MICROBIAL DYNAMICS DURING A CYANOBACTERIAL BLOOM COLLAPSE

A MESOCOSM APPROACH

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Phytoplankton blooming impact ?

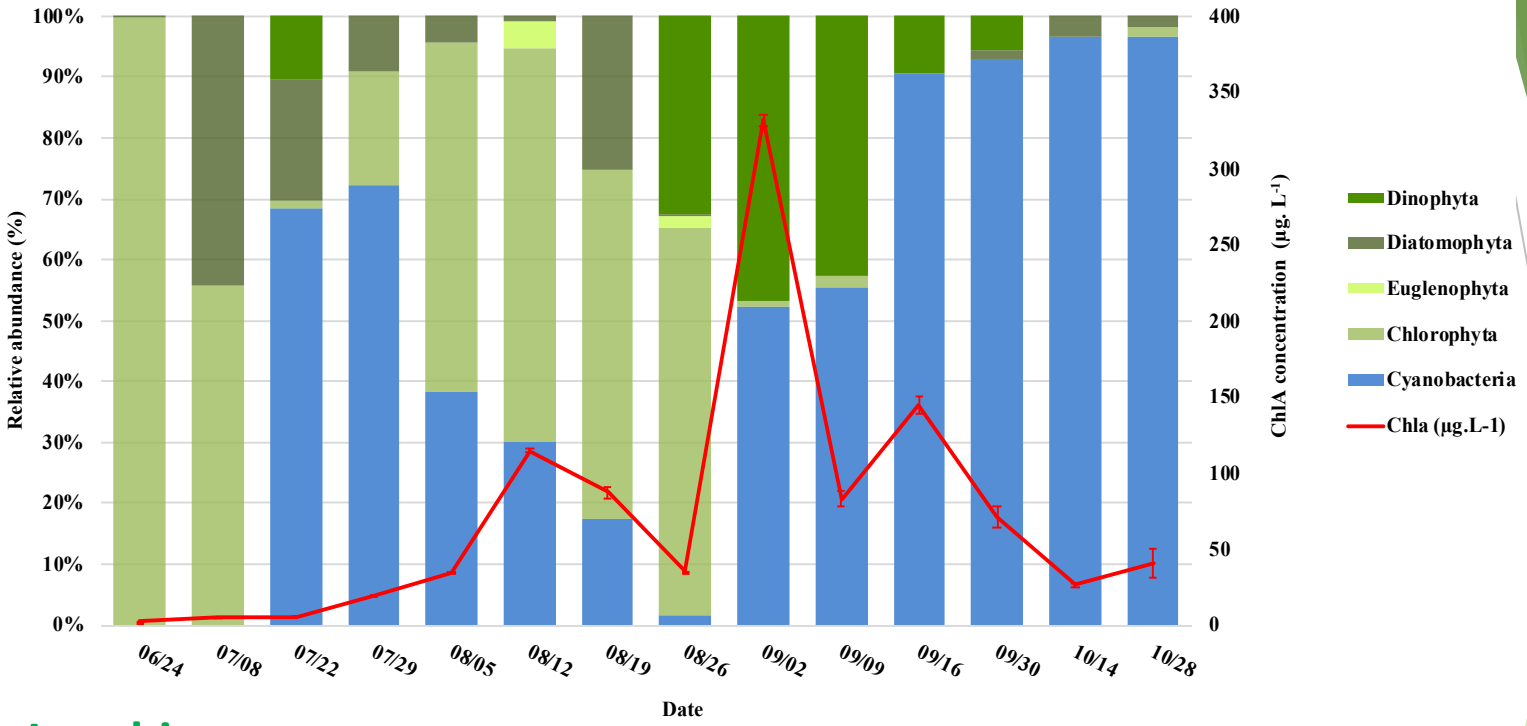
Phytoplankton blooms, mainly cyanobacterial ones, are annual events leading to strong perturbations in eutrophic ecosystems such as the decrease of phytoplanktonic diversity, potential release of toxins, and hypoxia



=> One of the main consequences is the huge release of OM when the bloom collapses

=> A good scenario to disentangle the mechanisms underlying the synergy between OM and microbial heterotrophs

Phytoplankton blooming impact ?



