Implementation of a new microwave scattering database and a forward model for active microwave sensors in CRTM

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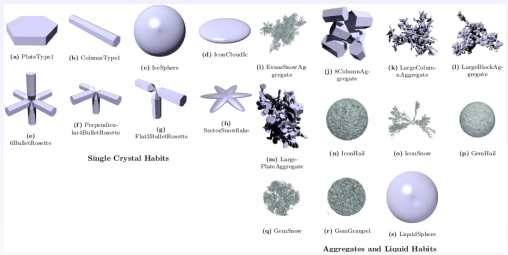
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Summary

The Community Radiative Transfer Model is widely used by the Numerical Weather Prediction communities for the assimilation of satellite observations into NWP models. CRTM currently lacks a forward model for the active sensors to be able to assimilate observations from spacebrone radars such as GPM DPR into NWP models. Additionally, the current cloud scattering lookup tables of CRTM were generated using the Mie theory, thus assume spherical shapes for the frozen and liquid hydrometeors. We discuss the implementation of a comprehensive scattering database with many different shapes generated using the Discrete Dipole Approximation into CRTM as well as developing a forward model for active sensors.

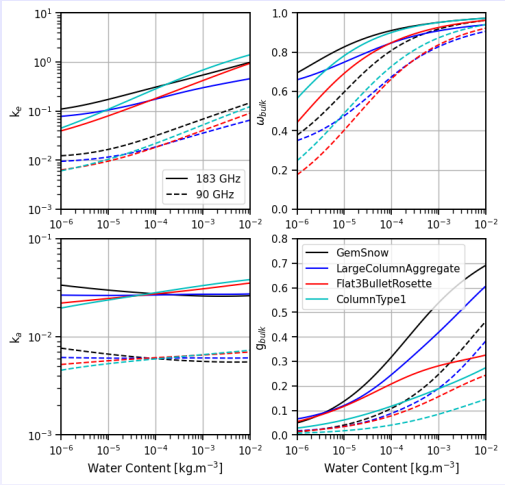
The DDA Database

The DDA database includes single scattering properties for both frozen and liquid hydrometeors. The lookup tables cover a wide range of frequencies (1-200 GHz), temperatures, and sizes. The lookup tables are developed for both passive and active microwave instruments and provides both scattering and backscattering information.

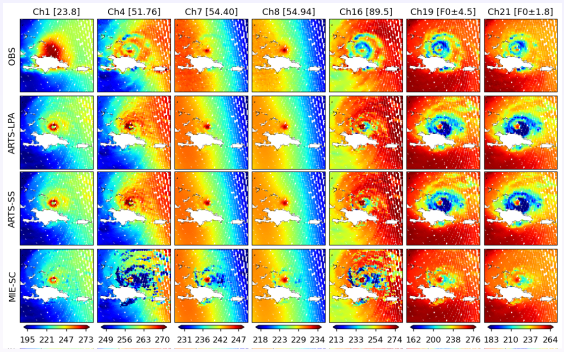


Single crystal, aggregates, and liquid habits from the ARTS database included in the CRTM cloud lookup tables.

The DDA Results

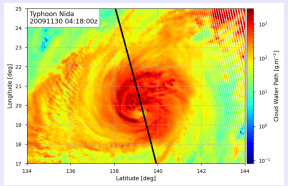


The mass extinction and absorption coefficients (in m^2kg^{-1}) as well as bulk single scattering albedo and asymmetry factor (both unitless) for several habits at 260 K. The solid lines are for 183 GHz and the dashed lines for 90 GHz.

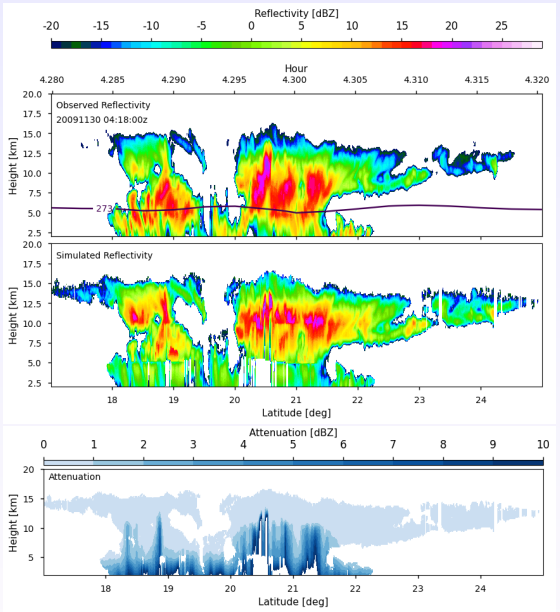


ATMS observed vs. CRTM simulated Tbs for Hurricane Irma, Sept 07, 2017 at 18 UTC, using IFS profiles as input and different CRTM lookup tables. The first row in top panel shows ATMS observations and the next three rows show simulations using DDA large plate aggregate (LPA), DDA Sector Snowflake (SS), and the default MIE SNOW_CLOUD.

The Active Sensor Simulations



Total hydrometeor water content for Typhoon Nida on November 30, 2009 with CloudSat passing over the eye.



CRTM simulations performed for the CloudSat CPR over Typhoon Nida. The upper panels display a comparison of observed and simulated reflectivity, while the lower panel shows the computed attenuation resulting from both atmospheric constituents and hydrometeors.

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Moradi et al., TGRS 2023, under revision, email imoradi@umd.edu for a copy!

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