A Millimeter Scale Perturbation to Leaf Litter at Soil-Water Interfaces Enhances Methane Emission

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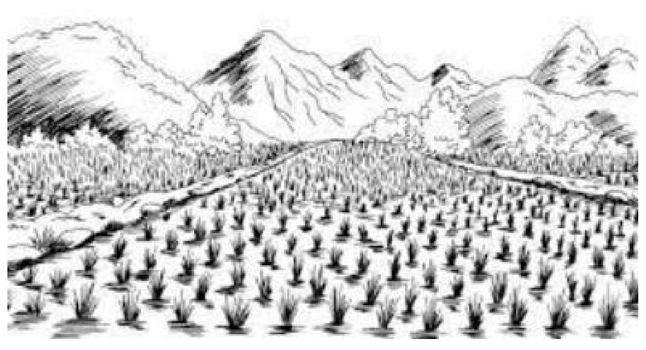
wetlands

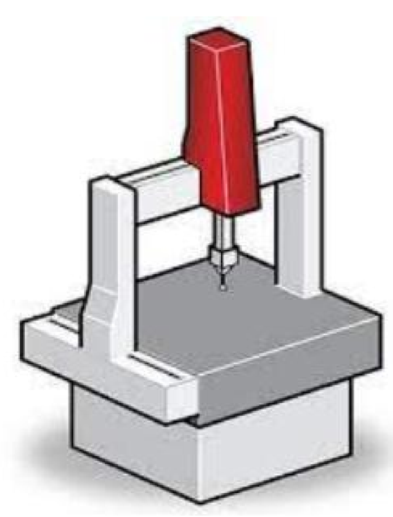
rice paddies



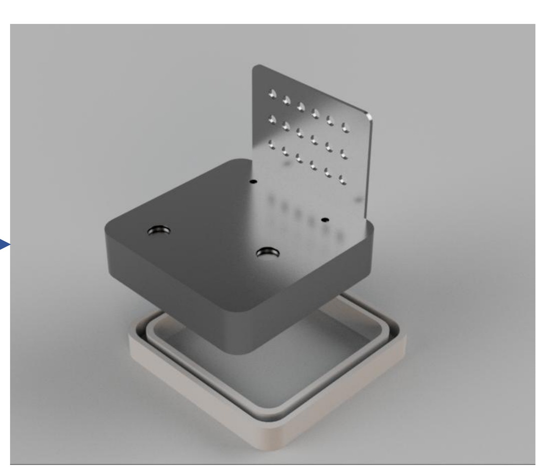
Wetlands and rice paddies contribute one-third of global methane emission.

METHODS

gantry robot

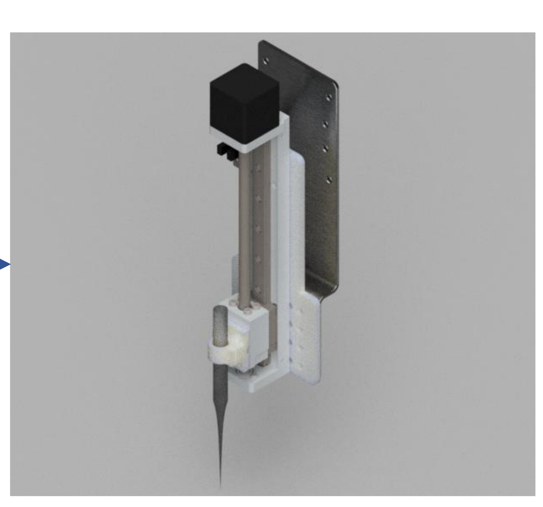


gas chamber



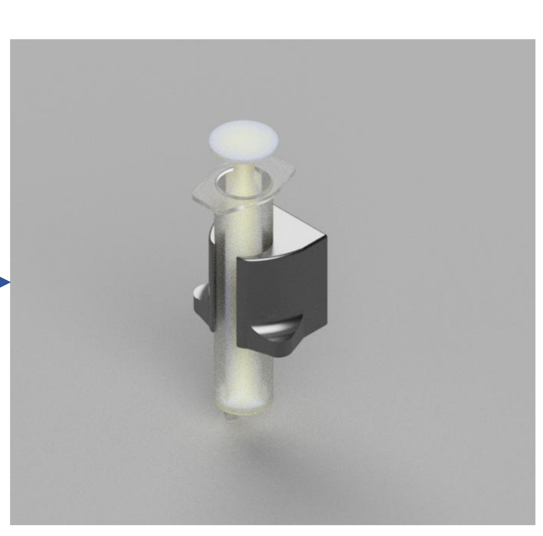
real-time monitoring
CO_2, CH_4, H_2O fluxes

