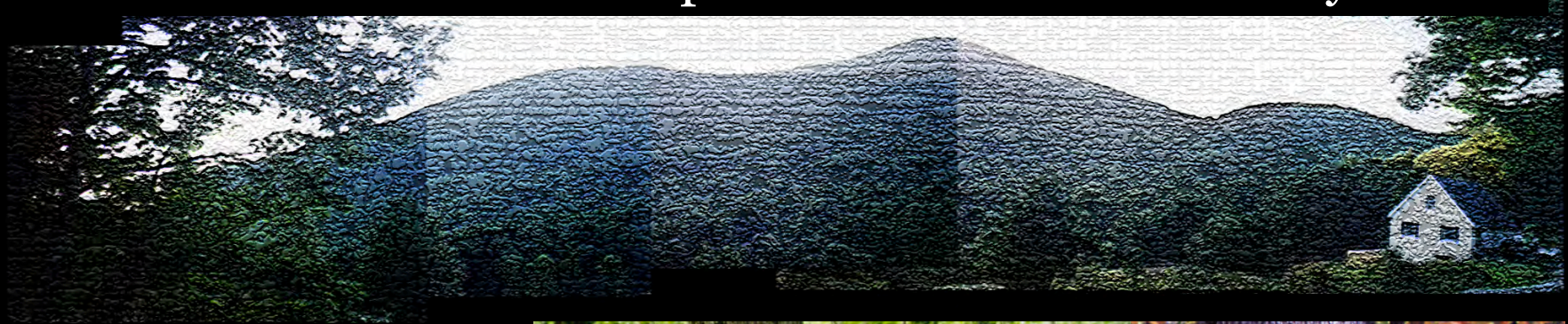


Climatic Sensitivity and Growth of Southern Temperate Trees in the Eastern US: Implications for the Carbon Cycle



neil pederson







climatic sensitivity and growth of southern temperate trees in the eastern US: implications for the carbon cycle

Chapter 1: Rationale for Dissertation Research and Dissertation Layout

Chapter 2: The Influence of Winter Temperatures on the Annual Radial Growth of Six Northern-Range-Margin Tree Species - Pederson et al., 2004 - *Dendrochronologia*

Chapter 3: Growth and Climatic Sensitivity of Northern Red Oak in the Northeastern U.S.: Placing Carbon Uptake at the Harvard Forest in a Regional Perspective

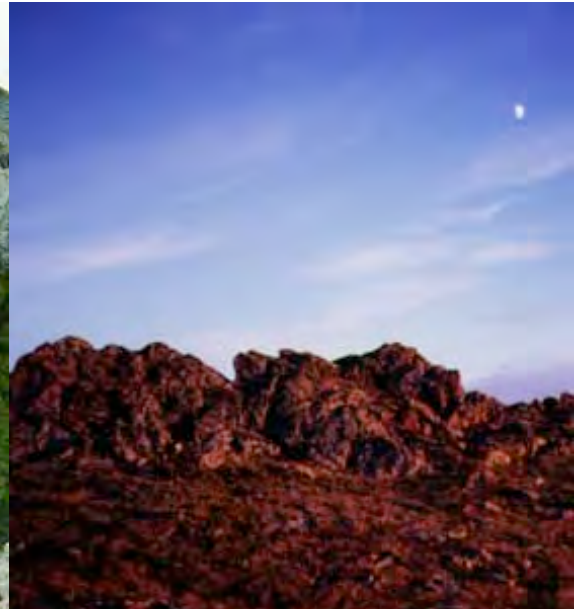
Chapter 4: Evidence of Accelerated Growth in Old Trees

Chapter 5: Climatic Sensitivity and Growth of Southern Temperate Species in the Eastern U.S.

Appendix A: Climate Sensitivity of Atlantic White Cedar at its Northern Range Limit - Hopton and Pederson, in press - Atlantic white cedar: ecology, restoration, and management: Proceedings of the Arlington Echo symposium. US. For. Service Gen. Tech. Rep.

Appendix B: Discussion of Gypsy Moth Defoliation

Appendix C: Table of Tree-Ring Collections Between 1999 and 2004





Dictionary.com Word of the Day for Tuesday May 14, 2002

You take on a project because of the feeling, perhaps **inchoate**, that it may in some way contribute to your deeper understanding of the larger-scale research program you have chosen as your life's work.

--Christopher Scholz, *Fieldwork: A Geologist's Memoir of the Kalahari*

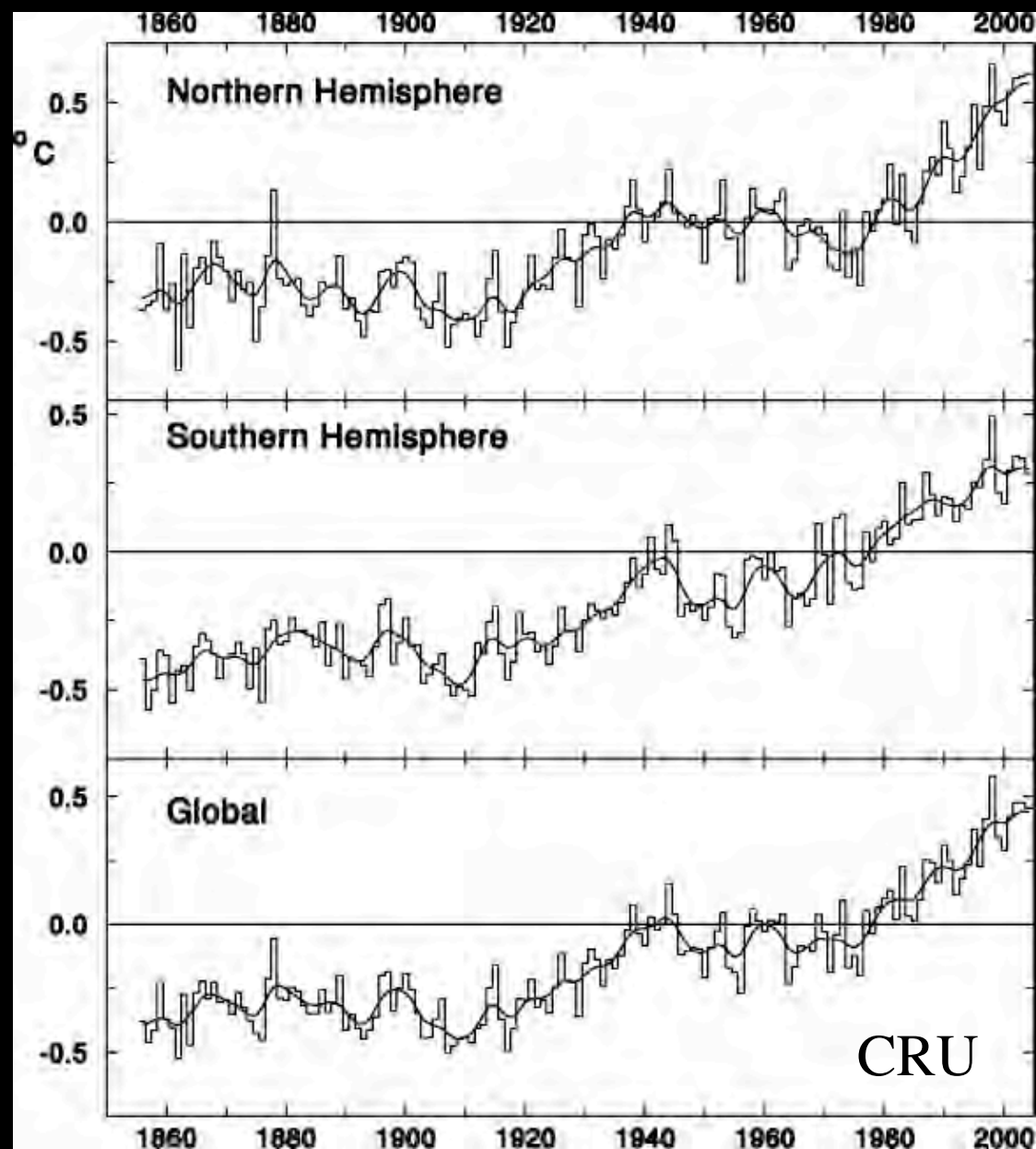
“Is temperature an important factor of the growth rates of southern temperate tree species?”

“What are the biotic and abiotic factors influencing tree growth rates/carbon uptake?”

“Have tree growth rates changed significantly over the past two centuries?”

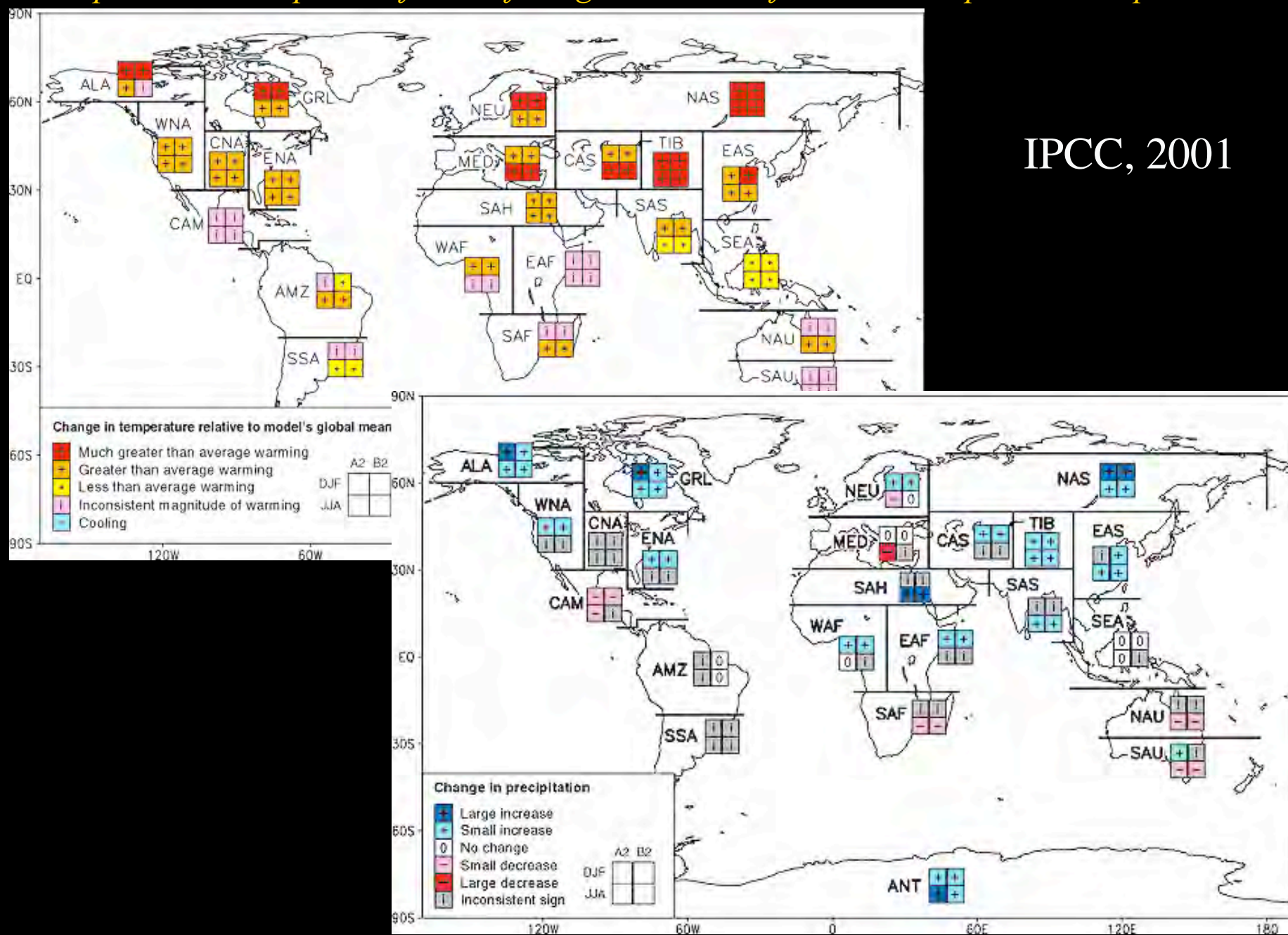
great smoky mountains

“Is temperature an important factor of the growth rates of southern temperate tree species?”



