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Detecting the mass change and its loading responses in the large reservoir, lake and groundwater depletion area in China, from GRACE Data, Land Surface Models and in situ observations

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The water impoundment of China's Three Gorges Reservoir (TGR), with the largest dam in the world, makes a large mass concentrated and thus influences the surface gravity field and crustal deformation field. In the TGR area, water impoundment began in 2003, and the Earth is responding to the ongoing changes of water storage. These responses can be investigated using the gravimeter and the GPS. In this study, we modeled the surface gravity and displacement changes in the front area of TGR caused by water storage variations. Predictive results are compared with the measurements derived from absolute gravity by A10, continuous gravity by gPhone and GPS time series at the sites of front area in TGR. Meanwhile, time-varying water storage capacity model was obtained by Stokes spherical harmonic analysis (degree and order up to 60), and our results are analyzed with monitoring results from the GRACE data.

Terrestrial water storage (TWS) changes in the Tibetan Plateau (TP) are sensitive indicators for water dynamics associated with climate variability. Joint analyses using both GRACE space mission and satellite altimetry data are increasingly being used to monitor TWS. The objective of this study is to confirm that it is possible to reliably monitor water storage changes in large lakes based on integrative analysis of GRACE data. This study focuses on data integrated and analyzed for Lake Qinghai located in the northeast TP, and shows a clear continuous water level rise since 2004. We have developed a simple framework to estimate water storage variations in individual regions using a spatial averaging kernel, while simultaneously minimizing the effects resulting from uncertainties of GRACE data using Land Surface Models (LSMs) and in-situ measurements.

The North China Plain, as interest region in this study, is one of the most uniformly and extensively altered areas due to overexploitation of groundwater by humans. Here, we use GRACE and GPS to study the seasonal and long-term mass change and its resulting vertical displacement. We also removed the vertical rates which are induced by TWS from GPS-derived data to obtain the corrected vertical velocities caused by tectonic movement and human activities.