

Le mycobiome des sols face aux changements climatiques

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Les sols et leurs fonctions
28/05/2024



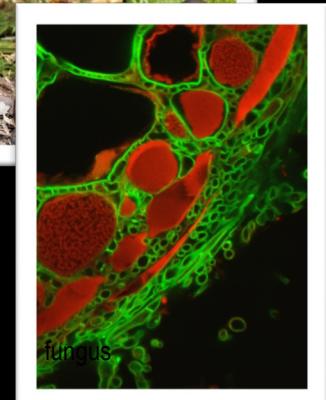
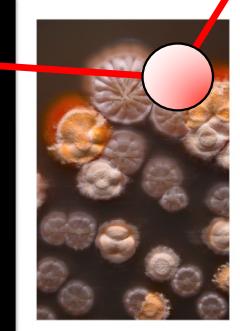
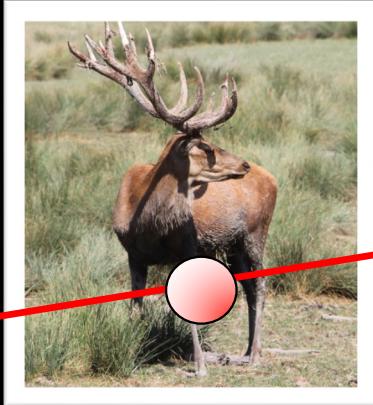
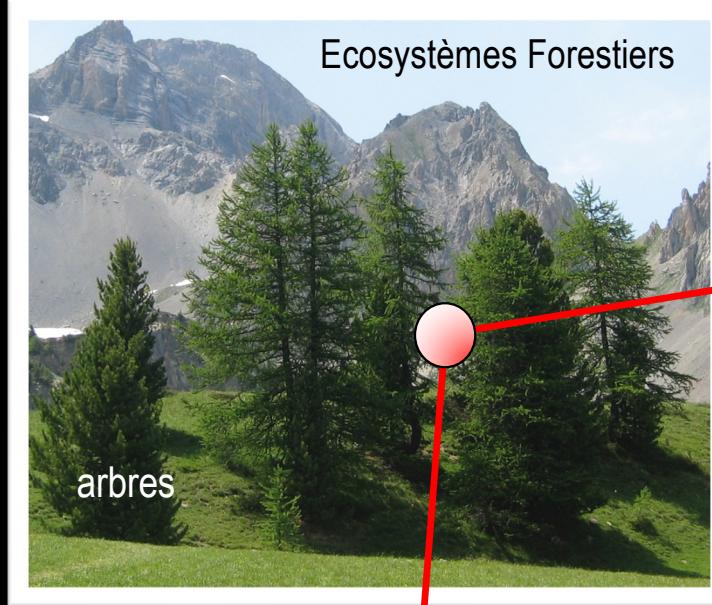
La forêt

