Inventory of Arctic Observing Networks Russia

Version March 2010

Arctic Observing Networks - Russia
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1. Overview of Approach

Networks, points and programs of observation in the Russian Arctic can be classified by their thematic, territorial or departmental belongings. Thematically observation networks can be divided into:

1. Hydrometeorological – observing the Arctic atmosphere and hydrosphere
2. Cryospheric – observing glaciers and permafrost
3. Environmental pollution control
4. Geophysical – observing Earth's magnetosphere, ionosphere and ozonosphere
5. Biologic – observing the Arctic flora and fauna
6. Socio-economic – observing people and medico-biologic and socio-economic aspects associated with their activity

Territorially observation networks can be divided into:

- Terrestrial and marine;
- High-latitude and arctic (adjacent to Arctic seas);
- Regional.

Departmentally, the organizations that actually conduct monitoring in the Russian Arctic are primarily as follows: Roshydromet, Russian Academy of Science and administrative-territorial units

2. Overview of the State of the Arctic Hydrometeorological Observation Networks

1. In the context of the tasks SAON SG steering group, the topology of the Arctic hydrometeorological observation network can be presented in the following concise form:

1. Agrometeorological;
2. Actinometric;
3. Aerological (radiosounding);
4. Water balance;
5. Hydrological on rivers;
6. Hydrometeorological on lakes;
7. Glaciological;
8. Meteorological;
9. Marine hydrometeorological (in the coastal zone, river estuaries, open areas including marine vessel and expeditionary);
10. Avalanche;
11. Ozone measuring;
12. Heat balance;
13. Atmospheric electricity;
14. Water, soil and snow surface evaporation;
15. Chemical composition of water and air.

Observation network data are operationally transferred to Roshydromet's data telecommunication network except for those indicated in items 4, 7,12-15.

The main networks in terms of the number of observation points and volume of information obtained are meteorological, marine hydrometeorological, river hydrological, aerological and actinometric ones.

Meteorological observations are considered as the main type of observations.

To establish a common database and control timely and complete collection and distribution of information, a catalog of meteorological bulletins is being created to be the plan of hydrometeorological information transfer from the sources to Roshydromet's data telecommunication network to distribute among information recipients

The catalog of meteorological observations is maintained by State Institution "Hydrometeorological Center" and State Institution "Main Radio-Meterological Center". Electronic version of the catalogs of meteorological bulletins is maintained by State Institution "Main Radio-Meterological Center" and located on the Internet site http://grmc.mecom.ru.

The catalog of meteorological bulletins contains the following information:

– Name of Roshydromet's subordinate Federal State Institution and observation point to input data into the automated data system;

– shortened title of the hydrometeorological bulletin in proper format;

– observation data coded form;

– hours of observation;

– data transfer check time;

– number of observation points taking part in one bulletin;

– lists of five-digit indices for observation points.

Changes are entered into the catalogs of meteorological bulletins quarterly.

WMO's WWW is considered as the main foreign information consumer. The lists of WMO correspondent stations are given in WMO publications # 9, vol. C, part 1 (Catalog of Meteorological Observations), vol. A (Observation Stations).

2. SAON is expected to stimulate the process of improving configuration and completeness of the circumpolar region monitoring system as a potential tool for international consolidation of the opportunities available in the functioning of observation networks in order to improve national standards quality and ensure more complete compliance of the Arctic research strategies proposed to socioeconomic needs and interests of Arctic countries

3. The catalog of points and main observations is given in Table 1 (see Fig. 1).

The maximum development of the Russian hydrometeorological observations in the Arctic was reached in early 1980s, when information was received from 110 stations. In subsequent years, the number of stations decreased more than twice (Fig. 2). The current level of observations is determined by the functioning of a network consisting of 49 points two of which are automatic weather stations. Three points are temporarily removed from operation. In short term, 8 automatic stations are expected to be opened; while in medium and long term, the number of manned observation points will increase up to 52-54, and the number of automatic ones – up to 20-25.

For the manned network, the meteorological program includes a set of eight-hour observations of: atmosphere pressure, wind parameters, air and soil temperature, relative humidity, weather phenomena, cloud height, visual range, precipitation, while for automatic weather stations – a set of reduced 4-hour observations.

The marine hydrometeorological program includes coastal observation of temperature, water salinity (density), sea-level variations, heave, ice distribution (and thickness) as well as meteorological parameters under the change of observation conditions from hourly to ten-day observations.

The river hydrological program is quite similar to the marine one. It does not include observations of water density, however, they can be included for the stations having a special status, measurement of water discharge, alluvia and chemical composition of water. The programs will include hourly and ten-day observations.

The aerological program will include 1-2 –hour measurements of: atmosphere pressure and wind parameters on selected isobaric surfaces.

Actinometric observations include measurement of 5 components of atmosphere radiation balance in case of the full program and measurement of total radiation under a reduced program.

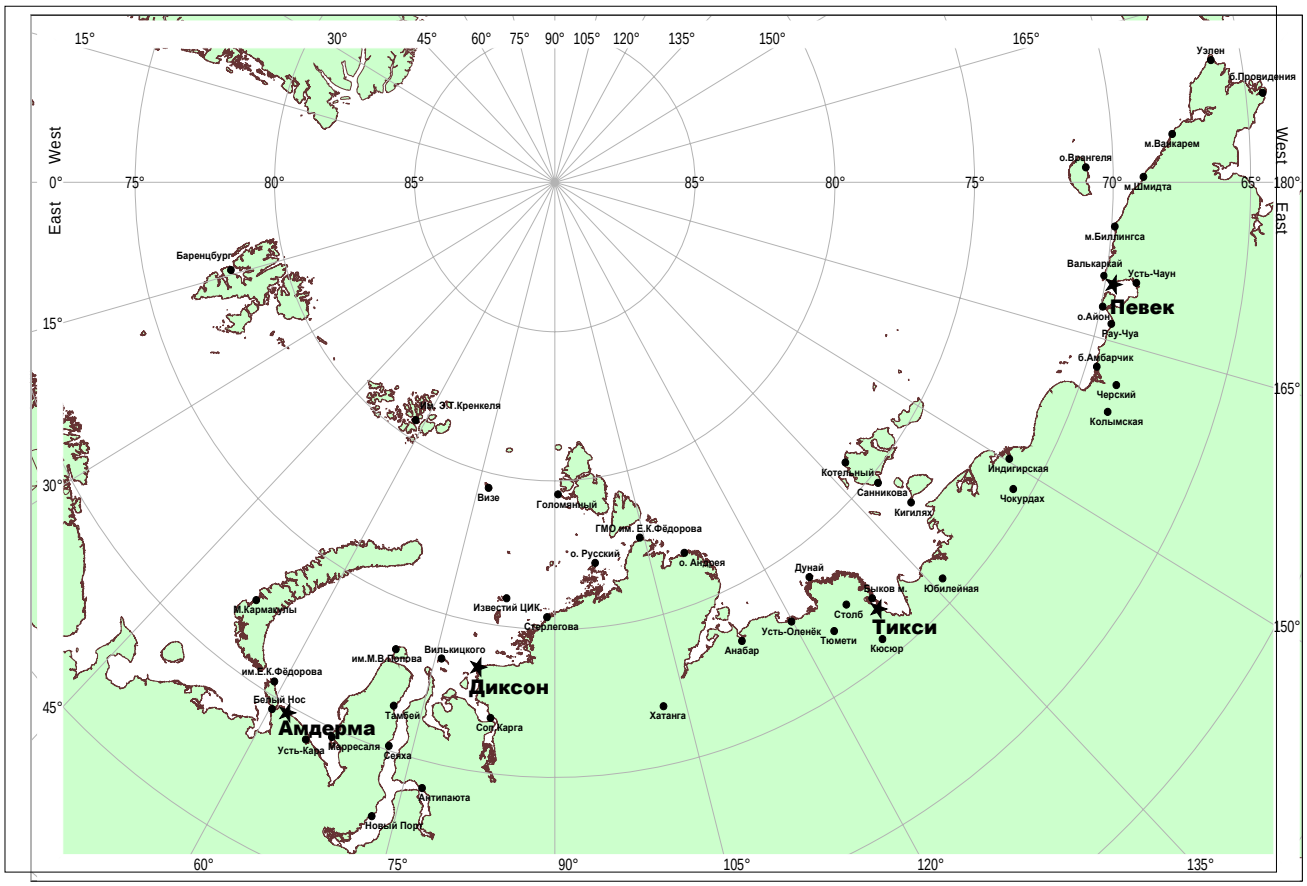


Fig.1. Polar stations in the Russian Arctic.

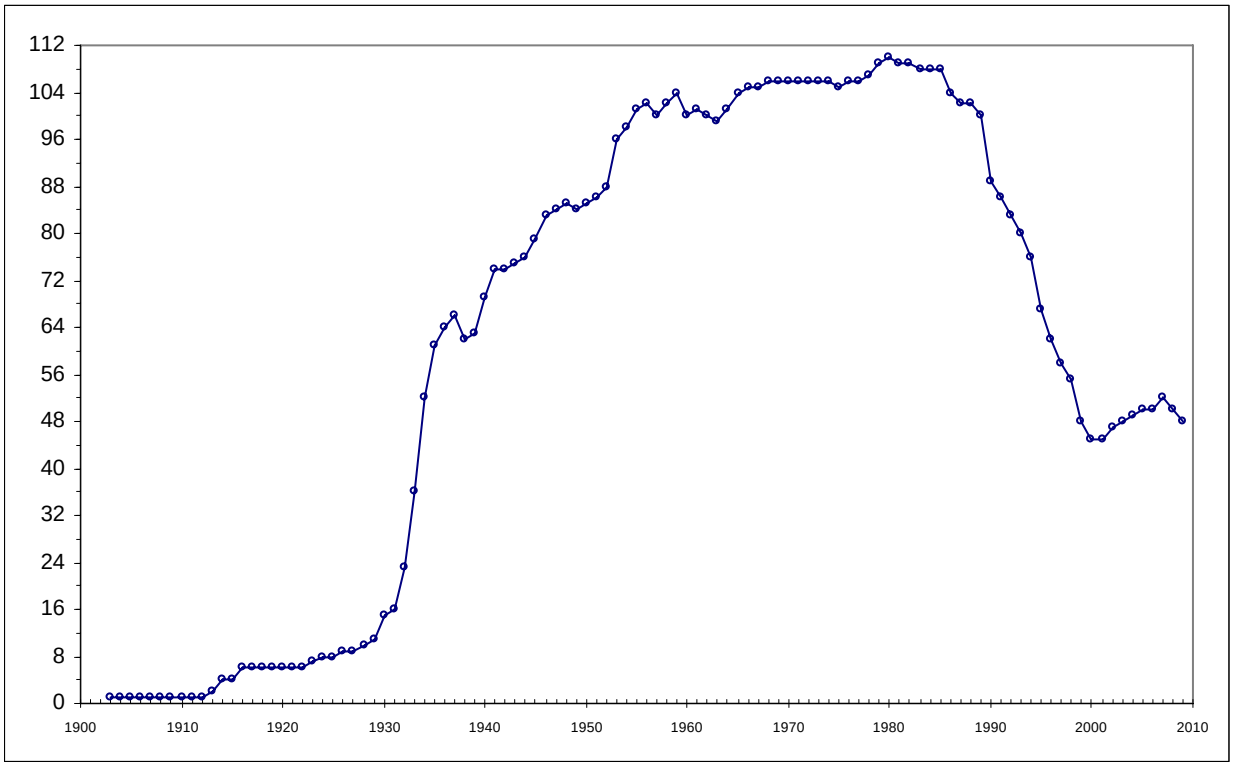


Fig. 2. Change in number of polar stations in 1900-2009.

Table 1

Catalog of hydrometeorological observation points and network

NO	OBSERVATION POINT	Coordinates		networks				
		Latitude (N)	Longitude (E)	Meteorological	Marine hydro meteorological	River hydro logical	Aerological	Actinpmetric
1	MALYE KARMAKULY	72^0 22	52^0 42	+	+		+	+
2	UST'-KARA	69^0 15	64^0 31	+	+			
3	MARE-SALE	69^0 43	66^0 48	+	+			
4	M.V. POPOV	73^0 20	70^0 03	+	+			
5	AMDERMA	69^0 45	61^0 42	+	+			+
6	BELY NOS	69^0 36	60^0 13	+	+			+
7	E.K. FEDOROV (CAPE BOLVANSKY NOS)	70^0 27	59^0 05	+	+			
8	NOVY PORT	67^0 41	72^0 53	+	+			
9	ANTIPAYUTA	69^0 05	76^0 51	+		+		
10	SE-YAKHA	70^0 09	72^0 34	+		+		+
11	TAMBEY (CONSERVATION)	71^0 30	71^0 50	-	-	-	-	-
12	E.T. KRENKEL	80^0 37	58^0 03	+	+		+	+
13	DIKSON ISLAND	73^0 30	80^0 25	+	+		+	+
14	CAPE STERLIGOV	75^0 25	88^0 54	+	+			
15	RUSSKY ISLAND (AUTOMATED)	77^0 08	95^0 36	+				
16	E.K. FEDOROV (CAPE CHELYUSKIN)	77^0 43	104^0 18	+	+			
17	VIZE ISLAND	79^0 30	76^0 59	+	+			+
18	GOLOMYANY ISLAND	79^0 33	90^0 37	+	+			+
19	IZVESTIA CIK ISLAND	75^0 57	82^0 57	+	+			
20	VILKITSKY ISLAND	73^0 31	75^0 46	+	+			
21	SOPOCHNAYA KARGA	71^0 52	82^0 42	+	+			
22	KHATANGA	71^0 59	102^0 28	+		+	+	+
23	CAPE ANDREY (AUTOMATED)	76^0 45	110^0 26	+				
24	ANABAR	73^0 13	113^0 30	+	+			
25	UST-OLENEK	72^0 59	119^0 52	+	+	+		
26	DUNAY	73^0 56	124^0 30	+	+			
27	KHABAROV (MAST)	72^0 24	126^0 21	+		+		
28	BYKOV CAPE	72^0 00	129^0 07	+	+			
29	TYUMETI	71^0 55	123^0 34	+		+		

30	TIKSI	71^0 35	128^0 55	+	+		+	
31	KYUSYUR	70^0 41	127^0 24	+		+		
32	KOTEL''NY ISLAND	76^0 00	137^0 52	+	+			
33	SANNIKOV (CONSERVATION)	74^0 40	138^0 54	-	-	-	-	-
34	KIGILYAKH	73^0 20	139^0 52	+	+			
35	YUBILEYNAYA	70^0 46	136^0 13	+		+		
36	NIZHNE-YANSK	71^0 25	136^0 05	+		+		
37	CHOKURDAKH	70^0 37	147^0 53	+		+	+	
38	CHERSKY	68^0 45	161^0 17	+		+	+	
39	KOLYMSKAYA	68^0 44	158^0 43	+		+		
40	INDIGIRSKAYA (CONSERVATION)	71^0 16	150^0 17	-	-	-	-	-
41	PEVEK	69^0 47	170^0 36	+	+			
42	AMBARCHIK	69^0 37	162^0 18	+	+			
43	AYON ISLAND	69^0 56	167^0 59	+	+		+	
44	CAPE SCHMIDT	68^0 55	180^0 45	+				
45	VALKARKAY	70^0 05	170^0 58	+	+			
46	CHAUN	68^0 53	170^0 47	+				
47	CAPE BILLINGS	69^0 53	175^0 48	+	+			
48	WRANGEL ISLAND	70^0 58	181^0 31	+	+			+
49	UELEN	66^0 08	190^0 50	+				
50	VANKAREM	67^0 50	184^0 50	+	+			+
51	RAU - CHUA	69^0 30	166^0 35	+	+			
52	PROVIDENIYA	64^0 23	186^0 50	+				
	TOTAL			49	31	12	8	11

3. Aerological Observation Network

Name and acronym:
Aerological Observation Network in the North Polar Region

Contact person (e-mail)
A.P. Makshtas – Chief Research Officer, Doctor of Physical and Mathematical Sciences, Arctic and Antarctic Research Institute, maksh@aari.nw.ru

Web site (if any)
No

Main objective of the network:
Monitoring and study of free atmosphere in the North Polar Region

Member of or connected to a global network; if yes, which:
No

Type of activity:
- Theme: Atmosphere
- Location(s): Russian Arctic
- Community-based: data are used in Russian and international programs
- Coordination, e.g. not directly involved in observations, but coordinating data and information (e.g., AMAP): AARI collects data and establishes

Main variables:

- atmosphere pressure,
- geopotential height,
- air temperature,
- dew-point deficit,
- wind structure,

the parameters are measured:

- at ground level,
- at standard heights,
- on standard isobaric surfaces,
- at tropopause level,
- at special points downwind and at the level of maximum wind
- and also cloud amount data as of the moment of sounding.

