

Pan-Eurasian Experiment

PEEX

**INAR**  
INSTITUTE FOR ATMOSPHERIC AND  
EARTH SYSTEM RESEARCH

# PAN-EURASIAN EXPERIMENT (PEEX) PROGRAM

For contact: Dr. Hanna K. Lappalainen

[hanna.k.lappalainen@helsinki.fi](mailto:hanna.k.lappalainen@helsinki.fi)

**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 &  
NON-PROFIT JOINT STOCK COMPANY "AL-FARABI KAZAKH NATIONAL UNIVERSITY" (UHEL-INAR & KazNU)**

**19 August 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



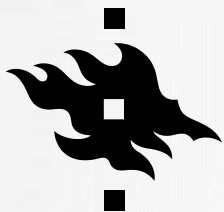
Pan-Eurasian Experiment

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/](http://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/](http://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/](http://climateuniversity.fi/)



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Pan-Eurasian Experiment

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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



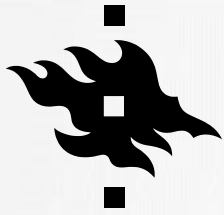
Dr. Alexander Mahura  
Regional Modelling Group  
INAR  
University of Helsinki, FI

20/08/  
2024

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Administrative matters Mrs. Alla Borisova





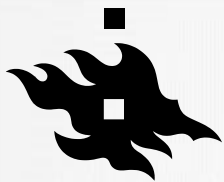
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Hanna K. Lappalainen  
Markku Kulmala  
Sergej Zilitinkevich  
*Editors*

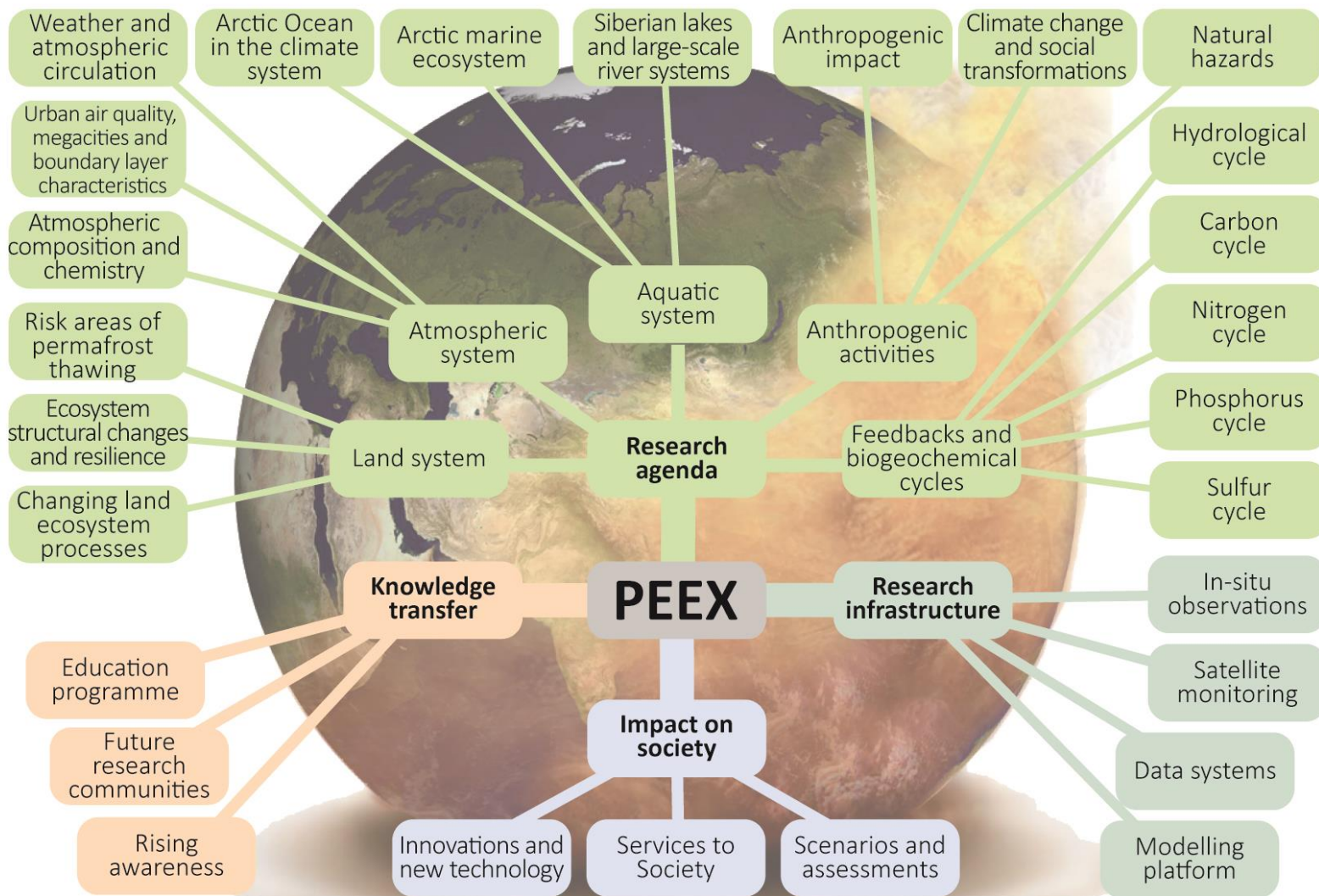


**PAN-EURASIAN  
EXPERIMENT  
PEEX  
SCIENCE PLAN**



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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 [\[Read more\]](#)



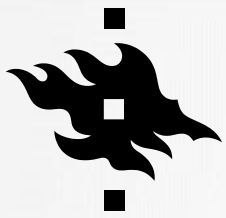
### Summaries of the Polar Symposium are available

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 [\[Read more\]](#)



