Supplement for

Method to calculate the aerosol asymmetry factor based on measurements from the humidified nephelometer system

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1.1 Measurements sites

The locations where the field campaigns are conducted are shown in Fig. S1. The two campaigns sites are AERONET BEIJING_PKU (PKU) and Gucheng. Filled colors represent the average aerosol optical depth at 550nm during the year of 2016 from Moderate Resolution Imaging Spectroradiometer onboard satellite Aqua.
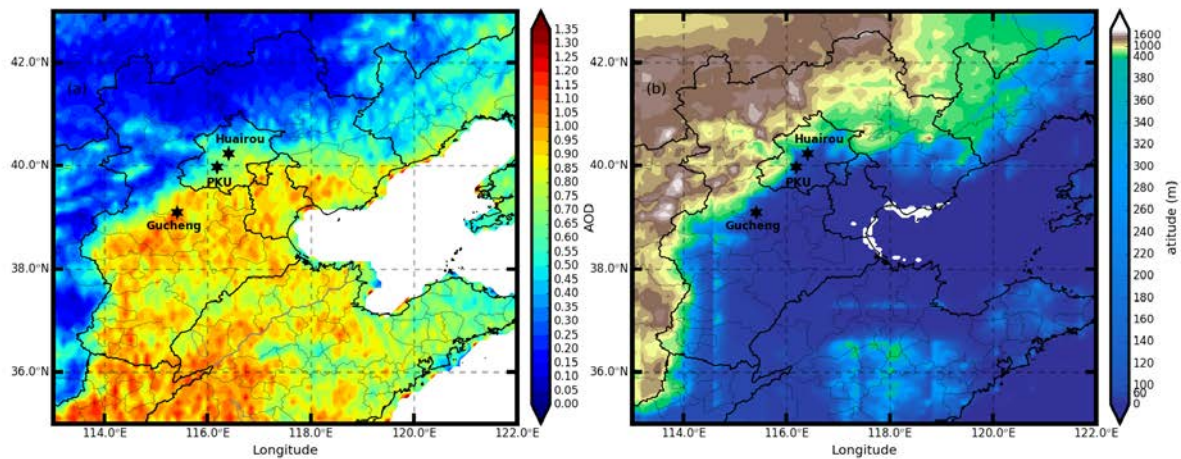
Figure S1: Measurement site of PKU and Gucheng (marked up with stars). Filled colors represent (a) the average aerosol optical depth at 550nm during the year of 2016 from Moderate Resolution Imaging Spectroradiometer onboard satellite Aqua, (b) the topography of the NCP.

1.2 The optical closure studies

To avoid the inaccuracy from the instrument, we compared the measured σ_{sca} from the nephelometer and calculated σ_{sca} from Mie scattering theory. These data, where the relative difference between measured σ_{sca} and calculated σ_{sca} are within 30%, are used to for analysis in the study. Fig. S2 gives the comparison results of the Gucheng. The measured σ_{sca} and calculated σ_{sca} show good consistence.
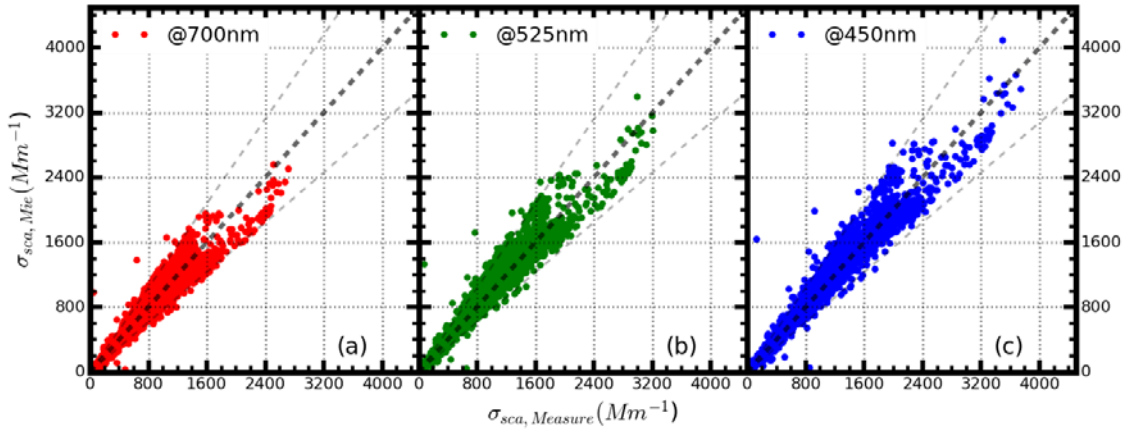
Figure S2. The comparison of the measured σ_{sca} and calculated σ_{sca} at wavelength of **(a)** 700nm, **(b)** 525nm, and **(c)** 450nm. The 1:1 line, and 30% relative difference line are shown in black dotted.

1.3 Comparison of the parameterized g values

Fig. S3 shows the comparison of the calculated g values from the Mie scattering model and the parameterized g values from the *Wiscombe and Grams* [1976], with the parameterisation scheme of

$$g = -7.143889 \cdot b^3 + 7.464439 \cdot b^2 - 3.96356 \cdot b + 0.9893 \qquad (1)$$

where b is the hemispheric backscatter fraction. From fig.S3, the parameterized g values are prevalently larger than the calculated ones for about 10%. When measured σ_{sca} is smaller, the deviations get larger. This finding shows that the previously established parameterization scheme is not applicable in the NCP.
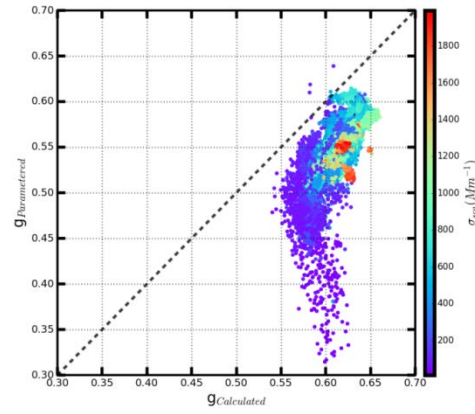
Figure S3. Comparison of the calculated dry g values from the Mie Model and the parameterized g values from *Wiscombe and Grams* [1976]. Colors of these dots represent the measured σ_{sca} corresponding to the time of g value.

Wiscombe, W. J., and G. W. Grams (1976), The Backscattered Fraction in two-stream Approximations, *J Atmos Sci*, *33*(12), 2440-2451, doi:10.1175/1520-0469(1976)033-2440.