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Interactive comment on "Landscape-scale changes in forest canopy structure across a partially logged tropical peat swamp" *by* B. M. M. Wedeux and D. A. Coomes

B. M. M. Wedeux and D. A. Coomes

bmmw2@cam.ac.uk

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We thank M. Disney, R. Hill, F. Espirito-Santo and M. Hayashi for their comments, which have helped improve the manuscript. We thank the handling associate editor A. Ito for considering the revised manuscript and hope he will now find it suitable for publication. We respond to the comments in detail below. Additions to the manuscript are marked in blue, both in this response and the manuscript.

Response to M. Hayashi's comments

General comments:

The manuscript describes a detailed analysis for forest canopy structure of peat swamp forest using ALS. I highly evaluate the manuscript, because it can widen utilization possibilities of ALS for forest observation. However, I recommend some minor revisions listed below.

Specific comments: Introduction

[Referee comment] - I dose not know what is the 'peat dome', and the term is also unfamiliar for many people. Please describe a brief explanation of 'peat dome', including its origin, spatial scale, and so on.

[Author response] A sentence was added in the introduction to give more details: 10987 l.24: Peat domes form by accumulation of organic matter over millennia; peat dome complexes can be up to 60 km in diameter, with peat depths reaching up to 20 m in the centre of the dome (Ashton, 2014).

[Referee comment] - Please describe the previous studies which apply ALS to canopy structure analysis, and clear the novelty of this study.

[Author response] We have clarified this as follows at 10988 l.20: Previous studies have used ALS to analyse the variation in gap sizes in different forest types within landscapes (Kellner & Asner, 2009; Kellner et al., 2011; Asner et al., 2013, 2014; Boyd et al., 2013; Espírito-Santo et al., 2014) and the impacts of logging on above-ground biomass (Andersen et al., 2013; d'Oliveira et al., 2012; Englhart et al., 2013; Kronseder et al., 2012; but see Weishampel et al., 2012). Changes in canopy structure along continuous environmental gradients within landscapes and the potentially long-term impact of logging on canopy structure remain to be studied.

Material and methods [Referee comment] - Was the ALS measurement conducted over the entire study area of 750 km2? If so,why did the authors analyze for only 100 plots of 1km 1km (= 100 km2)?

[Author response] We chose to analyse only a subsample of the area because we

needed discrete study entities in order to analyse gap metrics, notably the gap size frequency distribution, and relate them to peat depth. The study plots exceed the cover of many other studies. Finally, this was an arbitrary choice, but allowed a good coverage of the whole area while avoiding spatial clustering of plots and plots overlapping with land class boundaries. We added this justification in the text 10990 l.22: A total of 100 virtual plots of 1×1 km were positioned throughout the research area to yield a good coverage of the landscape and avoid having plots crossing land cover boundaries (Fig. S4).

[Referee comment] - [section 2.3.1] Because the peat depth was estimated from canopy hieght, I felt a little strange about the analysis of relationship between peat depth and canopy structure. I think it is better to explain that the procedure was without problems.

[Author response] We have attempted to clarify that the inference of peat depth by canopy top height was conducted from an independent data set. Thus it does not interfere with later analyses done on the plot data. We have added this section to the main text: We disposed of an independent data set of more than 300 peat depth measurements across the study area and measured canopy top height (99th quantile of height) within a 100 m neighbourhood. We first tested for the effect of logging on canopy top height in this independent dataset by fitting generalised linear models containing peat depth and additive or multiplicative effects of logging as a factor (yes, no). No significant logging effect was detected. We found that canopy top height was a good predictor of peat depth (R2=0.77) except on shallow peat within 3000 m of the Kapuas river (Fig. S3a). On shallow peat, distance to river was a good predictor of peat depth (R2 = 0.59; Fig. S3b). Peat depth for our study plots was thus inferred as (Eq. 3): Peat depth= {(28.0-0.8$\times$top.height for dist.riv>3000 m, or 0.31+0.002$\times$dist.riv for dist.riv$\leq$3000m,)} (3) where top.height is canopy top height (99th quantile) and dist.riv is distance to the large Kapuas river. The inference of peat depth from canopy top height was thus done from an independent data set to the plot data further used for analyses. This approach

was validated, as it yielded a fit going through the origin and with an R2 = 0.88 between predicted and measured peat values in 33 plots where peat data was available.

Results

[Referee comment] - [Figure 3] In Figure 3 (a), I wonder whether the canopy top height relates well to the peat depth, because the figure only looks that two data groups differed in characteristics (logged and old-growth vs. mixed) are plotted in a graph. I think it is better to explain the correctness about this.

[Author response] This is valid because the relationship, and the absence of logging effect, was tested on a larger independent data set of peat depth and canopy top height. We modified the text and the figure legend and refer to section 2.3.1 and the Supplement. 10996 l.5: In an independent data set of more than 300 peat depth measurements and associated canopy top height measurements, canopy top height was not affected by logging (see section 2.3.1, Supplement), suggesting that some large trees (presumably of low commercial value) were left within the plots. Figure 3 legend: For canopy top height only plots with direct peat measurements are shown and a single regression line is fitted as logging does not affect this metric in an independent data set (section 2.3.1, Supplement).

[Referee comment] And, two color bars are shown in Figure 3 (d).What's different?

[Author response] The colour bars refer each to either the old-growth (grey) and logged (red) canopy profiles.

[Referee comment] - [Figure 4] There is a clear relationship between the peat depth and logged or oldgrowth, although there is no relationship for mixed. For reader's underastanding, it is better to explain the reason.

[Author response] We did not address this point specifically in the previous draft of the manuscript. We now relate this to Figure 5, showing that the relationship between canopy top height and gap metrics breaks down in logged forests and add one sen-

tence at 10997 l.25: This explains the absence of relationship between peat depth and gap metrics in the first half of the peat depth gradient (Figs 4a-d).

Interactive comment on Biogeosciences Discuss., 12, 10985, 2015.