Reply to Anonymous Referee #1

We would like to thank the referee for its suggestions to improve the clarity of the manuscript and open it for a broader audience.
In this reply we give an overview of the main changes we did in order to address the referee's comments. Changes in the reviewed manuscript are highlighted in blue. Below you will find a point-by-point response to the comments, together with a description of the changes made to the manuscript. To address the comments of Reviewers 1 and 2, we split Figure 3 into two separate figures, one illustrating reversible responses and one illustrating hysteresis, and expanded them to include additional indicators related to plankton community structure and the carbon cycle. In addition, we introduced a quantitative indicator of hysteresis based on the coefficient of variation between alternative states, which also identifies a reversible response under wind forcing.

RC1: *First, I think the authors need to clarify the vocabulary they use. For example, I do not understand what they mean by "regime", "dynamic regime", "alternative regime", "system", "alternative dynamic regime", "operational model", etc. The paragraph lines 103-109 page 4 also really confused me. For example, you say that you "call the stable states dynamic regimes" while to me, "stable" and "dynamic" are contradictory.*
Reply: Thank you for pointing out that several key terms were not clearly defined in the manuscript. We agree that precise terminology is essential for the reader's understanding, and we have now added explicit and more detailed definitions of all specialized terms (e.g., *regime*, *dynamic regime*, *alternative regime*, *system*, *operational model*). We also clarified the paragraph in lines 103–109 to avoid confusion, particularly regarding the use of the term *dynamic regime* in relation to *stable states*.

RC1: *Second, the main figures are hard to understand. What are the authors trying to display? As you are talking about plankton dynamics, regime shifts, environmental data covering a given time period, etc, I was expecting to see time series, starting from a data t and ending at a time t+45 years (for example, a 45 years simulation is mentioned line 148 page 8), with maybe an indication that a perturbation was implemented at some point, so we can see the changes in the modelled plankton community, with and without the perturbation. Instead of that, we have a series of experiments, which make sense in the method, but no more in the results. For example, they say, for the EXP-SEQ experiment, that the regime returns to its original values, but when I am looking at Figure 3, I cannot really understand where I am supposed to see that. Furthermore, as the authors worked with a biogeochemical model, I was also expected to see how those modelled regime shifts impact the carbon cycle (for example) but only chlorophyll was investigated. [...] For the figure, maybe the authors should add an arrow below the panels, to highlight that the value of that environmental parameter is increasing forward and then backward, and also highlight where (and when?) the extreme values are reached for each environmental forcing. Adding a figure legend describing the meaning of the different lines/triangles would also help to understand quickly the figures after a first look.*
Reply: Thank you for pointing out that the figures are difficult to interpret. Because the perturbations in our experiments are constant in time and applied throughout each simulation, there is no clear 'before–after' transition that could be shown with time series. Our figures therefore focus on the long-term equilibrated behaviour after model transients

have decayed, and we now clarify this more explicitly in the manuscript. To improve readability, we will revise the figures to indicate more clearly the direction of the forward and backward forcing sequences. We will also add figures illustrating how the identified regime shifts affect carbon-cycle variables, not only chlorophyll. We trust these changes will make the results substantially easier to follow.

RC1: *Third, I have been disappointed by the title, which mentions "plankton communities", and the method, which describes various plankton functional types (PFT). Therefore, I was expecting to see the changes observed for those different PFT (diatoms, dinoflagellates, microzooplankton, etc) in response to the environmental perturbations. Instead, the only variables describing plankton dynamic are chlorophyll bloom, deep chlorophyll maximum and total production of chlorophyll. I also wonder how is it possible to talk about dynamic regime of plankton community while changes in community composition are not even displayed in any of the main figures? In the same way, the authors mention the seasonal cycles many times, but I cannot see how their results relate to the study of seasonality/phenology (except Fig S1?).*

Reply: Thank you for highlighting that our focus on aggregated chlorophyll metrics made the responses of individual plankton functional types (PFTs) difficult to appreciate. While detailed PFT-specific results were included in the Supplementary Information, we agree that their absence from the main figures obscured important aspects of community-level changes. We have therefore moved several key PFT-level figures into the main text to more clearly illustrate how community composition responds to environmental perturbations. We also clarify in the manuscript that the seasonal dynamics we refer to, namely the chlorophyll spring bloom and the deep chlorophyll maximum, are used as descriptors of the system's seasonal behaviour.

RC1: *I am sorry for those comments. I think the study is of interest, but I have not been able to understand the results. I suggest the authors should rewrite their article, e.g. reconsidering how their results are presented as well as clarifying the vocabulary they use. It will not be a huge work. For example, they should not mention "plankton community" but directly "chlorophyll" in the title and throughout the text. I would also highlight that the model is applied at a fixed point in the Mediterranean Sea (if not in the title, at least in the abstract), so those results may not be applicable at a world scale(?).*

Reply: Thank you for these final comments. We appreciate your perspective, and we agree that the manuscript will benefit from clearer terminology and a more transparent presentation of the results. To avoid implying a broader community-level analysis than is presented, we have revised the title to reflect more accurately that the study addresses biogeochemical dynamics, not exclusively plankton community composition. We also made explicit in both the abstract and the main text that the model is applied in a one-dimensional water-column configuration at a fixed location in the Mediterranean Sea, and therefore the findings should not be interpreted as globally representative.