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Implementation and evaluation of a comprehensive emission model for Europe

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Crucial input data sets for Chemical Transport Models (CTM) are the meteorological fields and the emissions data. While there are several publicly available meteorological models, the situation for European emission models is still different. European emissions data either lack spatial and temporal resolution, only cover specific countries or are proprietary and not free to use.
In this work the US EPA emission model SMOKE (Sparse Matrix Operator Kernel Emissions) has been successfully adapted and partially extended to create European emissions input for CTMs. The modified version of the SMOKE emission model (SMOKE/E) uses official and publicly available data sets and statistics to create emissions of CO, NOx, SO2, NH3, PM2.5, PM10, NMVOC. Currently it supports VOC splits for several photochemical mechanisms, namely CB4, CB5 and RADM2. PM2.5 is split into elemental carbon, organic carbon, sulfate, nitrate and other particles. Additionally emissions of benzo[a]pyrene (BaP) have been modelled with SMOKE Europe. The temporal resolution of the emissions is one hour, the horizontal resolution is up to 1x1 km^2. SMOKE/E also implements plume in grid calculations for vertical distribution of point sources. The vertical resolution is infinitely variable and is implemented in the form of pressure levels. The area covered by the emission model at this point is Europe and it's surrounding countries, including north Africa and parts of Asia.
Thus far SMOKE Europe has been used to create European emissions on a 54x54km^2 grid covering the whole of Europe and a 18x18km^2 nested grid over the North and Baltic Sea for the years 1990-2006. The currently implemented datasets allow for the calculation of emissions between 1970-2010. Besides this future emissions scenarios for the timespan 2010-2020 are being calculated using the EMEP projections. The created emissions have been statistically compared to the gridded EMEP emissions as well as to data from other emission models for the base years 2000 and 2001.
The 54x54km^2 emissions data for 2000 were used as input for the CMAQ4.6 CTM and the calculated air concentrations were compared to EMEP measurements in Europe. Statistical comparison of Ozone and three particulate species (NH4,NO3,SO4) showed that SMOKE/E performs very good under the tested circumstances.
O3 : (NMB 0.71) (SD 0.68) (F2 0.83) (CORR 0.55) using 48 Stations (hourly)
NH4: (NMB 0.25) (SD 1.01) (F2 0.55) (CORR 0.53) using 8 Stations (daily)
NO3: (NMB 0.42) (SD 0.60) (F2 0.40) (CORR 0.45) using 7 Stations (daily)
SO4: (NMB 0.34) (SD 0.84) (F2 0.65) (CORR 0.55) using 21 Stations (daily)
Abbreviations: Normalized Mean Bias (NMB), Standard Deviation (SD), Factor of 2 (F2), Correlation (CORR).

The calculated air concentrations were compared with CMAQ runs using two purchased emissions datasets. It could be shown that the modified SMOKE model produces results comparable to those of commonly used European emissions data sets.
For the future it is planed to implement emissions of heavy metals and polyfluorinated compounds into the SMOKE Europe model.