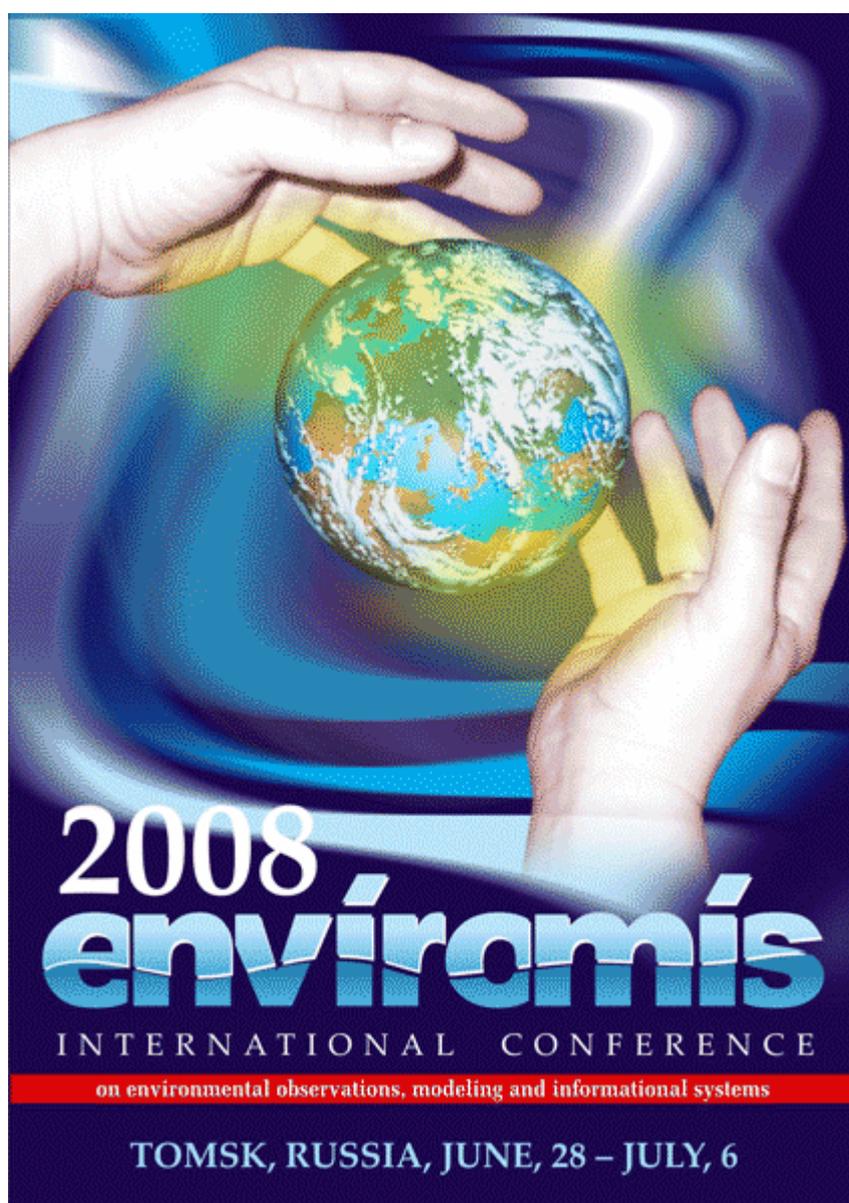


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Report to the Russian National Committee for IGBP (Russian Academy of Sciences)

Open Meeting of Russian National Committee for IGBP at the ENVIROMIS-2008 Conference: Development of Siberia Integrated Regional Study (SIRS)



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General framework

The ENVIROMIS-2008 International Conference took place in Tomsk Akademgorodok, June 28 to July 5, 2008. It appeared as a very successful follow-on event in a yearly series of international Conferences which are widening their scope year after year. These Conferences present interdisciplinary research outcomes within a top-level scientific tradition of excellence acknowledged by many participants. It should be reminded that ENVIROMIS is a SIRS activity (educational and capacity building component), and reversely SIRS plays a key role as an Integrated Regional Study in developing regional comprehensive and integrative studies presented during the ENVIROMIS / CITES series of Conferences.

118 representatives of 33 institutions took part in the Conference. Among them were 8 representatives of foreign organizations (Austria, Belarus, Denmark, France, Kazakhstan, Switzerland, and USA (2)).

Russia was presented by 25 scientific organizations:

7 from Tomsk,
6 from Novosibirsk,
3 from Moscow,
2 from Irkutsk,
2 from Krasnoyarsk.

There were also participants from Birobidzhan, Yekaterinburg, Obninsk, Petrozavodsk and Khanty-Mansiisk.

The ENVIROMIS-2008 International Conference included ten sessions:

1. Local and remote observations
2. Remote Sensing and GIS
3. Environmental Information Systems
4. Urban and regional environmental modelling
5. Hydrology and climate
6. Assessment of soil, forestry and wetland dynamics
7. Environment and climatic change assessment
8. Development of Siberia Integrated Regional Study (SIRS)
9. Workshop on man-made environment risks (EnviroRisks)
10. Workshop on Northern Eurasia Land Dynamics Assessment (NELDA)

The eighth session was an open meeting of the Russian National Committee for IGBP, which leads the SIRS project. SIRS is endorsed as a megaproject of the IGBP international project NEESPI, which falls into the category of the Integrated Regional Studies (IRS) encouraged by ESSP, the Earth System Scientific programme (ESSP)

This session was made of 10 invited reports, 2 invited lectures and 2 oral reports. The session Program is attached as an Appendix. Also SIRS related Invited and Contributed papers presented at ENVIROMIS Conference are listed there. The whole ENVIROMIS 2008 Conference Program can be seen at <http://www.scert.ru/en/conferences/enviromis2008/program/>.

Overarching presentations about the SIRS project, associated research and tools

M. V. Kabanov presented research methods and associated results for integrated regional studies at large, such drawing a general picture of the most recent findings of research in Siberian environment and climate change. E. P. Gordov and co-authors presented (a) the IGBP RNC positions and plans, (b) the state of the art of the Siberia Integrated Regional Study (SIRS) and (c) in particular the state of the art of the related information-computational infrastructure. P. Groisman and A. Shvidenko (orator) presented an update about the NEESPI project (SIRS is a NEESPI mega-project in support of the NEESPI Science Plan). V. N. Lykosov made a presentation about modelling and parameterisation of mesoscale processes in the climate system – a general issue that underpins any regional climate study over Siberia and Northern Eurasia.



- **M. V. Kabanov** made an overarching presentation about **the methods and investigation results of the integrated studies of climatic changes in Siberia**. He explained that the main IMCES SB RAS objectives were setting up (a) scientific and technological basis for monitoring and modeling climatic and ecosystem changes under impact of natural and anthropogenic factors and (b) basic foundation for designing new instruments, elements and materials for environmental monitoring.

