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Interactive comment on "Modelling above-ground carbon dynamics using multi-temporal airborne lidar: insights from a Mediterranean woodland" *by* W. Simonson et al.

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Referee 1

The paper is clear, scientifically sound, and well written. It represents an important study in the field of biomass and carbon forest monitoring, as few multitemporal lidar studies are available and none in the Mediterranean ecosystem under analysis. The methods are sound and the discussion is interesting. Minor scientific questions are posed below.

Response: We are grateful for this very positive review of our paper.

Line 118-121: How did you measure DBH, crowns etc. for shrubs? The list of what measured seems as better suited for trees not shrubs. Same applies for biomas calculation (line 122 to 130). In Med. Woodlands shrubs below and among trees can be consistent, and it would be interesting to understand if you measure them (and how) and how shrubs presence influence your study

Response: We measured shrubs and trees setting the DBH threshold to 7.5. We considered that smaller sizes do not significantly contribute to plot-level biomass, especially in the Alto Tajo study area, where shrub density is lower than that of other Mediterranean shrublands and forests due to harsh climatic conditions and rocky soils. This can be explained in the manuscript with appropriate reference to Stephenson et al 2014: Rate of tree carbon accumulation increases continuously with tree size, Nature, 507(7490), 90–93.

Line 152: The amount of ground truth plots for developing the lidar biomass map is quite limited. How this influenced the goodness of estimates (and the low coeff. Of determination you obtained). Did you perform additional validation of the lidar modelled AGB i.e with leave one out or similar method? May the low R2 be responsible for the large st. dev. of your AGB change map? Which are the reference values (R2) for lidar based AGB estimation in Mediterranean woodlands? The analysis of this issues can improve the study.

Response: We acknowledge that the number of ground truth plots is low, and can revise the manuscript to: - emphasise the importance of the validation of the lidar modelled AGB using independent datasets, and - suggest that the results of this validation indicate that the sample size was sufficient statistically to obtain the estimated parameters of our model. Our coefficient of determination of the AGB model (0.53) compares with a reference value from the region (0.67) (Garcia et al 2010), who sampled more plots across a greater range of woodland types, heights and carbon densities.

We do not consider that the additional analysis suggested is necessary because we

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are confident that the results will remain the same and, besides, the data are enough to support the results and conclusions of our analyses.

Line 63: airborne lidar cannot support large scale applications, is not cost-effective. Line 70: to lidar in? Line 77: I would add that multitemporal lidar acquisitions are still too expensive tool.

Response: We agree that the costs of lidar are still high, and this point can be emphasised in the discussion of making lidar operational in the future for better spatial and temporal coverage. We mention future space lidar capability as being an exciting development in this regard. However, it cannot be disputed that national level lidar applications are emerging, so the 'large-scale' use is still referred to. 'to lidar in' (line 70) should read 'to use lidar in'

Referee 2

Very good and inspiring paper that I really enjoyed reading. It is a step ahead in the process of operationalising the use of LiDAR for quantifying AGB and Carbon fluxes. The authors use a study in central Spain with data from archive and ground data collection as an example of other research work worldwide. I liked the use of cores and dendrochronology applied to the estimation of carbon. It opens my mind personally for a lot of possible applications using the same data.

Response: We are grateful for this second very positive review of our work.

Please, include a couple of sentences describing how cores are being extracted (e.g. just one core, two cores in N-S, E-W, at dbh level, at mid point from ground to base of canopy .etc). I assume most of the readers, including myself, may not get access to the reference you mentioned that supposedly describes this process

Response: Further information can be inserted, as follows: One core was extracted from each selected tree at a height of 1.3 m off the ground. Following a size-stratified random sampling approach, 12 trees per plot were cored in monocultures and 6 trees

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per species were cored in mixtures.

Please specify whether altitude is referred to above ground or above sea level

Response: Comment refers to flying altitude in Table 1, which is metres above sea level (asl). This can be easily clarified.

Page 14750, I think the authors should be talking more openly about Return Periods for extreme events in years rather than probabilities. I believe the first concept is better understood and transmit a far more powerful message

Response: Agreed, and return rates can be referred to.

The probabilities they used for their predictions are perhaps not very realistic, as the authors noticed at the end of the paper. They only contemplate fire events every 100, 250 and 500 years, whereas in Cataluña these returns periods are far shorter.

Response: The rates we used did seem conservative but were based on the only two sources of information that we found for the Guadalajara region: (Ministerio de Agricultura, 2002, 2012) and (Purves et al., 2007).

I think the size of the plots (30x30m) is big enough for calibrating the system. I do not believe they may introduce important errors. In our experiments with plantation forests, 30 meters is precisely the point where accuracy levels of.

Response: This is encouraging, and we can make this point in the text.

Interactive comment on Biogeosciences Discuss., 12, 14739, 2015.