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A European vision for hydrological observations and experimentation

Assimilation of measurements from hydrological observatories for better terrestrial system model predictions: experiences and challenges

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The hydrological observatory for the Rur catchment (2400 km^2) in Germany is highly equipped including 15 Cosmic Ray Neutron Sensors (CRNS) to measure soil moisture content, 6 eddy covariance stations with measurement of land-atmosphere exchange fluxes and further micrometeorological observations, and additional monitoring stations for river discharge and groundwater levels, amongst others. In addition, 3 intensive research sites at representative locations have been implemented with distributed soil moisture and temperature monitoring. These measurements allow for a better local verification of terrestrial model predictions, and the improvement of model predictions by model-data fusion methods. We did a series of studies on the assimilation of observations from the Rur observatory to improve predictions with the Terrestrial Systems Modelling Platform (TSMP), which models water, energy, carbon and nitrogen cycles of the land surface and subsurface. The data assimilation algorithm was in most cases the Ensemble Kalman Filter, but also the Particle Filter and Markov Chain Monte Carlo were used. Assimilated observations included soil moisture (from FDR-probes, CRNS or remote sensing), groundwater levels and net ecosystem exchange. We found that assimilation improved the characterization of the measured variable, also at verification locations. However, states and fluxes of variables that were not assimilated, such as evapotranspiration, often were not better characterized. The results suggest the importance of the joint assimilation of measurements for different variables, including remotely sensed information and vegetation information.