**Ressource
Naturalité
Biodiversité**

**Réseaux d'interactions
Conflits & coopération**

**Changement climatique
Maladies émergentes
Futur incertain**

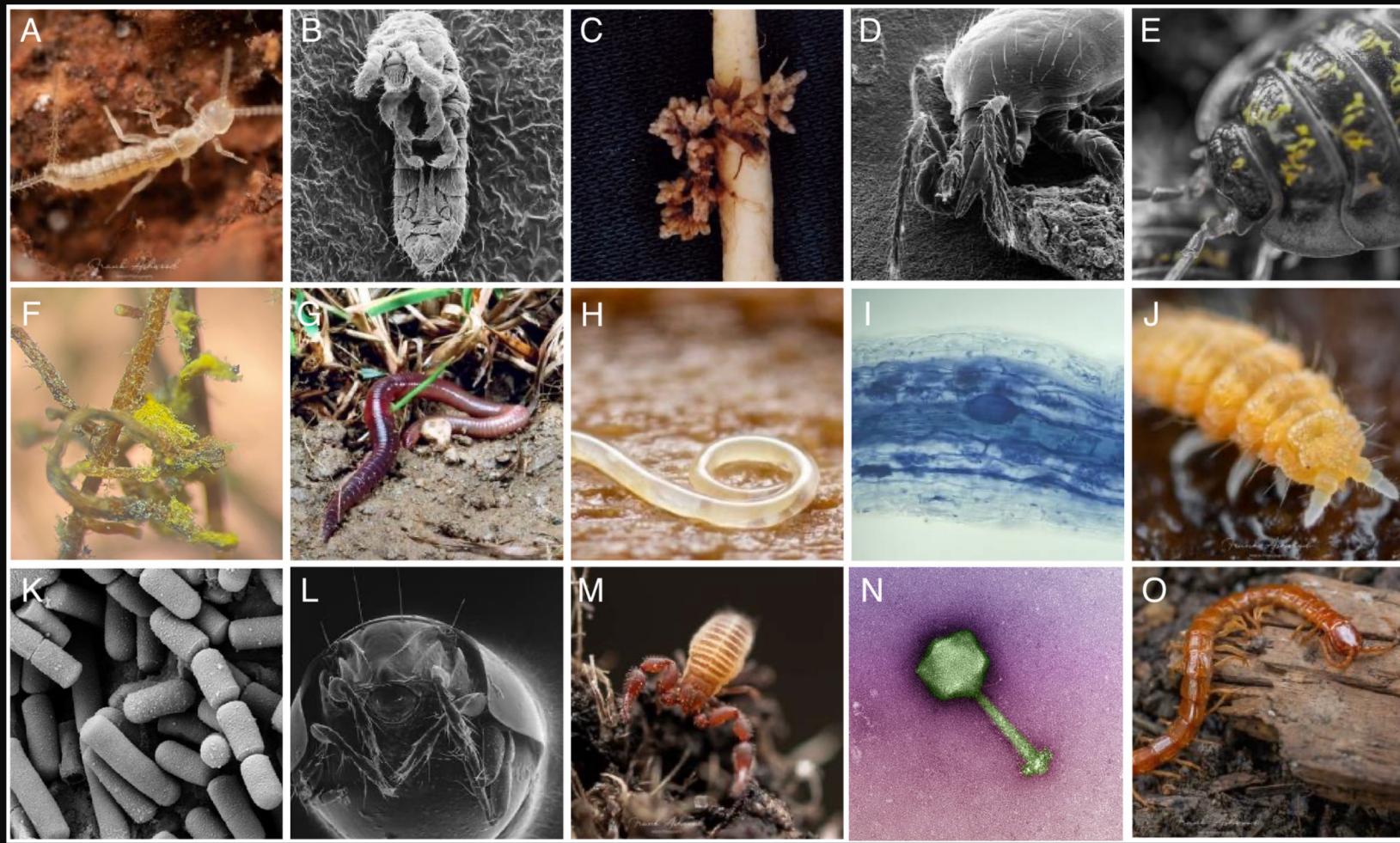
La forêt : un réseau social



Interfaces – Interactions

La recherche en écologie forestière :
décrire, décrypter et interpréter
ces réseaux complexes d'interactions

