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Climate of the Past Discussions

Interactive comment on "Influence of orbital forcing and solar activity on water isotopes in precipitation during the mid and late Holocene" *by* S. Dietrich et al.

Anonymous Referee #1

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Summary:

The authors examine the temperature and d18O responses to different orbital and solar activity forcings during the Holocene using an isotopically equipped AGCM. This is an important idea. It is unique among isotope-GCM studies in examining the effects of different external forcings through explicit simulations. The contributions of these forcings are usually inferred from different proxy records; this paper attempts to fill a gap in trying to understand these relationships mechanistically. Other modeling studies have conducted similar experiments in forcing models with different orbital, solar and GHG characteristics. But, to the best of my knowledge, this is the first to try and understand

their individual contributions and how they interact, and therefore uses the model to its full potential. The paper is generally well-written, aside from the odd awkard phrase.

I have a major concern, however, which is that the 10-yr runs were simply too short. The main result of the paper is that the d18O response to different forcings is difficult to identify. But I suspect that this 'complexity', as the authors state, could be absent if longer time slices were used. LeGrande and Schmidt (2009), for example, which makes for the most direct comparison, used a lower resolution A/O model, but their analysis was based on 100yr time slices. As a result, their precipitation d18O response at 6K was more coherent and statistically robust, over the Eurasian land mass, for example. The correspondence between the T and d18O change at 6K was indeed not straightforward in many regions (i.e. Europe), but one feels much more confident because of their longer simulation. I understand the effort involved in conducting these simulations –and am loathe to make this demand- but feel that the authors need to conduct several sensitivity tests with longer runs before they can draw their main conclusion. Perhaps they have already been conducted and the results were found to be insensitive to the run length, in which case this should be mentioned. Otherwise, the most straightforward approach would be 2 longer runs, perhaps at a lower resolution, for end-member forcings which have the greatest expected, opposite response. Otherwise, we are left with the sense that the difficulty in identifying the forced response is due to a low signal to noise ratio, and not due to the potential non-linearities involved.

Detailed points are as follows.

Abstract - Please give an indication in the abstract that the study was motivated by Bunker cave d18O interpretation

P3794-L20 or P3803-L20: Please elaborate briefly on the standard interpretation of the Bunker cave d18O (i.e. in terms of dominance of summertime precipitation with higher d18O?) given that it is counter to the conventional d18O 'paleothermometer' intepretation.

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P3795-L12: it is not clear what is meant by 'infer with each other'

P3796-L11: Mention the AOGCMs with water isotopes that do exist (GISS, HadCM3 of Tindall and Valdes, 2011, Glob. Plan. Change).

P3796-L21: Please indicate whether only the SST and SIC fields from the EGMAM model were used as boundary conditions in the ECHAM5-wiso runs, or the stratospheric winds also.

P3799-L10: Please add letter captions to Figure 2.

P3799-L26: Please indicate the direction in which the ITCZ shifted and how this can be inferred from the changes in precipitation d18O.

P3799-L23: It is difficult to identify the stronger gradients over central Russia during 5K.

P3800-L21: Replace 'on the opposite' with 'conversely'?

P3801-L4: 'exits' to 'exists'

P3802-L26: it is not clear what's meant by (sub) tropical - do you mean 'tropical and subtropical'?

P3804-L22: In the Discussion, please add additional comparison with the mid-Holocene results of LeGrande and Schmidt (2009). What were the similarities and differences?

P3804-L15: 'general stronger' to 'stronger general'

P3805-L15: Doesn't the temperature effect in this case largely reflect the continental effect – the cooling moving eastward?

P3805-L17: change 'easterly' to 'westerly' or 'eastward'?

P3805-L25: But in some cases, they often do correspond to temporal temperature changes (during winter in the continental interiors, for example) – so invoking them as

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generally consistent with the results here is innacurate.

P3806-L5: please elaborate on the agreement with LeGrande and Schmidt (2009). I think you've shown that the isotopic response can't (perhaps due to the run length, however) be associated with a corresponding temperature change. But you have not shown that it is the result of any broad circulation or moisture transport changes either.

P3810-L18: This may be true, but it could simply be because of the short simulation length.

P3818 - Fig 1.: Please indicate what the DJF and JJA curves represent (orbital forcing?)

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