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Ocean Science Discussions

Interactive comment on "On the freshening of the northwestern Weddell Sea continental shelf" *by* H. H. Hellmer et al.

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General comments

This is a nice, interesting paper presenting new (and for the first time) hydrographic data from the continental shelf of the northeastern Antarctic Peninsula, and discussing observations of ocean freshening in light of the drastic environmental changes in the region, particularly due to the melting and disintegration of ice shelves. The authors did a great job in rescuing and assembling data from a large variety of research cruises carried out over the past 20 years, which also include some observations of seasonal variations as well as long-term changes. However, not all cruises provided the same kinds and amounts of data, and such the interpretation of long term changes is mostly based on three main data periods, which may be a weak point worth discussing in

more detail.

The paper is very worth publishing, however, it would be desirable to clarify some issues discussed in more detail below. In particular, the text should be improved towards a better summary of the many different cruises, and should be clearer about which data have been used for which interpretation. This is mostly a matter of introducing clearer names for expeditions and improving some figure legends.

Also, I am surprised that the authors do not include surface melt of ice shelves and glaciers on the Antarctic Peninsula as a source for increased freshwater input. This should certainly be added with references from the glaciological literature.

Specific comments

Abstract:

Here and elsewhere, it is confusing how many cruises have been used for which purpose to derive the presented results. The abstract mentions five cruises, while Table1 lists 11, and the text uses some of these in a virtually arbitrary order.

Line 10 ff: Here and elsewhere, your discussion of the causes for freshening or reduced salinification are confusing. It would be nice to formulate the contributions of ice shelf melt, sea ice melt and retreat, and reduced winter formation of sea ice (?) more clearly. This is also related to a more careful discussion of the involved regions and processes suggested below.

Introduction:

It would be nice if the introduction could more carefully distinguish between different processes in different regions, and ideally only focus on the northeastern tip of the Antarctic Peninsula. The importance of different sea ice processes (freshening due to increased melt and reduced sea ice formation in the northwestern Weddell Sea proper, reduced freshening due to increased ice formation in Larsen polynyas) should be introduced more clearly, e.g. by extending the relevant paragraphs.

P. 2015, l16-23: similarly, be more specific what you mean and which region/location you discuss.

P. 2016, l7: two summer cruises, or three or more (e.g. with Ant X-7?); at some stage you could introduce cruises as primary cruises and additional/secondary cruises, to distinguish more clearly.

Data and methods:

In general, the paper would become much more readable if you would not use cruise names but clear acronyms for each cruise, e.g. W, S, F with the respective years (e.g. W97) for winter, summer, and fall cruises, and identify them through Table 1. ANT-XXIII/7 (p. 2017, l4) does not mean anything with regard to summer or winter cruise (nor does ISPOL and WWOS, unfortunately...). Not everybody is familiar with the naming conventions of most cruises.

P. 2018, l8-19: This should be moved to the introduction

L10: entERs

L12-13: can you explain the underlying reason/mechanism?

L 18: determination

Observations and methods:

P2019, l15-17: what was the mean GMW fraction?

L19-21: Over what depths were these values determined? ; what does "higher sampled austral summer" mean?

L24-25: where exactly are those regions? North of 64.5?

L29-1: interesting that you found high salinities. Maybe you could contrast them more clearly with the general freshening trend?

Discussion:

Summer:

P2020, l16-19: at what depths?

L26: why should there be enhanced storm activity?

P2021, l10-11: This is not very obvious from Figure 7?

Winter:

P2022: include discussion of surface melt and runoff!

L26: replace ANT-X/7 by S92 and move reference into Table 1

P2023, L13: but none of these papers discusses flow on the shelf, do they? How about possible counter-currents on the shelf?

P2023 bottom to P2024 top: this paragraph is confusing because it discusses salinity decreases and increases, and jumps between the northeastern Peninsula Shelf and the Larsen C much further south. Could you rewrite more carefully?

P2024, l7 ff: how is summer defined with these satellite data?

Figure 9: As this is critical for parts of the discussion of the paper, Figure 9 should focus on the study region, such that differences between different years can be better seen (I think they are not very clearly visible in this figure yet). Also, it may be good to combine both panels into one (overlying colors for one period with isolines for the other) to better show differences between both.

L12-17: Maybe this discussion should be extended because the situation is complicated by advection. A southward ice edge may introduce more freshwater, but the larger open water region could then also lead to more ice formation and salt rejection in the following fall. Why should freshening hamper ice formation (line 16?). Also the processes in the polynyas are different from the situation in the "deep" Weddell Sea.

P2024, bottom: Interesting discussion. But this example may not apply if water is

replaced in less than one year as suggested further above?

P2025: So what do you mean to say? Can precipitation changes explain your observations or not? Please summarize better how this affects you conclusions?

Figure 1: Did you use different colors for different depths in both panels? Add color scale. Numbers are very small.

Figure 5: why are GMW fractions increasing with depth?

Figure 6: include as third panel in Figure 3 and show with same scale for better comparability?

Figure 9: Would be nice to combine both panels for better comparability and to focus on NW Weddell (see above).

Interactive comment on Ocean Sci. Discuss., 7, 2013, 2010.