Le sol ... 59% de la biodiversité



Les réseaux mycéliens ... un rôle clé



Trois guildes majeures de champignons sylvicoles



Caries blanches

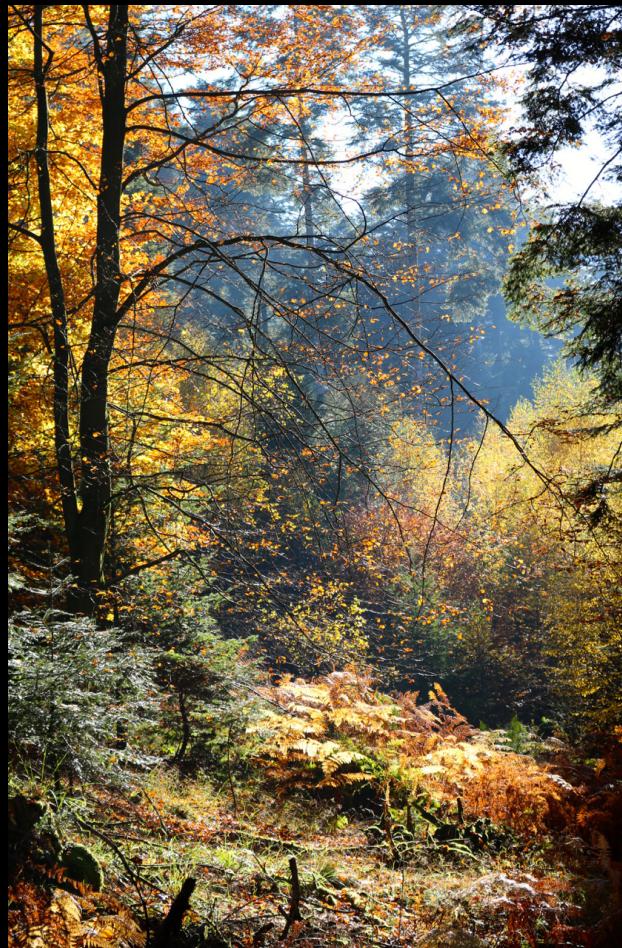
Saprotrophes



Caries brunes



Décomposeurs de litière



Ectomycorrhiziens



◀ C N P

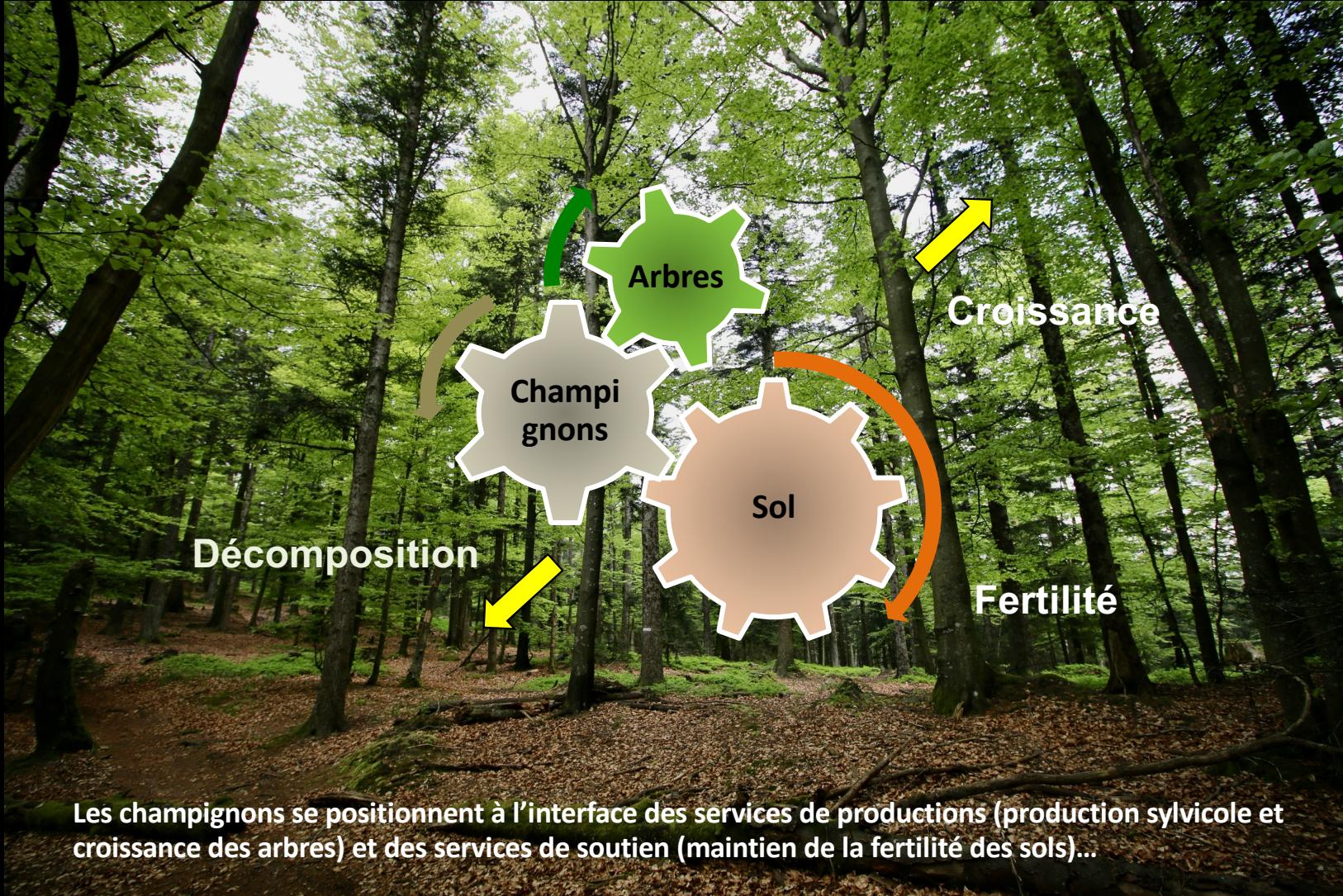
Symbiotrophes

Endomycorrhiziens



Pathogènes

Rôle des communautés fongiques à l'interface SOL - ARBRE





By Ersin Han Ersin (marshmallowlaserfeast.com)

Nos forêts se meurent ...



