

Dear reviewer,

Thank-you for this review and interesting suggestions that we have mostly followed (see below). We have also more carefully edited the manuscript, which, we hope, has improved it.

01/09 received from ESSD Copernicus editorial:

Scientific Significance: Good

Scientific Quality: Good

Presentation Quality: Fair

For the final publication the manuscript should be: Accepted subject to minor revisions

Recommendation to the editor: The authors made significant changes to the manuscript since the last review including a thoroughly revised introduction and results section. I think the results of the study are significant and well justified. However, I think this manuscript could be improved with some structural revisions that would improve the clarity of their findings and the logical flow of the manuscript.

Suggestions for revision or reasons for rejection: This manuscript presents a comprehensive analysis of the CISE-LOCEAN database. The study addresses the limitations of this database and analyzes isotopic variability and variability in the relationship between water isotopes and salinity to the best of its ability. The manuscript has been significantly revised since the last review and I appreciate the significant changes made to the introduction and discussion section; these changes greatly improve the scientific framing of the study. I believe this study is an important contribution to the community and provide insights on the relationship between salinity and water isotopes within this database. I have provided mostly minor revisions, with some more substantive changes to the structure of the paper to provide more clear scientific motivation and significance, as well as to improve the logical flow of the manuscript.

Report:

Major Comments

1. The introduction of this manuscript could benefit from adding more nuance to the section describing water isotopes in paleoproxy archives. It would be helpful to address the sea surface temperature versus seawater $\delta^{18}\text{O}$ contribution to $\delta^{18}\text{O}$ carbonate and acknowledge that this is a limitation in global hydroclimate reconstructions. There are some studies that provide qualitative and/or quantitative constraints on this contribution in coral archived (e.g. Thompson D.M. et al., 2022 across the tropical Pacific and O'Connor et al., 2021 in the central equatorial Pacific). It would also be informative to readers to provide some background on the major climatic insights resulting hydroclimate reconstructions can offer, previous studies have used proxy databases such as the ones you cite (Konecky et al., 2020) to reconstruct changes in the past hydrological cycle (e.g. Konecky B.L. et al., 2023; Falster G.L. et al., 2023). This background will provide more motivation and significance to your study and the applications of modern water isotope databases to paleoclimate reconstructions.

Au: We understand the interest of adding this background information to provide a more balanced vision on what is involved in reconstruct changes in the past and present hydrological cycle, and the need for that of combining in situ water isotope and salinity

measurements with the collection of material recording these proxies. We have thus added these references in the introduction, and this paragraph now is structured as:

These isotopic signatures in ocean water are archived in past climate records, for example, for $\delta^{18}\text{O}$ in carbonates from warm water corals, giant clams or planktonic foraminifera (Mulitza et al., 2003; Abram et al., 2020; Dissard et al., 2021; Dong et al., 2025), or for $\delta^2\text{H}$ in lipids (Schefuss et al., 2005; Schouten et al., 2006; Leduc et al., 2013). They are acquired from the seawater isotopic properties at the time when these organisms grow, at the same time as temperature-dependent effects. Measurements of seawater isotopes in the upper ocean is strongly recommended, often at the seasonal resolution, to understand these archives, as well as to gain a better understanding on how temperature and water isotopic properties influence the archived records, such as investigated in the recent past by Thompson et al (2022). These archives together with model studies have the potential to help reconstruct changes in the past hydrological cycle (Konecky et al., 2023). Thus, dedicated efforts should ideally combine collection of living (or recent) organisms nearly simultaneous to the seawater samples, surface salinity and sea surface temperature, which has been done for example at low latitudes within the frame of paleoclimatic research programs (e.g., PAGES CoralHydro2k working group; Konecky et al., 2020, Atwood et al., 2025, 2026, or locally by O'Connor et al., 2021) or to calibrate planktonic foraminifera $\delta^{18}\text{O}$ signals (e.g., Wilke et al., 2009; Rebotim et al., 2019; Salgueiro et al., 2020).

2. The results and discussion section could be reordered for a better logical flow. I suggest changing the order to go from monthly time series to average linear regression then address seasonal regressions. This ordering will provide more context for readers when they read the seasonal regressions section.

Au: It is an interesting suggestion, which goes a little bit contrary to how we proceeded (estimating the regressions on the seasonal scale, then averaging those regression coefficients to estimate the annual-average, finally presenting the time series, which we emphasize now more in the method section). We decided to follow the suggestion to first present the annual averages, as this is rather easy to visualize (and better known), then the seasonal averages (first in the boxes, and then averaged in the larger regions). On the other hand, we decided to retain postponing the presentation of the monthly time series afterwards. Our reason for presenting them last in this manuscript can be understood from former lines 526-527, as we use the average S-Wisotopes linear relationship of (now) table 1 to plot the blue curves of Figure 5 (5°N-5°S), which we have also tested in all the other small boxes (an estimated correction of the spatial representativeness error). It is also complementary information to the box regressions which are largely based on the intra-box spatial (and interannual) variability in S and Wisotopes.

