Comment on esd-2021-48
Gerald M. Ganssen (Referee)

Referee comment on "Sedimentary microplankton distributions are shaped by oceanographically connected areas" by Peter Nooteboom et al., Earth Syst. Dynam. Discuss., https://doi.org/10.5194/esd-2021-48-RC1, 2021

This is an important topic to better understand and potentially quantify the effect/amount of transported particles by ocean currents while sinking from the ocean surface to the seafloor and forming an archive for paleo reconstructions.

This process is hardly taken into account or discussed in the scientific reconstructing past ocean conditions which explains why the paper by Peter K Weyl (1978) is hardly cited and surprisingly not taken up in the list of references in this manuscript. Please allow me to quote his first sentence from the abstracts:

"The interpretation of micropaleontological data based on the fossil remains of planktonic organisms requires an appropriate reference frame."

Several papers have been published since then reporting observations and/or attempts to quantify this effect (e.g. Ganssen and Kroon 1991; earlier papers by the first author of this manuscript) where this particles are sometimes called "expatriates". To my knowledge a paper modelling this effect and quantifying the consequence for the sediment composition is still missing, while much more articles concentrate of vertical mixing (bioturbation) in sediments, a process which changes the original composition of surface ocean sediments (including the expatriates).

An extreme effect of this kind of process on particles in the micro- to nano-scale is reported by Mollenhauer Eglinton et al., 2003 and the effect on establishing an age frame of marine sediments by radiocarbon dating.

"This paper nicely clusters deep-sea sediment uses a 3D-flow model to shed more light on the complexity of the sedimentary microplankton composition."

Although not being an experts in statistics and modeling, the used methods sound carefully selected and applied.

The text is very well written and explanations are sound and convincing.

A few suggestions for improvement:
In the method section the authors do not mention the typical size fraction for their calculated sinking speeds of both dinoflagellate cysts and planktonic foraminifera; here it would be important to make a difference between empty shells and those still containing organic material which, during sinking, will get oxidized and the amount of gas within the shell will reduce sinking speed significantly.

- A discussion on the potential effect of very slowly sinking particles reaching the sediment archive: How high do the authors estimate this “bias”?
- To further prove the applicability of the authors’ approach they should compare their results with selected case studies from literature, where lateral advection of sinking particles has been reported to contribute to the sediment association and might disturb the original surface ocean signal.

Finally:

I do not see how:

“These type of studies could determine the relative contribution to the higher biodiversity outside compared to within oceanographically isolated clusters from ocean surface parameters, as well as dissolution (Frenger et al., 2018; Taylor et al., 2018) and mixing of particles during their sinking journey.”:

Detailed studies of productivity in surface mixing zones (Ottens and Nederbragt, 1992)) probably might be much stronger than advection during the sinking of the particles. I hence would like the authors to more thoroughly explain this conclusion.

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