The archive includes temperature wind sounding of atmosphere for 00,06,12,18 GMT.

When operational (year):

Catalog of observation points for 2009.

No	Station index	Longitude	Latitude	Height m.	Name	Period of observations
1	20046	5803	8060	20	Heiss	1958-2009
2	20292	10427	7770	16	Chelyuskin	1937-2009
3	20674	8022	7350	46	Dikson	1937-2009
4	20744	5272	7237	19	Cape Karmakuly	1950-2009
5	20891	10245	7197	26	Khatanga	1949-2009
6	21824	12890	7157	4	Tiksi	1935-2009
7	21946	14787	7060	44	Chokurdakh	1955-2009
8	22113	3303	6895	66	Murmansk	1950-2009
9	22217	3242	6712	24	Kandalaksha	1957-2009

10	22271	4412	6787	10	Shoyna	1952-2009
11	22522	3477	6497	7	Kem	1951-2009
12	22550	4050	6457	4	Arhangelsk	1938-2009
13	22820	3425	6180	110	Petrozavodsk	1957-2009
14	22845	3892	6150	126	Kargopol	1962-2009
15	23078	8828	6932	62	Norilsk	1950-2009
16	23205	5300	6763	5	Naryan-Mar	1943-2009
17	23330	6652	6652	15	Salekhard	1950-2009
18	23418	5708	6510	61	Pechora	1950-2009
19	23472	8793	6577	37	Turukhansk	1952-2009
20	23804	5083	6165	118	Syktyvkar	1950-2009
21	23884	9000	6158	63	Tunguska	1949-2009
22	23921	6042	6067	95	Ivdel	1953-2009
23	23933	6905	6095	44	Khanty-Mansiysk	1950-2009
24	23955	7785	6042	47	Aleksandrovskaya	1950-2009
25	24125	11242	6850	206	Olenek	1950-2009
26	24266	13337	6753	137	Verkhoyansk	1951-2009
27	24343	12338	6675	83	Zhigansk	1950-2009
28	24507	10005	6415	186	Tura	1951-2009
29	24641	12160	6375	110	Vilyuysk	1950-2009
30	24688	14313	6325	740	Oymyakon	1950-2009
31	24726	11385	6252	357	Mirny	1950-2009
32	24908	10225	6032	260	Vanavara	1953-2009
33	24944	12040	6038	135	Olekminsk	1950-2009
34	24959	12975	6207	100	Yakutsk	1939-2009
35	25042	16797	6993	16	Ayon	1960-2006
36	25123	16127	6878	26	Chersky	1951-2009
37	25400	15088	6572	40	Zyryanka	1961-2009
38	25428	16052	6522	263	Omolon	1958-2009
39	25703	15240	6290	206	Seymchan	1945-2009

Geographical coverage (countries)

Russia

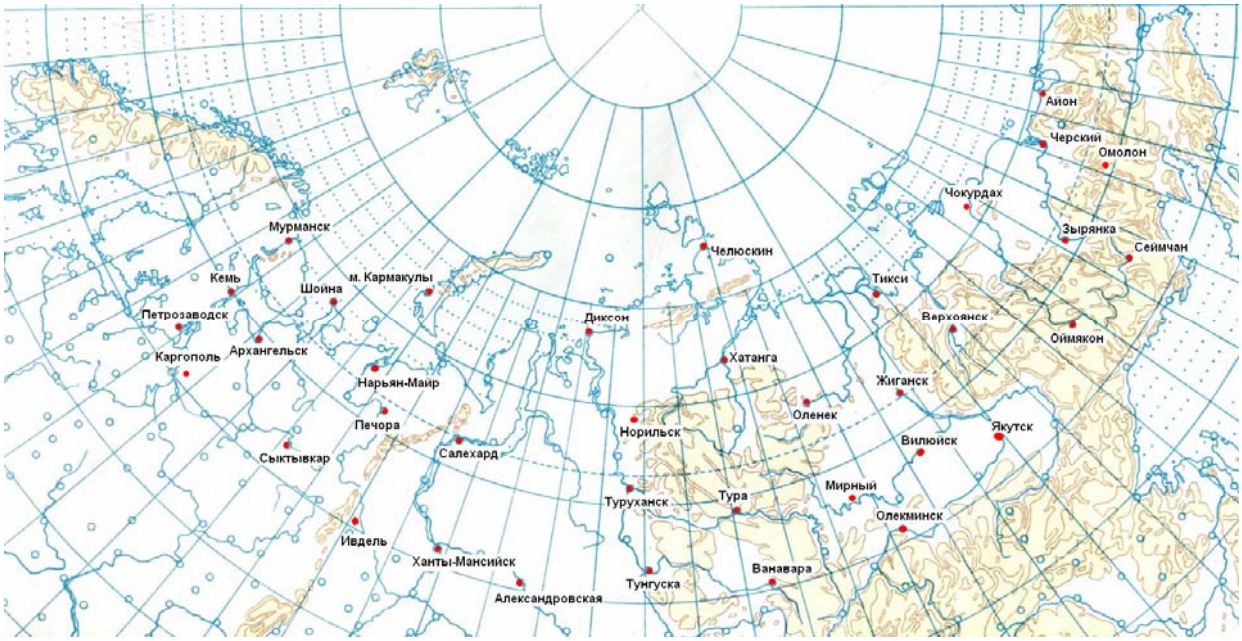


Fig. 3. Location of aerological stations

Data archive/centre, including Web site:

Arctic and Antarctic Research Institute (AARI) Roshydromet, Russia, aari.nw.ru

Data availability:

Metadata

4. Observation of Solar Radiation in the Arctic

Name and acronym:
Monitoring component of solar radiation in the Arctic

Contact person (e-mail)
World Radiation Data Centre
Voeikov Main Geophysical Observatory
7, Karbyshev Street,
194021, St.Petersburg
Russian Federation
wrdc@main.mgo.rssi.ru
Phone.: +7 812 297-43-90

Head, WRDC - Anatoly Viktorovich Tsvetkov
tsvetkov@main.mgo.rssi.ru
Research Officer Elena Anatolievna Samukova
wrdc@main.mgo.rssi.ru

Web site
http://wrdc.mgo.rssi.ru

Main objective of the network:

The World Radiation Data Center (WRDC) was established by the order of WMO in the Voeikov Main Geophysical Observatory (Saint Petersburg) in 1964 to centrally collect and provide solar radiation data from the world actinometric network stations.

Member of or connected to a global network; if yes, which:

The WRDC regularly cooperates the following Finland, Sweden, Canada and USA NHMS' providing radiation data including those from Arctic stations beginning with 1964.

FINLAND
Finnish Meteorological Institute
Observation Services
P.O.Box 503, FIN-00101 Helsinki

SWEDEN
Swedish Meteorological & Hydrological Institute
SE = 601 76 Norrköping

CANADA
National Archives & Data Management Branch
Atmospheric Monitoring & Water Survey Directorate
Meteorological Service of Canada, Environment Canada
4905 Dufferin Street
Toronto M3H 5T4

UNITED STATES OF AMERICA

Scientific Services Division, Climate Analysis Branch
National Climatic Data Center
151 Patton Ave.
Asheville, NC 28801-5001

14 Arctic stations belong to the WMO Global Atmosphere Watch. The WRDC regularly provides information on the entry of radiation data of Global Atmosphere Watch to the GAWSIS information system (GAW Station Information System) supported by the organizations of the Federal Office of Meteorology and Climatology MeteoSwiss and Swiss Federal Laboratories for Materials Testing and Research (EMPA, Dübendorf, Switzerland, http://gaw/empa/ch/gawsis). Also this system presents information from other international centers: WDCGG (Gases), WOUDC (Ozone/UV), WDCPC (Precip.chem.), WDCA (Aerosols/AOD), WRC-RSAT (Remot.sens.).
The WRDC partners with the World Radiation Monitoring Center (Alfred Wegener Institute, Bremenhaven, Germany) where the Baseline Surface Radiation Network archive is located (http://www.bsrn.awi.de). The BSRN archive contains data from several Arctic stations including those not presented in the WRDC (Ny-Ålesund, Spitsbergen and Greenland Summit).

Type of activity:

- Collection of actinometric data from National Meteorological Administrations and other organizations
- Processing and control of operational information
- Scientific and methodological interaction with NHMS'
- Publication and distribution of bulletins "Solar Radiation and Radiation Balance. World Network", including data access through the WRDC server http://wrdc.mgo.rssi.ru
- Service of users of information on solar radiation
- Analysis of historical data
- Creation of metadata base

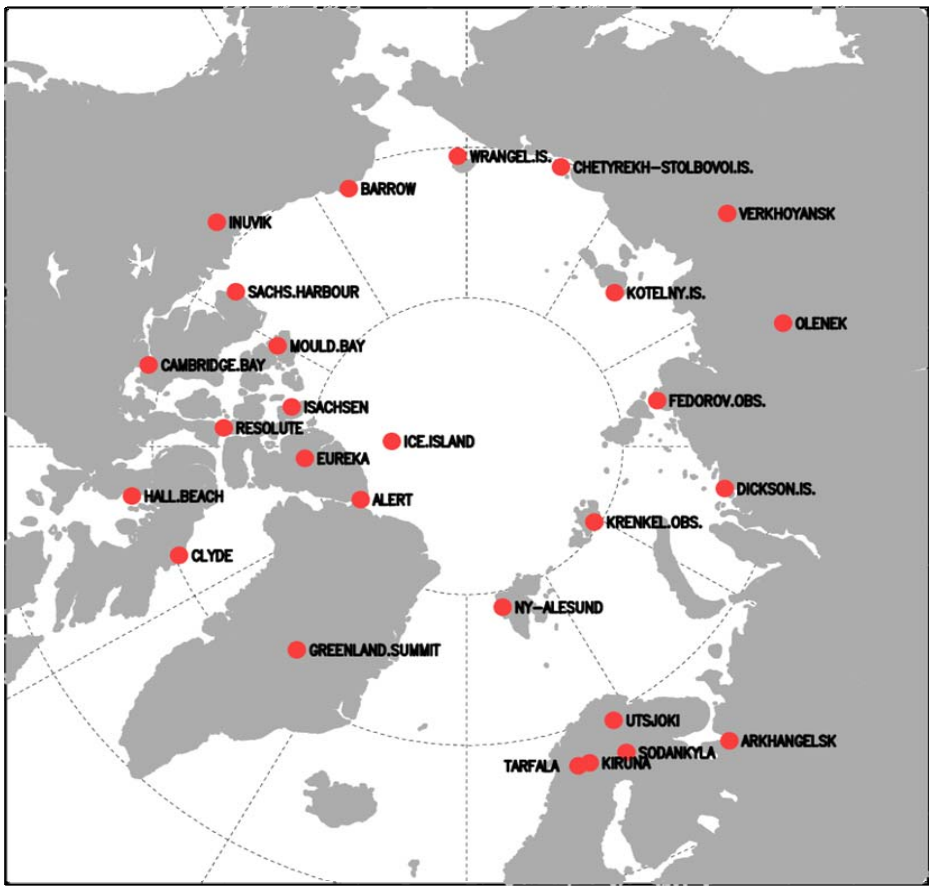
Main variables:

The WRDC has actinometric data from 25 Arctic stations of Russia, Norway, Finland, Sweden, Greenland, Canada and USA for 4 radiation parameters:

- Total short-wave radiation
- Direct short-wave radiation
- Scattered short-wave radiation
- Radiation balance

Radiation data obtained are accompanied by metadata including as follows:

- Description of meteorological station
- Information on station transfer
- Information on replacement of actinometric instruments, their height and position
- Horizon closeness chart
- Information on changes in measurement procedure (e.g. transition to hourly observation) and information processing algorithm
- Information on environmental changes near the station.



Arctic stations in the WRDC archive and their belonging to various programs

Country	Station	Latitude	Longitude	WMO Index	GAW station type/BSRN
Russia	Krenkel Observatory	80˚37'	58˚03'	20046	GAW Regional
Russia	Fedorov Observatory	77˚43'	104˚17'	20292	
Russia	Kotelny Island	76˚00'	137˚54'	21432	GAW Regional
Russia	Dickson Island	73˚30'	80˚24'	20674	GAW Regional
Russia	Wrangel Island	70˚58'	-178˚32'	21982	
Russia	Chetyrekh-stolbovoi Island	70˚38'	162˚24'	21965	
Russia	Olenek	68˚30'	112˚26'	24125	GAW Regional
Russia	Verkhoyansk	67˚33'	133˚23'	24266	
Russia	Arkhangel'sk	64˚35'	40˚30'	22550	GAW Regional
Finland	Utsjoki	69˚45'	27˚00'	02805	
Finland	Sodankyla	67˚22'	26˚37'	02836	GAW Global
Sweden	Tarfala	67˚55'	18˚36'	02029	
Sweden	Kiruna	67˚50'	20˚26'	02045	GAW Contributing

Norway	Ny-Ålesund, Spitzbergen	78˚56'	11˚57'	01004	GAW Global/ BSRN
Greenland	Greenland Summit	72˚34'	38˚29'		GAW Regional/ BSRN
Canada	Ice Island	85˚17'	-94˚03'		
Canada	Alert	82˚30'	-62˚20'	71082	GAW Global/ BSRN
Canada	Eureka	79˚59'	-85˚56'	71917	GAW Regional
Canada	Isachsen	78˚47'	-103˚32'	71074	
Canada	Mould Bay	76˚14'	-119˚20'	71072	GAW Regional
Canada	Resolute	74˚43'	-94˚59'	71924	GAW Regional
Canada	Sachs Harbour	72˚00'	-125˚16'	71051	
Canada	Clyde	70˚29'	-68˚31'	71090	
Canada	Cambridge Bay	69˚06'	-105˚07'	71925	
Canada	Hall Beach	68˚47'	-81˚15'	71081	
Canada	Inuvik	68˚19'	-133˚32'	71957	
United States	Barrow	71˚18'	-156˚47'	70026	GAW Global/ BSRN

Main gaps:
Actually the acquisition of data from some Arctic stations, including Russian ones, is paused due to reconstruction of national actinometric networks. The network included in the international data exchange is sparse.

5. Oceanological Observations

Oceanological observations in the Arctic Ocean and Arctic seas are conducted on the network of marine coastal stations, by marine expeditions, on drifting stations and using ITP-type drifting buoys and also using remote sensing (Fig. 4).

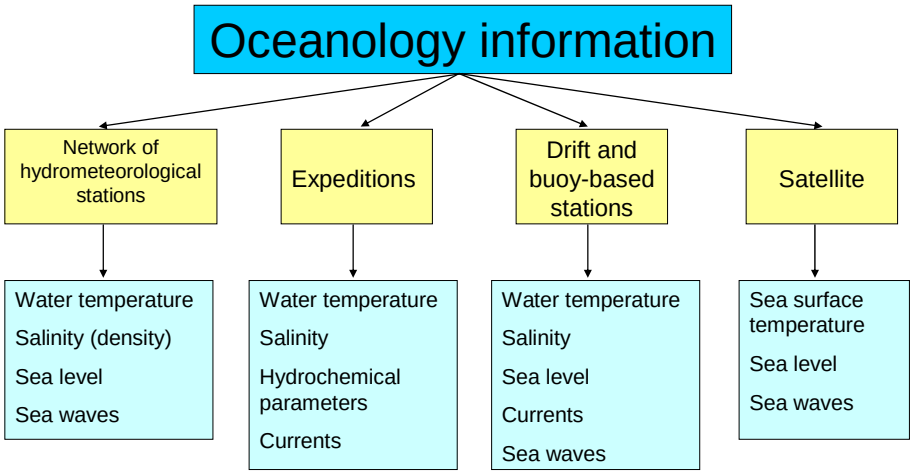


Fig. 4. Types and sources of oceanological information acquisition

Name and acronym:
Oceanological observations in the Arctic Ocean

Contact person (e-mail)
Ashik I.M. – Head of Oceanology Department, Cand. Sc. {Geography}, Arctic and Antarctic Research Institute, ashik@aari.nw.ru
Sokolov V.T. – Chief of High-Latitude Arctic Expedition, svt@aari.nw.ru

Web site (if any)
http://ocean8x.aari.ru/
http://ocean8x.aari.ru/lvlgraph/itp.php

Main objective of the network:
Monitoring and study of hydrophysical and hydrochemical parameters of the Arctic Ocean

Member of or connected to a global network; if yes, which:
No

Type of activity:
- Theme: Ocean
- Location(s): Arctic Ocean
- Community-based: data are used in Russian and international programs
- Coordination, e.g. not directly involved in observations, but coordinating data and information (e.g., AMAP): Data are collected and databases are created by AARI

Main variables:
- water temperature,
- water salinity.

