

Unearthing the soil microbiome towards sustainable use of soil resources

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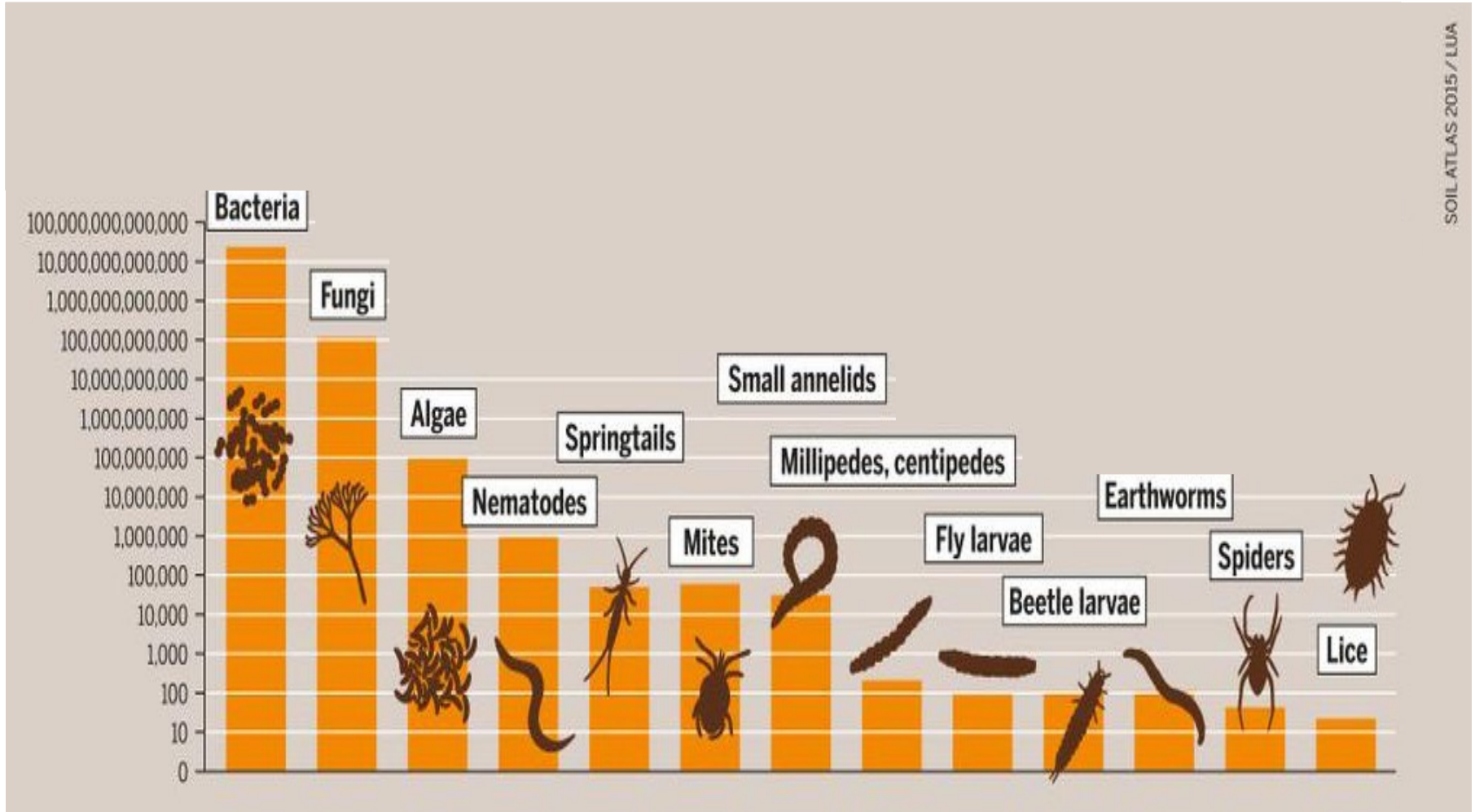
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Outline

- I. Soil microbes and methods to study their diversity
- II. Patterns and determinants of soil microbial diversity
- III. Plant-soil interactions
- IV. Path forward

Soil is home to a rich microbial life that is poorly known



Soil is home to a diverse microbial life that is poorly known

– 1000s species of microbes
in one gram of soil

> 90% of microbial
species remain
uncultured.

