

RECOMMENDATIONS

of the ENVIROMIS INTAS Strategic Scientific Workshop

<Towards integrated multidisciplinary study of the Northern Eurasia climatic Hot Spots>, Tomsk, 23-25 July 2004

Overall concept

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. Regions may manifest significantly different Earth System dynamics and changes in regional biophysical, biogeochemical and anthropogenic components may produce considerably different consequences for the Earth System at the global scale. 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. Regional studies can contribute substantially to the reconstruction of global dynamics from regional patterns.

Adopted within the Earth System Science Partnership definition (W. Steffen, 2003) of what is meant by an 'integrated regional study' (IRS) uses the following characteristics:

- 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 (i.e., be 'place-based'); and (iii) address regional research as an integrative Earth System science from planning to the synthesis and completion stages of such studies.
- IRSs should be built around regions that may function as switch or choke points or hot spots, in which small changes in regional systems may lead to profound changes in the ways in which the Earth System operates.
- 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.

Nowadays integrated regional studies represent a second major way to reconstruct the Earth System from its components and are complementary to the thematic project approach employed thus far in the international global change programmes.

Many disciplinary and interdisciplinary local and regional studies about environmental and climatic issues have been led so far in Northern Eurasia and Siberia. An overarching vision of regional aspects and its various connections to global aspects is now needed in line with the defined above the Earth System Science Partnership Integrated Regional Studies (IRS) which could lead to Siberia IRS (SIRS) and Northern Eurasia IRS (NEIRS) projects. 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. They should not build a “scientific closed world” but 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.

Some key facts and findings (present state of art)

Accordingly to present knowledge, Siberia is the place in the world where the most pronounced consequences of climate changes happen and will happen. Various models have been developed to address that issue. In addition, these changes are all but homogeneous. Variability in space and time as well as regions of critical weight (“hotspots”) have been evidenced through *in situ* and remote sensing measurement techniques. The figures presented hereunder illustrate these phenomena.

