

# ***Interactive comment on “Evolution of the Arabian Sea upwelling in the past centuries and in the future as simulated by Earth System Models” by Xing Yi et al.***

**Xing Yi et al.**

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Received and published: 12 August 2019

We thank the reviewer for detailed reading of the manuscript and for the suggestions for improvement. In the following, we quote the reviewer's comment for each point and then sketch how we plan to revise this manuscript to address these suggestions.

1. “Orbital forcing is not the major forcing of climate variability during the last millennium, except for the millennium-scale decreasing trend, is there any relationship between the upwelling and the volcano activities?”

We thank the reviewer for the suggestion. Yes, we actually meant the millennium timescales. We will examine the relationship between the upwelling and the volcano

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activities, for instance by superposed epoch analysis. The volcanic forcing used in the simulations is available and it will be discussed in the revised manuscript.

2. "Since the link between the ISM and the upwelling is pronounced, how is the relationship between ENSO and the upwelling?"

We thank the reviewer for this thought. In the revised manuscript, we will also discuss the relationship between ENSO and the upwelling. However, it has to be borne in mind that the models still show some deficiencies in the simulation of ENSO events, and the analysis may yield different results for the models included in this study.

3. "The authors showed the CESM ensemble results, have you evaluated the ensemble spread to measure significance or uncertainties, for example including ensemble ranges would be useful."

We appreciate the reviewer's suggestion. However, maybe we have misunderstood the comment. The ensemble ranges can already be seen in our timeseries plots. Does the reviewer mean that we should consider all the ensemble members from the CESM last millennium ensemble?

4. "The future upwelling under RCP8.5 scenario reveals a negative trend, given that the upwelling favorable wind-stress is projected to increase. This is opposite from our common understanding that coastal upwelling at global scale would be intensified as the upwelling favorable wind-stress would be strengthened due to the enhanced air-sea temperature gradient under the global warming scenario. The authors explain this from the point of surface water stratification, is there a critical time when we could explain by the two different theories?"

We appreciate the reviewer for sharing this point. We will analyse the decadal trends in the future scenario to estimate when the water stratification overrides the strengthened wind-stress to affect the upwelling. This will be discussed in the revised manuscript.

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