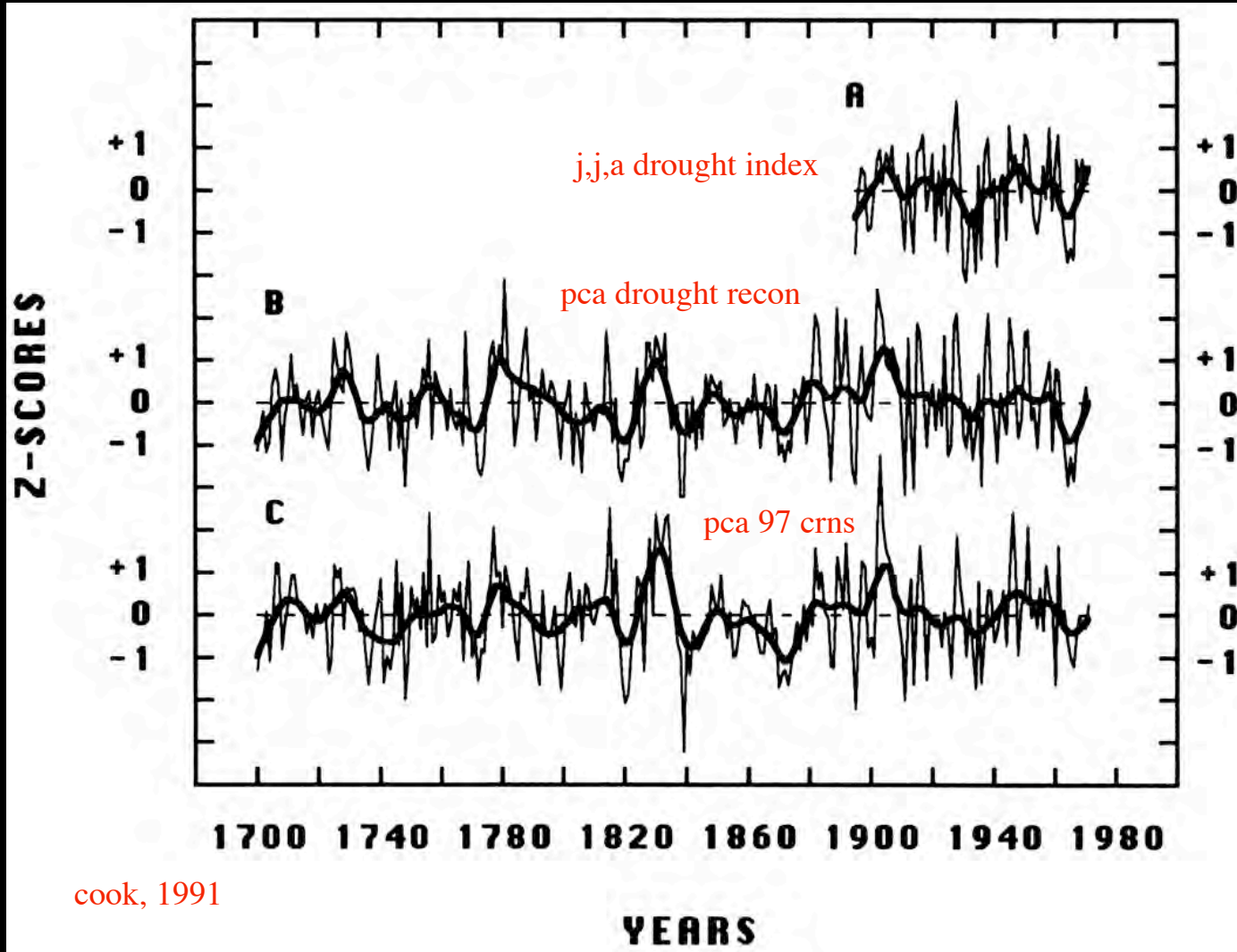
“Is temperature an important factor of the growth rates of southern temperate tree species?”

IPCC, 2001



Douglass, 1920; Schumacher & Day, 1939; Cook & Jacoby, 1977

LeBlanc & Terrell, 2001; Cook et al., 1999; 2001



cook, 1991

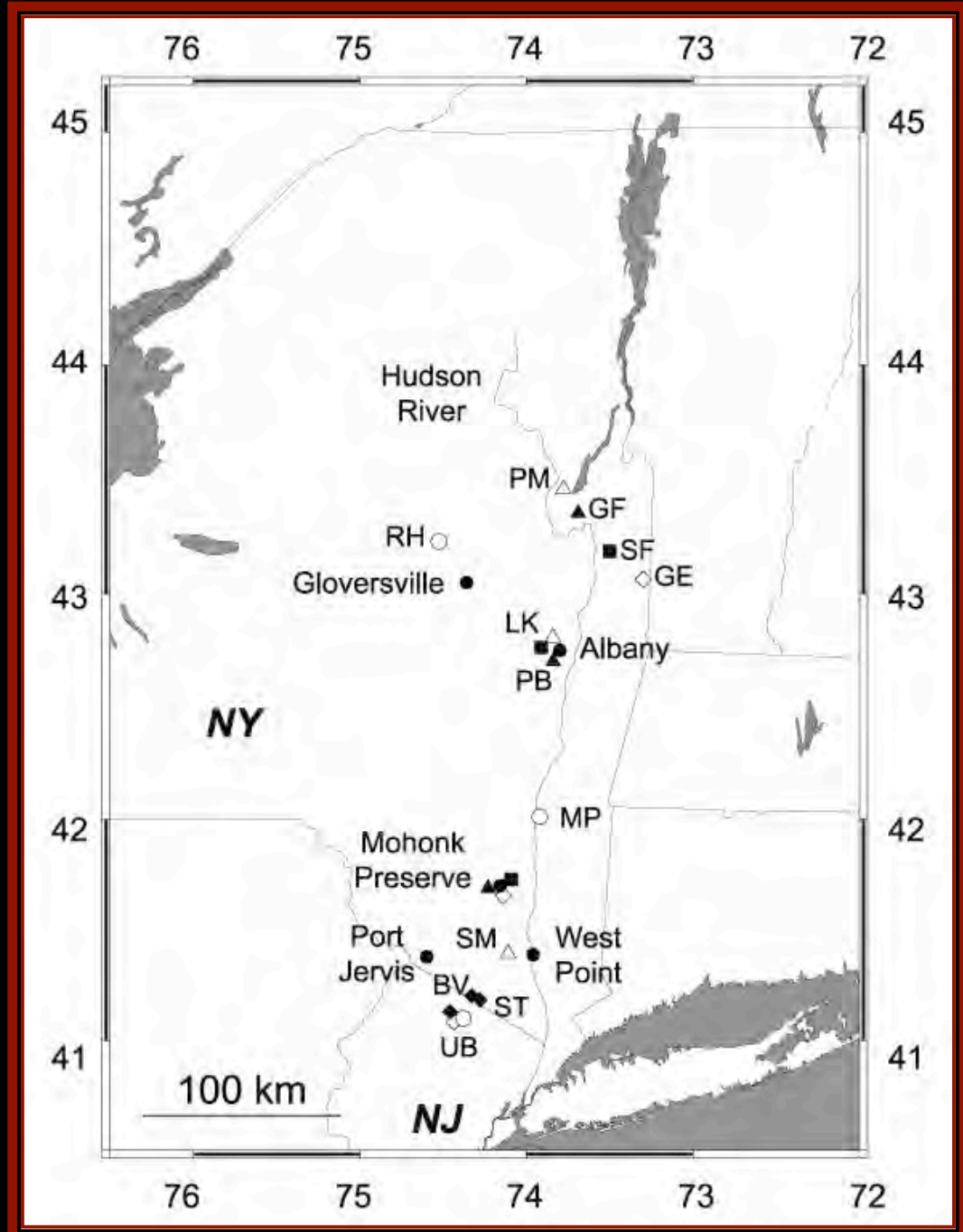
Currie & Paquin, 1987; Stahle & Cleaveland, 1992

Graumlich, 1993; Orwig & Abrams 1997; Pedersen, 1998; Stephenson, 1998

Chapter 3; unpub. data cited in Pederson et al., 2004

drought

- 6 northern range margin tree species
- radial growth indices were developed for 3 populations/species
- correlated against average minimum and maximum monthly temperatures from 1897-1994

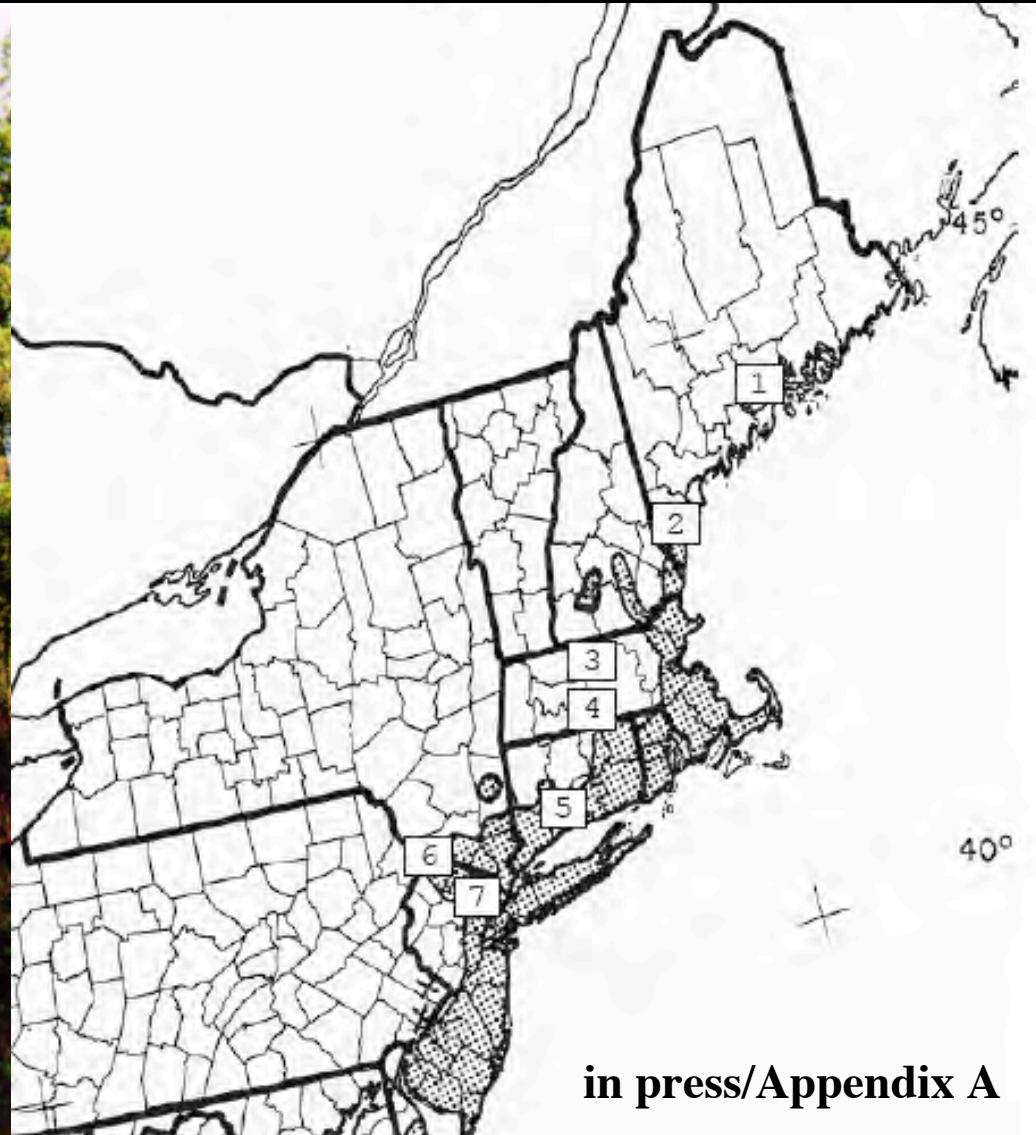


Climate Sensitivity of Atlantic White Cedar along its Northern Range Limit

H. Myvonwynn Hopton and Neil Pederson



saco heath, me



in press/Appendix A

The background of the slide is a photograph of snow-covered tree branches. The branches are dark and thin, with some snow clinging to them. The overall scene is a winter landscape with a soft, out-of-focus background.

results

“Is temperature an important factor of the growth rates of southern temperate tree species?”

winter temps important

- Pederson et al., 2004; Hopton and
Pederson, in press

across temperate N.A.

Brubaker, 1980; Conkey, 1982; Tainter et al., 1984; Cook et al., 1987, 2001; Pan et al., 1997;

Rubino and McCarthy, 2000; Naidoo and Lechowicz, 2001; D'Arrigo et al., 2001; Tardif et al., 2001

*“Is temperature an important factor of the growth rates of southern
temperate tree species?”*

differences between species

- esp. conifers vs hardwoods



montgomery place



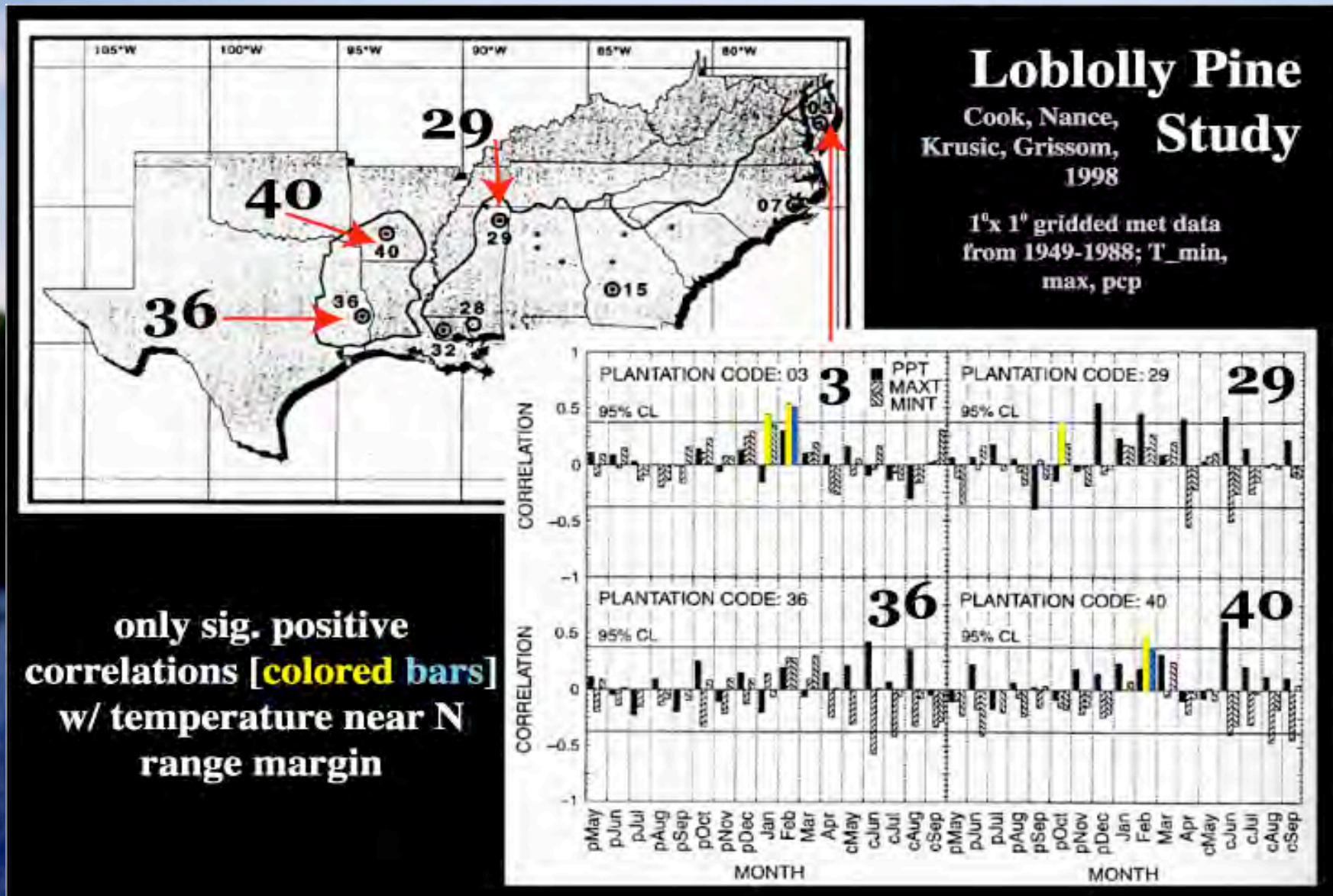
high point, nj



glen lake fen, ny

- Pederson et al., 2004; Hopton and Pederson, in press, Chap 3

Changing Temperature Sensitivity w/ Latitude



“Is temperature an important factor of the growth rates of southern temperate tree species?”