He listed the main related ongoing projects. He presented several key results about regularities in Siberian climate change:

- The analysis of inter-annual changes of temperature regime has evidenced the leading role of atmospheric circulation for warming in Siberia in 20th century. There is a high correlation between T and NAO index periodicities with a 30-50 years scale and a delay of up to 7 years between the above periodicities
- The analysis of inter-annual changes of subtropical stream flux and troposphere zonal circulation in Northern Hemisphere has shown an increase of wind velocity at subtropical stream flux axis by 1 m/s for 10 years for sequence of cold seasons in 1948-2005
- The analysis of inter-annual changes of temperature regime has shown that the amplitude of inter-seasonal temperature variations is mainly determined by the variations of winter temperatures.
- The results of long-term observations of CO₂ emissions at Great Vasyugan Bog (GVB) have evidenced an empirical dependence on CO₂ concentration and air temperature; Forecast made to 2080 accounting for IPCC scenario have shown that GVB carbon balance will remain positive. Natural cycles in peat forming process have been found at GVB with a 500 to 2300 years scale. These cycles are similar to hydrological cycles of European and North American bogs, as well as to paleo-levels of Caspian Sea.
- The results of long-term observations of Siberian stone pine growth have evidenced that cedar pines form a common phylogenetic system formed as a result of alternation of cycles of climatically stipulated species divergence and their natural hybridization.

He presented also some innovative projects of IMCES SB RAS:

- creation of information-measuring system for special monitoring and forecast of squall risks,
- creation of information-analytical center for ecological monitoring of man-induced risks under development of Bakchar iron-ore deposit,
- tests of new afforestation technologies and creation of a new arboretum for selected planting stock.

Pr. Kabanov introduced as well some developments of innovative instruments:

- AMK automated weather stations based on ultrasonic thermo-anemometers, using special software provide forecast of the main meteorological parameters up to 6 hours ahead.
- MGR multi-channel geophysical recorders based on low-frequency radiometers provide short-term forecast of earthquakes and landslip risks.



- **E. P. Gordov and co-authors** made three inter-related presentations drawing up a comprehensive picture of the IGBP RNC activities and the SIRS project. These presentations started with a description of the **IGBP Russian National Committee positions and plans**, introducing the **SIRS** (Siberian Integrated regional Study) project. Pr. Gordov and co-authors then presented **the state of the art of the Siberia Integrated Regional Study**, first in terms of **general and scientific outcomes** (co-

author E. Vaganov), then in terms of **information-computational infrastructure** (co-author V. Lykosov).

1 – IGBP Russian National Committee positions and plans

Pr. Gordov first introduced the Earth System Science Partnership (ESSP). He recalled its statute as a partnership for the integrated study of the Earth System, the way how this system is changing and the implications for global and regional sustainability. He also recalled the presentation made by ESSP at the UNFCCC-SBSTA in Bonn, June 5, 2008.

Pr. Gordov then introduced the IGBP Russian National Committee (RNC) and the guidelines of the approach recently adopted by the RNC:

- Regional emphasis (Europe, Siberia (SIRS), Far East) linked with IGBP and ESSP,
- Capacity building (including ENVIROMIS and CITES events),
- Information-computational infrastructure,
- Bulletin.

Within this overarching framework, Pr. Gordov introduced the Integrated Regional Study (IRS) approach of ESSP initiative aiming at developing IRS in the most important regions of the planet along with a set of prerequisites:

- The concept should be developed in the context of the Earth System as a whole,
- Scientific findings should support sustainable development of the region,

- Qualitative and quantitative understanding of global-regional interconnections and the consequences of changes in these interconnections should be achieved.

All the IRS have to answer a set of common questions:

- What will be in the region in 50 years?
- What are the consequences of forthcoming changes for the regional common weal?
- What are the consequences for the Earth System?

Regions are large geographic areas and “open systems”. The interconnections between regional and global processes play a key role. Some regions may function as choke or switch points (in both biophysical and socio-economic senses) and small changes in regional systems may lead to profound changes in the ways in which the Earth System operates – which is typically the case for Siberia. IRS must

- transcend disciplinary boundaries across natural and social sciences, address all relevant aspects of marine, terrestrial, atmospheric, social, economic, cultural, historical etc. components of the Earth System;
- reflect the particular socio-economic and biophysical characteristics of the region;
- be a complementary part of the Earth sciences.

The word 'integrated' in IRS refers specifically to two types of integration:

- 'horizontal integration', involving the integration of elements and processes within and across a region,
- 'vertical integration', involving the two-way linkages between the region and the global system.

Pr. Gordov then presented shortly the Northern Eurasia Earth Science Partnership Initiative (NEESPI), an international programme initiated by NASA and RAS (see further on). In 2006 the IGBP Science Steering Committee granted NEESPI the status of an IGBP External Project.

Pr. Gordov finally explained that the SIRS project had been launched under the auspices of the Siberian Branch of The Russian National Committee for IGBP in September 2006 for up to the next 3 years and detailed the various projects integrated into SIRS funded by the Siberian Branch of Russian Academy of Sciences:

- Integrated Interdisciplinary Projects for 2006-2008
- Basic Research Projects for 2007-2009
- Cooperative International Projects funded by several foreign Agencies and International Programmes.

SIRS has been acknowledged as a mega-project in support of the NEESPI Science Plan, which ranks it among the IGBP and hence ESSP projects.

2 – General and scientific SIRS outcomes

In 2002, Will Steffen (IGBP) had suggested to develop one of the Integrated Regional Studies in Siberia with the support of SB RAS, considering the unique regional features: drastic regional climate variations, major role in carbon cycle (forestry, bogs, peat), permafrost, Siberia-global system linkages, and capacities offered by SB RAS research infrastructure. This led to the SIRS project as introduced above.

SIRS has four basic components:

- Scientific: Clustering national (SB RAS, RAS, RFBR) and international projects on Siberia environment in line with SIRS objectives;
- Infrastructural: Development of informational-computational infrastructure of integrated regional study of Siberia environment;
- Organizational: Siberian Branch of Russian National Committee for IGBP is responsible for SIRS development;
- Educational (capacity building): ENVIROMIS Multidisciplinary Conference with elements of YSS (invited lectures embedded as well as thematic workshops) & CITES (Computational and Information Technologies for Environmental Sciences) YSS and Conference (lecture courses, training sessions as well as invited lectures).

According to SB RNC the initial stage of SIRS will be centred along the **four** following **activities** through a projects clustering approach:

- Study of greenhouse gases and aerosol exchange between biota and atmosphere ;
- Regional climate change impact monitoring and modelling;
- Development of information-computational infrastructure;
- Regional social-economical consequences of Global Change.

The most recent results are related to **boreal forests and wetlands**, the two major Siberian ecosystems dynamics, with a special emphasis on their role in the carbon cycle as well as results of climatic modeling for the region under study and first elements of the SIRS information-computational infrastructure forming glue for relevant multidisciplinary research.

One of the key SIRS scientific activities is the **study of the carbon cycle**. A key experimental station is **the ZOTTO tower**. ZOTTO is legally owned and operated by the V.N. Sukachev Institute of Forest (Krasnoyarsk) and administered through the International Science and Technology Center (ISTC). It is scientifically lead by a consortium of core institutions:

- Max-Planck-Institute for Biogeochemistry, Jena (performing continuous biogeochemical trace gas measurements, eddy covariance flux measurements, meteorology observations and local ecosystem process studies),
- Max-Planck-Institute for Chemistry, Mainz (performing measurements of aerosols and CO₂ concentration and isotopes)
- V.N. Sukachev Institute of Forest (performing local ecosystem process studies).

