Submersed aquatic vegetation modifies estuarine inorganic carbon and alkalinity dynamics

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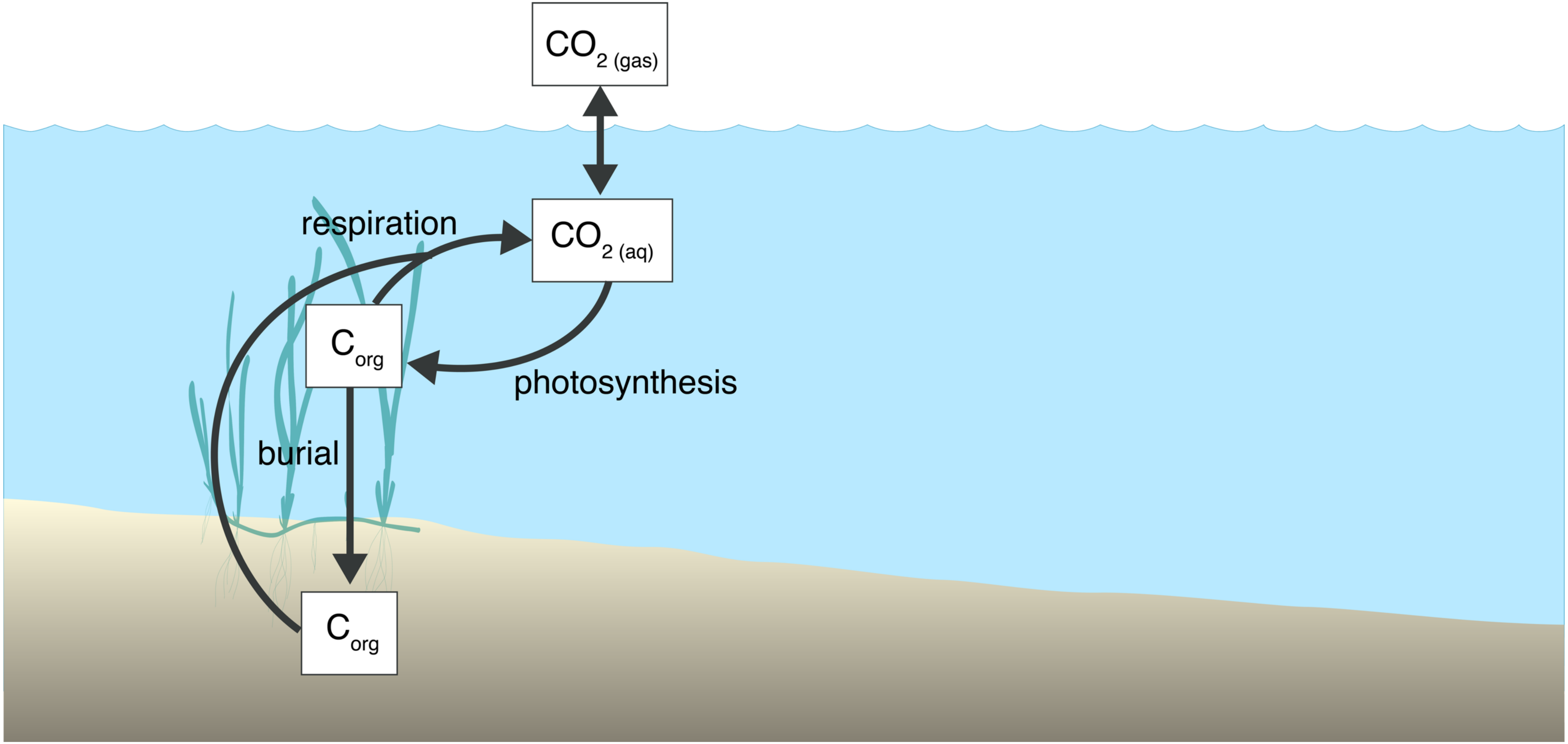
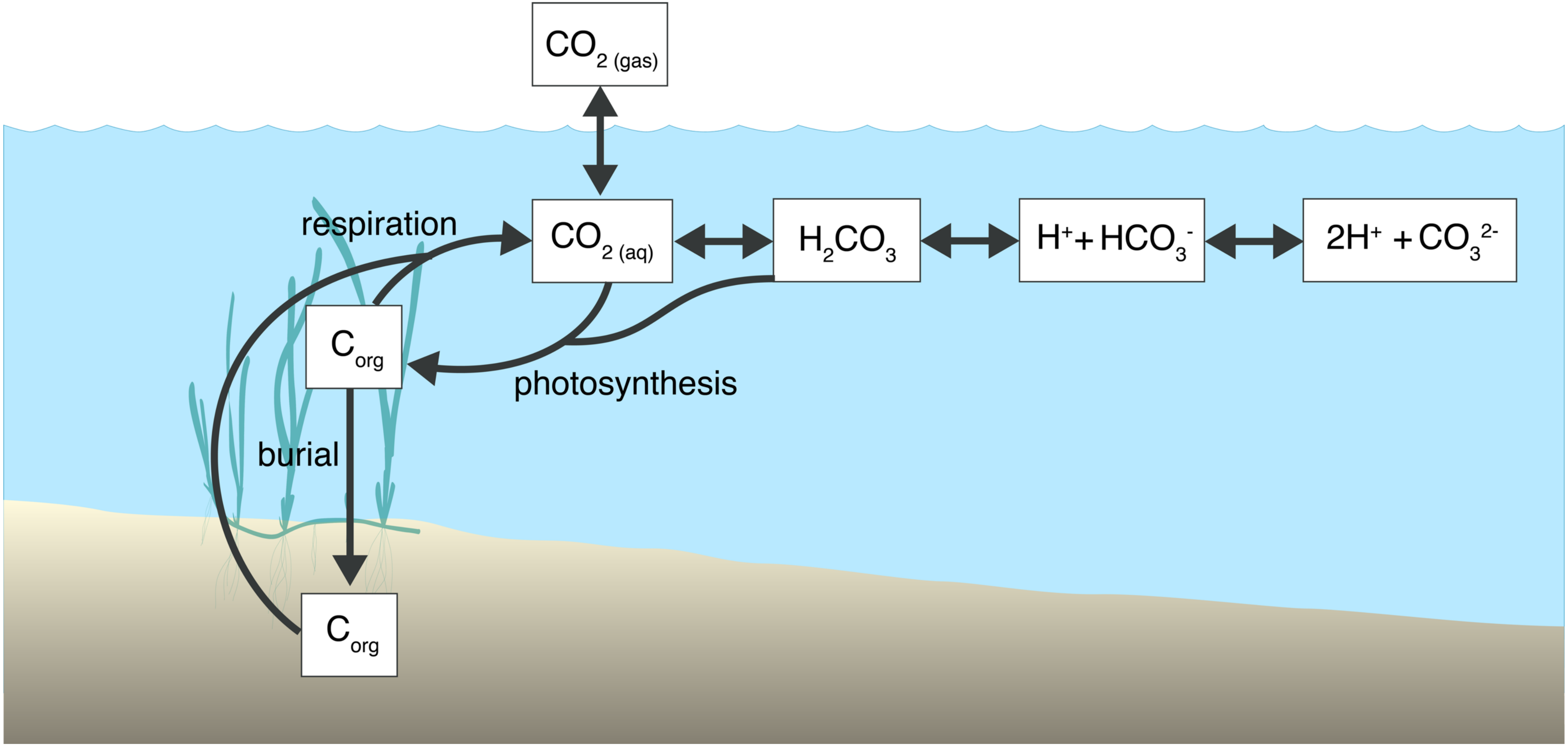
ITAT 22 April 2026

