Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.30527

# Trait-based modeling of microbial interactions and carbon turnover in the rhizosphere

**HOLGER PAGEL**[1,2], THILO STRECK[3], ANDREA SCHNEPF[1,2], AHMET SIRCAN[3], MONA GIRAUD[1], ADRIAN LATTACHER[3], ELLEN KANDELER[3] AND CHRISTIAN POLL[3]

[1]Forschungszentrum Jülich
[2]University of Bonn
[3]University of Hohenheim

Understanding the feedback mechanisms between roots and soil, and their effects on microbial communities, is crucial for predicting carbon cycling processes in agroecosystems. We developed a onedimensional axisymmetric rhizosphere model to simulate the spatially resolved dynamics of microorganisms and soil organic matter turnover around a single root segment to explore soil-root interactions. The model accounts for two functional groups with different life history strategies (copiotrophs and oligotrophs), reflecting trade-offs in functional microbial traits related to substrate utilization and microbial metabolism. It considers differences in the accessibility of soil organic matter by including the microbial utilization of low and high molecular weight organic carbon compounds (LMW-OC, HMW-OC). The model was conditioned using Bayesian inference with constraint-based parameter sampling, which enabled the identification of parameter sets resulting in plausible model predictions in agreement with experimental evidence. Mimicking the behavior of growing roots, the model assumed 15 days of rhizodeposition for LMW-OC. The simulations show a decreasing pattern of dissolved LMW-OC away from the root surface. We observed a dominance of copiotrophs close to the root surface (0–0.1 mm). Spatial patterns of functional microbial groups persisted after rhizodeposition ended, indicating a legacy effect of rhizodeposition on microbial communities, particularly on oligotrophic activity. Simulated microbial biomass exhibits a very rapid change within 0–0.2 mm away from the root surface, which points to the importance of resolving soil properties and states at submillimeter resolution. Microbial-explicit rhizosphere modeling thus facilitates elucidating spatiotemporal patterns of microorganisms and carbon turnover in the rhizosphere.