



HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

INAR

**INSTITUTE FOR ATMOSPHERIC AND
EARTH SYSTEM RESEARCH**



**FOR THE ONLY
PLANET
WE HAVE**

Institute for Atmospheric and Earth System Research (INAR):

MULTISCALED, MULTIDISCIPLINARY, EXCELLENT SCIENCE

>2500 scientific peer-reviewed publications
45 articles in Nature or Science
15 European Research Council grants

Leading by example

The Institute for Atmospheric and Earth System Research (INAR) at the University of Helsinki provides cutting-edge research and education on climate change, air quality, biogeochemical cycles and ecosystem processes.

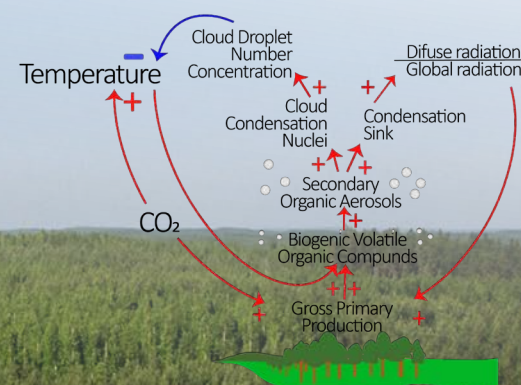
INAR, headed by Director Academician Markku Kulmala, places among the world's top ranked institutions for atmospheric sciences (Shanghai Ranking 2019). It hosts 10 of the highest cited geoscientists in the world and offers innovative pedagogical research-based courses.

Beyond academia, INAR has an active role in developing the European Research Infrastructure (ICOS; ACTRIS; LTER), has initiated international environmental programmes (Pan-Eurasian Experiment; PEEX), produced spin-offs in atmospheric aerosol measurement technology and its climate and air quality policy contributions have great societal impacts.

From nano- to global scale

INAR research is built on deep scientific understanding of the land/ocean – ecosystem – atmosphere interface, their interactions and feedbacks, from past to future and from a local to a global scale.

Our multidisciplinary research community is comprised of over 250 experts in physics, chemistry, biology, forest sciences, geosciences, meteorology, and social sciences and develops theory, field observations, laboratory measurements, data analysis and modelling. This is reflected in the array of INAR Research Groups that span from computational molecular simulations to global climate modelling and remote sensing. INAR has national partners in Finnish Meteorological Institute and University of Eastern Finland.



World presence: research networks, campaigns, and science diplomacy

INAR has been building collaboration networks at national, Nordic, European and global scales.

We coordinate and participate in international campaigns such as the decadal long CLOUD experiment at CERN (European Organization for Nuclear Research), investigating anthropogenic vs. pre-industrial atmospheres in a controlled chamber; and on-board MOSAiC, the largest Arctic expedition in history, to understand polar aerosol and clouds.

