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GRACE Equivalent Water Mass Balance of the Himalayas and Tibet Plateau Region

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The Himalayas and the Tibet Plateau form a region of about 3.4 million square kilometers. Home to numerous large lakes and tarns (glacier lakes), and to more than 50,000 glaciers and high-elevation snowfields, this region is the source of the Indus, Ganga, Brahmaputra, and Yamuna Rivers, the Indo-Gangetic River system. The Himalayan Mountains and associated ranges form a boundary separating continental air masses associated with the westerlies, and marine air masses associated with the summer South Asian monsoon. Adverse changes in water storage / river discharge driven by effects of climate change will impact agriculture, hydroelectric power facilities, commerce, and the lives of more than 1.3 billion people. Monthly water equivalent thickness, i.e. hydrologic mass balance, from the Gravity Recovery and Climate Experiment (GRACE) Level-3 Release 4 de-striped global grids from the University of Texas Center for Space Research are being investigated to assist in assessment of hydrologic changes. Processing adjusts the GRACE monthly grids for modeled atmosphere water mass, solid Earth and ocean tides and pole tides, and geoid. The ΔC_{20} geopotential coefficient which is caused by water mass transport is not modeled at this time. In this study, the monthly grids were adjusted for glacial isostatic adjustment (Paulson et al., 2007; ICE-5G/VM2), and regional-averages were computed for the Himalaya – Tibet Plateau and the Eastern India – Bay of Bengal to derive time series. Over the period of the GRACE observations, August 2002 through December 2006, annular periodicity of the mass balance is evident with minima occurring in May and maxima occurring in September. Comparison of the regional time series shows near synchronized annular periodicities with high positive correlation. Least-squares re-

gression after removal of an annual periodicity, suggests the Himalaya – Tibet Plateau had an area-average water thickness reduction of 0.031 ± 0.019 cm/month, equivalent to a water volume loss of 17.9 ± 11.0 km^3/yr. On continental regions, GRACE hydrologic mass balance can be composed of signals from changes in groundwater storage, permafrost, soil moisture, glacier mass balance and seasonal snowfield loads, and river discharge. Comparisons with other related geophysical datasets will be needed for validation, assessment of uncertainty, and separation of source components of the GRACE monthly trends and variations of hydrologic mass balance.