
ORCHIDEE training 2017

ORCHIDEE-CN-CAN

ORCHIDEE-CN-CAN

Anne Sofie Lansø, Alex Resovsky, Bertrand Guenet, Nicolas Vuichard & Sebastiaan Luyssaert

ORCHIDEE

current and previous members of the ORCHIDEE team

CN

Nicolas Vuichard, Palmira Messina, Sonke Zaehle & Bertrand Guenet

CAN

James Ryder, Juliane Otto, Matthew J. McGrath, Aude Valade, Philippe Peylin, Kim Naudts, Yi-Ying Chen & Sebastiaan Luyssaert



Fair Use Policy of ORCHIDEE

Staying at the forefront of land surface modelling requires the ORCHIDEE team to continuously invest in improving, developing, implementing and parameterizing biogeochemical, physical and anthropogenic processes in the ORCHIDEE code. Similarly, the ORCHIDEE team invests in creating and maintaining up-to-date driver files, support and training as well as an easy-to-use run environment (libIGCM). The model code, drivers and run environment are called the ORCHIDEE environment. These activities come with a significant investment of time for coding, debugging and evaluating the impacts of these developments on the overall performance of the model.

The fair use policy for the ORCHIDEE environment aims at fostering the access of the ORCHIDEE community to new developments, while recognizing the intellectual contribution of the individuals who contributed to the ORCHIDEE environment. Recognition of intellectual contributions to the ORCHIDEE environment will be ensured by:

Offering co-authorship on any publication that benefits of recent improvements in the ORCHIDEE environment. We deliberately refrain from specifying 'recent' as it should be function of the intellectual contribution and the exposure this contribution already received.

Discussing, early on, intended usage of recent improvements in the ORCHIDEE environment. This discussion should prevent uses and/or applications of the ORCHIDEE environment which are in conflict with the plans of the main contributor.

The main contributor to the ORCHIDEE environment lists his/her intended usage of his/her recent improvements in the ORCHIDEE environment (see Section "Intended studies").

The fair use policy is designed as a win-win opportunity for both users and developers of the ORCHIDEE environment. The developer will have time to contribute new and original aspects to the ORCHIDEE environment, with less stress associated to possible delays in publications. The users will be able to make use of an improved ORCHIDEE environment allowing him/her to design original simulation-experiments, test new ideas and further developed new functionalities based on those they inherit. They will in addition benefit from the developer's expertise on the model and will receive help with the interpretation.

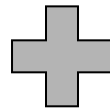
Adhering to the fair use policy of ORCHIDEE warrants the continuation of ambitious model developments and thus contributes to safeguarding our leadership in land surface modelling.

<http://forge.ipsl.jussieu.fr/orchidee/wiki/GroupActivities/UseOfORCHIDEEpolicy/InternalFair-use-policy>



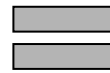
ORCHIDEE-CAN

(known as ORCHIDEE-DOFOCO on svn)



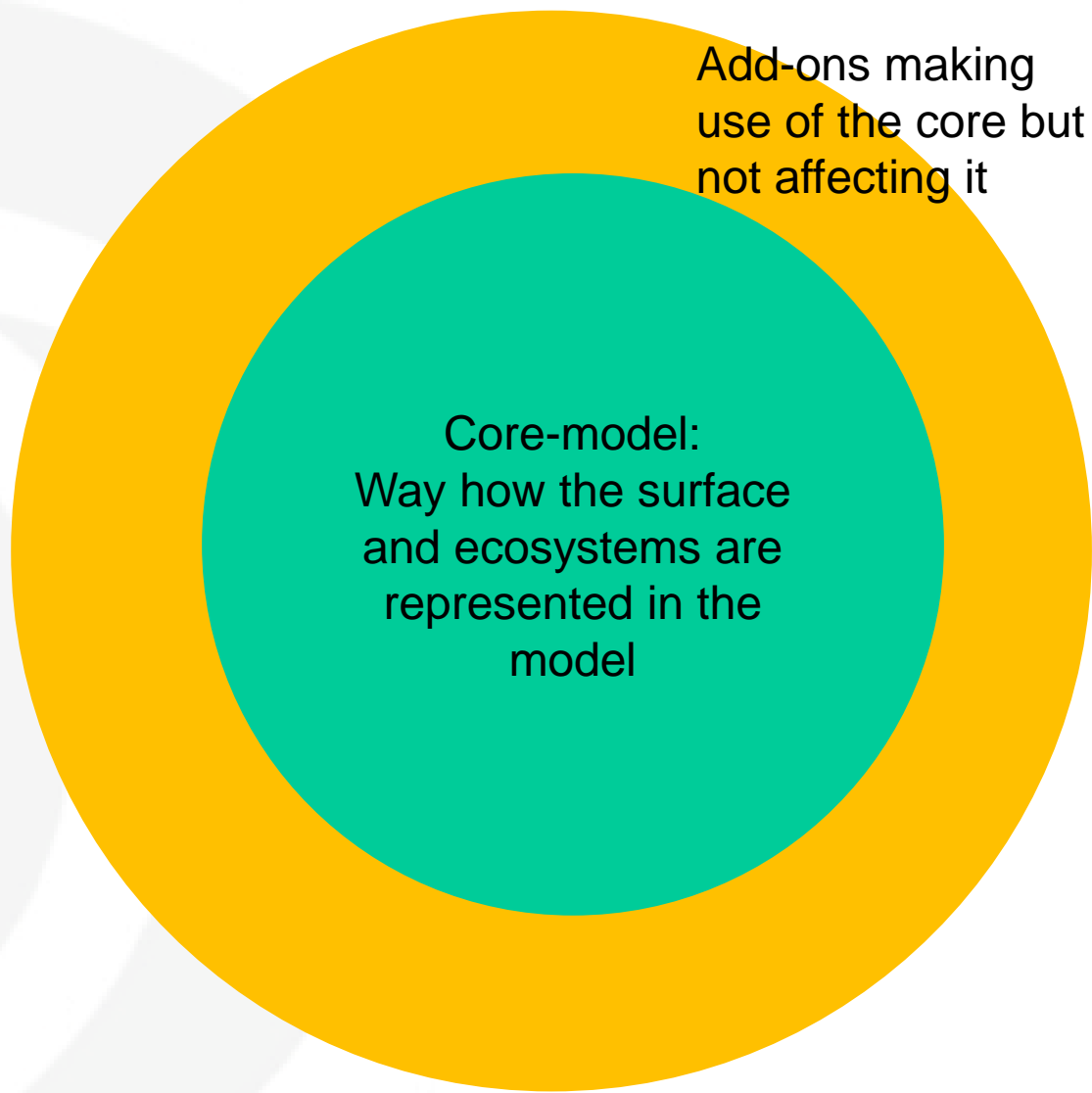
ORCHIDEE-CN

N-version of ORCHIDEE updated with the trunk, June 2017



ORCHIDEE-CN-CAN





Add-ons making use of the core but not affecting it

Core-model:
Way how the surface and ecosystems are represented in the model



Photosynthesis
Energy budget
Canopy structure
Soil water
Plant water stress
Nutrient cycles
Age classes
...

