Author's reply to Reviewer 2:

Authors response to comments by to the manuscript " Sargassum accumulation and transport by mesoscale eddies " by Sosa-Gutierrez et al. (rsosa@mercator-ocean.fr, julien.jouanno@ird.fr). We would like to thank Clément Vic for the detailed and helpful comments to improve the manuscript. Below, we use black text for comments and green text for our response.

1. **The introduction misses some discussion and references to recent studies on the role of submesoscales in structuring floating material, near-surface boundary layer material, and ecosystems, e.g., D'Asaro et al. (2018); Lévy et al. (2018); Esposito et al. (2021).**

Thank you for your review and suggestion. We have expended the references in the introduction: "*In particular, convergence zones associated with submesoscale dynamics have been shown to concentrate buoyant material and to structure the ecosystem (D'Asaro et al., 2018; Esposito et al., 2021, Lévy et al. (2018)"*

2. **L. 32, the reference to Provenzale (1999) is wrongly used. Quote from Provenzale (1999): "While in a nonrotating reference frame heavy impurities are always ejected from coherent vortices, in rotation-dominated systems, the Coriolis force may become stronger than the centrifugal term when the Rossby number is small. As a consequence, heavy impurities can be concentrated in the cores of anticyclonic vortices (Tanga et al 1996, Provenzale et al 1998)." See also their Figure 10.**

We agree that we made a shortcut in the interpretation of Provenzale (1999). This is now clarified and expended as follows :
"*Early theoretical and experimental work by Provenzale (1999) suggested that heavy impurities can be concentrated in the cores of anticyclonic vortices. Beron-Vera et al. (2015) provided both theoretical justification and numerical evidence for a more general principle governing the behavior of inertial particles near quasigeostrophic eddies: anticyclonic (cyclonic) eddies tend to attract heavy (light) particles and repel light (heavy) ones, respectively."*

3. **L. 48-58: I find this paragraph ambiguous. What is the link between AFAI, MODIS and SAREDA? It is unclear to me if the authors performed any processing on MODIS "raw" images or if they used an on-the-shelf climatology of sargassum biomass / concentration.**

Thanks, we agree it was not clear. The description has been rephrased as follows:
"*Sargassum detections were obtained from the SAREDA database (Sargassum Evolving Distributions in the Atlantic, Descloitres et al., 2021). This product estimates Sargassum cover by computing the Alternative Floating Algae Index (AFAI; Wang and Hu 2016) from ocean color acquisitions by the Moderate Resolution Imaging Spectroradiometer (MODIS), which operates aboard the Aqua and Terra satellites. The AFAI, computed using the processing chain described in Descloitres et al. (2021), was converted to Fractional Cover (FC), which represents the proportion of Sargassum cover in each pixel. Daily FC at 1 km from the SAREDA database were aggregated on a regular grid of 0.25° (~25 km) horizontal resolution."*

4. **L. 98: I am not sure I fully understand why the methodology would introduce a bias that would favour the detection of eddies with increased sargassum. It would be good to detail why and perhaps lean on references on composite approaches? I like that the authors address a potential methodological bias though!**

We try to better explicit our point as follows :
"Since the composites are constructed using eddies where Sargassum presence is detected at least once during the eddy's lifetime, this could introduce a bias favoring instances of Sargassum being trapped inside eddies. To verify that, we performed a null hypothesis test by compositing the Sargassum distribution with the same criteria but using the eddy contours for the previous year."

5. **Figure 3: I wonder if you could come up with a physical interpretation for the meridional shift between the peak of FC and the eddy centre for CEs in Figures 3b and 3f. Ekman pumping from a systematic wind stress difference on both sides of the eddies?**

Thank you for this observation. We missed it. We add the following comment:
"*Also, note in Figure 3b a meridional offset between the location of the maximum FC peak and the center of the eddies—unlike the Caribbean composites (Figure 3d), where the Sargassum distribution appears centered within the eddies. The pattern observed in Figure 3b may result from the influence of Central Atlantic cases included in the composite, which show a southward displacement of Sargassum relative to the eddy centers (see Figure 3f). The cause of this southward shift is not fully understood at this stage, but it may be linked to windage effects from the trade winds or to the background distribution of Sargassum, which generally tends to accumulate along the Intertropical Convergence Zone (ITCZ). Figure 4 also shows this latitudinal gradient of FC (see 4b and 4d), which means that this gradient is a result of sampling this peculiar region with this eddy scale."*

