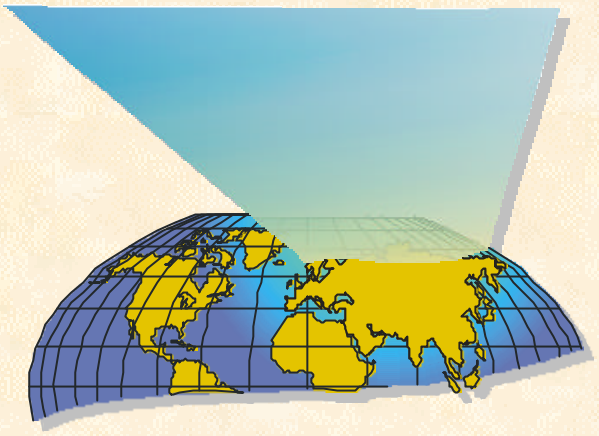
RUSSIAN FEDERAL SERVICE for HYDROMETEOROLOGY and ENVIRONMENTAL MONITORING



# On the progress of implementation of the Russian National AMAP Plan Projects (II stage) by Roshydromet in 2000

2000

## CONTENT

# 1. ON THE PROGRESS OF IMPLEMENTATION OF THE RUSSIAN NATIONAL AMAP PLAN PROJECTS (II STAGE) BY ROSHYDROMET IN 2000

In 2000 in the framework of the Russian National Plan and special projects, the research institutions under the administration of Roshydromet carried out:

- complex studies in seasonal expeditions;
- stationary systematic observations of atmospheric air contamination in the largest cities of the Russian Arctic (Murmansk, Monchegorsk, Vorkuta, Nikel, Amderma, Norilsk and Salekhard);
- observations of the levels of contaminants over the Roshydromet network points;
- complex studies and sampling within the framework of the joint Project PAIPON/AMAP/GEF: Persistent Toxic Substances, Food Security and Indigenous People of the Russian North.

## 1.1. Expedition studies

The expeditional studies in 2000 were performed both in western and in eastern parts of Arctic Region and included works at sea areas (eastern part of Central Arctic basin, Pechora, Kara, Laptev, Eastern-Siberian and Chukchi seas) and coast (region of Varandey settlement).

A total of five Arctic expeditions were carried out by Roshydromet in 2000 that conducted sampling of different environmental media for the levels of contaminants:

The 2000 expedition areas are presented in Figure 1.

The scope of work and the characteristics of the information set obtained from the results of each expedition are given in Table 1. The same table contains explanation of abbreviations of the names of contaminant groups used below.

### 1.1.1. The "Arctic - 2000" expedition

The expedition "Arctic-2000" on the vessel "The Academician Fedorov " included performing of complex climatic, hydrometeorological and hydrochemical studies in the eastern part of Central Arctic basin.

Period of the expedition is July - August of 2000.

Within the framework of the program of study of the state of the environment the samples of an atmospheric aerosol, snow cover, marine ice and water for their studies on the content on contaminants were selected at 20 oceanographic stations.

The following will be determined in samples of atmospheric aerosols : OH, PAH, OCs, PCBs and HM.

The following will be determined in samples of marine water, snow cover and marine ice: PAH, OCs, PCBs, HM, acidity, alkalinity, components of mineral composition and content of solid particles.

SSC AANII and RC “Monitoring of the Arctic” are the executors of the works.

### 1.1.2. The expedition at Hydrographical Vessel «Nikolai Kolomeets»

The expedition at Hydrographical Vessel «Nikolai Kolomeets» is being carried out within the framework of the program «Nature of the World ocean» and includes sampling of marine water, bottom sediments, benthos and plankton for studies of accumulation and transformation OCs and estimation of linked with it toxic effects for aqueous biocenoses.

The period of performing of marine studies is July - October, 2000.

The region of works of the expedition dispatch includes water areas of Pechora, Kara, Laptev, East-Siberian and Chukchi seas (fig. 1).

