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Observations of radiation fog chemistry in the Eastern United States

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The chemical composition of radiation fog in the Mid-Atlantic region of the United States has been the focus of an ongoing field campaign based in Selinsgrove, PA. This field study was established to provide a long term record that can be used to identify the effects of meteorology and air mass source regions on fog composition and to shed light on the role that fog can play in the production of secondary inorganic and organic aerosol mass. In the United States, studies that focus on radiation fog have been relatively rare. For the most part, they have been limited geographically to the Central Valley of California, though individual studies have also been conducted in the Central United States and along the Texas-Louisiana Gulf Coast.

Sample collection for the current study began during the fall of 2007. Through 2009, samples from 25 radiation fog events have been obtained. A Caltech Heated Rod Cloudwater Collector (CHRCC) having a Dp50 of approximately 8 microns was used to collect one fog sample per event. Samples were typically collected between 2:00 AM and 7:00 AM under conditions of light winds, clear skies, and recent rainfall. Sample volumes ranged from 2.9 ml to 150 ml. Following collection, samples were analyzed for pH and then one of the following: major inorganic ions, dissolved total organic carbon, N-nitrosodimethylamine (NDMA), metals, or organic speciation.

Through 2009, sample pH varied between 4.28 and 6.86 and averaged 5.03 based on H+ concentration. Ammonium and sulfate were found to be the most abundant ionic species in the fog samples. Sufficient ammonium was detected in nearly every sample to fully neutralize nitrate and sulfate. The concentrations of sulfate, nitrate, and ammonium observed in this study were lower than values reported in the literature for most other cloud and fog studies conducted in the US. Due to significant ammonium input, pH in the current study was higher than most other studies. Concentrations of total organic carbon averaged 7.22 mgC/L, which is lower than other radiation fogs studies but similar to that for many cloud studies. NDMA concentrations in two analyzed samples were considered high, but not outside the range that could be expected through equilibrium with potential gas phase concentrations.