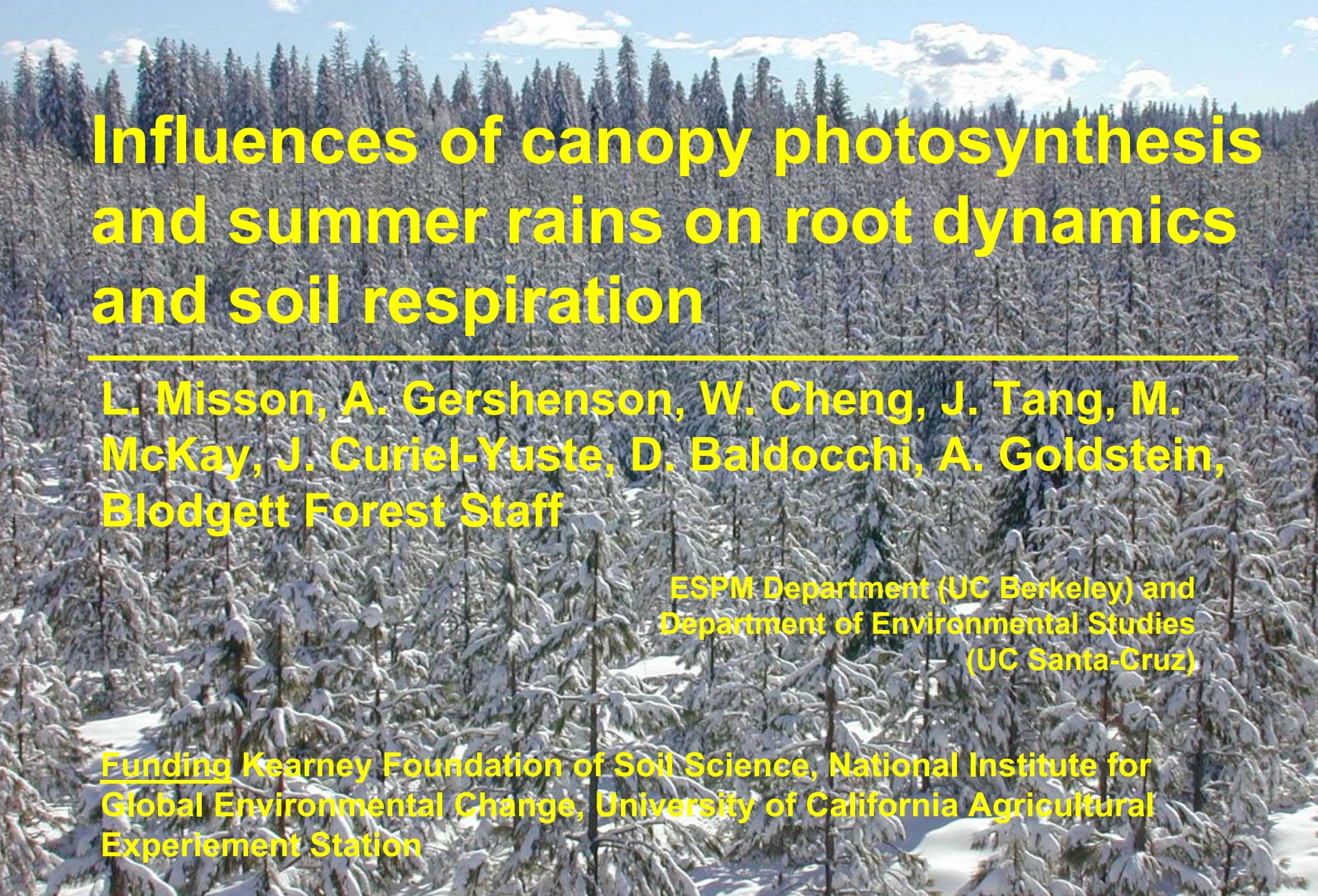


Influences of canopy photosynthesis and summer rains on root dynamics and soil respiration

L. Misson, A. Gershenson, W. Cheng, J. Tang, M. McKay, J. Curiel-Yuste, D. Baldocchi, A. Goldstein, Blodgett Forest Staff

ESPM Department (UC Berkeley) and
Department of Environmental Studies
(UC Santa-Cruz)

Funding Kearney Foundation of Soil Science, National Institute for Global Environmental Change, University of California Agricultural Experiement Station

First objective : understand controls of fine root dynamics

Hypothesis : fine root development is a high priority and is tightly coupled to canopy photosynthesis and soil water in forest ecosystems of California

Second objective : understand the link between root dynamics and carbon balance of forest ecosystems

Hypothesis : fine roots control soil respiration; this control is most apparent when roots are growing

