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Atmospheric
Measurement
Techniques
Discussions

Interactive comment on "Evaluation of a cavity ring-down spectrometer for in-situ observations of $^{13}CO_2$" *by* F. R. Vogel et al.

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Comments on manuscript amt-2012-171 by FR Vogel et al.:

The manuscript by Vogel and co-authors reports on a 1-year evaluation of a commercial CRDS analyzer (Picarro G1101-i) for following the δ13C signature in atmospheric CO2 with high precision. The major results can be summarized as follows:

1. The instrument precision of 0.26 to 0.28 ‰ for 10-min time slices does not meet the WMO inter-laboratory compatibility goal of ± 0.01 ‰ due to the limited signal-to-noise ratio.

2. The authors devised a calibration scheme which essentially eliminates short- and

long term drifts. After this, the determined offset for four target gases over the course of the measurement period is only 0.002 ± 0.025 ‰ . However, a long-term target with δ13C = -12.47 ‰ measured weekly had a precision of 0.177 ‰ in line with all other sources of error, limiting long-term errors to ± 0.18 ‰ for 20 min time slices.

3. There is a serious interference from CH4, amounting to 0.42 ± 0.024 ‰ per ppm methane, which needs to be corrected experimentally. For a typical air sample, this introduces an uncertainty of ± 0.048 ‰

4. The authors suggest to use their calibration scheme (or a similar one) for future measurements with improved instrumentation.

The paper is well written and describes all experimental results carefully. The figures provide a clear insight into the capabilities and limitations of the investigated instrument. The authors speculate that with improved signal-to-noise and reduced cross contamination from CH4 (and other components ?) the performance could be improved to values around ± 0.05 ‰ . This is still a factor of 5 (!) off the inter-laboratory compatibility target, but is in accord with the requirements for local studies using optical absorption technique, as discussed for the first time at the 16th GGMT experts meeting 2011 in Wellington, NZ (see recommendations).

Publication in the special GGMT issue of AMT is recommended, provided the following minor points are taken care of: - P6039 L27: Please be more specific regarding the consumption of reference gas. Moreover: The comparison is made with FTIR, which makes the CRDS system the winner. However, when compared to MS techniques, the comparison is much less favorable. - P6040 L16: The flushing time of 3 min translates to a 3-fold exchange of the gas in the cavity. For flasks, a 10-fold exchange is usually employed. The 3-fold exchange might be sufficient for the current accuracy level, but will have to be increased when better instruments become available. In principle, this low figure means a scale compression for δ13C, when larger isotopic deviations are measured. -P6042 L28: Mass spectrometric non-linearities seem to be much smaller and can usually be easily corrected for. P6044 L6 ff: The raw Picarro calibration is not important at all. It will vary from instrument to instrument and over time. Therefore, the emphasis should be formulated even stronger on the frequent on-line WGH and WGL calibration, which essentially overwrites all old, non-traceable factory calibrations. P6048 L 13: ‘negligible’ instead of ‘neglectable’ (?) P6048 L24 ff: Please be consistent with the sentence structure in the bulleted text: e.g. “(I) Quantify the fundamental… (II) Determine…. (III) Determine… (IV) Identify… (V) Establish… (VI) Develop most importantly…”

P6052 Fig 1: Is the MFC external to the instrument??

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 6037, 2012.