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Interactive comment on "Quantifying wind and pressure effects on trace gas fluxes across the soil–atmosphere interface" *by* K. R. Redeker et al.

Anonymous Referee #3

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Flux chambers are, and create, artifacts. This study presents results of experiments with a toroidal flux chamber nested inside a linear wind tunnel. Wind speed inside the toroid and outside of it were varied while concentrations of CO2 and CH4 inside the toroid were recorded. Effects of variations in wind speeds on derived fluxes are discussed. I find this an interesting study, but also wonder what it could provide in terms of generalisable insights. The toroidal flux chamber is probably unique in the world. Similar wind speeds in different parts of its cross section make me think of a small cyclone. A wind speed of 3 m/s equals along the inner circle 3 rounds per second and along the outer circle 1 round per second. This is impressive. Is it similar to air flow pattern and speeds in other, more common flux chambers?

Page 4807, line 17-19: The toroid has an outer diameter of 1 m, an inner diameter of

0.3 m, and a height of 0.4 m? If this is correct, its footprint is not 1.015 m2, but 3.14 x (0.5 m)2 – 3.14 x (0.15 m)2 = 0.715 m2, and the internal volume is not 428 L, but 0.714 m2 x 0.4 m = 0.286 m3.

Page 4813, lines 14-20: Flux was calculated assuming a linear increase in concentrations over time. Support for this assumption is gathered from r2 values of linear regressions larger than 0.9. This criterion is not convincing. The r2 was calculated for a sampling period of 120-180 s and is based on 120-180 data points (1 Hz sampling frequency). A value larger than 0.9 can easily be achieved even when concentration increase deviates substantially from a linear form, as long as white noise is small. I strongly recommend to reanalyse the data applying other than a linear model. Accounting for non-linearity can compensate artefacts associated with chambers (i.e. leaks) and substantially change results of flux calculations. The current state-of-the-art model was published a few years ago by Pedersen et al. (Eur. J. Soil Sci. 61, 888-902, 2010, DOI: 10.1111/j.1365-2389.2010.01291.x).

Page 4817, first paragraph: The example of a 10 °C temperature increase resulting not in 34 mbar, but only in 0.18 mbar pressure difference, does not necessarily support the concept of pressure buffering by air-filled soil pore space. To explain the observation, the buffer underneath the footprint of the toroid would have to have an air volume of 188 times the toroid volume (total volume of toroid plus buffer = 34/0.18 = 189). An alternative explanation, more plausible to me, is that the expanding air leaked out of the toroid through the "seal" of wet sand placed around its fringe.

Page 4821, lines 6 – 8: This statement would be justified, if previous flux estimates were also based on very short-term observations (120 – 180 s) during which pressure differences may play a role.

Interactive comment on Biogeosciences Discuss., 12, 4801, 2015.