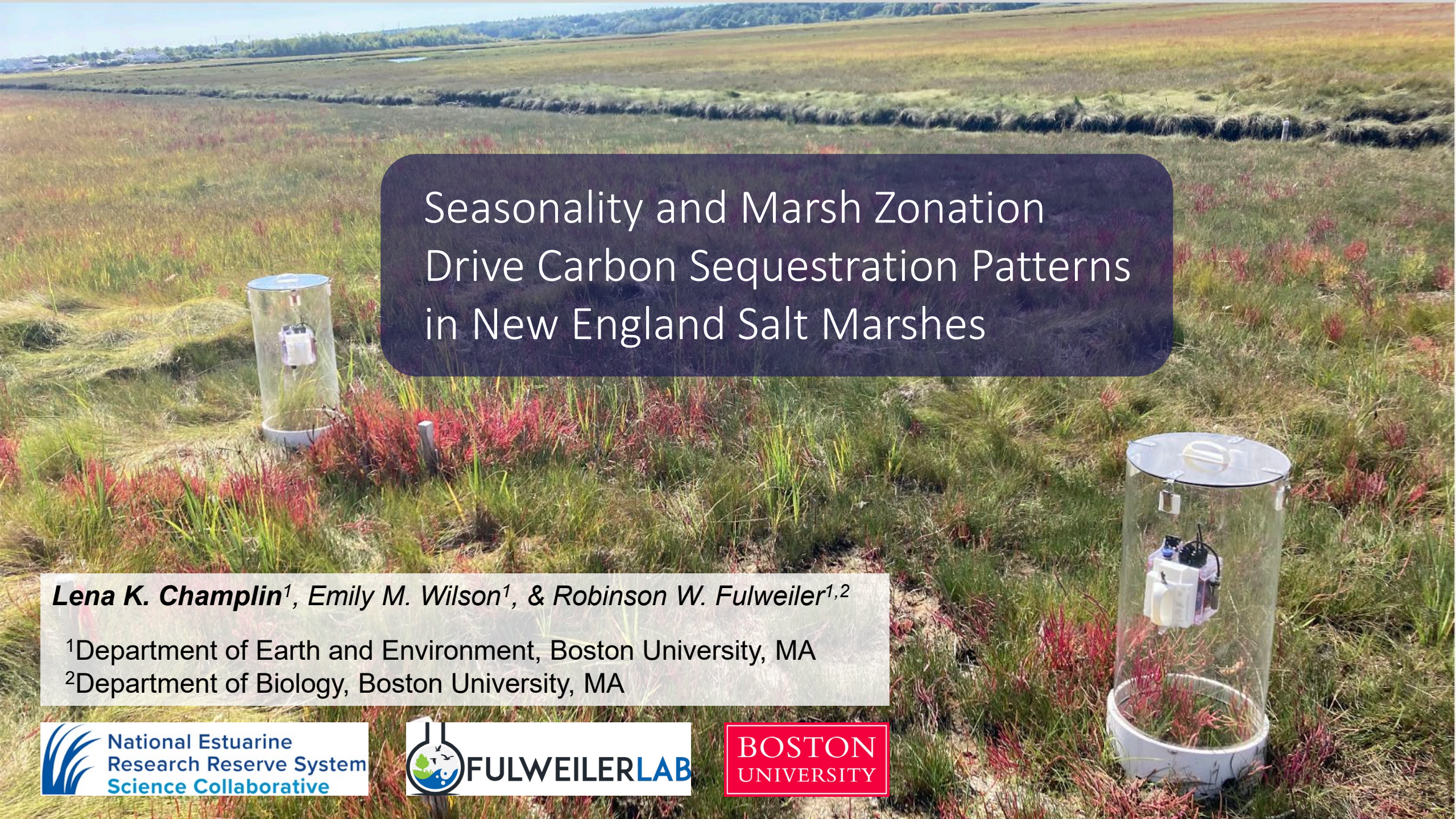

Seasonality and Marsh Zonation Drive Carbon Sequestration Patterns in New England Salt Marshes

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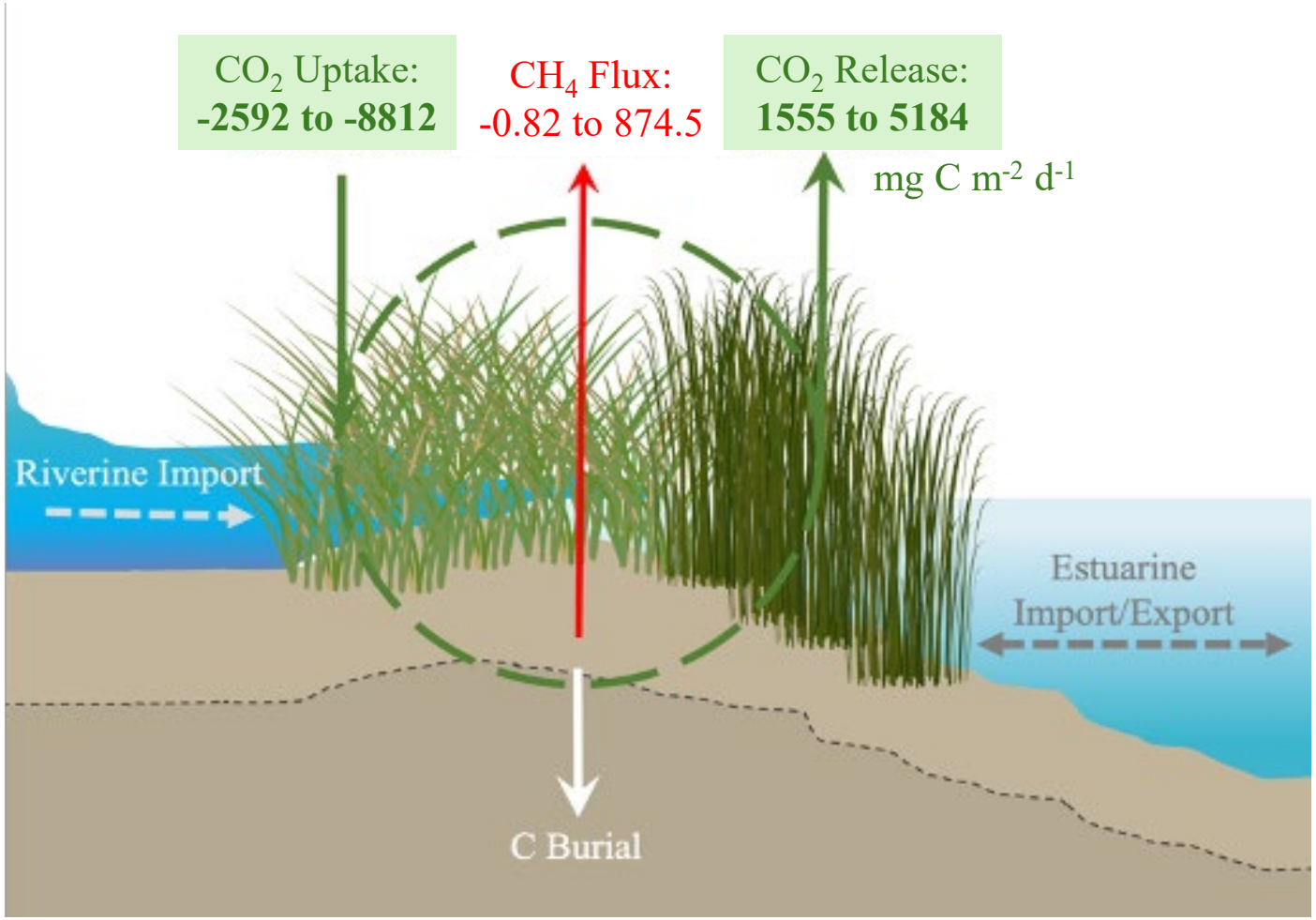
Vertical Fluxes

