

We wish to thank the reviewer # 2 for his insightful comments and helping us clarify our results. Here we offer detailed responses to all questions.

Comment #1: - I appreciate that they feel an estimate based on an individual for photoperiod is more appropriate for their hypothesis than one based on population. However, they need to make their reasons and assumptions more explicit in the text to avoid confusion. Specifically,

- it is assumed that the seed of the bloom is the first phytoplankton to experience a photoperiod above the critical duration i.e. not based on the population whose average will pass the threshold significantly later
- photoperiod is defined as continuous light exposure (sentences such as l1, p33 are ambiguous as they do not stress continuous light and Fig 5 implicitly assumes the - also assumed - convective trajectory)
- the assumption of well defined orbits under convection is an approximation and actual trajectories will be more variable

Response: Based on your comments, we have made our reasons and assumptions more explicit in the text to avoid any confusion:

-p.15 l.16 “The critical photoperiod hypothesis requires that individual cells can detect the duration of light. Thus, we compute the sustained light exposure of individual cells, not of the entire population.”

-p.34 l.10 “The photoperiod is the number of hours for which phytoplankton cells are exposed to sustained light during the day, i.e, the daily time spent in the euphotic layer.”

-p32. l.5 “The assumption of well-defined orbits is an approximation and real trajectories will be more variable”

Comment #2: - My comment #3 equally concerned how precise they can be about the day a bloom starts given the 10 day sampling frequency

Response: This is a good point. When we tested whether the start of the Nordic Seas blooms was consistent with the critical depth hypothesis, (the blooms begin when  $\frac{1}{H} \langle \bar{\mu} \rangle \geq m$  before they are detected by the fluorometers), we found that this condition was in general satisfied within a month prior the first accumulation of chlorophyll was detected. As suggested by the reviewer, there is indeed a 10-days-uncertainty in the

estimates of phytoplankton division rates due to the float sampling frequency. However, for sake of simplicity and because uncertainties in our estimates of phytoplankton division and loss rates are already large, we decided to not included the 10 day uncertainty in our calculation.

Comment #3: - I would like to see the figure created by the authors in response to my comment #4 added to the Supplementary Material as it gives very useful information on the accuracy of the model at the start of the bloom when there is significant variability

Response: We have added a new section in the Appendix (p.29) that evaluates the performance of the irradiance model using the float PAR measurements.