Federal Service for Hydrometeorology and Environmental Monitoring of Russia (Roshydromet)
Arctic and Antarctic Research Institute

Russian Scientific Center on Spitsbergen

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ARCTIC AND ANTARCTIC RESEARCH INSTITUTE, SPB, RUSSIA

METEOROLOGY

GEOPHYSICS

(PALEO)GEOGRAPHY

SHELF

HYDROGRAPHY

SURFACE LAYER

MARINE ICE

PACIFIC HALOCLINE

ATLANTIC HALOCLINE

1000 m

ATLANTIC WATER

OCEANOGRAPHY

2000 m

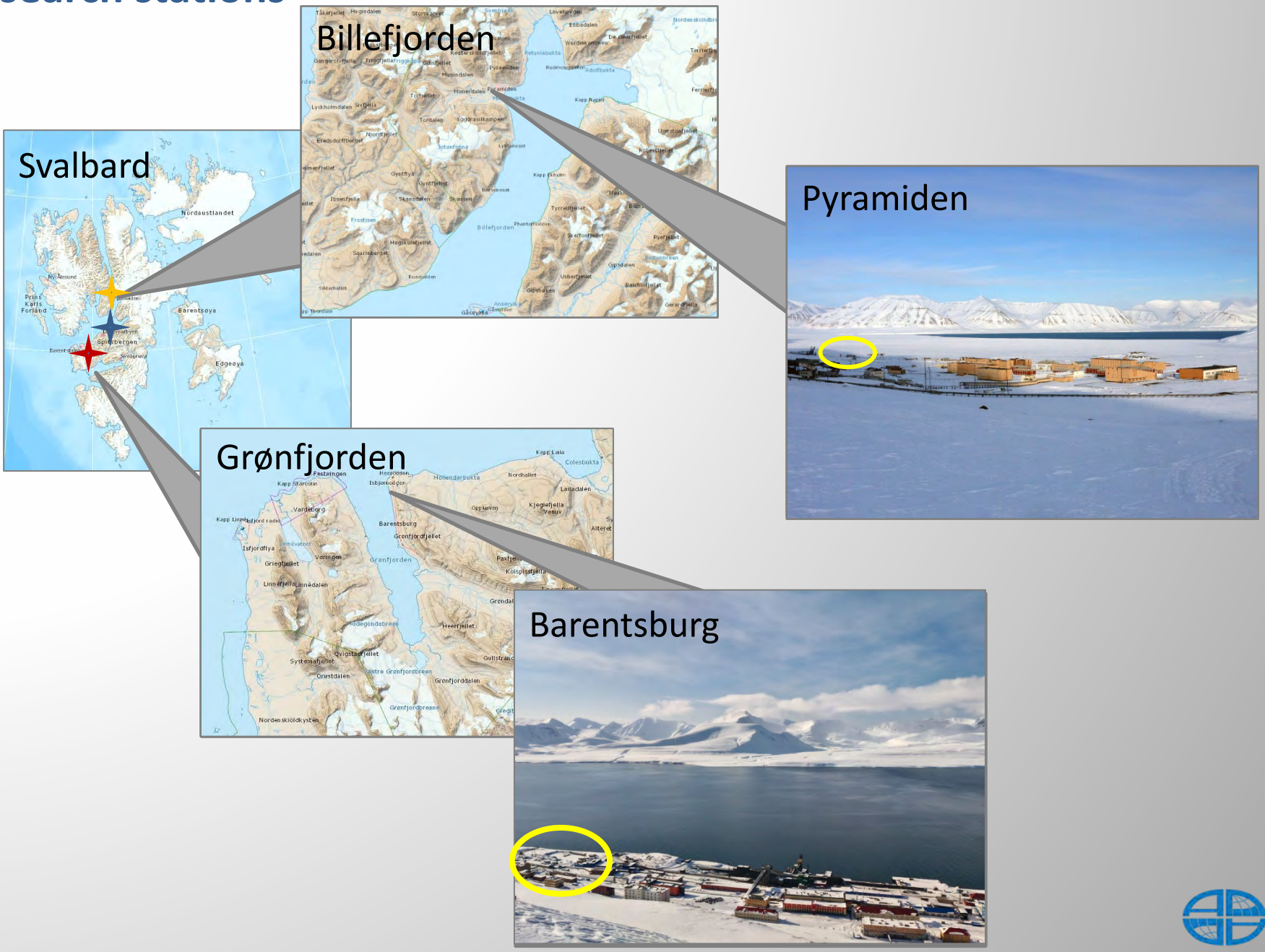
3000 m

ARCTIC DEEP WATER

Since 1920, started as Northern Research and Trade Expedition

Drifting station North Pole-1, 1937

Research stations



Establishing of the Russian Scientific Center on Spitsbergen (RSCS)

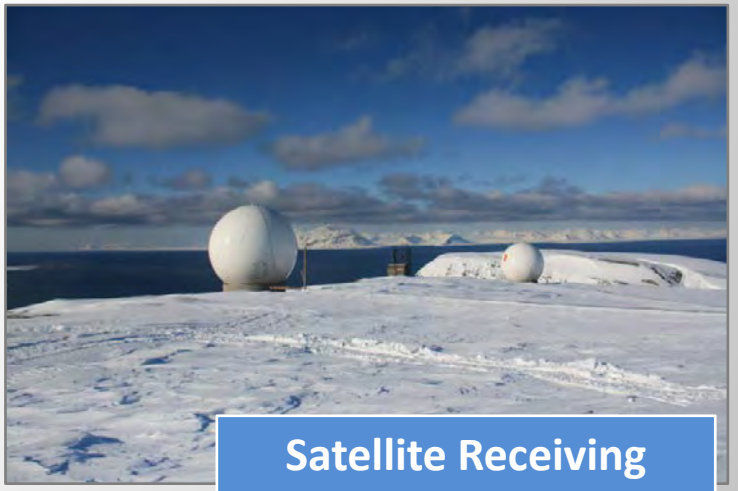
- 11 Russian Institutes of different branches doing research on the archipelago;
- Russian Scientific Center on Spitsbergen (RSCS) is to coordinate and facilitate their activity;
- 2009 – 2013: the main infrastructure was built and renovated;
- 2014: the concept of the Center was approved by the Government of the Russian Federation;
- Since April 4, 2016: the RSCS got independent status, run by AARI;
- Permanent staff of 7 (2016);
- Hosts over 40 researchers (2016).

Next steps

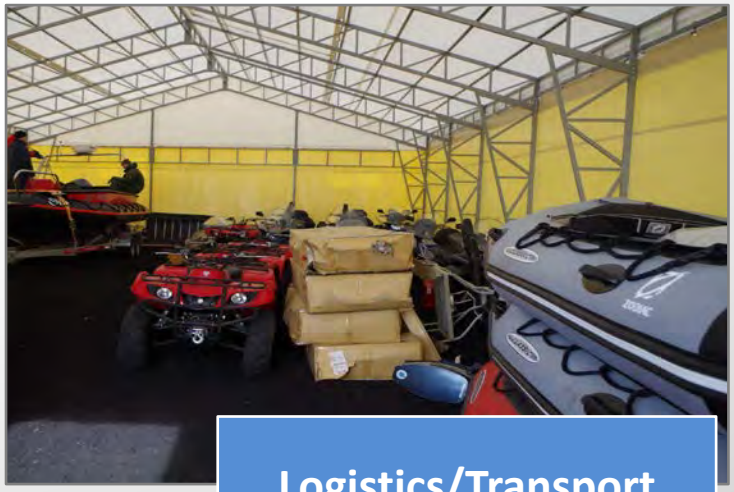
- Infrastructure of Russian institutions on Spitsbergen is to be united;
- Coordinated research programme;
- Student and PhD training;
- Involving more participants.

The infrastructure of Research Center in Barentsburg

Meteo/geophysical Observatory



Satellite Receiving Station

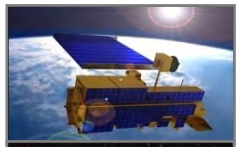


Logistics/Transport

Analytical Laboratory

Satellite receiving / transmission site

- Built and supported by Kongsberg
- Primary processing of satellite images and information before sending to AARI, 2 Tb per year
- Satellite missions of multiple channels, different resolution and swath:



EOS Mission (USA) TERRA & AQUA

NOAA Mission (USA) № 15,17,18,19

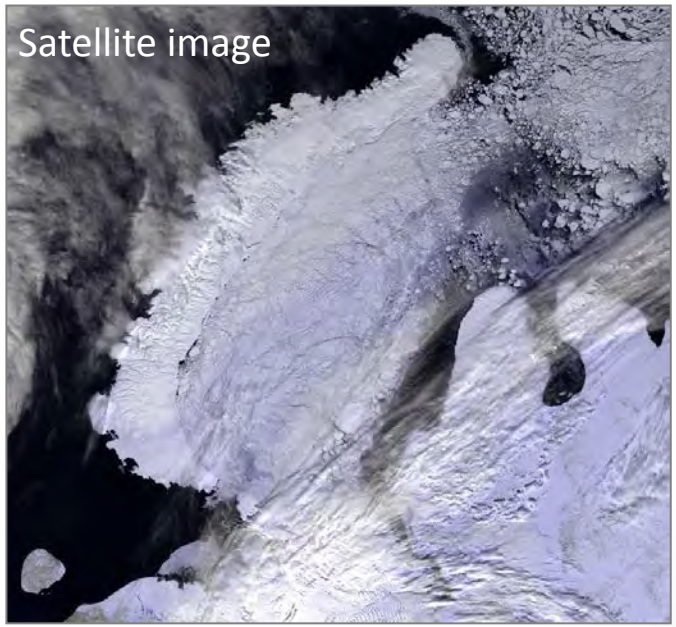
MetOp-B (EUMETSAT/ESA)

