

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 #2

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General comments

This is a well-written paper, and a nicely designed study to evaluate the potential influence of sustained meltwater delaying the ocean thermal maximum in the high North Atlantic during the Last Interglacial period. If correct, the evidence for the concept that increased melting in the early Eemian (relative to the early Holocene) suppressed AMOC and ocean temperatures would be an important contribution our understanding of the evolution of the Last Interglacial. I do have concerns about the sediment core age models, especially for those in the Labrador and Norwegian Seas, which are critical to the thesis of the paper. Providing that the authors can satisfy my concerns, primarily about the LIG age models of the marine sediment cores, I recommend that this paper be published.

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Specific Comments

My primary concern regards age model development. First, for all of the Northern Hemisphere cores, I think that authors' assumption that sea surface temperatures ought to be synchronous with global methane concentration needs a bit more investigation. Global methane concentration is influenced by the extent and wetness of boreal forests, which clearly are at their maximum during interglacials, but it is also related to tropical hydrology and circulation among other phenomena, so it's not self-evident that North Atlantic SSTs and global CH₄ should be synchronous during the LIG. It might be a fair assumption, but I think it needs more justification than the observation that they appear to have been synchronous during the early Holocene. Secondly, and most importantly, the authors need to better justify the choice of tie points for the Labrador Sea and Norwegian Sea cores, since the choice of tie points here is directly responsible for when the peak warmth appears to occur. It seems to me that the small, single-point peaks in SST around 128 ka, could easily be interpreted to match the small rises in CH₄ that occurred between 133 and 129 ka, as they were in the “North Atlantic” cores (Fig. 3). Likewise, the peak warmth that occurs around 125 ka, could be assigned to the peak CH₄ concentrations around 128 ka. I recognize that there is more evidence than just the wiggle-matching between CH₄ and inferred temperatures, such as the onset of the diatom-rich sediments which were also observed in the Holocene, but the choice of tie-points, and the alternative chronology I suggested, need to be more fully examined and discussed, because if the alternative points are correct, the entire premise of the paper (late peak SSTs) falls apart.

The description of how *N. pachyderma* percentages were calibrated to, and converted into temperature on page 3245, lines 8–14, is confusing, and needs to be clarified. Furthermore, I'd like to see a more thorough analysis of the calibration; specifically, a full error analysis, so that error bars could be included with the SST reconstructions. Furthermore, it would be good to see how the choice of where to truncate the calibration set (e.g., rather than creating a regression using 10–94%, one could argue that 15–83%

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would result in a more robust relationship) would affect the inferred SSTs. Lastly, the authors were clear in stating that a freshwater flux of 0.17 Sv is too high to be considered realistic over for the whole early LIG, and so the freshwater-melting simulation is to be considered an upper limit estimate. That said, it would have been really interesting to see how a more realistic estimate of the flux, even if not included dynamically in the model, would be simulated in the model, and whether it could potentially explain the suppressed warming in the North Atlantic. I realize that it's likely impossible to conduct such an experiment at this point, but it also means that the question of whether a realistic amount of meltwater could, by itself, drive the reduced AMOC and cooler early-LIG temperatures.

Technical Corrections

3244, line 15: Sea Surface Temperature and Ice-Rafted Debris should not be capitalized.

3244, line 20: replace "1,95" with "1.95"

3245, 15-19: Consider replacing or supplementing this discussion with the explicit equation used to calculate $\delta^{18}\text{O}_{\text{sw}}$

3248, 20: replace "at midpoint" with "at the midpoint"

3256, line 27: the second point begins "A mechanism involves". Please be explicit about what this mechanism is, or otherwise clarify this sentence.

Figures 5 and 6, in all of the other figures, the figures are labeled with a,b,c... , descending from the top, but in these figures they letters begin at the bottom and go up. This should be made consistent between figures, preferably descending.

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