Response to the Comments

Colour code:

comments of the reviewer

response by the authors

proposed changes in the manuscript

General comment:

This very well done paper systematically explores the reasons behind the observed differences in δD variation in the lower stratosphere. All of the major contenders are considered including sampling, vertical resolution between instruments and between data products, and the previously known “start altitude effect” in MIPAS. The analysis is convincing and the treatment is thorough, using appropriate averaging kernels and an understanding of the retrievals without becoming overly technical (this is well balanced with supplementary figures in the appendix). It is a fine example of how careful handling of such satellite observations is extremely critical for interpretation. I do agree with the other reviewer that a rephrasing of the last sentence of the abstract is required. Aside from some very minor suggestions for the authors to consider below, I recommend this paper be published in AMT.

Comment #1:

P1, line 15: annual variation in the MIPAS data up to an altitude of 40 hPa is substantially impacted

Response #1:

The text has been changed accordingly.

Comment #2:

P4, line 6: A focal point of the discussion is the MIPAS

Response #2:

The text was changed to:

The MIPAS results in the altitude range below 25 km (~25 hPa), that have not been included in scientific analyses so far, are considered in particular.

Comment #3:

P8, line 5: ACE-FTS data set systematically indicates an earlier occurrence

Response #3:

The text was changed accordingly.

Comment #4:

Is there qualitative rationale for requiring 20 observations per bin for MIPAS & SMR, and 5 per bin for ACE-FTS?

Response #4:

This choice basically reflects the precision of the data, which is better for the ACE-MIPAS than the MIPAS and SMR data sets. The numbers themselves are empirical, based on working with different water vapour data sets for quite some time.

Comment #5:

Consider showing the time series in Fig 1 on the same time axis. As it is, it is hard to interpret even though it is pointed out in the text.

Response #5:

It is actually unclear to us what was meant with “the same time axis”. Using the combined time axis from all data sets would result in a very squeezed representation of the MIPAS data. Alternatively, just showing a single year (maybe just as a climatology) is also difficult to due to limited tropical coverage of the ACE-FTS observations. That is why we picked two years in Fig. S2 in the

Supplement. Overall, our basic idea behind the Fig. 1 (and Fig. 2) was to show the time series that are the basis for the results presented in Fig. 3. The additional figures in the Supplement stemmed from internal discussions, feeling that more on that topic needed to be shown, in line with the comment of the reviewer.

Comment #6:

Figure 6: would it be better to show these results as a function of month at a few pressure levels, rather than as profiles? It might be easier to link to the discussion in the text.

Response #6:

The profiles show the start altitude effect as we defined it by Eqs. 5 and 8. Principally, the effect has been derived by combining retrieval results from a given month. Also, the change of the start altitude (see Eq. 9) depends on the month. To show the data at a given altitude as function of month, the start altitude effect should actually be normalised with the change of the start altitude, otherwise the data are inconsistent from month to month. Admittedly, it never came to our mind to plot the data like that.