

Measuring Water-Aerosol Interactions at T1: Inferences about Chemical Composition, Mixing State and Aging of Ambient Aerosol

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We describe independent observations of size-resolved hygroscopic growth and cloud droplet activation of ambient aerosol at the T1 site during the MIRAGE campaign. These combined measurements quantitatively characterize the ability of the aerosol to absorb water, yielding a powerful dataset that provides unique insight into the chemical composition of the aerosol. Our results provide important inputs for models of aerosol-cloud interactions and constraints on the aerosol indirect effect on climate.

We use a Droplet Measurement Technologies Cloud Condensation Nucleus counter (CCNc) to obtain the activation potential of the ambient aerosol, and a Hygroscopicity Tandem Differential Mobility Analyzer (HTDMA) to measure the hygroscopic water uptake. The CCNc is operated with an upstream Differential Mobility Analyzer (DMA) to obtain the size-resolved activation fraction, while the HTDMA scans over the same particle sizes to obtain the complimentary hygroscopic growth factors. Data acquisition software was written for both instruments to allow coordinated measurements that were run continuously from March 16th-31st.

With these measurements we determine both the fraction of insoluble aerosol and the probability density function of soluble fractions for the subset of the aerosol population that is CCN active. All of this is done with a resolution of 30 minutes for 5 dry particle sizes.