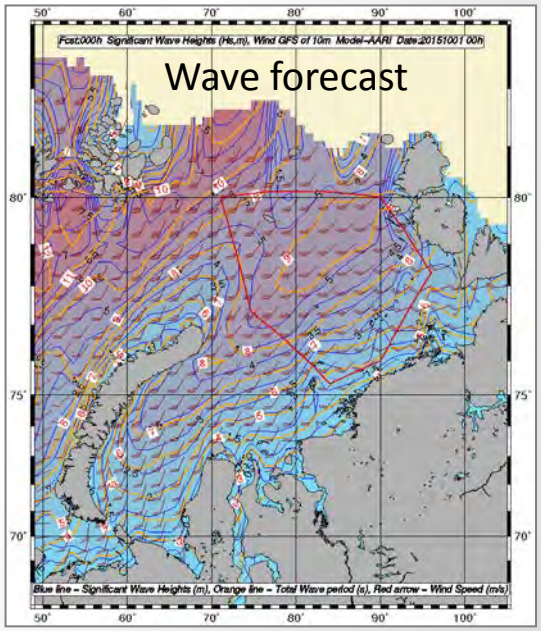
Suomi NPP (USA)

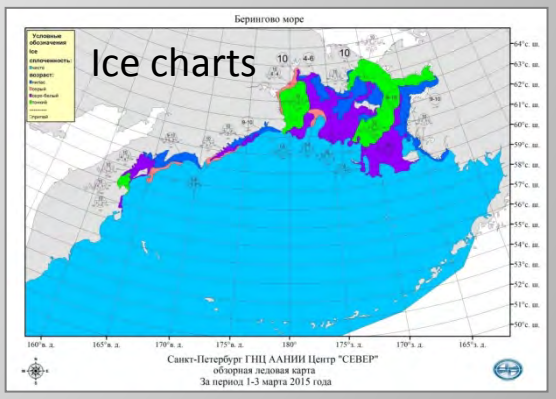
FY-3 (China)

Barentsburg's view area with an initial angle of elevation receiving antenna 5º

Satellite receiving / transmission site







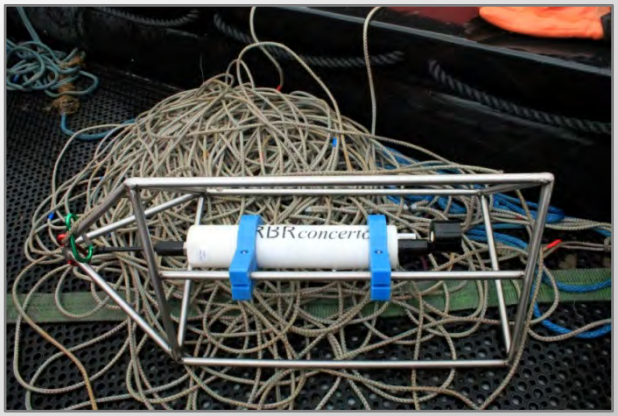
Mostly ice, wave, sea level forecasts
Synoptic maps: http://gmdss.aari.ru/ &
http://weather.gmdss.org

New tasks:

- To extend the data array beyond ice and synoptic data e.g. glaciers, phytoplankton, vegetation;
- On-the-spot processing and using of information in BB;
- Ground-truth observations to validate remote sense data;
- To receive data from future Arctic-M satellites with highly elliptical orbit over the Arctic region.

Logistics:
transport, basic equipment

- Vehicles (snow scooters, quads, cars)
- Boats
- Samplers
- Profilers
- Sample preparation room
- Helicopter and ship by ArcticUgol Trust



Analytical Lab

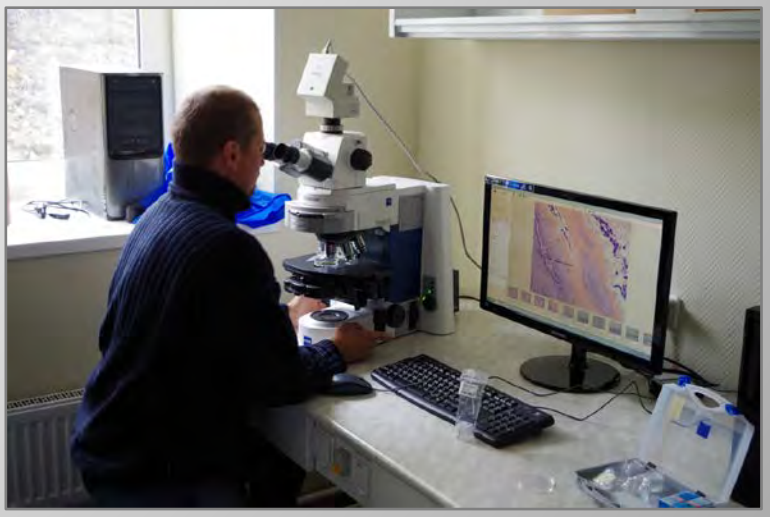
- to support research activity on the archipelago;
- equipped with analytical instruments by Shimadzu, Mettler Toledo, Zeiss, Sartorius etc.

Sample Preparation

- Water sample preparation and basic analysis of pH, conductivity, dis. O_2;
- Sediment samples preparation: freeze-drying, pulverising;
- Samples extraction, incubation, storage.

Microscopy

- 2 x Zeiss Axio Imager.A2 with achromatic-aplanatic universal condenser 0.9 H D Ph DIC for plankton, benthic, paleo and mineralogical studies.



Analytical Lab

Hydrochemical Lab

- TCN analyser (water), planned one for solid samples;
- Ion chromatographer;
- 2 x Spectrophotometer with a flow cell;
- Automatic titration by Mettler Toledo.

Metals analysis

- AAS with flame and electro-thermal atomisation - get running to the next season;
- Mercury analyser.

Analytical Lab

Organic compounds analysis

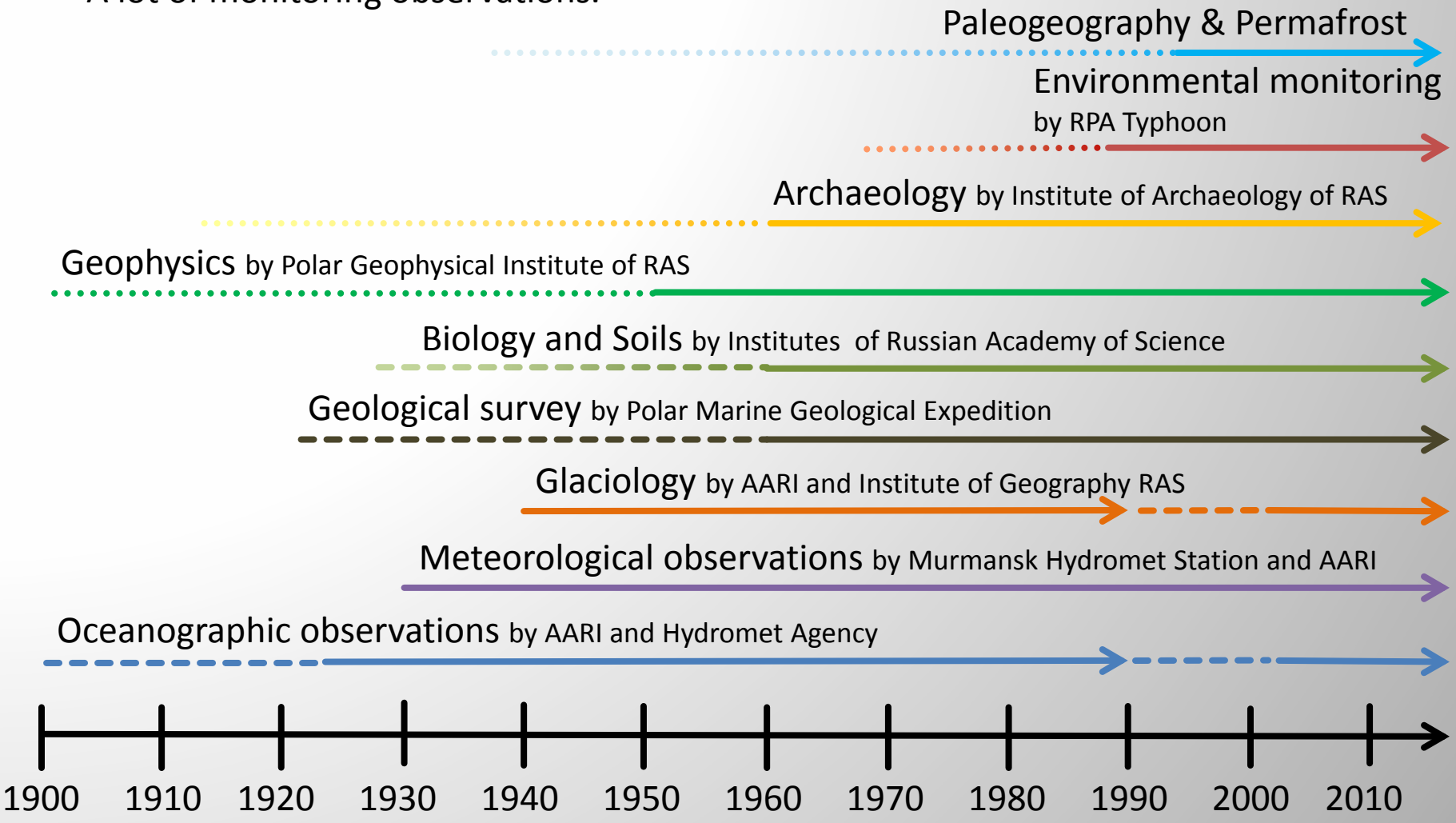
- 2 x LC with diode array and fluorescence detectors;
- GC with flame ionisation and electron capture detectors;
- The whole cycle of sample preparation and measurements completed, compared to RPA “Typhoon” lab results, will be intercalibrated with NILU;
- GC –MS quadrupole type to get running.

