

Evaluating critical thresholds of climate change impacting major regional environmental systems in Russia for developing adaptation strategies

This proposal is aimed at providing a quantitative assessment of critical levels of climate change that lead to significant impacts on major environmental systems and processes over diverse regions of terrestrial Russia to determine and evaluate potential negative and positive climate change impacts. The expected results will greatly contribute to the development of informed and adequate adaptation and mitigation strategies with regard to land use and infrastructure. We will utilize internationally recognized methodological approaches, criteria, and terminology developed and/or analyzed by the team members and will adapt them to specific bio-climatic conditions of Russia. Key components of natural environment, such as climate, vegetation, hydrologic regime, and permafrost will be analyzed within the framework of complex, integrative mathematical modeling using the full range of available in-situ and remotely sensed observations and climate projections.

The ongoing climatic changes in many Russian regions have already exceeded the level of natural variability accounted for in construction and management practices and norms regulating many types of human activities causing sizable infrastructure and economic losses. Numerous examples include catastrophic floods, deformation of linear structures (e.g., pipelines, roads, railroads, power lines) and buildings in the permafrost regions, increased frequency and intensity of forest damage due to fires and diseases. Simultaneously, analysis of remotely sensed and in-situ observations indicate the increased vegetation productivity in many northern regions and northward shift of the zonal and subzonal boundaries, which have a potential for new economic opportunities in several Russian regions. However, assessment of negative and positive climate-induced changes for Russia is essentially lacking. In contrast, significant intellectual and financial resources have been employed by the international scientific community to address these critical issues. For example, in 2008 the European scientists have developed a comprehensive map of potential climate change – related hazards for Western Europe, which served as a basis for the development of a strategic plan aimed at limiting climatic warming at 2 °C threshold above the pre-industrial level. Unfortunately, no such analysis was conducted for Russian territory. Moreover, no assessment of the balance between and relative importance of positive and negative climatic impacts in relation to different rates of projected warming for the diverse Russian regions and the country as a whole have ever been attempted.

The intellectual merit of the proposed research is warranted by: (I) the critical analysis and application of innovative methods of climate impact assessment corresponding to standards adopted by the Intergovernmental Panel on Climate Change; (II) complete range of in-situ data from national and international observational networks and remotely sensed products; (III) original models of different climate-dependent systems and processes developed as part of our past and ongoing research; (IV) comprehensive, latest generation CMIP5 General Circulation Model INMCM4. The research is motivated by scientific hypothesis, goals, and objectives not previously considered for and applied to terrestrial Russia.