Determining the role of different wetland plant communities on the export of dissolved organic carbon (DOC) in the Florida Everglades - a mesocosm experiment

Jorge A. Villa, William J. Mitsch

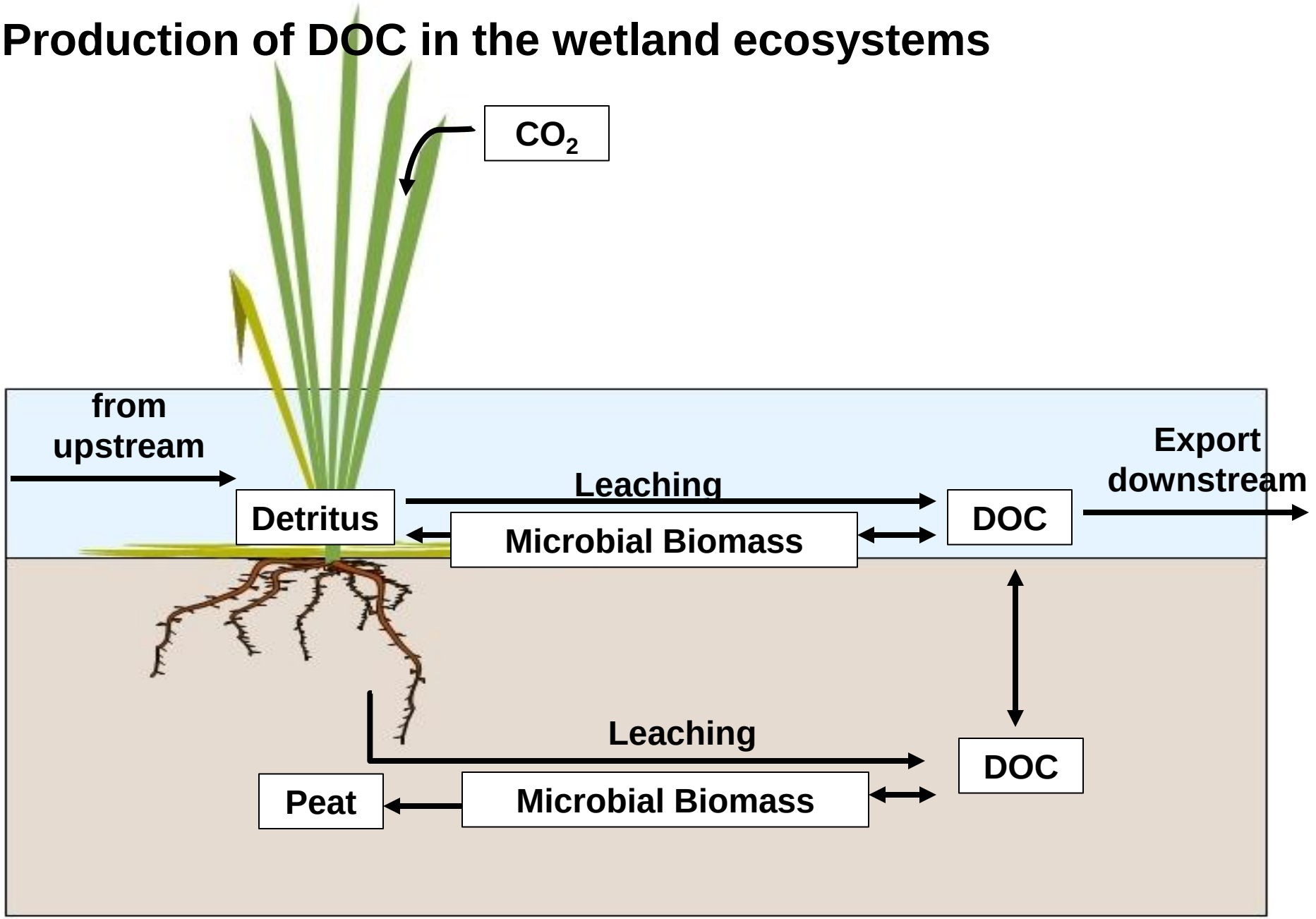
The Ohio State University, Columbus, OH, USA

THE OHIO STATE UNIVERSITY

ENVIRONMENTAL SCIENCE GRADUATE PROGRAM

INTRODUCTION

Production of DOC in the wetland ecosystems



The use of C stable Isotopes as a tracer

Stable Isotopes:

e.g. Natural abundance of Carbon Isotopes

^{12}C = 98.892%

^{13}C = 1.108%

Isotopic signature ($\delta^{13}C$):

