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Interactive comment on "Automatic processing of atmospheric CO_2 and CH_4 mole fractions at the ICOS Atmospheric Thematic Center" *by* Lynn Hazan et al.

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- P4 L18. The problem with keeping a target tank for 10-20 years is that the mole fractions will be so far removed from ambient levels (assuming the current growth rate for CO2 and CH4), that instrument non-linearity effects might dominate the comparison.

The idea is to install long term targets (LTT) with relatively high concentrations. Currently the recommendations for the LTT concentrations are ranging from 450 to 470 ppm for CO2 and 2100 to 2200 ppb for CH4. Considering current mean concentrations of about 400 ppm and 1900 ppb for CO2 and CH4 respectively, and the associated trends of about +2.5 ppm/yr and +10 ppb/yr this would lead to mean concentrations of about 450 ppm and 2100 ppb in 20 years from now. So the LTT cylinders will still

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be in the range of atmospheric concentrations. Regarding the calibration, in order to maintain the suite of 3-4 reference gases in line with the atmospheric range over time, the plan is to change one cylinder every 5 years, rather than changing the full suite after 20 years.

- P8 L9-19. To what extent can the differences be attributed to wet-dry sampling as opposed to instrumental differences between a G1301 and a G2301?

We have one reference gas measured regularly (twice a day) by the two instruments to assess their agreement when measuring dry air. We attribute the difference not explained by this reference gas (dry) to the water vapor correction.

- P8 L20-29. The text and Figure 7 are confusing as they show a comparison of data before and after water corrections – however, some of the instruments use physical dryers (which could bias the data), however, the information detailing which sites are using dryers is not given.

We have added the following precisions to the manuscript P8:

The instruments operated at Amsterdam Island, Biscarrosse, Lamto, the Observatoire Pérenne de l'Environnement and Puy de Dôme were measuring dry air, whereas the Trainou instrument was successively operated in the two configurations (wet and dry) in 2014.

- P3 L1-2. Text does not read very well, try – "Because this paper is focused on CO2 and CH4, only analysers deployed in the monitoring network that measure these gases have been considered".

We have corrected the sentence P3:

Because the paper is focused only on CO2 and CH4, only analyzers deployed in the monitoring network that measure these gases have been considered.

- P3 L4. Don't Los Gatos off-axis instruments meet ICOS requirements?

So far only the CRDS/Picarro analyzers have been labeled for CO2 and CH4 measurements in ICOS. The LGR analyzer has been labeled as well for CO measurements. The ICOS specifications can be found in the following document: https://icos-atc.lsce.ipsl.fr/?q=filebrowser/download/8681

We have evaluated on CO2/CH4 analyzer commercialized by LGR (model GGA 24 EP) but the repeatability of the measurements were not satisfactory (tested on 2 different units), as well as the feedback from the manufacturer to try solving this issue.

- P3 L28. Text does not read very well, try “uses an open-source content management system framework (Drupal)”.

We have corrected the sentence P3 L30:

This server hosts the ATC website and uses an open-source content management system framework (Drupal).

- P4 L2. Replace are with have been

We have corrected the sentence P4:

Specific processing chains have been developed for each type of trace gas analyzer, but the general framework remains the same.

- P4 L4. Replace are with have also been

We have corrected the sentence P4 L7:

Similar chains have also been developed for measurements of other ICOS parameters such as meteorological variables or radon but are not described in detail in this article.

- P4 L27. Each instrument does not flag their raw data, the instrument operators flag the data, or setup the parameters for automatic flagging or someone at the ICOS ATC sets this up?

The sentence has been rewritten P4 L29:

Because ways and conditions to automatically validate raw data may differ from an instrument model to another, the list of internal flags are instrument dependent.

- P5 L 7 ICOS-MSA, 2014 is not listed in the references.

The reference has been added on P5 L10:

ICOS Atmospheric Station Specifications, ICOS, 2015

- P6 L 5. Change “we are scanning” to “each data point is scanned for”

We have corrected the sentence P6 L7:

In the case of the CO2/CH4 analyzers currently used in the ICOS network, each raw data point is scanned for three parameters: the cavity pressure, the cavity temperature and the outlet valve opening.

- P6 L8. Change the “we” so something else.

We have corrected the sentence P6 L10:

Consequently, for each single data point, the values of the parameters are checked against a valid interval or threshold.

- P7 L3. Shouldn’t the unique identifier be #111 and also in Figure 3, it should be AMS #111 no AMS 111.

We have corrected the definition P7 L4:

identified by the 3-letter code AMS, instrument #111

- P7 L6. It looks more like stabilization is reached after 4-6 mins in the AMS #111 example. Figure 4 also indicates that 20% of CO2 values are not reached within a 10 minute period.

As indicated in the manuscript for the long term target, which are analyzed less frequently, the stabilization time is clearly longer.

We have corrected the numbers according to your comments P7 L8:

When looking at measurements of short-term and long-term target gases from several sites (Figure 4), one can see that stabilization is very often reached within 4-6 min, but more time may be needed for the equilibration of the long-term target.

- P8 L23. States that the Mace Head instrument is close to zero because it is using a dryer system, however the MHD #41 instrument shown in Figure 7 does not use a dryer?

This is correct. We are running two instruments in MHD, one measuring dry air (#54) and the other one measuring wet air (#41). However this normal configuration was switched during few weeks to evaluate the water vapor corrections. The reference of the instrument measuring dry air (#54) has been added.

P8 L31: Several instruments are operated with a drier system, and the water vapor corrections are consequently close to zero, as shown for the Mace Head station (for the instrument #54).

