

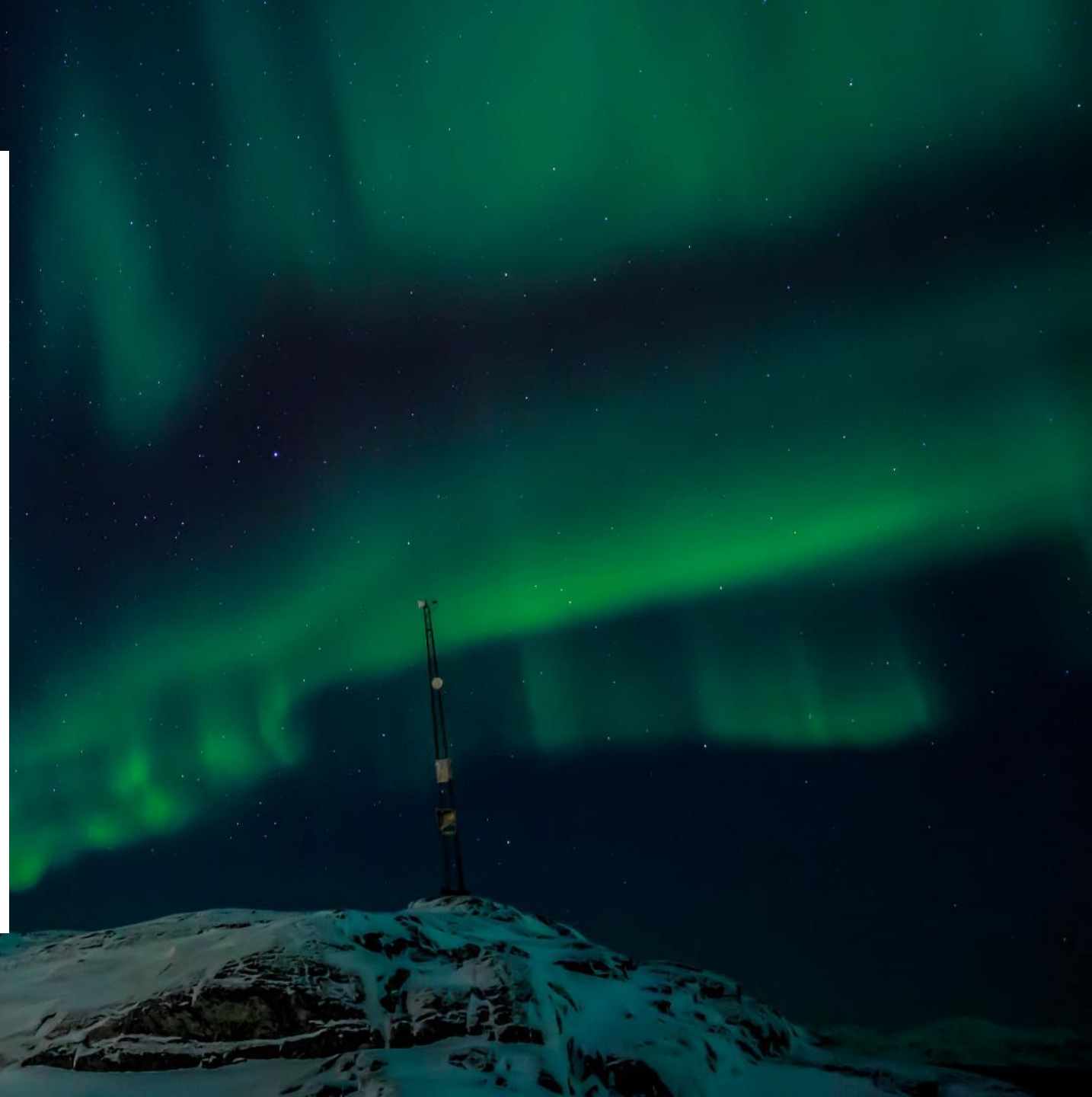
University of Copenhagen

Faculty of Science

**Mission and vision,
Organisation, Research and
Education**

Prof. Alexander Baklanov
Dr. Roman Nuterman
Niels Bohr Institute
Physics of Ice, Climate and Earth

UNIVERSITY OF COPENHAGEN
FACULTY OF SCIENCE



ORGANISATION AND FACTS

- Founded in 1479
- 6 faculties:
 - Health and Medical Sciences
 - Humanities
 - Law
 - Science
 - Social Sciences
 - Theology
- 10 Nobel Laureates
- 37 Prime Ministers
- 34 Olympic medals by 21 alumni
- 4 campuses
- 8 museums and research gardens
- 290 new start-ups launched each year

