



Past and Future: Greenland melt water impact on the Atlantic meridional overturning circulation during past and future warm climates – a model study

Michael Blaschek, Pepijn Bakker, and Hans Renssen

VU Amsterdam, Climate Change and Landscape Dynamics, Amsterdam, Netherlands (m.blaschek@vu.nl)

A crucial unknown in future climate projections is the sensitivity of the climate system to melting of the Greenland Ice Sheet (GIS) and its potential impact on the Atlantic meridional overturning circulation (AMOC). Investigations of past climates are used to assess the sensitivity of the climate system to such a feedback. However, due to the extremeness of future anthropogenic emissions and the imperfectness of past analogues to future warming, it is questionable whether estimates of climate sensitivity from palaeoclimate-reconstructions are applicable to predicted future changes. We have therefore analyzed the impact of GIS melt water on the AMOC strength in two past warm climates (Last Interglacial and early Present Interglacial) and three future scenarios with three different model parameter sets. These model parameter sets represent three different model sensitivities to freshwater perturbation: low, moderate and high. They allow us to estimate the dependency of our results on our model choice. We find that in both the moderate and high sensitivity versions for GIS melt rates below 72 mSv ($Sv = 1e6 \text{ m}^3/\text{s}$), there are clear differences between past and future warm climates in the sensitivity of the AMOC to GIS melt. These differences are connected to the strongly seasonal varying sea-ice cover. However GIS melt rates over 72 mSv give similar reductions of AMOC strength in all cases. If we consider the low sensitivity version of our model, our results suggest that for any GIS melt rate the influence on the AMOC is remarkably similar and therefore independent of the background climate. Our results and implications are thus strongly determined by the parameter set considered. Nonetheless, two out of three model versions suggest that when proxy-based reconstructions of past AMOC sensitivity to GIS melt are interpreted for future predictions, it is likely that they are misleading, because of the different sea-ice response.