

Interactive comment on “Earth System Models that simulate crops underestimate CO₂ emissions from land use by neglecting soil disturbance due to cultivation” by S. Levis et al.

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Levis et al.: “Earth System Models that simulate crops underestimate CO₂ emissions from land use by neglecting soil disturbance due to cultivation”

General comments: Levis et al. models the effect of cultivation on soil carbon decomposition by prescribing respiration enhancement into the Community Land Model (CLM) using parameters derived from a soil-carbon specific model (DayCent). Levis et al. demonstrates the biases in CLM from not including this effect and demonstrates substantial improvement in CLM representation of soil carbon pools at 8 validation sites across the United States. They then prescribe global cultivation factors to assess

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global soil carbon effects from representing cultivation/no-cultivation in CLM.

I find that the manuscript overall is relevant and well suited for Geoscientific Model Development. The manuscript represents a significant advance for the CLM model and should improve representation of carbon cycle processes in agricultural regions. The manuscript builds on previous work nicely, and is well presented. I have some specific comments and recommendations that I feel would improve the strength of the manuscript.

Specific comments: Page 6642, line 6 and elsewhere: I think the subset of 8 sites from Hartman et al. should have been selected on a different basis (e.g. climatic space or at random). Selecting sites solely on model-data agreement may over-represent improvement in CLM for continental or global applications.

Page 6642, line 26: Why did you select rainfed corn for your simulations? Based on Hartman et al. 2011 (Appendix A) and my experience, winter wheat and spring small grains are much more common non-irrigated crops in your 8 counties (and thus representative of actual conditions). Corn would be significantly more likely to be irrigated in these locations.

Page 6643, lines 17-18: Could you please provide references to support your scale assertions for DayCent and CLM?

Page 6645, line 18: It would be useful to show your global DayCent simulations in a supplemental materials section.

Page 6647, line 4: From Fig. 2b it looks like global CROP increases while CLTV is relatively constant (which is an opposite pattern from 2a where US CROP is relatively constant while CLTV decreases). The differences in these patterns warrant more discussion in the text.

Page 6648, line 21: Can you provide a couple of ESM references that define/use LULM differently? I see where processes are omitted/simplified in ESMs, but that doesn't

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mean there is a definition/usage inconsistency.

Technical corrections: Page 6640, line 20: Please change “show” to “shows” for subject-verb agreement and consistency with other references.

Figures: Both figures have text and labels that are too small to read (for example, when printed, the CLTV marker does not show up in the legend). The figures should be made larger. Since the journal is almost entirely electronic, I would also strongly consider using one or more colors along with black to make the figures easier to read.

Title: I feel the title, while descriptive, is too long. A more succinct version might be “Earth System Models that simulate crops underestimate CO2 emissions by neglecting cultivation”

Reviewed by Ray Anderson, USDA-Agricultural Research Service, US Salinity Laboratory

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