

Interactive comment on “Carbon dioxide emissions from an *Acacia* plantation on peatland in Sumatra, Indonesia” by J. Jauhiainen et al.

J. Jauhiainen et al.

jyrki.jauhiainen@helsinki.fi

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R1: Given the large area impacted and carbon density of tropical peatlands, understanding the fate of the carbon storage is important from both land-use change perspective and global climate policy. This study systematically samples a range of plantation ages and positions relative to trees in order to determine the contribution of tree root respiration and peat oxidation to CO₂ emissions. The authors then discuss the relative importance of water table and temperature for controlling variation in peat oxidation rates. My major suggestion is to conduct a more thorough investigation of temperature relationships within the data set as most of the discussion of temperature currently presented in the manuscript is based on literature values.

The authors state in the discussion that no relationship between temperature and CO₂

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emission was observed. Firstly, this should be stated in results. However, they go on to discuss that conversion of peat swamp forest to plantation alters temperature regime of the peat and that as the canopy develops temperature regime is again shifted due to shading. Given the study design, they can explore this directly, but do not present this analysis in the paper. For example, I believe that a multiple regression between average CO₂ emission furthest from trees (oxidation) with both soil temperature and water table will show that both are significantly related to CO₂ emissions. This will add strong evidence for the arguments made in the discussion and greatly improve the study.

MS TEAM REPLY: MS team thanks for the reviewer for providing this positive feedback. The results concerning CO₂ emission and temperature dependence were accidentally dropped out during an earlier editing phase, but are now added in to the results (section 3.4). The lack of direct response in this study was largely due to (i) we only had day-time measurements from each monitoring location (temperatures vary less between canopy closure conditions during day-time than between night and day), and (ii) differences in canopy closure conditions are not sharp in variably aged Acacia stands over the 2 year long monitoring period. In order to determine the emission-temperature relationship in detail, the time of measurements (sun position in the sky) and radiation intensity at each monitoring spot should have been accounted for in more detail alongside measurements of CO₂ emissions and peat temperatures at each monitoring location. These additional measurements might have removed some of the variation and resulted in clearer differences also in the day-time collected data. In order to study this effect, a specific intensive study concentrating specifically on this phenomenon may be more suitable than the large scale and long-term monitoring experimental design as applied in this study.

R1: A few minor comments: R1: For Section 3.4: Regression equations could be on a figure or in a table and not in the text.

MS TEAM REPLY: We believe that moving the equations to the table or graph would not increase clarity of presentation. No change has been made.

R1: Is there any relationship between temperature and CO₂ flux – instead of just taking the literature value and Q₁₀? MS TEAM REPLY: This question is answered in Section 4.4. “In this study, no significant relationship was found between mean daytime CO₂ emission and mean daytime peat temperature for all transects (R₂ values from 0 to 0.02), probably owing to the limited variation in daytime peat temperatures along each transect (Table 3).” This information is added to the results section (by request of R₂).

R1: Section 4.1: Where is the data for tree removal? Results? What is the variability in respiration rates near the trees or how does root density vary near trees? Does the 30 cm chamber diameter capture this variability in root density?

MS TEAM REPLY: In the earlier Methods section the impression was indeed given that data would be available for four differing growth stages (section 2.2. in the discussion paper). In practise, post-harvest conditions (the “missing” category & associated data) were included in the ‘open’ growth stage in the data processing. The original open post harvest condition prevailed only for a few weeks before the compartment was replanted with Acacia seedlings, and thus only a limited amount of data were available for this growth stage. The root system development of the newly-planted seedlings, which formed the next stage in the plantation life cycle, was extremely limited (i.e. roots barely extended beyond the tree stem) for seedlings and saplings in the ‘up to 6 month’ age class. Therefore, unplanted and recently planted growth cycle stages were considered to represent, in practise, similar conditions and these two data groups were merged together. Data for the open (unplanted and up to 6 month old) Acacia growth stages are presented in Fig. 2, and the results are described in the text (section 3.3).

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Sentences describing data classification have been corrected in the methods (section 2.2) to reflect this.

Variability of respiration (SD values) near trees is now added in the results section.

Variation in root density was expected to be captured sufficiently by (i) using relatively large size chamber diameter (30 cm diameter), (ii) by using a multiple level approach i.e. 4 sub-transects at each transect and monitoring emissions next to 2 healthy trees along each sub-transect, and (iii) by monitoring emissions at differing distances from each tree. This was all performed in the monitoring phase, but in addition a visual check up of root system extent was carried out before monitoring was started. Using this approach, we have 4 (sub-transects) x 2 (trees) x 2 (fixed monitoring locations at distances nearest to trees) i.e. 16 readouts taken during each monitoring event at one transect. This number of readouts was collected over a ~2 year period at about 2 week intervals, which provided temporal coverage in root system variation (i.e. development). The soil could not be disturbed in order to check root variability in the monitoring locations, thus we had to trust that the results from our pit digging experiments which were made prior to the start of monitoring (see methods section 2.5) provided sufficient understanding of the belowground root system. This is the first and only CO₂ flux monitoring study carried out in such detail in tropical peat.

R1: Water table and CO₂ flux: I would also suggest that the relationship between WT and respiration is not a linear one – respiration rate will fall either at higher or very low water contents/water table – some literature from drained northern peatlands could support this idea. MS TEAM REPLY: Mention of such a possible nonlinear relationship has been added to the text in the Discussion (last paragraph in section 4.3). Referee 2 also suggests a similar possibility. During manuscript production, this possibility was considered but it was left out because we had only circumstantial evidence available for most of the studied transects i.e. such conditions were transient phenomena, if they

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even existed.

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