Biogeosciences

Discussions

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Interactive comment on "The pyrogeography of eastern boreal Canada from 1901 to 2012 simulated with the LPJ-LMfire model" *by* Emeline Chaste et al.

Anonymous Referee #2

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General comments: The goal of this paper was to reconstruct the fire activity of the boreal forest in eastern Canada using the LPJ-LMFIRE dynamic vegetation model. Additional goals were to calibrate and validate the model and to determine how spatiotemporal patterns in fire activity, NPP, and aboveground biomass have interacted with climate over the past century. They found that the ability of the LPJ-LMFIRE model to capture spatial patterns in fire activity was significantly improved through incorporation of a high-quality lightning dataset. Overall, the model performed well at reproducing pattern in fire frequency, but with some area of under- and overestimation. Additionally, the authors conclude that CO_2 fertilization has contributed to increases in NPP, but that increased fire activity offsets this increase leading to relatively stable aboveground

tree biomass. I found the paper to be well written and appreciated the thorough treatment of model validation. This paper fits well within the scope of Biogeosciences and represents an important contribution to fire and vegetation simulation studies.

Specific comments: 1. I would like to see a more thorough treatment of the differences between the "Climate + CO2" and "Climate only" simulations, specifically with respect to how fire activity differed between the two scenarios. It was not clear to me whether the fire activity results reported in section "3.2.1 Fire activity" and Fig. 5 were from the "Climate only" simulation or the "Climate+C02" simulations. Because the authors emphasize that CO2 fertilization increases NPP but that this is offset by increased fire activity, I think the results for fire activity with and without C02 need to be more clearly presented. The effects of C02 on NPP are discussed in section 3.2.2. Fuels, but I do not see a similar discussion of the fire results.

2. Section 2.2 LPJ-LMfire model: Does the LPJ-LMfire model allow for cell to cell spread of fire? It is my understanding that the base LPJ model has no cell to cell interaction, a major limitation for simulating fire. It was my understanding that the SPITFIRE model did incorporate cell-cell interactions, but this needs to be explicitly stated in the manuscript.

3. Study area description: I think it would benefit the reader if the authors included some rough description of fire regimes (general fire frequencies and whether historical fires were predominantly low, mixed, or high-severity, for example) for each of the ecoregions. As written, only the Boreal Shield ecoregions is characterized as having "typically high" fire frequency, but no estimate is given as to what that means in terms of mean fire return interval.

4. On p14 L20-23, the authors suggest that strong correlations between simulated and observed annual burn rates indicate fire suppression efforts have had little affect on fire behavior. Although this makes sense overall, the authors also note on p13 lines 25-30 that overestimates of simulated burn rates in Ontario and Quebec were expected be-

cause the model doesn't consider anthropogenic effects and that forest management has influenced forest composition/fuels. Perhaps these paragraphs need to be combined and the nuances of how fire and forest management have varied spatially be expanded upon?

5. Table 1. The datasets and references for the temperature, precipitation, cloud cover and convectible available potential energy were listed in the text, but I found it odd for them not be listed in the table when that information is listed in the table for the remaining variables.

6. P3 Lines 11-16. I find it odd that the authors claim a "lack of quantitative knowledge regarding the relative changes in fire regimes that are attributable to human impacts". Perhaps this is true of boreal Canada, I am more familiar with fire history studies in the U.S. Southwest and US Pacific northwest. Especially in the U.S. Southwest, fire history and forest age/structure and species composition from dendroecological evidence have been used to quantify how human activities (logging, grazing, fire exclusion) have impacted fire regimes (see studies by Thomas Swetnam, Peter Fule, Peter Brown, among others). These statements need to be qualified.

Technical comments:

P1 Line 33-34: Change the sentence to read: "Agreement between the spatiotemporal patterns of fire frequency and the observed data confirmed that fire in the study are is strongly ignition-limited."