This is a well-written and rigorous manuscript that addresses water mass transport of the Caribbean Current and how it is affected by mesoscale variability. The authors use high-resolution underwater glider observations to quantify zonal water mass transport across a 600 km transect. Using satellite altimetry, they relate changes in transport between three transects to the presence and passage of mesoscale eddies. The study provides new insight into how mesoscale eddies influence transport in this critical inter-basin pathway.

The manuscript is clear and convincingly demonstrates the added value of high-resolution glider observations for capturing mesoscale variability and constraining the transport of water masses in a region characterized by sparse hydrographic and velocity observations. This study makes a valuable contribution to our understanding of circulation and variability in the Caribbean Throughflow, showing the necessity of resolving eddy-driven processes in both modeling and observational frameworks.

I recommend publication after the authors address the following comments.

<u>Comments</u>

L47: Clarify the direction of the transport (negative vs. positive). This applies throughout the manuscript, as the direction of transport is sometimes unclear.

Thank you for pointing this out. This has been clarified where appropriate throughout the manuscript.

L48–50: The sentence "To close the budget with... Windward Passage (refs)" is convoluted. One unclear aspect is that the observed transport is negative (previous sentence), but the total estimated transport is positive; then you state it should be augmented by 6–9 Sv. In addition to rephrasing for clarity, it may be useful to add a schematic of the general/mean circulation pathway in Figure 1 for non-regional experts.

I can see how this is confusing in light of the previous comment. The map in Figure 1 would likely get too busy with the addition of a schematic circulation. Instead, I chose to explain the "budget closing" language more thoroughly.

Figure 1: Keep color consistency for transects 1, 2, and 3 as in Figure 6 (Transect 1: blue; Transect 2: orange; Transect 3: light gray).

Corrected both figures to be consistent.

L73: The study compares transport among transects that each take almost three weeks to complete. This means that the southernmost values of transects 1 and 2 are closer in time (similarly for the northernmost values of transects 2 and 3). Please include a statement acknowledging and justifying this limitation, and discuss how it may affect comparisons of transport magnitude across transects.

The transects were sampled sequentially due to the large spatial extent of the study area and logistical constraints of glider operations. Each transect therefore represents conditions integrated over a multi-week period, rather than an instantaneous snapshot of the circulation. This temporal offset means that differences in transport magnitude between transects may reflect a combination of spatial variability and temporal variability occurring during the sampling period. To account for this, our interpretation emphasizes large-scale, persistent circulation features and places the transport estimates within the context of known regional dynamics, while acknowledging that short-term variability may influence the absolute transport values.

The first paragraph of the discussion has been revised to better reflect this.

L81: Define v as "... integrating the specific volume anomaly (v) relative to...".

Defined in revised manuscript.

L100: How do the results change if you consider the total eastward and total westward transport separately? These values might be important, as the net transport may be near zero while substantial eastward and westward flows still occur. Showing only the total (net) transport could mask significant exchanges.

Thank you for this interesting point. The revised manuscript includes a new Figure 8, which separately displays total eastward and total westward transport for the two transects. This comparison revealed areas where strong subsurface counter currents, with substantial vertical shear, are driving the decrease in transport in Transect #2.

L104: The authors eliminate dv/dx for simplification. Can you justify that dv/dx is negligible, using satellite data or by estimating the potential error introduced by this assumption?

We have removed the Rossby number calculation and replaced it with the revised Figure 8 for a more focused investigation into the mesoscale variability in the subsurface current field.

L111: Please provide an estimate of the residuals or uncertainties associated with the least-squares fitting in the water mass analysis.

Included in the Supplementary Material now is a figure showing the vertical structure of the mean temperature and salinity residual associated with the water mass analysis for each transect. This figure shows that the mean temperature and salinity residuals are quite low for both transects at ~-0.005 ± 0.002 °C and ~0.024 ± 0.012 g kg^{-1}, respectively. We have added these details to the results section as well.

L122: Is the surface layer ($\sigma < 24.5$) below the surface mixed layer? Please clarify.

The methods contain an expansion of the water mass definitions, where the surface layer represents "Tropical Surface Waters" identified by Rhein et al. (2005).

Figures 2–5: I recommend adding relevant isopycnal contours (e.g., in Figures 2 and 5) to improve clarity in the results and discussion. This would also help clarify the depth range of the different water masses analyzed.

Isopycnal contours added to Figures 2 and 5 in the revised manuscript.

L131: You mention that "closed contours were analyzed at 1 cm intervals," but the AVISO product has a 0.25° resolution. Please clarify this apparent discrepancy.

Thank you for raising this point. The 1 cm interval refers to the *contour levels* evaluated within the eddy detection algorithm, not to the native spatial resolution of the AVISO product. The CMEMS AVISO SSH/SLA fields are provided on a 0.25° latitude–longitude grid, and all analyses are performed on this grid. As implemented in *py-eddy-tracker* (Mason et al., 2014), closed SLA

contours are constructed by evaluating a sequence of SLA thresholds at 1 cm increments across the gridded field to identify coherent closed contours associated with mesoscale eddies. Thus, the 1 cm spacing represents the vertical (amplitude) resolution of the contour search in SLA space, rather than a horizontal spatial resolution finer than the underlying AVISO grid. We have clarified this distinction in the revised manuscript.

Table 1: How were the eddy characteristics (swirl velocity, translation velocity, depth scales, etc.) determined? If these are outputs from a py-eddy-tracker, please state so and provide a reference describing how these parameters are defined.

