Soil Moisture Initialization Input Scale Effect on Parameter Value Identification of a Physically Based Distributed Hydrologic Modelling

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Abstract

Data acquisition and an efficient processing method for hydrological model initialization, such as soil moisture, and parameter value identification are critical for a physically based distributed watershed modelling of flood and flood related disasters such as sediment and debris flow. Site measurements can provide relatively accurate estimates of soil moisture, but such techniques are limited due to the need for a variety of measurement accessories, which are difficult to obtain to cover a large area sufficiently. Available satellite-based digital soil moisture data is at 9 kilometers to 50 kilometers in resolution which completely filters the soil moisture details at the hill slope scale. Moreover, available satellite-based digital soil moisture data represents only a few centimeters of the top soil column that informs nothing about the effective root-zone wetness. A recently developed soil moisture estimation method called SERVES (Soil moisture Estimation of Root zone through Vegetation index-based Evapotranspiration-fraction and Soil-properties (Pradhan, 2019).

\[ \theta_i = (1.33 \text{NDVI} - 0.049)(\theta_{fc} - \theta_{wp}) + \theta_{wp} \]

\( \theta \) = soil moisture content
\( \theta_{fc} \) = field capacity soil moisture content and
\( \theta_{wp} \) = wilting point soil moisture content
\( i \) = any spatial location or grid/tin address for a numerical model.

\( ET_i \) = evapotranspiration fraction

NDVI = Normalized Difference Vegetation Index

SERVES, Soil-moisture Estimation of Root-zone through Vegetation-index based Evapotranspiration-fraction and Soil-properties (Pradhan, 2019).

Resolution effect on the initial soil moisture

Conclusion

Changing the input resolution of the initial soil moisture condition to coarser grid scale would produce significantly underestimated discharge and inconsistent moisture distribution state when simulated with hydrological model parameters calibrated / identified at finer resolution initial soil moisture resolution.

References