EGU2020-201
https://doi.org/10.5194/egusphere-egu2020-201
EGU General Assembly 2020

Enviro-HIRLAM modeling of atmospheric aerosols and pollution transport and feedbacks: North-West Russia and Northern Europe

Georgiy Nerobelov[1], Margarita Sedeeva[2], Alexander Mahura[3], Roman Nuterman[4], and Sergei Smyshlyaev[5]

[1]Saint-Petersburg State University, Physics, Atmospheric Physics, Saint-Petersburg, Russian Federation (akulishe95@mail.ru)

[2]Earth Sciences Institute, Saint-Petersburg State University (SPBU), Saint-Petersburg, Russia (sedgret@gmail.com)

[3]Institute for Atmospheric and Earth System Research (INAR) / Physics, University of Helsinki (UHEL), Helsinki, Finland (alexander.mahura@helsinki.fi)

[4]Niels Bohr Institute (NBI), University of Copenhagen (UCPH), Copenhagen, Denmark (nuterman@nbi.ku.dk)

[5]Department of Meteorological Forecasting, Russian State Hydrometeorological University (RSHU), Saint-Petersburg, Russia (smyshl@rshu.ru)

Undoubtedly, urbanization level has been rising rapidly during last decades, and due to growth in the number of industries the amount of anthropogenic aerosols and gases as pollution has been increasing. Some pollutants influence humans` health when others lead to changes in different meteorological parameters. In this study the aerosols influence on selected meteorological parameters (air temperature at 2 m, specific humidity, total cloud cover, precipitation) as well as anthropogenic SO2 and SO4 atmospheric dispersion and deposition on water bodies during January and August of 2010 were evaluated using the Enviro-HIRLAM online integrated modelling system. We focused on territories of the North-West Russia (with zooming to St. Petersburg, Moscow and Helsinki) and on territories of the Kola Peninsula and Northern European countries. Four model runs were performed: CTRL (no aerosols effects), DAE (direct aerosols effect), IDAE (indirect aerosols effect) and DAE+IDAE (direct + indirect aerosols effects).

Aerosol influence was stronger during Aug 2010. DAE basically lead to decrease in air temperature at 2 m and total cloud cover. IDAE and DAE+IDAE increased these parameters. DAE decreased specific humidity in Jan and increased in Aug 2010. IDAE and DAE+IDAE increased that parameter in Jan 2010 and decreased in Aug 2010. All aerosol effects caused reduction in precipitation for both months. With zooming to the metropolitan areas, in Aug 2010, DAE decreased air temperature in St. Petersburg and Helsinki, but increased in Moscow. IDAE decreased temperature in St. Petersburg and increased in other cities. DAE+IDAE decreased air temperature in St. Petersburg and Helsinki, but increased in Moscow. DAE decreased total cloud cover in three cities when IDAE and DAE+IDAE increased. All effects led to decrease in specific humidity and precipitation for territories of three cities. DAE decreased all analyzed parameters in three cities in Jan, except for precipitation in St. Petersburg. IDAE and DAE+IDAE caused growth in all parameters, except for precipitation in Helsinki and for temperature in Moscow (DAE+IDAE).

The analysis of the modeled SO2 spatial-temporal distribution showed that the number of cases with transboundary pollution on the territory of Northern Europe was higher during Aug 2010. An anticyclonic circulation led to high concentrations of SO2 over its sources during the same period. SO2 concentration reached its maximum values with periods of highest air temperatures quite often. It was revealed that the ambient air standard for SO2 was exceeded 13 times during a whole period studied. Only once SO2 concentration was excessed on the territory of Norway (Kirkenes) and the rest - on the territory of the Kola Peninsula (Russia). For the sulphates' wet deposition, the number of such cases as well as values were higher during Aug 2010. For Norther Europe countries, the maximum of deposited sulphates was observed on the territory of Finland, and the minimum - over Sweden.