Modelling of Organic Aerosol with the Volatility-Basis-Set approach during the MEGAPOLI Summer Campaign in the Paris Region

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In the framework of the FP7 / EU project MEGAPOLI, an intensive campaign for air pollutant measurement (both ground-based and airborne) was launched in the Greater Paris Region in July, 2009 and in January/February 2010. The major objective was to quantify different sources of organic aerosol (OA) within a megacity and to better understand the interaction of secondary aerosol formation with the gas phase. Organic aerosol (OA) is a major component of urban aerosol, but the contribution of different formation pathways is still difficult to quantify.

In this work, the Volatility-basis-set (VBS) approach (Shrivastava et al., 2008; Murphy and Pandis., 2009) has been integrated into the regional chemistry transport model CHIMERE, in order to obtain more realistic simulations of primary and secondary aerosol formation within the Greater Paris region. The VBS scheme considers Primary Organic Aerosol (POA) as partly evaporative and parameterises chemical aging (and related changes in volatility) of semivolatile VOC species. We performed systematic simulations for the summer MEGAPOLI campaign period with the traditional method (non-evaporative POA, classical SOA formation (Pun and Seineur 2006), with the VBS module for POA alone and with the VBS module for both POA and SOA formation. Sensitivity experiments testing different settings of the VBS scheme are also performed.

These simulations are compared to aerosol mass spectrometer (AMS) measurements distinguishing between HOA (hydrocarbon-like OA, referred to non-volatile POA) and OOA (oxidized OA, from Oxidized POA and traditional SOA) at 3 urban peri/urban sites, from 2 mobile vans and from the French ATR-42 aircraft. This large data set will allow assessing, if the model is able to reproduce the temporal and spatial OOA and HOA variability in the urban agglomeration and in its plume.

Based on first preliminary results of the summer campaign, we found more quantitative agreement with measurement data when using VBS approach for POA than when considering POA as refractory. For example, at SIRTA site (2.2°E, 48.7°N) situated at the southwestern edge of Greater Paris, OOA and HOA time series deduced from AMS measurements (preliminary data at this stage) are better correlated with simulations using the VBS scheme than when using the traditional scheme. The same periods with larger OA levels are found between 1st to 5th, 11th, 12th, 17th, 21st, 22nd and 26th of July from AMS data and simulations with the VBS approach, while with simulations with the traditional scheme larger OA concentrations are often missed (5th, 11th and 12th). This suggests that in these days, most OOA was formed from the aging of evaporated POA. From these first results, it appears that the VBS approach is able to better simulate total SOA levels in the CHIMERE model for a large European (Greater Paris).