

Item-by-item response to all review comments

NOTE: To facilitate the evaluation of our responses, original review comments are listed first in their originals (in black), followed by **our itemized response (in blue)**. An annotated version of revised manuscript is attached.

We thank the reviewers' comments, which are in black text below. **Our response is followed (in blue).**

Reviewer 1

I am pleased to inform you that your manuscript is accepted for publication after the following corrections have been considered:

P5, L131: "can" or "to". One of the words is obsolete.

P6, L161: El Nino and Southern Oscillation -> El Nino Southern Oscillation

P8, L219: Remove full stop after years (1970 and 1972)

P8, L242: You mean "as" in McLinden et al.? Has the same term set to zero in McLinden et al. or are only you doing this?

Response: Revised as suggested.

Section 3 and 4: Aren't these belonging to the method section? I would suggest to add these to section 2 as subsections.

Response: We've moved these sections to section 2 and modified accordingly.

P11, L307: What do you mean with phase change? Do you mean shifted?

Response: It is phase shift, revised as suggested.

P11, L326: What is meant with natural? Do you mean the reference run?

Response: This means the E3SMv2 natural run which is done by making a free-run with no nudging. We've made the modifications in the text. Please refer to line 165.

P12, L348: which -> where?

Response: Revised as suggested.

P15, L433: What do you mean with return branch? The downward branch of the BDC? If yes, then please write it like this.

P15, L434: What is meant with phase reversal in the tropics. Not clear, please rephrase sentence.

Figures 4-11: These figures are of similar type and in the caption always the same text is repeated. I think it would be easier if you have a detailed description in the first of these figures and then write for the following figures "As in Fig. X, but for....." and just point out what the differences are.

Response: Revised as suggested.

Reviewer 2

The authors have made major revisions to the manuscript in response to my previous comments. I apologize that I was not able to follow the motivation or method of the earlier versions. The latest revision is now straightforward to follow and I hope will be so for other readers. The substitutions of the terms “metric” and “SSO” for “model” to describe the steady-state solution was very helpful for keeping various options for ozone straight. I recommend that the paper be accepted after attention to a few minor comments given here.

1. I sometimes was confused about which simulation of E3SMv2 was being referred to. On some occasions the terms “E3SMv2 nudged”, “E3SMv2 natural” and “E3SMv2 Linoz-v3 nudged” are used whereas elsewhere just “E3SMv2” is used. It would be helpful for the reader if the names for the model runs were consistently used throughout.

Response: We’ve added the naming reference to the E3SMv2 nudged and natural simulations in the text to make further clarification of the simulations. Please refer to line 161 and 165.

2. As a related matter, I thought the natural run was the one with QBO generated by parameterized gravity waves, which has a weak QBO with a period of 27 months. Then I saw this (line 355-6): “the period of internally generated QBO in E3SMv2 is ~21 years”. Please clarify.

Response: There was a typo in the sentence. The Tuning is referred to changes in QBO period for EAMv1. Revised in the text. Please refer to line 100-102.