Do coastal wetlands drive or buffer coastal acidification?

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Research questions

- Do mangroves and saltmarshes produce and export more alkalinity (TA) or dissolved inorganic carbon (DIC)?
- What drives TA:DIC ratios of coastal wetlands? Can we use TA:DIC ratios to infer impacts on coastal seawater pH?

Introduction

- Mangroves and saltmarshes are sources of TA and DIC to the coastal ocean
- Exported alkalinity represents a permanent carbon sink and can buffer coastal acidification, whereas exported DIC can release CO_2 facilitating coastal acidification

Fig. 1. Pictures of mangroves (a) and saltmarshes (b).

Methods

- We compiled TA and DIC concentrations in groundwater and surface water, measured during time series or spatial surveys, at mangrove- and saltmarsh dominated creeks and estuaries
- We tested drivers of TA:DIC ratios
  - Tidal pumping
  - Physio-chemical parameters
  - Anthropogenic impact
  - Seasonality

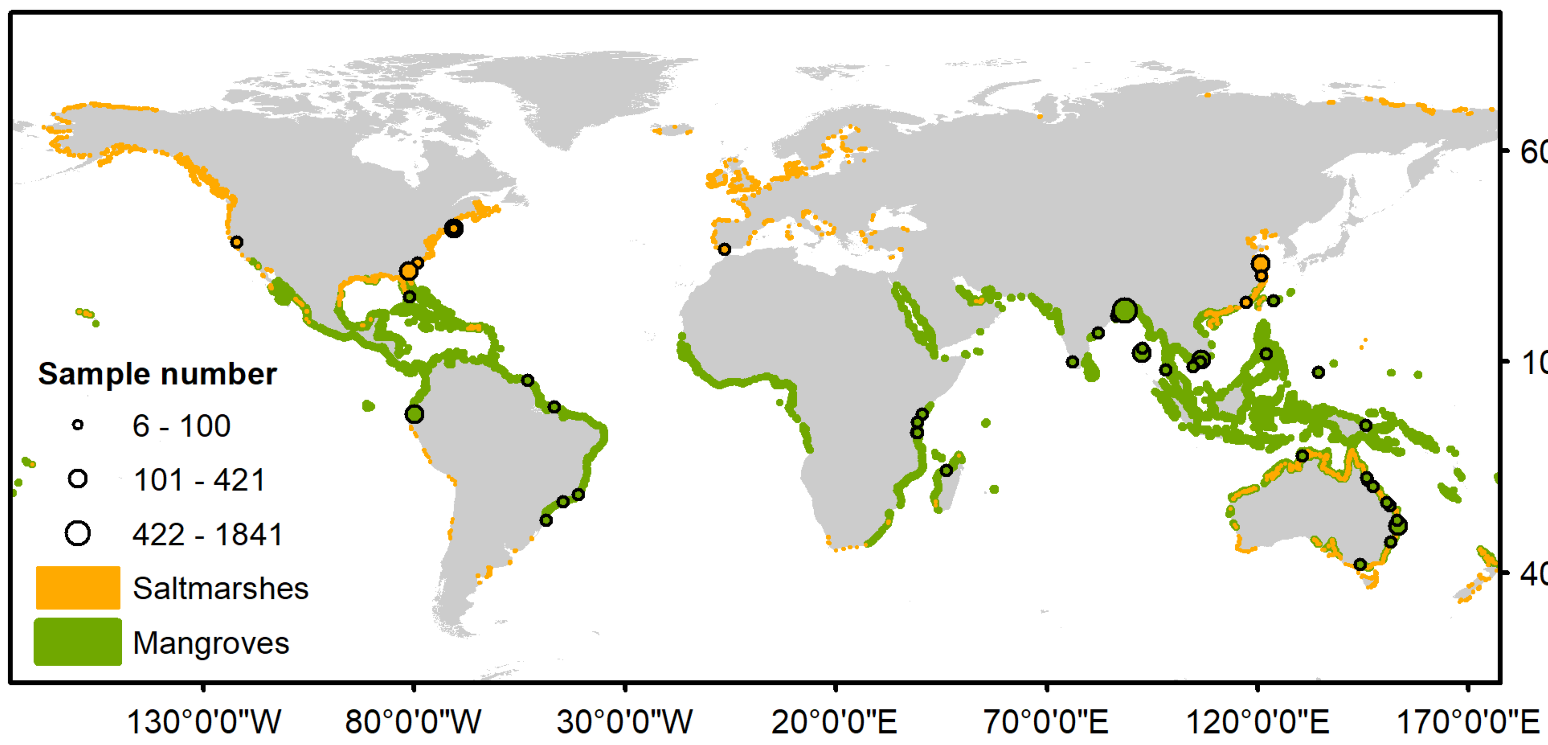

Fig. 2. Global map showing locations of 39 mangrove and nine saltmarsh study sites.