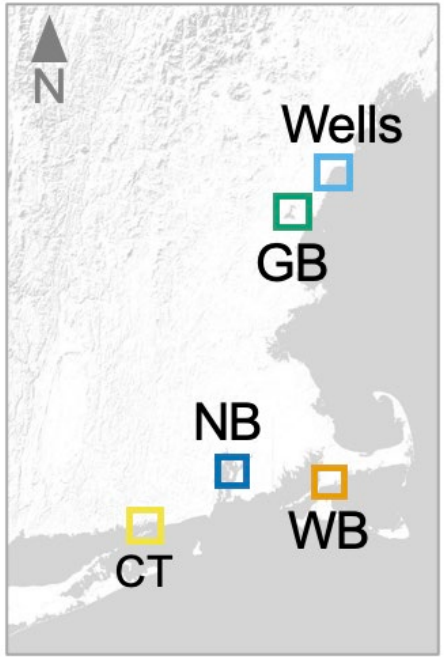


Data from Geoghegan et al., 2018 and Rosentreter et al., 2021

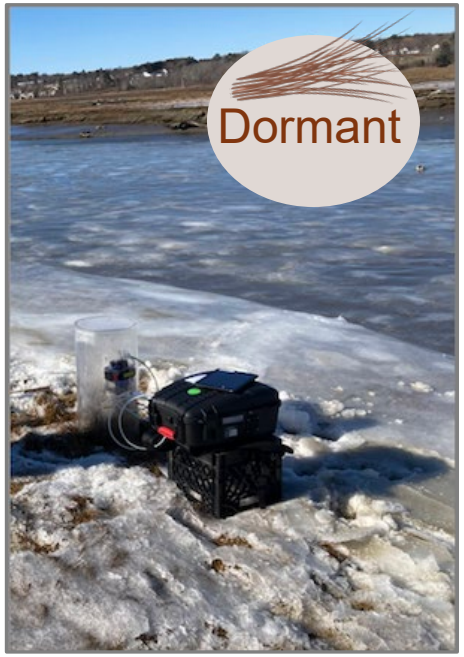
Figure by Dr. Amanda Vieillard

Data Limitations

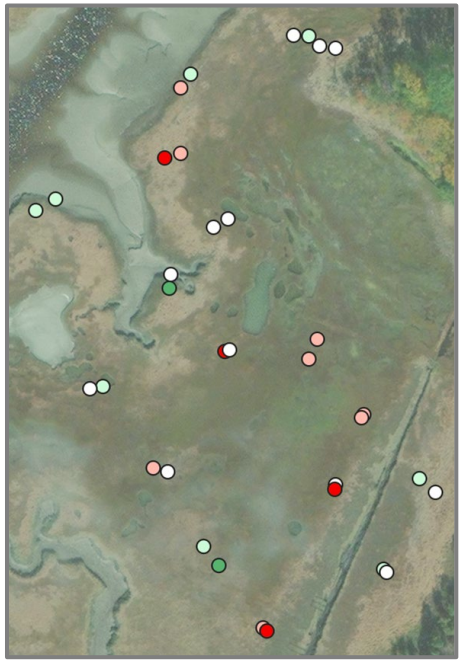
(1) Regional



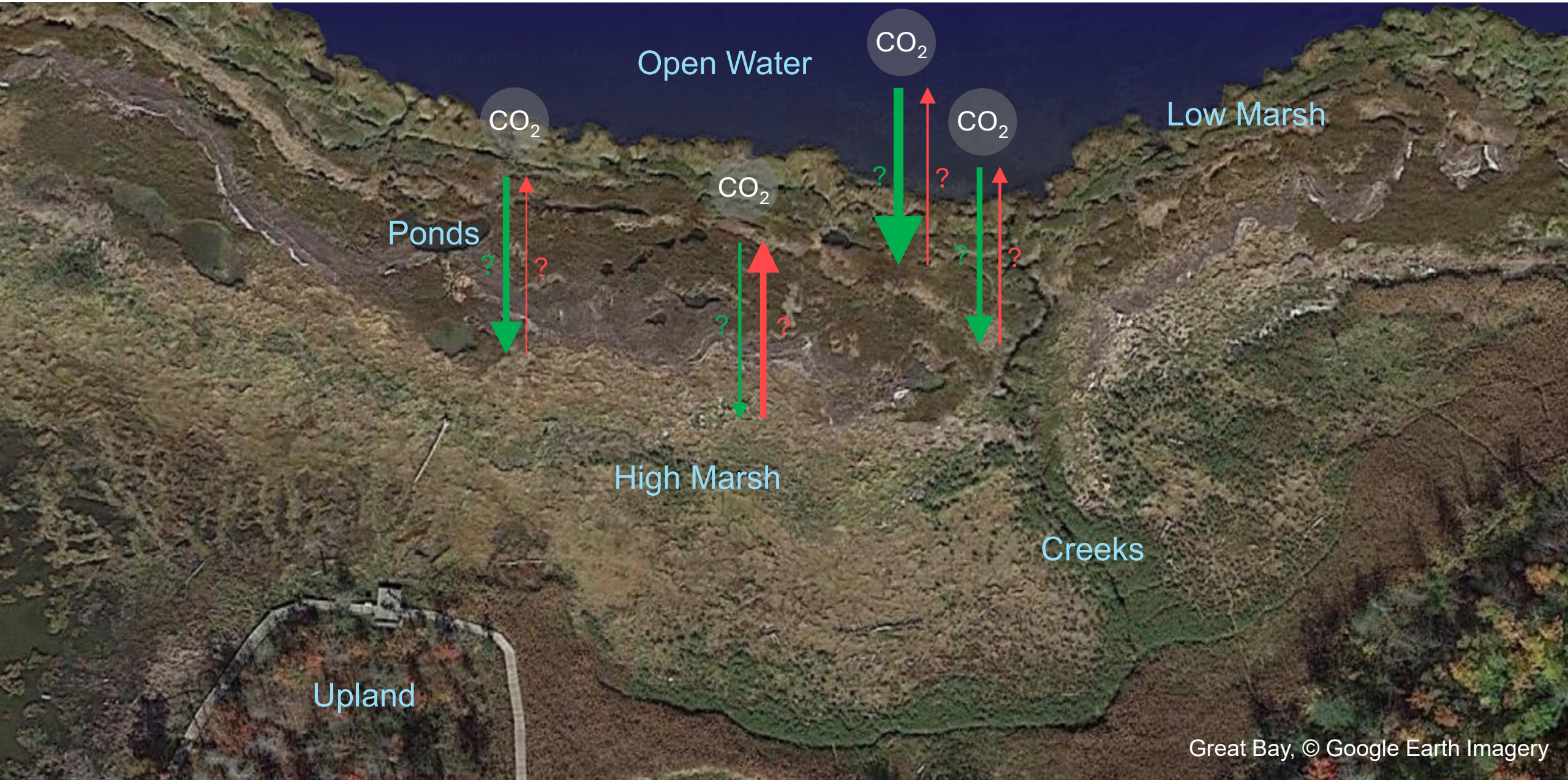
(2) Year-Round



(3) Within-Marsh



Spatial Heterogeneity

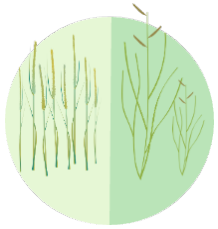


Drivers of CO_2 Fluxes

Table 3. Correlation coefficients (r)

Variable	CO_2 All	1	2	3	4
Temperature and PAR					
Ambient	−0.18	−0.32	−0.44	0.41	−0.07
Inside chamber	−0.18	−0.25	−0.39	0.18	−0.22
Soil	−0.33	−0.33	−0.42		−0.28
PAR	−0.11	0.07	−0.48	0.03	−0.10
Porewater					
pH	**0.34**	0.46	0.19	−0.37	0.06
Salinity	0.13	0.05	0.18	−0.80	0.18
Sediment					
SWC	−0.24	−0.19	0.63	−0.55	−0.08
Bulk density	−0.02	0.15			−0.25
LOI	−0.14	0.36	0.72	−0.13	−0.38
N%	−0.32	0.36			−0.16
C%	−0.29	0.26			0.13
C:N	−0.30	−0.32			**0.84**
Biomass					
Total AGB	−0.07	0.19	0.03	−0.57	−0.05
Live AGB	**−0.35**	−0.33	−0.45	−0.73	−0.39
Dead standing AGB	**0.36**	**0.67**	0.31	**0.93**	0.43
Species richness	−0.03	−0.07	0.45	−0.21	−0.19
Phragmites australis	−0.11	−0.19	−0.04	−0.77	−0.10
Spartina alterniflora	−0.03	0.08	0.18		0.09
Spartina patens	0.16	0.02	0.56	**0.88**	−0.05
Distichlis spicata	−0.21	−0.12	−0.50	−0.32	0.02
Salicornia spp.	−0.02	−0.04		−0.32	0.20
Agrostis spp.	0.18			−0.61	
Suaeda linearis	0.10			−0.32	

Weather?

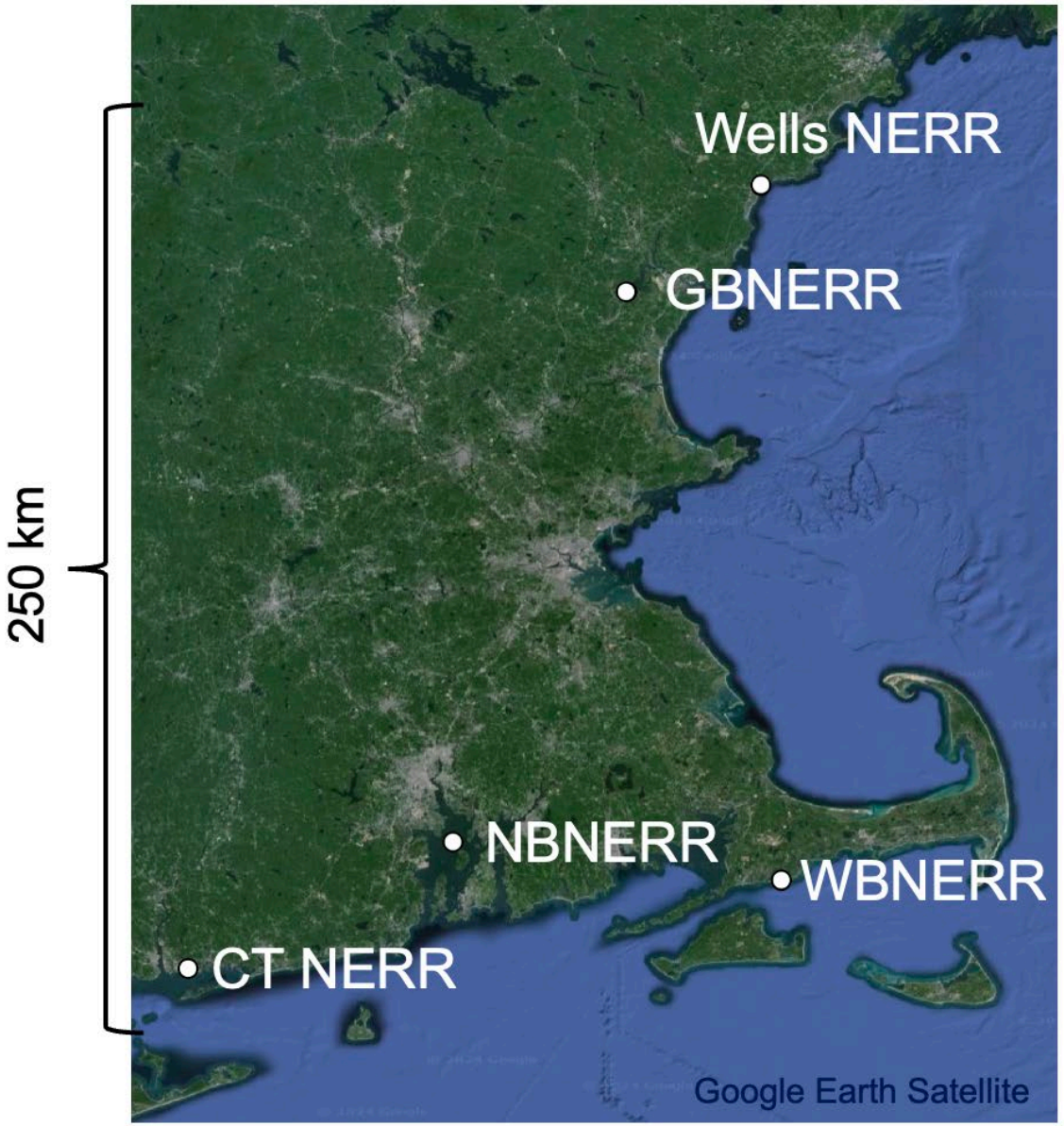


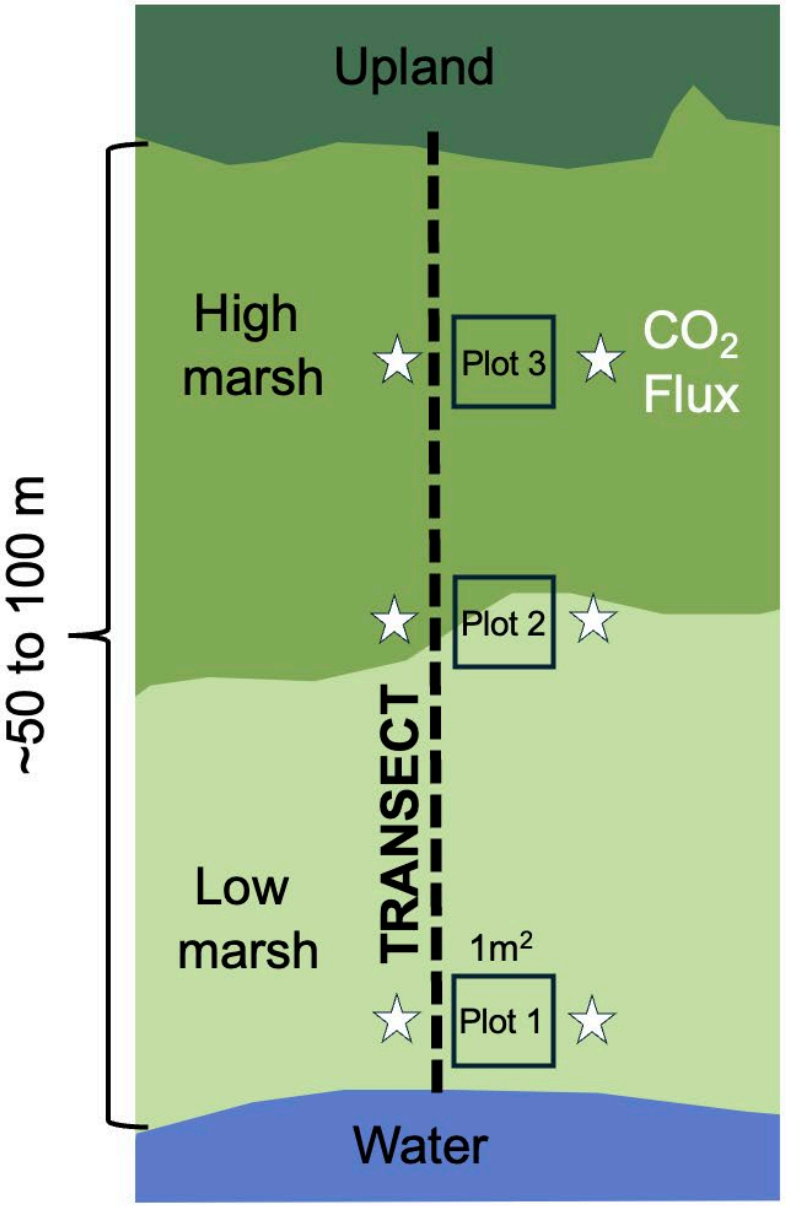
Plants?

