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Atmospheric Measurement Techniques Discussions

Interactive comment on "Comparison of nitrous oxide (N_2O) analyzers for high-precision measurements of atmospheric mole fractions" *by* B. Lebegue et al.

Anonymous Referee #4

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This paper is a timely assessment of new measurement technology, available for the precise determination of N2O in the atmosphere. Many of the tests presented in the paper follow on from similar tests described in Yver Kwok et al. (2015). The testing procedure is appropriate for the type of measurements being made, unfortunately the tests were obviously carried out at different times and the testing procedure/protocol tended to vary somewhat over time. I am sure that if all of the instruments were to be retested the results would differ a little from those presented.

Little is said within the paper about N2O isotopes and how the different analysers behave with regards to these. This is important with regards to measuring atmospheric

mole fractions and the standards used for calibration, especially as the former GC systems aren't isotopically sensitive. It might be good to mention something about the optical instruments being sensitive to isotopes in the conclusions and recommend that users bare this in mind when acquiring calibration standards and for these instruments.

Finally, the only recommendations given are for the drying of air samples prior to analysis due to the poor manufacturer water vapour corrections. The atmospheric community would probably welcome more recommendations based on the results presented in this paper, such as calibration frequency, etc. Some recommendations may be difficult due to the inclusion of certain manufacturers as authors of the manuscript.

Specific comments: - The Abstract states part of the drive to replace gas chromatography-electron capture detectors with optical methods are that ECDs are highly non-linear. However, page 10942, line 19 it is stated that the ECD used is linear over the ambient mole fraction range. These two statements do not concur, and I believe it is highly unlikely that the ECD is linear, although the correction for non-linearity over this range will be small. Some evidence on linearity of non-linearity should be presented. - It is also indicated that the short-term repeatability of an GC-ECD system is in the order of 0.1-0.3ppb (p10941), however the short-term precision detailed in Table 1 shows a repeatability of 0.016 ppb for a 1 hour average, better that some of the optical instruments? - - ICOS is defined as two different things - integrated carbon observation system (p10939) and integrated cavity output - Line 11 of section 2.1 - the acronym ICP is not defined. spectroscopy (P10941), this could cause some confusion. - Section 3.1 - the make up of the synthetic air is not presented, nor a mention of the isotopic matrix. - Section 3.2, it is a bit misleading to provide a drift value for the GC in Table 2, since the GC data was drift corrected (as described in the text). - Section 3.4 – the 2 ICOS-QCL instruments and the DFG instrument actually show a LTR of between 0.21 and 0.32 - Section 3.6 - There is no description of the inlet system used during the tests, just that the same system was used for all analysers - Section 3.7 – Fig 3e – it is difficult to conclude that this instrument shows a measurable temp dependence.

The mole fraction to temperature relationship look unusual – perhaps this text needs to be re-evaluated for this instrument? - Section 3.9 and Figure 6. The author states that in comparison to the FTIR, the ICOS SD, ICOS 40 and QC-TILDAS show and offset of the mean difference of more than 0.25 ppb. However, the data presented in Figure 6 indicates that a value of 0.13 ppb for the ICOS SD and 0.21 ppb for the ICOS 40? - Throughout the text precisions are reported with varying numbers of significant figures – be consistent. - Nomenclature - swap between using Aerodyne and QC-TILDAS. Try to be consistent throughout the manuscript. - Table 1 - not clear about calibration scales. DS and MPI aren't calibration scales for N2O but places where analysed. Should state that on WMO-X2006a and place where calibrated. - Tables 3 and 4 - Peak to peak need explaining in the table captions. - Table 5 - normalisation process needs explaining both in table 5 and section 3.5.

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 10937, 2015.