

Effects of soil, climatic, and anthropogenic drivers on the abundance, richness, and diversity of soil microbial communities: A European perspective



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Diverse microbial communities are fundamental to healthy and productive soils, accommodating essential ecosystem services including nutrient cycling, organic matter decomposition, land-atmosphere carbon exchange, water and climate regulation, and contaminant control. The immense taxonomic and functional diversity of soil microorganisms makes deciphering the intricate interactions between soil, its inhabitants, and the far-extending effects for life on earth a complex challenge. Advances in the analysis of eDNA, like metabarcoding to determine community composition from soil samples, enable large-scale assessments across manifold habitat conditions. Based on the LUCAS 2018 soil biodiversity datasets, we aim to (i) identify key drivers shaping soil microbial community composition, and (ii) quantify marginal changes in soil microbial abundance, richness, and diversity forced by soil properties, climatic, and anthropogenic pressures. To improve the understanding of interactions between external drivers and soil microbial communities, we employ machine learning algorithms, in particular generalized additive models for increased interpretability (Hassani et al., 2024), to investigate and identify the parameters influencing the observed soil microbial diversity and richness in the LUCAS datasets. Our modeling efforts will enable us to predict changes in soil biodiversity under the influence of anthropogenic pressures and projected climate scenarios. Such an analysis can further support decision-making in land management with potential policy implications on a pan-European scale.

References

Hassani, A., Smith, P., & Shokri, N. (2024). Negative correlation between soil salinity and soil organic carbon variability. *Proceedings of the National Academy of Sciences*, 121(18), e2317332121. <https://doi.org/10.1073/pnas.2317332121>



Patrik Heintze

In 2020, I received my Bachelor of Science in Environmental Engineering at RWTH Aachen University. My master's studies were focused on the intricate and multifarious relations between water, energy, and food resources. Continuing my studies in Aachen and spending an exchange semester at the Politecnico di Milano, I graduated with a Master of Science in Sustainable Management – Water and Energy in 2023. For my master's thesis, I developed and implemented a methodology for a GIS-based analysis of area-specific water, energy, and nutrient resources.

Starting in 2024, I am currently a Doctor of Philosophy (PhD) candidate at the Hamburg University of Technology's Institute of Geo-Hydroinformatics. My research concentrates on identifying key drivers shaping soil microbial community composition, and quantifying effects on soil microbial abundance, richness, and diversity caused by edaphic, climatic, and anthropogenic drivers.