13.49 CHARACTERIZING THE APPARENT MULTIFREQUENCY REFLECTIVITY SIGNATURES OF OROGRAPHIC PRECIPITATION USING A COUPLED RAINSHAFT MICROPHYSICS-RADIATIVE TRANSFER MODEL AND OBSERVATIONS

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Quantitative Precipitation Estimation (QPE) in mountainous regions is especially challenging due to the high spatial and temporal variability of orographic precipitation processes modulated by landform and regional circulation patterns, and the challenges posed to radar operations in complex topography (e.g. geometry and ground-clutter artifacts). Radar measurements at different frequencies provide distinct and complementary information of the impact of the vertical structure of precipitation on the radiative properties of the lower troposphere, which can be combined to better constrain QPE algorithms. Over the last twenty years, multiple satellite-based instruments profiling the vertical distribution of precipitation from space at different operating frequencies have been launched including the CloudSat-CPR (94 GHz), the GPM-Ka PR (35 GHz), and the TRMM-PR and GPM-Ku PR (13 GHz). There are also several centimeter and millimeter ground-based radars such as the S- (2 GHz), K- (24 GHz), Ku- (13 GHz), Ka- (35 GHz) and W- (95 GHZ) band radars observing precipitation from the ground, though generally only at sparse locations. The objective of this work is to characterize the apparent reflectivity signature of the vertical structure of orographic precipitation processes at multiple frequencies, which can be used as microphysical markers to improve QPE from remotely sensed reflectivity profiles.

First, a coupled rainshaft microphysics-radiative transfer model is used to generate a very large population of space-based multi-frequency apparent reflectivity profiles (ZaPs) representative of orographic precipitation regimes identified from ground-based observations of precipitation events in mountainous regions. The ZaPs are subsequently measured, classified and clustered vis-à-vis rainfall physical regimes using ground-based observations to constrain the analysis. Finally, a Bayesian model is derived that maps reflectivity profile metrics to orographic precipitation regime, rainfall microstructure and rainfall intensity.