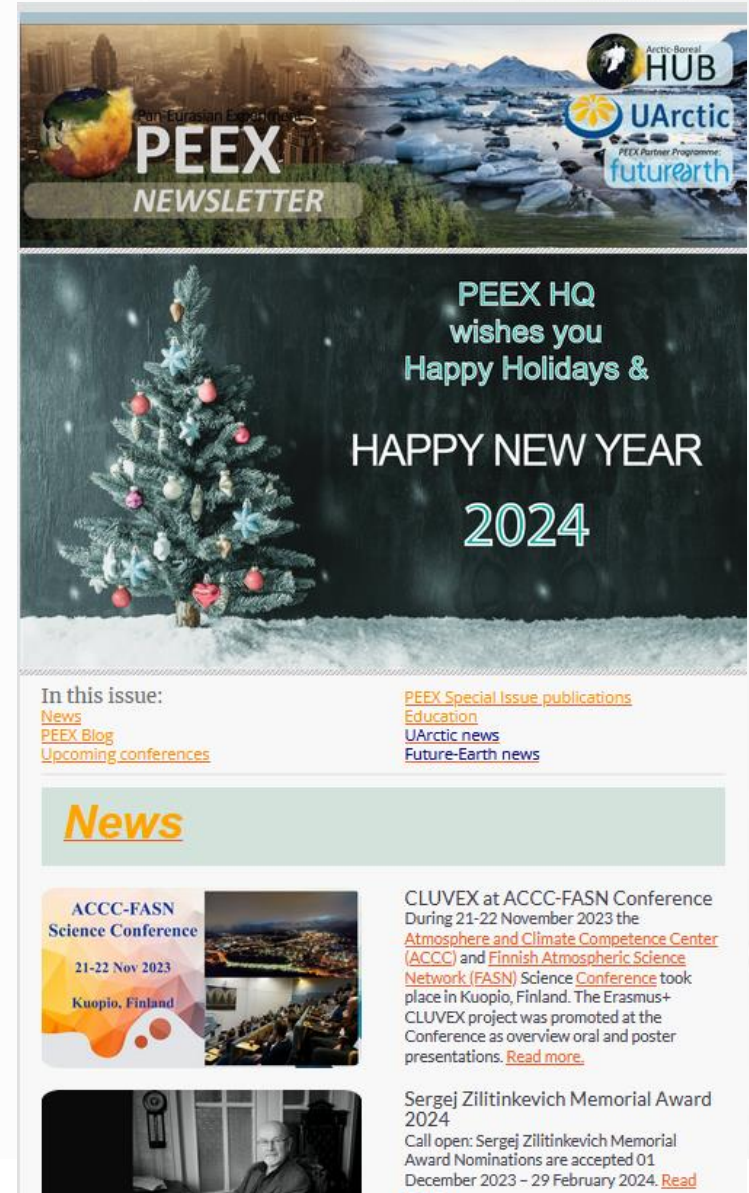
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# PEEX PROGRAM Newsletter

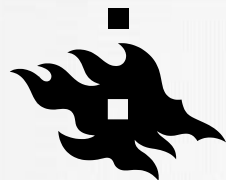
- 4 issues per year
- a forum to advertise your activities etc.
- For contact:  
Editor Alla Borisova  
[Alla.borisova@helsinki.fi](mailto:Alla.borisova@helsinki.fi)
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Atmospheric and Earth  
System Research







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# NEW PARTNERS SIGNED & IN SIGNING STAGE THE PEEX MoU status 6 June 24

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



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# PEEX RESEARCH



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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

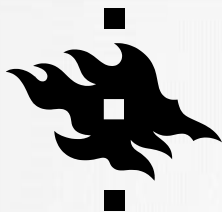
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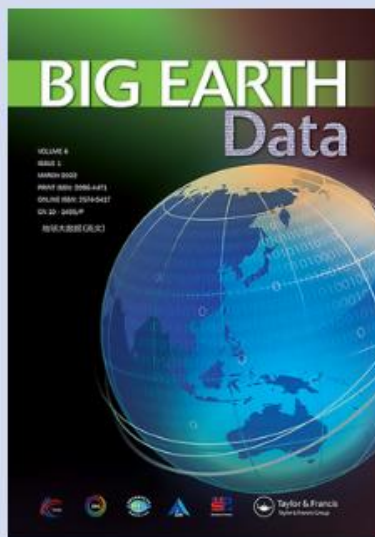
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# PEEX RESEARCH

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)

**Hanna Lappalainen**, *University of Helsinki, Finland*  
[hanna.k.lappalainen@helsinki.fi](mailto:hanna.k.lappalainen@helsinki.fi)

**Yubao Qiu**, *International Research Center of Big Data for Sustainable Development Goals (CBAS), China*  
[qiuyb@cbas.ac.cn](mailto:qiuyb@cbas.ac.cn)

**Any-Maija Sundström**, *Finnish Meteorological Institute, Finland*  
[anu-maija.sundstrom@fmi.fi](mailto:anu-maija.sundstrom@fmi.fi)

**Lanhai Li**, *Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences*  
[llh@ms.xjb.ac.cn](mailto:llh@ms.xjb.ac.cn)

**Veli-Matti Kerminen**, *University of Helsinki, Finland*  
[veli-matti.kerminen@helsinki.fi](mailto:veli-matti.kerminen@helsinki.fi)

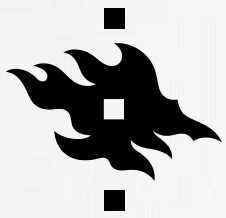
**Xiao Cheng**, *Sun Yat-sen University, China*  
[chengxiao9@mail.sysu.edu.cn](mailto:chengxiao9@mail.sysu.edu.cn)

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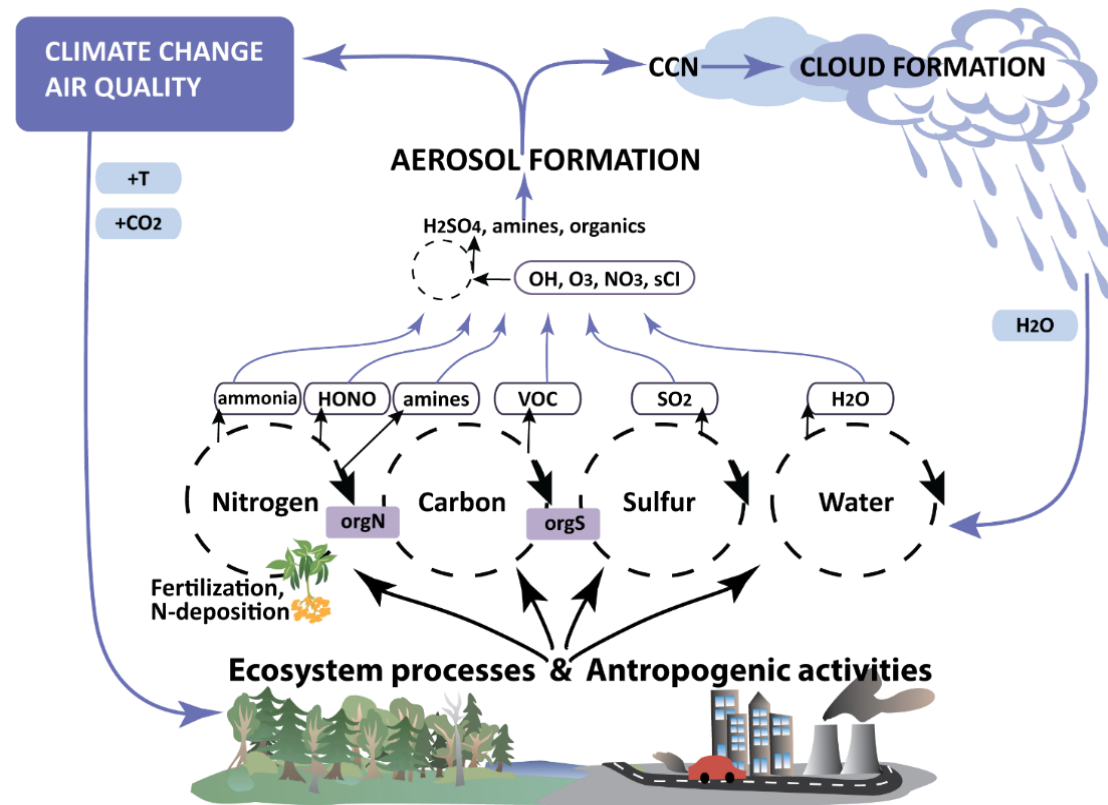


