Biogeosciences Discussions

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Comment on bg-2022-48

Anonymous Referee #1

Referee comment on "Unprecedented Summer Hypoxia in Southern Cape Cod Bay: An Ecological Response to Regional Climate Change?" by Malcolm E. Scully et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2022-48-RC1, 2022

General comment

Ongoing environmental changes such as warming and deoxygenation in the open and coastal oceans are altering biogeochemical cycles and ecosystems. However, a comprehensive understanding of the causes and consequences of deoxygenation in coastal areas is still lacking. The manuscript under review presents new results from a study on environmental changes recently observed in the ecosystem of the southern part of the Cape Cod Bay (CCB). The manuscript is well written and the main conclusion is justified by the presented data. (The answer to the question from the title is: yes it is.) However, I have some critical comments about the statistical analysis of the time-series data presented. Therefore, I can recommend publication only after minor revisions.

Specific comments:

- Methods: Wind speed data from two sources (Chapin Beach and NDBC buoy 44013) are presented at several places in the manuscript. But, unfortunately, I could not find any description of the wind speed data at all: How have they been measured? What was the time resolution of the measurements at Chapin Beach? How representative/comparable are the measurements from the two sites? The only reference for the source of the wind speed data from Chapin Beach (‘courtesy of Weather Flow, Inc.’) is given in the Figure 1 caption. So, add some text describing the wind speed data from Chapin Beach and the buoy 44013, please. And: is there no time-series available for the Chapin Beach site? (it would make more sense to analyse wind speed data which have been measured closer to the sites of the oceanographic measurements.)

- Methods: page 4, line 116: Add the details for the calibration of the DO sensor in the

lab.

- P8L195 and Figure 7d: I found it confusing that throughout the text ‘winds from the north’ and winds from the south’ are mentioned and used to explain downwelling and upwelling, but in Figure 7d winds from SW and NE are shown. I do not see the point to ‘change’ the wind direction for Figure 7d.

- P8L196/197: Upwelling occurs when there are winds parallel to the coast, which won’t be S or N in this case (please note: the hypoxia occur along the south coast of the CCB, not at the west coast of the CCB). The CCB seems to be a ‘semi-enclosed embayment’ open to the north. So, I wondering whether winds from the south may just lead to a decrease in the sea level (pushing the water away from the south coast). In turn, winds from the north just lead to an increase in the sea level (pushing water towards the south coast). I am wondering whether the authors should be more careful with their wording (i.e., down-/upwelling).

- Figure 6: K. mikimotoi appeared under ‘normal’ conditions in CCB already in 2017 and 2018. Is there an explanation why K. mikimotoi has appeared in CCB at all?

- P13L296/297: This statement about the data presented in Figure 7b is misleading: There is only one year (i.e., 2018) with >40 days with temperatures higher than 20°C in the period 2018-2020. But there was indeed another year (i.e., 2016) with >40 days with temperatures >20°C before that period (i.e., between 1986-2017). The authors should be more careful with their wording here. Please rephrase.

- Figure 7c): I am wondering whether the significance (trend) of the linear regression is only driven by the data points from 2018-2020. Please check.

- Figure 7d): There are two points about the wind speed data which seem to be interesting but which are not discussed at all: (i) There is an obvious regime shift around 1995. Before 1995 the percent of the SW winds (NE winds) have been increasing (decreasing). After 1995 the percent of the SW winds show no trend with time anymore, but the NE winds show an increasing trend; and (ii) Between 2014-2020 the variability of the percent of SW winds was surprisingly low (compared to the rest of the data) which obviously corresponds very nicely with the astonishing increase in days with temp. >20°C (see Figure 7b) from 2015-2020. So, I think that there were shifts in the wind regimes in 1995/6 and 2014/5. The later one may have caused the appearance of K. mikimotoi in CCB in 2017.

- Are there any water current data (i.e. ADCP data) available? It would be worth to see whether circulation patterns (-> ventilation, residence time of the bottom water) in the CCB have changed as well.

- Figure 7: It would make sense to calculate anomalies (i.e. the difference between the actual value and the average value from a reference period) for the data in a) and c). This will give a more robust idea about exceptionally warm or cold years (in a) or surface-bottom differences in c).

- Nutrient concentrations can be significantly affected by other inputs such as rain and groundwater discharge (rain increases groundwater discharge) as well: Are there rain data (from the meteorological station at Chapin Bay?) and/or groundwater discharge data available?

- Would it make sense to add a brief outlook in order to speculate about the time point when CCB might becoming seasonally anoxic and the resulting consequences for fisheries and tourism?