# Quantifying Inorganic Carbon Dynamics in Cold-Temperate Seagrass Meadows

**Samuel Scott-Askin**[1], Isaac R. Santos[1], Gerli Albert[2], Maria E. Asplund[1], Diana Deyanova[1], Sara C. Forsberg[2], Aurora M. Ricart[3], Martin Gullström[2], Mats Björk[4], Gloria Reithmaier[1]

This presentation participates in OSPP

Outstanding Student & PhD candidate Presentation contest

## Research questions

- Are cold-temperate seagrass meadows net sources or sinks of total alkalinity (TA) and dissolved inorganic carbon (DIC), and what are the drivers?
- Are cold-temperate seagrass meadows local refugia from ocean acidification?

## Introduction

- TA is a permanent atmospheric carbon sink and can buffer against coastal acidification
- No previous TA export rate estimates from cold-temperate seagrasses

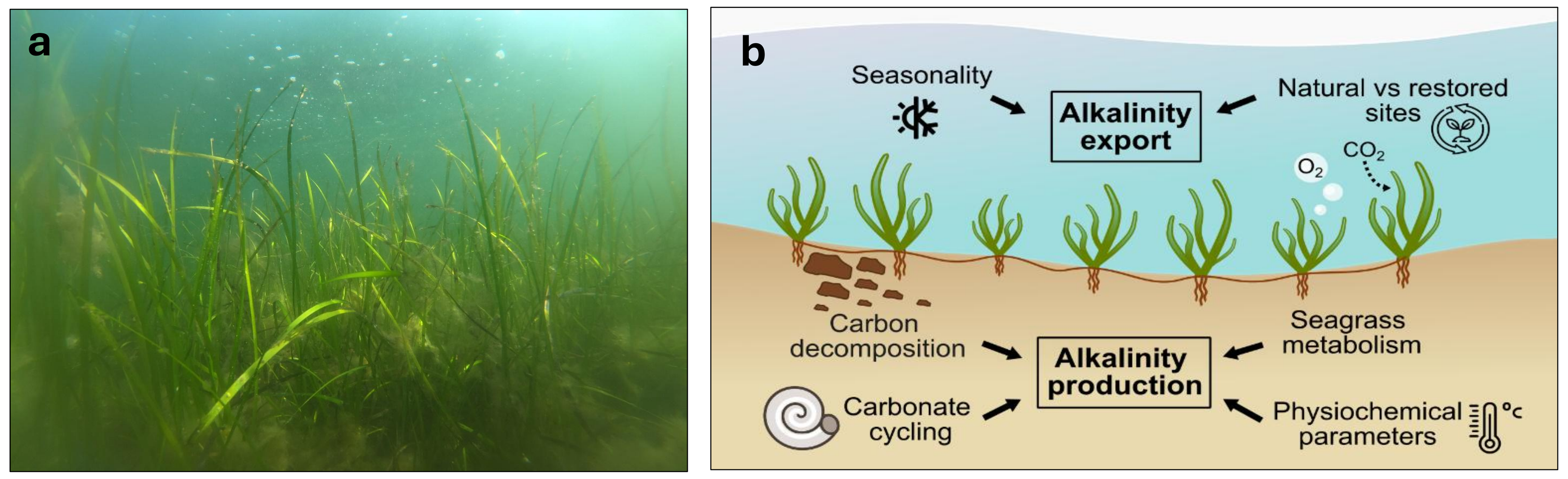


**Fig. 1.** Cold-temperate seagrasses (a) and drivers of TA production and export (b).

## Biogeochemical drivers

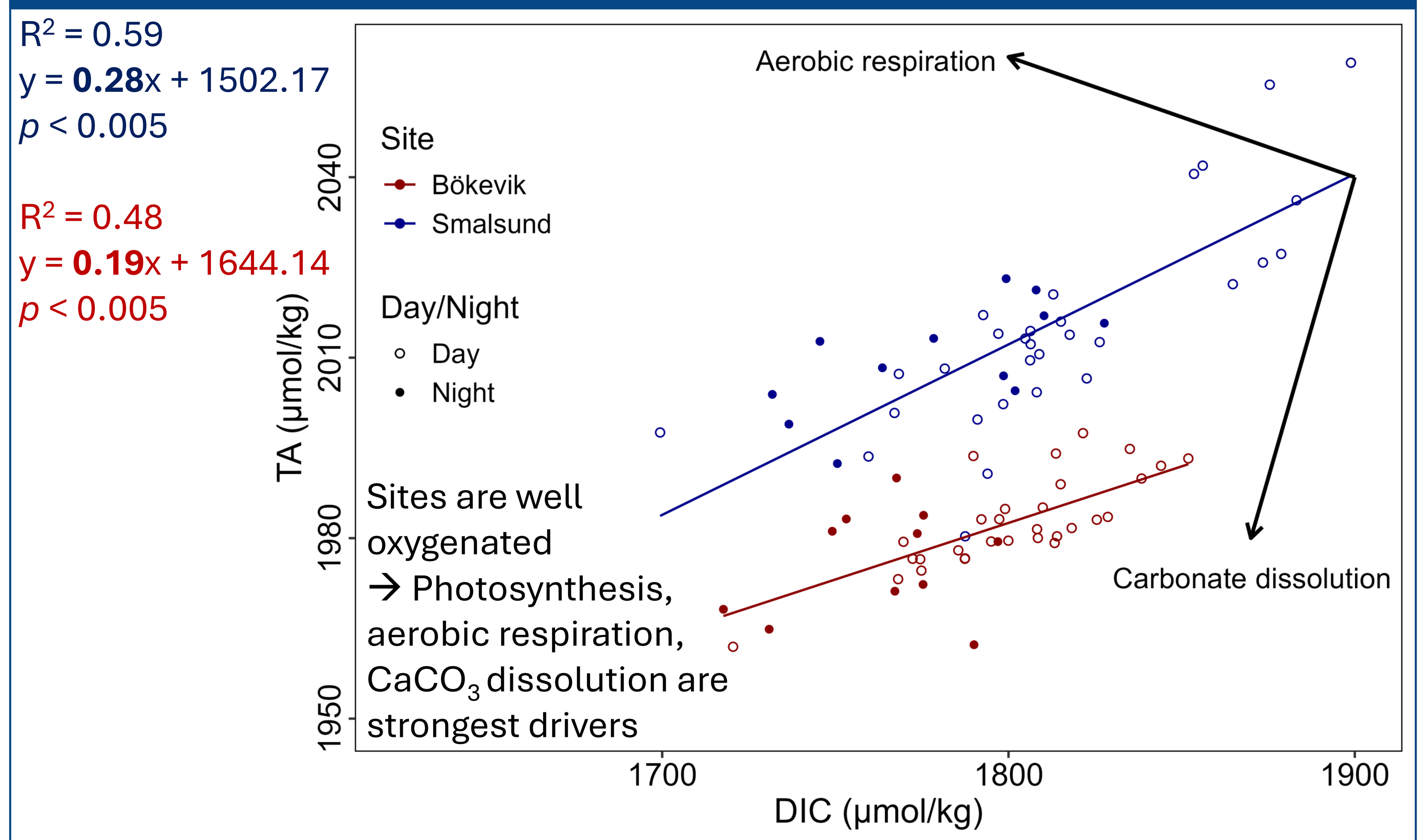


**Fig. 3.** TA versus DIC regressions. The slope determines the most likely driver. Aerobic respiration = -0.2, denitrification = 0.8, sulfate reduction = 1.0, calcium carbonate dissolution = 2.0

## Acidification proxies

- More stable $CaCO_3$, stronger buffering capacity during daytime
- Meadows are only refugia from local offshore environment during day

