

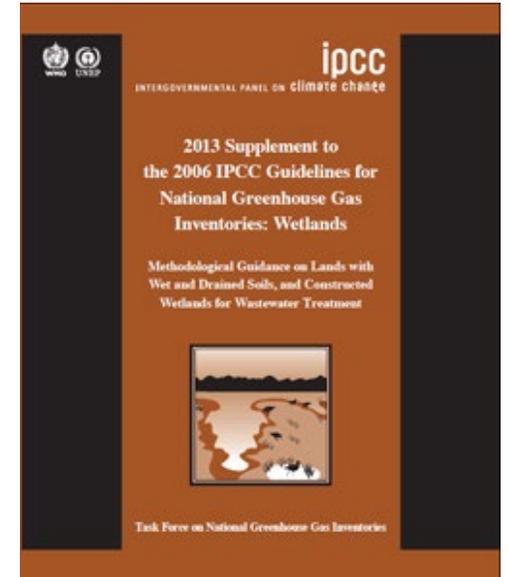
An underwater photograph showing a dense field of green seagrass in the foreground. The water is clear and blue, with sunlight filtering through from the top right, creating a bright, hazy area. The overall scene is serene and natural.

# Seagrass deep dive

Catherine Lovelock  
University of Queensland

# Carbon accounting for seagrass in IPCC Guidelines (2013)

- Few activities
  - Extraction
  - Rewetting
- At Tier 1 (global)
  - Limited carbon stock values (n=89)
  - Limited soil carbon sequestration values (n=6)
  - Biomass: tropical (n=396); subtropical (n=391); temperate (n=91)
  - Nitrous oxide from ocean aquaculture



