

INAR
INSTITUTE FOR ATMOSPHERIC AND
EARTH SYSTEM RESEARCH

PAN-EURASIAN EXPERIMENT (PEEX) PROGRAM

For contact: Dr. Hanna K. Lappalainen

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PEEX / GlobalSMEAR Secretary General
Institute for Atmospheric and Earth System Research (INAR)
University of Helsinki, FINLAND

**Institute for Atmospheric and Earth System Research, University of Helsinki &
Institute of Mathematical Machines and Systems Problems, National Academy of Sciences
(UHEL-INAR & IMMSP-NAS)**

6.June.2024

Global grand challenges



KEY QUESTION

Why understanding of Atmosphere – Earth Surface – Biosphere is important for Climate Change ?

- New feedback mechanism / interactions / processes
- More time to act: Mitigate & Adapt



Pan-Eurasian Experiment

PEEX



Tools for understanding of Atmosphere – Earth Surface – Biosphere interaction, feedbacks

- **Pan-Eurasian Experiment (PEEX) Program** for understanding the Atmosphere – Earth Surface – Biosphere in the Arctic – boreal context / Northern Eurasia / Silk Road Region (2012 ->) www.atm.helsinki.fi/peex/
- **GlobalSMEAR** (Stations Measuring Earth Surface Atmosphere Relations) Initiative for Global Earth Observatory for filling the observational gap of the atmospheric – ecosystem in situ data (2015 - >) www.atm.helsinki.fi/globalsmear/
- **Climate University** : free online courses for universities and everyone who wants to make the sustainability transition in the society real. climateuniversity.fi/



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Pan-Eurasian Experiment

PEEX

STATION FOR MEASURING
EARTH SURFACE –
ATMOSPHERE RELATIONS



GLOBAL
CHALLENGES
NEED GLOBAL
MEASURES

PEEX Program HQ / GlobalSMEAR Initiative at UH



Prof. Tuukka Petäjä,
Vice-Director INAR,
University of Helsinki, FI



Academician
Markku Kulmala
Director of INAR Institute,
University of Helsinki, FI



Dr. Hanna Lappalainen
PEEX /GlobalSMEAR
Secretary general
INAR
University of Helsinki, FI

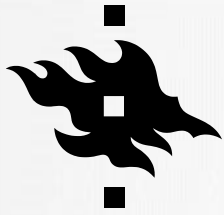


Dr. Alexander Mahura
Regional Modelling Group
INAR
University of Helsinki, FI

INAR Presentations

moderated by Alexander Mahura, INAR

- 14:40 – SMEAR (Station for Measuring Ecosystem–Atmosphere Relation) concept and measurements – Tuukka Petäjä
- 14:55 – Earth System and climate modeling – Risto Makkonen
- 15:10 – Seamless / online integrated regional/subregional/urban scales and -process modelling – Alexander Mahura
- 15:25 – Process-based fine scale modelling for meteorology-chemistry-aerosol system – Michael Boy
- 15:40 – Marine modelling ... – Petteri Uotila
- 15:55 – Observing the forest ecosystems: links between climate change, biodiversity and human activities – Jaana Bäck



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Hanna K. Lappalainen
Markku Kulmala
Sergej Zilitinkevich
Editors

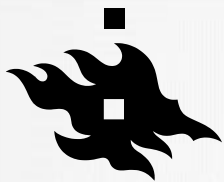


**PAN-EURASIAN
EXPERIMENT
PEEX
SCIENCE PLAN**

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HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

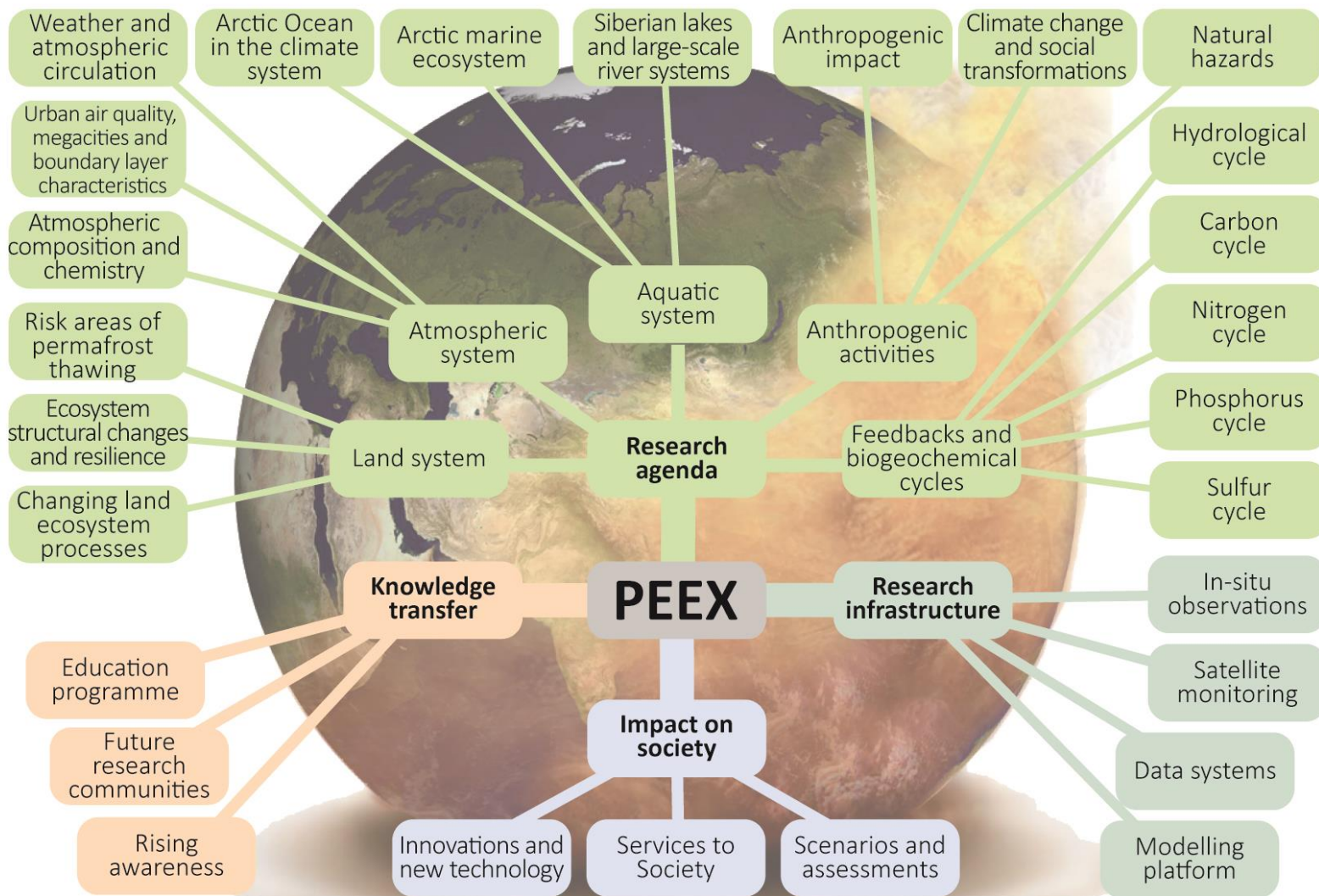
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PEEX PROGRAM STRUCTURE





