Comment on essd-2022-286
Anonymous Referee #2


This manuscript introduced the annual high-resolution (~1km) maps of woody biomass from both above- and belowground in China from 2003 to 2020. National biomass maps at such high temporal and spatial resolution are very important for ecological studies, earth system modeling, forest and ecosystem managements etc. The author utilized a wide range of remotely sensed and field plots data from different sources to generate the maps. Lots of efforts dedicated to clean data, match datasets of different spatial and temporal resolutions. Limited by the inconsistency among different datasets, a number of assumptions have been proposed to in the generation of final products. Some of them are not reasonable, particularly about the “benchmark map”, and “calibration factor”. Substantial experiments and changes are needed to make the final maps more trustable. Here are more specific comments:

- Figure 1: Too complicated to read. Summarize the main workflow instead of list all method details. More details can be described in caption and manuscript.
- Line 110 MAD: Need more details. How were outliers detected and defined?
- Line 110 “the average weighted by the corresponding canopy cover fractions.” How was the weighted average height calculated? Averaged over 1km pixel or ICESat-2 footprint?
- Line 110 “we mapped forest height over China” There are tree height maps at fine resolution over China such as Liu et al, 2022 (https://doi.org/10.1016/j.rse.2021.112844). Have you compared your mapping with these products? These height products can be used directly instead of generating a new height product.
- Line 140 “it is supposed that the spatial pattern of woody biomass at 1 km resolution would not change much from around 2000 to 2017~2020”: It is a not solid assumption. If the spatial pattern would not change much, why do you want to estimate temporal AGB/BGB? Land cover change, urbanization, reforestation, restoration and natural
forest growth can all lead to changes in spatial pattern of woody biomass.

- Line 145 “The extreme values (the highest and lowest 1%) were excluded as well. “
  The definition of extreme values are pretty arbitrary, sometimes, 1%, sometimes 2.5% (above) need more justifications.
- Line 160 “AGB maps are for 2017~2020, they are just used as the indicators of the spatial variability rather than the absolute values).“ Not a reasonable assumption. The AGB maps for 2017-2020 are more likely to be AGB backmark-2020s rather than 2000s.
- Line 170: “Through cumulative distribution function (CDF) matching among different VOD products, the vegetation optical depth climate archive (VODCA) was developed(Moesinger et al., 2020).” Unclear how VODCA was developed. Did you do these or it is a product by itself?
- Line 215 “Therefore, the mean bias of AMSR2-based VODCA data during 2013~2018 compared to that before 2012 could be estimated as the difference between the mean annual VOD calculated based on the above regression coefficients as well as LAI and VCF data during 2013~2018 and the mean value of the adjusted VODCA’s medians over that period.” Unclear. Unclear what is generated and how or why.
- Line 220 What is “the CDF matching algorithm”?
- Line 230 : Many paragraphs with only one/two sentences should be combined.
- Line 245: “Calibration factor” Is the same “Calibration factor” applied to VOD maps for all years? Seems to be a very risky step. 1. bench mark AGB is not actually from 2003, but actually vary among all years 1990s to 2020. 2. The calibration factor could change among years, depending not only on tree growth difference, but also land cover type changes. Will be more reasonable to use the corresponding year (or every 5years) of true AGB to find the calibration factor for that year of VOD AGB map?
- Line 274-275 “AGB decomposition generally followed” The description is very unclear, I suggest author to re-write it and use equations or conceptual figures to explain. The usage grid and pixels are very confusing. Suggesting using AGB-1km grid and LC-100m pixels if this is the correct understanding. “50 pixels”: use % instead, not sure how much is the 50 pixels taken.
- Line 280: “05, or R2 was below 0”: REALLY?? do you mean R?
- Line 285: Unclear. “situation. Specifically, for 1/12° grids with less than 50 pixels with forests, but the pixels with shrubland are sufficient, we can reliably estimate the AGB per area shrubland as the ratio of grid average AGB to the mean shrubland area percentage in the grid.” Do you mean assuming those 1/12 grids as all shrubland grids?
- Line 300: Another ‘calibration factor’: Do you mean the ratio of AGB map in 2017 between pre- and post-decomposition? Anything to do with 2003-2020 years? I am assuming the ratio of forest and shrubland area could change during 2003-2020. Are you using the same ratio from 2017 over the entire period?
- Figure 4: Mean annual woody biomass is a confusing title, sounds like annually stocked woody biomass. Do you mean “averaged woody biomass in 2003-2020”? please change accordingly. same for c.
- Line 490: what is “vegetation continuous fields”?
- Line 490: what this the data that you compared? if not VOD, what it is? Not clear about the logic of this sentence.

Line 505: if the absolute value is incorrect, the spatial and temporal variation will be impacted too. Not a reasonable assumption.