Forest management
Grass land management
Dynamic vegetation
More PFTs
Land cover change
Fire disturbance
Wind throw disturbance
Product use
Management changes
Species change



What is new in ORCHIDEE-CN-CAN?



LABORATOIRE DES SCIENCES DU CLIMAT & DE L'ENVIRONNEMENT
ORCHIDEE-DEV meeting May 9th 2017



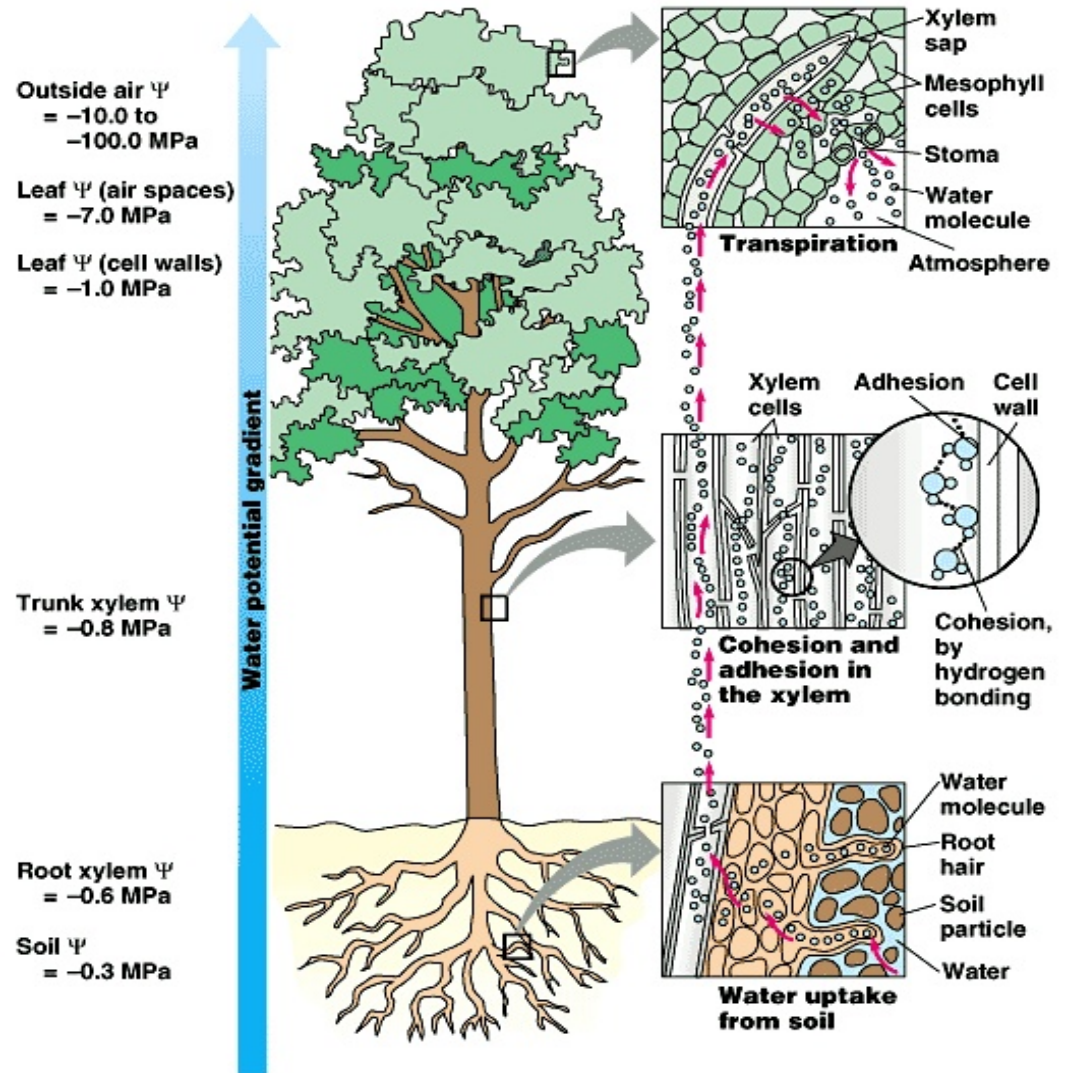
Simulating the canopy

Pipe model theory

- Recognize how stomata is hydrological connected to the roots and the need to invest carbon in building roots and stem
- Allometric relationships, leaf to sapwood area ratio, relationship between diameter and height

