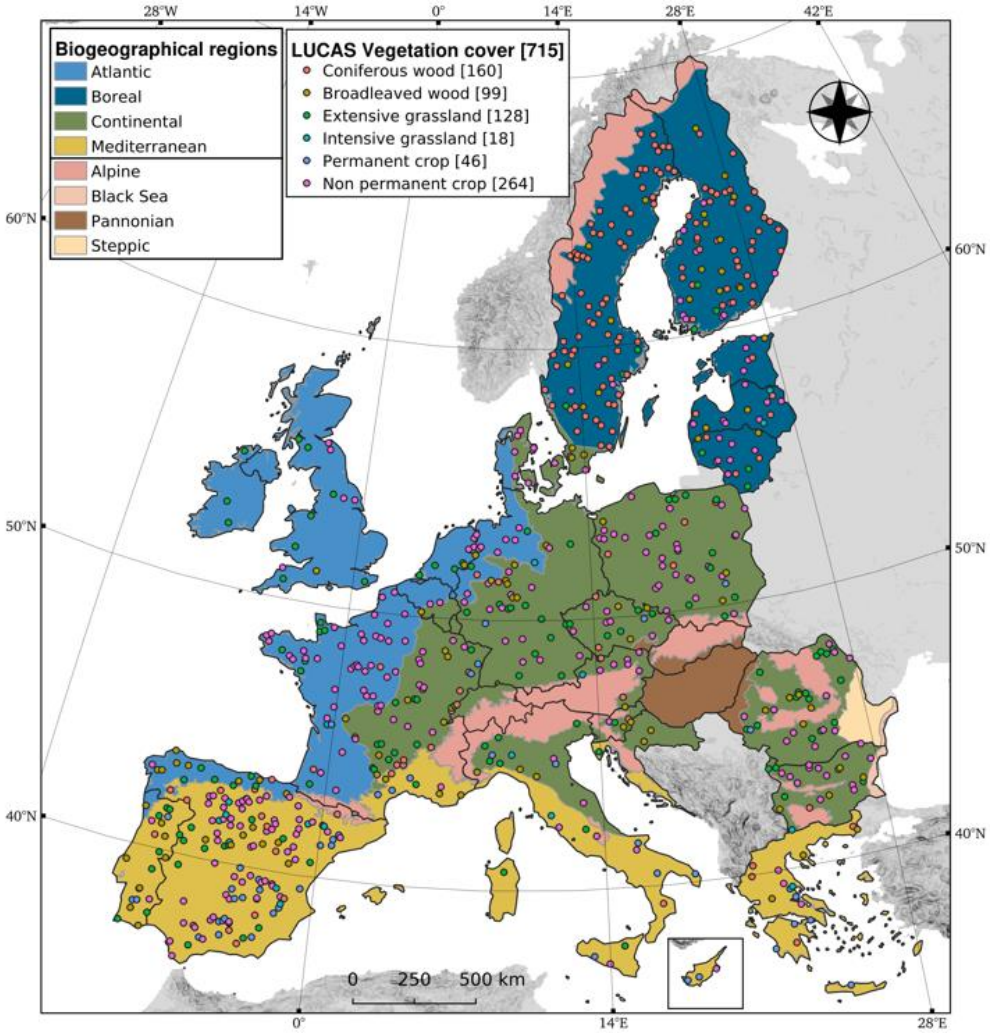
LAND INTENSIFICATION AND INTERACTIONS AMONG VEGETATION COVER, CLIMATE AND SOIL PROPERTIES DRIVE DIVERSITY AND FUNCTIONS OF SOIL MICROBIAL COMMUNITIES AT EUROPEAN SCALE

Maëva Labouyrie, Cristiano Ballabio, Ferran Romero, Panos Panagos, Arwyn Jones, Leho Tedersoo, Emanuele Lugato, Marcel G.A. van der Heijden, Alberto Orgiazzi