Prokaryotes

Eukaryotes



Bacteria



Fungi



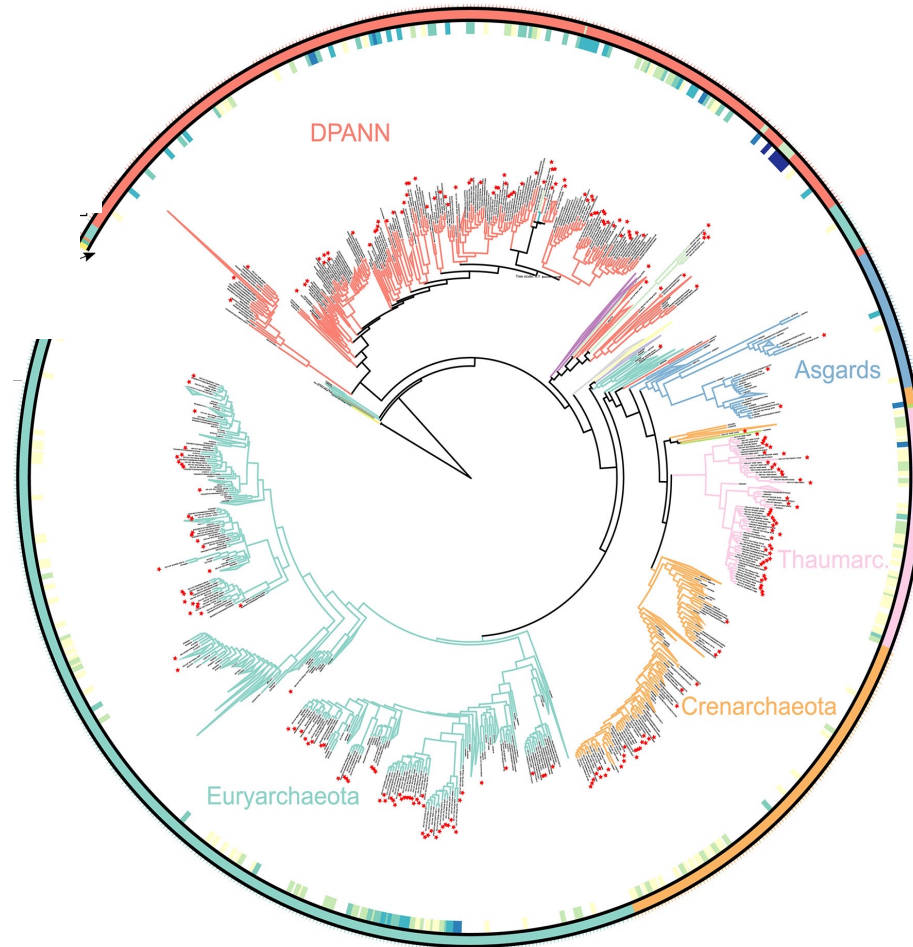
Archaea



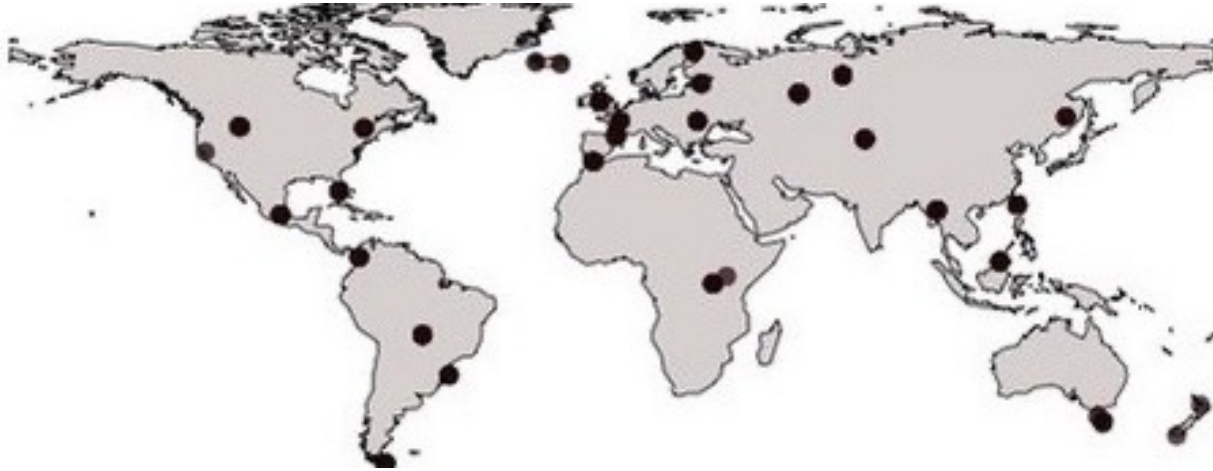
Protists

Photos by [CDC](#) on [Unsplash](#)

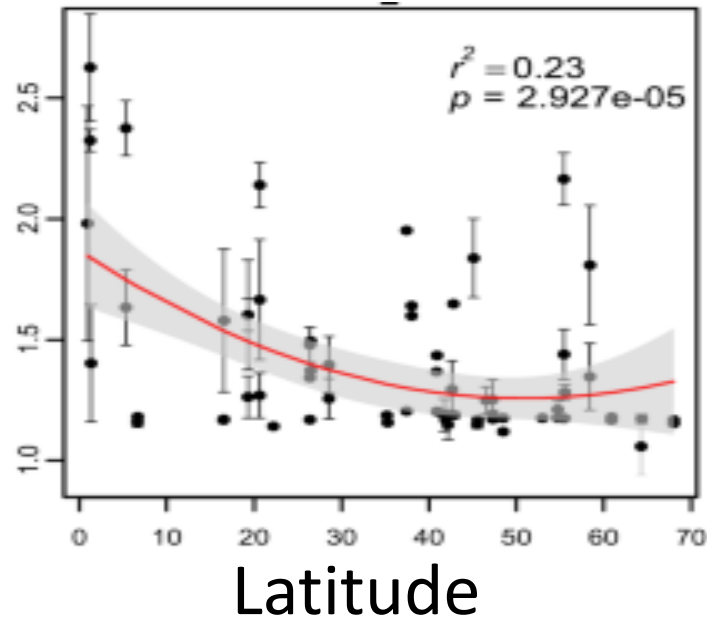
Identification of new species and clades that may play key functions



