ORCHIDEE development and performance in the Amazon

Hans Verbeeck

Overview

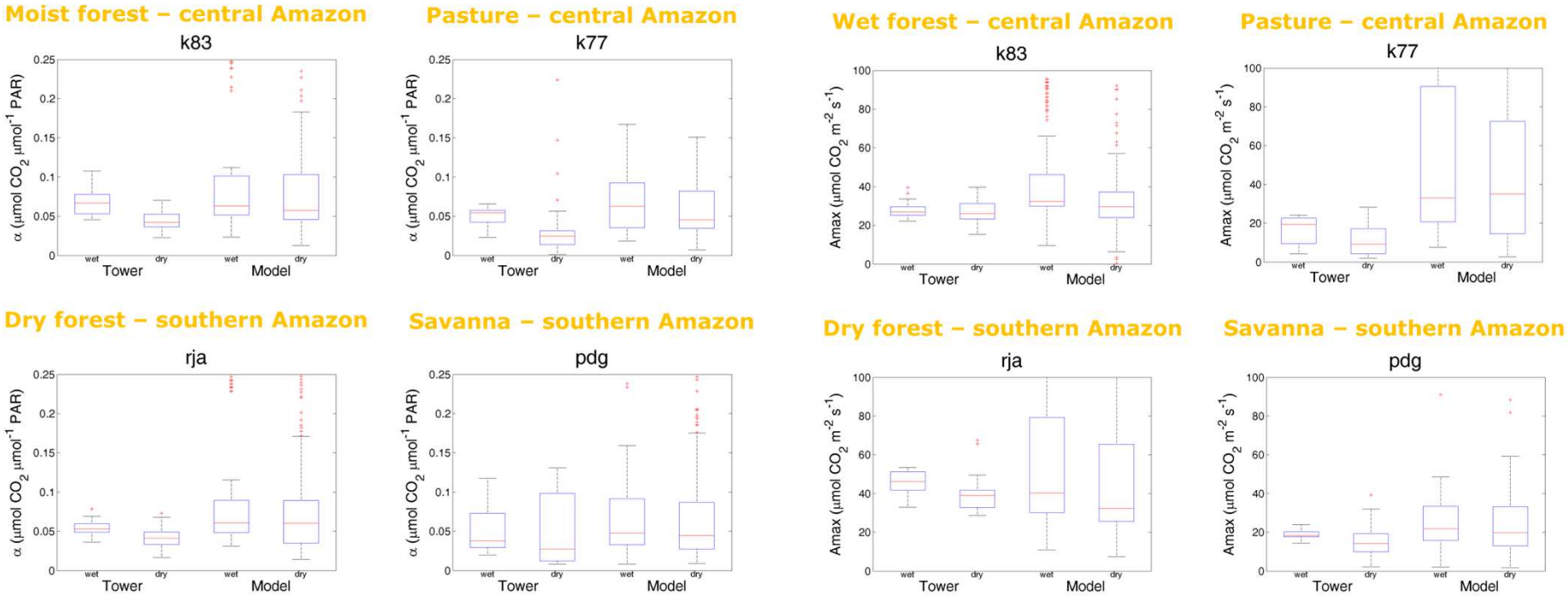
- LBA-DMIP
- VEGECLIM / PhD work Marjolein De Weirdt
- AMAZALERT work

LBA DMIP

- 8 fluxtower sites, different biome types
- A suite of models including ORCHIDEE
- Overview paper de Goncalves et al. 2013 AgForMet
- IAV paper: von Randow et al. 2013 AgForMet
- Christoffersen et al. 2014 AgForMet
  - Nice in-depth analysis on water supply versus demand mechanism for ET seasonality

LBA DMIP

- Ongoing analysis: LUE (Verbeeck-Poulter)
- Fitting GPP light response curves for al models and sites, alfa and Amax parameters:



Research Programme for Earth Observation - STEREO II

Belgian Science Policy Office

belspo

PhD work Marjolein De Weirdt

The VEGECLIM Project

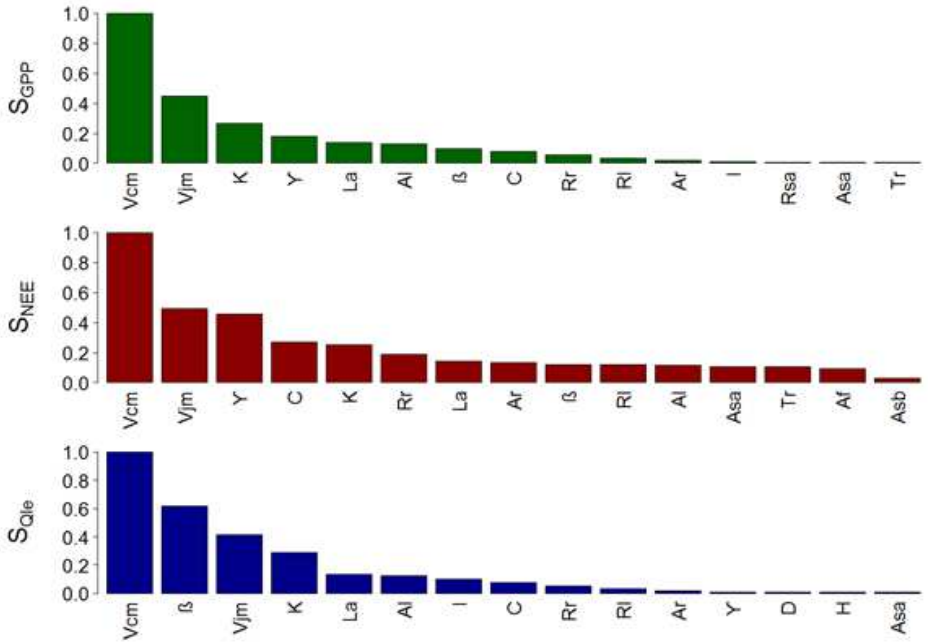
- STEREO II Program -

UNIVERSITEIT GENT

UCL Université catholique de Louvain

Earth and Life Institute - Geomatics

Sensitivity analysis of ORCHDEE parameters for tropical forest

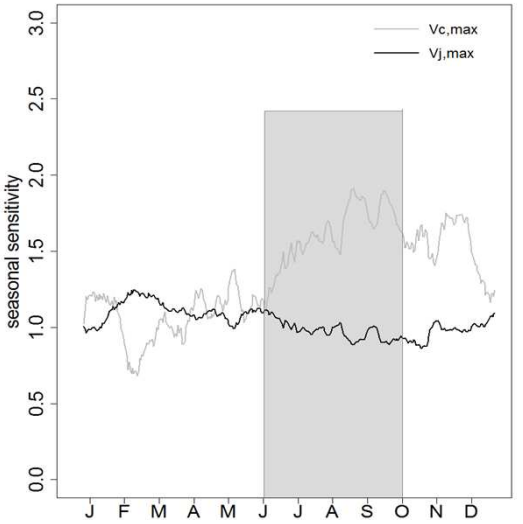


- small perturbations of default parameter values
- Sensitivity of fluxes and stocks are calculated for 2 sites: Guyaflux and Tapajòs

