

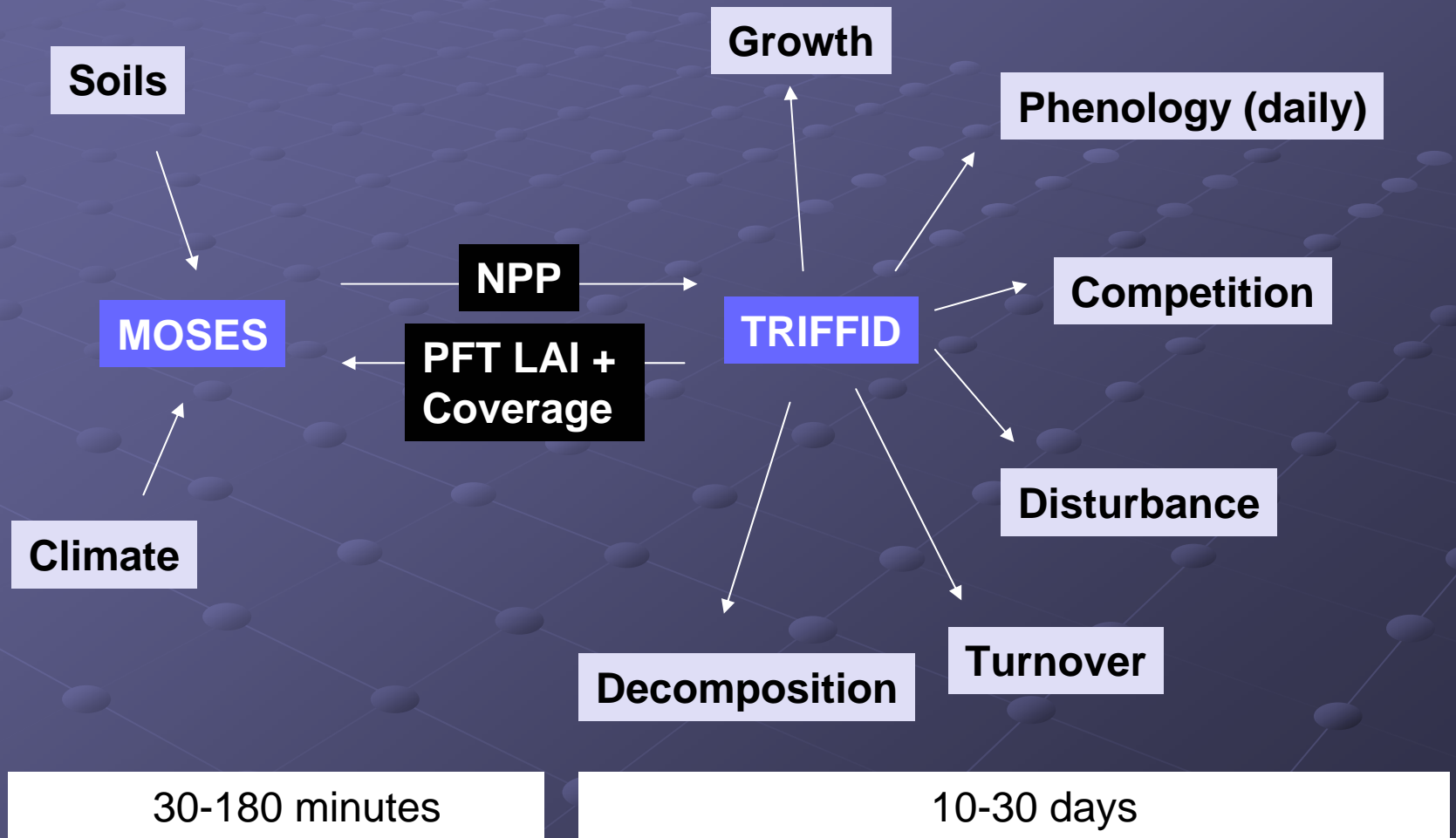
Vegetation Dynamics in JULES v2.0: The TRIFFID model.

