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High Resolution Modelling of Aerosols-Meteorology Interactions over Northern Europe and Arctic regions

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Aerosols have influence on weather, air quality and climate. Multi-scale modelling, and especially long-range atmospheric transport, dispersion, and deposition of aerosols from remote sources is especially challenging in northern latitudes. It is due to complexity of meteorological, chemical and biological processes, their interactions and especially within and above the surface layer, linking to climate change, and influence on ecosystems.

The online integrated meteorology-chemistry-aerosols model Enviro-HIRLAM (Environment – High Resolution Limited Area Model) was employed for evaluating spatio-temporal variability of atmospheric aerosols and their interactions and effects on meteorology with a focus on the Northern Europe and Arctic regions. The model setup covers domain having 510 x 568 grids of latitude vs. longitude, horizontal resolution of 0.15 deg, 40 vertical hybrid levels, time step of 360 sec, 6 h meteorological surface data assimilation. The model was run for January and July-August 2010 at DMI's CRAY-XC30 supercomputer. Emissions used are anthropogenic (ECLIPSE v5), shipping (combined AU_RCP and FMI), wildfires (IS4FIRES), and interactive sea salt, dust and DMS. The boundary conditions were obtained from ECMWF: for meteorology (from IFS at 0.15 and 0.25 deg. for summer and winter, respectively) and atmospheric composition (from MACC Reanalysis at 1.125 deg. resolution).

The Enviro-HIRLAM model was employed in 4 modes: the reference run (e.g. without aerosols influence on meteorology) and 3 modified runs (direct aerosol effect (DAE), indirect aerosol effect (IDAE), and both effects DAE and IDAE included). The differences between the reference run and the runs with mentioned aerosol effects were estimated on a day-by-day, monthly and diurnal cycle bases over the domain, Arctic areas, European and Nordic countries. The results of statistical analyses are summarized and presented.