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 $\alpha$ and $\beta$ of the new parameterization
Results new mortality

OLD

NEW

Height (m)

LAI

Height (m)
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 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

• 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.