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Assessing the added value of multiple remote sensing observations for hydrological model Cal/Val

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Calibration and validation (Cal/Val) of hydrological models are conventionally performed by analyzing lumped observations (e.g., streamflow time-series), which might not be able to capture internal processes dynamics (e.g., evapotranspiration, canopy interception, baseflow). Recent advances in remote sensing of hydrological variables present novel opportunities to a more comprehensive, distributed approach on the Cal/Val of hydrological models, by analyzing multiple observations other than streamflow. In this context, this study aims to assess the added value of multiple remote sensing observations (soil moisture, evapotranspiration, terrestrial water storage, altimetry, inundated areas extent) for hydrological model Cal/Val. We use the MGB model, a large scale, distributed hydrological-hydrodynamic model which has been widely applied in South American basins. Remote sensing observations for Cal/Val procedures are state-of-the-art remote sensing products representative of multiple hydrological variables (GRACE for terrestrial water storage, SMOS for soil moisture, MOD-16 for evapotranspiration, Jason-2 for altimetry, and ALOS-PALSAR for inundated areas extent). This methodology is applied in the Purus river basin in the Amazon (area $\sim$320.000 km^2). Results indicate that calibration with streamflow data improved estimates of streamflow itself (Kling-Gupta efficiency (KGE)>0.8), altimetry (KGE>0.9) and extension of inundated areas (KGE>0.7), but it did not expressively impact estimates of terrestrial water storage, soil moisture and evapotranspiration. This study discusses then the added value on the estimates of multiple variables by the Cal/Val of multiple variables (e.g., the impact on evapotranspiration by the Cal/Val of soil moisture; the impact on streamflow by the Cal/Val of terrestrial water storage; the impact of altimetry by the Cal/Val of evapotranspiration). By that, hydrological models are further committed to representing not only streamflow observations, but also the internal processes that occur within watersheds, providing consistency for applications in differing scenarios (e.g., climate and land use changes) and scales.