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Global Change Studies in Siberia

Study of climate change in Siberia

Preface

Russian National Committee of International Geosphere-Biosphere Program (RNC IGBP) decided to devote this issue of the Bulletin to study of global change of Siberian nature and climate and charge Siberian branch of RNC IGBP (http://scert.ru/ru/SB/) with its preparation.

Indeed, Siberia is one of the regions where global changes are most pronounced as we can see, for example, from rise in winter temperatures in 4-6 degrees during the last half a century (see, for example, Ippolitov et al., 2004). This future trend is also confirmed by climate change projections received during modeling (see, for example, Volodin et al., 2004). Regional ecosystems reaction to these changes can cause significant changes in the dynamics of the Earth System as a whole (see, for example, Frey and Smith, 2005). The Earth System Science Partnership (ESSP) and IGBP in particular regard Siberia as one of the regions that influences significantly the climate in the XXI century.

About 80 institutes of SB RAS, tens of universities and other research organizations act on the territory of Siberia. Most of them are involved this or that way into study of the regional environment. It is rather difficult to give an accurate account of all studies. That is why we start the issue from a review of activities aimed at the development of Integrated Regional Study of Siberian environment performed by Siberian Branch of RNC IGBP. Several large interdisciplinary projects supported by SB RAS Presidium were selected as a basis for this issue. Their thematic is closely connected with the study of global change manifestation in Siberian nature and climate. As a rule, these projects are performed by large consortiums including institutes of SB RAS, universities and other research organizations. Besides, short descriptions of key international projects performed in the region are included in this issue. The issue is finished by a brief description of activities aimed at capacity building via preparation of young scientists for participation in a modern research of the regional environment. We hope that this information represents a picture of the performed investigation, some their results and specialists who can give additional information on these activities. Some additional information on Siberian scientists' works is available in the Internet: www.scert.ru/files/1971d.pdf and www.scert.ru/conferences/cites/2005/presentation/Presentation/Workgroup/WG_SIRS.pdf

In spite of significant researchers' efforts of recent years the deep understanding of the dynamics of regional environment main components is not gained yet. In particular, lack of exact information on land cover of this huge region (10 mln. square kilometers) puts obstacles in the way of study of stated changes (see, for example, Chapin et al. 2004, Zhou et al. 2003) in vegetation periods, duration of growth period, depth of land freezing and in characteristics of snow cover and permafrost. Today's budgets of greenhouse gases are extrapolated using measurements from only several test sites and hydrological consequences of climate change are defined at a level of correlations. All this does not allow one to develop a modern climatic model of Siberian region and receive well-grounded projections of forthcoming climate changes in the region.

However many of these questions are already touched in researchers proposals and plans. It gives birth to hopes, that coordinated efforts of Siberian scientists and their national and abroad colleagues will result in a scientific breakthrough in understanding of main peculiarities in regional climate change dynamics and definition of their feedback with the global system. All this can be a basis for a scientifically-based assessment of the climate change impact on the regional environment, population, social life and economics, and an effective strategy can be developed to adapt to these changes.

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First steps on development of Integrated Regional Study of Siberian environment

Accordingly to present knowledge, Siberia is the region where the most pronounced consequences of climate changes happen and will happen. It is evidenced by a sharp increase of winter temperatures. The results of climatic modeling show that this tendency will continue and lead to environmental changes in the region including shifts of permafrost and boreal forests borders. These processes could change significantly a regional balance of greenhouse gases and influence the dynamics of the whole Earth System. That is why national and international community is interested in studying of different aspects of Siberian environment. For example, in 2003-2005 11 interdisciplinary and 7 complex integrated projects were performed in SB RAS devoted to studying the dynamics of regional environment. Large thematic projects in this field are sponsored by RAS, EC, ISTC, NASA, Max-Plank Society and other organizations. In 2003 IGBP and Earth System Science Partnership initiated [1] the Program of international Integrated Regional Study (IRS) in the regions with most pronounced changes of regional climate that could cause alterations in the functioning of the whole climatic system. In this paper first steps on development of Siberian Integrated Regional Study (SIRS) are described.

The regional (region here is a large geographical area, which functions as a biophysical, biogeochemical and socio-economical entity) aspect of science for sustainability and of international global change research is becoming ever more important nowadays. Modern technologies in land use, industrial and economical development lead to quick changes both in regional social-economical system and the Earth System. Consequences of these changes are very important on a regional and global scale. In this connection, IRSs on global changes and sustainable development problems are important to analyze changes and find "hot spots" and features of environmental degradation. It is important for citizens of these regions and should provide the sustainable development of the regions in question with scientific basis.

Regional approach to the study is also important from the point of view of Earth sciences. Regions may manifest significantly different Earth System compounds dynamics and changes in regional biophysical, biogeochemical and anthropogenic components may produce considerably different consequences for the Earth System at the global scale. Regions are "open systems" and interconnections between regional and global processes plays 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. Nowadays integrated regional studies represent a complex approach to reconstruct the Earth System from its components and are complementary to the thematic projects approach employed thus far in the international global change programs.

IGBP initiative aimed at organization of Integrated Regional Study in the most important regions of the planet has a set of rules for such studies:

- The concept should be developed in the context of the Earth System as a whole;
- Scientific understanding 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 gained as result.

IRS in each region should be developed lead and performed by regional scientists. It should reflect individual characteristics, interests, scientific opportunities and development priorities of the region and its research community. Common point of different IRS is that they answer 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?

It is clear, that "region" here means a large geographical zone with changes which may lead to deep consequences in the functioning of the Earth System as a whole. IRSs must (i) transcend disciplinary boundaries across natural and social sciences, must address all relevant aspects of marine, terrestrial, atmospheric, social, economic, cultural, historical etc. components of the Earth System; (ii) reflect the particular socio-economic and biophysical characteristics of the region and (iii) be a complementary part of the Earth sciences. The word 'integrated' in IRSs refers specifically to two types of integration: (i) 'horizontal integration', involving the integration of elements and processes within and across a region; and (ii) vertical integration', involving the two-way linkages between the region and the global system.

As it is mentioned above, IRS in each region should be developed, lead and performed by regional scientists mainly. The theme of sustainable development is a key theme in IRS and will be supported by a group of scientists interested in this research. A role of international scientific community on study of global changes, as it is defined by ESSP, is to help study regional and global interconnections and use the results of IRS in the analysis and synthesis of the Earth System. The only example of existing IRS is a large bioshere-atmosphere experiment in Amazonia. Now it joins 80 connected and coordinated research groups of 600 scientists from Northern and Southern America, Europe and Japan [2].

Taking into account the above requirements to IRS, the number of such projects could not be large and is about 5-6. IRS must be developed and admitted to the international set of EESP projects depending on a set of criteria: compliance with definitions; ability of regional scientific community to plan and perform such study and to find a financial support (with large sources outside the region). Each IRS should be managed by a regional administrative structure. For the purposes corresponding to global-regional interconnections and consequences for the Earth System the international administrative scientific committee should be set up including the participants of each ESSP program, of IRS itself and independent experts in Earth sciences.

Siberia is one of the promising regions for the development of such basic and applied regional study of environmental dynamics [3]. Regional consequences of global warming (e.g. anomalous increase of winter temperatures [4]) are strongly pronounced in Siberia. This tendency is supported by the results of climate modeling for XX-XXII centuries [5]. This process not only threatens Siberia with destruction of the most part of extractive and transport infrastructure caused by the shift of permafrost borders northwards but also can change the dynamics of the natural-climatic system as a whole as a result of extrication of a large mass of greenhouse gases. Although many projects supported by national (SB RAS, RAS) and international (EC, IGBP-2, NEESPI, etc.) organizations are devoted

to study of modern dynamics of Siberian environment, we know little about the behavior of main components of the regional climatic system. A review on state-of-the-art in Siberian environmental research is available in Internet (www.scert.ru/conferences/cites/2005/presentation/Presentation/Workgroup/WG_SIRS.pdf and www.scert.ru/files/1971d.pdf). Regional budget of the most important greenhouse gases CO_2 and CH_4 are still extrapolated on the measurements conducted in a few places. Boreal forests and Siberian bogs reaction on the climate change and the emerging feedback influencing the climate dynamics through exchange of energy, moisture, moment, greenhouse gases and aerosol are almost not identified yet [6].

All this leads to a high degree of international activity in study of different aspects of Siberian environment behavior. The leading role here is played by specialists from Europe. In particular, there are several large EC projects performed in Siberia on studying the dynamics of different components of the environment, such as: "Multi-sensor concept for Greenhouse Gases Accounting in Northern Eurasia" (Siberia 2, http://www.siberia2.uni-jena.de/index.php), "Terrestrial Carbon Observation System - Siberia" (http://www.bgc.mpg.de/public/carboeur/web_TCOS/). Nowadays the project "Zotino Tall Tower Observation" (ZOTTO) is performed in the framework of ISTC with the financial support of by Max-Plank Society to study the exchange of greenhouse gases between vegetation and atmosphere. International Institute of Applied System Analysis performs a work in the framework of the Forestry project (IIASA, http://www.iiasa.ac.at/Research/FOR/index.html). A key role in these projects is played by the institutes of SB RAS. In particular, Institute of Forest SB RAS is a responsible performer and coordinator in 14 international projects, financed by international funds and research agencies (CRDF, INTAS, NASA, NSF, EC, Max-Plank Society, USDA Forest Service, Japan Environmental Agency). These projects are focused on the assessment of Siberian forests role in greenhouse gases cycles and gas emissions from forest fires, reconstruction of climate changes with high temporal resolution (from centuries till millennia), development of new systems for satellite observations of Siberian forests state and productivity.

Many other institutes of SB RAS also work in this direction in the framework of their budget and initiative thematic. But taking into account their fragmentation, these studies will not lead to the emerging of the full picture of modern natural-climatic changes in Siberia. There are only several complex and integrated projects of SB RAS Presidium. In 2003-2005 SB RAS Presidium financed 12 complex and 11 interdisciplinary projects, devoted this or that way to studying the Siberian environment. In spite of significant resources used, the effectiveness of the work is not high because of insufficient funding and coordination between projects. To overcome these weaknesses a special activity is necessary. In particular, Institute of Monitoring of Climatic and Ecological Systems (IMCES) involves in the work in this field and coordinates the activities of many scientific and educational organizations in Russia. For example, the interdisciplinary integrated project "Siberian geosphere-biosphere project: IRS of modern natural-climatic changes" (**http://sgbp.scert.ru**) joins the efforts of 20 organizations of Siberia and Moscow and is directed to studying the dynamics of the regional system. The same is true for the interdisciplinary integrated project "Complex monitoring of Great Vasyugan Bog: study of modern state and development processes" which is aimed at studying the dynamics of this planetary im-

portant natural complex and its role in the regional climate forming. This project joins the efforts of 15 scientific and scientific-educational organizations in Siberia. Important aspects of the study of dynamics of some components of regional atmosphere are taken into account in the integrated project "Siberian Aerosols". Integrated project "Ecological problems of Siberian cities" is devoted to investigation of the influence of cities on changes of hydrothermodynamical features and components of atmosphere and the impact of these changes on the quality of life and health of regional population.

The important research, educational and organizational activity in this field on a national and international level is performed by International research center of SB RAS "Siberian Center for Environmental Research and Training" (SCERT, http://scert.ru/en/) organized as an initiative of IMCES. The first significant step in this field is the project of FP6 EC ENVIROMIS SSA (Environmental Observations, Modeling and Information Systems Special Support Action, 2004-2005). In course of the project implementation the basis is formed for interaction of leading scientific organizations of Byelorussia, Kazakhstan, Russia, Ukraine and Uzbekistan, working in the environmental sciences, the open informational system is created (http://enviromis.scert.ru/ru/) and two scientific-educational events are performed, combining international conferences with thematic young scientists schools ENVIROMIS 2004 (http://scert.ru/en/conferences/enviromis2004/) and CITES 2005 (http://scert.ru/en/conferences/cites2005/). About 80 young scientists took part in each of them and it gibes us a hope that a qualified young specialists will emerge soon in this field. The second step will be the project of FP6 EC: Man-induced Environmental Risks: Monitoring, Management and Remediation of Man-made Changes in Siberia (Enviro-RISKS) that starts in September 2005. It focuses on the development of scientifically-based understanding of ecological risks caused by anthropogenic factors, their influence on the regional environment and development of the optimal way of these risks mitigation. The project is coordinated by Danish Meteorological Institute and will be performed by a consortium of 10 Russian and European profile organizations, 5 of them are from Siberia.

As is obvious from the foregoing and from the contents of this issue of the Bulletin, IRS of Siberia (SIRS) already has a reliable scientific basis. The situation with an organizational basis of SIRS is not so good developed yet. The firs proposal to develop SIRS as a joint program of SB RAS and IGBP was made by an executive secretary of ISTC Will Steffen in 2003 during the conference on boreal forests in Krasnoyarsk. After the discussion with him and the President of IGBP Guy Brasseur further work in this direction was conducted by Prof. E.P. Gordov and co-authors of this paper. The first step was an INTAS Strategic Scientific Workshop "Towards integrated multidisciplinary study of the Northern Eurasia climatic Hot Spots" held in the framework of ENVIROMIS 2004 conference. Among its organizers were: INM RAS, IF SB RAS, IMCES SB RAS, SCERT, and International Institute of Applied System Analysis (IIASA), Max Planck Institute for biogeochemistry (Jena) and MEDIAS-France (Toulouse). The detailed discussions of performed and planned researches of contemporary nature and climate changes in Siberia led to elaboration of recommendations on SIRS development as an integral part of ESSP (http://scert.ru/en/conferences/enviromis2004/recommendations/). In particular, it was proposed to formalize organizationally the Steering group of specialists from SB RAS, RAS and other institutions which was already formed in course of a performance of joint projects on Siberian environment research and to

charge it with the coordination of activities on SIRS development.

On the basis of Recommendations the Steering group (authors of this paper, Dr. G. Begni (MEDIAS-France), Prof. A. Shvidenko (IIASA, Austria), Dr. M. Heimann (MPI for Biogeochemistry, Germany)) prepared proposals, on the basis of which the Siberian Branch of Russian National Committee of IGBP was created recently [7]. Creation of this body is the first organizational step of SB RAS to the development of SIRS in the framework of the Earth System Science Partnership and IGBP-2. It is structured according to five directions of its activity:

- Biological – ac. E.A. Vaganov (coordination of biosphere study);
- Climatic-ecological – RAS corresponding member M.V. Kabanov (coordination of study of modern natural-climatic changes);
- Paleo-climatic – ac. M.I. Kuzmin (coordination of study of Siberian paleo-climate);
- Permafrost – ac. V.P. Melnikov (coordination of study of Siberian cryolitosphere);
- Informational infrastructure – Prof. E.P. Gordov (organization of informational support of environmental research, data storage and access).

Organizational support of Siberian Branch of Russian National Committee of IGBP functioning (site http://scert.ru/ru/SB/, correspondence, database, etc.) is performed by IMCES SB RAS and SCERT. SB RNC made the decision that during the first stage of SIRS development it is necessary to focus on four lines of investigation:

- Quantification of the terrestrial biota full greenhouse gas budget, in particular exchange of major biophilic elements between biota and atmosphere.

- Monitoring and modeling of regional climate change impact.

- Development of SIRS information-computational infrastructure.

- Development of an anticipatory regional strategy of adaptation to and mitigation of the negative consequences of global change.

All these lines of investigation were discussed during the first Meeting of the Working Group on Siberia Integrated Regional Study (SIRS), which was hold within a framework of the Conference on Computational and Information Technologies for Environmental Sciences (CITES 2005, http://scert.ru/en/conferences/cites2005/) in Novosibirsk, Russia, 23 March 2004 under auspice of the Siberian Branch of IGBP Russian National Committee. The Workgroup was preceded by the cross disciplinary session "SIRS Scientific Background". Materials of this session, devoted to the state of the art of environmental investigations in the region, are available on: http://www.scert.ru/conferences/cites/2005/presentation/Conference-Rus.html. Workgroup recommendations (http://www.scert.ru/conferences/cites/2005/presentation/WorkgroupEng.html) direct scientific community toward clusterization of corresponding integrated projects of SB RAS and netting with profile national and international programs. Next step is to form the detailed IRIS research plan to combine isolated projects into a coherent structure according to SIRS concept.

Thus, integrated and international projects performed so far form the basis for the development of SIRS as an International Program of coordinated basic and applied research with SB RAS playing its adequate role and SB RNC acting as a managing body of this Program.

At the same time, new and larger national and international initiatives are emerging to develop a study of that kind on the territory of the whole Northern Eurasia.