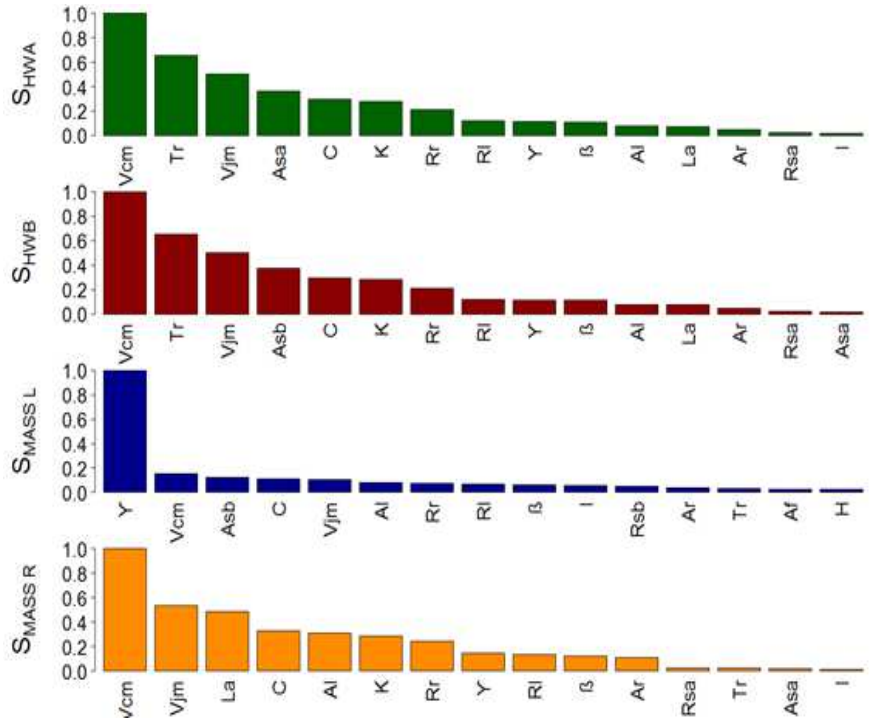
Sensitive parameters for fluxes are all related to canopy properties

- Vcmax, Vjm,
- K (extinction coeff)
- Γ (Johnson and Thornley)
- B ball-berry slope
- La→ critical leaf age

Seasonality of sensitivity:



Sensitivity analysis of ORCHDEE parameters for tropical forest



Sensitive parameters for stocks are not only related to canopy properties

- Vcmax, Vjm,
- La: critical leaf age
- γ (Johnson and Thornley)

But also to

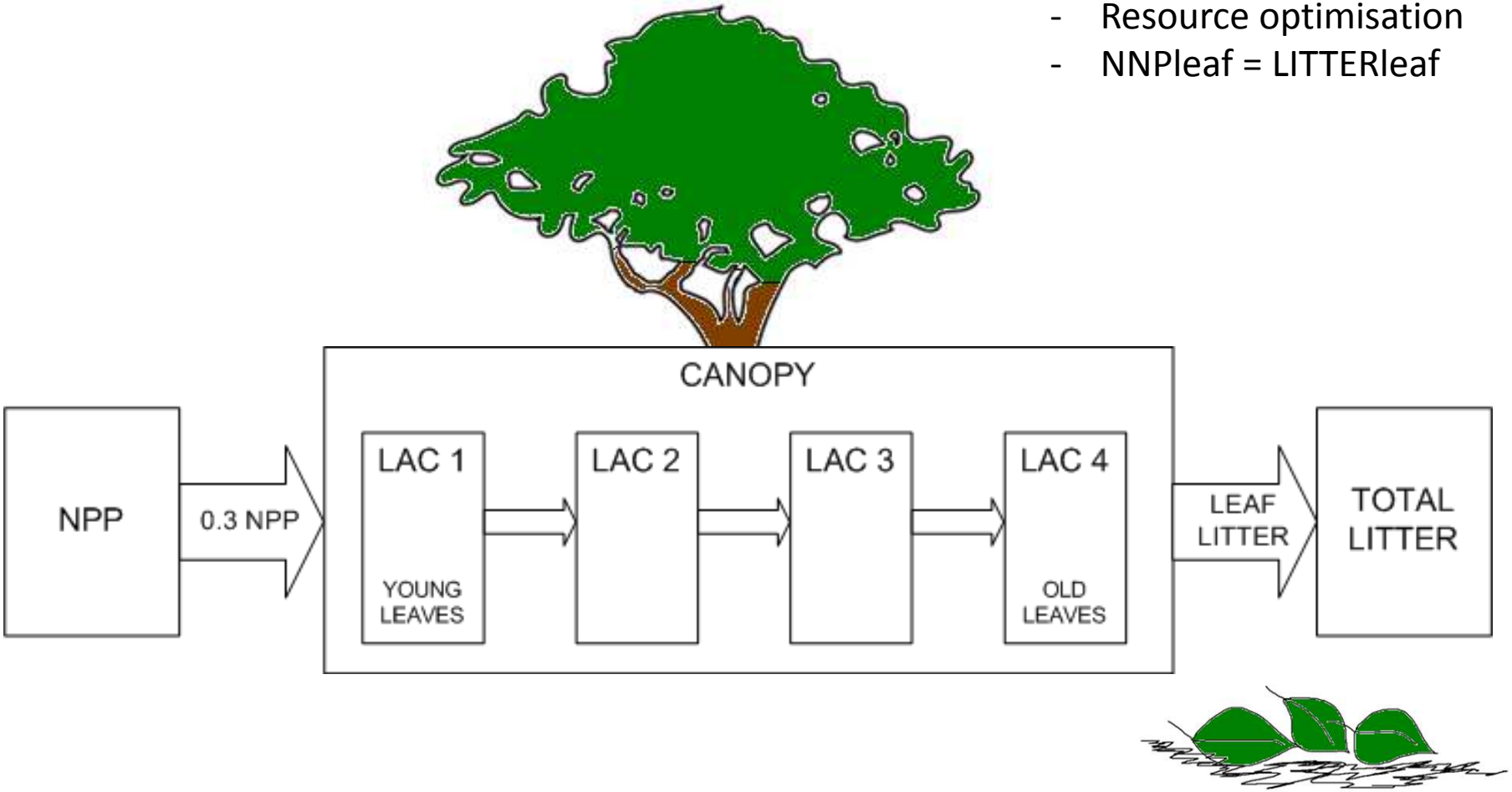
- Tr: residence time
- Allocation to sapwood

