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Combining measurements, modeling and machine learning to improve N_2O accounting for sustainable agricultural development in sub-Saharan Africa

Turry Ouma
ETH Zurich, D-USYS, Zurich, Switzerland (turry.ouma@sdsc.ethz.ch)

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- Ouma[1,2], E. Harris[1], M. Barthel[2], J. Six[2], A. Otinga[3], R. Njoroge[3], F. Perez-Cruz[1], S. Leitner[4]

[1] Swiss Data Science Centre, ETH Zurich, 8092 Zurich, Switzerland

[2] Department of Environmental Systems Science, ETH Zurich, Switzerland

[3] Department of Soil Science, University of Eldoret, Eldoret, Kenya

[4] International Institute of Livestock Research (ILRI), Nairobi, Kenya

Sub-Saharan Africa continues to grapple with food insecurity due to low crop yields. While an increase in synthetic fertilisers could potentially increase agricultural productivity in the region, it would lead to an increase in emissions of nitrous oxide (N_2O). Moreover, in this region, the lack of quantification of parameters and documentation of the processes relevant to N_2O emissions have hampered the adoption of climate-smart agricultural practices and advancement of N_2O inventories. This study aims to conduct the first online measurements of N_2O fluxes and isotopic composition from agricultural soils in Uasin Gishu County, Kenya, using the TREX-QCLAS system: quantum cascade laser absorption spectrometer (QCLAS) coupled to a preconcentration unit-TRace gas EXtractor (TREX). The isotopic measurements obtained will be useful in the inference of N_2O production and consumption rates for different pathways and will improve understanding of the key drivers of variability in tropical cropland N_2O fluxes. Further, a collation and analysis of available N_2O flux and isotope data along with campaign measurements and data science approaches will enhance the potential to predict future emissions and promote the development of targeted mitigation strategies.

A pilot phase of initial flux measurements set at the plant research station in Eschikon, Switzerland in early 2023 using the TREX-QCLAS system coupled with automated dynamic chambers optimised for continuous unattended N_2O flux measurements will be conducted before deployment in Kenya. Using clover and grass plots, we aim to understand N_2O fluxes and drivers in a simple system. N_2O measurements will be based on a three-stage calibration protocol (preconcentrated ambient air, preconcentrated compressed air, and calibration of the instrumental concentration dependence using progressive dilution of the anchor standard) followed by measurement of chamber air. Preliminary results of automated quality control and data analysis procedures will be key to ensure success of the instrumental deployment in Kenya in late 2023.

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