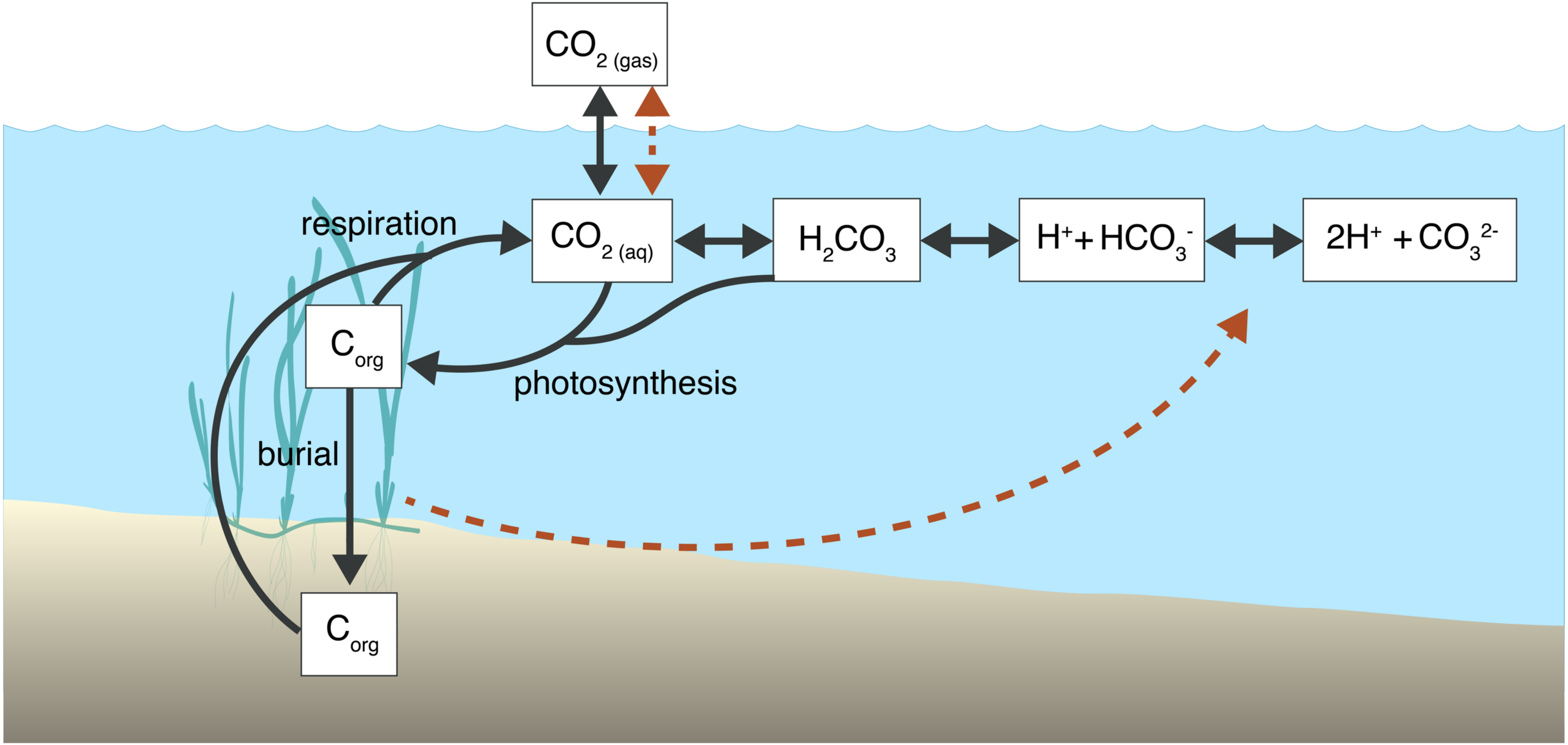
SAV is a carbon sink via CO_2 uptake and organic C burial



CO_2 is also in equilibrium with the aquatic inorganic C system



SAV can affect the inorganic C system



Question: How do SAV beds in estuaries affect the inorganic C system?

