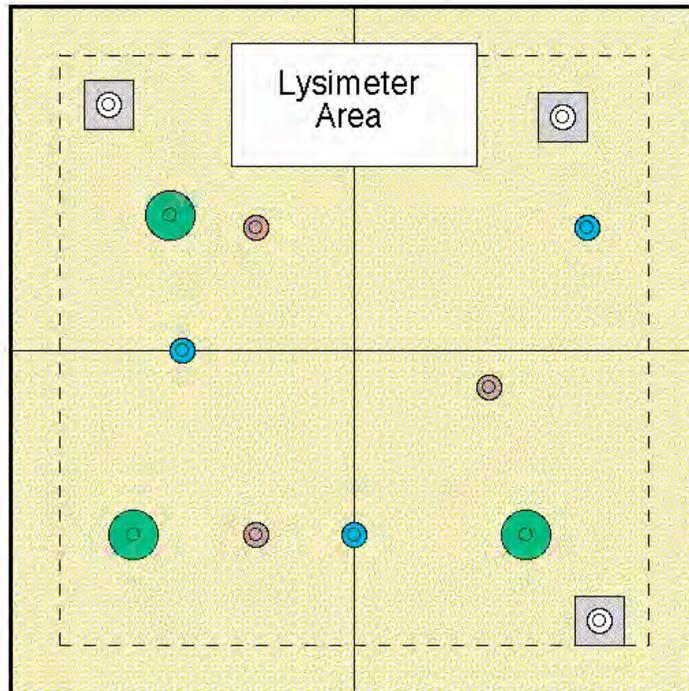


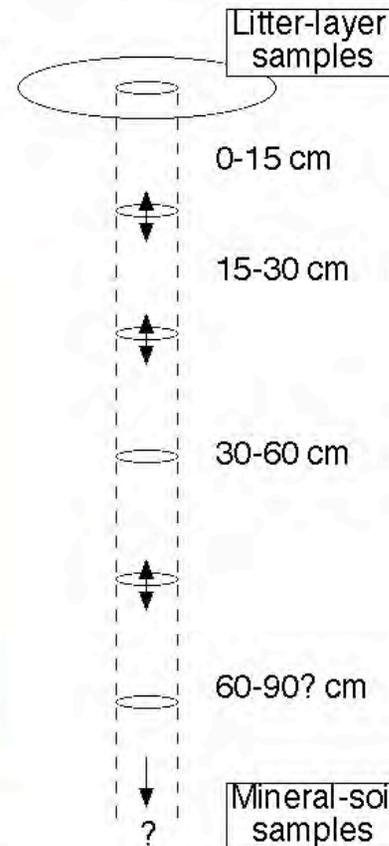
# **Bulk Organic and Soil $^{14}\text{C}$ Analysis**

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**EBIS Research Workshop**  
**January 6-7, 2004**  
**Gaithersburg, MD**

## Example 7x7 m Plot Sampling for WB#3 Through January 2004



-  All 0-year organic samples = 0.60 m<sup>2</sup>
-  All 1-year organic samples = 0.18 m<sup>2</sup>
-  All 2-year organic samples = 0.18 m<sup>2</sup>
-  All 3-year organic samples = 0.18 m<sup>2</sup>