Kearney Project Team

Goldstein Lab
UC Berkeley

Canopy scale fluxes
Ecophysiology
Soil respiration

Ponderosa pine

Oak/Savana

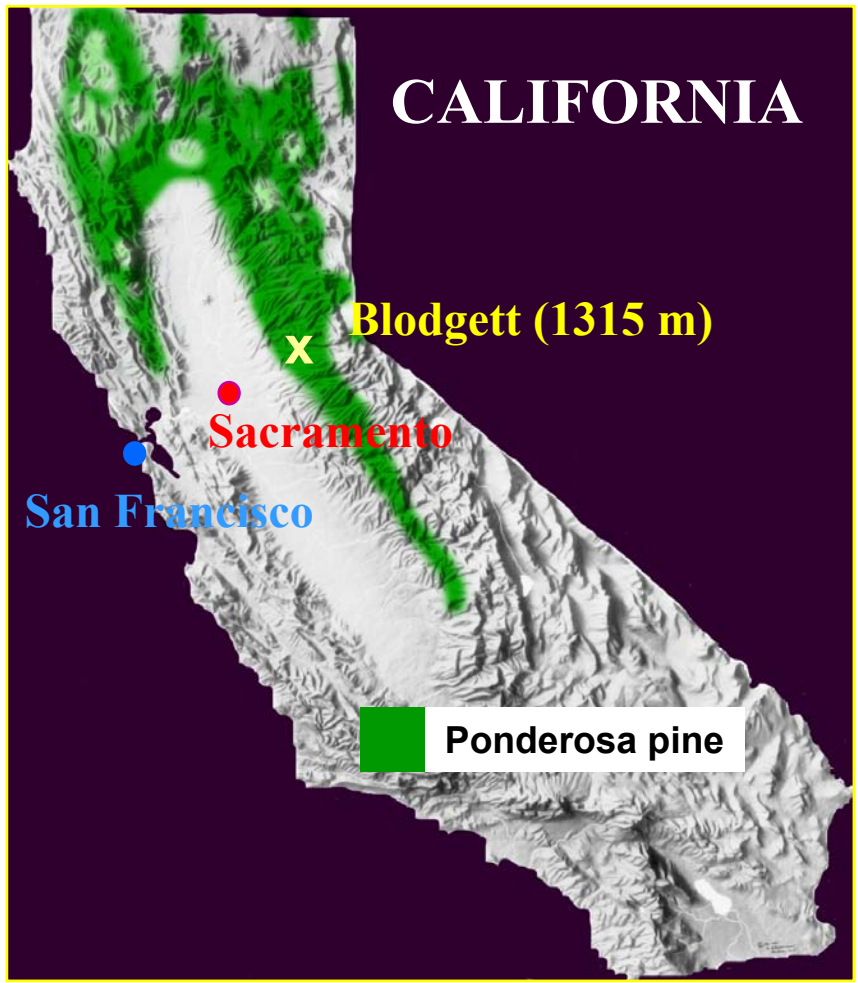
Baldocchi Lab
UC Berkeley

Canopy scale fluxes
Ecophysiology
Soil respiration

Cheng Lab
UC Santa-Cruz

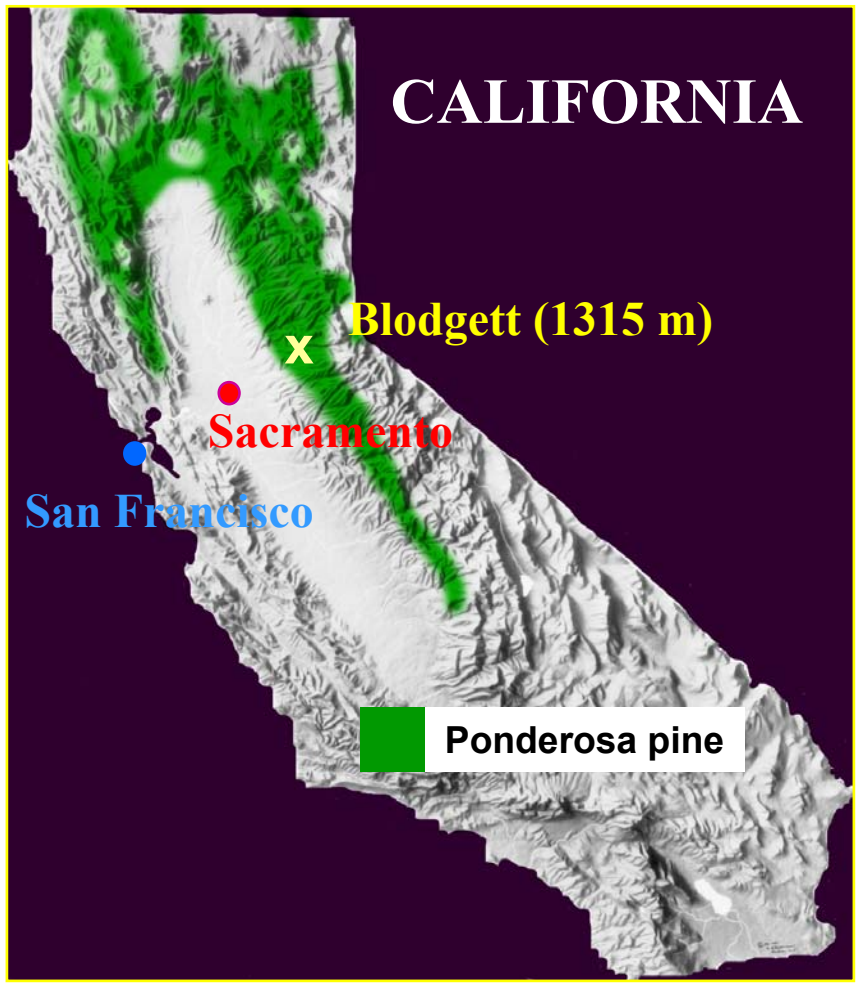
Root and
Belowground C dynamics

Experimental Site, Blodgett, Sierra Nevada



- Planted in 1990
- Semi-Arid climate
- Annual precipitation 1290 mm
- Winter Temp. 0-9°C, Summer 14-27°C
- Ameriflux/Fluxnet

Experimental Site, Blodgett, Sierra Nevada

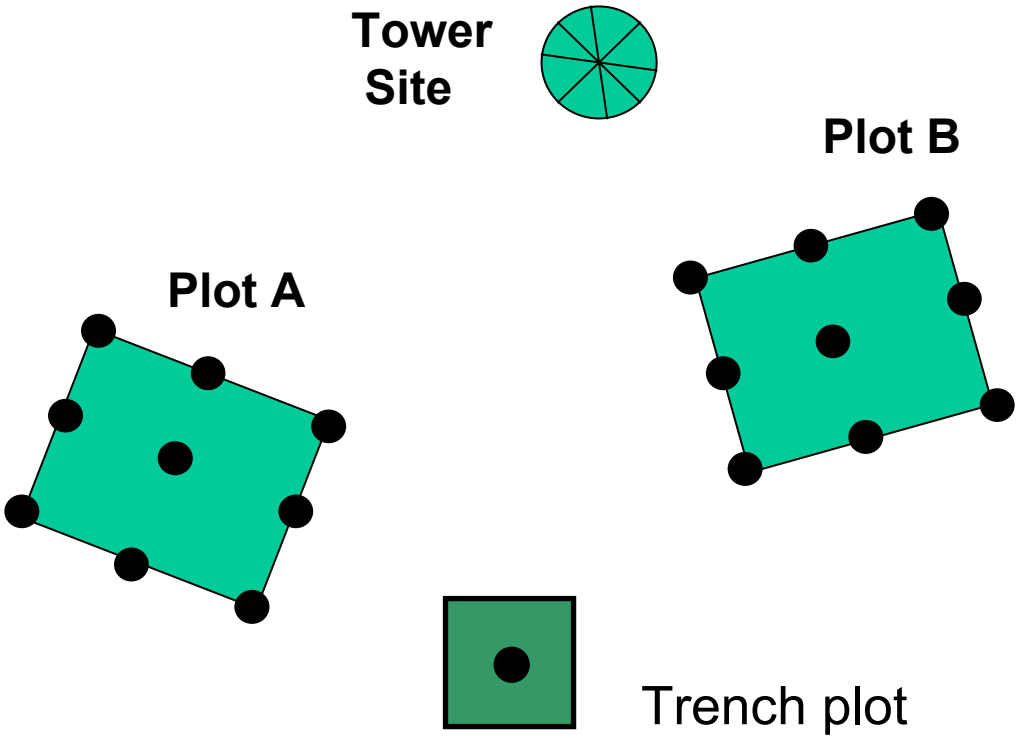


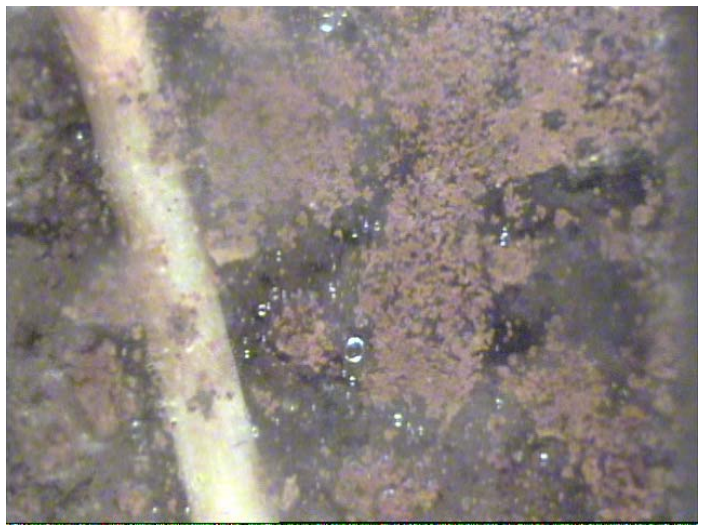
Research since 1997

- Climate and forest management
- Ecophysiology
- O3, CO, VOCs, NOx/NOy and Aerosols