To do

- Proper supplying of the lab;
- Permanent staff of 3;
- Methods & intercalibration – BareLab project with NILU & NMBU;
- Own research programme – metals accumulations in GF ecosystem with Murmansk Marine Biological Institute, passive sampling with NILU & NIVA.

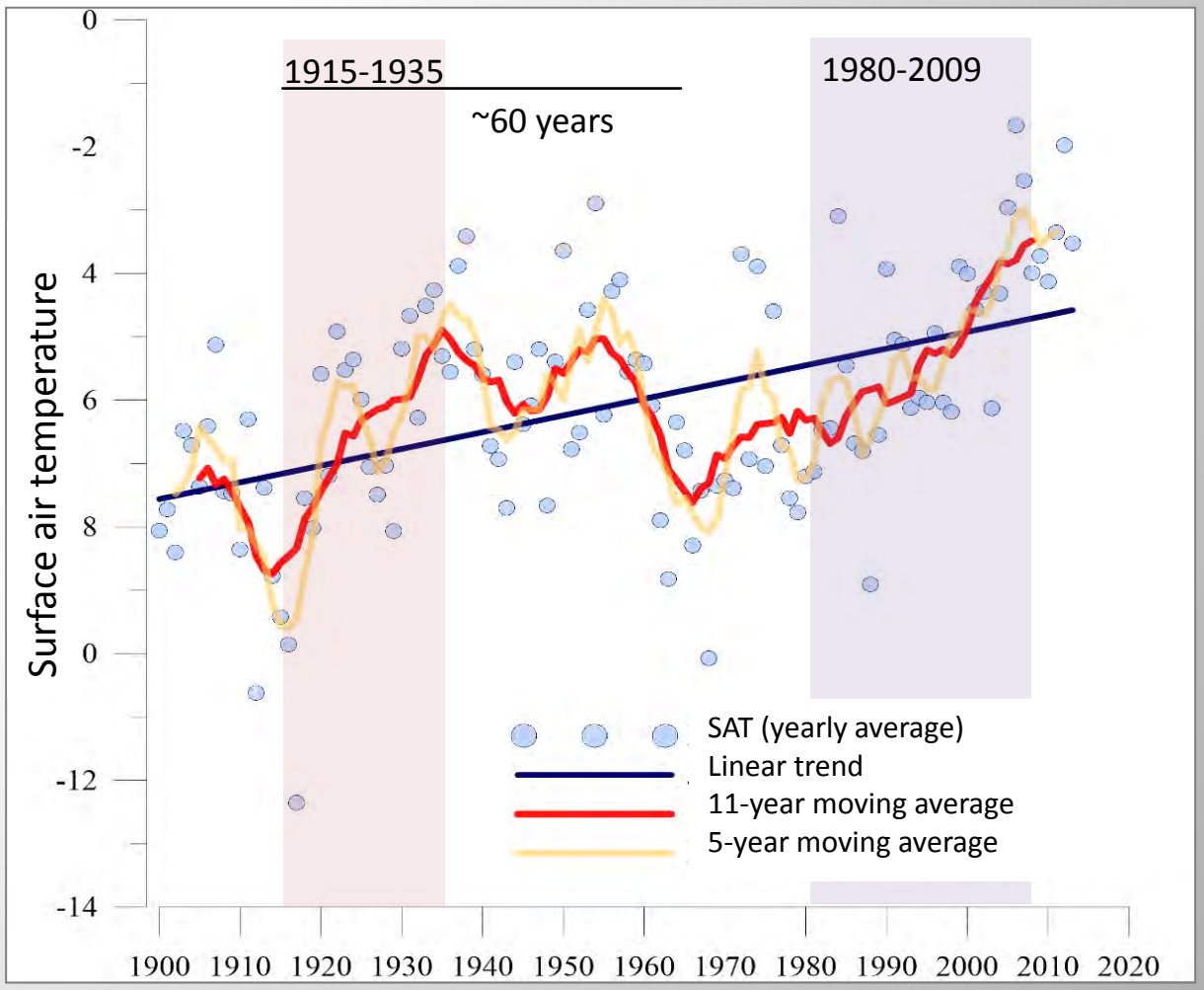
RSCS research programme

- The basis formed decades ago;
- A lot of monitoring observations.



Processing of archive data

- Air temperature from Norwegian and Russian stations on Svalbard (1898-2015)
- Sea ice cover data from BB (1937-2015) and Pyramiden (1948-1957)
- Oceanographic data for Grønfjorden and Isfjorden (1900-2015)
- Glaciers retreat (1939-2001)



D. Tislenko, B. Ivanov, 2016

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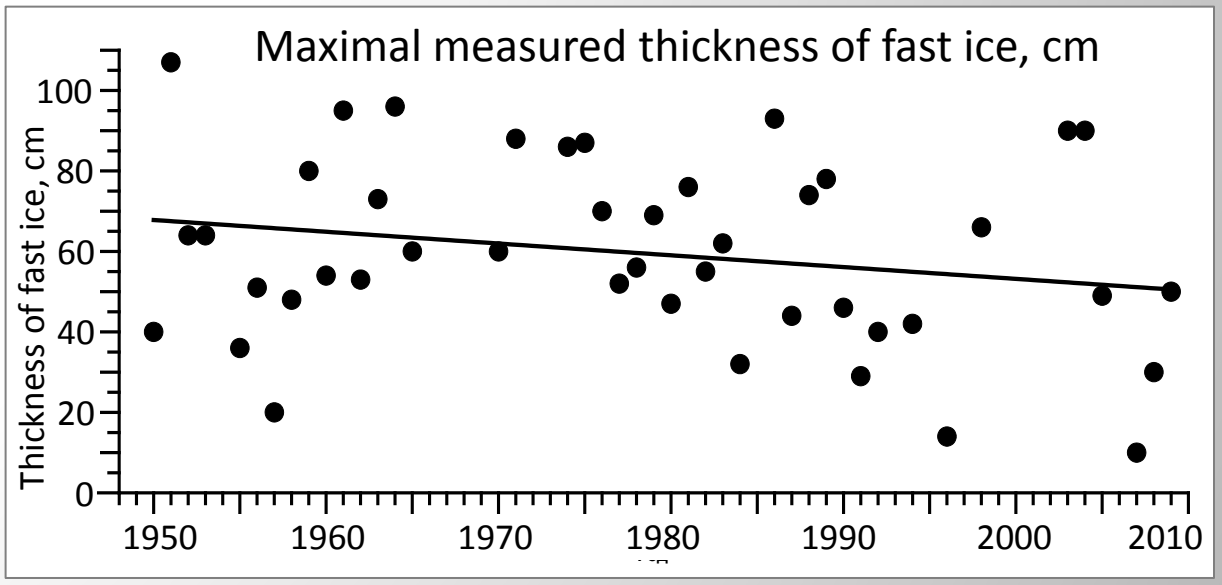

AARI report, 2014

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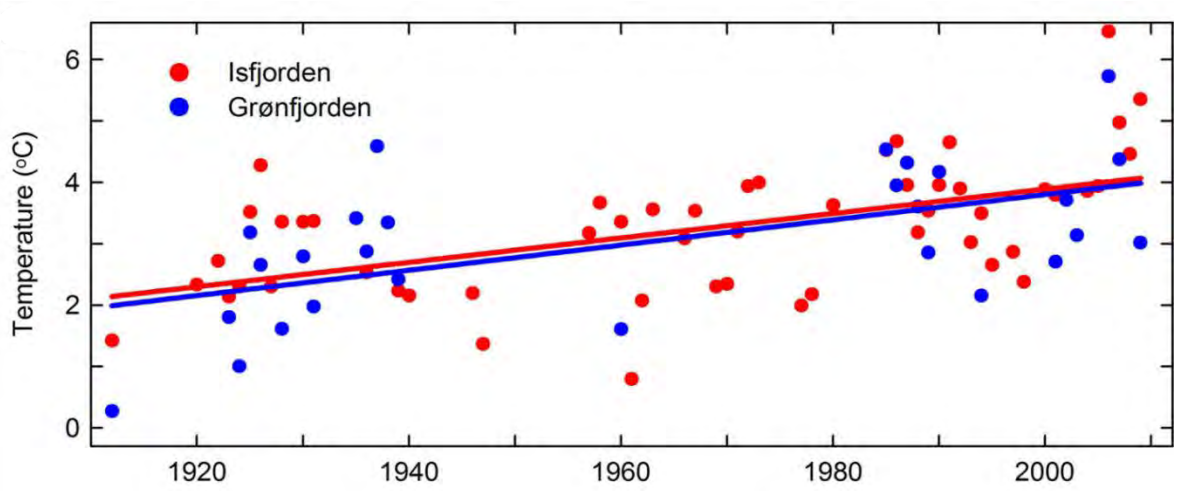
Time series of max Atlantic Water (AW) temperature with best-fit linear trend for the period 1912-2009

