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Passive Microwave Soil Moisture Retrieval through Combined Radar/Radiometer Ground Based Simulator with Special Reference to Dielectric Schemes

Dr. Prashant K. Srivastava (1,2) and Dr. Peggy O'Neill (1)

(1) NASA Goddard Space Flight Center, Hydrological Sciences (Code 617), United States (prashant.k.srivastava@nasa.gov), (2) Earth System Science Interdisciplinary Center, University of Maryland, College Park, Maryland, USA

Soil moisture is an important element for weather and climate prediction, hydrological sciences, and applications. Hence, measurements of this hydrologic variable are required to improve our understanding of hydrological processes, ecosystem functions, and the linkages between the Earth's water, energy, and carbon cycles (Srivastava et al. 2013). The retrieval of soil moisture depends not only on parameterizations in the retrieval algorithm but also on the soil dielectric mixing models used (Behari 2005). Although a number of soil dielectric mixing models have been developed, testing these models for soil moisture retrieval has still not been fully explored, especially with SMAP-like simulators. The main objective of this work focuses on testing different dielectric models for soil moisture retrieval using the Combined Radar/Radiometer (ComRAD) ground-based L-band simulator developed jointly by NASA/GSFC and George Washington University (O'Neill et al., 2006).

The ComRAD system was deployed during a field experiment in 2012 in order to provide long active/passive measurements of two crops under controlled conditions during an entire growing season. L-band passive data were acquired at a look angle of 40 degree from nadir at both horizontal & vertical polarization. Currently, there are many dielectric models available for soil moisture retrieval; however, four dielectric models (Mironov, Dobson, Wang & Schmugge and Hallikainen) were tested here and found to be promising for soil moisture retrieval (some with higher performances). All the above-mentioned dielectric models were integrated with Single Channel Algorithms using H (SCA-H) and V (SCA-V) polarizations for the soil moisture retrievals. All the ground-based observations were collected from test site-United States Department of Agriculture (USDA) OPE3, located a few miles away from NASA GSFC. Ground truth data were collected using a theta probe and in situ sensors which were then used for validation. Analysis indicated a higher performance in terms of soil moisture retrieval accuracy for the Mironov dielectric model (RMSE of 0.035 m3/m3), followed by Dobson, Wang & Schmugge, and Hallikainen. This analysis indicates that Mironov dielectric model is promising for passive-only microwave soil moisture retrieval and could be a useful choice for SMAP satellite soil moisture retrieval.

Keywords: Dielectric models; Single Channel Algorithm, Combined Radar/Radiometer, Soil moisture; L band

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