microsensor



in-situ measurements
Eh, DO profiles

liquid/soil sampler



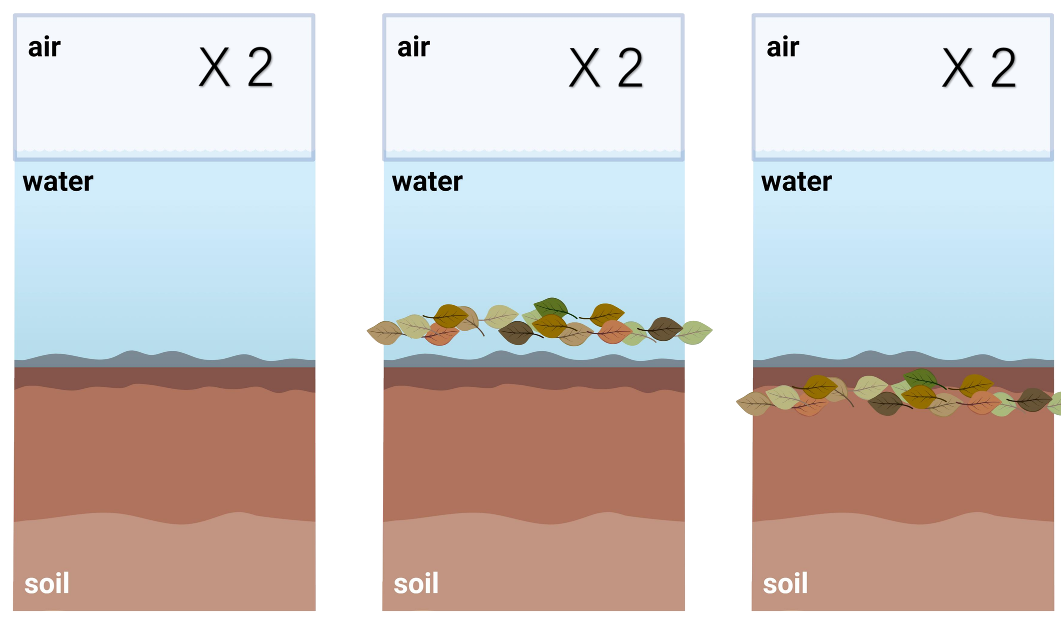
water and soil sampling
off-line methods

ABSTRACT

In this work, we built soil-water interfaces as mesoscale model for studying how the leaf litter primes the greenhouse gas emission in the submerged environments. With the gantry robot system, it was found that a ten-millimeter pertubation to the leaf litter at the soil-water interfaces significantly enhances the methane emission. The depth profiles of the (physico)chemical properties showed that the a small difference in depth is critical to the transformation of leaf litter. The sharp environmental gradient across the soil-water interfaces triggers different biogeochemical processes.