TA:DIC ratios

- On average, TA:DIC ratios are below one in groundwater and above one in surface water
- More DIC in groundwater and more TA in surface water

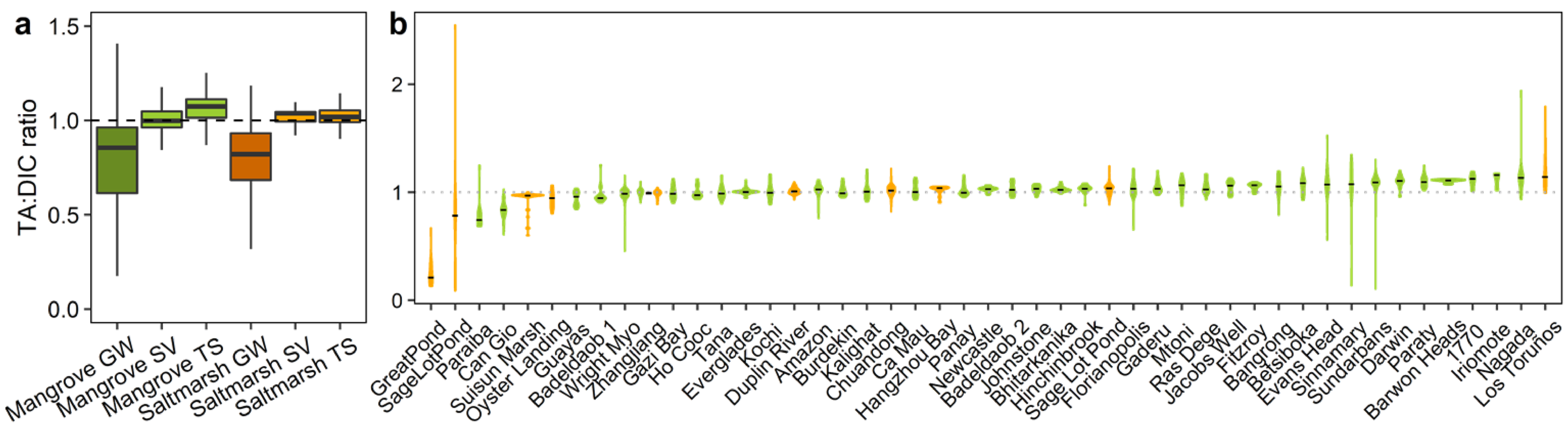

Fig. 3. TA:DIC ratios in (a) groundwater (GW) and surface water, measurand during spatial surveys (SV) and time series (TS), and (b) in surface water per site at mangroves (green) and saltmarshes (orange).

