



Forest Project

Forest Carbon Modelling

WP 320: LSCE

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LSCE Team

Frédéric Baron	Expert on KIC project management (budget, CA, contracts, ...)
Philippe Ciais	Carbon Cycle senior researcher
Fabienne Maignan	Technical manager (ORCHIDEE, optical RS, Quality)
Ben Poulter	PI
Nicolas Najdovski	PhD student

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The goal of the climate-KIC project

A commercial service to estimate carbon stocks for REDD+ projects

Tier 1 (basic): default emissions factors (biomass estimates from different eco-regions) from the IPCC Guidelines

Tier 2 (intermediate): country-level emission factors and a more detailed assessment of forest strata

Tier 3 (most demanding): actual inventory data and repeated measurements to model changes in carbon stocks.

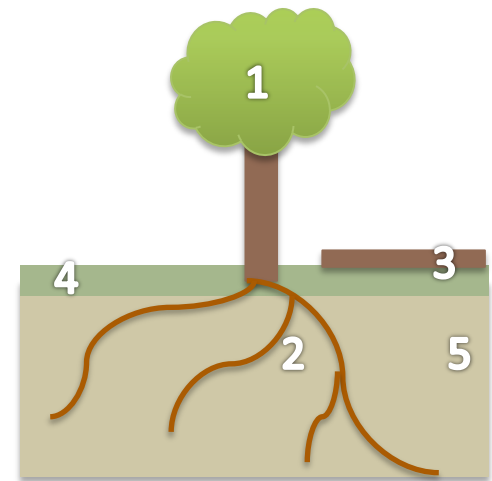
Three products are meant to be developed :

1. Biomass estimates based on VHR (pleiade 0.5 – 2 m)
2. Biomass estimates based on SAR-X (TerraSAR-X, TandemX ~1 m)
3. Carbon pools estimates based on ORCHIDEE-DOFOCO

Five carbon pools are tracked in REDD+ projects.

1. aboveground biomass;
2. belowground biomass;
3. dead wood;
4. litter;
5. soil.

Simplifications apply depending on the tier level



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What are the strengths and weaknesses of ORCHIDEE in such projects?

Weaknesses :

- Less accurate snapshot (present)
- Information about the history of the plots (past disturbances, management techniques)

Strengths :

- Estimates for all carbon pools
- Not dependent of acquisition date (past, future)
- Management techniques (selective logging, shifting cultivations)

Issues :