Rosie Fisher
Stephen Sitch
David Galbraith
Chris Huntingford

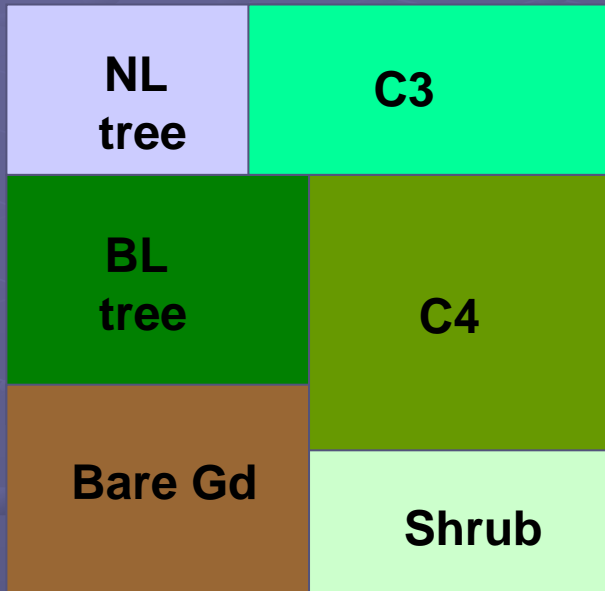
TRIFFID history

- TRIFFID is the global vegetation model embedded in the Hadley Centre GCM & JULES.
- TRIFFID is similar (not identical) to the majority of DGVMs in terms of physiology & PFT composition.
- Conceptually different in terms of vegetation competition & half-hourly gas exchange.

TRIFFID Structure in JULES



TRIFFID and PFT competition



Change in vegetation carbon

$$\frac{dC_v}{dt} = (1 - \lambda) \Pi - \Lambda_l$$

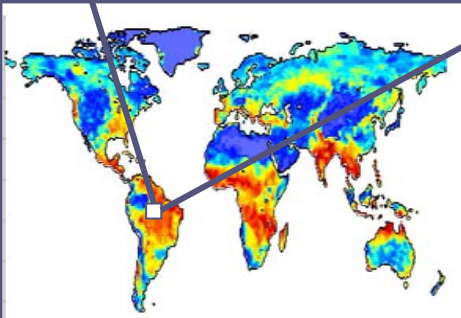
Area increase

NPP

Litter

Expansion of PFT area: Lotka Volterra

$$C_v \frac{dv}{dt} = \lambda \Pi v_* \left\{ 1 - \sum_j c_{ij} v_j \right\} - \gamma_v v_* C_v$$



PFT competition

- Competition parameters C_{ij}
- Define how PFT 'i' affects PFT 'j'
- 'Tree – shrub – grass' dominance hierarchy.
- These parameters are difficult to define...

Groups working with TRIFFID

- Hadley Centre JCHMR (HADGEM3)
 - First implementation of C-cycle in standard Hadley Model
- Reading – soil moisture parameters
- CLASSIC – snow modelling, physiology
- DGVM intercomparisons – Sitch, Friedlingstein, Cramer.