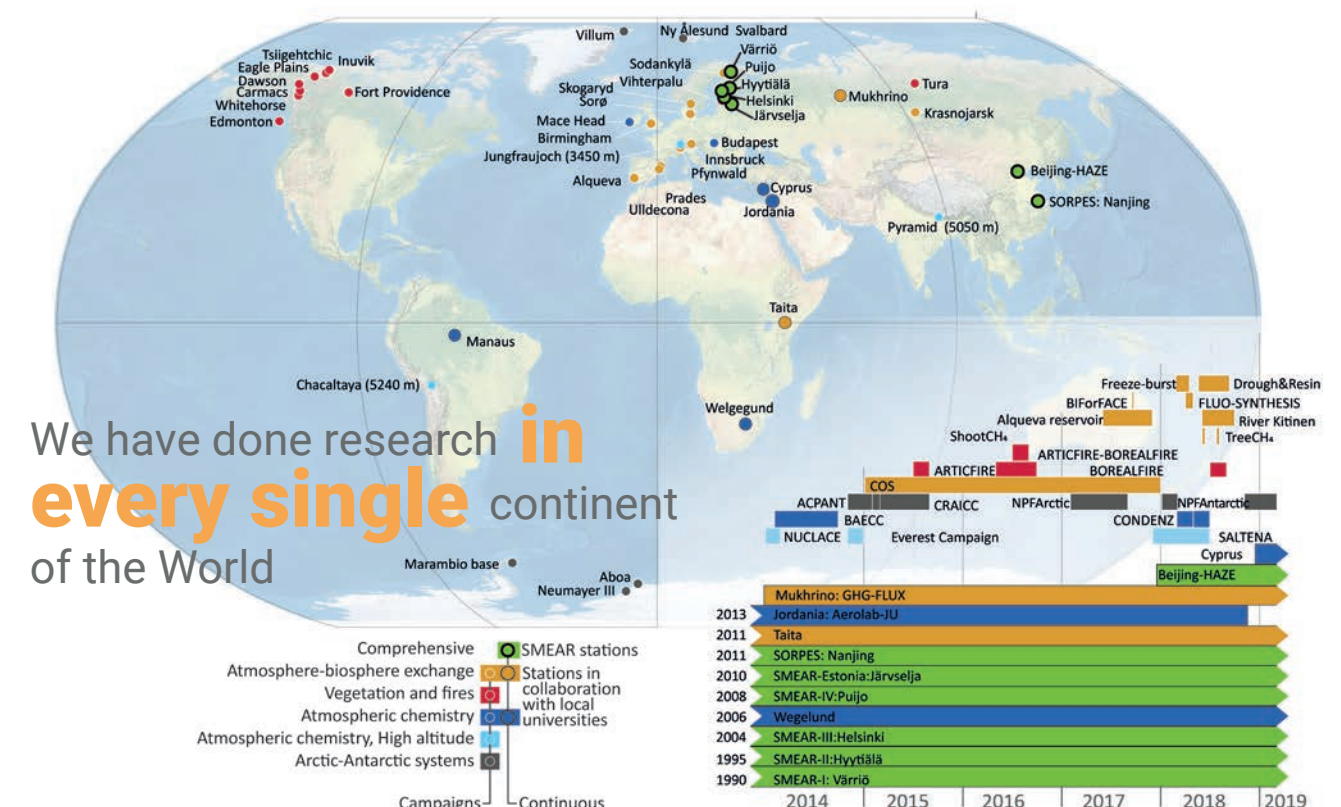
INAR works as coordinator and a data provider for European environmental research infrastructures, such as [ICOS](#) (Integrated Carbon Observing System), [ACTRIS](#) (Aerosols, Clouds, and Trace gases Research InfraStructure), and [LTER](#) (Long-Term Ecosystem Research).

The institute is a pioneer for work in science diplomacy, for example through its work as Head of the International Eurasian Academy of Sciences ([IEAS](#)) European Centre, and developing research platforms between Europe, Russia, China and the Arctic, such as its [Arctic-Boreal Hub thematic network](#) with the UArctic, the Pan-Eurasian Experiment ([PEEX](#)) programme (see below).

INAR research themes:

air quality,
climate change,
biogeochemical
cycles and ecosystem
processes.

We couple **basic research** with state of the art **technology**, **open data**, **education** and **innovation** to generate **new knowledge** and offer practical solutions to global challenges.



Infographics: Nuria Altimir. Photography: Juho Aalto

PREPARING FOR OUR FUTURE WORLD

The Pan-Eurasian Experiment (PEEX)

The Pan-Eurasian Experiment (PEEX) is set up to be a next-generation natural sciences and socio-economic research, research infrastructure, and knowledge transfer initiative aimed at resolving the major uncertainties in Earth System Science and sustainability in the Arctic, boreal Pan-Eurasian regions and China.

PEEX is built around four major activity types built on a collaboration between Russian, Chinese and European parties:

Research agenda: defines large-scale key topics and research questions of the land-aquatic-atmosphere-anthropogenic systems including climate and air quality.

Research Infrastructure: is building a network of state of the art observation systems to address the Research Agenda.

