Geophysical Research Abstracts
Vol. 19, EGU2017-14843, 2017
EGU General Assembly 2017

Evaluating drizzle formation parametrization using ship-based observations in the Northeastern Pacific

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Drizzle, common in marine boundary-layer clouds, plays a crucial role in the microphysical, thermodynamic and dynamic processes that determine cloud structure and properties. Consequently, our ability to model drizzle has a significant impact on understanding and quantifying cloud feedbacks. However, many global models continue to produce drizzle too frequently by a factor of 1.5–2 at cloud base, and likely too heavily in the marine stratocumulus regime. This common model deficiency clearly calls for stronger observational constraints, but progress has been difficult due to a lack of appropriate coincident cloud/drizzle measurements. The entwined nature of clouds and precipitation also compounds the problem further. The recent Marine Atmospheric Radiation Measurement (ARM) GPCI Investigation of Clouds (MAGIC) campaign, making routine ship-based measurements between Los Angeles and Hawaii in 2013, provides an excellent opportunity to evaluate drizzle formation parameterizations. We will show the observed characteristics of coincident clouds and in-cloud precipitation during the campaign, using a novel retrieval method and combined measurements from cloud radar, lidar and shortwave radiation. More importantly, we will present observational-constrained parametrizations suggested by this dataset, and discuss their differences from existing parametrizations that are based on large eddy simulations.