Response to editor:

Dear Dr. Ren and coauthors,
Thank you for your comprehensive response and revised manuscript.
Three of the reviewers are now satisfied with your revision, and the points by reviewer #4 also seem to be satisfied. Reviewer #2 points out a few technical details that need correcting:
"1. The subplot in Figure 1a should include explicit labels for both the x-axis and y-axis to ensure clarity. Please label the axes to indicate what variables they represent.
Response: We have added explicit x- and y-axis labels to Fig. 1a to clarify the plotted variables.

2. L382. classical -> typical
Response: We have changed "classical" to "typical" as suggested.

3. Figure 10, 12–14 should include a legend for the current vectors to clarify the magnitude of the ocean currents."
Response: We have added a reference-vector legend to Figs. 10 and 12–14 to indicate the magnitude of the current vectors.

I have a couple of remaining points, though, that I have mentioned before and that I think have not been adequately addressed: One relates to the layer thickness of NPIW, where you write "To obtain uniformly gridded vertical profiles for subsequent analyses including contour plots and depth-dependent temperature/salinity variability, the observations were linearly interpolated between vertically adjacent CTD measurements on the same mooring line onto a common set of standard depth levels. In addition, local linear interpolation was applied between vertically adjacent CTD sensors on the same mooring line that bracketed the 34.3 psu value to estimate the depths of the upper and lower isohalines used for NPIW thickness calculation."
This means that you use linear interpolation to estimate the exact layer thickness. Each of your instruments are around 100 m apart on each mooring line (see Figure 2), yet, you show variability as small as 50 m within one month (Figure 4) and subsequently analyse using linear regression with gradients as small as 50 m thickness over the whole range of isopycnally-averaged salinities at M1 (Figure 8a). Ideally, you would show a CTD-Profile taken at deployment and/or recovery of the mooring that illustrates why linear interpolation is appropriate here; e.g. are the profiles approximately linear or do they show strong changes in gradient within the NPIW range (or just above/below in the water column). At least I would expect a paragraph estimating the potential accuracy or error in your NPIW layer thickness, given that you use time series at discrete depths further apart than some of the signal you analyse.
Response:
We thank the editor for raising this important point. We agree that the uncertainty associated with estimating NPIW layer thickness from moored CTD sensors with finite vertical spacing should be explicitly addressed, especially because some short-term

thickness variations are smaller than or comparable to the nominal vertical spacing of the instruments.

In the revised manuscript, we have added shipboard CTD salinity profiles near the three mooring sites as new panels in Fig. 4d–f. These profiles show the vertical salinity structure near M1, M2, and M3, together with the nominal depths of the moored CTD sensors. The selected isohalines used for the thickness calculation are also marked in the figure. Specifically, the 34.3 psu isohaline was used at M2 and M3, whereas the 34.2 psu isohaline was used at M1 as a local proxy for the low-salinity core, because the lower 34.3 psu isohaline was not continuously resolved within the observed moored CTD depth range at M1. The added CTD profiles show a well-defined low-salinity intermediate layer and relatively smooth salinity variations across the selected isohaline intervals, supporting the use of local linear interpolation between adjacent moored CTD sensors when the selected isohaline is bracketed by two sensors.

We have also added a new paragraph in Sect. 3.2 to estimate the uncertainty associated with the isohaline-based thickness calculation. We clarified that the shipboard CTD profiles were not collected at exactly the same time as the daily moored observations and therefore were not used to validate individual daily estimates. Instead, they were used to evaluate the uncertainty introduced by the finite vertical spacing of the moored CTD sensors and by the local linear interpolation procedure. For each shipboard CTD profile, the layer thickness was first calculated from the full-resolution salinity profile. The same profile was then represented only by salinity values at the nominal depths of the moored CTD sensors, and the layer thickness was recalculated using the same local linear interpolation method as used for the mooring records. The difference between the two estimates was taken as the interpolation-related thickness uncertainty.

This comparison gives estimated uncertainties of 6.79 m at M1, 11.30 m at M2, and 1.16 m at M3, with a mean value of 6.42 m. These values are much smaller than the main seasonal, inter-site, and mesoscale thickness variations discussed in the manuscript. Nevertheless, we have revised the text to state explicitly that short-term thickness variations of several tens of metres should be interpreted cautiously, because the shipboard CTD profiles were not collected synchronously with the daily moored records.

In addition, we revised the caption of Fig. 4 and the relevant text in Sect. 3.2 to avoid ambiguity in the thickness definition. The revised text now states that the layer thickness was estimated as the vertical distance between the upper and lower selected isohalines, with 34.2 psu used at M1 and 34.3 psu used at M2 and M3. We also clarify that the M1 thickness mainly represents the temporal variation of the local low-salinity core and should not be interpreted as strictly equivalent in absolute magnitude to the 34.3 psu-based thickness at M2 and M3.