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PEEX PROGRAM WEBSITE

<https://www.atm.helsinki.fi/peex/>

Latest news



Autumn School on Analysis of Atmosphere-Surface Interactions and Feedback

Institute for Atmospheric and Earth System Research INAR, University of Helsinki, will organize Autumn School "Analysis of Atmosphere-Surface Interactions and Feedbacks" on 7-18 October 2024. The course is aimed for master's students in atmospheric, biospheric [\[Read more\]](#)



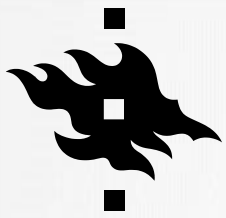
Summaries of the Polar Symposium are available

The Polar Initiative announced that the summary booklet of the Polar Symposium 2024, which captures the discussions and insights exchanged throughout the event is readily accessible online via the Polar Initiative website: Summaries of the [\[Read more\]](#)



PEEX signed new MoU with Institute of Forestry and Engineering, Estonian University of Life Sciences

The new Memorandum of Understanding was signed with the Institute of Forestry and Engineering, Estonian University of Life Sciences. The MoU is a bilateral document to encourage the development of the PEEX program in Pan-Eurasia [\[Read more\]](#)



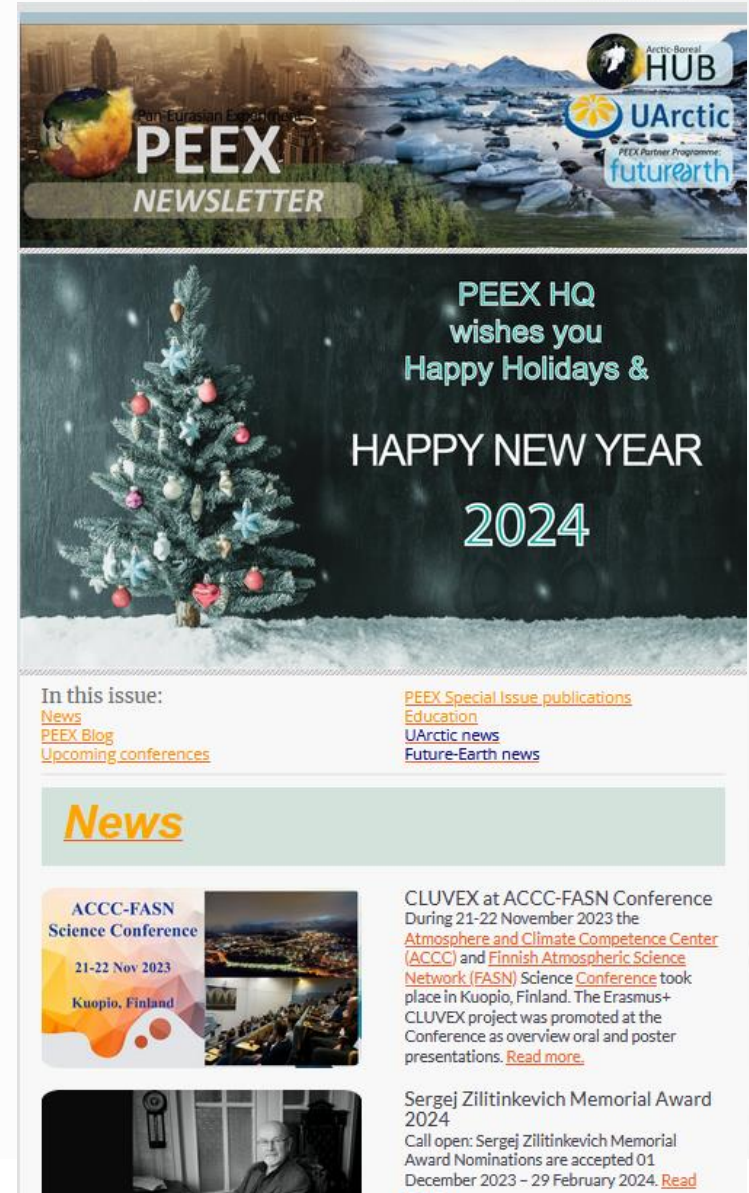
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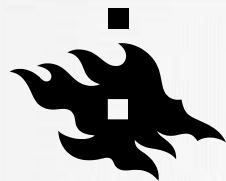
PEEX PROGRAM Newsletter

- 4 issues per year
- a forum to advertise your activities etc.
- For contact:
Editor Alla Borisova
Alla.borisova@helsinki.fi
- Want to receive our newsletter? Please subscribe
<https://helsinki.us11.list-manage.com/subscribe?u=9193f2d7d1d2cd44df10dd7d5&id=34b12ce65d>

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NEW PARTNERS SIGNED & IN SIGNING STAGE THE PEEX MOU 8status 6.6.24

YSU - Yerevan State University (signed 22 Dec 2022)	Armenia	Dr. Rafayel Barkhudaryan, Vice Rector for Scientific Affairs; Dr. Alexander Esayan, Director of Biology institute
ChNU - Chernivtsi National University (signed 20 Apr 2023)	Ukraine	Prof. Roman Petryshyn, Rector
LU - Latvia University (signed 10 May 2023)	Latvia	Prof. Valdis Seglins, Vice-Rector in field of natural, technological and medical sciences
KNUCA - Kyiv National University of Construction & Architecture (signed 28 June 2023)	Ukraine	Dr., Prof. Petro Kulikov, Rector of KNUCA; Dr., Prof. Vitaly Plosky, Head of Dpt of Architectural structure; Dr., Prof. Olena Voloshkina; Dr., Prof. Tetyana Tkachenko, Head of Dpt of Environmental Protection and Labor Protection Technologies
BTNAU - Bila Tserkva National Agrarian University (signed 21 June 2023)	Ukraine	Dr., Prof. Olena Shust, Rector; Dr., Prof. Tetiana Dyman, Vice-rector for education and international activity
UoT - University of Tromso (signed 2 Oct 2023)	Norway	Prof. Igor Ezau
IMMSP - Institute of Mathematical Machines and Systems Problems (signed 13.03.24)	Ukraine	Corr. member of NAS of Ukraine, Dr. Igor Brovchenko, Deputy Director
Yarmouk University (signed 13.03.2024)	Jordan	Prof Islam Massad, President of Yarmouk University
KAU - Kyiv Academic University (signed 26.03.2024)	Ukraine	Academician, Member of NAS of Ukraine Dr. Alexander Kordyuk, Director
Ukrainian Meteorological and Hydrological Society (UMHS) (signed 11.04.2024)	Ukraine	Prof. Sergiy Stepanenko, Prezident of UMHS
Faculty of Agriculture, University of Belgrad (signed 5.04.2024)	Serbia	Prof. Dusan Zivkovic, Dean and Dr. Ana Vuković Vimić
Institute of Forestry and Engineering, Estonian University of Life Sciences (signed 10.05.2024)	Estonia	Prof. Dr. Marek Metslaid and Prof. Dr. Steffen M. Noe



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PEEX RESEARCH



Atmospheric Chemistry and Physics

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Pan-Eurasian Experiment (PEEX) – Part II