Tidal pumping

- TA and DIC conc. low tide > high tide

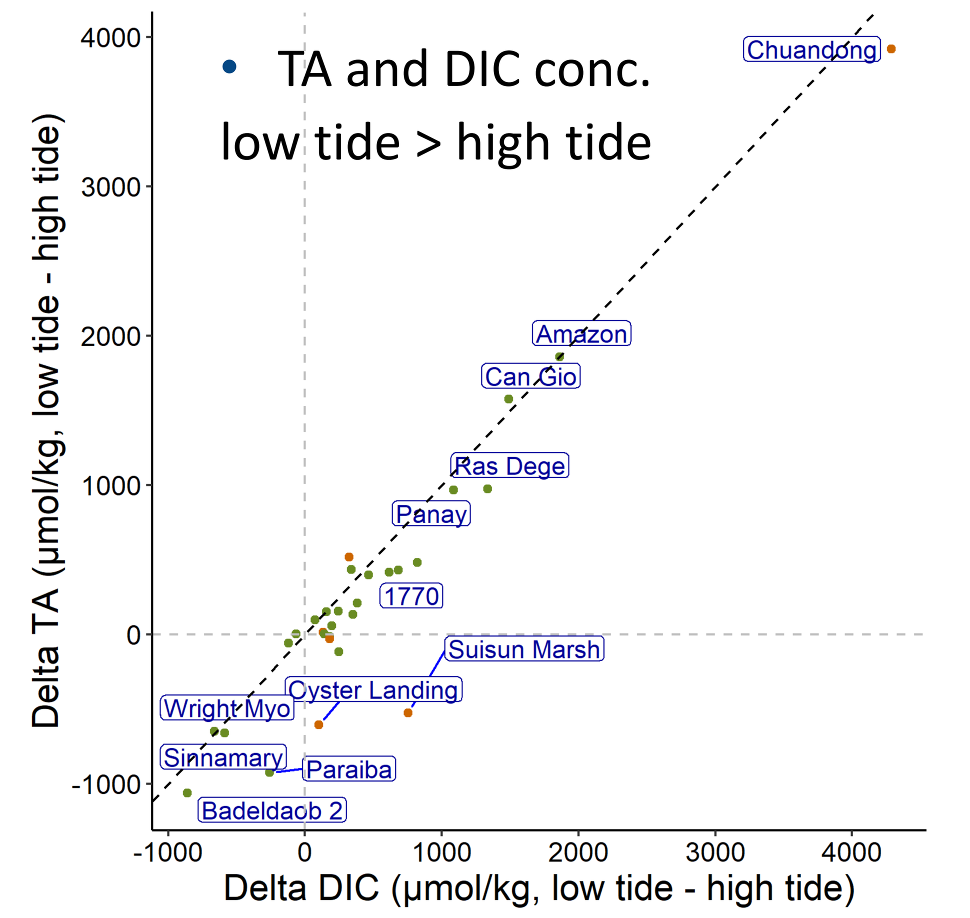

Fig. 4. Differences between low and high tide concentrations.

Physio-chemical parameters

- TA:DIC ratios are positively correlated with salinity and dissolved oxygen (DO)
- TA:DIC ratios are negatively correlated with radon (Rn), CO_2, and nutrients

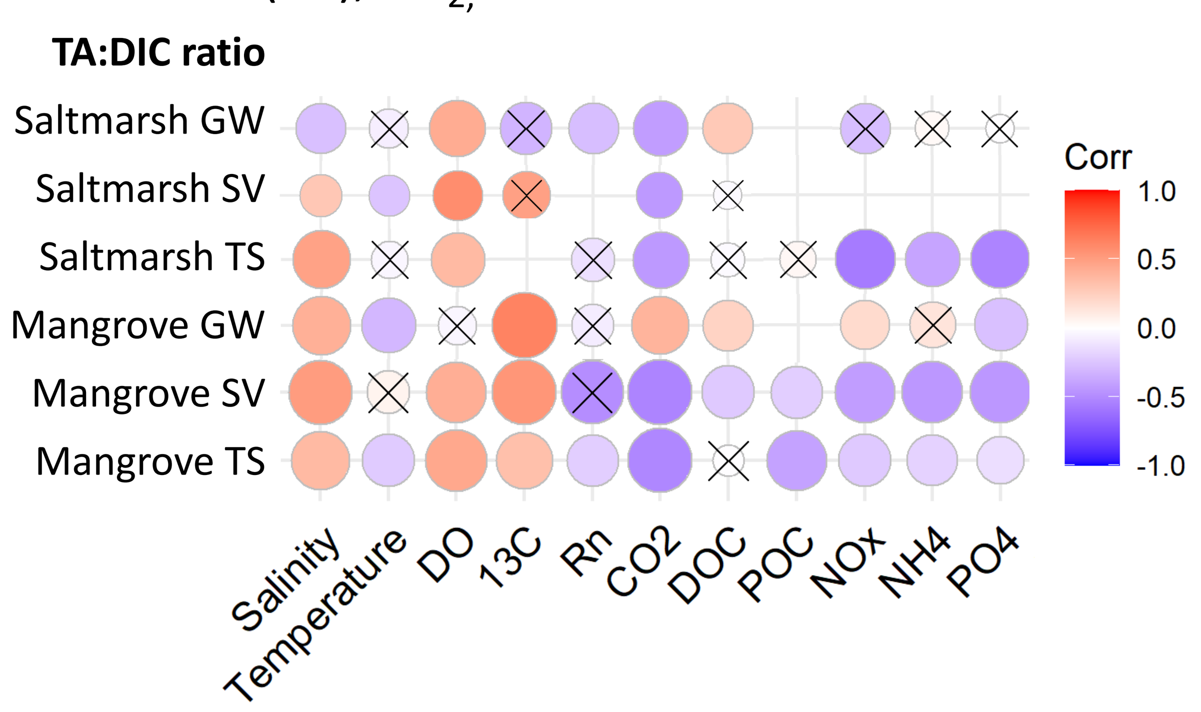

Fig. 5. Correlation matrix between drivers and TA:DIC ratios in groundwater (GW) and surface water, measurand during spatial surveys (SV) and time series (TS). Crosses represent unsignificant correlations.