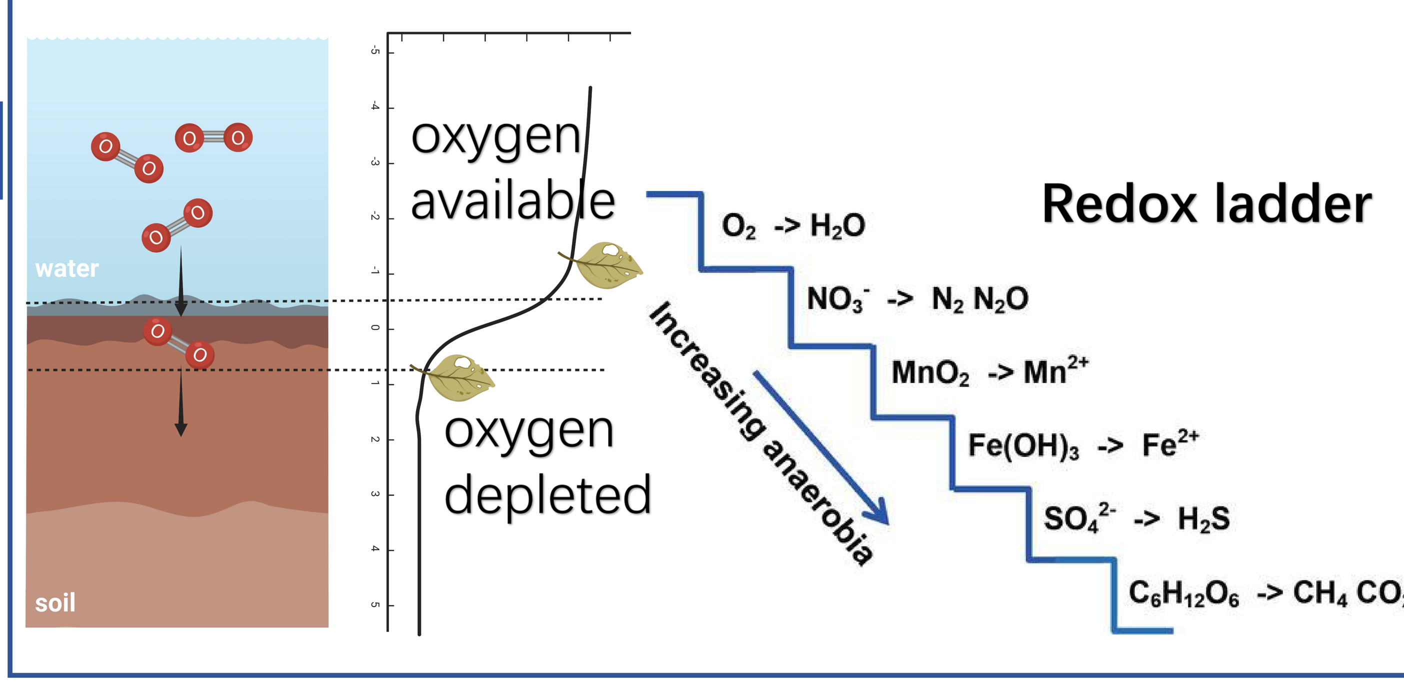
EXPERIMENTAL DESIGN

Control	Treatment 1	Treatment 2
NL	L0	L10
No leaf litter	Leaf litter, not perturbated	Leaf litter, perturbated



