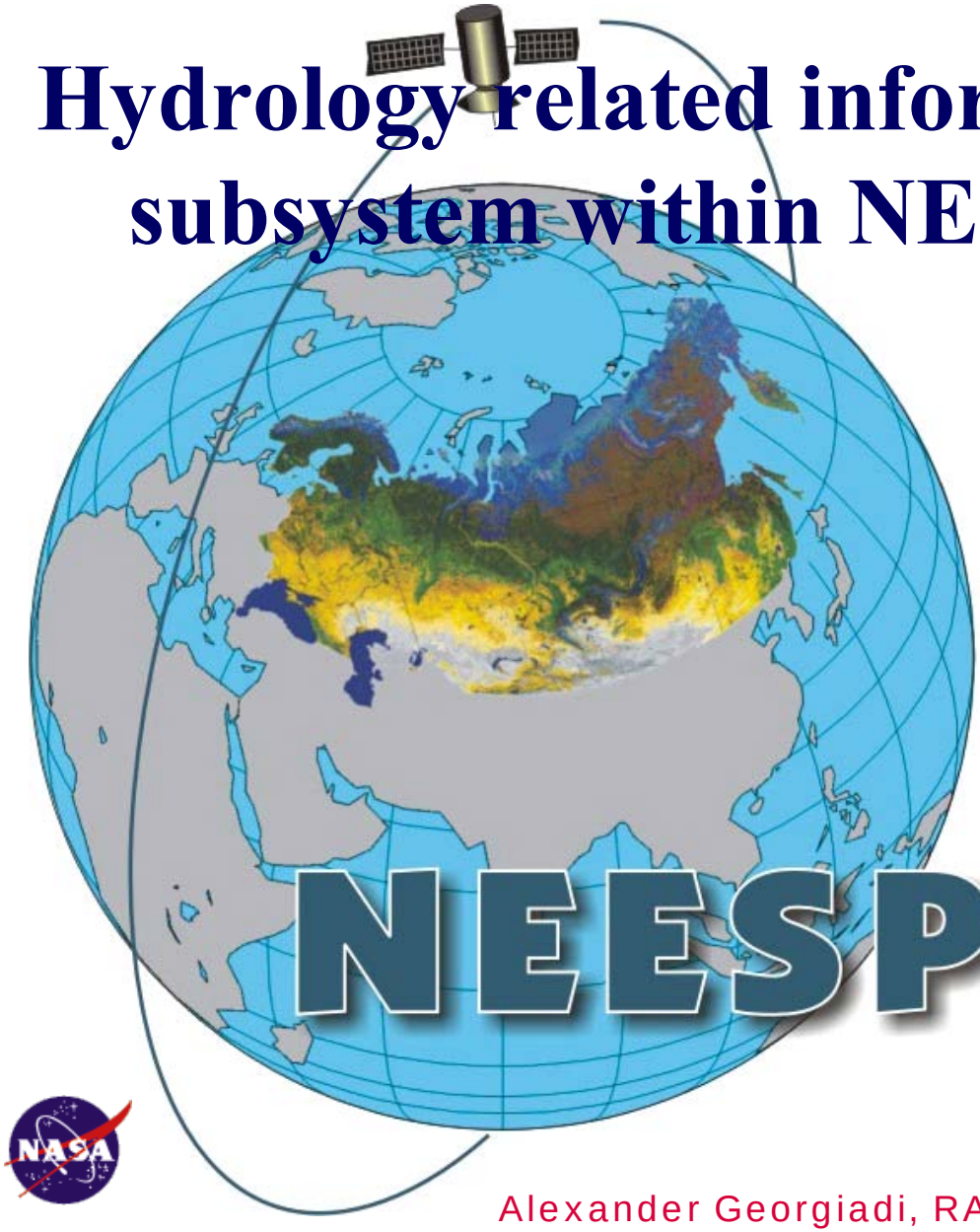
Hydrology related information subsystem within NEESPI



Alexander Georgiadi, RAS-NEESPI Project Manager

joint IGWCO/ CEOP workshop, Tokyo, February 28-March 4, 2005

1. **General information about recent NEESPI activities**

2. **Objectives and priorities of Northern Eurasia Regional Information Network**

3. **Hydrology related information**

   3.1. State network stations of standard observations

   3.2. Research stations

   3.3. Field experiments

What is the NEESPI?

- **The Northern Eurasia Earth Science Partnership Initiative, or NEESPI is**
- **An *active* multidisciplinary program of research focused on critical Earth system science issues in Northern Eurasia**
  - Current active partners are principally NASA and RAS – inishiators of NEESPI

  and
- **it is a *strategically evolving* program of internationally-supported Earth systems science research,**
- **which has as its foci scientific issues in northern Eurasia that are currently relevant to regional and Global scientific and decision-making communities.**

Russian Academy of Sciences

What is the NEESPI?

... from a Functional Perspective

- An instrument for coordinating with other countries and multiple government agencies on Northern Eurasian science topics of mutual interest - and defining the roles where each partnering organization can contribute effectively
- A tool for defining and developing a prioritized science planning strategy for optimizing allocation of scientific resources for the study of this enormous complex region of global importance
- A mechanism for integrating disparate Earth science investigations from many countries and agencies that are already working in the region of Northern Eurasia
- An opportunity to uniquely draw together knowledgeable scientists and develop mechanisms for obtaining and sharing sometimes difficult-to-obtain data and results about this large landmass and conduct critically important, unbiased Earth systems science

Russian Academy of Sciences

The overarching NEESPI science question is:

How do Northern Eurasia's terrestrial ecosystems and their components dynamics interact with and alter the biosphere, atmosphere, and hydrosphere of the Earth?

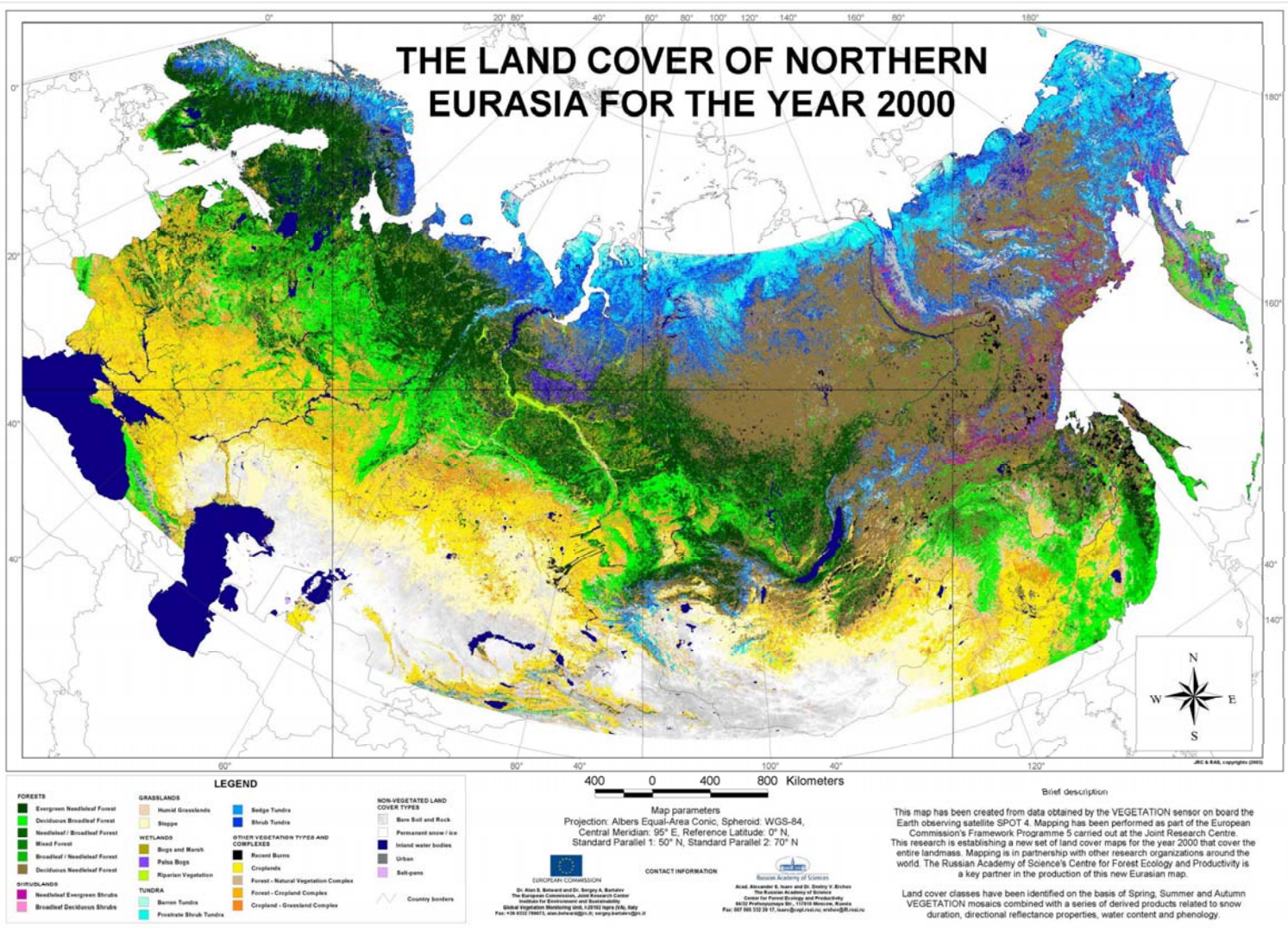
This question can be reformulated in a pragmatic way as:

How do we develop our predictive capability of terrestrial ecosystems dynamics over Northern Eurasia for the 21st century to support global projections as well as informed decision making and numerous practical applications in the region?

What is the NEESPI Study Area ?

NEESPI Study Area includes:

Former Soviet Union, Northern China and Mongolia, Scandinavia & Eastern Europe

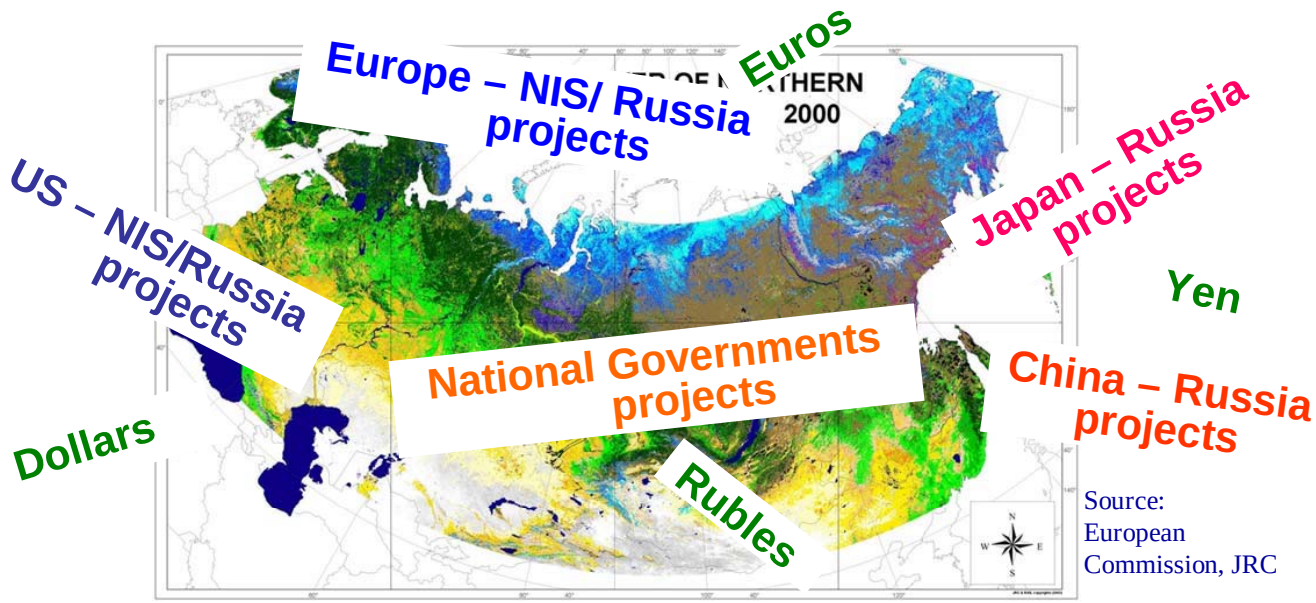


Map Courtesy of European Commission, JRC

Russian Academy of Sciences

Currently, This Region is Studied:

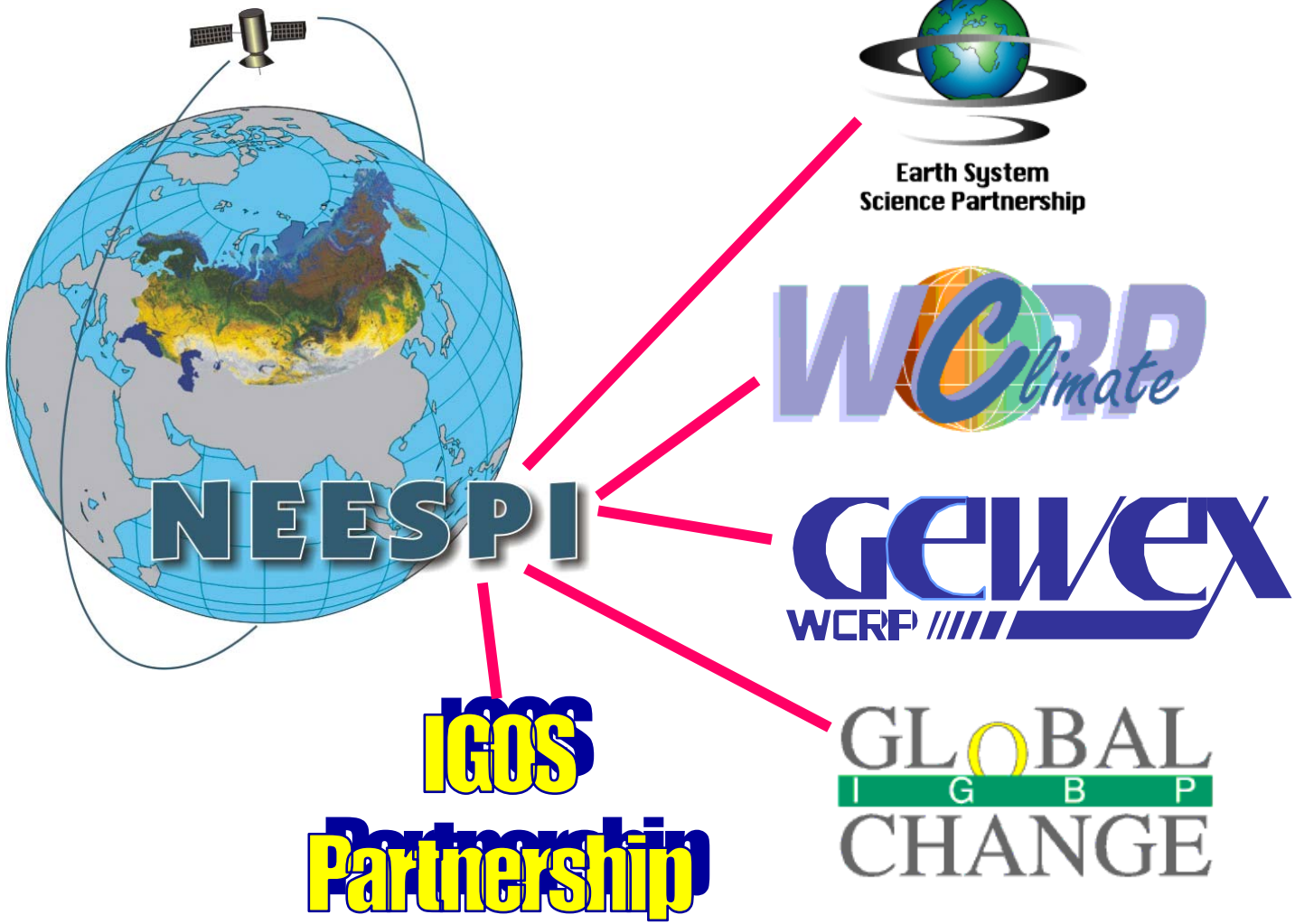
- Unilaterally, by national government scientists in-country
- Bi-laterally, by national scientists with foreign scientist collaborations on independent studies in-country
- Unilaterally, by foreign scientists using remote sensing technologies
- Internationally, through specific-focus coordinated projects in-country (e.g., IGBP "Transects")



Source: European Commission, JRC

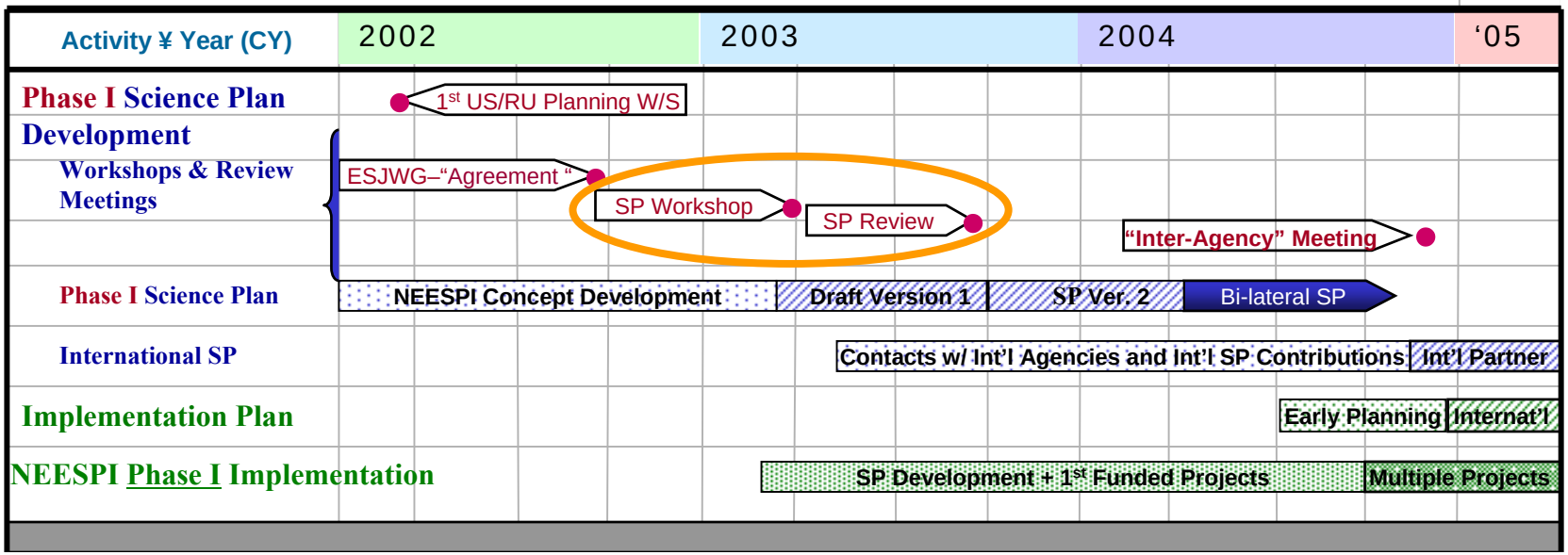
The NEESPI has many potential international links

(R.Lawford, GEWEX)



Russian Academy of Sciences

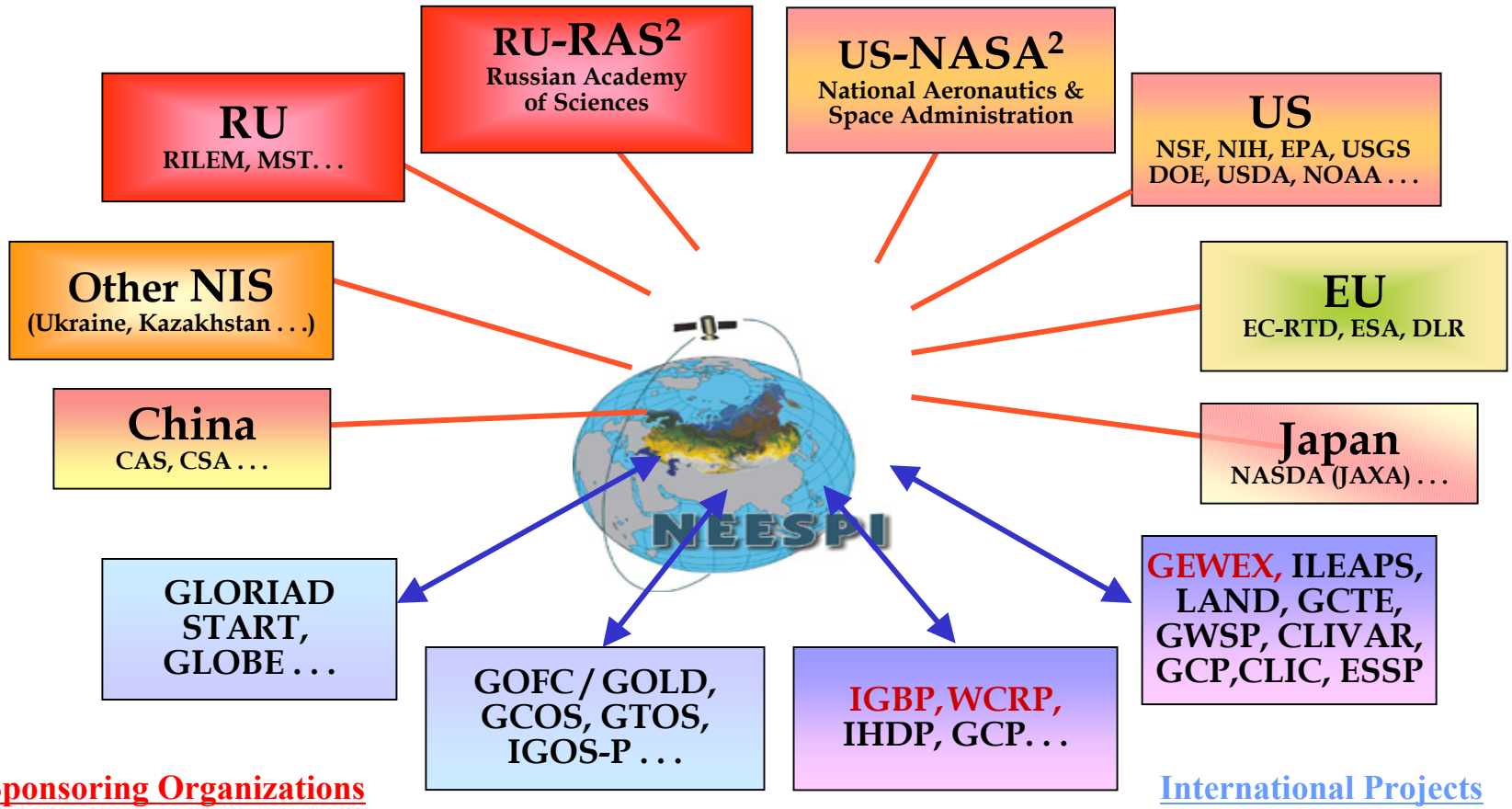
NEESPI Progress
& Development Timeline



Formation of Science Team

Preparation of Implementation Plan

NEESPI IS SEEKING ADDITIONAL SPONSORSHIP AND LINKAGES



Sponsoring Organizations

- NEESPI Program Development
- Research Funding Support
- Organization & Implementation Committee

International Projects

- Scientist Networks
- Data Sharing
- Data Analysis/ Synthesis

[1] anticipated participation with project maturation
[2] founding sponsoring organizations

The major scientific areas, or science themes, to be addressed in the NEESPI include terrestrial ecosystem dynamics, biogeochemical cycles, surface energy and water cycles, land use interactions: societal-ecosystem relationships, ecosystems and climate interactions, and topics of special interest, which include cold land region processes, coastal zone processes, and atmospheric aerosol and pollution.

NEESPI seeks to address interactions between Northern Eurasian ecosystems, water, climate, and human activity, using a combined framework of predictive models, long-term in situ and spatially complete modern remote-sensing observations, and process studies.

NEESPI Science Plan Structure

- 1. INTRODUCTION
- 2. BACKGROUND
- 3. MOTIVATION AND OBJECTIVES
- 4. MAJOR SCIENTIFIC TOPICS
  - 4.1 Terrestrial ecosystem dynamics
  - 4.2 Biogeochemical cycle
  - 4.3 Surface energy and water cycles
  - 4.4 Land use interactions: societal-ecosystem linkages
  - 4.5 Ecosystems and climate change interactions
  - 4.6 Topic of specific interest
    - 4.6.1 Cold land processes
    - 4.6.2 Coastal zone processes
    - 4.6.3 Atmospheric aerosol, pollution, dust
- 5. REMOTE SENSING OF THE EARTH SYSTEM
- 6. MODELING
- 7. DATA AND TECHNOLOGY
- 8. EDUCATION
- 9. RESEARCH STRATEGY

Through conducting the scientific research during the next decade as addressed in the NEESPI Science Plan the following products are expected:

- ***An integrated observational knowledge data base for environmental studies in Northern Eurasia that includes validated remote sensing products***
- ***A suite of process-oriented models for major terrestrial processes in their major interactions (including those with the society)***
- ***Prototypes for a suite of global and regional models that seamlessly incorporate major regionally specific feedbacks associated with terrestrial processes in Northern Eurasia and which could serve to improve scientific understanding that would enable future environmental change projections and provide input to informed decision-making for land use and environmental protection policies.***
- ***Systems demonstrated in the research domain in collaboration with operational partners that can serve the emergency needs of the society (early warning / management / mitigation of floods, fire, droughts, and other natural disasters)***

Overarching Scientific Questions for Water Cycle investigations

First: How will global climate change affect WC within Northern Eurasia?

Second: How will WC changes in Northern Eurasia affect surrounding and global climate, biosphere and human society?

Third: What are main mechanisms of functioning, dynamics and long-term changes of water cycle components of terrestrial ecosystems and water systems of different scales in very diverse conditions of the Northern Eurasia?

Attention will be paid to the processes that directly feed back to the Global Earth System.

