

## ***Interactive comment on “A reassessment of the discrepancies in the annual variation of $\delta D-H_2O$ in the tropical lower stratosphere between the MIPAS and ACE-FTS satellite data sets” by Stefan Lossow et al.***

**Anonymous Referee #3**

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The paper describes the analysis made to understand why ACE-FTS and MIPAS data on the behavior of the  $\delta D-H_2O$  coming from the retrievals of the  $H_2O$  and  $HDO$  volume mixing ratio (VMR) profiles do not agree. In particular MIPAS was finding a tape recorder behavior of  $\delta D$  with an amplitude larger than ACE-FTS and larger also than what was measured by SMR and predicted by models. It is an interesting investigation and deserves to be published.

However, first of all I feel that the title of the paper and also the paper itself, should clearly state that the MIPAS results discussed here are obtained with the IMK/IAA processor,

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because the reported discussion is valid only for the results obtained by that processor and not to MIPAS data itself. In fact, all the analyzed causes are related to features typical of the IMK/IAA analysis method (the starting altitude effect, the different vertical resolution, the Averaging Kernels) and the same results do not apply to retrievals made with different algorithms. This is my main concern. Below find my comments arranged by sections and lines of the discussion paper.

Abstract

At line 14 it is said that the  $\delta D$  annual variation is impacted by the start altitude effect. However, in the text (page 12 line 7) it is said that this effect does not remove the discrepancies with ACE-FTS. So, I suggest to change this sentence clearly saying that the start altitude effect alone does not explain the discrepancies among MIPAS and ACE-FTS. Also I would not say in the last sentence that MIPAS confirms the signal amplitude but that MIPAS data are consistent with the ACE-FTS signal amplitude

Introduction

When you introduce the concept of  $\delta D-H_2O$  I think it needs to be explained what  $\delta D$  stands for.

Line 2 page 3 'The link to results above' -> 'The link to results at altitudes above'

Line 8 page 3 'The remainder they' -> 'The remainder was'

Line 18-19 page 3 'The observational database yields very different pictures to this question' -> 'The reported observations show different answers to this question'

Line 6 page 4 'newer data' -> 'different data (MIPAS data do not change, it is the dataset that has changed)'

Line 7 page 4 'however the discrepancies ...' -> 'and we find that the same discrepancies exist'

Same line 'aspects that could give rise to' -> 'causes for'

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Data sets and handling

Line 19 page 4 'newer' -> 'different'

I have tried to understand the difference between the old and new MIPAS datasets. I could not find any real description of it. Could you please clearly state where the difference is?

Reassessment

In this section Figure 3 is introduced before Figure 2, please check it.

Figure 1 shows the full datasets used in the work. For the sake of comparison I would have liked to have Figure 1 reporting the results on similar time-scale, as it is difficult to compare the behavior of  $\Delta T_d$  for the different instruments. Maybe you can add a figure where the 4 datasets are shown on the same scale (1 year should cover the same length of the x axis) something similar to figure S2 but starting with the same month for all datasets.

Why you blame the start altitude effect on MIPAS and you do not mention the same problem for ACE-FTS? I suppose the two instruments are affected by the cloud coverage in the same way, since they measure in similar spectral regions with the same observing geometry (limb).

Also I think that discrepancies between ACE-FTS and MIPAS could also arise from the fact that MIPAS observes along track (therefore its LOS covers several degrees of latitude) while ACE observes the Sun through the atmosphere (therefore its LOS covers several degrees of longitude). The horizontal gradients experienced by the two instruments are different, and can cause part of the discrepancies in the results.

Line 24 page 6. I suggest to insert 'Running the model over' before the sentence starting with 'Other time periods'

Line 15 page 7 'Exemplarily' -> As an example

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Line 18 page 7 'as function of' -> as a function of

Line 19 page 7 'row' -> rows

Discussion

I will clearly say in the first paragraph of this section that you are investigating only the possible cause of errors for MIPAS analyses and check if any of them explain the differences between MIPAS and the other datasets.

Page 10 line 6 I do not agree that an ideal kernel is symmetric around its peak for limb observations

In section 4.2 I suppose that the start altitude effect is caused by the use of a fixed vertical (altitude, pressure?) grid in IMK/IAA analysis. I suppose ACE-FTS and SMR use a different strategy. Is it true? The global fit is used at least by both IMK/IAA and ACE-FTS retrievals, so it should affect the results in similar ways.

I have another comment of this section: you test the start altitude effect on real observations. Why don't you use simulated observations where you have all the parameters under control?

In Section 4.3 you say that 'ACE-FTS retrievals are unconstrained at the expenses of not considering effects by the finite field of view' I do not agree with this statement. Unconstrained retrieval does not disregard the field of view effects if they are properly included in the computation of the spectra and the jacobians of the measurements.

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