Remote Sensing based Soil Moisture Downscaling using Weighted Composite of CCI and GLDAS Soil Moisture using Random Forest

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Abstract: Soil moisture (SM) is one of the critical factors in understanding the terrestrial and atmospheric environment. Recently, SM data have been using various field including climate modeling, weather forecasting, agriculture and so on. Because the measurement of SM has carried out by stations only until a couple of decades ago, it was hard to reflect the spatial distribution of SM. Recent advances in various domain such as the Data Assimilation and Spatial Statistics make it possible acquiring gridded SM data. Remote Sensing is one of technique which able to acquire SM data in wide coverage and fine temporal resolution with near-real-time availability. However, these data have a coarse resolution that restricts to direct application. To overcome this limitation, in this study we designed downscaling process using machine learning method, Random Forest (RF) which is the multiple aggregations of the Classification And Regression Trees (CARTs) targeting weighted composite of ESA Climate Change Initiative (CCI) and Global Land Data Assimilation System (GLDAS) SM. Totally 7 type of Input variables were used, Soil Moisture Active Passive (SMAP) satellite product (L3_SM_P) and 6 auxiliary variables, NASA Global Precipitation Measurement (GPM) Integrated Multi-satellitE Retrievals for GPM (IMERG), Moderate Resolution Imaging Spectroradiometer (MODIS) Normalized Difference Vegetation Index, Land Surface Temperature, Land cover, SRTM Digital Elevation Model, and Köppen-Geiger Climate classification data. Validation has performed over 3 International Soil Moisture Network (ISMN) located in Spain (REMEDHUS), Australia (OZNET) and Tibetan plateau (NAQU) and South Korea. Each of them was have corresponded in different Köppen-Geiger climate classification. To find optimal weight, correlation analysis has conducted between in situ and composite of SM using Pearson correlation coefficient and improvement were 2.4% from CCI and 6.4% from GLDAS. In this study, we aimed to suggest a machine learning based downscaling approach using a weighted composite of CCI and GLDAS as a target variable for better correlation with in-situ data. The result of the current study has shown meaningful improvement in the modeling of spatial distribution and correlation value. Our result expected to be contributed to further enhancement in other fields.

Keywords: Soil Moisture; Downscaling; CCI; GLDAS; Random Forest