Editor(s): ACP co-editors | Coordinators: Dominick Spracklen and Paul Zieger | Co-organizers: Veli-Matti Kerminen, Martin Heimann, and Tuomas Laurila

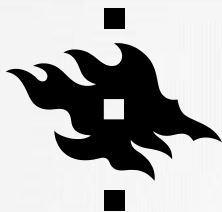
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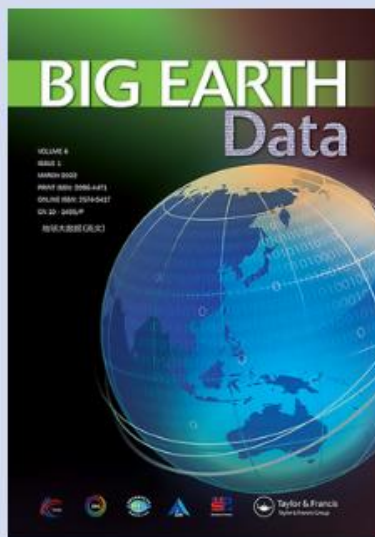
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PEEX RESEARCH

Submit a Manuscript to the Journal
Big Earth Data

For a Special Issue on
High-quality environmental information and analysis for the Arctic boreal
region and High Mountain Asia

Manuscript deadline
28 February 2023



Special Issue Editor(s)

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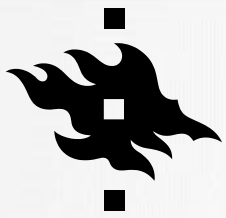
Veli-Matti Kerminen, *University of Helsinki, Finland*
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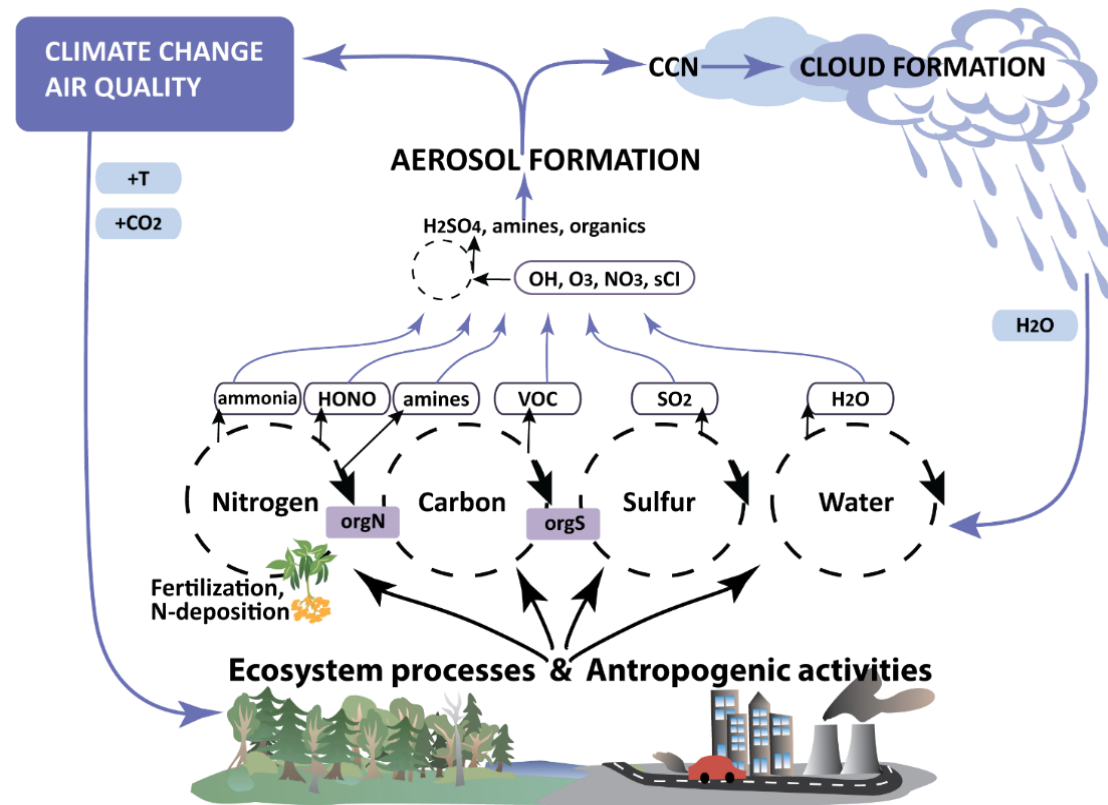


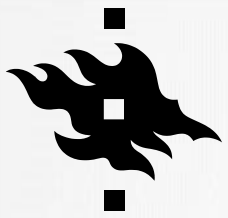
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PEEX: TOWARDS SYSTEM UNDERSTANDING OF THE ARCTIC- BOREAL REGIONS

Research approach from process studies towards understanding & quantification of feedbacks

- system specific topics are basically related to **process understanding**
- individual process understanding enables to **quantification of biogeochemical cycles**
- via biogeochemical cycles the energy and matter flows linked to a wider system context enabling us to **analyze the feedback phenomena**
- feedbacks are essential components towards **system understanding**

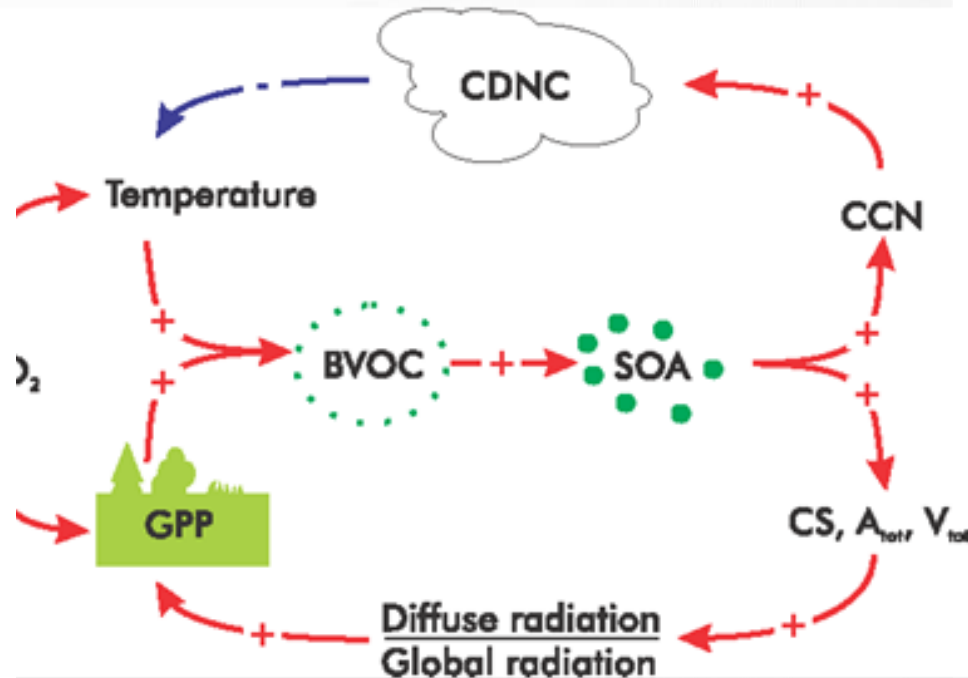




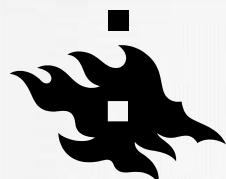
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A FEEDBACK LOOP RELEVANT TO ARCTIC-BOREAL REGIONS: COBACC (COntinental Climate) Biosphere-Aerosol-Cloud-

