RESPONSE TO REVIEWERS

Note: The reviewer's original comments are indicated in black, and our responses are indicated in blue. Our changes in the marked-up manuscript version are given in green. Figures in the manuscript are numbered and labeled using Arabic numerals, e.g., Figure 1; those in the response to reviewers file are numbered and labeled using Arabic numerals with a prefix "R", e. g. Figure R1.

Reviewer #3

Comments:

1. Lines 14-15: In the Abstract, the authors say that "the AE can modify the spatial distribution of tidal-induced dissipation by both refracting and reflecting low-mode SIT"; In lines 49-50, they say that "ME mostly modulates the propagation of IT in terms of refraction and scattering". What is more important, reflecting or scattering?

Responses: We are sorry for this confusion. As far as we know, the scattering mechanism is more significant, because internal tides can scatter energy over both steep continental slopes and flat abyssal plains, due to variations in stratification. However, the reflection of internal tides primarily occurs in areas of large topographic gradients (supercritical topography), usually with a slope steepness parameter exceeding 1. In a spatial sense, the impact of internal tide scattering is more widespread than that of internal tide reflecting in terms of occurrence probability. Now we rewrite the sentence in Lines 14-15 as "the AE can modify the spatial distribution of tidal-induced dissipation by refracting, scattering, and reflecting low-mode SIT."

(Change is made in Line 15 in the marked-up manuscript version.)

2. Lines 38-39: The authors say that the internal tide and mesoscale eddy have "comparable horizontal scales", and then they use the "multiscale" to describe their interaction. There seems to be some inconsistency in the phrases "comparable scales" and "multiscale".

Responses: We apologize for this unclarity. The horizontal scale of low-mode internal tide is comparable to that of mesoscale eddy; however, the horizontal scale of higher-mode internal tide is much smaller than that of mesoscale eddy. The interaction of mesoscale eddy with internal tide involves multi-modal (namely multiscale) internal tides (e.g., through the scattering process), so we describe it using the word "multiscale." Now we rewrite this sentence as "Due to the comparable horizontal scales of low-mode IT and ME, their interaction occurs easily and becomes a hotspot for studying multiscale dynamical motions (interaction process involves multi-modal/multiscale internal tides)."

(Changes are made in Lines 37–38 in the marked-up manuscript version.)

3. Line 69: "AE" and "SIT" have been defined in the abstract, but they should be defined again in the text. They are a bit abrupt here in line 69.

Responses: We added relevant definitions in the main text.

(Changes are made in Lines 67–68 in the marked-up manuscript version.)

4. Line 114: There's a small error in the formula of the dispersion relation of linear IWs. Sqrt((N^2-ω^2)/(N^2-f^2)) should be Sqrt((N^2-ω^2)/(ω^2-f^2)).

Responses: We have corrected this typo and examined other formulas.

(Change is made in Line 113 in the marked-up manuscript version.)

5. Line 117: The authors say "We selected a period for analysis, corresponding to 131-170 days". When using TPXO, the data necessarily corresponds to definite dates. Why don't you use the date here corresponding to the TPXO, instead of the number of days in the model? It feels like this would lead to a lot of inconvenience in the author's following description.

Responses: We understand the reviewer's concern. Based on two considerations, we chose to use the days of the model rather than real dates. First, the model days are expressed more briefly, which makes it easier to label as many moments as possible in the drawing; second, because the number of days in each month is not a constant, it is not as intuitive as Arabic numerals in judging unlabeled moments. Meanwhile, some observations (e.g., Osborne et al., 2011; Xie et al., 2013) are also labeled using "yearday."

References:

Osborne, J. J., Kurapov, A. L., Egbert, G. D., and Kosro, P. M. (2011). Spatial and temporal variability of the M_2 internal tide generation and propagation on the Oregon shelf. Journal of Physical Oceanography, 41(11), 2037-2062.

Xie, X., Shang, X., van Haren, H., and Chen, G. (2013). Observations of enhanced nonlinear instability in the surface reflection of internal tides. Geophysical Research Letters, 40(8), 1580-1586.

6. Line 135: the author do not seem to mention what "red curve (in Figure 2)" means.

Responses: We apologize for this information gap. The red curves are the main propagation path for different modes of semidiurnal internal tide. We have added this information in the revised version.

(Changes are made in Lines 136–137 in the marked-up manuscript version.)

7. Line 168 (Figure 3d-f): The Moon's orbit around the Earth is elliptical, with a change in perigee and apogee, a period of about 27 days. The interval between the three spring tides described in this article is exactly 27 days (137 to 164), which makes one wonder if the change in the energy of the internal tides is related to this 27-day inequality of tide. The data used by the authors are model data and should not include this factor of variation in the equinoctial tide. However, the authors should check the model and rule out this possibility.

