Method for flux and isotopic measurements from soil chambers using cavity ring-down spectroscopy (CRDS)

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PICARRO

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1. INTRODUCTION

- Cavity Ring-Down Spectroscopy (CRDS) is a powerful tool for the determination of soil fluxes because it enables rapid, concurrent, high-precision measurements of multiple compounds and their isotopologues.
- Quantifying the flux of key elements (C, O, H, N) from a variety of sources and sinks has never been easier, due to the portability and modularity of the CRDS-Soil Chamber methodology.
- We present a series of methodology and research highlights that demonstrates how these system may be deployed in the field.

2. MODULARITY

i Picarro Analyzer

The G2000, G4000 and G5000 family of Picarro (CRDS) analyzers may be used to collect concentrations of multiple gas species (CO_2, CH_4, N_2O, NH_3, H_2O, and others) and isotopologues (iCO_2, iCH_4, iH_2O, iN_2O and iO_2). In many cases at the same time, with high levels of precisions, low drift and strong interference corrections.

ii Commercial or Homemade Chambers

Chamber selection is not limited to commercial brands (LI-COR, Eosense), but may entail the use of custom-made chambers of variable complexities. With either, multiple-chamber deployments via multiplexers are supported.

LI-COR®

Eosense Inc.

Custom

iii Application Specific Add-ons

To support field deployments, other modules or accessories may be included to enhance the system. GPS antenna, anemometer data, battery power, vehicles support, additional filters, desiccants, etc.

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3. CONFIGURATIONS

Option A - Parallel

LI-COR Long Term Chamber

Higher-flow rate recirculating flow

LI-COR IRGA

Lower-flow rate recirculating flow

In this LI-COR setup, the CRDS acts as an additional analyzer. It is discrete and may be added to a variety of existing recirculation setups.

Picarro Analyzer

For more, see LI-COR App Note 138

Option B - In-line

Picarro Analyzer

Multiple recirculating flow-paths using an Eosense Multiplexer and Long Term Chambers

In this setup, the CRDS controls the flowrate of the entire setup and serves as a stand-alone analyzer. This setup can be used with existing solutions, such as Eosense's chamber and Mulitplexer setup, or custom home-built chambers.

For more, see Eosense App Note AN0003

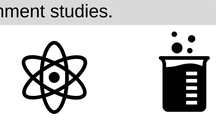
4. ADV. APPLICATION SUPPORT

Water and Particle Removal
Water traps, Acrodisc ®, Nafion ®, Drierite™ and other desiccants

Mobility
GPS integration, battery and generator support

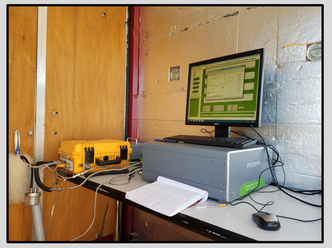
Discrete Sampling
Collect and analyze discrete, 20 ml headspace samples for concentration and/or isotopic data.

Advanced Gas Chemistry
Custom carrier gases and isotopic enrichment studies.



5. CASE STUDY – TEXAS A&M

Objective: Investigate the effect of agricultural management practices (tillage and cover cropping) on greenhouse gas emissions from soil in corn, sorghum and soybean organic cropping systems in Texas



In this setup, eight Li-COR long-term chambers are connected to a Picarro G2508 analyzer housed inside a trailer in the field

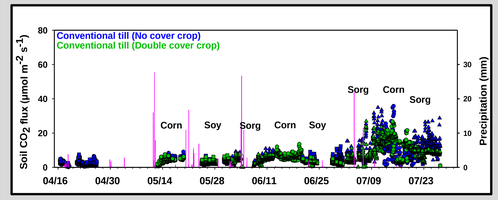


Figure 1 - Half-hourly soil CO_2 flux measured in the 2017 growing season (April – July) from corn, sorghum and soybean plots under conventional tillage with and without cover crops.

Summary

- In 2017, significant differences in soil CO_2 flux were observed between treatments; however m 3 minute measurement time that we used per chamber was inadequate to capture N_2O and CH_4 fluxes
- In 2018, measurement time/chamber was increased to 10 minutes which is sufficient to capture N_2O and CH_4 fluxes from the treatment plots

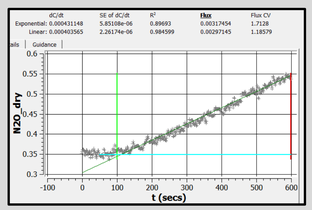


Figure 2 - N_2O flux from a single chamber.

For more information please contact Prof. Nithya Rajan, Dept. of Soil and Crop Sciences, Texas A&M University, E-mail: **nrajan@tamu.edu**

6. SUMMARY AND CONCLUSIONS

- The pairing of CRDS technology with commercial and/or homemade flux solutions opens doors to new types of research and datasets.
- The portability of this technology, paired with its ability to make high-precision, multiple-species and isotopic measurements at the same time will enrich present and future soil flux studies.