Reviewer #1 (Comments to Author):

I have reviewed the previous version of the manuscript. The revised manuscript has been improved substantially to address the review comments. The main concern I have now is that the conclusion of the manuscript is based on an ocean-ice model without coupled air-sea interaction, and depends on the surface fluxes prescribed. The authors should be careful and make explicit note about this caveat, because the results may not hold if using fully coupled ocean-atmosphere models. I recommend the paper be accepted for publications in Geophysical Research Letters after some minor revision.

We would like to thank again the reviewer for the thoughtful comments and suggestions. The manuscript is now revised based on the comments from the reviewer. In the revised manuscript, we provide more details about the surface boundary conditions used in section 3 (model experiment). In section 7 (discussion), a paragraph is added to stress that this study is based on a surface-forced global ocean-ice coupled model and to suggest a future work to explore if a fully coupled model simulation with realistic radiative forcing over the 20th century supports the main conclusions of this study.

1, *In my previous comment #2, I suggest the manuscript discuss the reasons for the discrepancy with previous coupled modeling studies. The revision partially addressed this issue, but missed pointing out one important difference between the manuscript and previous coupled modeling studies, i.e. the surface boundary condition is very different.*

The manuscript using an ocean-ice model without coupled air-sea interaction simulated in fully coupled ocean-atmosphere models, and the results of the manuscript depend on the surface fluxes prescribed. This issue should be explicitly discussed in the manuscript, and the manuscript should give more details of the surface boundary conditions used.

We provide more details about the surface boundary conditions used in section 3 (model experiment). In section 7 (discussion), a paragraph is added to point out that this study is based on a surface-forced global ocean-ice coupled model and to suggest a future work to explore if a fully coupled model simulation with realistic radiative forcing over the 20th century supports the main conclusions of this study.

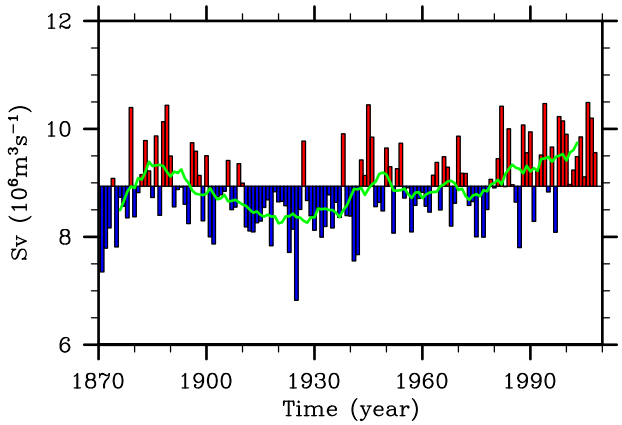
One simple experiment to test the importance of the coupled surface boundary condition in future studies could be that: using a fully coupled ocean-atmosphere models (such as CCSM3) with realistic anthropogenical radiative forcing over the 20th century, but fixing the ocean transport across 30S with climatology, i.e. no change in ocean heat transport across 30S. If there is no substantial increase in the Atlantic ocean heat content in this experiment, then the coupled model result is consistent with that shown in the manuscript. If there is substantial increase in the Atlantic ocean heat content in this experiment, then the coupled model result is inconsistent with that shown in the manuscript.

The suggested experiment will be a very useful way to further test the major findings in this study while allowing fully interactive atmosphere-ocean interactions. We appreciate the reviewer for suggesting this experiment for our future work.

2, *What is the simulated AMOC index in the North Atlantic, such as at 26N or 40N? Is it consistent with the phase of the observed Atlantic Multidecadal Oscillations (AMO)?*

The following figure in the upper panel shows the time series of the simulated AMOC index (maximum overturning stream function) at 25^{o}N in reference to the 1871 – 1900 period. It appears that the simulated AMOC index is somewhat consistent with the phase of the observed AMO time series (lower panel in the figure below). However, it is hard to say that the two time series are highly correlated. We also find that the time series of the simulated AMOC in the North Atlantic are quite different at different latitudes (not shown). More works are needed to understand if and how the simulated AMOC in the North Atlantic is linked to the observed AMO. Therefore, we think that this topic of the AMO-AMOC relationship deserves more in-depth researches, which may result in a new manuscript in the near future.

CCSM3_POP (EXP_CTR): AMOC at 25°N



ERSST3: North Atlantic SST Anomaly