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Value of satellite-derived soil moisture data to improve the internal consistency of process-based ecohydrological models

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It is widely acknowledged that calibrating and evaluating hydrological models only against streamflow may lead to inconsistencies of internal model states and large parameter uncertainties. Soil moisture is a key variable for the energy and water balance, which affects the partitioning of solar radiation into latent and sensible heat as well as the partitioning of precipitation into direct runoff and catchment storage. In contrast to ground-based measurements, satellite-derived soil moisture (SDSM) data are widely available and new data products benefit from improved spatio-temporal resolutions. Here we use a soil water index product based on data fusion of microwave data from METOP ASCAT and Sentinel 1 CSAR for calibrating the process-based ecohydrological model EcH$_2$O-iso in the 66 km² Demnitzer Millcreek catchment in NE Germany. Available field measurements in and close to this intensively monitored catchment include soil moisture data from 74 sensors and water stable isotopes in precipitation, stream and soil water. Water stable isotopes provide information on flow pathways, storage dynamics, and the partitioning of evapotranspiration into evaporation and transpiration. Accounting for water stable isotopes in the ecohydrologic model therefore provides further insights regarding the consistency of internal processes. We first compare the SDSM data to the ground-based measurements. Based on a Monte Carlo approach, we then investigate the trade-off between model performance in terms of soil moisture and streamflow. *In situ* soil moisture and water stable isotopes are further consulted to evaluate the internal consistency of the model. Overall, we find relatively good agreements between satellite-derived and ground based soil moisture dynamics. Preliminary results suggest that including SDSM in the model calibration can improve the simulation of internal processes, but uncertainties of the SDSM data should be accounted for. The findings of this study are relevant for reliable ecohydrological modelling in catchments that lack detailed field measurements for model evaluation.