**Session Proposal**

# Session Title

Physical, chemical, and biological drivers for soil greenhouse gas fluxes

# Session Organizers

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# Session Description

Soils are dynamic systems where physical, chemical, and biological processes interact to regulate the production and consumption of greenhouse gases (GHGs) such as carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O). While individual drivers—such as soil structure, redox conditions, or microbial activity—are well-studied, their synergistic effects remain poorly quantified. This session addresses the critical need to unravel how these interconnected drivers jointly modulate GHG fluxes across ecosystems and land use. By bridging across disciplinary silos, we aim to advance mechanistic understanding, improve predictive models, and identify leverage points for climate-smart land management. This session welcomes contributions on e.g.:

(1) Interactions Among Drivers:

How do physical factors (e.g., soil porosity, moisture) constrain chemical nutrient availability and microbial metabolic pathways? What role do plant-microbe feedbacks play in mediating gas transport and redox-driven CO₂/CH₄/N₂O trade-offs? Anoxic metabolism where and when?

(2) Modeling and Methodological Innovations:

Advances in coupled measurement techniques (e.g., isotopic tracing, sensor networks, omics approaches) to capture real-time interactions; Integrating micro-scale processes into ecosystem-scale models.

(3) Context-Dependent Dynamics:

Case studies across agroecosystems, wetlands, forests, and permafrost, highlighting how driver couplings shift under land-use change, warming, or extreme events.

# Format

Oral presentations

# Proposed Speakers

Pete Smith, Institute of Biological and Environmental Sciences, School of Biological Sciences, University of Aberdeen, UK, Science Director of Scotland's ClimateXChange;

Editor, Global Change Biology; Editor, Global Change Biology Bioenergy; Editor, Royal Society Open Science.