For Anonymous referee #1

The reviewer deserves our thanks for the comments, remarks, and suggestions on our manuscript and appreciate the time they dedicated to this review. Below (highlighted in blue and magenta) is an itemized response to the different issues raised in the review.

This is a good paper with solid analysis. It builds on a good framework of previous studies, and presents interesting new results.

Some of the discussion is a bit over-simplified. The pattern of energy transfer terms (Fig 5.6,) are complex and it is hard to know what to focus on. Features and 'results' highlighted not always as clear as the text suggests (e.g., most of what is emphasized in the discussion of Fig 6 can also be seen in Fig 5 - see comments on L473-475).

R: We thank the reviewer for this comment and the associated comments on L473 and L475, that helped us to be more precise in our analysis. The energy transfer terms are presented for each of the three selected cases with the specific intent of illustrating how the direction and magnitude of energy transfers are modulated by the presence and position of mesoscale eddies. We agree that the pattern of these terms is complex, and we have carefully verified and updated the results for local terms *Cmn* and *Hmn*, as well as the associated comments (in lines 451-456; 460-465; 476; 526-536; 549; 575-578; 585-594; 606 of the revised manuscript). We have revised the discussion of figures 5, 6 and 7 to more clearly guide the reader toward the key features and differences across cases, in order to avoid any ambiguity about what is being highlighted.

In addition to the changing mesoscale field, it is worth noting that the IT also changes quite a bit between the 2nd and 3rd cases - the forcing is about 50% larger! I don't think one can really ignore this and state that the IT fields are the same (L332). What are the impacts of a stronger IT (if the eddy field stayed the same)? I presume that this is part of the signal seen in Fig 7 (vs Fig 6).

R: We take note of and sincerely thank the reviewer for this important remark. We agree that the internal tide (IT) forcing is not strictly identical between the 2nd and 3rd cases, and we acknowledge that the statement at L332 was too strong. We have revised this sentence accordingly.
However, we wish to respectfully qualify the estimate of an approximately 50% difference in forcing. Examining the SSH amplitudes in Figure 3 between the two cases (~1.1 m for CEC and ~1.3 m for CEE), the difference is closer to ~18%, which is more modest than suggested.
We agree this difference should not be ignored. A stronger IT forcing, with the mesoscale field held constant, would be expected to increase IT energy and potentially enhance vertical mixing and energy fluxes. However, given the relatively small amplitude difference, this effect is expected to be secondary. We argue that the dominant signal observed in Fig. 7 compared to Fig. 6 remains primarily attributable to the contrasting mesoscale conditions between the cases, rather than to the modest change in tidal forcing.
To clarify this point, we have added the following sentence in lines 351-353 of the revised manuscript:
“

Although the tidal forcing is not strictly identical across the three cases, the differences in tidal amplitude remain small (less than 18%) and are therefore considered secondary compared to the large contrasts in mesoscale conditions between the cases.
“

The analysis is well done, and the results very interesting, although arguably pretty complicated. It could be good to build composites (for all cases when a CE is on top of the seamount, for example, or to the north of it, or...), or try to quantify the dominant terms in a control region over multiple realizations, or ... Overall, the manuscript leaves many questions open but still is a solid piece of work that might inspire other studies. As such, I recommend publication, with authors reading and thinking about my comments.

R: We humbly thank the reviewer for sharing this interesting suggestion.

We acknowledge that building composites or quantifying dominant terms over multiple realizations would be a valuable approach. However, it is one year and half more work to assess and quantify all these statistical events. The present study acts as a first step toward this quantification. It is specifically designed as a process-oriented investigation addressing three targeted questions: (1) whether the IT propagates freely, deviates, or becomes trapped by mesoscale features; (2) whether these outcomes depend on the IT's vertical mode, or on the location of the eddy encounters along with the associated background conditions (currents and stratification); and (3) what the synergistic roles of topography and cyclonic eddies are in governing modal energy transfers. In this framework, the three selected cases are chosen as qualitative configurations to dissect these interactions through vertical mode projection and intermodal energy transfer analysis. A systematic statistical analysis — such as composite maps or frequency-of-occurrence diagnostics — is scientifically very relevant and will be done in a second study.

