From microbiological to ecosystemic scale evaluation of carbon-based (CO2, CH4) greenhouse gas sources, production, and transfers in temperate peatlands: a pluridisciplinary week at the playground for Critical Zonists in Frasne, Jura Mountains

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Despite covering only 3% of the global land surface, peatlands are an active part of the Critical Zone (CZ) exchanging large water and greenhouse gas (GHG) fluxes with the surrounding aquifers, surface waters, and the atmosphere. While ecosystem services of peatlands (carbon and water storage, buffering of local climate) are essential to address 21st century challenges regarding climate, biodiversity, and water resources, they are directly threatened by human activities at global (climate change) and local (drainage for agriculture, forestry and peat harvesting) scales. Understanding the hydrological, biogeochemical, and ecological mechanisms of peatlands functioning at different spatiotemporal scales is therefore fundamental to mitigate these impacts.

In order to characterize the mechanisms and factors controlling GHG sources, production and transfers in peatlands, we organized an interdisciplinary field campaign at the Frasne peatland. The site (7 ha, 46.826 N, 6.1754E, 840 m a.s.l) is a long-term observatory since 2008 and one of the four French peatland observatories (SNO Tourbières) of the French CZ research infrastructure (OZCAR). The peatland is also an observatory of the Zone Atelier of Arc Jurassien dedicated to exploring the interrelationships between human and nature. This campaign is supported by the TERRA FORMA project, aiming at designing and testing in-situ smart, connected, low-cost, low-impact and socially appropriated environmental sensors to capture the trajectory of the CZ in the Anthropocene.

This field campaign will combine microbiological characterization (membrane lipid analysis to trace the involved microbial metabolisms) with hydrogeochemical analyses of peat pore water (major elements, DOC (quantity and quality), CO2, CH4, δ18OH2O-δ2HH2O, δ13CDIC, δ13CDOC, δ13CCH4, δ2HCH4, δ13CCO2) along upstream-downstream and surface-depth gradients. In parallel, GHG fluxes will be measured from the plot to the ecosystem scale, by combining dissolved gas profiles, chamber measurements, eddy-covariance and unmanned aerial vehicle characterization.

This multiscale campaign will have the potential to address various challenges faced by Critical Zonists and environmental managers: (1) assessing 3D carbon fluxes (lateral and vertical) at the peatland scale; (2) characterizing biological processes and in particular how they favor or limit GHG production; (3) and transfers and developing affordable and user-friendly tools to face the above-mentioned topics.

**Mots-Clés:** Drone, Eddy covariance, Methanogenesis, Methanotrophy, GHG, SocioEcosystems, Critical Zone, Peatland

*Intervenant*