

Comparison of GRACE with *in situ* hydrological measurement data shows storage depletion in Hai River basin, Northern China

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Abstract

Water storage change has implications not only for the hydrological cycle, but also for sustainable water resource management in especially semi-arid river basins. Satellite/remote sensing techniques have gained increasing application in monitoring basin and regional hydrological processes in recent decades. In this study, the latest version of GRACE (Gravity Recovery and Climate Experiment) is used to estimate total water storage change in the Hai River basin (HRB) of Northern China for the period January 2003 to December 2006. Time-series comparisons show a good agreement between the estimated storage change from the GRACE satellite data and *in situ* hydrological measurement data at especially the seasonal cycle with $R = 0.82$ and $RMSE = 17.25$ mm. The good agreement suggests that GRACE detects storage change in the 318 866 km² HRB study area. It also implies that the *in situ* hydrological measurements of soil moisture and groundwater sufficiently characterise storage change in the semi-arid river basin. Change in soil moisture storage is less than that in saturated storage, suggesting that storage depletion in the basin is mainly in the saturated zone. Both the GRACE and hydrological measurement data indicate storage loss in the range of 12.72 to 23.76 mm/yr – a phenomenon that has been detected in previous studies in the basin. GRACE hydrology data could therefore be handy in monitoring storage dynamics and water availability in the study area. As GRACE data are available for virtually every region of the world, their application in conjunction with hydrological models could improve hydrological studies. This may lead not only to water balance closures, but also to sustainable water resource management at basin to regional scale.

Keywords: Hai River basin, GRACE, saturated storage, soil moisture storage, hydrological measurement data, total water storage change