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The spread of ice mass loss into northwest Greenland observed by GRACE and GPS

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Greenland's main outlet glaciers have more than doubled their contribution to global sea level rise over the last decade. Recent work has shown that Greenland's mass loss is still increasing. Here we show that the ice loss, which has been well-documented over southern portions of Greenland, is now spreading up along the northwest coast, with this acceleration likely starting in late 2005. We support this with two lines of evidence. One is based on measurements from the Gravity Recovery and Climate Experiment (GRACE) satellite gravity mission, launched in March, 2002. The other comes from continuous Global Positioning System (GPS) measurements from three long-term sites on bedrock adjacent to the ice sheet. The GRACE results provide a direct measure of mass loss averaged over scales of a few hundred km. The GPS data are used to monitor crustal uplift caused by ice mass loss close to the sites. The GRACE results can be used to predict crustal uplift, which can be compared with the GPS data. In addition to showing that the northwest ice sheet margin is now losing mass, the uplift results from both the GPS measurements and the GRACE predictions show rapid acceleration in southeast Greenland in late 2003, followed by a moderate deceleration in 2006. Because that latter deceleration is weak, southeast Greenland still appears to be losing ice mass at a much higher rate than it was prior to fall 2003. In a more general sense, the analysis described here demonstrates that GPS uplift measurements can be used in combination with GRACE mass estimates to provide a better understanding of ongoing Greenland mass loss; an analysis approach that will become increasingly useful as long time spans of data accumulate from the 51 permanent GPS stations recently deployed around the edge of the ice sheet as part of the Greenland GPS Network (GNET).