Greenhouse Gases Emission and Leaf Litter-Derived Dissolved Organic Matter Across the Soil-Water Interfaces

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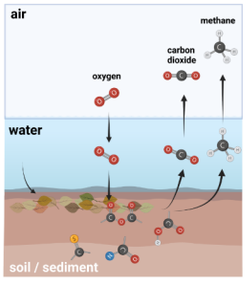
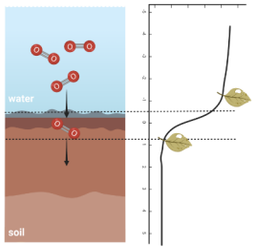
INTRODUCTION

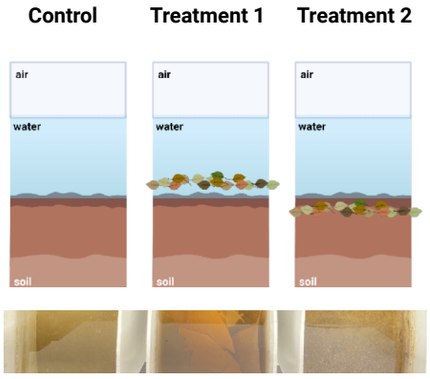




- Flooded environments, e.g. wetlands, rice paddies, are major sources of carbon dioxide and methane as well as an important reservoir of soil organic matter.
- The soil-water interface is a good mesoscale model for studying turnover of organic matter and associated gas emission.
- A sharp environmental gradient, for example, redox potential, naturally occurs across the soil-water interface.
- A transition from oxic to anoxic zone may occur over a depth of several millimeters.
- Leaf litter is a major source of organic matter in terrestrial aquatic system.
- We hypothesize that the transformation of leaf litter-derived dissolved organic matter is sensitive to the position of leaf litter.
- Leaf litter overlain by a 10-mm-thick soil layer at the soil-water interface should trigger different biogeochemical cycles and microbial activities, compared to that with no overlying soil.

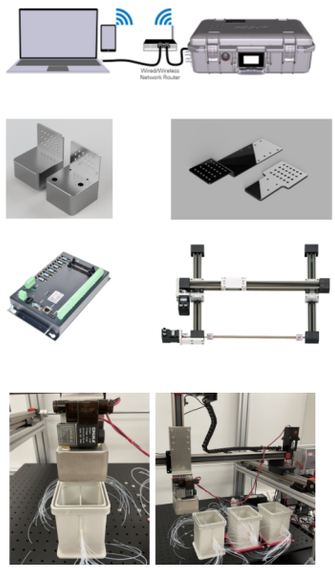
EXPERIMENTAL SETUP

- The control and two treatments were designed to testify the hypothesis.
- Control: no leaf litter amendment
- Treatment 1: 0.8 g leaf litter added, leaf litter on the interface
- Treatment 2: 0.8 g leaf litter added, leaf litter 10 mm below the interface



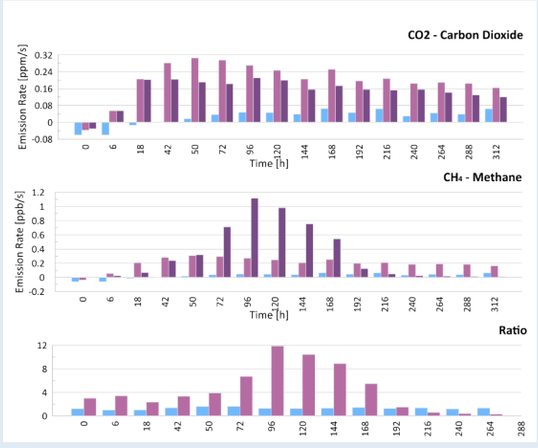
METHOD

- An automated chamber method was developed for determining the gas fluxes in the lab.
  - Carbon dioxide and methane concentration is online monitored using Licor LI-7810 gas analyzer.
  - A customized stainless steel chamber was designed for the built soil-water columns.
  - The chamber is connected with the gas analyzer and mounted on a flat gantry system to automate the testing.
- Excitation-Emission-Matrix (EEM) Fluorescence Spectroscopy is used to characterize the fluorescent components of leaf litter-derived dissolved organic matter in porewater.
- High Performance Liquid Chromatography-Fluorescence Detector (HPLC-FLD) is used to provide more quantitative information.

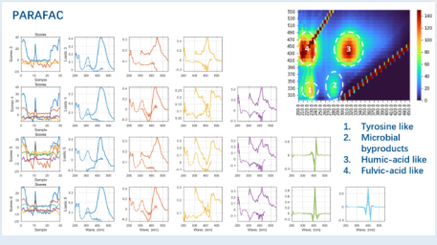


RESULTS

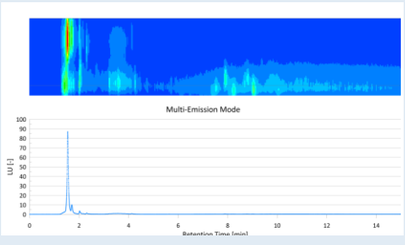
- Treatment 1 and Treatment 2 shows different patterns in carbon dixoide and methane fluxes.
  - Treatment 1 had a higher carbon dioxide flux than treatment 2, with a peak observed at 48 h.
  - Methane flux of treatment 2 was one order of magnitude higher than that of treatment 1, with a peak observed at 96 h.
- Parallel Factor (PARAFAC) analysis of the EEM data suggested that there are four fluorescent components.
- The results of HPLC-FLD showed a good consistency with that of EEM and suggested that the fluorescent components are polar compounds.



Carbon Dioxide and Methane Fluxes from Treatment 1 and Treatment 2



EEM & Parafac Analysis



HPLC-FLD at Multi-Emission Mode

CONCLUSION & PERSPECTIVE

- The soil-water interface can be considered a promising mesoscale model for studying sinks and sources of organic matters and greenhouse gas emission.
- A few millimeters matter. The decomposition of leaf litter-derived dissolved organic matter is sensitive to its position, leading to different biogeochemical processes.
- The tools of molecular biology, such as transcriptomics, shall be involved to verify the hypothesis at microbial level.