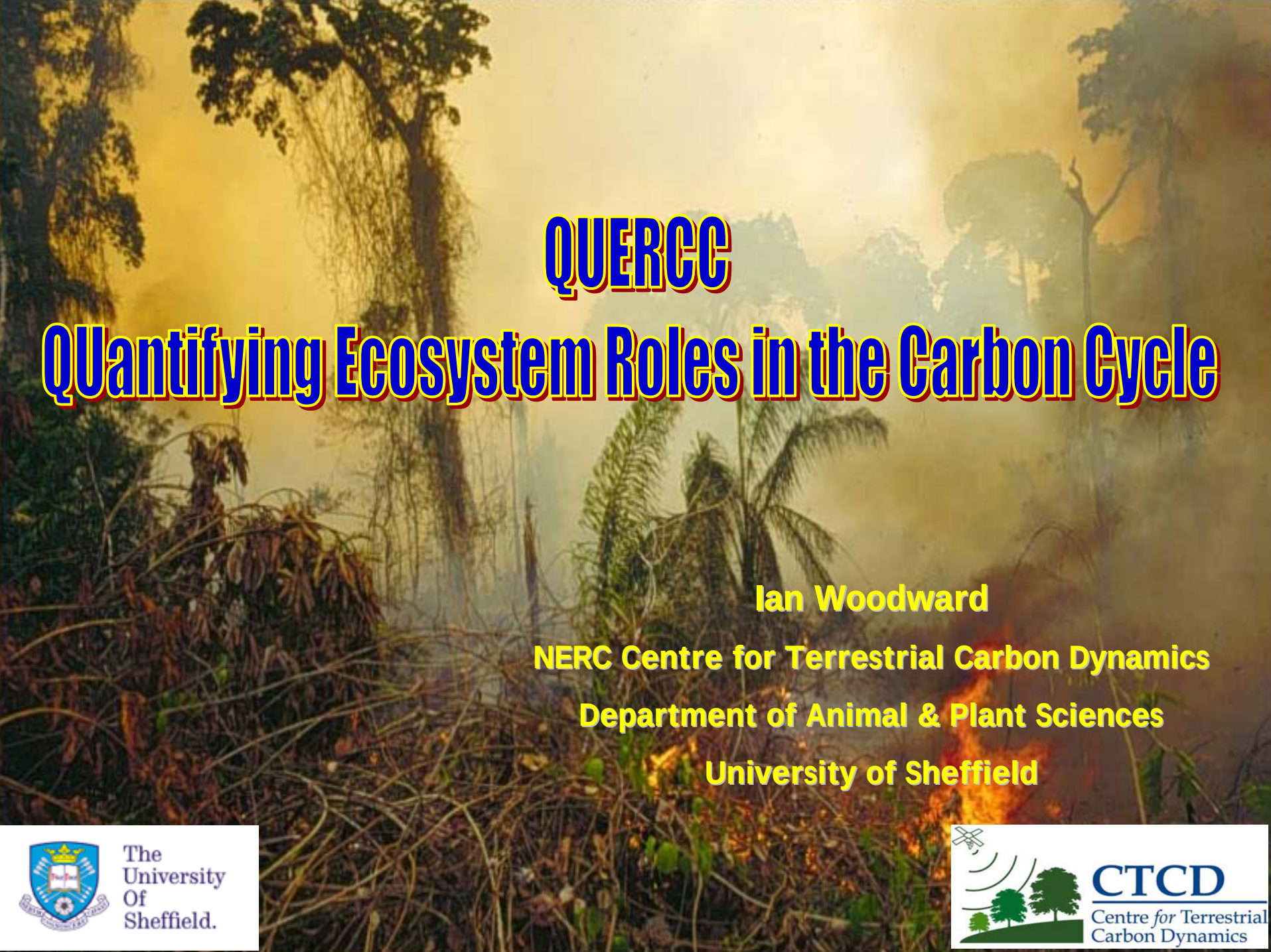

QUERCC

QUantifying Ecosystem Roles in the Carbon Cycle

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Department of Animal & Plant Sciences

University of Sheffield

The University Of Sheffield.

CTCD Centre *for* Terrestrial Carbon Dynamics

Quantifying and Understanding the Earth System

QUERCC: QUantifying Ecosystem Roles in the Carbon Cycle

Overall objective: – NERC-speak.

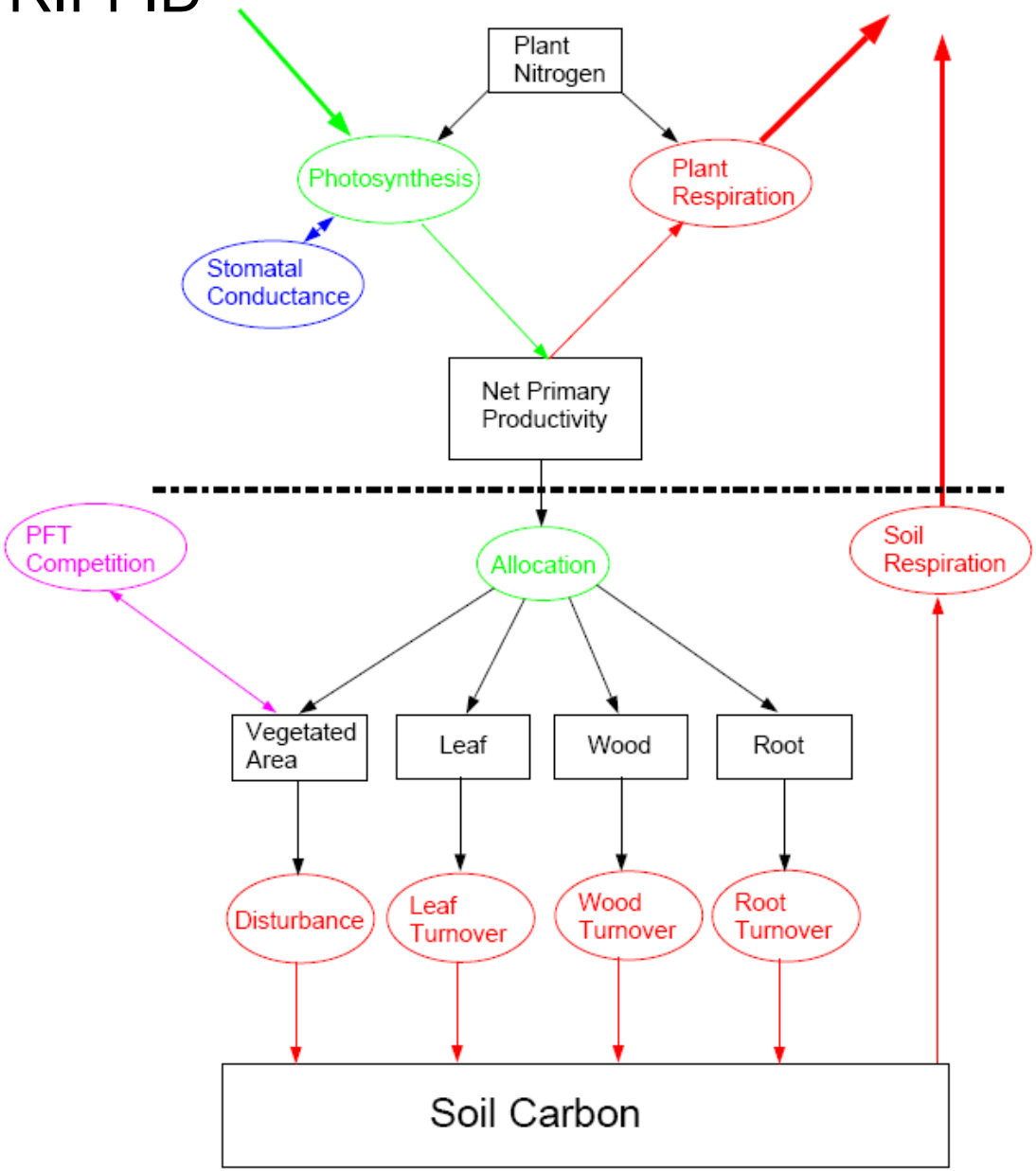
To quantify the contemporary terrestrial carbon cycle using new combinations of data and models.

This will be achieved through 4 work packages

Overall objective: – reality?.

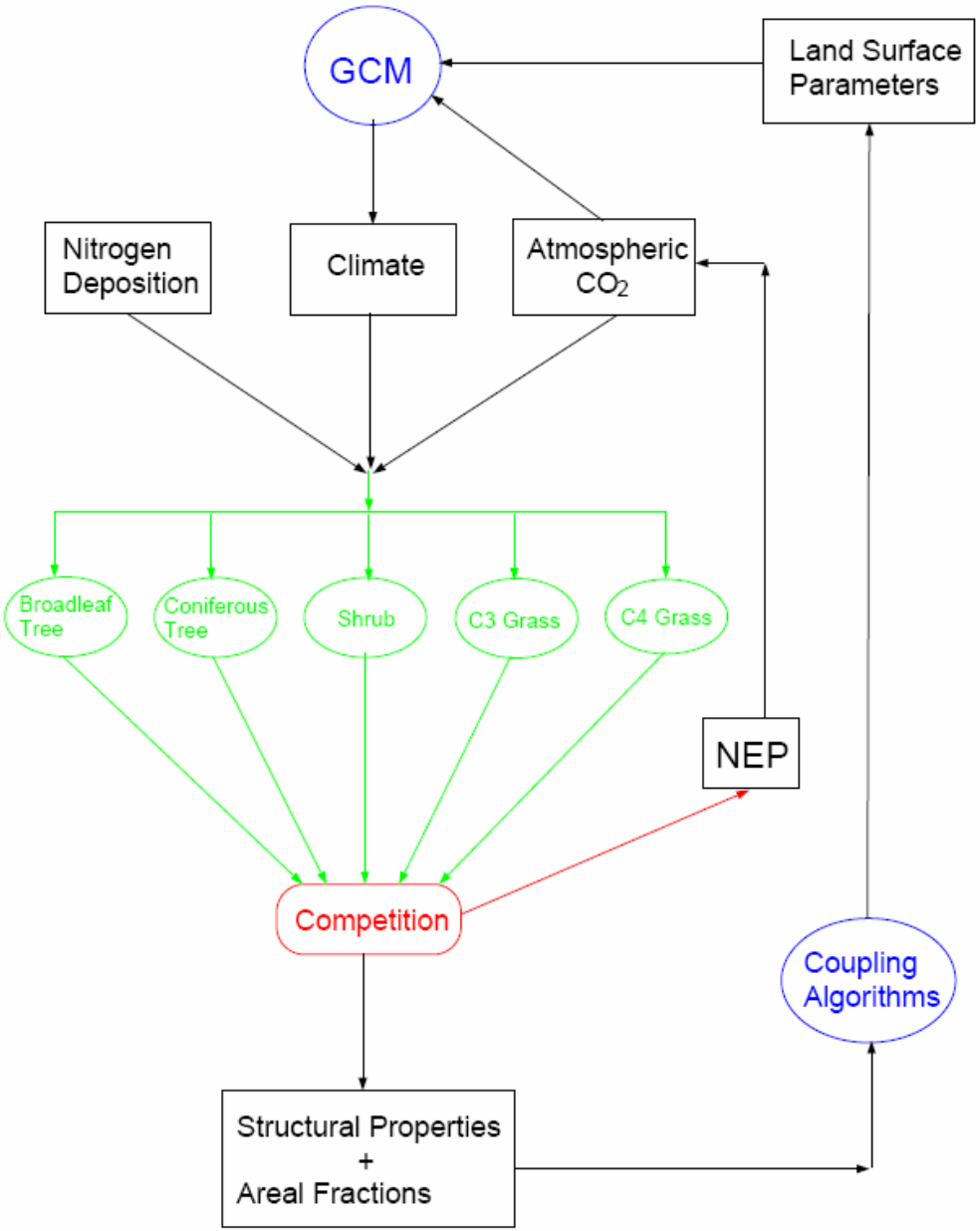
Change/replace TRIFFID components to include a nitrogen cycle, a wider range of functional types and more ecologically realistic sub-grid scale dynamics.

