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Integral constraints on cloud and precipitation processes

R. Bennartz
Vanderbilt University, Earth & Environmental Sciences, Nashville, United States (ralf.bennartz@vanderbilt.edu)

Constraining and quantifying the role of ice- and mixed-phase microphysical processes remains a challenge both in terms of process understanding and model parameterizations. My hypothesis is that the microphysical variability we are seeing is described largely by integral properties of the atmosphere, which in turn are determined more by the large-scale flow than by microphysical details. If appropriate integral constraints can be identified, such constraints can be used to validate and narrow down uncertainties in cloud microphysical parameterizations. The work presented here expands on earlier studies where we have developed a similar process understanding for warm rain processes.

Here, I will address the relative importance of riming, aggregation, and ice particle diffusional growth in high-latitude precipitation generation. Various long-term ground-based in-situ and remote sensing datasets are used to describe precipitation intensity and type and its relation to the state of the atmosphere. The relative importance of these processes appears to vary strongly between different precipitation events.

This study draws heavily on datasets obtained by our NSF-funded Integrated Characterization of Energy, Clouds,
Atmospheric state, and Precipitation at Summit, Greenland (ICECAPS) experiment, which, because of its high and cold location, provides a unique opportunities to study ice microphysical processes.