Root ^{14}C, Root Modeling

Julia B. Gaudinski, Margaret Torn, Bill Riley, Dev Joslin

EBIS WORKSHOP
LLNL
January 20, 2005

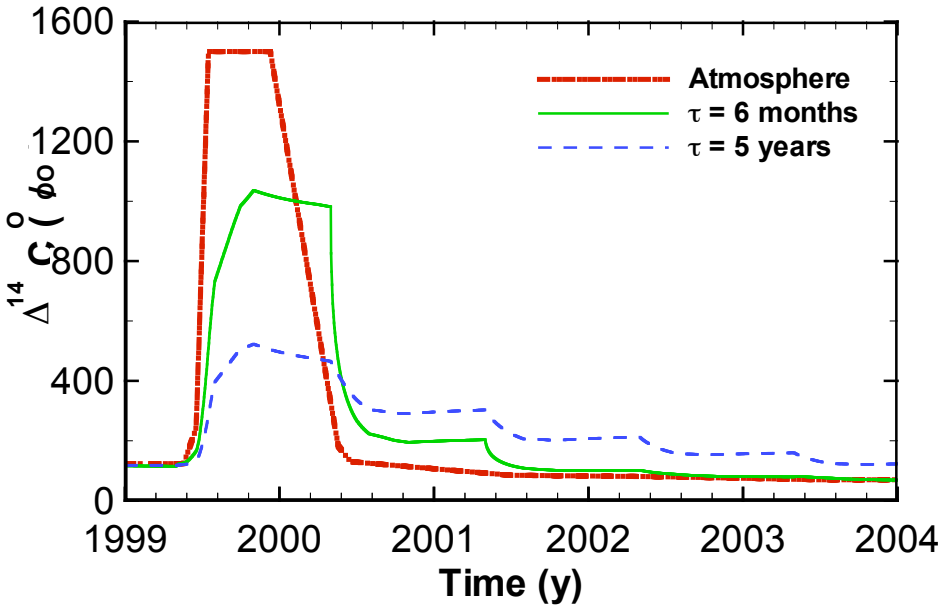
2. Root Lifetimes (qualitative)

Unearthing live fine root turnover times in a hardwood forest: the roles of root diameter, soil depth, and root branching order

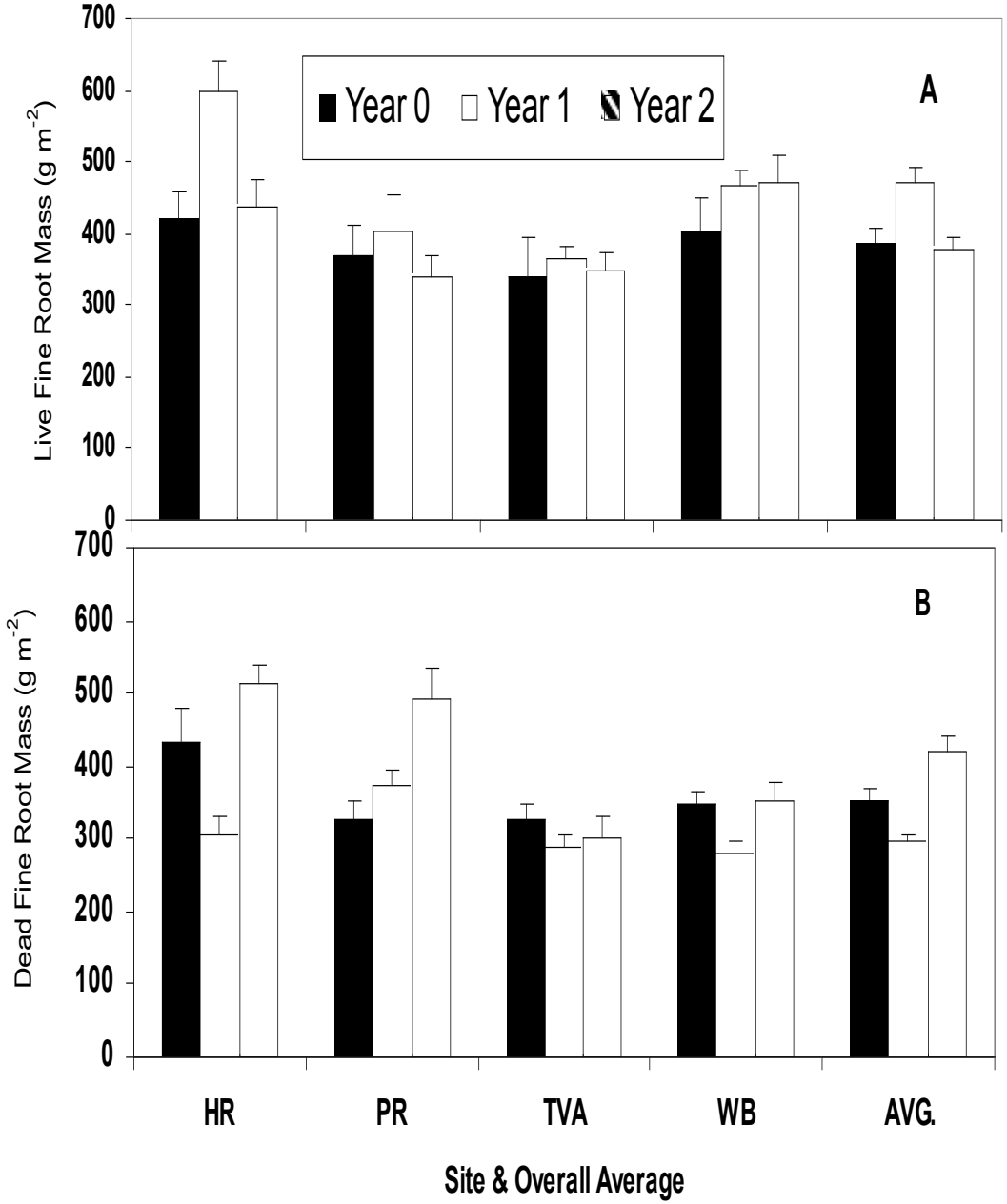
J. D. JOSLIN[1,*], J.B. GAUDINSKI[2], M.S. TORN[3], W.J. RILEY[3] and P.J. HANSON[4]

