Review of "Was the strengthening of the Northern polar vortex in 2024/2025 associated with the Hunga Tonga eruption?" by Ales Kuchar et al.

I was asked by the editor to review the revised version of Kuchar et al. In their paper, Kuchar et al. using observations and SOCOLv4 simulations, to analyse the unprecedented water vapour injected by the 2022 Hunga Tonga eruption likely strengthened the Northern Hemisphere stratospheric polar vortex in winter 2024/2025 through radiative cooling and ozone depletion. The model reproduces the observed evolution albeit with underestimated magnitudes and an earlier onset than observed. The simulations also suggest that the declining water vapour anomaly will favour more sudden stratospheric warmings in winter 2025/2026.

The reviewers had a couple of concerns regarding the interpretation and presentation of the results. For example, they questioned the link between water vapour anomalies and ozone and temperature anomalies, the influence of natural variability, and the application of radiative transfer calculations. In my view, the authors sufficiently addressed these concerns.

I therefore recommend publication of the article after minor revisions but as a regular research article and not as a letter. The results are not as clear-cut as originally presented and therefore do not meet the criteria for an ACP Letter. Ozone and temperature anomalies are significant only in some areas. In addition, to make a meaningful comparison between observational and model data, a one-year time shift has be assumed.

In addition, in its current form, the article is difficult to read due to the many appendices; an ACP research article structure would improve readability and clarity.

Specific comments

I have listed a few items here that might be helpful for a revised version of the paper:

Line, 86 How dependent are your results from the selection of the time interval?

- Figure 9: The mean trajectory path in panel c) is difficult to read, maybe another color?
- Figure 10: The red line lies with 50 hours so the test is a bit confusing

References

Some links were not working, I listed them below. Please double check

- line, 357 the link is not working anymore
- line, 366 Kroll et al (2021) is not cited anymore