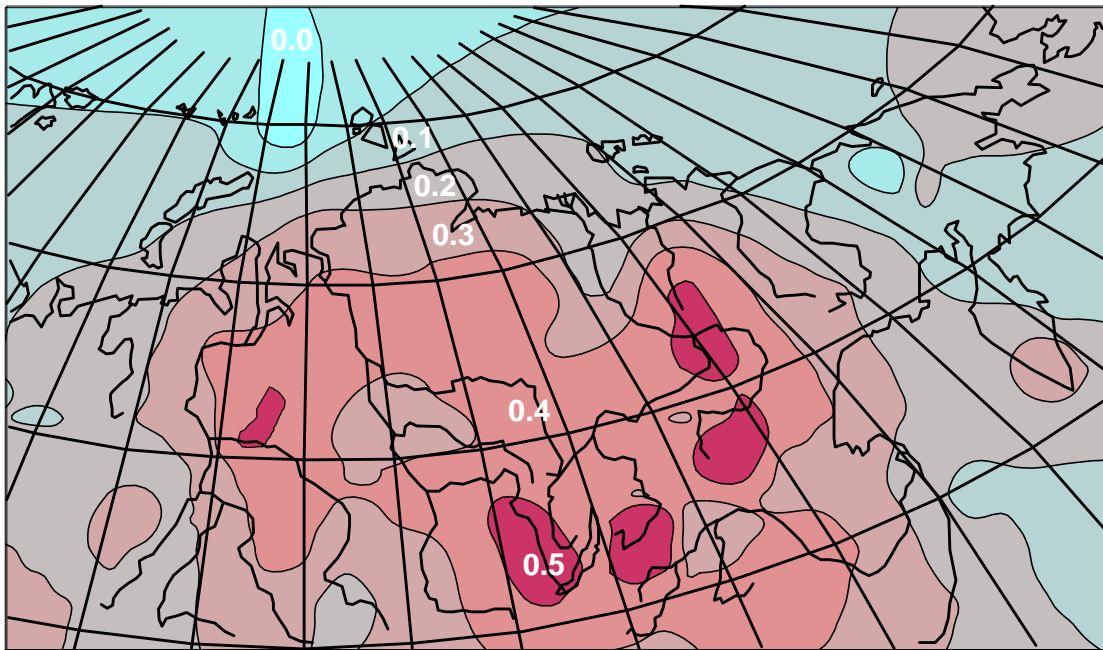


Fig. 1 - Map of linear trends of annual mean surface temperature on territory of Siberia and Far East over period from 1965 to 2000. Different colors correspond to different trend values (figures are in oC/10 years). Ippolitov et al.

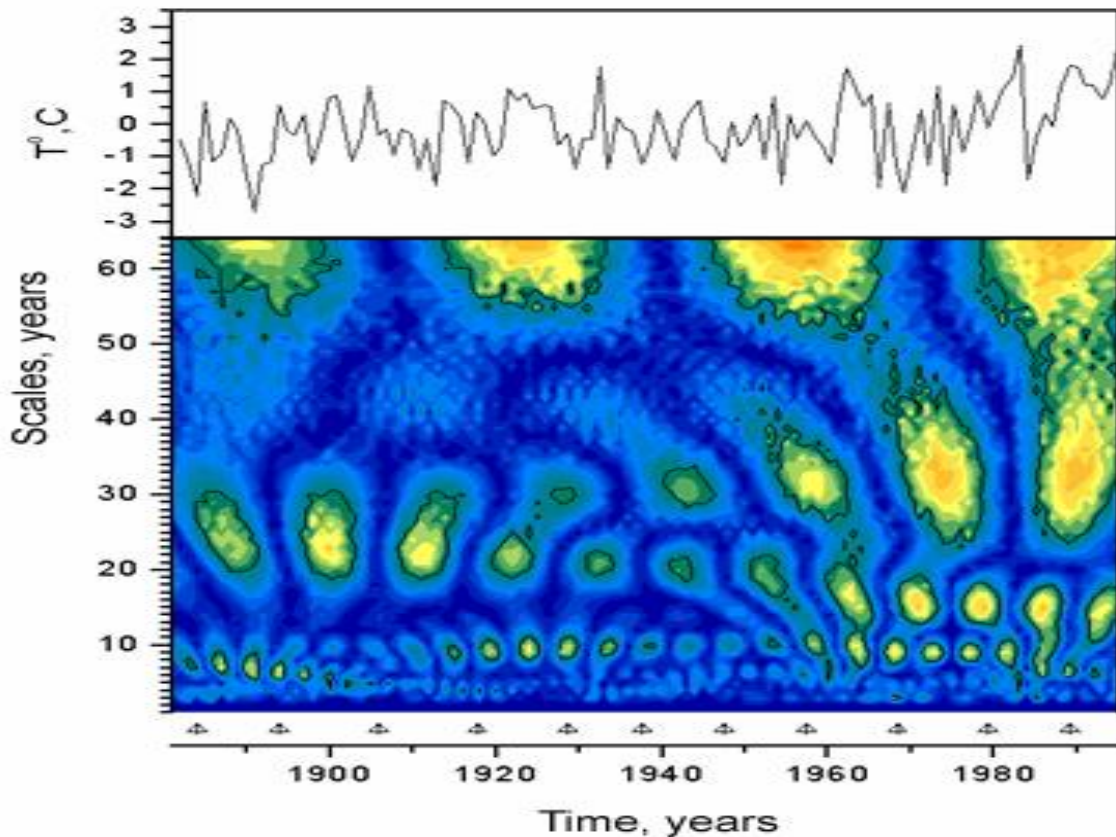


Fig. 2 – Time series of annual mean surface temperature for Tomsk (upper part) and its wavelet transform revealing characteristic time periodicities. Zolotov et al.

