A simplified approach to estimate aerosol water content under near ambient humidity conditions using two SMPS systems in parallel

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Introduction

The aerosol direct effect, atmospheric hetereogeneous chemistry and visiability are largely controlled by the water content of aerosol particles. Several reports on aerosol water-uptake ability can be seen recently [1-2], however, as of our best knowledge, there is no study in which percentage aerosol water content (AWC) is determined under the ambient humidity conditions (i.e., amount of aerosol water relative to atmospheric water-vapor).

Here, we operated two scanning mobility particle sizer (SMPS) systems in parallel, one under dry and the other under ambient humidity (wet) conditions to simultaneously measure the size distributions of ambient aerosols ($PM_{1.0}$) (Figure 1). Based on two types of particle size distributions and densities assumed, we calculated aerosol mass for dry and wet particles ($\mu g\ m^{-3}$), respectively, in order to estimate aerosol water content ($\mu g\ m^{-3}$). Using exponential empirical relation between atmospheric water-vapor concentrations ($M_{\text{water-vapor}}$, $g\ m^{-3}$) and temperature (°C), the $M_{\text{water-vapor}}$ in the atmosphere at given temperature and RH can be calculated.

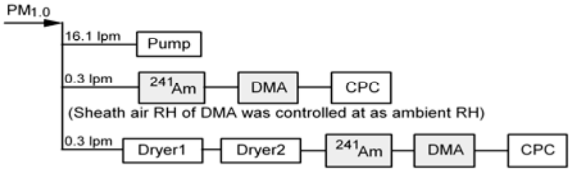

Figure 1: Experimental setup.

Results and Discussion

We performed SMPS measurements of atmospheric aerosols at Hokkaido University campus, Sapporo, Japan from July 23-25, 2008. For an unimodal distribution on July 24 (02:35 LT), AWC was calculated to be 10.6 $\mu g\ m^{-3}$ at 71.1% ambient RH and 23.6°C, which is 17% of total aerosol mass (M_{aerosol}) and 0.00007% relative to $M_{\text{water-vapor}}$. Similarly, for a bimodal distribution on July 24 (09:05 LT), AWC was 41.4 $\mu g\ m^{-3}$ at 65.2% RH and 24.8°C, which is 54% of M_{aerosol}, and 0.00028% relative to $M_{\text{water-vapor}}$. Aerosol water-uptake characteristic (hygroscopicity) is also measured based on the shift of particle mode peak obtained under dry and wet conditions, and verified to be consistent with the data predicted using AIM model (based on the chemical compositions determined from $PM_{1.0}$ filter samples) [2].

[1] Tsyro (2005) *Atmos. Chem. Phys.* **5**, 515-532. [2] Aggarwal *et al.* (2007) *Environ. Sci. Technol.* **41**, 6920-6925.

Fluorescence emissions and infrared-spectroscopies of uranyl sorption on organic colloids and clay minerals

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Reactions occurring at mineral surfaces and organic matter significantly affect the mobility of radionuclides in the environment. Sorption and complexation equilibrium constants between uranyl ions on organic colloids and clay minerals, were determined by measuring the system response to clays suspensions (pre-equilibrated with or without uranyl) and to perturbations of the solution chemistry.

The interaction of kaolinite, smectite and Fe-smectite and three fractions of dissolved organic matter (DOM) (colloidal, hydrophobic and transphilic) solutions saturated with uranyl ions were studied by molecular fluorescence, FT-IR and ATR-IR spectroscopies. The fluorescence emission analysis of uranyl ions aqueous solutions (concentration of 5.0×10^{-6} M and at pH=6.0) shows a decrease on the fluorescence intensity when DOM fraction are present. The IR spectra of sorbed uranyl on clay minerals are shown in. Symmetric stretching vibrations were observed in KBr pelletes. The stretching vibrations at 936 cm^{-1} and 805 cm^{-1} are assigned to υ_3 UO_2^{2+} and υ_1 UO_2^{2+}. Kaolinite sorbed uranyl show a large shoulder at 936 cm^{-1}, which would also corresponds to inner surface OH^- bending in kaolinite. Also, two strong vibrations were identified at 803 and 760 cm^{-1} in the same sample. The υ_1 stretching band of UO_2^{2+} is superimposed on Si-O bending vibration in kaolinite. Sample smectite sorbed uranyl show evidences of the UO_2^{2+} stretching band at 800 cm^{-1} superimposed on the band at 810 cm^{-1} corresponding to Al-O-Si out-of-planes. Both 810 and 770 cm^{-1} bands are typical for beidellite. Organic colloids, beidellite and kaolinite evidence good sorbents for uranyl ions.

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