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(Abstract)

INFLUENCE OF EVAPORATION ON THE MEASUREMENT OF LIGHT SCATTERING BY AMMONIUM NITRATE AEROSOL IN A HEATED NEPHELOMETER

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INFLUENCE OF EVAPORATION ON THE MEASUREMENT OF LIGHT SCATTERING BY AMMONIUM NITRATE AEROSOL IN A HEATED NEPHELOMETER . M. H. Bergin, J.A. Ogren, and L.M. McInnes, NOAA Climate Monitoring and Diagnostics Laboratory, 325 Broadway, Boulder, CO, 80303; S.E. Schwartz, Brookhaven National Laboratory, Environmental Chemistry Division, Upton, NY, 11973.

Anthropogenic aerosols are composed of a variety of non-volatile chemical species including sulfates, mineral dust and soot, as well as more volatile components such as nitrate, ammonium, and organics. Although sulfates are generally thought to be the main anthropogenic aerosol chemical species responsible for light scattering and direct radiative forcing of climate, measurements in the Netherlands have indicated that direct forcing by ammonium nitrate aerosols may be comparable to that of sulfates, at least locally in regions of relatively high ammonia concentrations. However, the volatile nature of ammonium nitrate has led to difficulties in the measurement of important properties such as aerosol mass concentration and size distribution. Light scattering properties of aerosols are generally characterized by an integrating nephelometer. Because of the hygroscopicity of inorganic salts, it is desirable to dry the aerosol to a relatively low reference RH . Nephelometer-based measurements of the aerosol light scattering coefficient made at NOAA's regional aerosol sites are obtained by heating the ambient airstream so that a reference relative humidity of 40% is achieved upstream of the nephelometer. The airstream may be heated by as much as 15 deg. C above ambient, and this heating may result in the evaporation of volatile aerosols (such as ammonium nitrate) and subsequent underestimation of the atmospheric scattering coefficient. We present laboratory results for nephelometer measured light scattering loss due to the evaporation of ammonium nitrate aerosols during heating. The experiments explore the effects of particle size, temperature, and residence time in the sampling system on scattering losses. In addition, a theory is presented that predicts the scattering loss based on volatility and mass transport properties of the aerosol. The theoretical scattering loss predictions are in general agreement with experimental values and indicate that for worst case field sampling conditions the scattering loss due to the evaporation of ammonium nitrate aerosol is less than 30%.