27/05 receive from ESSD Copernicus editorial:
You - as the contact author - are requested to individually respond to all referee comments (RCs) by posting final author comments (ACs) on behalf of all co-authors no later than 24 Jun 2026 (final response phase). Please log in using your Copernicus Office user ID 592621 at: https://editor.copernicus.org/egusphere-2026-851/final-response

AU: Overall response

The paper has been thoroughly rewritten. In particular, we have reorganized the presentation of results and discussion in what we believe is a more coherent fashion. In each section, this progresses from seasonal regressions of Wisotopes to SSS, to the spatial distribution of the annual regression coefficients, finally presenting the average Wisotope time series. It is more coherent than before because the annual regressions average the seasonal regressions described before, and the box-average time series involves adjusting the monthly means from spatial sampling bias using the average regressions. We have added further elements of interpretation in the discussion, which then opens on what interannual variability could do in this region..

We have redrawn most figures, both to improve them and because in the mean time the dataset had been updated. We have also added an App. A presenting the maps of seasonal data distribution with an indication of data density.

RC1:

General comments:

This study, titled "*Seasonal cycle in surface seawater isotopic composition" by* Reverdin et al., utilizes the valuable LOCEAN database to investigate surface seawater isotopes ($d^{18}O$ and dD) and their regional relationships with salinity. While the data itself has been previously published (Reverdin+2022, 2025), this deeper analysis of the dataset is of high scientific value. However, the current presentation of the results makes the manuscript difficult to follow, thereby limiting the immediate impact of the findings. Some descriptive explanations of the results are not shown with plots, inhibiting a full understanding of the results. Furthermore, although the authors subdivided the study area into 20 regions (Fig. 1 and Table 1), these subregion numbers are not consistently referenced in the text. To make the manuscript suitable for publication, I believe the following points should be addressed to enhance its clarity.

Au: we thank the reviewer for their comments and suggestions, and provide some responses below.

Major Comments:

1. While the Introduction provides a good overview of previous research, the specific aims of this study are somewhat vague. To guide the reader without stress, the authors should explicitly state the study's goal; for instance, add a clear statement such as: *"This study aims to..."*

   Au: Thank-you. We added at the end the introduction:

"In this study, we aim at investigating the seasonal cycle in surface water isotopes, and their relation to salinity across a large part of the Atlantic Ocean and in the south-west Indian Ocean, based on water samples mostly measured in the LOCEAN stable isotope laboratory."

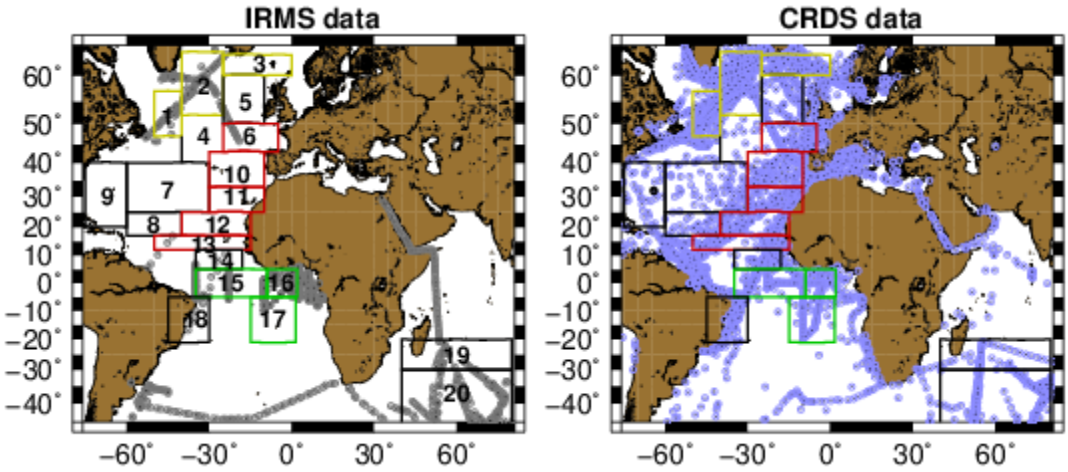
2. LOCEAN Database (Data Section): The LOCEAN database (Reverdin et al., 2022, https://doi.org/10.5194/essd-14-2721-2022) is a relatively recent and specific dataset. Some readers need fundamental information on this dataset. Please briefly introduce the LOCEAN database in Data Section, by citing relevant references and summarizing what was previously evaluated to clarify the aim of this current paper (Reverdin et al., 2025).

