The effects of aerosol composition on the hygroscopicity of atmospheric aerosols collected at three sites in Taiwan

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Aerosol hygroscopicity is one of the most fundamental properties of atmospheric aerosols. The variations of aerosol mass change (AMC) due to water uptake will affect aerosol deposition characteristics, size distribution, optical property, and heterogeneous chemical reactions. In this study, PM$_{2.5}$ at a rural (Shi-Men at northern tip of Taiwan), an urban (Northern Aerosol Supersite in northern Taiwan), and a mountain (Mt. Lu-Lin in middle Taiwan) sites are collected for measuring aerosol water uptake by using a water-mass measuring system (Lee and Chang, 2002) at high humid (90% RH) environment. The rural and the urban samples were collected during Asian dust transport, while mountain sample collections were made during biomass burning transport from Southeast Asia in March 2006.

Figure 1 shows the measured aerosol water mass, $W_{mea}$, at 90% RH, correlated well with PM$_{2.5}$ concentration. It indicates that hygroscopic components of aerosol are correlated linearly with aerosol water uptake. Among these aerosol hygroscopic components, sulfate is the one dominates aerosol water mass as can be seen from Figure 2.

To investigate aerosol composition in affecting AMC, this study analyzes water-soluble inorganic ions, organic and elemental carbons, and water-soluble organic carbon (WSOC) in the collected aerosols. Meanwhile, the aerosol water mass of water-soluble inorganic ions simulated from the ISORROPIA model (Nenes et al., 1998), $W_{model}$, is compared with $W_{mea}$ at 90% RH. This will enable the study on water uptake from the influence of aerosol organics.

For the investigation of the influence of aerosol organic components on aerosol water mass, Figure 3 shows the difference between $W_{mea}$ and $W_{model}$ for various WSOC mass ratios. It shows that the unaccounted aerosol water mass is weakly correlated with aerosol organic fraction. However, for aerosol organic fraction below a certain limit, e.g., 0.11 in Figure 3, the effect of organic fraction is uncertain or even shows an inhibition of aerosol water uptake.