Succession and competition in ORCHIDEE-CAN

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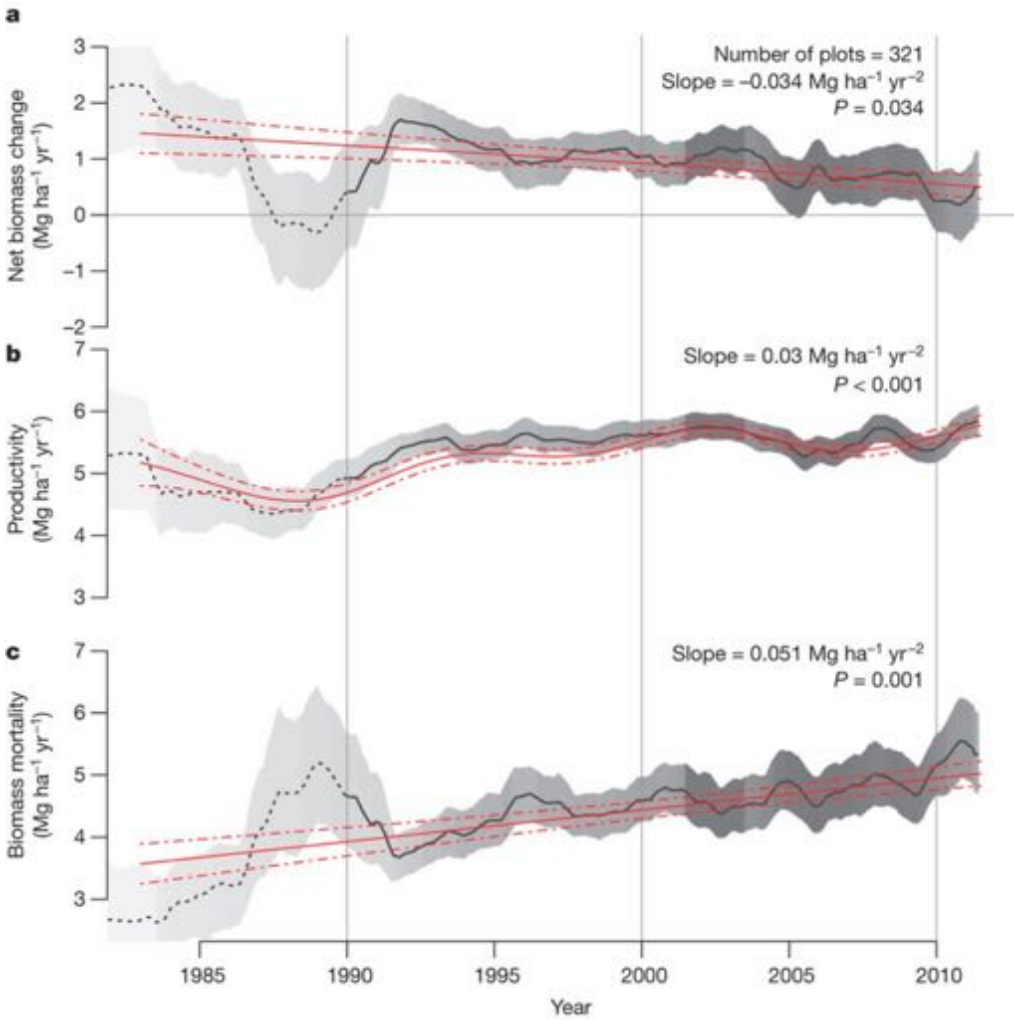
Succession in DGVMs

- Carbon stock change under climate change
  - Carbon stock decline despite increase in productivity
  - Accelerated recruitment and death

- We can predict ecosystem response to disturbances only if we take into account succession



From Brienen et al. (2015)

ORCHIDEE-CAN

- Developed originally **for forest management** implications on **temperate forest** monospecies
  (*Belassen et al., 2010, 2011*, *Naudts et al., 2015*)