   Au: We have updated this section. The earlier 'data' paper (2022) was in particular presenting what were the data collected, how they were stored and analyzed, the validation methods and the statistics of variability in some key deep areas. Those statistics have since then been updated, when data collection allowed it, with similar results. In the current paper, the emphasis is on the surface layer and its seasonal isotopic composition variability, as the surface ocean is the most active region with respect to the exchange of water molecules between the ocean, the atmosphere, the continents and the cryosphere (sea ice or continental ice inflow). One issue not addressed in the 2025 paper is an inhomogeneity in the surface data. Initially, the data base was strongly contributed by samples collected on research cruises (such as OISO and SURVOSTRAL, Reverdin et al., 2025), or by scientists embarking on various ships of opportunity (such as SURATLANT (Benetti et al., 2015; Reverdin et al., 2018), and SURVOSTRAL). To get a wider sampling of the surface ocean (both in space, but also in other seasons than the repeated cruises), we chose (starting in 2017, but to a wider extent since 2021) to also rely on collection by mariners or sailors of water samples mostly dedicated for measuring salinity, and from which we recover some water to measure the water isotopic composition. There can be other issues than the ones described in Reverdin et al. (2022) in this data stream which results in more dubious samples (this is also commented in Reverdin et al., 2025). In some areas of the ocean, these later data are the majority of what is available in most seasons. This is why we needed an independent estimate of the seasonal variability, which is provided with a set of data covering the surface ocean near Bermuda close to the BATS site, that had also been earlier measured at the University of Bergen. Despite some conservation issues, we find rather coherent results on this set to what is found with the LOCEAN-CISE dataset (and since the earlier draft, we use the slightly updated version V6)

3. While the authors define 20 subregions (Table 1), the text uses geographical names (e.g., "south-east of Greenland") without providing the corresponding subregion numbers. This makes it very difficult to cross-reference the descriptions with the tables and figures. Please consistently identify subregions by their ID numbers (e.g., "NW NASPG [Region X]") throughout the manuscript. additionally, these subregion numbers should be clearly annotated on the map in Figure 1.

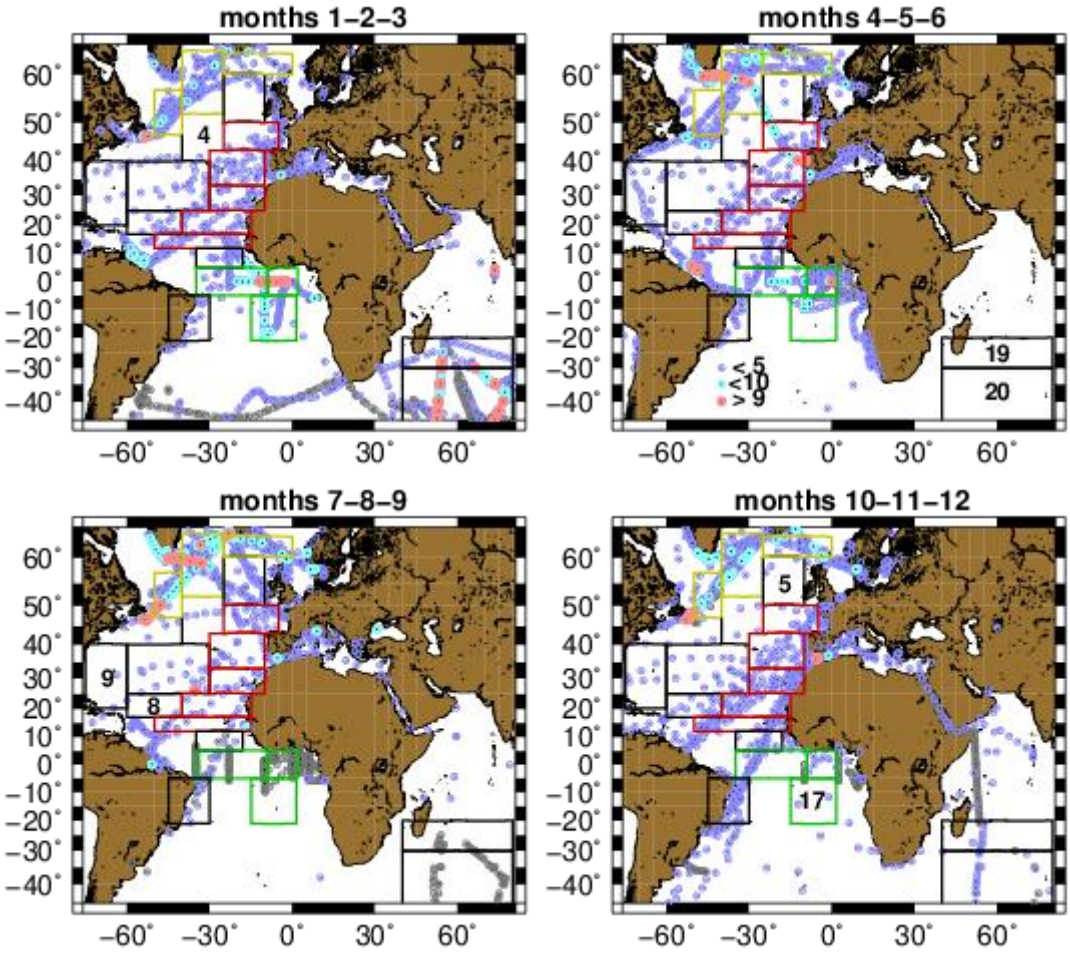
   Au: We agree, and we have adopted this suggestion. Now, it is only when we group sub-regions, such as to improve statistics on the seasonal cycle, that we retain a

