

## ***Interactive comment on “A decade of CH<sub>4</sub>, CO and N<sub>2</sub>O in situ measurements at Lauder, New Zealand: assessing the long-term performance of a Fourier transform infra-red trace gas and isotope analyser” by Dan Smale et al.***

### **Anonymous Referee #2**

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Smale et al. describe and document in this paper a ten year time-series of continuous Greenhouse Gas mole fractions measured using a FTIR analyser at Lauder, New Zealand. They describe the improvements introduced to the measurement setup and the instrument and evaluate how these affected the measurement precision and accuracy. Unfortunately they do not describe the results for CO<sub>2</sub> and <sup>13</sup>CO<sub>2</sub> in this paper and focus only on CH<sub>4</sub>, CO and N<sub>2</sub>O.

General comments:

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I concur with reviewer #1 that the paper is generally well written but way too long. Many of the detailed descriptions could be abbreviated with at least 50% or be transferred into the appendices (e.g. sections 5.4 and 5.5).

Although the paper claims that this is the longest time series from this kind of instrument to date, this could be taken with a grain of salt, one could argue that the actual homogeneous time series only starts after the many changes in setup that took place up until Feb 2014.

However, the careful evaluation of measurement biases and precision as a function of time as performed here are a significant improvement over just providing the mole fraction time-series, and should be recommended good practice for all published GAW in-situ observations.

Specific comments:

The paper refers in the abstract to the compatibility goals as set by WMO GAW for greenhouse gas observations and compares the most recent results after all improvements and fine tuning to these by looking at the comparison with analyses of flask samples. Although the comparison with flask samples is a useful and common measure for quality assurance it is not the most authoritative measure. As in section 6 the rejection criterium for the duplo analysis of the flasks for N<sub>2</sub>O at the NIWA GC system is set to 0.5 ppb, I assume that the GC analysis reproducibility is about half of this and thus we cannot expect that the comparison between flask and FTIR measurements will be conclusive and be better than this 0.3 ppb. A better comparison would be to compare with in-situ continuous observations with different techniques such as CRDS or QCL or results of one of the round-robin exercises from the GAW CCL.

Technical comments:

P8L8: for the PT100 RTD one should specify the tolerance class, the resolution of the transmitter is not that relevant as long as it is order of magnitude better than the

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tolerance class value. From the value specified in P8L16 one might guess the tolerance class is F 0.1.

P8L19: A thermocouple will show significant more short term and long term drift than any PT100 so the reason for this change is questionable. There also very thin, fast response time, PT100 RTDs.

P10L35:P11L8: There will be a small residual of sample air ( $1/200 \times 1/870$ ) left in the WS and TC air samples, is this corrected for in the analyses by using the mole fractions determined in the previous sample?

P10L35:P11L8: Why were the WS and TC measurements not performed in duplo or triplet? This would allow to detect offsets due to differences between flow and static mode especially for the first filling due to for example differences in water vapor content, this was recognized by the authors as since Feb 2014 the first calibration result is always skipped (P11L24). How big was the effect there?

P19L28: indication an -> indication of an

P19L34: approx. -> approximate

P30L25: The link given to the data will become obsolete after November 2018, as this website will be shutdown by JMA. The new WDCGG site is: <https://gaw.kishou.go.jp/>. It would be good to have the total uncertainty and bias estimates as in figure 15 also available together with the mole fraction time series in the same file or as a separate datafile.

Figure 16 there seems to be a cluster of obs for N<sub>2</sub>O where flask measurements are higher than the FTIR. It would be useful to see if the lower ring of dots below the 1:1 line between flask 325-328 ppb and FTIR 325-327 is a cluster connected in time that could be removed due to a problem in either GC or FTIR obs.

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