since 1900 for the Black and Azov Seas.

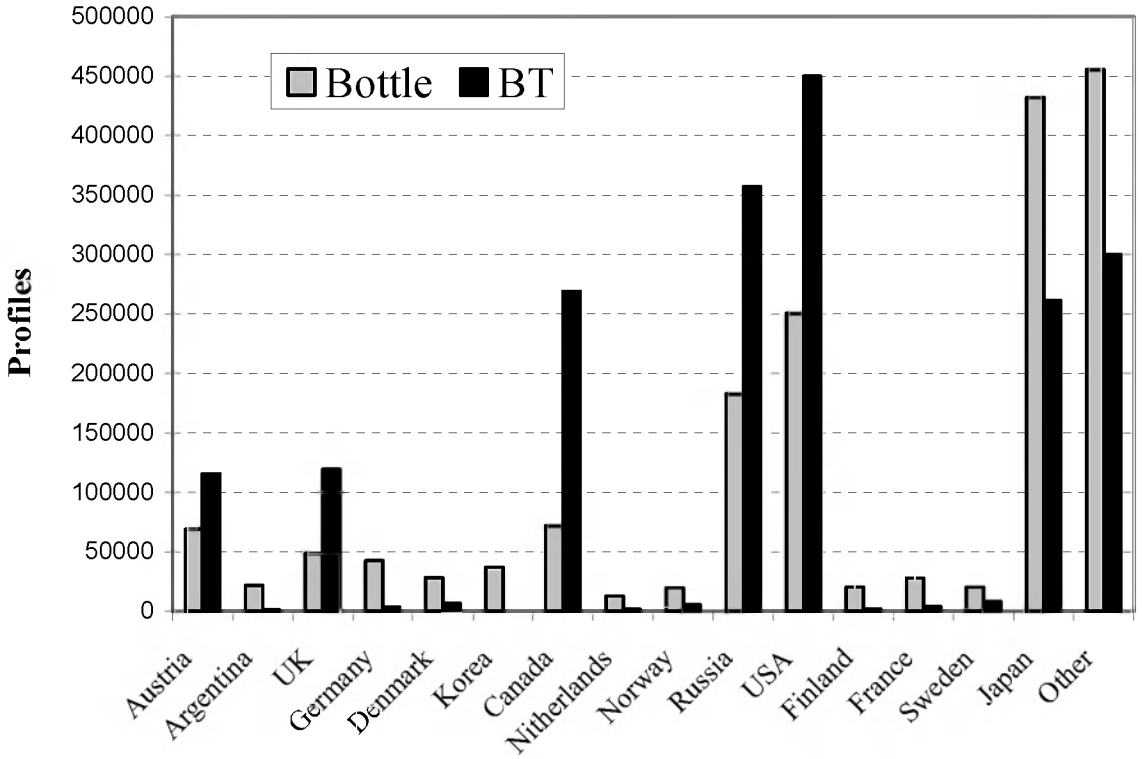


Figure 4.8 Contribution of IOC member states to the International Oceanographic Data Exchange (DNP, projects and programs)

Using the primary data, the following products were prepared:

1. Combined temperature, salinity and hydrochemistry data for the world ocean from 1900-1990 (about 2,200,000 BT stations);
2. BT and CTD profiles collected from oceanic weather stations of the North Atlantic and the North Pacific ("Charlie," "Echo," "Bravo," and others) from 1900 – 1990;
3. Time series of observations made at 400 coastal stations from 1924-1986, at both secular and standard sections of Russian seas such as the Baltic (including the Gulf of Riga, the Gulf of Vistula, the Kurshski Bay, the Gulf of Finland, and the Gulf of Tallinn), the Caspian, the Black, and the Azov Seas;
4. Single-point climatology obtained from temperature, salinity, and derived hydrophysical parameters (density, sound velocity, Vaisala–Brent frequency) observed at standard 1° Marsden squares for the northeastern basin (the Barents, Norwegian, and Greenland Seas and the North Atlantic area eastward from longitude 45□ W); and
5. Fields of climatological characteristics of temperature, salinity, density, sound velocity, and Vaisala-Brent frequency observed at standard horizons and one-degree-grid-point air temperature, surface water temperature, atmosphere pressure, wind speed, wave height and period for the Northeastern basin.

4.3 Application of marine expeditionary data

Oceanographic data sets acquired in the framework of national and international programs contain diversified information on the physical, chemical, biological, and geological processes occurring at the surface as well as within the water column; at the boundary between the atmosphere and the sea; and at the bottom of the sea.

In processing the data and performing analyses, Russian scientists have prepared many scientific papers and reports, series of monographs, atlases, manuals, and other scientific products. As new information becomes available and improved methods of scientific analysis are introduced, research efforts will continue to provide answers to challenging issues.

Oceanographic data collected by Russian RV cruises have gained wide-spread acceptance in all types of activities undertaken by man on the sea such as fishery, fish farming, shipping, ship-building, hydrotechnical construction, oil and gas exploration, prospecting and drilling, tourism and recreation, weather forecasting, climate change studies, environment pollution monitoring. Observational data are often used right aboard a ship to adjust a scientific program of the expedition but primarily they are intended for the use by data centers, research institutions, commercial organization and governmental bodies. Table 4.3 gives statistical information on the use of marine expeditionary data available in NODC. More than 120 institutions and organizations, both Russian and foreign, are users of the NODC data, and more than 80 of these are considered regular users. Within the last decade, 800 user requests have been received to provide data, perform calculations, and supply reference information. The NODC staff make every effort to respond to every request in a timely and efficient manner.

Table 4.3 Number of user requests for oceanographic information (distribution by years)

Types of requests	1991	1992	1993	1994	1995	1996	Total
Statistical calculations	98	1	2	4	3	2	110
Computer data extraction	322	41	26	32	30	3	454
Copying data	146	1	1	-	-	-	148
Providing information on data	101	-	5	14	12	9	141
Copying manuals and guides	25	1	1	-	1	1	29

Thirty per cent of all requests are from Russian marine institutions, which are developing specialized and regional data bases, and they desire hydrological, hydrochemical, and coastal hydrometeorological data. Information about the data (29% of the requests) and the results of analyses (16% of the requests) are provided on demand and within the framework of research programs.

The types of data that are requested are divided as follows:

1) deep-sea observations – 77%
2) coastal observations – 15%
3) current observations – 5%
4) other types of observations – 3%.

The distribution of requests by agency is as follows:

1) RAS – 39%
2) Roshydromet – 26%
3) GUNIO – 15%
4) Fishery Committee – 13%
5) Ministry of Education – 3%
6) other agencies – 4 %.

Nearly 70% of the requests by institutes of the RAS, Roshydromet, Ministry of Education and other agencies are for data or information, which are used in basic marine research.

5. CONCLUSION

This monograph contains information on marine expeditions, outstanding sea voyages, famous navigators and scientists, research vessels, methods of observations, data collection procedures, volume of data collected, and ship owners. It is not the intent of the authors to present the entire amount of work that has been done by the research fleet of Russia. This is a task that is far beyond the scope of this publication.

As a result of efforts made by many scientists and economists over many years, the concept of "environmental stewardship" has been introduced to the general public. However, the technology, which allows quantitative analyses of both the positive and negative impacts on the environment has not yet been fully developed. Numerous examples can be given where oceanographic information is efficiently used for the management of marine living and non-living resources and to support sea transportation, the fishery industry, recreation, and naval operations. But often, the significance of marine information is underestimated; and this can result in economic losses, marine accidents, or even ecological disasters. Today, it is imperative to recognize that human activities on the sea can have an enormous impact on the environment. In addition, an underestimation of available data and lack of awareness of the need for, and benefits from, such data may lead to labor-consuming production, rapacious extraction of renewable and non-renewable resources, and failure to utilize the extracted resources in an efficient manner. Full utilization of all available data will greatly contribute toward a long-term, sustained economic development strategy.

Much remains to be done to make environmental information available and cost-effective for modern business and production, and a close working relationship between the commercial and scientific communities is highly desirable. There is a great need for quantitative information on the impact of human activities on various environmental parameters, and advanced tools and technologies for information processing should be further developed.

A concerted effort at the federal, regional, and departmental level is currently underway to integrate the tools and technologies available within the country for the collection, processing, storage, and dissemination of ocean-related observations and information. A "Unified System of Information on the Condition of the World Ocean (ESIMO)" is being developed within the framework of the Russian Federal Target Program, The World Ocean, and will involve more than 500 organizations and institutions. ESIMO will be a one-stop source of information for any user wishing to obtain data and other products covering all aspects of Russia's past and future efforts to study the World Ocean, including expeditions, ships, observations conducted, coastal stations, buoys, and satellites. Additional information about ESIMO is available at http://www.oceaninfo.ru.

6. APPENDICES

1. Basic information on expeditionary ships and types of observations
2. Brief information on the most prominent national and international expeditions and projects (programs)
3. RVs involved in various programs and projects
4. Organizations of Russia and the Former USSR taking an active part in the study of oceans and seas
5. Additional literature with information on marine expeditions
6. Abbreviations

Appendix 1. Basic information on expeditionary ships and types of observations

Types of Observations

D	Dynamics of the Ocean	H	Hydrology
M	Meteorology	G	Geology and Geophysics
P	Pollution	B	Marine Biology

Geographical area of ship operation

AO	The Atlantic Ocean	Ind	The Indian Ocean
Aral	The Aral Sea	JS	The Japan Sea
ArcO	The Arctic Ocean	Kar	The Kara Sea
Azov	The Sea of Azov	LS	The Laptev Sea
Bar	The Barents Sea	MS	The Mediterranean Sea
Ber	The Bering Sea	NA	The North Atlantic
BlS	The Black Sea	PO	The Pacific Ocean
BS	The Baltic Sea	SO	The Sea of Okhotsk
Casp	The Capian Sea	White	The White Sea
Chuck	The Chuckchi Sea	WO	The World Ocean
ES	The East Siberian Sea		

Type of Ship

B	Boat	LFT	Large Fish Trawler
EL	Expeditionary launch	LFFT	Large freezer fish trawler
EOS	Expeditionary oceanographic ship	LL	Large launch
ES	Expeditionary ship	MBSS	Medium Black Sea seiner
FFFT	Fish freezer flaying trawler	MFT	Medium fish trawler
FFT	Fish freezer trawler	MFFT	Medium freezer fish trawler
FFT-A	Fish freezer trawler – Atlantic type	MFST	Medium freezer stern trawler
FFT-T	Fish freezer trawler – Tropic type	MS	Motor ship
FS	Fish seiner	ORS	Oceanographic research ship
FSH	Fish ship	RV(SRV)	Research(scientific-research) vessel
FST	Freezer seiner-trawler	S	Steamer
FT	Fish trawler	SCH	Schooner
HL	Hydrographic launch	SES	Scientific-expeditionary ship
HRS	Hydrographic research ship	SFT	Salting-flaying trawler
HS	Hydrographic ship	SL	Small launch
HuntB	Hunting boat	SRIB	Scientific-research icebreaker
HuntS	Hunting ship	SRV	Scientific-research vessel
IB	Icebreaker	SRWS	Scientific-research weather ship
IBS	Icebreaker ship	SSS	Scientific-search ship
IBST	Icebreaker steamer	SV	Scientific vessel
IC	Icecutter	TB	Tugboat
L	Launch	TES	Training expeditionary ship

Name of Ship	Period of Work		Type of Ship	Call	Area of Operation	Type of Observation					
	Start	Finish				M	H	P	G	D	B
Acoustic Institute											
Sergei Vavilov	1962	1984	SRV	VNOV	WO	-	+	-	-	-	-
Petr Lebedev	1967	1977	SRV	VFBY	WO	-	+	-	-	-	-
All Russian Research Institute for Fishery and Oceanography											
Akademik Arkhangelskiy	1971	-	-	-	MS	-	+	-	+	-	-
Yuriy Godin	1972	1973	ES	-	MS	-	+	-	+	-	-
SRT-331	1954	1954	MFT	-	Bar	-	+	-	-	-	+
Slava -9	1958	1958	-	-	WO	-	+	-	-	-	-
Akademik Knipovich	1974	-	SSS	USPO	NA	-	+	-	-	-	+
Amderma Hydromet											
Amderma	1986	-	SRV	UICP	Kar	-	+	-	-	-	-
Arctic and Antarctic Research Institute											
Stepan Malygin	1924	1936	IBST	-	Kar	+	+	-	-	-	-
G.Sedov	1926	1940	IBST	-	ArcO	-	+	-	-	-	-
Sibiryakov	1932	1939	-	-	ArcO	-	+	-	-	-	-
F.Litke	1932	1955	–	-	ArcO	+	+	-	-	-	-
Rusanov	1932	1936	ES	-	ArcO	-	+	-	-	-	-
Akademic Shokalsky	1940	-	-	-	Bar	-	+	-	-	-	-
Smolny	1941	1944	-	ESJG	PO	-	+	-	-	-	-
Slava-15	1955	1958	-	-	WO	-	+	-	-	-	-
Ob	1956	1973	SRV	-	AO	+	+	+	-	-	-
Azimut	1960	1970	-	-	ArcO	-	+	-	-	-	-
Prof. Vize	1968	1989	SRV	UPUJ	WO	+	+	+	-	+	-
Prof. Zubov	1969	1989	SRV	UMFW	WO	+	+	+	-	+	-
Michail Somov	1975	1988	SES	UPWW	WO	+	+	-	-	-	-
Rudolf Samoilovich	1978	1989	SRV	URYM	WO	+	+	+	-	-	-
Akademic Shuleikin	1982	-	SRV	UBNZ	AO	+	+	+	-	-	-
Prof. Multanovskiy	1983	1989	SRV	UJFO	AO	+	+	+	-	-	-
Akademik Fyodorov	1988	-	SES	UQYC	AO, Bar	+	+	-	-	+	-
Atlantic Research Institute for Marine Fisheries and Oceanography											
Temp	1945	1952	SSS	-	WO	-	+	-	-	-	-
Kazan	1957	-	LFT	-	NA	-	+	-	-	-	-
Alazan	1958	-	-	-	NA	-	+	-	-	-	+
Alazeya	1958	-	-	-	AO	-	+	-	-	-	+
Zvezda	1958	1975	SRV	-	AO	-	+	-	-	-	+
Lomonosov	1958	1966	MFT	-	AO	-	+	-	-	-	+
Mudjug	1958	1966	MFT	-	NA	-	+	-	-	-	+
Mosalsk	1958	1966	MFT	-	AO	-	+	-	-	-	+
Muinak	1958	1966	MFT	-	NA	-	+	-	-	-	+
Muksun	1958	1964	FT	-	AO	-	+	-	-	-	+
Aragats	1959	1974	MFT	-	AO	-	+	-	-	-	+
Artemovsk	1959	1963	MFT	-	NA	-	+	-	-	-	+
Mjag-Ostrov	1959	1964	MFT	-	AO	-	+	-	-	-	+
Orekhovo	1959	1969	MFT	-	AO	-	+	-	-	-	+

Name of Ship	Period of Work		Type of Ship	Call	Area of Operation	Type of Observation					
	Start	Finish				M	H	P	G	D	B
Gribojedov	1960	-	-	-	AO	-	+	-	-	-	+
SRT-4309	1960	1960	MFT	-	BS	-	+	-	-	-	+
Oskol	1960	1961	MFT	-	NA	-	+	-	-	-	+
Olekma	1961	1976	MFT	-	AO	-	+	+	-	-	+
SRT-4179	1962	1962	MFT	-	BS	-	+	-	-	-	+
Ostashkov	1962	1969	MFT	-	AO	-	+	-	-	-	+
Oleniy	1962	1968	MFT	-	AO	-	+	-	-	-	+
Oleksin	1962	-	MFT	-	BS	-	+	-	-	-	+
Otradny	1962	1969	MFT	-	AO	-	+	-	-	-	+
Obdorsk	1963	1968	MFT	-	AO	-	+	-	-	-	+
Obraztsovo	1963	-	MFT	-	AO	-	+	-	-	-	+
Olonets	1963	1969	MFT	-	AO	-	+	-	-	-	+
Okhta	1963	1968	MFT	-	AO	-	+	-	-	-	+
Albatros	1965	1977	MFT	-	AO	-	+	-	-	-	+
Zhuvedra	1965	-	MFT	-	AO	-	+	-	-	-	+
Atlant	1965	-	LFT	UOLF	AO	-	+	-	-	-	+
Vyandra	1965	1980	MFFT	-	AO	-	+	-	-	-	+
Gizhiga	1966	-	LFT	UJUH	AO	-	+	-	-	-	+
Langust	1966	1984	MFFT	-	WO	-	+	-	-	-	+
Prognoz	1966	1985	MFFT	-	WO	-	+	-	-	-	+
Antares	1967	1981	MFFT	-	WO	-	+	-	-	-	+
Ekliptika	1968	1973	MFFT	-	AO	-	+	-	-	-	+
Aliot	1969	1980	MFFT	-	AO	-	+	-	-	-	+
Argus	1969	1985	SSS	ESRL	AO	-	+	-	-	-	+
Marsianin	1969	1972	MFFT	-	AO	-	+	-	-	-	+
Vykhma	1970	1980	MFFT	-	AO	-	+	-	-	-	+
Kwant	1970	1983	MFFT	-	AO	-	+	-	-	-	+
Yu.Vitas	1970	-	LFT	-	AO	-	+	-	-	-	+
Volzhanin	1971	-	LFT	-	AO	-	+	-	-	-	+
Nekton	1972	1987	MFFT	-	AO	-	+	-	-	-	+
Evrika	1972	1988	SSS	-	AO	-	+	-	-	-	+
Anchar	1973	1988	LFT	-	AO	-	+	-	-	-	+
Zalesje	1973	-	FFT	-	AO	-	+	-	-	-	+
Merkuriy	1976	1982	MFFT	-	AO	-	+	-	-	-	+
Korifena	1977	1987	MFFT	-	AO	-	+	-	-	-	+
Kommunar	1978	1978	-	EVHJ	PO	-	+	-	-	-	+
Monokristal	1982	1988	MFFT	-	WO	-	+	-	-	-	+
Ocher	1983	1988	FST	-	WO	-	+	-	-	-	+
Saulkrasty	1986	1989	MFFT	-	SO, JS	-	+	-	-	-	+
Atlantida	1987	-	MFFT	-	AO	-	+	-	-	-	+
Atlantniro	1987	-	FST	-	WO	-	+	-	-	-	+
Strelnya	1987	1989	MFFT	-	WO	-	+	-	-	-	+
Baltic Research Institute for Fishery and Oceanography											
SRT-129	1958	1961	MFT	-	BS	-	+	-	-	-	+
Mazirbe	1960	1978	MFT	-	BS	-	+	-	-	-	+
Bespokoiny	1969	1981	-	-	-	-	+	-	-	-	+

Name of Ship	Period of Work		Type of Ship	Call	Area of Operation	Type of Observation					
	Start	Finish				M	H	P	G	D	B
Mara	19 71	1981	-	-	BS	-	+	-	-	-	+
Nara	1974	1974	–	-	BS	-	+	-	-	-	+
MSTB-38	1974	1976	-	-	BS	-	+	-	-	-	+
MRTR-0027	1976	1976	-	-	BS	-	+	-	-	-	+
Zvezda Baltiki	1977	1982	MFFT	-	BS	-	+	-	-	-	+
Far East Research Institute of Hydrometeorological Information											
Volna	1971	-	SRV	-	SO	+	+	-	-	-	-
Lebed	1934	1954	-	-	SO	-	+	-	-	-	-
SHCH-111	1946	1946	-	-	SO	-	+	-	-	-	-
Kapitan Pospelov	1948	-	-	-	PO	-	+	-	-	-	-
Toporok	1948	1950	-	-	PO	-	+	-	-	-	-
Balkhash	1949	-	-	-	JS	-	+	-	-	-	-
Utes	1949	-	-	-	PO	-	+	-	-	-	-
Gidrolog	1953	1967	MFT	-	PO	+	+	+	-	-	-
Ugolshik	1957	1960	SL	-	JS	-	+	-	-	-	-
Okean	1957	1988	SRV	ENCQ	WO	+	+	+	+	-	-
Zelenogorsk	1958	-	MS	-	JS, SO	-	+	-	-	-	-
A.I.Voyeikov	1959	-	SRV	UAAX	PO, Ind	+	+	+	-	-	-
Priboy	1959	1989	SRV	UQGW	WO	+	+	+	+	-	-
Yu.M.Shokalsky	1960	1980	SRV	-	WO	+	+	+	+	-	-
Nakat	1963	1987	ES	-	JS	+	+	+	-	-	-
Rassvet	1963	1979	MBSS	-	JS	+	+	-	-	-	-
Atlas	1966	-	-	-	JS	-	+	+	-	-	-
Sinoptik Iljinsky	1967	1972	MFT	-	PO	+	+	-	-	-	-
Ak. Korolev	1968	-	SRV	UHQS	NA	+	+	+	+	+	-
Ak. Shirshov	1968	-	SRV	UMAY	WO	+	+	+	+	+	-
Priliv	1969	1989	SRV	EREC	WO	+	+	+	-	+	-
Valerian Uryvayev	1974	1988	SRV	UEAK	PO	+	+	+	-	+	-
Georgiy Matveychuk	1977	-	ES	-	PO	+	+	+	-	-	-
Vyacheslav Frolov	1979	-	SRV	ESGG	PO	+	+	+	-	+	-
Akademik Shokalsky	1983	-	SRV	UUPB	WO	+	+	+	-	-	-
Professor Khromov	1983	1989	SRV	-	WO	+	+	+	-	-	-
Pavel Gordienko	1987	1988	SRV	-	PO	+	+	+	-	+	-
RK-66	1988	-	-	-	JS	+	+	-	-	-	-
Fishery collective farm, "1st May"											
Volna	1987	-	Launch	-	Azov	-	+	-	-	-	+
Hydrometeorological Service of Azerbaijan											
Uragan	1959	1969	-	-	Casp	+	+	-	-	-	-
Ekvator	1967	1988	MFT	UFKK	Casp	+	+	-	-	-	-
Radon	1969	1989	–	EREK	Casp	+	+	+	+	-	-
Antares	1979	-	HRS	-	Casp	-	+	+	-	-	-
Metan	1979	1988	–	EREL	Casp	+	+	-	-	-	-
Briz	1980	1987	SRV	-	Casp	-	+	-	-	-	-
Vasiliy Lominadze	1987	-	SRV	USCR	Casp	-	+	-	-	-	-
Hydrometeorological Service of Estonia											
Al. Smirnov	1961	1984	MBSS	-	BS	-	+	+	-	-	-

Name of Ship	Period of Work		Type of Ship	Call	Area of Operation	Type of Observation					
	Start	Finish				M	H	P	G	D	B
(formerly Orion)											
Johannes Vares	1965	1968	ES	-	AO	-	+	-	-	-	-
Delfin	1971	1986	SL	-	BS	-	+	-	-	-	-
Aul	1973	1979	SL	-	BS	-	+	+	-	-	-
Sekstant	1930	1931	ES	-	BS	-	+	-	-	-	-
Aju-Dag	1976	-	SRV	ENCQ	BS	+	+	+	-	-	-
Orbita	1982	1988	–	UNDL	BS	+	+	+	-	-	-
Hydrometeorological Service of Georgia											
Ekvator	1954	1954	ES	-	BlS	-	+	-	-	-	-
Nauka	1970	1986	SRV	-	BlS	-	+	-	-	-	-
Grigoriy Lezhava	1982	1988	SRV	UNEI	BlS	+	+	+	-	-	-
Drug Prirody	1987	-	IB	-	BlS	+	+	-	-	-	-
Hydrometeorological Service of Lithuania											
Okeanograf	1959	1988	SRV	UGTD	BS	+	+	+	+	+	-
Priboy	1978	1978	SL	-	BS	-	+	-	-	-	-
Gidrolog	1979	-	SEL	-	BS	+	+	+	-	-	-
Gintaras	1979	-	EL	-	BS	-	+	+	-	-	-
Piarlas	1980	1980	L	-	BS	-	+	-	-	-	-
Gidrolog	1986	-	ES	-	BS	+	+	+	-	-	-
Yurate	1962	1966	MBSS	-	BS	+	+	-	-	-	-
Geofizik	1967		ES	UGNW	BS	+	+	+	+	-	-
Shtorm	1973	1986	ES	-	BS	+	+	+	-	-	-
Lev Titov	1980	1988	SRV	UBFH	BS	+	+	-	-	-	-
Vilniale	1984	-	ES	UEBT	BS	+	+	-	-	-	-
Hydrometeorological Service of the Ukraine											
Uklei	1957	1957	SL	-	BlS	-	+	-	-	-	-
Poryv	1971	1974	SRWS	ERES	NA	+	+	+	+	-	-
Propagandist	1932	1936	ES	-	BlS	-	+	-	-	-	-
Shoina	1932	1934	SL	-	BlS	-	+	-	-	-	-
Vydvizhenets	1933	-	ES	-	BlS	-	+	-	-	-	-
Kurort	1933	1934	–	-	BlS	-	+	-	-	-	-
Gals	1937	-	SRV	-	BlS	+	+	-	-	-	-
Taifun	1937	1988	ES	-	Azov	+	+	-	-	-	-
Ratmanov	1952	1957	TB	-	BlS, Azov	-	+	-	-	-	-
Reika	1953	1973	–	-	Azov	-	+	-	-	-	-
Meteor	1954	1960	-	-	BlS	-	+	-	-	-	-
Tiagun	1954	1959	–	-	BlS	-	+	-	-	-	-
Aerolog	1955	1955	SL	-	BlS	+	+	-	-	-	-
Lot	1956	1958	L	-	BlS	-	+	-	-	-	-
Rybookhrana	1956	1956	ES	-	BlS	-	+	-	-	-	-
Globus	1957	1960	IB	-	BlS	-	+	-	-	-	-
Kontakt	1957	1963	SRV	-	BlS	-	+	-	-	-	-
Zhukovsky	1958	-	LFT	-	AO	-	+	-	-	-	-
Gidrozond	1961	-	SRV	UGTO	Azov	+	+	+	-	-	-
Priboy	1961	1988	SRV	UQGW	BlS	+	+	+	-	-	-
Meteorolog	1961	1961	–	-	BlS	-	+	-	-	-	-