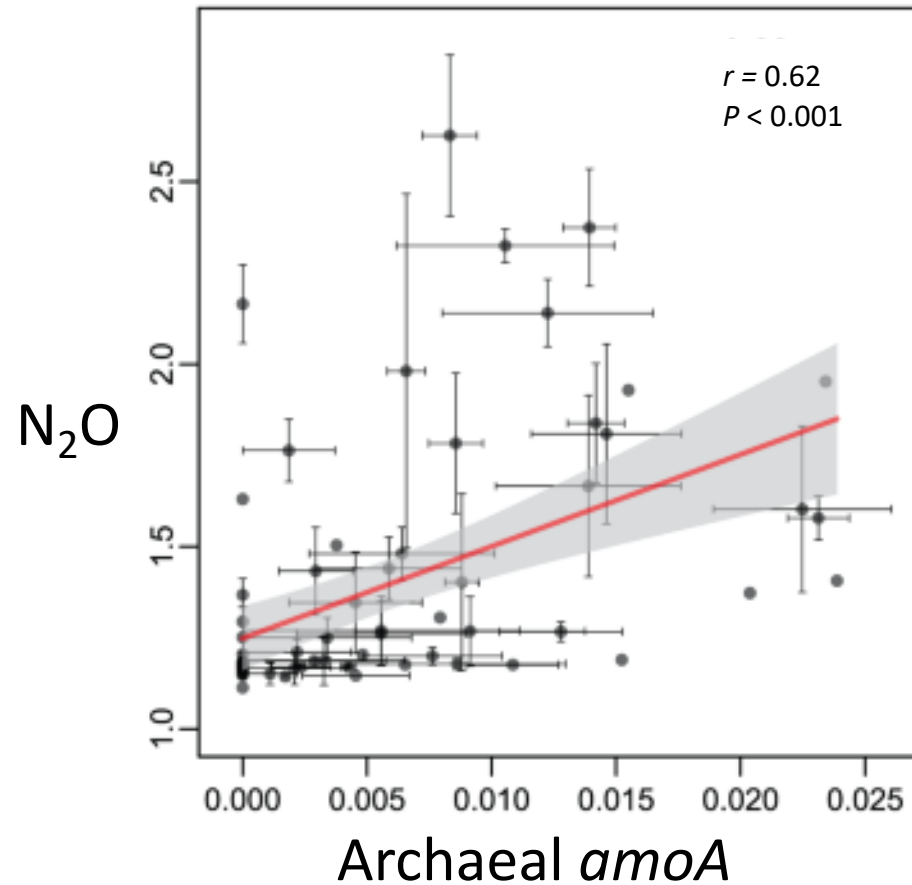
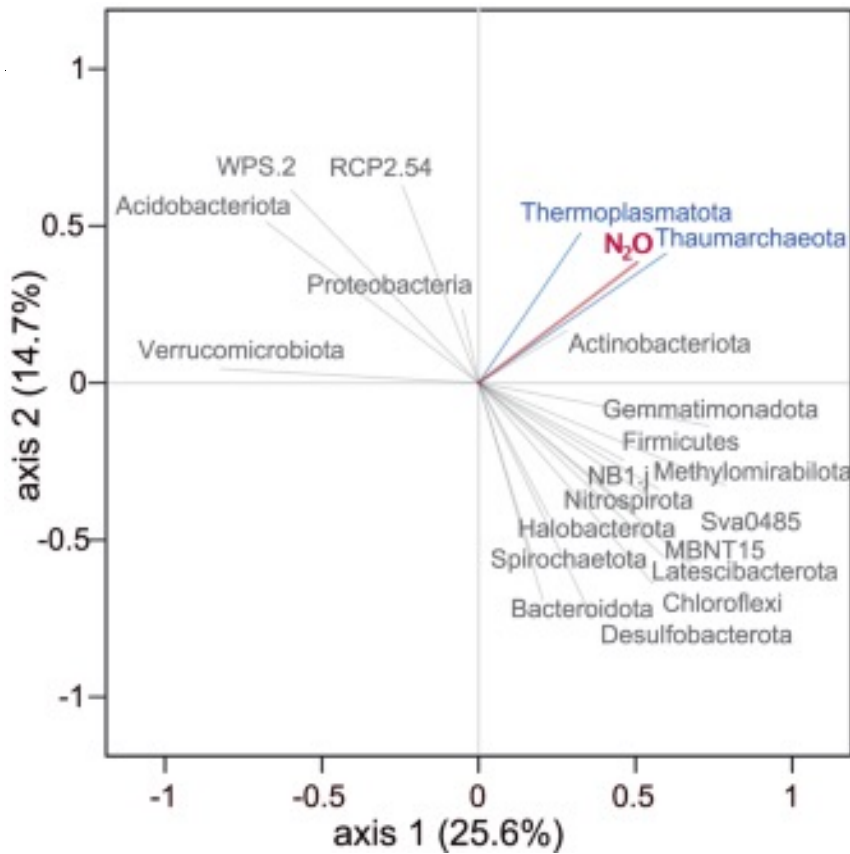
Key microbes involved in ecosystem processes



Nitrous oxide
(N₂O)