Improved leaf turnover in ORCHDEE for tropical forest

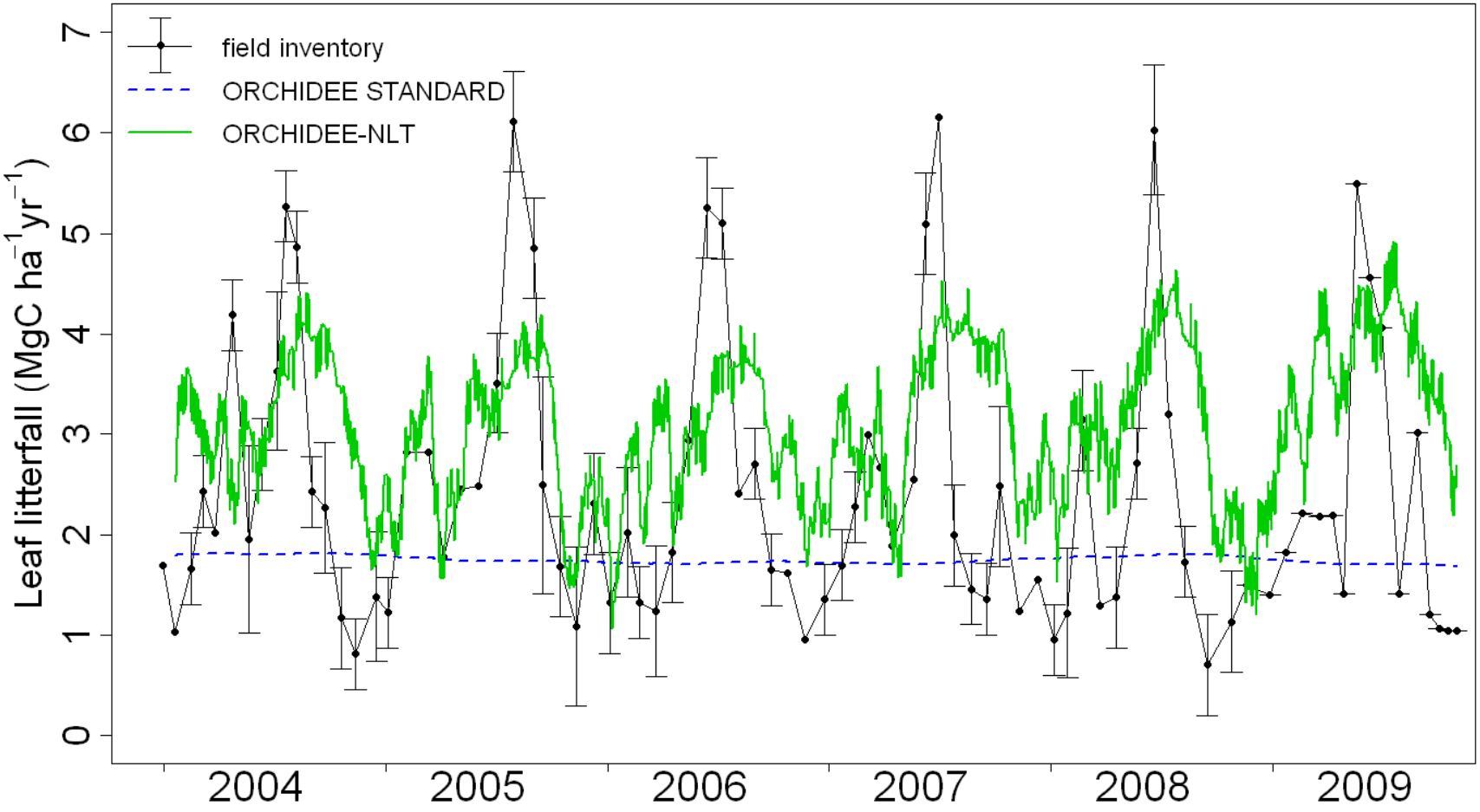
ORCHIDEE standard
- Constant leaf turnover in tropical forest

DATA: litterfall
- Clear seasonality
- No straightforward link with climate

ORCHIDEE-NLT
- Assumption of old-growth canopy with constant leaf biomass
- Resource optimisation
- NNPleaf = LITTERleaf