This leadership is supervised by a scientific steering committee. A data management facility supports the exchange of measurements and auxiliary data among the different partners performing measurements at the tower. The most recent findings about regional Carbon balance and associated uncertainties were presented.

As far as **climate studies** are concerned, statistical analysis and data reanalysis confirm a significant increase of weekly and monthly mean near surface temperatures in Northern Eurasia during winter, spring and summer seasons, and reveal temperatures time series inhomogeneities in some regions of Siberia. In the central part of Eurasia, the number of frost days increases annually by up to 1 day, while vegetation period duration increases by 1 day a year. It might manifest transient phenomena appearing at nonlinear climate system regime changes.

The **educational/capacity building programme** includes

- ENVIROMIS biannual Multidisciplinary Conference with elements of YSS (embedded Invited lectures and thematic Workshops)
- CITES (Computational and Information Technologies for Environmental Sciences) biannual YSS and Conference (Lecture courses, Training sessions and Invited lectures)

70-80/year NIS YS are selected and supported (thanks INTAS and INCO EC).

The IC infrastructure is developed in cooperation with European and American partners. It aims at supporting multidisciplinary distributed teams performing cooperative work with tools for exchange and sharing data, models and knowledge. The use of information-computational resources, services and applications has been optimized. The key elements are Web portals in with thematic web sites are providing an interactive access to data, models and tools: ATMOS, RISKS & ENVIROMIS. A Web based online system for analysis of climatic changes allows processing and performing reanalysis of meteorological stations data archives in Siberia, leading to such results as those presented above.

The perspectives and associated hypotheses are as follows.

The main ecosystems under study are **forests** (Krasnoyarsk), **wetlands** (Tomsk), and **permafrost** (Tiumen). ISTC focus its efforts on pursuing the project.

The structure is distributed between

- an Instrumental center (Krasnoyarsk - Tomsk participating for services),
- a data and services Center (Tomsk offering internet access to data and services for all participants)
- data and modeling Centers (Jena, Krasnoyarsk, Tomsk, Novosibirsk, Moscow).

The analysis is decentralized and involves all partners.

The creation of NEESPI/SIRS data bases and mirroring relevant NEESPI data bases in Siberia provides regional researchers with easy and inexpensive access. SB RAS would be able to cover hardware, operational and internal traffic costs, if other funding agencies cover relevant software and external traffic cost.

The Organization of distributed NEESPI **Siberia Focus Research Center (SFRC)** is as follows

- Krasnoyarsk (SB RAS Institute of Forest and Siberian Federal University) is in charge of boreal forests study and GHG measurements and associated capacity building/education,
- Tomsk (SB RAS Institute of Monitoring of Climatic and Ecological Systems and Siberian Center for Environmental Research and Training) is in charge databases and modeling and capacity building/education

SB RAS and SFU together with abroad partners would be able to co-fund SFRC, thus providing stability for its operations.

3 – **Information-computational infrastructure.**

As underlined above, a **distributed information-computational infrastructure** is required to support SIRS. Key features are as follows.

- In the adopted approach, each separate computational task can be represented as an information system, using a three-level model: data/metadata, computation and knowledge levels.
- It is implemented by developing Internet-accessible information-computational systems (Web sites and portals) for chosen thematic domains and organization of data and knowledge exchange between them to form a distributed collaborative information-computational environment supporting investigations in multidisciplinary area of Earth regional environment studies.

The information-computational infrastructure takes advantage of **the SB RAS IT structure** and includes the key elements listed above (ATMOS, RISKS, ENVIROMIS).

Among others, an online system for visualization and statistical analysis of meteorological and climatic data has been developed as a dedicated web-interface based on the web-portal ATMOS engine. It allows performing basic mathematical and statistical computations on various data delivered by observations (in-situ, satellites) and models (global and regional models, reanalysis) with consequent graphical representation of results. Such online system helps researchers to save time while performing the same repetitive analytical tasks via implemented access to datasets stored on the dedicated server. Additional datasets and additional functionalities have been developed, such as the computation of some standardized Climate Change Detection Indices (ETCCDI).

In order to serve **educational and capacity building objectives**, Information Computational technologies (ICT) tools should be newcomer friendly and provided with extensive thematic help. **Earth & Space Sciences Informatics and SIRS are facing challenges.**

A holistic approach to mediate and harmonize the different models and interfaces characterizing the two communities (i.e. Information Society and Earth & Space Sciences) is required for a real interoperability. For instance:

- When addressed by the GIS (solid earth and societal impacts) community, the world is a collection of static *features* with geographic footprints on the Earth (surface). These *features* are discrete geometric objects with attributes which can be stored and manipulated conveniently in a database.
- When addressed by the Fluid Earth Sciences communities, the world is a set of *parameters* which vary as continuous functions in 3-dimensional space and time. The behavior of these *parameters* in space and time is governed by a set of equations, while data are simply discrete points in the mathematical function space.

A possible answer is **GIS web server based upon open codes**. It could be developed by the SB RAS Institutes of Krasnoyarsk (Institute of Mathematical Modeling), Novosibirsk (Institute of

Computational Technologies) and Tomsk (Institute of Monitoring of Climatic and Ecological Systems) with mediation through ATMOS based ICS.



P. Groisman and A. Shvidenko

presented an **update** about the **Northern Eurasia Earth Science Partnership (NEESPI) project**. NEESPI is an interdisciplinary program of internationally-supported Earth systems and science research that addresses large-scale and long-term manifestations of climate and environmental change. Its study area includes: Former Soviet Union, Northern China, Mongolia, Fennoscandia & Eastern Europe. Its duration is about ten years. The key concern is that most of Northern Eurasia does not receive a sufficient amount of heat and in the regions where there is enough heat there is a

significant deficit of water. The rationale for NEESPI is as follows:

- There are strong climatic and environmental changes;
- There are strong interactions in the system terrestrial ecosystem - atmosphere hydrosphere - cryosphere - human society and feedbacks to global energy, water, and carbon cycles in the region and beyond;
- There are strong societal impacts and feedbacks;
- There is a lack of tools to address science questions.

The NEESPI Science plan major focuses on transient zones that are most vulnerable in the future changes and on biogeochemical, biogeophysical and anthropic feedbacks that make the projection of the future changes uncertain. The central science question is: how do terrestrial ecosystems dynamics in Northern Eurasia interact with and alter the biosphere, atmosphere, cyosphere and hydrosphere of the Earth?

NEESPI contributes to all ESSP Programs & Projects. The NEESPI Research Priorities are

- the processes that directly feed back to the global Earth system,
- the processes of major societal importance.

In December 2004, the NEESPI Science Plan was released after a successful peer review process. In May 2008, more than 560 scientists from more than 200 institutions were working on 127 individual funded projects under the Initiative umbrella (with annual budget ~\$15M) and several more projects are in the process of joining NEESPI – plus in-kind assistance from national and international institutions.

NEESPI is organized in Focus Research Centers (one being located in Siberia - see above SFRC) and includes five NEESPI Science Support Centers in USA, Russia, and China.