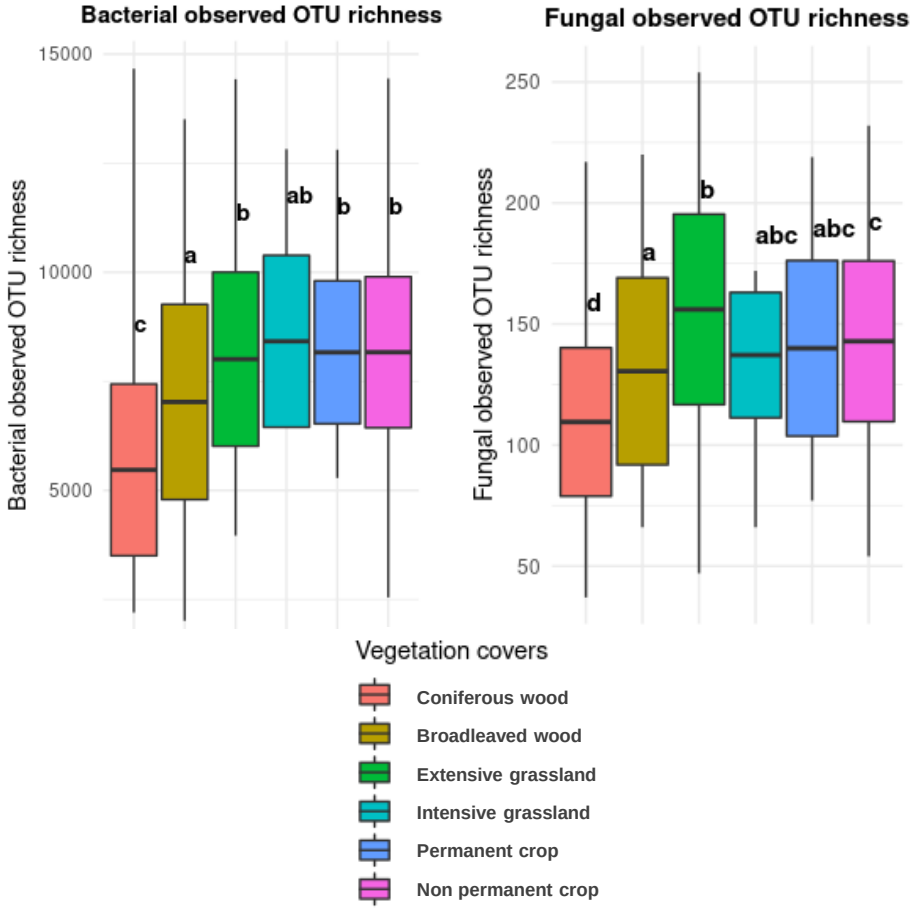


LUCAS Soil Survey

- 715 sampling points
- 3 land covers
  (cropland, grassland, woodland)
- 4 biogeographical regions

