Arctic vector of IMCES SB RAS

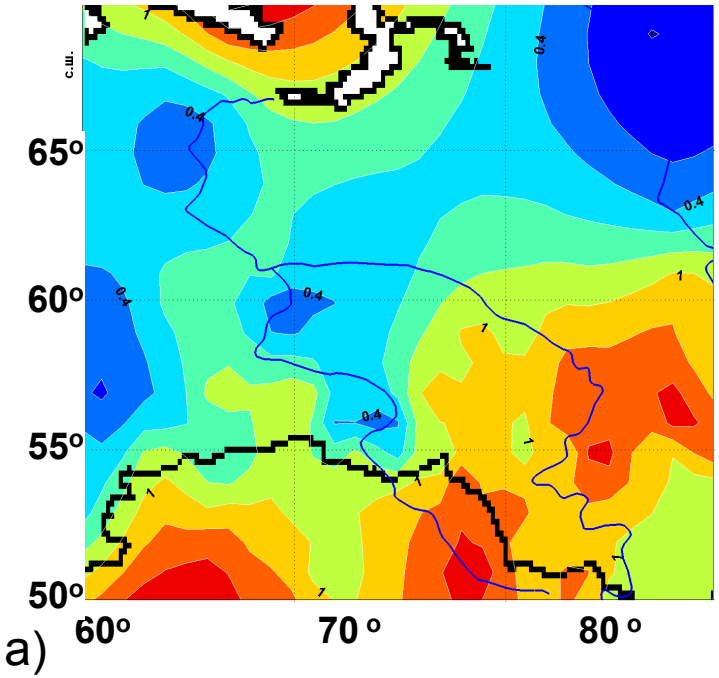
V.A. Krutikov, V.V. Zuev, E.P. Gordov

Institute of Monitoring of Climatic and Ecological Systems SB RAS

Basic components of a 5-D vector:

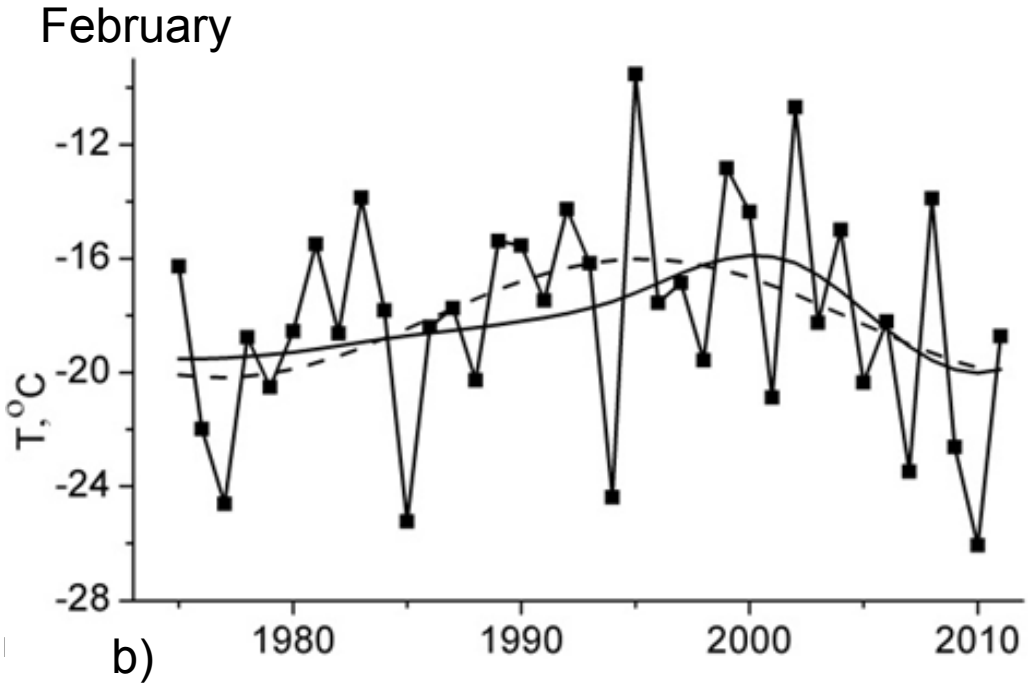
1. Monitoring (analysis of climatic processes occuring in Arctic region based on observations and modeling data (Dr. of Sci. I.I. Ippolitov, Dr. of Sci. V.A. Tartakovsky)
2. Climatic processes modeling (RAS Corr. Member V.V. Zuev)
3. Instrumentation development (Dr. of Sci. A.A. Tikhomirov, Dr. of Sci. V.A. Krutikov)
4. Development of a distributed information-measuring network for environmental monitoring (Dr. of Sci. E.P. Gordov, Dr. of Sci. V.A. Krutikov)
5. Cooperation (national, international)

Monitoring
Surface temperature dynamics in West Siberia over period of 1975-2011.



a)

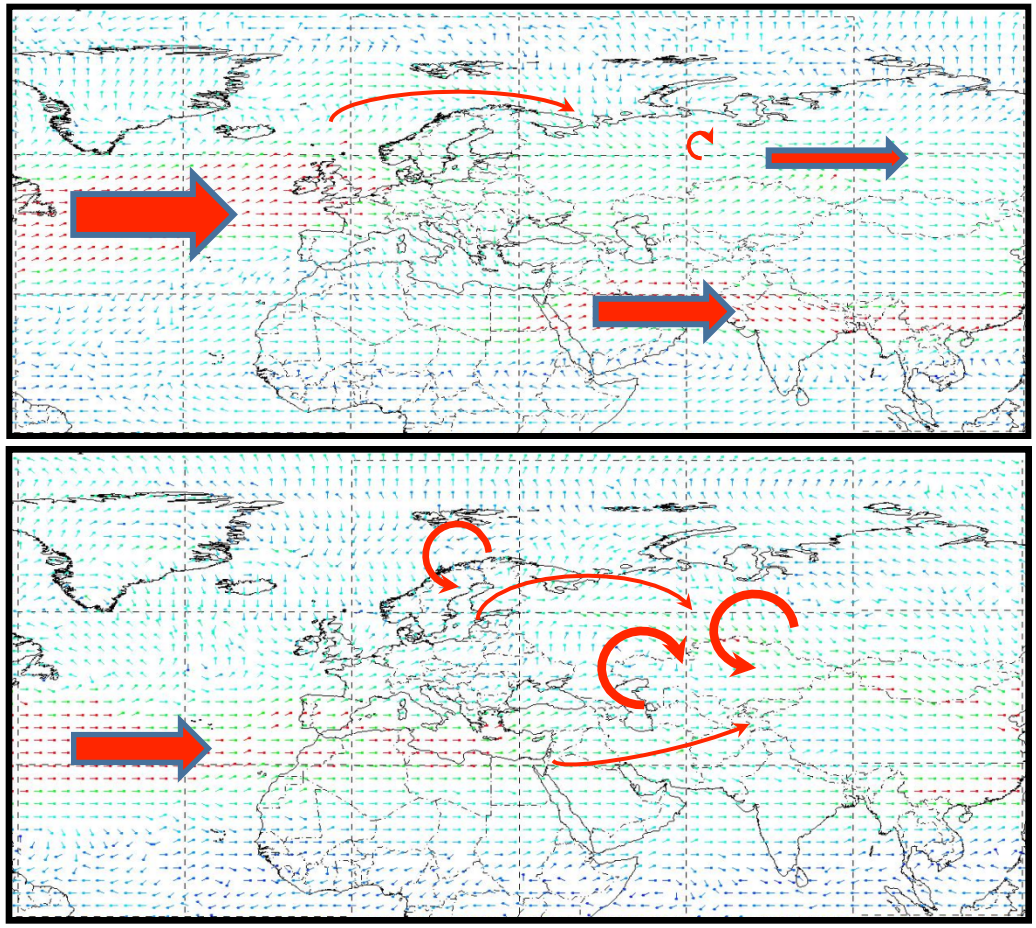
Distribution of linear trends
of surface temperature T (°C/10 years)



b)

