We'd like to thank the reviewer for taking the time to read our paper submission and give his expert feedback. In the following document we have addressed his remarks and indicated where the specific changes to the document have been made. All line numbers are with regards to the tracked changes document.

## General comments

The revised version of the article submitted by V. Onink and collaborators and entitled Empirical Lagrangian parametrization for wind-driven mixing of buoyant particles at the ocean surface, has replied to all the recommendations made by the two reviewers. To my mind, efforts for a more complete discussion of their results have been made. Nevertheless, by reading the new material provided in the revised version, below are some recommendations that need to be addressed for the manuscript to be granted publication.

1. By discussing the KPP model in greater details, especially by considering the influence of the parameters θ describing the Langmuir Turbulence (LT), the authors have improved the quality of the comparison with observations. However, the SWB model also has adjustable parameters, the most obvious one is the depth over which the intensity of turbulence is constant. The choice to make the transition for the decay of turbulence at Hs is as arbitrary as the value for θ to represent the intensity of the LT. Thus, it should be associated with a parametric study as well because changing this value into 1.5Hs or 2Hs could lead to improved comparison with observations as well. The sake of a parametric study for SWB is also to give an equivalent attention to the two models, there is currently a stronger emphasis on the KPP model. If the outputs are revisited for SWB, it can also modify the conclusion that KPP model performs better with respect to observations.

We thank the reviewer for raising this point, and we have made a number of revisions throughout the text to better balance the emphasis given to the two diffusion approaches. Specifically, we have introduced a new parameter $\gamma$, which controls the depth to which we have constant mixing as a multiple of the significant wave height. As we state in lines 144 - 145, there is uncertainty in what value $\gamma$ should take, as Poulain et al. (2020) implies $\gamma = 1.0$ while based on Kukulka et al. (2012) it would be $\gamma \approx 1.5$. As such, we now consider $\gamma \in [0.5, 1.0, 1.5, 2.0]$. As shown in the new figures 4, E1 and E2, taking higher $\gamma$ values results in deeper mixing of all particle types, and leads to better agreement with the field measurements (Figure 5). Overall, KPP diffusion can still lead to deeper particle mixing, but as we do not have sufficient field data below 5m we now state in line 271: "Considering the KPP and SWB diffusion profiles, the results in this study are inconclusive with regards to which approach performs better relative to field observations."

2. The goal of the comparison of the two diffusion models (KPP vs SWB) is to discuss the influence of the physics important for vertical transport modeling, and no model alone does a perfect job, although KPP with strong enough LT seems a better choice. The ultimate question that should be considered in this context is the question of adding up the two models.

Although using $\gamma = 1.5 - 2.0$ does improve the model performance of SWB diffusion relative to the field observations, we still consider KPP with sufficiently strong LT mixing a better parametrization choice (although as we outline in lines 292 - 297, setting the appropriate $\theta$ value is not trivial). We considered the possibility of combining the two diffusion approaches in some fashion, but ultimately, we concluded that expanding the KPP diffusion approach in a theoretical fashion would be beyond the scope of this study. Simply adding up the two diffusion models is a possibility, but this would mean that there is no longer one consistent theoretical framework underlying the parametrization. Furthermore, it would also imply that the wind-driven mixing is no longer constrained by the MLD, which is an important feature of the KPP diffusion model.

To examine the influence of increased near-surface $K_z$ values, we did include the KPP model modification where we set the roughness scale $z_0 = 0.1xH_s$. This led to higher near-surface $K_z$ values, but as we state in lines 306 - 311, overall this was a much weaker influence on the overall concentration profile than LT turbulence (as similarly shown by Brunner et al., 2015). As such, while we acknowledge that the KPP diffusion approach is not a complete representation of all turbulence processes within the surface mixed layer, it does capture the majority of turbulent mixing dynamics. This makes it suitable to be applied to model vertical particle transport in a larger 3D model setup.

## Other comments

- L. 271: ''by" instead of "be"?

Fixed.

- L. 319-320. The variance in the modeled data is much less here because the numerical runs are 1D, and does not reproduce the fluctuation of ocean dynamics... It is unlikely that wind condition are the only origin of this variability in observations (currents, fronts, meso-scale eddies, etc).

Indeed, there are many different oceanographic processes that contribute to the variance observed in the field measurements, and we intended our mention of wind to be an example, rather than suggesting it is the only relevant process. As such, we have updated the text at lines 323 - 325 to clarify this: "This is in part also due to assuming constant environmental conditions over 12 hours for the model simulations, while wind and other oceanographic conditions can change on much shorter timescales over the ocean surface."

- The reference Poulain et al. 2018 is with the wrong year. The online version of the paper is 2018, the official (doi) reference is in 2019 (53(3), 1157-1154)

Fixed.