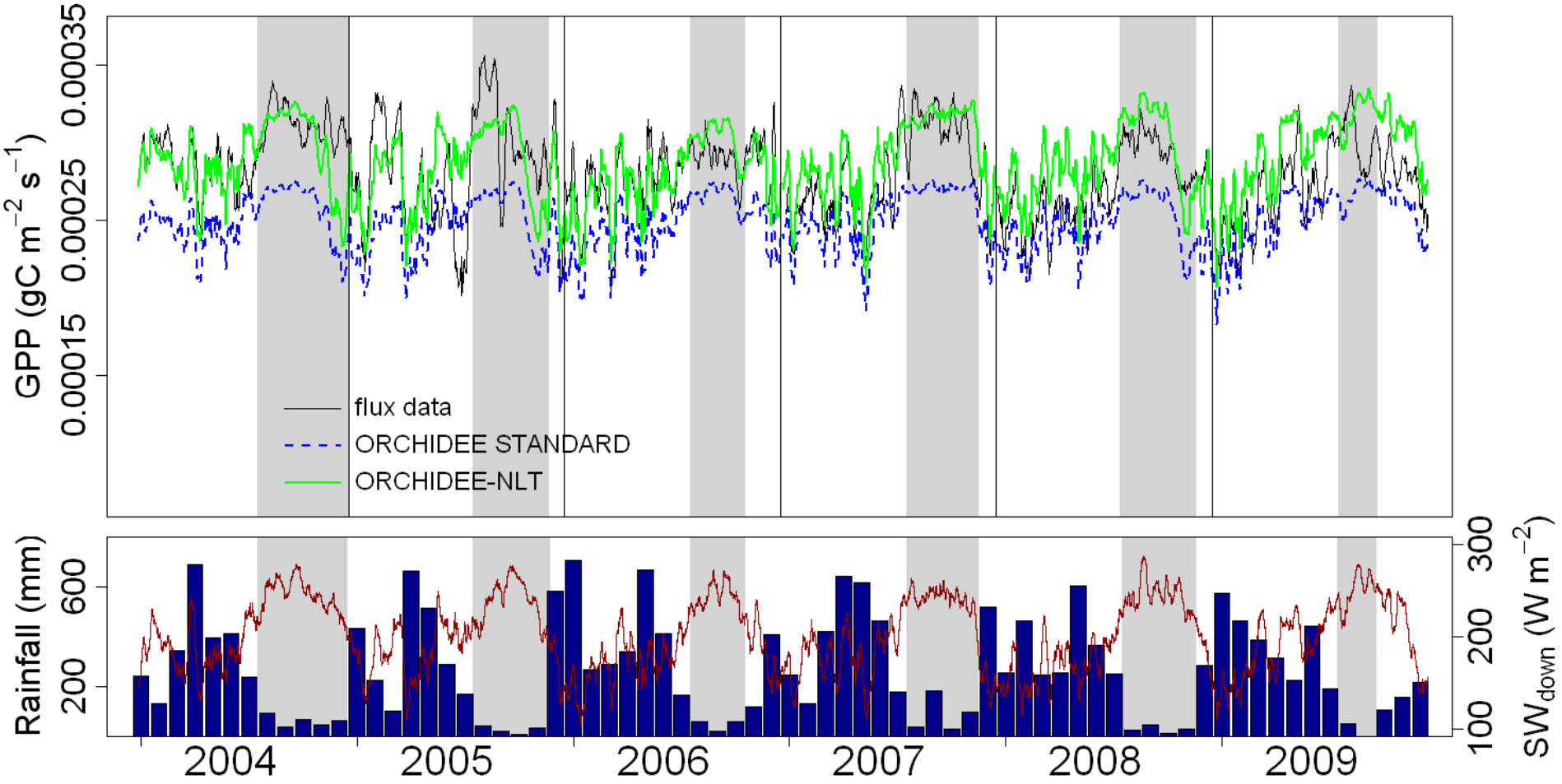
Guyaflux site, French Guiana



De Weirdt et al., Geoscientific Model Development 2012

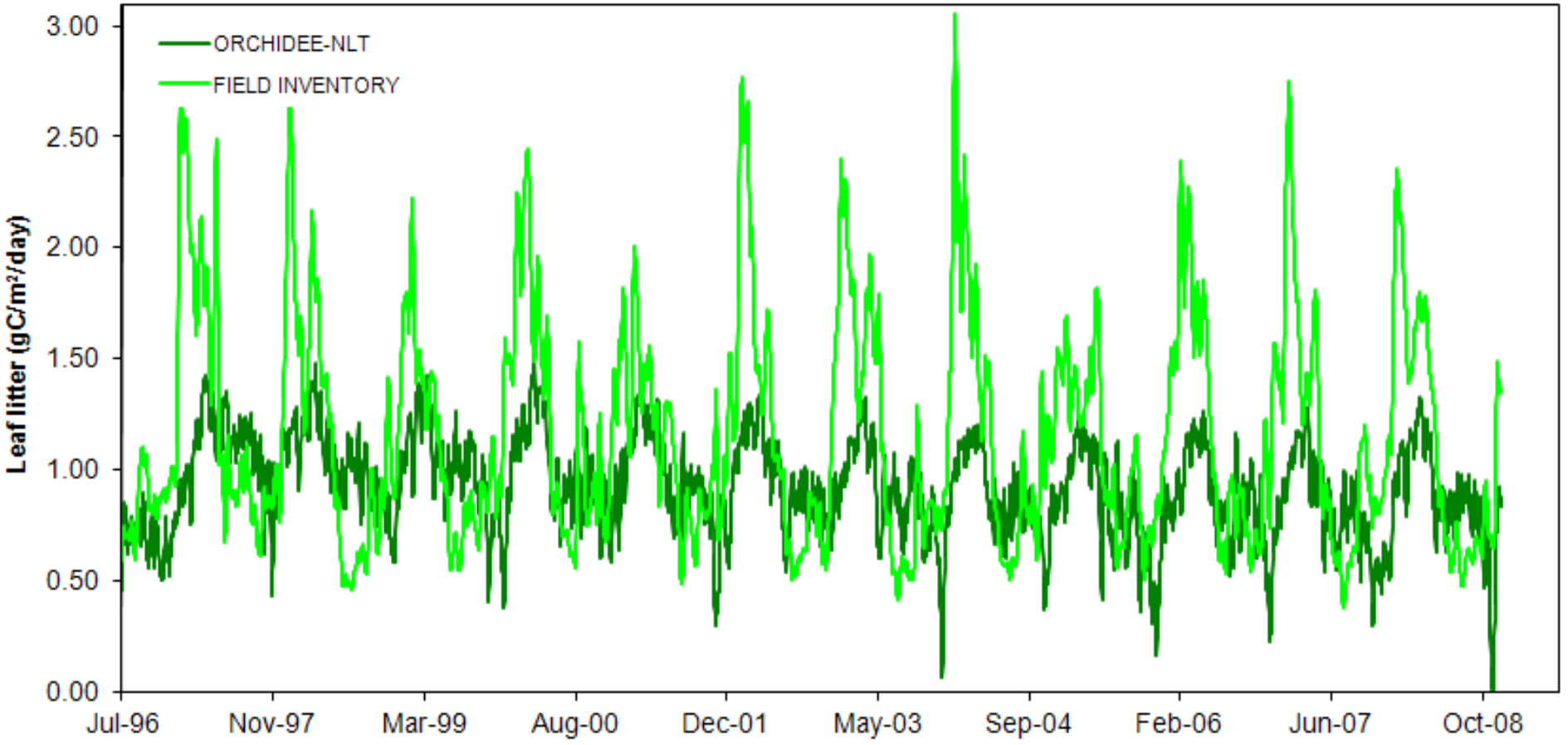
SEASONAL GPP

both order of magnitude, seasonal and interannual variations in GPP improved at the Guyaflux site

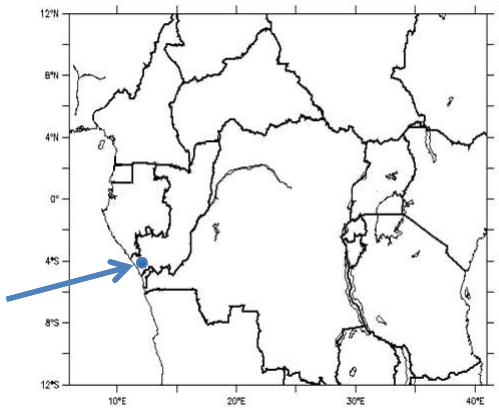


Validation for other sites

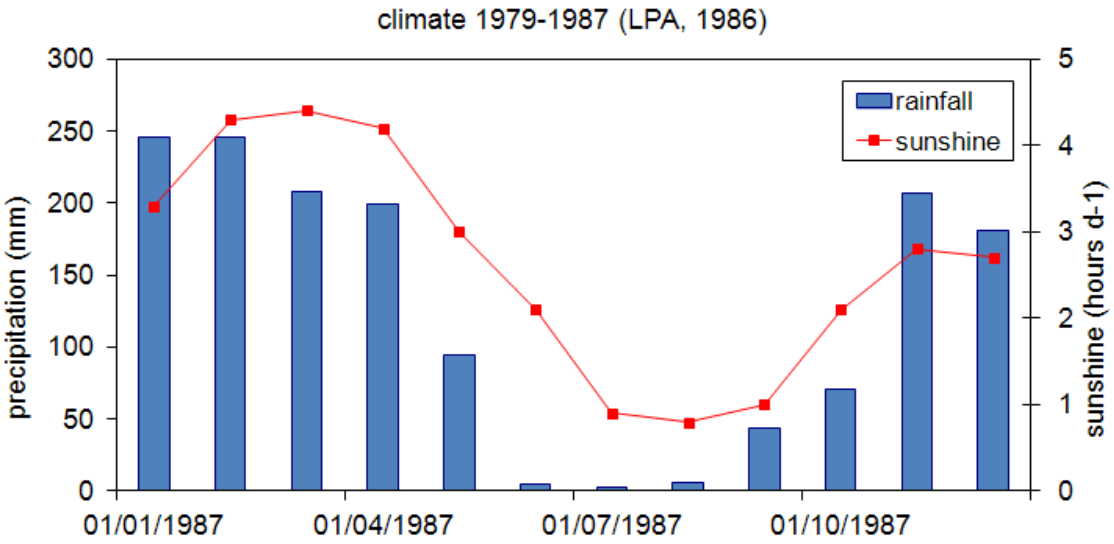
Barro Colorado Island, Panama



Validation for site in Mayombe



litter peaks with increased irradiance during the rainy season when there is less fog



Ongoing work:

- detailed validation for stocks, fluxes,for Amazon and Congo
- Vcmax vertical canopy profiles

Future development?

