Information-computational Infrastructure for Siberia Integrated Regional Study

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Introduction

• Distributed information-computational infrastructure required to support Siberia Integrated Regional Study (SIRS, http://sirs.scert.ru) investigations of environmental changes in Siberia.

The infrastructure developing in cooperation with European and American partners is aimed at support of multidisciplinary and “distributed” teams of specialists performing cooperative work with tools for exchange and sharing of data, models and knowledge optimizing the usage of information-computational resources, services and applications.

• Approach adopted:

  Development of Internet-accessible information-computational systems (Web cites and portals) for chosen Earth Science thematic domains

  Development of Internet-accessible satellite data Centers in the Region

  Development of distributed analytical environment supporting ecological systems study

  Result envisaged: distributed collaborative information-computational environment to support investigations in multidisciplinary area of Earth System Science and applications

• Realization:

  Set of interrelated SB RAS Integrated Projects with SIRS is a test bed for their outcomes implementation!
Siberia Integrated Regional Study (SIRS, http://sirs.scert.ru/)

Why Siberia:
Drastic regional climate variations;
Role in carbon cycle (forestry, bogs, peat);
Permafrost;
Siberia-global system linkages; and SB RAS research infrastructure
2003 – beginning of SB RAS specific activity!

Few years ago IGBP suggested to develop in selected regions integrated regional studies of environment, which would represent a complex approach to reconstruct the Earth System dynamics from its components. It considered as a complementary effort to the thematic project approach employed so far in the international global change programs. Nowadays Integrated Regional Study (IRS) approach is developed by the Earth System Science Partnership (http://www.essp.org/), joining four major Programs on global change research. IGBP initiative aimed at development of IRS in the most important regions of the planet puts a set of prerequisites for such studies:

- The concept should be developed in the context of the Earth System as a whole;
- Scientific findings should support sustainable development of the region;
- Qualitative and quantitative understanding of global-regional interconnections and the consequences of changes in these interconnections should be achieved.

The regional (region here is a large geographical area, which functions as a biophysical, biogeochemical and socio-economic 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 rapid changes both at regional social-economical system and the Earth System. Consequences of these changes are very important on a regional and global scale. Regional approach to the study is also important with respect to the point of view of Earth sciences. Regional compounds of the Earth System 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. Regions are “open systems” and the interconnection 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.
Development of scientific Web cites and portals as information-computational systems for chosen Earth Science thematic domains

Key elements:

Web portals with thematic web sites providing an interactive access to data, models and tools:


- **RISKS** ([http://climate.risks.scert.ru/](http://climate.risks.scert.ru/))


Each portal is provided with extensive tutorial and educational materials

Cooperation: DMI (Denmark), IIASA (Austria), MPI and FSU (Germany), (Italy), EROS (USA), new partners are welcomed (gordov@scert.ru)!
The bilingual (Russian and English) Enviro-RISKS web-portal is aimed at dissemination of the FP6 CA "Man-Induced Environmental Risks: Monitoring, Management and Remediation of Man-made Changes in Siberia" (Enviro-RISKS) results as well as relevant projects results and approaches. It is also an information resource on general environment issues adjusted also for usage in education process and giving an access to environmental information and basics on environmental monitoring and management to regional administrators, researchers, students and general public thus giving rise the environmental concern in NIS management bodies and general public.

The portal operation will be supported by a distributed information system with main server in Tomsk and nodes Krasnoyarsk, Moscow, Khanty-Mansiisk and Almaty thus providing easy access to structured information resources on Siberian environment, its management under anthropogenic environmental risks and methods of its remediation. Among the information resources there are also gathered and systematized environmental information resources obtained in process of environmental studies in Siberia and results of relevant expert groups studies. The portal is also aimed at exchange and dissemination of good practices examples of practically important results obtained in course of projects implementation, especially those obtained in area of remediation.

Additionally it is used as an instrument for exchange and dissemination of information between the project partners.

**Portal functionality**

- **Access to:**
  - Gathered and analyzed detailed information on all coordinated Projects;
  - Gathered and systematized results and findings obtained including relevant observation data and information resources;
  - Distributed database, which will give an access to data on characteristics of Siberian environment to the Project Partners and an access to relevant metadata to all interested professional community.

- The basic thematic sites integrated into the Enviro-RISKS web-portal are:
  - Air Quality Assessment and Management will compile basic aspects of air pollution and environmental impact assessment and include interactive tutorials. Specific case study examples will be drawn from Lake Baikal and the West Siberian Lowlands.

**ENVIRO-RISKS (INCO-CT-2005-013427)**

http://risks.scert.ru/
Online system for visualization and statistical analysis of meteorological and climatic data.

A dedicated web-interface based on the web-portal ATMOS engine, which allows one to perform basic mathematical and statistical computations on various observational (in-situ, satellites) and model (global and regional models, reanalysis) data with consequent graphical representation of results.

