Geoscientific

Model Development

Discussions

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Interactive
comment

Interactive comment on "Harmonization of Global Land-Use Change and Management for the Period 850–2100 (LUH2) for CMIP6" *by* George C. Hurtt et al.

George C. Hurtt et al.

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Short Comment #1 The paper by Hurtt et al. describes the LUH2 dataset and the harmonisation required to achieve a continuous dataset of human land-use activities required for CMIP6 ESM simulations. Thank you for this tremendous effort and this dataset.

While the scope of the methods and the results seem to cover the important aspects, I would appreciate if the discussion section would be a bit more elaborate. Topics that could be helpful to be discussed would be (a) in particular a discussion of emerged/possible issues for the usage of the data in LSMs/ESMs, since this is stated

to be one of the main goals of the dataset (three examples coming into my mind are (1) how to deal with the interpolations used to construct wood harvest; (2) how to deal with inconsistencies between the static forest/non-forest-map used in LUH2 when calculating with another (disagreeing) vegetation cover; (3)how to treat rangelands);

(b) a discussion of uncertainties (including the three scenarios but if possible even broader; further examples could be pointing to where uncertainties of underlying data are discussed; conflicts of assumptions taken with shifts in country borders; climate dependent changes in biomass (or is this accounted for in the MIAMI-LU model?),...);

(c) comparisons to other datasets, e.g. the land cover dataset ESA-CCI?

E.g. regarding (1) the interpolations used to construct wood harvest: the two time dependent interpolation rules (regarding slash fractions and inclusiveness of wood cut in conversions in the wood harvest statistics) probably cause problems for a straightforward usage of the data in ESMs. The fate of the carbon in the LSMs matter, i.e. it is important to which carbon pool the harvested carbon should be assigned (such as construction wood, fire wood, etc, since these have different turnover times).

(2) albeit LUH2 is a land-use data set and not a land cover dataset, there are several assumptions where information on the land cover is used in the construction of the LUH2 data and which might be in conflict with the land cover assumed in an ESM simulation?

(3) there has been quite some discussion about this in the TRENDY process, particularly if rangelands involve land cover change, or not. Furthermore, while reading I sometimes had the feeling that knowledge required for understanding was only given later (e.g. how grazing lands are treated and when rangelands and pastures are aggregated for grazing lands and information about the uncertainty scenarios).

> Thank you for these constructive thoughts and suggestions. The manuscript is already quite lengthy and, as mentioned, there is already a discussion of many of these

issues in other publications (that we have cited). However, we have added a couple of additional paragraphs to the Discussion section to address issues 2 and 3 above as well as comparisons to other datasets.

Some specific comments: l.80: Starting the 2016 version of the global carbon project (GCB) LUH2 has been used, i.e. LUH1 has not been used for the following GCBs: Le Quéré et al., 2016; Le Quéré et al., 2017; Le Quéré et al., 2018; Friedlingstein et al., 2019

> Modified around line 80 and line 925

l.281: First time mentioning of "low, baseline, and high LUH2 scenarios" (i.e. maybe not introduced so far?) – it would be nice to have some more information on these three scenarios, also to understand a bit more assumed uncertainties involved with LUH2.

> Thanks for this feedback. We have now added a brief description of the 3 historical scenarios in Section 3.1 as well as a sentence introducing them at the very end of the Introduction.

l.342: Please add that the "potential forest or potential non-forest" map described in this subsection is a static map for the whole 850-2100 time-span, or if this is not correct please give more detail.

> Done

l. 370: Could you give some information on wood harvest in the different SSPs?

> The various scenarios (including wood harvest) are well documented in the cited publications. We have added an additional reference to this section to provide additional information.

l.501: Why 2010, l.372 indicates start in 2015?

> IAM simulations began in 2010 and data is reported from that date onwards, even though the harmonization between historical reconstructions and future scenarios oc-

curs in the year 2015.

l.507: What does this mean in terms of harvest – is the resulting harvest scenario specific – or taken from one of the two GCAM scenarios? (If the latter, do the two GCAM scenarios differ in terms of wood harvest? If so which one is used?) Why is the GCAM model used and not one of the other IAMs?

> We have added a clarification at the end of paragraph 1 in Section 2.9 that the wood harvest comes from the analogous scenarios computed by the GCAM model.

l.510: How was pasture treated? As part of grazing-land?

> Managed pasture is part of grazing land (along with rangeland). We have now defined this in paragraph 2 of Section 2.9.

l.517: Can you specify which scenarios did not include slash?

> No IAM scenarios included slash, so we have modified this sentence to remove the phrase "to those that did not include slash", since we added it all scenarios.

l.591: Could you please clarify if wood harvesting on primary land degrades this to secondary land? (i.e. if harvest on primary land is a transition from primary to secondary land?)– reading on I found this information in line 653

> Since this information was provided and found on Line 653, we assume nothing else needs to be added here.

l.654: "whereas wood harvested from secondary land provides an age-(and biomass-) resetting transition" secondary to secondary"." What does this mean? Where is the age and biomass tracked?

> We have added a clarification in Section 2.11.2 that describes the variables that track these values and that the "resetting transition" represents a reduction in age and biomass.

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l.733: Changes into land use -> agricultural land use?

> Since urban land is also included in the LUH2 dataset, the changes into land use do not only include agricultural land.

l.745: Could you add a figure showing the three scenarios? Maybe in the supplementary?

> Thank you for your interest in viewing additional figures related to these scenarios. Although we would like to show as many figures as possible to represent this dataset, the paper is already pushing the limits of length, and there are many possible additional figures that could be included due to the richness of the dataset. The data always freely available for download and use if readers would like to view their own analysis of specific parts of the dataset.

l.862: has -> have

> Fixed

l.910: One of the two bookkeeping models used in the GCBs uses the FAO statistics, the other model - the BLUE model - uses the LUH2 data.

> Thank you for pointing out this error. We have now corrected it in the Discussion section, where the two bookkeeping models are mentioned.

l.913: What do you mean with earlier land cover reconstructions? (not LUH1 since this also includes wood harvest?)

> We agree that this sentence was confusing, and did not helpfully add to the discussion, so we have removed it.

Table 3: Why is there a question mark in "FAO value?" for Fuelwood and Wood harvest?

> Thank you for catching this error. We have now added the actual FAO reference values to the table.

Table 5 and Table 7: Maybe add the explanation here that negative "Total net transitions" are changes towards agricultural land use?

> Negative net transitions describe net transitions away from land-use (not towards land use). The definitions of net (and gross) transitions are already given in Section 3.1 so we don't think they need to be repeated in the table caption.

Fig.4: What is shown in panel b, pasture or total grazing land or? Panel c axis are hardly readable. It is interesting that in comparison to the IAMs LUH2 nearly always seems to have larger crop fractions, do you have an idea why?

> We fixed the inconsistency between "pasture" and "grazing land" in the figure title and caption. We also made the axis labels more readable. Although the LUH2 data does appear to have larger crop fractions than the IAM data in some scatter figures, this is not true for all scenarios and varies from model to model based on the assumptions each IAM makes (which the density of black dots can sometimes hide).

Fig.5: Legends are difficult to read.

> We updated the legends to improve this figure.

Fig.8: Category names hardly readable for scenarios. Overlaps of circles and text. Why different names for scenarios and time-periods?

> We have updated these figures so that they are larger and no longer have the labels for the various land-use types (and do not overlap each other). The colors representing each land-use type are now consistently described in the figure caption.

Interactive comment on Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2019-360, 2020.