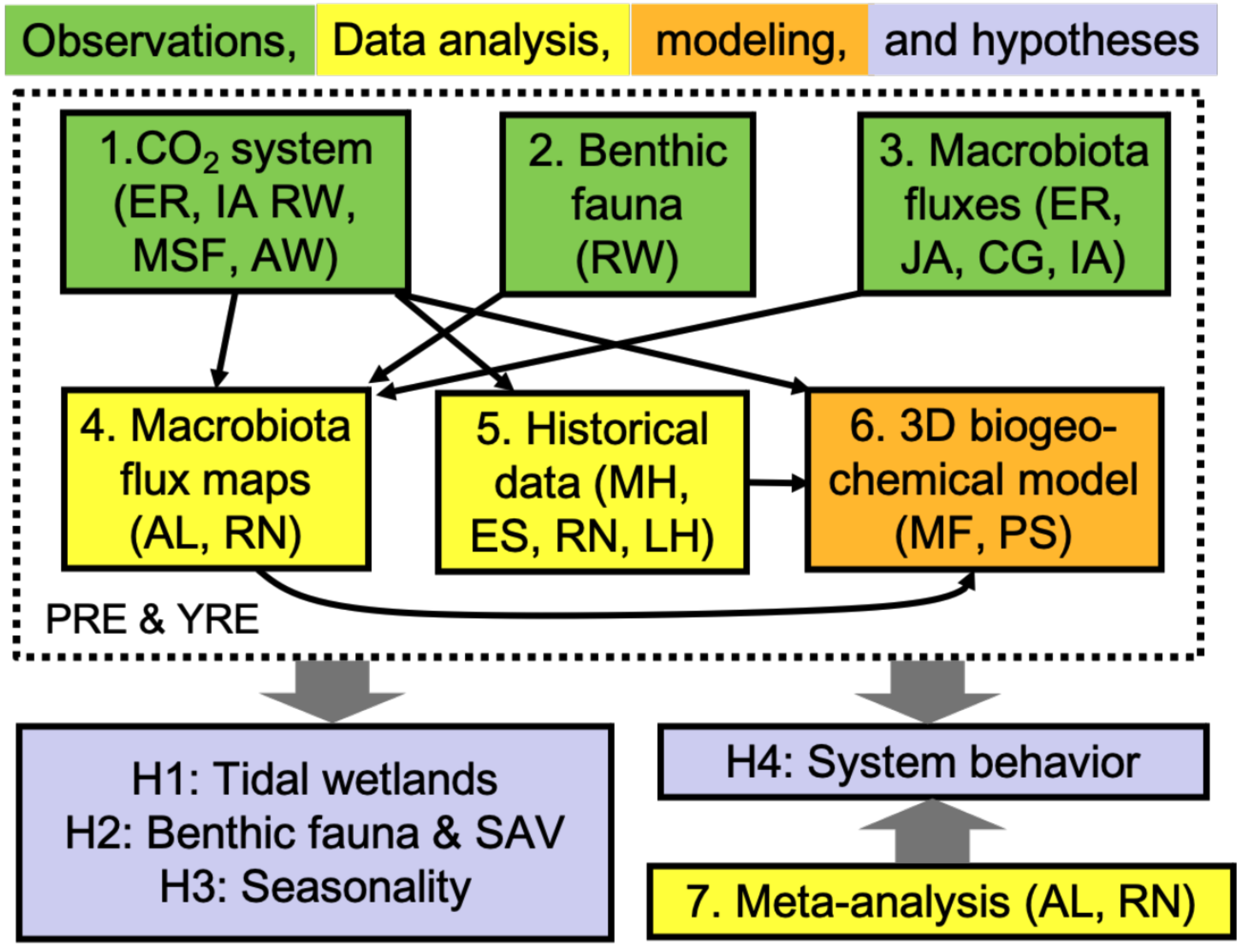
We measure net changes in the system using total alkalinity (TA)

proton acceptors — proton donor

$$TA = [OH^-] + [HCO_3^-] + 2[CO_3^{2-}] - [H^+]$$

higher TA *accept more H^+* *absorb more CO_2*

CHesapeake ALKalinity (CHALK) study



Collaborating institutions:

- Penn State University
- University of MD Center for Environmental Science
- Woods Hole Oceanographic Institution
- Virginia Institute of Marine Science
- USGS
- St. Mary’s College of Maryland

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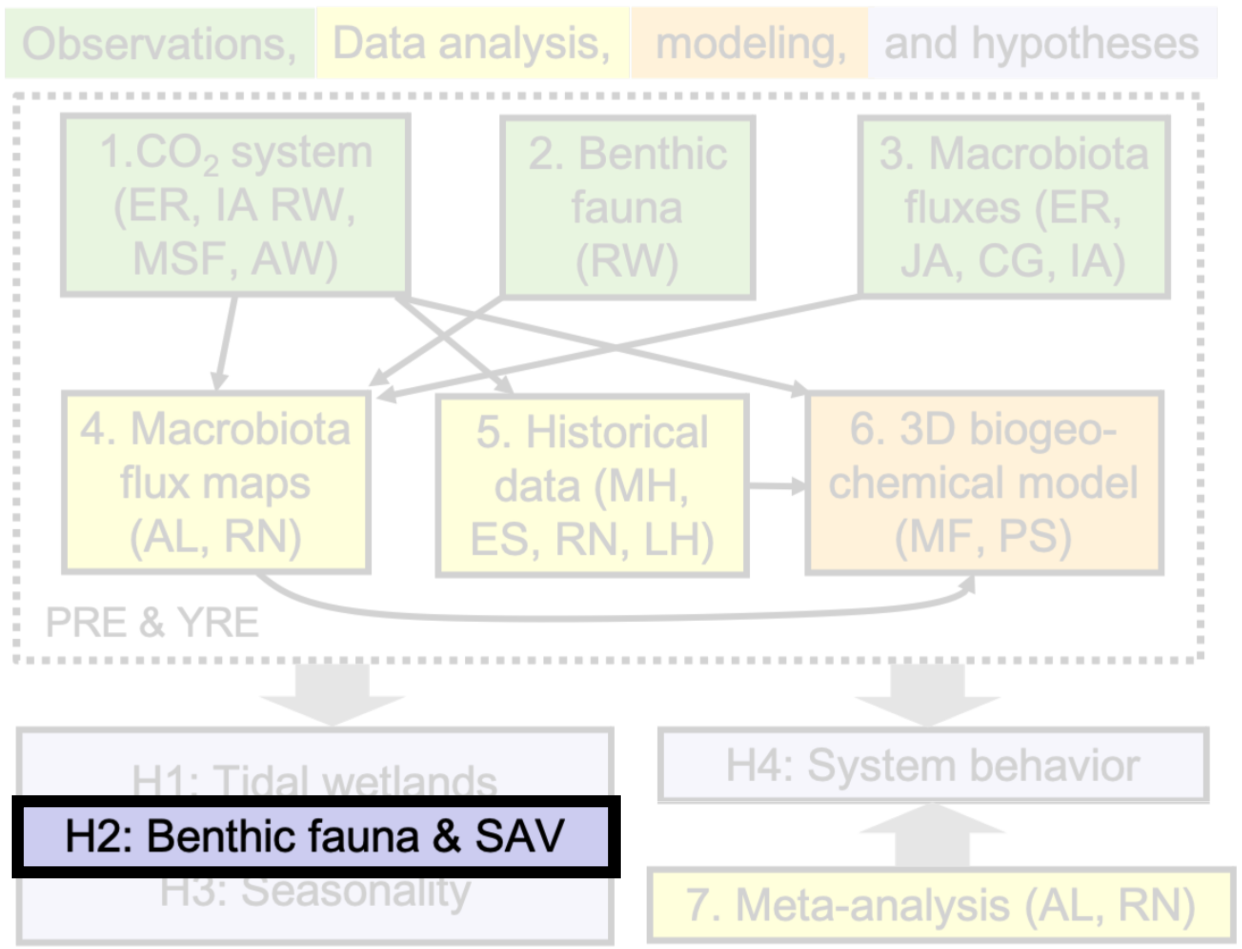

