Contribution of High Mountain Asia glacier changes to river basin hydrology using GRACE gravity and other data

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The overall science objectives of our project are to quantify the changes in glacier mass balance in HMA and determine their contribution to river basin hydrology to improve our understanding of the impact of glacier runoff on river basin hydrology, which in turn will help improve water resource management and forecasts.

Here, we propose to employ time series of time-variable gravity from the Gravity Recovery and Climate Experiment (GRACE) mission and GRACE Follow-On (GRACE-FO) mission to document the glaciers changes taking place in HMA since 2002 until present, clarify their role in the hydrological budget of single river basin, improve our understanding of the partitioning of the glacier signal, document changes in the terrestrial water budget of the main river basin in the region, and study the partitioning of the basin-scale water cycle.

To study the partitioning of the glacier signal and of the regional water budget, we will conduct an integrated analysis of the GRACE products and independent observations of precipitation, evapotranspiration, runoff, soil moisture, snow water signal from satellite, climate model outputs and ground observations. These data will include evapotranspiration from MODIS, soil moisture from AMSR and SMAP, precipitation from TRMM and GPCP.

For the technical part, we will design ad-hoc mascon configurations to calculate the upstream glacier change in mass balance and contribution to major river basins, determine appropriate corrections for the signal (e.g. post glacial rebound, atmospheric correction, re-scaling of the signal, and leakage effects), and evaluate the results via comparison with multiple satellite and ground observation and model output. The glacier products will document changes glacier runoff and contribution to major watersheds; while the TWS output products will document changes in total water storage also controlled by precipitation minus evaporation and removal/replenishment of ground water storage (e.g. as a result of human activities).