

Relative Humidity Effects on Aerosol Light Scattering in the Yangtze River Delta of China

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Scattering of solar radiation by aerosol particles is highly dependent on relative humidity (RH) as hygroscopic particles take up water with increasing RH. To achieve a better understanding of the effect of aerosol hygroscopic growth on light scattering properties and radiative forcing, a field campaign was carried out in the Yangtze River Delta of China in March 2013. During the observation period, the mean and standard deviation of enhancement factors at RH=85% for the scattering coefficient ($f(85\%)$) were 1.58 ± 0.12 , i.e. aerosol scattering coefficient increased by 58% as the RH increased from 40% to 85%. Air masses that arrived at LinAn in March can be classified into northerly polluted, locally-polluted and dust-influenced types, the scattering enhancement factors at 85% RH were 1.52 ± 0.10 , 1.64 ± 0.09 and 1.48 ± 0.05 , respectively. The relative amount of organic matter (OM) and inorganics in PM₁ was found to be a main factor determining the magnitude of $f(RH)$, the highest values of $f(RH)$ corresponded to the aerosols with a small fraction of organic matter (OM), and vice versa. The relative amount of nitrate in fine particles was strongly correlated to $f(85\%)$, which suggests nitrate played a vital role in aerosol hygroscopic growth during this study. In addition, we examined the RH effects on additional optical properties. The backscattering coefficient increased by ~25%, hemispheric backscatter fraction decreased ~21%, and single scattering albedo increased ~4% at 85% RH compared to dry conditions. Meanwhile, the direct radiative forcing increased by ~48% at 85% RH due to aerosol hygroscopic growth.

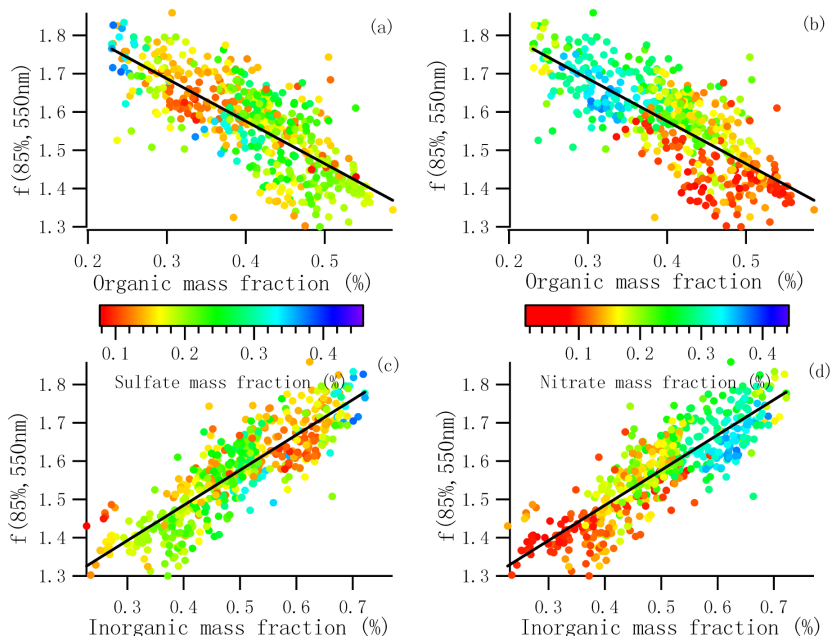


Figure 1. Scattering hygroscopic factor $f(85\%)$ vs. organic mass fraction and inorganic mass fraction (**a, b**) $f(85\%)$ vs. organic mass fraction colored by sulfate and nitrate mass fraction, respectively; (**c, d**) $f(85\%)$ vs. inorganic mass fraction colored by sulfate and nitrate mass fraction, respectively. Solid black lines represent the linear least square regression.