

Summary

This manuscript presents a useful status update on the freshwater budget for the Arctic Ocean. All components of the Arctic freshwater budget are reviewed in a comprehensive and interesting manner. The authors made a significant effort to improve the analysis and presentation of results from its previous version, however, significant issues remain. This study will be a useful contribution after a major revision that presents the main results in a consistent and straightforward manner.

Major comments

The authors have softened their claim that there is fresh water compensation between the Beaufort Gyre and the rest of the Arctic in the abstract, however the presentation throughout the manuscript still needs significant improvement. Studies that suggest compensation seem to be preferentially cited (See L162 comment below) and some seem to be misrepresented (see L159 comment).

The analysis of the reanalysis products is much more comprehensively presented, but it would be very helpful to include boxes indicating which areas are being integrated over in addition to describing the regions in the Figure 2 caption. The same holds for Figure 3.

The satellite and in-situ fresh water estimates are very different during the period that this study focuses on, yet this is not discussed. The methods used for the satellite calculation are not presented (what empirical constants are used? What isohaline/reference salinity is being targeted?), so it is unclear how we might expect them to compare with insitu measurements. Compensation in the satellite estimate appears to decrease in the last part of the record. This is also not discussed. It is unclear why half of the Arctic is left out of (part of?) this analysis, and also unclear why an insitu estimate for the Beaufort Gyre is not presented. Presumably it is a subset of the full Arctic dataset? Please explain these analysis choices.

My recommendation is for major revisions because these observational analyses are a foundational part of this study and it is important that they be presented clearly, but note that the changes are much less significant than those recommended in the last revision.

Specific Comments

Note: line numbers refer to the tracked-changes version of the manuscript.

L67: Generally $\Delta S = S_{\text{ref}} - S$, please check and revise.

L131: Only Greenland ice sheet contributions are discussed, this could be a good place to also introduce GIS runoff contributions.

L139: Not sure that adding the depths of the halocline and Atlantic layer is useful, as they vary substantially across the Arctic.

L159: Which studies are you referring to? (Proshutinsky et al., 2009; McPhee et al., 2009; Rabe et al., 2011; Haine et al., 2015)? It is inaccurate to state that these studies do not take redistribution or the Greenland Ice Sheet into account.

L161: Remove “(among other processes)” or explain which processes you are referring to.

L162: Rabe et al. 2011 and Morison et al. 2012 do not quantify the degree of compensation between the Beaufort Gyre and the rest of the Arctic Ocean. Wang et al. 2019 “Recent Sea Ice Decline Did Not Significantly Increase the Total Liquid Freshwater Content of the Arctic Ocean”, show an updated time series from Rabe, which suggests that there has not been compensation between the Amerasian and Eurasian basins.

Figure 2: It would be helpful to show which areas are summed over to produce panel D in panel C.

L226: It would be useful to provide a brief review of the method used in Giles et al. 2012 and Armitage et al. 2016, and now in this paper, including the empirical constant used, for clarity.

L265: Why aren't these areas included in Figure 3? Please explain this further.

L278: Does this mean that the in-situ estimates at the end of the record may be underestimates? In this case, the discrepancy between the satellites and in-situ estimates may be even larger than what is presented here.

Figure 3: Please indicate where your Beaufort Gyre region in panel B. In the caption you state that the time series are calculated to the 34 isohaline using a reference salinity of 35. This is likely not the case for the satellite calculation, which uses an empirical constant to relate steric changes to freshwater changes and should be clarified. Again, why is the in-situ BG time series not shown?

L329: Please justify this statement and include a citation: “Precipitation over the Arctic is the main source of freshwater into the Arctic Ocean”, including that from river discharge from the large continental drainage basins”

L456: Could reconsider the use of the word “Discharge” here as it is usually associated with only the solid component and you also discuss liquid runoff.

L497: It would be useful if you could explain and lay out why the total flux is larger than the net mass loss in a simpler fashion.

L509: Does Mankoff consider only solid freshwater flux? Or total? Please clarify.

L544: Translate Gt to mSv to make comparable with other sources.

L559: Could remove “as we do” since you are actively noting it in that sentence.

L628: Odd phrasing. Steric height changes do not redistribute fresh water, rather they are reflective of freshwater redistribution.

L640: Sentence is repeated.

L696: I didn't follow the last clause of this sentence, please clarify.

L706: Suggest weakening “is due” to “is potentially due”, or “appears to be”.

L714: Unclear why “to distinguish trends from low frequency variability” is included here.