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

Alexandre Lhosmot*[1], Adrien Jacotot[2], Camille Bouchez[3], Eliot Chatton[3], Sarah Coffinet[4], Philippe Binet[1], Robin Calisti[5], Edward A. D. Mitchell[5], Daniel Gilbert[1], Marie-Laure Toussaint[1], Marc Steinmann[6], Travis Meador[7], Christophe Loup[6], Delphine Combaz[8], Lilian Joly[8], Florian Parent[8], Nicolas Dumelie[8], Grégory Albora[8], Jean-Louis Bonne[8], Charbel Abdallah[8], Thomas Lauvaux[8], Jérémie Burgalat[8], Ngoc-Minh Hoang[8], Laurent Longuevergne[3], Olivier Mathieu[9], Philippe Amiotte-Suchet[9], Véronique Lavastre[10], Marie-Noëlle Pons[11], Arnaud Elger[12], Romain Walcker[12], Valentin Essert[6], Laurent Millet[6], Hélène Masclaux[6], Valérie Verneaux[6], Anne Boetsch[13], Joshua Ducasse[6], Christina Hazard[14], Huaiyu Wang[14], Vincent Jassey[12], Laure Gandois[12], Jean Sébastien Moquet[15], Sebastien Gogo[4], Vincent Milesi[16], and Guillaume Bertrand[1,17]

[1]Laboratoire Chrono-environnement, 25200 Montbéliard – CNRS : UMR6249, Université de Franche Comté – France

[2]Sol, Agro et hydrosystèmes, Spatialisation (SAS), Institut Agro, 35700 Rennes – CNRS : UMR1069, INRAE – France

[3]Géosciences Rennes, 35700 Rennes – CNRS : UMR6118, Université de Rennes I – France

[4]Ecosystèmes, Biodiversité, Evolution (Ecobio), 35700 Rennes – UMR 6553 CNRS, Université de Rennes I – France

[5]Laboratoire de Biodiversité du Sol, Université de Neuchâtel, 2000 Neuchâtel – Suisse

[6]Laboratoire Chrono-environnement, 25000 Besançon – CNRS : UMR6249, Université de Franche Comté – France

[7]Biology Center Czech Academy of Sciences, Soil Water Research Infrastructure, Ceske Budejovice, CZ-37005 – République tchèque

[8]GSMA, 51687 Reims – CNRS : UMR7331, Université de Reims - Champagne Ardenne – France

[9]Biogéosciences, Université de Bourgogne, 21000 Dijon – CNRS : UMR6282 – France

[10]LGL-TP, 42023 Saint-Etienne – Université Jean Monnet - Saint-Etienne, CNRS : UMR5276 – France

[11]LRGP, 54000 Nancy – Université de Lorraine, Centre National de la Recherche Scientifique – France

[12]Laboratoire Ecologie Fonctionnelle et Environnement (LEFE), 31326 Castanet – CNRS : UMR5245, Université de Toulouse Paul Sabatier – France

[13]OSU-THETA, 25000 Besançon – Université de Franche-Comté, CNRS : UMR6249 – France

[14]École Centrale de Lyon, Université de Lyon, 69134 Ecully – CNRS : UMR5005 – France

[15]Institut des Sciences de la Terre d'Orléans (ISTO), 45100 Orléans – Observatoire des Sciences de l'Univers en région Centre, Université d'Orléans, CNRS : UMR7327 – France

[16]Institut des Sciences de la Terre d'Orléans - UMR7327 – Bureau de Recherches Géologiques et Minières (BRGM), Observatoire des Sciences de l'Univers en région Centre, Institut National des Sciences de l'Univers, Université d'Orléans, Centre National de la Recherche Scientifique – France

[17]Water Resources and Environmental Engineering Laboratory, Federal University of Paraíba, 58051-900 Joao Pessoa – Brésil

Résumé

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, Eddycovariance, Methanogenesis, Methanotrophy, GHG, SocioEcosystems, Critical Zone, Peatland

*Intervenant