Recommending an overall approach

An overall classical scheme to address such an ambitious objective as SIRS and NEIRS is to fully address the following issues. Some of them have already been addressed from some specific points of views. That was evidenced among other in the ENVIROMIS 2004 conference and analyzed during the INTAS Scientific Strategic Workshop. Nevertheless most of them still remain widely open questions when considered under their ‘integrative’ form.

- What are the main features of the regional Siberian climate changes (overall trends, sub-regional trends and anomalies, interactions between ecosystem, atmosphere, and human dynamics, etc.)?
- What are the regional sources of these changes?
- How are they linked to the global climate change features?
- In turn, how do they impact them?
- In particular, what are the teleconnections with surrounding sub-regions and regions such as central Asia, Aral Sea basin, Mongolia, Arctic polar area...?
- How can sub-regional and regional modeling be led and nested into more global models?
- Can regional scenarios be developed in line with IPCC scenarios? What are the results of such scenarios?
- What are the anticipated physical, biological and socio-economic impacts of global change according to each scenario?
- Are relevant socio-ecological models available and validated to deal with these phenomena from such a point of view? Do satisfactory links between physical and socio-economical scientists addressing such issues exist?

- Are there actions that could be done to slow down the sources of adverse climate changes? At what cost?
- Which actions should be undertaken to mitigate adverse impact of climate change? At what cost?

Answering such questions implies that the work should be organized along proper guidelines, among which:

- Do not start from scratch and waste already existing work, but bridge the main institutes and scientists that addressed some aspects of that series of questions and/or may bring added value and relevant techniques that are necessary to the integrative aspect of these studies (including socio-economic aspects).
- Do not organize the work along with “home made” ideas but in line with such international organizations and programs as ICSU, ESS-P and its IRS’, conclusions and information needs of the IPCC.
- Think about centralization versus decentralization: how can such interdisciplinary collaborative networks be kept on its tracks, which kind of central structure do we need?
- Think about the fact that this should lead to concrete decisions that may be heavy in terms of economic, societal and political consequences: what outreach policy towards or better interaction with and involvement of decision makers?
- In particular, this means that setting up such a network and the relevant organization should be both a scientific and ‘political’ decision not only because public national and international funding is mandatory, but also because decision makers dealing with large investments and political guidelines should be convinced that this is the unique way for them to get the sound scientific bases that they need of.

This should lead to define ambitious Siberia (SIRS) and Northern Eurasia (NEIRS) Integrated Regional Studies as well as the associated means and structures (interdisciplinary collaborative networks, central structure).

Recommending components to be used as a background for start SIRS and NEIRS (Phase 0)

Below are listed recently finished or currently performed RTD projects, whose results will be useful for the initiated regional studies.

- **EC funded projects:**

Siberia 2 (Multi-sensor Concepts for Greenhouse Gas Accounting of Northern Eurasia, FP 5 project). The overall objective of the project is to demonstrate the viability of the Terrestrial Biota Full Greenhouse Gas Accounting (FGGA) based on a system integration of comprehensive land cover descriptions in the form of an Integrated Land Information System (ILIS), multi-sensor remote sensing concept, measurements of fluxes and concentrations of atmospheric gas composition and ecological models; Project Co-ordinator Prof. C. Schmullius.

TCOS Siberia (Terrestrial Carbon Observing System – Siberia, FP5 project). It consists of an implementation of first components of a continental scale observing system for the determination of the net Siberian carbon balance and its variation from year to year including an assessment of its uncertainty. This goal is addressed by means of an integrated top-down and bottom-up approach. Project Co-ordinator Prof. M. Heimann

FUMAPEX (Integrated systems for forecasting urban meteorology, air pollution and population exposure, FP5 project). The main objectives of the project are to improve meteorological forecasts for urban areas, the connection of numerical weather prediction models to urban air pollution and population exposure models, build improved Urban Air Quality Information and Forecasting Systems, and demonstrate their application in cities subject to various European climates. Project Co-ordinator Prof. A. Baklanov

