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Climate of the Past Discussions

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

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Answer Short Comments of Brad Rosenheim #1 - Clim. Past Discuss., 10, 1747-1782, 2014

Dear Brad Rosenheim, Thank you very much for your Short Comment on our manuscript, which raises an important issue and will be addressed in the revised version of the manuscript. Sincerely, On Behalf of all authors Ines Hessler

Comment Brad Rosenheim: How likely is it that the different proxies compiled herein are actually recording different depths and not precisely the same notion of SST? If so, and they are nonetheless grouped into the lump definition of "SST", is there a

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chance that we would lose oceanographic information, i.e. changing of currents or shoaling/heaving of subsurface water masses? Whereas other sources of uncertainty are addressed in this manuscript (eg. cleaning treatments, calibrations, etc.), the actual depth of the records is not dis- cussed. If the goal of compiling these reconstructions is to provide a benchmark for climate model simulations, then grouping these records together as "SST" may miss some fine details that simulations may be able to resolve and help us explain. Do we know enough about these proxies to be able to differentiate between them in terms of depth of record?

Reply: It is indeed very likely that different depth habitats of the different sensors bias the temperature pattern and/or temperature consistency in our study. We, therefore, will add a sub-chapter in the Material and Methods section addressing the depth habitat of the sensors: 2.3. Defining the 'sea surface' "The 'sea surface' and its related 'sea surface temperature' have been set to 10-m depth following the decision by MARGO (Kucera et al. 2005a). This decision reflects a compromise allowing a harmonisation of SST estimates among different sensors. This choice does not mean that the authors assumed that all sensors record temperature at that depth. Rather, the decision reflects an assumption that all sensors and proxies record an SST signal which is highly correlated to SST at 10-m depth and that it is therefore possible to calibrate the individual proxies against SST at that depth. In the context of this study where the focus lies on SST anomalies, the principle assumptions of this depth-homogenisation are thus that the SST recorded by each proxy and sensor is highly correlated to SST at 10-m depth and that this relationship remained the same between the present-day and the 6k Holocene time slice. Whereas the SST depth recorded by phytoplankton sensors is limited to the photic zone, the depth range of species of planktonic foraminifera can be broader. The foraminifera-based Mg/Ca SST estimates are based chiefly on symbiont-bearing species with shallow habitat, whose calcification depth has been constrained to lie within the top 100 m of the water column (e.g., Anand et al., 2003; Regenberg et al., 2009). In contrast, the foraminifera-based transfer function SST are based on analysis of the entire assemblage and as shown by Telford et al. (2013), it is possi-

CPD
10, C1567–C1569, 2014

ble that assemblage composition is sensitive to subsurface temperature, particularly in low-latitude regions. This depth mismatch may be significant when reconstructing temperature of the last glacial maximum, but it remains unclear whether it also has an effect on early Holocene SST estimates. Thus, in the absence of a universally applicable set of criteria for assigning depth to SST estimates by different proxies and sensors, we retained the 10-m depth definition used by MARGO, but we acknowledge that depth-misattribution of the reconstructed SST may be an additional source of uncertainty and may account for mismatch among SST proxies, particularly those based on planktonic foraminifera as a sensor."

We also will briefly address this point in the discussion. "As indicated in chapter 2.3 (Defining the 'sea surface') the SST pattern reconstructed in this study is also likely biased by sensitivity of planktonic foraminifera assemblages to temperatures at different depths in the water column, as well as by changes in the SST sensitivity or recording depth of the other sensors and proxies between the present-day and the early Holocene. The former is likely to be more significant, because the recording depth of all other sensors and proxies used in this compilation is bound to have remained within the photic zone."

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