The main NEESPI monitoring and analysis themes are:

- Monitoring the energy & water cycles
- Monitoring the cryosphere
- Monitoring the biogeochemical cycles, land use, and land cover
- Monitoring and projection of dust storms and air pollution.

Many figures and some key conclusions were presented.

- Changes in the surface water cycle over Northern Eurasia have been statistically significant in the 20th century. Some regions face more humid conditions. In some regions, potential forest fire danger has increased in the 20th century. In one region agricultural droughts have increased. In another region, prolonged dry episodes have increased.
- The Eurasian snow cover extent decreasing rate is estimated to -12% over 36 years (April-May period). In specific Northern coastal zones, extremely ice-rich permafrost cliffs retreats, supplying significant amount of organic-rich material to the near-shore ocean. Two possible scenarios of land cover change after the permafrost thaw are possible: wetlands and steppe.
- The frequency of dust storms and the rate of soil erosion are increasing, while thin aerosol particles are responsible for causing the greatest harm to human health.
- Several monitoring results of biogeochemical cycles, land use, and land cover were presented.

The most recent strengthening of the NEESPI research focus towards projections were presented, exhibiting dramatic trends in mean annual temperature, permafrost thawing, biome distribution. Annual land surface air temperature changes due to forcing by SST and sea ice changes show that Northern Eurasia is “attacked” globally and from the Arctic.

During the past 3 years, 20 dedicated NEESPI Workshops and 5 NEESPI Open Science Sessions at International Meetings were convened. A wide number of papers and books (about 200 in the period 2005-2006) were issued.



V. N. Lykosov made a presentation about **Modeling and Parameterization of Mesoscale Processes in the Climate System**. The author characterizes the related research by the fundamental question: “*what climatic parameters and with what accuracy must be reproduced by a mathematical model of the climate system to make its sensitivity to small perturbations of external forcing close to the sensitivity of the actual climate system?*”. The author described mesoscale processes and their interfaces on one hand, mesoscale atmospheric models on the other hand. Regional scale modeling includes modeling of atmosphere, catchments, vegetation, soil (including

permafrost), air and water quality, as well as coupling of regional models and statistical and dynamic downscaling. Only the dramatic increase of computing power allows modeling such mesoscale problems. Pr. Lykosov evidenced some results of RAS/INM models compared to actual measurements and some regional forecasts. He introduced the needs and challenges of comprehensive innovative Earth System Models. He presented in particular the plans developed by NCAR (Boulder, USA), the outcomes of the World Modeling Summit for Climate Prediction and the Climate Prediction Project that raise many scientific challenges and research topics. Within this framework, he presented some future advances in land-climate interactions modeling: carbon (including methane) cycle, hydrological heterogeneity (including lake models), aerosols, dust and snow interactions. This presentation drew the picture of an international cooperation to nest specific advanced research in a global advanced scientific challenge.

Specific topics addressed

- **V.I. Shishlov** made a presentation about **System and evolution analysis of environment and climate forming processes in Siberia**. He first introduced the spatial organization of the climate system, the global factors and mechanisms of climatic changes and how they interact. He presented then the global and regional factors of warming and the role of dynamic factors such as intensive cyclonic activity, illustrated with some regional figures. According to the author, two mechanisms define the dynamic properties of the continental climate system:
 - dynamic changes of a multi-regime process in weather formation based on the reorganization of energy conversion processes,
 - change of energy conversion and energy-mass transfer cycles during transformations of interconnections in the ocean-cryosphere-atmosphere-land system.

These conclusions may orient the topics of future research works.



- **A. A. Onuchin** presented a report about **spatial air temperatures trends in Northern Asia**. The author distinguishes four geographically specific seasonal air temperature trend types, such defining a **climatic zoning** of the region.

1 – **Continental**: divided into hollow-plain and mountain subtypes. In the hollow-plain subtype, the greatest warming occurs in February – 9.3 degrees / century, decreasing in the year up to 0 in September then increasing up to up to 5.4 by late fall. The mountain subtype is similar but

the monthly variation is less differentiated.

2 – **Arctic**: divided into marine arctic and mainland arctic. The greatest warming is about 1.5 degrees per century in March / April. The trend is a bit more pronounced in the latter case, which is common in vast valley rivers accessible for arctic air masses (such a trend is visible in many other presentations where temperature patterns obviously underline these valleys).

3 – **Northern Pacific** (or Chukotka): also divided into marine and mainland subtypes. It is quite specific of Pacific trends and opposite to other figures. Winter temperature trends are negative (trends up to -10 degrees / century in January). The warming in other seasons is in the 1.5 - 5 degrees / century range.

4 – **Okhotsk sea coast** and **Northern Primorye** regions exhibit the greatest January warming (6 degrees / century). Trends are somewhat similar to the continental type with lower values evolving smoother within the year.

These specific features demonstrate the key role of oceans in global climate change inertia and advocate for a better understanding of the mass-energy exchange in the ocean-land-atmosphere system at proper scales.

- **A. Shvidenko** presented a **system reanalysis of major indicators of productivity of Russian forests**. The major **prerequisites** for such a reanalysis are the following.

- Indicators should generate the informative combination: growing stock volume, gross growth, net growth; live biomass (phytomass); dead vegetation matter (CWD, DR); NPP, NEP (NEE), NBP.
- Uncertainties should satisfy requirements of the verified Terrestrial Biota Full Greenhouse Account.
- This implies a systems approach: (1) consistent information background; (2) explicit indication of spatial and temporal dimensions; (3) availability of strict formal algorithms; (4) formal use of heuristic elements; (5) non-contradictive modeling systems.

The major **drivers** impacting productivity are:

- Climate change – direct and indirect, short term and long term impacts,
- CO₂ fertilization effect,
- Nitrogen deposition,
- Human-induced and natural disturbances (fire, insects),
- Cryogenic perturbation,
- Forest management.

Some **major questions** are **unresolved** so far:

- How are forest ecosystems functioning under dynamic conditions of multiple limitations for life resources?
- How much stable is the direct stimulation of photosynthesis and NPP by the environmental change?
- To what extent do the limitations bound CO₂ fertilization effect and how long?
- How much nitrogen deposition is able to eliminate lack of available nitrogen in high latitudes?
- How do all these changes interact with the hydrological cycle, particularly with water stress?
- How will destruction of permafrost impact forest ecosystems of high latitudes?

There are many methods for assessing forest productivity but all of them require empirical validation. There is an urgent need for **reanalysis of empirical NPP forest estimations**. The outlines of such “empirical” reanalysis are:

- Using forest inventory as an information source;
- Using non-linear multidimensional models of live biomass;
- Using unified modeling system of growth of forest stands;
- Using a new method for assessment of NPP;
- Using a modeling system for assessment gross growth, net growth and mortality;
- Putting multiple constraints of results.

Pr. Shvidenko presented models to estimate dependence phytomass on forest biometric parameters, a comparison of live biomass defined by different models, a development of growth models, of models of total forest production by fractions and of total production of forest phytomass at a given year. He introduced errors assessment methods and examples, including the use of different models for NPP estimation and an analysis of similarities and differences of empirical estimates versus process modeling. Map of net growth, gross growth and mortality were presented. A key conclusion is that not accounted losses of wood due to stand-replacing disturbances amounted in 1993-2003 are not less than 500 million m³ yr⁻¹.



