

PAN-EURASIAN EXPERIMENT (PEEX) – A RESEARCH INITIATIVE MEETING “THE GRAND CHALLENGES OF THE CHANGING ENVIRONMENT OF THE NORTHERN PAN-EURASIAN ARCTIC-BOREAL AREAS” (International Geographical Union Conference 2015, Moscow, Russia)¹

The Pan-Eurasian Experiment (PEEX) is a multidisciplinary climate change, air quality, and environmental global change research program aimed at understanding biosphere-ocean-cryosphere-land-atmosphere interactions and feedbacks in the Northern Eurasian, particularly arctic and boreal, regions (<https://www.atm.helsinki.fi/peex/>). One of the sections of the International Geographical Union (IGU) Regional Conference held in Moscow in August 2015 was devoted to the PEEX program. The section hosted 34 oral and 16 poster presentations from the Russian Federation, Finland, Belarus, Norway, Greece, and China.

The keynote address “Pan-Eurasian Experiment (PEEX) Program – Grand Challenges in the Arctic-boreal context” was delivered by Markku Kulmala, in which he emphasized that 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, and food supplies are the main factors controlling the human well-being and security and stability of future societies. All the grand challenges are interlinked via complex feedbacks in the Earth system. He underlined

that in the future, the Northern Eurasian natural environment will play a crucial role for the Earth system feedback processes due to albedo change, carbon sinks and emissions, methane emissions and aerosol production via biogenic volatile organic compounds. This presentation was closely connected with the reports by Hanna Lappalainen (“Pan-Eurasian Experiment [PEEX] research agenda – system understanding of the Arctic-boreal regions for scenarios and assessments of the Northern Pan-Eurasian environments”) and by Pavel Alekseychik (“Towards the harmonized PEEX project observational infrastructure: building the metadatabase”). In the latter presentation, the author summarized information about the observational facilities included in the PEEX metadatabase and provided the details about their organization, measurement equipment, and a number of other features.

One of the main traditional research areas in the PEEX program is the research of the atmospheric composition, its future scenarios and their role in biogeochemistry. Alexei Eliseev presented the results of the assessment of climatic and ecological impacts of tropospheric sulphate aerosols on the terrestrial carbon cycle using the parameterisation of tropospheric sulphate aerosols on the terrestrial gross in the coupled model. The model response to sulphate

¹ The review is based on the IGU 2015 Book of Abstracts, International Geographical Union: Moscow, 2015.

aerosol loading is subdivided into the climatic and ecological impacts. It appears that the former basically dominates over the latter on the global scale and modifies the responses of the global vegetation and soil carbon stocks to external forcings by 10 %. Other model simulations were performed to evaluate the assessment of global CO₂ emissions to the atmosphere from crown, ground, and peat fires (Eliseev et al.). The results showed that ground and peat fires contribute significantly to the total emissions of CO₂ from natural fires (20–25 % at the global scale depending on scenario and calendar year). Meigen Zhang talked about the assessment of the biospheric contribution to surface atmospheric CO₂ concentrations over East Asia, in which a regional chemical transport model, RAMS-CMAQ, was employed to assess the impacts of biosphere–atmosphere CO₂ exchange on seasonal variations in atmospheric CO₂ concentrations over East Asia. The presentation “Cold CO₂ emission from sub-boreal soils: current trends and effect of repeating freezing–thawing events” made by Irina Kurganova was based on the long-term measurements in the Moscow region. The results of several experiments with soil temperature and precipitation manipulation and their influence on CO₂ fluxes were presented by Valentin Lopes de Gerenyu and Irina Kurganova. Egor Dyukarev discussed the analysis of observations and modelling of carbon fluxes from peatlands in southern taiga of Western Siberia. Leonid Golubyatnikov talked about methane emissions from northern lakes in Karelia and Western Siberia. The study on wildfire forest and peat aerosol emissions in the PEEEX regions including particulate matter and black carbon aerosols were presented by Olga Popovicheva. Another presentation on the aerosol optical depth retrieval over the arctic region using satellite data was made by Yong Xue.

The potential for space-borne monitoring of atmosphere pollution in Northern Eurasia under the PEEEX framework was discussed by E. Mityushina. C.A. Arutyunyan presented

