S1. Discussions on the function of describing size-resolved activation ratio

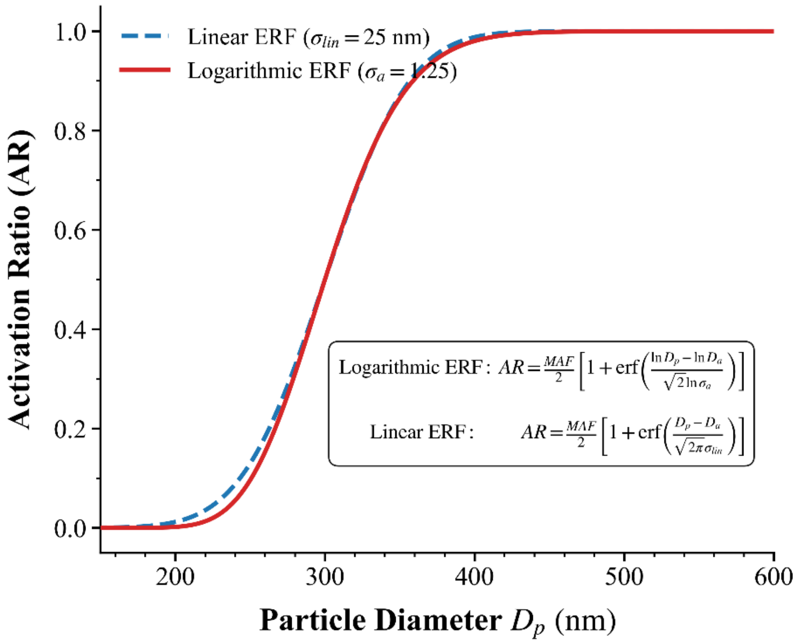

Figure S1. The comparison of two different error functions (ERF) that are used to describe size-resolved aerosol activation ratios under maximum activation ratio of 1, D_a of 300 nm and σ_a of 1.25 .

The following error function was previously proposed by Rose et al. (2008) to fit the SPAR measurements:

$$F_{act}(D_p) = \frac{\mathrm{MAF}}{2}\left[1 + \mathrm{erf}\left(\frac{D_p - D_a}{\sqrt{2\pi}\sigma}\right)\right] \tag{1}$$

where MAF represents maximum activation fraction and D_a represents the critical activation diameter, σ is associated with the slope of the curve near D_a. And other forms of fitting functions were also proposed thereafter. General consistency between these forms was confirmed by Tao et al. (2018) and Eq.1 is the most widely used. However, all these forms were not convenient for the scattering integrating purpose of this study. Therefore, we slightly modified Eq.1 to the following:

$$F_{act}(D_p) = \frac{\mathrm{MAF}}{2}\left[1 + \mathrm{erf}\left(\frac{\ln D_p - \ln D_a}{\sqrt{2}\ln\sigma_a}\right)\right] \tag{2}$$

where MAF and D_a hold consistent physical representations, while the parameter σ_a differs. Only slight difference would exist in shapes of fitted activation ratios as shown in Fig.S1. Therefore, the form change does not affect the relationship discussions between D_a and scattering fractions of interstitial aerosols.

S1. Simulations of SAE under different $D_{g,v}$ and σ_g conditions.

For the given volume size distribution:

$$v(D_p) = \frac{V_{tot}}{\sqrt{2\pi}\ln\sigma_g}\exp\left(-\frac{\left(\ln D_p - \ln D_{g,v}\right)^2}{2\ln^2\sigma_g}\right) \tag{3}$$

The PNSD could be converted and scattering coefficients (σ_{sp}) at wavelengths of 450 ($\lambda1$) and 525 nm ($\lambda2$) were calculated using the Mie theory with the complex refractive index of $m = 1.52 + 10^{-1} \cdot i$. Then the SAE could be calculated using the following formula $SAE = \log\frac{\sigma_{sp}(\lambda1)}{\sigma_{sp}(\lambda2)}/\log\frac{\lambda2}{\lambda1}$.