Blodgett

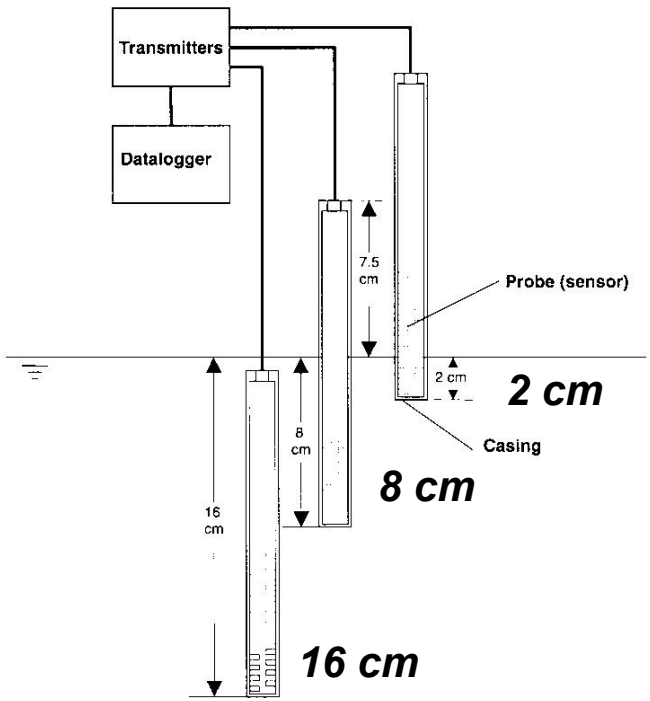
Sampling Design





Minirhizotron image
Alex Gershenson

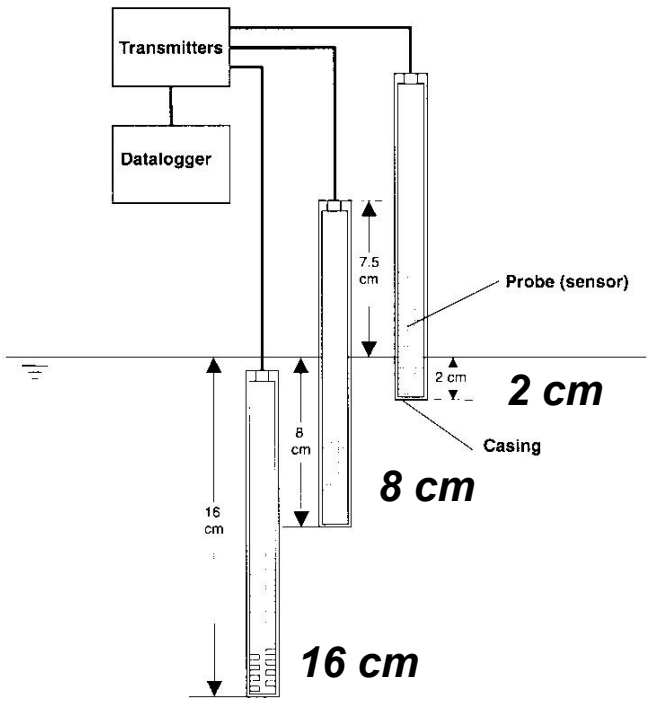
Continuous soil respiration



3 soil CO_2 sensors

Tang et al. AFM 2003,
Tang et al. AFM 2005 sub.

Continuous soil respiration



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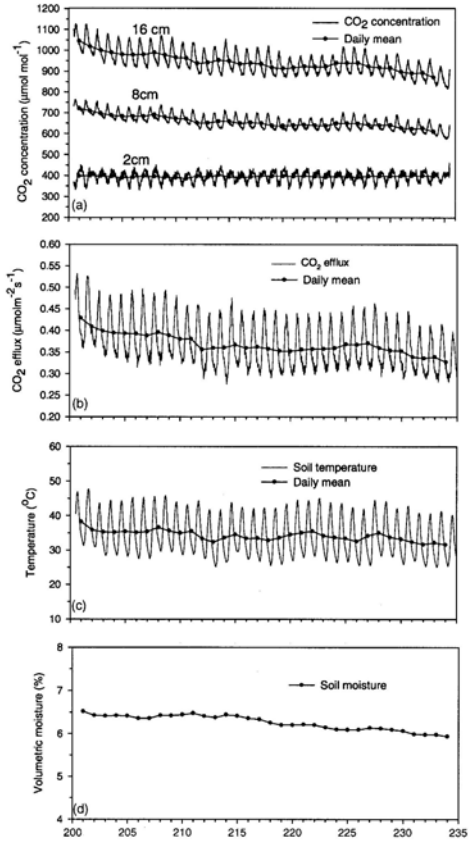


Day

CO_2 concentration

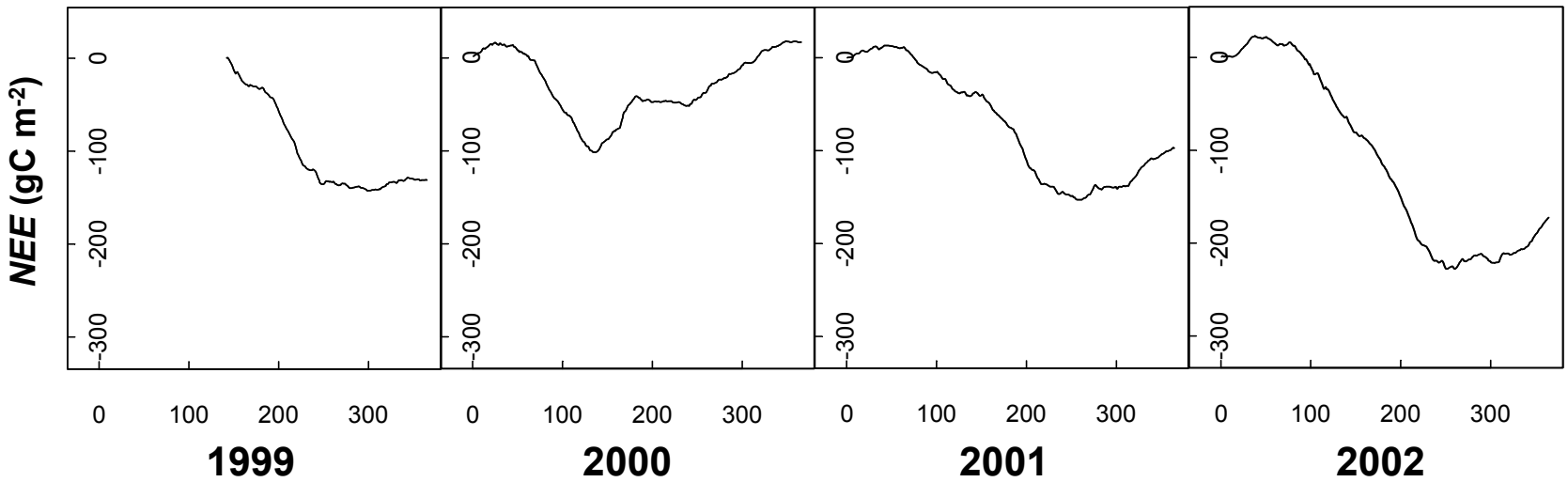
CO_2 efflux

Soil temperature

Soil water content

Interannual variability of CO_2 fluxes

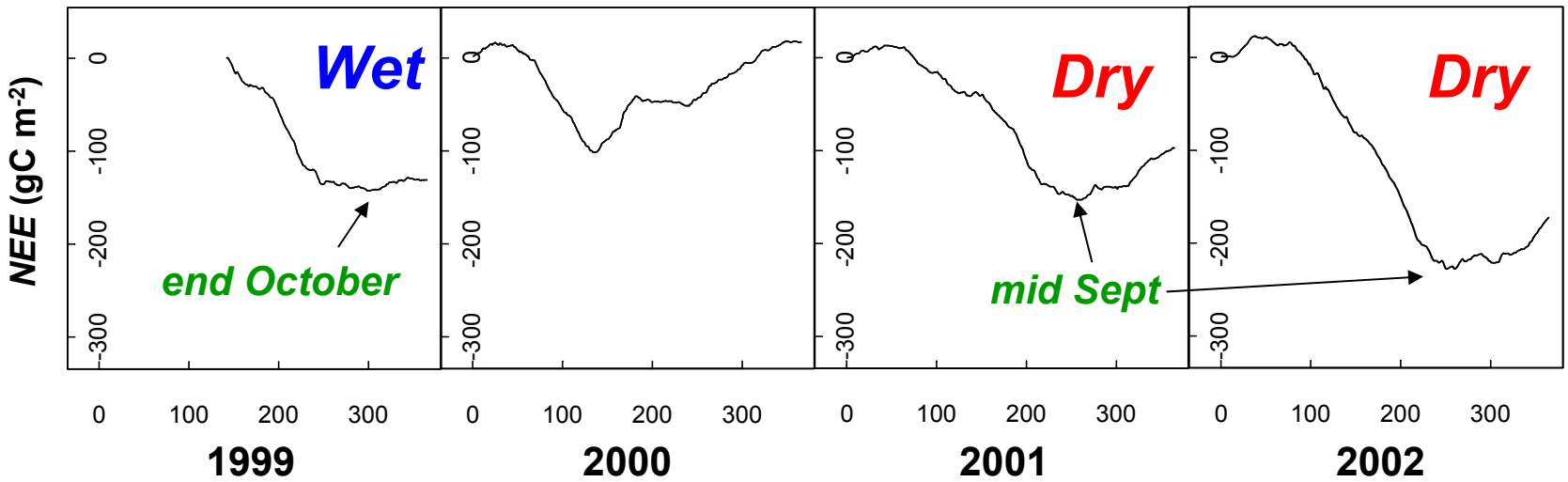
Cumulative NEE (g C m^{-2})
Effect of drought and thinning



