Understanding grassland response to land use intensity and climate change : **moving forward microbial trait based approach**

Gabin Piton[1], Jean Christophe Clément[1,2], Arnaud Foulquier[1]

Looking for postdoc
gabinpiton@gmail.com

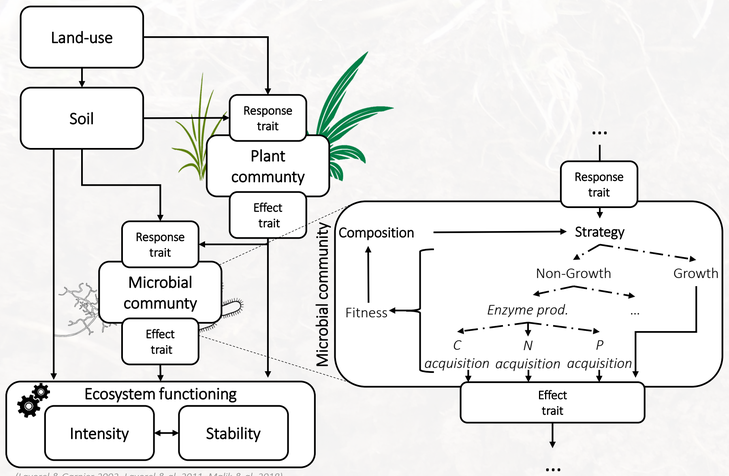
1. Univ. Grenoble Alpes, CNRS, LECA, 38000 Grenoble, France
2. Univ. Savoie Mont Blanc, INRA, CARRTEL, 74200, Thonon-Les-Bains, France

CONTEXT

Global changes impact ecosystem functioning and services ⟶ What are the underlying **mechanisms** ? How **biodiversity control** ecosystem response to global changes ?
Trait based approach offer a **mechanistic framework**. Highly developed in plant ecology, trait based approach is still at its **infancy in microbial ecology** ⟶ **How moving forward ?**

FRAMEWORK

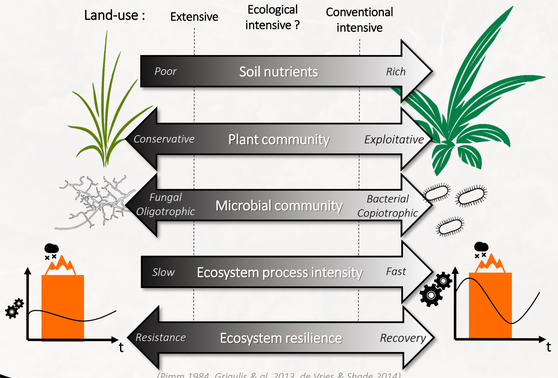
Multitrophic **response-effect trait** model



(Lavorel & Garnier 2002, Lavorel & al. 2011, Malik & al. 2018)

GLOBAL HYPOTHESIS

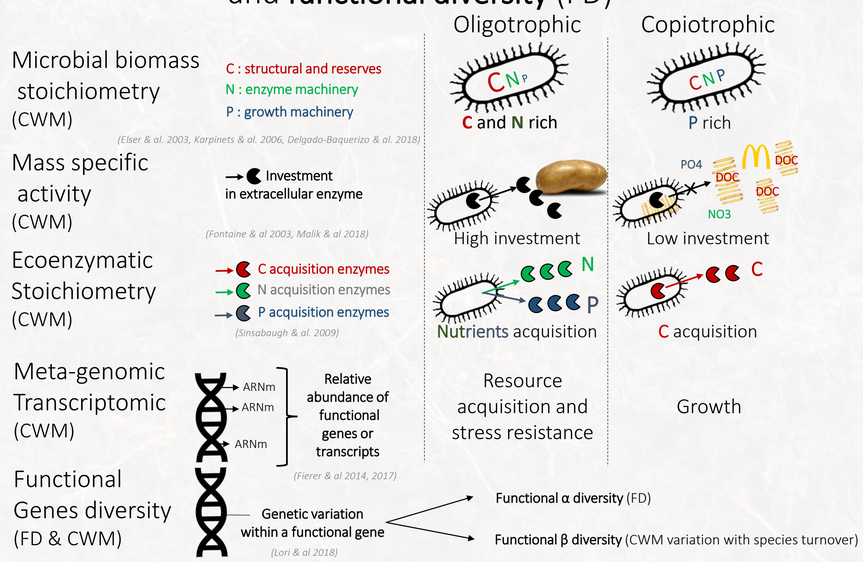
Functional trade-off and **ecosystem resilience**