ISIREMM (Integrated System for Intelligent Regional Environmental Monitoring & Management, INCO FP5 project) Information system for monitoring and management of air quality on city/region level is developed and tested in operation in Siberian city Tomsk. Project Co-ordinator Dr. K. Fedra, NIS Co-ordinator Prof. E. Gordov

ENVIROMIS-SSA (Environmental Observations, Modelling and Information Systems Special Support Action, FP6 Project). It is based on modern monitoring, information and computational technologies coherent set of coordination, dissemination and education actions directly aimed at environment and health protection and related safety aspects, stabilization of research and development potential in Russia and other NIS countries. Project Co-ordinator Prof. E. Gordov.

- **INTAS funded projects:**

ATMOS (Web portal on atmospheric environment) The developed under INTAS grant web portal ATMOS makes available to the international research community, environmental managers, and the interested public, a bilingual information source for the domain of Atmospheric Physics and Chemistry, and the related application domain of air quality assessment and management. Project Co-ordinator Dr. K. Fedra, NIS Co-ordinator Prof. E. Gordov

CLIMAS (Development of an information system for high latitude climate data, analysis and numerical simulations of climate change - Climate Data Access System). Project Co-ordinator S. Sandven. The objective of the project was to develop a prototype generic information access system, CLIMAS, for high latitude digital climate data, climate analysis, major climate events as well as numerical simulations of future climate change scenarios, which will disseminated to the public sector, governmental agencies, industry, media and the academic sector, including education.

- **NASA's Earth sciences research program**

NEESPI (Northern Eurasia Earth Science Partnership Initiative, NASA-RAS Project). It is a facet of NASA's Earth Science Enterprise dedicated to understanding the effects of natural and human-induced changes in Northern Eurasia on the global environment. Program Co-ordinator Dr. D. Deering.

- **RAS Presidium Program “Environmental and Climatic Changes: Natural Disasters”)**

Analysis and modeling of extreme hydrological phenomena in Siberian Environment. The Project is devoted to study of floods and draughts in Siberia. Project Co-ordinator Ac. O. Vasiliev.

- **SB RAS Integrated Projects**

Siberian Geosphere-Biosphere Program: integrated regional research of modern natural climatic changes. It is the first step of consolidation of working in this direction regional scientists efforts and aimed at initiation of regional environmental variations in Siberia. Northern Eurasia and its interrelations with global processes. Project Co-ordinators: Pr. E.P.Gordov and RAS Corr. Members I.M. Gadzhiev, M.V. Kabanov and V.A. Snytko.

Complex Monitoring of Great Vasyugan Bog: modern state and research of evolution processes It is based on field observations of enlarged number of physical, biological and chemical characteristics of the system study of unique natural complex that is globally important and weakly technogenically loaded.

Project Co-ordinator: RAS Corr. Members M.V. Kabanov.

- **MEDIAS-France** networking (MEDIAS network) and environmental information systems building activities

A crucial starting point is to properly analyze these various activities in light of the ESS-P/IRS approach, identify gaps and overlaps and the ways how to reduce them, understand how these activities pave the way to next integration steps and define such next steps, and probably build up an information Web portal about these projects based upon such analysis (including inputs and results), conclusions and perspectives.

Recommending components to be supported now (Tactical vision)

- **EC RTD Programs**

North (earlier **BOREAS Machine**) (**Current state and future trajectories of Northern Eurasia in the changing world**, IP will be submitted to FP6). The approach is based on two key terms, which also define the specifics of the current development stage of the Earth science: integration and integrated observing systems. Co-ordinator Prof. Schmullius.

TCOS Siberia (possible IP to be submitted to FP6). It might be the logical continuation of currently performed FP5 Project. Co-ordinator Prof. Heimann.