So, the joint program of RAS (ac. A.S. Isaev) and NASA (D. Deering) was established called "Northern Eurasia Environment Study Partnership Initiative" (NEESPI). In its framework a coordinated study of environmental dynamics and especially boreal forests in Northern Eurasia is planned. It was supposed that NASA will support financially Russian institutes taking part in joint research. Unfortunately, for the present Russian organizations and specialists play a role of service providers for emerging NASA projects on Siberian environment study. Now this initiative is changed. In particular, the RAS Presidium Program is prepared to support this research and the USA colleagues separated NEESPI from NASA and convert this program actively into the international one with the support from several USA national agencies (NASA, NOAA, NSF, etc.), see http://www.neespi.org/ . It is necessary to point out that during the recent International symposium on remote sensing of environment (18-24 June 2005, Saint-Petersburg) a special seminar, two plenary reports and two meetings of the "Land cover change" session were devoted to NEESPI promotion. It appears from this, that NEESPI initiators are eager to construct this Program as a kind of a vertical structure coordinating the Northern Eurasia environmental research on a projects level. It is supposed, that NEESPI as a whole interacts with IGBP, ESSP and other international Programs devoted to different aspects of the global change.

In this connection the question is brought up of SIRS interaction with these initiatives. We suppose that SIRS should cooperate both with national and international Programs on the Northern Eurasia environmental research as a whole. This approach will allow SB RAS to perform its mission in the region: to ensure the growth of scientific knowledge on main patterns of Siberian environment and its subsystems dynamics and to develop a basis for a scientifically-based strategy of mitigation and adaptation to negative consequences of such changes. Preliminary discussion of the situation shows that it is realistic to include SIRS into the planned RAS Presidium Program as an autonomous sponsored part. It is assumed, that the same will be realized with NEESPI, IGBP, ESSP and its Programs.

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Information on currently performed projects

Interdisciplinary integration project of SB RAS N 121 "Chronology and periodicity of global climate and environment change in the Late Cainozoe in Siberia and their influence on a human evolution"

A steady air temperature rise about 0,6- 0,7°C as compared to the end of the Little Ice period (1850) is one of the most significant peculiarities of climate in the last century. The warming after the 1960 runs especially rapidly. It makes 0,2°C for 10 years for the Globe and 0,29°C for the same period of time for Northern Hemisphere. The warming has got a catastrophic character in the last century and the year 1998 proved the warmest for this period of time at our planet as a whole. The area of the Arctic ice cover reduced by 10-15% for the last 50 years and its thickness in the late summer – by 40%. Presently a considerable decrease of mountain glaciers takes place and the permafrost becomes degraded as well. By assessments of computational modeling, also going from energy development, and not taking into account natural climate changes the average annual air temperature is projected to increase up to 1,4- 5,8°C by the year 2100. Nevertheless, the problem of climate change is still far from understanding and vagueness related to predictions of future changes increased in the last years. The contribution of natural and anthropogenic processes to the modern warming is not ascertained up to now. Difficulties for predicting climate changes and their after-effects for the near future are determined by numerous interacting processes and factors which impact on climate system, also by a great number of feedbacks and by deficiency of both empirical and model data.

Studying global changes becomes of high priority in the current international scientific programs. Siberia is a territory of a stupendous global importance owing to its vast area, history, ecological variability, also to large but vulnerable regions as well as sup-

posed dramatic climatic changes during this century. In studying this very important region of the planet the role of SB RAS which is able to combine efforts of different academic institutes is extremely high.

Since 1997 the paleoclimatic studies are within Integration programs which combine natural and humanitarian fields of studying. So, studying regional successive changes of natural and climatic events in Northern Asia for the past 5 million years is a result of realizing these programs. Seven books, three thematic collective books and more than 300 papers in Russia and abroad were published based on results of these studies. The 200 and 600 meters of sediment cores of the Baikal Lake were managed to get and it was a very important progress. The high resolution paleoclimatic records of Inner Asia obtained in this project had a great impact on development of paleoclimatic research in Siberia.

Reconstruction of the main stages of mountain formation in the Central- Asian mountain belt as well as their correlation with the main borderlines of climate change towards cooling in the late Cainozoe in West Siberia has revealed their clear coincidence. It was stated the extension of elevated areas in Inner Asia resulted in a large change of the global atmospheric circulation, deformation of snow line, albedo increase and essential climate cooling by the early Quaternary period.

A great amount of information on climates, paleological environment and culture of ancient socium in different stages of the Pleistocene based on various dated materials found in profiles of multi- layer archeological monuments was gained by archeologists of SB RAS in different Siberian regions. It was stated that in the north-west of Altai the initial stage of the upper Pleistocene was presented by the epoch of the warm and temperate humid climate, the middle stage – by cool and cold damp, then by cold dry climate also by phases of transitional character and the final stage – by cool damp, cold dry, maximum dry climate and by transitional phases. The epochs of cooling of the upper Pleistocene are characterized not so much by fall of average annual temperatures as by climate humidity increase.

Using dendrochronological and dendroecological studies the long- term regional (generalized) tree- ring chronologies are obtained for different regions of Siberia. Quantitative reconstructions of temperature and humidity change for the last 300-2000 years were made which demonstrate both the limits of natural fluctuations of the main climatic variables and also availability of super- century (160- 170 years) and intra-century (45-50, 30-33,22 and 11 years) cycles. It is stated for the northern Eurasia that the temperature variations correlate with the main climate forming factors – solar radiation, volcanic activity and carbon dioxide concentration in the atmosphere. It is also stated that the current warming does not exceed limits of natural changes in the period of the medieval warming or the shorter warming periods in the first half of the first millennium of A.D. Data bank on paleoclimate of Siberia is being formed. It includes instrumental climatic data (350 stations), network of long- term tree-ring chronologies (more than 320), data on spore and pollen spectra (more than 100 sites) as well as historical information on phenomena determined by climate.

Objective of the Project is 1) to elaborate chronologies of global climate and environment change in Siberia in the Late Cainozoe, 2) to reveal their spatial peculiarities in meridianal and latitudinal transects in different regions, 3) to reveal the nature of different- scale periodicity and 4) to analyze human response to environment change.

Structural scheme of the Project:

The horizontal structure:

"Temporal window 1" - deciphering (interpretation) paleoclimate and natural changes during the last 2000 years with the step "one year- one season" time scale;

"Temporal window 2" - deciphering (interpretation) paleoclimate and natural changes during the epoch of the Pleistocene and early Holocene with the step "100 – 1000 years" time scale;

"Temporal window 3" - deciphering (interpretation) paleoclimate and natural changes during the Pliocene epoch with the step "10000- 100000 years" time scale;

The vertical structure contains 6 blocks:

Block 1. Tendencies and periodicity of Siberian climate change in the Holocene and their effect on ecosystem dynamics and human economic activity

Main approaches and tendencies: dendroclimatic and dendroecological studies; extending the network of stations for dendroclimatic monitoring in Eurasia, enriching the databank according to indirect indicators of climate change in Northern Eurasia using new long- term tree- ring chronologies, palinospectra, ice cores, also analysis of timberline dynamics during the last millennia in the Polar Urals and Putoran plateau, dendrochronological analysis of carbon cycle components at the regional and local levels, analysis of spatial heterogeneity of droughts in some regions in the historical past and at the predicted future, analysis of dynamics of forest vegetation southern borderline in the Holocene as well as a complex paleobiogeocenotic studying ecosystems which are formed on the morain complexes of the Little Ice Epoch in water basins of Central Altai. Research organizations and methods: Institute of Forest (dendrochronological studying, palinological and carpological analysis, also analysis of meteorological data); Institute of Computer Modeling (databank of Siberian climate); Co-research organizations: IWEP (paleoecological and dendrochronological studying of the Altai region); Institute of Archeology, Institute of Earth cores (archeological and historical data); Baikal Institute of Nature Management (dendrochronological and archive data for Zabaikalie region); SIPBP (dendrochronological studies); YaIBPC, Krasnoyarsk State Pedagogical University, Novosibirsk State Pedagogical University.

Block 2. Reconstruction of nature and climate of Southern Siberia in the Pleistocene and their effect on a human being and his culture

Main approaches and tendencies: complex studying of multi- layer archeological objects (cave and open sites) of Southern Siberia using climatic stratigraphy, magnetic stratigraphy, "absolute" dating; correlation of regional chronicles with the high resolution global climate records; regional (topography, climate and biological resources of a separate region) and local (assessment of object location and living conditions of its habitants); paleological reconstructions of regions with concentrates ancient sites; analysis of impact of natural factors on mechanisms of cultural adaptation and nature use. Research organizations and methods: Institute of Archeology (complex studying archeological objects in Altai and Pribaikalie regions, palinological, paleontological, paleopedological and geochemical analyses, the complex of archeological methods directed to the analysis of human response and his culture to the change of paleological environment and climatic fluctuations; analysis of lithologic resources of an ancient human being); Institute of Geography (analysis of sediment accumulation, geomorphological, paleopedological studies, geochronological dating, paleontological and

paleomagnetic analyses); Institute of Limnology (palinological analysis). Co- research organizations: Krasnoyarsk State Pedagogical University.

Block 3. Reconstruction of the paleoclimate of Siberia using high resolution paleological records of lake sediments

Main approaches and tendencies: interdisciplinary studies in deciphering paleological indicators; absolute, correlation and spectral datings; experimental geochemie; neutron- fission radiography; calibration of paleosignals. Research organizations and methods: Institute of Limnology (experimental geochemie; paleological limnology; diatomaceous, spicule and palinological analysis and deciphering geochemical records of paleoclimate; elaboration of nuclear- physical methods for obtaining super high resolution records to reveal lag or advance of different responses and deciphering these records; distribution of organic geochemical markers by chromatography methods; studying geochemistry of uranium and phosphorus; uranium stratigraphy of columns by ICP- MS method; correlation, spectral, thorium- uranium and uranium- uranium datings; search of Pliocene events in deposits of Academic ridge). Co-research organizations: Institute of Geology, Geophysics and Mineralogy and Buryat Institute of Geology (thorium- uranium dating; neutron- fission and в - radiography; analysis of radioactive nuclides, neutron- activation analysis; geochemical analyses, analysis of sediment accumulation); Institute of Nuclear Physics (scanning SRXRF analysis to obtain paleological records with spatial resolution 100 mkm including also for dendrochronological studies; diffraction analysis).

Block 4. Regularities and cyclic recurrence of climate and environment change in Northern Asia (transect the Baikal lake- delta of the Lena river – Laptev sea) in the Pleistocene- Holocene using data on studying high resolution continental and sea records and their effect on ecosystems of Northern Hemisphere

Main approaches and tendencies: interdisciplinary studies of high resolution records, comparative analysis of environment and climate change along the meridianal transect, also revealing cyclic recurrence of climatic change in the long- term climatic records as well as determination of non- periodical drastic climate and environment change against this background and, finally, their effect on ecosystems and human evolution. Research organizations and methods: Institute of Geography (obtaining high resolution records; deciphering geochemical signals of paleological climate, also thorium- uranium, uranium-uranium, paleomagnetic and thermoluminescence datings; studying diagenesis of organic matter; clay minerals; geochemical modeling); Institute of Limnology (palinological studies), Institute of Geography (the method of X-ray powder diffractometry and infrared - spectroscopy as well as the method for simulation of complex X-ray diffraction profiles).

Block 5. Frost- geothermic studies of cryolite zone dynamics under climatic rhythms

Main approaches and tendencies: analysis and development of quantitative assessment of paleological temperatures of the Late Cainozoe using geocryological and geothermic data; analysis of evolution and dynamics of cryolite zone in the Late Cainozoe under climatic rhythms; (developing notions on global temperature as on a thermic resonance system; developing procedure for assessment of changes of paleocryolite zone parameters using data on modern permafrost and climatic rhythms); prognosis of geocryological conditions in Siberia; construction of paleological scenarios, electronic maps of cryolite zone evolution. Research organizations and methods: Institute of Geophysics

(collecting data, geothermic studies in West Siberia, inversions of thermograms), Institute of Earth Cores (data collecting, geothermic studies in Baikal region, inversions of thermograms). The experts from Institute of Frost Science and Institute of Earth Cryosphere may be potentially involved as the co- researchers.

Block 6. Chronology and periodicity of global climate and environment changes during the Late Cainozoe in Siberia using data of natural profiles

Main approaches and tendencies: complex detailed studies of profiles of the loess- soil formation, closed lake depressions, bottom sediments in lakes, also river and glacier sediments, peat deposits along the meridianal and latitudinal transects; databank on radiocarbon chronology; chronology development of environment and climate change; determination of fluctuations of glaciers; revealing and analysis of different- scale periodicity and trend; comparative analysis of spatial changes; revealing the dependence of different environment components on global climatic and geological events. Research organizations and methods: Institute of Geography (the couple analysis, lithologic- genetic, paleopedologic, geochemical, paleotemperature, paleomagnetic, petromagnetic, paleontological and paleobiogeographical, geomorphological, glaciological, geochronological (radiocarbon and thermoluminescence as well as paleomagnetic methods) of study, component analysis of environment, the method of paleological analogues, development of semiquantitative indices of climate fluctuations by magnetic characteristics; Institute of Limnology (palinological studies), Institute of Geology, Geophysics and Mineralogy (the method of X- ray powder diffractometry and infrared - spectroscopy as well as the method of simulating complex X-ray diffraction profiles).

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Interdisciplinary integration project of SB RAS № 138 "Siberian geosphere-bioshere program: Integrated regional study of modern natural and climatic changes" (SGBP)

Participants:

Institute of Monitoring of Climatic and Ecological Systems SB RAS, Institute of Water and Ecological Problems SB RAS, Institute of Soil Science and Agricultural Chemistry SB RAS, Institute of Forest SB RAS, Tomsk affiliation of the Institute of Oil and Gas Geology SB RAS, Institute of Computational Mathematics and Mathematical Geophysics SB RAS, Institute of Computational Modeling SB RAS, Institute of Geography SB RAS, Institute of Solar-Terrestrial Physics SB RAS, Institute of Catalysis SB RAS, Institute of Chemical Kinetics and Combustion SB RAS, Siberian Center for Environmental Research and Training, Institute of Numerical Mathematics RAS, Altai State University, Tomsk State University, Tomsk Politecnic University,

Tomsk University of Control Systems and Radioelectronics, Yugra State University, Yugra Research Institute of Informational Technologies

Main objectives of the project:

1. Development of a system for monitoring of Siberian mezoscale natural-territorial complexes and a supporting informational infrastructure.

2. Preparation of methodological and computational basis for modeling of main processes of regional natural-territorial complexes development taking into account the interaction between their main components and forecasting of geosphere-biosphere changes on Siberia in the context of the regional sustainable development.

3. Study of regional climate changes caused by natural and anthropogenic factors and the influence of the region on global processes.

4. Preparation of organizational basis and scientific groups for an appropriate presentation of the program and its parts in large international projects.

Results of the first three-year period of the project implementation:

First set of a net for monitoring of atmosphere and lithosphere electricity in three climatic zones (near Baikal, Krasnoyarsk and Tomsk) is developed to investigate the impact of the Earth magnetic field on climatic, biotic and seismic characteristics.

Trends of temperature and precipitations in different Siberian regions are discovered on the basis of the analysis of long-term sets of measurements of hydrometeorological characteristics. The work is started to find out a set of climatic parameters of the highest influence on Siberian biocenoses. In particular, statistic analysis of Siberian temperature regime based on last century instrumental measurements data shows that an increased rate of Siberian warming has clear spatial inhomogeneity (to 0,5 degree in 10 years in some regions).

Basing on a coupled model of atmospheric circulation and surface processes the first stage of modeling of Siberian regional climate and hydrology is performed. A one-dimensional model of surface processes takes into account an exchange of energy, water, greenhouse gases and a momentum between atmosphere and surface covered with vegetation, lakes, wetlands (e.g. bogs) or ice. It is shown that if the dynamics of vegetation is changed by doubling of CO_2, surface flow and drainage of Siberian rivers increases by 10 - 15%.

An interactive GIS is developed to work with geo-informational resources using Internet. A server allows one to work with maps using vector method of spatial data storage and transfer and provides with acceptable access time to spatial data while working on-line with electronic map. It also allows one to perform a selective principle of data access/protection on the level of separate cartographic layers.

Types of sources and capacity of atmospheric aerosol emission are identified on a basis of simultaneous measurements of changes in microphysical parameters and chemistry of atmospheric aerosols performed in different soil and climatic zones of Western Siberia in different seasons. Spatio-temporal changes of mass concentration and chemistry of aerosols on background territories and in the regions of Western Siberia influenced by technogenic load are determined. The composition of a biogenic component of Siberian atmospheric aerosols and of typical gas-aerosol emissions from forest fires is defined.

Methods of the usage of ecological-geographical data, space images and GIS-technologies are developed and applied to analyze the structure of forest-bog complexes of Western Siberia. A high degree of susceptibility to pollution (oil, gas) and mechanical effect produced by construction and usage of highways and hydromorphic objects is found out.

