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# Catchment-scale connection between vegetation accessible storage and satellite-derived Soil Water Index

**Laurène Bouaziz**[1,2], Susan Steele-Dunne[2], Jaap Schellekens[3], Albrecht Weerts[1,4], Jasper Stam[5], Eric Sprokkereef[5], Hessel Winsemius[1,2], Hubert Savenije[2], and Markus Hrachowitz[2]

[1]Department Catchment and Urban Hydrology, Deltares, Boussinesqweg 1, 2629 HV Delft, the Netherlands (laurene.bouaziz@deltares.nl)

[2]Water Resources Section, Faculty of Civil Engineering and Geosciences, Delft University of Technology,P.O. Box 5048, 2600 GA Delft, the Netherlands

[3]VanderSat, Wilhelminastraat 43A, 2011 VK Haarlem, the Netherlands

[4]Hydrology and Quantitative Water Management Group, Department of Environmental Sciences, Wageningen University, Wageningen, the Netherlands

[5]Ministry of Infrastructure and Water Management, Zuiderwagenplein 2, 8224 AD Lelystad, the Netherlands

Estimates of water volumes stored in the root-zone of vegetation are a key element controlling the hydrological response of a catchment. Remotely-sensed soil moisture products are available globally. However, they are representative of the upper-most few centimeters of the soil. For reliable runoff predictions, we are interested in root-zone soil moisture estimates as they regulate the partitioning of precipitation to drainage and evaporation. The Soil Water Index approximates root-zone soil moisture from near-surface soil moisture and requires a single parameter representing the characteristic time length T of temporal soil moisture variability. Climate and soil properties are typically assumed to influence estimates of T, however, no clear quantitative link has yet been established and often a standard value of 20 days is assumed. In this study, we hypothesize that optimal T values are linked to the accumulated difference between precipitation (water supply) and evaporation (atmospheric water demand) during dry periods with return periods of 20 years, and, thus, to catchment-scale vegetation-accessible water storage capacities. We identify the optimal values of T that provide an adequate match between estimated SWI from several satellite-based near-surface soil moisture products (derived from AMSR2, SMAP and Sentinel-1) and modeled time series of root-zone soil moisture from a calibrated process-based model in 16 contrasting catchments of the Meuse river basin. We found that optimal values of T vary between 1 and 98 days with a median of 17 days across the studied catchments and soil moisture products. We furthermore show that T, which was previously known to increase with increasing depth of the soil layer, is positively and strongly related with catchment-scale root-zone water storage capacity, estimated based on long-term water balance data.  This is useful to generate estimates of root-zone soil moisture from satellite-based surface soil moisture, as they are a key control of the response of hydrological systems.