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Assimilation of GRACE Hydrology Data: Recent Progress

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GRACE is unique among remote sensing systems in its ability to detect changes in total terrestrial water storage (TWS; the sum of groundwater, soil moisture, surface water, and snow). However, three factors have limited the value of GRACE data for hydrological research and applications: (1) low spatial and temporal resolutions relative to other observations; (2) product latency; (3) TWS is an unfamiliar quantity. Land surface models (LSMs) simulate the redistribution of water and energy incident on the land surface, but their accuracy is a function of the quality of the input data used to parameterize and force the models, the model developers' understanding of the physics involved, and the simplifications necessary to depict the Earth system economically. The advantages of GRACE and other observations and LSMs can be harnessed via data assimilation, which synthesizes discontinuous and imperfect observations with our knowledge of physical processes, as represented in a LSM. The model fills observational gaps, provides quality control, and enables data from disparate measurement systems to be merged, while the observations anchor the results in reality. Previously we have demonstrated assimilation of GRACE derived TWS anomalies into the Catchment LSM over the Mississippi River basin, using an Ensemble Smoother approach. We are now improving that capability, extending it to other parts of the world, evaluating the results, and applying the technique for scientific research and socially relevant applications. Here we describe recent progress in these areas.