First of all, we would like to thank again the editor and referees for all corrections and suggestions.

In relation to errors that referee 2 considers we take into account twice, we must clarify that we have followed all the steps documented by Ganachaud in "Error Budget of Inverse Box Models: The North Atlantic" (2003). Specifically, section 3.2b explains the baroclinic variability as a model's error independent of the reference level velocity's error, which is the case we have evaluated in our manuscript.

Regarding the referee 1's comments related to the imbalances in SW and CW: we have run the inverse model considering the upwelling of 0.6 Sv from CW to SW suggested by the referee 1's. The output of the model with this forcing has a higher imbalance (shown below).

We have put in SW: -0.6 Sv and in CW: +0.6 Sv. Hence, we consider that the reviewer was interpreting the transports with the opposite meaning as their actual criteria used along the paper (positive outward).

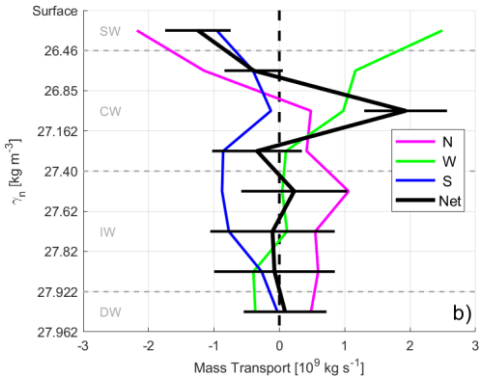


*Figure 1: Inverse model solution considering the upwelling. A water outlet of 0.6 Sv is forced from CW to SW.*

In any case, as the reviewer is rising a main concern related to the imbalance at SW and CW we have performed an additional analysis focused in reducing the imbalance. To do so, we have tested a change in the reference level to 27.82 kg/m3 and the mass transport imbalances in the first and third layers are reduced (Figure 2). Hence, we have updated the manuscript with this new reference level for the inverse model calculations.

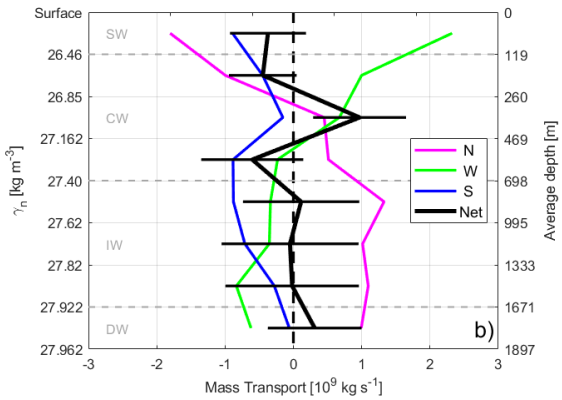


*Figure 2: Inverse model solution considering the reference level at 27.82 kg/m3 and without any forcing.*

In addition, the responses to referee 1's small comments and suggestions are included below.

The manuscript has changed with the modifications for the abstract and with the rest of suggestions proposed by this reviewer.

(4) p. 5, l. 5: "to validate the temperature interpolated to the XBT positions and set the signal to noise ratio..." I agree with the signal-to-noise ratio but you do not use interpolations to validate a measurement but the other way round.

(5) p. 5, l. 8: 10%? Is this correct, 10% and even 5% is far too high: 5% of 20C is 1C, which is very large.

(6) p. 5, l. 13-14, please clarify.

These three comments are addressed by changing the paragraph to this other:

"SP, O2, NO3, PO4 and SiO4H4 were optimally interpolated with DIVA at each transect independently. Before carrying out these interpolations, DIVA was applied to the T field suppressing one xbt profile from each transect to validate the method. In fact, the interpolated values had a relative error<3.5% in 75% of cases. This allows to set the signal to noise ratio (λ) and the horizontal and vertical correlation lengths (Lx and Ly). Hence, the interpolations of the remaining hydrological and biogeochemical variables were carried out with the following parameters: λ = 4, Lx = 110−135 km and Ly = 50 m. Despite the fact that each variable behaves differently depending on its physical, chemical or biological nature, the correlation scales were considered the same due to the limitation of the sampling resolution. DIVA provided error maps for the gridded fields of each variable which allowed us to check their accuracy and spatial distribution. 75% of the interpolated values of SP and O2 had a relative error ≤ 3.5%. Due to the lower sampling resolution of NO3, PO4 and SiO4H4, their interpolated values had higher errors. Between 70-75% of the interpolated values had a relative error ≤ 5.7%."

