

Earth Syst. Sci. Data Discuss., author comment AC2  
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## Reply on RC2

Annie P. S. Wong et al.

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Author comment on "Argo salinity: bias and uncertainty evaluation" by Annie P. S. Wong et al., Earth Syst. Sci. Data Discuss., <https://doi.org/10.5194/essd-2022-323-AC2>, 2022

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### Author's reply to Comment on essd-2022-323 by Mathieu Dever

General Comments:

I believe this work to be very important. The Argo literature can sometimes be a bit scattered and overwhelming in volume. A manuscript summarizing the state of the Argo salinity database, and its limitations is a welcome contribution as it can guide new, and experienced, users on how to best use the data, and most importantly understand its limits.

The findings presented in this study are almost undersold: this is a valuable stepping stone towards improving the delayed-mode approach by recognizing the requirements and current limitations.

AW: Thank you to Dr. Dever for taking the time to review this manuscript, and for these positive comments.

Specific comments:

P1L27: I particularly appreciate this sentence "These results reinforce the need for continual re-evaluation of this global dataset." As I believe to be a crucial component of the Argo program.

AW: Thank you.

P3L68-69: The manufacturer's specs are misleading in salinity unit. As the CTD is calibrated in conductivity space, the conductive spec should only be stated. Does that salinity spec include the uncertainty on T and P propagated through the equation of state? Is it at Standard Temperature and Pressure (STP)? I think this might be better formulated in the way it is done in the conclusion: that the 0.01 accuracy is not from a metrological standpoint, but rather based on decades of data analysis.

AW: I think, for completeness, it is useful to quote the manufacturer specified accuracies, but in the revision, I will add that 0.0035 psu corresponds to 0.0003 Siemens per meter at 2°C and 2000dbar.

P5L146: As a setup for the next paragraph (i.e., only using >600 dbar data), I would maybe add a sentence here saying that because floats park at depth before profiling upward, they start their profiling phase mostly thermally equilibrated and thus only near-surface large temperature gradients are likely to affect the data quality, only propagating into the surface layer as the float is profiling upward.

AW: This is not quite true. It is true that the CTD is at thermal equilibrium during the drift phase at park depth. But for most floats, their profiling depth is deeper than park depth, and so the floats need to descend to the profiling depth before ascending and sampling on the way up. Hence the CTD is not really thermally equilibrated at the start of the profiling phase.

Fig3: I'm slightly confused by what that figure shows. Is it the average, median, or maximum DM salinity adjustment per box? That stat might be biased by the number of float in the box. I am also noticing that the distribution of the salty drift match the density map of available reference profile. In other words, the more reference data we have available, the larger the drift is. If that is true, it could mean that some of the drift is missed due to a lack of available reference data.

AW: I have indeed forgotten to explain what Fig. 3 is. Thank you for catching that! The plot shows the overall mean of dS in each box. I will add that to the figure caption in the revision. The mean is influenced by the distribution of dS in each box. In replying to the open comments from Reviewer 1, I discuss that the larger magnitude corrections are related to the earlier years of Argo, when delayed-mode operators were less judicious in applying larger corrections. They are concentrated in the Atlantic and the North Pacific because in the earlier years of Argo, delayed-mode efforts were focused in those areas, partly because those areas have more reference data, as you pointed out. I will add this explanation in the revision. I think separating the overall mean in Fig.3 into two time blocks, e.g. 2000-2010, 2011-2021, will illustrate that point better. Please note that these large-magnitude corrections only account for about 2% of Argo data.

P10L219-219: This sentence sounds odd to me. Maybe something like "The raw data (DATA\_MODE = 'R') can sometime be evaluated/adjusted in real-time (DATA\_MODE = 'A', if available) before being evaluated/adjusted in delayed-mode (DATA\_MODE = 'D'; See Fig 4)." I would also suggest maybe including an example of real-time adjustment? It might not be obvious to the reader, as the text is especially focused on sensor drift and that would never be a real-time adjustment.

AW: I will re-write the material in L218-220, and provide a description of 'A' mode data.

P10L231-232. The point that BGC data is a whole different beast is actually quite important, and I would recommend including the Bittig et al (2019) reference and emphasizing that point in the introduction.

AW: I will include Bittig et al (2019) in Section 4.

Table 1: QC flag '5' is a bit enigmatic to me. What could "value changed" mean? Maybe include an "e.g." in the box, or extra information in the table caption?

AW: The Argo QC flag table has an accompanying set of notes that provides additional information on the flags, including QC '5'. I will add that reference in the table caption.

P12L239: typo; should be "mean" and not "means".

AW: "means" here is used as a singular noun, referring to a method.

P12L240-241: Is inactivity the only reason why floats are removed from the grey list - or can they be removed on the operator's decision that the float is -after evaluation- not malfunctioning? If the latter, then I suggest to rephrase the sentence as it might be misleading as is.

AW: The latter can happen, but it is not common, and is not the point here. The point here is that the grey list is not a comprehensive list of problematic floats. I will rephrase that sentence to clarify that point.

P14L308: The third and fourth moment of a PDF are not necessarily intuitive metrics, I think it would be helpful to remind the reader what they mean (positive skewness meaning longer tail on the positive  $\hat{\sigma}$ , and kurtosis  $>3$  meaning heavy tails with large outliers).

AW: This is a good suggestion. Thank you. I will include a reminder of skewness and kurtosis on page 14.

P14L309: I am surprised by the large number of datapoints still lying outside the  $\pm 0.015$  after delayed-mode adjustment ( $>18\%$ ). I think a discussion should be included on how to improve this number. The authors highlight a series of limitations to the method, but I think it would benefit from suggestions on how to improve the robustness of this very helpful analysis, which is a crucial point in monitoring the quality of the Argo fleet.

AW: Yes, I agree. I will add some more discussions at the end of L313.

P17L375-378: I believe this is a very important point and am glad to see it explicitly laid-out in this study!

AW: Thank you.

