



Online-integrated multi-scale atmospheric modeling

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Meteorological and chemical weather modeling for different spatial and temporal scales requires advanced downscaling chain of models, which include various parameterizations of meteorological process, aerosol microphysics and chemical mechanisms. These should be carefully selected and adjusted for a specific model scale. Interaction of these meteorological and chemical processes is of particular importance within the planetary boundary layer (PBL), because of their complexity and effect on weather and atmospheric composition.

The results of studies with regional-, meso-, city- and local-scale modeling performed are presented with the seamless/ online integrated meteorology-chemistry-aerosols Enviro-HIRLAM (Environment – High Resolution Limited Area Model) model interfaced with a local scale obstacle resolved computational fluid dynamics Micro-scale Model for Urban Environment (M2UE). The downscaling from regional- to urban-scale is realized with the Enviro-HIRLAM model. At urban scales it includes the building effects parameterization module accounting for different types of urban districts with different morphological and aerodynamical characteristics. The CBM-Z gas-phase chemistry mechanism and M7 aerosol microphysics module with parameterized wet and dry deposition processes for both gases and aerosols are also included. The M2UE model is based on the Reynolds averaged Navier-Stokes equations and includes various turbulent closures. It is also online coupled with simple photochemical scheme containing 20 reactions and including ozone, nitrogen oxides, sulphur, carbon oxide and hydrocarbons.

The Enviro-HIRLAM and M2UE models were run in downscaling chain from regional-to-urban and from urban-to-local scales, respectively, for selected high air pollution episodes and various meteorological conditions for Denmark, France and China and focusing on metropolitan areas of Copenhagen, Paris and Shanghai, respectively. The results and analyses of influence of urbanized areas on formation and development of meteorological (air and surface temperature, wind speed, PBL height, humidity, cloud cover and precipitation) and chemical (gas-phase and aerosol concentrations as well as their deposition patterns) weather patterns along with chemistry/aerosols-meteorology interactions are presented.