N

- T_{\min} -

- T_{\max} -

Prospect Mountain

-

-

Rooster Hill

-

*

Stott Farm

-

-

Goose Egg Ridge

-

-

Lisha Kill

-

-

Lisha Kill

@

*

Montgomery Place

-

-

Mohonk Preserve

@

-

Mohonk Preserve

*

*

Schunnemunk Mountain

**

**

Utertown

-

-

Utertown

*

*

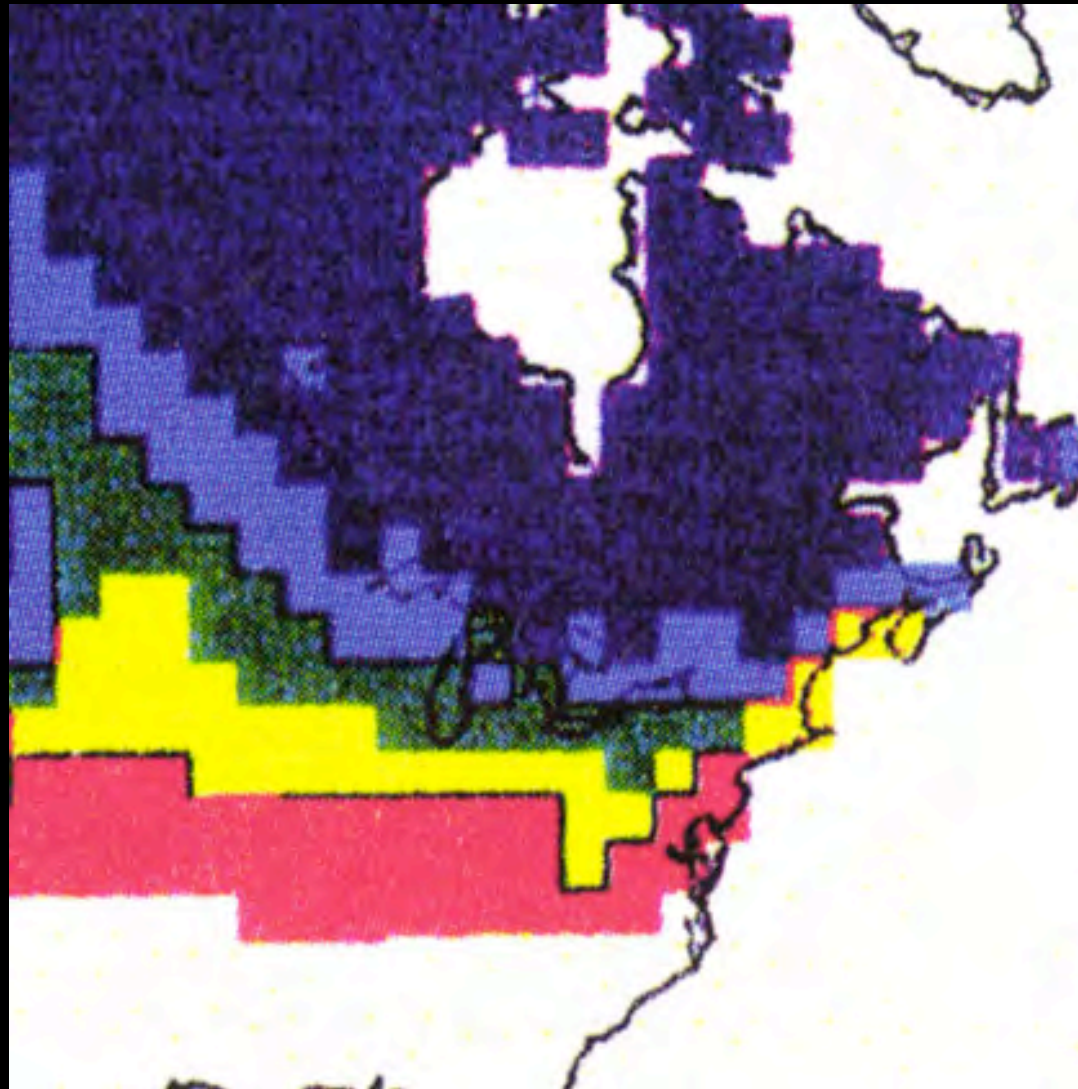


latitude

*** = $p \leq 0.001$; ** = $p \leq 0.010$; * = $p \leq 0.050$; @ = $p \leq 0.100$








why oak-hickory pattern? - snow blanket



Snow Cover Categories

(Map generated using the SnowCover model, a simple, single-layer, one-dimensional model)

5 <		≤ 25
25 <		≤ 50
50 <		≤ 75
75 <		≤ 95
95 <		

Groisman & Davies, 2001

“Is temperature an important factor of the growth rates of southern temperate tree species?”

HARDWOOD SPECIES

chestnut oak

white oak

northern red oak

pignut hickory

increasing
temperature
sensitivity

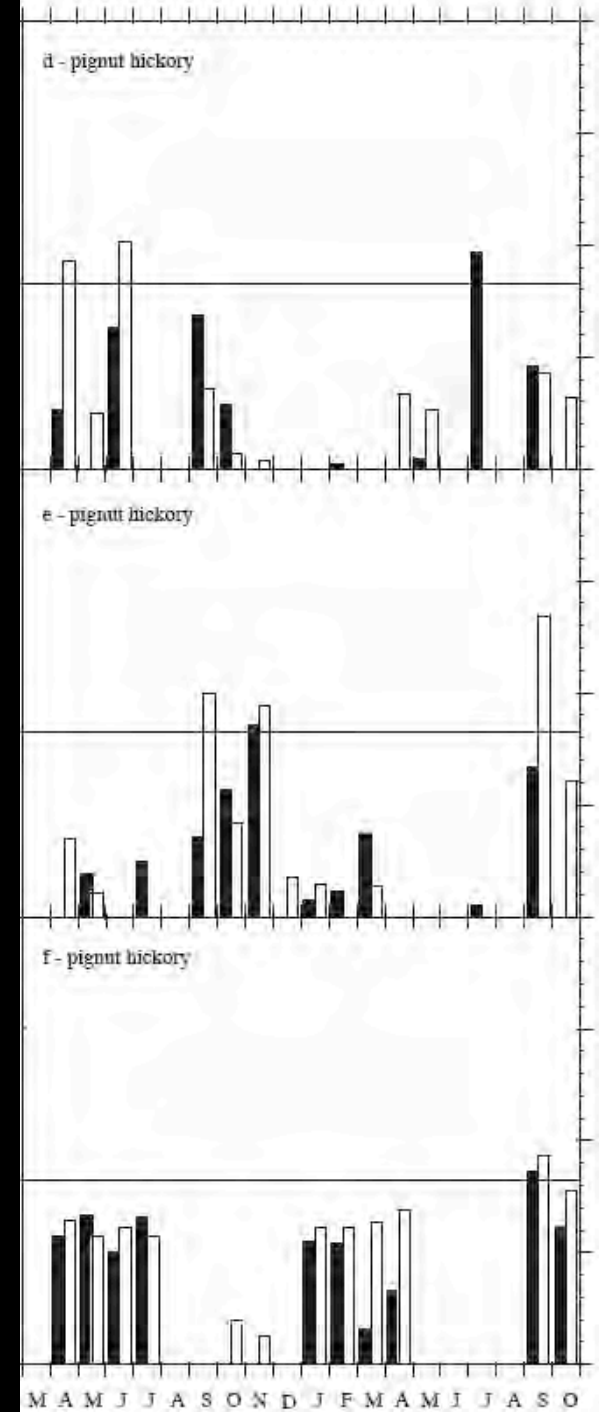
*“Is temperature an important factor
of the growth rates of
southern temperate tree species?”*



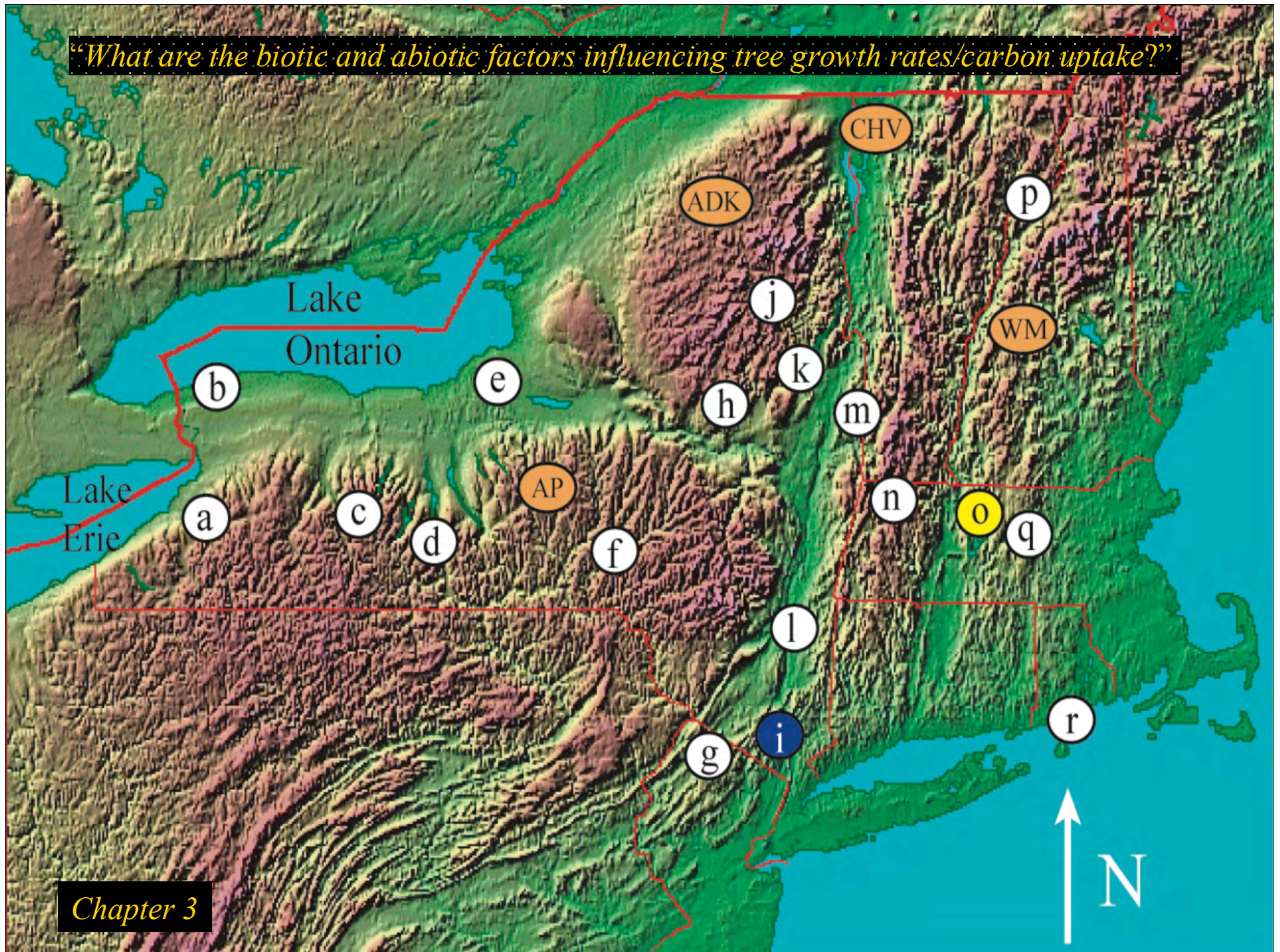
PHENOLOGY

species
distribution
productivity

long-term warming has mainly occurred in winter,
spring, and autumn - jones et al., 2001

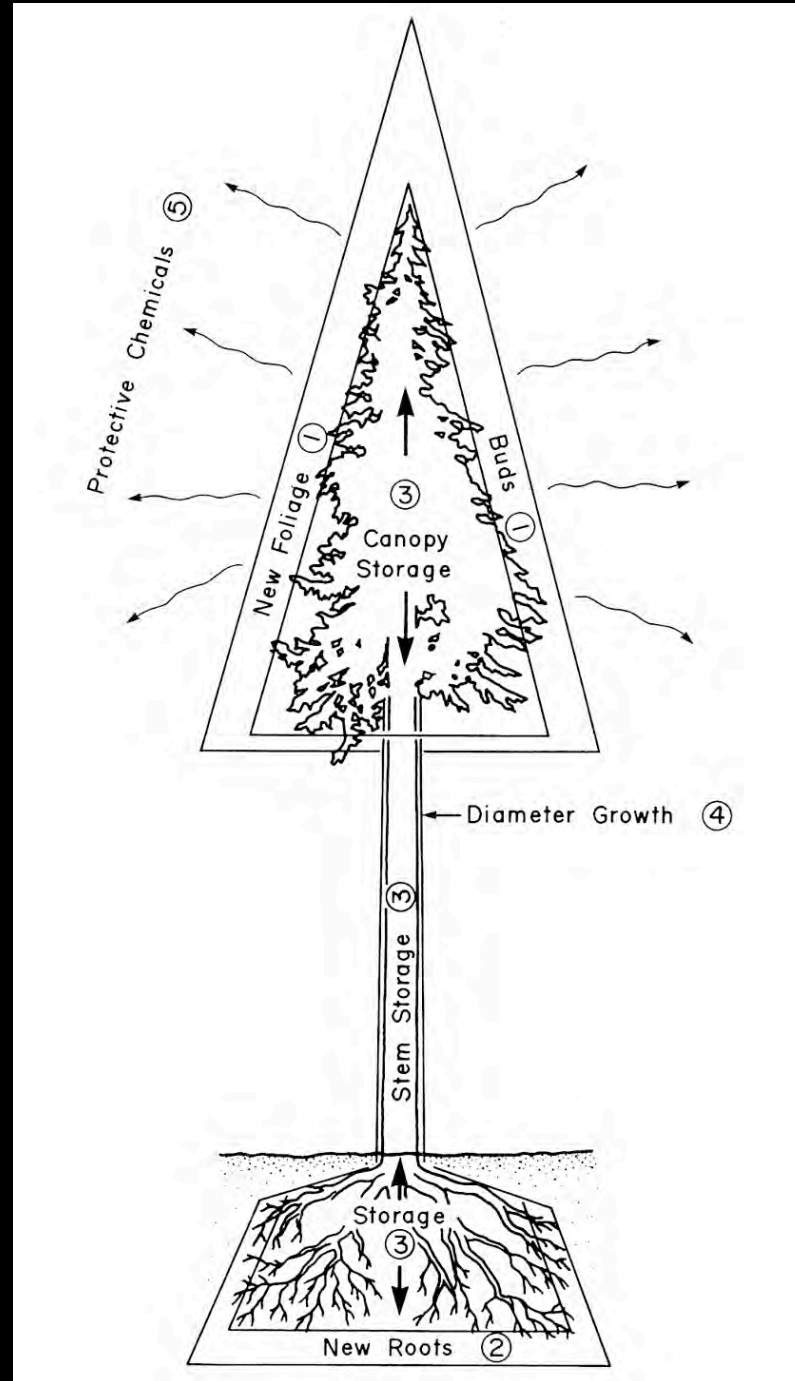


“What are the biotic and abiotic factors influencing tree growth rates/carbon uptake?”



