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The Effect of Solar Forcing on the Greenland Ice Sheet during the Holocene - A Model Study

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Abrupt climate changes did not only happen during glacials but also during interglacials such as the Holocene. Marine sediments provide evidence for the periodic occurrence of centennial-scale events with enhanced iceberg discharge during the past 11.000 years (Bond et al., 2001). These events were chronologically linked to reduced solar activity as reconstructed using cosmogenic isotopes (Bond et al., 2001), indicating that even an external forcing that is considered to be small, has a potential impact on climate due to several feedback mechanisms (Renssen et al., 2006). The interactions between climate and solar irradiance have been investigated using numerical models (e.g. Haigh, 1996; Renssen et al, 2006), but so far without dynamically computing the Greenland ice sheet and iceberg calving. Thus, the impact of solar variations on iceberg discharge and the underlying mechanisms have not been analysed so far.

To analyse the effect of variations in solar activity on the Greenland ice sheet (GIS) and the iceberg calving, as well as possible feedback mechanisms that enhance the impact of the total solar irradiance, we use the earth system model of intermediate complexity (iLOVECLIM, Roche et al., 2013), coupled to the ice sheet/ice shelf model GRISLI (Ritz et al., 2001) and to a dynamic-thermodynamic iceberg module (Jongma et al., 2009, Bügelmayer et al., 2014) to perform transient experiments of the last 6000 years. The experiments are conducted applying reconstructed atmospheric greenhouse gas concentrations, volcanic aerosol loads, orbital parameters and variations in the total solar irradiance. We present the response of the coupled model to different solar irradiance scenarios to evaluate modeled GIS sensitivity to relatively modest variations in radiative forcing. Moreover, we investigate the dependence of the model results on the chosen model sensitivity.

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