S2. Other Supplementary Figures

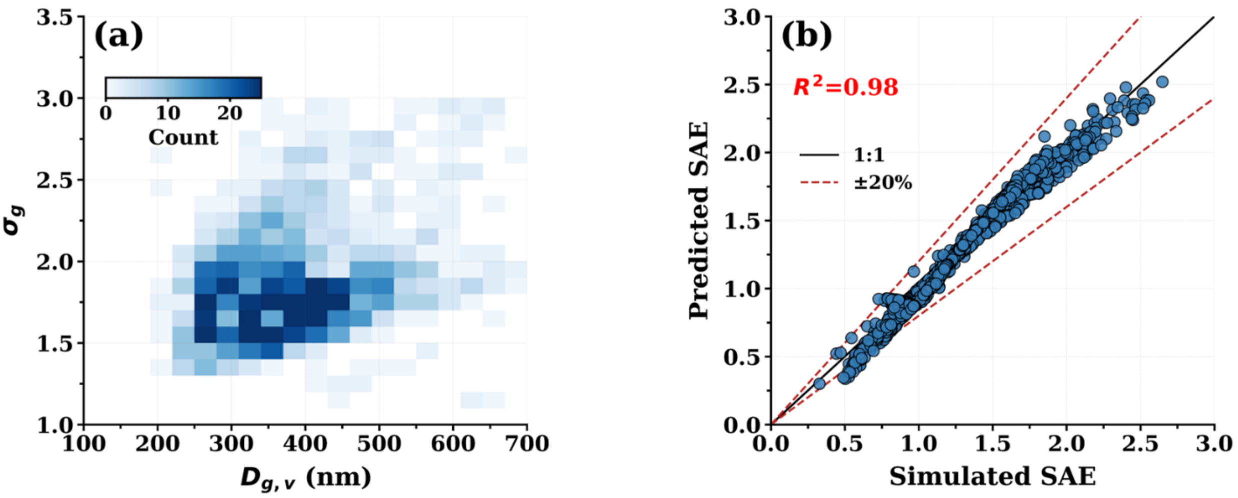

Figure S2. **(a)**The distributions of retrieved $D_{g,v}$ and σ_g during the AQ-SOFAR campaign with colors represents number counts in grids; **(b)** The comparison between simulated and fitted SAE.

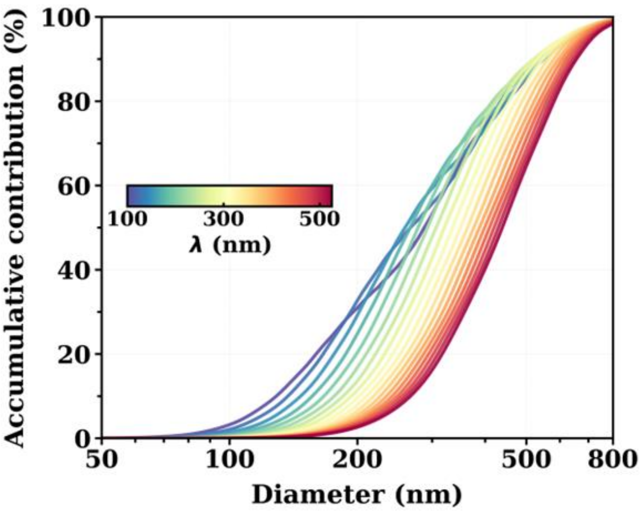

Figure S3. The size-resolved accumulative scattering contribution for aerosol size distribution with $D_{g,v}$ of 400 nm and σ_g of 1.8 under conditions of different wavelengths (λ).

References:

Rose, D., Gunthe, S. S., Mikhailov, E., Frank, G. P., Dusek, U., Andreae, M. O., and Pöschl, U.: Calibration and measurement uncertainties of a continuous-flow cloud condensation nuclei counter (DMT-CCNC): CCN activation of ammonium sulfate and sodium chloride aerosol particles in theory and experiment, Atmos. Chem. Phys., 8, 1153-1179, 10.5194/acp-8-1153-2008, 2008.

Tao, J., Zhao, C., Ma, N., and Kuang, Y.: Consistency and applicability of parameterization schemes for the size-resolved aerosol activation ratio based on field measurements in the North China Plain, Atmospheric Environment, 173, 316-324, https://doi.org/10.1016/j.atmosenv.2017.11.021, 2018.