- Optimising the litterfall model (to get rid of the constant LAI assumption)

AMAZALERT

A research project
on impacts of climate change
and land use change in
Amazonia

Historical and future DGVM runs for the Amazon

Hannes De Deurwaerder & Hans Verbeeck

HISTORICAL BASELINE RUNS

DGVM	A	B	D	River-Routing
Orchidee		X	X	X
Jules		X	X	
LPJmL	X		X	X
Inland	X	X	X	

Scenario	*Description*
A	*natural disturbances + no land-use change + changing climate (recycling the SHEF driver) + changing CO_2 .*
B	*natural disturbances by excluding fire + no land-use change + changing climate (recycling the SHEF driver) + changing CO_2*
D	*natural disturbances + land-use change + changing climate + changing CO2.*

Future runs

- 4 DGVMs
- 3 Land use scenarios INPE
- Climate forcings HadCM3, CCSM, PCM

→Ongoing

→All model runs, forcing data and validation data are or will be available on: www.amazalert.ugent.be

Forcing data for the Amazon

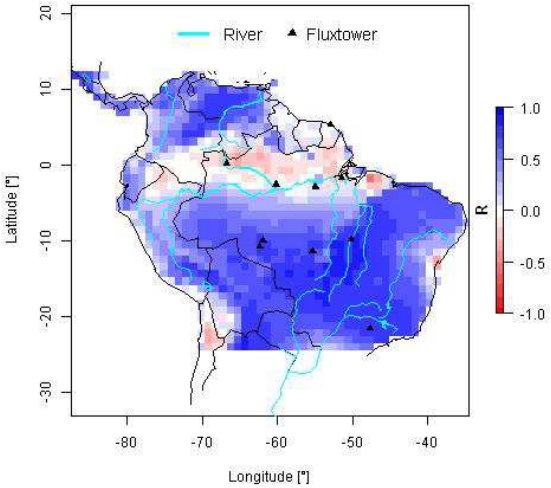
- Historical climate forcing data 1970-2008 (AAI project Sheffield)
- Future Climate forcing (AAI project):
- Historical land use data: Hurtt et al.
- Future land use scenarios developed by INPE
- Quesada soil texture map

Validation data

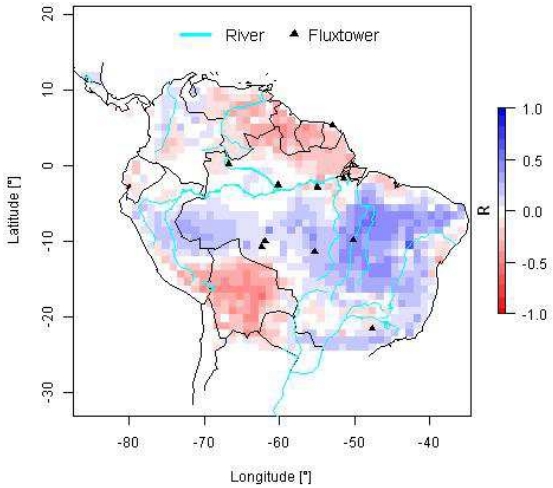
- Biomass data RAINFOR (143 plots)
- Biomass from network in Bolivia
- Maps based on RAINFOR
- Caxiuana drought experiment data
- Fluxtower data through LBA –MIP
- Hybam river discharge, precip
- ET data products compiled by Matthieu

Correlation maps

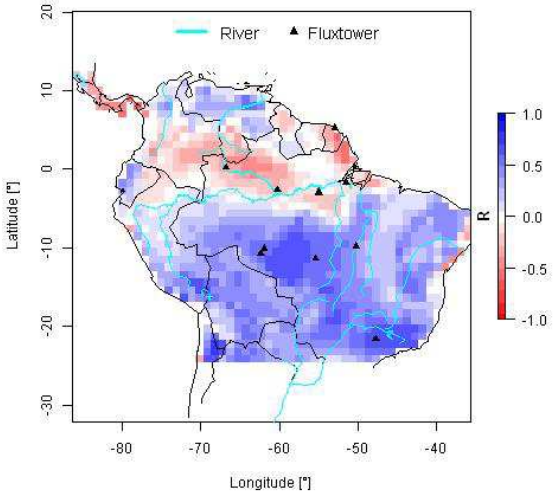
Jung Data: Correlation map Rainfall and GPP



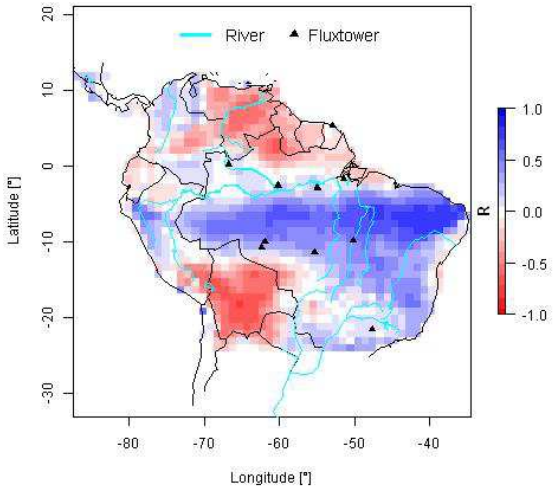
Orchidee: Correlation map Rainfall and GPP



