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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Global CFC-11 ($CFCl_3$) and CFC-12 (CF_2Cl_2) measurements with the Michelson Interferometer for Passive Atmospheric Sounding (MIPAS): retrieval, climatologies and trends" *by* S. Kellmann et al.

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article **Authors' Reply**

Authors' reply by S. Kellmann on behalf of all coauthors

The original review is printed in *italic face* and our reply is normal roman face. We thank both reviewers for their helpful and supportive reviews.

Review 1:

Review of Kellman et al., Global CFC-11 and CFC-12 measurements with MIPAS: retrieval, climatologies, and trends. This paper reports on 10 years of measurements of CFC-11 and CFC-12 by MIPAS. It includes and overview of the retrieval method, the climatology of both species, and trend analysis. I really liked this paper! I suggest publication provided the following minor comments can be addressed. Part of the reason I really liked the paper is that it was succinct,to the point, and provided potentially important new observations while not trying to "over interpret" the observations. While I choose to remain anonymous, let me say that I usually provide much more challenging reviews. I do not see anything in the submitted paper to challenge. And, Thomas gave a very nice talk on this study at a recent meeting I had intended. While of course I am basing my review solely on what is written, I was looking forward to reviewing this paper, because of the excellent talk.

We thank the reviewer for these encouraging words!

Major Point: 1. My only major point (i.e., very important I really hope will be addressed) is that the color scheme used for Figs 12 to 16 is, for some of the panels, chosen in a manner that not much quantitative info can be read from the plots. For instance, in the text, it is stated dCFC-11/dt from Elkin's group is about -25 pptv/decade. The blue shade for -25 pptv/decade in the top panel of Fig 12 is essentially identical to the blue shade used for -40 pptv/decade. Also, there are large patches of red in some of these panels. I think the modeling community will be keen to compare results of CCMs to the data in this paper. I also know a SPARC-led climatology is under development. Regardless, each paper needs to stand on its own. For this paper, I would like to see

ACPD

12, C9088–C9095, 2012

tabular representation of the values shown in every panel of Figs 12 to 16, either in supplemental material or a website the authors will maintain for the next 4 to 5 years. I think the color bars can be improved to provide more detail for many of the panels in Figs 12 to 16, but this is less important than providing easy access to the numerical values of the trends shown in these figures.

We see the need to communicate the results in a more quantitative manner. We will add data files in simple ASCII format as supplement to the revised version to make quantitative work with our data better possible. However, we have spent much time on finding a color table which represents the positive trends in a neutral way with clearly distinguishable zero trend. In most color tables we have tried, either positive or negative values seem to better catch the eye, and the zero is not clearly visible. We will try to find/build a better resolving color scale which still meets our criterion of symmetry, but in the case we fail with this, we still have the tables.

Minor Points, substance: 1. Page 18328, lines 23 to end of paragraph: I recall that LIMS also measured CFC-11. If so, should include a LIMS reference.

We have not found any website or reference mentioning that LIMS measured CFCs. To our knowledge LIMS measured temperature, ozone, HNO_3, NO_2, and H_2O. We have indeed found a website mentioning LIMS in the context of CFCs, but here LIMS does not mean the "**L**imb **I**nfrared **M**onitor of the **S**tratosphere" on the Nimbus-7 satellite but "**L**aboratory **I**nformation **M**anagement **S**ystem". The latter 'LIMS' is not relevant to our paper.

2. Page 18329, lines 18 and 19: The sentence "We consider...nominal mode..." was confusing upon first reading, because I tried to connect it to the FR and RR modes in

ACPD
12, C9088–C9095, 2012

the prior few sentences. I thought one of these most be the nominal mode, not that FR and RR both have a nominal mode. I now understand. But I suggest making this clearer, for an uninitiated reader.

Will be reworded:"We consider MIPAS measurements in the so-called nominal measurement modes of both the FR and the RR period"

3. Page 18330, line 6: I am not sure what is meant by "distinct data analysis schemes". Does this mean "different algorithms"?

Yes, we will replace 'distinct data analysis schemes' by 'different data analysis algorithms'.

4. Page 18342, line 17: suggest at least one other reference in addition to the one used, that reports on there being relatively young air in the lower stratosphere. Should refer to an early paper on this topic. I could suggest some, but these are easy to find. It looks strange to self cite here. Ok to keep the Stiller reference, but please add at least once citation to an early paper.

We will add the following reference:
Waugh, D. W. and Hall, T. M.: Age of stratospheric air: theory, observations, and models, Rev. Geophys., 40, 1010, doi:10.1029/2000RG000101, 2002,
and references therein.
The reason of citing our own paper in the original version was that we referred to the particular age distribution at this time, not to the generic statement that lower stratospheric air is younger.

