

Interactive comment on “Local sources of global climate forcing from different categories of land use activities” by D. S. Ward and N. M. Mahowald

Anonymous Referee #2

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Overview

The paper evaluates a wide range of mechanisms by which landuse change can affect climate. The data used is appropriate to the problem and it is well analysed. The results are important.

The two main revisions are to clarify what climate forcing data is used in the future simulations and to better explain the affect of LULCC in wildfire CO₂ emissions.

Minor Revisions

p1758 L25 – State how RF calculated from change in surface albedo. Is a radiative transfer model used? Is the surface downward shortwave flux somehow scaled?

C729

P1762 L14 – This assumption means that changes in soil carbon which could occur for a long time after a change in land cover are attributed to the direct category. It would be good to point out that these carbon fluxes due to “direct modifications,” can occur for decades after the land cover change is imposed. Also, should harvest be included as a loss term along with burning and tillage.

P1762 L21 – What errors do you expect from using 1948-1972 climate for the pre-industrial spin-up?

P1763 L16 – What climate forcing is used for the future? Do all simulations use RCP4.5 climate? Or does is each RCP landuse scenario used with the respective RCP climate?

P1766 Section 3.2 - Does the vegetation distribution respond to wildfire activity?

P1767 L5-7 – I don't follow this argument, it needs more explanation. I think you need to state that fire activity is increasing during the historic and future simulations, and therefore reducing the burned area reduces the net loss of carbon from the land. It would also be good to add the reason why fire activity is increasing and whether this is a robust result.

If I understand correctly the argument is as follows: If it is assumed that wildfires are carbon-neutral then changing the burnt area by increasing crop area will have no affect on the net carbon flux caused by wildfires. For there to be a net effect on the terrestrial carbon sink wildfires can not be carbon neutral and therefore the model must be simulating a period of trending global fire activity. In this case the trending fire activity must be an increase in fire CO₂ emissions.

In Figure 3 when there is no LULCC fires cause a small reduction in terrestrial carbon (blue lines), supporting the idea that it is a period of increasing fire activity. Yet including LULCC greatly increases the affect of fires on terrestrial carbon (difference in green lines compared to difference in blue lines), by much more than neglecting fires altogether in the no-LULCC case (blue lines). Does this mean that fire activity must

C730

be increasing a lot in some locations and decreasing a lot in other locations and that LULCC mostly occurs in locations of increasing fire activity?

P1767 L9 - "About half of this..." I found this sentence confusing at first. Can you explicitly say that this component is included in the direct modifications sector, and can you remove the reference to figure 3.

P1768 L4 - Why is RCP4.5 non-LULCC anthropogenic forcing used for all future scenarios? It would be more informative and clearer to use the non-LULCC forcings from the respective future scenarios. I accept the point that the LULCC scenarios are not tightly linked to the CO2 concentration scenarios, but it would still be useful to see the range of each.

P1768 L5 - this is only true of the TEC scenario and not of the Trop-BAU scenario.

P1770 - It would be good to add something on the uncertainty in these results. If this study were repeated using different models would the aerosol indirect effect/fire/NPP responses be expected to be the same? Or is there evidence that this model represents these processes robustly?

Technical corrections/suggestions

P1753 L29 delete "seasonal"

p1755 L24 change "and" to "however"

p1757 L5 delete "at the year the RF"

p1757 L15 change "Rfs" to Rfs"

p1758 L16 delete comma

p1765 L8 change "2100 present day" to "2100"

p1765 L25 add (1.65 W/m2) after "agricultural CH4"

p1770 L5 delete ", or, in the case of Ward et al. (2014), LULCC effects as a whole"

C731

p1770 L10 change "Therefore," to something like "We find that these changes cancel out and that"

p1771 L27 add "(Fig. 2)" after "in this study"

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