

Interactive comment on “Time and space variability of freshwater content, heat content and seasonal ice melt in the Arctic Ocean from 1991 to 2011” by M. Korhonen et al.

Anonymous Referee #2

Received and published: 13 November 2012

General comments

This paper illustrates time and spatial variability of freshwater content and heat content over last two decades based on the historical Arctic hydrographic data. Authors claim that increasing freshwater content in the Canadian basin can be attributed to the changes of sea ice formation and melt in this region whereas freshening of both Polar Mixed layer and upper halocline layer in Eurasian basin is mainly due to the advective origin.

As authors admit, spatial coverage of the historical hydrographic data is sparse and random in time and space, which makes difficult to examine time variability. This is

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an important issue, and this should be treated more properly. I also see seasonal ice melt analysis needs further thought. Focusing on fresh water content and heat content change with reliable error, uncertainty and offset estimate would increase the value of this study. Therefore, I would not recommend this manuscript for publication as it is.

Major comments

1. Separation of time variability and spatial variability As authors admit, spatial coverage of the historical hydrographic data is sparse and rather random in time and space, which makes difficult to examine time variability. I do not think this issue is treated properly throughout the analysis. Dealing with error, uncertainty and offset is a very important problem to draw decadal time series of freshwater content and heat content in each basin. What are the error, uncertainty and offset associated with such a sparse and random sampling data? Although I recognize this is a difficult question, I can not appreciate figure 5-9 so much as it is.

2. Figure 5-9 needs better illustration Figures 5-9 consist of same format. They are hard to examine the time variability of each water mass, and I would like to see better plots. Regarding figure 6, vertical axis are dominated by polar mixed layer and upper halocline water variability. No one can examine deeper water mass salinity changes, which are supposed to be less influenced by sparse and random sampling. Same argument can apply for figure 8. Regarding figure 5, it is hard to examine thickness variability for specific water masses as it is. It would be better to prepare one panel for one water mass with different defined sub-regions in different colors. Same argument can apply for figure 7 and 9.

Moreover, 8 sub-regions are too many to digest. I can see ridge sub-regions behave similar to surrounding basin sub-regions. Authors could discard ridge sub-regions and focus on main basin only, such as Southern Canada basin, Northern Canada basin, Makarov Basin, Amundsen basin and Nansen Basin.

3. Uncertainty of seasonal ice melt estimation I am suspicious about the method to

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estimate seasonal ice melt. How river input would affect on the estimate? How one time survey represents the upper ocean (above ~50m) ocean condition of the observation year? As authors mention in section 2.6, two months difference would give us a significant different picture on melt water content. I feel this topic should be studied by higher temporal observation such as 'Ice-Tethered Profiler' rather than a one time hydrographical survey.

4. Reliability of NCEP reanalysis data As authors aware, NCEP reanalysis heat flux quality is rather poor in the Arctic. Although we do not have so many options, a practical approach would be to employ different dataset, such as ERA-interim, JRA-25 etc.

5. Overstating sentences I find sentences in the manuscript are often overstating and subjective than authors could state based on the data. Rephrasing sentences and preparing result section and discussion section separately would make manuscript more objective and understandable.

Interactive comment on Ocean Sci. Discuss., 9, 2621, 2012.