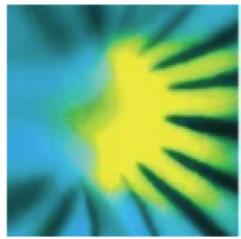


# Eco-Evolutionary Optimality (EEO) Models



# New Phytologist

Tansley review | **Free Access**

## Eco-evolutionary optimality as a means to improve vegetation and land-surface models

Sandy P. Harrison , Wolfgang Cramer, Oskar Franklin, Iain Colin Prentice, Han Wang, Åke Bränström, Hugo de Boer, Ulf Dieckmann, Jaideep Joshi, Trevor F. Keenan, Aliénor Lavergne ... See all authors

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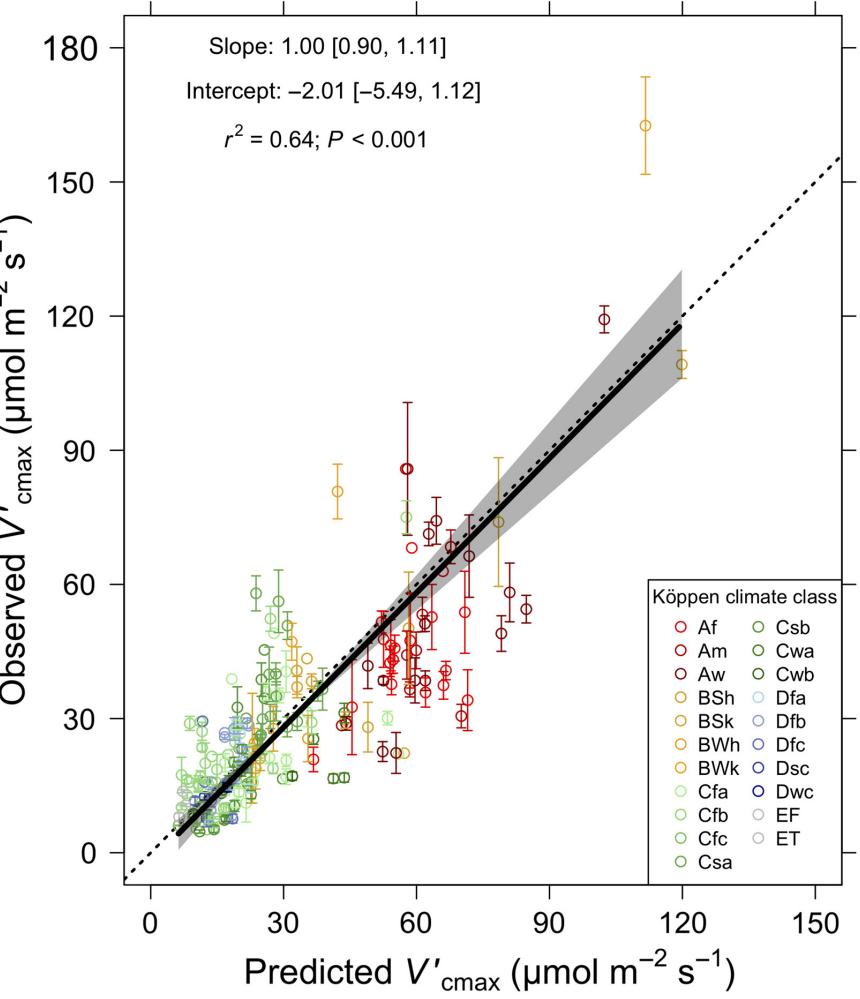
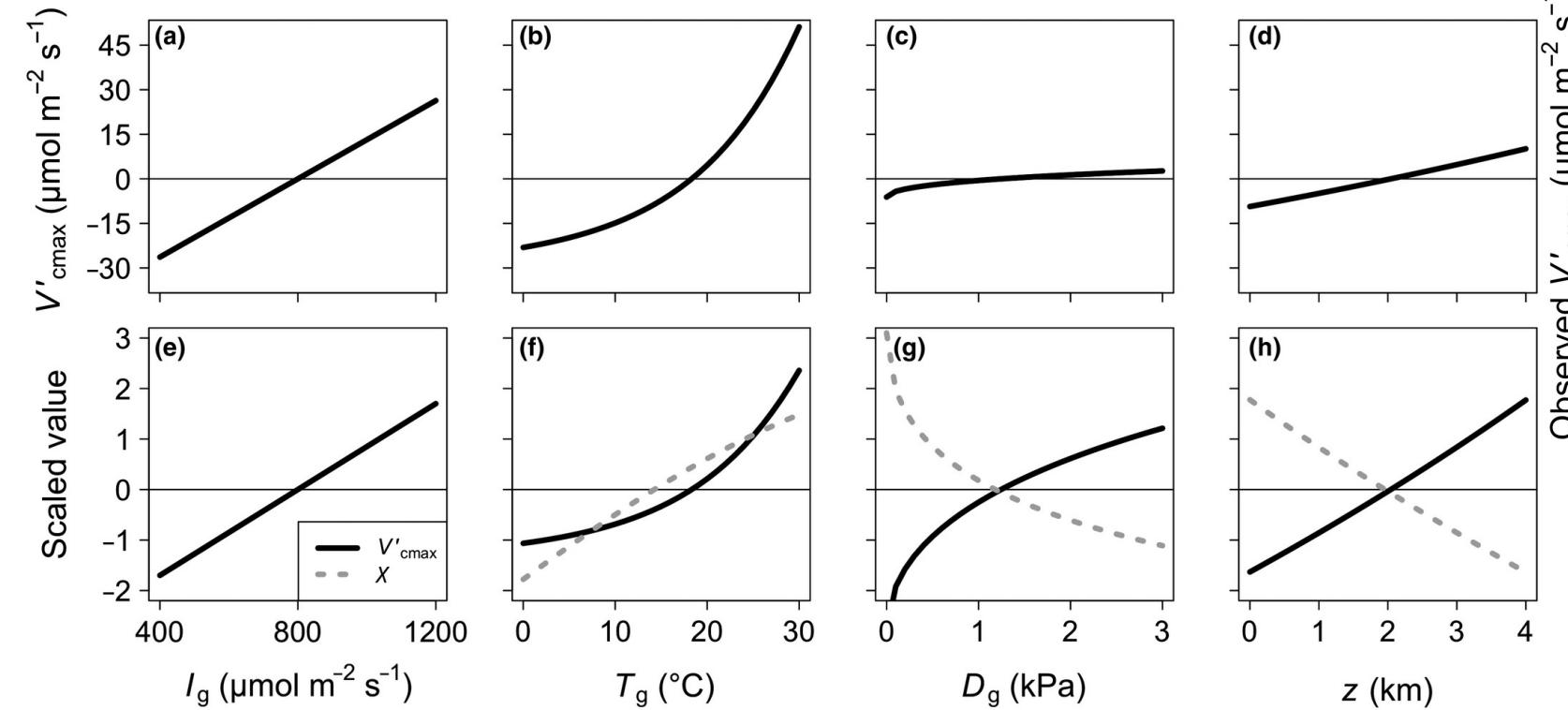
EEO invokes the power of natural selection to eliminate uncompetitive trait combinations, and thereby shape predictable, general patterns in vegetation structure and competition.

