A carbon budget of created wetlands

William J. Mitsch

Wilma H. Schiermeier Olentangy River Wetland Research Park

The Ohio State University

with contributions from: Evan Waletzko, Blanca Bernal, Kay Stefanik, Anne Altor, Amanda Nahlik, Sandy Sha, Chris Anderson

Wilma H. Schiermeier Olentangy River Wetland Research Park at The Ohio State University

Two experimental wetlands at the Olentangy River Wetland Research Park

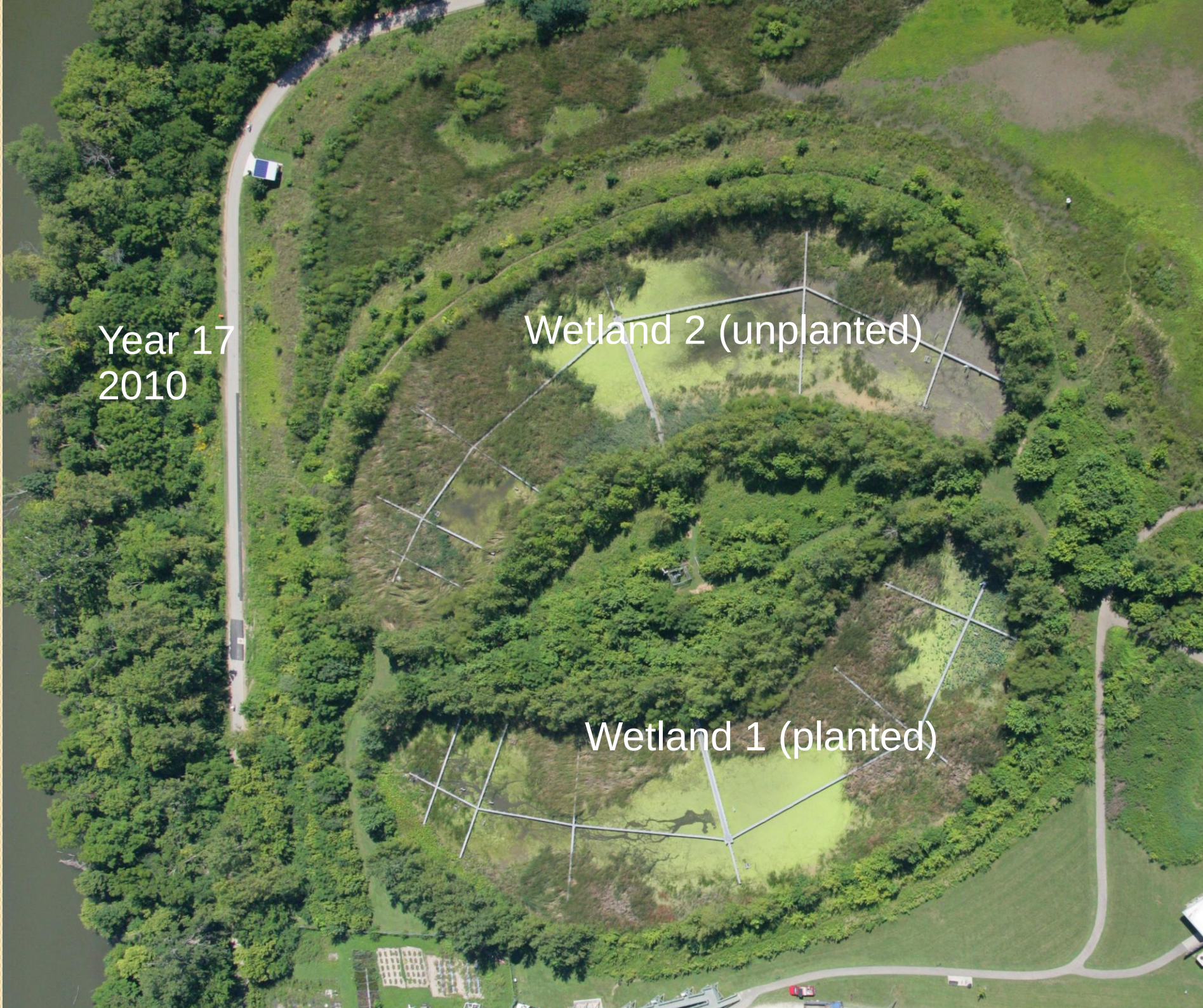
Two kidney-shaped 1-ha wetlands created in 1994.

Water is pumped from adjacent Olentangy River following the river's hydrologic pulses.

Hydric soils developed over parent non-hydric soils.

Western wetland planted in 1994, eastern wetland unplanted (naturally colonized).


Year 2
1995
Wetland 2 (unplanted)
Wetland 1 (planted)


Year 17
2010
Wetland 2 (unplanted)
Wetland 1 (planted)

