



Surface mass balance history of the Greenland Ice Sheet (1868-2005)

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We have reconstructed the recent (1868-2005) surface mass balance history of the Greenland Ice Sheet (GIS) on a 5 x 5 km grid using a runoff-retention model based on the positive degree-day method [Janssens & Huybrechts, *Annals of Glaciology*, **31**, p133-140, 2000]. We have extended this method to consider, for the first time, the influence of ice height changes on the mass balance estimates and have found this effect to be minor. The climatic input (precipitation and temperature) was assembled from ECMWF analyses for the period after 1958 and from a spatio-temporal correlation between coastal meteorological and ice core data and Polar MM5 output for the period prior to 1958. Our results show that the ice sheet is close to balance during the 1961-1990 climatological 'normal' period, with no significant change in ice thickness over the ice sheet. In contrast, during the temperature increases between 1920-1930 and 1995-2005, the ice sheet thinned at the margin while the centre remained more or less in balance, giving a net ice mass balance of approximately $-50\text{km}^3 \text{ yr}^{-1}$ or less during these periods. The warming during the 1930s is at least comparable to that experienced in the past ten years, and so our results lead us to the conclusion that the current changes in surface mass balance are not exceptional.