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FRANCE 2030 — PROGRAMME DE RECHERCHE CARBONE ET ÉCOSYSTÈMES CONTINENTAUX

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CANETE — FairCarboN

PROGRAMME DE RECHERCHE CARBONE ET ÉCOSYSTÈMES CONTINENTAUX
FairCarboN

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Soil microbial Carbon And Nutrient use Efficiency in managed Terrestrial Ecosystems (CANETE)

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INRAE · Université de Lorraine · Université de Reims Champagne-Ardenne · L'Institut agro Montpellier · AgroParisTech · Sciences Sorbonne Université · université PARIS-SACLAY · cnrs

Context

A major challenge is how to manage the production of terrestrial ecosystems while promoting the storage of soil organic **carbon (C)** and efficient use of **nitrogen (N)**. The activities of **heterotrophic microbial communities** are key: they consume organic C and N, then mineralize and release any excess back to the soil.

The environmental conditions have profound effects on the ecology of soil microorganisms that tend to establish ecologically distinct groups with **specific physiological traits**. Two such traits are the **C- and N-use efficiencies (CUE_{mic} and NUE_{mic}),** which quantify the proportion of total C or N obtained from organic resources that is invested in microbial growth. These values **distinguish between the flow of elements released as inorganic forms and that retained in the soil** as microbial biomass.

Kick-Off meeting February 2024 in Reims in presence of the international committee

Coordinator
G. Lashermes (INRAE)

1,488 k€, 5 years

16 labs, 9 sites, 8 academic establishments

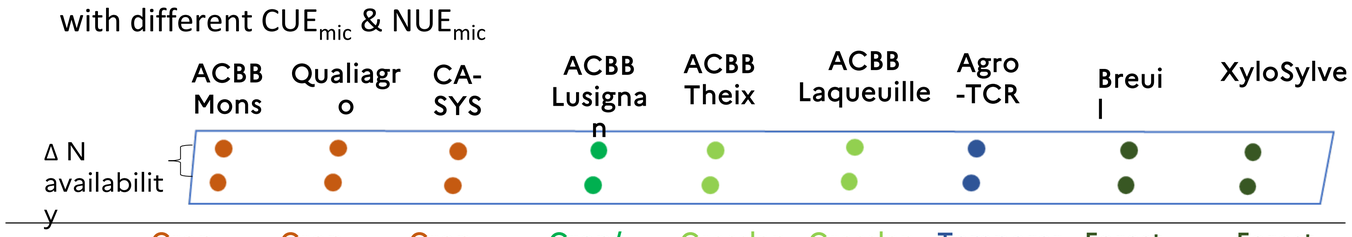
Objectives

In agricultural and forest ecosystems and covering different pedoclimatic conditions, by comparing treatments with **differentiated practices of N nutrition**:

1. To assess and model the **microbial physiological processes** of C-N consumption & release, & growth of microbial community in topsoil, as a response to **N availability.**
2. To analyze and consider in modeling how **microbial physiological traits** influence the current C-N fluxes, forms of the C-N accumulated, in interaction with pedological properties.
3. To assess and model the relative contribution of topsoil microbial physiology on C-N balance, and to the plant nutrient use efficiency for the soil-plant system.

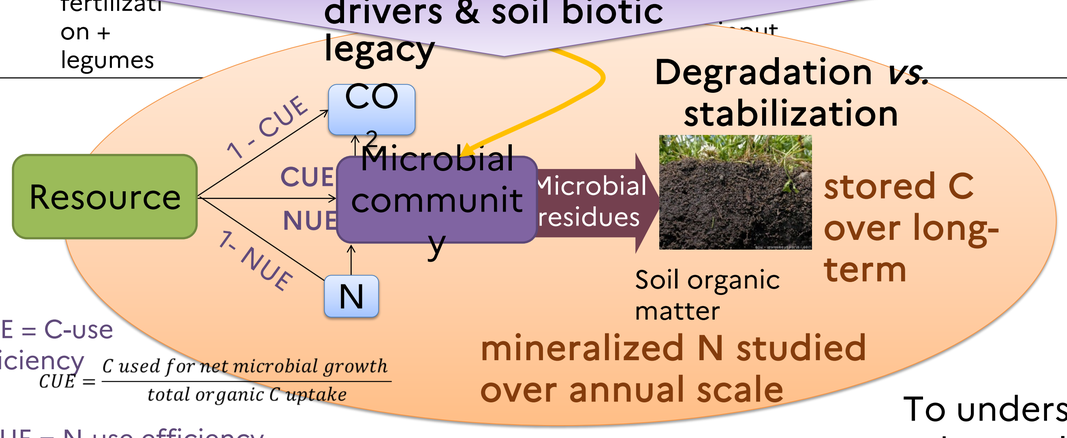
Strategy : coupling long term experiments & modelling

Paired treatments per site with contrasted management practices that we hypothesize with different CUE_{mic} & NUE_{mic}



	Crop	Crop	Crop	Crop/ Temporary grassland	Grassland	Grassland/ Pasture	Temporary grassland + agroforestry	Forest	Forest
+N treatment (crop / pasture)	T1 productive tillage, fertilization	FUM-PRO ~organic farming, tillage, manure	TS1 zero phyto, tillage, fertilization	T1 productive tillage, fertilization	T7 NPK fertilized mowed grassland	T1 intensive grazing & fertilization	T6 temporary grassland	Douglas (no-inhibition of nitrification)	T1 dense plantation
Fertilization	Mineral N	No organic	Mineral N (& legumes)	Mineral N	Mineral N	Mineral N	No	No	No
Alternative *(change in the N availability)*	T5 : intensified low input (legumes)	FUM-LEG : ~organic farming, no fertilization	TS2 tilled system zero fertilization	T2 fertilized mowed grassland & crop	*T6* PK fertilized mowed grassland	T2 extensive grazing zero input	T4 alder - temporary grassland	Nordmann fir (lower nitrification)	T2 optimized nutrition
N nutrition	mineral N fertilization + legumes	++		input	grazing.	(tree)	nitrification	demand & Legumes	

