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Estimation of terrestrial water storage from global hydrological modeling, GRACE and land-atmosphere water balance analysis

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Three methods are commonly used to estimate large-scale terrestrial water storage (TWS) variations: (1) the column-integrated water vapor convergence provides a global distribution of precipitation minus evapotranspiration (P-E). The combined land-atmosphere water balance computation using the atmospheric and river discharge data can be used to estimate the temporal change of spatially averaged TWS over large areas; (2) Satellite observations of Earth's time-variable gravity field from the Gravity Recovery and Climate Experiment (GRACE) mission launched in 2002 have provides a unique opportunity of monitoring monthly or longer TWS variations from space. (3) Land surface hydrological modeling used for climatic studies is the only tool at present to estimate the variations of TWS and its components (soil moisture, groundwater, snow, etc.) at any temporal and spatial scales, provided that the land surface models used are well constrained by realistic meteorological forcing and satellite- and ground-based observational data. In this study, large-scale TWS variations are estimated over selected world largest river basins by using the global scale hydrological modeling. The model simulations are validated against GRACE TWS data, and compared with the estimates from the combined atmospheric-land water balance computation at daily, monthly, seasonal and interannual timescales.