Misson et al. AFM 2005

Interannual variability of CO_2 fluxes

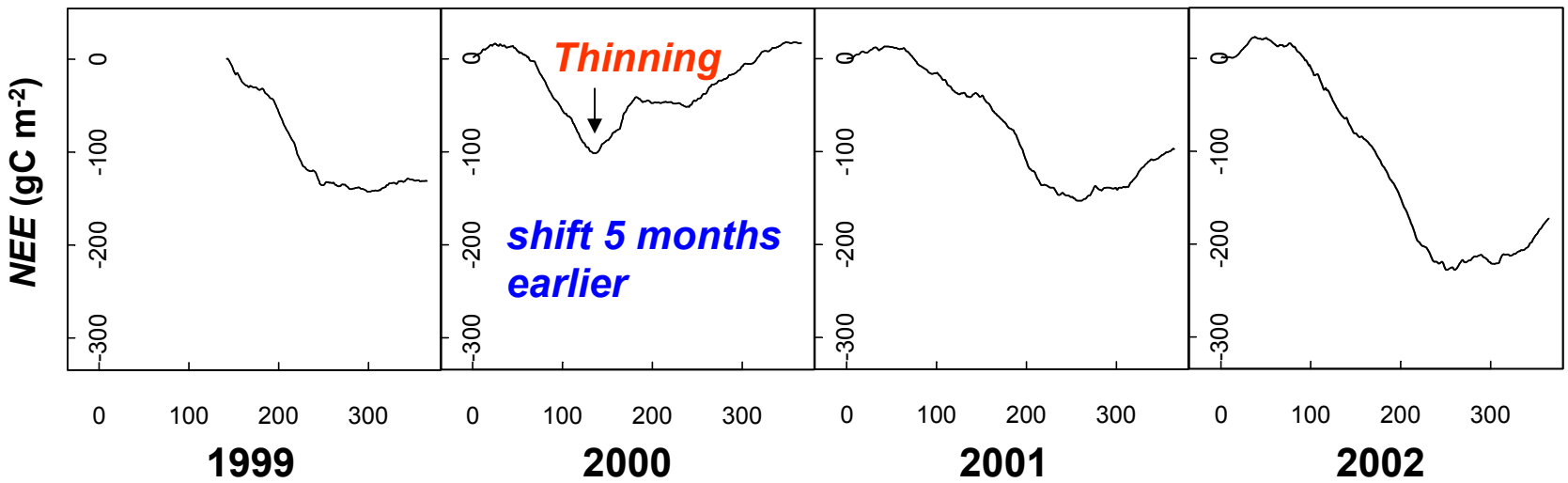
Cumulative NEE (g C m^{-2})
Effect of drought and thinning



Misson et al. AFM 2005

Interannual variability of CO_2 fluxes

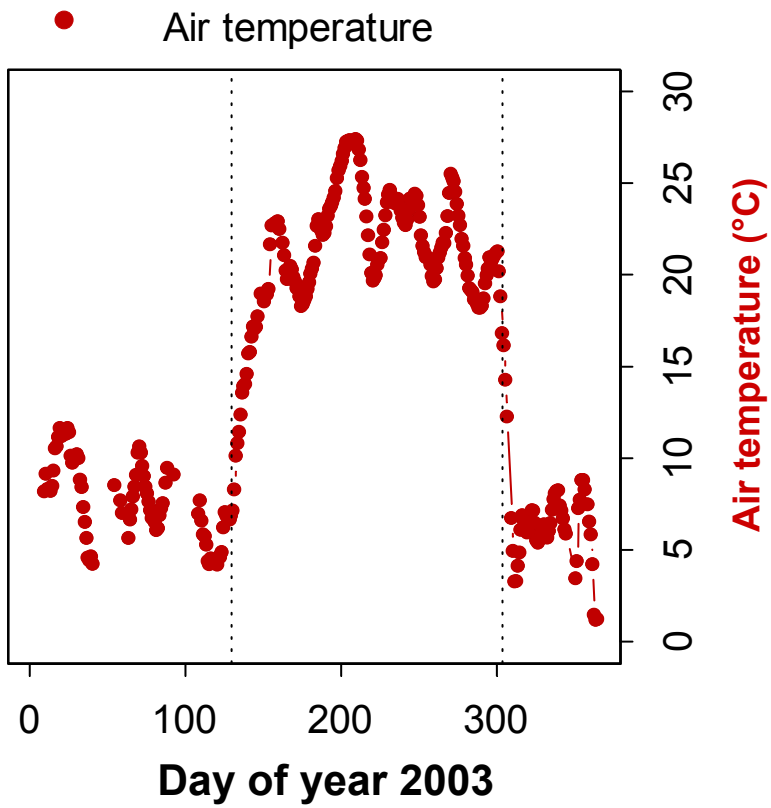
Cumulative NEE (g C m^{-2})
Effect of drought and thinning