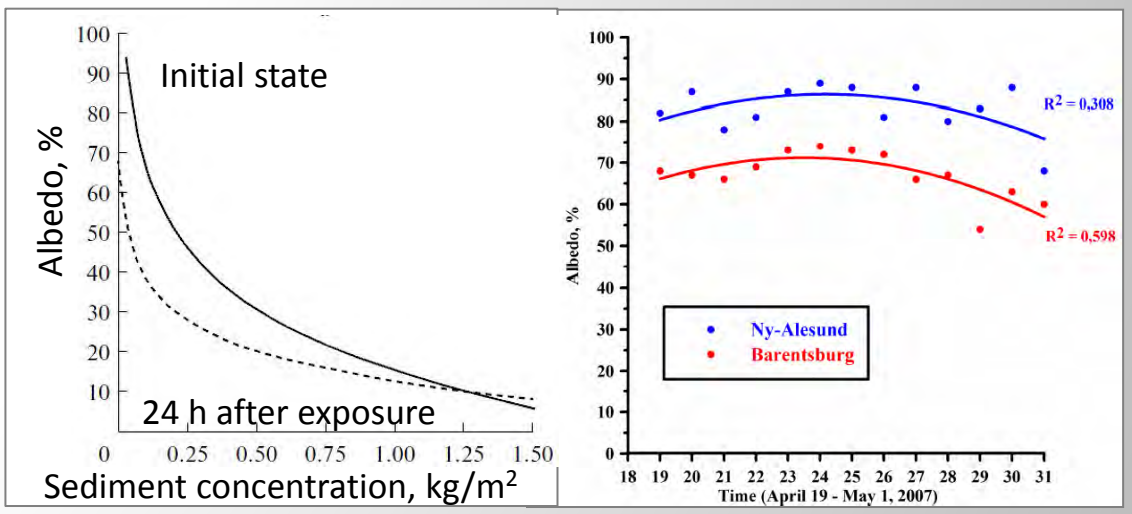


Pavlov et al, 2014

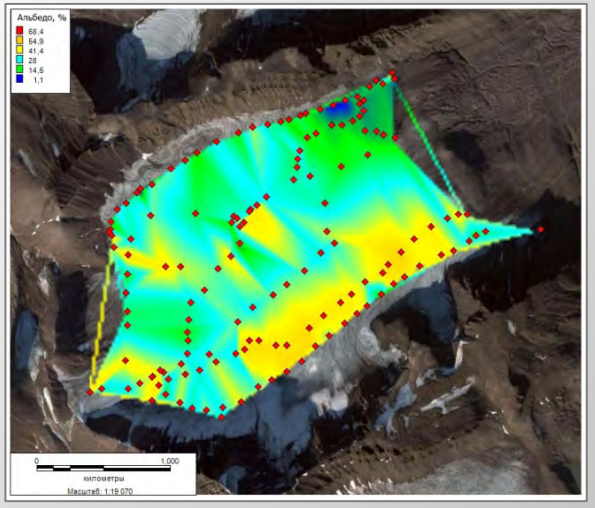
Meteorology and climate

AARI, SPb State University together with UiT, NPI

- Radiation properties of the snow in BB area, spectral analysis of reflected and absorbed radiation;
- Experimental setup: relations “albedo- snow contamination by coal particles”;
- Radiation properties of the glaciers surface;
- Microcirculation over Aldegonda glacier by station HOBOU30 – measurements & data processing in progress .



Ivanov, Sveshchennikov, 2015, Sviashchennikov et al, 2014



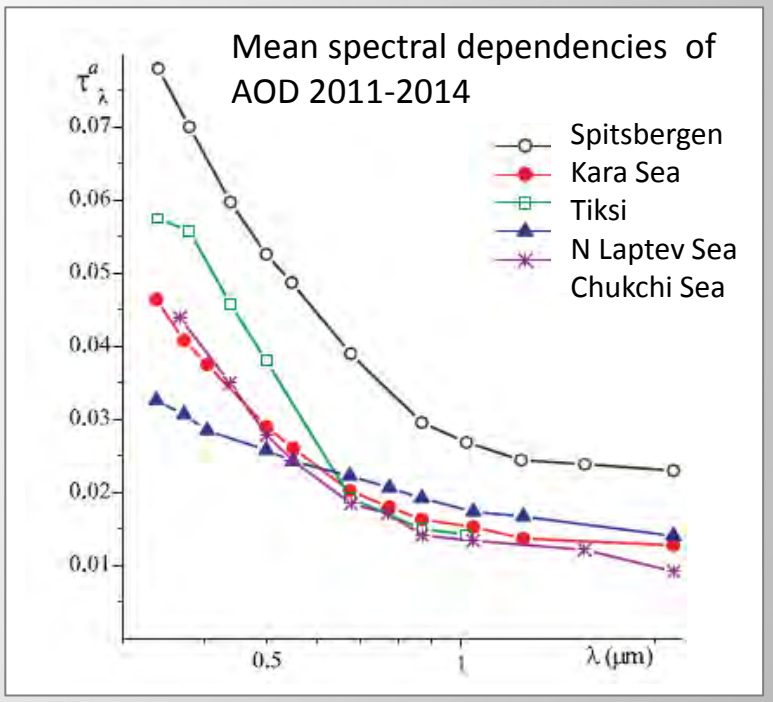
Albedo distribution on Aldegonda glacier, A. Tkachenko, 2016

Meteorology and climate

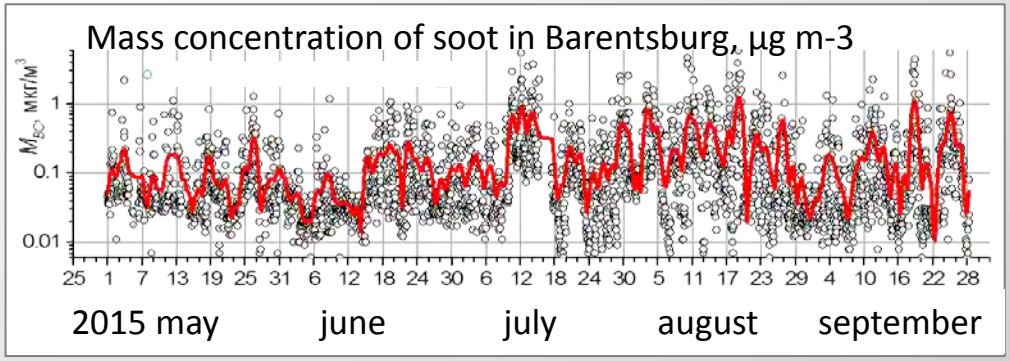
AARI and Institute of Atmosphere Optics RAS

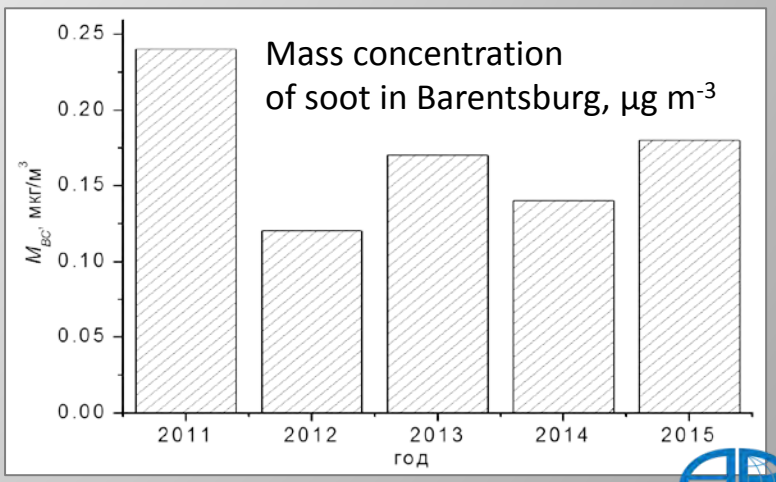
Aerosols in the atmosphere – constant observations:

- spectral aerosol optical depth;
- height of the atmospheric boundary layer;
- influence of aerosol on radiation properties in high latitudes;
- sources of aerosol- local vs global by chemical composition.