Such online system should help researchers to save time during performing the same repetitive analytical tasks via implemented access to datasets stored on the dedicated server.

Additional datasets – additional functionality
Web based online system for analysis of climatic changes. Archives of meteostations data and Reanalysis in Siberia can be processed now (http://climate.risks.scert.ru/reanalysis/).
Development of Internet-accessible satellite data Centers in the Region

Distributed service oriented system for integration of satellite environmental data with those obtained by local instrumental networks and modeling activity.

Centers receiving satellite data (Novosibirsk, Krasnoyarsk and Irkutsk) will be provided with IT tools facilitating data processing and share.

Additionally one more Center will be organized in Tomsk to support satellite data archive and provide relevant services.

SB RAS support relevant basic studies!

Cooperation: FSU (Germany), CNES/SPOT (France), EROS USGS (USA), new partners are welcomed (shokin@ict.nsc.ru)!
В Новосибирском научном центре СО РАН на базе системы хранения данных Института вычислительных технологий (объемом более 40 Тбайт) создан каталог спутниковых данных http://datacatalog.ict.nsc.ru. С марта 2009 г. каталог расширяется оперативными данными EROS-24 (по прямому каналу с приемо-передающей Зап-СибСИРЦОД). Информационная система спутниковых данных (ИССД) создана в Институте вычислительных технологий (ИВТ) СО РАН совместно с Западно-Сибирским Центром приема и обработки данных (ЗапСибСИРЦОД) при ГУ-Новосибирском центре по гидрометеорологии и мониторингу окружающей среды с функциями регионального специализированного метеорологического центра в северной части страны в соответствии с соглашением о совместной деятельности. ИССД предназначена для информационного обеспечения тематически фундаментальных и прикладных научных исследований, проведение на территории России, а также для представления результатов исследований через интернет.

- Правила работы с Информационной системой спутниковых данных
- Организация хранения данных каталога

Материалы по системе

http://gis-app.kt.nsc.ru/www/
Receiving satellite data

- NOAA (15, 16, 17, 19) – 1 Гбайт/сутки
- (Terra+Aqua)/MODIS – 3.5 Гбайт/сутки
- SPOT 2/4 – 16 Гбайт/сутки
- RADARSAT-1 (по заказам)
- IRS-P5 (Cartosat-1) (по заказам)
- EROS-B (по заказам)
- ALOS (по заказам)
- Метеор-М1 (с 2009 г.)
- Электро-Л1 (с 2009 г.)
Search in the Catalog

Sensor, Area, Time interval, Specific parameters
Схема функционирования системы

Пользовательские модули на C/C++

GrassGIS (обработка и анализ ДДЗ)

MapServer (генерация изображений)

Web Server (PHP-, Java-, Perl-приложения)

PostGIS (работа с векторными картами)

MySQL (работа с атрибутивной информацией)

DATA сервер (хранение архивной информации (ДДЗ, ЦМР, …))

Система хранения данных ИВТ СО РАН

Удаленные базы данных (ресурсы институтов и организаций)
Irkutsk
Novosibirsk
SPOT images (September 2008)
LandSat images archive (1982-2002 гг.)
Example
Usage of Landsat 7, Erdas 8.3 data

Result:
Model of spatial ecosystems organization overlaid on relief.
Development of distributed analytical environment supporting ecological systems study

Objectives:
Elaboration of IT tools aimed at integration of distributed DB of ecological systems observations, monitoring and modeling, including

- Integration of data into relevant environment,
- Elaboration of approaches to fast processing large data massive, and
- Elaboration of methods of interactive ecosystem models creation on the base of fiels and remote sensing data.

Cooperation is welcomed (fedotov@sbras.ru)!
Geoinformation server as a prototype of distributed information system integrating web and GIS technologies to support environmental studies is launched into test operation
Expert-analytical GIS “Biodiversity and dynamics of Ural and Siberia ecosystems: organization of thematic information"
Тематические базы натурных данных


- Создан прототип информационной системы для хранения связной и формализованной информации о видах растений ([http://gis-app.ict.nsc.ru/bio](http://gis-app.ict.nsc.ru/bio)). На данный момент информационная система содержит:
  - базу данных «Мхи России» (24809 записей);
  - таблицы «Регионы России» (115 зап.) и «Список видов мхов» (1337 зап.)

Examples:

Optimization map for forest management near lake Baikal;

Vector map of landscapes (South of Eastern Siberia)
Last but not least! Synergy of SIRS ICT infrastructure and professional education

Necessity to use information-computational technologies (ICT) as instruments and glue;

ICT tools should be newcomer friendly – to be provided with extensive thematic help, which make them also tools for education/training program.

**Threefold approach:**
Multidisciplinary Conference with elements of YSS (ENVIROMIS);

YSS and on Computational and Information Technologies for Environmental Sciences (CITES)

Web portals with thematic embedded tools for distant professional education/training (ATMOS, RISKS, ENVIROMIS)

http://www.scert.ru/en/conferences/
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