TRIFFID



Schematic showing TRIFFID carbon flows for each vegetation type. Processes above the dotted line are fluxes calculated in the MOSES2 land surface scheme every atmospheric model time step (≈ 30 minutes).

In dynamic mode, TRIFFID updates the vegetation and soil carbon every 10 days using time-averages of these fluxes.



TRIFFID and GCM coupling.

Changes in the distribution and structure of five functional types feedback to climate via two routes.

1. Vegetation determines the biophysical parameters which affect fluxes of heat, water and momentum.
2. Changes in the carbon stored in vegetation and soil (NEP) also change atmospheric CO_2 and climate.

Nitrogen deposition is also shown as a driver for vegetation change, but **this** version of TRIFFID does not include an interactive nitrogen cycle.

QUERCC: QUantifying Ecosystem Roles in the Carbon Cycle

Work package objectives

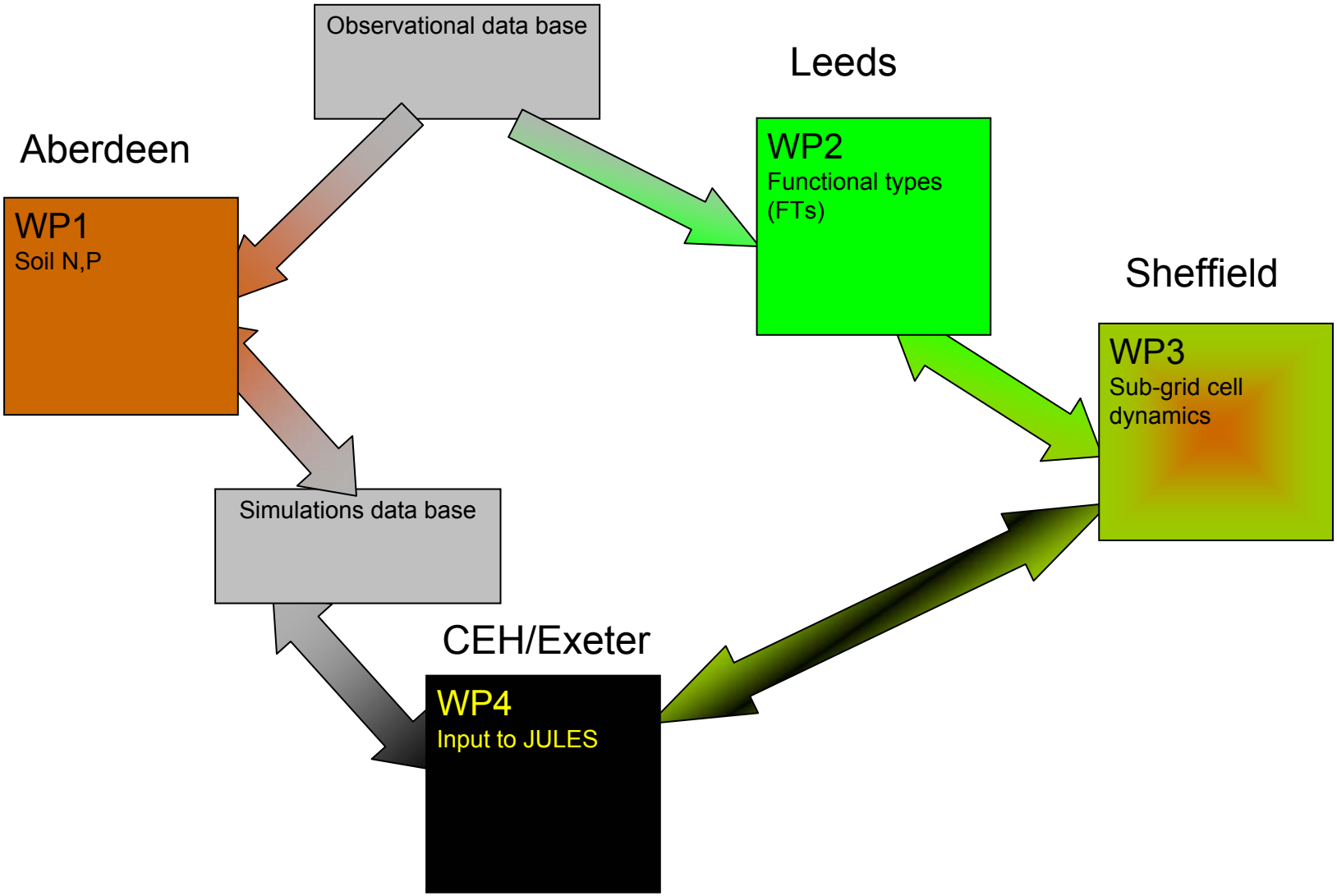
WP1. Develop new calibrated models of soil chemistry and nutrients that influence the carbon cycle, with particular emphasis on the N cycle.

WP2. Develop, expand and validate descriptions of plant function.

WP3. Create model(s) to capture sub-grid scale dynamics of vegetation behaviour.

WP4. Combine the above models into the JULES structure and apply globally.

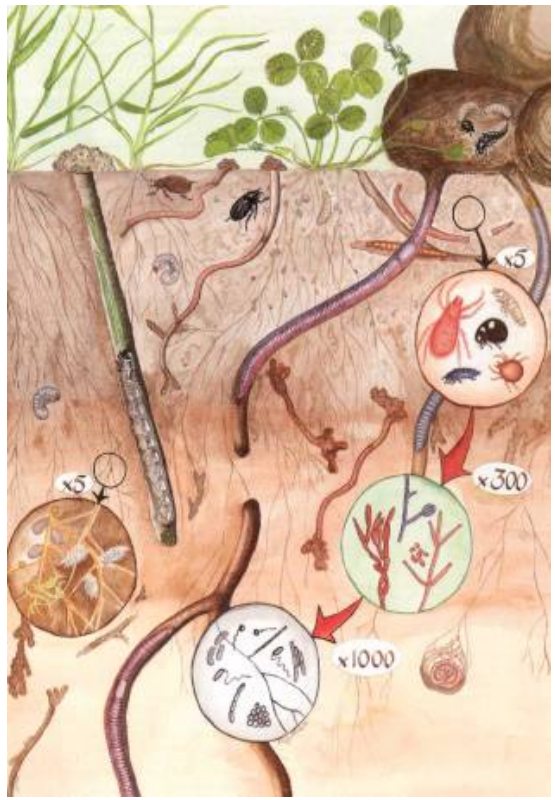
QUERCC: QUantifying Ecosystem Roles in the Carbon Cycle



Work Package 1

How to represent nutrient availability in models

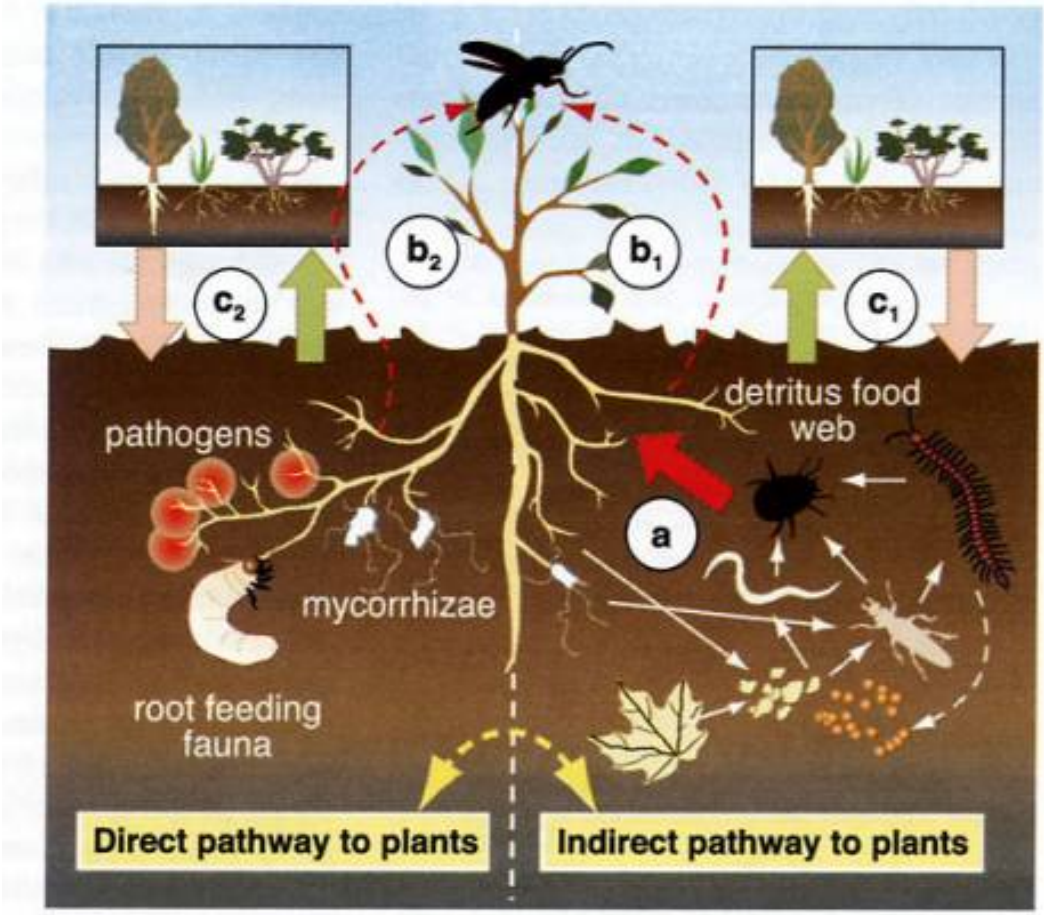
1. Temporal compartmentalisation of soil C cycling.
2. Identify the role of soil nutrient availability (N and P) on rapid and slow cycling.



