Network: **Pan-Eurasian EXperiment - Academic Challenge (PEEX-AC)**

Academic discipline: **Physical sciences**

1. Partners and persons in FIRST+ network:

HEI Partner: University of Helsinki (UH)
Contact person's name (Telephone #; Contact person's email; Department/Unit; Postal address; Post code & district)

Prof. Tuukka Petäjä; phones +358-9191-50878, +358-5041-55278; tuukka.petaja@helsinki.fi; Institute for Atmospheric and Earth System Research/ Physics, Faculty of Science, University of Helsinki; P.O.Box 64, FI-00014, Helsinki, Finland.
He has more than 15 yr of research experience related to atmospheric sciences. At UH he leads experimental aerosol group (60 people; 3 sub-groups); 10-15 PhD students and 2-5 PostDoc level members per group; educated 16 PhDs and now supervising 10 students; published 281 peer-reviewed articles (8 in Science, 8 in Nature), with total cit. of 9817 & h-factor 48; highly cited scientist (2014-, Thompson Reuters). He obtained the FAAR Award in excellent aerosol science & Vaisala Award 2013 for combining state-of-the-art science and instrument development. He is science director of Pan Eurasian Experiment (PEEX), national delegate to SAON board, board member of PACES initiative, academician of IEAS. His managerial expertise includes: head of technical staff of Kumpula science campus & Värriö sub-arctic research station in Lapland; participated in practical organization of 11 EU projects, UH PI in ACTRIS2 H2020 infrastructure project (constructing EU-wide harmonized observations on atmospheric trace gases, aerosol particles and clouds); team leader in Finnish Center of Excellence of Academy of Finland on atmospheric sciences responsible for long-term, comprehensive observations in Finland and developing observational capacity in Russia & China.

UH team
Markku Kulmala, Sergey Zilitinkevich, Hanna Lappalainen, Risto Makkonen, Michael Boy, Katja Lauri, Jouni Räisänen, Alexander Mahura

HEI partner: Russian State Hydrometeorological University (RSHU)
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Prof. Sergei Smyshlyaev; phone +7-812-6330174 & +7-911-2765808; e-mail - smyshl@rshu.ru; Department of Meteorology, Division of Meteorological Forecasts; P.O.Box 192027, Voronezhskaya 79, St.Petersburg, Russia
He has more than 25 yr of research experience related to atmospheric sciences. At RSHU he leads atmospheric chemistry numerical modeling group (10 people; 2 sub-groups); 4 PhD students and 2 PostDoc level members per group; educated 11 PhDs and now supervising 4 students; published 107 peer-reviewed articles. He obtained the St.Petersburg Government award for outstanding contribution to scientific results implementation into high education process; award of the Russian Academy of Sciences for "Outstanding contribution to the progress in natural sciences" (2002). His research interests: chemistry-climate modeling of the processes that define temperature and minor gases distribution globally and regionally; stratospheric and tropospheric aerosol and polar stratospheric clouds formation and evolution; numerical weather prediction, air quality modeling and data assimilation. His managerial expertise includes: participated in practical organization of 15 RFBR, RNF and Russian Ministry of Education and science projects; team leader in international INTAS projects.

RSHU team
Eduard Podgaiskii, Alexander Pogoreltsev, Lyudmila Kolomeets, Anna Fokicheva, Georgii Nerobelov, Margarita Sedeeva

2. Background, project aims, and relevance

The PEEX-AC goal is to strength international added value and prestige of the Finnish (FI) Universities (Univ) educational system. The aims are: 1) To strength UH&RSHU collaboration in the PEEX research and education agenda; 2) To share knowledge, experience and promote state-of-the-art research and educational tools through organization of Intensive Course (IC); 3) To improve added value of research oriented education in FI&Russian (RU) Univ systems and boost the PEEX international collaboration.

RSHU was chosen based on previous multi-year positive experience of collaboration existing since developing of PEEX (www.atm.helsinki.fi/peex) Program and Science Plan, active involvement in projects of bi-lateral and EU collaboration (TEMPUS QUALIMET, EU FP7 MEGAPOLI, NordForsk CRAICC-PEEX, PEEX-CRUCIAL, etc.) making longer-term top-level research activities, building direct links, establishing students/teachers/researchers trainings and exchanges.

