Measurements of the aerosol composition of the Brussels sub-urban atmosphere and implications for the emission scheme of a regional chemical transport model

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Abstract

The particle composition in the urban atmosphere is characterised by high spatial and temporal variability. In order to assess its composition and to be able to make sound predictions, both high quality measurements and model data at high spatial resolution are essential. Such data is relevant for decision makers and for investigations on links between atmospheric composition and human health. The objective of this study is to get more insight into the urban particle composition from measurements of aerosol optical properties and to feed this information into adaptations of the emission scheme of a regional chemical transport model.

The Royal Meteorological Institute of Belgium (RMI) uses the multi-scale chemical transport model CHIMERE, coupled to the high resolution regional numerical weather prediction limited area model ALARO, at a spatial resolution of 7 km^2 for the BENELUX area. CHIMERE is primarily designed to produce daily forecasts of ozone, aerosols and other pollutants and to make long term simulations for emission control or climate scenarios. Since 2013 RMI has gathered near-continuously ambient aerosol data in Brussels with a 7-wavelengths aethalometer (mass concentration and absorption coefficient of light-absorbing aerosol, e.g., soot, certain organic compounds) and a 3 wavelengths integrating nephelometer (aerosol total scattering coefficient).

The wavelength dependency of the measured aerosol parameters revealed distinct variations in the composition of light-absorbing aerosol, both on a daily and seasonal scale. The scattering properties indicated a daily variation in aerosol number size distribution (proxy for fresh, aged, long-range transported or secondary aerosol). Within CHIMERE, it is possible to adapt both daily and monthly profiles of emission species and the measured aerosol data will be used accordingly. CHIMERE has already been applied during the smog period in Brussels in March 2014. The model was able to represent the day to day variability and also the elevated PM10 concentrations were well captured.