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An uncertainty analysis for satellite-based estimates of cloud condensation nuclei

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Aerosol-cloud interactions (ACI) are the largest source of uncertainty in estimates of radiative forcing responsible for the on-going climate change. ACI for warm clouds depend on the number concentration of cloud condensation nuclei (CCN), not on aerosol optical properties. Yet, aerosol optical depth (AOD) and its variants weighted by the spectral dependence over visible and near infrared wavelengths are commonly substituted for CCN in ACI studies. The substitution is motivated by the wide availability in space and time of satellite retrievals, an advantage over the sparse CCN measurements. If satellite-based CCN estimates are to continue to complement purely model-based ones, what CCN-AOD relationship should we assume and how large is the associated uncertainty? The paper by Shinozuka et al. [2015] examines airborne and ground-based observations of aerosols to address these questions, focusing on the relationship between CCN and light extinction, σ, of dried particles averaged over one-kilometer horizontal distance. That paper discusses the way the CCN-AOD relationship is influenced not only by the CCN-σ but also by the humidity response of light extinction, the vertical profile, the horizontal-temporal variability and the AOD measurement error. In this presentation, we apply these findings to passive satellite data to analyze the uncertainty in CCN estimates.