From hydrological point of view

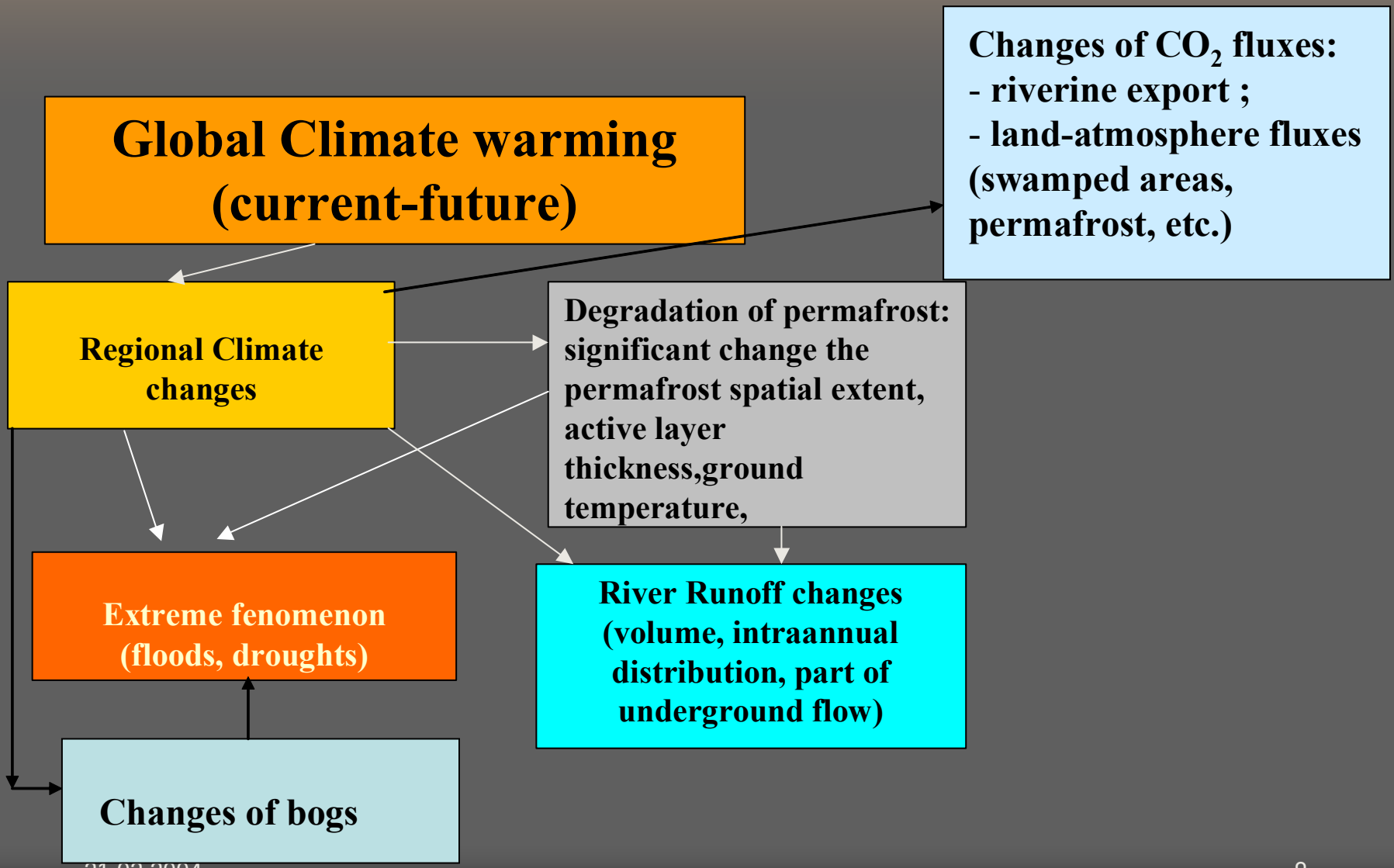
- **The fresh water transport through the Arctic Ocean (increasing of fresh water inflow)**

Thermohaline circulation is a global-scale overturning in the ocean that transports significant heat via a poleward flow of warm surface water and an equator-ward return of cold, less saline water at depth. The overturning, crucial to this transport in the Northern Hemisphere, occurs in the Greenland, Irminger and Labrador Seas. The overturning also moderates anthropogenic impact on climate because it removes atmospheric CO2 to the deep ocean. The occurrence and intensity of overturning is sensitive to the density of water at the surface in these convective gyres, which, in turn, is sensitive to the outflow of low-salinity water from the Arctic Ocean.

In the Arctic Ocean, freshwater accumulates due to precipitation and inflow from rivers and the relatively fresh Pacific waters (compared to the North Atlantic Ocean) through the Bering Strait. This freshwater and sea ice outflow from the Arctic basin is subject to significant interannual oscillations that influence the salinity balance and winter convection processes of the Greenland Sea and the North Atlantic. About 10% of the global river runoff is discharged to the Arctic Ocean, which is only 5% of the global ocean area and 1.5% of its volume. About three-quarters of the inflow come from the six largest rivers, the Yenisey, the Lena, the Ob, the Mackenzie, the Pechora and the Kolyma. Five of them are in Northern Eurasia.

- **Thawing of permafrost and connected hydrological changes**

(It is connected closely with previous objective)



Attention must be addressed to the processes of major societal importance.

They may or may not affect the Global Earth System but for the region's population they are of pivotal importance.

- ***Extremes***
- ***Terrestrial hydrology and water supply***
- ***Soil moisture changes, impact on agriculture***
- ***Soil / freeze/ refreeze/ thaw of permafrost interaction with hydrological processes***
- ***Snow cover impact on flooding***
- ***Glaciers changes, impact on hydrology***
- ***Water pollution***

Hydrological consequences of social-economic changes

Impact on water resources of a decrease (at least twofold) of industrial and agricultural production in Russia in the 1990s

A general weakening of anthropogenic loading

- Reduction of water withdrawal by most of users
- Decrease of arable land area
- Decrease of irrigated land area
- Decrease of amount of fertilizers
- Decrease of forest cutting area
- Decrease of melioration area

Opposite (to weakening) effects due to changes in spatial distribution and types of impacts as well as due to the degradation of the environment protection system

- Increasing of intensity of selected anthropogenic impacts
- Decrease of technology level in agriculture, forest cutting, etc.
- Increase of specific water consumption
- Degradation of water quality protection system

All hydroecological consequences of these changes are not yet fully investigated

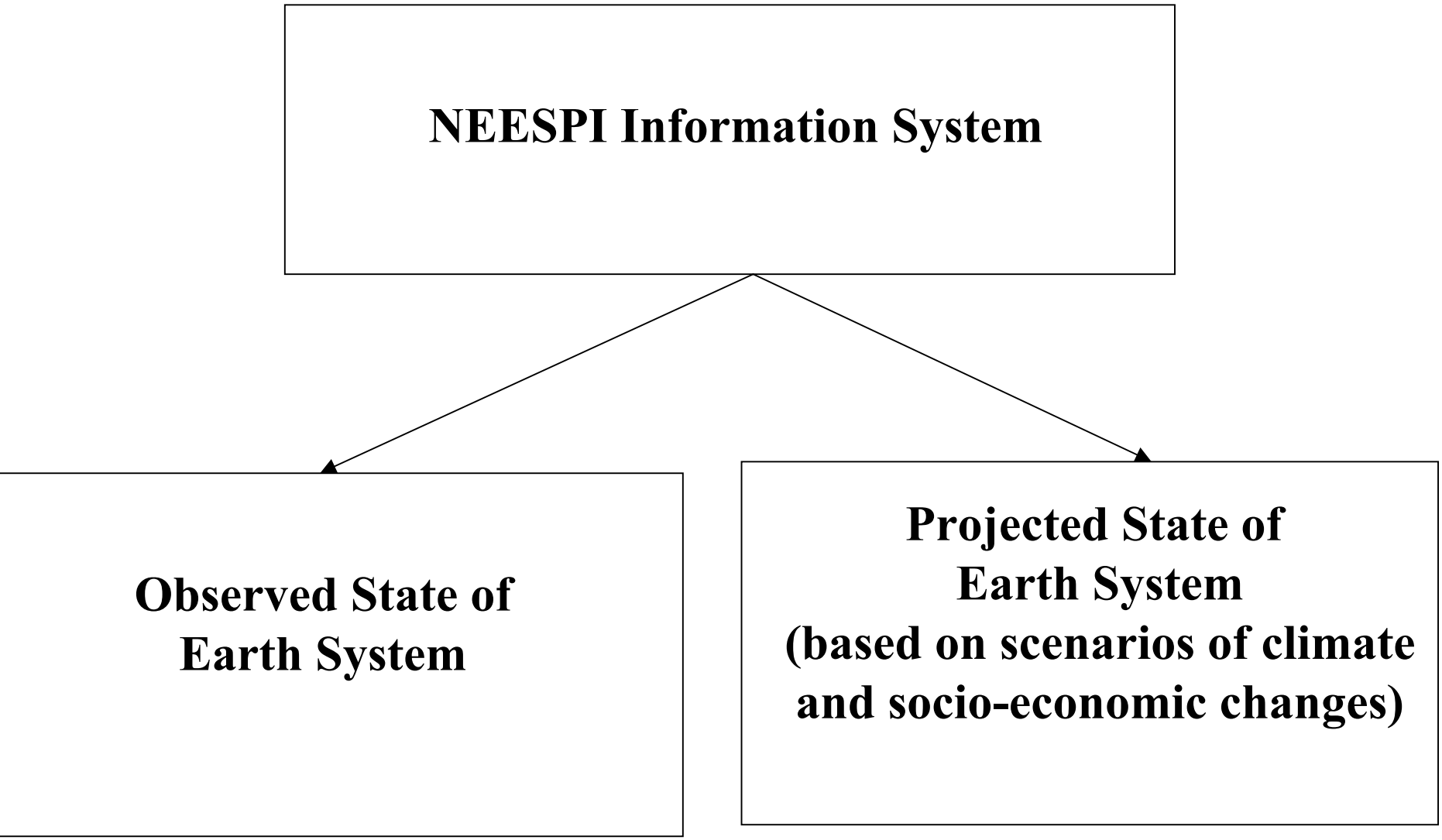
Success of the NEESPI project requires open exchange of data and information among the project participants, to the greatest extent allowable by institutional, national, and international regulations.

NERIN has emerged as an informal network of:

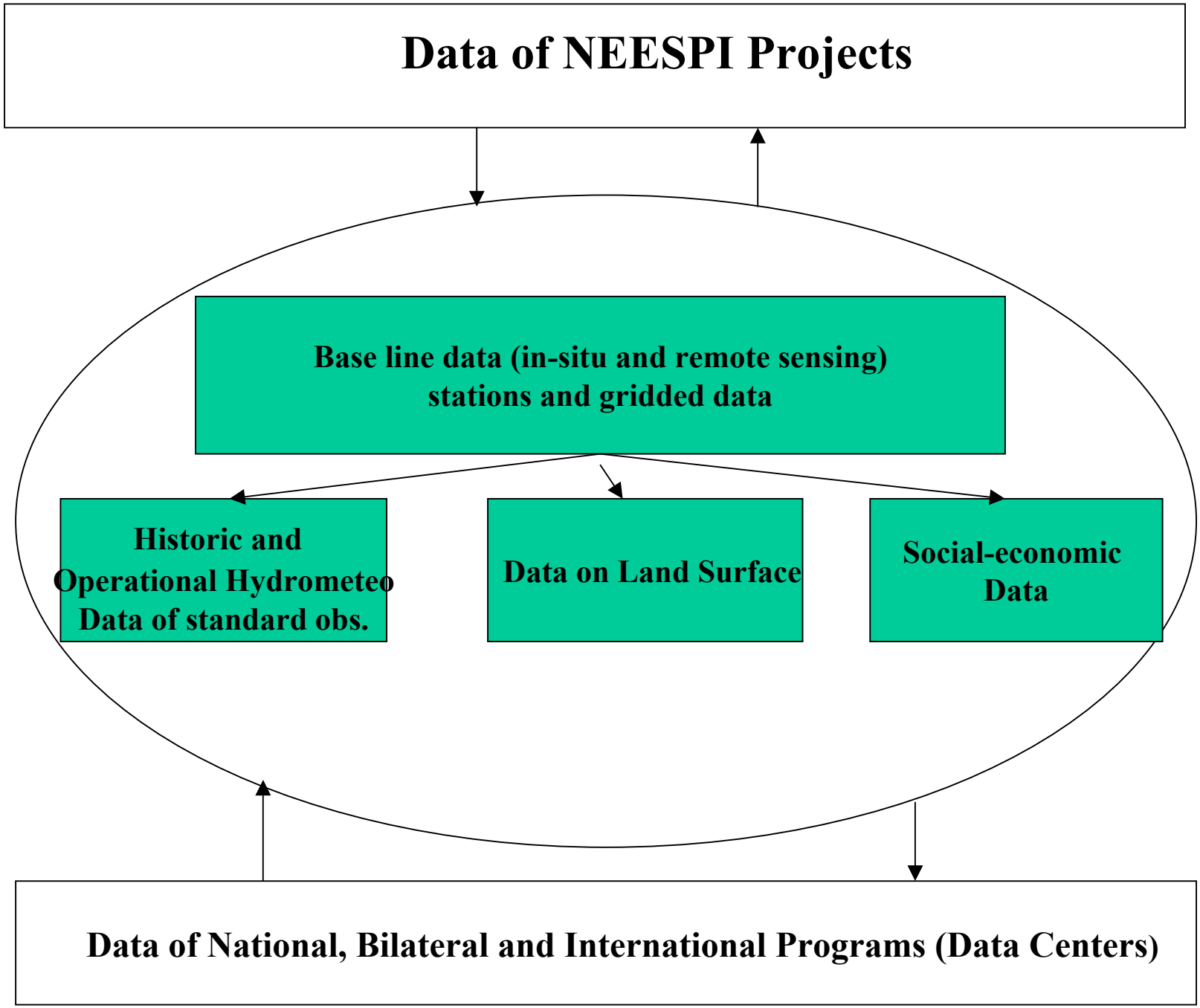
a. scientists and other professionals,
b. institutions and observational networks,
c. projects within the thematic scope of NEESPI,
d. network of points of contact for data users (under development).