Services to Society: develops climate scenarios and Science Assessments from PEEX peer-reviewed scientific articles ([ACP Special Issue](#)) for policy-making, mitigation and adaptation strategies.

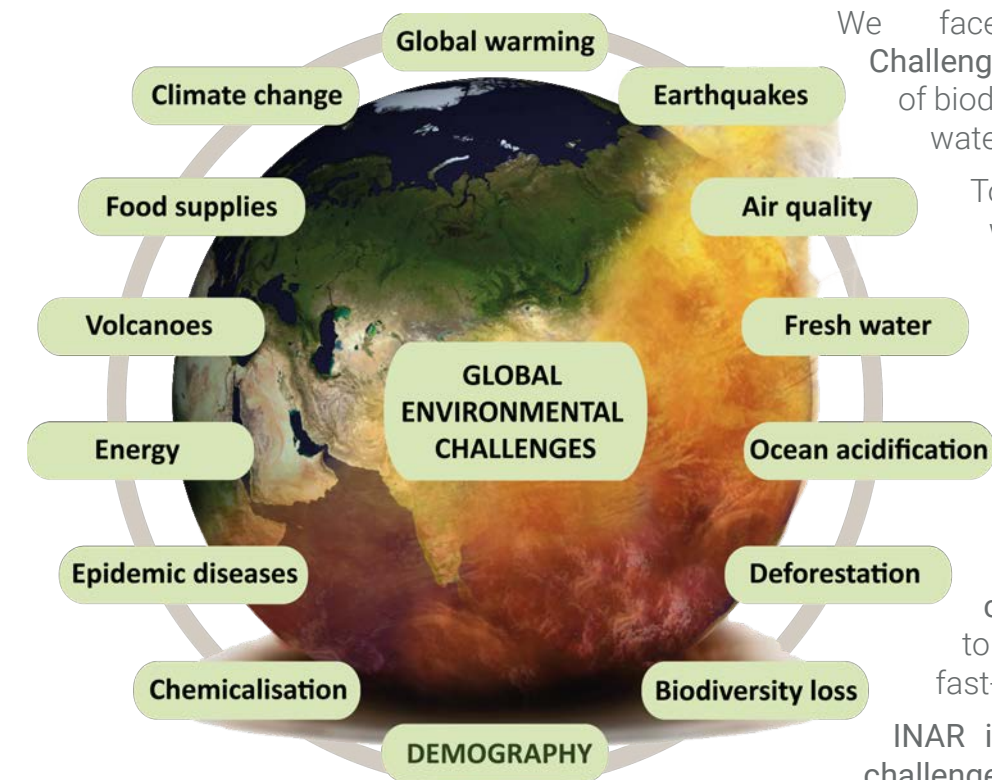
PEEX Education: provides an exchange platform between Europe, Russian and Chinese university students, offering courses and workshops suitable for networking and collaboration.

GlobalSMEAR open data: for **researchers**,
for **policy-makers**
to test policies
and their impacts;
and for **businesses**
to develop environmental
services.

The future of monitoring and data services: GlobalSMEAR

GlobalSMEAR is working towards an integrated Global Earth observatory for continuous, comprehensive environmental information and data services. It aims to integrate and harmonize regional research efforts into a global monitoring network (Kulmala, M., *Build a Global Earth Observatory*, Nature 553, 21-23, 2018).

The approach is based on the “**Stations for Measuring Earth-Atmosphere Relations**” (SMEAR) station concept developed at the “SMEAR II” flagship station in Finland. SMEAR II has the longest, continuous (24h) and most comprehensive measurement series (>1200 parameters) in the world on atmospheric aerosols and energy flows since 1995.



We face 'Global Environmental Challenges' such as air pollution, loss of biodiversity and shortages of fresh water and food.

To not act, we threaten human well-being and the security and stability of future generations.

However these challenges are highly interconnected and cannot be solved separately.

We need a framework based on multidisciplinary science and international collaboration that gives way to knowledge-based actions and fast-tracked policy-making.