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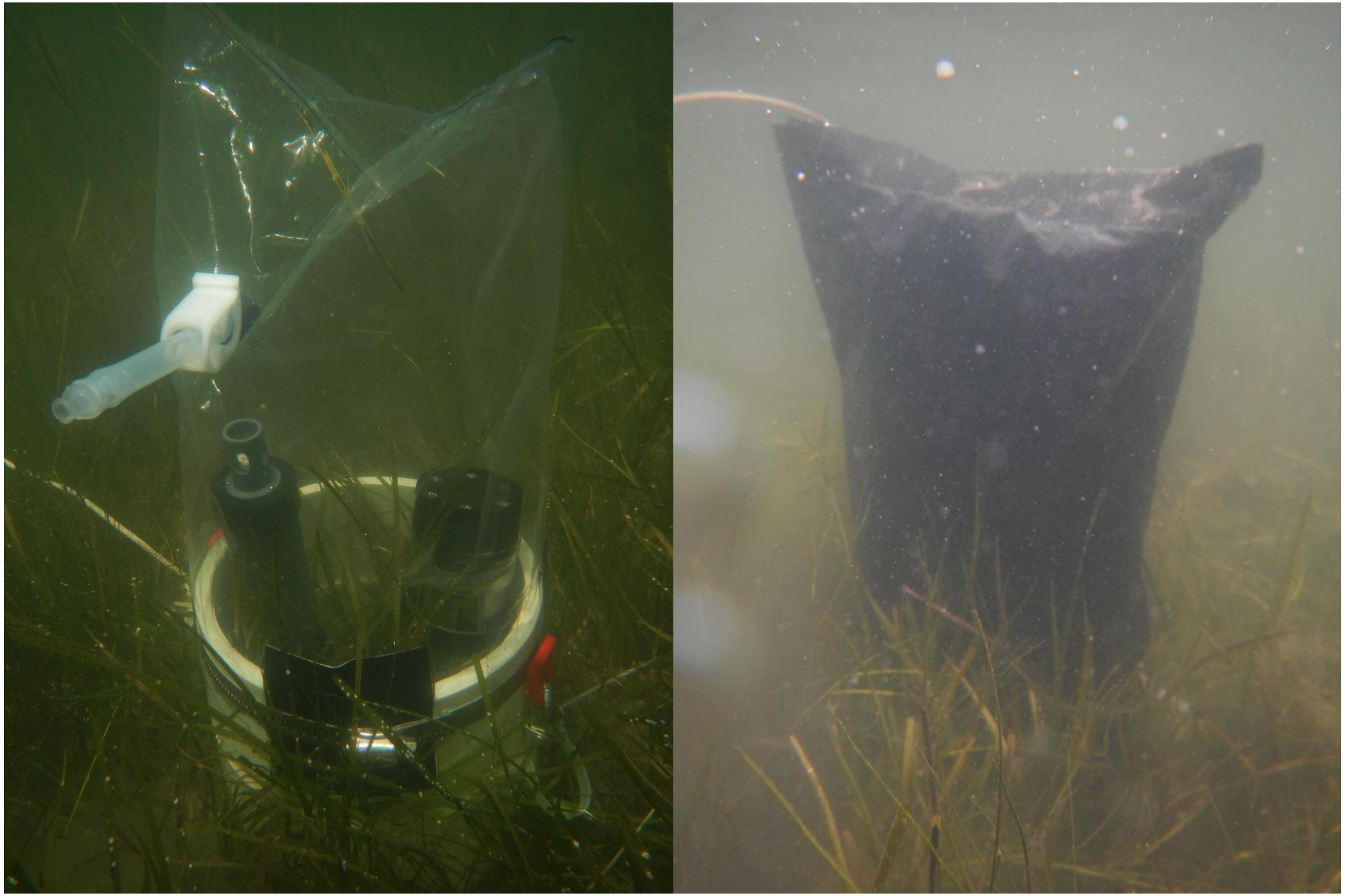
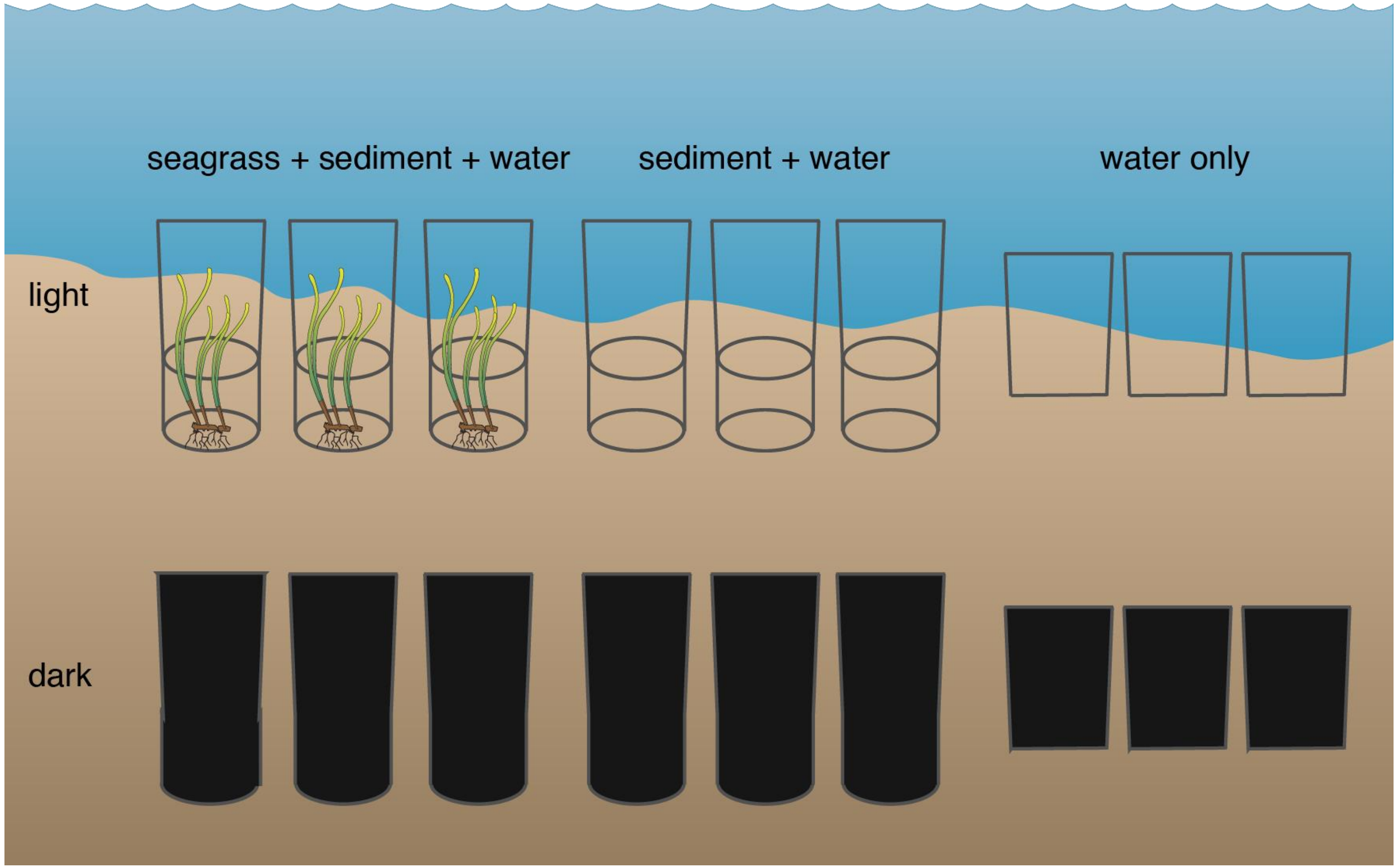
Chickamuxen Creek: **Potomac Fresh**
Potomac
St. George’s Island: **Potomac Brackish**
Pamunkey: **York Fresh**
York
Guinea marsh: **York Brackish**