Poor correlation of CO_2 fluxes with environmental variables (Emery & Fulweiler, 2017)

Icons from IAN Media Library

Regional Sampling





Year-Round Sampling

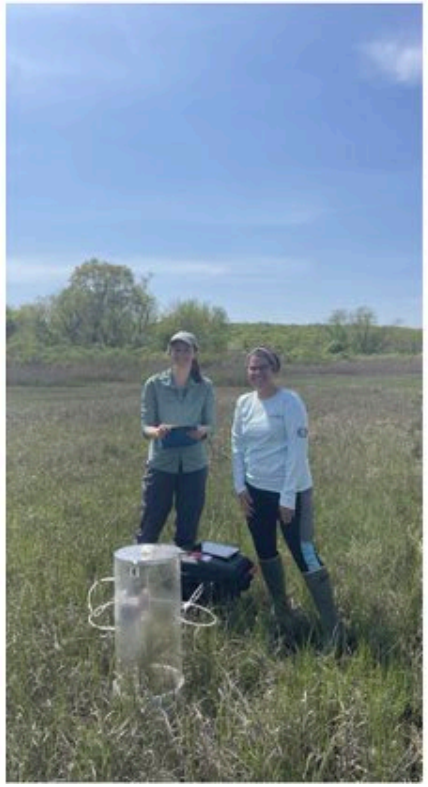
December

February

Dormant

May

July



August – September

Growing

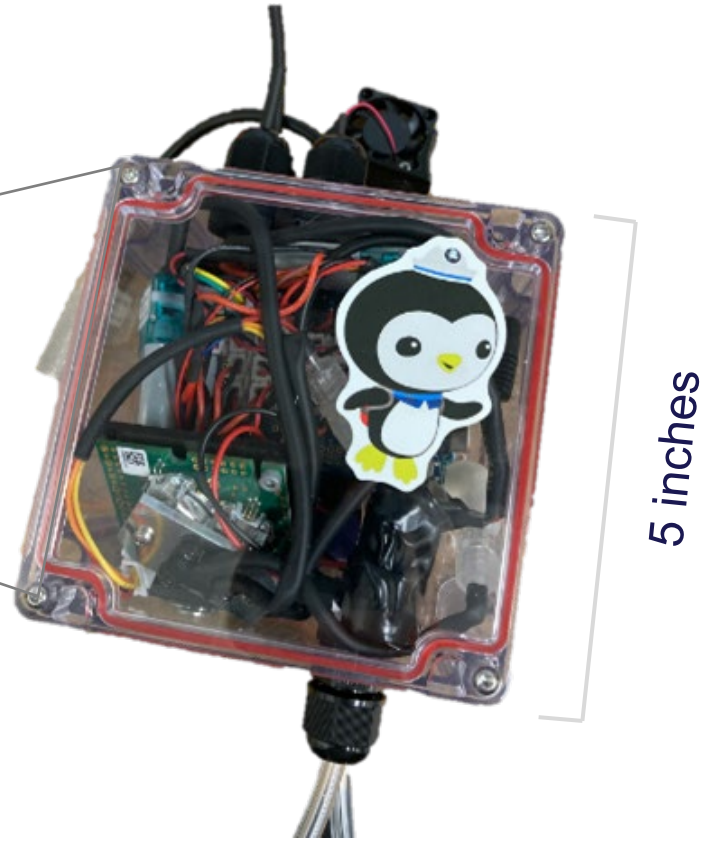
High-Resolution Sampling

Growing

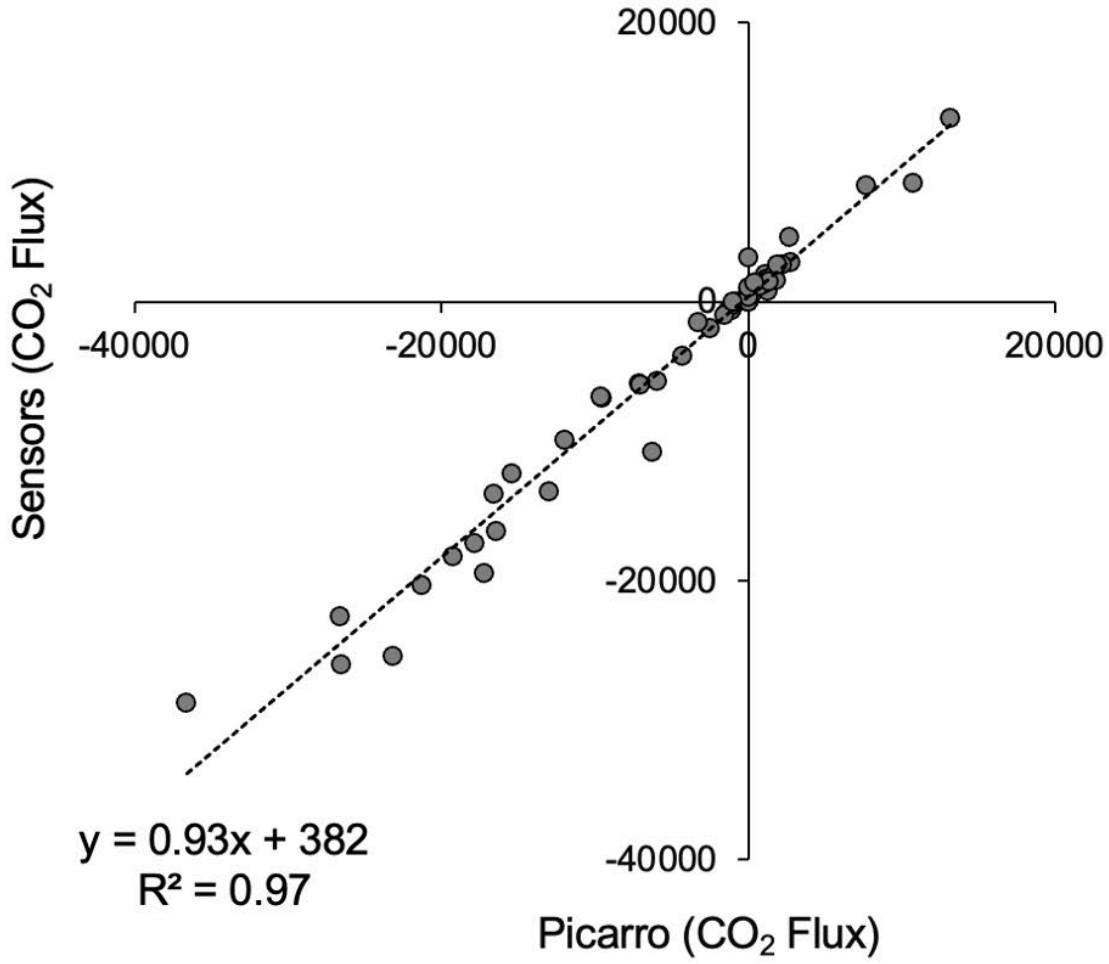
CO_2 Flux
(mmol m^{-2} h^{-1})

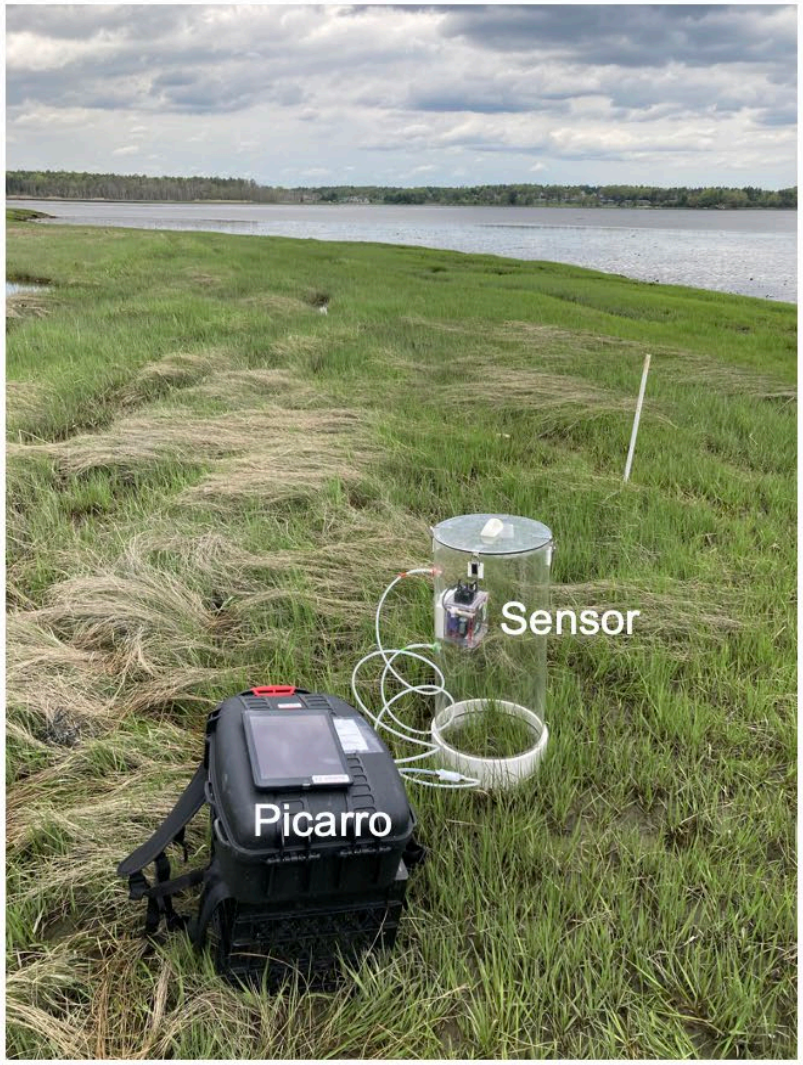
- 15 to 25
- 5 to 15
- -5 to 5
- -15 to -5
- -25 to -15
- -35 to -25

Low-cost, Ultraportable CO_2 Sensors

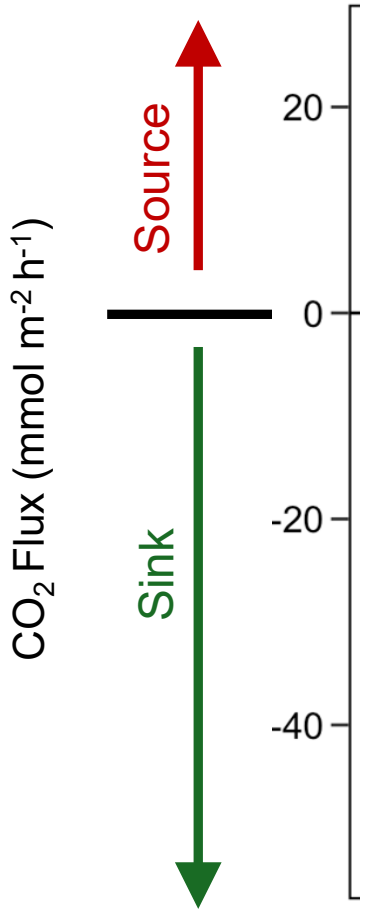


In Situ Validation



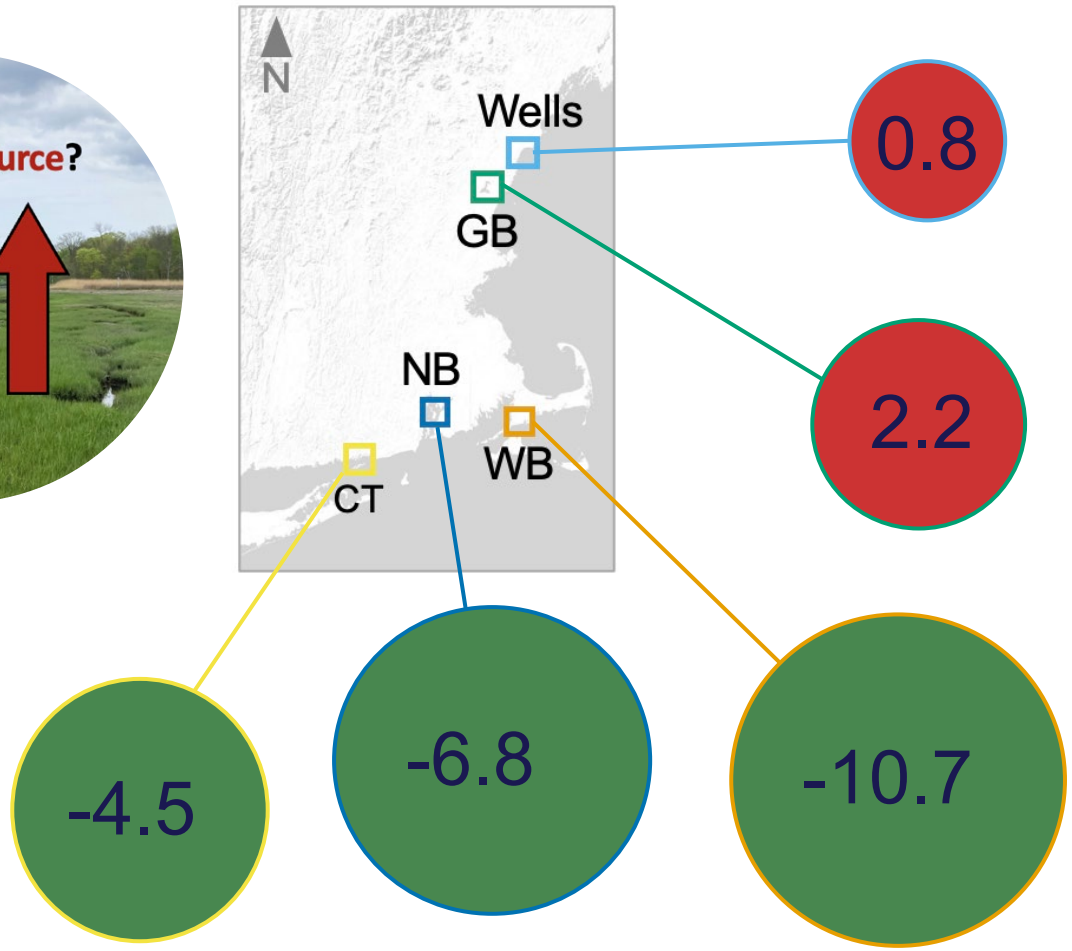


Interpreting Fluxes

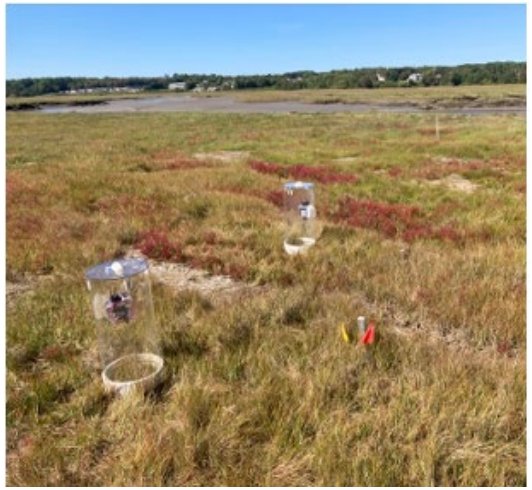


Regional Patterns

Median CO_2 Flux
(mmol m^{-2} h^{-1})

