RÉPUBLIQUE FRANÇAISE
Liberté Égalité Fraternité

FRANCE 2030 — PROGRAMME DE RECHERCHE CARBONE ET ÉCOSYSTÈMES CONTINENTAUX

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PROGRAMME DE RECHERCHE
CARBONE ET ÉCOSYSTÈMES CONTINENTAUX
FairCarboN

ALAMOD
Spatio-temporal dynamics of soil carbon in grasslands and forests in French Guiana

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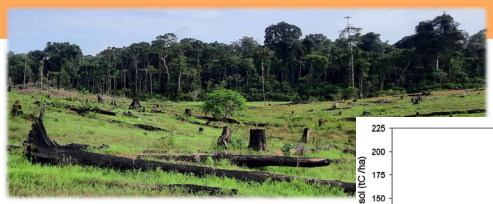
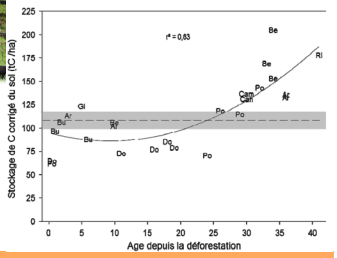
1- Objectives in French Guyana

- Using a synchronic approach, the **CARPAGG project** (2009-2014) provided preliminary results :
  → **25 years are needed after deforestation to restore soil organic carbon (SOC) stocks in grasslands**
  → **SOC increases mainly in depth over 20-100 cm**
- In the **ALAMOD** project, **reanalyzing SOC in the same plots (diachronic approach)** will allow the assessment/comparison of SOC temporal dynamics in pastures and forests (over 15 and 25 years, respectively) in relation to land use and climate change.
- Additional data will enable analysis of some **drivers of soil carbon dynamics**:
  → physical, chemical, and biological properties of soils
  → plant cover and plot management practices
- The data will be made available to the **FairCarboN community** and could be used for **modeling soil C dynamics in tropical pastures** (**PASIM** model)
- In association with **RIFT**, **ALAMOD** will contribute to the analysis of the **primary productivity partitioning in tropical grassland**



Stahl C, Fontaine S, Klumpp K, Picon-Cochard C,Grise Marcia M, Dezécache C, Ponchant L, Freycon, Blanc L, Bonal D, Burban B, Soussana JF, Blanfort V. 2017. Continuous soil carbon storage of old permanent pastures in Amazonia. Global Change Biology, 23 (8),3382-3392.



2- Experimental design

GRASSLANDS: 2 designs (with georeferenced sampling sites)

Design	2010 – 2025
Flux tower (2 plots of grassland): flux monitoring from 2011 to 2019 Flux tower (INRAE, native forest, in operation since 2003)	61 (183)
Chronosequence 2012, hilltop zone with clayey soils 24 plots of grassland (aged 14 to 54 y) + 4 control plots in forest	28 (84)
Chronosequence 2018, savannas, sandy soils 10 plots of grassland (aged 8 to 49 y) + 3 control plots in wooded areas	13 (39)

Number of cores and samplings (3 layers)

plots

Sampling scheme in the footprint area (the tower is located by the cross)

- *Apparent density, granulometry*
- *Organic matter (C, N, C/N, δ13C, δ15N)*
- *Exchangeable cations (P, K, Mg, Ca, Na, Mn, Al, CEC): 0-20 cm*
- *Comp. aboveground and root biomass (C, N) on flux tower footprint areas*

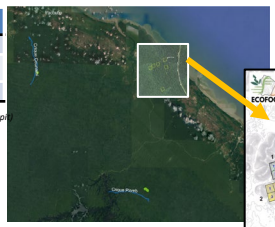
- *Vegetation: biomass, plant species diversity, weeds*
- *Soil biology: macrofauna, microbial activities*
- *Plot management 2012 → 2025 (surveys)*
- *Environment (soil types, topography) + climate (MF)*

