Improving Physically Based Retrievals of Rain and Snow over Land Surfaces for the GPM Constellation

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The joint NASA/JAXA Global Precipitation Measurement Mission (GPM) offers an unprecedented opportunity for development of highly accurate global rain and snowfall observation. Utilizing the GPM core satellite as a transfer standard, physically based Bayesian retrievals are applied consistently across a constellation of passive microwave radiometers for increased observations in both time and space. The use of a physically based retrieval scheme also allows for connection of the retrieval to models and physical processes, integrating them in valuable ways for the study of the processes themselves and more general Earth system science.

While the utility of the Bayesian retrieval has been well demonstrated over ocean surfaces, the relatively high surface emissivity in the microwave region over land and snow-covered areas makes the distinguishing of the precipitation signal more difficult. As the emission signals at lower frequency are extremely difficult to differentiate from the emissive land background, the scattering signal is the primary indicator of precipitation in this case, and the higher frequency channels more heavily weighted. Two crucial areas for such retrievals are therefore identified for improvement: accurate representation of scattering radiative transfer in the high frequency channels of the retrieval *a priori* database, and accurate identification of the surface characteristics for database indexing.

Early versions of GPM constellation retrievals model ice particles in the *a priori* database as spheres. Comparisons of radiative transfer results suggest that spherical particles do not correctly reproduce observed scattering in the high frequency channels, and that non-spherical particle radiative transfer is required for multispectral agreement. In order for the Bayesian retrieval scheme to choose the correct precipitation profiles, the radiative transfer must be accurate. For this work the full retrieval database is recomputed using non-spherical particles and the retrieval results compared.

Land surfaces in the current GPM constellation retrievals are classified statically, using a climatology of self-similar retrieved emissivities. Such a classification does not account for dynamic surface changes such as dramatic soil moisture shifts due to rainfall that have a large dielectric effect. For this work alternative classification using dynamically assessed land surface characteristics of soil moisture and vegetation is tested within the retrieval algorithm and compared to retrievals using the static classification.

Sensitivity to both the scattering radiative transfer and the dynamic definition of surface type will be demonstrated in the context of the full retrieval algorithm and a path forward suggested for improved performance.

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