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Climate of the Past Discussions

Interactive comment on "Can oceanic paleothermometers reconstruct the Atlantic Multidecadal Oscillation?" *by* D. Heslop and A. Paul

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The following is our response to the interactive comment submitted by Anonymous Referee #1. The referee's comments are given in *italics* and our responses are in normal text.

1, Fig. 2 shows the leading EOF of the AMOC. It would be very interesting to add a plot of the time series of this leading mode (PC1) and compare it with the modeled AMO Index. Are they in phase with each other at low frequency?

We have added a new panel to Figure 2 to demonstrate the relationship between the strength of the AMOC and the modeled AMO index. Rather than employing the time series of the leading mode, we felt it would be more appropriate to simply plot the maximum overturning as a function of time. This reveals a clear pattern between the AMOC and the modeled AMO index, which as discussed in the original manuscript demonstrates the role reversal in our forcing scenario. When the introduced anomalous heat flux warms the surface of the North Atlantic, stratification of the water column increases and after $\sim$10 years the vigor of the AMOC is reduced. Subsequently, when the forcing cools the surface of the North Atlantic the strength of the AMOC increases again after a small delay. This relationship demonstrates the intimate link between overturning and heat in the upper ocean, but to reiterate our original discussion, the role reversal of the forcing does not allow us to comment on the nature of AMO forcing in reality. A discussion of the above points has been incorporated into the manuscript text.

2, Fig. 5 shows a vertical section of S_{max} as a function of latitude. Is it the zonal averaged value in the North Atlantic? The expression "Meridional averaged" in the caption is confusing.

We agree with the reviewer and have changed the caption text to "zonally averaged".

3, It would be helpful to add a table to list the estimated s values (error) of various paleo proxies for comparison.

We have now added a table detailing the standard error of estimation of the referenced studies. We considered extending this table to include more references but found that many studies do not state explicitly what form of error was calculated during the

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calibration procedure. We therefore cannot be certain that published values actually correspond to the standard error of estimation as it is calculated in Equation 1.

4, Is it possible to apply similar approach to assess the signal-to-noise ratio of the tree ring records over land by comparing the modeled air temperature anomaly over land associated with the AMO forcing?

Absolutely. If you know the standard error of estimation of your proxy then you could make an estimate of the signal-to-noise ratio using exactly the same method. We now state this explicitly in the conclusions. Of course, when working with a specific dataset a number of the simplifying assumptions, such as large N, can be removed and replaced with study-specific values. We have added the following two statements to the manuscript to emphasize these points:

"As discussed above it is necessary to introduce simplifying assumptions in this study in order that a number of different calibrated proxies can be compared. For individual studies, however, the specific value of N can be employed in Eq. 2 and the standard error on a new prediction can be calculated separately for each new sample rather than assuming the minimum achievable error (Devore. 2008)."

"Finally, the presented approach is not limited to the AMO and seawater temperature, but can potentially be applied to a wide variety of calibrated proxies both in and outside the marine realm."

5, It worth to emphasize in the abstract that the results are dependent on the particular model used.

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We agree and have added the following sentence to the abstract:

"Whilst the presented results will inevitably be model-dependent to some degree, the statistical framework is model-independent and can be applied to a wide variety of scenarios."

Interactive comment on Clim. Past Discuss., 6, 2177, 2010.