

PAN-EURASIAN EXPERIMENT (PEEX) INITIATIVE

H.K. LAPPALAINEN^{1,2}, T. PETÄJÄ¹, J. KUJANSUU¹, T. SUNI¹, VM Kerminen¹, Y. VIISANEN², V. KOTLYAKOV³, N. KASIMOV⁴, V. BONDUR⁵, G. MATVIENKO⁶, S. ZILITINKEVICH² and M. KULMALA¹

¹Dept. of Physics, P.O. Box 64, FI-00014 University of Helsinki, Finland.

²Finnish Meteorological Institute, P.O. Box 503, FI-00101 Helsinki, Finland

³The Institute of Geography RAS, 119017, Staromonetny pereulok 29, Moscow, Russia

⁴Moscow State University, Moskovskij Gosudarstvennyj Universitet im. M.V. Lomonosova, Leninskie Gory, Moscow 119992, Russia

⁵AEROCOSMOS, 4, Gorokhovskiy lane, Moscow, 105064, Russia

⁶Inst. of Atmospheric Optics SB RAS, Academician Zuev square, Novosibirsk, Novosibirsk reg., 634021 Russia

Keywords: climate change, biogeochemical cycles, atmospheric aerosols, atmospheric boundary layer, , Siberian ecosystems, Arctic Ocean, research infrastructures, remote sensing, PhD education programmes, socio-economic research

INTRODUCTION

The increasing human activities are changing the environment and we are pushing the safe boundaries of the globe (Rökström et al. 2009). Actions are needed to ensure that the society remains within the sustainable utilization of the resources (Leach et al. 2012). It is of utmost importance to gauge with a comprehensive research program the current status of the environment, particularly in the most sensitive locations. Pan-Eurasian Experiment (PEEX) is a multidisciplinary research approach aiming at resolving the major uncertainties in the Earth system science and global sustainability questions in the Arctic and boreal Pan-Eurasian regions. The vision of PEEX is to solve interlinked global challenges influencing the human wellbeing and societies in northern Eurasia: climate change, air quality, biodiversity loss, chemicalisation, food supply, energy production and fresh water in an integrative way, recognizing the significant role of boreal regions and the Arctic in the context of global change. The PEEX vision includes the establishment and maintenance of long-term, coherent and coordinated research activities and research & educational infrastructures in the PEEX domain. PEEX aims to contribute to the Earth system science agenda and climate policy in topics important to Pan-Eurasian environment and to provide adaptation and mitigation strategies for northern Pan-Eurasian societies to cope with climate change.

PEEX agenda is built on a bottom-up initiative by several European, Russian and Chinese research organizations and institutes. The promoter institutes here have been University of Helsinki, Finnish Meteorological Institute in Finland and Institute of Geography, Moscow State University, Aerocosmos and Institute of Atmospheric Optics Siberian Branch, RAS, in Russia. The first PEEX meeting was held in Helsinki in October 2012, followed by the second PEEX meeting in Moscow in February 2013. PEEX is based on the collaboration of Russian, Chinese and European parties and currently involves ca 40 research institutes. From European perspective PEEX experiment can be considered as a crucial part of the strategic aims of several European and national roadmaps for climate change research and the development of next generation research infrastructures.

The PEEX domain covers natural and urban environments of Northern Pan-Eurasian region. The natural environments include boreal coniferous and deciduous forests, steppe, wetlands and aquatic

ecosystems including marshes, large river systems and freshwater bodies as well as the marine ecosystems, mountains and sub-arctic tundra ecosystems. Siberia and the Arctic Ocean is the core geographical region of the PEEEX domain. The majority of the PEEEX geographical domain is situated in the territory of Russia and China.

METHODS

The PEEEX agenda is divided into four focus areas: F-1 Research Agenda, F-2 Infrastructures, F-3 Society Dimension and F-4 Knowledge Transfer. F-1 Research Agenda will use an integrated observational and modelling framework to identify different forcing and feedback mechanisms in the northern parts of the Earth system, and therefore enable more reliable predictions of future regional and global climate. The PEEEX will apply the integrated research approach for solving the following large scale research questions.

1. How are the main climate parameters (temperature, precipitation, snow cover, cloudiness) changing in the Pan-Eurasian region over the next decades?
2. What are the important feedbacks in the Pan-Eurasian climate system and how they are related human activities and ecosystem behaviour in short (decades) and long (millennia) time scales?
3. How will the cryosphere, including the Arctic sea ice extend, snow cover and permafrost, change with changing climate?
4. How fast will the permafrost thaw proceed and how will it affect ecosystem processes and ecosystem-atmosphere feedbacks, including the hydrology and greenhouse gas fluxes?
5. How could the regions and processes especially sensitive to climate change be identified, and what are the best methods to analyse their responses?
6. Will there be tipping points in the future evolution of the Pan-Eurasian ecosystems and demographic development?
7. What are the present stage and expected changes of environmental pollution (air, water, soil) and related stresses on population and ecosystems in Eurasia, and how will these changes affect societies (livelihoods, agriculture, forestry, industry)?
8. How will human actions influence further environmental change in the region?
9. How do the fast climatic changes affect the physical, chemical and biological state of the different ecosystems, inland water, coastal areas, and the economies and societies in the region?
10. How could one identify the environmental and socioeconomic areas most vulnerable to climate change, and how could their adaptive capacities be improved?