Sakerin et al, 2015





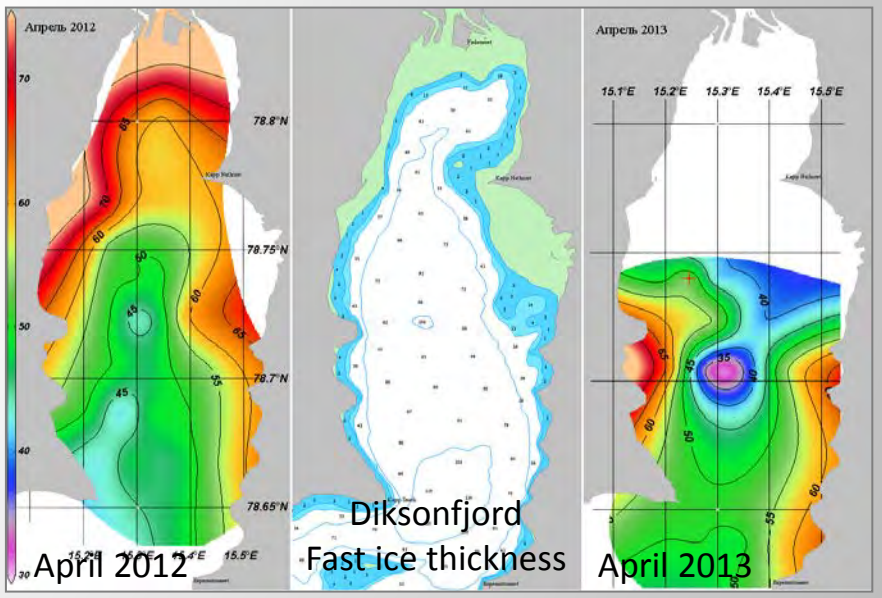
AARI report, 2015

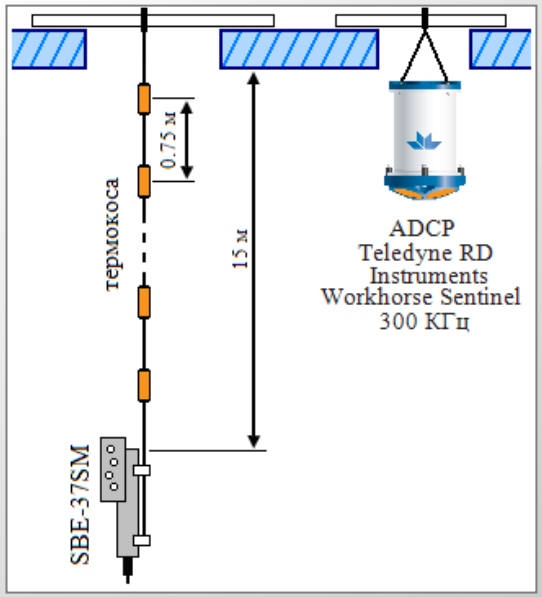
Oceanography

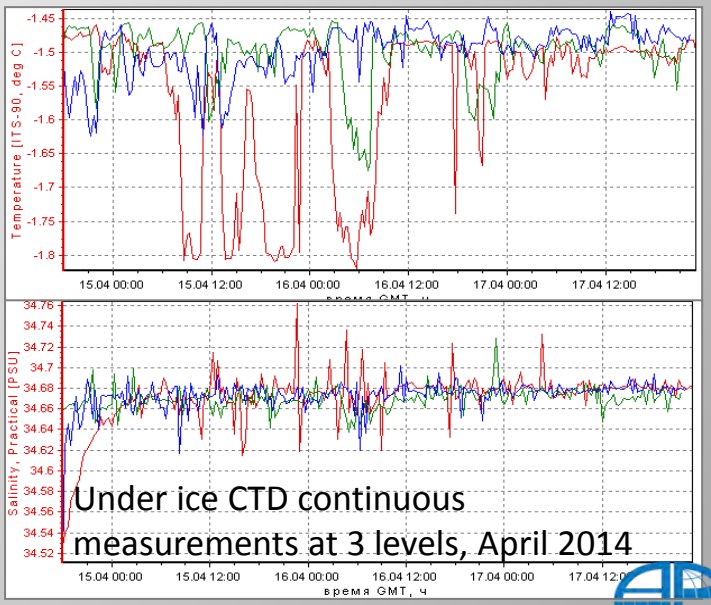
AARI

Dynamic and water structure in Grønfjorden, Nordfjorden, Billefjorden and Isfjorden:

- Fast ice measurements: thickness & morphology;
- Under ice measurements, water column microstructure.



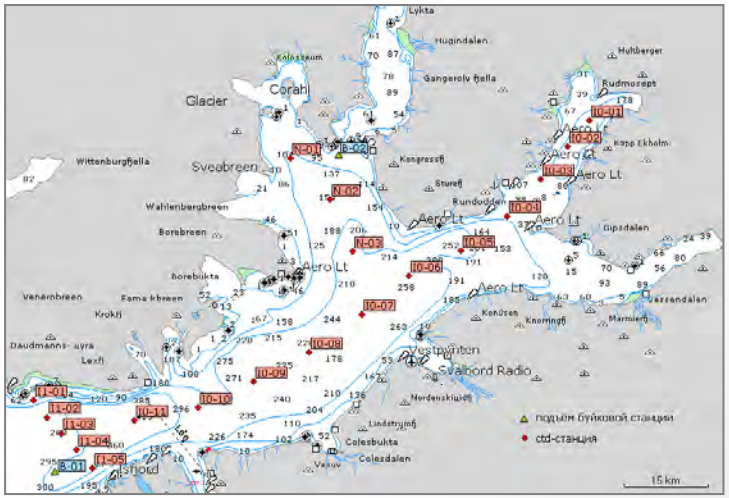


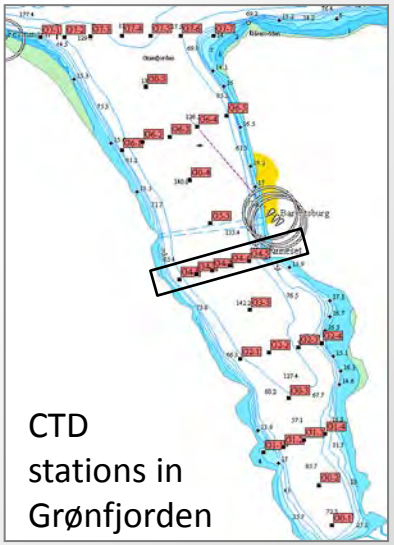


AARI report, 2014

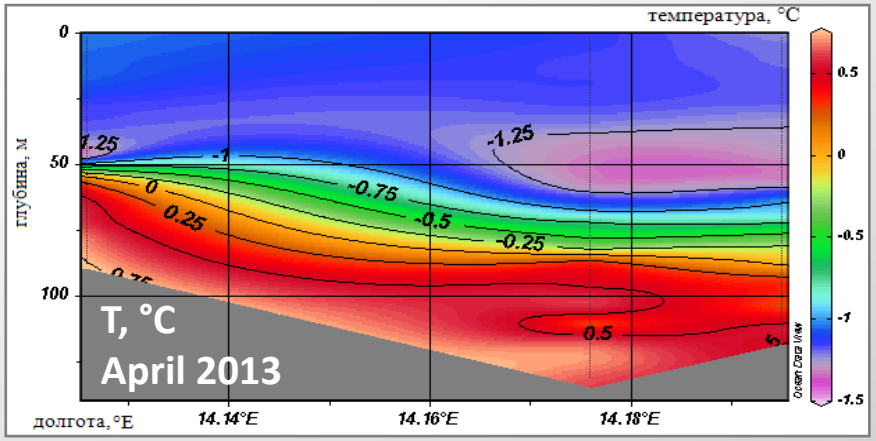
Oceanography

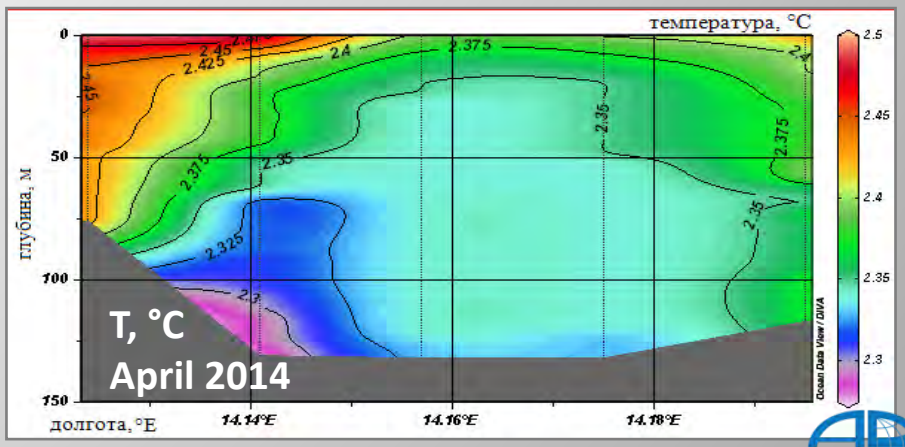
- Fresh water and cold glacier water in the fjords;
- Atlantic water in the fjords: strong interannual variability in the smaller fjords;





