

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

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I read this paper with interest and although I am not a referee I couldn't stop myself commenting on this interesting work.

My primary comment is while the brevity of the paper makes it succinct, given the overall short paper it would be extremely useful for any reader to have the appendix moved to the main text and add some more info and equations so that the methodology is clear.

Major comments

First, having read the paper I am still unclear how change in charcoal index can be used to derive change in emissions. There has to be an assumption somewhere that

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says percentage change in normalized charcoal index is assumed to yield percentage change in fire CO₂ emissions. Unless I missed this, I don't think this assumption is mentioned explicitly. Related to this assumption is the fact that charcoal indices are extremely uncertain. As authors very well know that the absolute values of charcoal indices changed from Marlon et al. (2008) to Marlon et al. (2016) release. Does the change the absolute values of charcoal indices also affect their normalized values? If yes, it makes sense to test the sensitivity of derived results to charcoal data used. The authors have used Marlon et al. (2016) charcoal data set. Will their results change significantly if Marlon et al. (2008) data set were used?

Second, the authors have chosen to represent the fire climate feedback in units of ppm/degree Celsius. This is somewhat confusing because later on they compare this feedback to carbon-climate feedback from Arora et al. (2013). The units of integrated carbon-climate feedback in Arora et al. (2013) are Pg C/degree C (their Table 2 and the mean model value for the 9 participating models in their study is -58.4 Pg C/degree Celsius). The negative sign indicates that the land gives up carbon due to increase in temperature. It is unclear how authors quote the Arora et al. (2013) carbon-climate feedback number to be 13.1 ± 6.4 ppm/degree Kelvin. I would suggest authors to please consider reporting their fire climate feedback in same units as in Arora et al. (2013) so that the numbers are directly comparable and therefore easy to interpret.

Third, I agree with reviewer 4 that the overall discussion in context of present day temperature and fire emissions is extremely confusing because it is overwhelmingly influenced by anthropogenic activities. As authors know, overall while temperatures increase over the 2000-2014 period the fire emissions are decreasing.

Finally, I am unclear how dC/dt (page 12, line 4) can be related to gain and climate sensitivity. Missing equations make the connection really difficult to understand.

Minor comments

Abstract, line 25, It is not clear just by reading the abstract why an estimate of climate

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sensitivity is required to calculate gain.

Page 3, lines 25-26. “Our estimates of total emissions . . . We also estimate the total emissions . . .”. The words “our” and “we” in these sentences are confusing and suggest that these emissions were calculated in this study. In fact, these emissions are from the GFED4s data set. Please consider rewording these sentences.

Page 4, line 6, just below equation 1. “. . . \bar{c}^* is the mean transformed influx”. Isn't \bar{c}^* just the mean? Why the fancy name “mean transformed influx”? Or perhaps, I am missing something.

Page 4, lines 12-13. “We adopted the age models for each record as published. We then applied the 0.51‰ correction described by Sapart et al. (2012) to the Northern Hemisphere data.” It may be worthwhile telling readers what does “adopting age models” means. I personally don't know what this phrase means. Also, it is not clear why was the “0.51‰ correction” applied. What does this correction addresses and what does it tries to achieve?

Page 5. Please consider defining “pseudoreplication”.

Page 6, line 10 reads “Equation 4 can then be resolved into the sum of three components . . .”. However, I see only two components in Equation 4. The one before the minus sign and the one after. Also, when referring to the individual components of equation 4 it would be worthwhile for authors to mention these explicitly in the text so that readers know which component is being referred to.

Page 6, lines 26-27. “However, an alternative convention exists in which the quantity defined in equation (5) is called the gain, while the quantity we call gain is called the feedback factor”. This sentence is confusing. Additional equations will be very helpful.

Page 7. Please say explicitly as soon as equation 6 is shown that its derivation is shown in the appendix.

Equation 6. ΔC and ΔF_b are mentioned as increases. It would be more appropriate to

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mention these are changes on lines 4 and 5 on Page 7.

Page 7, line 8. “. . . we related normalized anomalies (dimensionless) statistically to . . .”. Normalized anomalies of what.

Page 8, line 6. The sentence “. . . whereas ENSO-related changes in temperature and precipitation are variable in sign across extratropical regions . . .” is unclear. What does “variable in sign” means?

Page 8, line 29-30. “. . . $R^2 = 0.646$, $F = 41.98$ with 1 and 23 df . . .”. What does F and df mean? It may be useful to explicitly define these for folks who are not completely familiar with statistical terminology.

References

Arora, V. K., Boer, G. J., Friedlingstein, P., Eby, M., Jones, C. D., Christian, J. R., Bonan, G., Bopp, L., Brovkin, V., Cadule, P., Hajima, T., Ilyina, T., Lindsay, K., Tjiputra, J. F., and Wu, T.: Carbon–concentration and carbon–climate feedbacks in CMIP5 Earth System Models, *J. Clim.*, 26, 5289– 5314, DOI: 10.1175/JCLI-D-12-00494.1 (2013).

Marlon, J. R. et al. Climate and human influences on global biomass burning over the past two millennia. *Nat. Geosci* 1, 697–702 (2008).

Marlon, J. R. et al. Reconstructions of biomass burning from sediment-charcoal records to improve data–model comparisons. *Biogeosciences* 13, 3225–3244 (2016).

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