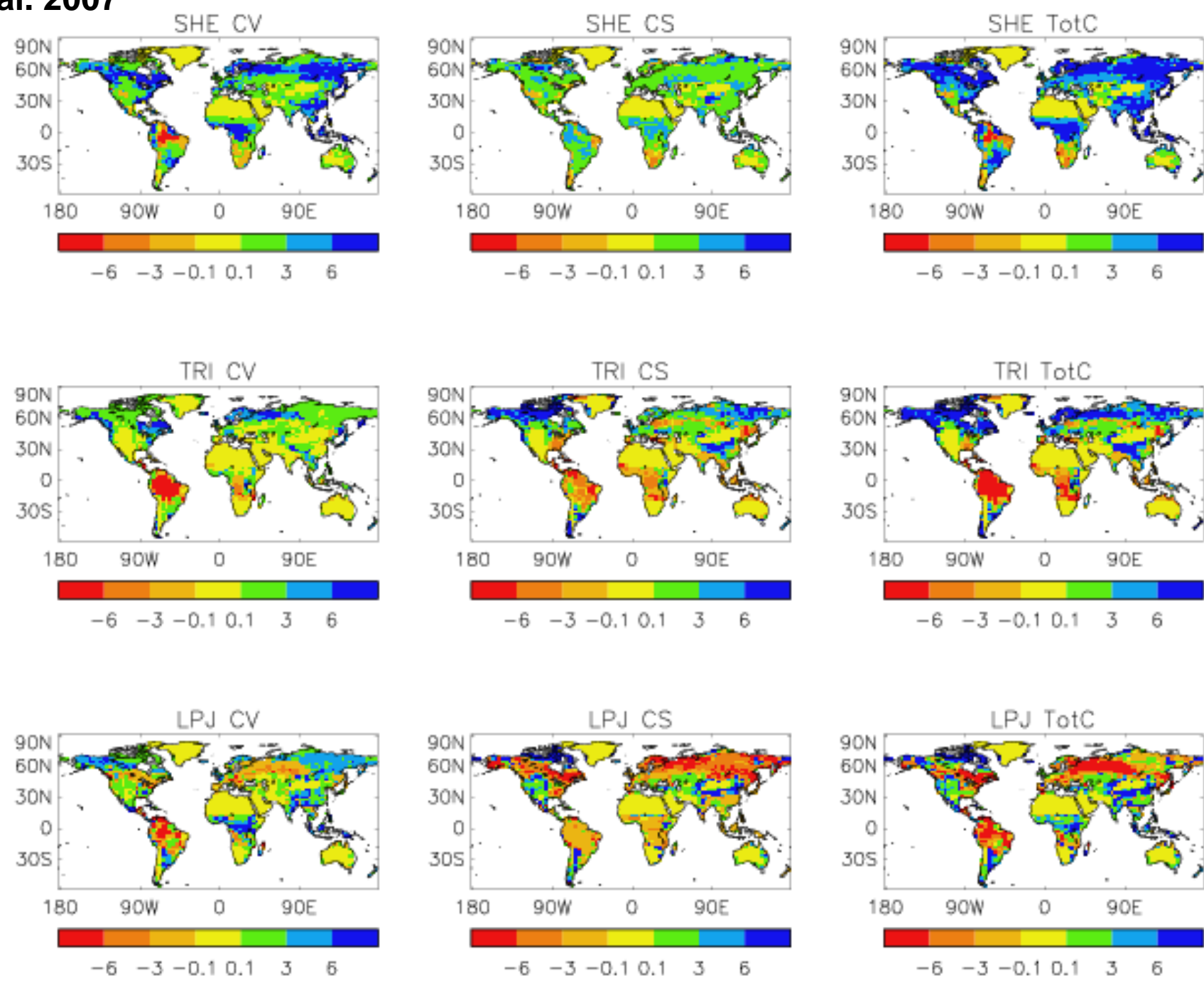
Results from TRIFFID

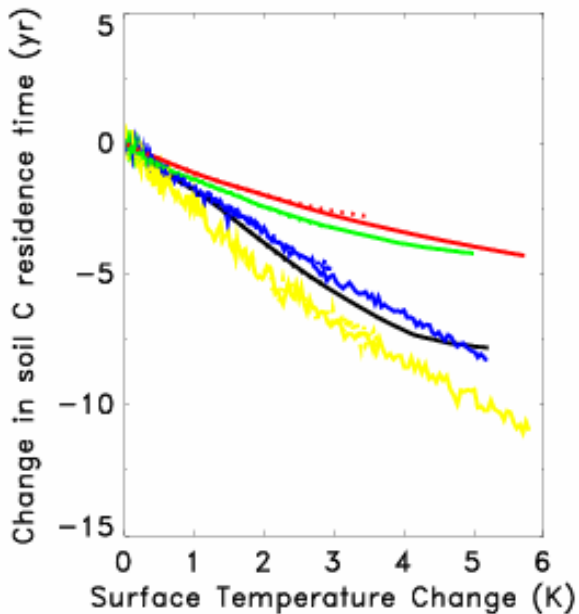
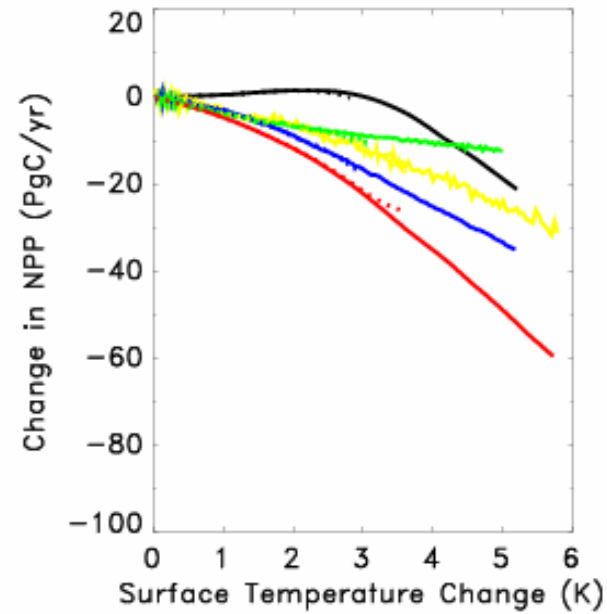
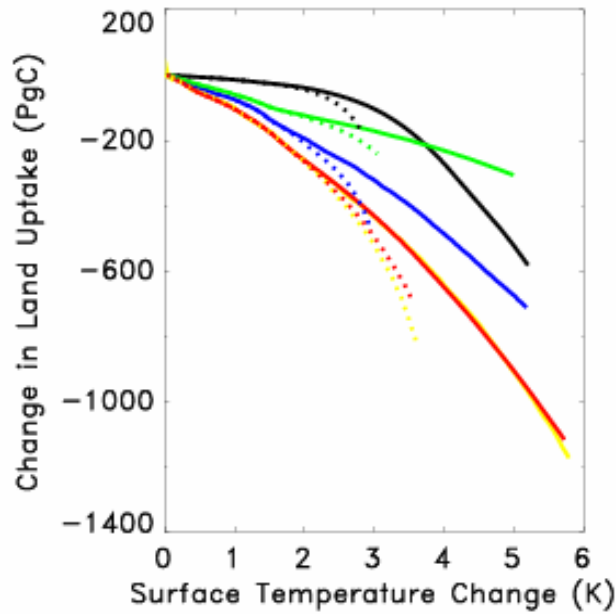
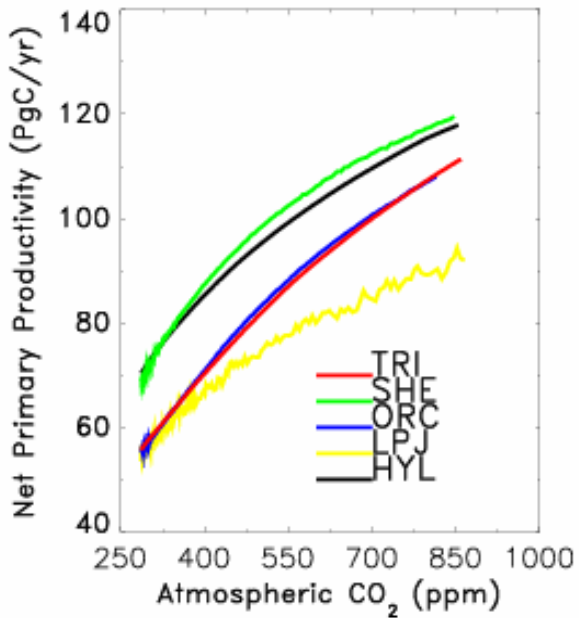
- Inter-comparison with other DGVMs in IMOGEN: Stephen Sitch
- Disaggregation of water and temperature responses in Amazonia: David Galbraith
- Acclimation of respiration to increasing temperature: Owen Atkin & Rosie Fisher

