

Interactive comment on “Varying relationships between fire intensity and fire size at global scale” by Pierre Laurent et al.

Pierre Laurent et al.

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Major concerns:

This manuscript is interesting and fit well with the focuses of BG. It can be published after a careful revision. I am not a fire ecologist. Consequently, I met a lot of difficulties in understanding concepts, variables names and their definitions you used in the manuscript. The guiding principle of your analysis is the Rothermel (1972)'s fire spread model (“Rothermel’s equation” line 35, “Following the hypothesis from Rothermel’s equation of fire spread” line 170). It is a very detailed local scale model. It is one of the most used models to simulate the forward rate of spread at the front of a surface fire, and is the primary fire spread model applied in many fire prediction systems. In the

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Rothermel’s model, rate of spread is simulated as a function of topography, microclimate conditions and a fire behavior fuel model or fuel model that consists of numerous parameters for a given fuel complex. Standard fuel models have often been shown inappropriate for representing local conditions. In this manuscript, you referred to the Rothermel (1972)'s equation. In the original USDA paper, the number of equations was c.a. 90. It will be fine that in your up-scaling procedure, from local to global, you explain how you summarized the Rothermel (1972)'s fire spread model for finally analyze the relationship between fire patch area and fire intensity. A short explanation will be useful and will clarify the discussion in which you mixed: fuel biomass availability, biomass gradient, moisture content of the fuel, fragmentation, wind speed, fuel bulk density, fuel load, etc.

Answer: Looking at your review and the reviews from the two other referees, we realized that we did not defined well the different quantities that we are using throughout the article : fire (reaction) intensity, FRP, and how they relate to Rothermel’s equation. We are now giving a more careful definition of all terms. Concerning Rothermel’s equation, we are using the “main” equation for Rate of Spead, which is used in most fire module : this is equation (10) in the Rothermel (1972) article. We will clarify this in our revision, because our description is not straightforward for anybody without a fire ecologist background. Also, note that following the suggestions from all referees, we decided to change “Fire Intensity” with “Fire Radiative Power” in the title and throughout the article. We are looking at relationships between fire size and FRP, and then we interpret FRP as a proxy of FI.

My second main concern is your cutting of continents by using the one proposed by the GFED. The 14 regions are very arbitrary. As an example EURO includes the surrounding of the northern part of the Mediterranean Sea where the fire regime surely doesn’t follow the same pattern than in more Northern regions. Likely using a more “ecologically-based” or “climatically-related” cutting will yield contrasted results?

Answer: Yes, this was a request from the three reviewers.

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Splitting the data following drought is difficult, because there are plenty numerous possibilities to perform the split (using the length of the season ? The intensity of the drought index ? A combination of both ?). We suggest to split each GFED regions using MODIS Land Cover information: this will allow not to mix together grassland, savannas and forests in Africa for example. The results are really striking in Australia, where the relationships strongly differs between different land cover types.

Also, we realized that the reliability of the hypothesis which claims that FRP could be used as a proxy of fire intensity depends on the land cover: FRP integrates all the radiative energy from the fire, from the flame front or from smouldering. Only the flame front is related to the rate of spread. In grassland, the flame-front will be the main contribution to FRP, but this is not always the case for other land cover. Therefore, separating our analysis depending on land cover also allows us to discriminate areas where FRP is a reliable proxy of fire intensity.

Please find our point-by-point answers to specific comments in the following.

1) Line 23 plant biomass distribution.

Answer: The text has been changed.

2) Line 25 rather ecological driver than climatic variable.

Answer: Through its effects on the carbon cycle, fire is an important climatic process. But this is true that fire is important for both ecological and climatic effects (as described later in the introduction). Since in this first paragraph we focus on climate modeling, we prefer to keep the sentence as it is.

3) Line 29 reliable burned area, active fires and fire intensity global dataset.

Answer: The text has been changed.

4) Line 45 fire patches vs raw burn area. Please could you explain?

Answer: Burned area integrates all fire patch areas into a single value. Recent studies

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now split analysis of the total burned area into patch level analysis allowing for a more precise information on ignitions and fire spread processes underlying the final burned area.

5) Line 54 please define BA here (burned area).

Answer: Actually we first used the term Burned Area on l. 30. We now introduce the term BA there.

6) Line 62 please detail MCD14ML. Best to give the complete name of the remotely sensed products you used and their DOI if available.

Answer: I will detail the dataset, and try to find the DOI.

7) Line 76 fire patch size why not fire patch area ?

Answer: We tried to keep the same terminology as in Laurent et al. 2018.

8) Line 74 "validated against Landsat fire polygons".

Answer: The text has been changed.

9) Line 77 Standard Deviation Ellipse (SDE) Please could you explain how this parameter calculated? It does not seem further used in the manuscript except lines 87 and 89. One SDE covers approximately 68 percents of the fire patch. You applied a cutoff at SDE + 1 km, why not 2 SDE?

