Integrated regional studies of climatic and ecosystem changes in Siberia

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Basis for the integrated regional studies

• Become accessible saved up and it is homogeneous formatted meteorological data for some thirty-year climatic periods, and also new information technologies for the statistical analysis of world data. They define necessity of qualitatively new approach to researches of laws of modern climatic processes and mathematical modeling of these processes.
Basis for the integrated regional studies

• Long-term experience of interdisciplinary land supervision and become accessible results of space sounding with the high vertical and horizontal permission define necessity of qualitatively new approach to researches of laws of modern natural processes separate ecosystem not separately, and in their interrelation with climatic and ecosystem changes in adjoining territories.
Basis for the integrated regional studies

• New means for field measurements and modern information-communication technologies define necessity of qualitatively new approach to working out of information-measuring complexes and processing methods for monitoring and the forecast of natural and climatic processes and the phenomena, including the catastrophic.
Structural features of the integrated regional studies

• **It is unprecedented difficult object of researches:** natural and climatic systems with continuously changing parameters of a condition and interaction processes under simultaneous influence of terrestrial and extraterrestrial factors, including anthropogenous influences.
Structural features of the integrated regional studies

- Special wide integration of scientific disciplines (physical and mathematical, technical, biological, geographical, etc.) as are necessary:
  - New methods and devices for monitoring of condition and processes;
  - New information technologies for multifactorial monitoring and modeling;
  - A new paradigm for the description and forecasting of dynamics of natural and climatic systems.
Natural and climatic changes in Siberia

Results of the analysis of tool data of a world network of supervision

For warming in Siberia in 20th century the lead role of atmospheric circulation in observable changes (mainly at the expense of winter months of last decades) is revealed.

From the correlation analysis of wavelet-spectra the climatic phenomenon in the middle of 20th century is revealed: the raised correlation for periodicity $T$ and index $NAO$ with scale in 30-50 years.

The analysis of time shifts for wavelet-spectra $T$ and index $NAO$ has revealed delay of correlated periodicity approximately 7 years that contacts inertial mechanisms of carrying over of heat oceanic currents.

3. Доклады Академии Наук, 2007, T. 412, № 6, с. 1-5.
Basis for the integrated regional studies

Changes of mid-annual pressure in Siberia

Linear trends of mid-annual ground pressure during 1975-2005 according to supervision (gPa/10 years)

Over mostly territory mid-annual ground pressure decreases with speed 0,2-0,5 gPa/10 years.
In northern widths (a mouth of Ob River, Novosibirsk and the Aleutian Islands) for the same period mid-annual pressure increases with speed 0,1 - 0,5 gPa/10 years (the Aleutian minimum is filled).
Basis for the integrated regional studies

Changes of mid-annual precipitations in Siberia

Linear trends of mid-annual precipitations (For the warm period of year) in 1975 - 2005

Linear trends of precipitations for the warm period of year in Siberia are negative and make 2-5 mm/10 of years. Linear trends of precipitations for the cold period of year are also negative for all territory.
Basis for the integrated regional studies

Distribution of trends of monthly average temperatures in Western Siberia

From the analysis of monthly average characteristics of a climate in Western Siberia during the accelerated warming (1976-2006) follows, that trends of warming for various months differ different mesoscale heterogeneity, and changes of monthly average temperature correlate with changes of a mode by vortex atmosphere of circulation.
Basis for the integrated regional studies

Fluctuations of discharge of Ob River at Salekhard in 1936-2004 (in km$^3$) and the forecast for 2005-2050

For the forecast of hydrological characteristics (freshwater runoff of rivers, moisture circulation and humidification) in territory of Siberia the model considering astrogeophysical cycles of sun-and-planet tidal waves and raising correctness of the forecast with 65 to 80 % is offered (IWEP)
Basis for the integrated regional studies

Scheme of indicators of exodynamic processes (IWEP)

Zone of processes of **bogging** with salinization and desalinization soils

Red background color - transitive areas of salinization and desalinization soils processes.

Zone of processes of **desertification** with erosion, salinization and desalinization soils

By results of the analysis in the time and spatial domain of natural risks in Western Siberia two zones exodynamic processes which are indicators of climatic changes for 3-5 years' and 40-50 years' cycles are allocated
Basis for the integrated regional studies

Climatic, hydrological, ecologo-economic intensity of Tomsk region

The technique of cartographical display of environmental risks taking into account territorial ranging climatic, hydrological and ecologo-economic intensity is developed.
For researches ecosystem changes and the environmental risks connected with them in mountain territory of Southern Siberia the regional GIS is created, including:

- information database (attributive data on natural complexes);
- program complex Microdem/Terra Base II;
- techniques and technologies of the analysis of land and satellite data.
Monitoring cedar ecosystem of Siberia and working out of new technologies of forest exploitation and forestation taking into account modern natural, climatic and technogenic influences.

Example of natural hybridization (Sohno, 1700 m). Cedar elfin woodland (at the left), Cedar Siberian (in the centre) and their hybrid (on the right).

Nursery forest of an elite tree-planting material (Kurlek, Tomsk region) with a unique Euroasian genofund.
Development of a network of aerosol-radiating monitoring of Siberia as a part of a world network for the control of aerosol-ecological safety of region (IAO)
Creation of the distributed network of off-line and field independent information-measuring systems of monitoring for maintenance of the landscape analysis of processes

The registrar bottom borders of clouds (height, a direction and speed of movement)  
*Russian patent № 2321029*

Off line measuring instrument of profiles of physical parameters in soil and in atmosphere

VLF radiometer for the control lithosphere structures and geodynamic processes
Creation of information-measuring system for monitoring and tool forecasting of the dangerous natural phenomena, including heavy risks
Information-measuring technologies for monitoring of natural and climatic processes

The new electromagnetic method of allocation of geophysical structures and the control of geodynamic processes on radio noise in VLF-range is developed by means of multichannel geophysical registrar MGR-01.
Information-measuring technologies for monitoring of natural and climatic processes

Field tests of an electromagnetic method of allocation of geophysical structures and the control of geodynamic processes on radio noise in VLF-range as bases of information-measuring technology for monitoring and the forecast slope of embankment risks are conducted.

Activity estimation slope of embankment of Kama River around gas pipeline transition «Siberia - Western Europe» (yellow points - installation stations MGR-01)
Information-measuring technologies for monitoring of natural and climatic processes

Activity estimation slope of embankment of Kama River around gas pipeline transition «Siberia - Western Europe» (yellow points - installation 8 stations MGR-01)
### Prospects of the further scientific researches

**Qualitatively new possibilities for researches of laws of climatic processes and their modelling with use of empirical laws.**

Are provided: the saved up meteorological data for some climatic periods and new information technologies.

**Qualitatively new possibilities for researches of laws of natural and climatic processes in their interrelation and in the big territories.**

Are provided: long-term experience of complex supervision on key sites and availability of data of space sounding with the high vertical and horizontal permission.

**Qualitatively new possibilities for monitoring and the forecast of prirodno-climatic processes and the phenomena, including the catastrophic.**

Are provided: new means for field measurements and new information-communication technologies.
Thanks for your attention!

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