

Interactive comment on “The role of photo- and thermal degradation for CO₂ and CO fluxes in an arid ecosystem” by H. van Asperen et al.

Anonymous Referee #2

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This discussion paper examines the CO₂ and CO emissions from photo- and thermal degradation in an Italian grassland. Results from the laboratory experiment suggest that previous studies may have overlooked the importance of thermal degradation in contributing CO₂ and CO emissions. It is also one of the first few that attempted to measure radiation-induced CO₂ and CO fluxes in field. They concluded that previous studies may have overestimated the role of photodegradation. Data that support this conclusion, however, were relatively weak: photodegradation-induced flux was only measured in field for three days; only one pair of transparent and opaque chambers was used; the UV transmission of the gas chamber was poor (~50%). I suggest the authors to systematically discuss the limitations of their experiment. In this current form, the paper appears a bit too long. I find the data from eddy covariance and flux gradient less relevant to the questions on photo- and thermal degradation. I suggest

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the authors to cut down the related methods and results. One possibility is to briefly summarize the findings of these two methods in the materials and methods and move figure 1 to the supplementary materials. Specific comments:

P2431L18: This sentence needs to be reworded. e.g. “It has been hypothesized that rates of photodegradation depend on...”. P2431L19: Other compounds such as cutin and suberin are usually more chemically recalcitrant than lignin. P2431L24: Uelman et al. 2011 and Kirschbaum et al. 2011 did not directly measure C fluxes. P2431L28: This is a good place to briefly explain what “indirect effects of radiation on decomposition” means. Also, it should be King et al. (2012). P2432L5: move “also” after CH₄ P2432L22-25: I cannot follow this sentence. P2433L4: “shift communities” is a bit awkward. Also, Smith et al. 2010 would be a good reference here. P2433L14: None of these studies used flux chambers. To my knowledge, this paper is the first that used flux chambers to measure photodegradation-induced CO₂ flux in field. P2433L21: Most cited studies here, except Rutledge et al., are not field-based. The authors considers the study site as an arid ecosystem. I find the site wetter than most arid ecosystems. Its annual precipitation was high, and CO₂ uptake can be found in the middle of the dry season. What if this study was conducted in a drier ecosystem? Would photodegradation-induced flux be more prominent in drier environment, given that background soil respiration would be low? The authors should consider addressing these questions in the discussion. P2436L8: Glass is not effective in transmitting UV radiation. Thus, radiation-induced fluxes (both photo- and thermal degradation) can be under-estimated. How was UV “transparency” measured? Any information on the spectrum of the transmitted radiation? Did glass transmit more UVB than UVA? P2437L3-12: Following one of my general comment, discussion on flux gradient and eddy covariance methods could be merged with other information on these methods. P2437L21: Was the pair of chamber moved among the 6 chamber locations during the 3-day period? Indicate the dates that were included in the 3-day period. P2438L10: Specify the model of plexiglass. Plexiglass differs in their optical properties and many models contain compounds that absorb UV. P2438L13: How much radiation was re-

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ceived by samples? Several key details about the laboratory experiment were missing. How long were these experiments conducted at a given temperature? How were the laboratory chamber sealed? What were the dimensions of the chamber? Did grass/soil samples cover the entire chamber? What type of grass was used? Did photodegradation experiments include soil? P2440L10: I would be very interested to see a figure with fluxes (transparent vs opaque) plotted against time during the 3-day period. P2441L18-20: Data that supported this important finding were not presented. The laboratory experiment also manipulated the amount of samples and the type of radiation. However, none of these results were presented. Does it mean that neither factors had significant impacts? P2442L11: The increase of fluxes after rain events was not obvious to me. It appears that the first week of the field campaign had relatively low CO₂ production compared to the following weeks (Figure 2). Because these data were used to examine photodegradation, it could be important to discuss reasons for this phenomenon, P2443L10: What does the plus and minus sign mean? P2443L22-25: Again, many citations here were not appropriate. P2444L5: both CO uptake and emission P2444L17: an abiotic P2445L25-: This paragraph repeated the results and can be reworked. P2336L3-5: This one also seems repetitive. P2446L16-: This paragraph did not directly discuss thermal production of CO. The sentences on the FG vs FC comparisons could be merged with the paragraph at P2444L5-16.

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