Time behavior of surface temperature T,
averaged over West Siberia territory

Wind field at altitude of 500 hPa. February



1997
Maximum temperature in West Siberia

NAO positive phase

2010
Minimum temperature in West Siberia

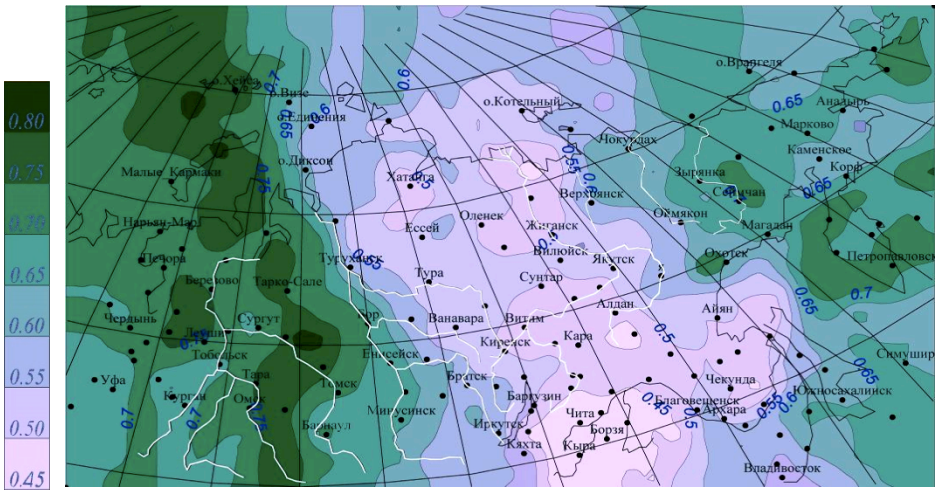
NAO Negative phase

Polar ice thawing causes change of temperature gradient between Arctic and middle latitudes, which, in turn, results in change of large-scale atmospheric circulation (weakening of western air mass transfer during recent decade)

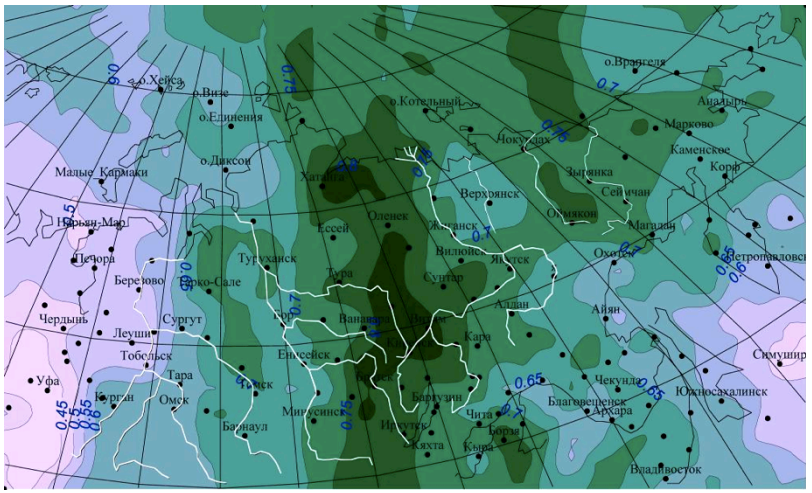
Synchronism of monthly-mean temperature variations in West Siberia in summer

Grounds: cyclonic processes and thermal absorption by river waters that are flooded in this period.

West Siberia flood-lands impact is as important as Arctic ice/open water influence!



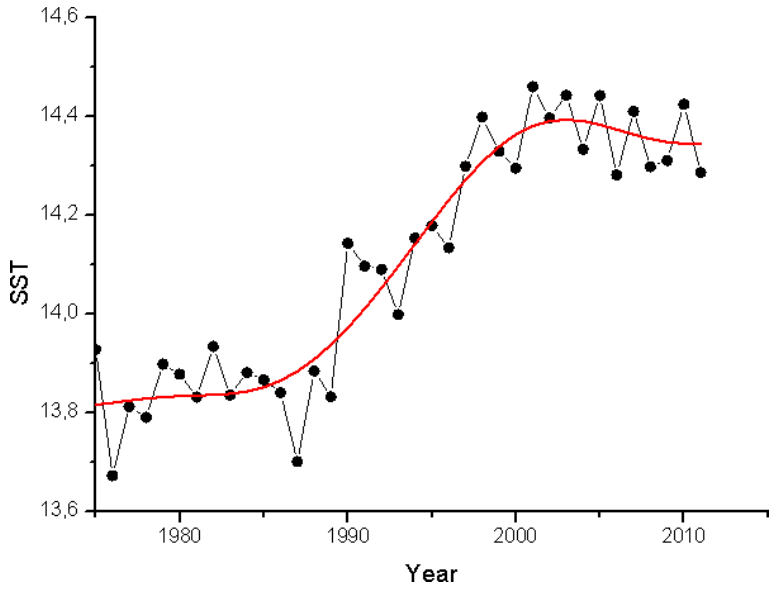
Asian part of Russia: 134 stations [1955,1998]. Synchronism of temperature field in: July



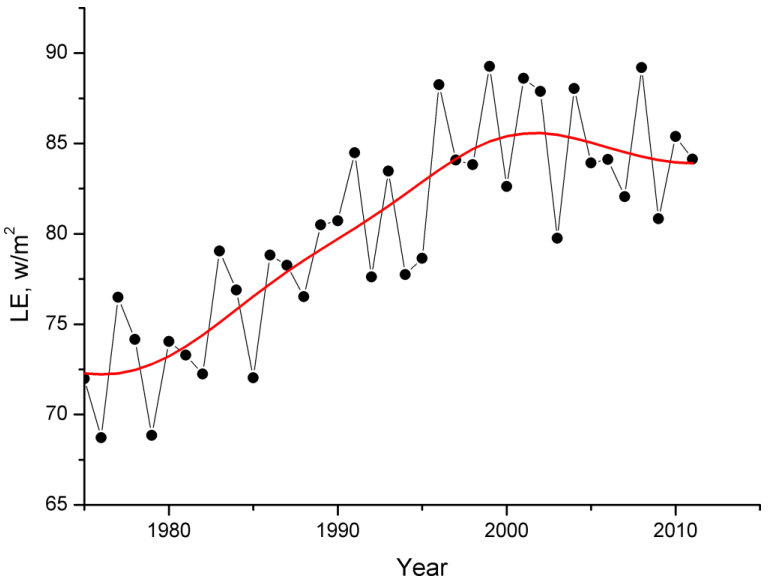
August

Modeling motive
Change of energy exchange characteristics in Northern Atlantics
(0° – 70° N, 80° - 0° W, February)

