

The authors thank reviewer#1/2 for the additional comments on our study. Here, the point-to-point replies are provided in blue, the comments are in black, and the modified texts for the manuscript are shown in orange.

**Referee #1's comments and replies:**

I would like to thank the authors for preparing the revised and improved manuscript as well as their extensive responses. I am mostly happy with how my comments have been addressed and only have minor comments where more major changes have been made.

Re: Thank you for the additional comments.

Fig. 6: It is evidently difficult to assess the realism of the seasonal amplitude of Arctic OHC (panel d). Additional evidence could be provided by referring to the data provided in Table A3 of Mayer et al. 2019 (<https://doi.org/10.1175/JCLI-D-19-0233.1>), who additionally constrained Arctic OHC with atmospheric data by enforcing energy budget closure: conversion of their monthly d/dt OHC to the units used here suggests a peak-to-peak amplitude of Arctic OHC of ~4 ZJ, which is in good agreement with the IAPv4 annual cycle presented in Fig. 6d.

Re: This is a good point, we have added this information in the revised manuscript: "This estimate of the Arctic annual cycle is consistent with a constrained Arctic OHC estimate with atmospheric data by enforcing energy budget closure (Mayer et al., 2019).".

Mayer, M., S. Tietsche, L. Haimberger, T. Tsubouchi, J. Mayer, and H. Zuo, 2019: An Improved Estimate of the Coupled Arctic Energy Budget. *J. Climate*, 32, 7915–7934, <https://doi.org/10.1175/JCLI-D-19-0233.1>.

Section 3.6: Please note that sea ice is neglected in the MHT equation but that the introduced error is small on at least annual time scales

Re: This is our oversight. We did use sea ice data (PIOMAS), so we have revised the approach description in the revised manuscript. "we integrate the OHCT, air-sea heat flux and heat gain/loss by sea ice changes from the North Pole southward in the Atlantic Ocean, and solve the energy budget equation, the residual at each latitude is the MHT, i.e.,

$$MHT(\varphi) = \int_{\varphi}^{90} \left[ Fs + \frac{dOHC}{dt} + Q_{ice} \right] a d\varphi$$

Where  $a$  is the Earth's radius,  $\varphi$  is latitude,  $Fs$  is net surface heat flux, and  $Q_{ice}$  is the heat inferred from the changes of sea ice mass. Consistent with Trenberth et al. (2019), this study uses the sea ice volume data from the Pan-Arctic Ice Ocean Modeling and Assimilation System (PIOMAS; Schweiger et al. 2011), and assumes a constant latent heat of fusion of  $3.34 \times 10^5 \text{ J kg}^{-1}$  and a density of ice of  $900 \text{ kg m}^{-3}$ ."

And, yes, the sea ice contribution is negligible for the derived time series (it is important for the annual cycle).

L882: question -> equation

[Re: Corrected.](#)

L1019: please add statement on statistical significance of the correlation coefficient.

[Re: Done:](#) “(the correlation is statistically significant at 90% confidence level, where autocorrelation reduction is taken into account)”

Section 3.9: The section reads better now, although an improved table compared to that in the original manuscript might have been useful (but not essential) for an overview. Other minor comments are:

L1054: Long-term GMSL increase is based on which data?

[Re:](#) Here we used the time series provided in Frederikse et al. (2020), where the GMSL is derived by combining tide-gauge observations with estimates of local vertical land motion from permanent Global Positioning System stations and the difference between tide- gauge and satellite altimetry observations (Frederikse et al. 2018; 2020).

The sentence is modified to “From 1960 to 2023, the observed GMSL rise is  $2.07 \pm 0.55$  mm yr<sup>-1</sup> (Frederikse et al., 2020), which is derived by combining tide-gauge observations with estimates of local vertical land motion from permanent Global Positioning System stations and the difference between tide- gauge and satellite altimetry observations (Frederikse et al., 2018).”

Frederikse, T., Jevrejeva, S., Riva, R. E. M. & Dangendorf, S. A Consistent Sea- Level Reconstruction and Its Budget on Basin and Global Scales over 1958–2014. *Journal of Climate* 31, 1267–1280. doi:10 . 1175 / JCLI - D - 17 - 0502 . 1 (Feb. 2018).

L1055: “sum of contributions”: suggest to state “contributors” in parantheses at first occurrence of this expression

[Re: Modified to](#) “the sum of contributors (Glaciers, Greenland and Antarctic ice sheets, land water storage, and steric sea level)”

L1073: I assume this is a “temporal” RMSD?

[Re: Yes,](#) “temporal” added in the revised manuscript.

L1087: I suggest to move the word “again” down to the end of the next paragraph, where you re-iterate the conclusion regarding the increased warming of IAPv4.

[Re: Yes,](#) moved.

L1088: stronger warming compared to what? Please link to the relevant figure/table/study.

[Re:](#) This is compared with the steric sea level estimate in IPCC-AR6 (Gulev et al., 2021), which is added in the revised manuscript: “This suggests that the stronger warming since the 1993 revealed by IAPv4 than assessed in IPCC-AR6 (Gulve et al., 2021), seems more realistic.”

**Referee #2's comments and replies:**

Fig. 16/18 Captions "Meridional" and "Atmosphere" are capital

[Re: Corrected.](#)

Fig.20 Captions: Not clear what "A 6-month running smooth " is. Should probably be replaced with "6-month running mean"

[Re: Modified to "6-month running means are shown here to reduce the noise."](#)