In-situ benthic fluxes of TA, DIC, and other parameters



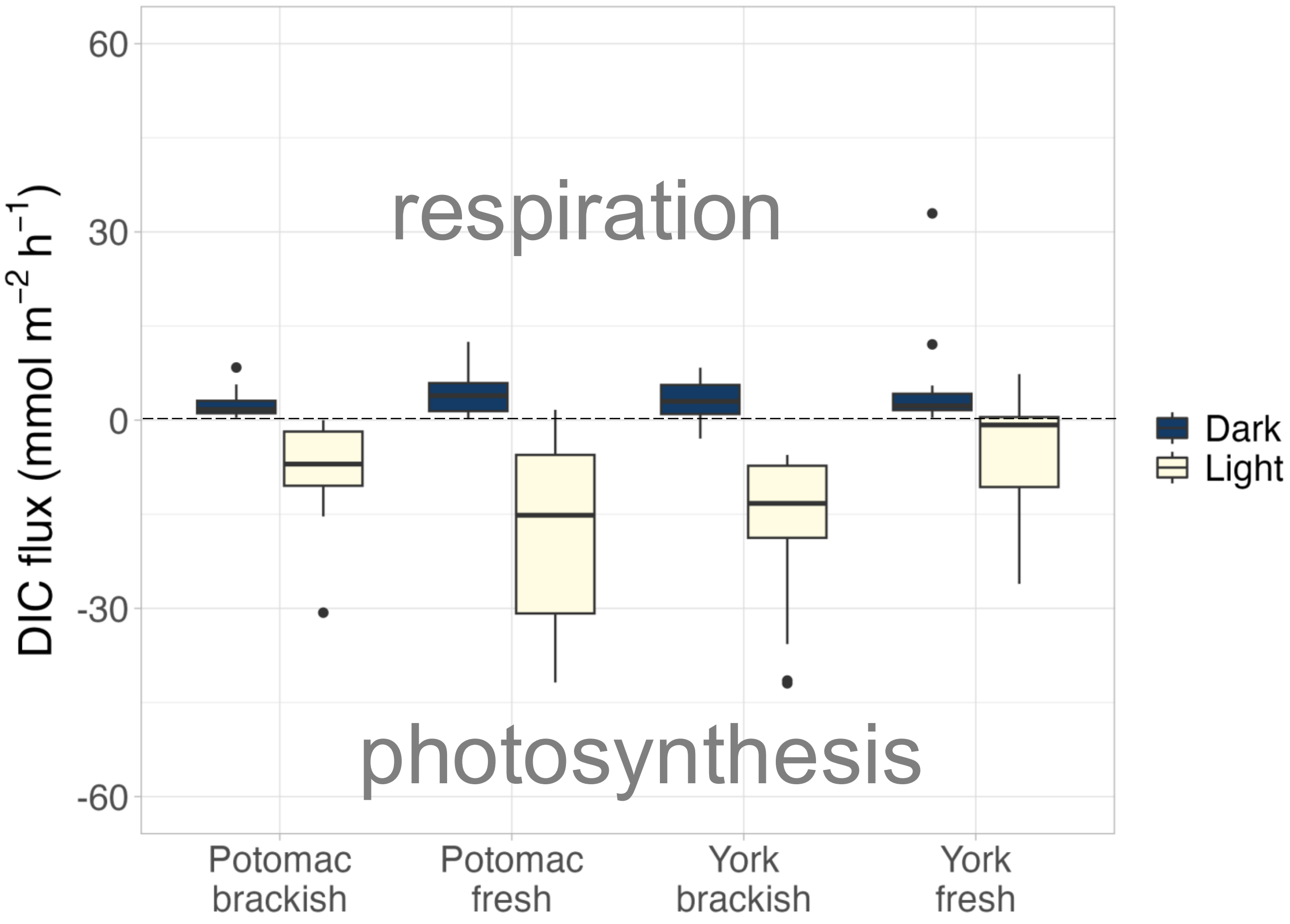
In-situ benthic fluxes of TA, DIC, and other parameters