Annual net primary productivity

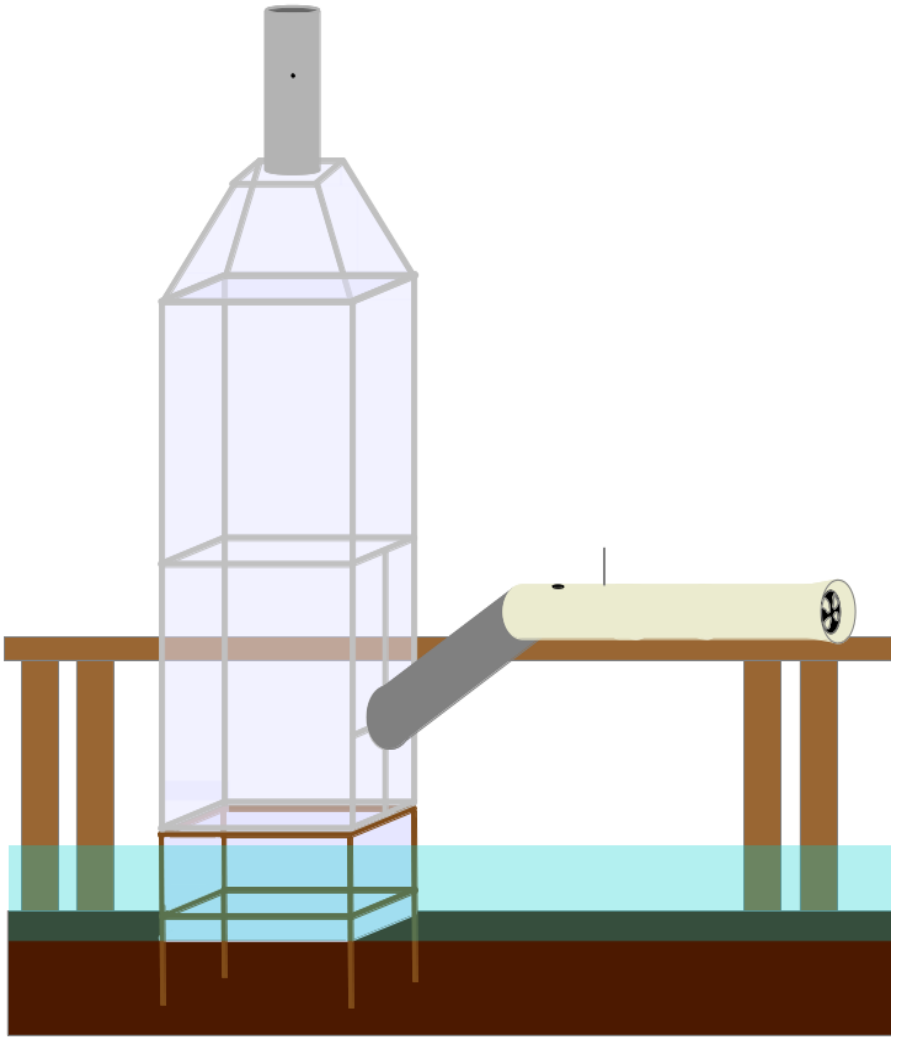
Methane emissions

Soil carbon sequestration

Wetland community metabolism

Wetland community metabolism

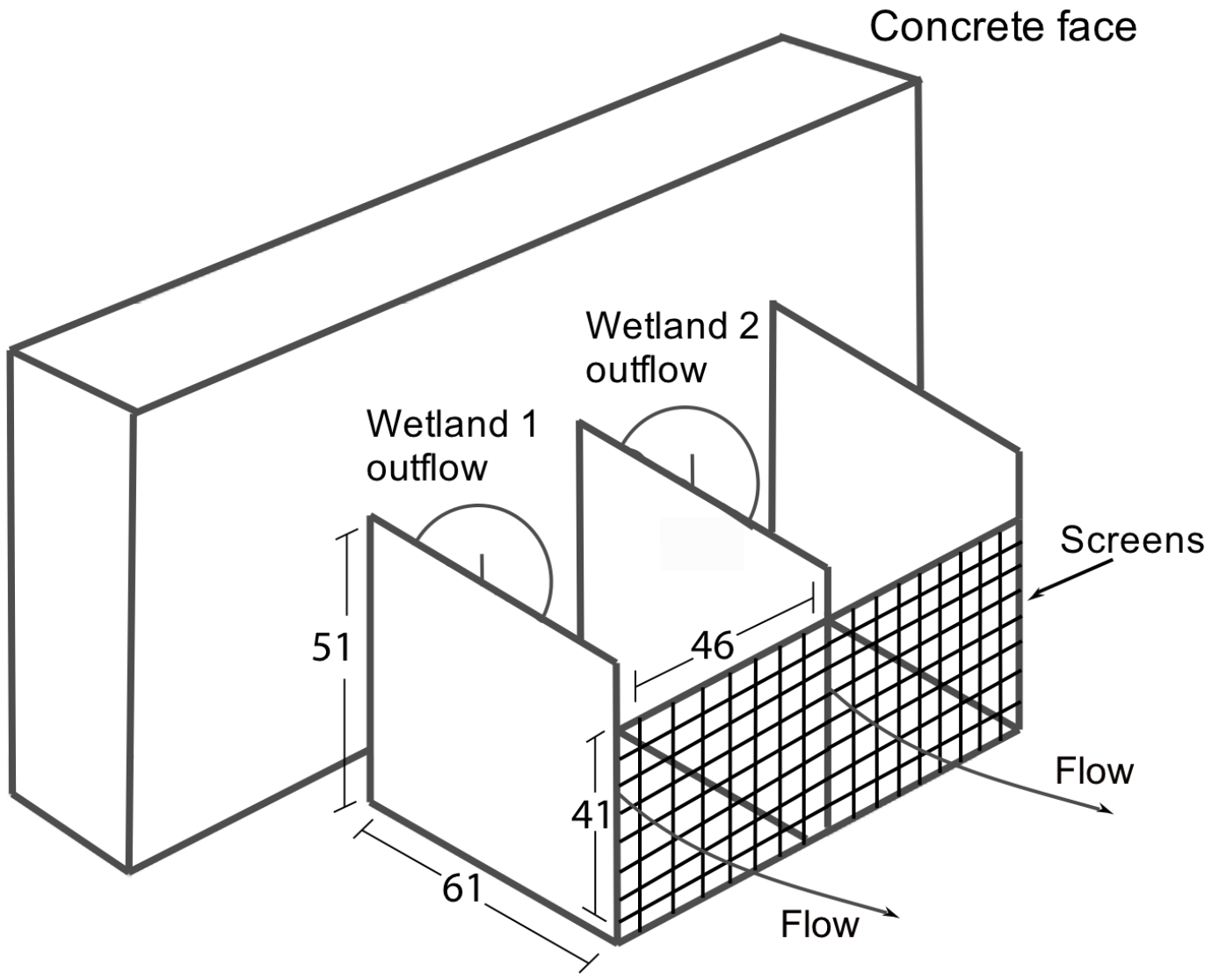
- Open system flow through chambers were placed over each community for approximately 48 hrs every month from April through September
- Samples were collected from the inflow and outflow pipes using a vial and syringe method
  - Every odd hour during the day
  - Two nightly samples