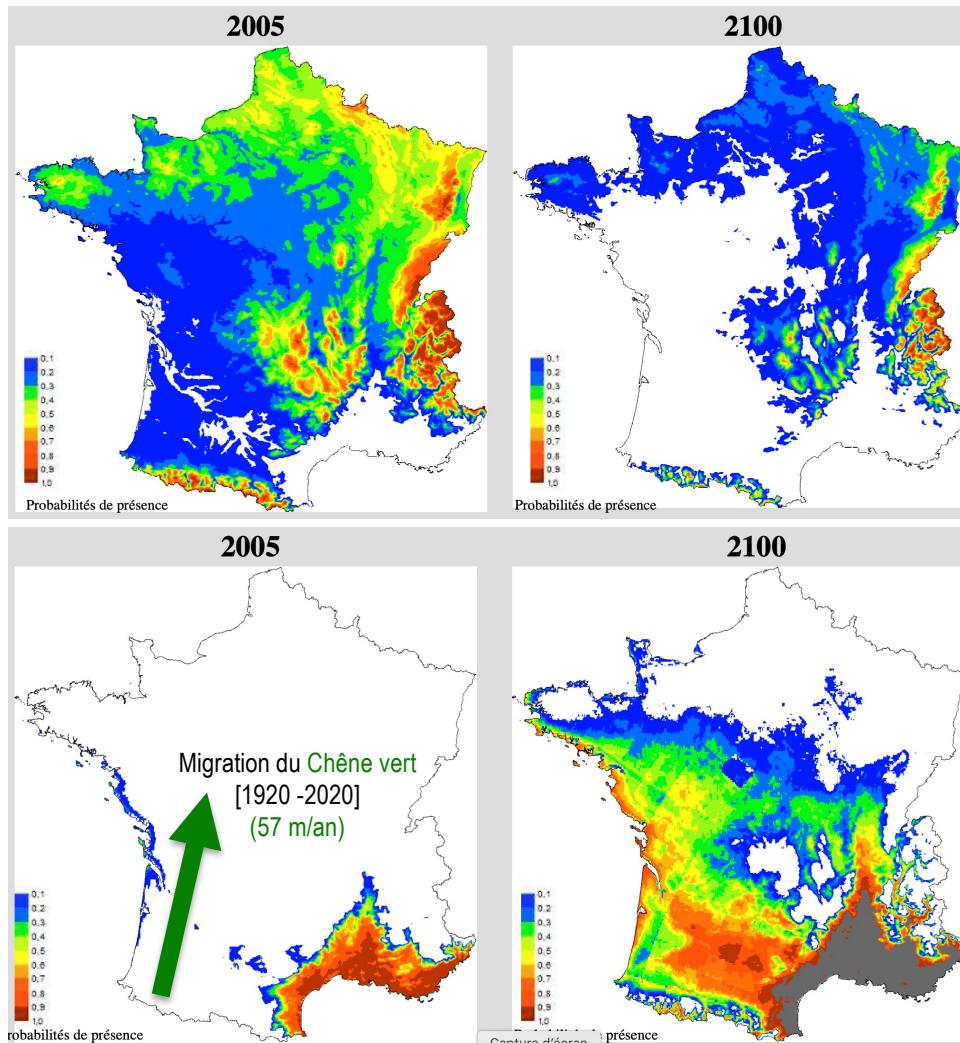
Grossmann, Massif du Donon, Vosges



**Sécheresse édaphique
Vagues de chaleur
Dépôts azotés
Teneur en CO₂**



Répartition géographique probable en climat futur



Le retrait du **Hêtre**, qui couvre 15 % de la surface forestière de production, pourrait concerter les 2/3 de son aire actuelle, avec un repli vers les massifs montagneux et le NE de la France.

Le **Chêne vert** et le **Pin maritime**, surtout présents en Aquitaine et en région méditerranéenne, voient leur extension stimulée par le réchauffement dans la moitié nord de la France, tandis qu'elle se maintiendrait dans le Sud à moyen terme

Badeau, 2010 / RMT AFORCE

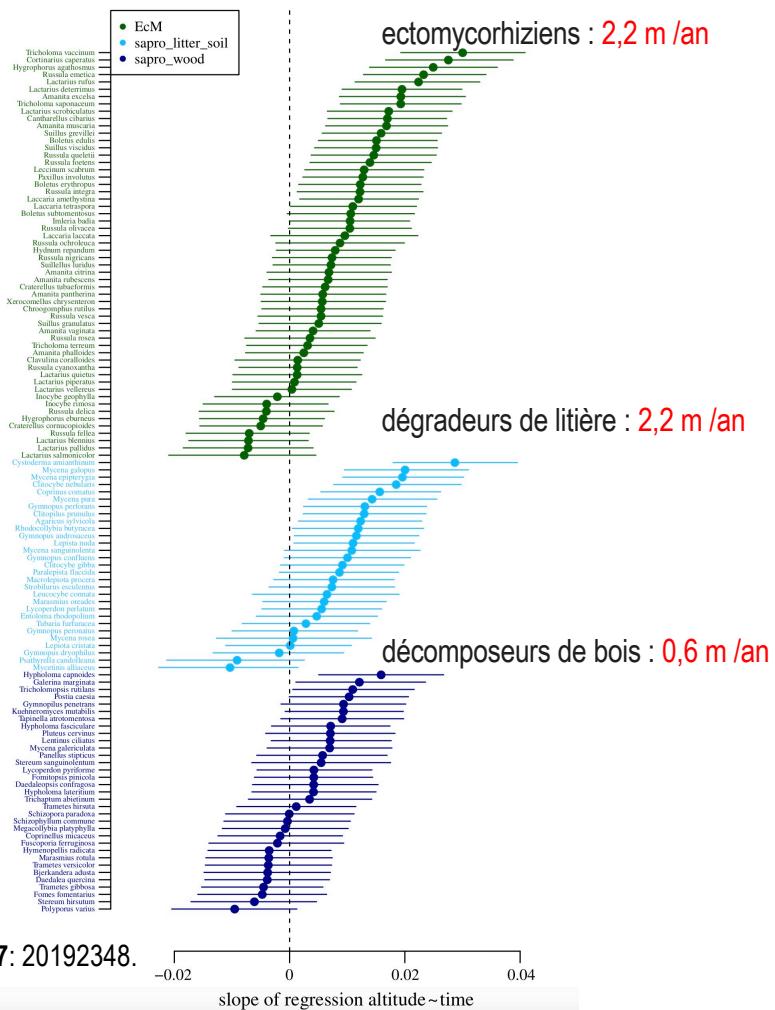
Les champignons migrent avec leurs hôtes

