Rapid decay of the Greenland and Antarctic ice sheets?

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In Chapter 10 ("Global Climate Projections") of the Fourth Assessment Report (AR4) of the United Nations Intergovernmental Panel on Climate Change (IPCC), an increase of the mean global sea level by 18-59 cm for the 21st century (more precisely: 2090-2099 relative to 1980-1999) is projected for the six SRES marker scenarios B1, B2, A1B, A1T, A2 and A1FI (Meehl et al. 2007). The main causes for this sea level rise are thermal expansion of sea water and melting of glaciers and small ice caps, and to a lesser extent changes of the surface mass balance of the Greenland and Antarctic ice sheets. However, recent observations suggest that ice flow dynamics could lead to additional sea level rise, and this problem is explicitly stated in the AR4: *"Dynamical processes related to ice flow not included in current models but suggested by recent observations could increase the vulnerability of the ice sheets to warming, increasing future sea level rise. Understanding of these processes is limited and there is no consensus on their magnitude."* (IPCC 2007). These conjectured dynamical processes are (i) surface-melt-water-induced acceleration of basal sliding, and (ii) increased ice discharge due to reduced buttressing from surrounding ice shelves. The former process is probably more relevant for the Greenland ice sheet, whereas the latter may affect the stability of the West Antarctic ice sheet. On the observational side, recent results from satellite gravity measurements for the period 2002-2005 (Chen et al. 2006, Velicogna and Wahr 2006) indicate surprisingly large mass losses of 239 ± 23 km^3/a (0.66 ± 0.06 mm/a sea level equivalent) for the Greenland ice sheet and of 152 ± 80 km^3/a (0.42 ± 0.22 mm/a sea level equivalent) for the West Antarctic ice sheet, whereas the East Antarctic ice sheet seems to be almost in balance. Furthermore, major outlet glaciers of the Greenland ice sheet (Jacobshavn ice stream, Kangerdlugssuaq and Helheim glaciers) and the West Antarctic ice sheet (Pine Island glacier) have sped up drastically during the last 15 years, and a number of significant break-up events of Antarctic ice shelves have occurred. The above-mentioned processes and observations will be reviewed, and it will be attempted to quantify the range of uncertainty of future sea level rise due to ice-dynamical processes by numerical simulations.

References:

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