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The melting of the Greenland Ice Sheet – How does it affect global sea level?

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The ice loss in Greenland shows acceleration during the last decade. The upper range of sea level rise by 2100 might be above 1 m or more on a global average, with large regional differences depending where the source of ice loss occurs. The last assessment report from the IPCC from 2007 projected a sea level rise of 18 - 59 centimeter. However the report also clearly stated that not all factors contributing to sea level rise could be calculated at that time. The numbers from the last IPCC are a lower bound because it was recognized at the time that there was a lot of uncertainty about ice sheets. The current ice loss in Greenland is close to 1 mm global sea level rise per year.

Air temperatures on the Greenland ice sheet have increased by 4 deg. C since 1991. The ice sheet melt area increased by 30% for the time period 1979-2012, with record melt years in 1998, 2005, 2007, 2010, and 2012. The bare ice region, the wet snow region, and the equilibrium line altitude have moved further inland and resulting in increased melt water flux towards the coast. Warm and extended air temperatures are to blame for 5.2 m water equivalent surface lowering at the long-term equilibrium line altitude at the west coast of the Greenland ice sheet between 2000 and 2010. Increase in ice velocity in the ablation region and the concurrent increase in melt water suggests that water penetrates to great depth through moulins and cracks, lubricating the bottom of the ice sheet. New insight was gained of subsurface hydrologic channels and cavities using ground penetrating radar, and a video system during the melt peak in August 2007-2012. Volume and geometry of a 100 m deep moulin were mapped with a rotating laser, and photographs with digital cameras. Subglacial hydrologic channels were investigated using a tethered, autonomous system, several hundred meters into the ice. These new results will be discussed in view of the rapid increase in melt area and mass loss of the Greenland ice sheet due to increasing air temperatures.