.1. DGVM inter comparison

Sitch et al 2007

- Compared 5 DGVMs with the same climate drivers within the IMOGEN framework.
- Previous inter-comparisons (C₄MIP) have used different GCM-DGVM pairs. This is a direct comparison
- Compare predicted change in land carbon over 21st century.
- Separate out the CO₂ and climate response.





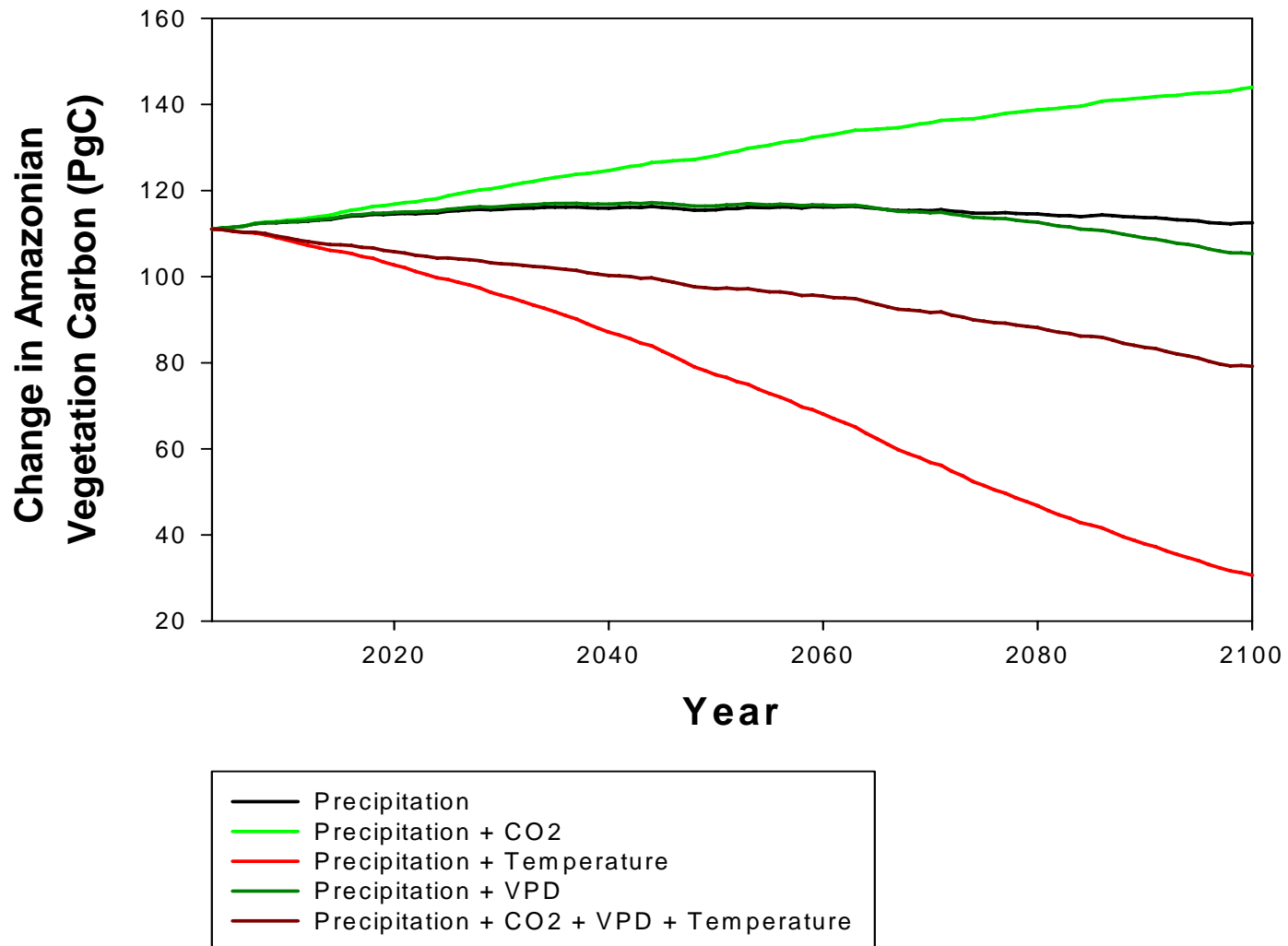
Conclusions:

TRIFFID is much more sensitive to climate changes than the 'mean' model response.

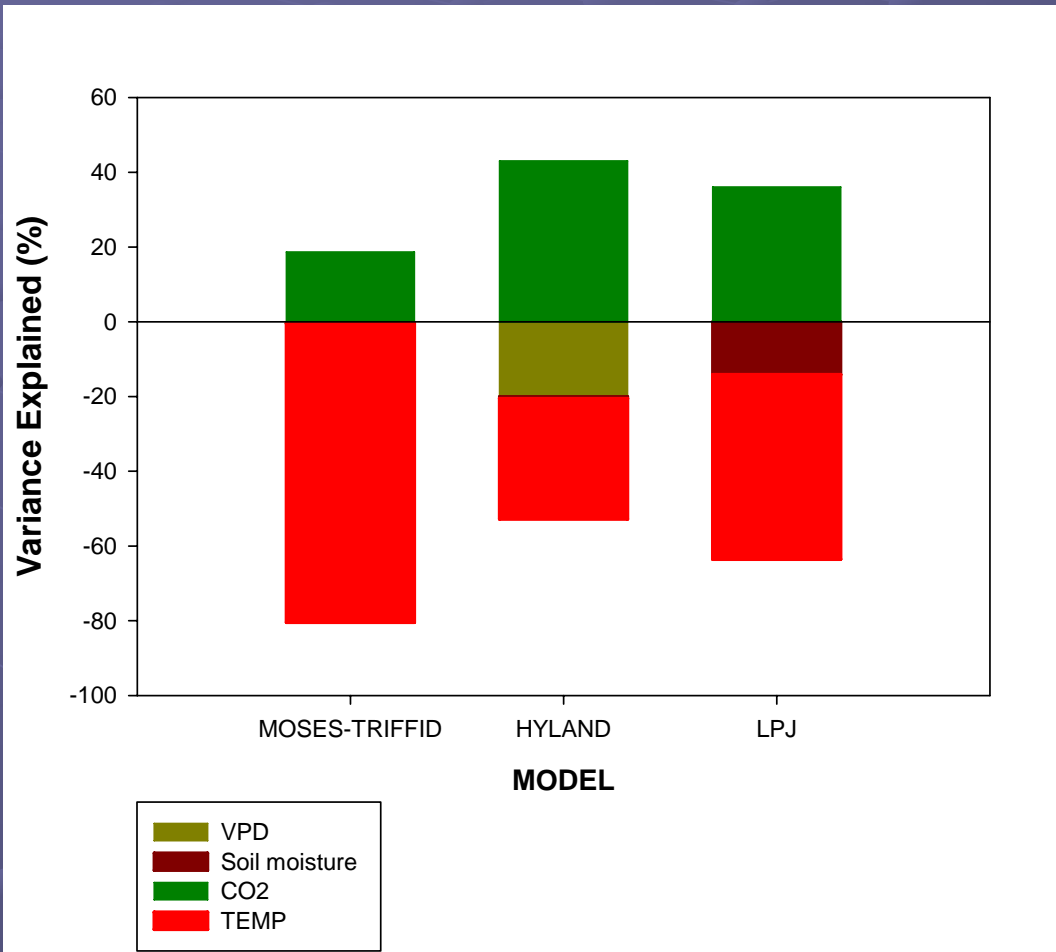
Why is this?