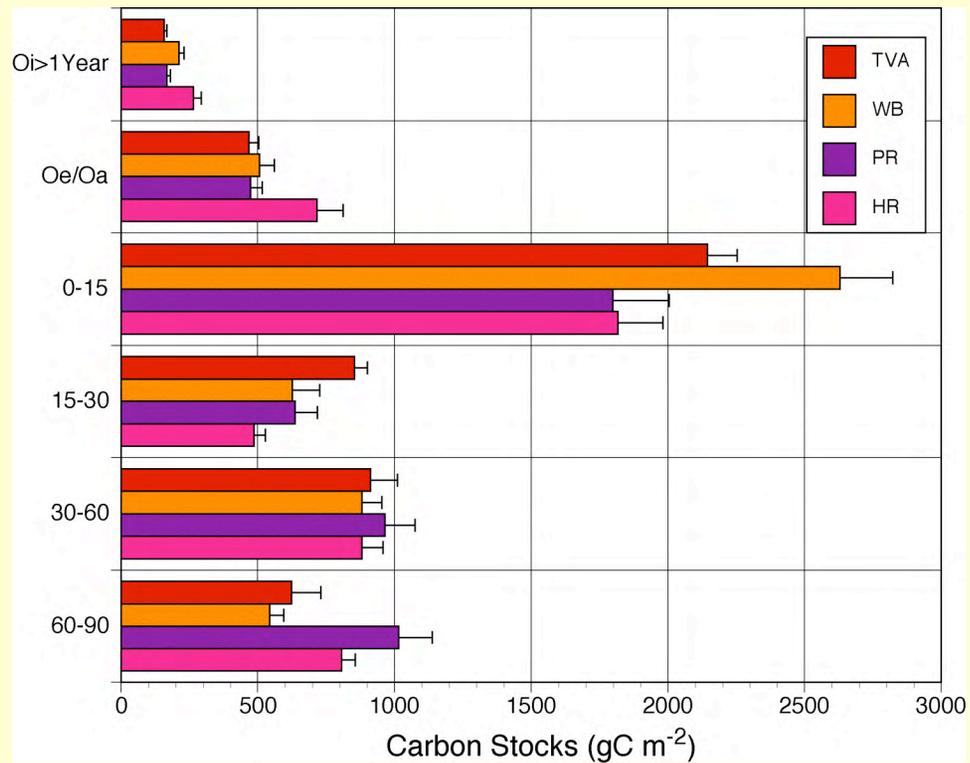
O<sub>e</sub>  
horizon is  
minimal  
0-15 cm is >  
A horizon

Depth of  
B horizon  
is highly  
variable

- **<4% of organic area and <0.3% of mineral area will