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A novel method for deriving the aerosol hygroscopicity parameter based only on measurements from a humidified nephelometer system

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1.1 Measurement sites

Datasets from five field campaigns are used in this paper. These campaigns are conducted at four sites on the North China Plain (NCP) during different time periods. The four sites are Wangdu (WD), Xianghe (XH) and Gucheng (GC) in Hebei province and Wuqing (WQ) in Tianjin, and their locations are shown in Fig.S1.

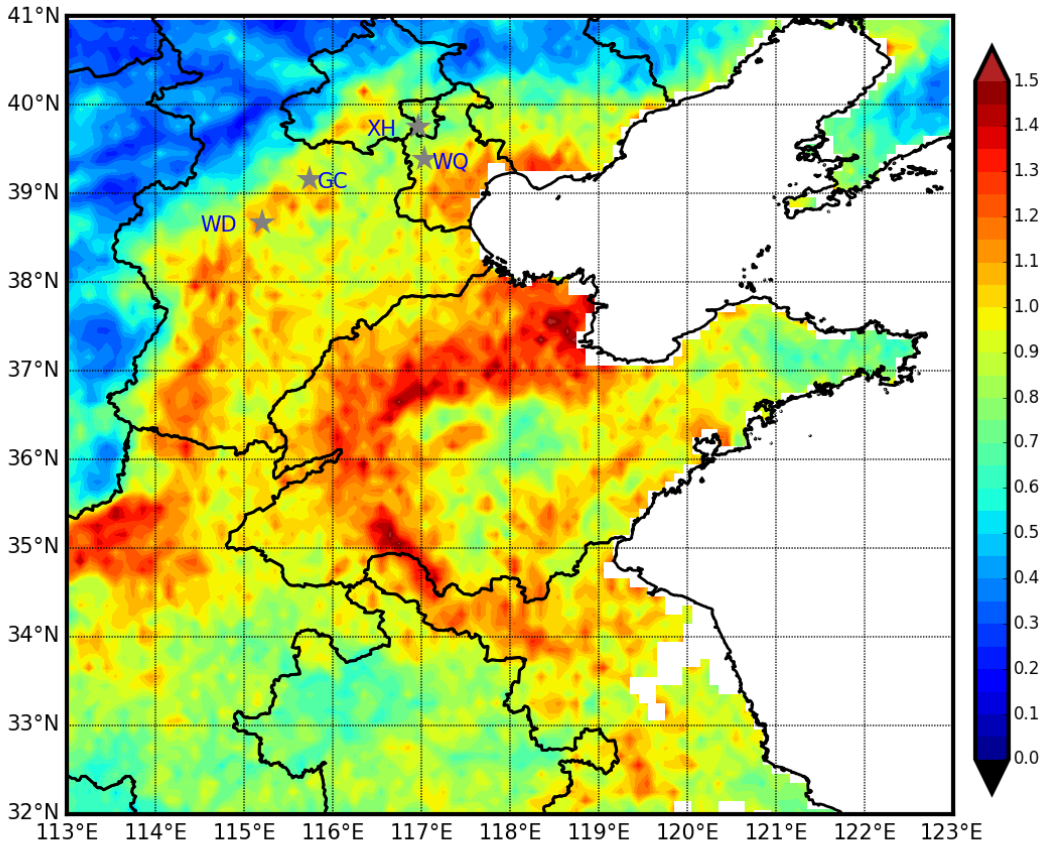

Figure S1. Locations of sites are marked with star markers. Colors represent average distribution of aerosol optical depth at 550 nm during summer from 2012 to 2014. The dataset of aerosol optical depth at 550 nm is from Moderate Resolution Imaging Spectroradiometer onboard satellite Aqua.

1.2 Traditional way of deriving $\kappa_{f(RH)}$ from f(RH) measurements

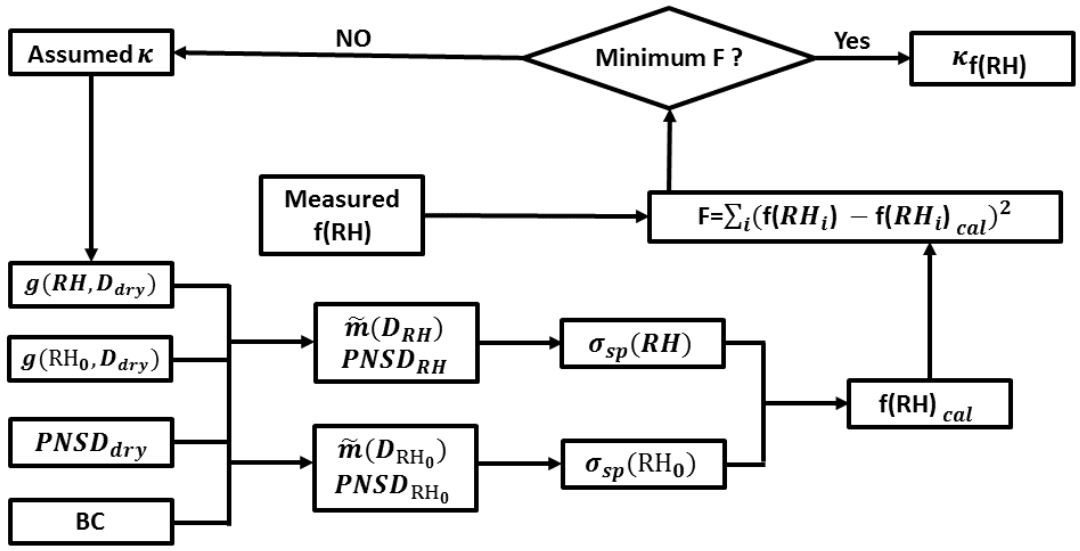

Figure S2. The flow chart of calculating $\kappa_{f(RH)}$ with f(RH) measurements, PNSD and mass concentration of BC.

The flow chart of deriving $\kappa_{f(RH)}$ from f(RH) measurements are shown in Fig.S2. Mass concentration of BC is distributed to different particle diameters with a fixed mass size distribution of BC which is provided by Ma et al. (2012). The $\tilde{m}$ represents refractive index. RH_0 is the sample RH of the dry nephelometer. The $\tilde{m}(D_{RH})$ can be calculated using the following formula: $\tilde{m}(D_{RH}) = f_{non-BC} \cdot \tilde{m}_{non-BC} + f_{BC} \cdot \tilde{m}_{BC} + f_{water} \cdot \tilde{m}_{water}$, where f_{non-BC}, f_{BC} and f_{water} represent the volume fractions of non-BC components, BC and water. Values of $\tilde{m}_{non-BC}$, $\tilde{m}_{BC}$ and $\tilde{m}_{water}$ are introduced in the manuscript.

Ma, N., Zhao, C. S., Müller, T., Cheng, Y. F., Liu, P. F., Deng, Z. Z., Xu, W. Y., Ran, L., Nekat, B., van Pinxteren, D., Gnauk, T., Müller, K., Herrmann, H., Yan, P., Zhou, X. J., and Wiedensohler, A.: A new method to determine the mixing state of light absorbing carbonaceous using the measured aerosol optical properties and number size distributions, Atmos. Chem. Phys., 12, 2381-2397, 10.5194/acp-12-2381-2012, 2012.