Soil microbial diversity

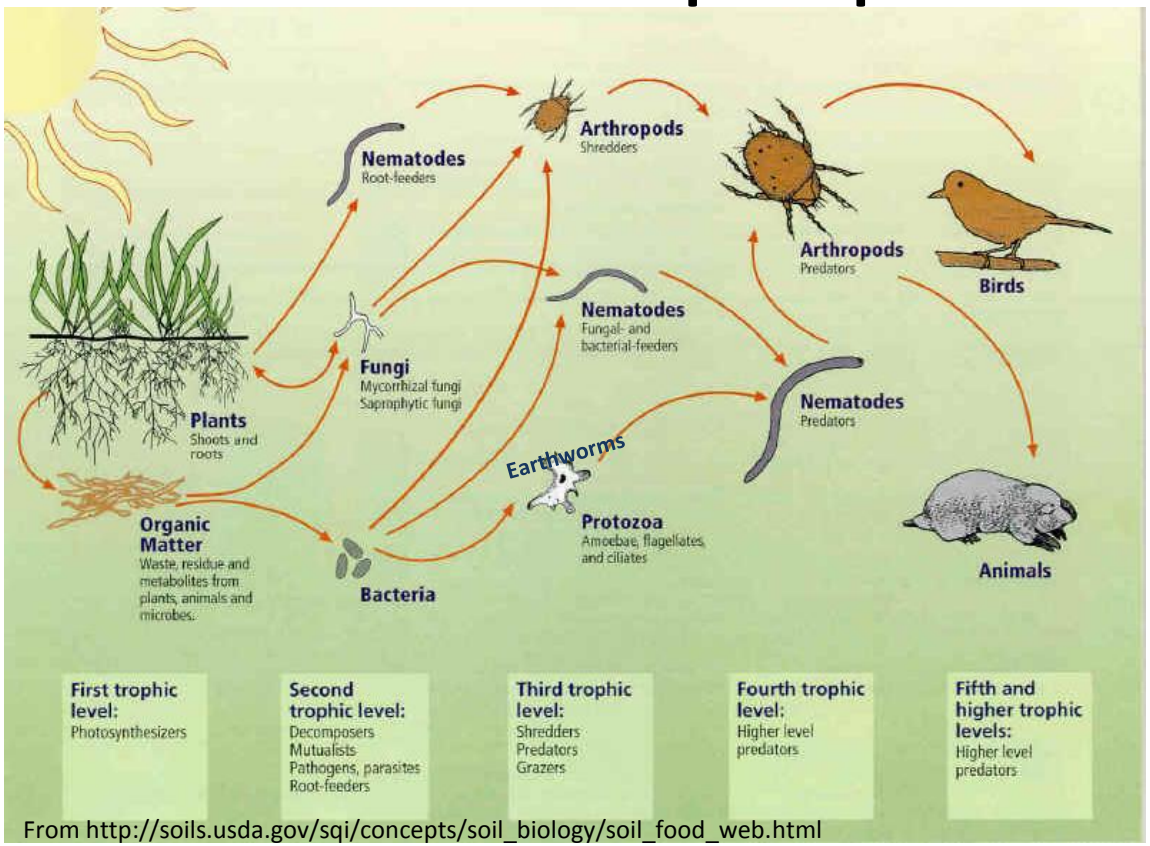
Diversité des prairies alpines, distribution spatiale et dynamique temporelle

Roberto A. Geremia, Jean-Marc Bonneville, Philippe Choler, Eric Coissac, Lucie Zinger, Bahar Shahnavaz, Tarafa Mustafa

Laboratoire d'Ecologie Alpine

Station Alpine Joseph Fourier
UMS 2925 CNRS UJF
Grenoble - Col du Lautaret [2100 m]

Organismes du sol et réseaux trophiques



From http://soils.usda.gov/sqi/concepts/soil_biology/soil_food_web.html

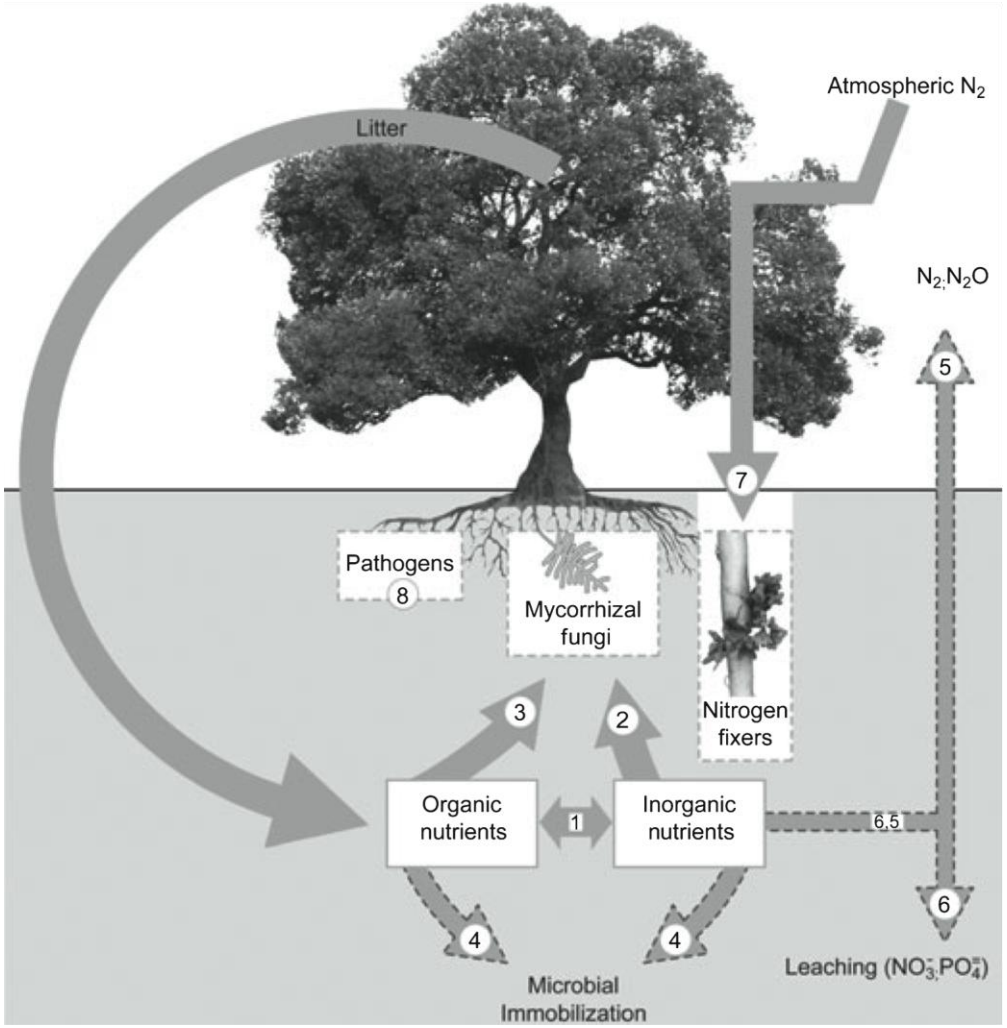
Communautés microbiennes du sol:

>10,000 espèces bactériennes/ gramme

>200 espèces fongiques/gramme

Pour étudier cette complexité: des méthodes moléculaires

Microbes du sol régulent la productivité végétale



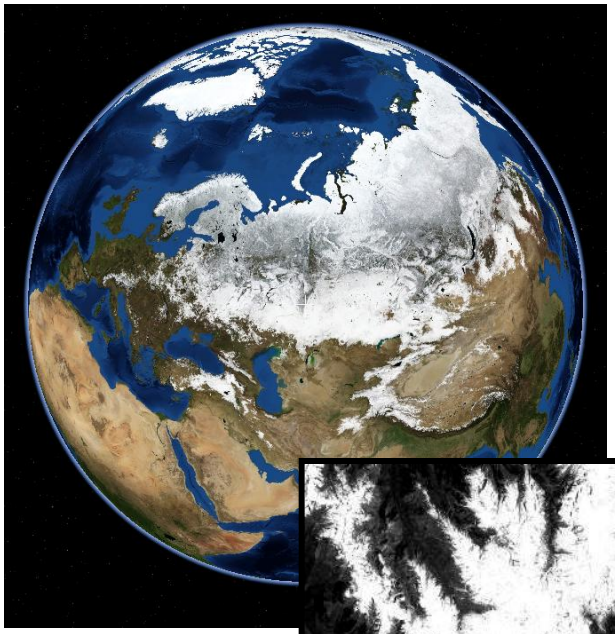
- Cycle de l'azote
- Recyclage du C végétale (dégradation de la litière)
- Transfert des nutriments vers la plante
- Pathogènes

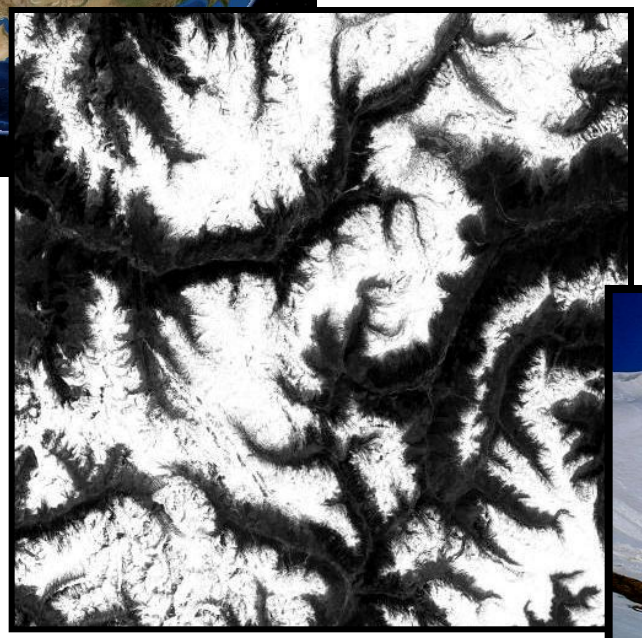
Liens avec :

- Agriculture
- Immobilisation du C

From: Van der Heijden *et al.* The unseen majority: soil microbes as drivers of plant diversity and productivity in terrestrial ecosystemsEcology Letters, (2008) 11: 296–310

Snow cover and carbon cycling





Snow exerts effects on :