Total for chemical-analytical analyses it is planned to sample at 50 oceanographic stations: 50 samples of marine water, 50 samples of suspension, 50 samples of bottom sediments , 50 samples of benthic organisms, 25 samples of phyto- and zooplankton.

Institute of a Global Climate and Ecology (IGCE) and RC “Monitoring of the Arctic” are the executors of the works.

### 1.1.3. The «Karex-Pechora 2000» expedition

The expedition «Kareks-Pechora 2000» includes two stages of performing of marine works:

1 stage - marine works on water areas of the Kara and Pechora seas at Scientific Research Vessel «Ivan Petrov» in August, 2000;

2 stages - marine works in the Pechora sea at Hydrographical Vessel "Hydrolog" in September - October, 2000.

Within the framework of the program of study of the state of the environment in August, 2000 at 30 oceanographic stations the samples of marine water, suspensions and bottom sediments were sampled for their analyses on the content of contaminants.

At 8 stations the performing of the hydrobiological works with sampling of benthic organisms, plankton and fishes is planned for analyses of accumulation and transformation of contaminants.

In samples of marine water and bottom sediments the following will be determined: OH, PAHs, OCs, PBCs and HM. Also dissolved oxygen, pH, alkalinity and nutrients are determined in samples of water.

In biological samples the content PAHs, OCs, PCBs and HM is determined.

SSC AANII and RC “Monitoring of the Arctic” are the executors of the works.

### 1.1.4. The «Lena 2000» expedition

The period of performing of the Russian-German expedition "Lena-2000" is August, 2000. The region of works of expedition includes mouth of Lena river and shelf of East part of the Laptev sea.

Within the framework of expedition sampling of the river and marine water, suspensions and bottom sediments is planned at 30 hydrological stations for study of the mechanism of transport of contaminants by river water.
SSC AANII is the executor of the works.

### 1.1.5. The "NAR-2000" expedition

The works performeded within the framework of expedition "NAR-2000" were the continuation of the works of years 1998-99.

The period of performing of expedition is August - September, 2000.

The region of works was limited by the territory of Varandey and Toravey oil fields.

The main purpose of works was obtaining of the complex information about the current ecological situation in region of works and examination of dynamics of its change in comparison with 1998-99 years.

The programme of works of the expedition envisages:

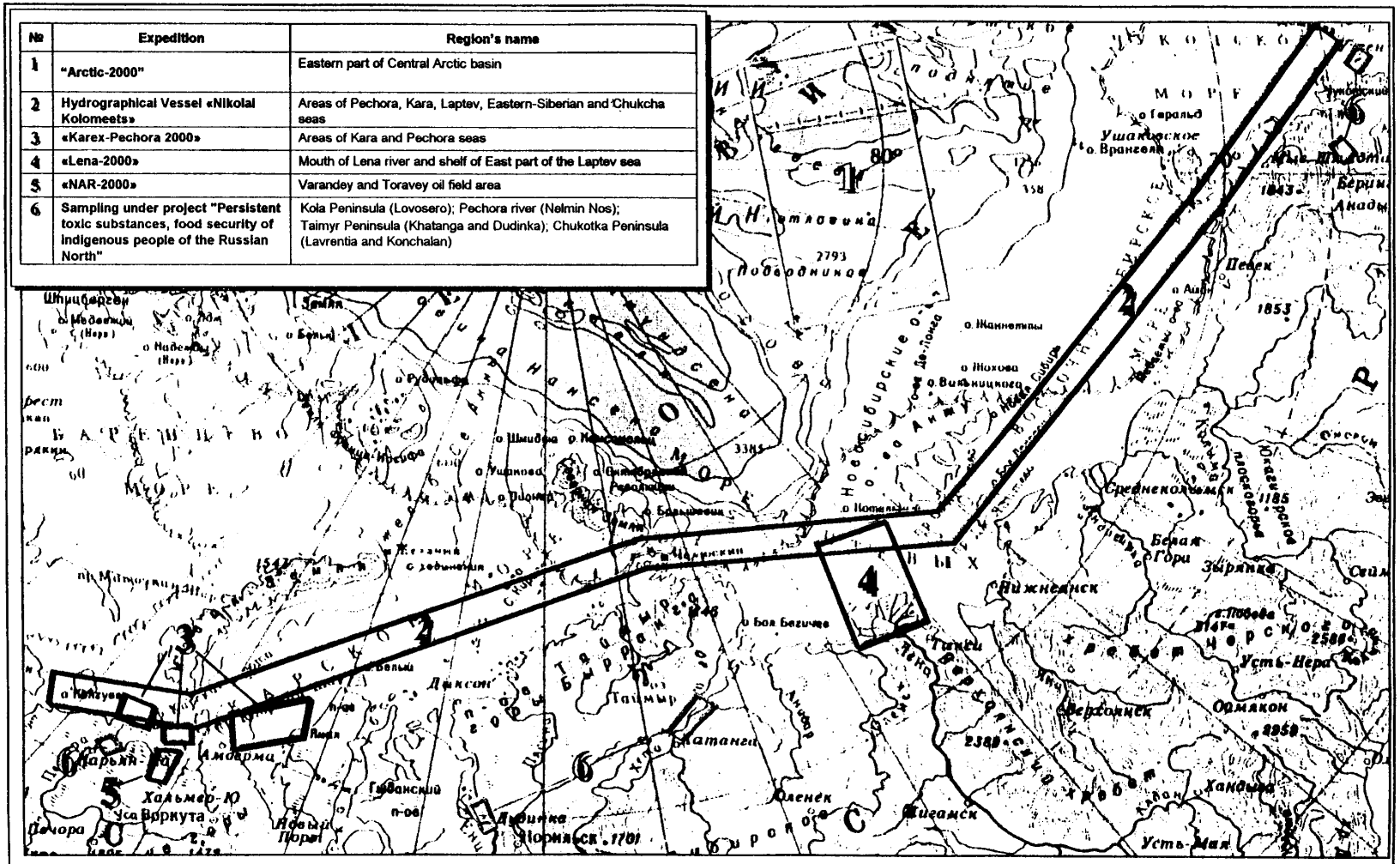
- monitoring of pollution of atmospheric air, waters and bottom sediments in freshwater reservoires, soils and terrestrial vegetation;
- soils-botanical studies;
- visual and tool (aerophoto and video surveys) observations of the damage of soil-vegetative cover.

Observations and the sampling for chemical-analytical and other laboratory examinations will be performed at 25 aqueous objects of the land and 16 observational platforms on the territory of Varandey and Toravey oil fields.

Samples of water, bottom sediments and soils are studied for the content: HM, totall content of OH, non-polar aliphatic hydrocarbons, volatile aromatic hydrocarbons, PAHs, detergents and individual phenols (alkyl-, chlorine- and nitro- derivates). The standard hydrochemical indexs are determined in samples of water also.

Samples of atmospheric aerosols and samples of terrestrial vegetation are studied for the content of: HM, PCBs and PAHs.

RC “Monitoring of the Arctic” is the executor of the works.



| № | Expedition | Region's name |
|---|---|---|
| 1 | "Arctic-2000" | Eastern part of Central Arctic basin |
| 2 | Hydrographical Vessel «Nikolai Kolomeets» | Areas of Pechora, Kara, Laptev, Eastern-Siberian and Chukcha seas |
| 3 | «Karex-Pechora 2000» | Areas of Kara and Pechora seas |
| 4 | «Lena-2000» | Mouth of Lena river and shelf of East part of the Laptev sea |
| 5 | «NAR-2000» | Varandey and Toravey oil field area |
| 6 | Sampling under project "Persistent toxic substances, food security of indigenous people of the Russian North" | Kola Peninsula (Lovosero); Pechora river (Nelmin Nos); Taimyr Peninsula (Khatanga and Dudinka); Chukotka Peninsula (Lavrentia and Konchalan) |

