Leaf litter carbon transfers to humus and mineral soils show dynamic intra-annual patterns of storage and release leading to minimal net storage

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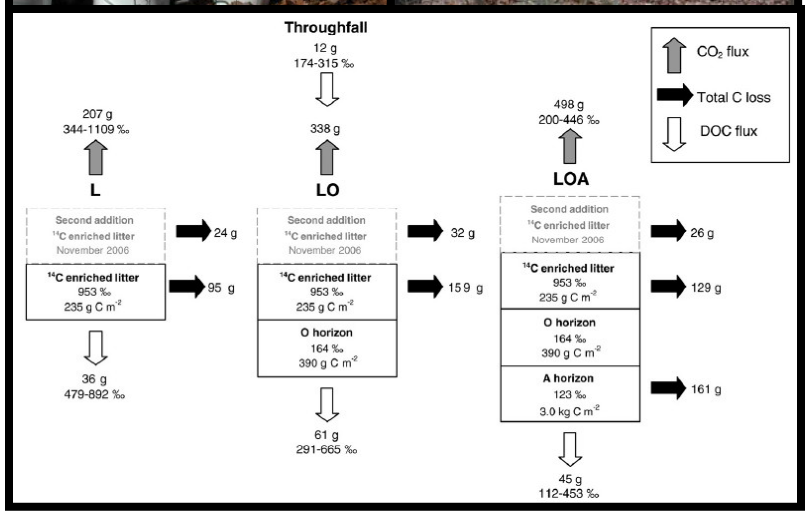
Funding: DOE Office of Science, Biological and Environmental Research

- Dissolved organic carbon (DOC) moves readily into soils and represents a theoretical pathway for delivery and retention of carbon in mineral soils.
- ^{14}C-enriched leaf litter was applied to replicated mesocosms to evaluate mechanisms of DOC transport and retention.
- Substantial leaching of newly form DOC from fresh litterfall was not absorbed by the soil humus layer, but was efficiently transferred to the mineral soil. Once in place, substantial loses of the $DO^{14}C$ were observed at intra-annual time steps.
- DOC transport to and retention by surface soils was extensive, yet net annual DOC input was small compared to C stocks and therefore not important for changes in soil C on an annual timescales.



U.S. DEPARTMENT OF ENERGY

OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

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Abstract:

The role of DOC for the build-up of soil organic carbon pools is still not well known, but it is thought to play a role in the transport of carbon to a greater depth where it becomes more stable. The aim of this study was to elucidate within-year dynamics of carbon transport from litter to the O (Oe and Oa) and A horizons. Mesocosms with constructed soil profiles were used to study dynamics of C transport from 14C-enriched (about 1000‰) leaf litter to the Oe/Oa and A horizons as well as the mineralization of leaf litter. The mesocosms were placed in the field for 17 months during which time fluxes and ^{14}C content of DOC and CO_2 were measured. Changes in ^{14}C in leaf litter and bulk soil C pools were also recorded. Significant simultaneous release and immobilization of DOC occurring in both the O and A horizons was hypothesized. Contrary to our hypothesis, DOC released from the labeled Oi horizon was not retained within the Oe/Oa layer. DOC originating in the unlabeled Oe/Oa layer was also released for transport. Extensive retention of DOC occurred in the A horizon. DOC leaching from A horizon consisted of a mix of DOC from different sources, with a main fraction originating in the A horizon and a smaller fraction leached from the overlaying horizons. The C and ^{14}C budget for the litter layer also indicated a surprisingly large amount of carbon with ambient $\Delta^{14}C$-signature to be respired from this layer. Data for this site also suggested significant contributions from throughfall to dissolved organic carbon (DOC) transport into and respiration from the litter layer. The results from this study showed that DOC retention was low in the O horizon and therefore not important for the O horizon carbon budget. In the A horizon DOC retention was extensive, but annual DOC input was small compared to C stocks and therefore not important for changes in soil C on an annual timescale.

Citation:

Fröberg M, Hanson PJ, Trumbore SE, Swanston CW, Todd DE (2009) Flux of carbon from ^{14}C-enriched leaf litter throughout a forest soil mesocosm. *Geoderma* 149:181-188.