- **V.V. Zuev presented a study of the ozone layer dynamics¹.** He first analyzed the destruction of the stratospheric ozone layer by Freon/CFC/HFC, noticing that natural freons emitted during volcanic eruptions are three orders of magnitude larger than anthropogenic emissions. Underlining the relationship of ground UV-B radiation and total stratospheric ozone content, Pr. Zuev evidenced significant relationship between variations of total stratospheric ozone content and dendrochronologic parameters, leading to a generalized chronology for subarctic Eurasian regions, locally validated by lidar

sensing. As a conclusion, perturbation of global stratosphere after major volcano eruptions like the Pinatubo one could cause major depression of stratospheric ozone, a growth of sea surface temperature and photosynthesis depression and hence a CO₂ increase in the atmosphere. In conclusion, according to the author, anomalous total stratospheric ozone trend in the last quarter of the twentieth century is associated with **long-term perturbation of the stratosphere by volcanic aerosol** rather than emissions of anthropogenic freons.

- **T. Zhuravleva presented a report about Spatio-temporal characteristics of clouds over boreal Siberian zone for simulation of shortwave component of the radiative balance in the “forest-atmosphere” system.** The ultimate goal is twofold:
 - on the basis of numerical simulation, to estimate (i) the radiation budget and (ii) cloud and aerosol radiative forcing in the boreal zone of Siberia;
 - to identify the regional features of RB (*radiative balance*), CRF (*cloud radiance forcing*) and ARF (*atmosphere radiance forcing*).

For that purpose, a model of solar radiative transfer taking into account clouds, aerosols, atmospheric gases and underlying surface (*IAOT, SB RAS, Tomsk*) was developed. The inter-comparison of model calculations and measurement data exhibits good results. Observations from MODIS were used to derive spectral cloud optical characteristics. This can lead to an estimation of PAR (*photosynthetically active radiation*) and hence carbon balance parameters of surface ecosystems. The results match well with measurements, thus evidencing that the developed radiation code allows an efficient computation of the shortwave radiative fluxes at the different levels under conditions of the cloudy and clear-sky atmosphere.

¹ A side conclusion of this presentation opens an important debate - now at a purely scientific level, but which might become a key decision making one if the idea was to be actually taken into account by decision makers at international level. The idea is to inject aerosols into stratosphere in order to combat global warming. According to one presentation in another session, this would result in increased solar irradiance scattering towards space at high altitude, hence reducing the solar irradiance at ground level (it is generally admitted that ‘white’ aerosols tend to cool the Earth surface temperature). According to the author, this would also (and mainly) cause a catalytic decomposition of ozone into oxygen, hence an increased UV-B radiation on the Earth surface that would tend to warm it up – not speaking of well-known harmful effects on human health and ecosystems at large. More generally, quite sound scientific conclusions of the author go against ideas accepted by the top-level scientific community and would deserve an in-depth international debate.



- **O. V. Vasiliev** presented a report about **the problems raised by the Aral Sea**.

Firstly he described history and the state of the art of this mesoscale environmental man-made disaster and suggested quite realistic way to return at least its deep western part to more or less normal situation. Hydrodynamic modeling shows that being separated from the Eastern part due to inflow of the Amu Darya river its salinity might be decreased up to a level allowing restoration of fishery. Such regional geo-engineering project is good example of possible usage of basic science results to improve well being of local population.



- **G. Begni** (CNES, France) presented **two international cooperation perspectives** (which include the public and private sectors). The first perspective is the use of some products and initiatives developed by public and private sectors in France together with other countries, including within the ESA and EU frameworks (POSTEL products and Planet'Action, a non-for profit initiative led by private companies). POSTEL can be instrumental in supplying regional studies with geocoded biogeophysical parameters, while Planet'Action can pave the way to

local studies, checks or local information for model assimilation. POSTEL and Planet'Action can be used in a synergistic way. The second perspective is the so-called "*Mediterranean Science Area*", a joint initiative of some 20 Academies in the Mediterranean that was just endorsed on July 26, 2008 and is so a work in progress. It could be backed to the so-called "*Barcelona Process - Union for the Mediterranean*" political initiative. Cooperative work could be taken into consideration between research led in that new framework and research developed by the Russian Academy of Sciences and other NIS countries. This can be understood in terms of regional system coupling studies since both Mediterranean and Siberian regions greatly interact with the global Earth system, but also in more general terms of scientific cooperation for methodological cross-fertilization.

Some conclusions

The series of ENVIROMIS and CITES Conferences allowed the inception of the SIRS concept under the impetus of IGBP (W. Steffen, 2002) and the SB RAS, as well as the refinement of its definition. It also allowed to properly positioning SIRS as a mega-project in support of the NEESPI Science Plan. This position keeps the initial ambition of the project and its international dimension, ensures the leadership of the SB RAS over it, and defines proper links with a large international project that includes the SIRS geographic area. This is a wise way to address linkages of the Siberian environment and climate issues with surrounding regions, and to enlarge the SIRS international cooperation framework. It formally started in 2006. Outstanding scientific results can be presented now, which shows the relevance of the organization and the intense scientific work led during these two years. This work takes advantage of all previous research and findings, encompassing them into integrated approaches and taking advantage of new infrastructures.

A key feature of the SIRS project which allowed it to get so many results in the 'integrative' direction is that proper infrastructures were developed as a part of the project rather than outside independent facilities, as it happens too often. Existing heavy investments were taken into account and properly tailored to the project needs through dedicated developments. A key element is the SIRS informational-computational infrastructure, which takes advantage of the SB RAS IT infrastructure. It allows the many international scientific teams involved to get a friendly and comprehensive access to multidisciplinary portals and databases. Without such a tool, leading the rapid and scientifically sound integrative studies described in this report would simply have not been possible. Another key infrastructure is the international ZOTTO tower (legally owned and operated by the V.N. Sukachev Institute of Forest and scientifically managed at an international level) allowing unique measurements of carbon fluxes. In such a vast, complex, and difficult to access region as Siberia, specific methodologies and monitoring systems have to be developed. ZOTTO is a key element of such systems. Mathematical approaches and tools to address these integrative issues were developed as well.

Significant advances have been made on the study and forecast of Siberian climate, confirming that the region (together with the Arctic Ocean) is a major 'hotspot' in the world in terms of climate change. Patterns of climate change and interactions with surrounding regions and the global climate system were deepened. Some climate change impacts were analyzed in depth. Some global studies (Pr. Zuev) raise innovative questions about usually accepted explanations of some phenomena (stratospheric ozone depletion).

A major issue addressed by SIRS is a better understanding of greenhouse gases exchange dynamics between atmosphere and the main Siberian ecosystems.

The main ecosystems under study are **forests** (Krasnoyarsk leadership), **wetlands** (Tomsk leadership), and **permafrost** (Tiumen leadership). In particular, the great Vasyugan Bog (GVB) was extensively studied. Inconsistencies in forest NPP were evidenced and reanalysis were undertaken through more rational innovative concepts.

Outreach and capacity building efforts of SIRS and NEESPI have proven positive and efficient. One can be confident about the capacities of the regional young scientists to ensure long term research objectives.

