Dear Reviewer,

We would like to express our sincere gratitude for your valuable comments and suggestions on our manuscript titled **" ENSO statistics, teleconnections, and atmosphere-ocean coupling in the Taiwan Earth System Model version 1"**. In response to your comments, we have carefully addressed each point and made two revisions accordingly:

1. (Major) After careful examination, we have acknowledged that there was confusion regarding the direction of total heat flux in El Niño evolution in the previous Figure S2, which has opposite direction with Figure 10 in the main text. To eliminate the confusion, Figure R4 below now displays the total surface fluxes with the direction sign aligned with Figure 10. This revised figure clearly illustrates that the surface heat flux has a strong effect in warming the sea surface. To facilitate a better understanding, it is included as the supplementary figure S5.
2. (Minor#4) In response to the comment, we have enhanced the completeness of our analysis by including information on zonal current in the Figure 8, which provides a more comprehensive picture of the subsurface ocean during El Niño events. The corresponding figure, now referred to as Figure R5, has been added as supplementary Figure S3 in the revised manuscript.

Please view the attached pdf file for the complete response report. Thank you again for your comments in improving the quality and clarity of this research.

Sincerely,
Yi-Chi Wang and Coauthors

RC2: 'Comment on gmd-2023-41', Anonymous Referee #2, 05 May 2023

I don't know how this journal exactly works, but this manuscript does not present a new model development, nor the first decription of this model. However, it provides the first detailed analysis of ENSO characteristics of this model. If this falls within the scope of the journal that would be ok then. Overall the quality of the analysis of ENSO characteristics is very good. However, I have one major concern, and a few minor comments.

Major: The TaiESM1 shows a very reasonable ENSO in various measures, but has a too strong magnitude. The authors provide some analysis why this may be the case and point to the solar radiation flux increase in El Niño events due to stratos cloud reduction. While this impact is clearly identified, I think it cannot be argued that this is the mechnism clearly responsible for too strong ENSO amplitude. For example, Fig. S2 clearly shows that the net surface heatfluxes much more strongly oppose the dynamically induced ENSO SST anomalies in the model compare to observations. Therefore, it seems more likely that other positive feedback that lead to stonger westerly wind anomalies in the central Pacific are relevant. More analysis is needed here. Perhaps looking at thermocline structure. Overall, while the shown solar radiation positive feedback is certainly there, other heatflux feedback do overcompensate this, leading to a strong negative net heatflux feedback. The authors have to make more effort if they want to convince that this solar radiation feedback is working.

Thank you for your suggestions. Upon careful reevaluation of our analysis, we acknowledge that there was confusion regarding the direction of total heat flux in Figure S2, leading to a potential misinterpretation of an opposing mechanism for the positive feedback between shortwave-SST that we proposed in our manuscript. We sincerely apologize for any confusion caused.

To ensure clarity and facilitate better understanding, we have reverted the sign of Figure S2 to align consistently with Figure 10 as shown below, ensuring coherence throughout the manuscript. As a result of this adjustment, it becomes evident that both Figure S2 and Figure 10 illustrate the effect of total heat flux entering the tropical Pacific region, which corresponds to the observed warm sea surface temperature patterns. Additionally, we have noticed that the evolution of total heat flux aligns more closely with the evolution pattern of shortwave heat fluxes in Figure 10, providing further support for our hypothesis that shortwave flux warming plays a significant role in driving the warm sea surface temperatures in TaiESM1.

We appreciate your keen attention to detail and for bringing these points to our attention.