Fig. 1 Roshydromet expedition areas in 2000 in framework AMAP project

**Table 1 Scope of work and characteristics of the information set obtained (planned) with the results of Roshydromet's expeditions in 2000**

| Study object/ kind of observations | Number of stations | Number of samples | Parameters under control | Quantity of records on parameters group |
|---|---|---|---|---|
| **1. The "Arctica 2000" expedition** | | | | |
| Atmospheric aerosol | 10 | 10 | HM, OCs, PCB, PAH | 660 |
| Snow cover | 20 | 20 | pH, Alk, MI, SP, HM, OCs, PCB, OH, PAH | 1520 |
| Sea ice cover | 20 | 20 | SP, HM, OCs, PCB, OH, PAH | 1360 |
| Sea water | 20 | 20 | $O_2$, pH, nutrients, SC, HM, OCs, PCB, OH, PAH | 1420 |
| **2. The expedition at Hydrographical Vessel "Nikolai Kolomeets"** | | | | |
| Sea water | 50 | 50 | OCs, PCB | 1550 |
| Sea water suspension | 50 | 50 | OCs, PCB | 1550 |
| Bottom sediments | 50 | 50 | OCs, PCB | 1550 |
| Benthic organisms | 50 | 500 | OCs, PCB | 1550 |
| Plankton | 25 | 25 | OCs, PCB | 775 |
| **3. The "Karex-Pechora 2000" expedition** | | | | |
| **1 stage on RV «Ivan Petrov»** | | | | |
| Sea water | 30 | 60 | $O_2$, pH, nutrients, SC, HM, OCs, PCB, OH, PAH | 3900 |
| Sea water suspension | 30 | 30 | HM, OCs, PCB, PAH | 1590 |
| Bottom sediments | 30 | 30 | HM, OCs, PCB, OH, PAH | 1620 |
| **2 stage on HV «Hydrolog»** | | | | |
| Sea water | 15 | 30 | $O_2$, pH, nutrients, SC, HM, OCs, PCB, OH, PAH, VAH | 2430 |
| Bottom sediments | 15 | 15 | HM, OCs, PCB, OH, PAH, VAH, nutrients | 1170 |
| Plankton | 8 | 8 | HM, OCs, PCB, PAH | 424 |
| Benthic organisms | 8 | 8 | HM, OCs, PCB, PAH | 424 |
| Fish | 4 | 8 | HM, OCs, PCB, PAH | 424 |
| **4. The "Lena-2000" expedition** | | | | |
| Sea water | 30 | 30 | $O_2$, pH, nutrients, SC, HM, OCs, PCB, OH, PAH | 1440 |
| Sea water suspension | 30 | 30 | HM, OCs, PCB, PAH | 1500 |
| Bottom sediments | 30 | 30 | HM, OCs, PCB, OH, PAH | 1530 |

**Table 1 (continued)**

| Study object/ kind of observations | Number of stations | Number of samples | Parameters under control | Quantity of records on parameters group |
|---|---|---|---|---|
| **5. The "NAR-2000" expedition** | | | | |
| Atmospheric aerosol | 6 | 6 | HM, OCs, PCB, PAH | 390 |
| River and lake water | 28 | 28 | $O_2$, BOD, COD, , h, Alk, nutrients, HM, OCs, PCB, OH, NAH, PAH, VAH, PHE, DET | 3080 |
| Bottom sediments | 28 | 28 | GMC, HM, OCs, PCB, OH, NAH, PAH, VAH, PHE, DET | 2770 |
| Soil | 16 | 16 | GMC, HM, OCs, PCB, OH, NAH, PAH, VAH, DET | 1584 |
| Terrestrial vegetation | 16 | 16 | HM, OCs, PCB, PAH | 880 |

**Notes:**

HM - heavy metals (Fe, Mn, Ni, Co, Cd, Pb, Zn, Cu, Sn, Cr, Hg, As)