have been sampled. How much sampling is too much?**

# Initial C Stocks and $^{14}\text{C}$ -Signatures

Carbon Stocks By Horizon



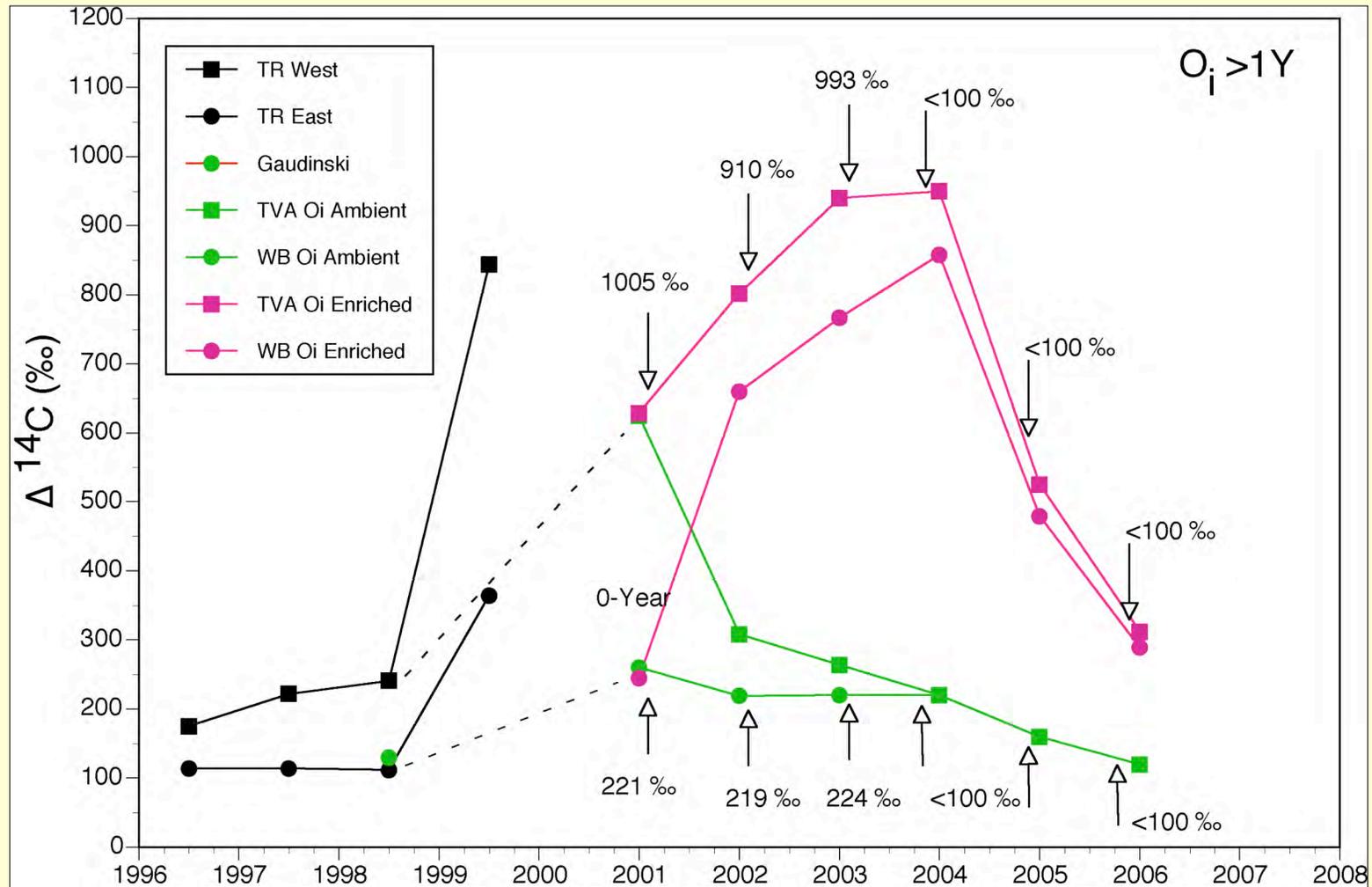
Time-zero  $^{14}\text{C}$  (‰)