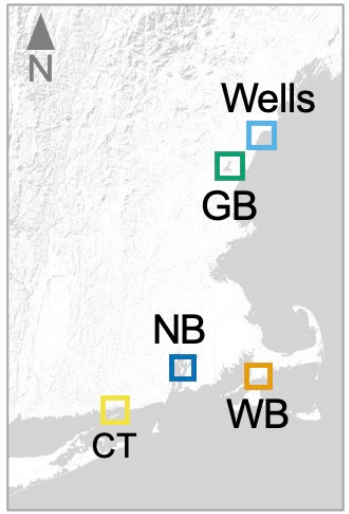


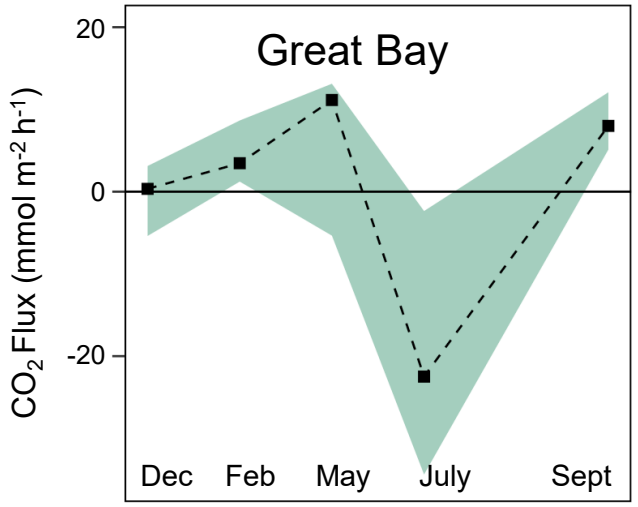
May at Wells

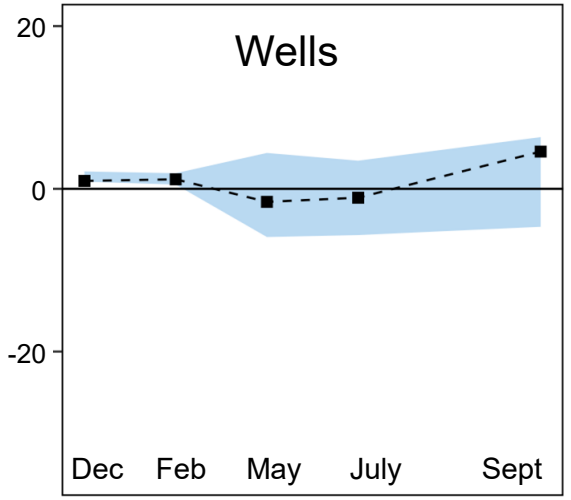


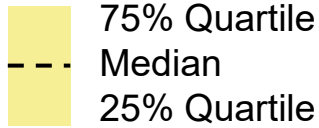
September at Wells

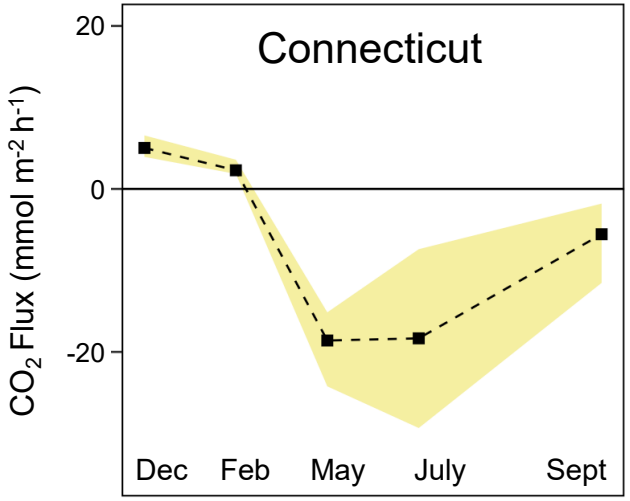
Seasonal Patterns

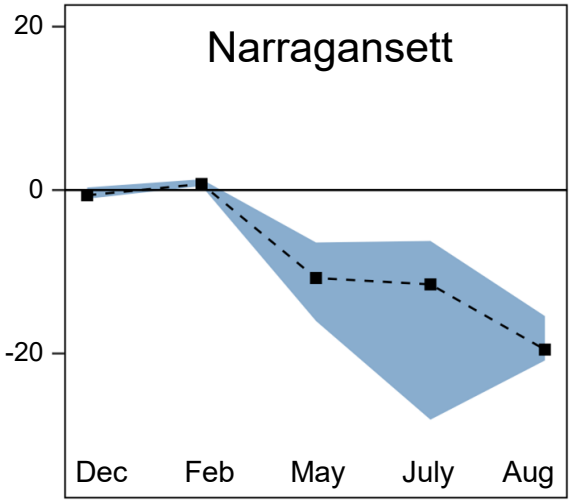


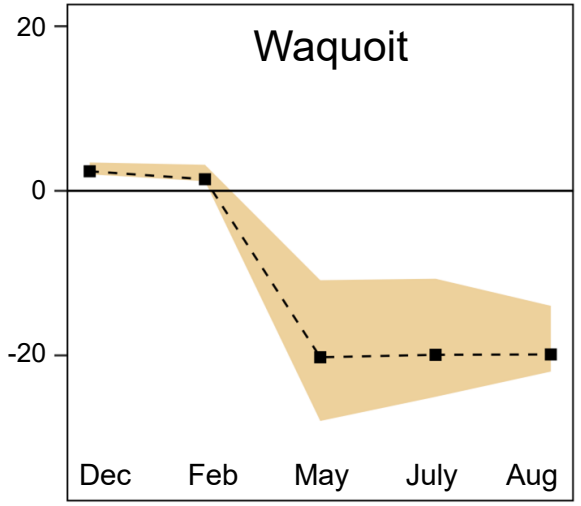




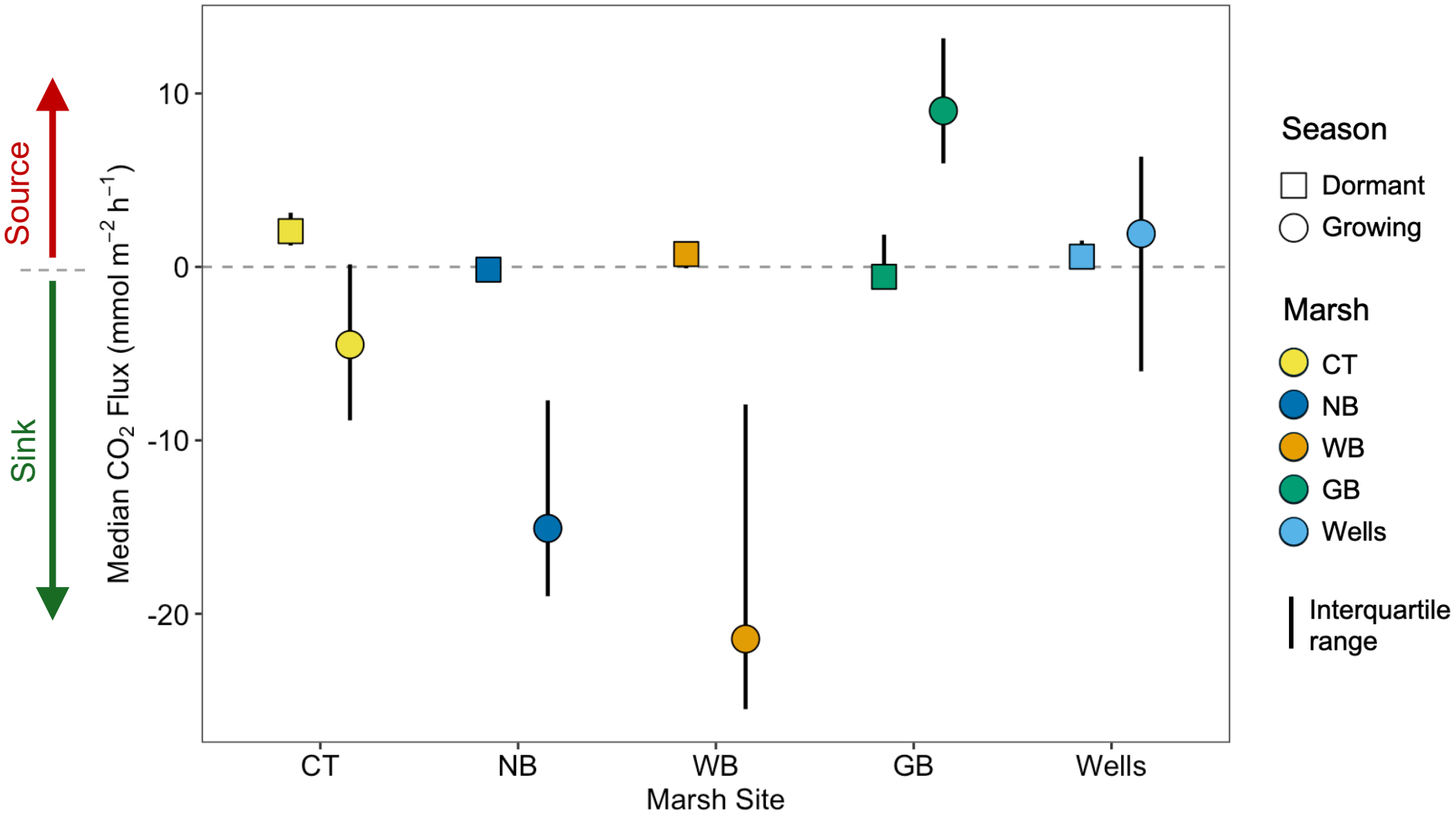






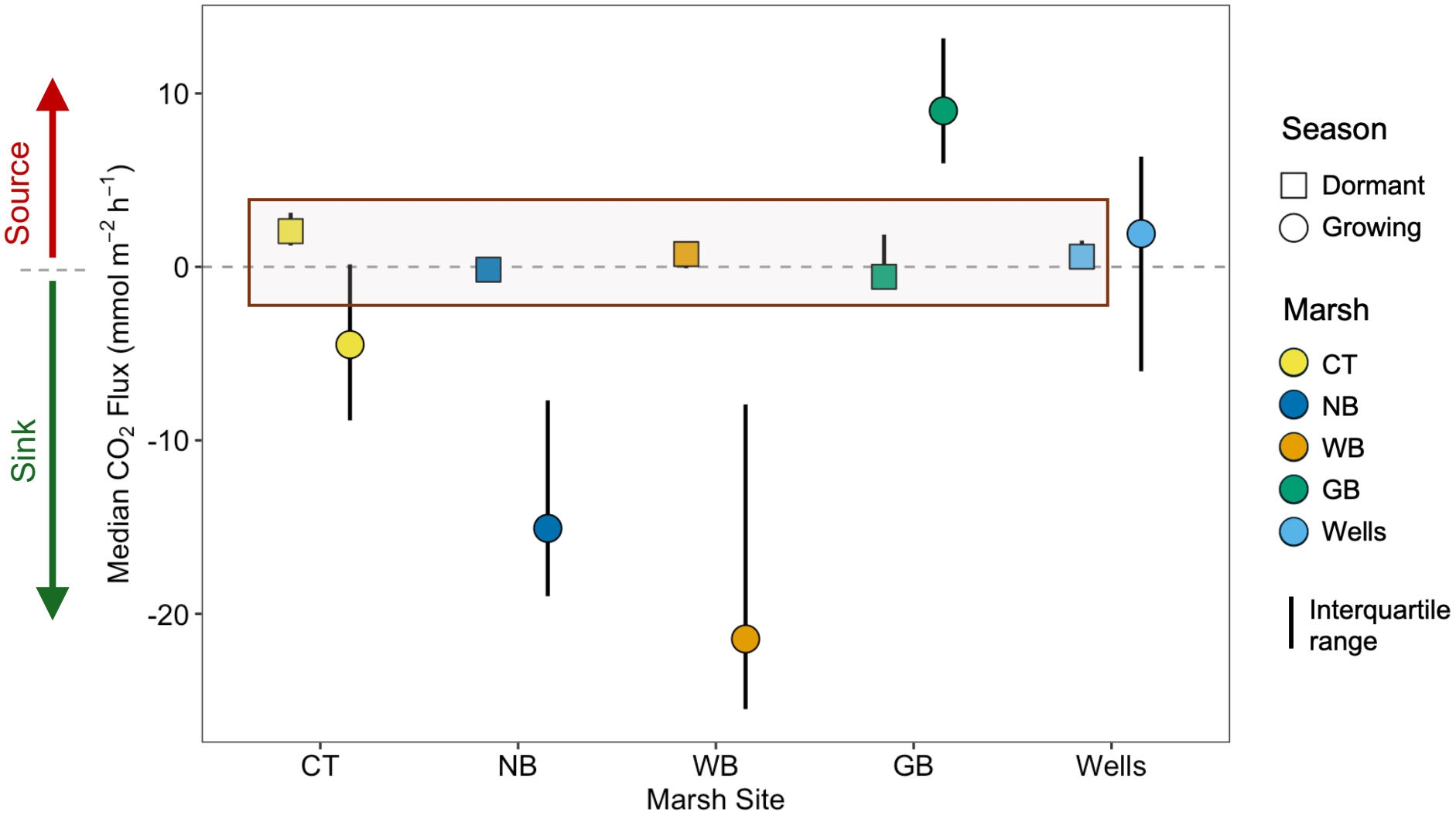


Growing vs. Dormant Season

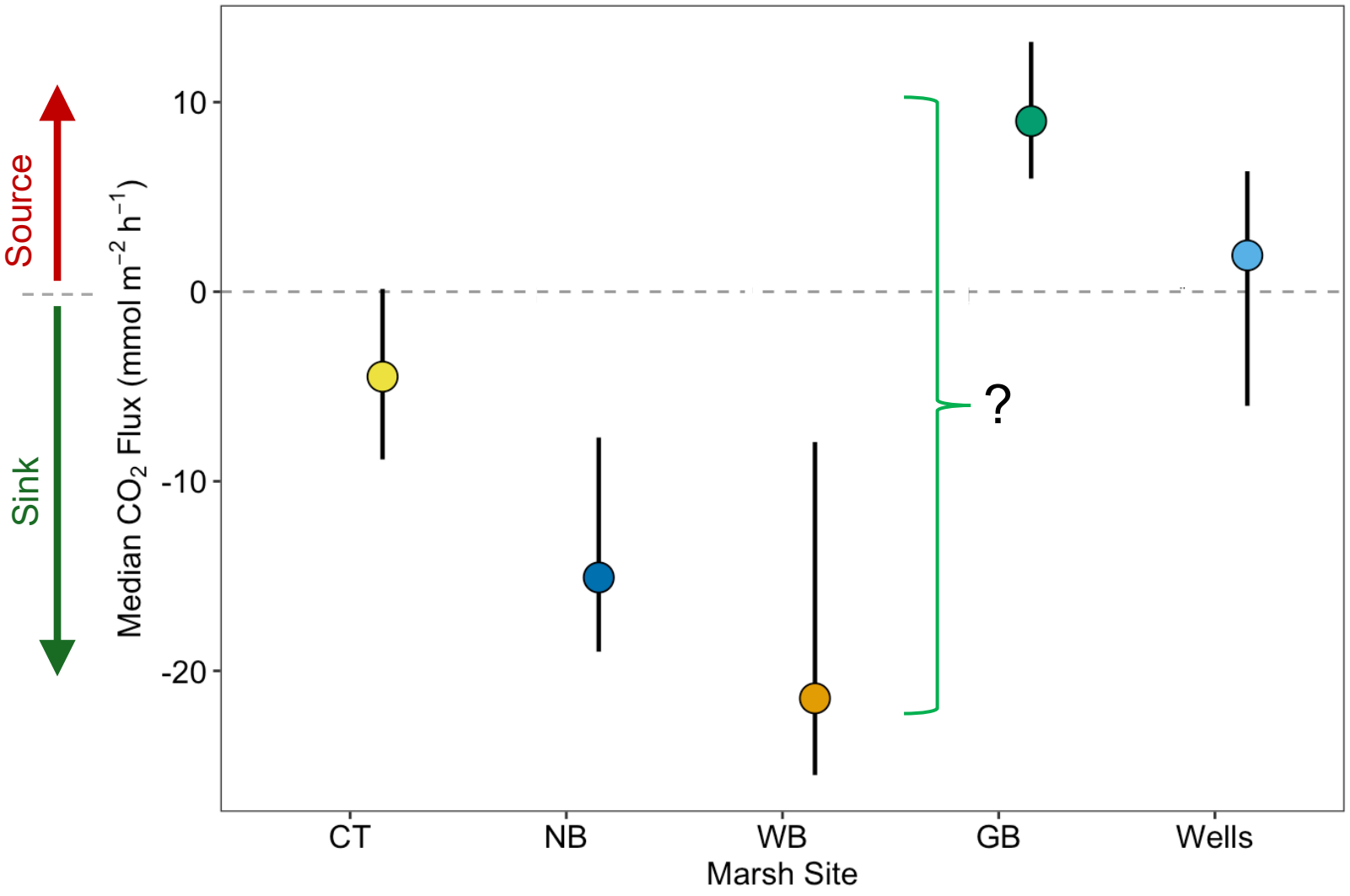


vs.

Growing vs. Dormant Season



Weather OR Site?



Growing

CO_2 Flux ~
PAR + Temp + Tide + Marsh

$R^2 = 0.44$

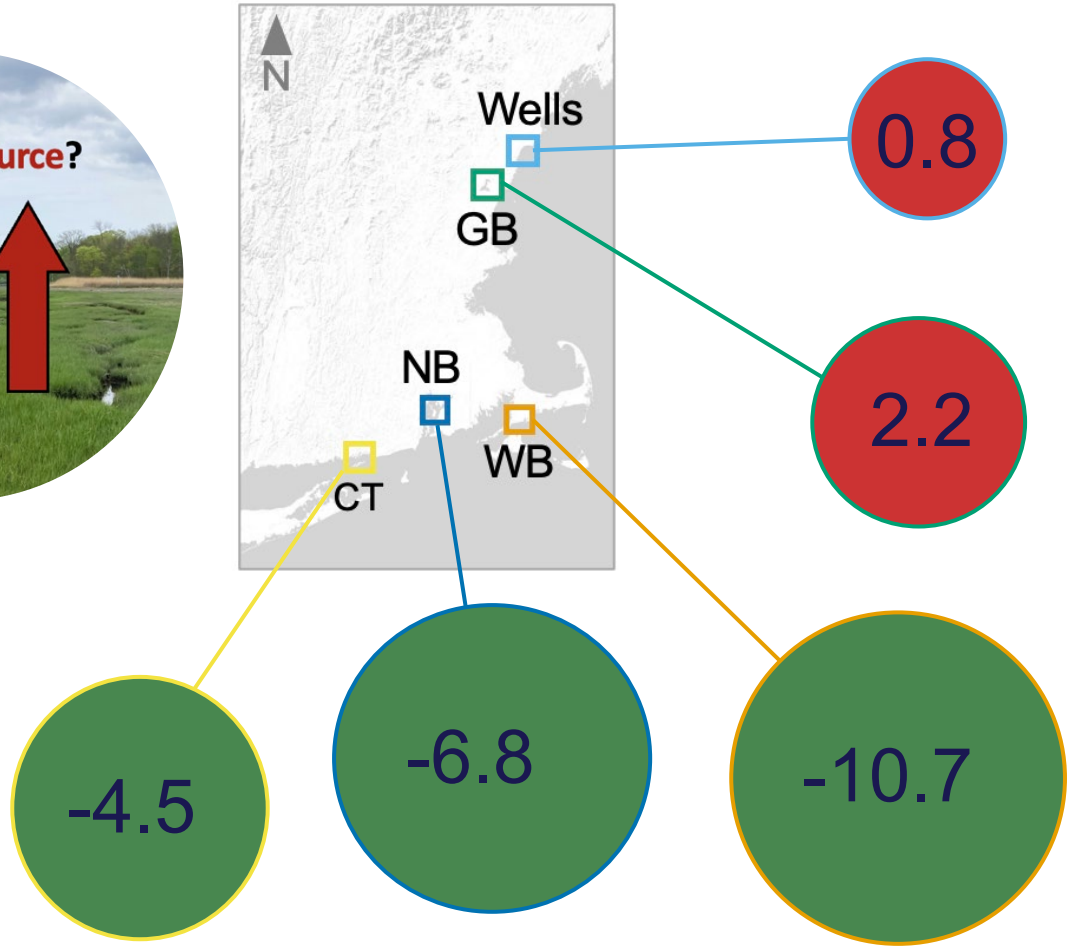
Relative Importance:

Light (PAR)	24%
Temperature	25%
Tide Timing	3%
Different Marshes	46%

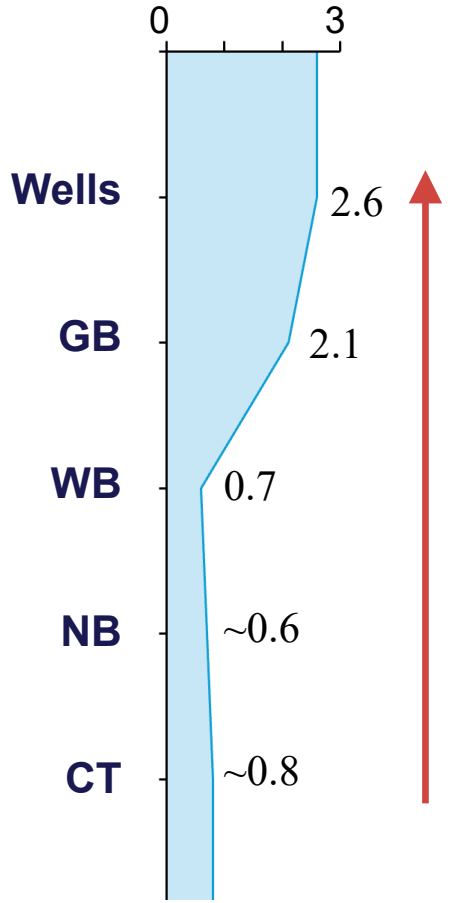
relaimpo package (Groemping, 2006)

Drivers of Regional Patterns

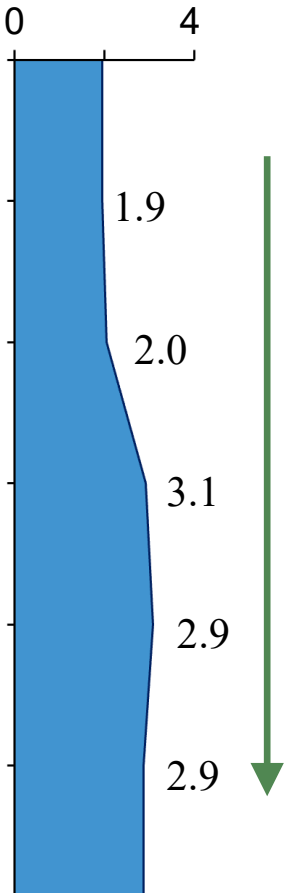
Median CO_2 Flux (mmol m^{-2} h^{-1})



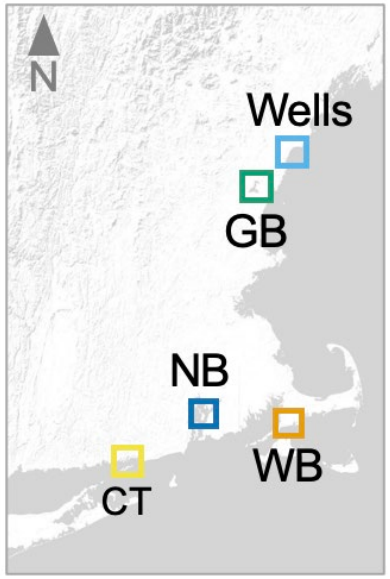
Tidal Range (m)

