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Interactive comment

Interactive comment on "Generating a global gridded tillage dataset" *by* Vera Porwollik et al.

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Thank you very much for providing helpful feedback. Please find below a point by point response to your comments.

Referee #5: The presentation is almost clear, but the English can be improved.

Author's response: We will carefully check the language and improve the wording and formulations.

Referee #5: Line 58: What is HYDE?

Authors' response: HYDE stands for 'History Database of the Global Environment'. HYDE is an internally consistent combination of historical population estimates and allocation algorithms with time-dependent weighting maps for land use including grassland but also cropland including its irrigated and rainfed shares. We now explain that

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abbreviation and have corrected the reference.

We improved the formulation as follows: ...Prestele et al. (2018) mapped reported national values of CA area from Kassam et al. (2015) to cropland from the HYDE database (History Database of the Global Environment; Klein Goldewijk et al. (2017)) for the year 2012.

Referee #5: Line 60: "For downscaling national values Prestele et al. (2018)..." this sentence is too complicated. Should be rephrased.

Authors' response: We agree and improved the paragraph as follows: Based on literature findings, Prestele et al. (2018) developed a CA adoption index per grid cell composed by a set of spatial predictors as aridity, field size, soil erosion, market access, and poverty for downscaling reported national CA area values. Their global map of CA at a spatial grid resolution of 5 arc-minutes is freely available for application in impact assessments in global model simulations.

Referee #5: Line 94: What is ESM?

Authors' response: Thank you for that hint – we have simply overseen to define this abbreviation. At first occurrence of the word 'Earth system model' in our manuscript we now introduced the abbreviation 'ESM'.

Referee #5: Line 106: I do not understand the sentence "... or can assess different tillage impacts just in form of scenarios". Should be rephrased.

Authors' response: We agree that our wording is not very precise so we rephrased the section as following: In the absence of detailed area and tillage type information, the global ecosystem modeling community currently can assess difference of contrasting tillage type impacts just in form of stylized scenarios simulating the effect on the entire cropland area (Del Grosso et al., 2009; Olin et al., 2015; Pugh et al., 2015). One recent exception is the assessment by Hirsch et al. (2018) who assess the effects of an altered albedo from residues used for soil cover on CA areas, using the data of

Prestele et al. (2018).

Referee #5: Line 110: “increase understanding of the drivers for different tillage practices”. What do the authors mean by “drivers”?

Authors’ response: We have revised that sentence to: The objective of this study is to a) increase understanding of differences in tillage practices at the global scale b) formulate rules to spatially map tillage systems to the grid scale, and c) develop an open source and open data crop-specific tillage system dataset for the parameterization of tillage events and area in global ecosystem models and assessments.

Referee #5: Line 222: “We developed several mapping rules have been in order to allocate the. . .”this sentence is too complicated. Should be rephrased.

Authors’ response: We have revised that sentence to: We developed several mapping rules to allocate the six tillage system to the grid scale, employing a decision tree as shown in Fig. 1.

Referee #5: Line 228: Here the authors mentioned the depth of 15 cm, but claimed that “we decided for a minimum depth of mechanized tillage of 20 cm” above. Please explain this inconsistency (the same for Figure 2).

Authors’ response: In section 2.1 we state the findings of Pimental and Sparks (2000) who state the minimum soil depth for agricultural production to be 15 cm, which we used as a first indication of suitability for some kind of tillage. We assume generally less soil depth to bedrock necessary for traditional tillage with hand tools and even less for no-tillage under CA. Following the statement of Kouwenhoven et al. (2002), we regard a minimum depth for conventional annual tillage of 20 cm as necessary for managing perennial weeds. So our reduced tillage system area in fact comprises a relic of mismatches between cropland reported by SPAM2005 but at the same time a shallow soil depth reported by our soil depth to bedrock dataset, where we currently cannot deduce which of the data products is right in the affected grid cells or in the case both are right – how the affected farmers in these specific cases manage their soil.

We improved figure 1 and the entire calculation for the fraction of rotational tillage crops on soil deeper than 15 but shallower than 20 cm depth to bedrock because of this detected inconsistency. That cropland fraction is now newly allocated to the reduced tillage system. An updated version of the tillage data set and R-script will be provided in the context of this revision process.