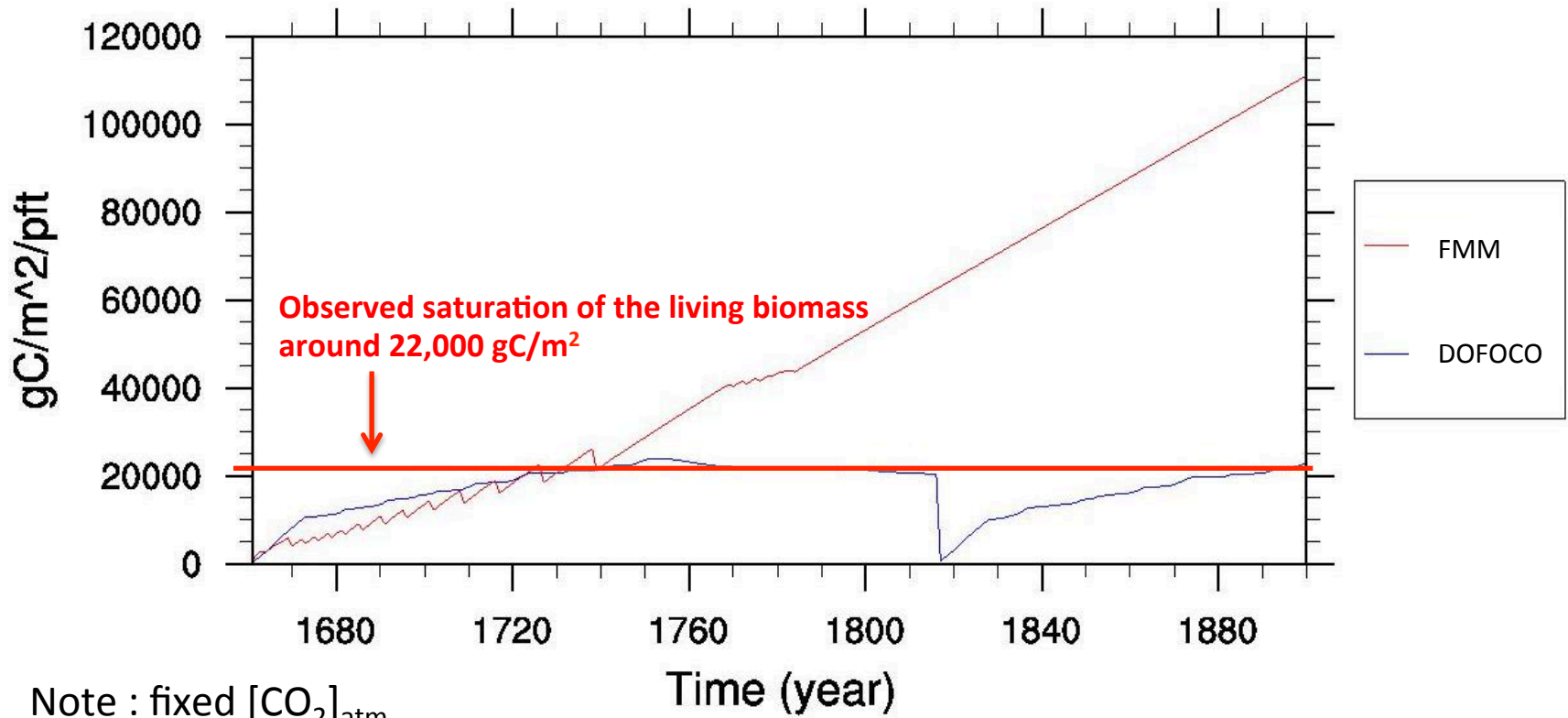
- Produce as accurate as possible carbon stocks estimations
- Modeling some logging activities requires the forest structure (selective logging) → FM / DOFOCO
- Calibrate the models for tropical forests.
- Modeling natural forests structure requires implementation of natural recruitment

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State “out of the box” : living biomass

