

Interactive comment on “Global carbon monoxide vertical distributions from spaceborne high-resolution FTIR nadir measurements” by B. Barret et al.

Anonymous Referee #1

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General Comments

The paper describes retrievals of CO from a limited set of nadir-viewing spectra taken by the Japanese IMG instrument. In particular it concentrates on the possibility of retrieving information on the vertical distribution of CO rather than a simple column amount. The results compare well with other available measurements but less so with the output of a CTM, which probably represents a deficiency in the CTM rather than the retrieval. The paper includes a thorough retrieval characterisation and error analysis which support the conclusion that, given favourable circumstances, useful information

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on tropospheric CO can be retrieved from nadir-viewing interferometers.

The paper is convincingly argued, well-structured with clear and relevant figures, and includes an extensive list of references to other work. I have no major objections to formal publication.

Specific Comments

p4600 I24: I believe that successful CO profile retrievals have been demonstrated by the TES and, possibly, SCIAMACHY teams by now, so instead of saying that MOPITT is the only instrument to have done so may no longer be accurate. I suggest qualifying this by saying that MOPITT is the only instrument which has done this "operationally".

p4604 I22: You state that the a priori covariance has to represent the "best" statistical knowledge of the state. This is only true if you intend the a priori to form a significant contribution to the retrieved state. In many cases the a priori is used in the OEM simply as a "mathematical" constraint to ensure well-behaved inversion, in which case it is sufficient simply to set the covariances to be large and uncorrelated in order to minimise the impact on the retrieved vector.

p4608 I10: The Voigt lineshape has been used (p4604,I13) but this is not necessarily a good approximation for CO₂ lines which often have a "chi"-factor or other correction applied in order to account for observed non-Lorentzian behaviour. It seems quite possible that this may contribute to your retrieved apodisation parameter "a", in which case it should not really apply to CO lines. Effectively, it seems that the retrieved "a" parameter would end up applying the non-Lorentzian behaviour of CO₂ lines to the CO lines, which would change the shape of the CO Jacobian spectra.

p4609 I16: The correlation between signal and RMS difference is a bit concerning. Assuming that you mean the RMS difference is larger at the spectral minima represented by CO lines (eg Fig.1) rather than where the radiance is largest (between lines), is this really a random difference which just happens to have larger amplitude coinciding with

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the line positions? Or is it a bias which represents some inadequacy in the forward model? In the latter case I would expect it to contribute some bias to the retrieval.

p4609 I18: Do you simply fit a surface temperature assuming an emissivity of 1? (ie use surface temperature to represent actual temperature/emissivity variations). What about day-time reflected solar radiation from the surface - is this a problem?

p4612 I13-22: I'm not sure how valid it is to compare DOFS from different studies. Doesn't DOFS depend on the assumed a priori covariance? Agreed that for instruments of the same spectral resolution a worse DOFS would be expected for the noisier instrument (ie TES), but for different spectral resolutions (IASI) or completely different measurement techniques (MOPITT) it is not clear.

p4613 I16: At what altitude are these "IMG lower tropospheric CO mixing ratios"? Later on (p4616, I4) you say 1.2km but it would be helpful if it were stated here. If it is 1.2km, wouldn't you expect some sort of bias of a few percent compared to surface measurements given the shape of the CO profiles in Fig2?

p4632 Fig5: x-axis units should presumably be multiplied by 1E9 if they really are errors in ppbv.

Technical Corrections

p4600 I19: replace "pollutant" by "pollutants" I20: replace "is thereby affecting" by "thereby affects" I23: replace "contributing" by "contributes" I23: replace "is also greatly influencing" by "also greatly influences"

p4601 I9: replace "is operating" by "has been operating". I6-13: this is a rather long sentence which would be more easily understood if divided into smaller sentences. I16: remove "that has been" I17: replace "serie" by "series" I18: insert "instruments" after "...Interferometer)" I20: replace "is measuring" by "measures" I21: replace "Earths" by "Earth's"

p4602 I1: remove comma after "1997" I1: remove comma after "Sect.2" I3: remove

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comma after "formalism" I19: replace "Ministry" by "Ministry" I22: remove comma after "1997"

p4603 I7: replace "8x8 km² squared pixel" by "square pixel of 8km x 8km", which I think is what you mean.

p4604 I6: remove comma after "satellite" I7: remove comma after "surface" I7: add comma after "atmosphere" I17: remove comma after "measurement"

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