Ocean surface temperature



Heat flux



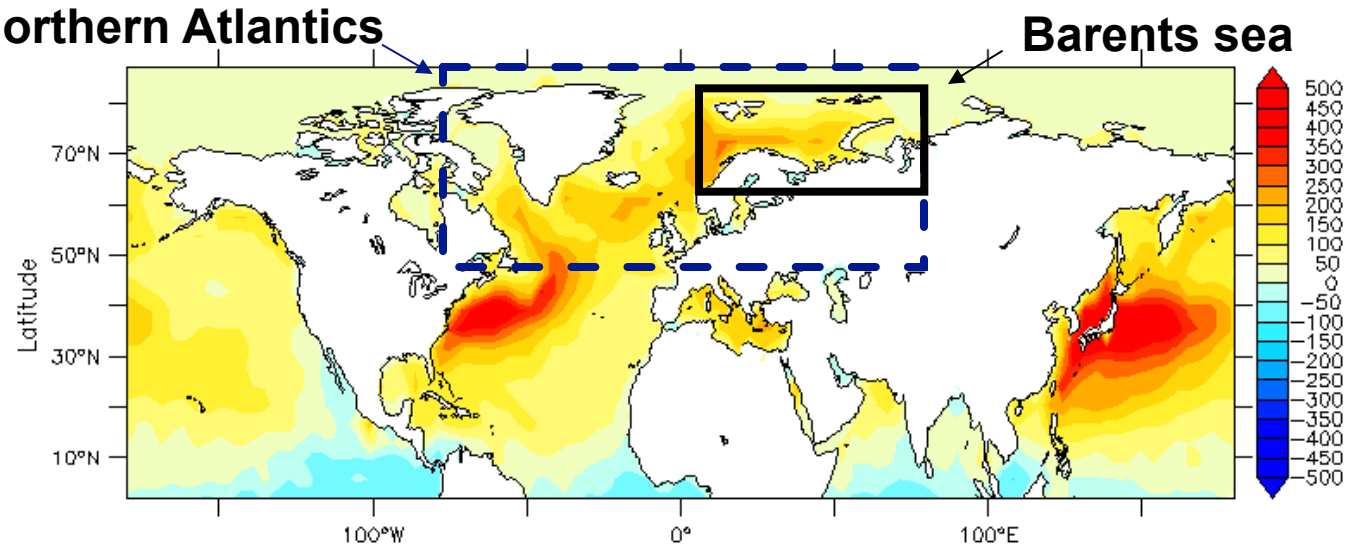
Revealed: ocean surface temperature and heat flux decreased since 2000 through 2010.
Eurasia heating by Northern Atlantics weakened
Global and regional warming rates decreased

Experiments planned (in collaboration with Institute of Atmospheric Physics RAS)

- AGCM ECHAM5 (spectral horizontal resolution T31 ~ 3.75ºx3.75º in latitude and longitude)
- Thermodynamic model of the upper ocean layer (50 m) by Max Planck Institute for Meteorology, Hamburg, Germany
- Boundary conditions:
  - Ocean surface temperature fields (OST)
  - Sea ice distribution (SID)
- Initial data:
  - Archive of monthly-mean values of OST and SID over period of 1870-2006. HadISST1.1
- Duration of every experiment: 100 model years

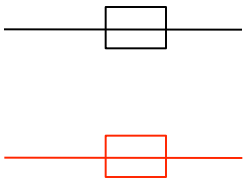
Oceanic heat conveyer

Currents' map with marked regions for winter (W/m^2)



Thermohaline circulation:
1) Warm water is lighter than cool one; 2) fresh water is lighter than salt one.

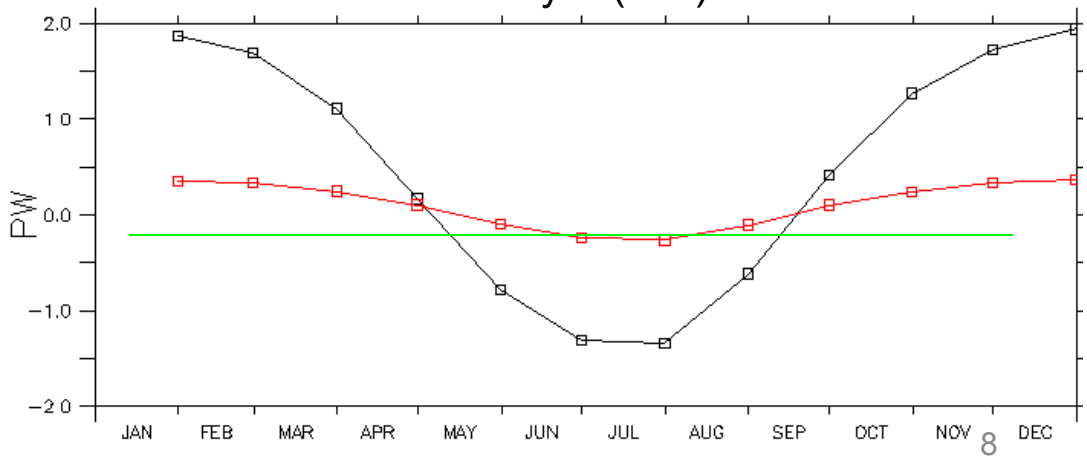
q−flu



Northern Atlantics

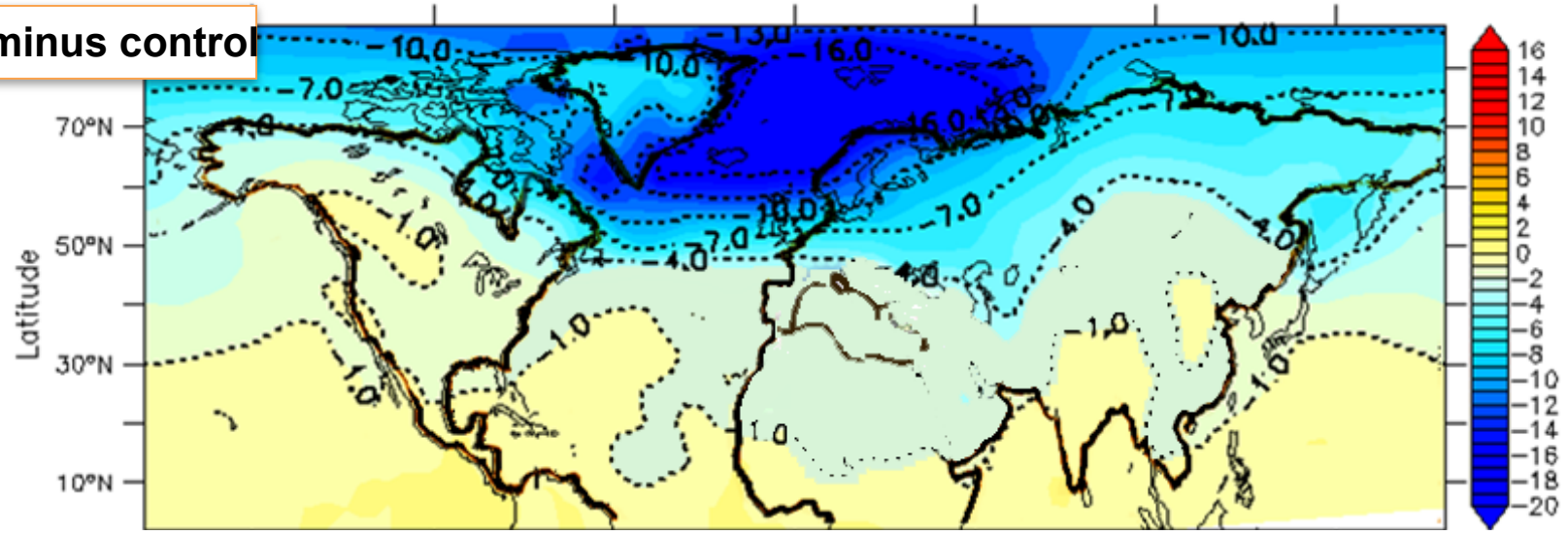
Barents sea

Oceanic heat conveyer (PW)

