Observations and parameterizations of autoconversion in marine stratocumulus: A closure study based on Giant Cloud Condensation Nuclei (GCCN).

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For warm marine stratocumulus, the aerosol-cloud interaction in climate prediction has been essentially reduced to studying the climate system's response to changes in the concentration and chemistry of small aerosol particles (Cloud Condensation Nuclei, CCN). Thus warm rain formation (autoconversion; i.e., self-collection of small drops to form incipient precipitation drops) is expressed in terms of bulk properties of the drops formed on small CCN (e.g., cloud liquid water mixing ratio (q_c) and cloud droplet concentration (N_c), Khairoutdinov and Kogan, 2000, KK2000).

Cloud-average autoconversion rates in marine stratocumulus are calculated based on VOCALS NSF/NCAR C-130 aircraft observations of drizzle drop concentration, vertical air velocity and cloud depth ("observed autoconversion rate").

Giant sea-salt aerosol particles (GCCN) were sampled using microscope slides exposed in order to calculate GCCN size distributions covering 0.7 – 13 µm dry radius (i.e., coarse-mode sea-salt aerosol particles). A simple process model calculates the condensational drop growth of these sea-salt GCCN in cloud. This yields the GCCN-based autoconversion rate from the concentration of GCCN drops that grow past the autoconversion threshold (25 µm radius) within their average residence time in cloud.

The surprising result, in comparison to the KK2000 values, is that the GCCN calculated cloud-average autoconversion rates yield a better fit to the observed cloud-average autoconversion rates. This has very important implications, because almost all current weather and climate models assume dilute drops after drop activation, thus omitting the dominant impact of solute term in the droplet growth equation.

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Refreshments 3:15 PM

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