

Dear Editor,

Please find attached the second review of our manuscript, “Variability of surface gravity wave field over a realistic cyclonic eddy”. We expect that this new manuscript will be relevant for different applications, as the assimilation of waves measurements in oceanic models to improve the accuracy of fine-scale current gradients, or to improve the estimation/correction of the sea-state bias in radar remote sensing measurements. Thank you for all your recommendations and corrections for this second review of our paper. Your comments helped to improve significantly the quality of this paper. We sincerely acknowledge you for the kindness of your comments.

In this manuscript it is shown, thanks to idealized wave simulations, that the significant wave height, the mean period and the peak direction of surface gravity waves are strongly modified by the presence of an isolated mesoscale eddy and even more when the geometry of the eddy is realistic with coherent features both at the mesoscale and submesoscale ranges. The proportionality between the surface current vorticity and the spatial gradients of the wave parameters are discussed and operated to know if the statistics of the flow can be inferred from the statistic of the wave field. Because the wave field is strongly modified by the current induced by the realistic eddy field, we discuss about the wave steepness and applications for radar altimetry. It is shown that operational sea-state bias parametric models are based on erroneous assumptions. Finally, we show that the exchanges of wave variance in the wave spectrum, due to wave-wave interactions, have the tendency to smooth the wave parameter spatial gradients.

Please find below all the detailed corrections and the main elements that have been added for this new version.

- Abstract: The abstract has been modified in agreement with the new elements.
- Section 3.1.1: the abular 1 has been added.
- Section 3.2: the section has been partially rewritten, a discussion has been added.
- Section 4: the section has been partially rewritten.
- New section: the section 5 about wave steepness has been added.
- Conclusion: The conclusion has been partially rewritten.
- Appendix: The Appendix has been removed. I have edited the core of the paper accordingly.

All my corrections are in red.

Detailed comments.

<Beginning of the corrections>

Generally: “dynamics” for the noun and “dynamic” or “dynamical” (different meanings) for the adjective. Also “upstream” → “upstream of”, “downstream” → “downstream of” or “downstream from”; “Gaussian” (upper case G).

We sincerely acknowledge the editor for these typo corrections.

Line 9. “approached” → “estimated”? “Until” is the wrong word but I am not sure what is your intended meaning.

It has been edited.

Line 10. “small” → “fine”? (Usual adjectives for resolution are “high” and “low” but I prefer “fine” and “coarse”).

We have followed your suggestions throughout the manuscript.

Line 23. “narrow” is wrong. Maybe “close”, “strong” or “weak”?

« Finally, Villas Boas et al. 2020, under the same assumptions, emphasized the relationship between the vertical vorticity of the flow and the ∇H_s . »

Lines 41-42. “variabilities” of what? “multi-scale dynamic” is unclear.

Multiscale has been changed by : dynamical at the meso- and the submesoscale range. And most of the sentences with « variability» have been edited.

Lines 43-44. Sentence is too long so “as well as extreme wave height waves” is not clear. Do you mean that wave heights are underestimated?

The sentence has been corrected in agreement with the new diagnostics proposed in this new version.

Line 52. “approached” → “estimated”?

It has been corrected.

Line 91. “integrated over a certain depth along the first meters of the water column” – “averaged over the top few metres of the water column”

We have followed your suggestion. The sentence has been edited.

Line 99. “wave group” → “wave group velocity”

It has been corrected.

Line 119. “. . evolution of the significant wave height H_s and . .”

Lines 120, 125. Are all these suffices of T necessary?

Because the mean period can be weighted on higher moments of the wave spectrum, we choose to specify all suffices.

Line 131. “both in horizontal and vertical directions” → “in both horizontal directions” (there is no vertical in (1)).

It has been edited. Thank you.

Line 137: “top” (use inverted commas).

It has been corrected.

Line 137. Units for 09:15 etc.? I think this sentence should come later.

We have corrected the sentence with another time notation and shift it at the beginning of the section 3.

Lines 165-166. “The response of other waves variability for this underlying current, as the directional spreading or the mean direction, are not described in this manuscript.” → more simply “Other aspects of waves’ variability, e.g. directional spread or mean direction, are not described here.”?

We took your advice and re-write the sentence.

Line 172. “along meridians (fixed X-axis)” → “along lines of constant X”? (“axis” is confusing).

We have rewritten this sentence and took your advice for the other sentences.

Lines 177-178. “One can see that more incident waves are short more are the extremes values measured at constant X.” Unclear. Do you mean shorter waves have larger extreme values?

Your remark yielded new diagnostics. This part has been edited.

Line 183. “. . the current forcing”

Sorry for the typo. It has been corrected.

Lines 189-190. “more incident waves are short more ∇H_s are sharp.” Unclear. Do you mean shorter incident waves have sharper ∇H_s ?

It has been edited for the panel g of H_s at $X=300$ km. « Shorter the incident waves, sharper the ∇H_s »

Line 191. “zonally” → “in X”?

It has been corrected.

Line 199. South, North → +Y, -Y?

It has been corrected. Toward the South=> toward $Y=0$ km and Toward the North=> toward $Y=500$ km.

Lines 203-204. Sentence “Narrow yellow bands . .” might be better in figure caption.

We moved the sentence to the figure caption.

Lines 215, 228. “absolute frequency”. Is this the “intrinsic frequency” in (2)?

It has been clarified «The surface currents have an effect on the wave frequency (Phillips 1977). Due to the conservation of the absolute frequency in surface current, the intrinsic frequency is modified which in turn changes the $T_{m0,-1}$. »

Line 223. Use the symbol for theta.

Sorry for the typo. It has been corrected.

Lines 224-226. I have trouble understanding this sentence. Maybe “This . .” → “It . .”

It has been clarified. « It is not clear if there is a link between the incident wave frequency and the slight differences in $\Delta T_{m0,-1}$ shown in Fig 4g both in the main eddy structure or the submesoscale eddies. Indeed, $\Delta T_{m0,-1}$ are stronger for long incident waves whereas we see the opposite in the core of the fully developed eddy. »

Line 230. “waves are extended of about 153 m” → “wavelengths increase to about 153 m”?

It has been edited.

Line 232. Not “precise”.

Sorry, it was translated too quick from French. It has been replace by « recall ».

Line 259. Omit “zonally”?

It has been removed.

Lines 264-266. “is deviated of” → “ deviates by”

It has been corrected.

Line 282. Lines 280-282. The notation is confusing. Gradients are vectors not scalars. If you mean the magnitude of the gradient than use $|\nabla U|$ etc.

You are totally right. Thank you. It has been corrected in Fig.6 as well.

Equations (7) and (A6) to (A7). Better “Cte” → “constant”.

The Appendix was removed. We have preferred to rewrite the scaling of Villas Boas et al. 2020 in term of wave steepness. The section was edited.

Line 343. “resolution . . more than 600 km” is not clear. “finer” or “coarser”?

It has been clarified. « The resolution of global map of surface currents derived from altimetry has been calculated and show a mean effective resolution coarser than 200 km at mid-latitudes and coarser than 600 km in the equatorial band ».

Line 398. “. . parameters (significant wave height and mean wave period) inside . .”

It has been edited.

Line 408. “. . budget by ~7.5%. . .”?

The sentence has been modified. « Thanks to the sea-state measurements and period provided by wave model (only forced with wind), authors showed the possibility to reduce significantly the error budget in the SSB estimation. »

<End of the correction>

We hope that you will find this manuscript acceptable for Ocean-Science and we look forward to your comments.

With best regards, on behalf of my co-author,

Gwendal MARECHAL