Atmospheric Chemistry and Physics Discussions

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Comment on acp-2020-1237

Anonymous Referee #2

Referee comment on "Does the coupling of the semiannual oscillation with the quasi-biennial oscillation provide predictability of Antarctic sudden stratospheric warmings?" by Viktoria J. Nordström and Annika Seppälä, Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2020-1237-RC4, 2021

Comments on "Does the coupling of the mesospheric semiannual oscillation with the quasi-biennial oscillation provide predictability of Antarctic sudden stratospheric warmings?" by NordstroÌ□m and SeppaÌ□laÌ□ (2021).

Summary

NordstroÌ□m and SeppaÌ□laÌ□ (2021) used the MERRA-2 reanalysis to study the possible impact of the Quasi Biennial Oscillation and the Semiannual Oscillation on the SH SSWs in 2002 and 2019. They proposed that the interaction between QBO and SAO can improve the predictability of the SH SSW. However, such a link between the QBO-SAO combined interaction and the predictability of the SH SSW is not stable and not applicable to other year with similar QBO-SAO configuration in the upper stratosphere and mesosphere. Most of the results are fairly descriptive and different SH stratospheric responses to the QBO-SAO in different years are not well explained. Therefore, I would possibly recommend publication of the paper after a major revision is performed with the following comments considered.

Major comments

- The introduction has a large bias toward the studies of QBO in literature. The authors should present a comprehensive review on the recent studies of the QBO in literature. Can the authors also give a complete review on the modelling of the QBO and possibly the SAO in literature? In addition, the QBO simulations from CMIP5/6 models have made a big progress recently, and the authors did not review in this paper (several JC, GRL, QJ, JGR papers report the simulation of the QBO in CMIP5/6 models, please refer to them for details). The Holton-Tan relation has also been assessed for the CMIP5/6 models in literature. I suggest the authors to read those new publications.

- L68-73: Factors influencing the occurrence of SSW in SH and NH have been reported in some papers, and summarized in Baldwin et al. (2021). Those factors include the QBO, ENSO, MJO, Solar cycle, and extratropical blockings. The authors did not read those original papers but see the summary in Baldwin et al. (2021). It is an efficient way to get an overall image on the latest study progress of SSW by reading the review paper Baldwin et al. (2021), but more details should be traced to the original paper. See the original paper (https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2019JD030826) Tables 1-3 for more details.

- The structure of the paper should be well trimmed and organized. The paper tries to emphasize the impact of the QBO and SAO, but the timeseries of the QBO and SAO are not shown in the paper. Show the QBO index at 10 hPa and the SAO index at 1 hPa at least. From the display of the paper, the maximum SAO westerlies are much stronger than the maximum SAO easterlies in some years. Readers do not know the SAO zonal wind asymmetry in other years. Further, the authors display some redundant figures (9-12). Is it necessary to composite the SSW group in different decades (or data streams in MERRA-2, L118-121)? Please condense the paper with your largest endeavor.

- Some papers might not be well understood by the authors. Gray et al. (2020) indeed

tried to improve the prediction (rather than simulation or modelling, L304, L353) of the extreme polar vortex by considering the high-level impact.

Other comments

- L28: has occurred => have occurred

- L33: The strong polar vortex in March 2020 and the Arctic ozone loss have also been reported (https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2020JD033524).

- L44: The impact of SSW is wide, from polar region to midlatitudes. Please well read the reference and use the correct word.

- L49: The relationship between SSW and NAM in the NH is discussed for S2S model, and the uncertainty is also present (https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2019JD031919).

- L51: Here a reference should be added, like Allen et al. (2003) https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2003GL017117

- L68-73, L81: Please see the discussion in Rao et al. (2020) for the possible impact of ENSO, QBO, MJO, Solar cycle on the SSW.

- L74: east and westward => eastward and westward

- L124: average average => (delete one)

- L135: is discussed => are …

- L146: The author might use a composite analysis. Please write more specific.

- L151: Only two SSWs are commonly reported for the SH in record. There was no SH SSW in 1988. (also see your L340)

- L159, 161: there are two “theta” in the formulas, the authors should change the second one to “phi” (latitude). Please well read the book or reference and avoid those unnecessary errors.

- L163-164: What mean did the authors use? Zonal mean? Or time mean? Please be more specific.

- L166: correspond => correspond to

- L167: What is the “upcoming EP flux”?

- L190: What latitude band do you describe?

- L198: form => from??

- L207-209: Could you provide the timeseries of the SAO from 1979 – nowadays?

- L210-225: This paragraph is too descriptive.

- L228-230: How regular is the SAO? See the major comment and provide the timesires of the SAO.

- L238: Figure 8b should be put in a pair of parentheses.

- L240: grammar error “is does”

- L242-L277: This subsection is too descriptive and should be condensed.

- L317-319, L364: I don’t think the SAO can help to explain why the SSW in SH is much less than the NH. This is mainly caused by the land-sea distribution responsible for the forced planetary waves.

- L320: It is nearly impossible to forecast an SSW with 2-3 months in advance.

- L326-327: The QBO is still a challenge for forecast systems. Not to mention the SAO. Please refer to https://journals.ametsoc.org/view/journals/clim/33/20/jcliD200024.xml

- L330: read the original paper mentioned by Baldwin et al. (2021) for details.

- L334-335: What do the authors mean “the MJO index was positive”? There are two MJO modes, and their combination presents a phase space. We use phases 1-8 to describe the MJO rather than “positive/negative”.

- L344: into the SH => into the SH extratropics.

- L347-348: Incomplete sentence. It is a long phrase.