6. **Figure 5: I am confused by the colour code, contrasts are too light I think. To me, the dark red boxes are above light red boxes, but dark blue boxes are below light blue boxes. Also, I think it would be insightful to give the biomass outside of eddies, defined as the residual between total and within eddies (AEs and CEs, with an outer limit of say, between 1.5 and 3 radii?)**

Thank you for your feedback regarding the color contrast. We modified the figure for better visualization. The biomass outside the eddies can already be inferred from Figure 8 so we prefer not to add it again here.

7. **L. 134: Could you be more quantitative? What is the ratio of the surface covered by AEs vs CEs and how does it compare to the biomass within AEs vs CEs?**

We have added a table where the ratio between the total areas of AEs and CEs is compiled and shown, as well as the ratio of the biomass of the eddies, and add the following text:
"*To quantify these differences in Table 1 we show the ratio of total area and biomass ratio of CEs vs AEs. In the Caribbean, while the area ratio CEs/AEs is of 0.54, the accumulation of Sargassum in CEs lead to a biomass ratio CEs/AEs of 0.80."*

8. **L. 142 and Figure 7: The fact that CEs increase their sargassum biomass within their lifetime is very interesting. This is different from the hypothesis made in Vic et al. (2022) that submesoscale processes prior to the mesoscale eddy formation are instrumental at gathering material. So, is there any mechanism that could help explain this result? I thought of Ekman pumping à la Gaube et al. (2015), considering that winds in the area are dominated by westward Trade winds… Also, I wonder if using a normalized time scale is physically meaningful. You would merge eddy characteristics at very different stages.**

We agree this is very interesting. We have no preferred hypothesis so far. We choose this methodology of normalized time scale as a first and basic attempt to see the evolution over

time. This could be refined. In some sense this result is coherent with Sargassum Lagrangian model from Beron-Vera (2021). Our next step will be to further understand this behavior and investigate whether other ingredients could play: windage, non-linear Ekman pumping, regional dynamics or air-sea mesoscale coupling effect.

Wording, typos, etc.

L. 10: was not … so far → has not been
Corrected

L. 50: remove “chain”
Corrected

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L. 55: the tracking of high-frequency decay? → generation of near-inertial waves? Please clarify.
Corrected as follows : *They have already allowed the tracking of rapid decrease in Sargassum coverage in the lee of tropical cyclones (Sosa-Gutierrez et al. 2022)*

L. 70: strongly → partially? I would not say that Figure 1 strongly supports this statement. It hints at a mesoscale influence, but there remain areas with high FC and no eddy and vice-versa. Corrected

Figure 1: It would good to see the boxes for the three regions discussed in the manuscript. Also, in the caption, I would recall that only eddies with non-zero FC are shown.
Thanks, we added the boxes and completed the caption.

Figure 5: typo “Radio” in panels c,f,i,
Corrected, thanks

Figure 6: Why is the colour range so different from previous plots? (x10^-5)
Thanks for the point this is. It was an error and it has been corrected.

Figure 8: Are red and blue histograms stacked or are they zero-based? Please clarify.
They are stacked and this was clarified, thanks.

L. 171: “connectors”? unclear, please rephrase
We agree and we removed the sentence.

L. 184: Nutrient availability, and more generally, vertical motions, are driven at submesoscales more than mesoscales, e.g., Uchida et al. (2019); Picard et al. (2024).
Indeed, but they are also evidence that cyclonic/anticyclonic mesoscale shape the nutrient availability (Gaube et al., 2014, McGillicuddy, 2016, Damien et al. 2021)

Damien, P., Sheinbaum, J., Pasqueron de Fommervault, O., Jouanno, J., Linacre, L., & Duteil, O. (2021). Do Loop Current eddies stimulate productivity in the Gulf of Mexico?. *Biogeosciences Discussions*, *2021*, 1-52.