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Atmospheric Measurement Techniques Discussions

Interactive comment on "Application of Open Path Fourier Transform Infrared Spectroscopy (OP-FTIR) to Measure Greenhouse Gas Concentrations from Agricultural Soils" *by* C.-H. Lin et al.

Anonymous Referee #3

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I really appreciate the here presented application of OP-FTIR for observation of characteristic GHG emissions from soils and agricultural landscapes. To my knowledge there is only a minor amount of papers describing the usage of this remote sensing technology in this area of interest and I fully agree with the authors concerning the potential of this method to remotely detect the emission volatile gas components in a fast and effective way.

From my side I would like to mention a few minor comments:

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- Title: "...GHG concentrations from agricultural soils" - you measure GHG concentrations in ambient air above ground surface - these concentrations can stem from emissions from the soil (including roots and microorganisms) or from the above ground vegetation. You do not measure fluxes - so be careful within your introduction - to estimate fluxes the concentration is only one of the variables needed!!!
- Page 2, line 10 ff: The authors mention chamber measurements as the most common way to investigate emissions from soils. In the same time they point out the relatively small footprint as the main limit of this method. However, I would like to introduce in this context the opportunity to measure GHG fluxes on larger scale using the Eddy Covariance flux measurements. This method is also an established method nowadays and a common micro-meteorological technique with an increased footprint to determine emissions for instance of CO_2, CH_4 and water from soils and vegetation. (e.g., Baldocchi, D. (2003): Assessing the eddy covariance technique for evaluating carbon dioxide exchange rates of ecosystems: past, present and future. https://doi.org/10.1046/j.1365-2486.2003.00629.x). Concerning to comment No. 1 - all methods are based on the measurement of the concentrations of GHGs and have their own processes to obtain emission rates.
- General comment: Time series on GHG concentrations at S-OPS including measured ambient air conditions (to have an idea about the variability of wind speed, direction, air temp, etc.) would be helpful.
- Page 4, line 24: How often did you acquire single beam spectra (how many spectra did you measure during the operational period - also to make the number of 877 valid OP-FTIR spectra more valuable)?
- Page 5, line 17: What do you mean here: "we selected ninety spectra containing 338 ppbv N_2O and ninety-three spectra containing 400 ppmv CO_2?" These spec-

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tra do contain the same concentration like the measurements at the S-OPS? Is the impact of IR absorbance due to water vapor within this spectra not so significant (my interpretation of figure 2d)? (In Figure 2 the readers find the histograms of 418 half-hour average-intervals? In Fig.2a the light grey line is located at x = 340 ppb and not at x = 338 ppb, by the way ...)

- Page 6, line 23: I see the potential and limitation of the here discussed methods to obtain a target gas free background spectrum. In my opinion, using one background spectrum per day for the zap-bkg determination is to less due to the extensive impact of changing environmental conditions on the measured IR spectra (which is surely occurring during the day in ambient air conditions like air humidity, pressure variability, ...).
- Page 6, line 30: what is meant with: all data points are stored as one data file? You calculated from each SB spectra the synthetic background and store this in the same manner like the original data spectra and us these files for the calculation of abs-spectra? How many data points are used to determine the smooth background spectra function (which order of polynom)?
- Page 8, line 27: humidity
- Page 9 / 10: Figure 5 and 6 imply, that the authors did not show all the results. To evaluate the presented methods in order to agree with the proposed "optimal approaches", a comparison of all concentration estimations (CLS, PLS, used spectral windows and background spectra) should be shown (or at least mentioned for instance as a table). Otherwise, the assessment is very hard for the reader... (For instance in chapter 3.3 the PLS for CO_2 is missing.)

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