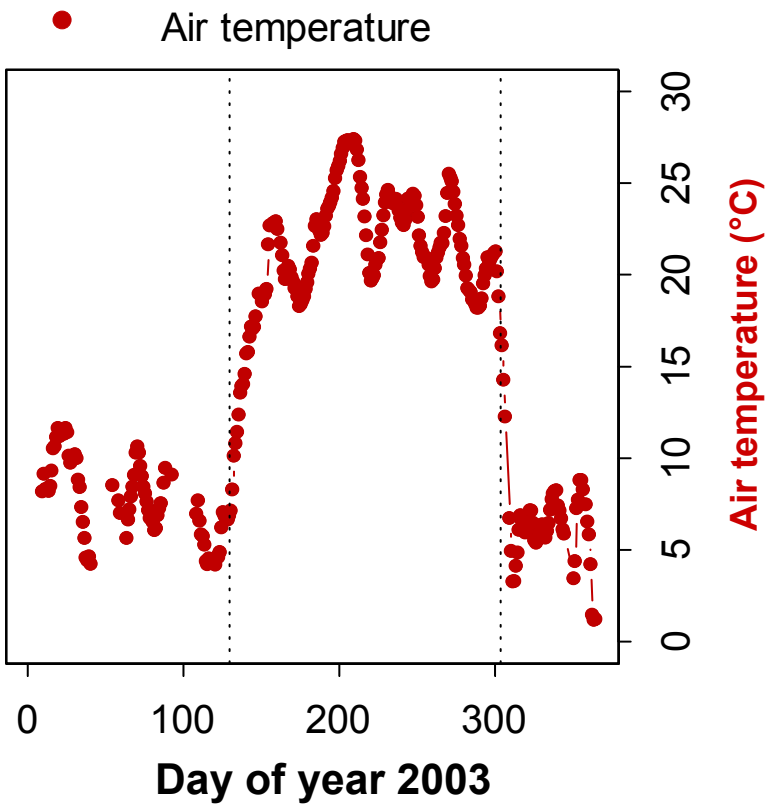
Misson et al. AFM 2005

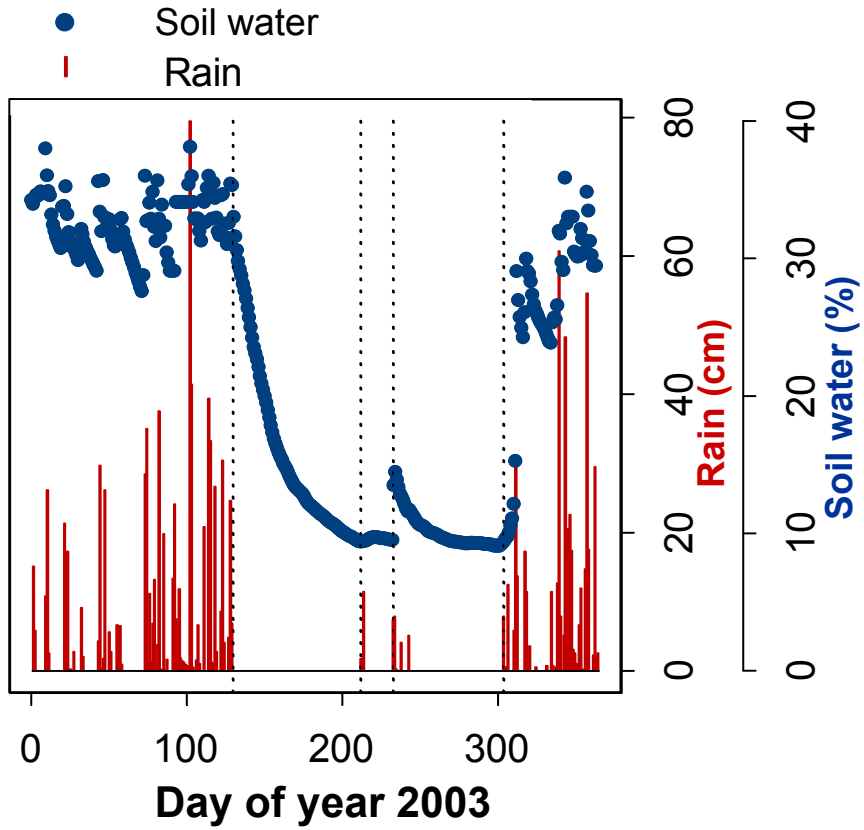
Meteorology, 2003

Misson et al. TP 2005 sub.

