5.1 A MOMENT-BASED POLARIMETRIC RADAR FORWARD OPERATOR FOR RAIN MICROPHYSICS

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Polarimetric radars have often been used to provide information about the hydrometeor distribution within storms (e.g., via hydrometeor classification algorithms). Of greater use to the modeling community are studies exploring polarimetric radar "fingerprints" of individual microphysical processes observed in precipitation. Numerical models are useful for this purpose, but typically employ microphysical parameterization schemes with poorly constrained and ill-defined structural and parameter-value uncertainties and biases. A new parameterization approach that explicitly quantifies these uncertainties is in development (BOSS), and differs from most traditional schemes in that it does not impose a functional form for the drop size distribution (DSD). This presents challenges for the forward-simulation of radar quantities from model prognostic DSD moments (typically the 0th and/or 3rd and/or 6th moments for traditional one-, two-, and three-moment microphysics schemes), because such forward simulation requires discretizing a DSD using a priori knowledge of the DSD functional form (e.g. exponential, gamma, etc.). What is required for the new probabilistic approach is a moment-based polarimetric radar forward operator with no fundamental restrictions on the DSD form. We present the development and initial testing of such an operator. To capture the large parameter space of "realistic" DSDs, we use (i) 1D bin microphysical rain shaft simulations, and (ii) surface disdrometer measurements from around the world. The resulting dataset includes nearly 200 million DSDs, allowing for a robust statistical assessment of forward operator uncertainty. To our knowledge, such a forward operator is unique in relating polarimetric radar observables (ZH, ZDR, and KDP) to integrated DSD moments. Comparison of "truth" and forward-simulated vertical profiles of the polarimetric radar variables are shown for bin simulations, including an assessment of error statistics.