Response to reviewer 4

For easier reading, we have reproduced the reviewer's comments (in black) and give our responses in blue.

The paper "Glacial fluctuations of the Indian monsoon and their relationship with North Atlantic abrupt climate change: new data and climate experiments" presents interesting results based on a marine sediment core from the Bay of Bengal and based on climate model experiments in coupled and uncoupled mode using the IPSL_CM4 model. A focus of the paper is to interprete oxygen isotope variations in the sediment data in terms of glacial fluctuations of the Indian monsoon and to link these fluctuations to abrupt climate change in the North Atlantic realm. The model experiments are set up to achieve a better understanding of the atmospheric teleconnections contributing to the signal found in the marine sediment and to identify key ocean regions involved. The numerical experiment design is reasonable and provides insight into glacial atmospheric anomalies associated with North Atlantic Heinrich events. In general, the paper is written in a very clear way and should be published in CP. But I have a few (mostly minor) comments to be addressed before publication.

We thank the reviewer for his suggestions and corrections.

- Section 2: From the literature, it seems that data from core MD77-176 have already been published quite some years ago. Therefore, the authors should provide some historical perspective on their sediment core analysis by stating in which respect their proxy analysis is new or builds on formerly published records which are now interpreted differently. The authors might want to check whether the symbols of d18O, d_w and GISP2 d18O (not explained on p. 6275) are used consistently in the paper.

The high resolution isotopic record of the core MD77-176 is a new record. It has never been published before. The SST record is also a totally new record. The only use of the isotopic data of this core was made by Duplessy et al., 1982.

- Section 3.1: Is the hosing simulation (p. 6279 l. 13) branched off the LGMc? I would add this for clarity.

The hosing simulation does not actually branch off the control simulation LGMc but from an intermediate simulation (which we do not present here). This precision is now added in the text.

What do you actually mean by "integrated climatologies" (p. 6279 l. 18)?

"integrated" has been replaced by "computed" since this is what we meant.

Also, it is not fully clear how the three initial states of the AMOC-off simulation have been chosen (p. 6280 l. 19).
The three initial states have been arbitrarily chosen to be 50 years apart.

- Section 3.3: The names of the regions (North Atlantic, tropical Atlantic, Indian/Pacific Ocean) could already be given near l. 8 (p. 6283).
Fine.The regions are now defined earlier in the section.

- The approach of prescribing SST in a certain region to force an AGCM has already

quite a history. It is reasonable to use this approach to address the questions of this paper. But since the AGCM sensitivity experiments are a central point, it would be good to mention this approach already in the introduction and to refer to this kind of modelling approach in the literature (e.g. Lau and Nath 1994 J. Climate Vol. 7; Kharin 1995 Clim. Dyn. 11 and References therin).

Fine. The fact that this approach has been widely used for other topics is now mentioned in the introduction. We now better describe (in the introduction) the results from Kucharski and colleagues who precisely use this approach in papers very relevant to our topic. This better highlights the importance of such experiments.

- Section 3.3 near p. 6285 ll. 25-29: I am not fully convinced by this. From Figs. 5 and 6, it looks as if the Pacific SST produces anomalies of opposite sign than in Figs. 5a and 6a. I would rather stress the importance of the tropical Atlantic SST which really seems to contribute most.

We have reformulated this paragraph to make it clearer.

- Section 3.4 and Fig. 8: You should specify more clearly how you define the ocean transport.

We thank the reviewer for spotting this missing information. It was actually the maximum total ocean heat (and not mass, there was a mistake in the units given in the legend) transport in the Atlantic (the maximum is searched between the equator and 25°N).

- Conclusions: Given the papers by Kucharski et al. and others who discuss the teleconnection between tropical Atlantic and Indian monsoon, I would be careful with the expression "new teleconnection pathway" (p. 6289 l. 5). You should state more clearly that you applied the hypothesis (importance of tropical Atlantic SST) to glacial climate / abrupt climate change.

We have removed the expression “new teleconnection pathway” and added a sentence explaining the mechanism outlined by the works of Kucharski.

- p. 6270 l. 10: I suggest to include an expression like "complex", "Earth System", "general circulation" to indicate the type of model.

Fine, done.