ACPD
12, C9088–C9095, 2012

5. Fig 11 and 14 are NICE... but no need for so many zeros for the altitude designation. Please use simple integers and a slightly larger font, so that the altitude designation is more apparent.

agreed.

Minor Points, grammar:...

We thank the reviewer for spotting these and will correct the text accordingly.

Review 2:

Global CFC-11 (CFCl3) and CFC-12 (CF2Cl2) measurements with the Michelson Interferometer for Passive Atmospheric Sounding (MIPAS): retrieval, climatologies and trends by S. Kellmann et al. This manuscript describes global infrared measurements of CFC-11 and CFC-12 by MIPAS and their anticipated scientific usage in monitoring the stratospheric chlorine budget. The retrieval characterization and associated errors are described with satisfactory detail. The manuscript is suitable for publication. I have some minor corrections and questions which are outlined below.

The authors thank the reviewer for the helpful review. Below we include only the comments and questions with respect to the contents of the paper. Language and technical errors will be corrected. Thanks for spotting them!

P18328, L25: Aura HIRDLS also measured CFC-11 and CFC-12

ACPD

12, C9088–C9095, 2012

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We will reference:
Khosravi, R., et al. (2009), "Overview and characterization of retrievals of temperature, pressure, and atmospheric constituents from the High Resolution Dynamics Limb Sounder (HIRDLS) measurements", J. Geophys. Res., 114, D20304, doi:10.1029/2009JD011937.

P18330, L5: Surely the five other attempts (make that six including the official ESA products) to retrieve CFCs from MIPAS merits further discussion?

Unfortunately, there is not much published information available on the other CFC data sets. Thus this kind of discussion would be somewhat speculative. However, in order to acknowledge all the other work, we make reference to all papers on MIPAS CFC retrievals we are aware of.

Why so many alternative datasets from the same instrument? Why do we need yet another? How do the others compare?

This is a good question but we do not know if we are indeed the ones to whom this question should be addressed: Our CFC-data set was one of the first available (Glatthor et al., J. Atmos. Sciences, 2005). The reason that we have published the manuscript dedicated to MIPAS CFCs only now is that we do not consider the previous MIPAS CFC products (neither ours nor the other ones) generated with 1D retrievals without consideration of horizontal temperature gradients as a mature product. Related artifacts, i.e. differences due to horizontal inhomogeneities of up to 15 %, have been found by Kiefer et al., AMT, 2010.

Comparison of the CFC data products derived from MIPAS by different processors

ACPD
12, C9088–C9095, 2012

goes beyond the scope of this paper.

I noticed that the Moore et al (2004) reference is for an abstract which is no longer accessible according to ...
http://www.geophysical-research-abstracts.net/volumes.html
Geophysical Research Abstracts (GRA) is published primarily online as an open access publication. Volume 6, 1st EGU General Assembly, The volume is no longer online available.

We will replace the reference with:
D. P. Moore, A. M. Waterfall, J. J. Remedios, "The potential for radiometric retrievals of halocarbon concentrations from the MIPAS-E instrument", Adv. Space Res, Vol. 37, pp. 2238-2246, doi:10.1026/j.asr.2005.06.058, 2006.

P18331, L3: Seems odd to use zero as the a priori for a product with significant non-zero values when there is apparently an ESA climatology available. The intent is presumably to avoid introducing a latitude dependent bias in the data products arising from a varying a priori contribution. Or does it mean the initial guess retrieval is set to zero?

Our regularization scheme constrains the altitude gradient of the profile rather than the values themselves. Thus zero a priori is equivalent to any other a priori as long it is constant with altitude, we could well have chosen any other number. The use of climatological a priori profiles has been tried but has led to oscillations if the exact altitude of the gradient change of the true profile was not known.

P18331, L14: SI units would be useful to know in addition

ACPD
12, C9088–C9095, 2012

yes, agreed.

P18331, L28 and P18332, L9: Artefact or Artifact? Either is ok, probably should prefer the former for a European journal.

The other reviewer seems to prefer the American spelling ... anyway, we will make the spelling consistent throughout the paper.

P18332, L3

Introduce the specific data versions produced by IMK/IAA (V5R_CFC..., V4O) at the end of first paragraph of section 3. Also useful to indicate where/how/if users may obtain the data products.

We have introduced the specific data versions used for this work already in Section 2.

We will add the information how to obtain our data products at the end of the conclusions.

ACPD

12, C9088–C9095, 2012