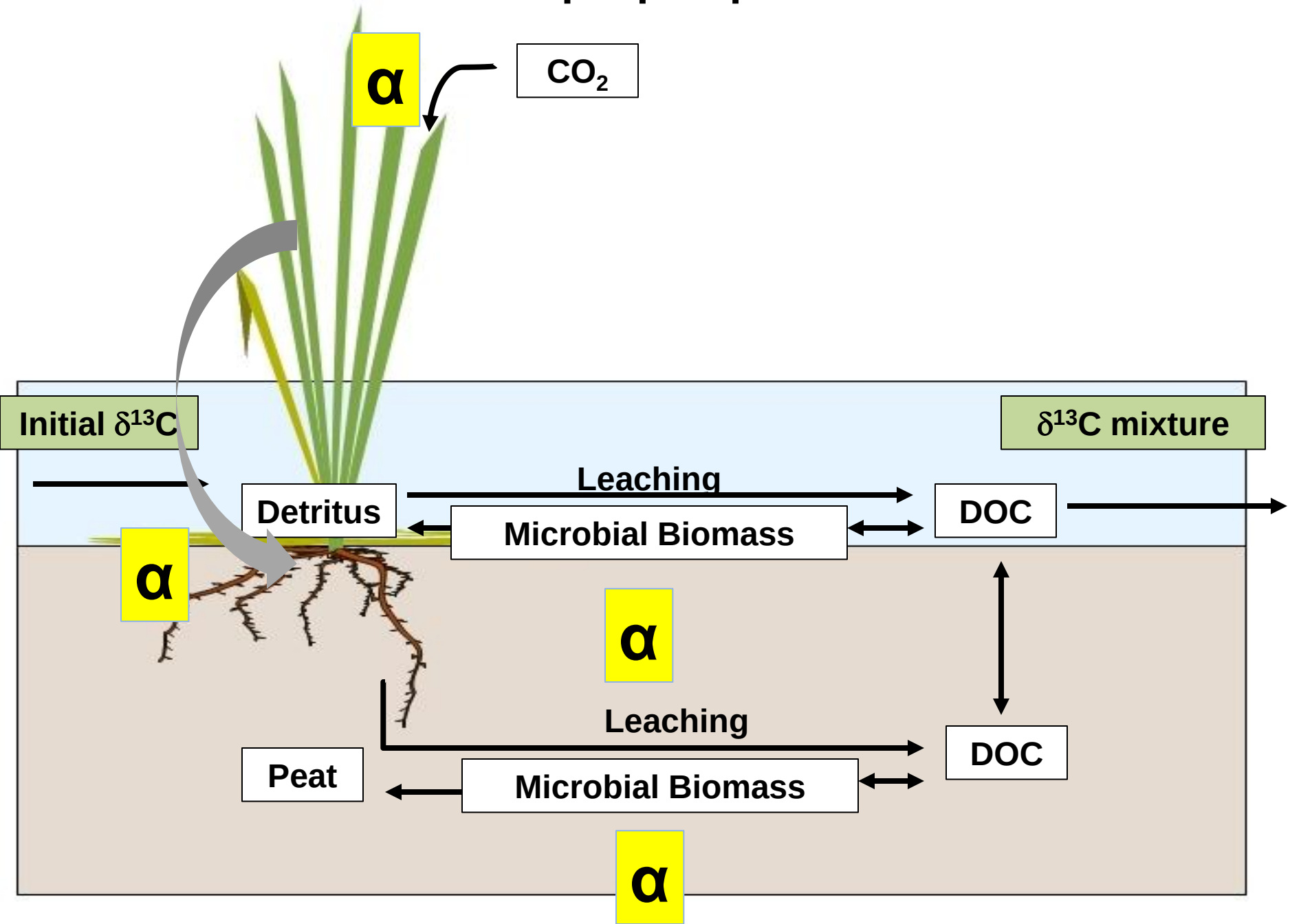
$R_{sample} = {}^{13}C/{}^{12}C$

$\delta^{13}C_{sample} = [(R_{sample} - R_{reference})/ R_{reference}] * 1000‰$

Fractionation (α):

- Evaporation-condensation
- Kinetic effects (e.g. Biological mediated reactions, like photosynthesis)
- Diffusion
- Others

Flow of C from and Isotopic perspective



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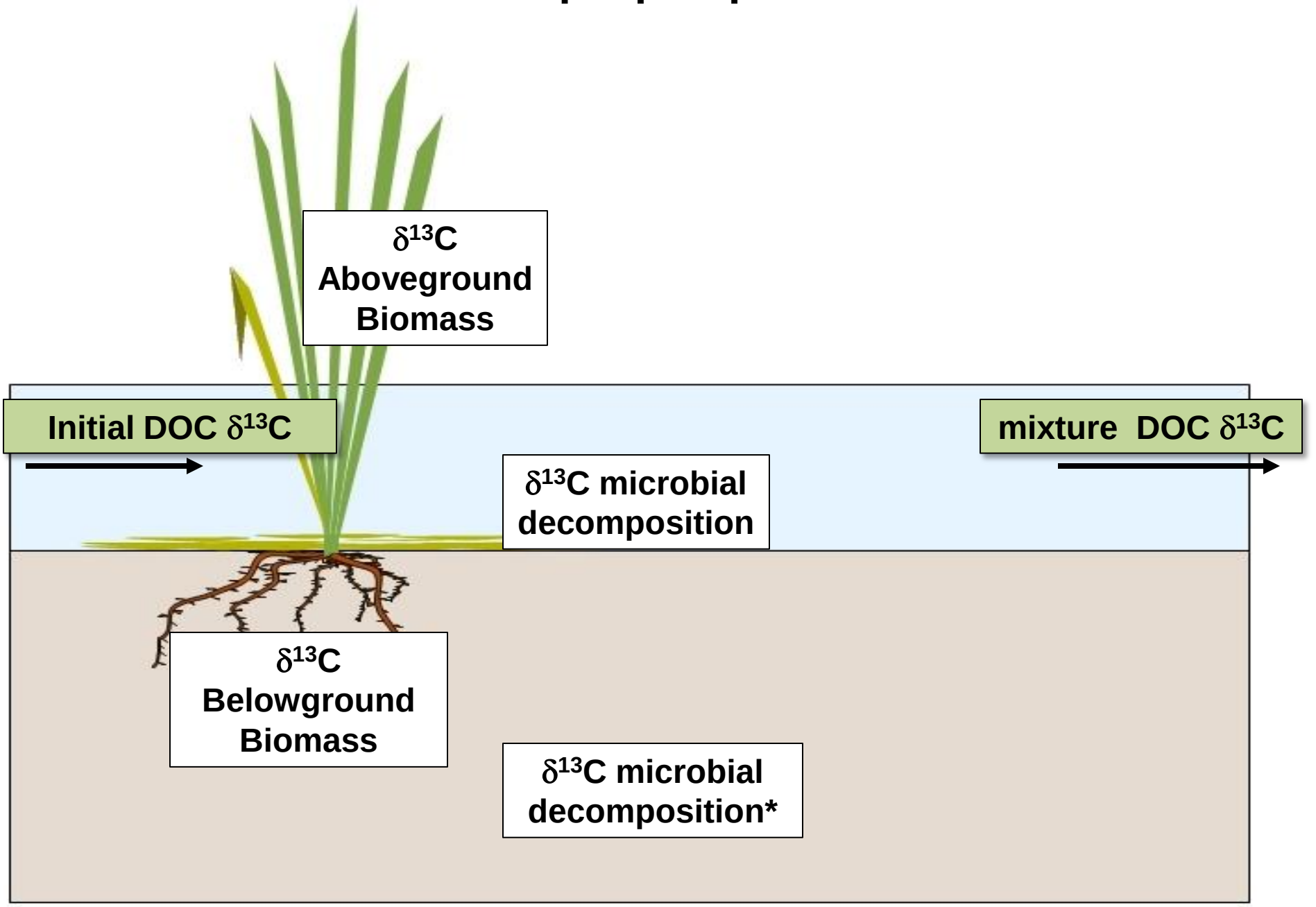


Why DOC?

