

## ***Interactive comment on “Comparison of nitrous oxide (N<sub>2</sub>O) analyzers for high-precision measurements of atmospheric mole fractions” by B. Lebeque et al.***

**M. Vanderschoot (Referee)**

marcel.vanderschoot@csiro.au

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A good and timely paper which appears to be the first to report a comprehensive comparison between new and established techniques for the high precision, in situ measurement of atmospheric N<sub>2</sub>O. This is an important step for global networks to develop the capability for greater precision and inter-comparability to enable greater understanding of the global N<sub>2</sub>O biogeochemical cycle. It introduces the background and need for such a study very well. It does appear to be a little too focussed on providing recommendations to the European ICOS community specifically. It does read a little too much like an expanded internal ICOS document. Some of the sections could be

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trimmed down. Perhaps some more thought about co-authors who are also instrument vendors in the study as it may appear to some as a conflict of interest, especially as not all vendors in the study appear to be listed as co-authors. This is more relevant as the paper makes instrument recommendations to the reader. It is difficult at times to compare instrument techniques where not all is equal eg the impact of sample size/cell volume and averaging time have on reported instrument precisions; sample drying or not, and different research applications may have different needs. Some comment should be made about N<sub>2</sub>O isotopes, and the difference between techniques regarding this. GC techniques are not sensitive to these, however optical techniques are. There are also isotopologue specific analyzers available by at least two of the instrument vendors mentioned in this study. The abstract could be reworded to remove the sentence starting in line 19 (WMO comparability goals) should be omitted from abstract as that reference should be introduced in the introduction as it is a research community specific term. This concept would be better explained by reference to the small spatial gradients of N<sub>2</sub>O and the need for greater instrument precision and comparability. Line 22 remove ‘robust’ as it is used twice in the same sentence and without context a technique that has been used for a “. . . a few decades..” sounds quite “robust”. If this study is the first to report these comparisons then it is a good leading statement as well, or at least include it in the abstract. “ICOS” is defined for defined for two different things, although they are not related it would be better to make the distinction clearer for those outside the community. Pg 2, line 15 in the introduction could be moved to the end of the paragraph. Pg 2. The sentence starting in line16 should include the mention of the CSIRO GASLAB network in that global network list as a very significant network, particularly for the SH. Especially since Cape Grim station is specifically mentioned (a suitable reference could be Francey et al. 1996). This should include more long term N<sub>2</sub>O growth rates determined from CSIRO GASLAB integrated ice-core, firn air and the Cape Grim Air Archive. Growth rates given in the paper only refer to the last 5 years. “AGAGE” should probably be replaced with “ALE/GAGE/AGAGE”. Pg 2, line 32 “..expert group..” should be specific to WMO/GAW GGMT meeting. Pg 3, line 9 sentence

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better worded as “Since 1995 methods incorporating this technique have achieved a typical short term repeatability of 0.1 to 0.3 ppb N<sub>2</sub>O.” Pg 3, sentence beginning Line 27 could be removed. Pg 4. Title 1 suggestion “Instrument specifications” Pg 4. Sub-heading suggestion “Gas Chromatograph with Electron Capture Detector (GC-ECD)” Pg 4. Sentence starting line 17 could be confusing for those outside community w.r.t to leading comment in abstract the GC-ECD’s are “highly non-linear”. Pg4. Sub heading 1.2 should be titled “Fourier Transform Infra-Red (FTIR)” and exclude the vendor name. “Agilent” is not included in sub-heading 1.1. Or include commercial name in parenthesis. Also this section seems overly long and could perhaps be trimmed down or referenced to another document. Also sub headings 1.3, 1.4, 1.5 and 1.6 should all be consistent with 1.1 and 1.2 as specified above. Pg 4. Line 29 “FTIR” has already been defined on pg 3. Pg 8. Title 2 suggestion. “Calibration Protocol” and move much of section 2.1 into this. Much of laboratory description may not be required for this paper. A table of the different sets of calibration gases and mixing ratios may be useful. Pg 12. Line 22 “dispersion”? used several times in the document. Pg 14. Line 14 “constructors” should be “vendors” or “manufacturers” Pg 17. Suggested subheading 2.9 “Ambient air measurement comparisons”. Pg 21. Line 11. clarify “..and the room temperature should be monitored to correct for dependency”.

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