# Discussion corner 1

Carbon and water cycle monitoring
– potential contribution to our understanding of the impact of drought and climate hazards on the processes of primary production in forests

Moderator: Marcus Lindner (European Forest Institute)

Motivation

- Ecosystem experiments and other measurement programmes ongoing in 2003 have been observing impacts of an extreme climate event in-situ at the scale of organs, trees, ecosystems, ... to the continental or global scale

- The unplanned experiment Drought 2003 offers a unique opportunity to learn about processes driving production, survival, competitive relationships
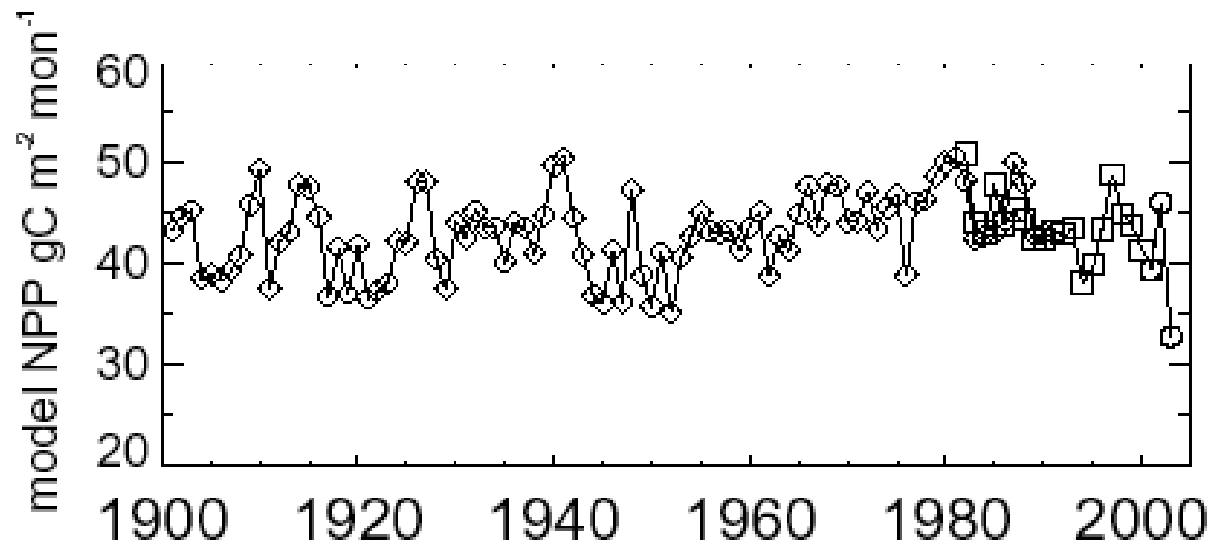
2003 - an unprecedented decrease in NPP across Europe over the past century (Ciais et al. Manuscript)

The last two decades have shown an increase in NPP in the Northern Hemisphere (e.g. Myneni et al. 1997 and 2001)

Increased growth of forests (Spiecker et al. 1996, RECOGNITION Project) explains fair part of "missing carbon sink" (Janssens et al. 2003)

Observations ...

- differences between tree species
- differences between sites (exposition, slope, soil type, elevation)

  ➢ what can we learn about competition between species and future responses to climate change???

Species differences in drought responses

- direct effects and delayed effects (Discussion corner 3...)

- is it too early to draw conclusions?

Yes, but we can still learn about processes!

Some examples   (1)

- difference between beech and spruce – coniferous species deplete soil water store earlier. One more month of water stress expected under coniferous species.

- Comparison of pine and beech – pine has a hotter stand climate than beech. Beech has beneficial influence on water balance.

- Pine is able to respond quickly once drought is over. Other species respond more slowly

Some examples   (2)

- Some species fluctuate a lot in their productivity (beech, silver fir, …) whereas others remain more or less at a similar level (spruce, oak)

- Oak is using reserves for the early growth – this induces some time lags in the response to drought

- Living sapwood area restricts water conductivity – after several years of stress, possibility for rehabilitation is limited.

Take home messages from this section...

- Many expect oak to suffer more than beech in the long run, but so far oak does not show so much wide-spread responses (but some local mortality)
- Beech is growing in quite wide range of environments, but carbon and water dynamics are quite similar everywhere. However, few sites close to physiological limit have been investigated
- Beech was more affected by defoliation in 2004, but also pests and blossoming/fruit production played a role

More examples?

- the participants of the discussion corner had only limited experience.

- Many relevant experimentally working groups were not present.

- It would be very useful to intensify contacts between different communities...

Methodological considerations

- ground truth information is important to check/validate model projections Recognition project: nitrogen deposition was the most important factor explaining increased growth of European forests in the 1990s. However, climate change impacts are expected to become more relevant in the future

- certain processes like time lag effects and interactions with pests and diseases can not be incorporated in simulation models

Methodological considerations (2)

- Eddy Covariance measurements have only been started around 1996 and are lacking long time series. Coverage of forest types and age classes has improved, but total number of sites is still relatively small (expensive!)

- most valuable results come from flux sites like Hesse where EC was combined with dendrochronological studies, soils and root investigations...

- there should be more integration of research to combine the strengths of different approaches

Methodological considerations (3)

Genetics are probably important!

- Provenance trials potentially interesting data basis, available in many countries, but not yet fully utilized.

- However, relationship between genetics and growth characteristics under different climate not well established.

Questions remaining...

- How do trees adapt to climate conditions? Can we incorporate the ability of trees to adapt to climate change into modelling approaches?

- ...