

Submission Title:

Developing a Radar Signal Simulator for the Community Radiative Transfer Model

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Abstract

Active radar instruments provide vertically resolved clouds and precipitation measurements that cannot be provided by the passive instruments. These active measurements are not conventionally assimilated into the data assimilation systems because of the lack of fast forward radiative transfer models and also difficulties in the error modelling of the measurements. This paper describes the development, evaluation, and sensitivity analysis for a forward radar model implemented in the Community Radiative Transfer Model (CRTM). The scattering properties required by the forward model are provided by the hydrometeor lookup tables that were generated using the discrete dipole approximation. The model is able to calculate both the reflectivity and the attenuated reflectivity for any given radar instrument at any given zenith angles as long as CRTM instrument specific coefficients are available. The evaluation using CloudSat measurements shows a very good agreement between the simulations and measurements as long as the input profiles of hydrometeors are consistent with the measured reflectivity profiles. Major sources contributing to the differences between the measured and simulated reflectivities are input hydrometeor profiles, scattering lookup tables, lack of melting layer in the forward model, CRTM scattering solvers, and attenuation calculations. In addition to the forward model, both Tangent Linear and Adjoint of the model are also implemented and tested within CRTM. These components may be required by some data assimilation systems for the assimilation of radar measurements.