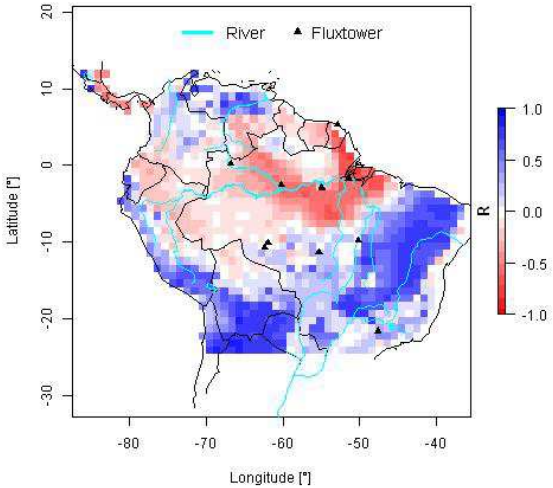
Jules: Correlation map Rainfall and GPP



LPJ: Correlation map Rainfall and GPP

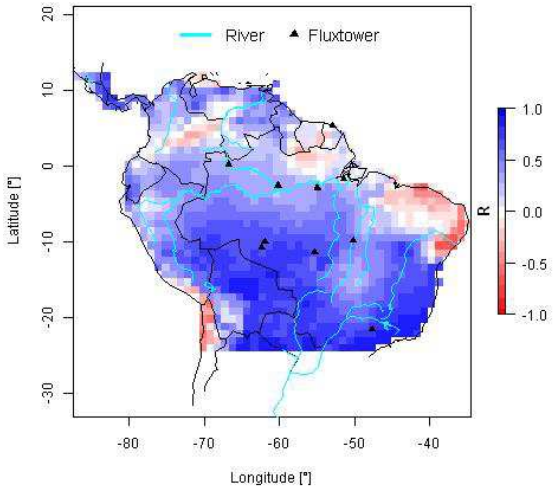


Inland A: Correlation map Rainfall and GPP

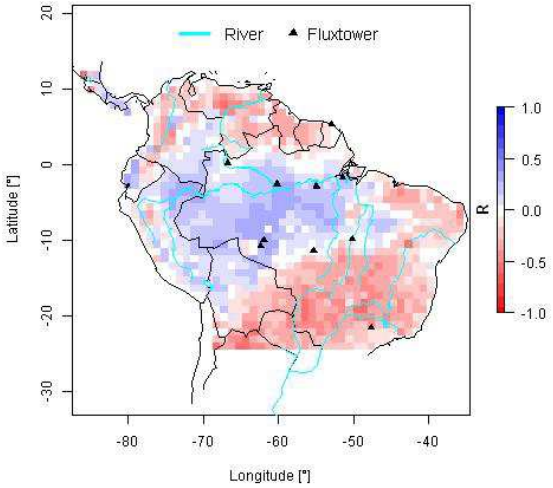


Correlation maps

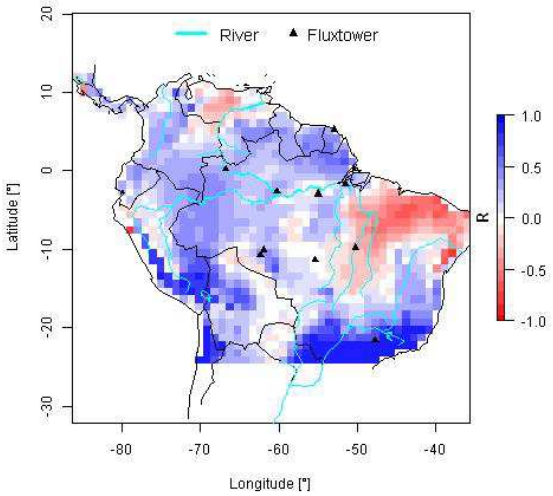
Jung Data: Correlation map Temperature and GPP



Orchidee: Correlation map Temperature and GPP



Jules: Correlation map Temperature and GPP



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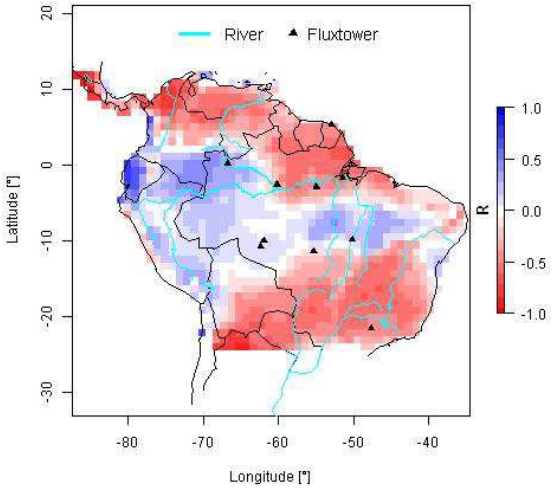

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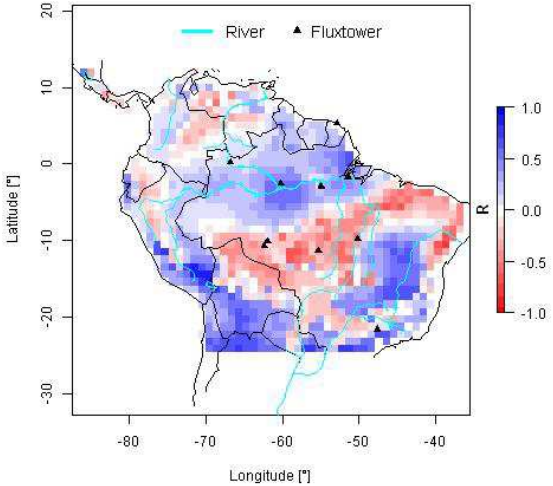
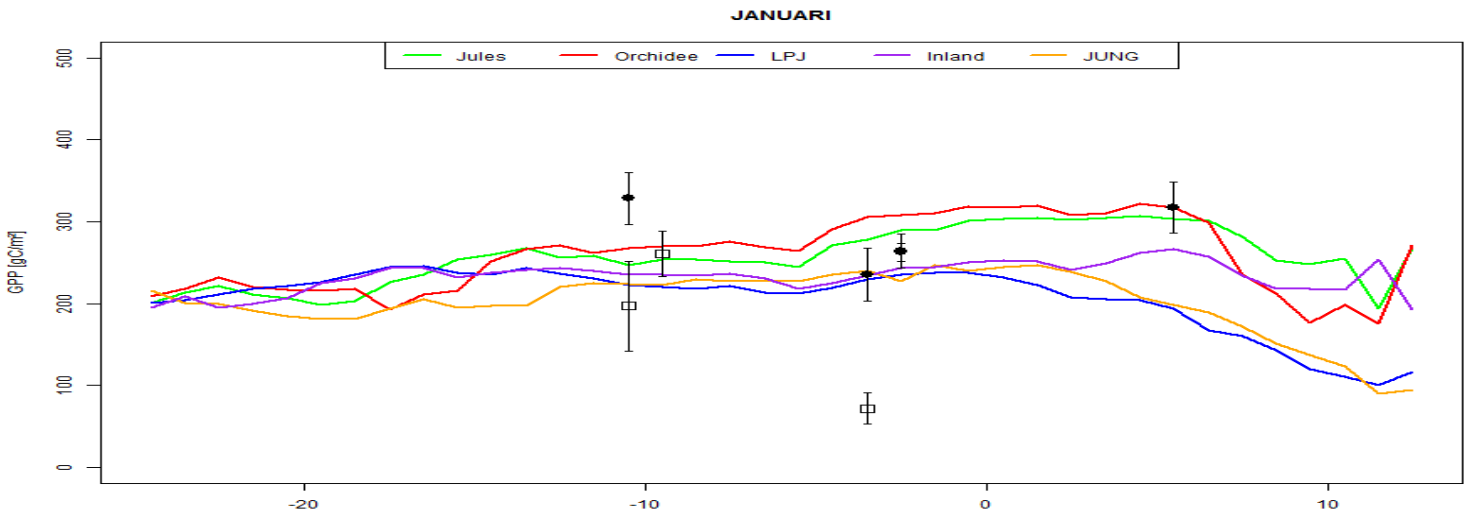
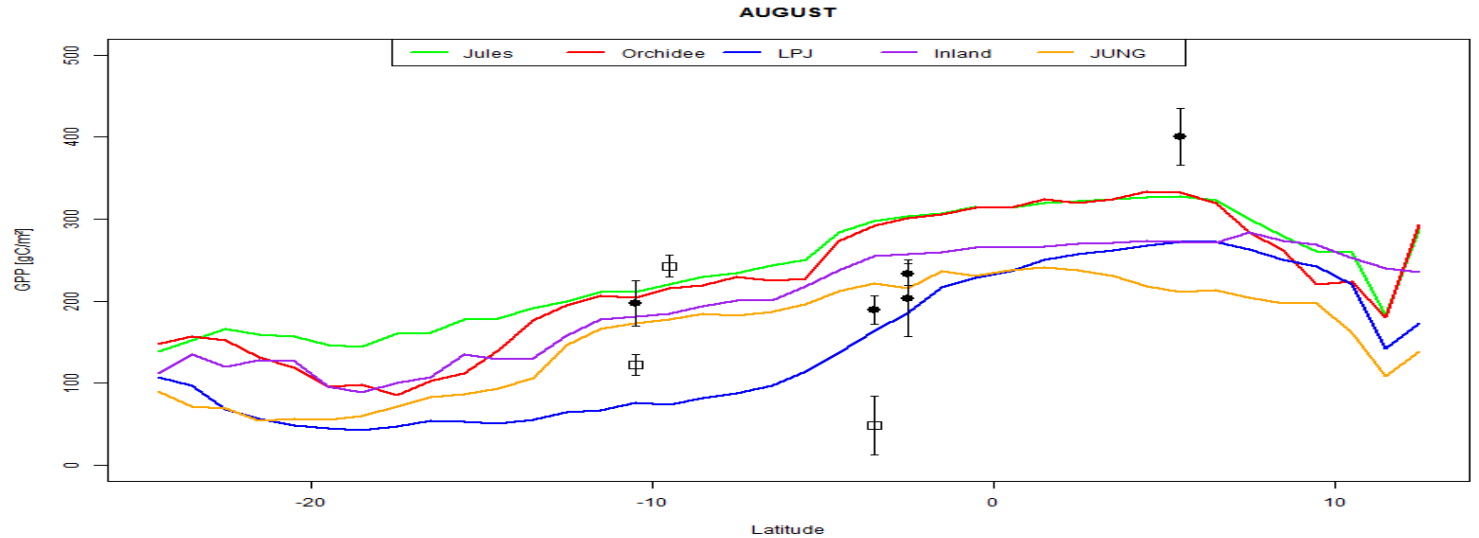