Rare but key microbes for ecosystem functions

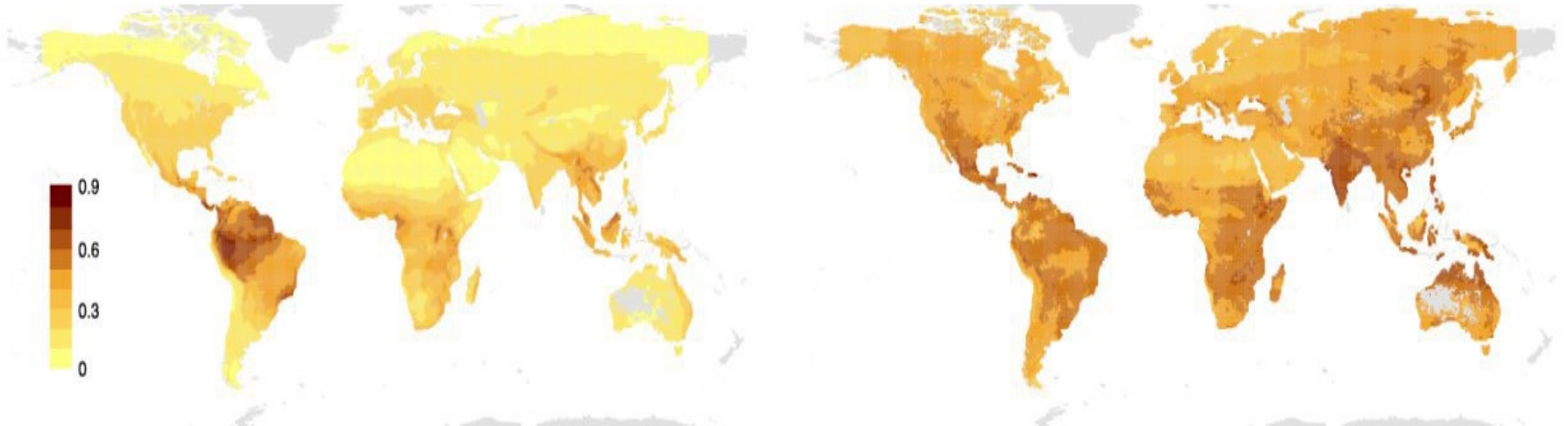


Patterns and determinants of soil and plant-associated microbial diversity

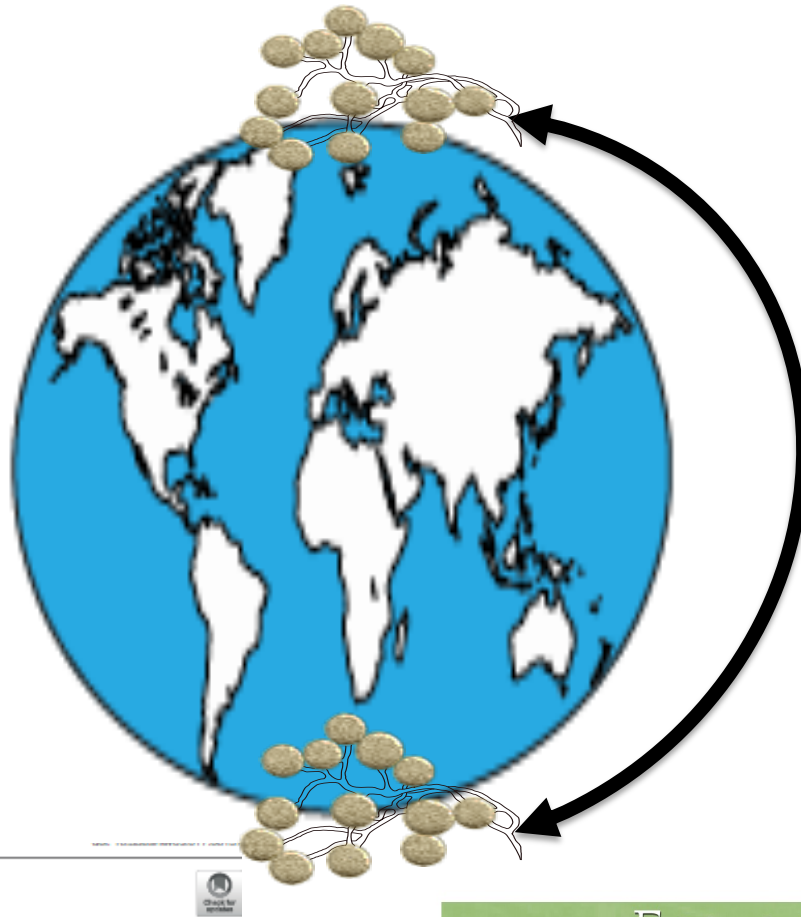
Global aboveground vs soil biodiversity patterns

Mammals, birds, amphibians, plants

Soil bacteria, fungi, fauna



Pole-to-pole connections of soil microbes



**Pole-to-Pole Connections:
Similarities between Arctic and
Antarctic Microbiomes and Their
Vulnerability to Environmental
Change**