- two major overlapping feedback loops. The focal points of these two loops are ambient temperature and plant gross primary production (GPP).
- The loops are closely tied with aerosol-cloud interactions and with the atmospheric carbon sink, and both tend to act toward suppressing global warming



BVOC=biogenic volatile organic compounds
SOA=secondary organic aerosol
CS=the condensation sink
 A_{tot} =total aerosol surface area
 V_{tot} =total aerosol volume
CCN=cloud condensation nuclei
CDNC=cloud droplet number concentration
GPP=Gross Primary Productivity



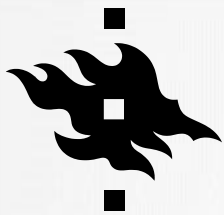
Atmos. Chem. Phys., 22, 4413–4469, 2022
<https://doi.org/10.5194/acp-22-4413-2022>
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Atmospheric
Chemistry
and Physics
Open Access

Overview: Recent advances in the understanding of the northern Eurasian environments and of the urban air quality in China – a Pan-Eurasian Experiment (PEEX) programme perspective

Hanna K. Lappalainen^{1,36}, Tuukka Petäjä¹, Timo Vihma², Jouni Räisänen¹, Alexander Baklanov³,
Sergey Chalov⁴, Igor Esau^{5,44}, Ekaterina Ezheva¹, Matti Leppäranta¹, Dmitry Pozdnyakov^{6,23},
Jukka Pumpanen⁷, Meirrat O. Andreac^{8,41,42}, Mikhail Arshinov⁹, Eija Asmi², Jianhui Bai¹⁰,
Igor Bashmachnikov⁶, Boris Belan⁹, Federico Bianchi¹, Boris Biskaborn¹¹, Michael Boy¹, Jaana Bäck¹²,
Bin Cheng², Natalia Chubarova⁴, Jonathan Duplissy^{1,43}, Egor Dyukarev¹³, Konstantinos Eleftheriadis¹⁴,
Martin Forsius¹⁵, Martin Heimann¹⁶, Sirkku Juhola¹⁹, Vladimir Kononov¹⁷, Igor Kononov¹⁸,
Pavel Konstantinov^{4,32}, Kajar Küster¹², Elena Lapshina²⁰, Anna Lintunen^{1,12}, Alexander Mahura¹,
Risto Makkonen², Svetlana Malkhazova⁴, Ivan Mammarella¹, Stefano Mammola^{21,22},
Stephany Buenrostro Mazon¹, Outi Meinander², Eugene Mikhailov^{23,24}, Victoria Miles¹,
Stanislav Myslenkov⁴, Dmitry Orlov⁴, Jean-Daniel Paris²⁵, Roberta Pirazzini², Olga Popovicheva²⁶,
Jouni Pulliainen², Kimmo Rautiainen², Torsten Sachs²⁷, Vladimir Shevchenko²⁸, Andrey Skorokhod²⁹,
Andreas Stohl³⁰, Elli Suhonen¹, Erik S. Thomson³¹, Marina Tsidilina³⁸, Veli-Pekka Tynkkynen³¹,
Petteri Uotila¹, Aki Virkkula², Nadezhda Voropay³⁴, Tobias Wolf⁵, Sayaka Yasunaka³³, Jiahua Zhang³⁸,
Yubao Qiu³⁶, Aijun Ding³⁷, Huadong Guo³⁶, Valery Bondur³⁸, Nikolay Kasimov⁴,
Sergej Zilitinkevich^{1,2,45,†}, Veli-Matti Kerminen¹, and Markku Kulmala^{1,39,40}



