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Interactive comment on "The role of photo- and thermal degradation for CO_2 and CO fluxes in an arid ecosystem" *by* H. van Asperen et al.

Anonymous Referee #1

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General comments: The paper is well written and summarises a lot of data from a range field and lab studies. It is novel in that is uses a range of CO2 and CO measurement techniques to investigate photodegradation in the field (though only for three days) and the laboratory. The findings of the work are interesting and raise questions for future photodegradation experiments. However, the eddy covariance and gradient flux measurements do not appear to have much relevance assuming the objectives of the paper were to assess photodegradation and thermal degradation. If the objective of the work was to measure CO2 and CO fluxes in an arid system then EC and GF data would be appropriate to be included. It would appear that due to a leak in the opaque treatment, the field experiment for photodegradation was only three days long which may also reduce the relevance of this work to addressing the objectives of the paper. Therefore, the only pieces of work included in this paper that appropriately address

the title which the authors have chosen is the laboratory data. For each measurement technique, there is a separate method, however I felt that the Materials and Methods section did not adequately describe the experimental plan for each of the methods used and lacked detail in some aspects.

Specific comments: P2430 L9 The second sentence does not make it clear that the CO2 and CO fluxes were observed in the authors work. Suggest changing to something like "In the laboratory, we measured CO2 and CO fluxes that were derived from thermal degradation." The same comment for L10, again does not specifically say that the CO uptake and emission was found in the work being presented in the authors paper. P2431 L21 (As well as P2443 L22) The authors have referred to papers that we published (Kirschbaum et al 2011; Lambie et al 2014) and, as written, the sentence is not strictly accurate. We investigated the role of UV in direct photodegradation and then separately on microbial facilitation of UV using CO2 monitoring. We were very particular in our separation of these two processes. L21 is structured in a way that infers that we assessed measured CO2 fluxes during the UV exposure part of our experiment – however this was not case. While I accept that the term photodegradation often includes the indirect effects of radiation, e.g. microbial facilitation, as mentioned in L26 it would be preferable to either change L21 to reflect that we were assessing microbial facilitation or move L26 to precede the sentence starting on L21. P2433 L20 The authors have again referred to the work that we published (Kirschbaum et al 2011; Lambie et al 2014) and the sentence is structured in a way that is not quite accurate. While we have discussed in our work that there are many different results of field experiments, we did not in fact conduct a field experiment, and the sentence suggests that we did. We did not also write a full review of all of the literature on this subject as it was a research paper than a review paper. I suggest either removing our work from the citations for this sentence or rewriting the sentence to reflect that we did not conduct field experiments. P2436 L4 How many soil collars were inserted? In the photodegradation assessment part of the work, it was stated there was 6 fixed chamber positions, is it the same for the earlier part of the methodology? P2436 L8 The trans-

parent chambers removed 50% of the radiation, is this still a valid representation of what would be occurring under natural conditions? Can the authors please comment on why they did not artificially enhance the UV (i.e. artificial lighting) within the chambers to bring it back up to natural conditions. Or change the chambers to a more UV transparent media to be able to more accurately assess the effect of UV under these conditions. P2437 L17 The authors have stated there were 6 fixed chamber locations but then when they tested the transparent chambers at "both locations", what were the "both locations"? I thought assessing the field chambers before applying the photodegradation treatment showed very good experimental design but the change from 6 to 2 was a bit confusing. Also the data presented in Figure 2, looking at the colours assigned to I assume each different chamber, then there are only 5 chambers including the one that was bare. P2437 L21 The authors assessed the flux chambers for CO2 and CO production, but only mention that they found CO production – for which they did not correct the data for. Please insert some statement with reference to the CO2 production during the blank testing. P2438 L7 Was the grass material cut to a specific size (e.g. 2 cm lengths) or ground? Was the soil material sieved to a consistent size? P2438 L9 The photodegradation part of the laboratory experiment did not assess photodegradation in the soil. In these arid systems bare soil would be an important part of the ecosystem and bare soil has been assessed in the other parts of the experimentation, including the chamber measurements and the thermal degradation experiment in the laboratory. Can the authors please comment on why photodegradation of the soil was not assessed? P2438 L15 During the photodegradation laboratory experiment, how long was the grass samples assessed for CO2 and CO? P2439 L22 I assume that they data presented in figure 1 is from transparent chambers only, the dates mentioned for the transparent and opaque chambers overlap according to the dates on the figure and in the text. Could the authors please clarify on the figure title as well as in the methods section of the manuscript? P2440 L2 Are these locations without organic surface material, the same ones referred to as bare soil (green diamonds on the figure), if so please be consistent with the names for these points. P2440 L10 Was the field

photodegradation experiment which took place over three days only undertaken as a comparison of 1 chamber for each treatment (i.e. one for opaque and one for 50% transparent)? While the authors have been very clear that this data is representative of only three days, can they comment on the relevance of this very limited window in time to the overall system dynamics? P2441 L2 Is there a P value for this statement, using the phase "significantly higher" indicates that a statistical analysis has been undertaken. P2441 L5 Why was such a short period of CO flux measurement presented in Figure 4? Assuming that this is the same data presented in figure 2 then a far greater period of measurement occurred. P2441 L7 Is there a possibility that there was no relationship between the incoming radiation and CO fluxes because the experimental procedure greatly reduced the incoming radiation? P2441 L17 Why is the data for the laboratory photodegradation experiment not shown? I would have liked to have seen the data for this. At the very least, "data not shown" should have been in this sentence. P2442 L4 I assume that these are the "bare soil" locations as displayed on Figure 2. P2442 L10 While I accept that rainfall events do lead to flushes of CO2 from soil, some of the rainfall events were between chamber shifts, so some of the post-rain flushes may have been emphasised by a shift in the chamber to one of the 6 locations which may have had a naturally slightly higher flux.