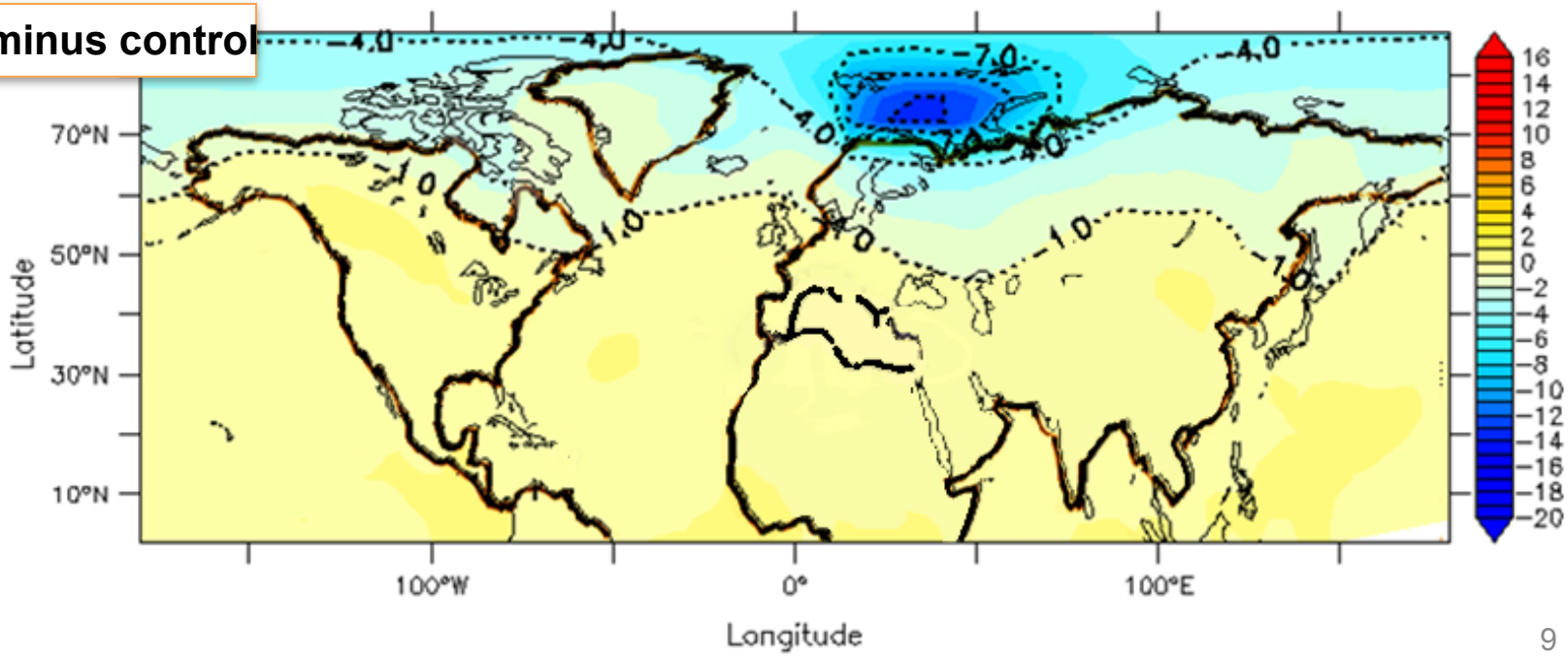


Winter temperature (end of XXI century (Zuev, Semenov)

Exp. 1 minus control



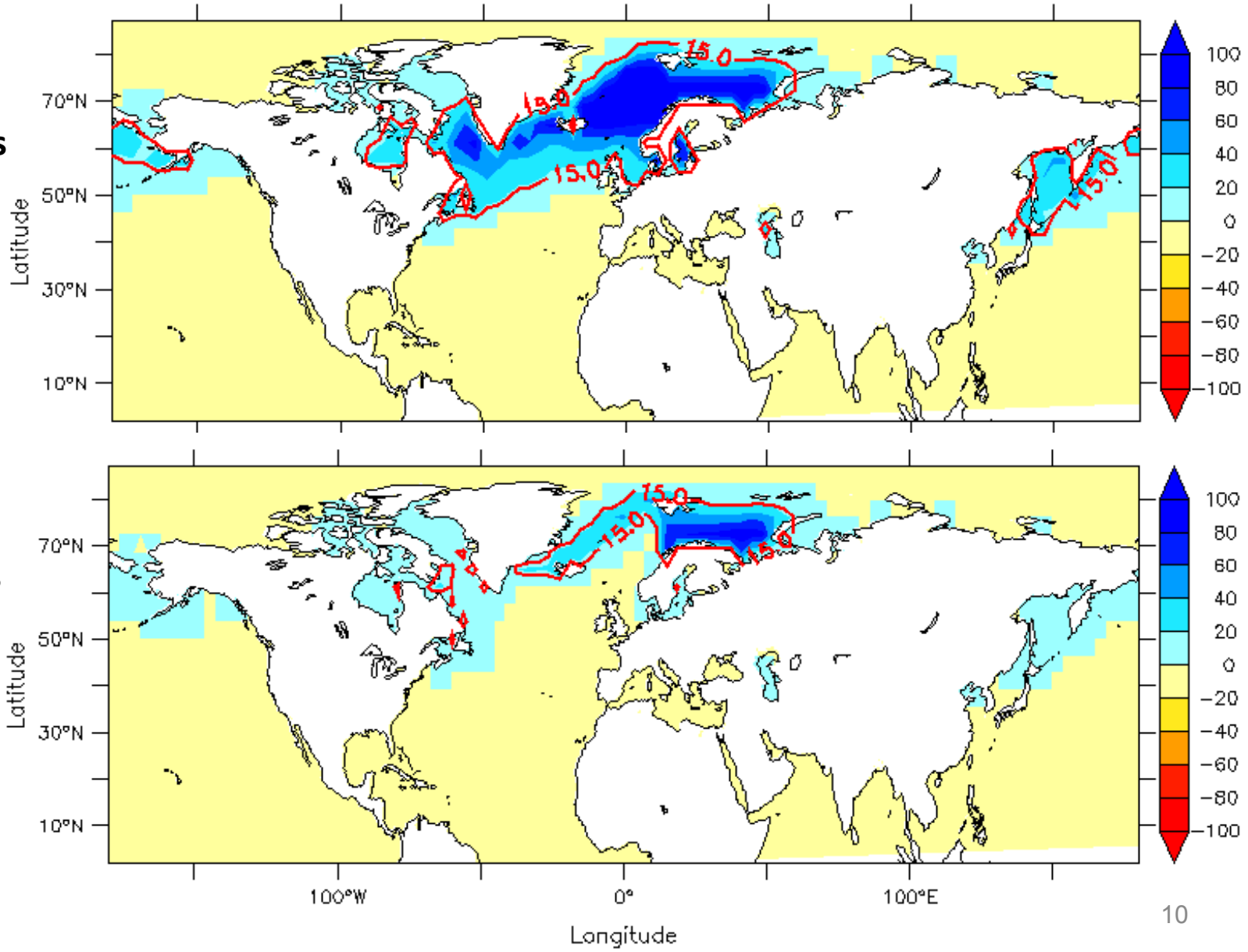
Exp. 2 minus control



Sea ice distribution (winter) (end of XXI century)