Submitted: *Biogeochemistry* processing comments now

Use the rate of ^{14}C incorporation and dilution over time as qualitative index to fine root TT



Mean live root mass and dead root mass



Live and dead root mass ~ equivalent

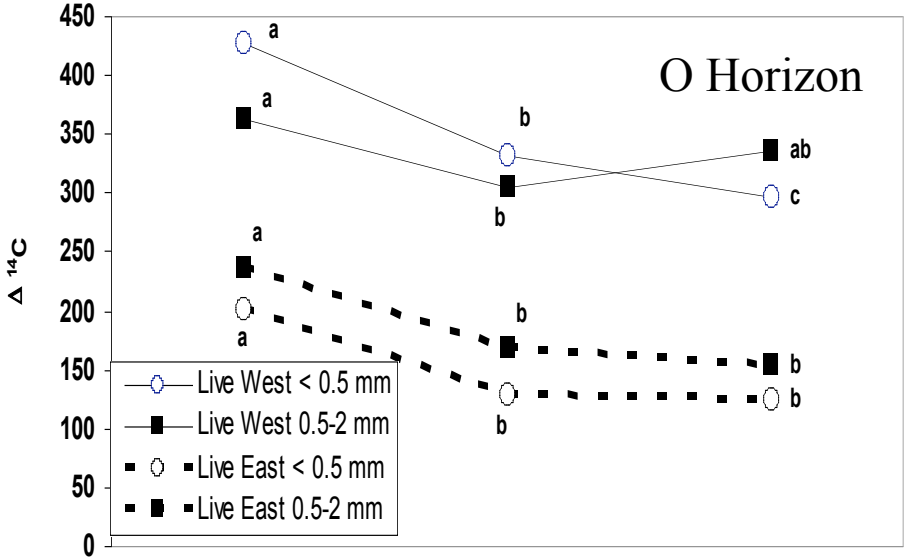
(live = 411 ± 36, dead = 356 ± 44)

Annual variation in live and dead root mass minimal

Near steady state

Suggest decay rates ≅ TT of live roots

Δ ^{14}C signature of live roots segregated by size class



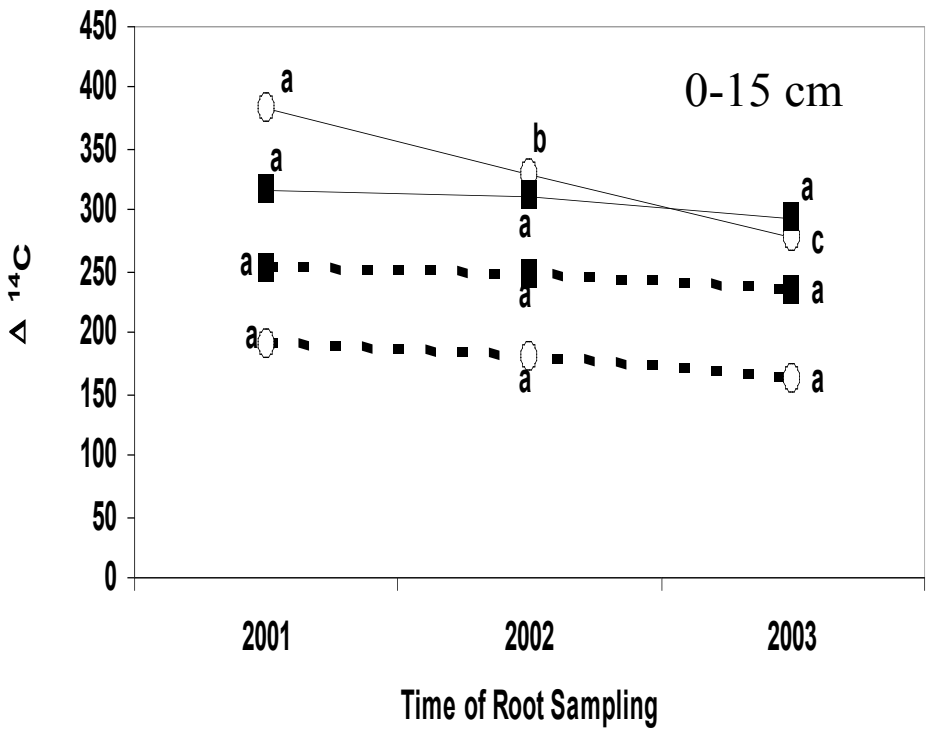
All roots show continued ^{14}C elevation

