The Impact of Raindrop Collisional Processes on the Polarimetric Radar Variables

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**Introduction**

We investigate how the raindrop collisional processes in warm rain (coalescence, breakup) affect the radar reflectivity factor at horizontal polarization $Z_R$ and specific differential phase $K_D$.

The fingerprint of each microphysical process is quantified individually and in combination for a variety of DSD shapes and nominal rainfall rates using a spectral bin model and electromagnetic scattering calculations. These fingerprints are compared to disdrometer and radar observations.

**Methods**

The 1-D version of the explicit bin microphysical model of Prat et al. (2012) is initialized with various DSDs and rainfall rates at the top of the model domain.

The DSD is allowed to evolve under the influence of selected microphysical processes: size sorting/settling, coalescence, collisional breakup, and aerodynamic breakup.

The predicted DSDs are converted into vertical profiles of $Z_R$, $Z_D$, and $K_D$ using 1-Matrix scattering calculations (details of the parameters can be found in Kumjian and Ryzhkov 2012).

**Evolution of Profiles**

![Figure 1](image1.png)

**Microphysical Fingerprints**

![Figure 2](image2.png)

**Comparison with Observations**

![Figure 3](image3.png)

**Conclusions**

- Each individual microphysical process (size sorting, breakup, coalescence, evaporation) produces a distinct fingerprint in vertical profiles of $Z_R$, $Z_D$, and $K_D$. This can allow for identifying the dominant process in rainfall.
- These polarimetric fingerprints are dependent on radar wavelength.
- Comparisons with disdrometer and radar observations suggest that the accepted parameterizations of drop breakup are too aggressive for the largest rainfall rates, resulting in very "tropical" DSDs heavily skewed towards smaller drops.
- Polarimetric radar observations in rain may be used to improve such parameterizations via inverse modeling techniques.