A novel method for calculating ambient aerosol liquid water contents based on measurements of a humidified nephelometer system

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1.1 Field campaigns

Datasets from five field campaigns are used in this paper. These campaigns are conducted at three locations on the North China Plain (NCP) during different time periods. The three locations are Wangdu (WD) and Xianghe (XH) in Heibei province and Wuqing (WQ) in Tianjin, and shown in Fig.S1. These three sites are background sites of the NCP. Time periods and locations of these filed campaigns are listed in Table S1.
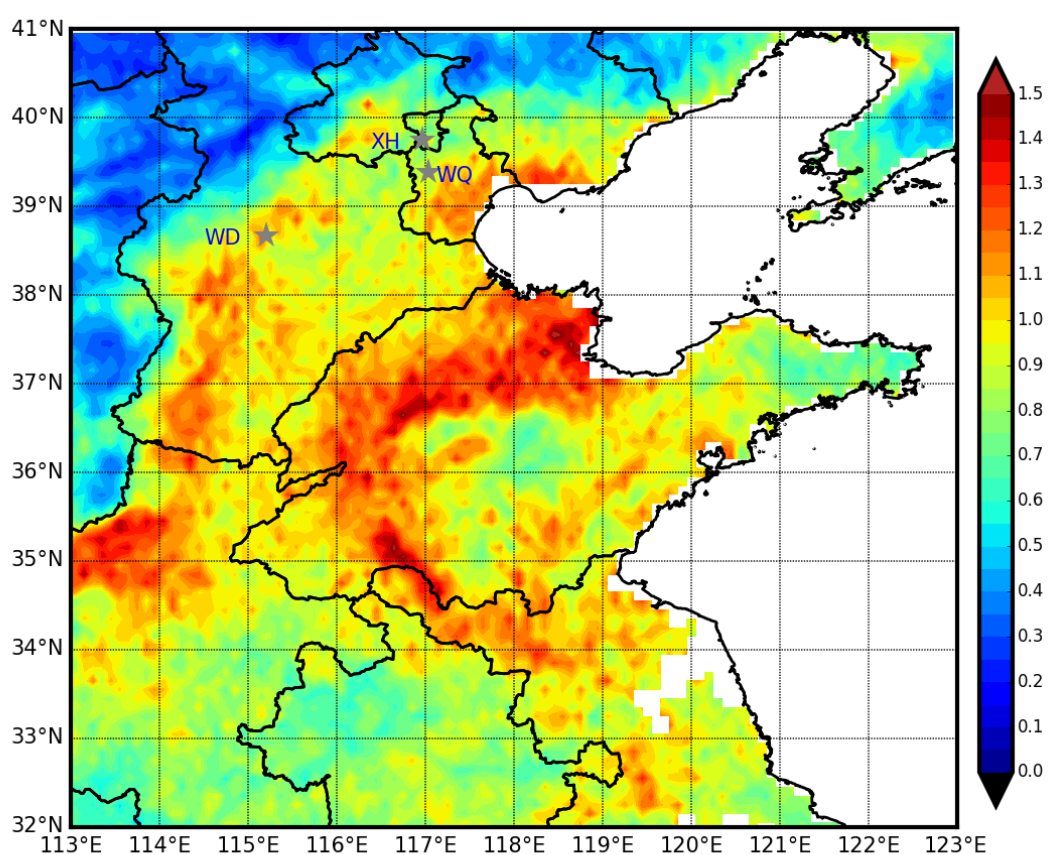
Figure S1. Locations of sites are marked with star markers. Colors represent average distribution of aerosol optical depth at 550 nm during summer from 2012 to 2014. The dataset of aerosol optical depth at 550 nm is from Moderate Resolution Imaging Spectroradiometer onboard satellite Aqua.

30 **Table S1**. Locations and time periods of fived field campaigns

Campaign name	Location	Time periods
F1	Wuqing	7 march to 4 April, 2009
F2	Wuqing	12 July to 14 August, 2009
F3	Xianghe	22 July to 30 August, 2012
F4	Xianghe	9 July to 8 August, 2013
F5	Wangdu	4 June to 14 July, 2014

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32 During campaign F5, a humidified nephelometer system are available for measuring
33 σ_{sp} of aerosol particles in dry state and f(RH). This humidified nephelometer system
34 consists of two nephelometers (TSI Inc., Model 3563) and a humidifier. After passing
35 through a dryer which is capable of reducing the RH of the sample air to lower than
36 30 %, the sample air was pumped into different instruments. The total and back
37 scattering coefficients in the dry state were measured by the first nephelometer (Neph1).
38 After passing through Neph1, the aerosol particles passed through a humidifier which
39 humidified the sample air through a Gore-Tex tube. The water vapor penetrates through
40 the Gore-Tex tube, which is surrounded by a circulating water layer in a stainless steel
41 tube. The temperature cycle of the circulating water layer was specified and controlled
42 by a water bath. Next, the total and back scattering coefficients at certain RH points
43 were measured by the second nephelometer (Neph2). Two combined RH and
44 temperature sensors (Vaisala HMP110; accuracy of $\pm 0.2\,℃$ and $\pm 1.7\,\%$ for RH
45 ranges from 0 to 90 %, respectively, and accuracy of $\pm 2.5\,\%$ for RH ranges from
46 90 % to 100 % according to the manufacturer) are placed at the inlet and outlet of
47 Neph2, and the measured RHs and temperatures are defined as RH_1/T_1 and RH_2/T_2,
48 respectively. The dew points at the inlet and outlet of Neph2 are calculated using the
49 measured RH_1/T_1 and RH_2/T_2, and the average value is considered the dew point of
50 the sample air. The sample RH can then be calculated through the derived dew point,
51 and the sample temperature is measured by the sensor inside the sample cavity of the
52 nephelometer. Measurements from the humidified nephelometer system were only
53 available from 21 June, 2014, to 1 July , 2014.