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Reply on RC2

Malcolm E. Scully et al.

Author 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-AC2, 2022

I apologize for my delay in submitting this review. I thought this paper was clearly written and convincingly documents a complex environmental change that spans physical, chemical, and biological variables. I have a few suggestions and comments.

(1) I wonder if the N-S wind plot in figure 3, currently at the top of this figure, could be placed to the left and rotated 90 degrees? This might help the wind-events be more easily aligned with the contour data. This is just a suggestion if it works.

We tried rotating the N-S wind plot but found that this orientation was confusing and was harder to read with the text of the axes rotated.

(2) were any PAR of kd measurements made? It would be a nice addition to know how much light is available at 10- and 20-meters depth in this system where the fluorescence peaks were found.

PAR data was collected in conjunction with the chlorophyll fluorescence by CCS during their monthly cruises and these data can be used to calculate values of the light attenuation coefficient (Kd). These data span the period from 2011-2020. We analyzed these data and there are no clear trends in Kd values over this period. In fact, on average, 2019 had the highest Kd values in late summer (Aug and Sept) and 2020 had the lowest. It is worth noting that the sub-surface chlorophyll peaks were shallower in 2019 and deeper in 2020 and there is a statistically significant correlation between the euphotic depth (estimated as log[.01]/Kd) and the shallowest depth that chlorophyll fluorescence exceeds 15 mg/L in the CCS data. This is generally consistent with blooms of a light-adapted, motile species that can maintain its vertical position where there is just enough light and is adjacent to sub-pycnocline nutrients. There are only three profiles from August or September for the period 2011-2018 where the chlorophyll fluorescence exceeds 15mg/L at a depth deeper than 5m at any of the 8 CCS stations. In contrast, there are 16 profiles for the period 2019-2020. For 15 of these 16 profiles, the depth where the chlorophyll fluorescence first exceeds 15mg/L is shallower than the estimated euphotic depth. We are happy to try and include this analysis in the paper if it would significantly add to the interpretation. However, the processes that control light

availability are relatively complex and we don't have enough information to clearly identify what is controlling these variations in Kd.

(3) there are a couple of instances in the 2011-2018 fluorescence records (figure 5) where values reached comparable levels to the recent data at 5N and 6M. Did you examine if these periods were associated with comparable physical conditions as 2019-2020?

As noted above, there were only 3 cases from 2011-2018 where chlorophyll fluorescence exceeded 15mg/L at any of the CCS stations. In these three cases, the chlorophyll max did not exceed 25mg/L. In all three cases the water column was strongly stratified, the chlorophyll max was deep (~20m) and located at the base of the thermocline, so the physical conditions were generally similar to our 2020 data. However, these profiles were isolated and in an integrated sense, the chlorophyll was much lower during these years. Bottom DO was above 5 mg/L at all stations, and we see no evidence for hypoxia, consistent with the lack of a significant bloom in these years.