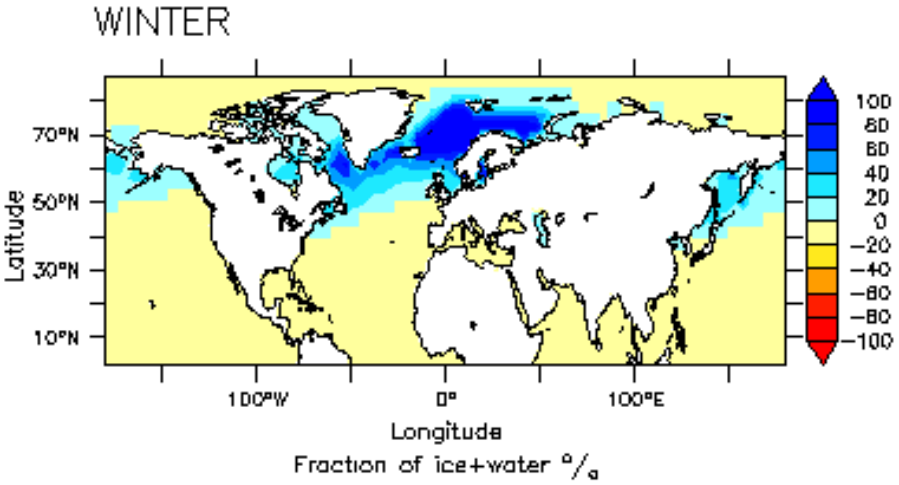
Exp. 1 minus control

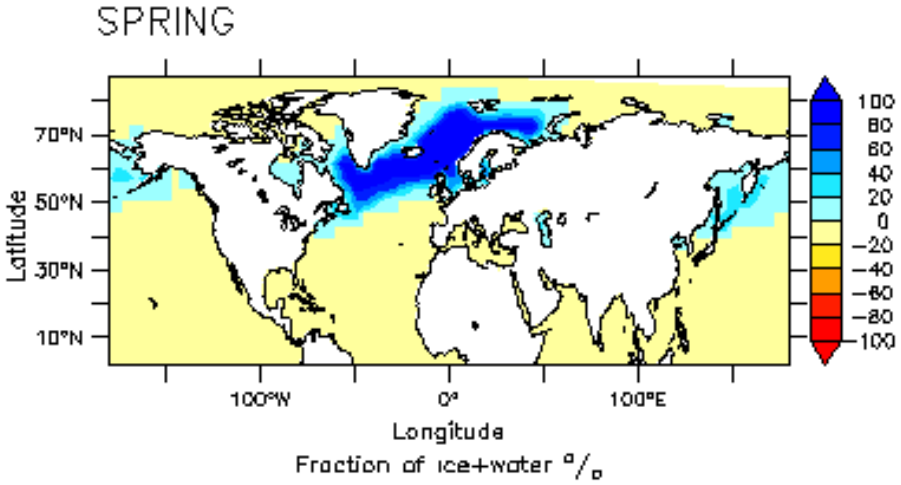
Exp. 2 minus control

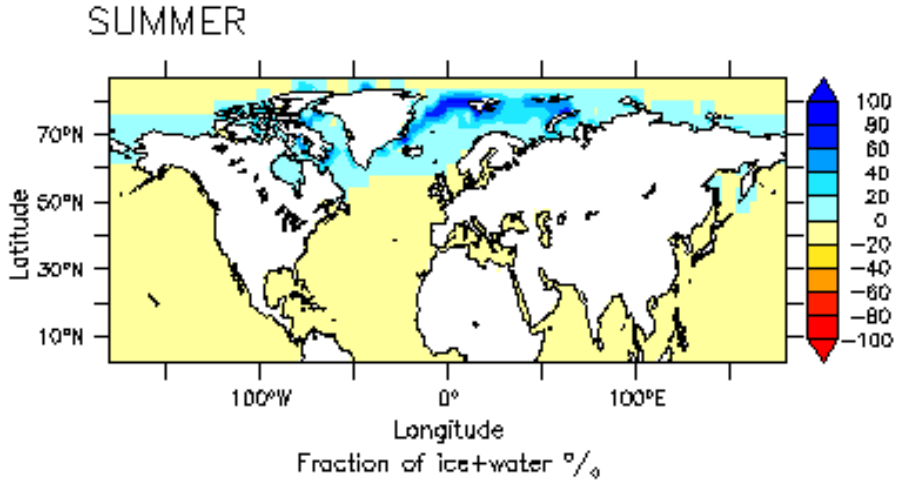


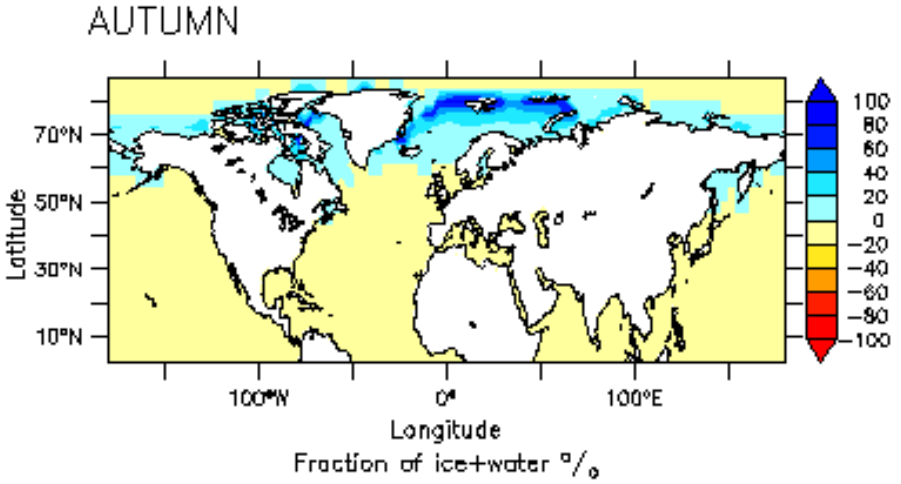
Sea ice distribution (seasons) (end of XXI century)

