Geophysical Research Abstracts
Vol. 12, EGU2010-314-1, 2010
EGU General Assembly 2010

Urban Effects in Numerical weather prediction model at Saint-Petersburg Metropolitan Area for winter

Yulia Gavrilova, Alexander Mahura, Sergei Smyshlaev, and Alexander Baklanov
Russian State Hydrometeorological University,St.Petersburg. Russia, (gavrilova@rshu.ru)

In this study, the spatial and temporal variability of meteorological fields due to influence of the thermal and dynamical urban effects of the metropolitan area was estimated for St. Petersburg (Russia). Dependence of these fields on the temporal variability of meteorological variables in the lower surface layer (wind at 10 m and air temperature at 2 m fields) was estimated as a function of modified parameters – roughness, anthropogenic heat flux, and albedo. The urban modifications were made in the Interaction Soil-Biosphere-Atmosphere (ISBA) land surface scheme of the numerical weather prediction model (NWP). As NWP model a research version of the Environment - High Resolution Limited Area Model (Enviro-HIRLAM) was used in simulations.
To select an urban case study for the modelling domain, the meteorological conditions during 2008-2009 were analyzed based on available archived synoptical maps, vertical sounding diagrams, ground stations observations; and several specific dates – with low and typical wind conditions – in more details. The winter period of 29 Jan – 1 Feb 2009 (characterized by dominating low wind conditions and prevailing strong deep inversion and isothermal layers extending even up to almost 700 Mb) was chosen for evaluation of the thermal and dynamical effects of the St. Petersburg metropolitan area.
For selected specific dates several independent runs were performed for: (i) no modifications in scheme (control run) and (ii) modified run. In the later, the combined effects of the anthropogenic heat flux (ranging from 50 up to 200 W/m2), urban roughness parameter of 2 m, and albedo increased were included. These modifications were done only for the urban cells taking into account the urban class fractions in each cell. Due to presence of a snow cover in urban areas the albedo was also increased up to 0.65 comparing with other free snow seasons.
The Enviro-HIRLAM runs were performed for 48 hour forecast length, taking into account a spin up of the model during the fist day. The diurnal cycles of key meteorological variables such as the temperature at 2 m and wind at 10 were analyzed comparing outputs (i.e. difference fields at each UTC term) from the control run with those where changes made. The simulation results were compared with observations at urban/ sub-urban synoptical stations: Sosnovo, Ozerki, St. Petersburg, Oranienbaum, Belogorka, Shlisselburg, Vyborg, Kronshtadt, Volosovo, and Sosnovyy.
In our study, we found that urbanization of the model with modified roughness, anthropogenic heat fluxes and albedo allowed showing urban areas effects. For winter dates (with dominating low wind conditions and inversion/isothermal layers), the differences between control vs. urbanized runs over the metropolitan area and surroundings were the following: wind at 10 m up to 2 m/s (with a maximum up to 2.9 m/s, at nighttime) and air temperature at 2 m is more than 1ºC (with a maximum up to 2.7ºC, at nighttime).