[General comments] Authors present in this paper a set of algorithm to spatially downscale global land use change dataset that is simulated by GCAM, a regional/AEZ- based integrated assessment model, into gridded formats that are more familiar with Earth system / land ecosystem modelers. The basic idea and overview of the down- scaling algorithm are firstly introduced, and then the detailed procedure in the system is explained in source-code level. They execute sensitivity tests of the downscaling system, by applying the system to a historical land use change. Demonstrations of downscaling for future LULC (land use and land cover) scenarios are also introduced, with discussions on the potential applications and limitations of their systems. The algorithm and system introduced here are clearly important, because land use change is one of the key issues that make linkages between scenario making, climate projection with the Earth system models, and impact assessments by land/agricultural models. The system introduced in this paper will help to bridge the research works between them. Thanks to the authors' careful descriptions on the downscaling procedure, this paper will help to understand the creation of LULC datasets simulated by GCAM. The system is well designed for general usages of downscaling and being available for everyone. No logical fault is found in this paper, but I think there are rooms to be improved, and they are listed below. Most of them will not require so much effort to improve.

We thank the reviewer for his helpful review, please find below our responses to comments and suggestions.

[Detailed comments] p3, L17 "energy demand (biomass crops)" Is "energy demand (bioenergy crops)" more adequate?
Yes indeed, we changed it.

P4, L1 "gridded LULC data" It seems better to note that this data is observation-based, not simulated by GCAM.
We now specify that the initial gridded data for the downscaling are observation-derived.

Fig.2 Figure title is as same as Fig.1, and thus should be changed. Because the figure outlines all downscaling algorithms, I hope enough explanation to be put in the caption. Specifically, readers will read the manuscript more easily if you can put in the caption the linkages between technical words ("reconciliation", "transition priorities", "proximity expansion", etc) and the subsection number: e.g. "land area matching in the reconciliation process is shown in 2.2.2.1".
We updated the caption accordingly:
"Overview of the downscaling method. The figure shows the successive computational steps to downscale a LULC change scenario from 2005 to 2100 described in the text (Sect. 2). The "Reconciliation" phase is detailed in Sect. 2.1 ; The "Downscaling rules" are detailed in Sect. 2.2, including the "treatment order" (Sect. 2.2.1), Intensification versus expansion ratio" (Sect. 2.2.2), the "Transition priorities" (Sect. 2.2.3) and the spatial constrains (Sect. 2.2.4)."

P5 L8 The subsection number "2.2.2.1" should be replaced by "2.2.2.2".
This was corrected while re-structuring the manuscript (see other reviewer's comments).

P5 L10 "cropland PFT" should be replaced by "cropland plant functional type (PFT)", or simply "cropland type". In my thinking, since you have already used three types of categories ("GLTs", "SLTs", and "FLTs") for land types, additional use of "PFT" will make readers confused.
Indeed, we replaced cropland PFT with "cropland type".

Table 2 and 3: "Final land types (FLTs) for downscaling" looks better for the column title, and it will be helpful for readers if there are brief explanations in the caption on how to read this table.
Changed

P5 L29-30 In Fig.2, "transition priorities" and "spatial constraints" are shown, but "treatment order" and "intensification versus expansion ratio" likely not. It will be helpful for readers if you can put the latter two items on the figure.
Thanks ! We added the missing downscaling rules in the figure.

P6, L7: "Intensification versus expansion ratio" looks better for the title, as you describe in p5, L31.
Changed

P6 subsection 2.2.3.4: In my view, the definition of index S ("suitability index"), which first appears in 2.2.4, should be done in this subsection, because readers cannot imagine how the KD, NA, and SW work to constrain the spatial distribution. In addition, NA and SW in eq (3) seem to have units with dimensionless: please specify them in the text.
We moved the definition of the suitability index to the "spatial constrain" section as suggested (note the overall change in structure following the other reviewer feedback). We also specify that S is dimensionless:
"Each spatial constrain being a dimensionless index bound from 0 to 1, the suitability index is dimensionless as well."

P8, L2: "see Sect. 1.2.3.2" should be changed to "see Sect. 2.2.3.2".
Corrected in the new structure.

Fig.3: 1) I found no loop for global grid cells. Does the loop represented by "For each land type" correspond to the loop? 2) I can find the terms "lt1" and "lt2" in the figure, but there is no explanation for them. Do they respectively represent "FLT1" and "FLT2"? 3) The figure title is ambiguous for me, and should be replaced by adequate one?
1) There is actually no loop on grid-cells. Once the algorithm reached a given Region/AEZ and FLT to be expanded, it then considers at once all potential grid-cells for the transition. Computations (e.g. suitability, area available for transition) are done with a 1-D array that contains those potential grid-cells.

2) The lt1 and lt2 were left from a previous draft of the figure, sorry about that, they are in fact FLT1 and FLT2.

3) The new title for the figure now reads: "Computation flow of the downscaling code."