Water stress

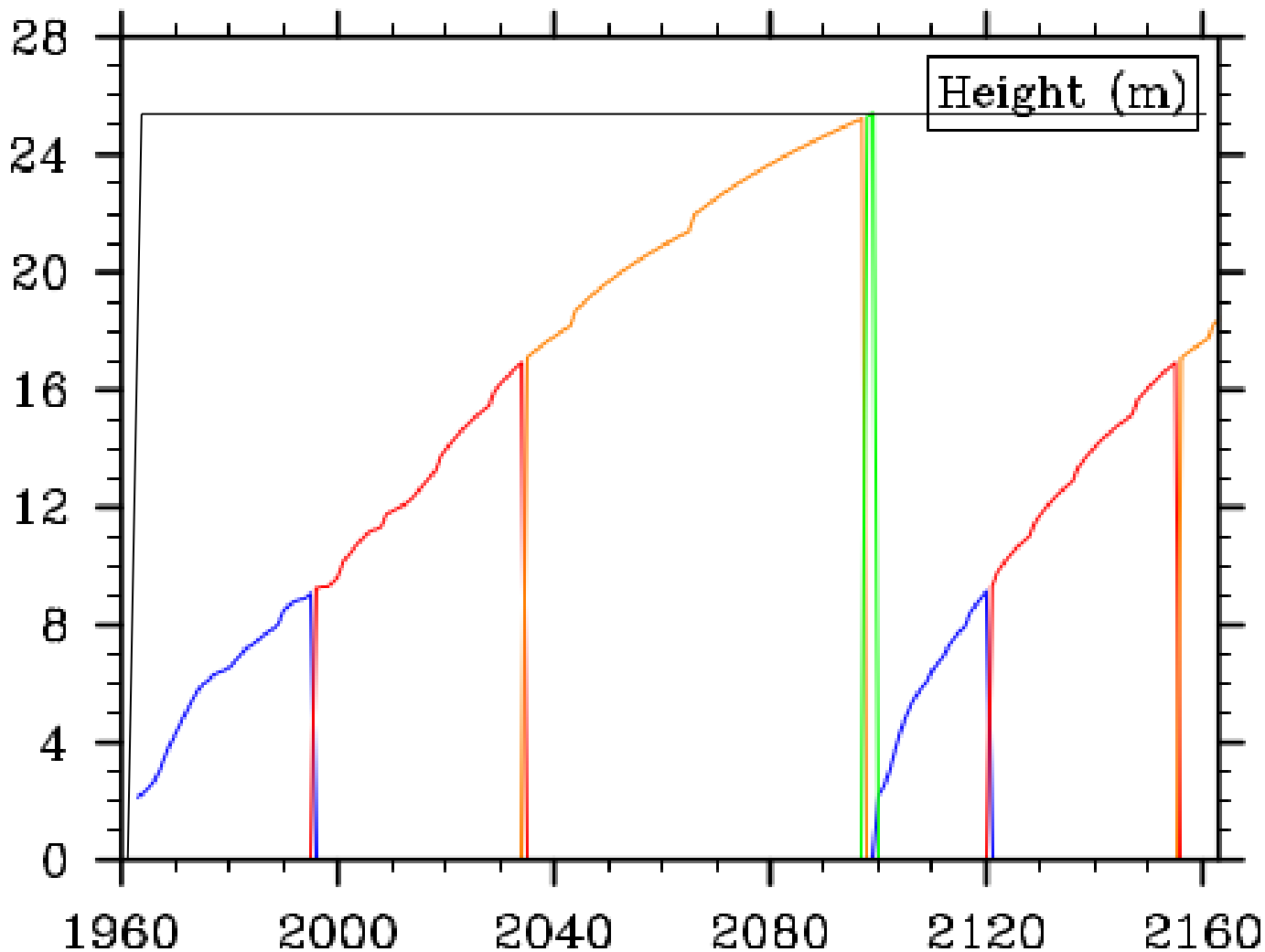
- Hydraulic architecture



Copyright © Pearson Education, Inc., publishing as Benjamin Cummings.



Simulating the canopy



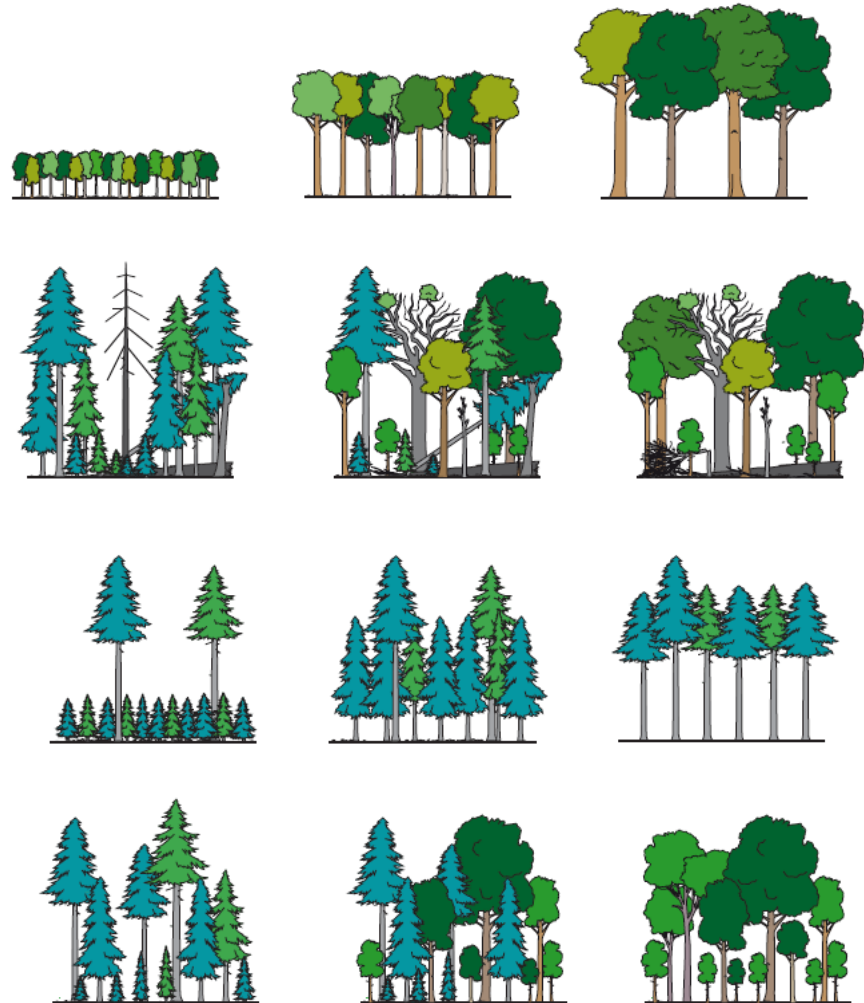
Simulating the canopy

Diameter classes and age classes are introduced

Number of PFTs depend on number of age classes

Each PFT has x numbers of diameter class

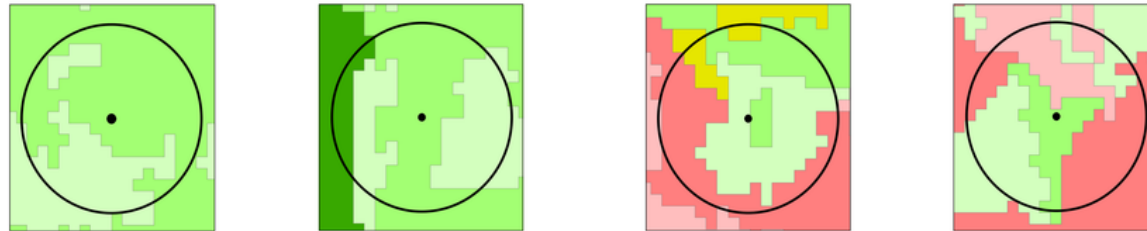
Each diameter class has x number of trees depending on basal area - self-thinning rule



