

Review of “Hysteresis of phytoplankton communities over Subpolar North Atlantic to CO₂ forcing” by Lee et al.

RC2: 'Comment on egusphere-2025-1474', Rebecca Wright,

Summary

The authors present an interesting and generally well-written and well-structured manuscript investigating the response of phytoplankton communities to future climate change and “negative emissions” using model simulations. They find substantial shifts in community composition towards smaller species, which persist after atmospheric CO₂ concentrations are reduced. They attribute these shifts primarily to changes in the Atlantic Meridional Overturning Circulation (AMOC) and nutrient availability, and highlight the negative consequences for carbon export efficiency.

Response: We thank the reviewer for his/her encouraging and constructive comments on our manuscript. We have carefully considered all points raised and revised the manuscript to fully incorporate the reviewer’s valuable suggestions.

Overarching comments

I have some reservations about the use of “hysteresis” as the key term to describe the main findings. The term is likely unfamiliar to many readers and risks obscuring the central message, while also not being used entirely accurately in this context. Throughout the introduction, the authors refer to “irreversible responses”, “irreversible changes”, and state “we report irreversible shifts”, which sets the expectation that this language will underpin the key message of the paper. I therefore recommend replacing “hysteresis” with “irreversible shifts” or “irreversible changes” throughout the manuscript. Alternatively, if the authors wish to retain “hysteresis”, it should be clearly defined and introduced in the introduction rather than appearing for the first time, with no explanation, in the Experimental Design section (line 114).

Response: We thank the referee for the valuable comment. For easier readability for the reader, we have replaced the term “hysteresis” with “irreversible shift” or “irreversible change” throughout the manuscript. Additionally, we have revised the title to “Irreversible phytoplankton community shifts over the subpolar North Atlantic to CO₂ forcing.”

Line by line comments

84: The acronym SO is undefined at this point. At line 132 it is defined as Southern Ocean, but that seems inconsistent here given the study's focus on the SPNA region. Please clarify or correct.

Response: We have defined the acronym "SO" on line 84. Additionally, to keep the focus of the manuscript clear, we have removed descriptions about the Southern Ocean and omitted the Supplementary Figure 1 that presented the global map of the BC index.

96: Duplicated Long et al. (2021) reference.

Response: Corrected.

120-130: The description of the statistical method ("The statistical method ... [] ... simulation") would fit better in the Methods section rather than the Results.

Response: We have displaced a methodological description of the Bray–Curtis (BC) dissimilarity method in the Methods section.

186: the statement '... it has been reported that...' requires a reference.

Response: Corrected. We added related references.

244: 'prestige' seems inappropriate in this context; consider replacing it with 'lose this status'.

Response: Corrected.

262: 'negative CO2 emission' should be changed to 'negative CO2 emissions'.

Response: Corrected.

269-270: 'exacerbated' means to intensify or increase, which is the opposite of what you report in your results for carbon export. This word needs changing to 'reduced' or a suitable synonym.

Response: Corrected.

Figure 1: The green used for Diatoms in panel (b) is identical to the green used for Ramp-Up in panels (c–e), which could be confusing. I recommend selecting a different colour for the diatom category to avoid ambiguity.

Response: Corrected. We changed to different colors to avoid ambiguity.