NERIN is currently assembling information about the content, quality, condition, and other characteristics of number of data sets available to support new research in Northern Eurasia. Searchable METADATA are available and new contributions to the METADATA are welcome.

The development and implementation of NERIN defined the thematic foci of the recent Workshop "OBSERVATIONAL DATA in Support of NEESPI" was held February 23-26, 2004 in Repino, near St. Petersburg, Russia.


NEESPI Information System
Observed State of Earth System
Projected State of Earth System (based on scenarios of climate and socio-economic changes)

Hydrology related information subsystem **will be an important part of NERIN having a wide range of data on main fresh water components and their factors including human activities on different temporal and spatial scales from different observational systems developed on national, bilateral and international levels. Data of state network, research stations, and field experiments as well as land cover land use data will be included in hydrological subsystem.**

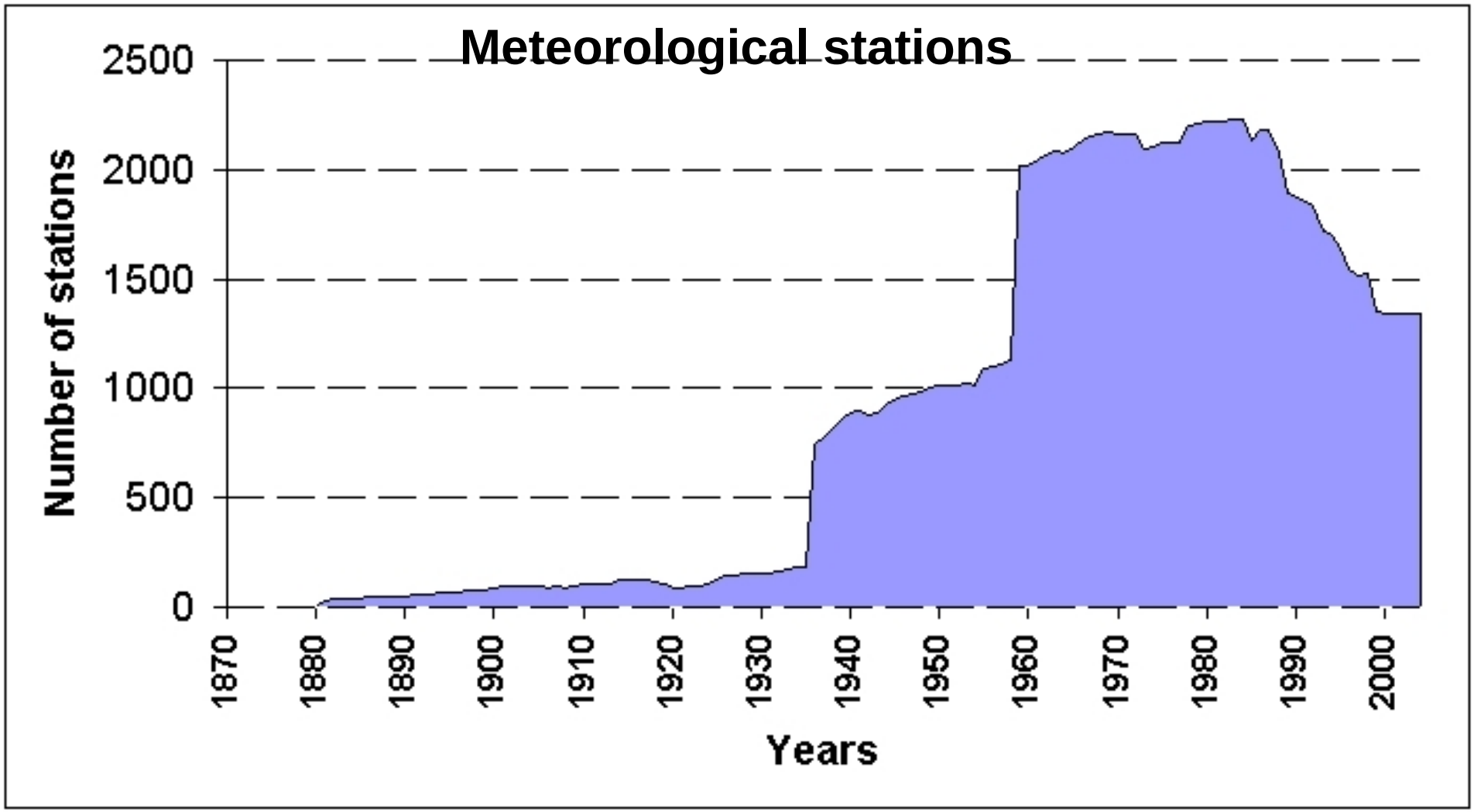

Data of NEESPI Projects
Base line data (in-situ and remote sensing) stations and gridded data
Historic and Operational Hydrometeo Data of standard obs.
Data on Land Surface
Social-economic Data
Data of National, Bilateral and International Programs (Data Centers)

State of network of hydrometeorological observation (mainly for Russian territory)

RUSSIAN RESEARCH INSTITUTE FOR HYDROMETEOROLOGICAL INFORMATION – WORLD DATA CENTER (RIHMI-WDC)

This Institute accumulates most of hydrometeorological information which is coming from regional Hydrometeorological Centers

Operational meteorological data


Meteorological stations
Number of stations
2500
2000
1500
1000
500
0
1870
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
Years

List of meteorological elements

3-HOURLY DATA SET

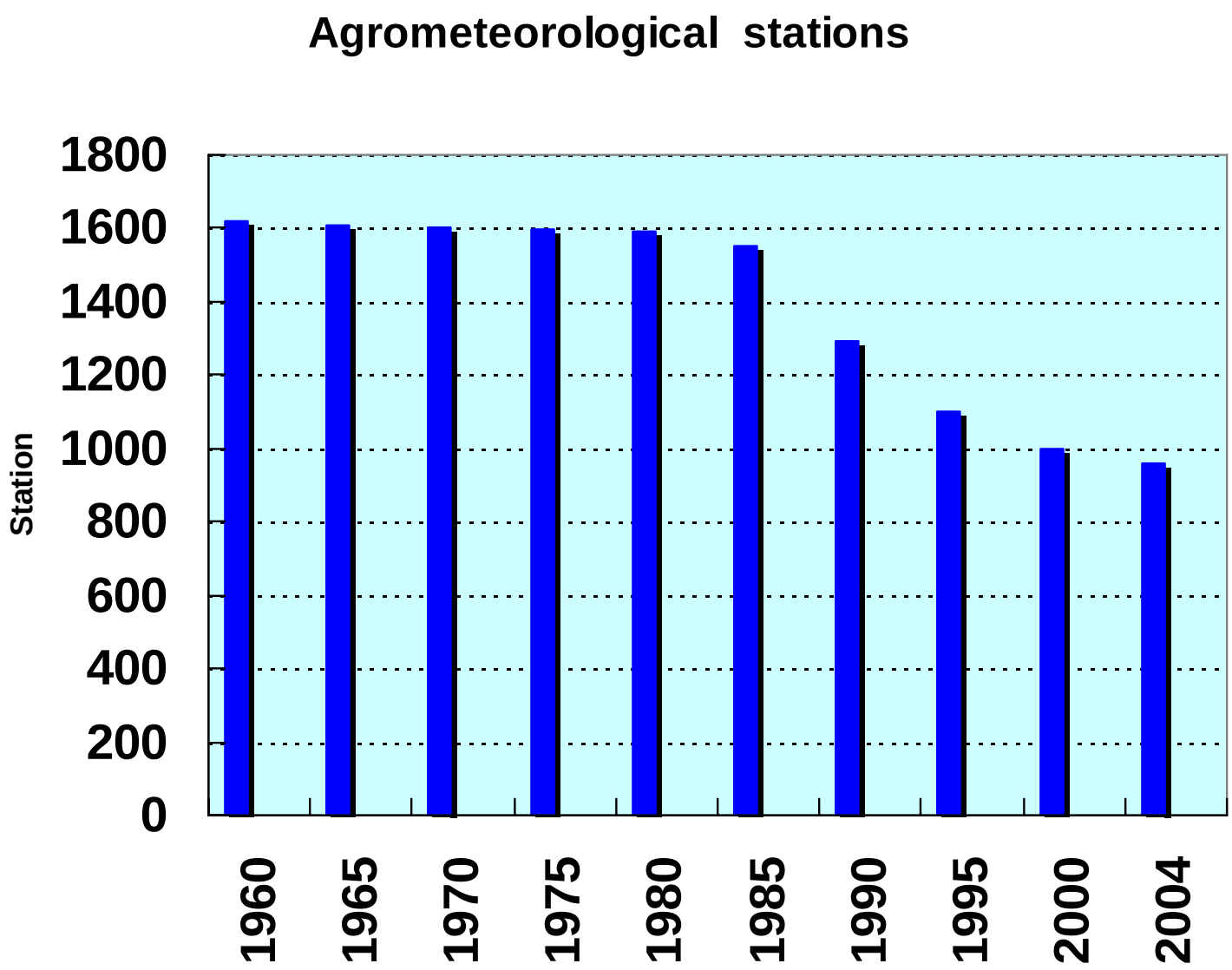
Air temperature
Water vapour pressure
Dew-point temperature
Relative humidity
Sea level pressure
Station level pressure
Air pressure tendency
Visibility
Total cloud amount
Lower cloud amount
Cloud general
Height of cloud base
Wind speed
Wind direction
Precipitation
Present weather
Past weather
Surface temperature
Ground state
Atmospheric phenomena

DAILY DATA SET

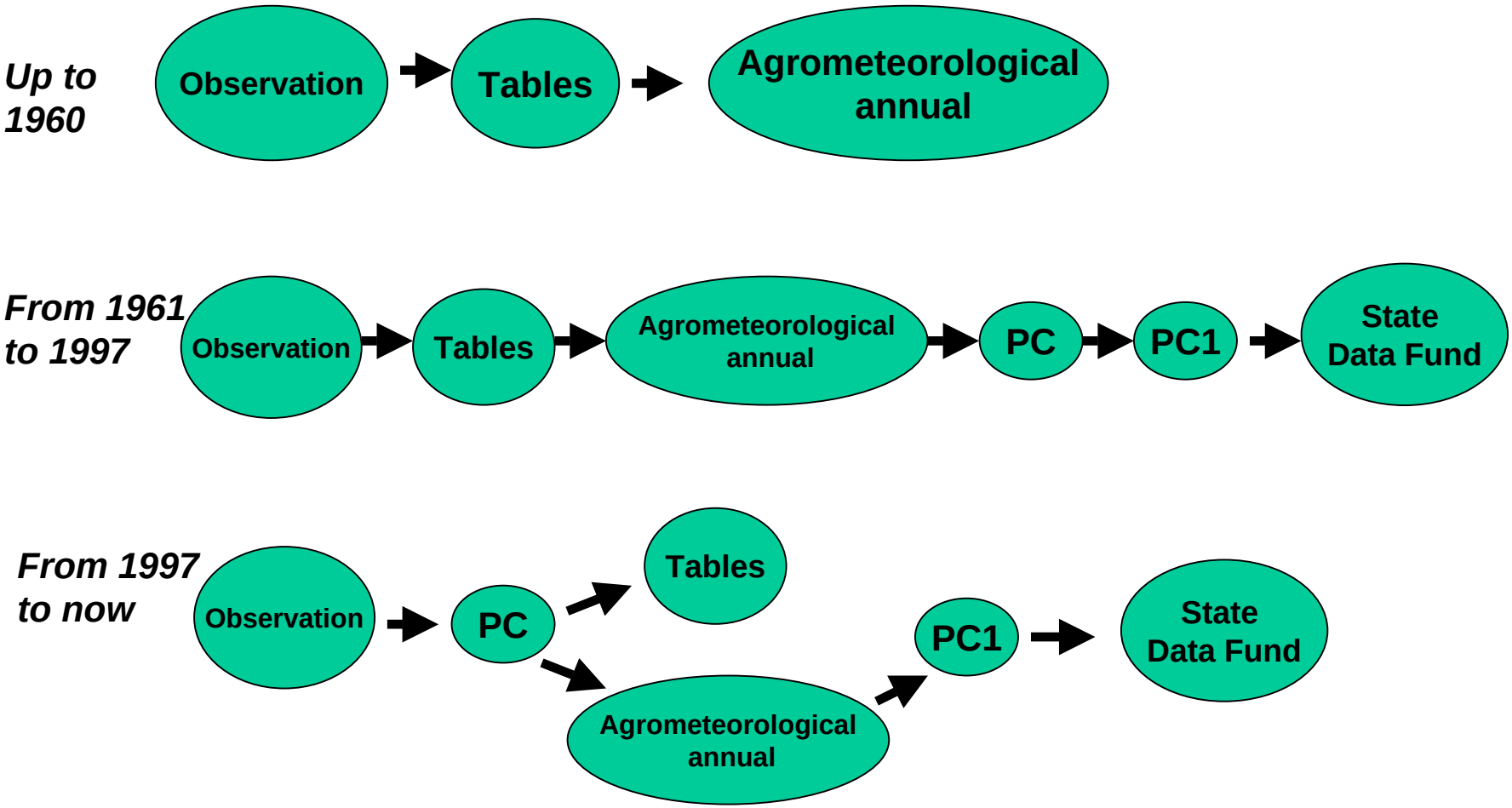
Mean daily air temperature
Maximum air temperature
Minimum air temperature
Daily precipitation
Snow depth
Snow coverage
Characteristics of site
Minimum of relative humidity
Minimum of surface temperature
Wind speed maximum
Atmospheric phenomena
Atmospheric phenomena duration
Daily total and low cloud amount
Sunshine duration

