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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Evaluation of in situ measurements of atmospheric carbon monoxide at Mount Waliguan, China" *by* F. Zhang et al.

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Anonymous Referee #2 Received and published: 17 March 2011

General comments In the paper "Evaluation of in situ measurements of atmospheric carbon monoxide at Mount Waliguan, China", Zhang et al. present 3 years of quasi-continuous measurements of carbon monoxide. A large part of the paper focuses on the methods that were used to assure the quality of the data set. This subject is treated with due care and its description will be useful to others performing such measurements. The second part of the paper is dedicated to source apportionment

of the air masses arriving at the measurement station, using statistical analysis of backward trajectories. This is important for validation of the site as a WMO/GAW global baseline station. I agree with the first reviewer regarding the "global background" and "local baseline" considerations. Overall, the quality of the paper is good. Still, before publication in ACP there are some points that must be addressed / corrected. Specific comments and technical corrections When describing the station, some more details would be desirable, including information on the beginning of CO measurements at this location, what else is measured there, and what is the reason for not presenting data more recent than June 2007.

Re: more details the reviewer mentioned have been added in the section of description of the site as follows: "...In-situ measurements of ambient CO2 and CH4 have been conducted since 1990s (Zhou et al., 2003, 2004), and quasicontinuous measurements of ambient CO at WLG started in 1997(Zhou et al., 2001) and stopped in July 2007. However, discreet air samples are still collected weekly for CO, CO2 and CH4 by the NOAA cooperative air sampling program (http://www.esrl.noaa.gov/gmd/ccgg/). Observations of these trace gases at WLG provide essential information on sources and sinks within the Eurasian continent because of its unique location (Zhou et al., 2005, 2006). Here we focus on measurements recorded from July 2004 to June 2007 to evaluate CO at WLG..."

Page 1939: affiliations – "Zuerich (or Zürich)", not "Zurich"

Re: corrected.

Page 1941, Line 1 (1941/11): using "high frequency" is not justified – replace by "quasicontinuous", which is used throughout the text.

Re: "high frequency" replaced by "quasicontinuous".

1941/11: "affected", instead of "effected"

Re: corrected.

1941/17 and throughout the text: wrong usage of capital letters when describing cardinal directions (North, West, . . .) – should be written in small letters.

Re: revised.

1941/23: do the authors mean “The background: : :”, and not “These background: : :”?

Re: revised.

1942/10: it would read better “: : :methane and other hydrocarbons: : :”

Re: revised.

1942/21: should be “: : :(WMO, 2010): : :”

Re: corrected.

1943/2: correct “Junfraujoch”

Re: corrected.

1943/section 2.2.1: There is no figure presenting the analytical setup. If the technical setup is published elsewhere, please refer to it here. Otherwise, an overview schematic of the system should be presented here to improve clarity and complete the information.

Re: a reference has been cited: Zhou L. X., Tang J., Ernst, M. K., Worthy, D. E.: Continuous measurement of baseline atmospheric carbon monoxide in western China. Environ. Sci., 22, 1-5, 2001.(in Chinese with English abstrct)

1943/24;1944/3: it is unclear to what 5 L min-1 and 1 L min-1 are referring to. Was the flow rate through the Dekabon tube 5 or 1 L min-1? Please clarify.

Re: this has been clarified as follows: “The ambient air was first pumped at approximately 5 L min$-$1 by a KNF Neuberger N2202 vacuum pump via a dedicated 80m 0.95 cm i.d. Dekabon tube sampling from the intake on an 89m steel triangular tower located approximately 15m away from the laboratory. The ambient air then passed

through a bypass line to release excess pressure and keep the flow rate in the sample line at 1L min-1. The air was then filtered via a 7 μm inline filter and dried to a dew point of -65 °C. A bleed valve reduced the flow to approximately 0.23 L min$-$1 before reaching the sampling loop.”

1944/4: cryogenic(-ally) actually refers to temperatures below _ -150_C; instead “: : :filter and dried to: : : : : :using a: : :”.

Re: corrected.

1944/9:”Molecular Sieve 5 A: : :” correct the unit to Å

Re: corrected.

1944/11: as described here, it may be unclear for the reader how the oxidation/reduction takes place – rephrasing/adding a few words here would benefit the clarity.

Re: a reaction formula of CO +HgO(s) $\rightarrow$CO2 + Hg (g) has been added to clarify.

