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Advances and Challenges in Linking Small-Scale Cloud Process Observations with Models

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Improvement of model parameterizations of coupled cloud dynamical and microphysical interactions are needed to narrow cloud feedback uncertainty in general circulation model simulations. Such interactions are involved in a range of processes important to climate sensitivity including entrainment, phase transitions, and precipitation processes. New opportunities for parameterization improvement are emerging from the simultaneous maturation of observations from ground-based supersites and large-eddy simulations (LES) for realistic atmospheric conditions. In particular, advanced remote-sensing instrumentation and newly developed retrievals from supersites enable synergistic study of atmospheric processes at the high spatial and temporal resolutions needed to capture small-scale processes, and LES provides a comprehensive picture of the cloud-dynamical-microphysical system at resolutions comparable to the observations. However, challenges are encountered when attempting to interface observations and LES in a meaningful way. This paper presents recent advances and challenges involved. Examples will be drawn from activities surrounding the development and application of LES routinely run as part of the US Department of Energy's LASSO Project (https://www.arm.gov/capabilities/modeling/lasso).