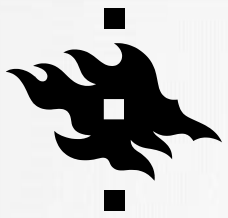
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# PEEX: TOWARDS SYSTEM UNDERSTANDING OF THE ARCTIC- BOREAL REGIONS

## 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 (climate)**

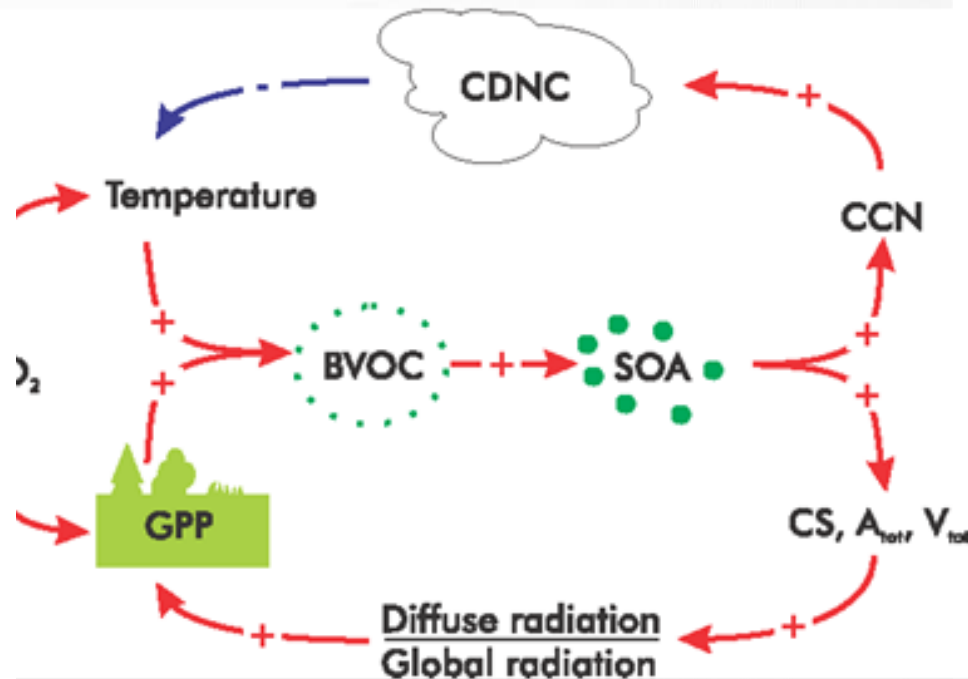




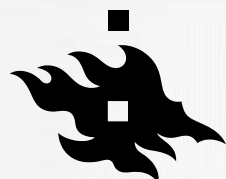
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# A FEEDBACK LOOP RELEVANT TO ARCTIC-BOREAL REGIONS: COBACC (COntinental Climate) Biosphere-Aerosol-Cloud-

- 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<sup>1,36</sup>, Tuukka Petäjä<sup>1</sup>, Timo Vihma<sup>2</sup>, Jouni Räisänen<sup>1</sup>, Alexander Baklanov<sup>3</sup>,  
Sergey Chalov<sup>4</sup>, Igor Esau<sup>5,44</sup>, Ekaterina Ezhova<sup>1</sup>, Matti Leppäranta<sup>1</sup>, Dmitry Pozdnyakov<sup>6,23</sup>,  
Jukka Pumpanen<sup>7</sup>, Meirrat O. Andreac<sup>8,41,42</sup>, Mikhail Arshinov<sup>9</sup>, Eija Asmi<sup>2</sup>, Jianhui Bai<sup>10</sup>,  
Igor Bashmachnikov<sup>6</sup>, Boris Belan<sup>9</sup>, Federico Bianchi<sup>1</sup>, Boris Biskaborn<sup>11</sup>, Michael Boy<sup>1</sup>, Jaana Bäck<sup>12</sup>,  
Bin Cheng<sup>2</sup>, Natalia Chubarova<sup>4</sup>, Jonathan Duplissy<sup>1,43</sup>, Egor Dyukarev<sup>13</sup>, Konstantinos Eleftheriadis<sup>14</sup>,  
Martin Forsius<sup>15</sup>, Martin Heimann<sup>16</sup>, Sirkku Juhola<sup>19</sup>, Vladimir Kononov<sup>17</sup>, Igor Kononov<sup>18</sup>,  
Pavel Konstantinov<sup>4,32</sup>, Kajar Küster<sup>12</sup>, Elena Lapshina<sup>20</sup>, Anna Lintunen<sup>1,12</sup>, Alexander Mahura<sup>1</sup>,  
Risto Makkonen<sup>2</sup>, Svetlana Malkhazova<sup>4</sup>, Ivan Mammarella<sup>1</sup>, Stefano Mammola<sup>21,22</sup>,  
Stephany Buenrostro Mazon<sup>1</sup>, Outi Meinander<sup>2</sup>, Eugene Mikhailov<sup>23,24</sup>, Victoria Miles<sup>1</sup>,  
Stanislav Myslenkov<sup>4</sup>, Dmitry Orlov<sup>4</sup>, Jean-Daniel Paris<sup>25</sup>, Roberta Pirazzini<sup>2</sup>, Olga Popovicheva<sup>26</sup>,  
Jouni Pulliainen<sup>2</sup>, Kimmo Rautiainen<sup>2</sup>, Torsten Sachs<sup>27</sup>, Vladimir Shevchenko<sup>28</sup>, Andrey Skorokhod<sup>29</sup>,  
Andreas Stohl<sup>30</sup>, Elli Suhonen<sup>1</sup>, Erik S. Thomson<sup>31</sup>, Marina Tsidilina<sup>38</sup>, Veli-Pekka Tynkkynen<sup>31</sup>,  
Petteri Uotila<sup>1</sup>, Aki Virkkula<sup>2</sup>, Nadezhda Voropay<sup>34</sup>, Tobias Wolf<sup>5</sup>, Sayaka Yasunaka<sup>33</sup>, Jiahua Zhang<sup>38</sup>,  
Yubao Qiu<sup>36</sup>, Aijun Ding<sup>37</sup>, Huadong Guo<sup>36</sup>, Valery Bondur<sup>38</sup>, Nikolay Kasimov<sup>4</sup>,  
Sergej Zilitinkevich<sup>1,2,45,†</sup>, Veli-Matti Kerminen<sup>1</sup>, and Markku Kulmala<sup>1,39,40</sup>