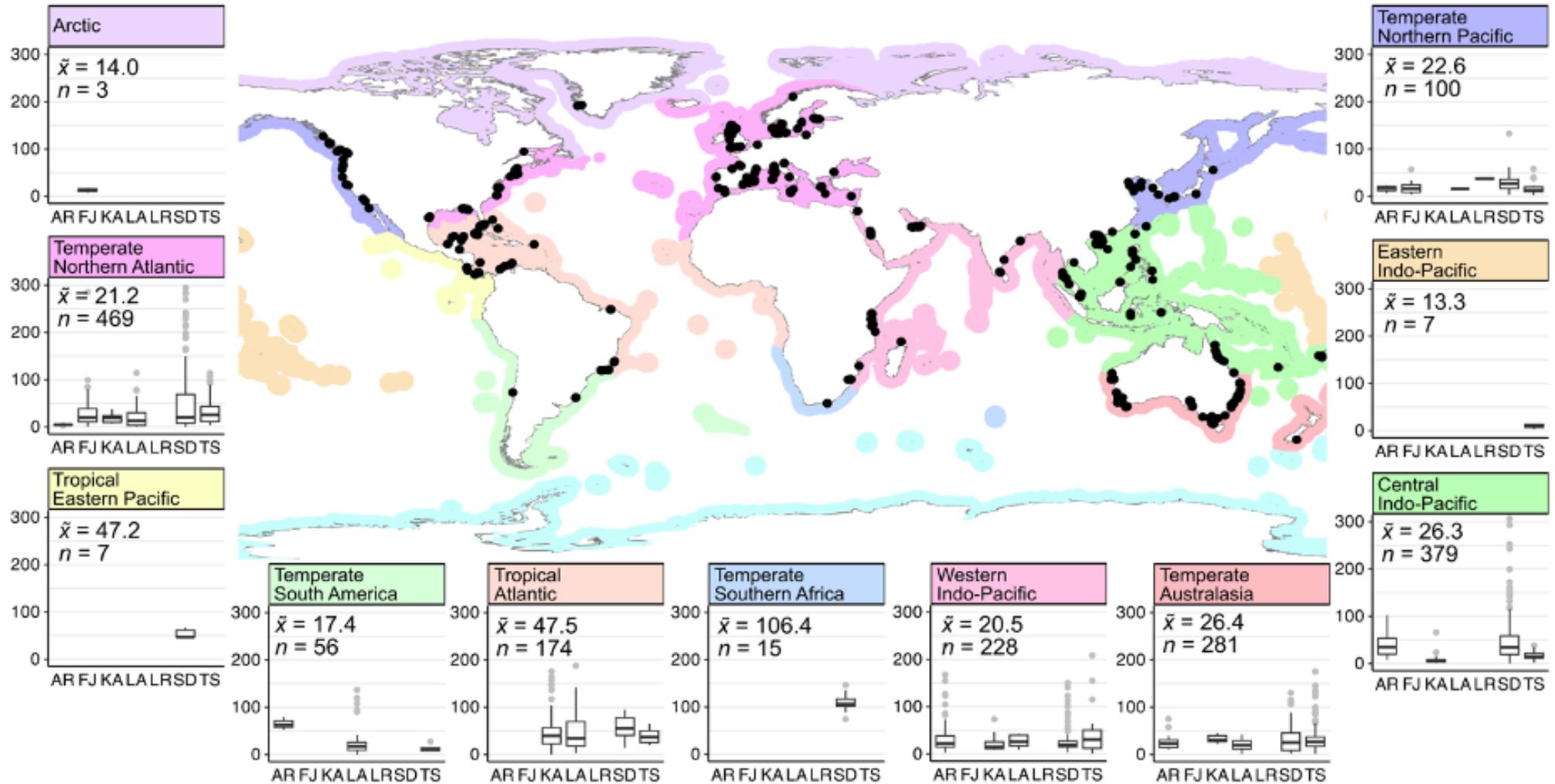
Highlights that knowledge was limited

# Seagrass is variable in form and function



# Seagrass $C_{org}$ Stocks (30cm, Mg C ha<sup>-1</sup>) by Marine Ecoregion

Coastal typologies: AR = Arheic; FJ = Fjords; KA = Karst; LA = Lagoons; LR = Large rivers; SD = Small deltas; TS = Tidal systems



