

Interactive comment on “Persistent influence of ice sheet melting on high northern latitude climate during the early Last Interglacial” by A. Govin et al.

Anonymous Referee #3

Received and published: 8 November 2011

This is a very well written and structured paper which examines the timing of peak Last Interglacial (LIG) climate conditions in the North and Southern Hemispheres, with an emphasis on high northern latitudes. They find from high resolution sediment records there is a delay in peak climatic conditions in the northern latitudes compared with southern latitudes attributed to persistent iceberg melting at the beginning of the LIG. As a result they infer weaker North Atlantic overturning circulation during the early LIG compared with the late LIG. Comparison with their model results, however, shows that insolation changes alone cannot explain this weakening and that in addition freshwater input is required.

The results presented here provide an insightful comparison between model and data for the LIG and emphasises the need for climate - ice-sheet modelling in order to un-

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derstand the peak climatic conditions of the LIG. As such, this manuscript addresses relevant scientific questions within the scope of CP.

Specific Comments:

Below are specific comments/questions that should be addressed, however, before publication:

1. There is virtually no description of the model used. A few sentence describing components, resolution etc would be useful. Furthermore, the performance of the General Circulation Model for modern day is not discussed at all in the model simulation description in section 2.2 and would be beneficial to the reader in order to put the LIG results into context.
2. A comment regarding the ocean model spin-up would be useful. The authors describe the length of the simulations accordingly as 250 yrs (126ka), 800 yrs (122ka) and 700 years (115ka). Is the ocean fully spun-up in the 126ka simulation? It is possible that you may not be making a fair comparison between the 126ka and 122ka simulations. Also, please state how long the 126ka simulation with a melt-water pulse included was run for. This is important because previous work with coupled climate ice-sheet models (e.g. Ridley et al., 2005) have shown that although freshwater input under a warm climate can lead to a decline in the overturning circulation they showed recovery after a few hundred years.
3. The authors are correct to state that the freshwater input is idealised and not realistic and that coupled climate - ice-sheet simulations are required to ‘realistically’ model this effect. However, they do not discuss in any detail what other mechanisms could affect the discrepancy between model and data. For example, more detail on the model sensitivity to sea-ice changes would be advantageous including model dependency. Another example could be changes to precipitation

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patterns that would occur over a smaller Greenland ice-sheet (e.g. as proposed by Otto-Bliesner et al., 2006). This would change the atmospheric freshwater input and hence potentially affect the overturning circulation. It would also have been interesting to perform sensitivity studies to different more 'realistic' freshwater inputs. Although I realise this is not possible I think that it warrants mentioning at least as future work.

4. It is also important to remember that this comparison with data only involves one model simulation and therefore weakens the conclusions to an extent. It would be very beneficial in the discussions and conclusions section to discuss these model results in the context of some of the previous studies that already exist. For example, comparisons could be made with Gröger et al. (2007, Palaeoceanography) who found a weakening of the overturning circulation at 126ka with only atmospheric freshwater inputs required. Furthermore, the sensitivity of different models to overturning circulation changes observed for future climate simulations should also be considered as outlined in the IPCC (2007) report.

Technical Comments:

Abstract

When mentioning the 126ka melt-water pulse simulation please state this was an idealised simulation looking at an extreme scenario of freshwater input.

Introduction

P3242, line 25-28: please rephrase this sentence since it is difficult to follow.

P3243, line 1: Please give the dates for the Late Saalian glacial periods in terms of thousands of years as well.

Model simulations

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P3246, first paragraph: Please mention the preindustrial greenhouse gas concentrations for reproducibility.

Model data comparison

P3256, line 29: Insert "the" before Fram Strait

Figures:

Figs 5 and 6. The shaded regions are not really red so perhaps change to orange.

Figs 3 and 4 have the labels (a) to (d) going from top to bottom on the panels while Figs 5 and 6 have them going from bottom to top. Please keep this consistent.

Interactive comment on Clim. Past Discuss., 7, 3239, 2011.

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