Geosci. Model Dev. Discuss.,
https://doi.org/10.5194/gmd-2016-301-RC3, 2017

Geoscientific Model Development Discussions

Interactive comment on "Identifying required model structures to predict global fire activity from satellite and climate data" *by* Matthias Forkel et al.

Anonymous Referee #2

Received and published: 31 August 2017

The authors simulate fraction burned area at the global scale using a flexible modelling approach that is fed by climate and satellite-derived data. The topic is relevant because fire is an important component of the Earth System, and improving our estimates of fire activity can improve our capability of the Earth System itsefl. Nevertheless, I have serious doubts that the way the study is designed will help move the body of knowledge of fire in the Earth System forward. At some point in the work it seems like the authors are adding variables to a box without clearly understanding their relation\interaction with fire activity. In my opinion, this does not move the body of knowledge forward. Instead this is an exploratory approach that could be used to identify important variables and relation forms (or structures), although I don't think it will ever "identify required

model structures". In my opinion the work would benefit by a more constrained analysis instead of adding too many things to a box and trying to make sense of it in the end.

Some major comments:

1) The equifinality in the modelling approach is clear. Choosing 1 model from a bunch of good candidate models and identifying the controls of fire activity just misses the whole point. It gets more critical if you think that not all combinations were tested. What would make sense in my opinion would be analyze all valid models and trying to extract relevant information on the most important variables and influential controlling factors. Not sure on how you could do that but perhaps it would be worthwhile to take a look at Keith Beven's work and the GLUE methodology (references below).

2) The spatial resolution is a problem, as you correctly mentioned (L693-698). You are modelling fire closer to the landscape scale than the fire regime scale. To model fire activity at such a fine scale you would need other type of information and confine your analysis to specific regions. I think the work would gain a lot by doing the analysis at coarser resolutions.

3) The work needs a more solid background on how environmental and human factors influence fire patterns. This is absolutely crucial, frames the entire work and I suggest you do this at the beggnining of the Introduction. The "effects" described in 3.2 need this background information. Your work assumptions should be clear and supported by the correct literature.

4) The work is lacking many important references of relevant past works. Please see the list at the bottom of this document.

5) A proper analysis on the importance of crop inclusion is not made. It seems that there is a compensation between adding explicitly "crops" and adding a "human-related variable". This is strange for several reasons, since fire is used as a tool in croplands

all over the globe (see Korontzi et al 2006) both in poor and rich countries, as well in dense or sparsely populated regions (see Li et al. 2013). Mmost importantly you need to better support and investigate this result. Additionally, as you mention in the Discussion, you do not mimic the shape of the function that relates pop. Density with ignitions (e.g. Pechony & Schindell 2009), therefore excluding pop. density is most likely the problem of the model rather the problem of the variable. This in fact troubles me because I can make the same question for several other "effects": is the lack of importance of an effect\variable the consequence of having bad variables and\or models?

6) The comparisons of the impact of controlling effects and predictor variables on model performance made along the work are troublesome. I highlight one clear example. The land cover grouping scheme\classes is especially relevant for your modelling approach, since it controls model performance and model complexity. The analysis that you made does not help the reader to reach a clear conclusion. In one hand, PFTs lead to the best IoAs, on the other hand the additional complexity is extremely penalized. Why don't you make a simple a robust comparison with the same (or similar) degree of complexity? Do you need all classes in all land cover schemes?

7) The way conclusions are drawn needs to be moderated. You have a "virtual lab" called SOFIA that can help make some experiments, it will not inform you about the truth, certaintly not about what really determines fire activity at the global scale. An example (there are many) is related with the way you interpret the importance or not of separating crops from herbaceous. The only implication is on model performance...not on reality itself. Fires occur in croplands and in herbaceous areas for different reasons, independently of what the importance of the variables or controlling functions points out.

8) Some contraditory results : RF is better globally although you state that SOFIA outperforms both RF and JBACH. Fig 2 shows clear improvements depending on land cover grouping scheme which is contradicted in L523-524.

9) The stratified sampling is necessary and interesting, but confusing. It looks like you stratified in space, per biome (which biomes??), and then on the level of fire activity. Finally you sample in time, correct? I am not sure I totally understood the methodology I suggest you improve the way it is written and take a look at Boschetti et al 2015.

10) The abstract needs to be completely rewriten, so that the reader can undersand the relevance of the problem, what limitations you identified and are going to tackle, how are you going to tackle these limitations (really missing this one), your major results and finally implications for the evolution of the body of knowledge on this area.

Some Minor Commnts

11) There are Several terms in the text need to be revised: - fire suppression: Moisture does not suppress fires, it contrains\reduces\restricts fire activity (see Bradstock et al 2010) Firefighters suppress fires. - You mention several times "before a fire". You are modeling the occurrence of a fire, if it doesn't happen you still need predecent conditions, so I suggest you drop the term.

12) NLDIg adds extra parameters depending on the number of land cover groups. Did you consider this in your 100 parameters threshold? Did you consider this in the AIC calculation? Is the calculation shown in L302-303 correct?

13) Figure 2: Number of variables or number of controlling factors? Maybe I missed something, but each controlling actor can have multiple variables? (e.g. temperature can have both DTR and annual temp?). If not, as I originally understood, then I don't understand that does "number of variables" mean in Figure 2.

Some suggestions: - A pairwise plot between estimated and GFED\CCI burned area - Maps of differences in estimated-observed burned area - A map showing disagreements between GFED and CCI would help frame the evaluation better. (low expectation on areas where both disagree)

At this stage I don't think it makes since to go into gramar details.

The references I mentioned previsouly:

Le Page et al. 2010. Seasonality of vegetation fires as modified by human action: observing the deviation from ecoâĂŘclimatic fire regimes Magi et al 2012. Separating agricultural and non-agricultural fire seasonality at regional scales Le Page et al 2015. HESFIRE: a global fire model to explore the role of anthropogenic and weather drivers. Li et al 2013 Quantifying the role of fire in the Earth system – Part 1: Improved global fire modeling in the Community Earth System Model (CESM1),. Bradstock 2010. A biogeographic model of fire regimes in Australia: current and future implications (the “switches” that control fire); Boschetti et al 2016. A stratified random sampling design in space and time for regional to global scale burned area product validation Beven & Binley, 1992. The future of distributed models: model calibration and uncertainty prediction. Beven, 2002. Towards a coherent philosophy for modelling the environment. Beven & Binley, A., 2014. GLUE: 20 years on. Pettinari & Chuvieco 2016. Generation of a global fuel data set using the Fuel Characteristic Classification System Rabin et al. 2015 Quantifying regional, time-varying effects of cropland and pasture on vegetation fire (the effects of crops on burned area) Broxton et al. 2014. A Global Land Cover Climatology Using MODIS Data (for Discussion) Korontzi et al. 2006. Global distribution of agricultural fires in croplands from 3 years of Moderate Resolution Imaging Spectroradiometer (MODIS) data.

Interactive comment on Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2016-301, 2016.