Improved land surface characterization for the next generation of passive microwave precipitation retrievals

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Accurate, physically-based precipitation retrieval over global land surfaces is an important goal of the NASA Global Precipitation Measurement Mission (GPM). This is a difficult problem for the passive microwave constellation, as the signal over radiometrically warm land surfaces in the microwave frequencies means that the measurements used are indirect, and typically require inferring some type of relationship between an observed scattering signal and precipitation at the surface. GPM, with collocated radiometer and dual-frequency radar, along with a constellation of partner radiometers, is an excellent tool for tackling this problem and improving global retrievals. In the years following the launch of the GPM core satellite, physically-based passive microwave retrieval of precipitation over land continues to be challenging. The operational GPM passive microwave retrieval scheme, the Goddard Profiling Algorithm (GPROF) is a Bayesian probabilistic scheme, utilizing an *a priori* database constructed using the GPM core satellite along with radiative transfer to expand to the full constellation. This current technique, along with the emergence of AI/deep learning technology, makes the accuracy of the *a priori* database of utmost importance for the implementation and training of the schemes. For accuracy in the radiative transfer portion of the database creation, emissivity is key over land surfaces. In this work several improvements are proposed and tested to improve the database and resulting retrievals over land surfaces. These include concurrent water vapor and emissivity retrievals, which will be part of operational radar/radiometer combined retrievals within the year, as well as dynamic snow cover retrievals. In addition global scale semi-empirical emissivity modeling is explored in the database for precipitating footprints where emissivity retrievals are not available but accurate brightness temperature calculations are of great importance, particularly in the case of light snow and drizzle. Improvements are presented with respect to the database as well as carrying through to the retrievals themselves.