

Interactive comment on “First multi-year occultation observations of CO₂ in the MLT by ACE satellite: observations and analysis using the extended CMAM” by S. R. Beagley et al.

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General Comments:

In response to the reviewers comments, the paper has been significantly altered to add to the measurement part of the paper with sections 2.1,2.2 and 2.3 being added. Included is a more thorough analysis of the data quality, the retrieval method and its uncertainties.

Specific Comments:

Question: accuracy of temperatures and their effect on the retrieval and the transforma-

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tion of CO₂ abundance to CO₂ vmr. A summary (reference) of ACE-FTS temperature uncertainties and validation should be given. And what is the uncertainty of the relative altitude spacing (Δz).

Reply: A reference to the ACE-FTS temperature validation paper by Sica et al has been added, and temperature uncertainties are discussed in the new text and error estimate section. We have also added to the text (in Section 2.1) an estimate of the uncertainty on tangent height separations at high altitude: approximately 10 m, limited by the precision of the on-board clock.

Question: there is a statement on page 6 about the constant CO₂ vmr > 125 km in the p/T retrieval. This should be quantified.

Reply: The issue of the use of the constant CO₂ vmr for $z > 125$ km is now discussed in section 2.3 of the paper.

Question: A detailed list of microwindows in the retrieval should be given.

Reply: A list of microwindows is now part of the new sections 2.1-2.3. See Table 2.

Question: The vertical representation of CO₂ vmr and p/T in the retrieval (forward model, inversion module) should be addressed and possible uncertainties given.

Reply: the paper has been significantly altered to add to the measurement part of the paper with sections 2.1,2.2 and 2.3 being added in response to the reviewers concerns. Included is a more thorough analysis of the data quality, the retrieval method and its uncertainties.

Question: what is the radiometric accuracy of ACE-FTS at 4.3 μ m? In which way is the ACE-FTS ILS considered? (Like in the Boon et al. paper?) Any uncertainties here?

Reply: The ACE-FTS performs absorption-based measurements, not emission, so the question of radiometric accuracy is not applicable. The signal-to-noise ratio of the instrument near 4.3 μ m is greater than 300:1. Contributions to the uncertainty from the

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ACE-FTS ILS have now been considered in the error budget.

Question: CO₂ spectroscopy uncertainties should be considered in the error budget as well.

Reply: We have now added CO₂ line strengths to the list of items considered in the error budget. The uncertainty estimate for line strengths in HITRAN was 2-5%, The estimated the contribution to the error from this source by changing line strengths by 4%. See new section 2.3 in the revised manuscript.

Question: Lopez-Puertas et al., 2000 AGU Monograph, which is an important work in this context, should be mentioned.

Reply : Lopez-Puertas et al., (2000) is now referenced and discussed in the paper and a discussion of their results added.

Question: I do not see the point, why ATMOS measurements are not considered.

Reply: we did not consider ATMOS data for comparison because we wished to target principally data which has multi-year and global coverage in the assessment.

Question: The CRISTA profile in Figure 5 should be referred to as CRISTA-1.

Reply: The CRISTA data profile is now referred to as CRISTA-1 data and a statement has been added to highlight the CRISTA deviation from the well mixed lower atmospheric state is significant only above 80km.

Question: Accuracy of ACE-temperatures (at the end of section 5): What quantitative conclusion (with respect to the comparison between ACE and CMAM CO₂) can be drawn from Fig. 11?

Reply: No quantitative analysis was done between the CMAM and ACE temperatures in this paper however we feel from the good qualitative comparison that Fig 11 indicates confidence in the CMAM's ability to represent the basic climate state of the region in which the CO₂ issue occurs.

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