- p. 6270 l. 26: from... Something is missing here.

Yes, this seems to be a technical problem with the referencing. It should read from Yanase and Abe-Ouchi, 2007.

- p. 6271 l. 2: A reference for these modelling studies showing the reduced moisture transport would be helpful.

This was the information missing (previous comment) which should now be visible.

- p. 6271 l. 20: "as shown in speleothem"

Corrected, thank you.

- p. 6271 around line 27 and Fig. 1: I think a surface salinity map would be helpful to illustrate these structures

A salinity map is now used as a background map to describe the core location (Figure 1)

- p. 6272 l. 8: missing: "by"

Corrected, thank you.

- p. 6273 l. 7, 11: Since the authors list of this article is different from Kageyama et al. (2009), I would try to present it more neutrally (also p. 6282 l. 21).
This has been corrected, thank you.

- p. 6273 last paragraph of Introduction: The outline should be done at the Section level only and not for subsections.
The reference to subsection 3.4 has been removed.

- p. 6274 l. 16 and Fig. 2: Including a reference for this coefficient is suggested.
The dissimilarity coefficient is now defined.

- p. 6277 l. 17: summer/winter precipitation ratio - This needs a reference.
The reference to Wang et al, 2001 is now re-quoted here. This is the original interpretation of the Hulu Cave data.

- p. 6277 l. 24: missing "of"
Corrected, thank you.

- p. 6278 l. 11: I would write "model analysis".
Yes, thank you for the suggestion.

- p. 6278 l. 21: with a resolution of 96 x 71 x 19 gridpoints
Corrected, thank you.

- Sometimes you write Last Glacial Maximum, sometimes last glacial maximum (same for Indian Monsoon / Indian monsoon)
This is right. We have attempted to be more consistent in the new version, by using “Last Glacial Maximum” and ‘Indian monsoon”

- p. 6280 l. 28: confidence intervals - better write "the significance is not shown"
Corrected, thank you.

- p. 6281 l. 9 and Fig. 4: This Figure does not really show the Southern Ocean.
This is right. We have added a (not shown) next to the mention of the Southern Ocean to avoid misleading the reader.

- p. 6281 l. 13: delete "experiment"
Corrected, thank you.

- p. 6281 l. 15: Please also mention the even stronger increase of precip. further to the south seen in Fig. 4b.
OK, done.

- p. 6282 l. 6: Are you sure about the units? Giving some absolute numbers would be interesting for comparison with modern observations.

We have checked the units and they are right. It would not be very meaningful to compare the values of the runoff with present observations since these are all glacial state experiments. We believe that it is the relative anomalies which are the most relevant here so we have not added more numbers, which would make the text even less clear.

- p. 6282 l. 20: This structure seems much more large-scale and not only confined to the Himalaya.

This has been corrected to: “upper tropospheric cooling over most of Eurasia”

- p. 6283 l. 14: rephrase: "of the coupled simulations presented in the previous subsection"
OK, done.

- p. 6283 l. 23: "north of 30 N" instead of "above 30N"
Sorry, this has been corrected.
- p. 6284 l. 13: rephrase "reciprocate the precipitation results" to "reproduce the results" (also l. 23)
Corrected, thank you.

- p. 6285 l. 20-21: I have difficulties seeing this. This rather seems to be true for the open Indian Ocean than for the Bay of Bengal.
This has been corrected to “the western Bay of Bengal and the eastern part of India” which might be a more correct description of the regions in orange/red on Fig.6d.
- p. 6286 l. 22: "contribution to" instead of "component of"
OK (this text now appears in the introduction).

- p. 6288 l. 22: rephrase this sentence, it is a bit hard to read
Ok, sentence rephrased.

- p. 6289 l. 4: I would write "regional" or "regionally confined" instead of "local" here.
Ok, this has been corrected.

- Figures: Using a),b)... for the Figs. 3 and 8 would help for the captions. The long part in brackets in the caption of Fig. 3 is not directly obvious. Please rephrase.
a)b)... are now being used for Figs. 3 and 8.
Figure 3 has been updated, the caption is therefore new.

- Fig. 4: I would place JJAS (June to September mean) in front of (a) as it refers to all subfigures.
OK, done.