



Discussion corner:

***DELAYED EFFECTS OF CLIMATE HAZARDS
ON TREE GROWTH AND HEALTH:
IMPORTANCE AND A FEW HYPOTHESES***

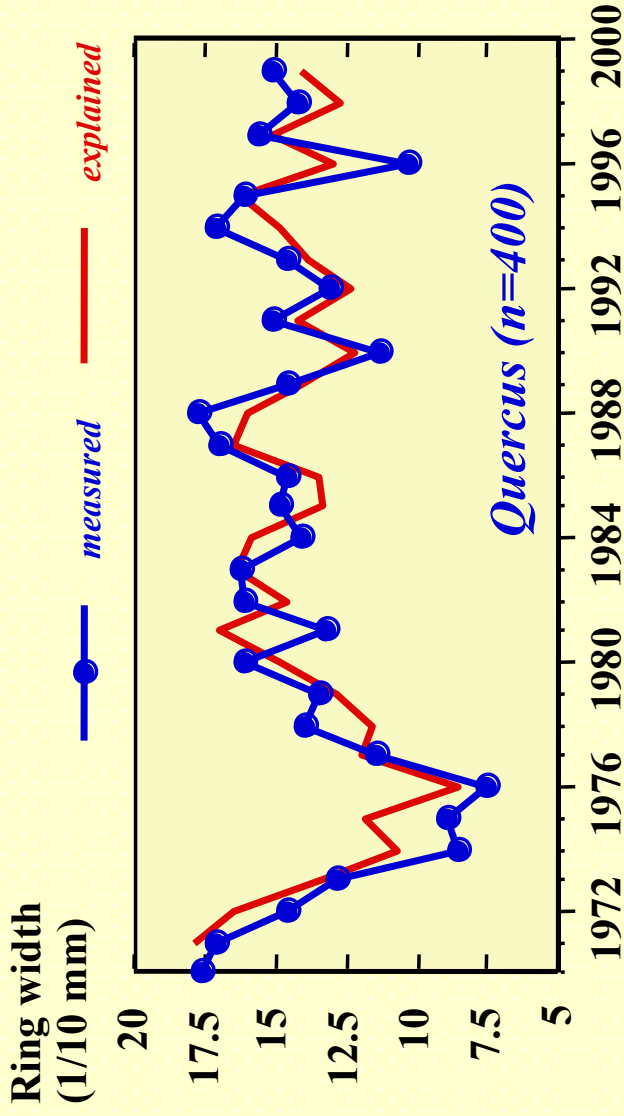
Moderator: Erwin Dreyer, INRA

Discussion:

1. Delayed effects on growth: facts or artifacts? Duration?
2. Monitoring and recording delayed effects (not only on tree rings)
3. Hypotheses? Observations? Experiments? Modelling?

A few observations...

Radial growth and soil water deficit



<i>Quercus</i> sp. (n=400)	Variable	Coefficient	%explained
	constant	2.453	
	Ring width previous year	0.376	54.0
	Summer soil water deficit	-0.109	18.7
	Tmax-July	0.365	5.0
			77.7

