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Earth System Dynamics
Discussions

Interactive comment on "Synergy between land use and climate change increases future fire risk in Amazon forests" *by* Yannick Le Page et al.

Anonymous Referee #2

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Le Page et al. made some (simple) improvements in the prognostic fire model HESFIRE followed by parameter optimization. After the model is properly evaluated, they used it to predict future patterns of understory fires in Amazon forests under the CMIP5 RCP4.5 and RCP 8.5 scenarios. They found that land use change and climate change have a synergic role in strengthening fire activities in the RCP 8.5 scenario, with climate change exerting a dominant role, while conservative land use change under the RCP 4.5 scenario can actually mitigate fire occurrences. They also show that fire sizes will largely increase under both scenarios.

It is already known from previous studies that degradation fires (though not all of them are understory fires) in Amazon forests are largely controlled by drought conditions in relation to climate variations (Malhi et al., 2009, PNAS), and land fragmentation and

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logging tend to increase the flammability of forests (Malhi et al., 2008 Science, Nepstad et al., 1999 Nature). Morton et al. (2008, GCB) shows that fire is an important agent in active management of agricultural lands after deforestation, for both pasture and croplands. In Morton et al. (2013) it is further shown understory fires are highly linked with deforestation frontiers (which is essentially land use change) and respond strongly to dry climate years or in general, to dry climate conditions. So in view of these studies, the conclusions in the current manuscript are not really very novel. But I recommend it being considered for publication for two reasons: (1) it incorporates the understory fires that are often neglected in global fire models. (2) it can provide useful insights for the future mitigation strategies for Amanzon forests.

Some general comments:

My general comments mainly concern with improving the presentation, especially to be more precise in the texts.

I find that the introduction section is written in a too much general and somewhat "loose" manner. For example, page 2, line 1-2 could be expanded to give more details. Descriptions in Page 2, line 23–26 is also too general, expressions like "predictable patterns of drought and fire risk form the basis of regional early-warming systems" could essentially apply on other fire types as well (e.g., boreal fires). The background of the current study is relatively well described, but I have a sense that it lacks a specific context that allow readers appreciating and better understanding the current study. For example, how about previous works by Alencar et al. 2004 (Ecological Applications) and Silvestrini et al. 2011 (Ecological Applications)? What are the progresses of the study in comparison to previous studies like these? The authors can also to think to enhance the specificity in the discussion section as well.

The flow of texts, to my point of view, sometimes lacks the necessary rigour needed in scientific writing. For example, page 2, line 24, "under a changing climate": although readers could guess from the contexts that the authors imply global warming or climate

change, or more specifically, climate change that induces more frequent drought, I still think it's better the authors directly write it out precisely as they intend to mean. Some other examples include: page 2 line 34, "under novel climate and land use conditions", what do you mean by "novel" here? Page 3 line 12, "... while addressing their respective issues... ", what are these respective issues? Page 4 line 10, "... MODIS patterns appeared more consistent with the contemporary distribution of land use ...", how such a conclusion is reached?

Minor comments: Page 4 line 15: in this equation, what are terms originally included in the HESFIRE in Le Page et al. (2015)? What are the new terms added accounting for understory fires? In section 3.1, could you explain how a better agreement between model and data is achieved? Is the inclusion of the extra term (land fragmentation impact on fire size) critical, or a recalibration of the original parameters more critical? (The authors could give some words based on their experts on their model, not necessarily with new simulations) I have a feeling like the interannual variability of the original model result is OK but just its magnitude is too high (Figure S2), so that an extra term is needed to bring down the burned area. Visually looking Figure 2(c) is quite OK but could you show a scatter plot (model versus observation) as well (maybe in the supplement)? Finally, how the land fragmentation is measured in the model? Like you used some land cover map derived index?

Figure 3 and the associated results: Are these percentiles calculated by pooling on over each grid cell the results from different climate models? Is there a risk that the fires could be overestimated because different climate models give different spatial patterns of drying (Fig 1 B)? I mean, spatially we pick up the 90th percentile over each pixel so that the spatial total of the 90th percentile fires are much larger than, if we just pick up the 90th of total fire impacted areas from different models, because models compensate for each other spatially?

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