

Dear Editor,

We would like to sincerely thank you and the reviewers for the time and effort devoted to evaluating our revised manuscript. We greatly appreciate the constructive feedback, which has helped us to further improve our work.

We acknowledge the concerns raised regarding some of our statements not being sufficiently supported by the data, and we have carefully revised the manuscript to address these points in detail. Below, we provide a point-by-point response to the issues raised and outline the changes made in the revised version.

The statement to the effect that ‘N₂ fixation ... plays a central role in shaping the biological productivity of the Arctic’ should be deleted, because it is not supported by the data presented.

- This has been changed and reworded to “The fixation of dinitrogen (N₂) gas, a biological process mediated by diazotrophs, provides a source of new nitrogen to marine ecosystems and has been increasingly recognized as a potential contributor to nitrogen supply in the Arctic Ocean. “

The title of section 3.2 should be replaced by a more neutral, descriptive title. As it stands it includes a claim not supported by data. The statement is valid as a hypothesis, but then it should be presented in the Introduction, and then contrasted with the results obtained. The fact that N₂ fixation on average contributed 1.6% to estimated N requirements of primary production is, if anything, evidence against N₂ fixation playing a role in bloom dynamics at the time of the study.

- The title has been changed to a more neutral version “N₂ Fixation Rate Variability and Associated Environmental Conditions”.

The result that N₂ fixation on average contributed 1.6% of estimated N requirements of primary production should be included in the Abstract, to make it more informative and avoid misunderstandings.

- This has been changed and added.

The sentences in sections 3.2 and 4 claiming a potential link between N2 fixation and the development of a secondary summer bloom should be accompanied by an acknowledgement or a clarification that to prove this link requires new evidence, so that it remains just a possibility with the data available in the manuscript.

- Sentences in section 3.2 has been rewritten to “Consequently, it is plausible that Fe and nutrients from the Isbræ glacier create favorable conditions for both bloom development and diazotroph activity in Qeqertarsuaq. However, we emphasize that confirming a causal link between N₂ fixation and secondary bloom development requires further evidence, such as time-series data on nutrient concentrations, diazotroph abundance, and bloom dynamics. “
- Sentences in section 4 has been rewritten to “This suggests that N₂ fixation may contributes only a certain fraction to export production or that it might have begun to play a role in isotopic fractionation during later stages of the bloom. However, due to the limited temporal resolution and lack of direct measurements of N sources over time, we cannot confirm this dynamic. Additional data – including time-series isotopic profiles and turnover measurements of subsurface nitrate and diazotroph activity – would be needed to establish a causal link between N₂ fixation and the observed isotopic patterns in the bloom context. “

Referee #3 pointed out the need to calculate the minimum quantifiable N2 fixation rates. You responded to this comment in your letter of response but the calculations are not shown in the revised version of the manuscript, which should report the actual detection limits for N2 fixation rates in units of nmolN L⁻¹ d⁻¹. See White et al. 2020 (Limnol. Oceanogr.: Methods 18, 129–147).

- MQR (minimum quantifiable rates) have been calculated together with a detailed sensitivity analysis and detection limits. This has been added as a table in the Appendix for all stations as well as a supplementary table with the error contributions for all measured parameters.

Referee #2 pointed out that the study of Robicheau et al. 2023 should be cited. In your response letter, you indicated that this reference would be included in the revised manuscript, but referee #2 notes this is not the case.

- This has been included into the Reference list.