geographical name (and this is helped in Fig. 1 by adding the number of the boxes with a color which depends on this grouping)



4. The current plots do not indicate the data density for each regional dataset. Please provide the number of observations (*N*) for each monthly or season data point (e.g., Fig 3). This is essential for interpreting the differences in the magnitudes of SD and SE (e.g., Fig. 2 vs. Fig. A1). Furthermore, several descriptions (e.g., L. 268-271 and the "unexpected regressions" in L. 474-475) lack corresponding plots. Without a plot showing the relationship (e.g., salinity vs. d18O), it is difficult for the reader to assess the "unexpected" nature of these results.

   Au: We have added the total number of data for each box in Table 2. We have also added in App. A, seasonal maps with data density. The number of monthly data is now reported in one of the panels of Fig. 5 (former 2), which helps understand how one gets from SD to SE (in Fig. B1). However, we find that the data density is not necessarily the most useful indicator (except in the North Atlantic subpolar gyre). In many regions (such as the eastern Atlantic south of 45°N or the equatorial Atlantic), it varies widely between seasons, due to repeated cruises having contributed data, often along the same track, at specific months of the year, as seen in App. A.



Au: On former line 268-271, we do not thus think that it is that important to separately provide a plot of SE, as the sentence clearly indicates the range of SE obtained. One needs to be reminded that this estimated SE is relatively qualitative, as explained in App. B (and based on salinity).

Au: In line 474-475, the 'unexpected regressions' commented was referring to the mean plot of Fig. 4 (for d-excess), and the standard errors provided in Table 2, which are rather large in this box 19, in particular for $\delta^{18}O$ and d-excess. This is directly related to a large variability between seasonal regressions (with changes of sign for the slope of d-excess). Due to relatively poor sampling in some seasons, we do not think that this warrants a specific presentation. The sentence has been changed to:

'Similarly, in the 20-30°S band of the southwestern Indian Ocean, we find a large variability between rather noisy seasonal regressions (Table 1).'

Minor Comments

1. **L21:**Replace "CISE-LOCEAN" with "the isotopic platform facility at LOCEAN (hereafter "CISE-LOCEAN")".

Au: done

2. **L23:**For clarity: “This investigation… **for each of the 20 subregions** indicates…”

   Au: done (‘subregion’ has been changed to ‘box’)

3. **L176-178:**Phrasing check: “frozen... before been analyzed... before been refrozen.” This appears to be a typo.

   Au: yes. Thank-you.

4. **L249, 251 (Salinity Climatology):**Please specify the source and definition of the term “salinity climatology” used in your analysis. It is unclear whether this refers to WOA or another gridded dataset. If you compared measured bottle salinity with CCI v4.4, as suggested in the Acknowledgements, this should be explicitly described in the Methods or Results instead of only being mentioned in the Acknowledgements.

   Au: yes; The climatology is the average seasonal cycle in CCI V4.4 (which annual mean adjusts to ISAS, not WOA), as well as another climatology (only resented in B1) (Reverdin et al., 2007). In this case, for the CCI V4.4, we settled to just using the 14-year seasonal average from 2011 to 2024, which is close to the period with the core of observations in the LOCEAN-CISE database. This is now added in the chapter Methods (near former line 209), in addition to the presentation in Appendix A.

5. **L285 & 288:**please ensure consistent use of subregion names and IDs (e.g., “NW NASPG” rather than “south-east of Greenland”). As noted above, Fig. 1 should be updated with these ID annotations to help the reader follow the regional descriptions.

   Au: yes. We agree, and have updated figure 1, and refer to these IDs whenever they happen.