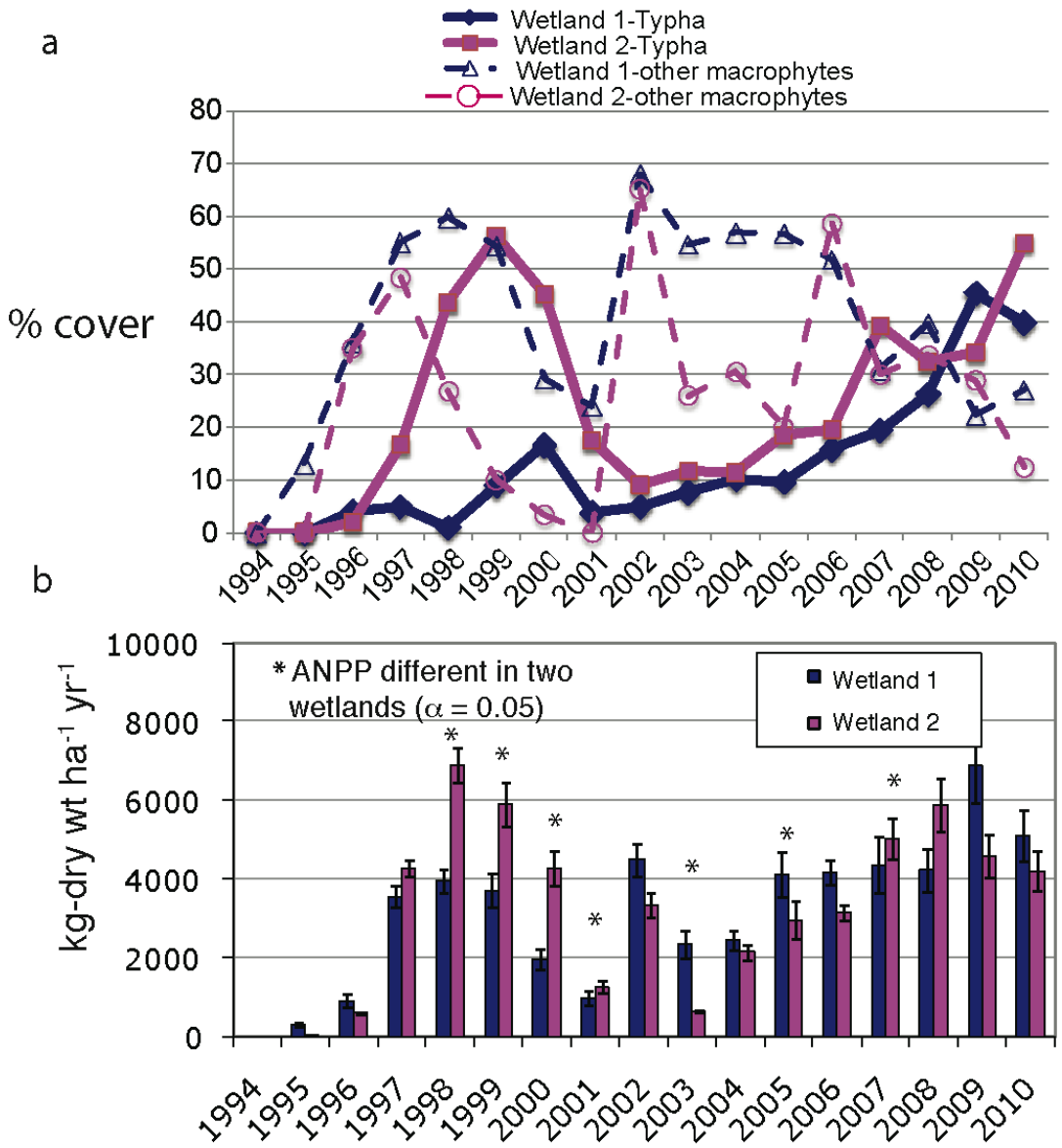
DOM, FPOM export

CPOM export from wetlands

CPOM export from wetlands

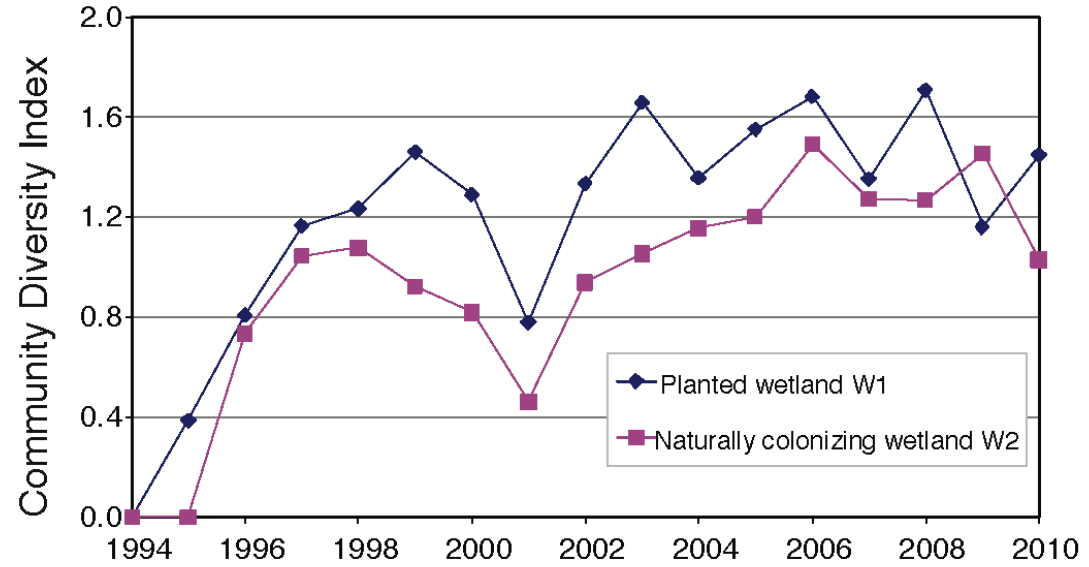


