Relationship between methane flux and carbon uptake in three cosmopolitan wetland plant genera

Villa Jorge A.[1]

[1]The Ohio State University

November 16, 2022

Abstract

Wetlands are the most important natural source of methane (CH4) to the atmosphere. When present, plant efflux is often the dominant pathway for methane emissions from the anoxic wetland sediments, however, they are rarely considered in chamber measurement campaigns of CH4 flux in wetlands. While studies have focused on the mechanisms that govern transport through plant structures, none have addressed how CH4 emissions relate with carbon uptake or how this relationship may vary among plants. Understanding this relationship has important implications for linking carbon flux at the ecosystem level to wetland CH4 emission predictions, and ultimately, to help improve current carbon budget and greenhouse gas models of wetlands. This study presents simultaneous measurements of CH4 and CO2 fluxes in three macrophyte species of different cosmopolitan genera: Typha (emergent), Nelumbo, and Nymphaea (floating attached). These measurements were conducted using the Picarro GasScouter G4301 fitted with custom-designed leaf chambers. Chamber measurements were performed three times during a day (morning, noon and afternoon), in three separate months. Results indicate significant negative correlations between CH4 flux and carbon uptake in Nelumbo and Nymphaea species and a non-significant positive correlation in Typha sp. We term the rate of CH4 flux per unit CO2 uptake – CH4 flux efficiency. We found that in Nymphaea CH4 flux efficiency is almost double that of Nelumbo. These results suggest the dependence of CH4 efflux in stomatal conductance in the floating attached macrophytes, while in the Typha CH4 flux is primarily through other pores, probably aerenchyma, not regulated by stomata. Our results emphasize the importance of species-specific knowledge and considering the growth type of different wetland macrophytes (e.g. emergent vs floating attached) in scaling of bottom-up observations and ecosystem models.

Relationship between methane flux and carbon uptake in three cosmopolitan wetland plant genera

Villa, J.A.[1], Stephen, T.[2]., Rey-Sanchez, A.C[1], Bohrer, G.[1]

[1] Department of Civil, Environmental and Geodetic Engineering. The Ohio State University

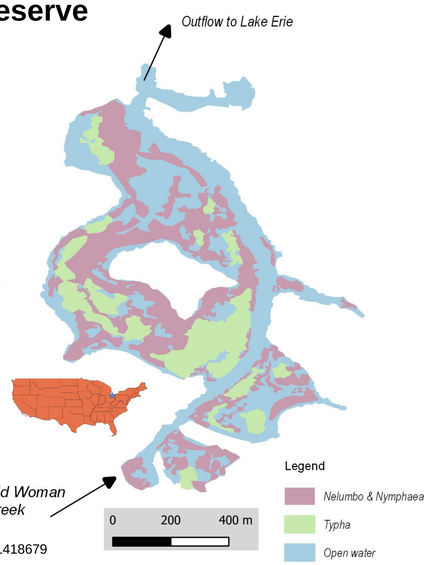
[2] Department of Chemical, Biochemical and Environmental Engineering. University of Maryland, Baltimore County

ABSTRACT

Wetlands are the most important natural source of methane (CH_4) to the atmosphere. When present, plant efflux is often the dominant pathway for methane emissions from the anoxic wetland sediments, however, they are rarely considered in chamber measurement campaigns of CH_4 flux in wetlands. While studies have focused on the mechanisms that govern transport through plant structures, none have addressed how CH_4 emissions relate with carbon uptake or how this relationship may vary among plants. Understanding this relationship has important implications for linking carbon flux at the ecosystem level to wetland CH_4 emission predictions, and ultimately, to help improve current carbon budget and greenhouse gas models of wetlands. This study presents simultaneous measurements of CH_4 and CO_2 fluxes in three macrophyte species of different cosmopolitan genera: *Typha* (emergent), *Nelumbo*, and *Nymphaea* (floating attached). These measurements were conducted using the Picarro GasScouter G4301 fitted with custom-designed leaf chambers. Chamber measurements were performed three times during a day (morning, noon and afternoon), in three separate months. Results indicate significant negative correlations between CH_4 flux and carbon uptake in *Nelumbo* and *Nymphaea* species and a non-significant positive correlation in *Typha* sp. We term the rate of CH_4 flux per unit CO_2 uptake – **CH_4 flux efficiency**. We found that in *Nymphaea* CH_4 flux efficiency is almost double that of *Nelumbo*. These results suggest the dependence of CH_4 efflux in stomatal conductance in the floating attached macrophytes, while in the *Typha* CH_4 flux is primarily through other pores, probably aerenchyma, not regulated by stomata. Our results emphasize the importance of species-specific knowledge and considering the growth type of different wetland macrophytes (e.g. emergent vs floating attached) in scaling of bottom-up observations and ecosystem models.

STUDY SITE

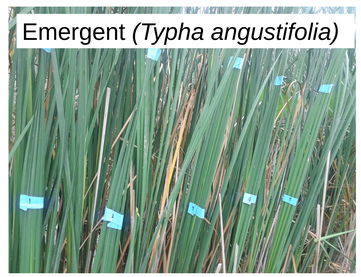
Old Woman Creek National Estuarine Research Reserve



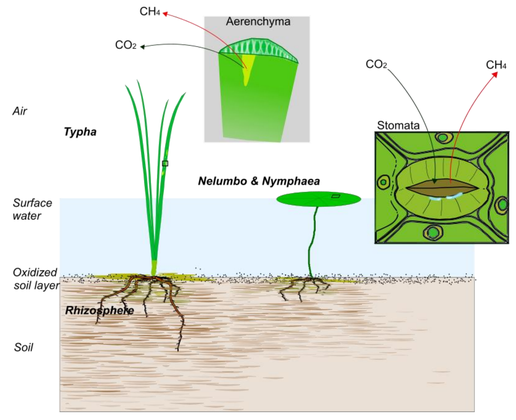
Site data at:
AmeriFlux US-OWC Old Woman Creek, doi:10.17190/AMF/1418679
http://coastal.ohiodnr.gov/oldwomancreek

AKNOWLEDGEMENTS: Ohio Water Development Authority (project 7880)
OWC site access and technical support: Kristin Arend (NERR/NOAA/ODNR)

THREE PLANT SPECIES



CH_4 EFFLUX THROUGH PLANTS



TRANSPORT PATHWAY CONTROL CO_2 RELATIONS