6. L309: .. larger winter-spring salinity -> **higher** winter-spring salinity

   Au: changed

7. L333: uncertainties... are larger than between them -> .. are larger than **the differences between these seasonal values**.

   Au: changed

8. **L376-378, 448-450, 503:**Refer to the corresponding subregion numbers. Au done
9. **L397-405:** Please provide the geographic coordinate ranges for the merged subregions.

   Au: the merged boxes into larger regions are now described in Figure 1, with different color codes for the regions.

10. **Fig. 1:** The primary purpose of these two plots is currently unclear. Please provide a more detailed explanation in the caption to guide the reader. For example, the caption could state: “The LOCEAN database comprises xxx% CRDS measurements; based on

this data density, the study area was subdivided into 20 subregions." Additionally, I note that some areas containing data were not included in the subregion analysis. What was the rationale for this? Please explicitly define the criteria used to determine and classify these subregions.

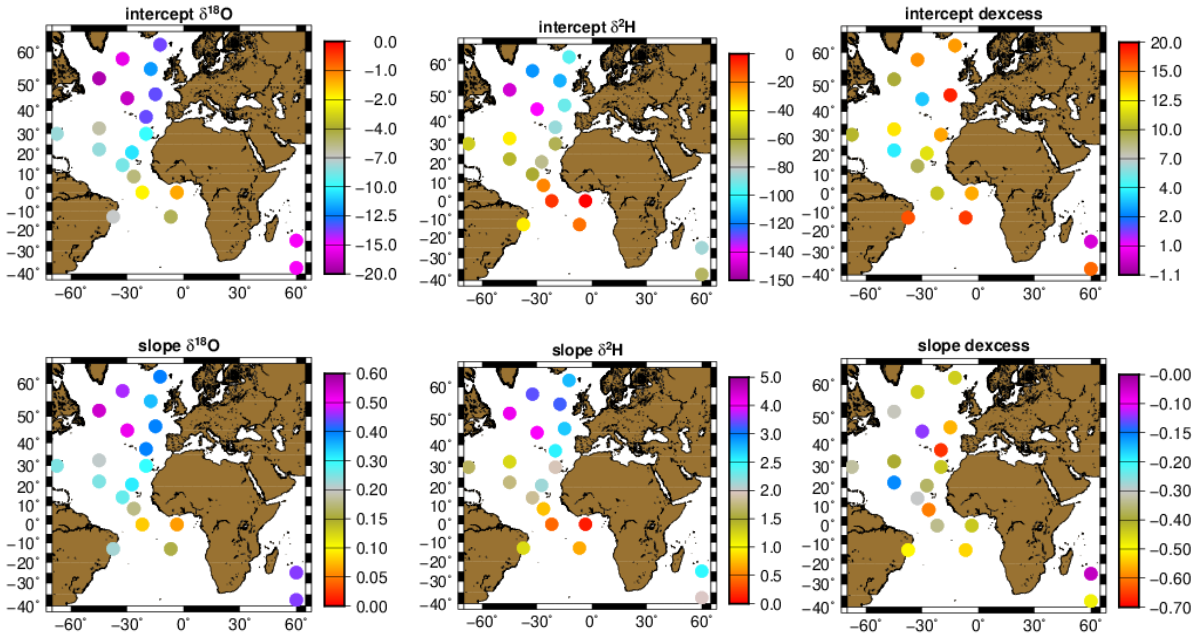
Au: Although the majority of data are CRDS, plotting separately IRMS and CRDS data, illustrates that in two regions (the equatorial Atlantic and the southwest Indian Ocean), there is a substantial set of IRMS data in the base, and they contribute largely to the data coverage in some seasons (see App. A). The rationale for not including certain regions with data was mostly due to insufficient seasonal coverage (this is now more explicitly mentioned; typically, when more than 3 consecutive months have less than 3 data per month in a region for any of the parameters investigated, we do not attempt this mapping; also, the regions have to be relatively homogeneous, which is not the case in the far eastern or far western equatorial Atlantic). We also excluded certain well-sampled shelf areas for reasons clearly explained in the paper. As time goes on, the database size increases. Thus, there are other subregions when the characterization of the seasonal cycle could be attempted, such as in part of the Mediterranean Sea and Red Sea, parts of the tropical and subtropical Pacific Ocean, primarily between Panama, Tahiti and New Caledonia, and parts of the Nordic Seas.

11. **Fig. 2:** Please ensure that the subregions 5N–12N and 5S–5N are clearly defined and consistent across Fig. 1 and Table 1. Additionally, the text following "(--- deviations)" appears to be truncated or cut off; if so, please provide the missing texts.

