TECHNICAL COMMENT

Response to Comment on "Impacts of Fine Root Turnover on Forest NPP and Soil C Sequestration Potential"

We commend Luo *et al.* (*1*) for their effort to extend the analysis of our data (*2*) and partition root C turnover into the turnover of structural C (SC) and nonstructural C (NSC) in root tissues. Clearly, the rate of replacement of SC, which is mostly cellulose, and NSC, which consists of starch and metabolites, must differ because of the functional and structural differences between the two C pools. Replacement of NSC is dynamic and dependent on the root energy requirements, whereas the less understood replacement of SC in existing root structures follows repair, maintenance, and other structural requirements.

Applying a model assuming two C pools, Luo *et al.* (*1*) found that the sum of the modeled SC and NSC pools is similar to the average root C turnover that we reported (*2*). However, we do not agree with the basic premises and assumptions of their model design. Luo *et al.* (*1*) propose a model in which C for root maintenance and growth is drawn entirely from an NSC storage pool, without accounting for movement of photosynthate to roots that bypasses the storage pool.

The linear approach of the two-pool model clearly contrasts with our observations that most of the C for new root growth comes from current assimilates (*2*). Although the existence of a storage pool in trees is known and is

certainly important for initiation of root growth in some species (*3*), its function as a continuous central point from which NSC is taken for all tissue growth and maintenance is not clear. Furthermore, published evidence indicates that (i) after a pulse-chase experiment, the tracer moves rapidly (within hours) to root tips (*4*); and (ii) soil respiration is driven by the current flux of assimilates (*5*).

Our observation that most of the C for new tissue comes from current assimilates is further supported by a simple calculation. According to Luo *et al.* (*1*), the mean residence time (MRT) of the plant NSC is about 2 years for pine trees. The implication for our experiment is that the NSC in the storage pool after about 2 years should have reflected 50% replacement of the old C label (–27.6‰) by the new C label (–39.2‰), for a ^{13}C value of –33.4‰. In contrast, new roots produced in in-growth cores 2 years into our experiment had a ^{13}C value of –39.6‰. This result is possible only if most of the C for new growth came from current photosynthesis and a small or sporadic supply came from a plant storage pool.

Although the proposal of Luo *et al.* to separate SC and NSC is reasonable, their model design does not agree with our observations and those of others, and without additional data on NSC ^{13}C pool dynamics

in trees, their model does not specifically describe fine root MRT. Accordingly, we believe that the estimates of root C turnover that we presented (*2*) are a better representation of the MRT of C in the root system.

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