Meteorological observations in Russia

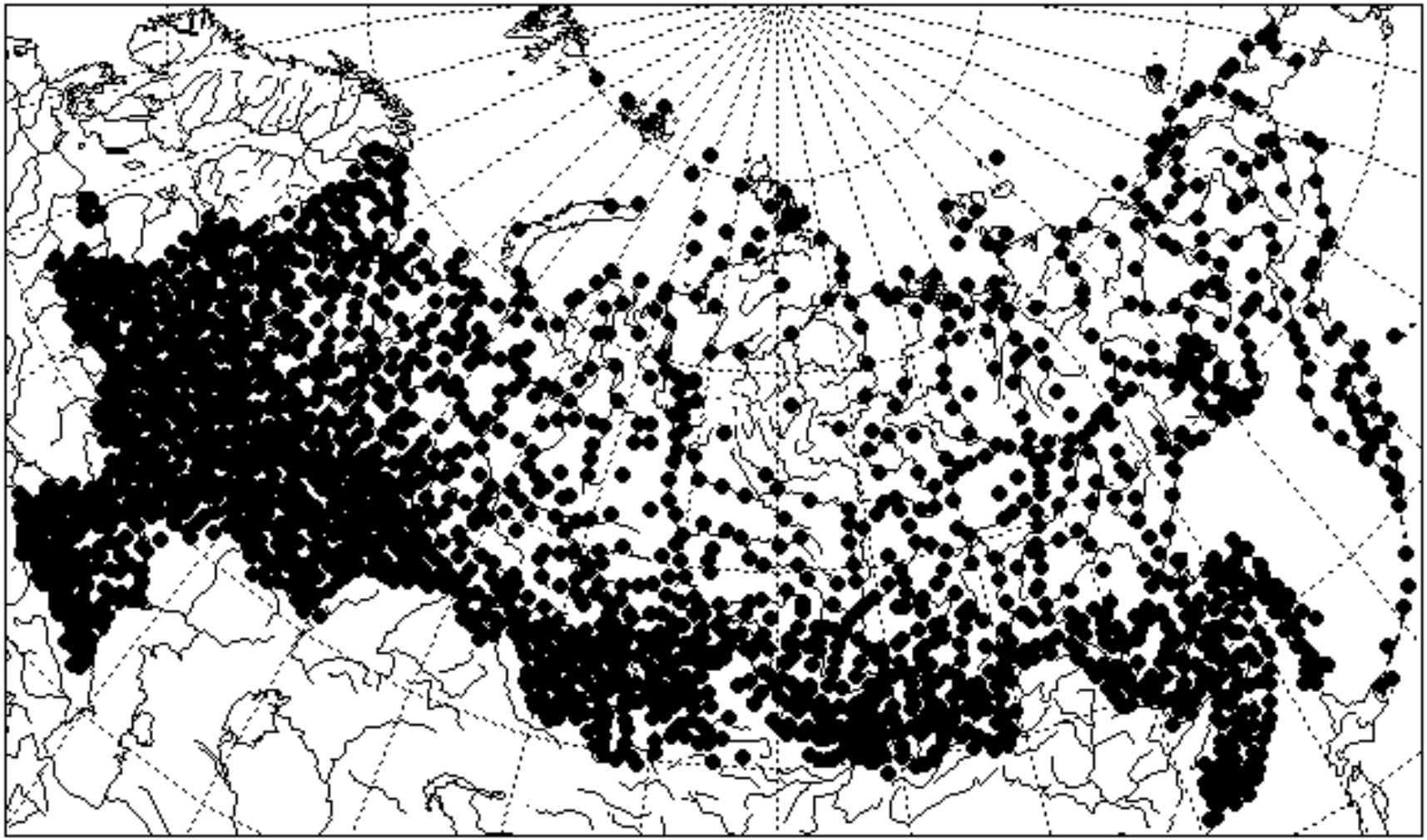
Years	Times day	Format
1891 - 1935	Three (7, 13, 21 Local Time)	A
1936 - 1965	Four (1, 7, 13, 19 LT)	B
1966 - 1976	Eight (3, 6, 9… Moscow Time)	C
1977 - 1984	Eight (3, 6, 9… Moscow Time)	D
1985 - now	Eight (3, 6, 9… Moscow Time)	E


Agrometeorological stations
Station
1800
1600
1400
1200
1000
800
600
400
200
0
1960
1965
1970
1975
1980
1985
1990
1995
2000
2004

Soil moisture data



Meteorological stations
(Snow cover characteristics. Daily data)



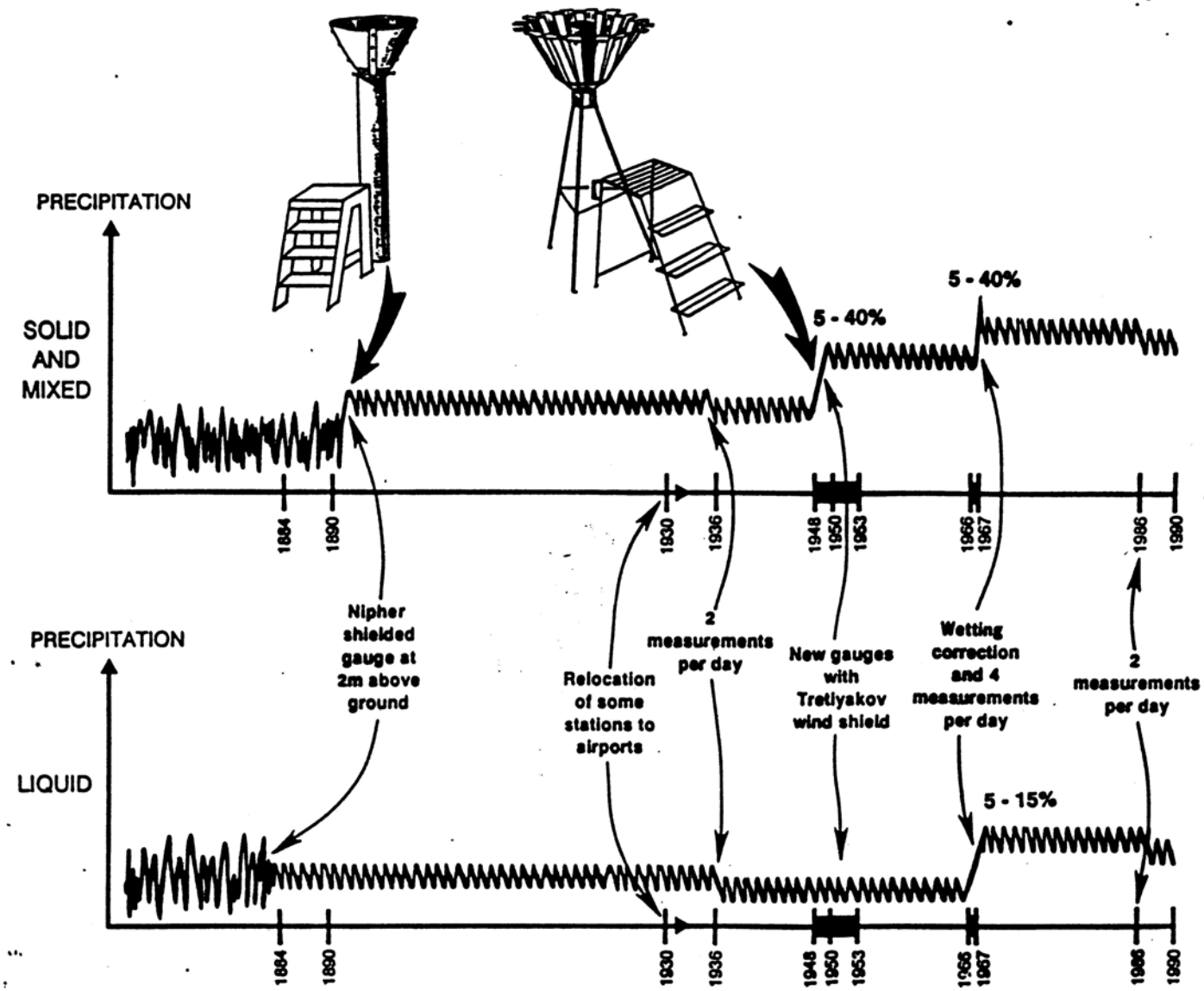
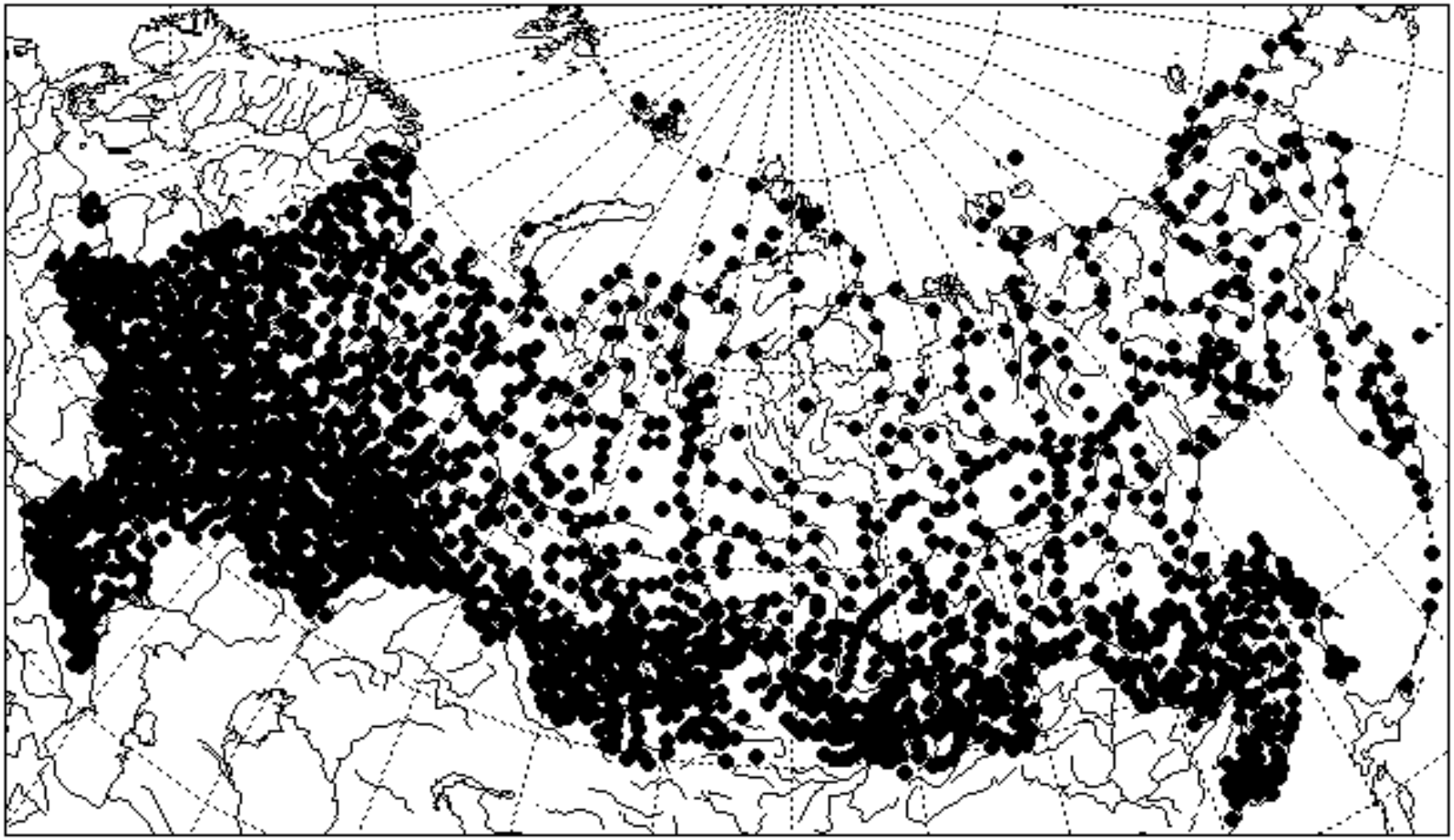
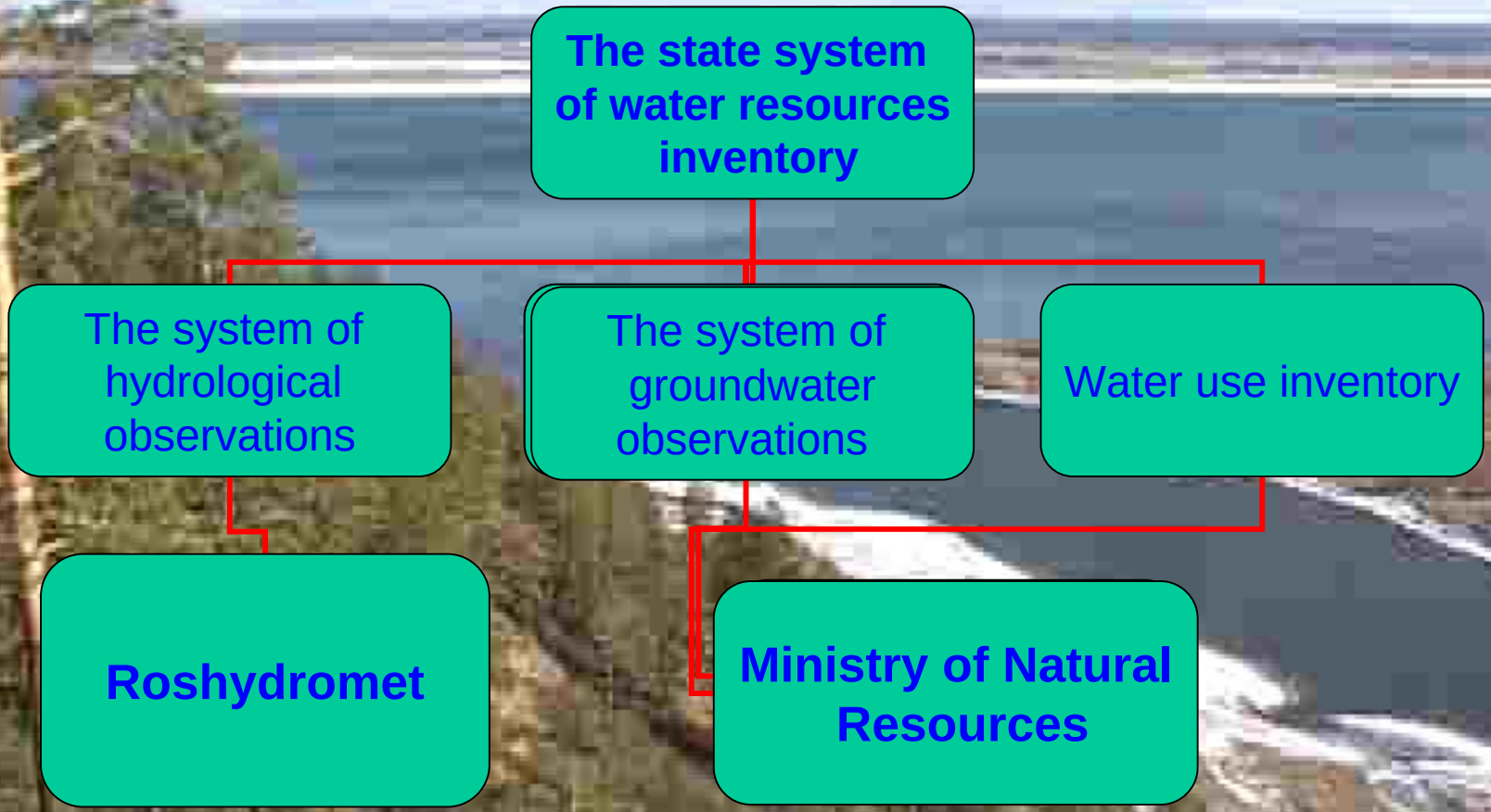