36,528

students

14,298

research publications

9.6

billion DKK in revenue

10,063

employees of whom 5,381 are researchers

5th

best university in Europe

951,211

square metres floor area

FACULTY OF SCIENCE

RESEARCH & EDUCATION

12 DEPARTMENTS

- Department of Biology
- Department of Computer Science
- Department of food and resources
- Economics
- Department of food science
- Department of nutrition, exercise and sports
- Department of mathematical sciences
- Department of geosciences and natural resource management
- Department of science education
- Department of plant and environmental sciences
- Department of chemistry
- Niels Bohr Institute
- Natural history museum of Denmark



4000 employees
9700 students



25 Bachelor programmes
37 Master's programmes



1520 Academic staff
1050 PhD students



4129 Peer-reviewed research articles
(2018/19)



35 ERC grants
34 Centres of Research Excellence

Niels Bohr Institute

The Niels Bohr Institute represents physics at the University of Copenhagen

At the Niels Bohr Institute we research and teach within a broad spectrum of physics areas:

Astrophysics, Biophysics, Solid State Physics, **Climate and Geophysics**, Quantum Physics and Particle Physics.

The institute was inaugurated March 3, 1921, by Professor Niels Bohr.

We are approx. 430 researchers, 100 administrative and technical staff, 140 Ph.D. students and 750 Physics students.

The institute is engaged in providing courses for the interdisciplinary MSc programme in Climate Change.

Physics of Ice, Climate and Earth

The section for the Physics of Ice, Climate and Earth at the Niels Bohr Institute studies the elements of the Earth and climate system – the atmosphere, oceans, ice sheets and glaciers, sea ice, and the solid Earth itself – and the interactions between them.



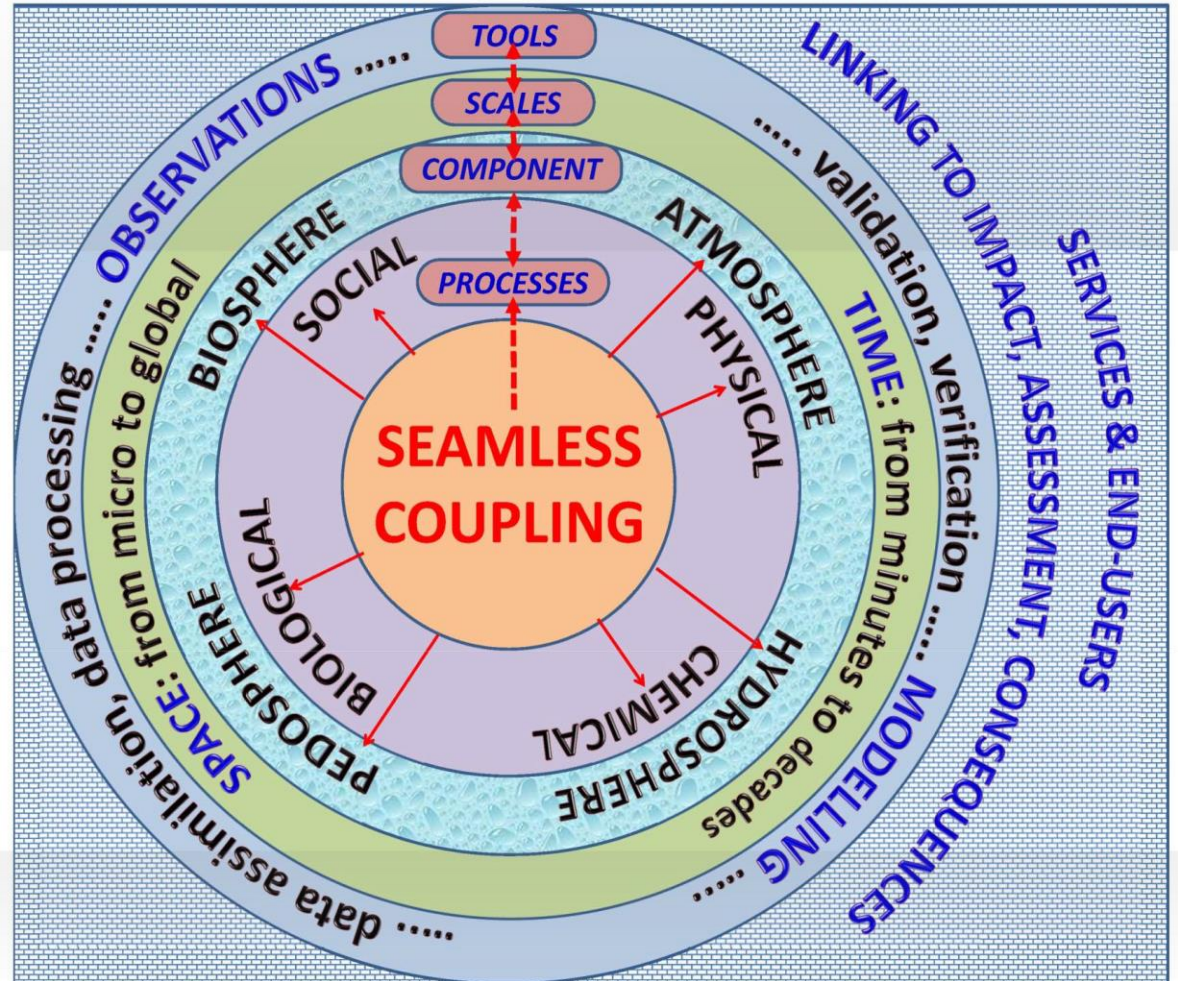
Research Contributions to the PEEEX Programme:

- Co-leadership of the PEEEX Modelling Platform (Mahura, Baklanov et al., BED, 2024)
- Seamless integrated online coupled chemistry-meteorology modelling (CCMM) (Baklanov et al., ACP, 2015; WWSC, 2016; Baklanov & Zhang, 2020)
- Development and applications of EnviroHIRLAM model for PEEEX domain (Baklanov et al., GMD, 2017; Nuterman et al., ACP, 2021)
- Northern Urbanization focus studies (within PEEEX, PACES, GURME) (Varentsov et al., 2018; Baklanov et al., 2021; Esau et al., 2021)
- Integrated Urban Systems and Services for climate-smart megacities (Grimmond et al., 2015, 2021; Baklanov et al., 2020, 2021; Lappalainen et al., 2022)
- New EU-China project IMTEC «Integrated systems and analysis of urban Mobility for climate-neutral and susTainable Cities in Europe and China» (UoC, AURS, Zhejiang University) (2023-2026)
- New Nordic project NORDDUST: High Latitude Dust as a driver for climate change and air pollution in the Arctic

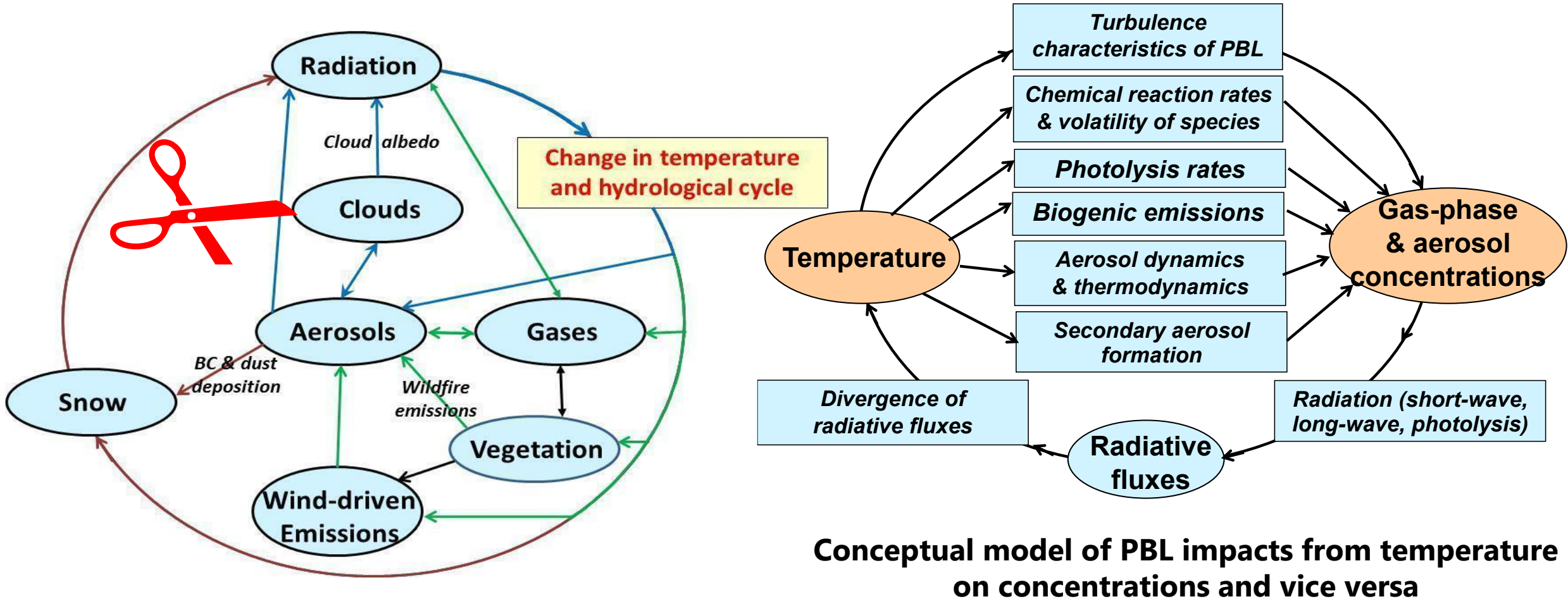
Seamless prediction of the Earth system approach

Several dimensions of the seamless coupling/integration, including:

- Time scales: from seconds and nowcasting to decadal and centennial (climate) time-scale;
- Spatial scales: from street-level to global scale (downscaling and upscaling);
- Processes: physical, chemical, biological, social;
- Earth system components/environments: atmosphere, hydrosphere, lithosphere, pedosphere, ecosystems/biosphere: PBL;
- Different types of observations and modelling as tools: observations-model fusion, data processing and assimilation, validation and verification;
- Links with health and social consequences, impact-based prediction & assessment, and services and end-users.