Work Package 1

Hypothesis –

Organic matter pool turnover regulated by nutrient driven feedbacks in the short and long term

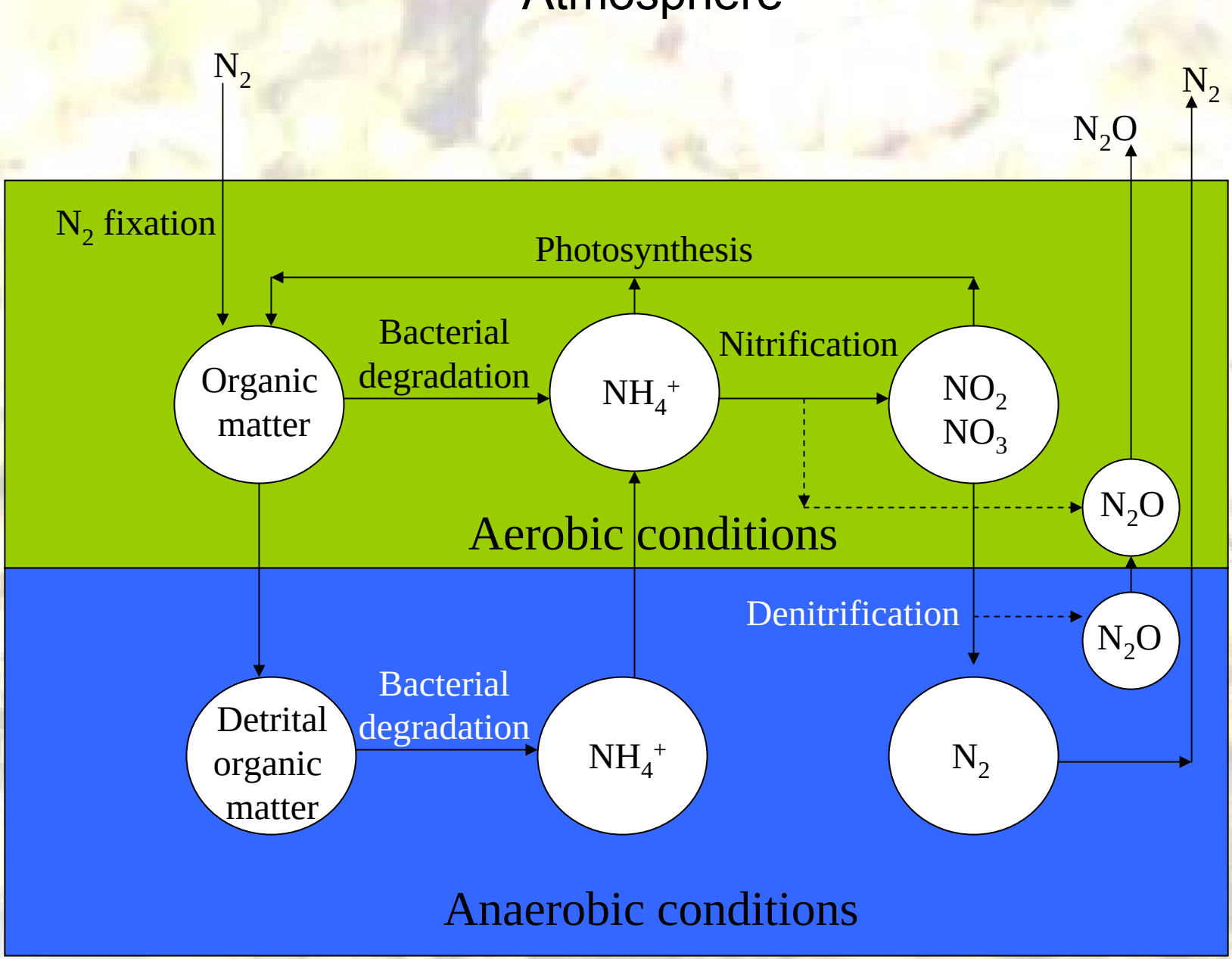


Connect the soil and vegetation models

Wardle *et al*. (2004) *Science*

WP1

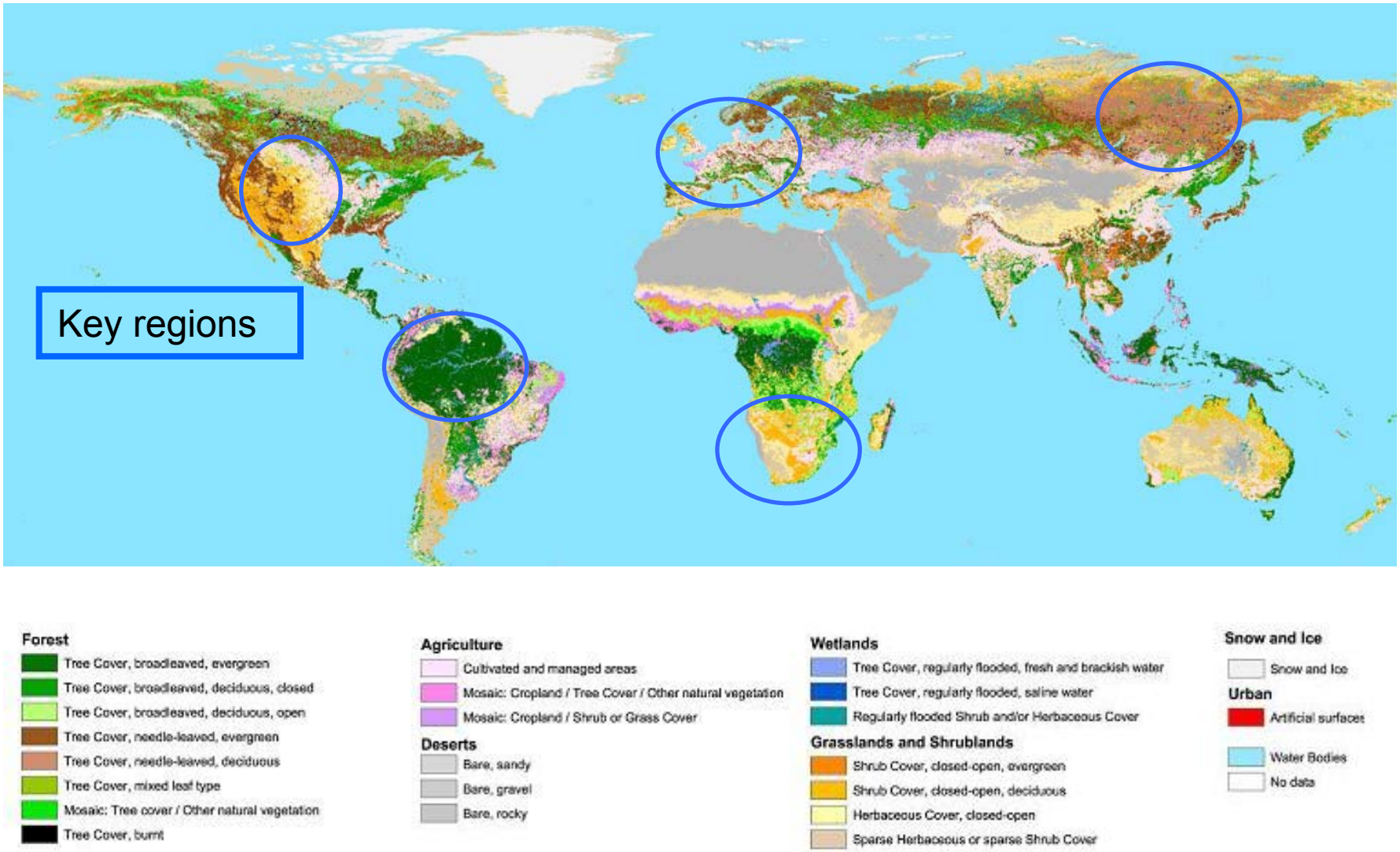
The Nitrogen cycle



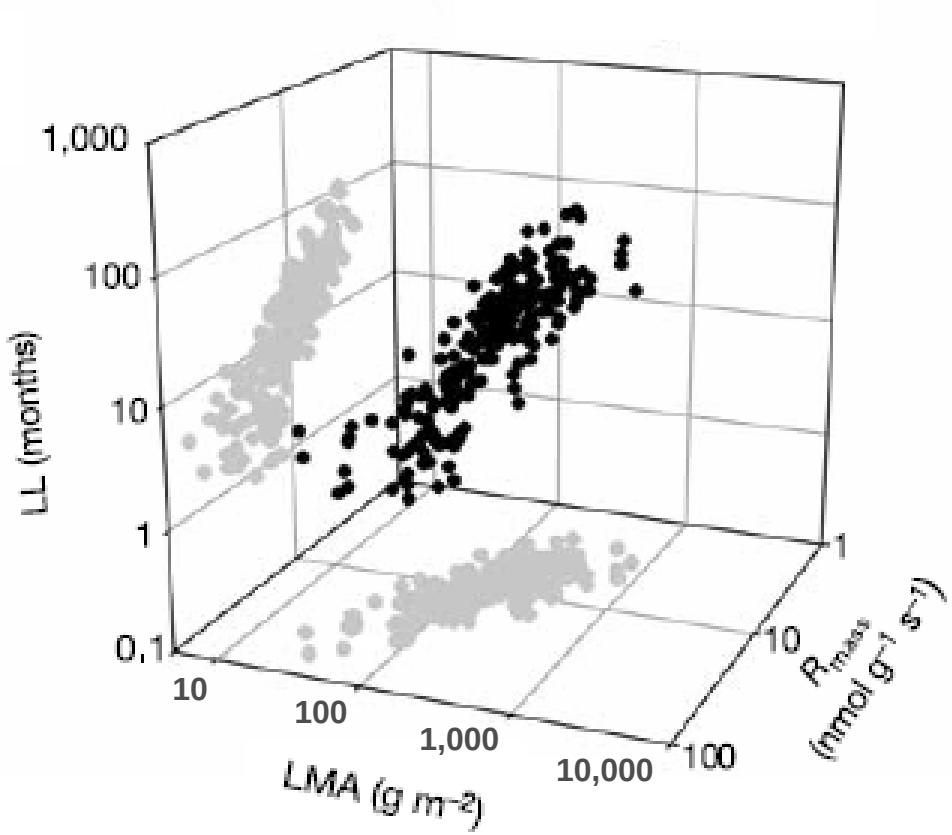
After Wollast (1981)

Work Package 2

GLC 2000 vegetation map

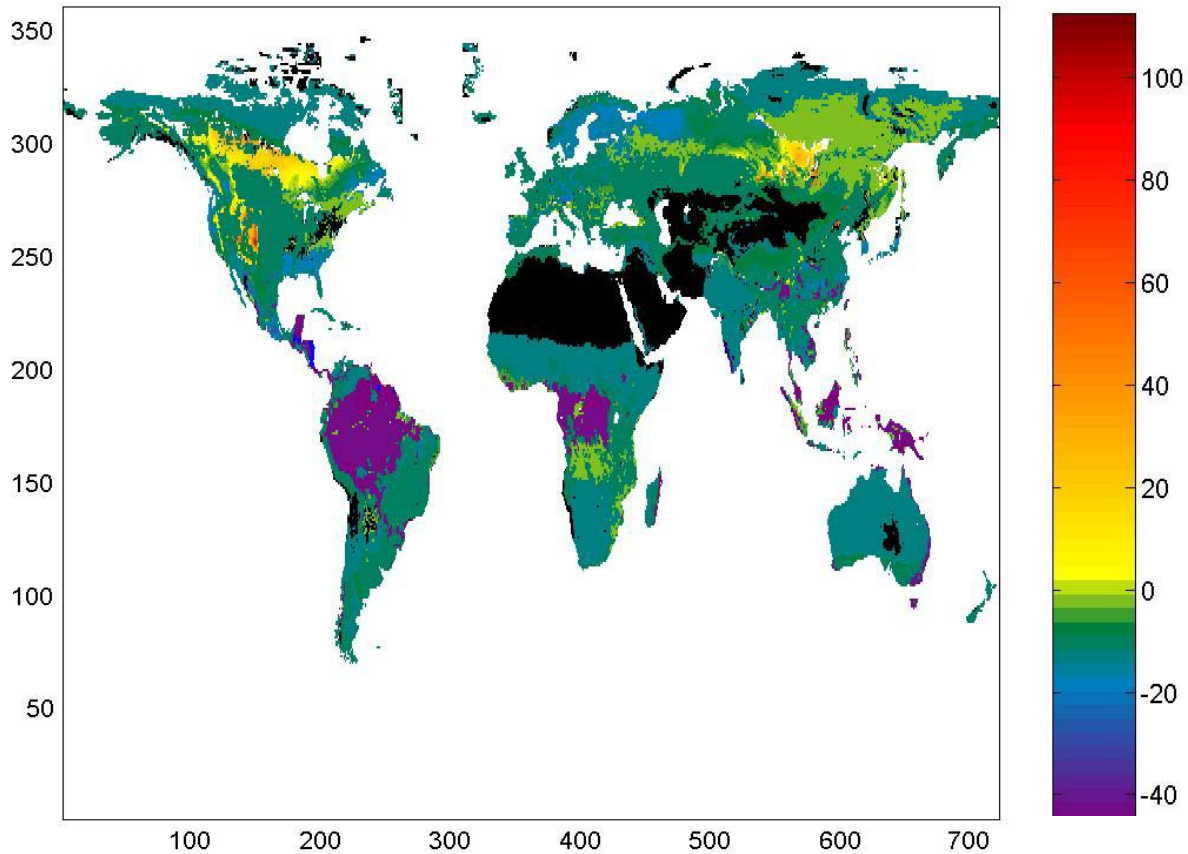


Wright *et al*.: Major axis of leaf variation



- Major axis of variation from **fast** to **slow** living plants.
- Also correlated:
  - N content,
  - P content
  - Assimilation capacity,
  - Dark respiration