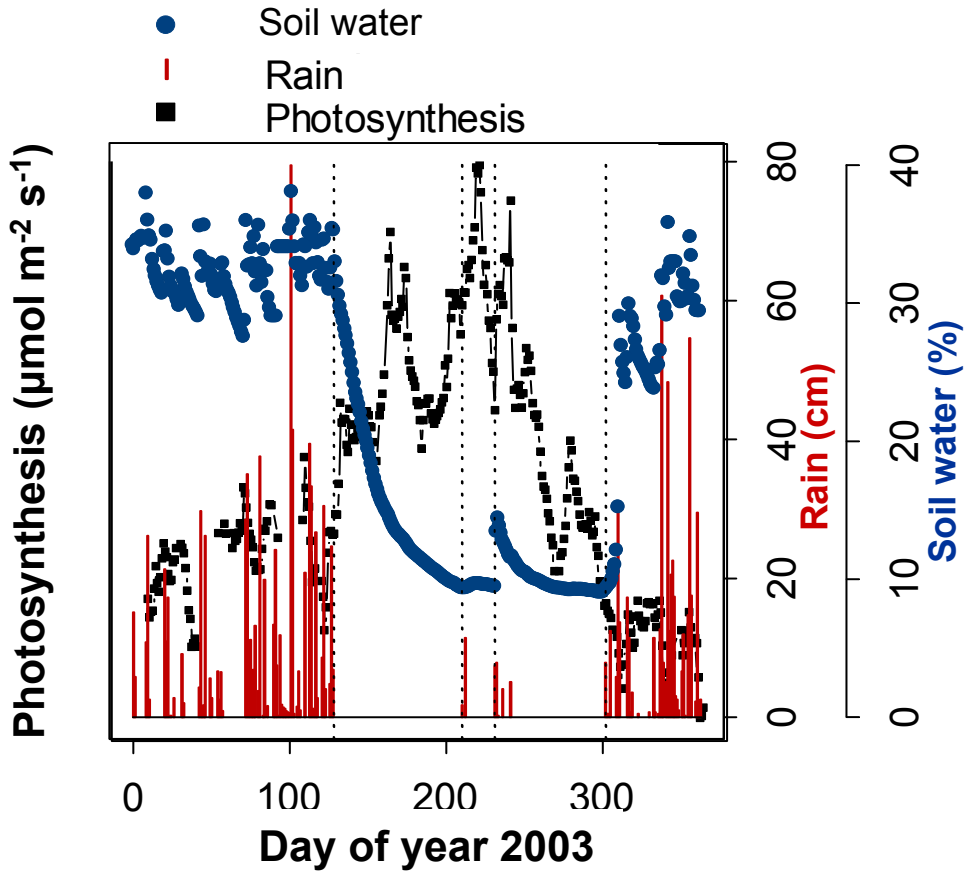


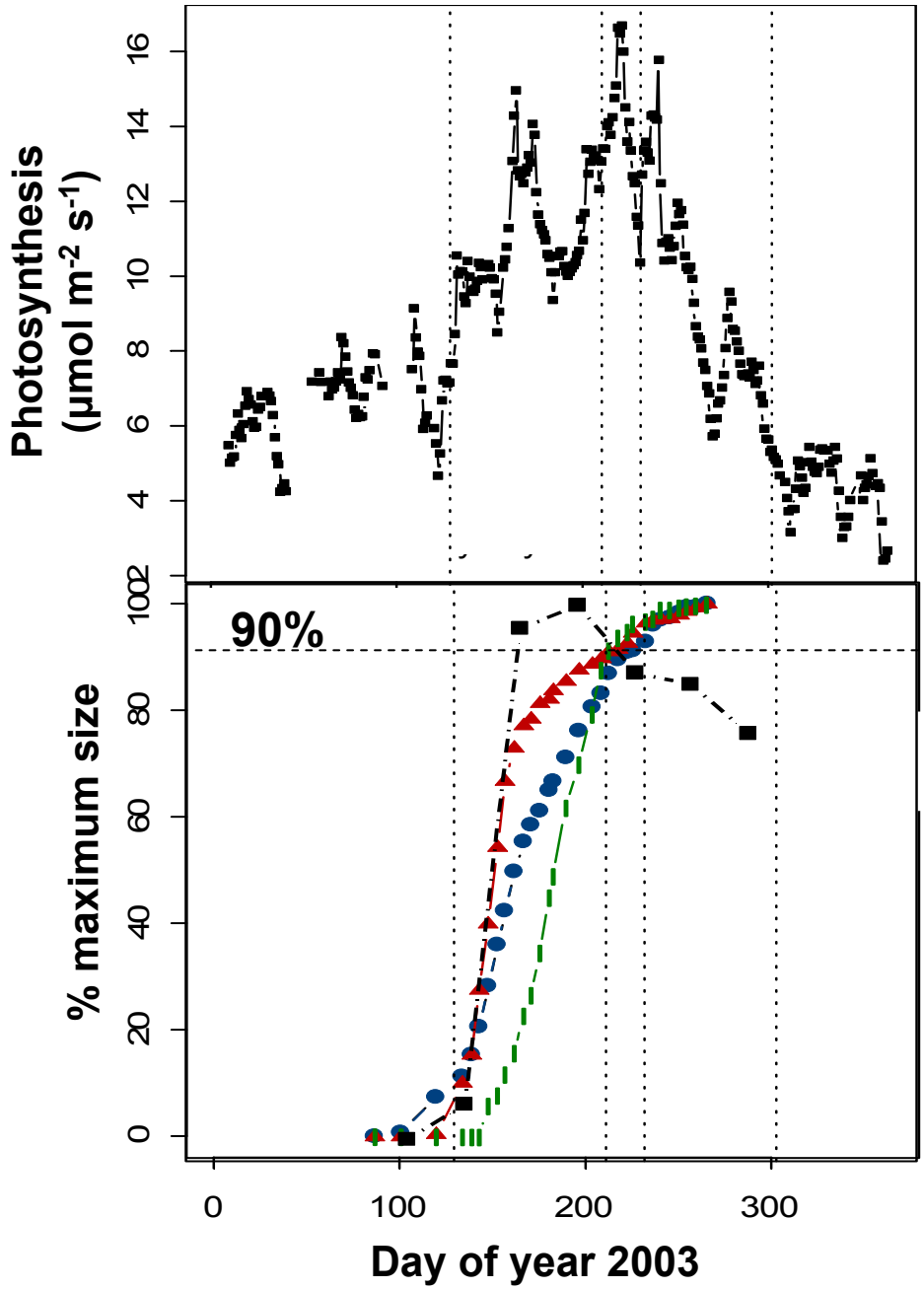
Meteorology, 2003





Canopy photosynthesis

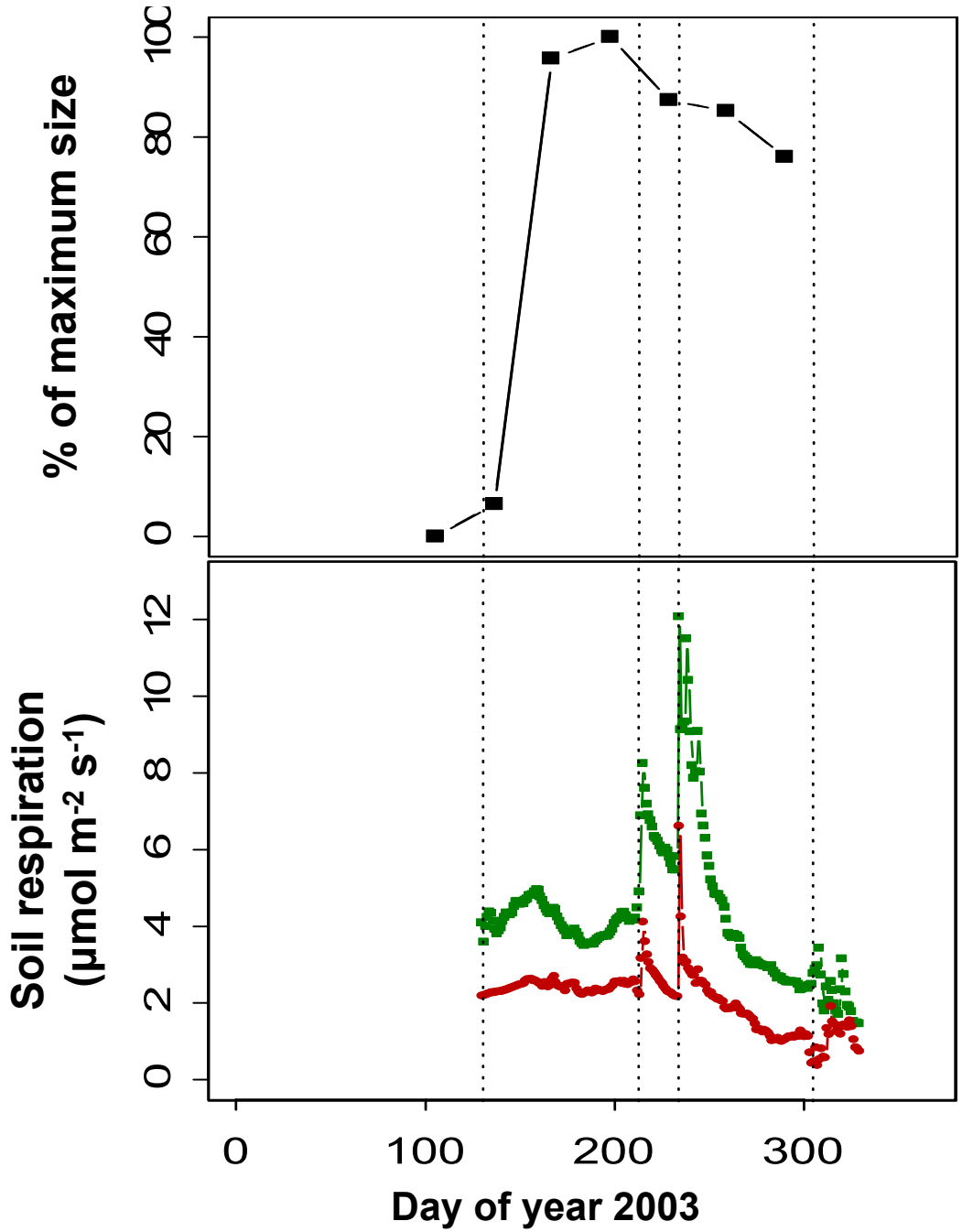




Canopy photosynthesis

Tree growth

- Root
- Shoot
- Stem
- Needle



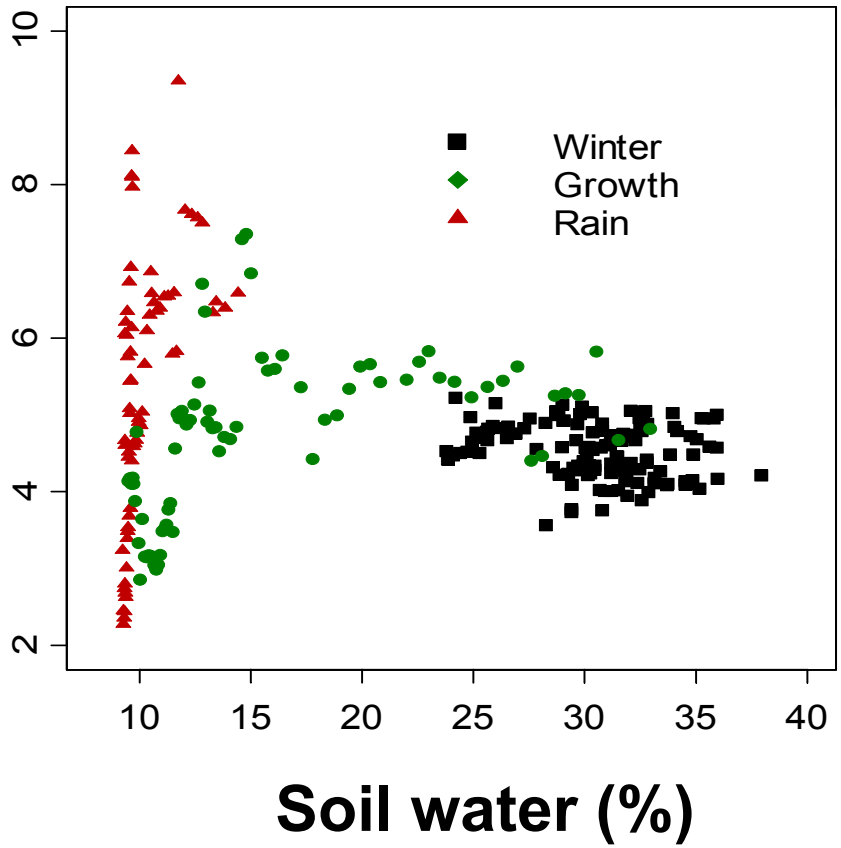
Root growth

Soil respiration

Control
Trench

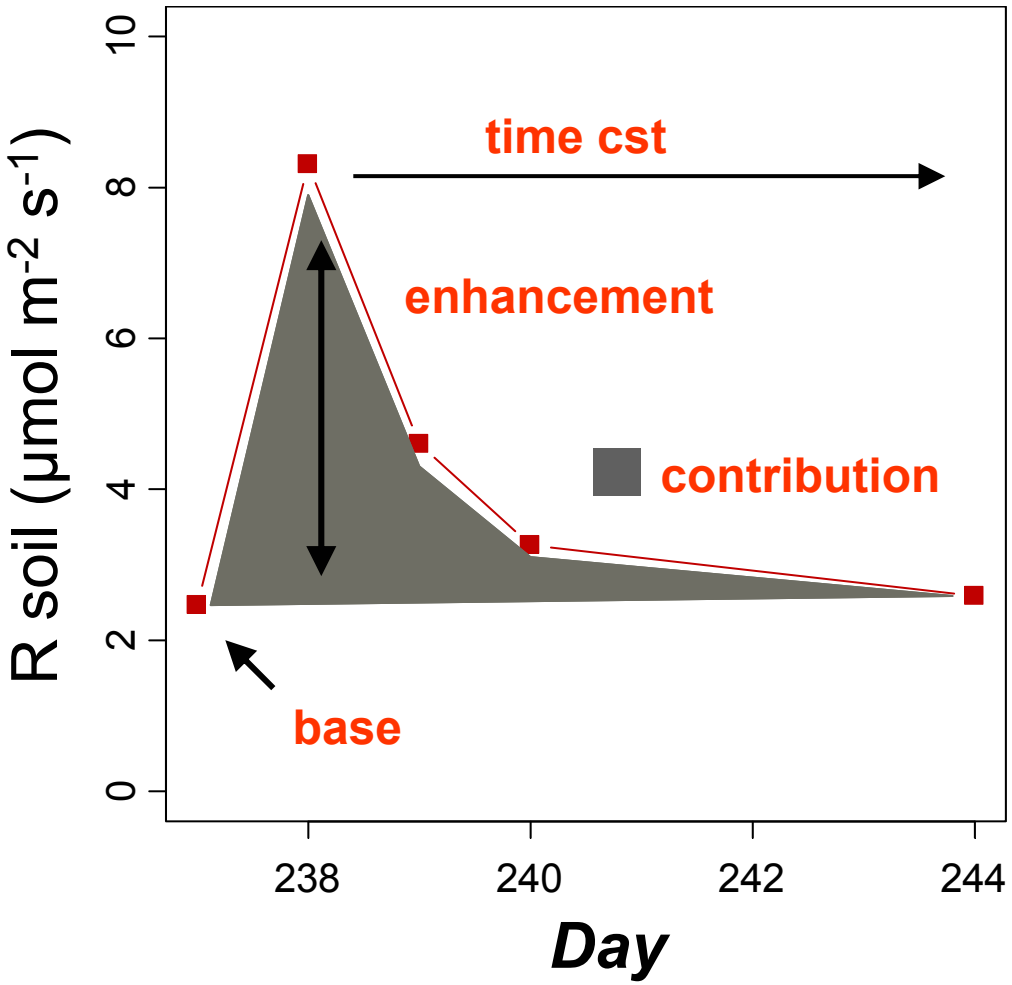
Ecosystem respiration normalized for temperature