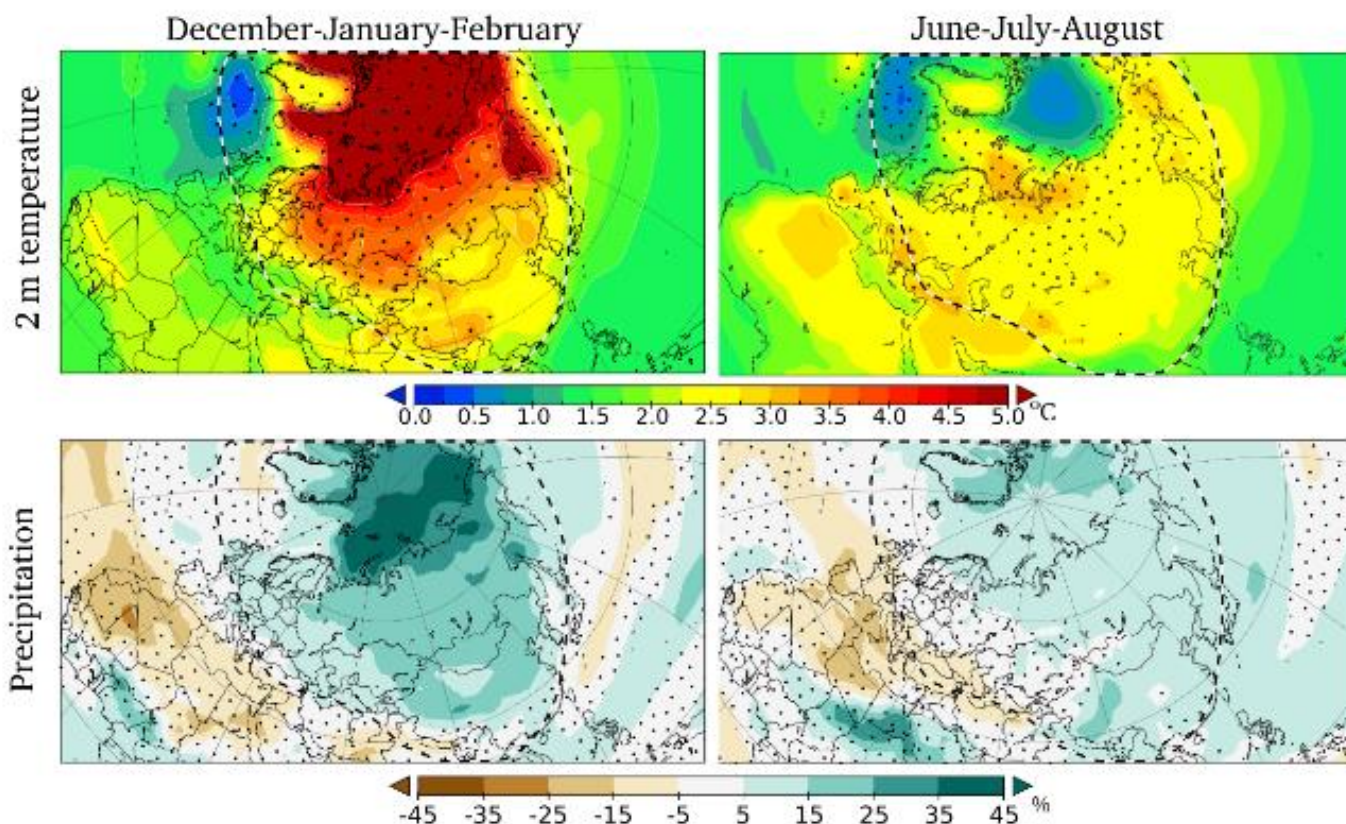




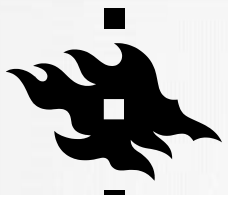
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# PEEX RESEARCH OVERVIEW 2015-2020

