Dear Dr. Anderson,

Thank you for your helpful comments. Our point-by-point response follows:

1) You wrote: "Selecting sites solely on model-data agreement may over-represent improvement in CLM..."

To clarify, we selected the eight sites based on DayCent-to-data agreement rather than CLM-to-data agreement. The manuscript includes the following sentences in Section 2.1, p. 6643, lines 12 and 15:
"...we treat the DayCent model as a baseline for comparisons with the CLM at the eight sites."
and
"...we select the eight sites where DayCent performs best against observations."

Right after, we now add this sentence for clarification: "We do not expect this selection approach to bias the CLM simulations."

We also modify an existing sentence on p. 6642 line 6 to say: "We perform simulations at eight sites distributed across the Great Plains of the American Midwest that span much of the region's climate variations:"

2) You wrote: "Winter wheat and spring small grains are much more common non-irrigated crops in your 8 counties (and thus representative of actual conditions)."

We do not have a working winter wheat parameterization in the CLM, yet. We agree with your comment as pertains to actual conditions. We expect that the first order effect of cultivation on the soil carbon decomposition would not change by replacing rainfed corn with rainfed spring small grains. So, for clarification, we add the following sentence to p. 6642 line 26: "We expect that the first order effect of cultivation on the soil carbon decomposition will not depend on the crop type present in the simulations (rainfed corn rather than the more common at these sites rainfed winter wheat and spring grains."

3) We add this reference at the end of the sentence on p. 6643 line 19:

Bonan, GB, Hartman, MD, Parton, WJ, Wieder, WR, Evaluating litter decomposition in earth system models with long-term litterbag experiments: an example using the Community Land Model version 4 (CLM4), GLOBAL CHANGE BIOLOGY, 19, 957-974, DOI:10.1111/gcb.12031, 2013

This article describes another CLM to DayCent comparison where the CLM (designed for coupling to an Earth System Model) is evaluated against the more complex DayCent ecosystem model at a series of sites.

4) We do not show global DayCent simulations because M. Hartman has performed such simulations only WITH the effect of cultivation on soil carbon decomposition; this would not add useful information to the manuscript.

5) We add this explanation to the figure legend: "Soil carbon increases by about 120 g/m2 in both the U.S. and globally in the CROP simulation. Soil carbon decreases by about 900 g/m2 in the Central U.S. and by about zero globally in the CLTV simulation. This difference in simulated trends is because the enhanced soil carbon decomposition due to cultivation applies to a much larger fraction of the total land area in the Central U.S. than on the global scale."

6) We now include three references that support our statement:

Pongratz, J., Reick, C.H., Houghton, R.A., and House, J., Terminology as a key uncertainty in net land use flux estimates, Earth Syst. Dynam. Discuss., 4, 677-716, DOI: 10.5194/esdd-4-677-2013, 2013

Gasser, T., and Ciais, P., A theoretical framework for the net land-to-atmosphere CO_2 flux and its implications in the definition of "emissions from land-use change", Earth Syst. Dynam., 4, 171-186, DOI:10.5194/esd-4-171-2013, 2013

Houghton, R.A., Keeping management effects separate from environmental effects in terrestrial carbon accounting, Global Change Biology, 19, 2609-2612, DOI:10.1111/gcb.12233, 2013

7) We reword as follows: "The Community Land Model (CLM) underestimates the global land use and land management (LULM) C flux to the atmosphere, compared to the Houghton (2003) estimates, in large parts of the 19th and 20th centuries in simulations coupled to the Community Earth System Model (CESM) (Lawrence et al 2012)."

8) We will make all text in the figures larger and will consider using color.

9) Thank you for the suggestion. To preserve information included in the original title and in response to a comment by your co-reviewer, we came up with this alternative:
"The Community Land Model underestimates land-use CO_2 emissions by neglecting soil disturbance from cultivation."

Dear Dr. Houghton,

Thank you for your helpful comments. Our point-by-point response follows:

1) You wrote: 'The authors claim that other Earth System Models underestimate the emissions of carbon from land use because they do not account for the enhanced decomposition of soil organic matter that results from cultivation. Their claim seems reasonable as long as other Earth System Models are like the CLM and "compute an instantaneous C flux to the atmosphere from the conversion of unmanaged to managed (and vice versa) land; they do not include cumulative C effects of land cover change in the calculated flux for the years following the change." This reviewer does not know whether/how other ESMs calculate a loss of soil C from cultivation.'

Point well taken. We change the title to: "The Community Land Model underestimates land-use CO2 emissions by neglecting soil disturbance from cultivation."

And we change the sentence on p. 6641 line 18 to: "...definitely a missing process in the CLM and, as far as we know, in other land biogeochemical models used in ESM simulations."

2) You wrote: "There are other reasons, besides accounting for soil carbon, why estimates of the emissions of carbon from LULM as calculated by a bookkeeping model are different from those calculated by LBMs, and why estimates differ among LBMs (see Gasser and Ciais, 2013; Houghton, 2013; Pongratz et al., in review)."

We do not focus on other reasons in this study but make the following changes for clarity:

On p. 6641 in line 11 we start the paragraph with a new sentence and modify the second sentence: "There are other inconsistencies in the ESM and bookkeeping communities' definitions and usage of the LULM flux (Pongratz et al. 2013; Houghton 2013; Gasser and Ciais 2013). As just one example, the Houghton (2003) estimates..."

And we modify the first two sentences in the last paragraph of the Conclusions: "There are concerns of consistency on multiple levels regarding our community's varying definitions and usage of the LULM C flux (Pongratz et al. 2013; Houghton 2013; Gasser and Ciais 2013). As just one example, current generation..."

3) Regarding how we initialize the soil carbon in our global simulations:
Yes, in a sense we did start the global simulations with native soils in 1973, since the precursor CROP simulation does not include the enhanced C decomposition algorithm. Hence your statement is correct that the soils at initialization have more carbon to lose than "old" agricultural soils would.

On p. 6643 in line 5 (Methods) we modify this first sentence to say: "We initialize the simulations from a 1972 CROP simulation as a proxy for starting with native soils in 1973. In contrast to the site simulations, here we assume that cultivation begins in 1973 on all temperate corn, soybean, and cereal crop areas. This is a first evaluation of the potential biogeochemical effect of enhanced C decomposition from soils disturbed by agricultural practices."

On p. 6648 line 13 (Conclusions) we wrote: "This loss rate declines with time as soils affected by the enhanced decomposition gradually approach a new equilibrium. In our global simulations we activate the process of enhanced soil C decomposition in 1973 using present-day crop distributions rather than using transient crop areas and starting from the emergence of agriculture to the present. Given that humans have significantly disturbed present-day crop areas for years to centuries, we assume that true CO2 emissions from cultivation have been more evenly distributed through time and that soil C losses have declined with time since the initial disturbance."