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Probabilistic Assessment of Soil Moisture using C-band Quad-polarized Remote Sensing Data from RISAT1

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Information on spatio-temporal distribution of surface Soil Moisture Content (SMC) is essential in several hydrological, meteorological and agricultural applications. There has been increasing importance of microwave active remote sensing data for large-scale estimation of surface SMC because of its ability to monitor spatial and temporal variation of surface SMC at regional, continental and global scale at a reasonably fine spatial and temporal resolution. The use of Synthetic Aperture Radar (SAR) is highly potential for catchment-scale applications due to high spatial resolution (∼10–20 m) both for vegetated and bare soil surface as well as because of its all-weather and day and night characteristics. However, one prime disadvantage of SAR is that their signal is subjective to SMC along with Land Use Land Cover (LULC) and surface roughness conditions, making the retrieval of SMC from SAR data an "ill-posed" problem. Moreover, the quantification of uncertainty due to inappropriate surface roughness characterization, soil texture, inversion techniques etc. even in the latest established retrieval methods, is little explored.
This paper reports a recently developed method to estimate the surface SMC with probabilistic assessment of uncertainty associated with the estimation (Pal et al., 2016). Quad-polarized SAR data from Radar Imaging Satellite1 (RISAT1), launched in 2012 by Indian Space Research Organization (ISRO) and information on LULC regarding bareland and vegetated land (<30 cm height) are used in estimation using the potential of multivariate probabilistic assessment through copulas. The salient features of the study are: 1) development of a combined index to understand the role of all the quad-polarized backscattering coefficients and soil texture information in SMC estimation; 2) applicability of the model for different incidence angles using normalized incidence angle theory proposed by Zibri et al. (2005); and 3) assessment of uncertainty range of the estimated SMC. Supervised Principal Component Analysis (SPCA) is used for development of combined index and Frank copula is found to be the best-fit copula. The developed model is validated with the field soil moisture values over 334 monitoring points within the study area and used for development of a soil moisture map. While the performance is promising, the model is applicable only for bare and vegetated land.

References:

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