Prof. Risto Makkonen Finnish Meteorological Inst. team

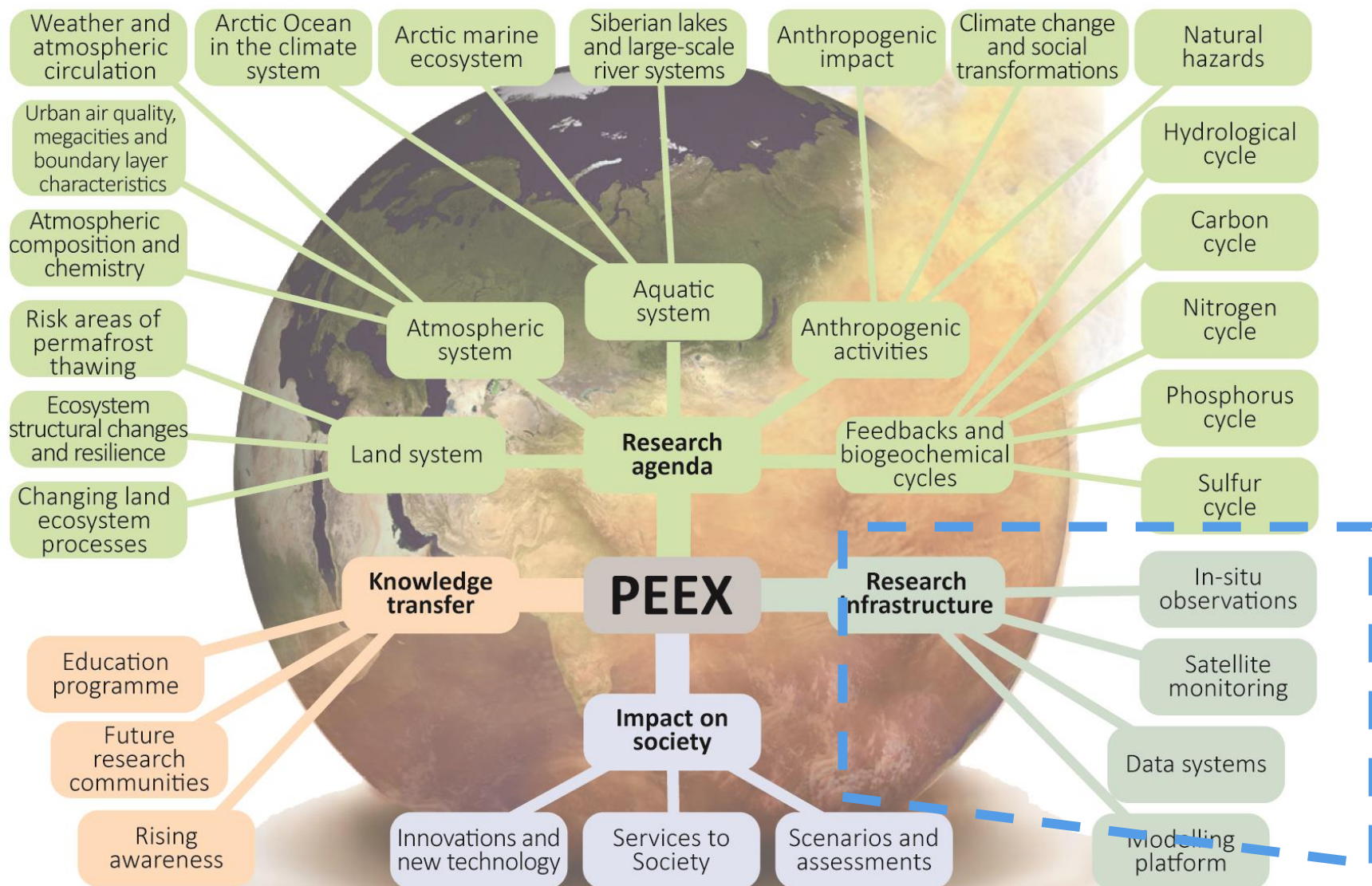


**Figure 9.** Changes in 2 m temperature (°C, upper panels) and precipitation (% , lower panels) during the 21st century. Present-day climatology is averaged over the years 1981–2010 and end-of-century climatology over 2070–2099. Winter (left) and summer (right) are shown separately. Dotted areas indicate 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.

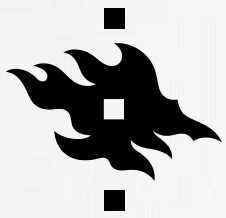


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# RESEARCH INFRASTRUCTURE







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# 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



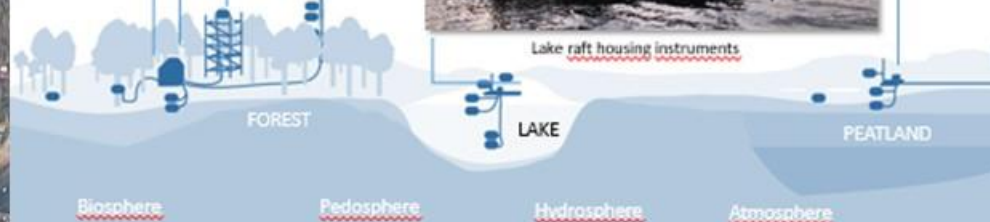
Aerosols



Shoot-level flux chamber



Lake raft housing instruments



Biosphere

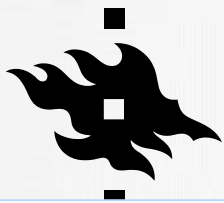
Pedosphere

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

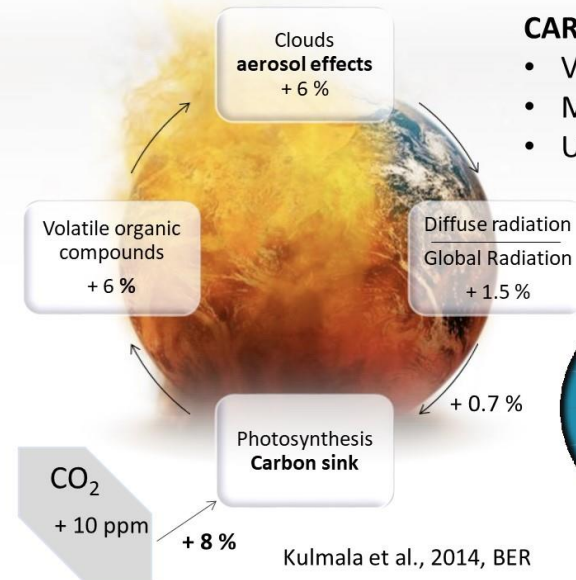
BIG EARTH DATA  
2021, VOL. 5, NO. 3, 277-305  
<https://doi.org/10.1080/20964471.2021.1936943>