L'augmentation de la T°C moyenne annuelle impacte déjà la distribution spatiale des plantes et de leur cortège microbien :

Le Hêtre a migré en altitude. Ses conditions optimales de croissance étaient en 1905 à 121 mètres en aval.

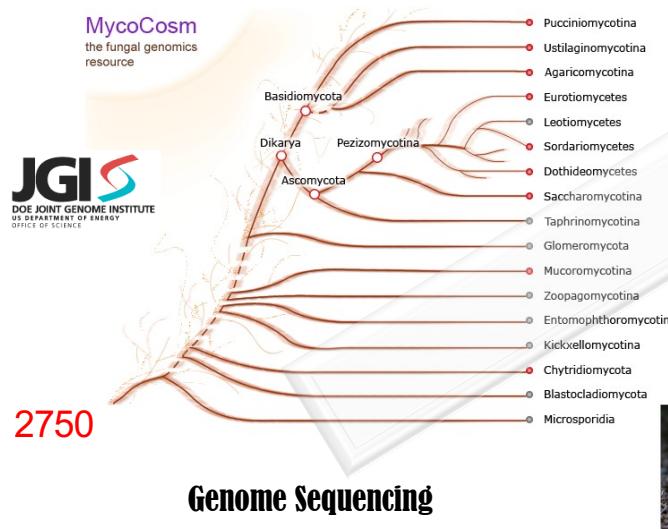
Les plantes alpines migrent. Quand la température augmente de $0,6^{\circ}$, les plantes remontent de 100 m.

Dans les Alpes, les champignons montent également en altitude, de 0,6 à 2,2 mètres/an !



Shift to large-scale, environmental genomics projects ...

Analyses of multiple genomes will provide insights into the diversity of mechanisms for the mycorrhizal symbiosis, including endo- and ectomycorrhiza. In concert with the proposed sequencing of a suite of fungal wood decayers, these genomes will also illuminate the functional basis of transitions between decayer and symbiotic lifestyles.



RNA-Seq

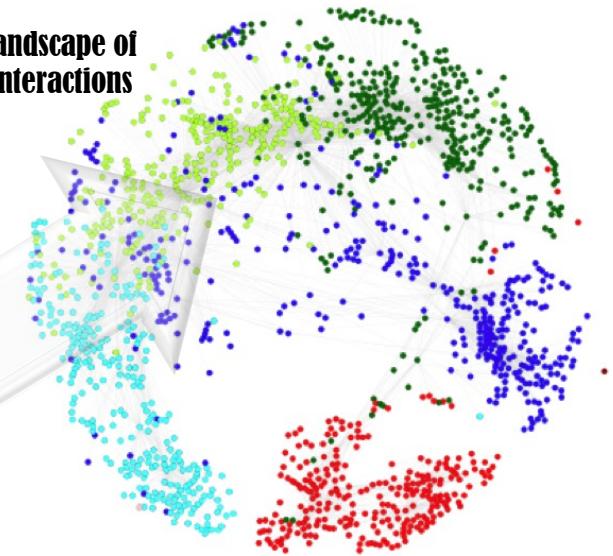


BioInformatics



Building capacity ...