2. Interactions between climate drivers using MOSES-TRIFFID (40% Precip Reduction to 2100)

Slides by David Galbraith



Interactions with other climate drivers: Partitioning the 'dieback' response

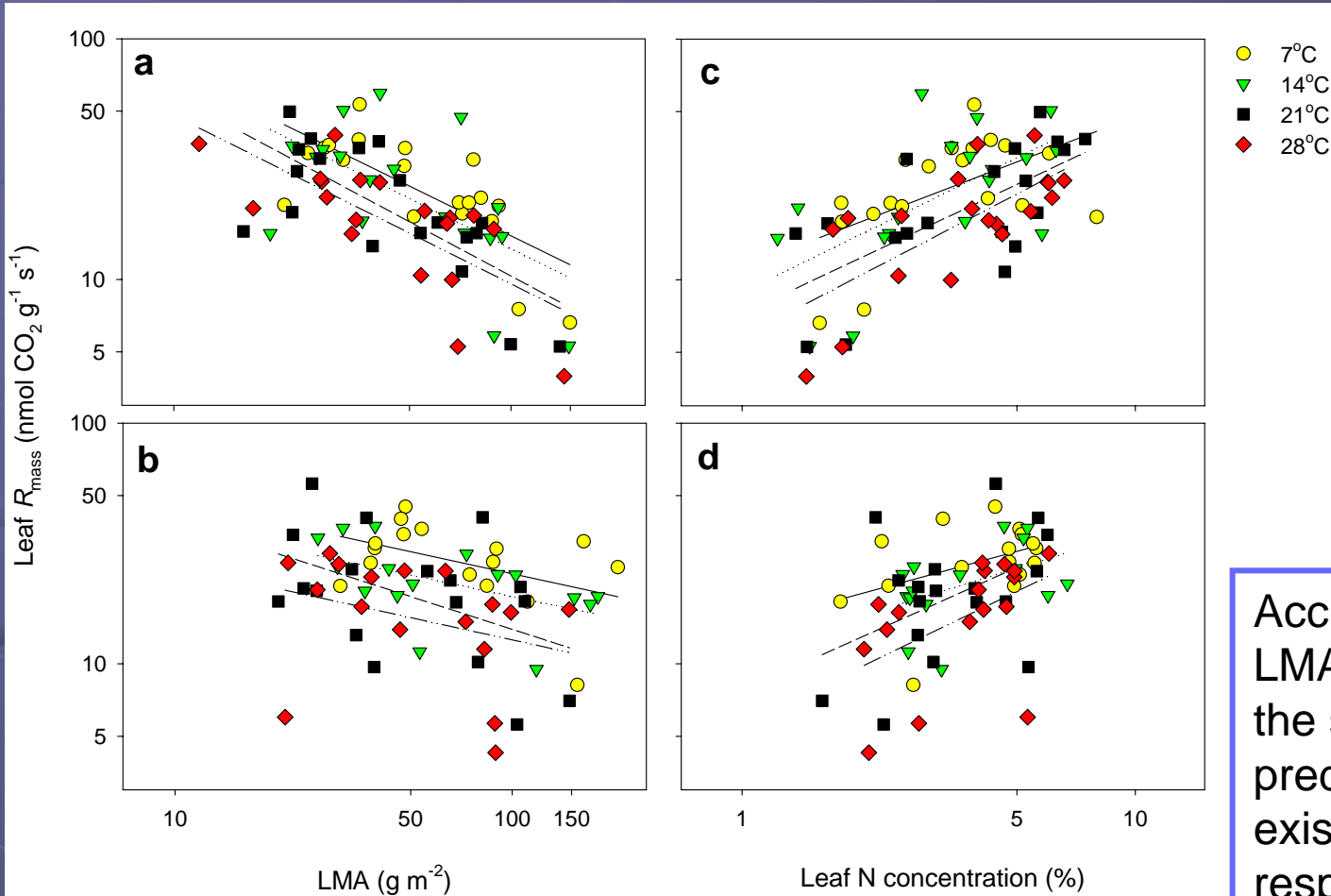


Which aspect of temperature is causing the dieback?

Respiration increase or photosynthetic decline?