An international workshop "Towards integrated multidisciplinary study of the Northern Eurasia climatic Hot Spots" (http://scert.ru/ru/conference/enviromis2004/workshop_rus/) and a Workgroup on Siberia Integrated Regional Study development (http://scert.ru/ru/conference/cites2005/group/) are held to develop the organizational basis for the project inclusion in thematic international programs.

Additional information on the project run and results is available on a project site (http://sgbp.scert.ru). This site is also used to scientific and organizational support of the project performance, to improve the coordination and gives the participants access to informational resources gathered by the partners.

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Interdisciplinary integration project of SB RAS No. 137 "Complex Monitoring of Great Vasyugan Bog: modern state and development processes research"

Participants

SB RAS: Institute of Monitoring of Climatic and Ecological Systems, Institute of Water and Ecological Problems, Institute of Atmospheric Optics, Institute of Petroleum Chemistry, Institute of Soil Science and Agrochemistry, Affiliation of Institute of Geology, Geophysics and Mineralogy, M.A. Lavrent'ev Institute of Hydrodynamics, Institute of Computational Mathematics and Mathematical Geophysics, Institute of Computational Modelling, Siberian Center for Environmental Research and Training.
SB RAAS: Siberian R&D Institute of Peat.
Higher-Education Institutions: Tomsk State University, Siberian Physico-Technical Institute at TSU, Tomsk Polytechnic University, R&D Institute of Ecological Monitoring at Altai State University.

Main goals of the project:

1. To show the role, importance and scientifically grounded ways of development of the unique natural-climatic complex Great Vasyugan Bog (GVB) as the natural formation of planetary importance for global and regional environmental and climate change. This will be done on the basis of basic and applied multidisciplinary research of GVB.

2. To assure further development of GVB monitoring technologies on biological, physical, chemical and technogenic components, as well as methods of multifactor analysis and forecast of regional changes under impact of natural and anthropogenic factors in addition to traditional technologies of monitoring and forecasting of regional environment and climate state.

Main objectives of the project:

To create a database on characteristics of biological, physical, chemical and technogenic processes proceeding on GVB territory.

- To investigate GVB evolution scenario in interactive connection with the published scenarios of the global climate change.
- To investigate functional patterns of GVB geosystem under impact of natural and anthropogenic factors.
- To study modern rhythms of Earth's crust movement in Western and Eastern Siberia and, on this basis, to find out the peculiarities of geodynamic processes on the GVB territory.
- To approve basic methodology of multidisciplinary investigations of natural complexes by the example of GVB based on results of combined expedition and stationary field observations, application of modern geoinformation technologies and new instrumentation.

Object of investigation

Great Vasyugan Bog (GVB) is the largest natural complex in West Siberia and on globe (53 thou. km^2 in Novosibirsk, Omsk and Tomsk regions). In accordance with its sizes other parameters of this complex are also unique: age – 6-10 thousand years, water reserves – 400 km^3, explored peat reserves – more that 1 mlrd. tons. The main GVB func-

tions, as a stable natural complex, play an important role in formation of regional peculiarities that influence mesoscale environment and climate changes. Specific meaning of GVB among other West Siberian bogs is that this southern bog did not incur significant technogenic impacts until recent times.

Investigation results

An inventory has been made of vascular plants and bryophyte flora (586 species have been distinguished, among them 12 species of liverworts, 19 species of leafy moss and 5 species of vascular plants have been found on this territory for the first time).

- Regularities have been revealed for formation of flora and vegetation on peat bogs. When climate changes, many vegetation species are displaced from natural habitats to peat bogs where they find congenial refuge and grow there for a long time. This defines the role of bogs in reservation and maintenance of biological diversity.

- The principles have been developed and multilevel classification has been constructed for bog landscapes in south-east of West Siberia that allows one to use all set of parameters at relatively small number of classification features distinguished at every level. Three levels have been distinguished: zone-geographical, geologo-geomorphological and landscape-hydrological.

- Estimation of biological cycle components in GVB ecosystems has shown that turnover rate, evaluated by primary production value, is great and reaches 14.3 T/hectare per year.

- High efficiency has been determined when applying peat from GVB for purification of aqueous petroleum micro emulsions (purification efficiency of industrial waste is up to 88-75 %), that shows high profitability and promise for using GVB peat as a cheap adsorbent for wastewater treatment.

- The nature-conservative and ecologo-economic zoning has been performed on the GVB territory. The borders of a representative area that is the most suitable, according to natural peculiarities and location, for organization of a closed territory, have been determined; a territory was assigned for state interregional preserve having federal importance.

- Scientific approaches have been suggested to coordination of natural and economic relations and regulation of spatial arrangement of oil-producing plants on the basis of evaluation of bog system survival capability under different impacts.

- Spatial scale for GVB stabilizing action on interseasonal variations of monthly mean temperature up to 10-km altitude was determined. The temperature differences between GVB and adjacent territories in the ground layer reach 5^{o} C in February and 2^{o} C in July.

- On the GVB territory three zones have been separated that are noticeably distinguished in the last decade by stable warming and simultaneous decrease of annual precipitation in the south-west zone and their increase in the northern one.

- Based on results of studying stratigraphy of components of GVB oligotrophic ridge-limnetic complexes, as well as absolute age of up to 6.5 thousand years, new genetic type of complexes has been revealed, which has varied mineral bottom micro relief that sets conditions for bog formation of different types and trochlear stratigraphy of peat deposit.

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Interdisciplinary integration project of SB RAS No. 145 "Biodiversity and dynamics of ecosystems: information technologies and modeling"

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Novosibirsk State University (Doctor of Biology M.G. Sergeev, head of a chair)

Main research directions and results in 2004–2005

Prediction of the dynamics of species and ecosystem diversity requires (1) description of the actual biodiversity; (2) detection of the main regular patterns and development of approaches to data formalization; and (3) creation of mathematical models based on the preceding information and verification of these models. A great heterogeneity of both the primary data and the conventional approaches to their representation and formalization, on the one hand, and a continuous nature of the ecosystems and nonuniform scale of the processes occurring in them, on the other, complicate the problem. An informational system (IS) describing the ecosystem should provide not only the analysis of its current state, but also the possibility to accumulate the data and calculate the behavior dynamics of virtually all ecosystem variants that could arise from such template.

Within the context of the first direction, ICT SB RAS is working over a new generation IS, namely, electronic libraries (ELs). The distinctive feature of ELs is their capability of accumulating and utilizing heterogeneous information in a unified format concurrently preserving its properties, specific features of the representation, and user options for manipulating this information. For example, it is possible to obtain information as electronic documents with preserved specifics of the initial text (which allows for utilizing the experience and standards of the traditional bibliography) in combination with non-textual information (images, video, etc.). Moreover, ELs catalogue all the information stored according to an integrated unified format, thereby providing an efficient navigation by using in parallel various search mechanisms and tools for accessing electronic data. Based on these principles, the EL "Biodiversity of animal and plant worlds in Siberia" (http://web.ict.nsc.ru/~cancel/new_atlas) was created at the Siberian Branch of the Russian Academy of Sciences. This EL unites the resources that describe various aspects of biodiversity from the ecosystem level (the atlas *Plant Communities of North Eurasia,* databank of annotated photos *Photographs of Siberian Landscapes,* etc.) through organismal level (*Catalogue of the Vascular Plants of Siberia,* the bank of annotated photos of the butterflies of Northern Siberia under natural conditions, the atlas *Siberian Plants in Herbarium Collections,* etc.) to cytogenetic level (*Catalogue of Spindle Abnormalities in Plant Cell; Chironomus-NPCV*: *Natural Populations and Chromosome Variation in Diptera, Chironomidae; Wheat Lines with Intercultivar Chromosome Substitutions; Wheat Monosomic Lines,* etc.) as well as the resources containing contiguous information (for example, the atlas *The Aerosols of Siberia*). Over 20 various databases and information resources are under development now; these developments are supported by various institutions with the Siberian Branch of the Russian Academy of Sciences (CSBG, ICG, and IAS&E). These resources are accessible via any Internet browser; however, the collections of differ-

ent authors are initially accessible only for authors or via local networks. In future, a more flexible policy of a free access is planned.

Long-term monitoring studies are also being continued; their goal is to collect the necessary information for modeling of behavior of economically significant ecosystems under conditions of anthropogenic influence or climatic alterations and/or verification of the models constructed. Those related to the anthropogenic influence include study of the bioproductivity and dynamics of genetic, physicochemical, and other properties of chernozems and dark-gray forest soils of the typical Western Siberian forest steep (Salair Foothills), performed by ISSA SB RAS; to climatic changes, study of the dynamics of trematode parasitic systems and the connected dynamics of parasitic diseases in the region of eutrophic Lake Chany (Novosibirsk oblast) under conditions of natural cyclic alterations in the water level, performed by IAS&E SB RAS. IF SB RAS is involved in constructing the biodiversity distribution maps for main forest-forming coniferous species (*Pinus sylvestris, Larix sibirica*, *L. sukaczewii*, and *L. gmelinii*) on the territory of Siberia.

In the context of the second direction, IAS&E SB RAS is involved in development of the approaches to application of the technologies based on geographic informational systems (GIS) in cartography and study of the spatial typological population structure of small rodents and birds in Western Siberia. Upon conversion of heterogeneous initial data on the abundance of animals into universal units (an arbitrary value per area), their averaging over the basic map in order to level the annual and individual differences and evening up these characteristics according to their fraction in the Shannon total biodiversity coefficient, cluster analysis allows the main structure-forming environmental factors and their indivisible combinations (modes) to be detected. The last types of data makes it possible to construct population maps for small animals by GIS tools and produce legends for these maps using conventional geographic maps, aerospace photos, and classification of communities. The same is true for the maps forecasting the populations of small animals. IF SB RAS also have developed the approaches to prediction of potential biodiversity of the forest-forming coniferous species in Siberia based on the analysis of the above-mentioned maps of coniferous species biodiversity and climatic transfer functions. ISSA SB RAS developed a format for the EL "Microorganisms as a component of the soil ecosystem", intended for comprehensive certified description of microorganisms taking into account the soil typology and metamorphosis and realization of the GIS expert–analytical potential in this field. ICG SB RAS is involved in development of an IS for compilation, visualization, and modeling of the structure–function interactions in ecosystems. The data obtained in experiments and through observation will be represented as hierarchical systems nested into one another and the diagrams of interactions between the biogeocenosis components that take into account the spatial dynamics and time course that can be opened at will of the user. The expansion of this hierarchy to lower organization levels of the living matter (organism, organs and tissues, cells, and molecular biological level) is also possible.

In the context of the third direction, the GIS "Biodiversity and dynamics of Ural and Western Siberian ecosystems" was developed due to joint efforts of several SB RAS institutions (CSBG, ICG, IF, IAS&E, ICT, and ISSA) and URIIT, where various information levels of biodiversity reflect the stages how the primary information about the ecosystem components is transformed into a most capacious form—subject maps. Subject databases (DB) have

been developed for each level, namely DB of geobotanical descriptions, DB of the types of plant communities, DB of the plant community spatial units—the map of plant communities, DB of soil profiles, DB of soil types, etc. All these subject databases as well as the mentioned DB on animal populations form the subject core of GIS. GIS allows for a quick and capacious extraction of samples related to any soil-related and geobotanical information, its superposition with the available zoogeographic data, and using the aerospace data, generation of new layers of subject information based on successive processing of the initial data available in the databases and decoding characteristics (Fig. 1). CSBG SB RAS used this GIS to develop an algorithm for modeling the spatial organization of ecosystems, which was realized when developing the GIS model of Western Sayan forest ecosystems. Forecasting models of plant distribution as a result of various scripts of changes in the climate were developed.

Fig. 1. A sketch map of the overall air-dry biomass (t/ha) of the soil multicellular invertebrates (including mollusks) in the system of plant formations of the Western Siberian Plain.

Origination of the biodiversity was modeled at CSBG, ICG, IM, and LIN SB RAS. The computer method SINAP, developed at CSBG SB RAS, was used to model phylogenetic relationships in the genus *Euphorbia.* At ICG SB and IM RAS, the divergence of band sequences in chromosomes of 63 *Chironomidae* species was assessed using computer tools. It is found that the number of chromosome breaks increases, while the average sizes of their conservative regions decrease with the growth in phylogenetic divergence. Molecular epigenetic mechanisms of biodiversity were modeled, and the principal possibility of existence of a "latent" phenotype, the transition to which is determined only by epigenetic factors (not reduced to only genetically determined alternative functioning modes of molecular trigger type) was demonstrated. The processes of divergent speciation were modeled at LIN SB RAS followed by verification of the resulting models using molecular phylogenetic data on various benthos species of the Lake Baikal littoral (oligochaetes, crustaceans, and mollusks) whose populations had distinct borders.

Publications during 2004–2005:

A special issue of *Sibirsky Ekologichesky Zhurnal* (Siberian Journal of Ecology) no. 5 (2004) "Biodiversity and Dynamics of Ecosystems: Information Technologies and Modeling" was published to report the results of the integration project no. 145, 2004; a multiauthor monograph *Biodiversity and Dynamics of Ecosystems: Information Technol-*

ogies and Modeling was submitted for publication.

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Interdisciplinary integration project of SB RAS No. 49 «Biological diversity of West Siberian Plain; space-structured organization, modern state and main development trends»

Participants: Central Siberian Botanical Garden SB RAS, Institute of Systematics and Ecology of Animals SB RAS, Institute of Problems of Development of a North SB RAS.

A forest-steppe zone of West Siberian Plain has been chosen as a model ground. Species diversity has been revealed in the ground and water forest-steppe ecosystems of higher plants, algae and moss. Nine hundreds ninety seven species of higher plants were registered, as well as 126 of moss and 1245 of algae species. An analysis has shown that forest-steppe is characterized by the largest diversity of higher plants and algae as compared to other zones.

Based on a vegetation map made in 2003, the surface and underground phytomass reserves have been calculated for the main types of forest ecosystems. (Table 1).

The main directions of territorial variability of summer bird population in forest-steppe zone have been studied. The flow chart plotted by correlation Pleiades method (Fig. 1) mapped space-typological structure of summer bird population.

The structure diagram demonstrates existence of three weakly related population systems. The bird population at built-up areas differs particularly strongly. It is characterized by the most specific species composition of predominant species, and by the level of total bird abundance. The differences between bird population at vacant areas and at water and near-water habitats are weaker pronounced.

Analysis of spatial structure, revealed for population sub-types, shows close connection between variability of ornithological complexes and hydrological regime of the habitats, that determines formation of one or another type of vegetation. Information content of such a representation of spatial population structure, estimated from fraction of accounted variance of quotient of similarity between all initial (not averaged) variants of population, reaches 36% that corresponds to correlation coefficient equal to 0.6. The analysis made gives grounds for conclusion on structural and organizational uniformity of bird population on all West Siberian Plain because in all other native zones, not only in forest-steppe one, the population is organized according to hydrothermic principle.

A database has been created for taxonomic diversity of arthropods in Siberian steppe including more than 4 thousand species. Ecological ordination of species has been carried out on standard matrix of ecological

conditions made as 5-position catenas, for 7 latitudinal zones of West-Siberian Plain. It was found that all arthropods species of forest-steppe fauna complex are attributed to 10 ecological groups: grass-bog starthorns (Hygrophila), nemoral-forest starthorns, nemoral-forest mesophyles, forest-meadow mesophyles, meadow mesophyles, meadow halomesophyles, steppe-meadow xeromesophyles, meadow-steppe mesoxerophyles, meadow obligate halophyles, typically-steppe xerophyles.

It should be noted that 6 groups from 10 have index "meadow" in their names.

Exactly these species reach in forest-steppe the most large abundance, highest taxonomic diversity and stand out for their ecological tolerance and, as a rule, have polyzonal areals.

Thus, the following main characteristics of forest-steppe ecosystems have been revealed: species diversity of higher plants, algae and bryophytic plants, underground phytomass reserve, arthropoda diversity, surface phytomass reserve and territorial distribution of summer bird population.

