



EGUsphere, author comment AC2  
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## Reply on RC2

Yiyu Zheng et al.

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Author comment on "El Niño–Southern Oscillation (ENSO) predictability in equilibrated warmer climates" by Yiyu Zheng et al., EGU sphere,  
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In this manuscript the authors have examined the predictability of ENSO in coupled ocean-atmosphere models whose simulations are more than 1000 years long. Many of the conclusions about the changes in ENSO characteristics is wellknown based on previous work in this area. The main advantage of this work is their ability to look at a much longer simulation and hence differentiate between transient and equilibrium response. The authors have not discussed the role of spatial resolution on the simulation of ENSO. This is important since a recent work by Wengel et al, Nature Climate Change ,2022 "Future high-resolution El Niño/Southern Oscillation dynamics" has claimed that the resolution of mesoscale processes is important to simulate the robust weakening of ENSO with global warming. Hence there is a need to add some discussion about this paper and convince the readers that the results reported in the manuscript are not sensitive to spatial resolution

**We thank the reviewer's time and valuable comments on our results' sensitivity to model resolution. We add to both Line 59 and Line 256, now the first paragraph in Section 2 and the second paragraph in Section 4 become:**

We analyze model outputs from the LongRunMIP archive, a large set of simulations from atmosphere-ocean general circulation models that last at least 1000 years (Rugenstein et al., 2019). This archive includes 15 models, each contains a pre-industrial control simulation of constant 1850-forcing and at least one forced simulation, ranging from instantaneous steps of two-, four-, eight-, or sixteen-time CO<sub>2</sub> to realistic Representative Concentration Pathway (RCP) scenarios with constant forcing beyond year 2300. We select seven models from the archive with abrupt quadrupling CO<sub>2</sub> simulations (hereinafter referred to as *abrupt4xCO<sub>2</sub>*) and compare them with their pre-industrial control simulations (hereinafter referred to as *control*). This forcing level is chosen because it shows a better signal-to-noise ratio than the doubling of CO<sub>2</sub>. The spatial resolution of these seven models ranges from 3.75° in both the atmosphere and ocean to 1.4° in the atmosphere and 0.8° in the ocean. Though models with different resolutions might show different ENSO dynamics, our results on ENSO response are robust among the models. We treat the period between year 150 and the end of the simulation as.....

The weakening in ENSO characteristics can be seen in both ultra-high-resolution models and proxy records. Wengel et al. (2022) showed a decreased ENSO amplitude in a model with 0.25° atmospheric resolution, which is both qualitatively and quantitatively consistent

with our results (compare their Fig. 4a with our Fig.6a). White and Ravelo (2020) showed a reduced El Niño amplitude during early Pliocene, during which the climate resembles closely the one projected in RCP4.5 scenario (Burke et al., 2018).

From the robust response of ENSO characteristics under *abrupt4xCO<sub>2</sub>* forcing, we would expect ....