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Climate of the Past Discussions

Interactive comment on "Pulses of enhanced North Pacific Intermediate Water ventilation from the Okhotsk Sea and Bering Sea during the last deglaciation" *by* L. Max et al.

Anonymous Referee #2

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The new data presented by Max et al. from the Okhotsk Sea and Bering Sea reveal in a convincing way the emergence of well ventilated North Pacific intermediate waters during HS1 and YD and a weaker ventilation during the Boelling Alleroed.

Unfortunately, an uncritical assessment of major conclusions drawn from previous studies muddles the discussion of the author's findings. This needs to be revised.

Hoping to provide some guidance for the discussion, I am showing here (in the attached pdf file) a rough consistency matrix of intermediate water, deep water and bottom water changes from recent studies.

Contrary to the claims in Lund et al. 2011, the Lund data in fact document increased

ventilation during HS1, at least down to 2300m (see figure below), which is entirely consistent with the paleo and model data discussed in Okazaki. So far, the biggest inconsistency among the datasets is between the Jaccard studies and the Rae and Sarnthein 2013 data for North Pacific deepwater formation in the eastern North Pacific (I don't know whether the Rae paper is already out, but it would be worth for the authors to inquire about the paper and the data).

Specific comments, line numbers refer to the printed version - Please specify which depth range is referred to as intermediate water, versus deep and bottom water in the Pacific

- Page 6222, line 19: "antiphase to those of the North Pacific" – this is only one part of the story, because the Rae and Sarnthein data suggest an in-phase relationship for data in the NW Pacific.

- Page 6223, line 16, "salinity-driven stratification" sounds strange

- Lines 16-20, there is a little bit a mix-up between feedback (Stommel) and forcing (atmospherically induced changes in Atlantic/Pacific freshwater transport) – please clarify

- Line 21 ". . . hence the proposed. . .." – it is a common confusion (see also Jaccard) that the SST changes are an indicator only of the (heat) transport changes. SSTs in the North Pacific are driven by changes in heat transport convergence, mixing and air-sea heat fluxes. Even with an increased heat transport convergence, one can still have a due to enhanced mixing, reduced SW radiation (clouds) and enhanced evaporation. Please rectify this oversimplification.

- Page 6224, line 9 replace "likely source" by "possible source"

- Page 6227, please discuss the issue of a constant reservoir age, given the fact that much older intermediate waters are brought up to the surface of the North Pacific during HS1 and YD. Would this probably change the age model? If yes, in which direction?

- Line 23, If the Rae and Sarnthein data are already available I would also include them,

if not, never mind

- Page 6229, line 16 “intensified” ventilaion of intermediate waters” – specify depth range

- Page 6230, line 9 replace “was” by “were”

- Page 6230, line 25 “Minor ventilation changes” – although claimed by Lund, their data (see figure below) suggest actually the opposite. A decrease of projection ages at depths of >2000m of 1500 years during HS1 can not be regarded as a small change and is consistent with the conclusions of Okazaki.

- Page 6231, line 13, definition of “deep water,. . .” should be moved to the introduction

- Page 6231, line 27, Looking at the data in Lund, I would say that there was enhanced HS1 NPIW/deep water formation down to 2700m (see figure below), maybe even further down to 3600m (see Figure 3c of Lund et al. 2011)

- Page 6232, line 8 “contradict the model-derived hypothesis” - double check the exact depth horizons discussed in Okazaki versus Galbraith. I am not sure that there is a contradiction (see table above).

- Pages 6232 and following, avoid using the word “shallow meridional overturning” which is reserved in the physical oceanographic literature for the subtropical cells. Why not just call “intermediate-depth overturning cell”?

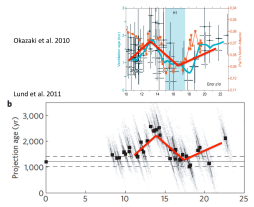
- Page 6232, line 27-28, again double-check with the consistence table.

- Page 6233, line 11, the Okazaki model overturning only goes down to 2500m (their figure 2B).

- Page 6233, lines 20-25 “rendering this scenario unlikely” – this is an oversimplified view of the heat budgets in the North Pacific (unfortunately also shared by reviewer 1), see my comment above and revise. There can be increased heat transport along with the surface cooling, if e.g. enhanced mixing or heat fluxes cause an extra heat loss.

Interactive comment on Clim. Past Discuss., 9, 6221, 2013.

	Increased H1 ventilation of upper 1500m	Increased H1 ventilation 1500m-2800 m	Increased H1 ventilation >2800m	Decreased BA ventilation of upper 1500m	Decreased BA ventilation 1500m-2800 m	Decreased BA ventilation >2800m
Max	Yes	-	No (decreased, their figure 5)	Yes	-	No (increased, figure 5)
Okazaki (data)	Yes	Yes	No	Yes	Yes	No (increased)
Okazaki (model)	Yes	Yes	No	Yes	Yes	No
Rae and Samthein	-	-	Yes	-	-	Yes
Lund et al 2011	-	Yes (their figure 3b)	Yes (their figure 3c)	-	Yes (their figure 3b)	Yes (their figure 3c)
Jaccard studies	-	No (JG, 2013)	No (older Jaccard paper)	-	No (JG, 2013)	No (older Jaccard paper)



Comparison between Okazaki and Lund data at 2700m depth and note the good correspondence.

Fig. 1. Table and Figure