

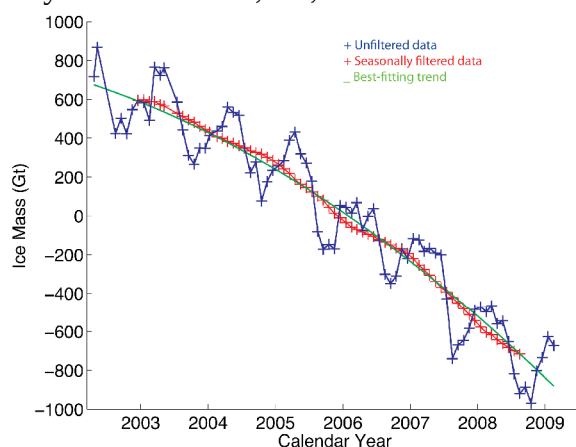
## GRACE Reveals Accelerated Mass loss of the Greenland and Antarctic Ice sheets.

Gravity and Mass redistribution in the Earth system: The Earth's gravity field is the result of the mass distribution in the complete Earth system, including solid Earth, oceans, atmosphere, ice, land, and biosphere. Mass redistribution in any of the Earth sub-systems changes the gravity field. Satellite gravity missions provide integral measurements of mass redistribution and transport from the whole Earth system including all sub-systems from the outer atmosphere to the center of the Earth.

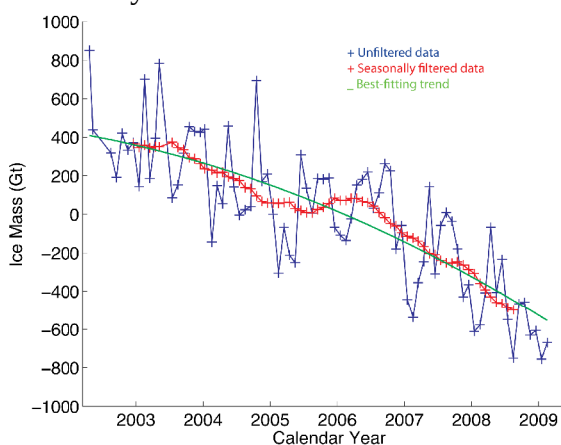
The Gravity Recovery And Climate Experiment (GRACE) provides the most accurate measurements of temporal changes in the Earth's gravity field. This mission has a designed lifetime of 5 years, and it is currently in its 8<sup>th</sup> year of operation. GRACE has demonstrated that satellite gravity missions have a *unique* capability to measure ice-sheet and glacier mass ablation or accumulation, terrestrial water storage change, and ocean mass variations. Measurements of net decreases in the masses of ice stored in Greenland, certain regions of Antarctica, and Alaskan glaciers provide direct quantification of the impact of climate change on processes contributing to global sea level rise.

*During the period of April 2002 to February 2009 the mass loss of the polar ice sheets was not constant but increased with time, implying that the ice sheets' contribution to sea level rise was increasing.*

Antarctica and Greenland are the Earth's largest reservoirs of fresh water. If they were to completely melt, the two ice sheets have the potential to raise sea level by about 70 m. Recent studies show that the ice sheets respond more quickly to climate perturbations than previously thought, particularly near the coast. The GRACE observations allow for the first time a direct measure of the mass loss of the entire Greenland and Antarctica ice sheets. Velicogna (2009) estimated that in Greenland the mass loss increased from 137 Gt/yr in 2002–2003 to 286 Gt/yr in 2007–2009, i.e., an acceleration of  $-30 \pm 11$  Gt/yr<sup>2</sup> during 2002–2009. In Antarctica the mass loss increased from 104 Gt/yr in 2002–2006 to 246 Gt/yr in 2006–2009, i.e., an acceleration of  $-26 \pm 14$  Gt/yr<sup>2</sup> in 2002–2009.



The trend line of Greenland ice mass (green) bends downward with time, suggesting that losses have been accelerating.



The trend line of Antarctica ice mass (green) bends downward with time, suggesting that losses have been accelerating.

**Reference:** Velicogna, I. (2009), Increasing rates of ice mass loss from the Greenland and Antarctic ice sheets revealed by GRACE, *Geophys. Res. Lett.*, 36, L19503, doi:10.1029/2009GL040222.