Technical corrections: The differing order of the references throughout the text is somewhat distracting as there does not appear to be a consistent format used, for example not consistently numeric or alphabetical in order. Also there are a lot of sets of brackets in the text, which can impede the ease to which the text is read, I suggest removing some of the sets of brackets to make the paper easier to read. P2430 L8 Could change "field and in the.." to "field nor in the. . ." P2430 L12 Would be good to not have studies followed by studying. Could change "studying" to "focusing", "addressing", "investigating", or "researching" etc. P2431 L14 Change sentence to read "Photodegradation is attributed to UV as well as visible radiation" P2431 L17 Change sentence to read "it is assumed that rates . . ." P2432 L9 Change sentence to read "Soils are known for being sources as well as sinks of CO. . ." P2432 L21 Consider adding "CO than pho-

tosynthesising leaf material" or something similar to the end of this sentence. Always good to state what you are comparing more specifically. P2432 L24 Could change to sentence to read "to a larger extent, photodegradation. . ." P2433 L10 Suggest changing "in where one" to "in that one" P2434 L16 Could refer to the appropriate figures for the rainfall and temperatures during the period in this sentence. P2435 L20 Consider changing sentence to read "By using the FG method. . ." P2436 L4 change "until" to "to" P2436 L15 Change sentence to read "Chamber opening and closure was after 4 and 18 minutes, respectively." P2437 L10 Change to "between flux methods footprints, and sparse photosynthetically active vegetation present in the . . ." P2437 L19 Consider changing "introduced" to "found", introduced suggests that it was done a leak was introduced for a specific purpose, which is counterproductive for this kind of experiment. P2437 L20 Consider changing "wherefore" to "therefore" here and at other points through the manuscript. P2438 L9 Change "set up" to "system" P2438 L10 Change "an" to "a" P2438 L14 Spelling error, change "cylinder" to "cylinder" P2438 L19 Could change the sentence "Every experiment was performed twice" to "Each treatment was duplicated". P2439 L12 The sentence here is repetitive, suggest changing to something like "..of the EC signal came from the grassland area within 150 m." P2439 L18 Suggest changing "visible" to "recorded" or "measured" P2439 L19 Change "is" to "was". P2441 L24 Replace "senecest" with "senescent', in this line and many other parts of the manuscript. P2443 L7 Change to "temperatures), it is expected that soil thermal. . ." P2443 L10 Change to "C3-grass at 55°C), but also at lower. . ." P2443 L19 change "set up" to "system" or "methodology" P2443 L23 Change ". . .in the field as well as in the laboratory." to something like "in the field nor in the laboratory." P2444 L5 Change "uptake as emission" to "uptake and emission"? P2444 L8 change "uptake up to 1 nmolm-2s-2 was observed. . ." " to "uptake of up to 1 nmolm-2s-1 of CO was observed,. . ." P2444 L16 Could omit "should be observed" P2444 L19 change "a abiotic" to "an abiotic". The remaining of the sentence is also clumsy. Suggest rewriting this sentence to something like "It is expected that an abiotic process may be occurring simultaneously with the biotic uptake of CO, leading to a "buffering" effect on

CO uptake." P2444 L23 There are no (a) or (b) labels on Figure 1. Would suggest putting these on the figure if going to refer to them in this nature in the text. P2445 L1 consider changing to ". . .with FC temperatures, and no relationship with radiation input, indicating that not. . ." P2445 L2 Change "significant" to "significantly", although as mentioned earlier in the my comments, generally the word significantly indicates that a statistical test has been undertaken and that a P value is recommended to be added to the sentence or change significantly to another word. P2445 L11 Change "In the laboratory experiment, in where grass from the fieldsite.." to "In the laboratory experiment, where grass from the field site. . ." P2445 L13 Remove "field site" from this sentence. Also change "senecest" to "senescent" P2445 L14 Change "visible already" to something like "even measureable" P2445 L18 change ". . .than the measured (net) field" to "than the net measured field" P2445 L20 change "by the upper. . ." to "from the upper. . ." P2445 L28 The r^2 in this sentence is different to that on the figure, 0.85 instead of 0.84. P2446 L18 Remove "(higher)" P2446 L26 Remove the brackets from "annual" P2446 L27 Remove the brackets from "CO2" P2447 L6 Change "In the field, as well biological. . ." to "In the field, biological . . ." P2453 Figure 2 Suggest clarifying in the figure title that this data is for transparent chambers only. P2454 Figure 3 Suggest clarifying in the figure title that this data has both opaque and transparent chambers, I know it is in the legend, but would also be good to have in the title. P2455 Figure 4 This figure needs to made clearer that the data is for grass samples only, if that is the case. P2456 Figure 5 Is the r^2 0.84 or 0.85? Different between legend and figure title, and also text.

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