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# *Interactive comment on* "The biomass burning contribution to climate-carbon cycle feedback" *by* Sandy P. Harrison et al.

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Response to Referee #2

We thank the reviewer for their positive comments about the novelty of this work, and for recognizing the value of the palaeo-record in addressing issues that are not satisfactorily resolved using contemporary data alone.

1. Yes human activities do affect ignitions, and we propose to further emphasize this in the Introduction, but the primary impact is through modifying fuel availability and fire spread.

2. We use GFED4s in this paper, but we agree that since this is derived from GFED4, it is appropriate to include the van der Werf (2017) reference here.



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Discussion paper

3. The Arora et al. paper was cited correctly in the reference list as 2013, but incorrectly as 2014 at some places in the text. We will correct this.

4. Yes, we can (and propose to) provide a more detailed breakdown of the total land climate-carbon cycle feedback from different "no-fire" models as given in Arora et al. (2013). The spread of values among all models is large, but this is partly due to the inclusion of two CMIP5 Earth System models (using the same, fire-enabled land model) that have been shown to greatly underestimate the strength of this feedback based on the observed relationship between tropical land temperatures and the growth rate of atmospheric CO2 (Wenzel et al. 2014). After removing these two models we are left with only two that explicitly represent fire, and their feedback strengths are in the same range as those for the five models that do not explicitly represent fire. Thus, the main purpose of citing Arora et al. (2013) here is simply to give a general idea of the magnitude of this feedback as represented in Earth System models. We suggest this is best expressed by the median of the "no-fire" models (17.5 ppm K–1 after correction for the airborne fraction). The total range (excluding the two models mentioned above) is from 6.8 to 19.9 ppm K–1.

5. We point out already that the total fire-feedback estimate from Ward et al. (2012), which is negative, depends strongly on the (highly uncertain) magnitude of the indirect aerosol effect. We should point out that their estimate of the effect of fire on the carbon cycle is also questionable. They estimated that elimination of fire would increase land carbon storage by a large amount, approximately 500 Pg C. The effect of this change on atmospheric CO2, however, is masked in their analysis by the application of a small effective airborne fraction of 0.177 – which is based on a formula designed for application to much longer than centennial time scales. Moreover this analysis is based on a single model. Work now in progress (Lasslop et al.: Geophysical Research Abstracts 20, EGU2018-13445, 2018) shows that there are very substantial differences in how current models treat fire: for example, the decrease in the carbon turnover time due to fire varies between 2.5 and 10% across the FIREMIP ensemble of models. It would be

much more useful and robust to address this issue using outputs from multiple models, and preferably when we have a better understanding of why models show such a large range of responses.

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