

Source-resolved simulation of fresh and chemically-aged biomass burning emissions

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Biomass burning can be a significant source of organic aerosol, both locally and far downwind. Most previous modelling work assumes that biomass burning primary organic aerosol (POA) is non-volatile, but as the emissions travel and dilute, the oxidation of evaporated semi-volatile POA forms secondary organic aerosol (SOA) (Robinson *et al.*, 2007). In this study, the 3D chemical transport model PMCAMx was used to simulate the emission and evolution of biomass burning organic aerosol (bbOA) to determine its predicted contribution to total organic aerosol concentrations in the continental U.S. PMCAMx simulates the evolution of semi-volatile POA and the formation of SOA using the volatility basis set framework (Donahue *et al.*, 2006). A source-resolved emission inventory was used as input for PMCAMx to simulate three representative months (April, July and September) with significant biomass burning for the year 2008. Corresponding zero-out simulations were then performed to determine the predicted contribution of bbOA to total OA concentrations. The zero-out results were compared to the results of PSAT, a source-tracking module within PMCAMx.

A source-resolved version of PMCAMx (PMCAMx-SR) was then used to simulate the same representative months to investigate the importance of the volatility representation of bbOA. PMCAMx-SR allows bbOA emissions and their oxidation products to be tracked separately from other OA sources and to have their own volatility distribution proposed by May *et al.* (2013). The proposed volatility distribution includes surrogate compounds up to a volatility of $10^4 \mu\text{g m}^{-3}$ at 298 K. Extra simulations were performed to

quantify the sensitivity of the biomass burning contribution to assumptions about the emissions of unknown VOCs, IVOCs. So, two sensitivity scenarios were investigated: one with low IVOC emissions and the other with more high volatility material.

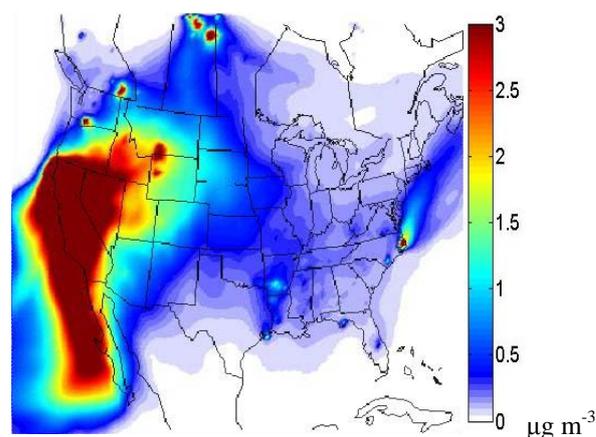


Figure 2. Biomass burning organic aerosol concentrations predicted by PMCAMx-SR during July 2008 for the high IVOC emissions simulation.

Figures 1 and 2 depict average ground-level bbOA concentrations in the continental U.S. during July 2008 as predicted by PMCAMx-SR. This period was characterized by major fire events in California. For both cases the impacts of the fires are predicted to extend over more than a thousand kilometres. The use of low IVOC emissions results in a maximum daily bbOA concentration of around $120 \mu\text{g m}^{-3}$. For the higher IVOC emissions the maximum increases to around $150 \mu\text{g m}^{-3}$. These results were used to estimate the importance of biomass burning as an OA source in the U.S.

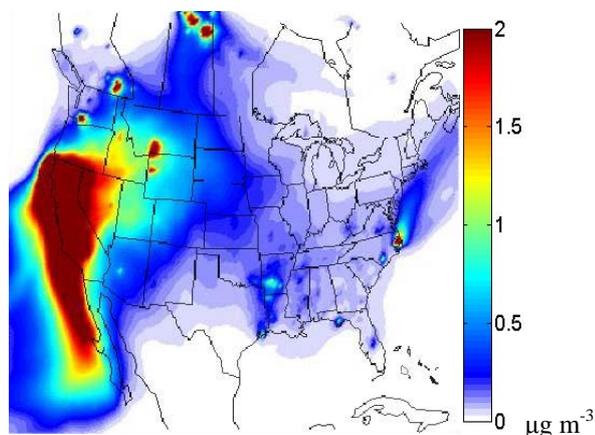


Figure 1. Biomass burning organic aerosol concentrations predicted by PMCAMx-SR during July 2008 for the low IVOC emissions simulation.

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