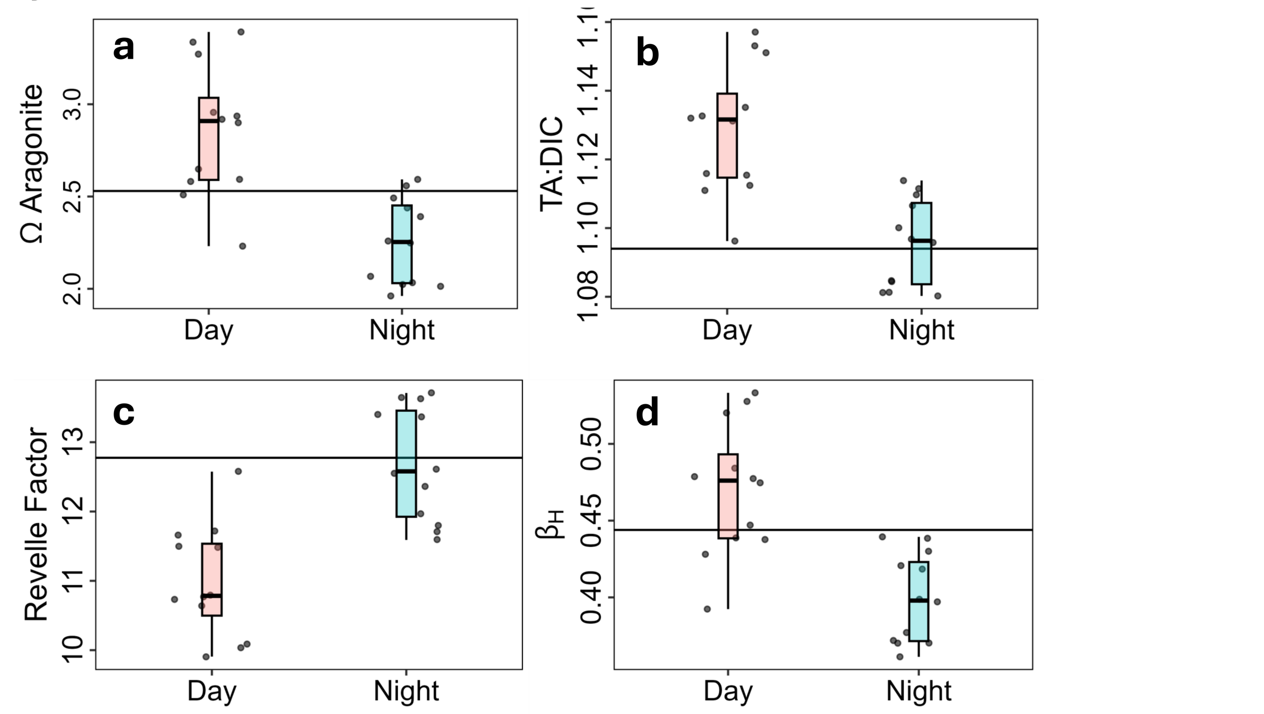


**Fig. 4.** Ωaragonite, $CaCO_3$ stability (a), TA:DIC, proxy for pH (b), Revelle Factor, oceanic resistance to $CO_2$ changes (c), $\beta_H$, buffering against acid-base changes (d), Daily average values from local offshore seawater is represented as black lines.

## Methods

- A series of 24h in-situ chamber incubations at two cold-temperate seagrass (*Zostera marina*) meadows
- Late productive season (early September)
- Fluxes of TA and DIC were calculated
- Acidification proxies were calculated using CO2sys