    Au: done (see also colors on Fig. 1 indicating the 3 regions);

12. **Fig. 4:**The color palette should be changed to a colorblind-friendly version (e.g., viridis or plasma) to comply with modern publication standards.

    Au: The color palette has been changed. It is not fully color-blind friendly, but I find the new one more pleasing than the previous one.



RC2 :

Summary Comments

This study presents a detailed characterization of seasonal variability in surface seawater isotopic composition (δ18O, δ2H, and d-excess) and its relationship to sea surface salinity from the expanded CISE-LOCEAN database across the Atlantic and Southern Indian oceans. This is an important contribution, as it discusses this database's ability to resolve regional relationships between water isotopes and salinity, as well as their seasonality. These relationships are foundational to the interpretation of many marine proxy records in the region, as such this study has implications for paleoclimate proxy studies. Furthermore, the results presented in this study could provide valuable benchmarks for isotope-enabled models. However, I have major concerns about the structure, scientific clarity, and legibility of the manuscript as it is presented currently. I have provided substantive revisions to improve this manuscript, with the goal of strengthening the scientific framing and to ensure that the observational uncertainties and sampling limitations are clearly communicated.

Au: thank-you. We also feel that the structure should be revised. See overall comment at the beginning of the response letter.

Major Comments

1. The introduction of this manuscript would benefit from more discussion of the scientific motivation and border significance of the constraints provided on seasonal variability in water isotopes. More context on the climatic insights that water isotopes and their relationships to salinity can provide, and how this may vary regionally, would improve the framing of the introduction. The authors briefly reference the application of seawater isotopes to paleoclimate proxy calibrations, however, I think this deserves more attention and is a very important application of this work. The authors could draw on a broader base of literature and paleoclimate studies from the region which use modern studies of seawater isotopes to make interpretations about past hydroclimate to ground this work. Similarly, the application of this study for isotope-enabled model validation is briefly mentioned, however, I think more discussion of these tools and the importance of this study for model development and benchmarking would make this introduction more effective. Overall, a more clear framing of what new insights the CISE-LOCEAN database brings and what kind of scientific questions are being addressed would greatly benefit this manuscript.

   Au: We agree that the reference to the application of seawater isotopes to paleoclimate proxy calibrations was too briefly mentioned, and probably not at the right place. We have thus partially rewritten the introduction section. We have tried to more clearly refer to the importance for paleoclimatic calibrations as better understanding past hydrological cycle and hydroclimate, with a step of model development and benchmarking to present world data. We have now more clearly pointed out that one would like to fully resolve at least seasonal variability in the data to be able to best use some of the paleoclimate records of the near surface ocean. The paper is dedicated to this investigation of seasonal variability: where do we stand for that in a relatively 'safe' environment of measurements of a single laboratory (instead of a compilation), with the current data distribution in the open ocean.

2. The results section would greatly benefit from more sub-headings, and a more concise presentation.

Au: we thank the reviewer for this appreciation (sub-headings). We now have four sub-headings in the Results section, and three in the Discussion section.

3. The figures in this manuscript would benefit from a clearer depiction of spatial sampling and coverage. Some representation of the temporal coverage of the database would be helpful. I think a figure showing the number of measurements in each domain through time would be helpful. Walter et al. (2023) figure 1 is a good example of this kind of figure: https://essd.copernicus.org/articles/15/2081/2023/. Atwood et al. (2026) figure 4 is also a good example of a figure showing temporal resolution.

   Au: Thank-you for this interesting suggestion. We decided to add an App. A showing sampling in individual seasons. In this App., data point sizes are made proportional to number of data points, after a grouping of data on a 0.25°*0.25° grid, as suggested. In particular, this takes into account the interannual cruise repeats. On the other hand, we preferred not to change figure 1, as this can be misleading, as a very large number of data in one month mask a lack of data in other seasons (this is nicely illustrated in Fig. 5, where monthly number of data are indicated. On the other hand, because of the large regional differences, we do not see a clear benefit of adding the number of data points in other figures. The temporal coverage is not presented here. It is highly variable depending on the different boxes, and very hard to interpret in terms of what percentage of interannual (or decadal) variability is sampled.

   In figure 1, it would be helpful to indicate on the figure which domain is the central equatorial Atlantic, North Atlantic subpolar gyre, and eastern North Atlantic regions which are referenced in later text and figures. In this same figure, it would be helpful to indicate the number of data points in each domain. Does each point represent one measurement? Or are there some sites with multiple measurements being used? If so, this should be indicated.