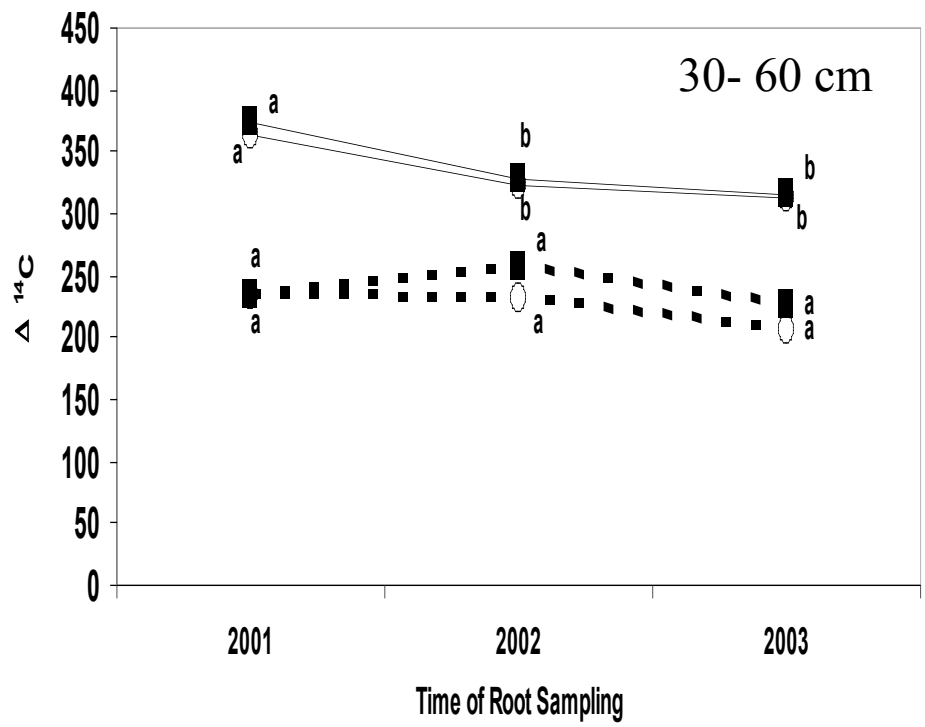
< 0.5 mm tended to have faster TT

- $\Delta^{14}C$ declined faster
- Declines more often statistically significant

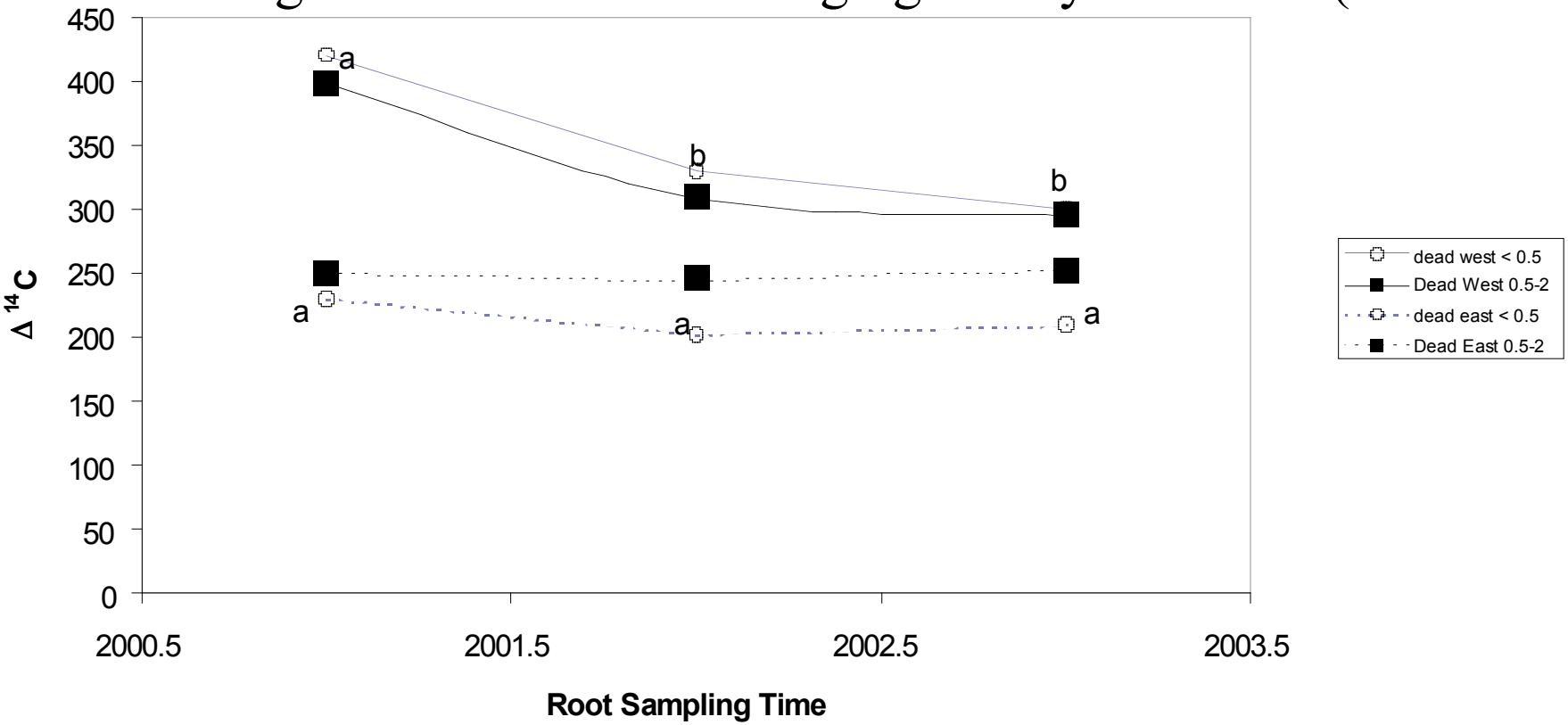
Live root TT order of years

Diameter weak indicator of TT





Δ ^{14}C signature of dead roots segregated by size class (15 cm only)



Within 6-18 months dead roots elevated by 1.5 – 3.2 to new roots.

