RESPONSE TO REVIEWERS

REVIEWER 2

Thank you for the careful revision of this manuscript. A point-by-point response follows.

Carbon sequestration by forests is sensitive to drought. This paper studied the drought severity of GPP and its partitioning among carbon pools in a Quercus ilex coppice using field measurements. This is a well-written and interesting paper. It is publishable after some minor modifications.

1. *Field capacity is assigned 205 mm. Is this value measured or estimated?*

Field capacity is defined here as the water stored in the soil two to three days after a large rainfall event, when excess water drains away by the downward forces of gravity. This value of field capacity assumes that the water removed from the soil profile is only removed by gravity, not through plant transpiration or the soil evaporation. From our measurements of soil water storage (see figure 1) we fixed this value to 205 mm. Even if the fine fraction of the soil is fine-textured (clay loam), we considered it to be at field capacity when the water potential in the soil is at -33 kPa. So at a relative water content SWS/FC = 1, the retention curve is at a potential of -33 kPa.

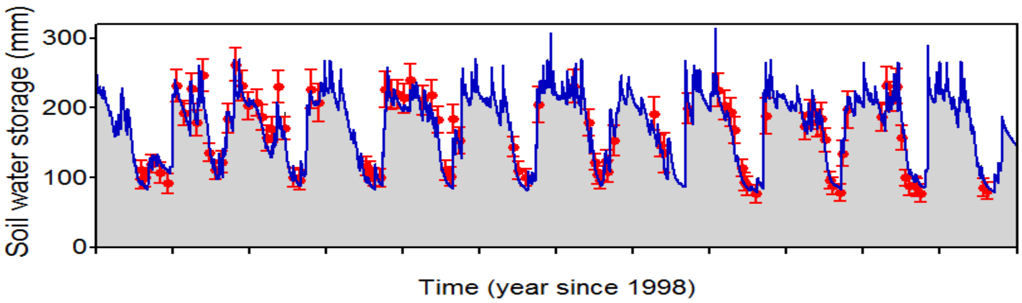


Figure 1. Time course of soil water storage. The blue line is the continuous simulated daily values (see part 2.4). Red points (+ SEM) are the discrete measurements obtained by integrating soil water content profiles. During the wet seasons or after large rainfall events we observed that the rate of change in soil water content presented a significant change at about 205 mm

2. *Some valuables, such as $BNPP_{coarse}$ and $BNPP_{fine}$, were estimated. Please analyze the uncertainties of these estimates.*

There are several methodological pitfalls associated with sampling perennial root biomass and estimating its belowground production in our *Quercus ilex* coppice, where 90% of soil volume is stones below 50 cm depth. These pitfalls include the difficulty to sample for deep roots and to extend the sampling to many replicate trees. To account for the missing root parts, we corrected our estimates of total root biomass by adding 10% of sampled root biomass. Including other data sets from colleagues in North East Spain in *Quercus ilex*, we obtained an isometric partitioning between above- and below-ground biomass (see for instance Hui et al. 2014 for a substantial account).

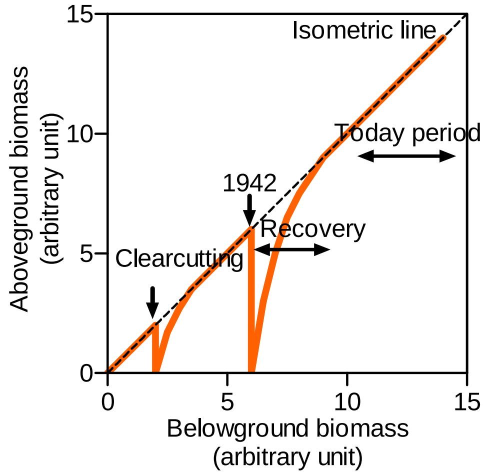


Figure 2 Theoretical scheme showing the time courses of belowground and aboveground biomass of an individual of *Quercus ilex* submitted to clearcutting. Two successive clear cuts have been represented followed by their recovery phases. For the today period we observed that both biomasses were isometrically related.

The isometric hypothesis has been disputed in several studies. Our contribution to the ongoing debate about allometry of biomass partitioning is more an empirical evidence than a theoretical advancement (see Figure A1). It will help understanding the biomass partitioning pattern in coppices, which has been largely overlooked despite its importance in ecosystem modeling and ecology. We postulate that the error we made in estimating $BNPP_{coarse}$ is equivalent to the one we made in evaluating the change in stem biomass; approximately 20% (see Figure 2).

