

Interactive comment on “In-situ measurement of atmospheric CO₂ at the four WMO/GAW stations in China” by S. X. Fang et al.

Anonymous Referee #2

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Interactive comment on “In-situ measurement of atmospheric CO₂ at the four WMO/GAW stations in China” by S. X. Fang et al.

General comments

The paper reports new CO₂ data from high quality, quasi-continuous atmospheric measurements in China. This very valuable addition to the global data set fills an important gap in the observation network in the region and provides interesting insights into the regional flux patterns.

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A larger part of the paper is dedicated to the analysis/source apportionment of the measured CO₂ – parts of this exercise are in my opinion too subjective and should be rewritten or shortened accordingly. Also, I would like to stress that local surface wind should be used with caution for interpretation of source areas of the measured air masses - particularly in complex terrain, as is the case for the stations described in this manuscript, the errors in the interpretation may be considerable. Including other gas species measured at the sites (e.g. CO, CH₄, etc.) and atmospheric transport models in the interpretation, allows a better constrained analysis. In this context, Fang et al. 2013 (full citation in this manuscript) has in many aspects a structure that is very similar to identical to the one of this manuscript – partly with additional analysis included (e.g. cluster analysis of backward trajectories in summertime) – which makes it a sort of a “companion paper” to this manuscript (even if the Shangdianzi site is not included in Fang et al. 2013). This is not, but should be, stated in this manuscript. Furthermore, several sections contain text identical or very similar to that in Fang et al. 2013. This is to certain extent understandable for a technical/descriptive part, where the same measurement systems and sites are described, but less in other sections. Please check and make sure that Fang et al. 2013 is referred to in all places where this is applicable and necessary. Some rewriting might be unavoidable. Otherwise, the paper is well structured, but has room for improving its writing style (mostly in the second half of the text), including punctuation, spelling and consistency of formats and symbols throughout text (e.g. CO₂ data, ratios, values, CO₂ mole fractions – and, it should be stated at least once in the text that you are actually referring to “atmospheric CO₂ dry air mole ratios”). I have marked several sections that should be improved, but the list is not exhaustive.

In their reply to the anonymous referee #1, the authors state that an updated manuscript is available. Please note that at the moment of writing this review, it was not available to me (nor did I find it at submission of this review). In my opinion, the paper is suitable for publication in ACP, but only if the comments have been addressed properly.

Specific comments and technical corrections

Page 27288, Line 3 (27288/3): “at 4 atmospheric” – write out 4 “at four atmospheric” and keep this consistent throughout the text

27288/3-4: to many parentheses in “((Lin’an, LAN), (Longfengshan, LFS), (Shangdi-anzi, SDZ), and (Waliguan, WLG))

27288/4-5: “Cavity Ring Down Spectroscopy” to “Cavity ring-down spectroscopy”

27288/8: change “in China’s most economically developed region” to “in China’s economically most developed region”

27288/9: “the northern east of China” to “northeastern China” and check/correct usage and spelling other where in the text

27288/18: delete “thorough” in “a thorough characterization”

277289/6: “yr” to “years”

277289/7-8: So far, . . .worldwide. . .

277289/23: delete “Nevertheless,”

277289/26: delete “However,”

27290/10-11: replace [] parentheses with () parentheses

27290/14-20: the brief history of the stations could be described better (c.f. the information that is accessible at <http://gaw.empa.ch/gawsis/>; when did the different stations get WMO status, what else is/was measured, etc.). Although the acronym GHG is well known, every acronym used in the text must be written out at least once (when first used).

27290/24: “Yangzi” or “Yangtze” as other where in the text – correct as needed

2.1 Sampling sites: in addition to Fig. 1, refer also to Table 1

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27291/14: 0.6 km in which direction relatively to the station is the railway?

27291/19: replace “above the ground” with “a.g.l.”