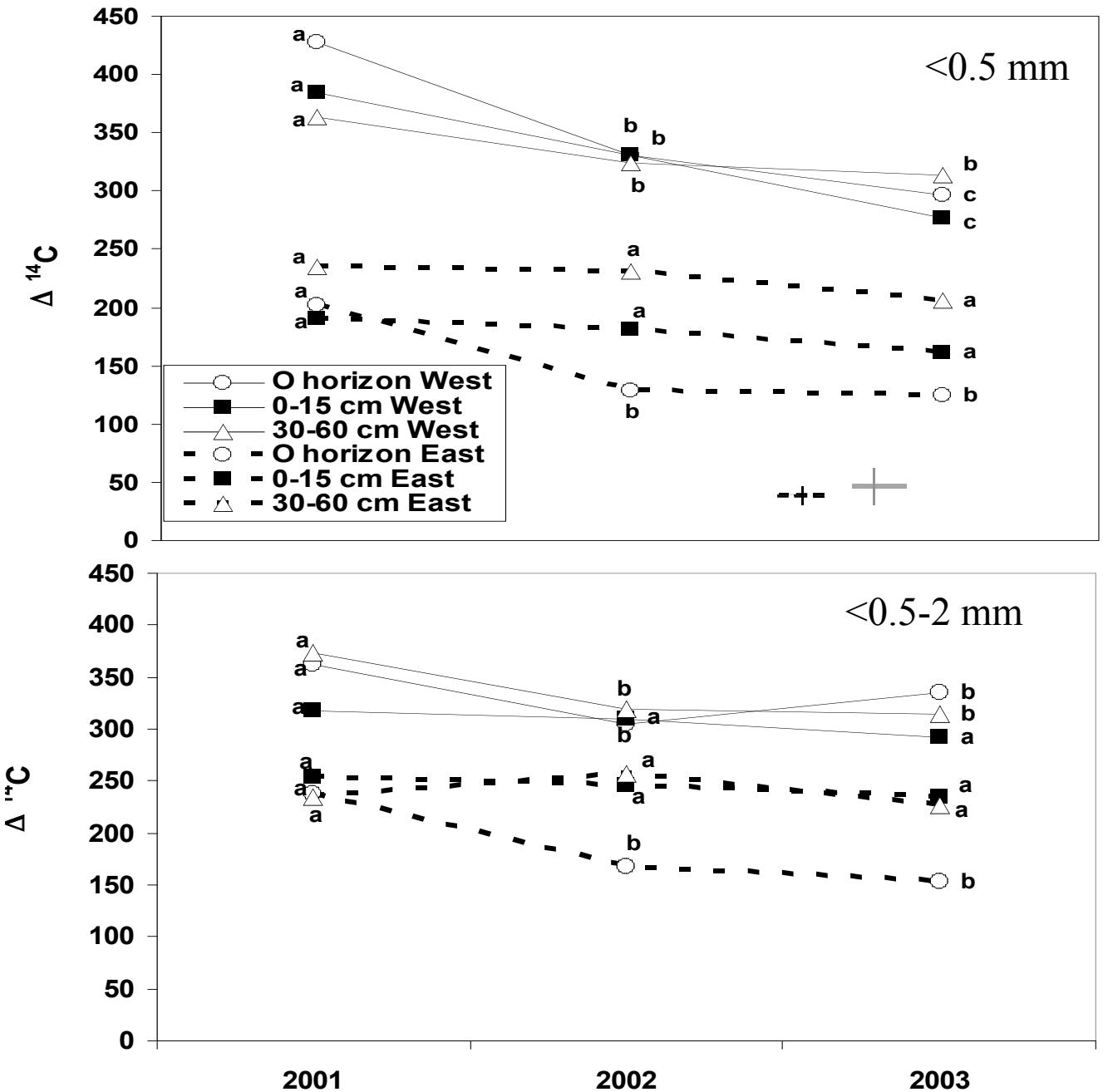
Must be fast cycling component

Implies live roots have two pools (months, years)

Diameter class separation did not isolate fast and slow

Traditional one pool approach →411 g C m^{-2}/224 g C m^{-2} y^{-1} = 1.8 yrs

Δ ^{14}C signature of live roots segregated by soil depth interval

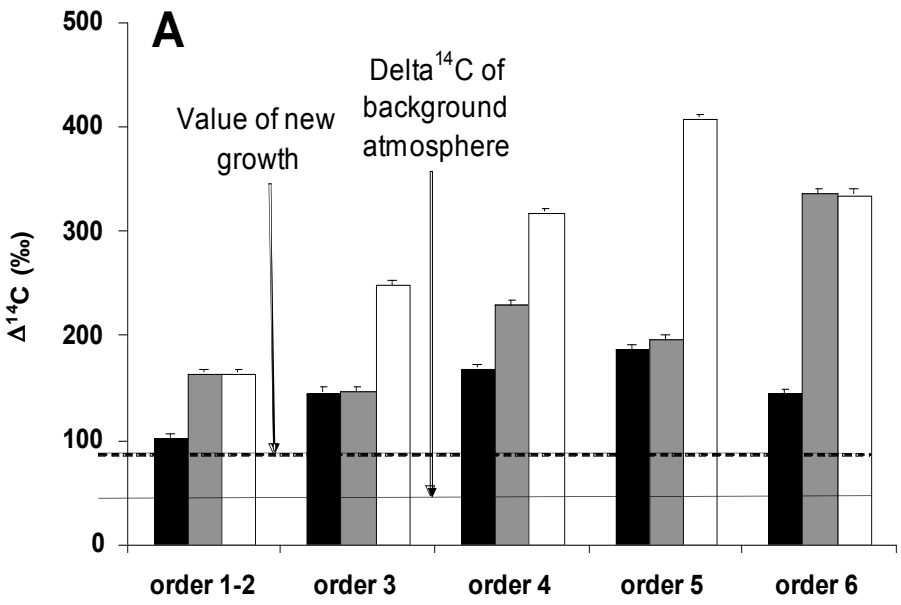


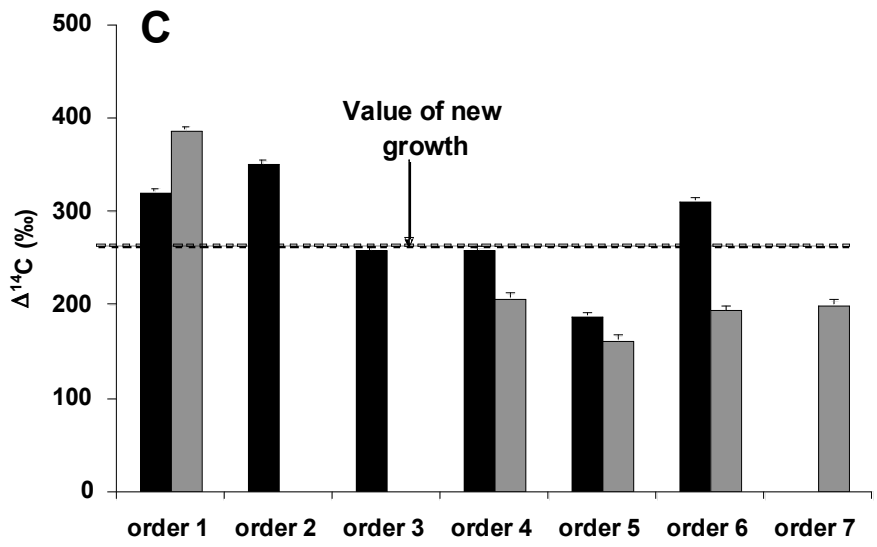
TT declines by horizon:

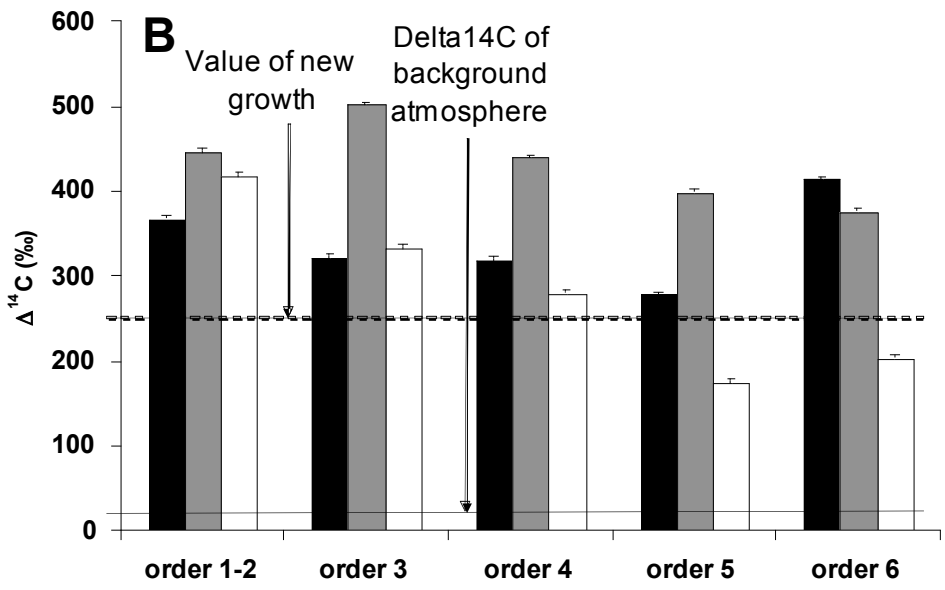
0 horizon = 80 ± 22‰
15 cm = 45 ± 21‰
60 cm = 36 ± 12‰

