This work updated the emissions made by bookkeeping models by Dr. R. A. Houghton and colleagues by using updated land use data from FAO by considering three alternative explanations of excessive forest loss compared with increase in agricultural lands by FAO.

This work is without doubt worthy for publication in ESSD as it is a core dataset underlying the annual global carbon budget made by the Global Carbon Project. But at the same time, I have quite some comments and thoughts which I take chance to discuss with the authors here, which I hope the authors can consider while making revision.

Major comments:

- The bookkeeping approach has been well developed. Because it is a bottom-up approach based on the idea of quantifying anthropogenic effects only, there are no large-scale independent observations to validate this quantification. Despite this is an update that the authors tried their best to make, however, it is also the improvement against which we have no objective standard to benchmark that gives us a chance to verify such an improvement. I think this point needs to be made clear in the paper so that people understand this.
- Related to the comment above, I think the core contribution of this paper is to enhance clarity and provide a one-stop information hub for this dataset and the associate methods, datasets used. The bookkeeping model has a long history (the earliest
version was in 1983?). I think it would be useful to make this current paper long but it can be used as a full reference to understand the details of this dataset, so that people don’t have to check very often Houghton & Nassikas (2017) and when they refer to that paper, the readers were furthered referred to some earlier papers. Some information, for example, the carbon densities used for different vegetation types, their response curves, could be repeated in the Supplement but they will be useful. It is very important to have this kind of one-stop information hub for this method.

- For the sake of clarity and traceability. An exact of cross-walking table from land use types in FAOSTAT to the land use types in this study and the associated assumptions need to be provided. The authors simply cited FAOSTAT, 2021. But when readers go to the webpage, it is really unclear which information has been used and how the land cover types were interpreted into the land use types used here.

It has to be made explicit that all land use transitions reported by FAO are considered anthropogenic although this assumption is very difficult to verify.

- The nomenclature or terminology used is sometimes confusing and vague. The most vague one is ‘degradation’. The whole block of discussion centering on ‘forest degradation’ (section 4.2.2) is based on an *undefined* term of ‘forest degradation’. If the terminology cannot be clearly defined and made consistent among different studies, comparing different studies won’t make things clearer.
- What made the authors believe that the adjustments made in section 2.3.1 are necessary and indeed are close to the real world?
- Will the authors consider making available the underlying data, e.g., areas of different land use types, carbon densities for different land use types, key parameters for response curves? I believe there are wide interest in using this information from the community.

Minor comments:

There seem many of them, but most are demanding clarifications.
Line 36: So what is the difference between LULCC and LULUCF? The readers are expecting explanations but then there are no further explanations. Perhaps lines Line 475-477?

Line 50–52: wood harvest is a form of land use but not land use change. If this is the case, then it is not the difference between LULCC and LULUCF? I think the authors are free to choose the name they like but without the explanations that are expected in my previous comment, confusion starts to arise here.

Line 74-76: I don’t understand the reason exactly. The reasons listed in the brackets are still vague. Could the authors clarify on this?

Line 110: Since FAOSTAT 1960 every year the national areas of forest were reported but in lines 62-63 it says the forest area information was not used until 1989. Is my understanding correct? Maybe explain the reasons so that readers won’t get confused.

Line 143-145: I would suggest putting this information much earlier than here and maybe in the Introduction. This is a fundamental aspect that the readers need to keep in mind while reading the paper. Its scope is not limited to the title of this section.
Line 149-151: do these lines continue describing ‘degraded lands’? they are not easy to understand. What is the difference between ‘permanent croplands’ and ‘cropland’ introduced previously? Or you are describing ‘degraded croplands’ which seems in a transitional state between cropland and forest? (abandoned but not fully recovered to forest yet). ‘Degraded croplands’ should have higher carbon density than ‘normal cropland’ or ‘permanent cropland’? I think ‘permanent cropland’ is the most confusing term here.

Line 162: the thing described in this paragraph was called ‘shifting cultivation’ in Houghton and Nassikas (2017)? I am not sure I am correct. But if I am, then this is in conflict with the next paragraph?

I have another question here: In Houghton and Nassikas (2017, GBC) it says “We did not attempt to account for shifting cultivation in this analysis ”. So would be nice to explain that you accounted for this because in Table 1 there is such information. In your paper on GCB on negative emissions there it was clearly said shifting cultivation was included. So I guess either it’s a wrong citation or you just need to explain. Given the wide influence of your work in the carbon cycle community and the wide usage of this data, it would always be nice to be traceable as far as it allows.