27292/10: all four systems were installed precisely on 1. January 2009? Correct “in 1 January” to “on 1 January”

2.3 Calibration. . . I would not refer to the Target gas as “standard” as it is used as “unknown sample” during the measurement in order to check the quality of the calibration done with the help of the “standards”. In Fang et al. 2013 you write: “The two standards and the target cylinder are analyzed by the system every 12 h.”, which is in contrast to what you write here (“The three standards are analyzed by the system for 5min every 6 h.”). As it is the same systems in the same time period – please clarify.

From 5 min measurements, you take last 3 min – it is therefore not appropriate to state that 5 min averages are recorded. You mention 97% twice – is this 97% of 97% or overall 97%?

27294/9: replace “were” with “are”

27295/7-8: I presume used data is for all three years? Please state this clearly. Add “, respectively.” at the end of the sentence.

27296/18-19: what exactly do you mean by “. . .the standard deviations of the hourly averages are so large that the daily amplitudes could not be calculated.”

27296/25-26: last sentence could be deleted.

3.3 Comparison. . .

This section should be rewritten (lines 2-5) to improve clarity. In addition: “local sources” add “and sinks”, decide on “night” or “early morning” (or clarify which is for which station. Values in Line 15 should be negative (c.f. Fig. 4). Line 20: the bias you mention is relative to 50 and 80 m, not to the well mixed air above the boundary layer.

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3.4 Impact. . .

The title of this section is not explicit – impact on what. Please elaborate or replace “impact”.

27299/8: correct order of words “. . . that mole fractions of most compounds. . .”

27299/15: delete “Obviously,”

27299/28: Replace “absorption” with “uptake”

27300: please explain why it is necessary or advantageous to use the Beaufort scale.

27300/18-20: I am not sure to understand this correctly. When looking at Fig. 8, this statement seems wrong (e.g. in Spring, sectors with higher wind speeds as NE and W can have both high (NE) and low (W) CO₂ concentrations, etc.). Please clarify.

27301/16-19: Here you could refer to Fig. 4 – and mention in its caption that SDZ is not shown (and the reason for not showing it). From Fig. 4, it seems to me that it would be better to take 10-16 and not 9-17 LT for the “regionally representative” (values close to 0).

3.6 Long-term trends

As you note in 4. Conclusions, “The relatively short 3 yr record may introduce bias in our analysis of the seasonal variations and estimates of trends”. For this same reason, I do not like the title of section 3.6 – you can rather discuss short-term trends here. But what you could do is take into account also the earlier WLG CO₂ data from 1994 on. An almost 20 years-long record would qualify for long-term trend analysis much better.

27304/6-8: from Fig. 9, it looks like it is Dec. (not Jan.) for LFS and LAN, and May (not Apr.) for WLG. Please clarify.

27305: this page would benefit from a partial rewrite

Table 1.: Correct format/alignments to improve legibility. Correct “Ecnomic”.

Table 3.: I suggest adding an * to the column name “Station” (in the footer: * see text (and <http://gaw.empa.ch/gawsis/> ?) for station name acronyms and other information).

Fig. 1: scale should be in kilometers. Add in text: “. . . four Chinese WMO. . .”.

Fig. 4: Label on y-axis – suggest to put it same as on other figures (“CO2 mole fraction difference (ppm)”)

Fig. 6: put wind speed line on the top layer (is currently covered N-NE section of the graph).

Figs. 5-8: usage of “concentration” instead of “value” in the legends would be better. Do you really need parentheses around the names of the seasons? When reading carefully the text and looking at the figures, there are some inconsistencies. Only as one example, I find it difficult to understand how in Fig. 7 that in summer from the WSW direction (direction of Beijing), with relatively high wind speed, the CO2 is less enhanced (and the sector is labeled as “regionally representative”), while the opposite is the case for the other seasons (labeled as “local sources” at comparably elevated wind speeds)? SDZ is located 150 km NE from Beijing – anything that reaches SDZ from Beijing would therefore have a “regional” character.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 27287, 2013.

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