TT shortest in the O horizon and increases with depth

$\Delta^{14}C$ values of living roots sampled in May 2002 by branch order





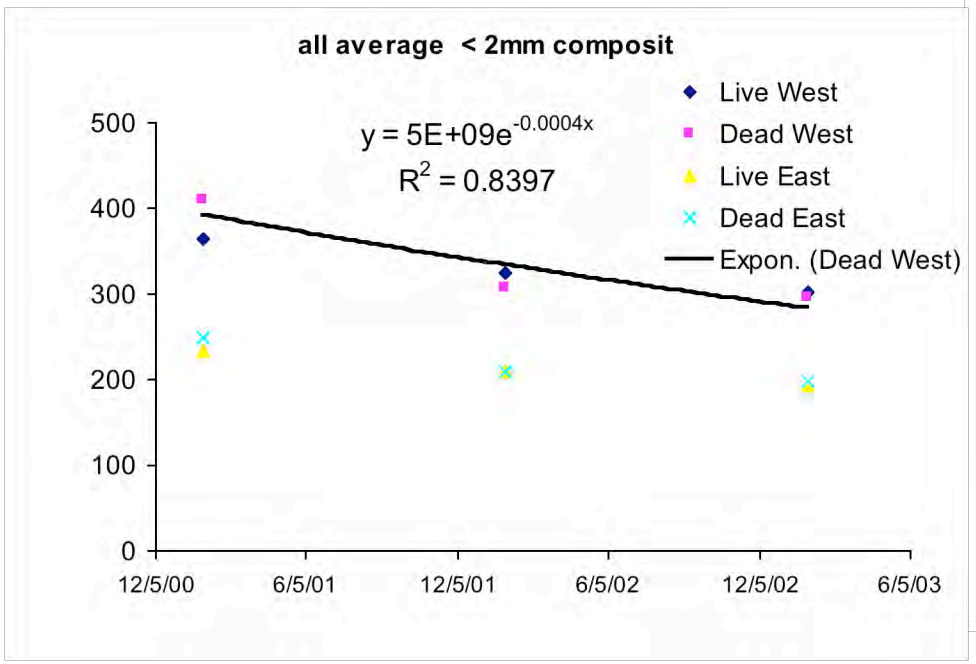


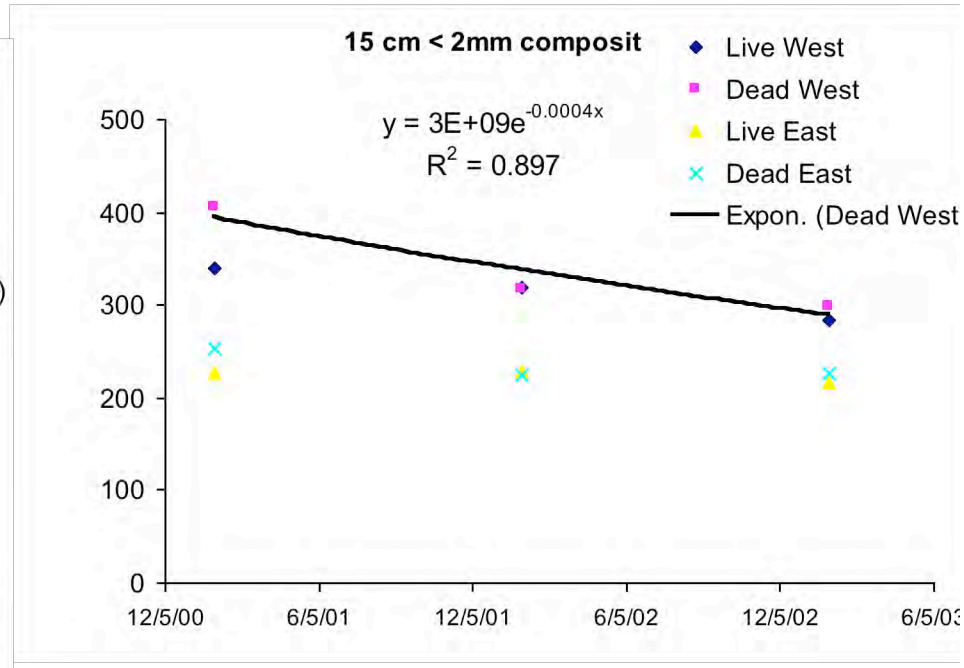
Branch order related to TT

Patterns across sites inconsistent

Interpretation too complicated to draw conclusions

