Interactive comment on "Net primary productivity, allocation pattern and carbon use efficiency in an apple orchard assessed by integrating eddy-covariance, biometric and continuous soil chamber measurements" *by* D. Zanotelli et al.

Anonymous Referee #2

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This MS presents a full ecosystem carbon balance for a Mediterranean apple orchard, using multiple methodologies, including eddy-covariance, automated soil respiration chambers and detailed biometric measurements. While representing only one site for one year, this study is commendable for its use of multiple methodologies, thoroughness of those methodologies and attempts to quantify uncertainties related to these measurements and their scaling to the site level over the entire year. The main result highlighted, a CUE of approximately 70%, is surprising when put in the context of managed and unmanaged 'natural' forests, being very near the upper estimates made by

physiological ecologists for these systems. As the authors themselves point out, this estimate is even above the theoretical range estimated by Amthor (2000), which leaves one wondering if this result is a representative value for this ecosystem or the product of some measurement bias. Given the lengths the authors go to answer this question, I recommend publication with the addition of a few minor clarifications considering the assumptions implicit in the approaches taken.

The authors highlight well the factors that make this agro-ecosystem different from other forests in ways that may lead to a higher CUE. Indeed, the detailed partitioning of NPP from biometric components is likely of great interest to those studying similar systems. Representative values of respiration values from the literature also provide good support for the contention that the large NPP investment in fruits may lead to lower respiration per unit biomass than other forests. Overall, the authors do a very good job finding support from the literature for why this ecosystem should have a higher CUE than most.

The authors provide estimates of uncertainty throughout the tables and results for most measurements. However, it is unclear what sources of uncertainty are included in each (other than the EC NEE). I would request some clarification of this in the methods and/or results. For example, it seems that chamber based respiration measurements were scaled spatially in two ways. One is is what I would term a 'horizontal' scaling factor (about 0.8) based on the June 2010 measurement campaign of spatial distribution of soil respiration (which suggested the automated sampling area had higher respiration than average across the site). In order to construct an estimate of total autotrophic respiration independent of eddy-covariance measurements, the authors also use a 'vertical' scaling factor based on the distribution of nitrogen in the ecosystem in March 2010 (Eq. 6, Table 2). From my reading of the paper, it is unclear whether uncertainty in these correction factors are included in the estimates.

Another point concerning these two scaling factors is that they are both based on measurements during one period of the growing season (June and March respectively),

then used for scaling throughout the year. It is unclear if any attempt was made to estimate how they might vary seasonally. Some more detail about the methods or assumptions concerning this is crucial. Of particular concern is whether seasonal changes in N distribution would cause the vertical scaling factor (k in Eq. 6) to change throughout the year. As the effects of these scaling factors are multiplicative, they could generate considerable uncertainty in estimates of Ra (Table 6, number 3) and NPPbiom, as well as the CUE derived from them (Table 7).

Finally, it is unclear how representative 2010 is of NPP at this site. As the major component of NPP, it would be interesting to know how 2010 is situated to other years in terms of fruit yield.

The remaining comments are smaller details:

(P14095, L20) Is this a typical yearly application of fertilizer? What were the fertilization dates?

(P14097, L24) What % of total measurement period consisted of gaps for NEE?

(P14102, L7) I think 'multichambers' should be 'multichambered'

(P14102, L23) What % of total measurement period consisted of gaps for Rs and Rh(averaged across chambers)?

(P14103, L13) It would seem that these first two methods both are derived partially from EC measured NEE. I therefore would remove the word 'independent.' It may also be worth noting how Ra and GPP are both inferred from NEE, rather than being actually measured, perhaps by a reference to the section on EC above.

(P14106, L10-17) In giving GPP, Reco and NEP for the different methods, keep the order consistent.

(P14116, L17) I think 'favorites' should be 'favors'