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Interactive comment on "The contribution of trees and grasses to productivity of an Australian tropical savanna" *by* C. E. Moore et al.

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Author response to reviewer comments for "The contribution of trees and grasses to productivity of an Australian tropical savanna"

We thank both reviewers for their comments and suggestions about our manuscript and provide the following as our interactive responses to their points.

Reviewer 1

1. Section 2.2 – Please specify the location of the understory tower relative to the main tower, and also describe how it sits in relation to the canopy openings.

The understory tower is located 10 m to the west of the main ecosystem tower. Over-

story cover at this site is approximately 50 % (Kanniah et al., 2009), so the understory tower was located in a representative spot taking this into consideration. However, we did ensure no large trees were too close to the tower (i.e. <5 m), as these can cause wake turbulence and confound the turbulent fluxes. This explanation will be included in section 2.2.

2. How does the fetch of the understory tower compare to that of the overstory tower? How does the vegetation composition compare between these two fetch areas?

The fetch of the understory tower is less than that of the main tower. Footprint analysis, using Kljun et al. (2004) in EddyPro v4.1.0 (LI-COR Biosciences, Lincoln, NE) showed that during daytime turbulent conditions, the main tower fetch extended up to 205 ($\pm$ 9) m, primarily in the west to northwest directions in the wet season and south to southeast directions in the dry season. The understory tower fetch extended up to 44 ($\pm$ 9) m, primarily in the west and northwest direction in the wet season and east to southeast directions in the dry season. While these two fetch areas do not completely match all the time due to the separation of the two towers, vegetation composition at the site is homogenous when viewed at these spatial scales. This gives us confidence that the understory tower is measuring a representative subset of the ecosystem tower. We will add this to the tower description in section 2.2.

3. Results- The comparison of wet/dry season fluxes in units of season-1 is confusing if readers don't catch the fact that dry & wet season are each defined as 6 months. It would be helpful to remind readers of this definition at the point where this is presented in the text, and also probably in the figure legends.

We will reiterate in the results section that the units of season-1 are defined as 6 months each for the wet and dry season.

4. p. 19326, lines 1-2: Stem expansion is not a direct indicator of C allocation to woody growth. Stem expansion can be driven far more by water status than by C (Zweifel, 2006). In addition, there is a lag between tree stem expansion and woody biomass

production (Cuny et al., 2015). Please modify this statement accordingly.

Cuny HE, Rathgeber CBK, Frank D et al. (2015) Woody biomass production lags stemgirth increase by over one month in coniferous forests. Nature Plants, 1, 15160.

Zweifel R (2006) Intra-annual radial growth and water relations of trees: implications towards a growth mechanism. Journal of Experimental Botany, 57, 1445–1459.

The reviewer raises valid points here and we feel that the wording of our sentence was misleading. While external factors such as water availability and temperature can induce a lag between photosynthetic performance (GPP) and stem growth, particularly in northern hemisphere systems (as shown in the references provided by the reviewer), we do not believe this to be the case for Australian savannas. A-seasonal patterns of water use occur in savanna trees, with increases in dry season sap flow indicating a tree scale response to VPD (O'Grady et al., 1999;Hutley et al., 2000) but with limited leaf water stress (Prior et al., 1997;Prior and Eamus, 2000). To account for this, canopy adjustment via reduction in leaf area helps the trees to manage water stress and maintain GPP through the late dry season (O'Grady et al., 2000;Beringer et al., 2007). Allocation of carbon for starch reserves to replace damaged foliage after regular dry season fires also directs photosynthate away from stem growth (Cernusak et al., 2006;Beringer et al., 2007). Therefore, we propose to amend the sentence in question (p. 19326, lines 1-2) to read as follows:

In addition, stem growth slows and then ceases by the late dry season, therefore GPP measured during this period is likely to be allocated to woody tissue maintenance rather than biomass accumulation (Prior et al., 2004;Cernusak et al., 2006). Allocation of carbon for starch reserves, to replace damaged foliage after regular dry season fires, also directs photosynthate away from stem growth (Cernusak et al., 2006;Beringer et al., 2007). In addition, the dominant eucalypt species also flower and fruit in the dry season, producing a large number of woody capsules (Setterfield and Williams, 1996), which would redirect carbon allocation from biomass accumulation.

Reviewer 2

1. The paper would benefit from a separate results section and a separate discussion section instead of a combined Result and Discussion section. This section also includes additional methodology (for example page 19321, row 3-8) which decreases clarity. The Result & Discussion section is also very long and includes a lot of numbers which occasionally make the section less readable. Can some of this be replaced/complemented by/with illustrations?