Low biomass and richness

High biomass and richness

High biomass but low richness

Louati et al., 2023

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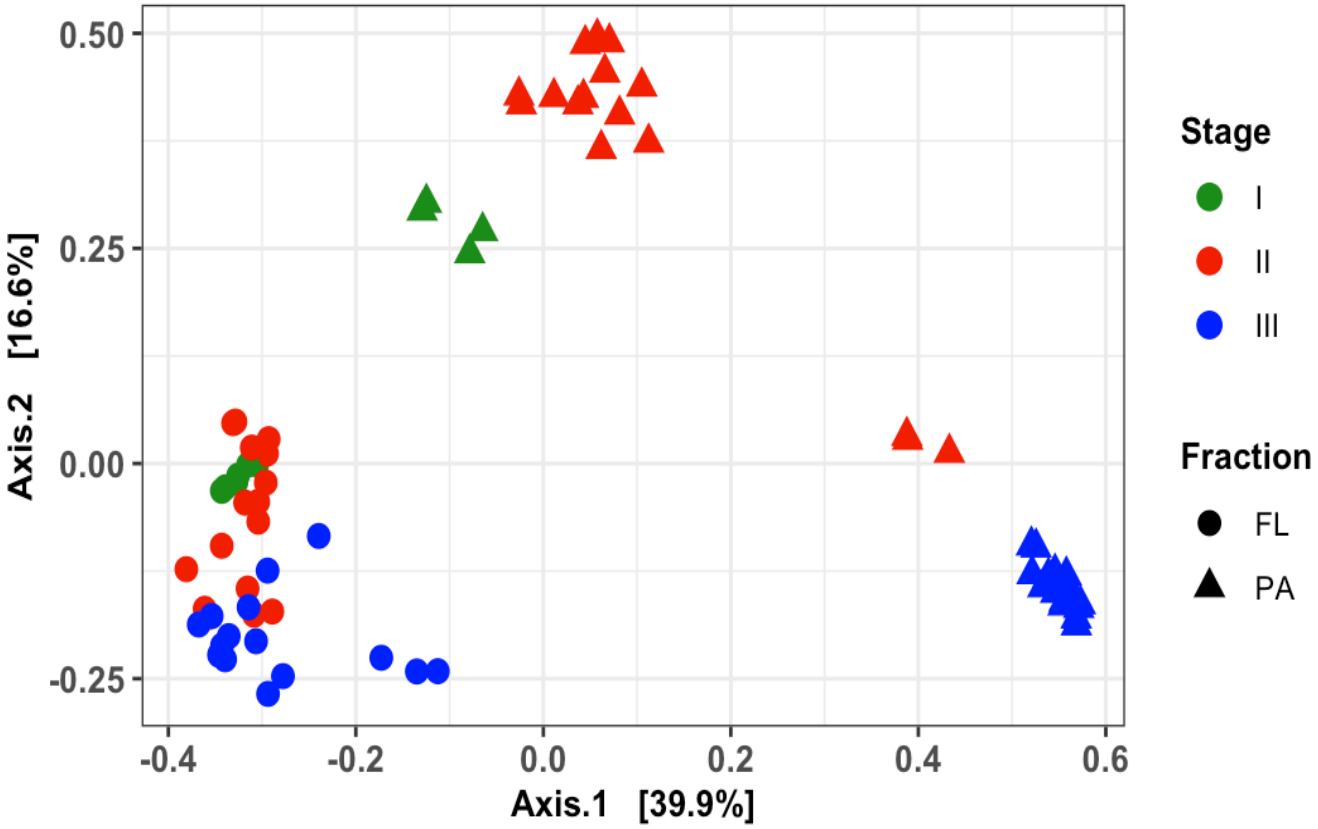
Phytoplankton selectivity ?



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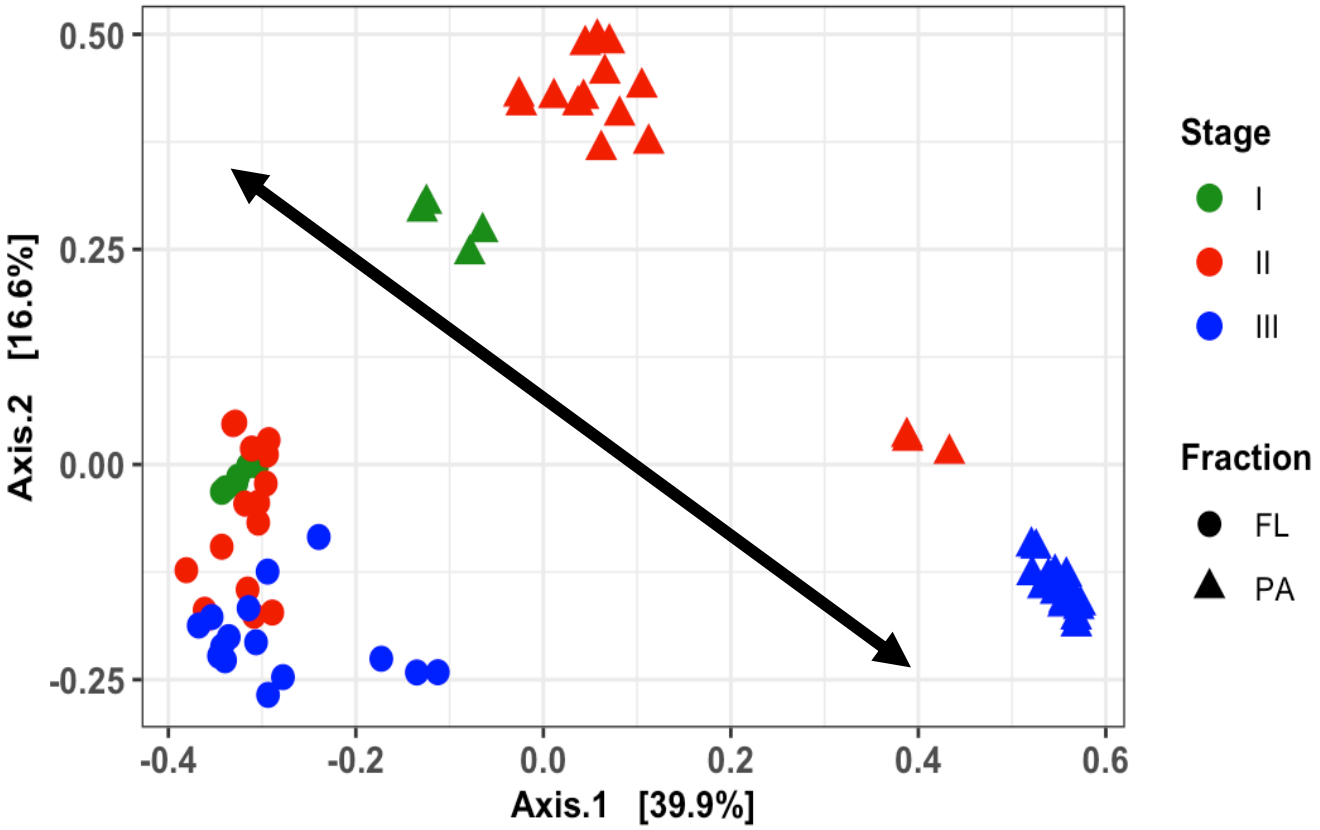