P9, L23- I'm not sure about the target dataset to which the downscaling method was applied. Did you use HYDE information that was aggregated into regional/AEZ map, and then apply the downscaling algorithm to it? Or have you used historical LULC changes simulated by GCAM? In the latter case, it might be better to refer to the existing work that created the LULC changes.
Indeed that was not clear in the manuscript. We did the first case, we aggregated LULC change from HYDE data into Region/AEZ tabular data, from 1700 to 2005, and used these tabular data to run the downscaling. So GCAM was not part of the evaluation. It is now specified in the evaluation section of the manuscript:

"Gridded estimates of historical land use from the HYDE database (version 3.1) were combined to gridded estimates of potential vegetation from the SAGE database to create base-year gridded maps of LULC and Region/AEZ aggregated data of LULC change as inputs to the downscaling code."

P10, L18- About initial condition for the projection: Did you use HYDE for base-year- map in 2005? Or MODIS?
Again sorry that wasn't well specified, we used MODIS. It is now clearly stated in the text:
"Contrarily to the historical evaluation analysis that was using HYDE data for the base-year gridded LULC, the projection analysis starts in 2005 with observation-derived MODIS LULC. The downscaling is run with the default configuration presented in Sect 2."

P11, section 3.1 I hope to see some description on the score of the metric in the basic configuration run. Although we can see in Fig. 4 the spatial distribution of the result with the configuration, we are not sure how the basic configuration did reasonable job in the metric.
We now provide a little more detail on the performance metric. However, as mentioned in the text, HYDE is a reconstruction product and shows significant discrepancies with observation-derived LULC. The main application of the metric is for the sensitivity analyses.

"The historical downscaling of LULC change starting from the 1900 base-year is presented in Figure 5. Europe had already acquired most of today's cropland extent by 1900, but all other regions experienced a substantial increase in cropland area, both in the form of intensification (e.g. India) or expansion (e.g. North America). The downscaling algorithm leads to a spatial 2005 cropland distribution that is in general agreement with the HYDE data, yet lacking their smooth patterns (e.g. North America, India in Figure 5b,c). However, this smooth aspect seems to be an artifact of the HYDE data when compared to the MODIS data (Figure 5c and Figure 7a).

The performance metric generally ranges from 0.3 to 0.7 according to the region and configuration considered (Figure 6), indicating that the downscaling allocates fairly well the changes in cropland area (the metric is bound from -1 to 1). Performance and sensitivity to the downscaling parameters are quite different between tropical, temperate and boreal regions, indicating that LULC dynamics differ and cannot be captured by a single downscaling configuration. Overall, however, sensitivity to the intensification versus expansion ratio and to the relative contribution of kernel density are the strongest, suggesting the importance of proximity to pre-existing agricultural areas for the allocation of new crops. The performance of the downscaling is also clearly influenced

by the base-year, especially in the case of tropical regions, and, expectedly, by the aggregation of the output LULC to coarser resolution."

About figure: it seems slight curious for me that we cannot see any comparison of maps between "before downscaling" and "after-downscaling" throughout this paper, although downscaling is the main topic. In my simple thinking, such maps would attract attention from the readers who are not so familiar with integrated assessment models or creation of LULC scenarios, and would visualize the significance of your downscaling work. I propose the authors to put such maps in supplementary materials (or main body).

Indeed that was clearly missing, thanks ! We now added figure 2 below, showing the Regional/AEZ scale distribution of croplands, which can be compared to the downscaled maps in Figure 5 and Figure 7 as mentioned in caption.

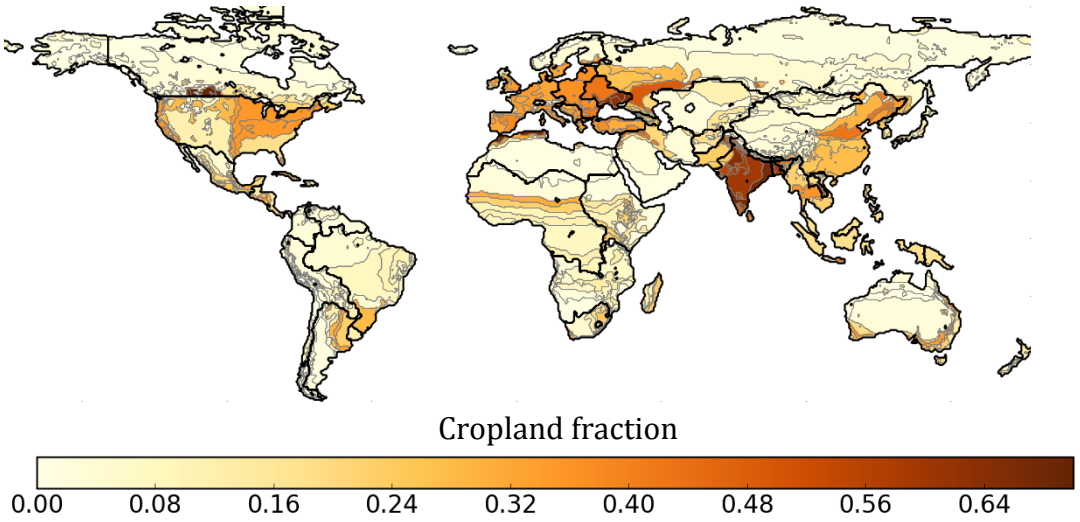

Figure 1. Distribution of 2005 GCAM croplands at the Region/AEZ scale. The algorithm presented in this paper downscales these patterns to a gridded scale (Figure 5 and Figure 7).