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Interactive comment on "UV-induced carbon monoxide emission from living vegetation" *by* D. Bruhn et al.

Anonymous Referee #2

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The paper presents data on the influence of UV radiation on CO emissions from living vegetation. The short paper has a simple message, but for such a short paper I found it extremely difficult to read (and review) due to two issues:

1) The presentation is very short and in many cases necessary details are not given (see below).

2) The constant mixing-up of presentation of results and discussion in individual paragraphs makes it very difficult to grasp the full picture. I strongly recommend separating the observations (results) from the interpretation (discussion). In this way, it is also possible to present and discuss the flux chamber and leaf chamber results together, which would make the paper much better readable.

The introduction is very short and would benefit from some more motivation on the CO budget and UV related emissions of trace gases in general.

The discussion on the relevance for the global scale is very rudimentary, it is not what you expect from this title of the section. So what is the relevance? It is not even mentioned in this section whether it could be relevant or not. The OH effect is presented poorly.

Introduction:

a) The relevance of CO emissions from vegetation to the global CO budget is not made clear, because even a short review of the global CO budget is missing. Please provide the total CO source strength, and cite some papers on the global CO cycle, e.g. Novelli, P. C., Masarie, K. A., Lang, P. M., Hall, B. D., Myers, R. C., and Elkins, J. W.: Reanalysis of tropospheric CO trends: Effects of the 1997-1998 wildfires, J. Geophys. Res., 108, 4464, doi:4410.1029/2002JD00303, 2003.

Or others, Khalil & Rasmussen, or a global CO model study.

b) some references are not entirely adequate: It would be better to cite Logan, J. A., Prather, M. J., Wofsy, S. C., and McElroy, M. B.: Tropospheric chemistry: A global perspective, J. Geophys. Res., 86, 7210-7254, 1981. instead of the soil modeling paper by Potter in the first sentence.

Also, Schade, 1996b is not the best paper to cite to highlight that CO is “an important trace gas in the atmosphere”.

Please check other references!

c) It would be useful to mention as additional motivation that in recent years several studies have found that UV irradiation of organic matter leads to emission of a number of atmospheric compounds (e.g. CH4, CO, VOC, H2, CH3Cl).

2) Materials and methods:

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2.1

I find it strange to refer to a flux chamber setup as “ecosystem scale experiment”. (also in abstract and throughout the paper). It oversells the chamber results, why not call it flux chamber on a natural grass field.

2.2.1/2

The UV radiation was not excluded in the chamber experiments, but reduced to 32% (and 17% for the leaf scale exp). It could still have an effect. Is this taken into account? See comment later.

2.2.3

This description is not clear to me at all. Give equation and if it is complicated give an example.

3) Results and discussion

I do not understand what Fig 1a shows. I thought the leaf scale data are shown in Fig 2, but these values are different. Maybe I overlooked it, but please describe clearly.

3.1.1

Give values for the uptake rate in the dark.

What is the relevance of the following statement: “The measured uptake rate of CO in the dark can be approximated as the product of the CO diffusion coefficient of the top soil and the CO concentration profile in the top soil profile (Potter et al., 1996) according to Fick’s first law. Therefore, CO uptake in the grassland is in agreement with the expectation of an active microbial community in the grassland oxidizing the CO (Potter et al., 1996; King and Weber, 2007).”

It seems trivial and out of place here. Would you have expected something else?

3.1.2.

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It would be much clearer to move the discussion to the end when all results have been presented (also for other sections)

3.1.3.

As mentioned above, the second chamber is not almost completely UV-opaque, but transmits 32% of UV radiation. I see from Fig 1 that the gross flux for full sun is the difference between the full sun and dark net fluxes, but this is not the case for the "Sun excl UV" gross flux. Has the 32% UV fraction been taken into account? Please specify clearly how the gross rates are derived.

The last paragraph of 3.1.3 is more a general conclusion and should be separated from presentation of the results.

3.2.2

Refer to Fig 3, not 4.

Could you compare the slopes in Fig 3 with the ones from the literature quantitatively? Regarding the origin, maybe it is useful to relate the discussion on the origin of CO emissions briefly to the suggested origin of other trace gases that are emitted under UV in a short discussion (similar or different mechanisms?).

3.2.3

Why not use the standard notation of the parameters in the Arrhenius equation from textbooks, rather than α and β? This would also facilitate the comparison to published studies.

Replace "subtracted" by "minus"

β needs a unit.

3.3

first paragraph: have you really shown that emissions from excised leaves are the same

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than from attached leaves? Is this the conclusion from Fig 1a, which was not clear to me?

second paragraph: The discussion of the role of OH is very cryptic and inconclusive although the effect is rather straightforward to estimate.

In the chamber experiments in a natural atmosphere, yes, the OH sink will be under operation, and OH levels should not be much different from ambient air levels since both H2O and UV levels should be similar. BUT: The lifetime of CO versus oxidation by OH is of the order of weeks to months under natural conditions, so the effect is negligible in the experiments with natural sunlight. It could affect lab measurements with artificial sunlight in principle, but only if the UV component is extremely high. I do not understand what the OH effect has to do with the carrier gas flow rate. If the flow rate is higher, then the residence time of air in the chamber decreases, thus also the OH effect, but on the other hand also the emitted CO from the plants.

Interactive comment on Biogeosciences Discuss., 10, 9373, 2013.