Geophysical Research Abstracts
Vol. 19, EGU2017-11666, 2017
EGU General Assembly 2017

Neural Network-Based Retrieval of Surface and Root Zone Soil Moisture using Multi-Frequency Remotely-Sensed Observations

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Knowledge of root zone soil moisture is essential in studying plant's response to different stress conditions since plant photosynthetic activity and transpiration rate are constrained by the water available through their roots. Current global root zone soil moisture estimates are based on either outputs from physical models constrained by observations, or assimilation of remotely-sensed microwave-based surface soil moisture estimates with physical model outputs. However, quality of these estimates are limited by the accuracy of the model representations of physical processes (such as radiative transfer, infiltration, percolation, and evapotranspiration) as well as errors in the estimates of the surface parameters. Additionally, statistical approaches provide an alternative efficient platform to develop root zone soil moisture retrieval algorithms from remotely-sensed observations.

In this study, we present a new neural network based retrieval algorithm to estimate surface and root zone soil moisture from passive microwave observations of SMAP satellite (L-band) and AMSR2 instrument (X-band). SMAP early morning observations are ideal for surface soil moisture retrieval. AMSR2 mid-night observations are used here as an indicator of plant hydraulic properties that are related to root zone soil moisture. The combined observations from SMAP and AMSR2 together with other ancillary observations including the Solar-Induced Fluorescence (SIF) estimates from GOME-2 instrument provide necessary information to estimate surface and root zone soil moisture. The algorithm is applied to observations from the first 18 months of SMAP mission and retrievals are validated against in-situ observations and other global datasets.