These parameters are measured at standard depths.

When operational (year):

Since 1987 up to the present day

Geographical coverage (countries)

Arctic Ocean

Data archive/centre, including Web site:

Arctic and Antarctic Research Institute (AARI) Roshydromet, Russia, aari.nw.ru

Data availability:

Metadata

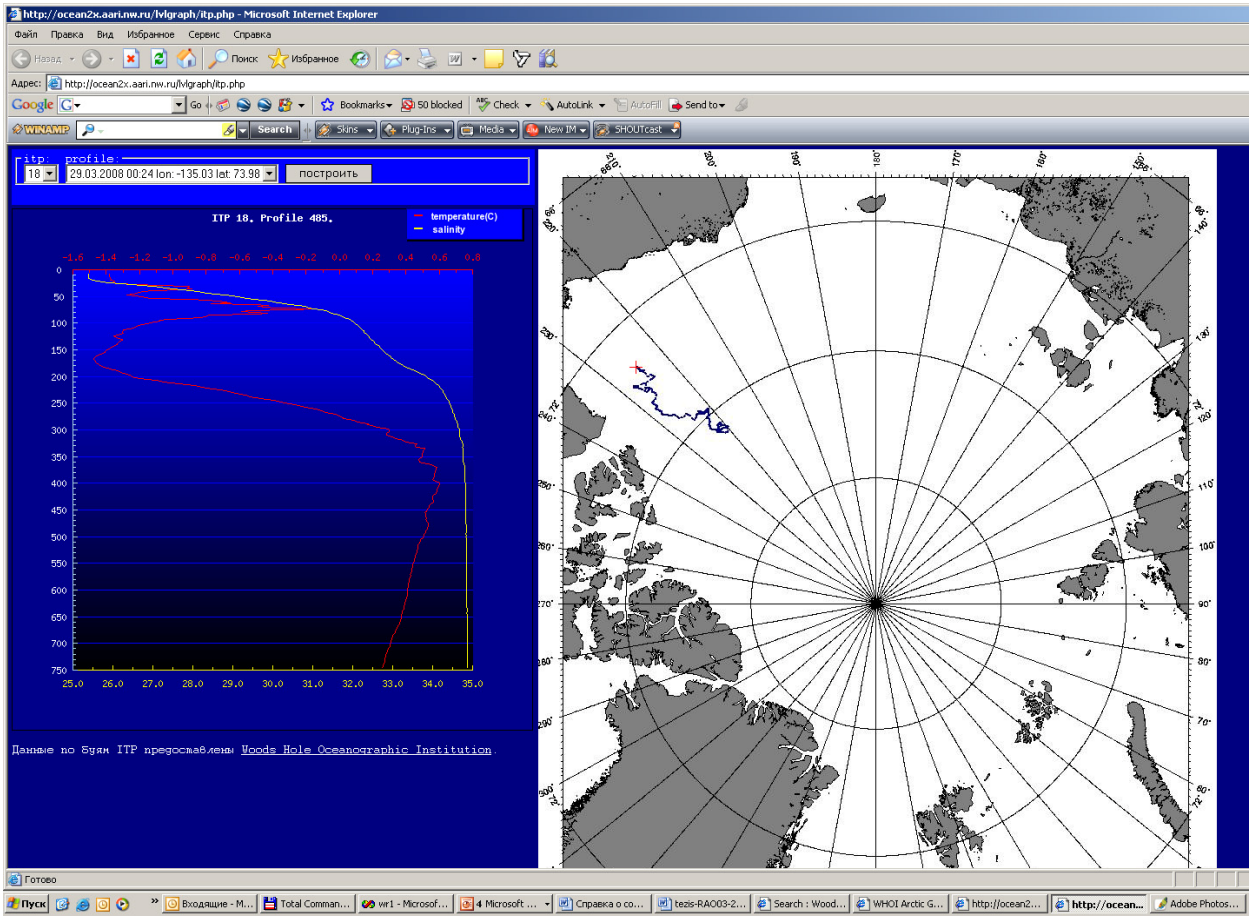


Fig. 5. ITP and North Pole data on the AARI's web-site

6. Observations of Sea level

Name and acronym:
Network of coastal observation of Arctic seas level

Contact person (e-mail)
Ashik I.M. – Head of Oceanology Department, Cand. Sc. {Geography}, Arctic and Antarctic Research Institute, ashik@aari.nw.ru

Web site (if any)
http://ocean8x.aari.nw.ru/lvlgraph/lvGraph.php

Main objective of the network:
Monitoring and study of fluctuation of Arctic seas level

Member of or connected to a global network; if yes, which:
GLOSS

Type of activity:
- Theme: Ocean
- Location(s): Arctic seas
- Community-based data are used in Russian and international programs
- Coordination, e.g. not directly involved in observations, but coordinating data and information (e.g., AMAP): Data are collected and databases are created by AARI

Main variables:
Sea level according to coastal stations data

When operational (year):
Since the 1930s up to the present day

Geographical coverage (countries)
Russian Arctic seas

Data archive/centre, including Web site:
Arctic and Antarctic Research Institute (AARI) Roshydromet, Russia, aari.nw.ru

Data availability:
Metadata

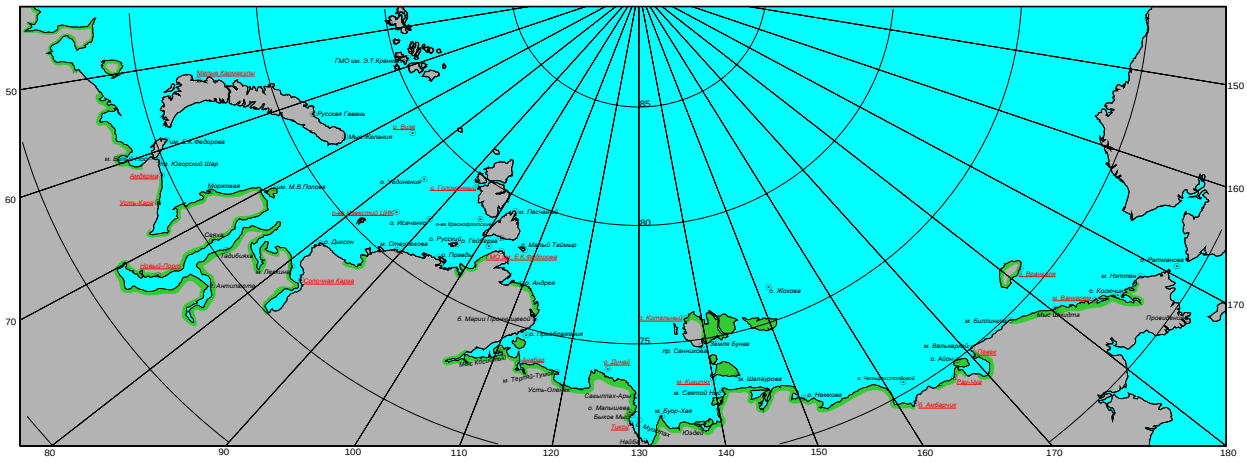


Fig. 6. Location of the sea level observation network in Arctic seas as of the late 1980s гг. (the stations are underlined on which sea level observations have been conducted up to 2009)

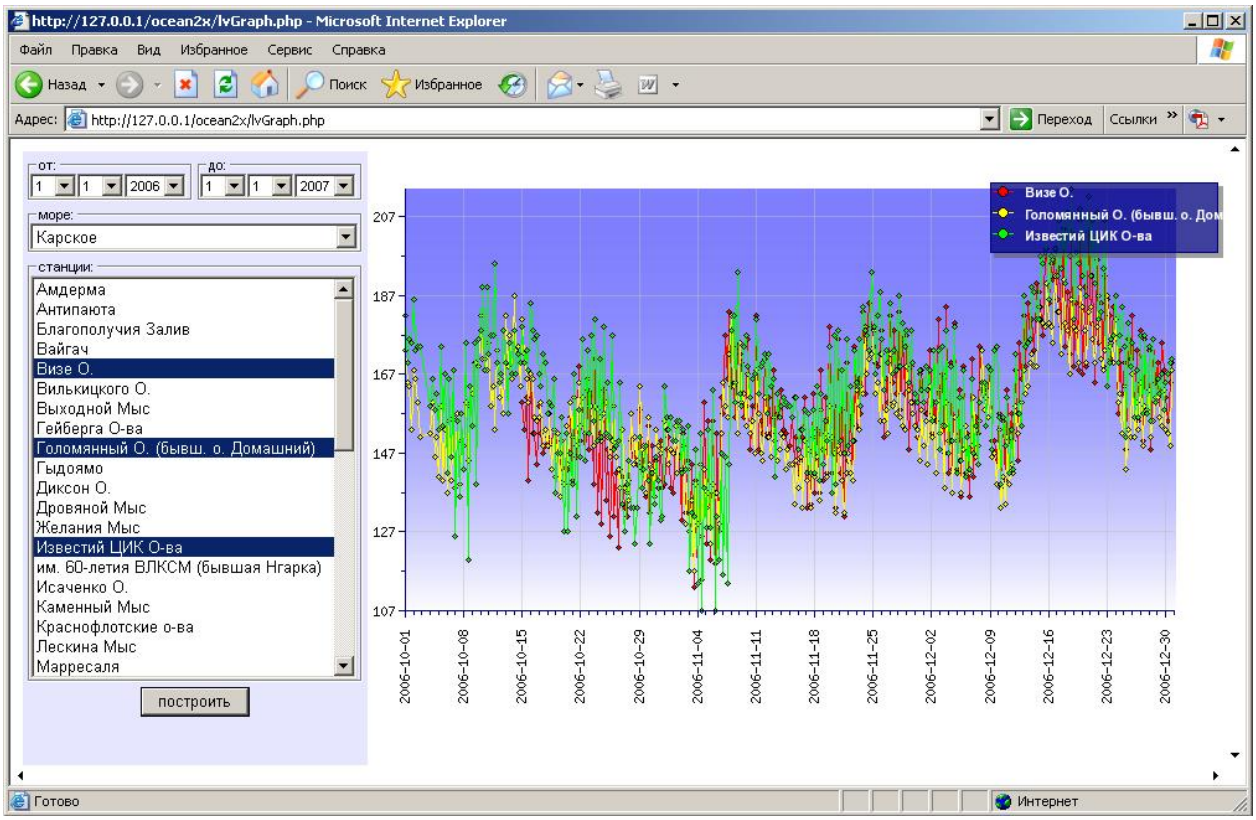


Fig. 7. Levels data on the AARI's web-site

7. Sea Ice

Name and acronym:
Observations of ice conditions of the Arctic Ocean and Arctic seas

Contact person (e-mail)
Smolyanitsky V.M. – Head of Laboratory, AARI
vms@aari.nw.ru
Yulin A.V. – Head of Laboratory, AARI
icefor@aari.nw.ru

Web site (if any)
www.aari.nw.ru

Main objective of the network:
Monitoring of ice conditions: providing of collection, analysis, archiving and presentation of information obtained from different information sources

Member of or connected to a global network; if yes, which:
JCOMM

Type of activity:
- Theme: Sea ice
- Location(s): Arctic Ocean, Arctic seas and estuarine areas of the Asian Arctic rivers.
- Community-based: data are used in Russian and international programs
- Coordination, e.g. not directly involved in observations, but coordinating data and information (e.g., AMAP): Data are collected and databases are created by AARI

Main variables:
Monitoring includes observation and recording of the following phenomena and processes:
– main phases of ice phenomena in autumn – ice formation, occurrence of stationary ice (fast ice), specific ice age scales (young ice, light first-year ice, medium first-year ice, etc.);
– growth, drift and expansion of ice cover in winter;
– development and variability of stationary ice (fast ice), state of coastal flaw leads in winter;
– main phases of ice phenomena in spring – beginning of ice melting, destruction of fast ice, clearance of sea ice;
– melting, destruction and evolution of ice cover in summer;
– state of the ice cover surface (snow and ice thickness, forms and size of ice features, ridging, state of the surface and a whole series of other characteristics)

When operational (year):
Since the 1920s up to the present day

Geographical coverage (countries)
Arctic Ocean and Russian Arctic seas

Data archive/centre, including Web site:
Arctic and Antarctic Research Institute (AARI) Roshydromet, Russia, aari.nw.ru

Data availability:
The continuous monitoring system is based on information from two main groups. The first one is immediate direct observation of the state of ice cover. The information sources are Roshydromet's permanent polar stations, automatic weather stations and buoys, satellite images

in different wave ranges through international hydrometeorological information exchange channels under the auspices of WMO (ETSI) and Ice Services of different countries. Occasional observations by marine expeditions and "North Pole" drifting stations also belong of this group of observation. These are so-called initial or raw data to be further processed, accumulated and archived. As a rule, this information is interesting only to specialists and is not presented without special processing.

The second one is processed and summarized information, i.e. diagnostic, analytical and prognostic information. Diagnostic information is a result of processing of initial or raw information. These are adapted and geographically bound satellite images, ice maps, diagnosis of the current state in the form of descriptions and different bulletins. Analytical information is a consolidation of heterogeneous initial and diagnostic information on the ice cover state in the form of overviews and bulletins for different periods of time and different components of ice conditions. Prognostic information is a forecast of different lead times for different phenomena and characteristics of ice conditions.

Actually ESIMO AARI web-portal presents a series of group 2 information products having the best informativity and ready for the direct use by customers.

Diagnostic Information

#	Types of information products placed on web sites	URL on AARI servers	Type of presentation	Update frequency
1	Base 7-day map of the state of the Arctic Ocean ice cover	http://www.aari.ru/resources/d0015/arctic/gif/slo.txt	Maps	weekly
2	Base 7-day map of the state of the Arctic Ocean ice cover in SIGRID-3 format	http://www.aari.ru/resources/d0015/arctic/sigrid/slo_sigrid3.txt	Structured file	weekly
3	Archive of base 7-day maps of the state of the Arctic Ocean ice cover (in GIF format)	http://www.aari.ru/projects/ecimo/modul.php?mod=d0015&in=1	Maps	Year
4	Daily map of assessment of total ice concentration of the Arctic Ocean according to AMSR by hybrid algorithm (for the last 30 days in GIF format)	http://www.aari.ru/gdsidb/amsr/arctic_ctl_oper.txt	Maps	Daily
5	Daily map of assessment of total ice concentration of the Arctic Ocean according to AMSR by hybrid algorithm (archive in GIF format)	http://www.aari.ru/gdsidb/amsr/arctic_ctl_archive.txt	Map	Daily
6	Aggregate map of the state of the Kara Sea ice cover (archive in GIF format)	http://www.aari.ru/resources/d0004/ctl_kar.txt	Map	montly (with one month delay)
7	Aggregate map of the state of the Kara Sea ice cover in SIGRID-3 format	http://www.aari.ru/resources/d0004/ctl_kar_sigrid.txt	Structured file	montly (with one month delay)
8	Aggregate map of the state of the Laptev Sea ice cover (archive in GIF format)	http://www.aari.ru/resources/d0004/ctl_lap.txt	Map	montly (with one month delay)
9	Aggregate map of the state of the Laptev Sea ice cover in SIGRID-3 format	http://www.aari.ru/resources/d0004/ctl_lap_sigrid.txt	Structured file	montly (with one month delay)
10	Aggregate map of the state of the East Siberian Sea ice cover (archive in GIF format) East Siberian Sea	http://www.aari.ru/resources/d0004/ctl_ess.txt	Map	montly (with one month delay)
11	Aggregate map of the state of the East Siberian Sea ice cover in SIGRID-3 format	http://www.aari.ru/resources/d0004/ctl_ess_sigrid.txt	Structured file	montly (with one month delay)
12	Aggregate map of the state of the Chukchi Sea ice cover (archive in GIF format)	http://www.aari.ru/resources/d0004/ctl_chu.txt	Map	montly (with one month delay)
13	Aggregate map of the state of the Chukchi	http://www.aari.ru/resources/	Structured file	montly (with