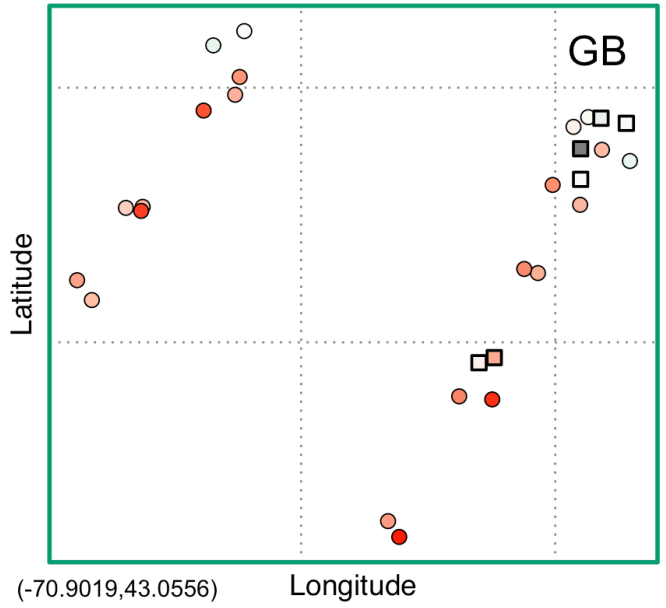


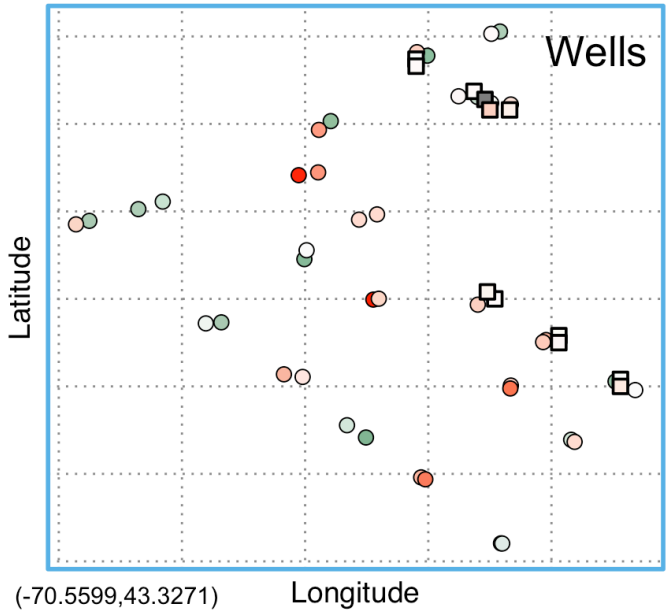
Sea Level Rise (mm/year)

