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Uncertainties in estimating Greenland's long-term melt

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The Greenland melt season in 2012 exceeded by far any year in the satellite record since 1979 in terms of melt extent and duration. It may seem straightforward to link global warming to intense summers that facilitate a longer and more intense melt season but it is not. Many processes and feedbacks affect the surface mass balance of the Greenland Ice Sheet, the most important being accumulation of snow, surface melt, and refreezing. Regarding estimates, refreezing is the least understood (and least observed) process but the most important one regarding future estimates for which all processes will culminate in one big number that is relevant to society: global sea level rise which is one of the largest threats due to global climate change. In this exercise, I give some estimate on the individual processes adding to Greenland surface mass balance and discuss uncertainties in terms of process understanding, modeling, and observations.

Melting the entire Greenland Ice Sheet would culminate in a global sea level rise of 7m and melt rates are increasing since the beginning of the satellite era. But where the melt water finally ends up is poorly understood and, thus, a matter of uncertainty. This uncertainties is based on the poor understanding of Ice Sheet dynamics and relevant surface processes. To reduce uncertainties for future melt estimates we have to constrain model parameters to fit present-day and past interglacial conditions. Studying parameter sensitivities is a key to this kind of problem.