Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC1
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Comment on amt-2022-272

Anonymous Referee #1

Referee comment on "Intercomparison of commercial analyzers for atmospheric ethane and methane observations" by Róisín Commane et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2022-272-RC1, 2022

General comments

The paper report on tests and comparison of three recent optical analyzers dedicated to measuring both CH4 and C2H6. These sensors are increasingly needed for partitioning CH4 emissions from the fossil fuel sector. This is a very timely study since CH4 emissions from the oil and gas sector are under increasing scrutiny with the potential to achieve rapid climate change mitigation results.

The study has selected three available optical sensors that represent practical option now for field measurements and offer the possibility to run long term observations as well. The authors have brought careful consideration to properly running the instruments in their test environment. The tests offer insight into water vapour dependencies and corrections, precision, short term precision and stability against zero gas. The paper provide thoughtful considerations on practical aspects and compliance of the analyzers for different scientific purposes and contexts.

Overall the paper is well written, well presented and clear.

I suggest to compare succinctly metrology definitions with those used in a large network with systematic pre-deployment sensor verification such as ICOS (e.g. Yver et al 2015 www.atmos-meas-tech.net/8/3867/2015/)

I have three main remarks about this study :

- In this study the instruments are not compared against a reference measurement technique such as GC for C2H6. This is a missed opportunity of the study to highlight the added vallue of these optical analyzers against GC dedicated to light alkanes such as ease of operation and time resolution. On the other hand comparing the results of each sensor against GC performance would have been extremely instructive. Without this comparison it is less conclusive wether the best optical sensors are more adapted than GC for long term observations of background atmospheric composition or analysis of airmasses of regional representativity.

- The paper lacks discussion on linearity especially toward large concentrations that could be useful in the context of industrial applications. Do the three sensors perform equally linearly within the full concentration ranges that can be observed in near-source studies for both species?

- The obvious problem about the Picarro not detecting the ambiant air 10ppb C2 peaks is a major concern (section 3.5). Is it representative of a shortcoming of the G2210 model, or is it just a problem with this particular unit at that particular time, mishandling or poor quality control at the factory by the manufacturer ? This is an important concern that is opened by this study but is frustratingly not really addressed. Such a poor performance is useful to publish since this particular case suggest that the instrument do not work according to expectations. However if this is behavious is not representative of the G2210 model it cannot left as it is. Further work is needed that investigates wether this poor performance is to be attributed either to shortcomings of the G2210 model or to another reason (and if there is another reason, is there hope that it can be corrected by the manufacturer or the user). In my opinion, before this paper is published this work should really be completed to address this point. Ideally by running in parallel another G2210 unit that could maybe be borrowed from the manufacturer or elsewhere. This could be done even through a few days worth of measurements close to a known C1/C2 emitter (natural gas industrial site) with only the 2 picarros.

Specific comments

Abstract - I would encourage the authors to provide numeric values for precisions in the abstract

L44 the statement could reflect the nuance that biomass burning co emits CH4 and ethane

L81 please explain the values of 2 and 1.45

L81 define footprint in this context

L95 typically could an external flush pump solve the problem?

L114 should be lowest humidity or driest air,

L243 it should be noted here that the G2201-i, unlike the G2210 is not intended for ethane measurements. Is the value reported for Defratyka et al. applying any specific correction? Are the two sensors similarly configured in terms of laser wavelengths?

Section 3.4 Would measuring a gas cylinder with concentration typical of ambiant air yield similar or different conclusion about long term stability?

L287 : difficult to see the longer CH4 peak duration in the fig

L289 This is noticeably incompatible with the 0.8ppbprecision reported in previous sections

L304: For the picarro, not being applicable close to sources is a strong problem when considered the 0.8ppb C2H6 precision: such a precision orients the applicability of this analyzer to near-source measurements

L328, continuing on my general comments: is this problem specific to a deficient unit or representative of all G2210? as it is, it cannot be concluded wether the picarro technique

is performing poorly or if this particular unit has a problem. Has it been check with the manufacturer? It would be useful to reproduce test with another unit.

Editorial

Table 1 Aeris CH4 formula: would there be a way to better present the different formulas: linear vs quadratic

Fig 2 x axis would be more useful labelled in seconds.

L242 please choose unit ppb or nmol mol-1

Fig 4 there seems to be a technical problem with the figure: it might be not well constructed.

L327 TestS plural