Distribution of plant and functional diversity

Above and Belowground carbon pools

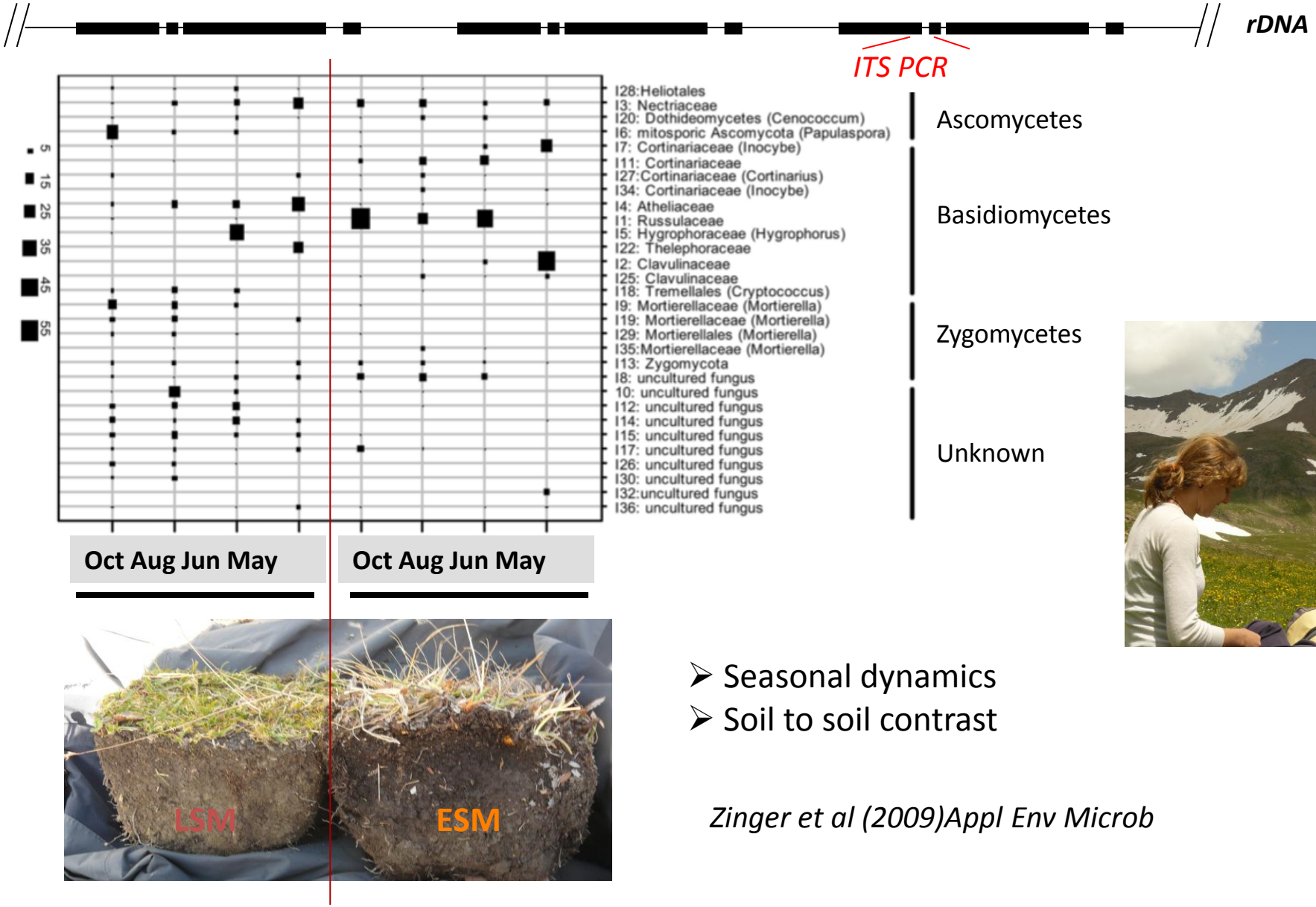
Soil Climate

Ecosystem fluxes

Microbial diversity?

Early *vs*. late snowm

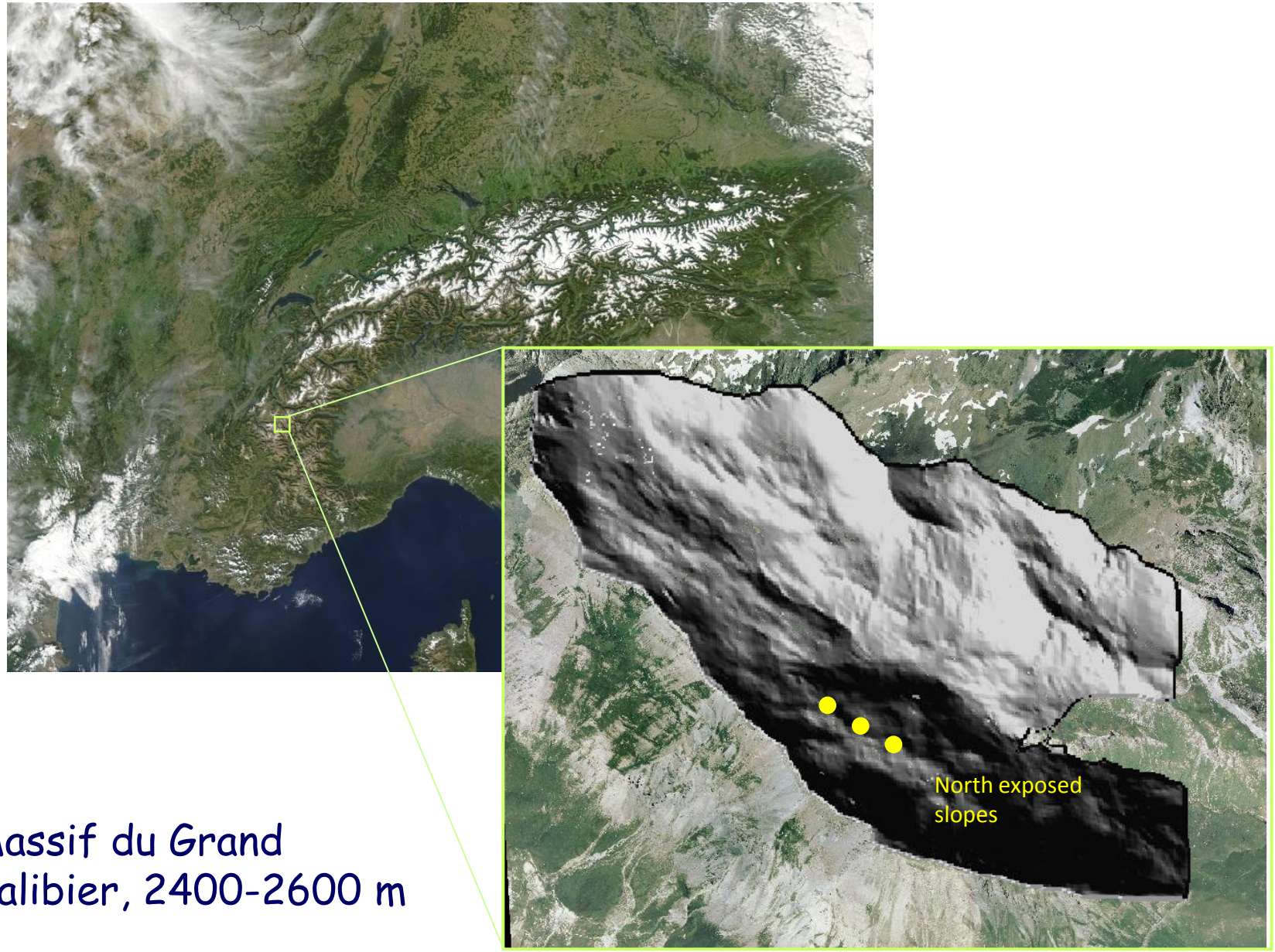
Distribution of major fungal MOTUs in two alpine soils