Siberia climatic HOT SPOTS (a candidate for the coming FP7). The proposed interdisciplinary project is devoted to a better understanding of interactions between the ecosystem, atmosphere, and human dynamics in Siberia under the impact of global climate change – in the line with the new IGBP regional, integrated Earth Science studies emphasis. Co-ordinator Prof. Gordov.

FUMAREX+ISIREMM (possible STREP for FP6). Usage of FUMAPEX approached to study potential consequences from accidental radionuclide release. Co-ordinator Prof. Baklanov.

- **APN**

Joint project with Central Asia and Mongolia on regional environmental issues and teleconnections with Siberia. Co-ordinator Dr. Begni.

- **RAS Programs**

Terra Norte (Terrestrial Ecosystem Monitoring in Northern Eurasia). Planned Russian Academy of Sciences' Programme aimed at improvement of knowledge on large-scale dynamics of terrestrial ecosystems within entire Northern Eurasia, including past and immediate changes, an comprehensive understanding of main driving forces of these dynamics and scientific explanation of their links with the fundamental physical, biogeochemical and socio-economic processes in the Earth system. Co-ordinator Ac. A. Isaev.

Planned SB RAS distributed database on Siberian environment. Recently proposed to SB RAS Project aimed at development of the Database on environmental characteristics observed/measured by key actors belonging SB RAS. Co-ordinators Prof. Gordov and RAS Corr. Member Fedotov.

Planned development of informational-computational infrastructure of integrated regional study of Siberia environment. Planned SB RAS project aimed at elaboration of an information-computational infrastructure supporting a set of developed regional models

Planned development of Web portal ATMOS and its localization in different Siberia regions. It might give an element for informational-computational infrastructure of integrated regional study of Siberia environment. Co-ordinator Prof. Gordov.

Such projects and initiatives should take full advantage of the targeted IRS approach defined above and be defined and led according to this approach. In particular, the way how they fill gaps and allow going one step ahead in that way should be clearly identified. This implies among other defining ways to intercompare and whenever possible homogenize methodologies, make use of compatible and standardized data and/or metadata sets both for inputs and results, and if decided in the phase 0 fill in the dedicated Web portal with new information.

Recommending elements for a strategic vision

According to the above statements and in line with them:

- Elaborate an organizational structure for SIRS as a part of NEIRS
- Elaborate an information and networking infrastructure for SIRS

Detailed strategic recommendations

- SR01** Acknowledge the role that SCERT/IMCES could act as a key central element in SIRS organization, information infrastructure development and scientific management. Recommend it to bring together all the institutions that work closely with it (SB RAS, MEDIAS-France, Nansen Center, Max Planck Institutes, ENEA, ICTP...) into a “core network” that shall have a proper mandate to address the organization, management, development and support of SIRS as a component of NEIRS. This should include organization of a small network advisory board with national and international representatives being based on SCERT (also being a core for the future SIRS Steering Committee). Also this should include following and managing the recommendations listed hereunder.
- SR02** Recommend to that core network to find the proper way(s) to bridge physical scientists, socio-economic scientists, decision and policy makers, then to progressively deepen the synergies between these actors in order to turn findings into facts at regional and local levels.
- SR03** Recommend that the relevant scientific authorities take proper actions in order to set up close links with the IPCC and if possible involve key scientists of the NEIRS and SIRS project into it.
- SR04** Recommend to national Russian authorities and international funding organizations to find proper opportunities to support operational expenses of in situ and remote sensing data collecting systems in order to get relevant primary information and make it available to all involved researchers through relevant information management systems.
- SR05** Recommend to EC to support North (Boreas Machine) as a FP6 Integrated project and Northern Eurasia sub-regions of critical climatic weight (“hotspots”) within an integrating approach as one of the FP7 topic of investigation.
- SR06** Recommend to INTAS to take into due consideration the various basic aspects of NEIRS and a relevant support to the above described core structure and its integrative work.
- SR07** Recommend to ISTC to take into due consideration a support to various aspects of NEIRS in line with its own strategy and policy.
- SR08** Recommend to NASA and GOF-C-GOLD to encourage and develop close links and proper synergies between the NEESPI project and the NERIN network on one hand, the NEIRS and SIRS projects and the associated network.
- SR09** Recommend to SB RAS to bring the relevant support to the SCERT/IMCES activity aimed at setting up SIRS, keeping it on tracks and acting as a hosting organization for dedicated information storage and management.
- SR10** Recommend to TACIS to take advantage of SCERT mission and expertise to jointly organize a set of training and capacity building activities (e.g. assisting in setting up training centers in Central Asia) aiming at a better integration of NIS scientists into the European Research Area.
- SR11** Recommend to the core network to have contacts with APN to set up any relevant support actions, in particular APN grants.
- SR12** Recommend to the core network to have contacts with NATO to set up regional workshops about environment and develop follow-on activities in line with NATO

