Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.18060

# Impact of Precipitation On Greenhouse Gas Emissions in a Forest Soil

**SIMIAO WANG**[1], FILIPPO MIELE[1], PAOLO BENETTIN[1], MITRA ASADOLLAHI[1,2], MANON FRUTSCHI[1], ANDREA RINALDO[1] AND RIZLAN BERNIER-LATMANI[3]

[1]École Polytechnique Fédérale de Lausanne (EPFL)
[2]Columbia University
[3]Ecole Polytechnique Fédérale de Lausanne (EPFL)

Presenting Author: simiao.wang@epfl.ch

The changing climate will impact rainfall events and is predicted to affect the frequency and intensity of hydrologic drivers. Alteration of the hydrological forcing will modulate the concentration of dissolved oxygen (DO) and the bioavailability of solutes, indirectly altering microbial community structure and function. Redox-dependent microbial processes and the associated biogeochemical cycles will be particularly impacted. For instance, the abundance and activity of greenhouse gas (GHG)-emitting microorganisms, such as those related to nitrous oxide ($N_2O$) and methane ($CH_4$) emissions, will change. However, the direction and magnitude of this change is not readily predictable. Thus, establishing a fundamental understanding of the dependencies of soil microbial redox processes on hydrological constraints and deciphering the latter's impact on biogeochemical cycles is a key step. In this work, we investigate the impact of a change from frequent and mild to sparse and intense precipitation patterns on microbial processes in a forest soil. To perform this comparison, we designed laboratory-scale experiments in which a forest soil is subjected to controlled precipitation events characterized by realizations of stochastic Poisson processes (known to closely portray daily rainfall-at-a-point), while biogeochemical dynamics are monitored in space and time. Three lysimeters holding 50-cm soil columns received artificial rainwater according to the mean annual precipitation amount of Switzerland and varying inter-arrival time of 3 days or 14 days. Leaf litter, placed at the soil surface, provided organic carbon and nitrogen. Physicochemical parameters such as pH, redox potential, moisture content, matric potential, DO, and the concentration of solutes were measured as a function of depth and time over the course of three months. $N_2O$ and $CH_4$ emissions were monitored at the soil surface. Depth-resolved microbial community analysis was performed to identify shifts in the community structure under different precipitation patterns. Finally, we leveraged a newly-developed 1-D mathematical model that integrates the spatiotemporal data and the microbiome analysis to delineate the dominant microbial processes contributing to $CH_4$ and $N_2O$ emissions. Overall, this work will help decipher the role of changing precipitation on microbial community structure in soil and their contribution to GHG emissions.