

**Response to Reviewers**  
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**Responses to the Comments of Reviewer**

**Reviewer #2:**

*This study presents a new hybrid coupled model based on ROMS and a SVD Atmosphere model. The results show that the model can will simulate ENSO cycles and associated three-dimensional temperature anomalies. In the revision, I do see some improvements compared to the previous version. I still have some questions and comments on the details as follows:*

**Our response:** We thank the reviewer for the suggestions (in italic black). We have revised the manuscript based on these suggestions and comments. Below are our point-by-point responses to the reviewer's comments (in blue).

*1. The ROMS model domain is from 95 °E to 70 °W and 30 °S to 30 °N. As we know that ENSO is not only air-sea dynamics of tropical region, extratropical signals also have large influences on ENSO evolutions. Especially for the extreme El Nino events. I wonder how the authors deal with this issue?*

**Our response:** Extratropical processes can significantly influence the evolution of ENSO, particularly during extreme El Niño events. In this study, the model domain is limited to 30°S–30°N and therefore does not include extratropical dynamics. However, since our current focus is on air-sea coupling processes within HCM<sub>ROMS</sub>, we use this domain to isolate and better understand the tropical mechanisms. The role of extratropical influences will be addressed in future work, potentially through improved lateral boundary forcing or an expanded model domain. We address this issue in Lines 147–150 as:

“It should be noted that the limited domain of 30 °S–30 °N excludes extratropical dynamics, which also influences ENSO. The present study primarily focuses on air-sea coupling processes within the tropical Pacific. The role of extratropical influences will be addressed in future work, potentially through enhanced lateral boundary forcing or an expanded model domain.”

*2. How does authors dispose boundary conditions of the ROMS model, since they are important for ENSO dynamics?*

**Our response:** The boundary conditions of the ROMS model are derived from the climatological monthly SODA3 data, as mentioned in Lines 210–212: “The climatological monthly SODA3 data also served as the lateral boundary conditions of sea surface height (SSH), currents, temperature, and salinity throughout the model integration. ”

*3. There are some unclear or long sentences. Such as, Lines 15-20, “For basin-wide applications to the tropical Pacific, here, the ROMS is incorporated with a statistical atmospheric model, which is based on singular value decomposition (SVD), capturing interannual relationships of atmospheric perturbations such as wind stress and freshwater flux anomalies with sea surface temperature (SST) anomalies.” Please make them more clearly.*

*Lines 525 “With the  $\alpha\tau$  set at 1.5, a stable quasi-three-year ENSO cycle, characterized by alternating occurrence of El Niño with a positive SSTA of 2 °C and La Niña with a negative SSTA of -1 °C, exists in the HCMROMS after the first-eight-month model “initial kick”.*

**Our response:** We have rewritten the long sentences as suggested.