Simulating the canopy

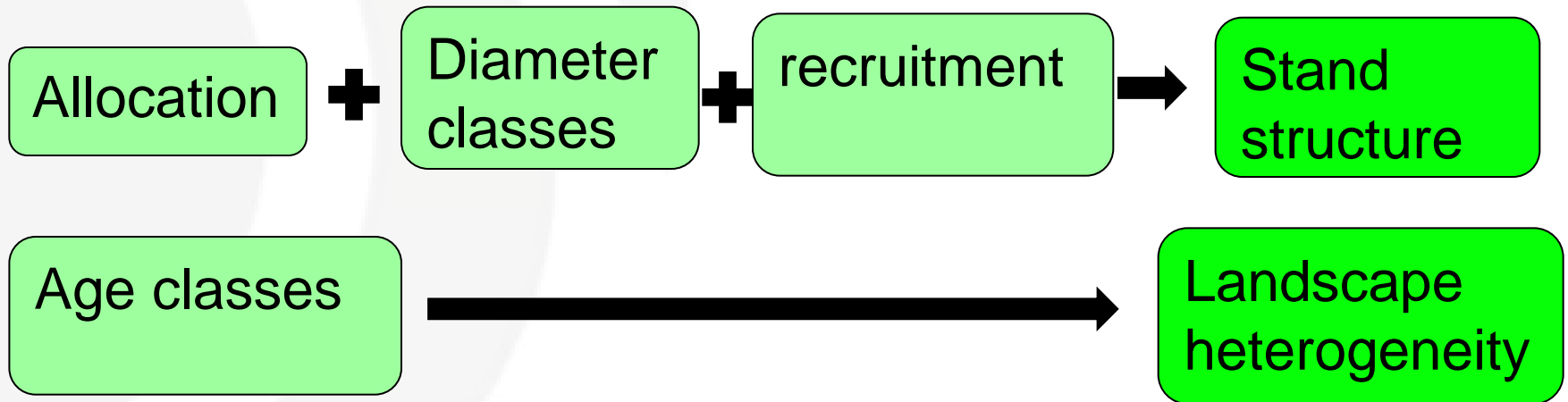


Stand structure



landscape heterogeneity

*Illustrations from
Moreira et al 2015
PLoS One*

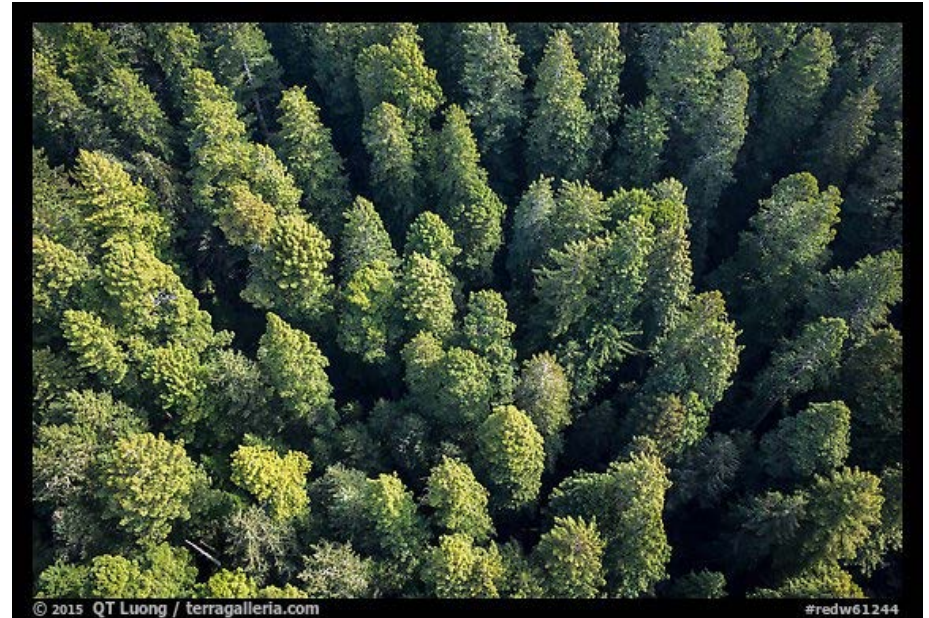


Simulating the canopy

The trees are horizontally distributed following a Poisson distribution

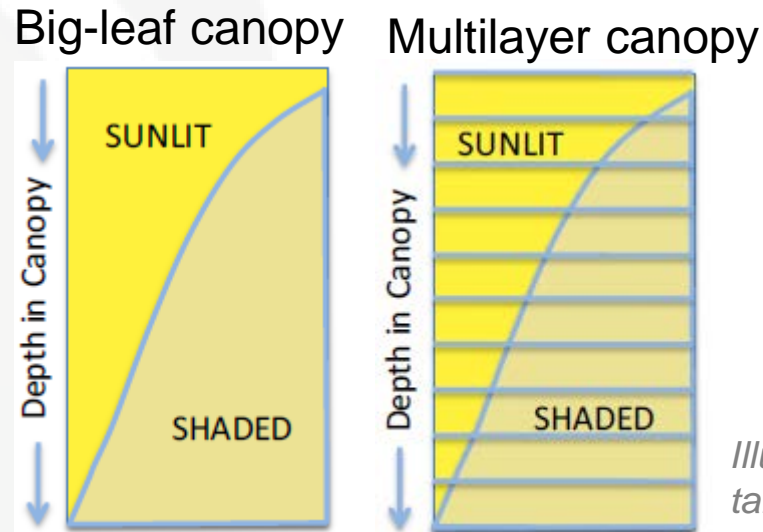
The structured canopy allows for calculations of light penetration within the canopy.