FIG. 1. A depiction of the systematic changes in the precipitation network over the USSR. Characteristic ranges of the changes are provided where possible.

Meteorological stations (snow cover state characteristics for fixed routes observations)

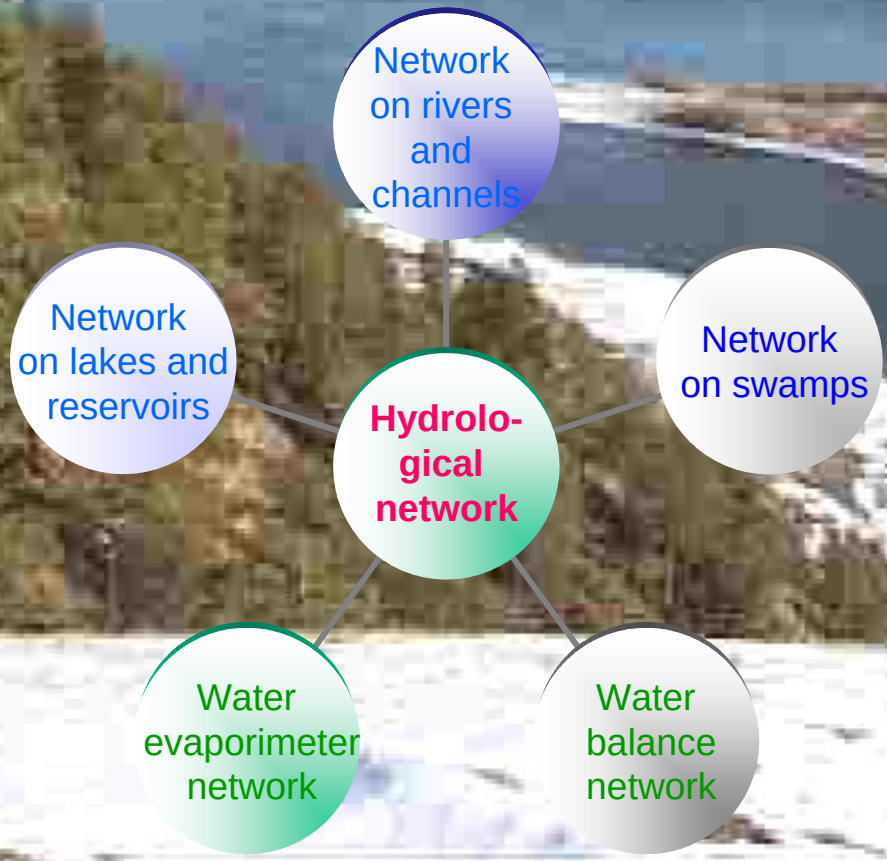


The system of hydrological observations is the main source of information on the surface water.



Hydrological network is the main part of surface water inventory. Hydrological observation data are required for many branches of the national economy, scientific purposes, environmental requests and others. Therefore, the requirements for this information are diverse with time.

Main components of hydrological network



Dynamic of hydrological network

Number of stations						
Rivers		Lakes	Swamps		Evaporation	Water balance
Total	Discharge		Total	Posts		
1986						
4161	**2664**	**514**	**6**	**15**	**302**	**10**
2003						
2844	**2188**	**350**	**3**	**8**	**203**	**6**

Hydrometric operational stations

Main types of observations on swamps:

- Heat balance
- Meteorological observations
- Water discharge
- Water level
- Water quality
- Ice regime
- Peat and soil properties

Main types of observations on lakes:

- Meteorological observations
- Water level
- Water temperature
- Water quality
- Waves
- Currents
- Ice regime characteristics
- Ice thickness

Main types of observations on rivers:

- Water discharge
- Water level
- Sediment discharge
- Sediment composition
- Water temperature
- Water quality
- Ice regime characteristics
- Ice thickness

The National Water Cadastre structure

Water resources, their quality and use
Integrated, selected and generalized information
Annual and long-term generalizations

Subsurface water

Catalogues of subsurface water objects and points for observations; results of observations of subsurface water regime and quality; annual and long-term generalizations; subsurface water storage

Surface Water

Distributed according to the kind of information
Catalogues of water bodies and observation sites , results of observations of water regime and quality; annual and long-term generalizations within the water bodies

Rivers and canals	Lakes and reservoirs	Seas and sea mouths of rivers	Water quality on land	Glaciers	Mudflows

Water use

Catalogues of water use; results of annual statistical reports of water users; annual generalizations

The structure of the published part of the NWC

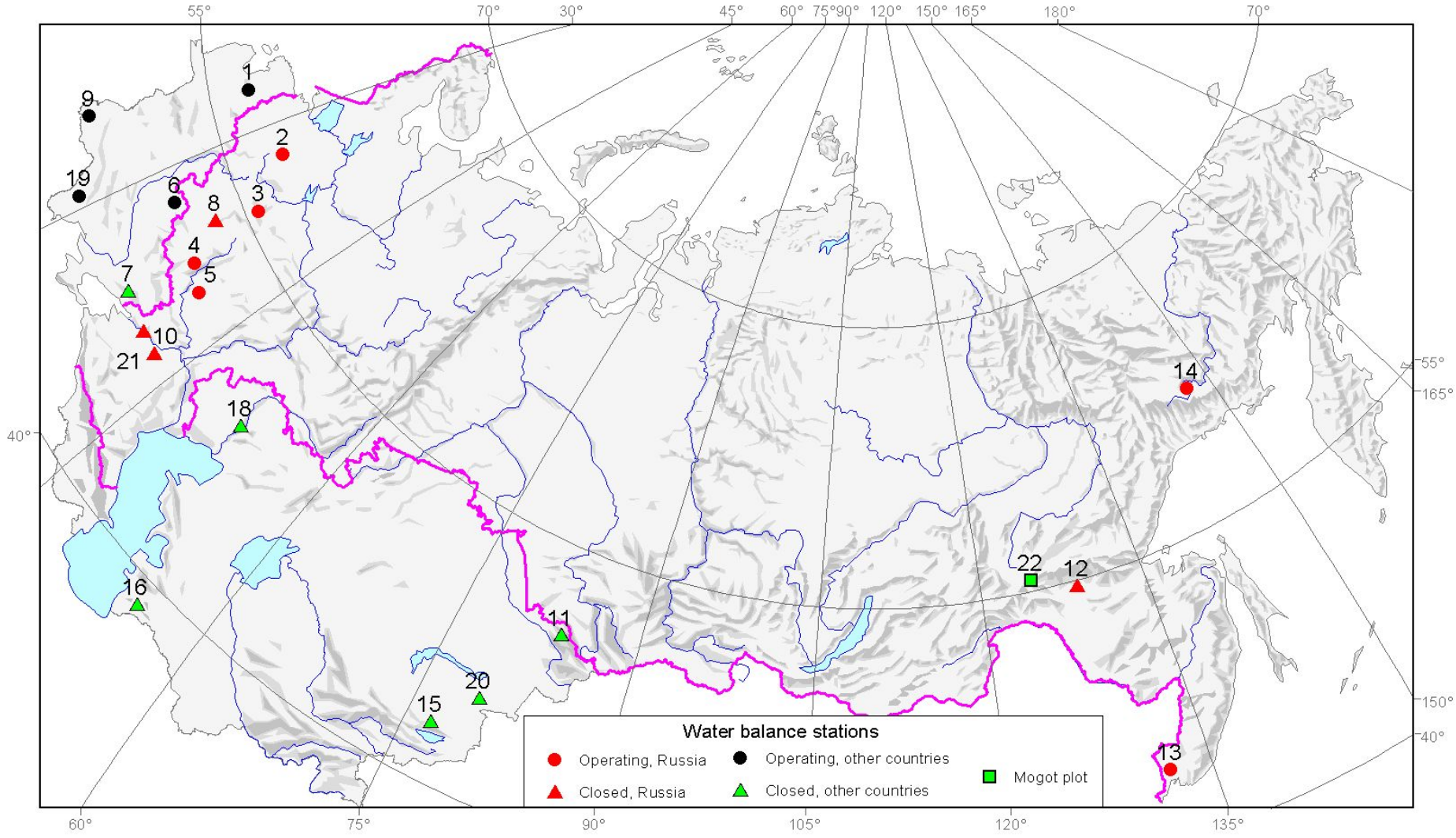
Three series of reference books in each section and subsection:

“Catalogue Data”,
“Annual Data” (yearbooks)
“Long-term Data”. (long-term issues)

Two combined reference books :

“Surface and Subsurface water resources, their use and quality”
(yearbooks)
“Water Resources and their Development” (long-term issues)
(one-volumed reviews of the appropriate multi-purpose generalized data on large river basins and their parts, large lakes or reservoirs, units of administrative and territorial division, economic regions and country as a whole) .

