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# ***Interactive comment on “Iterative land proxy based reconstruction of SST for the simulation of terrestrial Holocene climate” by K. Haberkorn et al.***

**M. Crucifix (Referee)**

michel.crucifix@uclouvain.be

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## **1 Summary**

Haberkon et al. propose a methodology to infer (reconstruct) sea-surface temperatures and European climate during the Holocene, based on an isotopic record sampled at Lake Ammersee (Southern Germany), which is interpreted as a temperature record.

This work fits the broad category of studies aiming at combining palaeoclimate observations with physical constraints to infer past climate states. With few exceptions, the literature on this subjects is divided into studies with a strong emphasis on statistics, with careful treatment of uncertainties and definition of stochastic processes (e.g.[Haslett et

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al. 2006, Li et al. 2010, Tingley et al. 2012]); and studies based on more sophisticated physical models, but with a pretty ad hoc procedure because a full statistical treatment would be currently infeasible. The present article by Haberkorn et al. belongs to the latter category.

Haberkorn et al. use the atmospheric model PLASIM. The methodology, which they propose, consists in iteratively adjusting seasonal sea-surface temperatures over a large region of the North Atlantic Ocean basin. The adjustment is proportional to the difference between ‘simulated’ and ‘observed’ temperature, using a set of seasonal coefficients describing a linear dependency of Ammersee temperature on North Atlantic SST. It is not entirely clear from the manuscript whether the coefficients are first determined based on a series of off-line sensitivity experiments, or whether they are adjusted iteratively until convergence between the simulated temperature and the ‘observed’ one. Compared to previous studies in this vein, Haberkorn et al. innovate in playing on the ‘boundary conditions’ of their model, and introducing the sensitivity parameter  $\lambda$  that plays the role of a simplified adjoint.

While the study would naturally find its place within the current ‘palaeoclimate reanalysis’ efforts, the present article falls short of acceptance standards, for three reasons mainly: edition, lack of specification of the methodological process, and disappointing results. I believe, though, that these issues may be addressed in a substantially revised manuscript.

## 2 Edition

The edition is below the expected standard, and sufficiently so to distract the reader. Words have to be chosen more carefully (the use of the words ‘climate’ (often used for surface air temperature), or ‘spectral’ are problematic). More importantly, a number of sentences are clumsy. Examples: p. 159: “Whereas for the model the problem

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is mostly due to simulating the forcing correctly" (what does 'simulating the forcing' mean, in this case?); p. 160: "The main deficiency of the ocean with climatological SST" (this is not an ocean deficiency, but a consequence of the experiment design); p. 161 : "follows the assumption of a distinct dependency" (what is meant by distinct? The sentence is overall awkward), p. 169 : "regarding the statistical significance of the reconstructed time series (...) the reconstruction of the mid-Holocene climate seems to show the best results, whereas it is only minor in the other" (difficult to read: what is meant by minor; and whatever the message is it does not seem obvious from the figure). Inappropriate use of 'consequently' p. 170. Some sentences are hardly understandable (e.g.: "The overall differences between the reference and the reconstruction are only minor (...) which is in line with the aforementioned results of hardly converging time slice means"). Pages 169 and 170 are particularly in need of editorial improvement, but the whole manuscript has to be revised.

Information could also be better organised at the level of the manuscript, avoiding unnecessary references in the methodology and result sections, better focus on relevant information, and aim at conciseness in the discussion and conclusion. For example, the discussion on climate sensitivity is both arguable (climate sensitivity does depend on the forcing [Hansen et al. 2005]) and unnecessary.

### 3 Methodological approach and results

The methodology is founded on the hypothesis that sea-surface temperatures in the North Atlantic is the main factor controlling the discrepancy between the simulation and the record at Lake Ammersee. This is a strong hypothesis that is in fact little assessed or questioned in this manuscript. The other important hypothesis is the assumption of linearity, expressed in equations (1) to (5). Again, this assumption is little assessed or questioned. More specifically, for preparing Table 1, the authors targeted a change

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in annual mean temperature of 1.5 °C, but what if a target of 0.5 or 3.0 °C had been chosen? How do these methodological hypotheses link with the differences between observed and ‘reconstructed’ annual mean surface air temperature at Ammersee for the different epochs (Fig. 6) ?

The manuscript also lacks tangible evidence that the reconstruction method actually has skill in predicting temperature away from Ammersee Lake (the discussion p. 173 is insufficient and lacks quantification).

Finally, the ‘iterative’ character of the procedure was not entirely clear to me. How many iterations are needed? At which point is  $\lambda$  estimated? Is it re-estimated for the different periods? Or is it estimated at every iteration?

#### 4 Advice for a revision

The problem of assimilating data by a dynamical adjustment of boundary conditions is relevant, but the problem should be more explicitly posed in this way, with a focus on solving that problem. Solving a problem means proposing a solution and assessing this solution, ideally both with perfect model (twin) experiments and actual observations

Reference to statistical literature may also be helpful. More specifically, statistics provide us with a framework and vocabulary to accommodate apparently conflicting observations. ‘Climate’, be it local or global may be represented by a hidden variable, and palaeoclimate observations combine this variable with an observational error. Relevant references are given below.

Finally, the authors are encouraged to solicit their colleagues for editorial advise before submission. Even though the text is syntactically correct throughout the manuscript, a language barrier is evident.

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## References

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