CTD stations in Grønfjorden

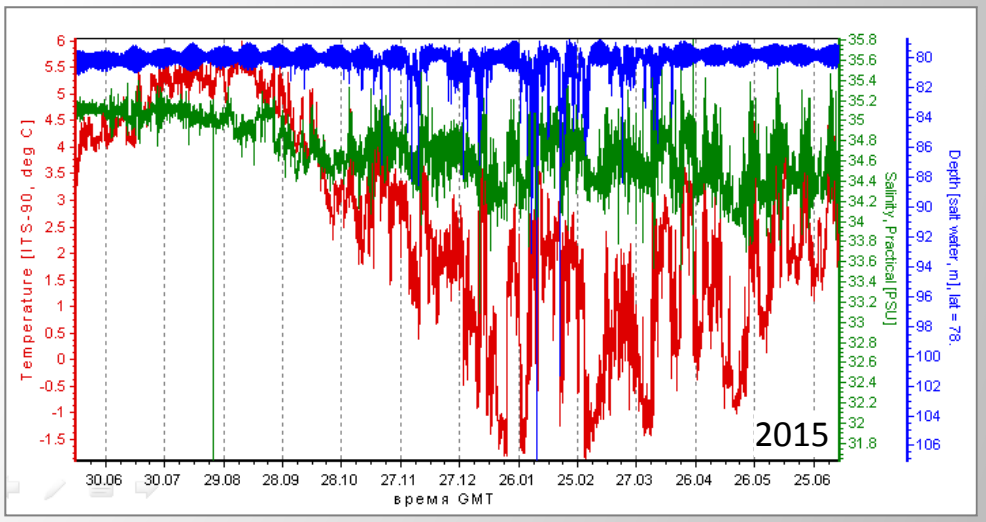


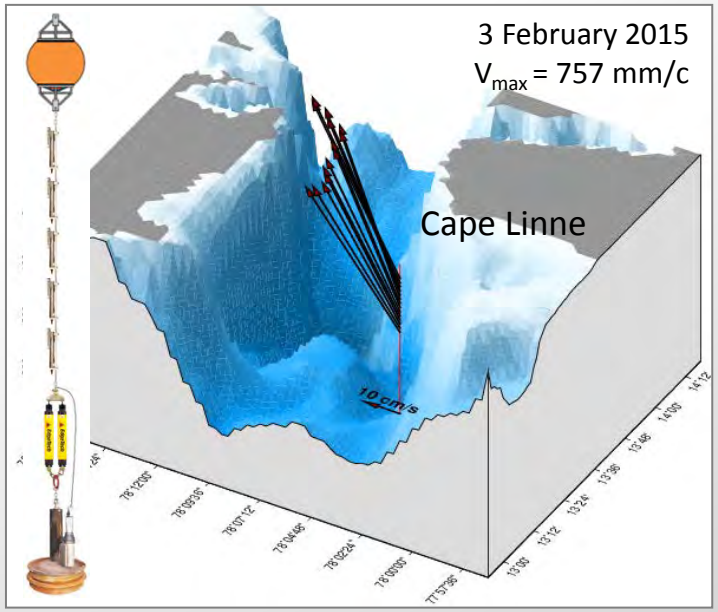


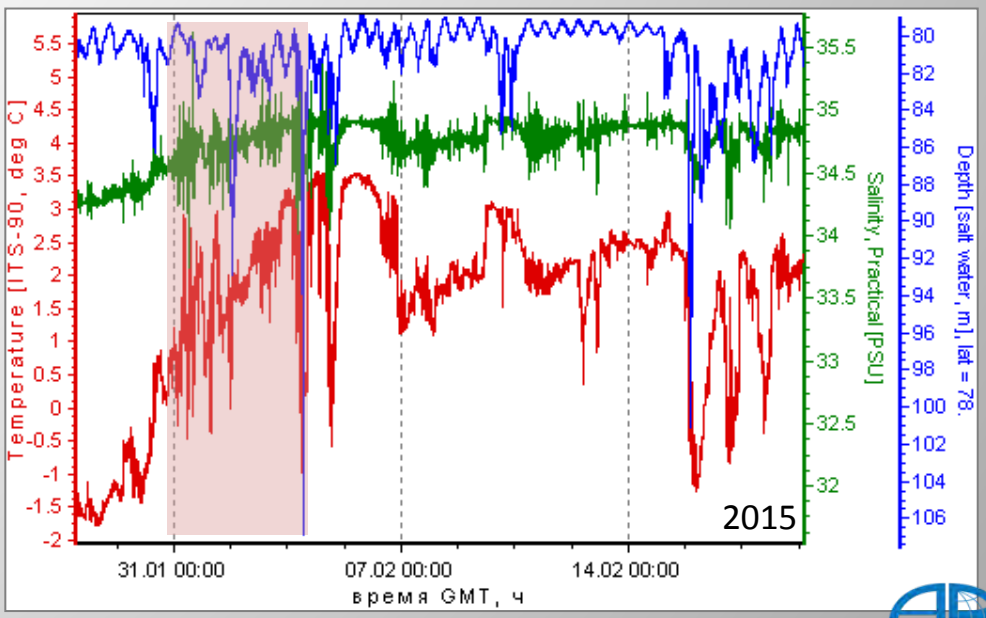
AARI report, 2015

Oceanography

- Short and long-term mooring stations in Isfjorden show drastic changes in temperature and current velocity & direction within days strongly affecting smaller fjords.







K. Filchuk, 2015

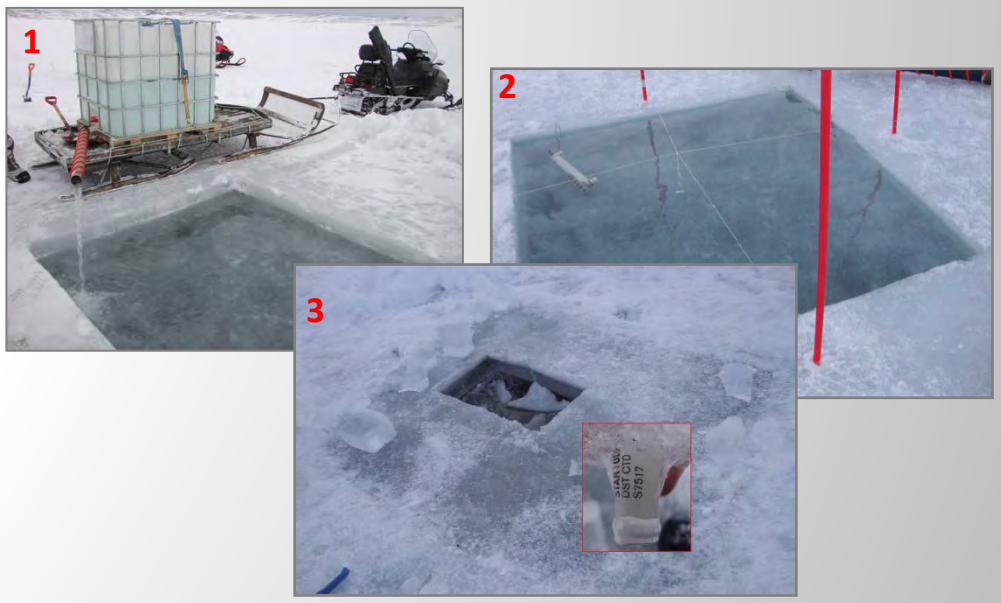
Oceanography

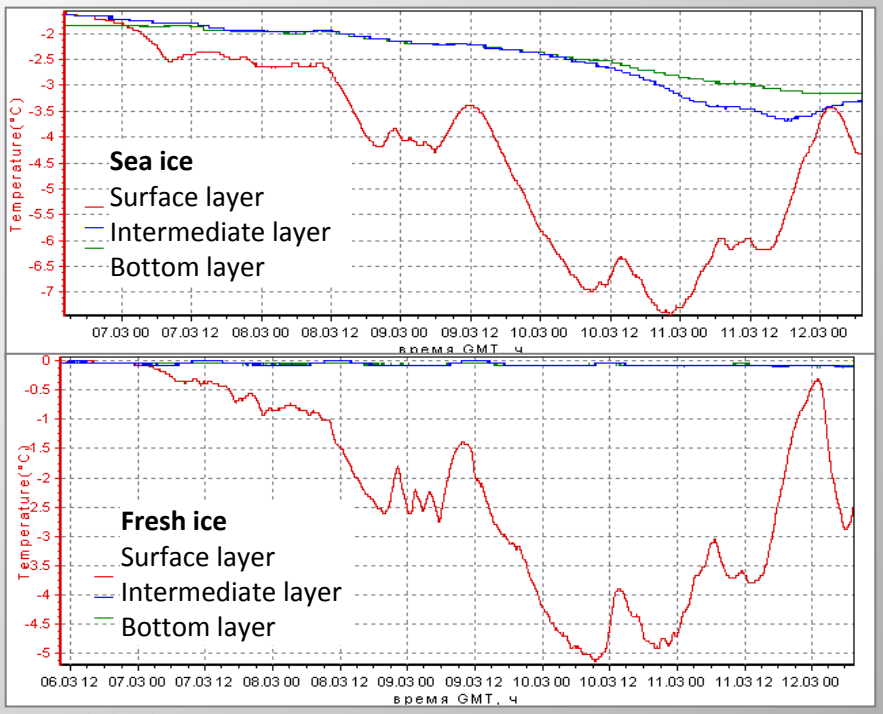
AARI together with UNIS
(P. Bogorodsky & A. Marchenko)

Experimental set-up at Sveagruve:

Energy and mass exchange in freezing melted puddle, March 2016

- Pools in sea ice and lake ice in Braganza bight;
- Filled with fresh water;
- Synchronous measurements of temperature and salinity by frozen-in instruments;
- Ice morphology.



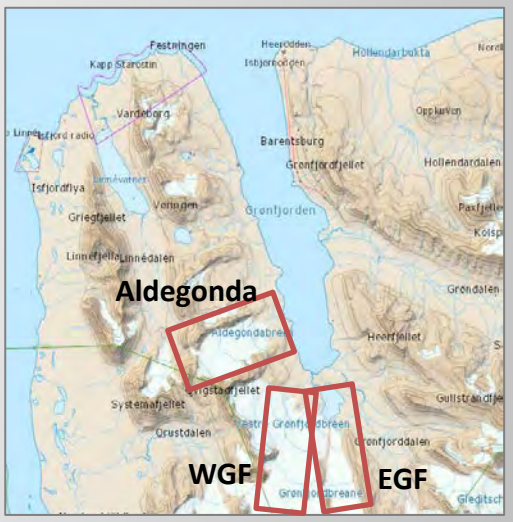


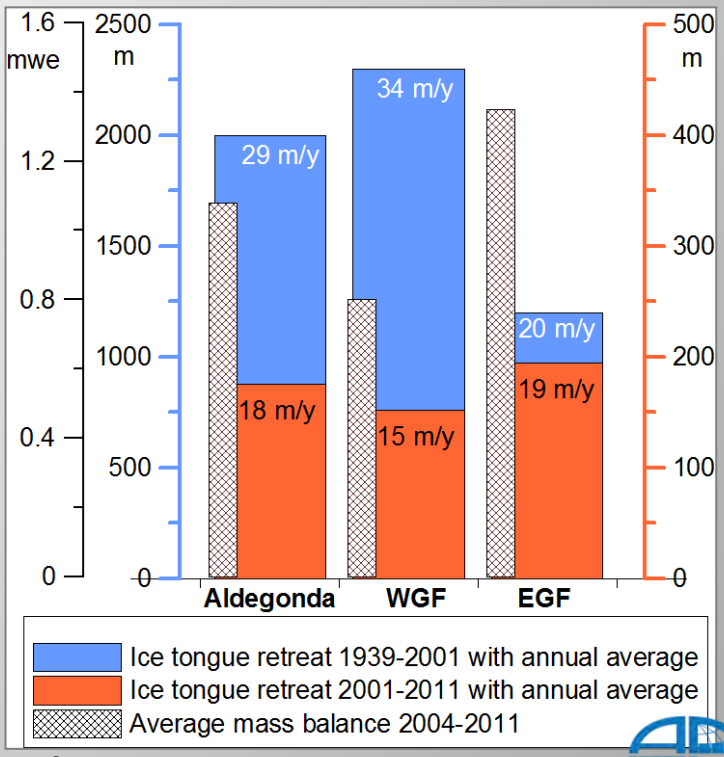
K. Filchuk, 2016

Glaciers

AARI and Institute of Geography of RAS

- Ablation stake measurements, also by georadar;
- Video registration of snow line;
- Mass-balance estimations;