Name of Ship	Period of Work		Type of Ship	Call	Area of Operation	Type of Observation					
	Start	Finish				M	H	P	G	D	B
Troika	1961	1961	–	-	BlS	-	+	-	-	-	-
Rif	1962	1988	MBSS	-	BlS, Azov	+	+	+	-	-	-
Zyb	1963	1965	–	-	BlS	-	+	-	-	-	-
Neptun	1971	1988	SRV	UZFA	BlS	+	+	+	-	-	-
Shkval	1971	1972	SRVS	-	NA	+	+	-	-	-	-
Burun	1979	1985	L	-	BlS	+	+	-	-	-	-
Uragan	1979	1988	SRV	-	BlS	+	+	+	+	-	-
Sneg	1980	1987	-	-	Azov	+	+	-	-	-	-
Tantal	1980	1985	SSS	-	BlS	-	+	-	-	-	-
Grom	1987	-	ES	-	BlS	+	+	-	-	-	-
Shkval	1988	1988	MS	-	Azov	-	+	-	-	-	-
Hydrometeorological Service of Uzbekistan											
Otto Shmidt	1966	1977	ES	-	Aral	+	+	-	-	-	-
Levberg	1970	1970	-	-	Aral	-	+	-	-	-	-
Institute of Biology of the Southern Seas (Ukrainian Academy of Sciences)											
Miklukho-Maklai	1977	1977	SRV	-	BlS	-	+	-	-	-	+
Akademik Kovalevsky	1958	-	SRV	UEWJ	NA	+	+	-	-	-	+
Prof. Vodianitsky	1977	1988	SRV	-	WO	+	+	+	-	-	+
Institute of Oceanology (RAS)											
Vityaz -I	1887	1894	-	-	WO	+	+	-	+	-	+
Vityaz -II	1949	1979	SRV	UPJA	WO	+	+	-	-	-	+
Nerpa	1955	1956	-	-	PO	-	+	-	-	-	+
Akademik Obruchev	1958	-	–	-	BlS	-	+	-	-	-	+
Akademik Sergei Vavilov	1959	-	ES	-	AO	-	+	+	-	-	+
Akademik Kurchatov	1967	-	SRV	UBLF	WO	+	+	-	-	-	+
Dmitriy Mendeleev	1969	1987	SRV	UILS	WO	+	+	+	-	+	+
Prof. Shtokman	1979	1988	SRV	-	WO	+	+	+	-	-	+
Akademik Mstislav Keldysh	1981	-	SRV	-	WO	-	+	+	+	+	+
Vityaz -III	1982	-	SRV	-	WO	+	+	-	-	-	+
Rift	1985	1986	-	-	BlS	-	+	+	-	+	+
Institute of Thermophysics and Electrophysics (Estonian Academy of Sciences)											
Arnold Veiner	1984	-	SRV	UWEP	AO, BS	-	+	-	-	-	-
Institute for Vulcanology (RAS)											
Vulkanolog	1978	-	-	UQGI	PO	-	+	-	+	-	-
Institute for Water Problems (RAS)											
Akvatoria	1986	-	MFT	-	BlS	-	+	-	-	-	-
Kamchatka Hydromet											
Vostok	1938	-	-	-	PO	-	+	-	-	-	-
Volna	1962	1972	MBSS	UFRA	PO	+	+	-	-	-	-
Pogranichnik Dergach	1971	1971	MFFT	-	Ber	-	+	-	-	-	-
Pogranichnik Zmeev	1972	1972	MFFT	-	Ber	-	+	-	-	-	-
Pluton	1978	1986	SRV	-	PO	+	+	-	-	-	-
Toros	1985	1986	MFT	-	PO	-	+	-	-	-	-
Vadim Popov	1986	-	SRV	-	PO	-	+	-	-	-	-

Name of Ship	Period of Work		Type of Ship	Call	Area of Operation	Type of Observation					
	Start	Finish				M	H	P	G	D	B
Vyacheslav Timonov	1986	-	-	-	PO	-	+	-	-	-	-
Kolyma Hydromet											
Issledovatel	1948	1982	MBSS	UROA	PO	+	+	+	+	-	-
Shkval	1951	1960	EL	-	PO	+	+	-	-	-	-
Kvarts	1979	1979	SV	UXMN	PO	-	+	-	-	-	-
Leonid Morozov	1983	1988	SRV	UFLW	PO	+	+	+	-	-	-
Saturn	1985	1985	IB	-	SO	-	+	-	-	-	-
Tungus	1985	1985	MFFT	-	PO	+	+	-	-	-	-
Main Geophysical Observatory											
Severoid	1932	1932	-	-	Kar	-	+	-	-	-	-
Lenin	1932	-	IB	-	Kar	-	+	-	-	-	-
Voronov	1933	-	Boat	-	Kar	-	+	-	-	-	-
Lomonosov	1953	1962	HS	-	Kar	-	+	-	-	-	-
Marine Hydrophysical Institute (Ukrainian Academy of Sciences)											
Mikhail Lomonosov	1957	1988	SRV	UQIH	AO	+	+	+	-	-	-
Prof. Koleshnikov	1983	1988	SRV	-	WO	+	+	+	-	-	-
Maritime Hydromet											
Dalnevostochnik	1932	1979	ES	UVZN	PO	+	+	-	-	-	-
Groza	1950	-	MFT	-	AO	-	+	-	-	-	-
Gvardeisk	1963	-	MS	UNGN	PO	+	+	-	-	-	-
Vladivostok	1965	-	IB	UWCD	ArcO	+	+	-	-	-	-
MFFT-8-412	1967	1967	MFFT	-	JS	-	+	-	-	-	-
MFFT-8-414	1967	1967	MFFT	-	Ber	-	+	-	-	-	-
MFFT-8-410	1968	1968	MFFT	-	Ber	-	+	-	-	-	-
MFFT-8-432	1968	1968	MFFT	UDVH	JS	-	+	-	-	-	-
Moscow State University											
Moskovsky Universitet	1957	1962	ES	-	BlS	-	+	-	-	-	-
Gorizont	1964	1981	SRV	-	BlS	+	+	-	-	-	-
Akademik Petrovskiy	1977	-	-	-	BlS, MS	-	+		-	-	-
Murmansk Hydromet											
Ermak	1899	1938	IB	UNZO	Bar	+	+	-	-	-	-
H.Knipovich	1932	1949	ES	UNIZ	NA	-	+	-	-	-	-
Sadko	1936	1936	ES	UPCT	Bar	-	+	-	-	-	-
Isslrdovatel	1937	1941	ES	-	Bar	-	+	-	-	-	-
Murmanets	1938	1957	HS	UNTY	ArcO	-	+	-	-	-	-
Mgla	1940	1940	LL	UPEY	Bar	-	+	-	-	-	-
Kashalot	1944	1948	ES	-	Bar	-	+	-	-	-	-
Meridian	1949	1949	ES	UUYY	Bar	-	+	-	-	-	-
Aisberg	1950	1981	Logger	UMXF	Bar, NA	+	+	+	-	-	-
Krater	1950	1951	MFFT	UUAF	NA	-	+	-	-	-	-
Diana	1952	1957	ES	-	Bar	-	+	-	-	-	-
Konstantin Derugin	1952	1958	ES	-	Bar	-	+	-	-	-	-
Polarnik	1953	1978	SRV	UZSK	NA	-	+	-	-	-	-
Vjuga	1954	-	Boat	-	Bar	-	+	-	-	-	-
Rosa	1954	1954	TB	-	Bar	-	+	-	-	-	-

Name of Ship	Period of Work		Type of Ship	Call	Area of Operation	Type of Observation					
	Start	Finish				M	H	P	G	D	B
Topseda	1956	1973	MFT	UNHO	NA	-	+	-	-	-	-
Vestnik	1958	1973	MFT	URGT	Bar	-	+	-	-	-	-
Bataisk	1960	1963	S	UKKN	NA	-	+	+	-	-	-
Shtorm	1960	1987	MS	UIGE	Bar	-	+	-	-	-	-
Burevestnik	1961	-	MBSS	UGNN	Bar	-	+	-	-	-	-
Severodvinsk	1961	1963	–	UJJW	AO	+	+	-	-	-	-
Pechenga	1961	1964	–	UEIV	AO	+	+	-	-	-	-
SHL-2	1962	1962	-	-	NA	-	+	-	-	-	-
Melitopol	1962	1962	FT	UMWG	NA	-	+	-	-	-	-
Raduga	1963	1971	-	-	Bar	-	+	-	-	-	-
Voskhod	1965	1979	Logger	UHBH	NA	+	+	-	-	-	-
Nabludatel	1965	1983	SRV	-	Bar, White	-	+	-	-	-	-
Briz	1972	1987	Launch	-	White	-	+	-	-	-	-
Kavraiskiy	1972	-	EOS	-	Bar	-	+	-	-	-	-
MRB-20	1972	1972	-	-	Bar	-	+	-	-	-	-
Vsevolod Beryozkin	1975	-	SRWS	UVMJ	NA	+	+	+	+	-	-
Murmansk Marine Biological Institute											
Dalniye Zelentsy	1979	1988	SRV	UTPB	NA	-	+	-	-	-	+
Navy Directorate for Navigation and Oceanography											
Ingul	1923	1924	HS	-	BlS	-	+	-	-	-	-
Pervoye Maya	1923	1932	HS	-	BlS	-	+	-	-	-	-
Polarny	1924	1946	-	-	WO	+	+	-	-	-	-
Murman	1924	1925	HS	-	Bar	+	+	-	-	-	-
Beglitskiy	1925	1926	-	-	BlS	-	+	-	-	-	-
Gidrograf	1925	1939	HS	-	WO	-	+	-	-	-	-
Lag	1925	1929	HS	-	BlS	-	+	-	-	-	-
Maxim Gorkiy	1925	1928	HS	-	Casp	-	+	-	-	-	-
A. Kovalevsky	1926	1935	-	-	BlS	-	+	-	-	-	-
Vorovsky	1926	-	-	-	JS	-	+	-	-	-	-
Lot	1926	-	HS	-	BlS	-	+	-	-	-	-
Krasny Vympel	1926	1930	–	-	PO	-	+	-	-	-	-
Pakhtusov	1927	1928	HS	-	White	-	+	-	-	-	-
Zagraditel	1928	-	HS	-	BlS	-	+	-	-	-	-
Priboy	1928	-	HS	-	Kar	-	+	-	-	-	-
Samoyed	1930	-	HS	-	BS	-	+	-	-	-	-
Kolyma	1930	-	HS	-	ES	-	+	-	-	-	-
Kommuna	1931	-	HS	-	BS	-	+	-	-	-	-
Seyner	1932	1939	-	-	WO	-	+	-	-	-	-
Cheluskin	1933	-	IBST	-	ArcO	+	+	-	-	-	-
Val	1940	1958	HRS	-	BlS	-	+	-	-	-	-
Severny Polus	1946	-	HS	UERL		-	+	-	-	-	-
Ekvator	1949	1976	HRS	-	BlS, MS	+	+	-	+	-	-
Polus	1955	1988	EOS	UCMR	WO	+	+	+	-	-	-
Buyrep	1956	1963	HRS	-	Bar	-	+	-	-	-	-
Sedov	1958	1965	EOS	-		+	+	+	-	-	-
Stvor	1958	1988	HRS	-	WO	-	+	+	-	-	-

Name of Ship	Period of Work		Type of Ship	Call	Area of Operation	Type of Observation					
	Start	Finish				M	H	P	G	D	B
Lots-60	1959	1962	HS	-	MS	-	+	-	-	-	-
Prizma	1959	-	HRS	-	Bar	-	+	-	-	-	-
Aitodor	1960	-	HRS	-	MS	-	+	-	-	-	-
Ivan Kruzenshtern	1961	1988	EOS	-	WO	+	+	+	-	-	-
Metel	1961	-	HRS	-	Bar	-	+	-	-	-	-
Uljana Gromova	1961	1967	EOS	-	PO	-	+	-	-	-	-
G. Nevelskoy	1962	1980	EOS	UHDN	WO	+	+	+	-	-	-
Mayak	1964	1970	HRS	-	NA	+	+	-	-	-	-
G.Sarychev	1965	-	HRS	-	WO	-	+	-	-	-	-
Baikal	1965	-	HRS	UKNZ	MS	-	+	-	-	-	-
Balkhash	1965	-	EOS	-	MS	-	+	-	-	-	-
Globus	1965	1970	HRS	-	AO	-	+	-	-	-	-
Nikolai Zubov	1965	1984	ORS	-	WO	+	+	-	-	-	-
Gigrometr	1966	1983	HRS	-	WO	-	+	-	-	-	-
Alexei Chirikov	1966	1978	EOS	-	PO	+	+	-	-	-	-
Zenit	1966	1975	HRS	-	NA	+	+	-	-	-	-
Faddey	1966	1988	ORS	-	WO	+	+	+	-	-	-
Askold	1968	1971	HRS	-	AO	-	+	+	-	-	-
Andrey Vilkitsky	1968	1982	ORS	-	AO	+	+	+	-	-	-
Boris Davydov	1968	1983	EOS	-	AO	+	+	+		-	-
Arktika	1968	1984	HRS	-	WO	-	+	-	-	-	-
Vasily Golovin	1968	1988	ORS	UCNK	WO	+	+	+	-	-	-
Semen Dezhnev	1968	1984	EOS	UHGZ	WO	+	+	+	-	-	-
Pamyat Merkuria	1968	1983	HRS	-	WO	+	+	-	-	-	-
Kompas	1969	1978	HRS	-	AO	+	+	-	-	-	-
M. Uritsky	1969	1970	MS	-	-	+	+	-	-	-	-
Rumb	1969	1970	HRS	-	JS	-	+	-	-	-	-
Berezan	1970	1987	HRS	-	AO	+	+	-	-	-	-
Dunai	1970	-	-	-	-	-	+	-	-	-	-
Fyodor Litke	1970	1979	EOS	-	WO	+	+	+	-	-	-
Cheleken	1971	1987	HRS	-	WO	+	+	+	-	-	-
Liman	1971	1988	HRS	-	WO	+	+	+	+	-	-
Maria Ulyanova	1971	1972	MS	-	WO	+	+	-	-	-	-
Kolguev	1972	1974	HRS	UGRX	AO	-	+	-	-	-	-
Okean	1972	1988	HRS	-	WO	+	+	+	-	-	-
Abkhazia	1973	1988	ES	-	PO	+	+	+	-	-	-
Altair	1973	-	HRS	-	PO	+	+	+	-	-	-
Adjaria	1974	1988	-	-	NA	+	+	+	-	-	-
Bashkiria	1974	-	EOS	-	PO	+	+	+	-	-	-
Moldavia	1974	1987	EOS	-	AO	+	+	+	-	-	-
Turkmenia	1974	1974	-	-	PO	+	+	-	-	-	-
Elton	1974	1982	HRS	-	NA	+	+	-	-	-	-
Akademik Krylov	1975	-	ORS	-	NA	+	+	+	+	-	-
Leonid Sobolev	1975	1986	ORS	-	PO	+	+	-	-	-	-
Kriljon	1975	1984	HRS	-	NA	+	+	-	-	-	-
Admiral Vladimirsky	1976	-	ORS	-	NA	+	+	+	-	-	-

Name of Ship	Period of Work		Type of Ship	Call	Area of Operation	Type of Observation					
	Start	Finish				M	H	P	G	D	B
GS-59	1976	-	HRS	-	BlS	+	+	-	-	-	-
GS-60	1976	-	HRS	-	BlS	+	+	-	-	-	-
Azimut	1976	-	-	-	NA	+	+	-	-	-	-
Zapolarje	1976	1986	HRS	-	PO	+	+	-	-	-	-
Tropik	1976	1983	HRS	-	WO	+	+	-	-	-	-
GS-273	1977	-	HRS	-	BlS	+	+	-	-	-	-
Anadyr	1977	-	HRS	USXU	PO	+	+	+	-	-	-
Sever	1978	-	HRS	-	WO	+	+	+	-	-	-
Strelets	1978	1986	HRS	-	AO	+	+	-	-	-	-
Leonid Demin	1978	1987	ORS	-	WO	+	+	-	-	-	-
Taiga	1978	1980	HRS	-	PO	+	+	-	-	-	-
Yug	1978	1980	HRS	-	AO	+	+	-	+	-	-
Persey	1979	1988	HRS	-	AO	+	+	+	-	-	-
Pluton	1980	1987	HRS	-	AO	+	+	+	-	-	-
Gidrolog	1981	-	HRS	-	WO	+	+	-	-	-	-
Zodiak	1981	1988	HRS	-	AO	-	+	-	-	-	-
Pegas	1981	1988	HRS	-	PO	+	+	+	-	-	-
Mikhail Krupsky	1981	1988	ORS	-	AO	+	+	+	-	-	-
GS-401	1982	-	HRS	-	BlS	+	+	-	-	-	-
GS-402	1982	-	-	-	BlS	+	+	-	-	-	-
Vizir	1983	-	HRS	-	NA	+	+	-	-	-	-
Nikolai Matusevich	1983	1987	HRS	-	NA	+	+	+	-	-	-
Donuzlav	1984	-	HRS	-	WO	+	+	+	-	-	-
Marshal Gelovani	1985	1985	HRS	-	PO	+	+	+	-	-	-
GS-296	1987	-		-	PO	+	+	-	-	-	-
Kapitan Voronin	1948	-	-	UNXW	PO	-	+	-	-	-	-
North Caucasus Hydromet											
Yakor	1932	1934	–	-	BlS	-	+	-	-	-	-
Okeanograf	1956	1988	TES	-	BlS	+	+	+	-	-	-
Gorizont	1957	-	ES	-	BlS	+	+	+	-	-	-
Rassvet	1960	1961	ES	-	BlS	-	+	-	-	-	-
Gradient	1964	1980	MBSS	-	-	-	+	-	-	-	-
Gidrograf	1965	1968	SRV	-	BlS	-	+	-	-	-	-
A.Vlasov	1965	1975	MBSS	-	BlS	-	+	+	-	-	-
Glubomer	1965	-	-	-	BlS	-	+	-	-	-	-
Zadorny	1965	1979	SRV	-	BlS	+	+	-	-	-	-
SChS-86	1968	1968	MBSS	-	BlS	-	+	-	-	-	-
Lazurit	1970	1972	MS	-	BlS	-	+	-	-	-	-
Agat	1971	-	-	-	BlS	-	+	-	-	-	-
Izumrud	1972	1973	MS	-	BlS	-	+	-	-	-	-
Dzhugba	1973	-	MS	-	BlS	-	+	-	-	-	-
Volna	1974	1988	SRV	-	BlS, Azov	+	+	+	-	-	-
Briz	1976	1987	ES	-	BlS, Azov	+	+	+	-	-	-
Rif	1976	1976	-	-	BlS	-	+	-	-	-	-
Mgla	1978	1980	-	-	Azov	-	+	-	-	-	-
Gidrofizik	1979	-	ES	-	Azov	-	+	+	-	-	-

Name of Ship	Period of Work		Type of Ship	Call	Area of Operation	Type of Observation					
	Start	Finish				M	H	P	G	D	B
Buran	1979	-	L	-	BlS, Azov	+	+	-	-	-	-
Kazanka	1979	-	Boat	-	Azov	-	+	+	-	-	-
Tantal	1986	1986	-	-	Casp	-	+	-	-	-	-
Glubina	1987	-	ES	-	Azov	-	+	-	-	-	-
Northern Hydromet											
Okeanograf	1963	1981	SRV	UTPW	White	+	+	-	-	-	-
Rombak	1963	1986	Logger	UUFJ	White	+	+	+	-	-	-
Uran	1980	1988	SRV	UYOI	White	-	+	+	+	-	-
Gorizontal	1985	-	EL	-	White	+	+	-	-	-	-
Aisberg -2	1986	-	EL	-	White	+	+	+	+	-	-
Alaska	1986	-	ES	-	BS	-	+	-	-	-	-
Ustjevik	1986	1988	ES	-	White	+	+	+	+	-	-
Grom	1987	-	SRV	-	White, Bar	+	+	-	-	-	-
Dreif	1988	-	EL	-	White	-	+	-	-	-	-
Ivan Petrov	1989	-	SRV	UROV	-	-	+	-	-	-	-
Northwestern Hydromet											
Leninets	1975	1980	IBS	-	BS	-	+	-	-	-	-
Raduga	1975	1983	SRV	-	BS	-	+	-	-	-	-
Volna	1979	-	L	-	BS	-	+	-	-	-	-
Tsiklon	1979	1988	MBSS	-	BS	+	+	+	+	-	-
Leningrad	1980	1986	IBS	-	BS	-	+	-	-	-	-
Komsomolets Azova	1983	1988	SRV	-	BS	+	+	-	-	-	-
Damba -1	1987	-	ES	-	BS	+	+	-	-	-	-
Odessa Brach of the State Oceanographic Institute											
Musson	1968	1989	SRWS	EREA	NA	+	+	+	-	+	-
Volna	1969	-	SRWS	EREB	WO	+	+	+	-	+	-
Passat	1969	1989	SRWS	UZGH	NA	+	+	+	-	+	-
Ernst Krenkel (formerly Vikhr)	1971	1989	SRWS	EREU	NA	+	+	+	+	+	-
Georgy Ushakov	1973	-	SRWS	ERET	NA	+	+	+	-	+	-
Viktor Bugaev	1974	1989	SRWS	ERES	NA	+	+	+	-	+	-
Yakov Gakkel	1976	1989	SRV	UZMU	AO	+	+	+	+	-	-
Vladimir Parshin	1989	-	RV	UINF	MS	+	+	+	-	+	-
Pacific Administration of the Fishery and Research Fleet											
Prostor	1983	1987	FFFT	-	AO	-	+	-	-	-	+
Gorny	1985	-	MFST	-	PO	-	+	-	-	-	+
Nemirov	1985	1986	MFFT	-	PO	-	+	-	-	-	+
Cheremkhovo	1986	1986	FS	-	SO	-	+	-	-	-	+
Pacific Bureau of Fishery Survey											
Georgy Masimov	1979	-	HS	-	PO	+	+		-	-	-
Akademik Gamburtsev	1989	-	SRV	-	PO	-	+	-	-	-	-
Pacific Oceanographic Institute, Far East Branch of the RAS											
Krylatka	1954	1956	-	-	PO	-	+	-	-	-	-
Prof. Bogorov	1977	1989	SRV	UWJE		+	+	+	-	+	+
Kallisto	1978	-	SRV	UWMN	WO	-	+	+	-	-	+

Name of Ship	Period of Work		Type of Ship	Call	Area of Operation	Type of Observation					
	Start	Finish				M	H	P	G	D	B
Akademik Nesmeyanov	1982	-	SRV	UBVK	PO	+	+	+	+	-	+
Akademik Vinogradov	1983	-	SRV	UYEV	NA	+	+	+	+	+	+
Akademik Lavrentjev	1985	-	SRV	UJFY	WO	+	+	+	+	-	+
Prof. Gagarinsky	1988	1989	SRV	UKZW	JS	-	+	+	-	+	+
Pacific Research Institute for Fishery and Oceanography											
Suchan	1932	1969	MFFT	-	Chuck	-	+	-	-	-	+
Krasnoarmeets	1932	1933	-	-	PO	-	+	-	-	-	+
BO-316	1946	-	-	-	PO	-	+	-	-	-	+
Ametist	1951	1958	MFT	-	PO	-	+	-	-	-	+
Zhemchug	1954	1965	MFT	-	PO	-	+	-	-	-	+
Korshun	1954	1954		-	SO	-	+	-	-	-	+
S-171	1956	1956	-	-	PO	-	+	-	-	-	+
Nora	1956	1956	-	-	PO	-	+	-	-	-	+
Pervenets	1956	1982	ES	-	PO	-	+	+	-	-	+
Kolpin	1956	1956	MFT	-	SO	-	+	-	-	-	+
Shuleikin	1956	1956	-	-	PO	-	+	-	-	-	+
Baidar	1957	1957	MFT	-	SO	-	+	-	-	-	+
MFT-4348	1957	1957	MFT	-	SO	-	+	-	-	-	+
Abakan	1958	-	-	UQHM	PO	-	+	-	-	-	+
MFT-4453	1958	1958	MFT	-	SO	-	+	-	-	-	+
Alatyr	1959	-	MFT	-	PO	-	+	-	-	-	+
MFT-1037	1959	1959	MFT	-	SO	-	+	-	-	-	+
Algama	1960	1968	MFT	-	PO	-	+	-	-	-	+
Orlik	1960	1972	MFT	-	WO	-	+	-	-	-	+
Pelamida	1961	1978	FT	-	WO	-	+	-	-	-	+
Birokan	1964	1967	MFT	-	PO	-	+	-	-	-	+
Adler	1965	-	FT	-	WO	-	+	+	-	-	+
Lira	1965	1973	SSS	-	WO	-	+	-	-	-	+
Kalmar	1965	-	MFT	UYRB	WO	-	+	-	-	-	+
Ogon	1965	1978	FT	-	PO	-	+	-	-	-	+
Seskar	1966	1979	FT	-	PO	-	+	-	-	-	+
SRTM-8-417	1966	1966	MFFT	-	PO	-	+	-	-	-	+
Iskatel	1966	1969	MFFT	-	PO	-	+	-	-	-	+
Kanopus	1966	-	MFFT	-	PO	-	+	-	-	-	+
SRTM-8-453	1967	1967	MFFT	-	AO	-	+	-	-	-	+
SRTM-8-459	1967	1971	MFFT	-	PO	-	+	-	-	-	+
SRTM-8-461	1967	1983	MFFT	-	PO	-	+	-	-	-	+
Raduga	1967	1974	MFFT	-	WO	-	+	-	-	-	+
Prof. Derugin	1968	1986	SSS	-	WO	-	+	-	-	-	+
Korifei	1968	1983	MFFT	-	WO	-	+	-	-	-	+
Tamango	1968	1973	MFFT	-	PO	-	+	-	-	-	+
Alba	1969	1974	FFT	-	PO	-	+	-	-	-	+
SRTM-8-452	1970	1980	MFFT	-	PO	-	+	-	-	-	+
Prometei	1970	1972	MFFT	-	Ind	-	+	-	-	-	+
Ucheny	1970	1970	MFFT	-	PO	-	+	-	-	-	+

Name of Ship	Period of Work		Type of Ship	Call	Area of Operation	Type of Observation					
	Start	Finish				M	H	P	G	D	B
Akademik Berg	1971	-	LFT	UQAE	PO	-	+	-	-	-	+
Neritsa	1971	1977	SSS	-	WO	-	+	-	-	-	+
Poseydon	1971	1985	LFT	EWGF	WO	-	+	-	-	-	+
Kamenskoe	1971	1978	SSS	-	PO	-	+	-	-	-	+
Ekvator	1971	1983	LFT	-	PO	-	+	-	-	-	+
Gerakl	1972	1983	SSS	EWVU	PO	-	+	-	-	-	+
Artem	1972	1972	MFFT	-	PO	-	+	-	-	-	+
Shantar	1972	1986	SSS		PO	-	+	-	-	-	+
Optimist	1972	1972	MFFT	-	Ind	-	+	-	-	-	+
Kavalerovo	1975	1980	MFFT	-	PO	-	+	-	-	-	-
Tikhookeansky	1977	1987	SSS	-	PO	-	+	-	-	-	+
MFFT-8-449	1978	1978	MFFT	-	PO	-	+	-	-	-	+
Mys Dalniy	1978	1985	LFT	UWKC	PO	-	+	-	-	-	+
Pulkovsky Meridian	1978	1986	LFT	-	PO	-	+	-	-	-	+
Mys Tikhiy	1979	1984	SSS	UFRT	PO	-	+	-	-	-	+
Partizansk	1980	1980	MFFT	-	PO	-	+	-	-	-	+
Yeleninsk	1982	-	SSS	EWZU	PO	-	+	-	-	-	+
Novokotovsk	1982	1986	SSS	UGZG	PO	-	+	-	-	-	+
Pioner Nikolaeva	1982	1986	FFFT	-	WO	-	+	-	-	-	+
Professor	1982	1983	SRV	-	NA	-	+	-	-	-	+
Mlechny Put	1982	1987	SSS	UWAA	PO	-	+	-	-	-	+
Milogradovo	1982	1984	SSS	ESKB	PO	-	+	-	-	-	+
Mys Yunony	1982	1986	SSS	UNGG	PO	-	+	-	-	-	+
Rubezhnoye	1982	1984	SSS	-	PO	-	+	-	-	-	+
Babayevsk	1983	-	SSS	UQJQ	PO	-	+	-	-	-	+
Gissar	1983	-	SSS	-	PO	-	+	-	-	-	+
Antiya	1983	-	SSS	-	PO	-	+	-	-	-	+
Dolinsk	1983	-	SSS	UIWO	PO	-	+	-	-	-	+
Irkutsk	1983	1983	SSS	-	PO	-	+	-	-	-	+
Uglekamensk	1983	1985	-	-	PO	-	+	-	-	-	+
Trubchevsk	1983	1987	SSS	-	PO	-	+	-	-	-	+
Gnevny	1984	-	SSS	-	PO	-	+	-	-	-	+
Artyk	1984	1984	SSS	UFAO	PO	-	+	-	-	-	+
Novodrutsk	1984	1986	SSS	UOUV	WO	-	+	-	-	-	+
Novouljanovsk	1984	1986	SSS	UKGF	PO	-	+	-	-	-	+
Mys Vaigach	1984	1984	SSS	-	Ber	-	+	-	-	-	+
Ochakov	1984	1984	SSS	-	PO	-	+	-	-	-	+
Omar	1984	1984	SSS	-	PO	-	+	-	-	-	+
Timashevsk	1984	1986	MFFT	-	PO	-	+	-	-	-	+
Khronometr	1984	1984	SSS	-	PO	-	+	-	-	-	+
Mirny	1985	1988	-	UUWZ	PO	+	+	-	-	-	+
Mys Babushkina	1985	1986	SSS	UWFH	PO	-	+	-	-	-	+
Donchak	1986	-	MFFT	-	PO	-	+	-	-	-	+
Lesozavodsk	1986	1986	SSS	-	JS	-	+	-	-	-	+
Omega	1986	1986	FST	UONC	JS	-	+	-	-	-	-
Tamga	1987	1987	SSS	-	PO	-	+	-	-	-	+