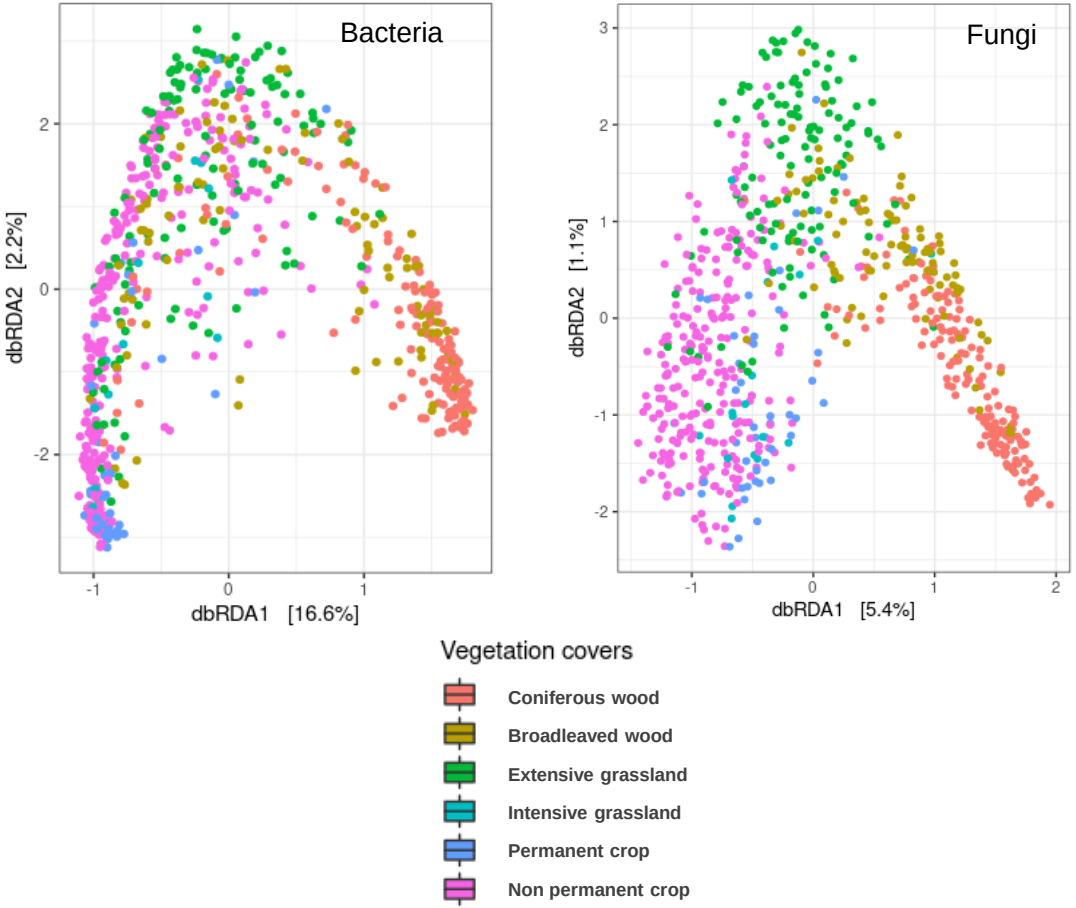
- Soil physico-chemical properties
  (e.g., bulk density, pH, P, SOC)
- Climatic variables
  (e.g., temperature, aridity, precipitation)
- Microbial community
  (16S, ITS)