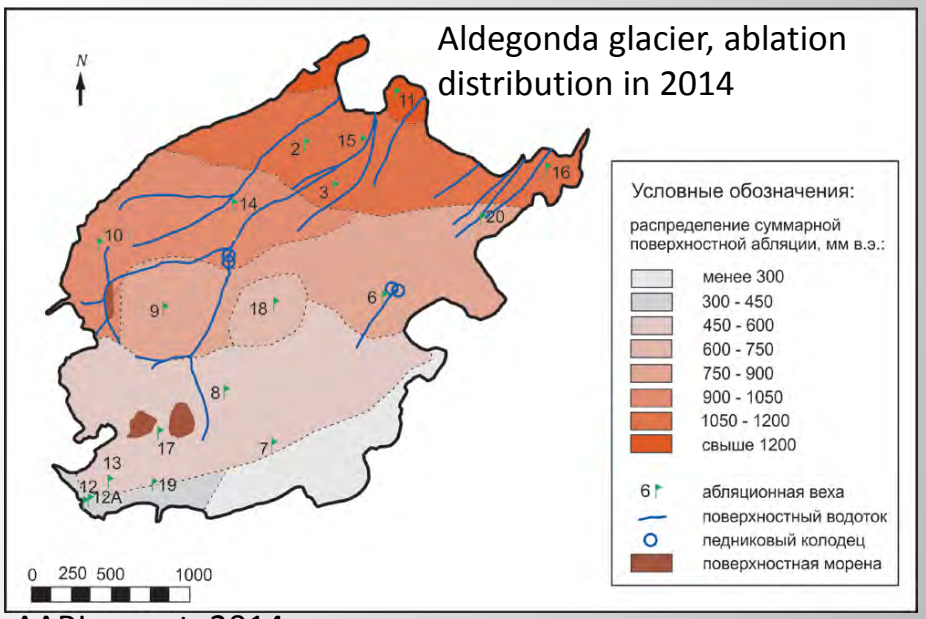


After AARI report, 2014, 2015

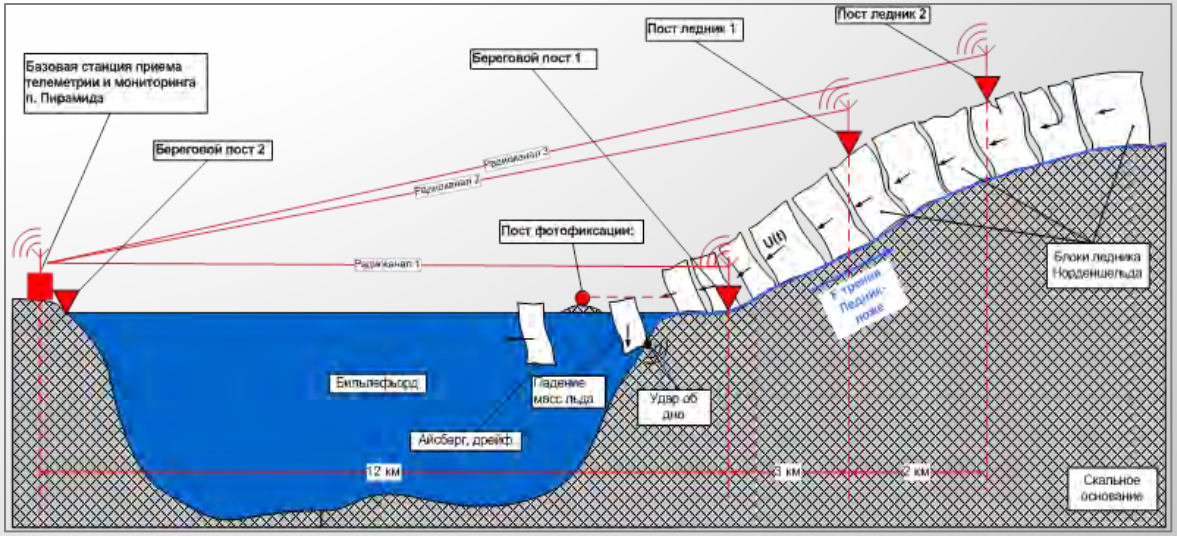
Glaciers

AARI and Institute of Geography of RAS

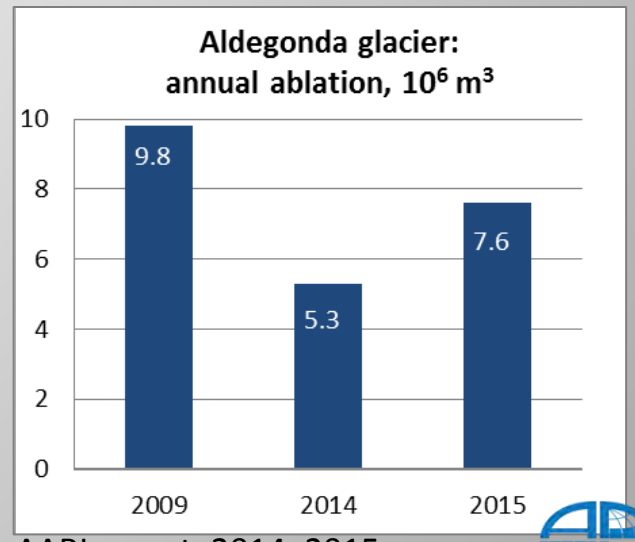
- Ablation distribution, surface properties;
- Drainage systems by IG RAS;
- Geophysics - dynamic processes on Nordenskjold glacier, glacier movements, interaction with the ground surface, wave propagation.



AARI report, 2014



Monitoring scheme at Nordenskjold glacier, 2016

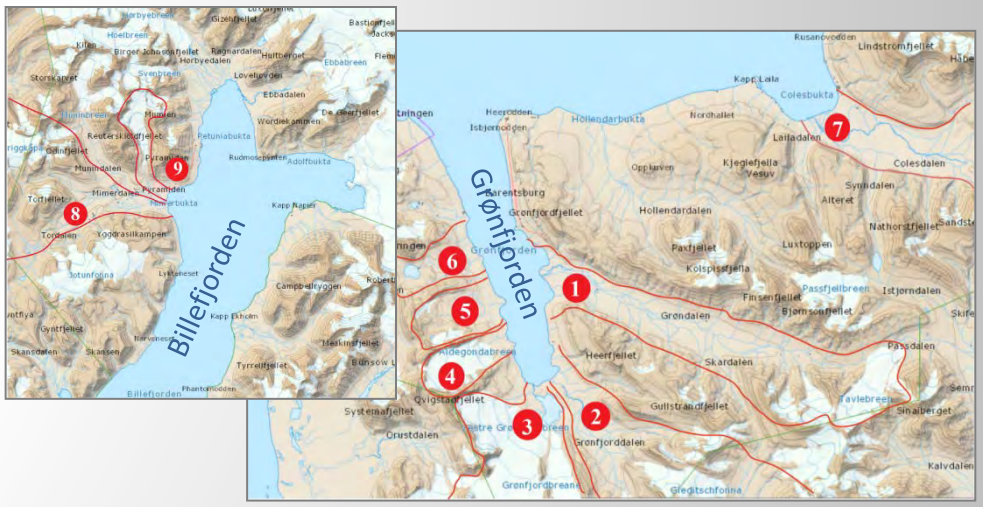


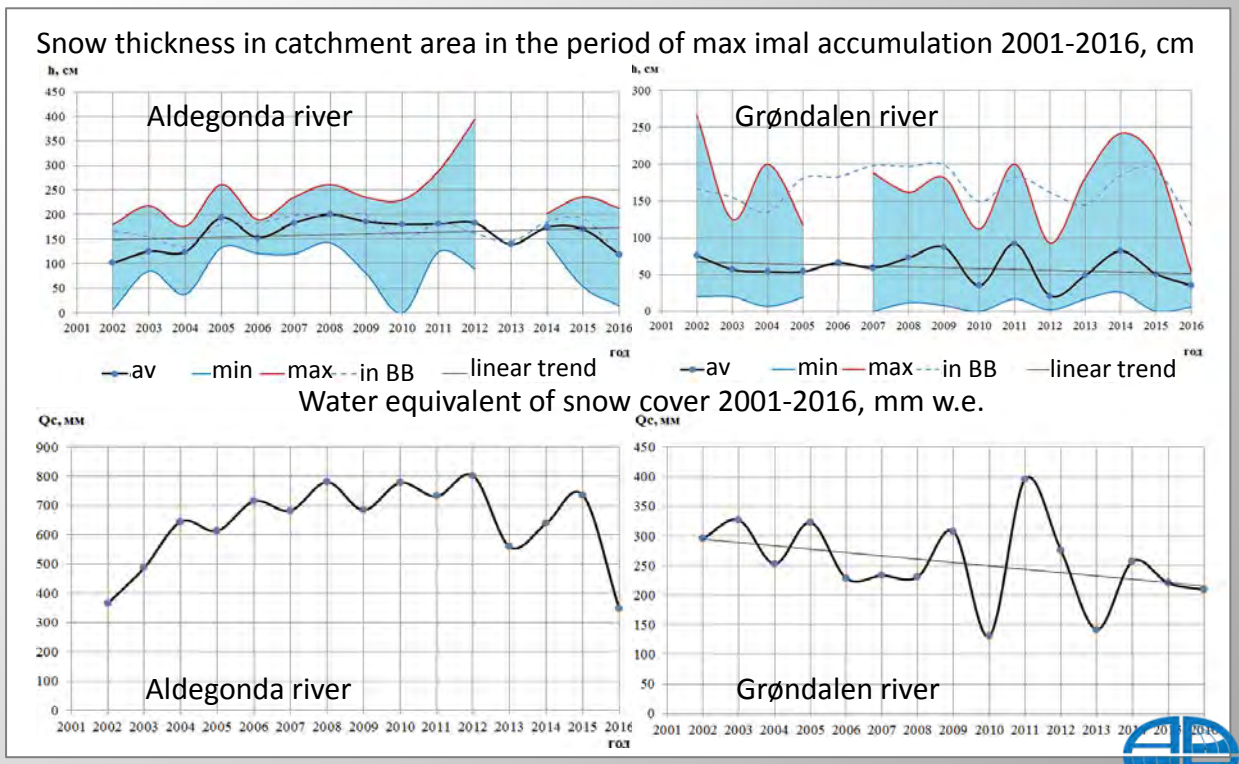
AARI report, 2014, 2015

Hydrography

Water balance of the catchment area:

- Snow survey and water supply;
- Snow physical and chemical properties;
- Rivers water and suspended matter discharge, ion discharge, flow rate dynamic;
- Catchment area modelling.