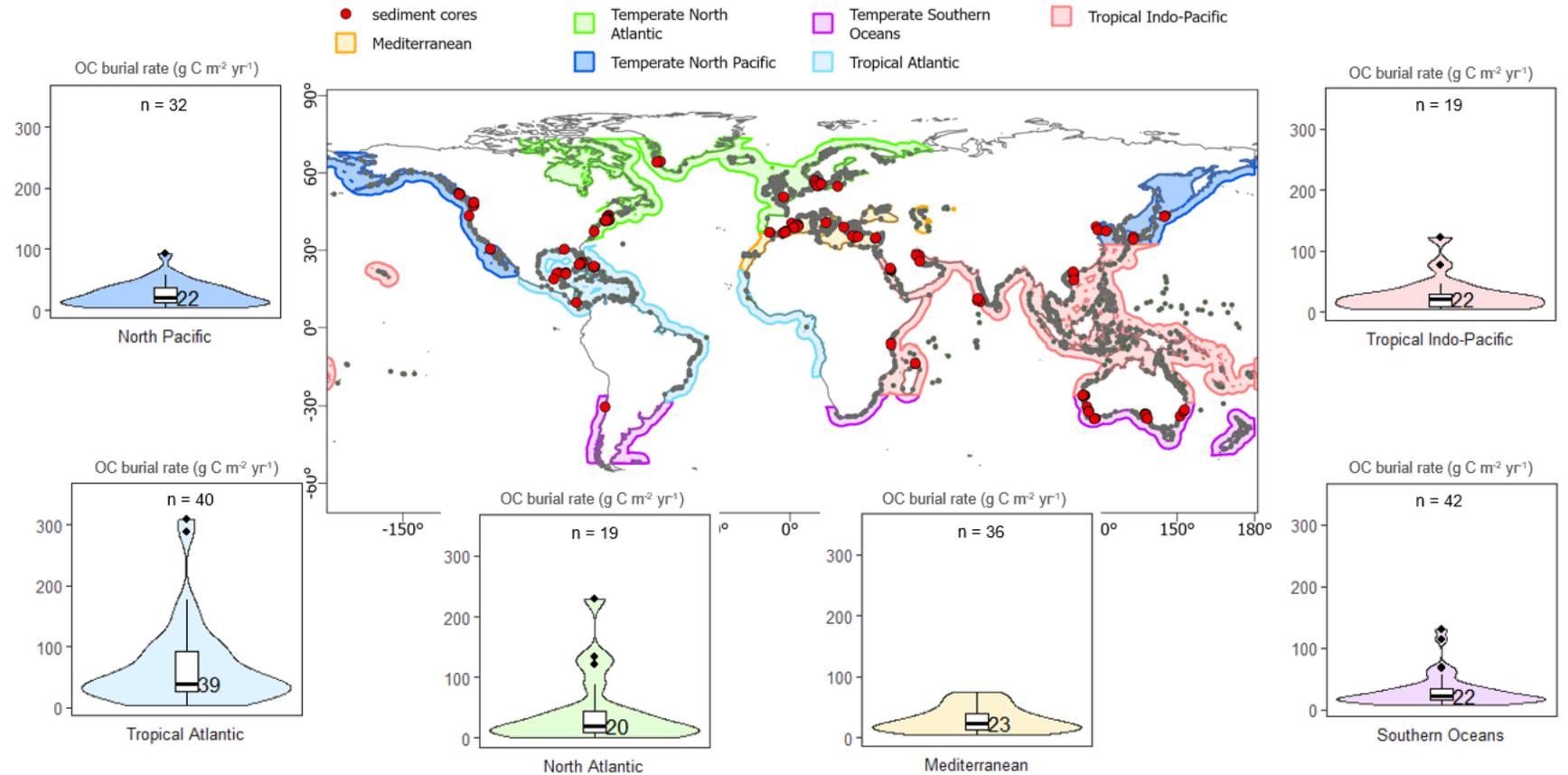
**N = 1,716 over 11 regions**

Krause et al. in prep  
Seagrass working group, Blue Carbon Initiative

# Carbon and GHG fluxes – new data syntheses

- Mean carbon burial of  $0.26 \text{ Mg C ha}^{-1} \text{ year}^{-1}$  (range  $0.002$  to  $9.8 \text{ Mg C ha}^{-1} \text{ year}^{-1}$ ,  $n > 100$ )
- Methane and  $\text{N}_2\text{O}$  offset  $0.3$  -  $10\%$  of carbon burial, higher GHG with pollution (Yeo et al. 2024)

Distribution of seagrass meadows where  $\text{C}_{\text{org}}$  accumulation rates have been estimated



Global map - Ariane Arias-Ortiz (U Barcelona)

# Monitoring seagrass extent

- Global extent is large but uncertain: between 177,000 to 600,000 km<sup>2</sup>
- Maps of change in extent are limited to some sites
- Mapping techniques are improving at all scales
  - Extent
  - Species
  - Condition
- Two examples from Australia