“Studying emissions of trace gases and aerosols resulting from wildfires into the atmosphere of Northern Eurasia with satellites”; Vadim Rakitin talked about “Satellite and ground based measurements: comparison of CO and CH₄ total contents for background and polluted conditions” and “Background CO and CH₄ total contents: long-term IAP spectroscopic datasets, typical and abnormal variations and temporal tendencies.”. Oleg Postilyakov discussed the investigation of atmospheric composition using ground-based methods in cloudy conditions within the Russian-Belorussian DOAS Network. Black carbon studies in the atmosphere over the White, Barents, Greenland, and Kara seas during summer 2014 were described by Vladimir Shevchenko. Anna Vinogradova also focused on the black carbon topic in her presentation “Black carbon atmospheric emissions from Russian oil/gas industry open fires”. Aircraft-borne measurements over Southern Finland during the PEGASOS 2013 campaign were the subject of Riikka Väänänen’s talk. Jiahua Zhang presented the results of the assessment of the biospheric contribution to surface atmospheric CO₂ concentrations over East Asia with a regional chemical transport model. Long-term variability of aerosols in Moscow according to AERONET, their radiation effects, and comparison with the results of radiative calculations in COSMO-Ru mesoscale model were discussed by Alexei Polyukhov. Yury Shtabkin presented the results of the seasonal variations of near-surface carbon monoxide (CO) concentration in central Siberia in 2007–2012, according to ZOTTO observations and model simulation. Natalia Pankratova analyzed ozone and nitric oxides in the surface air over Russia under background conditions and in extreme situations.

Tuukka Petaja with colleagues talked about “Biogenic Aerosols – Effects on Clouds and Climate (BAECC) project as a showcase for benefits of comprehensive atmospheric observations,” where they described the comprehensive aerosol measurement facilities that allow linking precursor emissions and aerosols and aerosols at the

surface and in the mixing layer and free troposphere, and investigating the aerosol indirect effects on clouds and precipitation. Xuemeng Chen discussed verification of aerosol diffusion spectrometer on the measurement of atmospheric aerosol particles.

The results of simultaneous measurements of the temporal variations in wind velocity, atmospheric pressure, and gas constituents (NO₂, NO) near Moscow and Beijing were presented by Igor Chunchuzov. The characteristics of the coherent structures (dominant periods, spatial scales, and translation speeds) in the troposphere were obtained, and their influence on temporal variability of gas components in the atmosphere has been evaluated. In addition, regular observations of the integral content of formaldehyde and nitrogen dioxide in the lower troposphere in the Moscow region were discussed by Alexander Borovski.

Valery Bondur talked about "Methods of satellite monitoring for the purpose of the Pan-Eurasian Experiment (PEEX)" and discussed different methods and the potential of remote sensing.

The new PEEX-labeled projects: "Influence of natural and anthropogenic emissions of greenhouse and polluting gases on climate and ecosystem changes in Eurasia" and "Project SLICFONIA: complicated study of short-lived climate forcers in the Arctic" were presented by Andrei Skorokhod.

The report "Cognitive chaos: turbulence in the Earth system" was made by Sergej Zilitinkevich. Igor Esau also analyzed interaction of temperature and planetary boundary layer (PBL) in "Paradox of the surface air cooling in response to the global warming: a role of the stably stratified PBL and free atmosphere temperature inversions." The evaluation of convective boundary layer parameterizations based on large-eddy simulation (LES) data was presented by Andrey Debolskiy and Victor Stepanenko.

Another important topic on sustainability of carbon fluxes between forest and bog ecosystems in southern taiga of European Russia was discussed by Juliya Kurbatova. The results of measurements of carbon dioxide fluxes have shown that southern taiga ecosystems can function during the vegetative period both as a source and a sink of carbon for the atmosphere.

Evgeny Gordov discussed web-GIS based virtual research environment for the Northern Eurasia climatic studies, which could be an important tool for regional climatic and ecological monitoring and modelling as well as for continuous education and training support.

In the presentation by Natalia Chubarova "Temporal and spatial variability of biologically active UV radiation and UV resources over northern Eurasia" a new approach was proposed, which allows a user to estimate different impacts of biologically active UV radiation (vitamin D production, eye damage, erythema) over the territory of Northern Eurasia and to characterize its benefit or hazard for people with different skin types. Using the same approach, an interactive tool has been developed, which was described by Ekaterina Zhdanova. Long-term UV variations in Moscow since 1968 and the reasons of UV change were discussed by Elena Nezval'.

Vladimir Platonov and Stanislav Myslenkov analyzed the meteorological conditions over Northern seas in the presentation "Implementation of SWAN model with COSMO-CLM wind forcing for the Barents Sea storm events." They showed that the technique of high-resolution coupling between regional atmospheric and wave models could well reproduce extreme events, such as polar lows, and its main features like strong winds, pressure, and temperature as well as ocean wave distribution. The SWAN wave model was also used for studying the influence of swell waves from the North Atlantic on the wave field in the Barents

and White seas (Myslenkov et al.). Alexander Demidov talked about the mass structure and circulation in the south-eastern part of the Baltic Sea based on the data of the joint expeditions of Moscow State University and Baltic Federal University in 2009–2014. Alexander Chernokulski demonstrated a general increase of convective activity in Northern Eurasia over the last four decades, which also can be expected under the XXI century climate.

Several studies were devoted to the chemical composition and gas exchange in boreal lakes. Galina Gavrilenko discussed the oxygen regime of shallow lakes. Sofya Guseva and Victor Stepanenko presented the results on the numerical study of water-atmosphere gas exchange parameterization for a boreal lake.

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