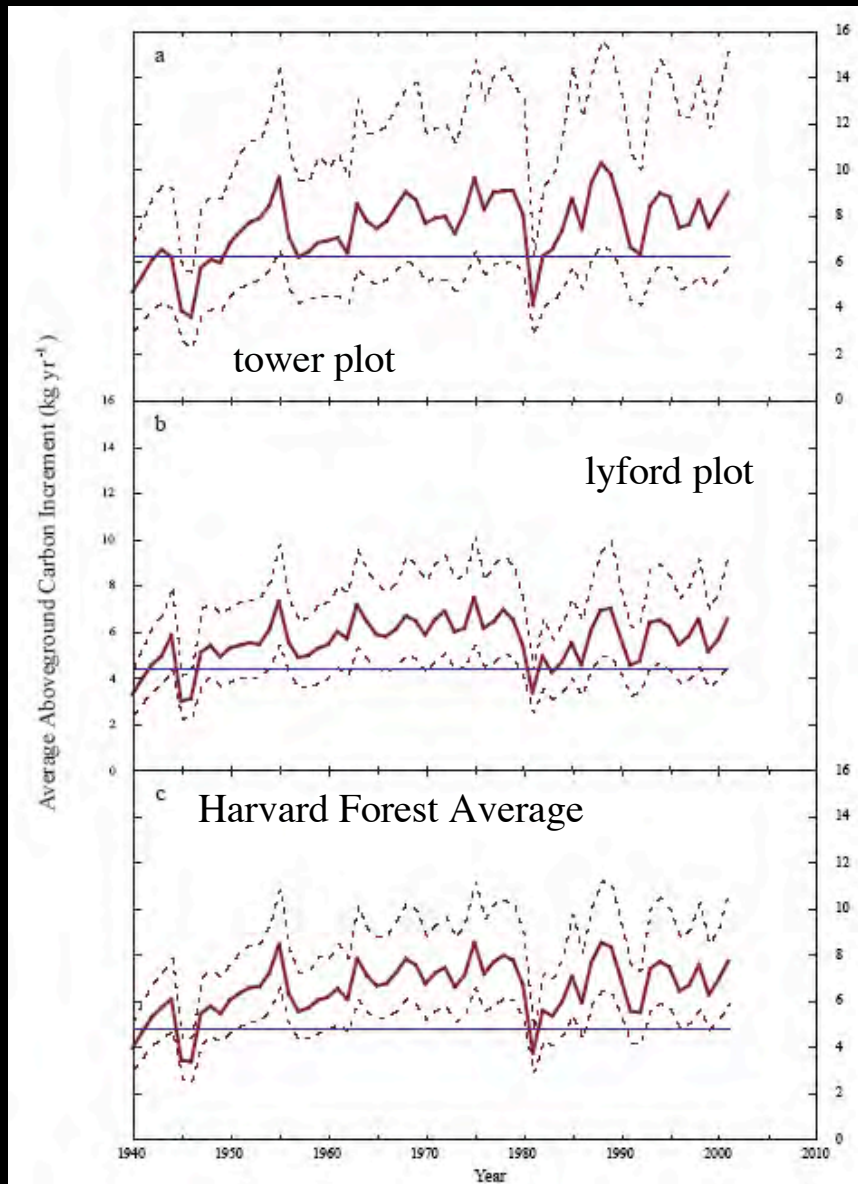
growth allocation

Waring and Pitman - 1985

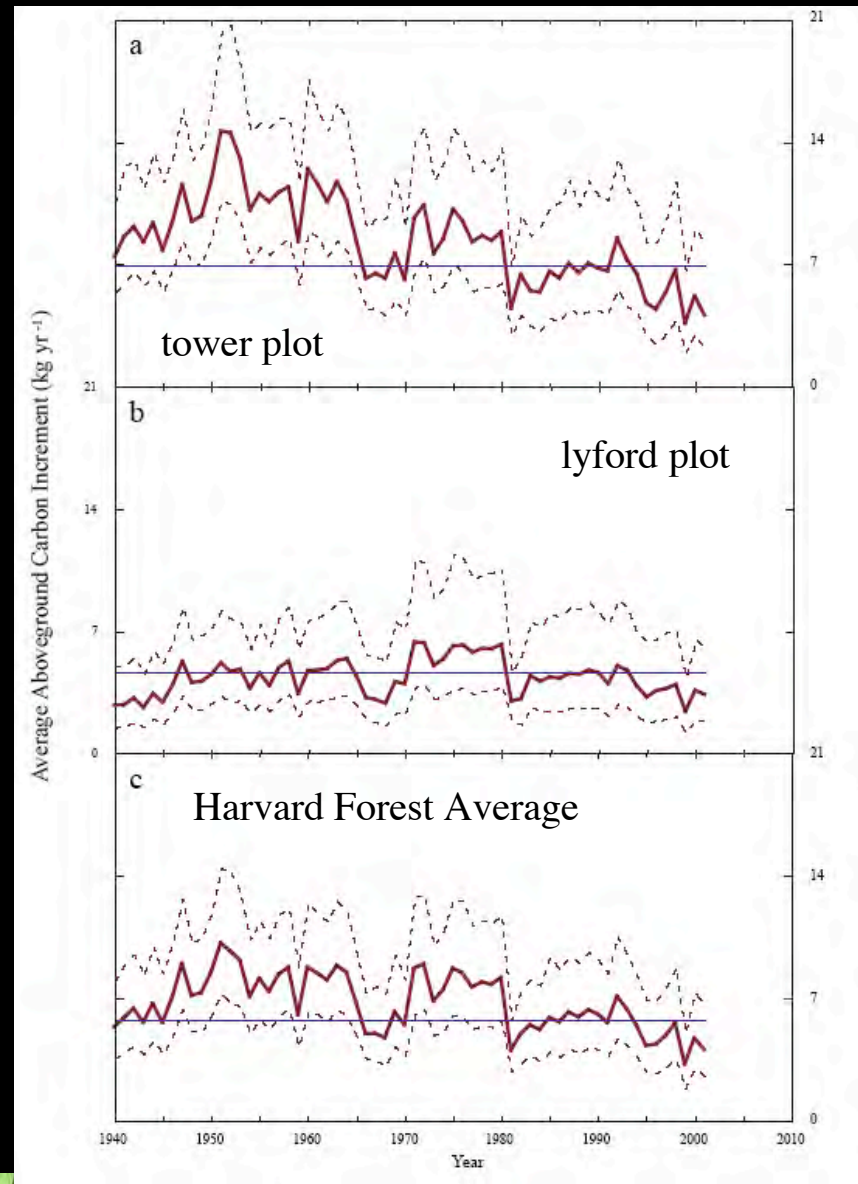


carbon

“What are the biotic and abiotic factors influencing tree growth rates/carbon uptake?”



northern red oak



red maple



singer farm

6x

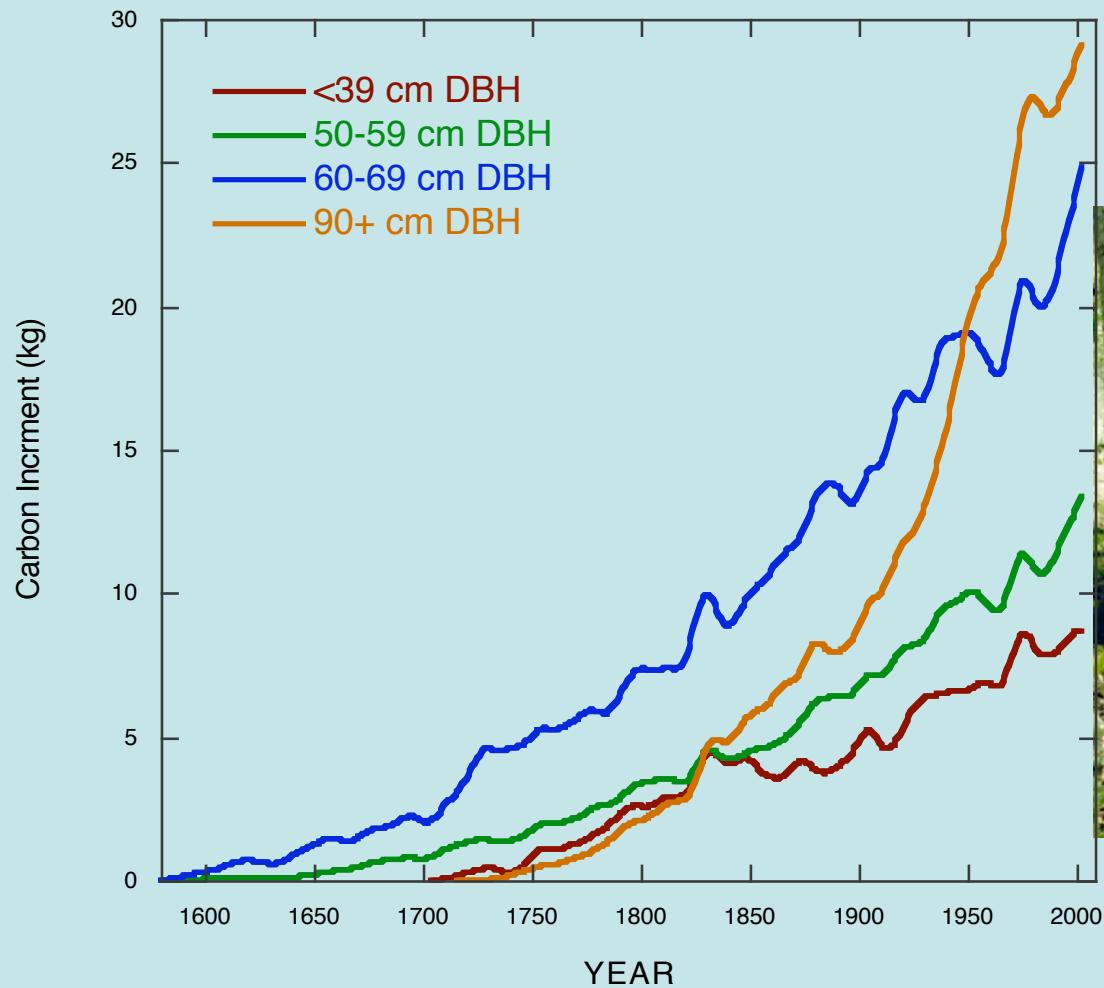


harvard forest

“What are the biotic and abiotic factors influencing tree growth rates/carbon uptake?”

big trees - higher growth rates

“What are the biotic and abiotic factors influencing tree growth rates/carbon uptake?”



white & chestnut oaks



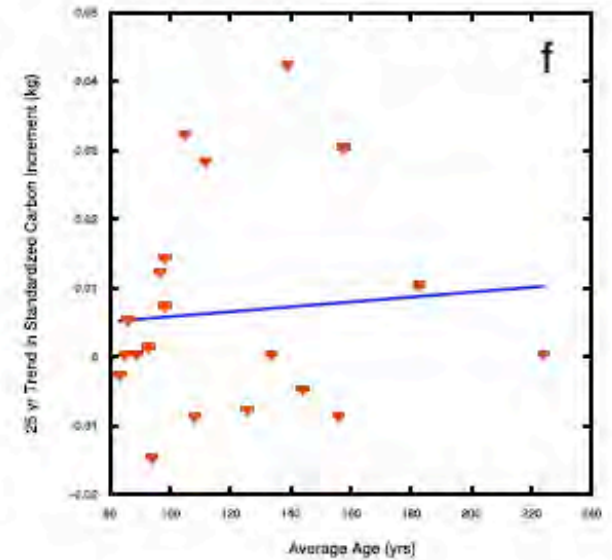
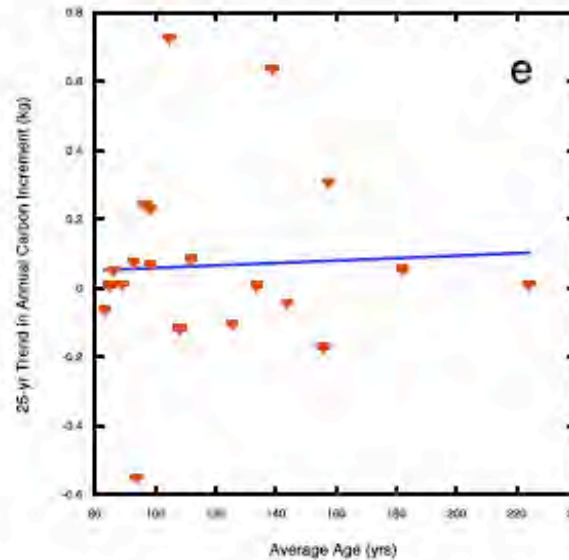
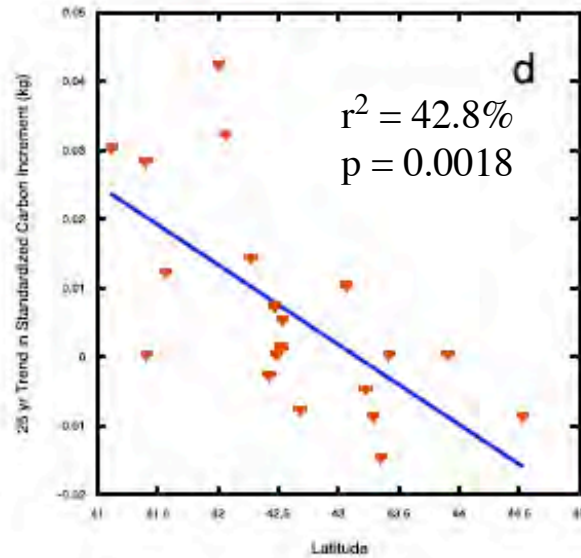
Chapter 4

“What are the biotic and abiotic factors influencing tree growth rates/carbon uptake?”