Table 1. *Phytomass reserves and productivity of the main forest-steppe formations of West Siberian Plain*

No.	Formations	Area, km^2	Phytomass		Production	
			t/km^2	total	t/km^2/year	total
1.	Tallgrass prairie, coarse-tussock and tallgrass	673000	3500	2355500000	1500	1009500000
2.	Deciduous forests	37000	37000	1369000000	2200	81400000
3.	Meadow-steppe, steppe-meadow	2143000	2500	5357500000	1300	2785900000
4.	Saline meadow-steppe formations	57000	1600	91200000	500	28500000
5.	Grass bogs	31000	1500	46500000	700	21700000
6.	Parvifoliate forests	239000	20000	4780000000	800	191200000
7.	Flood-plain vegetation	31000	8500	263500000	1200	37200000
	Total	3211000		14263200000		4155400000

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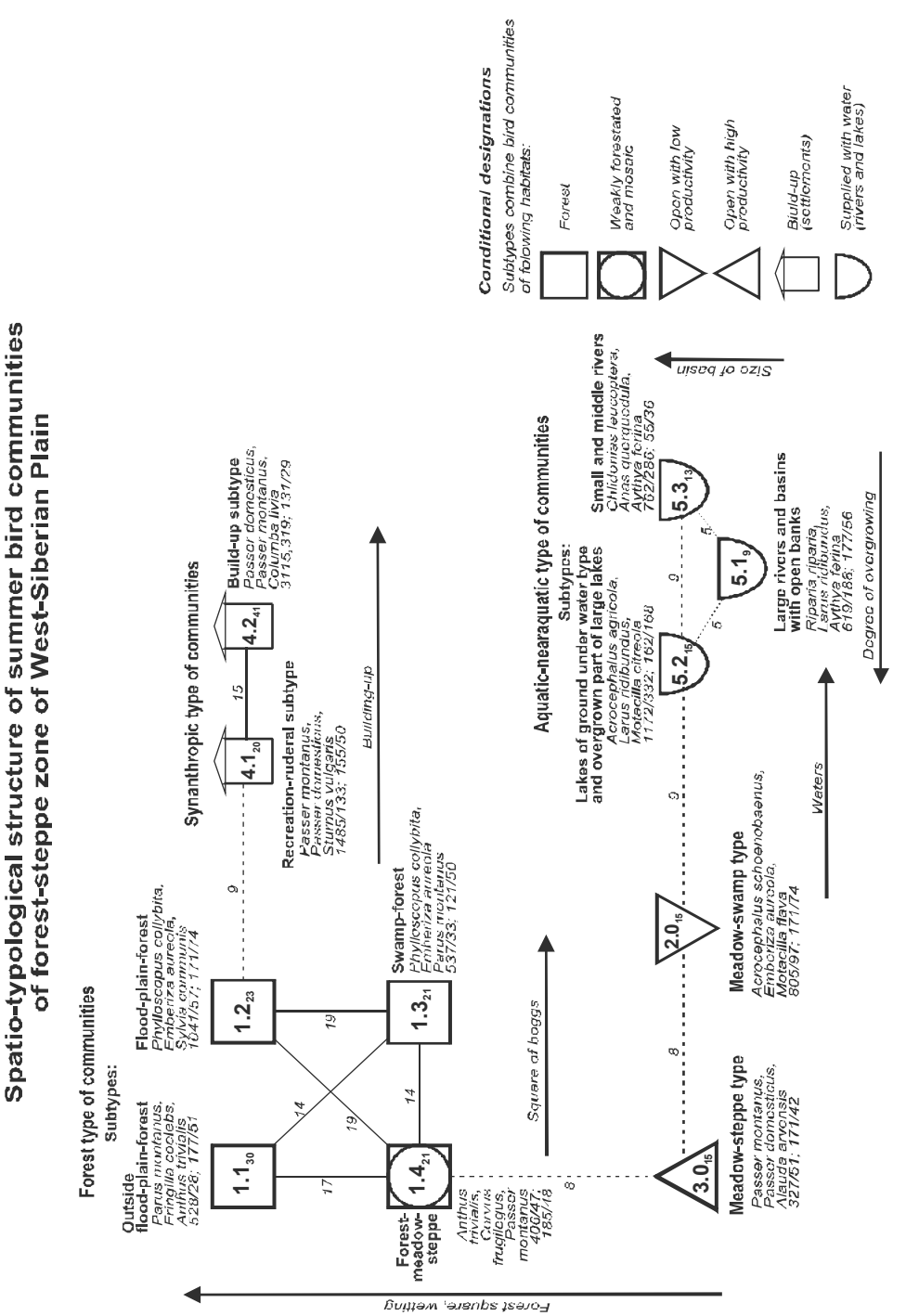
Fig. 1. Space-typological structure of summer bird population in forest-steppe zone of west Siberian Plain.


Spatio-typological structure of summer bird communities of forest-steppe zone of West-Siberian Plain
Forest type of communities
Subtypes:
Outside flood-plain-forest
Parus montanus, Fringilla coelebs, Anthus trivialis
528/28; 177/51
1.1 30
Flood-plain-forest
Phylloscopus collybita, Emberiza aureola, Sylvia communis
1641/57; 171/74
1.2 23
Forest-meadow-steppe
Anthus trivialis, Cuculus frugivorus, Passer montanus
400/47; 185/18
1.4 21
Swamp-forest
Phylloscopus collybita, Emberiza aureola
Perus montanus
537/33; 121/50
1.3 21
Synanthropic type of communities
Recreation-ruderal subtype
Passer montanus, Sturnus vulgaris
1485/133; 155/50
4.1 20
Build-up subtype
Passer domesticus, Passer montanus, Columba livia
3115;319; 131/29
4.2 41
Building-up
Square of boggs
Forest square, wetting
Meadow-steppe type
Passer montanus, Passer domesticus, Alauda arvensis
327/51; 171/42
3.0 15
Meadow-swamp type
Acrocephalus schoenobaenus, Emberiza aureola, Motacilla flava
805/97; 171/74
2.0 15
Waters
Aquatic-nearaquatic type of communities
Subtypes:
Lakes of ground under water type and overgrown part of large lakes
Acrocephalus agricola, Larus ridibundus, Motacilla citreola
1172/332; 162/168
5.2 15
Small and middle rivers
Chlidonias leucoptera, Anas querquedula, Aythya fuligula
762/286; 55/36
5.3 13
Largo rivers and basins with open banks
Riparia riparia, Larus ridibundus, Larus cachinnans
619/186; 177/56
5.1 9
Size of basin
Degree of overgrowing
8
14
17
19
19
14
8
9
15
9
9
5
6
Conditional designations
Subtypes combine bird communities of following habitats:
Forest
Weakly forestated and mosaic
Open with low productivity
Open with high productivity
Build-up (settlements)
Supplied with water (rivers and lakes)

Interdisciplinary integration project of SB RAS № 99 «Analysis and model of the transformation substances in system «River Selenga-delta - lake Baikal»

In connection anthropogenic loading on surrounding environment actually are the problems of preservation unique ecosystem with feebly economic activity. Ecosystem of the lake Baikal is ancient aqua object on the earth with the large supply of fresh water. However the dimension of ecosystem and complexity of correlation between living organisms and environment make difficult the estimation of the factors that influence on evolution of ecosystem and transformation the substances. It is important to study the main part of a lake shore for the investigation of principal elements of ecosystem, quantitative and qualitative changes of the substances and energy, determination of the indicators. The delta of river Selenga is the main principal part of the shore.

The river Selenga is one of the main sources of pollutants getting into the lake. In the river Selenga delta the changes of the level water lake are associated with natural and anthropogenic processes, operation of the Irkutsk hydro-electric power plant.

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Interdisciplinary integration project of SB RAS №169 “Siberian aerosols-2. heterogeneous chemistry and physics of atmosphere. Impact of atmospheric aerosols on biogeochemical cycles in biosphere”

Project objectives:

- To study patterns of formation, transformation and transport of aerosols in the Siberian region and Arctic basin of Russia at local, regional and global level in order to clarify their sources and sinks;
- To assess the influence of atmospheric aerosols on the air quality, on soil, water and vegetation pollution level, and on the velocity of migration of different substances and elements in the environment;
- To clarify the influence of atmospheric aerosols of different origin on atmospheric processes, human health and fauna.

The research consists of four thematic blocks:

1. Monitoring of atmospheric aerosols in the Siberian region and Arctic basin of Russia.

2. Laboratory research and ground tests.

3. Models of atmospheric aerosols formation, transformation and distribution.

4. GIS-technologies and databases.

The system of atmospheric aerosols monitoring operates on the territory of Western and Eastern Siberia and in Arctic basin of Russia. It consists of ground points of measurements on the territories of high technogenic load (big industrial centers), in suburbs and on background territories. Monitoring from space, jets and ships is also performed.

By using space monitoring important information on forest fires in Siberian boreal forests is gathered. These data help to identify separate forest fires and their smoke formation areas. Areas of smoke plumes influence have not only local but also regional scale. Structure of gas-aerosol emission sources is a complicated one. It depends on spatial location and intensity of fires, type of forest and meteorological conditions. Space monitoring data give only a part of information necessary for description of environmental consequences of forest fires. To get additional data ground and air-borne experiments are conducted in a special testing area to measure the value of gas-aerosol emission from different types of combustible materials and regimes of combustion. First experimental data received allowed us to determine emission coefficients of main reaction-active gas and aerosol combustion products depending on the mass of forest materials burned. It also gives the opportunity to determine chemistry of emerging aerosols of submicron and coarsely dispersed fractions. These results allows one to assess the influence of gas and aerosol emissions on climate and ecological consequences of forest fires in Siberian boreal forests. As results of ground and air monitoring first data are received on composition of atmospheric aerosol biocomponent in Siberia and its spatio-temporal changes. The patterns of daily and season changes of mass, concentration and type are revealed for pollen component of Western Siberian atmospheric aerosol.

The results of 10-year research show that atmospheric aerosols of Siberian region and Arctic basin of Russia are a complicated dynamic system, which qualities are determined by an interaction of physical, chemical and biological processes in biosphere. Gathered data and their analysis allowed us to reveal a set of common patterns and develop a set of parameterization models as a first approximation for a description of main characteristics of the system studied.

Disperse composition of Siberian atmospheric aerosols can be approximated by three-mode log-normal distribution. According to the existing classification Siberian atmospheric aerosols are close to continental atmospheric aerosols of remote territories. The parameters of this distribution are defined. A dynamic model of daily and season changes of disperse composition and concentration of submicron fraction of atmospheric aerosol is proposed taking into account photochemical conversion processes, coagulation of emerging particles, daily changes of height of atmospheric boundary layer and atmospheric humidity. The proposed model allows one to assess possible changes in characteristics of this fraction in different climatic zones, and taking into account chemistry of this fraction to detect influence on fogs and clouds formation, changes in visibility and radiative heat transfer.

The criteria of division of the input of anthropogenic and natural sources of gas-aerosol emission were developed using data

on Siberian aerosol chemistry and its changes depending on particle size and season in different soil-climatic zones. Spatio-temporal variability of atmospheric aerosol chemistry and dynamics of atmospheric circulation allowed us to define inputs of different types of local, regional and global sources (big industrial centers, forest fires, industrial enterprises of different types, traffic, acid precipitation, land and water erosion). Combined definition of ionic composition of atmospheric aerosol, precipitations and surface water allows one to determine a role of an interaction "atmosphere – hydrosphere - lithosphere" in forming ecologically dangerous acid rains in dependence on specific features of soil-climatic zones. The study of seasonal and daily dynamics of morphologic composition of a pollen component in atmospheric aerosols allowed us to determine its sources, to assess the input of this fraction into mass concentration of coarse-dispersion fraction in Siberian atmospheric aerosols, to develop a seasonal calendar of the component change in the South of Western Siberia and to propose a method to forecast discovered patterns in other Siberian areas. A mathematical model of formation of coarse-dispersion fraction in atmospheric aerosols under convective stratification of atmosphere is proposed. For an assessment of long-term impact of pollutions on underlying surface (soil, snow) the semi-empirical models of local and regional scale are proposed that describes experimental data well. Laboratory setups are developed to find out the detailed mechanisms of stages in chemical and physical processes of formation, transformation and transport of aerosols from natural and anthropogenic sources. The method of digital stereophotogrammetry using GIS technologies is proposed to get geo-spatial data assessing ecosystems state. A block of experimental data and its theoretical synthesizing using semi-empirical models is a necessary stage for a correct interpretation of remote sensing methods.

The results of such complex researches allowed us to receive a rather whole picture of spatio-temporal changes of Siberian aerosol. Thanks to this the gap was filled in the knowledge on aerosols characteristics in Siberia which is one of the largest regions of continental territories in Northern hemisphere. This experience is very important to develop a global aerosol model.

The first stage results will serve to develop an optimal plan of a further research in Siberia and in following federal and international programs on ecology and global change.

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Interdisciplinary integration project of SB RAS No 130 "Ecological Problems of Siberian Cities"

The project team consists of the scientists from the following research institutes of the Siberian Branch of the Russian Academy of Sciences (SB RAS): Computational Mathematics and Mathematical Geophysics, Atmospheric Optics, Chemical Kinetics and Combustion, Monitoring of Climatic and Ecological Systems, Solar and Terrestrial Physics, Thermophysics, Theoretical and Applied Mechanics, Systematics and Ecology of Ani-

mals, Soil Science and Agrochemistry, Chemical Biology and Fundamental Medicine, Central Siberian Botanic Garden, Siberian Center for Environmental Research and Training , Baikal Institute of Nature Management, as well as from the other organizations, such as Central Clinic of SB RAS, the Federal Scientific Center of biotechnology "Vector", and the West-Siberian Remote Sensing Center.

The goal of the project is the interdisciplinary studies intended to the solution of the fundamental problems which answering the questions how cities change the hydrometeorological regime and the composition of the atmosphere and how these changes may govern the quality of life, health and environment. One of the practical results of the project should be a methodology of interdisciplinary ecological expertise for assessment of environmental quality and changes caused by the acting or projecting riskful objects. Some stages are provided by the concept of the expertise: scenario assessment of the atmospheric quality changes by means of mathematical modeling with the use of in situ measurements, air monitoring and remote sensing; comparative analysis of the whole number of accessible data on the state of bio- and ecosystems and human health in the regions under investigation; tendency analysis of possible changes under different variants of the human induced loads; revealing the situations characterized by the increased degree of the risk/vulnerability with respect to these loads.

The project's main directions and task activities

1. Numerical modeling as a tool for the knowledge integration and assessment of ecological prospective:

- To develop the models and modeling system of mesoclimates and pollutant transport for the typical conditions of Siberian city taking the large scale circulation as a background.
- To develop the methodology to the solution of the inverse problems designed to revealing the sources of risky pollutants and parameters of the sources with the use of monitoring data.
- To study the possible changes of the city mesoclimates and quality of environment that can be the consequences of the land-use changes.
- To develop the methodology for revealing the preconditions of ecologically negative situations in cities.
- To design the zonation schemes for industrial regions with respect to the degree of ecological risk and vulnerability for biosphere and men

2. Some aspects of atmospheric chemistry as applied to Siberian conditions

- To carry out the analysis of different cycles of pollutants transformation in the atmosphere and the mechanisms of deposition for divers land-use categories.
- To develop the method for assessment of toxic transformation products for the typical sets of substances - precursors in the city

3. Targeted monitoring for providing the studies and specific cases for ecological expertise:

- With the help of mobile laboratories (ground-based and aircraft), to carry out the comprehensive studies of the urban environment of some Siberian cities for providing measurement data on general amount of aerosols, spectral intensity of UV-B, gas and aerosol content of the atmosphere, characteristics of the soil and vegetation cover pollution, etc.
- To analyze the remote sensing results of high spatial resolution for estima-

tion of the areas of anthropogenic changes of the underlying surface in cities and their surroundings.

- To fulfill monitoring of the heat and power plant emissions in some Siberian cities on CO, CO2, NO, NO2, SO2. To work out the recommendations on optimal regimes of the fuelburn plants.

4. Analysis of medical and biological aspects of the life quality and ecosystem dynamics

- Taking Novosibirsk city as an example, to recognize and study the lichenes as well-known indicators of the atmospheric quality in different polluted areas.
- To study of the bio-component of atmospheric aerosols. To analyze and generalize the new and collected data. To develop the approaches to revealing the influence of the bio component of the city-aerosols on the human health.
- To study the soil as a factor putting in the pollution of the atmosphere and plants.
- To study the changes in the biotopes under different antropogenic loads.
- To systematize the knowledge how anthropogenic impact influences on the elements of the environment and human health in the cities.
- To study the possible interrelations between the factors of the environment and human health from the point of view of fundamental medicine.
- To carry out a case study on analysis of the human health, morbidity, life quality in the different microdistricts of the Novosibirsk scientific center with the use of the results of ecological expertise.

5. Informational technologies for providing the project studies

- To design the data bases for some Siberian cities, specific objects, situations, numerical scenarios. On the base of Internet technologies to develop the structure of Internet-accessible data bases.
- With the use of geoinformation system to construct the software for visualization of different kinds of data as electronic maps.
- To design the internet site for presentation of ecological situation of the city Tomsk and its Akademgorodok.

