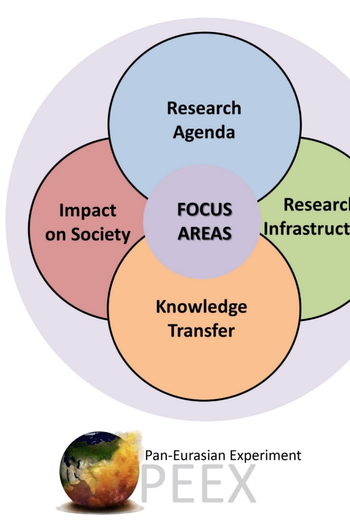
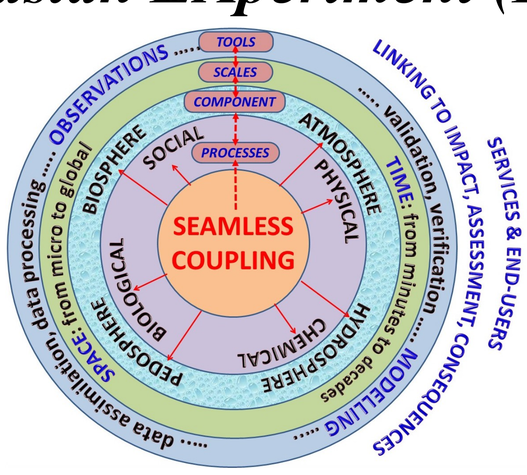
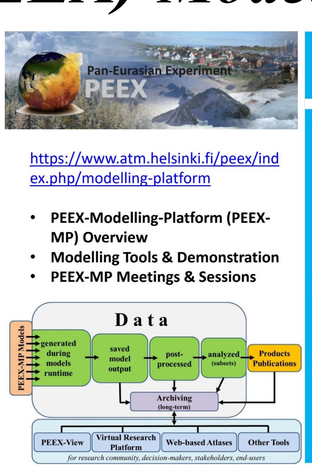
A. MAHURA[1], A. BAKLANOV[2,3], T. PETÄJÄ[1], R. NUTERMAN[3], S. IVANOV[4], S. MICHAELIDES[5], I. RUBAN[4], R. MAKKONEN[1,6], H.K. LAPPALAINEN[1], S. ZILITINKEVICH[1,6], and M. KULMALA[1]

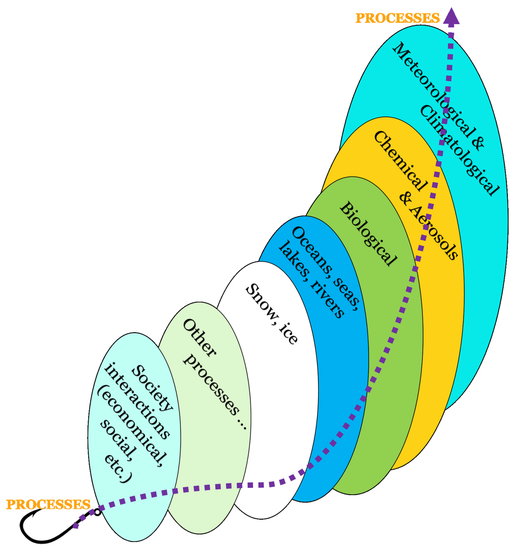
PEEX Integrated Multi-scales and -Process Modelling for Environmental Applications

Pan-Eurasian EXperiment (PEEX)-Modelling-Platform





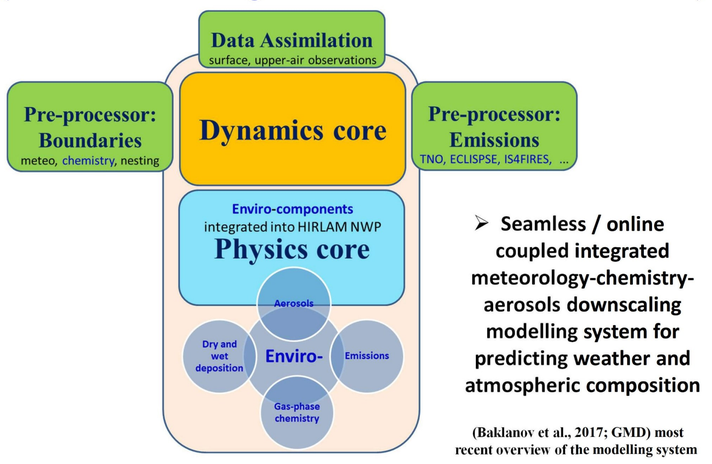




Seamless coupling approach: multi-dimensions (tools, scales, components and processes) and linking to services and end-users through evaluation of impacts and consequences and assessments.