Source of carbon (C) for microbial growth

Decomposition, humification and stabilization of Organic matter

DOC is a stable component of Dissolved Organic Matter (DOM)

Why DOM?

Mode for organic C, nitrogen (N) and phosphorus (P) export

Transport and toxicity of metals

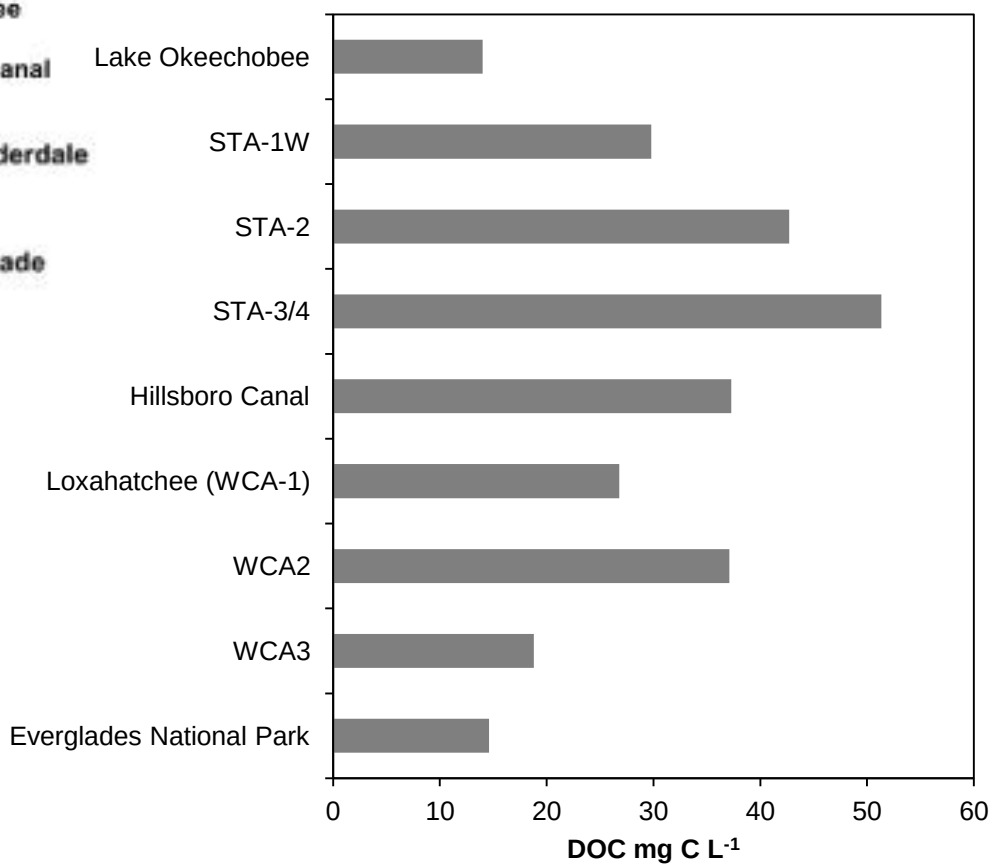
DOM is crucial to assess ecosystem functioning, especially in regards to the biochemical cycling of nutrients

Important in the design of functional constructed wetlands

Storm Treatment Area (STA)

Adapted from: Chimney and Goforth (2006)

Average DOC in the Everglades (North – South)



Data from: Aiken et al. (2011)

What is the contribution of different wetland plant communities to the bulk DOC exported from a mesocosm experiment to remove Phosphorus in the Florida Everglades?

DOC and $\delta^{13}C$ of DOC in inflow and outflows of each treatment

$\delta^{13}C$ and $\delta^{15}N$ of biomass and soils

Contribution of each source

METHODS

Study Site:

18 fiberglass tanks
(6 m L x 1 m W x 1 m D)

Retention time: 14 d

Soils: Hisotosols
(from STA -1W)

6 plant communities:

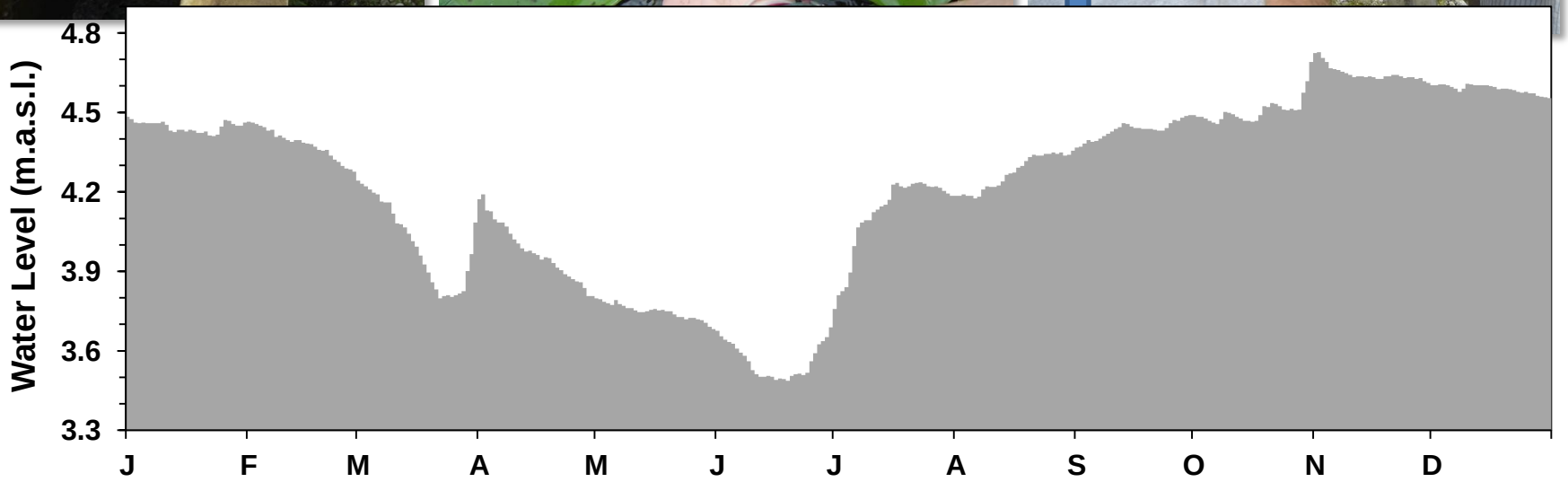
- *Typha domingensis* (Cattail)
- *Cladium jamaicense* (Sawgrass)
- *Nymphaea* sp. (Water lily)
- *Nymphaea* sp. + *Eleocharis* sp. (Spikerush)
- *Najas* sp. + *Charas* sp.
- Self Design (*Najas* sp.)

Field Sampling:

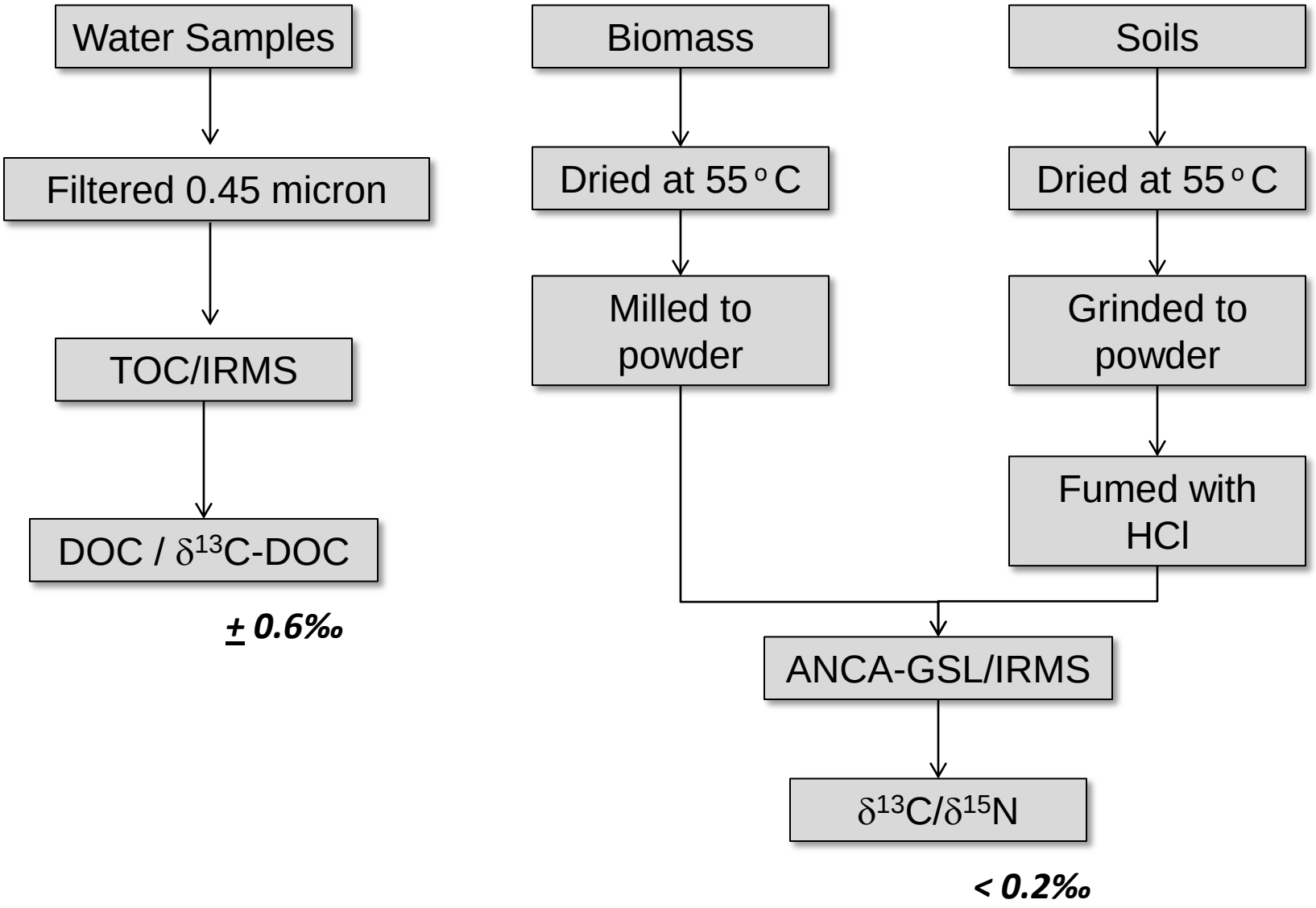
Water

Soil

Component	3/24/11	6/02/11	9/02/11
Water (Inflow/Outflow)	X	X	X
Biomass (Above/belowground)		X	X
Soils (0-2 cm, 2-10 cm)	X		X

