

Interactive comment on “Impact of West Antarctic Ice Shelf melting on the Southern Ocean Hydrography” by Yoshihiro Nakayama et al.

Anonymous Referee #2

Received and published: 16 January 2020

General Comments:

Many satellite and oceanographic observations revealed that Antarctic ice sheets and the Southern Ocean have been changing in recent decades. The interaction between Antarctic ice sheets/shelves and the Southern Ocean is one of the most important topics in the climate sciences. This study investigates pathways of ice-shelf meltwater from the West Antarctic ice shelves and its role on the Southern Ocean conditions, using a series of sea-ice/ice-shelf/ocean simulations. In my reading, the results of this study will be a valuable contribution to the Antarctic sciences. I recommend publication in The Cryosphere after addressing the comments listed below.

I have two major comments.

C1

(1) This paper used numerical experiments with different levels of basal melting (by tuning the transfer coefficients) to explain the observed changes (e.g., lines 97-104). In my reading, the results from CTRL (or CTRL-LMELT) shows a transition from the LMELT conditions and are not suitable for explaining the observed changes. The transition timescale is useful information, but the comparison of the Southern Ocean water properties between the model and observation in the present manuscript may be misleading.

(2) Although there are sentences about the impact of the meltwater on AABW formation in the remote regions (Cape Darnley and Weddell Sea) in abstract and discussion (lines 9-11 and 158-159), Figure 5d-f show no pronounced change in the bottom water properties. I understand the idea, but the simulations didn't support it.

Specific comments:

(3) lines 31-34: Wrong and missing citations Kusahara et al. (2017) is a modeling study of dense shelf water, not ice-shelf meltwater. Kusahara and Hasumi (2013, JGR-Oceans) performed virtual (meltwater) tracer experiments in idealized warming climates, showing that increased basal meltwater from the Amundsen and Bellingshausen Seas causes the bottom water freshening in the Ross Sea and Australia-Antarctic Basins.

(4) lines 38-40 Please briefly explain what kind of model development allows the longer integration.

(5) The description of ice-ocean interaction is missing.

(6) I think that 10-years spin-up is short.

(7) Lines 97-104 and Fig. S2a What is the mechanism of the bottom water warming in the Ross Sea?

(8) All map figures need longitude and latitude information (at least one panel).

C2

(9) The manuscript is not so long. I suggest merging the supplementary material into the main text to increase readability.

Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2019-244>, 2019.