OCs - organochlorines (pentachlorobenzene, $\alpha$ - HCH, hexachlorobenzene, $\beta$ - HCH, $\gamma$ - HCH, heptachlor, aldrine, octachlorostyrene, heptachlorepoxide, trans-chlordane, 2,4 - DDE, cis-chlordane, trans-nonachlor, 4,4 - DDE, 2,4 - DDD, 4,4 - DDD, cis-nonachlor, 2,4 - DDT, 4,4 - DDT, fotomirex, mirex)

PCB - polychlorinated biphenils (#28, #52, #101, #105, #118, #138, #153, #156, #180, sum of PCB)

OH - oil hydrocarbons

PAH - polycyclic aromatic hydrocarbons (naphthalene, acenaphthylene, biphenyl, 2-methylnaphthalene, 1-methylnaphthalene, fluorene, acenaphthene, phenanthrene, anthracene, 2,6-dimethylnaphthalene, fluoranthene, 2,3,5-trimethylnaphthalene, 1- methylphenanthrene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(e)pyrene, perylene, benzo(k)fluoranthene, benzo(a)pyrene, dibenzo(a,h)anthracene, indeno(123cd)pyrene, benzo(g,h,i)perylene)

VAH - volatile aromatic hydrocarbons (benzene, tholuene, orto-, para- and meta-xylene)

NAH - non-polar aliphatic ($C_{15}$-$C_{31}$)

PHE - phenols

DET - detergents

$O_2$ - dissolved oxygen

nutrients - nutrients (nitrates, nitrites, ammonium, total nitrogen, phosphates, total phosphorus, dissolved silicates)

$BOD_5$ - biochemical oxygen demand (5 days)

COD - chemical oxygen demand

pH - hydrogen index

Eh - redox potential

Alk - total alkalinity

SC - suspension concentration

GMC granulometric composition

SP - solid particulates

## 1.2. Stationary systematic observations of the pollution of atmospheric air and atmospheric precipitation

In 2000 the observations of the contamination level of atmospheric air in the cities of the Arctic zone were carried out at stationary posts in Murmansk, Nickel, Monchegorsk, Salekhard, Norilsk. Sampling was made daily (4 times a day) in equal 6 h time intervals at 1.00, 7.00, 13.00 and 19.00 hours Moscow time to the filters and adsorbing tubes. The following indicators were determined:

- in Norilsk - level of dust, sulphur dioxide, carbone oxide, nitrogen dioxide, nitrogen oxide, formaldehyde, hydrogen sulphide, phenol, chlor, benz(a)pyrene, heavy metals;
- in Murmansk - level of dust, sulphur dioxide, carbone oxide, nitrogen dioxide, nitrogen oxide, formaldehyde, mercury, benz(a)pyrene, heavy metals;
- in Monchegorsk - level of dust, sulphur dioxide, carbone oxide, nitrogen dioxide, nitrogen oxide, formaldehyde, benz(a)pyrene, heavy metals.

It should be noted that in connection with a difficult financial situation it was not possible for Rosgidromet in 2000 to extend the scope of the observed parameters.

Monitoring of sulphur and nitrogen compounds in air and atmospheric precipitation was continued, and besides acidification of atmospheric precipitation was determined at the stations of atmospheric contamination control Yaniskosky (Kola peninsula) and Pinega (Arkhangelsk region) in the framework of the EMEP.

In 2000 observations were continued at the station of carbonic acid gas monitoring system - Teriberk. Frequency of sampling under the programme was 4 times in a month. Air samples were analyzed at Major Geophysical Observatory under name of Voeykov.

It should be noted that operative obtaining of data on $CO_2$ concentrations at the Teriberk station is very difficult because of considerable lack of finances, which reduces operativeness of data obtaining.

In 2000 observations of chemical content of atmospheric precipitation were carried out at 5 stations of Arctic web of stationary observations, situated in the region of Krasnoshelye settlement (Kola peninsula), Naryan-Mar (the Pechora river), Dikson island, Turuhansk (the Yenisey river), Kusyur settlement (the Lena river). The programme considers taking of integral sample of precipitation every month.