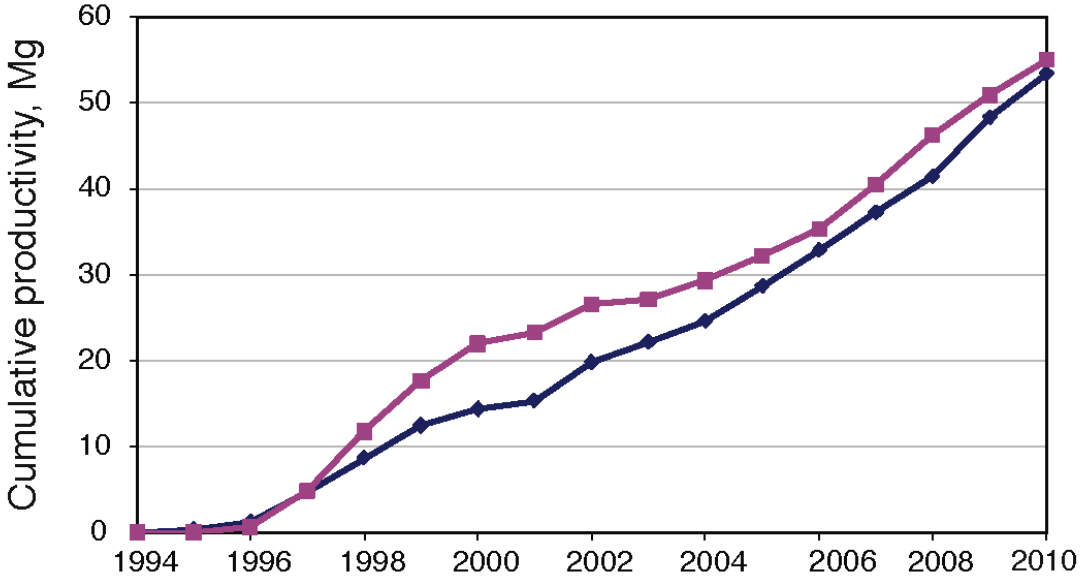
Annual net primary productivity



Mitsch et al. 2012

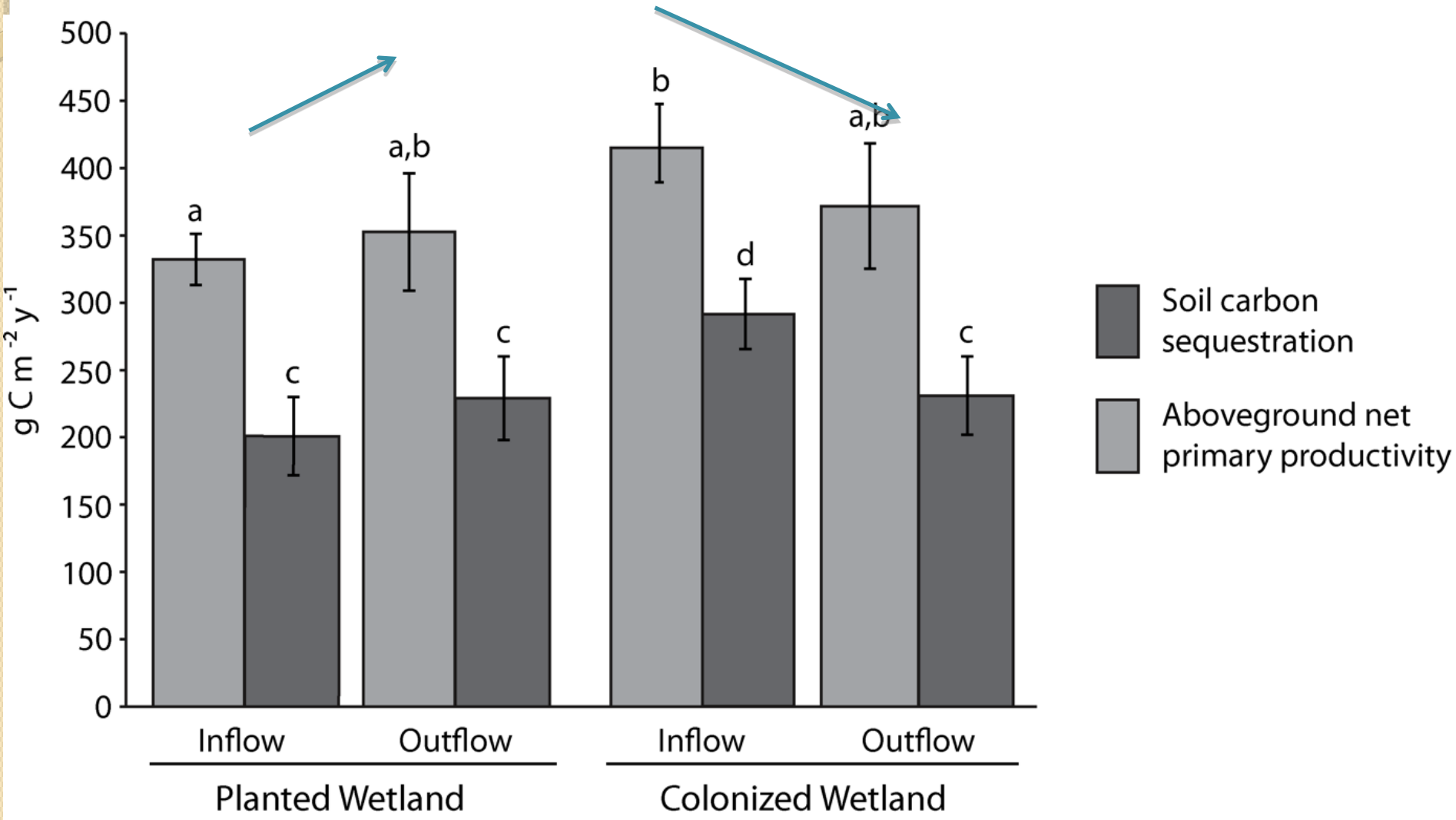
Community diversity and accumulated productivity