Name of Ship	Period of Work		Type of Ship	Call	Area of Operation	Type of Observation					
	Start	Finish				M	H	P	G	D	B
Piramida, Research and Production Enterprise											
N. Gusev	1988	1988	-	-	NA	-	+	-	-	-	-
Polar Research Institute for Fishery and Oceanography											
Taimyr	1932	1971	ES	-	WO	-	+	-	-	-	+
Persey	1933	1973	-	-	NA	-	+	-	-	-	+
Nerpa	1936	1940	ES	-	NA	-	+	-	-	-	+
Masshtab	1941	1941	HS	-	Bar	-	+	-	-	-	+
Rynda	1944	1950	ES	-	Bar	-	+	-	-	-	+
Saratov	1946	1948	–	UNLZ	Bar	-	+	-	-	-	+
Persey -II	1949	1962	FT	UNIB	AO	-	+	-	-	-	+
Sazan	1950	1950	MFT	-	Bar	-	+	-	-	-	+
Musson	1950	1954	MFT	-	Norv	-	+	-	-	-	+
A.Otkupshikov	1951	1978	MFT	UWHH	NA, Bar	-	+	-	-	-	+
Korablestroitel	1951	1952	MFT	USMA	AO	-	+	-	-	-	+
Prof. Mesyatsev	1952	1965	SRV	UWHH	AO	-	+	-	-	-	+
Akademik Berg	1953	1964	SRV	URKT	NA	-	+	-	-	-	+
Toros	1953	1973	ES	-	White, Bar	-	+	-	-	-	+
Sevastopol	1954	1967	LFT	UWHO	AO	-	+	-	-	-	+
S.Andreev	1955	1957	MFT	-	NA	-	+	-	-	-	+
Bayan	1956	1957	MFT	-	-	-	+	-	-	-	+
Rossia	1956	1970	LFT	UFAB	AO	-	+	-	-	-	+
Vozrozhdenie	1958	-	MFT	UBKT	Bar	-	+	-	-	-	+
Ivan Khabalov	1958	-	-	-	NA	-	+	-	-	-	+
Novorossiysk	1958	1967	LFT	UWWI	NA	-	+	-	-	-	+
Prof. Somov	1958	1972	–	UXLG	AO	-	+	-	-	-	+
Kreml	1958	1964	LFT	-	NA	-	+	-	-	-	+
Tunets	1958	1979	MFT	UJCN	NA	-	+	-	-	-	+
Stalingrad	1959	1959	LFT	-	NA	-	+	-	-	-	+
Odessa	1959	1961	LFT	UWIU	NA	-	+	-	-	-	+
Uglomer	1959	1961	ES	-	Bar	-	+	-	-	-	+
Balaklava	1960	1964	MFT	UBKU	NA	-	+	-	-	-	+
Boguchar	1960	1979	MFT	UBKW	AO	-	+	-	-	-	+
Ayaks	1960	-	MFT	UUWI	WO	-	+	-	-	-	+
Yunga Sigarayev	1960	1960	MFT	UWJM	Bar	-	+	-	-	+	+
Gidrolog	1961	1961	HRS	-	Bar	+	+	-	-	-	+
Akademik Knipovich	1962	-	MFT	UEHX	NA	-	+	-	-	-	+
Argun	1962	-	MFT	UMRP	NA	-	+	-	-	-	+
Zapad	1962	-	FT	UJCM	NA	-	+	-	-	-	+
Pobeda	1962	1964	LFT	UETV	NA	-	+	-	-	-	+
Topseda	1962	1973	MFT	UNHO	NA	-	+	-	-	-	+
Skala	1964	1964	ES	-	Bar	-	+	-	-	-	+
Fritjof Nansen	1965	1989	-	UEHU	NA	-	+	-	-	-	+
Altair	1967	1980	MFFT	-	AO	-	+	-	-	-	+
Volgograd	1967	-	LFT	-	AO	-	+	-	-	-	+
Andromeda	1968	-	-	-	AO	-	+	-	-	-	+
Atlantida	1968	1975	MFFT	UMRZ	AO	-	+	-	-	-	+

Name of Ship	Period of Work		Type of Ship	Call	Area of Operation	Type of Observation					
	Start	Finish				M	H	P	G	D	B
Nikolai Maslov	1969	1973	–	-	NA	-	+	-	-	-	+
Persey -III	1969	1988	SSS	ESGU	AO	-	+	+	-	-	+
Gemma	1970	-	MFFT	ESNJ	AO	+	+	-	-	-	+
Protsion	1970	1983	MFFT	ESNI	AO	-	+	-	-	-	+
Ural	1970	1972	–	-	Bar	-	+	-	-	-	+
Artemida	1972	-	SSS	EWVT	AO	-	+	-	-	-	+
Akhill	1972	-	MFT	UUVQ	NA	-	+	-	-	-	+
Poisk	1972	1989	MFT	EWEL	WO	-	+	-	-	-	+
Odissey	1972	1977	SSS	EWGG	NA	-	+	-	-	-	+
Alaid	1973	1983	MFFT	UMOV	AO	-	+	-	-	-	+
Anchous	1975	-	–	UMTZ	Bar	-	+	-	-	-	+
Vychegda	1975	-	–	UIVE	AO	-	+	-	-	-	+
Alkei	1976	-	MBSS	UMLO	Bar	-	+	-	-	-	-
Zvenigorod	1976	-	FS	-	Bar	-	+	-	-	-	-
Rzhev	1977	1978	LFT	EUZW	NA	-	+	-	-	-	+
Suloy	1979	1984	–	EV W	AO	-	+	-	-	-	+
N.Kononov	1980	1986	LFT	USOP	NA	-	+	-	-	-	+
Mikhail Verbitsky	1981	1982	–	USTJ	NA		+		-	-	+
Kokshaisk	1983	1987	SFT	UJJS	AO	-	+	-	-	-	+
Vilnus	1984	-	SFT	UFJN	NA	-	+	-	-	-	+
Lensk	1984	-	SFT	EKRC	AO	-	+	-	-	-	+
Vitebsk	1985	-	SFT	UJLN	NA	-	+	-	-	-	+
Menselinsk	1985	1985	SFT	EMZY	AO	-	+	-	-	-	+
Genichesk	1985	-	–	UFIM	WO	-	+	-	-	-	+
Boguslav	1985	-	–	UFLR	AO	-	+	-	-	-	+
Kapitan Shaytanov	1986	-	SFT	UFYN	NA	-	+	-	-	-	+
Klintsy	1986	1986	SFT	UTRZ	AO	-	+	-	-	-	+
Maksheevo	1986	1988	FSH	ULGM	AO	-	+	-	-	-	+
PINRO	1988	1988	SRV	UYSC	NA	-	+	-	-	-	+
Prof. Marti	1989	1989	SRV	UTTG	Bar	-	+	-	-	-	+
Russian State Hydrometeorological Institute											
Nerey	1968	1981	SRV	-	NA	+	+	+	-	-	-
Prof. Sergei Dorofeev	1985	1988	TES	-	NA	+	+	-	-	-	-
Saint Petersburg Branch of SOI											
Prof. Rudovits	1957	1959	SCH	-	BS	+	+	-	-	-	-
Sakhalin Comprehensive Research Institute											
S.Malygin	1976	1985	HS	-	PO	-	+	-	-	-	-
Morskoy geofizik	1978	1985	SRV	-	WO	+	+	-	-	-	-
Fyodor Matisen	1978	1979	-	-	WO	-	+	-	-	-	-
Tym	1978	1978	MFT	-	PO	-	+	-	-	-	-
Sakhalin Hydromet											
Gidrolog	1943	1948	-	-	SO	-	+	-	-	-	-
Abrek	1949	1960	SCH	-	PO	-	+	-	-	-	-
Prof. Soldatov	1949	1949	Launch	-	SO	-	+	-	-	-	-
Gidrolog	1950	1968	ES	-	SO, JS	+	+	-	-	-	-
Ayaks	1950	1950	SCH	-	SO	-	+	-	-	-	-

Name of Ship	Period of Work		Type of Ship	Call	Area of Operation	Type of Observation					
	Start	Finish				M	H	P	G	D	B
Vestnik	1952	1970	MBSS	-	JS	-	+	+	-	-	-
Izumrud	1952	1963	MFT	-	PO	-	+	-	-	-	-
Akademik Shulekin	1953	1956	MFT	-	PO	-	+	-	-	-	-
SRT-395	1953	1954	MFT	-	SO	-	+	-	-	-	-
RS-617	1953	1953	FS	-	SO	-	+	-	-	-	-
SRT-635	1954	1954	MFT	-	SO	-	+	-	-	-	-
Nezhin	1956	1957	MFT	-	SO	-	+	-	-	-	-
Nikopol	1956	1956	MFT	-	JS	-	+	-	-	-	-
Orlovka	1956	1958	FS	-	SO	-	+	-	-	-	-
Sakhalin	1957	1958	MFT	-	SO, JS	-	+	-	-	-	-
Priboy	1957	1964	MFT	-	PO	+	+	-	-	-	-
Orenburg	1957	1957	FS	UYXH	SO	-	+	-	-	-	-
BL-205	1958	1960	-	-	SO, JS	-	+	-	-	-	-
Kaluga	1958	-	-	-	JS	-	+	-	-	-	-
Musson	1958	1958	ES	-	-	-	+	-	-	-	-
Ordzhonikidze	1958	1958	FS	-	SO	-	+	-	-	-	-
Neiva	1960	1960	MFT	-	SO	-	+	-	-	-	-
Sovetsky Sakhalin	1961	1965	-	UEJA	PO	+	+	-	-	-	-
Nikolai Boshnak	1961	1961	-	UBHE	PO	+	+	-	-	-	-
Shkiper Gek	1962	1969	-	-	PO	+	+	-	-	-	-
Zakat	1964	1971	MBSS	-	JS, SO	+	+	-	-	-	-
Sakhalinles	1964	1965	S	-	SO	+	+	-	-	-	-
Baksan	1967	1967	MFT	-	SO	-	+	-	-	-	-
Boshniakovo	1968	-	-	-	JS, SO	-	+	-	-	-	-
Borgsten Dolfin	1977	-	-	-	SO	-	+	-	-	-	-
Okha -1	1981	1983	-	-	SO	-	+	-	-	-	-
Igor Maksimov	1987	1989	SRV	-	WO	+	+	+	-	-	-
Pegas	1973	1986	SRV	UIQV	WO	+	+	-	-	-	-
Sevastopol Branch of the State Oceanographic Institute											
Donets	1891	-	-	-	BlS	-	+	-	-	-	-
Zaporozhets	1891	-	-	-	-	-	+	-	-	-	-
Kazbek	1891	-	–	-	Azov	-	+	-	-	-	-
Nogaisk	1913	1914	SL	-	Azov	-	+	-	-	-	-
Samorodok	1923	1923	-	-	BlS	-	+	-	-	-	-
White	1924	1924	-	-	BlS	-	+	-	-	-	-
Bakhchisaray	1931	1931	-	-	BlS	-	+	-	-	-	-
Kafa	1931	-	-	-	BlS	-	+	-	-	-	-
Abkhazets	1932	-	-	-	BlS	-	+	-	-	-	-
Nekton	1932	1933	HS	-	BlS	-	+	-	-	-	-
Gemeinovets	1934	1937	ES	-	BlS	-	+	-	-	-	-
Glubina	1936	-	-	-	BlS	-	+	-	-	-	-
Chekist	1937	1951	ES	-	Azov	-	+	-	-	-	-
Vl. Kochetov	1937	-	-	-	BlS	-	+	-	-	-	-
Strela	1937	1938	-	-	BlS	-	+	-	-	-	-
Pioner	1937	-	-	-	BlS	-	+	-	-	-	-
Yakov	1937	-	-	-	BlS	-	+	-	-	-	-

Name of Ship	Period of Work		Type of Ship	Call	Area of Operation	Type of Observation					
	Start	Finish				M	H	P	G	D	B
Khenken	1937	-	-	-	BlS	-	+	-	-	-	-
Zuid	1938	-	-	-	BlS	-	+	-	-	-	-
Papanin	1938	1939	-	-	BlS	-	+	-	-	-	-
Malvina	1938	1938	-	-	BlS	-	+	-	-	-	-
Mys Kodosh	1938	-	ES	-	BlS	-	+	-	-	-	-
Cheluskin	1939	1941	ES	-	BlS	-	+	-	-	-	-
Uglomer	1941	-	-	-	BlS	-	+	-	-	-	-
Seiner-1	1949	1950	-	-	Azov	-	+	-	-	-	-
Issledovatel	1949	1961	ES	-	BlS	-	+	-	-	-	-
Vest	1950		ES	-	Azov	-	+	-	-	-	-
Vetromer	1951	1956	ES	-	Azov	-	+	-	-	-	-
MBSS-7	1953	1954	ES	-	Azov	-	+	-	-	-	-
Izogalina	1954	1960	–	-	BlS	-	+	-	-	-	-
Oktjabr	1954	-	–	-	BlS	-	+	-	-	-	-
RK-715	1954	1954	-	-	BlS, Azov	-	+	-	-	-	-
SChS-105	1955	1955	MBSS	-	Azov	-	+	-	-	-	-
Moreved	1955	1960	ES	-	BlS	-	+	-	-	-	-
Fprel	1955	1955	ES	-	Azov	-	+	-	-	-	-
Gidrolog	1956	1958	ES	-	BlS	+	+	-	-	-	-
Kontur	1956	1963	ES	UVSM	BlS	-	+	-	-	-	-
A.Vavilov	1957	-	ES	-	BlS	-	+	-	-	-	-
SChS-168	1957	1957	MBSS	-	Azov	-	+	-	-	-	-
Zeya	1957	1958	ES	-	BlS	-	+	-	-	-	-
Prof. Vasentsov	1957	1957	-	-	-	-	+	-	-	-	-
Kovalevsky	1957	1957	ES	-	BlS	-	+	-	-	-	-
Mgla	1957	1978	SRV	-	BlS	+	+	-	-	-	-
TShch-531	1957	1957	-	-	BlS	-	+	-	-	-	-
TShch -810	1957	1957	-	-	BlS	-	+	-	-	-	-
Aitodor	1958	1982	ES	-	BlS	-	+	-	-	-	-
BTShch- 816	1958	-	MFT	-	BlS	-	+	-	-	-	-
Delta	1960	-	ES	-	BlS	-	+	-	-	-	-
MBSS-206	1972	1972	MBSS	-	Azov	-	+	-	-	-	-
Adelgunda	1974	1988	-	-	BlS	-	+	-	-	-	-
Southern Research Institute for Fishery and Oceanography											
Vest	1937	1952	-	-	BlS, Azov	-	+	-	-	-	+
Akademik Zernov	1947	1951	ES	-	Azov	-	+	-	-	-	+
Vjun	1947	-	L	-	Azov	-	+	-	-	-	+
Vladimir Vorobjev	1948	1969	MFT	-	WO	-	+	-	-	-	+
Bystry	1949	-	ES	-	Azov	-	+	-	-	-	+
BChS-614	1951	-	ES	-	Azov	-	+	-	-	-	+
Akademik Knipovich	1951	1952	ES	-	Azov	-	+	-	-	-	+
Gonets	1951	1963	MFT	-	BlS	-	+	-	-	-	+
Grot	1951	-	ES	-	Azov, BIS	-	+	-	-	-	+
Luch	1951	1951	ES	-	Azov	-	+	-	-	-	+
Kovda	1951	1952	ES	-	Azov	-	+	-	-	-	+
Moksha	1952	1953	ES	-	Azov	-	+	-	-	-	+

Name of Ship	Period of Work		Type of Ship	Call	Area of Operation	Type of Observation					
	Start	Finish				M	H	P	G	D	B
FS-614	1952	1952	FS	-	Azov	-	+	-	-	-	+
Kristall	1959	1976	MFT	UVSR	BlS	-	+	-	-	-	+
Monometr	1959	1959	HRS	-	Bar	-	+	-	-	-	+
SRT-4509	1960	1960	MFT	-	BlS	-	+	-	-	-	+
Ikhtiolog	1965	1973	MFT	ESGV	WO	-	+	+	-	-	+
Marlin	1965	1981	MFFT	-	WO	-	+	-	-	-	+
Chernomor	1966	1978	MFFT	-	WO	-	+	-	-	-	+
Nauka	1966	1987	FFT-T	UYRI	WO	-	+	-	-	-	+
Krasny luch	1966	1966	-	-	WO	-	+	-	-	-	+
Ariel	1968	1986	MFFT	-	Ind	-	+	-	-	-	-
Aelita	1968	1985	MFFT	UMOY	WO	-	+	-	-	-	+
Nikolai Reshetniak	1971	1988	MFFT	EWGC	WO	-	+	-	-	-	+
Zhelezniakov	1969	1980	MFFT	-	WO	-	+	-	-	-	+
Yelagin	1975	-	MFFT	ESLG	Ind	-	+	-	-	-	+
Sevastopolsky rybak	1977	1988	MFFT	EWGB	WO	+	+	-	-	-	+
Gerojevka	1980	-	FFFT	UBJA	Ind	-	+	-	-	-	+
Vozrozhdeniye	1980	-	FFFT	-	WO	-	+	-	-	-	+
Kerchensky Komsomolets	1987	1988	MFFT	ULGB	WO	-	+	-	-	-	+
Kometa Galeya	1988	1988	MFFT	UZZE	WO	-	+	-	-	-	+
South Fish Search											
Lesnoy	1965	1984	FFT	UYVG	WO	-	+	-	-	-	+
Prof. Mesyatsev	1965	1988	SSS	EWVS	WO	-	+	-	-	-	+
Skif	1969	1988	SSS	ESGÒ	WO	-	+	-	-	-	+
Myslitel	1969	1986	MFFT	-	WO	-	+	-	-	-	+
Kara-Dag	1971	1986	FFT-A	EWVW	WO	-	+	-	-	-	+
Fiolent	1972	1988	SSS	UVIX	WO	-	+	-	-	-	+
Chatyr-Dag	1973	1988	FFT-A	EWVX	WO	-	+	-	-	-	+
Pantikapey	1973	1986	MFFT	UURM	WO	-	+	-	-	-	+
Shedar	1973	1981	FFT	-	WO	-	+	-	-	-	+
Zvezda Kryma	1976	1988	FFT-A	UWGM	WO	-	+	-	-	-	+
Poltava	1978	1983	FFT-A	ESEG	WO	-	+	-	-	-	+
Primorets	1978	1987	MFFT	ESLW	WO	-	+	-	-	-	+
Mys Ostrovskogo	1978	1988	LFT	UWFI	WO	-	+	-	-	-	+
Torzhok	1978	1978	–	-	PO	-	+	-	-	-	+
Semen Volkov	1979	1981	MFFT	-	PO	-	+	-	-	-	+
Yelsk	1979	-	MFFT	UWRT	PO	-	+	-	-	-	+
Kalper	1979	-	LFT	UHVF	WO	-	+	-	-	-	+
Zhelezny potok	1980	1987	MFFT	-	PO	-	+	-	-	-	+
Novoukrainka	1980	1986	FFFT	UHCF	WO	-	+	-	-	-	+
Zvezda Chernomorja	1981	-	FFFT	UNNP	WO	-	+	-	-	-	+
Zvezda Azova	1981	1988	FFFT	UNNR	WO	-	+	-	-	-	+
Zvezda Sevastopolia	1981	-	LFT	UUTU	WO	-	+	-	-	-	+
Slava Kerchi	1985	1986	-	-	Ind	-	+	-	-	-	+
Estafeta Oktyabrja	1985	1985	-	-	NA	-	+	-	-	-	+
Sovremennik	1986	1986	SSS	-	WO	-	+	-	-	-	+

Name of Ship	Period of Work		Type of Ship	Call	Area of Operation	Type of Observation					
	Start	Finish				M	H	P	G	D	B
Dmitry Stefanov	1987	-	FST	UTTX	Ind	-	+	-	-	-	+
Tiksi Hydromet											
Gidrolog	1986	-	ES	-	LS	+	+	-	-	-	-
Okeanolog	1951	1986	ES	-	LS	+	+	+	-	-	-
Briz	1987	-	ES	-	LS	+	+	-	-	-	-
West Fishery Reconnaissance Company											
Belogorsk	1965	1982	FFT	UYVX	AO	-	+	-	-	-	+
Yubileiny	1967	1984	MFFT	-	AO	-	+	-	-	-	+
Blesk	1968	-	MFFT	-	-	-	+	-	-	-	+
Bakhchisarai	1969	-	FFT	UIXS	AO	-	+	-	-	-	+
Alferas	1969	1982	MFFT	UXNA	BS, AO	-	+	-	-	-	+
Foton	1969	1980	MFFT	ULLS	NA	-	+	-	-	-	+
Vaida	1970	1979	MFFT	ONLY	AO	-	+	-	-	-	-
Spektr	1970	1983	MFFT	UNOY	WO	-	+	-	-	-	+
Stvor	1970	1983	MFFT	UOAB	WO	-	+	-	-	-	+
Pioner Latvii	1971	1989	LFT	ESUV	AO	-	+	-	-	-	+
Andrus Jokhanis	1972	1988	LFT	UVKL	AO	-	+	-	-	-	+
Salekhard	1972	1989	LFT	FSUX	WO	-	+	-	-	-	+
Betelgeize	1973	1974	MFFT	UOAA	AO	-	+	-	-	-	+
Saturn	1973	1980	MFFT	UNLK	AO	-	+	-	-	-	+
Nogliki	1973	1986	MFFT	EWAP	WO	-	+	-	-	-	+
Flaningo	1973	1985	FFT	UYMA	AO		+	-	-	-	+
Zvezda	1978	1987	FFFT	URRD	WO	-	+	-	-	-	+
Suvalkia	1978	-	FFFT		PO	-	+	-	-	-	+
Prometei	1978	-	MFFT	UEFF	PO	-	+	-	-	-	+
Kristjan Raund	1978	-	LFT	UNVC	WO	-	+	-	-	-	+
60 let VLKSM	1979	1987	MFFT	EWYB	AO	-	+	-	-	-	-
Plunge	1979	1987	–	USXE	AO	-	+	-	-	-	+
Vysota	1980	-	MFFT	-	WO	-	+	-	-	-	+
Sokrat	1980	1989	FFFT	UBKS	WO	-	+	-	-	-	+
Novocheboksarsk	1980	1988	FFFT	UGVJ	WO	-	+	-	-	-	+
Kulikovo pole	1980	1988	FFFT	UZUR	AO	-	+	-	-	-	+
Volny veter	1981	-	FFFT	UVWZ	WO	-	+	-	-	-	+
Patriot	1981	1989	MFFT	UUVU	WO		+	-	-	-	+
Russkoye pole	1981	1989	FFFT	UEYJ	AO	-	+	-	-	-	+
Charoit	1982	1989	MFFT	LYEF	NA	-	+	-	-	-	+
1500 let Kievu	1982	1989	FFT	LYFB	AO	-	+	-	-	-	+
Malta	1982	1989	FFFT	LUEB	WO	-	+	-	-	-	+
Otkrytiye	1982	1989	MFFT	LYFC	AO	-	+	-	-	-	+
Borodinskoye pole	1983	-	FFFT	LYEX	AO	-	+	-	-	-	+
Gradient	1984	-	MFFT	UBOY	AO	-	+		-	-	+
Pregolia	1984	1989	MFFT	USLO	NA	-	+	-	-	-	+
Titanit	1984	1989	MFFT	EKRB	WO	-	+	-	-	-	+
Afeliy	1985	-	FFT	UKYW	AO	-	+	-	-	-	+
Tava	1985	1989	MFFT	-	AO	-	+	-	-	-	+
Torok	1985	1989	MFFT	LYIN	AO	-	+	-	-	-	+

Name of Ship	Period of Work		Type of Ship	Call	Area of Operation	Type of Observation					
	Start	Finish				M	H	P	G	D	B
Lublino	1987	1988	MFFT	LYKO	AO	-	+	-	-	-	+
Maltsevo	1987	1988	MFFT	ULNE	WO	-	+	-	-	-	+
Unknown Owner											
Tor	1910	1910	-	-	-	-	+	-	-	-	-
Valkiria	1923	-	-	-	BlS	-	+	-	-	-	-
Sukhum	1925	1927	-	-	BlS	-	+	-	-	-	-
Krasin	1929	1935	-	-	ArcO	-	+	-	-	-	-
Delfin	1930	-	-	-	Bar	-	+	-	-	-	-
Simeiz	1932	1932	-	-	Azov	-	+	-	-	-	-
Sovet	1932	1932	-	-	SO	-	+	-	-	-	-
Beluga	1933	1933	-	-	BlS	-	+	-	-	-	-
Belukha	1933	1933	Boat	-	Kar	-	+	-	-	-	-
Smely	1937	1937	-	-	BlS	-	+	-	-	-	-
Kavasaki	1937	1958	-	-	AO	-	+	-	-	-	-
Tavrida	1937	1938	-	ESJS	BlS	-	+	-	-	-	-
Turist	1937	1937	-	-	BlS	-	+	-	-	-	-
Viluy	1939	1949	-	EKLN	PO	-	+	-	-	-	-
SHCH-118	1946	1946	-	-	PO	-	+	-	-	-	-
Bering	1947	1947	-	-	PO	-	+	-	-	-	-
SRT-662	1953	1954	MFT	-	-	-	+	-	-	-	-
SRT-342	1956	1956	MFT	-	PO	-	+	-	-	-	-
SRT-419	1956	1956	MFT	-	PO	-	+	-	-	-	-
SRt-626	1956	1956	MFT	-	PO	-	+	-	-	-	-
Lermontov	1958	-	-	-	AO	-	+	-	-	-	-

Appendix 2. Brief information on the most prominent national and international expeditions and projects (programs)

	The Second Kamchatka Expedition
Period of operation	1724 – 1741
Aim	Investigation of the Far East lands
Geographical area	Kamchatka, Sakhalin, the Japan Sea, the Sea of Okhotsk
Organizer	Peter the Great
Data processing institution	Imperial RAS
Data archive	RAS
Participating countries	Russia
Types of observations	Geography, hydrography
	The Great Northern expedition
Period of operation	1733–1743
Aim	Investigation of the Arctic regions and Siberia
Geographical area	The Arctic Seas
Organizer	Peter the Great
Data processing institution	Imperial RAS
Data archive	RAS
Participating countries	Russia
Types of observations	Geography, hydrography
	The First Russian circumnavigation of the Earth in the sloops, "Nadezhda" and "Neva"
Period of operation	1803
Aim	Search for new lands
Geographical area	The Atlantic, Indian and Pacific Oceans; the Antarctic
Organizer	Russian Government
Data processing institution	Imperial RAS
Data archive	RAS
Participating countries	Russia
Types of observations	Geography, hydrography
	The First International Polar Year
Period of operation	1882–1883
Aim	Investigation of Arctic
Geographical area	The Arctic Ocean
Organizer	International Meteorological Commission
Data processing institution	Imperial RAS
Data archive	RAS
Participating countries	Russia, France, the United Kingdom, Germany, the USA, Canada, Netherlands, Denmark, Sweden, Norway, Finland, Austria
Types of observations	Hydrometorology, ice
Brief results	13 Arctic geophysical stations were established including 2 stations in Russia (Sagastyr – in the mouth of the Lena river and Malye Karmakuly – in the New Land). 2 stations were established in Antarctica.

