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Discussions

Interactive comment on "Climate, CO_2, and demographic impacts on global wildfire emissions" *by* W. Knorr et al.

Anonymous Referee #2

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General Comments

The study of Knorr et al. explores a models sensitivity in fire emissions to climate CO2 and population density for the 20th and 21th century.
The study is based on a large number of simulations which differ in their input datasets. This and the differentiation between differnt degrees of urban population represents a substantial novel aspect.
The manuscript is well-structured with an appriate number and high quality of figures.
My major concern is the design of the factorial experiment. Stein and Alpert describe a method for factor separation in numerical simulations. They show that the synergies between different factors can be rather large and are important to consider, when

quantifying the effect of a variable. The effects of different variables are not simply additive as assumed in eq. 4. The authors here not only negelect the effect of synergies but map them into the effect of fertilization (eq. 6). This procedure can bias the derived effect of CO2. The way the method is presented here is quite complicated. Following more closely the proposed method by Stein and Alpert (1993) could simplify the presentation and analysis and most importantly remove possible biases. See for instance Calvo and Prentice (2015) for a similar application of the method.
Another assumption that has the potential to change the explored trends is the crop mask. Regions with high changes in crop cover often show strong changes in fire, these regions are masked in the present study although at least on the regional scale these gridcells might strongly contribute to the trends. See for instance Andela et al. (2014) for the importance of cropland cover increase on trends in Africa. Also a number of studies on cropland abandonment exist.
The effect of CO2 fertilization has been adressed by some previous studies that should be mentioned and discussed (for instance Calvo and Prentice, 2015, Lasslop and Kloster, 2015, Kelley and Harrison, 2014).

Technical Comments

p.1502, l. 10: also here synergies are neglected, moreover, can only fuel change or could it also be the fuel combustion completeness.
p.1502, l. 17: in order "to"
p. 15029, l. 15: there are also some studies indicating an increase at least at the end of the 20th century that are worth mentioning, for instance Mouillot and Field (2005).
p. 15030 l.23: a large part of savannas are used as pasture and fire is used as a tool to avoid woody encroachment. pasture areas may most likely be maintained as grasslands and therefore woody encroachment could actually lead to an increased use of fire to maintain the pastures. Is your model applicable to such systems over

such time scales where strong changes in human land use can be expected? As far as I understand the only way you consider land use is by masking cropland areas?
p. 15032, l. 25: fire frequency in terms of burned area?

References

Stein and Alpert, Factor Separation in Numerical Simulations, Journal of Atmospheric Sciences, Vol. 50, Num. 14, 2107-2115, 1993.
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Calvo and Prentice, Effects of fire and CO 2 on biogeography and primary production in glacial and modern climates, New Phytologist, 208, 987 – 994, 2015.
Lasslop and Kloster, Impact of fuel variability on wildfire emission estimates, Atmospheric Environment, doi: 10.1016/j.atmosenv.2015.05.040, 2015.
Kelley and Harrison, 2014, Enhanced Australian carbon sink despite increased wildfire during the 21st century, Environmental Research Letters, 9, 104015, doi:10.1088/1748-9326/9/10/104015, 2014.

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