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0.1 Optimized Recovery of Global Terrestrial Water Storage Changes From GRACE Time-Variable Gravity Measurements

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We estimate global terrestrial water storage (TWS) changes using the time-variable gravity fields from the Gravity Recovery and Climate Experiment (GRACE) twin satellites gravity mission during the first three years. The high degree and order spherical harmonics of GRACE-observed time-variable gravity fields are dominated by noise. We construct two optimized variance-dependent smoothing methods that can more effectively reduce the high degree and order errors than the commonly used Gaussian smoothing. These optimized smoothing methods can maximize the signal-to-noise ratio between GRACE recovered TWS change and residual signal and noise over the ocean. With the optimized variance-dependent smoothing, GRACE estimated global TWS show significantly improved spatial resolution and less leakage error than similar results from the Gaussian smoothing and other published optimal smoothing techniques. We compare GRACE-estimated TWS changes in selected major basins, including the Amazon, Mississippi, Ganges, and Zambezi river basins, and compare with hydrological model estimates from the NASA Global Land Data Assimilation System (GLDAS). At seasonal time scales, there reasonably good agreement between GRACE observations and GLDAS estimates. However, GLDAS appears to have significantly and consistently underestimated basin-scale seasonal TWS changes.