Geophysical Research Abstracts
Vol. 20, EGU2018-11277, 2018
EGU General Assembly 2018

Microphysical Properties of Marine Stratocumulus Clouds Measured with Airborne Digital Holography: Cloud Droplets to Drizzle, and Microphysical Variability

Susanne Glienke (1,2,3), Alex Kostinski (1), Jacob Fugal (2,3), Raymond Shaw (1), Stephan Borrmann (2,3), and Jeff Stith (4)

(1) Michigan Technological University, Houghton, USA, (2) Johannes Gutenberg University, Mainz, Germany, (3) Max Planck Institute for Chemistry, Mainz, Germany, (4) National Center for Atmospheric Research, Boulder, USA

Aircraft measurements of the ubiquitous marine stratocumulus cloud type, with over 3000 km of in situ data from the Pacific during the Cloud System Evolution in the Trades experiment, show the ability of the Holographic Detector for Clouds (HOLODEC) instrument to explore two microphysical properties. First, HOLODEC is able to smoothly interpolate the small and large droplet data collected with Cloud Droplet Probe and 2DC instruments, revealing a surprisingly large contribution in the predrizzle size range of 40–80 μm (transition droplets, or drizzlets), a range typically not measured and assumed to reside in a condensation-to-collision minimum between cloud droplet and drizzle modes. Besides shedding light on the onset of collision coalescence, drizzlets are essential contributors to optical and chemical properties because of a substantial contribution to the total surface area. When adjusted to match spatial resolution of spaceborne remote sensing, the missing drizzlets bring in situ measurements to closer agreement with satellite observations. Second, HOLODEC allows cloud microphysical variability to be examined within spatially localized 3D sample volumes, without averaging over long distances as with typical single-droplet instruments. Individual holograms correspond to a $\sim$10 cm^3 sample volume, so that variability can be examined both on the cm scale within holograms and on the $\sim$10-m-scale by comparing neighboring holograms. The measured clustering of droplets within a hologram is compared to the Poisson ideal using the Kolmogorov-Smirnov test. Microphysical variability at the $\sim$10-m scale is large, deviating strongly from the Poisson ideal, whereas variability at the $\sim$5-cm scale is weaker, but still statistically distinguishable from the Poisson comparison. Size dependence of the microphysical variability is also explored.