
Pan-Eurasian Experiment (PEEX) Program – Towards understanding the environmental change and it's impact on the Northern Eurasian regions and in China

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Abstract: Pan-Eurasian Experiment (PEEX) initiative (<https://www.atm.helsinki.fi/peex/>) is an international, multi disciplinary, multiscale bottom up initiative establish in 2012 (Lappalainen et al. 2014). The main focus of the initiative is to solve interlinked global challenges influencing societies in the Northern Eurasian region (Kulmala et al. 2015). PEEX is creating concepts, which are applicable in various environments relevant to “the Silk Road Economic Belt and the 21st-Century Maritime Silk Road” Program. The initiative has grown fast and at the moment it is involving research communities from 20 different countries from Europe, Russian, and China. PEEX will also expand the collaboration with research and research infrastructure communities in Northern America. Altogether 80 institutes have contributed the PEEX Science Plan, which identifies the PEEX Program at large and introduces the research agenda, the components of the future PEEX research infrastructure and the topics relevant for impact making and outreach activities. Program delivers scientific assessments for the mitigation and adaptation planning to facilitate the sustainable development of Northern societies. In China the main focus of PEEX agenda is improving the air quality and find solutions for long-term improvements. The program is coordinated by the University of Helsinki and Finnish Meteorological Institute together with the strong support by the Moscow State University (MSU) and AEROCOSMOS from Russia and Institute of Remote Sensing and Digital Earth (RADI) and University of Nanjing from China.

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The Pan-Eurasian Experiment (PEEX) is a multi-disciplinary, multi-scale and multi-component research, research infrastructure and capacity building programme (Lappalainen et al., 2014; Kulmala et al., 2015). The PEEX initiative has been sparked as a bottom-up approach by a science community in 2012 to study the major uncertainties in Earth System Science and global sustainability issues concerning the Arctic and boreal Pan-Eurasian regions as well as China. The PEEX vision is to solve interlinked global grand challenges influencing human well-being and societies in northern Eurasia and China. The Grand Challenges relevant here are changes in population, climate change, air quality, biodiversity loss, chemicalization, food and fresh water availability, energy production and use of natural resources by mining, industry, energy production and transport sectors. PEEX uses an integrative approach with supradisciplinary methods and recognizes the important role of the Arctic and boreal ecosystems in the Earth system. The PEEX research agenda consists of twelve highlighted research areas relevant to atmospheric, land, aquatic and society systems. PEEX Special issue in the Journal of Atmospheric Chemistry and Physics (http://www.atmos-chem-phys-discuss.net/special_issue265.html). This issue serves as a first platform collecting PEEX relevant scientific results for the first PEEX science assessment. The Assessment(s) will be distributed to different stakeholders and policy making processes such as COP /IPCC, Arctic Council, Future Earth and the European, Russian and Chinese ministries (Lappalainen et al., 2015; Lappalainen et al. 2016).

To ensure the successful research approach PEEX is also establishing its own long-term, coherent and coordinated research infrastructure activities such as in situ observation network of the ecosystem – atmosphere interactions (Lappalainen et al. 2014; Alekseychik et al. 2016; Kulmala et al. 2016). The concept of the hierarchical PEEX in situ station network is based on know-how of the 20 year development of the SMEAR-II flagship station measurement theory and techniques (Hari et al. 2016). The backbone of the station network is built on the existing land surface (biosphere/ecological or urban) and atmospheric observation networks in collaboration with European, Russian, Chinese and global partners. PEEX-infra pillar underlines that the satellite observations needs to be connect to the ground based observations of the PEEX network. Also establishing new SMEAR stations are envisioned. The first ideas of Global SMEAR network has been introduced in the Paris COP side-meeting. Thus PEEX continues deepening the collaboration with the European, Russian, Chinese and global partners to maximize the impact of the PEEX research highlights, scientific assessment and research infrastructure development in the climate policy relevant processes. The key partners and stakeholders here are IIASA, Digital Earth, Future Earth, Arctic Council (SAON), WMO and GEO – GEOSS.

PEEX recognizes the unique opportunity to explore cooperation in the sustainable development of environments along the Silk Road Economic Belt and Road. PEEX has potential to establish a framework for solving environmental problems in the Belt and Road countries, and become a community of shared interests. PEEX research outcome and observation activities and the new methodological concepts are providing new information not only for the climate policy making in the global scale but also for the regional scale; for the mitigation and adaptation planning.

Now PEEX Science Plan is addressing the primary aim of mitigation plans/strategies of the Arctic-Boreal region, which is “to move towards low-carbon societies”. It is also addressed that, in the Arctic-boreal, the future actions are needed first stabilize and then reduce greenhouse gas emissions from agriculture and forestry, energy production and manufacturing. For this GHG stabilization, we need to develop new technologies as well as management and urban planning practices, and increase the use of renewable energy (such as wind). Furthermore, conservation activities and changes in land use patterns in agriculture and forestry, as well as protection of ocean ecosystems, are needed to protect the natural carbon sinks of the Northern Eurasian environments. The same type of thematic approach and analysis, which PEEX has already specified for the Arctic-boreal regions, could be preformed also for the environments relevant to “the Silk Road Economic Belt and the 21st-Century Maritime Silk Road” Program. In addition to analysis of the future mitigation needs, could PEEX holds know-how, how the multidisciplinary - multiscale research approach concept could be applicable also the Silk Road geographical domain. This concept has successfully been carried out by European Union Framework Program 6th “European Integrated project on Aerosol, Cloud, Climate, and Air Quality Interactions (EUCAARI)” (Kulmala et al. 2009, 2011) and, currently, by “The Finnish Centre of Excellence in Atmospheric Science - From Molecular and Biological processes to The Global Climate”(Kulmala et al. 2014). Both projects being coordinated by the University of Helsinki and have lead several scientific breakthroughs published in Nature and Science. In order to realize the PEEX – Silk Road collaboration, this multiscale research concept together with the SMEAR - Global Observation Network serves a starting point for the detailed designing the collaboration, namely, the research approach and all scale monitoring activities for the Silk Road mitigation and adaptation planning.

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