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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 1 for the positive comments and suggestions. Below we address the referee's suggestions regarding the rationale for selecting a local sensitivity analysis (SA).

Comment (1): "Authors in their methodology section could have included some more information on their rationale for selecting to perform a local sensitivity

analysis (SA) and not one that is global/variance in their study."

Reply (1): Our study built on that of Horrocks et al. (2001), expanding on that work by examining three different carbonaceous gases (rather than the single SO2 of Horrocks et al.), using an FTIR with a different detector (MCT as opposed to the formers InSB), and retrieving the species concentrations with a different retrieval code (MALT as opposed to the formers use of the code of Burton et al. (1998). In part we therefore selected to adopt the commonly applied local sensitivity analysis method so that our results could be directly compared to those of Horrocks et al. (2001), which is indeed done at various points throughout the manuscript. The decision to perform a local SA was furthermore based on the expected scale of variation in the input variables. For the two meteorological inputs examined (temperature and pressure), each is expected to be relatively well constrained using the standard meteorological data taken at the time of the measurement (e.g. by a small portable weather station mounted alongside the FTIR) and thus the degree of uncertainty in the parameterization of the retrieval code is expected to be in actual fact rather limited – for this reason a local SA appeared most appropriate, rather than a global SA where parameter values were ranged over very large (but in reality unlikely) intervals. The spectrometer field-of-view was the third input variable examined, and this too is rather well known and not expected to be subject to very large variations (its value can actually also be estimated from the data itself to a reasonable degree of precision). Finally, as can be seen in the results (Figures 9, 10 and 12), the retrieval sensitivity to the uncertainties in each input variable appears highly linear. Given this linear sensitivity, and the fact that the range of variation in the input values is quite tightly constrained, we consider that our local sensitivity analysis is sufficient to examine the expected variation in the output retrievals, and that we can compare the magnitude of the sensitivity found to that determined by Horrocks et al. (2001) using essentially the same approach.

We will adjust the manuscript to refer to our analysis as a “local SA”, with a short explanation [based on the above] given as to why this approach was chosen.

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Comment (2): "Similarly, in the discussion section, authors could have included some reference to the interpretation of their results addressing the limitations of the SA method they chose in their study in comparison with the case a variance-based method."

Reply (2): Since we selected a local sensitivity analysis approach, we feel the need to compare the advantages of this to those potentially gained by employing a variance-based SA method is limited. The latter may provide information of the effects of simultaneous uncertainties in multiple inputs (i.e. how errors in retrieved concentration might be increased or decreased by errors in two or more variables). However, as explained above, the linear sensitivity of the output concentrations to uncertainties in the three input variables suggests that a global/variance-based SA (which is best used when the sensitivities are nonlinear and the range of variation in the inputs is large) is not required.

References

Burton, M.R.: Remote sensing of the atmosphere using Fourier transform spectroscopy, PhD thesis, Department of Chemistry, University of Cambridge, 1998.

Horrocks, L. A., Oppenheimer, C., Burton, M. R., Duffell, H. J.: Open-path Fourier transform infrared spectroscopy of SO2: An empirical error budget analysis, with implications for volcano monitoring, J. Geophys. Res., 106(D21), 27647-27659, 2001.

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