

-

Pan-Eurasian Experiment (PEEX) Program

-

Grand Challenges in the Arctic-boreal context

M. Kulmala¹, H.K. Lappalainen^{1,2}, T. Petäjä¹, T. Kurten³, V.-M. Kerminen¹, Y. Viisanen², V. Kotlyakov⁴, N. Kasimov⁵, V. Bondur⁶, G. Matvienko⁷, A. Baklanov⁸, HD. Guo⁹ and S. Zilitinkevich^{1,2,110}

¹Dept. of Physics, University of Helsinki, Finland.

²Finnish Meteorological Institute, Helsinki, Finland

³Dept. of Chemistry, University of Helsinki, Finland.

⁴The Institute of Geography RAS, Russia

⁵Moscow State University, Russia

⁶AEROCOSMOS, Russia

⁷Inst. of Atmospheric Optics SB RAS, Russia

⁸World Meteorological Organization, Switzerland

⁹Institute of Remote Sensing and Digital Earth, CAS, China

¹⁰ Dept. of Radiophysics, Nizhny Novgorod State University , Russia

Keywords: Grand challenges, climate change, biogeochemical cycles, feedbacks, multi-scale modeling, continuous comprehensive observations, research infrastructures, open data systems.,

The Earth system is facing several global-scale environmental challenges, called “Grand Challenges”. Grand challenges such as climate change, air quality, ocean acidification, fresh water, food supplies are the main factors controlling the human well-being, security and stability of future societies. All the grand challenges are interlinked via complex feedbacks in the Earth system. In the future, the Northern Eurasian arctic-boreal natural environment will play a crucial role for the Earth system feedback processes via the albedo change, carbon sinks and emissions, methane emissions and aerosol production via biogenic volatile organic compounds (BVOCs) (Arneth et al. 2010, Carslaw et al. 2010, Kulmala et al. 2014). In addition to atmosphere- biosphere interactions the warming of northern latitudes is related to socio-economic changes via the thawing of permafrost and the Arctic Ocean becoming ice free part of the year. If the northern sea route is opened for shipping between the Atlantic and Asia’s Far East and if the exploitation of the natural resources (oil, natural gas and minerals) is increased, the global trade activities will be accelerated in the Arctic. In order to advance the understanding of the future changes in the Arctic-boreal regions and be able to apply it for reliable mitigation and adaptation planning and for the climate scenario and the early warning system development, we need a holistic science approach, which is based on the multi-scale modeling, continuous comprehensive observations and open data systems. Pan-Eurasian Experiment (PEEX) Program (<https://www.atm.helsinki.fi/peex/>) is covering all these components and will be producing, comprehensive understanding of the future development of the Northern Eurasian regions (Lappalainen et al. 2014, 2015).

REFERENCES

Arneth A. et al. (2010) Terrestrial biogeochemical feedbacks in the climate system. *Nature Geosci.*, 3, 525–532.

Carslaw, K. S. et al.. (2010) A review of natural aerosol interactions and feedbacks within the Earth system. *Atmos. Chem. Phys.*, 10, 1701–1737.

Kulmala et al. (2014) CO₂-induced terrestrial feedback mechanism: From carbon sink to aerosol source and back. *Boreal Env. Res.*, 19, suppl. B, 122–131.

Lappalainen et al. (2014): Pan-Eurasian Experiment (PEEX)- a research initiative meeting the grand challenges of the changing environment of the northern Pan-Eurasian arctic-boreal areas. *J. Geography, Environment, Sustainability* No 2(7) pp. 1 pp. 14-48.

Lappalainen H.K, Kulmala M. & Zilitinkevich S. (eds) (2015). Pan-Eurasian Experiment (PEEX) Science Plan. http://www.atm.helsinki.fi/peex/images/PEEX_SciencePlan_PROOFversion.pdf