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Estimating CCN Number Concentrations Using Light Scattering Measurements: Role of Particle Number Size Distribution and Parameterization

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Aerosol-cloud interactions (ACI) are the most significant sources of uncertainty in estimating the radiative forcing of the Earth's climate system. Considering the tremendous spatiotemporal heterogeneity of atmospheric aerosol, neither direct measurements of CCN number concentrations (NCCN) of the concentrations estimated from particle size distribution are adequate for climate research. In this study, we introduce a method to estimate NCCN from Light Scattering Measurements only.

The relationships between aerosol optical properties (AOP), NCCN and particle number size distributions were firstly investigated based on long-term measurement at Station for Observing Regional Processes of the Earth System–SORPES in Nanjing, East China. Then a general combined parameterization was derived from and successfully applied to six sites worldwide include SORPES, SMEAR II inside Boreal forest in Finland and 4 ARM Climate Research Facility (ACRF) sites: Ganges Valley (PGH) in the Himalayas, Cape Cod, Massachusetts (PVC) in a coastal area of U.S., Manacapuru (MAO) inside the Amazonian rain forest, and Ascension Island (ASI) on the South Atlantic Ocean downwind from Africa. The squared correlation coefficients between the AOP-derived and measured NCCN varied from $\sim$0.5 to $\sim$0.8 and the average ratio of the NCCN(AOP) to measured NCCN varies from$\sim$0.5 to $>$ 3.5. At supersaturations 0.3 – 0.8 % the ratio varies in the range $\sim$0.5 to $\sim$1.5.