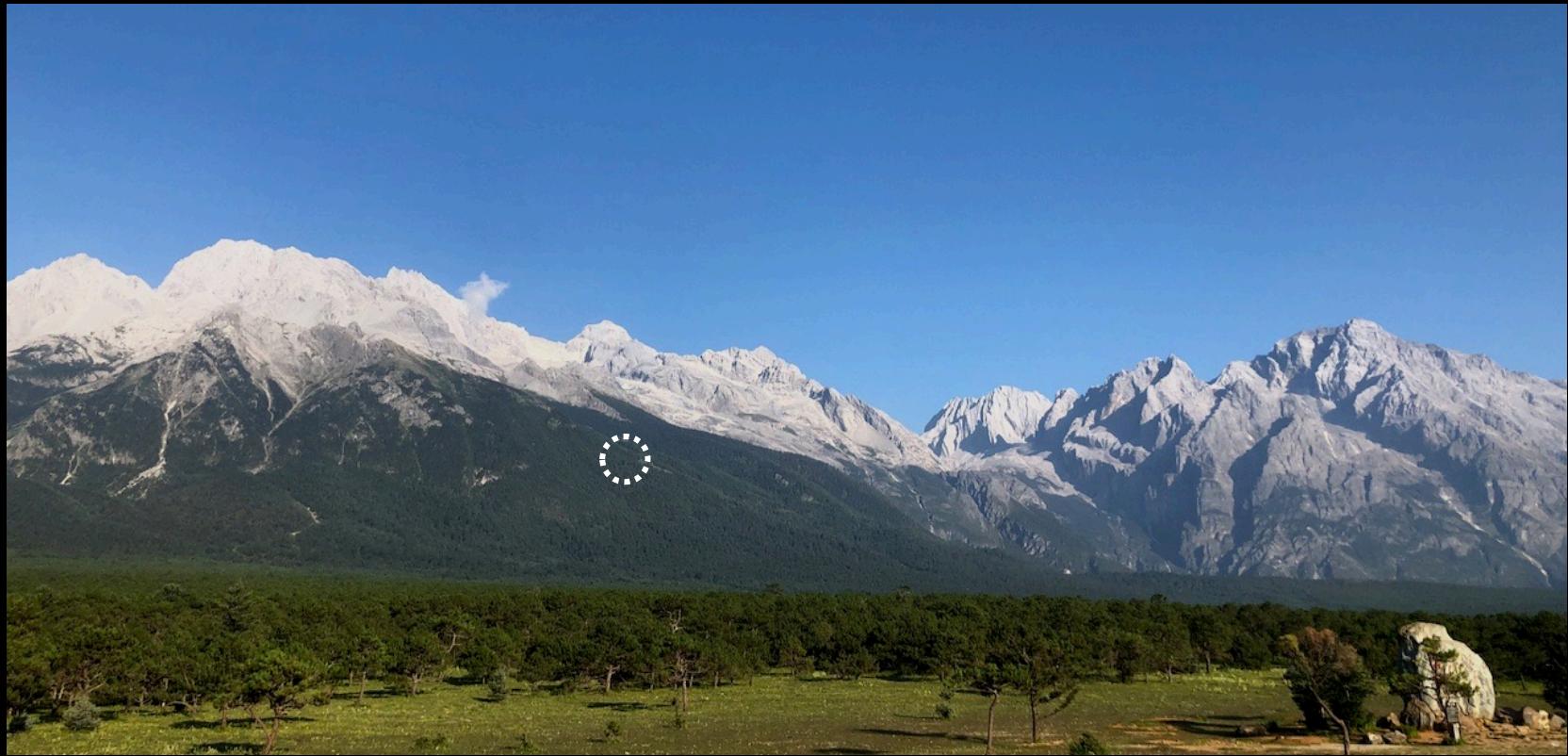
The Genetic Landscape of Fungal-Tree Interactions



U.S. DOE Joint Genome Institute
Community Sequencing Program

Mycorrhizal Genomics Initiative
10,000 Fungal Genomes

Saprotrophic Agaricomycotina Genomics
Soil Forest Metatranscriptomes
Defining the *Populus* Microbiome



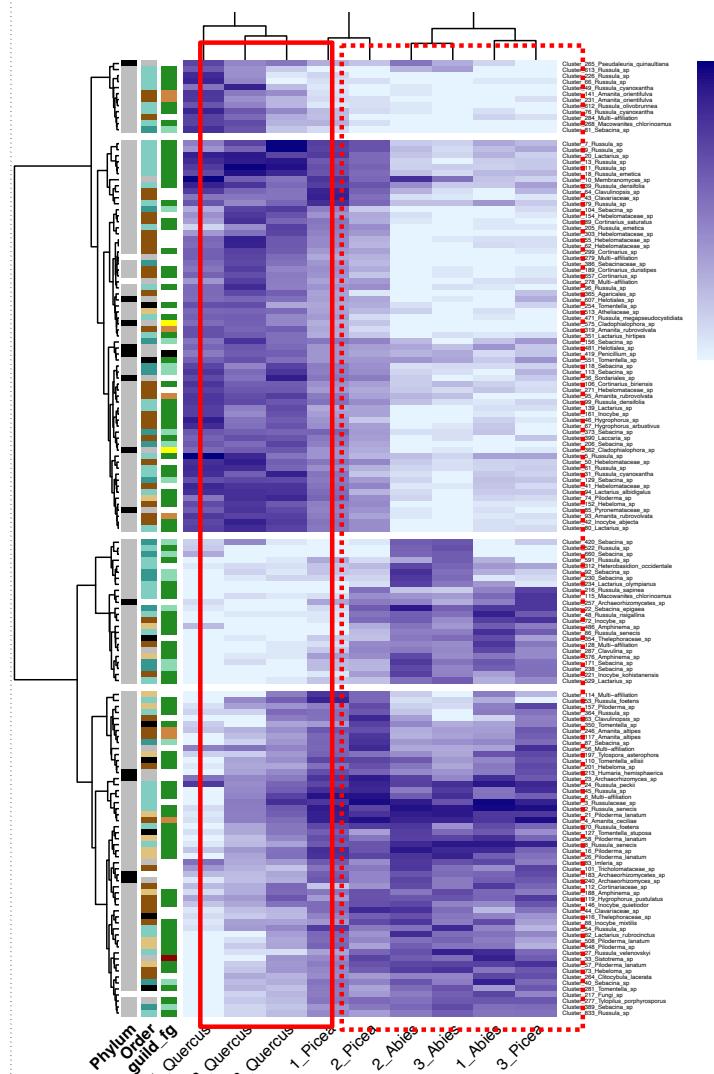
Yulong Xue Shan, Jade Dragon Snow Mountain, Yunnan Province, China

