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Comment

## ***Interactive comment on “Comparison of continuous in-situ CO<sub>2</sub> observations at Jungfraujoch using two different measurement techniques” by M. F. Schibig et al.***

### **Anonymous Referee #1**

Received and published: 26 August 2014

This manuscript describes the details about CO<sub>2</sub> intercomparison measured by NDIR and CRDS at Jungfraujoch. The manuscript contains a lot of information for in-situ CO<sub>2</sub> observations. But more detail explanations are needed in some important sections. I recommend the publication of the manuscript in AMT after the major revisions.

### General comments

In KUP system, there is no description how to calculate the CO<sub>2</sub> mole fraction of sample gases by using the assigned values of working gas, low span and high span. In other words, how to transfer the WMO X2007 scale to sample gases?

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The manuscript concludes that most of the reasons for discrepancy between NDIR and CDRS measurements are due to NDIR system such as (i) adsorption/desorption effects in the calibration gas, (ii) insufficient nonlinearity correction of the NDIR and (iii) badly assigned calibration gas cylinders. Also (iv) recommendation to use aluminum cylinder is mentioned in conclusion. I think these are not enough for conclusion section of this manuscript, since (i) is deeply discussed in other paper (Leuenberger et al., 2014) and (ii), (iii) and (iv) are not new findings. In the conclusion section, it is better to describe more new or useful information found in this intercomparison.

### Specific comments

Page 7057, line 23-24, It is hard to conclude “a precision better than 0.04 ppm” from Table 1.

Page 7058, line 9-11, According to Rella et al. (2013), water vapor collection can be possible in case of lower H<sub>2</sub>O level. Had the observed H<sub>2</sub>O mixing ratio been lower enough from August 2010 to July 2011? Even if the empirical humidity correction was smaller enough, it is worth to describe the amount of correction and its uncertainty.

Page 7060, line 19-21, Why one month values are needed for calculating seasonality? Hourly average data are better for this purpose.

Page 7062, line 14-15, “the offset was probably caused by the change of the Picarro analyzer”. Are there any other reasons such as drying system for sample gas?

Page 7063, line 21-23, Fig. 8 is not necessary, since the information from Fig. 8 is limited.

Page 7063, line 23-24, “The remaining working gases cylinders were recalculated in the same manner, too.” The “large offsets” in B27 and B29 are supposed to be found by this recalculation using low and high span gases. Is it possible to correct these “large offsets”?

Page 7064, line 12-24. It is hard for me to accept these sentences and Fig. 9. It is well

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known that relation between output signals of NDIR and CO<sub>2</sub> mole fractions shows nonlinear. But in Fig. 9, both CRDS (Empa) and NDIR (KUP) are CO<sub>2</sub> mole fractions calibrated by other standard gases. Even if the analyzer has substantial nonlinearity, calibrated values remain no such effect when they use suitable numbers and suitable range of standard gases. Therefore I suppose the numbers and/or range of standard gases were not adequate for measuring CO<sub>2</sub> values by NDIR. I recommend to describe the method of measuring eleven used calibration gas cylinders of the KUP system more precisely.

Page 7065, line 20-26, I agree that one of the reason for discrepancy of the trend is due to the short observation period. But I think the contribution of assigned values for the working gases is not significant. Because the difference of the CRDS-NDIR CO<sub>2</sub> measurements plotted in Fig. 3 shows no such trend (0.2 ppm year<sup>-1</sup>). The error of fitting process assumed to contribute the trend discrepancy.

Page 7066, line 13-20, When we use a nonlinear analyzer, calculated CO<sub>2</sub> mole fractions depend on the range of standard gases. Have you confirmed that the influence of different CO<sub>2</sub> mole fraction in working gases is small enough?

Page 7067, line 11-20, The large volume of the drying unit leads to both damping and delaying effects. The delaying time of three minutes is not negligible when you pick up the 115 s data from CRDS measurement in Figs. 4 and 5. The difference between the two systems expected to be improved by considering this delaying time.

Page 7067, line 26-29, It is possible to make a correction of working gases by comparing low and high span gases or re-calibration in University of Bern after used in Jungfraujoch.

Page 7081, Figure 6, The differences between black points and grey points look small before Apr. 2010. But it is not easy to confirm in steep slope periods. Are differences small enough?

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## Technical corrections

Page 7058, line 23-24, “Table 1” should be changed to “Table 3”.

Page 7060, line 21, “do” → “to”?

Page 7061, line 25, “0.75 ppm” → “0.75 ppm h<sup>-1</sup>”.

Page 7061, line 27, “0.996 ppm” → “0.996 ppm/ppm”.

Page 7061, line 27, “1.5696 ppm/ppm” → “1.5696 ppm”.

Page 7062, line 20, “Langmuir, 1918” cannot be found in References.

Page 7072, Table 1., The value of LK94521 measured by CO2 Maihak seems to be “359.96” rather than “459.96”.

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