	Sea ice cover in SIGRID-3 format	d0004/ctl_chu_sigrid.txt		one month delay)
14	Aggregate map of the state of the Greenland Sea ice cover (archive in GIF format)	http://www.aari.ru/resources/ d0004/ctl_gre.txt	Map	montly (with one month delay)
15	Aggregate map of the state of the Greenland Sea ice cover in SIGRID-3 format	http://www.aari.ru/resources/ d0004/ctl_gre_sigrid.txt	Structured file	montly (with one month delay)
16	Map of analysis of fields of ice concentration and mean daily ice drift in the Arctic Ocean and Arctic seas (for the last 30 days)	http://www.aari.ru/f0013/r010 401_oper_slo.txt	Map	Daily
17	Map of analysis of fields of ice concentration and mean daily ice drift in the Arctic Ocean and Arctic seas (archive for the last year)	http://www.aari.ru/f0013/r010 401_arch_slo.txt	Map	Montly
18	Map of analysis of fields of ice and mean daily ice drift in the Western Arctic (for the last 30 days)	http://www.aari.ru/f0013/r010 401_oper_west.txt	Map	Daily
19	Map of analysis of fields of ice and mean daily ice drift in the Eastern Arctic (for the last 30 days)	http://www.aari.ru/f0013/r010 401_oper_east.txt	Map	Daily
20	Operational information from IABP and ARGO Arctic drifting buoys	http://www.aari.ru/clgmi/gts/ buoy/buoy.daily.csv.n.txt	Structured file	Daily every 3 hours
21	Operational data on drift parameters of North Po;e-37 drifting station	http://www.aari.ru/resources/ d0014/np37/data/drift/np37.v ector.csv	Structured file	Daily every 3 hours
22	Operational map of North Po;e-37 station drift	http://www.aari.ru/resources/ d0014/np37/data/drift/drift_bi g.png	Map	Daily every 3 hours

Analytical Information

1	Statistical characteristics of Arctic seas and their regions ice coverage	http://www.aari.ru/projects/e cimo/modul.php?mod=d000 5_s&in=1	Table	Montly
2	Ice massif areas in Arctic seas	http://www.aari.ru/projects/e cimo/modul.php?mod=d000 6&in=1	Table	Montly
3	Arctic seas and their regions ice coverage	http://www.aari.ru/projects/e cimo/modul.php?mod=d000 5&in=1	Table	Montly
4	Time of occurrence of main ice phenomena in Arctic seas according to data from polar stations	http://www.aari.ru/projects/e cimo/modul.php?mod=d000 9&in=1	Table	Montly
5	Reference book for navigation ice conditions on the Northern Sea Route	http://www.aari.nw.ru/ecimo /manuals/pr21/manual_smp/ content.html	Appendix	
6	Reference book for dangerous weather events on the Northern Sea Route	http://www.aari.ru/resources/ a0011_12/manual_op/conten t.html	Appendix	
7	Electronic atlas of the Arctic Ocean sea ice	http://www.aari.ru/resources/ m0001/sea_ice/CD1/VISUA L_ATLAS/welcome.htm	Appendix	
8	Review of the state of weather and ice conditions in the Arctic Ocean (for the last year)	http://www.aari.ru/resources/ /sea_ice/obzor/ content.htm	Structured file	Annualy

Prognostic Data

1	Short-range forecast map of the Barents and Kara Seas ice cover evolution with 7-day time lead (a set of maps for the current week)	http://www.aari.ru/resources/f0011/ice_map_oper.txt	Structured file	Weekly
2	Prognostic map of ice concentration in the Arctic Ocean with 0-6-day time lead	http://www.aari.ru/resources/f0013/P0255_00.txt	Map	Daily
3	Prognostic map of mean daily ice drift in the Arctic Ocean with 0-6-day time lead	http://www.aari.ru/resources/f0013/P1030.txt	Map	Daily
4	Prognostic map of instantaneous ice drift in the Arctic Ocean with 0-6-day time lead	http://www.aari.ru/resources/f0013/P1028.txt	Map	Daily
5	Long-term forecast of the dates of stable ice formation in the south-west and north –east Kara Sea	http://www.aari.ru/odata/_f0018.php	Object file	Annualy
6	Ice forecasts for 5 Arctic seas with 1-5-month time lead	http://www.aari.ru/odata/_f0022.php	Object file	4 times a year
7	Ice forecasts for estuarine areas of Siberian rivers for spring and autumn	http://www.aari.ru/odata/_f0017.php	Object file	4 times a year
8	Medium-term forecast of the dates of ice break-up in estuarine areas of Siberian rivers	http://www.aari.ru/resources/f0017/icego.txt	Structured file	As needed
9	Medium-term forecast of the dates of ice clearing in estuarine areas of Siberian rivers	http://www.aari.ru/resources/f0017/clear.txt	Structured file	As needed
10	Medium-term forecast of the dates of south ice edge location in estuarine areas of Siberian rivers	http://www.aari.ru/resources/f0017/kromka.txt	Structured file	As needed

8. Hydrological Observation Network for Land Water Bodies and River Estuaries in the Russian Arctic

Name and acronym:
Hydrological observation network for land water bodies

Contact person (e-mail)
Ivanov V.V. – Head of Department of Hydrology of Estuarine Areas, Cand. Sc. {Geography}, Arctic and Antarctic Research Institute, ivanov@aari.nw.ru

Web site (if any)
www.aari.ru

Main objective of the network:
Monitoring of the state of land water bodies and river estuaries

Member of or connected to a global network; if yes, which:
Basic hydrological network is linked to the WMO global network.
Data on the network for land water bodies and river estuaries covers the region of the Russian Arctic limited with its water resource boundaries close to the AMAP boundaries. Within these boundaries, when the network extension was the greatest in the 1980s, there were 288 points including 199 basic ones (97 of which are reference ones) and 89 auxiliary and departmental ones.
Actually in the Russian Arctic, there are 182 points including 137 basic ones (88 of which are reference ones) and 52 auxiliary and departmental ones and 12 of which function under special estuarine programs

Type of activity:
- Theme: land hydrology
- Location(s): surface land and river estuary waters of the Russian Arctic
- Community-based: data are used in Russian and international programs
- Coordination, e.g. not directly involved in observations, but coordinating data and information (e.g., AMAP): Data are collected and databases are created by AARI

Main variables:
- water levels
- water discharge
- water temperature
- ice phenomena
- ice thicknesses
- water turbidity
- suspended and transported sediments discharge
- chemical composition of water (only on reference posts)

When operational (year):
Systematic observations for specific areas started in 1930
The maximum expansion of the network – 1980s

Geographical coverage (countries)
Watersheds of the rivers pf the of the Russian Arctic seas basins within the Arctic water resource doundaries.

Data archive/centre, including Web site:
Arctic and Antarctic Research Institute (AARI) Roshydromet, Russia, aari.nw.ru

Data availability:
Metadata

9. Databases for the Russian Arctic Hydrometeorological Observation and Information Networks

9.1. Atmospheric observations

9.1.1 Terrestrial meteorological observations

Name and acronym:
Network of terrestrial meteorological observations

Contact person (e-mail)
V.N. Razuvaev (razuvaev@meteo.ru)

Web site (if any)
http://www.meteo.ru/

Main objective of the network:
Monitoring and forecast of the atmosphere state and climate change.

Type of activity:
- Theme: lower atmosphere
- Location(s): irregular within the territory of the Russian Federation including those on Arctic islands see Figure 8)

Main variables:

- air temperature and humidity,
- type and amount of clouds,
- atmosphere pressure,
- wind structure,
- visual range,
- atmospheric phenomena.

Observations – every 3 or 6 hours.

When operational (year):
Since 1813 (Arkhangelsk station)

Geographical coverage (countries)
Russian Federation.

Data archive/centre, including Web site:
RIHMI-WDC, http://www.meteo.ru/

Data availability:
Metadata - station certificates are available on-line (http://meteo.ru/climate/katalog.htm)
Average daily data on air temperature and amount of precipitation from 223 stations and average monthly data from 476 stations are available on-line (http://meteo.ru/climate/sp_clim.php/).

The rest data can be prepared on request.

Key problems:

Initial historical data from specific stations have not been digitized
It is needed to control and recover gaps in historical data from specific stations.

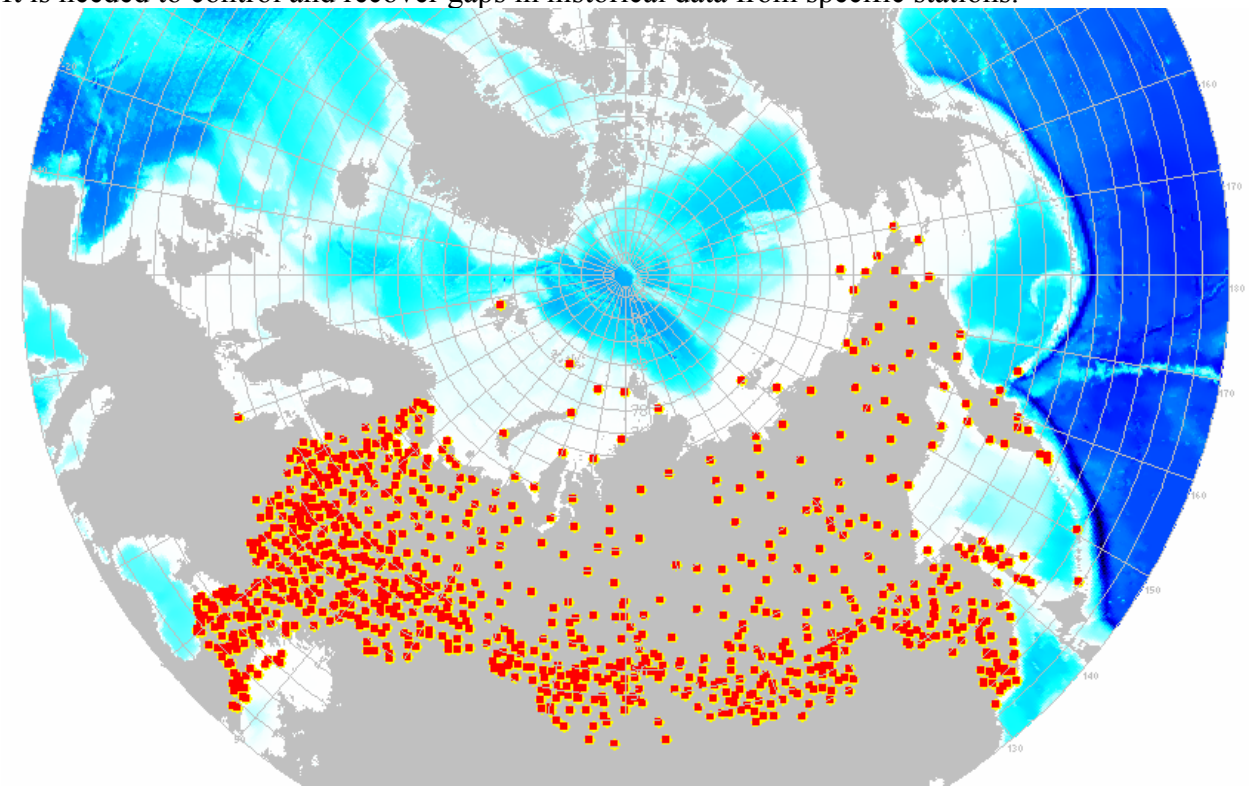


Figure 8 – Location of terrestrial meteorological stations

9.1.2 Aerological observations

Name and acronym:
Aerological observation network

Contact person (e-mail)
A.M.Sterin (sterin@meteo.ru), A.V.Khokhlova (anna_x@meteo.ru)

Web site (if any)
http://www.meteo.ru/

Main objective of the network:
Monitoring and forecast of the atmosphere state and climate change.

Type of activity:
- Theme: troposphere and lower stratosphere
- Location(s): irregular within the territory of the Russian Federation

Main variables:
- air temperature,
- air humidity,
- atmosphere pressure,
- geopotential height,
- wind structure,
- characteristics of clouds.

Observations – every 12 or 24 hours.

When operational (year):
Since 1936

Geographical coverage (countries)
Russian Federation.

Data archive/centre, including Web site:
RIHMI-WDC, http://www.meteo.ru/

Data availability:
Aerological data from 12 stations are available on-line (http://meteo.ru/climate/sp_clim.php/).
The rest data can be prepared on request.

Key problems:
Initial historical data before 1961 from specific stations have not been digitized. A part of metadata have not been digitized

9.1.3 Marine meteorological observations

Name and acronym:
Network of voluntary marine meteorological observations

Contact person (e-mail)
S.M. Somova (ssm@meteo.ru)

Web site (if any)
http://www.meteo.ru/

Main objective of the network:
Incidental hydrometeorological observations along vessel routes. Monitoring and forecast of the surface layer atmosphere state, hydrometeorological support of safety of navigation and marine activities.

Type of activity:
- Theme: surface layer atmosphere and sea surface
- Location(s): along vessel routes in the Arctic Ocean and Arctic seas (Figure 9). Over 200 vessels participate in the program, over 130 of which sail in the Arctic Ocean and Arctic seas.

Main variables:
- air temperature,
- air humidity,
- type and amount of clouds,
- atmosphere pressure,
- wind structure,
- visual range
- hydrometeorological phenomena,
- characteristics of ice accretion,
- wave height and direction,
- water temperature near the surface.

Observations – every 4 or 6 hours

When operational (year):
Since 1946

Geographical coverage (countries)
Russian Federation, Norway.

Data archive/centre, including Web site:
RIHMI-WDC, http://www.meteo.ru/

Data availability:
Data for the period from 1988 to 2008 are available on-line (http://meteo.ru/data_navigat/)
The rest data can be prepared on request.

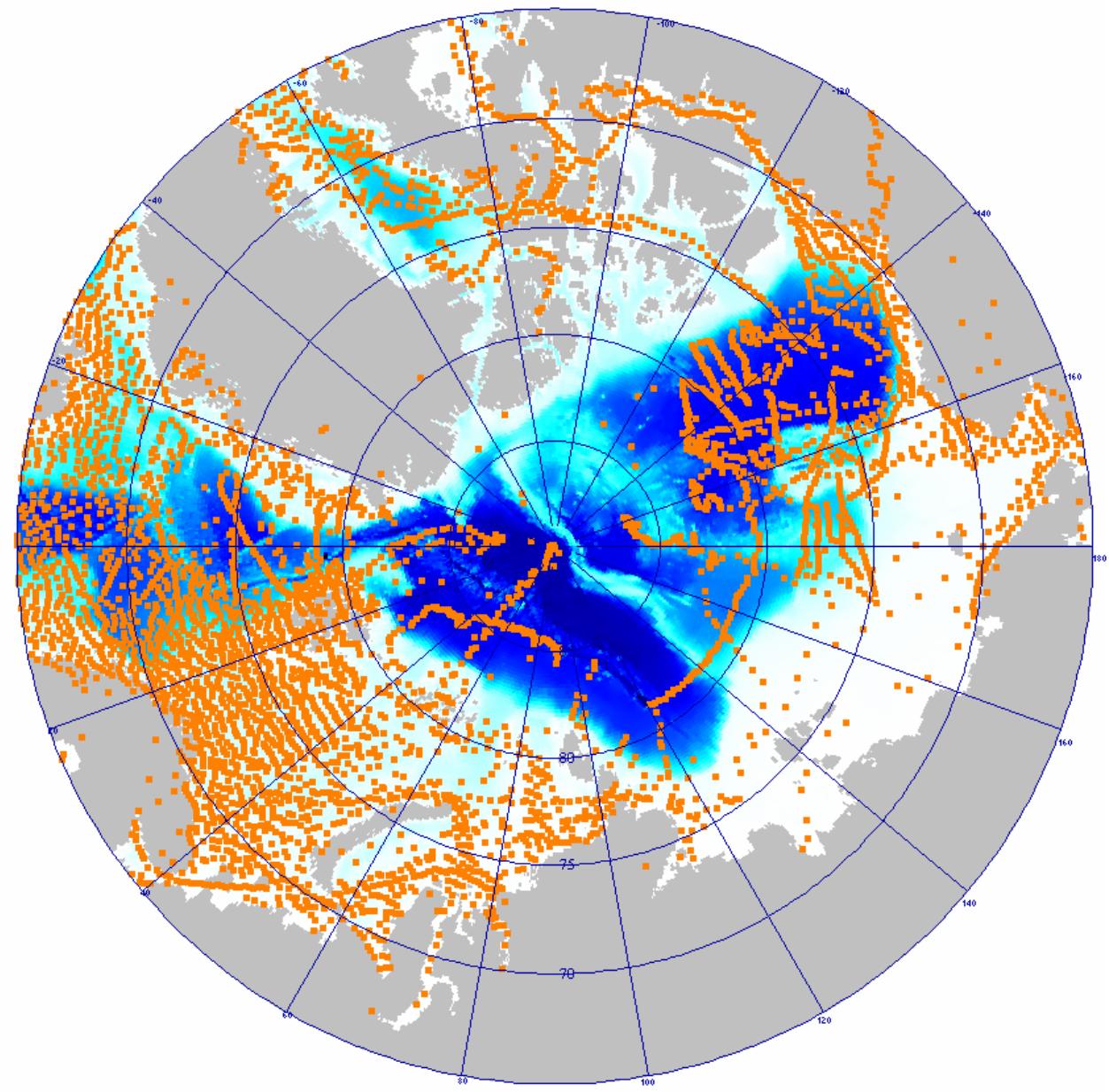


Figure 9 – Points of ship meteorological observations carried out in 2008

9.2. Data on land surface conditions and resources (rivers and channels)

Name and acronym:
Network of hydrological stations located on rivers and channels

Contact person (e-mail)
I.L. Gotovchenkova (gil@meteo.ru)

Web site (if any)
http://www.meteo.ru/

Main objective of the network:
Monitoring and forecast of the state of water streams and hydrological hazards, assessment of water resources.