Responses: We thank the reviewer for this valuable comment. By carefully inspecting the model configuration, we confirm that the tidal forcing of the LLC4320 is a body forcing implementation, which is called tidal geopotential forcing in the model. Tidal geopotential forcing considers the celestial gravitational tidal force between the Sun, the Moon, and the Earth, which is described in https://github.com/joernc/tidal-potential. In our view, the model output contains the variation of the equinoctial tide. However, the magnitude of barotropic tide varies only by 10% between the first two spring tide moments (Figure 1b), which is about 1/3 of the variation in the energy of the semidiurnal internal tide, so we believe that the energy of semidiurnal internal tide is mainly influenced by the anticyclonic eddy.

(Changes are made in Lines 123–124 in the marked-up manuscript version.)

8. Line 248: I did not find explanation on mode 0 in Figure 7. Is it the barotropic tide, or AE?

Responses: Mode 0 is the barotropic tide. We added this explanation in the revised version.

(Change is made in Lines 251 in the marked-up manuscript version.)

9. Line 251: The word "respectively" seems unnecessary.

Responses: We removed this word.

(Change is made in Line 251 in the marked-up manuscript version.)

10. Lines 268, 535: A "*" indicates ordinary multiplication in computer language, but not in math

language. When a “*” is occasionally used in math to denote multiplication, it must be a special defined multiplication, such as convolution. Likewise, expressing powers of 10 in terms of “e” (Line 535, Figure B1) is also not normal in math language. “e” equals 2.71828... in math.

Responses: The reviewer is right, we apologize for these improper uses of “*” and “5.66e-4”, and we have replaced them with “×” and “5.66×10^{-4}”.

(Changes are made in Line 269 and Figure B1 in the marked-up manuscript version.)

11. Line 359 (Figure 14b-c): The authors use “onshore (Northward)” and “offshore (Southward)” to present the direction of energy fluxes integrated along section S1 and S2. In my view, section S1 is along-shore and the energy integrated along it is cross-shore; section S2 is cross-shore and the energy integrated along it is along-shore.

Responses: The reviewer is right. In the original manuscript, we use the words "onshore" and "offshore" to describe the behavior of mode-2 semidiurnal internal tides when they encounter the continental slope. The incident waves (toward the shore) are reflected, and the reflected waves propagate in a direction away from the shore. As the reviewer suggested, we changed "onshore" to "cross-shore" and "offshore" to "along-shore" to depict this process accurately in the revised text.

(Changes are made in Lines 261-267, 364, 550, Figures 14 and C1-C2 in the marked-up manuscript version.)

12. Line 374 (Figure 15): Typically, wave rays can be found in the contours of the current speed. But here the contours of the current speed show no clear pattern of the wave rays. I wonder how do the author give the black wave rays in Figure 15?

Responses: We understand the reviewer’s concern. We have only filled in the baroclinic velocity of mode-2 SIT in Figure 15. Examining closely, we can see that the black wave ray passes mainly through regions with positive velocity. Assuming that mode-2 SIT propagates mainly from the continental slope where the topographic steepness parameter is greater than 1, and then integrating the equation (R1) over time gives us the black wave ray in the figure.

$$\frac{\mathrm{dz}}{\mathrm{dx}}=\sqrt{\frac{\omega^2-f^2}{N^2-\omega^2}} \quad \text{(R1)}$$

(Changes are made in Lines 366, 372, and 375-376 in the marked-up manuscript version.)

13. Line 380 (Figure 16c-d): The authors gave two sub-figures to compare topographic steepness parameters for days 137 and 151. Unsurprisingly, they are very similar. In Lines 390-391, the authors talked about the similarity but do not explain why they are so similar. In fact, according to Eq. (3), the difference between the two is only in the stratification, which will not change significantly in just half a month, so the similarity is inevitable. This should have been explained in the text.

Responses: We thank the reviewer for this nice interpretation, we added this in the revised text.

(Changes are made in Lines 391-392 in the marked-up manuscript version.)

14. The article uses a lot of formulas, and some of the math symbols are so similar that it's easy to get confused. For example, "c_n" and "c_p" are the eigen speed and phase speed (Line 412), "C_n" is topographic conversion term usually appears with energy exchange term "P_n" (Line 466), "p_n" is the pressure perturbation (Line 510). Then what's the meaning of "c_n" (Line517, A4) and "c_m" (Line 512, A3)?

Responses: We apologize for this information gap, c_n and c_m share the same meaning, c_n stands for the eigen speed of the *n*th mode and c_m stands for the eigen speed of the *m*th mode. The reason for using the "new" expression c_m is to distinguish it from c_n, since the intermodal interaction involves the eigen speed of both the *n*th and *m*th modes. We checked all the equations in the paper to make sure the meaning of each variable is clear.

(Change is made in Line 509 in the marked-up manuscript version.)

15. Line 517: should the "ω" in Eq. A4 be "ω_n"? The expression of this equation may be related to the modes, I think.

Responses: We understand the reviewer's concern. Vertical modal decomposition is usually used for internal waves with a fixed frequency (e.g., for SIT in this paper), and as a result, all decomposed modes also have a fixed frequency ω.