	TVA	WB	PR	HR
<b>Oi&gt;1Y</b>	<b>627</b>	<b>252</b>	<b>515</b>	<b>193</b>
<b>Oe/Oa</b>	<b>466</b>	<b>218</b>	<b>361</b>	<b>194</b>
<b>0-15</b>	<b>192</b>	<b>84</b>	<b>163</b>	<b>121</b>
<b>15-30</b>	<b>95</b>	<b>24</b>	<b>92</b>	<b>72</b>
<b>30-60</b>	<b>62</b>	<b>7</b>	<b>40</b>	<b>72</b>
<b>60-90</b>	<b>-104</b>	<b>-90</b>	<b>58</b>	<b>35</b>

# Inter-Annual Bulk $^{14}\text{C}$ Data

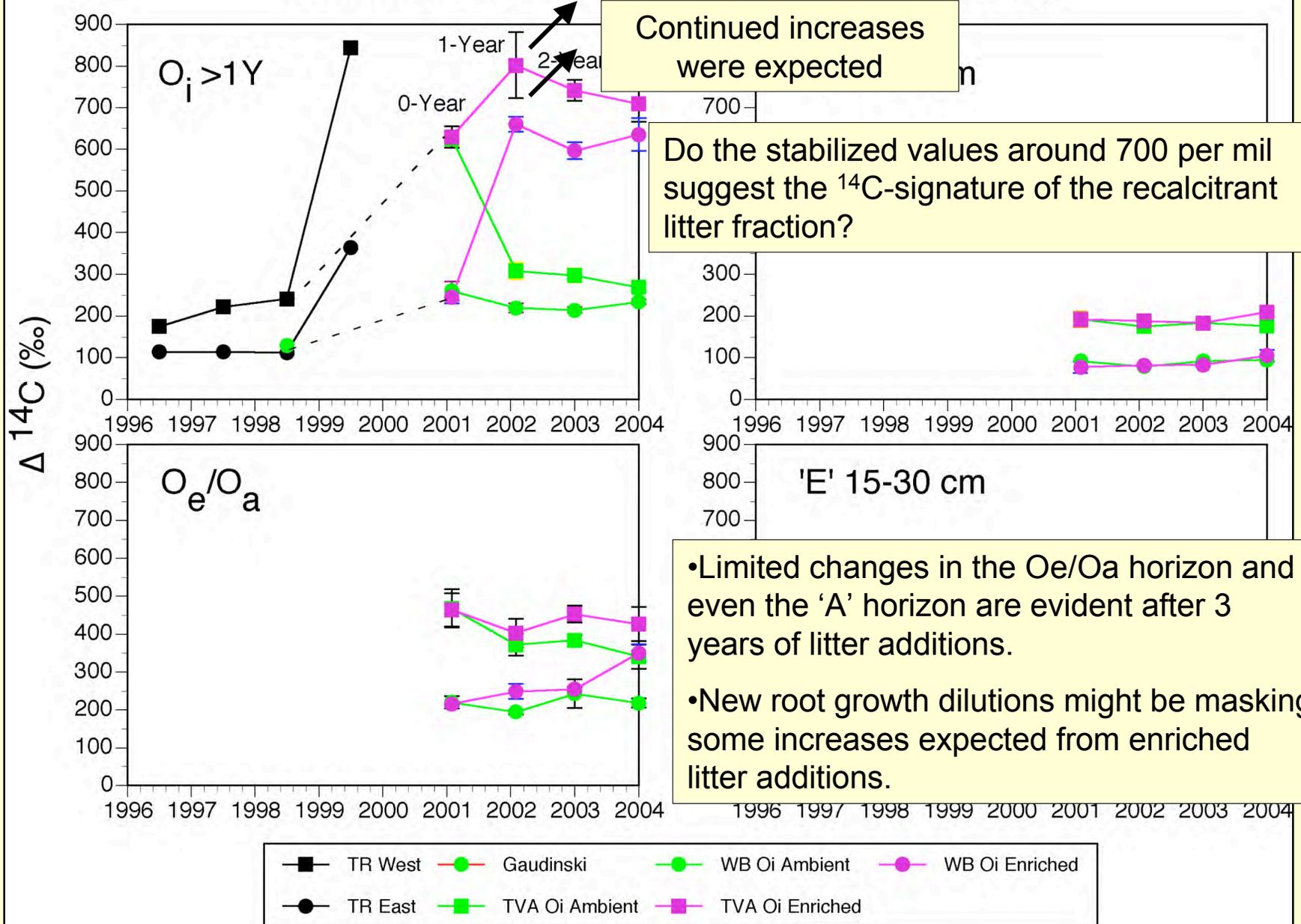
- The following graphs contrast  $^{14}\text{C}$ -signatures of pre-study tree ring sapwood rings (TR) for eastern and western trees with bulk  $^{14}\text{C}$  data for organic layers (Oi, Oe/Oa) or mineral soil depths/horizons (A,E).
- Time zero measurements for the experiment are the January 2001 data.

