Geophysical Research Abstracts
Vol. 12, EGU2010-10411, 2010
EGU General Assembly 2010

The importance of high spatial resolution for the performance of atmospheric chemistry-transport models

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We have investigated the importance of spatial resolution for the performance of the Danish Eulerian Hemispheric Model (DEHM), a state-of-the-art atmospheric chemistry-transport model covering the majority of the Northern Hemisphere with a horizontal grid resolution of 150 km X 150 km. DEHM has 29 vertical layers in terrain-following sigma-coordinates extending up to a height of 100 hPa. Two-way nesting options with a nesting factor of three can be applied with higher resolution over a limited area of the model. At present the model can be run without nests or with one, two or three nests, each with resolutions of 50 km X 50 km, 16.7 km X 16.7 km, and 5.6 km X 5.6 km, respectively. The model includes a comprehensive chemistry scheme with more than 100 reactions and 67 atmospheric constituents, of which 4 relate to primary particulates (PM2.5, PM10, TSP and sea salt), other species are SOx, NOx, NHx, VOCs, and secondary inorganic particulates. DEHM is driven by meteorological data from the numerical weather prediction model MM5v3. Three simulations were performed with DEHM: one simulation with only the mother domain, one simulation with one nest over Europe, and one simulation with an additional nest covering Denmark and surrounding countries. All three simulations cover the period from 1989 to 2006. The predicted concentrations were evaluated against measurements from the EMEP monitoring network. Only sites within the innermost nest were included in the evaluation and the evaluations of the three simulations were compared to test the influence of spatial resolution on the performance of the model.