Bacterial and fungal richness across vegetation covers



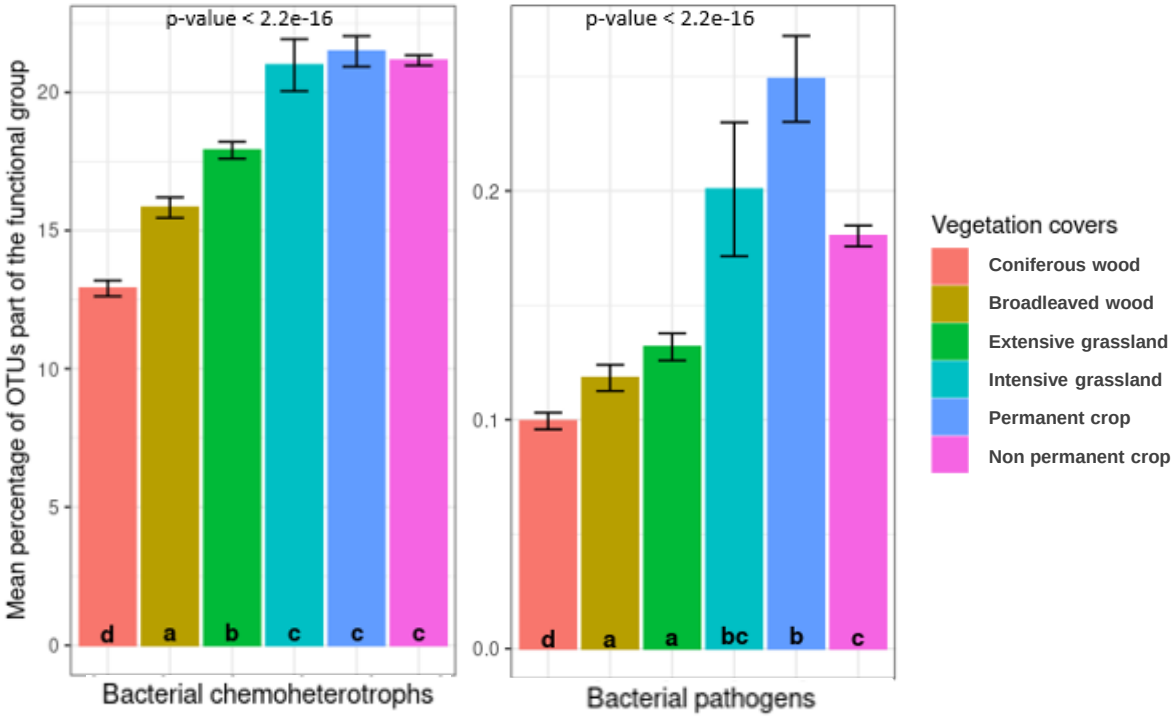
- Land use intensification associated to vegetation cover had a significant impact on bacterial and fungal α-diversity.
- Bacterial observed richness and diversity (Shannon index) were the lowest in woodland and significantly higher in cropland and grassland.
- Higher fungal richness and diversity predominated in grassland and cropland.

Bacterial and fungal beta-diversity across vegetation covers



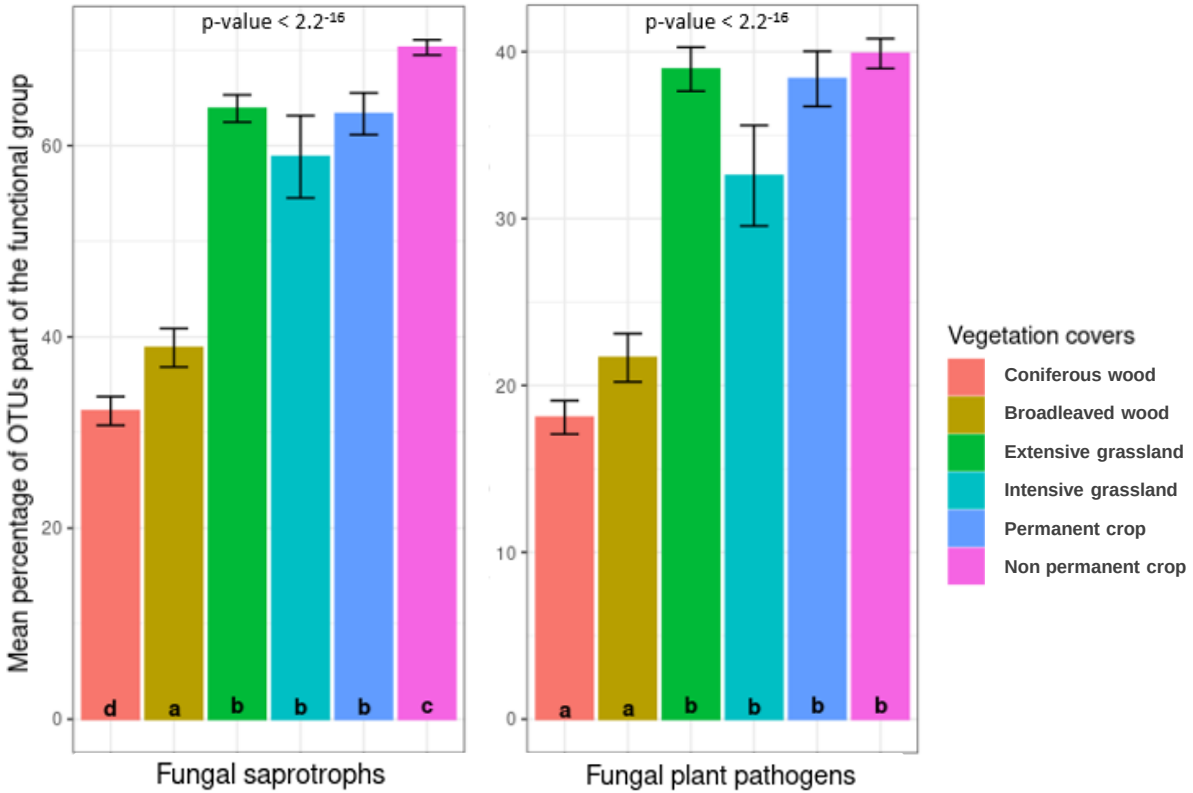
- Land use intensification associated to vegetation cover had a significant impact on bacterial and fungal community structure (β-diversity).
- Bacterial and fungal communities in cropland and woodland were the most distinct.