The Northern research-fishery expedition	
Period of operation	1920
Aim	Investigation of navigation and fishery sea routes, preparation of navigation manuals
Geographical area	The Arctic Seas
Organizer	Supreme National Economy Council
Data processing institution	PLAVMORNIN
Data archive	All Russian RIFO
Participating countries	The Russian Soviet Federative Socialist Republic
Types of observations	Meteorology, hydrography, biology
The Black Sea oceanographic expedition	
Period of operation	1923 – 1927
Aim	Obtaining marine information, organization of regular observation
Geographical area	The Black Sea
Organizer	The USSR Government
Data processing institution	Sevastopol SOI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography, hydrography
The Northern hydrographical expedition	
Period of operation	1924
Aim	Investigation of the Northern Seas, exploration of the Northern Sea Route, exploration of fish resources
Geographical area	The Barents, White and Kara Seas
Organizer	Government of Russia
Data processing institution	North Research Institute
Data archive	ARI
Participating countries	The USSR
Types of observations	Oceanography, meteorology, biology
The Second Polar Year	
Period of operation	1932 – 1933
Aim	Investigation of the Arctic
Geographical area	The Arctic Ocean
Organizer	International Meteorological Commission
Data processing institution	North Research Institute
Data archive	ARI
Participating countries	12 countries (the USSR, the USA, Norway, the United Kingdom and others)
Types of observations	Hydrometorology, ice
Brief results	New Polar stations were established
Aircraft high-latitude expeditions	
Period of operation	1937–1995
Aim	To obtain information on hard-to-reach Arctic regions, aircraft observations
Geographical area	The Arctic Ocean and Arctic Seas

Organizer	Main Directorate of Hydrometeorological Service
Data processing institution	AARI
Data archive	AARI
Participating countries	The USSR
Types of observations	Oceanography, meteorology, glaciology
	"North Polar" drifting stations
Period of operation	1937 – 1995
Aim	Investigation of hard-to-reach Arctic regions
Geographical area	The Arctic Ocean
Organizer	Roshydromet
Data processing institution	AARI
Data archive	AARI
Participating countries	The USSR
Types of observations	Oceanography, meteorology, hydrobiology
	Ocean Weather stations
Period of operation	1946 - 1991
Aim	Support of air flights across the oceans, preparation of long-term time series, weather and hydrological forecasts, development of new forecasting technique
Geographical area	North Atlantic, North Pacific
Organizer	International Civil Aviation Organization (1946 - 1957), Intergovernmental Oceanographic Commission (since 1958)
Data archive	ICES, WDC-A, WDC-B
Participating countries	Stations in the North Atlantic-the USA (Alfa, Bravo, Charlie, Delta, Echo, Foxtrot, Yankee, Hotel), Canada (Bravo), the United Kingdom (India, Juliett), Netherlands (Kilo), Belgium (Kilo), France (Lima), Norway (Mike), Sweden (Mike), Denmarc(Mike), the USSR (Charly since 1975); in the Pacific Ocean-the USA (November, Oscar, Papa, Quebec, Sierra, Uniform, Victor), Canada (Papa), Japan (Tango, Xray)
Types of observations	Oceanography, meteorology, plankton
Participating ships	From the USSR: RVs "Passat," "Musson," "Victor Bugaev," "Krenkel"
	SAE – Soviet Antarctic Expedition
Period of operation	1956 – 1996
Aim	Investigation of the Southern Polar region – Antarctic and surrounding waters
Geographical area	The Atlantic and South Oceans, Antarctic
Organizer	Main Directorate of Hydrometeorological Service (Goskomhydromet, Roshydromet)
Data processing institution	AARI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Meteorology, hydrography, biology, glaciology, geology, oceanography
Participating ships	"Ob', "Lena", "Zubov", "Vize"

International Geophysical Year

Period of operation	1957 – 1958
Aim	Geophysical investigation
Geographical area	Northern hemisphere
Organizer	International Council of Scientific Unions
Place of processing	WDCs
Data archive	WDC-A, WDC-B
Participating countries	17 countries including the USSR
Types of observations	Oceanography, meteorology, geophysics
Brief results	The USSR performed more then 30 oceanographic expeditions in all oceans and seas

International Indian Ocean Expedition

Period of operation	1961 – 1964
Aim	Ocean-atmosphere circulation study. Determining zones of ocean fronts, determining heat balance and water exchange, search for new fishery areas
Geographical area	The Indian Ocean
Data processing institution	WDC-B
Data archive	WDC-B
Participating countries	The USSR, India
Types of observations	Oceanography, meteorology, geophysics, hydrography,

CSK – Cooperative Study of Kuroshio and adjacent regions, the component of International Decade of Ocean Exploration (IDOE)

Period of operation	1965 - 1977
Aim	Investigation of physical, chemical and biological structure of Kuroshio and adjacent regions and its seasonal, annual and long-term variations
Geographical area	The South China, East China, Japan, Inland, Philippine Seas, the Southwest Pacific
Organizer	IOC
Data processing institution	NODC of Japan, functions of RDC were performed by Kuroshio data center which is the branch of NODC
Data archive	WDCs
Participating countries	Thailand, China, France, the USSR, Japan, Korea, Philippines, the United Kingdom, Vietnam
Types of observations	Hydrology, hydrochemistry, meteorology, biology; currents

CIM – Cooperative Investigation of the Mediterranean Sea

Period of operation	1969 - 1981
Aim	Multi-discipline study of Environment
Geographical area	The Northeast Atlantic, the Mediterranean Sea, the Straits of
Organizer	IOC
Place of processing	RDC (NODS of Russia up to1986)
Data archive	WDCs
Participating countries	Austria, Arab Republic of Egypt, Belgium, France, FRG, Israel, Italy, Lebanon, Malta, Monaco, Morocco, Romania, Spain, Switzerland, Tunisia, the United Kingdom, the USSR

Types of observations	Meteorology, hydrology, biology, geology, hydrochemistry, geophysics, pollution

CICAR - Cooperative Investigation of the Caribbean and Adjacent Region (a component of IODE)

Period of operation	1968 - 1975
Aim	Multi-disciplinary investigations
Geographical area	The Caribbean, the Gulf of Mexico and adjacent regions of the Atlantic

GARP – Global Atmospheric Research Program

Organizer	IOC
Place of processing	Functions of CICAR RDC performed by US NODS
Data archive	WDCs
Participating countries	The United Kingdom, the USSR, Brazil, Colombia, Cuba, France, FRG, Guatemala, Jamaica, Mexico, the Netherlands,
Types of observations	Meteorology, hydrology, biology, hydrochemistry, geology, geophysics
Period of operation	1969 - 1980
Aim	Atmosphere-Ocean interaction study. Data collection
Geographical area	The Tropical Atlantic
Organizer	WMO, ICSU
Data processing institution	NODCs of participating countries, NODC and WMC (the USA); CAO, Hydrometcenter, IEM and RIHMI-WDC (the USSR)
Data archive	WDCs
Participating countries	Belgium, France, FRG, Portugal, the United Kingdom, the USSR, the USA
Types of observations	Oceanography, hydrochemistry, meteorology; currents
Brief results	A number of regional experiment were carried out such as GATE, ALPEX, MOMEX, MEDALPEX, MONEX, Monsoon, FGGE, TOPEX

Quasi-two-year cycle

Period of operation	1970 – 1987
Geographical area	The Indian and Pacific Oceans
Organizer	Goscomhydromet
Data processing institution	FERHI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

IAGP – International Antarctic Glaciology Project

Period of operation	1970 - 1982
Aim	Investigation of Antarctic glacial cover, its external energy exchange and its part in global energy processes
Geographical area	Coastal areas of Antarctic – the South Ocean
Data archive	WDCs
Participating countries	The USSR, Austria, the United Kingdom, the USA, France, Japan
Types of observations	Glaciology

IDOE – International Decade of Ocean Exploration

Period of operation	1971 - 1980
Aim	Global multi-purpose ocean study. IDOE combines a number of projects dealing with forecasting of environment, marine environment quality; living and non- living resources of the World Ocean
Geographical area	the World Ocean
Organizer	IOC
Data archive	WDC
Participating countries	IOC member states
Types of observations	Meteorology, hydrology, biology, hydrochemistry, geology, geophysics, currents, pollution

"Breeze" project

Period of operation	1971 – 1978
Geographical area	The Japan Sea
Organizer	Goscomhydromet
Data processing institution	Far East RIHMI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

"Southern Circulation" project

Period of operation	1972 - 1978
Geographical area	The South Ocean
Organizer	AS of the USSR
Data processing institution	MHI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

MESCAL-I, II; JOINT-I, II – Analysis of ecosystems in the area of deep-water rise (a component of IODE)

Period of operation	1972 - 1978
Aim	Investigation of chemical, physical, and geological processes and interrelations typical for biological aspects of marine organisms
Geographical area	The Northeastern Atlantic, the Southeastern Pacific, the northeastern coast of the USA and Africa, the coast of California
Organizer	IOC
Data processing institution	US NODC
Data archive	WDCs
Participating countries	Canada, Colombia, Ecuador, France, FRG, Japan, Mexico, the United Kingdom, the USSR, the USA, Venezuela
Types of observations	Meteorology, hydrology, biology, hydrochemistry, currents

CINECA - Cooperative Investigation of Northeastern part of Central Africa (a component of IODE)

Period of operation	February 1973 - May 1974

Aim	Investigation of physical processes related to deep-water formation in the Northeastern part of Central Africa
Geographical area	The Northeastern Atlantic between Gibraltar and Dakar
Organizer	IOC
Place of processing	ICES RDC
Data archive	WDCs
Participating countries	France, FRG, Korea, Mauritania, Morocco, Norway, Poland, Portugal, Senegal, Spain, the USSR, the USA, the United Kingdom
Types of observations	Meteorology, hydrology, biology, hydrochemistry, currents, pollution

"Monsoon"

Period of operation	1973 – 1984
Aim	Investigation of monsoon
Geographical area	The Indian Ocean
Organizer	Goscomhydromet
Place of processing	Far East RIHMI
Data archive	RIHMI-WDC
Participating countries	The USSR, Japan
Types of observations	Oceanography

POLYMODE - Joint U.S.- U.S.S.R. Mid-Ocean Dynamics Experiment or Expanded Mid-Ocean Dynamics Experiment

Period of operation	July 1974 - November1978
Aim	Investigation of current circulation in the North Atlantic. Investigation of atmospheric processes and their impact on the ocean.
Geographical area	The North Atlantic
Organizer	IOC
Data archive	WDCs
Participating countries	The USSR, the United Kingdom, the USA
Types of observations	Meteorology, hydrology, hydrochemistry, currents, pollution, geology, geophysics

GIPME - Global Investigation of Pollution in the Marine Environment

Period of operation	1974 - 1990
Aim	Investigation of pollution and its impact on the World Ocean; large-scale long-term program combining all pollution project
Geographical area	The World Ocean
Organizer	IOC
Data processing institution	RNODCs on pollution of the USSR, Japan, the USA
Data archive	WDCs
Participating countries	IOC member states
Types of observations	Meteorology, hydrology, hydrochemistry, currents, pollution

GATE – GARP Atlantic Tropical Experiment (a component of IODE)

Period of operation	17 June 1974 - 23 September 1974

Aim	Investigation of convective and meso-scale systems, their interrelation with large-scale tropical disturbances and more accurate determination of parameters of their feedback with large-scale circulation, required for numerical models
Geographical area	Tropical area of the Atlantic Ocean
Organizer	IOC, WMO
Place of processing	WDC
Data archive	WDC
Participating countries	Brazil, Canada, France, FRG, Mexico, the Netherlands, Portugal, the USSR, the United Kingdom, the USA, Venezuela
Types of observations	Meteorology, hydrology, hydrochemistry, currents
Brief results	In the framework of GATE, the following was collected: 722 magnetic tapes (the United Kingdom – 96, GDR – 3, Canada – 18, Mexico – 2, the Netherlands – 3, the USA – 499, France – 6, FRG – 41); microfilms (radar cloud observations – 129, radar precipitation observations – 8, aircraft data – 9, aerostat data – 2, satellite cloud observations – 2, meteorological data – 30, oceanographic data - 6

POLEX – Polar Experiment

Period of operation	1974 – 1990
Aim	Investigation of Polar areas
Geographical area	The Southern Ocean, the Norway, Greenland, Barents, & Kara Seas
Organizer	Goscomhydromet
Data processing institution	AARI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

"Shelf" project

Period of operation	1975 - 1986
Aim	Investigation of coastal areas of the USSR seas
Geographical area	The Far East Seas
Organizer	Goscomhydromet
Data processing institution	SOI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

FDRAKE – First Dynamic and Kinematic Experiment in frames of ISOS project

Period of operation	January 1975 –December 1977
Aim	Investigation of dynamical processes in the oceans
Geographical area	The Northeastern and Southeastern Pacific, the North Atlantic, the South Atlantic
Organizer	IOC
Data archive	WDCs
Participating countries	The USSR, the USA, Argentina, Chile

Types of observations	Meteorology, hydrology, hydrochemistry, currents, pollution, geology, geophysics, biology

"Baltic" project

Period of operation	1975 - 1989
Aim	Complex investigation of ecosystem
Geographical area	The Baltic Sea
Organizer	ICES
Data archive	WDCs
Participating countries	Denmark, Sweden, FRG, the USSR, Finland, GDR
Types of observations	Meteorology, hydrology, hydrochemistry, currents, pollution, geology, biology

MAPMOPP - Marine Pollution (Petroleum) Monitoring Pilot Project

Period of operation	1975 - 1981
Aim	Monitoring of petroleum pollution in frames of IGOSS
Geographical area	The Northern Pacific, the Philippine, Coral, Solomon, Bismarck, Japan, East China, Caribbean, & Mediterranean Seas
Organizer	IOC, WMO
Place of processing	Odessa SOI
Data archive	WDCs
Participating countries	Japan, the USA, the USSR
Types of observations	Meteorology, hydrology, hydrochemistry, currents, pollution, biology

"Typhoon" project

Period of operation	1975 - 1987
Aim	Forecast of typhoon movement
Geographical area	The Pacific Ocean
Organizer	Goscomhydromet
Data processing institution	Far East RIHMI, SPA "Typhoon"
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

ISOS – International Southern Ocean studies

Period of operation	1975 - 1979
Aim	Multi-disciplinary cooperative investigation of the South Ocean
Geographical area	The Southern Ocean, the South Atlantic, the South Pacific, the Indian Ocean
Organizer	IOC, WMO
Data archive	WDCs
Participating countries	Argentina, Australia, Belgium, Brazil, Chile, France, Japan, New Zealand, Norway, Republic of South Africa, the USSR, the United Kingdom, the USA
Types of observations	Meteorology, hydrology, hydrochemistry, currents, geology, geophysics, biology

"Ples" project

Period of operation	1976 – 1978

Aim	Investigation of coastal zones
Geographical area	The Far East Seas, the Atlantic
Organizer	SCST (State Committee for Science and Technology)
Place of processing	Far East RIHMI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

SAMEX – Soviet-American Microwave Experiment

Period of operation	1976 - 1980
Geographical area	The North Pacific
Organizer	Goscomhydromet
Place of processing	Far East RIHMI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

"Front" project

Period of operation	1976
Geographical area	The Northwestern Pacific
Place of processing	POI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

BOSEX – Baltic Open Sea Experiment

Period of operation	1977 - 1979
Aim	Investigation of synoptic variability of physical fields
Geographical area	The Baltic Sea
Organizer	ICES – International Council for the Exploration of the Sea; SCOR – Scientific Committee on Oceanic Research
Place of processing	ITPE (Estonia)
Data archive	WDCs
Participating countries	FRG, Sweden, the USSR, Denmark, Finland, GDR, Poland
Types of observations	Hydrology, hydrochemistry, currents, geology, geophysics, pollution

"Program "

Status	National
Period of operation	1977 - 1981
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

STRAMEX – Stratosphere Meteorological Experiment

Period of operation	1977 - 1986
Geographical area	The Pacific Ocean
Place of processing	Far East RIHMI
Data archive	RIHMI-WDC
Participating countries	The USSR

Types of observations	Oceanography
"Kamchia" project	
Period of operation	1977 - 1978
Geographical area	The Black Sea
Place of processing	IBSS
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography
Soviet-Guinea Expedition	
Period of operation	1977 - 1978
Geographical area	The Northwestern Atlantic
Data processing institution	MHI
Data archive	WDCs
Participating countries	The USSR, Guinea
Types of observations	Oceanography
LIHMA – Long-term investigation of hydrometeorological processes in the Atlantic	
Period of operation	1977 – 1982
Geographical area	The Mediterranean Sea
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography
Participating ships	"Passat," "V.Bugaev," "E.Krenkel," "G.Ushakov" (Odessa SOI)
BIOMASS - Biological Investigations of Marine Antarctic Systems and Stocks	
Period of operation	1978 - 1985
Aim	Biological investigation in the Southern Ocean
Geographical area	The Indian Ocean, the southern sector of the Indian Ocean, the west Pacific
Organizer	IOC, SCAR – Sciântific Committee on Antarctic Research
Data archive	WDCs
Participating countries	Argentina, Australia, Japan, New Zealand, Norway, the USSR, the United Kingdom, the USA, FRG, Chile
Types of observations	Meteorology, hydrology, hydrochemistry, currents, pollution, geology, biology, geophysics
"Tsunami" project	
Period of operation	1978 - 1987
Geographical area	The Northwestern Atlantic
Organizer	Goscomhydromet
Data processing institution	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography
FGGE – First GARP Global Experiment	
Period of operation	1978 – 1980
Aim	Investigation of oceanic processes, including atmospheric impact and feedback

Geographical area	Tropical zone of the North and South Atlantic, the Northeastern and South Pacific, the Indian Ocean
Organizer	IOC, WMO
Data processing institution	German Hydrographic Institute, Meteorological Bureau of the US Navy, RNODs in different countries
Data archive	WDCs
Participating countries	23 countries were involved in the Experiment such as Brazil, Canada, France, FRG, Mexico, the Netherlands, Portugal, the USSR, the USA, the United Kingdom, Venezuela and others
Types of observations	Hydrology, hydrochemistry, currents, geology, geophysics, meteorology
Brief results	The following data sets have been created: standard bathometry observations - 2 magnetic tapes (MT), 9 countries, 128 cruises; currents – 2 MT, 1 country, 294 mouths of measurements; bathythermograph data – 3 MT, 13 countries, 28000 stations; STD sounding - 1 MT, 2 countries, 4030 soundings, 62 cruises

"Sections" project

Objective	Ocean-Atmosphere interaction study
Period of operation	1979 - 1990
Aim	Investigation of spatial-time variations of basic ocean and atmosphere characteristics within the time-scale from a month to a season. Revealing interrelation between thermal and dynamical anomalies in the ocean and atmosphere anomalies of circulation
Geographical area	Tropics, the Newfoundland zone, the Norwegian zone
Organizer	SCST
Place of processing	RIHMI-WDC
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography, meteorology, actinometry, aerology

Kara Experiment

Period of operation	1979 – 1994
Geographical area	The Kara Sea
Organizer	Goscomhydromet
Place of processing	AARI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

IOCARIBE

Period of operation	1979 – 1995
Geographical area	The Caribbean Sea
Organizer	IOC
Place of processing	WDCs
Data archive	WDCs
Participating countries	The USSR, the USA

Types of observations	Oceanography

SCOPE – Scientific Committee on Problems of the Environment (Soviet-Swedish program on the investigation of the biochemical cycle of sulfur and the most important pollutants in the atmosphere and water and oceanic precipitation)

Period of operation	1979
Geographical area	The Pacific Ocean
Data processing institution	Far East RIHMI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

MONEX – Monsoon Experiment

Period of operation	1979 – 1985
Aim	Investigation of monsoon
Geographical area	The Indian Ocean
Organizer	Goscomhydromet
Data processing institution	FERHI, SPA "Typhoon"
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

WESTPAC - Cooperative international investigation of the Western Pacific

Period of operation	May 1979 - March 1987
Aim	Study and monitoring of marine environment pollution; ocean dynamics, marine biology and living resources; geology, geophysics and non-living resources
Geographical area	The Philippine Sea, the Northwestern Pacific, the South China, Japan, Okhotsk Sea, the North Pacific, the East China and Inland Seas
Organizer	IOC
Place of processing	NODC of Japan
Data archive	WDCs
Participating countries	The USSR, Japan, Australia
Types of observations	Meteorology, hydrology, hydrochemistry, currents, geology, biology, geophysics

CENP–80 project

Period of operation	1980
Geographical area	The Pacific Ocean
Organizer	Goscomhydromet
Place of processing	Far East RIHMI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

"Seas" project – Investigation of interior and marginal seas

Period of operation	1980–1990
Aim	Preparation of reference publications

Geographical area	The White, Barents, Okhotsk, Japan, Bering, Black, Caspian, Azov, & Baltic Seas
Organizer	Goscomhydromet
Data processing institution	SOI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

CIPRIO – Inter-Agency Program for Complex Investigation of Fishery Resources in the Indian Ocean

Period of operation	1980
Geographical area	The Indian Ocean
Organizer	The USSR AS
Data processing institution	MHI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

"Triangle" project

Period of operation	1980
Geographical area	The Sea of Okhotsk
Data processing institution	Far East RIHMI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

"Hurricane" project

Period of operation	1981
Geographical area	The North Pacific
Data processing institution	Far East RIHMI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

"Polynia" project

Period of operation	1981
Geographical area	The South Ocean
Organizer	SCST
Data processing institution	AARI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

ALPEX – Alpine Experiment

Period of operation	September 1981 –October 1982
Aim	Investigation of atmospheric processes over the alps
Geographical area	The western part of the Mediterranean, the Tyrrhenian, the Ligurian, the Adriatic Seas (50E W – 30E E; 38E – 50E N)
Organizer	WMO
Data processing institution	ESA – European Space Agency; NODCs of the USA and the USSR

Data archive	WDC
Participating countries	The USSR, FRG, the USA, Canada, the Netherlands, Austria, Belgium, Czechoslovakia, France, Greece, Hungary, Yugoslavia, Italy, Poland, Romania, Switzerland, Israel, Portugal, Turkey
Types of observations	Hydrometeorology

MEDALPEX – Mediterranean Alpine Experiment

Period of operation	September 1981 – September 1982
Aim	Investigation of Water-Atmosphere interaction in the Northern Mediterranean
Geographical area	The Western Mediterranean, the Tyrrhenian, Ligurian, Adriatic Seas
Organizer	IOC
Data processing institution	RNODS MEDALPEX functions were performed by NODC of Russia
Data archive	WDCs
Participating countries	Belgium, Spain, Italy, the USSR, Yugoslavia, France, Turkey
Types of observations	Meteorology, hydrology, hydrochemistry, currents, biology

MARPOLMON - Marine Pollution Monitoring

Period of operation	1981 - 1990
Aim	Pollution monitoring in frames of GIPME
Geographical area	The Northern, Northwestern, Northeastern Pacific, the Philippine, Japan, Okhotsk, East China, Inland, Caribbean Mediterranean, Baltic Seas
Organizer	IOC
Data processing institution	RNODCs of the USSR (Odessa SOI) and Japan
Data archive	WDCs
Participating countries	Nearly all IOC members
Types of observations	Meteorology, hydrology, hydrochemistry, currents, biology, pollution

"Krill" project

Period of operation	1982 - 1983
Geographical area	The South Ocean
Organizer	Ministry of fishery
Data processing institution	TINRO
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

SAGAPE – Soviet American Gas-Aerosol Pacific Experiment

Period of operation	1983 - 1985
Geographical area	The Northeastern Pacific
Data processing institution	Far East RIHMI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

CEPI project

Period of operation	1982
Geographical area	The Pacific Ocean
Organizer	Goscomhydromet
Data processing institution	Far East RIHMI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

"Vertical" project

Period of operation	1983 – 1984
Geographical area	The Indian Ocean
Organizer	Goscomhydromet
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

BAREX

Period of operation	1984 – 1987
Geographical area	The Northern, the Norwegian, the Greenland, the Barents Seas
Organizer	Goscomhydromet
Place of processing	Murmansk Hydromet
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

TOGA – Tropical Ocean Global Atmosphere

Period of operation	1985 – 1995
Aim	Investigation of the dynamics of the coupled tropical ocean-atmosphere system. Operational assessment of large-scale climate variations in the tropical ocean zone and global atmosphere (i.e. El Nino, Monsoon variation in Asia and Africa, droughts in Africa and South America and other). Different level models have been applied ranging from simple to very complicated.
Geographical area	Tropical ocean zone from 20E N to 20E S and global atmosphere.
Organizer	WMO, IOC
Data processing institution	WDCs
Data archive	WDCs
Participating countries	The USSR, the USA
Types of observations	Meteorology, currents, oceanography
Brief results	One of the first programs having an interdisciplinary view of the climate system and promoting close cooperation between meteorologists and oceanographers

"Kosmos" program

Period of operation	1985 – 1988
Geographical area	The Atlantic Ocean

Organizer	AS of the Ukraine
Data processing institution	MHI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

GSEPM – Program of Governmental Service for Environmental Pollution Monitoring

Period of operation	1985
Geographical area	The Black Sea
Place of processing	Odessa SOI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

Geomorphological expedition

Period of operation	1985 - 1986
Geographical area	The Indian Ocean
Organizer	AS of the USSR
Place of processing	POI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

"Patchiness" experiment

Period of operation	1986
Aim	Investigation of small-scale variations of hydrophysical parameters
Geographical area	The Baltic Sea
Organizer	ICES
Data processing institution	ICES
Data archive	ICES
Participating countries	The USSR, Finland, Sweden, Denmark, Germany
Types of observations	Oceanography

"Stratosphere" project

Period of operation	1986
Geographical area	The North Pacific
Organizer	Goscomhydromet
Data processing institution	Far East RIHMI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

"Maritime territory" program

Period of operation	1986
Geographical area	The Japan Sea
Organizer	Goscomhydromet
Data processing institution	Far East RIHMI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography

"Wave" project	
Period of operation	1986 - 1987
Geographical area	The Northwestern tropical Atlantic
Organizer	SCST
Place of processing	MHI
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography
"Megapolygone" project	
Period of operation	1987
Geographical area	The Pacific Ocean
Organizer	SCST
Data processing institution	POI
Data archive	RIHMI-WDC
Types of observations	Oceanography
"Abyssal" project	
Period of operation	February 1987 - February 1988
Geographical area	The North Pacific
Organizer	Goscomhydromet
Data processing institution	RIHMI-WDC
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography
"Barents" project	
Period of operation	1987–1990
Aim	Investigation of the Barents Sea
Geographical area	The Barents Sea
Organizer	Goscomhydromet
Data processing institution	Murmansk Hydromet
Data archive	RIHMI-WDC
Participating countries	The USSR
Types of observations	Oceanography
WOCE – World Ocean Circulation Experiment (a component of WCRP)	
Period of operation	1990 – 2002
Aim	To develop models useful for predicting climate change and to collect the data necessary to test them; to determine the representativeness of the specific WOCE data sets for the long-term behaviour of the ocean, and to find methods for determining long-term changes in the ocean circulation
Geographical area	The Globe
Organizer	IOC
Data archive	WDCs
Participating countries	30 nations
Types of observations	Oceanography, meteorology