   Au : This is now indicated with different colors (one per region) on the box contours that have been added to Figure 1. The box numbers of table 2 are also reported on Figure 1. The number of data points in each of the subregions is now also reported in Table 2, but not in figure 1. Obviously, data points overlay each other with this plotting resolution, and furthermore some data are from repeated cruises (OISO, Ovide, PIRATA been the most common examples), but often happening in the same season. So, for the sake of defining the seasonal cycle, this is not particularly helpful to provide/plot the total number of data points. It will nonetheless be important later on, when possibly investigating interannual variability. There is now a more general description of the data set which points to the respective contributions of these repeated cruises, and the other surface data, either collected by an embarking scientist on ships or sailing boats of opportunity, as well as by mariners and sailors, often for the purpose to measure ocean salinity, and from which we recover water to measure its isotopic composition. This last data source (mostly since 2016-2017) is becoming more important, and is a critical contribution to investigate the seasonal variability in a large part of the region (see the data distribution in App. A figures). However, the proportion of dubious data in this data stream is higher. Thus, we decided to also reanalyze at LOCEAN samples that had been collected to investigate seasonal and interannual variability near Bermuda, and which are in a box otherwise only sampled from these ships of opportunity (and in insufficient number in most months). Although these samples had conservation issues, results are too a good extent complementary

and reinforce what we obtain with the CISE-LOCEAN data base (I have to go further on that!).

4. The limitations of spatial coverage are mentioned in reference to some of these figures; however, this topic should be treated more, as the analysis of the regional coverage of this database is an important finding which will be useful for future work. To what degree do these sampling limitations impact climatic interpretations and your ability to constrain the seasonal cycle? Moreover, you should provide the number of measurements being used to define the seasonal cycle and the regression slopes for each region.

Au: the annual number of data points is now provided in Table 1 for each subregion. However, coverage is highly variable between seasons, which is now illustrated in the figures of App. A. In many areas, there are clearly seasons with insufficient sampling, and thus poor constrains on the seasonal variability. This is what we discuss, and what motivated grouping subregions in Figure 5 (the subregions correspond to different color codes on Fig. 1). In Fig. 5, we also provide a first attempt at trying to correct the spatial representativeness error.

5. The discussion of seasonal variations in the results section should be streamlined both with regard to the figure showing the raw seasonal cycles, which have vastly overlapping error bars, as well as seasonal variations in the slope/intercepts. These results take up too much room in the paper when there is not a robust result on seasonal variability from this database. This database seems to be a poor fit for the question of seasonal variability in water isotopes and their relationship with salinity given the sparse data available. Consider streamlining or putting these figures (especially figures 2 and 3) in the supplemental information.

   Au: We agree to streamline, but we do not agree with the conclusion of the referee, which might be caused by a misunderstanding on what is plotted on Fig. 5 (ex-Fig. 2). What is plotted on the monthly means is not error bars (SE), but the standard deviation in the monthly sampling (SD). Error bars (SE) are smaller and are illustrated for S in App. B. However, estimating SE requires a strong assumption on the number of degrees of freedom discussed in the paper, and which is only valid in a statistical sense. It is likely not valid in months when sampling is fairly intense, and repeated in different years over the same track. We prefer to plot SD to SE on this figure 5, as some of it could be random, but some could be indicative of interannual or longer variability (either real or due to uncertainties in the LOCEAN measurements). On other figures, where the sampling involves just the number of seasons (as in Fig. 3), or the fit of the regression (and thus standardly estimated errors on slopes…), it is SE that is plotted. There are boxes where seasonal variability is highly significant due to intense sampling over more than 10 year resolving both seasonal and some of the interannual variability (boxes 1, 2? 3, thanks in particular to the SURATLANT project), and for which SE are really small.

6. The progression through topics in the discussion section should follow the order of presentation in the results section. Do not present results materials in discussion (eg. lines 518-528) and figures should be presented in the results section (e.g. Figure 6 and 7).

Au: Thank-you for the suggestion. We are now fully consistent in the discussion section to follow the plan of the result section. In some ways figure 6 could be presented in section 3. However, in the discussion section, when discussing seasonal variability), we retain a focus on processes. This is in that spirit that Figure 6 is presented there and not earlier in Results (section 3) (it combines the seasonal averages and the average regressions lines presented earlier, with the average of the four seasonal estimates). Afterwards, Figure 7 is there to hint at what could be the nature of deviations of individual samples from the mean seasonal cycle, and thus in particular to interannual variability, something that we cannot fully investigate with the present dataset, and that is not in the results section. Thus, Figure 7 is left in the discussion section (see also below our reply to comment 8)

7. The BATS timeseries should not be presented in Appendix B with results presented in the discussion. Remove figure from discussion.