INAR initiatives are tackling these challenges.

A future Global Observatory has...

- ~1000 SMEAR-like stations around the world tracking interactions between the atmosphere and key ecosystems, fully and continuously
- Ground data combined with remote-sensing data + laboratory experiments + computer models assimilated by machine learning tools
- Multi-stakeholders

Stations Measuring Earth Surfaces and Atmosphere Relations (SMEAR) stations in operation:

SMEAR I: Värriö, subarctic pine forest

SMEAR II: Hyytiälä, Flagship Station
boreal pine forest, lake and wetland

SMEAR III: Helsinki, urban environment

SMEAR IV: Kuopio-Puijo, semi-urban

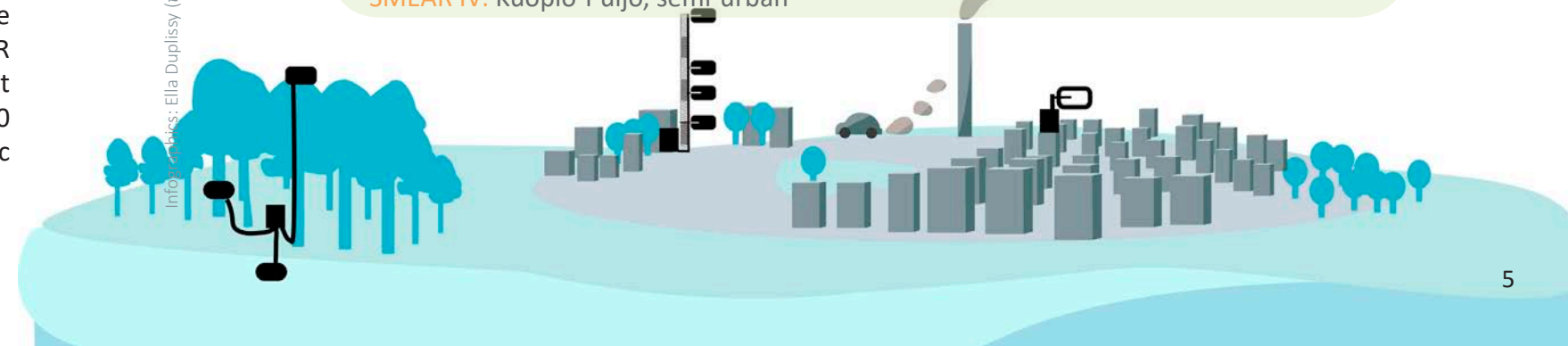
International sites:

SMEAR – Estonia: hemiboreal forest

SMEAR – Beijing: Chinese megacity

SORPES – Nanjing: Chinese megacity

Information: Ella Duplissy (top), Nuria Altimir (bottom)



KNOWLEDGE TRANSFER

INAR is committed to facilitate its expertise and unique datasets for an open, educated and inclusive society.

INAR masters and doctoral programmes

INAR offers its own **multidisciplinary Masters and Doctoral Programmes in Atmospheric Science**, including mobility exchange opportunities with collaborating Nordic universities.

Additionally, INAR researchers are active collaborators at all levels of education: schools, universities, international intensive training schools on data-analysis and field/laboratory courses, high school and undergraduate internships and summer work.

Outreach with Open Data

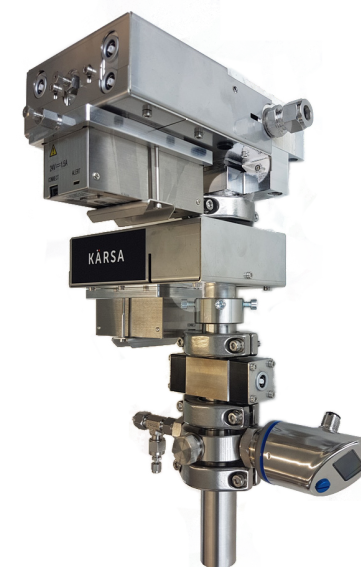
SmartSMEAR - Online data repositories and visualization tools with open access to INAR's unique, long-term monitoring data from its SMEAR stations.

