

Dear Editor,

*We express our gratitude to the editor for their invaluable comments, Comments are reproduced below, followed by our responses in italics.*

Specific comments:

P1, L10ff: The abstract is too long and needs to be shortened (see the new ACP author guidelines: [https://www.atmospheric-chemistry-and-physics.net/policies/guidelines\\_for\\_authors.html](https://www.atmospheric-chemistry-and-physics.net/policies/guidelines_for_authors.html), maximum allowed length is 250 words).

*Here is the shortend abstract: The tropical tropopause layer is the transition region between the well-mixed convective troposphere and the radiatively controlled stratosphere and plays a crucial role for air mass transport between these layers. In this paper, we present updated trends of tropopause and lower stratospheric temperature from radiosondes, GNSS-RO data and the reanalyses ERA5, JRA-3Q, and MERRA-2. Given its importance in determining the concentration of water vapor entering the stratosphere, we focus on temperature trends at the cold-point tropopause, which we determined from radiosonde observations after correcting for time-varying biases.*

*Radiosonde and GNSS-RO data show a significant shift from strong cold-point cooling for 1980-2001 to warming for 2002-2023. Reanalysis data sets reproduce the robust change in the tropical tropopause temperature trends and furthermore show opposite trends in tropical upwelling for 1980-2001 compared to 2002-2023, consistent with the cold-point and lower stratosphere temperature changes. The shift in cold-point temperature trends around 2000 suggests a regime shift in the dominant mechanism controlling CPT temperatures, from ozone depleting substance-induced dynamical changes before 2000 to greenhouse gas-induced radiative warming with some dynamical contributions after 2000. While the role of dynamical changes after 2000 is not completely clear, this regime shift suggests that in the absence of strong dynamically induced cooling trends, radiative warming could dominate the cold-point temperature trends and thus stratospheric water vapor entry values.*

P2, L59-60: Please rephrase the sentence so that it becomes clear that Aura is the satellite and MLS the instrument onboard of it. A suggestion would be "...as detected by the Microwave Limb Sounder (MLS) onboard the NASA's Aura satellite."

P3, L81: I would suggest to rephrase the sentence as follows: "In our study, we aimed on updating existing studies of.....".

P3, L82: I would suggest to write instead of "Our analysis will focus...." rather "Our analysis focuses on....."

P3, L87ff: “Section” should be abbreviated as “Sect.” unless it appears at the begin of the sentence (please correct this throughout the manuscript).

P4, L98: Add a reference for this statement?

P4, L107: Time is usually abbreviated with a small “t”, thus I would suggest to write “t00” or “t0” and “t12”.

P4, L115: The dataset? You mean the IGRA dataset. I would suggest to clearly state this.

P5, Figure 1 caption and all following figure captions: Only the text “Figure” with the respective number is written with bold face. The rest of the caption should have the same font as the text.

P6, L150-151: Abbreviations of the instrument names should be introduced and “Metop” should be written consistently as “Metop” or “METOP” (I think the correct writing is “Metop”).

P6, L162: Abbreviation “ECMWF” should be introduced.

P6, L167: This was rather an “update” of the current data set than a “new” data set.

P6, L173-175: Also here the instruments abbreviations should be introduced.

P7, L198, Sect. 3.1 title: error bars -> errors

P7, L210: Add here the also the abbreviation of this data set in parenthesis -> (GloSSAC)

P8, L215: Write here in the section header Nearby Level also with quotation marks -> ‘Nearby Level’

P10, L274: I would suggest to move “with differences of less than 10%” behind “very similar” and using parenthesis.

P14, Figure 6 caption: Rather “hatches” than “crosses”?

P17, L394: Is this shown in this study? Which section? Add a reference or on which place in the manuscript this is discussed.

*For all the above comments, we have modified the text accordingly.*

In Line 389 you mention a warming, but without a specific month

*We have modified the next paragraph and mentioned October warming as well:*

*“The seasonal cycle of the temperature trends shows that the 1980-2001 lower stratospheric cooling is only interrupted in March when temperature trends are around zero for the radiosonde data. The absence of cooling in March might be related to the weakening of the BDC in this month, as the Arctic polar vortex has intensified during NH spring over 1979-1999 (Langematz and Kunze, 2006). This signature of the BDC trends in the seasonal cycle of the tropical cold-point temperature trends with a reduced cooling*

*trend in March (end of NH winter) is similar to the strong October warming found for 2002-2023 at the end of the SH winter (Fig. 4). ”*

P18, Figure 9 caption: Same here as for the caption of Figure 6. Rather “hatches” than “crosses”.

P17, L405: “Discussion and reanalysis vertical residual circulation” sounds weird. I would suggest to name this section just “Discussion”.

P18, L429: It is not clear if you refer here to Fig. 1 in your manuscript or in Shine et al. (2003).

P19, L440: Add a reference for this statement

P19, L444: “Here” not clear. Do you mean in this study or in this section? References: Journal names should be abbreviated. For some references it is done, but for some not. Note, for the reference of Simmons (2020) the journal and volume are missing.

Technical corrections:

P3, L82: Add “by” so that it reads “by covering”.

P3, L93: “last” -> “past” (?)

P7, L180: skip “models”

P7, L185: ERA-5 -> ERA5

P10, L274: omit “Appendix”, just writing “see Fig. A2” is sufficient.

P12, L307: omit also here “Appendix”.

P12, Figure 5 caption: MERRA-22 -> MERRA-2

P18, L424: It should read “Arblaster et al, 2014” and a space between the year and “and” is missing.

P18, L435: Add “by” so that it reads “.....by somewhat weakening...”.

P19, L462: shows -> show

P20, L477: shows -> show

P20, Figure 10 caption: for three periods -> for the three time periods

P22, 517-521: Rather than “last accessed” I would suggest to write “last access”.

*For all the above comments, we have modified the text accordingly.*