

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.

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We found the review comments useful and would like to thank the referees for their input. Both our responses are below.

REFeree 1

1. We have compared the heat input derived from NCEP Reanalysis and ERA-Interim surface fluxes. Difference between these two was not significant for the aims of this study. Nevertheless, the heat input obtained from ERA-Interim will be included for comparison and will hopefully improve reliability of the meltwater estimate. In addition, uncertainties in reanalysed data will be better addressed.

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2. A more complete review of literature and a more extensive discussion on studies using oxygen isotopes to distinguish between freshwater components will be added and, if applicable, compared to the estimated seasonal ice melt. Overall, we shall clarify the approach used to distinguish meltwater from hydrographic (CTD) data.

3. Unfortunately, the Beaufort Gyre Exploration Project does not cover the 1990s. However, as it has a more extensive horizontal coverage of the Canada Basin during the 2000s compared to the data sets used here, we will include selected years to the analysis. This will hopefully help to build a more solid basis for some of the conclusions. If not, the uncertainties will be more strongly underlined and the speculative conclusions will be formulated as such in order to remove naivety from the text. Finally, we will cut down the arbitrariness in methodology by giving more justifications for the choices we have made.

REFeree 2

1. We will try to better quantify the errors and additional data for the Canada Basin will be analysed and included. However, as the referee comments, this is a sparse data set and ambiguity most likely cannot be avoided.

2. The salinity and temperature plots will be divided into two separate figures to better demonstrate the variability in deep water masses as the referee suggested. However, we still think the columns illustrating the water mass thickness, freshwater content and heat content have certain advantages that disappear when the water masses are plotted separately and thus we will leave them as they are. We will reconsider the importance of the sub-surface ridges in this study and the possibility to concentrate only on the sub-basins.

3. The problem with river runoff fraction in the meltwater estimate should be better addressed. We do not consider the river runoff to be a major problem, as the the runoff peaks in early summer (June) and the distance from the Eurasian continental shelf to the location of observations is too large (>1000 km) to cross in a couple of months

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(this would require velocities over 10 cm/s). The Southern Canada Basin remains the only sub-basin where the Mackenzie discharge could influence the estimated meltwater content. The Mackenzie discharge is a problem when the hydrographic survey is conducted near its estuary (especially in 1997). As the referee commented, the error in hydrographic meltwater estimate could better be assessed from data collected by the Ice-Tethered Profilers. An ongoing study based on the ITPs in the Canada Basin shows that the method used here likely overestimates the seasonal ice melt. Both the diffusivity of salt from underlying waters (increasing reference salinity for meltwater) and downwelling due to Ekman convergence (deepening of the temperature minimum) increase the meltwater estimate.

4. We have compared the heat input derived from NCEP Reanalysis and ERA-Interim surface fluxes. Difference between these two was not significant for the needs of this study. The heat input obtained from ERA-Interim will be included for comparison.

5. The text will be revised for needs to emphasize the uncertainties and the style will be formulated to be more speculative. The suggestion to write separate results and discussion sections would certainly add clarity to the text and this will be carried out.

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