Answer: The SDE were obtained with the "aspace" R package. We have modified the text (l. 80). Taking 2 SDE as the matching radius with FRP pixel would have yield lots of double association in the database. We prefer to be conservative, even if this result in a reduction of the usable number of fire patches.

10) Line 90 30-day buffer seems very long. During this delay surface reflectance may drastically change with resprouter shrubs or some bunchgrasses.

Answer: We agree, but this corresponds to the high uncertainty on the burn scar de-

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tection from BA dataset. Moreover, we did some test by reducing the 30 day buffer, and this had no significant effect on the result (it only reduces the number of patch with associated FRP).

11) Line 95 you wrote "In this analysis, we used FRP as a proxy of fire in intensity, later called FI". Further we still found FRP in the text and in the graphs.

Answer: Following the remarks of the other referees, we preferred to change FI into FRP throughout the text.

12) Line 112 "Brazilian tropical savannas". On fig 1b, most red dots are located across Argentina and not across Brazilian tropical savannas!

Answer: Yes, we agree. We have changed "Brazilian tropical savannas" to "Patagonia".

13) Line 125 please define the meaning of GFED. Please use the full names of the regions in Table 1.

Answer: We have inserted the full name on line 120, the first time GFED is mentioned.

14) Line 126 fitted rather than interpolated.

Answer: We have changed the text.

15) Line 130 humped relationships in CEAM, EQUAS, SEAS. This type of "humped" relationships seems to occur elsewhere? You presented these three areas as equatorial biomes. This means closed to equator or with a particular climate pattern? (See my previous comment on your geographical cutting).

Answer: We now separate each GFED region depending on their vegetation types, using land cover from MODIS. This has yield a new paragraph in the Methodology and the Results section.

16) Line 139 MW-1

Answer: Text has been changed.

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17) Line 206 percolation or cellular automata?

Answer: We meant percolation.

18) Figure 2 FI in the figure legend and FRP in the x-axis. Y-axis scales drastically change depending of geographic area and so complicate the reading.

Answer: This was a mistake, we have modified the text.

19) Figure 3 are you sure that this figure is necessary (see Table 1 content).

Answer: We agree, especially now that we are separating GFED regions in multiple biomes. We have removed the figure.

Interactive comment on Biogeosciences Discuss., <https://doi.org/10.5194/bg-2018-334>, 2018.

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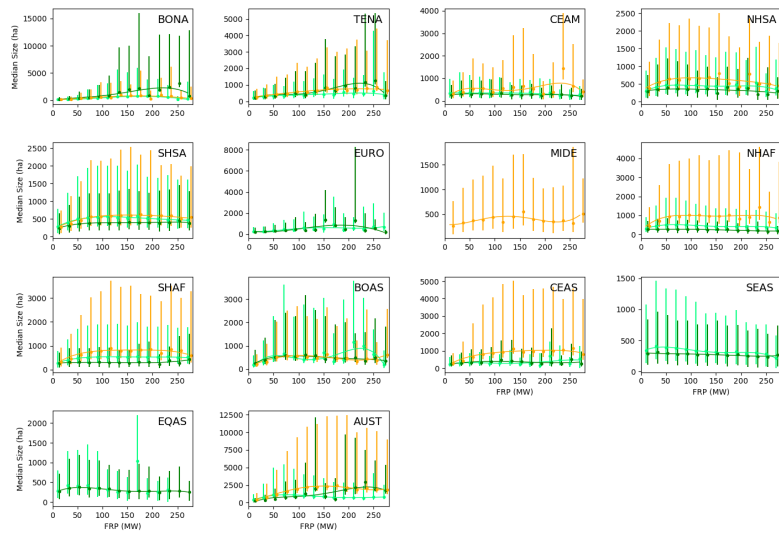


Fig. 1. FRP vs fire size for different biomes

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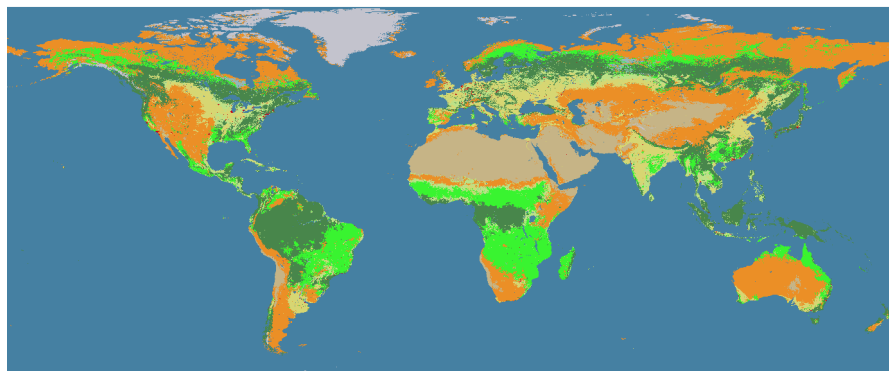


Fig. 2. Map of the land cover biomes

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