=> Strong differentiation according to the living mode

Louati et al., 2023

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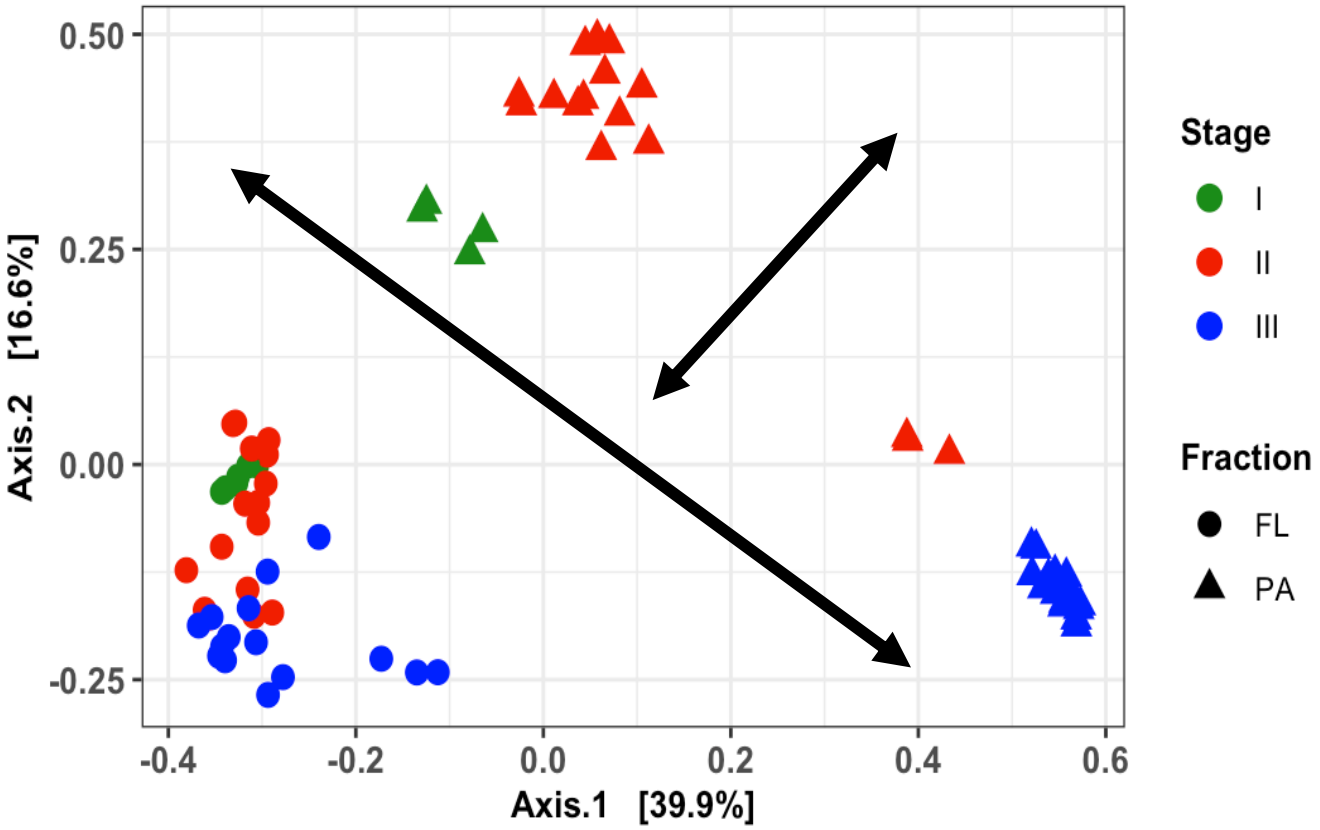

