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Atmospheric Measurement Techniques Discussions

# *Interactive comment on* "$XCO_2$-measurements with a tabletop FTS using solar absorption spectroscopy" *by* M. Gisi et al.

**M. Gisi et al.**

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Dear Anonymous Referee #1,

Thank you very much for evaluating our publication and for the numerous suggestions for improvements.

We adopted nearly all your recommendations concerning the English language. We will answer your content-related questions in the following:

Q: "page 3, equation 1 I assume that .2095 is the mole fraction of O2 in dry air. Why is it in this equation? Some brackets might make it clearer that .2095 is not multiplied by the denominator of the fraction." A: We changed the formula as you suggested and



explained the factor 0.2095 as the O2 dry air mole fraction.

Q: "Figure 5 The systematically occurring solar line residuals do not seem to stand out from other residuals of the fit." A: The solar line residuals do not stand out, but are in the same range than the highest peaks in the overall residual. When comparing the EM27 residuals with resolution-reduced TCCON spectrum (smaller FOV), the marked peaks can be identified easily.

Q: "page 13, line 16: Is there a reference for the statement that the intensity and shape of solar lines vary as a function of the projected solar disc radius? Also, one might argue that there would be less variation in the solar output by averaging over a larger disc." A: We added the following reference to the publication: Hase, F., P. Demoulin, A.J. Sauval, G.C. Toon, P.F. Bernath, A. Goldman, J.W. Hannigan and C.P. Rinsland: An empirical line-by-line model for the infrared solar transmittance spectrum from 700 to 5000 cm-1, Journal of Quantitative Spectroscopy and Radiative Transfer 102, 450-463, doi:10.1016/j.jqsrt.2006.02.026, 2006. We agree, that a large FOV helps minimizing temporal and spacial variabilities. However our solar model is currently optimized for the FOV of the IFS120HR spectrometers.

Q: "page 15, line 4 It is convenient in the analysis, for both this work and for TCCON, to be able to introduce some "tuning" factors, but not very reassuring to this reader. With every tuning factor and adjustment we weaken the meaning of accuracy." A: We agree that the most convincing scheme would avoid any calibration factor. However, working at a subpercent level, various small detrimental effects (spectroscopic line-parameters, radiative transfer calculation, instrumental effects) of the remote sensing approach become significant, so currently still an empirical postcorrection is required to match with the WMO XCO2 reference. The portable EM27 spectrometer allows for side-by-side intercomparisons with reasonable effort, to ensure network consistency of an hypothetical EM27 network.

Q: "page 15, line 5 I also would have expected the EM27 and HR_Reduced to give the

most similar results. In the HR_Reduced analysis was the same spectral region used for fitting as in the EM27 fitting?" A: Yes, we used exactly the same parameters (spectroscopy, spectral windows, a-prioris, ....). We clarified this in the respective sentence.

Q: "page 15, line 11 I think it would be better to leave the discussion with "we do not know" rather than "we assume it is the ILS"." A: The observed systematic discrepancy fits well within our currently estimated systematic ILS uncertainty budget. Therefore, we cannot conclude, but we think it is reasonable to assume that most of this discrepancy is due to the ILS. (It would be an unlikely coincidence if the ILS would not generate a bias of the observed size.)

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Interactive comment on Atmos. Meas. Tech. Discuss., 5, 5691, 2012.