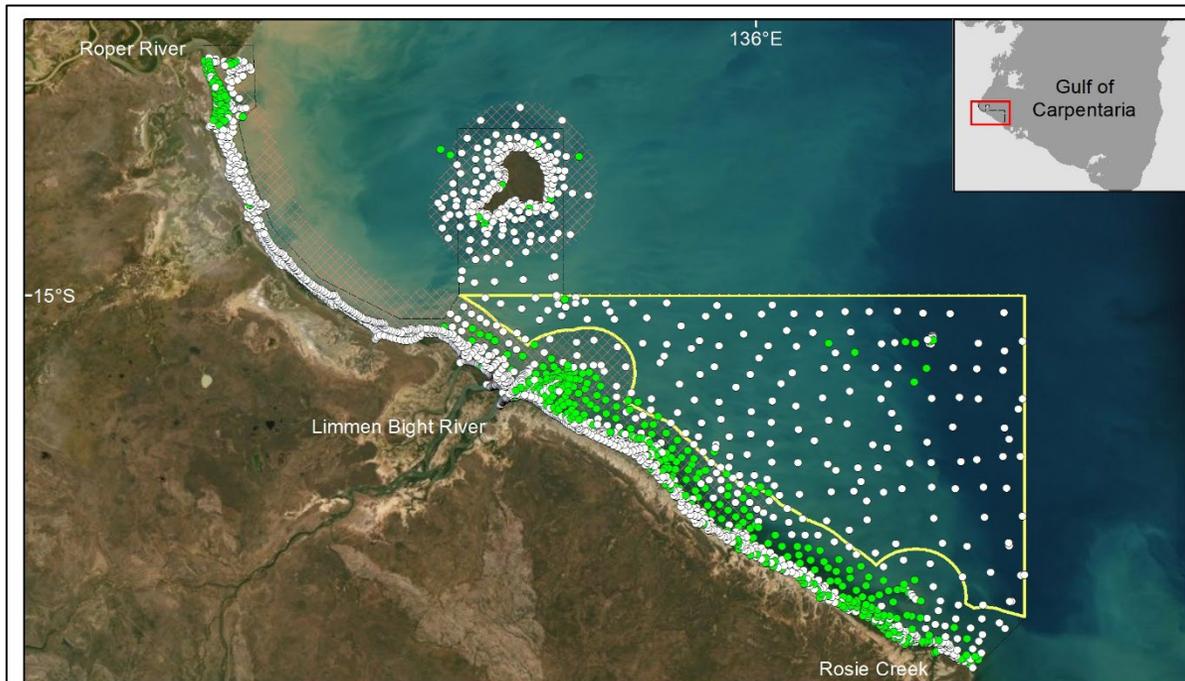


Phinn, S. *et al.* (2018). Mapping, Monitoring and Modelling Seagrass Using Remote Sensing Techniques. [https://doi.org/10.1007/978-3-319-71354-0\\_15](https://doi.org/10.1007/978-3-319-71354-0_15)

McKenzie *et al.* 2020 Environmental Research Letters. DOI 10.1088/1748-9326/ab7d06

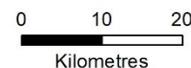
# On-ground mapping – Marra Sea Country

- Collaboration: li-Anthawirriyarra Rangers, Mabunji Aboriginal Resources IC, Charles Darwin University, TropWATER JCU, Parks Australia and NT Government
- Mapped 2021, habitat monitoring and fish surveys in 2023

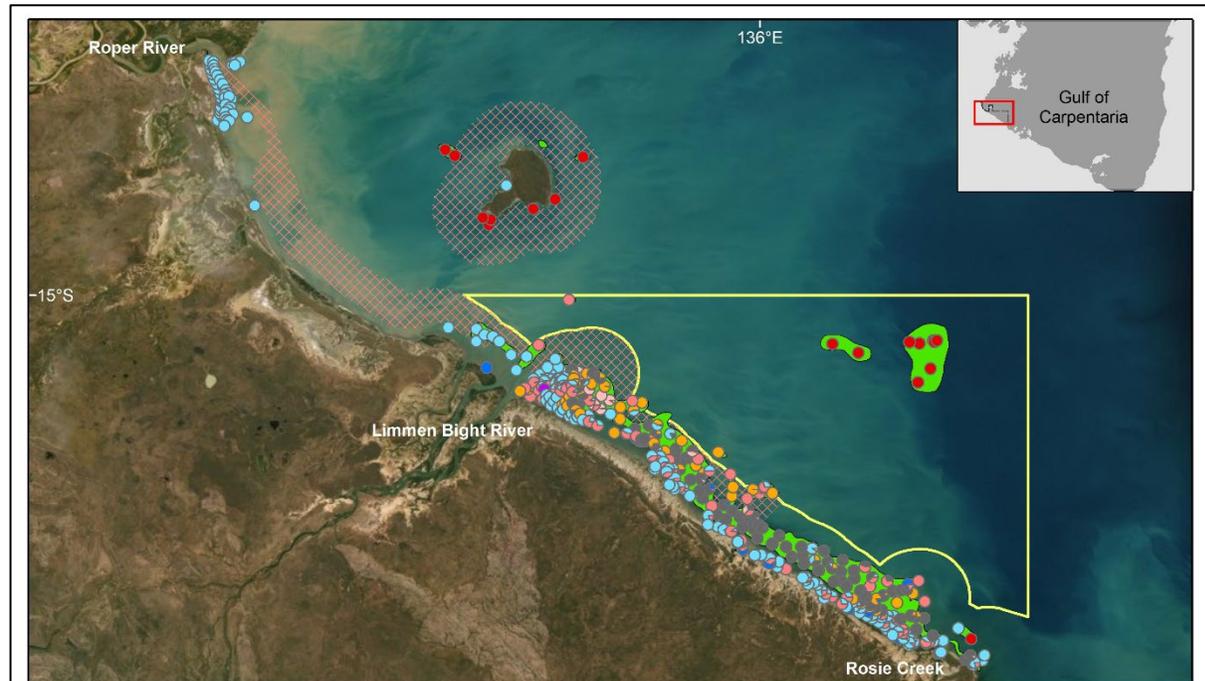


## Legend

- Survey Sites**
- Seagrass Absent
  - Seagrass Present
- Survey Boundary
- ▨ Limmen Bight Marine Park
  - ▭ Limmen Marine Park



Satellite image: courtesy ESRI



## Legend

### Seagrass Species

- *E. acoroides*
- *C. serrulata*
- *S. isoetifolium*
- *H. spinulosa*
- *H. ovalis*
- *H. decipiens*
- *H. uninervis* (wide)
- *H. uninervis* (narrow)