FORESTS : 3 forest sites

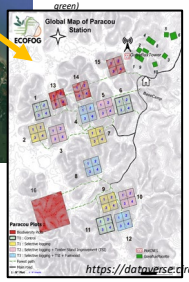
GUYAFOR network, **24 georeferenced pits,** 5-6 layers at a depth of 1 m

Dispositif	Prélèvement	2000	2010	2024-2025
Counami	Soil (0-100 cm)	18	3	6 (41)
Crique Plomb	Soil (0-100 cm)	8	1	4 (20)
Paracou	Soil (0-100 cm)		14	14 (70)

Number of pits and samplings (5-6 layers / pit)



Study sites and location of sampled plots (unexploited native forest in red and flux footprint area (Guyaflux) in green)

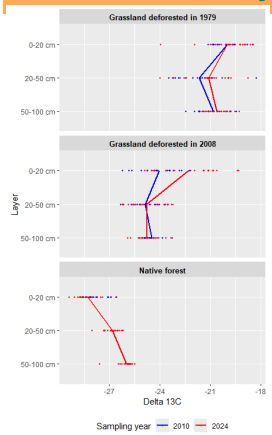


- *Apparent density, granulometry*
- *Organic matter (C, N, C/N)*

→ *Paracou: forest inventory*
- *DBH ≥ 10 cm, tree georeferencing, floristic determination*
- *Aboveground biomass: allometric equations ~ stem density, DBH, soil, topography*
- *Dataverse* https://dataverse.cirad.fr/dataverse/paracou

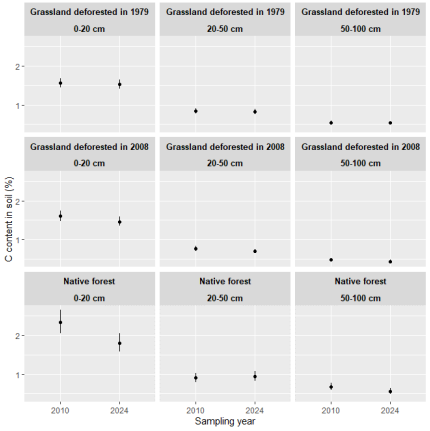
https://dataverse.cirad.fr

3- Preliminary results (on 3 flux tower footprint areas)



- The δ13C values measured in Paracou (native forest) are characteristic of C3 plants.
- A high level of δ-13C in soil of pastures indicates a higher level of organic matter from C4 grasses.
- For the plot of grassland deforested in 1979, analyses 15 years apart show a relative stability: a large proportion of C in soil originate from C4 grasses, in all layers
- For the plot of grassland deforested in 2008, the C3 → C4 substitution is high at depth of 0-20 cm, but remains incomplete in deeper layers.

→ **After deforestation, it seems that approximately 30 years are required to achieve a maximum C3 → C4 substitution,** with soil C originating mainly from the herbaceous cover (grasses, legumes, weeds).



- For the forest plot, the decrease in C content in soil is significant for the upper layer
- For the plot of grassland deforested in 2008 (16 years ago), a limited but significant decrease in C content in soil is also observed for upper layer.
- For the oldest plot of grassland, deforested in 1979, C contents in soil is stable between 2010 and 2024, for all the layers.

→ **25 to 30 years after deforestation, the C content in soil of grasslands seems to be stable.**

C Stock in soil (in Mg C ha^{-1})	2010	2024
Pasture 1979	153.33	149.98
Pasture 2008	99.83	94.42
Native Forest	93.35	75.73

- The collection of soil samples and additional data on biomass and soil (physicochemical and biological properties), and plot management are underway.
- The preliminary results obtained on two plots of grassland and one native forest area (Guyaflux tower footprint) will have to be confirmed by other analyses currently being carried out in native forests and plots of grassland (chronosequences).
- A PhD will start in November 2025 for analyzing all the data collected in French Guiana.
- The DYNASOL project (FEDER European funds, CTG, 2025-2028) will provide additional informations on soil biological properties (microbial activities, macrofauna).) that will be used in conjunction with those provided by the ALAMOD project

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