3. I had a hard time keeping track of the different boxes you used for individual analyses. While I think it is a logical choice to use regional boxes with more data points for specific analyses, it would be helpful to have a clearly defined methods subsection which addresses which boxes were used for which analysis/results section and why or make sure this is clearly described at the beginning of each results subsection. Some of this reasoning is contained within the methods section, but it is hard to parse out the different boxes used for the different results section and why.

Au: The focus is on the individual boxes. The grouping is just an averaging of the individual boxes seasonal regressions to reduce uncertainty in seasonal regressions due to insufficient

sampling, and is only presented for that. We hope that this is clearer in the final version, and that we don't juggle too much between the boxes and the larger domains in the discussion.

4. Please move figure 6 and the accompanying text (L610-620) to the results section. This would fit in much better conceptually in either section 3.4, where you show the climatologies from these boxes or in section 3.1, where you present seasonal linear regressions. The logical flow of the results and discussion sections is hindered by the addition of results in the discussion section.

Au: Thank-you. Indeed, Fig. 6 and the associated part of the discussion can be inserted in 3.4, as fig. 6 is complementary to figure 5 and earlier results (table 1)

5. It is not clear why the BATS time series is presented in the discussion section rather than the results. Is the BATS time series included in the LOCEAN database? If so, I think this would qualify as an analysis of a particular region or subset of that database and much of section 4.3 of the discussion should be moved to the results. I think it is appropriate to discuss the potential impacts of interannual variability in the discussion section and refer to this figure. However, Figure 7 and L714-736 seem to be results from your analysis.

Au: The BATS time series is not part of the LOCEAN-CISE database (this is now more formally acknowledged). It is nonetheless important here, as it contrasts what can be done at a fixed point to the approach with the LOCEAN-CISE database, where we have to group data spatially distributed in fixed regional boxes. The presentation of its seasonal cycle (in App. C) is indeed mentioned with the box time series in the result section (after presenting the times series for boxes 14 and 15). The issue and the reason to present figure 7 in the discussion section is to discuss the question of interannual variability, and what this would imply on the seasonal results (notice that except for the BATS time series at a nearly fixed location and regular sampling, it is not straightforward to explore the issue in other tropical or subtropical areas with varying spatial sampling and with the box approach).

Minor Comments

6. **L23-28:** I suggest breaking this sentence into two for clarity.

Au: Thank-you. Done with cut at: 'for $\delta^{18}\text{O}$ and $\delta^2\text{H}$. Weakest slopes are found near the equator, but also to a lesser extent in the western Atlantic compared with the eastern Atlantic at low and mid-latitudes.'

7. **L33-34:** Is this correlation significant? If so, consider revising to "A significant correlation between observed seasonal cycles in d^{18}O , d^2H , and d -excess and that of salinity is found...".

Au: Changed as suggested.

8. **L53:** Remove "thus" from the beginning of the topic sentence. Or consider combining this paragraph with the paragraph above.

Au: 'Thus' removed.

9. **L63:** Consider adding a topic sentence at the beginning of this paragraph which describes variability in the relationship of water isotopes and salinity that is inclusive of both high and low latitudes, as the paragraph addresses both.

AU: Thank-you. We added: 'There has been considerable interest in monitoring the water isotopes of sea water both at high and low latitudes.'

10. **L63:** "continental (or icebergs) glacial melt" is confusing here, please rephrase this part of the sentence.

Au: moved to the end of the sentence, and rephrased as. ‘In the high latitude oceans, the formation or melt of sea ice, freshwater inputs from high-latitude rivers, and continental ice melt from marine terminating glaciers and icebergs...’

11. **L76:** Please spell out El Niño-Southern Oscillation (ENSO) the first time you introduce it in the text.

Au: Done.

12. **L76-78:** Revise to “decadal modes of variability in the southwest equatorial Pacific (Horikawa et al., 2023), the central equatorial Pacific (Conroy et al., 2017), and the South Pacific Convergence Zone (Dassié et al., 2018).

Au: Thank-you. Done.

13. **L80:** Revise to “Conroy et al (2014)”.

Au: Done.

14. **L82:** I recommend removing “To some extent” at the beginning of this topic sentence and AU: Done. Maybe the last part of the sentence is missing after ‘and’. The paragraph has also been revised to include the suggestions made by the reviewer in major comments.

15. **L95-100:** Please revise this sentence for clarity, “Except where sea ice forms or melts” is a bit confusing at the beginning of the sentence.

Au: Thank-you. We revised the sentence as:

‘Putting aside high latitudes where sea ice forms or melts, one expects regionally quasi-linear relationships between ocean surface salinity S (practical salinity with no unit) and water isotope properties ($\delta^{18}\text{O}$, $\delta^2\text{H}$, but also the derived d-excess defined as $\delta^2\text{H} - 8*\delta^{18}\text{O}$, together later referred to as Wisotopes) (Craig and Gordon, 1965), because...’

16. **L100:** Remove the “)” after the end of the sentence.

Au: Thank-you. Done.

