

***Interactive comment on “The key role of topography in altering North Atlantic atmospheric circulation during the last glacial period” by F. S. R. Pausata et al.***

**Anonymous Referee #2**

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The manuscript by Pausata et al. deals with the influence of separate and combined effects of key boundary conditions of the LGM on the mean state and variability of the atmospheric circulation. In contrast to previous studies addressing similar questions the investigations in Pausata. et al. are based on fully coupled model simulations. This is important, since the model design with a fully dynamical ocean component allows for a broader representation atmosphere-ocean interactions and associated feedbacks. The different simulations comprise the preindustrial and the LGM control runs, plus 4 sensitivity experiments testing the isolated influence of greenhouse gases, albedo, topography and ice sheets.

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Based on the analysis of mainly, sea level pressure anomalies, surface air temperature pattern in combination with heat transport changes in the coupled atmosphere - ocean system the authors confirm and extend the findings by previous studies (Justino et al., 2005; Pausata et al., 2009), suggesting a dominance of glacial topography in determining the atmospheric response. The main feature that distinguishes this work from previous work is the finding that North Atlantic sea surface temperatures are of minor importance in influencing the North Atlantic atmospheric circulation under LGM conditions. However, this important result is not sufficiently supported by the presented results.

What has been shown is that the atmospheric circulation and its variability are similar under full glacial conditions (experiment LGM) and in a climate state with preindustrial boundary conditions, but with glacial topography(experiment LGMtopo). While this is an interesting result it doesn't prove that North Atlantic sea surface temperatures do not substantially affect North Atlantic atmospheric circulation in the LGM.

Such a statement needs to be substantiated on the basis of full glacial boundary conditions, because the potential implications are fundamental for a deeper understanding of glacial climate dynamics. In particular the role of North Atlantic atmospheric circulation changes relative to sea surface temperatures changes and their influence on stadial-interstadial climate variations in the North Atlantic are of special interest. One potential test could be a classic freshwater release experiment in the North Atlantic to generate sea surface temperature changes in the Atlantic via changes in the Atlantic overturning circulation, while all boundary conditions are in full glacial conditions.

Specific comments.

- Line 23 'Each equilibrium experiment is 500 years long' – This integration length seems to be quite short in order to achieve equilibrium conditions. Therefore, it would be helpful if the authors present for instance the trend in global annual mean surface temperature, which should be no larger than -0.05 K/Century.

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- In the context of the presentation of the northward heat transport differences in Fig. 5, a brief discussion of the different Atlantic overturning states in comparison to data (e.g. strength and latitudinal extent) would be appropriate.

In summary I suggest that the authors investigate the impact of SST changes on the North Atlantic atmospheric circulation in more detail to provide a robust basis for their interpretation and conclusions. Therefore, I recommend to accept the paper for *Climate of the Past* with major revisions.

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Interactive comment on *Clim. Past Discuss.*, 7, 575, 2011.

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