Replies to editor for:
Evidence for Hunga-Tonga eruption influence on the anomalously strong Northern-Hemisphere stratospheric polar vortex in 2024/2025

ACP, Ales Kuchar et al.

Reply to Editor

Dear Editor,

We appreciate your very helpful comments! We revised the manuscript according to your suggestions and hope the revised version obtains your approval for publication in ACP. Please find our point-by-point answers to the comments below.

Best wishes

Ales Kuchar et al

Comments:

L46: please rephrase this statement. First, the study cannot "seek", you might write "the aim of this study is to…" Secondly, I find "extend the portfolio of pathways by which the HT eruption may have modulated stratospheric and mesospheric conditions" a bit strange. The goal should be to investigate what really happened, not to invent possible mechanisms.

We replaced "seek" with "the aim of this study is to" and "extend the portfolio" with "document the portfolio".

L51: "what predictive power" or "what degree of predictive power"

We added "what" before "predictive power".

L54: "a reanalysis data set"

We added "dataset".

L74: If the quality screening criteria are described in a citable document a citation should be included here.

We removed this sentence as not necessary since we refer to Livesey et al. (2026) in this subsection.

L84: The description of the SOCOL simulations should be moved to the Methods section rather than the Data section.

We moved this subsection to the Methods section.

L86: what is meant by HT forcing? Is it just a WV injection? How much WV, where injected, over what time period, spatial distribution? Was SO2 included as well, or prescribed stratospheric aerosols?

We added a sentence about the injection region of WV and SO_2.

L87: "We can demonstrate" is difficult to deal with as a reader and editor. Do you mean it has already been demonstrated, in which case provide a citation. If this result is important to the present study and has not been previously published, then there should be evidence (e.g., a figure) provided to support it. If it is not central to the present study, I would suggest to cut the statement.

We revised the sentence so that it is clear that we use equatorial zonal wind at 10 hPa as a proxy for the Quasi-biennial Oscillation (QBO) to demonstrate a link between the QBO and the polar vortex in SOCOLv4, i.e. the so-called Holton-Tan mechanism (Holton and Tan, 1980).

L93: It is hard or nearly impossible to identify the 0.5 ppmv contour on Fig 2 with the close spacing of the degrees of the color scale. Do you mean the labeled 0.8 ppmv contour? Please either label the 0.5 ppmv contour in the figure or rephrase in terms of 0.8 ppmv.

We revised the figure description so that it is clearer.

L95: It's not quite clear here if the model bias is common to all models, or many models, or just different versions of SOCOL. There is room to expand this text for clarity, especially as it seems very important to the methodology of the study.

We reformulated the paragraph so that it is clear that the bias is common for the SOCOL model family but it also persists in other CCMs.

L103: the Konrad radiative convective model is introduced here, but not mentioned again in the manuscript. Later instances refer only to RRTMG. It remains unclear whether any of the capabilities of Konrad are used in the present study, or if it simply is a wrapper to the RT calculations of RRTMG. If this is the case, it would be necessary to rewrite this section as it would be more accurate to frame this as using RRTMG.

We rearranged the sentence so that it is clear that we use *konrad*'s to RRTMG only.

L104: On what evidence do you base the statement "these radiative calculations are robust for various solar zenith angles"?

We run these radiative calculations using various solar zenith angles.

L107: The student's t-test is used to quantify the significance of anomalies, correct? This should be made clearer, and more details on the method given, i.e., how does the method differ for observations (when one compares I presume to the distribution of non perturbed conditions) and the paired simulations.

We added the following sentences: "For the MLSv6 observation we compute local p-values as empirical two-sided rank p-values for each target month-pressure bin. We confirm this approach using local Monte Carlo p-values with 1000 samples.".

L110: The PW analysis described here is applied to the SOCOL output?

We added that the PW analysis was applied to the SOCOLv4 6-hourly outputs.

L151: I would suggest the phrasing "we argue that the winter MW2 in our simulations is comparable to OW3. . . "

We replaced "corresponds" with "is comparable to"

L173: What line-by-line calculations are referred to here? No line-by-line model has been mentioned (RRTMG is a band model).

We mention now that the RRTMG calculations are accompanied by calculations using a line-by-line RT model (Bell et al., 2025).

References

Bell, A., Murk, A., and Stober, G.: Radiative impact of increased middle atmospheric water vapour in the aftermath of the Hunga 2022 volcanic eruption at two locations in the Northern Hemisphere, EGUsphere, 2025, 1–22, https://doi.org/10.5194/egusphere-2025-1396, 2025.

Holton, J. R. and Tan, H.-C.: The influence of the equatorial quasi-biennial oscillation on the global circulation at 50 mb, Journal of Atmospheric Sciences, 37, 2200–2208, 1980.

Livesey, N., Read, W., Wagner, P., Santee, M., Froidevaux, L., Schwartz, M., Lambert, A., Millan, L., Werner, F., Pumphrey, H., Manney, G., Fuller, R., Jarnot, R., Knosp, B., and Vuu, B. C.: Earth Observing System (EOS) Aura Microwave Limb Sounder (MLS) Version 6.0x Level-2 and Level-3 data quality and description document, https://doi.org/10.5067/AURA/MLS/DOC/v6_dataqualitydocument, 2026.