Since 1999 in settlement Amderma the joint Project with Seintific Manufacture Company "Typhoon", linked with expluatation of self-acting equipments of sampling of the air on the content contominants is fullfiled. Now the problem on installation of equipment for sampling on the content of organic compounds of Hydrargyrum by organizations Roshydromet.

## 1.3. Radiation monitoring in the Russian Arctic

In 2000 observations in the framework of planned work for control of radioactive contamination of environmental compartments were continued at 34 sites of the State System of Radiation Monitoring in the Russian Arctic.

At all stations daily monitoring of the exposure dose strength of gamma emission and daily sampling of radioactive fallout from the atmosphere are carried out to determine total beta-activity.

At the sites in Arkhangelsk, Naryan-Mar, Salekhard, Murmansk, Dikson island, Zhelaniya cape, Kheis island and Kandalaksha sampling of aerosoles in the surface atmospheric layer and atmospheric precipitation was performed for a specific radioisotopic analysis, including determination of tritium. The analysis is being conducted at the laboratories of NPO "Tayphoon" and territorial administrations of Rosgidromet in the cities of St.-Petersburg and Yakutsk.

Samples of surface water for determination of levels of 90-Sr and tritium were collected at the stations of radioactive contamination control, located in the mouth regions of the largest rivers of the Russian Arctic (Severnaya Dvina, Pechora, Mezen, Ob, Yenisey, Khatanga, Indigirka). In 2000 26 samples for this purpose were collected. Also, the control for level of 90-Sr in sea water was conducted in the White and Barents Seas in the most significant regions of the water area.

## 1.4. Conclusion

In conclusion it is necessary to stress that in spite of a complicated situation with the financing of the Arctic studies, in 2000 Rosgidromet continued rather considerable expeditional studies and observations on the stationary web of condition of natural environment components. The collected samples were passed to the base chemical laboratories of the Regional Center "Monitoring of the Arctic", NPO "Tayphoon" and Institute for global climate and ecology, where they were analyzed.

It is necessary to stress that, unlike previous years, considerable amount of complex data on condition of ecosystems of concrete regions of Arctic land and local sea water areas was obtained in the framework of contract works with interested investors. In this connection this data can be available in the AMAP Secretariat only in generalized way.

Data on these regions for concrete samples and models could be passed to the Secretariat only after agreement with investors financing this case.