Prof. Risto Makkonen Finnish Meteorological Inst. team

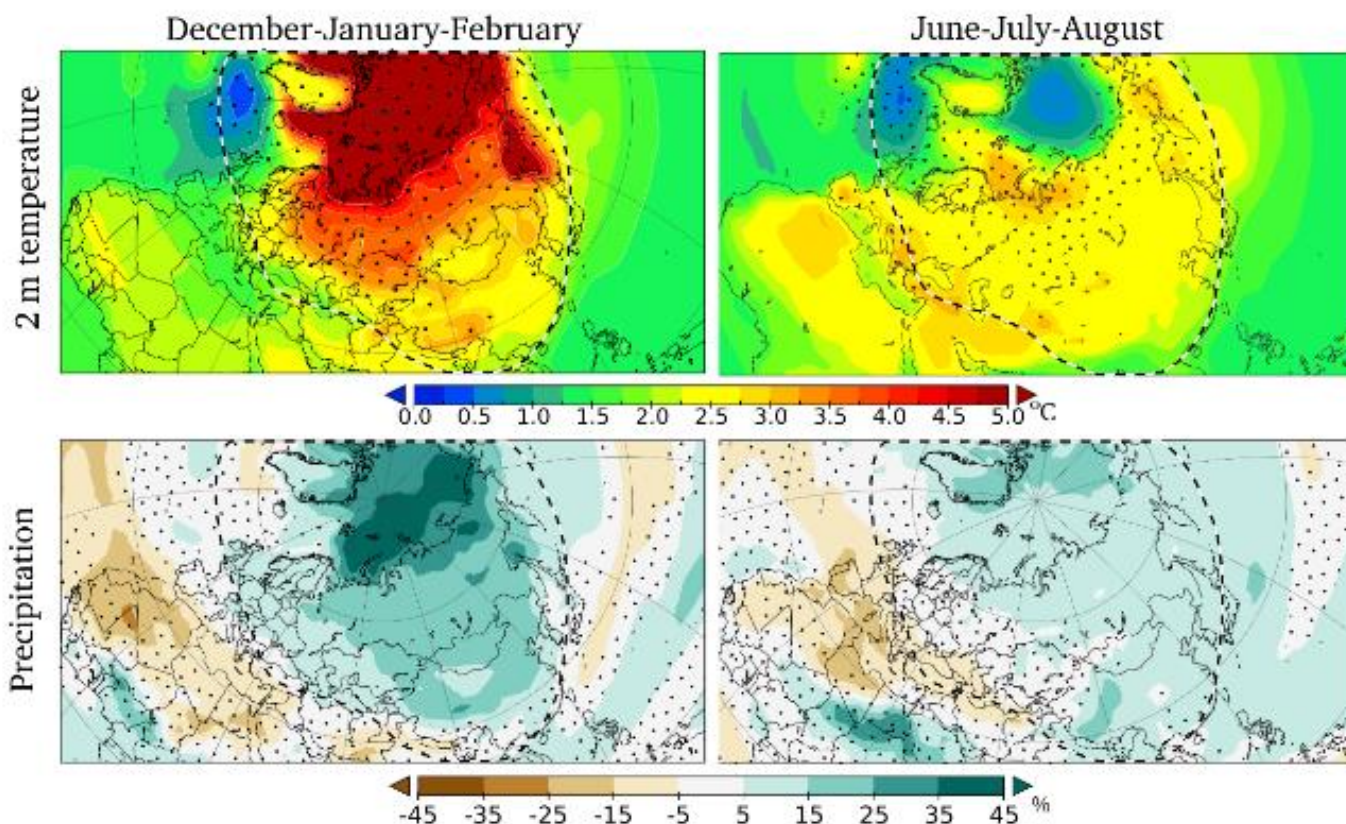
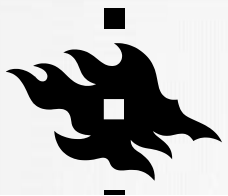
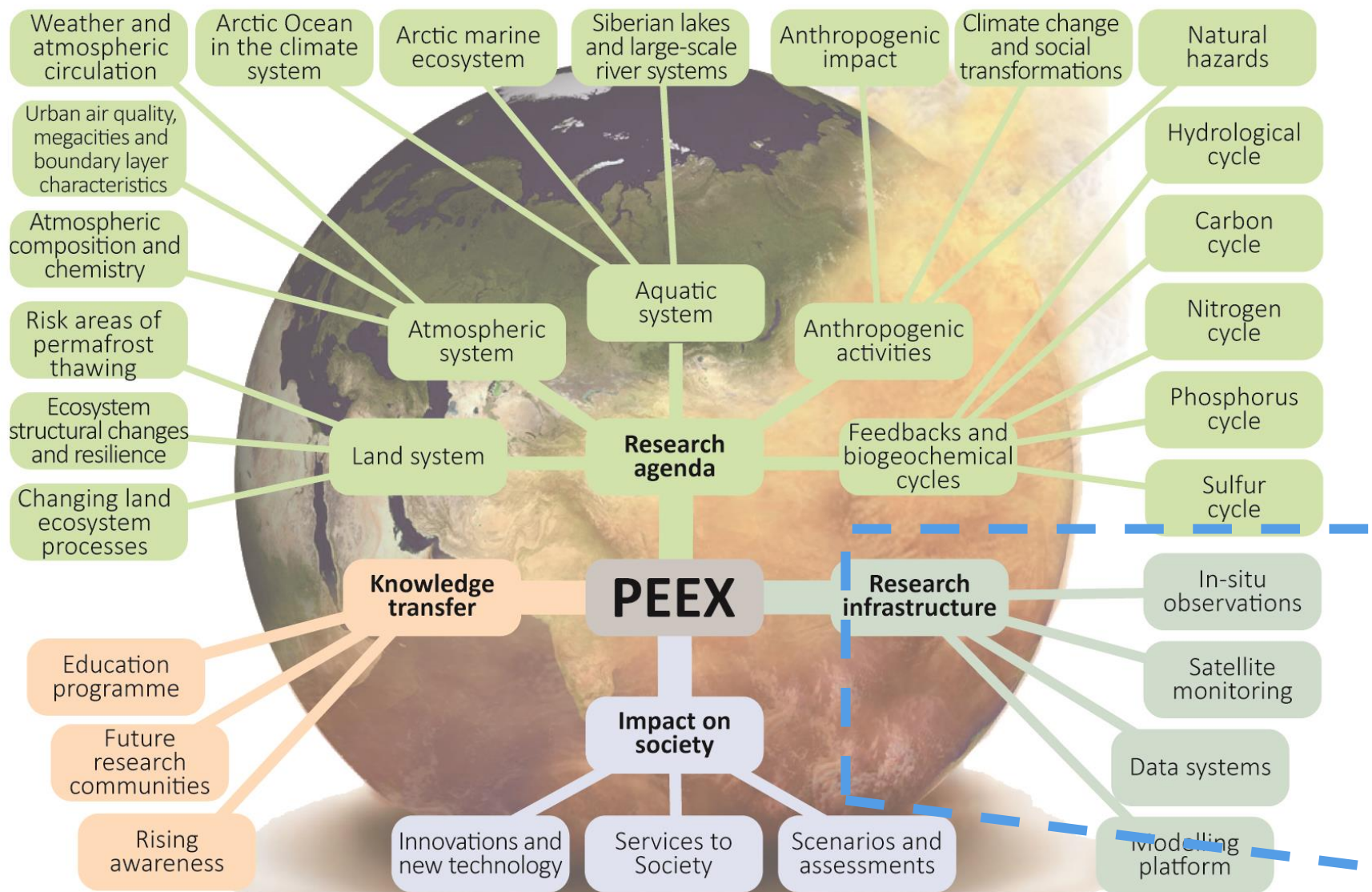


Figure 9. Changes in 2 m temperature (°C, upper panels) and precipitation (% , lower panels) during the 21st century. Present-day climatology is averaged over the years 1981–2010 and end-of-century climatology over 2070–2099. Winter (left) and summer (right) are shown separately. Dotted areas indicate high variability in the model ensemble (for temperature: standard deviation of 21st century change exceeds 1 °C; for precipitation: standard deviation of 21st century change exceeds 100 % or present-day precipitation). The model results are from IPCC AR5, based on 42 individual models in CMIP5 experiments under the RCP4.5 scenario.



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RESEARCH INFRASTRUCTURE





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Pan-Eurasian Experiment

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Vision: Global observation network

THERE IS A NEED FOR ADVANCED IN SITU STATIONS IN

**M. Kulmala: Nature Comment,
Nature 553, 21–23 4 Jan 2018)**

The answer is a global Earth observatory — 1,000 or more well-equipped ground stations around the world that track environments and key ecosystems fully and continuously

- Researchers could find new mechanisms and feedback loops in this coherent data set
- Policymakers could test policies and their impacts
- Companies could develop environmental services



An enclosure for measuring gas exchange between plants and the atmosphere at a station in Finland.

Build a global Earth observatory

Markku Kulmala calls for continuous, comprehensive monitoring of interactions between the planet's surface and atmosphere.

SMEAR II-station in Hyytiälä, FINLAND

GlobalSMEAR Flagship station

Boreal forest country side

Flagship station SMEARII

N 61° 50.845', E 24° 17.686', altitude 180 m a.s.l.



The SMEAR II (Station for Measuring Ecosystem – Atmosphere Relations) in Hyytiälä, Finland, represents the most advanced station of the SMEAR concept. SMEAR II station is carrying out measurements 24/7 on 1200 parameters on different ecosystems: boreal forest, wetland and lakes.

SMEAR II is contributing to several global Earth Observation systems and networks such as WMO GAW, GEO-GEOS, FluxNet, AERONET and SolRad-Net, and to the European Research Infrastructures such as ICOS, ACTRIS, AnaEE and eLTER.