=> Strong differentiation according to the living mode

=> Strong differentiation according to the phytoplankton community

Louati et al., 2023

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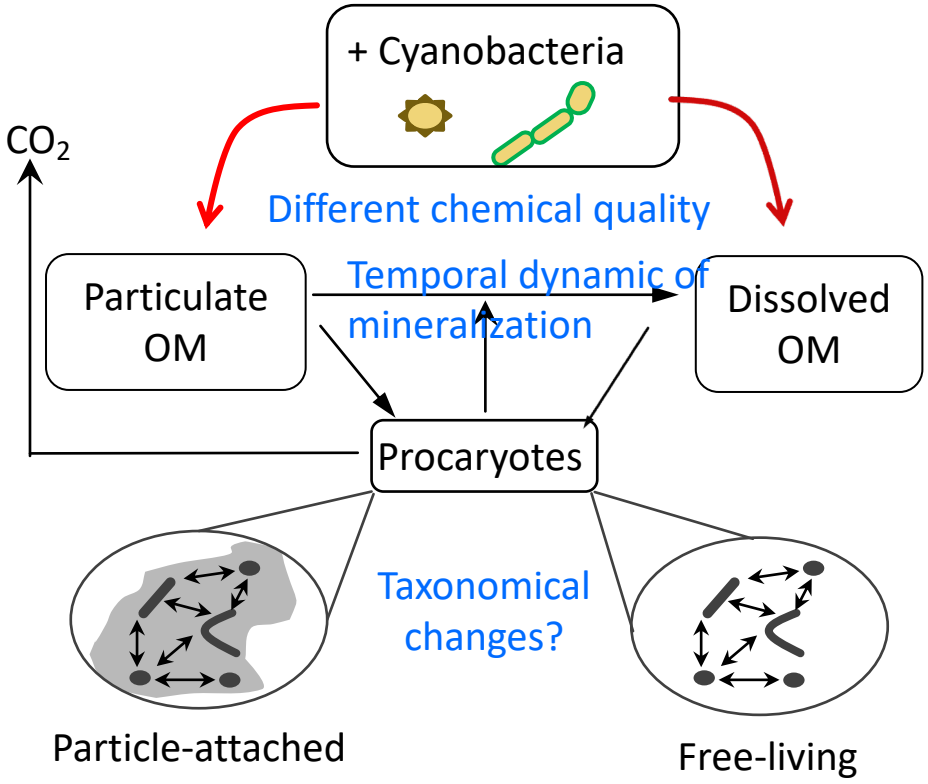
Phytoplankton selectivity ?

=> Synergy established between microbial heterotrophs and organic matter

=> Mainly driven by its bioavailability, chemical composition as well as its biotic origin



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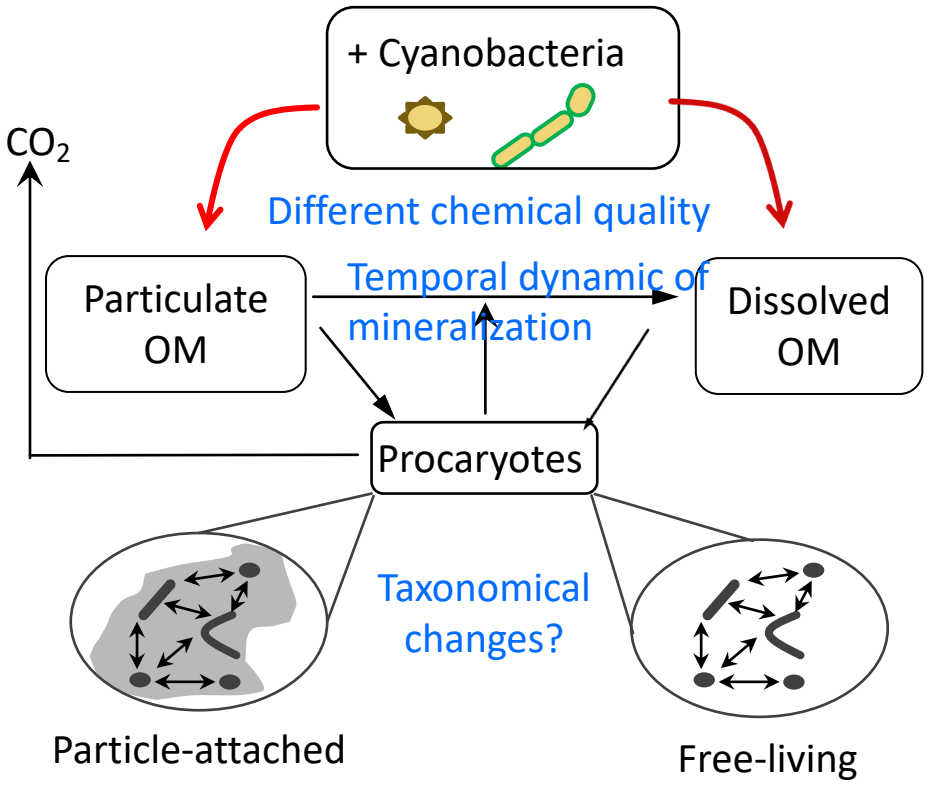

What is happening at the end of the bloom?

Simulation of a the strong release of particulate and dissolved OMOM

How to do so?

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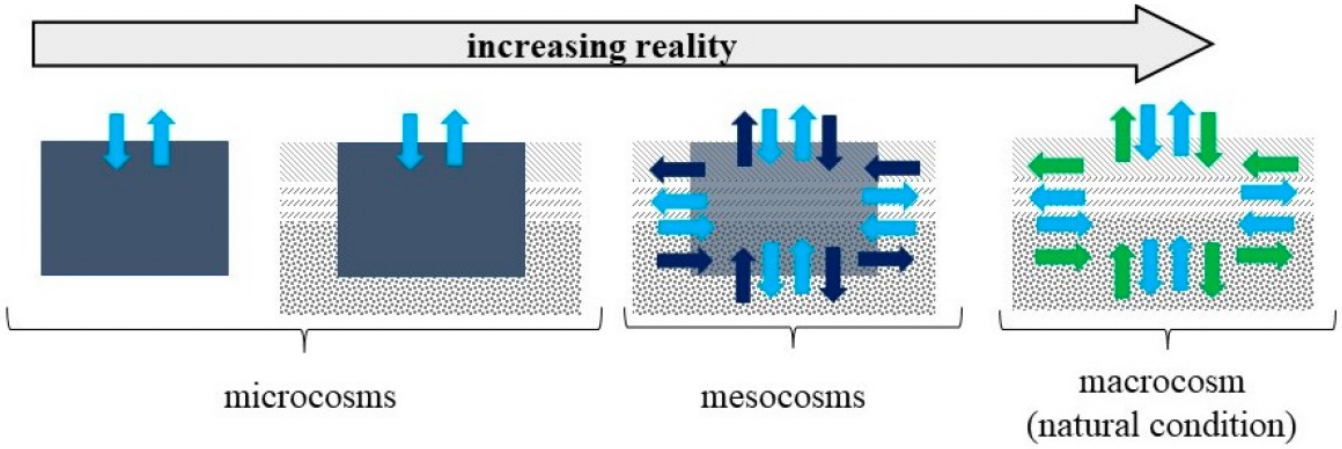
Size matters in aquatic ecology?