We have added a sentence explicitly acknowledging this as a natural and promising direction for future work (lines 771-775 of the revised manuscript), as follows:

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Limiting our analysis to three case studies reflects the primarily qualitative nature of our approach. A natural next step would be to extend it toward more quantitative results by conducting composite analyses over a larger set of eddy–IT interaction cases. Grouping configurations by eddy position relative to the seamount, for instance, would allow the IT response to mesoscale variability to be characterized in a statistically robust way.

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Figure 1 - Cyan contour should not be used for Ceará Rise seamount. In the rest of the paper, cyan is used to mark eddies. It would be better to mark the seamount by a different color (thick black?), and repeat it in later figures (Fig 2,4) where the seamount is hard to locate.

R: We welcome and appreciate the reviewer's suggestion. We agree that using cyan for the seamount contour is inconsistent with its use for eddies in fig. 4. However, since black is already used for velocity and energy flux arrows, white and red/blue for vorticity and CE/AE fields, yellow-red-black for EKE amplitude, and magenta for the Mid-Atlantic Ridge, we have used a thick green contour to mark the seamount in all figures.

L332 and Figure 3 - Magnitude of the internal tide for the 3rd case is much larger.

R: We thank the reviewer for this comment. This point is addressed in our response to the previous comment regarding the selection of the three cases.

Figure 4 - it might be worth stating that while the conditions for the 3rd case seem very similar to the second case, the energetics (discussed later) are very different. Looking at Fig 4, I was wondering why there was a 3rd case.

R: We thank the reviewer for this comment. We have added a comparison of the background conditions (currents and stratification) along the IT propagation paths from sites A and D across the three cases (NE, CEC, and CEE). This comparison shows that the key distinction between the eddy cases lies not only in where the IT beam encounters the eddy (eddy core vs. eddy edge), but also in the associated background conditions. This is illustrated in lines 368-383 of the revised manuscript. In our study, the three cases are qualitatively distinguished by the presence or absence of a cyclonic eddy (CE), and, when a CE is present, by the geometry of the IT–CE intersection. We have also added a quantitative definition of the CE "core" and CE "edge" in terms of normalized distance from the eddy centroid, in lines 384-389 of the revised manuscript..

L338-343: Information about the seamount is scattered in the first two items. Combine in a new sentence before listing the 3 cases (L335).

R: We extend our sincere thanks to the reviewer for this suggestion. We agree that the information about the seamount was scattered across the case descriptions. We have reorganized the text by adding an introductory sentence before the list of cases that gathers all the topographic information (Ceará Rise/seamount location, dimensions, and distance to the Mid-Atlantic Ridge) in one place. This reorganization is mentioned in the lines 355-358 of the revised manuscript as follows:

“

The three selected cases are located in a region shaped by two major topographic features: the Ceará Rise seamount (~500 km from sites A and D; between 4°N–6°N, 45°W–42.5°W), with an amplitude (hmax) of ~1000 m and a width (wmax) of ~100 km, and the Mid-Atlantic Ridge (~1100 km from sites A and D).

“

L473: "In the CEC case, the net effect of Hmn (Figs. 6g-i) is primarily governed by its symmetric part (Figs. 6m-o)." This is a bit of an overstatement. Like in the previous case (Fig. 5), I would argue that it is 'clear' that H^A_{1-3} dominates H_{1-3} and H^S_{2-3} dominates H_{2-3}, but it's hard to immediately decide if A or S dominates for H_{1-2}. In this case, its's really a combination of both. The symmetric component plays a bigger role than it did in the previous case.

R: We thank the reviewer for this comment that will help us to be more precise and clearer. We have carefully verified and updated the results for local terms Cmn and Hmn, as well as the associated comments for figures 6, 7 and 8 (in line 451-456; 460-465; 476; 526-536; 549; 575-578; 585-594; 606 of the revised manuscript). We have revised L473 to make this distinction more explicit and to avoid any overstatement regarding the overall dominance of the symmetric component.