Added value that PEEX-AC network and IC will allow to add more strengthen horizontal collaboration among young generation of FI&RU students. It will speed-up building professional contacts for students and local networks for future carrier and collaboration; additionally contributing to realization of practical themes of the PEEX agenda. Students will get a unique knowledge and experience in integrated approaches for atmospheric, climate, ecosystems, etc. processes measurements; observational and modeling systems understanding; global-regional climate changes; methodological approaches for meteorology-chemistry-aerosols-etc. measurements and modelling; atmosphere–land–ocean interactions and feedbacks; etc. These will significantly enhance on-going values received by students' FI&RU Univs curriculum and joint co-supervision of students on research projects. It will allow to educate a new generation of future professionals for multi- and interdisciplinary studies on national/ international levels. The added value is also linked to UH state-of-the-art modelling systems (EC-Earth, Enviro-HIRLAM, MALTE-Box - part of PEEX-Modelling-Platform) and flagship observation stations (SMEAR – PEEX-Observational-Platform) to be promoted and demonstrated. It will show advanced capabilities of multi-scale and -processes modelling for environmental applications and PEEX tasks. Modelling and observation results (with GIS integration for assessments) will be used in students' research projects under joint co-supervision. UH will also benefit from exchange of knowledge regarding RU&EU approaches to observational and modelling strategies. All these contributions are valuable asset for further improvement of the Univ curriculum from educational and research points of view. These will lead to more advanced levels and quality of taking classes/ disciplines with modern knowledge incorporated into lecture and practicum materials. Such updates are needed practical step towards a better quality Univ educational system.

UH as HEI is promoting mutual understanding and encouraging collaboration between Universities (Univ). The world is rapidly changes, sharing and transferring of knowledge are needed, and can be realized though international collaboration. There is always a need in society and employment market for a younger generation with international, multi-cultural and multi-language skills. Such skills are important for internationalization strategy. It can be done by including aspects of teaching, research, culture, etc. in the Univ curriculum or can be realized though distance web-learning, young researchers schools, training and intensive courses, building programs on themes of mutual interests, etc.

UH is leading PEEX program and key player in realization of PEEX Science Plan, where PEEX-Educational-Platform is one of the main bricks in foundation. The internationalization strategy is very important for overall PEEX activities, as PEEX is a multidisciplinary climate change, air quality, environment and research infrastructure long-term program. UH actively collaborates with RSHU through involvement into research and educational projects, training visits, schools, workshops, etc.

Network will help: to improve and wide student's education, its quality and preparedness for future jobs; to provide additional value to Univ curriculum; to broad and strength research activities; to generate additional knowledge; to make more visible the Univ profile on international level; to learn more about shortcomings and advantages of the Univ educational systems in FI&RU; to build horizontal contacts among students and teachers for expanding international collaboration in education and research.

Through internationalization, involved FI&RU partners can get valuable benefits such as: encourage direct student-student and student-teacher collaboration; lead to new approaches in teaching, learning, researching; improve Univ educational process; be aware on issues in education and research, better understand on how Univ education system works in FI&RU with different cultural traditions.

It will also help: to strength partnership between both Univs; to build stronger multi-disciplinary FI&RU research teams; to increase visibility on national/ international levels; to add value to student learn-research experience; to attract more talented students to national system; even to contribute to national economic growth and innovations; to provide insights and explain benefits for decision-makers; etc.

Moreover, for RSHU (being the WMO Regional Meteorological Training Center), the collaboration within PEEX is one of the priority areas. These cover research and education on topics of atmosphere-land-ocean processes and interactions, approaches to experimental work and measurements, multi-scale and –processes modeling, climate change, etc. The activities are supported by workshops, schools, trainings, etc., and are in line with international strategy of education transparency.