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

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



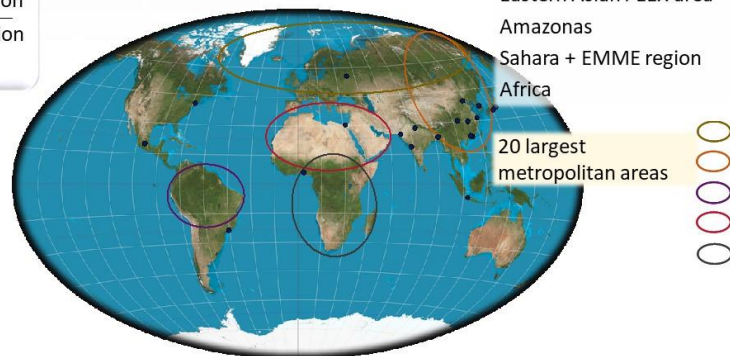
## THE POTENTIAL OF SMEAR CONCEPT: GLOBAL COMPREHENSIVE FEEDBACK ANALYSIS

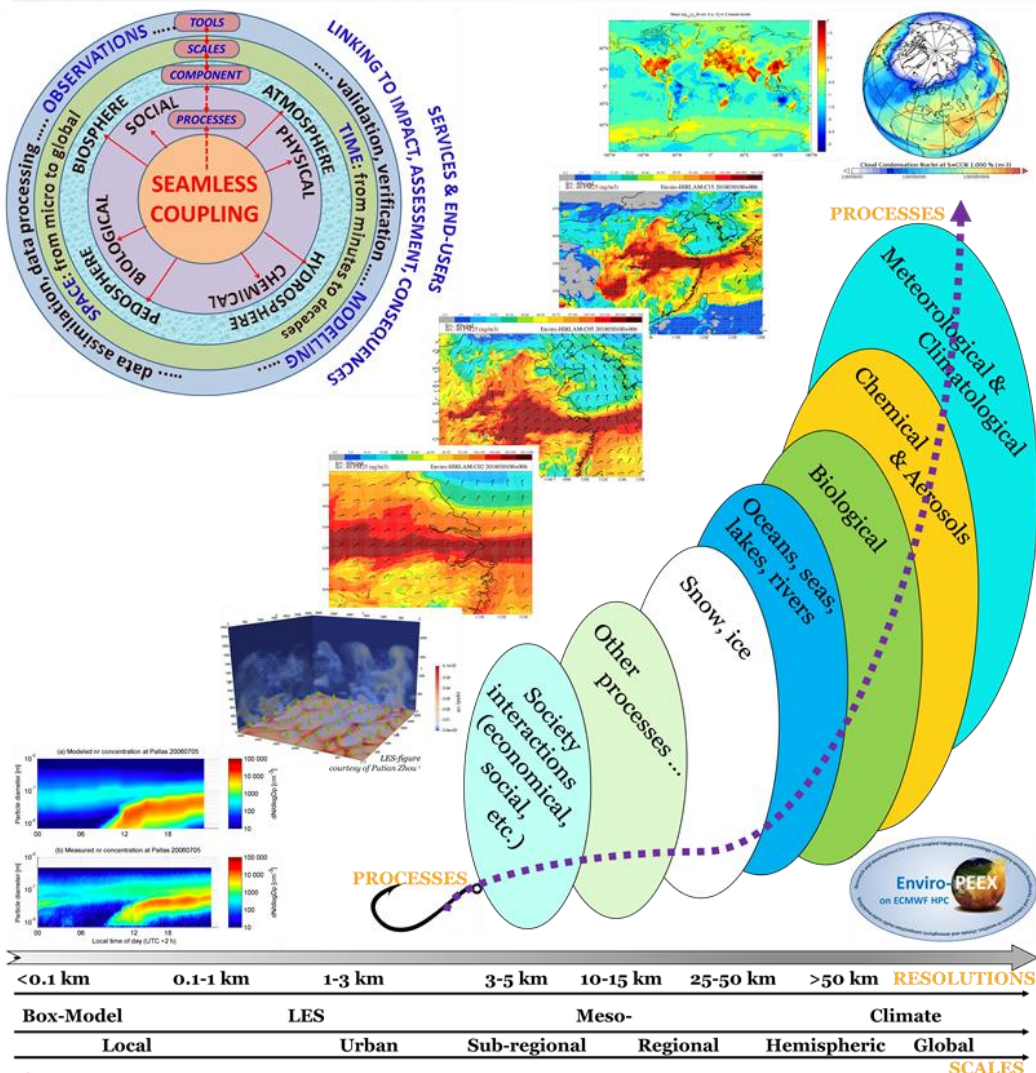


### CARBON SINK PLUS

- 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”**

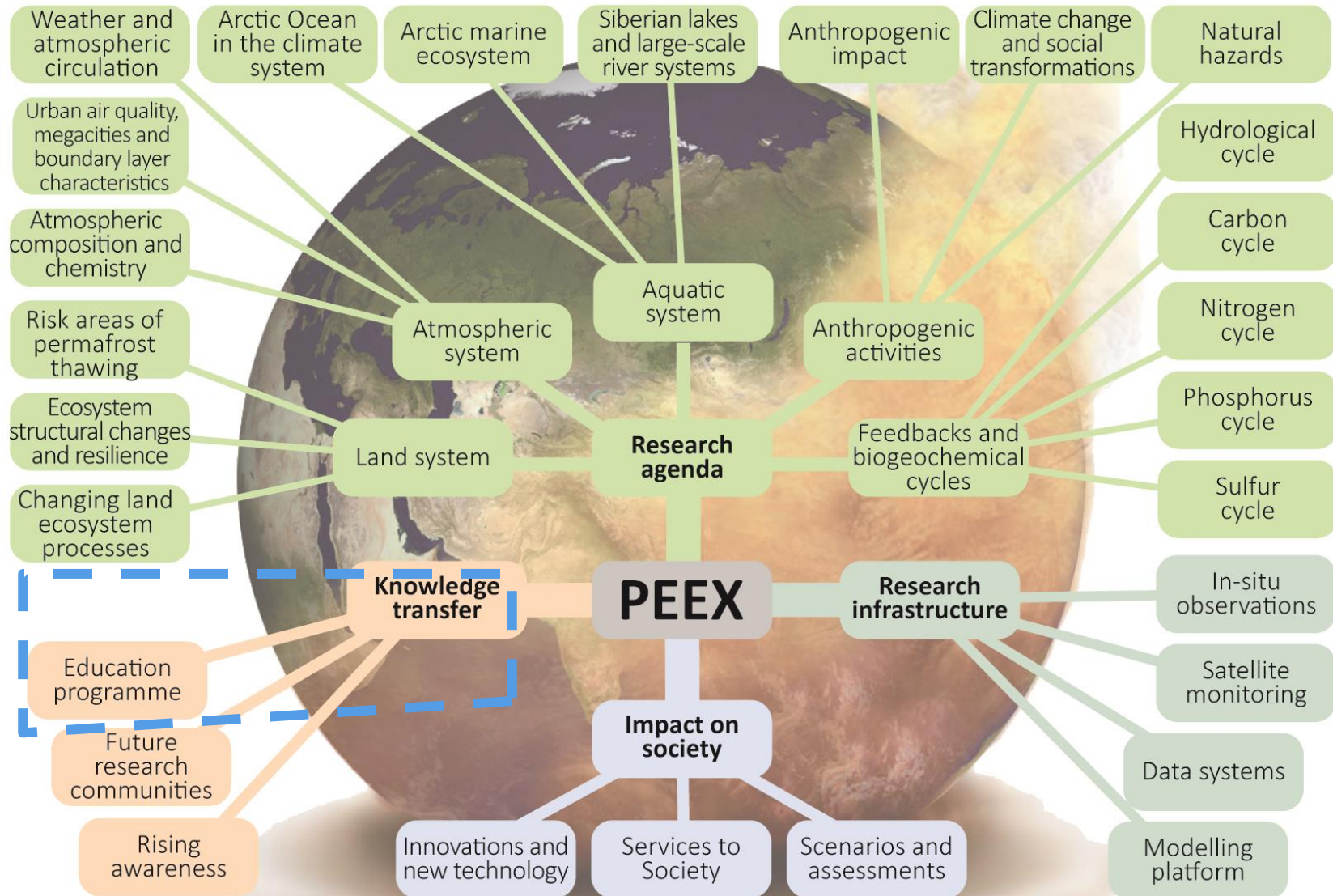
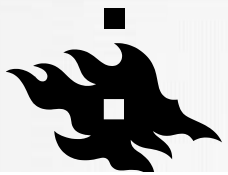
(2018-2020, 202102023, 2024-)

