

## ***Interactive comment on “Implication of methodological uncertainties for Mid-Holocene sea surface temperature reconstructions” by I. Hessler et al.***

**I. Hessler et al.**

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Answer Comments Anonymous Referee #1 - Clim. Past Discuss., 10, 1747-1782, 2014

Dear Referee #1,

On behalf of all authors I would like to thank you for taking the time to conduct the review and comment on our manuscript. We greatly appreciate the kind words and provided suggestions. In the following we will address each of your comments individually and indicate how they will be implemented in the revised version of the manuscript.

Sincerely, Ines Hessler

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Comment Referee #1: The challenge of modelling the indicators themselves could actually be emphasised at the end of the revised manuscript, as it is clear that it will be essential to understand the different messages from the data. Reply: We agree with referee #1 and will highlight the challenge and necessity to fully understand the sensors ecology to represent it correctly in the model. In the revised version of the manuscript we will add the following sentence to the conclusions. "The observed mismatches among the estimates of the different sensors indicate that something fundamental about the sensors ecology is not yet understood, which, however, is essential to represent the sensors correctly in the models."

Comment Referee #1: On the technical side, the maps are a little small when printed out but are clearly displayed on a computer screen. It would be good if the technical editor could ensure the largest possible figures for the final version. Reply: We will liaise with the technical editor to ensure that larger maps are included in the revised manuscript.

Comment Referee #1: Also, I found that the supplementary material was wrongly described (wrong number of tables and figures in the supplementary material described provided at the beginning of the corresponding document) or that Figures are missing. Reply: The number and labelling of tables will be corrected in the revised version of the manuscript. "The SI contains (a) details of the sites used in these analyses (SI Table 1) and references to the primary data, (b) details of the reconstructions at individual sites (SI Table 2, 3, and 4), and (c) grid cell reconstruction (SI Table 5)." The figures presented in the Supplementary Material went missing in the course of the first re-submission of the manuscript, which is clearly a sloppy mistake. We will correct it in the revised version of the manuscript and make sure that all figures will be available as indicated in the descriptive paragraph at the beginning of the Supplementary Material.

Comment Referee #1: LGM SST model-data comparisons have also been performed within the Paleoclimate Modelling Intercomparison Project: Otto-Bliesner et al. (2009) are cited for the tropics, Kageyama et al. (QSR, 25 (2006) 2082-2102) could be

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cited for the North Atlantic. Reply: We will include the suggested reference in the revised version of the manuscript. "Sea-surface temperature (SST) reconstructions have proved to be a valuable tool for evaluation of Last Glacial Maximum (LGM) simulations (Kageyama et al., 2006; Otto-Bliesner et al., 2009; Hargreaves et al., 2011; Wang et al., 2013)."

Comment Referee #1: Kageyama et al. (Climate Dynamics, 40 (2013) 2469-2495) can also be cited for attempts to model foraminifera for the LGM, based on the FORAM-CLIM model described in Lombard et al. (Biogeosciences, 8 (2011) 853-873). Reply: We will cite Kageyama et al., (2013) in the revised version of the manuscript. "New approaches to SST reconstructions, including the use of inverse modeling, are required to improve this situation (e.g., Kageyama et al., 2013)."

Comment Referee #1: All these works actually use the pre-industrial state as the reference climate for the models, which could prove inadequate for the mid-Holocene, since the mid-Holocene anomalies are shown to be so sensitive to the reference climate. This could be pointed out for modellers. Reply: We will incorporate your suggestion in the Discussion. "Due to the dependency of MH SST anomalies to different baseline climates it may prove inadequate to use pre-industrial climates as reference state in MH model simulation."