INRAE – Beijing Forestry University – Kunming Institute of Botany
(Profs Y-C Dai, Z-L Yang & G Wu)



Oak Spruc Fir

Fungal OTU distribution in soils of old-growth oak, fir or spruce forests



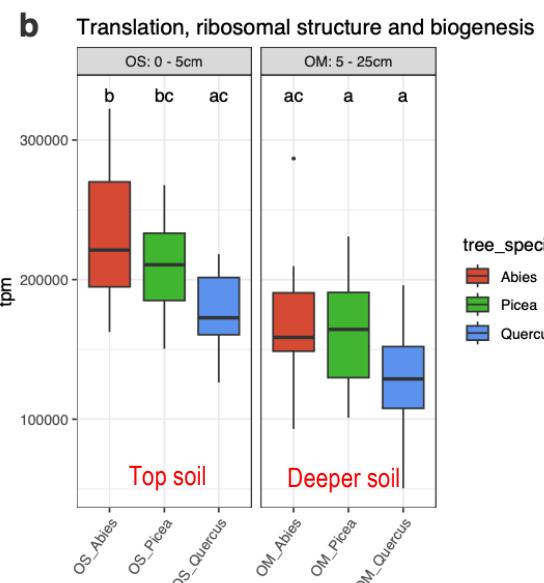
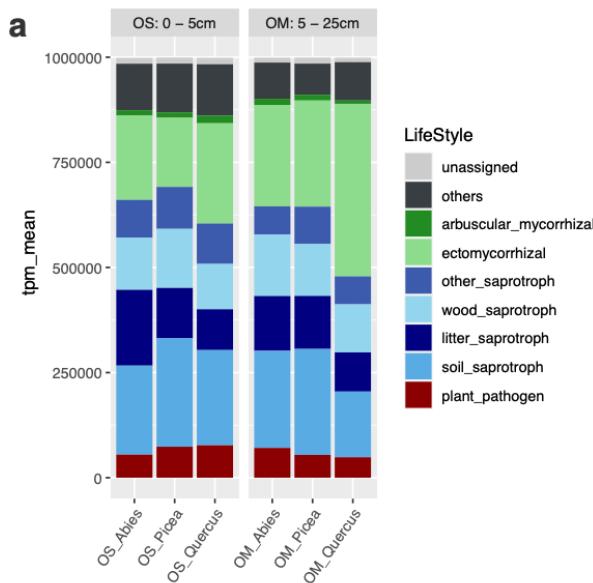
rDNA ITS metabarcoding



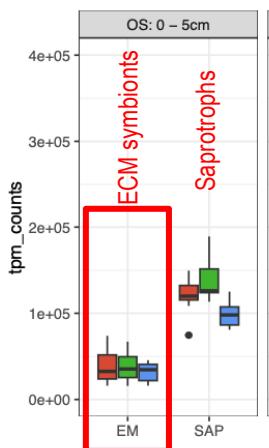
The taxonomic composition within individual functional groups (saprotrophs, symbiotrophs) was highly variable in the oak- or conifer-dominated forests, in terms of the occurrence of OTUs as well as the proportions of OTUs within each functional group. The core fungal microbiome comprised only ~20 % of the total OTUs across all soil samples.

