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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Validation of ACE-FTS satellite data in the upper troposphere/lower stratosphere (UTLS) using non-coincident measurements" *by* M. I. Hegglin et al.

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Reply to reviewer 1:

We thank the reviewer for his/her comments. We address the reviewer's major concerns as follows. (The comments of the reviewer are given in italics)

a) It is not true that satellites are the only means to get information on tracers at global scale. This is true for CO but not for O3 and H2O. O3 climatologies are available from a large number of ozonesondes in both the UT and the LS particularly in the NH, coincident in time with ACE-FTS, which could be used for evaluating the performances of the instrument, as done for SAGE, HALOE etc. Similarly, water vapour measurements are available in the troposphere, up to 300 hPa with the old RS-80 Vaisala sondes, now up

to 150 hPa with the recent RS92 version, whose data are assimilated in meteorological models available for ACE-FTS validation.

We disagree with the reviewer that sondes provide global coverage. How about over the oceans? The SH is very poorly represented by sondes. However we do agree that ozonesondes provide a very useful validation data set and we now use them. We do not trust water vapour from the radiosondes in the UTLS. The Vaisala RS80 measurements was generally not trusted at altitudes higher than 500 hPa, and although the newer generation of radiosondes (e.g. the Vaisala RS92) performs better than its predecessors in the upper troposphere it still does not measure adequately in the stratosphere (Vaughan et al., 2005).

b) Tracer-Tracer correlations The plots shown in Fig 4 are just illustrative. No quantitative information at all is derived. Tracer-tracer correlations hold in the stratosphere but not in the UT where large longitudinal and interannual variations of O3, H2O and CO are known to occur related to source distributions (pollution, biomass burning, etc.). In addition to the seasonal variation shown in Fig 4, the correlation changes in latitude in the stratosphere. The study would require some latitudinal separation. For deriving some quantitative information on CO and H2O in the stratosphere, I could suggest the authors to use ozone (after studying biases and variability in the ACE-FTS data by comparison with ozonesondes) as a reference.

We have assessed the possible effects of longitudinal and interannual variations by subsampling the ACE-FTS data, and find this makes no significant difference to the stated result. It is true that the correlations cannot be used for quantitative error assessment, unless the errors of one species are known. However they do provide a powerful constraint on the vertical resolution, since vertical smearing would necessarily reduce the curvature of the correlations.

c) Profiles relative to tropopause height. The comparison is restricted to 40N-60N in DJF and MAM (SON and MAM for H2O). Why not showing the other seasons and

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latitudes? Are the differences similar? Again, I have serious doubts about the usefulness of comparing 2004-2007 global NH ACE-FTS and SPRUT 2001-2003 Europe climatotologies in the troposphere where the concentrations of the species are highly variable in space and time. As in the case the tracer-tracer method, my feeling is that it could apply to the stratosphere only. Before deriving conclusions on possible biases, the approach itself should be validated, by comparing for example ACE-FTS O3 and H2O profiles with ozonesondes and meteorological models humidity profiles coincident in time.

We now show the results for all seasons. We agree that spatial and temporal variability in CO is strong in the lower troposphere. However, its lifetime in the upper troposphere and lower stratosphere which is longer than transport time scales (3 months versus 1 week, respectively) well mixed at these altitudes. This is obvious in CO distributions measured from space (e.g. MOPITT), but also follows from a model-measurement comparison study by Fischer et al. (2006). Their study shows that up to 60

We also validate the method in our new Section 3 using model data (as suggested by reviewer 2), as well as a posteriori by subsampling the ACE-FTS and ozonesonde data using different time and longitude ranges. We agree that we did not provide sufficient proof that the increased number of measurements allowed using non-coincident measurements would offset the increased geophysical variability. We trust that our revisions have now addressed this deficiency.

Conclusion Tracer-tracer and profiles relative to tropopause height methods for comparing non-coincident observations may have some merit, but which needs first to be demonstrated. A possible approach suggested for this would be to perform similar comparisons with contemporary ozonesondes and humidity profiles. But until this is not done, the figures provided for the performances of ACE-FTS in the UTLS seem to me very premature and I would thus not recommend publication at this stage.

We hope that the very significant revisions made to the paper have now addressed the

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reviewer's concerns.

References:

Vaughan, G., Cambridge, C., Dean, L., and Phillips, A. W.: Water vapour and ozone profiles in the midlatitude upper troposphere, Atmos. Chem. Phys., 5, 963–971, 2005.

Fischer, H., Lawrence, M., Gurk, Ch., Hoor, P., Lelieveld, J., Hegglin, M. I., Brunner, D. and Schiller, C.: Model simulations and aircraft measurements of vertical, seasonal and latitudinal O3 and CO distributions over Europe, Atmos. Chem. Phys., 6, 339–348, 2006.

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