(μmol m^{-2} s^{-1})



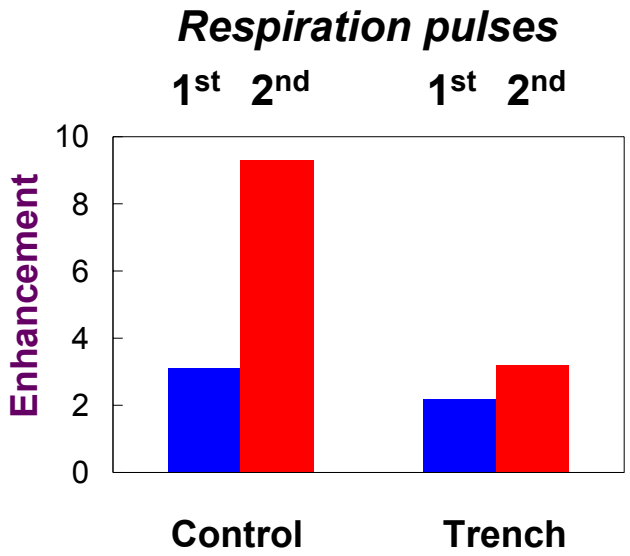
Analysis of respiration pulses

Analysis of respiration pulses

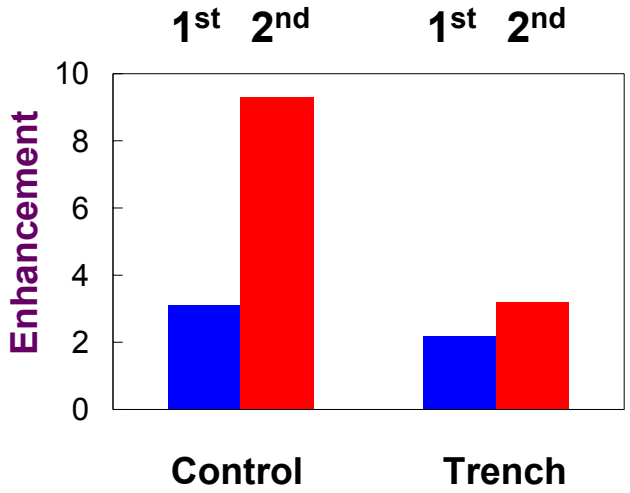


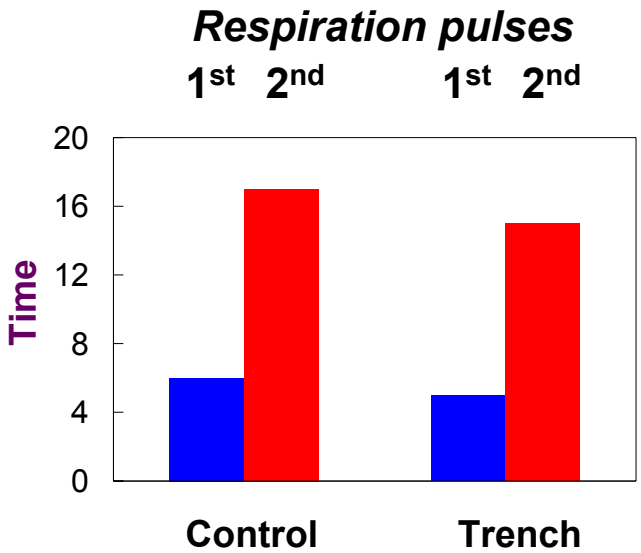
Decay function

$$R_s = b_0 + b_1 e^{-t/\tau}$$

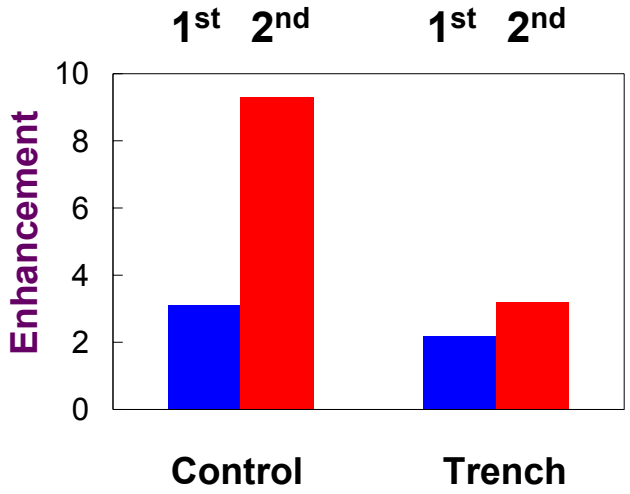


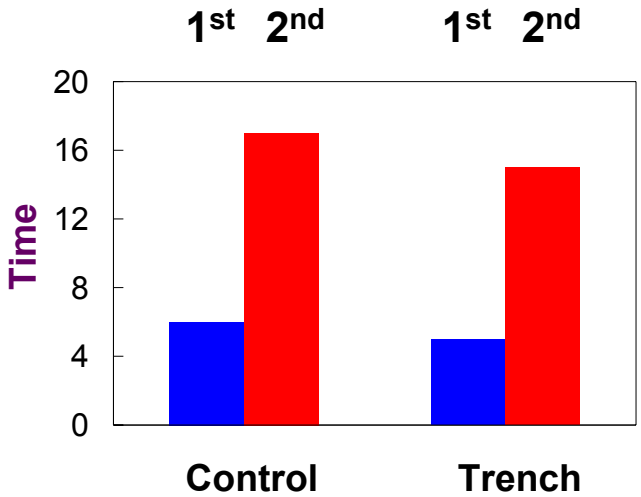
Enhancement (μmol m^{-2} s^{-1})


1st 2nd 1st 2nd
Enhancement
10
8
6
4
2
0
Control
Trench

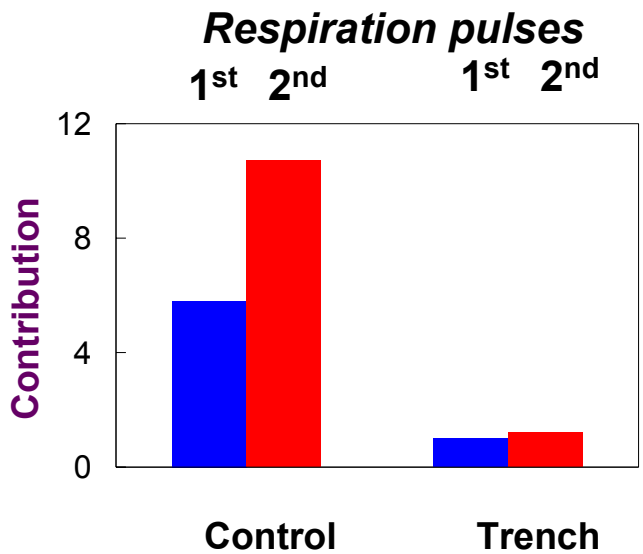

Respiration pulses
1st 2nd 1st 2nd
Time
20
16
12
8
4
0
Control
Trench

Time cst **(day)**





Contribution (%) to seasonal soil respiration



Conclusion

First Hypothesis: fine roots is a high priority and is tightly coupled to canopy photosynthesis and soil water