3. Acclimation of respiration to temperature.

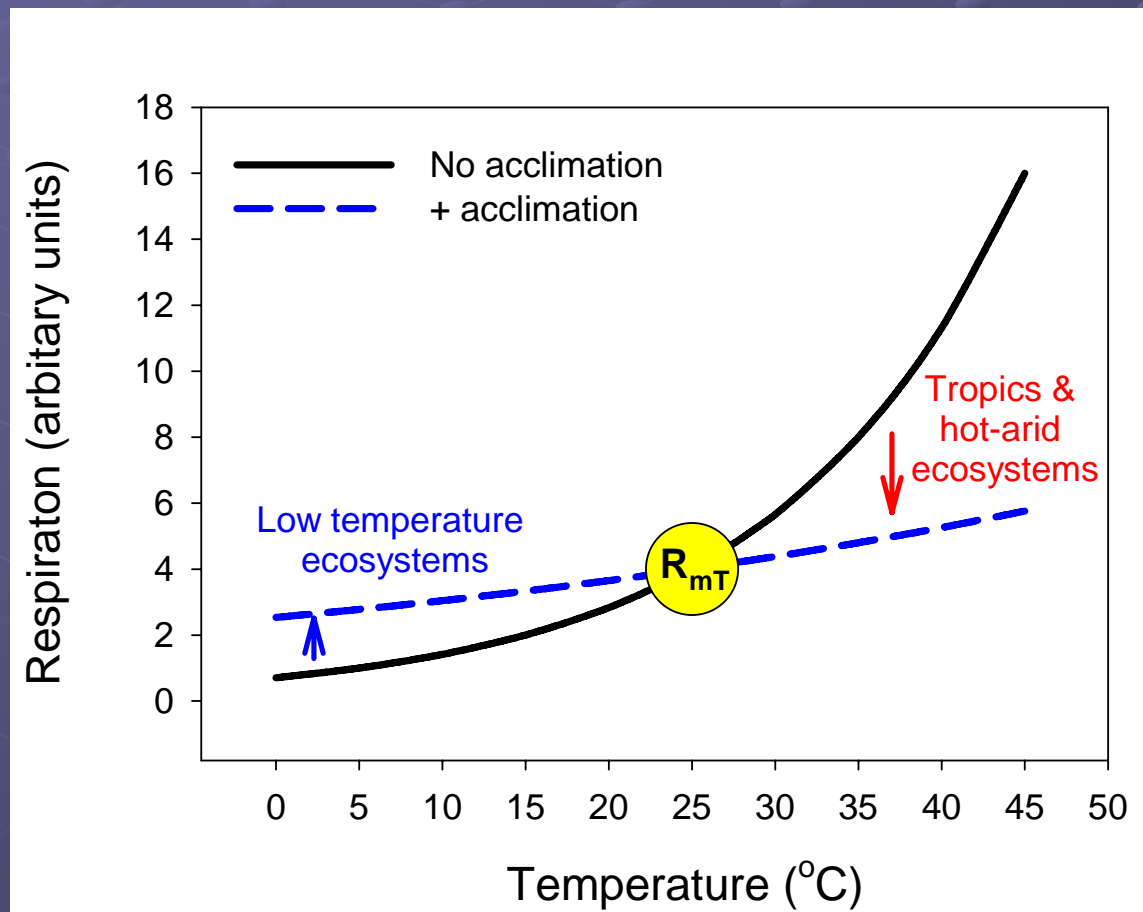
Atkin O, Zaragoza-Castells J, Fisher R et al. in review



Acclimation adjusts the LMA:R intercept, but not the slope, so is predictable from the existing rate of respiration and the temperature change from the reference value

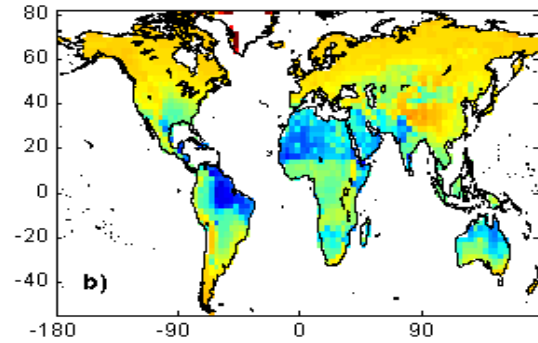
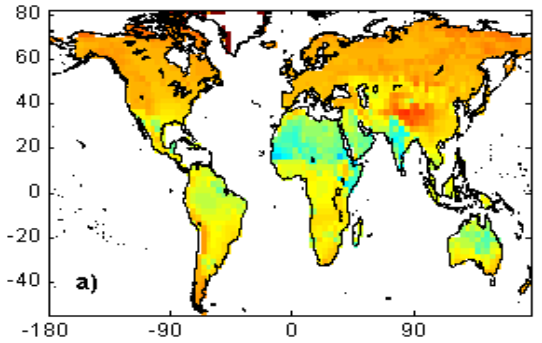
Inclusion of temperature acclimation in JULES