Trend vs. Lat.

Trend vs. Ave. Age

STD Trend vs. Ave. Age



Chapter 3

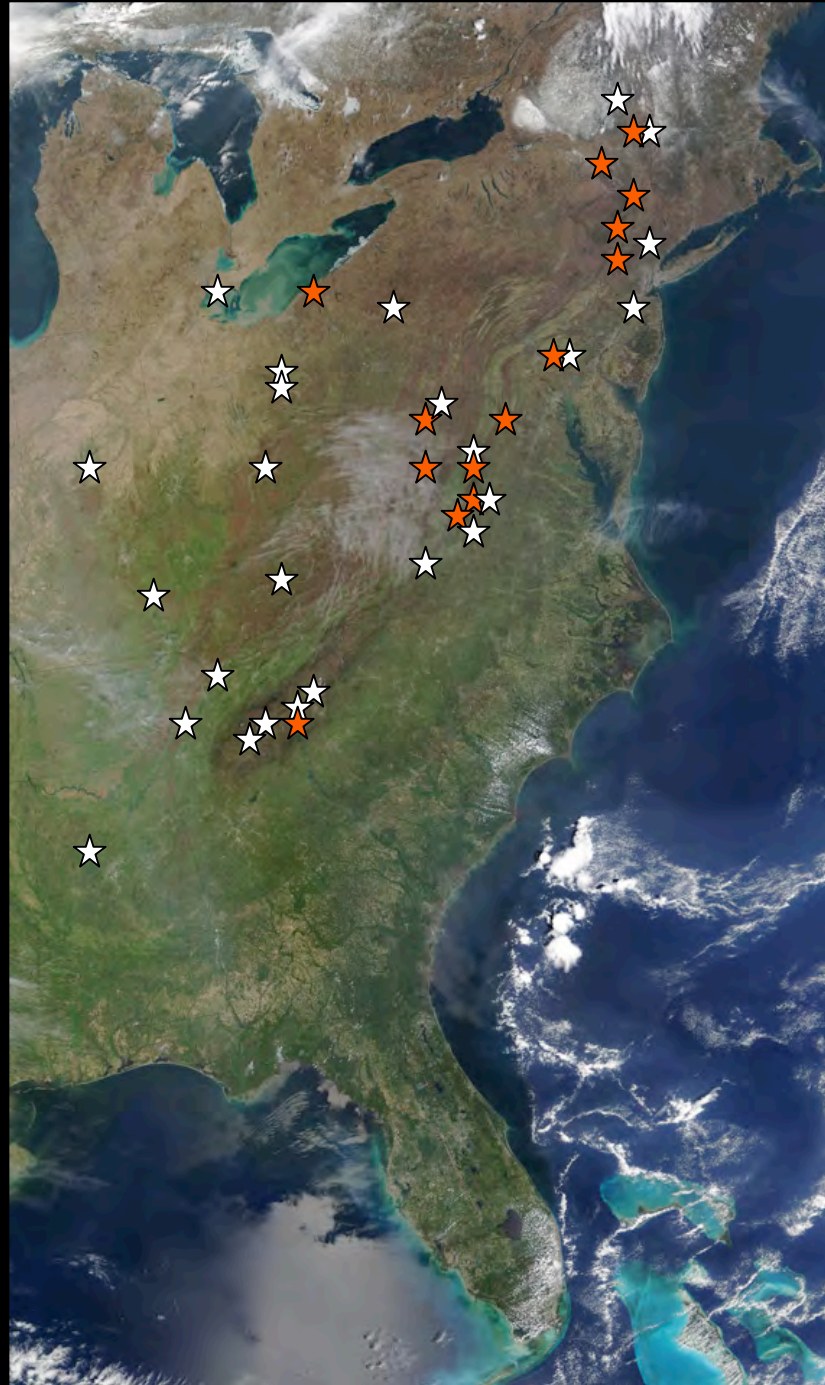
“Have tree growth rates changed significantly over the past two centuries?”



age

study area

modis image



Chapter 4

chestnut
oak

white
oak

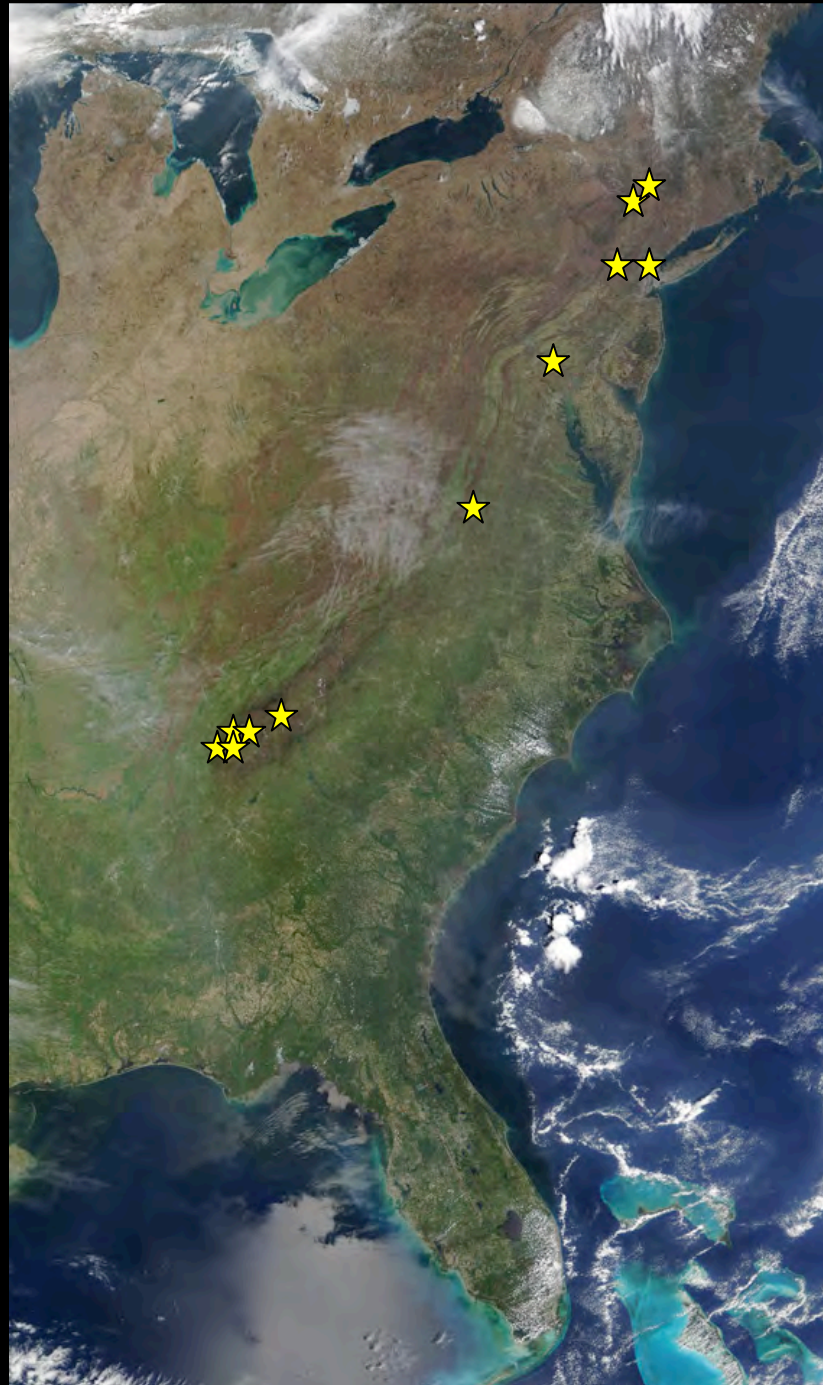
837 trees
collected over 2
time periods:
1977-1983 &
1999-2003

no removal of
growth trends

split into 50 yr
Periods:
1651-1700, etc.

study area

modis image



Chapter 4

tulip-poplar

144 trees collected
by 3 researchers:
D. Duvick '82,
Stahle Lab late-'90s
Lamont - 2001-03

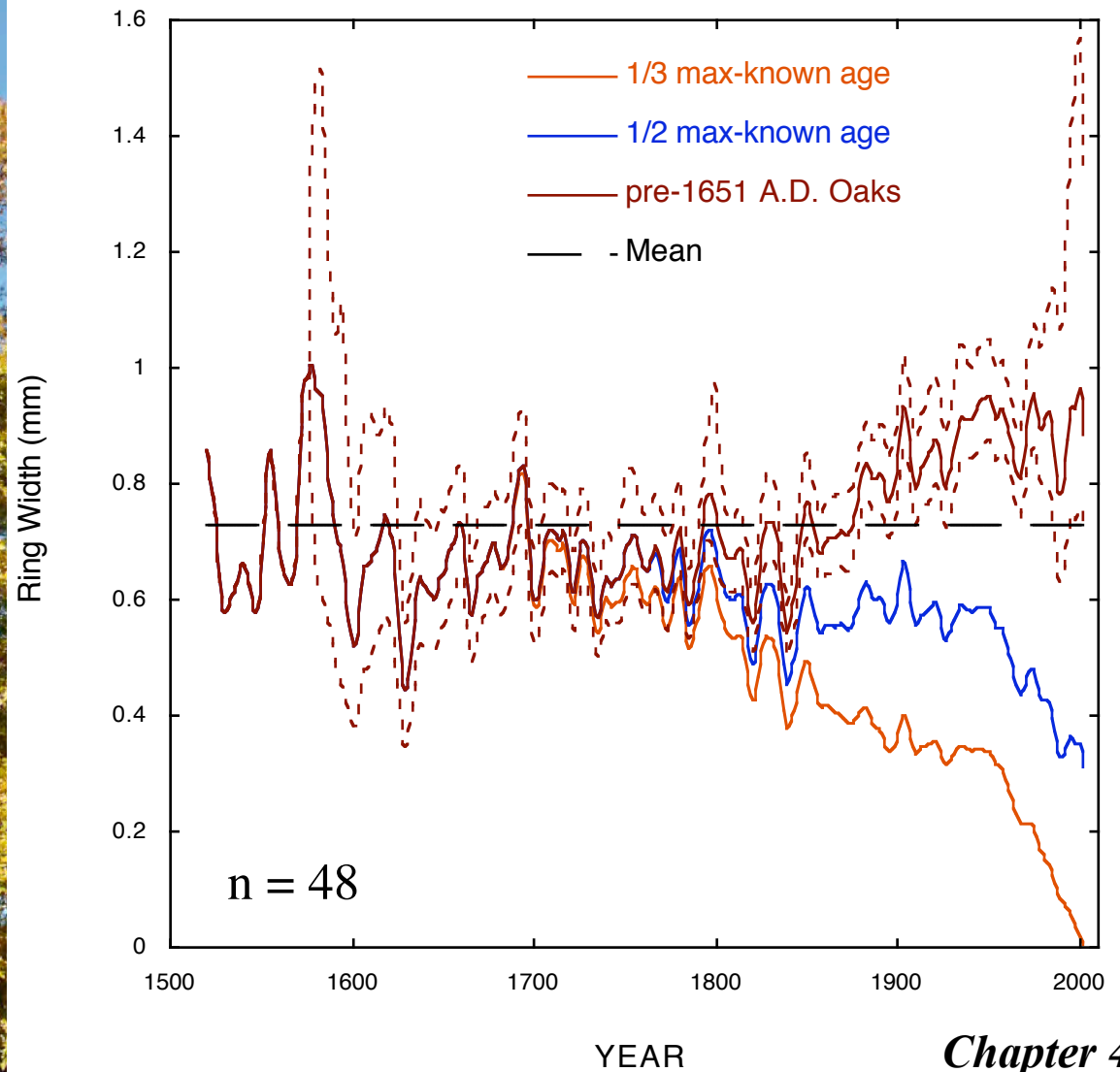
no removal of
growth trends

split into 3, 70 yr
age classes -
pre-1781, etc

“Have tree growth rates changed significantly over the past two centuries?”

