



Interactive comment on “Ice Algae Model Intercomparison Project phase 2 (IAMIP2)” by Hakase Hayashida et al.

Anonymous Referee #2

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General comments: The manuscript “Ice Algae Model Intercomparison Project phase 2 (IAMIP2).” presents a well-designed and well-written protocol for a Model Intercomparison Project designed to address a knowledge gap in expected global and regional variability in sea ice algae abundance in the future. The authors describe the planned experiment design and rationale behind their choices of boundary conditions well, such as the reanalysis data and climate model output chosen for the forcing.

Overall, the proposed Modelling Intercomparison Project presents an opportunity for improving our understanding of the current ice algae communities and their expected development over the 21st century. I recommend this manuscript for publication after the following minor edits have been addressed. The tables and figures are appropriate.

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Specific comments: As the authors mention in the manuscript, sampling of ice algae -related processes has been limited and is challenging, largely due to logistical constraints. As a result, also the knowledge of nutrient inventories in the polar regions includes significant uncertainties both for now and for the future (e.g. Lannuzel et. al 2020). I think that the approach of using the nutrient fields from World Ocean Atlas v2 (WOA13v2), following the approach chosen for the Ocean Model Intercomparison Project, is appropriate for this work. However, the availability of nutrients is one of the key uncertainties as a limiting factor for primary production in sea ice. The chosen assumption for future nutrient availability over the MIP period (unchanged from the WOA13v2 climatologies?) and resulting uncertainties for the output quantifications should be addressed in the manuscript, for example in the discussion.

L184: Please revise and clarify “zero velocity and sea level”. Does this mean no major circulation patterns and currents in the atmosphere and the oceans, and a constant sea level everywhere despite varying sea level pressure?

L291: Revise the "...allows to quantify...". This goes back to my earlier comment. Accurate quantification the impact of ice algae on the ecosystems in the future would also require a good understanding of the nutrient availability in the future.

L325-327: please quantify the temporal resolutions needed to appropriately simulate the high-frequency climate variability or provide a reference

Technical corrections: L42: Consider revising the wording “unknown” to “unclear”. This makes it sound like earlier contributions from IAMIP1 and other previous studies were rather insignificant

L47: Define IAMIP1 acronym here, where discussed for the first time

L147: The EVP acronym is not used elsewhere, is it necessary to be defined?

L176 & Fig.1 caption: Add “radiation” to “downward shortwave” and “downward long-wave”

L307: Clarify what is meant with two-dimensional fields. Is all data with more dimensions disregarded in the archiving completely? If so, I would expect leaving out variables such as oceanic and atmospheric temperatures (3D) negatively affects reproducibility

L309: consider replacing the hyphen in “model’s”

References: Lannuzel, D., Tedesco, L., van Leeuwe, M. et al. The future of Arctic sea-ice biogeochemistry and ice-associated ecosystems. *Nat. Clim. Chang.* 10, 983–992 (2020). <https://doi.org/10.1038/s41558-020-00940-4>

Interactive comment on *Geosci. Model Dev. Discuss.*, <https://doi.org/10.5194/gmd-2020-305>, 2020.

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