

The study describes the temporal variations of internal tide around New Caledonia from an energy perspective and serves as a companion to Bendinger et al. (2023). The authors conclude that mesoscale eddies contribute to the variations of internal tide generation, as shown through the decomposition of the incoherent term  $C^{inc}$ , and propagation, analyzed using a ray-tracing model. Specially, at the generation site (the near field), variations in conversion are linked to changes in baroclinic bottom pressure, which correlate positively with mesoscale-induced stratification changes. After propagation (the far field), regions with strong eddy activity exhibit enhanced incoherent tides and refraction in the propagation direction. The study also explores implications for SSH observability, highlighting that incoherent tides and the orientation of altimetry tracks can impact the separation of balanced and unbalanced motions.

Overall, the study is well-executed, providing solid evidence for the proposed mechanisms through quantified analysis. The discussion on the impact of altimetry track orientation on SSH wavenumber spectra is novel and relevant to the SWOT mission. However, the manuscript is somewhat lengthy, and certain sections could be condensed for clarity. Additionally, I have several questions and comments that would like to be addressed before publication.

## **Introduction**

- The recap for Part 1 (l.34-54) can be shorten by focusing on those related to incoherence.
- The energy dissipation is introduced in l.71-81, and understanding its temporal variation is stated as one of the objectives in l.106. However, the analysis of energy dissipation is only addressed at the annual mean timescale and described in a single paragraph (l.241-251). The emphasis

on the dissipation term in the introduction does not align with the following analysis focus.

## Section 2

- Equation 1 can be omitted to maintain relevance and save space.
- Equation 7, why is the energy flux intergraded from 0 instead of  $\eta$ ?
- Equation 11, the right parathesis and “dt” for  $D_{bc}^{coh}$  term are missing.
- At the end of Section 2.2, the authors state that the  $D_{bc}^{inc}$  represents the overestimated portion of  $D_{bc}^{coh}$ . A similar statement appears in Section 3 (l. 246-247). However, I think the  $D_{bc}^{inc}$  includes both the overestimated coherent portion AND the actual dissipation from the incoherent tide. The presence of real incoherent dissipation can be verified by the net incoherent dissipation at North (1). Nevertheless, the conclusion regarding the overestimation remains unchanged.
- Section 2.3 is similar to Bendinger et al (2024) and can be shorten.

## Section 4

- It is unusual to have only one subsection. I suggest reorganizing the structure. The same applies to Section 5.
- The explained variability is expressed as (%) in text (e.g. l.259-260) while as decimal (0-1) in Table 2. Please ensure consistency.
- L.315: “The negative conversion/bottom pressure amplitude anomalies in Fig. 5b”. Should likely refer to “Fig. 5a”?
- L.327: “In phase with the local tidal forcing,  $p_{bc}^{inc}(-H)$  induced ...”. If  $p_{bc}^{inc}(-H)$  is “in-phase”, why it is incoherent?

## Figure 3

- The bathymetric labels are too small to be clearly visible.

## Figure 5

- 5(a): What is the physical meaning of the negative values for the ratios of  $C^{cross1}/C^{D2}$  on the y axis?

## Table 3

- The unit for “delay” should be [days].

## Section 5

- The “group arrival time” is not clearly defined in Section 5.1. Based on the caption in Table 3, which states “equivalent to 500 km”, I assume the “group arrival time” refers to the time taken to propagating 500 km. If so, for South (2) domain, both mode-1 and mode-2 tide propagate faster with the mesoscale currents, which is consistent with the negative “delay” time. If my understanding is correct, the statement in l.409-410, “Mode 2 is substantially *more delayed* than mode 1”, is incorrect for the South (2) domain, as both mode-1 and mode-2 *arrive earlier*, with negative delayed time.
- I also speculate on the “delay” for South (2) domain. The standard deviation is large enough to cause the "delay" time to switch signs.

## Section 6

- The paragraphs before 6.1 (l.421-445) serve as a recap in Part 1 and an introduction, so they can be condensed. The same applies to l.459-465 in Section 6.2.

Below are some minor comments, which I leave to the authors' discretion to consider.

**Vague pronoun reference:** please explicitly state the references for clarity.

- L.10: "it"
- L.77: "this can have..."
- L.141: "their Fig. 13 a-d"
- L.259: "it explains"

**Overuse of "i.e.":** here are some suggested replacements.

- L.141: "... Caledonia, **including** the location ..."
- L.163: "... incoherent parts **for**  $u$  and the pressure perturbation  $p$ "
- L.255: "... spring-neap cycle, **driven by** the interaction of  $M_2$  ..."

**Formatting and grammar corrections:**

L.5: "...from coherence, in...", add space after the comma.

L.8 & L.255: The phrase "astronomically forced fortnightly modulated spring-neap cycle" is wordy and grammatically incorrect, which reduces readability. Consider a revision.

L.9: use an "em dash" rather than a hyphen. The same applies to others in the manuscript.

L.29: "semi-analytical theory"

L.45: "representative **to** the coherent"

L.57: I think "near-field" and "far-field" that have a hyphen in between, are commonly used as adjectives, rather than nouns.

L.64-65: suggested revision “The mechanisms governing the temporal variability of internal tide vary geographically, and cannot be generalized as the importance ...”

L.67-69: suggested revision “New Caledonia is a particularly challenging region as it is a hot spot of internal tide generation and a region of strong mesoscale variability, making it potentially ...”

L.94: “estimate the length scale **at which** unbalanced motions ...”

L.186: “taken from the harmonic analysis and vertical mode ...”

L. 215: missing the right parathesis after “(see Fig.1)”

L. 220: “mimic”

L.239: “distance **from** the generation”

L.247: “This **accounts for** 10%, 9% ...”

L.276 (Figure 3 caption): The second sentence lacks a verb.

L.280: “Similarly to the **analysis** above, we show **in** the South (2) domain, the contribution of different terms that make up  $C^{inc}$  ...”

L.282-283: “**While** the three terms feature similar amplitudes, **their** spatial patterns differ.”

L.283: “Based on the area-integrated explained ... ”

L.317 & 319: “compute 5-day mean” and “period of 180 days”

L.324: “conversion and mesoscale variability ...”, which conversion?

L.335: “pressure amplitude variations are very pronounced, **suggesting** the influence of the local effects”

L.379: “closely correlated to **that** of semidiurnal”

L.612: “concerns the impact of conversion variability on outward energy propagation and local energy dissipation”? The logic between these three terms in Equation 2 is unclear to me.