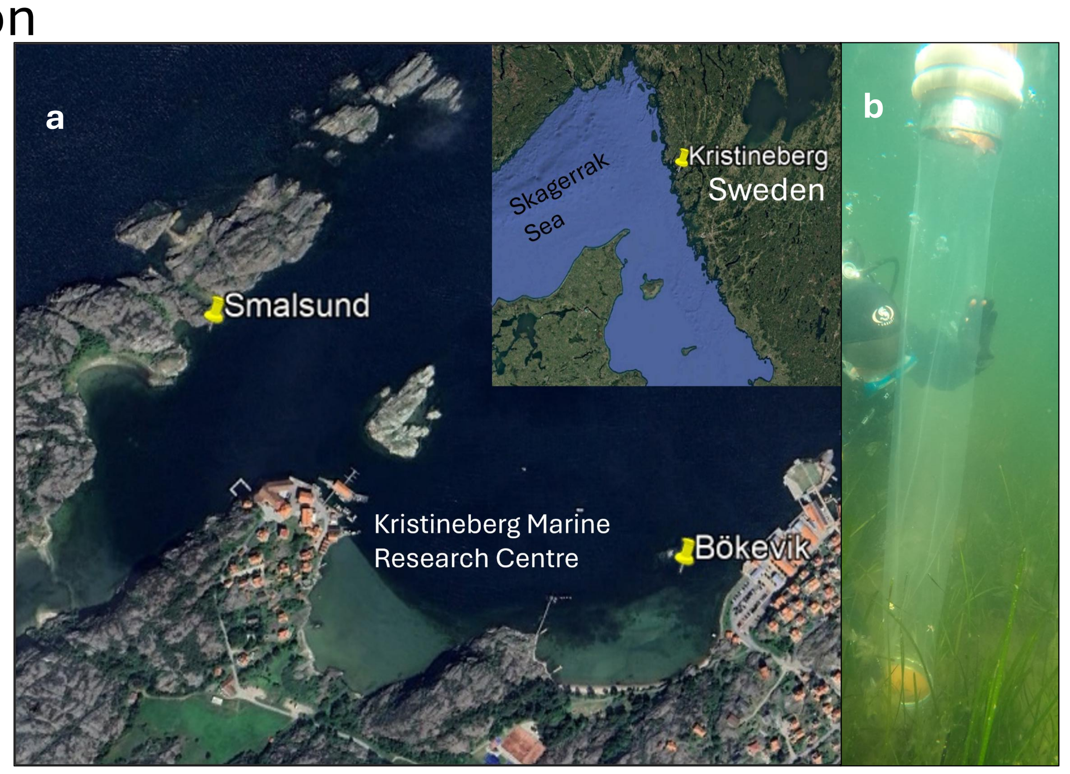


**Fig. 2.** Study sites near Kristineberg Marine Research Centre, Sweden (a), and the incubation chamber design (b)

## Inorganic carbon fluxes

- Fluxes display a clear day/night trend
- Net TA Flux: 16.1 ± 33.5 mmol $m^{-2}$ $d^{-1}$
- Net DIC Flux: -4.7 ± 61.8 mmol $m^{-2}$ $d^{-1}$

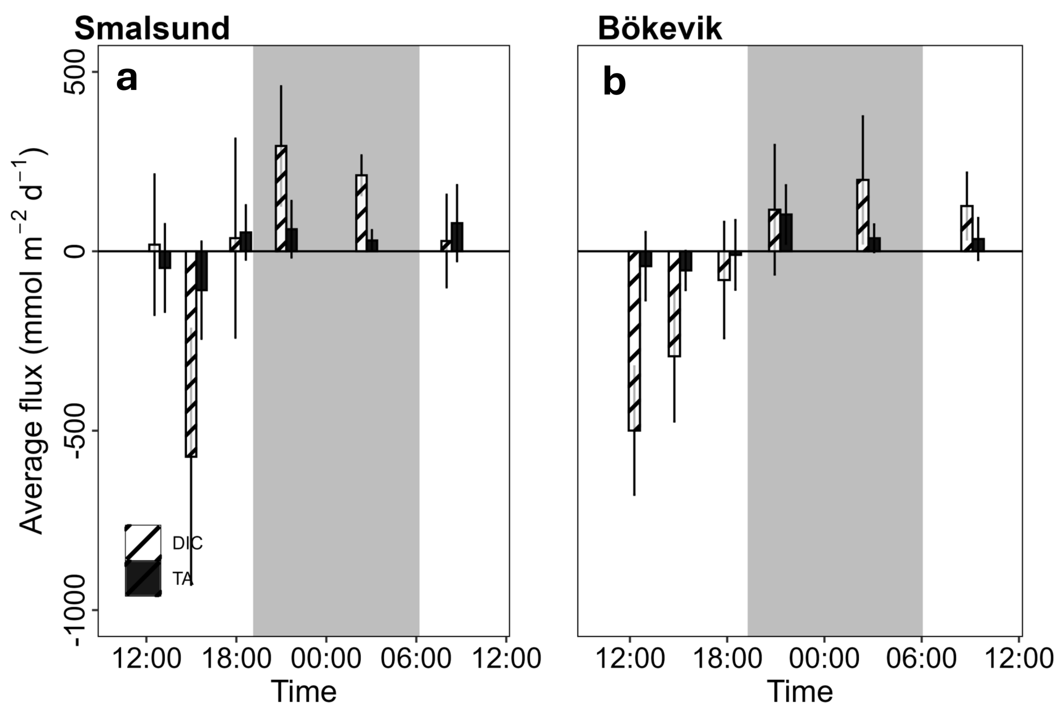


**Fig. 5.** Fluxes of TA (black) and DIC (white) at Smalsund (a), and Bökevik (b). Grey areas represent nighttime.

## Carbon budget

- TA source is 4-fold higher than C burial
- Lateral export of TA and DIC is currently unquantified