# Initial Expectations

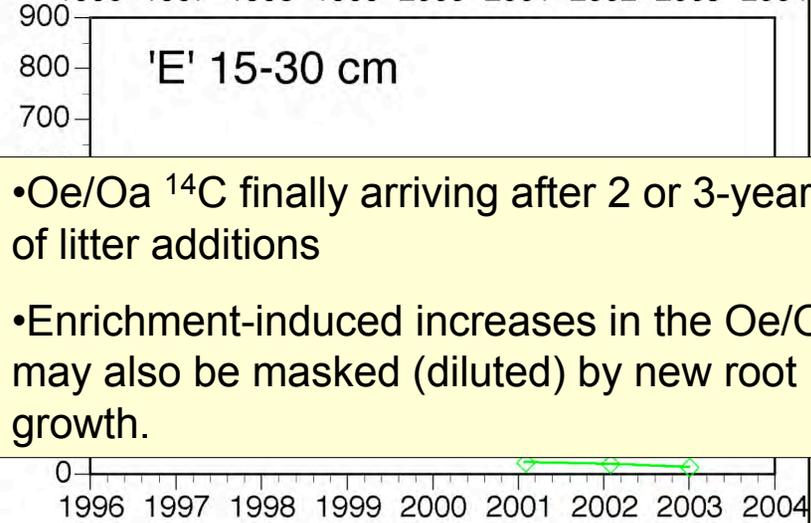
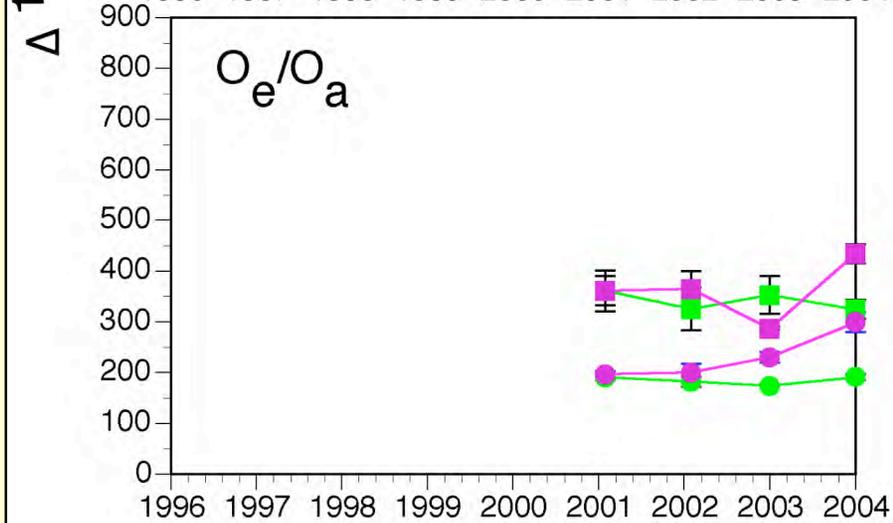
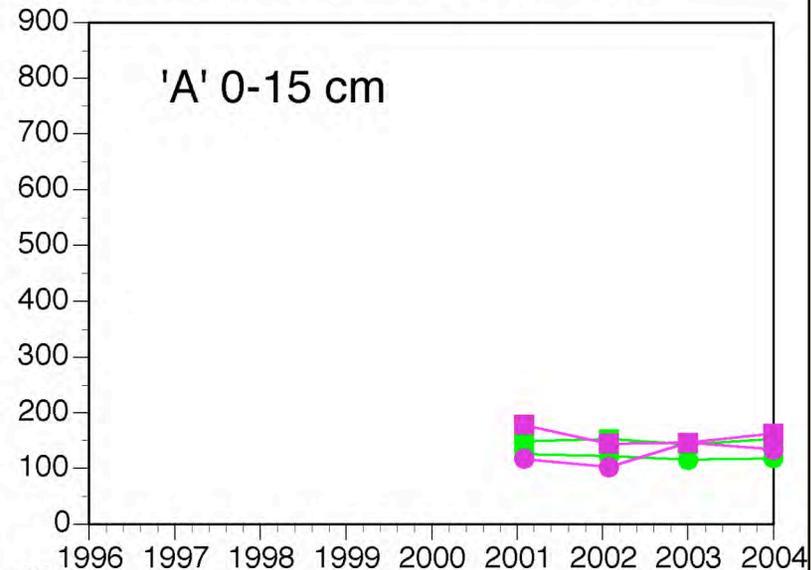
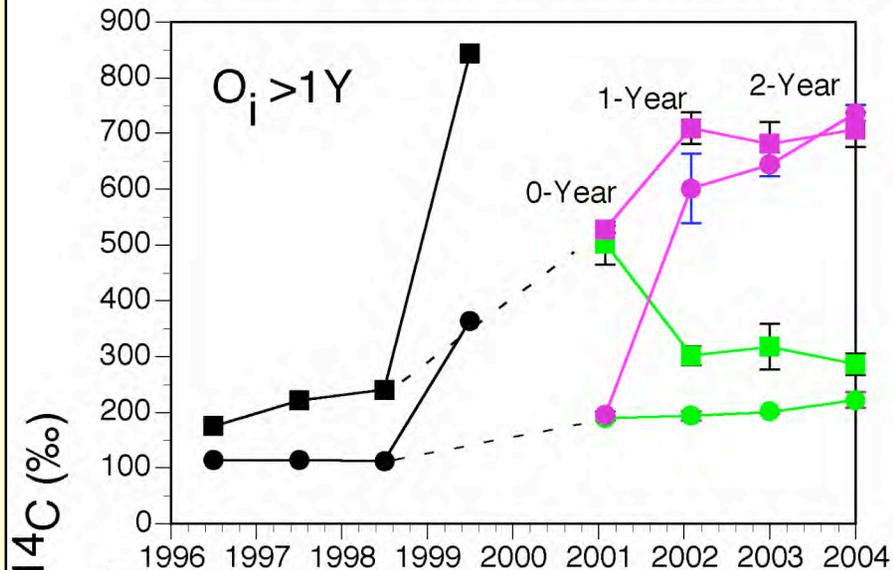


$$^{14}\text{C}^*[\text{C}_{\text{O}_i}] = ^{14}\text{C}^*[\text{C}_{\text{C}_1}] + ^{14}\text{C}^*[\text{C}_{\text{C}_2}] + ^{14}\text{C}^*[\text{C}_{\text{C}_3}]$$

