



# ***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 appreciate the careful reading and thoughtful comments by all three reviewers. These comments have helped us to improve the clarity of the presentation and to refine the discussion of the main contribution of this manuscript. Following the reviewer comments, we have worked on making our terminology more precise and clarifying the presentation of the main results. The essence of the contribution of our manuscript is that growth triggered by a reduction in grazing pressure through dilution of plankton populations in a deepening mixed layer can develop only for specific grazing functions. This has not been pointed out in the literature, despite much attention to the dilution

effect. In the manuscript we use simplified models to illustrate this key point. Based on their comments, all reviewers appear to be convinced by our analysis and conclusions. The comments primarily focus on a wide variety of additional factors that could and do contribute to the annual cycle of phytoplankton growth and wintertime phytoplankton biomass accumulation rates. These comments are well-taken; we appreciate the complexity of the system and any model of a biological system is incomplete. Our approach is not to propose a complete set of processes that should be considered but instead to advance understanding of a limited set of processes. We base our methods on the perspective that to be useful models should be as simple as possible but not simpler. We recognize that additional processes can increase phytoplankton growth or reduce grazing in a less direct way than the simple functional forms. These will not invalidate the basic results that grazing or other sources of mortality must decrease more rapidly than linear for small prey concentrations. In the detailed responses we explain that all the additional processes highlighted by the reviewers do not seem to impact our key conclusions. The manuscript, however, is neither addressing nor rejecting hypotheses of wintertime accumulation due to alternative processes. There are a number of models that do include a wide range of biological processes. These models are implemented in global and regional models and used to make predictions about ecosystem responses to global change. Many of these models are moving towards non-linear grazing functions. We demonstrate that that choice is quite important for wintertime biomass accumulation, a point that has not been made explicit in the literature.

We have provided detailed responses to each reviewer in separate comments.

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Discussion paper