Appendix 3. R/Vs involved in various programs and projects

Number	Ship	Institution	Start	Finish
Abyssal project				
16545	Okean	Far East RIHMI	87.02.11	87.05.27
16898	Prof. Khromov	"	87.05.09	87.08.21
16947	Volna	Odessa SOI	87.08.28	87.12.26
17131	Akademik Shokalsky	Far East RIHMI	87.11.04	88.02.16
Baltics project				
12587	Rudolf Samoylovich	AARI	81.01.15	81.03.13
12887	"	"	81.04.01	81.05.31
12913	"	"	81.08.28	81.10.12
13629	"	"	82.02.09	82.03.26
13813	"	"	82.02.24	82.06.25
14009	Lev Titov	CMR, Lithuania	82.02.13	82.02.25
14011	Okeanograf	"	82.03.21	82.05.13
14074	G. Ushakov	Odessa SOI	82.07.24	82.09.03
14172	Rudolf Samoylovich	AARI	82.08.03	82.10.06
14211	"	"	82.11.03	82.12.05
14534	Akademik Shuleikin	"	83.04.08	83.05.18
14535	Rudolf Samoylovich	"	83.01.05	84.04.20
14598	Okeanograf	CMR, Lithuania	83.03.24	83.05.23
14599	Rudolf Samoylovich	AARI	83.05.21	83.07.04
14857	"	"	83.08.06	83.09.27
14901	"	"	63.10.01	63.12.08
15254	"	"	84.08.03	84.10.02
15157	"	"	84.04.17	84.06.30
15910	Okeanograf	CMR, Lithuania	85.07.25	85.08.18
15533	"	"	85.01.13	85.03.08
15746	Rudolf Samoylovich	AARI	85.05.15	85.07.19
15884	Arnold Veiner	ITPE	85.01.01	85.12.30
15870	Rudolf Samoylovich	AARI	85.08.29	85.10.28
16144	"	"	86.06.11	86.07.24
16145	Arnold Veiner	ITPE	86.04.17	86.05.23
16203	"	"	86.06.03	86.07.12
16297	"	"	86.11.13	86.12.12
16302	Rudolf Samoylovich	AARI	86.08.19	86.10.03
16303	"	"	86.01.23	86.12.07
16471	Lev Titov	CMR, Lithuania	87.01.07	87.02.18
16526	Okeanograf	"	87.01.14	87.02.27
16543	Arnold Veiner	ITPE	86.09.29	86.11.01
16679	Prof. Dorofeev	RSHMI	87.02.06	87.04.08
16892	Rudolf Samoylovich	AARI	87.07.31	87.09.10

Number	Ship	Institution	Start	Finish
17012	Arnold Veiner	ITPE	87.05.04	87.06.12
16907	"	"	87.06.24	87.07.28
16979	"	"	87.09.28	87.11.02
17082	Okeanograf	CMR, Lithuania	88.01.20	88.03.04
17437	Arnold Veiner	ITPE	88.04.25	88.06.05
17600	Okeanograf	CMR, Lithuania	88.12.06	88.12.21
18100	Arnold Veiner	ITPE	89.11.20	89.12.19
18204	Lev Titov	CMR, Lithuania	89.11.16	89.12.30
18386	Arnold Veiner	ITPE	90.04.07	90.05.15
18393	Rudolf Samoylovich	AARI	90.08.23	90.10.12
BAREX project				
15224	Patriot	AtlantNIRO	84.02.01	84.07.25
15952	Otto Shmidt	Murmansk Hydromet	85.10.25	85.12.31
16276	Prof. Dorofeev	"	86.10.03	86.12.21
16432	Vasily Berezkin	"	87.01.15	87.02.28
16693	Prof. Dorofeev	"	87.04.10	87.06.15
16902	Vasily Berezkin	"	87.08.11	87.10.25
16903	Otto Shmidt	"	87.08.28	87.10.01
16886	Akademik Shuleikin	AARI	87.07.07	87.09.13
16973	Victor Buynitskiy	Murmansk Hydromet	87.11.17	88.01.12
17323	Vasily Berezkin	"	88.03.29	88.04.30
17417	Prof. Dorofeev	"	88.03.30	88.06.17
17505	Vasily Berezkin	"	88.08.05	88.09.03
17707	"	"	88.12.01	89.01.20
17708	Victor Buynitskiy	"	88.11.18	89.01.05
17830	Vasily Berezkin	"	89.02.08	89.02.20
17832	Prof. Dorofeev	Murmansk Hydromet	89.01.10	89.03.03
17915	"	"	89.03.23	89.05.31
17914	Vasily Berezkin	"	89.03.06	89.05.07
18257	Victor Buynitskiy	"	90.01.17	90.02.28
BOSEX project				
10321	Victor Buynitskiy	Murmansk Hydromet	76.02.01	76.10.30
10322	"	"	77.07.15	77.07.25
11917	"	"	80.04.18	80.05.14
11918	"	"	80.06.08	80.06.09
11919	"	"	80.06.23	80.07.18
11920	"	"	80.07.04	80.09.12
Breeze project				
10389	Atlas	Far East RIHMI	71.07.23	71.08.07
4226	Sinoptik Ilyinsky	"	71.07.15	71.09.26
10432	"	"	72.05.14	72.05.24
10431	Vikhr	"	73.11.24	73.12.02
15595	Atlas	"	84.06.27	84.12.17

Number	Ship	Institution	Start	Finish
9435	Vikhr	“	75.01.21	75.12.17
9436	Adelgunda	“	75.04.09	75.12.24
9373	Vikhr	“	75.06.20	75.11.08
9437	Rassvet	“	75.09.10	75.09.24
9870	Vikhr	“	76.01.25	76.04.08
9751	“	“	76.04.16	76.05.01
9871	Nakat	“	76.04.11	76.12.13
9665	Volna	“	76.07.20	76.09.24
9915	“	“	77.03.07	77.05.06
9916	“	“	77.03.05	77.06.26
10123	Georgy Matveychuk	“	77.06.15	77.09.02
10147	Priboy	“	77.10.04	77.11.29
10066	Volna	“	77.10.01	77.12.31
10124	Georgy Matveychuk	“	77.11.04	77.11.21
10268	Priboy	“	77.12.01	78.04.30
10408	Georgy Matveychuk	“	78.04.09	78.04.10
10410	“	“	78.04.14	78.05.12
10411	“	“	78.05.23	78.07.26
10463	“	“	78.10.07	78.10.31
10110	Okean	“	77.10.01	78.01.31
10409	Volna	“	78.11.16	78.11.27
Camchia project				
10091	Miklukho-Maklay	IBSS	77.09.01	77.10.30
10348	Akademik Kovalevsky	“	78.08.31	78.11.04
CENP project				
11679	Akademik Shirshov	Far East RIHMI	80.07.17	80.11.01
11701	Priboy	“	80.07.06	80.11.03
11714	Volna	“	80.07.05	80.11.02
11767	Akademik Korolev	“	80.07.08	80.11.05
11975	Priliv	“	80.07.06	80.11.03
14730	Akademik Shirshov	“	83.05.18	83.08.31
14818	Okean	“	83.05.16	83.09.11
CEPI project				
14020	Priboy	Far East RIHMI	82.05.25	82.08.21
14077	Akademik Korolev	“	82.05.22	82.09.04
14173	Akademik Shirshov	“	82.05.29	82.08.12
14178	Volna	“	82.05.13	82.09.04
14212	Priliv	“	82.05.20	82.08.26
14366	“	“	82.10.02	82.12.21
14367	Volna	“	82.10.21	82.12.27
14368	Okean	“	82.11.06	82.12.27
14369	Priboy	“	82.09.17	82.12.16
14378	V.Frolov	“	82.11.28	82.12.22

Number	Ship	Institution	Start	Finish
14379	Akademik Shirshov	"	82.10.26	82.12.26
14405	A.I.Voeikov	"	82.11.03	83.02.10
CICAR				
13192	Antares	AtlantNIRO	72.01.15	73.03.24
CIPRIO project				
12582	Mikhail Lomonosov	MHI	80.04.02	80.08.30
Crill project				
14573	Mys Dalny	TINRO	82.12.03	83.06.06
CSK				
12736	Seskar	TINRO	79.08.09	79.11.27
First GARP Global Experiment (FGGE)				
10488	Okean	Far East RIHMI	78.09.08	78.12.08
10533	Priboy	"	78.11.25	79.02.27
11004	"	"	79.04.06	79.08.17
10526	Okean	"	79.01.10	79.02.25
10582	"	"	79.04.06	79.06.08
10525	Priliv	"	78.11.22	79.02.09
10562	V. Frolov	"	79.01.31	79.03.11
10583	"	"	79.04.17	79.06.19
10584	Valery Uryvayev	Sakhalin Hydromet	79.04.17	79.06.19
10585	"	"	79.04.27	79.07.13
10589	Prof. Zubov	AARI	78.12.01	79.02.22
10570	Prof. Vize	"	79.01.02	79.02.26
10579	Rudolf Samoylovich	"	79.01.07	79.03.14
10652	"	"	79.04.18	79.08.03
10571	V. Bugaev	Odessa SOI	78.12.21	79.03.31
10617	"	"	79.04.21	79.08.07
10587	Yakov Gakkel	"	78.12.05	79.04.06
10623	"	"	79.04.22	79.06.11
10588	Akademik Kurchatov	South IO of RAS	79.03.05	79.05.08
10577	Adjaria	GUNIO	79.01.08	79.02.14
10639	Akademik Kurchatov	South IO of RAS	79.06.13	79.08.28
10599	Mikhail Lomonosov	MHI	79.01.24	79.03.17
10650	Akademik Vernadsky	"	79.04.24	79.08.12
10991	Adjaria	GUNIO	79.01.04	79.06.03
10639	Akademik Kurchatov	South IO of RAS	79.06.13	79.08.28
10488	Okean	Far East RIHMI	78.09.08	78.12.08
Front project				
9945	Stepan Malygin	POI	76.11.08	76.12.18
GARP Atlantic Tropical Experiment (GATE)				
8130	Mikhail Lomonosov	MHI	74.06.19	74.09.21
8137	Ernst Krenkel	Odessa SOI	74.06.04	74.10.08
8138	Poryv	"	74.06.04	74.10.09

Number	Ship	Institution	Start	Finish
8141	Passat	"	74.06.01	74.10.09
8142	Musson	"	74.06.03	74.10.09
8181	Prof. Vize	AARI	74.06.05	74.10.09
8182	Prof. Zubov	"	74.06.05	74.10.09
8241	Volna	Far East RIHMI	74.04.23	74.12.08
8242	Okean	"	74.04.23	74.11.30
8266	Akademik Korolev	"	74.04.23	74.12.08
8289	Priboy	"	74.04.24	74.12.08
8554	Akademik Kurchatov	IO of RAS	74.06.21	74.09.19
8607	Semyon Dezhnev	GUNIO	74.06.26	74.09.15
Geomorphology project				
15963	Akademik Lavrentjev	POI	85.11.20	86.01.13
GSEPM program				
18259	Yakov Gakkel	Odessa SOI	85.01.24	85.02.14
Hurricane project				
13163	Priboy	Far East RIHMI	81.07.31	81.11.27
Kara experiment				
10879	Otto Shmidt	Murmansk Hydromet	79.10.20	79.11.20
11785	"	"	80.09.26	80.11.03
14189	"	"	82.08.10	82.10.15
15393	Vasily Berezkin	"	84.08.16	84.09.04
15951	Otto Shmidt	"	85.07.16	85.10.10
16143	P.Multanovskiy	AARI	86.06.24	86.09.23
18408	Otto Shmidt	Murmansk Hydromet	90.08.23	90.09.27
10490	Prof. Vize	AARI	78.08.10	78.10.08
17495	P.Multanovskiy	"	88.06.25	88.09.21
Kosmos program				
16028	Akademik Vernadsky	MHI	85.02.18	86.06.03
16157	Mikhail Lomonosov	"	86.06.24	86.10.08
16288	Akademik Vernadsky	"	86.08.03	86.12.05
16620	"	"	87.01.15	87.04.30
16895	"	"	87.05.16	87.08.15
17509	"	"	88.07.02	88.10.04
17510	Mikhail Lomonosov	"	88.04.30	88.08.31
MAPMOPP program				
8006	Priliv	FAR EAST RIHMI	74.01.22	74.04.05
8747	"	"	74.12.25	75.04.07
9433	"	"	76.02.18	76.04.14
9025	"	"	75.05.07	75.07.01
10389	Atlas	"	71.07.23	71.08.07
10105	"	"	77.04.05	77.12.15
10407	"	"	78.04.10	78.12.06
9373	Vikhr	"	75.06.20	75.11.08

Number	Ship	Institution	Start	Finish
9435	“	“	75.01.21	75.12.17
9438	Nakat	“	75.10.08	75.12.24
9871	“	“	76.04.11	76.12.13
7699	A.I. Voeikov	“	74.03.20	74.06.11
9436	Adelgunda	“	75.04.09	75.12.24
9437	Rassvet	“	75.09.10	75.09.24
10290	U.M. Shokalsky	“	78.04.01	78.06.16
10410	G. Matveichuk	“	78.04.14	78.05.12
10670	Volna	“	79.09.06	79.11.21
13161	Akademik Shirshov	“	81.10.08	81.12.11
13954	G. Ushakov	Odessa SOI	82.05.12	82.07.14
10116	Priboy	FAR EAST RIHMI	78.01.05	78.02.20
13014	“	“	81.05.06	81.07.01
13740	Priliv	“	82.02.03	82.04.18
14212	“	“	82.05.20	82.08.26
14911	“	“	83.10.23	83.12.18
15369	Akademik Shokalsky	“	84.05.09	84.08.09
15728	Priliv	“	85.02.12	85.06.29
10488	Okean	“	78.09.08	78.12.08
12004	“	“	80.10.25	80.12.29
12926	“	“	81.06.18	81.08.24
14621	“	“	83.02.19	83.04.19
15115	“	“	84.02.14	84.05.03
15948	“	“	85.10.09	86.01.31
16161	“	“	86.07.23	86.09.13
16255	Komsomolets Azova	Northern Hydromet	86.08.03	86.11.03
16343	Priboy	Far East RIHMI	86.12.27	87.01.19
16700	Priliv	“	87.02.06	87.04.20
11575	Evrika	AtlantNIRO	80.03.14	80.08.09
14565	Musson	Odessa SOI	83.04.09	83.06.21
14875	“	“	83.10.11	83.12.22
14904	Passat	“	83.11.09	84.01.22
15315	Passat	Odessa SOI	84.05.27	84.09.11
15532	E. Krenkel	“	84.12.25	85.03.16
15539	Prof. Dorofeev	Murmansk Hydromet	85.01.12	85.03.27
15558	Passat	Odessa SOI	85.02.06	85.05.18
15625	Volna	“	85.03.02	85.06.07
15727	Prof. Dorofeev	Murmansk Hydromet	85.07.12	85.09.20
15953	Vasily Berezkin	“	85.08.30	85.09.29
16258	Donuzlav	GUNIO	86.05.15	86.06.01
Maritime territory project				
16027	A.I. Voeikov	Far East RIHMI	86.01.22	86.05.22

Number	Ship	Institution	Start	Finish
MEDALPEX				
13723	V. Bugaev	Odessa SOI	82.01.31	82.04.24
13804	Zodiak	GUNIO	82.01.19	82.04.29
14091	Prof. Vodyanitsky	IBSS	82.03.21	82.05.24
14202	Musson	Odessa SOI	82.09.17	82.11.22
Megapolygone project				
16896	Akademik Nesmeyanov	POI	87.06.02	87.08.20
16887	Prof.Bogorov	"	87.08.11	87.08.26
MONEX				
15356	Volna	Far East RIHMI	84.02.08	84.06.14
15580	A.I. Voeikov	"	85.02.06	85.05.08
10527	Akademik Shirshov	"	78.12.06	79.02.15
11001	"	"	79.04.03	79.08.14
10532	Akademik Korolev	"	78.12.04	79.02.14
11000	"	"	79.04.03	79.08.15
11003	Volna	"	79.04.05	79.07.24
14003	Akademik Vernadsky	MHI	82.01.14	82.04.17
15155	Prof. Kolesnikov	"	84.02.08	84.05.18
15635	"	"	85.03.06	85.06.09
11072	Mikhail Lomonosov	"	79.11.24	80.01.31
14003	Akademik Vernadsky	MHI	82.01.14	82.04.17
14302	"	"	82.07.21	82.10.29
14669	"	"	82.12.29	83.05.07
Monsoon project				
5747	Okean	Far East RIHMI	73.04.27	73.08.03
5939	Priliv	"	73.04.28	73.08.03
5745	U.M. Shokalsky	"	73.04.21	73.08.10
5744	A.I. Voeykov	"	73.04.21	73.08.08
9957	Priboy	"	77.05.08	77.09.12
9966	Akademik Shirshov	"	77.05.11	77.09.15
9967	Priliv	"	77.05.07	77.08.19
9997	U.M. Shokalsky	"	77.04.20	77.09.15
9998	Okean	"	77.05.08	77.09.12
15441	A.I. Voeykov	"	84.08.17	84.12.17
11002	Priliv	"	79.04.06	79.08.17
Patchiness experiment				
16047	Lev Titov	CMR, Lithuania	86.04.15	86.04.15
PLES project				
9790	Vikhr	Far East RIHMI	76.05.12	76.09.19
9789	Tropik	GUNIO	76.03.04	76.05.12
10123	G. Matveichuk	Far East RIHMI	77.06.15	77.09.02
9665	Volna	"	76.07.20	76.09.24
10411	G. Matveichuk	"	78.05.23	78.07.26

Number	Ship	Institution	Start	Finish
Polar Experiment				
10490	Prof. Vize	AARI	78.08.10	78.10.08
17495	P. Multanovskiy	"	88.06.25	88.09.21
9916	Volna	Far East RIHMI	77.03.05	77.06.26
9915	Volna	"	77.03.07	77.05.06
9792	Priboy	"	77.01.20	77.03.22
9786	Priliv	"	77.01.27	77.03.19
9766	Okean	"	76.10.14	77.02.13
9705	Priboy	"	76.10.07	76.12.23
9766	Okean	"	76.10.14	77.02.13
8084	Passat	Odessa SOI	74.02.23	74.04.30
8171	Aisberg	Murmansk Hydromet	74.05.23	74.09.05
8571	E. Krenkel	Odessa SOI	74.11.05	75.01.31
8608	Akademik Korolev	Maritime Hydromet	75.01.07	75.03.01
8669	Volna	Odessa SOI	75.01.14	75.03.26
8678	Okean	Far East RIHMI	75.01.09	75.03.20
9486	Prof. Zubov	AARI	76.03.01	76.06.10
9588	Nerei	RSHMI	76.05.20	76.06.18
9619	Prof. Vize	AARI	76.04.05	76.07.20
9627	Akademik Shirshov	Far East RIHMI	76.05.11	76.08.30
9628	Priliv	"	76.05.14	76.08.13
9653	Aisberg	Murmansk Hydromet	76.04.11	76.06.30
9654	Vasily Beryozkin	"	76.04.13	76.06.27
9673	Priboy	Far East RIHMI	76.05.06	76.09.05
9674	Okean	"	76.06.09	76.09.20
9767	Prof. Vize	AARI	76.12.23	77.03.08
9886	Nerei	RSHMI	77.05.03	77.06.30
9960	Prof. Zubov	AARI	77.07.01	77.09.30
10054	Nerei	RSHMI	77.10.19	77.11.15
10062	Prof. Vize	AARI	77.08.17	77.10.16
10292	Nerei	RSHMI	78.05.12	78.06.16
10405	Prof. Zubov	AARI	78.07.05	78.09.16
10649	"	"	79.05.11	79.08.10
11262	Vasily Beryozkin	Murmansk Hydromet	80.04.06	80.05.27
10638	Prof. Vize	AARI	79.04.30	79.08.03
11641	Otto Shmidt	Murmansk Hydromet	80.06.16	80.09.04
11025	"	"	79.12.01	80.02.09
11275	"	"	80.03.01	80.05.27
11595	Prof. Vize	AARI	80.05.12	80.08.05
11635	Vasily Beryozkin	Murmansk Hydromet	80.06.14	80.08.31
11848	"	"	80.09.20	80.11.27
12067	Okean	Far East RIHMI	75.12.25	76.02.25
12860	Prof. Vize	AARI	81.06.04	81.08.05

Number	Ship	Institution	Start	Finish
13339	“	“	81.09.27	81.12.29
14005	Prof. Zubov	AARI	82.05.25	82.07.04
14156	Akademik Shuleikin	“	82.09.21	82.10.01
14174	Prof. Zubov	“	82.08.10	82.10.14
14187	Vasily Beryozkin	Murmansk Hydromet	82.07.09	82.08.29
14189	Otto Shmidt	“	82.08.10	82.10.15
14556	Vasily Beryozkin	“	83.04.04	83.05.21
14609	Otto Shmidt	“	83.05.13	83.07.30
14671	Prof. Vize	AARI	83.05.27	83.07.15
14672	Akademik Shuleikin	“	83.06.13	83.07.14
14693	Lev Titov	CMR, Lithuania	83.05.11	83.07.10
14697	Prof. Dorofeev	Murmansk Hydromet	83.04.07	83.07.06
14822	Akademik Shuleikin	AARI	83.08.22	83.09.12
14853	Prof. Zubov	“	83.06.06	83.08.10
14876	Prof. Dorofeev	Murmansk Hydromet	83.10.19	83.12.28
14900	P. Multanovskiy	AARI	83.10.05	83.12.14
14903	Akademik Shuleikin	“	83.10.20	83.12.19
14979	Prof. Zubov	“	83.11.28	84.03.10
14989	Vasily Beryozkin	Murmansk Hydromet	83.12.14	84.02.22
15082	P. Multanovskiy	AARI	84.01.13	84.04.12
15112	Akademik Shuleikin	“	84.03.19	84.05.30
15175	Prof. Dorofeev	Murmansk Hydromet	84.04.28	84.06.10
15244	“	“	84.06.22	84.09.11
15255	Otto Shmidt	“	84.07.07	84.09.18
15340	P. Multanovskiy	AARI	84.07.20	84.09.18
15341	Akademik Shuleikin	“	84.06.26	84.09.24
15342	Prof. Vize	“	84.06.11	84.09.27
15383	P. Multanovskiy	“	84.10.17	84.12.21
15390	Prof. Dorofeev	Murmansk Hydromet	84.11.11	84.12.26
15513	Akademik Shuleikin	AARI	85.01.29	85.03.28
15515	P. Multanovskiy	“	85.01.21	85.03.21
15539	Prof. Dorofeev	Murmansk Hydromet	85.01.12	85.03.27
15620	P. Multanovskiy	AARI	85.04.22	85.06.23
15727	Prof. Dorofeev	Murmansk Hydromet	85.07.12	85.09.20
15809	Prof. Zubov	AARI	85.05.16	85.07.05
15891	Akademik Shuleikin	“	85.11.05	85.12.20
15900	Prof. Dorofeev	Murmansk Hydromet	85.10.08	85.12.30
15892	P. Multanovskiy	AARI	85.10.19	85.12.16
15937	Akademik Shuleikin	“	86.01.10	86.03.11
15938	P. Multanovskiy	“	86.01.11	86.03.19
15952	Otto Shmidt	Murmansk Hydromet	85.10.25	85.12.31
15992	Prof. Dorofeev	“	86.01.24	86.03.21
16030	Akademik Shuleikin	AARI	86.04.01	86.06.12

Number	Ship	Institution	Start	Finish
16031	Otto Shmidt	Murmansk Hydromet	86.03.21	86.05.10
16206	“	“	86.08.01	86.09.23
16162	Akademik Shokalsky	Far East RIHMI	86.06.30	86.10.10
16276	Prof. Dorofeev	Murmansk Hydromet	86.10.03	86.12.21
16295	Akademik Shuleikin	AARI	86.10.29	86.12.02
16296	P. Multanovskiy	“	86.10.26	86.12.24
16331	V. Buynitskiy	Murmansk Hydromet	86.12.12	87.01.14
16330	Vasily Beryozkin	“	86.11.18	86.12.30
16134	Prof. Dorofeev	“	86.04.15	86.06.04
16432	Vasily Beryozkin	“	87.01.15	87.02.28
16891	Prof. Vize	AARI	87.07.31	87.09.18
16983	Akademik Shuleikin	“	87.10.09	87.12.09
17080	Akademik Shokalsky	Far East RIHMI	87.07.01	87.10.16
17837	Prof. Khromov	“	88.07.01	88.10.09
17890	P. Multanovskiy	AARI	89.01.26	89.04.07
17911	Akademik Shuleikin	“	89.04.12	89.06.21
17928	P. Multanovskiy	“	89.06.27	89.08.22
17930	Prof. Vize	“	89.05.11	89.07.17
8681	Prof. Zubov	“	74.11.11	75.04.02
9893	“	“	77.02.07	77.04.01
10186	“	“	77.10.01	78.03.31
10589	“	“	78.12.01	79.02.22
10570	Prof. Vize	“	79.01.02	79.02.26
12851	Volna	Far East RIHMI	80.12.20	81.04.24
12864	Prof. Zubov	AARI	80.12.20	81.04.22
12868	Priliv	Far East RIHMI	80.12.20	81.05.03
12872	Prof. Vize	AARI	80.11.13	81.05.05
13810	Prof. Zubov	“	81.10.19	82.05.03
14539	“	“	82.11.06	83.05.17
15102	Prof. Vize	“	83.11.06	84.05.15
16023	Prof. Zubov	“	85.12.04	86.05.20
16529	Prof. Vize	“	86.11.12	87.05.05
16530	Prof. Zubov	“	86.12.24	87.05.13
17321	“	“	87.11.12	88.04.25
17320	Prof. Vize	“	87.11.10	88.05.12
17884	“	“	88.12.23	89.04.11
18834	“		90.11.15	91.04.04
POLYMODE				
10115	Akademik Krylov	GUNIO	77.06.01	77.11.30
10092	Akademik Kurchatov	South IO of RAS	77.07.17	77.10.02
9953	V. Bugaev	Odessa SOI	77.06.06	77.09.24
10546	Moldaviya	GUNIO	78.03.26	78.06.12
10046	Sergei Vavilov	AI of RAS	77.08.12	77.09.11

Number	Ship	Institution	Start	Finish
10376	Akademik Vernadsky	MHI	78.05.26	78.10.25
10106	Akademik Vernadsky	“	77.07.24	77.10.02
10419	Mikhail Lomonosov	“	78.03.18	78.07.18
10148	“	“	77.11.02	78.02.10
10294	Akademik Vernadsky	“	78.01.03	78.02.21
14380	Akademik Kurchatov	South IO of RAS	78.01.12	78.06.16
14381	“	“	78.08.13	78.09.30
14830	Vityaz	IO of RAS	77.10.29	78.01.04
Polynia project				
14837	Vityaz	SIO of RAS	81.10.21	81.11.13
14012	Mikhail Somov	AARI	81.09.07	82.06.11
SAE-Soviet Antarctic Expedition				
12882	Kulikovo pole	WESTFISHREC	81.03.15	81.04.29
12871	Mikhail Somov	AARI	80.11.11	81.07.03
SAGAPE				
14899	Akademik Korolev	Far East RIHMI	83.10.17	83.12.13
16832	“	“	85.04.16	87.08.13
SAMEX				
9704	Akademik Korolev	Far East RIHMI	76.07.31	76.12.03
9968	Volna	“	77.07.14	77.09.09
11342	Akademik Shirshov	“	80.03.14	80.06.24
SCOPE				
11074	Akademik Korolev	Far East RIHMI	79.11.20	80.03.25
Seas project				
15260	Valery Uryvaev	Far East RIHMI	83.09.22	83.11.06
15410	Akademik Shokalsky	“	85.01.27	85.04.12
15801	Akademik Shirshov	“	85.08.22	85.09.26
15944	Valery Uryvayev	“	85.11.06	86.01.24
16020	V. Frolov	“	86.04.01	86.09.08
16025	Akademik Shokalsky	“	86.02.14	86.05.24
16032	Valery Uryvayev	“	86.02.13	86.06.18
16162	Akademik Shokalsky	“	86.06.30	86.10.10
16163	V. Frolov	“	86.08.20	86.10.08
16204	Priliv	“	86.08.12	86.09.26
16205	Valery Uryvayev	“	86.08.20	86.10.08
16467	V. Frolov	“	86.11.05	87.02.04
16477	Valery Uryvayev	“	86.11.18	87.02.17
16698	Akademik Shokalsky	“	87.03.27	87.06.05
16696	Valery Uryvayev	“	87.03.10	87.05.08
16721	Priboy	“	87.06.06	87.07.10
16722	V. Frolov	“	87.03.01	87.04.24
17811	Akademik Shokalsky	“	88.10.10	89.01.05
18508	V. Frolov	“	90.03.11	90.04.10