Instrument cottage



Instruments on mast and towers to measure at different heights



Eddy Covariance systems



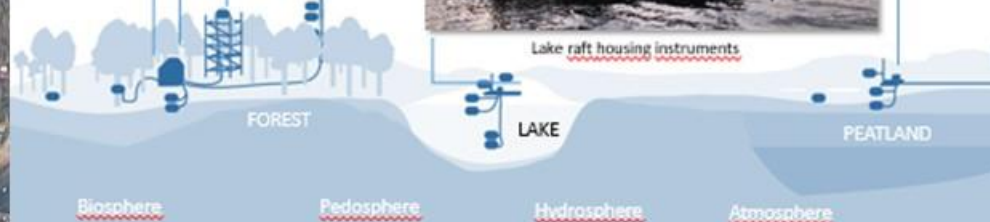
Aerosols



Shoot-level flux chamber



Lake raft housing instruments



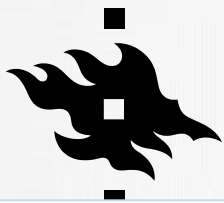
Biosphere

Pedosphere

Hydrosphere

Atmosphere

* WMO GAW World Meteorological Organization - The Global Atmosphere Watch, The Intergovernmental Group on Earth Observations (IGEO) - a Global Earth Observation System of Systems (GEOSS), ICOS (Integrated Carbon Observation System), ACTRIS (Aerosols, Clouds, and Trace gases Research Infrastructure), AnaEE (Infrastructure for Analysis and Experimentation on Ecosystems), eLTER (Integrated European Long-term Ecosystem)



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STATIONS MEASURING EARTH SURFACE- ATMOSPHERE RELATIONS (SMEAR)

Research infrastructure -
proof of concept for meeting the UN SDGs

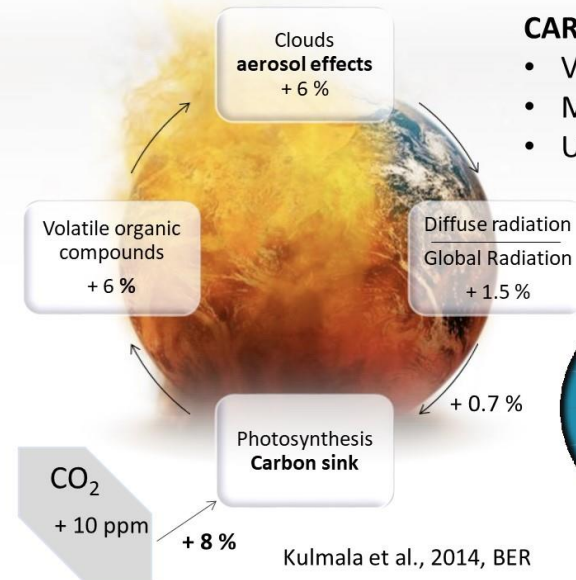
BIG EARTH DATA
2021, VOL. 5, NO. 3, 277-305
<https://doi.org/10.1080/20964471.2021.1936943>

Atmospheric and ecosystem big data providing key contributions in reaching United Nations' Sustainable Development Goals

Markku Kulmala ^{a,b,c,d,e,f}, Anna Lintunen ^{a,g}, Ilona Ylivinkka ^a, Janne Mikkala ^a, Rosa Rantanen ^a, Joni Kujansuu ^{a,b,c,f}, Tuukka Petäjä ^{a,b,c,e}, and Hanna K. Lappalainen ^{a,e,h}



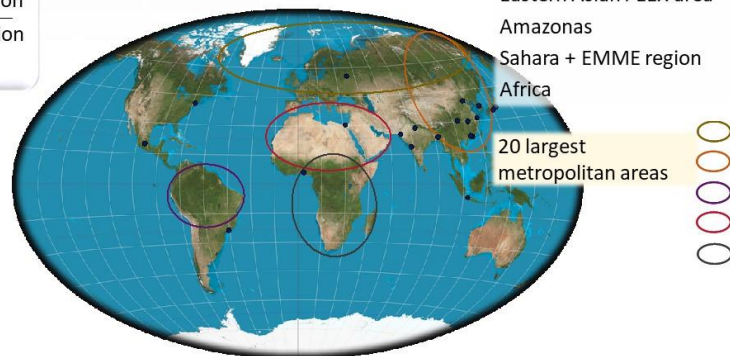
THE POTENTIAL OF SMEAR CONCEPT: GLOBAL COMPREHENSIVE FEEDBACK ANALYSIS

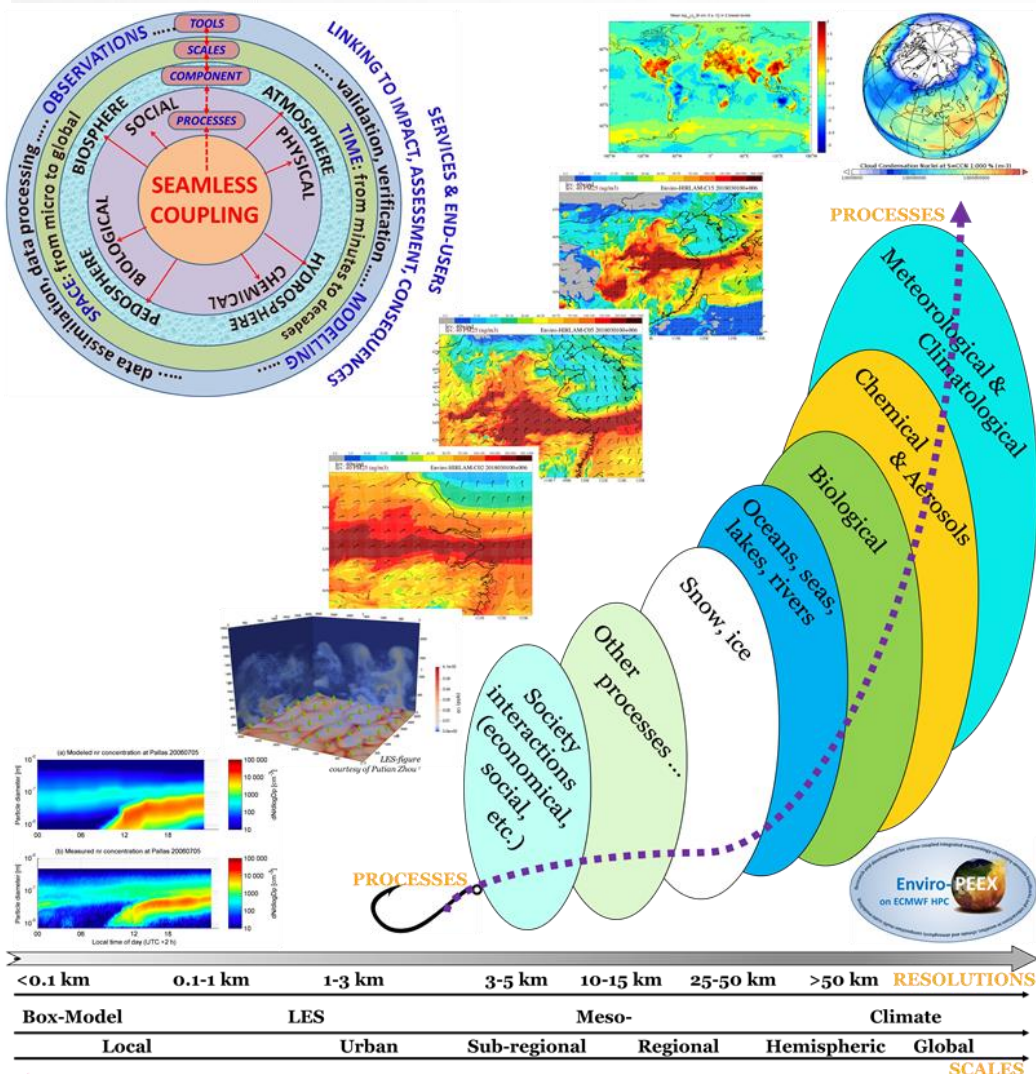


CARBON SINK PLUS

- VOCs, Aerosols, clouds, precipitation
- Max 1.8 x carbon sink (Hyytiälä / SMEAR II results)
- Uncertainties