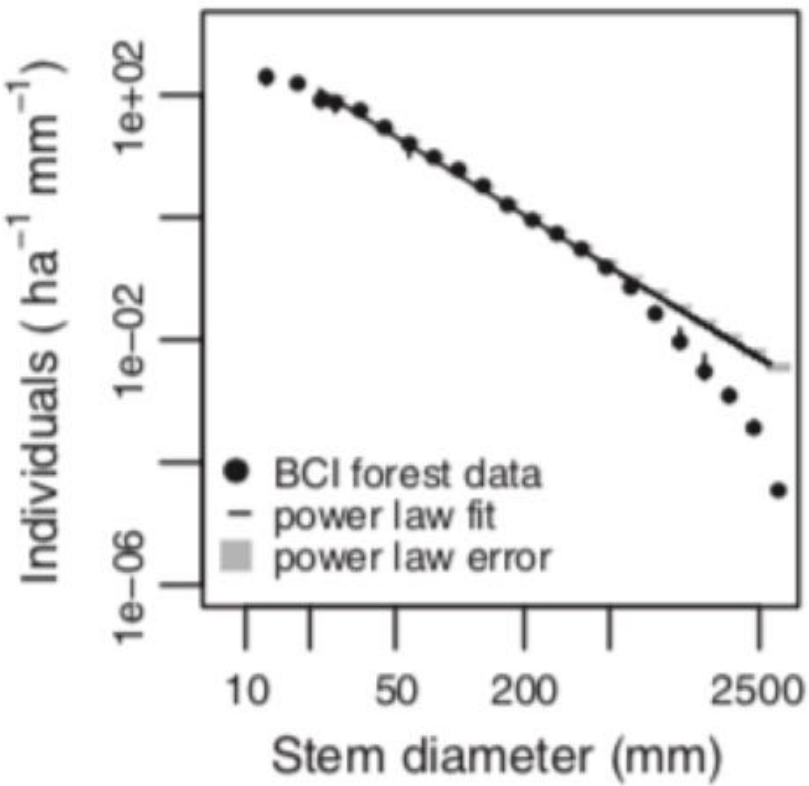
- Process-based model based on ORCHIDEE with the inclusion of new forest-relevant processes:
  - diameter classes
  - PGAP model for light transmission
  - Self-thinning law

- A tropical version of ORCHIDEE-CAN,
  (*Joetzjer et al., submitted to BG, 2018*)
  - New recruitment scheme
  - Calibration of parameters (sites + Amazonia)
  - New water uptake process

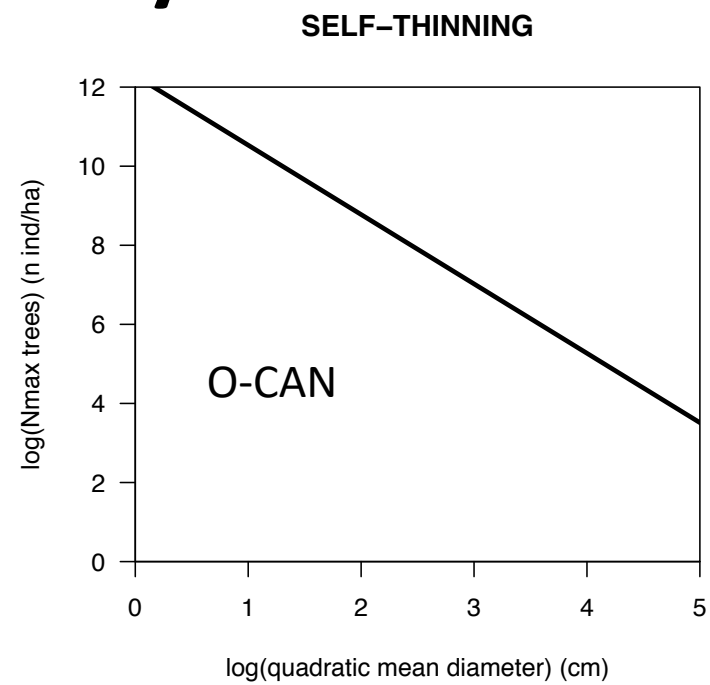
Towards a representation of forest succession in ORCHIDEE-CAN

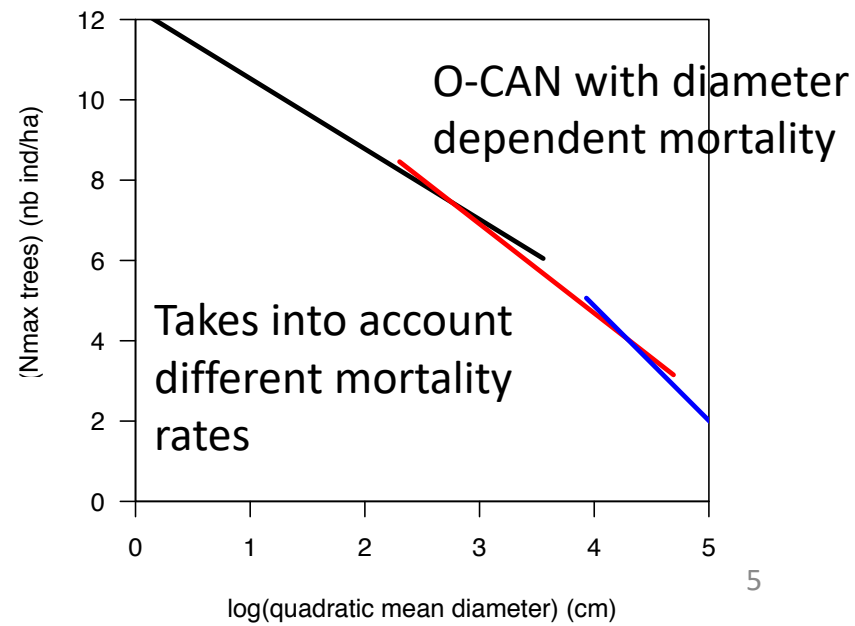
- New mortality
- We want to simulate **forest succession** in tropical forests, and in particular the interactions between "*pioneer trees*" that grow faster and occupy the free space, and the "*late successional trees*", shade tolerant species which grow slowly under the pioneers
- Introduction of vegetation dynamics
- Competition for light among species