SIRS and its synergy with NEESPI is a short but full success story. It serves the scientific objectives of **IGBP and ESSP** in region of major importance, quite large and difficult to access. It also serves the needs of decision and policy makers, providing them with sound scientific multidisciplinary and integrated outcomes.

Illustrations

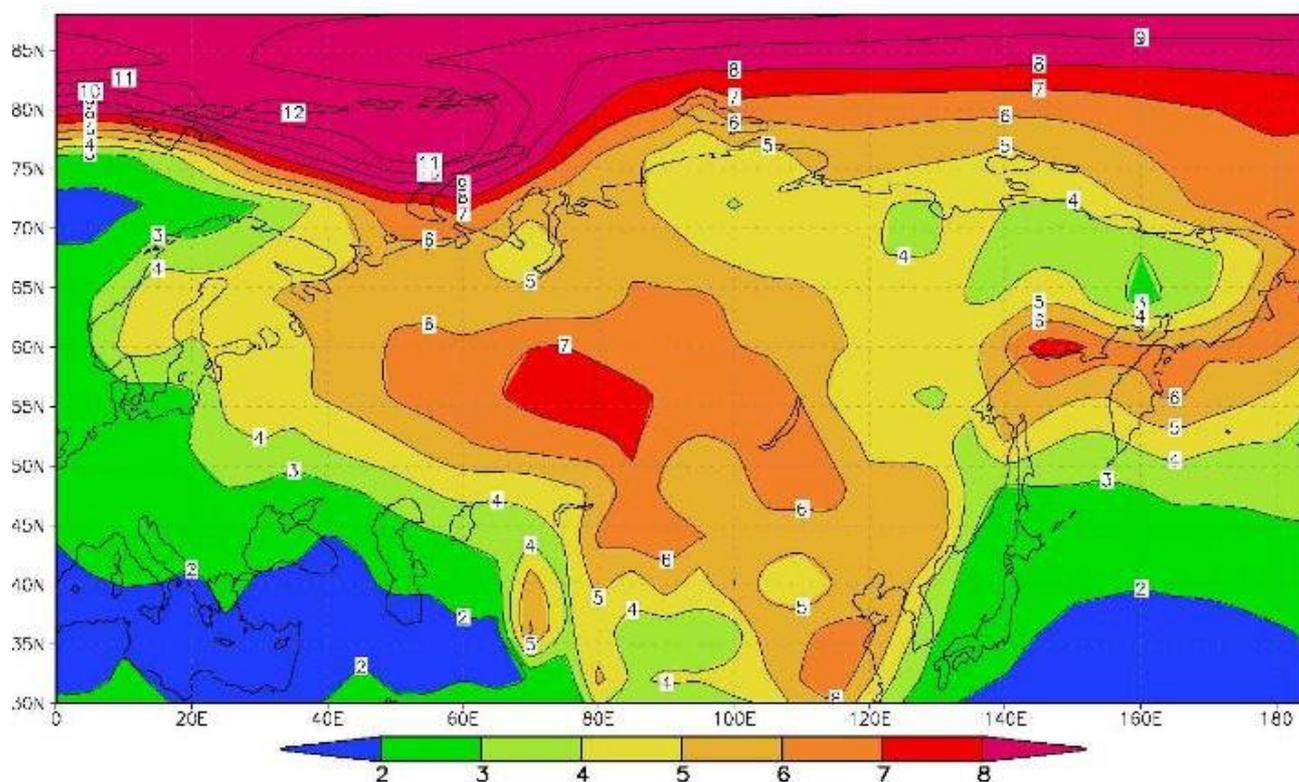


Fig. 1 – CLIMATE CHANGE - The key issue: Possible changes in near-the-surface winter air temperature to end of XXI century (averaged for 2081-2100) in comparison with observations for end of XX century (averaged for 1981-2000) based on results of the INM climate model (scenario A1B) – Presented by V.N. Lykosov, INM/RAS, Moscow.



Fig. 2 – LAND COVER CHANGE - Cryosphere - Land cover feedback: Two possible scenarios of land cover change after permafrost thawing: Wetlands (left) and steppe (right) - Presented by A. Shvidenko, IIASA, Laxenburg, Austria

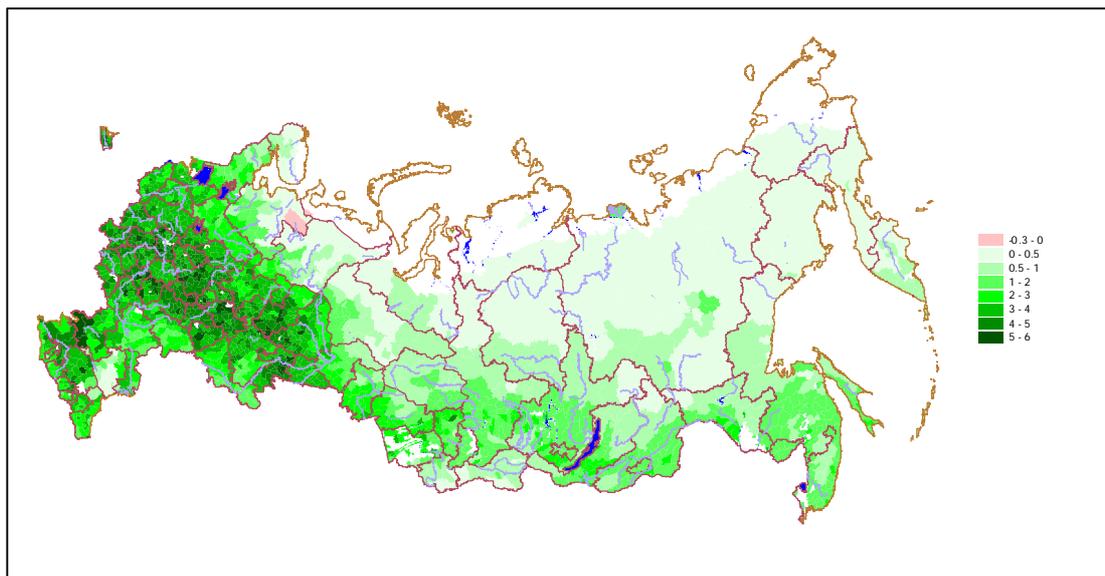


Fig. 3 – LAND COVER QUANTITATIVE MAPPING - Siberian forests net growth, $m^3 ha^{-1} yr^{-1}$. Total net growth in Russian forests is estimated to be $1.623 10^9 m^3 yr^{-1}$ or $2.09 m^3 ha^{-1} yr^{-1}$ including European Russia $2.44 m^3 ha^{-1} yr^{-1}$ and Asian Russia $0.77 m^3 ha^{-1} yr^{-1}$. Presented by A. Shvidenko, IIASA, Laxenburg, Austria

