

Earth Syst. Sci. Data Discuss., referee comment RC2
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Comment on **essd-2021-220**

Anonymous Referee #2

Referee comment on "Monitoring the ocean heat content change and the Earth energy imbalance from space altimetry and space gravimetry" by Florence Marti et al., Earth Syst. Sci. Data Discuss., <https://doi.org/10.5194/essd-2021-220-RC2>, 2021

Comments on:

Monitoring the ocean heat content change and the Earth energy imbalance from space altimetry and space gravimetry
by Florence Marti et al. 2021, submitted to *essd*

general comments:

The presented study provides estimates of ocean heat uptake and the Earth's energy imbalance, mainly focusing on the space geodetic retrieval (from radar altimetry and GRACE gravimetry). The topic is timely and important, and the material in the paper provides a good basis for further scientific discussions and explorations. Emphasis is laid on the more exhaustive error analysis compared to previous research of the same topic.

IMHO, the paper still contains areas for improvement before a publication is justified. I'll highlight these below.

recommendation to editor: Major revision

Main points:

- * How does the choice of averaging region affect the estimates? I realize that the inclination and Argo coverage prohibit high latitude estimates, but the consequence is that the reported errors do not take into account the omission of the high latitude signals. Since the main selling point of this paper is the computation of the errors, it would actually be an added value if the authors could try to quantify this high latitude omission error in a (stochastic, i.e. from models) way. I realize this adds extra work, but I think it would be very fitting in this paper.
- * Related to this, is that the restoring of the ocean/atmosphere products in GRACE and

consequently subtracting the estimates from IB corrected altimetry should be described in more detail as it can falsely introduce atmospheric signals in the averages of global ocean mass. Are there still ocean averaged atmospheric components in the GRACE data? Or have these been corrected before comparing with altimetry?

* Uncertainties of EEH. The method to estimate the expansion efficiency of heat comes from a paper which I don't (yet) have access to, so more clarifications may be needed. For example, it is claimed that the EEH is most sensitive to salinity and at the same time it is claimed that the error bars are reduced because of the Argo data. Argo data is known to have considerable biases and errors in the salinity estimates so I wonder whether the authors could better clarify why they think the errors are now considerably smaller.

* The authors may be aware that in parallel to this paper a similar one has come out: Hakuba et al 2021 (<https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2021GL093624>) They actually find a larger EEI (0.9 W/m²). This paper would in fact be a nice opportunity to put these numbers in perspective (e.g. why do they arrive at a higher number?). Since the GIA correction on GRACE has such a large effect I indeed do wonder whether the GIA corrections can be one of the culprits.

Minor remarks:

Intro l33 "play a minor role" is the other 10% meant or something else?

l72: "innovative algorithms" I don't want to temper your enthusiasm, but maybe "new" or "original" is better here (let the reader judge themselves whether these are innovative)

l89 Negligible Or assumed to be negligible? In the former case maybe provide an estimate from the cited papers.

l172-l173 "It is however .. content" I don't understand this sentence

l190 "if included here" -> if it would be allowed to absorb a fraction of the ocean heat uptake

l245: What kind of numeric differencing scheme is used here?

"256: "is implicitly accounted for in the local EEH coefficients". I'm trying to get my head around this, and understand how the salinity effect would be implicitly accounted for. Please clarify (maybe add a formula for to explain this)

l289-299 "Thus on the overall ... we neglect it here". I don't really understand the word "correlation" in this context, and why it would be an argument not to apply a GIA

correction to altimetry. I suggest to address this together with the comment of the other reviewer on geocentric sea level rise

l409 power plant -> power plants