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Interactive comment on "CO_2 uptake of a mature *Acacia mangium* plantation estimated from sap flow measurements and stable carbon isotope discrimination" *by* H. Wang et al.

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Peer review for:

CO2 uptake of a mature Acacia mangium plantation estimated from sap flow measurements and stable carbon isotope discrimination

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The discussion paper under review presents a four-year study of carbon and water gas exchange dynamics in a subtropical Acacia forest plot in China. It applies a novel ap-

proach to calculate canopy-scale CO2 uptake by combining sap flow measurements and 13C carbon isotope discrimination, and presents diurnal, monthly, seasonal, and annual variations in relation to main environmental determinants. The results are further compared to leaf gas exchange measurements and a sensitivity analysis is performed.

This is a timely, important paper, which presents a thorough, carefully planned study. The analyses and methodology are of the highest standards. The scientific results and conclusions are presented in a clear, concise, and well-structures way.

My only major concern regards with the general perspective of the scientific approach, which must consider the current status of the scientific field. Together with several smaller comments, this paper should be acceptable for publication in Biogeosciences.

General comment

The paper presents a novel approach to the very important challenge of forest CO2 uptake quantification. However it overlooks the important role of forest CO2 uptake measurement using the eddy-covariance method. To the best of my knowledge, over the recent decade this method has become the state-of-the-art in the field, and is being applied across hundreds of locations globally. The fluxnet network is one good example. To put the paper into the right perspective, this fact must be put upfront, and not hidden within the introduction (P11586 L12).

In fact, the authors would have been able to present a much stronger case if their novel approach would have been compared, and agreed, with contemporary eddy-covariance measurements. Nevertheless this does not reduce from the excellent scientific work that has been performed and carefully presented.

Therefore, my advice is to put the study into the right perspective, and to highlight the significance of the approach: (1) ideal for plot-scale (the second paragraph in the introduction deals with this aspect, yet the distinction between canopy and whole-forest scales is not sufficiently explained); (2) a solution where the eddy-covariance method is limited. For example, as noted in the text, in mountainous sites. Another advantage could be in sites where wind regime is limiting for eddy-covariance application; (3) If this novel approach provides quantitatively valid estimates, the potential is huge considering the large number of sites with sap flow monitoring and the relatively easy sampling for carbon isotope analysis.

Specific comments

In the second paragraph of the introduction authors should clearly define 'canopy' (or alternatively, plot), e.g. by size between 0.1 and 1 km2. Also, the comparison between water and photosynthesis fluxes must regard the simple fact that water fluxes are by three orders of magnitude (!) larger than CO2 fluxes.

In the methodology, it can be useful to show, for trees 1-4, whether the difference between the mean Js and North Js was significant. In the development of delta (Eq. 13), the authors can improve accuracy of their estimates using the adjusted Farquhar equation (Seibt et al. 2008) that accounts also for mesophyll conductance and CO2 compensation point effects. Also, equation development can be more intuitive if an Ohm's law analogue is presented upfront, e.g. Fc = gc x (Ca-Ci) or similar.

In the discussion, section 4.3 could be elaborated to include a comparison of gs vs. Gs. Also, if leaf gas exchange measurements are representative of the entire canopy, then a simple multiplication by LAI should yield a rough estimate of Fc and Gs. Yet here this would yield values that are much higher than estimated by the applied method. Can this be settled? Section 4.4 is central for the conclusion of the paper and needs to answer the following questions: Why was the Brazilian A. magnium Fc estimate so different? Age difference should not explain such a large gap. Needs to explore the differences closely, e.g. stand density, LAI etc. Regarding the other literature presented, it seems that sap flow-based methods tend to yield lower estimates. Is there any underestimation involved?

The conclusions section is repetitive and could be shortened.

The tables and figures are informative, concise and well designed. The authors must make sure that the final version presents a unified figure size: at the moment most figures are too small to read (Figs. 3-4 specifically) or appear too large (Fig. 1).

Technical comments

P11585 L7: Carbon is abbreviated as C without preliminary definition. P11585 L10: 'relatively rare', more accurate: 'less common'. P11586 L9: '. . . sap flow measurement is non-destructiveness, easy, and low cost', better: ". . . sap flow measurement is non-destructive, easy, and relatively low cost'. P11586 L27-28: The sentence is repetitive; can omit. P11587 L17: 'Acacia mangium', the genus name can be shortened. P11587 L24: 'The projected canopy area. . .'. The use of canopy here is confusing. Perhaps can change to 'crown'. P11589 L10-13: This sentence can be shortened. P11600 L11-12: This sentence refers to Fig. 6, and hence can be changed into: '. . .values of both gs and Pn were higher than. . .'. P11602 L17-21: This sentence reads strange. Perhaps rephrase. P11603 L1: 'Gs stayed high at low D...' Should this be 'Gs stayed high at high D' instead? P11603 L 4-5: The sentence is redundant. Fig. 1. 'DBH ranks' better DBH bins/categories. Fig. 2. Values of annual precipitation amounts could be useful here. Stand transpiration seems to depend on SWC and not P. This is interesting since both SWC and stand transpiration are affected by some carryover effect, which can explain the inter-annual differences.

Interactive comment on Biogeosciences Discuss., 10, 11583, 2013.