

## ***Interactive comment on “Enhanced 20th century heat transfer to the Arctic simulated in the context of climate variations over the last millennium” by J. H. Junglaus et al.***

**Anonymous Referee #1**

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### General comments

Junglaus et al. present results from Earth system model simulations over the last millennium that reproduce and explain reconstructed integrated quantities such as pan-Arctic temperature evolution during the pre-industrial millennium, and the Atlantic Water warming in Fram Strait in the 20th century. They suggest that the associated increase in ocean heat transfer to the Arctic can be traced back to changes in the ocean circulation in the sub-polar North Atlantic. The interplay between a weakening overturning circulation and a strengthening subpolar gyre as a consequence of 20th century global warming could act as a driving mechanism for the pronounced warming along the Atlantic Water path toward the Arctic.

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Generally, the data is very interesting. As the ocean circulation is among the dominant climate factors, the research papers of this kind discussing on basin-wide circulation variability are very important regarding to present-day climate change. The paper is definitely suitable for Climate of the Past and should be published. However, since I am not a modeler, I cannot take a stand on quality of modeling despite its key role in this paper.

In my point of view, the missing assessment of external factors (volcanic and solar forcing) and especially the interaction of Arctic sea ice – AMOC is the main weakness of the paper. I can understand that the authors want to keep the paper as compact as it stands now. However, the role of sea ice is not recommended to pass over due to its robust role in the ocean circulation system.

Apart from that, I can find only some minor technical issues which should be taken into account before the manuscript could be published in Climate of the Past.

### Minor comments:

2901, lines 21-25: I wonder why the “great 1258” eruption is not clearly discernible in model simulations though Tambora eruptions 1809/1815 can be seen in all models (see Fig. 2a)? 2901, line 22: ‘see Fig. 5 in Junglaus et al’. 2909, l. 10: ‘Miettinen’. 2909, l. 12: ‘Reykjanes’. 2910, l. 8: ‘Häkkinen’. 2918, Fig. 1 is small in its size and thus it is difficult to see different time series. 2918, Fig. 1: indicate the colours of different simulations. 2919, Fig. 2a: indicate the colours of different simulations. 2920, legend for Fig. 3: explain dotted lines. 2903, Pavlov et al. 2011 is 2013 in references. 2904, Årthus et al., 2012 is 2013 in refs. 2915, Refs.: I could not find Müller et al. 2014 in the text. 2916, Refs.: Schauer et al. 2008 in the text?

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