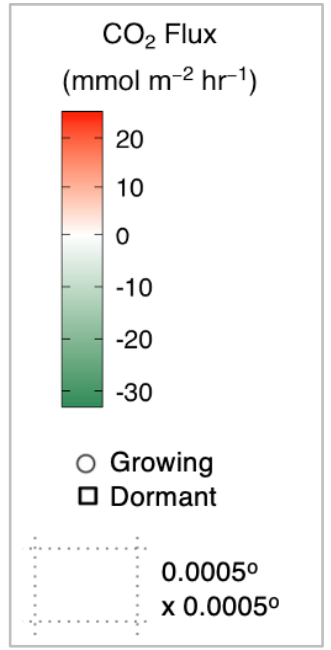


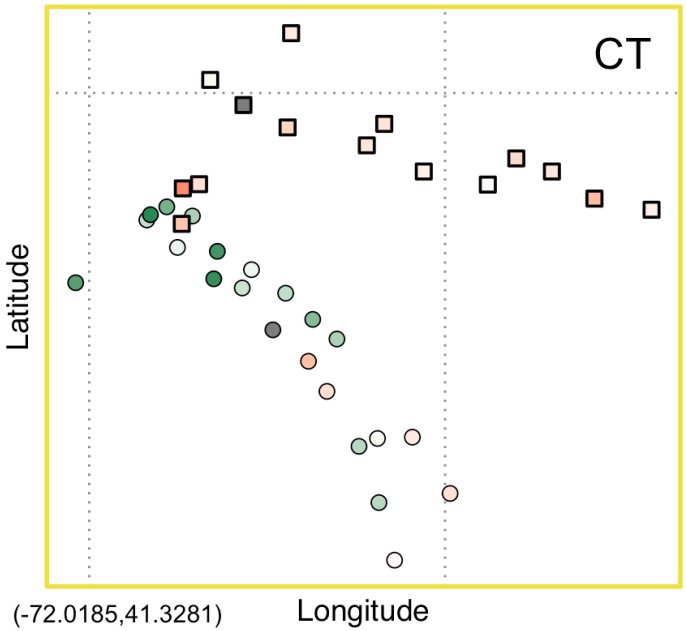
Within-Marsh Variability

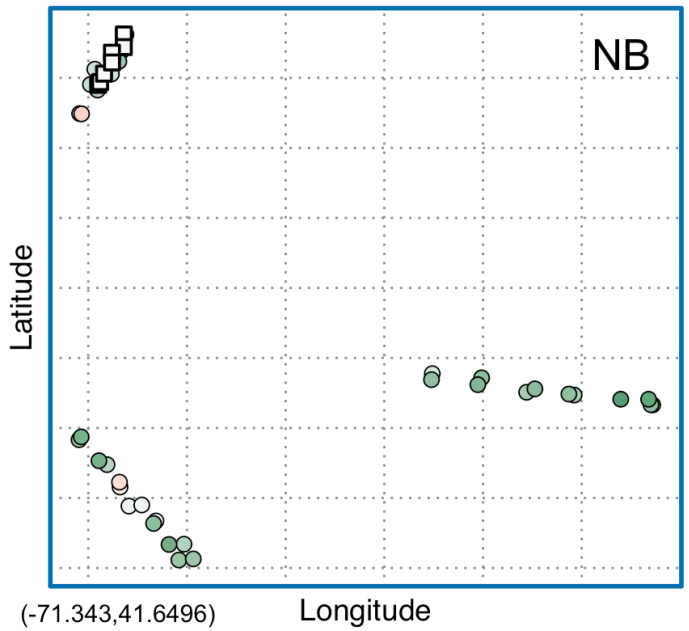


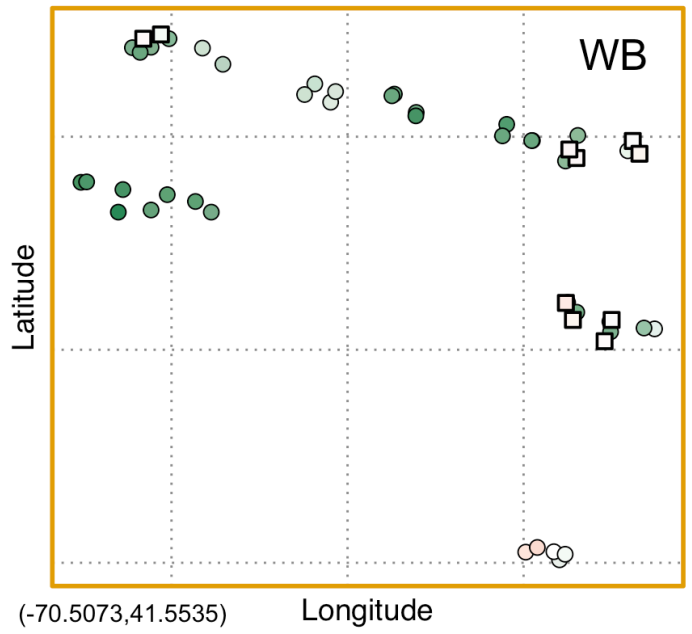




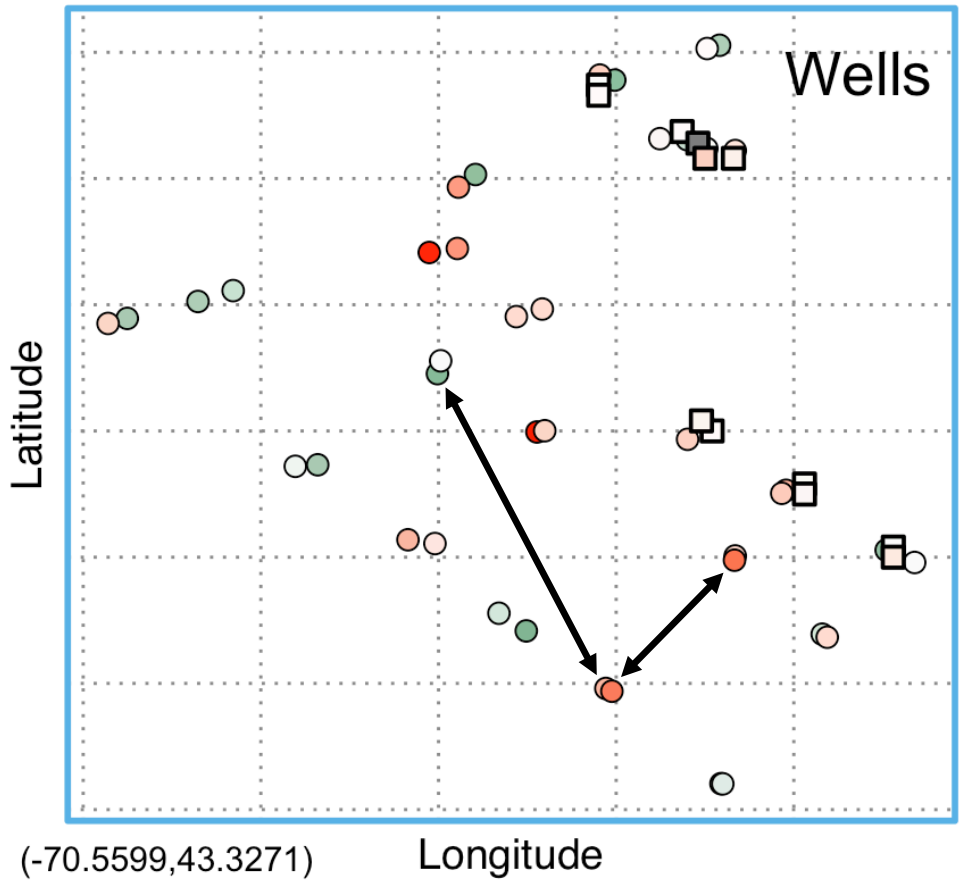


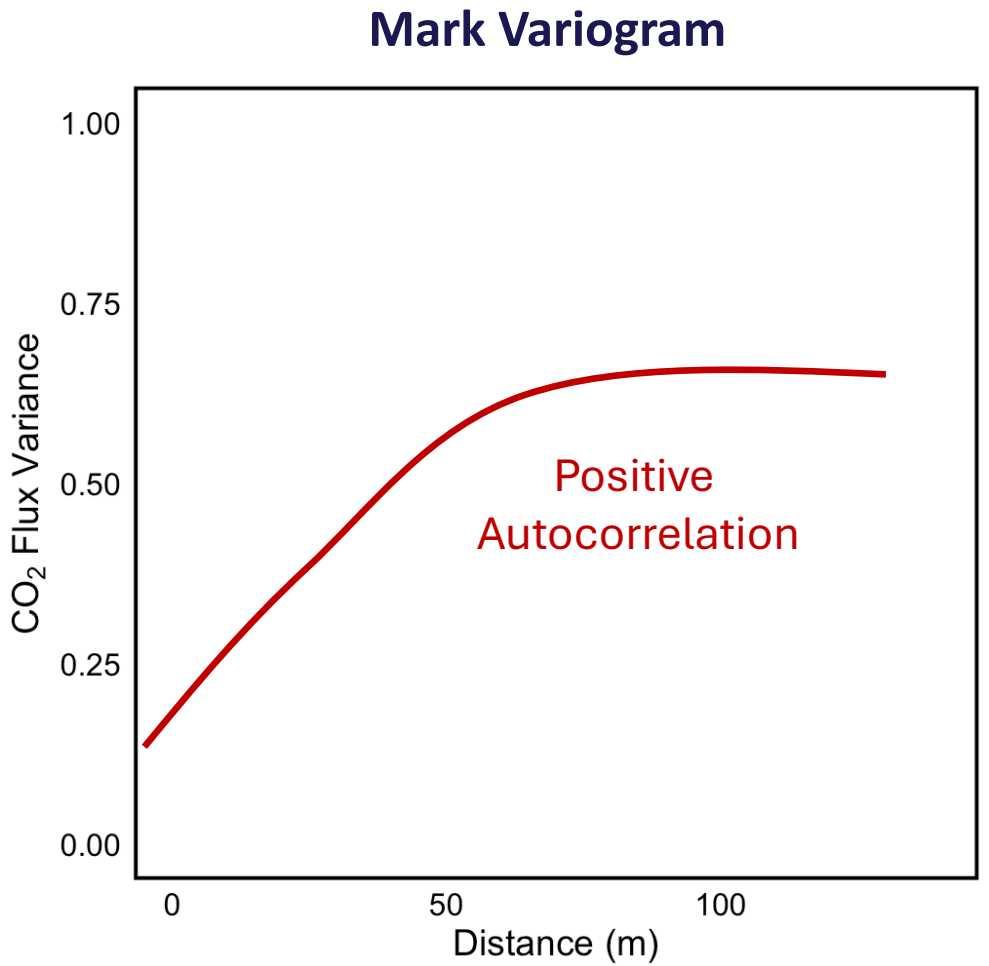






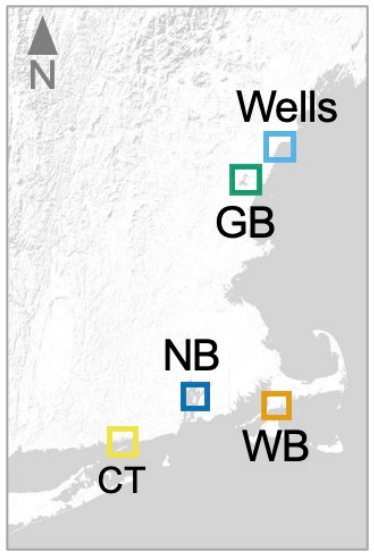