- Seasonal dynamics
- Soil to soil contrast

Zinger et al (2009)Appl Env Microb

Location of study site



Massif du Grand
Galibier, 2400-2600 m

Seasonnal sampling

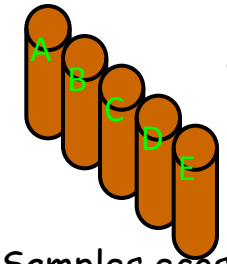
Winter

Summer

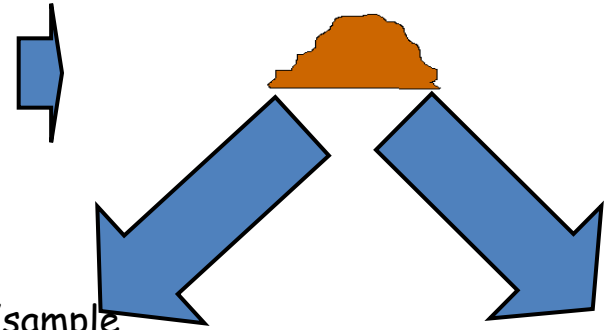
1 site, (ESM and LSM) two years)

<u>3 sites, 1 ESM and LSM each one year</u>

Soil samples processing

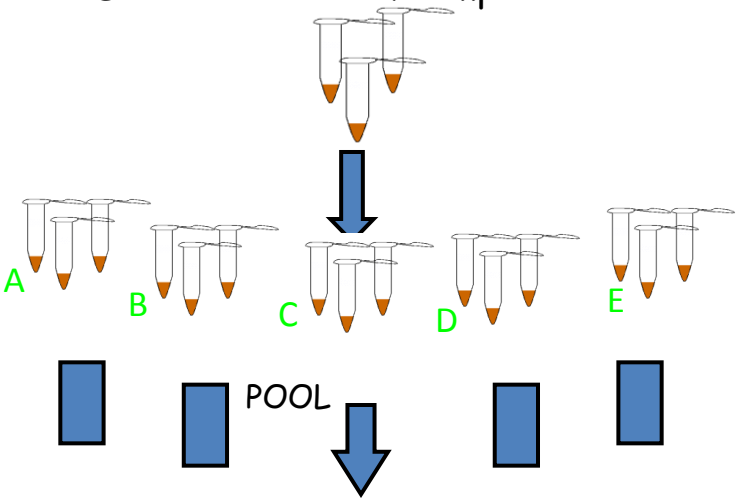


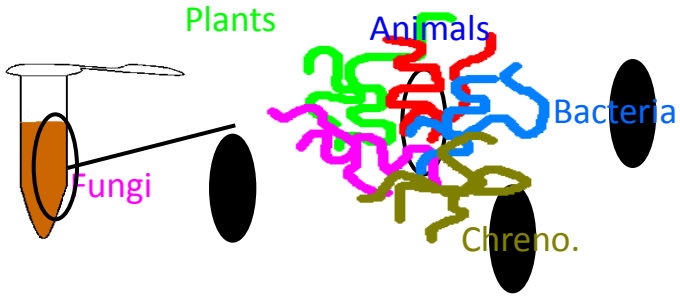
5 Samples ecosystem
(>50 g)



