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Ameliorating uncertainties in satellite-derived rainfall using GRACE observations over the Congo Basin

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The Congo River has the second largest drainage area in the world, making it very important for the water resources of Africa. Nevertheless, the sparsity of measurements has made the study and modeling of water resources over the basin very difficult and reliant on satellite remote sensing. The Hillslopes River Routing (HRR) model was used to simulate hydrological states and fluxes over the Congo River basin, driven by a TRMM rainfall data product. However, errors in the satellite-derived rainfall, which vary both spatially and temporally, propagate through the model and result in errors in the simulated streamflow and water storage. The GRACE satellite provides measurements of variations of the Earth's gravity field, which can be translated to variations of water storage over large-scale basins. We evaluate a data assimilation system that ingests GRACE water storage variation observations into the HRR model to potentially correct errors in the TRMM precipitation. The data assimilation algorithm, an Ensemble Kalman Filter (EnKF), is able to improve HRR water storage and streamflow predictions when compared with the actual GRACE observations as well as gauge and ENVIsat measurements over select sites, by updating the model rainfall inputs. Additionally, we examine the sensitivity of the rainfall estimates with spatial and temporal scales, i.e. the information content of GRACE observations with respect to estimating TRMM errors. Finally, a Bayesian framework is explored in order to identify the error components that correspond to the HRR parameterization and TRMM inputs.