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Towards a framework for the validation of kilometer-scale land-surface schemes

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The coupling between the land-surface and the atmosphere is a fundamental process of the climate system. On the one hand, soil moisture introduces memory effects of monthly to annual timescales to NWP and climate simulations. On the other hand, the available soil water in the upper soil determines the partitioning of available energy into latent, sensible and ground heat fluxes and thereby regulates the boundary layer growth and cloud formation on diurnal time scales. Therefore, an inaccurate representation of soil moisture will degrade forecast quality for near-surface variables. However, soil moisture is inherently difficult to measure and thus the validation of land surface schemes in high-resolution simulations is challenging. Here, we present a process-oriented validation approach quantifying catchment mass budgets of mesoscale catchments. This approach allows us to validate the mass fluxes given by evapotranspiration and runoff individually. This facilitates the diagnosis of important model sensitivities and deficiencies in the soil hydrology. As a first application, we use this framework to validate a recently developed runoff parameterization for the COSMO NWP and climate model. We see that biases in the terrestrial water storage (and thus in soil moisture) are mainly controlled by biases in runoff. Furthermore, we observe a strong sensitivity of runoff to different implementations for infiltration.