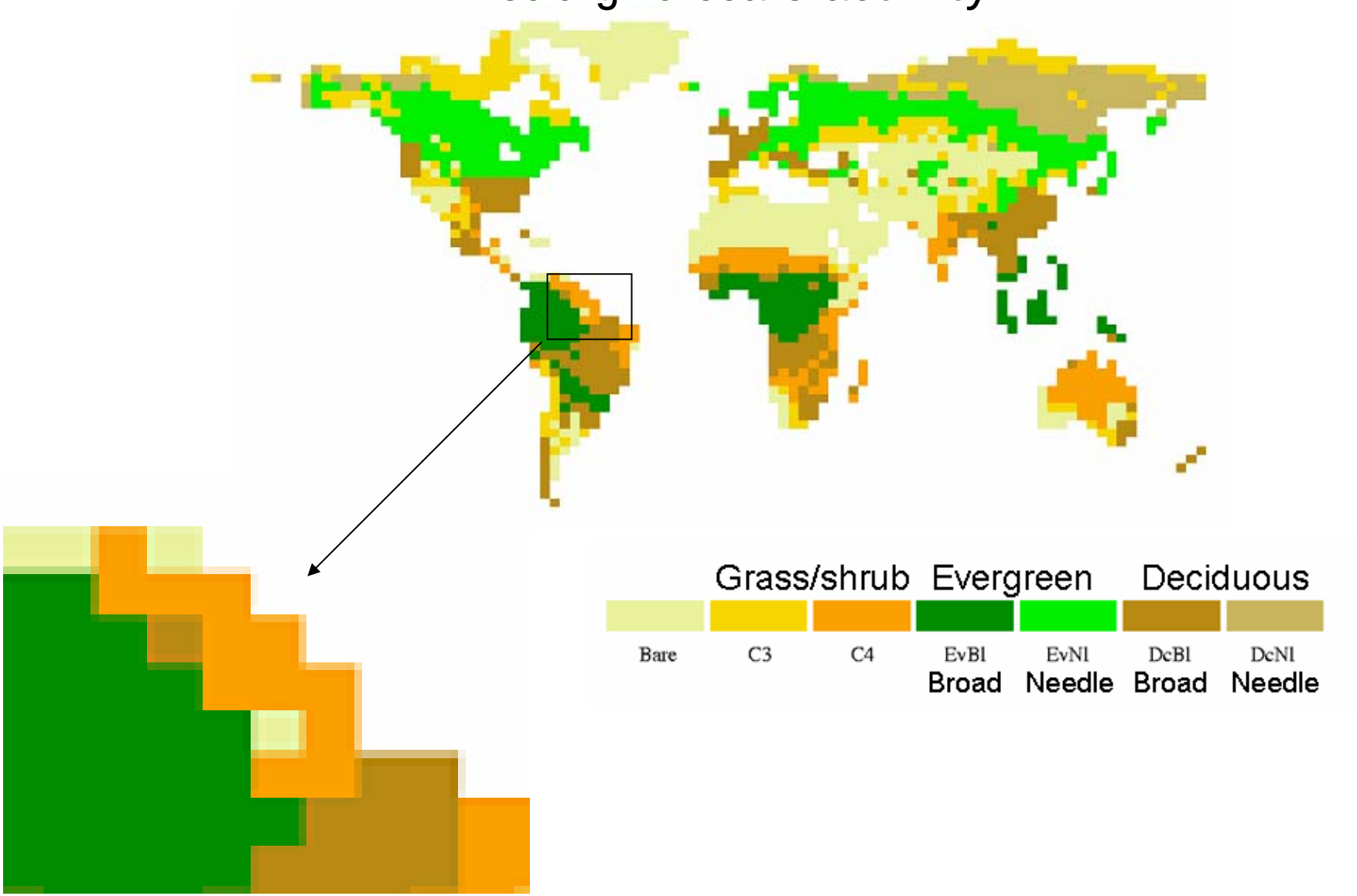
Change in leaf longevity of dominant vegetation (months)



- Black = Outside Climatic range

Work Package 3

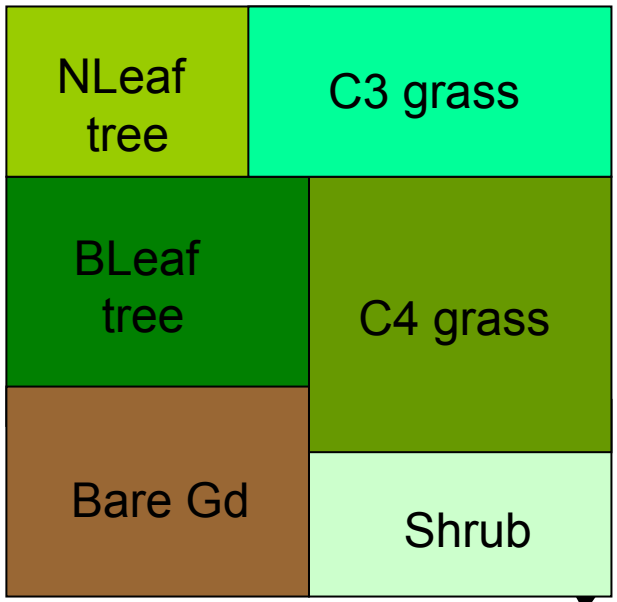
Sub-grid scale activity

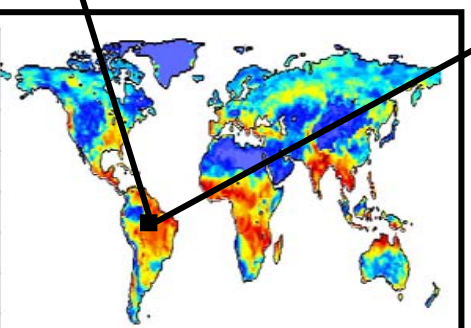


Work Package 3

TRIFFID/MOSES land surface scheme

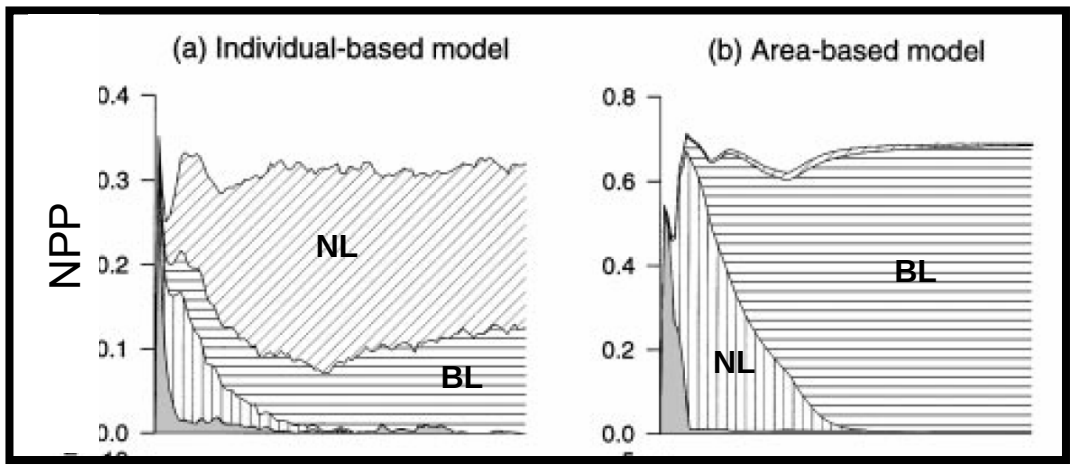
Existing JULES model





- Grid cell divided into tiles.
- Each tile is one PFT
- Size of tile determined by empirical dominance hierarchy
- **Tendency for a single vegetation type to dominate**

- E.g. LPJ (Smith et al 2001)

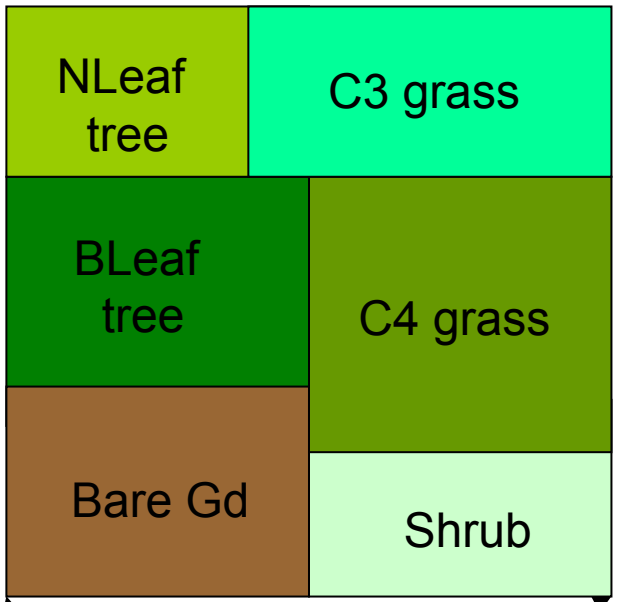


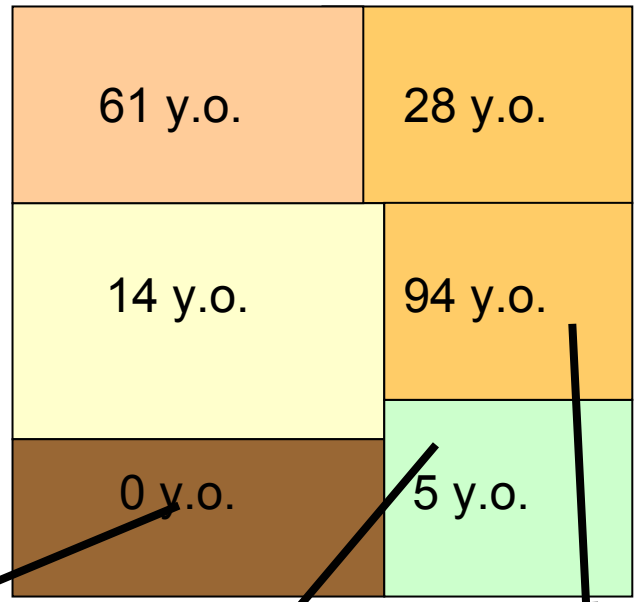
Work Package 3

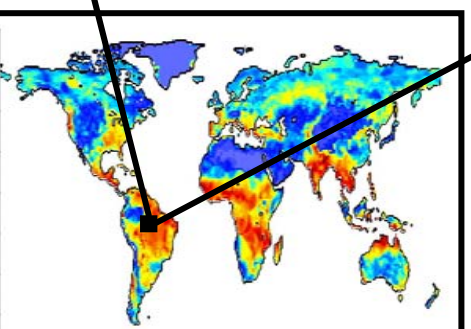
Ecosystem Demography Model (ED)

