

Response to SC2:

We were always surprised how confident researchers have been in trace gas instruments using broadband light sources for the determination of gaseous emissions from agriculture. The present paper focuses on interferences occurring in ammonia concentration determination by INNOVA instruments. It convincingly shows the severe limitations of this measurement technology and documents the strong influence of other gases on the readout of these devices. Reliable concentration measurements need in addition the determination of a large variety of compounds in order to perform the suggested correction algorithms. This is a paradoxical situation, as such measurements need complex and costly instrumentation that will make the use of broadband filter based instruments redundant. In some cases cheaper NH<sub>3</sub> passive samplers or liquid impingers can be used as a robust and reliable alternative, if high time resolution is not required. Innova-based NH<sub>3</sub> concentration measurements are likely influenced by compensating errors. The positive interferences discussed in this paper focus on the detection side, but in parallel there are potential losses of NH<sub>3</sub> in the inlet tubing/lines and switching valves, especially in multiport systems. Within livestock production systems rather high dew points are present that facilitate absorption onto most types of surfaces. Often low flow rates are used, tubing is not heated, and some inlet filters are put in place to protect the analyzer from dust ingress, which all exacerbate the adsorption/desorption problem.

It is also striking that in many peer-reviewed articles reporting emission data based on Innova or similar instruments, detailed information on the sampling and analytical system are missing, which prevents a critical re-evaluation of such data. Consequently, emission factors based on these instruments should be taken with great caution. Fifteen years ago, we investigated in detail the dependence of the concentration output, for a large range of CO<sub>2</sub>-CH<sub>4</sub>-N<sub>2</sub>O-H<sub>2</sub>O mixtures, of three different Innova's (1312, 1314) as a function of the cell temperature and the water vapor (dew point). An overview of the measurements is given in the supplement. These analyses are the base of the evaluation algorithm developed by Flechard et al. (2005) for the determination of N<sub>2</sub>O concentrations, which showed the large influence of CO<sub>2</sub>, water vapour and temperature. Another striking result was the large influence of the water content and the cell temperature on the CH<sub>4</sub> concentration. The contribution of H<sub>2</sub>O to the CH<sub>4</sub> raw signal depends on the ratio of the two gases. It will e.g. be less important in cow stable, compared to our INNOVA experiment where CH<sub>4</sub> was only a couple of ppm.

Only in case Innova devices are operated in a temperature-controlled environment, with the dew point being kept constant, can reliable CH<sub>4</sub> measurements be made. Reference Flechard, C. R., Neftel, A., Jocher, M., Ammann, C., and Fuhrer, J.: Bidirectional soil-atmosphere N<sub>2</sub>O exchange over two mown grassland systems with contrasting management practices, *Glob. Change Biol.*, 11, 2114–2127, 2005.

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Please also note the supplement to this comment:

<https://www.atmos-meas-tech-discuss.net/amt-2018-412/amt-2018-412-SC2-supplement.pdf>

Response: Thanks for the comment. We agree that reliable concentration measurements need in addition the determination of a large variety of compounds in order to perform the suggested correction algorithms. Nevertheless, depending on the application case, the dominating compounds might be limited to a few major ones, where the measurements and correction likely be possible. Still, we agree that such measurements generally need complex and costly instrumentation which make the use of broadband filter-based instruments less attractive.

In this study, we focused on interference for the detection side, there are indeed some potential losses of  $\text{NH}_3$  in the inlet tubing/lines and switching valves, which we did not investigate in this study. Typically, the PTFE tubing is used, therefore the adsorption/desorption problem was not focused but need systematic investigation in the future.

We agree very well that we have to take great care when using emission data from many peer-reviewed articles based on Innova or similar instruments, especially when detailed information on the sampling and analytical system are missing, and the corresponding emission factors should not be used otherwise.

We admit that we did not look into the effect of temperature which seem to influence significantly the greenhouse gas concentration measurement especially methane. In the future this should be investigated together with combined interference effects from various compounds on ammonia and greenhouse gas measurement by the broadband light PAS.