

Interactive comment on “Interdependence of the Northern Hemisphere ice-sheets build-up during the last glaciation: the role of atmospheric circulation” by P. Beghin et al.

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We thank the reviewer for his comments. We made a revisited version of the paper which take into account the comments and remarks of all reviewers. Here are the responses of the specific comments :

Page 2197, Line 24: “Although: : :” is an incomplete sentence.

The text has been modified.

Section 4.4: The simulations seem to end at 15 ka. Out of curiosity, why not run the simulations through to present day? I suppose there would be related effects concern-

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ing deglaciation based on the same processes. It would be interesting to see how the ice sheets interplay during this time period too.

We acknowledge that it would have certainly been interesting to investigate the interplay of ice sheets throughout the last deglaciation. Actually, in the version of the model used in this study, we neglected some processes that have been shown to play a major role in the deglaciation process like the impact of dust deposition on snow albedo or the temporal variation of daily amplitude of temperature. Our choice is motivated by the necessity of better constraining the mutual influence of past Northern Hemisphere ice sheets driven only by changes in atmospheric circulation, without accounting for the potential influence of these factors. However, this model configuration prevents from a satisfactory simulation of the last glacial termination. This is why we focused our analysis on the 126-15 ka period. However, we acknowledge that our motivation should have been better explained. Therefore, in the revised version of the manuscript, we described more thoroughly our approach (see end of section 3.3)

Figure 4: The time series plots of the various ice volumes is interesting, but somewhat difficult to understand. Would it additionally be possible to extract more universal relationships between the two ice sheets by plotting FIS-volume vs LIS-volume, for example? Also, why does the legend for the dashed lines appear twice above the figure?

In this study, we put forward two mechanisms involved in the relationship between ice sheets :

- The first one, easy to understand, is the local cooling induced by the growth of one ice sheet. This cooling spreads over the Arctic and helps the other ice sheet to grow. If this mechanism was the only one to operate, the growth of one ice sheet would induce the growth of the other one.
- The second mechanism that we highlighted is linked to the atmospheric circulation. This mechanism involves more complex relationships between ice sheets. As an example, the growth of the LIS implies a western shift of the accumulation area over the

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LIS, promoting the westward extent of the LIS. This accumulation pattern is progressively displaced towards eastern longitudes (0° - 180°) and leads further to the growth of the eastern part of the FIS. At the opposite, a larger LIS seems to decrease snow fall in North Atlantic until Scandinavia, slowing down the formation of ice sheet in this later region. The influence of the atmospheric circulation is particularly significant when the SLP parameterization accounts for the topography.

Finally, we have also demonstrated that ice sheets evolve differently depending on the history of the glaciation process : for example, is the FIS is growing, the impact on the LIS is different if the LIS is already very large (in this case, the LIS ice volume decreases : see figure 7, ORO-FIS at 40 ka : the FIS is growing and at the same time, the LIS ice volume is decreasing) or if the LIS is small (the LIS will grow). These effects demonstrate that the influence of the LIS on the evolution of FIS is not direct and is associated to several feedback processes. Therefore, plotting FIS-volume vs LIS-volume does not display a universal relationship. However, we tried to plot the request figure, but the trend we observed was essentially a simultaneous growth of both ice sheets. This is due to the fact that our experiments were conducting during a glaciation, during which the two ice sheet are supposed to growth. To find a direct relationship between the LIS and the FIS, it would have been more appropriate to make equilibrium experiments. (it is actually what we are working on now!)

We agree with the reviewer concerning the figures 4 and 7 : these figures are difficult to read, but we did not manage to simplify them further without removing some crucial information. One of the problem in the original version of the manuscript was that dotted and dashed lines were not really distinguishable in the figure captions. In the revised version, we made them clearer.

Figure 8: Is it true that panel (a) and (b) are identical? Is this an error? The scales are supposedly different but the patterns seem indistinguishable, which is surprising.

Yes, there was an error : both panels were indeed identical. Figure 8 has been change

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in the revised manuscript.

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