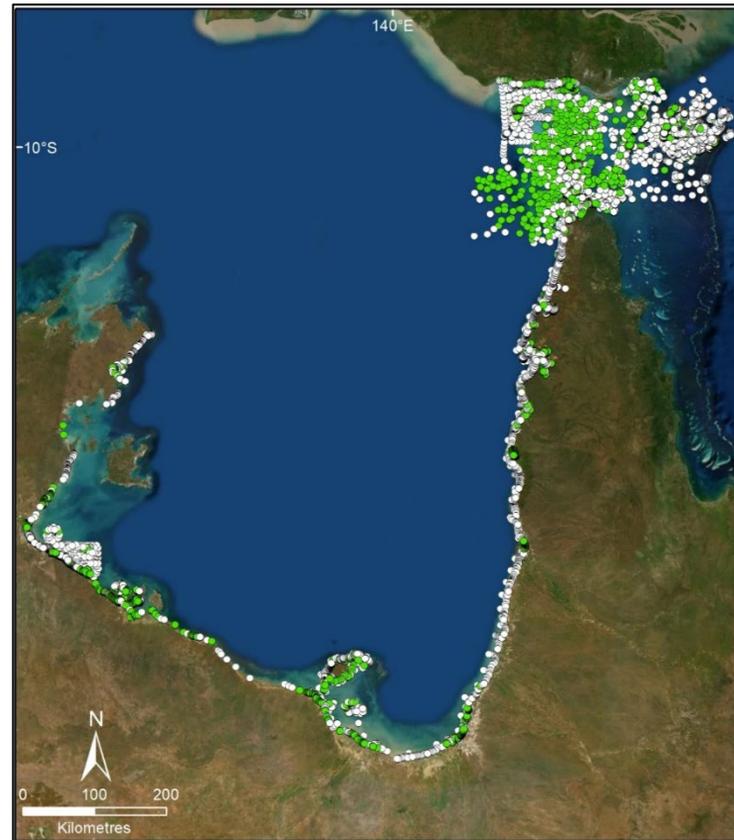
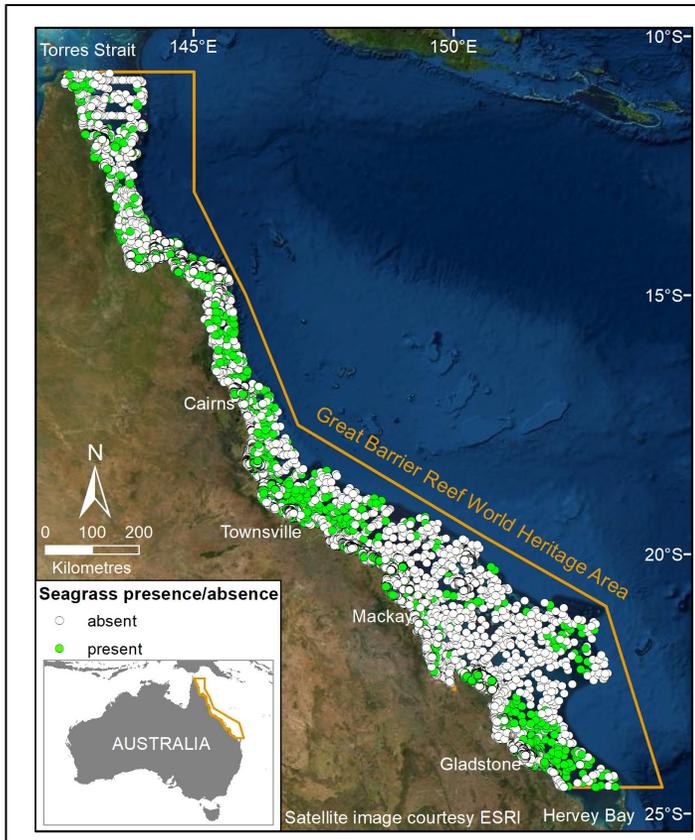
■ Seagrass Meadows

- Survey Boundary
- ▨ Limmen Bight Marine Park
  - ▭ Limmen Marine Park



Satellite image: courtesy ESRI

# Seagrass data synthesis



Alex Carter, Catherine Collier,  
Rachel Groom, Kathryn  
McMahon



LIMNOLOGY AND OCEANOGRAPHY  
**Letters**

**ASLO**  
Open Access

© 2021 The Authors. *Limnology and Oceanography Letters*, 2021, 216–226  
on behalf of Association for the Sciences of Limnology and Oceanography.  
doi: 10.1002/lol2.10193