Network of Water balance stations in the Former Soviet Union



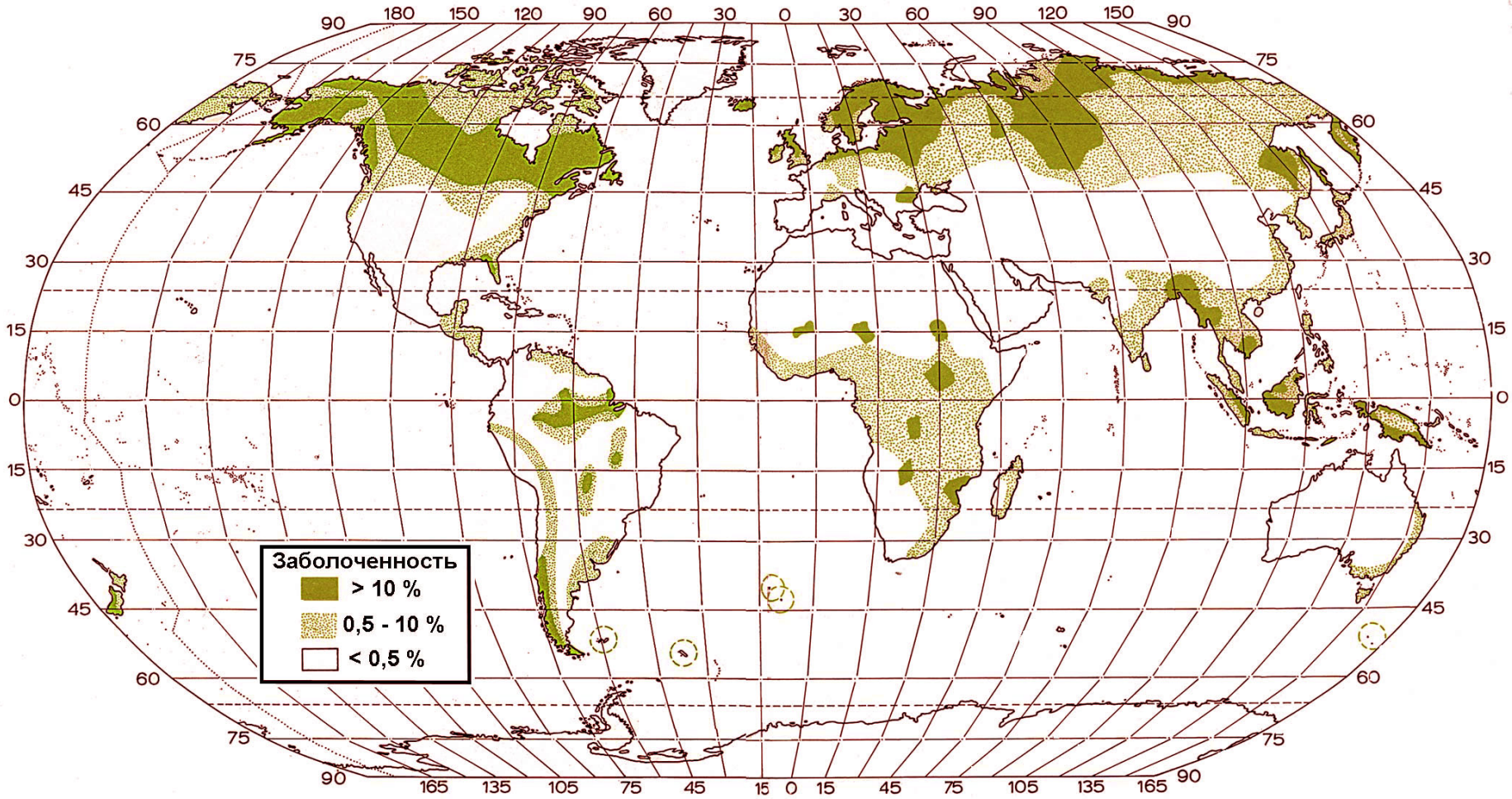
Designed by Orlova E. and Sedov V.

Scale 1: 30 000 000

Projection Lambert Equal-Area Azimuthal

#	Water Balance Station	Geographical zone	Total area	Basins number	Operating period
1	Pribaltijskaya	Coniferous Forest	40	6	1946 - operating
2	Valdai Branch of the SHI	Coniferous Forest	Up to 10000	15	1933 - operating
3	Podmoskovnaya	Mixed Forest	25.6	9	1945 - operating
4	Nizhnedevitsk	Forest-Steppe	103	10	1947 - operating
5	Kamennaya Steppe	Steppe	4.9	6	1949 - operating
6	Pridesnianskaya	Mixed Forest	29.7	8	1929 - operating
7	Veliko-Anadol	Steppe	44.2	5	1950 - 1986
8	Bolkhov	Mixed Forest	1930	16	1972 - 1986
9	Zakarpatskaya	Mountain, Forest	550	23	1956 - operating
10	Dubovskaya	Steppe	206	12	1948 - 1986
11	Leninogorskaya	Mountain	400	2	1982 -
12	Bomnak	Forest, Permafrost	22	4	1935 - 1968
13	Primorskaya	Forest	1370	20	1946 - operating
14	Kolymskaya	Mountain, Permafrost	21.2	7	1948 - operating
15	Alma-Atinskaya	Mountain	118	21	1939 - 1972
16	Zapadno-Turkmenskaya	Desert	13.6	6	1950 -
17	Kustanaiskaya	Steppe	181	9	1960 - 1971
18	Zap. Kazakhstanskaya	Semi-desert	248	5	1951 - 1973
19	Moldavskaya	Steppe	62.4	9	1953 - operating
20	Aksusskaya (irrigation)	Steppe	600	1	1974 - 1984
21	Semikarakorskaya (irrigation)	Steppe	20	3	1965 - 1996
22	Mogot Experim. Plot	Mountain, Permafrost	31.8	6	1976 - 1985, 2000 - 2002

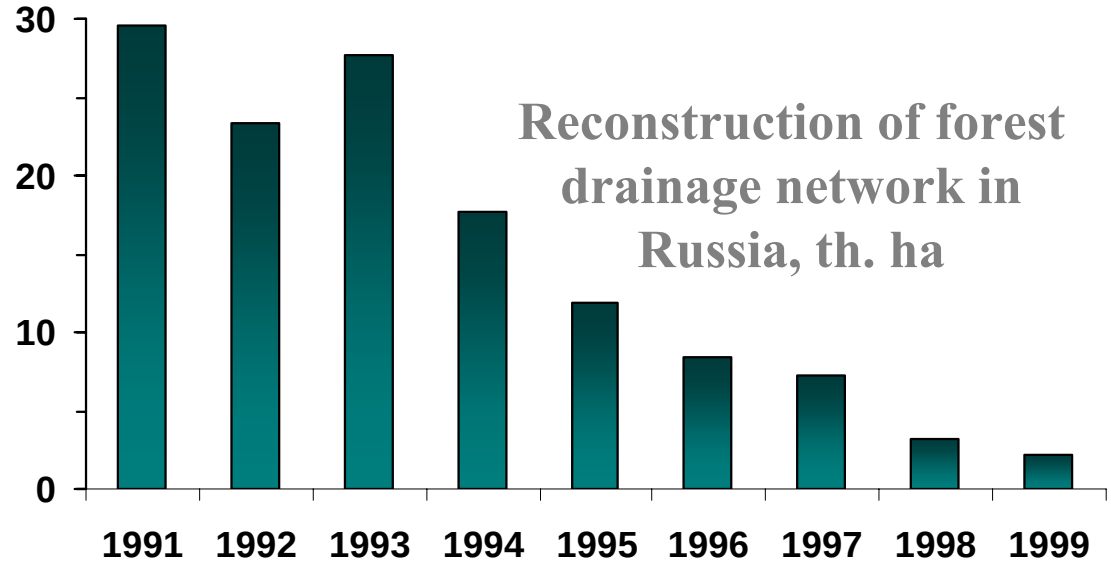
Peatlands cover from 2 to 6 % of the land surface, contribution from Russia - up to 50 %



Ecosystems of the World. 4A. Mires: Swamp, Bog, Fen and Moor (Ed. Gore A.J.P.), 1983

Peatlands could be considered in the climate change problem regarding following aspects:

- Peatlands – main terrestrial sink of atmospheric carbon
- Peatlands – GHG (CO_2, CH_4 , N_2O) source
- Peatlands could have a mitigation effect for the climate change consequences
- Peatlands strongly urge the climate change adaptation strategy



Reconstruction of forest drainage network in Russia, th. ha

Only in European Russia secondary paludification occurs on the territory over 750 th hectares

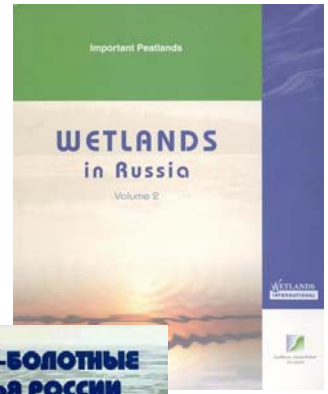
WETLANDS INTERNATIONAL

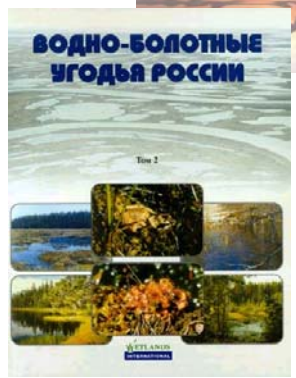
Russia presents high diversity of peatlands

Polygon and palsa mires

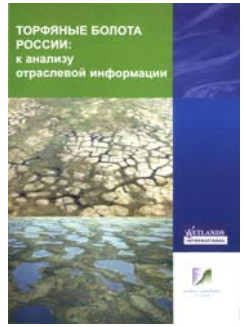
Raised bogs and aapa mires

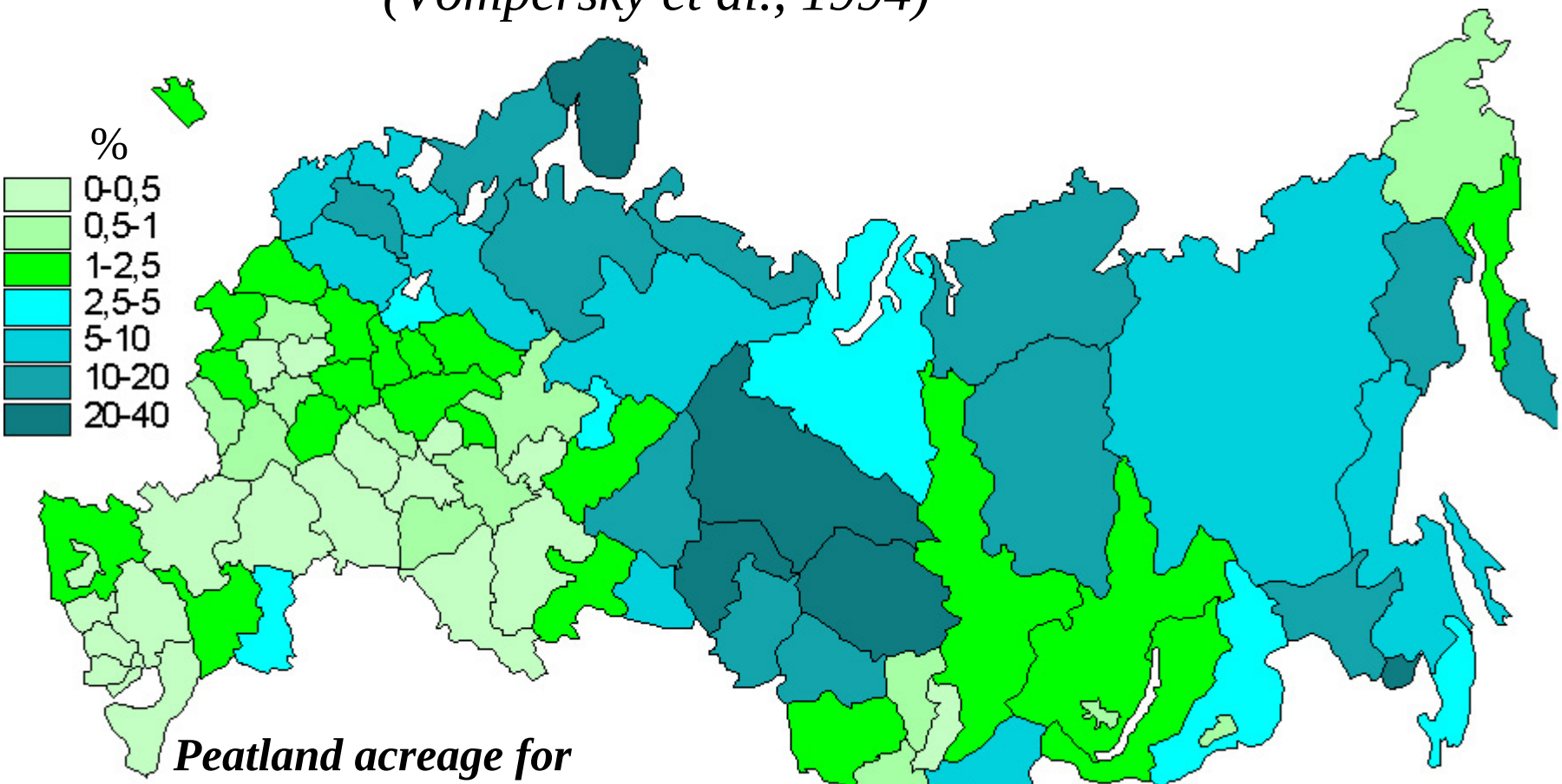
Different sw





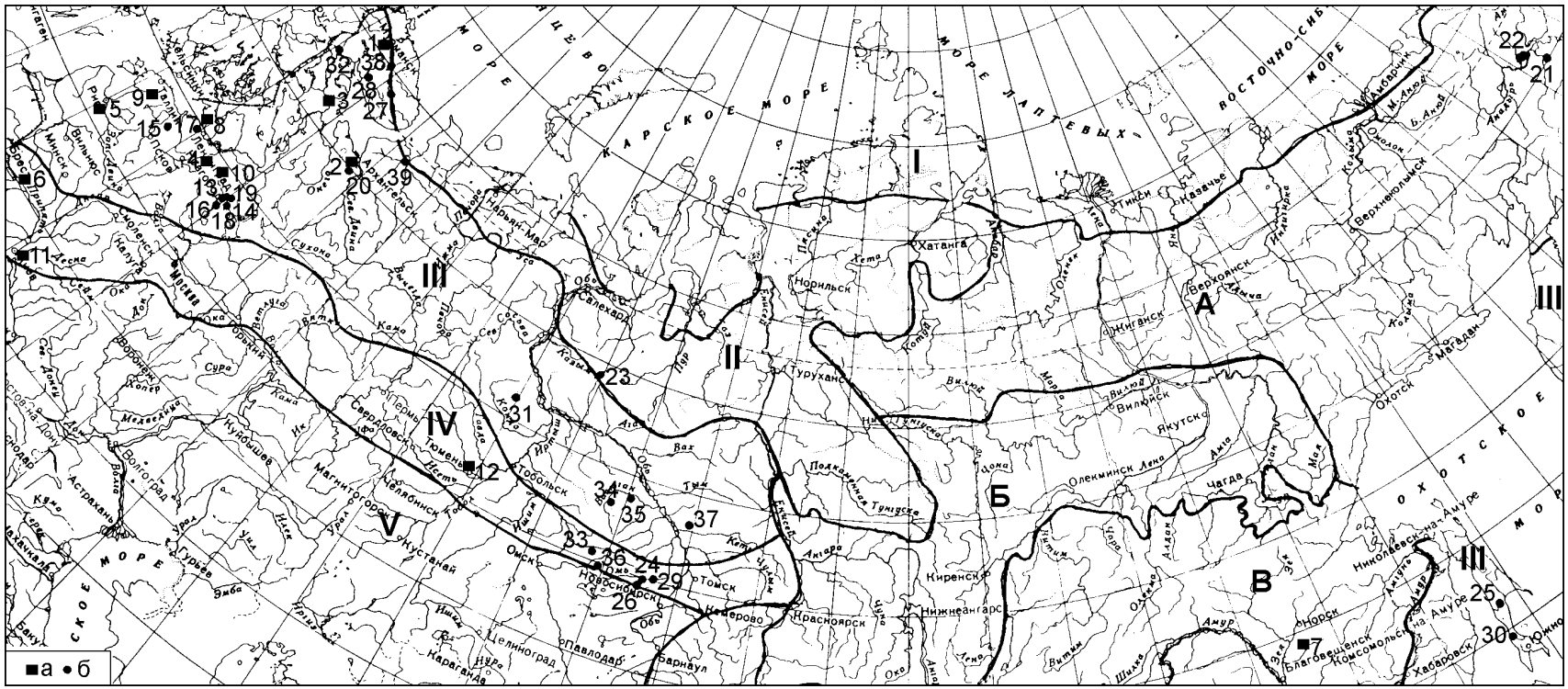
Peatlands cover over 8 % of Russia
(State report ..., 2000);
Peatlands (peat >30 cm) and paludified lands (<30 cm)
could cover up to 21,6% of Russia
(Vompersky et al., 1994)