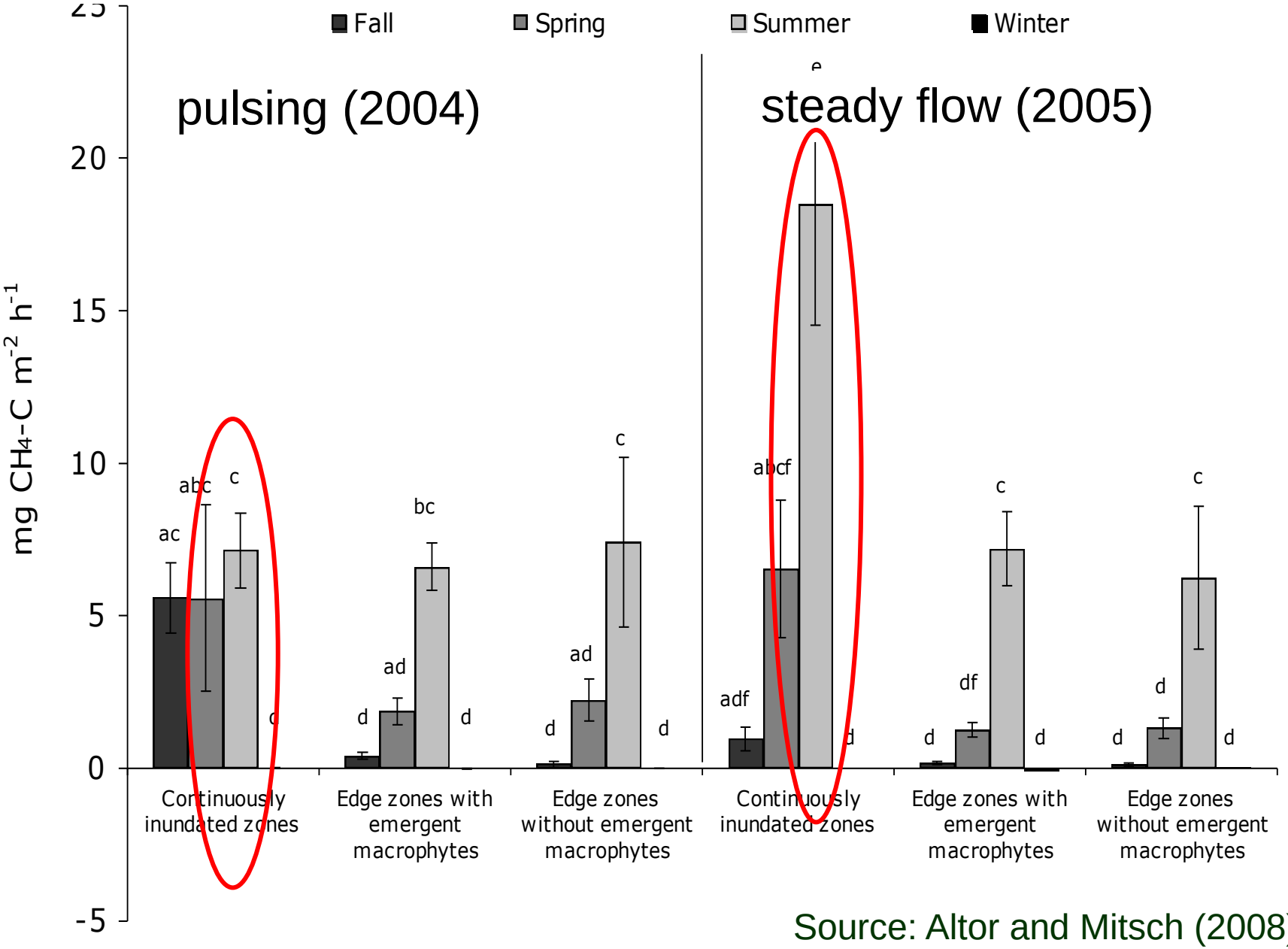


Mitsch et al. 2012

Annual net primary productivity and soil carbon sequestration

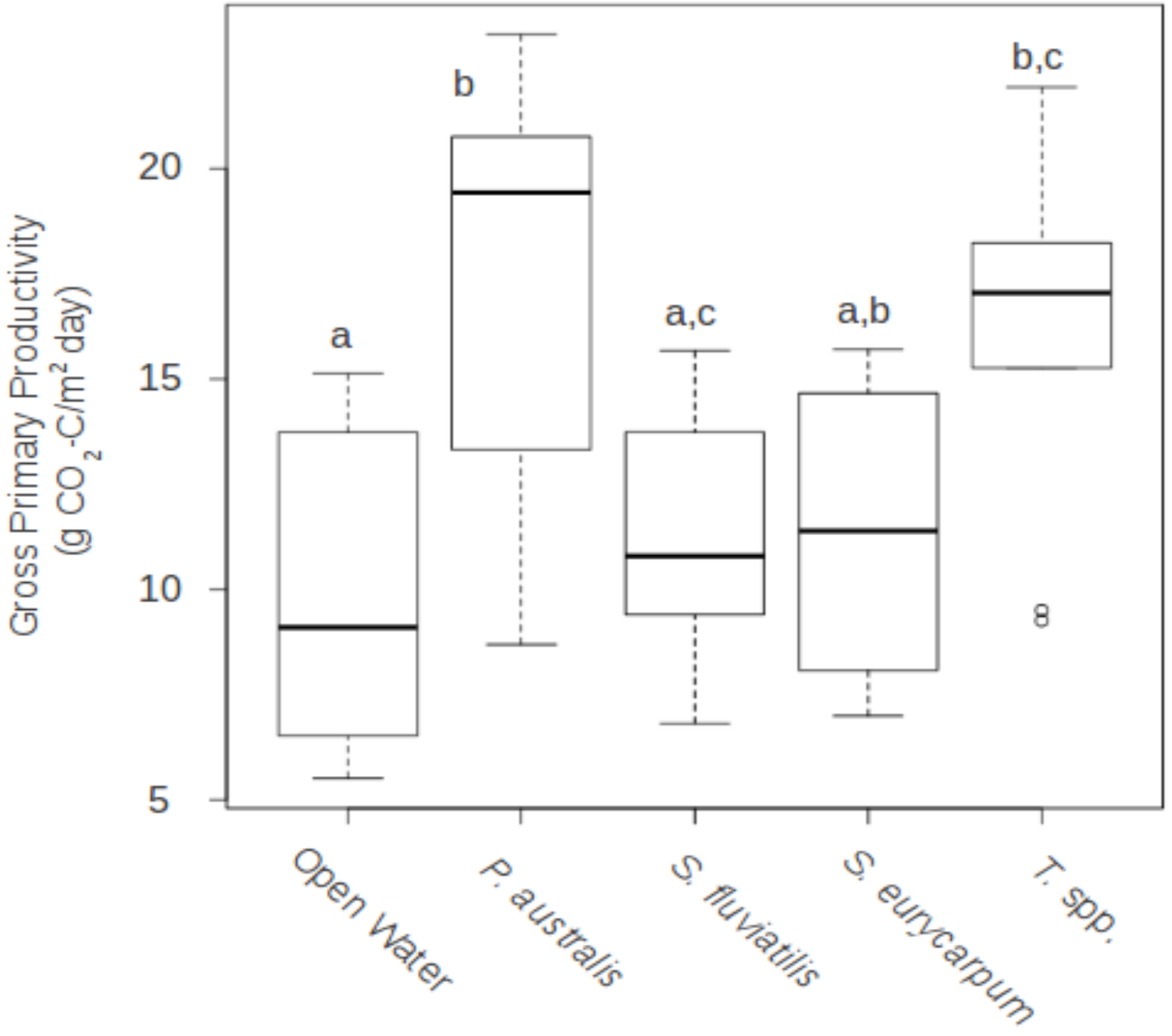


Methane emissions



Source: Altor and Mitsch (2008)

Wetland community metabolism



Wetland community metabolism

Wetland carbon retention, extrapolated to the entire wetland by weighted gross primary productivity, respiration, and methane emissions:

Planted Wetland (W1): 160 g-C m^{-2} yr^{-1}

Unplanted Wetland (W2): 195 g-C m^{-2} yr^{-1}

22% higher in unplanted wetland

By soil carbon sequestration method:

Planted Wetland (W1): 219 g-C m^{-2} yr^{-1}

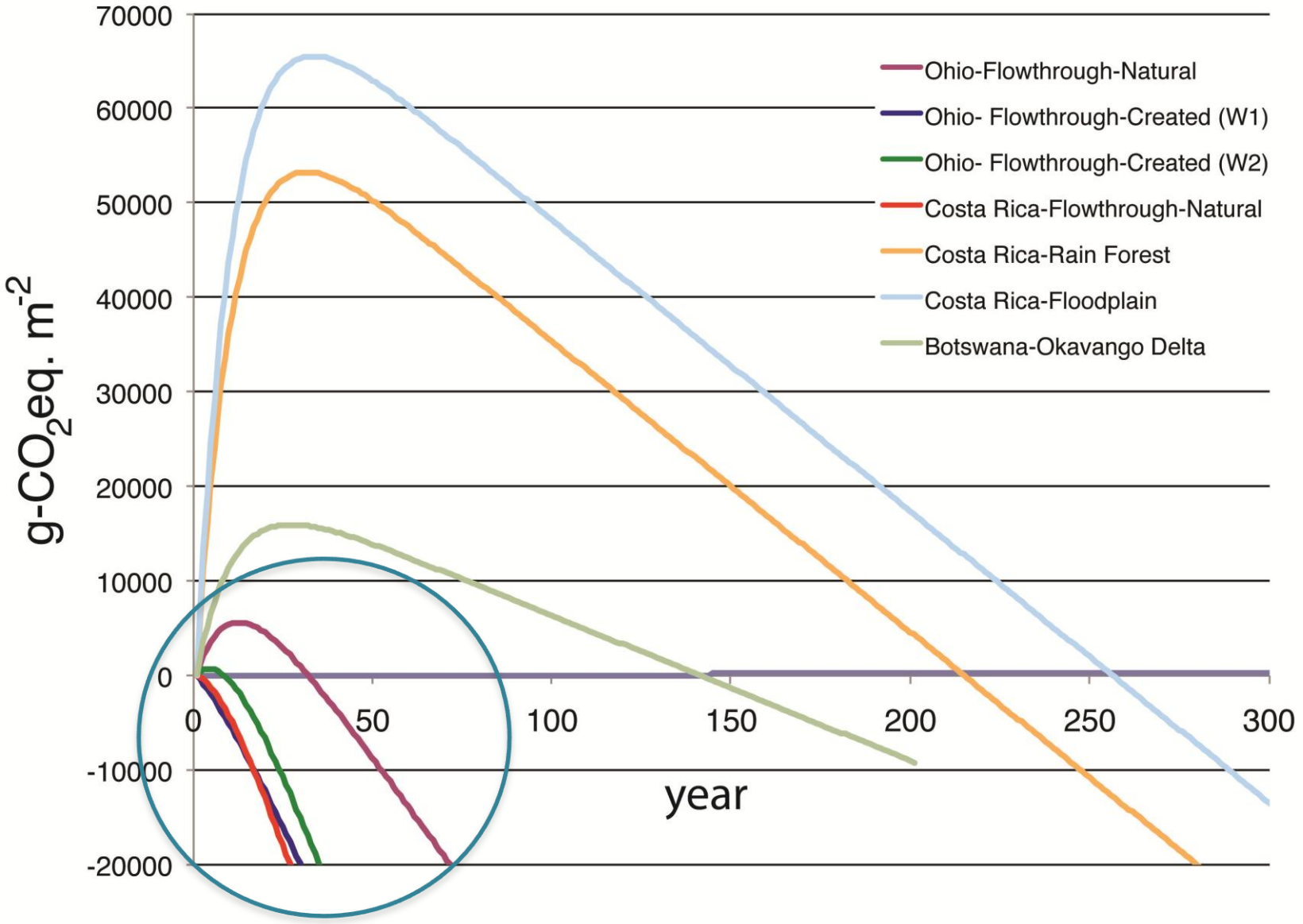
Unplanted Wetland (W2): 267 g-C m^{-2} yr^{-1}

22 % higher in unplanted wetland

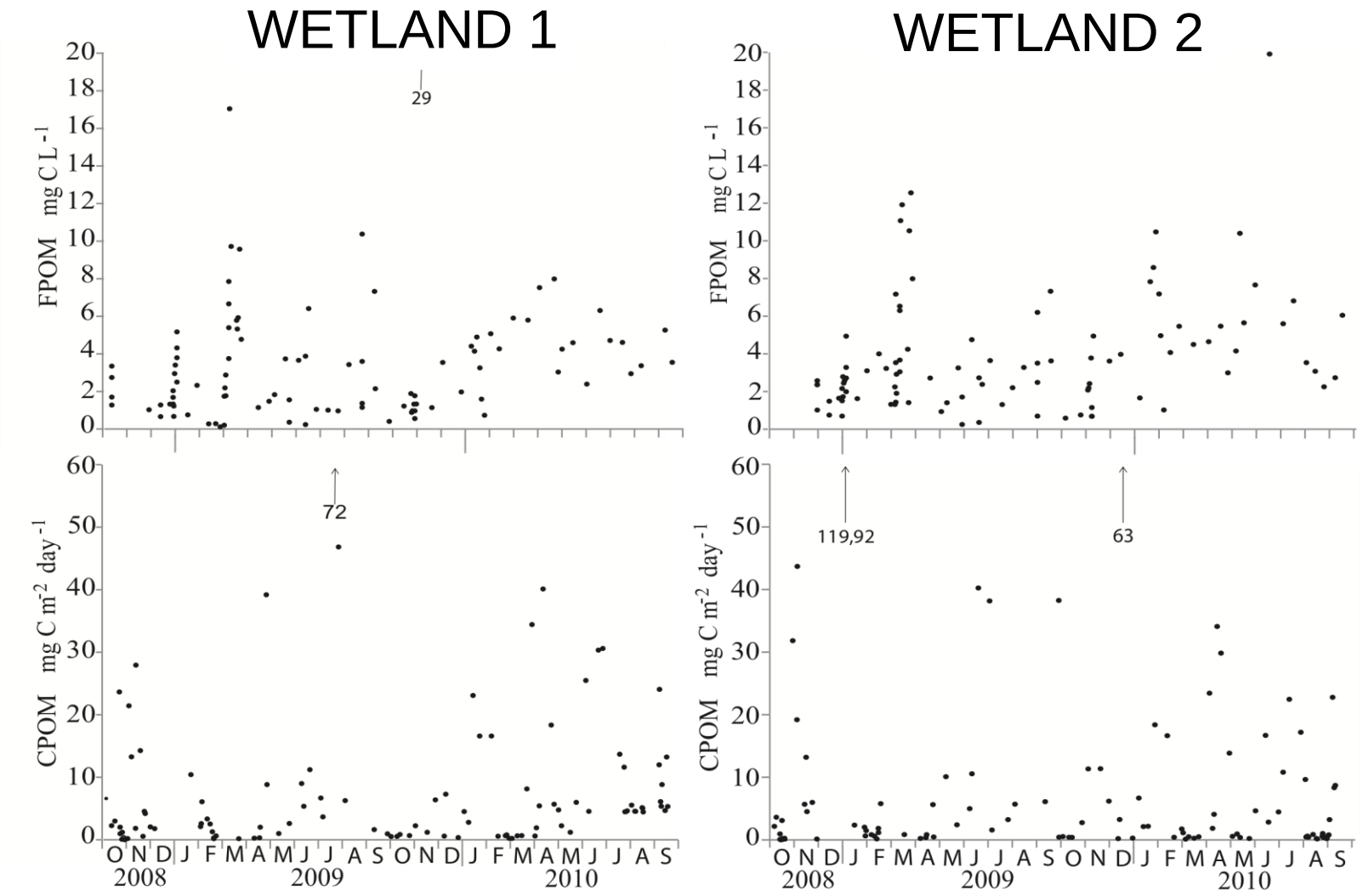
Methane emissions and carbon sequestration in experimental wetlands (g-C m^{-2} yr^{-1}) (Mitsch et al. 2012)

Wetland	Hydrology	Methane emissions	Carbon sequestration	CO2/CH4 Ratio
Planted wetand W1	Pulsing (2004)	16	181	**37:1**
	Steady flow (2005)	16		
	Normal river pulsing (2006-2008)	13	219±15	**46:1**
Unplanted wetland W2	Pulsing (2004)	32	193	**17:1**
	Steady flow (2005)	31		
	Normal river pulsing (2006-2008)	47	267±17	**16:1**
Reference wetland		57	140±16	**7:1**
General range for wetlands		1 to 1000	20-40	

