Interactive comment on "Oceanic response to the consecutive Hurricanes Dorian and Humberto (2019) in the Sargasso Sea" by Dailé Avila-Alonso et al.

The reviewer is thanked for his/her positive and constructive comments on the manuscript.

REVIEWER 1

My main criticism is that it's not clear what is new or surprising about the results or why they are important. These aspects need to be emphasized, and I think additional analysis will be needed to do it. It seems like the unexpected or surprising result might be that there was so much additional increase in MLD, decrease in SST, increase in chl-a after Humberto, even though Dorian caused significant changes beforehand. One might have thought that the preconditioning of Dorian would have suppressed the impacts from Humberto. Is the strength of the ocean's response to Humberto due to the quick ocean recovery after Dorian passed? Or was Humberto strong enough to cause even more cooling and enhanced chl-a in the well-mixed upper-ocean that Dorian left behind? Topics such as these should be investigated and discussed (and maybe comparisons made to other single or multiple TC passages in the western Atlantic), otherwise readers will not know how to interpret the results or why they might be important.

In the new version of the manuscript we have included new information in order to emphasize the novelty and main contribution of our study (lines 58–63, 427–429, 498–501, 518–524). In the manuscript we cited several articles assessing the SST and chl-a concentration response to the passage of consecutive typhoons in the western Pacific Ocean (e.g., Wu and Li, 2018; Ning et al., 2019; Wang et al 2020). However, to the best of our knowledge there are no previous studies assessing the biological response to consecutive TCs in the western Atlantic Ocean (lines 58–63). In general, the main finding of this work is the additional oceanic variability (i.e., increased ocean cooling and chl-a concentration, deepening of the mixed layer and enhanced upwelling) observed after the passage of a second TC in the western Sargasso Sea indicating that consecutive TCs within a short period of time superimpose effects on the upper ocean response (498–501). In addition, our climatological analysis revealed that the strongest oceanographic response in the western Sargasso Sea is associated with consecutive TCs and long-lasting TC forcing (427–429).

On the other hand, new analyses were performed to make clearer the contribution of consecutive hurricanes superimposing effects on the ocean in the study area. We assessed the individual response induced by Humberto (lines 436–455) and we compared the oceanic response induced by Dorian and Humberto with the one induced by an individual hurricane (Irene, 2011) and other consecutive hurricanes (Dennis and Floyd, 1999) in the study area (lines 456–476). We included a new figure (Figure 13) in the manuscript showing the main results derived from the last analysis mentioned above. Overall, we found that maximum sea surface cooling and chl-a concentration increase induced by Irene occurred immediately after its passage and then cooling and phytoplankton bloom started to decrease from this day onward (lines 468–469). In contrast, when analysing the oceanic response to consecutive Hurricanes Dennis and Floyd, we observe that the most intense cooling and phytoplankton bloom occurred at the end of the third post-storm week (i.e., after the passage of the second TC Floyd) (Figure 13D and F), which is consistent with the temporal evolution of SST and chl-a concentration anomalies retrieved for Dorian and Humberto (lines 473–476).

As we mentioned in the revised version of the manuscript, consecutive TCs superimpose effects on the upper ocean response because of strong-induced mixing and upwelling (lines 476–480). We also mentioned that the maximum deepening of the MLD at the beginning of the third post-storm week (after the passage of Humberto) is consistent with the suggestion made by Ezer et al. (2017), stating that several storms affecting the same region within a relatively short period of time have a cumulative impact on ocean mixing (lines 354–356).

