



Influence of aqueous chemistry on the chemical composition of fog water and interstitial aerosol in Fresno

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A measurement study was conducted in the Central Valley (Fresno) of California in January 2010, during which radiation fog events were frequently observed. Fog plays important roles in atmospheric chemistry by scavenging aerosol particles and trace gases and serving as a medium for various aqueous-phase reactions. Understanding the effects of fog on the microphysical and chemical processing of aerosol particles requires detailed information on their chemical composition. In this study, we characterized the chemical composition of fog water and interstitial aerosol particles to study the effects of fog processing on aerosol properties. Fog water samples were collected during the 2010 Fresno campaigns with a Caltech Active Strand Cloud water Collector (CASCC) while interstitial submicron aerosols were characterized in real time with an Aerodyne High-Resolution Time-of-Flight Aerosol Mass Spectrometer (HR-ToF-AMS) and a scanning Mobility Particle Sizer (SMPS). The fog water samples were later analyzed using the HR-ToF-AMS, ion chromatography, and a total carbon analyzer. The chemical composition and characteristics of interstitial particles during the fog events were compared to those of dissolved inorganic and organic matter in fog waters. Compared to interstitial aerosols, fog water is composed of a higher fraction of ammonium nitrate and oxygenated organics, due to aqueous formation of secondary aerosol species as well as enhanced gas-to-particle partitioning of water soluble species under water rich conditions. Sulfate is formed most efficiently in fog water although its contribution to total dissolved mass is relatively low. The HR-ToF-AMS mass spectra of organic matter in fog water (FOM) are very similar to that of oxygenated organic aerosols (OOA) derived from positive matrix factorization (PMF) of the HR-ToF-AMS spectra of ambient aerosol ($r^2 = 0.96$), but FOM appears to contain a large fraction of acidic functional groups than OOA. FOM is also enriched of organic nitrogen compounds, with an average N/C ratio ~ 3.8 times that of OOA. Most strikingly is the enhancement of the $C_xH_yN_2^+$ family ions in FOM spectra, indicating the presence of imidazole compounds, which commonly result from the aqueous phase reactions of tropospheric aldehyde such as glyoxal, formaldehyde or acetaldehyde with amino compounds. The results of this study demonstrate that aqueous phase reactions in fog water lead to the formation of some oxidized and nitrogen-containing compounds. Details and the environmental implications of results will be discussed.