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Atmospheric Measurement Techniques Discussions

Interactive comment on "Feasibility study of using a "travelling" CO_2 and CH_4 instrument to validate continuous in-situ measurement stations" *by* S. Hammer et al.

Anonymous Referee #1

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Review: Feasibility study of using a "travelling" CO2 and CH4 instrument to validate continuous in-situ measurement stations

General Comments The paper outlines an interesting and relevant study in which the feasibility of a travelling comparison instrument is investigated. This is a very pertinent paper considering the current rapid expansion in in situ instrumentation and networks and the necessity of ensuring the comparability of the data collected at these stations. The paper is generally well written, however, the abstract and sections 1 and 2 could benefit from some editing. A particular request of the associate editor was suggestions

as to ways to shorten the paper. As such, I've listed areas in the "Technical Corrections" section which I feel could and should be streamlined and given some specific examples of how I would do this. Once these small corrections are made I would be happy to recommend it for publication.

Specific Comments The paper presents a study highly relevant to the greenhouse gas (GHG) measurement community. Although not a new concept the application of a Travelling Comparison Instrument to GHG measurements is an exciting development in the effort to assess the comparability of disparate data streams. The paper contains a sufficient level of detail and the study itself appears to have been particularly thorough. The results of the comparison are presented clearly and discussed in detail with adequate references to related work.

Technical corrections Abstract P7142, ln 16 "their flushing pumps" not "there flushing pumps" I found the last few sentences (P7142, ln 15-20) of the abstract a little confusing. The paragraph lists two potential sources of differences (Leakages/contamination in the intake lines and/or pumps and insufficient standard gas flushing at Cabauw only). It then says that differences in working standards and drying systems (neither which were listed as a potential source of error) are too small to explain the differences. So what did cause the differences? Did you mean to say? "Offsets arising from differences in the working standard calibrations or leakages/contaminations in the drying systems are too small to explain the observed differences. Hence the most likely causes of these observed differences are leakages or contaminations in the intake lines and/or their flushing pumps. At Cabauw station an additional error contribution originates from insufficient flushing of standard gases." It would be nice to give more details of the locations of the two measurements stations for those not familiar with them, "... two ICOS field stations, Cabauw, the Neatherlands and OPE, France, were compared..." would be sufficient.

1.Introduction Remove the sentence starting "Good results from..." (p7144, ln 2-5) the same point is made in the following sentence. An example of how I would streamline

paragraphs 3 to 6 is given below. This reduces the number of words by $\sim$20 %. The compatibility of measurements within a network have been examined in other studies for example, the WMO Round Robins (RR) (Zhou et al.,2011). Although an extended comparison campaign in terms of participating labs these RRs are temporally limited as the gases (prepared and calibrated by the CCLs) are measured at individual stations only once every four years. A campaign of higher frequency (approximately annually) is the CarboEurope IP "cucumber" project (http://cucumbers.uea.ac.uk/) (Manning et al., 2009). It, however, is limited to mainly European stations/laboratories. As RR programs can only compare the precision and the accuracy of cylinder measurements at the sites, observed offsets in RRs cannot be directly transferred to ambient air measurements that may potentially also be affected by the intake system, including pumps and the drying unit. A more comprehensive "end-to-end" comparison exercise is that performed at the GAW site Alert in the high Arctic (Worthy et al., 2012). Here ambient air samples are filled for different laboratories at the same time and compared with each other and with the in-situ measurements at the site. Measurements like these can validate the complete chain from sample collection, analysis and data evaluation, but this type of comparison is not suitable for continuous measurement sites. The atmospheric observational network in the new European ICOS infrastructure (http://www.icos-infrastructure.eu/) will consist of field stations equipped with continuous analysers. This network aims for the highest possible quality and compatibility of measurements. As such a feasibility study on the use of a Travelling Comparison Instrument (TCI) within the network was initiated. This TCI will be set it up at a monitoring station and run in parallel to the existing monitoring system, sampling the same air for a sufficiently long comparison period. It is vital to this quality control (QC) concept that the TCI is a completely independent instrument that measures precisely enough to determine concentration offsets on the order of the WMO ILC targets (i.e. for CO2 at the 0.1 μmolmol$-$1 level and for CH4 at the level of 2 nmolmol$-$1). Although common in the reactive gases community (Brunner, 2009), TCI's are rare for GHG measurement as gas chromatography (GC) the traditional GHG measurement

technique has not been considered robust enough for travel. In recent years, however, a new generation of optical techniques like FTIR (Fourier Transform InfraRed) spectrometers or CRDS (Cavity Ring-Down Spectroscopy) analysis have become a standard analysis technique. These approaches are much more robust, easier to use and less demanding in terms of laboratory conditions making them ideal TCIs for GHG comparisons. The in-situ FTIR spectrometer used in the present experiment was calibrated and evaluated against the conventional GC instrumentation in the Institut f ÂÍ ur Umweltphysik (IUP) carbon cycle laboratory, located in Heidelberg, Germany (Hammer et al., 2012). During summer 2011 the FTIR analyser was used as a TCI at two stations: Cabauw, in the Netherlands and Houdelaincourt (OPE), in France. At both stations and in Heidelberg individual sections of the instrumental setup, including the intake and drying system were assessed. In the following we present the results of these comparison experiments and discuss a possible quality management strategy for in-situ GHG monitoring networks, such as ICOS.

2. Methods and site description P7148, ln 13 Change "smple" to "sample" Options for streamlining: P7146, ln 21 – Replace "travelling comparison instrument" with "TCI" as you've already defined the acronym in the introduction and in the heading above. P7146, ln 22-24 – Replace "...Heidelberg. For a comprehensive description and performance evaluation of the TCI please refer to Hammer et al. (2012)" with "...Heidelberg (See Hammer et al. (2012))." P7146, ln26 to P7147, ln 2 – Replace "...Thus, a reason for using the in-situ FTIR as the TCI was to implement a different analytical technique for comparison. This might prove advantageous in order to detect possible biases that may occur due to the applied analytical technique" with "Hence using an FTIR as the TIC has the advantage of identifying possible biases inherent in the analytical technique".

3. Experimental I feel that Table 1 and Figure 1 show the same information. As length is an issue I would remove the table, similarly remove Table 2 and leave Figure 2. If you'd like to give the exact values of the differences then perhaps give them in the text

but it is quite easy to estimate them from the Figures.

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 7141, 2012.