

4.040 Chemical Aging of Primary and Secondary Organic Aerosol.

Presenting Author:

Spyros Pandis, Carnegie Mellon University, spyros@andrew.cmu.edu

Co-Authors:

Evangelia Kostenidou, University of Patras

Ningxin Wang, Carnegie Mellon University

Kalliopi Florou, University of Patras

Christos Kaltsonoudis, University of Patras

Antonios Tasoglou, Carnegie Mellon University

Abstract:

Secondary organic aerosol (SOA) formation in the atmosphere can be thought of as a succession of oxidation steps. The production of later-generation SOA via continued oxidation of the first-generation products or the primary organic aerosol components is defined as chemical aging. Our work investigates the changes in composition (oxygen to carbon ratio, average mass spectrum), physical properties (volatility, density, water solubility), and mass concentration of organic aerosol (OA) as its components continue reacting. A series of experiments was conducted in the environmental simulation chambers at Carnegie Mellon University and the University of Patras. The fresh particulate matter consisted of secondary OA (from the photooxidation of α -pinene, β -caryophyllene, toluene, xylenes), primary OA (from cooking, wood burning), and model secondary OA compounds (MBTCA). This first-generation OA was allowed to react further with hydroxyl radicals (OH) generated via HONO photo-dissociation. The SOA was characterized by a High-Resolution Time-of-Flight Aerosol Mass Spectrometer (HR-AMS) and the gas phase by a Proton Transfer Reaction Mass Spectrometer (PTR-MS). Additional measurements included the density of the OA, its volatility, and hygroscopicity. Positive matrix factorization was used to separate the fresh and aged OA in these experiments. A wide variety in behavior was observed during these chemical aging experiments. For some systems additional OA was formed and the oxygen to carbon increased suggesting that the functionalization pathway dominated the various reactions. For some others (mainly highly oxidized SOA), there was a decrease of the oxygen to carbon ratio and of the mass concentration indicating that the fragmentation of later-generation SOA products was the dominant process. The results for the various systems investigated are summarized and synthesized.