New mortality

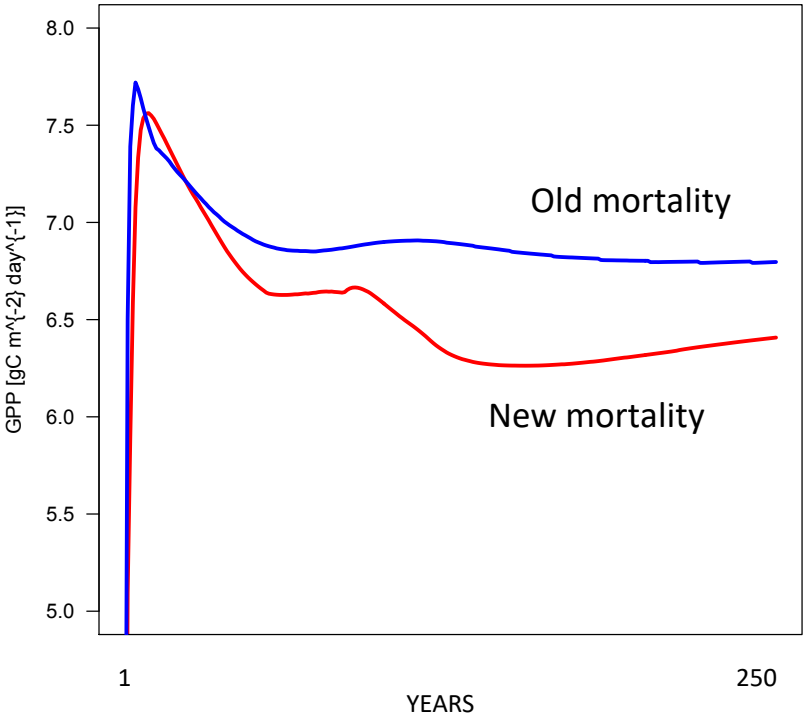


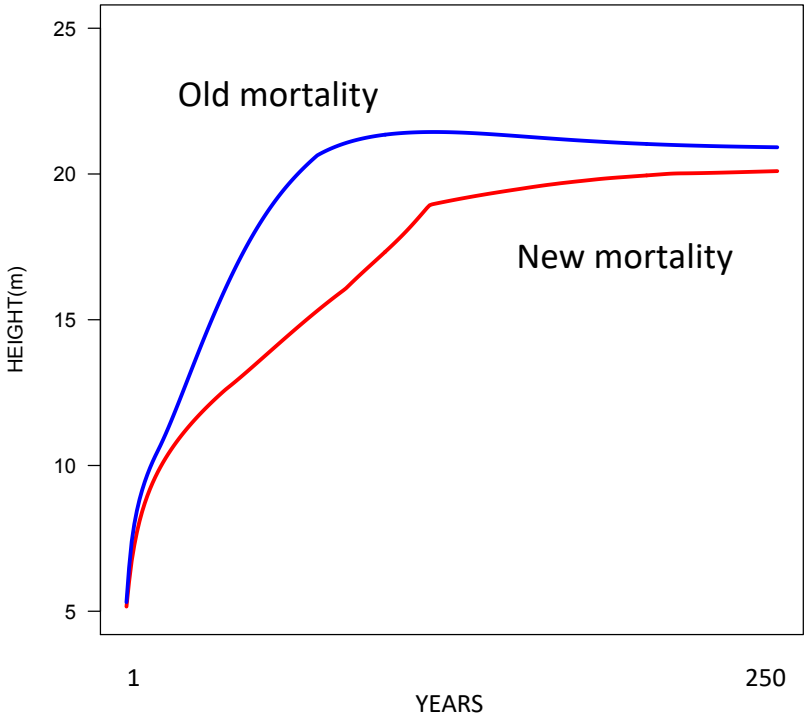
From Farrior et al. (2016)