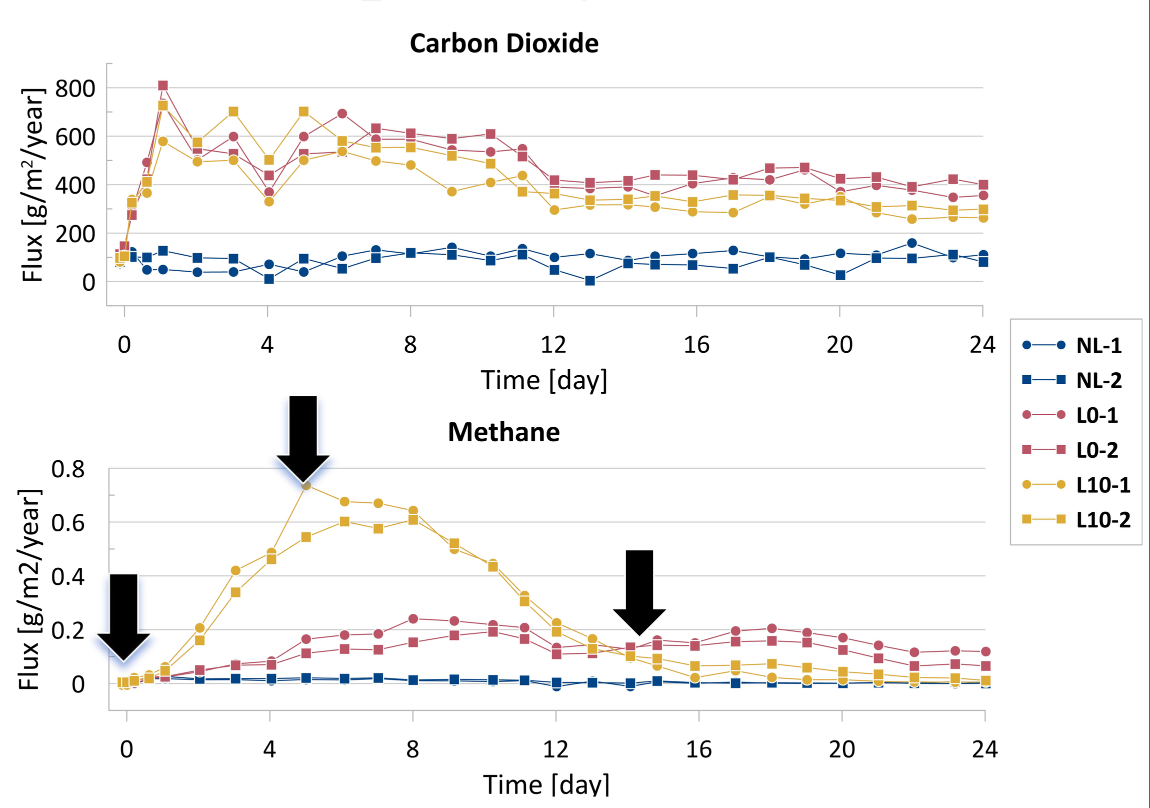
HYPOTHESIS

Leaf litter
a major source of organic matters in wetland systems

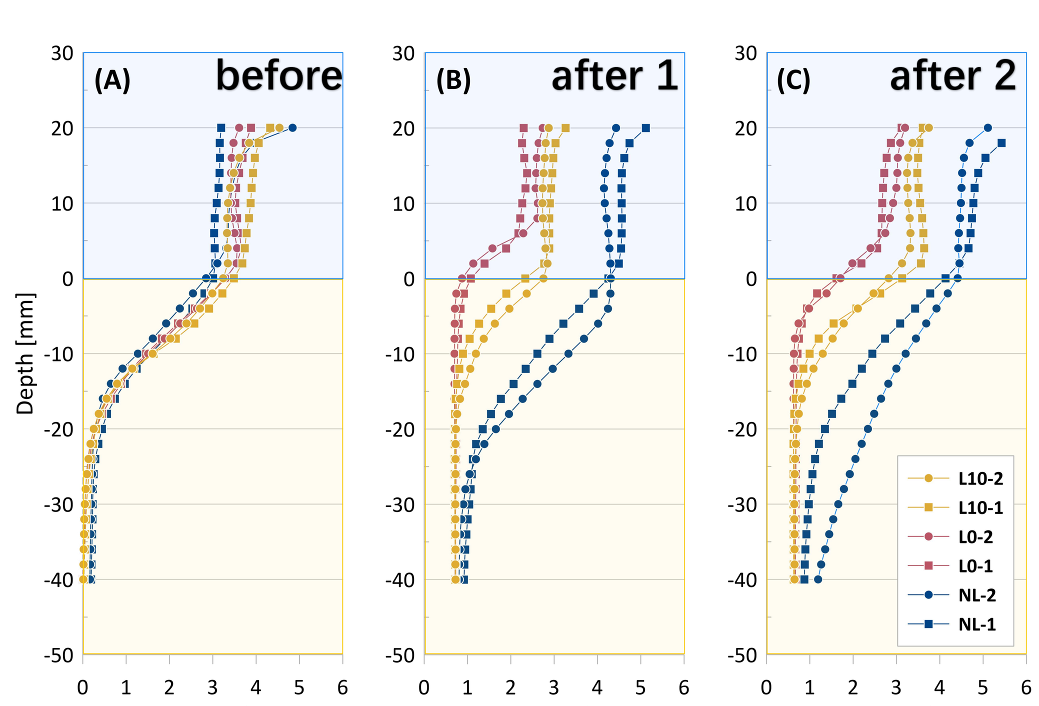


RESULTS

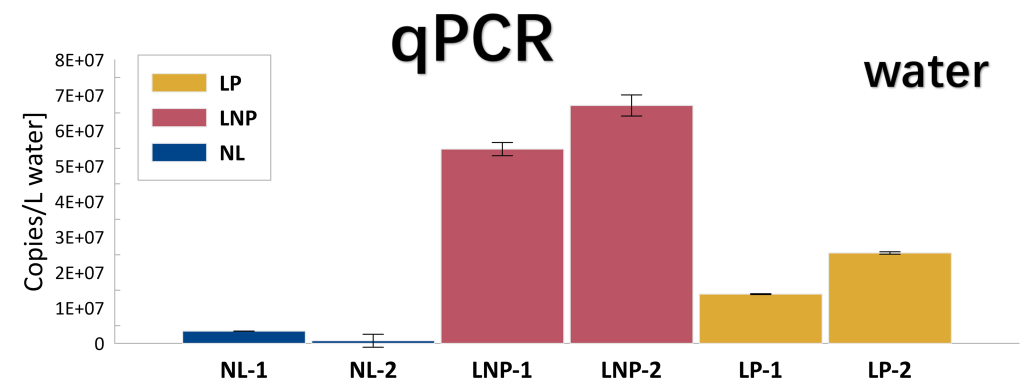
CO_2 & CH_4 fluxes

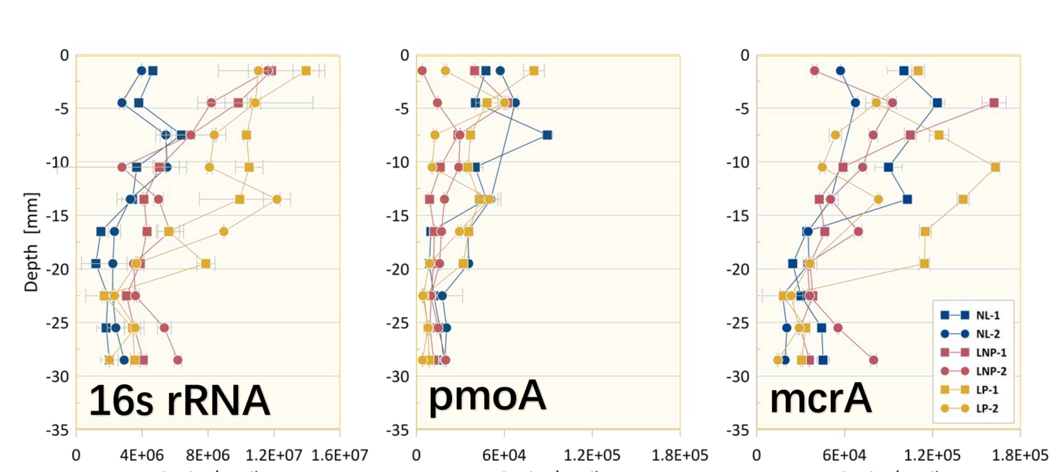


dissolved oxygen



qPCR





DISCUSSION

Carbon dioxide
The fluxes reached a plateau at ca. 36 hour. L10 group is ca. 5% higher than L0 group.

Methane
The fluxes showed different patterns. A peak of methane emission was observed for L0 group, which is five times as intense as L10 group.

Dissolved oxygen (DO)
The front of oxygen fluxes are controlled by the location of leaf litters, lasting for weeks.

Redox potential (Eh)
The Eh profiles are consistent with DO profiles. The sign of heterogeneity development was noticed.

Fluorescent dissolved organic matters (fDOM)
fDOM was released into water and porewater after leaf litter amendment, and declined in two weeks for both groups, implying carbon assimilation and aerobic respiration.

Nitrate
Denitrification was observed for both groups. Likely, the inorganic nitrogen was assimilated and became the limiting factor of microbial growth.

Quantitative PCR (qPCR)
16s rRNA gene copies suggested that input of leaf litter primed the bacterial growth in both water and soil with different spatial patterns

"**A few millimeters do matter.** A underwater perturbation, even at millimeter scale, significantly changes the methane emissions from the water surface."