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Interactive comment on "Carbon transfer, partitioning and residence time in the plant-soil system: a comparison of two $^{13}CO_2$ labelling techniques" *by* M. S. Studer et al.

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We would like to thank Referee #1 for having read the manuscript thoroughly and for the detailed and valuable comments. The specific comments will be incorporated into the manuscript. Here we would like to respond to the major points that were discussed by Referee #1.

1) Assumptions of the decay model

We discussed mainly the assumption of constant pool size (steady state), because we think that this had the largest effect in this study (increase of pool size by 28% and 65% during the PL and CL, respectively). Other assumptions for the application of the decay

model, are first-order kinetics (fluxes are proportional to pool size), a single active pool and (in PL) that the signal decay is only due to the label efflux via carbon losses (as discussed in Epron et al., 2012). These other assumptions are simplifications of the reality, which help us to better understand the most essential processes. For example, the bulk material represents not a single pool, but a mixture (e.g. labile, transient pool of stored carbon and structural pool). In a revised version we will highlight this issue more specifically.

2) 13C dynamics during PL and CL at steady state vs. at growth (Fig. 1)

We agree with Referee #1 that the dilution with post-pulse assimilated 12C should lead to a faster decay of the tracer signal after the 13C pulse for a growing plant (dotted line below the steady state line). However, more 13C is thought to be allocated into the structural pool, i.e. more 13C would remain in the bulk tissue after the decay of the pulse labeling signal (dotted line above the steady state line at the end). The dotted line in the continuous labeling would have to be extended (and the curve for the growing system should be higher than the steady-state curve), indicating a phase of increasing signal strength (due to incorporation of the label into the structural C pool) till the tissue reaches the maximum label strength (stationary state II). A corrected figure can be found below (please note the logarithmic time scale).

3) Number of replicates

The maximum number of plants was restricted to 15 with the current setup in the MICE facility. We set the number of replicates to three in order to have enough (five) sampling dates to show the dynamics in the 13C distribution over time. We think that strategy is justifiable, 1.) since we used poplar clones and 2.) all plants were subject to the same labeling treatment (the same atmosphere for all plant shoots, the same controlled environmental conditions). Although we observed unexpectedly large variations in this experiment between the plant individuals in terms of total assimilation, the dynamics of the 13C distribution were consistent for each plant individual. But we agree with

Referee#1 it would be better to have more replicates if possible.

4) Modeling with different pool types and GPP/NPP considerations

Although it would be valuable to include GPP and NPP, our study was not designed to assess these parameters, and we do not have the needed data for that. The GPP/NPP can only be measured as an integrated value over all plants in the climate chamber (and not for each individual plant). Since we destructively sampled plants during the experiment, the GPP/NPP measurements would be based on different composition of plant individuals. Therefore a more complex modeling according to Street et al. (2011) is not possible. However we can differentiate between pools more clearly in our discussion of the results.

Interactive comment on Biogeosciences Discuss., 10, 16237, 2013.

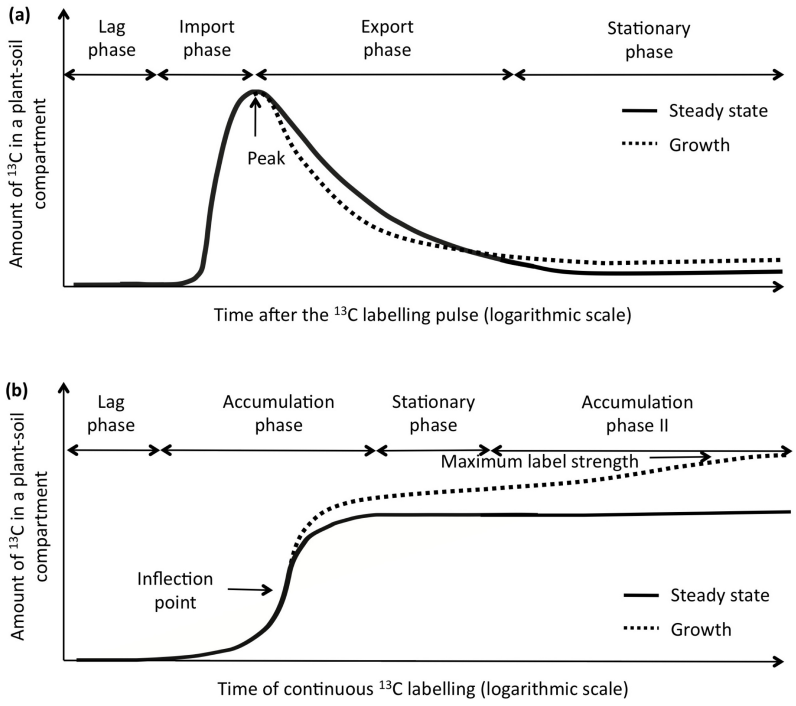

Fig. 1. 13C tracer dynamics after label addition. Visualisation of the 13C dynamics in plant-soil compartments after pulse labelling (a) or during continuous labelling (b).