

***Interactive comment on* “Quantifying the role of fire in the Earth system – Part 2: Impact on the net carbon balance of global terrestrial ecosystems for the 20th century” by F. Li et al.**

Anonymous Referee #1

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Review of Li et al. Biogeosci 2013.

Dear Editor,

General Comments:

Li et al. use the newly improved CLM4.5 model to estimate the global effect of fire. They perform simulations over the 20th century looking at the fire direct and indirect effects (simulations performed with fire on and off). The work on the fire direct effect is persuasive and their model is demonstrated to generally perform quite well. I think in general the fire model they have constructed does a good job as they demonstrate with due consideration of the other observational and modelling estimates.

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My main concerns are around the estimation of the fire indirect effect. The main shortcoming of this estimation (as they note on page 17328 I.18) is using a prescribed vegetation cover. The change in fire-prone biomes after the exclusion of fire is quite substantial as estimated by Bond et al. (2005). Li et al. do not attempt to quantify how much of an influence changes in plant distribution would make. I am glad to see that Li et al. do acknowledge this deficiency, but it only happens almost at the very end of the manuscript. As well their prescribed changes in land cover implicitly include the influence of fire over the historical period giving a confusing signal for the fire-off simulations. These simulations are also uncoupled from climate, which is not a major deficiency, but it would be good to have this made apparent earlier in the paper to ensure clarity. I do agree with their argument that climate model biases in precipitation could make interpretation of a coupled model run challenging.

As a result of these concerns, I do support publication but only after the following changes are made to address these shortcomings. I believe that exclusion of vegetation distribution changes will give a false estimate of the fire indirect effect making this contribution possibly misleading if that is not understood by the reader. Therefore I believe the following changes are important and required to allow publication:

- 1) Mention in the abstract that the simulations are performed without dynamic vegetation response and are uncoupled from the climate.
- 2) In the methods, explicitly state that the vegetation are not dynamic. Presently one has to read almost until the end to be made aware that the simulations use prescribed vegetation cover.

Specific comments:

Abstract - Confusing at times, it could use some smoothing out, as could other parts of the manuscript.

***Section 2.1 - More information is needed to help the reader understand how fire

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affects vegetation mortality, transfer to litter and soil C pools, etc. Give numbers to how these processes are parameterized. The description of the fire model is almost absent. I do realize that this is a companion paper, but some information is warranted. I also understand that much of the model is described in previous publications of Li and coworkers, but it would be helpful to have some parameters given here that are important for determination of the fire direct vs. indirect effect. Readers should not have to sift through a dozen CLM publications to piece together how model parameterizations could influence the reported results.

p. 17314 l.23 - The description on maintenance respiration is too vague. Please add in more detail.

p. 17315 l. 18 paragraph- This might be useful to CLM users, but it is rather opaque otherwise, consider revising for clarity for people who do not use the model.

p. 17317 l. 18 - This makes it seem like they use the model generated CO₂ and not observed, is that correct?

p. 17323 l. 15 - Was NBP defined earlier?

p. 17324 l. 5 - Keep in mind that GFED emissions are a modeled result too.

l. 15 - Why is CLM4 relevant? All model results presented here are for CLM4.5 are they not?

l. 17 - 23 - Confusing. Missing a closing parentheses?

l. 21 - Prentice et al. 2010 is not in references, what paper is this referring to?

Fig 2 - Can the Fire-on - Fire-off label be changed? I found myself looking for a narrow black line before realizing that it was meant to be minus symbol.

References:

Bond, W. J., Woodward, F. I. and Midgley, G. F.: The global distribution of ecosystems

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in a world without fire, *New Phytol.*, 165(2), 525–537, 2005.

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