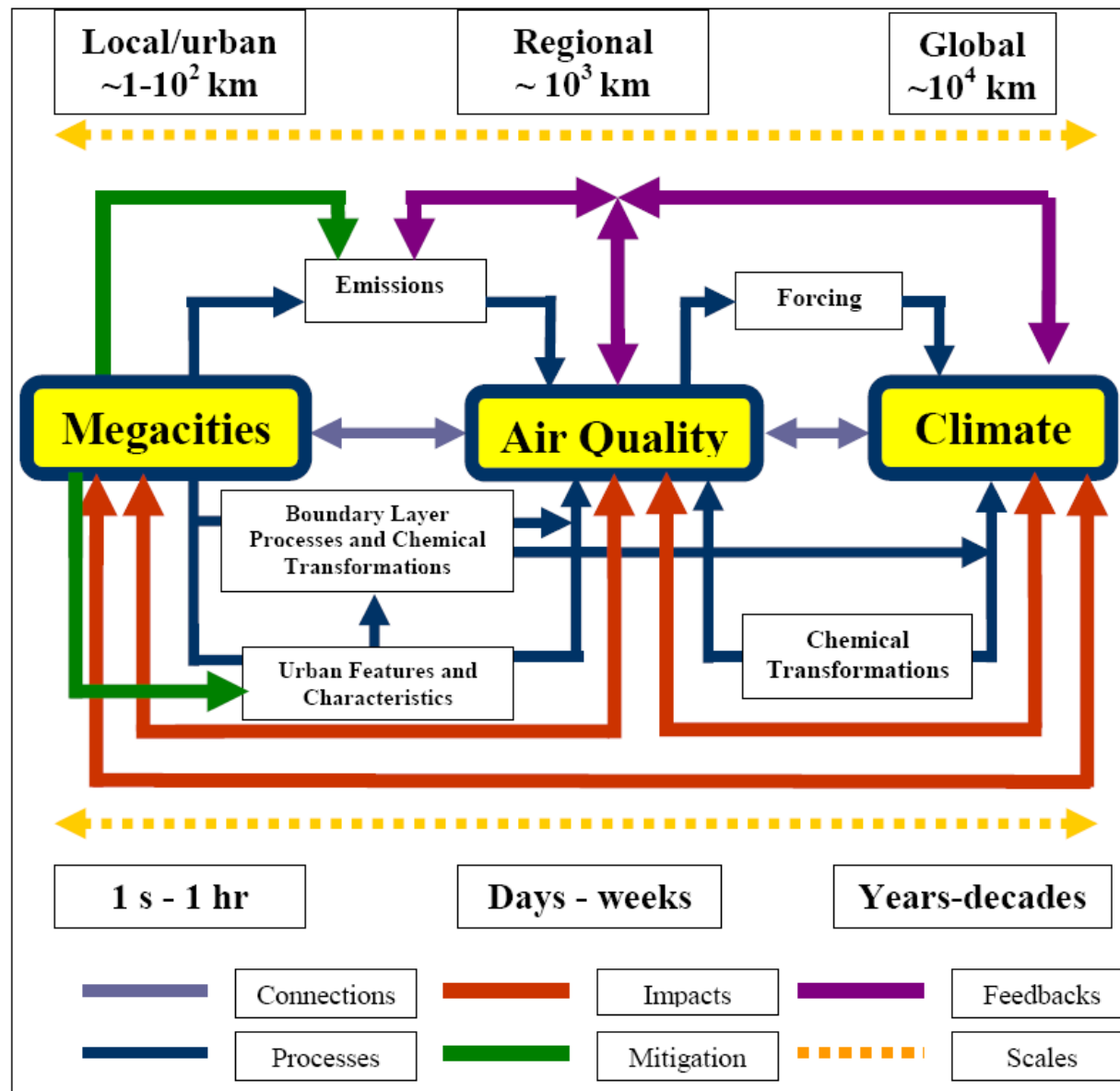
Interactions between aerosols, gases and components of the Earth system on different scales