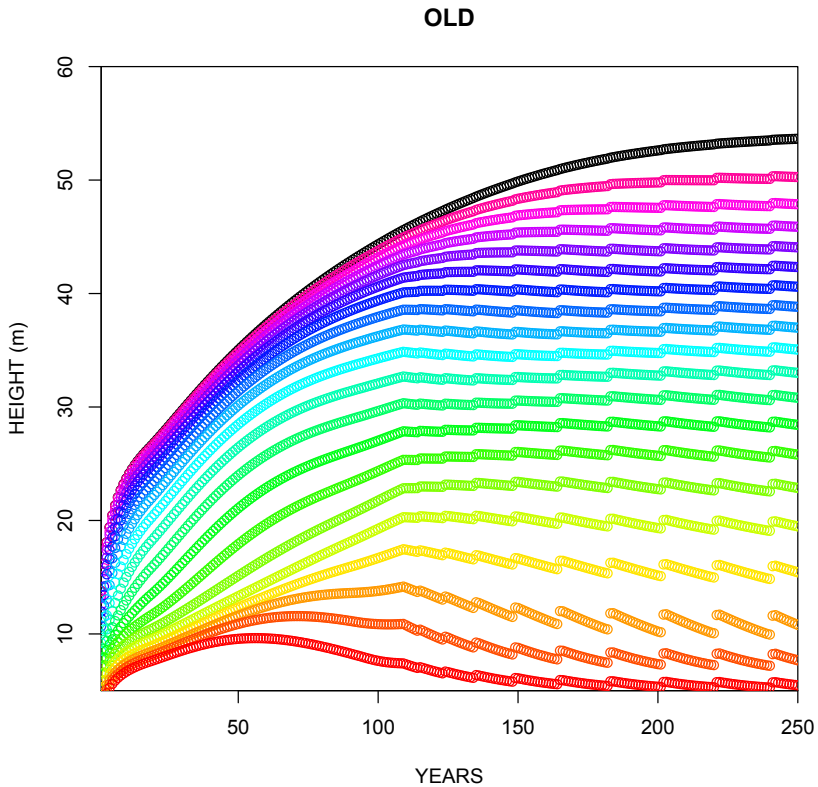
Adjustments to the mortality curve impact the model state

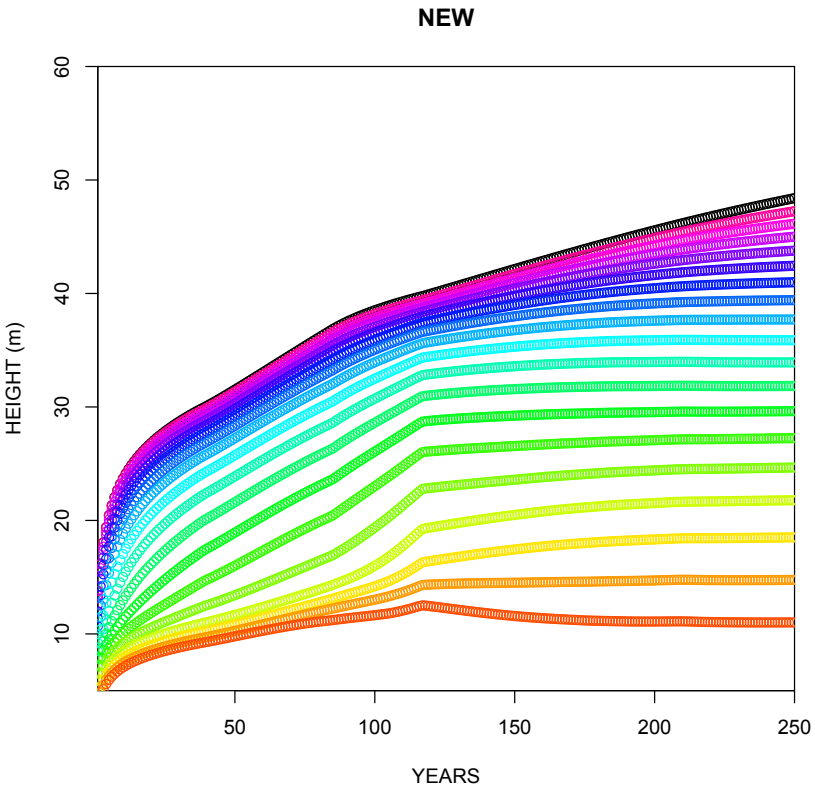




- The new mortality scheme has an impact on the GPP and it changes the model stable state
- The new mortality scheme, not allowing as many “big trees” as in the classic ORCHIDEE-CAN, leads to an average smaller height