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Integration Project of SB RAS and FEB RAS No 4 Development of informational and telecommunication technologies for monitoring of the environment with the help of data provided by a new generation of satellites

Project Participants: Institute of Computational Technologies SB RAS (Principal Investigator Corresponding Member of RAS A.M. Fedotov; Krasnoyarsk Scientific Center SB RAS (Principal Investigator, Cand. Phys.-Math. Sci. V.M. Vladimirov); Institute of Automation and Control Processes, Far-Eastern Branch of Russian Academy of Sciences (Principal Investigator, Cand. Tech. Sci. A.I. Aleksandrin)

The main goal of the project is a development of the informational and telecommunication tools and technologies for the environmental monitoring relaying on the data provided by a new generation of satellites (TERRA, AQUA, MTSAT). These satellites may provide 5-10 times more information on the fast processes in the ocean and the atmosphere than the widely used NOAA and GMS-5 can do along with the superior spatial resolution and brightness. Specific processes under consideration are as follows: 1) informational support of the fundamental and applied research conducted by FEB and SB RAS on natural and anthropogenic disasters, physics of the atmosphere and the ocean, oceanography, ecology, hydrology, estimation of natural resources etc; 2) monitoring of natural disasters (typhoons, tsunami, bush fires, floods), estimation of their impact, ecological control and forecast; 3) development and design of the joint instrumental and algorithmic base for the regional satellite monitoring (RSM); 4) collection of archives and databases of RSM on the unified instrumental platform; 5) development of the access tools to the SB and FEB informational resources and databases provided by satellites; 6) coordination of the research process; 7) informational support of the business, control of the meteorological hazards and natural disasters, fishery industry, polar navigation, ecological control and forecast (oil spills, air pollution due to different sources, etc), estimation of the snow and water resources.

A communicational channel between the SB RAS and FEB RAS is organized in the framework of the project. ICT SB RAS has developed the technology of integration of the informational resources including data of the satellite monitoring. The Regional satellite centre for the environmental monitoring of the FEB RAS is developing the advanced telecommunication technologies of transfer and processing of the satellite data. Three antenna stations allowed to receive data from the NOAA, FY-1C, FY-1D polar-orbiting satellites; GMS-5, FY-2B, FY-2C, MTSAT geostationary satellites. One antenna is updating now for AQUA/MODIS data reception. Joint processing of various satellite data allows getting complete information on the time and spatial dynamics of the sea surface and in the atmosphere. Different special methods are developed for detection, tracing and evaluation of thermodynamic parameters of the sea surface. The base output products are the calibrated images in Mercator projection (at 1.1 km/pixel resolution). Additional output products include a number of charts and maps: various spectral channels combination, isotherms of the sea surface temperature in 24 and 48 pseudo-thermal colors, sea surface current velocity vectors, calculated manually using feature tracing method, thermal structures on the base of dominant orientations of the thermal contrasts. All output products have been tested during the real operational work.

To access the satellite data of the FEB RAS Centre, a site has been developed *(*http://www.satellite.dvo.ru*)*. The user interface allowing a remote user to make a request for satellite data processing has been developed, as well as a request registration and user identification facility. Web and the ftp interfaces have been developed for both interactive and automatic access to data and metadata (ftp://ftp.satellite.dvo.ru).

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Science researches in the area of cryology of the Earth

Institute for Earth Cryosphere of SB RAS (director – Academician V.P. Melnikov, member of Belgium Royal Academy of Science) implements researches on the problems of global changes of cryolitezone under the influence of natural and anthropogenic factors. There are 3 integration programs of Presidium SB RAS: "Dangerous natural phenomena on the surface of the land: mechanism and catastrophic consequences"; "Fundamental problems of oceanology: physics, geology, biology, ecology" and "Natural processes in Polar Regions of the Earth and their probable development in the nearest decades".

The project "Fundamental problems of functioning and evolution of cryosphere under conditions of global environment changes" has allowed bringing out regularities of spreading and dissymmetric changes of permafrost thicknesses, cryogenic processes and conditions. They are concerned with the dynamics of natural exo- and ennogenious factors, technogenous influences, which can be used as a basis of rational nature management planning when anthropogenic loading in Russia is growing.

There are cartographic informational models, realized as a kind of computer digital sheet with a different level of generalization with proper databases. On it basis estimation's method of changing tendencies of unstable natural zones in West Siberia and in Russian cryolitezone were working out. Bases include descriptions of compound, ice content, temperature and depths of rock's frost penetration – thawing; landscape's, geomorphologic, geological and engineering-geocryological conditions, spreading of exogenous geocryological processes, climatic parameters and others. Analysis of interconnected cartographic informational models of global, regional and local levels of generalization and replenishment of databases have provided creation of series of small-scale prediction charts and script's development of possible changes of landscape-geocryological conditions in developing regions of Siberia in XXI. There are some researches of factors, defining global changes, such as developed numerical model of Solar System, the numerical decision program of Earth rotatory movement for calculation the evolution of insolation and for comparison with dynamics of changing of cryosphere processes.

The results were received, defining more precisely theoretic statements about

cryogenic and accompanied physico-geologic processes in different environments. They allow to make a prognosis about cryolitezone, pollutions in arctic water area, receipt of gaseous streams in composition of atmosphere and to appreciate its secondary influence on a dynamics of upper border of permafrost thicks – active layer at the time of global climate changes.

The project "Dynamics of Russian Arctic's seacoasts" combines all complex of problems of land and Arctic Ocean co-operation. For previous last years regularities of seacoast dynamics have been studied and unique Geo-Information System of Russian Arctic seacoasts has been worked out. It contains detailed information about all arctic coasts, including facts about their landscape structure, geology, geomorphology, geocryology, dynamic type and quantitative characteristics of their actions. Estimating co-operation of land and Arctic Ocean influence of global environmental and climate changes, increasing of World Ocean's level are considered.

It was for the first time when on the basis of detailed field researches reliable balance was made, and the role of seacoasts in reception of hard material, organic carbon and soluble salts at the Arctic shelf was appreciated. First quantitative estimations of releasing hothouse gases influence on the atmosphere composition's changing were realized at the time of Arctic seacoasts destructions. The foundation for research of fundamental problem: subaqua cryogenic thickness forming and dynamics at the Arctic shelf was created. These researches have fundamental character, but they moreover have a big value, mainly because of oil and gas fields opening at the Russian Arctic.

The project "Cryolitezone and natural processes in seacoast shelf area of Eurasia polar seas" is carrying out with co-operators PI SB RAS, INREC SB RAS at the direction "Surface glaciation and permafrost of polar regions" program P-34. Researches are aimed to study the conditions of underwater permafrost forming and evolution, and the end of the Geo-Information System seacoast creation. The main target of the program – intensification of fundamental researches of Polar Regions of the Earth and preparation to the International Polar Year planned on 2007-20008. Besides new scientific workings for each project, plan of this research's developing during International Polar Year should be prepared, as the result of this year. Its necessary to work out the main ideas of coming researches, plans of their conduction, the ways of collaboration with other scientific organizations in Russia and abroad, to plan a list of data, which are proposed to get, to define a method and place of their keeping and ways of exchange.

The institute executes international projects: Coast Dynamics in Arctic Region (ACD, 2001-2004) and Circumpolar active layer monitoring (CALM, 2000-2003; 2004 - 2007). Activities on the projects include realization of researches on different objects of cryolitezone, monitoring of its characteristics - landscapes, temperature conditions, active layer etc. As a result of execution the international legend is developed, GIS-databases are created, the cards of geocryological conditions and vegetation in different scale, including electron versions, are issued. The Academician V.P. Melnikov is a representative of Russia in International association of cryopedology and chairman of Scientific council of cryology of the Earth PAH.

Since 1996 the institute organizes an annual International conference, integrating cryological researches of lithosphere, biosphere, hydrosphere, technosphere, cryology of Solar system's planets, assessments of interaction of engineering structures and meth-

odology of rational nature management in cryolitezone. Since 1997 the magazine "Cryosphere of the Earth" (kriozem@online.ru) is issued. Educational centers, the chair "Cryology of the Earth" and SubArctic scientific-educational ground, where will be conducted international student's practice, are created in Tyumen State Oil and Gas University.

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International Scientific-Technical Center Project № 2757 "Response of biogeochemical cycles to climate changes in Eurasia"

Under the project a scientific observatory with a tower (300 m) is built in a far from industrial centers region to prove an assumption that significant trends in an atmospheric-ecosystem interchange are caused by warming of last decade. Siberian measurements will be conducted in parallel with measurements from a tower in Northern Bavaria (Germany). The tower region in Germany covers a huge industrial and agricultural region and will be a contrast with Siberian measurements region with a homogeneous forest landscape. The stable isotopes are planned to use in order to distinguish anthropogenic and biological flows. These measurements include 13C/12C in CO_2, CH_4 and CO, 18O/16O in CO_2, 15N/14N in N_2O, and a correlation O_2/N_2. During the project the data will be used received in course of ground-based observations conducted by two partner-institutions in the sphere of forest valuation, dynamics of plantations growth, forest fires dynamics and in the field of exchange processes between ecosystem and atmosphere for a representative set of ecosystems which are typical for this region. Further modeling of atmospheric and biogeochemical processes will serve to interpret atmospheric observations and connect them with seasonal and annual vegetation changes.

The project activity includes

1) Tower and laboratory construction in Central Siberia (90 E, 60 N);

2) Permanent measurements of concentrations and flows of atmospheric compo-

nents connected with a carbon cycle and meteorology;

3) Regular air sampling from a tower and delivery of the samples to Krasnoyarsk and Jena for further analysis.

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The Terrestrial Biota Full Carbon Budget at National and Regional Scales

At present a post-Kyoto negotiation process considers a *partial* carbon budget associated with land use, land-use change and forestry (LULUCF). LULUCF activities reported under the Kyoto Protocol include those that are mandatory under Article 3.3 (direct human-induced afforestation, reforestation and deforestation activities since 1990), and those that are voluntary during the first commitment period under Article 3.4 (forest management, grazing land management, and revegetation). However, it is obvious that only the *full* carbon budget (FCB; or, more accurately, the full account for major biogeochemical cycles) meets the requirements and eventual goals of the UN Framework Convention on Climate Change. Over the last decade, the International Institute for Applied Systems Analysis (IIASA) in collaboration with Russian institutions (V.N. Sukachev Institute of Forest of the SB RAS, Krasnoyarsk; V.V. Dokuchaev Institute of Soil, Moscow; Far Eastern Forestry Research Institute, Khabarovsk; and others), as well as with a number of foreign partners carried out investigations on developing a methodology and estimating the full carbon budget of the terrestrial ecosystems of Russia as a whole and for a large region of Middle Siberia.

At both continental (national) and regional scales the methodology of perceiving the carbon cycle starts with recognizing that it is a very complex dynamic open fuzzy system formed by complicated combinations of non-stationary stochastic processes. The main scientific goal of the full carbon account (FCA) is to minimize the uncertainties of estimating the results. The peculiarities of the assessment's system define that it is necessary to (1) apply the principles of systems analysis as comprehensively as possible, and (2) integrate different information sources, methods and models. In its 'ideal' form, the FCA is realized as a system integrating methods that describe carbon fluxes and dynamics of carbon pools; a comprehensive description of natural landscapes and ecosystems in an Integrated Land Information System (ILIS); uses data from monitoring land cover and condition of ecosystems (based on a multisensor remote sensing concept) and relevant combinations of different types of ecological models. Direct measurements of fluxes and atmospheric concentrations are used for the parameterization of models. Inverse modeling serves as a tool for independent control. ILIS is represented as a multi-layer GIS (including digital maps of landscapes, soils, vegetation, land cover, etc.) and associated attributive databases. A landscape-ecosystem approach is the basis for modeling the main FCA components. The estimation results are presented by a spatially-distributed structure that describes the dynamics of carbon pools and fluxes by landscape units of a reasonable scale. Collection of experimental data of various types, their synthesis and analysis as well as the development of semi-empirical mod-

els (particularly those that relate remotely sensed parameters to the FCA components) is an important part of the approach.

On **the country scale**, it has been shown that Russian vegetation ecosystems sequestered 0.35 Pg (= 10^{15} g) C $year^{-1}$ during 1988–1992, i.e., the initial period of the Kyoto Protocol (Figure 1). The Net Primary Production (NPP) and heterotrophic respiration (HR) are basic FCB components. However, fluxes caused by natural and human-induced disturbances and the consumption of plant products (i.e., a "manageable" part of the FCB) are substantial and can reach 20% of the NPP. The uncertainties of assessing Net Biome Production are within the limits of 50%. However, it is necessary to take into account that this result refers to a 5-year average and was obtained by an inventory approach that includes some 'hidden' averaging of results over time.

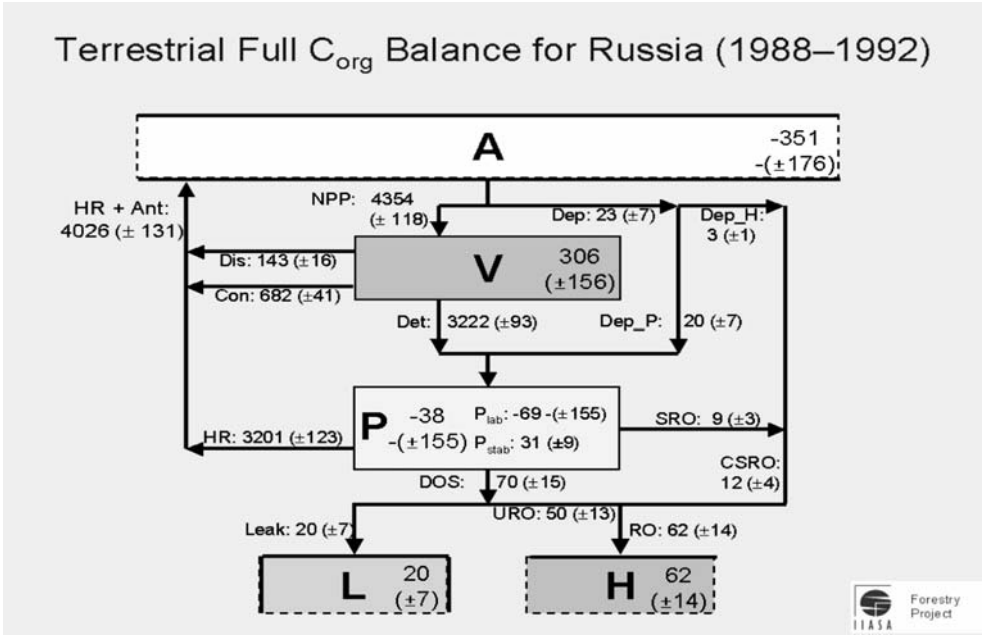

Fig. 1: The full carbon budget of vegetation ecosystems of Russia (annual means of fluxes and changes of pools from 1988–1992). All values are in Tg C (= 10^{12} g) * $year^{-1}$. Pools: A is atmosphere, V is vegetation, P is soil (divided into 2 C pools – labile and stable organic matter), L is lithosphere, and H is hydrosphere. Fluxes: NPP is Net Primary Production, Dep is dry and wet deposition, HR is heterotrophic respiration, D and Cons are fluxes resulting from disturbances and consumption of plant material; Det is detritus; WT (water transport of carbon) as a sum of surface runoff (SRO) and under-ground runoff (URO); DOC is dissolve organic carbon; TL and TH are the transportation of carbon into the lithosphere and hydrosphere, respectively. Estimated uncertainties (in parentheses) are for the confidence probability of 0.9.

Based on model modifications of the influence of environment characteristics on the main FCB components, estimates of the dynamics of fluxes caused by natural and human-induced disturbances, land-use/land-cover dynamics, data of land and forest inventories, etc., it was shown that in 1998–2002 ecosystems in Russia sequestered, on average, at 520 ± 128 Tg C $year^{-1}$ from the atmosphere, of which 78%relate to forest, forest-bog and bog systems. The inter-annual variability of the main components of the FCB is very large; the annual carbon sink values during this period varied from 180–750 Tg C $year^{-1}$. It was also shown that the often discussed "missing sink" does not exist in the FCB frameworks, but results from incomplete partial accounts.

The FCB estimation on the regional scale has peculiarities relating mainly to the possibility of operatively monitoring environmental parameters and a more detailed representation of the state and dynamics of land cover. This predetermines the necessity for the system application of remote sensing methods. Two large scale projects of this type were recently carried out by European and Russian institutions (7 and 4 partners, respectively) in Middle Siberia. The projects were financed by the European Union and coordinated by the Friedrich-Schiller-University, Jena, Germany (Prof. C. Schmullius). The project, SIBERIA (SAR Imaging for Boreal Ecology and Radar Interferometry Applications), studied the possibilities of applying synthetic-aperture radars from European (ERS-1 and ERS-2) and Japanese (JERS) satellites. As a result, forests in the south of Middle Siberia have been mapped at 1:200000 scale (about 100 map sheets have been produced) on an area of about 100 million hectares since 2000. The results show that this method has a high sensitivity in identifying areas having moderate above-ground phytomass, which allows to the reliable detection of rapid changes of land cover due to disturbances or reforestation; to estimate above-ground phytomass of non-forest and unforested lands, as well as to reliably update forest inventory data. The use of advanced radar technologies (pixel of 20 m) in stable winter conditions allows the evaluation of forest growing stock and above-ground phytomass with an accuracy of ± 20–30% within a stand. However, accuracy decreases for a growing stock value that exceeds 120–150 m^3 ha^{-1}. At the same time, the threshold saturation values are relatively low (30, 50 and 150–200 t/hectare at wavelengths of ~6 cm (C band), ~24 cm (L band) and ~70 cm (P band), respectively), and there are essential limitations imposed by mountainous reliefs. There have been no radars operating at the P band of the satellites, although ESA and NASA are currently discussing the possibility of launching a satellite that will allow estimating 80–90% areas of boreal forests with an accuracy of 10–15 t* ha^{-1}.

