Development of Dual-Pol Radar Forward Operator in Simulation of a Supercell Storm and possible Use in the Variational Data Assimilation Schemes

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There has been a high expectation in polarimetric radar data (PRD) assimilation into numerical weather prediction (NWP) models to improve weather forecasts. To assimilate PRD in NWP models, a forward operation operator, also called dual-pol simulator, is needed to establish the relation between model physics parameters and polarimetric radar variables. So far, the radar reflectivity factor of the 6th moment of DSD/PSD is used in cloud analysis, which was established based on Rayleigh scattering approximation and is valid only for small spherical particles. Dual-pol simulators have been developed in recent years, but they are overly simplified or too complex, computationally expensive and difficult to use in data assimilation (DA). This motivates us to derive a parameterized dual-pol simulator to link NWP model state parameter and radar variables for DA use. Single moment and double moment microphysics parameterization schemes are commonly used in NWP models. In single moment NWP model simulations, water mixing ratios, which is directly related to water content, are the only prognostic physics variable for hydrometeor physics. In double moment microphysics, the number concentration and water mix ratio are predicted variables. In this study, a new developed dual-pol simulator will be used with both single moment microphysics schemes and double moment microphysics schemes. The new operator will be tested along with radar observations and do comparisons with a more complex and accurate dual-pol simulator, and evaluate its performance. In the second step, this radar operator will be used in a 3DVAR scheme by directly assimilating dual-pol observation in an OSSE 3DVAR data assimilation framework.

Keywords: dual polarimetric radar forward operator, radar data assimilation, Convective scale NWP