# Where'd the name EEO come from?

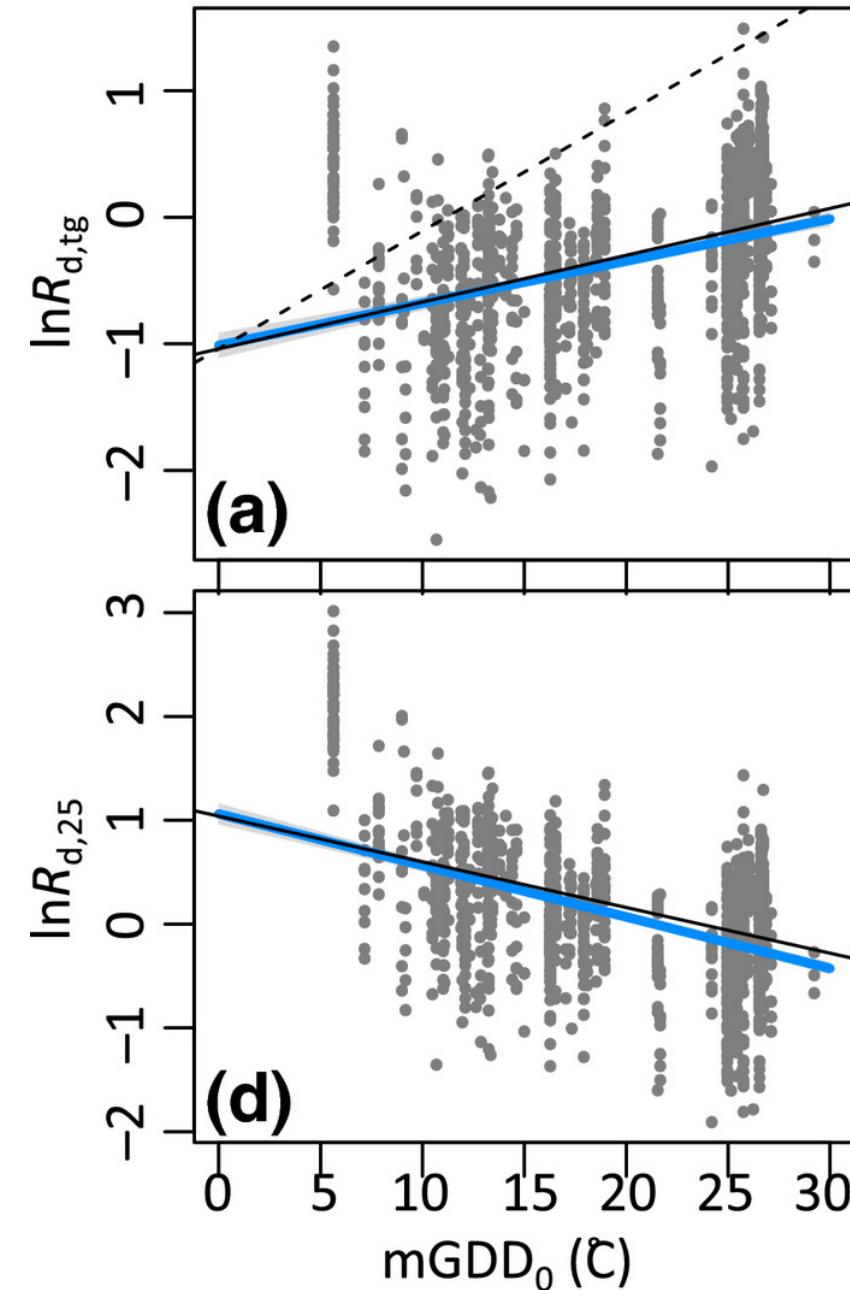
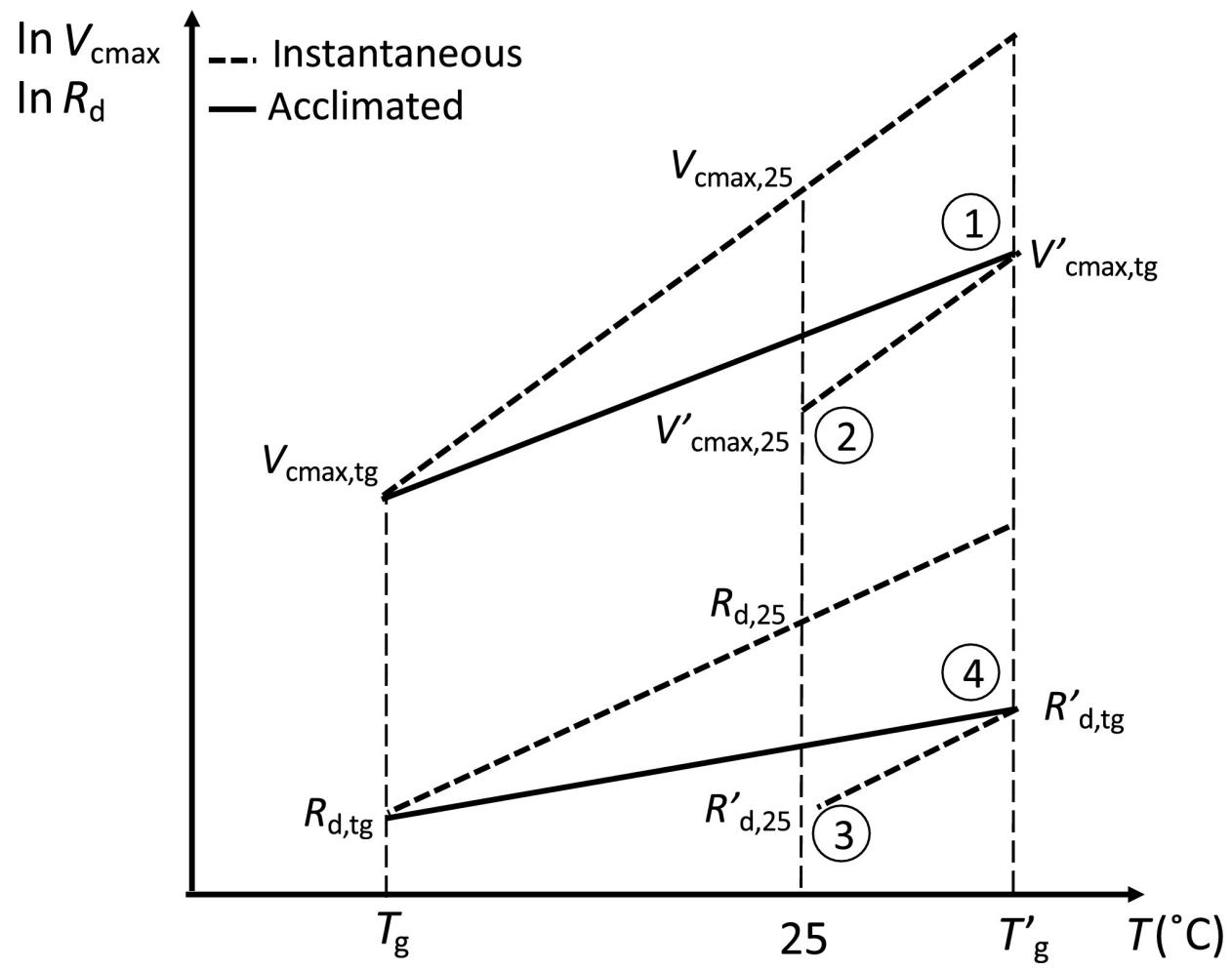
- **Eco**: trait adjustments can happen through ecophysiological responses on short time scales
- **Evo**: trait adjustments can occur over evolutionary time scales

