Biogeosciences Discuss.,
doi:10.5194/bg-2016-271-SC1, 2016

Biogeosciences
Discussions
Open Access

Interactive comment on "Gas chromatography vs. quantum cascade laser-based N_2O flux measurements using a novel chamber design" *by* Christian Brümmer et al.

N. Cowan

nickcowanuk@gmail.com

Received and published: 8 July 2016

The manuscript "Gas chromatography vs. quantum cascade laser-based N2O flux measurements using a novel chamber design" by C. Brümmer et al,. is a methodical and well written study. The results show that modern quantum cascade lasers are able to out-perform aging GC methodology when it comes to N2O flux measurements from soils. The paper highlights some strengths of the new methodology and I believe that it should be published.

However, I do have some concerns with the cited literature. This is not the first study of its kind and the novelty of the setup could be questioned. An almost identical experiment was carried out in:

Cowan, N. J., Famulari, D., Levy, P. E., Anderson, M., Bell, M. J., Rees, R. M., Reay, D. S. and Skiba, U. M.: An improved method for measuring soil N2O fluxes using a quantum cascade laser with a dynamic chamber, Eur. J. Soil Sci., 65(5), 643–652, doi:10.1111/ejss.12168, 2014.

Both of these studies conclude very similar points and I believe that this paper should be cited in both the introduction and discussion part of the manuscript before publication. Further examples of this closed loop chamber methodology include:

Hensen, A., Groot, T.T., van den Bulk, W.C.M., Vermeulen, A.T., Olesen, J.E. & Schelde, K. 2006. Dairy farm CH4 and N2O emissions, from one square metre to the full farm scale. Agriculture, Ecosystems & Environment, 112, 146-152.

Laville, P., Lehuger, S., Loubet, B., Chaumartin, F. & Cellier, P. 2011. Effect of management, climate and soil conditions on N2O and NO emissions from an arable crop rotation using high temporal resolution measurements. Agricultural & Forest Meteorology, 151, 228-240.

I believe it would improve the manuscript to mention some of these papers, at least in the introduction section, if not also the discussion when comparing results. Another reference that is very relevant when investigating negative fluxes/instrumental detection limits is:

Cowan, N. J., Famulari, D., Levy, P. E., Anderson, M., Reay, D. S. and Skiba, U. M.: Investigating uptake of N2O in agricultural soils using a high-precision dynamic chamber method, Atmospheric Meas. Tech., 7(12), 4455–4462, doi:10.5194/amt-7-4455-2014, 2014.

The uncertainty cited in the manuscript for the fluxes measured using the QCL chamber method in the abstract was $\sim$0.1%; however, how can the authors be so sure of chamber volume? The uncertainty in flux is not the same as uncertainty in dc/dt. In the flux equation the uncertainty in the volume of the chamber is relative to the height measurement, which on a uniform flat surface is negligible, but on a soil surface is more difficult to measure. Surely this uncertainty is at least 1% if not an order of magnitude greater, and so when propagated with uncertainty in dc/dt the flux uncertainty must also rise. See above references for examples.

There is no mention of a lag time between the instrument and chamber. It is suggested the first two minutes of measurement data are removed to avoid artifacts from soil disturbance. Does this also cover the time it takes for the gas to circulate fully between chamber to instrument and back to chamber again. If not then this "dead time" should be extended until the closed loop completes one full circulation to ensure mixing of the air within the tubing and chamber.

Uncertainties in comparisons of fluxes seem relatively low. Have you used standard errors in these comparisons? Would 95 % confidence intervals not be more relevant when comparing measurements known to have such large spatial and temporal variability?

A mobile field scale experiment was carried out using a similar methodology. It may not fit with this specific manuscript, but I include it for the author's interest.

Cowan, N. J., Norman, P., Famulari, D., Levy, P. E., Reay, D. S. and Skiba, U. M.: Spatial variability and hotspots of soil N2O fluxes from intensively grazed grassland, Biogeosciences, 12(5), 1585–1596, doi:10.5194/bg-12-1585-2015, 2015.

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