Exp. 1 minus control



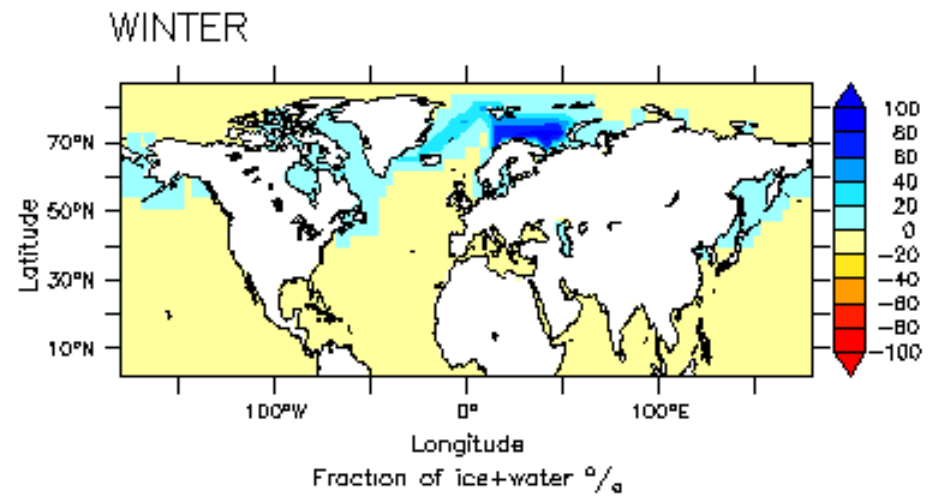


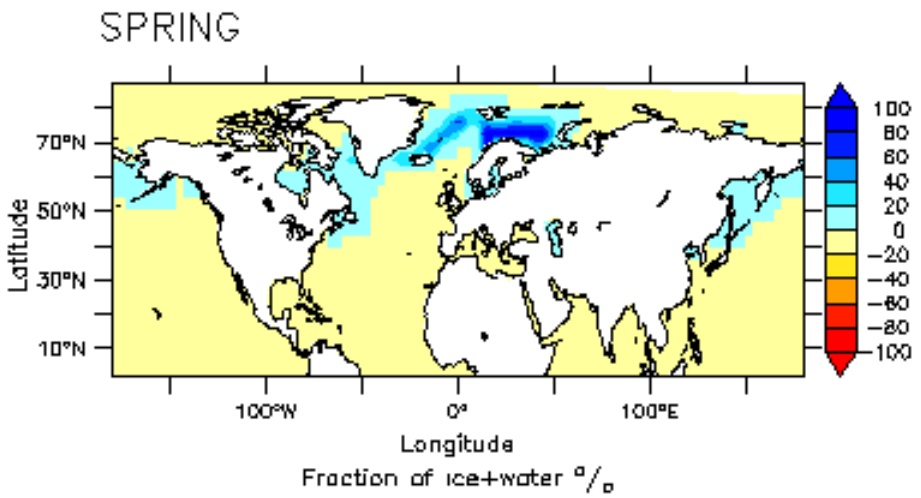


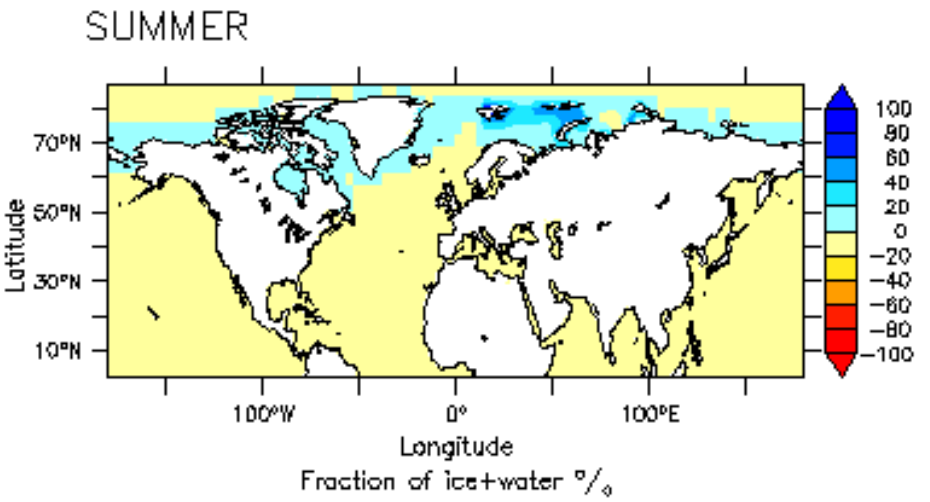


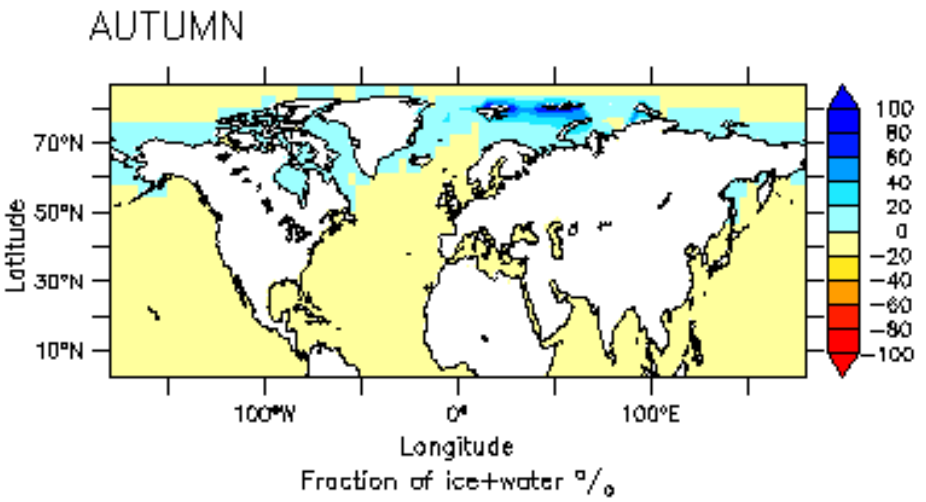
Sea ice distribution (seasons) (end of XXI century)

Exp. 2 minus control









There is possibility to have 2.7^{0}C cooling for Northern hemisphere in spite of taken into account green house warming

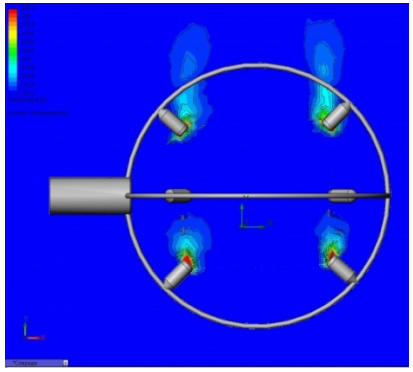
Scientific instrument-making

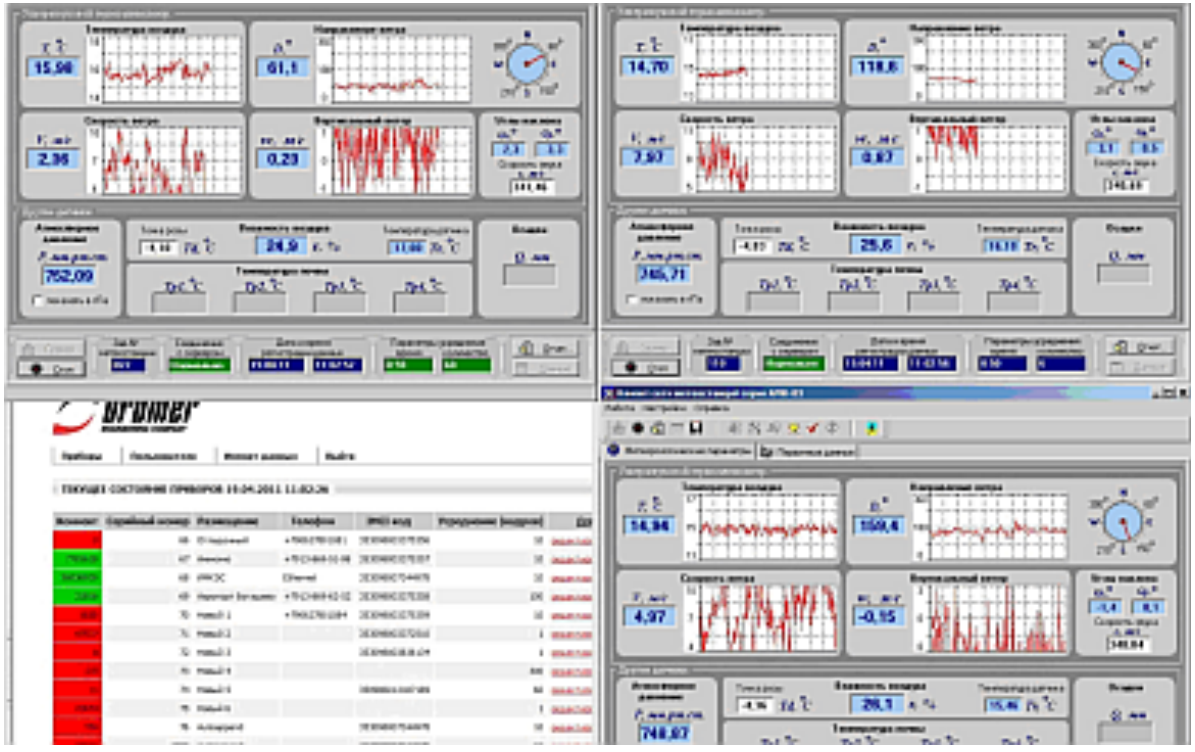
Development of new measuring instruments and operation technologies for

- automated (and stand-alone) measuring of a large set of meteorological quantities,
- serviceable under different climatic conditions including Arctic and marine climates

Production and technological facilities that allow carrying out researches, as well as to design and to produce instruments are available. Test station provides overall climatic and mechanical tests for new instruments.