Statistic approach to reduce memory allocation



Using the canopy

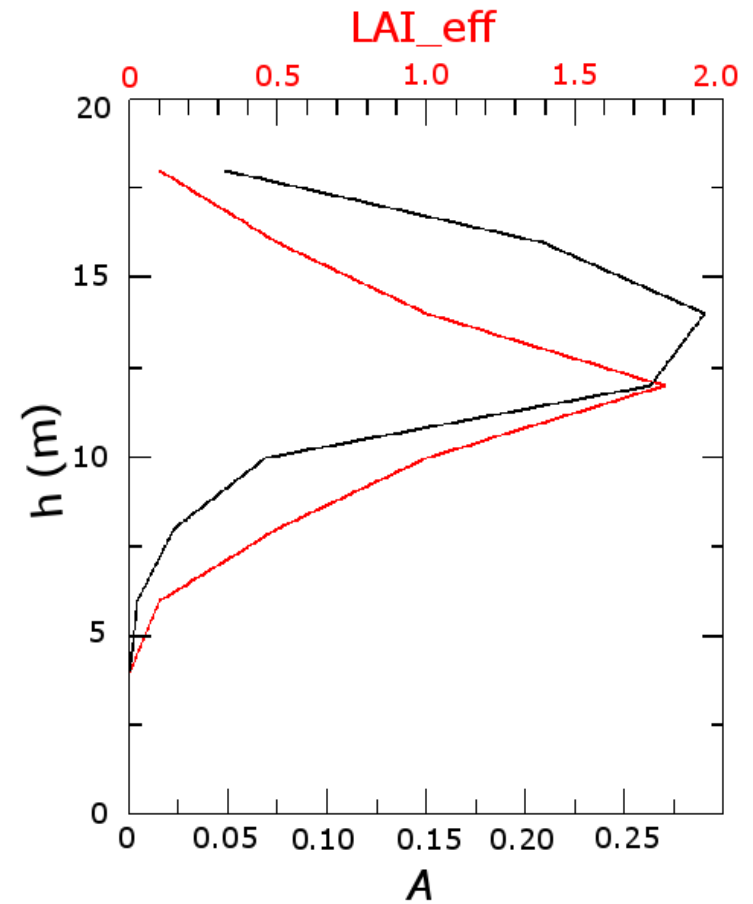
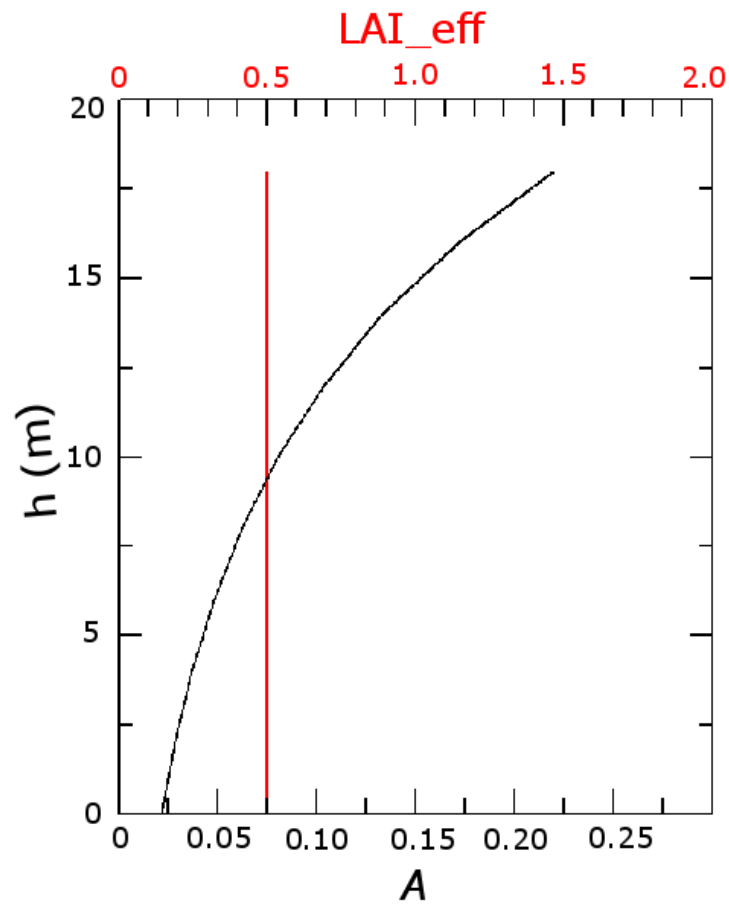
Changing the formalization of the canopy



