Dynamic Emissivity Estimates to Support Physical Retrievals for GPM

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The objective of this work is to continue to provide, evaluate, and test dynamic emissivity estimates over land surfaces to support physical precipitation retrievals for GPM. Previously funded work has shown that surface emission, particularly over the range of frequencies included in the GPM constellation, is sensitive to land surface states, including soil properties, vegetation type and greenness, soil moisture, surface temperature, and snow cover, density, and grain size. Previous work has further demonstrated that a regression-based approach trained on clear air emissivity estimates can reproduce dynamic emissivities as effectively as a calibrated microwave emission model (Harrison et al., 2015; Tian et al., 2015) or a semi- physical model (Ringerud et al., 2015). Providing a robust land surface emissivity estimation capability in a simplified framework suitable for real-time retrievals is essential to support GPM-era physical radiometer algorithms over land.

The work is approached from the parallel directions of an empirical, regression-based approach along with a more physically-based emissivity forward modeling approach. We will first establish the relation between Tbs from GMI and any other satellite in the GPM constellation radiometers via the Simultaneous Canonical Overpass (SCO) technique (You et al., 2017). By doing so, the method developed for GMI can be easily applied to other sensors in the constellation. Validation of emissivity estimates from the parallel methods will include comparison to retrieved emissivities from GPM constellation radiometer estimates as well as broad testing within the operational Goddard Profiling (GPROF) precipitation retrieval scheme.

Surface characterization is used by the retrieval in two important ways – the surface emissivity used in forward radiative transfer modeling within the retrieval database, and also in the organizing of the database by surface type. Upwelling Tbs from the forward model will be calculated using emissivities derived from physical models as well as from the empirical techniques, and compared with those calculated via the current operational technique using retrieved values, which suffer from large errors in raining areas. On the retrieval side, we will demonstrate the impact of surface characterization by testing alternative GPROF retrievals using a database stratified by (1) empirically-derived simultaneous emissivity estimates or (2) dynamic surface characteristics such as soil moisture and leaf area index. These test retrievals can be directly evaluated against current retrievals that organize the GPROF database according to static surface types based upon monthly climatologies of retrieved emissivity. Retrievals will be compared at both global and regional scales over instantaneous to seasonal time scales. These types of robust comparisons are designed to demonstrate the value of dynamic surface information to the GPM constellation retrieval scheme.