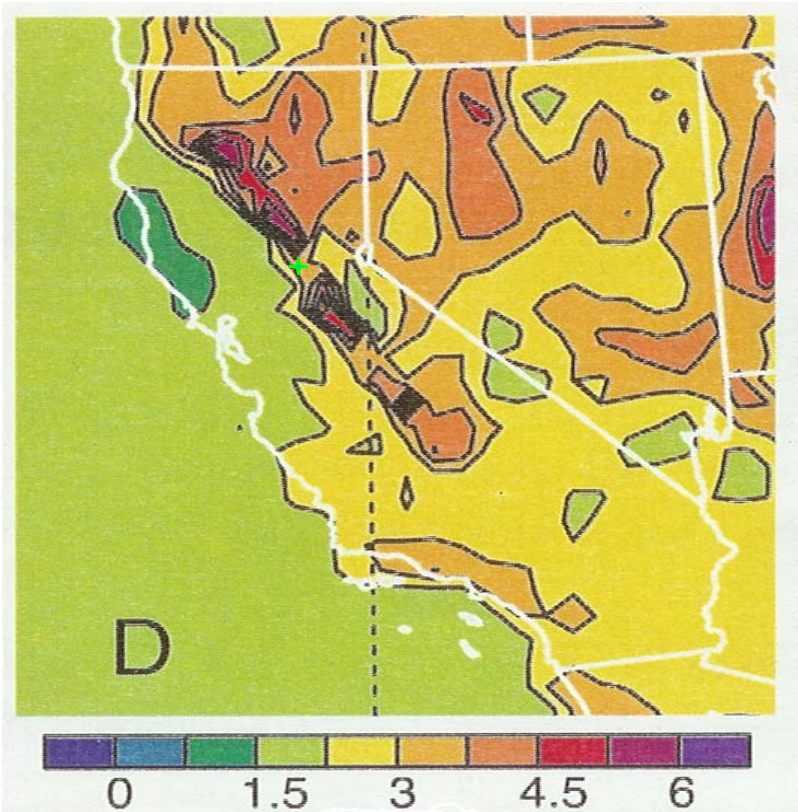
Yes, but only during the first part of the vegetation period. There is a decoupling during the second part that might involve non-structural carbohydrate dynamics.

Second Hypothesis: roots control soil respiration; this control is most apparent when roots are growing

Yes, growth influence soil respiration. However, the influence of roots was moslty indirect through their contribution on heterotrophic respiration during summer rains.

Predicted Climate Change

Changes in April temperatures, 2020



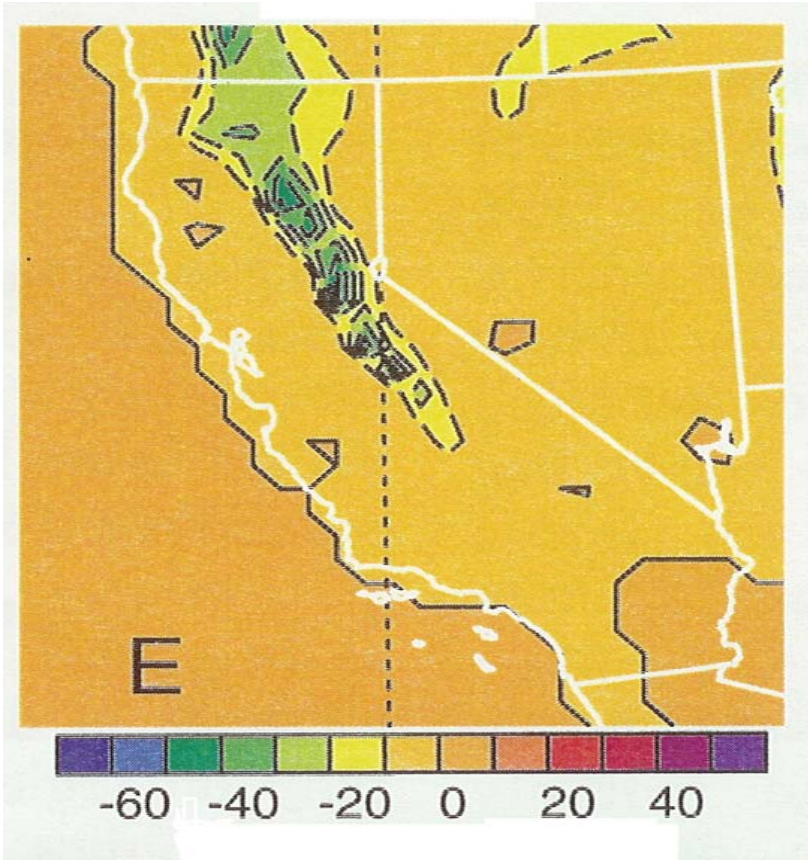
Degrees C º

Warmer in Spring

Adapted from Snyder et al., 2002

Predicted Climate Change

Changes in snow cover, 2020



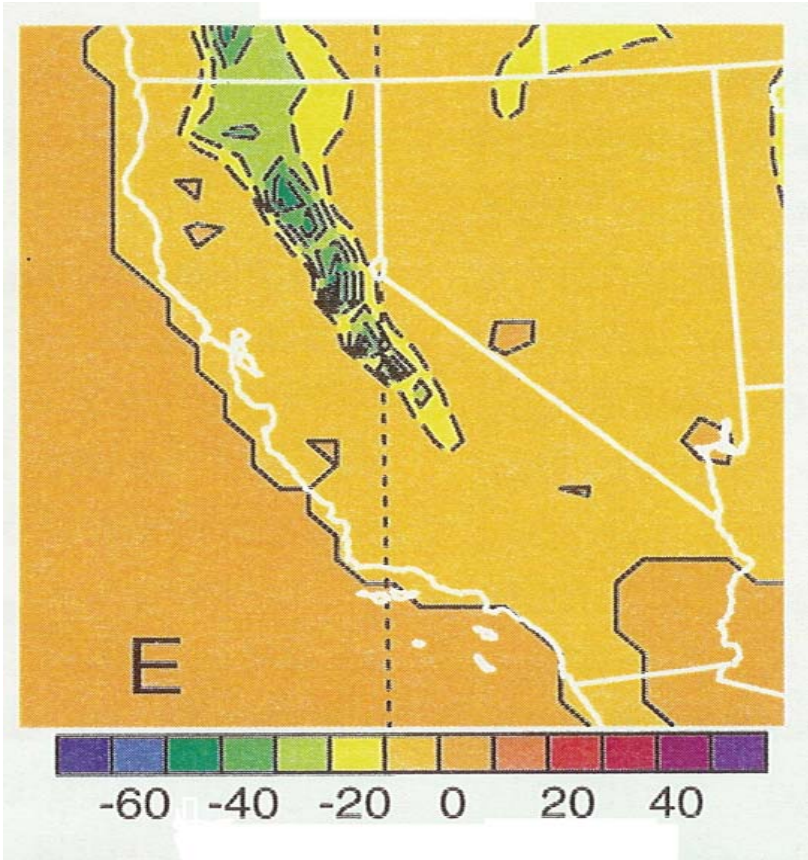
cm water equivalent

Dryer in Spring and Summer

Adapted from Snyder et al., 2002

Predicted Climate Change

Changes in snow cover, 2020



cm water equivalent

Dryer in Spring and Summer

Photosynthesis, tree growth, respiration, and C sequestartion

Adapted from Snyder et al., 2002

Ongoing work 2004-2005

- *Canopy flux, soil respiration, tree growth, minirhizotron at both sites*
  - *Rain pulse experiments at both sites in 2004*
    - *NSC dynamics at Blodgett in 2005*
      - *Modeling in 2005*