**Table 2. List of points of radiation control and kinds of radiometric observations**

| Point of observation | Synoptical index | Geographical coordinates | | Kind of observation | | | Carring out of radiometric observatioms in situ |
|---|---|---|---|---|---|---|---|
| | | latitude | longitude | G | P | AFE | |
| **Coastal** | | | | | | | |
| 1. Nikel M | 22004 | 69° 25’ | 30° 11’ | + | * | | |
| 2. Ura-guba M | 22018 | 69° 17’ | 32° 48’ | + | * | | |
| 3. Dalniye Zelentsy M | 22037 | 69° 07’ | 36° 04’ | * | * | | |
| 4. Cape Svyatoy Nos M | 22140 | 68° 08’ | 39° 46’ | + | * | | r/m |
| 5. Intsy N | 22452 | 65° 58’ | 40° 13’ | * | * | | |
| 6. Kanin Nos N | 22165 | 68° 39’ | 43° 18’ | + | * | | r/m |
| 7. Tobseda N | 23105 | 68° 33’ | 52° 15’ | * | * | | |
| 8. Khodovarikha N | 23103 | 68° 56’ | 53° 46’ | + | * | | |
| 9. Chernaya N | 23118 | 68° 00’ | 57° 25’ | * | * | | |
| 10. Varandey N | 23112 | 69° 49’ | 58° 01’ | + | * | | |
| 11. Korotaikha A | 23121 | 68° 46’ | 61° 26’ | * | * | | |
| 12. Mezen N | 22471 | 65° 52’ | 44° 13’ | + | + | | |
| 13. Kem-port N | 22522 | 64° 59’ | 34° 48’ | + | + | | |
| 14. Severodvinsk N | 22546 | 64° 35’ | 39° 47’ | + | * | * | |
| 15. Unskiy Mayak N | 22541 | 64° 50’ | 38° 24’ | + | * | | |
| 16. Kego N (Arkhangelsk) | 22555 | 64° 32’ | 40° 28’ | + | + | + | |
| 17. Zimnegorskiy Mayak N | 22446 | 65° 28’ | 39° 44’ | * | | | |
| 18. Mud’yug N | 22551 | 64° 51’ | 40° 17’ | + | * | | |
| 19. Zhizhgin N | 22438 | 65° 12’ | 36° 49’ | + | | | |
| 20. Amderma A | 23022 | 69° 46’ | 61° 41’ | + | + | 0 | |
| 21. Tiksi T | 21824 | 71° 40’ | 128° 50’ | + | + | * | |
| 22. Pevek P | 25051 | 69° 42’ | 170° 15’ | + | * | * | |
| 23. Krasnoarmeyskiy P | 25055 | 69° 33’ | 172° 02’ | 0 | 0 | | r/m |
| **Island** | | | | | | | |
| 24. Barentsburg M (Spitsbergen Island) | 22107 | 78° 04’ | 14° 15’ | + | + | * | r/m |
| 25. Morzhovets Island N (White Sea) | 22361 | 66° 43’ | 42° 29’ | + | + | | r/m |
| 26. Bugrino N (Kolguev Island) | 22193 | 68° 48’ | 49° 20’ | + | + | | r/m |
| 27. Uedineniya Island TM | 20274 | 77° 30’ | 82° 14’ | 0 | 0 | 0 | 0 |
| 28. Vrangel Island P | 21982 | 70° 59’ | 178° 29’ | + | 0 | 0 | 0 |
| 29. Karmaguly A (Novaya Zemlya Island) | | - | - | + | * | * | |
| 30. Cape Zhelaniya TM (Novaya Zemlya Island) | 20353 | 76° 57’ | 68° 33’ | 0 | 0 | 0 | 0 |
| **Points of observation within 100-km area of the Kola NPP** | | | | | | | |
| 31. Apatity M | 22213 | 67° 33’ | 33° 21’ | | + | + | |
| 32. Pulozero M | 22119 | 68° 21’ | 33° 18’ | | + | * | |
| 33. Umba M | 22324 | 66° 40’ | 34° 20’ | | + | * | |
| 34. Zasheek M | 22214 | 67° 24’ | 32° 33’ | | + | + | |

**Note:**
G - measurement of exposuse dose capacity
P - plane-table
AFE - air-filtering equipment
\+ - ongoing measurements
* - planned observations
0 - to resume earlier interrupted observations
M - Murmansk HMSA
N - Northern HMSA
A - Amderma HMSA
T - Tiksi HMSA
TM - Taimyr HMSA
P - Pevek HMSA
HMSA - Hydrometeorological Service

## 2. THE JOINT GEF, AMAP, CIRCUMPOLAR ASSOCIATION OF THE INUITS AND ROSHYDROMET PROJECT " PERSISTENT TOXIC SUBSTANCES (PTS), FOOD SECURITY OF INDIGENOUS PEOPLE OF THE RUSSIAN NORTH"

The works were begun within the framework of the Project "Persistent Toxic Substances (PTS), Food Security of Indigenous People of the Russian North" by RC "Monitoring of Arctic" of Roshydromet, with involving of the specialists of Zoological and Botanical institutes of Russian Academy of Science in a field season of 2000. The programme of works for year 2000 envisages sampling of the fresh water; marine water; lake, river and marine bottom sediments; soils; mosses; lichens; organs of terrestrial and waterflown birds, Arctic hares, reindeers; characteristic species of marine and freshwater fishes, marine mammals, mushrooms and berries used in nutrition by the indigenous people of the Russian Arctic Region.

