Clim. Past Discuss.,
https://doi.org/10.5194/cp-2019-73-RC2, 2019

Climate of the Past Discussions

Interactive comment on "Can we use sea surface temperature and productivity proxy records to reconstruct Ekman Upwelling?" *by* Anson Cheung et al.

Anonymous Referee #2

Received and published: 1 September 2019

In this study, the authors conducted statistical analysis on the co-variability among SST, wind stress, and chlorophyll (CHL) concentration using satellite-derived high spatial and temporal resolution data. The study is focused on an Eastern Boundary Upwelling Systems (EBUS), the southern California region. The results suggest that the dominant mode of co-variability among SST, wind stress and CHL does not reflect the Ekman upwelling process. The second and third modes of co-variability are found to reflect upwelling patterns but exhibit complicated region and timescale dependence. The authors findings imply that paleoclimate records over the EBUS may reflect complicated physical processes other than the Ekman upwelling.

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Discussion paper

The scope of the study is of course important as there is large uncertainty in the interpretation of paleoclimate reconstructions and the related implications are huge. However, I think the limitation from short length of data could be better explored. Physical process-based interpretations of statistical results should be better presented. Please see my detailed comments bellow.

Major comments:

1. Page 9 Line 19: “Instead of strong cross-shore gradients, TAU and CHL display a weak cross-shore gradient, and SST exhibits a meridional gradient pattern (Fig. 5).” Can you be more quantitative? How is the gradient defined? How big are the gradients to be considered strong or weak?

2. What is the physical meaning of EEOF1 in Figure 5? Are these statistical results physically meaningful? The authors briefly described the spatial pattern but did not show any results on the temporal variability (PCs). What do the PCs tell us about the co-variability among these variables?

3. Limitation from short instrumental data could be better explored. Length of data analyzed in the manuscript is only seven years, which could limit interpretations of the results, especially considering the interannual and decadal variability in the system. The co-variability between SST and TAU could be explored in high-resolution ocean reanalysis, e.g., the Simple Ocean Data Assimilation (SODA; http://www.soda.umd.edu/). SODA provides SST and wind stress data of $\frac{1}{4}^{\circ}$-horizontal and 5-day temporal resolution with a length of 30+ years. The spatial and temporal resolution of SODA is comparable to the data sets in the authors’ manuscript, but the data length is much longer. With longer data coverage, we can, at least, examine (1) whether the dominant co-varying pattern between TAU and SST reflects Ekman upwelling, (2) whether results from satellite data are consistent with reanalysis, (3) how the results depend on low-frequent climate variability, and (4) how CHL variation may further complicate the co-variability among these variables.

Minor comments: 1. What is the variance explained by each EEOF mode?

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