

### **Response to Referee Comment #1:**

I have found this paper quite interesting as how to approach scale mismatch. The mathematical/statistical procedures are rigorous, and appropriate to derive indexes.

*Response: Thank you for the very positive evaluation of our manuscript. Below we provide a point-to-point reply to your comments.*

I only suggest including brief comments or modifying the following:

Do you think that DGVM models might increase resolution by using remote sensing data in order to improve spatial variability? Such as MODIS GPP/NPP at 1km.

*Response: The resolution of DGVMs is always defined by the resolution of the climate input data. Spatial variability in DGVMs could hence only be increased by using input climate data at higher resolution (e.g., from regional climate models). As simulated GPP and NPP are a model output, MODIS GPP and NPP could only be used to evaluate model output. However, note that MODIS is derived from NDVI which tends to saturate in dense forests such as the Amazon and, thus, has limited capability to identify spatial variations (Hall et al 2011). As pointed out in the conclusion (page 9, line 30) the integration of forest structural information derived from upcoming Lidar remote sensing missions (such as GEDI or BIOMASS) may reveal more information on spatial variability than previous optical remote sensing (NDVI).*

I see more emphasis in spatial variability than temporal variability. How to assess the variability of the observed/estimated forest properties (as biomass) due to gap dynamics? Is this more important than edaphic properties or Site Index?

*Response: Thank you for pointing this out. Gap dynamics clearly have an effect on the spatial variability of biomass (e.g. see Rödig et al. 2017, 2018) and this is discussed in our manuscript on page 9, l.15-18. However, we emphasise that most gaps in tropical forests are much smaller than the one hectare scale of the plot data used for model validation (e.g. 99% of gaps on BCI are <0.04 ha; Hubbell et al. 1999), and so the plots are generally representative of the disturbance regime in each landscape. Additionally, gap dynamics and site properties cannot be separated easily as site characteristics strongly influence forest dynamics (e.g. Quesada et al. 2011). We will make this more clear in the introduction by rephrasing p.2, l.17-22. We agree that it would be interesting to assess the temporal variability and the respective model behaviour, but this is out of the scope of this study.*

Do you consider that some of the forest plots you used were subject to selective logging or natural gaps? and for this reason a cause of mismatch.

*Response: Thank you for pointing this out. The plot data are taken from Brienen et al. (2014, 2015) and Mitchard et al. (2014) who excluded all plots that were subject to anthropogenic disturbances, including selective logging, so this is not a cause of the mismatch. . As above, the spatial scale of the plot data means that they incorporate most size classes of natural gaps, particularly as the plot data were averaged across sites occurring within the same pixel. Across the plot network, the biases introduced into estimate of carbon balance by one hectare plots not sampling the very largest and rarest natural gaps are in fact very small (Espirito-Santo et al. 2014). We will make that more clear in the Methods section.*

Can you provide a reference of studies calculating a “pixel-wise within-pixel variability”? See line 1 page 10.

*Response: To our knowledge, there is no previous study that calculates pixel-wise within-pixel variability. This is the reason why we propose this in our manuscript. We will revise the text in l. 1, p.10 to “... which could be used to calculate a pixel-wise within-pixel variability based on our approach.” to make this more clear.*

Page 2, Line 27, do you mean “uneven spatial distribution and -temporal- variability due to natural gap dynamics”

*Response: We mean “uneven spatial distribution and spatial variability due to natural gap dynamics” and will change it accordingly in the manuscript.*

Page 3, line 10, there is a typo error.

*Response: Thank you, will be corrected.*

Page 3 line 24, what do you mean by “resolution of the study area”

*Response: Thank you, this is indeed not fully clear in our text. We will revise the sentence to “Landscape variability depends on the extent and heterogeneity of the study area (Turner et al., 2001). Point measurements within a pixel of larger spatial scale, for example, may reveal small-scale spatial variabilities within the pixel.”*

I found figure 1 misleading. At some point, the distance between plots (in b) should depict what “corresponds to the size of the grid cell” (in c). Or maybe explaining this better in the caption.

*Response: Yes, we agree that Figure 1b is misleading. We will revise Figure 1 so that the red arrows indicate better that they correspond with the size of the grid cell.*

Page 5, line 30. I assume is 2.1.3 instead of 1.3

*Response: Yes, agreed, we will correct that.*