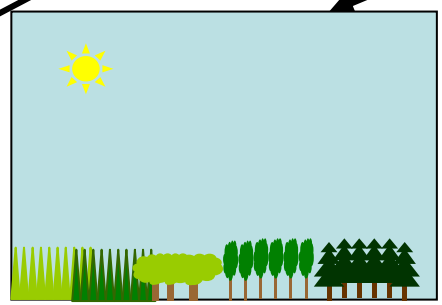
Moorcroft et al. (2001)

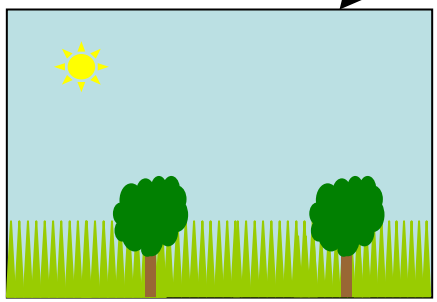
"Size and age structured approximation of an individual based model"

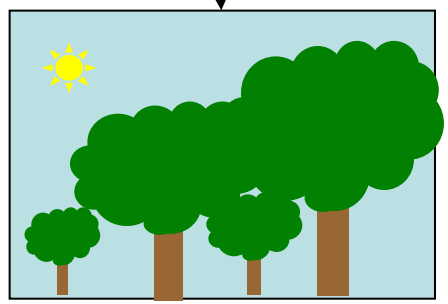






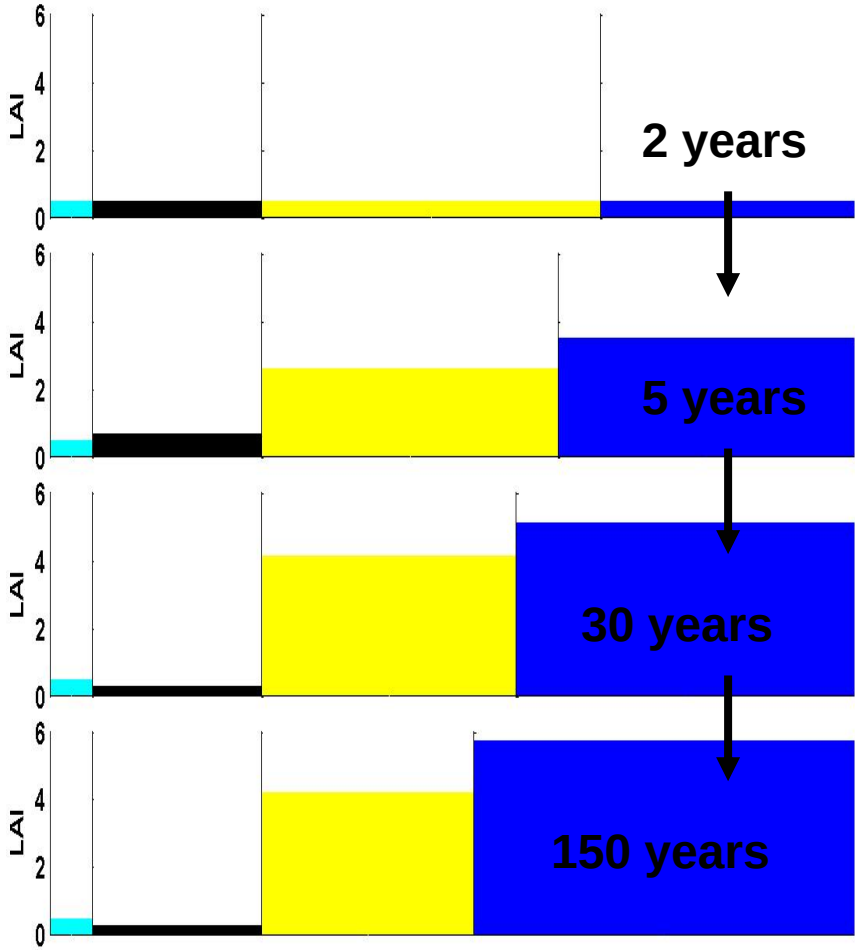




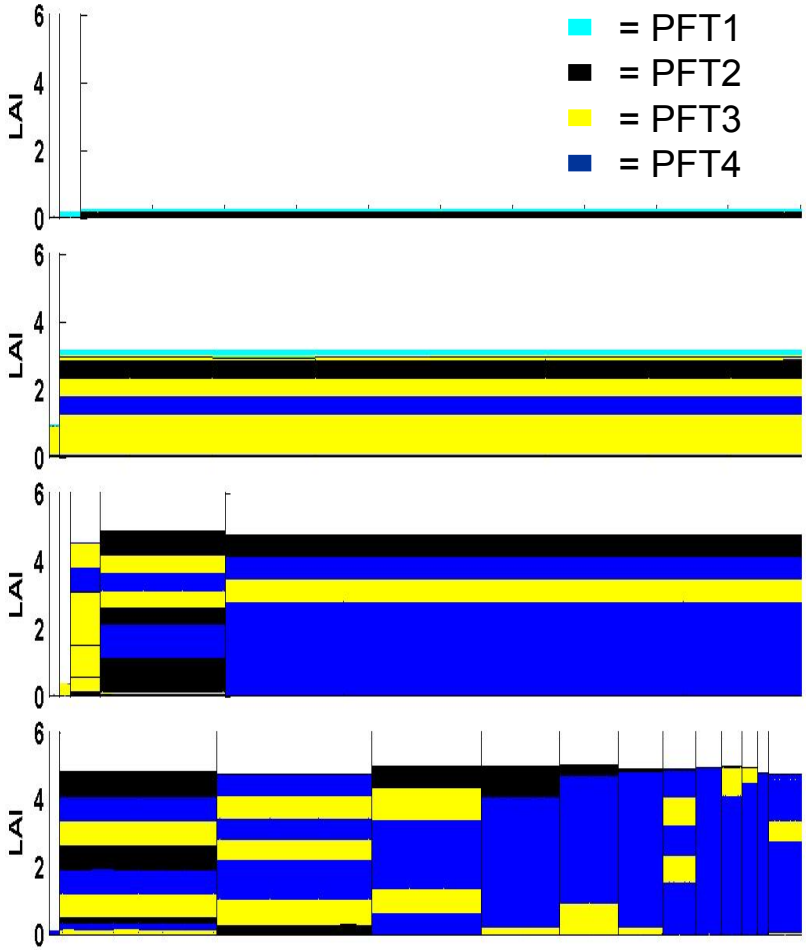


TRIFFID

ED



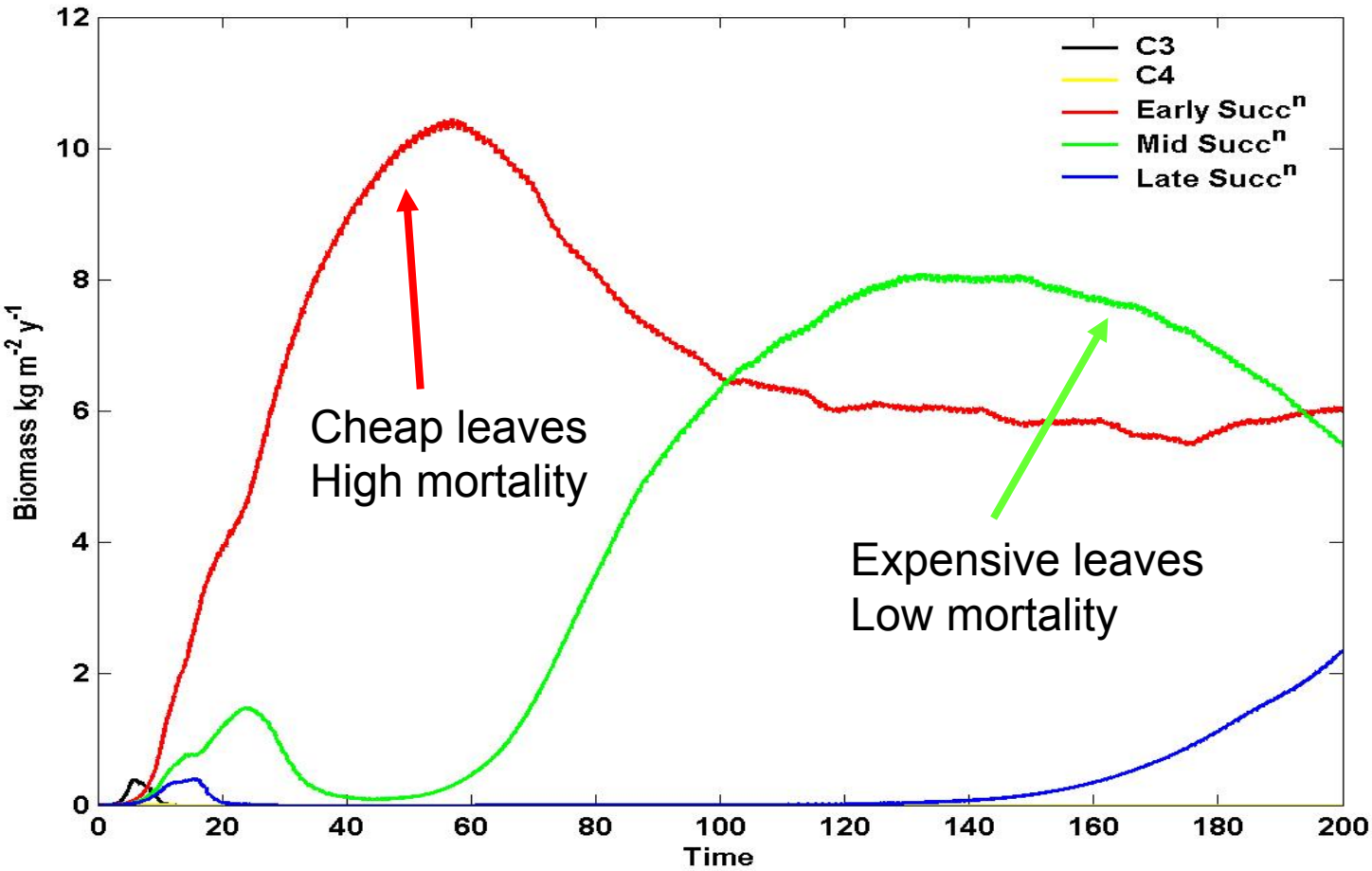
Area



Area

Simulating succession in ED

Leaf cost vs. mortality trade off