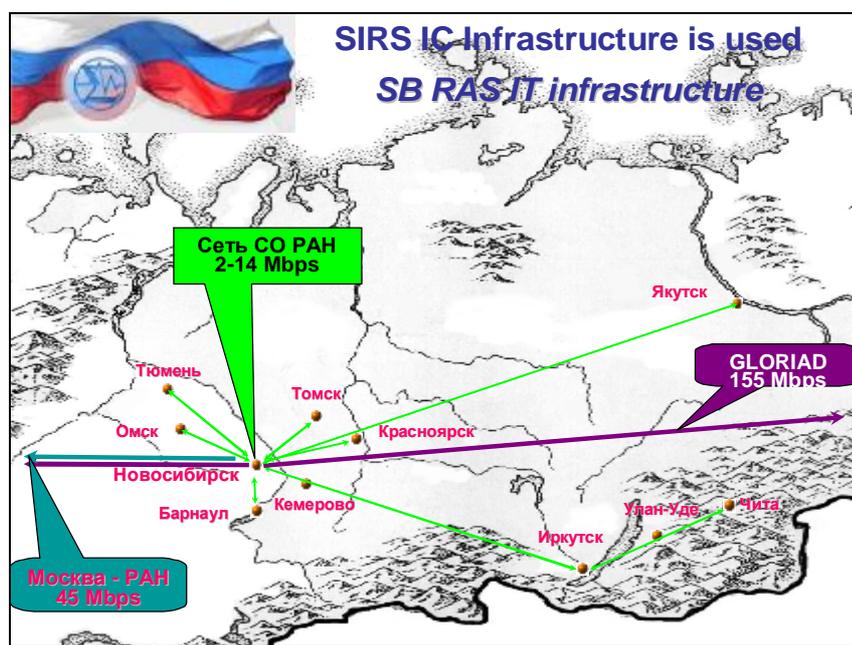


Fig. 4 – INFRASTRUCTURES; The SIRS informational-computational infrastructure taking advantage of the SB RAS IT infrastructure (left) and the internationally used ZOTTO tower (right) - Presented (left) by E. P. Gordov, Siberian Center for Environmental research and Training, Tomsk, Russia and V. Lykosov, Institute for Numerical Mathematics RAS, Moscow, Russia and (right) by A. Shvidenko, IIASA, Laxenburg, Austria.





Fig 5. Participants of the RNC Open Meeting



Fig. 6 - Field survey in mixed bog and forest ecosystems, West of Tomsk. Left to right: H. Ahrends, Switezrlans; O; Krankina, USA; G. Begni, France; A. Dyukarev, Russia

RNC Open Meeting Program

Invited papers

Gordov E.P., Vaganov E.P. “The state of the art of the Siberia Integrated Regional Study”

Groisman P. and A. Shvidenko A. “Northern Eurasia Earth Science Partnership Initiative: An Update”

Vasiliev O.F. “Aral sea problem: On possibilities to restore hydrology regime and ecosystems in its separate parts”

Kabanov M.V. “Integrated studies of climatic changes in Siberia: methods and investigation results”

Lykossov V.N. “Mesoscale Processes in the Climate System: Modeling and Parameterization”

Zuev V.V. “Study of ozone layer by the dendrochronological technique”

Shvidenko A., Shchepashchenko D., Nilsson S., McCallum I. «Major indicators of productivity of Russian forests: a system reanalysis»

Begni G., Leroy M., Guerre L.F., Sand, A. “Two initiatives of interest for northern Eurasia initiated by France: POSTEL and Planet Action”

Onuchin A.A., Musokhranova A.V., Burenina T.A., Korets M.A. “Spatial regularities of air temperature dynamics in Northern Asia”

Gordov E.P., Lykosov V.N. “The state of the art of the information-computational infrastructure for Siberia Integrated Regional Study”

Shishlov V.I., Preis Yu.I., Krutikov V.A. “System and evolution analysis of environment and climate forming processes in Siberia”

Contributed papers

Zhuravleva T.B., Sklyadneva T.K., Bedareva T. “Spatiotemporal characteristics of clouds over boreal Siberian zone for simulation of shortwave component of the radiative balance in the “forest-atmosphere” system”

Begni G. New Regional Climate Changing Initiative in Mediterranean

SIRS related papers presented at ENVIROMIS Conference

Invited papers

Baklanov A.A., Gordov E.P. "Analysis of major anthropogenic risks for Siberia"

Dyukarev A.G., Pologova N.N. "Soil formation process at the interface between landscape zones"

Gordov E.P., Okladnikov I.G., Titov A.G. "Web system for comparative analysis of regional climatic changes"

Kirpotin S.N., Polishchuk Yu.M., Bryksina N.A. "Investigation of West-Siberian permafrost landscape dynamics under global warming"

Krankina O. "Mitigation of climate change in the forest sector and the challenge of monitoring land cover in Northern Eurasia"

Lykosov V.N., Krupchatnikoff V.N., Kuzin V.I., Golubeva E.N., Platov G.A., Krylova A., Martynova Yu.V. "Estimation of feedbacks in Northern Eurasia and Arctic climate system under global climate changes"

Mahura A., Baklanov A., Sorensen J.H. "Enviro-RISKSs: overview of applications for short- and long-term modelling and assessment for atmospheric pollutants"

Onuchin A.A., Burenina T.A., Ziryukina N.V. "Forest harvesting influence on river flows in Nizhnee Priangarye"

Penenko V.V. "New variational technique for direct and inverse problems of atmospheric chemistry"

Penenko V.V., Tsvetova E.A. "Advanced scenario approach for assessment of environmental changes"

Penenko V.V., Tsvetova E.A. "Formation of environment protection strategy for risk and uncertainty diminution"

Polishchuk Yu.M., Dneprovskaya V.P., Bryksina N.A. "Study of warming impact on thermokarst state in continuous permafrost zone of Western Siberia on base of remote sensing data"

Pushistov P.Yu., Vtorushin M.N. "Basic principles and some results on creation of the monitoring and warning system of natural and man-made emergency situations of the Khanty-Mansiysk Autonomous Okrug-Yugra"

Raputa V.F. "Inverse problem for estimation of aerosol falling fields from area sources"

Shvidenko A. "Boreal Forests dynamic and carbon sequestration"

Shvidenko A., Kabanov M., Baklanov A., Gordov E., McCallum I., Lykosov V., Nilsson S., Onuchin A., Pushistov Yu., Schepaschenko D., Vaganov E. "Man-made Environmental Risks in Siberia: Terrestrial ecosystems and hydrological cycling"

Contributed papers

Akimov V.S., Goroshkevich S.N. “Some results for monitoring of crop dynamics in Nizhne-Sechenovo Siberian Stone pine forest in related with weather conditions”

Antipov A.N., Bazhenova O.I., Danko L.V. “Regional features of semi-arid landscape dynamics in southern Siberia and the desertification problem of Central and Northern Asia”

Baklanov A.A., Gordov E.P., Heimann M., Kabanov M.V., Lykossov V.N., Onuchin A.A., Penenko V.V., Pushistov P.Yu., Shvidenko A.Z., Zakarin E.A. "Man-induced Environmental Risks: monitoring, management and remediation of man-made changes in Siberia"

Bart A.A., Starchenko A.V., Fazliev A.Z. “Web system for operative description of air quality in the city”

Bobrova A.Yu., Skugarev A.A., Gorina N.V., Bazanov V.A. “Use of satellite imagery and gis for assessing carbon balance on the territory of Tomsk oblast”