Calculation of TT with Exponential fit (For Paul)





Using equation (Trumbore et al. 2002)

$N_1 = N_0 e^{-T/tt}$

tt = 7-9 years

Assumes roots act as one pool (BAD!)

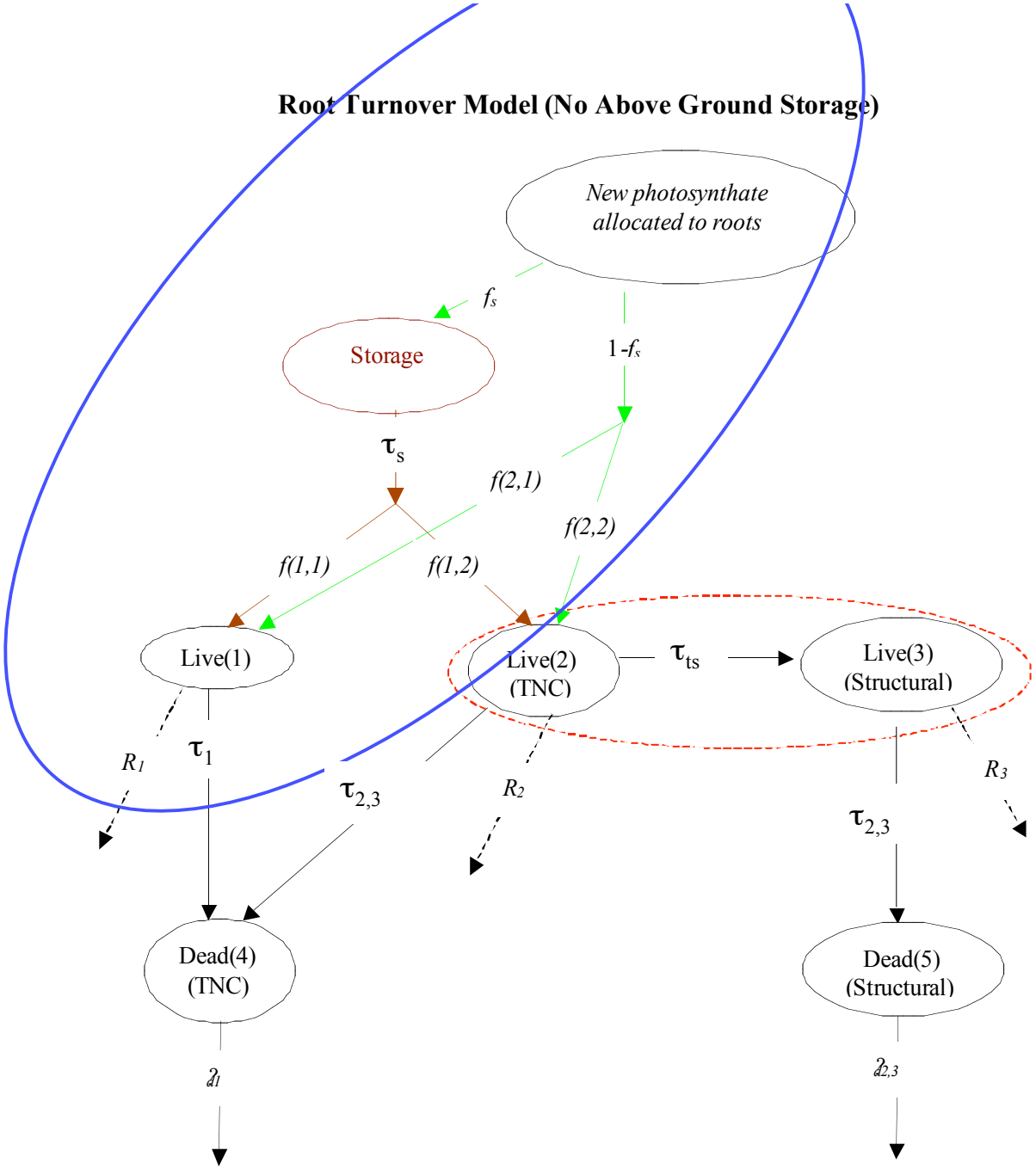
3. Modeling Results to Date: Storage

Bill?? Want to do this?? Does not have to just be storage??

