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Comment on bg-2020-460

Anonymous Referee #1

Referee comment on "MODIS Vegetation Continuous Fields tree cover needs calibrating in tropical savannas" by Rahayu Adzhar et al., Biogeosciences Discuss.,
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General comments:

Bias in MODIS VCF is a known issue. The study by Adzhar et al. adds new interpretation to the issue by comparing the latest version (Collection 6) of the satellite-based dataset with field data collected at ecological sites (24 forest and 24 savanna sites). The authors developed a simulation technique to address the scale discrepancy between the 100m x 100m sites and the 250m x 250m MODIS pixels, and extrapolated the derived relationship across the tropics. The study went on and analyzed the bias patterns of MODIS VCF per land-cover class using the MODIS land cover product. A major finding of the study is that MODIS VCF underestimates tree cover in tropical savannas and woody savannas, which has important implications for carbon cycle and forest restoration potentials. The paper is well written and easy to follow.

Specific comments:

Multiple definitions of "tree cover" exist in the literature. The manuscript provides a clear definition of Canopy Area Index (CAI, the fraction of ground covered by tree crowns). A primary semantic difference between CAI, and percent tree cover of MODIS VCF (the portion of skylight orthogonal to the surface that is intercepted by trees), is whether within-crown gaps are taken into account (CAI) or not (VCF). Within-crown gaps can be non-linear and species specific. For example, a recent analysis by Tang et al. (2019) shows that within-crown gap in a 30m pixel increases as tree cover increases and reaches a maximum of ~10% for conifer trees. The current study addressed the definitional discrepancy by dividing MODIS VCF by 0.8 based on Hansen et al. (2002). A discussion on the uncertainties associated with applying this uniform relationship will benefit the manuscript. Better yet, quantitatively analyze the uncertainty with the collected in situ

data, if possible.

The manuscript can also benefit by adding a clear description of how Canopy Area Index (CAI) is measured or calculated. The reference of Torello-Raventos et al. (2013) is provided, but the details are not sufficient for understanding how CAI is derived and what's the uncertainties associated with CAI at the site level, especially for those who are not familiar with this paper. From Torello-Raventos et al. (2013), it appears that CAI was not directly measured at sites, but was calculated using allometric equations. Then, what is the uncertainty level associated with CAI estimations at the 100 m x 100 m sites, attributable to the allometric equations or the reference data underlying the allometric equations? Site-level uncertainty could be associated with specific direct measurement techniques. Moreover, tree cover definitions and measurement techniques could be connected, as hemispherical photography, terrestrial laser scanner, airborne waveform and discrete-return lidar all tend to measure different types of tree cover (e.g. Fiala et al. 2006, Korhonen et al. 2006, Rautiainen et al. 2005, Tang et al. 2019).

The inherent scale discrepancy between 100 m x 100m sites and 250m x 250m pixels is nicely addressed by simulations. Comparison results between the four types of simulations are also interesting. The authors could consider including the Landsat VCF data (Sexton et al. 2013) in the analysis, which is a satellite-based product most close to MODIS VCF. With a 30m x 30m spatial resolution, Landsat VCF can be averaged to close to the site scale, and a circa-2005 Landsat VCF product is available. This might generate additional insights, and might help resolve the difference with Brandt et al. 2020 in the Sahel region.

The striking difference between open shrub and savannas (Figure 3) is puzzling, even with the discussion provided. Much like fractional land cover (e.g. MODIS VCF), the accuracy of discrete land cover classification such as the MODIS IGBP land cover product is also generally lower over open canopy ecosystems, and misclassifications often occur among those classes. Could the in situ data provide some estimates on the accuracy of MODIS land cover product as an additional analysis? In addition, if open shrubland and grassland do have higher accuracy, for completeness, this might be better pointed out in the abstract.

Technical corrections:

Figure 1. Quite a few savanna sites have TROBIT tree cover > 60%, which falls in the definition of forest in the text (lines 22-23). Are those sites better considered as savanna or treated as forest sites?

Line 313, change "classed" to "classified"

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