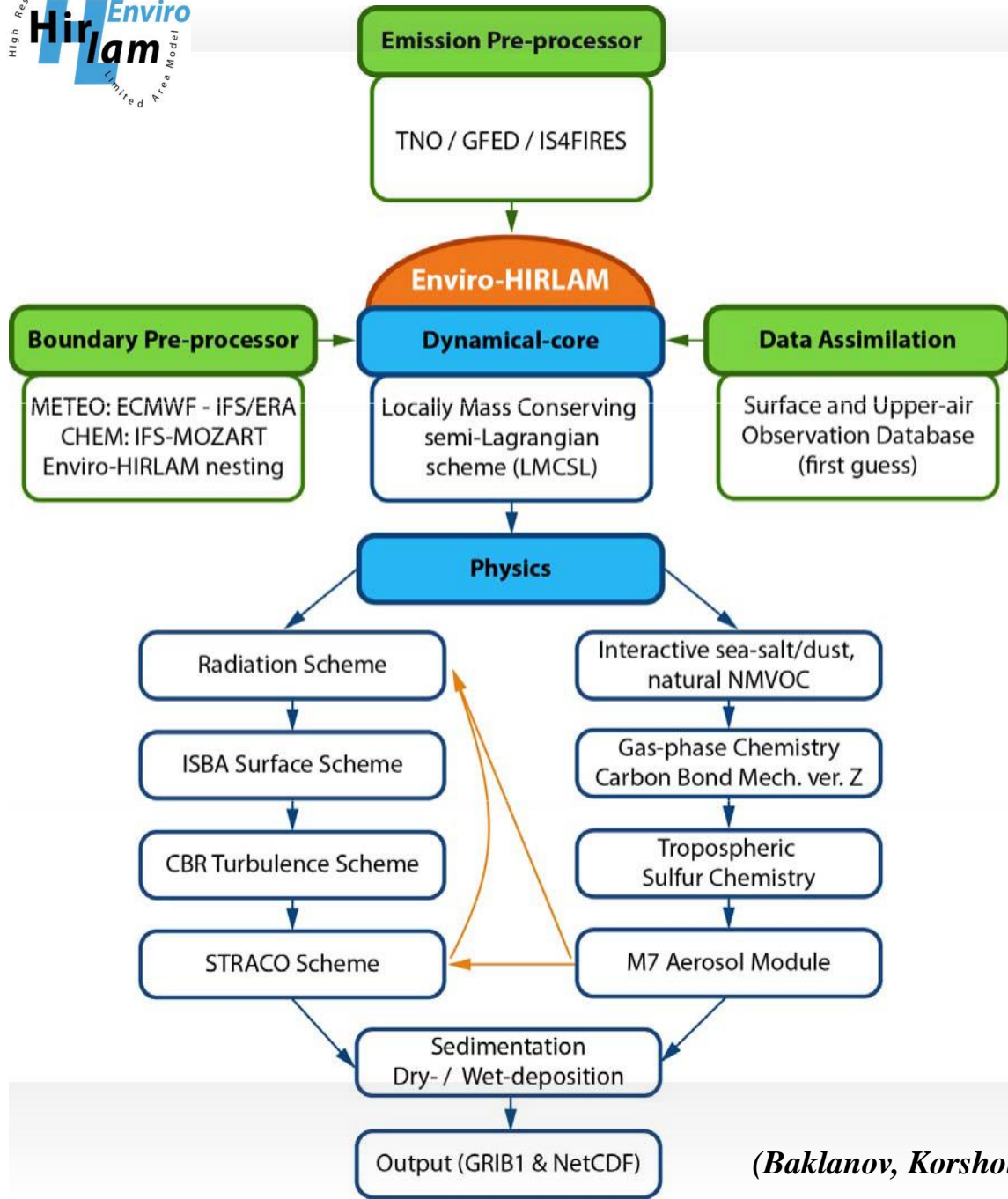
Connections between Megacities, AQ, Weather and Climate

main feedbacks, ecosystem, health & weather impact pathways, mitigation

- Science - nonlinear interactions and feedbacks between emissions, chemistry, meteorology and climate
- Multiple spatial and temporal scales
- Complex mixture of pollutants from large sources
- Scales from urban to global
- Interacting effects of urban features and emissions
- From urban meteorology, climate and environment research to integrated city services