3. Cooperation, activity design and implementation

PEEX-AC network will promote to Univs students and young researchers importance and value of PEEX international research and educational approach leading to better understanding of environmental problems through organization and carrying out ICs. Network will: facilitate exchanges between Univs, students, professors, lecturers, researchers; lead to elaboration of joint programs; open opportunities to expand existing collaboration; exchange with best practices on teaching/ researching; involve into each other workshops, conferences, etc.; invite in planned initiatives/ proposals; etc. Partners will organize WebEx/Skype meetings concerning realization of objectives and planned/ on-going activities. PEEX public web-portal will serve as the most visible environment for demonstrating network progress by including (in newsletters/ newslines) relevant information, announces, summaries of planned and realized UH&RSHU collaborating activities. The lecturing/presented materials from IC will be also web-linked. Self-education, broadening areas of expertise, outreach activities by students for colleges, high schools and general public will be encouraged.

RSHU will be responsible for hosting IC (with local/ national TV/newspapers/press, admin., decision-makers, stakeholders invited at opening). To broader opportunities for new Univs to join PEEX, students from other RU Univs will be allowed to apply for IC (but covering own travel/ accommodation).

UH will coordinate networking activities; contribute to organization and carrying out of IC; joint co-supervising students on research projects; lecturing on methodological and practical aspects of observations, modelling at multi-scales, etc.; activities and tasks of PEEX agenda.

Both teams will check progress, quality control, efficient use of resources. Quality assurance plan will be setup and undergo regular updates. Progress will be monitored in terms of achieved milestones, reportings, resources. Important issue will be collaborative joint research-education activities of involved Univs faculties/departments (Meteorology at RSHU; Faculty of Science & INAR at UH). For that, joint workshop or poster session (extra day in IC) can be arranged. PEEX-AC will follow synergy between Univs, PEEX Science Plan and PEEX-Educational-Platform activities. The way of open and constant communication and best practices between teams will be maintained, allowing efficient exchange between Univs students/teachers/researchers. All partners will be treated equally; both Univs will ensure commitment, innovation, continuity. At start, the communication procedures will be setup with all involved persons contact information provided. For efficient flow, key issue will be considered: equality and collective responsibility of all participants; efficiency and transparency of management; ensuring compliance with all relevant regulations; realization of monitoring and professional administration to prevent time and cost escalation.

FI&RU Univs have been cooperating since 1995 through the CIMO FI&RU cooperation programs in Higher Education. UH&RSHU have a long cooperation history in different student and teacher exchange programs such as FIRST, TEMPUS, e.g. on development of competence-based approach to hydrometeorological higher education and training. Univs have been involved in joint research network projects on aerosols, pollution, meteorology, forest fires, environmental and ecological topics. RSHU was actively involved in development of PEEX Science Plan; already participated in various activities/ tasks linked with the PEEX Observational-Modelling-Educational platforms. PEEX-AC network will strength existing collaboration in the PEEX research and educational agenda.

The methods planned to use are various, developed also in collaboration with a variety of FI&RU institutes and scientists, more often include multi- and cross-disciplinary cooperation among physicists, chemists, meteorologists, ecologists, biologists, other specialists.

UH&RSHU collaboration includes implementation of projects: TEMPUS JEP-26005-2005 COMBAT-METEO, 159352-TEMPUS-FI-TEMPUS-JPHES QUALIMET, EU FP7 MEGAPOLI, NordForsk CRAICC-PEEX & PEEX-CRUCIAL. All these allowed to strength and expend further collaboration, develop new long-term top-level research activities, improve educational activities with research visits and research trainings for students.

UH&RSHU also involved in "Nordic-Russian University Network for Successful Cooperation in Higher Environmental Education" (2008-2009) & "Nordic-Russian Virtual University Campus for Higher Environmental Education" (2009-2010) projects. These aimed at bridging Univs from North-West RU and Nordic countries together for creation of Univs Network: establishing sustainable links and strengthening international partnership with Univs in neighboring countries in field of environmental education; exchanging ideas, best practices, experiences on joint educational programs and related problems; enhancing academic mobility; development of e-learning tool for environmental education; development on-line specialized training tools for environmental studies.

Both teams also involved in the ERASMUS-PLUS ECOIMPACT project. It is aimed at developing a personal learning environment (PLE) for competence in economic and societal impacts of local weather, air quality, climate. PLE features custom-tailored learning materials, "smart" weather observation instruments, learning management software – all integrated into one system. Such approach allows for learning in contact with a studied physical environment and develops competences required for today's modern life.