Questions:

What is the age of C in the storage pool?

How much of new root growth is from stored C?

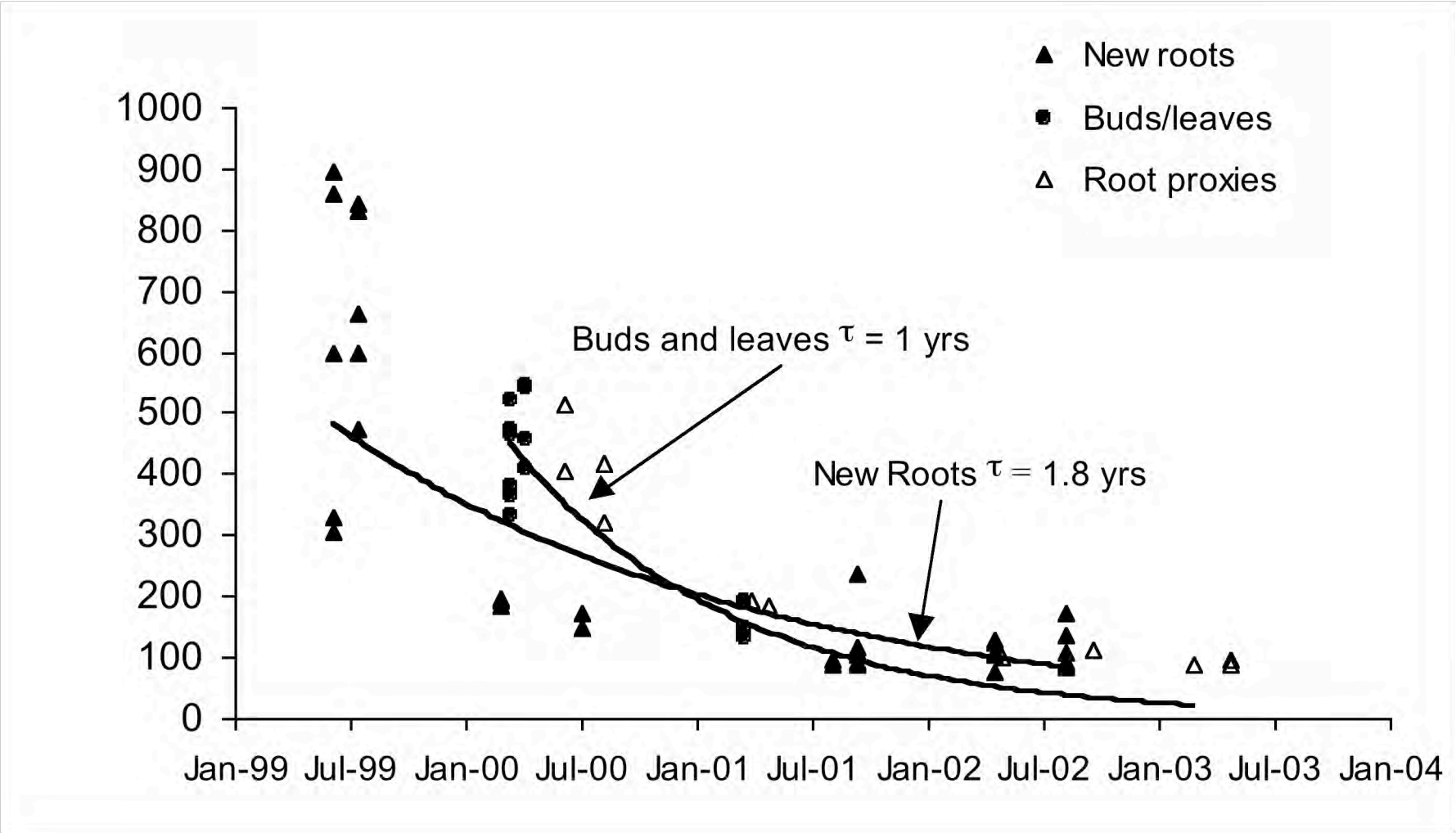


Using Chi squared analysis with new root data we constrain: τ_s, F_s and τ_1

East ORR only

Biomass not constrained

Bills figs for chi squared

Bills figs for chi squared

Comparison with Sue's bud/leaf data