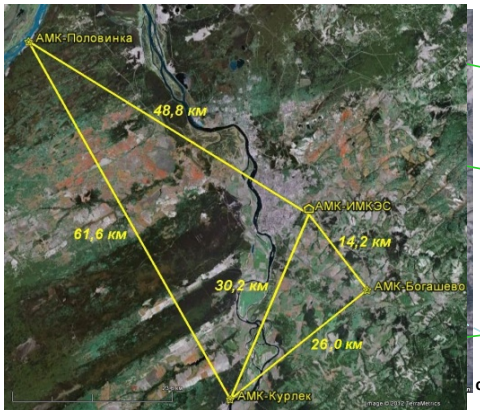
The AMK-03 ultrasonic meteorological complex intended for measuring the main meteorological quantities: wind speed and direction, air temperature and humidity, atmospheric pressure

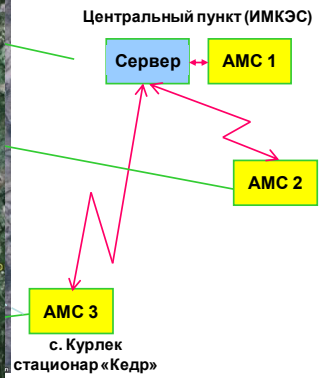


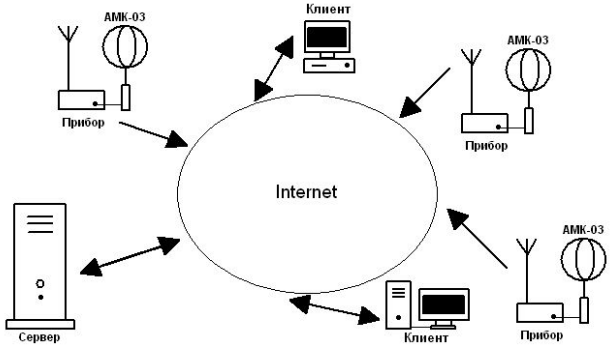


AMK-03 mobile models

A prototype of the regional information-measuring system for weather hazards monitoring







Enhancement of the AMK-03 functionality (measurement of precipitation, soil temperature profiles, snow cover parameters, solar radiation, etc.)

