An Overview of the Effect of Water Uptake on Aerosol Particle Light Scattering: Observations, Evaluation of Proxies, and Comparison with Global Models

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Ambient aerosol particles can take up water and thus change their optical properties depending on their hygroscopicity, their size, and the relative humidity (RH) of the surrounding air. Knowledge of the hygroscopicity effect is of importance for radiative forcing calculations but is also needed for the evaluation of remote sensing and model results with *in situ* measurements. The dependence of particle light scattering on RH can be described by the scattering enhancement factor f(RH), which is defined as the particle light scattering coefficient at a given RH divided by the scattering coefficient at dry conditions.

Here we present an analysis of the scattering enhancement factor from tandem nephelometer measurements at 26 sites across the globe. The raw measurement data sets from multiple research groups were analyzed identically in order to ensure the best comparability of the results. The lowest f(RH) was observed at a desert site, while the highest values were found at arctic and marine sites (Figure 1). Scattering enhancement values for rural and urban sites fell between these two extremes.

Most measurements of aerosol light scattering are made at low humidity (RH<40%) to comply with international protocols. The data set described here may be useful in developing proxies for estimating f(RH) for sites where tandem nephelometer data are not available. Such proxies would simplify relating dry measurements to ambient data (e.g., aerosol optical depth). We present preliminary results evaluating the use of other aerosol optical properties (e.g., scattering Angstrom exponent and single scattering albedo) to estimate aerosol hygroscopicity.

Finally, a major goal of this project is to use the observations of aerosol hygroscopic growth to evaluate and constrain simulations of the effect of water uptake on aerosol optical properties in global climate models (GCMs). Some initial results comparing the observational data set to GCM simulations demonstrate that some models better capture observed measurement diversity while other models exhibit a narrow range of f(RH) regardless of aerosol type.

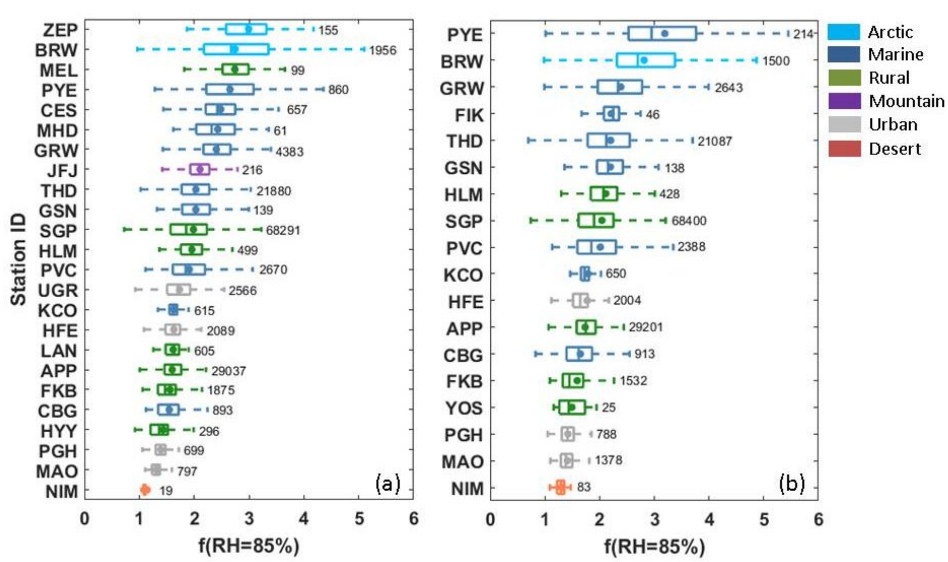

Figure 1. Observed scattering enhancement factor at 26 sites for (a) PM_{10} and (b) PM_1 aerosol.