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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Carbon monoxide distributions from the upper troposphere to the mesosphere inferred from 4.7 μm non-local thermal equilibrium emissions measured by MIPAS on Envisat" *by* B. Funke et al.

Anonymous Referee #2

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General comments

The paper "Carbon monoxide distributions..." from Funke et al. presents several improvements of carbon monoxide retrievals from the upper troposphere to the mesosphere using the MIPAS instrument onboard ENVISAT. Apart from a detailed description of these algorithm improvements, several case studies covering sudden stratospheric warming events, middle stratospheric CO abundances and upper tropospheric CO enhancements caused by biomass burning are shown.

Overall, I consider the paper well written and especially the many challenges ad-

dressed with the new retrieval algorithm deserve publication. The broad scope of the paper (covering algorithm development, some case studies with focus on stratospheric and mesospheric air masses and a case study on the troposphere and biomass buring) makes it sometimes hard to read as a mixed audience (and reviewers) is not necessarily very familiar with all topics. In particular the case studies are somewhat too descriptive and personally I think that the authors try to put too many findings into one paper while the paper would have benefited from a stronger (and more quantitative) focus on less case studies. However, this might be more of a personal taste and is not a reason not to publish the paper which I recommend after the following specific comments are addressed.

Specific comments

- **Introduction, line 8** troposheric lifetime of 1-2 months: The mean trop. lifetime is about 2 months and can, depending on season and latitude be far longer.
- **Page 20609, line 16** SCIAMACHY/ENVISAT: Please add at least one citation from other SCIAMACHY groups (Buchwitz et al and Gloudemans et al)
- **Page 20612, line 6** typo: profil es
- **Page 20612, line 7** Are spectral shift and instrumental line shape correction performed for each scan separately or fixed for longer time periods? What impact would it have to change this?
- **Page 20612, line 26** How is gamma being determined (arbitrarily, using the L-curve, etc?). How does the choice of gamma impact the retrieval? Does the side constraint consist of the derivative of VMR or log(VMR) and what impact would it have?
- **Page 20613, line 2** Why is a height-independent radiance offset needed (fixed offset, relative offset, origin of the offset)?

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Interactive Comment

- **Page 20614, lines 10+** The authors mention that the differences between ACE and MIPAS are largest in the unusual strong CO-downward events. Why is this the case? Is it caused by the different measurement principles or is any of the instruments having problems in this situation and how does it affect the intrepretation? Please elaborate.
- **Page 20618, lines 11+** Why don't you restrict the retrieval to weaker lines, avoiding the problems of nonlinear absorption along the LOS? Would the retrieval noise be too high then?
- **Page 20620, lines 4+** Are fit residuals stochastic or partially systematic? A plot of a fit would be nice (perhaps also illustrating the impact of the algorithm improvements on fit quality (residuals, etc))
- **Ch. 4, Seasonal variations** Can't a seasonal change in CO lifetime cause some of the seasonality?
- **Page 20622, lines 10++** Where is CH4 data takem from and why does it have a seasonality (the authors mention it shortly in the conclusion but it belongs in the main text)
- **Page 20622, lines 15+** How is the descent rate being calculated and what is the estimated accuracy of it? Is MIPAS equally sensitive to all heights or could differences in averaging kernels at different height levels impact the computation of descent rates (if, for instance, CO is being transported to a height level with higher sensitivity or narrower AK). What are typical expected descent rates in literature and how does the 1200m/day fit in (ie how extraordinary is it?)
- **Ch. 6 Upper tropospheric CO** Please also refer to Velazo et al (GRL, 2005, D16807) and Gloudemans et al (GRL, 2006, D16807) both showing similar findings caused by BMB in South America in the Oct. season.Interestingly, MOPITT

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doesn't see an enhacement at the 250 hPa layer in the time periods under investigation and Velazo et al had similar discrepancies and argued that the height resolution of MOPITT is too coarse making MIPAS one of the few instruments that can actually measure the upper trop.

- **Page 20630, lines 10++** The highest CO total column abundances from NADIR sounders (SCIAMACHY, MOPITT) are mostly seen over industrial China and less over Bangladesh.
- **Page 20631, line 7** over the Tibet...
- **Conclusions** The conclusions actually present partially new discussions which are missing in the main text. Please ensure that all discussions and citations are discussed earlier and are only summarised in the conclusions!
- **Figure 3** How is the distance-weighted averaging being performed (weighting function, width!)?
- **Figure 7 and CO-CH4 correlation in general** What is the lifetime of CH4 at this level and how does it correspond to the 0.05 scaling factor and why is there no time lag between CH4 and CO abundances? (eg at a lifetime of 8 years, 2% of methane is oxidised within 2 month. In the plot, CO always seems to be almost exactly 5% of the methane VMR, can this be explained by a simple model with given CH4 and CO lifetime?)
- **Figure 8** Continental outline are hardly visible (please change like in Fig 12) Weighting method?
- **Figure 12** In the individual measurements, there seems to be quite high scatter, is this in line with the estimated single retrieval precision and what is the estimated error in the mean maps?

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 20607, 2008.