Type of activity:
- Theme: rivers, channels and other water streams
- Location(s): irregular within the territory of the Russian Federation (Figure 10)

Main variables:
- water discharge,
- water level,
- water body state,
- water temperature,
- ice thickness,
- suspended sediments discharge,
- water turbidity,
- granulometric composition,
- sediments density.

When operational (year):
Since 1880

Geographical coverage (countries)
Russian Federation

Data archive/centre, including Web site:
RIHMI-WDC, http://www.meteo.ru/

Data availability:
Data can be prepared on request. Consolidated hydrological characteristics – from the moment of opening of a specific hydrological station, observation data – since 1984.

Key problems:
Initial data before 1984 have not been digitized.

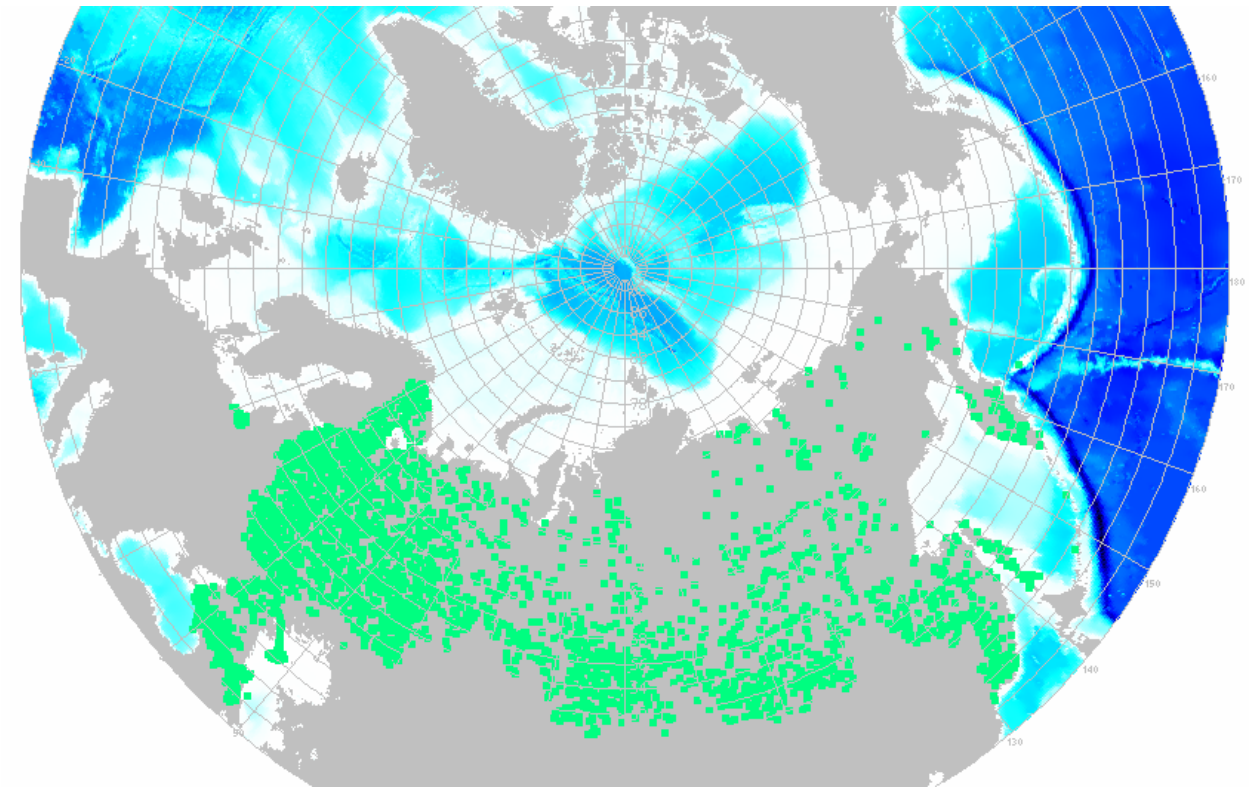


Figure 10 – Location of hydrological stations

9.3. Marine observations

9.3.1 Coastal observations

Name and acronym:
Marine coastal observations

Contact person (e-mail)
A.A. Vorontsov (vorv@meteo.ru)

Web site (if any)
http://data.oceaninfo.ru/

Main objective of the network:
Monitoring and forecast of the sea and atmosphere state in the coastal area, support of safety of navigation and marine activities.

Type of activity:
- Theme: lower atmosphere and sea surface
- Location(s): 178 stations and points on sea coast, islands and estuaries of the Russian Federation. More than a half of them are located in the Arctic and North regions.

Main variables:
Atmosphere:

- air temperature,
- air humidity,
- type and amount of clouds,
- atmosphere pressure,
- wind structure,
- visual range,
- atmosphere phenomena.

Sea:

- wave height and direction,
- characteristics of surf,
- sea level,
- tidal characteristics,
- surface water temperature and salinity,
- characteristics of ice cover.

Observations – every 6 or 12 hours (salinity observations – daily, characteristics of ice cover – daily or less).

When operational (year):
Since 1804 (Kronshtadt)

Geographical coverage (countries)
Coastline of the Russian Federation

Data archive/centre, including Web site:
RIHMI-WDC, http://www.meteo.ru/

Data availability:
Metadata – station certificates are available on-line (http://data.oceaninfo.ru/meta/)
Data can be prepared on request (observation data since 1977, daily average data from specific stations since 1957)

Key problems:
Initial data before 1977 have not been digitized.

9.3.2 Oceanographic observations

Name and acronym:
Oceanographic observations

Contact person (e-mail)
N.N. Mikhaylov (nodc@meteo.ru)

Web site (if any)
http://data.oceaninfo.ru/

Main objective of the network:
Monitoring and forecast of the sea and ocean state, support of safety of navigation and marine activities.

Type of activity:
- Theme: atmosphere surface layer, sea surface and deep layers
- Location(s): Arctic seas and Arctic Ocean. Observations are conducted from vessels, drift ice (North Pole station) and autonomous buoys (Figure 11).

Main variables:
Atmosphere:
- air temperature,
- air humidity,
- type and amount of clouds,
- atmosphere pressure,
- wind structure,
- visual range,
- atmosphere phenomena.

Sea surface:
- wave height and direction,
- characteristics of ice cover

Observations – every 6 or 12 hours
Deep-sea observations:
- water temperature,
- sea water salinity,
- hydrochemical parameters (oxygen content, alcalinity, concentration of biogenic elements).
- current direction and speed.

When operational (year):
Since 1866

Geographical coverage (countries)
Arctic seas of the Russian Federation and Arctic Ocean.

Data archive/centre, including Web site:
RIHMI-WDC, http://www.meteo.ru/

Data availability:
Metadata – catalog of expeditions, information on vessels and organizations is available on-line - http://data.oceaninfo.ru/meta/
Data are available on-line - http://data.oceaninfo.ru/srbd_data/index.jsp

Metadata and data for the 2007/08 IPY period are available on-line - http://www.mpg-info.ru/

Key problems:
Additional control is needed for historical data, especially with regard to hydrochemical parameters.

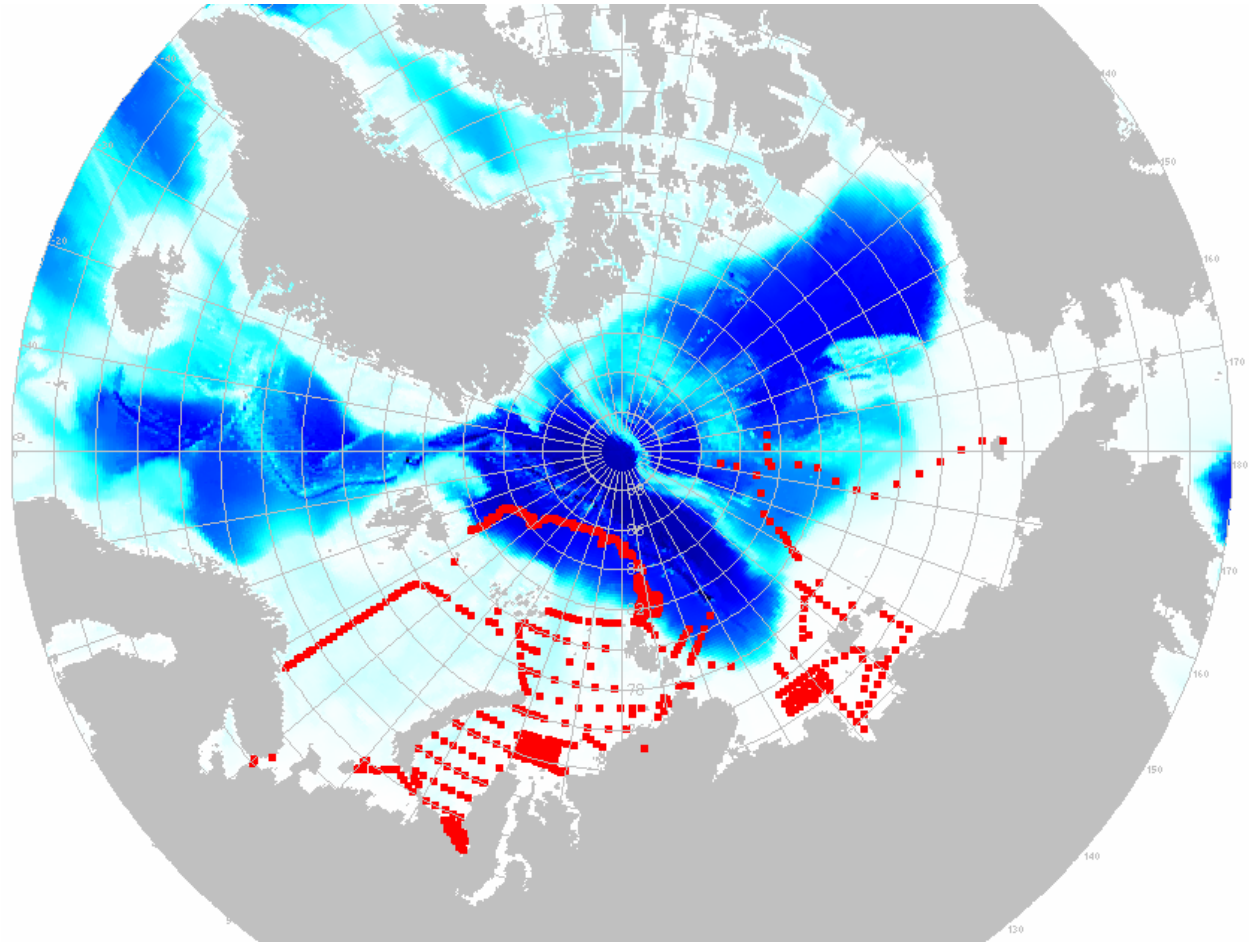


Figure 11 – Points of deep-sea oceanographic observations, research vessels and North Pole-35 in 2008.

10. Network of Permafrost Observations

State of permafrost observational networks in Russia

Introduction

Lack of consistent spatially representative and sufficiently long time series characterizing the state of permafrost and its dynamics under changing climatic conditions necessitates improvement and further development of observational networks. The purpose of this section is to provide an insight into the permafrost networks available in the Russian part of the Artic.

Data characterizing the state and dynamics of Russian permafrost in the past several decades come from three independent sources. The first source of data is soil temperature observations up to 3.2 m. depth conducted at selected meteorological stations. These conventional measurements are not specifically targeted at studying permafrost parameters. Two other networks, authorized under the Global Climate Observing System (GCOS) and its associated organizations, have been developed for monitoring permafrost temperature and seasonal thaw depth. Temperature observations in the boreholes are conducted under the framework of the Thermal State of Permafrost (TSP) project. Another source is the data from the Circumpolar Active Layer Monitoring (CALM) project. Here we give brief description of these networks and results obtained so far for Russian permafrost regions.

Soil temperature observations at weather stations.

Soil temperatures are measured at selected Russian weather stations by extraction thermometers enclosed in ebonite pipes and installed at depths 0.2 m, 0.4 m, 0.6 m, 0.8 m, 1.2 m, 1.6 m, 2.0 m, 2.4 m, and 3.2 m under natural surface cover. Survey of available data is given by (**Frauenfeld**, O.W., Zhang, T., Barry, R.G., Gilichinsky, D., **2004**. Interdecadal changes in seasonal freeze and thaw depths in Russia. Journal of Geophysical Research, 109 (D05101, doi:1029/2003JD004245), more detailed description may be found in Russian language publications, i.e. (**Byhovetc**, C.C., Sorokovokov, V.A., Martuganov, R.A., Mamukin, V.G., Gilichinskiy, D.A., **2007**. History of soil temperature observations at meteorological network. Earth Cryosphere, 11 (1): 7-20; **Chudinova**, S.M., Byhovetc, C.C., Sorokovokov, V.A., Barry, R., Zhang, T., Gilichinskiy, D.A., **2003**. Changes in soil temperature in Russian during the last warming period. Earth Cryosphere, 7 (3): 23-30; **Sherstukov**, A.B., **2007**. Soil temperature at depth up to 320 cm in Russia under the changing climate, Annals of the Russian institute for hydrometeorological information, Observationinsk, pp. 72-88; **Sherstukov**, A.B., **2008**. Contemporary changes in the thermal state of permafrost in Russia and impacts for infrastructure. Ph.D thesis Thesis, Institute of Global Climate and Ecology, Moscow, 135 pp; **Sherstukov**, A.B., **2008**. Correlation between the soil temperature, air temperature, and snow depth in Russia. Earth Cryosphere, 12 (1): 79-87. The earlier study by Frauenfeld et al. (2004) was based on a station network comprised of 242 stations, including those outside the permafrost regions. The subsequent studies include data from larger network of 461 stations, however, still only a small portion is located in permafrost region.

Map in figure 12 shows the annual-mean soil temperatures at 3.2 m depth averaged over the 1976-2006 period (Sherstukov, 2008). Trends of the mean annual soil temperature at 0.8 m, 1.6 m, and 3.2 m depth for 1976-2006 are shown on the maps in figures 13-15 (Sherstukov, 2008).

Changes in the soil temperatures at depth up to 3.2 m are largely coherent with the air temperature changes, however show depth is also an important factor. In the European part of Russia air temperature changes account for 20%-50% of total variability of the soil temperature at 1.6 m depth, while the contribution of the snow depth in total variability is less than 10%. In the rest of the territory snow depth plays more important role. Map in figure 16 illustrate these effects. Vertical bars indicate the contribution of each of the two factors to variability of soil temperatures at 1.6 m depth in 1976-2006 (Sherstukov, 2008).

