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# *Interactive comment on* "Automatic high-frequency measurements of full soil greenhouse gas fluxes in a tropical forest" *by* Elodie Alice Courtois et al.

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In the recent years, several studies highlighted the need for continuous measurements of soil GHG other than CO2, which has been technically challenging for long time. However, combination of different new instrumentation allows addressing this challenge nowadays. I think this manuscript a timely technical note addressing one of the most important issues regarding continuous measurements: which is the balance between frequency and reliability of measurements? Despite some of the points discussed in the paper are instrument specific considerations (Li8100 and G2308), I think that most of them apply for high-frequency studies using other instrumentation. In my



opinion, two points could be covered more in depth in order to make the manuscript more strong and inspiring for the community: (i) suitability of linear or exponential fits for estimating GHG fluxes, especially under high emissions and long chamber closure time; (ii) which threshold criterions do we have to apply for low rate fluxes and which are the consequences of using different criterions on temporal patterns (both short and long term scales) and on accumulated emission estimates. Finally, I want to recognize the challenge of running this complex instrument setup in a tropical forest. Dealing with high moisture when using IRGAS and CRDS is not easy, but the authors succeeded. I am looking forward to see the data in the full experiment context with their ecological implications. Here you could find some specific comments, suggestions and open discussion points: Pg3 L19-28. Li-8100 can detect really small fluxes of CO2 as well. I guess that the main reason for using both Li-8100 and Picarro G2308 is that one instrument controls the chambers and the other measures the three gases. Additionally, measuring simultaneously CO2 with two independent systems is a good control to validate the proper performance of the instruments. I wonder which was the agreement in CO2 between Li8100 and G2308. P4 L24-28. I don't know if I understand this statement, but SoilFluxPro (Li-COR software) allows to directly upload hundreds of Picarro files simultaneously (up to 2 months). You can choose to open all the files in one single file, and directly merge it with the Li-COR data. P4 L28-30. One of the best things of using SoilFluxPro is that calculates the fluxes using both linear and exponential fits, which could result in substantial differences in fluxes (see the attached example from my own data). My experience is that exponential equations usually fits better than linear ones (in terms of R2), especially for high flux rates under long chamber closure times.

P4 L29. Which was the actual length of each measurement without including the deadband? P5 L5. Why are you not using CO2 measured with Picarro? P5 L7-8. I guess that it has to be the volume of the system (chamber, Li8100, Picarro, multiplexer and tubing). This is really important since the volume of the system is a parameter controlling the minimum detectable flux, so Table 1 might substantially change depending

on this “detail”. P5 L16-17. Again, this can be solved using exponential fits. P6 L7, L13 and L17. I guess these are not the correct figures. P6 L14-20. As far as I understood, you kept values higher than MDF (for emissions) and lower than –MDF (for sinks), but what happen with values close in between (-MDF < x < MDF)? What did you do with values close to 0 flux? And what happen if a flux was higher than MDF but had low R2? The same applies for N2O. Which criterion we have to use when measuring gas emissions at low rates? Is it a 0 flux, NA, should we keep the calculated flux regardless of the R2? Choosing one or other criterion might have several implications in order to estimate cumulative or mean fluxes, especially if the data does not have normal distribution and it’s not 0 centered. In L11 you describe an R2 criterion for considering stable micrometeorological and chamber conditions based on CO2. Then, why we should apply other criterion for the other gases if the conditions are stable? I understand that for this might not be super relevant for a technical note, but this is a key question if you want to quantify emissions in natural conditions. In my opinion, this is the core of the study, and one of the most challenging issues we need to address when measuring CH4, N2O and other trace gases. When we have high fluxes, everything is clear, but when we have low fluxes, it turns more complicated. We were discussing this issue in Petrakis et al. 2017, but I still don’t have the answers. I guess there is not a silver bullet. Figure 1A. There is something in this panel it’s not completely clear. As far as I understand, the air goes from the chamber to the multiplexer, to Li8100, to G2308, to the external pump, to the multiplexer and again into the chamber. However, in the schematic view there is a black circuit (T piece sub-sampling loop) that connects the multiplexer, Li8100, G2308 and the external pump. Since the air composition does not change between these four elements, why the subsampling tub was not inserted in serial at one point of the circuit? Table 2. I wonder which closure time did you use in this table (2 or 25min). It would be interesting a comparison between 2 and 25 closure times. I’m not sure you will find differences in the means. This would suggest that short closure times might not affect the annual balance but deviation of the data (as we can see in Ap Figure 2). Appendix Figure A1. In my opinion, this is one of the most inter-



esting figures in the manuscript and I think it should be place in the main manuscript. Some suggestions: a) Regressions will have better fit if you use exponential equations for estimating the flux. For each flux you can choose linear or exponential depending on the R2 b) Could you display R2 and the coefficients of the regressions between 2 and 25min? Regression B shows a good fit, but it seems that 2 min fluxes tends to overestimate fluxes compared to 25min estimates. Again, this could be an artifact of using linear regressions and not exponential. c) It would be interesting plotting the regression for N2O including all values (without removing data using R2 or MDF criterions)? This is related to my comment on Table 2. Apendix Figure A2. Please, edit the figure caption. Petrakis, S., Barba, J., Bond-Lamberty, B. and Vargas, R.: Using greenhouse gas fluxes to define soil functional types, Plant Soil, 1–10, 2017.

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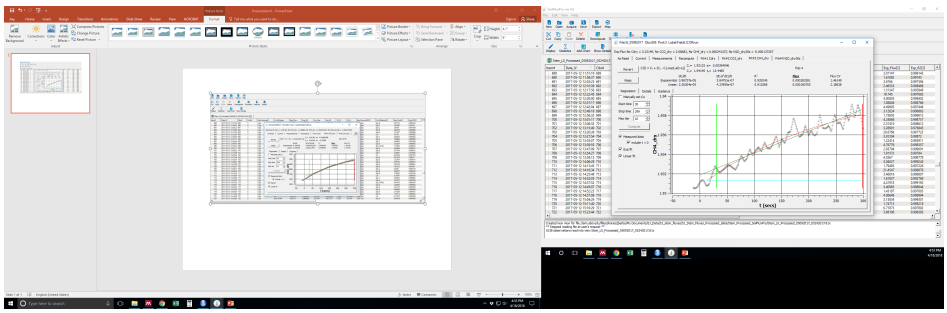

**Fig. 1.**