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Ocean Science
Discussions

Interactive comment on "The relationship between Arabian Sea upwelling and Indian monsoon revisited" *by* X. Yi et al.

Anonymous Referee #1

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Review of Yi et al., "The relationship between Arabian Sea upwelling and Indian monsoon revisited"

General Comments

The authors present a study aimed at clarifying the relationship between the Indian summer monsoon and upwelling along the coast of the Arabian Peninsula, in the northwest Arabian Sea. The analysis looks directly at vertical velocity in a 10km resolution global ocean model rather than upwelling proxies, which is a strength of the study. Most of the analysis consists of reporting correlations between a various time series and indices. However, there is little to no consideration for any mechanisms driving the dynamics of the study region, or for the physical meaning of indices that are being used. As a result, the analysis at times is circular and/or makes little sense, and

dubious claims arise as a result. While the topic is worthy of publication and the authors have the tools at hand to make a contribution, the manuscript is not publishable in its current form. Major revisions to the analysis, conclusions, and writing are necessary before publication should be considered. The manuscript would also benefit from proofreading by a native English speaker.

Specific Comments
Introduction: There is no consensus on the correctness of the Bakun hypothesis. Recent studies suggest that upwelling trends are region dependent and latitude dependent, and that the governing dynamics may be different from the Bakun hypothesis. I recommend expanding this discussion if upwelling trends are part of your manuscript. Also, you discuss EBUS but it's not clear how that relates to the Arabian Sea. Some relevant papers are Sydeman et al. (2014), England et al. (2014), Rykaczewski et al. (2015), Belmadani et al. (2014).

Methods: Why not take the wind stress that forced the model rather than estimate it from NCEP/NCAR using the equation? Then you can look at the relationship between upwelling and wind stress directly without introducing uncertainty in the wind stress calculation. Also, the equation at L5 is wrong. Care needs to be taken to do this calculation right. Finally, alpha and beta should be based on the coastal orientation, not the direction of the wind (L10). The purpose of the equation at L5 is to rotate the wind stress to the alongshore direction; the wind direction should not be assumed a priori.

P2688,L19-22: Move this text to the second paragraph of section 2. Also, why average upwelling over the upper 200m? Upwelling should be the velocity though a fixed depth.

P2689,L9-15: Is the EOF analysis conducted on JJA averaged upwelling?
L15-18: I don't see any basis for this statement. This analysis on its own doesn't tell you anything about the processes. Please avoid these kind of unfounded statements.
L23-27: Authors should perform a proper significance test do decide whether the trend

is negligible. If it is negligible (as stated), why is detrending necessary?

P2690,L1-3: You said earlier that a strength of this analysis is looking directly at upwelling, not proxies. Now you are using those proxies to validate the model upwelling? This issue comes up again at L11-21 and in the second paragraph of section 7.
L16-21: Correlations of .45-.49 mean less than 25

P2691,L3-6: For consistency, monsoon indices should be correlated with the regionally averaged upwelling, not grid cell by grid cell.
L7-26: This section is unconvincing. Remember, correlation is not causation. Why would upwelling be sensitive to rainfall? Is there any mechanism? The authors need to think about what each of these indices physically represent and tie it to upwelling. Spatially heterogeneous correlations don't necessarily say anything about forcing mechanisms.

Section 6: The analysis here is circular and the conclusions unfounded. First the authors find out what areas correlate best with upwelling PC1, then pick the areas with strongest positive and negative correlations, and show that the gradient between them is correlated with PC1. Of course it is, they've made sure it would be! As a result of this process, the conclusion is reached that upwelling along the Arabian Peninsula is highly sensitive to the SLP gradient between the Arabian Sea and the Himalayas. If this system behaves anything like an EBUS (as suggested throughout), then the SLP gradient between the Arabian Sea and the Arabian Peninsula is what's important, as it dictates the local geostrophic wind. If the authors stand by the statements in the text, a mechanistic explanation is needed. The same is true for the methodology and conclusions about the air temperature. In the last paragraph of this section the authors correlate SLP to Indian Monsoon indices. Two of these indices are calculated from wind speed, which is very closely related to SLP, so I'm not sure how this analysis is illuminating. The paper generally needs a focus on what's physically happening, rather than equating a statistical index to the Indian Monsoon and all it entails.

Section 7: As before, revisit analysis with some consideration of mechanisms. In general, I do not find the conclusions to be supported by the analysis.

Technical Details:

P2690,L4-6: What is the area used for wind stress? If estimating Ekman transport, the authors should use the wind stress at a fixed distance offshore, not a spatial average.
P2692,L7: Please explain the calculation and meaning of the two-dimensional correlations.
P2694,L25: How would ocean color help validate these results?

References

Sydeman, W. J., M. García-Reyes, D. S. Schoeman, R. R. Rykaczewski, S. A. Thompson, B. A. Black, and S. J. Bograd (2014), Climate change and wind intensification in coastal upwelling ecosystems, Science, 345, 77–80.âĂĺ

Belmadani, A., V. Echevin, F. Codron, K. Takahashi, and C. Junquas (2014), What dynamics drive future wind scenarios for coastal upwelling off Peru and Chile?, Clim. Dyn., 43(7–8), 1893–1914.âĂĺ

England, M. H., et al. (2014), Recent intensification of the wind-driven circulation in the Pacific and the ongoing warming hiatus, Nat. Clim. Change, 4, 222–227.âĂĺ

Rykaczewski, Ryan R., et al. "Poleward displacement of coastal upwellingâĂŘfavorable winds in the ocean's eastern boundary currents through the 21st century." Geophysical Research Letters 42.15 (2015): 6424-6431.

Interactive comment on Ocean Sci. Discuss., 12, 2683, 2015.