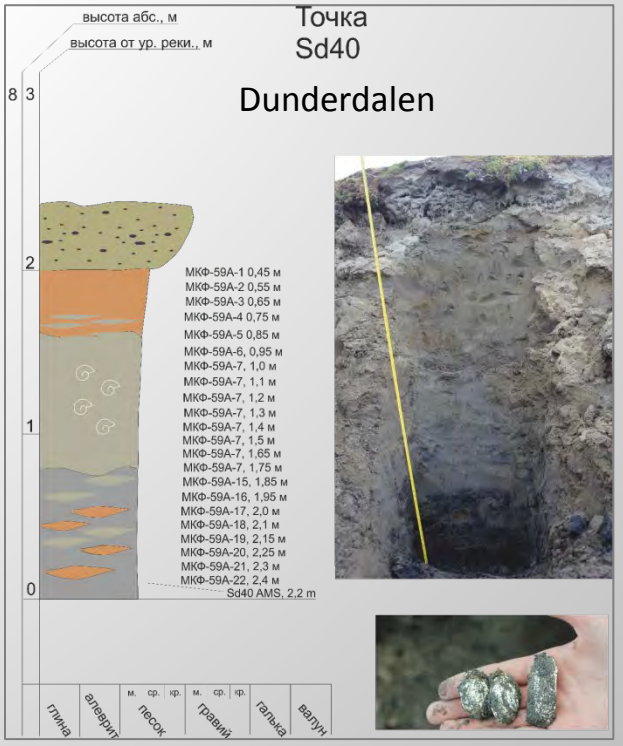
AARI report, 2016

Paleo studies

AARI together with Polar Marine Geological Survey

- Annual expeditions to various regions – paleo-reconstruction of Holocene changes. Collecting samples for ^{14}C analysis and microfauna;

- Short sediment cores from Kongress and Bretjorna lakes for sedimentation rate analysis, micropaleontology to reconstruct conditions for the past few hundred years.



S. Verkulich, 2016

Permafrost

IISP PSN RAS: **Thermal state and physico-chemical properties of permafrost in Svalbard**

Field work

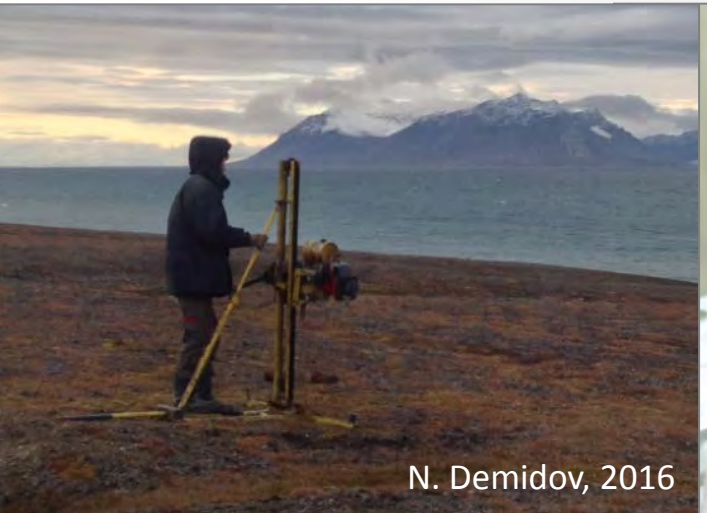
- drilling boreholes;
- collecting frozen cores;
- monitoring of temperatures in boreholes (TSP program);
- establishing polygons for active layer thickness monitoring (CALM program).

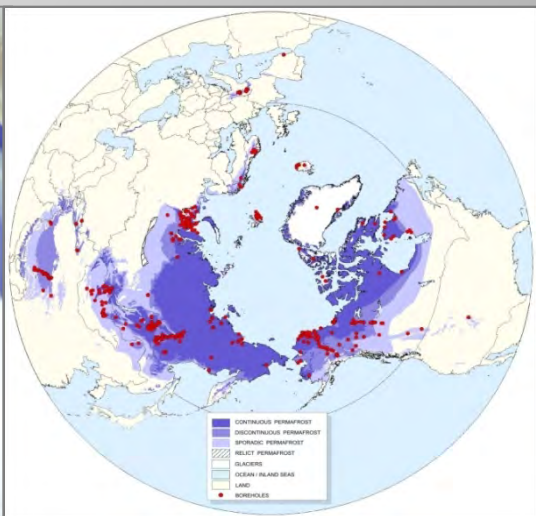
Laboratory analysis

- C_{14} dating;
- paleomicrofossils;
- grain size;
- dry residue;
- CH_4;
- organic carbon;
- viable microorganisms etc.

Scientific output

- permafrost response to climate change;
- paleogeography of Spitsbergen during Holocene & Pleistocene;
- biogeochemical contribution of thawing permafrost to global CH_4 and C_{org} cycles;
- Mars analogy studies, testing instruments for planetary exploration.


N. Demidov, 2016



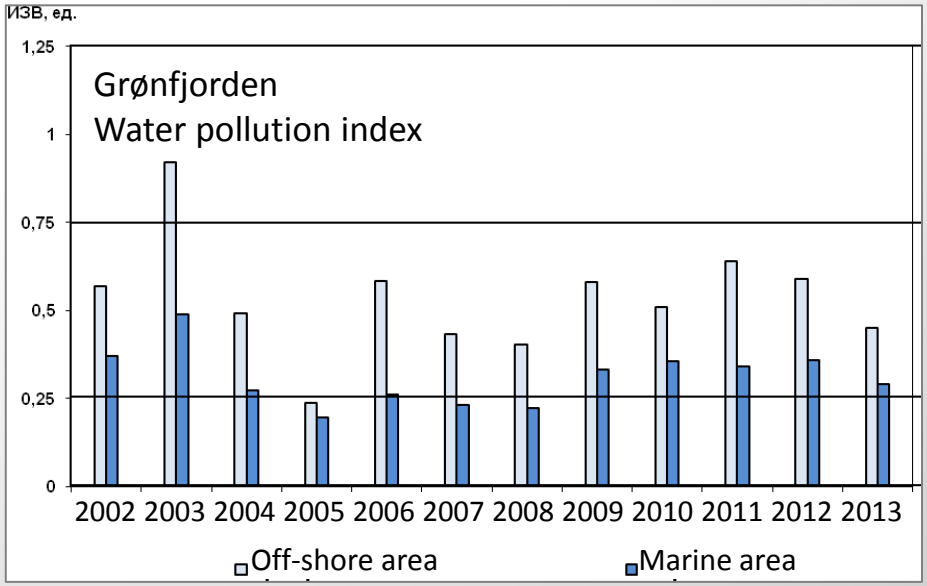
Contamination monitoring

RPA “Typhoon”

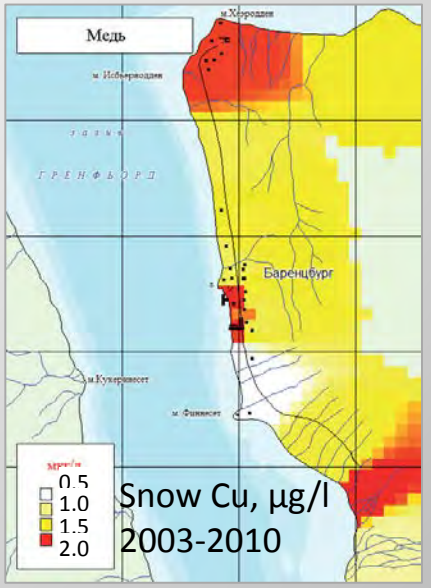
Monitoring program of local contamination in Barentsburg and adjacent area since 2001;

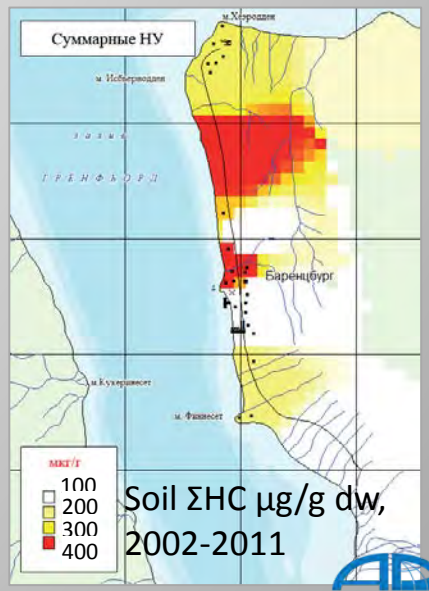
Defining the sources: coal mining (coal dust), power station, vehicles, sewage, outdoor paint, long-range transport;

PAH, PCB, pesticides, metals in air, snow, fresh & marine water, marine sediments, soil, organisms – different distribution patterns.



Demin et al, 2011, Demeshkin, 2015





Students involvement

- Annually master and PhD students from SPb State University and Hydromet University work in the research groups:
- Course field practices;
- Collecting data for thesis;
- 2016: Field practice-Summer school for SPbSU POMOR master students with lectures and field experience.

Plans

- Increasing number of researchers staying over the whole year;
- Logistics development, uniting the infrastructure;
- Facilitation of further collaboration between research groups and institutes working in Barentsburg;
- Developing of long-term research projects;
- International cooperation;
- Fostering master and PhD students;
- Internal report on the research in the last decade, also in English.


Thank you for attention!