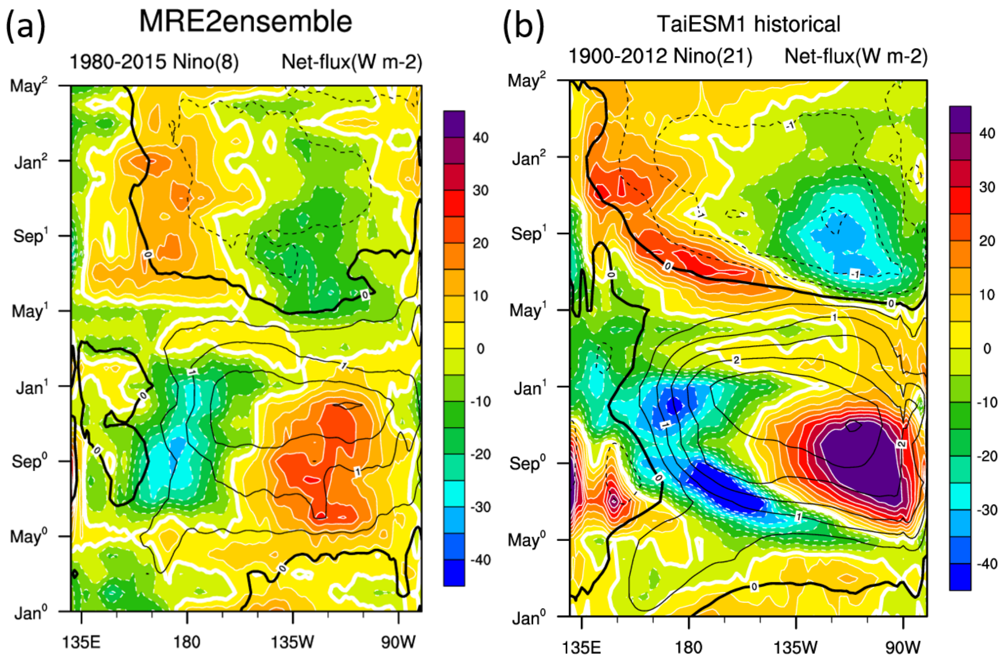

Figure R4: Similar to Fig9c, (a,b) but for net radiation flux (color shading; net = rsus-rsds+rlus-rlds-hfss-hlfs, W m-2) for MRE2 and TaiESM1, respectively. Rsus represents shortwave upwelling fluxes, rlus as longwave upwelling surface fluxes, rlds as longwave downwelling surface fluxes, hfss as surface sensible heat fluxes, and hlfs as surface latent heat fluxes.

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Minor:

1. Line 128: Perhaps also quote the observed Niño3.4 standard deviation in the Satellite period (1981 to 2022), which would be substantially larger than 0.84 and closer to the TaiESM1.

Thank you for the suggestions. Upon calculating the standard deviation of the Niño3.4 index using ERSSTV5 data from 1981 to 2022, we determined that the standard deviation is 0.85, which is similar to the value of 0.84 obtained when considering the entire period.

2. Fig. 4: What is the box shown and why?

Sorry for the confusion. The box marks the Niño-4 region where the average taken to calculate regression maps. We have added the description in the caption of Fig.4.

3. Fig. 6: Also mention the dominance of IOD-like response in modelin DJF compared to obs, where we see already the dominance of an IOBM response.

Thank you for the suggestion. We have updated the discussion in light of the temperature dipole observed over the Indian Ocean in Figure 6g. Specifically, we have added a mention of the dominance of the IOD-like response in the model during DJF, as opposed to the observed data where the dominance of an IOD response is already apparent.

"however, the west shift of tropical SSTA causes the surface temperature response pattern also shift westward, resulting in enhanced cooling in the East and Southeast Asia. The cooling further extends into the Indian Ocean, causing an Indian Ocean Dipole-like response as depicted in Fig. 6g."

4. Fig. 8: Please provide an additional (supplementary) figure which shows the equatorial temperature structure in a longiture-depth plot to also see the thermocline structure. Perhaps also zonal currents could be shown there.

Thank you for your suggestion. We have included an additional supplementary figure, Figure R5 below, which presents a longitude-depth plot depicting the equatorial temperature structure (color shading) and zonal current (blue contours). This new figure provides a clear visualization of the thermocline depth during El Niño events, represented by a green line.

Upon examining this plot, it becomes evident that in TaiESM1, as the El Niño event develops, the westerly current anomaly (solid blue contour) within the thermocline strengthens. This aligns with the stronger sea surface temperature (SST) and warmer subsurface temperature anomaly over the East Pacific region. In TaiESM1, the westerly current anomaly is significantly stronger and extends further east compared to observations in the SODA analysis. While our study does not explicitly investigate the role of zonal advection in contributing to the warming near the East Pacific, it is an interesting aspect that merits further examination. The revised manuscript now includes Figure R5 as Figure S3, enhancing the understanding of the thermocline dynamics and zonal current behavior during El Niño events in TaiESM1.