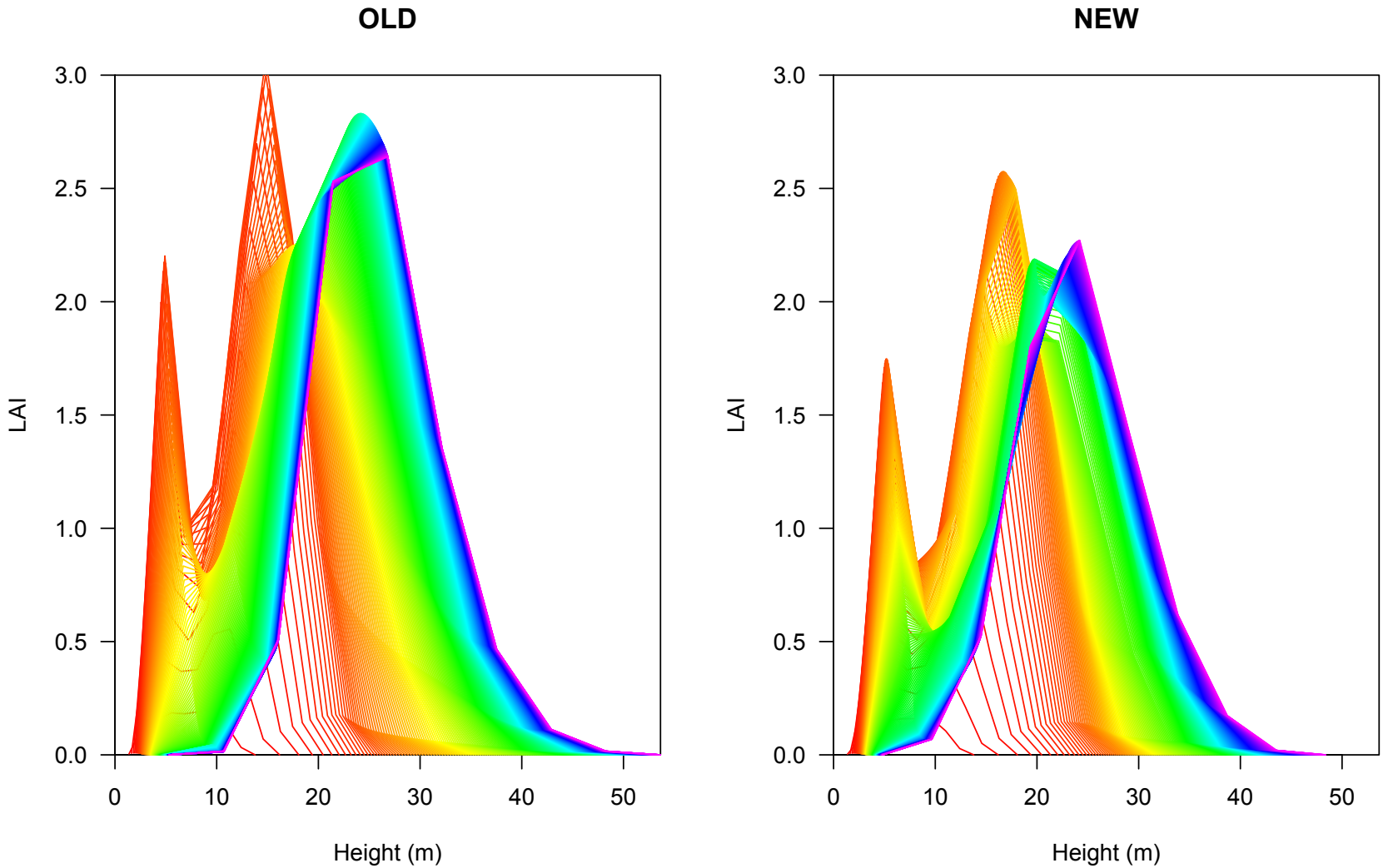
Results new mortality



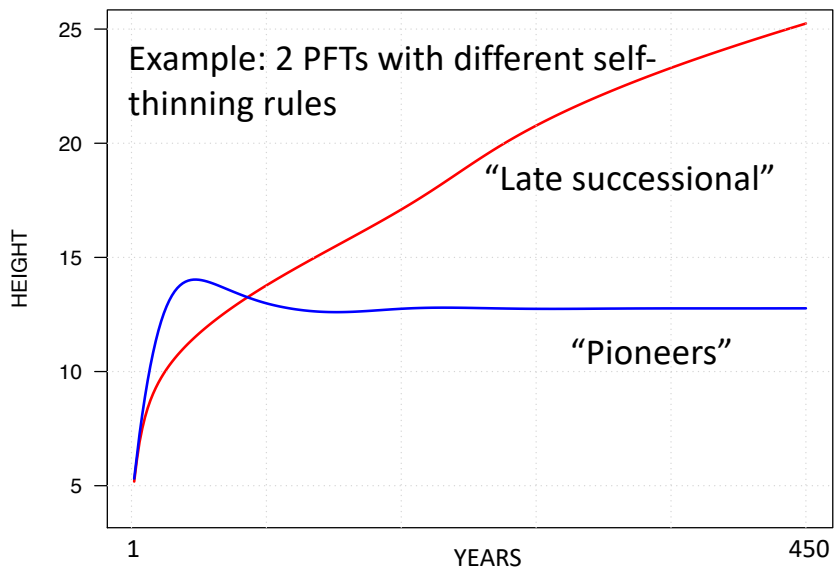


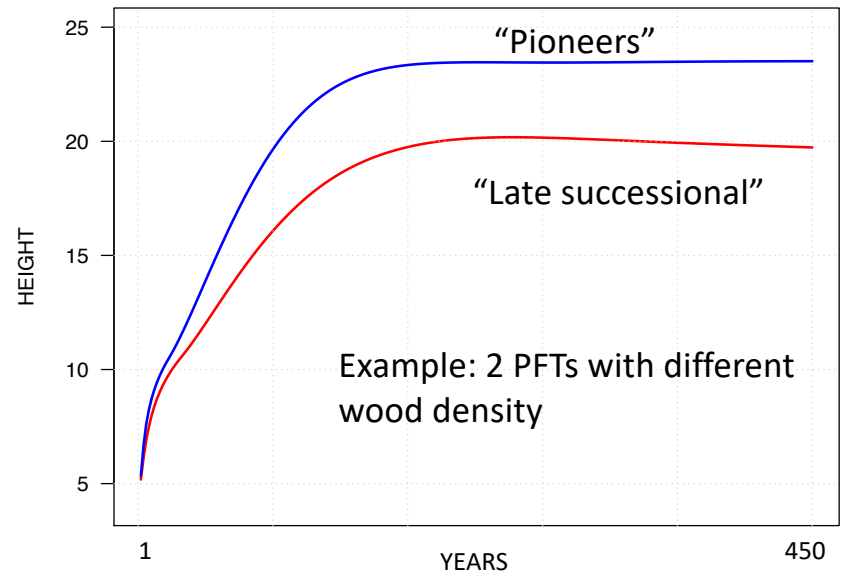
- The new mortality scheme has an impact on the GPP and it changes the model stable state
- The new mortality scheme, not allowing as many “big trees” as in the classic ORCHIDEE-CAN, leads to an average smaller height
- These impacts are sensitive to the α and β of the new parameterization

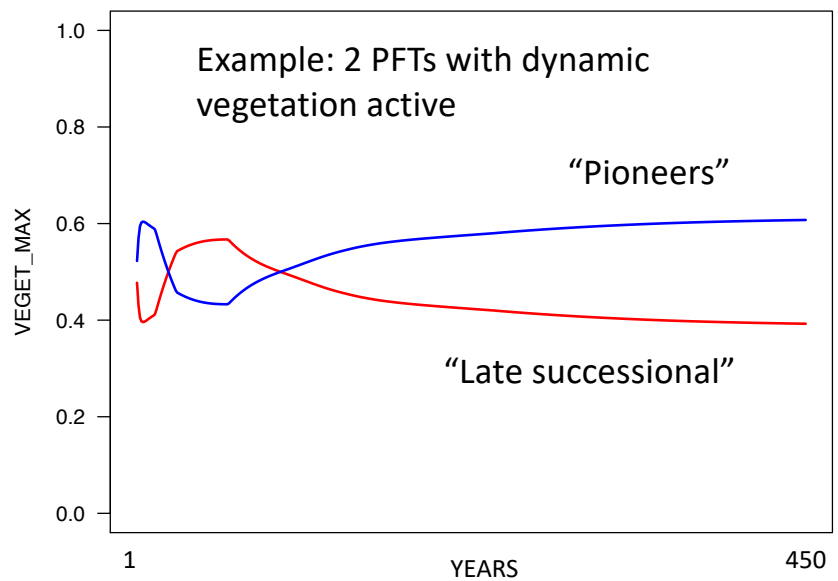
Results new mortality



Multiple PFTs: dynamic vegetation







- We then introduced some LPJ subroutines from the latest version of ORCHIDEE-MICT to simulate colonization of empty space left by a dying PFT.
- These parameter must be constrained by observational datasets

The ARBOCEL dataset

- Site in French Guiana (described in Chave et al., in preparation)
- 1 plot of 6.25 ha in secondary forest
- Clear cut in 1976
- Abandoned in 1978 -> regrowth from clear-cut
- 5468 trees: AGB and Basal Area