Degree of control, replication

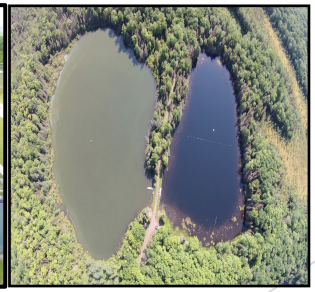
\+ ←——————————————— -

Temporal and spatial scale, complexity

\- ———————————————→ +








Microcosm | Mesocosm | Macrocosm | Manipulation of natural ecosystems | Observation

Modified From Boeck et al. 2015

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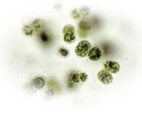
Mesocosm approach

N_2-fixing and non-fixing bloom-forming cyanobacteria

C:N ratio 4.6

Aphanizomenom spp



Microcystis spp

C:N ratio 5.6

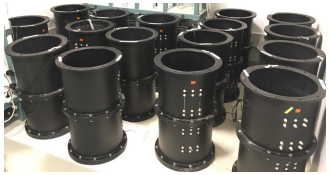
High-density cultures

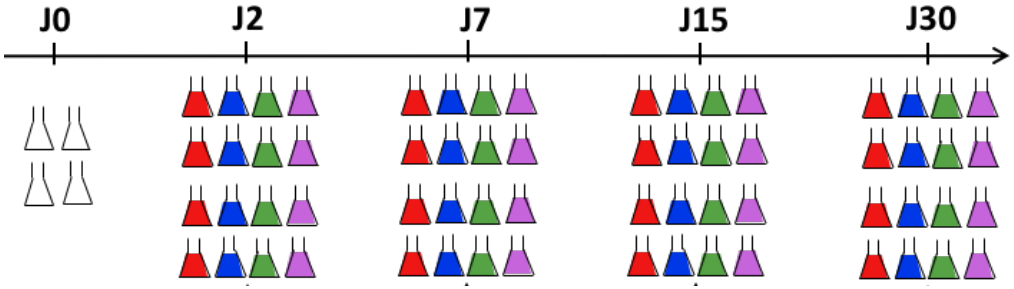
+

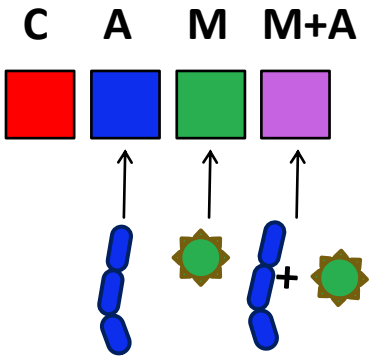
Natural microbial communities (Planaqua macrocosms)

CEREEP-Ecotron IDF - St-Pierre-lès-Nemours
https://www.cereep.bio.ens.psl.eu/

Mesocosm approach







30 days-long incubation in the dark at 23°C in 20L-mesocosms

- Optical characterization of the OM
- Chemical identification of fatty and amino acids
- Nutrient concentrations

- Functional diversity (Biolog®)
- Microbial diversity (16S rRNA metabarcoding)
- Viral and bacterial abundances (cytometry)

CEREEP-Ecotron IDF - St-Pierre-lès-Nemours
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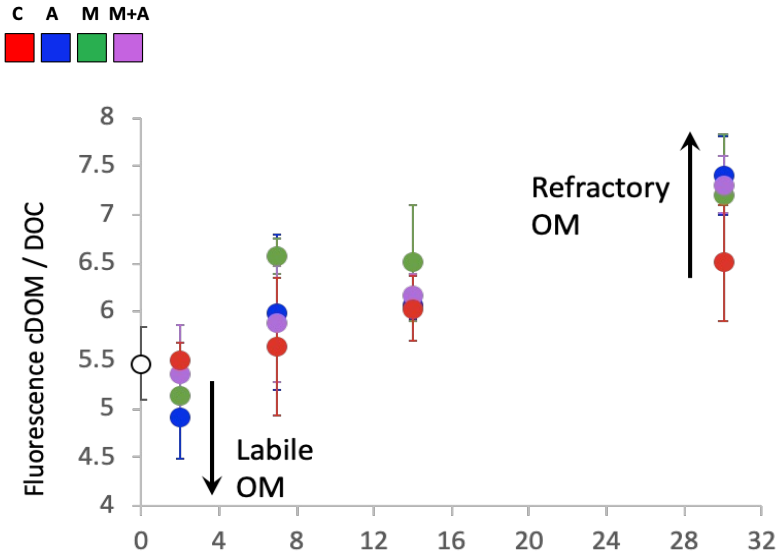
How organic matter respond ?