To address the first point raised by reviewer 2, the main reason the results and discussion sections were combined for this manuscript is because we felt it would provide the best way to present and discuss our results within neat subsections. These subsections being "3.1 Validation of the understory tower", which we first needed to establish and discuss to assure the reader that we'd considered the drawbacks associated with understory towers. This then lead into section "3.2 Net Ecosystem Productivity", where we present and discuss the differences in measured NEP fluxes over time between the overstory and understory. Likewise for sections 3.3, 3.4 and 3.5, that discuss the respiration component, the GPP and inter-annual differences. We can see though that this approach makes the results and discussion section a longer section. Therefore, if the editorial team advise it, we will endeavour to separate these sections in our resubmission.

For the second point raised, we placed the section identified (page 19321, row 3-8) where it was as we thought that it aided our discussion. However, we will remove this section and integrate it into section 2.4 in the methods, where we outline our technique of partitioning NEE.

For the third point raised, we felt that the inclusion of numbers in the presentation of our results supported our claims. However, in some cases, these numbers are also referred to in Table 3. We will omit some of these numbers from the body of the results/discussion and direct the reader to Table 3 instead.

2. Page 19317, row 24-27: "We assumed OR to be the difference between ER and UR". Please provide additional support for this assumption. When the flux of CO2 is from the soil and biosphere to the atmosphere could not then the same CO2 be measure by both sensors?

Our feedback from reviewer 1 may help clarify this point. The understory tower is measuring a subset of the footprint from that of the main ecosystem tower. Given the homogeneity of the site, we assumed that OR would be the difference between ER and UR. Under turbulent conditions, we are making the assumption that the understory tower is capturing the respiration component from the soil and above ground understory vegetation. Given the ecosystem tower is capturing all respiration components, the subtraction of UR from ER should give us an estimate of the above ground overstory respiration (OR) component. We will amend Page 19317, row 24-27 to include this description to make this point clearer in section 2.4

3. Page 19326 row 5 says Annual GPP = 2267, wheres table 3 says 2187. A typo?

Upon double checking Table 3, it seems reviewer 2 may have taken the value of 2187 from the 2013-2014 annual sums section, instead of the mean (+/- SE) section. The mean annual value in Table 3 (last column) gives a value of 2267 for GPP, which is correctly presented on page 19326 row 5. However, we will make Table 3 clearer by separating the sections better so this type of confusion is less likely to occur in future.

References used in responses:

Beringer, J., Hutley, L. B., Tapper, N. J., and Cernusak, L. A.: Savanna fires and their impact on net ecosystem productivity in North Australia, Global Change Biology, 13, 990-1004, 2007. Cernusak, L. A., Hutley, L. B., Beringer, J., and Tapper, N. J.: Stem and leaf gas exchange and their responses to fire in a north Australian tropical savanna, Plant, Cell and Environment, 29, 632-646, 2006.

Hutley, L. B., O'Grady, A. P., and Eamus, D.: Evapotranspiration from eucalypt open-

forest savanna of northern australia, Functional Ecology, 14, 183-194, 2000.

Kanniah, K. D., Beringer, J., Hutley, L. B., Tapper, N. J., and Zhu, X.: Evaluation of Collections 4 and 5 of the MODIS Gross Primary Productivity product and algorithm improvement at a tropical savanna site in northern Australia, Remote Sensing of Environment, 113, 1808-1822, 2009.

Kljun, N., Calanca, P., Rotach, M. W., and Schmid, H. P.: A simple parameterisation for flux footprint predictions, Boundary-Layer Meteorology, 112, 503-523, 2004.

O'Grady, A. P., Eamus, D., and Hutley, L. B.: Transpiration increases during the dry season: Patterns of tree water use in eucalypt open-forests of northern Australia, Tree Physiology, 19, 591-597, 1999.

O'Grady, A. P., Chen, X., Eamus, D., and Hutley, L. B.: Composition, leaf area index and standing biomass of eucalypt open forests near Darwin in the Northern Territory, Australia, Australian Journal of Botany, 48, 629-638, 2000.

Prior, L. D., Eamus, D., and Duff, G. A.: Seasonal and diurnal patterns of carbon assimilation, stomatal conductance and leaf water potential in Eucalyptus tetrodonta saplings in a wet-dry savanna in northern australia, Australian Journal of Botany, 45, 241-258, 1997.

Prior, L. D., and Eamus, D.: Seasonal changes in hydraulic conductance, xylem embolism and leaf area in Eucalyptus tetrodonta and Eucalyptus miniata saplings in a north Australian savanna, Plant, Cell and Environment, 23, 955-965, 2000.

Prior, L. D., Eamus, D., and Bowman, D. M. J. S.: Tree growth rates in north Australian savanna habitats:

Seasonal patterns and correlations with leaf attributes, Australian Journal of Botany, 52, 303-314, 2004. Setterfield, S. A., and Williams, R. J.: Patterns of flowering and seed production in Eucalyptus miniata and E. tetrodonta in a tropical Savanna Woodland, Northern Australia, Australian Journal of Botany, 44, 107-122, 1996.

Interactive comment on Biogeosciences Discuss., 12, 19307, 2015.