Review of “Exceptional 2023 marine heatwave reshapes North Atlantic coccolithophore blooms” Guinaldo & Neukermans

This review is based on egusphere-2025-1862-manuscript-version3

The authors present an observations-based study of coccolithophore blooms in two geographical domains, the Celtic Sea and the Baltic Sea, over the period 1998-2023, looking in particular for anomalies in 2023 corresponding to the marine heatwaves at that time.

Reviewers #1 and #2 were critical of many aspects in the original submission. They found many claims without references, and that several important terms and concepts were not well defined. Both reviewers described the paper as purely descriptive, contributing no new understanding of methods or concepts. In response, the authors have substantially revised their manuscript.

The revised paper appears to have addressed many of these criticisms. It is still a chiefly descriptive paper, but of a subject that is topical and relevant. As Reviewer #1 notes, it is a decent documentation of the event and as an analysis it does have quality. It is clear that a lot of work has gone into the study. The paper contributes to our knowledge of the impact of marine heat waves on ecosystems, a subject that is topical and that we know too little of. The impact on coccolithophores is important for carbon uptake, as discussed in the paper. The impact of MHW more generally on algal blooms is also important for higher trophic levels, the wider ecosystem, and for commercial interests such as aquaculture. The study gives useful confirmation that the environmental ranges defined by O’Brien et al for coccolithophore blooms do seem to apply even in these anomalous MHW conditions and in two separate regions.

There is a lot of material in the appendix. I would prefer to see some of this moved to the main paper. As a reader, it can be frustrating to have to skip to the appendix to view information that is important in understanding key points in the paper. In particular figures A4 and A6, if that is allowed.

Below are more detailed comments on specific parts of the paper.

Line 13: replace “forms” with “form”

Section 2.1:
This should mention the origin of the data sources used (SST, PAR, MLD). Details can be provided in the appendix but a brief mention is needed here.
For explanation of O’Brien *et al* we are told to look at A1.4. Lines 309-313 of A1.4 give a very short explanation which could be moved here so that the reader doesn’t have to jump.

Lines 72, 73 and 90, 91: These have reminders of the ranges from O'Brien. Not needed.

Line 77: "later" would be better than "onward"

Lines 81-84: Strictly, the NAO is just a number and doesn't drive turbulent mixing. Strong positive values of the NAO are associated with storms that do drive mixing. References to the NAO in this section do need to make clear when they are talking about positive or negative values of this index.

Line 87: replace "relations" with "relationship"

Line 87,88: I suggest deleting "the consequences of"
Also, choose either "the persistent high-pressure system" or "persistent high-pressure systems" (no "the")

Line 97: "close to the normal winds" would be better without "the".

Line 104: "fall" is repeated. Unless EGU editorial policy recommends American English, this should be "autumn"?

Line 111 mentions correlations shown in the appendix, table A1. It's a very small table. Could these numbers please be moved into the main paper?

Line 118: "intrusion" implies that the coccolithophores have moved into the BS from the Atlantic. Is this what the authors mean? If so, it needs some evidence. If not, perhaps "expansion" would be a better word, as it's neutral over whether the coccolithophores moved there or bloomed *in situ*.

Line 120 and Figure 3 mention LOESS. As an acronym it needs expanding the first time it's used. Maybe even a citation such as Cleveland 1979?
https://doi.org/10.1080/01621459.1979.10481038

Line 126 talks about Atlantification. As the other reviewers noted, it would be useful to describe what this word means. I guess that water on both sides of the Polar Front is becoming more "Atlantic"? This might be worth mentioning, so that we don't view Atlantification as just being a northward shift in the Polar Front.

Caption for Figure 3: In the final sentence, replace "indicated" with "indicate".

Line 138: "hinder" isn't quite the right word. "disregard" would be better.

Line 143: replace "a shift" with "an eastward shift"

Line 144: I suggest replacing "front positions have" with "front position has"
Also, replace "another value close to the record high" with "a value close to the maximum"

Line 151: replace "revealed" with "reveals", "both" with "the two" (else you are saying that each region independently has dynamics that contrast with itself)

Line 156: Suggest delete "despite interannual variability"

Lines 156-157: replace "seems to imprint" with "gives"

Line 159: “durations” should be singular

Line 160: the 2nd “mid-June” needs deleting?

Lines 168-169: The sentence beginning “In both regions” doesn’t read very well and needs rewriting. I suggest:
“Positive stratification anomalies were recorded in both regions in 2023, with the CS reaching record levels, which supported favourable conditions for *G. huxleyi*."

Line 174: replace “analyses” with “analysis”

Line 178: suggest deleting “oceanic”

Line 179: suggest deleting “dedicated”

Line 187: suggest deleting “within the 6-16°C range”. Either that or add a range for PAR, so that SST and PAR are given consistently.

Lines 192-193: Suggest deleting the sentence “In addition…”
It feels out-of-place as this paper is not about wider ecosystem responses or adaptation plans and policies. If the authors did want to keep this sentence then the paper really needs more text on this subject.

Lines 200-202: Suggest deleting from “and combine” to the end of the sentence. Again, this opens a new topic that would need more text. For instance, can we really believe that numerical simulations of coccolithophore blooms will “accurately quantify the contributions of the respective processes”? I understand that it is a suggestion for further work, but I think it isn’t needed and that the science isn’t yet able to comply.

Line 205: suggest “due to masking by cloud cover” to make clear how cloud cover affects the satellite estimates

Lines 209-210: suggest replacing “vertically resolved” with “sub-surface” which has clearer meaning

Line 215: The sentence beginning “Additionally…” doesn’t completely make sense after the word “Atlantic”.

Lines 218-221: Do we know the impact of these blooms on the regional ocean carbon cycle? If not, you might delete from “Knowing” up to the first comma?

Line 222: suggest deleting “and reaching exceptional level”. The next words (“are an extreme signature”) give the same message and sound better.

Lines 245-246: suggest “…where blooms occur annually and marine heat waves resulted in…”

Line 270: “in a regular” should be “on a regular”

Line 278: Can the authors explain why March-April SSTs are used for estimating the Polar Front?

Lines 283:285: “To evaluate…”
No need to mention this evaluation unless you quote results from it.

Figure A9: I found this figure hard to interpret. Wouldn't a timeseries plot be clearer?

Table A1: Please explain that MJ and JAS indicate months.
All the values in the table have *** to indicate p value < 0.01
Suggest adding a comment that they are all significant at this level, and omitting the ***
Suggest also explaining why no values were calculated for BS for May-June.