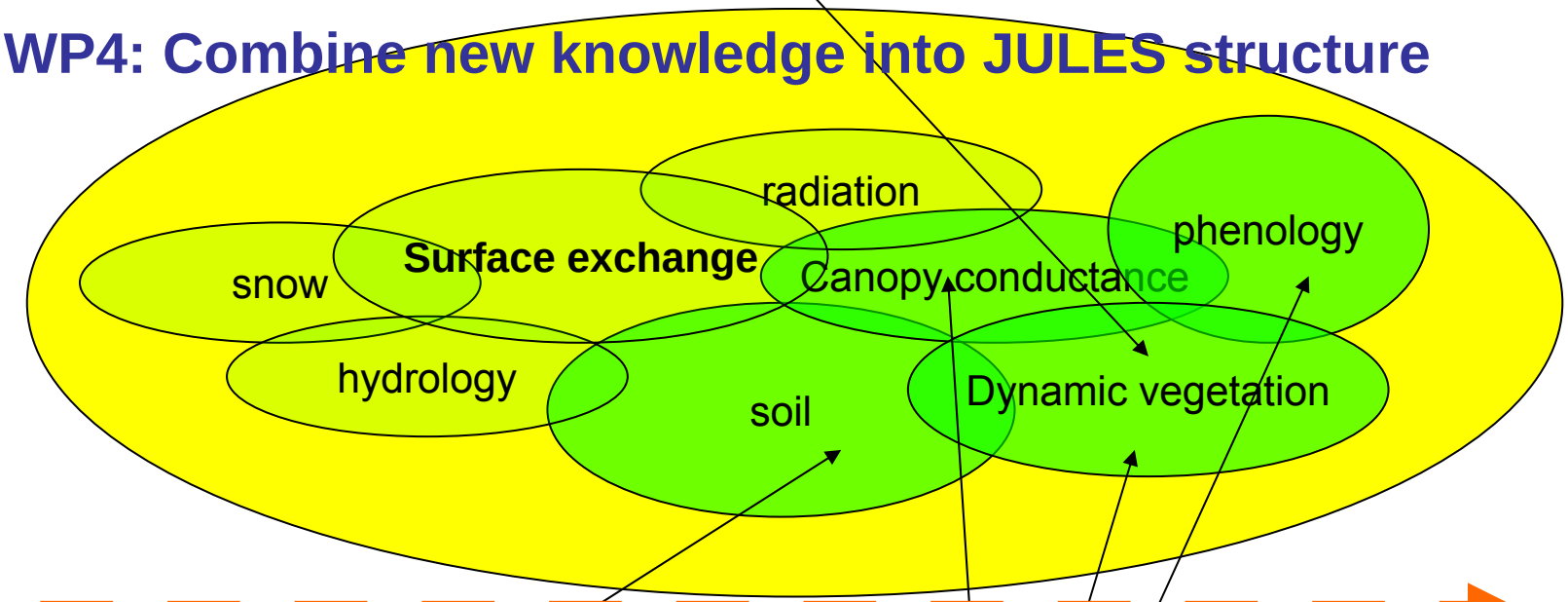


Work Package 4

JULES links

WP3: Sub-grid cell dynamics

WP4: Combine new knowledge into JULES structure

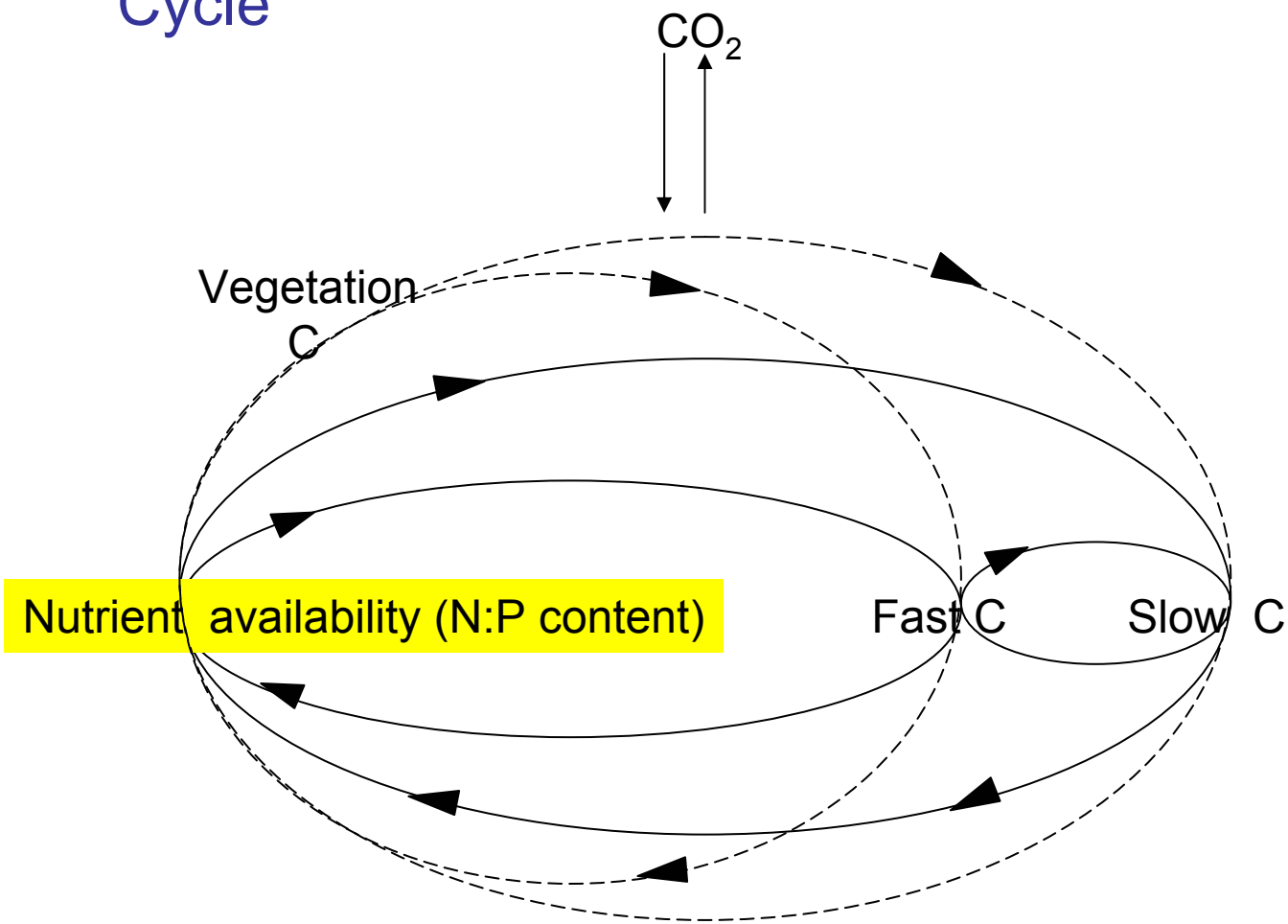


"Newer" processes for land surface modelling

WP1: N cycle and P response

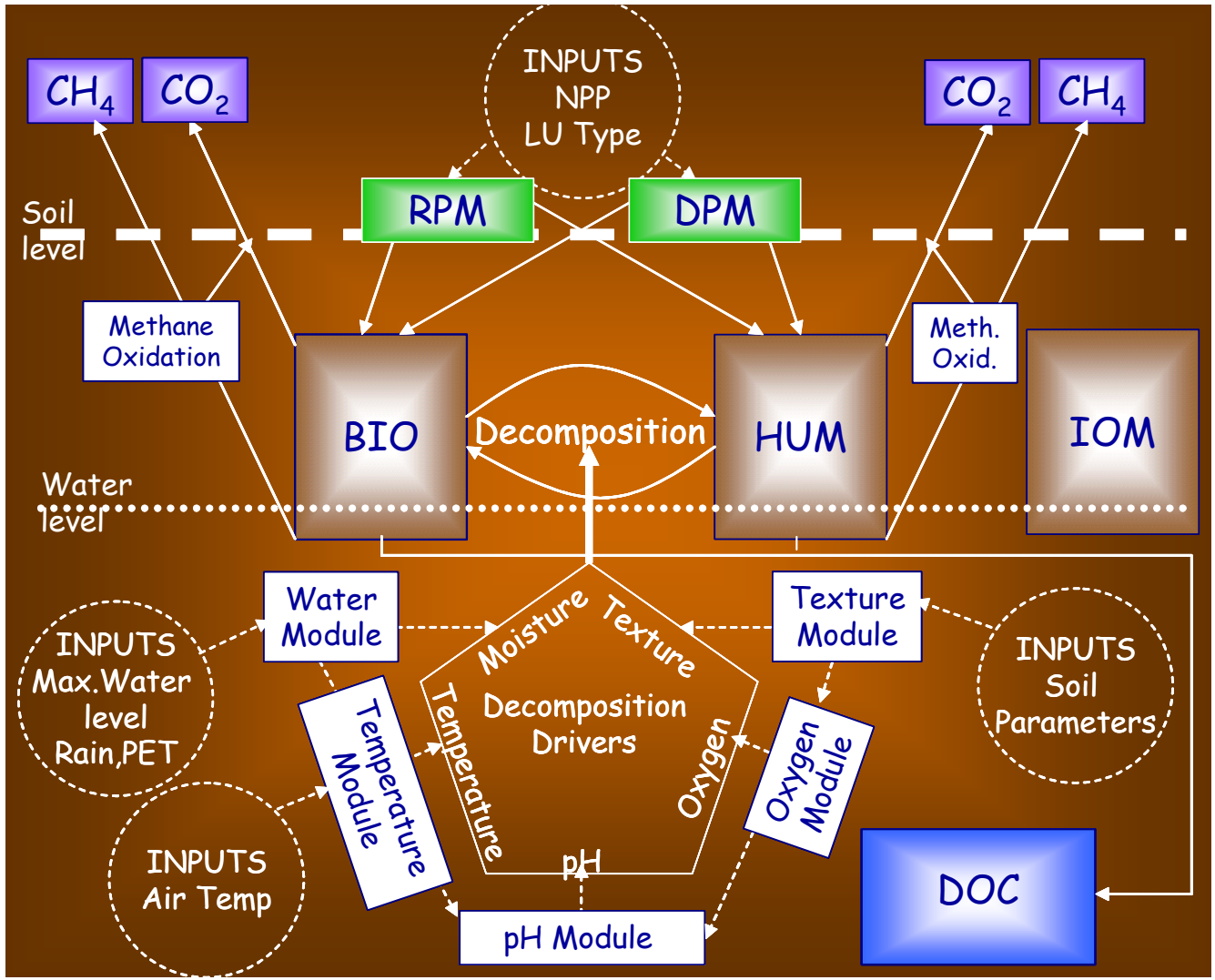
WP2: Improved characterisation of PFTs

Soil Nutrient regulated Ecosystem Carbon Cycle



Can N and P availability be used as a predictor of Carbon cycling?