Distribution of BACTERIAL functional groups across vegetation covers



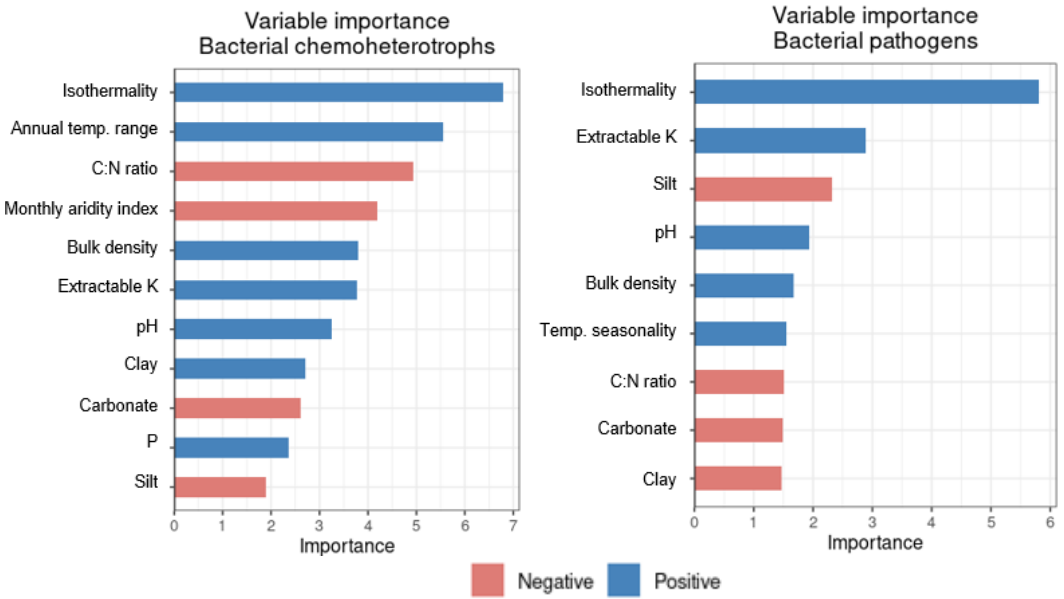
- Bacterial chemoheterotrophs were more abundant in croplands and intensively-managed grasslands.
- Bacterial pathogens were more abundant in permanent crops and intensively-managed grasslands.
- Bacterial N-fixers were also analyzed.

Distribution of FUNGAL functional groups across vegetation covers



- The distribution of fungal functional groups also differentiated among vegetation covers.
- A higher proportion of saprophytic and pathogenic fungi was found in more intensified (anthropic) areas.
- Ectomycorrhizal and arbuscular mycorrhizal fungi were also analyzed.

