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Climate of the Past Discussions

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 #1

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This paper compiles existing records from the North Atlantic and Southern Ocean for the last interglaciation (LIG). The authors compare this compilation with existing climate model simulations for 126, 122 and 115 ka to test if insolation alone can explain a delay in LIG warmth in the North Atlantic. They conclude that persistent ice-sheet melting likely slowed ocean circulation until ∼126 ka, resulting in delayed LIG warmth relative to boreal summer insolation.

In general, I think this paper represents a nice review of previous work, placing the observations of delayed LIG warmth in context of one set of model simulations. The authors do gloss over certain problems, however, with their data-model comparison and do not compare their results with other model simulations that could lead to different conclusions. I think the paper is fine for publication once the discussion is increased

and justification for several of the approaches is further provided.

The authors should consider the climate simulations of Felis et al. (2004, Nature), who showed a spatially variable North Atlantic response to peak LIG insolation. Their simulation would explain much of the climate pattern observed by the authors without the meltwater forcing. Kaspar and Cusbasch (2007) also simulated a somewhat similar pattern, again without the need of freshwater forcing. Thus, I think the authors need to weaken their conclusions that the delayed warmth is caused by remnant ice-sheet melting as they have only used one model and other models show a similar climate map without needing meltwater.

The authors need to justify their approach for calculating d18Osw using SST effects on a deeper dwelling foraminifera test. The common means of d18Osw calculation is to use the calcification temperature determined from Mg/Ca to remove temp effects on test d18O. The authors here are using transfer function SST, which does not have to reflect the calcification temperature of the test. Indeed, why is the d18Osw of site 980 increasing while cores to the south are depleted? If this is to be from remnant ice melting, I would expect the d18Osw signal to be more depleted further north closer to the remnant ice sheets. Also, where does the CH69-K09 d18Osw depletion come from at ∼127 ka? IRD is ∼0 in the core at that point and the core is in the middle of the North Atlantic making me wonder about such a large d18Osw change not seen elsewhere and the applicability of the faunal SST to calculating d18Osw.

The authors should show the raw d18O from these cores so the reader can see what is a d18Osw change that is in the raw d18O record versus one that is based on the assumption that the SST corresponds to the calcification temp.

Where do the uncertainties on the core chronology come from? More justification is needed to explain the core chronologies if they are to be really +/-2.2 ka for a period with only two tie points used to make the age model. The authors subsequently rarely discuss the uncertainty in their interpretations, even using dates at 100's of years ac-

curacy. This should be dampened given the uncertainties (and what I think are overly optimistic based on the lack of justification) in the age model.

On the origin of the freshwater, the authors need to discuss their options beyond arm waving at some remnant ice melting somewhere. With $\sim$20 m of sea-level rise to go between 130-126 ka according to their line 26 on 3459, that's $\sim$0.06 Sv, much less than the 0.17 Sv they have in the 126 ka simulation. Has their model been run using just 0.06 Sv? Does it match the data? Greenland ice retreat would only be a smaller forcing, <0.01 Sv based on the Colville et al. (2011, Science) results that show that ice persisted on southern Greenland through the LIG, consistent with the lower end of of the Otto-Bliesner et al. simulations, or only $\sim$2.2 m of sea level rise through the LIG from Greenland. The authors should also include reference to "small" Greenland retreat suggested by NGRIP (2004) and Willerslev et al. (2007, Science) on line 20 of page 3260. What about an elevated hydrologic cycle with warmer wetter Arctic supplying more freshwater?

Can the authors add in a comparison of when the peak Holocene temps were reached in these cores when radiocarbon chronologies can be applied? If their mechanism of melting lingering ice sheets is correct for the LIG, wouldn't then the peak of the Holocene be reached at the end of the last deglaciation $\sim$7 ka in these some cores? I think such a comparison could supply further support for their hypothesis.

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