- P9 L1. WMO scale for CH4 was updated in 2015 to WMO X2004A

The change of reference scale for CH4 is underway. For the ICOS network this action is organized by the calibration center (CAL).

- P9 L13. What happens if the values plotted do not follow a liner function? Or the calibration sequence mole fraction range do not cover the ambient mole fraction range?

The calibration scales are chosen to cover the atmospheric range. In addition all the analyzers are evaluated at the ICOS/ATC laboratory with an extended calibration scale (e.g. 300 to 500 ppm for CO2), prior to their installation in the field.

However, for the events with atmospheric concentrations exceeding the highest reference gas, e.g. in case of pollution event, we may have to increase the uncertainties. This estimation of the uncertainties is still under evaluation by a dedicated ICOS work-

ing group. The residuals from the linear fit will be used for the estimation of uncertainties. The additional figure 2 shows the residuals from a linear fit performed during the initial test period of instruments at ATC/ICOS laboratory (using the same set of tanks). During the automatic processing, both linear and second order functions are computed. By default the linear fit is used to process the ambient air measurements, but the differences between the two functions may be used in the estimation of the uncertainties.

- P15 L19. What does this refer to in the Manning reference? K., S., R., S., L. P., S., J., T.,Y., T., R. L., V., 20 A., V., F., and Worth, D

The reference has been corrected P16 L16:

Manning, A. C., Jordan, A., Levin, I., Schmidt, M., Neubert, R. E. M., Etchells, A., Steinberg, B., Ciais, P., Aalto, T., Apadula, F., Brand, W. A., Delmotte, M., Giorgio di Sarra, A., Hall, B., Haszpra, L., Huang, L., Kitzis, D., van der Laan, S., Langenfelds, R. L., Leuenberger, M., Lindroth, A., Machida, T., Meinhardt, F., Moncrieff, J., Morgu ′ Äś, J. A., Necki, J., Patecki, M., Popa, E., Ries, L., Rozanski, K., Santaguida, R., Steele, L.P., Strom, J., Tohjima, Y., Thompson, R.L., Vermeulen, A., Vogel, F., and Worth, D.: Final report on CarboEurope "Cucumber" intercomparison programme. Available at http://cucumbers.uea.ac.uk/documents/2014_InGOS_NA3_Cucumbers_Report.pdf, 2009.

- P15 L 21. Should the reference link be: http://cucumbers.uea.ac.uk/documents/2014_InGOS_NA3_Cucumbers_Report.pdf

The reference link has been corrected. P16 L16:

http://cucumbers.uea.ac.uk/documents/2014_InGOS_NA3_Cucumbers_Report.pdf, 2009.

- P16 L 6. Yver Kwok,

The reference has been updated P17 L6:

Yver Kwok, C., Laurent, O., Guemri, A., Philippon, C., Wastine, B., Rella, C. W., Vuillemin, C., Truong, F., Delmotte, M., Kazan, V., Darding, M., Lebègue, B., Kaiser, C., Xueref-Rémy, I., and Ramonet, M.: Comprehensive laboratory and field testing of cavity ring-down spectroscopy analyzers measuring H2O, CO2, CH4 and CO, Atmos. Meas. Tech., 8, 3867–3892, 2015.

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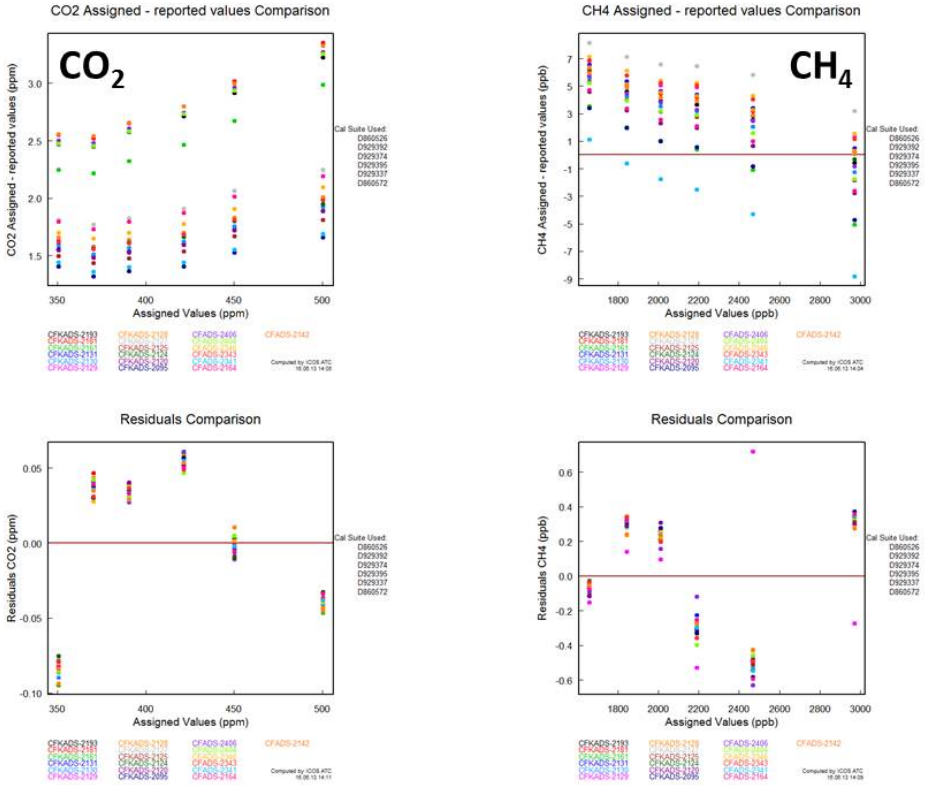

Fig. 1. Additional figure 2

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