Reply to comments of Anonymous Referee #1

I want to thank the authors for considering and addressing all my comments in detail. The manuscript improved considerably and can be accepted after some last minor revisions.

Dear Reviewer,

Thank you for appreciating the improved manuscript and providing feedback on the new version. Please see below a response to your comments and concerns.

I appreciate the added discussion about non-linear changes in freshwater runoff on Svalbard. However, the introduction is still only mentioning an increase in freshwater runoff (L49). I suggest specifying that this increase is a short term (until 2060) increase.

The increasing meltwater runoff is not mentioned in the Introduction. However, the short term increase was already specified in the Discussion as previously requested (L348):

"While the melting potential is rising, the annual runoff in Svalbard is expected to increase till 2060, then it will likely decrease towards 2100 due to the reduction in glacier storage (Bliss et al., 2014; Van Pelt et al., 2021; Nowak et al., 2021)."

The argument that subglacial upwelling is likely not a major nutrient source due to the shallow grounding line depth is acceptable for Hornsund and probably for most Svalbard fjords with shallow tidewater glacier. However, this means that the model is also limited to similar fjords (shallow tidewater glaciers, where subglacial upwelling is not the most important summer nutrient source), which does not include most Greenland fjords with deep tidewater glaciers, or Fjords with land-terminating or deglaciated catchment. Also comparisons with Antarctica are quite speculative since the drivers of primary production are very different (e.g. iron limitation, deep wind mixing). This needs to be clarified throughout the manuscript and generalizations such as in L515ff should be avoided or discussed more carefully. I don't think the study becomes less important by specifying more clearly for which system it is valid (fjords with shallow tidewater glaciers), but that it would really help to make the discussion and conclusion more robust and more clear where the model has its strengths. Also the abstract should specify that this model is specific for fjords with shallow tidewater glaciers (because subglacial upwelling would change the effect of the meltwater considerably at deeper glacier fronts).

Thank you for pointing that out. We added a clarification about the shallow grounding line depth in the Abstract, Discussion, and Conclusions and removed the generalizations.

Abstract (L13-16):

"Here, we present an analysis of satellite, meteorological, and SPM data as well as results of the coupled physical-biogeochemical model (1D GOTM-ECOSMO-E2E-Polar) with the newly implemented iSPM group, to show its impact on the ecosystem dynamics in the warming polar fjord (Hornsund, European Arctic) with the numerous shallow-grounded marine-terminating glaciers."

Discussion (L491-497):

“Studies in deep Greenland fjords indicate that macronutrients were primarily supplied to the surface waters by mixing and not the transport from land with glacial meltwater as it was shown to have a relatively low nutrient load (Hopwood et al., 2020). However, Svalbard fjords are relatively shallow, and thus the upwelling pump might not be as efficient as for Greenland fjords or the shallower, nutrient-deficient waters might be transported (Hopwood et al., 2018). Furthermore, while macronutrient concentrations can be higher in the Arctic rivers, most of the discharge in Hornsund comes from marine-terminating glaciers (Błaszczyk et al., 2019).”

Conclusions (L515-518):

“Relatively well-studied areas adjacent to rapidly retreating marine-terminating glaciers in Hornsund are representative of similar coastal environments with shallow grounding line depth and, therefore, shed light on the formation and development of new marine habitats not only on a local but also on a regional scale.”

Conclusions (removed sentence):

“Thus, the findings are potentially important for predictions in other regions such as Greenland, Patagonia, Alaska, and the Antarctic Peninsula, which experience temperatures close to, or above the melting point and hence are exposed to similar warming effects.”