Illustrations from Gordon Bonan, talk 2016, CMMAP meeting



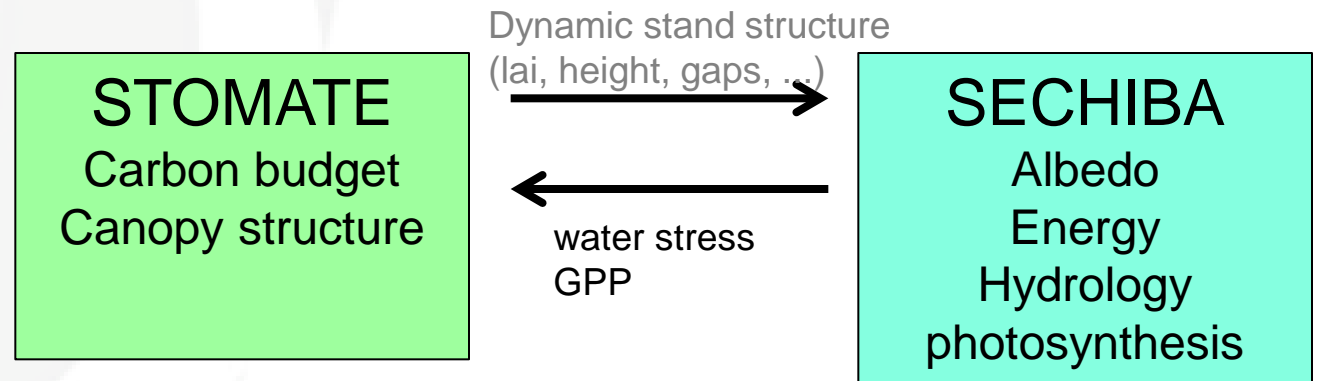
Using the canopy



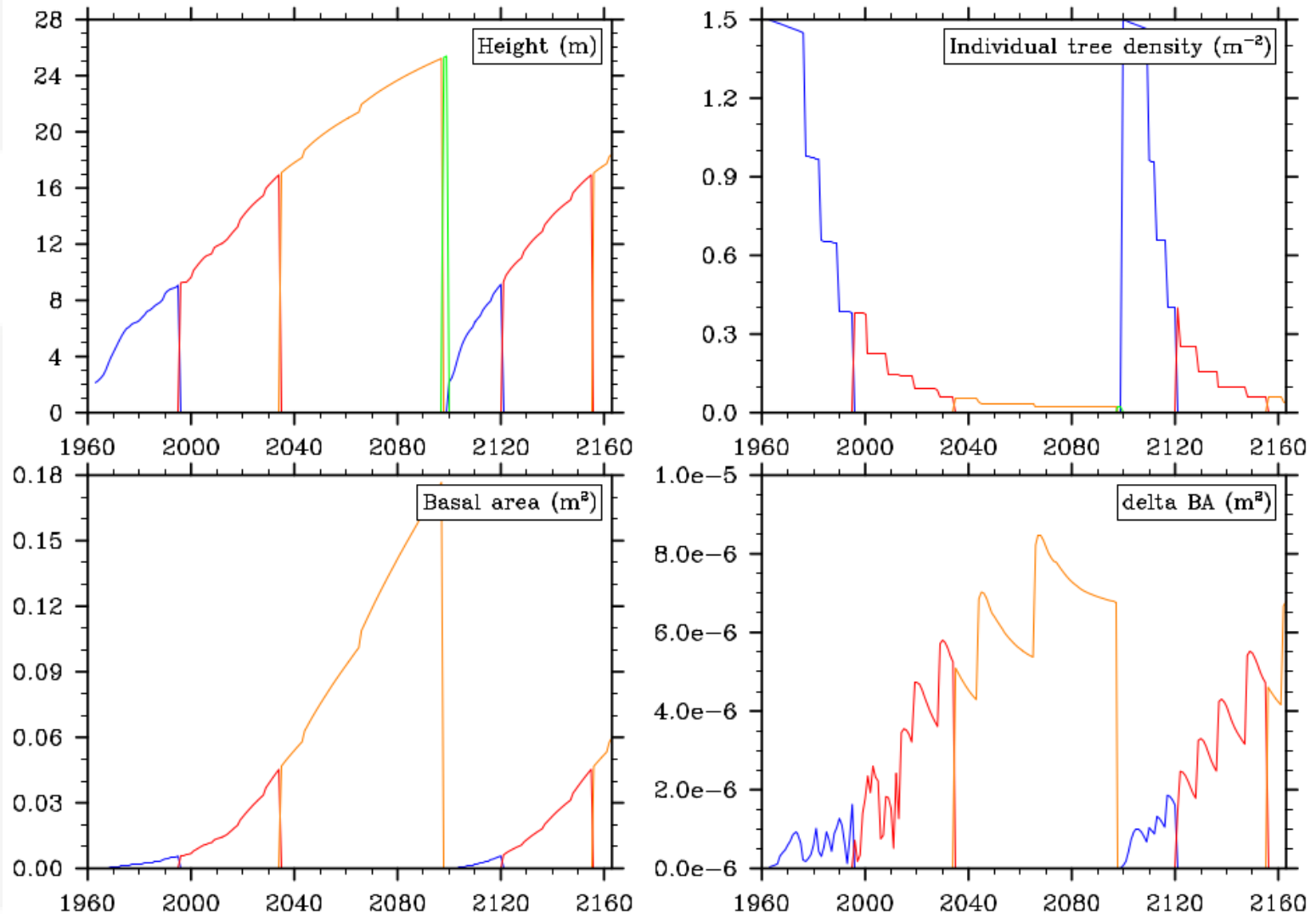
Using the canopy

Together with the calculations of light penetration, the dynamic canopy structure permits for canopy layers in which we can simulate

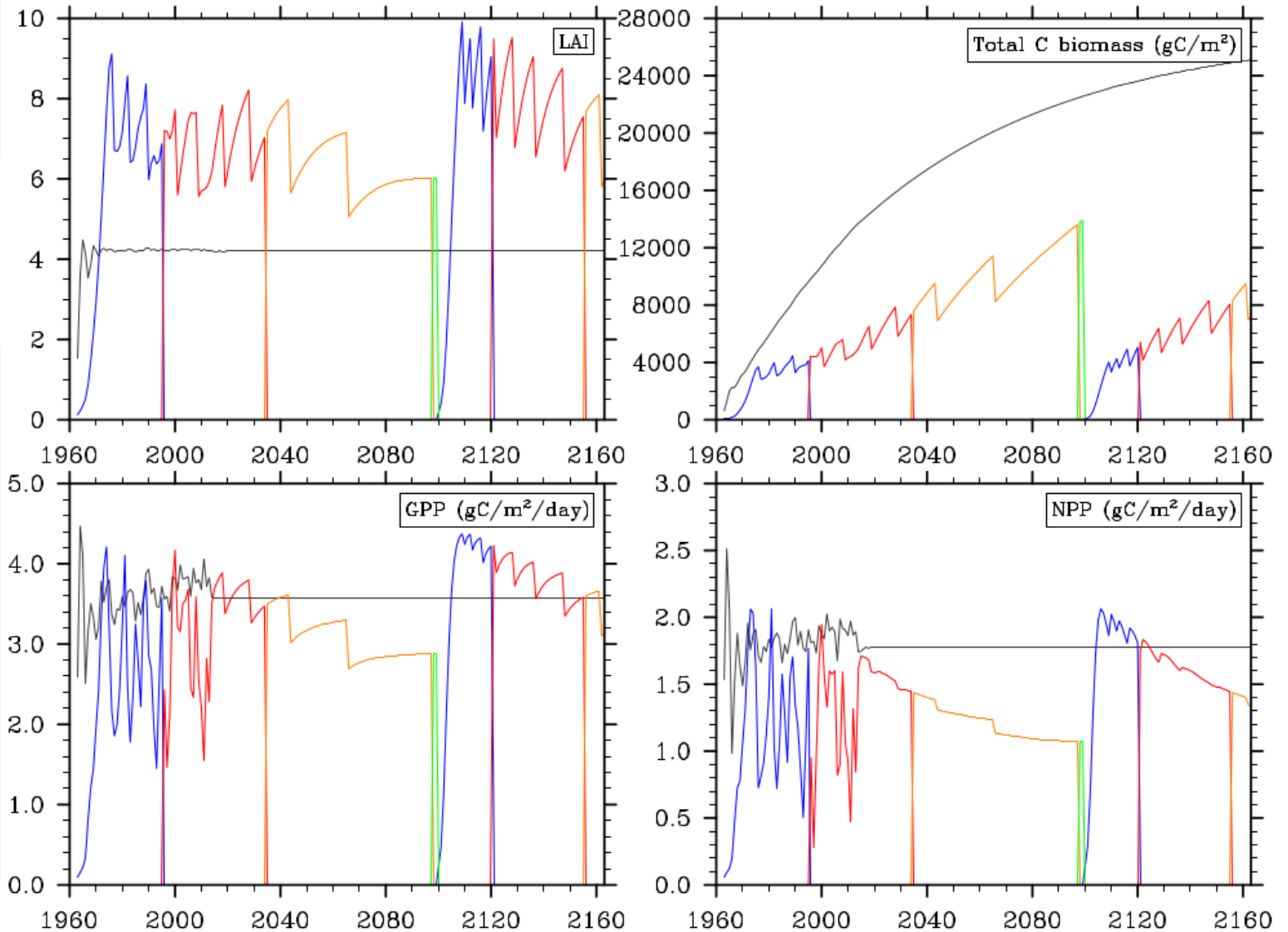
- Dynamic LAI
- Albedo
- Photosynthesis
- Hydraulic architecture to calculate water stress
- Energy budget (inc. leaf temperature)



Ecosystem dynamics



Ecosystem dynamics

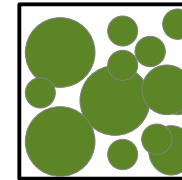
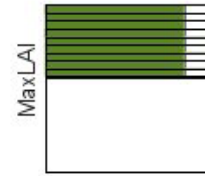


Summary sheet of CAN

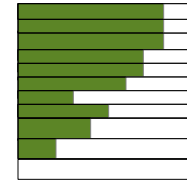
Real world



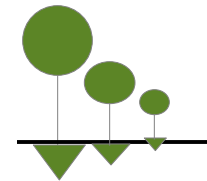
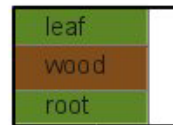
LAI & GPP



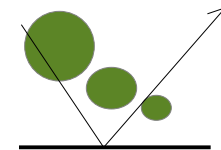
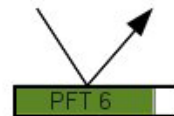
Height



