

## ***Interactive comment on “Deciphering the spatio-temporal complexity of climate change of the last deglaciation: a model analysis” by D. M. Roche et al.***

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Review of the paper: Roche, D. M. Renssen, H. Paillard D. "Deciphering the spatio-temporal complexity of climate change of the last deglaciation: a model analysis" Climate of the Past Discussion paper 6, 2593-2623, 2010

In this manuscript, the authors aim to gain a better understanding of the global climate system during the last deglaciation, through a coupled transient simulation using the LOVECLIM model. The purpose was to study the outcomes of the major, slow types of forcing, and therefore no potentially abrupt forcing parameters like glacial meltwater were included. The model results were not evaluated against data, but were investi-

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gated using elementary statistical significance tests to highlight important spatial and temporal changes in the model output.

The main results of this study include the identification of the areas most likely to be the first to respond to an orbitally forced warming (deglaciation onset); the northern Atlantic and Labrador seas and the Southern Ocean, where sea ice production was suggested as the important responding mechanism. The results also indicate that caution is needed when leads or lags are inferred in the interpretation of model results or proxyrecords of the deglaciation. A last important finding for both model and proxy data, is that the definition of the time frame of climate change (as a time long enough to permit detection against background noise) will vary depending on the time series length and the spatio-temporal resolution, and hence must be seen in relation to what is studied.

The conclusions are of interest to a wide audience of scientists working with models as well as data. The manuscript is well written (with a few small errors and difficult wordings, specified below), well structured and has good illustrations. All the author's conclusions are reasonable and do not go beyond the limitations of the model.

1. Does the paper address relevant scientific questions within the scope of CP? YES
2. Does the paper present novel concepts, ideas, tools, or data? YES
3. Are substantial conclusions reached? YES
4. Are the scientific methods and assumptions valid and clearly outlined? YES, but requires some added discussion (see specific comments below).
5. Are the results sufficient to support the interpretations and conclusions? YES
6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? YES
7. Do the authors give proper credit to related work and clearly indicate their own

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new/original contribution? YES (a few more references are suggested, see below).

8. Does the title clearly reflect the contents of the paper? YES

9. Does the abstract provide a concise and complete summary? YES

10. Is the overall presentation well structured and clear? YES

11. Is the language fluent and precise? YES (Given that some difficult sentences are changed, see below)

12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? YES (Given suggested changes, see below)

13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? YES (small changes to text and figures, see below)

14. Are the number and quality of references appropriate? YES

15. Is the amount and quality of supplementary material appropriate? N/A

Specific comments (suggested changes after -> symbol) P2594, L5: “Though many studies have focused at a complex understanding of...” - semantic question: can understanding be complex? I suggest to rephrase: “Though many studies have focused on a detailed understanding of the complex sequence...”

P2594, L12: “...freshwater forcings that have led to rapid climate shifts -> “...freshwater forcings that potentially cause rapid climate shifts...”

P2596, L5: “...an ocean (CLIO) and a vegetation (VECODE)...” -> “...ocean (CLIO) and vegetation (VECODE)...”

P2596, L18-19: realistic bathymetry = LGM bathymetry? Adopted from where, at what resolution, re-interpolated (re-gridded) using what algorithm to fit your model resolution? This should be stated. Also see comment for P2597, L22-28.

P2596, L26-27 – P2597 L1-2: The overestimated precipitation over the Arc-

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tic and North Atlantic in LOVECLIM has been described previously, e.g. Renssen et al. 2001 (GRL 28, p. 1567-1570), and [http://www.pik-potsdam.de/emics/table\\_of\\_emics\\_08.02.pdf](http://www.pik-potsdam.de/emics/table_of_emics_08.02.pdf). Please cite the most relevant reference for this.

P2597, L22-28: You state that you use ICE5-gV1.2 for the ice sheet evolution. This is incorporated with (and inseparable from) a glacio-isostatic model (Peltier 2004), already taking changes in sea level in account. You thus “lock” the land-sea mask in LGM-state for the climate reconstructions, while the ice is allowed to change in accordance with changes in the land sea-mask, because you adopt the ICE-5g-time slices as fixed ice states and interpolate between these (how this was performed needs also to be stated). What implications does this have for the modeled climate evolution? Please comment this in the (good but insufficient) discussion on the land-sea mask implications.

P2599, L14-17: The simple and effective scheme for statistical testing is a good part of the paper, and is pedagogically described. However, it should be stated that it's the sample variance that is used in the test, and it should be denoted  $[\sigma]^2$  (“[sigma]” normally refers to standard deviation, and the total variance is denoted “s<sup>2</sup>”). Using the tvalue  $>1.962$  gives anomalies that are significant at the 5% level ( $P=0.05$ ), not 95% (probably confusion with confidence intervals). You also write “When variances. . . If not, we make use of. . .” which is a bit confusing (when-if). Suggestion: “When sample variances. . . When not, we make use of. . .”

P2600, L22-24: Please clarify whether the part about “local orbital forcing” and not “delayed response to NA warming” was proposed by or contradicts the referred papers (Duplessy et al., 2007; Renssen et al., 2010).

P2601, L23: “depicted by those to samples” -> “depicted by those two samples”

P2602, L25: “Not all proxies for climate change as well as not all regions of the world do exhibit. . .” -> “Not all proxies for climate change, nor do all regions of the world

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exhibit. . .”

P2608, L14: “understood within slowly vaying forcing framework.” -> “understood within a slowly varying forcing framework.”

Figures: Fig 4, 5, 7-9: Add “°N”, and “°E” or “Latitude (°)” and “Longitude(°)” to map axes.

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Interactive comment on Clim. Past Discuss., 6, 2593, 2010.

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