   Au: We think that there was a misunderstanding, and thus do not follow the request made. App. C (former B) presents the seasonal cycle of these BATS data (not the time series) with comparison to regional box 9, whereas Fig. 7 presents interannual variability (deviation from the seasonal cycle). As such, Fig. 7 has its full place in the discussion section (and not either in the results section, which focuses on the average seasonal cycle, etc…). This is the only figure which opens to the important issue of interannual variability, and as such has an important place in the discussion.

8. The discussion of the physical mechanisms that drive variability in the relationship between water isotopes and salinity is underdeveloped as is. There is some discussion about the isotopic signature of upwelling and horizontal advection in surface water masses, however, I think this could be expanded more. This is a significant scientific question, especially in regards to the use of paleoclimate proxies in the region to understand past hydrological changes. The authors should expand their literature base to include some context on the physical oceanography of the literature which can potentially drive the observed variability in these regressions. This discussion would also highlight the value of these datasets to the broader community.

   Au: Thank-you. We agree that this was not developed enough, but this is not the main focus of this paper. For that, we refer to some earlier studies, both in the equatorial Atlantic, the North Atlantic subpolar gyre and the SW Indian Ocean. Going fully into that would be a much larger undertaking.

Minor Comments

1. **L45:** It would be helpful to provide context to what the scientific goals of programs such as GEOTRACES and GO-SHIP are and to establish why this classification is important.

   Au: added ‘respectively aiming to improve the understanding of biogeochemical cycles, and to develop a globally coordinated network of sustained hydrographic sections as part of the global ocean/climate observing system’.

2. **L66-67:** "...as well as through the water column in order to provide a climatology to which isotope-enabled models can be referred to." Are you referring to benchmarking efforts for isotope-enabled models? Please revise for clarity.

   Au: 'referred to' changed in 'benchmarked'

3. **L70:** Please clarify the regional relationship you are referring to.

   Au: added: 'Regional relationships between Wisotopes and salinity'

4. **L80-82:** What potential biases in the data are you referring to? The database contains information on a number of potential biases so please specify. Atwood et al (2026) does not evaluate interannual or decadal variability across the entire dataset, as there are not enough time series with the temporal coverage to do so. Please clarify what you mean by "can be modelled".

   Au: We are sorry, the sentence was incorrect. We propose to rewrite the end of the paragraph, as '… (Atwood et al, 2025). Potential remaining biases in data and possible interannual/decadal variability can also result in apparent variability in the relationships between water isotope properties and salinity. Thus, it can be difficult to attribute differences in the relationships between water isotopes and salinity in relatively nearby regions, such as the western and eastern North Atlantic subtropics in Benetti et al. (2017b).'

   L87-88: Replace "surface seasonal variability" with "surface water isotope seasonal variability" for clarity.

   Au: done

5. **L110-112:** The CoralHydro2k seawater database has been published (Atwood et al., 2026): https://essd.copernicus.org/articles/18/1921/2026/essd-18-1921-2026.html

   Au: Changed in '(see for example, the CoralHydro2k seawater data base with a focus on the tropics (35°N-35°S) (Atwood et al., 2026))'

6. **L191-194:** Are all measurements open ocean? If so, please state that.

   Au: The database is now explicitly described. It does not contain coastal time series, although occasionally some near-coastal data are gathered either during research cruises or by VOS. Figure 1 clearly indicates that most subregions avoid the coastal areas, except in mostly dry areas near the African coast. Because of that data distribution, the percentage of very low salinities associated with river plumes is rather low. Furthermore, except on the North Atlantic subpolar shelves (but which are not included here in any subregion), the percentage of very low salinities directly associated with Arctic inflows and influenced by sea ice melt (or sea ice freeze) is low.

7. **L192:** Please specify the ranges used.

Au: Thanks. This is important information. We avoid mostly the lowest salinities by using these ranges that are now reported in Table 1.

8. **L196-198:** Are you indicating that you are sampling so the domains are representative of identifiable oceanographic domains? Please rephrase for clarity.

   Au. This is correct. To help clarify what we do, the paragraph is rewritten as:

'The boxes should correspond to identifiable oceanographic domains with respect to ocean circulation as well as for specific regimes of the water air-sea exchange (by Evaporation (E) and Precipitation (P)) and its seasonal cycle or of other freshwater sources. In practice, the boxes have usually to be large in order to retain data throughout the seasonal cycle. Despite that, except in the North Atlantic subpolar gyre boxes 1 to 3, there is often at least one season much less sampled than the others.