3 DNA extractions/sample

Strain isolation



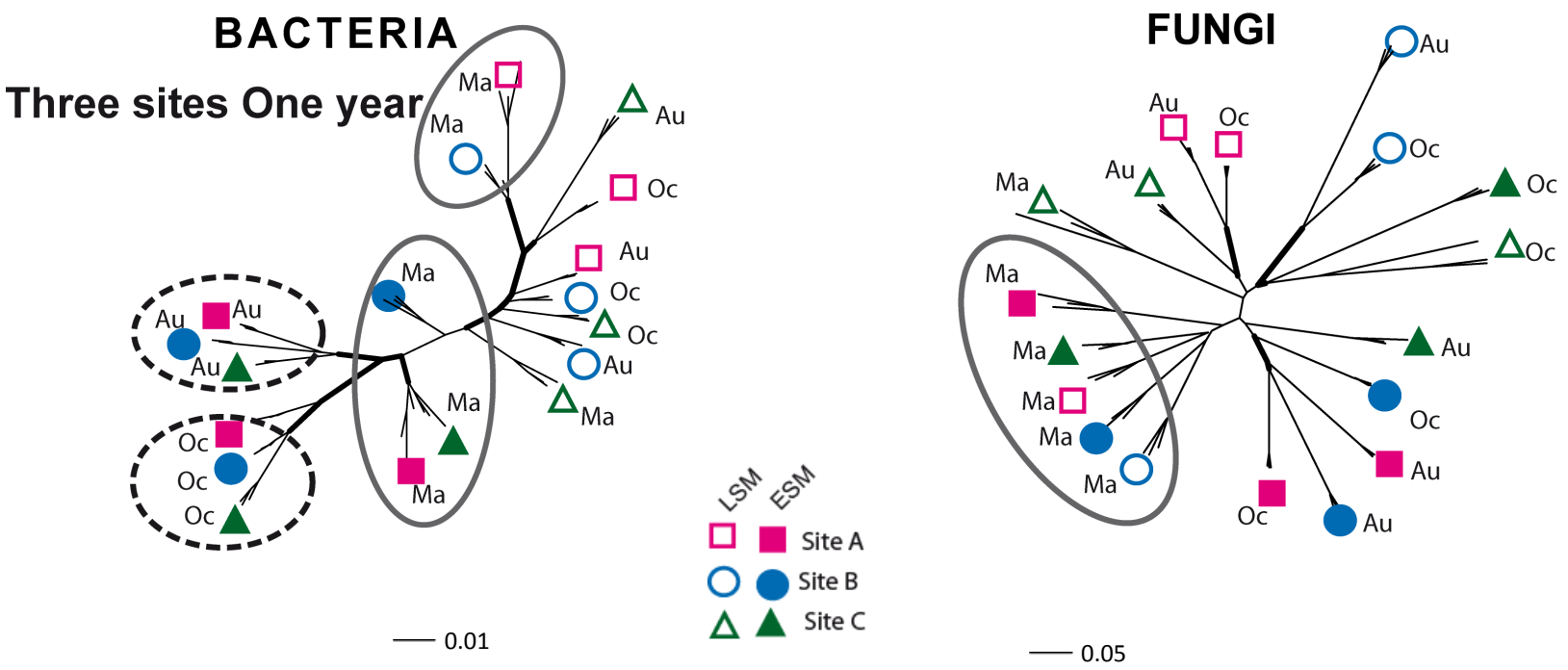


PCR with kingdom specific primers

Molecular Profiling

Cloning and sequencing

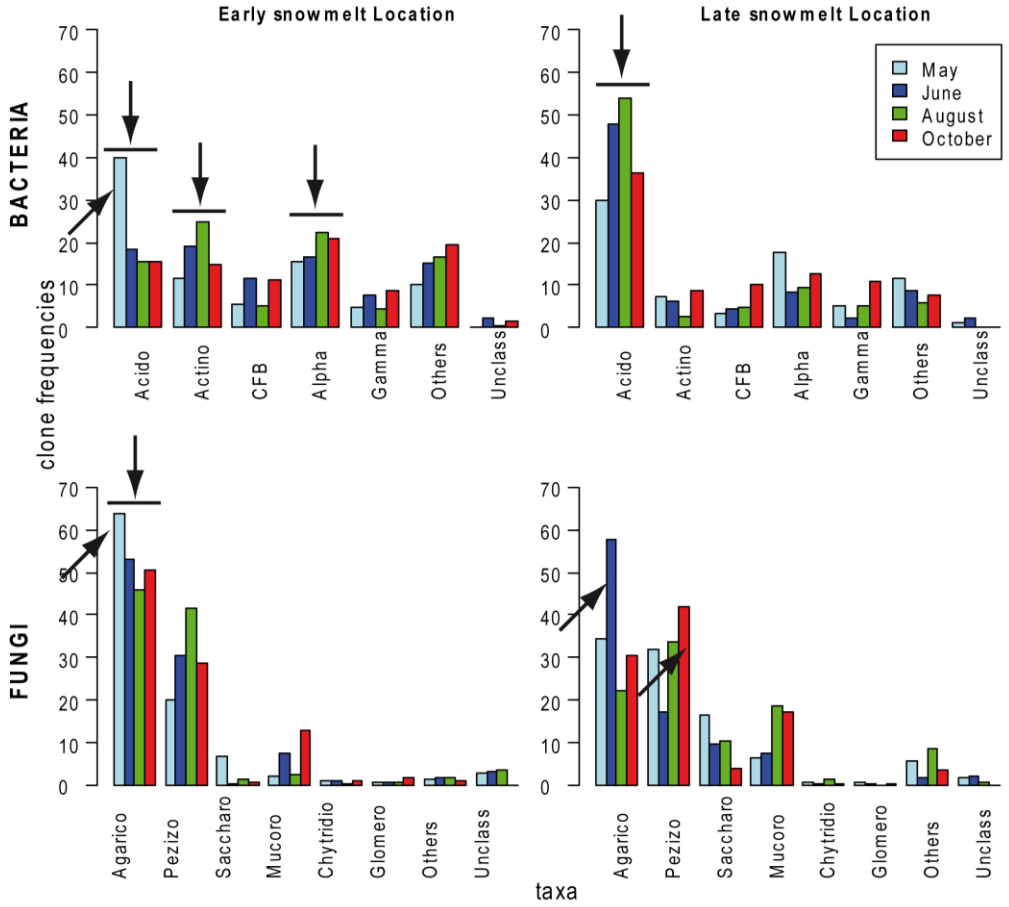
Molecular Profiling of Microbial



Early and late snowmelt locations are clearly separated => the influence of the snow cover is stronger than the influence of the season.