The ECOFOG Sites

- Nouragues
- Paracou
- Arbocel

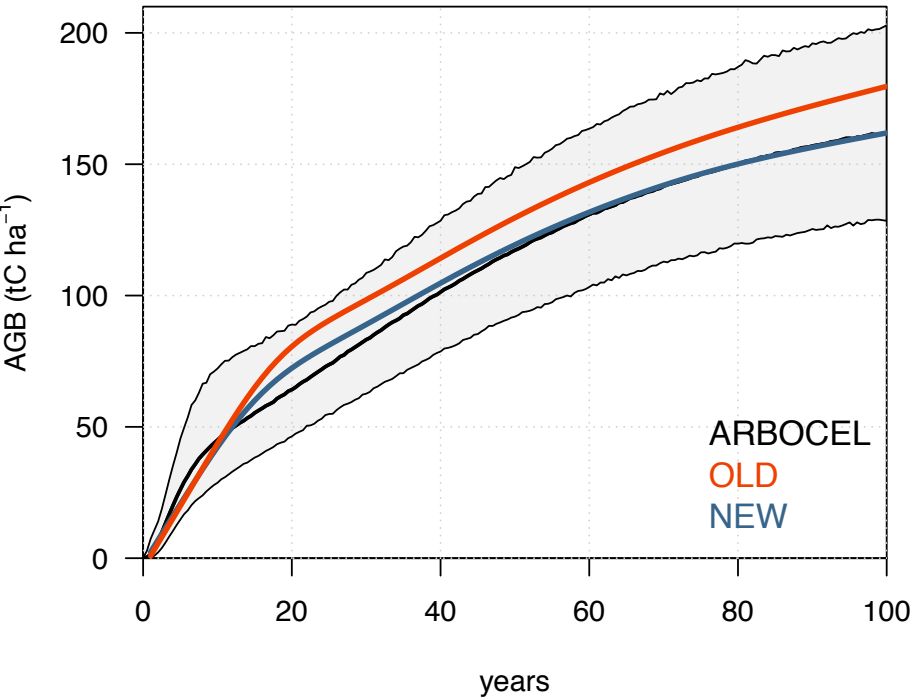
Calibration site

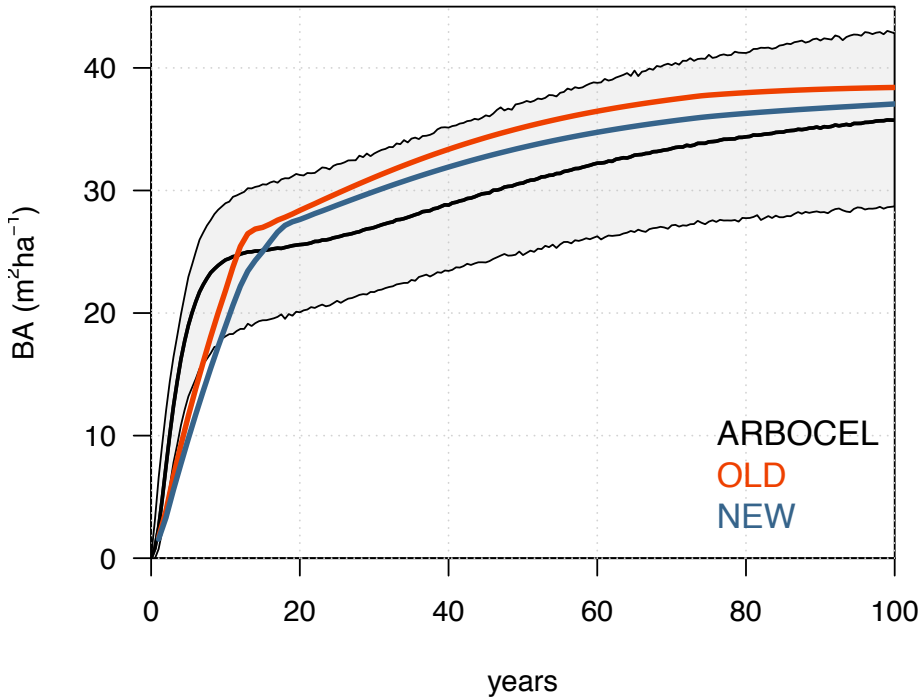
- Rochambeau

Other sites

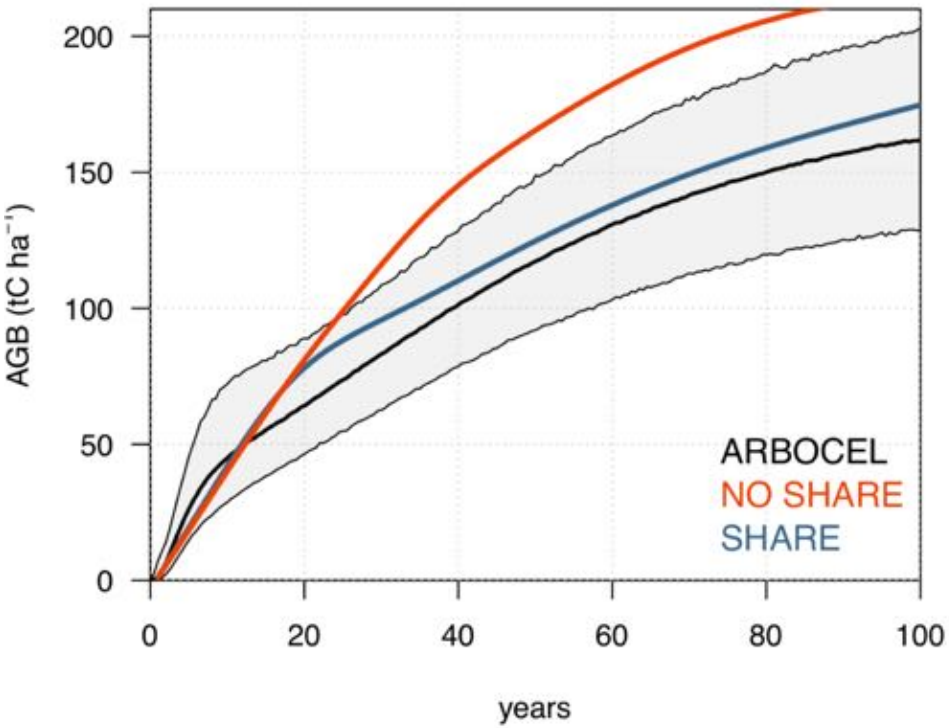
- Marais de Kaw Mangroves

ARBOCEL vs ORCHIDEE-CAN





- The new mortality scheme decreases total biomass, while its impact is not large on the average basal area
- All out simulations are comparable with the ARBOCEL dataset



- In both simulations the total Above Ground Biomass is not far from data (configuration used by E. Joetjzer to calibrate ORCHIDEE-CAN)
