



Evolution of Organic Aerosols in the Atmosphere: A Synthesis of Emerging Approaches

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Organic aerosol (OA) particles affect climate forcing and human health, but their sources and evolution remain poorly characterized. In this presentation we will summarize several emerging approaches to describe the atmospheric evolution of OA that are constrained by high-time-resolution measurements of their composition, volatility, and oxidation state, including and building on the recent Jimenez et al. paper (Science, Dec. 2009). OA and OA-precursor gases evolve by becoming increasingly oxidized, less volatile, and more hygroscopic, leading to the formation of oxygenated organic aerosol (OOA) mass with concentrations comparable to sulfate aerosol throughout the Northern Hemisphere. We identify two types of OOA, semivolatile OOA (SV-OOA) and low-volatility OOA (LV-OOA), with LV-OOA being more aged and hygroscopic. LV-OOA is effectively non-volatile and will not return to the gas-phase under any plausible atmospheric conditions (Cappa et al., ACPD, 2010). The evolution of ambient OOA can be captured in a 2-dimensional diagram based on AMS fragments; chamber SOA mostly falls in the same region of the diagram but does not reach the levels of aging observed in the atmosphere, due to too little oxidation and sometimes too high concentrations (Ng et al., ACPD, 2009). When plotted in a Van Krevelen diagram (H/C vs O/C), the OA evolution in multiple field studies from Mexico City to the pristine Amazon basin is consistent with the addition of carboxylic acids (Heald et al., GRL, submitted, 2009). A two-dimensional basis set using organic O/C and volatility (C*) as its coordinates can reproduce the lab and field observations and should allow faster model development because it is experimentally verifiable (Jimenez et al., Science, 2009; Donahue et al., in prep., 2010). An alternative 2D basis set based on carbon number and mean carbon oxidation state provides very useful insights about the nature and evolution of gas and particulate-phase organic species (Kroll et al., in prep., 2010).