ECOLOGY LETTERS

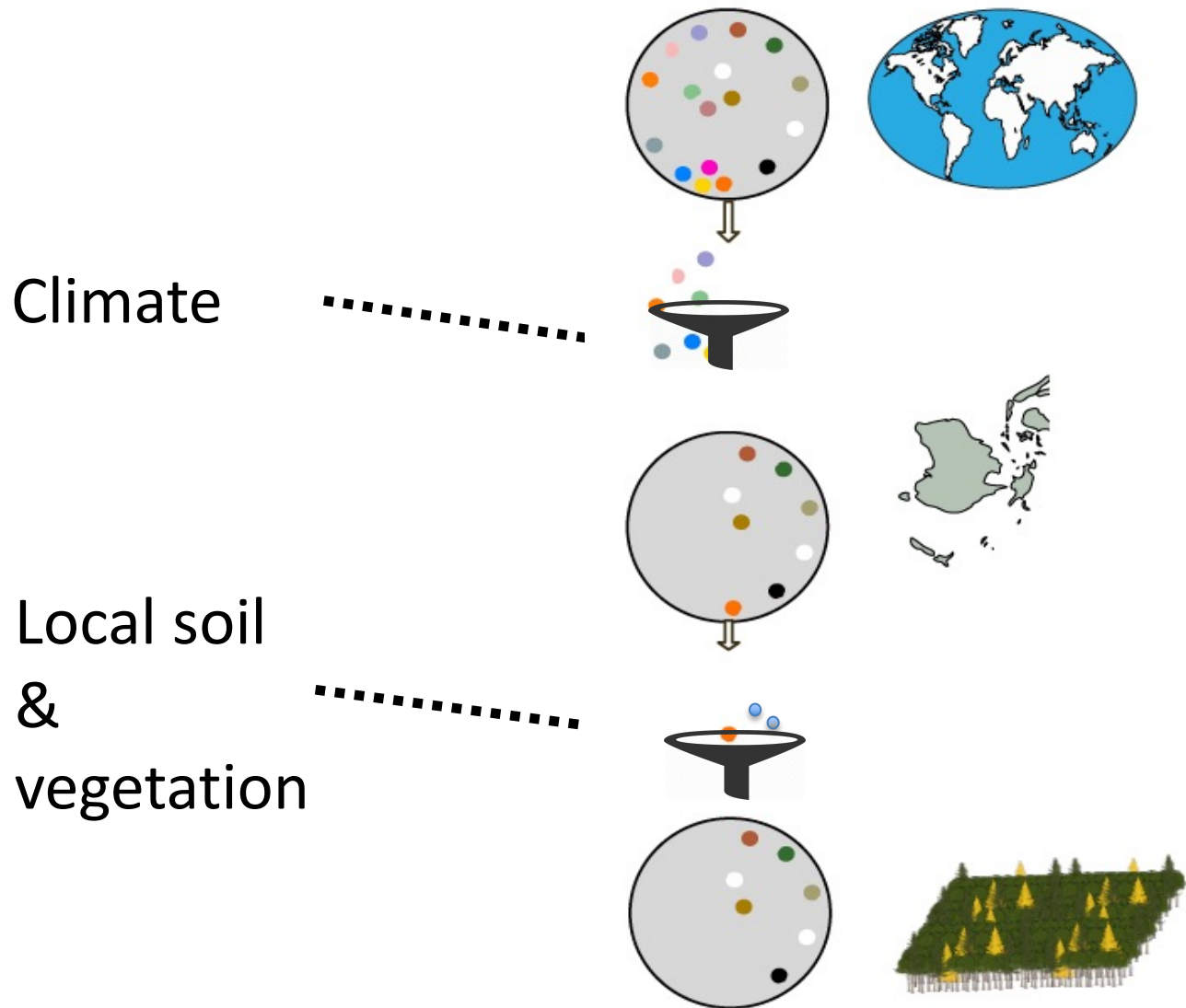
Ecology Letters, (2016) 19: 528–536

doi: 10.1111/ele.12587

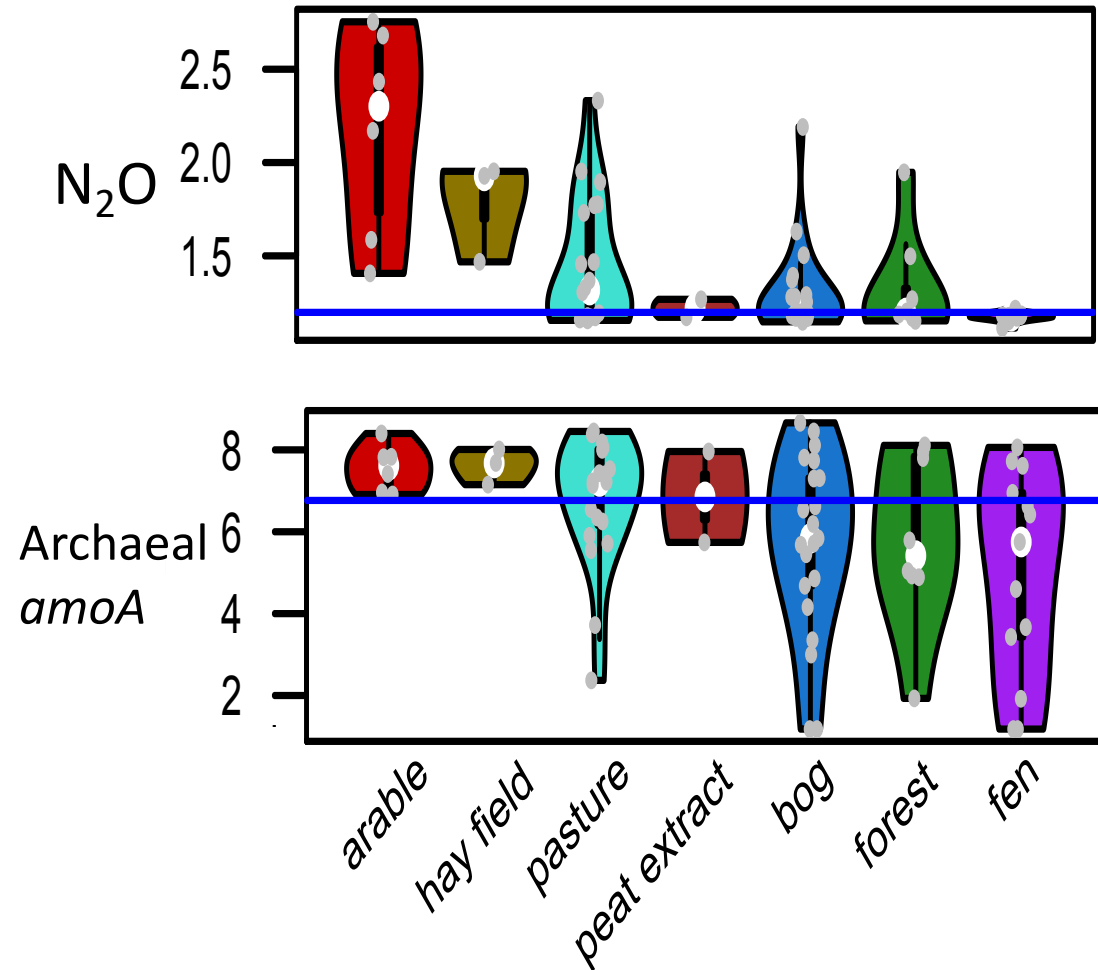
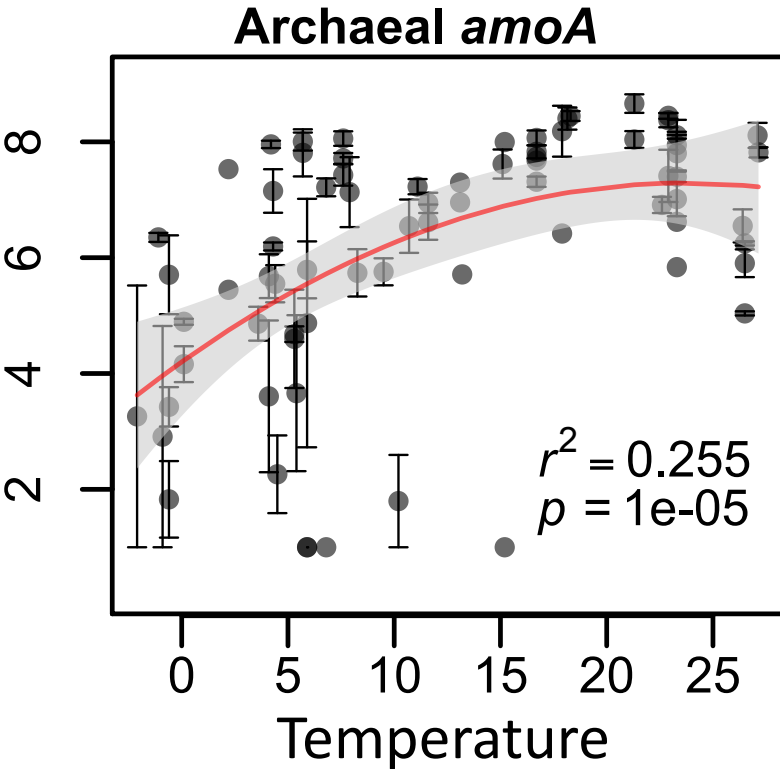
LETTER

Not poles apart: Antarctic soil fungal communities show similarities to those of the distant Arctic

Environmental filtering as a key mechanism shaping the diversity and distribution of soil microbes