The sampling is performed:

- at the Kola Peninsula - in the region of Lovozero;
- in the downstream current of the Pechora River- in the region of Nelmin Nos;
- at Taimyr - in the region of the settlements Khatanga and Dudinka;
- at Chukotka - in the region of the settlements Lavrentia and Konchalan;

In the specified regions a great number of episodic sampling is planned to perform for making of the integrated samples.

After delivery in Saint-Petersburg all samples will be transferred in the Laboratories, chosen by the AMAP Secretariat, for analyses on Persistent Toxic Substances.

The scope of work under project are given in Table 3.

**Table 3. Scope of work on sampling in the frameworkof the project "Persistent toxic substances (PTS), food security of indigenous people of the Russian North" in 2000**

| Sampling region | Ecosystem | Sampling object | Number of samples (individuals) |
|---|---|---|---|
| **The Kola Peninsula, region of Lovozero** | Terrestrial | Soil | 30 |
| | | Mosses and lichens | 40 |
| | | Eatable berries | 20 |
| | | Hare | 15-20 |
| | | Ptarmigan | 20 |
| | | Tissues of reindeer | 10 |
| | | Waterflown birds | 20 |
| | Freshwater-peatbog | Water | 2 |
| | | Bottom sediments | 10 |
| | | Benthos | 10 |
| | | Fish | 60 |
| **Downstream current of the Pechora River, region of the Nelmin Nos Cape** | Terrestrial | Soil | 30 |
| | | Mosses and lichens | 40 |
| | | Eatable berries | 20 |
| | | Hare | 15-20 |
| | | Ptarmigan | 20 |
| | | Tissues of reindeer | 10 |
| | | Waterflown birds | 20 |
| | Freshwater-peatbog | Water | 2 |
| | | Bottom sediments | 10 |
| | | Benthos | 10 |
| | | Fish | 60 |
| **The Taimyr Peninsula, region of Dudinka** | Terrestrial | Soil | 30 |
| | | Mosses and lichens | 40 |
| | | Eatable berries | 20 |
| | | Hare | 15-20 |
| | | Ptarmigan | 20 |
| | | Tissues of reindeer | 10 |
| | | Waterflown birds | 20 |
| | Freshwater-peatbog | Water | 2 |
| | | Bottom sediments | 10 |
| | | Benthos | 10 |
| | | Fish | 60 |
| **The Taimyr Peninsula, region of Khatanga** | Terrestrial | Soil | 30 |
| | | Mosses and lichens | 40 |
| | | Eatable berries | 20 |
| | | Hare | 15-20 |
| | | Ptarmigan | 20 |
| | | Tissues of reindeer | 10 |
| | | Waterflown birds | 20 |
| | Freshwater-peatbog | Water | 2 |
| | | Bottom sediments | 10 |
| | | Benthos | 10 |
| | | Fish | 60 |

**Table 1 continued**

| Sampling region | Ecosystem | Sampling object | Number of samples (individuals) |
|---|---|---|---|
| **Chukotka, region of Konchalan** | Terrestrial | Soil | 30 |
| | | Mosses and lichens | 40 |
| | | Eatable berries | 20 |
| | | Hare | 15-20 |
| | | Ptarmigan | 20 |
| | | Tissues of reindeer | 10 |
| | | Waterflown birds | 20 |
| | Freshwater-peatbog | Water | 2 |
| | | Bottom sediments | 10 |
| | | Benthos | 10 |
| | | Fish | 60 |
| **Chukotka, region of Lavrentia** | Terrestrial | Soil | 30 |
| | | Mosses and lichens | 40 |
| | | Eatable berries | 20 |
| | | Hare | 15-20 |
| | | Ptarmigan | 20 |
| | | Tissues of reindeer | 10 |
| | | Waterflown birds | 20 |
| | Sea | Water | 10 |
| | | Bottom sediments | 10 |
| | | Zooplancton | 10 |
| | | Sea mammals | 20 |