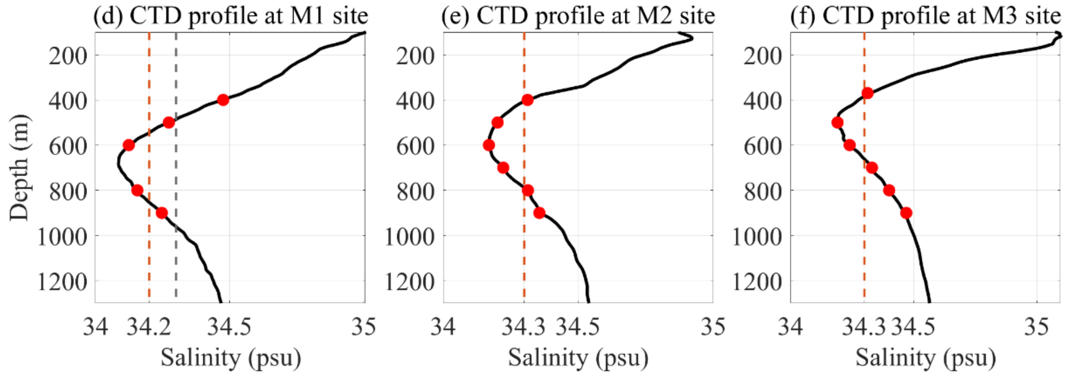

Figure 4. (d–f) Shipboard CTD salinity profiles near M1, M2, and M3, respectively. The black curves denote the full-resolution shipboard CTD salinity profiles, and the red circles indicate salinity values sampled from these profiles at the nominal depths of the moored CTD sensors. The orange dashed lines mark the selected isohaline used for estimating the thickness of the low-salinity intermediate layer: 34.2 psu at M1 and 34.3 psu at M2 and M3. The grey dashed line in panel (d) marks 34.3 psu for comparison. These profiles show a well-defined low-salinity intermediate layer and relatively smooth salinity variations across the selected isohaline intervals, supporting the use of local linear interpolation between adjacent moored CTD sensors.

Data: You give two DOI in the Data Availability section, yet, you do not cite them. Please cite with an entry in the reference list that contains each DOI (e.g. for the Copernicus data, as under https://help.marine.copernicus.eu/en/articles/4444611-how-to-cite-copernicus-marine-products-and-services?pk_vid=926987ee88e2d6571782844875ebffa3 , and as listed under "For a specific product's citation").

Further, you state"Researchers interested in accessing the mooring data may contact the corresponding author, who will facilitate access through a formal data request procedure. If required by the journal, the authors commit to coordinating with the data owner to deposit the dataset in a publicly accessible repository and to provide a DOI upon acceptance." Please provide a doi and cite it in the text with reference to an entry in the reference list, so that the data is publicly accessible and any reader can follow-up what you have done in your work.

Response:

We thank you for pointing this out. We have revised the Data Availability section and the reference list accordingly.

In the revised manuscript, the previous statement that researchers should contact the corresponding author to access the mooring data has been removed. The mooring temperature and salinity data used in this study have now been assigned a DOI: https://doi.org/10.12157/IOCAS.20260710.001. This dataset is cited in the Data Availability section and included as a formal data citation in the reference list.

We have also added formal data citations for the Copernicus Marine products used in this study. The sea level anomaly and derived geostrophic current product is now cited with DOI 10.48670/moi-00145, and the multi-observation three-dimensional temperature, salinity, height, geostrophic current, and mixed layer depth product is cited with DOI 10.48670/moi-00052. Both data products have been added to the reference list following the Copernicus Marine product citation format.

Minor comments:
Figures 12/13/14: Those are showing CMEMS data, correct? Please note this in the figure captions (you did note it in the caption of Figure 15, for example). Further, I would call the arrows in those figures black, not blue (or if they're blue than a very dark shade of blue) -- perhaps that will make it more clear to the reader, as the colour-scale includes blue shading. Colour scales: Did you check if your figures are suitable for colour-blindness? Guidelines can be found here: https://www.ocean-science.net/submission.html#figurestables .
Response:
Thank you for the helpful suggestions. We have carefully revised the manuscript accordingly. The CMEMS data sources have been added to the captions of Figures 12, 13, and 14. The color of the velocity vectors in these figures has been changed to black to improve their visibility against the background color scale. In addition, we have checked all figures and adjusted the color schemes where necessary to ensure that they are more suitable for readers with color-vision deficiencies.