Enviro-PEEX: Downscaling & Meteorology/Chemistry/Aerosols Interactions

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



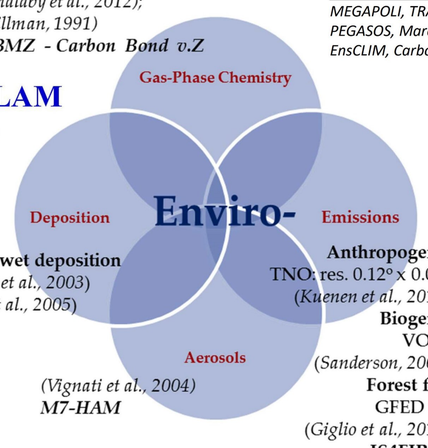
➢ **Seamless / online coupled integrated meteorology-chemistry-aerosols downscaling modelling system for predicting weather and atmospheric composition**

(Baklanov et al., 2017; GMD) most recent overview of the modelling system

Enviro-HIRLAM Components

(*Zaveri and Peters, 1999*); (*Shalaby et al., 2012*); (*Sillman, 1991*) ***CBMZ - Carbon Bond v.Z***

Note: emission datasets used depend on research projects: MEGAPOLI, TRANSPHORM, PEGASOS, MarcoPolo, EnsCLIM, CarboNord, etc.



Deposition
Dry & wet deposition
(*Zhang et al., 2003*)
(*Stier et al., 2005*)

Emissions
Anthropogenic
TNO: res. 0.12° x 0.06°
(*Kuenen et al., 2010*)
Biogenic
VOCs
(*Sanderson, 2009*)
Forest fire
GFED v.3
(*Giglio et al., 2010*)
IS4FIRES
(*http://is4fires.fmi.fi*)

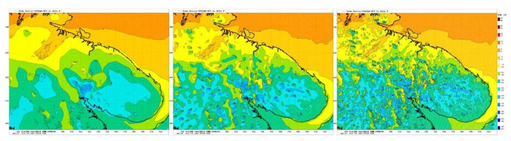
Aerosols
(*Vignati et al., 2004*)
M7-HAM

Objectives

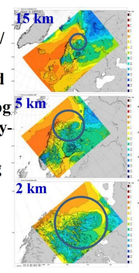
- To analyze the importance of the meteorology-chemistry-aerosols interactions and feedbacks;
- To provide a way for development of efficient techniques for on-line coupling of numerical weather prediction and atmospheric chemical transport via process-oriented parameterizations and feedback algorithms;

& Leading to improvement of weather, climate and atmospheric composition forecasting.

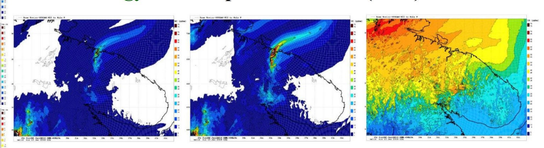
Downscaling (with zooming) over the Kola Peninsula area)



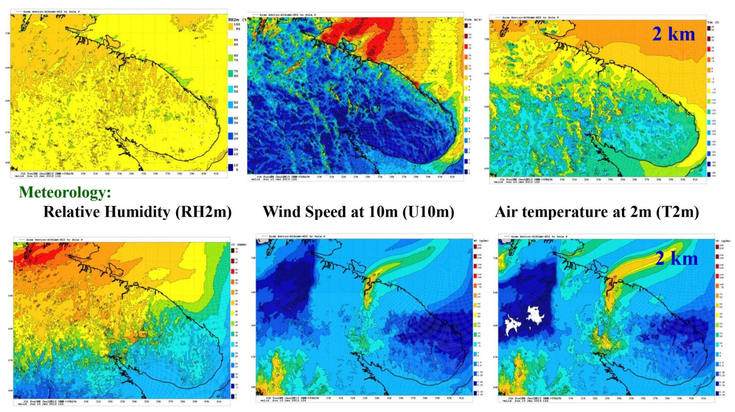
Meteorology: Air temperature at 2m (T2m)



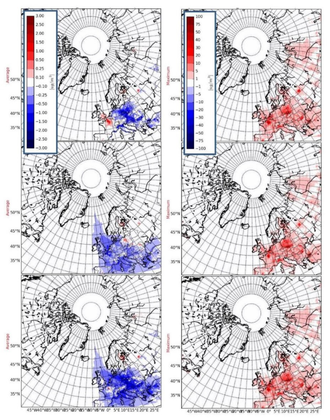
Seamless / online integrated meteorolog-chemistry-aerosols modelling at multi-scales