Comment Referee #1: About the interpretation of the alkenone based SST reconstruction, Barton et al (Progress in Oceanography 116 (2013) 167-178) discuss the interpretation of alkenone-derived SST recent trends off the coast of Morocco. They find that a possible explanation to the cold trend over the last decades could be that coccolithophorids could actually be living at deeper and deeper depth, hence giving information on temperature, but not SST's. This could be added in the discussion, I think. Reply: We will add a chapter about the definition of the "sea surface" (Chapter 2.3) in the Material and Methods section and include information about the preferable depth habitat of the different sensors. In this chapter we will also incorporate your comment. "A recent study, however, suggests that alkenone-derived SSTs based on

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coccolithophorids may, in particular regions, live deeper in the water column as originally assumed (Barton et al., 2013). Therefore, near surface temperature estimates could be biased by subsurface temperatures and lower the actual SST (Barton et al., 2013)."

Comment Referee #1: Fig. 4. legend: if the whiskers indeed show the maximum and minimum values, why then do the outliers showed by the diamonds show even larger/smaller values? (the whiskers on a box plot usually show the 10-90th or 5-95th quantiles, don't they?) Reply: "The Box-Whisker Plots were drawn using the Golden Software Grapher, which applies Tukey's method showing the 5 to 95 percentiles. The whiskers are drawn down to the 5th percentile and up to the 95th. Points below and above the whiskers are drawn as individual dots. Outliers are calculated 75th (25th) percentile plus (minus) 1.5 times IQR (interquartile range). If this value is greater than (smaller than or equal to) the largest value in the data set, the upper whisker are drawn to the largest value. Any points greater (smaller) than 75th (25th) percentile plus (minus) 1.5 IQR are plotted as individual points. The chance of finding "outlier" by Tukey's rule in data sampled from a Gaussian distribution depends on sample size." To avoid future obscurity for the reader we will add this information to the respective figure caption (Figure 4).

Comment Referee #1: Fig. 6., legend about the dotted lines: each line is defined by the anomaly = +/- the standard error. Stating this would be clearer than the current description, I think. Reply: We appreciate the suggestion and will adapt it in the revised version of the manuscript to clarify the description. It will then read: "Each dotted line is defined by the anomaly  $\pm$  the standard error, i.e. points that fall outside these lines (taking into account the measurement or calibration uncertainty) would be considered to show a significant anomaly at the 95% confidence level."

Comment Referee #1: Page 1759, line 11: remove "the" between "of" and "choosing" Reply: Will be incorporated in revised manuscript as following. "We tested the impact of choosing different sampling windows by examining. . ."

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Comment Referee #1: Page 1760, lines 11-12: sentence could be clarified by indicating precise latitudes/sites where these behaviour occur (i.e. by guiding the reader on Fig. 6). Reply: We will adapt Referee #1 suggestion and clarify the sentence by adding a reference to Figure 6 at the end of the sentence. "e.g. dinocyst reconstructions show conditions both colder and warmer than the corresponding foraminifera-based reconstructions (Figure 6)."

Comment Referee #1: Page 1760, line 13: "there are insufficient points" could be replaced by "There is an insufficient number of points" Reply: We will incorporate the suggestion in the revised version of the manuscript. It will read: "However, there is an insufficient number of points both overall and for any one season to make site comparisons meaningful."

Comment Referee #1: Page 1764, line 4: sensor -> sensors Reply: We will incorporate the suggestion in the revised version of the manuscript. It will read: "Most of these have been based on one or (at best) two types of sensors, and..."

Comment Referee #1: Page 1765, line 19: provides -> provide Reply: We will incorporate the suggestion in the revised version of the manuscript. It will read: "...were assumed to provide summer temperature estimates and alkenones to provide estimates..."

Comment Referee #1: Page 1780, middle caption of Fig. 4: "rom each record" -> "from each record" Reply We will incorporate the suggestion in the revised version of the manuscript. It will read: "...time window from each record."

Comment Referee #1: Page 1782: foraminifera -> foraminifera Reply: We will incorporate the suggestion in the revised version of the manuscript. It will read: "...on the sensor (Foraminifera:  $\pm 1.35^{\circ}\text{C}$  winter,..."

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Interactive comment on Clim. Past Discuss., 10, 1747, 2014.

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