

Interactive comment on “Can sparse proxy data constrain the strength of the Atlantic meridional overturning circulation?” by T. Kurahashi-Nakamura et al.

Anonymous Referee #1

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This paper attempts to determine to what extent proxy data – data from the MARGO project in particular – constrain the North Atlantic meridional overturning circulation (AMOC). This paper is a valuable contribution to this discussion and therefore worthy of publication. There is nothing problematic about this paper. My only major criticism is that, unfortunately, the paper does not provide much insight. One conclusion is that the AMOC can be reconstructed if one has a sufficiently good first guess. It is well-known in twin experiments of this nature that the degree to which the target state can be reconstructed is dependent on the first guess, so there is nothing surprising here. The other conclusion regarding what constraints are needed to constrain the AMOC could potentially be very insightful. This conclusion, however, is unclear as there are

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some large inconsistencies in the results. One is left wondering whether the issues with the reconstructions arise from proxy data uncertainties, the assimilation method, the sampling locations, or with using the AMOC as the goal metric. If one were going to try to make this paper more insightful I would recommend trying to better explain the results from knowledge of the AMOC dynamical sensitivity, which at least one co-author has written on before. One thing that the manuscript would definitely benefit from is a clarification as to why the addition of data sometimes makes the fit worse, even if that data has small uncertainty (e.g. comparing E1-7 with E1-8). An effort by the authors to make the results more intelligible would be greatly appreciated.

The manuscript would benefit by adding a couple sentences on

- 1) the fact that deriving the target from the same model as is used for the reconstruction neglects model error. (could go at the end of the introduction section)
- 2) the fact that the resolution is very coarse, especially in the vertical. How does this effect the problem, especially given the fact that the authors highlight the sensitivity to MLD?
- 3) the timing intervals chosen (i.e. a 20 year run with the objective function assessing the mean over the last 10 years). Is this an appropriate interval for the time-scales of the AMOC?

Minor revisions:

Section 4.2 line 28 and 29. I disagree that it was difficult to pull the model as the optimized AMOC varied in strength from 14 to 44Sv.

Interactive comment on Geosci. Model Dev. Discuss., 6, 4417, 2013.

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