- In the “Share” case, the shading of one PFT over the other one limits the total growth

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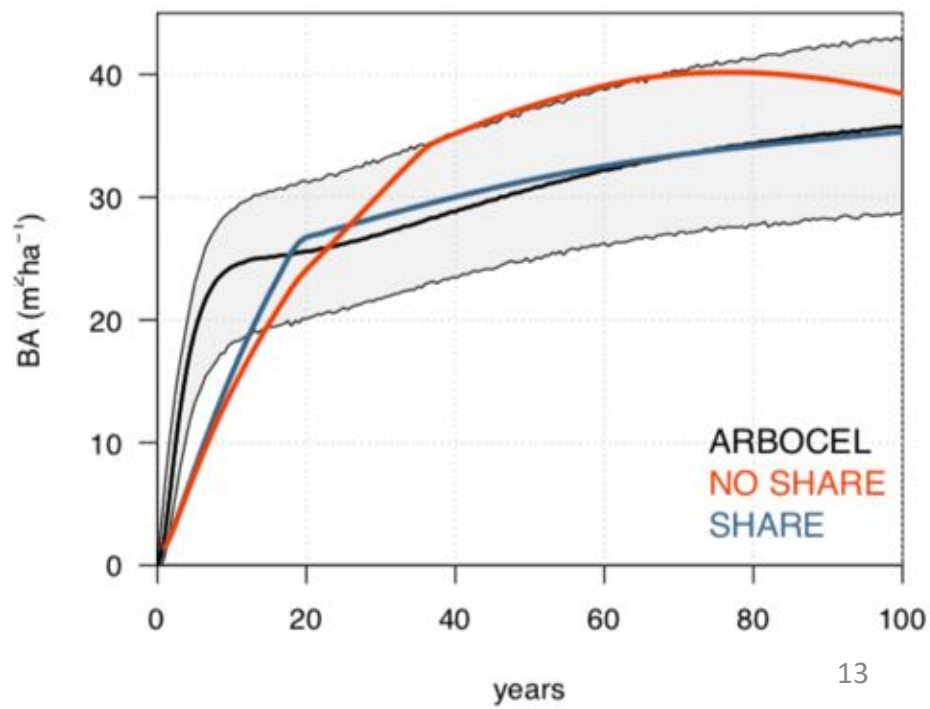
- Still waiting for forest inventory data for diameter distribution



Conclusions and Outlook

- We introduced a novel parameterization of mortality, vegetation dynamics and succession in tropical forests in ORCHIDEE-CAN.

- These new processes affect the forest structure and potentially the ecosystem response to disturbances.

- Amazon run with disturbance map in order to better understand impact of new processes on biomass.