L475. "Specifically, between the shelf break and the southern edge of the CE, Mode-2 IT loses energy to the Mode-3 background flow (Fig. 6o, blue patches)." That statement is also true for the previous case (Fig 5o). Maybe it is stronger here, but it's really hard to see with this (saturated) colorbar.

R: We recognize and appreciate the reviewer's observation.
We agree that this signal was also visible in Fig. 5o for the NE case. We have carefully verified and updated the results for local terms Cmn and Hmn, as well as the associated comments (in line 451-456; 460-465; 476; 526-536; 549; 575-578; 585-594; 606 of the revised manuscript). We have revised L475 to explicitly acknowledge any similarity and difference between the cases.
Regarding the saturated colorbar, the colorbar range and the spatial smoothing were deliberately chosen as a compromise to highlight specific features in panels of figures without losing meaningful information. We have added a sentence in the figure caption to explicitly note that the colorbar is saturated to aid the visualization of energy transfer. This is mentioned in lines 488-489 of the revised manuscript as follow:

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It should be noted that the colorbar range is saturated in panels to enhance the visibility of energy transfer features..

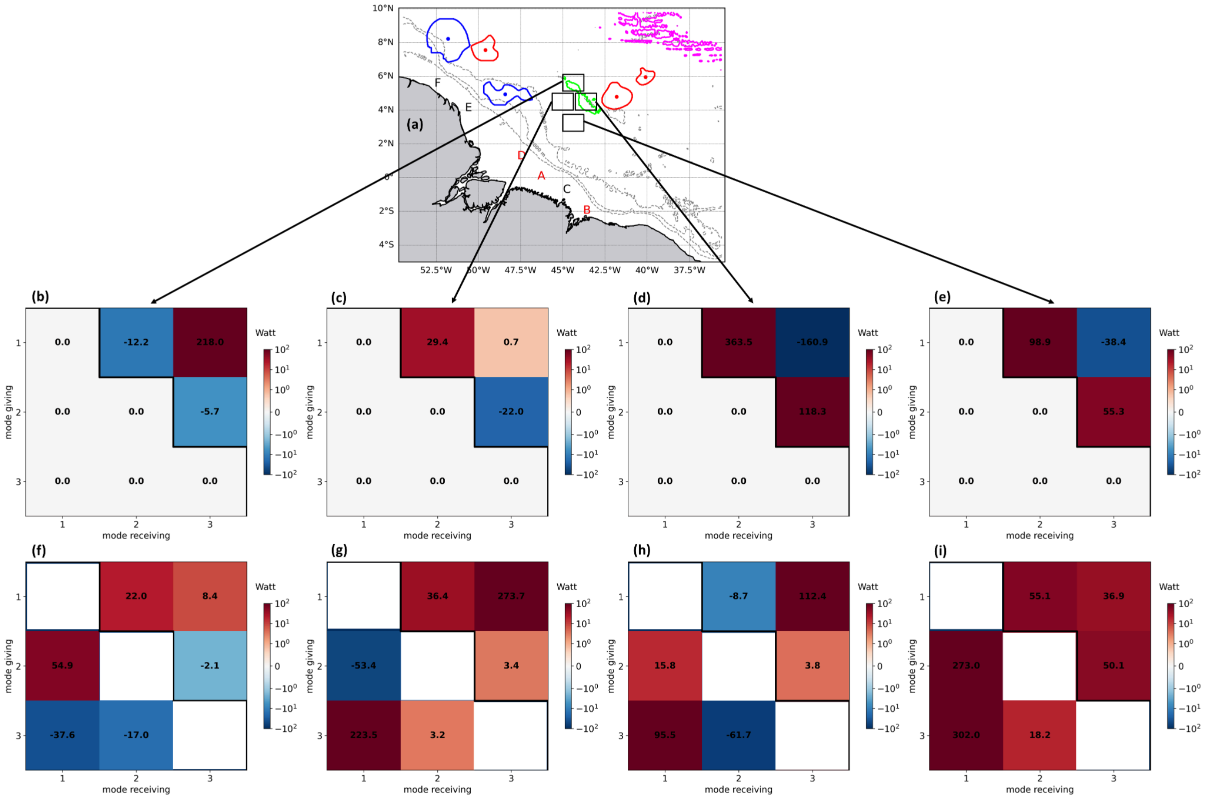
“

For revised terms *Cmn* and *Hmn*, we have integrated the budget over a clearly defined interaction box in all three cases and presented it below in Figure in figure RC1.1-3. We did not find it necessary to include them in the manuscript, as the existing results already support our main conclusions:

In the NE case, the term Cmn is dominated overall by a forward energy cascade between IT modes, both upstream of (Figs. RC1.1c, e) and directly over (Figs. RC1.1b, d) the seamount. For the term Hmn, its symmetric part dominates overall in these same regions (Figs. RC1.1f–i). This indicates an interplay between Cmn and Hmn in the NE case.

In the CEC case, the term Cmn is dominated by an inverse energy cascade between IT modes near the CE core and seamount (Figs. RC1.2c, d). For the term Hmn, its symmetric part likewise dominates overall in these regions (Figs. RC1.2f–i), indicating a similar interplay between Cmn and Hmn as in the NE case.

In the CEE case, both forward and inverse energy transfers coexist for the term Cmn near the CE edge and seamount (Figs. RC1.3b–e). For the term Hmn, its symmetric part again dominates overall in these regions (Figs. RC1.3f–i), indicating a similar interplay between Cmn and Hmn as in the CEC case.



(b)

	1	2	3
1	0.0	-12.2	218.0
2	0.0	0.0	-5.7
3	0.0	0.0	0.0

(c)

	1	2	3
1	0.0	29.4	0.7
2	0.0	0.0	-22.0
3	0.0	0.0	0.0

(d)

	1	2	3
1	0.0	363.5	-160.9
2	0.0	0.0	118.3
3	0.0	0.0	0.0

(e)

	1	2	3
1	0.0	98.9	-38.4
2	0.0	0.0	55.3
3	0.0	0.0	0.0

(f)

	1	2	3
1		22.0	8.4
2	54.9		-2.1
3	-37.6	-17.0	

(g)

	1	2	3
1		36.4	273.7
2	-53.4		3.4
3	223.5	3.2	

(h)

	1	2	3
1		-8.7	112.4
2	15.8		3.8
3	95.5	-61.7	

(i)

	1	2	3
1		55.1	36.9
2	273.0		50.1
3	302.0	18.2	

Figure RC1.1. Matrices of energy couplings integrated (in Watt) over a defined interaction box, where each matrix entry represents the coupling between a row mode and a column mode, for the NE case. A positive (negative) value indicates a net energy transfer from the row mode to the column mode (and vice versa). The upper triangle shows the anti-symmetric part of the energy couplings, while the lower triangle and diagonal show the symmetric part. Panel (a) shows the spatial extent of the interaction box, along with the detected eddy edges (blue and red contours). Panels (b–e) show the topographic scattering and stratification term (Cmn; color shading). Panels (f–i) show the horizontal shear coupling term (Hmn; color shading).