1944/15-18: I have trouble understanding this sentence – from the range of the gases, it seems that you are referring to working secondary standards. Please clarify/rephrase – a figure would be helpful, too.

Re: the text has been revised as: The overall precision, defined as the standard deviation of repeated calibration of three reference samples ($\sim$100–300 ppb CO), with 30 measurements per tank) was 1.0–2.5 ppb.

1944/26:”: : :the instrument linearity: : :”: as correctly stated earlier in the text, the used instrument has a non-linear response – I suggest using “: : :instrument response curve: : :” or similar.

Re: we agree the reviewer’s comments and have revised it in the text.

1945/9: “: : :six primary gases: : :”: as these are the gases used for the calibration and

considering line 11 on the same page, the correct term would be “working standards” or “working secondary standards”. On page 1943/22, for example, “: : :standard tanks: : :” is used – check for consistency throughout the text (there are several places).

Re: revised, in the text we called all the S1-S6 standards 'laboratory primary standards' which is in consistent with the WMO nomenclature.

1946/27- : Could you please shortly elaborate on the influence of non-inclusion of some Sx gases in re-calibrations on the precision of measurements for CO mixing ratio values beyond the calibration range of the WCC cylinders?

Re: revised as “. . .We only used results (marked with an asterisk in Table 1) that fell within the range of CO mixing ratios in these transfer gases to assurance accurate measurements of ambient CO mixing ratios due to the instrument non-linear response of GC-HgO...”

1948/6: remove “of” after “a.s.l.”.

Re: corrected. It is not clearly said which data set was used (presumably Non-dispersive IR). Where does it come from (downloaded from WDCGG web page?).

Re: the data are measured by NDIR technique, as has been clarified in the text. The data used in the paper was supplied by Empa.

1949/4: “pollution measurements” – remove “pollution”; one measures ambient air – pollution or not.

Re: corrected.

1949/25: delete “oil” in “petroleum oil”.

Re: accepted and revised.

1950/21: rephrase “: : :due to agricultural biomass burning (Yan et al., 2006) and growing fossil fuel combustion.”

Re: the sentence has been revised as: The relatively remote area defined in cluster 1 has widespread but relatively low emissions from fossil fuel combustion under a growing economy in the region. Biomass burning of agricultural products may also add to enhanced air parcels from the west (Yan et al., 2006).

1951/11: adding these “hot spots” on the maps would help the authors to better demonstrate their results and would increase the value of the paper.

Re: Total anthropogenic CO annual emissions for the region around WLG (including biofuels) based on the INTEX-B (Intercontinental Chemical Transport Experiment-Phase B, Zhang et al., 2009) has been added to the text, by comparison with the CO emission inventory (including biofuels) , it showed a relatively high emission in northwest Gansu but with much lower emissions in the west.

1953/7:”: : :background CO mixing ratio shows: : :”

Re: revised.

1953/10: “: : :in winter background CO between the two sites, when at JFJ the CO mixing ratio is 20-40 ppb higher, reflect: : :”

Re: revised.

1953/11: “: : :greater wintertime OH concentration/mixing atio/quantity/: : :”

Re: revised.

Table 1: as noted before, the use of “primary” should be reserved to standards that define the scale. Therefore better use “working secondary standards”.

Re: we revised this and now called all the S1-S6 standards 'laboratory primary standards' which is in consistent with the WMO nomenclature.

General comment on Figures: Format of axes labels should be improved (put only units in parentheses or use "CO (text) [ppb]"). Homogenize the labeling – e.g. for CO mixing

ratios CO mixing ratios (ppb), Ambient CO (ppb), etc. is used.

Re: revised.

Fig. 1: Adding a map inset showing the global location of the site would be helpful. The overall quality of the map should be improved (lines/borders missing).

Re: revised. Fig. 5: identical to Fig. 3, the correct Fig. 5 must be provided.

Re: revised.

Fig. 8: what are the two black dots? I cannot see a black cross in the figure as you mention it in the caption.

Re: the Figure 8 has revised.

Fig. 9: I suggest that all numbers (trajectory clusters) are positioned vertically to improve legibility.

Re: revised.

Fig. 10: add the highest possible value for W (1) in the caption/figure.

Re: revised.

Re: the Figures and Tables have been updated and corrected according to the reviewer's suggestions.

Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/11/C2481/2011/acpd-11-C2481-2011-supplement.pdf

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