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GRACE estimates of 2003-2010 glacial mass loss across High Mountain Asia

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Conventional mass loss estimates for large mountain glacier systems require the extrapolation of sparse mass balance measurements from a few individual glaciers that typically represent only a small fraction of the total glaciated area. The GRACE satellite gravity mission, which was launched in spring 2002 and continues to return high-quality data, provides an alternative. Unlike conventional methods, GRACE is not able to resolve one individual glacier from another. But it is able to recover the total mass variability integrated over large regions - typically on the order of several hundred km on a side, and larger. Here, we use monthly, global GRACE gravity field solutions to estimate ice mass loss across all glacier systems in High Mountain Asia (eg. the Tainshan, Pamirs, Kunlun Shan, Himalaya, Karakoram, and Qilian Shan) during 2003-2010. We conclude that this region lost mass at an average rate of only 4+/-20 Gt yr-1 during this time period, compared to 47-55 Gt yr-1 in previously published estimates that cover similar time periods. We apply a mascon-fitting technique to the GRACE data, that allows us to separate the glaciated regions from the groundwater loss regions to the south that lie across the adjacent plains in northern India, Pakistan, and Bangladesh. We employ numerical experiments and various physically based models, to assess the possibility that other geophysical signals might be contaminating our solution .