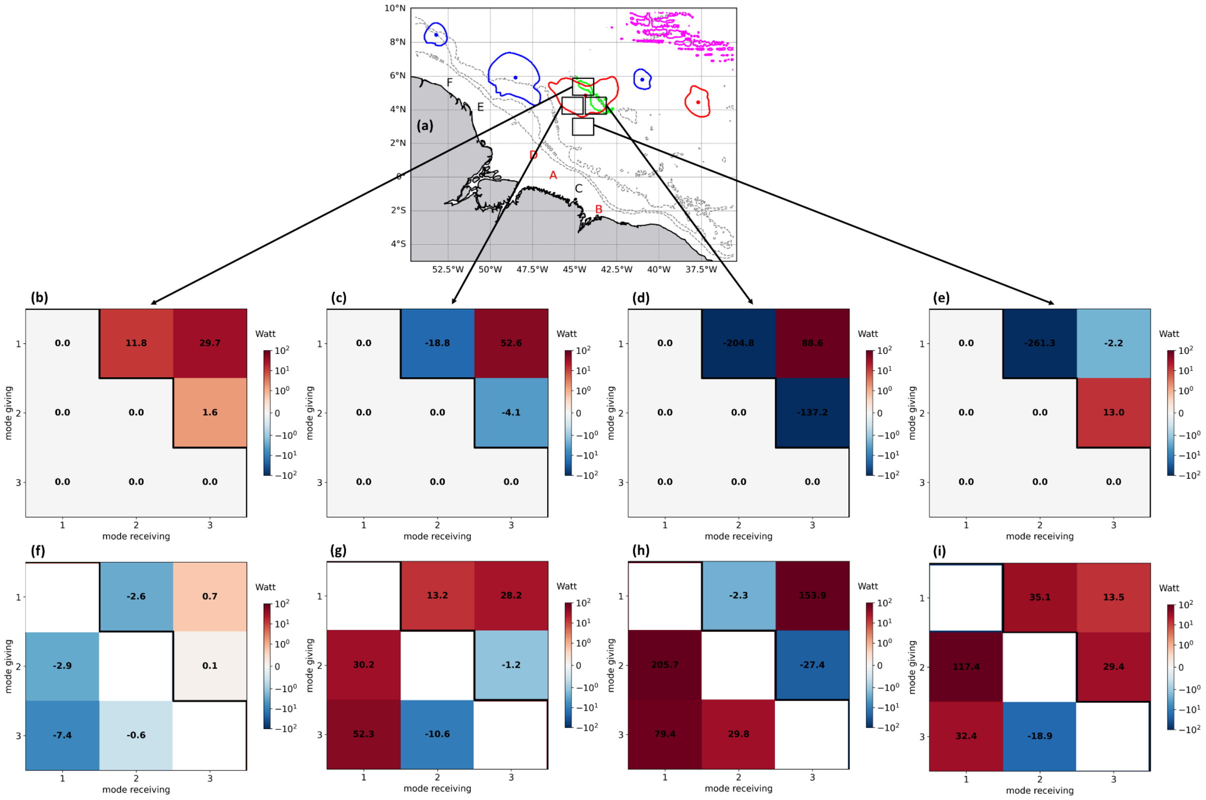


Figure RC1.2. Matrices of energy couplings integrated over a defined interaction box, where each matrix entry represents the coupling between a row mode and a column mode, for the CEC case. The format follows that of Fig. RC1.2.

