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Interactive comment on "Gross and net land cover changes based on plant functional types derived from the annual ESA CCI land cover maps" *by* Wei Li et al.

Anonymous Referee #2

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General comments: This paper investigated recent global land cover change (gross and net). The analysis based on recent annual remote sensing maps (ESA-CCI). The results of this study were compared with other data sets. The authors presented a nice data-driven analysis to assess gross land change dynamics, which serves as a valuable contribution for validating gross land change dynamics around the world, a necessity; given that, gross land changes have significant impact on our Earth System. Although the study itself was carried out very well, I have serious doubts in the quality of the input data used for the analysis. Before the paper can be published, a number of major issues should be tackled and clarified in the document first.

Major Comments:

First: Throughout the manuscript, the authors referred to data sets for comparison (Hansen 2013, Hurtt et al. 2011, Houghton & Nassakas (2017). I assume that people from various research disciplines will be interested in reading this paper. However, each one of them might consider something else as a data set. Data sets often refer to measurements (e.g. remote sensing), while you also list historic reconstructions, a model output, as data sets (e.g. Hurtt et al.). I would advise to make very clear what the differences are between measurements and reconstructed model outputs.

Second: The authors' main aim seemed to be the comparison of data from the observational period with reconstructed model outputs. I do not fully understand why the authors only used one data set (ESA-CCI) instead of using multiple data sets of the observational period, knowing that many other data sets would have been available for larger regions (U.S., Europe, China, Africa, India, Indonesia, Brazil, etc.) or even globally (Globeland30). This would have strengthened their observational evidence. The authors argument from page 5 (line 7), that their chosen data sets for comparison were the best data sets available does not really hold and seems artificial. These products are commonly known state-of-the art products for land cover and land use change, but not necessarily the best available to assess gross land changes. A critical reflection in the introduction and discussion section would be good to highlight alternatives (from both observations and model reconstructions).

Third: The authors described on page 3 (bottom) and page 4 (top) the accuracy assessment that was performed for ESA-CCI. I was wondering, what were the results? I could not find a single accuracy measure result. How does this product compare with others? Does it qualify to assess land cover change?

Fourth: Recently I reviewed a paper that compared the suitability of different observation based products for cropland monitoring. Compared to FAO cropland statistics and other observation based products (GLC2000, MODIS, GLC-Share, Geo-Wiki, GLC-

NMO2008, Globeland30) the ESA-CCI products (epoch maps and yearly maps) and the previous Globecover product seem to overestimate cropland by lot (20% and more compared to others). Unfortunately, the paper is still in review, otherwise I would have forwarded it. Other than discrepancies in definitions and spatial resolution, which were mentioned by the authors, I wonder how suitable the classification algorithm of ESA-CCI (and Globecover, since the same group carried it out) is for land cover detection. Reading these numbers, I have serious doubts. Your study seems to support these numbers: global forest area was underestimated by roughly 20-25% compared to other products (page 6 first paragraph), while cropland was overestimated by ca. 20% compared to Hurtt et al., which is based on FAO estimates in the end. Again, here I would like to see a critical discussion.

Fifth: This brings me from land cover detection to land cover change detection. The authors mentioned that all products used for comparison (Hurtt, Hansen, Houghton & Nassikas) yielded more gross land changes than ESA-CCI. To be honest, I am a bit puzzled. How can a model reconstruction (LUH2) that is largely based on net land changes (due to HYDE 3.2), which again is based on FAO net land changes, yield more gross change than RS-based products? LUH2 only accounts for gross land changes in shifting cultivation areas and it was proven that gross land changes also appear in other world regions (Fuchs et al. 2015 & 2016, Global Change Biology; Bayer et al. 2016, Earth System Dynamics). It seems that ESA-CCI is not optimal to detect land cover changes for various reasons. Differences in spatial resolution between products does not seem to play a role between Hurtt et al. and ESA-CCI. Again, a critical discussion is urgently needed.

Sixth: All changes were given as changes in km^2, spread throughout the document here and there. Personally, I find this hard to compare and put in relation. I would recommend a table with yearly change rates in percent (global and continental) for each of your products. This way a direct comparison per region and product is possible as helps the reader to find what he is looking for.

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