

Ice loss in the Asian high mountains from satellite gravimetry

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The bulk of water ice on the Earth lies in continental ice sheets in Greenland and Antarctica. However, melting of smaller amount of mountain glaciers and ice caps is contributing more to the current eustatic sea level rise (Meier et al., 2007). Among these glaciers, more than a half of the total amount of melting comes from southeastern Alaska, high mountains of Asia (HM Asia), and Patagonia (Dyurgerov and Meier, 2005). Although GRACE (Gravity Recovery and Climate Experiment) measurements of ice loss in Alaska (Tamisiea et al., 2005) and Patagonia (Chen et al., 2007) have been reported, gravity 2002-2008 shows rather moderate amount of mass decrease in HM Asia. Here we show that the gravity increase associated with ongoing crustal uplift may partially cancel the negative gravity trend. The Lhasa GPS station shows secular uplift of ~ 3.2 mm/year, and we considered that this partly comes from tectonic uplift (isostatic) and partly from glacial isostatic adjustment (GIA) (Kaufmann, 2005). After appropriate correction the ice loss rate in this region becomes 56 ± 20 Gigaton/year, equivalent to ~ 0.16 mm/year sea level rise. This is roughly twice as fast as the 1961-2003 average ice loss rate in HM Asia (Dyurgerov and Meier, 2005), suggesting that the global tendency of accelerating ice loss also applies for Asia. If we assume that the ice loss rate scales with the seasonal volume change (Meier, 1984), the total mass loss rate of worldwide mountain glaciers becomes 277 ± 0.40 Gt/year. This is equivalent to 0.77 ± 0.11 mm/year sea level rise, which coincides with the value reported for 1993-2003 by Intergovernmental Panel on Climate Change except for our smaller uncertainty. Mass loss in Himalayan glaciers has been constant while melting of Karakoram glaciers seems to have started lately. Huge amount of glacial ice loss in HM Asia, second only to those in southern Alaska, would affect future water supplies in highly populated Asian countries depending on these glaciers.

References

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