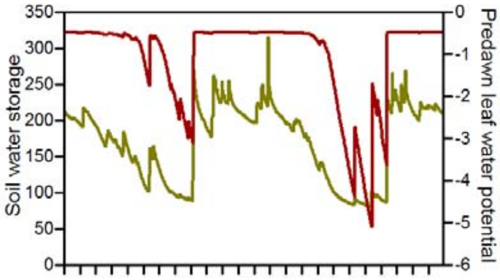
The production and turnover of fine roots contributes significantly to carbon cycling in forest ecosystems. Unfortunately, limited observations of fine root dynamics make difficult to quantify and predict fine root growth pattern and productivity. The errors in estimating fine root biomass production originates from the fine root turnover rate and the maximum standing belowground biomass. Some compilations of global database help us to constraint and validate the estimate we used in this work. In Jackson et al. (1997) (see also Gill and Jackson, 2000) most of the results retained for describing the so-called class “sclerophyllous shrubs and trees” are from the works that Jochen Kummerow did in Mediterranean-type ecosystems in California and in Southern France, where some of the species are Mediterranean evergreen oaks. More recently, compilation of a new global database estimated fine root production and fine root turnover ranged in the boreal, temperate and tropical forests (Finér et al. 2011).

In our work we used data obtained on the same species growing in coppice under close ecological conditions. We adopted as strong hypothesis the main results of López et al., 2001. They found annual fine root production over the 0-60 cm soil layer was quasi identical to the annual leaf production and found a ratio of fine root/leaf production of 1.04. We corrected this value to consider fine roots production over the whole profile (4.5m), by considering (i) the distribution of fine roots over the soil profile proposed by Jackson et al. (1997) for sclerophyllous shrubs and trees, and (ii) the increase of fine root turnover rate with depth (López et al., 2001). We obtained a ratio of fine root/leaf production of 1.25. We postulate that the error we made in estimating $BNPP_{fine}$ is greater to the one we made in evaluating $BNPP_{coarse}$; approximately 30% as most studies did on this component we could not reach easily.

Finér, L., Ohashi, M., Noguchi, K., & Hirano, Y. (2011). Fine root production and turnover in forest ecosystems in relation to stand and environmental characteristics. *Forest Ecology and Management*, *262*(11), 2008-2023.
Gill, R. A., & Jackson, R. B. (2000). Global patterns of root turnover for terrestrial ecosystems. *New Phytologist*, *147*(1), 13-31.
Hui, D., Wang, J., Shen, W., Le, X., Ganter, P., & Ren, H. (2014). Near Isometric Biomass Partitioning in Forest Ecosystems of China. *PloS one*, *9*(1), e86550
Jackson, R. B., Mooney, H., and Schulze, E.-D. (1997). A global budget for fine root biomass, surface area, and nutrient contents, P. Natl. Acad. Sci. USA, 94, 7362–7366,
López, B., Sabaté, S., and Gracia, C. (2001). Fine-root longevity of *Quercus ilex*, New Phytol., 151, 437-441.

3. *WSI was used as the indicator of drought severity. Did you try use anomaly or standard precipitations index to indicate the drought severity?*

We tested some concurrent drought severity indices. In Mediterranean-type climate areas, the yearly rain amount is the worst descriptor of drought severity (see line 7 page 13). Below we present, for two consecutive years, 2005 and 2006, the time courses of soil water storage (SWS) and predawn leaf water potential (figure 3a) simulated by our soil water model, used to calculate the water stress integral (WSI). We compared it with some other drought indices (data not shown): drought length (that is, the day at which water content expressed in percent of field capacity was below a given threshold of 0.7 or 0.4), and drought intensity (the area between the soil water storage corresponding to the retained threshold and the SWS time course). We retained WSI because the predawn water potential controls many plant functions and has been largely proved efficient in forest ecology (see discussion lines 8 to 20 on page 17). It is well adapted to the non-linear nature of the soil water retention curve (particularly on fine-textured soil) in comparison with drought length or drought intensity, for instance. We also present (Figure 3b), for comparison, the time course of the SPI_3 (standardized precipitation index with a time window of 3 months); negative values of SPI_3 mean drought periods. We observe that the SPI_3 is able to identify well the dry months in 2006. It suggests a dry Spring in 2005 followed by a summer period without any significant drought, in opposition to our simulations and observations. Its standardized nature make difficult to use it over a rather short period of 10 years. Our calculations of SPI_3 presented in Figure 3b have been done using 30 years of monthly rainfall amounts.



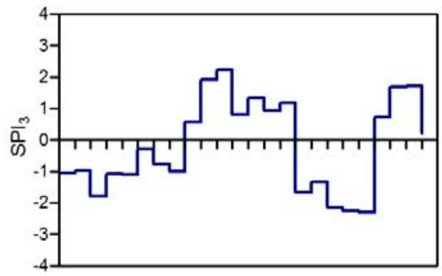


Figure 3. a) Daily time courses of soil water storage in mm (green line) and of predawn leaf water potential in MPa (red line) for two consecutive years 2005 and 2006; b) course of monthly Standardized Precipitation Index (SPI). Different SPIs are obtained for different time-scales representing the cumulative rainfall amount balance over the previous k months. Here we plotted SPI with a time window of k=3 months or SPI_3. Negative values mean months with water limitation or drought and positive values are for well-watered conditions or excess water.