

Interactive comment on “Multi-station intercomparison of column-averaged methane from NDACC and TCCON: impact of dynamical variability” by A. Ostler et al.

C. Frankenberg (Referee)

christian.frankenberg@jpl.nasa.gov

Received and published: 9 September 2014

The manuscript by Ostler et al describes comparisons between NIR and MIR uplooking methane retrievals and attribute systematic differences between them to dynamic processes such as strat-trop exchanges as well as subsidence. It is in general well written and suitable for AMT. It can be published once some major comments (below) are incorporated as a proper discussion on what has been done to mitigate the impact of stratospheric methane has not been discussed thoroughly:

General: The problems with stratospheric variability have been dealt with in previous

C2552

publications and those should be referenced. This paper was the first to retrieve tropospheric CH₄ amounts using NIR spectra and the HF method. The paper and the method should be cited and discussed, as it is highly relevant in this study. It is striking that the HF method, which might help greatly here to detect dynamic events, is not even discussed. Washenfelder, R. A., P. O. Wennberg, and G. C. Toon (2003), Tropospheric methane retrieved from ground-based near-IR solar absorption spectra, *Geophys. Res. Lett.*, 30, 2226, doi:10.1029/2003GL017969, 23.

The Sepulveda paper is cited but not really discussed in terms of how it attempts to isolate the troposphere, which would reduce smoothing errors: Sepúlveda, E., Schneider, M., Hase, F., García, O. E., Gomez-Pelaez, A., Dohe, S., Blumenstock, T., and Guerra, J. C.: Long-term validation of total and tropospheric column-averaged CH₄ mole fractions obtained by mid-infrared ground-based FTIR spectrometry, *Atmos. Meas. Tech. Discuss.*, 5, 1381-1430, doi:10.5194/amtd-5-1381-2012, 2012.

For these reasons (dependence of XCH₄ on tropopause height), a proper validation of satellite data (and models) should, in general, take the vertical sensitivities into account, esp. for methane which can be highly depleted in the stratosphere. This should be discussed, esp. as also the satellites have their own AK and in some cases it is advantageous to validate them against a ground-based network with similar sensitivities (for this, NIR TCCON data may be better than NDACC if SWIR sounders are concerned). In general though, models can be applied to bound the potential smoothing errors.

Page 6746, Lines 9-11: Models have to be improved to detect and quantify local emissions? I would guess that the more diffuse regional through continental scale emissions inversions are more susceptible to transport bias. Page 6750, Line 15: “because of a special smoothing effect as explained in the following” somehow sounds as if something very unusual would be explained. The effect of AKs on retrievals is well known though, so I would just state: “can still arise because of different vertical sensitivities for both retrievals. The smooth...” Page 6752, line 16: I think the impact on inversions is

C2553

somewhat overstated. If the CH₄ data from NDACC and TCCON are to be assimilated into the atmospheric inversion models, these would use their respective averaging kernels. While the stratospheric variability might not be perfectly reproduced by the CH₄ model, it would at least reduce the bias as the AK corrections would be in general applied. Models could even act as a transfer standard between MIR and NIR column retrievals. You should mention that models can actually take the the smoothing error due to the AK directly into account. Page 6752, Line 19ff: Here, you should mention previous paper describing how to reduce the impact of the highly variable stratosphere. Can HF help in this case? It is well known that column CH₄ is highly sensitive to tropopause height. Page 6755, line 8: Would you consider these improvements significant? They seem very small.

In general: The analysis of STE and subsidence events is interesting and worthwhile. It would be good though if the authors can make recommendations as to how to identify them in a more operational (instead of case study) sense. What kind of stratospheric tracers (e.g. HF) could help? Also: It is seen as a problem that the AK between NIR and MIR are different. A real step forward would be to combine the two regions in a concurrent retrieval setup, which should greatly enhance the degrees of freedom for profile retrievals and might alleviate many of the problems discussed here and could also help atmospheric model if more atmospheric layers can actually be differentiated. I would encourage the team to look at these aspects in the future but realize that it is probably beyond the scope of the current study. The potential could be discussed though, esp. because the impact of stratospheric events on differences between NIR and MIR column retrievals is not very surprising and this discussion would add some more novelty.

PS: My apologies for the late review.

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 6743, 2014.

C2554