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Atmospheric Measurement Techniques Discussions

Interactive comment on "Stratospheric CH_4 and CO_2 profiles derived from SCIAMACHY solar occultation measurements" *by* S. Noël et al.

Anonymous Referee #2

Received and published: 21 December 2015

SCIAMACHY CH4 and CO2 review

The manuscript is a good introduction to the new SCIAMACHY retrieved data sets. It's great to see new data sets of CH4 and CO2 from an atmospheric limb sounder, as these are rare. The paper is fairly well written. There's a bit of concern with some of the uncertainty characterization and the choice of coincidence criteria. The lack of correlative CO2 comparisons is also an issue, especially when there is an ACE CO2 data set (as referenced in the paper). Other than these issues, there are just a few minor issues and technical corrections that are needed.

Specific issues

If the majority of ACE profiles are within 1 hour, why not make that the coincidence

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criteria (as opposed to 6 h) and have it consistent with HALOE? Even if that were to halve the number of coincident profiles, 650 pairs would still be statistically significant. Similarly, a 9 h criteria, yielding 25,000 coincident pairs with MIPAS, isn't necessary. Tightening up the criteria to something closer to the HALOE 1 h criteria will lead to more reliable comparison statistics while in no way sacrificing statistical significance.

As noted in the manuscript, ACE does have a CO2 product. Even if it doesn't have the same altitude range as the SCIAMACHY data it does have overlap in the lower altitude range. It would be extremely beneficial to include comparisons with ACE in the overlapping altitude range.

Smoothing the data would only reduce the error if the error was purely random. There will absolutely be systematic uncertainties in the derived scaling factors, and smoothing the profile does not reduce these errors. If you are going to claim that smoothing improves your error estimates, then there needs to be a more rigorous analysis of the breakdown of the altitude dependent systematic and random errors in the retrieval, and show how these are both affected by the smoothing and how they contribute to the total estimated uncertainty.

As the saturation and temperature scale factor values can be relatively large, there needs to be some further analysis and discussion on what uncertainties there are in the pre-calculated scale factors and how these contribute to the overall uncertainty in the derived profiles.

A number of times pressure/temperature differences between data sets has been cited as a source of uncertainty. It should be fairly straight forward to quantify the error in the SCIAMACHY VMRs due to p/T uncertainties and include this in the total error.

Minor issues

Abstract: Just needs a few more details about the actual retrieval. E.g. Spectral band, CO2 altitude range, etc. Also the discussion of trends could be more specific and give

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the values/altitudes/significance.

SCIAMACHY data section: should state/describe what the absorption features are being observed

HALOE data section: It should be noted that the HALOE validation reference was using v17 data, not v19.

11470 lines 10-13: I don't think these lines are necessary

11471 lines 9-14: If this altitude region isn't considered, there isn't much need for this discussion.

11471 lines 26-28: The way this is worded makes it sound like you are only using one reference spectrum rather than two.

11473 line 16: is 800 km a typo? It says this is the same as the ACE criteria, but the ACE criteria was previously stated to be 500 km.

Error correction section: what is being used as the covariance matrix?

When comparing with ACE profiles, it should be noted that the ACE error bars represent the retrieval statistical fitting error, which are not necessarily representative of the precision (or the accuracy or the total uncertainty).

11480 line 4: It might not be accurate to say that most optimal estimation algorithm make use of regularization

Comparisons with MIPAS: In order to be more accurate, the agreement is not "almost perfect", the systematic differences are near zero.

Figure 1 caption: last sentence is more discussion that belongs in the main text than information about the plot.

Figure 3 caption needs to be more specific.

Figure 12: Latitude units should indicate that it's Northern hemisphere (e.g., °N).

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Technical issues

All references to “manuscript” should be “study”

11468 line 8: “extended to” should be something like “broadened from ?? - ?? to 17-45 km”.

11470 line 5: “to CH4 retrieval” should be “CH4 retrievals”

Line 6: unclear what “at that time” refers to

Line 24: “most recent” should be deleted

11471 line 6: “already” should be deleted

Line 19: is signal to noise meant by “signal”?

Line 25: “scan” should be “scans”

11774 line 7: “in” should be “on”

11775 line 1: ONPD has already been defined

Line 17: “in solar occultation” isn’t necessary

11776 line 3: “radiative transfer calculations using” could be better as “using the radiative transfer model”

11782 line 12: “as can be seen from this figure” is not needed

11786 line 13: delete “also”

11791 line 12: “in” should be “on”

Figure 2 caption: last sentence is not necessary

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 11467, 2015.