=> Significant mineralization of the labile pool of OM by microbial heterotrophs in a short term

=> No difference of mineralization according to the biotic origin

=> Refractory OM accumulation

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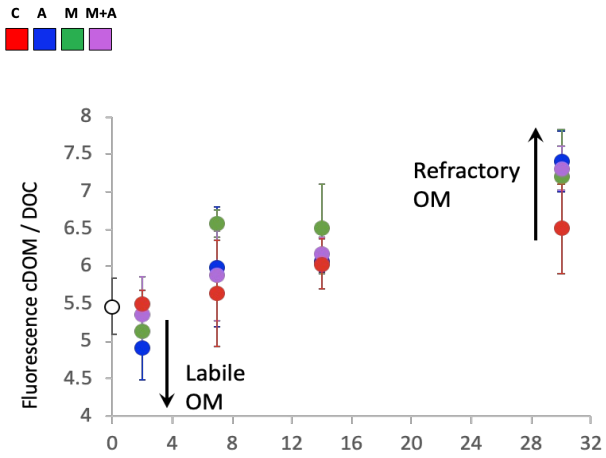

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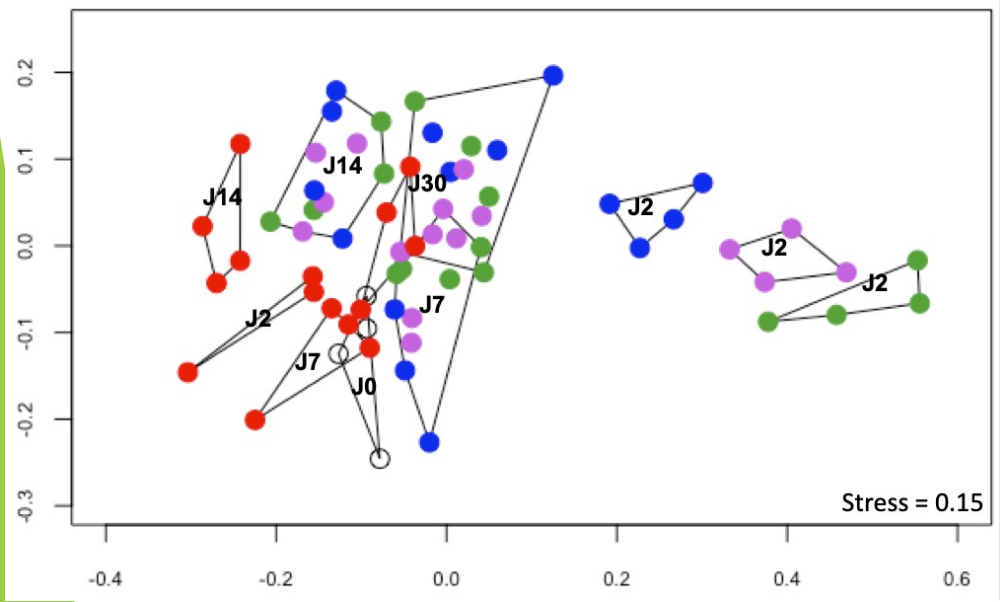

=> Rapid evolution of the OM quality during mineralization

=> OM trajectory according to the biotic origin, with different resilience response

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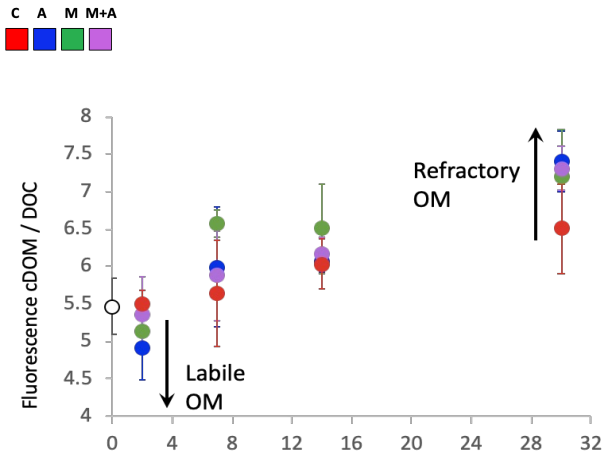

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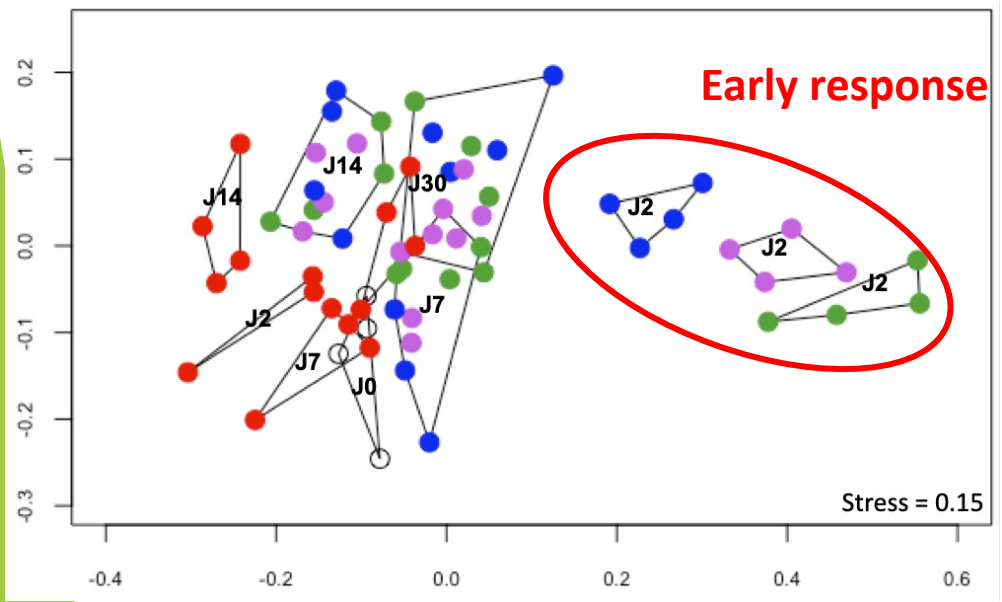

