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Atmospheric Measurement Techniques Discussions

Interactive comment on "A multi-year record of airborne CO_2 observations in the US Southern Great Plains" *by* S. C. Biraud et al.

Anonymous Referee #2

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The manuscript clearly described the airborne CO2 program in the US Southern Great Plains. Both flask and in-situ programs are detailed, and the two dataset are compared to assess the overall uncertainty of the measurements. Finally, the typical CO2 variability (vertical/horizontal variability, seasonal cycles) are discussed. Such long term and high quality monitoring programs are very important to better understand the regional distribution of CO2 sources and sinks, and their time variations. Consequently I recommend the manuscript for publication in ACP with minor revisions.

Page 8: The authors claim an accuracy of 0.1ppm for more than 329 flights. I think this value remains quite optimistic, and may not take into account all bias. Figure 5 shows indeed a good precision and accuracy of RM0 during one hour. There is not much

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detail about the condition of this experiment. What is performed on the ground ? at a constant elevation ? Was the reference gas passed through the drier ?

The comparison of RM0 and RM12 shown on figure 4 has a mean difference of 0.04 ppm. Still this difference doesn't has a very strong meaning considering the structure of the differences being -0.3 ppm during most of the ascent, and +0.3 ppm during most of the descent. Have you plot the differences versus altitude ?

Regarding the flask/in-situ comparison, the storage drift described in page 8 (and on the ESRL website), corresponding to a CO2 depletion over time, is not applied in the figure 6. Using a mean correction of +0.2ppm for a 3 weeks storage time, the mean difference would be about -0.2 ppm overall and -0.4 ppm in the free troposphere. By the way how do you explain the larger bias in the free troposphere compare to lower altitude ? Could it be related to a pressure effect on in-situ measurements ? Lines 23-25/page 10 seem in contradiction with the results of figure 6.

You should also explain more precisely which part of the in-situ measurements you are using to compare with the flask samples. Are you using the whole average at a given level, or do you extract the closest time period +/- 30sec ?

There is a recent publication describing a similar program with the same type of in-situ analyzer: 'Variation of CO2 mole fraction in the lower free troposphere, in the boundary layer and at the surface', Haszpra et al., JGR 2012. The uncertainty of the in-situ measurements estimated for this program is higher than 0.1ppm. Is the setup different from SGL flights ?

Page 5: Number of levels: the last paragraph gives the impression that only two levels are sampled, whereas the first paragraph is stating 12 sampled levels.

Page 10: Detection of problems (line 7-10): could you give more details on the kind of problems which were detected thanks to the multiple technologies program ?

Page 12/line 20-21: The profile observed in Figure 12 doesn't look like a 'typical' one,

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as written on line20, since the FT values are lower than PBL ones.

Figure 3: Do you pass the reference gases through the drier ? Have you estimate the bias due to the drier by injecting reference gases alternatively through the drier or directly to the analyzer ?

Figure 7: the mean difference is 0.06 ppm

Figure 9: It looks like the measurements start from 0m agl, which is not the case, except if you use surface data as combined to aircraft measurements.

Figure 11: there is a large variability in the summer vertical profiles. Is this variability due to the diurnal cycle of the sampling (you could analyze the vertical profiles according to the timing of the flight), or rather to the origin of the air masse (you could use backtrajectories to estimate this factor).

Figure 13: it is not very clear for me how you came up with these profiles. Are you subtracting the mean vertical profile derived from flasks from the mean vertical profiles derived from in-situ measurements ?

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 7187, 2012.