

Interactive comment on “Inter-comparison of four different carbon monoxide measurements techniques and evaluation of the long-term carbon monoxide time series of Jungfraujoch” by C. Zellweger et al.

Anonymous Referee #2

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1) General impression:

The paper discusses two important aspects of great interest to the air-chemical community, i.e. a field inter comparison of four analytical techniques for CO and the 12-year long CO time series at JFJ. As such, the manuscript actually deals with two topics, which could have appeared in two separate papers. However, I concur with the decision of the authors to combine the two (the content is small enough) to enhance interest in this paper and raise its overall scientific value. The paper is well written in

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spite of a few minor English language glitches, which can be improved somewhat in places. It is very systematically set out and warrants publication.

2) *More detailed evaluation:*

Yes, the paper addresses (without doubt) all relevant scientific questions within the scope of ACP.

The paper presents so far unpublished CO inter comparisons of four of the most widely used analytical techniques for this trace gas. This is very useful information, since – as the authors have also correctly stated – a measure of uncertainty still surrounds CO measurements at remote sites. Institutes, who are on the verge of starting CO measurement programs will certainly also benefit from the analytical discussion presented here.

Furthermore, the JFJ CO time series and its trend are of great interest to the scientific community. The authors very aptly explain possible causes for this negative trend in terms of emission inventories and measurements made at other European stations. This is new information, which should be made known.

The conclusions reached are succinct, well thought through and clear. I greatly appreciate the fact that no unnecessary issues are repeated again in the conclusions.

The scientific methods and assumptions are valid and clearly outlined. The inter-comparison of analytical techniques is presented in great technical detail and good use is made of statistical techniques such as the Wilcoxon-Mann-Whitney test to verify the comparisons.

The results are sufficient to support the interpretations and conclusions.

The description of experiments and calculations are sufficiently complete and precise

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to allow their reproduction by fellow scientists (traceability of results). Yes, this holds especially for the analytical methods. From my (and my colleague's) own experience with CO measurements I can go along with the general presentation of arguments.

Yes, the authors give proper credit to related work and clearly indicate their own new/original contribution. This is evidenced by the reference list.

The two sub-topics (techniques and time series for CO) are well captured in the title. The "s" after measurements should, however be dropped.

The abstract provide a concise and complete summary. In the same way as the conclusions are brief and to the point, the abstract also provides a good summary of the paper's content. The order of the two topics in the paper is reversed in the abstract. It seems that the authors probably want to focus the reader's attention first on the more interesting section (i.e. CO time series and trend) and to contrast the abstract with that of the conclusions in order to avoid a too close similarity.

The paper is well structured and easy to follow. However, the authors could improve on this by keeping the two topics: "CO trends" [section 3.1] and "field inter comparison of the 4 CO techniques" [section 3.2] in this order also within the abstract and introduction.

The language is precise, but the grammar and expression style could be improved. This applies especially to section 3.2. See recommendations listed under point 3 below.

The term "concentration" is sometimes used together with the unit "ppb" (e.g. page 2390, line 2; page 2392, line 28). "Concentration" and "mixing ratio" do not express the same in a quantitative sense due to their definitions. Consequently, they cannot be interchanged when assigning values in ppb. Furthermore, the term "mole fraction" is actually preferred over "mixing ratio". In the case of CO it will then be expressed in nmol / mol (or ppb). Please correct accordingly.

The mathematical formulae, symbols, abbreviations and units correctly defined and used.

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Figure 6 could have an (a) and (b) part, where the present CO time series graph will be (a). In addition, a growth rate curve (part b) would be useful to show inter-annual growth variability, instead of merely relying on the linear trend. The presentation of a growth-rate curve could highlight some noteworthy inter-annual fluctuations, which might throw more light on specific events such as the Indonesian fires.

The number and quality of references are appropriate. The list is very substantial, well-balanced and appropriate.

The amount and quality of supplementary material is suitable and fitting.

3) *Some language improvements (suggestions):*

The greater part of Section 3.2 is shown below with a few small suggestions of how to improve the text:

1. Page 2394, line 20:.....sets instead of set.
2. Page 2395, line 13:.....decreased significantly during the period....
3. Page 2395, line 15:.....by setting $a_3=0$ and to calculate....
4. Page 2395, line 22:..... seasons (spring and summer). This is in line with.....
5. Page 2395, line 26:.....and reached its lowest values.....
6. Page 2396, line 1:..... biomass burning. Elevated mixing ratios were....
7. Page 2396, line 3:.....mixing ratios during the summer of 2003.....
8. Page 2396, line 6:.....and the forest fires in Portugal.....

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9. Page 2396, line 19.but may be due to a difference in air mass origins measured.
10. Page 2397, line 2.at lower altitudes in Switzerland.
11. Page 2397, line 10.are both situated close to a highway.
12. Page 2397, line 12.and represent a reliable mixture of traffic.
13. Page 2398, line 8. Asia (approx. 35%), North-America (~30%), Europe (~25%). Why is “approx.” used for Asia and “~” for the other continents?

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 2381, 2009.

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