263e Hygroscopicity of Multi-Component Organic Aersols Using an Enivronmental Scanning Electron Microscope

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Atmospheric aerosols are ubiquitous throughout the atmosphere and have far-reaching influences on the global radiation budget, visibility degradation, and human health. Because of these effects, significant research in the past two decades has focused on individual particulate constituents and their interactions with water. Previously, the interaction between water and the inorganic fraction of atmospheric aerosols has been well characterized, and the role of single-component and two-component organics in aerosols is becoming more fully understood. What remains is to investigate the water interactions of particles containing several inorganic and organic constituents to develop a more realistic simulation of the complex nature of ambient particulates.

To accomplish this goal, aerosols were collected by electrostatic plate collection at a rural site in central Pennsylvania and in a controlled laboratory setting. The aerosols were imaged using an Environmental Scanning Electron Microscope, or ESEM (FEI model Quanta 400). The ESEM allows us to work in a controlled relative humidity atmosphere which can be brought to supersaturation by cooling the sample support. In this manner, we were able to absorb, condense, and evaporate water directly onto and off of the aerosol surface and image the interactions. We were then able to analyze the deliquescence and efflorescence behavior of aerosols, while observing particle morphology and growth rate.

Previous researchers have characterized the properties of aerosols utilizing various techniques including TDMA, FTIR, and EDB. These techniques, however, are limited by their inability to account for morphological changes or the effects of repetitive deliquescence/efflorescence. Recent work with ESEM has provided results consistent with those of the other methods, while allowing the sample to be imaged in-situ. In these earlier studies, samples were ground to submicron sizes using a mortar and pestle or between two glass slides before being impacted on carbon substrates or liquid droplets of aqueous sodium chloride were permitted to dry on the substrate. Arguably, these sample preparation techniques may provide unrealistic particle morphologies or increased interactions with the substrate. By employing an electrostatic impactor to collect dry particulates from an air stream, these problems may be avoided and a more realistic interaction is observed.

Aerosols from 100 nanometers to 100 microns were used to investigate aerosol-water interactions on a range of scales. Results of the aerosol hygroscopicity and morphology imaging will be presented along with some discussion of the advantages and disadvantages of using the ESEM technique to study aerosol water uptake.