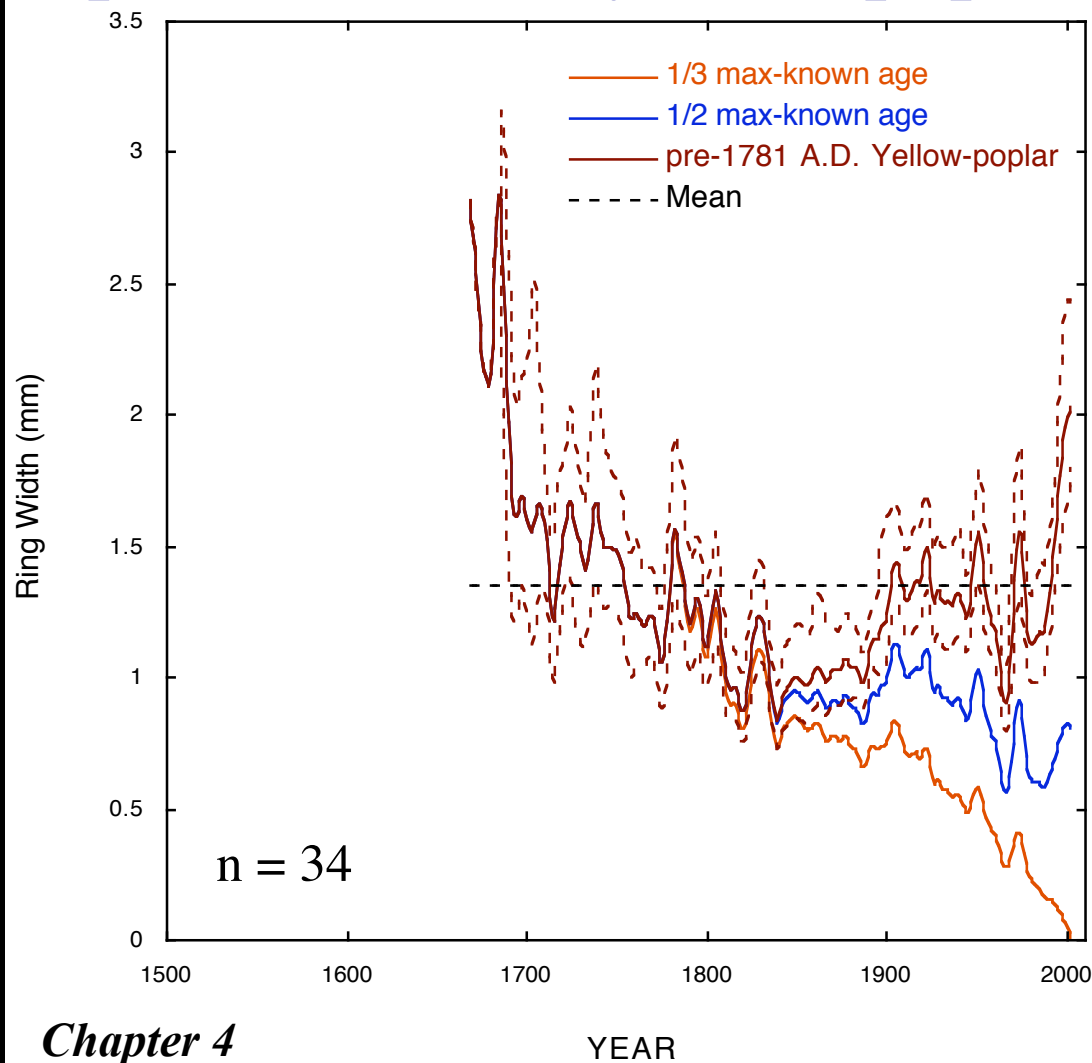


pre-1651 A.D. oak



“Have tree growth rates changed significantly over the past two centuries?”

