

## Review of “A strategy for the measurement of the CO<sub>2</sub> distribution in the stratosphere”

### General:

The use of combined FIR and TIR measurements to determine the vertical distribution in the stratosphere is a very interesting idea. The authors have pointed out that the measurement capabilities are available, as is the retrieval software. They have shown that it should be possible, based on measurements in a single orbit, to determine the volume mixing ratio (VMR) from the upper troposphere to 40 or 50 km altitude. The assumptions appear reasonable.

The description of the inadequacy of the sequential retrieval is good.

### Specific points:

**Introduction:** What is the need and use for such measurements? What are the requirements for determining the accuracy of the stratospheric distribution of CO<sub>2</sub>? Is an accuracy of 1 ppmv a useful constraint?

P. 4: line 10: Please give the low temperatures that are required.

l. 18: Indicate that these are the O<sub>3</sub> v<sub>2</sub> band transitions

l. 20: are these transitions rotational, continuum, or both?

l. 25ff- Does this procedure for determining MW's lead to a unique result? Do the results depend on the order of the seeds chosen?

P. 5: ll. s11ff: How much information was lost by reducing the number of MWs? How would the later results have been different if these MW's were included?

P.6: l. 5: Could the horizontal gradients be treated just as well by using a shorter orbital segment, and moving the segment around the orbit? Would this save computer resources?

l. 6: Clarify that target here refers to the different gases.

l. 24: Please say something more about the 2-D averaging kernel- how wide is it?

A plot or reference would be nice.

l. 25: Have you tried doing 1-D retrievals to get the first guess field, then go to 2-D as a correction, or refinement?

P.7: ll. 5,7 These could be stated more clearly by “For each perturbation profile a random value of A is assigned”, and “ For each perturbation profile a random value of  $\phi$  between 0 and  $2\pi$  is assigned”

P. 8: l. 19: Apparently 401 limb scans are included in a “full orbit”. If overlap to the next orbit is done, it should be stated and if necessary described.

l. 31: Spell out VCM first mentioned here (and refer to appendix)

l. 31: B values seem very large, especially 80% for CO<sub>2</sub>. Are there any model results on the variations of CO<sub>2</sub> in the stratosphere?

P. 9: I. 14: Discussion of Fig. 4- what is the reason for the vertical pattern of larger differences? Does this undercut the ability to get a geographic pattern of differences?

I. 20: Figs. 5 & 6 need standard deviations as well as mean values. My understanding of Figs. 5 & 6 is that for B=2 the perturbation is ~0.65%, or about 2.6 ppmv, so that the retrieval has reduced the uncertainty to ~ 1ppmv- is that right?

I. 32: The green lines are very interesting, in that they could be implemented by a much simpler instrument than OXYCO2. How much could the bulge around 30 km be reduced by averaging more orbits? Why is the bulge smaller in Fig. 6 for B=2?

Again, if a shorter segment of the orbit were used, could more MW's and more spectral points be used, and would this allow better retrievals of CO<sub>2</sub>? Would this improve results with only TIR channels?

P. 10 I. 25ff: If the ozone interference even with OXYCO2 high resolution leads to a systematic error of ~ 1 ppmv, what is the plan for dealing with this?

P. 12 II. 8-11: This is unclear; it seems to say that at the end of an orbit part of the next orbit is added to allow the same views of all scans. If this is right, please say more clearly.

### **Suggestions for Changes in Wording**

There are a number of places where I have suggested alternate wording for smoother English.

P 1, I. 29 ...platforms have been demonstrated

P2, I. 1: transitions are clearly visible

I. 8: Dynamics

I. 11: this assumption

I.12 ...features from being used

I. 23: suggest "uncouple" in place of 'relax", also "connection" in place of "correlation"

I. 28: ...suggest using an instrument capable of measuring simultaneously...

P.3, I.15 Hydroxyl

I. 23: ENVIronmental

I. 25: ...enables the use of the GMTR...

II. 28-29: ...IRLS spectrometer that was designed to ...

- P. 4, l. 5: ...recording time, which defines...  
l. 11: ...systems such as Joule-Thompson...  
l. 16: I would suggest “goal” rather than “target”  
l. 33: ...does not yield an increase ...
- P. 5, l. 1: corresponds  
l. 28: ...highlights how much larger ...
- P. 6. l. 14: root-mean-square
- P. 8, l.7: Again, I suggest “uncouple” in place of “relax”; other possibilities include avoid, bypass, or decouple.  
l. 11: ...T results are constrained...  
ll.23-24: ...twice as wide as the measurement...
- P. 9, l.12: ...CO<sub>2</sub> fields were negligible...
- P. 10, l. 30: ...possibility of measuring the CO<sub>2</sub>...
- P. 11, l.1: suggest “circumvent” instead of “relax”
- P. 12, l. 17,18: ...enables the modeling of horizontal ...