

Interactive comment on “Harmonization and Diagnostics of MIPAS ESA CH₄ and N₂O Profiles Using Data Assimilation” by Quentin Errera et al.

Anonymous Referee #2

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General comments

In this paper, Errera et al. describe assimilation experiments using MIPAS upper-tropospheric/stratospheric CH₄ and N₂O profiles from the ESA processing version 6 and, partly, also version 7. These tests indicate deficiencies in the retrieval results in the equatorial lower stratosphere/upper troposphere and problems due to the calibration during certain periods. The aim of the study is to demonstrate the possibilities of data assimilation for the diagnosis of space-borne atmospheric observations. To make this point clearer, it would be good if the authors could summarize, e.g. in the conclusions, which issues could only (or with more confidence) be detected due to the application of data assimilation and which would be obvious also without this technique. After addressing the items listed below, I support publication of the manuscript in AMT.

Specific comments

P1L5: 'can be noisy'

The term 'noisy' may imply that the effects are due to measurement noise; perhaps 'unstable' would be more suited(?)

P1L6: 'B matrix'

This is 'slang' for insiders. Please use an explanatory term.

P1L11: 'the calibration method'

Is it really the method or the availability of calibration data/files?

P4L92: '(NOM) with altitude soundings between 7-72 km'

I think it is important to note here the latitude-dependence of the lowest tangent altitude in the OR phase.

P4LL105-120:

Please give the exact pages, where to find this in Rodgers, 2000. How has the interpolation of A and y_0 been performed? Please give the formulas. Which vertical-grid has been used (altitude, pressure, theta)? Have dedicated AKs for each MIPAS profile been applied?

P5L129: ' This is due to the use of an oscillating MIPAS profile'

Is it really only due to the oscillating MIPAS profile or also due to the AK? Could you please explain why it is 'allowed' to apply the Rodgers formulation using an already oscillating y_k – should the formulation not also be valid when a non-oscillating profile is used as y_k (I understood that this is not the case)? If it is only due to the profile and the oscillations are not in the AK, does this mean that the reason for the oscillations are due to some kind of systematic error (comparing the error bars in Fig. 1b with the strength of the oscillations it seems that those are not only due to random errors)? Is

there any speculation on the reason for the oscillations? Will those be less strong in MIPAS version 8?

P7L221: 'the variance of R is given by the ML2PP retrieval'

Does this account only for random noise or also for 'random'-like or systematic other error components, like calibration etc?

P8L253: 'Figure 3 shows the zonal mean analysis of CH₄ from six BASCOE experiments'

It would be interesting to plot here also zonal means of the 'pure' MIPAS dataset. Further, has the latitude dependent lower boundary of MIPAS been considered? I.e. are you sure that no data are plotted which are below the lowest tangent altitude of the limb-sounder or is this covered by use of location-specific AK's?

P9L293: 'This suggests that the observational error covariance matrices provided by the MIPAS ML2PP retrieval are not optimal for data assimilation.'

Could you show such a covariance matrix? Are there any ideas if there are general problems with the error covariances of MIPAS?

P12L384: 'in the tropics. In that region, REAN analyses are relatively noisy and the N₂O seasonal variations observed by MLS are not reproduced by the reanalysis of MIPAS N₂O and CH₄.'

Do you mean at the lowest level? Any idea why this is not observed by MIPAS? Is it present in the MIPAS raw data? Could it be due to cloud contamination? Is this feature present in the raw simulations?

P13L415: 'are in good agreement'

This expression is also used elsewhere in the paper. It would be better to make 'good' more quantitative by e.g. providing a specific context ('good' compared to what?).

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P13L418: 'show unexpected discontinuities which are to be due to the weekly calibration of L1 data'

It would be very helpful for users of MIPAS data to provide a table with the exact dates affected by the calibration issues.

P21Fig5:

It would be illustrative to show the ACE-FTS regression curve from (a) in all sub-plots (b-f).

Technical corrections

P6L171: 'recommandation' -> 'recommendation'

P10L326: ' (Fig. 5)': but BASEv7 is not shown there(?)

P11L338: 2x 'agreement': please improve text

P21, Figure 5a: please use the same grid lines as in other sub-plots

P21, Figure 5 caption: 'experiments' -> 'experiments'

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