Reply to RC1

Manuscript information:

- Title: Mean age from observations in the lowermost stratosphere: an improved method and interhemispheric differences
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- MS No.: egusphere-2022-1197
- MS type: Research article
- Iteration: Final response

We would like to thank the reviewer for the kind words and the constructive comments. In the following document, the reviewers' comments are marked in *italic font* and indented, our answers are in regular font. Changes in the manuscript are marked-up in red and listed as framed screenshots below the respective comment. The line numbers in our listed changes refer to the marked-up version of the revised manuscript, that is provided separately.

Point-by-Point reply

1. *Line 192: add 'of' after 'instead'*

Done.

> with SF_6 source regions being located primarily in the northern hemisphere (Rigby et al., 2010).
>
> We performed a Monte-Carlo simulation in order to test if t_{xi} can be considered to be constant over time for each entry region. Firstly, for each entry region we calculated weighted means and standard deviations for each year (instead of for the

2. *Table 2 could go in the supplement.*

Done, thanks. We applied small changes to the manuscript accordingly:

> create 10000 time series for each entry region. Thirdly, we applied a linear fit to each of the 10000 time series and calculated the mean and the standard deviation of the slope for each entry region. The resulting mean slopes, standard deviations and the ratio of mean slope and standard deviation are listed in Table S1 in the supplementary information~~Table 2~~. For NH exTR

> ~~**Table 2:** Mean slopes and slope standard deviation from Monte-Carlo simulation using the data shown in Fig. 2. Ratios of mean slopes and standard deviations have been calculated prior to rounding.~~

~~-~~	~~mean time shift slope / years years-1~~	~~time shift slope standard deviation / years years-1~~	~~ratio of mean slope and standard deviation~~
~~NH exTR entry region~~	~~$-2 * 10^{-3}$~~	~~$3 * 10^{-3}$~~	~~-0.9~~
~~TR entry region~~	~~$-5 * 10^{-4}$~~	~~$3 * 10^{-3}$~~	~~-0.2~~
~~SH exTR entry region~~	~~$-1 * 10^{-3}$~~	~~$2 * 10^{-3}$~~	~~-1.1~~

We updated the supplementary information accordingly:

S2 Time shifts to three entry regions: Monte Carlo simulation to test slopes in annual mean time shifts

Table S1: Mean slopes and slope standard deviation from Monte-Carlo simulation using the data shown in Fig. 2. Ratios of mean slopes and standard deviations have been calculated prior to rounding.

	mean time shift slope / years years-1	time shift slope standard deviation / years years-1	ratio of mean slope and standard deviation
NH exTR entry region	$-2 * 10^{-3}$	$3 * 10^{-3}$	-0.9
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SH exTR entry region	$-1 * 10^{-3}$	$2 * 10^{-3}$	-1.1

S~~2~~3 Software implementation of calculating mean age in the LMS

3. *Line 246: 'datasets were processed in three steps.'*

Done.

dynamical tropopause (defined by the value of 2 PVU) $\Delta\theta$ is used as vertical coordinate. Horizontally, data are sorted by eq. lat. In order to visualize and compare our results, datasets were processed in ~~a~~ three-steps ~~process~~:

4. *Line 250: I don't see this age correction formula in the Leedham Elvidge et al. paper. How was this derived?*

We took the correction function that is shown in Fig. 4 of the Leedham Elvidge et al. paper. There, linear fits for different subsets of their data are given in the legend. We took the top one, named "All (no tropical)". We refer to this Fig. 4 in the revised version of our manuscript:

3. The averaged mean ages have been corrected for mesospheric loss using a linear correction function by ~~(~~Leedham Elvidge et al., ~~(~~2018), given in their Fig. 4:

$$\Gamma_{corr} = 0.85 * \Gamma - 0.02\ years \quad (7)$$

5. *Lines 313, 385, 390, 420: 'extend' should be 'extent'.*

Done.

mixed vertically and horizontally with young air in the LMS. The vortex edge is less sharp than during ST1, resulting in younger air at high latitudes and altitudes and older air outside the PGS2 vortex region compared to ST1.

These results cover only isolated time periods of less than two months for each campaign. In addition, as discussed by Jesswein et al. (2021) the exten~~d~~t of the respective polar vortices and therefore also the location of the respective vortex edge

The contribution of the individual parameters (i)-(v) is shown in Fig. 6. Each row depicts isolated sensitivities to uncertainties in a single parameter with all other parameters being held at their best estimate. This allows us to test the relative importance of the individual parameters to the exTR-TR method's overall sensitivity. Most strikingly, uncertainties in the ratio of moments (parameter (v)) seem to contribute only to a negligible exten~~d~~t to the overall sensitivity (panels (m),

in the ratio of moments (parameter (v)) seem to contribute only to a negligible exten~~d~~t to the overall sensitivity (panels (m), (n), (o)). Measurement uncertainties in the stratospheric mixing ratio $\chi(x)$ contribute evenly distributed to the overall sensitivity to a moderate ~~extend~~extent (panels (j), (k), (l)). Due to the slightly worse measurement precision during

TR method instead, the number and extent~~d~~ of negative mean age values is reduced. Maximum absolute differences between