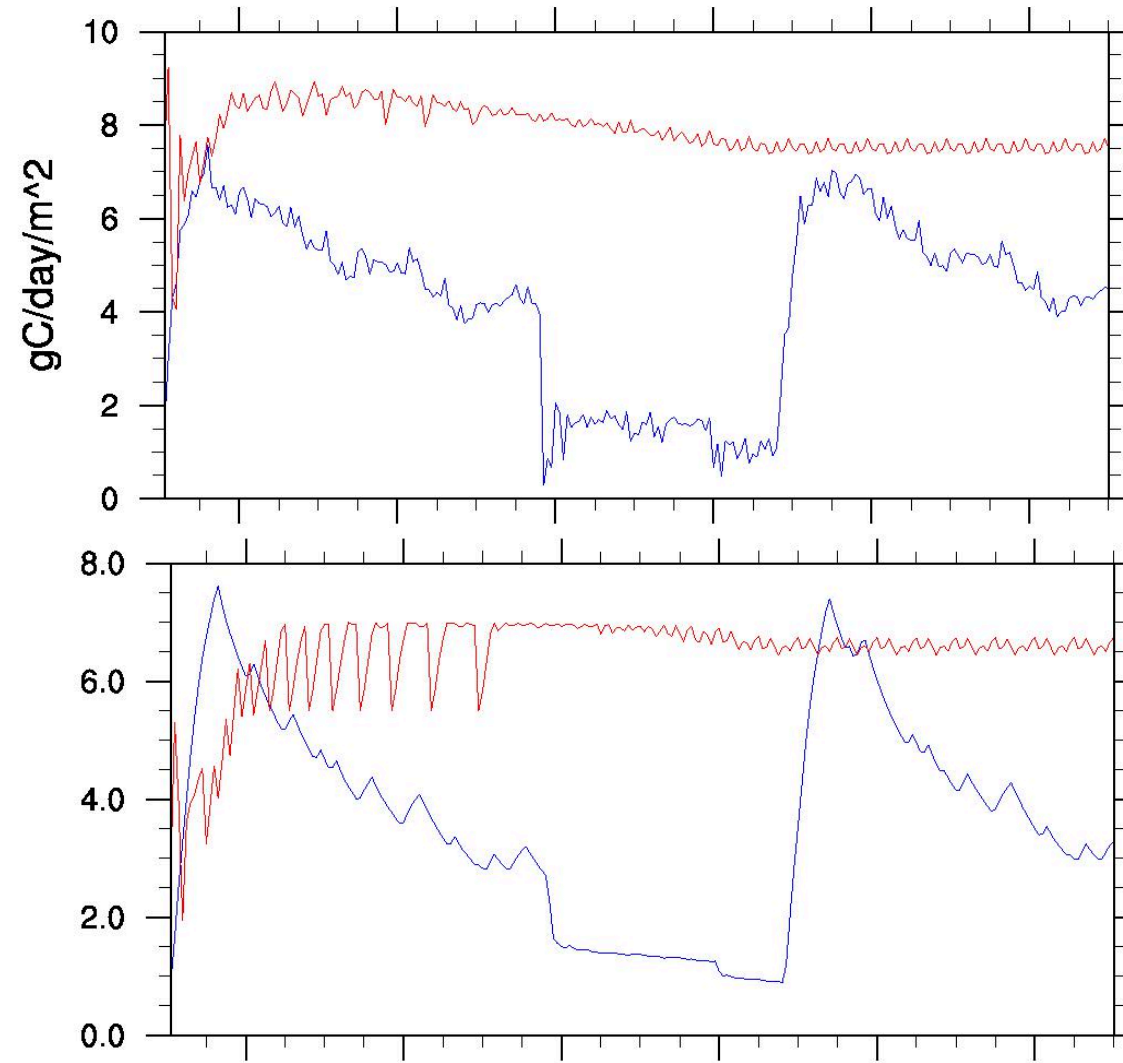
Evolution of the Total living biomass



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State “out of the box”: LAI and GPP



GPP

Compared to the literature, FMM has the correct GPP.

LAI

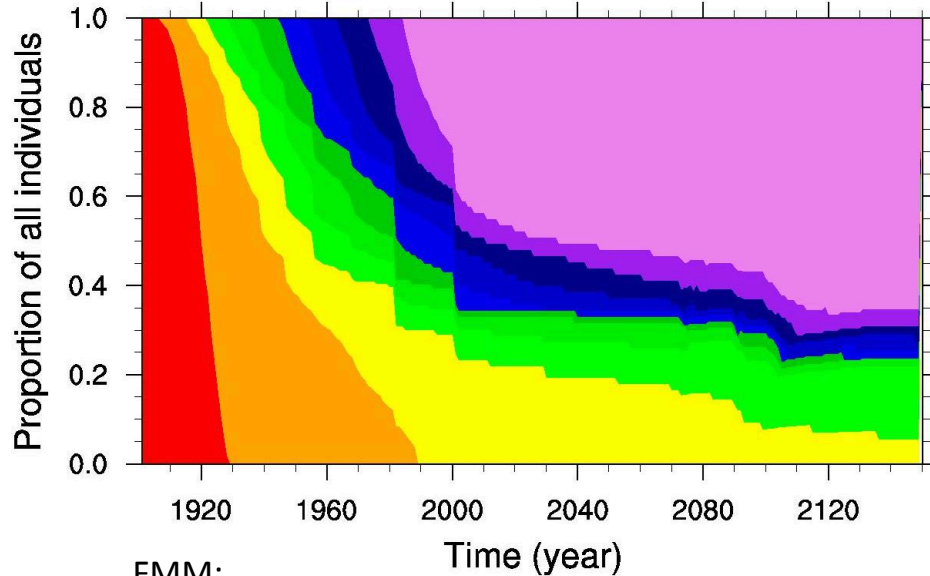
➔ Issue related to the evolution of the LAI, so most probably the stand canopy structure.

