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The impact of atmospheric and oceanic circulations on the Greenland Sea ice concentration

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The revised version of the manuscript is a substantial improvement on the original submission. For the most part I think that my concerns have been well addressed, but I still have some comments regarding the TOPAZ-EN4 comparison and the upper-ocean stratification in the western Greenland Sea that I hope the authors will take into consideration.

Specific comments:

Hovmöller plots of SST and SSS and time series of potential temperature, salinity, and stratification from the western Greenland Sea region are shown in Figs. 3 and 4. The data are taken from the TOPAZ reanalysis and from the EN4 objective analysis from the period 1991 to 2017. The authors note that the temporal evolution of these parameters appears to be well represented in TOPAZ, but that there are some differences such as the magnitude of the stratification and the location of the polar front separating the cold, fresh polar waters along Greenland from the warmer, saltier Arctic waters in the Greenland Sea. My concern is that there are hardly observations from the western Greenland Sea region chosen for this comparison (consider, for example, Fig. 2a in Brakstad *et al.*, 2019). It appears that EN4 will relax to climatology when there are no observations (Good *et al.*, 2013). The western Greenland Sea is an exceptionally data-sparse region, so I am very sceptical that these two figures provide much information about how well TOPAZ represents the hydrographic conditions in this region. I suggested instead that TOPAZ is evaluated against observations in the central Greenland Sea and that Latarius and Quadfasel (2016) or Brakstad *et al.* (2019) would be good points of comparison. In my opinion that would be a more sensible evaluation of TOPAZ.

I have some concerns about the upper ocean buoyancy frequency (Fig. 9a) in the western Greenland Sea. The western Greenland Sea region that you have defined is a region of complex hydrography. It includes the Greenland shelf, which is dominated by polar surface water, the shelf break and upper slope where the EGC transports Atlantic-origin water at intermediate depth, and the interior Greenland Sea where Arctic-origin water is formed (e.g. Håvik *et al.*, 2017; Renfrew *et al.*, 2019). I don't think that a spatial average across this region is very meaningful. The Greenland shelf is highly stratified, while offshore of the polar front the stratification is far weaker and deep convection is possible. In my opinion stratification averaged across this region is not a robust measure of vertical mixing of Atlantic-origin water or of the strength of the Greenland Sea Gyre.

Line 26:
The importance of the Greenland Sea to the AMOC is still overstated. While recent results of Huang *et al.* (2020) indicate that the Greenland Sea is an important source of the densest overflow waters from the Nordic Seas in the present climate and Chafik and Rossby (2019) demonstrate that the overflows from the Nordic Seas are key to the lower limb of the Atlantic Meridional Overturning Circulation, none of the references cited in the paper (or any other papers that I am aware of) demonstrate that the strength of the overturning circulation partly depends on the amount of freshwater in the Greenland Sea.

Line 42:
This sentence is unclear. Ice free conditions, or at least partially ice free conditions, are required for deep convection to occur. According to Moore *et al.* (2015) the reduced depth of convection in the central Greenland Sea is not because it is ice free - that is a prerequisite for deep convection. It is instead caused by the retreat of the ice edge, and the region of strongest ocean-to-atmosphere fluxes which is tied to the ice edge, toward Greenland such that heat loss from the central Greenland Sea is reduced.

Lines 53-55:
I counted 6 different acronyms on these three lines. Are all of these really necessary? The readability of the text would improve if the number of acronyms were reduced.

Line 57:
The subpolar North Atlantic is generally considered the subpolar gyre south of the Greenland-Scotland Ridge, not the Nordic Seas.

Line 147:
The region outlined in Fig. 2 is in the very southwestern part of the Greenland Sea (the Iceland Sea is more or less immediately to the south of this region). As such, I think referring to it as southwestern Greenland Sea rather than western Greenland Sea would be more appropriate.

Line 219:
The term “temperature advection” should be defined also in the text, not only in the caption of Fig. 8.

Line 246:
How often is this pattern, which resembles the NAO but has centers of action shifted toward the north, realized?

Figure 1:
The thick black line marking the 3000 m isobath is not clearly visible.

Figure 3:
It would be good to specify in the caption that monthly values are considered.

Figure 10:
Ekman is misspelled in box A2.

References

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