Spatial Modeling

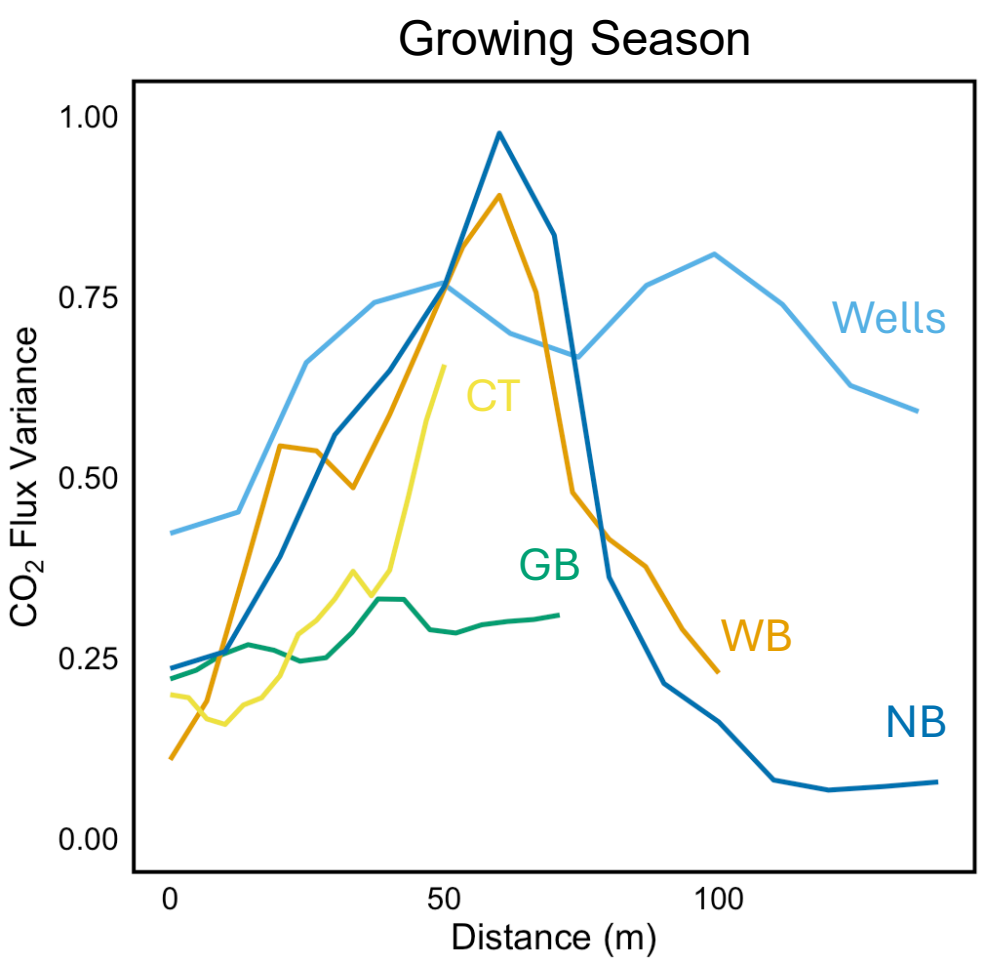


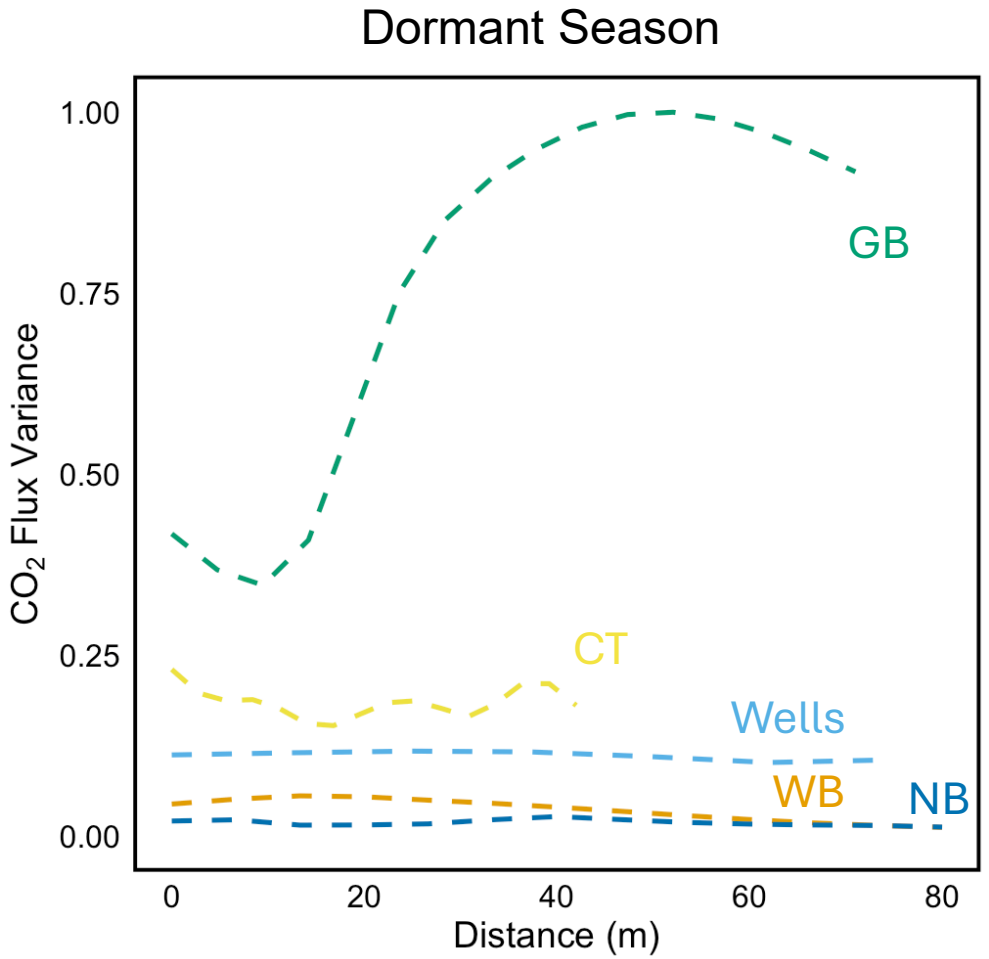


"*spatstat*" package (Baddeley et al., 2015)

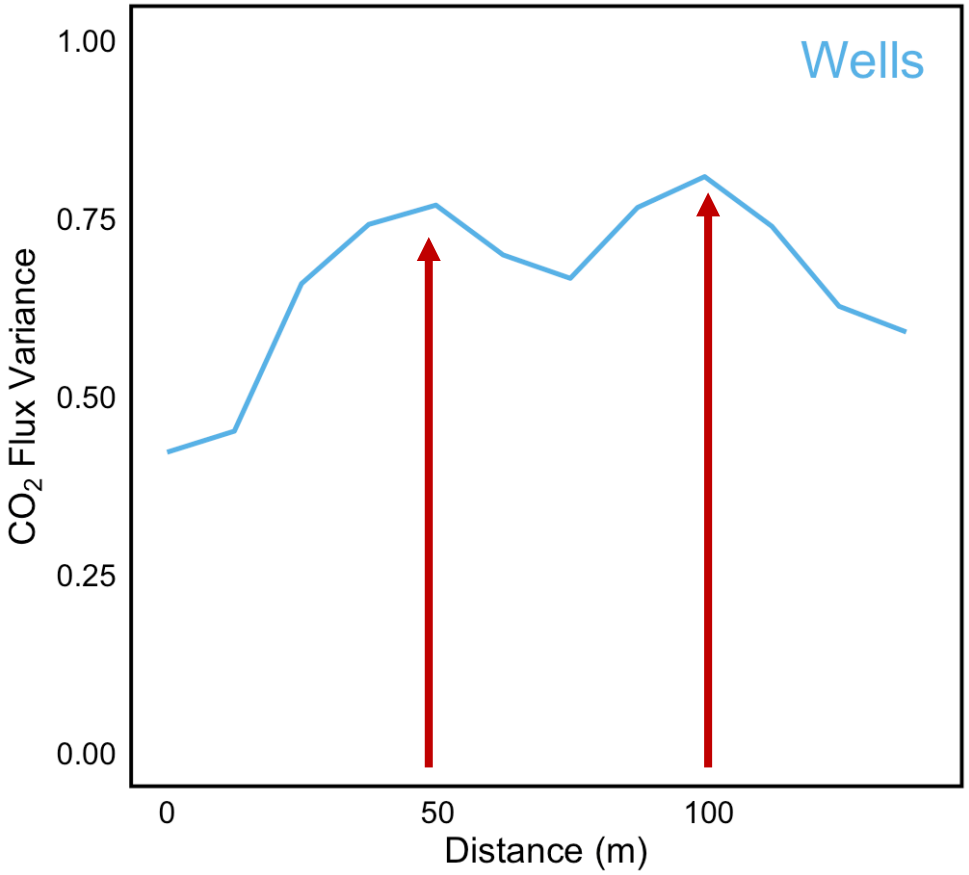
Spatial Modeling







Increased Dissimilarity



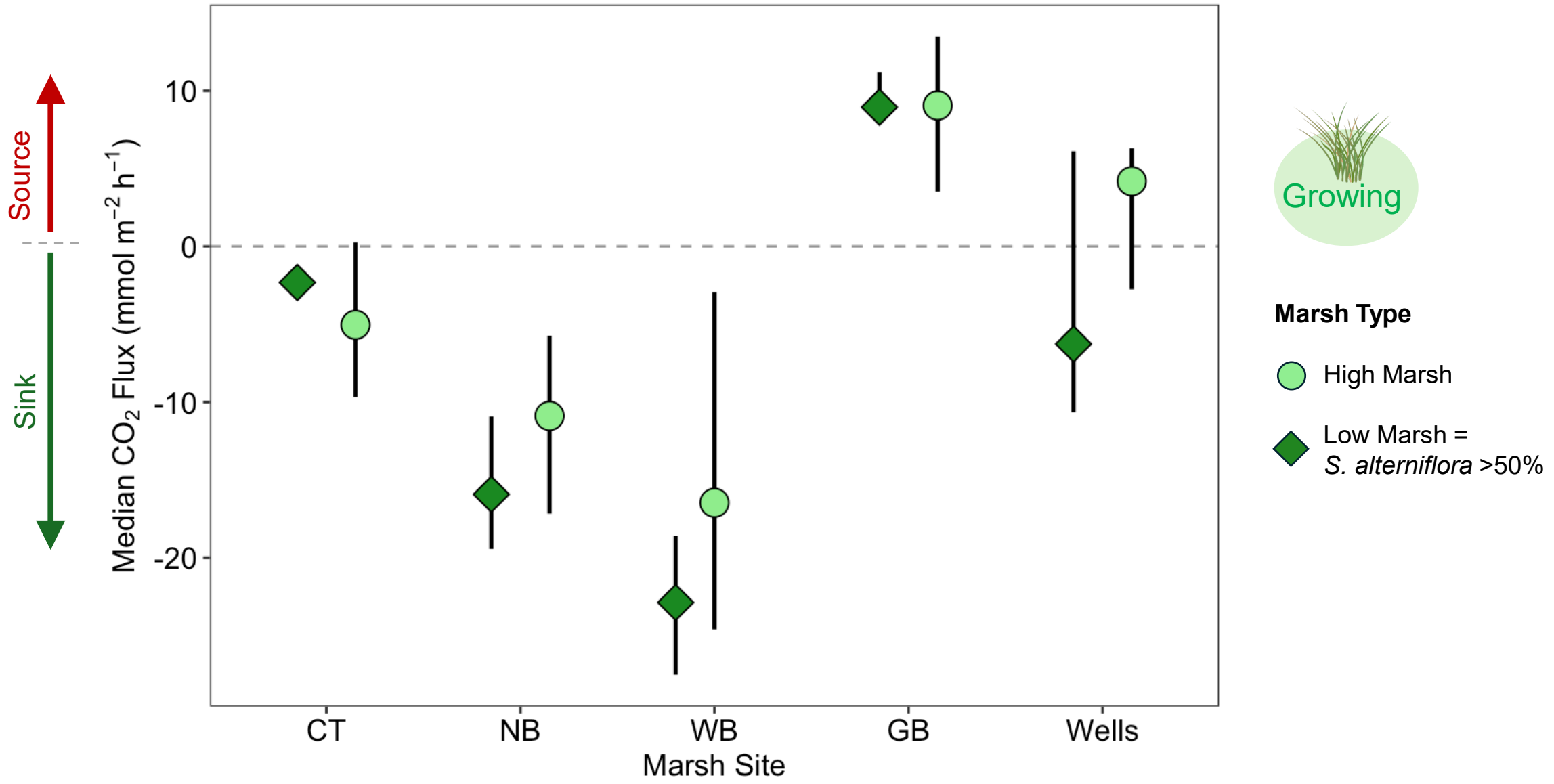
Interpretation:

Change of veg type, creek, ponds, etc.