ect



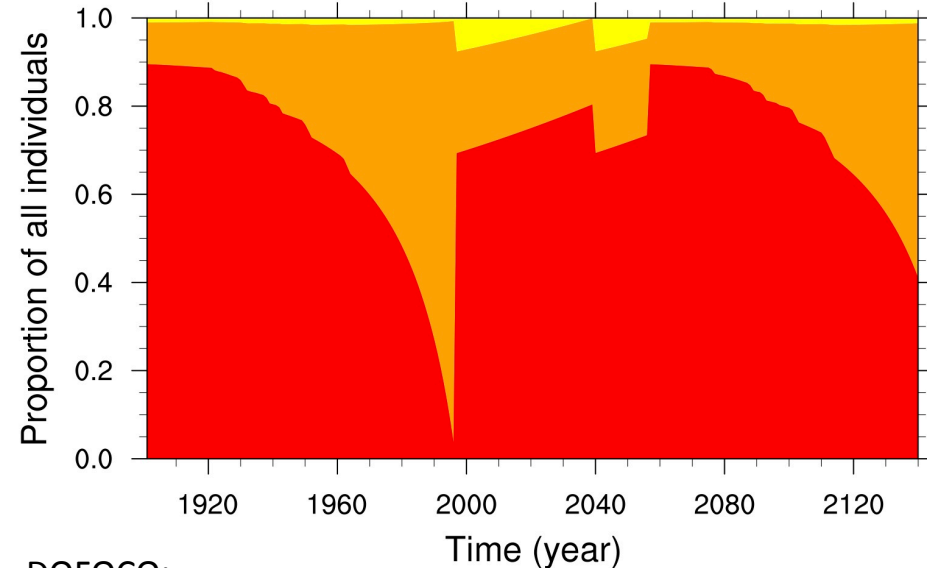
State “out of the box”: stand structure

Evolution of proportion of individual in each circumference class



FMM:

- 10 Default fixed circumference classes
- Model simulate too big circumferences (60% with >2m circumference)
- Convenient to compare to ground data



DOFOCO:

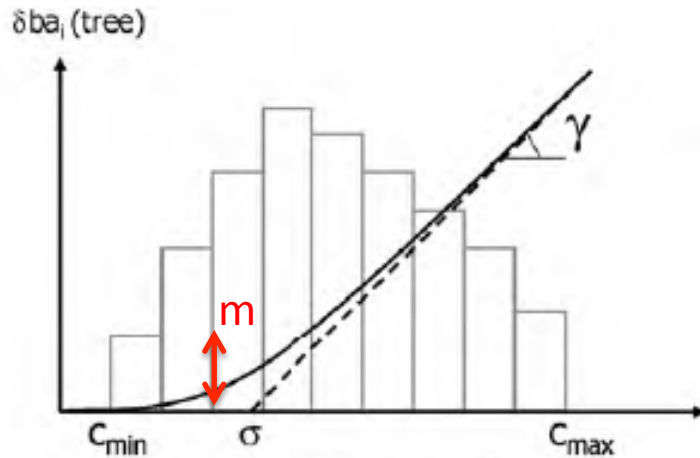
- 3 Default classes with evolving mean circumferences
- Not easy to compare to ground data.
- When the trees number reaches 0 in a class, they are rebuilt. Conservation of the forest structure?