=> observations / models





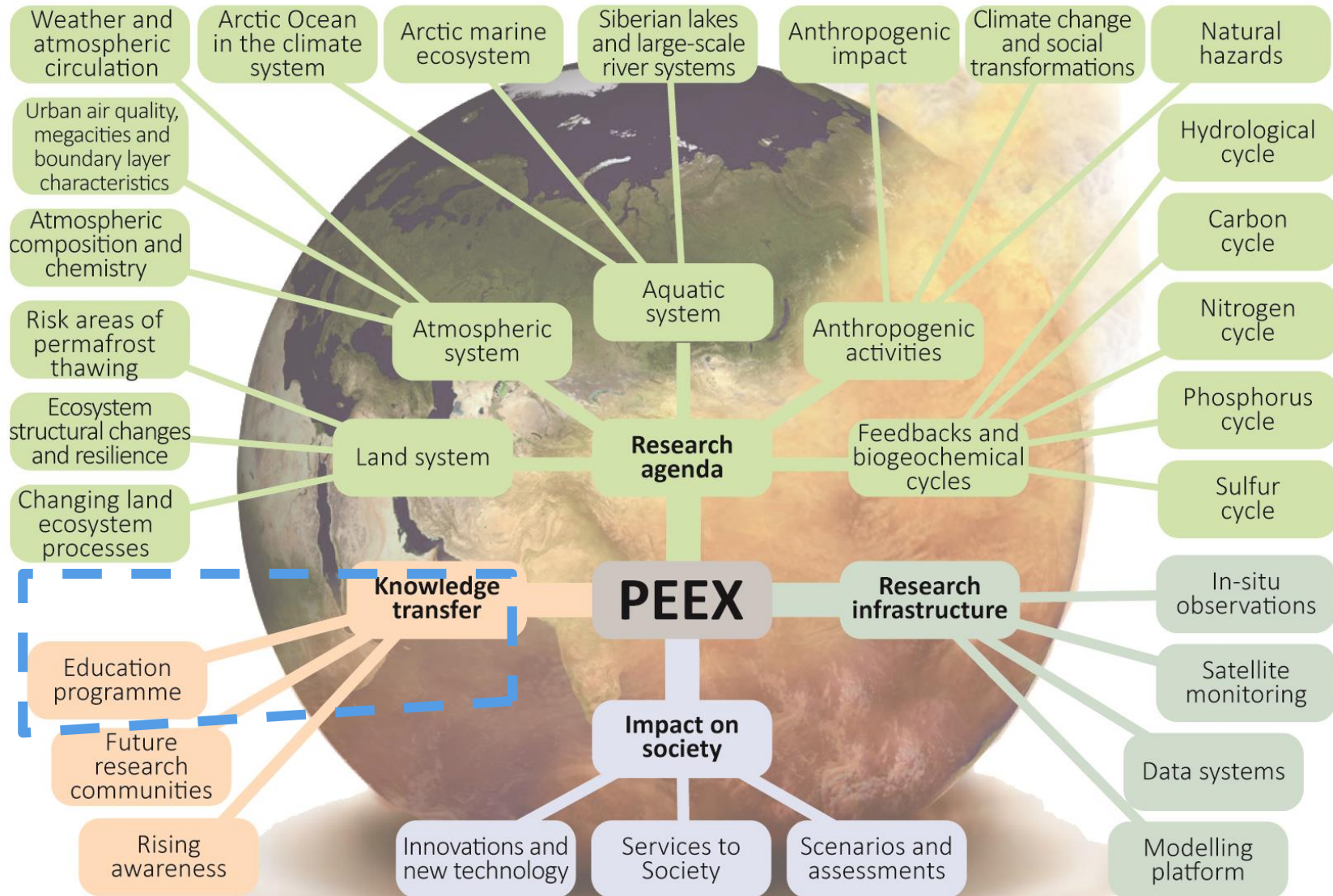
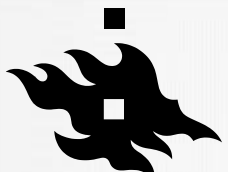
“PEEX-MP research and development for online coupled integrated meteorology-chemistry-aerosols feedbacks & interactions in weather, climate & atmospheric composition multi-scale modelling”

(2018-2020, 202102023, 2024-)

www.atm.helsinki.fi/peex/index.php/enviro

Objectives:

- to analyze importance of meteorology-chemistry-aerosols interactions & feedbacks;
- to provide a way for development of efficient techniques for on-line coupling of NWP and ACT via process-oriented parameterizations and feedback algorithms.





Pan-Eurasian Experiment

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EDUCATION

European Union Erasmus+ Programme Virtual Exchange(s) projects in 2023-2027



CLimate University for **V**irtual **EX**changes
– **CLUVEX** –
EU Programme Erasmus+



Funded by the
European Union



Una Europa - **V**irtual **EX**changes for **S**ustainability
– **UnaVEx** –
EU Programme Erasmus+



Funded by the
European Union

una
europa

- to engage students with climate competences and green agenda together with interdisciplinary, green and soft skills
- to educate 500 students in 1 Virtual Exchange (VE) Week (2x5 VE Weeks in total)
- to educate altogether 5000 students as Climate Messengers in 3 years
- Projects coordinated by INAR, University of Helsinki



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EDUCATION

For contact Dr. Laura.riuttanen@helsinki.fi

Courses

2-5 ECTS each
35 ECTS in total
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SUSTAINABLE CHANGE