Number	Ship	Institution	Start	Finish
15949	Valery Uryvayev	“	84.06.07	84.07.09
Sections program				
13993	Prof. Bogorov	POI	81.03.13	81.05.25
10856	Passat	Odessa SOI	79.09.13	79.12.23
10936	Achill	PINRO	79.05.28	79.07.23
10852	E.Krenkel	Odessa SOI	79.10.10	79.12.22
10649	Prof. Zubov	AARI	79.05.11	79.08.10
10638	Prof. Vize	“	79.04.30	79.08.03
10617	V. Bugaev	Odessa SOI	79.04.21	79.08.07
10991	Adjaria	GUNIO	79.01.04	79.06.03
10909	G. Ushakov	Odessa SOI	79.10.14	80.01.21
10665	E. Krenkel	“	79.06.13	79.09.22
11335	Priliv	Far East RIHMI	80.04.15	80.06.03
11323	Priboy	“	80.04.08	80.06.14
11198	Musson	Odessa SOI	80.02.23	80.06.20
11199	E. Krenkel	“	80.02.20	80.06.21
11262	Vasily Beryozkin	Murmansk Hydromet	80.04.06	80.05.27
11114	G. Ushakov	Odessa SOI	80.02.07	80.05.11
10724	Passat	“	79.05.14	79.08.29
11341	V. Bugaev	“	80.04.12	80.08.10
11433	Akhill	PINRO	80.05.24	80.07.01
11635	Vasily Beryozkin	Murmansk Hydromet	80.06.14	80.08.31
11653	Ayaks	PINRO	80.02.12	80.06.09
11701	Priboy	Far East RIHMI	80.07.06	80.11.03
11714	Volna	“	80.07.05	80.11.02
11767	Akademik Korolev	“	80.07.08	80.11.05
11242	Vityaz	South IO of RAS	78.06.14	78.08.12
11848	Vasily Beryozkin	Murmansk Hydromet	80.09.20	80.11.27
11935	Musson	Odessa SOI	80.10.24	81.02.25
11972	G. Ushakov	“	80.10.09	80.12.20
11973	Passat	“	80.10.14	81.01.21
11974	V. Bugaev	Odessa SOI	80.09.12	80.12.07
11975	Priliv	Far East RIHMI	80.07.06	80.11.03
11989	V. Frolov	“	80.11.04	80.01.13
12077	E. Krenkel	Odessa SOI	80.12.10	81.03.21
12267	Akademik Shirshov	Far East RIHMI	81.01.09	81.04.10
12269	V. Bugaev	Odessa SOI	81.01.08	81.04.23
10752	V. Frolov	Far East RIHMI	79.10.10	79.12.15
12573	Dalniye Zelentsy	Murmansk Hydromet	79.10.26	79.12.05
12626	Ayaks	PINRO	80.07.30	80.11.19
12630	Passat	Odessa SOI	81.02.11	81.05.20
12631	E. Krenkel	“	81.04.08	81.06.21
12641	Novocheboksarsk	AtlantNIRO	80.08.05	80.12.20

Number	Ship	Institution	Start	Finish
12642	Seskar	TINRO	79.04.14	79.07.01
12644	Mys Tikhiy	PBFS	78.10.10	79.03.24
12670	G. Ushakov	Odessa SOI	81.01.17	81.05.19
12671	Musson	"	81.03.16	81.06.23
12722	Priboy	Far East RIHMI	81.01.10	81.04.08
12739	Protsion	PINRO	81.02.20	81.04.21
12736	Seskar	TINRO	79.08.09	79.11.27
12859	V. Bugaev	Odessa SOI	81.05.13	81.07.25
12860	Prof. Vize	AARI	81.06.04	81.08.05
12865	Prof. Zubov	"	81.05.11	81.07.30
12883	G. Ushakov	Odessa SOI	81.06.09	81.09.19
12926	Okean	Far East RIHMI	81.06.18	81.08.24
12927	Akademik Shirshov	"	81.05.10	81.09.01
12958	Achill	PINRO	81.06.14	81.07.03
12893	Leonid Demin	GUNIO	81.01.15	81.03.18
12894	Zodiak	"	81.01.15	81.04.15
12960	Pluton	"	81.01.15	81.04.15
12996	E. Krenkel	Odessa SOI	81.07.10	81.09.30
13096	Akademik Vernadsky	MHI	81.01.15	81.04.24
13097	Ayaks	PINRO	81.01.31	81.05.21
13138	V. Bugaev	Odessa SOI	81.09.25	81.12.25
13139	V. Frolov	Far East RIHMI	81.10.19	81.12.12
13015	"	"	81.07.28	81.09.05
13014	Priboy	"	81.05.06	81.07.01
13022	Musson	Odessa SOI	81.07.14	81.11.05
13059	Persey -III	PINRO	81.04.08	81.07.27
13133	Passat	Odessa SOI	81.10.26	81.12.25
13161	Akademik Shirshov	Far East RIHMI	81.10.08	81.12.11
13098	Mikhail Lomonosov	MHI	81.02.25	81.04.25
13339	Prof. Vize	AARI	81.09.27	81.12.29
13379	G. Ushakov	Odessa SOI	81.10.10	82.01.22
13380	E. Krenkel	"	81.10.20	82.01.31
13381	Musson	"	81.11.17	82.02.24
13383	Akademik Kurchatov	IO of RAS	81.07.30	81.10.24
13336	Mikhail Lomonosov	MHI	81.08.10	81.09.08
13100	Mikhail Krupsky	GUNIO	81.09.15	81.11.08
13474	Pluton	"	81.09.08	81.11.08
13101	Persey	"	81.09.01	81.11.08
13479	Lev Titov	CMR, Lithuania	81.10.06	81.12.19
13482	Volna	Far East RIHMI	81.10.15	81.12.27
13483	Priliv	"	81.09.26	81.12.24
13500	Ayaks	PINRO	81.06.25	81.09.04
13506	Okean	Far East RIHMI	81.09.23	81.12.25

Number	Ship	Institution	Start	Finish
13507	Passat	Odessa SOI	82.01.16	82.03.23
13530	Dalniye Zelentsy	MMBI	81.03.31	81.06.19
13532	Salekhard	AtlantNIRO	73.03.13	73.09.11
13624	Dmitry Mendeleev	South IO of RAS	81.09.11	81.11.11
13660	G. Ushakov	Odessa SOI	82.02.11	82.04.21
13710	Volna	Far East RIHMI	82.01.31	82.04.08
13711	Akademik Korolev	"	82.01.28	82.04.18
13721	Prof. Vize	AARI	82.02.21	82.03.19
13723	V. Bugaev	Odessa SOI	82.01.31	82.04.24
13738	Otto Shmidt	Murmansk Hydromet	82.02.26	82.05.05
13739	A.I. Voeikov	Far East RIHMI	82.03.12	82.04.20
13740	Priliv	"	82.02.03	82.04.18
13795	Passat	Odessa SOI	82.04.10	82.06.17
12863	Valerian Uryvaev	Sakhalin Hydromet	81.07.03	81.08.04
13798	V. Frolov	Far East RIHMI	82.01.26	82.03.21
13812	Okean	"	82.03.21	82.05.21
13811	V. Frolov	"	82.05.10	82.06.26
13954	G. Ushakov	Odessa SOI	82.05.12	82.07.14
13955	Musson	"	82.03.13	82.06.28
13993	Prof. Bogorov	POI	81.03.13	81.05.25
13809	Gemma	PINRO	82.01.05	82.05.03
13999	Akhill	"	82.03.01	82.04.22
14003	Akademik Vernadsky	MHI	82.01.14	82.04.17
14004	V. Bugaev	Odessa SOI	82.05.11	82.07.27
14329	Vasily Beryozkin	Murmansk Hydromet	82.11.16	83.01.19
14005	Prof. Zubov	AARI	82.05.25	82.07.04
14008	Otto Shmidt	Murmansk Hydromet	82.05.21	82.07.18
14009	Lev Titov	CMR, Lithuania	82.02.13	82.02.25
14075	Passat	Odessa SOI	82.06.29	82.09.19
14077	Akademik Korolev	Far East RIHMI	82.05.22	82.09.04
14082	Vityaz	IO of RAS	82.05.09	82.05.19
14083	Akademik Kurchatov	IO of RAS	82.01.09	82.03.14
14084	Akademik Mstislav Keldysh	"	81.03.15	81.05.04
14085	"	"	82.02.04	82.02.07
14156	Akademik Shuleikin	AARI	82.09.21	82.10.01
14173	Akademik Shirshov	Far East RIHMI	82.05.29	82.08.12
14174	Prof. Zubov	AARI	82.08.10	82.10.14
14175	E. Krenkel	Odessa SOI	82.07.09	82.09.28
14176	V. Bugaev	"	82.08.01	82.10.19
14178	Volna	Far East RIHMI	82.05.13	82.09.04
14179	Akhill	PINRO	82.06.01	82.07.09
14180	Suloy	"	82.04.09	82.08.02
14181	A.I. Voeikov	Far East RIHMI	82.06.17	82.09.13

Number	Ship	Institution	Start	Finish
14187	Vasily Beryozkin	Murmansk Hydromet	82.07.09	82.08.29
14189	Otto Shmidt	"	82.08.10	82.10.15
14193	Lev Titov	CMR, Lithuania	82.08.07	82.08.19
14201	G. Ushakov	Odessa SOI	82.09.29	82.11.11
14202	Musson	"	82.09.17	82.11.22
1429	Prognoz	AtlantNIRO	82.08.19	82.09.26
14222	E. Krenkel	Odessa SOI	82.10.12	82.12.23
14231	Mikhail Verbitskiy	PINRO	82.03.19	82.07.19
14240	Andrus Jokhani	AtlantNIRO	82.08.24	83.01.04
14239	Novocheboksarsk	"	82.08.06	82.11.14
14259	SRTM-8-449	PINRO	78.08.20	78.09.01
14260	Okeanograf	CMR, Lithuania	82.10.04	82.11.24
14262	Partizansk	TINRO	80.03.06	80.04.13
14263	SRTM-8-452	"	80.05.11	80.05.19
14264	Poseidon	"	82.07.15	82.07.18
14294	Passat	Odessa SOI	82.10.06	83.01.16
14295	V. Bugaev	"	82.11.11	83.01.15
14300	Lev Titov	CMR, Lithuania	82.09.08	82.10.25
14302	Akademik Vernadsky	MHI	82.07.21	82.10.29
14327	Dalniye Zelentsy	MMBI	82.09.27	82.10.30
14335	Protsion	Murmansk Hydromet	82.09.11	82.12.02
14342	Prof. Dorofeev	"	83.01.26	83.03.13
14344	A. Vilkitsky	GUNIO	82.07.01	82.07.18
14354	Langust	AtlantNIRO	82.11.02	83.02.18
14355	Vysota	"	82.11.01	83.02.04
14362	E. Krenkel	Odessa SOI	83.01.13	83.03.19
14363	Musson	"	82.12.14	83.03.26
14366	Priliv	Far East RIHMI	82.10.02	82.12.21
14367	Volna	"	82.10.21	82.12.27
14368	Okean	"	82.11.06	82.12.27
14369	Priboy	"	82.09.17	82.12.16
14378	V. Frolov	"	82.11.28	82.12.22
14379	Akademik Shirshov	"	82.10.26	82.12.26
14380	Akademik Kurchatov	South IO of RAS	78.01.12	78.06.16
14381	"	"	78.08.13	78.09.30
14384	Kokshaysk	PINRO	83.01.10	83.01.16
14400	Dmitry Mendeleev	South IO of RAS	82.12.22	83.02.17
14402	Alaid	PINRO	83.03.02	83.03.26
14404	Gemma	"	82.11.29	83.03.11
14405	A.I. Voeikov	Far East RIHMI	82.11.03	83.02.10
14407	V. Bugaev	Odessa SOI	83.02.11	83.04.26
14495	Akademik Shirshov	Far East RIHMI	83.02.04	83.04.17
14496	Akademik Nesmeyanov	POI	82.09.18	82.11.21

Number	Ship	Institution	Start	Finish
14504	Prof. Shtokman	IO of RAS	79.03.16	79.04.22
14505	Rubezhnoye	TINRO	82.02.07	82.05.13
14506	Novokotovsk	“	82.09.16	83.01.26
14508	Darvin	“	82.11.18	83.04.18
14536	Passat	Odessa SOI	83.02.16	83.05.23
14556	Vasily Berezkin	Murmansk Hydromet	83.04.04	83.05.21
14562	Rubezhnoye	TINRO	83.03.13	83.06.13
14565	Musson	Odessa SOI	83.04.09	83.06.21
14576	Babayevsk	TINRO	82.12.03	83.02.01
14608	G. Ushakov	Odessa SOI	83.03.24	83.07.21
14617	Akademik Korolev	Far East RIHMI	83.04.14	86.05.15
14619	Priboy	“	83.01.18	83.04.28
14620	Volna	“	83.01.18	83.04.28
14621	Okean	“	83.02.19	83.04.19
14622	Akademik Shokalsky	“	83.04.14	83.06.18
14623	Prof. Khromov	“	83.04.23	83.07.13
14625	Gizhiga	AtlantNIRO	83.02.18	83.07.19
14629	E. Krenkel	Odessa SOI	83.05.15	83.08.23
14635	Dalniye Zelentsy	MMBI	83.03.30	83.05.09
14669	Akademik Vernadsky	MHI	82.12.29	83.05.07
14671	Prof. Vize	AARI	83.05.27	83.07.15
14672	Akademik Shuleikin	“	83.06.13	83.07.14
14676	Musson	Odessa SOI	83.07.12	83.09.20
14693	Lev Titov	CMR, Lithuania	83.05.11	83.07.10
14697	Prof. Dorofeev	Murmansk Hydromet	83.04.07	83.07.06
14701	Dalniye Zelentsy	MMBI	83.05.25	83.06.25
14702	Gemma	PINRO	83.04.01	83.05.31
14705	Passat	Odessa SOI	83.07.29	83.10.23
14708	Evrika	AtlantNIRO	83.04.30	83.09.13
14714	Vasily Berezkin	Murmansk Hydromet	83.07.15	83.09.05
14715	Protsion	PINRO	83.02.01	83.05.20
14730	Akademik Shirshov	Far East RIHMI	83.05.18	83.08.31
14789	Volzhanin	AtlantNIRO	83.06.14	83.10.05
14791	Kokshaysk	PINRO	83.02.12	83.05.14
14792	Persey -III	“	83.03.28	83.06.19
14818	Okean	Far East RIHMI	83.05.16	83.09.11
14820	Prof. Vize	AARI	83.08.17	83.10.26
14822	Akademik Shuleikin	“	83.08.22	83.09.12
14823	E. Krenkel	Odessa SOI	83.09.09	83.11.22
14824	G. Ushakov	“	83.08.11	83.11.17
14825	Yakov Gakkel	“	83.08.02	83.10.23
14827	Akademik Korolev	Far East RIHMI	83.06.07	83.09.02
14828	Suloy	PINRO	83.04.16	83.08.04

Number	Ship	Institution	Start	Finish
14850	A.I. Voeikov	Far East RIHMI	83.07.30	83.11.23
14851	Prof. Khromov	"	83.08.07	83.10.02
14852	Priboy	"	83.07.14	83.09.21
14855	Prof. Zubov	AARI	83.06.06	83.08.10
14860	Persey -III	PINRO	83.08.02	83.10.16
14861	Protsion	"	83.08.20	83.09.21
14875	Musson	Odessa SOI	83.10.11	83.12.22
14876	Prof. Dorofeev	Murmansk Hydromet	83.10.19	83.12.28
14879	Semyon Dezhnev	GUNIO	83.04.19	83.06.21
14878	Leonid Demin	"	83.07.13	83.10.21
14883	Volna	Far East RIHMI	83.09.25	83.12.27
14900	P. Multanovskiy	AARI	83.10.05	83.12.14
14903	Akademik Shuleikin	"	83.10.20	83.12.19
14904	Passat	Odessa SOI	83.11.09	84.01.22
14911	Priliv	Far East RIHMI	83.10.23	83.12.18
14912	Akademik Shirshov	"	83.10.28	84.01.01
14859	Prof. Dorofeev	Murmansk Hydromet	83.08.03	83.10.02
14916	Prostor	TINRO	83.06.07	83.11.18
14920	Novokotovsk	"	83.05.02	83.08.31
14950	G.Ushakov	Odessa SOI	83.12.17	84.02.17
14957	Kokshaysk	PINRO	83.10.28	84.01.16
14961	Akademik Vinogradov	POI	83.09.04	83.11.10
14973	V. Bugaev	Odessa SOI	83.11.29	84.03.12
14979	Prof. Zubov	AARI	83.11.28	84.03.10
14982	E. Krenkel	Odessa SOI	83.12.11	84.03.23
15216	Anchar	AtlantNIRO	84.04.06	84.08.29
15222	Zvezda	"	84.03.12	84.08.14
12408	Tunets	PINRO	61.04.18	61.05.21
12409	"	"	61.06.03	61.07.10
12410	"	"	61.07.23	61.08.28
12404	"	"	63.04.21	63.05.18
12405	"	"	63.06.10	63.07.12
15076	Suloy	"	83.10.01	84.02.10
15078	Darvin	TINRO	83.10.11	84.01.15
15079	Rubezhnoye	"	83.12.19	84.02.04
15080	Mlechny Put	"	83.10.06	83.12.31
15082	P. Multanovskiy	AARI	84.01.13	84.04.12
15085	Pluton	GUNIO	83.08.15	83.10.09
15087	Akademik Nesmeyanov	POI	83.05.12	83.09.08
15088	Akademik Vinogradov	"	83.12.01	84.01.30
15089	Priliv	Far East RIHMI	84.01.07	84.03.02
15090	Okean	"	83.10.14	84.01.12
15095	V. Frolov	"	83.10.20	83.12.29

Number	Ship	Institution	Start	Finish
15097	Priboy	“	83.11.01	84.02.07
15101	Ayaks	PINRO	83.11.26	84.03.03
14989	Vasily Berezkin	Murmansk Hydromet	83.12.14	84.02.22
15108	Akademik Kurchatov	IO of RAS	83.12.31	84.03.25
15112	Akademik Shuleikin	AARI	84.03.19	84.05.30
15113	Prof. Khromov	Far East RIHMI	83.12.02	84.03.31
15115	Okean	“	84.02.14	84.05.03
15149	G. Ushakov	Odessa SOI	84.03.11	84.06.06
15151	V. Bugaev	“	84.04.02	84.07.12
15152	Musson	“	84.04.16	84.06.25
15154	Vilnus	PINRO	84.03.14	84.05.21
15155	Prof. Kolesnikov	MHI	84.02.08	84.05.18
15166	Akademik Vernadsky	“	83.12.30	84.05.13
15170	Anchar	PINRO	84.03.07	84.05.29
15174	Poisk	“	84.03.03	84.06.30
15171	Akademik Korolev	Far East RIHMI	84.02.11	84.05.11
15175	Prof. Dorofeev	Murmansk Hydromet	84.04.28	84.06.10
15177	Vasily Berezkin	“	84.05.24	84.08.06
15178	A.I. Voeikov	Far East RIHMI	84.02.04	84.05.23
15176	Lensk	PINRO	84.03.29	84.07.02
15180	Valerian Uryvaev	Far East RIHMI	83.12.16	84.04.09
15181	E.Krenkel	Odessa SOI	84.06.11	84.08.24
15245	Dalniye Zelentsy	MMBI	84.05.18	84.06.27
15246	Arnold Veimer	ITPE	84.07.19	84.09.11
15250	Mys Yunony	PBFS	84.03.20	84.05.15
15251	Novokotovsk	TINRO	84.01.23	84.06.21
15304	Achill	PINRO	84.03.26	84.07.07
15315	Passat	Odessa SOI	84.05.27	84.09.11
15316	G. Ushakov	“	84.06.21	84.09.20
15333	Ayaks	PINRO	84.05.05	84.08.18
15338	V. Bugaev	“	84.06.01	84.09.05
15340	P.Multanovskiy	AARI	84.07.20	84.09.18
15341	Akademik Shuleikin	“	84.06.26	84.09.24
15342	Prof. Vize	“	84.06.11	84.09.27
15349	Artyk	TINRO	84.03.12	84.04.28
15358	Akademik Korolev	Far East RIHMI	84.06.19	84.09.22
15360	V. Frolov	“	84.02.02	84.04.17
15362	Leonid Demin	GUNIO	84.06.04	84.09.17
15363	Akademik Shokalsky	Far East RIHMI	84.04.27	84.08.05
15366	Okean	“	84.06.03	84.08.15
15369	Akademik Shokalsky	“	84.05.09	84.08.09
15368	Priboy	Far East RIHMI	84.06.20	84.09.27
15380	G.Ushakov	Odessa SOI	84.10.09	84.12.12

Number	Ship	Institution	Start	Finish
15379	Akademik Shuleikin	AARI	84.10.24	84.12.26
15383	P. Multanovskiy	"	84.10.17	84.12.21
14728	Akademik Nesmeyanov	POI	82.12.29	83.03.08
15384	E. Krenkel	Odessa SOI	84.09.10	84.11.28
15385	Eleninsk	TINRO	84.05.24	84.09.22
15390	Prof. Dorofeev	Murmansk Hydromet	84.11.11	84.12.26
15404	Akademik Nesmeyanov	POI	84.06.30	84.10.21
15406	Persey -III	TINRO	84.07.24	84.08.24
15407	Okean	Far East RIHMI	84.09.12	84.10.30
15259	Priboy	"	84.11.10	85.01.08
15409	Suloy	TINRO	84.03.18	84.08.19
15262	Akademik Shokalsky	Far East RIHMI	84.09.08	84.12.07
15438	Akademik Kurchatov	IO of RAS	84.08.22	84.10.24
15440	V. Frolov	Far East RIHMI	84.05.22	84.08.26
15463	Yakov Gakkel	Odessa SOI	84.10.08	85.01.10
15464	Passat	"	84.05.03	85.01.15
15473	Akademik Vernadsky	MHI	84.07.20	84.12.12
5256	Akademik Korolev	Far East RIHMI	84.10.26	85.01.24
15512	Kokshaisk	TINRO	84.10.16	85.01.31
15365	Prof. Khromov	Far East RIHMI	84.12.13	85.01.22
15513	Akademik Shuleikin	AARI	85.01.29	85.03.28
15514	Omar	TINRO	84.07.04	84.08.05
15515	P. Multanovskiy	AARI	85.01.21	85.03.21
15517	Timashevsk	TINRO	84.07.27	84.09.26
15518	Ayaks	PINRO	84.10.06	85.01.19
15258	Priliv	Far East RIHMI	84.10.16	85.01.16
15530	V. Bugaev	Odessa SOI	84.11.19	85.03.07
15531	G. Ushakov	"	85.01.10	85.03.13
15532	E. Krenkel	"	84.12.25	85.03.16
15536	Mlechny Put	TINRO	84.09.18	84.11.30
15537	Prostor	PBFS	84.12.07	85.02.03
15539	Prof. Dorofeev	Murmansk Hydromet	85.01.12	85.03.27
15465	Musson	Odessa SOI	84.10.25	85.01.04
15558	Passat	"	85.02.06	85.05.18
15560	Musson	"	85.01.29	85.05.14
15410	Akademik Shokalsky	Far East RIHMI	85.01.27	85.04.12
15408	Priboy	"	85.02.08	85.05.25
15582	Prof. Khromov	"	85.02.14	85.04.26
15583	V. Frolov	"	85.01.29	85.04.19
15584	Ayaks	PINRO	85.03.19	85.05.08
15632	Dalniye Zelentsy	MMBI	85.03.21	85.05.07
15633	Mikhail Lomonosov	MHI	84.12.11	85.04.29
15636	Akademik Vernadsky	"	84.12.29	85.04.28

Number	Ship	Institution	Start	Finish
15646	G. Ushakov	Odessa SOI	85.05.10	85.07.31
15701	Musson	"	85.06.04	85.09.06
15727	Prof. Dorofeev	Murmansk Hydromet	85.07.12	85.09.20
15728	Priliv	Far East RIHMI	85.02.12	85.06.29
15729	"	"	85.07.04	85.08.19
15730	Akademik Shokalsky	"	85.04.30	85.07.03
15735	Ayaks	PINRO	85.05.13	85.07.28
15733	Atlant	AtlantNIRO	85.06.05	85.10.15
15736	Kokshaisk	PINRO	85.07.31	85.10.08
15748	Akademik Vernadsky	MHI	85.06.04	85.09.29
15753	Dmitry Mendeleyev	IO of RAS	84.05.17	84.08.18
15799	Okean	Far East RIHMI	85.05.18	85.09.18
15800	Priboy	"	85.07.12	85.10.21
15801	Akademik Shirshov	"	85.08.22	85.09.26
15802	Prof. Khromov	"	85.07.27	85.10.20
15804	V. Frolov	"	85.07.17	85.09.08
15808	Arnold Veimer	ITPE	85.06.10	85.07.30
15809	Prof. Zubov	AARI	85.05.16	85.07.05
15811	P. Multanovskiy	"	85.07.18	85.09.12
15829	Volna	Odessa SOI	85.06.27	85.10.02
15830	E. Krenkel	"	85.07.24	85.10.11
15831	Yakov Gakkel	"	85.07.10	85.10.12
15832	V. Bugaev	"	85.07.22	85.09.25
15833	Prof. Khromov	Far East RIHMI	85.05.15	85.07.04
15886	Akademik Lavrentjev	POI	85.07.24	85.11.01
15891	Akademik Shuleikin	"	85.11.05	85.12.20
15890	Volna	Odessa SOI	85.11.05	86.01.27
15887	G. Ushakov	"	85.09.01	85.12.11
15899	Mikhail Lomonosov	MHI	85.11.14	86.01.25
15888	Musson	Odessa SOI	85.10.04	85.12.23
15885	Passat	"	85.10.20	85.12.30
15900	Prof. Dorofeev	Murmansk Hydromet	85.10.08	85.12.30
15892	P. Multanovskiy	AARI	85.10.19	85.12.16
15869	E. Krenkel	Odessa SOI	85.11.09	86.01.25
15868	Yakov Gakkel	"	85.11.27	86.01.24
15909	Gnevny	TINRO	85.05.10	85.06.16
15937	Akademik Shuleikin	AARI	86.01.10	86.03.11
15938	P.Multanovskiy	"	86.01.11	86.03.19
15962	Ayaks	PINRO	85.11.26	86.01.20
15944	Valerian Uryvayev	Far East RIHMI	85.11.06	86.01.24
15952	Otto Shmidt	Murmansk Hydromet	85.10.25	85.12.31
15948	Okean	Far East RIHMI	85.10.09	86.01.31
15947	Prof. Khromov	"	85.11.13	86.01.27

