

## ***Interactive comment on “Investigating the consistency between proxies and between proxies and models using data assimilation: a mid-Holocene case study” by A. Mairesse et al.***

### **Anonymous Referee #2**

Received and published: 17 September 2013

The paper "Investigating the consistency between proxies and between proxies and models using data assimilation: a mid-Holocene case study" by Mairesse et al. investigates how climate models behave while proxy-based temperature reconstructions are assimilated in the models. It seems to force climate models to better match to climate reconstructions, and hence provides very interesting diagnostics on why models and proxy-based reconstructions do or do not fit in some cases.

I am not an expert in climate models, so I find the method very elegant and insightful. I suggest the manuscript should be published after moderate revisions as detailed below.

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I agree with the comments made by referee 1. I also feel more discussion should be introduced to precisely diagnose what's happening while data are assimilated.

For example, I would have appreciated some more basic information/description of the model behavior when, once data are assimilated, atmospheric and/or oceanic circulation patterns are shifted. Are there key records that push or pull North or South some of the atmospheric/oceanic features towards some kinds of directions, in a way that it can be easily described with an ezra figure? Having a kind of example to put things more into context might help the reader who is not familiar with data assimilation to better envision what is occurring in the model once data are assimilated.

In the same vein, there is a lack in the description of the assimilation procedure of some firm explanation on how strongly the data assimilation forces the model to drift from an unperturbed response. Can you please specify a little more how data assimilation weight in the model run? In other words, can data assimilation be considered as a kind of forcing, or does it modify only the likelihood that a model falls into one state or another? Such kinds of things are still unclear to me, and I think the authors should try to explain it in a way which can be easily understood by people not involved in climate modeling.

minor comments:

page 3954, line 15-16: the sentence suggests that the fact that data assimilation improves the agreement between data and models. As it stands, it sounds like something not obvious, but my understanding of the procedure is that, by design, constraining models with data are done to improve model-data comparison. Would it be better to state "This assimilation leads to improving the consistency. . ." in such case?

page 3955, line 21-27: Schneider et al., 2010, Paleoceanography, not Lohmann 2012, were the first to observe this model-data mismatch in terms of magnitude, and so should be cited as well.

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page 3963 lines 1-4 and page 3968 lines 13-15: The paper by Risebrobakken, 2003, Paleooceanography is cited many times and pointed as a SST record which might be representative of subsurface temperature. Although it is a nice test for the data assimilation robustness - so that temperature record and the discussion associated with that record should be kept - please be aware that another alkenone record from the same site (Clavo et al., 2002, QSR) shows a temperature warmer than the one from Risebrbakken by at least a couple of degrees celcius. That paper should be cited to justify your sentence from page 3968 lines 13-15.

pages 3964-3965, the two last sentences of that paragraph: please comment and describe a bit more those points, in particular by using better the figures to highlight your point.

I re-emphasize, as Reviewer 1, that figures are much too small, in particular the size of the markers that spot the climate records.

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Interactive comment on Clim. Past Discuss., 9, 3953, 2013.

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