Practices and environmental conditions well defined to provide **a snapshot** of drivers & soil biotic legacy



CUE = C-use efficiency

$$CUE = \frac{C\ used\ for\ net\ microbial\ growth}{total\ organic\ C\ uptake}$$

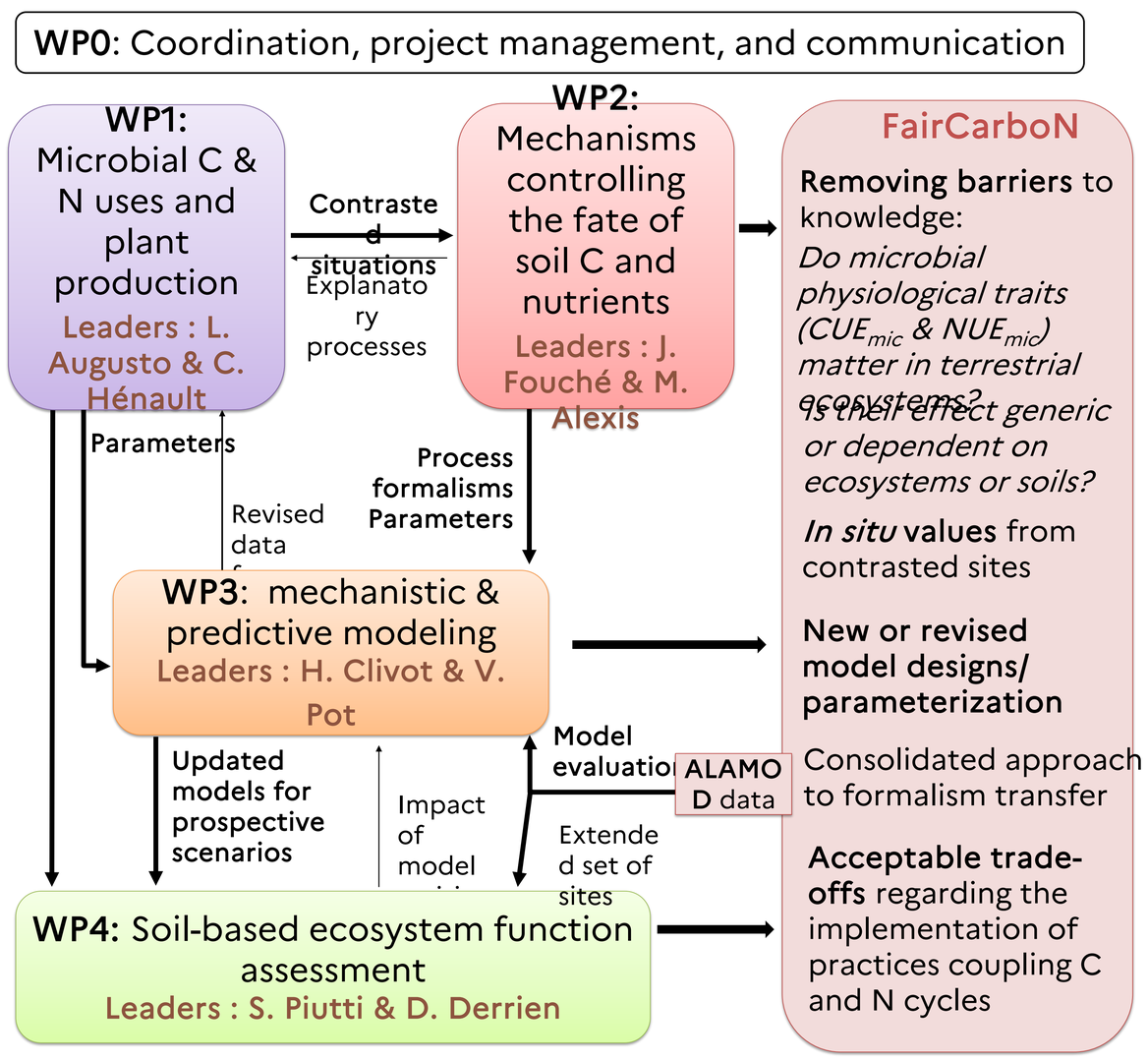
NUE = N-use efficiency

$$NUE = \frac{N\ used\ for\ net\ microbial\ growth}{total\ N\ uptake}$$

Spatial and temporal integration through modeling

Models → To understand at the small scale; To predict at the board scale

Workflow diagram & contribution



International committee

Stefano Manzoni (Stockholm University, Sweden), **Steven Sleutel** (Ghent University, Belgium), **Andreas Richter** (Vienna University, Austria), **Jean-Thomas Cornelis** (University of British Columbia, USA), **Lionel Alletto** (INRAE AGIR, France)

Conclusions

The CANETE project will identify the ways in which **soil microbial communities can be more effectively managed to promote the efficient use of C and N** in terrestrial ecosystems. The project will generate **open data** and **model frameworks** for simulation of the main microbial mechanisms involved and will produce **improved tools and methodology for projections of C and N stocks**.

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