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Synergy between passive (SMOS) and active (RADARSAT-2) microwave soil moisture over Berambadi, India

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This study presents comparison and analysis towards blending of the SMOS derived soil moisture and RADARSAT-2 derived soil moisture over the Berambadi watershed, South India. SMOS (Soil Moisture and Ocean Salinity) satellite from ESA has a passive microwave L-Band sensor providing acquisition at $\sim$40 km resolution and less than 3 days temporal resolution. RADARSAT-2 is an active microwave sensor from (CSA) operating in C-Band at a decametric spatial resolution and 24 days temporal resolution. Both satellites are all-weather satellites. SMOS is less impacted by roughness effects as it operates in passive mode at L-Band compared to RADARSAT-2, which on the other hand has a significantly higher spatial resolution.

Twenty four images of RADARSAT-2 and SMOS-L2UDP soil moisture product, along with extensive field data collected in field campaigns during 2010-2012 in the framework of the ongoing AMBHAS (Assimilation of Multi-satellite data at Berambadi watershed for Hydrology And land Surface experiment) project were used in the analysis. A non parametric algorithm based on the CDF transformation method was developed to retrieve the soil moisture from RADARSAT-2 backscatter coefficient at a spatial resolution of 100 m. This product is validated using a random sampling procedure to divide the data into calibration and validation set each one consisting of 12 images. The developed algorithm provided a good estimate of the surface soil moisture with a RMSE of 0.05 m^3 m^{-3}.

Then the validated RADARSAT-2 soil moisture maps were upscaled to compare with the SMOS data. Eight upscaling strategies were considered, taking into account the surface heterogeneity in terms of texture (clay sand), surface cover (forest, land cover) and SMOS mean antenna pattern. The strategies use linear combination of the different parameters. Significant differences were observed between the eight strategies. The RMSE and coefficient of determination of the different strategies varied between 0.06-0.09 m^3 m^{-3} and 0.3-0.9 respectively. The best comparisons with a RMSE of 0.06 m^3 m^{-3} and a coefficient of determination of 0.7 were obtained for upscaling strategies that include land cover effect.

This result was used in the development of a downscaling procedure to merge the spatial information from RADARSAT-2 with the temporal dynamics from SMOS acquisitions. In order to implement this method the persistence of the spatial patterns in the RADARSAT-2 soil moisture map were evaluated by inspecting the spatiotemporal correlation coefficient across the two years, which was approximately 0.55. The impact of rain and farming activities were also taken into consideration in the analysis of the spatial heterogeneity.

This study shows the potential synergy between the use of active/passive microwave soil moisture retrievals for spatial and temporal down-scaling of soil moisture. This study also shows the potential synergies between SMOS and SMAP (Soil Moisture Active Passive) mission from NASA due to launch in 2015 since SMAP will make active L-band acquisitions.