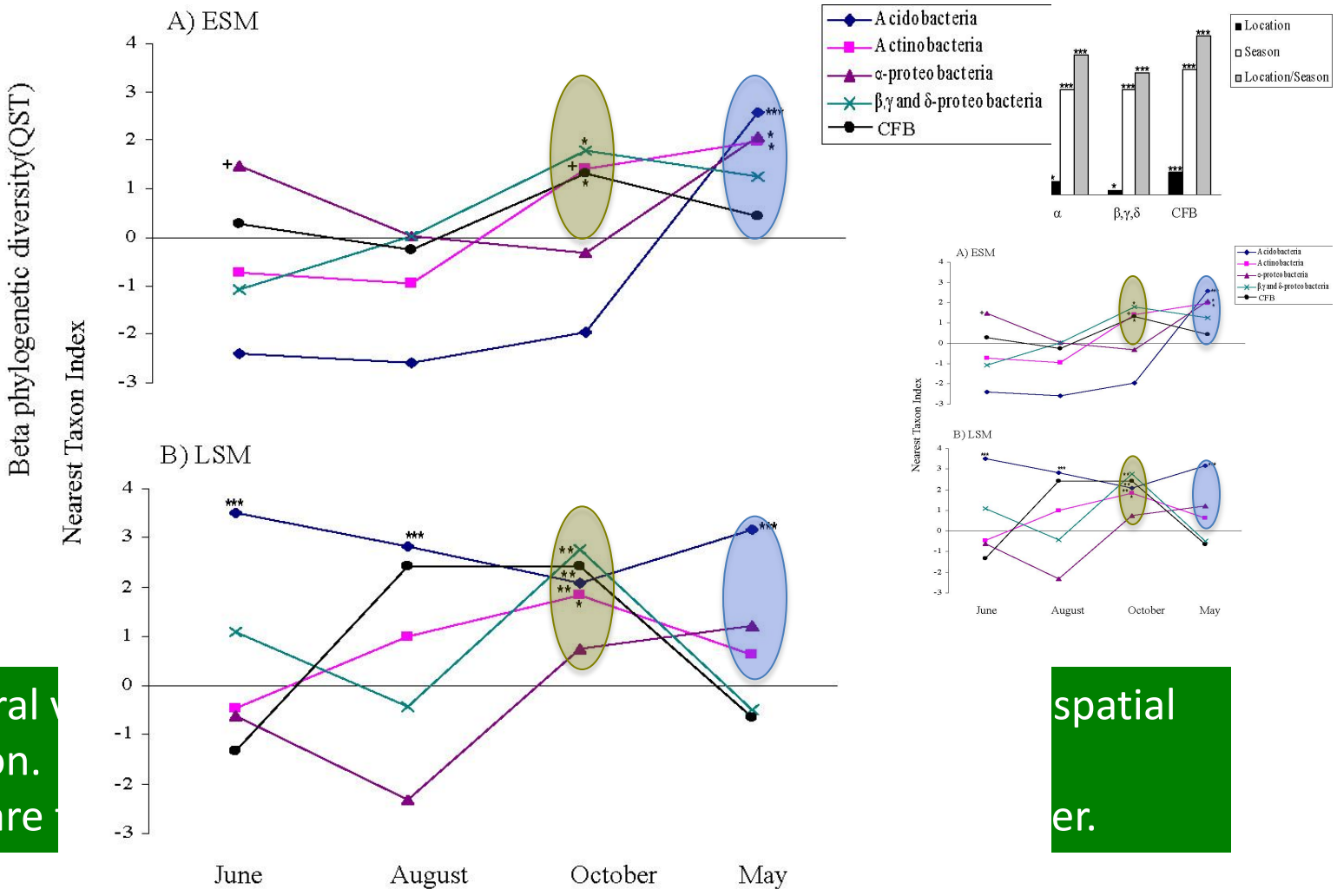
Shift on microbial communities in the late winter: strong "selective" effect of snow or freezing.

10000 sequences later … Sequence analysis supports molecular profiling data (1 Site 1 Year)



Microbial communities of ESM and LSM are different. In late winter (May) there is a convergence of this communities (supported by molecular fingerprinting)

