

Ocean Sci. Discuss., author comment AC3  
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## Reply on RC1

Gwendal Marechal and Charly de Marez

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Author comment on "Variability of surface gravity wave field over a realistic cyclonic eddy"  
by Gwendal Marechal and Charly de Marez, Ocean Sci. Discuss.,  
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**Dear Referee #1,**

**me and my co-author really appreciated your comments on the paper submitted at Ocean Science. Thanks to your remarks we were able to improve the manuscript body, highlight a better key message, and propose a wider range of application. Please find below the answers to your remarks (one by one).**

The paper by Marechal and de Marez presents an interesting study on the effects on the wave field bulk parameters of small-scale oceanic currents. The focus is particularly on a specific cyclonic eddy, which is derived from the literature. Wave-current interaction is simulated with the phase-averaged wave model WAVEWATCH III, without source terms. The topic raised in the study is potentially relevant for the wave community, but some aspects of the paper must be improved to make it more understandable and to push ideas further. I, therefore, recommend that authors revise the manuscript addressing the general and specific comments outlined below.

- Title: it is not clear if the study will focus on the scale of the eddy. Reading the manuscript, indeed, it seems that a real distinction between mesoscale and submesoscale is not done, and the eddy is taken as a whole. I suggest, for the title, to focus on the actual subject of the work, that is the variability of the wave field over a realistic cyclonic eddy.

**The title has been modified.**

- Line 2: the wave amplitude is mentioned here, while later (Line 13) the wave height is used as the reference vertical scale. Probably, given the results presented in the study, the use of wave height is more appropriate.

**Wave amplitude has been changed to significant wave height.**

**The following mistakes have been corrected.**

- Line 17: an "and" between the two references is probably missing
- Line 17: wave height == > significant wave height
- Line 23: gaz == > gas

- I have not a particular suggestion on how to improve the Introduction (section 1), but at the present stage, it seems to be more a list of results instead of a place where briefly introduce the study in a broad context and highlight why it is important. My suggestion is for a reshaping of this section, to focus on the current state of the research field and key publications.

**We have improved the introduction. After the long state of the art of how current affect waves we showed that studying a more realistic shape of eddy will have a significant impact on the Sea-Level Anomaly from space but also on wave forecast.**

- Section 2.1 title. I'd rather say: "A realistic cyclonic eddy" (see also my comment below).

**In agreement with referee 3 we proposed a new title for this section.**

- Line 62: define the variable Bu.

**It has been defined.**

- Lines 69-70: here is mentioned the duration of "half a year", while later (caption of Fig1) the duration is 210 days (more than half a year). Please homogenize and keep throughout the whole paper the actual value used for the simulations.

**« Half a year » has been corrected by 210 days.**

- Fig. 1. Since the current field (speed and direction) is relevant for the wave model, I'd add two panels showing this variable, which will largely help readers to interpret the changes in wave parameters.

**The current intensity/direction have been added in two new panels in Fig.1**

- Fig. 1. what is the meaning of f\_0?

**It has been clarified.**

- Fig. 1. Since the current field is not stationary, is there any reason to choose that specific interval (210 days) after initialization? To me, it seems an arbitrary choice that influences the results and must be carefully motivated in the text. Please add a comment, also about what authors mean for "final state of the simulation" (Line 69).

**We really appreciated this comment, we gave more informations to explain why we have chosen this current forcing and not another one. It has been clarified in agreement with referee #3**

- Figs. 1, 2, and 3. To understand the effect of the eddies on the wave parameters, a comparison with the undisturbed wave field (i.e., no current) is necessary at this stage.

**Instead to overload the manuscript, with too much figures, a line has been added in caption of Fig.2 and Fig3 . The difference mean period between simulation with and without current has replaced the instantaneous mean wave period in this new version of the manuscript.**

- Page 4. It is defined the surface current, but waves "feel" a wave-averaged current even below the surface. Probably it is not necessary to change the formula, but it is important to specify how waves behave over a realistic current field and that the use of the surface current is an approximation of the real process.

**It has been clarified in the wave model setup.**

- Fig. 1 and other Figures labelled with X- and Y-axis. Since in the text geographical coordinates are used (i.e., west, north, longitude, ...), I suggest placing them together with labels X and Y on the axes specifications.

**« Longitude » and « latitude » have been removed, « west » and « east » as well. We have re-write the manuscript such that paragraphs are consistent with figures axis.**

- Page 5. It is not clear how simulations were performed. In particular:

▪

What kind of "narrow band spectrum" was used? **It has been clarified (gaussian in frequency)**

**For the three next remarks :**

**We have redo all wave simulations such that a new wave train is propagating in the domain every hour. Thanks to this new parametrization waves reach a stationary state for all initializations ( $T_p=7, 10.3$  or  $16.6$ sec). Details of the new parametrization are given in the paper. We thanks gratefully the reviewer for this remark, the new results are more rigorous and improve significantly the manuscript.**

■

Were simulations initialized with waves travelling from left (west) to right with no boundaries conditions (see the next comment on figures showing the results)?

■

If so, simulations do not reach a stationary condition, therefore results are representative of a specific time step (as it is mentioned later; indeed, at the given time steps,  $H_s$  at  $X < 100$  km is zero, as well the wave period): does this selection affect results and conclusions? Mind also that, because of the different current fields between unperturbed and perturbed simulations, the two wave fields (for a given  $T_p$  and time step) do not necessarily correspond to the same "state".

■

Would have changed the conclusions if, alternatively, the simulation had been done by forcing the field from the boundary and then by trying to reach a steady state for the interior wave field?

- Line 117 "the intensity of the current has been multiplied by five". Does the artificial increase of the speeds cope with the assumption of "realistic cyclonic eddy"? **In term of surface current intensity, multiply by five the initial vortex make the new vortex still realistic. Nevertheless, as noticed by the referee #1, the vorticity do not remains realistic.. We thus multiplied by 2 rather than 5 the initial vortex of de Marez et al. 2020. The new intensity and vorticity are given in Fig.1. It has been compared with realistic eddies in western boundary currents.**

- Line 122.  $C_g$  is the speed of the wave energy. **It has been clarified.**

- Line 124. Longitude, without geographical coordinates specified in the Figures, is meaningless (see my comment above). **It has been corrected.**

- Line 152: it is not easy from the Figures inspection to appreciate the gradient. A new Figure showing this variable would help. As well it would help a new Figure showing the relative differences between the simulations with different eddies. I let, however, authors decide how to improve the presentation of the results. **The initial Fig 2g has been extended to the mean wave period (Fig.4g). Wave parameters gradients have been described more accurately by adding some indication in the caption of Fig.2, Fig.3 and Fig.4.**

- Line 162: what do authors mean by "spurious"? It is shown a value of 360, while it should be 270. **It was due to the fact that only one wave train was propagating in the eddy field in the first version of the Manuscript. That is why when the unique wave train have propagated entirely over the surface current field the wave direction becomes  $0^\circ$  ( $=360^\circ$ ) upstream. With the new parametrization this large yellow band has been removed because waves are continuously emitted from the left boundary.**

- Line 265: I wonder how one can obtain the  $H_s$  field over such a large area. A comment on the available (or planned) instrumentation would be appreciated. **It has been**

**clarified. Moreover thanks to the new parametrization the conclusion of the paper has changed. A remark on high resolution wave height measurement from space has been added.**