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Interactive comment on “The Barents Sea polar front and water masses variability (1980–2011)” by L. Oziel et al.

Anonymous Referee #2

Received and published: 14 April 2015

The discussion paper focus on climate variability, impact on water masses (their variability and area coverage), and the frontal structures in the Barents Sea. It is based on an extensive observational data set, in addition to simulations conducted by a numerical model. The main result, according to the abstract, is that Atlantic Water occupies larger volumes of the Barents Sea. This is accompanied by a northward displacement of the southern frontal in the eastern part of the Barents Sea. The paper is interesting to read and novel, in particular regarding the separation and location of the fronts and their variations between seasons and cold and warm years. However, some major issues need to be addressed before final publication can be recommended. More details are given below.

Major comments:

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1. The paper should be rewritten somewhat to be more directly focused on the southern and northern fronts. Location, variability and characteristics of the frontal zones in the Barents Sea are important and not well studied, and this study is a highly relevant contribution on the topic. Climate variability in the Barents Sea, on the other hand, is relatively extensively studied. The main results given in the abstract, that Atlantic Water occupies larger volumes of the Barents Sea, has been published before, although then with focus on climate impacts on the ecosystem (Johannesen et al., 2012; Dalpadado et al., 2012).

2. There are several “strange” definitions/choices/etc. that need to be addressed. More details are given below.

Detailed comments:

As also stated by the other reviewer; usually Atlantic Water and Arctic Water is named in singular form without the “s” at the end.

Polar front is usually used when separating Atlantic Water from Arctic or Polar Water. This is the case in the western Barents Sea (along the Spitsbergen Bank). In the eastern Barents Sea, the fronts are found to be separation between Atlantic Water and Barents Sea Water (“southern polar front”, which is essentially a temperature front) and Barents Sea Water and Arctic Water (“northern polar front”, which is essentially a haline front). Thus, these are not true polar fronts. I suggest to simply naming them “southern front” and “northern front”. I also suggest changing the title to “The Barents Sea frontal zones and water masses variability (1980-2011).”

Page 450, line 5: Mixing alone cannot generate dense water. Additional modification of cooling and brine release is necessary.

Page 451, line12: A reference should be added to support the statement of significant turbulent mixing. Sundfjord et al. (2007) is already in the reference list and should be appropriate.

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Page 451, line15: “mass water transform “ is strange. I suggest rewriting to “water mass transformation”.

Page 451, line 26: I suggest rephrasing to: “...into the Arctic Ocean along the bottom...”.

Page 452, line 11: I suggest rephrasing to: “...(together with the Baffin Bay)...”.

Page 452, line 15: I suggest rephrasing to: “... the region with air-sea exchanges in the BS increases”.

Page 453: objective 2 should be the most important.

Page 457, line 4: Why limit the period to 1980-1985 when documenting changes in the Norwegian Sea and the Nansen Basin? Seems very strange, and is not addressed at all. The same question applies to figs. 3 and 4.

Page 457, line 16: “Fresh Water” should be replaced by “Melt Water”. Freshwater has salinity 0. Although “freshwater content” commonly is used in marine science, this is used when calculating relative to freshwater (salinity 0).

Page 459, line 10-15: defining Atlantic Water by maximum salinity probably work well here since it seems not to be any really dense water formed by brine release in the provided figures. Atlantic Water is not necessarily the most saline water mass, but it is the most saline of the main water masses (Atlantic, Arctic and Coastal).

Page 460, line 5: here you state that the polar front separates Atlantic Water and Arctic Water. Then you cannot use “polar front” in the eastern region where you define Barents Sea Water. This section is by the way very interesting.

Page 463, line 5: Why is it expected that low AW is associated with maximum sea ice extent in the Barents Sea? If low AO index gives increased westerly's, which in turn will increase the inflow (as argued several times in the manuscript), this should imply minimum sea ice extent as stronger heat transport would melt ice/prevent ice freezing. This is also consistent with higher air temperature. So why is it more ice when there

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are stronger westerly's, higher air temperatures and stronger inflow?

Page 463, line 14: I suggest rephrasing to: "... and numerical modeling indicate that the heat losses of the ocean..."

Page 464, line13-14: "...Atlantic Water volume increase in the BS represents the major result of our study". This has been shown before. Your results on the frontal zones on the other hand have not been documented earlier, and should be emphasized.

Page 468, line 2-3: About seasonality. Very interesting and important. Should be emphasized.

Page 468, line 8-11: About interannual variability. Very interesting and important. Should be emphasized.

Page 468, line 17: "As the volume of the Barents Sea Water remains unchanged,...". According to fig. 12 the volume of Barents Sea Water changes from 20-25% in 1998 to below 5% in 2000. Thus it is reasonable that the southern front has moved north while the northern front has stayed put.

Page 469, line 14-24. This is interesting and important.

Figures

Several of the figures are too small to read properly. This goes for fig. 1, 5, 6. There are 15 figures in the paper, and I am not convinced that all of them are needed. E.g. the TS-figures 3, 4 and 10 are hardly used. Are they really necessary? And the time series from the model (figs. 9 middle and lower panel, fig. 11); do you really need to show the time series as long as you state the correlations and the lacking trends? I could be possible to combine figs. 8, 9, 11 and 12 into one figure.

Figure 3: "Nansen Basin", not "Nansen Bassin".

Figure 11: It is hard to see the difference between blue and black in this figure.

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References:

Dalpadado et al. (2012). Climate effects on Barents Sea ecosystem dynamics. ICES Journal of Marine Science (2012), 69(7), 1303–1316. doi:10.1093/icesjms/fss063.

Johannesen et al. (2012). Changes in Barents Sea ecosystem state, 1970–2009: climate fluctuations, human impact, and trophic interactions. ICES Journal of Marine Science (2012), 69(5), 880–889. doi:10.1093/icesjms/fss046.

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