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Atmospheric Measurement Techniques Discussions

Interactive comment on "Accurate measurements of carbon monoxide in humid air using the cavity ring-down spectroscopy (CRDS) technique" *by* H. Chen et al.

Anonymous Referee #2

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The paper demonstrates the possibility to make CO measurements with a CRDS analyzer without the necessity of drying the sample air. This possibility will significantly simplify CO measurements, as drying the air sample is often difficult in field conditions, and it can be a source of additional errors. Moreover, the fact that sample drying is not necessary allows receiving potentially interesting information on the atmospheric water vapor. Each analyzer has to be characterized individually, for which the present paper provides a clear methodology. The paper is well written and should be published in AMT after minor revisions.

General comments

1. I think it should be made clear that this paper refers to the CRDS instruments manufactured by Picarro Inc. Also, are there other CRDS instruments available for CO measurements? Would this research be applicable to any CRDS instrument?

2. The averaged residuals of deltaCO and COdry in Figs. 3, 4 and 6 are compared to the WMO intercomparability goals, and this is mentioned several times through the paper. However the noise in non-averaged deltaCO, COraw and COdry in the same figures is obviously larger than the WMO goals. Please explain why it was considered that the comparison with the data averaged over H2O and CO2 intervals is correct and meaningful.

3. From Fig. 7, and as stated in Sect. 5, it is clear that different analyzers react differently and need individual water correction functions. It is not clear to me why it is considered that the differences come only from the line interference coefficients (A, B, C, D) and not also from the coefficients for pressure and broadening effects correction a' and b'. These are supposed transferable from one analyzer to another only based on analogy with CO2, since the CO tests were performed on only one analyzer (Sect. 2.1, from line 14). If there is any physical reason to believe this please explain, otherwise state it clearly that this is for now only an assumption. If a' and b' were different for different analyzers, would the differences be (partly) compensated for when fitting the forth degree function for the A – D coefficients?

4. How good is the water vapor measurement of the considered instruments, in terms of precision and accuracy?

5. Figure 3 suggests that the water correction function may introduce a bias at very low water concentrations. What are the implications for the calibration which is usually done with dry air cylinders - could this lead to a systematic error in reported CO mole fractions?

Specific comments

- page 6497, lines 21-24: it is not clear what H2Opct is, and what is its relation to the water vapor content. Could you please give more details.

- page 6498, line 21: is the CO mole fraction not affected by silica gel or acidified water?

- page 6499, lines 10-11: How precisely are these coefficients determined? It is stated that the coefficients for CO are “very close” to the ones for CO2, but the b and b’ coefficients look quite different. Are these differences not significant?

- page 6500, line 1: five tests were made in total, from which three were used and one (the Feb 2011 one) was not used due to incompleteness of data. What happened to the fifth one?

- page 6501, lines 1-2: It is stated that there is no evidence for drift in water correction functions from Feb 2011 to Mar 2012. Looking at Fig. 3b, however, the data for Feb 2011 seem positively biased compared to the 2012 data, and the curvature estimated from the 2012 data does not seem to correspond to the 2011 data. Can you explain this? Is this due to different analyzers and/or test methods?

- page 6501, line 11: differences in what?

- page 6503, lines 5-6: please see General comment 3.

- Fig. 2d: Were the residuals obtained at 1000 ppm CO proportionally scaled to a CO mole fraction of 200 ppb? The assumption is needed for this that the residuals are proportional to the CO mole fraction. Is this true and known?

- Fig. 8: In this case, binning the measurement results could help detecting possible dependencies.

Technical corrections

- page 6501 line 8: typo “liner”;
- Fig. 8: a) ... f) are missing in plots.

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 6493, 2012.