Number	Ship	Institution	Start	Finish
15950	Priboy	Far East RIHMI	85.11.11	86.01.07
15986	G. Ushakov	Odessa SOI	86.01.07	86.04.06
15987	Passat	"	86.01.18	86.04.05
15989	Musson	"	86.01.14	86.04.06
15992	Prof. Dorofeev	Murmansk Hydromet	86.01.24	86.03.21
15998	Akademik Lavrentjev	POI	85.04.18	85.06.29
16017	Prof. Vize	AARI	85.11.12	86.04.16
16019	Arnold Veimer	ITPE	86.01.23	86.04.05
16018	Dalniye Zelentsy	MMBI	86.04.05	86.05.25
16020	V. Frolov	Far East RIHMI	86.04.01	86.09.08
16022	Priboy	"	86.02.01	86.04.29
16025	Akademik Shokalsky	"	86.02.14	86.05.24
16026	Prof. Khromov	"	86.04.25	86.06.15
16028	Akademik Vernadsky	MHI	85.02.18	86.06.03
16030	Akademik Shuleikin	AARI	86.04.01	86.06.12
16032	Valerian Uryvayev	Far East RIHMI	86.02.13	86.06.18
16035	Volna	Odessa SOI	86.02.11	86.06.04
16029	Mikhail Lomonosov	MHI	86.02.15	86.05.29
16149	Passat	Odessa SOI	86.04.26	86.08.22
16151	Musson	"	86.05.02	86.08.10
16157	Mikhail Lomonosov	MHI	86.06.24	86.10.08
16161	Okean	Far East RIHMI	86.07.23	86.09.13
16204	Priliv	"	86.08.12	86.09.26
16276	Prof. Dorofeev	Murmansk Hydromet	86.10.03	86.12.21
15975	Prof. Khromov	Far East RIHMI	86.02.18	86.04.04
16158	Volna	Odessa SOI	86.06.30	86.10.25
16278	E. Krenkel	"	86.10.10	87.01.10
16293	Prof. Vize	AARI	86.08.28	86.10.22
16295	Akademik Shuleikin	"	86.10.29	86.12.02
16296	P. Multanovskiy	"	86.10.26	86.12.24
16331	V. Buynitskiy	Murmansk Hydromet	86.12.12	87.01.14
16134	Prof. Dorofeev	"	86.04.15	86.06.04
16326	A.I. Voeikov	Far East RIHMI	86.08.01	86.11.17
16403	G. Ushakov	Odessa SOI	86.11.24	87.02.08
16467	V. Frolov	Far East RIHMI	86.11.05	87.02.04
16468	Prof. Khromov	"	86.08.30	86.12.07
16469	Akademik Shokalsky	"	86.11.10	87.03.01
16472	Priliv	"	86.10.15	87.01.19
16474	Akademik Shuleikin	AARI	87.01.05	87.03.13
16475	P. Multanovskiy	"	87.01.07	87.03.13
16477	Valerian Uryvayev	Far East RIHMI	86.11.18	87.02.17
16519	Volna	Odessa SOI	87.01.16	87.04.19
16552	Arnold Veimer	ITPE	87.01.06	87.04.20

Number	Ship	Institution	Start	Finish
16542	Musson	Odessa SOI	87.02.09	87.05.18
16681	Akademik Shuleikin	AARI	87.04.01	87.06.05
16620	Akademik Vernadsky	MHI	87.01.15	87.04.30
16682	P. Multanovskiy	AARI	87.04.06	87.06.10
16698	Akademik Shokalsky	Far East RIHMI	87.03.27	87.06.05
16699	A.I. Voeikov	"	86.12.24	87.04.07
16696	Valerian Uryvayev	"	87.03.10	87.05.08
16700	Priliv	"	87.02.06	87.04.20
16693	Prof. Dorofeev	Murmansk Hydromet	87.04.10	87.06.15
16697	Prof. Khromov	Far East RIHMI	87.01.06	87.04.15
16722	V.Frolov	"	87.03.01	87.04.24
16780	P. Multanovskiy	AARI	87.07.12	87.09.04
16796	Volna	Odessa SOI	87.05.11	87.08.04
16895	Akademik Vernadsky	MHI	87.05.16	87.08.15
16893	Mikhail Lomonosov	"	87.05.13	87.09.19
16900	A.I.Voeikov	Far East RIHMI	87.08.12	87.09.09
16971	Prof. Dorofeev	Murmansk Hydromet	87.10.15	87.12.20
17470	Akademik Shirshov	Far East RIHMI	88.02.12	88.06.06
17504	Prof. Dorofeev	Murmansk Hydromet	88.07.12	88.09.29
17497	V.Bugaev	Odessa SOI	88.05.13	88.08.20
17496	Akademik Shuleikin	AARI	88.06.22	88.09.13
17510	Mikhail Lomonosov	MHI	88.04.30	88.08.31
17509	Akademik Vernadsky	"	88.07.02	88.10.04
17811	Akademik Shokalsky	Far East RIHMI	88.10.10	89.01.05
18227	Akademik Shuleikin	AARI	90.01.19	90.03.20
18199	Musson	Odessa SOI	89.11.13	90.01.28
18254	Prof. Khromov	Far East RIHMI	89.11.28	90.03.02
18387	"	"	90.03.24	90.06.08
18510	"	"	90.11.06	91.01.11
15886	Akademik Lavrentjev	POI	85.07.24	85.11.01
10484	G. Matveichuk	Far East RIHMI	78.08.13	78.09.19
16888	Prof. Zubov	AARI	87.06.12	87.09.30
10276	Passat	Odessa SOI	78.03.11	78.06.03
15257	Persey -III	PINRO	84.03.02	84.06.20
9739	Akademik Korolev	Far East RIHMI	76.12.27	77.01.24
9758	Akademik Shirshov	"	76.10.15	77.02.03
Shelf project				
10066	Volna	Far East RIHMI	77.10.01	77.12.31
10110	Okean	"	77.10.01	78.01.31
16163	V.Frolov	"	86.08.20	86.10.08
Southern circulation project				
6273	Mikhail Lomonosov	MHI	72.12.14	73.04.23
9765	"	"	76.04.18	76.08.26

Number	Ship	Institution	Start	Finish
10176	Prof. Vodyanitsky	IBSS	77.05.01	77.09.30
10267	Mikhail Lomonosov	MHI	77.06.01	77.09.30
10545	Prof. Vodyanitsky	IBSS	78.12.17	79.02.17
Soviet-Guinea expedition				
9950	Akademik Vernadsky	MHI	77.04.19	77.06.16
10544	Mikhail Lomonosov	"	78.09.18	78.10.06
Triangle project				
11253	Volna	Far East RIHMI	80.05.12	80.06.13
Tsunami project				
10467	Valerian Uryvayev	Sakhalin Hydromet	78.08.05	78.10.05
11324	Okean	Far East RIHMI	80.02.27	80.06.09
12850	Valerian Uryvayev	Sakhalin Hydromet	81.02.13	81.05.24
12862	Okean	Far East RIHMI	81.02.01	81.05.22
13794	Valerian Uryvayev	Sakhalin Hydromet	82.03.04	82.05.18
13812	Okean	Far East RIHMI	82.03.21	82.05.21
14851	Prof. Khromov	"	83.08.07	83.10.02
15408	Priboy	"	85.02.08	85.05.25
16033	Okean	"	86.02.20	86.05.30
16720	Priboy	"	87.02.07	87.05.08
Typhoon project				
9303	Priboy	Far East RIHMI	75.08.18	75.11.14
9273	Priliv	"	75.07.25	75.11.06
9240	Akademik Korolev	"	75.07.25	75.11.05
9296	Volna	"	75.07.24	75.11.06
9274	Okean	"	75.07.24	75.11.05
10378	Akademik Shirshov	"	78.07.26	78.10.29
10379	Priliv	"	78.06.20	78.10.13
10380	Priboy	"	78.06.20	78.10.13
10384	Volna	"	78.06.20	78.10.28
10466	Akademik Korolev	"	78.09.14	78.10.17
11056	Priboy	"	79.11.14	80.03.14
11024	Volna	"	79.12.07	80.03.25
10905	Priliv	"	79.12.25	80.03.01
13162	Akademik Korolev	"	81.08.12	81.12.06
13163	Priboy	"	81.07.31	81.11.27
13482	Volna	"	81.10.15	81.12.27
13483	Priliv	"	81.09.26	81.12.24
13506	Okean	"	81.09.23	81.12.25
16027	A.I. Voeikov	"	86.01.22	86.05.22
16325	Akademik Korolev	"	86.09.26	86.12.06
16699	A.I. Voeikov	"	86.12.24	87.04.07
16945	Akademik Shirshov	"	87.05.28	87.09.15
16977	Priliv	"	87.05.14	87.09.11

Number	Ship	Institution	Start	Finish
Vertical project				
15171	Akademik Korolev	Far East RIHMI	84.02.11	84.05.11
15178	A.I.Voeikov	"	84.02.04	84.05.23
15356	Volna	Odessa SOI	84.02.08	84.06.14
Wave project				
16620	Akademik Shokalsky	Far East RIHMI	87.01.15	87.04.30
WESTPAC program				
14694	Akademik Nesmeyanov	POI	82.05.30	82.08.12
14728	"	"	82.12.29	83.03.08
14496	"	"	82.09.18	82.11.21
15088	Akademik Vinogradov	"	83.12.01	84.01.30
15404	Akademik Nesmeyanov	"	84.06.30	84.10.21
15717	Akademik Vinogradov	"	85.03.03	85.05.25
14325	Morskoy Geofysik	Sakhalin Hydromet	82.07.23	82.11.15
14326	Pegas	"	82.07.29	82.11.25
15886	Akademik Lavrentjev	POI	85.07.24	85.11.01
14607	Pervenets	"	82.05.15	82.09.06
15947	Prof. Khromov	Far East RIHMI	85.11.13	86.01.27
15968	Pegas	POI	85.02.10	85.05.15
15969	"	"	85.10.25	85.10.25
15970	Morskoy Geofysik	"	85.02.15	85.05.20
15971	"	"	85.10.05	85.11.04
15998	Akademik Lavrentjev	"	85.04.18	85.06.29
16281	Prof.Bogorov	"	86.05.03	86.07.08
17014	"	"	87.09.05	87.09.20
17080	Akademik Shokalsky	Far East RIHMI	87.07.01	87.10.16

Note: Institutional affiliation of the above ships are those at the time of cruise. Many of the above ships now belong to the former republics of the USSR, i.e., Ukraine, Lithuania, etc.

Appendix 4. Organizations of Russia and the former USSR taking an active part in the study of seas and oceans

Acoustic Institute, RAS	
Address	4, Shvernika St., 117036 Moscow
Telephone	7 (095) 126-7401
Fax	7 (095) 126-8411
URL address	http://www.akin.ru
E-mail	bvp@akin.ru
Activities	Investigation of sound propagation in sea water
All-Russian Research Institute of Hydrometeorological Information, World Data Center, Roshydromet	
Address	6, Korolyov St., 249020 Obninsk, Kaluga Region
Telephone	7 (095) 255-21-94, 7 (08439) 7-41-81
Telegraph	Obninsk Kaluga Region, RIHMI-WDC, 205443, autoreply
Fax	7 (095) 255-22-25
E-mail	wdcb@meteo.ru
Director's office	7 (095) 546-39-10
URL address	http://www.meteo.ru
Activities	Key institution within Roshydromet specializing in the automatic collection, control, processing, storage, and dissemination of hydrometeorological information
Amderma Hydromet, Roshydromet	
Address	28, Polyarnaya, 164744 Amderma, Arkhangelsk Region
Activities	Ice, aerometeorological, marine hydrometeorological observations; monitoring of environment pollution, provision of weather forecasts and storm warnings to users
Atlantic Research Institute for Marine Fisheries and Oceanography, Goskomrybolovstvo	
Address	5, Dmitry Donskoy Street, 236000 Kaliningrad
Fax	7 (0112) 219-997
E-mail	atlant@baltnet.ru
URL address	http://www.atlantniro.ru/eng/atlantniro.html
Activities	Investigation of biological resources of the Baltic Sea and Atlantic, Pacific, and Indian Oceans and environment conditions for determination of rational exploitation level; identification of living marine organisms
Arctic and Antarctic Research Institute, Roshydromet	
Address	38, Bering St., 199397 St. Petersburg
Telephone	7 (812) 352-00-96, 352-26-85, 352-21-43
Fax	7 (812) 352-26-88
URL address	http://www.aari.nw.ru
E-mail	aaricoop@sovam.com
Activities	Complex hydrometeorological study of the Arctic, Southern, and the Atlantic Oceans
Astrakhan Zonal Hydrometeorological Observatory, Roshydromet	
Address	37, Solnechnaya St., 414028 Astrakhan

E-mail	ug@eden.astrakhan.su
Activities	Aerometeorological, marine hydrometeorological and river mouth observations
Azov Research Institute for Fishery Problems, Goskomrybolovstvo	
Address	21/2, Beregovaya St., 344007 Rostov-on-Don
Telephone	7 (8632) 62-47-42 or 62-48-50
Fax	7 (8632) 62-47-42
E-mail	root@azniirkh.rnd.su
Activities	Hydrobiological, ichthyological and oceanographic observations and investigations in the Azov Sea
Baltic Branch of Institute of Oceanology, RAS	
Address	1, Mir Prospect, 236000 Kaliningrad
Fax	7 (0112) 27-29-15
Activities	Thin-structure ocean observation, marine geology
URL address	http://www.sio.rssi.ru/index.htm
Baltic Research Institute for Fishery, Latvia	
Address	1, Bezdelichu St., 266049 Riga, LATVIA
Activities	Ichthyobiological and hydrobiological observations and research, oceanographic observations
Caspian Fisheries Research Institute, Goskomrybolovstvo	
Address	1 Savushkina Street, 416607Astrakhan
Telephone	7 (8512) 25-55-68
Fax	7 (8152) 25-86-36
E-mail	Kaspiv@astranet.ru
Activities	Hydrobiological, ichthyological and oceanographic observations and investigations; reproduction of sturgeon-type fish
Center of Marine Research, Lithuania (formerly known as Klaipeda Hydrometeorological Observatory)	
Address	26, Taikos Pr.., 5802 Klaipeda, LITHUANIA
Telephone	370 (464) 10-450
Fax	370 (464) 10-460
E-mail	CMR@klaipeda.omnitel.net
URL Address	http://www1.omnitel.net/juriniai_tyrimai/
Activities	Oceanographic observations and investigations; monitoring of the Baltic Sea and the Kurshski Bay pollution
Central Aerological Observatory, Roshydromet	
Address	3, Pervomaiskaya St., 141700 Dolgoprudny, Moscow Region
Telephone	7 (095) 408-6148
Fax	7 (095) 576-3327
Activities	Development of methods and methodological guidance of aerological observations, including marine aerological observations performed by Roshydromet RVs
Central Asian Research Hydrometeorological Institute, Main Administration of Hydrometeorology, Uzbekistan	
Address	72, K. Makhsumov Street., 700052 Tashkent, UZBEKISTAN

Telephone	998 (71) 235-84-68
Fax	998 (71) 133-11-50, 133-20-25
E-mail	sanigmi@meteo.uz
Activities	Aerometeorological and hydrological observations and research; provision of hydrometeorological forecast and storm warnings to users; development of techniques and research in the field of recreation climatology
Central Design Bureau of Hydrometeorological Instruments, Roshydromet	
Address	6, Korolyov St., 249020 Obninsk, Kaluga Region
Telephone	7 (08439) 74-484
Activities	Hydrometeorological Instruments
Chukotka Hydromet, Roshydromet	
Address	2, Obruchev St., 686610 Pevek, Chukotka Region
Telephone	7 (413-00) 2-23-47
E-mail	meteo@pewk.mecom.ru
Activities	Ice, marine coastal, and aerometeorological observations; weather forecasts and issuing storm warnings to users
Far Eastern Hydrometeorological Research Institute, Roshydromet	
Address	24, Fontannaya, 690600 Vladivostok
Telegraph	Vladivostok GIMET
Telephone	7 (4232) 26-97-88, 26-79-02, 22-77-54
Fax	7 (4232) 22-77-54
E-mail	fehri@stv.iasnet.com
URL address	http://www.hydromet.com
Activities	Complex hydrometeorological investigations; observations in the Pacific and Indian Oceans
Far Eastern National University, Ministry of Education	
Address	27, Oktyabrskaya, 690600 Vladivostok
Telephone	7 (4232) 261-280
Fax	7 (4232) 220-315
E-mail	rectorat@dvgu.ru
URL address	http://www.dvgu.ru
Activities	Training students; research in the field of oceanography
Head Department of Navigation and Oceanography (Navy), Ministry of Defense	
Address	8, 11th Line, B-34 199034 St. Petersburg
Fax	7 (812) 277-59-00
E-mail	gunio@homepage.ru
URL address	http://www.navy.ru
Activities	Guidance of oceanographic observations and research performed by the Navy RVs and Research Institutions
Hydrochemical Institute, Roshydromet	
Address	61, Lenin St., 344450 Novocherkassk
Activities	Development of technique for hydrochemical river and river mouth observations; methodological guidance of these observations
Hydrometeorological Center of Russia, Roshydromet	

Address	11-13, Bolshoi Predtechenski Lane, 123242 Moscow
Telephone	7 (095) 252-34-48
Fax	7 (095) 255-15-82
E-mail	vilfand@rhmc.mecom.ru (Director's e-mail)
URL address	http://hmc.hydromet.ru
Activities	Preparation of short- and long-term hydrometeorological forecasts, reviews, reference materials, and other documents, which are provided to the Government of the Russian Federation; methodological guidance for the Russian forecasting offices
Institute of Applied Geophysics, Roshydromet	
Address	Rostokinskaya 9, 129128, Moscow, Russia
Telephone	7 (095) 181-4494
Fax	7 (095) 187-7513
E-mail	geophys@sovam.com
Activities	Investigation of natural and antropogenic physical and chemical processes occuring in the Earth's atmosphere and the World Ocean
Institute of Biology, Latvian Academy of Sciences	
Address	3, Miera Iela, LV-2169 Salaspils, LATVIA
Telephone	371 (7) 944-988
Fax	371 (7) 944-986
E-mail	office@email.lubi.edu.lv
URL address	http://www.lubi.edu.lv/
Activities	Hydrobiological investigations
Institute of Biology of Southern Seas, National Academy of Sciences of Ukraine	
Address	2, Nakhimov Avenue, 335011 Sevastopol, Crimea, UKRAINE
Telegraph	187124 IBSS SU
Telephone	380 (692) 544-110
Fax	380 (692) 557- 813
E-mail	ibss@ibss.iuf.net
URL address	http://www.ibss.iuf.net
Activities	Hydrobiological investigations
Institute of Global Climate and Ecology, RAS and Roshydromet	
Address	20-B, Glebovskaya St., 115541Moscow
Telephone	7 (095) 169-2430
Fax	7 (095) 160-0831
Activities	Monitoring of environmental pollution; organization of an international system for global monitoring of land, atmosphere and ocean pollution
Institute of Numerical Mathematics, RAS	
Address	8, Gubkina Street, GSP-1, 117951 Moscow
Telephone	7 (095) 938-37-86 or 938-17-69
Fax	7 (095) 938-18-21
E-mail	director@inm.ras.ru
URL address	http://www.inm.ras.ru
Activities	The Laboratory of Ocean Dynamics conducts numerical modelling of

	hydrological characteristics of the World ocean, seas and lakes
Institute of Oceanology, RAS	
Address	23 Krasikova Street, 117851 Moscow
Telephone	7 (095) 124-7940
Fax	7 (095) 124-5983
E-mail	rocc@sovam.com
URL address	http://www.sio.rssi.ru or http://www.ocean.ru
Activities	Complex study of the world ocean; elaboration of theoretical problems in the field of oceanology, expeditionary research in seas and oceans
Institute of Volcanology, Far Eastern Branch of RAS	
Address	9, Piip Boil, 683006 Petropavlovsk-Kamchatski
Telephone	7 (4152) 25-91-75
Fax	7 (4152) 25-47-23
E-mail	volcan@kcs.iks.ru
URL address	http://kcs.iks.ru/iv/index.html
Activities	Investigation of Kamchatka volcanoes and volcanic surface and underwater activities
Kamchatka Hydrometeorological Service, Roshydromet	
Address	12, Molchanova Street, 683602 Petropavlovsk-Kamchatski
Telephone	7 (4152) 25-94-16
Fax	7 (4152) 25-84-44
E-mail	kammet@intercome.kamchatka.ru; mts@ptrp.mecom.ru
Activities	Aerometeorological, hydrometeorological, marine hydrometeorological, and oceanographic observations; environmental pollution monitoring; provision of hydrometeorological forecasts and storm warnings to users
Kamchatka Research Institute of Fisheries & Oceanography, Goskomrybolovstvo	
Address	18, Nabereshnaya Street, 683600 Petropavlovsk-Kamchatski
Telephone	7 (4152) 11-27-01
Fax	7 (4152) 11-50-48
E-mail	mail@kamniro.kamchatka.su
Activities	Monitoring of environmental pollution; organization of an international system for global monitoring of land, atmosphere, and ocean pollution
Kolyma Hydrometeorological Service, Roshydromet	
Address	7/13, Parkovaya St., 685000 Magadan
Telegraph	Magadan GIMET
Telephone	7 (413-22) 2-30-08
Fax	7 (413-22) 2-52-68
Activities	Provision of forecasts, information, emergency warnings to industry and population; study of hydrometeorological conditions; monitiring of environment pollution; preparation of reference publications
Latvian Hydrometeorological Agency	
Address	165 Maskavas St., 1019 Riga, LATVIA
Telephone	371 (7) 144-390, 703-2600
Fax	371 (7) 145-154
E-mail	lhma@meteo.lv

URL address	http://www.meteo.lv
Activities	Aerological, hydrological, and marine coastal observations; provision of weather forecasts and storm warnings to users
Main Geophysical Observatory, Roshydromet	
Address	7, Karbysheva St., 194021 St. Petersburg
Telephone	7 (812) 247-01-03, 247-43-90
Fax	7 (812) 247-86-61
URL address	http://www.mgo.rssi.ru
Activities	Atmosphere climate change study, investigation of environmental pollution
Marine Geophysics Research Institute	
Address	79, Krymskaya St., 353461 Gelendzhik, Krasnodar Region
Telephone	7 (86141) 243-30
Fax	7 (86141) 245-31
E-mail	info@okg.sea.ru
URL address	http://www.okg.sea.ru
Activities	Marine geology and geophysics, creation of data bases and banks
Marine Hydrophysical Institute, Ukraine National Academy of Sciences	
Address	2, Kapitanskaya St., 335000 Sevastopol, UKRAINE
Telephone	380 (692) 54-52-04
Fax	380 (692) 55-43-52
E-mail	eremeev@mhi2.sebastopol.ua
URL address	http://www.mhi.iuf.net/DEPTS/mistdpt.html
Activities	Oceanographic, hydochemical and geophysical observations and investigations of the Black and Mediterranean Seas
Marine Systems Institute at Tallinn Technical University, Estonia (formerly the Institute of Thermophysics and Electrophysics)	
Address	1, Paldiski Road, 10137 Tallinn, ESTONIA
Telephone	372 (no city code) 662-2249
Fax	372 (no city code) 661-3657
URL Address	http://www.msi.ttu.ee/
Activities	Baltic Sea water and material exchange processes and their impact on Estonian coastal waters; dynamics of turbulent processes and nonlinear waves; estimation of ecological conditions of Estonian coastal waters and lakes by optical methods
Moscow State University, Education Ministry	
Address	Geography Department, Vorobyovy Hills, 119899 Moscow
Telephone	7 (095) 939-2238
Fax	7 (095) 939-8836
E-mail	administrator@geogr.msu.ru
URL address	http://www.geogr.msu.ru
Activities	Higher education institution; provides high-quality training of marine experts in hydrobiological, hydrogeological, and oceanographic research; post-graduate course work
Murmansk Hydrometeorological Service, Roshydromet	
Address	23, Schmidta St., 183789 Murmansk

Telegraph	Murmansk GIMET
Telephone	7 (815) 247-25-49
Fax	7 (815) 247-24-06
E-mail	leader@kolgimet.murman.ru
URL address	http://www.murman.ru/kolgimet
Activities	Provision of forecasts, information, emergency warnings to industry and population; study of hydrometeorological conditions; monitoring of environment pollution; preparation of reference publications
Murmansk Marine Biological Institute, RAS	
Address	17, Vladimirskaya St., 183010 Murmansk
Telephone	7 (815)256-52-32
Fax	47 (789) 10-288 (Norwegian line)
E-mail	mmbi@mun.rospac.ru
URL address	http://mmbi.murman.ru/
Activities	Marine biological and ichthyological research
Naval Academy, Defense Ministry	
Address	73/1 Vyborgskaya Nab., 197045 St. Petersburg
Telephone	7 (812) 242-1618
Activities	Training high-quality experts for the Navy, post-graduate course
Navy Central Cartographic Company of GUNIO, Ministry of Defense	
Address	2, Atamanskaya St., 199167 St. Petersburg
Activities	Processing of marine bathymetry magnetic and gravimetry observations; preparation of marine navigational maps and atlases and other cartographic products
North Hydrometeorological Service, Roshydromet	
Address	2, Mayakovski Street, 163020 Arkhangelsk
Telephone	7 (818) 0-22-33-44
Fax	7 (821) 2–43-58-18
Telegraph	Arkhangelsk GIMET
E-mail	adm@arhn.mecom.ru
Activities	Forecasting, information, and issuing emergency warnings to industry and general public; study of hydrometeorological conditions; monitoring of environmental pollution; preparation of reference publications
North-Caucasus Hydrometeorological Service, Roshydromet	
Address	1/7, Erevanskaya St., 344025 Rostov-on-Don
Telephone	7 (863) 2-51-09-01
Fax	7 (863) 2-51-59-27
Telegraph	Rostov GIMET
E-mail	admin@rost.mecom.ru
Activities	Forecasting, information, and issuing emergency warnings to industry and general populace; study of hydrometeorological conditions; monitoring of environmental pollution; preparation of reference publications
North-West Hydrometeorological Service, Roshydromet	
Address	2a, 23rd line, 199026 St. Petersburg
Telephone	7 (812) 218-17-54

Fax	7 (812) 218-09-62
E-mail	admin@meteo.nw.ru
URL address	http://adm.meteo.nw.ru
Activities	Aerometeorological, hydrological, and marine hydrometeorological observations; weather forecasts and issuance of storm warnings to users; monitoring of environmental pollution
Odessa Branch, Institute of Biology of Southern Seas, National Academy of Sciences of the Ukraine	
Address	37, Pushkinskaya St., 270011 Odessa, UKRAINE
Telephone	380 (482) 25-09-18
Fax	Same as telephone
URL address	http://bioassay.narod.ru/obibss/
Activities	Hydrobiological and ichthyological observations and investigations, oceanographic observations
Odessa Hydrometeorological Institute, Ukraine	
Address	15, Lvivska Street, 65016 Odessa, UKRAINE
Telephone	380 (482) 63-62-09
Fax	380 (482) 42-77-67
E-mail	synop@ogmi.farlep.odessa.ua
URL address	http://www.ogmi.farlep.odessa.ua/indexe.htm
Activities	Training of oceanographers, atmosphere-ocean interaction study
Pacific Oceanological Institute, Far East Branch RAS	
Address	43, Baltiiskaya, 690041 Vladivostok
Telephone	7 (4232) 311-420
Fax	7 (4232) 312-573
E-mail	rostov@pacificinfo.ru
URL address	http://www.pacificinfo.ru
Activities	Hydrophysical ocean investigations; investigation of various physical ocean fields; geological and geophysical study of ocean bottom; development and creation of new methods and technical tools for ocean study
Pacific Scientific Research Fisheries Center, Goskomrybolovstvo	
Address	4, Shevchenko St., 690600 Vladivostok
Telephone	7 (4232) 25-77-83
Fax	Same as telephone
URL address	http://www.tinro.ru/
Activities	Commercial oceanography, marine fishery
Polar Research Institute of Marine Fisheries and Oceanography, Goskomrybolovstvo	
Address	6, Knipovich St., 183763 Murmansk
Telephone	7 (8152) 47-25-32
Fax	7 (8152) 47-25-32
URL address	http://pinro.murmansk.ru
Activities	Commercial oceanology, fishery, pollution
Russian Federal Research Institute of Fisheries and Oceanography, Goskomrybolovstvo	
Address	17/1, Verkhne-Krasnoselskaya St., 107140 Moscow

