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The sensitivity of aerosol in Europe to two different emission inventories and temporal distribution of emissions.

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The sensitivity to two different emission inventories, injection altitude and temporal variations of anthropogenic emissions in aerosol modelling is studied, using the two way nested global transport chemistry model TM5 focussing on Europe in June and December 2000. The simulations of gas and aerosol concentrations and aerosol optical depth (AOD) with the EMEP and AEROCOM emission inventories are compared with EMEP gas and aerosol surface based measurements, AERONET sun photometers retrievals and MODIS satellite data.

For the aerosol precursor gases SO_2 and NO_x in both months the model results calculated with the EMEP inventory agree better (overestimated by a factor 1.3 for both SO_2 and NO_x) with the EMEP measurements than the simulation with the AEROCOM inventory (overestimated by a factor 2.4 and 1.9 respectively).

Besides the differences in total emissions between the two inventories, an important role is also played by the vertical distribution of SO_2 and NO_x emissions in understanding the differences between the EMEP and AEROCOM inventories.

In December NO_x and SO_2 from both simulations agree within 50 % with observations.

In June $SO_4^=$ evaluated with the EMEP emission inventory agrees slightly better with

surface observations than the AEROCOM simulation, whereas in December the use of both inventories results in an underestimate of SO4 with a factor 2. Nitrate aerosol measured in summer is not reliable, however in December nitrate aerosol calculations with the EMEP and AEROCOM emissions agree with 30%, and 60 %, respectively with the filter measurements. Differences are caused by the total emissions and the temporal distribution of the aerosol precursor gases NO_x and NH_3. Despite these differences, we show that the column integrated AOD is less sensitive to the underlying emission inventories. Calculated AOD values with both emission inventories underestimate the observed AERONET AOD values by 20 - 30%, whereas a case study using MODIS data shows a high spatial agreement.

Our evaluation of the role of temporal distribution of anthropogenic emissions on aerosol calculations shows that the daily and weekly temporal distributions of the emissions are only important for NO_x, NH_3 and aerosol nitrate. However, for all aerosol species $SO_4^=$, NH_4^+, POM, BC, as well as for AOD, the seasonal temporal variations used in the emission inventory are important. Our study shows the value of including at least seasonal information on anthropogenic emissions, although from a comparison with a range of measurements it is often difficult to firmly identify the superiority of specific emission inventories, since other modelling uncertainties, e.g. related to transport, aerosol removal, water uptake, and model resolution, play a dominant role.