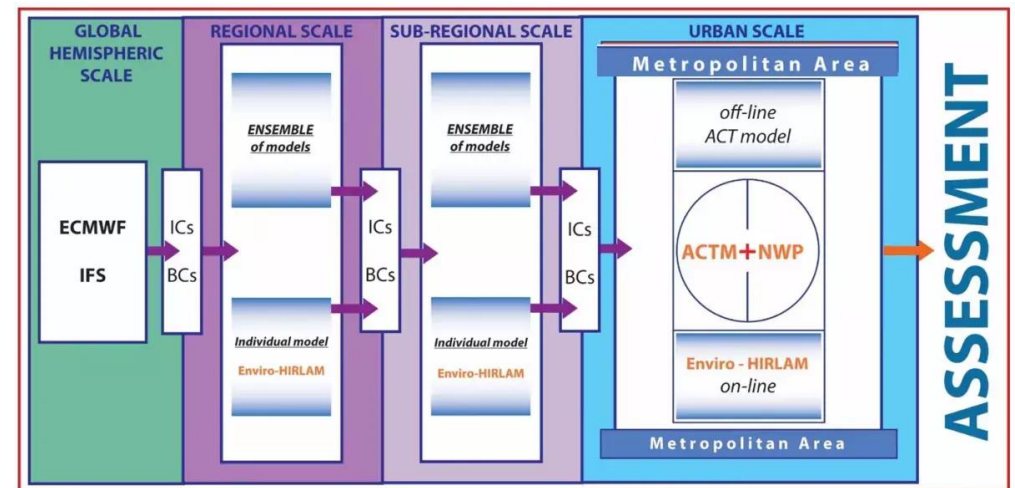


Nature, 455, 142-143 (2008)
 Baklanov et al., 2010, 2016, 2018, 2020



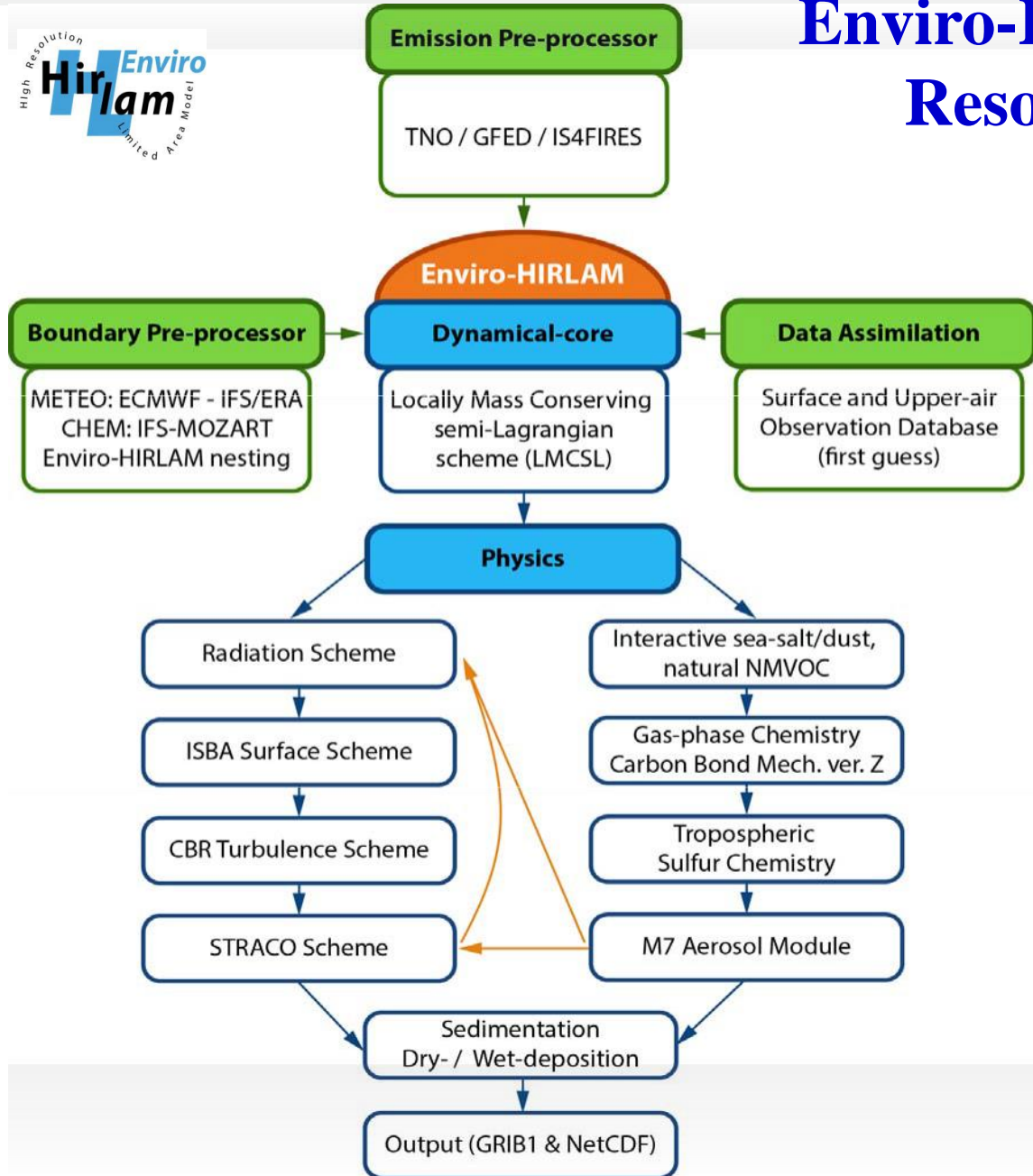
Enviro-HIRLAM (Environment – High Resolution Limited Area Model)