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Recruitment implementation

Deleuze and Dhote equation and PGAP model might cause some trouble with recruitment

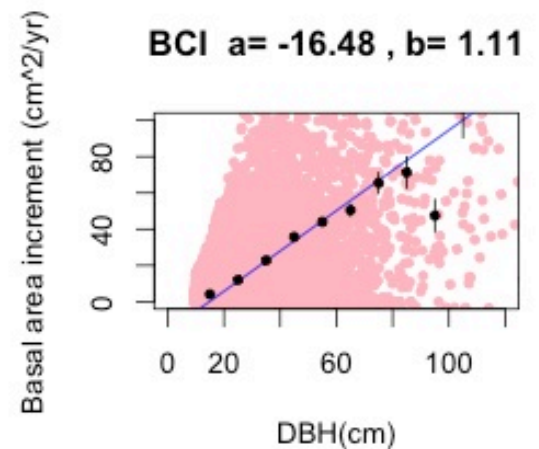
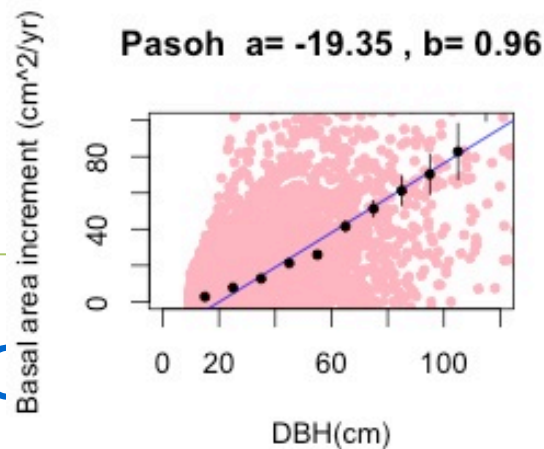
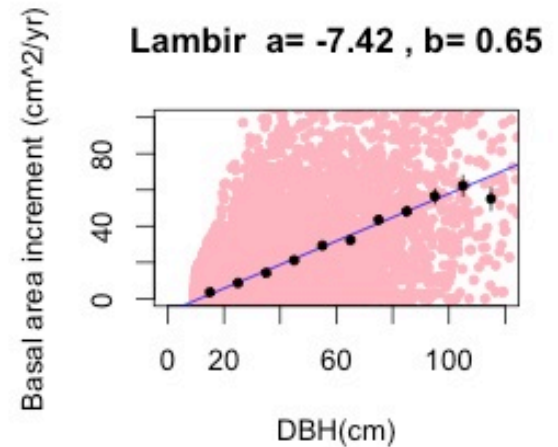
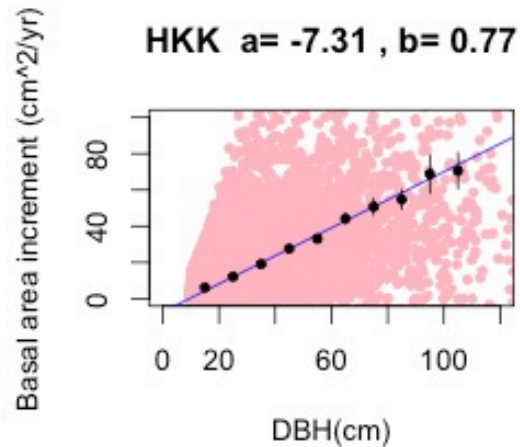


(a) Increment allocation

Two approaches :

1. Tuning m (time dependent?)
2. Introduce cohort structure

FC



Behaviour analysis

Development

Calibration

Goals

May - June

July - September

October - November

December

Jonathan

Parameterisation from literature and forests plots

Impact of multi-layer canopy on productivity

Dev. water stress module

(Potential) PFT refinement

Dev. feedback on recruitment

Implementation of recruitment – tuning m

Implementation of recruitment – cohort introduction

Number of classes & their definition

Degradation and forest management implementation

Test simulations at Fluxnet Sites & AMAZONICA sites

Apply the PYVOR Data assimilation tool using Fluxnet, & Biomass (Amazonica)

