

Dear referees,

*We thank the reviewers for their valuable comments which have helped us to improve the paper in revision. We have changed the manuscript according to the comments listed below. Most importantly, we have updated SWOOSH v2.6 to v2.7, adjusted all figures and discussions, improved the hatching to display significance, and improved the overall discussion and conclusion section. Comments are reproduced below, followed by our responses in italics.*

**Anonymous Referee #1:**

General:

This paper is well-written and presents new and interesting results. It relies solely on experimental data to establish positive trends in cold point temperatures for the period 2002-2020, subsequently leading to corresponding positive trends in stratospheric water vapor. The paper explores the seasonality of these trends and their zonal patterns, offering a comprehensive analysis. The abstract effectively summarizes these crucial findings. One particularly noteworthy discovery is the observed decrease in tape-recorder amplitude over the last two decades. The findings are supported by clear and well-constructed figures. However, a minor improvement could be made regarding the crosses in the figures that mark statistically nonsignificant trends, as it can be challenging to see them.

*Thanks for pointing out the quality of the crossing in the figures. We have chosen a different crossing (darker color and reduced the density of lines) and replaced all figures. Regions with significant trends can now be detected more easily.*

Congratulations on this convincing piece of work.

*Thanks!*

Here, few detailed comments:

Abstract:

L20: ...on the other hand, seems to be related...

*We have modified the text accordingly.*

L36: As your introduction is very comprehensive, I would also suggest referencing Riese et al, 2012, doi:10.1029/2012JD017751. See their Figure 1 for insight into the motivation behind the extreme radiative sensitivity of the TTL in relation to its composition.

*We have modified the text accordingly.*

L97: Concerning your sentence: "Zonal mean temperature trends from reanalysis over 2002–2020 suggest small but substantial cooling of -0.3 to -0.6 K/decade at 100 hPa and AT the cold point, which are statistically compatible with trends based on the adjusted radiosonde data sets (Tegtmeier et al., 2020a)." I believe Figure 11 from the cited paper displays results for the 1979-2005 period, not the 2002–2020 period as mentioned in the sentence. Additionally, you later

demonstrate that the trends are predominantly positive, not negative, for the 2002–2020 period. Please provide clarification.

*This is correct. Tegtmeier et al. show temperature trends for 1979-2005, sorry for the confusion. We have modified the text accordingly.*

L125-135: It would be nice to have 1-2 sentences, how does radio occultation work and how atmospheric temperature can be derived from such observations.

*We have added the following text to section 2.1 of the manuscript: ‘GNSS-RO measurements are obtained when a low earth orbiter (LEO) satellite measures the Doppler shift of the radio signal emitted by GNSS satellites after it travelled through the Earth’s atmosphere, which slightly bends the signal’s path due to its refractivity gradients. The relative motion between LEO and GNSS satellite orbits enables a vertical scan of the atmosphere. In the upper troposphere and stratosphere, the high-resolution refractivity profile is effectively a function of pressure and temperature, while humidity is increasingly important lower down.’*

L145: I thought, the newest SWOOSH version uses MLS v5.1?

*Thanks for pointing this out. We realized that we originally used SWOOSH v2.6 (using MLS v4.2) and changed all figures and corresponding text to now be based on SWOOSH v2.7 (using MLS v5.1).*

L153: It would be nice to have the explanation of the abbreviation "SAOD" in this sentence and not first in L159.

*We have modified the text accordingly.*

L171: Please reformulate: It should be emphasized that substantial residuals (not shown here) indicate a significant portion of variability of around 70%.... You mentioned that only 30% of the variability can be explained by your MLR model. Sometimes, people utilize lagged MLR models, considering that ENSO and SAOD signals take time to propagate from their source regions (ENSO - from the Earth's surface, SAOD -from the maximum of aerosol absorption around 50 hPa) to the region of interest. This might slightly increase the amount of variability that can be explained by the MLR.

*We have modified the text accordingly.*

*We have also conducted sensitivity studies using a lagged regression for the ENSO and SAOD terms but found that the overall regression did not improve in a consistent way over all regions and seasons. We have therefore decided to use the regressions without time lag.*

Fig 4: I think, you show mean tropical values (20S-20N). You should mention it both in the caption and in the text.

*We have modified the text accordingly.*