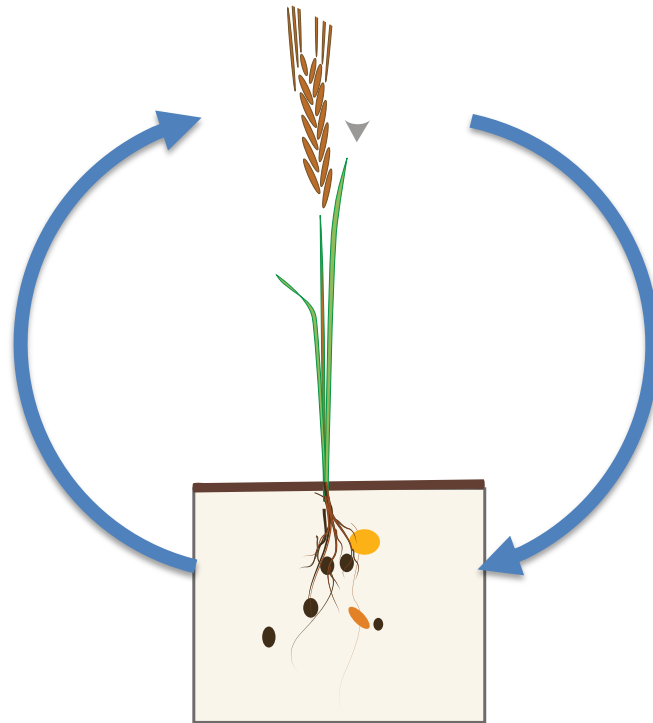


Climate warming and land-use intensification may increase N₂O emission

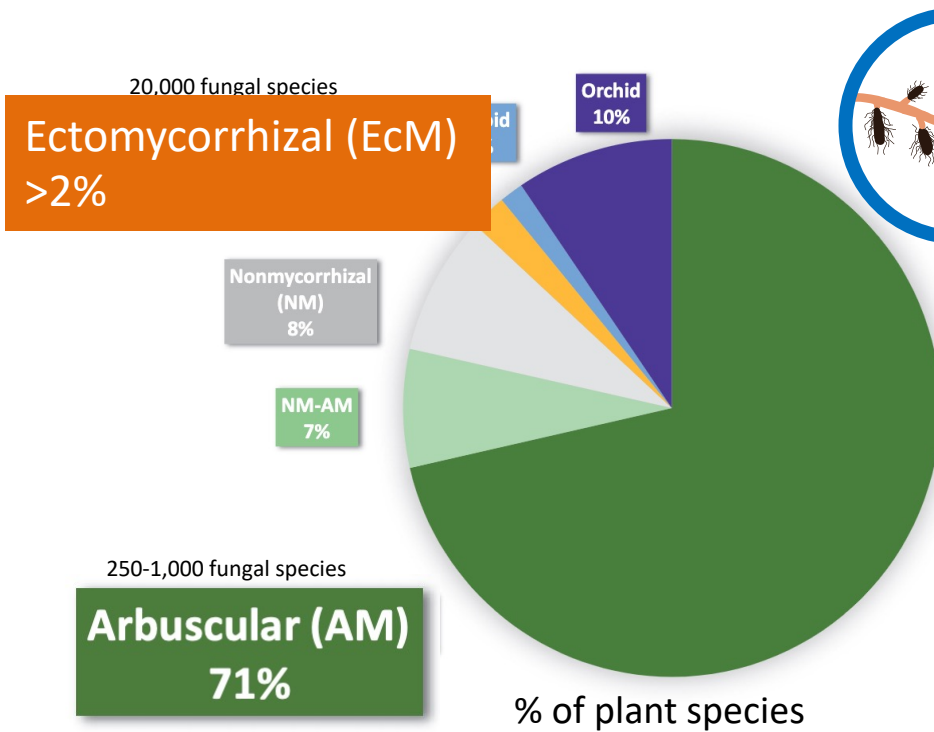


Lessons from studies on plant-soil interactions

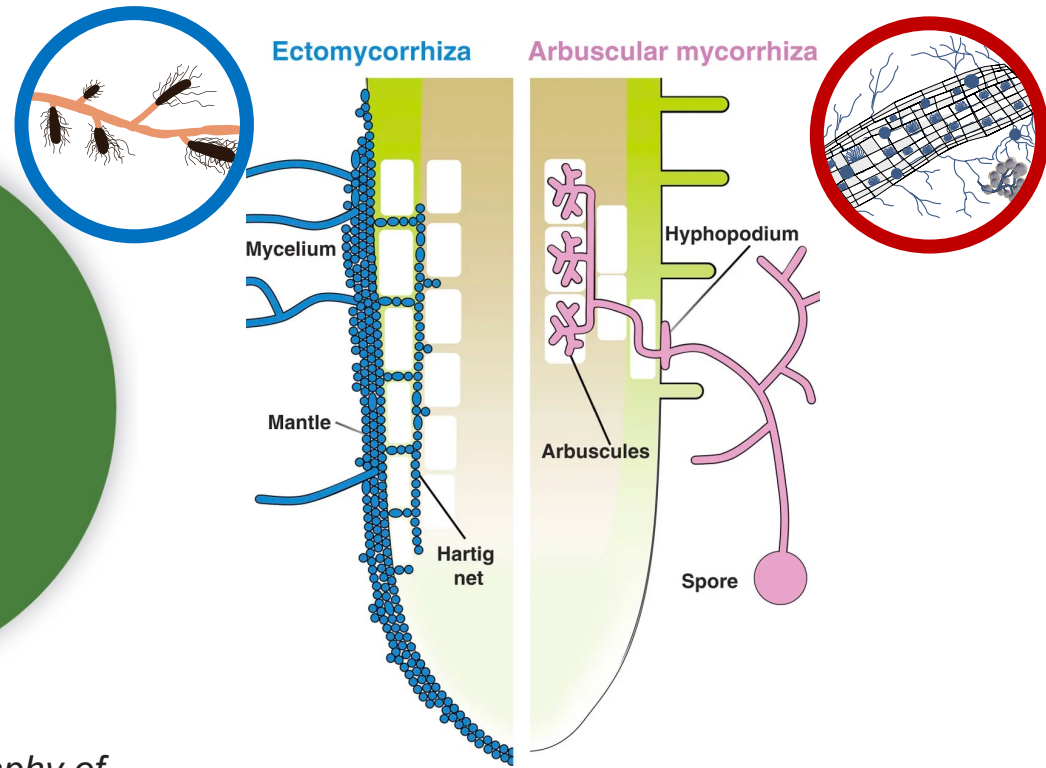
- Changes in carbon and nutrient conditions
- Direct interaction with microbes



Mycorrhizal types

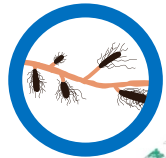


Brundrett, 2017. In *Biogeography of mycorrhizal symbiosis*.