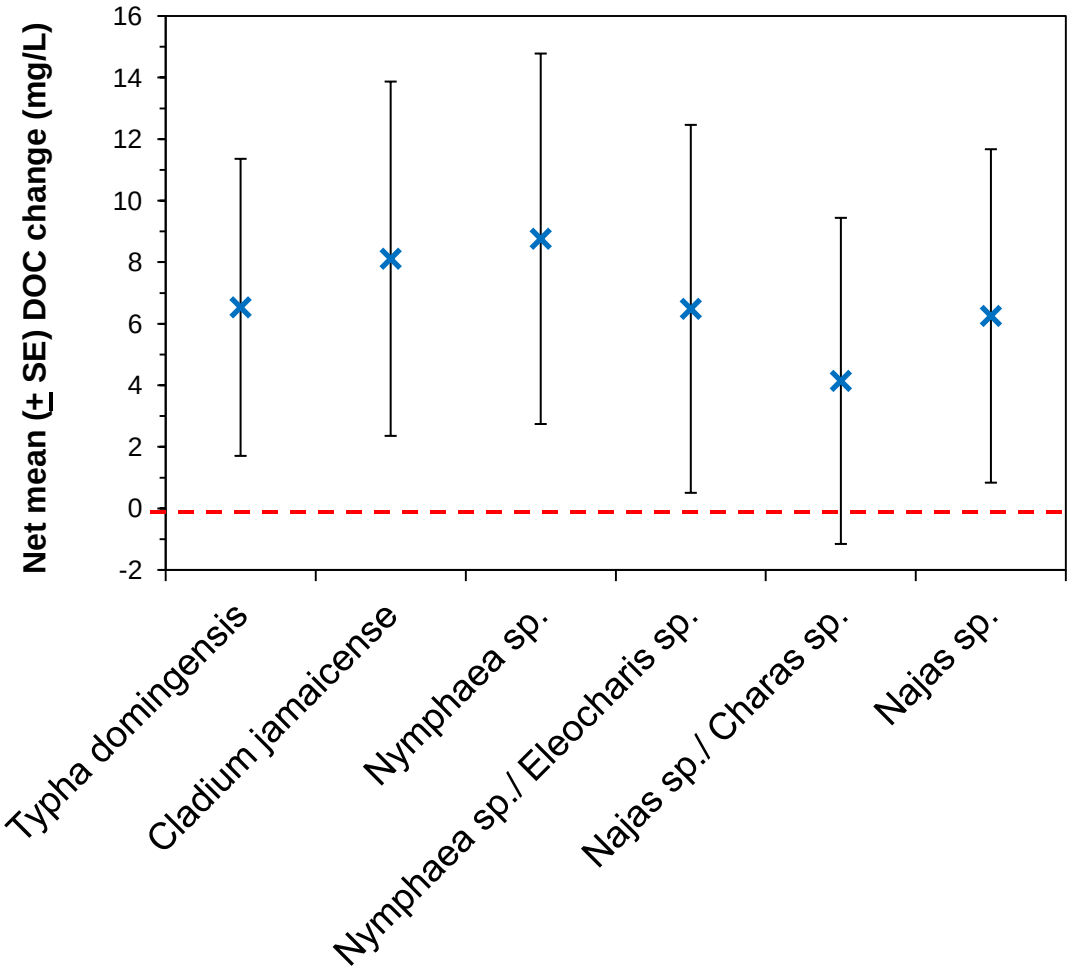


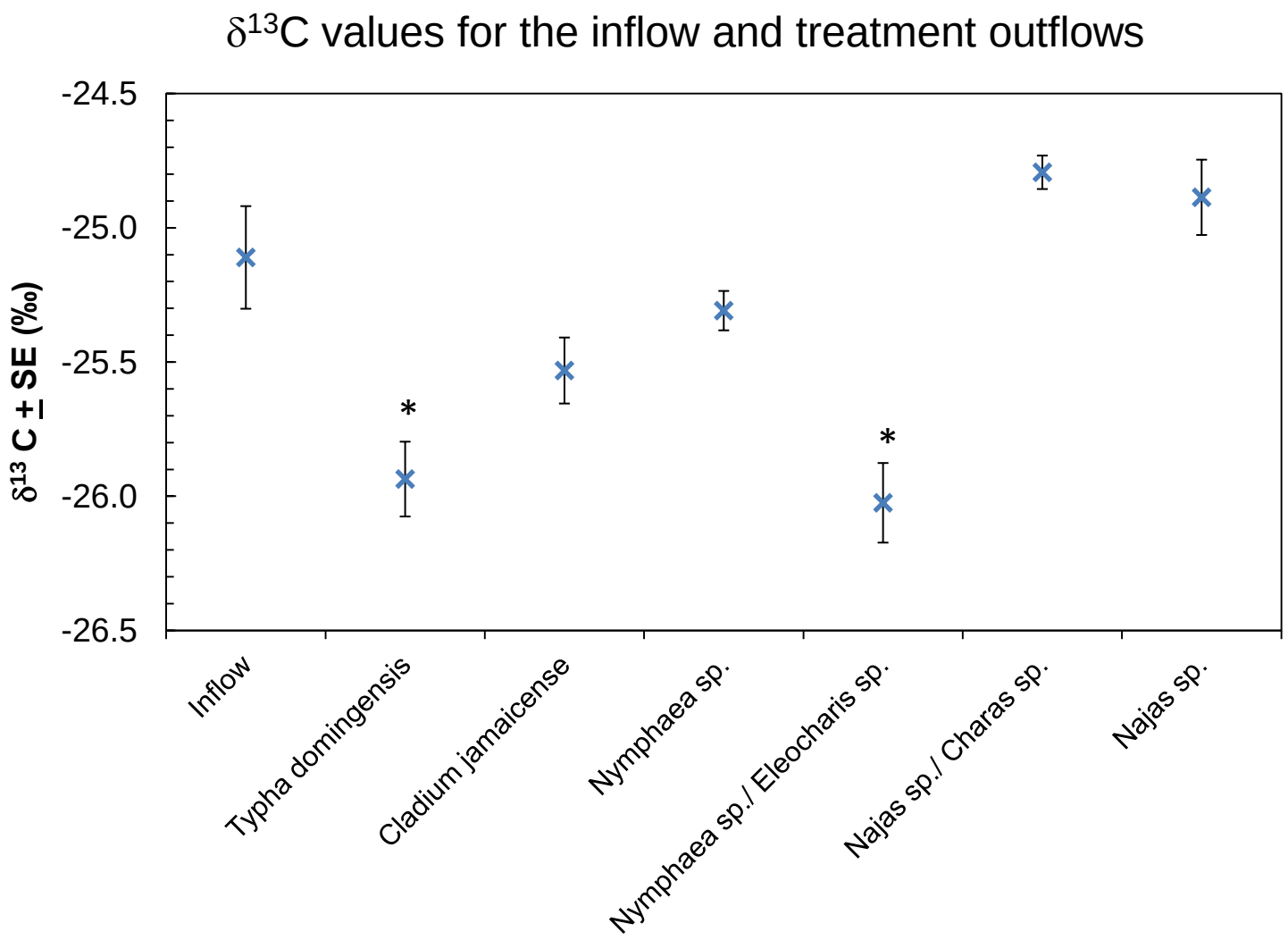
Analytical methods:



RESULTS (Water)

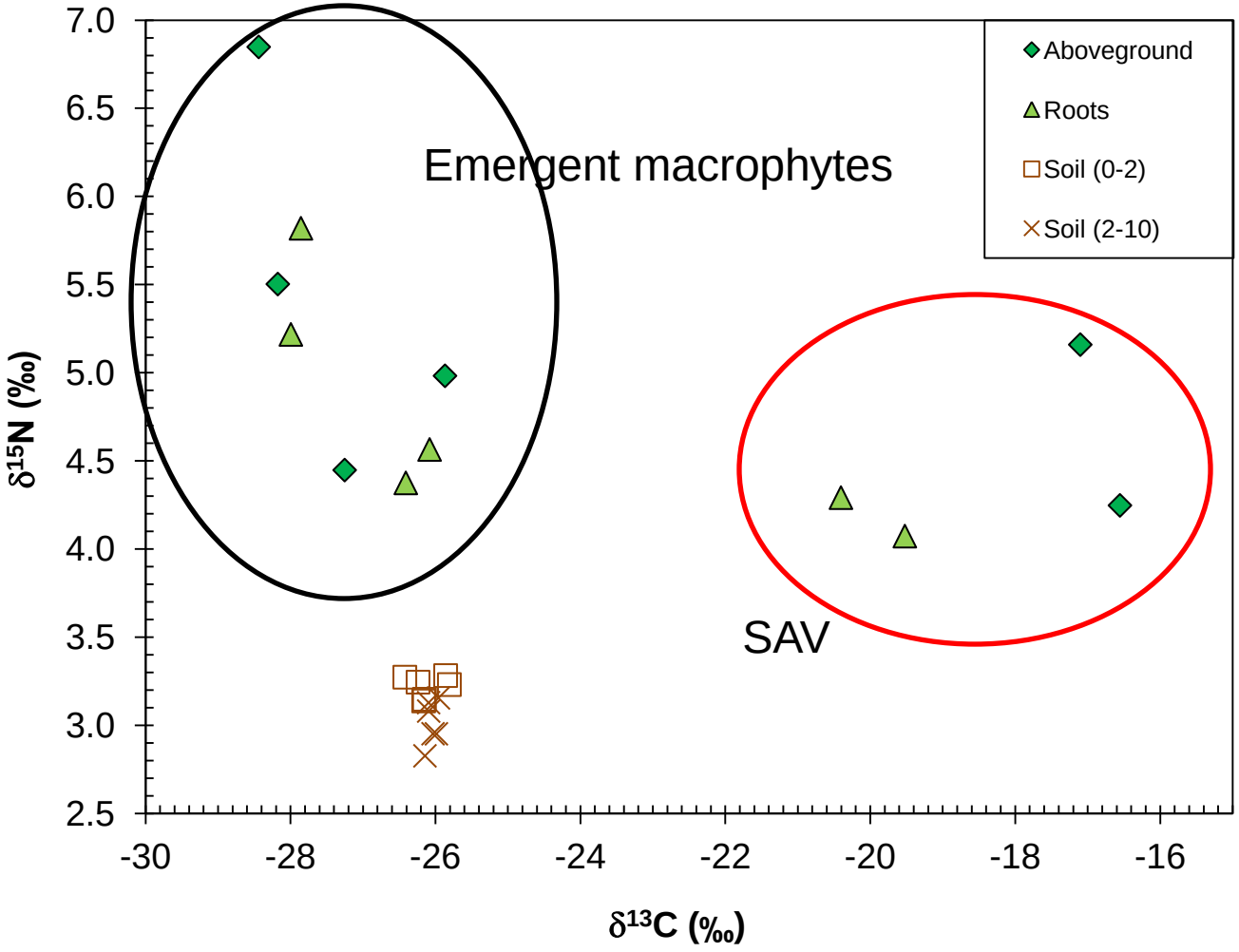
Average change in DOC concentrations between inflow and treatment outflows