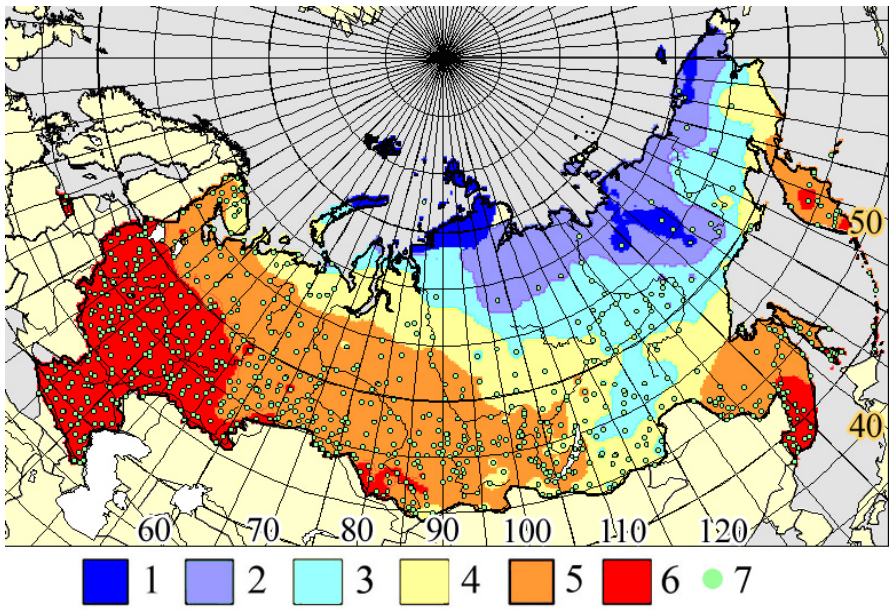


Figure 12. Mean annual soil temperatures at 3.2 m depth averaged over the 1976-2006 period. 1 – $t \leq -6$; 2 – $-6 < t \leq -3$; 3 – $-3 < t < 0$; 4 – $0 \leq t < 3$; 5 – $3 \leq t < 6$; 6 – $t \geq 6$. (Sherstukov, 2008).

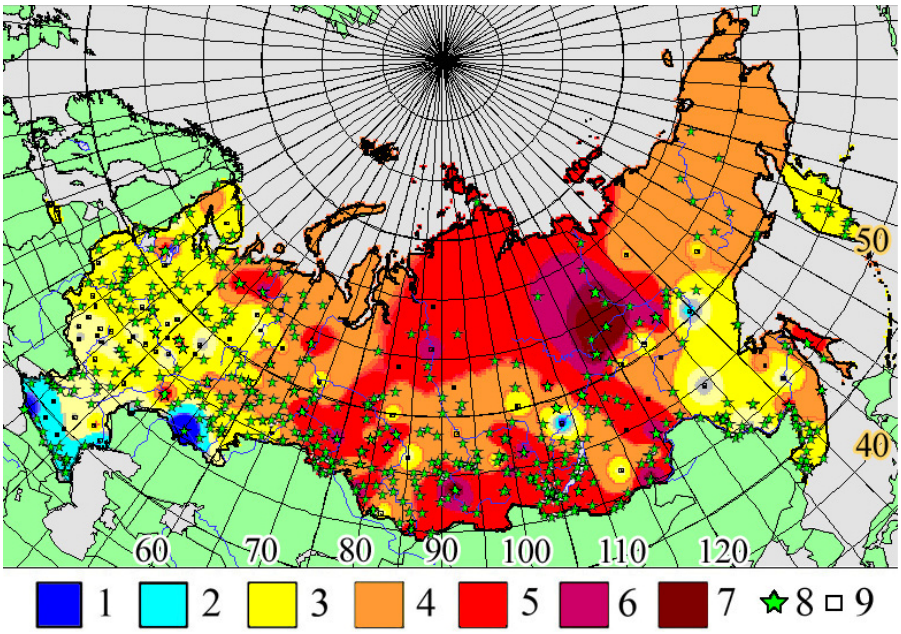


Figure 13. Linear trends (k, °C/10 y) of the mean annual soil temperatures at 0.8 m depth for 1976-2006. 1 – $-0.3 \leq k < -0.1$; 2 – $-0.1 \leq k < 0$; 3 – $0 < k \leq 0.1$; 4 – $0.1 < k \leq 0.2$; 5 – $0.2 < k \leq 0.3$; 6 – $0.3 < k \leq 0.4$; 7 – $0.4 < k \leq 0.6$. Large starts (8) designate stations with trends significant at 95% level. Small stars (9) – stations with insignificant trends. (Sherstukov, 2008).

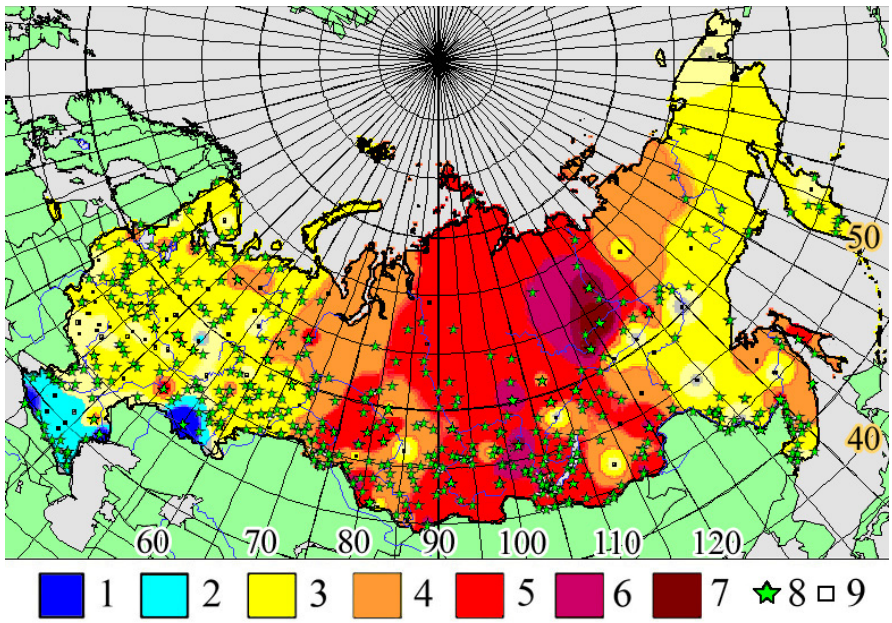


Figure 14. Linear trends (k, °C/10 y) of the mean annual soil temperatures at 1.6 m depth for 1976-2006. 1 – -0.3≤k<-0.1; 2 – -0.1≤k<0; 3 – 0<k≤0.1; 4 – 0.1<k≤0.2; 5 – 0.2<k≤0.3; 6 – 0.3<k≤0.4; 7 – 0.4<k≤0.6. Large starts (8) designate stations with trends significant at 95% level. Small stars (9) – stations with insignificant trends. (Sherstukov, 2008).

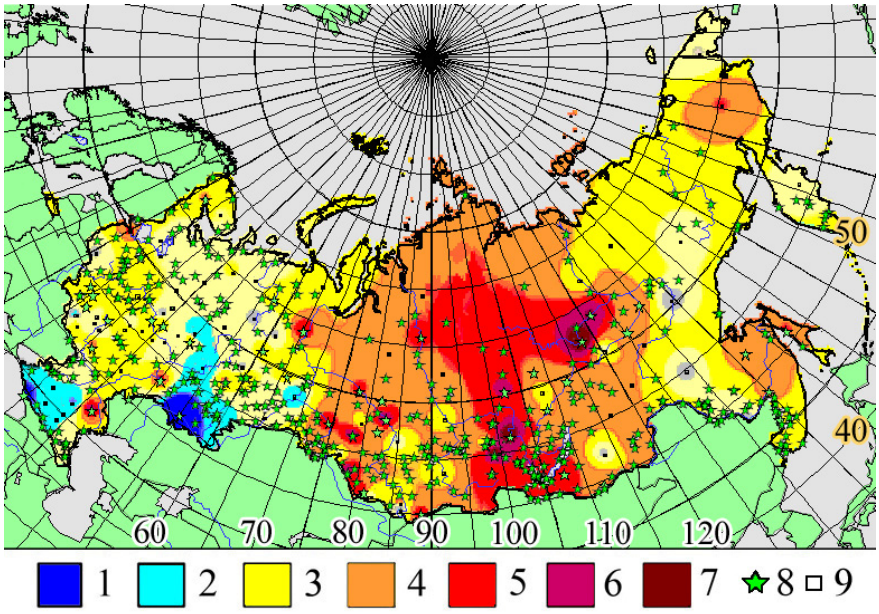


Figure 15. Linear trends (k, °C/10 y) of the mean annual soil temperatures at 3.2 m depth for 1976-2006. 1 – -0.3≤k<-0.1; 2 – -0.1≤k<0; 3 – 0<k≤0.1; 4 – 0.1<k≤0.2; 5 – 0.2<k≤0.3; 6 – 0.3<k≤0.4; 7 – 0.4<k≤0.6. Large starts (8) designate stations with trends significant at 95% level. Small stars (9) – stations with insignificant trends. (Sherstukov, 2008).

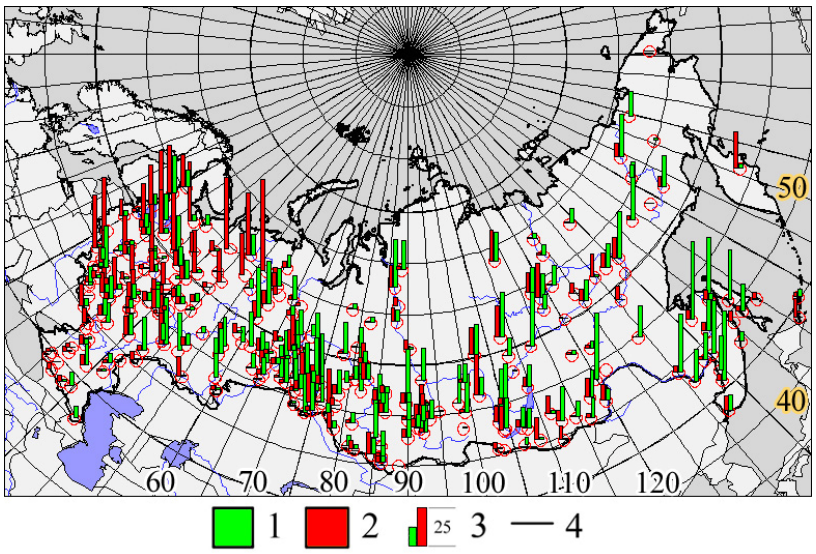


Figure 16. Fractions of total variation of the mean annual soil temperature at 1.6 m depth in 1976-2006 explained by snow depth (1) and mean annual air temperature (2). (Sherstukov, 2008).

Conclusions from the analysis of the data coming from the soil temperature observations and weather stations are the following.

- Although soil temperatures are measured at many of the Russian stations, observations in permafrost regions are sparse and do not capture the whole range of permafrost variability due to difference in climatic and biophysiographical conditions.
- Evaluation of the soil temperature regime and dynamics through correlations with air temperatures is not an option, since only a small part of total variability is explained.
- Other networks and measurements are needed to evaluate the dynamics of permafrost.

Thermal State of Permafrost network.

This project is targeted at instrumenting and obtaining data in a large number of globally distributed boreholes, including those in Russia, in order to provide a "snapshot" of permafrost temperatures in both time and space. The secondary goal is to provide the baseline to reconstruct past surface temperatures, to assess the future rates of change in near-surface permafrost temperatures and permafrost boundaries, and to provide spatial data for validation of climate scenario models and temperature reanalysis approaches. The TSP project is funded and coordinated by the USA NSF, so that most of the work in Russia is also curried out with this support. At its current state, the following goals of the TSP project have already been achieved.

Memorandums of agreement were signed with 11 Russian partners' organizations representing Russian Academy of Sciences, Russian Universities and Industrial organizations at the level of Directors of these organizations.

Protocol of geothermal measurements development. In order to standardize all investigation within the frame of the Project, the "Manual for monitoring and reporting data permafrost borehole temperatures" was developed. It allows better permafrost data collection and interpretation. This protocol was discussed among the all participants and the final version was produced.

Boreholes participating in GTNP observations (total number 282) are shown in Figure 17 and together with the inventory data are available at GTNP site http://www.gtnp.org/inventory/russia_e.html. Currently observational network includes boreholes situated in the European part of Russia (46 boreholes); Western Siberia (35); Northern

(13), Central (7) and Southern (12) Yakutia; Baikal region (10); Chukotka and Magadan region (3) and Kamchatka (5). Most of the boreholes are less than 30 m deep (surface, shallow or intermediate in according to GTN-P classification) and instrumented for continuous observations. Some of them are 50 – 200 m deep and measured once or twice per year. Results of measurements and maps showing the location of the boreholes are available for download from the Cooperative Arctic Data and Information Service (CADIS) website.

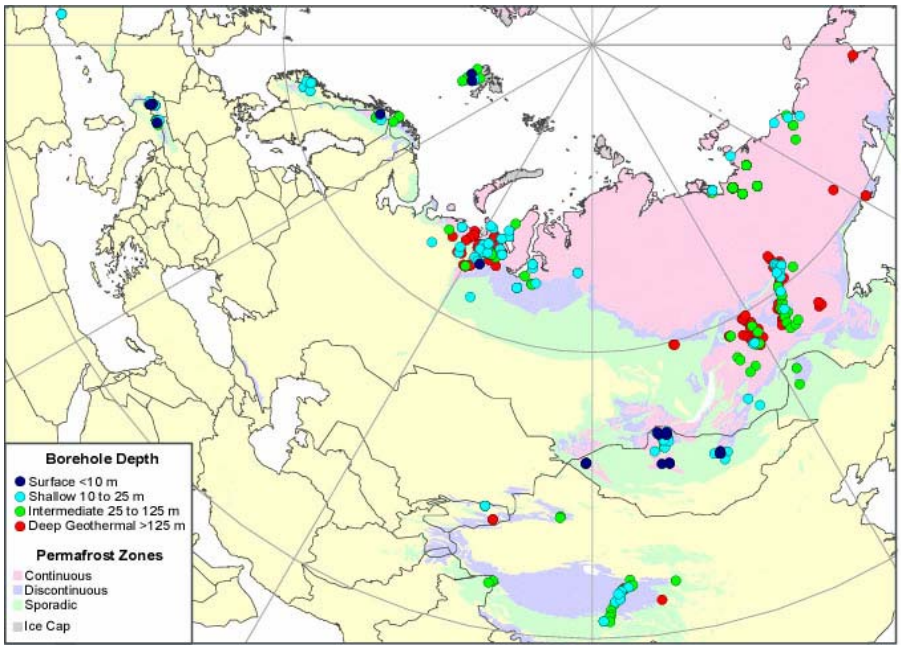


Figure 17. Boreholes participating in GTNP observations.
(http://www.gtnp.org/inventory/russia_e.html.)

Circumpolar Active Layer Monitoring (CALM) network.

The Circumpolar Active Layer Monitoring (CALM) program is a network of sites at which data about active-layer thickness (ALT) and dynamics are collected. CALM was established in the 1990s to observe and detect the long-term response of the active layer and near-surface permafrost to changes in climate. CALM is among the international permafrost community's first large-scale efforts to construct a coordinated monitoring program capable of producing data sets suitable for evaluating the effects of climate change. Together with the IPA's Thermal State of Permafrost program, CALM comprises GTN-P, the Global Terrestrial Network for Permafrost. The CALM network's history and organizational structure are reported in **Brown**, J., Hinkel, K.M., & Nelson, F.E., **2000**. The circumolar active layer monitoring (CALM) program: Research designs and initial results. *Polar Geography*, 24(3): 165–258 and **Nelson**, F.E., Shiklomanov, N.I., Hinkel, K.M, & Christiansen, H.H., **2004** The Circumpolar Active Layer Monitoring (CALM) Workshop and the CALM II Program: Introduction. Polar Geography, 28(4): 253-266..

Three methods are used to determine the thickness of the active layer: 1) Mechanical probing using a graduated metal rod; 2) temperature measurements; 3) frost/thaw tubes. The method-specific measurement procedure adopted by the CALM program is described in detail at the CALM web site (www.udel.edu/Geography/calm) and by Brown J. 2000. The circumolar active layer monitoring (CALM) program: Research designs and initial results. *Polar Geography*, 24(3): 165–258. At most Russian sites, the active layer is measured by mechanical probing on regular grids of sampling points ranging from 10×10 m to 1000×1000 m. The time of probing varies from mid-August to the end of September, i.e., when thaw depth is at or near the maximum. The gridded sampling design allows for analysis of intra- and inter-site spatial

variability and yields information useful for examining interrelations between physical and biological parameters. Grids are established at undisturbed locations, characteristic of dominant environmental conditions. Their size varies depending on site geometry, and the level of natural variability of surface and subsurface conditions. In general, 10×10 m to 100×100m size grids are established within relatively homogeneous landscape units. Several sites contain a number of grids representing various landscape units within the area. The 100×100 m to 1000× 1000 m grids usually encompass several characteristic landscapes within the area. CALM adopts a systematic sampling scheme for thaw depth measurements on most grids. The systematic sampling design involves annual replicate measurement at regularly spaced grid nodes. With a few exceptions, each 10, 100, and 1000 m -side grid contains 121 nodes distributed evenly at 1, 10, and 100 m spacing respectively.