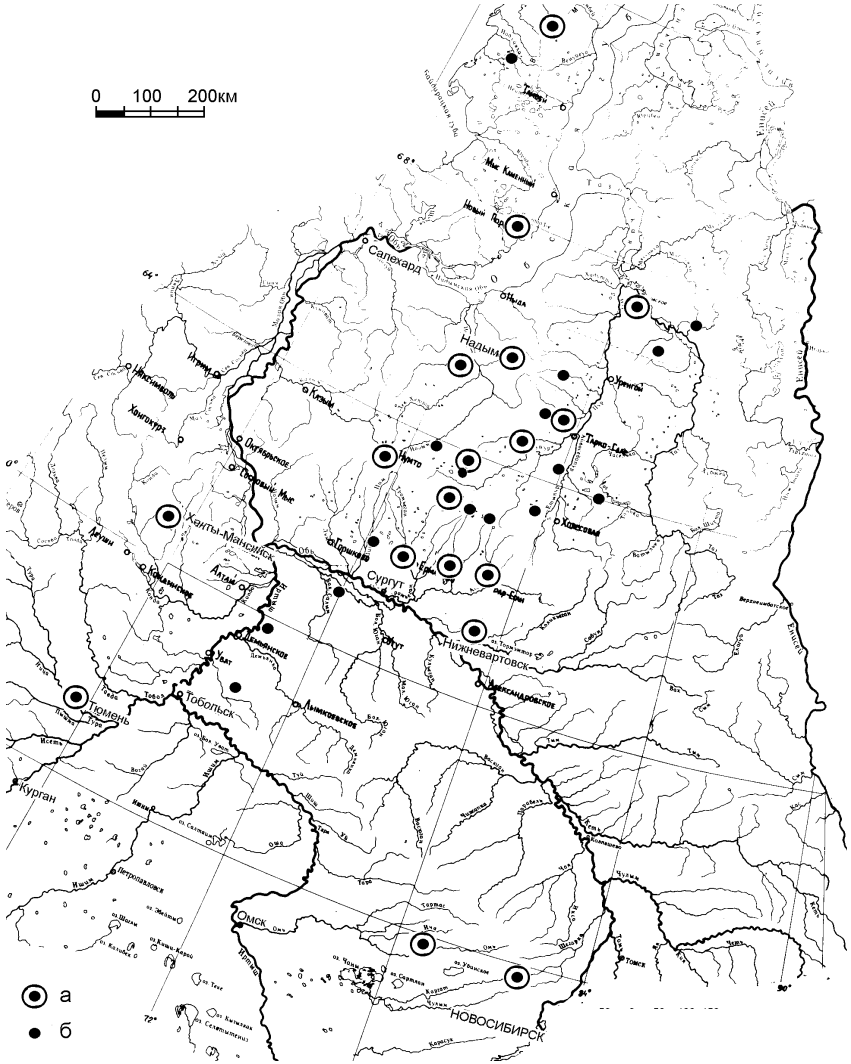


Peatland acreage for
the regions of Russian Federation
(01.01.2000, Roszemkadastr)

Location of peatland observation stations and points of State Committee of Hydrometeorology and Environmental Monitoring



Mire zones: I – polygon mires; II – palsa mires; III – raised (sphagnum) bogs; IV – flat eutrophic and mesotrophic mires; V – concave eutrophic and saline mires. Mountain regions of the Asian part of Russia according to N.Ja. Katz (1971): А – East Jakutiya; Б – Jakutia; В – Dauric-Amur.



Location of field peatland stations and observation points of the West-Siberian Expedition of the State Hydrological Institute of the State Committee of Hydrometeorology and Environmental Monitoring

Data of research stations

Complex Research Stations of RAS Research Institutes

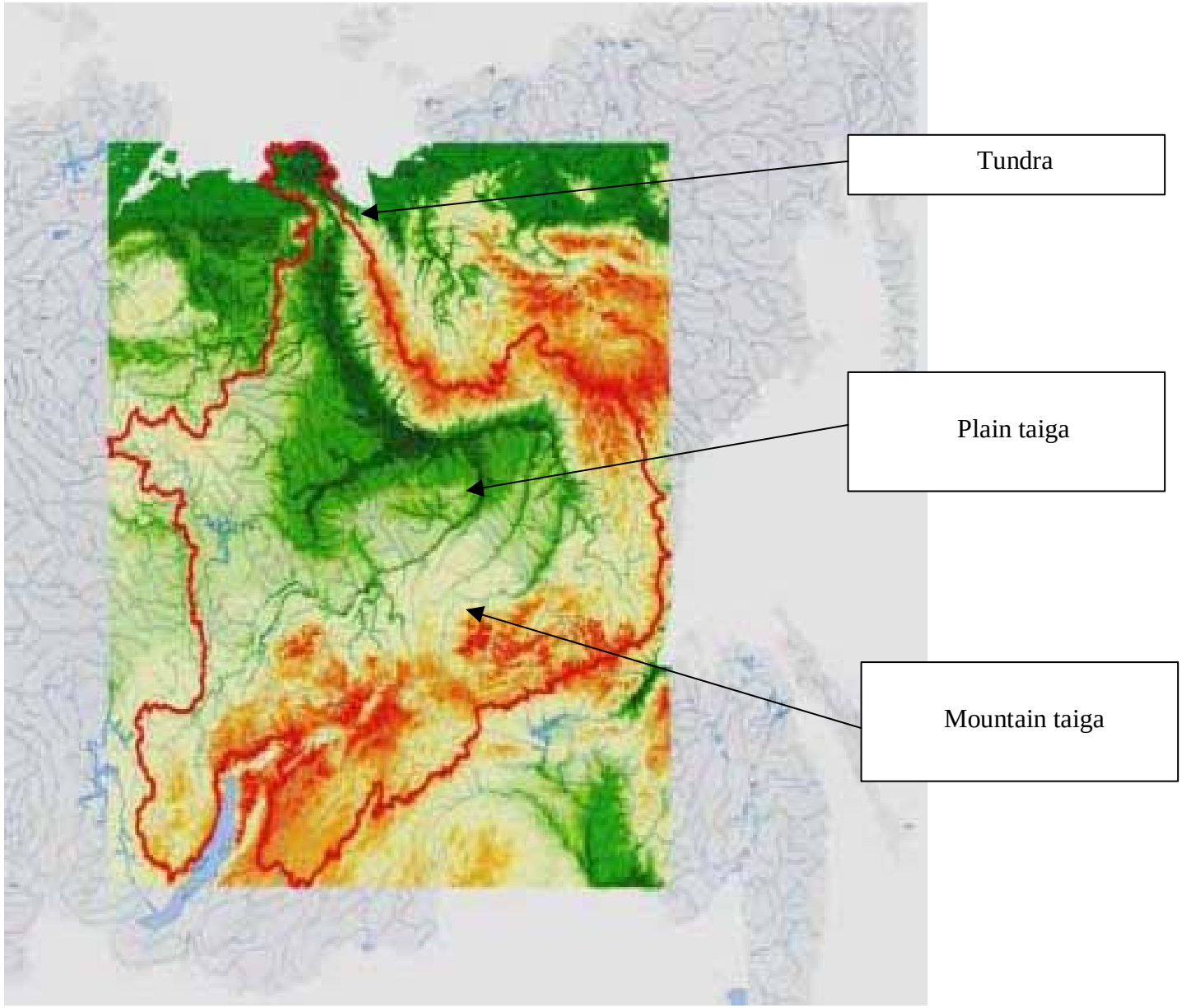
Kursk Biosphere Station (1965)
Stations of Institute of Forest, SB (Krasnoyarsk)
Stations of Institute of Geography, SB (Irkutsk)
Station of Institute of Biological Problems of Cryolithozone, SB (Yakutsk)

Field Research Stations

Data of international field experiments

KUREX- 88, KUREX- 91
GAME/Siberia
IGBP (Enisey meridian)

GAME/Siberia, 1996-2003



Conclusions

1.There is rather dense hydrometeorological station network over Russia which includes stations of standard observations, monitoring stations as well as research stations and network of field experiments. Number of stations was decreased during 1990th.

2. This network combined with network of water quality monitoring, land data as well as socio-economic and satellite information form reliable basis for solving of major tasks of NEESPI Sci. Plan.

3. Availability of state network data was deteriorated due to stoppage of their open Publication during last 10-15 years.

4. The main objective of NERIN is to create better conditions for getting of necessary information based on:

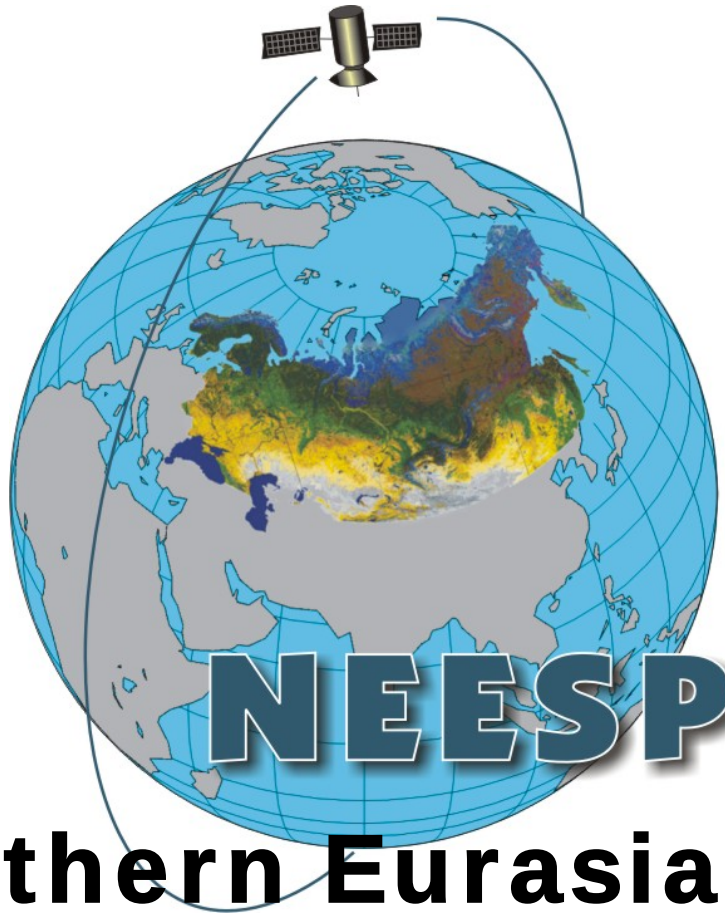
4.1. Creation of detail Metadata archive which should combine main data bases on national, bi-lateral and international levels as well as on level of institutes and scientists.

4.2. Creation of effective relationships between owners of data and NEESPI Projects.

5. The attention should be paid on main problems of observational data assimilation (quality control, homogeneous of data sets, accuracy of measurements of some elements (solid precipitation), re-analysis of hydrometeoelements for mountain area and north-eastern part of Eurasia, etc.

FOR MORE INFORMATION SEE THE NEESPI WEB SITE:

http://neespi.gsfc.nasa.gov



Side Note:
"NEESPI" is pronounced approximately like the Russian phrase for

"Don't sleep "

Northern Eurasia Earth Science Partnership Initiative

Materials of V. Razuvaev, V.Vuglinsky, S. Zhuravin, S.Sirin, O.Krankina, A.Shiklomanov, A.Georgiadi presented at NEESPI WS, February 2004, Sankt-Petersburg;
D.Deering, A.Georgiadi presented at AGU Meeting, December 2004;
NEESPI Science Plan
were used in preparation of this talk.