



Urban scale modelling for a megacity and a medium size city: evaluating sulphate aerosol indirect effects

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Sulphate aerosols affect climate and air pollution in urban areas by altering clouds and precipitation properties and radiation. To assess such aerosol effects, both the first and second aerosol indirect effects are analysed together with the influence of the urban area itself (heat island, etc). This impact was evaluated for two metropolitan areas: Paris (11 million inhabitants) located inland of France over a semi-flat terrain, and Bilbao (0.875 million inhabitants) located in a coastal area, north of the Iberian Peninsula and surrounded by complex terrain.

High resolution simulations were carried out employing the Enviro-HIRLAM (Environment – High Resolution Limited Area Model) which is an online coupled numerical weather prediction and atmospheric chemical transport modelling system. The Interaction Soil-Biosphere-Atmosphere (ISBA) land surface scheme was modified to include urban effects using the Building Effect Parameterization (BEP) module and Anthropogenic Heat Fluxes (AHF) extracted from the LUCY model (which considers energy fluxes from traffic, metabolism and energy consumption). In addition, the urban areas were divided into different types of districts with few specific thermo-dynamical characteristics (height of buildings, street width, wall building temperature, specific heat, etc). Four types of simulations were carried out for both metropolitan areas: 1) control run: i.e. without any modifications; 2) run considering the influence of the urban area only (BEP and AHF); 3) run only with aerosol effects implemented in STRACO (Soft TRAnsition CONDensation) scheme; 4) and runs including the BEP, AHF and aerosol effects. Short and long-term runs corresponding to the summer 2009 period were performed under different meteorological conditions for both the Paris and Bilbao metropolitan areas. The modelled output was validated versus data collected during the MEGAPOLI (Paris) and K-EGOKITZEN (Bilbao) summer 2009 campaigns.

The influence of the urban areas on formation of 3D meteorological fields was analysed in details. For example, in Bilbao during 12th August 2009, on average, for temperature at 2 m the difference between urban and control runs was 1.3°C (with a maximum of 2.1 °C between 05:00 and 06:00 UTC). For wind at 10 m difference was 1.1 m/s (with a maximum 1.4 m/s at 5-6 UTC). The impact of the sulphate aerosols in urban areas on formation of key meteorological fields such as air temperature, wind, cloudiness, cloud liquid water content and precipitation and the assessment of each city influence on the aerosol atmospheric dispersion, transport and deposition will be presented.