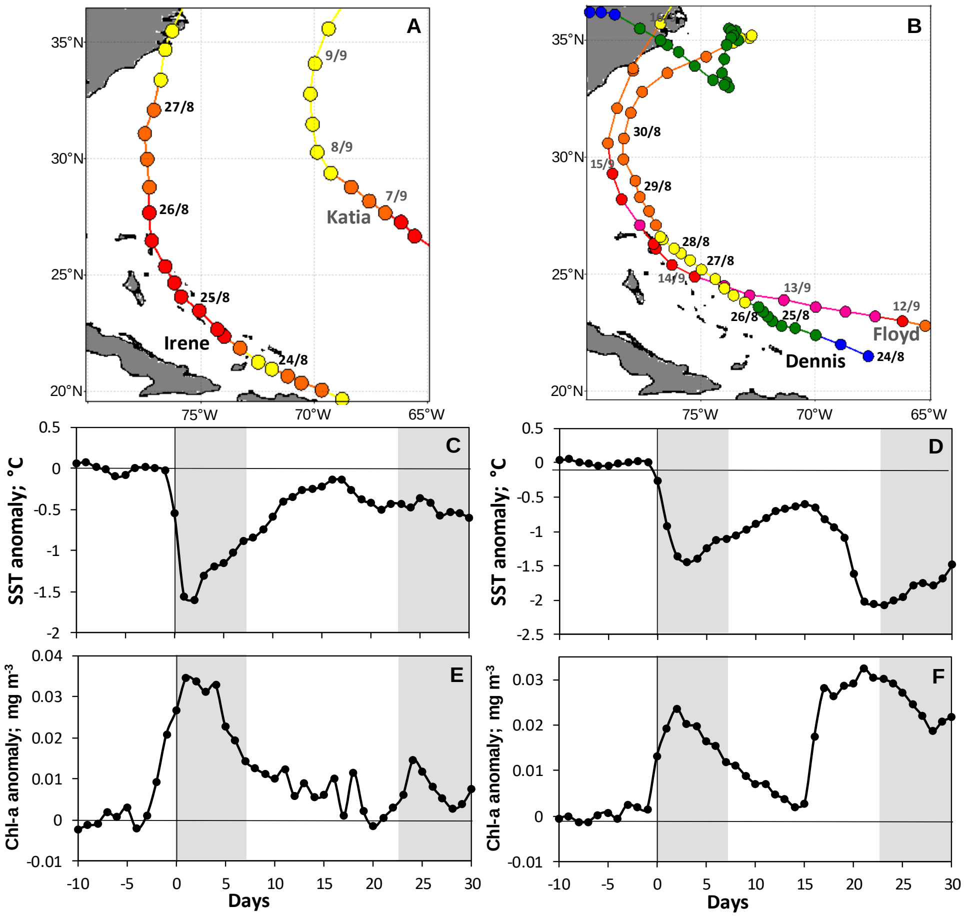

Figure 13. Trajectories of Hurricanes (A) Irene and Katia (2011) and (B) Dennis and Floyd (1999), with colour coding as defined in Figure 1A. Numbers along trajectories indicate the day/month. Daily mean evolution of anomalies of (C and D) sea surface temperature (SST) and (E and F) chlorophyll-a (chl-a) concentration induced by Irene (C and E) and Dennis+Floyd (D and F). The grey shaded area depicts the first and fourth post-storm weeks.

Minor comments:

Lines 203-204: It's unclear what 'respectively' refers to because you mention deepening of 10 and 11 m, along trajectory and in the square area, and days 1 and 2. Is it deepening of 10 and 11 m along the trajectory and in the square area, respectively? Or at day 1 and 2, respectively?

We have rewritten this sentence as follow: The mixed layer started to deepen 3 days before Dorian's arrival in both study areas, reaching a maximum mean deepening of 10 m along Dorian's trajectory at day 1 and 11 m in the square study area at day 2 (lines 233–235).

Lines 220-225: It looks like there's a large positive SST trend in Fig. 6A. What if you remove the trend before calculating the 2019 percentages? Do they change?

In the revised version of the manuscript we included a new analysis in order to remove the positive trend in the time series of SST anomalies shown in Figure 6A (lines 260–267). Removing the positive trend allowed us to compare anomalies in 2019 with the ones in the previous years on the same basis, i.e., without considering the effect of ocean warming in the region. From the detrended time series (Figure 6B), we observe that SST anomalies in 2019 were the coldest ones in the climatological record except for the ones in 1984 and 1999 confirming the considerable cooling induced by the combined effects of Dorian and Humberto.

