Soil moisture estimation from inverse modeling using multiple criteria functions

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Abstract

Soil hydraulic parameters are essential inputs to agricultural and hydrologic models for simulating soil moisture. These parameters however are difficult to obtain especially when the application is aimed at the regional scale. Laboratory and field methods have been used for quantifying soil hydraulic parameters but they are proved to be laborious and expensive. An emerging alternative of estimating soil hydraulic parameters is soil moisture model inversion using remote sensing (RS) data. Although soil hydraulic parameters could not be derived directly from remote sensing, they could be quantified by the inverse modeling of RS data. In this study, we conducted a multi-criteria inverse modeling approach to estimate the rootzone soil hydraulic parameters in a rainfed rice field at depths 3, 12, 28 and 60 cm, respectively. The conditioning data used in the inverse modeling are leaf area index (LAI) and actual evapotranspiration (ETa) from satellite imageries, and soil moisture (SM) data from in situ measurements. The performances of all the model inversion experiments were evaluated against observed soil moisture in the field, and measured LAI during the growing season. The results showed that using remotely sensed LAI and ETa in the inverse modeling provided a good matching between observed and simulated soil moisture down to 28 cm depth from the soil surface. With the addition of soil moisture information from the site, the model inversion significantly improved the soil moisture simulation up to a depth of 60 cm.