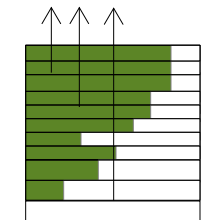
NPP & biomass



Albedo

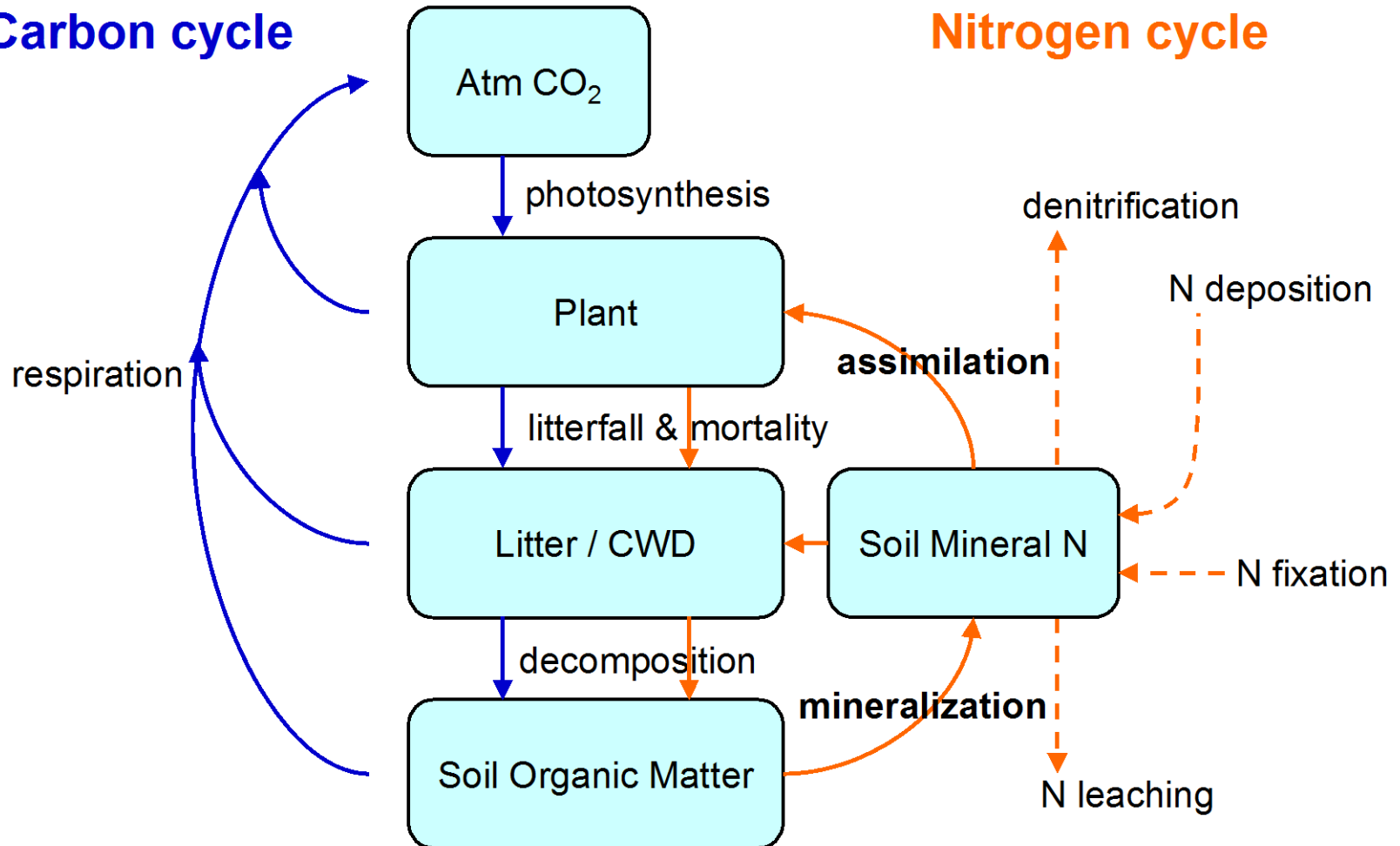


Energy budget



Simulating the nitrogen cycle

Carbon cycle

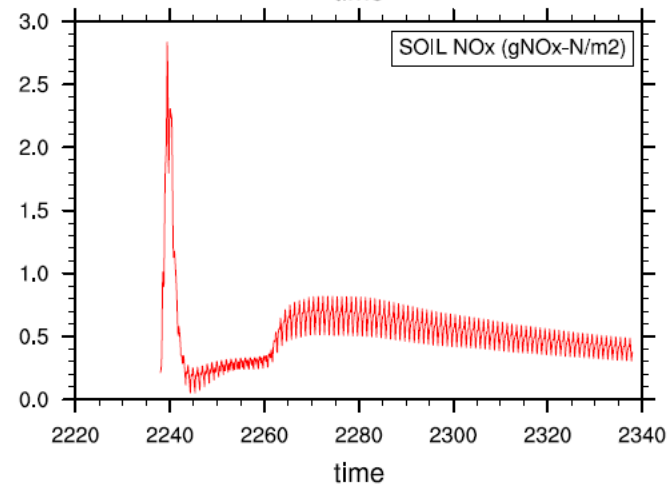
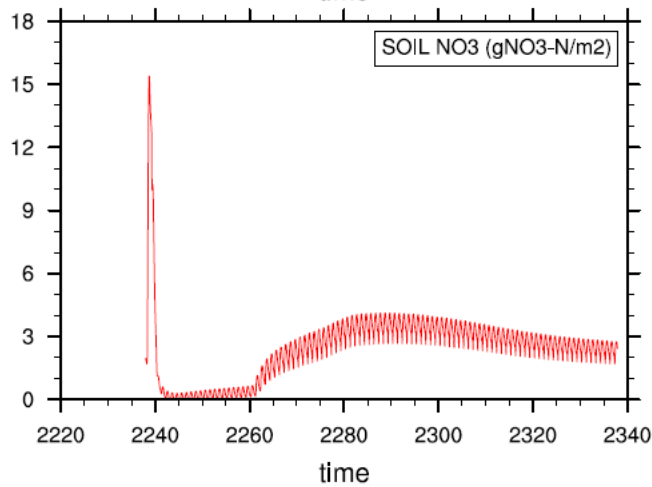
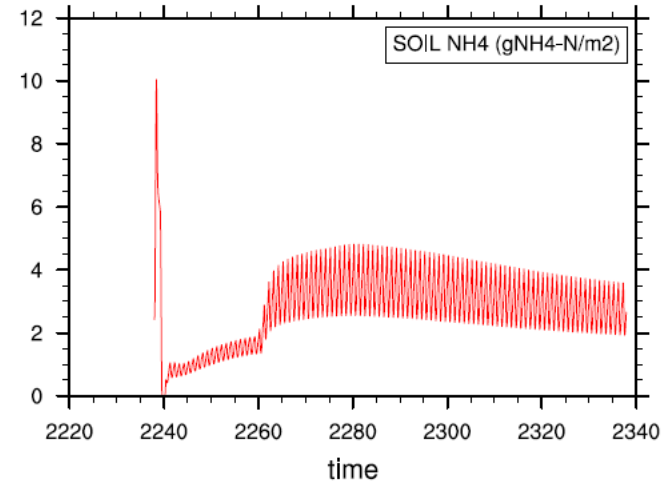
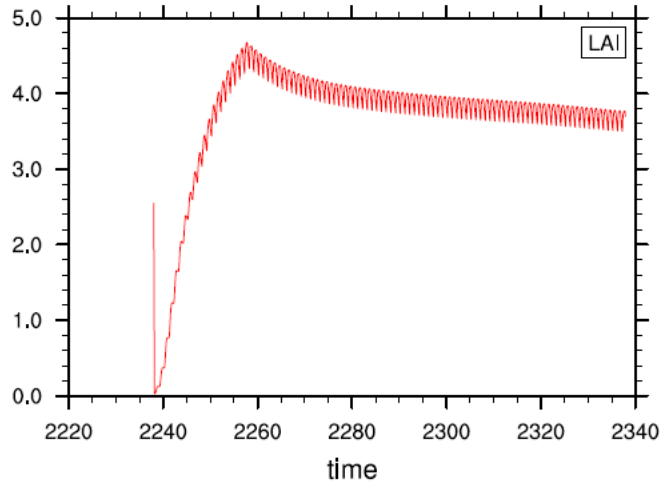


