

## ***Interactive comment on “Field inter-comparison of two high-accuracy fast-response spectroscopic sensors of carbon dioxide” by B. A. Flowers et al.***

**Anonymous Referee #1**

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In this manuscript the authors present a comparison of in situ CO<sub>2</sub> measurements from two instruments deployed in the same location. The results show good agreement. Such comparisons are valuable. The manuscript as written is difficult to follow in parts, not well organized, and leaves a few holes in the analysis. I recommend publication after major revisions.

Organization: Much of the description of procedures in the Results and Discussion section should be moved to the Methods section. It might be useful to separate the Methods into subsections corresponding to the subsections in the Results and Discussion section, particularly if there are procedures that are relevant to a specific part of the study.

C1925

Organization: Any conclusions that appear in the Abstract or Conclusions section should also appear in the Results and Discussion section.

Organization: Any sections of the paper that are extraneous and don't contribute to the analysis or discussion should be removed from the paper. Figure 6 and the corresponding text (Lines 6-19 on Page 10) is an example. The sentence that starts on Line 23 of Page 4 and ends on Line 1 on Page 5 should also be removed.

Abstract: Shouldn't the mean difference be the same as the difference of the means for the same number of points? The difference of the means given in the abstract is 0.17 ppm; whereas the mean difference is declared to be 0.04 ppm. I couldn't find where the mean difference was discussed in the text, except in the conclusions. It should be described elsewhere.

Abstract: In the text and caption for Fig. 4 the  $x_0$  for the Gaussian fit is given as 1.003, but in the abstract it is 1.000.

Abstract (and elsewhere): Precision should be in units of ppm or ppb for a defined time interval. See, for example, Werle et al. (1993) and Tuzson et al. (2010).

Abstract (and elsewhere): The CRDS instrument has notorious water vapor biases. Please include a comment about the range of relative humidity over which the study was performed.

Methods: What is the wavelength of the CRDS laser?

Methods: Subscripts are missing for gas species in Lines 1-2 on Page 4.

Methods: This section should include the description of where the instruments were housed (e.g., Lines 5-14 on Page 8) and how the lab was climate controlled.

Methods: The description of how the instruments were calibrated should go in this section.

Methods: How frequently was the TDL calibrated?

C1926

Results and Discussion (3.1): Since the Rella document is not in the open literature, please include specifics about the procedure and equations used to correct the CRDS data and produce dry mixing ratios.

Results and Discussion (3.1): I don't understand the section about the instrument cross calibration. It seems that, if the instruments are cross-calibrated, you are removing systematic bias between the instruments and then concluding that there is no systematic bias between the instruments, which seems circular. I don't understand how or why the TDL is forced to measure  $557.6 \pm 0.1$  ppm for CO<sub>2</sub>high and  $354.6 \pm 0.1$  ppm for CO<sub>2</sub>low and the reason for the unknown standard. If possible, see if you can improve the clarity of this section.

Results and Discussion (3.1): There is no reference for Van Pelt 2011.

Results and Discussion (3.2): The Gaussian fit shown in Fig. 4 does not appear to be very good. The peak does not seem representative of the peak of the histogram, and the width does not capture the true width of the distribution. Since this figure and analysis is important for the results and conclusions, more effort needs to be made to describe the differences.

Results and Discussion (3.2): Because the CRDS instrument has been shown to have water vapor biases (in some cases beyond that suggested by the manufacturer), I suggest including a figure that plots the ratio of (or differences between) the instruments vs water vapor mixing ratio.

Conclusions: What does the following statement mean: "the agreement between the two sensors was perfect (1.000)"? That conclusion does not seem to be supported by the evidence in the manuscript.

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Interactive comment on Atmos. Meas. Tech. Discuss., 4, 5837, 2011.