From Bréda & Barbaroux,
Oak from 20 stands
in Fontainebleau forest,
France

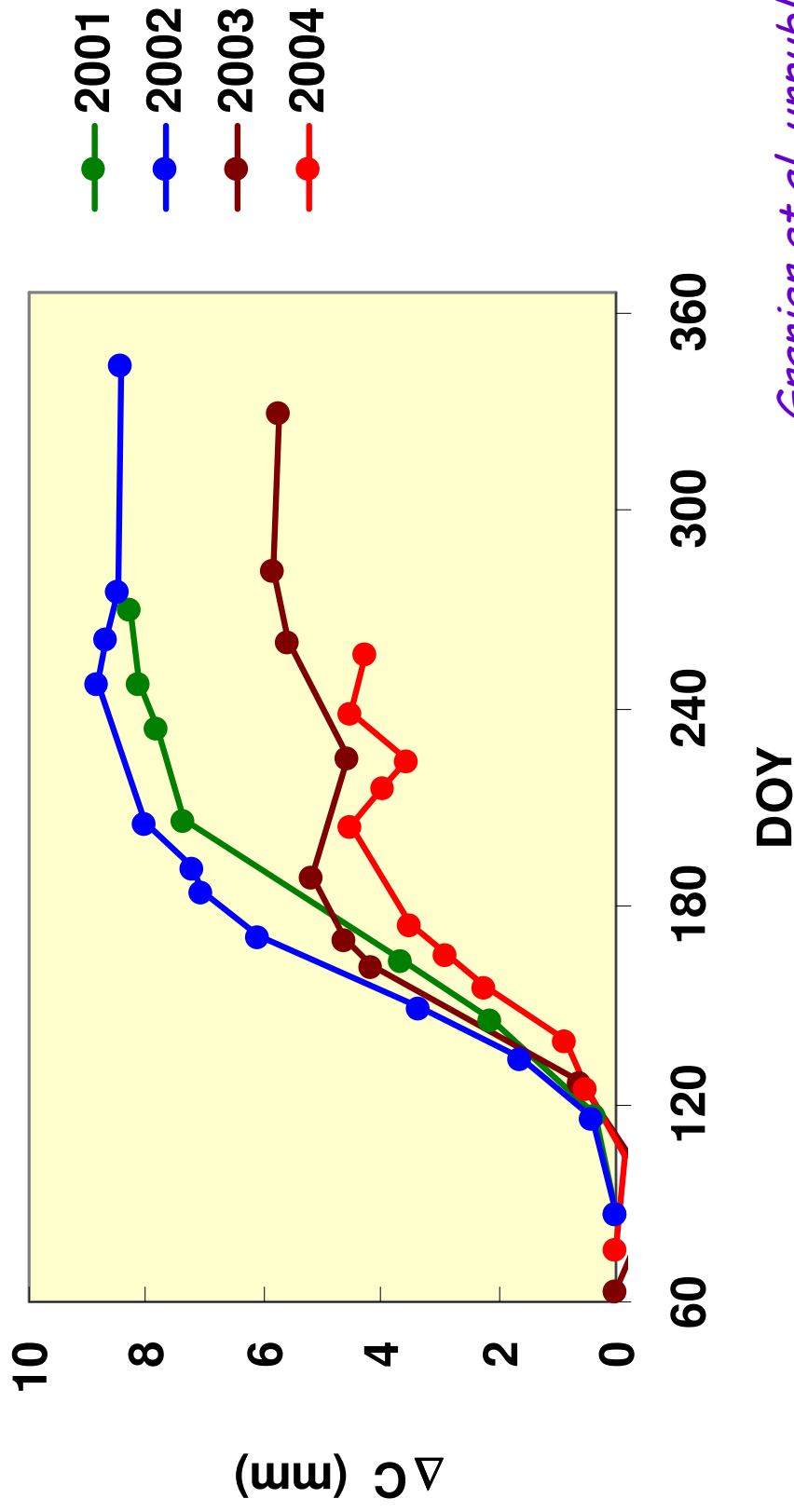
1. Delayed effects on growth: facts or artifacts? Duration?

- Autocorrelations...
- Growth inertia...
- Time lag effects...
- Recovery from stress... vs. slow decline.
- Very general phenomenon
- Species related? No clear evidence despite some claims (large variability depending on local conditions)
- Duration: several (?) years.