Line 166: So what is the standard be counted as ‘deforestation’. If it is measured by decrease in carbon density, by my understanding the first class ‘degraded croplands’ seem having a lower carbon density than ‘shifting cultivation’ and hence, conversion from forest to ‘degraded croplands’ should qualify ‘deforestation’ as well?

Line 163-173: Does this mean shifting cultivation has a strict rotation length < 5 years?
Line 181: what is this FCO?

Line 182: a small note explaining that the area of fallow of shifting cultivation was provided in FAO/UNEP (1981) and whether their definition is consistent with yours can be helpful for readers here.

Line 207: Here the fallow lengths are between 2 and 15 years but in Line 163-164 the fallow length is limited to 5 years by definition?

Line 210: need to describe what do you mean by ‘traditional shifting cultivation’, after all these lengths of descriptions of ‘shifting cultivation’.

Line 163: Need to warn the readers about its importance in this paper (i.e. the third interpretation) and briefly explain why, and then warn the readers that a lot descriptions will be devoted to this type so that the readers can be well prepared for the paragraphs that follow and will have better understanding (I hope). I say this basically because the words used for each type of interpretation are highly disproportionate.

Line 187-190: this comparison is really nice and informative. Thanks.
The title of section 2.3.2: might be useful saying directly which is the 'new data from the FAO' by being less ambiguous.

Line 227: “the results of the four steps” => the effects of the four steps on the results?

Table 1: Explain the last column so that the table can be independently understood.

Figure 2: its caption is confusing with the caption of Figure 2. Do they really have the same caption? At least the lines are quite different. Pls check.

Figure 3: ‘appeared’ in the caption is not exact. What do you mean by this? Is this figure a ‘direct’ treatment of FAO data, or it is after your interpretation detailed in section 2.3.3?

Line 268: "The qualitative results from the three alternatives were as expected if run to equilibrium" => this sentence needs to be expanded to enhance clarity.
Line 268-276: the discussions here needs improving in two aspects: (1) what are the expected carbon densities for the three interpretations? This information is already needed in section 2.3.3. Without this we don’t know what are the expected comparisons among the three interpretations of FCO. (2) based on point 1, what is the expected ranking? This is unclear. Hence it is unclear what has been compared with when stating “expected ranking held” in line 274.

Line 280-284: how is the equilibrium determined? How long these emissions can last? The whole point is about extended emissions when moving into equilibrium but the paragraphs ends on uncertainty, which is confusing for me.

Table 2: again, explain the last column.

Section 3.5: a better more descriptive section title is needed.

Figure 6: stacked area figure is not appropriate when there are negative values. Confusing. I would just use multiple panels for different regions. A least it is clearer. Maybe think to combine figure 6 and figure 7 using simple line plot rather than stacked area.
Line 330: this justifies my suggestion to merge Fig 6 and 7.

Section 3.5.2: a more descriptive title could be considered. Of course the whole paper is on emissions by land use.

Table 5: I don’t understand why there is no gross sink in wood products. Not all wood products lead to immediate emissions so there will be some cumulative carbon increase shown as wood product pool compared with a world without any wood harvest. This should be counted as a gross sink, no?

Figure 9. The legends are confusing. The readers have to guess the meaning. I suppose ‘Pasture’ and ‘Cropland’ should represent deforestation or more specifically, forest conversion to cropland, and forest conversion to pasture. But then what is ‘fire’? Should we use ‘afforestation’ or ‘plantation’? I guess ‘plantation’ means there is a net transition in land from agricultural land to forest, but the reason could naturally abandoned cropland. ‘afforestation’ would be a better name. Here there is no ‘forest degradation’ which I also have some comments there. If ‘forest degradation’ cannot be mapped to one of this usages which are relatively clear, are there good reasons we must use this term? For me the land use types shown here are much less ambiguous.

Line 409: I think BLUE and OSCAR are based on LUH? Because in HYDE there are changes in areas of cropland and grazing land but BLUE and OSCAR need land transitions and these were only available in LUH data.

Line 423-424: I get confused. Should Feng et al. be compared with net emissions here or gross emissions? I would argue for net emissions. I suggest the authors clarify on this
first before making such comparison.

Line 465-467: all reported changes by FAO are counted as anthropogenic is a key assumption of this paper and should be stated at the early beginning. My second question is, is this assumption valid and why? This question is also relevant to the whole paragraph of 489-497.

Section 4.2.2 what does the term ‘degradation’ mean here? Is it wood harvest? Selective logging? Or unknown reason for forest loss or decrease in forest biomass? Is this what is called ‘degraded land’ in section 2.3.3? are authors in line 579-585 talking about the same thing by using ‘degradation’?