Hygroscopic Growth of Tropospheric Particle Number Size Distributions over the North China Plain

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Atmospheric aerosol particles absorb water vapor at relative humidities well below supersaturation. This hygroscopic growth has consequences on atmospheric visibility and the scattering of downwelling and upwelling solar radiation. The hygroscopicity of particles is furthermore connect with their ability to act as cloud condensation nuclei.

A relatively new experimental method (HDMPS, see Fig. 1) to determine particle hygroscopic growth is the comparison of complete dry and humidified particle size distributions measured by electrical mobility spectrometer, [Birmili et al., 2008; Eichler et al., 2008]. We apply this recently developed technique to obtain growth factors of tropospheric particles over the North China Plain, i.e. in a region where anthropogenic sources highly contribute to the tropospheric aerosol.

Our atmospheric in-situ measurements were conducted between August 10 and September 9, 2006, within the framework of CAREBEIJING (Campaigns of Air Quality Research in Beijing, 2006). The overall goals of CAREBEIJING included the quantification of pollution transport from the southern provinces of the North China Plain into the agglomeration of Beijing to identify and characterize the atmospheric conditions that lead to a degradation of air quality and visibility in the entire region.

Figure 2 provides a comprehensive view of the observation of the atmospheric in-situ measurements at Yufa during CAREBEIJING [Achtert et al., 2009]. Over the 22 day period, dramatic variations occurred in the PM1 mass concentration. Also contains the descriptive hygroscopic particle growth factors (DHGF) obtained at Yufa. DHGFs were extracted for the diameters Dp = 50, 150 and 250 nm — representing key diameters in the size-dependent behaviour of the particles, although the data provided by the summation method allows to extract any particle diameter between 30 and 300 nm. Among the three diameters investigated, the highest DHGFs were obtained for Dp = 250 nm, i.e. the accumulation mode.

Because the influence of different synoptic-scale air masses was highly evident, the entire measurement period was divided into appropriate sub-periods based on back-trajectories as well as the level of total particle mass.

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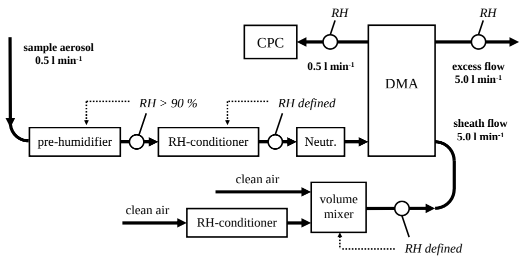

Figure 1: Sketch of the HDMPS. Lines indicate flow scheme. CPC: Condensation particle counter; DMA: Differential mobility analyser.

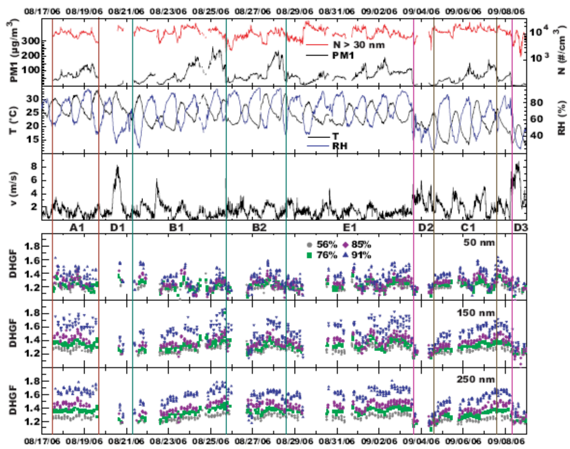

Figure 2: Atmospheric measurements at the Yufa site during CAREBEIJING: PM1 mass concentration, particle number concentration (N) (Dp >30 nm), temperature (T), relative humidity (RH), wind speed (v), and DHGFs extracted for Dp = 50, 150 and 250 nm.

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