2. Monitoring delayed effects on growth

Delayed effects of the 2003 drought on carbon uptake and tree growth

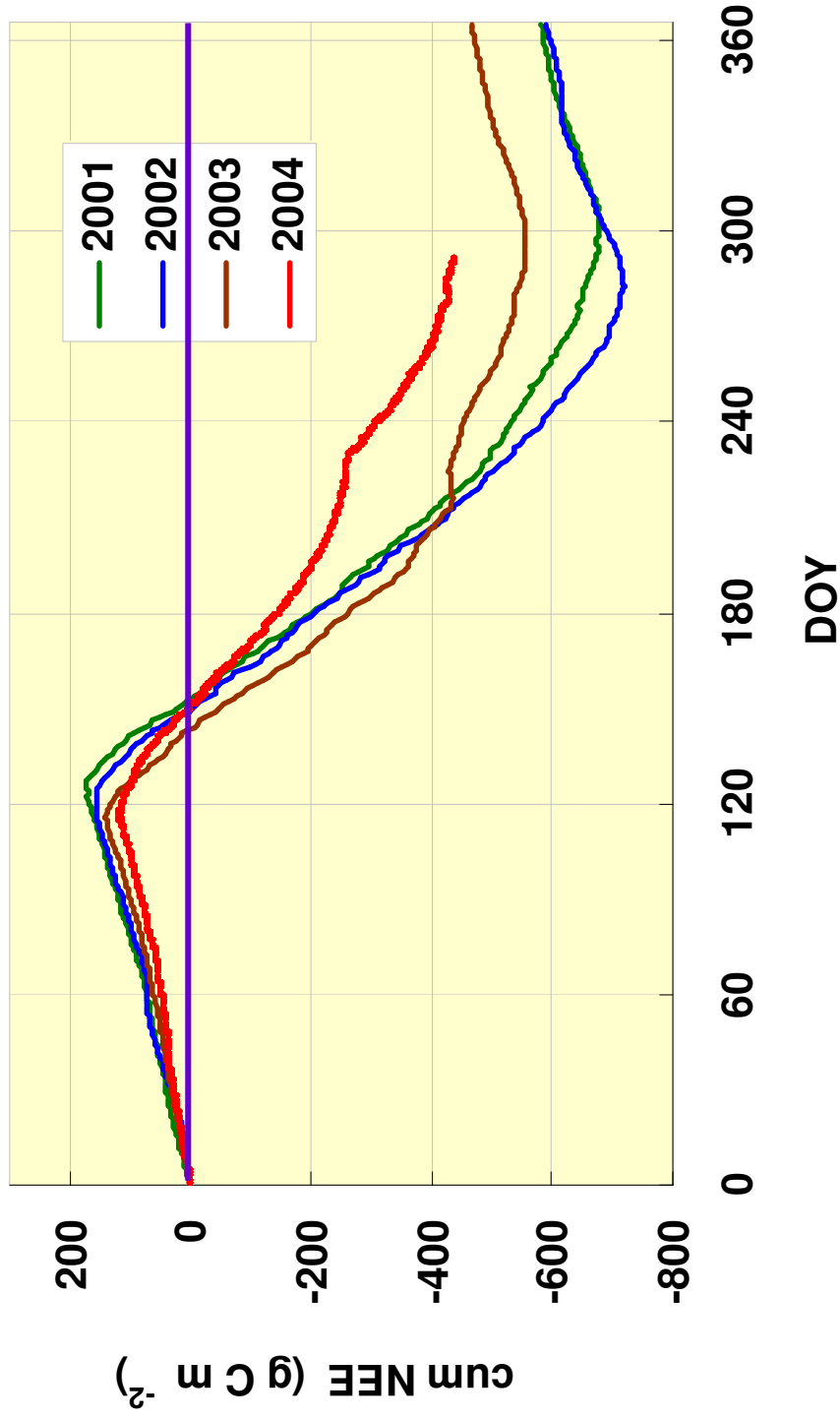
Circumference increment at Hesse (373 trees)



Granier et al. unpublished

Drought and heat 2003 (Freiburg)

Cumulated NEE at Hesse (*Fagus sylvatica*)



2. Monitoring delayed effects on growth

- Dendroecology
- Much less data from growth (biomass) analysis
- Change in allocation patterns or change in biomass accumulation? Probably both!
- Data on roots urgently needed!