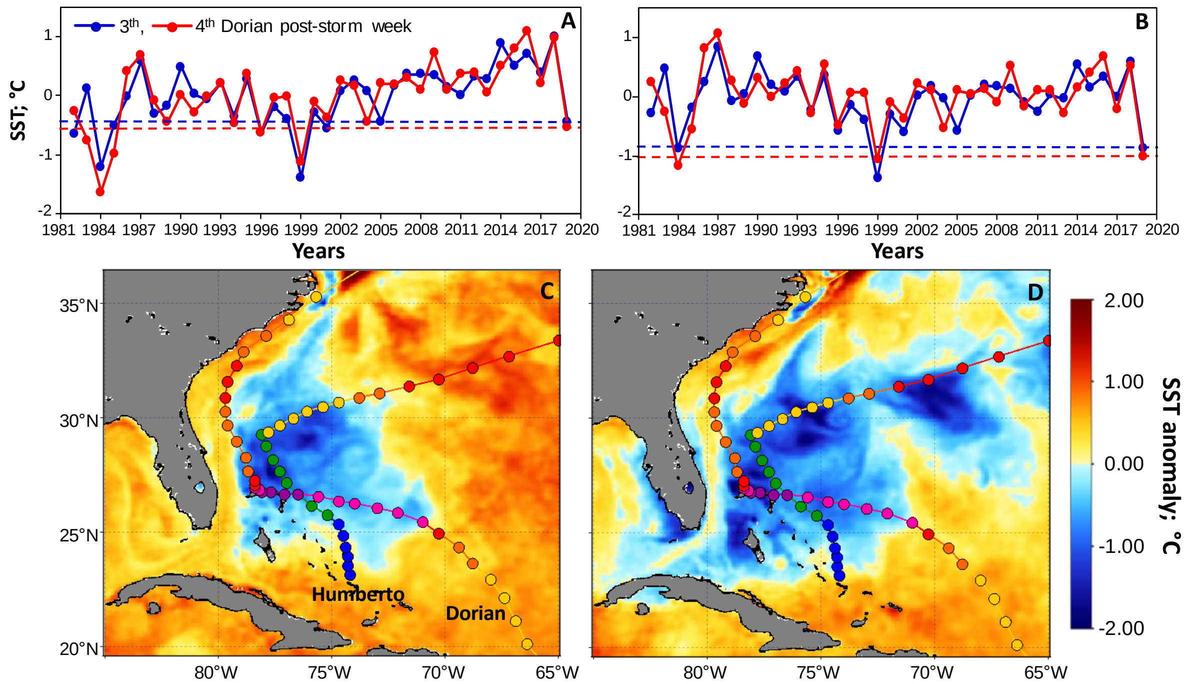

Figure 6. (A) Time series of weekly mean sea surface temperature (SST) anomalies during the third and fourth post-storm weeks of Dorian in the square study area shown in Figure 1B. (B) Detrended time series of SST anomalies. The dashed lines mark anomalies in 2019 for comparison with the previous years. (C) and (D) Spatially explicit SST anomalies (Dorian+Humberto (2019) induced effects – Climatology (1982–2018)) in the third and fourth post-storm weeks of Dorian, respectively.

Line 375: Several papers dispute the result of Kossin (2018). These should also be cited (Lanzante, Uncertainties in tropical-cyclone translation speed. Nature., 570, E6–E15, 2019; Yamaguchi et al., Nature Communications, 11, 47, 2020; Moon et al., Climate change and tropical cyclone trend, Nature, 570, E3–E5, 2019)

We included the suggested references in the revised version of the manuscript (line 426).

References

Ezer, T., Atkinson, L. P., and Tuleya, R.: Observations and operational model simulations reveal the impact of Hurricane Matthew (2016) onthe Gulf Stream and coastal sea level, Dynamics of Atmospheres and Oceans, 80, 124–138, 2017.

Ning, J., Xu, Q., Feng, T., Zhang, H., and Wang, T.: Upper ocean response to two sequential tropical cyclones over the northwestern Pacific Ocean, Remote Sensing, 11, 2431, doi:10.3390/rs11202431, 2019.

Wang, T., Zhang, S., Chen, F., MA, Y., Jiang, C., and Yu, J.: Influence of sequential tropical cyclones on phytoplankton blooms in the northwestern South China Sea, Chinese Journal of Oceanology and Limnology, doi:10.1007/s00343-020-9266-7, 2020.

Wu, R. and Li, C.: Upper ocean response to the passage of two sequential typhoons, Deep Sea Research Part I: Oceanographic Research Papers, 132, 68–79, 2018.