

“Seamless Modelling of Atmospheric state and composition under influence of Helsinki and other cities in the Baltic Sea region” SMART

The study is focused on the evaluation of interaction between the atmospheric boundary layer and metropolitan areas in the continental conditions using 3D seamless numerical modelling. For that numerical weather prediction and atmospheric chemical transport Enviro-HIRLAM (Environment - High Resolution Limited Area Model; Baklanov et al., 2017) model with building effect parametrization (BEP) module and anthropogenic heat flux (AHF) will be employed to simulate meteorology and atmospheric composition (with focus on aerosols) for urban areas of Helsinki and other cities in the Baltic Sea region. In this study the urban areas influence on the main meteorological parameters and aerosols content will be investigated as part of the PEEEX Modelling Platform research and development at CSC (Mahura et al., 2024).

Background information

The urban territory can be characterized as a surface with complex thermal-physical properties. Urbanized area influences the state of lower atmosphere [Collier, 2006] which leads to the changes in spatio-temporal distribution of atmospheric pollutants (e.g. aerosols). Implementation of BEP (see [Martilli et al., 2002]) into Enviro-HIRLAM allows to simulate physical-chemical processes on a scale of a few kilometers and finer. Therefore, small-scale interactions between the urban territory and the atmospheric boundary layer have been actively studied for, at least, two decades mainly with the focus on subtropical/tropical cities (e.g., [Hendricks et al., 2020; Yu et al., 2021; Ribeiro et al., 2021]). However, only few of such studies were dedicated to study urbanization effects in the north continental conditions, e.g., [Esau et al., 2021a,b; Gommershtadt et al., 2020]. The fact that climate changes in the northern regions evolve faster than on other Earth regions [Semenov, 2021] makes the studies of urban effect in the northern cities even more relevant.

The main aim is to study effects of Helsinki and other cities in the Baltic Sea region on meteorology and atmospheric composition in the atmospheric boundary layer. Specific objectives are: (1) to simulate meteorology and atmospheric composition (with focus on aerosols) taking into account effects of buildings and anthropogenic fluxes in the studied region for elevated pollution episodes employing seamless modelling approach (Enviro-HIRLAM); (2) to analyse the modelled data (selected meteorological variables and aerosols); and (3) to validate against observations. Research methods include: regional to urban scale modelling, multi-scale statistical analysis and interpretation of results, geoinformation mapping.

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