3. Causes? Hypotheses, experimental evidence modelling

3. Causes for the delayed effects on growth

- Endogenous: impaired carbon balance and storage at tree level
- Exogenous: secondary pathogens, insects, increased sensitivity to other climate hazards (freezing)... that may also impair carbon balance

**Reduced carbon balance
at tree level:
hypothesis
modelling
observations**

Hypothesis:

The stored carbon cannot cover the cost of

1. maintenance
2. construction of new organs during following spring

Cumulative effects:

1. reduced LAI
2. reduced carbon assimilation
3. amplification of the deficit and decline

or : gradual recovery after several years of reduced growth

Experimental demonstration:

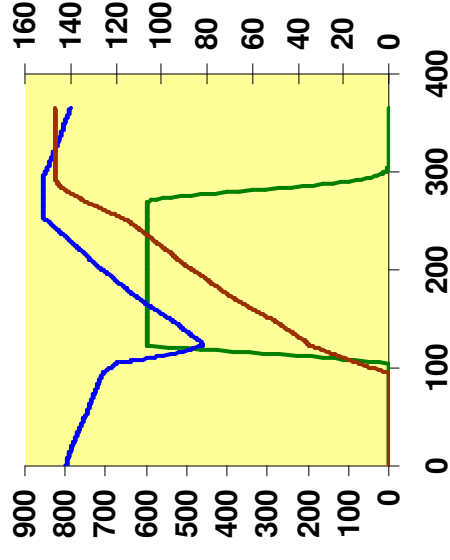
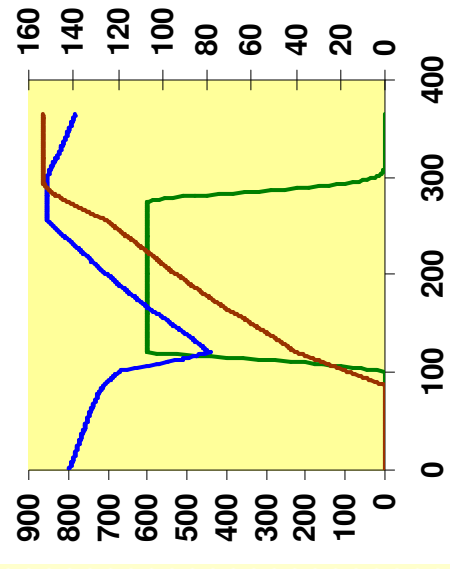
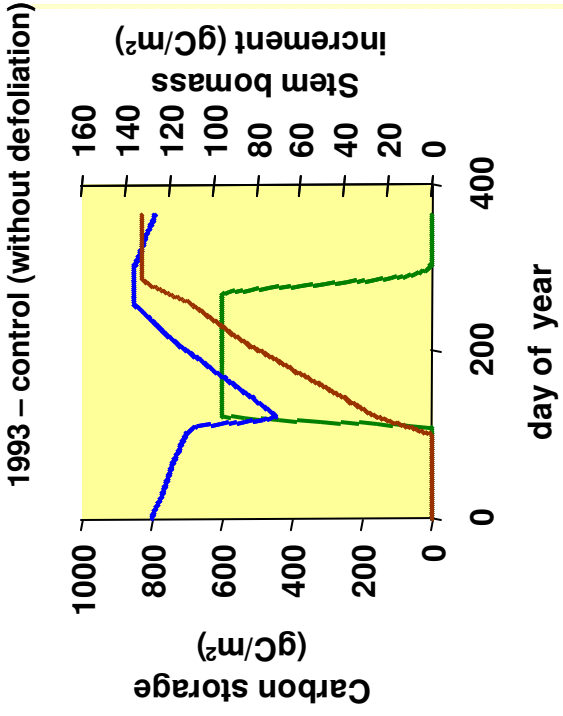
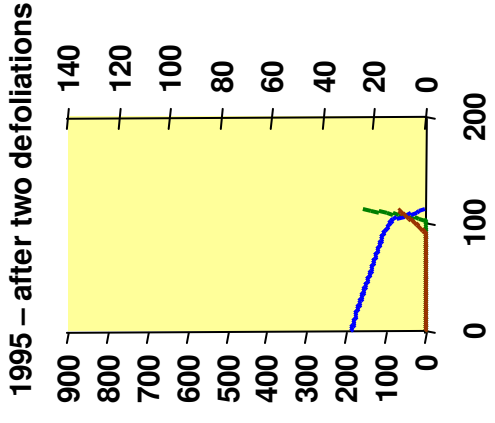
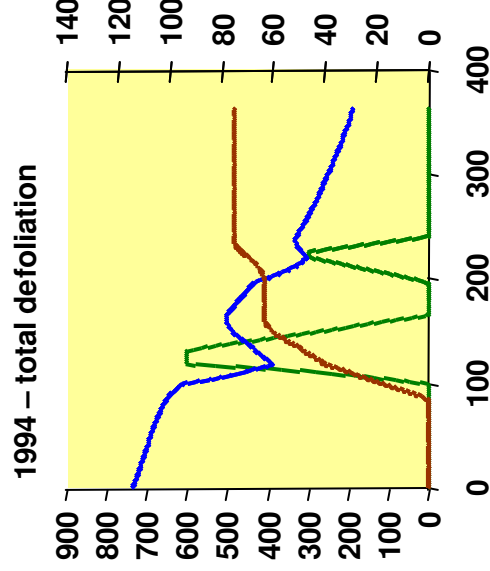
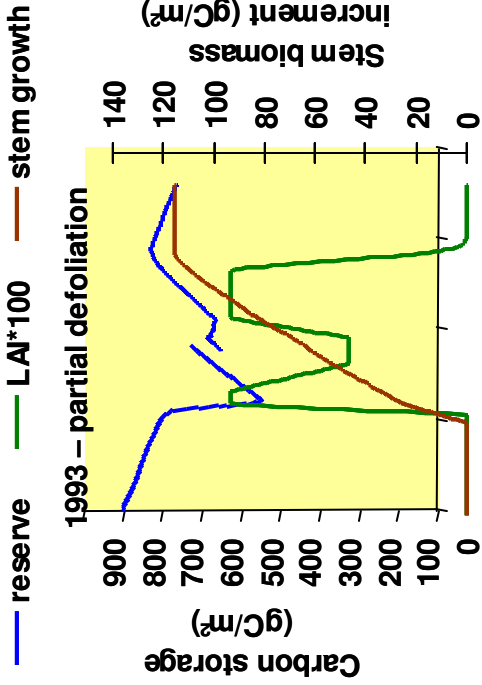
Very difficult

1. defoliation experiments
2. estimating the amount of stored and remobilisable C at whole tree scale is very difficult
3. death of a tree?

Carbon balance modelling to test hypothesis

After two successive defoliations
by caterpillars, could the
restricted amount of carbon
reserve be responsible for oak
mortality ?

From Bréda, Dufrêne & Barbaroux,
Oak stand in Haguenu forest, France



Causes of carbon balance impairment

Changes in allocation patterns
roots
fruits (associated costs)
Hydraulic constraints (reduced
ring width and sapwood
area, twig decline, branching
architecture)

Causes of carbon balance impairment

Reduced leaf area index

Changed phenology (bud burst)

...

From tree to stand scale

- **Competition and shifts in stand structure**
- **Associated vegetation recovers faster?**
- **Genetics: changes in population composition.**



(Temporary) conclusion

**Missing data for some compartments
(roots)**

**Consequences for management: how
predict recovery of trees after
drought?**

...

18/11/04

Drought and heat 2003 (Freiburg)

20