Some EEO examples

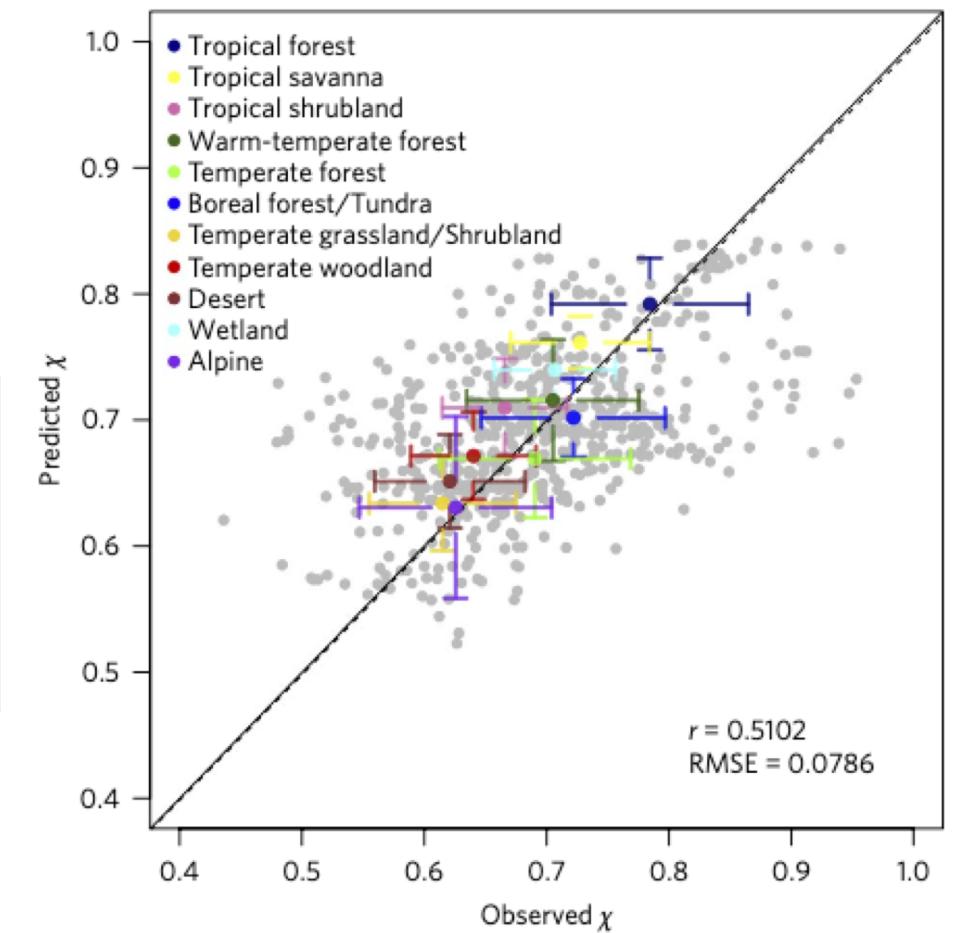
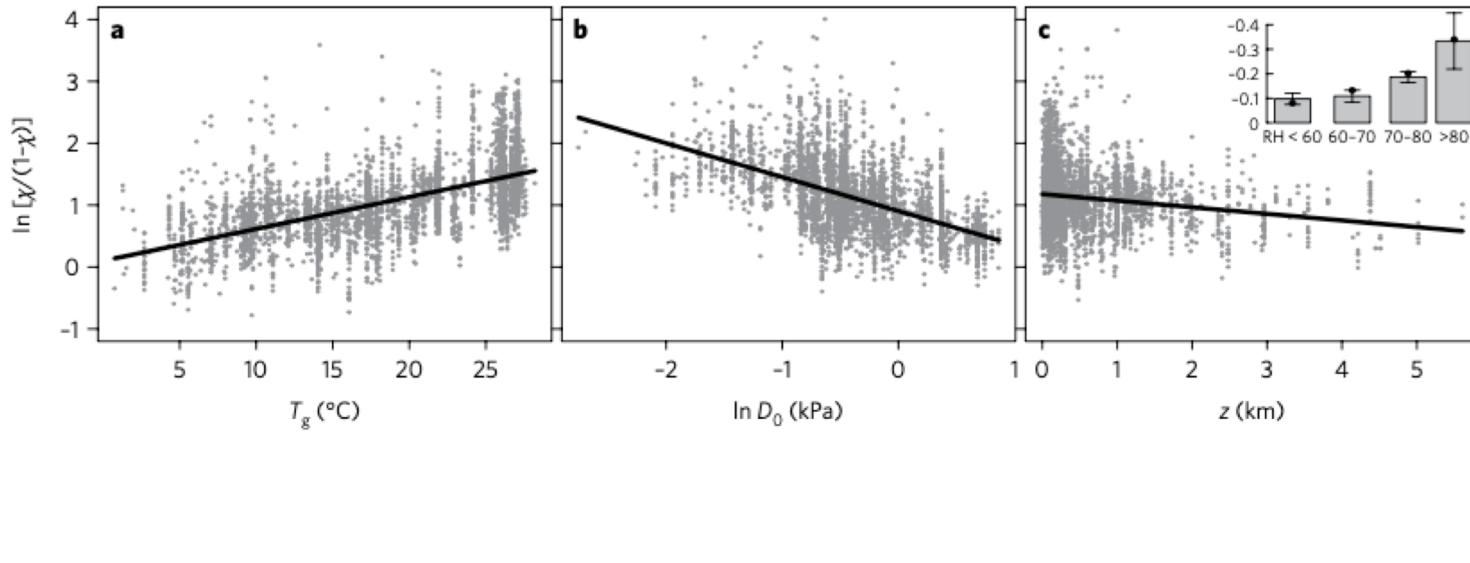
# Photosynthetic capacity



