Geophysical Research Abstracts,
Vol. 10, EGU2008-A-05298, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-05298
EGU General Assembly 2008

The effect of surface runoff on enhancing basal sliding and ice-sheet sensitivity in a three-dimensional Greenland ice sheet model

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It is often stated that melt water percolating through the Greenland ice sheet may lubricate the bottom and enhance flow rates. Such a mechanism has been suggested as a positive feedback on downwasting of the ice sheet in a warmer climate with more surface melting. Many questions to this so-called Zwally effect have been raised, ranging from difficulties to explain meltwater percolation through more than 1000 m of cold ice, the relatively small amplitude of the accelerations observed in central West Greenland, and the erratic nature and/or absence of similar observations elsewhere on the ice sheet. However a full 3-D analysis of the potential significance of this mechanism to enhance the contribution of the Greenland ice sheet to future sea-level rise has hitherto not been performed. This is partly due to a poor understanding of the processes controlling basal sliding and their dependence on basal water pressure but also the neglect of longitudinal stress gradients in currently available whole ice-sheet models. As a first step we introduce here a simple linear sliding law in a three-dimensional thermomechanical ice-sheet model with a rate factor that depends on ablation. We take a maximum approach in that it is assumed that all surface meltwater reaches the bed. A basic sensitivity analysis of the linear sliding factor shows the influence of basal sliding on the ice sheet flow and on the ice sheet geometry. Based on the results of the sensitivity analysis, the sliding calculation has been further improved with a rate factor tuned to available observations of runoff and surface velocity. The poster presents the main results of the time-dependent changes in ice thickness, flow velocity, mass balance, surface elevation and basal conditions depending on basal sliding and gives

prospects for future work.