Based on successful realization of all listed above joint educational, research and networking projects we do not expect any obstacles. In addition, corresponding invitations for visas processing to participants will be arranged in advance in order to make planning of activities more efficiently/ smoothly.

4. Expected results and impact

Networking activities will provide exposure and interaction opportunities. The transfer of knowledge between partners will positively influence realization of PEEX agenda. Through PEEX-AC, a new generation of talented students will emerge expanding community of young researchers. To be successful, we need to learn together, to research together, and to save the environment, where we live together. UH will get more respect and visibility among Univs increasing its qualitative and quantitate value. As PEEX has long-term research agenda, more students will be interested to enroll into UH educational programs. And especially, where PEEX provides more opportunities (state-of-the-art modelling and observational capabilities, research infrastructures, "puzzling" and "intriguing" scientific questions to be answered, etc.) for self-realization of students, their potential, research curiosity. For RU Univs, it will expand existing collaboration to more advanced level of partnership, more students will be involved into international education-research activities, learning more about modern observational and modelling methodologies and tools, improving communication skills, building international research teams, etc. UH will ensure networking continuation, expansion and collaboration with RU partners via PEEX.

UH&RSHU will contribute and benefit from unique working experiences as both successfully worked together. Through exchange, strategies towards multi- and inter-disciplinary research, including assessments, technical solutions, conservation measures, promotion more advances methodological approaches, future projects to proceed. Network will lead to strengthen and improving collaboration with other Univs (for example, in intensive courses), environmental services, stakeholders, FI&RU institutions; improving knowledge transfer (especially, from advanced students directly into wider public community as more efficient way of communication) and interactions with the society.

There are benefits for both Univ and society. Analysis of observations will provide information on the current state of the environment; modelling results – past/ future environmental conditions; assessments – potential impact on population and environment, etc. All these, at local-regional-national levels are important and valuable information for decision/policy-makers, stakeholders, end-users.

For transferable skills for students, PEEX-AC will strive to improve and expand: new and advanced knowledge on modern methods, approaches and tools required to answer on research questions; collaborative learning; self-education; scientific ethics; capabilities to work independently/ team member; research planning, brainstorming; multi-disciplinary approach; skills in modelling, visualization, data analysis; making/ delivering research presentations; publishing data/ findings; taking personal responsibility to achieve tasks; communication, constructive criticism, self-criticism; etc.

5. Intensive Course on "Multi-Scales and -Processes Modelling and Assessment for Environmental Applications" *(to be hosted at RSHU, St.Petersburg, in 2020)*

(i). Information about the course theme and the added value for participants
Research Training Intensive Course on "Multi-Scales and -Processes Modelling and Assessment for Environmental Applications". Lectures will cover the following aspects: fundamentals of atmospheric processes and modelling, surface and atmospheric boundary layer processes, atmospheric chemical transport modelling, aerosol physics and chemistry and modelling, evaluation and application. Exercises (or small-scale research projects, SSRPs; 6 in total expected) will be focused on modelling and analysis of aerosols impact on meteorology on regional scales (with focus on Finland and North-West Russia regions) as well as on impact of metropolitan areas on meteorology (for selected megacities). SSRPs will be realized by groups of 4-5 students intensively working on each research project. The new knowledge from lecturing and obtained skills from realization of research projects by international teams of students will be the most valuable added value to the participants. In addition, the socializing events for participants will be arranged such as Ice-Breaking Party, Official Dinner, Excursion to the city and to the University.

The preparation and realisation of the intensive course will take the best experience in organization of the Young Scientist Summer Schools on online integrated modelling (held in 2008, Russia; 2011, Ukraine; 2014 – Portugal, http://aveirosummerschool2014.web.ua.pt) and annual schools on atmospheric aerosol physics, atmospheric processes and feedbacks and atmosphere-biosphere interactions (at the Hyytiälä Forestry Field Station in Southern Finland; http://www.atm.helsinki.fi/SMEAR/index.php) as well as host University experience in carrying out such intensive courses and training events.