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STATISTICAL TOOLS



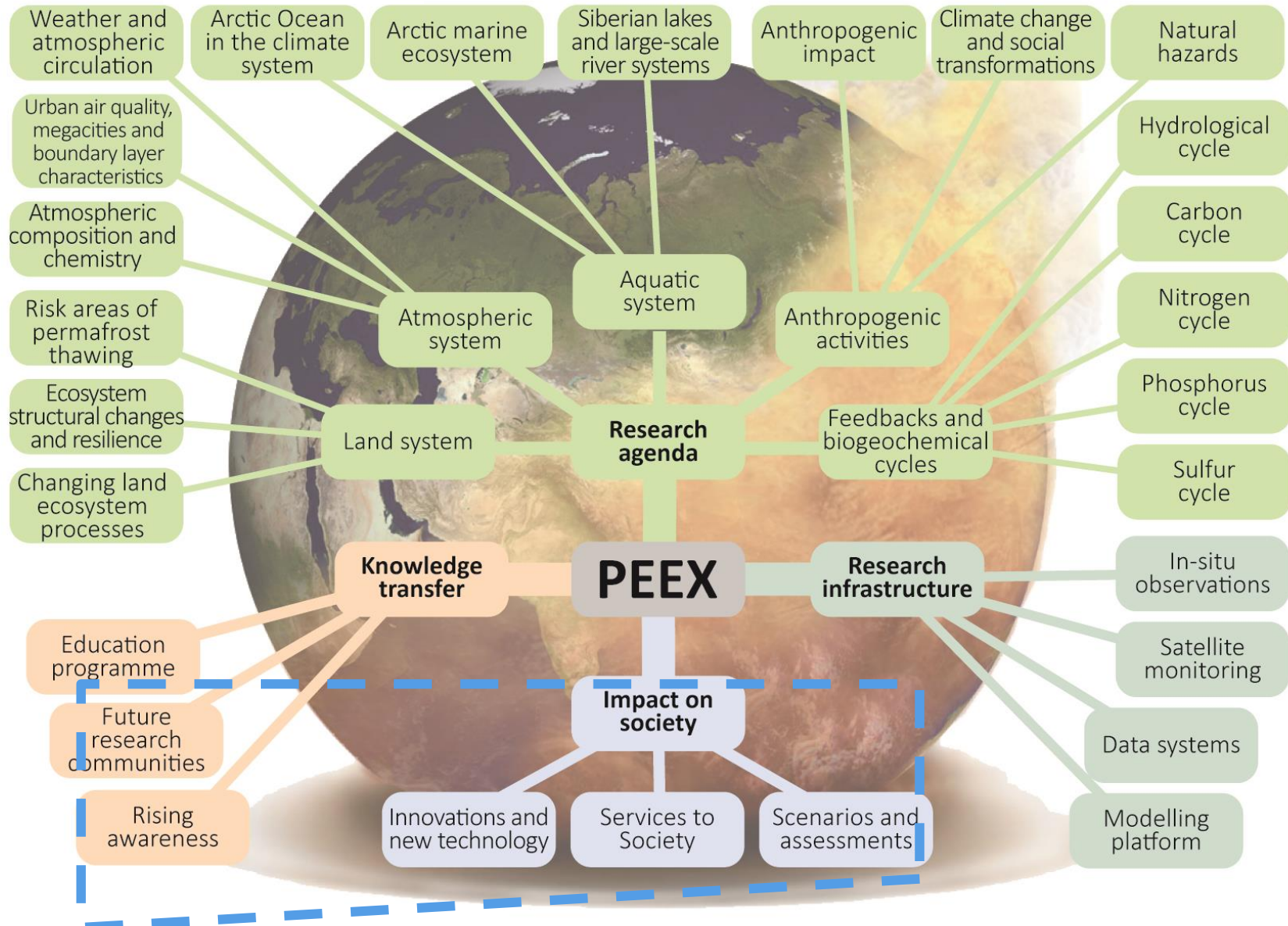
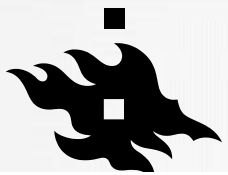
CLIMATECOMMS.NOW

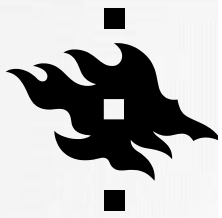


SOLUTIONS.NOW



LUKIOLAISEN ILMASTO.NYT





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PEEX SCIENCE DIPLOMACY /IMPACT ON SOCIETY

Gap analysis of the existing Arctic Science Co-Operations (AASCO)

HSH Prince Albert II of Monaco visited Värriö Research Station (SMEAR I) on 6 June 2023



In figure in front, from left; Olivier Wenden, Hanna Lappalainen, Mikko Sipilä, HSH Prince Albert, Erkki Parkkinen, Bernard Fautrier together with station staff, Riikka Karppinen and Jaana Bäck.

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SAON
SUSTAINING ARCTIC
OBSERVING NETWORKS

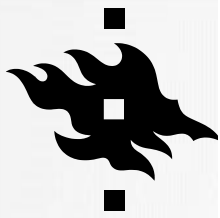
 **WORLD
METEOROLOGICAL
ORGANIZATION**

 **UArctic**
Thematic Networks

 **unitar**
United Nations Institute
for Training and Research

 **SIOS**
SVALBARD INTEGRATED ARCTIC
EARTH OBSERVING SYSTEM

 **CBAS**

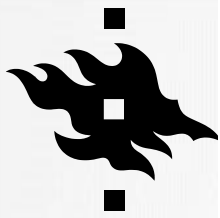


- **Projects :**

- ERASMUS + Multilevel Local, Nation- and Regionwide Education and Training in Climate Services, Climate Change Adaptation and Mitigation (ClimEd, 2020-2023), Lappalainen, Tyuryakov, Mahura
- ERASMUS+ Climate University for Virtual Exchanges (CLUVEX, 2023-2025), Lappalainen, Riuttanen, Mahura

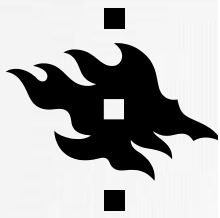
- **Proposals :**

- *Developing Air quality Research and Services in Ukraine (DARSU), Academy of Finland, Petäjä, Mahura, Lappalainen (INAR) + Sundström et al. (FMI)*
- Pan-Eurasian EXperiment – Finnish-Ukraine Earth System Research Network (PEEX-Ukraine RNe), Ukraine Call, Ministry of Education and Culture, Team Finland Knowledge programme, Lappalainen, Mahura, Petäjä + TAU, UEF



COLLABORATION WITH ORGANIZATIONS IN UKRAINE:

1. Odessa State Environmental University (Odessa, Ukraine)
2. Kyiv National University of Construction and Architecture (Kyiv, Ukraine)
3. O.M. Beketov National University of Urban Economy (Kharkiv, Ukraine)
4. Lviv Polytechnic National University (Lviv, Ukraine)
5. Bila Tserkva National Agrarian University (Bila Tserkva, Ukraine)
6. Odessa National Medical University (Odessa, Ukraine)
7. Ministry of Education and Science of Ukraine
8. Ministry of Environmental Protection and Natural Resources of Ukraine
9. Taras Shevchenko National University of Kyiv (TShNUK)
10. Ukrainian Hydrometeorological Institute (UHMI, Kyiv; uhmi.org.ua/eng) of the State Emergency Service of UA
11. National Academy of Sciences of UA

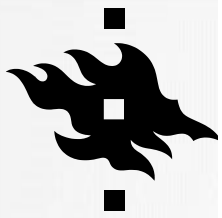


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FUTURE OUTLOOK

UHEL-INAR suggestions:

- <https://www.aka.fi/en/research-funding/apply-for-funding/calls-for-applications/> - Research Council of Finland (RCF), looking for suitable Calls, research projects, fellowships
- <https://www.atm.helsinki.fi/peex/index.php/portfolio-items/mp-at-csc/> - High Performance Computing projects at IT Center for Science Computing (CSC, Finland; <https://www.csc.fi/>)
- Possibility of individual proposals for visiting/ doing research at SMEAR-II (Hyytiälä station, Finland; (<https://www.atm.helsinki.fi/SMEAR/index.php>)
- Welcome to online webinars arranged by UHEL-INAR & ACCC (Atmosphere and Climate Competence Center; <https://www.acccflagship.fi/>)
- <https://www.atm.helsinki.fi/peex/index.php/education/> - UHEL-INAR proposed educational courses/ trainings
- <https://www.atm.helsinki.fi/cluvex/> - CLUVEX (Climate University for Virtual Exchanges) - virtual exchanges for students
- Joint research proposals for Horizon Europe, RCF and FI-UA bilateral Calls; publications, presentations, etc.
- Joint co-supervision of PhD students



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