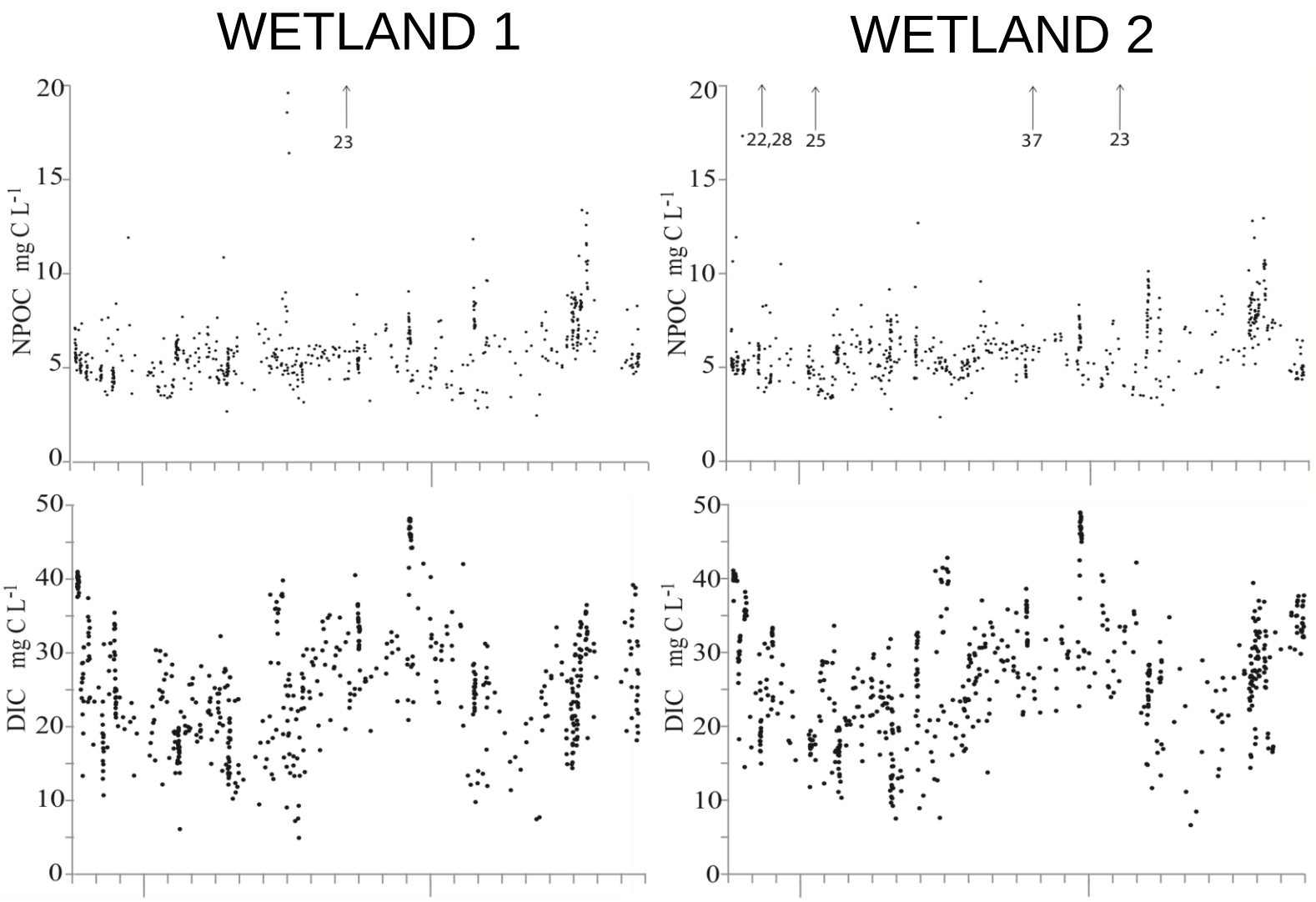
Net radiative forcing of climate change (Mitsch et al. in press)