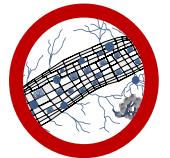
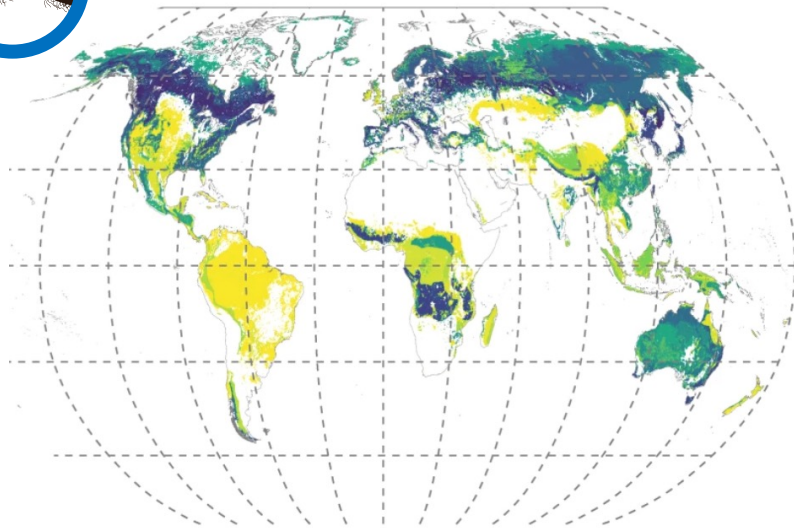


Bonfante & Genre, 2010. *Nat. Commun.*

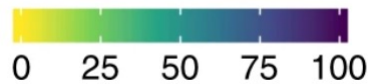
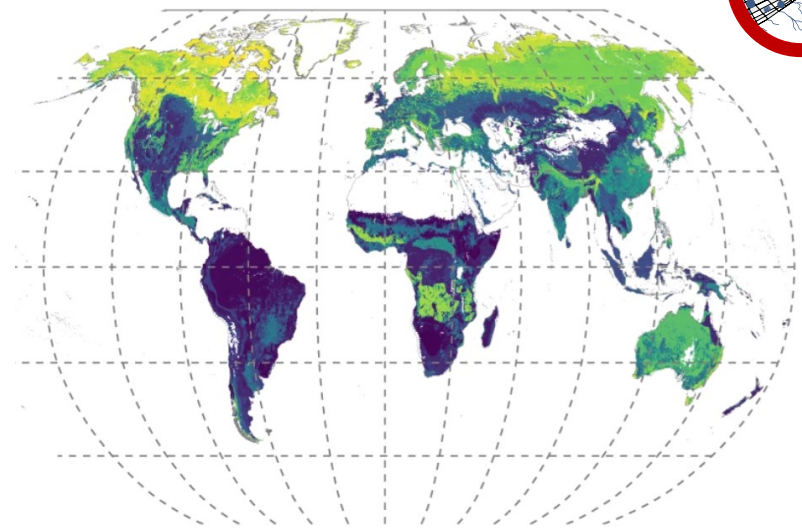
Global distribution of EcM vs AM associations



EcM



AM



% of global aboveground vegetation biomass

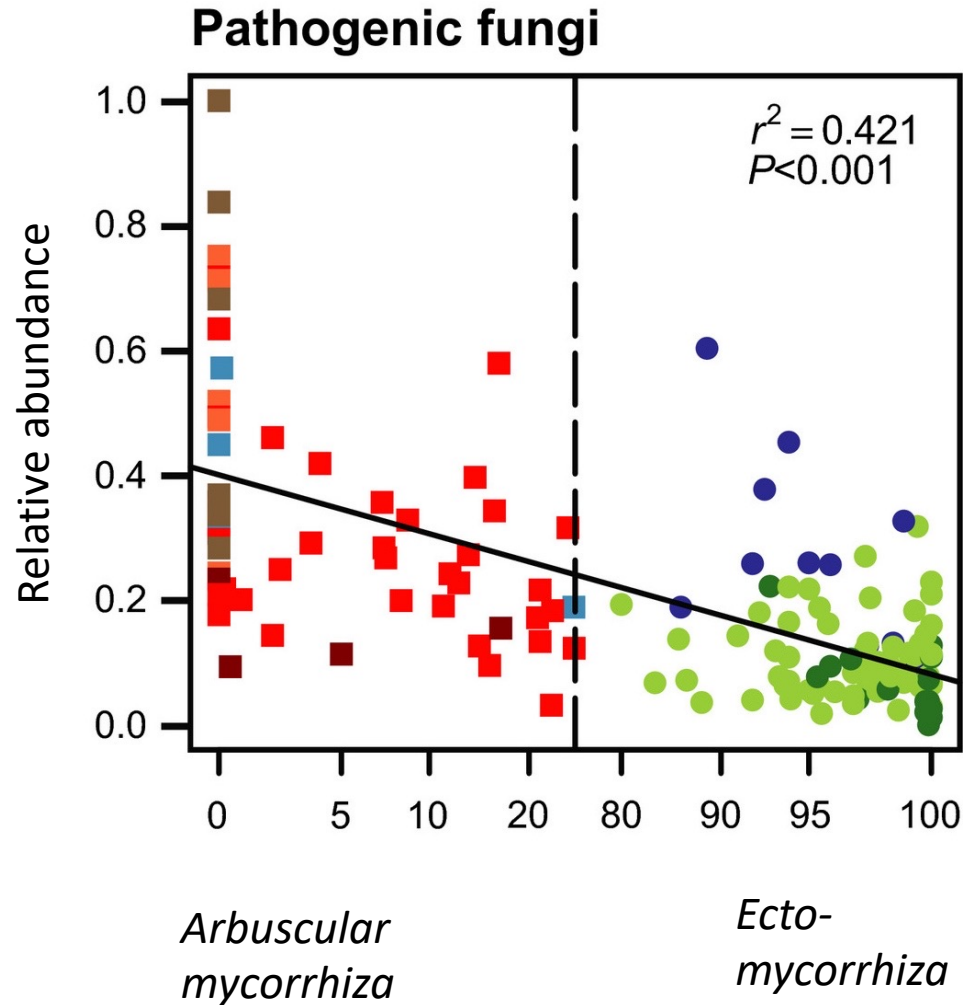
Plant-soil feedbacks in AM vs EcM systems