- Seamless / online coupled integrated meteorology-chemistry- aerosols downscaling modelling system for predicting weather and atmospheric composition



Enviro-HIRLAM downscaling chain from hemispheric- down to urban-scale

Enviro-HIRLAM (Environment – High Resolution Limited Area Model)



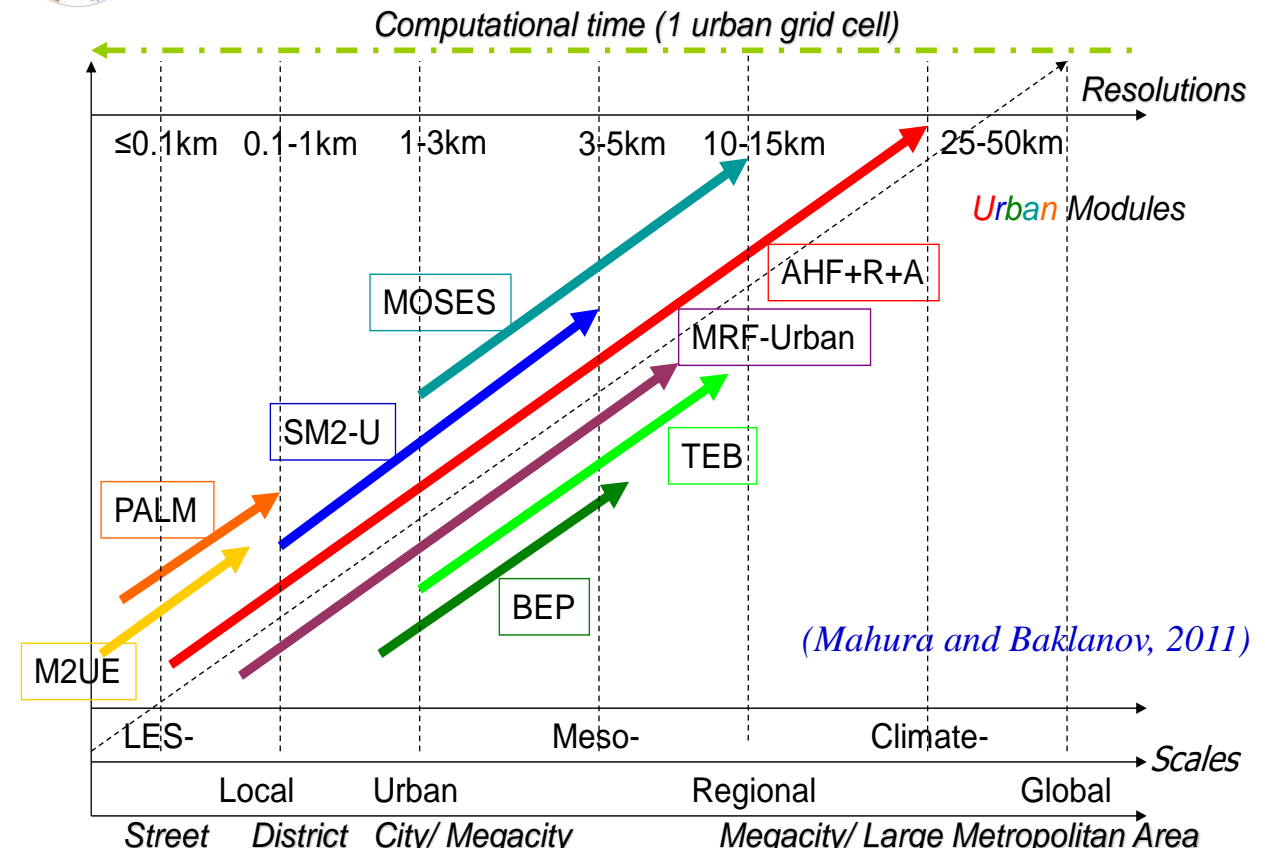
(Baklanov, Korsholm, Mahura, Nuterman et al., GMD, 2017)

- Seamless / online coupled integrated meteorology-chemistry-aerosols downscaling modelling system for predicting weather and atmospheric composition



Hierarchy of Urbanization Approaches

Urban canopy schemes for different type & scale models:



(Mahura and Baklanov, 2011)

