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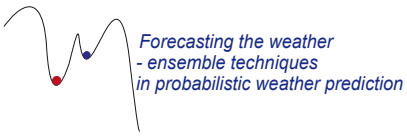

Multi-scale meteorological and chemical weather forecasting with downscaling model system

R.B. Nuterman (1,2), A.A. Baklanov (1), A. Mahura (1), A. Zakey (1), U.S. Korsholm (1), B. Amstrup (1), and I. Gonzalez-Aparicio (3)

(1) Danish Meteorological Institute, Research Department, Lyngbyvej 100, DK-2100, Copenhagen, Denmark, (2) Tomsk State University, Lenin Ave., 36, 634050, Tomsk, Russia, (3) Environmental Unit, TECNALIA Research and Innovation, Edificio 700 C/ Geldo 48160, Derio, Spain

Most of micro-meteorological urban studies for real weather conditions consider only a small part of an urban area; however, heterogeneities outside of street modelling domain affect micro-scale phenomena. Therefore, it is important to build a chain of different scale models with down-scaling from lower to higher resolution models.
The developed system consists of the regional-, urban- and street-scale models. There are two approaches (off-line and on-line) for coupling of Numerical Weather Prediction (NWP; High Resolution Limited Area Model - HIRLAM) with Atmospheric Chemistry Transport (ACT) models realized in a framework of the chain. Thereby, the first element of the chain is divided into two parts: (a) off-line NWP combined with ACT model (the Comprehensive Air quality Model with extensions - CAMx), and (b) on-line coupled NWP-ACT model (called Enviro-HIRLAM; with two-way interactions between different atmospheric processes including chemistry and aerosols, clouds, radiation, boundary layer, emissions, and other meteorological phenomena). Several types of urban sub-layer parameterisations which depend on selected scales and resolutions are considered. For urban scale, it is based on the building effects parameterisation (BEP) module and corrections to anthropogenic heat fluxes. The high resolution GIS data from the CORINE land-use database were applied for both off- and on-line approaches.
For local- and micro-scale nesting the Micro-scale Model for Urban Environment (M2UE) was developed and ap¬plied. It is a comprehensive obstacle-resolved urban wind-flow and dispersion model based on the Reynolds averaged Navier-Stokes equations and k-ε linear and non-linear eddy-viscosity turbulent closures. The M2UE is on-line coupled with simple photochemical scheme containing 20 reactions and including ozone, nitrogen oxides, sulphur, carbon oxide and hydrocarbons. Boundary and initial conditions for this model are used from lower resolution models with radial basis function interpolation.
The demonstration was performed for the Jagtvej Street (Copenhagen, Denmark) by down-scaling from regional-, urban- to street scale. The chain (off-line as well as on-line) is run separately and nesting to micro-scale is carried out at every forecast hour. The study of different urban sub-layer parameterisations and optimal coupling time interval for both meteorology and chemistry was done for micro-scale model. The full model chain was validated vs. meteorological and chemical observation, and models have shown good performance.