Telephone	7 (095) 264-93-87
Fax	7 (095) 264-91-67
E-mail	vniro@vniro.ru
URL address	http://www.vniro.ru/en/index.html
Activities	Commercial oceanology, fishery
Russian Federal Service for Hydrometeorology and Environmental Monitoring (Roshydromet)	
Address	12, Novovagankovski lane, 123376 Moscow
Telephone	7 (095) 252-14-86
Fax	7 (095) 252-55-04, 252-94-84, 255-24-34
URL address	http://www.mecom.ru/roshydro/pub/index.htm
Activities	The main federal agency for coordinating national meteorological and oceanographic/marine observations and environmental monitoring
Russian State Hydrometeorological University	
Address	98, Malookhtinski Prospect, House #98, 195196 St. Petersburg
Telephone	7 (812) 444-41-63
Fax	7 (812) 444-60-90
E-mail	rshu@rshu.ru
URL address	http://www.rshu.ru
Activities	Training for oceanographers, hydrologists, and meteorologists; research in the field of atmosphere-ocean interaction, thermodynamics, water dynamics etc.
Saint Petersburg State University	
Address	7-9 Universitetskaya Avenue, 199034 St. Petersburg
Telephone	7 (812)326-2000
URL address	http://www.spbu.ru/e/
Activities	Training highly qualified marine experts; research in the field of hydrobiology, thermics, acoustics
Sakhalin Administration of Hydrometeorological Service, Roshydromet	
Address	78, Zapadnaya St., 693000 Yuzhno-Sakhalinsk
Telephone	7 (424-0) 73-15-91
E-mail	ugms@sakhalin.ru, admin@mts1.shln.mecom.ru
Activities	Hydrometeorological observations, provision of environmental information to users
Sakhalin Scientific Center, Far Eastern Branch of RAS	
Address	5 Nauka Street, 693022 Yuzhno-Sakhalin
Telephone	7 (42422) 791-517
Fax	Same as telephone
E-mail	nauka@sakhalin.ru
URL address	http://www.febra.ru/index_.html
Activities	Marine hydrophysical and hydroacoustic observations and investigations
Sakhalin Scientific-Research Institute for Fishery Industry and Oceanography, Goskomrybolovstvo	
Address	21, Marx St., 693000 Yuzhno-Sakhalinsk
URL address	http://www.science.sakhalin.ru/SakhNiro/Index.html

Activities	Marine biological and ichthyological investigations; reproduction of sturgeon-type fish
Southern Branch of the Institute of Oceanology, RAS	
Address	Golubaya Bukhta, 353470 Gelendzhik-7, Krasnodar Region
Fax	7 (86141) 2-31-89
URL address	http://www.sio.rssi.ru/index.htm
Activities	Complex exploration of the Black Sea
Southern Scientific Research Institute of Marine Fisheries and Oceanography, Ukraine	
Address	2, Sverdlov St., 98300 Kerch, Crimea Region, UKRAINE
Telephone	380 (6561) 2-10-65
Fax	380 (6561) 2-15-72
E-mail	island@crimea.com
Activities	Hydrobiological, ichthyological and oceanographic observations
State Hydrological Institute, Roshydromet	
Address	23, Second Line, 199053 St. Petersburg
Telephone	7 (812) 213-85-17, 231-95-79
Fax	7 (812) 213-10-28
Activities	Hydrological observations and investigations on the rivers of Russia; hydrological observations in mouths of rivers falling into interior and border seas of Russia
State Hydrometeorological Committee of Azaerbaijan	
Address	3, Resula Rza Street, 370601 Baku, AZERBAIJAN
Telephone	994 (12) 939-500
Fax	994 (12) 936-937
Activities	Aerometeorological, hydrological, and coastal observations; provision of forecasts and storm warnings to users
State Maritime Academy	
Address	15A, Kasaya Liniya, 195196 St. Petersburg
Telephone	7 (812) 322-7267
URL address	http://www.gma.ru
Activities	Largest maritime educational institution in Russia
State Oceanographic Institute, Roshydromet	
Address	6, Kropotkinski Lane, 119838 Moscow
Telephone	7 (095) 246-7288
E-mail	vasiliev@soi.msk.ru
URL address	http://www.oceanography.ru
Activities	Preparation of observational techniques, manuals and guides; analysis of marine environment conditions; investigation of sea and river mouth pollution
State Research Navigation-Hydrographic Institute of GUNIO, Defense Ministry	
Address	41, Kozhevennaya line, 199106 St. Petersburg
Telephone	7 (812) 322-1966, 322-1060
Fax	7 (812) 322-3319
E-mail	gningi@nvy.ru
Activities	Development of new technologies and technical means for hydrographic and

	oceanographic surveys and cartographic work; measurement of oceanographic, hydrometeorological and geophysical field parameters in different areas of the world ocean; design and development of aids to navigation systems for the coastal and water areas, traffic control systems for vessels and other movable objects; prompt and efficient hydrographic, topographic and geodetic support for surveys intended for construction of ports and other hydrotechnical structures
Ukrainian Hydrometeorological Center	
Address	105, Science Prospekt, 252650 Kiev, UKRAINE
Telephone	380 (44) 221-93-87
E-mail	kulbida@ukrweather.kiev.ua
URL address	http://www.ukrweather.kiev.ua
Activities	Study of atmosphere physical processes, atmosphere-underlying surface interaction
Ukrainian Scientific Center for the Ecology of the Sea, Ministry for Ecology & Natural Resources	
Address	89 Frantsuzski Blvd, 370009 Odessa, UKRAINE
Telephone	380 (048) 263-6673
Fax	380 (048) 263-7200
E-mail	root@accem.odessa.ua
Activities	Oceanographic, hydrometeorological, hydrochemical and ecological exploration of the Black and Mediterranean Seas

Appendix 5. References and additional literature with information on marine expeditions

Achievements of Soviet Oceanology, 1979: Moscow: Nauka,168 pp.

Aircraft Expedition to the "Inaccessible Pole:" Scientific Results, 1946: Moscow-Leningrad: Izd. Glavsevmorputi, ANII, 196 pp.

ALPEX Data Catalog, 1984: Moscow: World Data Center B, Vol. 1, 17 pp.

Altman, E.N., 1989: Information about the water-bottle database for the Black Sea basin. In: *Factors Affecting Water Conditions in the Black Sea: Information Database and Procedures for Its Analysis*. Leningrad: Publishing House Gidrometeoizdat, pp. 254-261.

Ammon, G.A., 1987: *Marine Memorable Events*. Moscow: Voennoe Izdatelstvo, 398 pp.

Andreev, N., 1900: The Arctic Ocean: Hydrological materials collected for the period 1889-1893, *Izvestiya Imperator Russian Geographical Society (IRGO)*, 34:1, 136 pp.

Andreev, N.P., 1883: Results of meteorological and hydrological observations conducted in the White Sea and off the coasts of Murmansk in 1880-1882, *Izvestiya Imperator Russian Geographical Society (IRGO)*, 19:1, pp. 22-27.

Bagrov, L.S., 1912: Expedition in the Kara Sea. *Vesti Telegrafii Bez Provodov*, 1, pp. 14-20.

---------, 1913: Expedition in the Kara Sea. *Vesti Telegrafii Bez Provodov*, 3, pp. 99-101.

Bekyashev, K.A. and V.V.Serebryakov, 1979: *International Marine Organizations*. Leningrad: Gidrometeoizdat, 607 pp.

Belov, M .I., 1956: History of the discovery and exploration of the northern marine road. In *Arctic Voyages from Antiquity to the Mid-18th Century*, Vol 1. Moscow: Marine Transport, 591 pp.

---------, 1959: History of the discovery and exploration of the northern marine road. In *Arctic Voyages from Antiquity to the Mid-18th Century*, Vol 2. Moscow: Marine Transport, 508 pp.

---------, 1962: History of the discovery and exploration of the northern marine road. In *Arctic Voyages from Antiquity to the Mid-18th Century*, Vol 3. Moscow: Marine Transport, 765 pp.

---------, 1969: History of the discovery and exploration of the northern marine road. In *Arctic Voyages from Antiquity to the Mid-18th Century*, Vol 4. Moscow: Marine Transport, 615 pp.

Belysheva, E. (ed.), 1960: The question of hydrochemistry in the Arctic Ocean. In *Proceedings of AARI*, 218, pp. 176-178.

Brekhovskikh, L.M., and E.M. Kukhorenko, 1986: Marine Expedition Works by the USSR Academy of Sciences and Academies of Sciences of Union Republics. *Bulletin of the Academy of Sciencies*, 5, 89-96.

Bruevich, V., 1952: Hydrochemical observations in the White Sea by the expedition ship "Sharlotta" in August 1931. In *Proceedings of SOI*, 11, pp. 114-161.

Buinitskiy, V.Kh. and I.V. Maksimov (ed.), 1962: The fourth and fifth cruises of the "Ob," 1958-60: Scientific and observational results, in *Proceedings of the Soviet Antarctic Expeditions*, Vol. 20. Leningrad: Marine Transport, 312 pp.

Bulatov, R.P., 1964: Water Circulation in the Atlantic and Adjacent Seas: Bibliographical Index (1638-1962). Moscow: Mezhvedomstvennyi Geofizichesky Komitet AN SSSR, 115 pp.

Catalog of Data and Publications for Oceanographic Data (Ship Observations) arriving at WDC B1 during the period 06/01/86-12/31/86, 1988: Moscow: World Data Center B, Issue 15, 268 pp.

Catalog of Deep-Sea Bathymetric Observations in the Vicinity of the Ocean Weather Stations in the Pacific, 1987. Obninsk: RIHMI-WDC, 39 pp.

Catalog of Foreign Materials for Hydrometeorological Conditions, 1982: Obninsk: RIHMI-WDC, 211 pp.

Catalog of Foreign Oceanographic Data, 1981: Obninsk: RIHMI-WDC, Issue 2, 43 pp.

Deryugin, K.K., 1968: *Soviet Oceanographic Expeditions*. Leningrad: Gidrometeoizdat, 236 pp.

Efimov, A.V., 1948: *From the History of Russian Expeditions in the Pacific*. Moscow: Voennoe Izd-vo Ministerstva Voorushennykh sil Soiuza SSR, 340 pp.

Eremeev, A.M., A.M. Suvorov, V.L. Vladimirov, E. Altman, O. Andrianova, A. Batyev, V. Belenkova, N. Berlinskiy, N. Bondarenko, Yu. Demidyuk, G. Efimove, A. Gilyaev, S. Ignatyev, S. Intelegatory, O, Kovaleva, A. Kuzin, S. Kuznetsov, A. Mitropolskiy, V. Mikhailov, A. Mishonov, Yu. Negoda, V. Nikolskiy, A. Poddahkin, V. Simon, M. Skipa, B. Trotsenko, E. Klebnikov, V. Tsyganok, V. Yakovlev, and N. Yakovleva, 1995: *Catalog of Marine Scientific Data in the Ukraine*. Sevastopol: MHI of Ukrainian AS, 78 pp.

Expedition Activity of the Shirshov Institute of Oceanology of RAS for 1967-1989, 1993: Moscow: Institute of Oceanology, RAN, Issue 1, 60 pp.

Expedition Activity of the Shirshov Institute of Oceanology of RAS for 1967-1989, 1993: Moscow: Institute of Oceanology, RAN, Issue 2, 81 pp.

Fedulov, E., B.P. Bruns, P.G. Lobza, 1937: Scientific results of the expedition in the "Sedov" in 1934. *Proceedings of AARI*, V. 83. Leningrad: Glavsevmorput, 134 pp.

FGGE Data Catalog, 1982: Moscow: World Data Center B, 59 pp.

---------, 1983: Supplement 1. Moscow: World Data Center B, 38 pp.

Gakkel, J.J., ed., 1938: Scientific results of the one-season voyage of the "Vantsetti" in 1935. *Proceedings of AARI*, 129, pp. 15-27.

Galachkin, Yu.I., V.S. Myasnikov and G.A. Panasenko, 1989: A data bank of hydroacoustic surveys. *Rybnoe Khozyaystvo*, 5, pp. 75-76.

GATE'74 Data Catalog, 1979: Section 1: Ship Observations. Issue 1: Soviet Ship Data. Obninsk: RIHMI-WDC, 190 pp.

---------, 1979: Section 1: Ship Observations. Issue 2: Ship Data from the USA, Great Britain, West Germany, France, Canada, and the Netherlands. Obninsk, RIHMI-WDC, 113 pp.

Gertman, I. F., 1984: A regional bank of deep-sea hydrological data for the Black Sea and the Sea of Azov. *Proceedings of RIHMI-WDC,* Obninsk, 113, pp. 27-32.

Gomoyunov, K.A., N.P. Demme, V.P. Meleshko, A.I. Chausov, 1937: Hydrological materials for the coasts of the Soviet sector of the Arctic from observations at polar stations. In *Proceedings of the AARI*, 88, 67 pp.

Grekov, V. I., 1960: *Essays on the History of Russian Geographical Research during 1725-1765.* Moscow: Academy of Sciences of the USSR, 370 pp.

Hydrological, Hydrochemical, Geological and Biological Research: the Electrically Driven Motorship "Ob," 1955-1956, 1958: In *International Geophysical Year Proceedings of the Antarctic Expedition of the USSR AS.* Moscow: Gidrometeoizdat, 218 pp.

Kerimov, A. A., 1989: Water temperature and salinity database for the open part of the Caspian Sea. In *Factors Affecting Water Conditions in the Caspian Sea: Information Database and Procedures of Analysis*. Leningrad: Gidrometeoizdat, pp. 261-266.

Kireev, A. (ed.), 1937: *General Information on the Activity of Marine Expeditions: Issue I: Hydrological Observations by Marine Expeditions during the Second IPY, 1932-33.* Leningrad-Moscow: Gidrometeoizdat, 86 pp.

Kort, V. (ed.), 1961: Third marine expedition in the "Ob", 1957-58. In *Proceedings of the Soviet Antarctic Expedition*, 19, 299 pp.

Lykov, A.A., V.V. Polkovnikova, 1985: *Coverage of the North Atlantic with Deep-Sea Temperature and Salinity Measurements*. Obninsk: RIHMI-WDC, 47 pp.

Lykova, V.V., A.A. Lykov, 1984: Deep-sea bathymetric data set from ocean weather stations. In *Proceedings of RIHMI-WDC*, Issue 113, pp. 83-94.

Lykova, V.V., 1984: *Data Catalog of Deep-Sea Bathymetric Observations at Ocean Weather Stations in the North Atlantic*. Obninsk: RIHMI-WDC, 75 pp.

---------., 1989: Climatic time series of deep-sea data for the open ocean. In *Proceedings of RIHMI-WDC*, Issue 152, pp. 9-22.

Lyvov, I.I., 1936: Observations of the sea surface layer made by the icebreakers "Rusanov" and "Metel" in the summer 1932. In *Proceedings of AARI*, 68, pp. 7-26.

Makarov, S.O., 1894: The "Vityaz" and the Pacific Ocean: Hydrological observations during the world voyage of the "Vityaz" during 1886-1889. Eds. N. Zubov and A. Dobrovolskiy. Two volumes. Moscow: Geographical State Publishing House, rpt. 1950. 240 pp.

Manual on Expedition Ships of the World, 1966: In *"A Study of Seas and Oceans and Application of Their Resources."* USSR State Committee for Science and Technology, Scientific Council, 401 pp.

Marine Encyclopedia, Volume 1, 1986: Leningrad: Sudostroenie, 512 pp.

Marine Encyclopedia, Volume 2, 1986: Leningrad: Sudostroenie, 518 pp.

Methodical Recommendations for the Centralized Accumulation of Marine Geological Information, 1983: Gelendzhik: PO Yuzhmorgeologiya, 55 pp.

Muromtsev, A. M., 1958: Major Features of the Hydrology of the Pacific. Leningrad: Gidrometeoizdat, 632 pp.

---------, 1959: *Major Features of the Hydrology of the Indian Ocean*. Leningrad: Gidrometeoizdat, 438 pp.

---------, 1963: *Major Features of the Hydrology of the Atlantic Ocean*. Moscow: Gidrometeoizdat, 837 pp.

---------, 1970: Development of oceanographic research in the USSR. *Meteorol. and Hydrol.*, 4, 102-111.

Nazarov, V.S. and A.A. Rybnikov, 1954: Hydrometeorological observations in the whaling ship "Slava-15" of the Antarctic whaling flotilla in 1951-52. In *Proceedings of SOI*, 25(37), 106 pp.

Nikitin, O. P., 1984: POLYMODE XBT data. *POLYMODE Newsletter*, Issue 9, pp. 3-11.

On the hydrology of the Matochkin Shar Strait: Materials of hydrological observations in 1932-33 from the ships "Karbas" and "Arctic", 1936: In *Proceedings of AARI*, 44, 59 pp.

Ovchinnikov, I. M., 1994: Research on the winter regime of Syrian waters in the eastern Mediterranean (24th cruise of the "Vityaz", February-March 1992). *Oceanology*, 34:3, 464-466.

Paka, V.T., 1977: Creating an SST measurement data set. In *Proceedings of RIHMI-WDC*, 54, pp. 27-32.

The Polar Geophysical Station on Bolshoi Lyakhovsky Island: the Work in the Schooner "Polyarnaya Zvezda" in 1927-28, 1932: Leningrad: Izd. AN SSSR i Vsesoyuznogo Arkticheskogo Instituta, 249 pp.

Polilov, 1906: Review of Voyages of the Hydrographic Expedition in the Arctic Ocean. In supplement of *Hydrographic Notes*, 27. St. Petersburg: Tipographiya Imperatorskoi AN, 131 pp.

The Research Vessel, "Vitiyaz," and its Expeditions During 1949-1979, 1983: Moscow: Nauka, 392 pp .

Results of hydrophysical observations in the North Atlantic in the R/V "Mikhail Lomonosov" in 1957-58 (first and second cruises), 1962: In *Proceedings of MHI of the Ukrainian AS*, 21, 507 pp.

Results of the research expedition in the icebreaker "Rusanov" in 1932, 1936: In *Proceedings of AARI*, 42, pp. 10-19.

Rudnev, D. and N. Kulik, 1915: *Materials for Studying the Northern Sea Route from Europe to the Ob and Yenisei*. Petrograd: Tipographiya A.E. Kollins, 127 pp.

Rudovits, L.F. (ed.), 1954: Hydrometeorological observations by the Antarctic whaling fleet in the "Slava" (1949-50). In *Proceedings of SOI*, 24(36), 128 pp.

Science in the Far East: 50–year Results, 1968. Vladivostok, Publishing House AN SSSR, 103 pp.

Scientific results of expeditions in the "Sedov," "Taimyr," and "Tsirkul" in the Kara Sea in 1934, 1936: In *Proceedings of AARI*, 64, pp. 99-170.

Scientific results of expeditions in the ship "Mossovet,"1939: In *Proceedings of AARI*, 120, pp. 29-85.

Shpindler, I.B., 1893: *Results of Hydrological Research on the Black Sea, 1890-91*. St. Petersburg: Imperator Academy of Science, 32 pp.

Sokolov, A.P., 1849: Bering and Chirikov, *J. Severnaya Pchela*, 98, p. 392.

Sorokin, A.I., 1981: *Hydrographic Research into the World Ocean*. Leningrad: Gidrometeoizdat, 287 pp.

State of the Art of the World Ocean Research, 1969. Translated from English. Moscow: VINITI, 605 pp.

Tauber, G.M., 1951: The SOI's expedition in the "Slava" (1947-49). *Proceedings of SOI*, 19(31), 271 pp.

Terziev, F.S., 1983: The 40-Year Anniversary of the State Oceanographic Institute. In *The Study of the Oceans and Seas*, 1. Moscow: Gidrometeoizdat, pp. 3-18.

Treshnikov, A.F. (ed.), 1962: The sixth cruise of the "Ob," 1960-61: Scientific and observational results. In *Proceedings of the Soviet Antarctic Expedition*, Vol. 39. Leningrad: Marine Transport, 228 pp.

Vaksel, S., 1940: *The Second Kamchatka Expedition of the Vitus Bering*. Moscow-Leningrad: Nauka, 168 pp.

Varnek, A.I., 1902: *A Brief Report on the Voyage of the R/V "Pakhtusov" in the Arctic Ocean in the Summer 1901*. St. Petersburg: Tipografiya Morskogo Ministerstva, 16 pp.

---------, 1903: *Notes on the Voyage to Yugorski Shar. Written on the Basis of the Research by the Arctic Ocean Expedition in 1898. Materials and Pilot Charts of the Arctic Ocean, Kara Sea, and Novaya Zemlya*. St. Petersburg: Publishing House Izdanie Glavnogo Gidrograficheskogo Upravleniya, 15 pp.

---------, 1903: *A Brief Report on the Work of the Arctic Ocean Hydrographic Expedition in 1902*. St. Petersburg: Tipographiya Imperator Academy of Science, 36 pp.

Veber, V., 1908-1909: From the expedition of the "Ermak," 1901. Notes of the Mineralogical Society, Ser. 2, V. 46, pp. 213-246.

Veselago, F.F., 1872: *A List of Russian Military Ships: 1668-1860*. St. Petersburg: Imperator Academy Science, 712 pp.

---------, 1893: *A Brief Hystory of the Russian Fleet*. St.-Petersburg, 1893.

Vilkitsky, A., 1896: A review of the hydrographic expedition activity in the mouths of the Yenisei and Ob in 1894-95. *Marine Collected Papers*, 5, pp. 153-176.

Vize, V.Yu., ed., 1929: Scientific Expeditions in the icebreaker "Malygin" in the Barents Sea in summer 1928. *Proceedings of the Institute of Northern Research.* Moscow: Izv. nauchno-tekhnich Upravleniya VSNH SSSR, 45, 111 pp.

---------, 1933: A cruise of the icebreaker "Malygin" to Franz Josef Land in 1931. *Proceedings of AARI.* Leningrad: Glavsevmorput, V. 6, pp. 14-22.

---------, 1933: Scientific results of the expedition in the "Sibiryakov" in 1932. *Proceedings of AARI.* Leningrad: Glavsevmorput, V. 10, pp. 39-83.

---------, 1933: Scientific results of expeditions in the "Sedov," "Sibiryakov," and "Murmanetz" in 1930. *Proceedings of AARI.* Leningrad: Glavsevmorput, V. 1, pp. 16-98.

---------, 1935: Temperature and salinity observations in the sea surface layer. *Proceedings of AARI.* Leningrad: Glavsevmorput, V. 29, pp. 7-28.

---------, 1950: Results of the high-latitude expedition in the icebreaker "Severny Polyus" in 1946. *Proceedings of AARI.* Leningrad: Glavsevmorput, V. 40, pp. 122-150.

Volkov, N.P., N.N. Mikhailov, I.G. Ulyanich and K.B. Yudin, 1990: The state of the art of the information base of oceanographic data for the Baltic Sea. *Proc. of RIHMI-WDC*, 151, Obninsk, pp. 84-98.

Water temperature and salinity observations during ichthyological observations, 1933. *Proceedings of the All-Union Arctic Institute*, 8, 106 pp.

Yakovlev, V.N., 1976: *Hydrometeorological Support of Oceanic Fishery.* Moscow: Pishchevaya Promyshlennost, 230 pp.

Zeidel, I., 1967: A long expedition mounted during the reign of Peter the Great in 1723. In *Marine Collected Papers*, 9, pp. 65-83.

Zverev, A.A. (ed.), 1959: The second marine expedition in the electrically-driven motorship "Ob," 1956-57: Observational materials, in *Proceedings of the Antarctic Expeditions*, Vol. 6. Leningrad: Marine Transport, 387 pp.

Appendix 6. Abbreviations

Institutions of Russia and the Commonwealth of Independent States

AARI	Arctic and Antarctic Research Institute
AI of RAS	Acoustical Institute, Russian Academy of Sciences
AtlantNIRO	Atlantic Research Institute for Marine Fisheries and Oceanography
AzNIRKH	Azov Research Institute for Fishery Problems
BRIF	Baltic Research Institute for Fishery (now AtlantNIRO)
CaspNIRKH	Caspian Research Institute for Fishery Problems
CMR	Center of Marine Research, Lithuania
Far East RIHMI	Far East Research Institute of Hydrometeorological Information
Far East SU	Far East State University
Goskomrybolovstvo	Russian State Committee for Fisheries and Oceanography
GUNIO	Head Department of Navigation and Oceanography (Navy)
Hydromet	Russian Federal Service for Hydrometeorology and Environmental Monitoring (also known as Roshydromet)
IAG	Institute of Applied Geophysics
IBSS	Institute of Biology of the Southern Seas
IEM	Institute of Experimental Meteorology
IGCE	Institute of Global Climate and Ecology
SIO	Shirshov Institute of Oceanology, Russian Academy of Sciences
ITPE	Institute of Thermophysics and Electrophysics (now the Marine Systems Institute at Tallinn University, Estonia)
IV	Institute of Vulcanology
IWP	Institute of Water Problems
MBDC	All-Russian RIFO's Marine Biological Data Center, Committee for Fishery
MGGDC	Marine Geological and Geophysical Data Center, Russian Committee for Natural Resources
MGO	Voeikov Main Geophysical Observatory
MHI	Marine Hydrophysical Institute, Ukrainian Academy of Sciences
MMBI	Murmansk Marine Biological Institute
MSU	Moscow State University
NODC	National Oceanographic Data Center (RIHMI-WDC)
Odessa SOI	Odessa Branch of the State Oceanographic Institute (now the Ukrainian Scientific Center of Ecology of the Sea – USCES)
PBFS	Pacific Bureau of Fishery Survey
POI (Far East Branch)	Pacific Oceanographic Institute, Far East Branch
PINRO	Polar Research Institute for Marine Fisheries and Oceanography
RAS	Russian Academy of Sciences
RIHMI-WDC	All-Russian Research Institute of Hydrometeorological Information – World Data Center
RIMG	All-Russian Research Institute for Marine Geology
ODC	Oceanographic Data Center, Ministry of Defense
RSHMI	Russian State Hydrometeorological Institute (now University)

SakhNIRO	Sakhalin Scientific-Research Institute for Fishery Industry & Oceanography (formerly Sakhalin Comprehensive Research Institute)
SCST	State Committee for Science and Technology, Ministry of Science (now Ministry of Science and Technology)
Sevastopol SOI	Sevastopol Branch of the State Oceanographic Institute (now Marine Division of Ukrainian RIHMI)
SHI	State Hydrological Institute
SOI	State Oceanographic Institute
South RIFO	Southern Scientific Research Institute for Marines Fisheries and Oceanography
SPA "Typhoon"	Scientific-Production Association "Typhoon"
St. Petersburg SOI	St. Petersburg Branch of the State Oceanographic Institute
State Data Holding	State Data Holding for Hydrometeorology and Environmental Monitoring
TINRO	Pacific Research Institute for Marine Fisheries and Oceanography
UkRIHMI	Ukrainian Research Institute of Hydrometeorological Information
VNIRO	Russian Federal Research Institute of Fisheries and Oceanography
WESTFISHREC	West Fishery Reconnaissance Company

International Organizations

CAS	Committee on Atmospheric Sciences
ICES	International Council for the Exploration of the Sea
ICSU	International Council of Scientific Unions
IOC	Intergovernmental Oceanographic Commission
UNESCO	UN Educational, Scientific, and Cultural Organization
WDC	World Data Center
WMO	World Meteorological Organization

Observations and Data Processing

ABS	Automatic Buoy Station
ACC	Antarctic Circumpolar Current
AIRS	Automated Information Reference Systems
AODC	Automated Oceanographic Data Catalog
BT	Bathythermograph
DBMS	Database Management System
DCM	Digital Current Meter
GTS	Global Telecommunication System
IODE	International Oceanographic Data Exchange
ODB	Oceanographic Data Bank
R/V	Research vessel
SST	Sea surface temperature
STP	Salinity - water temperature – pressure

World Data Center for Oceanography, Silver Spring
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