

Interactive comment on “CO₂ uptake of a mature *Acacia mangium* plantation estimated from sap flow measurements and stable carbon isotope discrimination” by H. Wang et al.

Anonymous Referee #3

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CO₂ uptake of a mature *Acacia mangium* plantation estimated from sap flow measurements and stable carbon isotope discrimination. Wang et al. in Biogeosciences Discussions Claudia Keitel

In the present paper carbon uptake on the canopy scale was estimated using a combination of sap flow and carbon isotope techniques. While the method is not completely novel, it is an important contribution to the literature as there is a need for more publications presenting measurements of whole canopy carbon uptake. The dataset is comprehensive and the methodology sound. In the majority of publications, ecosystem scale CO₂ exchange is measured with the eddy covariance technique or scaled up from leaf-level gas exchange to the stand. The main advantage of the method used

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here is the possibility of application in many field environments, even ones that do not allow the eddy covariance approach. Another advantage is that the measurements taken integrate whole-tree processes and do not rely on models to partition NEE and GPP or scale up from the leaf level. The introduction would benefit of adding more relevant papers. For instance, the paper by Hu et al. 2010 would be well-suited to be introduced here. The paper could be made more concise in some instances. Some sections would be better placed in different parts of the manuscript (e.g. part of the results or discussion in the method section or vice versa, see more detailed comments below). The results section is currently difficult to read with the many numbers in the text. I would suggest to put these in a table and to summarise the main trends in the text without giving numbers. The main comparison of the canopy carbon uptake estimated by the sapflow and carbon isotope technique was with estimates based on leaf-level gas exchange measurements. In the results section, the leaf-level measurements are somewhat hidden among the other measurement and need to be clearly discerned. It would also help to specify in the captions of the different figures which approach was used. Table 1 and Figure 1 are not required for the main message of this paper and could be moved to supplementary material. Table 5 could be deleted and regressions presented in Table 5 added to the caption of Figure 8.

Detailed comments: P. 11584, line 10: “acceptable estimate”. Acceptable in what sense – how was this determined, by comparing it to other estimates? Please delete or rephrase. Line 21: “...could be reduced for the combined sap flux and isotope technique, ...”. P. 11585, line 13: “The canopy scale is an important intermediate scale between the leaf and the ecosystem.” Line 15 – 18: please rephrase. There are currently a variety of methods to estimate photosynthesis at the canopy scale which are valid, but the advantage here is that measurements on the whole tree scale were taken (sap flow), rather than scaled up or down from the leaf or the ecosystem level. P. 11586, lines 1 – 5 are repetitive, and could be more concise. Line 10: “Additionally, the combination of sap flux and stable isotope techniques provide an advantage over leaf-level ...”. Line 12: “It avoids the errors ... and facilitates continuous data collection

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which is suitable for ...". Line 15: "We demonstrate in this paper that..." (include both the representative canopy scale and comparability with other methods). Line 21: "Our aims were:..." Line 24: delete "which could be used to"; line 26: "by stomatal conductance". Delete the remaining lines from 27 to the end of the paragraph. p. 11587 onwards: Materials and Methods should be in past tense. Lines 24 – 25: You could move this to section 2.2 as this is where the method is described. Line 25 – line 2 next page: this should be moved to section 2.3. p. 11589, line 21: How was zero flux determined? Please specify if no flow was assumed at predawn as in Granier (1987). p. 11590: line 1 – 2: specify what somewhat larger is or delete that part of the sentence and start with "A. mangium is a diffuse..."; line 24: "diffusion" – do you mean dampening of the signal? p. 11591, line 10 onwards: delete "data were excluded" everywhere in the numbered sections, as it is already mentioned in line 9. p. 11592, line 10 – 12: delete the last 2 sentences. Line 24: "Leaf sap" needs to be defined better as it is currently unclear what was sampled. Commonly, xylem sap is harvested by pressure bomb, but if enough pressure is applied, phloem sap or cell contents would be pushed out of the leaf. The sampling method should be specified, e.g. how much was the pressure increased after the xylem sap appeared at the petiole? Delete "Then, the leaf sap was sucked up with a micropipette" and replace "injected" with "pipetted". Line 26: stored at what temperature? P. 11593, line 1: specify how it was measured – was the sap pipetted into tin cups and dried and how much? Line 5 to 7: Delete. There is definitely a difference between bulk and soluble organic matter. The last sentence could be rephrased to emphasise that an indicator for recent photosynthates was needed to combine with the high-resolution sap flow data. Line 15: "preconcentration" instead of "pretreatment". Line 16: here could be added: " $\delta^{13}C$ values were expressed as: ... (enter formula 11 and explanation)" and lines 18 to 20 deleted. p. 11594, line 6: "linear relationship" p. 11595, line 10: Please specify what "seasonally integrated ^{13}C discrimination" means; were seasonal averages taken, and if so over how many months? Should the annual canopy uptake not be a sum of daily averages? Or was it similar between seasons that it could be

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multiplied it by number of days? Please specify. Line 13: Perhaps component carbon analysis could be replaced by carbon allocation studies here and in Table 4. p. 11597, lines 5 – 7 could be moved to a table. Line 13: "Diurnal and seasonal variability of physiological parameters and carbon isotope data". Line 15: Please specify that the c_i/c_a was estimated from carbon isotope measurements, and also add this information to the caption of Figure 3. p. 11598, lines 3 – 5, 12 – 14: delete and present the main trends without data in the text; data could be presented in a table. p. 11600, line 1 onwards: A separate heading introducing leaf-level measurements and comparison with G_s and F_{CO2} estimated from sap flow and carbon isotope measurements would help the reader discern between the two different approaches. As this is the main method the sapflow and isotope method is compared to, it needs to be made clearer. Please also specify in the captions of the different figures which approach was used. P. 11601, lines 1 – 13: The approach by Hu et al. uses D estimated by air temperature and relative humidity. In this paper, D is incorporated in the calculation in equation 18, so I do not follow the argument here. p. 11602, lines 1 – 6: This should be in the methods. Specify how the 24h data was used. Line 11 – 13: Do you mean irradiance or evaporative demand with heat load? How can a higher heat load meet the demands of photosynthesis? How can PAR and T_a be sufficient? Please explain and rephrase. Lines 17 to 21: Unclear or circular argument. P. 11603, line 4 – 5: Delete. p. 11605, line 7 and 17: rephrase "is forced on the fact", and "which is most parsimonious in terms of"

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