Mean of monthly GPP per latitude



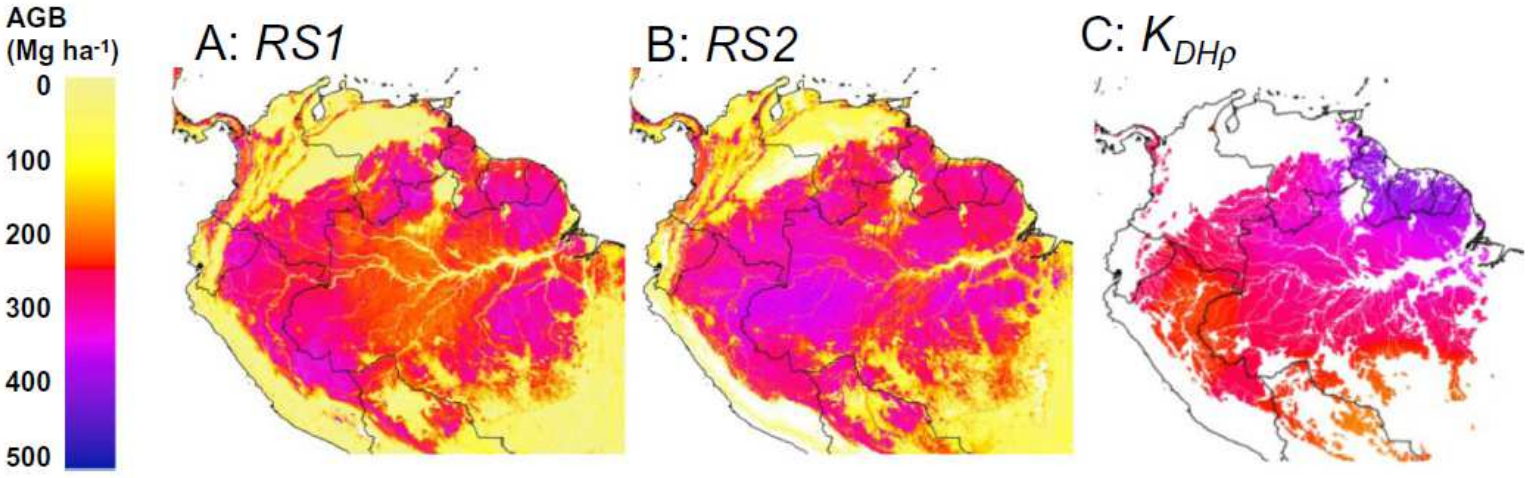


Flux Tower Data

- ● Tropical evergreen
- □ Others

Spatial variability of AGB in the Amazon

Mitchard et al. GEB 2014



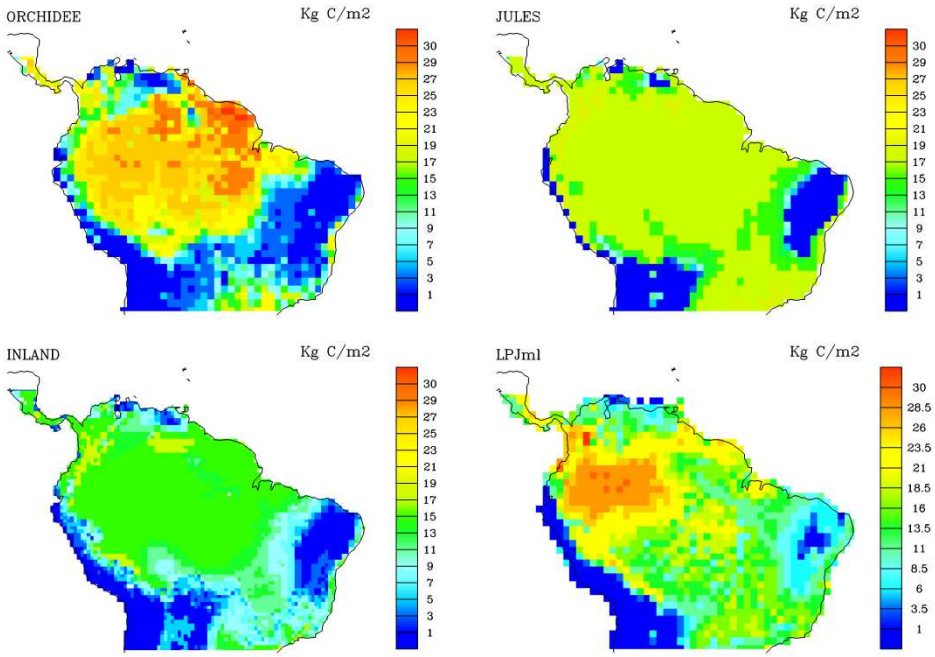
Saatchi-map

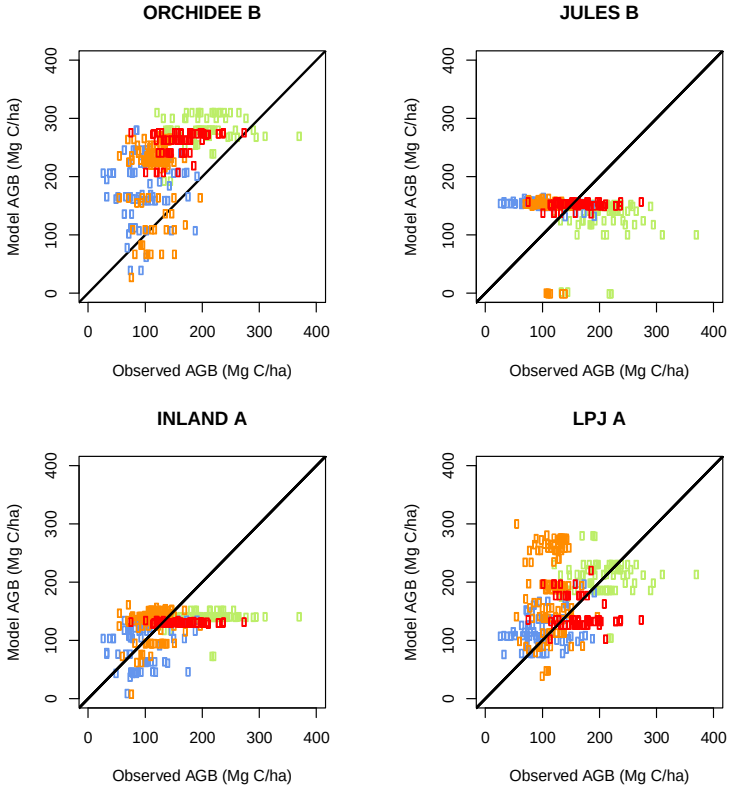
Baccini-map

RAINFOR-map

East-West gradient in the RAINFOR data, not represented by the RS products

How do the DGVMs perform?… (Johnson et al. in prep)

