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Interactive comment on “The impacts of climate, land use, and demography on fires during the 21st century simulated by CLM-CN” by S. Kloster et al.

Anonymous Referee #2

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The paper explores changes in global wildfires and wildfire emissions during the 21st century as a result of climate change projected in SRES A1B scenario and studies the influence of single forcing factors (climate, population, land-use) on the future fire emissions, all this using two different climate models. Overall the work is interesting and informative and is suitable for Biogeosciences Discussions, but needs revision before it can be published. Below are some remarks which I hope will help improve this paper.

It is rather unclear what was the primary objective of this study: investigating how wildfire emissions may change in the 21st century (as stated not once in the text), or demonstrating how fire emissions projections may depend on climate model used (to which much of the paper is dedicated). In the first case use of only single climate

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scenario is clearly insufficient, while in the second case it is quite justified. The authors should decide what is the main goal pursued, and tune the study and/or the text accordingly.

In this study the SRES A1B scenario is used for the climate projection along with the corresponding A1 population projections. While land-use and harvest rates were prescribed according to the RCP 45 scenario. However, the RCP45 scenario is quite different from SRES A1B, projecting lower fossil and industrial emissions, higher land-use emissions etc. Climate, population growth and land-use are closely inter-linked, and it is not clear that such mix of scenario components is meaningful.

Comparison of findings to earlier studies is insufficient. At least in two earlier published works, both mentioned here (Krawchuk et al 2009 and Pechony and Schindell 2010) the impact of individual forcings on fires was explored. Krawchuk et al studied influence of individual factors on fires utilizing a statistical model. Pechony and Schindell studied this subject within a framework very similar to what is done in this paper. How do results for individual forcing in this work compare with their findings?

Provided description of the model is insufficient (even if more details can be found elsewhere), since it lacks some details immediately needed to understand results presented in the paper. A more specific description of how anthropogenic ignitions and fire management relate to population density in this study is necessary. Also, it appears from the text that the fire management affects only densely populated areas. What is regarded as "densely populated"? To what extent this assumption is justified, given that modern fire-management efforts are clearly not limited to the vicinity of large human settlements? Furthermore, it has to be guessed here if vegetation dynamically changes with climate in the model, or is it only prescribed/scaled according to RCP land use and harvest rates (as appears from the text, but then it is unclear why authors regard it as advantage over Pechony and Schindell work where fuel loads were prescribed according to SRES land-use scenarios).

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Additional remarks: 1) Considering the focus on fire emissions in the paper, "fire" in the title should be substituted with "wildfire emissions". 2) Section 2, Model, below eq. (1): "...and mort the mortality factor..." - "mort" should be in italic. Same for "cc" further in same paragraph. 3) Same section, last paragraph: " The model was able to capture much of the observed mean and variability in fire carbon emissions" - in present-day fire carbon emission - pls be specific here. 4) Table 1. human ignitions: "constant value of 0.5" - provide units, otherwise this information is meaningless. 5) Figure 3. Yellow line and label text are hard to see; Also use of "related" colors (like blue and cyan) for both climate lines would be much appreciated. 6) Figure 4 and all those showing maps are very hard to track (despite the explanations in the captions). Please add brief title to each map and units to colorbars. 7) There is no reference to Figures 7 and 8 in the text. 8) Last sentence is teasing: "A fire model as presented in this study is a first step towards this direction." - Many steps were already taken in this direction. This study might be a further step forward, but hardly the first.

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