Of the 45 CALM sites in Russia, 31 have continuous periodic active layer monitoring (Fig. 18). The remaining 14 were either discontinued or are visited only sporadically. All Russian sites have grids ranging from 100 m^2 to 1 km^2. Several sites have supplemental transects that pre-date the establishment of CALM. The Russian CALM network extends from the European tundra of the Pechora and Vorkuta regions to West Siberia and the Lena Delta, eastward to the lower Kolyma River, and to Chukotka and Kamchatka. Most of these sites are within the continuous permafrost zone.

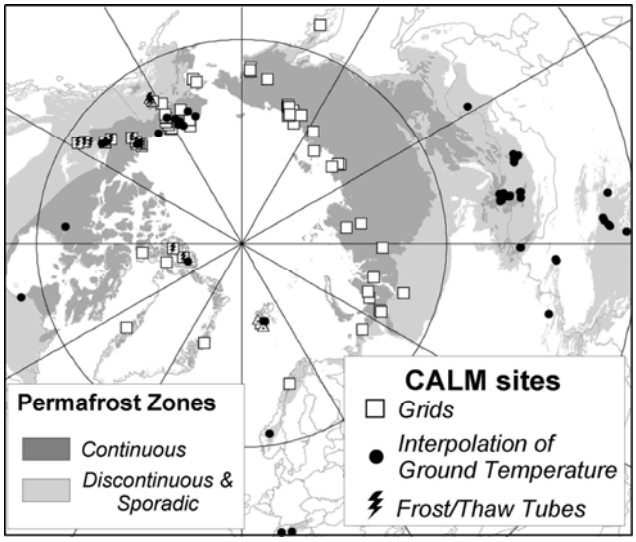


Figure 18. Location of CALM sites in the Northern hemisphere, including those in Russia.

European North: Three 1 ha grids are located in the discontinuous permafrost region of the European tundra; Ayach-Yakha and Talnik near Vorkuta and Bolvansky in the Pechora lowlands (**Mazhitova**, G., Malkova, G., Chestnykh, O., & Zamolodchikov, D., **2004.** Active-layer spatial and temporal variability at European Russian circumpolar-active-layer-monitoring (CALM) sites. Permafrost and Periglacial Processes, 15 (2): 123-139). Each site has 7 to 11 years of continuous active-layer record. The auxiliary data include detailed soil and vegetation characterization, soil temperature and soil moisture records. Since 1999, periodic, spatially oriented frost heave and ground subsidence measurements using optical leveling are conducted at the Ayach-Yakha site.

West Siberia: Eight active CALM sites are located in West Siberia. The core of the data sets consist of observations from two 1 ha grids at Mare Sale and Vaskiny Dachi in the continuous permafrost zone and 1 km^2 Nadym grid in the discontinuous zone. The active layer observations for Mare Sale are available since 1978, and for Nadym since 1972. The active layer record at the Vaskiny Dachi site dates to 1991. Pre-CALM (1993) observations were performed at the environmentally homogeneous 10 × 10 m plots, and along several transects incorporating the dominant landscape units. Each site has continuous soil temperature records of variable

length and detailed spatial landscape, soil, and vegetation characterizations. An additional 1 ha site was established in the continuous permafrost zone in 2005. During the summer of 2007 four grids were established in the discontinuous permafrost zone in landscapes inadequately represented by the Nadym grid.

Central Siberia: In association with the GEWEX Asian Monsoon Experiment (GAME) program in the Siberian Arctic, a 1 km^2 CALM grid was established in 1997 near Tiksi, on the Lena River. The site-specific data base is available in the GAME Siberia website (http://www.hyarc.nagoya-u.ac.jp/game/siberia/index.html). Thaw depth measurements are also available for two 1 ha grids representing different landscapes of the Lena delta since 2004.

Lower Kolyma River: Beginning in 1996, a series of 15 1 ha grids spanning a distance of approximately 300 km was established to represent characteristic climatic and environmental conditions in the Kolyma-Indigirka lowlands on the northeast Eurasian tundra (**Fyodorov-Davydov**, D.G., Sorokovikov, V.A., Ostroumov, V.E., Kholodov, A.L., Mitroshin, N.S., Mergelov, I.A., Davydov, S.P., Zimov, S.A., & Davydova, A.I., **2004**. Spatial and Temporal Observations of Seasonal Thaw in the Northern Kolyma Lowland. Polar Geography, 28 (4): 308-325). At present, 11 sites are reporting data. Annual active-layer and soil temperature observations are carried out at the five most accessible sites situated in close proximity to the North-East Scientific Station in Cherskyi in the transitional zone between taiga and tundra. Logistical problems led to some interruptions in observations at the remaining six sites. All sites have detailed descriptions of surface and subsurface conditions.

Chukotka and Kamchatka Peninsulas: Beginning in 1996, a Mt. Dionisy site was established on the Chukotka Peninsula. A new site was initiated at Lavrentia along the Chukchi Sea coast in 2000 (**Zamolodchikov**, D.G., Kotov, A.N., Karelin, D.V. & Razzhivin, V.Y., **2004**. Active-Layer Monitoring in Northeast Russia: Spatial, Seasonal, and Interannual Variability. Polar Geography 28 (4): 286-307). Both sites consist of 1 ha grids. Annual soil moisture observations and detailed soil characterizations are available for Lavrentia site. Active layer records are also available for two 1 ha grids on Kamchatka since 2003.

CALM is the oldest and most comprehensive permafrost-oriented international global-change monitoring program, and has achieved considerable success in this role. Although the CALM network continues to grow in terms of the number of participating sites and the quantity and quality of observations, two outstanding data issues remain to be resolved.

1) Continuation of periodic measurements: This problem relates to difficulties associated with unattended operation of scientific equipment at remote locations and periodic accessibility of sites. For example, approximately one-fourth of Russian sites were discontinued during the last five years due to substantial increases in logistical costs. A large number of sites have suffered from equipment malfunction and vandalism.
2) The methodology of simple sharing of basic data, adopted by CALM in the late 1990s, does not entirely satisfy the growing needs of the increasingly international and interdisciplinary scientific community and general public. Newly developed web-based database and mapping applications provide more advanced and user-friendly vehicles for presenting and sharing geographically referenced information.

11. Network of Glacier Observations

Name and acronym:
Permanent research base in the field of glaciology in Barentsburg (Spitsbergen).

Contact person (e-mail)
Lev Savatyugin, AARI, savat@aari.nw.ru
Nikolay Osokin, RAS IO,
Ivan Lavrentiev, RAS IO

Web site
http://www.glac.igras.ru
http://www.aari.ru/main.php

Main objective of the network:
1. Snow cover (Spitsbergen)
- Study of multi-year changes in snowiness near Nordenskiöld Land
- Study of impact of spring-summer snow melting on superimposed (infiltration) ice formation on glacier surface
- Study of mechanical and thermophysical properties of snow cover in different Spitsbergen landscapes
- Study of impact of snowiness and summer melting conditions on the STL conditions under modern climate change (by the example of multi-year measurements near Barentsburg)
- Study of structure and dynamics of large and multi-year snowfields as indicators of current climate change in this region.

Contact person: Nikolay Osokin (jsokinn@mail.ru), Ivan Lavrentiev <ilavrentiev@gmail.com>

2. Spitsbergen glacier surge mechanism:
- Studies on Grenfjord non-surging glacier Fridtjovbreen surging glacier. Methods: radiolocation, radiophysics, DGPS, mass balance.

Contact person: Yury Macharet <macheret@gol.ru>

3. Monitoring of Spitsbergen polythermal glaciers to assess long-period climate change.
Objects of long-term monitoring of changes in geometry and hydrothermal structure of polythermal glaciers: Tavle, Aldegonga

Contact person: Yury Macharet <macheret@gol.ru>

4. Ice deposits on Spitsbergen
- Obtaining of new data on glacier thickness and volume
- Definition of correlation relationships
- Contribution of glaciers to world ocean level

Contact person: Andrey Glazovsky <icemass@yandex.ru>

5. Glacier mass balance on Nordenskiöld Land (Spitsbergen):
- Aldegonga, Eastern Grenfjord, Tavle
- Development of new methods of mass balance measurement: core and non-core drilling, DGPS, temperature survey.

Contact person: Andrey Glazovsky <icemass@yandex.ru>

6. Remote sensing (RSD), (Novaya Zemlya, FJL)

Development of GIS-base for glaciers on the Russian Arctic archipelagos for remote monitoring of their current state and changes. Assessment of iceberg discharge and ice caps. Observation of glacier dynamics.

Contact person: Andrey Glazovsky <icemass@yandex.ru>, **Yury Macharet** <macheret@gol.ru>

7. Remote sensing and validation (if possible) in situ (Russian Subarctic mountains – Polar Urals, Byrranga, Putorana, Suntar-Khayata mountains, Chersky Range, Koryak Upland, Chukotka)

Executors: M. Ivanov, G.A. Nosenko, M.D. Ananicheva, G.A. Kapustin et al (RAS IO), gnosenko@mail.ru, maria_anan@rambler.ru, gregrus@mail.ru, V.A. Sarana, MSU, Research Laboratory "North's Ecology", <saranav@mail.ru>

Member of or connected to a global network; if yes, which:

Established partnerships: www.glims.org;
Cooperation is planned with Scientific Center of Operational Earth Monitoring to use remote sensing data.

Type of activity:

Data are given for Barentsburg station
- atmosphere (RAS PGI, Murmansk)
- coastal ecosystem, including freshwater (yes/no)
- marine ecosystem:

Biological center on Spitsbergen. MMBI, Murmansk (http://www.mmbi.info)
Integrated study on Spitsbergen has been carried out since 1994 in the biological center within the framework of MMBI's International Environmental Laboratory.
The main areas of scientific activities on Spitsbergen are as follows: acquisition of comparative data on biodiversity of flora and fauna and marine ecosystems on the north part of the Gulf Stream western branch; development of the model of the impact of melting (fresh) waters on the marine ecosystem in glacier bays of different types on western Spitsbergen; monitoring of Arctic ecosystems evolution and other natural phenomena.
- ocean AARI, Saint Petersburg (http://www.aari.ru/main.php?lg=1)
- cryosphere: periodic observations of snow cover and glaciers and seasonally melting layer of permafrost formation on Spitsbergen. Remote observations of Novaya Zemlya and FJL glaciers.
- human factor anf socio-economic indicators
(http://igras.ru/index.php?r=17&id=12)
- space physics - (http://www.kolasc.net.ru/pgi_r/)

Main variables:

- mass balance (Aldegonga glacier, planned for Spitsbergen's Tavle, Eastern Grenfjord glaciers)
- ice thickness (Novaya Zemlya, FJL)
- area and length of outlet glaciers (Novaya Zemlya, FJL)
- area, length and height of the equilibrium line, mass balance elements – (Russian Subarctic mountains, RSD, periodic field work)

When operational (year):

Modern observations: start:
Spitsbergen – 2002/2003
Novaya Zemlya, FJL – remote sensing started in 2001
Putorana – started since the mid-1990s
Khibins – periodically observed by MSU and RAS Kola Scientific Center since the 1970s
Byrranga – since 2001

Suntar-Khayata mountains, started in 2001, last field work – in 2008.
Polar Urals – started in the late 1990s, assessment of the current state of glaciers according to RSD and in situ
Chukotka (Meynypilgynsky Range) – periodic expeditions since the 1990s.

Geographical coverage (countries)
Spitsbergen, in the vicinity of Barentsburg and Pyramid
Novaya Zemlya
Franz Josef Land
Russian Subarctic mountains

Data archive/centre, including Web site:
Not yet, the "Ice and Snow" magazine, Nauka Publisher, web-site is being developed, which will include the main glaciology publications. Magazine "Materials of Glaciological Studies" published until recently has a web-site - http://mgi.igras.ru/

Data availability:
No access currently exists.

12. Network of the Arctic Environmental Pollution Observations

Name and acronym:
Local network of pollution control in Barentsburg (Spitsbergen)
(North-West Branch, SPA Typhoon)

Contact person (e-mail)
Boris N. Demin (typhoon@aari.nv.ru)

Web site
www.typhoon.observationinsk.ru

Main objective of the network:
Local monitoring, Barentsburg: regular sampling, twice a year

Member of or connected to a global network; if yes, which:

Type of activity:
- Theme: environmental pollution
- Location(s): Spitsbergen
- Community-based: data are used in Russian and international programs
- Coordination, e.g. not directly involved in observations, but coordinating data and information (e.g., AMAP): Data are collected and databases are created by North-West Branch, SPA Typhoon

Fig. 15 Location of Barentsburg station where environmental pollution is monitored.

Main variables:
- Organochlorines (OC) including polychlorobiphenyls (PCBs)
- Polycyclic aromatic hydrocarbons (PAHs)
- Oil hydrocarbons including total hydrocarbons (OH)
- Composition of the fraction of non-polar aliphatic hydrocarbons (NAH)
- Volatile aromatic hydrocarbons (VAH)
- Individual phenols (alkylphenols, chlorophenols and nitrophenols)
- Heavy metals and arsenic

Samples are collected at the following sites:
- Atmospheric air
- Snow cover
- Soil
- Sea waters
- Surface waters

- Bottom sediments
- Land flora

When operational (year):

Geographical coverage (countries)
Spitsbergen

Data archive/centre, including Web site:
North-West Branch, SPA Typhoon, Roshydromet, Russia,
http://www.typhoon.observationinsk.ru/

Data availability:

13. Monitoring of Biodiversity in the Arctic

(Birds and partially marine biodiversity)

Seabirds

Briefly and schematically, data on the availability of monitoring information on seabirds nesting in the Russian Arctic are given in the Table. It should be noted that the less favorable situation with monitoring of nesting sea birds is in the central Russian Arctic and its high-latitude regions where colonies exist of Arctic and high-Arctic type. No monitoring is being conducted there, and no systematic observations were made before. The situation is a little bit better with facultative-colonial disperse nesting species, they are rarely the subjects of long-term research and monitoring programs. The situation is better with the Arctic peripheral zones, i.e. White-Barents Seas and Bering-Far East sectors. There are areas covered by long-term observations, but they are often those that are out of the Arctic region according to CAFF definition (Onega Bay, Taui Bay, Commander Islands). Unfortunately, the most representative sea bird monitoring series in the CAFF area, collected in Kandalaksha and Wrangel Island reserves, were interrupted and/or disturbed in the 1990s (in terms of continuity of methods of material collection).

In the 2000s, inventories of nesting seabirds were conducted in south Chukotka within the framework of the GEF ECORA Project, (http://www.grida.no/ecora/documents.aspx) and the base was built for the future monitoring of colonies with local people involved

Table – Availability of monitoring data on seabirds of the Russian Arctic and Far East.

Seas	Region	Institution	Historical data (before 2000)	Current data (2000 -)	Types and seasons
Barents	Aina Islands	Kandalaksha Reserve	Since 1947 with intervals	Fragmentaril y**	NP: CSB, SG, E
	Seven Islands	Kandalaksha Reserve	Since 1929 with intervals	Fragmentaril y**	NP: CSB, SG, E
	Gavrilov Islands	Kandalaksha Reserve	1970-1998	Fragmentaril y**	NP: E
	Cape Gorodetsky	MMBI	-	C 2000	NP: CSB
	East Murman	MMBI	-	C 2000	NP; CSB, SG
	FJL, Hooker Island	expeditions	(1929, 1931, 1939, 1981, 1991, 1993)**	(+)	NP: CSB
	Novaya Zemlya	Kandalaksha Reserve, MMBI, NPI	1950, 1970, 1990	2005	NP: CSB
	Murmansk coast	MMBI + international projects	Since 1990	+	NNP: E
	Pechora Sea	MMBI + international projects	Since 1990	+	NNP: E, SG, CSB
	Offshore water	MMBI, AARI and others	Since 1990	+	NNP: CSB, SG
White	Kandalaksha Gulf (reserve)	Kandalaksha Reserve	Since 1930 with intervals	+	NP: SG, E
	Kandalaksha Gulf	MMBI	Since 1990	+	NNP: E
	Tersky Coast	Reserve + MMBI + international projects	(+)	+	NNP: E
	*Onega Bay.**	White Sea MSU biological station (Solovki Reserve	Since 1984	+	NP: CSB, SG, E

Seas	Region	Institution	Historical data (before 2000)	Current data (2000 -)	Types and seasons
		Museum biological station)			
Kara	Islands and Severnaya Zemlia	Russian Research institute for Nature Protection, AARI + international projects	(Since 1980)	2006-2007	NP: CSB, SG
	Yamal (several sites)	IPAE	Since 1969	+	NP: SG
	Gydan (north)	Gydan Reserve + expeditions	(Since 1990)	(+)	NP: SG, E
	Taymyr (reserve)	Taymyr Reserve	Since 1980	+	NP: SG
	Taymyr (several sites)	IEE + international projects and expeditions	(Since 1980)	+	NP: SG, E
Laptev	Lena River estuary	Ust-Lena Reserve, biological station "«Lena-Nordenskiöld"	Since 1980	+	NP: E, SG
Laptev /East-Siberian	New Siberian Islands	expeditions	(1950)	(+)	NP: CSB, SG
East-Siberian /Chukchi	Wrangel Island	Wrangel Island Reserve	Since 1976	No data	
	Coastal tundra	international projects	1992 – 1995	2003 – 2007	NP: E
Chukchi	Kolyuchin Island, continental coast	IBPN + expeditions	1970 – 1990	-	NP: CSB, SG
Bering	Chukchi coast	IEE + expeditions	(Since 1980)	(+)	NP: CSB
	Cape Navarin	GEF ECORA Project	-	2005 – 2008	NP: CSB
Okhotsk	*Taui Bay*	IBPN	Since 1986	+	NP: CSB
	Commander Islands	RAS PIO Commander Islands Reserve	Since 1980	+	NP: CSB
	Kamchatka, Kuril Islands	RAS PIO	Since 1990	+	NP: CSB, SG

* - area is out of the Russian Arctic according to CAFF definition
** - non-systematic monitoring / disembodied and fragmentary data
NP – monitoring of nesting populations
NNP – monitoring of nesting populations in the sea (mainly - mew, wintering)
SG – sea gull; E – eider; SCB – colonial seabirds

The study of birds in the sea areas is the youngest branch of marine ornithology. Only since the 1990s, inventories of birds in the Russian Barents Sea have been conducted on a more or less regular basis.

