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Interactive Comment

Interactive comment on "Amazon forest structure generates diurnal and seasonal variability in light utilization" *by* D. C. Morton et al.

D. C. Morton et al.

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Referee #2 The manuscript by Morton et al parameterizes the 3D DART model to evaluate diurnal and seasonal changes in APAR for a tropical site. They find that DART is able to reproduce changes in APAR at diurnal and seasonal scales throughout the forest canopy and that these temporal and vertical dynamics are not reproduced with simple big leaf and Beer's Law approximations. In addition to making a useful contribution to further understanding the attenuation of radiation in tropical canopies over varying timescales, the authors provide useful estimates of likely APAR values that could serve as a constrain for ecosystem models.

Main comment reflects the use of ED. When the authors make the sensitivity test of

1, 25, and 2500 patches, what exactly is varying in ED? My understanding would be that this test is modifying the age-structure component of ED, and so each patch would have a different age, introducing more heterogeneity in the spatial distribution of vertical light gradients. Please specify.

Response: The reviewer's understanding is correct; adding more patches increases the representation of vertical heterogeneity, albeit without any interactions between patches (see Figure 5). When the ED model was run with a single patch, only one vertical distribution of light was provided (the average distribution), whereas the simulations with higher number of patches represent a landscape that has the same average vertical profile but with more variability because each individual patch may have a different vertical profile. Age structure is an emergent property that distinguishes patches in long-term simulations with ED, but ED can be initialized with different forest structures (for example, different forest inventory plots, or, in our case, a portion of the original domain) and ED will treat them as separate patches as long as their vertical light profiles are sufficiently different.

Also, its not entirely accurate to say that with 1 patch, ED is using a 'big-leaf' approximation. The representation of the forest canopy would be the same in ED for 1 patch, 25, or 2500 patches. The sensitivity test carried out here is introducing heterogeneity in the vertical gradient. Please clarify in the description and analysis.

Response: We have removed the reference to "big-leaf" models, as suggested. ED simulations with 1 patch are closest to a big-leaf approximation, but the representation of layers in the vertical profile of leaf area differentiates ED from big-leaf models, even with a simplified representation of horizontal variability in vertical structure.

Adding patches in the ED simulations increases the heterogeneity of light environments. The average forest structure is the same for cases of 1, 25, or 2500 patches, but light absorption in each patch will differ substantially as the number of patches changes, altering the vertical profile of leaf area (see Figure 5). We have now made

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this point clearer in the main text.

For the 1 m3 voxel size, is this a standard size to use in DART? It seems this is a critical assumption, should some sensitivity test be carried out?

Response: The choice of 1m3 voxels in this study was based on the typical scale for analyses of airborne lidar data. Lidar point clouds are often summarized at 1m2 spatial resolution for surfaces such as canopy height, although lidar point densities may support finer or coarser spatial resolution. Small voxels (1m3) were chosen to allocate leaf area to locations with canopy material, while retaining computational efficiencies from modeling turbid cells as opposed to individual leaves (see response to Referee #1). DART can simulate 3D scenes with any resolution.

In Figure 3, it would be helpful to add the dry season shading to see which phase of the seasonal cycle corresponds to wet/dry cycles.

Response: We have modified the figure to show the dry season shading, as suggested.

Interactive comment on Biogeosciences Discuss., 12, 19043, 2015.