Anthropogenic & seasonal impacts

- TA:DIC ratio: pristine > impacted, dry > wet

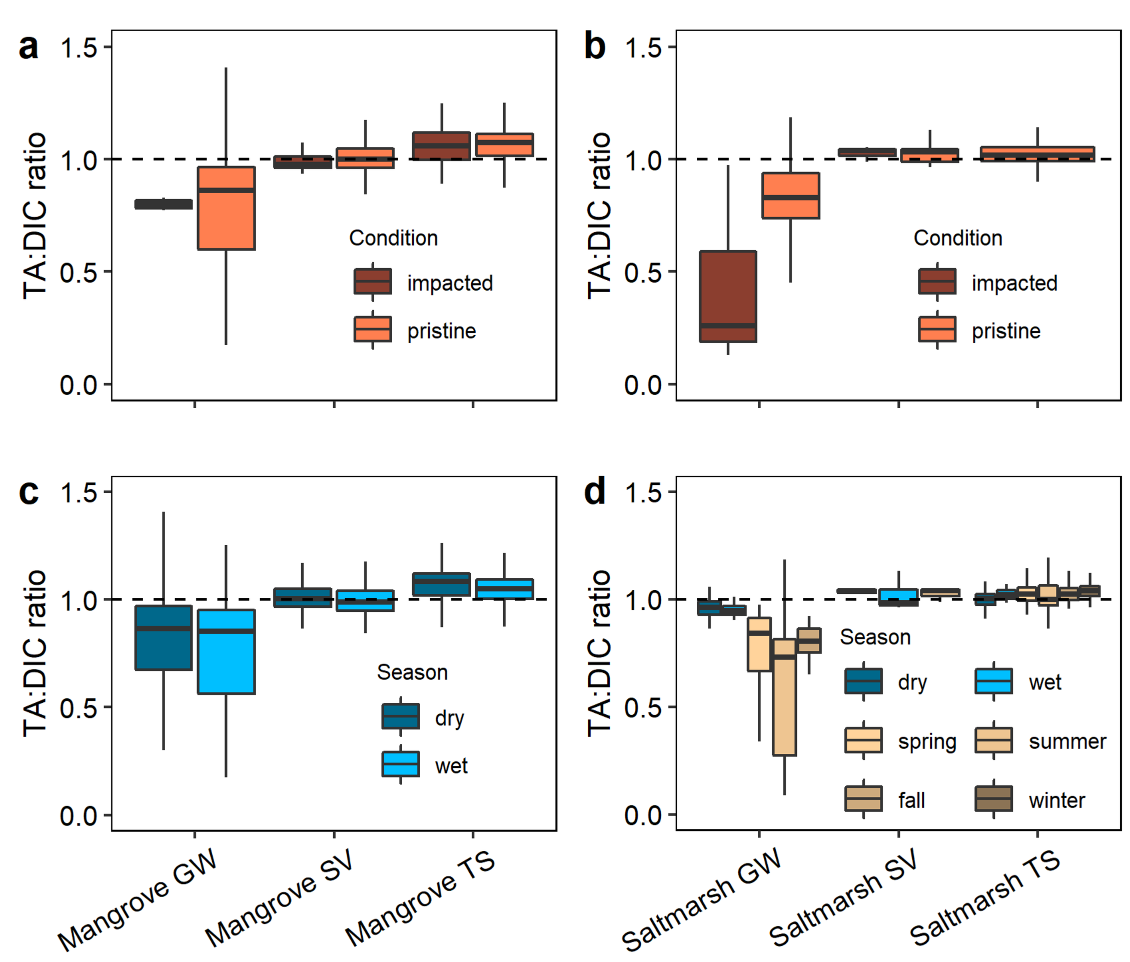

Fig. 6. Anthropogenic (a, b) and seasonal (c, d) impact on TA:DIC ratios.

Conclusions

- Coastal wetlands produce more DIC than TA in their sediments. Tidal pumping exports TA and DIC from sediments to surface waters.
- On average, surface water TA:DIC ratios are above one → coastal wetlands potentially buffer acidification of adjunct waters
- Salinity and oxygen positively affect TA:DIC ratios, whereas CO_2 and nutrients negatively affect TA:DIC ratios
- Pristine systems and dry seasons favor TA over DIC production and export

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