AIR POLLUTION IN THE BENELUX/RHINE-RUHR AREA: SCENARIOS AND INTERANNUAL VARIATIONS BASED ON MODEL CALCULATIONS

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The Benelux/Rhine-Ruhr area is a strongly industrialized region in Central Europe with high population density. As a part of it, Rhine-Ruhr with about 10 Million inhabitants is one of the regions in Europe which has a megacity character with respect to population density, traffic, industry and environmental issues. The main centre of European steel production and the biggest inland port of the world is located in Duisburg, one of the major cities in the Rhine-Ruhr area. Together with the nearby urban agglomerations of the Benelux area, e.g., Brussels, Amsterdam and Rotterdam as one of the most important sea harbours of the world, it is one of the regions in Europe which is most heavily burdened with air pollutants like ozone, NO_2 and PM_{10}. Therefore several studies investigating the air quality in the Rhine-Ruhr area as part of North-Rhine-Westphalia have been conducted by the LANUV-NRW. It is planned to extend these studies from North-Rhine-Westphalia to Benelux as one of the hot spots within the framework of the recently established FP7 project CityZen, which include global, regional and local multi-scale modelling of air pollutants in megacities. Some examples of numerical simulations with the European Air Pollution dispersion model EURAD focusing on Rhine-Ruhr will be presented. The model calculates the transport, chemical transformations and deposition of air pollutants in the troposphere from the surface up to about 16 km. Meteorological fields are provided by the meteorological model MM5. Gas phase kinetics are computed using the RACM-MIM chemistry mechanism (Geiger et al., 2003). Dry deposition is treated with a resistance model. The MADE-SORGAM (Schell et al., 2002) model is used to account for the formation of organic and inorganic secondary particulates in the atmosphere. MADE-SORGAM provides size resolved concentrations of secondary and primary aerosol species, including PM_{10}, $PM_{2.5}$ and PM_1. Horizontal grid sizes are in the range of 125 km down to 1 km for the heavily polluted urbanized areas within Benelux/Rhine-Ruhr. The planetary boundary layer is resolved by 15 layers below 3000 m, 8 layers cover the range from 3 km to 16 km. Emission projections have been used to calculate the future development of air pollution as well as the contribution of different sources and regions to air pollution. The results are discussed with respect to different characteristic meteorological conditions which control the occurrence of air pollution episodes. Examples for episodes with high particle concentrations, in particular during anticyclonic conditions in fall and winter, and ozone episodes in summer, e.g. in 2003 and 2006 are investigated. The impact of atmospheric transport on the local concentrations is demonstrated. Interannual variations caused due to changes in meteorological conditions from year to year also will be discussed. It turned out that the impact of emission reduction on air pollution could be masked by the interannual variation of weather conditions which influence concentrations of air pollutants. Possible extensions and plans for the further development and application of the modeling system to include future changes of climate and consequently the coupling to the global scale are discussed with respect to the recently established FP7 research project CityZen.

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