Self-contained monitoring stations

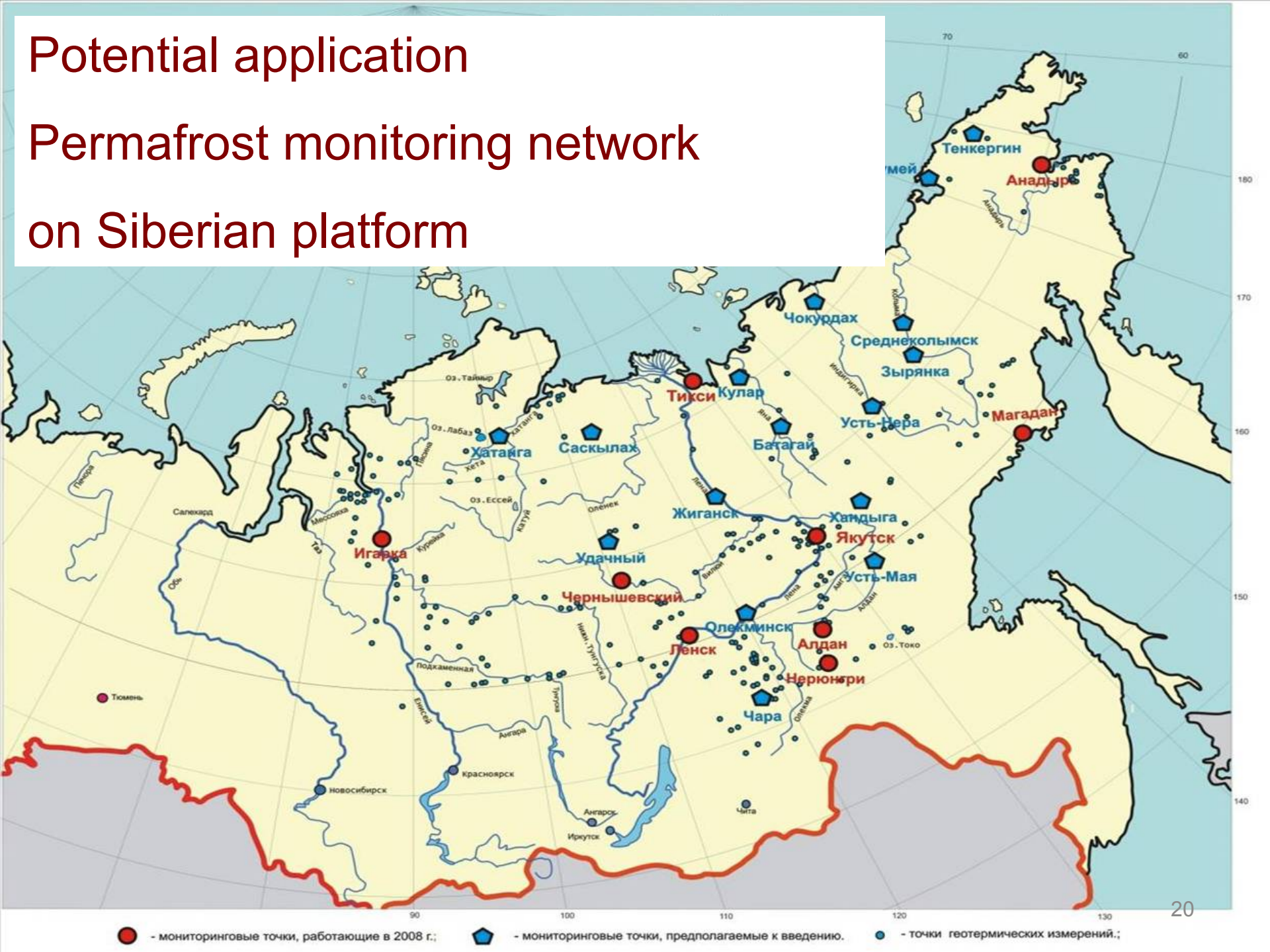
Vasyugan bog, Tomsk region

Tunka station, Buryatiya

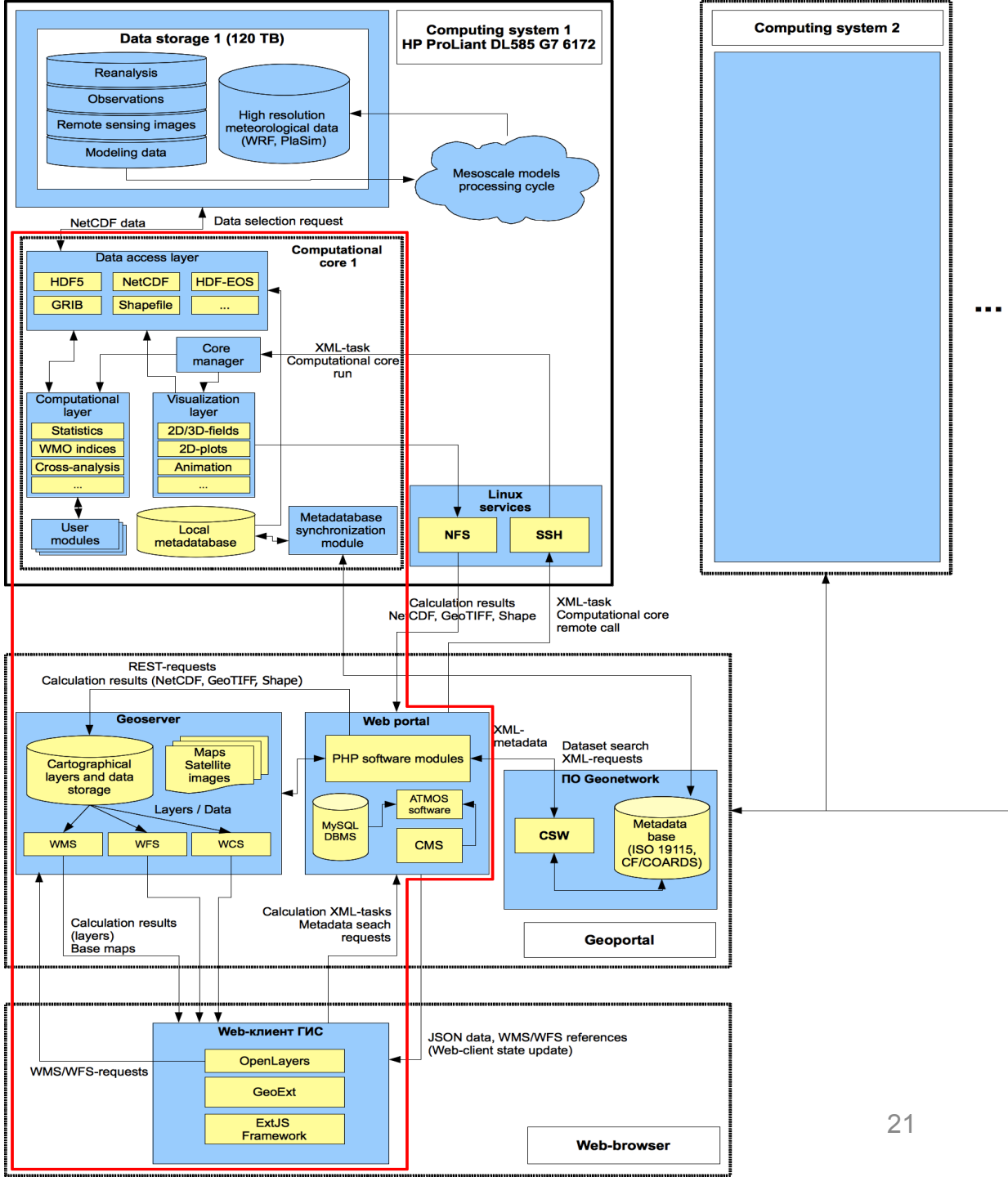
Potential application

Permafrost monitoring network

on Siberian platform



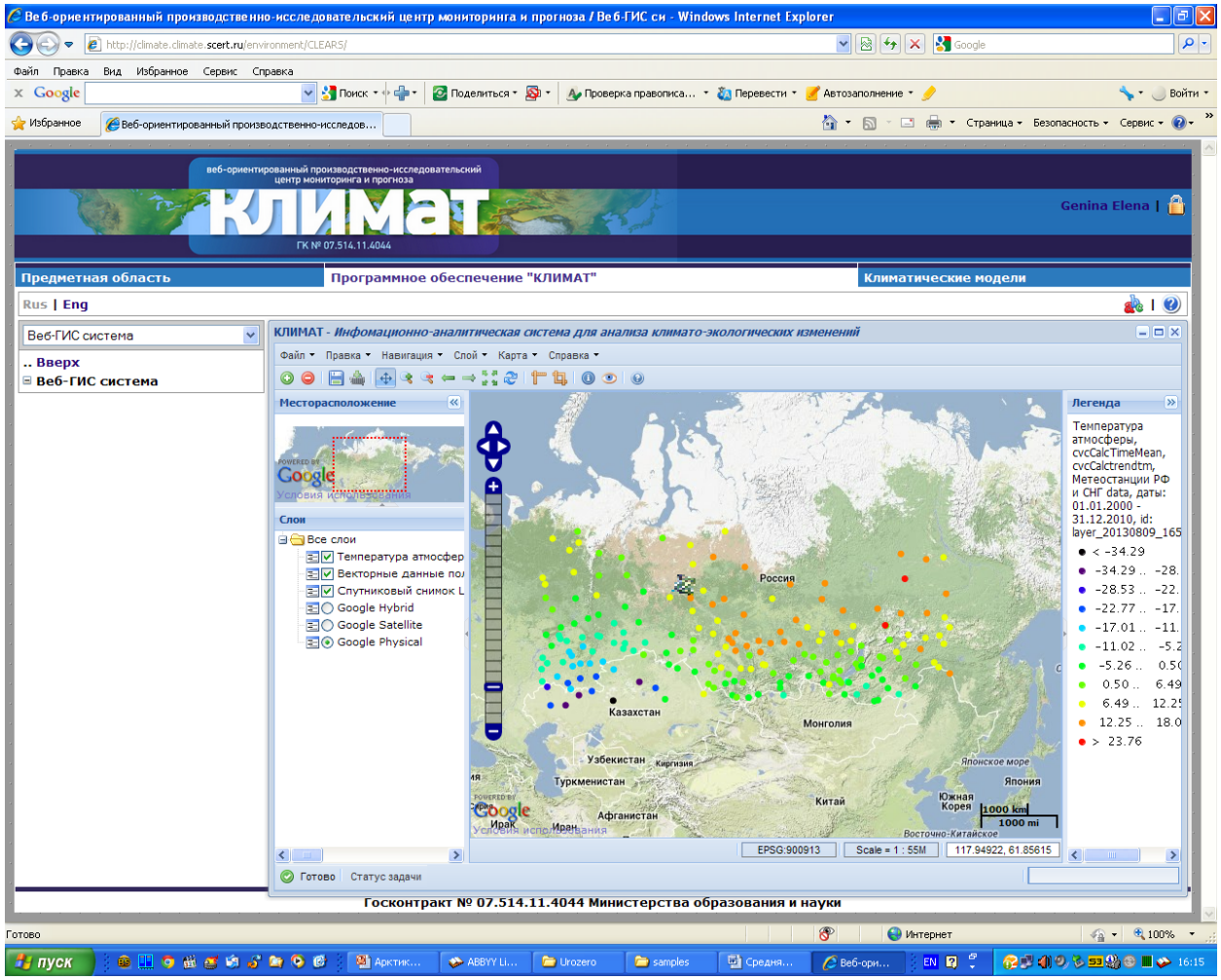
Distributed information-computational system for environmental monitoring in Northern Eurasia



Web-GIS platform CLIMATE

Information-computational technologies

Web-GIS system CLIMATE –example of operation



Cooperation with RAS institutes, universities and industry

1. Cooperation with RAS institute and universities within integration programs of RAS and SB RAS: IPGG SB RAS, IG SB RAS, IEC SB RAS, IWEP SB RAS, IG SB RAS, IF SB RAS, ICMMG SB RAS, INM RAS, IAP RAS, IO RAS, SibNIGMI, TSU, TPU, etc.)
2. Program of Strategic development of the Technological Platform «Technologies of ecological development»
3. Programs of Federal administrations
4. Development Programs of industrial companies and administrations of RF northern territories

Thanks for your attention!