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Interactive comment on "Atlantic Multidecadal Variability from the Last Millennium Reanalysis" *by* Hansi K. A. Singh et al.

Anonymous Referee #2

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Overview

In this paper, Singh and coauthors examine the characteristics of North Atlantic Multidecadal SST variability in the Last Millennium Reanalysis (LMR). The LMR is a simulation carried out with CCSM4 using data assimilation from proxies over the years 0-2000CE, and is mainly documented in a previous study. They find some known changes associated with the Atlantic Multidecadal Variability (AMV), e.g.: warming of the northern hemisphere, decrease in sea ice and northward shift in the ITCZ, and some unknown changes, in particular that there is a difference in the ocean heat transport between CCSM4 and the LMR. In addition, they carry out a wavelet analysis and show that there is no distinct peak at multidecadal timescales in the AMV index in the LMR, consistent with the notion that the AMV may be interpreted as a red noise pro-

cess (which is in contrast to many modeling studies argue that there is multi-decadal peak in the AMV driven by oscillations in the AMOC). I think the results are interesting and fit in the broader discussion of the mechanisms and timescales of the AMV. The paper is well written, however I recommend some changes to improve the clarity in the presentation, which I elaborate in more detail below.

General comments

1.It is quite hard to understand for a general audience how this data assimilation works, how it compares with other studies, and in particular why there are so many differences with CCSM4 prior. When discussing ocean and heat transports I don't understand why LMR is so different from CCSM4. In general, I find it hard to follow because there is no comparison with mechanisms operating in the real world and would be easier to understand if it was compared with direct observations (even if we know that observations over the 20th century are affected by anthropogenic forcings).

2. In the paper AMV and AMO are used interchangeably, making it quite confusing to understand what the authors refer to. AMV is typically used to refer to internal+forced North Atlantic variability while AMO is used to refer to internal variability only (see Booth 2015).

3. The AMV index is defined as the area average SST index from 120W to 0 and from 0 to 60N, and some studies are referenced including Clement et al. 2015. Clement et al. used 80W-0,0-60N as well as other studies which use 70/75W. In other words, 120W seems too far west, including a lot of not ocean (land) areas. The authors should check if their results are consistent when using the most commonly utilized index (80W-0,0-60N).

4. A lot of times the authors generally refer to similarities amongst figures in a very qualitative and general way. They have to be more quantitative and compute pattern correlations between each figure in order to draw any solid conclusion.

Specific comments

P1L20: Kushnir 1994 analysis was based on the hypotheses of the earlier Bjerknes 1964 paper

P2L30: please cite also Murphy et al. 2017 and Bellucci et al. 2017 which are more recent papers addressing the role of external radiative forcing in driving the AMV

P2L10: "Several dynamical studies have suggested that zonal and meridional oscillations in the AMOC on multidecadal time scales may drive changes in north Atlantic SSTs (Dijkstra et al., 2006, 2008)." Can you elaborate what you mean by "zonal oscillations in the AMOC"? I am not aware of any zonal variations, usually the AMOC is seen as a meridional source of heat transport changes.

P2L20: Tandon and Kushner 2015 also find that there's a lot of inter-model spread in the lead-lag correlation between the AMV and AMOC indices

P6L25: The fact that the anomalies are smaller after low-pass filtering is expected as a consequence of the low-pass filter.

References

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