Atmospheric composition: at 2 km horizontal resolution

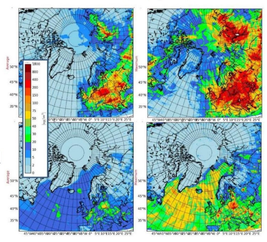


Influence of Direct & Indirect Aerosols Effects



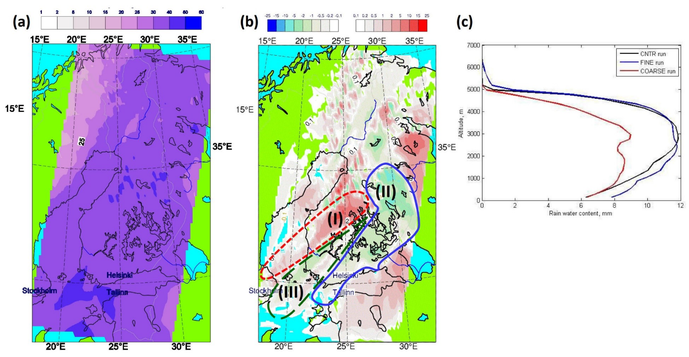
◄ Difference fields between CTRL&DAE (top), CTRL&IDAE (middle), CTRL&DAE+IDEA (bottom) runs with the Enviro-HIRLAM model for monthly (January) averaged (left) and maximum (right) concentration of **black carbon**, BC (in μg/m³).

CTRL – reference run
DAE – Direct Aerosol Effect
IDAE – Indirect Aerosol Effect



January (12 UTC) monthly averaged (left) and ▲ maximum (right) simulated concentration (in μg/m³) of **SO_2** (top) and **PM2.5** (bottom) based on the Enviro-HIRLAM control run simulations.

Mesoscale Resolution Radar Data Assimilation

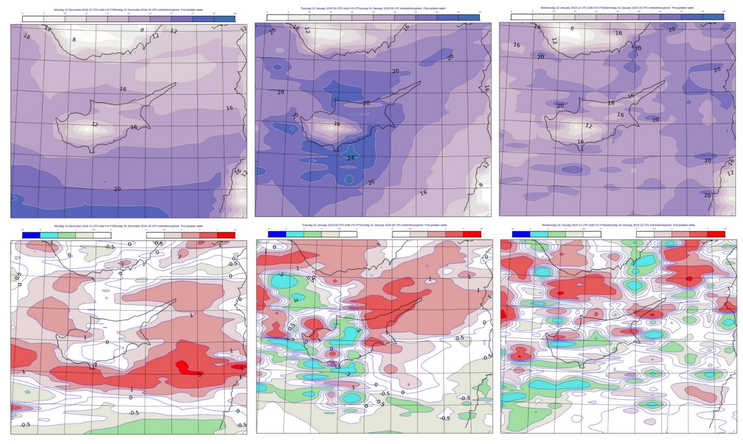


← **HARMONIE**
(a) Modelled spatial distribution of precipitable water over territory of Finland;
(b) Impact of mesoscale radar data assimilation /areas I, II, and III outline specific regions in redistributing of precipitable water/;
(c) Vertical profiles of rain water in the atmosphere for different model runs.

HARMONIE →
(top) Modelled precipitable water vapor field

&

(bottom) impact of radar data assimilation over the Eastern Mediterranean.



Research Trainings

- Apri 2019 (Helsinki, FI)
- Jun 2019 (Tyumen, RU)
- Apr 2020 (St.Petersburg, RU)
- Aug 2020 (Moscow, RU)
- *2020 events – covid19 - postponed*

RESEARCH TOOLS & PARTNERS

Enviro-HIRLAM & HARMONIE models
Enviro-PEEX on ECMWF HPC:
(https://www.atm.helsinki.fi/peex/index.php/enviro)
PEEX Modelling Platform (PEEX-MP)
(https://www.atm.helsinki.fi/peex/index.php/modelling-platform)
IT Center for Science
(CSC, Finland; https://www.csc.fi)
European Center for Medium-range Weather Forecasting
(ECMWF, UK; https://www.ecmwf.int)

RESEARCH INSTITUTIONS

1 Institute for Atmospheric and Earth System Research (INAR), Faculty of Science, Physics / University of Helsinki (UHEL), Helsinki, Finland
2 University of Copenhagen (UCPH), Niels Bohr Institute (NBI), Copenhagen, Denmark
3 World Meteorological Organization (WMO), Geneva, Switzerland
4 Odessa State National Environmental University (OSNEU), Odessa, Ukraine
5 The Cyprus Institute (CyI), Nicosia, Cyprus
6 Finnish Meteorological Institute (FMI), Helsinki, Finland

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The ECMWF boundary conditions, meteorological and air quality observations/ datasets were used for application, validation and verification of the models.
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