

# Response to referee 1

## 1. GENERAL REMARKS

- *The instrument apparently no longer does tipping curves. Are these not necessary to establish the level of tropospheric attenuation of the stratospheric measurement?*

The current focus of interest is stratospheric dynamic. Therefore, the latest operational mode performs without tipping curve, to maximise the observation time for stratospheric retrievals. Details on the tropospheric correction can be found below.

- *The diurnal temperature tides do not appear unreasonable, but, given that the measurements need to be taken from an instrument at a diurnally varying surface through a diurnally varying troposphere, are there any steps taken to ensure that these tropospheric variations are not mapped into the small (<1%) stratospheric variation shown in Figure 6? Perhaps the errors have been estimated and are much smaller than 1%, but, in any case, some short discussion of this would be appropriate.*

According to radiative transfer principals, the observed spectra can be separated into an tropospheric contribution (O<sub>2</sub> complex Figure. 2) and fine structure features ("Spikes" in Figure. 3), containing the stratospheric information. In the previous version of the retrieval the tropospheric contribution was corrected, using the line-wings according to (<https://doi.org/10.1029/98RS01000>). In the present version of the retrieval, the tropospheric profile is retrieved simultaneously with the stratospheric profile also by using the line wings. This is mentioned in Section 3 and we added further discussion in section 4. The accuracy of the tropospheric profile is not enough for weather forecasting, but this method is much more sensitive for tropospheric variations than the previous version. Also, the current surface temperature is used in the apriori profile. However, during very cloudy or raining conditions the observations are removed from the dataset. In addition the ASF algorithm fits the spectral parameters over a 4-day sliding window, very short time scale variations are further reduced by this method. The tropospheric influence can also be estimated by looking at the rows of the AVK matrix, for stratospheric grid points but at tropospheric altitudes (Figure 1 in this document, not included in the manuscript). A row of the AVK matrix mirrors how much a specific grid point is influenced by grid points from other altitudes. Note the x-axis scale compared to Figure. 4 in the manuscript. Almost all values are below 1% up to around 9 km.

## 2. SPECIFIC REMARKS

- *Please present Figure 7 and Figure 8 in the same aspect ratio so that they can be more easily be compared.*

Figures were re-scaled

- *The result that stands out in these figures is the consistency of the 18 LST phase in the upper stratosphere and lower mesosphere. This recent article by Leroy and Gleisner seems to agree: <https://doi.org/10.1029/2021EA002011>*

Reference was included.

- *Line 241- "Mai" should be "May"*

Term was corrected

- *Paragraph beginning on line 248 and Figure 11- According to the text Figure 11 is a correlation between ozone mixing ratio and tidal amplitudes. If that is correct then please state it clearly in the caption as well. I don't understand the relevance of the ozone diurnal cycle mentioned in the first line of the paragraph. If ozone is driving a diurnal temperature variation I would think that this is related to the presence of solar irradiation during the day and has nothing to do with the small diurnal ozone variation. The final sentence of this paragraph is also confusing in this regard.*

The correlation is made between ozone VMR and atmospheric temperatures, we added "VMR" in the caption.

The forcing driven by the ozone diurnal cycle with a VMR variability of about 2% will be small. This part was meant as a motivation for further studies. We are currently, evaluating heating rates from WACCM and other data sources to estimate the energy fluxes. But a detailed analysis is beyond the scope of the paper. We have revised the main text.

- *"was located partially" should be "was*

Term was corrected.

- *Line 110 "frequency stretch"? What does this mean?*

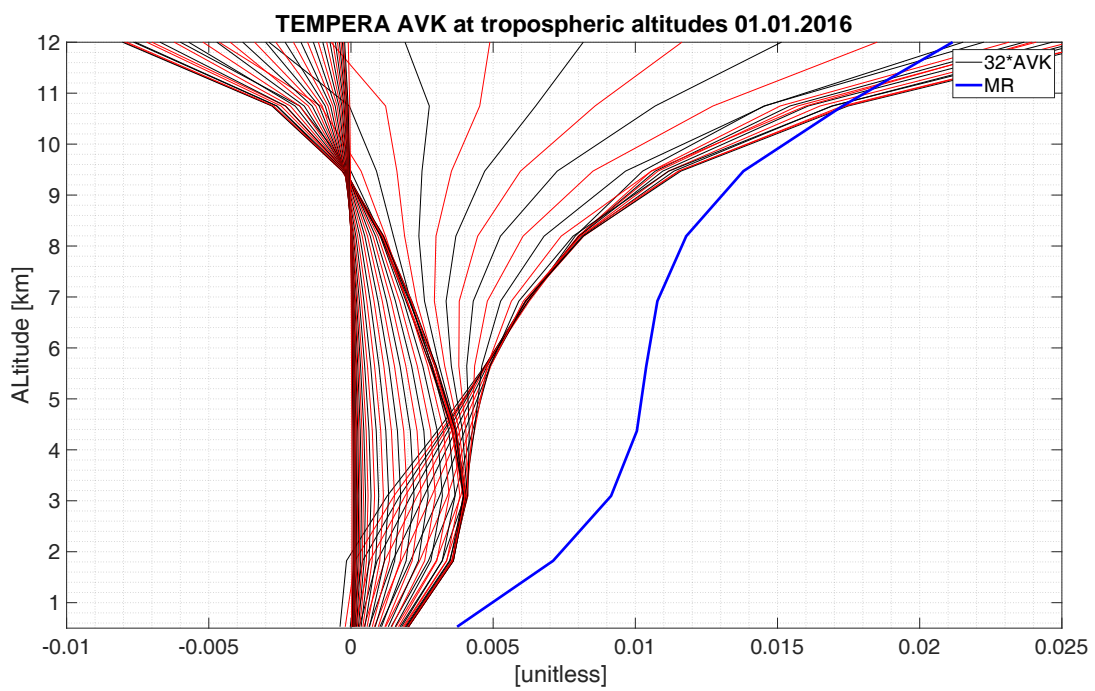
The bandwidth of the spectrometer channels can have a small error ("frequency stretch") which is accounted for by including this quantity in the ensemble of retrieval quantities.

- *Figures 2 and 3 are referred to before Figure 1.*

Figure was moved to position 3.

- *Figure 5 – Any comment on why there is such a very low altitude peak in the earliest data (Feb. 2014?)*

The time series starts in January 2014. The anomaly the reviewers refers to belongs to a FSW (Final Stratospheric Warming) event and the corresponding planetary wave activity (<https://egusphere.copernicus.org/preprints/2024/egusphere-2024-65/>).



**Fig. 1.** Rows of the AVK matrix for stratospheric grid points, plotted at tropospheric altitudes the x-axis scale was reduced in comparison to Figure. 4 in the manuscript.