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Climate of the Past Discussions

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.

Anonymous Referee #1

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This study analyzed the simulated water vertical velocity to investigate the variations of the coastal upwelling in the western Arabian Sea over the last millennium. The two models are also employed to study the changes in upwelling in the 21st century under the strongest and the weakest greenhouse gas emission scenarios. With a negative long-term trend caused by the orbital forcing of the models, the upwelling over the last millennium is found to be closely correlated with the sea surface temperature, the Indian summer Monsoon and sediment records. The future upwelling under the Representative Concentration Pathway (RCP) 8.5 scenario reveals a negative trend, in contrast with the positive trend displayed by the upwelling favorable along-shore winds. Therefore, it is likely that other factors, like water stratification in the upper ocean layers

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Discussion paper

caused by the stronger surface warming overrides the effect from the upwelling favorable wind. The paper is overall well written and contributes to improve our knowledge of how the upwelling evolves from the past to future. Nevertheless, I consider that some important points must be addressed before the paper can be published. General comments: 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? 2. Since the link between the ISM and the upwelling is pronounced, how is the relationship between ENSO and the upwelling? 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. 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?

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