Hillipuu (Carbon Tree) - Artistic and storytelling interactive data visualization platform for public education.

INAR Climate University

INAR leads the Climate University, a National effort to design and provide high quality and accessible climate change and sustainability education put together by a cohort of 11 Finnish universities and funded by the Ministry of Education and Culture and Finnish Innovation Fund Sitra.

Climate University offers multidisciplinary digital learning in the form of **Massive Open Online Courses (MOOCs) in English** with open sourced material available to teachers anywhere in the world, including texts and video lectures and teaching guides. The courses include **Climate.now**, **Leadership for Sustainable Change** and **Circular.now** on basics of circular economy.



FROM SCIENCE TO BUSINESS

INAR Spin-offs: from deep understanding to practical solutions

INAR has developed scientific equipment built on its 40 years' research experience, testing, craftsmanship and deep theoretical understanding of the field.

Through the design and maintenance of its

SMEAR stations, INAR has achieved world-class expertise on integrative measurements of Earth and Atmosphere interactions, and a clear understanding on the technology needed. The resulting innovation has led to spin-off companies.

KÄRSA

Karsa Ltd. launched in 2016 and produces one of the most sensitive molecular detectors in the world and applies it to e.g. the detection of explosives in air cargo. The innovative ion source MION allowing to rapidly switch ion chemistry is enabling groundbreaking discoveries in atmospheric research. Visit karsa.fi

AIRMODUS

Founded in 2010, Airmodus Ltd. makes commercially available particle counters that detect aerosol particles as small as 1 nm. Its products are relevant to both researchers and industries, with applications including air quality and vehicle emission control. Visit airmodus.com

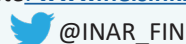
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Director Academician Markku Kulmala

Kumpula Science Campus
Gustaf Hållströmin katu 2. PO BOX 64
FI-00014 University of Helsinki, Finland

INAR website: www.helsinki.fi/en/inar



INAR units at the University of Helsinki:

Physics / Geosciences / Chemistry, Faculty of Science

Forest Sciences / Agricultural Sciences, Faculty of Agriculture and Forestry

INAR National Partners: Finnish Meteorological Institute, University of Eastern Finland.

Education

International university degree programmes:

Master's Programme in Atmospheric Sciences (**ATM MP**) and Doctoral Programme in Atmospheric Sciences (**ATM DP**): www.helsinki.fi/en/inar/education

Climate University: blogs.helsinki.fi/climateuniversity/

Climate.now online course: www.climatenow.fi

Leadership for Sustainable Change online course: www.leadforsust.fi

Circular.now online course: www.circularnow.fi

Kysy Ilmastosta (Ask about the Climate): www.kysyilmastosta.fi

Hiilipuu (Carbon Tree): <http://hiilipuu.fi>

SmartSMEAR - SMEAR open database: <https://avaa.tdata.fi/web/smart/smea>



Research Infrastructures at INAR

ACTRIS- Finland: www.actris.eu/Countries/Finland

ICOS Finland: www.icos-finland.fi/ | @ICOS_Finland

GlobalSMEAR: www.atm.helsinki.fi/m/globalsmea/ | @GlobalSMEAR

SMEAR research stations: www.atm.helsinki.fi/SMEAR/ | @HyytiäläHY

SmartSMEAR open online database: <https://avaa.tdata.fi/web/smart>



International Initiatives

Pan-Eurasian Experiment (PEEX) program: www.atm.helsinki.fi/peex |

peex-hq@helsinki.fi | @PEEX_News

International Eurasian Academy of Sciences (IEAS) European Centre:

www.atm.helsinki.fi/m/ieas/

Future Earth Finland National Committee: futureearthsuomi.fi/ | @FESuomi

UArctic Arctic-Boreal Hub: www.uarctic.org/organization/thematic-networks/arctic-boreal-hub/



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