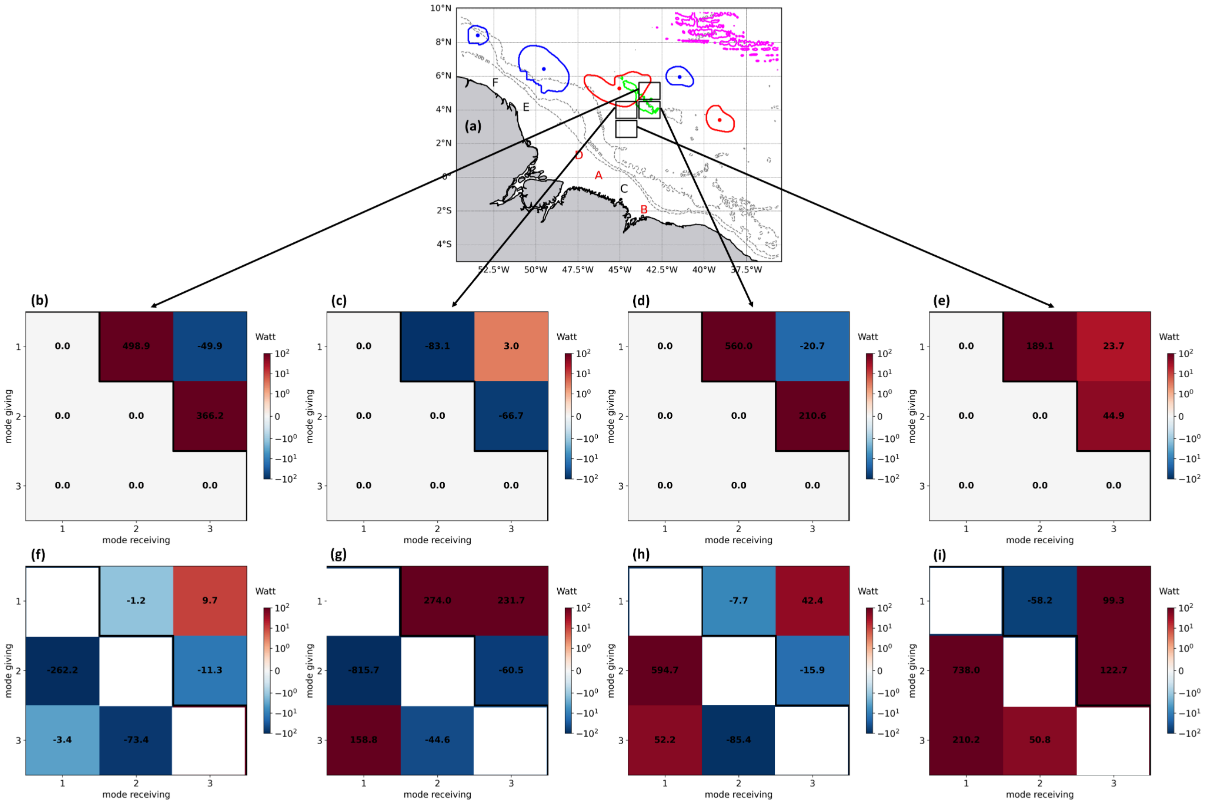


Figure RC1.3. Matrices of energy couplings integrated over a defined interaction box, where each matrix entry represents the coupling between a row mode and a column mode, for the CEE case. The format follows that of Fig. RC1.2.

L5530-538: One of the most striking feature of Fig 7 is the alternating bands in H_{12}, and H{23}, to a lesser extent. This is noted in L532, but left without explanation. This is due to the symmetric part (background and IT interactions). Is this due to an interference pattern (stronger IT)? You see it both before and after the seamount...

R: The reviewer's comment, remark, and suggestion are duly noted and appreciated.
We agree that the alternating bands in H_{1-2}, and to a lesser extent H_{2-3}, dominated by the symmetric component, are among the most striking features of Fig. 7. We also agree with the reviewer's suggestion that these bands could result from an interference pattern, as they appear both upstream and downstream of the seamount. We have added a sentence at L532 to explicitly acknowledge this and propose it as a plausible physical mechanism. This is mentioned in lines 589-592 of the revised manuscript.

L602: The impact of anticyclonic eddies is not shown in this paper.

R: We acknowledge that the impact of anticyclonic eddies is not explicitly analyzed in the present study. The brief observation of AE-induced deflection at site E (Fig. 4b) was included as a qualitative illustration supporting the polarity-dependent refraction discussed in the literature, and not as a systematic result of our study. Recent observations from the SWOT satellite on the interactions between internal waves and mesoscale eddies in my study region supported our finding, documenting analogous refraction at a CE core and diffraction at a western AE edge (Goret et al., 2026).
We have revised L602 to make this distinction more explicit and to avoid any ambiguity regarding the scope of our analysis. This is mentioned in lines 666-676 of the revised manuscript:

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IT beam deviation is sensitive to eddy properties. The direction of deviation depends strongly on eddy polarity, as shown by previous studies (e.g., Huang et al., 2018; Guo et al., 2023; Dunphy et al., 2017; Wang and Legg, 2023; Li et al., 2024; Goret et al., 2026). While the present study focuses exclusively on CEs, a qualitative illustration of AE-induced deflection can be glimpsed in the energy flux path emanating from the less energetic generation site E (Fig. 4b: deviation of the energy flux due to an AE core centered at 5.9°N and 48.5°W). While earlier work noted that AE cores speed up Mode-1 propagation and induce clockwise (southward) refraction, whereas CE cores slow it down and induce counterclockwise (northward) refraction, our findings link specific interaction geometries to distinct intermodal energy pathways in a realistic framework. The impact of AEs on intermodal energy pathways remains an important open question. Based on previous studies (e.g., Dunphy and Lamb, 2014; Goret et al., 2026), we can assume that AEs exhibit a symmetric response; however, precise quantification is left for future investigation.
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