Bogomolov V.Yu., Gordov E.P., Krupchatnikoff V.N., Vrazhnov D.A., Martynova Yu.V. “Development of regional model on the basis of WRF model”

Bondarenko S. L., Loginov S. V., Smirnov S. V. “Assessment of a meteorological influence on the growth bioproductivity in Siberian region using remote sensing data”

Danko L.V. “Trends and cycles of soil formation in the Baikal region’s landscapes in the Holocene”

Dubrovskaya O.A., Klimova E.G. “Reconstruction technique for concentration values of smoke loops gas components from forest fires”

Dyukarev E.A., Pologova N.N., Golovatskaya E.A. “Spatial structure and dynamics of forest-mire complexes at the key area “Vasuganie””

Eliseev A.V., Arzhanov M.M., Demchenko P.F., Mokhov I.I. “Future projections of surface thermal and hydrological state in the northern Eurasia with a climate model of intermediate complexity”

Glagolev M.V. “Standard model of methane emission from the West Siberian wetlands”

Golovatskaya E.A., Dyukarev E.A. “Regional carbon balance assessments for mires of southern taiga zone in West Siberia”

Golubeva E.N., Platov G.A. “Climate changes according to the Arctic – North Atlantic ice-ocean numerical model”

Golubyatnikov L.L. “Model estimations for the impact of climate change on the vegetation dynamics in the Northern Eurasia”

Gustokashina N.N., Kochugova E.A. “Vertical air temperature distribution over the Irkutsk region”

Kharanzhevskaya Yu.A. “Influence of forest reclamation on peat moisture”

Kharyutkina E.V., Ippolitov I.I., Loginov S.V. “Assessments of convection flux energy within cyclone formations based on reanalysis data”

- Kichigina N.V., Gustokashina N.N., Maksutova E.V. “Variability of hydroclimatic characteristics of river basins with a different runoff regime”
- Kokovkin V.V., Raputa V.F., Morozov S.V. “Aerosol pollution control in the highway vicinities”
- Koshkin D.A., Kochugova E.A. “Trends of extreme annual temperatures over Predbaikalie”
- Krupchatnikoff V.N., Borovko I. “Connection of polar stratosphere vortex dynamics with circulation in troposphere”
- Kuskov A.I., Krutikov V.A., Preis Yu.I., Sharapova T.A., Shishlov V.I. “Reconstruction of cycles water modes of mires and climate”
- Kuzin V.I., Golubeva E.N., Platov G.A. “Numerical simulation of the Bering Sea and the Siberian Rivers water propagation to the Arctic-North Atlantic system”
- Malakhova V.V., Scherbakov A.V. “Modelling of the global ocean response on cooling of surface waters with time scale of a glacial cycle”
- Martynova Yu.V. “Study of soil humidity influence on summer precipitation quantity against the background of CO₂ concentration increase for Western Siberia”
- Myasnikova S.I. “Modeling of progressive-age dynamics of the mountain-taiga forest in Pribaikalye and maps of forest management optimization”
- Nabieva O.R. “Modelling of pollution distribution in water-currents during emergency break of underwater pipelines”
- Nagorsky P.M., Ippolitov I.I., Kabanov M.V., Smirnov S.V. “Matched oscillations of meteorological, actinometrical and electrical quantities in the surface layer”
- Nikitchuk K.L., Shulgina T.M. “Analysis of the Siberia regional climate dynamics based on the climate change indices assessment”
- Pankratov F.F., Konoplev A.V., Rychkov A.M. “Effect of the elemental mercury decrease in atmosphere of the Russian Arctic”
- Pisman T.I., Slyusar N.A. “Modeling of galophytic plants productivity taking into account the temperature factor”
- Podnebesnykh N.V., Ippolitov I.I., Loginov S.V. “Comparative analysis of baric formations dynamics above Western Siberia: observations and reanalysis data”
- Preis Yu .I. “Reconstruction of cryogenic processes in peat deposit of the southern taiga of Western Siberia”
- Pugacheva Yu.I., Shevyrnogov A.P. “Studying features of NDVI dynamics for vegetation monitoring of the South of Central Siberia”
- Pugacheva Yu.I., Sidko A.F., Shevyrnogov A.P. “Analysis of backscattered spectra dynamics of agricultural crops in the south of Krasnoyarsk krai and Khakasia based on ground and satellite measurements”

Pyanova E.A. “Study of the region of water reservoir effect on microclimate of adjacent areas depending on orography”

Pyanova E.A., Faleychik L.M. “Influence estimation of unfrozen water in the hydrostation’s downstream on the temperature and humidity of the ambient atmosphere”

Raputa V.F. “Models of nuclei blasts traces reconstruction”

Rykova V.V. “Natural and anthropogenic risks at the territory of Siberia and the Far East: information aspects of the problem”

Semenova I.V., Semenov V.A., Stepochkina T.I. “Hydrochemical assessment of restoration of man-disturbed bogs in the south of the non-chernozem zone of Russia under present-day climate conditions”

Sharapova T.A., Preis Y.I., Antropova H.A. “Ridge-pool complexes of watershed mires of West Siberia”

Shevchenko L.B., Lavrik O.L. “Information support of scientific researches on the environment and ecology protection in State Public Scientific Technical Library of the Siberian Branch of RAS”

Shishlov V.I. “New methods for description and assessment of climate system changes”

Shulgina T.M., Titov A.G. “Analysis and comparison of basic meteorological and climatic characteristics calculated using NCEP/NCAR Reanalysis and NCEP/DOE Reanalysis AMIP II data”

Slyusar N.N., Pechurkin N.S., Pis'man T.I. “Local monitoring of structure-functional features and productivity modelling of halophytic vegetation in the coastal zone salt Lake Kurinka (the South part of Central Siberia)”

Smirnov S.V. “Operation and results of spectrophotometric measurements with a high temporal resolution at the observatory of IMCES”

Sorokovenko O.R., Preis Yu.I. “Detailed research of ridge-hollow-pool complex dynamics on peripheral of Iksinskoe bog”

Starchenko A.V., Belikov D.A., Yesaulov A.O., Nuterman R.B. “Meso- and microscale models with high resolution for investigation of urban sublayer aerodynamics”

Stepanenko V.M., Mikushin D.N. “Numerical modeling of energy and mass exchange between the atmosphere and inner land water bodies”

Sukov Ya.V., Yakimov A.S., Golovanov A.N. “Mathematical modelling of process of ignition of peat”

Titov A.G., Okladnikov I.G., Shulgina T.M. “Web-system for analysis of climate change indices dynamics for Siberia region”

Tokareva O., Polishchuk Yu. “Analysis of change of dark-coniferous forests state in petroleum production territory using space images Landsat”

Volkova E.S. “Particularities of ecological risks in the West Siberian North”

Vtorushin M.N., Pushistov P.Yu, Romanenko R.D. “Synthesis of field researches and applications of mathematical models for risk analysis and extreme ecological and hydrological situations on water objects forecasting Khanty-Mansiysk Autonomous Okrug-Ugra”

Zavalishin N.N. “Dynamic model of vegetation pattern in Northern Euro-Asia based on probabilistic plant types interaction scheme”

Zavalishin N.N. “Studying dynamics of the carbon cycle functioning in Russian peatlands under the climate change and human perturbations”