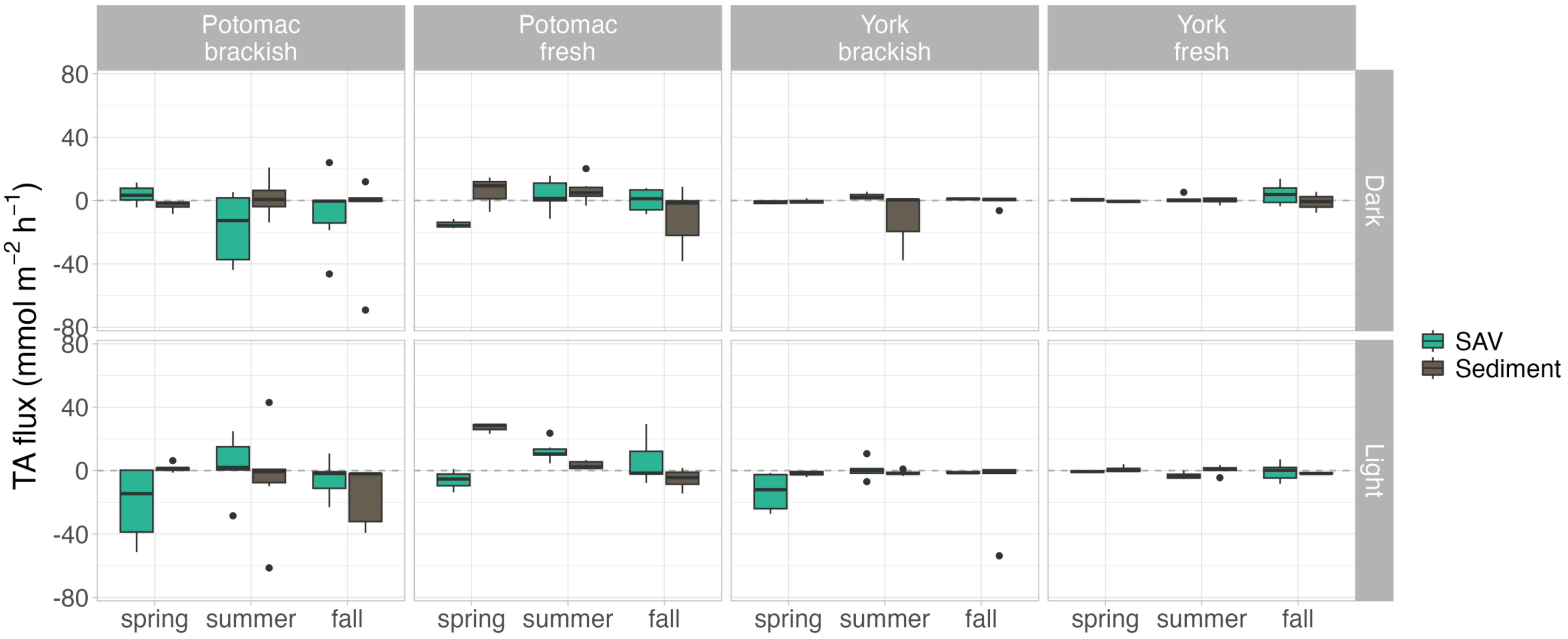
3 x per year:

- Spring
- Summer
- Fall

DIC fluxes were as expected: the chambers work



TA fluxes were not predictable: processes are complex and variable



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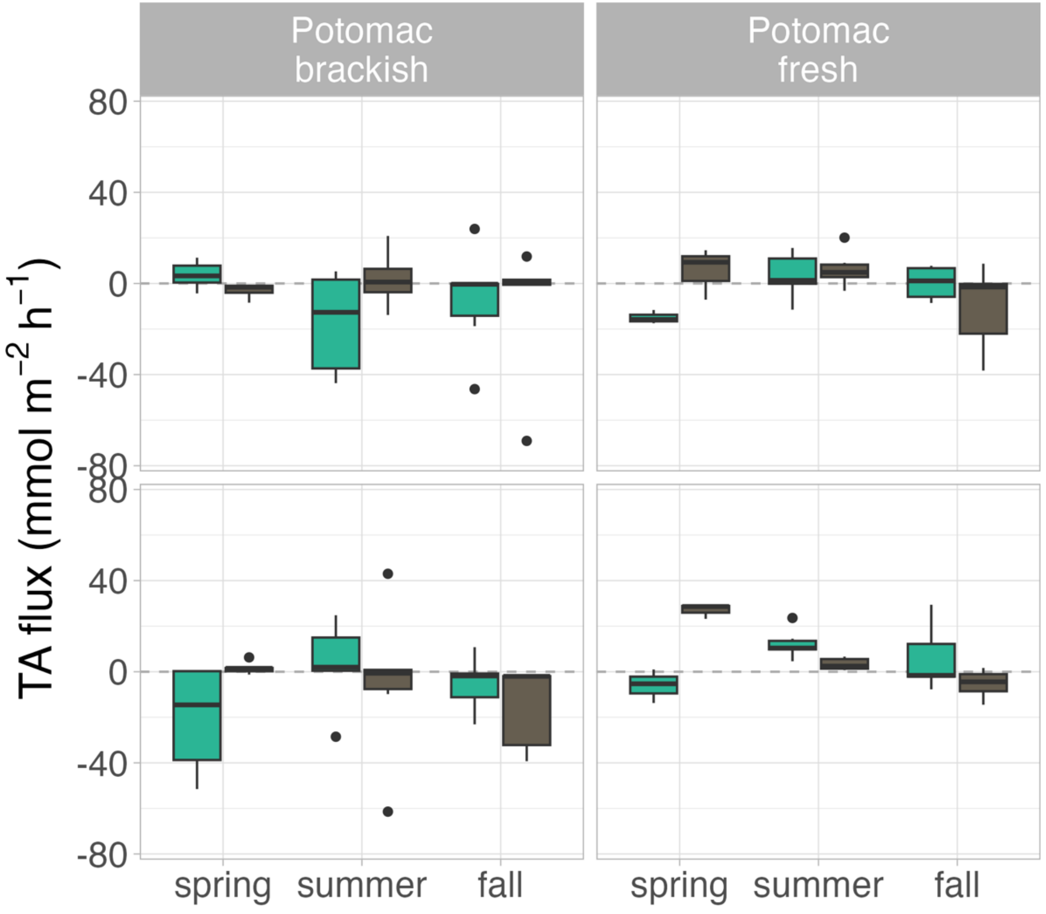
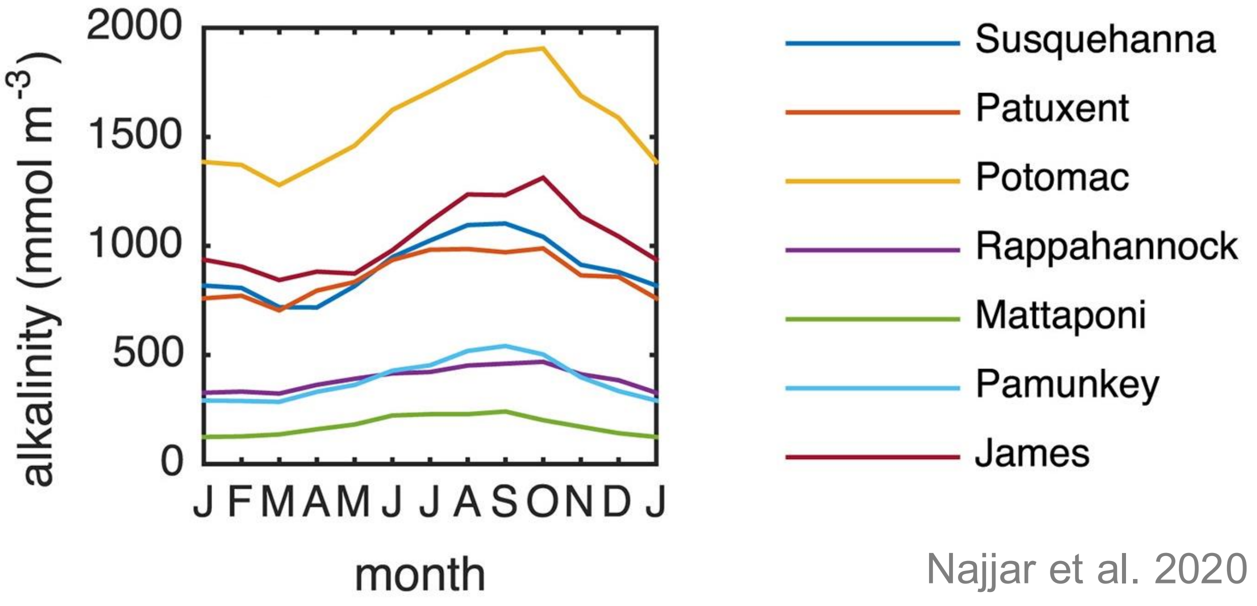
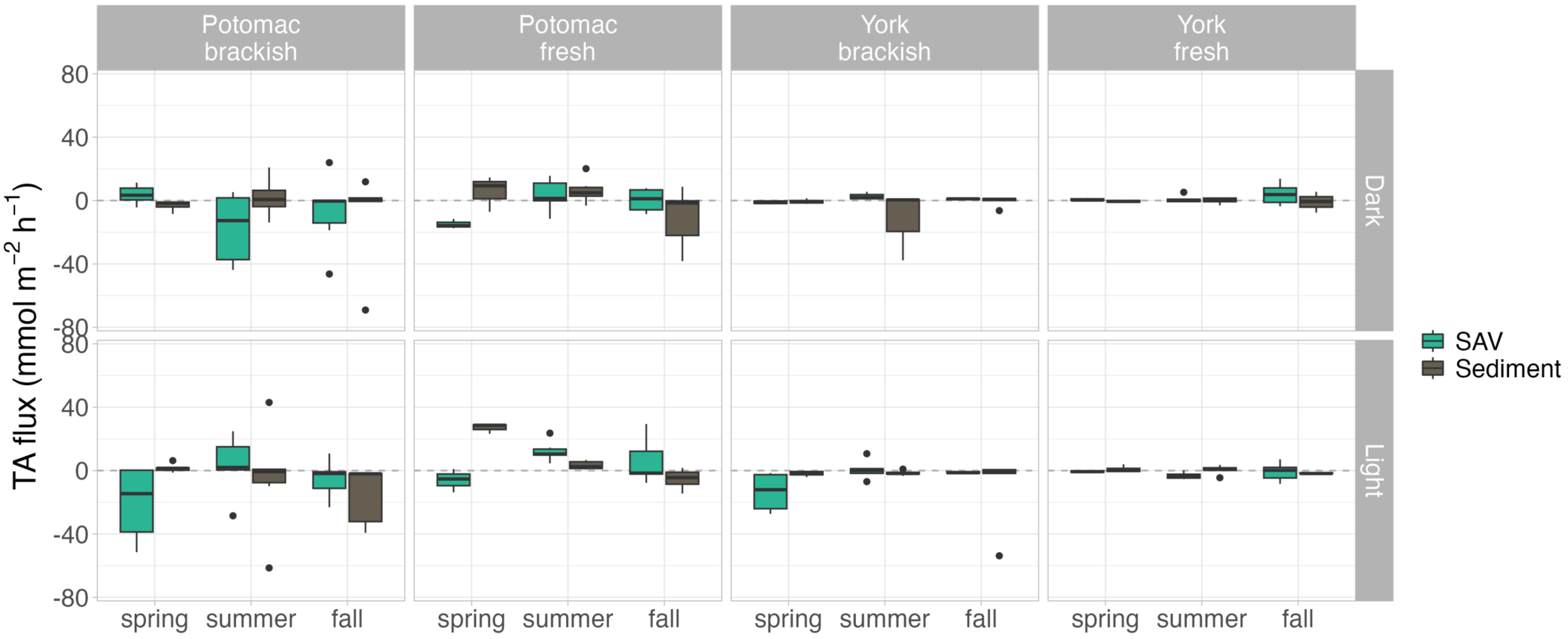




Najjar et al. 2020

TA fluxes were not predictable: processes are complex and variable



Multiple regression models:

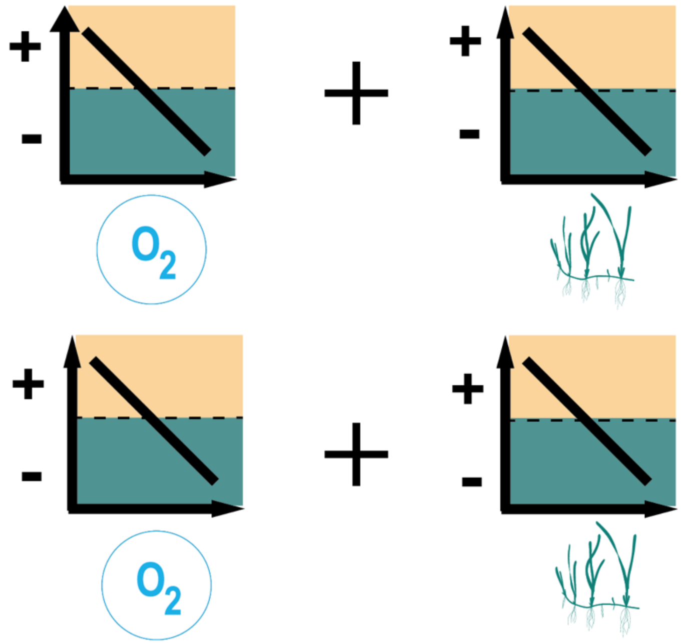
What two environmental variables best predict SAV effect on TA fluxes?

