Carbon Transfer from Labeled Leaf Litter into Mineral Soil at the University of Missouri Baskett Research Area, a Deciduous Forest in the Eastern United States.

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Introduction

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We have analyzed samples of soil for their carbon-14 isotopic signature. This ratio was used to determine the amount of carbon flux through the soil profile in plots at the University of Missouri Baskett research area, a deciduous forest in the Eastern United States. Carbon-14 enriched leaf litter was added to 5 plots at the site and allowed to decompose with sampling done each year.

This year's samples represent the third year of data. The soil samples were graphitized and then analyzed in an accelerator mass spectrometer at the Center for Accelerator Mass Spectrometry at Lawrence Livermore National Laboratory .

Fig. 1. One of five plots at the Missouri Ozarks site.

Materials and methods

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Fig. 2. Collection.
The samples were extracted from each plot and sent to Oak ridge National Laboratory where they were put through a 2mm sieve and dried at 70°C for several days (until constant mass was reached). These samples were then sent to L.L.N.L.

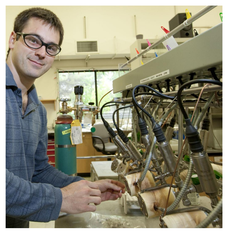

Fig. 3. Preparation
Soil samples were combusted to produce CO_2 gas. The CO_2 was condensed on a graphitization rig where it was reduced at 570°C with a stoichiometric amount of H_2 gas in the presence of an iron catalyst to bind onto. The graphite produced was pounded into aluminum targets.

Fig. 4. Analysis
The targets were analyzed in an accelerator mass spectrometer. Targets were sputtered with cesium. The ion beam was accelerated using electric potentials to collide with a foil and break the isobar bonds. The ions in the beam were separated using magnetic fields. The ^{14}C. And ^{13}C were both measured.

Results

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The concentration of radiocarbon in 2009 taken from the first 0-5 cm has increased by 58 +/- 8‰ since 2007. This increase is beyond the standard error and furthermore passes a t-test at α=0.005 and can be used to calculate the carbon flux from the enriched ^{14}C leaf litter on the surface to the 0-5cm mineral soil depth.

Using the following mixing model, we were able to quantify the carbon transferred to the 0-5 cm mineral soil depth.

$$(\Delta^{14}C^{*}[C])_{mixture} = (\Delta^{14}C[C])_{a} + (\Delta^{14}C[C])_{b}$$

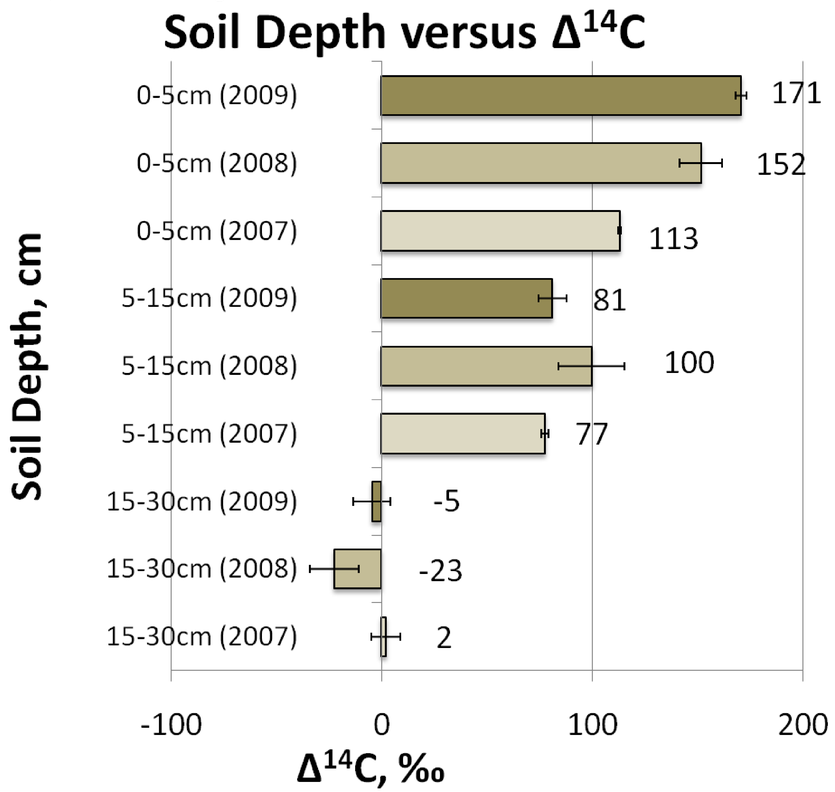
Where the carbon concentration weighted by the $\Delta^{14}C$ signature of the mixture from 2009 is a combination of soil carbon from 2007 plus the carbon transferred from the added leaf litter. "a" is the weighted carbon concentration of the soil in 2007 before labeled litter addition, and "b" is the weighted carbon concentration of the labeled litter from 2009.

Substituting and evaluating with:
$\Delta^{14}C_{soil}$ (2007) =113,
$\Delta^{14}C_{litter}$ (2007)=934,
$\Delta^{14}C_{mixture}$ (2009)=171

We determined that 8% of the carbon present in the 0-5cm mineral soil mixture in 2009 was transferred from the added leaf litter.

Using t-tests, there is not enough evidence to support the claim that there is more radiocarbon present in the 2009 5-15cm depth than in the 2007 5-15cm at the α=0.25 level. The same applies to the 2009 15-30cm relative to the 2007 15-30cm depth.

Fig. 5. Soil depth as a function of Carbon-14 isotope signature in parts per mil.



Discussion

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Although some of the litter decomposed and transferred as dissolved organic matter down through the soil profile, an explanation that accounts for much of the 8% flux of carbon from the added leaf litter from 2007 to 2009 is due to the

- Macrobiota, in particular earthworms found at the site.
- Climate also plays a role in the rate of decomposition and resulting flux of carbon.

Conclusions

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Using the mixing model we determined 8% of the carbon present in the 0-5cm depth of the mineral soil at the Missouri Ozarks site was transferred from the enriched radiocarbon leaf litter. The remaining fraction of carbon was the initial carbon present before the 2007 litter addition.

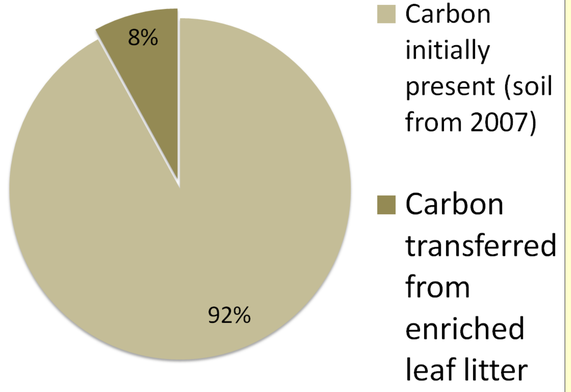

Fig. 6. Percent carbon transferred from the enriched leaf litter into the 0-5cm depth

Acknowledgments

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For further information

Regarding research conducted on carbon retention and flux in the soil carbon reservoir, refer to the Enriched Background Isotope Study (EBIS).

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