(7) p. 6, l. 20: I'm not sure about how the journal handles citations to manuscripts in preparation but I would say this is highly irregular. I suggest simply to state "(not shown)".

We would like to include this citation, so we will contact and ask to the journal about it.

(8) p. 7, l. 2-3: "to avoid any issues related with the temporal evolution of structures, the volume is closed with land instead of with the eastern transect". Please clarify.

We have changed it with: " to avoid any imbalances induced by the temporal evolution of the system, the volume is closed with land instead of with the eastern transect".

(9) p. 9, l. 27: explain this beforehand, in section 2.2.

The text "The climatology produced with GLORYS outputs is used to present the front spatial distribution within the domain" has moved to section 2.2. like this: "Specifically, the climatological salinity was used to present the CVF spatial distribution within the domain".

(10) p. 10, l. 14-15 and elsewhere (including tables): I suggest not mentioning the results for

DW. You are only sampling a tiny fraction of these DWs, what is the sense of providing these values?

They are included because it has been sampled up to there and every piece of data is valuable.

(11) P. 12, l. 12: Luyten et al. (1983) did not document this shadow zone, they provided a theory that explains its existence. You may rather for example cite Kawase and Sarmiento (JGR, 1985).

We have changed it with this new citation.

(12) Fig. A1: I suggest you show the grid every 1 degree.

We have done it.

(13) Fig. A11a: I suggest to separate SW from CW and remove the DW results.

We have separated SW from CW.

(14) Fig. A15: perhaps you are missing an axis for phosphate transports?

These transports are multiplied by 10 (it is indicated in the image caption).

(15) I suggest adding an additional figure like A15 but for the net values, both within the original domain and within the domain that excludes the upwelling region.

Instead of including this new figure associated with the problems related to the imbalaces suggested by the referee, we have included a new figure that shows the mass transports per transects and per layer (CW only) in both sides of the front, independently.

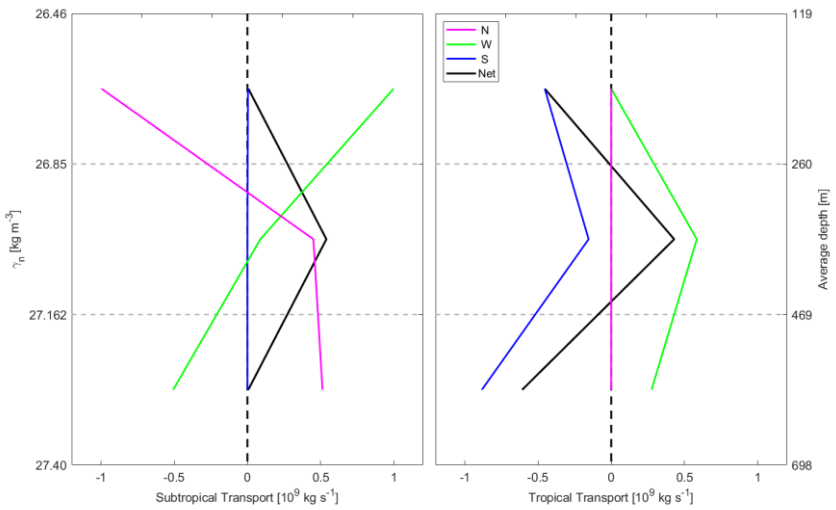


*Figure 3: Mass transports ($10^9$ kg $s^{-1}$) integrated per transect at north (N, pink line), west (W, green line) and south (S, blue line) of the subtropical (left) and tropical (right) areas separated by the CVF at the three CW layers and considering transports between WOA stations. Black line represents the net transport. Negative/positive values indicate inward/outward transports as in Fig. A11.*