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Atmospheric Measurement Techniques Discussions

Interactive comment on "Absolute accuracy and sensitivity analysis of OP-FTIR retrievals of CO_2, CH_4 and CO over concentrations representative of clean air and polluted plumes" *by* T. E. L. Smith et al.

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We would like to thank anonymous referee #2 for the positive comments and suggestions. Below we address each of the referee's comments.

Comment (1): The statement that increasing mixing ratio is equivalent to a longer path length is not true in general due to broadening effects (self broadening, air broadening). It needs to be shown that these effects do not play a role.

Reply (1): To a good approximation, the linewidths are a mixing-ratio-weighted average of the self and air broadening linewidths for a gas in air. Thus, if the mixing ratio is below about 1% (10,000 ppm), the simulated line width maximum error, when just assuming air broadened linewidths would be <1%. Therefore, any errors due to self-broadening for the mixing ratios investigated for CH4 and CO (all < 0.61%) will be negligible. However, this is not true for the higher mixing ratios used for investigating CO2 (mixing ratios ranging from 1% to 34%), where the measured linewidths will be significantly affected by self-broadening relative to longer path-lower concentration spectra of the same total gas amount. The MALT model accounts for this by including a mixing ratio-weighted linewidth (Figure 1). Figure 1 shows two spectra of 340,000 ppm.m CO2, simulated across a short (1 m) and a long (1,000 m) pathlength. The difference between the two spectra demonstrates the affect of shorter path-higher concentration self-broadening.

The manuscript will be adjusted on page 8, line 21 to acknowledge the effect of self-broadening for the CO2 measurements and to state that the MALT model accounts for this by including a self and air broadened mixing ratio-weighted linewidth.

Comment (2): I would suggest a table that summarizes the accuracies for different path-lengths assuming typical atmospheric variations.

Reply (2): Table 3 summarises the absolute accuracy of the concentration retrievals for each gas cell mixing ratio (the final line of each gas section, labeled 'accuracy of retrieved:true (best parameters)'). To make this clearer, these lines will be made bold in Table 3 in the revised manuscript and will be relabeled 'retrieval error (optimum retrieval model parameters)'. To interpret the accuracy for different pathlengths, the reader can refer to Table 1, which states the equivalent concentration at different pathlengths (30 m, 100 m and 800 m) for each gas cell concentration. If the reader was interested in ambient concentrations (e.g. CO2 at 385 ppm, CH4 at 1.8 ppm, CO at 0.15 ppm) using a 100 m pathlength, they could then identify which of the gas cell mixing ratios investigated in this study is the equivalent to those conditions (for this example the

reader would refer to the accuracies when the gas cell mixing ratio was 45,799 ppm for CO2, 168.5 ppm for CH4 and 18.96 ppm for CO).

Figure 1.*(top) Two transmission spectra of 340,000 ppm.m CO2 at 296 K and 1,000 hPa. The black line is transmission across a 1 metre pathlength, whilst the red line is transmission across a 1,000 m pathlength. The difference between the two spectra is also plotted (bottom). This figure demonstrates the self and air broadened mixing ratio-weighted linewidths used by the MALT model, and also shows the small residual between the two scenarios for the largest pathlength amount used in our study (340,000 ppm.m).*

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 3675, 2010.

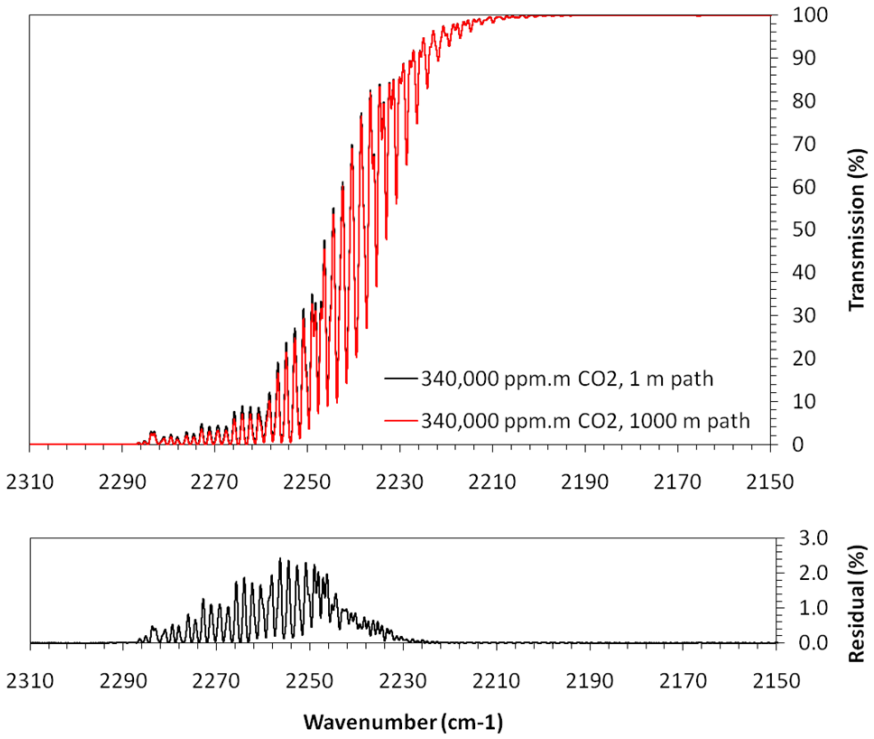

Fig. 1. Please see description in main text.