- We assume that the 'reference temperature' for respiration is 25°C



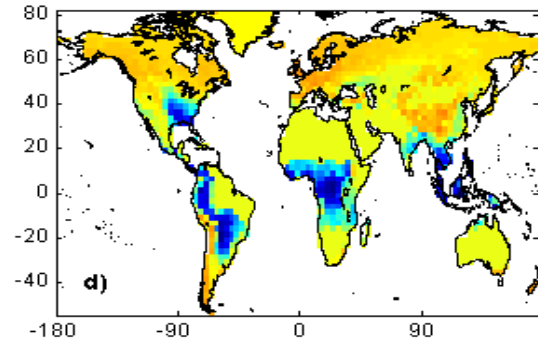
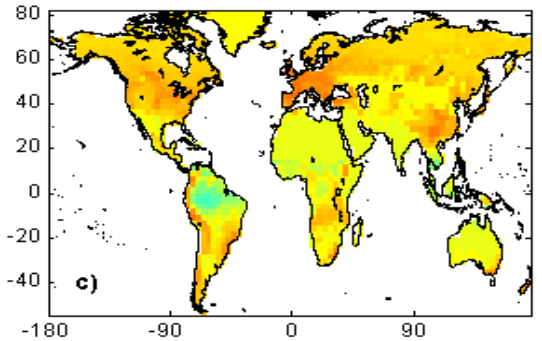
1861

2100

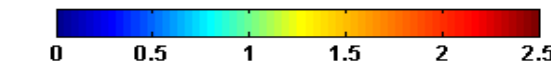
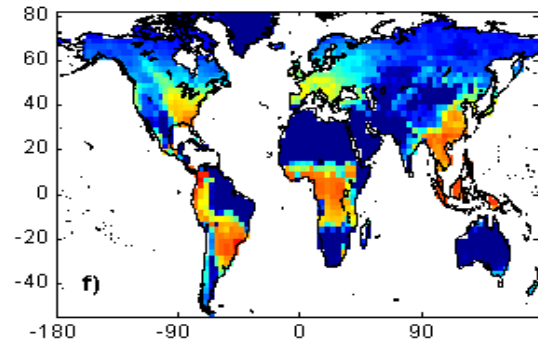
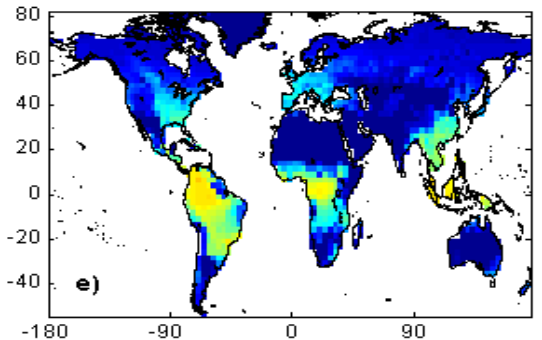


Acclimation-dependent
change in plant R
(% control)

Latitude

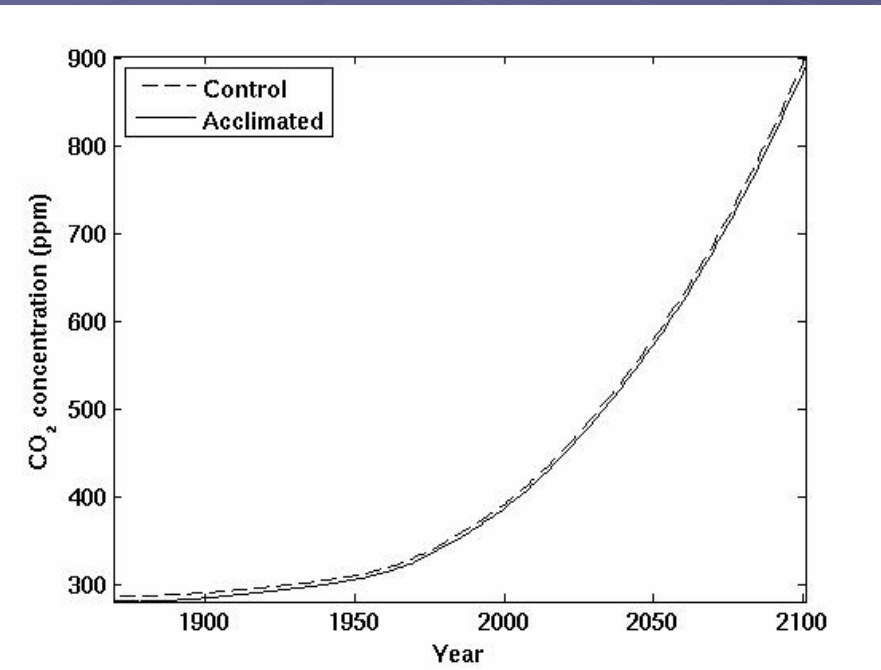


Acclimation-dependent
change in plant R
($\text{g C m}^{-2} \text{ yr}^{-1}$)



Control rates of
plant R (no acclimation)
($\text{g C m}^{-2} \text{ yr}^{-1}$)

Conclusions



- Expectation is that acclimation reduces respiration with increasing temperature.
- Our net result is no change in carbon balance as +ve acclimation in boreal zone cancels out -ve acclimation in tropical zone