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Performance of MODIS satellite and mesoscale model based land surface temperature for soil moisture deficit estimation using Neural Network

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Soil Moisture Deficit (SMD) is a key variable in the water and energy exchanges that occur at the land-surface/atmosphere interface. Monitoring SMD is an alternate method of irrigation scheduling and represents the use of the suitable quantity of water at the proper time by combining measurements of soil moisture deficit. In past it is found that LST has a strong relation to SMD, which can be estimated by MODIS or numerical weather prediction model such as WRF (Weather Research and Forecasting model). By looking into the importance of SMD, this work focused on the application of Artificial Neural Network (ANN) for evaluating its capabilities towards SMD estimation using the LST data estimated from MODIS and WRF mesoscale model. The benchmark SMD estimated from Probability Distribution Model (PDM) over the Brue catchment, Southwest of England, U.K. is used for all the calibration and validation experiments.

The performances between observed and simulated SMD are assessed in terms of the Nash-Sutcliffe Efficiency (NSE), the Root Mean Square Error (RMSE) and the percentage of bias (%Bias). The application of the ANN confirmed a high capability WRF and MODIS LST for prediction of SMD. Performance during the ANN calibration and validation showed a good agreement between benchmark and estimated SMD with MODIS LST information with significantly higher performance than WRF simulated LST.

The work presented showed the first comprehensive application of LST from MODIS and WRF mesoscale model for hydrological SMD estimation, particularly for the maritime climate. More studies in this direction are recommended to hydro-meteorological community, so that useful information will be accumulated in the technical literature domain for different geographical locations and climatic conditions.

Keyword: WRF, Land Surface Temperature, MODIS satellite, Soil Moisture Deficit, Neural Network