



EGUsphere, referee comment RC2
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Comment on egusphere-2022-702

Anonymous Referee #2

Referee comment on "The signature of NAO and EA climate patterns on the vertical structure of the Canary Current upwelling system" by Tina Georg et al., EGU sphere, <https://doi.org/10.5194/egusphere-2022-702-RC2>, 2022

The authors describe an analysis of upwelling off the NW African coast associated with the Canary Current system. A 25 year period is considered using data from various sources. A particular focus of this study is the relationship between upwelling and variability that may be driven by the North Atlantic Oscillation (NAO) and the East Atlantic (EA) teleconnection patterns. A new aspect of this study appears to be an analysis of the vertical structure of the water column associated with upwelling variability.

On the whole, the paper is well written and contains copious references to previous relevant literature. There are a few issues though that I would like to raise. I believe that this paper contains results that would be of interest to the community and once the issues mentioned below have been addressed, it should be appropriate for publication.

General comments:

(1) For this reviewer, one of the major weaknesses of this study is the very coarse horizontal resolution of the GREP ocean data set that is used for analysis of SST and vertical structure. The horizontal grid spacing of GREP is only 1 degree which means that in reality the effective resolution is probably more like 3 or 4 degrees. On the otherhand, the width of the upwelling region due to Ekman divergence at the coast may only be \sim the Rossby radius of deformation, which is probably \sim 40km for the 1st baroclinic mode. This is much shorter than the resolution of the GREP data. If wind stress curl is an important factor in enhancing coastal upwelling in the region, the width of the upwelling zone may be larger, but again still less than the GREP resolution. Therefore, this study is really more a reflection of how upwelling varies in the model ensemble described by GREP rather than in nature. While coastal upwelling is clearly being captured by GREP, it is undoubtedly a highly distorted view compared to the real world. This should be discussed clearly in the manuscript, at the outset and in the conclusions.

(2) Two different upwelling indices (UIs) based on the wind were used: one is the standard PFEL product while the other is one that the authors compute based on equation (5). The definition of the PFEL index is not given in the manuscript, so it is not clearly what the relationship is between UI_{PFEL} and UI_{ERA5} . Figure 3b shows that they vary consistently over time, so why consider both? Why not just use the accepted UI_{PFEL} ? This needs further discussion and justification.

(3) Figure 3b shows that there is a lag in the SST response and the upwelling indices. This is mentioned in the manuscript, and has been noted by others, but this manuscript sheds no further light on this issue. Studies of coastal upwelling by Marchesiello and Estrade (2010, *J. Mar. Res.*, **68**, 37-62) and Jacox et al. (2014, *GRL*, **41**, 3189-3196) have shown that coastal upwelling can be suppressed by onshore geostrophic flow leading to considerably less upwelling than might be expected based on the wind alone. I wonder if this might be the reason why the upwelling peaks later than the wind-based upwelling indices in the Canary Current system. This could perhaps be easily checked using GREP which presumably also contains the near-surface ocean current data.

Specific comments:

(1) Caption for figure 1: More information is needed here - all the acronyms and symbols should to be defined in the caption.

(2) Line 115 and equations (2) and (3): Non-standard notation is used here. I would suggest using u and v instead of W_x and W_y , and U and V instead of Q_x and Q_y .

(3) Equation (3): Can you comment on the relative role of Ekman divergence at the coast and wind stress curl? It is likely that both contribute in a significant way to upwelling, as they do at other upwelling centres.

(4) Line 124: The upwelling threshold of 1.5 for UI_{ERA5} needs some explanation/justification.

(5) Line 127: Please provide a full definition of the PFEL upwelling here (see comment above).

(6) Caption for Fig. 3: Please explain the format of the boxplots in panel (a) (i.e. what do the coloured boxes and various tick marks represent?).

(7) Line 178: What are you referring to here by "trend" - there are no plots presented that indicate a trend.

(8) Lines 187-189: Have you computed lagged correlation coefficients? What about the potential role of onshore geostrophic flow (see comment above)?.

(9) Lines 210-214: The changes in depth for the ILD discussed here seem very small. Can you discuss their significance? The very low horizontal resolution of the GREP model data sets used must be an important limiting factor here.

(10) Figure 4: It would help to show the location of these profiles in Fig. 2. Also, this figure is not easy to read. Is there a better way of demonstrating how T and ρ vary with distance from the coast?

(11) Caption for Fig. 5: I don't think you mean "representative" here. According to the main text these are the average temperature profiles based on several events that exceed a threshold based on UI_{SST} - is that correct?

(12) Line 247: I think that you mean "combination" rather than "coupling." The reason why you chose to consider these particular combinations of the NAO (+ -) and EA (+ -) in Fig. 6 should to be explained.

(13) Line 250: Replace "not present anymore" with "largely absent"

(14) Figure 6: Please indicate more clearly the depths represented by each row of plots.

(15) Line 268: Replace "coupled" with "combined"

(16) Line 272: Rephase "...NAO and EA couplings..." as "...the combined influence of the NAO and EA in the ..."

(17) Lines 296-297: Why is the lag larger in your study? See comment above about possible role of onshore geostrophic flow.

(18) Section 4: It would be useful to discuss clearly what this study adds to the existing literature.