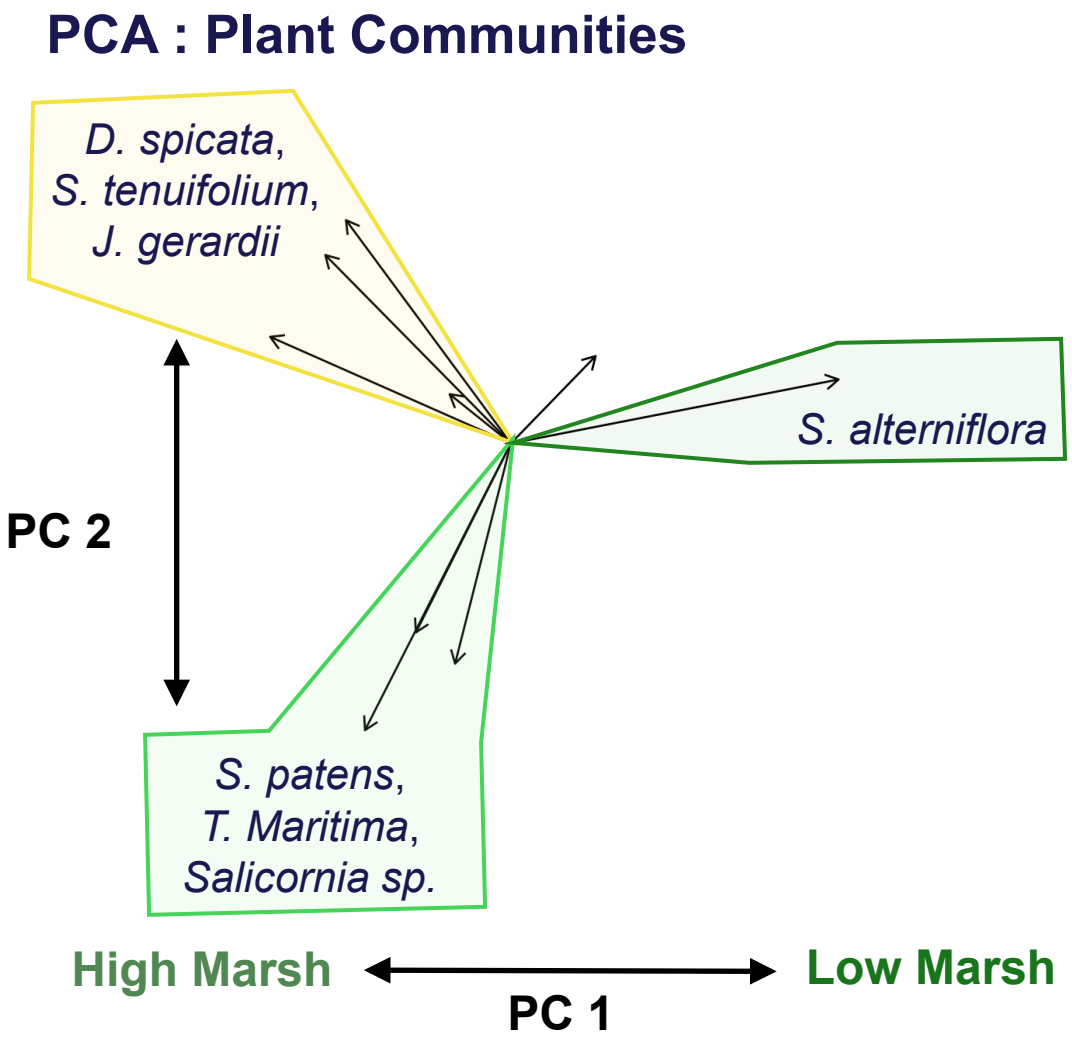
Implication:

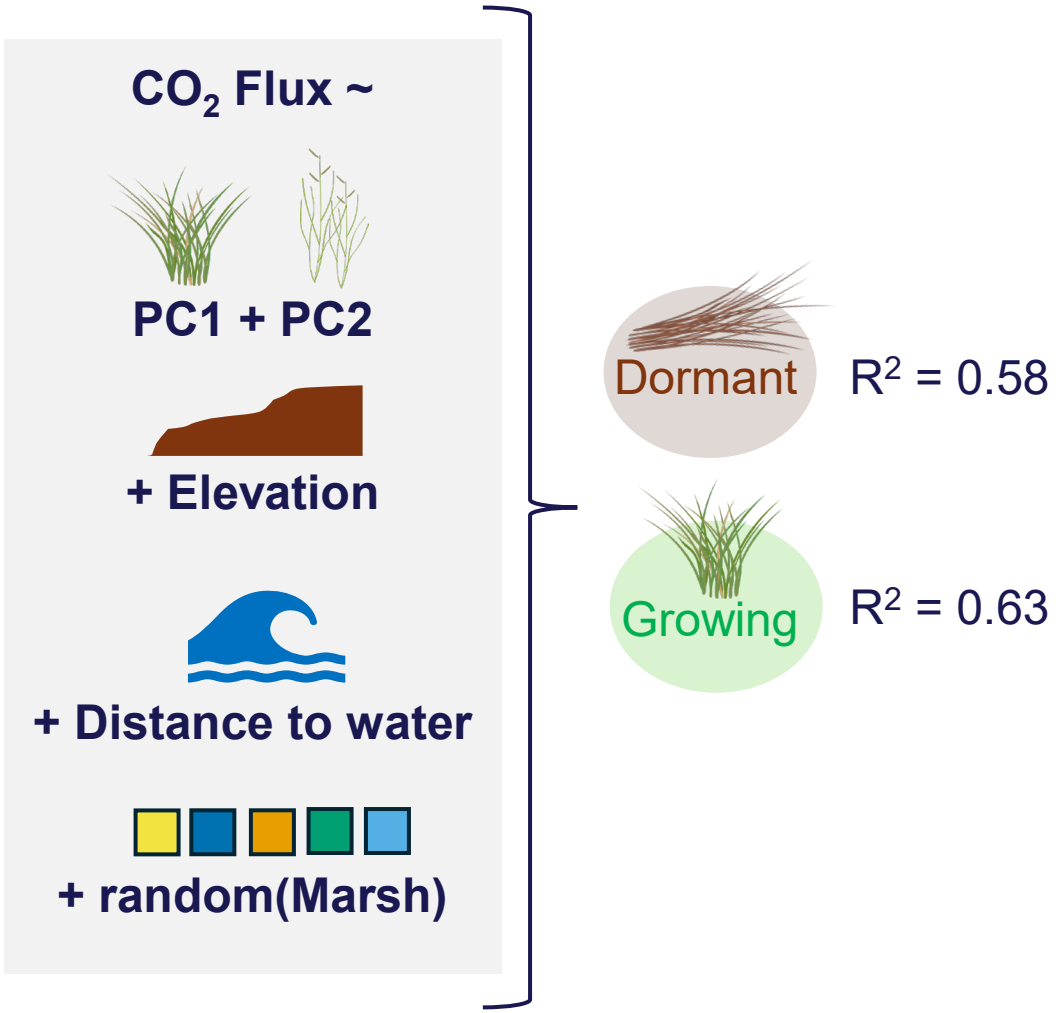
~50m and ~100m are scales of variability to capture

High vs. Low Marsh



Drivers of Within-Marsh Patterns



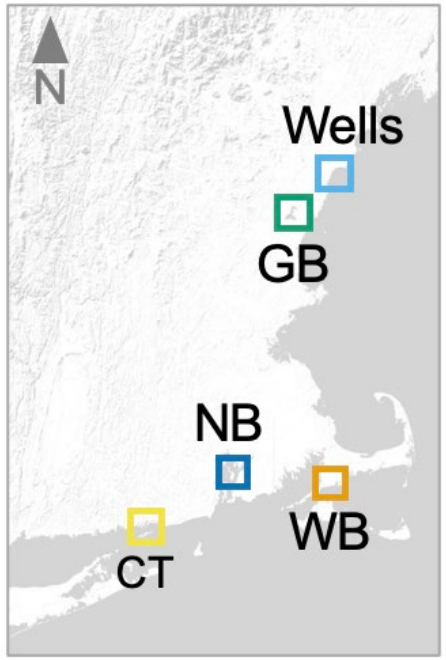


prcomp function (R Core Team, 2024)

lme4 package (Bates et al., 2015)

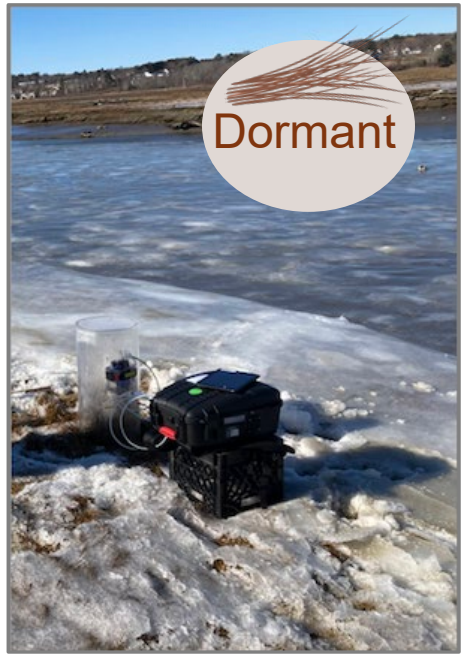
Main Takeaways

(1) Regional



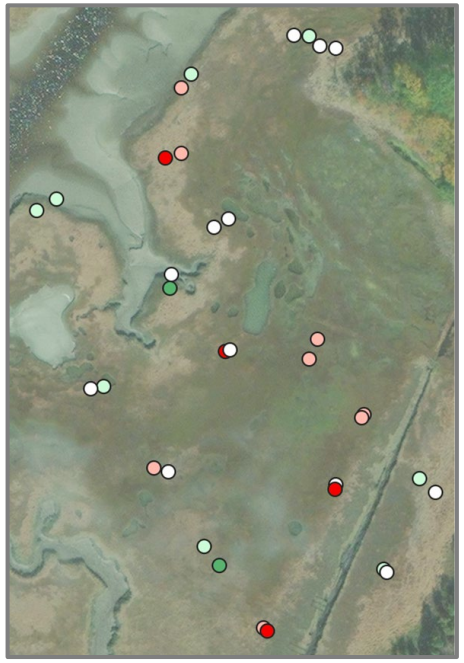
Regional patterns depend on seasonality and tidal gradients

(2) Year-Round



Winter-time CO_2 fluxes are low, but they do occur

(3) Within-Marsh



Variance of fluxes over space are related to plants communities

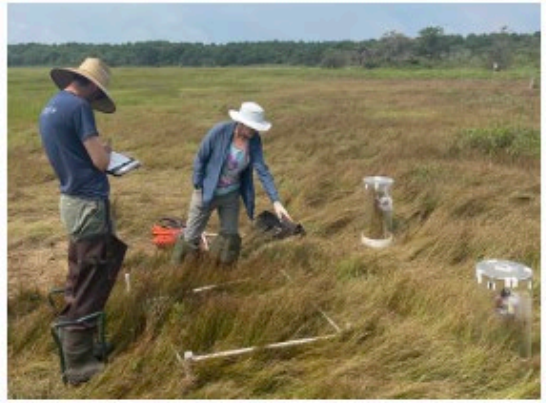
Acknowledgements

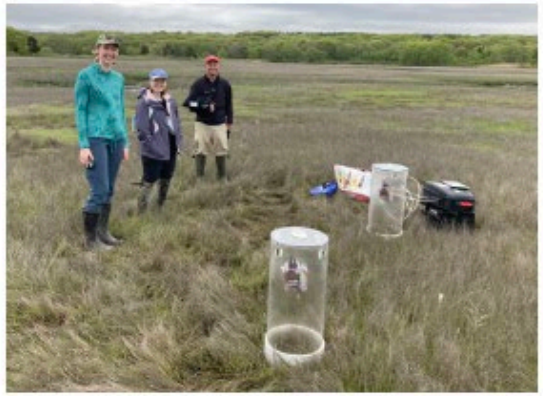
This project is thanks to:

Narragansett Bay NERR
Connecticut NERR
Waquoit Bay NERR
Great Bay NERR
Wells NERR

The Fulweiler Lab group

NERR Science Collaborative





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https://nerrssciencecollaborative.org/Fulweiler23