support policy to environmental studies, in particular NATO grants and/or support to information infrastructure.

- SR13** Acknowledge the efforts led by SCERT and its national and international partners to run the ENVIROMIS series of Multidisciplinary Environmental Conferences, consider these forums as central events for NEIRS and recommend to the international funding organizations (UN, UNESCO, IGBP, START, APN...) to find any opportunity to support this series of events in order to let them run on a stable, follow-on basis targeting the above described objective.
- SR14** Acknowledge the efforts led by SCERT and its national and international partners to run the International series of International Young Scientists Schools and Conferences, consider these forums as central events for education and training of young researchers to be involved into NEIRS/SIRS and recommend to the international funding organizations to find any opportunity to support this series of events in order to let them run on a stable, follow-on basis targeting the above described objective.
- SR15** An effort should be made to edit more key research results on Northern Eurasia environment dynamics through publications in international peer reviewed journals and collective monographs.

Detailed technical recommendations

- TR01** The core network should better define the scientific objectives and output of the SIRS/NEIRS projects in line with the strategic recommendations listed above.
- TR02** Include into SIRS and NEIRS physical approach the major components listed above:
- Integrated assessment modeling of global change impact on regional climate and environment
 - Data, metadata and computation-informational technologies
 - Land data assimilation, including special aspects of seasonal freezing and permafrost dynamics
- TR03** Include into SIRS and NEIRS a socio-economic approach with proper tools and models aiming at evaluating the societal, economic and political costs of regional climate change impacts, of the ways to slow down its adverse sources and mitigate its adverse impacts.
- TR04** Analyze and underline the role of data and information “blocks” in each component of SIRS and NEIRS. Consider the relevance, quality and homogeneity of data as one of the key criteria for the evaluation of the projects at their various stages.
- TR05** Pay a specific attention on one hand to remotely sensed satellite data and derived information, on the other hand on maintenance and improvement of *in-situ* data measurement networks and develop or improve proper assimilation models.
- TR06** Pay a specific attention to the role of aerosols in regional climate change, making best efforts to collect relevant measurements and information and integrate them into relevant coupled models.
- TR07** Pay a specific attention to the regional contribution to the global net radiative and GHG balances due to exchanges between soil, ecosystems and atmosphere in close connection with IPCC, addressing among other the following specific issues:
- Permafrost melting due to temperature increase and associated release of CO₂ and CH₄
 - Extension of peats and bogs due to permafrost melting and associated balance of CO₂ and CH₄ balance
 - Changes in forest ecosystems due to temperature increase, and namely extension of forest towards the North
 - Increase in albedo of deforested areas, especially during the snowy period.
- TR08** Pay a specific attention to tropospheric chemistry and stratospheric chemistry and their variability at relevant sub-regional and temporal scales.
- TR09** Pay a specific attention to practical applications of basic results to enhance current state of environment, especially at such vulnerable region like Siberia. In particular, in course of organization of ENVIROMIS 2006 to include into its fabric Strategic Scientific Workshop “Control and Rehabilitation of Environment” and to apply to INTAS for its support.