Improved text at the end of section 2.1: We applied a downscale algorithm of national reported CA area values on potential CA area (see Fig. 1 box "Downscaling"; see following section for more details). The remaining cropland not being assigned to CA is checked again for soil depth to bedrock. In case it was lower than 20 cm, the cropland was assigned to reduced tillage assuming less depth, frequency, mixing efficiency or alternative cultivation practices. In case of soil depth to bedrock of 20 cm or more the remaining cropland was depending on crop type either mapped to the conventional annual or rotational tillage system following the finding of Kouwenhoven et al. (2002) mentioned above for perennial weed management.

Referee #5: Line 533: "global ecosystem models currently run on 0.5° resolution and may have to aggregate the data for input usage" this is not always the case. In many ecosystem models (e.g. ORCHIDEE), their dynamics are simulated at a coarse resolution, but they divide the large model pixel to smaller ones in considering the agricultural processes.

Authors' response: Thank you for the hint. We see that the sentence was generalizing current spatial resolution in global model simulations too much so we rephrased it.

Improved: Global ecosystem models are currently mostly run at a coarser resolution than our data set's resolution and the tillage data may have to be aggregated in such cases. This could introduce further uncertainty to the area under a certain tillage system. Other models (e.g. ORCHIDEE) are able to account for increased resolution of agricultural input data by dividing the large model pixel to smaller ones in considering the agricultural processes.

References

Del Grosso, S. J., Ojima, D. S., Parton, W. J., Stehfest, E., Heistemann, M., DeAngelo, B., and Rose, S.: Global scale DAYCENT model analysis of greenhouse gas emissions and mitigation strategies for cropped soils, Global and Planetary Change, 67, 44-50, doi: 10.1016/j.gloplacha.2008.12.006, 2009. Hirsch, A. L., Prestele, R., Davin, E. L., Seneviratne, S. I., Thiery, W., and Verburg, P. H.: Modelled biophysical impacts of conservation agriculture on local climates, Global Change Biology, 24, 4758-4774, doi:10.1111/gcb.14362, 2018. Kassam, A., Friedrich, T., Derpsch, R., and Kienzle, J.: Overview of the Worldwide Spread of Conservation Agriculture. Field Actions Science Reports [Online].5., 2015. Klein Goldewijk, K., Beusen, A., Doelman, J., and Stehfest, E.: Anthropogenic land use estimates for the Holocene – HYDE 3.2, Earth Syst. Sci. Data, 9, 927-953, doi: 10.5194/essd-9-927-2017, 2017. Kouwenhoven, J. K., Perdok, U. D., Boer, J., and Oomen, G. J. M.: Soil management by shallow mouldboard ploughing in The Netherlands, Soil and Tillage Research, 65, 125-139, doi: 10.1016/S0167-1987(01)00271-9, 2002. Olin, S., Lindeskog, M., Pugh, T. A. M., Schurgers, G., Wårlind, D., Mishurov, M., Zaehle, S., Stocker, B. D., Smith, B., and Arneth, A.: Soil carbon management in large-scale Earth system modelling: implications for crop yields and nitrogen leaching, Earth Syst. Dynam., 6, 745-768, doi: 10.5194/esd-6-745-2015, 2015. Pimental, D. and Sparks, D. L.: Soil as an endangered ecosystem, BioScience, 50, 947-947, doi: 10.1641/0006-3568(2000)050[0947:saaee]2.0.co;2 2000. Prestele, R., Hirsch, A. L., Davin, E. L., Seneviratne, S. I., and Verburg, P. H.: A spatially explicit representation of conservation agriculture for application in global change studies, Global Change Biology, 24, doi:10.1111/gcb.14307, 2018. Pugh, T. A. M., Arneth, A., Olin, S., Ahlström, A., Bayer, A. D., Klein Goldewijk, K., Lindeskog, M., and Schurgers, G.: Simulated carbon emissions from land-use change are substantially enhanced by accounting for agricultural management, Environmental Research Letters, 10, 124008,

2015.

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