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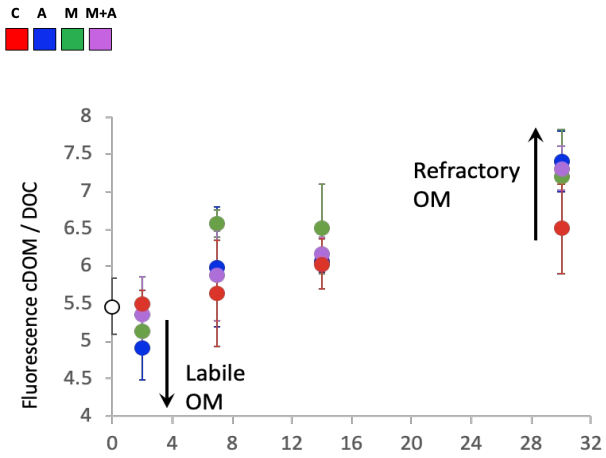

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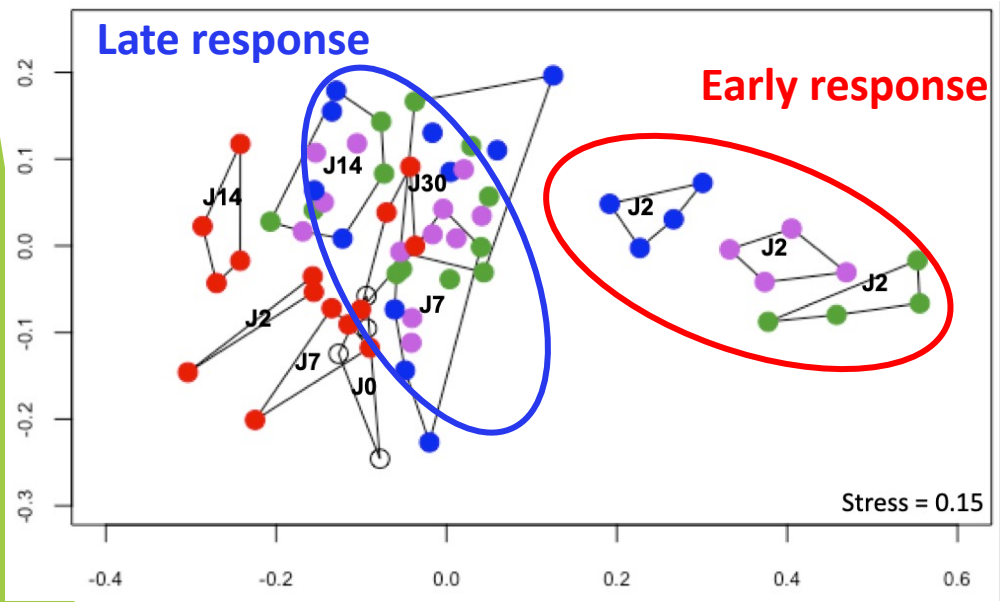

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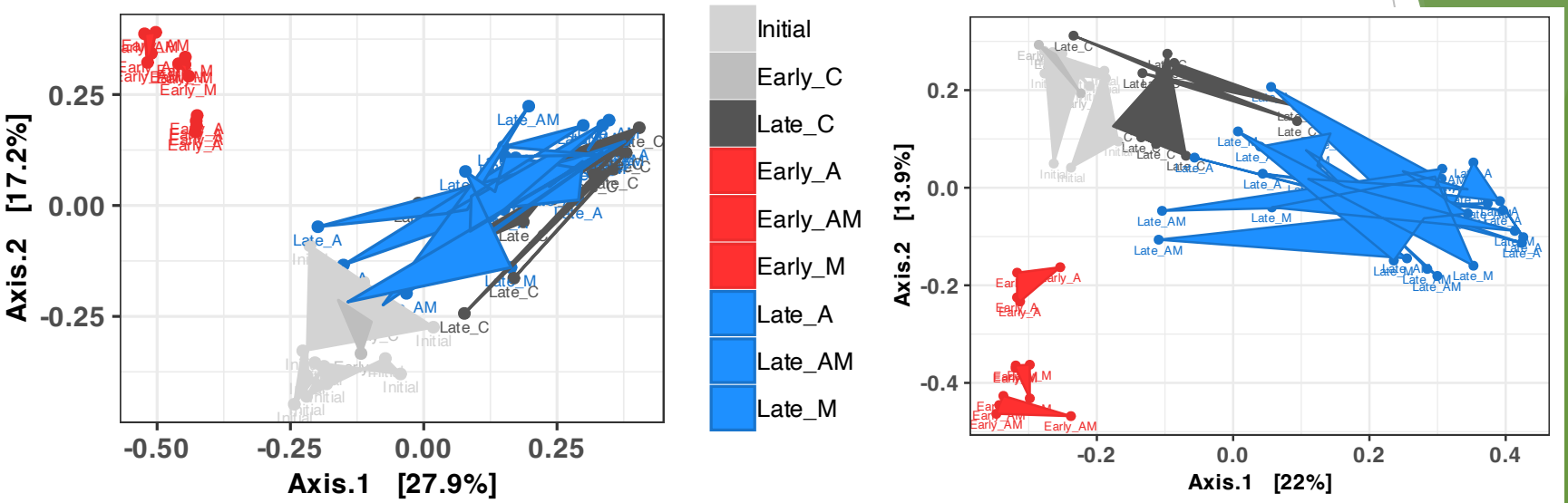
How microbial communities respond ?

