Geosci. Model Dev. Discuss., 6, C2817–C2819, 2014
www.geosci-model-dev-discuss.net/6/C2817/2014/
© Author(s) 2014. This work is distributed under
the Creative Commons Attribute 3.0 License.

Geoscientific Model Development Discussions

Interactive comment on "Earth System Models that simulate crops underestimate CO_2 emissions from land use by neglecting soil disturbance due to cultivation" *by* S. Levis et al.

S. Levis et al.

slevis@cgd.ucar.edu

Received and published: 10 March 2014

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."

Interactive comment on Geosci. Model Dev. Discuss., 6, 6639, 2013.