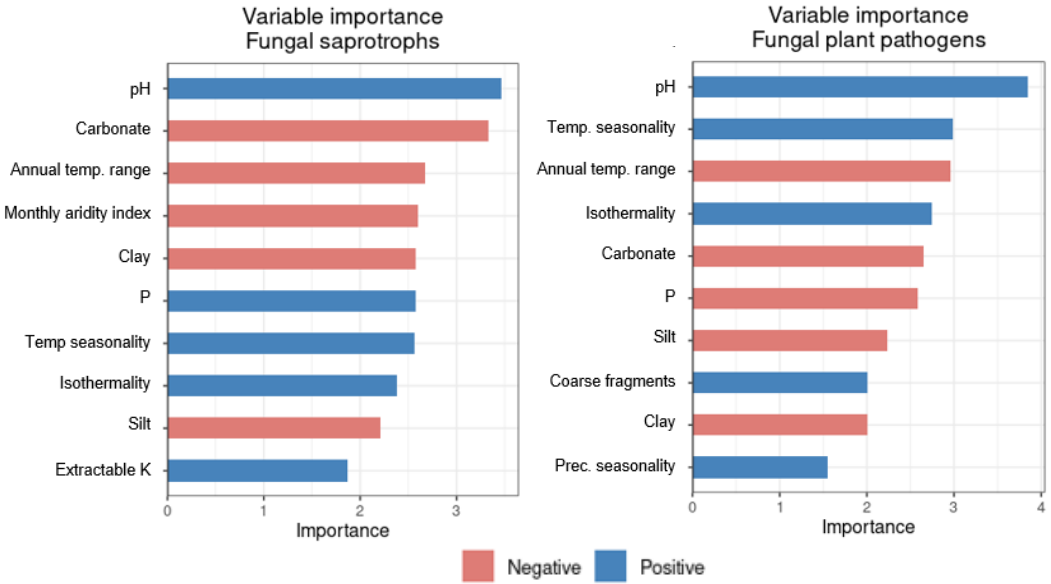
Drivers of BACTERIAL functional groups



Variable importance for each soil property and climatic variable in explaining the proportion of OTUs belong to a given bacterial functional group. Only the numerical properties selected by the models are presented, but the vegetation cover was selected as a significant important (categorical) variable as well and included in the models.

- Temperature had a **positive** effect on the presence of both bacterial chemoheterotrophs and pathogens.
- Carbon-to-nitrogen ratio, monthly aridity index, and silt content had a **negative** effect on both bacterial chemoheterotrophs and pathogens.

Drivers of FUNGAL functional groups



Variable importance for each soil property and climatic variable in explaining the proportion of OTUs belonging to a given fungal functional group. Only the numerical properties selected by the models are presented, but the vegetation cover was selected as a significant important (categorical) variable as well and included in the models.

- The distribution of fungal functional groups was influenced by a large set of soil properties and climatic variables. pH was the most influencing variable.
- Depending on the considered climatic variable, the impact of climate favored or hampered functional groups presence.

Take-home messages

1. Land intensification **affected soil microbial** diversity and functions with a **higher diversity** detected in more **anthropic environments at European scale**.

2. **Changes in microbial diversity were associated with changes in functional groups**; croplands showed the highest proportion of chemoheterotrophic and pathogenic bacteria, as well as saprotrophic and pathogenic fungi.

3. A **higher taxonomic richness does not necessarily imply better ecosystem performance**, as a higher richness may be associated to a larger presence of pathogens.

4. There is a need to **deepen the knowledge on drivers of soil microbial functional groups** by **including as many soil physico-chemical properties as possible.**

5. Difficulties in assessing one overall effect (positive or negative) of climate on soil microbial functions highlighted the need to **investigate a large set of climatic variables** to better capture their effects on each functional group.

Thank you!

Further questions ?

maeva.labouyrie@ec.europa.eu