Northern Urbanization: Sustainable Cities



Pan-Eurasian Experiment

PEEX

Fairbanks
pilotEurasian
twin-city
to benefit

PACES

air Pollution in the Arctic:
Climate Environment and Societies

- Urban WG of Pan-Eurasian Experiment (PEEX) (Kulmala et al., 2018; Lappalainen et al., 2021),
- Air Pollution in the Arctic: Climate, Environment and Society (PACES) (Arnold et al., 2016; Schmale et al., 2018),
- WMO Global Atmospheric Watch Urban Research Meteorology and Environment project (GURME) (WMO, 2019; Sokhi et al, 2021),
- EnviroRISKS: Monitoring, Management and Remediation of Man-made Changes in Siberia (Baklanov et al, 2013);
- UHIARC: Urban heat island observation network in Arctic cities (Konstantinov et al, 2018);
- iCUPE: Integrative and Comprehensive Understanding on Polar Environments (Petäjä et al., 2020)
- SERUS Belmont Forum project (Nansen Center, Norway; George Washington University, USA; Tyumen State University, Russia) (Esau et al., 2020),
- NordForsk TRAKT-2018 (Mahura et al., 2018; Esau et al., 2021),
- Kola Arctic and Apatity urban studies (Baklanov et al., 2012; Amosov et al., 2014; Varentsov et al, 2018).



“Integrated systems and analysis of urban Mobility for climate-neutral and susTainable Cities in Europe and China (IMTEC)”



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Project Focus & Aims

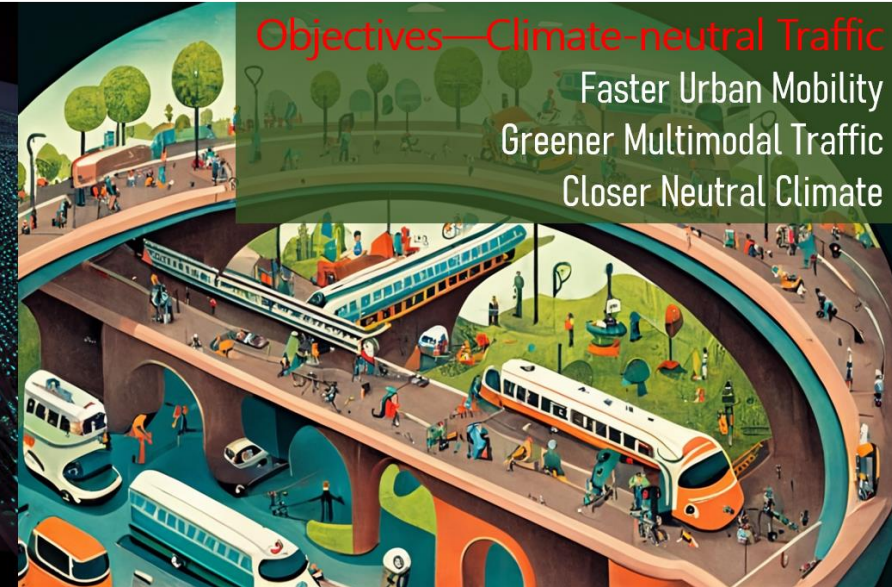
Demonstration cities in focus:

- Copenhagen, Denmark
- Paris, France
- Hangzhou, China

IMTECC – Integrated analysis of Mobility for sustainable European & Chinese Cities

Tools – Integrated Urban Services

Big Data
Sufficient Measurements
Multidisciplinary Models



- **IMTECC project aims to provide tools and case studies for optimizing multimodal traffic management, improving urban mobility, reducing traffic emissions, and finding new solutions towards greener mobility practices, climate-neutral and smart cities.**
- Based on big data, smart traffic management technologies, and integrated interdisciplinary methods, **this project will build an Integrated Urban System (IUS)** and key performance indicators (KPIs) for each city.
- With evolving urban planning, energy consumption, transport supply and demand, and group behaviours, the system will **improve our understanding of interactions among urban multimodal mobility, traffic emissions, air quality and climate change**, and quantify these interactions for the Sino-European cities.
- The results will allow to quantify the leverage effects observed, and to highlight issues of environmental justice.
- The **results will establish a model for building smart cities, promoting Sino-European exchanges** and cooperation, and jointly exploring climate neutrality pathways under future urbanization processes.

Education Projects and Activities within the PEEEX Programme:

- Partner in EU TEMPUS project QUALIMET “Development of Qualification Framework in Meteorology”
- Partner in Erasmus+ CLUVEX “Climate University for Virtual Exchanges” project, leading WP4 (2023-2026)
- Young Scientists Summer Schools and Training courses (2008, 2011, 2016, 2023, 2024)
- Collaboration with the WMO Education and Training Programme (ETRP)
- Students TextBook “Air Quality: Science, Impacts, and Management” (2024)
- ClimComp Advisory Board: “Learning of the competencies of effective climate change mitigation and adaptation in the education system”
- CLIMADEMY Advisory Board of “Climate Change Teachers’ Academy”



Thank you for the attention

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