Eddy characteristics reported in Table 1 were obtained using the automated eddy detection and tracking outputs from *py-eddy-tracker* applied to CMEMS AVISO SLA fields (Mason et al., 2014). Horizontal eddy properties, including radius, amplitude, swirl velocity, and translation velocity, are computed from closed SLA contours and their temporal evolution following the definitions in Mason et al. (2014). Eddy vertical (depth) scales were not derived from altimetry, but were estimated independently from co-located glider temperature, salinity, and velocity anomalies associated with each tracked eddy. The manuscript has been revised to clarify the provenance and definitions of these parameters.

L160: The sentence "The total zonal transport... Transect #2" follows immediately after the meridional transport description. I suggest moving it to follow the description of E–W transport for Transects 1 and 2 (around line 154).

This change has been made in the manuscript.

Figures 2–5e,f: Clarify the sign convention for transport. In Figure 2, do red or blue areas indicate eastward/westward or northward/southward transport? The color bar is reversed in Figure 5e,f—please clarify and ensure consistency between figures.

All figure colorbars are consistent and text has been added to the methods clarifying the sign convention.

L165–174: The definitions of water masses lack references and density ranges. Figure 3 shows core densities but not references. Relatedly, how is the transport of each water mass (Figure 4) computed? If by density range, please specify; if by another method, please clarify.

Thank you for pointing out the lack of clarity in this point. The methods originally referred the reader to a prior publication for a more detailed explanation of the water mass analysis methodology. We have included a simplified version of this methodology in the revised manuscript for ease.

L184: The sentence "Though other water masses... linear mixing of two water masses" could be expanded. Which other water masses could alter this mixture or contribute to transport? Can you estimate the potential uncertainty or overestimation in your transport estimates due to this simplification?

Thank you for this important point. We have substantially revised the discussion section around the water mass analysis, its assumptions, pitfalls, and alternative means of SAW transport estimation.

L188: uCW is not defined, nor is its density range provided.

Thank you for catching this. We have substantially revised the description and labeling of water masses throughout the text to ensure consistency and clarity.

Figure 3: CW is missing in panel c. Consider making the scattered dots semi-transparent; currently, the yellow points appear to overlay and obscure variability.

Thank you for catching this. We have substantially revised the description and labeling of water masses throughout the text to ensure consistency and clarity.

Figure 4: Are the transport estimates per water mass an average or the total transport per water mass? Please clarify and provide associated variability.

Modified Figure 4's caption and added a revised Figures 7 & 8 that investigates water mass transport & variability throughout the transects, rather than simply integrated as Figure 4 does.

L201: Does "15 km of an anticyclone" refer to the distance from the eddy border or from its center?

Thank you for catching this. That phrasing refers to the eddy center, and the manuscript has been revised to reflect this.

L206: The use of multiple distance thresholds (15 km inside, 45 km inside, 50 km buffer outside) is confusing. Please clarify all definitions and distances. I suggest using a logarithmic scale in Figure 5b and marking these thresholds as horizontal lines to help the reader identify when the glider was inside or outside eddy boundaries.

Thank you for this important point. We have dramatically simplified the manuscript text on these distances and altered the figure to simply be the eddy interaction to highlight the anomalies themselves.

Figure 5: Add markers indicating transect limits to help relate temporal and spatial components of the time series. In panel d, clarify the label "Eddy Absolute Salinity Anomaly"—what does "absolute" mean here? Also, in the figure caption, you refer to "glider RU29." Since only one glider is used, simply state "glider" for consistency with other figures.

See point above. Figure modified to only show eddy interaction period. Absolute refers to "Absolute Salinity" the primary salinity variable from the Thermodynamic Equation of Seawater 2010 (TEOS-10). "RU29" also removed from figure label and caption.

L250: Based on your argument, I would expect a difference between DHA and AVISO ADT for Transect 2 vs. 1. Can you show this to strengthen the argument?

This definitely helps strengthen the argument! Revised Figures 8 and 9 better reflect the relationship between glider DHA and subsurface structure between the two transects.

Figure 8: Maintain color consistency (blue for Transect 1, orange for Transect 2) and adjust line styles for variable differentiation.

The content of this figure has been reincorporated into a new Figure 7 to more clearly illustrate this point.

L262: Please state the transport values after interpolating the glider data to a coarser resolution—this would support your statement quantitatively.

Good point, transport values now included in the revised manuscript.

L305: The study underscores the importance of eddies in modulating the Caribbean Current. Can you suggest what is needed to better constrain and quantify the variability these structures induce in the mean flow?

Great point! Suggestion added to the conclusion based on our findings.

L316: Define NASTG.

Defined in revised manuscript.

L317–end of conclusions: This section introduces a new topic not discussed elsewhere in the paper, though it is important for future work. I suggest moving it to the Discussion section.

Thank you for this suggestion. While the discussion of extended optimum multiparameter (eOMP) analysis introduces a forward-looking methodological topic, we have retained it in the Conclusions because it directly highlights a critical observational gap and future direction stemming from our results. Including this point here emphasizes the broader implications of our study for improving water mass pathway constraints and the design of future observational campaigns, providing a natural forward-looking closure to the paper.

Additional comment:

Have you compared your estimates to surface geostrophic transport derived from altimetry? Discussing what the glider observations add to those estimates would strengthen the paper, particularly if you can show that altimetry alone cannot (or can) capture the observed transport.

Thank you for this suggestion. While surface geostrophic transport from altimetry provides a large-scale perspective, our study focuses on subsurface structure and full-depth transport, which surface-only estimates cannot resolve. Glider observations capture vertical profiles of velocity, temperature, and salinity, allowing quantification of vertical shear, water mass contributions, and eddy-driven variability—information not available from surface altimetry alone.