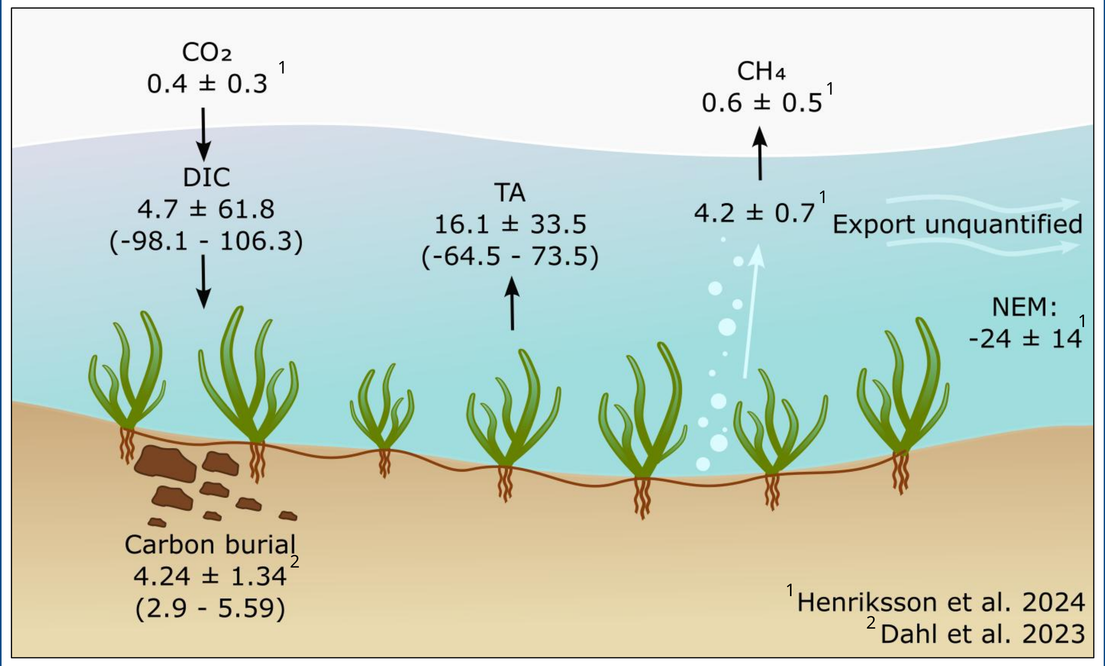


**Fig. 6.** A preliminary carbon budget for our two sites with fluxes presented in mmol $m^{-2}$ $d^{-1}$. Net ecosystem metabolism (NEM), $CO_2$, $CH_4$ (µmol), and carbon burial were based on the literature.

## Conclusions

- Photosynthesis, aerobic respiration and $CaCO_3$ dissolution are the strongest drivers of DIC dynamics in cold-temperate seagrass meadows
- Stronger acidification refugia during the day due to $CO_2$ uptake
- Meadows were a net source of TA, and a variable net sink of DIC
- The overlooked TA production vs. carbon burial demonstrates its potential to contribute to carbon sequestration in cold-temperate seagrass meadows

**Contact**
samscottaskin@gmail.com

BAREFOOT BIOgeochemistry .com

1 UNIVERSITY OF GOTHENBURG

2 SÖDERTÖRN UNIVERSITY STOCKHOLM

3 Institut de Ciències del Mar

4 Stockholms universitet

Dahl, M., Asplund, M. E., Bergman, S., Björk, M., Braun, S., Löfgren, E., Martí, E., Masque, P., Svensson, R., & Gullström, M. (2023). First assessment of seagrass carbon accumulation rates in Sweden: A field study from a fjord system at the Skagerrak coast. *PLOS Climate*, 2(1). https://doi.org/10.1371/journal.pclm.0000099

Henriksson, L., Yau, Y. Y. Y., Majtényi-Hill, C., Ljungberg, W., Tomer, A. S., Zhao, S., Wang, F., Cabral, A., Asplund, M., & Santos, I. R. (2024). Drivers of Seasonal and Diel Methane Emissions From a Seagrass Ecosystem. *Journal of Geophysical Research: Biogeosciences*, 129(11). https://doi.org/10.1029/2024JG008079