

Interactive comment on “Retrievals of heavy ozone with MIPAS” by Bastiaan Jonkheid et al.

Anonymous Referee #2

Received and published: 21 July 2016

Retrievals of Heavy Ozone with MIPAS by Jonkheid et al

Reviewer Comments.

Summary

The paper describes profile retrievals of the relative concentrations of 18O variants of ozone, based on a single day of MIPAS data. The authors acknowledge and appear to deal adequately with the two major problems associated with 'ratio' retrievals: the handling of systematic error correlations and differences in vertical resolution/sampling. It is unfortunate that the analysis is limited to just a single day as I would have liked to have seen if the observed distributions were reproducible from day-to-day, or if there is any hint of a seasonal cycle. Perhaps that will be a separate publication.

But, as it stands, the paper is clear and concise, it presents scientifically interesting and justified results, and I have only minor comments and queries, as listed below.

C1

Minor comments

P2, L24: Suggest 'parts per thousand' rather than 'parts per mill' in case the non-expert reader assumes that 'mill' is an abbreviation for 'million'.

P2, L27: I believe HITRAN implicitly assumes VSMOW isotopic concentrations by scaling the line intensities. I suppose the authors have taken this into account. This could also slightly modify the a priori assumption of $\delta^{50}\text{O}_3 = 0$ (P4, L22) unless the standard IMK/IAA retrieval also modifies the isotopic intensities.

P4, Retrieval Set-Up. I eventually concluded that the retrieval here is a combined retrieval of the main isotopologue as well as both minor isotopomers, rather than just a retrieval of the minor isotopomers assuming the IMK/IAA V5 ozone for the major isotopologue. It could be made a little clearer that this is the case (or, if it isn't, then I don't understand P5,L10).

P4, L27: Table 1 lists only 6 microwindows in the AB band.

P4, L27: Given that most of the O₃ absorption is in the AB band, I suppose the question here is whether it is really necessary to include the two A band microwindows? Given the altitude range for these two microwindows, their inclusion appears to be for low altitude ozone where, presumably, the AB lines are saturated.

P6 Eq (7): It took a while before I understood how this fitted in with Steinwagner's formulation, but then I realised that this was only the generic definition of J. Perhaps it would help to add a further equation showing the evaluation of these two terms given the definition of delta.

P6, L13: 'matricies' should be 'matrices'. Strictly speaking these cross-terms don't account for the 'correlation between the two VMRs' (which, I assume, a priori are assumed to be independent) but the error correlations in the retrievals. On this I assume that all the systematic errors are assumed fully correlated across all microwindows/altitudes?

C2

P6, L18: I was initially surprised how small the error was in the 'enrichment' retrieval given that 5% would be considered a 'good' uncertainty for a retrieval of the main isotopologue. But then reading more carefully I realised that this actually represented an 'absolute' uncertainty in the enrichment, which is itself only a few percent. Perhaps add something here and to the Figure 1 caption to point this out, and/or add curves showing 'typical' retrieved enrichment profiles to the panels for comparison.

P6, L23: It seems odd that, of all the interfering molecules, CFC-113 should provide the most significant uncertainty. It is a minor atmospheric component (20 pptv in the troposphere, much less in the stratosphere), a long-lived gas (so one would expect its profile to be relatively well modelled) and a heavy molecule with broad spectral features (so the continuum retrieval should remove much of the effect). Is it just an unfortunate overlap for a particular key O3 isotopic line?

P6, L23: How was the gain uncertainty modelled? If it is assumed fully correlated (spectrally) one would expect the error to almost disappear once the ratio of minor/major isotopologues is taken since it just acts as a scaling of the spectrum.

P6, L27: Even instrumental parameter errors (associated with calibration) might be expected to reduce with averaging, but the spectroscopic uncertainty is the classic case of an error which (a) poorly defined and (b) irreducible by averaging.

P7, L1: 'vmr' - upper case used elsewhere

P7, L15: 'Global mean' can be calculated in a variety of ways from a simple average of all available data at whatever latitude, to cosine(latitude) weighted averages allowing for the different area of each latitude band. Given the sparsity of some of the comparison data I guess it the former is used. However, making such a comparison does assume that either (a) the latitudinal variation is small compared with the difference in datasets (which may be true), or (b) all datasets sample the range of latitudes with equal weight (which is certainly not the case)

C3

L9, P19: '<2% accuracy' - I regard accuracy as the sum of the random error (precision) plus systematic errors, but this figure <2% seems to represent just the systematic error, unless the authors are referring to the accuracy of an averaged product rather than individual profiles. Either way, clarification is required.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2016-144, 2016.

C4