(ii). The workplan, implementation and division of tasks between partners
1) Development of training programme (FI+RU; sharing responsibilities on specific lecturing materials and preparation of practical exercises; host's preparatory tasks with accommodation, computing facilities, lecture rooms, etc.) – draft agenda is included;
2) Announcement through web & networkings (note, that other successful applicants from other FI+RU Universities will be also welcome to attend at own funding & no registration fee) and PEEX and host web-sites;
3) Evaluation of application forms of students from other Universities (e.g. non-members of the current network) and e-mail confirmation;

4) Lecturers are preparing the lectures to be delivered during the course;

5) Teachers are preparing small-scale research projects (SSRPs) – student workbook and necessary supplementary materials;

6) Participants are arranging travel/accommodation (& visa if necessary – with help/ invitations from the host) to attend the course;

7) Organizers are finalizing the course booklet (content: basic information on the course, networking project and involved partners, PEEX programme) and distributing among all participants (& linking to course web-page);

8) All participants are arriving at the course and settling with accommodation (assistance from host);

9) Opening the course (welcome from host and PEEX) followed by lectures and practical exercises as SSRPs, and socializing events;

10) At last day, oral presentations/ defences of SSRPs by groups of students with awarding diplomas (& summary and closing event);

11) All lectures and exercises materials to be freely distributed among the participants as well as linked to web-page of the course;

12) Questionnaire for students to evaluate quality of the intensive course (as well as a wish-list).

(iii). Information about the participants, students and teachers involved

See attached programme of the intensive course (with listed names of lecturers with titles of lectures and teachers of small-scale research projects, SSRPs (with EC-Earth, Enviro-HIRLAM, MALTE-Box models) included from UH and host institution).

1) Lecturers and SSRPs teaching (FI – Tuukka Petäjä, Sergey Zilitinkevich, Markku Kulmala, Hanna Lappalainen, Risto Makkonen, Alexander Mahura, Michael Boy, UH & RU - Sergey Smyshlayev, Alexander Pogoreltsev, Lyudmila Kolomeets, Anna Fokicheva, Eduard Podgaiskii, Georgii Nerobelov, Margarita Sedeeva, RSHU);

2) Students from UH (10) & RSHU (10);

3) Non-network partners (about 10+ students whom are successful applicants).

(iv). Describe the recognition of studies after completion of the course

Awarded certificates (3 credits) for students, whom have successfully completed the training. Training includes the lecture material and small-scale research projects realisation (with official oral presentation/ defence of the research carried out).

(v). Information about the evaluation and dissemination of results and experiences

The key evaluation will be based on successful defence of the research projects by students. Obtained project based experience will be used for education of young generation of researchers. All materials from the intensive course (lectures and exercises) to be freely distributed among participants as well as linked to web-page of the course; these will be also used for the Universities curriculum. In addition, a questionnaire for students to evaluate quality and outcomes of the intensive course will be distributed.

For each student the gained experience will include: realization of practical exercise as the small-scale research project; working as international team of young researchers whom may follow the schedule proposed or adapt research programme (minimum or maximum tasks); utilization of individual best skills working as a member of a team; learning collaboration and communication skills and attitude between teams involved into other SSRPs; opportunity to address scientific and technical questions to both teachers and lecturers; preparation of oral presentations in English (each person should have a talk contribution) starting from the 1st day (by presenting research plans) to the last day (by presenting results and findings).

The technical aspects of the models setup; steps of compilation; running the model with different settings (reference run, modified run(s); with different time steps; horizontal resolutions, selected forecast lengths, etc.) and controlling the model runs (compilation, initialization, climate files generation, preparation of boundary conditions, steps of forecasting, etc. through graphical interface) will be useful experience for young researcher. Students will also improve experience on visualization and analysis of modelling results using different research tools (Metgraf, Grads, Metview, etc.), scripts (in perl, python, etc.), spatio-temporal representation of modelling results (fields: 2D and 3D surface and model levels data, individual vs. difference between model runs, instantaneous vs. accumulated) for various meteorological and chemical/aerosol parameters. A step-by-step structuring and delivering of presentation with - main aim and objectives of the SSRP; methodology (model, methods, approaches, etc.); model setup (modelling domain(s), boundary conditions, etc.); case studies/ periods (description of meteorological situation); model runs performed (reference/control vs. modified runs); evaluation of results (dates/periods, diurnal cycle, differences, meteorology/chemistry/aerosols in focus) and discussions (with illustrative examples); findings and conclusions – will be valuable experience for the student as well.