The SIBERIA-II Project (Multi-Sensor Concepts for Greenhouse Gas Accounting of Northern Eurasia, 2002–2005) created a prototype of a modern FCB accounting system for large territories of boreal and temperate zones and demonstrated progress following the system application or remote sensing (~20 various sensors operating in different spectral bands were examined) in combination with information from other sources (e.g., forest inventory data). These data were applied to two well known Dynamic Global Vegetation Models (DGVM, LPJ and SDGVM models) adapted to the region, and to a landscape-ecosystem method that is being developed by IIASA in collaboration with Russian science and forest management institutions. With respect to remote sensing methods, promising results have been obtained in delineating and estimating the dy-

namics of land cover classes; assessment of reforestation processes; identification of burnt forests and other disturbances; parameterization of fire intensity (which is of critical importance for reliably estimating fire emissions); estimating phenological, climatic and other environmental parameters that are used in almost all models (characteristics of vegetation period; hydrological parameters, such as snow depth and water content; dynamics of soil thawing and freezing; parameters important for the process models, such as leaf index, absorbed fraction of photosynthetically active radiation, etc.); and a number of other results. At the same time, the satellite methods do not fulfill all of the information requirements needed for the FCA, and significant synergism is achieved when using remotely sensed data in combination with other information sources.

The multi-layer GIS developed at 1:1 million scale contains an exhausting digital characteristic of ~30000 polygons (the total area of the region is above 300 million ha) in a unified hierarchical classification of land cover. The parameterization of polygons is represented by a detailed description of ecosystems including basic components of the full account of major greenhouse gases (such as the carbon and nitrogen content in different pools, the factional composition of phytomass, NPP, HR, N_2O and CH_4 emissions, and many other characteristics). The 'regionalization' of DGVM (e.g., the implementation of real instead of potential land cover; development of special regional blocks of processes, e.g., such as permafrost influence on hydrology and ecosystem productivity, etc.) makes the results obtained with this type of model much closer to the "real world" and provides important information for understanding the ecosystem functioning in a changing environment, although it does not yet provide an accuracy on a regional scale. On the other hand, inter-seasonal variability of the major FCB components is large; therefore applications of the 'semi-empirical' landscape-ecosystem approach require corrections of the results based on implementing weather conditions and other environment characteristics of individual vegetation seasons. Uncertainties of major FCB parameters on a regional scale appeared to be two times less than those calculated for the whole country.

In the frameworks of the above projects, numerous databases have been compiled for different types of experimental measurements; 'semi-empirical' models of different types were developed Ï growth of main forest forming species of the country; phytomass dynamics in forest ecosystems; transformation of organic matter, etc. The already started processes of acclimation of Russian forests to climate change was experimentally confirmed. An original method of NPP estimation has been developed. The application of this method confirmed the hypothesis expressed earlier, namely that the previously reported forest NPP is underestimated. The new NPP value for the country's forests is estimated to be 306 gC m^{-2} $year^{-1}$ (based on forest inventory data for 2003), which is a third higher than previously estimated (which were based on the database prepared by N.I. Bazilevich, 1993).

The results of the above projects confirm the principal importance of a systems approach to solving the problem. With respect to information supply, the fundamental decision consists of the development and implementation of integrated observation systems, which are understood as continuously functioning monitoring systems covering all biosphere components (land cover, atmosphere and hydrosphere) involving specialization And at reasonable periods of time.

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IIASA Forestry Project

International Institute for Applied Systems Analysis (IIASA), located in Laxenburg, Austria, is supported by 16 countries from Africa, Asia, Europe and Northern America. Russia is one of the founders of the Institute. At IIASA international and interdisciplinary research are carried out in the field of environment, economics, new technologies, contemporary ecological and social problems. Being, *per se*, an institute of global changes studies, IIASA investigates urgent problems associated with the biosphere state and dynamics, contemporary energy problems, economics of transitional world, plant ecosystems, demography, transboundary pollution transport, water resources, dynamics of land use and land cover, theory and application of the system analysis. The system analysis and mathematical modeling are the basic constituents in the scientific methodology of the Institute research. Founded in 1972, IIASA is well known nowadays as a leading research center of international collaboration, organizer of a number of conferences and symposia and an important element of the world research community and organizations studying global changes.

IIASA Forestry Project considers the planet forests as the most important natural system, as an object and a moving power of environmental stability and as the most important factor for existence of human society itself. Within recent 15 years the Project paid special attention to boreal forests and, in particular, to Russian forests as the objects of the global scale. Despite wide spreading natural and anthropogenic disturbances in boreal forests, they are still one of the most stable forest systems on the globe. However, extreme climatic changes are expected to be exactly here (in high-latitude Eurasia, in particular, in Siberia), that challenges the boreal ecosystem stability and a fate of giant carbon amount accumulated in both forest and bog ecosystems of boreal biome. At the same time, boreal forests are the most important source of raw materials and in fact only these forests have sufficient potential for satisfaction in the nearest future of rising world needs in timber. Therefore qualitative assessment of boreal vegetation role in the contemporary and future global climatic systems as well as development for boreal forest of adaptation strategy to global changes and mitigation of undesirable consequences of such changes are problems of high international importance. That is why IIASA in collaboration with many Russian institutes (in some years forest research network organized by the Project in Russia included up to 20 research and industrial organizations), studied state, dynamics, raw material resources and biosphere role of Russian forests. Philosophical basis for these studies is in the fact that only knowledge of total budget of the main biophilic elements can make a basis for purposeful efforts of the world society applied to restraining negative climatic changes. All this resulted in development of a system methodology for assessment of biosphere role of forests realized in a number of projects within recent decade (such as *Total carbon budget of plant ecosystems in Russia, SIBERIA, SIBERIA-II*).

Conservation and maintenance of resource potential, vitality, biosphere and ecological functions of the world forests require purposeful forest policy and management. In 1988-1996 the IIASA Forestry Project studied possibilities of transition to stable forest management in Russia as well as made a number of attempts to apply in practice the results obtained by means of organizing professional and public seminars in 5 forests regions in Russia. The Project presented basic reports

on global and Russian forest states at many international symposia and congresses, for example, World Committee on Sustainable Development and Forestry, XII International Forest Congress, IUFRO congresses. The Project regularly presents assessments of the state and tendencies in forest dynamics in a number of summary publications.

The plan of operation of IIASA Forestry Project accepted for 2006-2010 intensifies tendencies of forest system analysis on the global scale. The beginning of the third millennium presents an essential change in human – forest interaction paradigm. World forest management and potentialities of international and national influence on this process become one of the governing problems in forestry. One of the corner stones in transition to stable management is step-by-step implementation of high technologies and knowledge of ecology and forestry. These problems, against a background of dominating importance of forests as an environment forming factor, are the kernel points in the future Project activity. Research activity aimed at management of forest carbon budget on the global scale is also of prior importance. INSEA project (Integrated Sink Enhancement Assessment) coordinated by the Forestry Project is an example of such activity. This funded by the European Union project develops system methods and analytical tools for estimating impact of carbon sink enhancement and decrease of greenhouse gases emission in agriculture and forestry on economics and environment. Global considerations obtain special sense when they are practically implemented. That is why the Project plans to advance in-depth research into forestry of such important countries as China, India and Russia.

Detailed information on IIASA Forestry Project is available on www.iiasa.ac.at/Forestry

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Enviro–RISKS: Man-induced Environmental Risks: Monitoring, Management and Remediation of Man-made Changes in Siberia (FP6 INCO CA project, 2005-2008)

Partners:

Danish Meteorological Institute (Co-ordinator), Copenhagen, Denmark; Siberian Center for Environmental Research&Training (NIS Co-ordinator), Tomsk, Russia; Max-Planck-Institut fuer Biogeochemie, Jena, Germany; International Institute for Applied Systems Analysis, Laxenburg, Austria; Institute for Numerical Mathematics RAS, Moscow, Russia; V.N. Sukhachev Institute of Forest SB RAS, Krasnoyarsk, Russia; KazGeoCosmos, Almaty, Kazakhstan; Ugra Research Institute of Information Technologies, Khanty-Mansisk, Russia; Institute of Monitoring of Climatic and Ecological Systems SB RAS, Tomsk, Russia; and Institute of Computational Mathematics and mathematical Geophysics SB RAS, Novosibirsk, Russia.

Context and objectives:

Siberia environment has been subjected to serious man-made transformations during last 50 years. Current regional level environmental risks are: direct damages to environment caused by accidents in process of petroleum/gas production and transporting; caused by deforestation variations in Siberian rivers runoffs and wetland regimes; influence of forest fires, flambeau lights and losses of gas and petroleum during their transportation on regional atmosphere composition; deposition of hazardous species leading to risks to soil, water and consequently to risks in the food chain.

Strategic objective

Strategic objective of the project is to facilitate elaboration of solid scientific background and understanding of man-made associated environmental risks, their influence on all aspects of regional environment and optimal ways for it remediation by means of coordinated initiatives of a range of relevant RTD projects as well as to achieve improved integration of the EU research giving the projects additional synergy in current activities and potential for practical applications.

Scientific background is formed by a number of different levels RTD projects devoted to near all aspects of the theme but in virtue of synergy lack not resulting in improvement of regional environmental situation. The set comprise coordinated/performed by Partners EC funded thematic international projects, Russian national projects and other projects performed by NIS Partners.

One of the project tasks is a possible development of Siberia Integrated Regional Study (SIRS). Accordingly to present knowledge, Siberia is the region where the most pronounced consequences of climate changes already happen and will happen. Various models have been developed to address different dimensions of this issue. Variability in space and time as well as regions of critical importance ("hotspots") have been evidenced through in situ and remote sensing measurement techniques and were forecasted by advanced climatic models. Siberia environment has been subjected to serious man-made transformations during last 50 years. Current regional level environmental risks are: direct damages form accidents on nuclear enterprises and transportation of nuclear materials as well as long term influence on neighborhood of those via air and water transport of radionuclides; direct damages to environment caused by accidents in process of petroleum/gas production and transporting including their influence on water, soil, vegetation and animals; caused by deforestation (cutting and forest fires) variations in Siberian rivers runoffs and wetland regimes; direct and indirect influence of forest fires, flambeau lights and losses of gas and petroleum during their transportation on regional atmosphere composition; deposition of hazardous species leading to risks to soil, water and consequently to risks in the food chain. These regional problems are typical for number of NIS and some European countries, whose territory are crossed by pipelines and/or are used for petroleum production and for near all Northern countries.

Elaboration of solid scientific background and understanding of man-made associated environmental risks, their influence on all aspects of regional environment and optimal ways for it remediation is required to get practical results in enhancing of environment and diminish environmental risks. The region requires a new research paradigm. An overarching vision of regional aspects and its various connections to global aspects is now needed in line with the defined by the Earth

System Science Partnership Integrated Regional Studies (IRS) approach, which could lead to Siberia IRS (SIRS) program. This requires bringing together scientists from several disciplines and sub-regions into a much wider approach and setting up the relevant structures (institutions, regional and trans-regional and international networks, funding) to lead such integrative studies. Results of such studies should be bridged with and acknowledged by relevant decision policy makers in order to implement proper mitigation and remediation actions at managerial and political decision levels.

Activities:

The main activities, aimed at realization of the Enviro-RISKS objective and coordination of number (18) of environmentally oriented Projects, will be realized into 11 interrelated workpackages and include:

- Development and support of the Project web portal and environmental information distributed database;
- Gathering and systematization of information resources obtained;
- Gathering, analysis and synergy search in different level projects on Siberian environment;
- Organization of first conference and experts meeting;
- Preparation of technical implementation plan on finished Projects;
- Gathering of information on recently started projects in Siberia;
- Search for synergy between the different projects on Siberian environment and elaboration of recommendation for new Projects;
- Organization of second conference and experts meeting;
- Documentation and dissemination;
- Exchange of research personnel and postgraduates.

Expected results and outcomes:

Direct impact of the Project is in elaboration of on the base of dedicated studies of the expert groups practical recommendations for regional level activities in basic and applied environmental problems solving. It includes based on satellite remote sensing methods, local measurements and numerical modeling early detection and monitoring of accidents in process of petroleum/gas production and transporting including their influence on water, soil, vegetation and animals; appearance of new forest fires and flambeau lights, variations in Siberian rivers runoffs and wetland regimes; best approaches to mitigate environmental risks in process of industrial activity in the region and modern technologies for remediation of damaged territories.

Strategic impact of the CA is in dissemination of effective approaches and tools for monitoring, management and remediation of man-made environmental risks in Siberia and in suffering from similar problems regions of NIS. Due synergism and synchronization in project performance it also improves the state-of-the-art of Environmental Science and applications in Russia, NIS and EU. Elaborated by the expert groups practical recommendations being implemented at the Siberian federal District will lead to improvement of well being and security of local population.

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CIRCLE - Climate Impact Research Coordination for a Larger Europe (EC ERA-NET project, 2005-2009)

Climate change is increasingly seen as one of the greatest issues facing the world in the 21st century, and Europe is taking a leading role in responding to its challenges. Climate change impacts have enormous economic implications – at the regional, national and European level (cp. various analysis of re-insurance companies). Impacts of Climate Change do not stop at borders but require cross-border cooperation in all aspects.

CIRCLE plans to foster such European cross-border cooperation regarding national research activities taking a crucial look on the topic of socio-economic developments from Climate change impacts. Whatever the success of mitigating climate change may be, certain impacts are unavoidable and European countries will need to adapt to those impacts. Their adaptation response must be informed by a coherent body of research and it is CIRCLErs prime objective to contribute to such efforts by aligning national research programmes using a complete application of the ERA-Net principles.

Presently, numerous excellent groups work at national level on Climate Change impacts. The FP6 funds research projects with European consortia, but there is a strong lack of cooperation between national research programmes on climate change impact and weak administrative linkages between national research programmes and the FP6.

CIRCLE initiates enhanced cooperation of national programmes within the EU (including the new member states). It provides a platform for cooperation activities among programmes, establishes a sound knowledge base on national activities and prepares the base for a multi-national network of research programmes throughout Europe. As an ERA-Net SSA of partners from 7 countries, CIRCLE already established a sound basis for cooperation, an information base for national programme scientific content and management structures and through this preparatory work paved the way towards this CIRCLE CA project with 17 countries taking part in it and remaining open for additional regional and national pertinent programmes.

The means of integration comprise four serial activities leading to an in-depth integration. The partners aim to learn about each others programmes, will plan how to address specific issues (e.g. legal and financial constraints and evaluation procedures) and then will start to connect their research programmes by aligning their research agendas and management procedures in order to fulfill an in-depth integration by providing options for col-laborative research (four options, including a geographical return principle). Four cross-cutting activities will support this process. The coordinator will lead the action; the partners will address how to continue the integration beyond the life of the CA. The programmes will be enabled to group on a geo-climatic/socioeconomic scale (e.g. Mediterranean countries, Nordic countries, Continental central and Eastern Europe, Alpine/Mountainous countries and Atlantic coastal countries) to address specific regional transboundary impacts. Knowledge will be spread to stakeholders by designed interaction processes.

Long-term objective of the Project is a strong network of European research programmes in this field with multi-national joint calls and strong cooperation with the FP7. To reach this goal, CIRCLE will establish new

contacts, arrange conferences and workshops with research programme managers and research policy makers, analyse funding mechanisms and structures for the different national programmes, establish working groups regarding management/financing mechanisms and evaluation structures of programmes, exchange best practices and set up a preliminary database of experts, advisors and evaluators.

Although Climate Change Impact and adaptation needs form an international phenomenon, pertinent research funding mechanisms are not yet sufficiently coordinated in Europe. This field of research is very dynamic and new programmes emerge as successors of old programmes or are being initiated especially in the new member states and in Eastern Europe. Owing to this dynamic state, a systematic approach of research coordination is urgently needed.

The essential objective of CIRCLE is to coordinate European research on Climate Change Impact Assessment and Adaptation to facilitate the research needed by European and national decision makers to design effective yet economically efficient and feasible adaptation strategies.

CIRCLE defines a clear focus by including Assessment and Adaptation issues and by excluding mitigation efforts. The chosen field of research encompasses a wide range of disciplines and scientific and policy questions.