17. **L105-111:** Please combine this paragraph with the paragraph above, as it does not read as a standalone paragraph conceptually.

Au: We do not understand the suggestion. This is a standalone paragraph, as it elaborates on another use of the dataset, and the need for that purpose to explore finer regional scales than in Legrande et al (2006).

18. **L209-212:** Please combine this sentence with the paragraph above, as this is not a standalone paragraph.

Au: Done.

19. **L221-224:** Cite figure 1 in this sentence, as this shows the spatial sampling distribution.

Au: Thank-you. Now added.

20. **L260-263:** I still do not see the information on the specified ranges of salinity used to avoid fresh waters in table 1 as indicated in the response. Please add the ranges in parentheses in line 261, this is important for readers who are interested in using this database for future research.

Au: Sorry, with the reorganization, this was in Table 2, not Table 1 (and only for the lower salinity bound; we removed the constraint of the higher salinity bound). This is added as ‘(later reported in Table 1)’ (notice that former Table 2 is now Table 1)

21. **L291:** It is not clear what you mean by “The data did not warrant going further than linear relationships”. Please specify!

Au: there is just not enough data to try that, as it involves the less sampled tails of the distributions (which we tried to curtail at the low end). There is however the exception of boxes 1 and 2, but that has already been discussed elsewhere. Later on, there could be some interest to better position the extreme values relative to these linear regressions. The sentence is reformulated as:

‘The data were not numerous enough to investigate non- linear relationships, especially within the restricted salinity range retained. The linear regression of $\delta^{18}O$ as a function of S are obtained with ...’

22. **L307-309:** I think it is necessary to include some information on the number of measurements going into these monthly averages and report the range across regions and if there are some regions with much more measurements contributing to the monthly (and thus seasonal) averages. The attached errors will reflect the sample size of these estimates to some degree, but including this in the text will provide readers context on how the number of measurements may bias a monthly estimate (i.e. would also provide more context for the next paragraph (L317-330).

AU: yes, but this is very hard to present systematically, and we provide uncertainties which take that into account, to a large extent. We added on former line 313: ‘This error can be large, as can be guessed by the seasonal sampling distribution plotted in App. A, with monthly sampling ranging from less than 4 samples (in more than half the month-boxes averages) to over 100. We estimate the effect of limited spatial sampling in App. B using...’

23. **L334-343:** This section presents results from seasonal linear regressions in boxes 1 and 2, however, this first paragraph only discusses the motivation for this investigation in box 2. It seems these boxes are from a similar region and impacted by similar climatic processes, but a clearer reasoning for the inclusion of these two boxes would be helpful. In this paragraph, please address the reason for the linear regression and comparison in box 1 as well.

Au: We expect rather similar performances in boxes 1 and 3, in addition to box 2 (and we find it, with the caveat of a different sampling). Box 2 was exemplified as it has the best seasonal sampling. We added a sentence on line 342:

‘Similar significance levels are found in the nearby boxes 1 and 3 in the NASPG, with the caveat of slightly larger uncertainties due to somewhat weaker sampling in some season. This...’

24. **L364:** Which box is this on figure 1? This sentence doesn’t seem relevant in this particular results section, as results from this box are not presented here.

Au: This was box 3. We decided not to show it, as signals are weaker (weaker seasonal variability), as expected from this box position relative to the other two, and sampling is also a little less regular between different seasons. The sentence moved a little later (former line 369), as: ‘This is supported in a nearby region (3) with reasonable sampling south-east of Iceland (not shown).’

25. **Figure 4:** Please increase the font size for the labels of each sub-figure.

Au: Done.

26. **L392-400:** Please split this sentence up. As written, this is very confusing to read. Perhaps you could introduce each region in a single sentence and address the climatic influences.

Au. Thank-you. We now split the sentence into four separate sentences.

27. **L472:** Add a period at the end of the sentence.

Au: Done.

28. **L507-508:** I suggest revising the beginning of this sentence to “The overall anti-correlation of slope and 0-intercept may arise from noise in the dataset...”.

Au: Thank-you. Done.

29. **L549-551:** Please revise this sentence for clarity. Are you saying this is similar to other regions?

Au: To clarify, this was modified in:

‘In most other regions, the seasonal cycle in salinity and $\delta^{18}O$ variables is rather weak and present large uncertainties , with the exception of three better sampled boxes in the North Atlantic subpolar gyre.’

30. **L562-566**: I suggest working this sentence into one of the defined discussion subsections to emphasize the scientific significance of your findings. Its current placement is confusing.

Au: we agree. Moved after 4.1 ‘Seasonal linear regressions’

31. **L579**: Add parenthesis after “(and publications therein”.

Au: Done

32. **L585**: Please specify what “it” is.

Au: Change (to it’ by ‘in the respective contribution of these two water masses’.

33. **L756**: The beginning of this sentence seems to contradict the rest of it, don’t you provide some qualitative interpretations regarding changes in ocean circulation?

Au: part of the sentence missing. Added, as ‘We have not interpreted... matter. This would involve relating them...’