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Improving Evapotranspiration simulation in SWAT using remote sensing

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Abstract: Evapotranspiration (ET) is the main hydrological component besides precipitation, but evapotranspiration calculations in hydrological models are poorly validated. In our study, we used an ensemble of monthly ET estimations derived from remote sensing (RS) obtained from ALEXI, MODIS, CMRSET and SSEBOP RS models, as a reference for evaluating ET simulation results from SWAT in the Upper Blue Nile Basin (UBN). A comparison indicates that SWAT ET estimation is lower than the ensemble mean RS-ET estimations during dry season, where as for the wet season simulated SWAT ET is comparable with RS ET. These results indicate an underestimation of vegetation transpiration during the dry season. In this study we explored methods to improve dry season ET simulation in UBN basin SWAT model using RS. First we investigated the use of Leaf Area Index (LAI) obtained from RS. A comparison of LAI modeled in SWAT and LAI obtained from RS showed that in SWAT, LAI drops to zero during the dry season, meaning that there is no vegetation activity. We modified the SWAT input files in a way that monthly LAI from remote sensing are imposed in the SWAT model for the forest dominated sub-basins. Secondly, we modify the SWAT model structure in a way that the forested areas can use groundwater for transpiration in case the soil water content is low. Using remote sensing LAI for the forested areas in SWAT lead to a 10% increase of ET, while allowing SWAT to use groundwater for forest transpiration had little impact on ET.

Keywords: Evapotranspiration; SWAT; Remote sensing; Environmental modelling