From S. Zaehle



Simulating the nitrogen cycle

Needleleaf Evergreen Boreal



Simulating the nitrogen cycle

The N-cycle follows the C-cycle

Diagnostic setting – debugging:

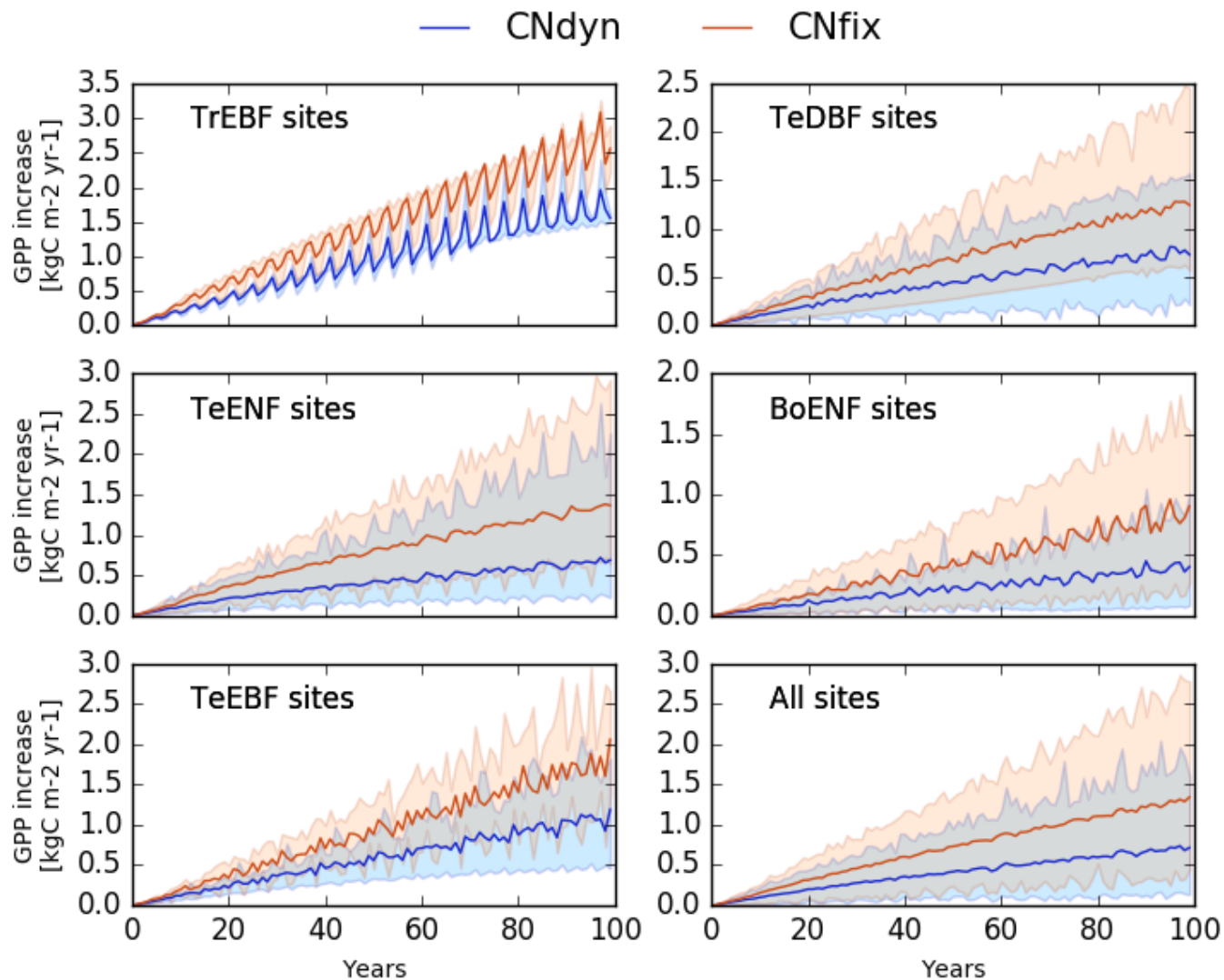
- Take the N from the preferred pools;
- If this is not enough take it from the atmosphere.

Prognostic setting – applications

- Spin-up the N-pools;
- Take the N from the preferred pools;
- If that is not enough change C/N ratios;
- Use C/N ratios in the calculations at the next time step.



Simulating the nitrogen cycle



Existing add-ons ORCHIDEE-CN-CAN

- Forest management with age classes (AC)
- Anthropogenic species changes (w. AC)
- Forest management changes (w. AC)
- Wind throw (w. AC)
- Product use
- Species parameters
- Land cover change (w. AC)



Validation

- Science is working: strengths and weaknesses of the formalization
- Regional improvements (evapotranspiration) but unclear whether this comes from the formalization or the parameters
- ORCHIDEE-CN-CAN -> new core so will need to re-parameterize the whole model
- ORCHIDEE-CN-CAN -> new core so will need to test and validate different set-ups (interactions between core and add-ons and among add-ins)