In each region, horizontal and vertical mixing between different water masses and their advective paths, as well as freshwater inputs and evaporation result in a spread of surface salinity, as well as in water isotopes. Sometimes the different water masses are not isotopically distinguishable in a (water isotopes, salinity) diagram. For example, Benetti et al. (2017a) for the equatorial Atlantic and the eastern subtropical gyre of the Atlantic Ocean could not distinguish the signatures of upwelled waters from the ones of the surface water masses advected from higher eastern subtropical latitudes.'

9. **L249:** Please specify what climatology you are referring to.

   Au: we rewrote the sentence as:

   'The sampled SSS seasonal cycle in this last region presents a good agreement with monthly salinity climatologies, whereas in box 15 to its south (5°N-5°S) there were larger differences, in part because of large month-to-month spatial differences in the sampling (cf App. B). '

   Note: The monthly seasonal salinity climatologies used are described in App. B; only two such climatologies are used, because they best fit the time period of the isotopic data used, but we believe that the conclusions would also hold with other climatologies.

10. **L264-265:** It would be helpful to report correlations between d-excess and SSS.

    Au: This is now indicated, with emphasis on the version with correction of the spatial representativeness error, as well as whether they are significant or not.

11. **Figure 3:** This figure would benefit from some representation of the number of data points the slopes are being calculated from in addition to the average plotted as a point.

    Au: notice that these are not just points, but points with SE (error bars). Because in these two boxes, there is a large number of data points included in each of the seasonal averages (over many different years) (as commented in the paper), and the exact number of data points is not relevant. We add in the figure caption the range in lowest and highest number of data points used in the seasonal fit for $\delta^{18}O$ versus S (numbers for $\delta^{2}H$ and d-excess are close, but a little lower to those)

12. **L314:** Please stay consistent with how you report the season (e.g. JFM versus 7-9).

    Au: Thanks. This is a good idea. We now systematically refer to months (in season context) by number 7-9…

13. **L331-333:** I believe this is a typo, please include "difference" in the sentence if applicable: "...are larger than between them."

    Au; Thanks. Replaced by '… are larger than the differences between these seasonal values.'

14. **L334-335:** By "individual data" do you mean 3 individual data points or 3 individual locations with data and calculated slopes and intercepts? 3 data points seems quite small to calculate a regression slope, so if that is the case it would be worth discussing associated uncertainties in the slope in more detail.

    Au: The conditions we set were to have three individual years sampled and at least 4 data points. We are aware that it is the bare minimum to have an estimate (two parameters). Such low data density (with less than 10 data points in one season) happen only in a small number of boxes (mostly 4, 5, 8, 9, 17, as reported in Fig. A1). We preferred for consistency to retain these poorly determined seasonal coefficients when averaging them to obtain the annual average, as hope is that when the time series will extend these will be better estimated. It is clear that it often results in larger standard errors for these boxes than for other better sampled ones in all seasons. During the revision, we have updated the data set and released on seanoe an update of the dataset. However, this has not filled most of those data poor seasons.

    L512: This is not a stand-alone topic sentence, perhaps consider deleting or combining with previous paragraph

    Au: We have rewritten the beginning of the paragraph:

    'As a complementary vision on what this entails, the different seasonal averages for $\delta^{18}O$ and $\delta^{2}H$ are plotted with the average of the seasonal regression lines (Fig. 6). They nearly overlay it, suggesting that the seasonal changes mostly correspond to the action of similar hydrological processes as the spatial spread during one season. This is...

15. **Table 1:** Please include the number of samples used in the regression.

Au: (now Table 2) The total number of retained data is added (for $\delta^{18}O$), as well as the minimum salinity criteria in each region. Notice however that a large number of data points during the whole year can mask a season with very poor sampling (for that, cf the maps of App. A).

16. **Figure 5:** Please make the y-axis of the plot large enough so we can see all the points and uncertainties.

    Au: Thank-you. To include the full uncertainties (which were cut on the two right panels), we slightly extended the scale for all panels

17. **Table 2:** Please include the number of samples used in each seasonal regression.

    Au: We prefer not to add it, as this is not directly relevant for the standard error estimates (but see comment in caption for domain 3, seasons 3 and 4).

    L554: I think the "?" in this sentence is a typo. Additionnally please clarify what a good timeseries means.

    Au: yes for '?'. We replaced by 'good' and that part of the sentence by 'although there is a long time series with often adequate spatial sampling for austral (1-3) conditions (Akhoudas et al., 2023),...'

18. **L798:** Please specify which climatology you are referring to.

    Au: changed with '… with the two monthly climatologies…' (they have just been described above)