EGUsphere, author comment AC2
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Reply on RC2

Corentin Clerc et al.

Author comment on "Including filter-feeding gelatinous macrozooplankton in a global marine biogeochemical model: model–data comparison and impact on the ocean carbon cycle " by Corentin Clerc et al., EGUsphere,
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The authors would like to thank reviewer #2 for his/her valuable and useful comments. The authors considered all suggestions and addressed the raised issues, which we believed increased the clarity of the revised manuscript. Below are given point-by-point answers to the comments.

Reviewer comments are in bold, responses in normal font. Proposed changes to the manuscript are in italics.

This is an excellent paper tackling to evaluate the impact of large filter-feeding gelatinous zooplankton (i.e. pelagic tunicates, except for appendicularians) on the marine geochemical cycle on a global scale. Although there will be some uncertainties about the calculated figures due to the paucity of data on the distribution, I believe it is worthwhile to publish them as a basis for raising the issue and for discussion. The manuscript is well prepared and I have no critical comments for the publication except for minor points as shown below.

We would like to thank Reviewer #2 for her/his very supportive comments on our manuscript.

- **Some large salp species commonly show a large extent of diel vertical migration. So authors need to mention how they compile the data sets taken at different timing of the day. Also, the effect of the diel vertical migration on carbon transportation through the mesopelagic migrant pump (Boyd et al. 2019) could be added to the discussion.**

The data retained for our analyses lie within the first 300 meters of the ocean's water column. This depth range was indeed chosen to capture the majority of DVM behavior of the target PFT, and to reflect the observational biomass data, most of the observed Thaliacaea biomass is indeed located in the upper 300 m of the ocean. Indeed, when

analyzing the raw AtlantECO dataset (i-e non gridded), the mean biomass for FFGM is 4.93 mg C m^{-3} and the median 0.31 mg C m^{-3} for the data with a maximum sampling depth shallower than 300 m. These metrics drop to 0.04 mg C m^{-3} for the mean and 0.0 mg C m^{-3} for the median when focusing at the data with a minimum sampling depth deeper than 300 m.

We agree that tunicate biomass estimates are likely to be underestimated since some salp species can migrate several hundred meters per day (e.g. 600 m for *Salpa fusiformis* (Pascual et al. 2017), 300 m for *Salpa thompsonii* (Henschke et al. 2021)). Accounting for this bias as a function of sampling time would require 1) having a clear quantification of migration depth intervals for each tunicate species in the observation dataset, and 2) having an idea of the spatial heterogeneity of the migrations for a given species. However, these data are only available for a small number of species and are based on a few local studies that do not show the spatial variability of migration depths, and that are thus not representative of processes at global monthly scales. For all these reasons, we opted for the simplest approach, namely to average the data according to the month of collection independently of time of the day. We will add to the manuscript a mention of this potential bias in the observational data by adding the following sentence (L273): *"Although some pelagic tunicate species show a large extent of diel vertical migration (Pascual et al. 2017, Henschke et al. 2021), the present observational data were averaged per months regardless of sampling time, due to the lack of precise quantitative information on the taxon-specific magnitude and spatial heterogeneity of these diel vertical migrations. A low […]."*

We agree with Reviewer#2 that diel vertical migration (DVM) is widespread in the zooplankton and can have significant impacts on carbon fluxes. However, the effect of active transport on the biological carbon pump is still poorly quantified at the scale of all migrating communities (Boyd et al., 2019). Quantitative data are even less available for a FFGM-specific parameterization of the DVM process and its associated fluxes of organic carbon.

The following paragraph will be added at the end of the discussion, just before the conclusion (L616):

"Diel vertical migration (DVM) is a key process that is currently not included in the model and that could deepen the production of carcasses and fecal pellets. Recent modeling studies that accounted for DVM at the community level demonstrated significant impact of migrants on carbon export (Aumont et al. 2018, Gorgues et al. 2019, Boyd et al. 2019). As some FFGM species undergo DVM (Pascual et al. 2017, Henschke et al. 2021b), this process is likely to strengthen their impact on carbon export by increasing the average depth at which carcasses and fecal pellets would be released into the water column, inducing a shorter path to the seafloor associated with lower total remineralization of these particles.»

The corresponding section name will be changed from *"4.3.2. Carcasses and fecal pellets transfer efficiency"* to *"4.3.2. Carcasses and fecal pellets".*

New references :

Pascual, M., Acuña, J., Sabatés, A., Raya, V., and Fuentes, V.: Contrasting diel vertical migration patterns in Salpa fusiformis populations, Journal of Plankton Research, 39, 836–842, 2017.

Boyd, P. W., Claustre, H., Levy, M., Siegel, D. A., and Weber, T.: Multi-faceted particle pumps drive carbon sequestration in the ocean, Nature, 568, 327–335, 2019.

Gorgues, T., Aumont, O., and Memery, L.: Simulated changes in the particulate carbon export efficiency due to diel vertical migration of zooplankton in the North Atlantic, Geophysical Research Letters, 46, 5387–5395, 2019.

- **Generally the size of doliolids residing in the epi-pelagic layer is small except for one species. Therefore I consider that role of doliolids in their estimation was negligible. Is it possible to estimate the impact depending on the taxonomic group?**

The data do show a much lower median concentration for doliolids (0.01 mg C m^{-3}) than for salps (0.55 mg C m^{-3}) and pyrosomes (0.59 mg C m^{-3}) (taking the median of non-null biomass samples for each Order). This suggests that the role of doliolids on the carbon cycle would be negligible within large pelagic tunicates. For instance, assuming that carcasses and fecal pellets are identical within pelagic tunicates, and that the median of an Order divided by the sum of the medians of the Orders (Salpida + Pyrosomatida + Doliolida) is a good proxy of the contribution of the order to the biomass of large pelagic tunicates, doliolids would contribute to less than 1% of the production of carcasses and fecal pellets from FFGMs and thus to the associated carbon fluxes. These are very uncertain values based on very rough assumptions, but it would be difficult to assess the impact by taxonomic group using the PISCES-FFGM model, given the lack of constraints on the parameterization of the different groups, which led to the choice to represent only one group of "Large pelagic tunicates".

- **Please add references to the CNP ratio of pelagic tunicates in line 103.**

Following the C:N:P ratio implemented for the other zooplankton groups modelled in PISCES-v2 (Aumont et al. 2015), and to avoid variable stoichiometry (which requires a substantial increase in computational resources), the C:N:P ratio of the two present macrozooplankton groups was set to the Redfield ratio (122:16:1). This will be clarified in the manuscript as follows:

L103: *"As with micro- and mesozooplankton in the standard version of PISCES, the C:N:P stoichiometric composition of the two macrozooplankton groups is assumed to be constant."*

Will be replaced by: *"As with micro- and mesozooplankton in the standard version of PISCES, the C:N:P stoichiometric composition of the two macrozooplankton groups is assumed to be constant and equal to the Redfield ratio (Aumont et al. 2015)."*

Please also note the supplement to this comment:
https://egusphere.copernicus.org/preprints/2022/egusphere-2022-1282/egusphere-2022-1282-AC2-supplement.pdf