Clim. Past Discuss., 10, C1358–C1362, 2014
www.clim-past-discuss.net/10/C1358/2014/

Climate of the Past Discussions

Interactive comment on "Global sensitivity analysis of Indian Monsoon during the Pleistocene" *by* P. A. Araya-Melo et al.

P. A. Araya-Melo et al.

pablo.arayamelo@uclouvain.be

Received and published: 22 August 2014

We appreciate the various comments provided by the second referee, Guangshan Chen. They had helped us to improve various aspects of the paper.

One of the main concerns of the referee was the selected region to study the Monsoon. We wanted to make the use of the emulator as the main focus of our paper, and show its application in a well studied climatic phenomena, the Indian Monsoon. We therefore chose the study of Zhao et al. (2005) as our guide for comparison, since its study of the Indian Monsoon is quite complete, We used the region they chose for their study as it would provide a direct and easy comparison with our results.

However, we agree with the referee that the region chosen included most of the Tibetan

Plateau, which could have an impact on land temperature and land precipitation, as was pointed out by the referee. In order to see the potential effect that this region may have on the study, we will present in a separate supplement material the same study but selecting the region suggested by the referee, as it appears in his paper, Chen et al. (2011).

In this supplement material, we will follow the same steps described in the main text for the construction of the emulator, its validation and its application, and we will present the same analysis in order to provide a fair and concise comparison.

1 Comments in detail

1. In the introduction part, please give some introduction to what is a global sensitivity analysis (VS local sensitivity analysis). It is very easy to make climate modelers to understand it as global of the world.
We added a short definition of what global sensitivity analysis is.

> Global sensitivity analysis allows the study of several variables that are allowed to vary through a selected range.

2. Please check the spelling of "Paleoclimate". We followed the European convention for spelling Paleoclimate.

3. In the introduction part, please mention that currently with long transient simulation and cross-spectrum analysis, climate modelers do can distinguish the individual effect of some factors. Please see the reference at the end of

comments.
We agree, and we will include the reference in the revised text.

4. Page 1614, Line 9: change to reference to (Gordon et al., 2000)

Correct. Changed in the text.

Following the Latin Hypercube sampling, the maximum combination of M divisions and N variables is $(M!)^{N-1}$. For example, M=4 divisions and N=3 variables, it would have 576 possible combination. So for this study, M = 10 and N =5. I could see there would be lot combinations. I would like to know how the authors decided to have 57 combinations.

That is correct ! There are many possible latin hypercubes, and not all have equal merits. That is the reason why statisticians have developed theories and algorithms to chose optimum latin hypercubes. We now make this more clear:

> Theoretical considerations and experience point to the latin hypercube design (McKay et al., 1979; Sacks et al. 1989, Morris and Mitchell, 1995; Samtner, 2003, Urban and Fricker, 2010) as a good starting point for computer experiments. Such designs are said to be space-filling. The principle, for a latin hypercube design of n elements, is to divide the ranges covered by each input factor into n distinct categories, each experiment sampling one of the n categories without 20 replacement. However, many latin hypercubes could be constructed in this way, and the design most appropriate for emulation should satisfy additional constraints (Sacks et al. 1989). Following Samtner, 2003 p. 167 and Joseph and Huang (2008) we combine two criteria. First, we select, among the possible latin hypercube designs, those maximising the minimum Euclidean distance found between any two

> design points. This is called the maxi-min criteria. Among those designs, we chose those maximising the determinant of $X'X$, so that the resulting design is also near-orthogonal.

Regarding the number of 57 experiments, this is explained in the text:

> Table 1 lists the simulations with their input parameters. The choice of 61 members is a conservative implementation of the recommendation of 10 experiments per input factors Leopky et al. 2009. In fact, a first 57 member design was produced using the method above, to which 4 members were added (exp. 20–23).

Comments 6 through 12

These points deal extensively with the emulator technique. We can see that this is a major concern as reviewer 1 also made useful and insightful comments.

Given that the detailed comments posted by the second reviewer are similar to those pointed out by the first referee, we went thoroughly through section 2.3 and 3 of the article, making the necessary changes to provide a much more detailed description of the emulator. We refer to the comments posted to the first referee and to the upcoming revised version.

13. For figures, I would recommend the authors rearrange all the figures according the order appeared in the text. I have pain to look at the figures back and forth.
We realized the order of the figures and this has been changed in the revised verison of the text.

We are confident that the changes we will implement in the manuscript will improve its clarity and understanding. We once again thank the referee for the comments and corrections.

Interactive comment on Clim. Past Discuss., 10, 1609, 2014.