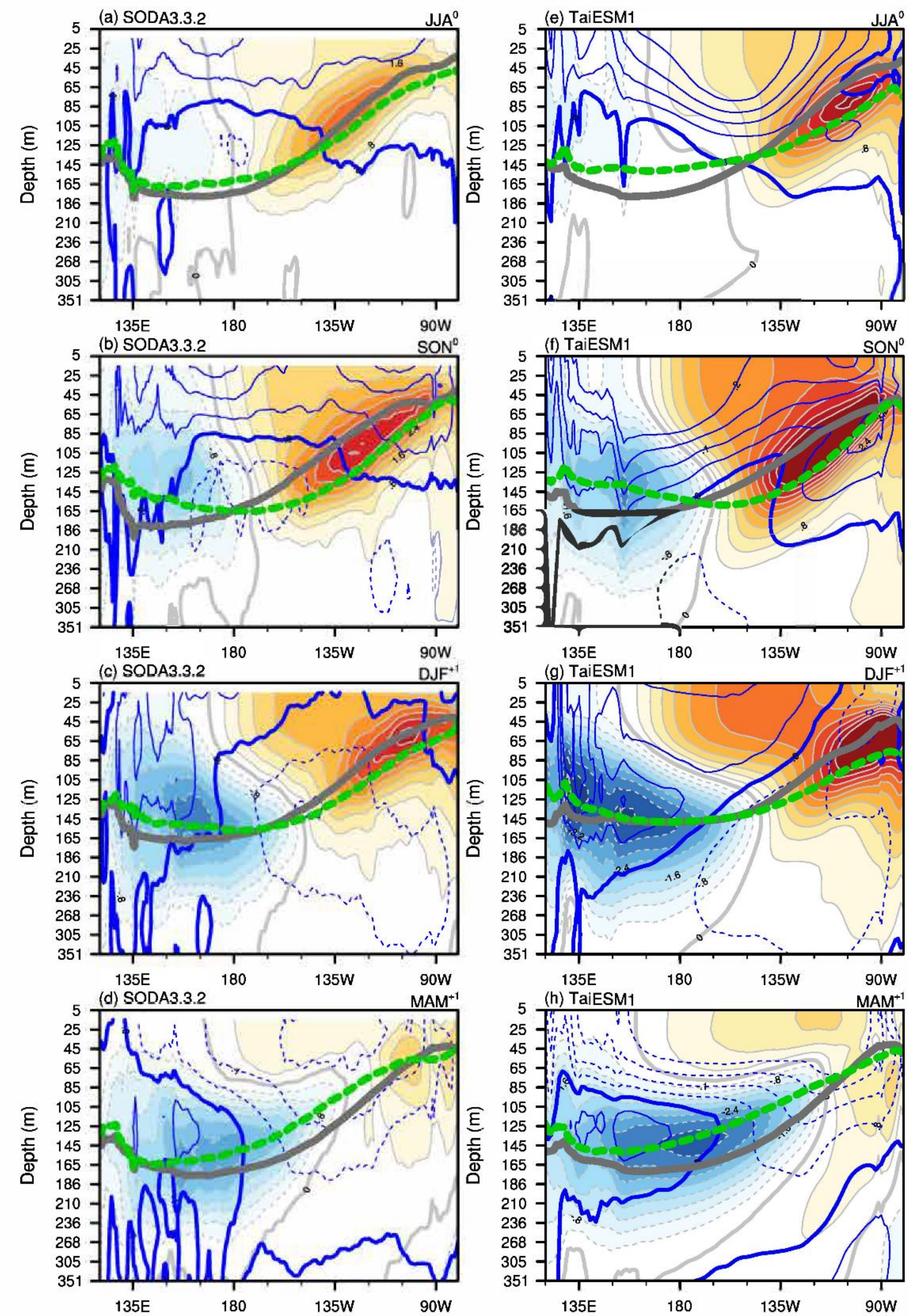

Figure R5: Equatorial cross-section (5°S–5°N) of the El Niño composite of the zonal current (blue contour) and potential temperature anomaly (color shading) in (a, e) JJA^0, (b, f) SON^0, (c, g) DJF^{+1}, and (d, h) MAM^{+1} based on SODA3.3.2 (left column) and TaiESM1 historical run (right column). The gray line shows the climatological 20°C isotherm (Z20), and the green dashed line shows the Z20 at the Niño state.