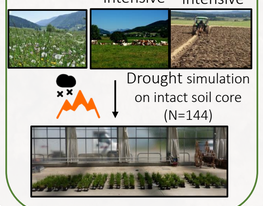
(Pimm 1984, Grigulis & al. 2013, de Vries & Shade 2014)

APPROACH

Proxy of **microbial trait community weighted mean** (CWM) and **functional diversity** (FD)



Experiment 1 :
Mountain grasslands :
4 Extensive, 3 Eco. intensive, 5 Conv. intensive



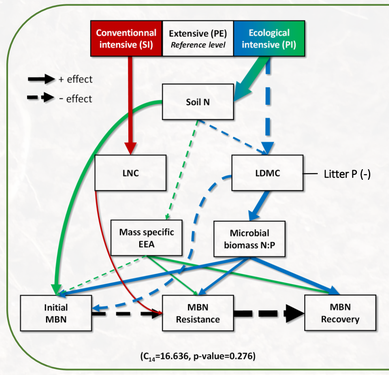
Drought simulation on intact soil core (N=144)

Experiment 2 :
Eco- and conventional intensive grasslands across Europe
4 Eco & 4 Conv Fields/country
X 4 rain regimes
(Dry / Normal / Wet / Intermittent)
simulated on intact soil core (N=96)

Experiment 3 :
Mountain grassland soil
Fertilization
X Plant presence
X Climate
(Normal / Drought
Flood /Freeze Thaw)
Simulated on reconstituted soil and plant community (N=48)

MAIN RESULTS

Mechanisms of **land-use** control on **ecosystem functioning** under **climate change**



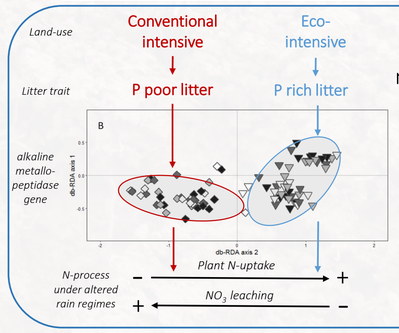
(C_{14}=16.636, p-value=0.276)

Experiment 1

1.**Cascading effect** of **land-use** on **ecosystem resilience** through soil, plant and microbial **CWM traits**.

2.**Trade-off between resistance** (Extensive and conventional) and **resilience** (Eco-intensive)

(Piton et al., Journal of Ecology, under revision).



Experiment 2

1.**Eco-intensive** grasslands have more **beneficial proteolytic microbes** for ecosystem functioning under altered rain regimes
(Lori*, Piton* et al. in prep) *co-1st authors

2.**Trade-off between resistance** (Conventional) and **resilience** (Eco-intensive) **of microbial biomass and activity**
(Piton & al in prep)

Experiment 3 (Piton & al. in prep)

Mineral fertilization changes microbial community composition (Actinobacteria ↑, Deltaproteobacteria ↓, Bacteroidetes ↓, Glomeromycetes (planted soil only ↓)), **CWM traits** (Biomass C:N (Unplanted ↓), N acq. enzyme (Planted ↓)) **and decreases ecosystem processes stability** (Respi, N-min, Nit, Denit)
Plants modulate fertilization effect (composition, trait and the processes)

TAKE HOME MESSAGE :

1) **Starting tools exist** to characterize **functional variation and trade-off** in **soil microbial strategy** (CWM and FD proxy) : can complement classical approaches (PLFA, DNA)
2) **Land-use intensity influences microbial CWM and FD** (composition) through soil and plant traits modifications : especially **P-associated traits** need to be investigated.
3) **Microbial traits are central in ecosystem functioning and resilience** under climate change : need to be included in **model** and **land-use planning.**