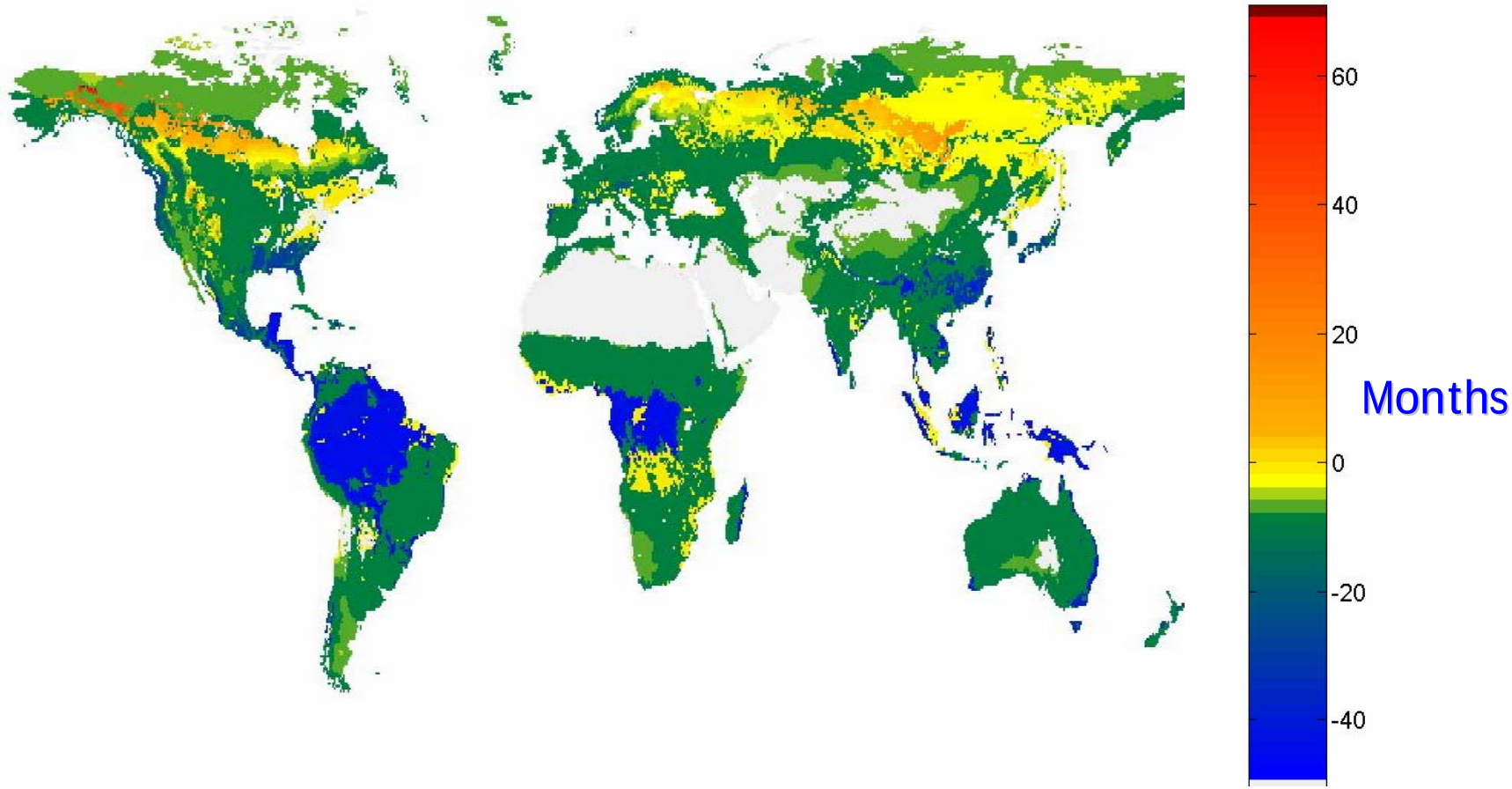
Slide from Nick Ostle, CEH Lancaster



Slide from Peter Smith, Aberdeen

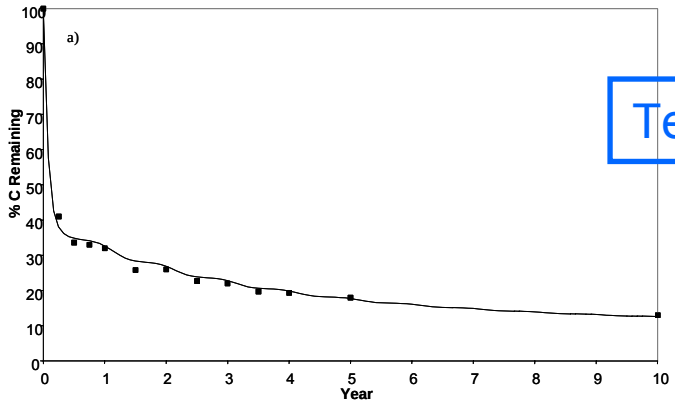
Work Package 3

Leaf life span change from fixed per FT to Wright *et al* variable relationship with temperature and precipitation