SAV effect = SAV TA flux – sediment TA flux

York: O_2 concentration and SAV biomass predict SAV effect

York fresh

York brackish



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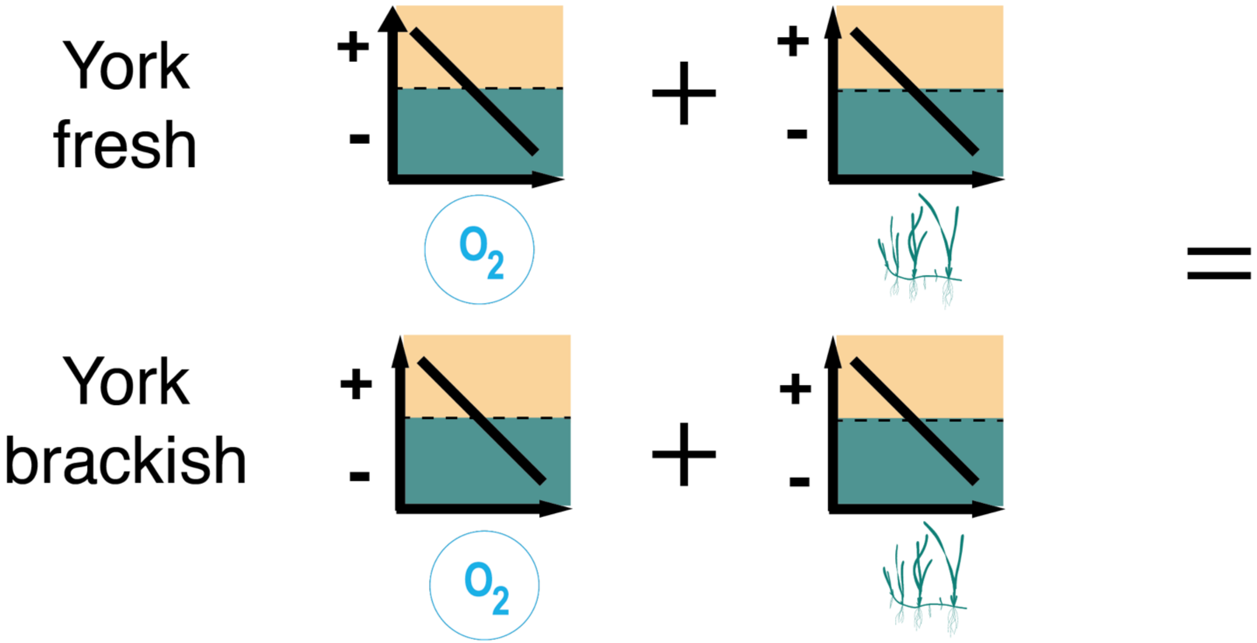
SAV effect on TA:
SAV TA flux -
sediment TA flux

More O_2 and SAV biomass = **less TA production in SAV beds**

York: O_2 concentration and SAV biomass predict SAV effect



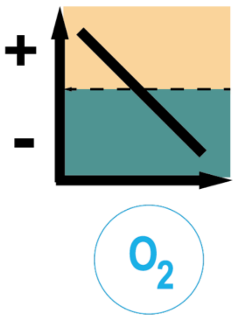
SAV effect on TA:
SAV TA flux - sediment TA flux

More O_2 and SAV biomass = **less TA production in SAV beds**

Decreased anaerobic respiration? → *TA consumption*
Increased nitrification?
NH_4^+ assimilation?

Potomac fresh: O_2 concentration and NO_3^- flux predict SAV effect

Potomac fresh



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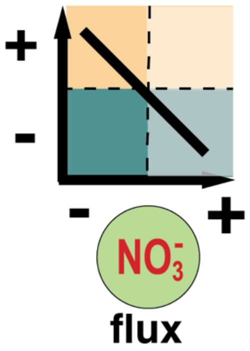

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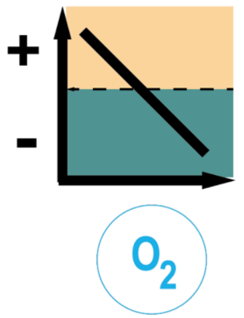
SAV effect on TA:
SAV TA flux - sediment TA flux

Low O_2 and NO_3^- consumption = **more TA production in SAV beds**

Increased anaerobic respiration? → *TA production*

Potomac fresh: O_2 concentration and NO_3^- flux predict SAV effect

Potomac fresh



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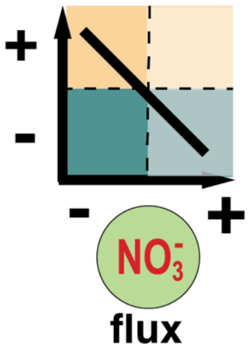

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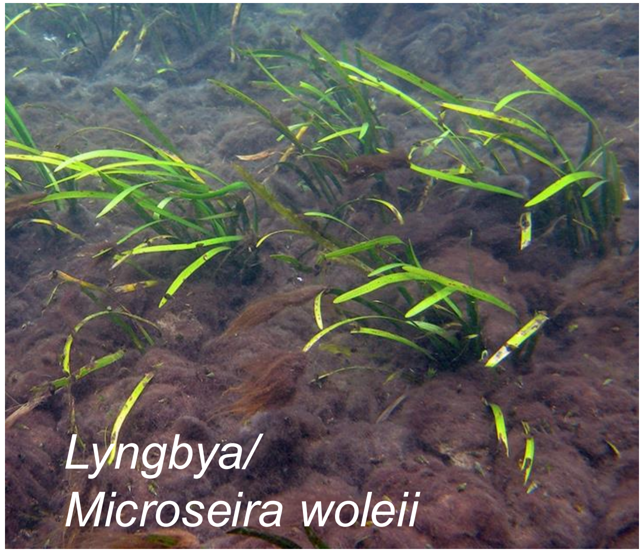
SAV effect on TA:
SAV TA flux - sediment TA flux

More O_2 and NO_3^- production = **less TA production in SAV beds**

N-fixation + nitrification? → *TA consumption*



No clear predictors of SAV effect in Potomac brackish

Potomac brackish **?** = SAV effect on TA: SAV TA flux - sediment TA flux

Next steps

- Do these effects matter?
- Are they scalable?


Thanks!