

Ocean Sci. Discuss., referee comment RC2  
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## **Comment on os-2021-114**

Anonymous Referee #2

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Referee comment on "Internal tides off the Amazon shelf during two contrasted seasons: interactions with background circulation and SSH imprints" by Michel Tchilibou et al., Ocean Sci. Discuss., <https://doi.org/10.5194/os-2021-114-RC2>, 2022

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Review of "Internal tides off the Amazon shelf during two contrasted seasons: Interactions with background circulation and SSH imprints"

This paper presents an internal tide energy budget and wave-number frequency spectra analysis for two seasons for the Amazon internal tide hot spot using nested high resolution model simulations. It is good to see that the model captures the nonlinear aspect of the internal tides near the Amazon (higher harmonics in Figure 9f), an aspect that most global and regional studies have not focused on much.

The paper's English is generally good with small grammatical errors here and there and the figures are pretty and clear (although the spectral line plot is quite dense). However, I noticed more grammatical errors in the discussion section, which seemed to be less well polished. The paper is quite long, dense, and in some places descriptive. To make sure the reader stays captivated, I suggest shortening the paper and make it more focused. The title suggests the theme is about seasonal internal tide variability (very interesting topic), but it seems to be that for the variables considered it is not very strong and/or not well communicated in the paper. The authors could go more in depth in either the energy analysis or the SSH frequency wave-number analysis (I think you could make two stand-alone papers on these topics).

Regarding the energy analysis, why do the authors consider the energetics of the coherent surface and internal tides but not the incoherent internal tides? To describe the incoherent internal tides the authors use SSH in sections 3.4 and 3.5. Similar to Pickering et al (2015) and Buijsman et al (2017), the authors could have computed incoherent signals as the tidal band-passed minus the harmonically fitted time series. This allows for a better discussion on what fraction is scattered to the incoherent internal tide and what fraction is “truly” dissipated.

Quite a bit of text is focuses on 8 separate generation sites. I suggest the authors focus mainly on site A as that is the largest generation site and its beam is best captured by the high resolution model. On a site note, to better investigate the energetics of this beam a bigger model domain would be better. This could also be discussed in the discussion section.

The authors show there are significant seasonal differences in mesoscale currents and stratification, suggesting that this may be important for the energetics and beam orientation. However, they show this does not have a strong impact on the conversion. I am not completely surprised because conversion generally happens between 100 and 1000 m, where  $N$  does not change much. How does this seasonality affect the propagation of the modes for example (e.g. in their energy fluxes)? The authors could do some ray tracing to entangle the mechanisms behind the refraction?

The discussion section reads like a long summary section of the results. I suggest the authors write a shorter and more focused discussion section and also a stand-alone conclusion section. It would be nice to see a discussion section that discusses the paper’s findings in light of the literature and any deficiencies the model and or analysis may have (e.g., the spectral bump at 20 km).

L35. Also cite Shriver et al (2012) here.

L41. Some more references would be justified here. Zaron and Egbert (2014), Shriver et al (2014), Buijsman et al, (2017), Ponte et al (2015), etc etc

L52. I believe Zaron et al and Muller et al also wrote some papers on the seasonal variability of the internal tide. Maybe include some more references here?

Figure 1. Instead of contours use curves.

L105. 45 and 30 degrees are relative to what (east, north)?

L114. Please define "(un)balanced motions".

L116. I do not understand "before calculating geostrophic currents".

L125. Here you suggest you look into the total dissipation, but the paper discusses only the energetics of the coherent internal tide.

L108-131. The paper raises questions that are not discussed in the same order in the manuscript.

L174. It is not clear what definitions you mean precisely.

L176. What is a non-zero mode? After depth integration?

L177. Can you comment how much the improvement is (1%, 10%)? This is useful information for future studies.

L180. Can you provide some more information on your steps here? Do you solve for the eigenfunctions using spatially varying stratification? Then you fit the U eigen modes to the harmonic constants of the 3D velocity and pressure fields? This yields the modal amplitudes that you then use in the energy analysis? Or do you only use barotropic and baroclinic SSH? You can compute baroclinic SSH from the sum of the rigid lid modal surface pressures (or is this what you do)? How many modes do you fit (this is most likely limited by frequency and by vertical and horizontal resolution; see Buijsman et al, 2020)?

L207. Figure 2c should be Figure 1b?

L208. "differences" Note that the altimetry is based on 20+ years of data while your model is only based on 9 months. The longer the period over which the harmonic analysis is performed the smaller the coherent amplitude (see Ansong et al, 2015 and the appendix of Buijsman et al, 2020). Hence, your comparison may not be quite an apples-to-apples comparison. In the model far field there is clearly some coherent energy that is not present in the altimetry, possibly due to time series duration?

L233. There is no Coriolis balanced flow near/at the equator. How does that affect AVISO and your comparison?

Figure 3. Why do you not show the currents in the Aviso data?

Figure 4. Can you explain negative N in the figure? Maybe correct for that (set  $N=0$ )?

L258. "expected" since you do a modal analysis do you have the answer?

L260. "barrier" for the total or the coherent internal tide? This causes reflections?

L265. What are the reasons you ignore these terms?

Equations 1 and 2 and table 3. I am confused here. Why is BT dissipation positive and BC dissipation negative? Both should be positive. See Kang and Fringer (2012).

Eq3.  $Z=H$  not  $z=H+\eta$ ?

L357-378. The authors discuss the dissipation of the coherent internal tide in these sections. It is generally known from Zaron and Buijsman studies that the coherent dissipation includes energy loss to the incoherent internal tide and higher harmonics. However, the authors do not clearly a priori state that. Hence, it sometimes seems if they are discussion the total dissipation. The authors could focus more on determining what fraction of the coherent dissipation scatters to the nonstationary internal tides.

Section 3.4 and 3.5. Instead of focusing on the SSH, the authors could focus on the total internal tide energetics and compare that to the coherent energetics?

Section 3.4. This is very dense description of Figure 8. I wonder if this can be either shortened or made more quantitative (e.g. include ray tracing)?

Eqs 8-9. You assume that the higher harmonics are always incoherent. Is this really true? Can you do a harmonic analysis and fit for M4, M6, etc and see what variance fraction they comprise of the total higher harmonic variance?

L493. "justifying the incoherence ratio of more than 0.5 noted by Zaron (2017, its Figure 8)"

I am not sure if this is correct. Zaron looks at the primary frequencies, while you also include the higher harmonics. Hence this is not an apples to apples comparison.

L499. "components" what components precisely?

Figure 11. Add period [hours] to the right axis of right subplot.

Figure 12. This is a nice figure, but the colored lines are hard to distinguish. You could add more clarity by increasing the thickness for some lines and making the panels wider?

L559. "However, defining the transition scale from the super tidal is delicate" It is not directly clear to what the super tidal scale transitions to (super-super tidal?). Why is it relevant to discuss this transition scale?

L567. What are meridian spatial scales?

L665. Refer to a Figure here?

L677. The MAR radiates southward waves.