EcM

AM

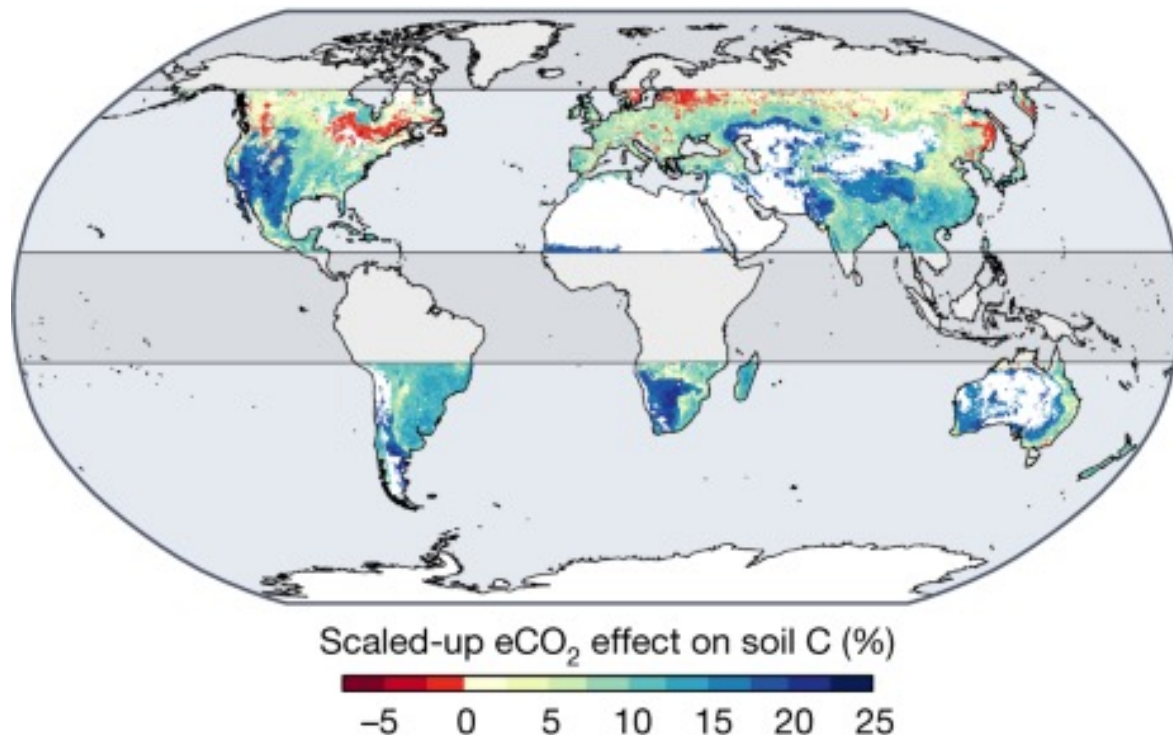


Plant-soil feedbacks in AM vs EcM systems



Role of mycorrhizae in driving carbon storage under climate change

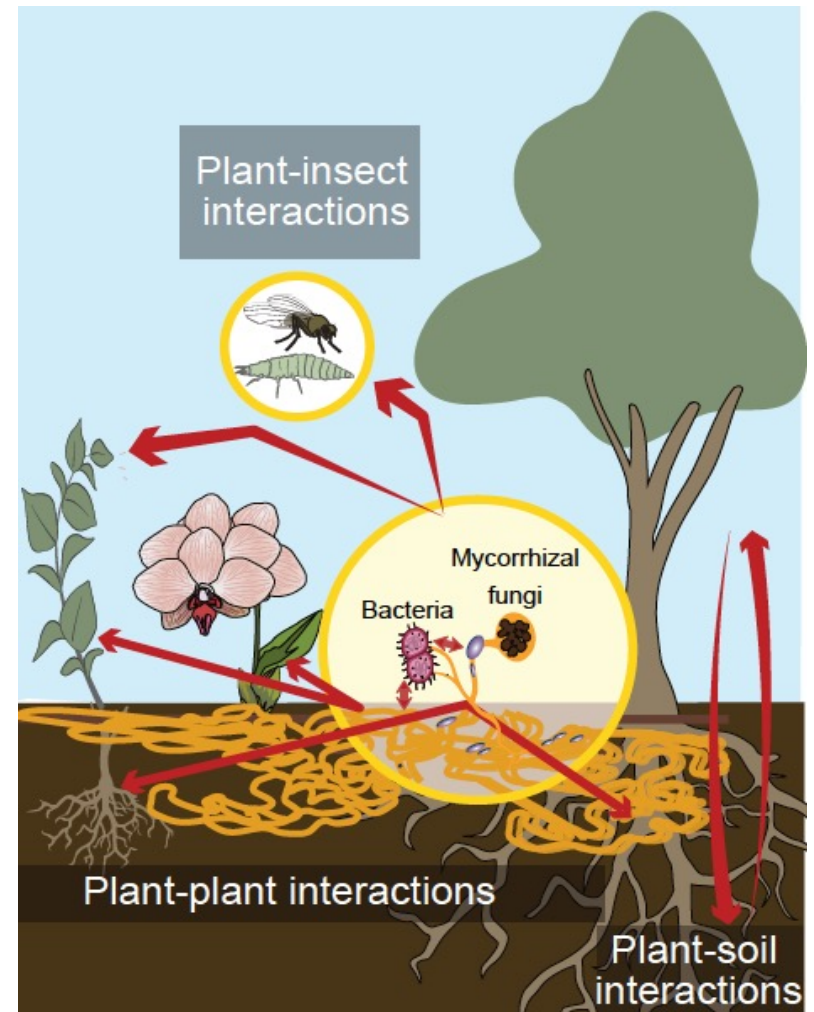
- **Plant biomass increases at the expense of soil carbon storage**



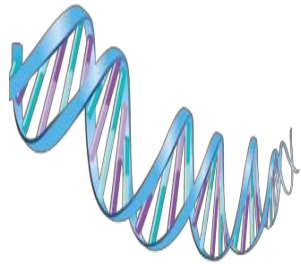
Path forward

A better understanding of the evolution and ecology of soil and root microbes in a changing environment towards improved:

- Plant health and production
- Soil carbon storage

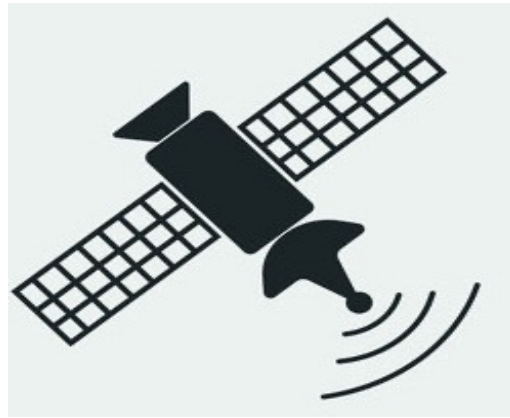


A holistic view of ecosystems - towards resilient ecosystems



eDNA

+



remote sensing

+



audio

One-size does not fit all

