

(Re-)Review of Capet et al.

The authors did a good job in addressing my comments and I think the manuscript has significantly improved, especially with regard to structure and inclusion of the most important methodological aspects, which were pointed out by Reviewer 4. I further think the authors made the right choices (in most cases) for what to move to the main text and what to keep in the appendices.

I am basically satisfied with the manuscript, I just have a few minor points that I would like to see addressed before endorsing publication in Biogeosciences. Therefore, I recommend publication after minor revisions. My detailed comments follow below. I don't need to see a revised version of the manuscript.

General comment

I think Reviewer 4 raised an important point (4.3 in the response document) that the new regime may not necessarily be a new "steady" regime—even though it has been identified as such by the change point analysis—but that it could be part of a downward trend that started in the mid-1990s. I appreciate the authors' response to the reviewer, which suggests that the data point to a non-linear change (i.e. different regimes) but that it may need more work (and probably a longer time series, which is not possible just now as it would need to be extended into the future) to verify that. I, therefore, would like to see a similar statement that this work proposes such new view (and that future data may be needed) in the Discussion and the Conclusions.

Specific comments (line numbers as, e.g. "L123")

L187: How did you verify the methodology? Do you refer to the discussion of the different assumptions provided in the appendix? Maybe remove "and verified", it's rather confusing.

L273-277: It seems like year 2013 really stands out in the time series as there is not even a slight sign of ventilation in February/March, different to all other years. Although it's rather a detail, it could be worthwhile to briefly mention it if you were able to link it to specific atmospheric conditions.

Fig. 4: For the reader's ease, you could consider adding two differently colored (e.g. blue/red) arrows starting at $dC/dt = 0$ (one up, one down) to the right of panels c and/or d with labels "formation" and "erosion". Caption: "Vertical dotted lines separate"; replace "evidenced" with "identified" or "detected".

L207/308: "almost never" seems to be a bit of an exaggeration. You could add the fractions of the records of such temperatures for the different periods to emphasize your point.

Fig. 7: I quite like this figure, however, I think you could combine it with Fig. 8: Panel e is not really needed as the 8.35°C line is a good reference for comparison between P4 and the other regimes, which is the key message. Perhaps you can instead plot Fig. 8a as panel e, with the 75% outlines (not filled) plotted over the O2-T-S data? Fig. 8b is not referred to anywhere, so I assume it can be omitted. Add time periods to labels of panels a-d. Caption: "contours delineate"; insert white space before "criterion"

L317/318: This is not exactly correct; the P4 regime corresponds with such reduction in frequency but this is not described by the regime shift analysis. Please rephrase.

L327-330: It took me quite a while to get the message from Fig. 8. I think the problem is that the time information is missing in Fig. 8a. Please see my suggestion above on combining Figs. 7 and 8a. This paragraph will then need rewriting.

L338: I think here would be a good location to add a discussion related to my general comment.

L362: Also related to my general comment, here would be a good location to add a brief statement that this study proposes this new "regime view" but that "only future will tell" if it is already a new regime or not. It's also questionable whether different superimposed oscillations with different periodicity can be resolved by a combination of one linear and one periodic function (as done in this study if I am not mistaken), which could be added to the Discussion as well (see previous comment).

L371-373: I suggest to rephrase this as it sounds like the Black Sea is a prototype ecosystem that can easily be compared to other ecosystems in terms of its O₂ dynamics and effects of climate change. However, I would strongly disagree with that BECAUSE of its special geomorphology. Reading the following sentences, I understand that you don't mean to say that but it reads like this.

Technical corrections

L75: "explains"

L76: no comma after "years" but maybe split the sentence here to make it easier to follow; "oxygenation state"

L78: Maybe "to expand on these investigations"? "as a component"

L97: "characterizes"

L135: "present"

Table 2: This table leaves a lot of unused (white) space. I would suggest to either simply write the text in the table cells as regular text or to move the table to the appendix and state that "all data sets are either strictly independent or can be considered as such" with reference to the table in the appendix. Replace "time series" with "datasets" in the caption. Replace "data sets" and "data-set" in the Atmos-Model3D field with "datasets" and "dataset", respectively. "atmospheric fluxes' bulk formulations" (apostrophe after "fluxes"); "in situ"; "a common dataset"

L167: I wouldn't start a new line here.

L171: "e.g."; insert "and" between "C^{Ship}" and "C^{Argo}"

L172: remove text in parentheses; move "respectively" after "approaches" on next line

L178: "into a unique"

L184: "types"

L197: "i.e."

L207: I wouldn't start this sentence on a new line.

Fig. 3: Move labels to top (above figure frame) to not cover part of the time series; what are the red lines next to the "1984" and "2008"? Maybe also add the labels "P1" to "P4" to the figure as they are used frequently in the text.

L240: Should it be "standard regime"?

L242: "standard" instead of "routine" or just "this regime" (which makes it clear that it refers to the "standard regime")

L261/2622: Even though $dC/dt < 0$ implies erosion, erosion is positive: "between 0 and about 1 MJ m⁻² d⁻¹"

L265: insert Argo sampling period in parentheses after “sampling”

L269: “depicted in Fig. 5 denote”

Fig. 5: The data for the densest 2 or 3 levels look a bit odd in years 2011-2013; are those real data or are there data missing and points have just been connected by straight lines?

L288: “nonlinear system”

L289: “to external forcing”. Only use "on the other hand" if "on the one hand" was used in the preceding statement. Perhaps "In contrast" at the start of the sentence works?

L291: “quantitative analysis presented in this study”

L294/295: “data sources used to construct this metric demonstrates”; “no multi-source”; “has been”; move “previously” before “no”

Fig. 6: the heading of the legend should state “p-value”; caption: no comma after “estimates”; “Color of the points”; everything after “while” can be removed

L304: “appear”

L307: “in situ” cursive and without dash

L308: “ $T > 8.35^{\circ}\text{C}$ ”; no [] around density range

L316: “described by Ivanov et al.”

L320: Maybe “more profound consequence”?

L321: “Black Sea”; This text block is a bit lengthy and hard to follow. I suggest starting a new sentence after the references, e.g.: “This layer is characterized by a density between about 14.6 and 116 kg m⁻³ and is formed following entrainment of CIL waters by the Bosphorus inflow, the lower end-member, and subsequent lateral ventilation (Buesseler et al., 1991).” (Not sure if I placed the end-member note at the right location.)

L324: “years” instead of “yr” (twice)

L327: “indeed shows a generally deeper oxygenation”

L328: “characteristic for”

L333: “current” or “present” instead of “actual”

Fig. 8 caption: “T-S”; as stated I don’t think Fig. 8b is needed (and it’s not used in the text)

L336: “detail”; “asking, e.g. how”

L337: remove “on” before “planktonic”

L338: “detected” or “identified” instead of “depicted”

L340: remove “considering”; this (“ventilating ... terms”) is a bit repetitive from the previous lines

L345: “contributed 42% and 58%” (and remove “for 42% and 58%” at end of sentence)

L346: “assessments” or “an assessment”

L351: Maybe “For this purpose”?

L358: “standard regime”

L361: “cannot”

L363: “hydrodynamic”

L364/365: move “through convective ventilation” to end of sentence

L365-370: Very long sentence. I would try to split it after making the point that changes in CIL formation will affect oxygen. Then you can state that this will in turn have an impact on ecosystem structure/functioning given the structuring role of oxygen (please add a reference for this, too).

L367: “dominant”

L371: remove “on” after “impacts”

Fig. A1: Please add to the caption what the different acronyms mean (“sd”, “RMS”)