

## ***Interactive comment on “Intercomparison of TCCON data from two Fourier transform spectrometers at Lauder, New Zealand” by David F. Pollard et al.***

**David F. Pollard et al.**

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Anonymous Referee #2

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We thank the reviewer for taking the time to review our manuscript and for their constructive and thought provoking comments.

Below we have included the full text of their review as indented text, interspersed with our responses addressing their comments as non-indented text.

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Review of Pollard et al “Intercomparison of TCCON data from two Fourier transform spectrometers at Lauder, New Zealand” for AMT.

The paper by Pollard et al describes the intercomparison of two collocated Bruker FTIR high resolution spectrometers. The instruments are operated within the Total Column Carbon Observing Network (TCCON. This network has well controlled analysed procedures (GFIT suite of software), as well as agreed upon instrumentation (Bruker 125HR), and measurement protocols. The NZ team is very experienced in both measurements and analysis procedures demanded by TCCON. They are actively involved in the TCCON network in terms of running their own site and contributing to the success of this network. On this basis this team is well placed to compare these instruments, one a new introduced FTIR, comparing the new one with an older established dataset. Their attention to detail is very good.

The text is well written, and as far as this referee can find, only one misplaced word (remove the first “of” in line 102). The authors establish that the measurement conditions are such that the comparison of the two datasets is relatively straightforward, that is, the conditions under which the data is collected is very similar in terms of instruments, collocation, and hence atmospheric conditions. They systematically consider the important nuances that have been carefully scrutinised and worked through over the years within the TCCON community, including Ghosts, air mass dependence, frequency shifts, signal to noise etc. The paper demonstrates that under normal conditions experienced at Lauder these two instruments perform at a remarkably consistent level, more than meeting various TCCON metrics.

The only suggestion here is a straightforward statistical one. Since the

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main product that is compared, the means of the various retrieved Xgas, a simple t-test would give a solid quantitative basis to the conclusion that both instruments are measuring the same thing.  
This paper is recommended for publication in AMT.

The spurious "of" at line 102 has been removed.

The authors have spent some time considering the reviewer's suggestion of including a t-test. However, for the reasons set out below, we have decided not to.

The purpose of the manuscript, and its main conclusion, is to show that the TCCON data record at Lauder can be considered continuous across the change of instrument. This has been achieved by demonstrating that the difference between  $X_{gas}$  retrievals of both instruments is smaller than the likely uncertainty in the retrieval process and site-to-site biases, and so will not have an adverse effect on users of the data.

There will, however, always be small differences between the instruments and hence a bias between their results. This, combined with the large sample of ten-minute averages ( $N=833$ ), and the effect that has in reducing the standard error of the mean (SE), means that a t-test will inevitably conclude that there is a difference between the two sets of measurements. Indeed, conducting a paired t-test on the two sets of  $X_{CO_2}$  values yields  $t(832) = 18.2$  and  $p < 2.2 \times 10^{-16}$ . This problem is illustrated in Fig.1, which shows a histogram of the  $X_{CO_2}$  differences along with the mean, standard deviation ( $\pm\sigma$ ) and 95% confidence interval ( $\pm 1.96 \times SE$ ) which is wholly on the positive side of zero.

In the manuscript we have presented the differences in retrieved values for a representative selection of  $X_{gases}$  and supplied the reader with ancillary data (standard deviation and sample size) to allow them to assess the magnitude and uncertainty of the biases, and so we have concluded that including a t-test or any other statistical metric will not

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add significant further insight.

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Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2020-367, 2020.

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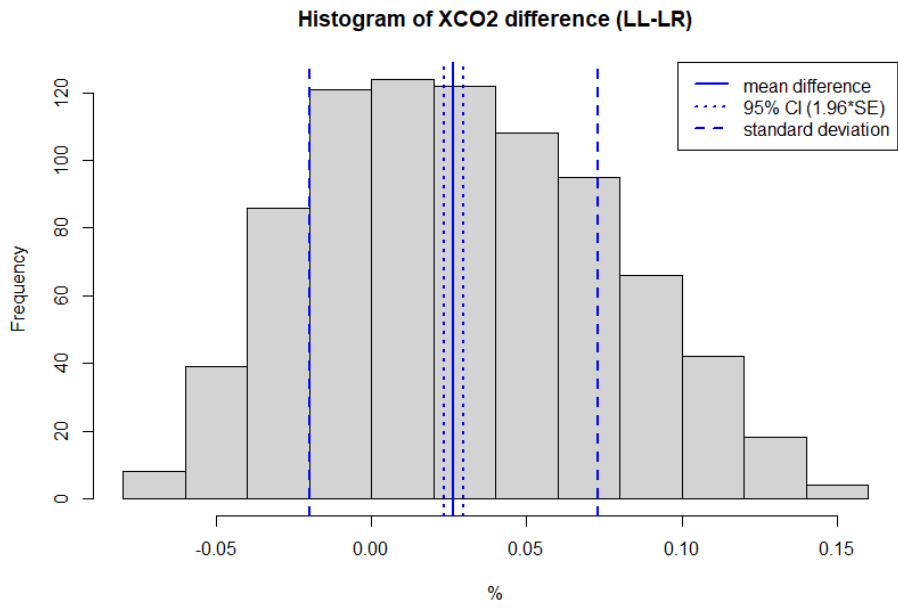


Fig. 1.