Different observation platforms are used for inventories including: vessels of different sizes and purposes, helicopters and airplanes. Aerial inventories are concentrated in the west sector (White and Barents Seas). The observations conducted are often occasional and can hardly be considered as a systematic monitoring.

The major institutions conducting observation of seabirds in the sea areas are as follows:

RAS Kola Scientific Center MMBI– White and Barents Seas (contact person: Yu.V. Krasnov, Doctor of Biology, kharlov51@mail.ru)

Roshydromet's AARI – White and Barents Seas, Siberian shelf seas (contact person: M.V. Gavrilo, m_gavrilo@mail.ru).

RAS IO Pacific Branch (Yu.Artyukhin, artukhin@mail.kamchatka.ru) and RAS Far Eastern Branch IBPN – Bering and Okhotsk Seas

Waders and Other Tundra Birds

In Arctic terrestrial communities, waders dominate among both in terms of number of species and population density. The stable study of ecology and population dynamics of waders in the Russian Arctic started in the 1970s. In the subsequent 20 years, the study has been conducted in different parts of the Russian Arctic, from Bolshezemelskaya tundra to Chukotka as well as on some islands. The work by the scientists from RAS Ural Branch IPEA (USSR RAS Ural Branch's Institute of Plant and Animal Ecology) fitted the best the requirements of monitoring (study of waders at permanent sites on Yamal). Since 2000, monitoring of birds (not only waders) has been conducted at permanent inventory sites in the Ob river lower reach in forest tundra zone (M.G. Golovatin) and on the southern Yamal since 2002 (V.A. Sokolov).

In the 1990s to present, monitoring of the number of waders is conducted in Arctic reserves (Kandalsksha, Nenets, Gydan, Bolshoi Taymyr, Arctic, Ust-Lena, Wrangel Island) within the framework of respective sections of "Nature Records". However, this work was usually performed using route inventories, which resulted in a number of waders only.

In the early 1990s, intensive ornithological studies were carried out on Taymyr (two continuous wader monitoring points were established). Monitoring on the north-west Taymyr has been conducted up to now at permanent sites on V. Barents station (territory of Bolshoi Arctic Reserve). On the south-east and central Taymyr, the studies are supported by Taymyrsky State Biosphere Reserve. Since 2004, Dutch researchers (Alterra Institute, Netherlands) survey the sites of wader monitoring in the Pyasina estuary.

Since 2000, the RAS Institute of Plant and Animal Ecology expeditions work on the Chukotka Peninsula. Intensive studies in the vicinity of Meynypilgino started in 2003 mainly focused on nesting biology of spoon-billed sandpipers can be also considered as wader monitoring.

Since 1988, the Working Group on Waders started collecting data on successful breeding of waders in the Arctic. Annual reviews of these data were published in 1989-1999 Information Materials of the Working Group on Waders available in electronic format on the Group web-site (http://www.waders.ru). Their English translation was also published in the Wader Study Group Bulletin and then in a separate volume of "Proceedings of Wader Study Conference, Odessa" (International Wader Studies, vol. 10). Later on, the project was expanded not only geographically – all Arctic ground nesting birds became subjects of research – received the name "The Arctic Birds Breeding Conditions Survey" (ABBCS). Since 1999, the annual bulletin "Arctic Birds" is published in Russian and English and is distributed among interested researchers. The Bulletin contains not only information from specific research sites and overview of the situation in regions but also an annual analysis of a share of young waders on Australian wintering grounds. The most information obtained from respondents is published on the Project web-site http://www.arcticbirds.ru. Besides the descriptions of breeding conditions, the site contains periodically updated general maps of successful breeding, populations of rodents and air temperature in the Arctic since 1988. Data on populations and nesting status of specific species can be obtained on on-line request to the database. Electronic versions of "Arctic Birds" and project questionnaires can also be downloaded from the web-site.

Project Coordinators
M.Yu. Soloviev (Department of Zoology of Vertebrates, MSU Biological Faculty, soloviev@soil.msu.ru)

P.S. Tomkovich (MSU Zoo Museum, pst@zmmu.msu.ru).

International Cooperation
ARCTIC COUNCIL / CAFF
In the Russian Federation, the procedures were determined for the fulfillment of obligations under CAFF programs:
The RF Ministry of Natural Resources is the body responsible for the fulfillment of obligations under CAFF programs.

V.A.Orlov (Russian MNR) is the representative of Russia to CAFF Bureau
E-mail: vorlov@mnr.gov.ru
Yu.A.Buyvolov (Rosprirodnadzor) is the coordinator for collection and fusion of information in the reserves within the territory of the Russian Arctic.
E-mail: oopt_rf@mnr.gov.ru
Within the framework of Arctic countries cooperation under the Arctic Council's Conservation of Arctic Flora and Fauna Program (CAFF), the CBird group CAFF was established to coordinate research and support conservation of Arctic seabirds. Two Russian representatives are members of the Group coordinating information from the west and east sectors of the Russian Arctic. Currently, they are AARI (west sector, M.V.Gavrilo, m_gavrilo@mail.ru) and RAS IO Pacific Branch representatives (east sector, Yu.Artyukhin, artukhin@mail.kamchatka.ru).

Recent initiative within the framework of Arctic Council is the Circumpolar Biodiversity Monitoring Program (CBMP) - the Integrated Arctic Biodiversity Monitoring Network. www.caff.is/CBMP

A key objective of the CBMP is to create an effective mechanism and transparent platform to facilitate the access to information on the state and trends of biodiversity in the Arctic, preferably on the base of raw data and in digital format. An overarching challenge for the CBMP is to be able to detect Arctic biodiversity trends in reasonable time frames, identify the underlying causes of these trends and report on trends the most efficient way.
Contributors and data range widely across the Arctic biodiversity community and outside. Partner programs within the Arctic Council and others are invited to participate and to contribute. The CBMP is nested in a global initiative lead by the CBD to halt the loss of biodiversity by 2010, and is also closely linked with other Arctic Council Declarations.
The program can be accomplished by several ways: through special international expert networks (e.g. group on anseriformes, group on seabirds, etc), through international information centers (e.g. WCMC), and finally through the contributions of national information networks or monitoring centers.
The Russian Federation contribution supported to some extent by stable government funding is collection and fusion of information in Arctic reserves. Observations at scientific stations (RAS, Roshydromet, the Ministry of Education, etc) can be considered as relatively stable.
Irregular and non-coordinated monitoring observations are carried out by extracting companies having long-term licenses and license agreements in the Arctic.
Expert groups have been established, e.g. the Marine Expert Monitoring Group, in which I.A.Melnikov is an expert from Russia (RAS IO, migor@online.ru)

BILATERAL AND INTERNATIONAL COOPERATION
Research and monitoring in regions is coordinated within the framework of bilateral international cooperation.
Russian-Norwegian cooperation in the field of the study of sea and aquatic birds is one of the most active and fruitful directions within the framework of bilateral cooperation in environmental protection in the Barents Sea Region. The Russian-Norwegian Expert Group on seabirds was established in 1989 as a part of the Joint Russian-Norwegian Commission on Environmental Cooperation. The representative of the main Russian institutions involved in

ornithological studies in the Barents and White Seas are permanent participants of Russian-Norwegian cooperation in the study of seabirds:

- Roshydromet's Arctic and Antarctic Research Institute (AARI), Saint Petersburg.
- RAS Institute of Geography (RAS IO), Moscow;
- Moscow State University, White Sea Biological Station Solovki Branch (MSU), Moscow;
- RAS Kola Scientific Center's Murmansk Marine Biological Institute (RAS MMBI), Murmansk;
- Kandalaksha Reserve (KReserve), Kandalaksha;
- Ministry of Natural Resources Russian Research institute for Nature Protection, Moscow.

Russian-American cooperation under the Project "*Conservation of seabird populations and their management*" is based on the Cooperation Agreement in the field of Environmental Protection and Natural Resources between the RF and the US Governments (signed in 1994 to replace the 1972 Agreement that had expired). The main Russian partners are RAS Far Eastern Branch IBPN, RAS IEE, RAS PIO.

GEF PROJECT (GLOBAL ENVIRONMENTAL FACILITY)

In the 2000, inventories of nesting aquatic birds were carried out at three model sites in the Russian Arctic: Kolguev Island, Kolyma lower reaches, Bering Region in south Chukotka, within the framework of GEF ECORA Project (GEF ECORA, http://www.grida.no/ecora/modelareas.aspx) and the base was built for the future monitoring of bird populations with local people involved.

ECORA Project General Manager is Eugene Kuznetsov ecohealth@mtu-net.ru .

14. Integrated Arctic Socially-Oriented Observation System (IASOS) Network

Russian Academy of Sciences
Institute of Geography
Integrated Arctic Socially-Oriented Observation System

Contact person
Vlasova Tatiana Kouzminichna **tatiana.vlsv@gmail.com**

Web site: http://igras.ru/index
http://iasos.igras.ru (under construction)

Main objectives of the network
The aim of the IASOS network is to monitor changes on the way to better (or worse) Quality of Life (QL) and sustainability, increase knowledge of trends in socio-economic, political and living conditions of residents (indigenous and non-indigenous) of the Russian North under the impacts of happening changes in climate, biodiversity, character of human impacts, socio-economic and political changes and human responses (including strategic planning for climate change adaptation, etc.)

The major objectives of the IASOS network are:

- Identify main QL issues, factors effecting these issues;

- Observe and analyze human-defined targets and solutions of arising QL issues taking into account local people's perceptions and strategies developed at different scales (from local to national and circumpolar) in order to achieve better QL and sustainability;

- Detect key indicators (most important from the QL improvement point of view) to be monitored and tested during long-term observations in case study regions (observation sites);

- Carry out local observations of socio-economic and environmental trends impacting QL and human capital on the base of specially developed methodology, approaches and tools of socially-oriented observations;

- Involve arctic residents (indigenous and non-indigenous), their local and traditional knowledge in QL observations;

- Raise peoples' awareness of happening changes in living conditions, policy and environment, help people to set targets in order to achieve better QL and sustainability. This is to be done with the help of participatory observations, information-educational workshops and other tools;

- Consolidate national and international collaborations in the Russian North on socially-oriented observations and research;

- Translate better experience of the Arctic states in achieving higher quality of life and sustainability into local, national policies and adaptation strategies.

Member/ connected to global network

The IASOS network is a partner of the International Polar Year cluster project PPS Arctic # 151 (*P*resent day processes, *P*ast changes, and *S*patiotemporal variability of biotic, abiotic and

socio-environmental conditions and resource components along and across the Arctic delimitation zone) under the leadership and coordination of Norway (coordinator Annika Hofgaard, NINA and co-coordinator Gareth Rees, Scott Polar Research Institute, UK). Within this multidisciplinary project - **The Northern Socially-oriented Observation Network** in the taiga-tundra interface zone, has started to be constructed and supported both by Research Council of Norway Norwegian Cooperation program on Research and Higher Education with Russia and the Presidium RAS Program N 16, part 2 (coordinator V.M. Kotlyakov, Institute of Geography). The IASOS network is connected to the Northern Socially-oriented Observation Network.

The IASOS network is also taking part in various global initiatives and networks, both in permanent basis as well as in ad hoc collaborations :

- IPY ICSU/WMO JC Sub-committee on observations (social direction of observations);

- Arctic Council Sustainable Development Working Group (the IASOS Network has been recognized as a parallel component of the Arctic Human Development Report follow-up);

- Coordinator of IASOS was a working group liaison to the Arctic Social Indicators project and now is a member of the ASI- II working group under the leadership of Iceland. As it is known, ASI has been recognized as a building block of SAON;

The IASOS network cooperation is widening and we are looking forward to closer collaboration with other networks, projects, government and non-government organizations both in Russia, other Arctic states and at the international level (Russian Geographical Society, Russian Association of the Indigenous Peoples of the North, Russian Academy of Civil Service under the president of the Russian Federation, Roshydromet, International Geographical Union Commission on Cold Regions Environment (CRE), WWF, UNEP/Grid-Arendal, CBMP, ECORA, ECONOR, ArcticStat, CAVIAR, ArcticNet projects and others).

Type of Network

- Thematical observations

- Community-based observations

Thematic Area

Quality of life, sustainability, human capital development and socio-economic issues and indicators.

Main variables

Main variables are structuralized according to main types of quality of life, sustainability, human capital development and socio-economic issue revealed in the Russian North as to March 2010.

Common issues and indicators for further observations identified for all our sites (although there are some local distinctions in specific sites of observations) are:

1. Material well-being (wages, disposable incomes, etc.) and level of income differentiation among the poorest and the richest groups of the society;

2. Unemployment level is becoming more and more important issue and indicator, especially youth unemployment;

3. Life expectancy (especially men), child mortality and sickness;

4. Quality of health-care system;

5. State of the natural environment impacting quality of life and sustainability (climate change variability, seasonal uncertainties in river ice melting, pollution and quality of drinking water, etc.);

6. Quality of administration control from the local government;

7. Peoples' participation in decision making, capacity to control their fate;

8. Quality of education;

9. Quality of socio-cultural service; the share of education, health and social services in GRP;

10. Migration especially youth migration and the overall population aging.

When operational

Since 2008

Geographical coverage

Regions of the Russian North;

Sites situated in different bioms (from tundra to southern taiga zone) in sparsely populated rural areas and industrial regions of Murmansk, Arkhangelsk Oblast and Komi Republic.

Data archive

IASOS network metadata is registered in the International Polar Year Data and Information Service http://ipydis.org/data/submission.html

Data availability

Data on various subjects can be found in publications and presentations at international meetings as well as on the website now under construction.

All data is in the process of development and renewal. It is available through collaboration with partner networks, projects, organizations.

15. Human Health

Name and acronym:
Human Health
National Social-hygienic monitoring system

Contact person (e-mail)
Dr. Alexander Vereschagin

Web site
http://www.fcgsen.ru/

Main objective of the network:
To establish and maintain the state-owned national system of monitoring, analysis, assessment and support of decision making in the area of environmental and public health with focus on management of health risk factors such as environmental pollution, infections, food and water quality etc.
The system has been enforced by the federal governmental Decree Feb. 2. 2006 # 60. It comprises all administrative units (republics, oblasts (counties), autonomous okrugs, cities and some municipalities of Russian Federation including those located in the arctic region.

Type of activity:
Service of Protection Consumers' Right and Human Wellbeing, Federal Service of Hydrometeorology, laboratories accredited for contaminant measurements, regional/city administration health committees, hospitals

Type of network:
Regional and City based observations

Thematic area:
Human & socio-economic

Main variables:
Environmental pollution (56 groups of variables).
Infections
Food contamination
Water quality
Social characteristics and quality of life
Health and demography
GIS based data mapping

When operational (year):
ongoing

Geographical coverage
Russian Federation

Data archive

Data availability:
www.fgsen.ru (available in only Russian language)

Main gaps:
The health and demographic data link exclusively to administrative provinces of Russia which are not always applicable to geographical and climatic regions such as arctic.