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Earth System Dynamics
Discussions

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

Anonymous Referee #4

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Harrison and co-workers use two independent approaches to calculate how biomass burning emissions vary with temperature. They fully acknowledge the limitations of both approaches, which are substantial, and I have some doubts whether the overall conclusions are warranted for contemporary times. The charcoal and methane approach yield a certain slope or gain which is representative for fire and temperature changes over roughly 500-1750AD. It clearly shows that over that period fire and temperature are positively linked and I believe this is an important finding, although the same has been found using only charcoal data but the CH4 addition is a welcome one given the uncertainty in how representative charcoal data is for global fire emissions.

The same seems to hold for the 2000-2014 period as shown in the paper, in fact the slope between temperature and fire is roughly the same as for the charcoal approach.

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However, that is strange: over the past decades fire emissions have decreased while temperature has increased, especially over land. That seems difficult to reconcile with the overall narrative of the paper, although the authors do note that the correspondence between the slopes of the charcoal era and satellite era is fortuitous and the latter related to ENSO variability.

But if I take the full 1997-2016 GFED time period instead of the 2000-2014 period the slope becomes negative (-0.2 Pg C / K instead of +0.7 Pg C / K as shown in the paper, whether 'anthropogenic' fires are included or not). See the Figure at the end. I understand that emissions for the 1997-2000 are less reliable, but it is well known that fire emissions were anomalously high in 1997 and 1998 and land temperature was still relatively low. 2016 was a very warm year and fire emissions were low. I just don't see a good justification to exclude those years.

Now, that does obviously not mean that higher temperatures never lead to higher fire emissions. But for the past decades this is simply not the case if all available information is included. I can imagine that in general, a warmer world leads to more fires, especially in boreal and some temperate regions, and there is abundant literature on that. But on a global scale other factors are playing a role as well at the moment and I think these should be better addressed. This could be done by analyzing the temperature – fire relationship for separate regions for example, figuring out where and when there is a good relation and trying to explain the cases where the relation is lacking or negative. Taking into account precipitation and temperature before or after the fire season instead of mean annual temperature may be helpful as well.

In conclusion: the charcoal / methane analysis is very informative but much more work has to be done before a statement about temperature-fire relations on a global scale can be made that are also applicable now and in the future. A regional analysis for the satellite era could be part of that (including discussing whether there are feedbacks between temperature, fire, and vegetation that may impact the slope over time), and obviously would include a discussion why the positive relation between temperature

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and fire emissions historically has changed to a negative one nowadays, and why the authors think this could be reversed once more in the future.

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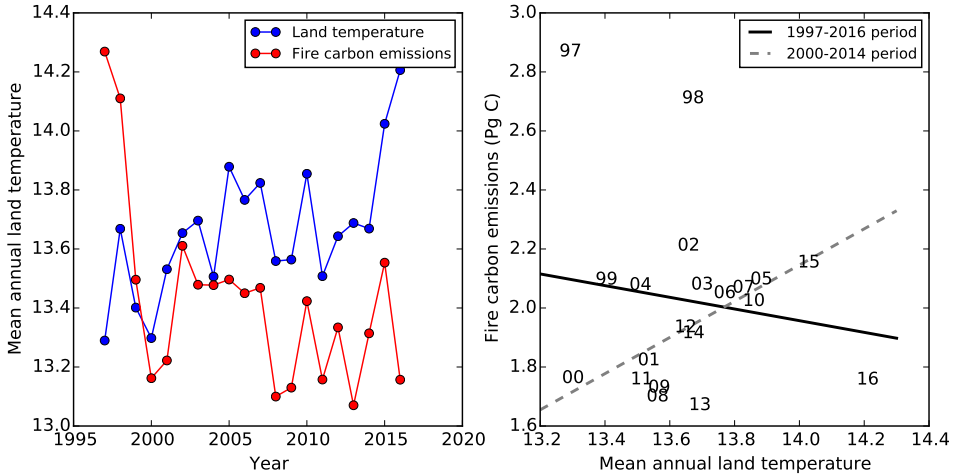

Fig. 1.

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