pre-1781 A.D. yellow-poplar

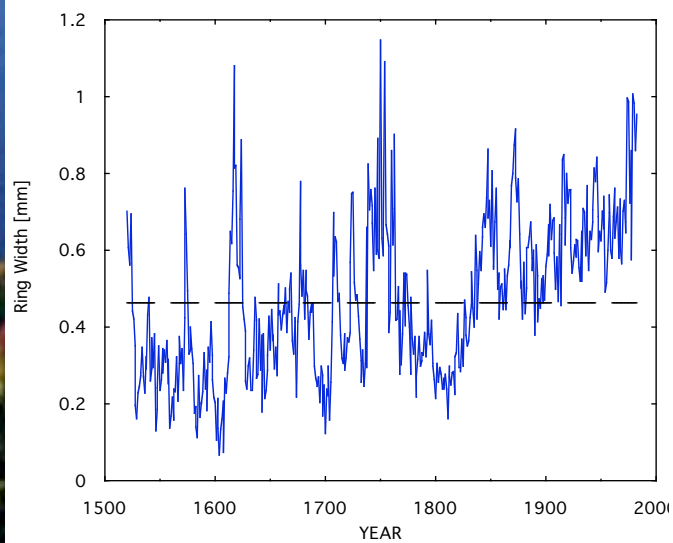


Chapter 4

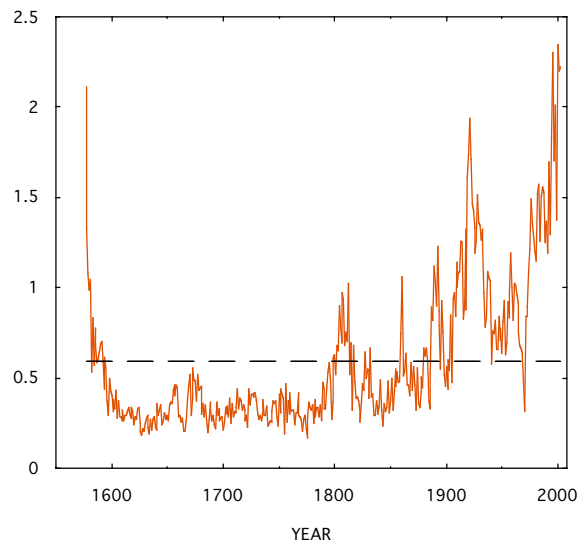




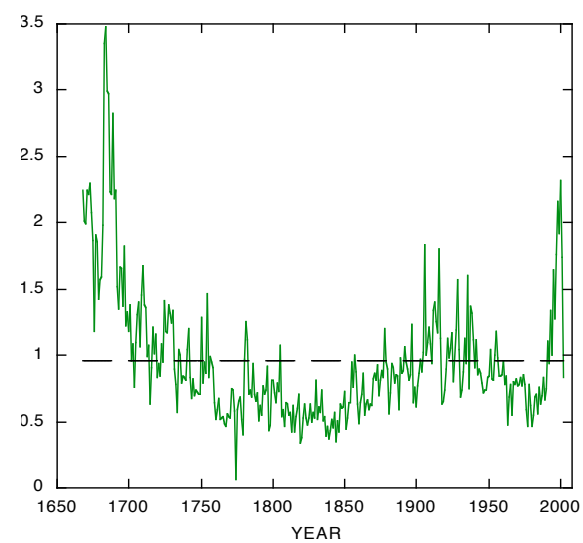
white oak



chestnut oak

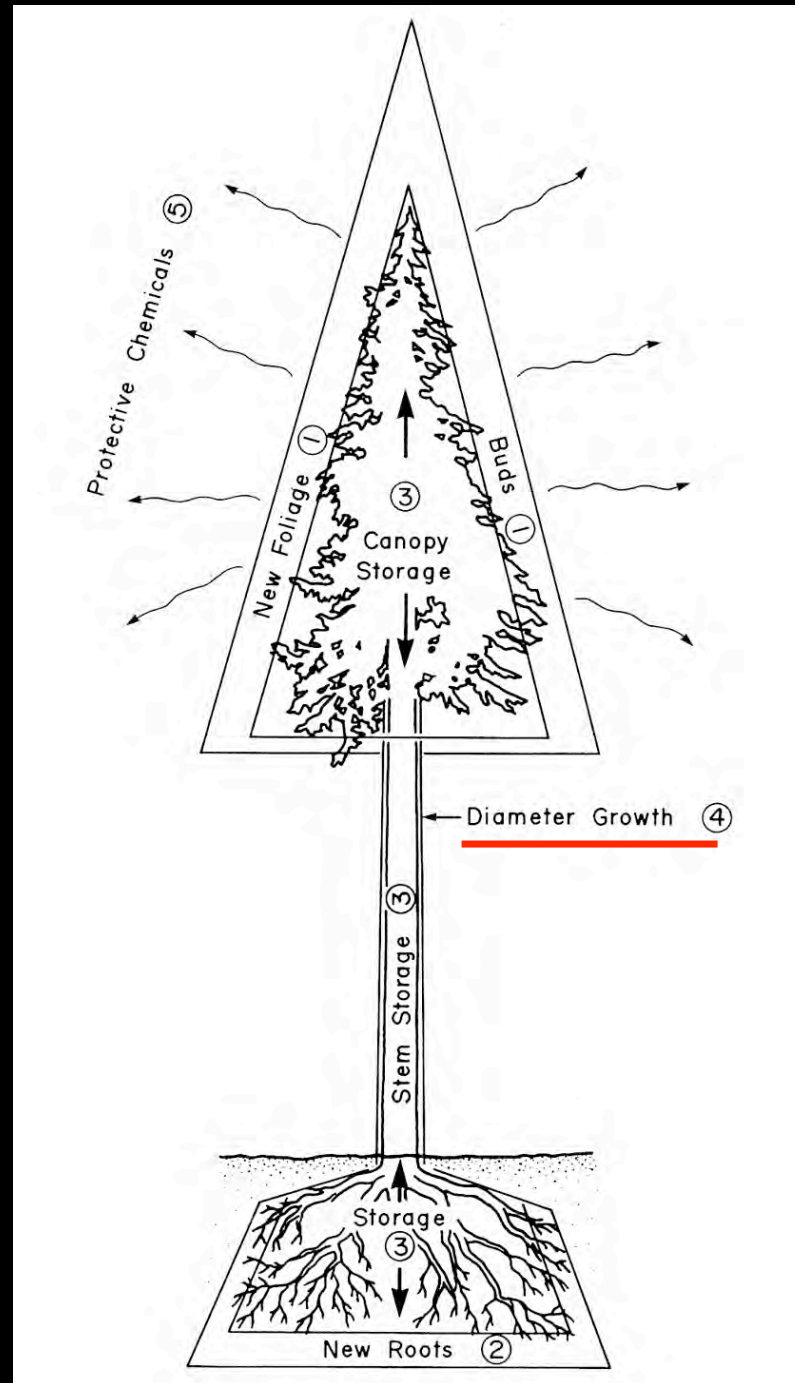


yellow-poplar



growth allocation

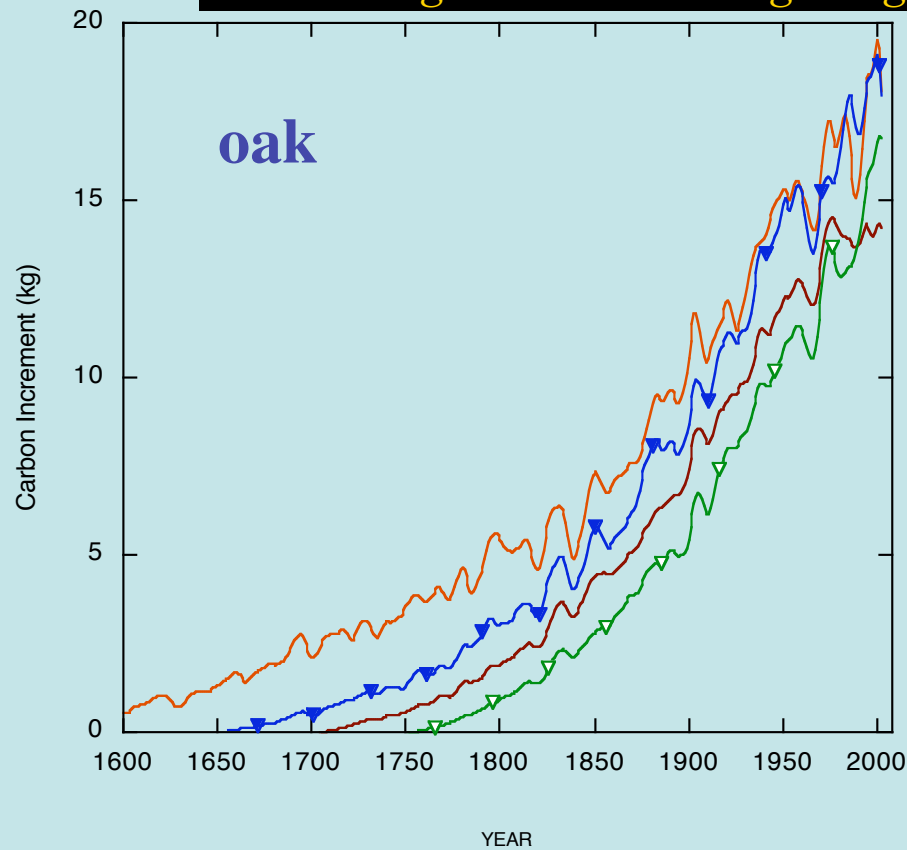
Waring and Pitman - 1985



vigor
carbon

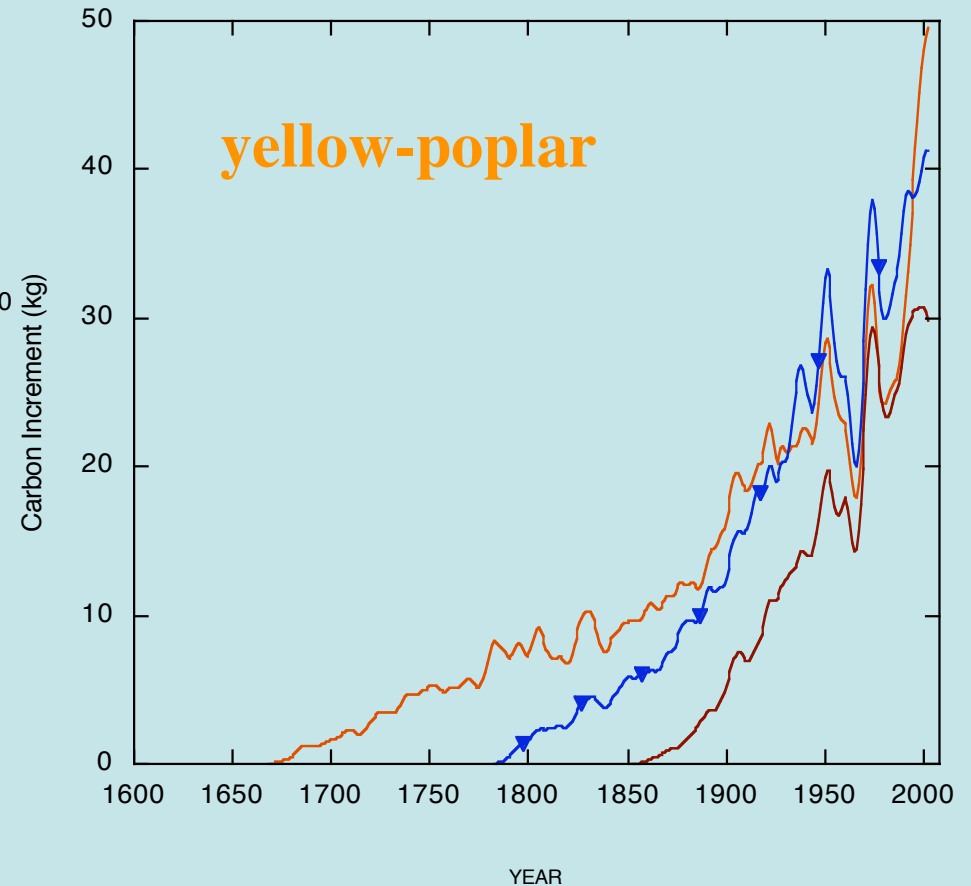
Chapter 4

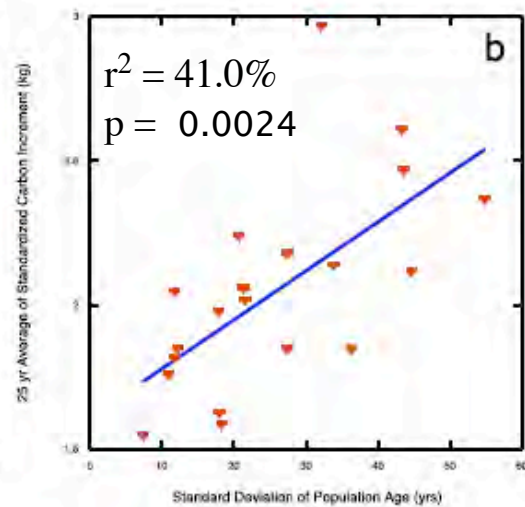
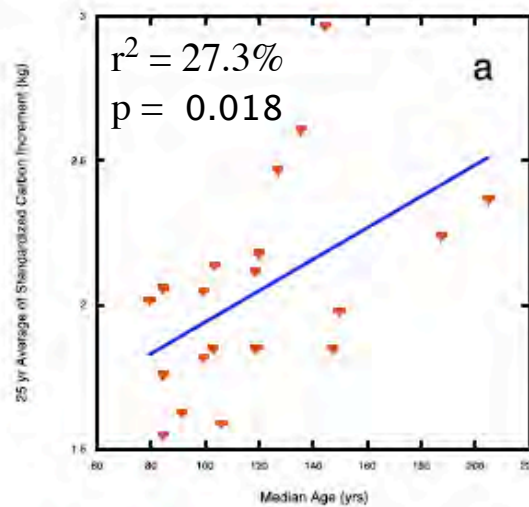
"Have tree growth rates changed significantly over the past two centuries?"



carbon
uptake

growth
rates





*“Have tree growth rates
changed significantly over
the past two centuries?”*

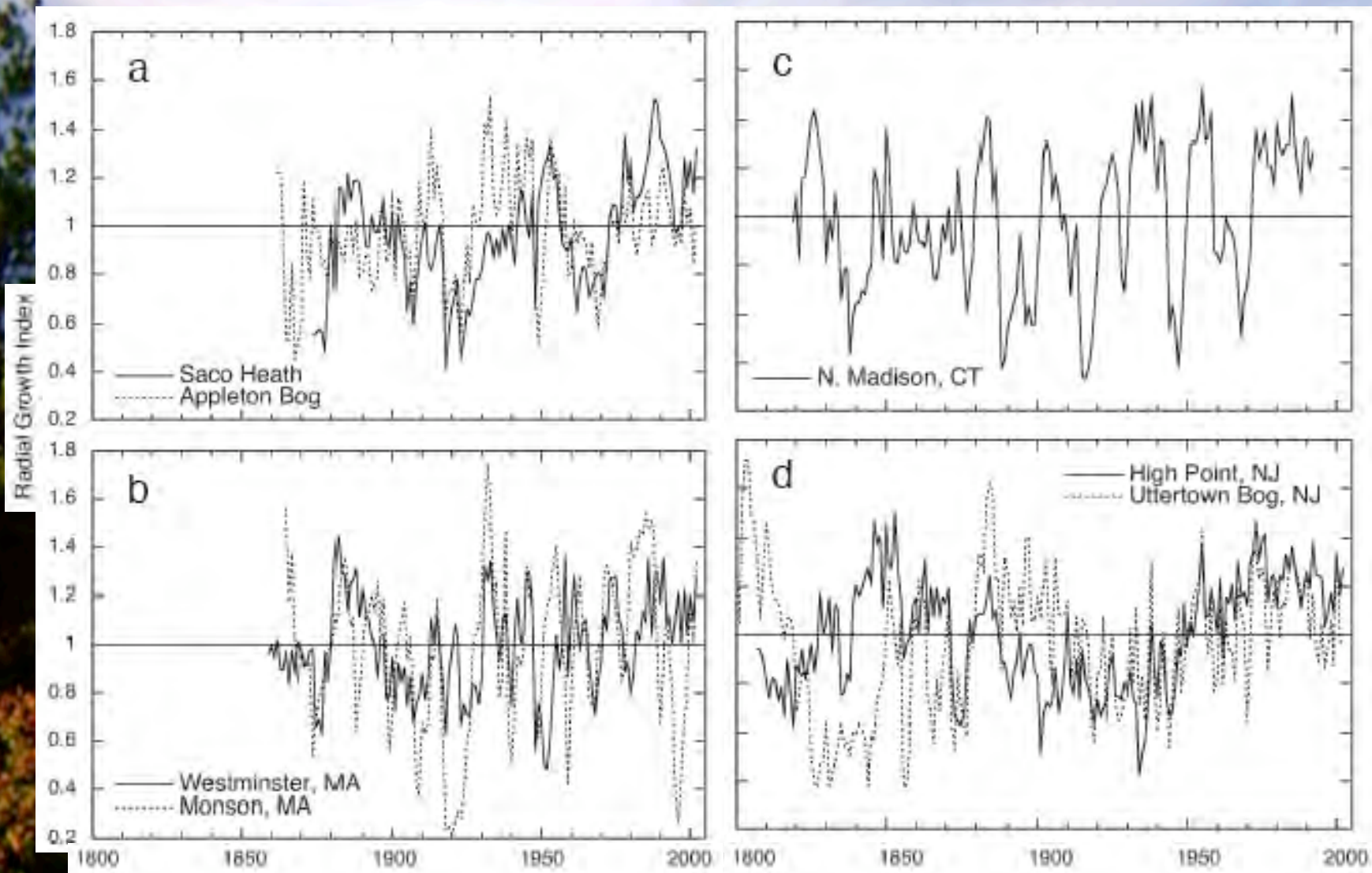
age



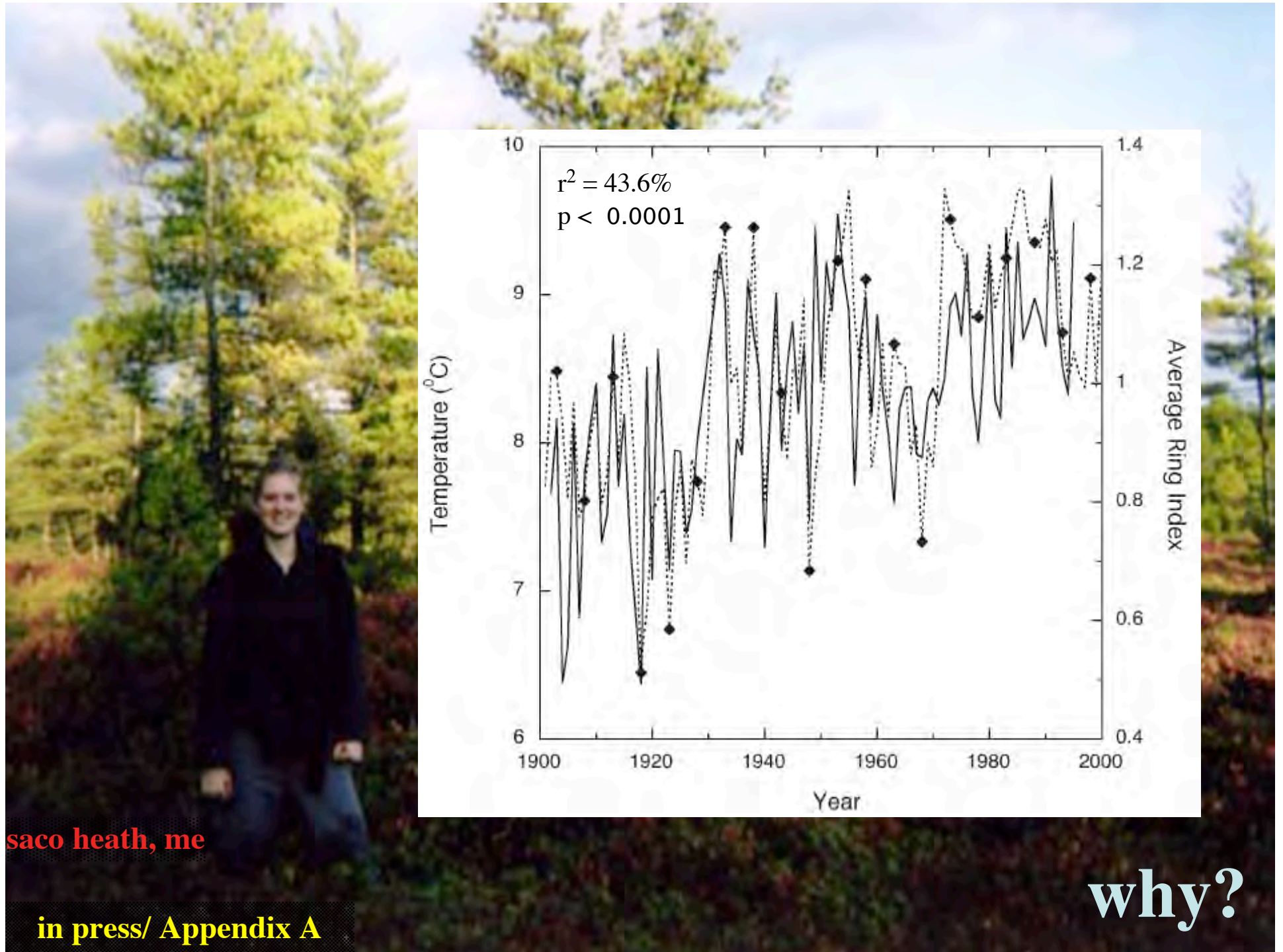
NORTHERN
RED OAK

Chapter 3

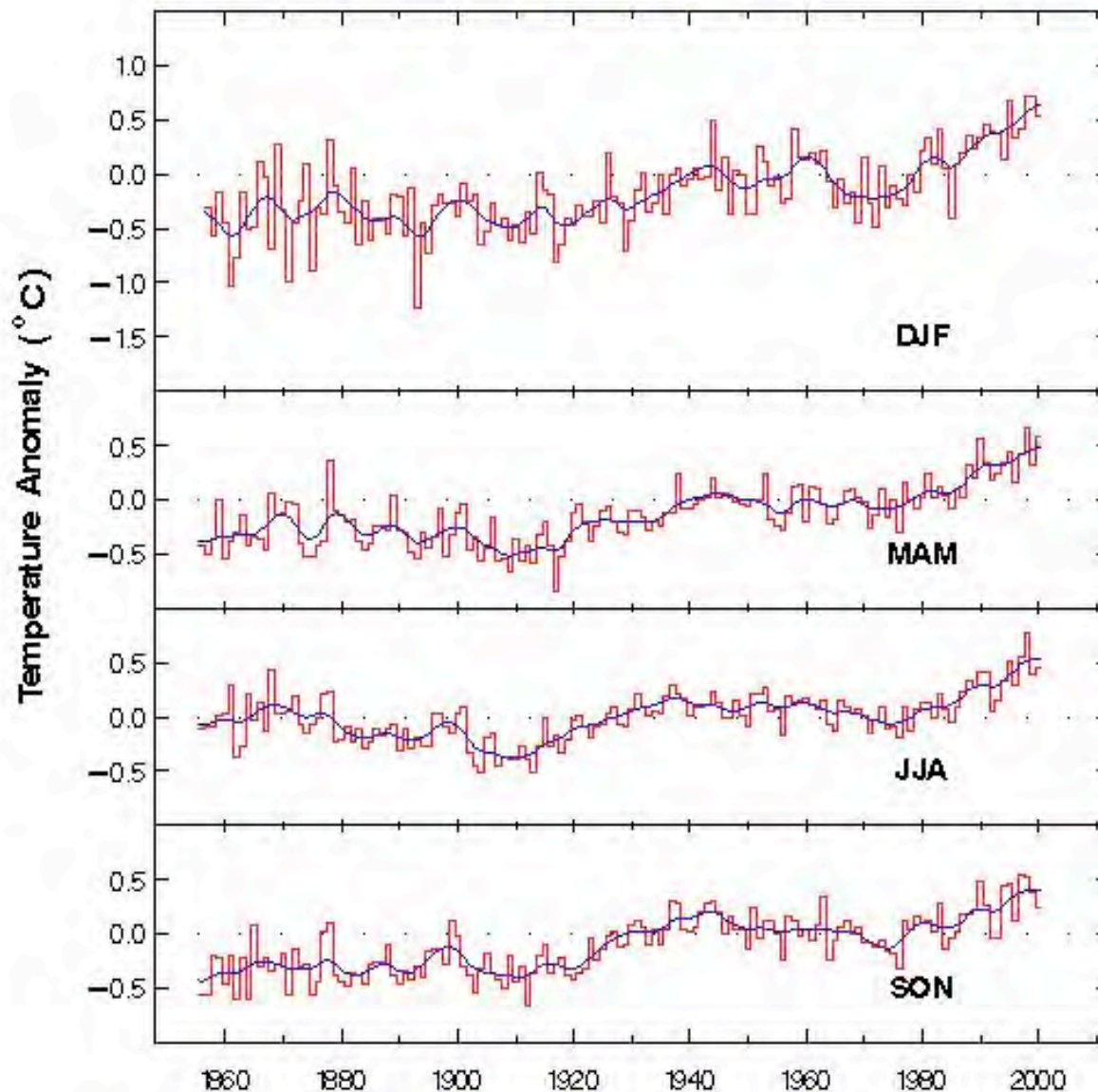
“Have tree growth rates changed significantly over the past two centuries?”