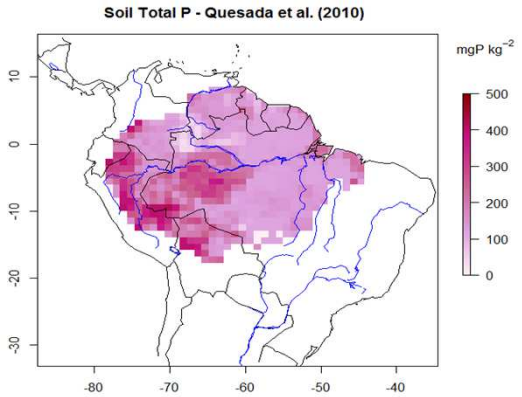


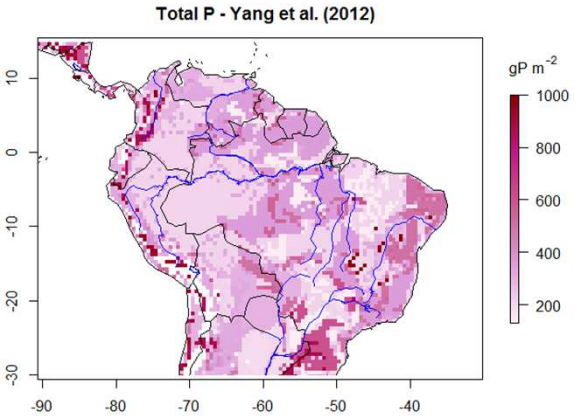


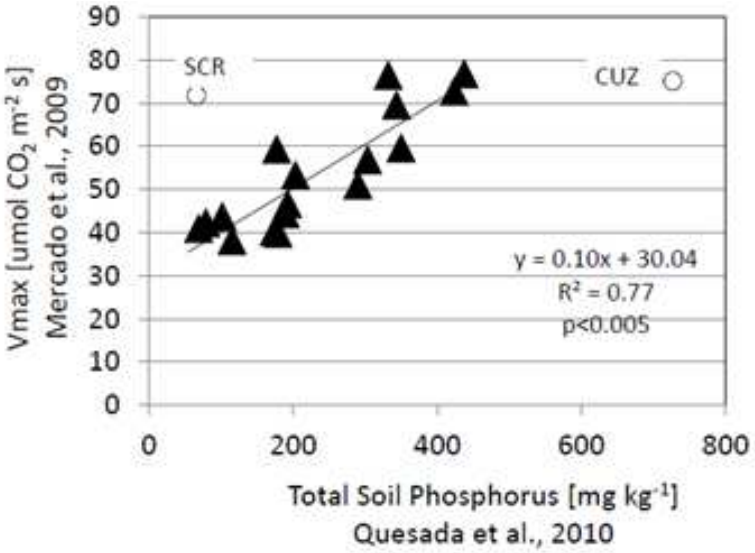
How to improve the DGVMs?

- Account for variation in soil nutrient availability → productivity
- Account for variation in soil structure → mortality
- Account for variation in vegetation structure

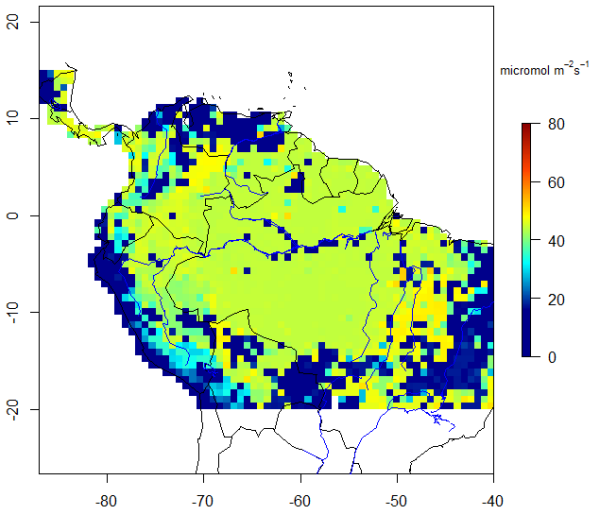
Using a soil P map in ORCHIDEE



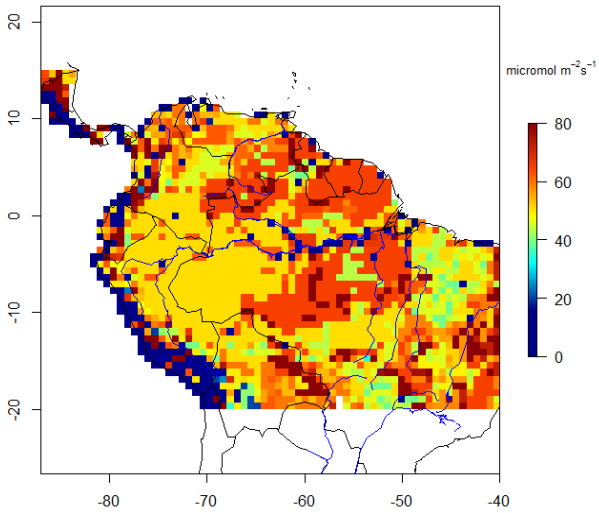




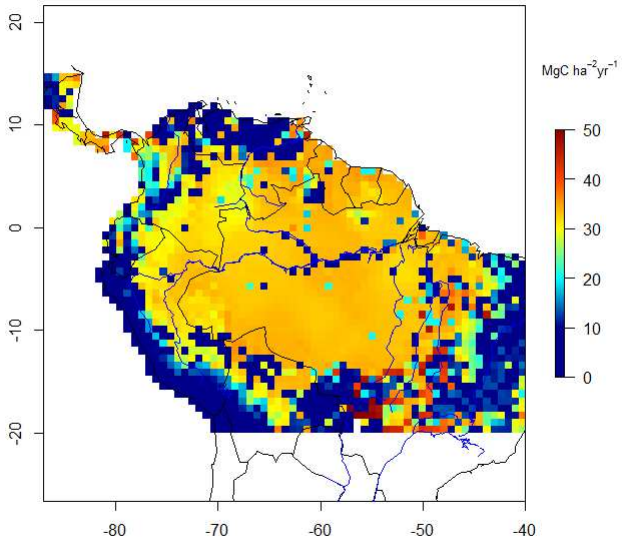
Vc,max STD all PFTs 1992



Vc,max PHO 0.1+30 all PFTs 1992



GPP STD all PFTs 1992



GPP PHO 0.1+30 all PFTs 1992