Zeng, Lebreton et al. (2023) *Microbiome* 11: 217

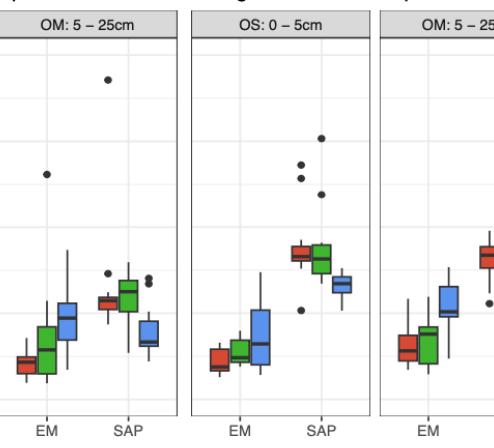
Distribution of transcripts among lifestyles



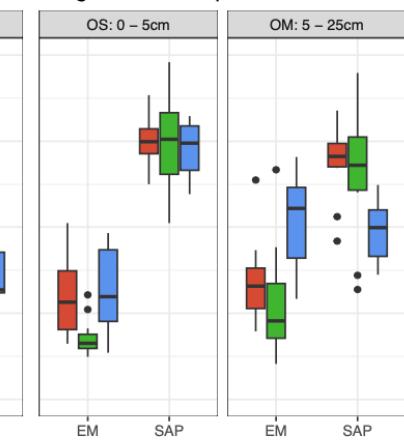
Carbon-related transporters



Nitrogen-related transporters



Inorganic ion transporters

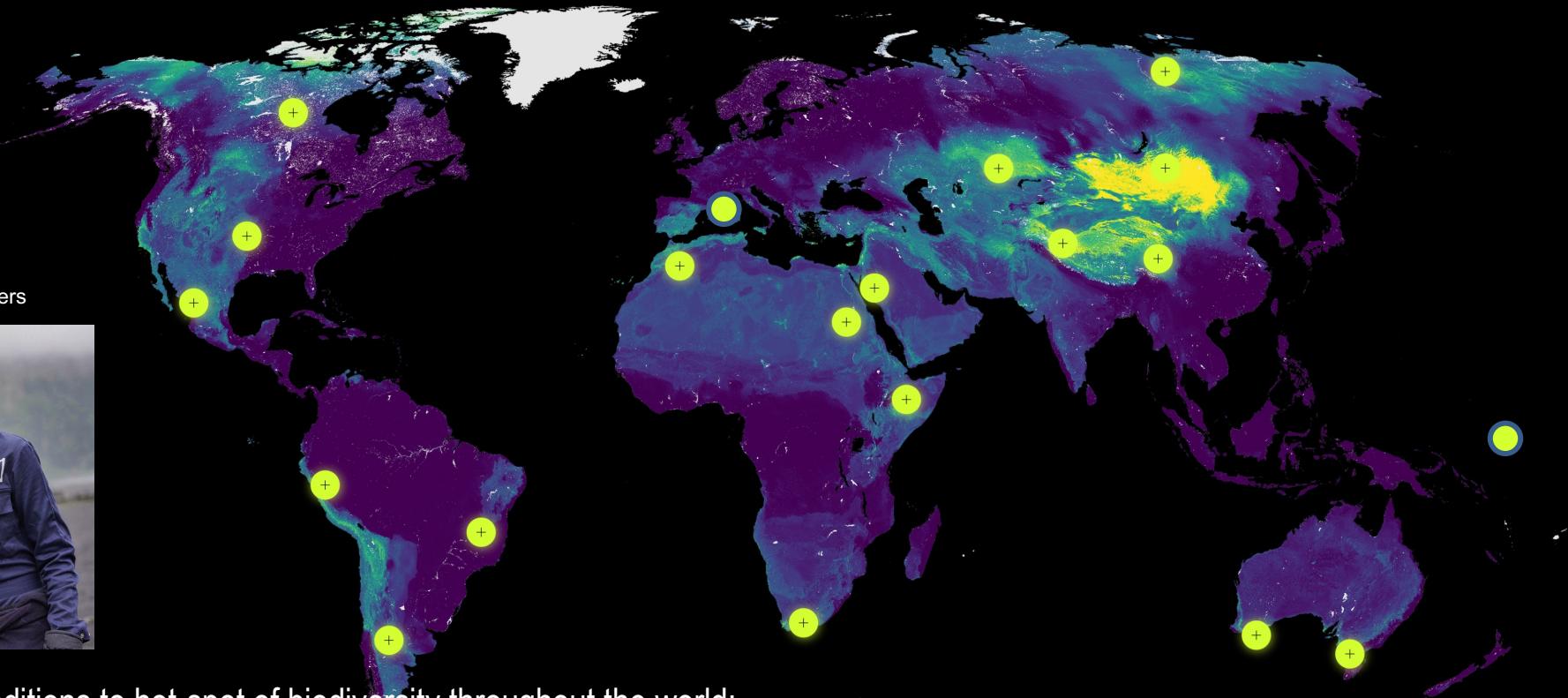


Expression of growth-related transcripts

Expression of transport-related transcripts

SPUN: Society for the Protection of the Underground Networks

Prof. Toby Kiers



Expeditions to hot-spot of biodiversity throughout the world:

- To explore microbiomes in terrestrial ecosystems and their sensitivity to climate change
- To popularize science & team with local communities
- To educate
- To influence policy