Appendix A



Northern Hemisphere Seasonal Annual Temperature Anomalies
1856–2000

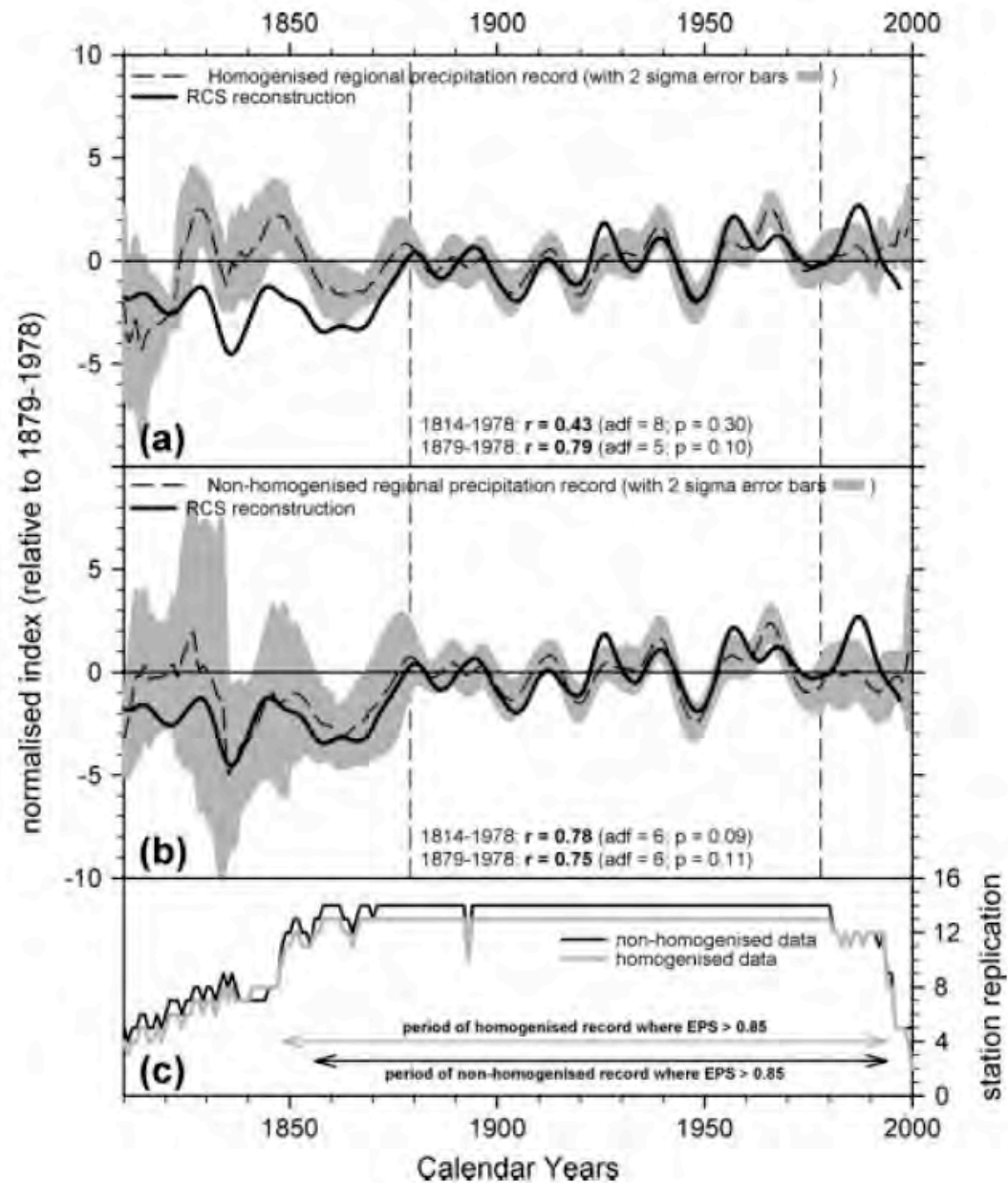


Source: R. D. Jones, T. J. Osborn, and K. R. Briffa
University of East Anglia, Norwich, UK
D. E. Parker, Met. Office, Bracknell, Berkshire, UK

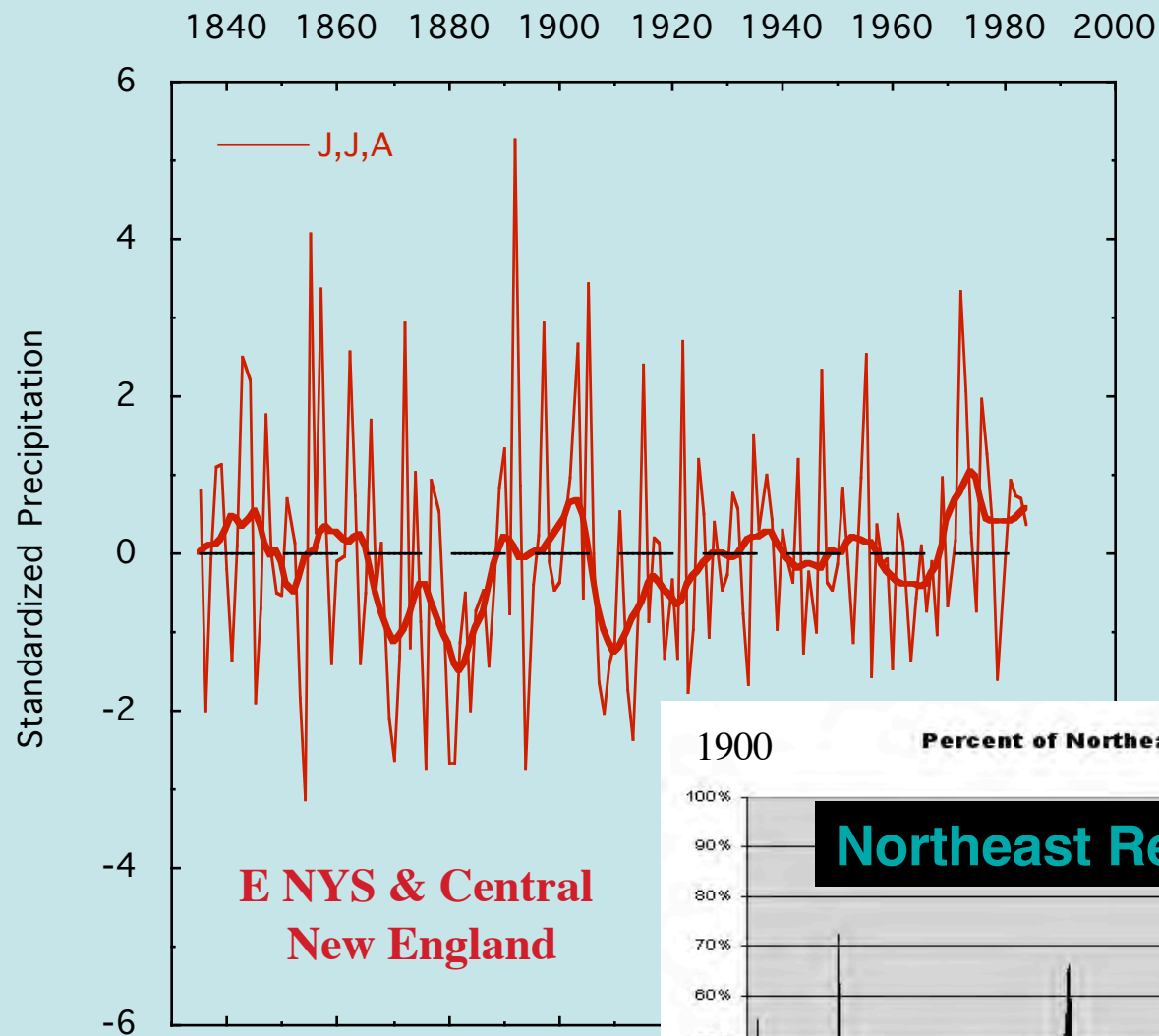
why?

long-term warming has mainly occurred in winter, spring, and autumn; only recently have summers become warmer
- jones et al., 2001

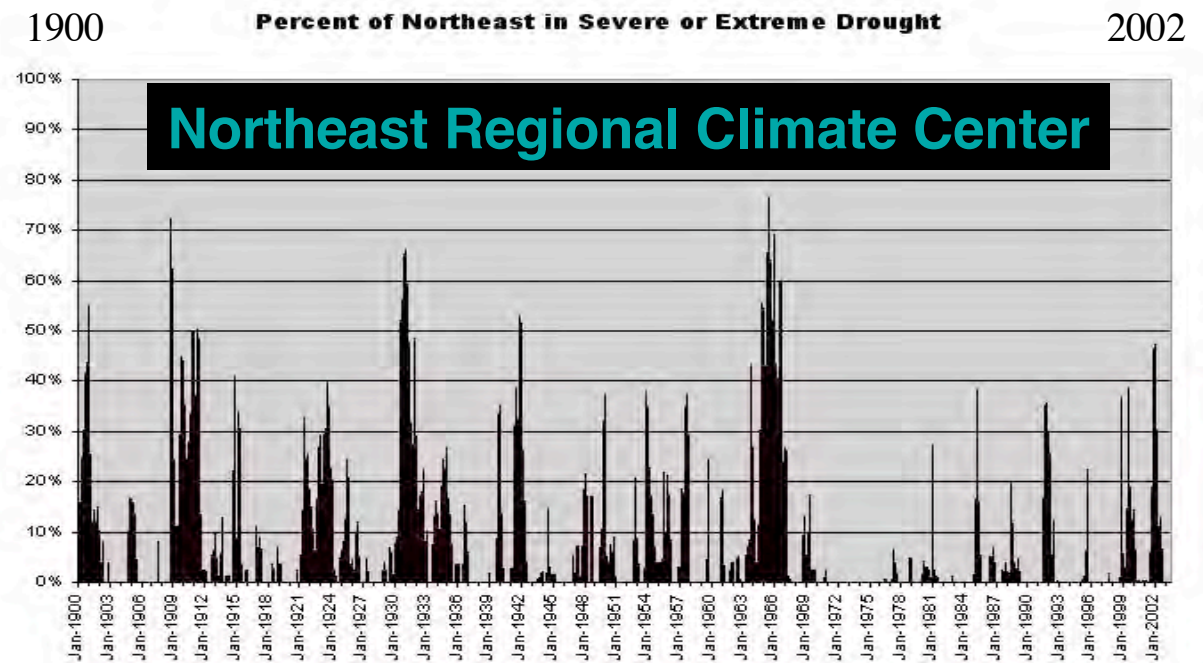
R. J. S. WILSON, B. H. LUCKMAN AND J. ESPER



why?

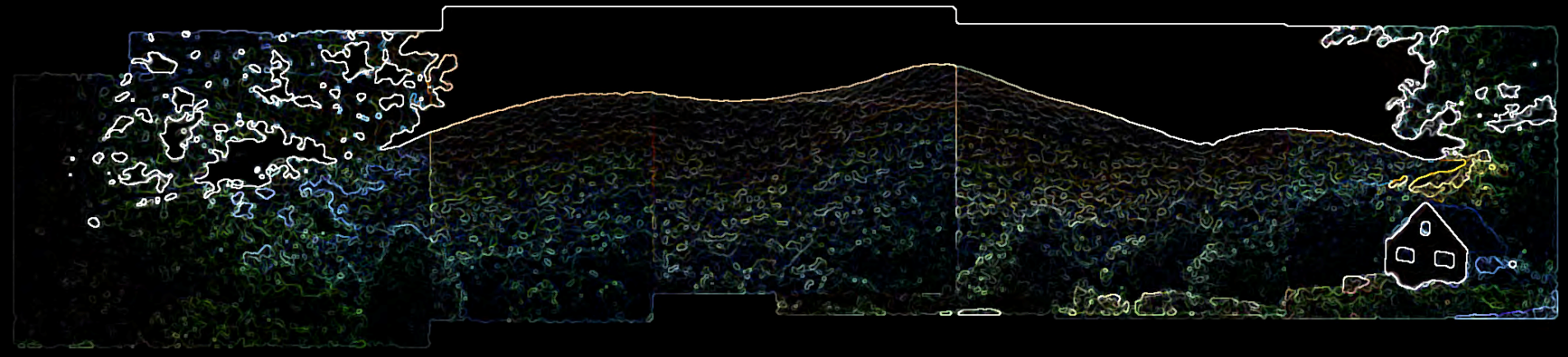


why?



summary sketch - sketchy summary

- winter temps are more important than summer temps
- important differences between species:
 - Atlantic white-cedar most temperature sensitive
 - phenological differences in temperature sensitivity
- gypsy moth has a strong multi-annual impact on growth rates
 - big trees have higher growth rates than smaller trees
 - latitude, not age, related to growth trends of NRO
- Harvard Forest has some of the lowest northern red oak growth rates in the northeastern US



summary sketch - sketchy summary

- evidence of old trees with accelerated growth across E. US
- northern red oak growth rates positively correlated with age
- Atlantic white cedar has accelerated growth since the 1920s, which is strongly tied to temperature

Yes - growth rates in E US have changed for 5 species
and Old Age does not slow tree growth



Eastern Kentucky University Dept. of Biological Sciences



Eastern Kentucky University
Dept. of Biological Sciences