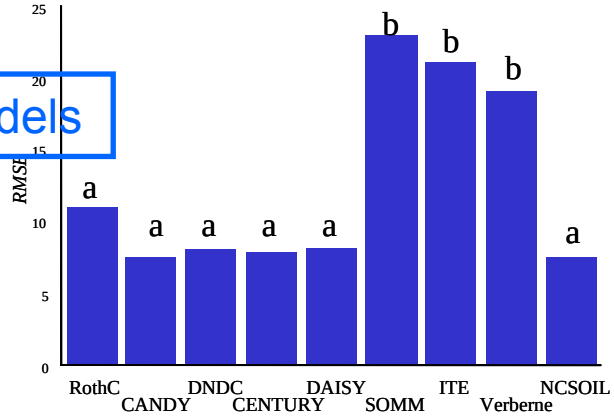


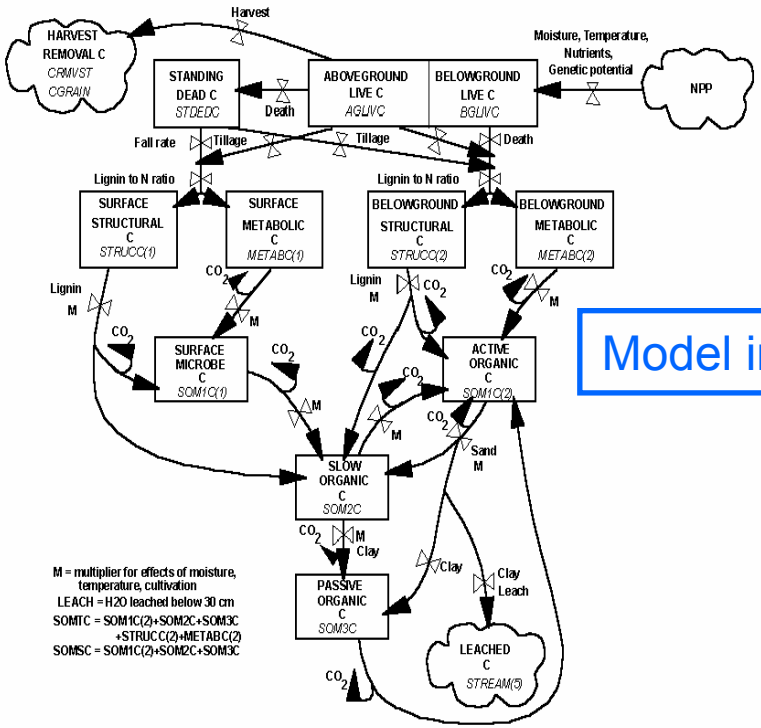
WP1

Soil model evaluation and improved process description

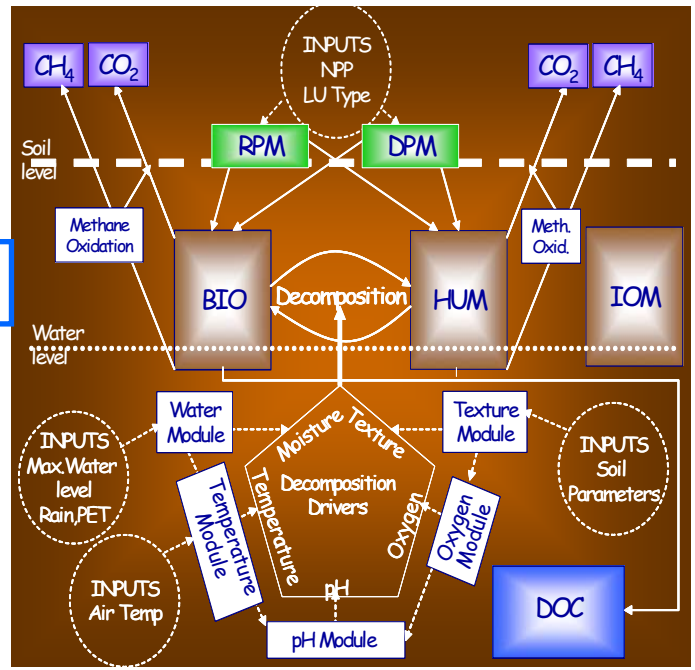


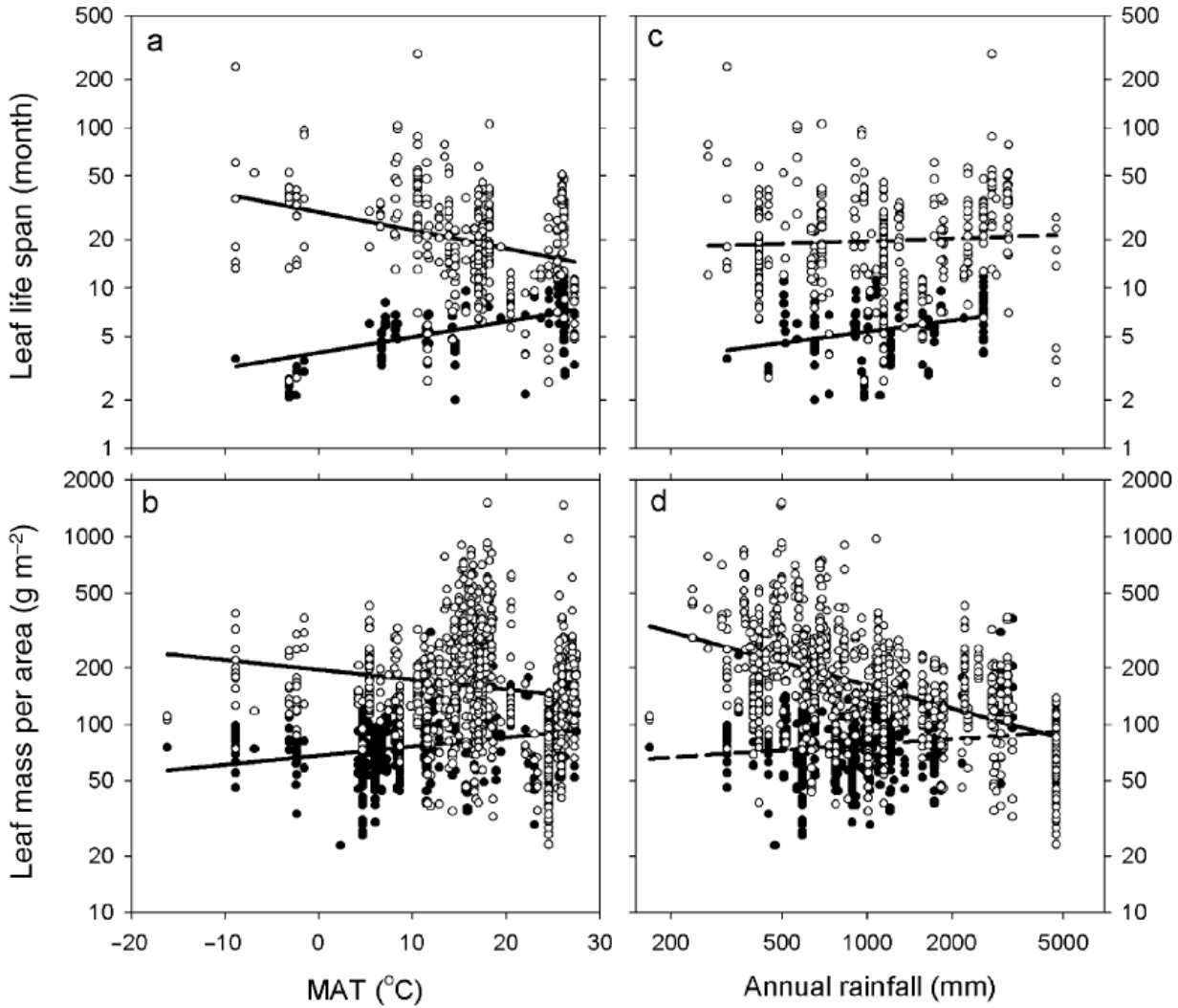
Testing models



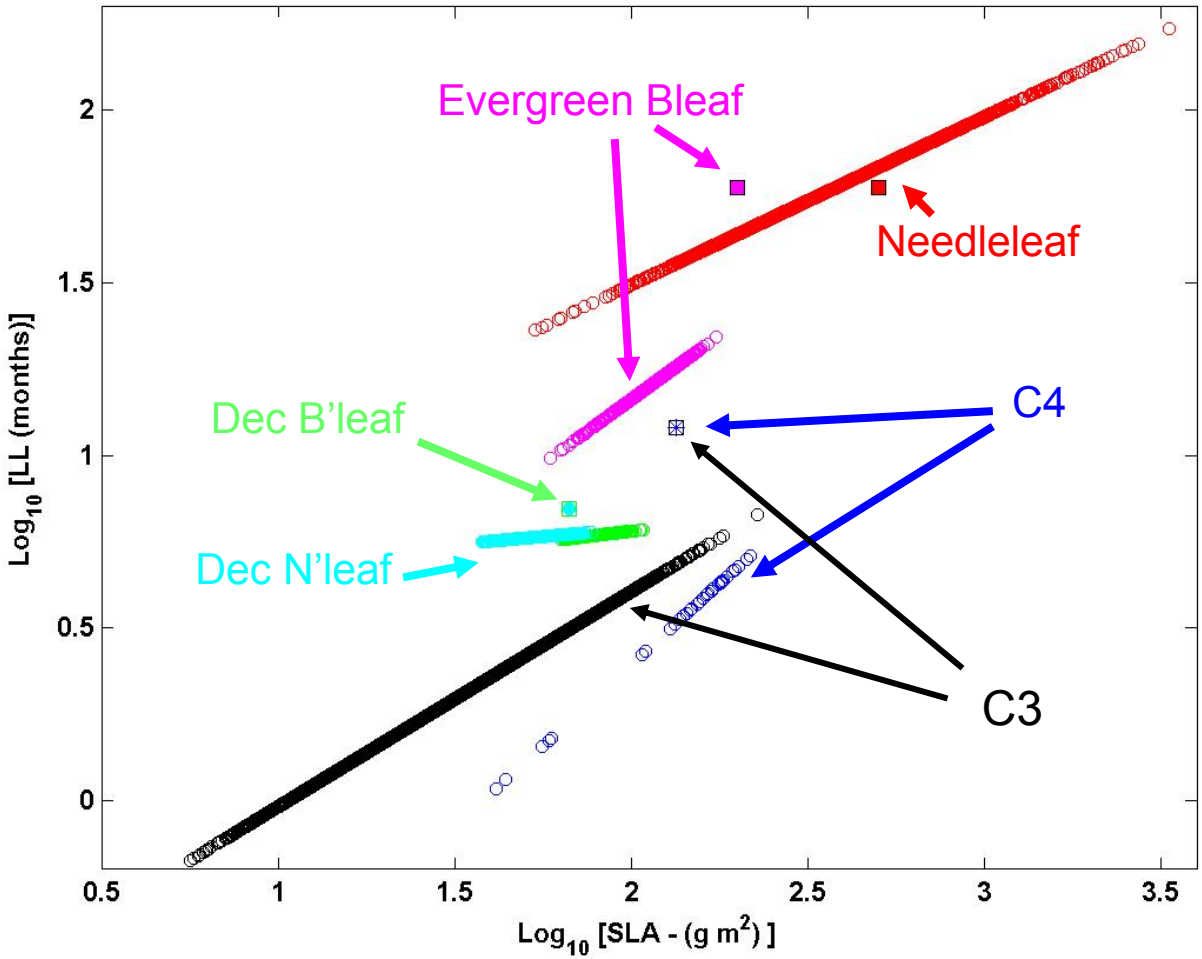


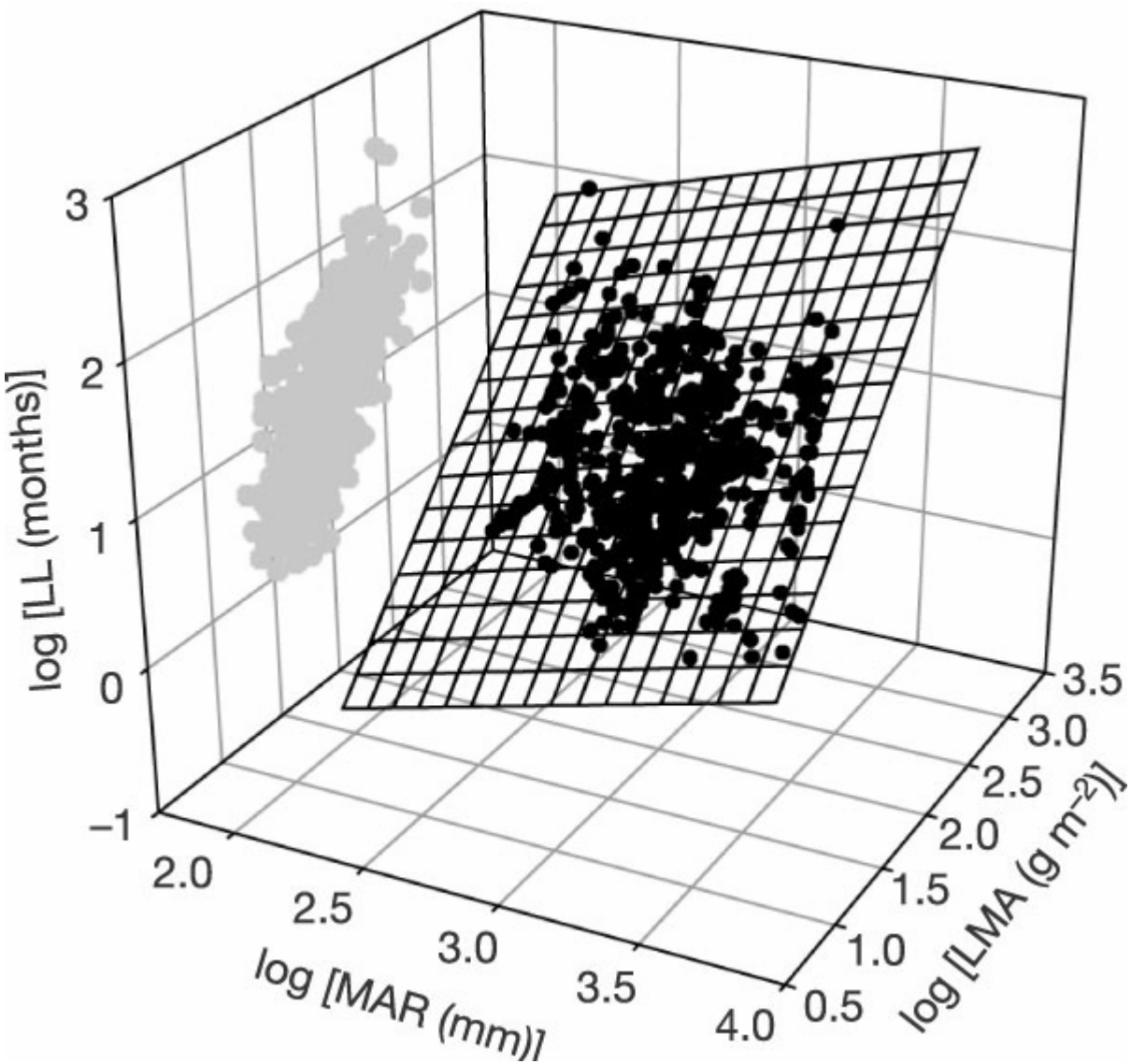
Model improvement




a
b
c
d
Leaf life span (month)
Leaf mass per area (g m^{-2})
MAT ($^{\circ}$C)
Annual rainfall (mm)
500
200
100
50
20
10
5
2
1
2000
1000
500
200
100
50
20
10
−20
−10
0
10
20
30
200
500
1000
2000
5000

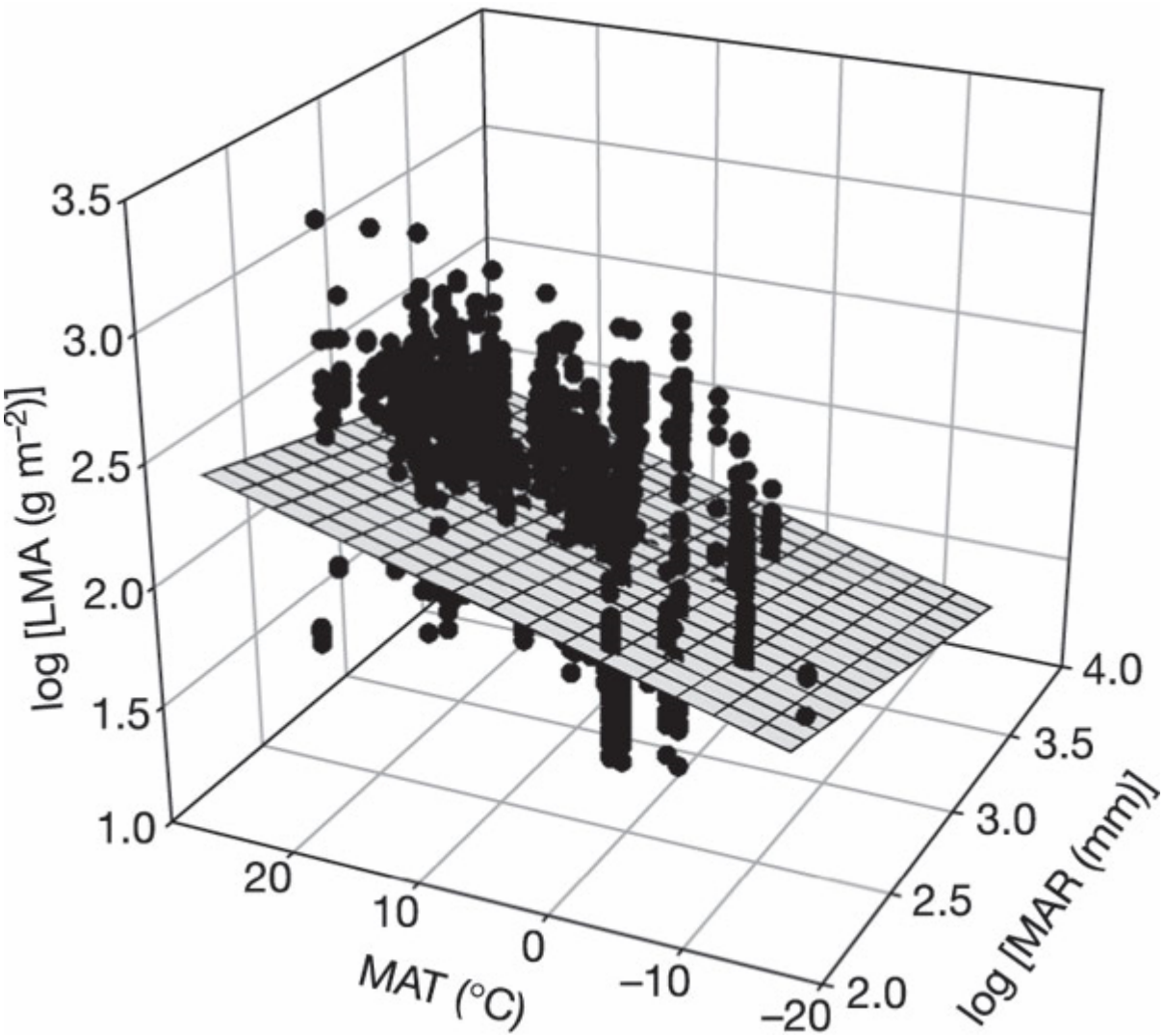
Predicted changes in LL/SLA ratio





Wright *et al* 2004

Work Package 3



Wright *et al* 2004

Work Package 4