The strategic focus of the F-2 Infrastructures is to ensure the long-term continuation of advanced measurements in the land-atmosphere-ocean continuum in northern Eurasian area. Thus, one of the first steps of implementation plan is to start building the long-term, continuous and comprehensive research infrastructures (RI) in the northern Pan-Eurasia. These RIs will include ground-based, aircraft and satellite observations as well as multi-scale modelling. The F-3 Society Dimension, is aimed to provide fast-track assessments of global environmental change issues for climate policy-making and mitigation and adaptation strategies for the northern Pan-Eurasian region.

F-4 Knowledge transfer will provide education programmes for the next generation scientists, instrument specialists and data engineers. It will distribute information for general public to build the awareness of climate change and human impact on different scales of the climate problematic and increase visibility of the PEEEX activities in Europe, Russian and China. Part of the F-4 PEEEX will engage the larger international scientific communities also by collaborating with, utilizing, and advancing major observation infrastructures such as the SMEAR, ICOS, ACTRIS, and ANAEE networks in addition to building its own in the Pan-Eurasian region. PEEEX will promote standard methods and best practices in creating long-term, comprehensive, multidisciplinary observation data sets and coordinate model and data comparisons and development; PEEEX will also strengthen the international scientific community via an extensive capacity building programme.

The implementation of PEEEX agenda is based on two components: (i) coordination of existing activities and (ii) new PEEEX activities. PEEEX funding will be built on national, bilateral and Nordic and European funding instruments based on the matching funds concept. Furthermore, PEEEX initiative will co-operate with several EC and ESA funded activities aimed to develop next generation research infrastructures and data products such as EU-FP7-ACTRIS-I3-project (Aerosols, Clouds, and Trace gases Research InfraStructure Network-project 2011-2015), ICOS a research infrastructure to decipher the greenhouse gas balance of Europe and adjacent regions and EU-FP-7 e-infra ENVRI “Common Operations of Environmental Research Infrastructures” project. PEEEX will be part of the iLEAPS programme (Integrated Land Ecosystem – Atmosphere Processes Study) bringing the PEEEX under umbrella of the International Geosphere-Biosphere Programme (IGBP) / Future Earth.

FUTURE PROSPECTS

PEEX will integrate a new Earth system research community in the Pan-Eurasian region by opening its research and modeling infrastructure and inviting international partners and organizations to share in its development and use. PEEEX initiative will be a major factor integrating the socioeconomic and natural science communities to working together towards solving the major challenges influencing the wellbeing of humans, societies, and ecosystems in the PEEEX region. PEEEX research community is currently finalizing the Science Plan. The first version of the Implementation Plan will be drafted in the autumn 2013. The next PEEEX-3 meeting will take place in Hyytiälä, Finland in August, 2013. PEEEX aims to be operational starting from 2014.

REFERENCES

Kulmala M., Alekseychik P., Paramonov M., Laurila T., Asmi E., Arneth A., Zilitinkevich S. & Kerminen V.-M. (2011). On measurements of aerosol particles and greenhouse gases in Siberia and future research needs. *Boreal Env. Res.* 16: 337-362.

Leach, M., Rockström, J., Raskin, P., Scoones, I., Stirling, A.C., Smith, A., Thompson, J., Millstone, E., Ely, A., Erond, E., Folke, C. and Olsson, P. (2012) Transforming innovation for sustainability, *Ecol. Soc.* 17, 11-16.

Pan Eurasian Experiment (PEEX) Science Plan, draft version 0.4 . <http://www.atm.helsinki.fi/peex/>

Rockström, J., W. Steffen, K. Noone, Å. Persson, F. S. Chapin, III, E. F. Lambin, T. M. Lenton, M. Scheffer, C. Folke, H. J. Schellnhuber, B. Nykvist, C. A. de Wit, T. Hughes, S. van der Leeuw, H. Rodhe, S. Sörlin, P. K. Snyder, R. Costanza, U. Svedin, M. Falkenmark, L. Karlberg, R. W. Corell, V. J. Fabry, J. Hansen, B. Walker, D. Liverman, K. Richardson, P. Crutzen, and J. A. Foley. 2009. A safe operating space for humanity. *Nature* 461:472–475.