The Associated Partners including Institute of Monitoring of Climatic and Ecological Systems (IMCES) SB RAS, Tomsk, Russia, are a valuable component of CIRCLE, because they actively take part in the exchange among the programmes and, although to a smaller degree than the consortium members, contribute to certain Tasks. Each of the Associated Partners puts some valuable expertise and qualification into CIRCLE and, in return, benefits from the exchange with all of the members of the project. The general purpose of associating organisations to CIRCLE is to enable the establishment of new pertinent research programmes in the respective countries or regions to fully join CIRCLE in the future. The developed by IMCES and the Siberian Center for Environmental research and Training Siberia Integrated Regional Study is one of examples of such programmes.

CIRCLE will remain an open partnership. Most of the pertinent research programmes in Europe are now integrated in this initiative, but few still are not. New programmes will likely be installed, especially by the current Associated Partners, which will then change their eligibility status. CIRCLE offers further partners that they be included as consortium members, provided the Commission will support this desire.

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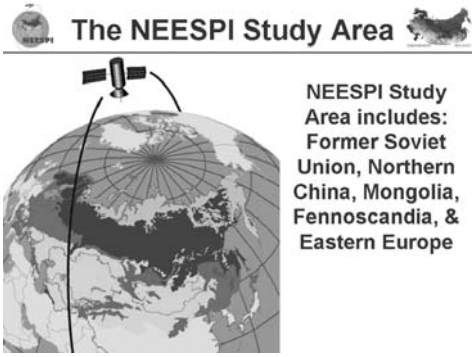
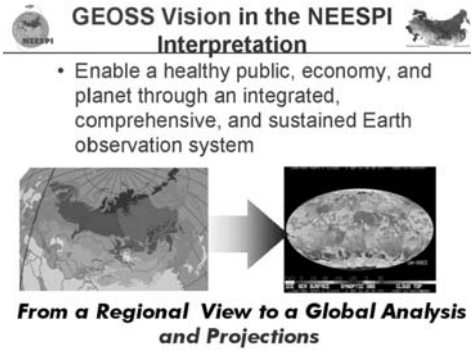
Northern Eurasia Earth Science Partnership Initiative (NEESPI)

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. NEESPI addresses all Northern Eurasian ecosystems and needs to draw on all environmental scientific disciplines during the coming decade. Northern Eurasia is undergoing rapid and significant changes associated with warming climate and with socio-economic changes during the entire 20th century. Climatic changes over this largest land mass in the northern extratropics (and ~ 20% of the global land mass) interact and affect the rate of the Global Change through atmospheric circulation and (which is a unique feature of the region) through strong biogeophysical and biogeochemical feedbacks. These feedbacks arise from changes in surface energy, water, and carbon budgets of the continent. How this carbon-rich, cold region component of the Earth system functions as a regional entity and interacts with and feeds back to the greater global system is to a large extent unknown. Thus, the capability to predict future changes that may be expected to occur within this region and the consequences of those changes with any acceptable accuracy is currently uncertain and hampers projections of the Global Change rates.





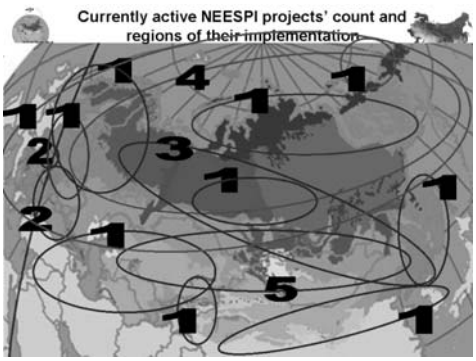
One of the primary reasons for this lack of regional Earth system understanding is the relative paucity of well-coordinated, multidisciplinary and integrating studies of the critical physical and biological systems. Furthermore, the critical measurements needed to monitor changes in the area are not available. **NEESPI strives to understand how the land ecosystems and continental water dynamics in northern Eurasia interact with and alter the climatic system, biosphere, atmosphere, and hydrosphere of the Earth.** Its overarching Science Question is: ***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?*** The foci of the NEESPI research strategy are the deliverables, which support both national (e.g., the National Climate Change Science Programs) and international science (e.g. IGBP) programs. Major NEESPI-related research deliverables, in approximately ten years, will be a suite of process–oriented models for each major terrestrial process in all its interactions; a suite of global and regional models that seamlessly incorporate all major regionally specific feedbacks associated with terrestrial processes; an

integrated observational knowledge data base for environmental studies; and an environmental hazards warning system in place that can serve the emergency needs of the society. A synergetic approach to projections of the future changes is a core of the NEESPI.

NEESPI Science Plan Preparation Team (that worked in 2003-2004) included more than 90 scientists from 11 countries with the majority of them being from the United States and Russia. From the beginning, three terms characterize the NEESPI: ***Global, Interdisciplinary, and Active.***

- **Global** - Priorities were assigned to projects and topics that address regional changes that affect (or may affect) Global Earth System
- **Interdisciplinary** –It was early recognized and shown in examples, that strong interactions within the system terrestrial ecosystem, hydrosphere, cryosphere, atmosphere, and human society in the region require interdisciplinary studies
- **Active** - Preparation of the NEESPI Science plan (2003-2004) occurred simultaneously with pilot projects initiation and the writing of proposals (some of them have been already funded)

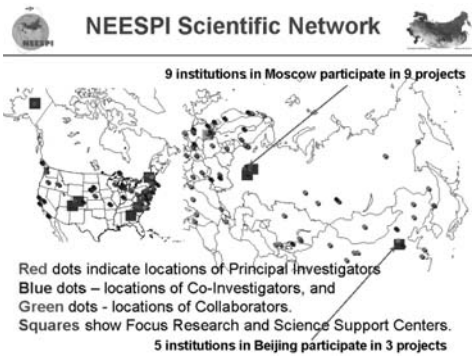
Over the past three years the NEESPI Science Plan has been developed, peer-reviewed and adopted (http//:neespi.org), and NEESPI scientists have secured funding for more than twenty five new research projects mostly through NASA but also through NOAA, NATO, Russian, Chinese, and Finnish Academies of Sciences, and EU INTAS Programs. Figures in this page provide the current NEESPI statistics (as of July 2005) only for funded projects. Always peer-reviewed and with international participation these first–tier projects cover a broad spectrum of the Earth Science disciplines in the region. Another 25 NEESPI related projects are currently waiting for decisions from funding Agencies. Among the first NEESPI public steps were:



- Presentations at the International Conferences, including Open Science Sessions at the American Geophysical Union Fall Meeting (San Francisco, USA, December 2004) and at the 31st International Symposium on Remote Sensing of Environment (St. Petersburg, Russia, June 2005),
- Proposals to the International Polar Year,
- Preparation of the special NEESPI issue of "Global and Planetary Change" journal, and
- Establishment of the network of the NEESPI Focus Research and Science Support Centers in the United States, Russia, China, and Germany.

As a result of these steps, NEESPI is widely recognized and endorsed as being potentially valuable to the international scientific community for development of the scientific plan that fostered regional research and has already created scientific research partnerships around the world. Several International Projects such as Global Water System Project, Global Carbon Project, Global Land Project, and the WCRP Climate and Cryosphere Project endorsed NEESPI while major Earth Science Programs (in particular, IGBP and WCRP) have been requested to consider NEESPI as their *Integrated Region-*

al Study Programs. During the Science Plan preparation phase, most of the NEESPI logistics and scientific coordination work has been conducted by volunteers and/or within separately funded activities of NOAA, NASA, Roshydromet and Russian Academy of Sciences. Now, with up to 50 projects to be activated in the next year within the Initiative, it became an imperative to coordinate them within the NEESPI Integrated Regional Study Program. The NEESPI benefits will only be realized through strong leadership and an active ongoing coordination function of the Program. It will provide synergism, build common infrastructure, minimize duplication for research activities involving agencies and nations, and will harmonize scientific work across disciplines and cultural groups.



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AVHRR-based mapping of fires in Russia: New products for fire management and carbon cycle studies

Project NASA NRA-04-OES-01: Modeling and Monitoring Effects of Area Burned and Fire Severity on Carbon Cycling, Emissions, and Forest Health and Sustainability in Central Siberia (2004)

The need for a consistent, broad-scale approach to mapping fires globally has led to several recent initiatives to detect and characterize fire using satellite remote-sensing systems The documentation of when and where fire has occurred is important for understanding fire's impact on the land and atmosphere. Fire and land managers need accurate maps of past fire so they can manage the landscape. Climate researchers are interested in quantifying burned area to understand how emissions from fire affect the atmosphere. Programs such as the International Geosphere–Biosphere Program (IGBP) and Global Observation of Forest and Landcover Dynamics (GOFC/GOLD), an international program under the Global Terrestrial Observing System (GTOS), have encouraged an integrated and comprehensive accounting of global fire and have promoted the use of remote sensing methods. The extensive area and remote nature of much of boreal Russia make remote sensing an important source of information for studying fire and the consequence of fire in this region.

In this project, a new database of fire activity in Russia derived from 1-km resolution remote sensing imagery is presented and discussed. The procedure used to generate this burned-area product is described, including active-fire detection and burn-scar mapping approaches. Fire detection makes use of a probabilistic procedure using image data from the United States National Oceanic and Atmospheric Administration's (NOAA) advanced very high resolution radiometer (AVHRR) system. Using the combination of AVHRR data collected at the Krasnoyarsk, Russia, high-resolution picture transmission

(HRPT) receiving station, and data from the NOAA Satellite Active Archive (SAA), fire maps are being created for all of Russia for 1995 to 1997 and all of Eastern Russia (east of the Ural Mountains) for 1995 to 2002. This mapping effort has resulted in the most complete set of historic fire maps available for Russia. An initial validation indicates that the burned-area estimates are conservative because the approaches do not detect smaller fires, and, in many cases, fire areas are slightly underestimated. Analyses using the fire database showed that an average of 7.7_106 ha yr_1 of fire occurred in Eastern Russia between 1996 and 2002 and that fire was widely dispersed in different regions. The satellite-based burned-area estimates area were two to five times greater than those contained in official government burned-area statistics. The data show that there is significant interannual variability in area burned, ranging between a low of 1.5_106 ha in 1997 to a high of 12.1_106 ha in 2002. Seasonal patterns of fire are similar to patterns seen in the North American boreal region, with large-fire seasons experiencing more late-season burning (in August and September) than during low-fire years. There was a distinct zonal distribution of fires in Russia; 65% of the area burned occurred in the taiga zone, which includes southern, middle, and northern taiga subzones, 20% in the steppe and forest steppe zones, 12% in the mixed forest zone, and 3% in the tundra and forest-tundra zones. Lands classified as forest experienced 55% of all burned area, while crops and pastures, swamps and bogs, and grass and shrubs land cover categories experienced 13% to 15% each. Finally, the utility of the products is discussed in the context of fire management and carbon cycling.

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AEROSIBNET Program

Aerosol plays an important role in radiation-climatic processes along with greenhouse gases and clouds. One of the effective methods of definition of atmospheric aerosol optical characteristics is a method of photometry of direct ("transparency method") and scattered solar radiation. Nowadays a network of aerosol measurements AERONET (*http://aeronet.gsfc.nasa.gov*) is the most developed system in the view of observations automation, efficient data organization and global coverage. Until recently waste spaces of the Asian part of Russia were not practically involved into the global system of aerosol monitoring in spite of an important role of these territories in a gas-aerosol exchange and climate.

Since 2003 on the basis of the agreement between Institute of Atmospheric Optics SB RAS (IAO) and Goddard Space Flights Center (GSFC)a project aimed at forming a joined photometric network AERO-SIBNET is performed. Russian coordination is performed by IAO. Russian coordinator is Dr. S.M. Sakerin, leading network manager is Dr. D.M. Kabanov.

Organization of regular observations

The long-term objective of AERO-SIBNET (network monitoring of atmospheric aerosol characteristics in Siberia) organization is to specify the climatic impact of aerosol, to find out peculiarities of spatio-temporal changes and to assess the role of local, regional and global factors. By now the set of stations has been launched in several regions: Tomsk (October 2003), Tory (December 2003), near Yakutsk and Ekaterinburg (June 2004), near Ussuriisk (November 2004).

Fig. 1. AEROSIBNET in 2005.

Sites managers:

S.A. Beresnev, S.Yu. Gorda – Ural State University,

V.A. Poddubnyi – Institute of Industrial Ecology UB RAS, Ekaterinburg,

G.I. Kornienko – Ussuriisk Astrophysical Observatory FEB RAS, Ussuriisk,

S.V. Nikolashkin – Institute of Cosmophysical Research and Aeronomy SB RAS, Yakutsk,

M.A. Tashilin – Institute of Solar-Terrestrial Physics SB RAS, Irkutsk

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On preparation of professional scientific community for modern environmental research

During the last decade a significant lack of middle-aged researchers in RAS institutes have been noticed. The problem of generations' gap still threatens the succession of scientific schools and the existence of scientific groups. In environmental sciences this problem is sharpened both by natural interdisciplinarity of required research and by the recent enlargement of conceptual and mathematical tools. Usually, environmental research was conducted in the framework of geographical sciences and quantitative methods in use were of a subsidiary nature. But if the phenomena endowing to forming of environmental processes are taking separately, they should be studied by physics, chemistry, hydrodynamics, gas-dynamics, biology, ecology and other sciences. It follows from this list that it is necessary to use a multidisciplinary approach to study environmental processes. And the eagerness to understand and forecast phenomena which is common for every science requires wide usage of mathematical modeling and modern computational technologies. At present environmental sciences transform actively into exact sciences. Besides, the ideas and methods of e-Science are introduced. It is connected with the evolution of the process of scientific knowledge. Earlier scientific knowledge emerged from theoretical or experimental work of separate scientists and their small groups and it resulted in scientific publications. Now, as a rule, scientific groups combine many interdisciplinary groups from different countries. It is necessary to create large observations databases, develop computational models and be able to exchange information in the group almost instantly during the working process. It is especially typical for environmental science because the observation data received is almost so important for specialists as the scientific publication based on the results of their processing. That is why distributed informational –computation systems are thriving in this science. All these technologies combining work with data and models construct an infrastructure of modern environmental science. And the common problem of professional scientific community preparation is sharpened here by the necessity to become familiar with new informational –computation technologies which the elder generation of scientists don't always manage and to be able to work in large distributed international interdisciplinary groups. The lack of such skills in Russian scientific community is a result of two decades of "reform" of the system of financial support of scientific research. Special measures to prepare young scientists for new scientific, organizational and administration tasks are needed. If not, young scientists will not be able to support existing and emerging scientific trends and groups.

In this paper the approach to solve these problems is described which is realized in Tomsk as a result of a concerted action of representatives of several SB RAS institutes, Institute for Numerical Mathematics RAS (INM) and Tomsk universities. For preparation of young generation for environmental science a "two-component" approach should be used: organization of thematic young scientists schools and participation of young scientists in interdisciplinary conferences comprising the elements of young scientists schools. The following format should be used for a narrow thematic domain: first comes a thematic young scientists school with courses of review lectures on 2-3 questions of informational –computation technologies, one of which is supported by trainings and then

comes a conference where the audience is enlarged by invited specialists. The second way is to organize an interdisciplinary conference with a basic set of thematic sessions and three invited lectures on each area of the domain. Additional educational moment is to train young scientists to present their results clearly during their poster presentations. In both components the scientific basis of the questions discussed is informational–computation technologies forming the infrastructure of modern environmental research.

