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Interactive comment on "A fire model with distinct crop, pasture, and non-agricultural burning: Use of new data and a model-fitting algorithm for FINALv1" *by* Sam S. Rabin et al.

Anonymous Referee #2

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This paper presents a new fire model FINAL (Fire Including Natural & Agricultural Lands model) which simulates fires on managed agricultural land as distinct from non-agricultural fires. These managed fires are further separated into types of land-use: cropland and pasture management fires. This is an important development for fire modelling because, as the authors correctly point out, there are very few fire models that currently distinguish between agricultural and non-agricultural fires, and even fewer that separate cropland fires from pasture fires. One of the main reasons for this has been a lack of observational data, but the recent development of estimated burned area datasets for cropland, pasture and non-agricultural land by Rabin et al (2015) has now made it possible to incorporate this information into fire modelling. The dynamic

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Discussion paper

global vegetation model LM3 is used, with the fire model for non-agricultural land based on Li et al (2012, 2013), and the agricultural fire model based on gridded climatology maps from Rabin et al (2015) unpacking analysis of monthly estimates of burned area.

It is my opinion that this paper presents a relevant advance in modelling science within the scope of GMD, which leads the way for future studies reviewing the contribution of agricultural fires to total burned area and emissions. The paper presents a novel way of using new data from Rabin et al (2015) to model fires within a DGVM. The methods of modelling non-agricultural fires after Li et al (2012, 2013) are clearly outlined along with the relevant equations, and it is stated where they have moved away from Li et al methods to, for example, Gompertz functions and why. Later in the paper there is a detailed explanation of the parameter optimization used for the non-agricultural fires to adapt it to LM3. There is also a clear description of the set-up for the experimental runs. Now the code has also been made available on GitHub, the description of methods seems comprehensive and reproducible.

There is a fairly thorough presentation of results and analysis of the model, including improvements from FINAL v0 to v1, the mean burned area and carbon emissions compared to GFED data and the unpacking analysis data, presented spatially and temporally. These support the evaluation and conclusions made in the paper. There is one appendix including two figures, describing the implementation of the Levenberg-Marquardt algorithm, which seems appropriate in content and length.

The title accurately reflects the content of the paper, and the abstract gives a good summary of what the model does, what is new about the approach, and highlights the key results of the model in simulating the amount, distribution, and timing of burnt area and emissions. Agricultural fire simulations are very close to the unpacked data from Rabin et al (2015), which is to be expected because the data were used to force the model over crop and pasture areas, but the results for non-agricultural fires are less closely matched to observations. The authors present an excellent discussion on why this might be the case, and make suggestions for future work to improve the model. Overall the paper is presented well, with fluent language and a clear and logical structure.

Specific comments:

It would be nice to see a fuller discussion about how large the contribution of land-use / agricultural fires is in the introduction, to give some context to how important this is and why it is necessary to breakdown fires into crop, pasture and non-agricultural categories. As a regional example, Xie et al ('Dynamic Monitoring of Agricultural Fires in China from 2010 to 2014 using MODIS and GlobeLand30 Data, 2016) showed that agricultural burning in China accounts for 60% of all fire activity in the last 5 years.

The observational data used was from GFED3s. Whilst it is an improvement that GFED3s was chosen over GFED3 to include small fires, can the authors explain why the latest dataset GFED4s which also includes the contribution from small fires was not used?

I am not an expert in the optimization method used, so will leave others to comment on this.

Technical comments:

Double check equation 7; from the Li et al (2012) paper – π is used, although this is not used for any calculations here so is purely a typographical comment

On page 16 line 14, you state 'Pasture fire did not experience such severe error in burned fraction anywhere (Fig. 9d)', after pinpointing the two errors in figure 9c over one European gridcell and over several gridcells in Northern Australia. At first it seemed as though you were overlooking the errors in pasture burning in Europe, SE Asia and across Australia. Then I spotted the 'x10-3' in between the plots, which must correspond to the bottom plot, although this is quite hidden. Perhaps it is worth also pointing out these error points, but also making clear that the scale for the pasture plot is different.

Page 16 line 20; I think the reference here should be to figures 8e and 8i, not 8b and 8f

Page 23 refers to FINALv1 being represented in an ESM, but in the introduction it states that the offline DGVM version of LM3 was used. I assume there would be further work needed to couple this into the ESM, so this statement is not quite accurate

I believe figure 2 is not referenced in the paper until the Appendix. Considering there are already a lot of figures, perhaps this should be moved and added to the list of figures in the Appendix

In some of the figures the term ‘Non-agricultural fires’ (figures 7, 8, 9, 11) is used, and in some ‘Other’ is used (figures 10, 12). It would be better if this was made consistent across the figures

Figures 9 uses a different order of presenting results (total, non-agriculture, crop, pasture), to 10 (total, non-agriculture, pasture crop,) and to 11 & 12 (total, crop, pasture, non-agriculture). As with (5), it would be better if this was made consistent across the figures.

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