Calibration on Cameroun and Ghana

Calibration on French Guiana

Recruitment and mortality rates

Calibration of degradation and forest management in Cameroun/Africa Based on TerraSARX and TandemX data

Papers on :

- The benefit of multi-data streams assimilation in the Amazon (sites and/or basin wide scale)
- Mean and recent IAV of the amazon C balance using: optimized DA-param of DOFOCO and atm. Obs as 2nd final constraint (atm inversion with Luis)

Carbon stocks in African and South American dense forest

Management scenarios impacts on carbon stocks

Papers on :

- Deleuze in tropics
- Recruitment and death implementation
- Degradation scenarios
- Calibration of ORCHIDEE and data assimilation

Nicolas

DOFOCO diagnostic run, comparison to reality and FM results

Parameters sensitivity analysis



What data?

Remote sensing data from Astrium (Airbus):

- Land cover (VHR)
- Canopy height (VHR, Band X)
- Biomass estimates (VHR, Band X)
- Trees logged/ha under different management type (Band X data, ONFI)

Flux tower data only in French Guiana.

Ground census data:

- Guyafor network in French Guiana
- AMAP plots in Ghana and Cameroun
 - DBH every two years (with recruitment and mortality)
 - Soil texture
 - Climate data (unsure)

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The GUYAFOR network

Courtesy of J Chave

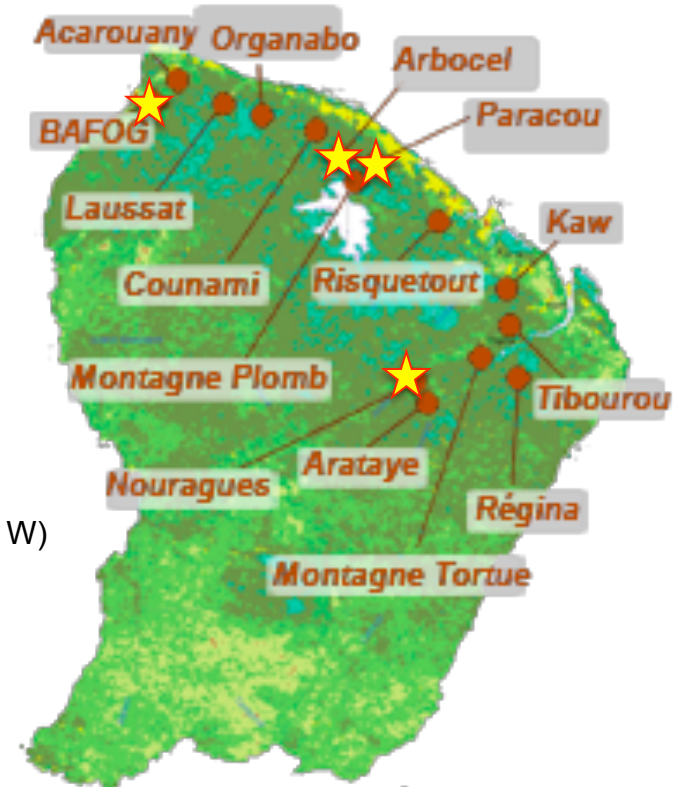
Multiple heterogeneous sites gathered in a network.

- Large (~ 1 ha) permanent forest plots
- Plots are regularly monitored (every 2-5 years) since 80's
- Various initial disturbances then recovering forest
- High measurement standards

Managed by CIRAD/CNRS/ONF

Most interesting sites :

- Paracou : Flux tower + very high data quality (5° 15' N, 52° 56' W)
- Nouragues : Very high data quality (4°05' N, 52°41' W)
- Arbocel : Disturbance was a clear cut (5° 16' N, 53° 03' W)
- BAFOG : Time series starting in 1960



Adapté de Gond et al. 2009

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