Particle-attached vs Free-living



=> Strong and rapid impact of the cyanobacterial senescence

=> Highly resilient communities in PA mode

=> Resilient but without return to the initial state

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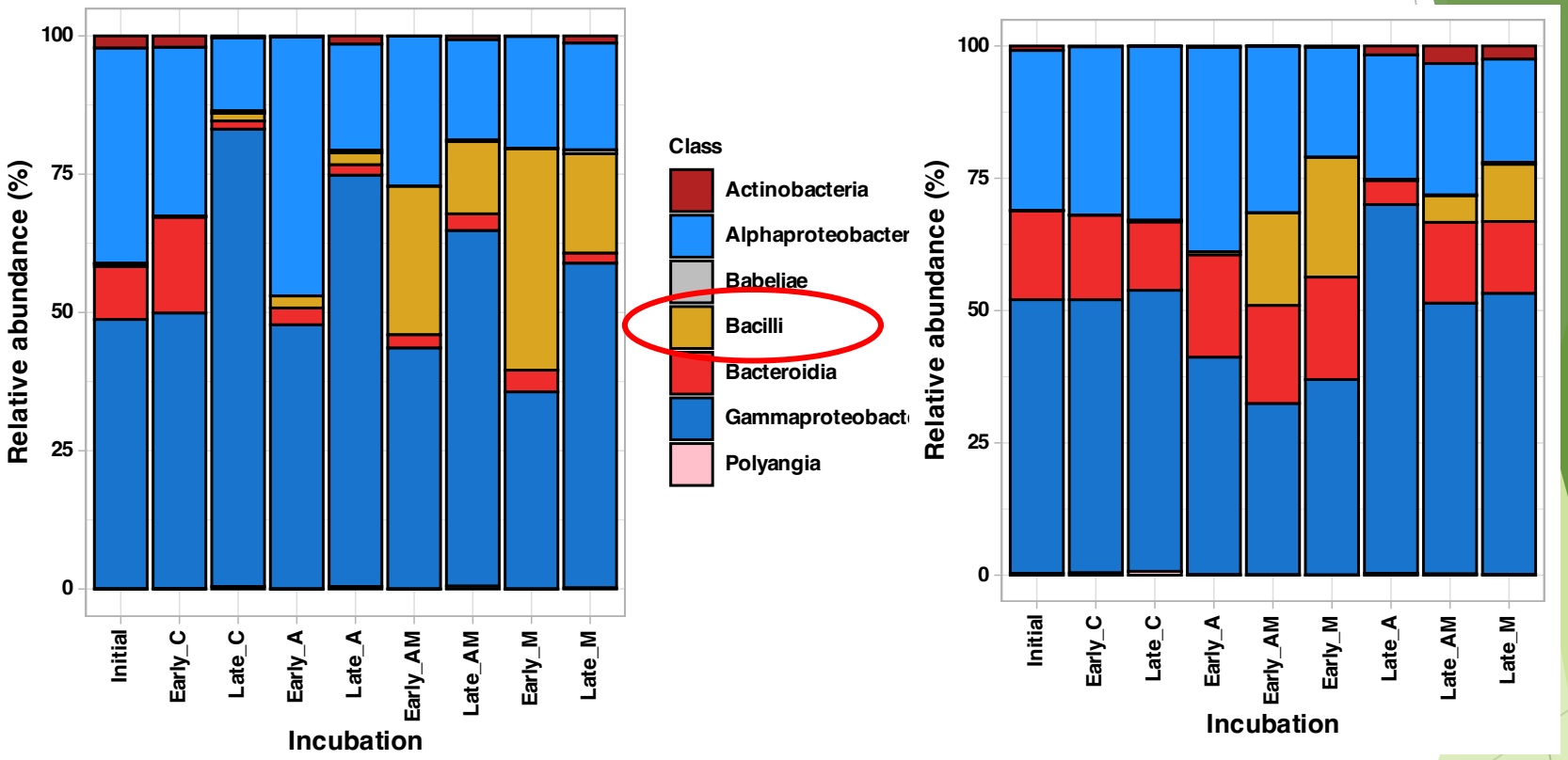
How microbial communities respond ?



=> Emergence of specific microbial groups = Bacilli

=> According to the biotic origin of OM

=> Remain after 30 days

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To conclude

Cyanobacterial bloom senescence

= Strong and impact on the OM pool with a more refractory quality

= Intense and rapid impact on the PA and FL microbial communities

= No return to the initial state of the natural freshwater communities

= Appareance of Bacilli members, specifically *Exiguobacterium* spp followed by *Bacillus* spp