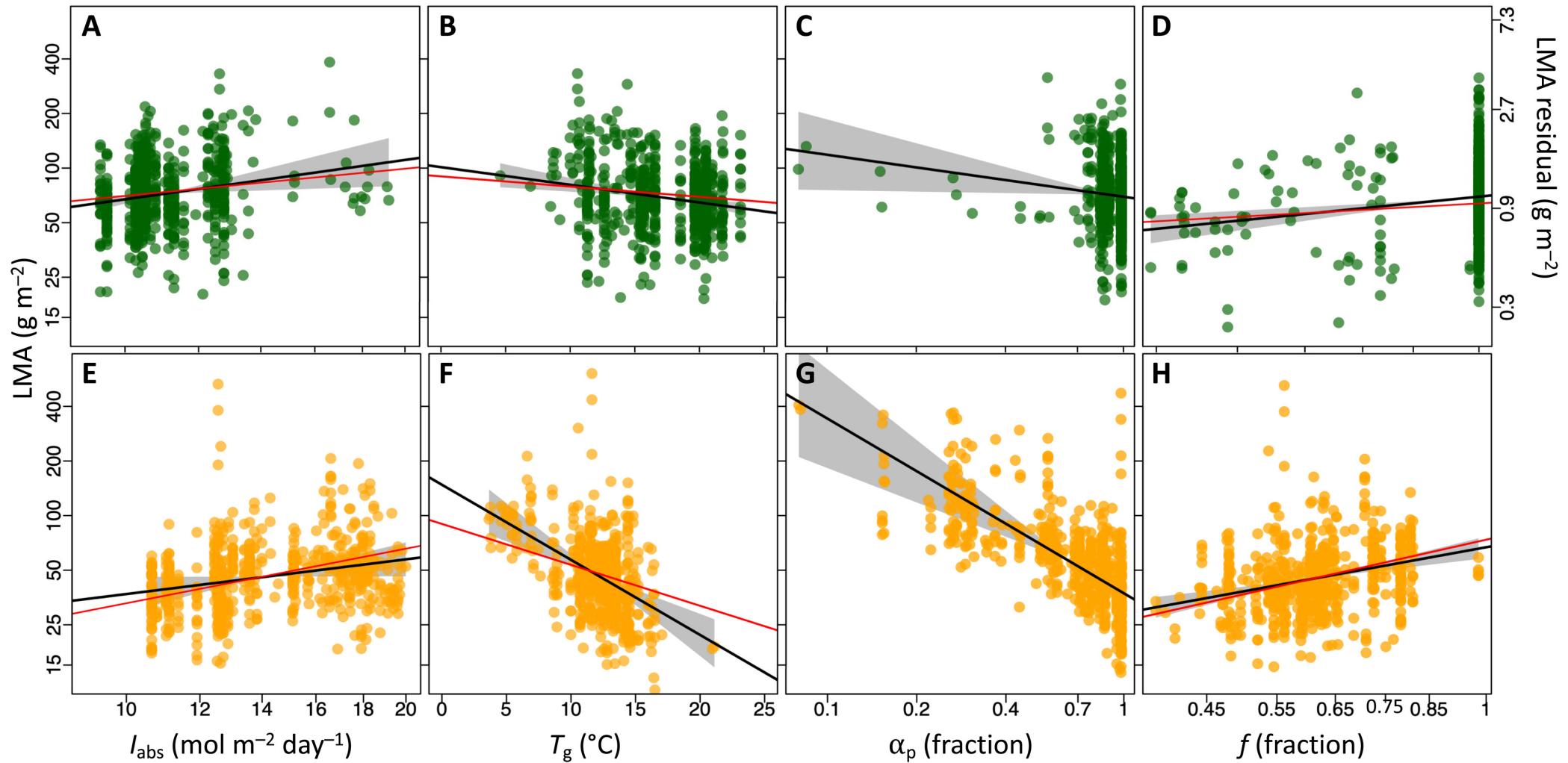
# Dark respiration



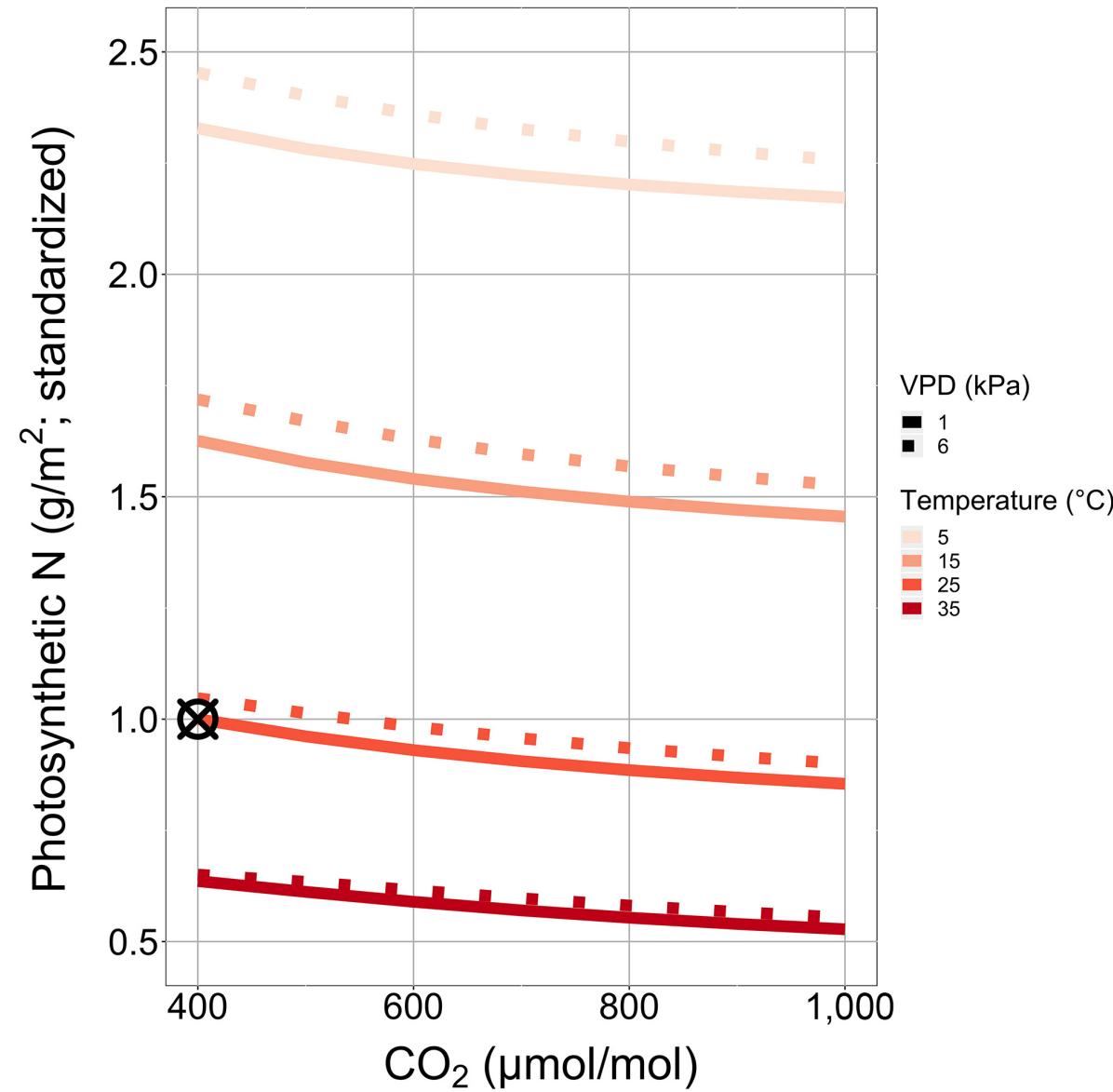
# Stomata



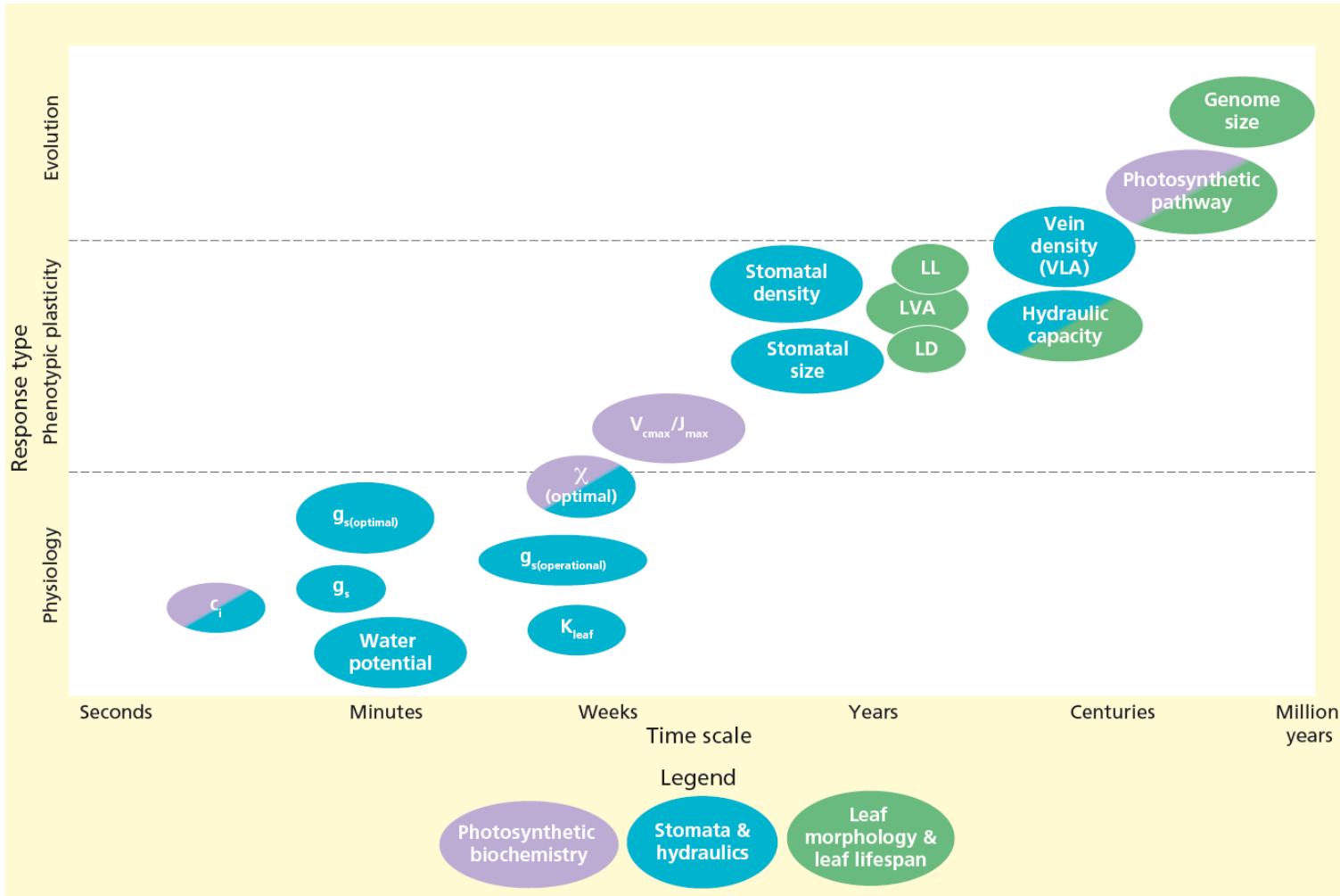
# LMA

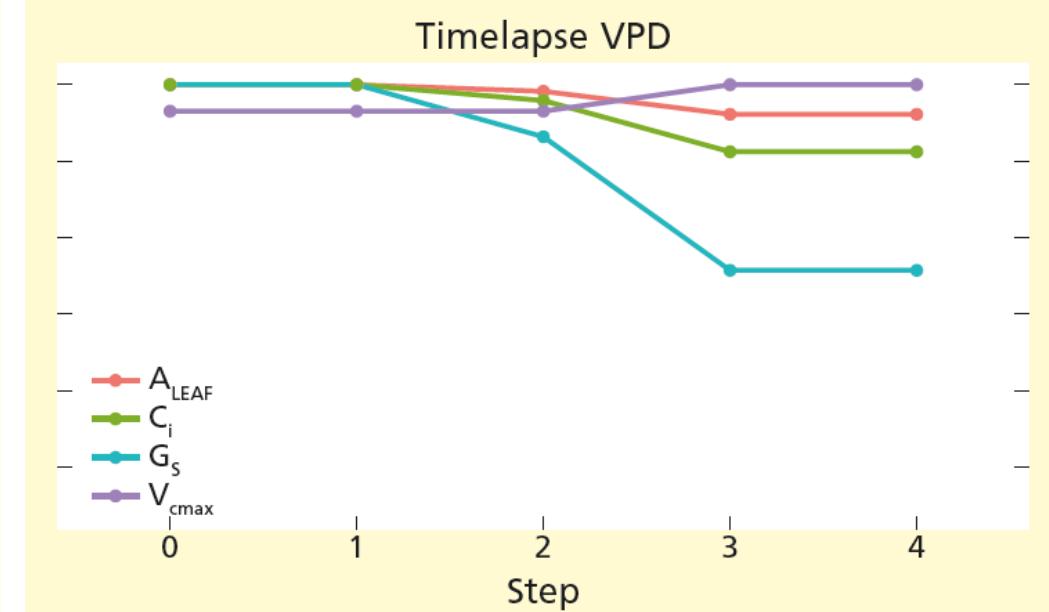
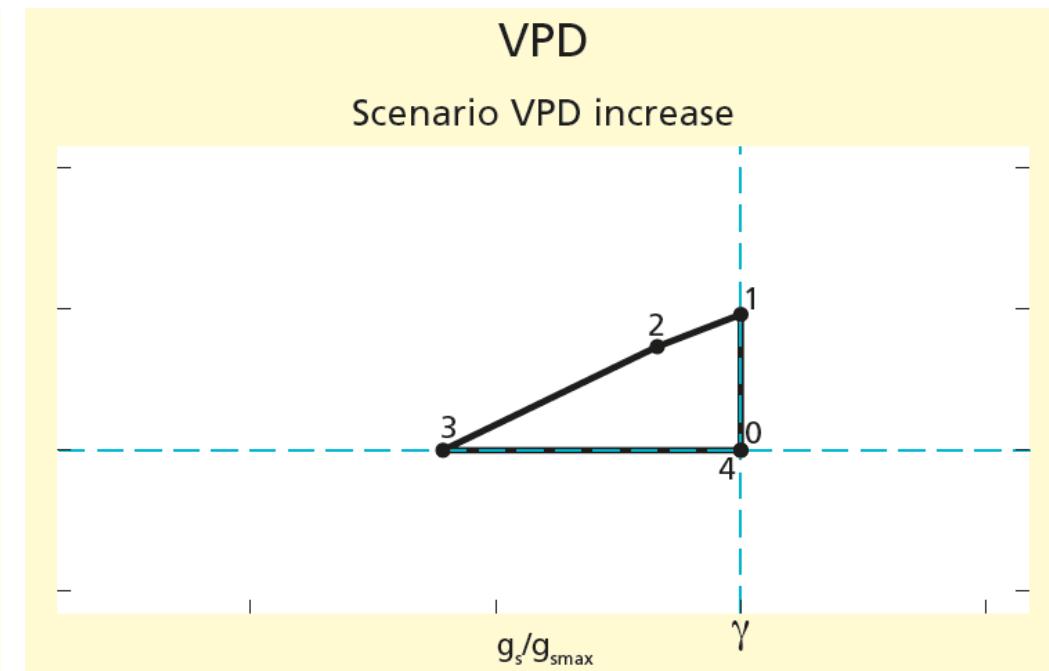
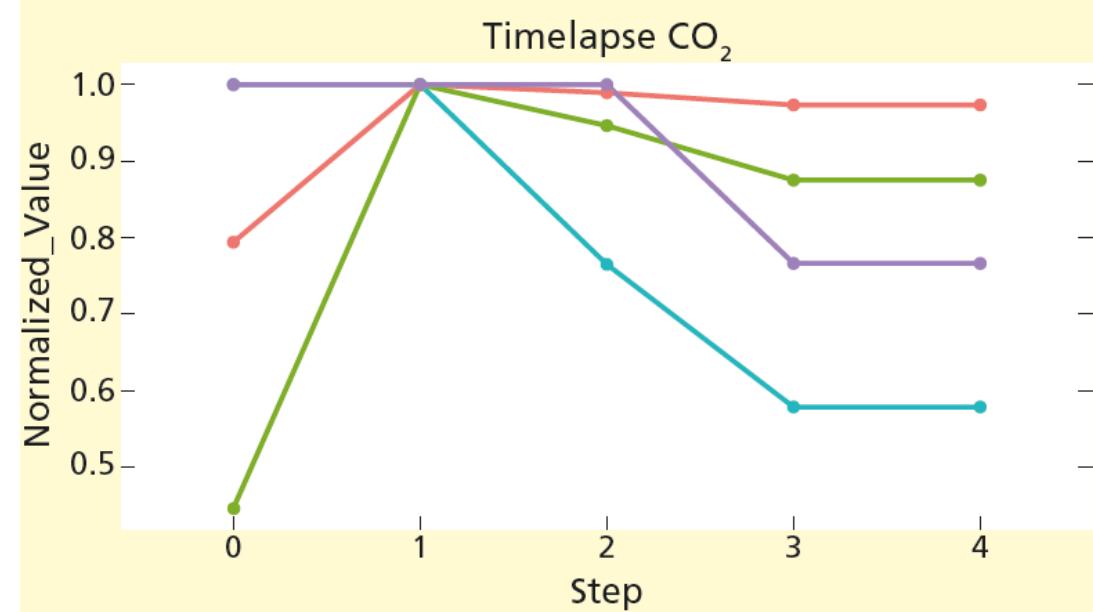
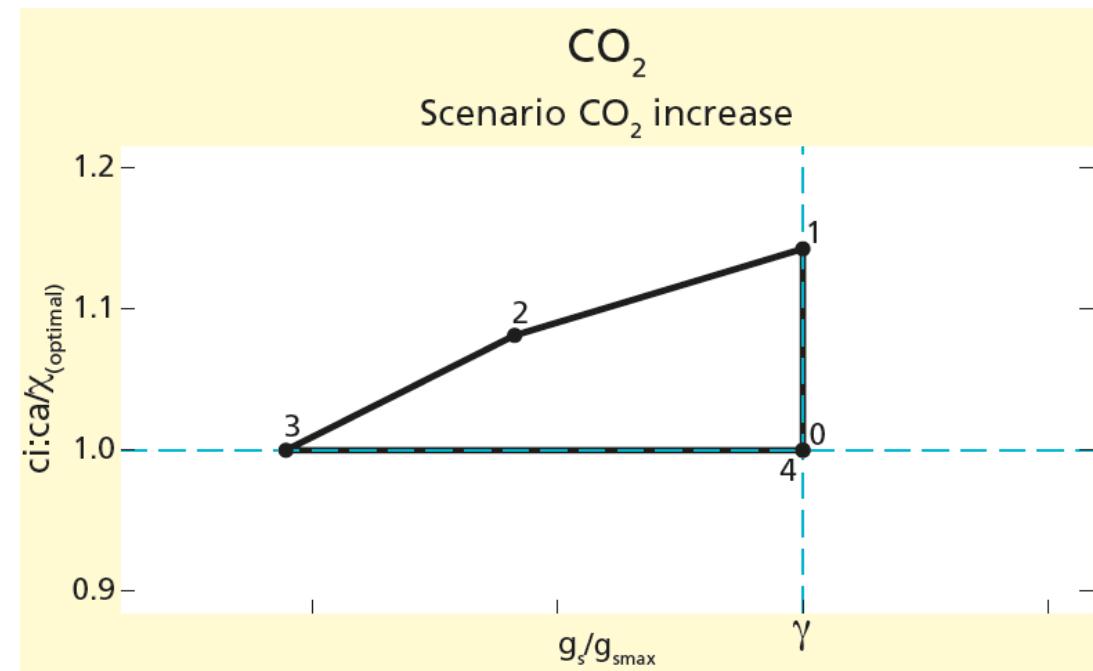


# Leaf N



# Timescale sidebar: there could be many!





EEO hypothesis development is based on trade-offs. Does your module process represent a trade-off?

# Model development problems and solutions

- **Problem:** models do not encapsulate a coherent body of theory
- **Solution:** integrate testable theories and test one-by-one

# Model development problems and solutions

- **Problem:** lack of clarity about hypotheses
- **Solution:** test processes independently

# Model development problems and solutions

- **Problem:** core process representations tend to be conserved
- **Solution:** revisit and reevaluate core processes

# Model development problems and solutions

- **Problem:** neglect of available observations
- **Solution:** use observations to test core assumptions (experiments are critical!)

Does your module represent a  
testable theory?

# Moving beyond the leaf

- Carbon allocation
  - Allocation to limiting pool
- Soil-plant interactions and mycorrhizae
  - Additional allocation constraints
- Competition and coexistence
  - Game theory

# Outstanding issues

- Natural selection acts on reproductive fitness
- Limits on optimality are unknown
- Optimality is approached by different processes
- Dispersal/migration and absent species
- Experiments are important
- Fire and land use are difficult to deal with