Specific cause for this scientific-educational activity in Tomsk was the preparation and realization of EC FP5 project "Integrated System for Intelligent Regional Environmental Monitoring & Management - ISIREMM" (http://isiremm.scert.ru/). The project initiated by one of the co-authors (E.G.) was supported in 1999 by EC INCO Program. It combined efforts of 8 organizations from NIS and Europe and was aimed at the development of integrated informational–computation system for urban pollutions monitoring in Tomsk. It became necessary to establish an interdisciplinary scientific group which was able to accept and use the results received by all organizations – project participants. With that end in view an informal group was organized on a basis of the Institute of Atmospheric Optics SB RAS (IAO) combining collaborators from IAO, Institute for Optical Monitoring SB RAS (now Institute of Monitoring of Climatic and Ecological Systems SB RAS, IMCES), Institute of Petroleum Chemistry SB RAS (IPC), Tomsk State University (TSU) and Tomsk University of Control Systems and Radioelectronics (TUCSR). Right away it became clear that project participants – specialists from different sciences can not (and often don't want to) understand each other and recent graduates are not trained in modern methods and technologies used in this domain of environmental science. The decision was maid to organize an interdisciplinary conference on Environmental Observations, Modeling and Information Systems as Tools for Urban/Regional Pollution Rehabilitation (ENVIROMIS-2000, http://scert.ru/ru/conference/enviro/) in 2000 in Tomsk to overcome these problems. This conference was proposed as a one-time action to solve specific questions and problems brought up by the project requirements. But academician V.P. Dymnikov helped the organizers to realize that this scientific forum should be continued. Being a director of the Institute for Numerical Mathematics RAS (INM) in Moscow where the process of educated youngsters leaving for commerce is very significant he realized the necessity of a purposeful activity to prepare young scientists managing modern informational–computation technologies that are used in environmental science. After familiarizing himself with the works of Tomsk specialists in this domain, V.P. Dymnikov made the decision on collaboration of INM with Tomskovites to develop the joint work on education and up-bringing of a new generation of specialists who would be able to perform joint research with specialists from other sciences and familiar with new tools and methods of informational–computation technologies. Since that the joint work of two collectives started both to choose instruments and methods for the problem solving and to apply them in practice. ENVIROMIS-2000 Conference was per se the first purposeful try to use a scientific conference as a tool to establish interdisciplinary links between specialists in different fields of knowledge and to teach young scientists both professional skills and skills of collaboration in interdisciplinary groups. Although the core element of the Conference was informational–computation technologies for environmental science, its sessions were devoted to different applications from measurements in at-

mospheric science to monitoring and modeling the processes in soil and vegetation cover. Following approaches were used during the conference preparation: no parallel sessions; coherent program; absence of English reports translation into Russian; one-hour invited lectures presenting author's point of view on some key problems of the domain. These lectures and large amount of young scientists among the participants of the conference gave it the elements of a young scientists school, which format was very popular and played a positive role during the period of Soviet science.

But the chosen format allowed neither a deep involvement into specific problems of informational–computation technologies for environmental science nor a transfer of global thematic knowledge to young scientists. After the conference on the specific thematic area (International Conference on Modeling, Databases and Information Systems for Atmospheric Sciences MODAS – 2001, http://scert.ru/ru/conference/modas/) it became clear, that special measures are needed to solve an educational task. The Siberian Center for Environmental Research and Training (SCERT, http://scert.ru/) was founded in 2002 by IMCES SB RAS initiative and on its basis as the measure. It is a non-commercial partnership combining efforts of several SB RAS institutions, Siberian universities and their partners in Siberia and Moscow to realize the scientific-educational activity as its basic work. According to the decision of the SBRAS Presidium SCERT was included into a list of SB RAS international research centers.

The first step of SCERT activity was ENVIROMIS-2002 Conference (http://scert.ru/ru/conference/enviro2/) in Tomsk. During the process of its preparation and realization the ways were developed to organize interdisciplinary conferences with elements of young scientists schools in this domain of environmental science and a minimal set of thematic sessions was defined: observations/measurements; remote sensing; data; atmospheric modeling (urban and regional scale); hydrological modeling; vegetation and soil (processes and models); climate modeling; informational-computation systems. The educational component of the conference was realized by including into the program not less then three invited lectures on each area of the domain. It resulted in decrease of a number of initiative reports and increase of a number of poster presentations. The conference running and the participants responses [1] showed the profit of this action. Modern tools of lectures and reports preparation as presentations allowed the organizers to collect a huge informational-educational resource which was issued as a CD and also placed on the conference site. The criteria for young scientists selection and financial support was a level of his/her report. Young participants were interested in their poster presentations as during those presentations reports were selected by the program committee for publication in the conference proceedings.

The mentioned above technology was successfully tested during the International Conference on Environmental Observations, Modeling and Information Systems ENVIROMIS-2004 (http://scert.ru/ru/conference/enviromis2004/) in Tomsk, see also [2]. At present this approach is used to organize the next conference of this series: ENVIROMIS-2006, planned in July 2006 (http://scert.ru/ru/conference/enviromis2006/).

Forming of the conception of an interdisciplinary scientific-educational action and the experience of its realization allowed us to understand clearly the ways to solve the problem put in the narrow specific area. For this case a following format was developed:

thematic young scientists school with courses of review lectures on 2-3 questions of informational–computation technologies, one of which is supported by trainings which id followed by a conference where the audience is enlarged by invited specialists. It was proposed by ac. V.P. Dymnikov to start the school with so-called "academicians day" - a whole day of key lectures of RAS academicians. No doubt, young scientists should have a fund of professional knowledge to take part in this action. That is why the participants are selected on the basis of the level of their papers and their professional skills. Groups for trainings (3 persons at one working place) were formed from one participant professionally skilled in the area in question and two others from different regions/organizations. In fact, each group is a mini-consortium performing a computational or informational project. In process of tasks performing participants are trained to work in cooperation and establish personal contacts that will be useful in their future careers.

The above defined approach was tested during the International conference and young scientists school on computational-information technologies for environmental sciences CITES – 2003, (http://scert.ru/ru/conference/cites/) in Tomsk, see also [3]. More than 70 young scientists from Russia, Ukraine, Byelorussia, Kazakhstan, Uzbekistan and Georgia and more than 50 Russian and foreign specialists took part in it. In addition to a usual set of invited and oral papers one-hour lectures were delivered by key specialists in the area on the newest results received by their research groups. Additional information and presentations of main reports was placed on the SCERT site. Program committee recommended for publishing several reports and after reviewing their were published in two special editions of a magazine «Computational technologies», 2004. A similar action CITES-2005 (http://scert.ru/ru/conference/cites2005/**)** in Novosibirsk showed that the methods applied are successfully approved by time. Key points of ENVIROMIS-2006 conference (http://scert.ru/ru/conference/enviromis2006/) are defined and a main working direction of CITES-2007 School is chosen – computational technologies of "chemical" weather forecast (natural and men-induced atmospheric pollutions on a regional and urban scale) that develops rapidly today.

The work on searching new forms of a young scientists training gives a result now. This is a high scientific level of papers proposed by young scientists who already took part in such actions, a high level of their Ph.D. thesis and appearance of new international interdisciplinary projects. In fact, it means that actions performed already became an "incubator" for new large international projects. As a whole, the experience of the developed concept realization showed that young scientists receive necessary skills to meet the challenges of modern science and enter quickly into multidisciplinary research of national and international scientific groups. And this experience could be useful also for other branches of science. We suppose, that this combination of scientific-educational and scientific-organizational activities has an additional potential for a successful development of national science.

It is clear that the gathered experience can not overcome a negative situation with young generation in environmental science in Russia and other NIS countries. We think that this activity should be one of priorities of the Earth science department of RAS, RNC IGBP and its Siberian branch. It is obvious that a considerable financial support is needed to realize similar actions. There is a need to develop a specific program of RAS for it. We hope, the program will be developed and realized taking into account the elab-

orated experience. We also hope that the international Program START (Global Change **S**yst**e**m for **A**nalysis, **R**esearch and **T**raining) will find resources to support this activity.

All above mentioned is an achievement of not only the author of this paper. Both the approaches development end realization during CITES and ENVIROMIS actions would not be impossible without the support of a great number of like-minded persons, especially, from SCERT, INM RAS, IMCES SB RAS, TSU and many other universities and institutes of Tomsk, Siberia, Russia and NIS. We thank all the colleagues for their contribution to the described activity development. The authors also express their great thanks to international organizations (INCO EC Program, http://www.cordis.lu/fp6/inco and INTAS, http://www.intas.be) for their support of young scientists education in Russia and NIS, including the measures described in this article.

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In memory of Academician Vladimir L. Kasyanov

Vladimir Kasyanov
(January 4, 1940 – October 1, 2005)

On October 1, Vladimir Kasyanov died in a car accident.

V.L.Kasyanov was an outstanding biologist, well known in the world scientific community for his basic works on comparative embryology of marine organisms, in the field of the study preservation of marine biota, and problems of biosphere evolution as well as environmental and climatic changes. He formulated fundamental statements reproductive on strategy of sea invertebrates; many of his articles and monographs were translated into foreign languages and published abroad. The leading research school in comparative embryology created by Academician V.L.Kasyanov has been fruitfully working in Russia during more than 20 years. On his initiative and under his direction, the Institute of Marine Biology is publishing a series of monographs "Biota of Russian Waters of the Sea of Japan" in many volumes, comprising the entire biological diversity from bacteria to vertebrates. V.L.Kasyanov was Editor-in-Chief of the All-Russian journal "Biologia Morya (Russian Journal of Marine Biology)", which is a significant scientific publication of the Russian Academy of Sciences.

Vladimir Leonidovich was born on January 4, 1940 in Leningrad (St.Petersburg). He graduated from Leningrad University in 1962; in 1965 he finished a post-graduate course, received a candidate degree, and up to 1971 had worked at this University. By invitation of A.V. Zhirmunsky in 1971 he moved to Vladivostok, entered the research staff of the Institute of Marine Biology and went over the path from a junior research scientist to Academician and Director of the Institute.

Being a scholar of authority with a worldwide known name, Academician V.L.Kasyanov headed large national and international scientific organizations. He was Chairman of the National Committee for the International Geosphere-Biosphere Programme, Joint Scientific Council on Biological Sciences FEB RAS, Temperate East Asia Committee of START, Vice-President of Otto Kinne Foundation (Germany), a member of the International Ecological Institute (Germany). In Vladivostok, scientific capital of the Russian Far East, he organized seven meetings related to global change studies, resulting in involvement of Russian scientists into the IGBP and related programmes activity, he was leader of several Asia-Pacific Network for global change research (APN) projects, edited *TEACOM Publications* and Bulletin of the Russian National Committee for IGBP.

Up to the last tragic moments Vladimir Leonidovich was full of creative prospects, connected with development of the Institute, new large-scale programs of FEB RAS, large international projects and ecological programs, as well as initiatives in the region. We have lost a wonderful colleague, teacher, friend, like-minded person. A brilliant creative life, tragically broken off in the prime of new ideas and creative plans…

Russian National Committee for IGBP
Administration of the Institute of Marine Biology FEB RAS

Calendar of IGBP and Related Meetings in 2006

08 - 12 JANUARY

Merida, Mexico

Ecology in an Era of Globalization: Challenges and Opportunities for Environmental Scientists in the Americas

http://www.esa.org/mexico

09 - 12 JANUARY

Paris, France

4th Franco-British climate change seminar for Young Researchers: 'Climate-Society Interactions - Case Studies from Africa'

http://www.britishcouncil.org/france-science-inys.html

09 - 13 JANUARY

Dakar, Senegal

18th session of the GEWEX Scientific Steering Group

http://www.wmo.ch/web/wcrp/meetings.htm

16 - 21 JANUARY

Bangkok, Thailand

EcoMod Modelling School

TheresaLeary

http://www.ecomod.nt

19 - 21 JANUARY

Boulder, CO, USA

ILEAPS

3rd iLEAPS Scientific Steering Committee Meeting

iLEAPS IPO

http://www.atm.helsinki.fi/ILEAPS/

21 - 26 JANUARY

Boulder, CO, USA

ILEAPS

1st iLEAPS Science Conference

http://www.atm.helsinki.fi/

ILEAPS/boulder

ILEAPS IPO

Michael Boy

26 - 28 JANUARY

Boulder, CO, USA

Workshop on "Flux Measurement in Difficult Conditions"

http://www.atm.helsinki.fi/ILEAPS/fluxworkshop2006/

30 JANUARY - 01 FEBRUARY

Brisbane, Australia

LOICZ

LOICZ/UNEP Nutrient Flux Assessment in estuaries and coastal seas - Interventions Workshop

LOICZ IPO

09 - 11 FEBRUARY

Grenoble, France

ERCA 2006: European Research Course on Atmosphere

http://www-lgge.obs.ujf-grenoble.fr/enseignement/erca/home.html

16 - 20 FEBRUARY

St. Louis, MO, USA

AAAS: IGBP Session, Symposium No. 913: Vital Organs in the Earth System: What Is the Prognosis? (Sat 18 Feb, 2-5pm)

http://www.aaas.org/meetings/Annual_Meeting/

20 - 24 FEBRUARY

Honolulu, Hawaii

AGU Ocean Science Meeting with special sessions of Southern Ocean, Georges Bank, Northeast Pacific GLOBEC and CLIOTOP

AGU Meetings Department
http://www.agu.org/meetings/

03 - 07 MARCH

Pune, India
IGBP
21st SC-IGBP Meeting
Clemencia Widund

06 - 07 MARCH

Pune, India
IGBPWCRP
Joint Session IGBP-WCRP
http://www.tropmet.res.in/~jsc/contact.htm

06 - 11 MARCH

Pune, India
WCRP
27th session of the WCRP-JSC
http://www.wmo.ch/web/wcrp/meetings.htm

14 - 16 MARCH

TBA, UK, TBD
IHDP
SC-IHDP Meeting
http://www.ihdp.org

16 - 22 MARCH

Mexico City, Mexico

4th World Water Forum: Local Actions for a Global Challenge

http://
www.worldwaterforum4.org.mx
/home/home.asp

27 - 29 MARCH

Palisades, NY, USA

Workshop on Tropical Cyclones and Climate

http://iri.columbia.edu/outreach/meeting/TropicalCyclones/index.html

19 - 21 APRIL

Honolulu, USA
GLOBEC
PICES/GLOBEC symposium on 'Climate variability and ecosystem impacts on the North Pacific: a basin-scale synthesis'
PICES Secretariat
http://www.pices.int/meetings/international_symposia/Honolulu2006/default.aspx

20 - 21 APRIL

Miami, FL, USA

17th Global Warming International Conference & Expo

gw17@globalwaming.net

24 - 28 APRIL

Foz de Iguacu, Parana State, Brazil

8th International Conference on Southern Hemisphere Meteorology and Oceanography

http://www.cptec.inpe.br/SH_Conference/

12 - 14 MAY

Frankfurt/Geisenheim, Germany
Open LUCIFS Workshop 2006
http://web.uni-frankfurt.de/fb11/ipg/lucifs/2006/Ivan Heaney

18 - 19 MAY

Plymouth, UK
SCOR
SCOR Working Group 115 on standards for the survey and analysis of plankton
Ivan Heaney

23 - 25 MAY

Honolulu, Hawaii
GLOBEC
GLOBEC Scientific Steering Committee Meeting
GLOBEC IPO

23 - 26 MAY

Baltimore Convention Center, Maryland, USA
The 2006 Joint Assembly
http://www.agu.org/meetings/ja06/

05 - 07 JUNE

Ekaterinburg, Russia
Climate Changes and their impact on Boreal and Temperate Forests
http://ecoinf.uran.ru/conference/

12 - 15 JUNE

London, Uk
PAGES
Holivar 2006 Open Science Meeting: "Natural Climate Variability and Global Warming"
http://www.holivar2006.org/

01 - 08 JULY

Tomsk, Russia
International Conference on Environmental Observations, Modeling and Information Systems ENVIROMIS-2006
http://www.scert.ru/en/conferences/enviromis2006/

03 - 07 JULY

Brisbane, Australia
IGU 2006 Brisbane Conference "Regional Responses to Global Changes: A View from the Antipodes"
http://www.igu2006.org

16 - 18 AUGUST

Beijing, China
International Conference on Regional Carbon Budgets
http://www.icrcb.org.cn

18 AUGUST - 01 SEPTEMBER

Grindelwald, Switzerland
5th International NCCR Climate Summer School. Adaptation and mitigation: responses to climate change
http://www.nccr-climate.unibe.ch

27 AUGUST - 01 SEPTEMBER

Fukuoka, Japan
17th International Sedimentological Congress (ISC)
http://www.isc2006.com

04 - 08 SEPTEMBER

Mexico City, Mexico
Carbon Management at Urban and Regional Levels: connecting development decisions to global isues
Penelope Canan

17 - 23 SEPTEMBER

Cape Town, South Africa
CACGP
IGAC
SOLAS
Joint IGAC/CACGP/SOLAS/WMO Symposium: Atmospheric Chemistry at the Interfaces (The 9th Scientific Conference of the IGAC Project)
Conference Secretariat http://www.atmosphericinterfaces2006.co.za/

20 - 22 SEPTEMBER

Prague, Czech Republic
Biohydrology 2006 Conference
Lubomir Lichner http://www.ih.savba.sk/biohydrology2006/

23 - 26 OCTOBER

Concepcion, Chile
SCOR
SCOR General Meeting 2006
http://www.jhu.edu/~scor/2006GM.htm

07 - 08 NOVEMBER

Beijing, China
2nd International Young Scientists' Global Change Conference
Conference organizers:
ysc@agu.org

09 - 12 NOVEMBER

Beijing, China
DIVERSITAS
IGBP
IHDP
WCRP
Global Environmental Change: Regional Challenges. An Earth System Science Partnership (ESSP) Open Science Conference
http://www.essp.org/essp/ESSP2006/

06 - 09 DECEMBER

Bali, Indonesia
2006 IDGEC Synthesis Conference
http://fiesta.bren.ucsb.edu/~idgec/science/synthesis.html
http://fiesta.bren.ucsb.edu/~idgec/events/IDGEC1stAnncmtUSlttrSize.pdf

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PROGRAMME
2005, № 4**

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