**Integration and Testing of** **Improved Ice and Mixed-Phase Precipitation Models for TRMM-GPM Combined Radar-Radiometer Algorithm (CORRA) Applications**

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**Summary of Planned Work**

In the TRMM and GPM missions, the combined radar-passive microwave radiometer precipitation algorithm can provide, in principle, the most accurate and highest resolution estimates of surface rainfall rate and precipitation vertical structure from a spaceborne observing platform. In addition to direct applications of these estimates, they will serve as a crucial reference for "cross-calibrating" passive microwave radiometer-only precipitation profile estimates from the TRMM-GPM radiometer constellations. And through the microwave radiometer-only estimates, the combined algorithm calibration will ultimately be propagated to TRMM-GPM infrared-microwave multi-satellite estimates of surface rainfall.

However, to ensure that combined radar-radiometer estimates of precipitation provide an unbiased reference for the radiometer-only and multi-satellite algorithms, the physical parameterizations utilized in the combined algorithm must be accurate. In particular, the proper specification of the microwave single-scattering properties (specific extinction and scattering, and the angular distribution of scatter) of ice- and mixed-phase precipitation will be crucial at higher latitudes, where the ice- and mixed-phase layers typically represent a greater proportion of the total depth of precipitation in the atmosphere.

Recently, the scattering properties of nonspherical aggregate ice particles were introduced into the operational GPM combined radar-radiometer algorithm (CORRA). Simulated ice scattering signatures from the algorithm were, overall, much less biased in comparisons to GPM-observed signatures. Also, a new parameterization for nonspherical melting particles in stratiform precipitation, including a thermodynamic model for the melting process that includes particle aggregation, was developed.

The ongoing work effort will

• validate snow estimates from the revised CORRA using ground-based radar observations, including data from Finland and the US for which appropriate reflectivity-snow rate relationships have been derived.

• integrate new nonspherical ice particle types, including bullet rosettes, rimed aggregates and graupel, into CORRA, using a classification method to decide what proportions of particle types should be utilized as functions of the climate regime, observed environmental conditions, and precipitation system morphology.

• perform sensitivity studies with the new melting precipitation parameterization to determine how reflectivity-attenuation relationships are affected by initial ice particle types and concentrations at the freezing level, as well as aggregation/breakup within the melting layer.

• introduce the melting parameterization into CORRA as well as versions of CORRA suitable for applications to airborne radar-radiometer observations from field campaigns, and study the impact of these changes on precipitation retrievals, validating them with additional radar channels (W-band) and *in situ* microphysics data.

• explore new parameterizations of mixed-phase precipitation in convective environments.

The expected benefits of the proposed investigation will be improved CORRA estimates of precipitation profiles, as well as greater accuracy of the radiometer-only and multi-satellite algorithms that are supported by these precipitation estimates.