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

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We are grateful to Y. Yu for this interactive comment.

- **1. Please describe the physical meaning of the emulator method.**

  We agree that the emulation methodology is reasonably new to climate science (though there is some previous work, including by, e.a. A. Schmittner and N. Edwards that will be better referred to in the revised version), and we understand the need of helping the audience by giving them key get a better intuitive grasp. For this reason, we have followed this comment as well as reviewer #1's suggestions of better describing the meaning of the parameters λ. In addition, we supply a

tutorial video in supplementary material.

- **2. Four variables are selected in the manuscript in order to describe Indian monsoon, authors had better explain why these four variables are chosen.** It is a fact that four variables only incompletely describe monsoon dynamics. Let's face it: emulation is complex, and monsoon is complex, and so we needed some compromises to convey the concept. In particular, we followed the choices of Zhao et al. (2005) to define box boundaries, and even though more information would admittedly be needed to fully capture monsoon dynamics, we found that it was enough for showing how the emulator works, demonstrate its potential as an investigation tool. Our purpose was clearly to make a proof-of-concept. This said, following reviewer 2's comment, averages over different boxes were analysed.

- **3. P1610, L13-14, the authors mentioned âĂŽ"detect potential non-linear" in the abstract, but it seems to the non-linear process is hardly touched in the text.**
We now better emphasize and show, for example, that the response to obliquity is more linear than that to precession. This said, the question of linear vs non-linear response is more systematically developed in a companion paper submitted to Earth System Dynamics: www.earth-syst-dynam-discuss.net/5/901/2014/

- **4. P1628, L5-10, Figure 5 of Williams et al. (2001) is related to global mean temperature response to CO2 doubling, but this manuscript just discussed local temperature response in Indian Ocean or continent. So these are different issues, and it is not necessary to combine them in this manuscript.** Figure 5 of Williams et al. 2001 are spatial maps. This is precisely for that reason that we refer to that article because, indeed, it shows more than just global averages. **Minor comments** Typos and minor corrections are naturally considered. If we compare to 2x or 4x CO_2 scenarios that are generally considered for anthropogenic climate change, the variation of CO_2 over the Pleistocene are,

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after all, fairly model. There is little direct effect of Pleistocene CO_2 changes on atmospheric and oceanic circulation, and these variations are mainly felt through their radiative effects on CO_2. We did not find this that surprising, but the revised version of the text makes this a little bit clearer.

Regarding the difference between exp. 11 and 15 : it is not sure that a difference with ensemble mean would be really more relevant, because the ensemble would be an average over all ice configurations : the ice signal will therefore dominate the anomaly. A better approach would be to plot the difference between the spatial distribution of temperature obtained with the simulation, with respect to that predicted by the emulator, but this approach requires a spatial emulator. The spatial emulator is out of the scope of the present article, but this approach is used in the companion paper submitted to Earth System Dynamics referred to above.

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