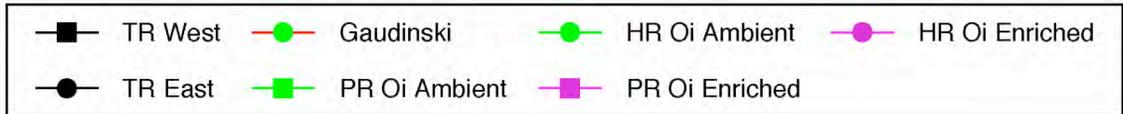
# Ultisols: TVA and Walker Branch (WB)



# Inceptisols: Pine Ridge (PR) and Haw Ridge (HR)



- $O_e/O_a$   $^{14}C$  finally arriving after 2 or 3-years of litter additions
- Enrichment-induced increases in the  $O_e/O_a$  may also be masked (diluted) by new root growth.



# Ultisol: Change in $^{14}\text{C}$ from Litter Additions

$^{14}\text{C}$ - Enrichment (WB)

$^{14}\text{C}$ -Dilution (TVA)



Horizon	Year = 0		Year = 3 or 2
Oi>1Y	245 ± 15	↗↗	635 ± 40
Oe/Oa	216 ± 5	↗	350 ± 23
0-15	77 ± 14	NS	83 ± 4
15-30	27 ± 5	NS	49 ± 9
30-60	-4 ± 21	NS	-10 ± 6
60-90	-93 ± 10	NS	-45 ± 14

Year = 0		Year = 3 or 2
625 ± 28	↘↘	269 ± 11
468 ± 5	↘	340 ± 32
192 ± 7	NS	183 ± 7
99 ± 9	NS	118 ± 13
62 ± 16	NS	-14 ± 16
-157 ± 26	NS	-150 ± 25

- As expected, rapid changes are evident in the O-horizons
- There is little evidence for change in the bulk mineral soils, but large C stocks may mask small changes.
- New root growth will also add to the dilution of the Oe/Oa and mineral horizons in the absence of more  $^{14}\text{C}$  inputs.

# Inceptisol: Change in $^{14}\text{C}$ from Litter Additions

$^{14}\text{C}$ - Enrichment (HR)

$^{14}\text{C}$ -Dilution (PR)



Horizon	Year = 0		Year = 3 or 2
Oi>1Y	195 ± 7	↗↗	736 ± 14
Oe/Oa	197 ± 6	↗	299 ± 20
0-15	117 ± 11	NS	146 ± 6
15-30	96 ± 17	NS	105 ± 8
30-60	74 ± 11	NS	24 ± 28
60-90	34 ± 2	NS	-14 ± 31

Year = 0		Year = 3 or 2
503 ± 38	↘↘	286 ± 19
361 ± 40	↘	324 ± 19
148 ± 16	NS	143 ± 14
100 ± 24	NS	97 ± 14
27 ± 20	NS	12 ± 18
82 ± 19	NS	-37 ± 39

- **Patterns of change for the Inceptisol soils are similar to those observed for the Ultisols.**

# Results Through Year-3

- After one year of enriched (1005‰) or background (221‰) litter additions (2002 data points), recognizable litter greater than 1-year of age ( $O_i > 1Y$ ) showed the expected patterns of enrichment or dilution. There was little evidence of new C movement below the  $O_i$  horizon after one year.
- Surprisingly, after the second and third year of enriched litter additions (910‰ and 993 ‰, respectively) the  $O_i$   $^{14}C$ -signatures did not continue to increase for the 'enriched' treatment plots.
- $^{14}C$ -signatures consistent with enrichment or dilution patterns are just beginning to develop within the  $O_e/O_a$  horizon.
- Reasons for limited accumulation of  $^{14}C$  with enriched litter additions:
  - Not sampling error or wind disturbance
  - Differential decomposition of individual litter cohorts in one year vs. another
  - Differential labeling of soluble (or labile) and bulk litter fractions
  - Preferential removal of newly added material by macrobiota?