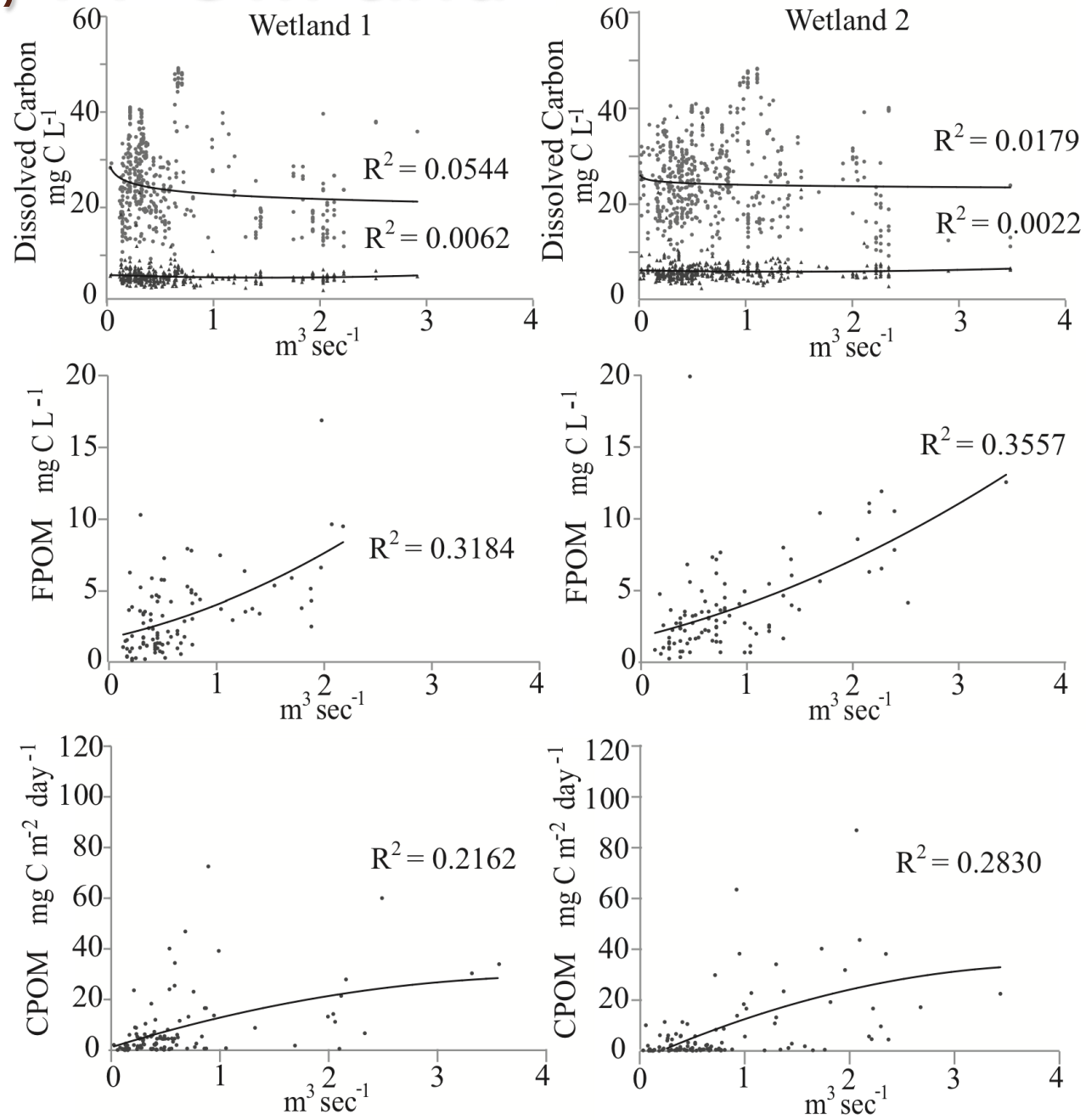
FPOM and CPOM - Outflows



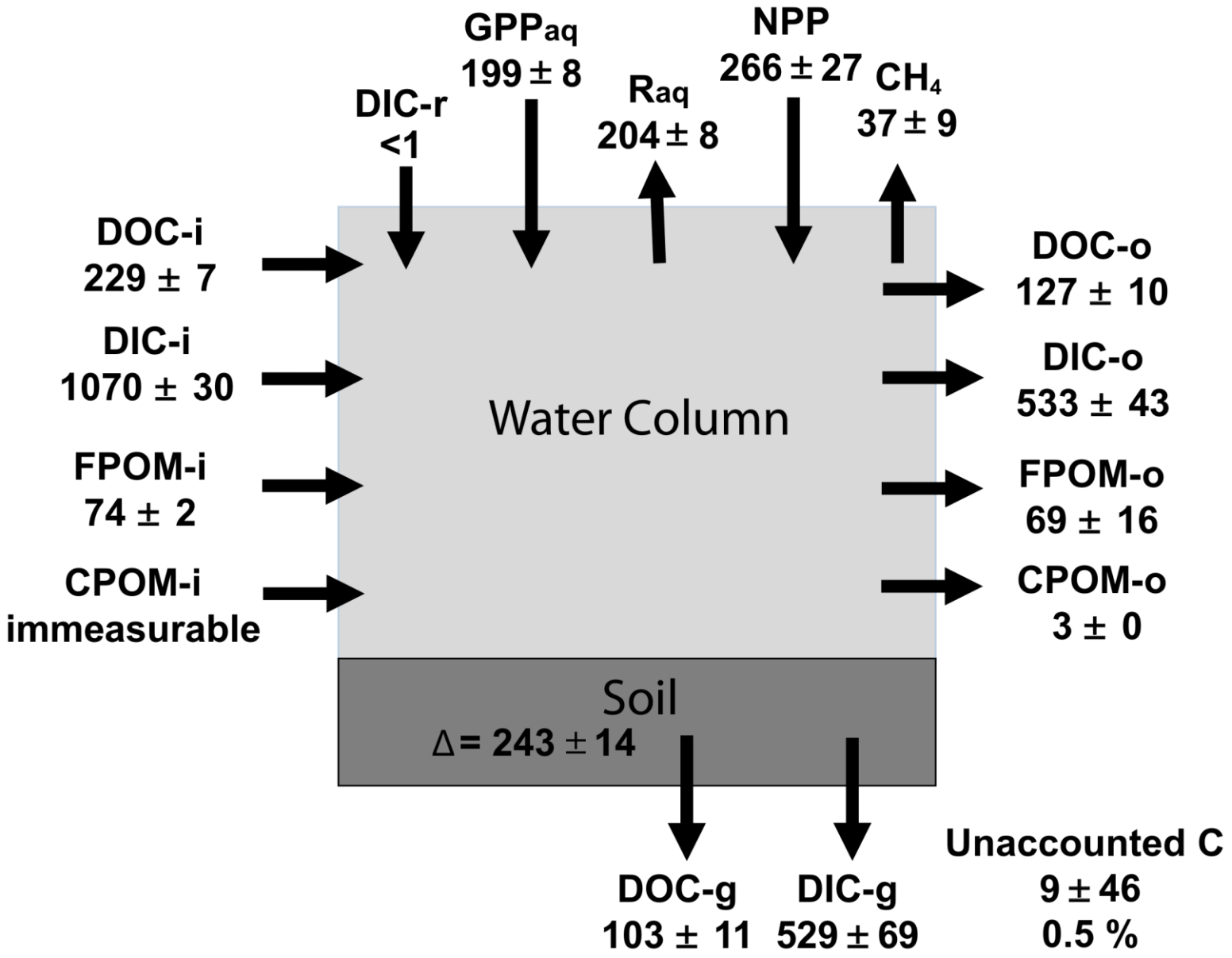
OC and DIC - Outflows



POC, FPOM and CPOM vs. Flow



Carbon Mass Balance g-C m^{-2} yr^{-1}



Conclusions

- Created wetlands can be significant carbon sinks, more so than even natural wetlands.
- The unplanted wetland maximized power, the planted wetland was more diverse.
- There are long-term unintended consequences of seemingly inconsequential actions such planting.
- Carbon sequestration in wetlands can only be determined with multi-year integrated studies with checks and balances.
- Methane from created wetlands should not be viewed as a significant concern and wetlands can be designed to minimize these emissions.

Many thanks to the hundreds of students and staff at the Olentangy River Wetland Research Park (ORWRP) over the past 21 years and even the pre-ORW students who set the stage for the ORWRP at wetlands in Ohio and around the Midwest

1996

1997

2000

2002

2004

2006

2008

2010

2012

EcoSummit 2012 will bring together the world's most respected minds in ecological science to discuss restoring the planet's ecosystems. Come hear Nobel Prize laureate Elinor Ostrom, Pulitzer Prize winners E.O. Wilson and Jared Diamond, Kyoto Prize winner Simon Levin, Stockholm Water Prize laureates Sven Jørgensen and William Mitsch, and many others in the first conference ever linking the Ecological Society of America (ESA), The International Association for Ecology (INTECOL) and the Society for Ecological Restoration International (SER).

Over 1950 abstracts from 100 countries were received by EcoSummit 2012 for presentations in 65 symposia, dozens of general sessions, and hundreds of poster presentations. More than a dozen professional workshops and forums with 100 additional participants will also be included in the Program.

After EcoSummit 2012