[www.atm.helsinki.fi/peex/index.php/enviro](http://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.







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# EDUCATION

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



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



Funded by the  
European Union



ALMA MATER STUDIORUM  
UNIVERSITÀ DI BOLOGNA

KU LEUVEN



UNIVERSITY OF NAIROBI

UNIVERSITE  
DE KINSHASA

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



Funded by the  
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una  
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- 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](mailto:Laura.riuttanen@helsinki.fi)

## Courses

2-5 ECTS each  
35 ECTS in total  
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LEADERSHIP FOR  
SUSTAINABLE CHANGE



SYSTEMSCHANGENOW



STATISTICAL TOOLS



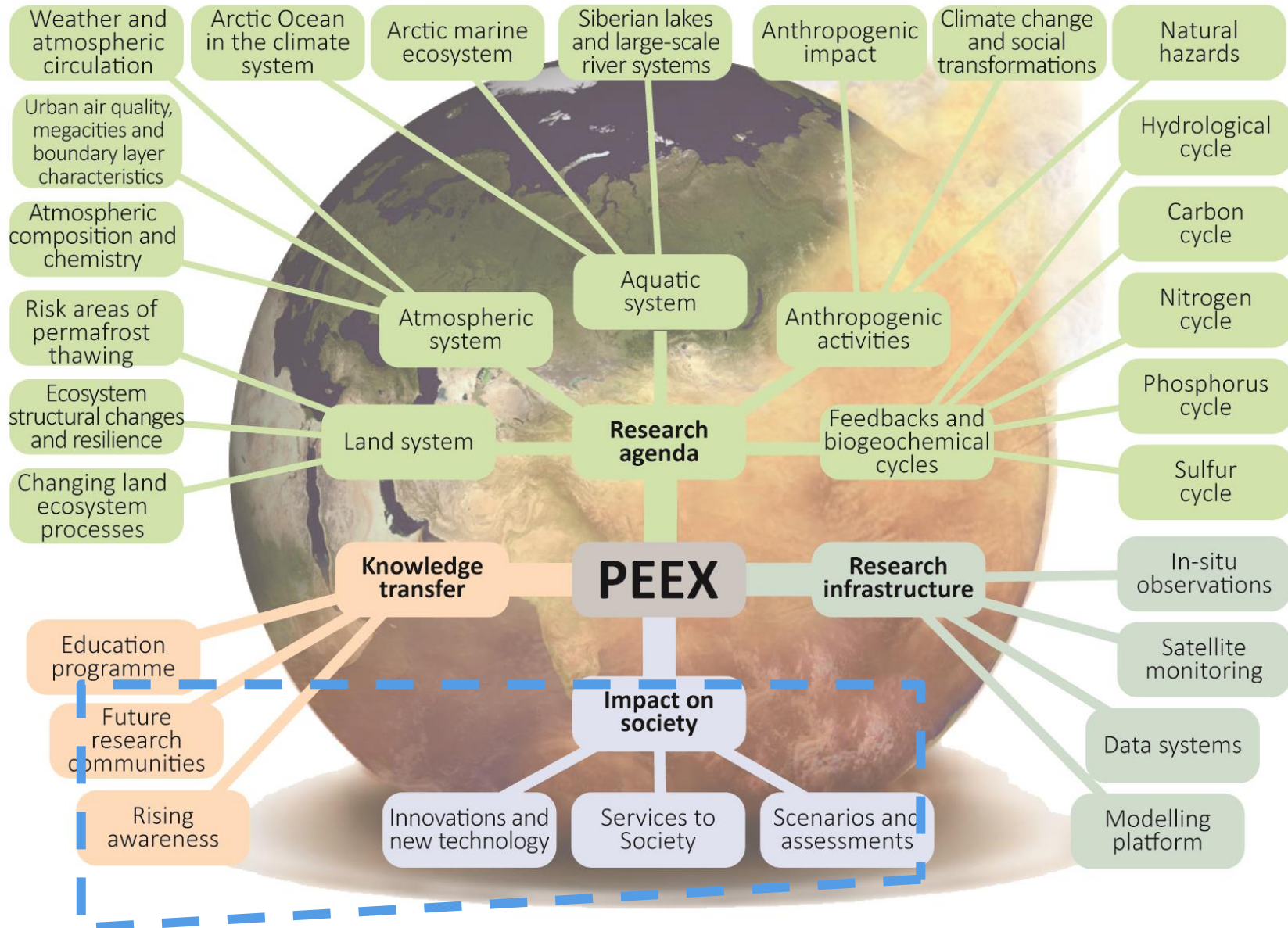
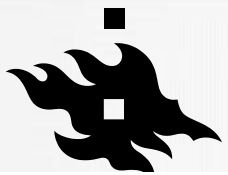
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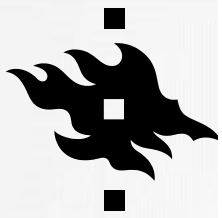
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LUKIOLAISEN ILMASTO.NYT







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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

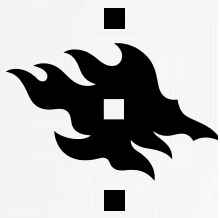
 **WORLD  
METEOROLOGICAL  
ORGANIZATION**

 **UArctic**  
Thematic Networks

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

 **SIOS**  
SVALBARD INTEGRATED ARCTIC  
EARTH OBSERVING SYSTEM

 **CBAS**



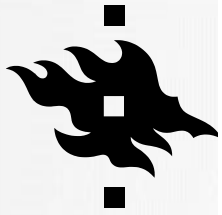
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# FUTURE OUTLOOK

