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Ocean Science
Discussions

# *Interactive comment on* "Heat loss from the Atlantic water layer in the St. Anna Trough (northern Kara Sea): causes and consequences" *by* I. A. Dmitrenko et al.

**Anonymous Referee #3**

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In this article the authors have investigated the relationship between upward oceanic heat flux from the Atlantic water (AW) layer and sea-ice growth/reduction. The eastern flank of St. Anna Trough is identified as an important location where heat loss from a recirculating branch of the Fram Strait AW occurs. Based on observations from 1996 and 2008-2010 as well as model simulations they find that the most likely process contributing to the upward heat flux and subsequent ice reduction is mixing generated by shear instability.

The study nicely highlights a potentially important location for heat loss and water mass modification of AW in the Arctic Ocean. It is generally well written with an easy to follow and logical structure. However, the evidence for the proposed mechanism – shear



instabilities – is not supported by their data that weakens the conclusions and further studies are thus needed.

General comments: i) Shear instability is proposed to be the main mechanism releasing heat, but no evidence is found in the data. I think the paper could benefit from a wider discussion of what other processes that could be attributed to the heat loss. ii) Rudels (2010) argues that the partitioning of the heat loss from the ocean to the ice/atmosphere (in the western Nansen basin) is about 30/70 based on a simple model for heat loss constrained by surface salinity. Could you apply a similar approach and further constrain how much heat is going into ice melt vs atmosphere?

Specific comments: P546 L27: Why do you use WOA? I believe PHC http://psc.apl.washington.edu/nonwp_projects/PHC/Climatology.html is better suited for the Arctic Ocean.

P547 L10: Zhang & Steele (2007) show that to get a realistic AW circulation in their model, using KPP, they need to reduce the vertical background diffusivity to 1*10**-6 m**2/s.

P547 L13-L27: In this section the model performance is discussed mainly based on results at the entry gates, i.e. Fram Strait and BSO. However, a lot of water mass transformation of the AW takes place downstream of these sections and I think you need to better demonstrate the model performance for AW circulation? This could be done by e.g. plotting a map of max(potential temperature) in depth range 150-800 m as well as sections of modeled potential temperature and salinity across St. Anna Trough.

P554 L1-L11: In this section I think you should mention the uncertainties of the satellite-derived ice thicknesses and drift.

Technical comments: Change all "seaice" to either sea ice or sea-ice.

P547 L13: Suggestion: change "The model is capable in realistic reproducing of the AW inflow . . ." to "The model is capable of realistically reproducing the AW inflow . . ."

P556 L4: Suggestion: “In this sense, the St. Anna Trough is generally similar to an “ice bay” known as Whalers’ Bay formed by inflowing Fram Strait branch of AW north of Svalbard (e.g., Ivanov et al., 2012).” I think “generally” is unnecessary in this context. Fig 1: Is (AW)_to a typo?

Fig 4: the text is very confusing with references to “left”, “center” and “right” when figures are labeled “a”, “b” and “c”.

Fig 10: I don’t think “measured” fits well when you refer to satellite data. I recommend using observed or satellite-derived in this context.

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Interactive comment on Ocean Sci. Discuss., 11, 543, 2014.