Snow cover and bacterial dynamics



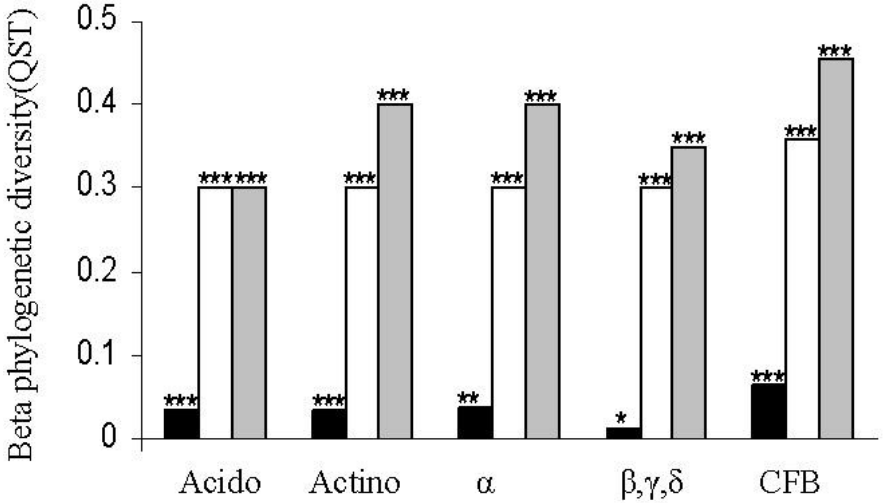
Temporal v
variation.
There are

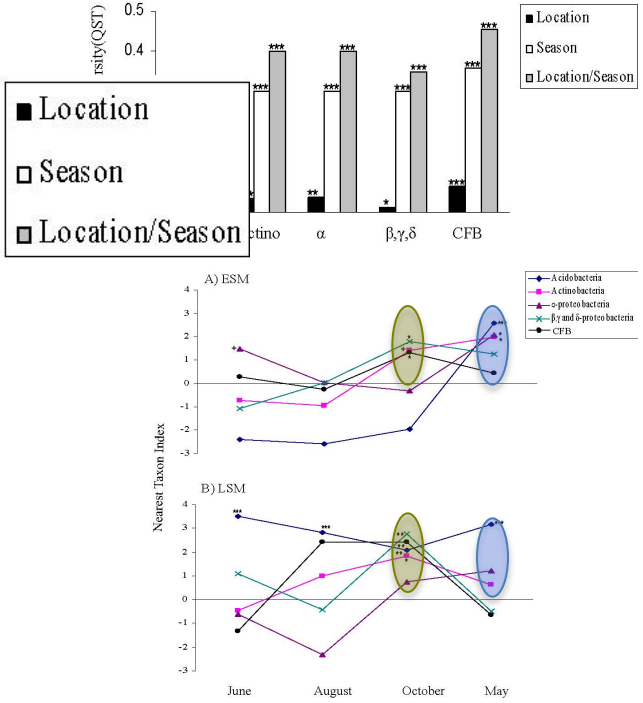
spatial

er.

From: Zinger *et al* ISME Jounal (2009) *in press* and Shahnavaz *et al* (2009) submitted

Snow cover and bacterial dynamics





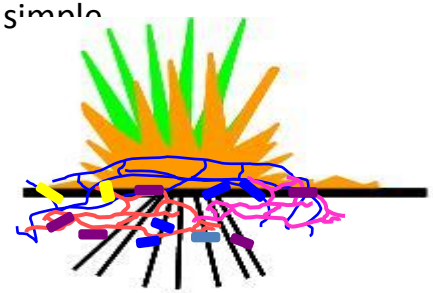
Temporal variations of bacterial diversity are more drastic than spatial variation.
There are two environmental filters: plant senescence and winter.

From: Zinger *et al* ISME Jounal (2009) *in press* and Shahnavaz *et al* (2009) submitted

Variations saisonnières

Automne

Sénescence Végétale, développement fongique sur la base de la matière végétale simple

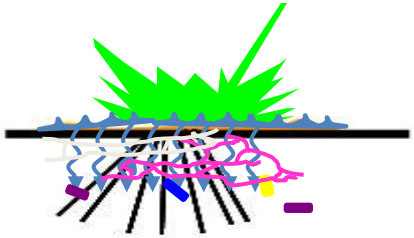


Hiver

Anaérobiose, dégagement de CO_2 et méthane.
Dégradation de la matière organique

Eté

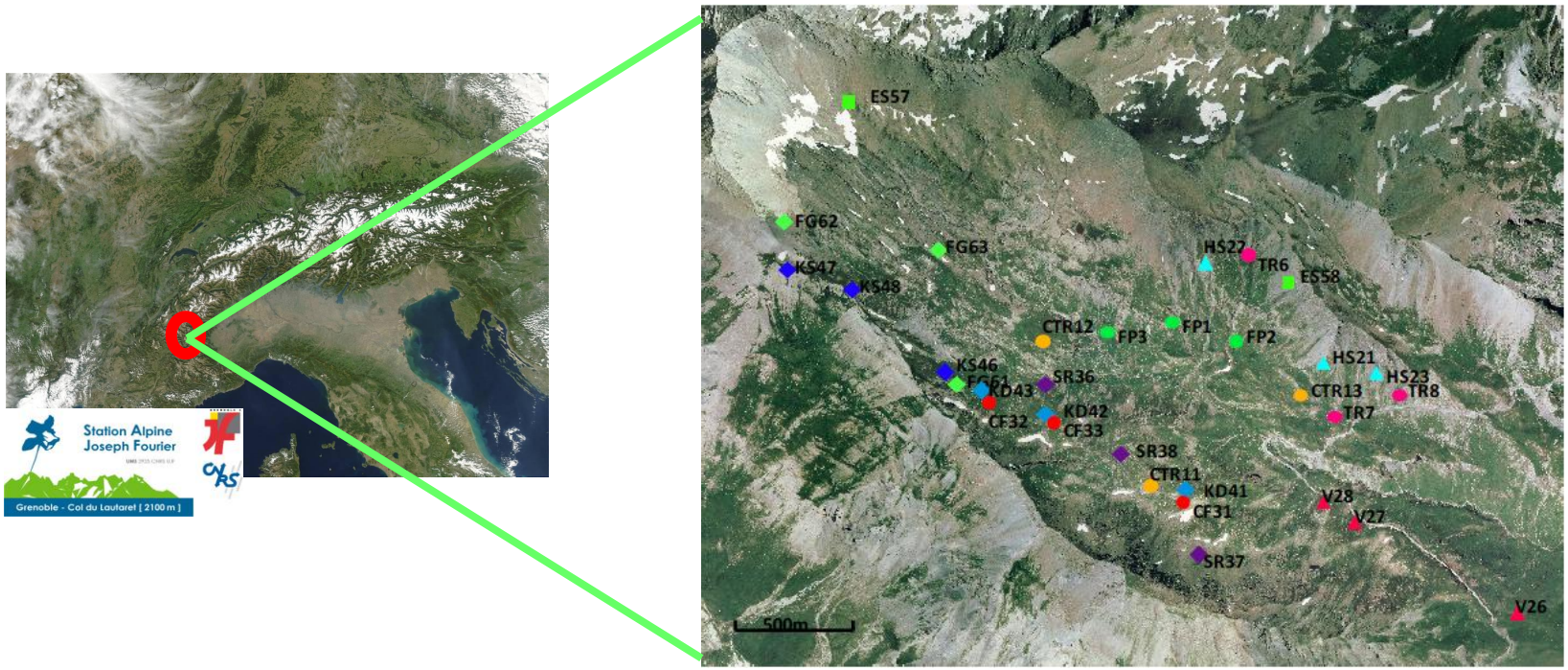
Exsudat des plantes actives.
Epanouissement des mycorhizes?



