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Interactive comment on "An investigation of grazing behaviors that result in winter phytoplankton biomass accumulation" *by* Mara Freilich et al.

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We thank the reviewer for their thoughtful comments. We agree with the reviewer about this manuscript's main contribution to the literature and appreciate the suggestions to improve the manuscript. We outline the changes we have made based on these comments below. We have included excerpts of the reviewer's comments in italics.

I appreciate that this paper focuses on zooplankton. However, other phytoplankton loss terms can be equally important in the formation and progression of a blooms (including relatively high winter biomass). For example, viral infection, possibly one of the main causes of mortality after grazing, could also be described by a non-linear,

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density dependent functional response (e.g. Mateus, 2017, FMS), and have a reduced effect on phytoplankton at low biomass concentration.

As long as the mortality has a nonlinear dependence on P, our conclusions remain unchanged. It was indeed an oversight to neglect viruses in the discussion as they clearly contribute to phytoplankton mortality. Their inclusion would further strengthen our conclusions. We have added the following sentence in the presentation of the model "The grazing function represents a density-dependent mortality process. Other mortality processes such as viruses may also be density-dependent and could be studied in a similar manner but are not included in this analysis (Weitz et al 2015, Mateus 2017). Some of the results may nonetheless be applicable to other density-dependent mortality processes."

The presented model follows the classic dichotomy between autotrophic and heterotrophic organisms. However, we know that most phytoplankton exhibits mixotrophic metabolism, perhaps with the important exception of diatoms (see e.g. Flynn et al 2012 JPR, Gonçalves Leles et al., 2018 JPR and 2020 Progress in oceanography). I am wondering if mixotrophy could be involved in the increase of biomass observed under light limiting conditions.

We agree that mixotrophy could be involved in the increase of biomass during the wintertime. Further modeling and observational studies would be needed to evaluate the role of heterotrophy and mixotrophy in the wintertime North Atlantic. We have now included this point in the discussion by adding the following sentence on line 295: "Functional diversity beyond that included in this model is also likely important. For example, mixotrophic metabolisms may contribute to phytoplankton accumulation in light-limited conditions (Barton et al. 2013, Flynn et al. 2013, Gonçalves Leles et al. 2020)."

Figure1 is a bit misleading. I think that the different functional responses (II and III) need to be run with the same parameters in order to clearly assess differences and

similarities.

As it is currently presented Figure 1 aids with interpretation of Figures 3 and 4, which use the optimal parameters for each functional type. We need to use different parameters for each model otherwise the model for which the parameters are optimized will by definition perform better. We have now plotted the functional responses with the same parameters for both functional grazing functions in an appendix to aid in the comparison of the functional types.

Line 88: the term 1/kdH(t) is "the average light over the mixed layer.." but light is not explicitly modelled, right? Is the specific growth rate which is averaged over the ML, assuming an exponential decay

It is correct that light is not explicitly modeled. We have revised this sentence for clarity to read "The term $\mu_0/K_dH(t)$ is the average growth rate over the mixed layer, which is computed as the integral of the light-depth growth over the mixed layer depth divided by the mixed layer depth."

Line 110: the formulation (type III) "is quadratic in p for low p". Why only for low p? I see that the focus here is on low winter biomass values but the formulation is quadratic for any p.

We have modified this sentence for clarity. It now reads "is quadratic in p for low p and asymptotes to a constant rate at high p."

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