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Ocean Science
Discussions

Interactive comment on "Technical note: On the importance of a three-dimensional approach for modelling the transport of neustic microplastics" *by* Isabel Jalón-Rojas et al.

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We would like to thank Referee #2 for the interest in our work and the effort spent on reviewing our manuscript. In this interactive discussion, we address the general comments; a new version of the manuscript will be submitted with the final revision.

Referee comment: The manuscript describes the trajectory and fate differences of the neustic microplastic in three scenarios, i.e. 2D only, 3D weak vertical turbulence and 3D strong vertical turbulence. And it tries to indicate the importance of the 3D approach. The manuscript is well organized and clearly analyzed all the numerical experiments. I am providing some comments that are required to be considered by

authors.

Referee comment 1: The conclusion of the manuscript is obvious. Because of vertical transport, MPs may be trapped and driven by the horizontal currents at difference depth, for numerical models at difference sigma layer. And due to the difference of the horizontal current field at different sigma layer, the trajectories and fates of MPs in 3 scenarios are different. I noticed the vertical transport of MPs is driven by random walks, vertical current and vertical diffusivity. The manuscript only evaluated the importance of vertical diffusivity, but what is the contribution of the other two factors?

Response: We think that our conclusion is not so obvious, because practically all the previous numerical studies ignored the potential impact of vertical transport and used a 2D approach to evaluate the horizontal transport of microplastics. Even if the above statements are known, the scientific community has hypothesized that the vertical transport, induced by turbulence in this case, is not so important as to impact the horizontal trajectories and the fate of microplastics. For that reason, we think it is important to pass this message through this technical note. In addition, we not only show the differences between the 2D and 3D approaches, but we also quantified them. We could give a few more details about this quantification in the conclusions of the final version.

The vertical diffusivity is given through the random walk, but it is true that there is also vertical currents. However, the selected period is characterized by negligible vertical currents, so the differences mainly came from vertical dispersion. We will detail this information in the final version. If required, we could evidence that the advective vertical velocity of this specific study case is not highly impacting the differences between the 2D and the 3D approaches for this case study in supplementary material. However, the impact of vertical velocities for different scenarios such as upwelling and atmospheric cooling will be further analyzed in future works.

Referee comment 2. What is the vertical resolution of the hydrodynamic model? How

could it be if the vertical resolution changes?

Response: As discussed in the response n° 1 to referee 1, the model uses a total of 21 sigma layers, so the depth represented by a given sigma layer changes significantly over the space as a function of bottom depth. For example, the 5m surface layer thickness is represented by the layers 1-5 near the mouth while it is represented by layers 1-12 in the inner bay. A decrease of the vertical resolution might decrease the differences between the 2D and the 3D approaches in much as this decrease impacts the accurate representation of currents in this stratified system. As we responded to referee 1, we will describe the vertical resolution and its potential impact in the new version, and discuss the differences with the typical setups for deep ocean models.

Referee comment 3: page 4 line 22-23: not all the particles stay in the bay in the 3D approach with weak vertical turbulence.

Response: We described that all the particles stayed in the bay for the 3D approach with weak vertical turbulence because only one particle (among thousands) left the bay, so the probability of particles going out is negligible for this scenario. We prefer to keep this statement, but we may include some clarification if required.

Referee comment 4. page 6 line 1-2: Without validation, there is no stand for the author to conclude a “more-accurate” prediction.

Response: As discussed in the response n° 7 to referee 1, we acknowledge that the lack of observations is a shortcoming of this study. Future work is in progress to apply for funding to conduct field work in Jervis Bay in order to validate the 3D model prediction. This study compares the two approaches by considering the 3D approach “as a reference solution” (page 2, line 12), closer to real conditions, and we evaluated the potential consequences of using a 2D approach, the typical approach used in previous studies. We will modify this statement in the revised version by emphasizing the assumptions of this work.

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