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Simulating Organic Aerosol over Europe: Concentration, Chemical Composition and Sources

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A 3-D Chemical Transport Model was applied over Europe to simulate the concentration and chemical composition of organic aerosol during the months of May 2008, March 2009, July 2009 and January 2010. PMCAMx-2008 includes the recently developed volatility basis set framework to describe OA absorptive partitioning by organizing the total OA mass into surrogates along an axis of volatility. We evaluate the performance of the model against AMS measurements taken during the above periods from various sites in Europe. The model predictions are also compared against the Positive Matrix Factorization analysis of AMS observations.

The model predicts that fresh primary OA is a small contributor to organic PM concentrations in Europe, and that oxygenated species (oxidized primary and biogenic secondary) dominate the ambient OA. The Mediterranean region is the only area in Europe where sulfate concentrations are predicted to be much higher than the OA during the late spring period. The model performance against the high time resolution AMS measurements is encouraging. The model tends to predict relatively flat diurnal profiles for PM1 OA in many areas, both rural and urban in agreement with the available measurements.

During the winter the model performs reasonably well at most sites, however both the model results and the measurements point towards missing wood-burning emissions in the inventories used, mostly in Scandinavia and East Germany.

During the July 2009 and January 2010 periods, we applied the two-way nesting of PMCAMx-2008 with special focus over 4 Megacities in Europe in which a higher grid resolution was used. The importance of horizontal grid resolution for the description of chemical transformations in Megacities was analyzed. The improvement in the reproduction of the observations at the urban scale of the PM1 OC and EC during the summer is modest. During the winter the improvement is more significant, although the major reasons of the differences between the model predictions and observations in both seasons are not due to the modelling scale used, but to other problems (meteorology, emissions, process description, etc.).