Printemps

Crash des populations microbiennes
suite aux cycles gel/dégel ou engorgement d'eaux.

Site study and vegetal communities

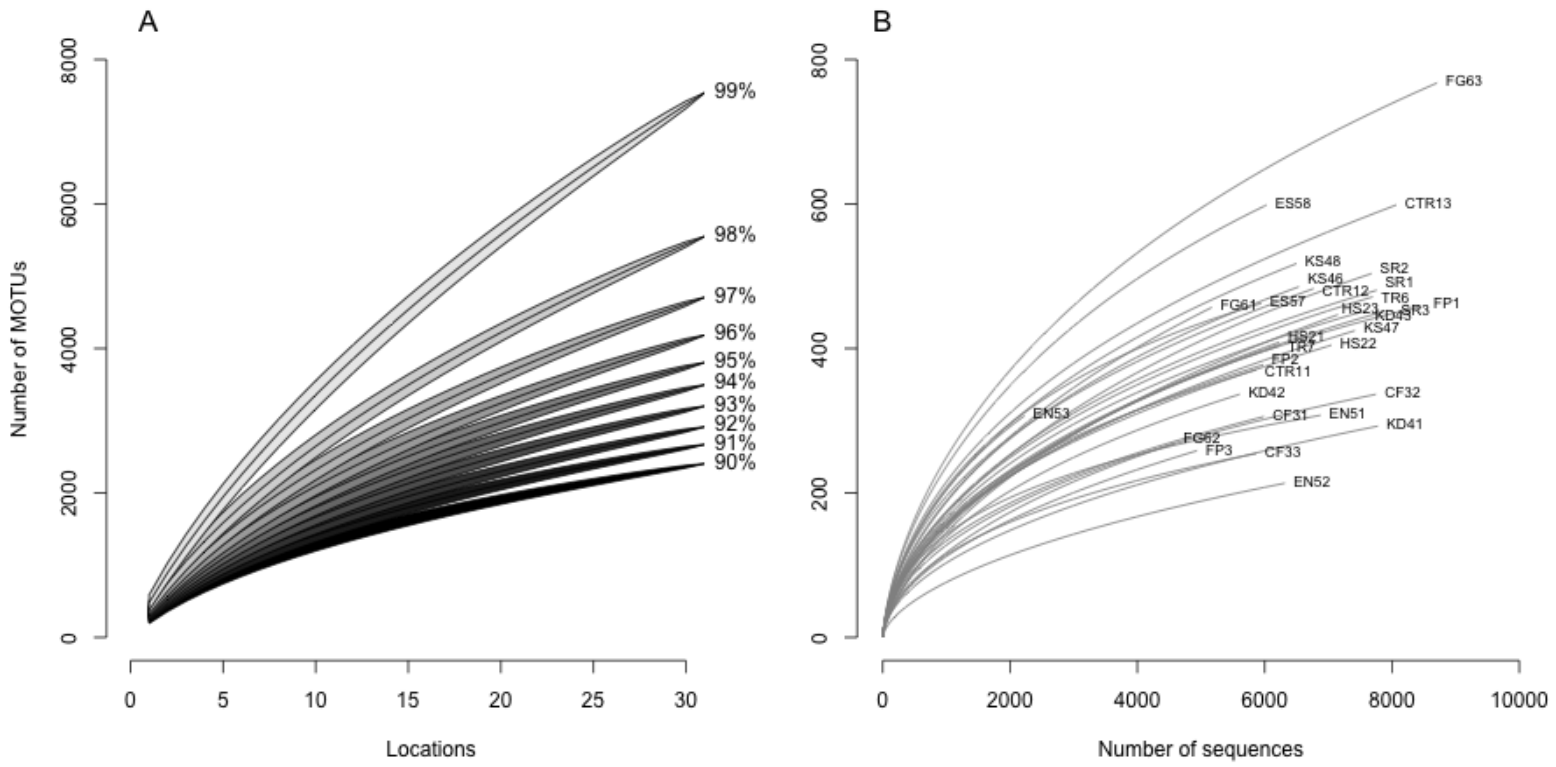


- Roche Noir Bassin
- Massif du Grand Galibier, French Alpes.
- 1900-2800 m above sea level encompasing subalpine and alpine habitats.

Putting in the context of Ecology: Habitat comparison

			Similarity in MOTUs composition			Without rare MOTUs[1]			Rare MOTUs only[1]		
	Source	**Df**	**F.Model**	**R2**	**Pr**	**F.Model**	**R2**	**Pr**	**F.Model**	**R2**	**Pr**
2 EC (KD, CF)	Locations	1	1.83	0.31	0.001 ***	2.71	0.4	0.001 ***	1.23	0.24	0.001 ***
	Residuals	4		0.69			0.6			0.76	
	Total	5		1			1			1	
11 EC	Locations	10	1.49	0.43	0.001 ***	2.1	0.51	0.001 ***	1.17	0.37	0.001 ***
	Residuals	20		0.57			0.49			0.63	
	Total	30		1			1			1	

Alpha and Beta Diversity



The fungal diversity is higher than expected, >700 MOTUs/gr sol, and increasesat the regional scale

Thanks to...

Lucile Sage, Jerôme Gury, Armelle Monier, Jean Christophe Clement, Eric Coissac, …

Bahar Shahvanaz, Bacterial Isolation and bacterial libraries
Jean-Christophe Clement, N Cycle,
Lucile Sage, Fungal Strain isolation
Jerôme Gury, Molecular Markers
Jean Martins (LTHE), Soil biomass

Lucie Zinger
Fungal libraries
SSCP

Florence Baptiste
Litter degradation

Christiane Gallet
Tannins and polyphenols

The Ecology behind, Philippe Choler

You see, in this world there's two kinds of people, my friend... those with loaded guns, and those who dig. You dig.


Thanks !!!