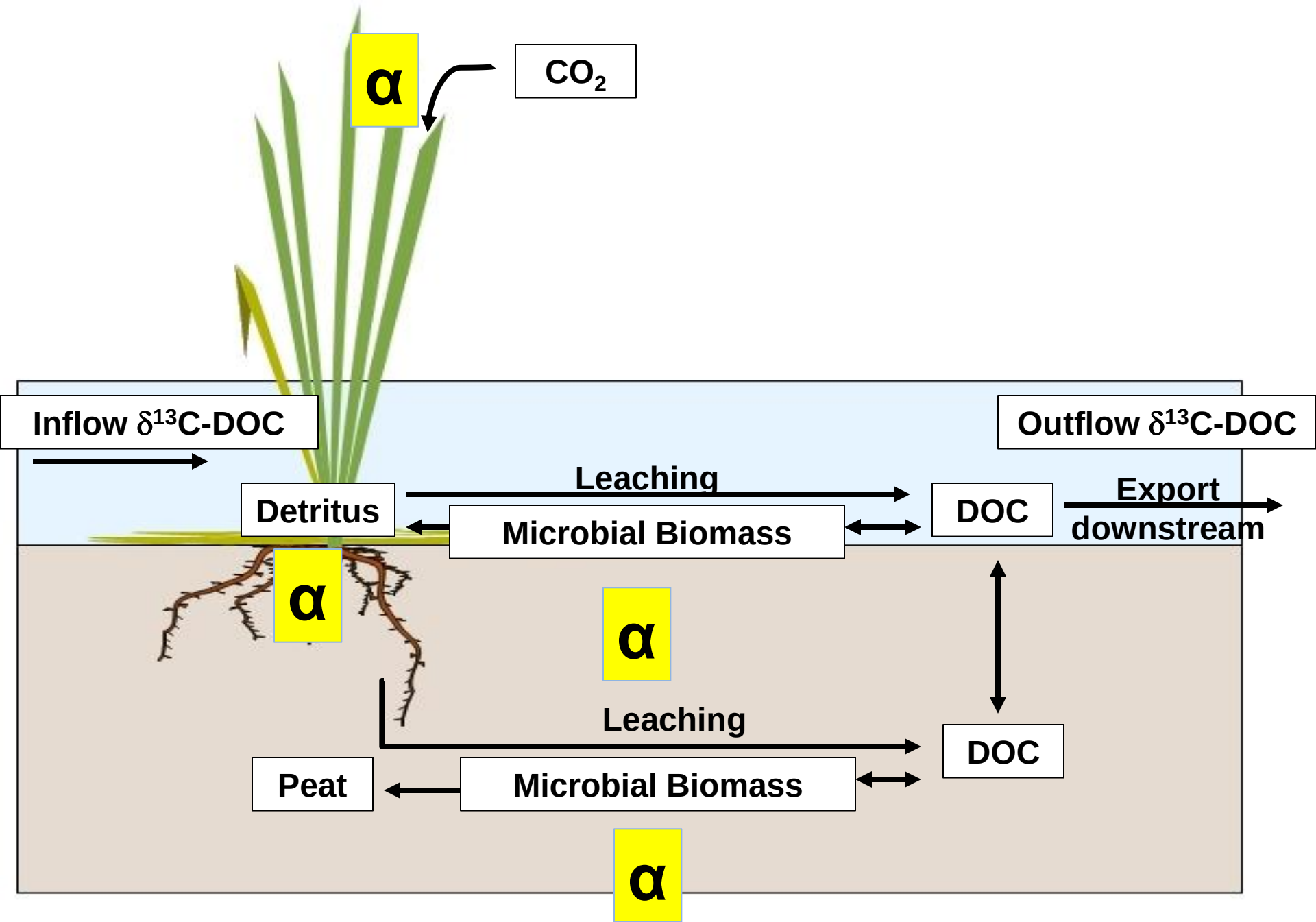


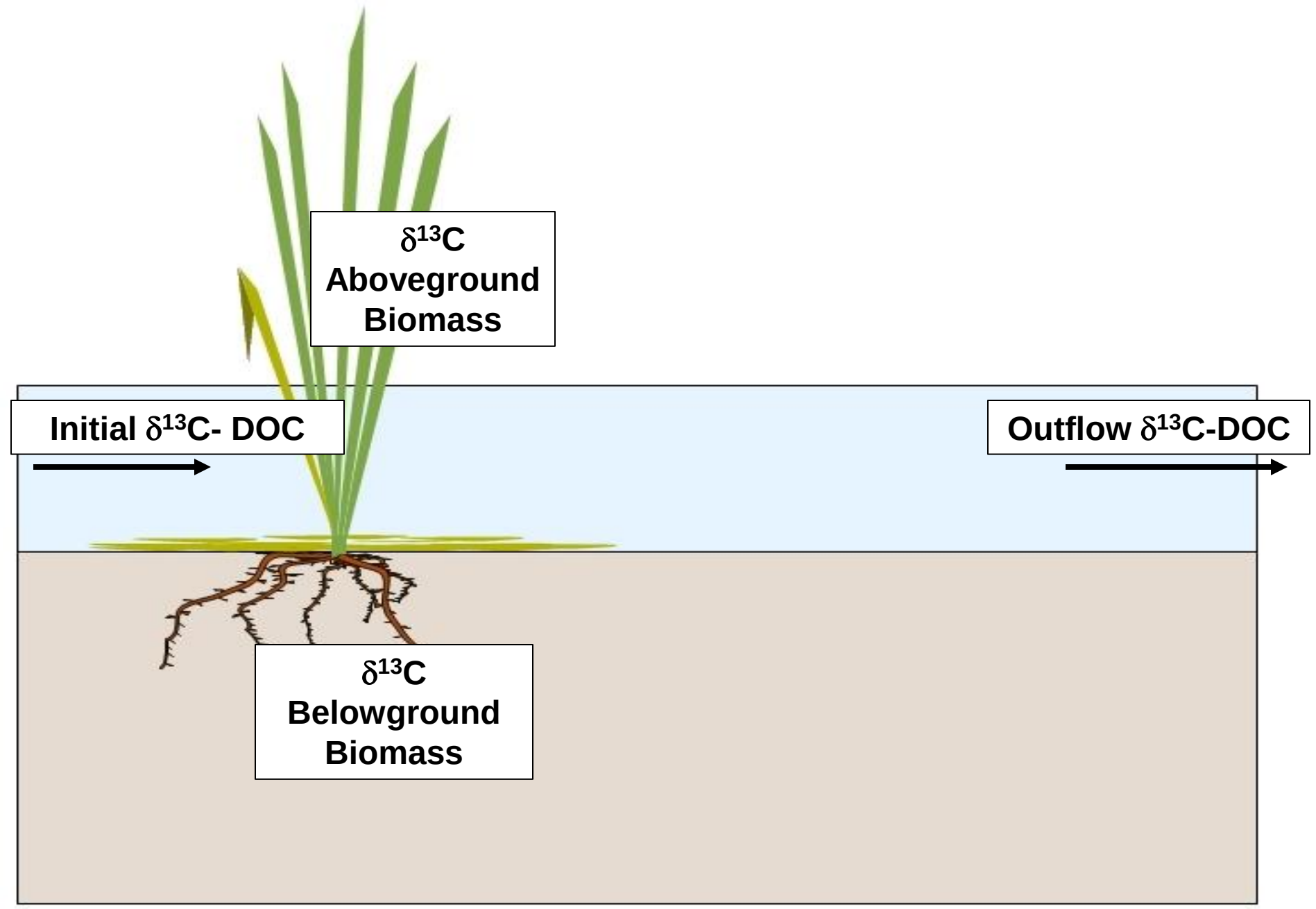

δ13C values for the inflow and treatment outflows
δ13 C ± SE (‰)
-24.5
-25.0
-25.5
-26.0
-26.5
*
*
Inflow
Typha domingensis
Cladium jamaicense
Nymphaea sp.
Nymphaea sp./ Eleocharis sp.
Najas sp./ Charas sp.
Najas sp.

RESULTS (Biomass and Soils)

Average $\delta^{13}C/\delta^{13}N$ ratios for biomass and soils for all the treatments




α
CO_2
Inflow δ^{13}C-DOC
Outflow δ^{13}C-DOC
Leaching
Detritus
Microbial Biomass
DOC
Export
downstream
α
α
Leaching
DOC
Peat
Microbial Biomass
α

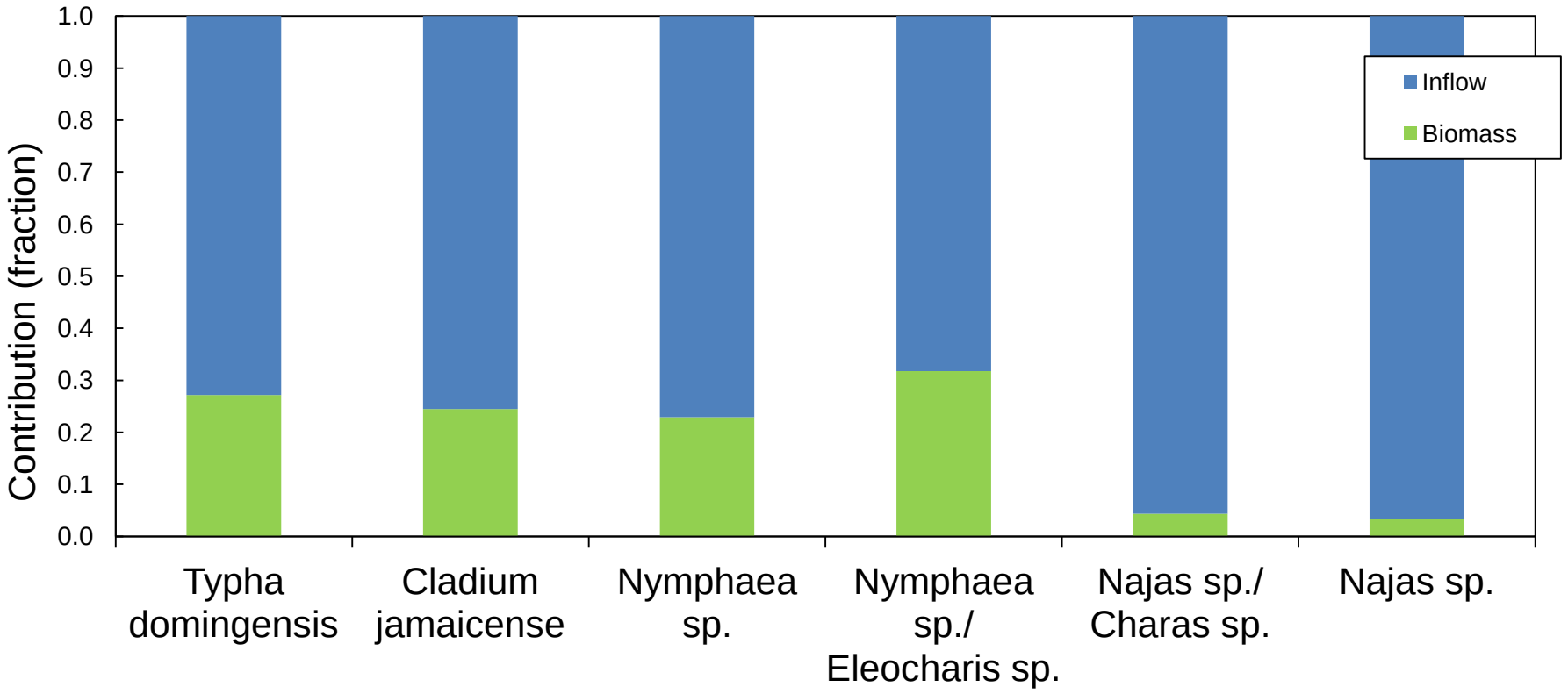

δ13C Aboveground Biomass
Initial δ13C- DOC
Outflow δ13C-DOC
δ13C Belowground Biomass

RESULTS (Isotope Mixing Model)

$$\delta^{13}\text{C-DOC}_{outflow} = (f_{inflow})\,(\delta^{13}\text{C-DOC}_{inflow}) + (f_{biomass})\,(\delta^{13}\text{C-DOC}_{biomass}) \quad (1)$$

$$1 = f_{inflow} + f_{biomass} \quad (2)$$

Inflow and biomass contributions to the outflow from each treatment



SUMMARY

All the treatments, except the *Najas* sp./*Charas* sp. were net exporters of DOM in the period evaluated.

Emergent vegetation has a considerable greater effect on DOM exports than submerged vegetation.

IMPLICATIONS

In the short term, recently constructed wetlands in the Everglades area will function as exporters of DOM and possibly other dissolved organic nutrients.

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Thanks for your Questions!!

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