## 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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# THANK YOU

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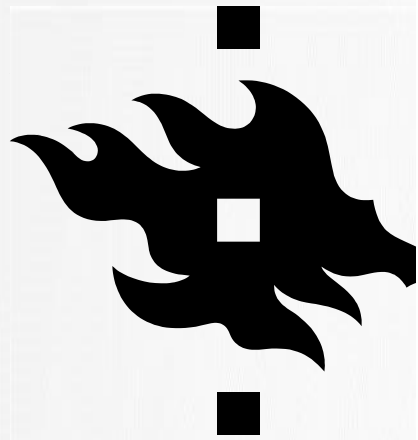
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Pan-Eurasian Experiment

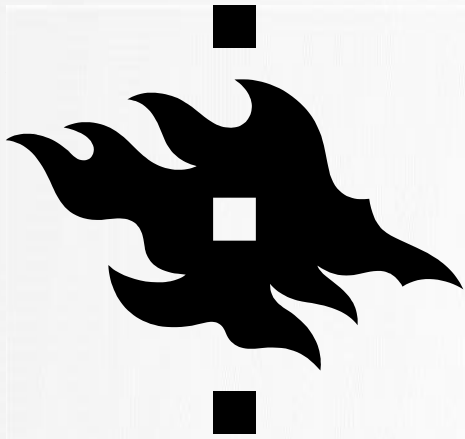
PEEX





HELSINGIN YLIOPISTO  
HELSINGFORS UNIVERSITET  
UNIVERSITY OF HELSINKI



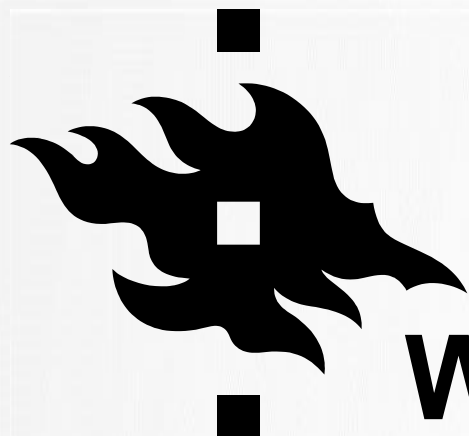


# INAR

INSTITUTE FOR ATMOSPHERIC AND  
EARTH SYSTEM RESEARCH

- Interdisciplinary research and education Institute under the Faculties of Science and Agriculture and Forestry in the University of Helsinki
- Multiscale research from molecular to global scale with a focus on climate change, air quality, biogeochemical cycles and ecosystem processes
- 255 research, teaching and technical staff
- National partners based on a contract in Finnish Meteorological Institute, University of Eastern Finland and Tampere University

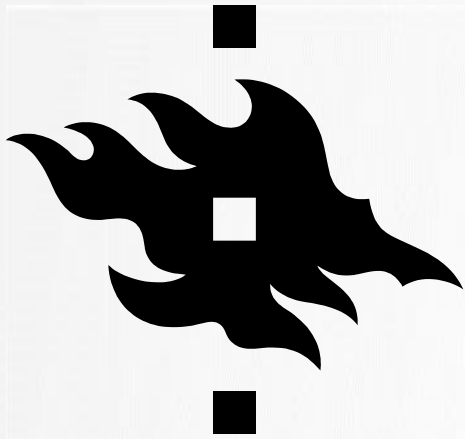




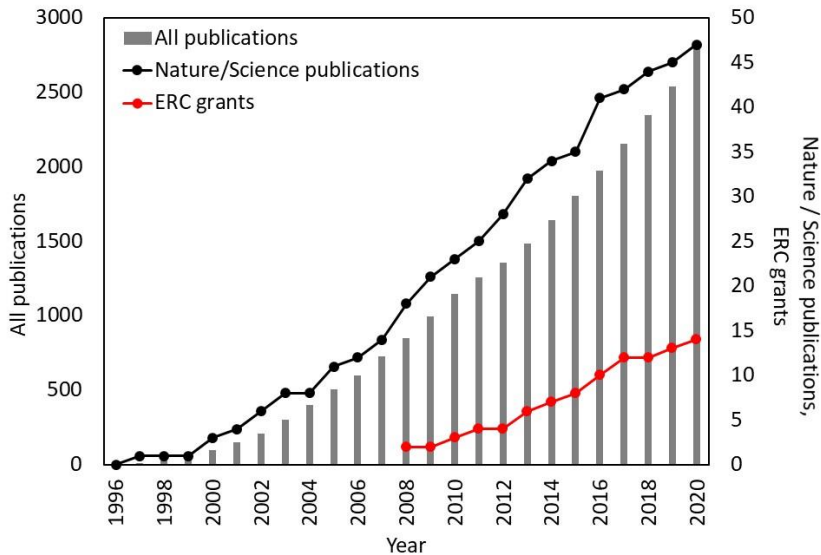
# WHY

- Two urgent global grand challenges are climate change and air quality
- The remaining allowable net carbon emissions with the 1.5°C Paris temperature targets are highly uncertain
- Major part of this uncertainty is related to aerosols, their direct effects on reflectance, their impact on clouds and feedbacks in the natural carbon cycle
- **We aim to create new knowledge, reduce the scientific uncertainties and support creating solutions related to climate change and air quality**





# SCIENTIFIC IMPACT



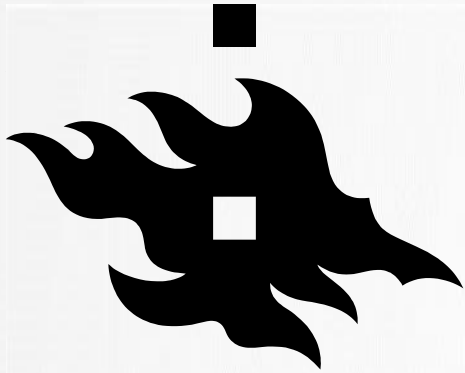
**ISI Highly cited**

**Disciplines covered**

**Professors educated**

1990	2018	2026	2035
0	8	15	25
2	4+9	19	30
1	40	70	120





# **SOCIETY IMPACT**

- Finnish Research Flagship: **Atmosphere and Climate Competence Center (ACCC)**
- Top-level scientific knowledge on climate change and air quality
- Co-create science-based solution to reach climate neutrality
- Collect environmental big dataa for different stakeholders to use
- Establish international and interactive atmospheric research – business innovation ecosystem to Finland