## DATA ARTICLE

### Synthesizing 35 years of seagrass spatial data from the Great Barrier Reef World Heritage Area, Queensland, Australia

Alex B. Carter<sup>1</sup>, Skye A. McKenna<sup>1</sup>, Michael A. Rasheed<sup>1</sup>, Catherine Collier<sup>1</sup>, Len McKenzie<sup>1</sup>, Roland Pitcher<sup>2</sup>, Rob Coles<sup>1</sup>

<sup>1</sup>Centre for Tropical Water and Aquatic Ecosystem Research (TropWATER), James Cook University, Cairns, Queensland;

<sup>2</sup>Commonwealth Scientific and Industrial Research Organization (CSIRO), St Lucia, Queensland

LIMNOLOGY AND OCEANOGRAPHY  
**LETTERS**

**ASLO**  
Open Access

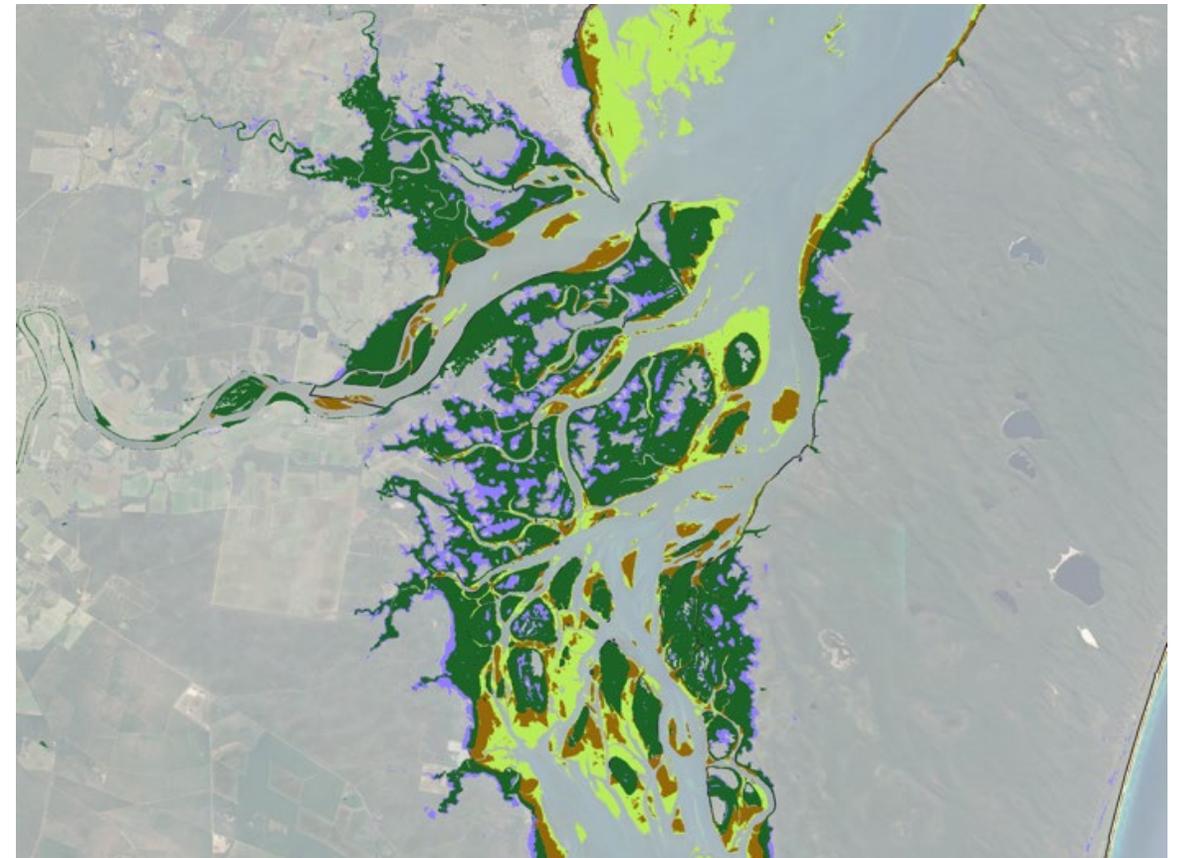
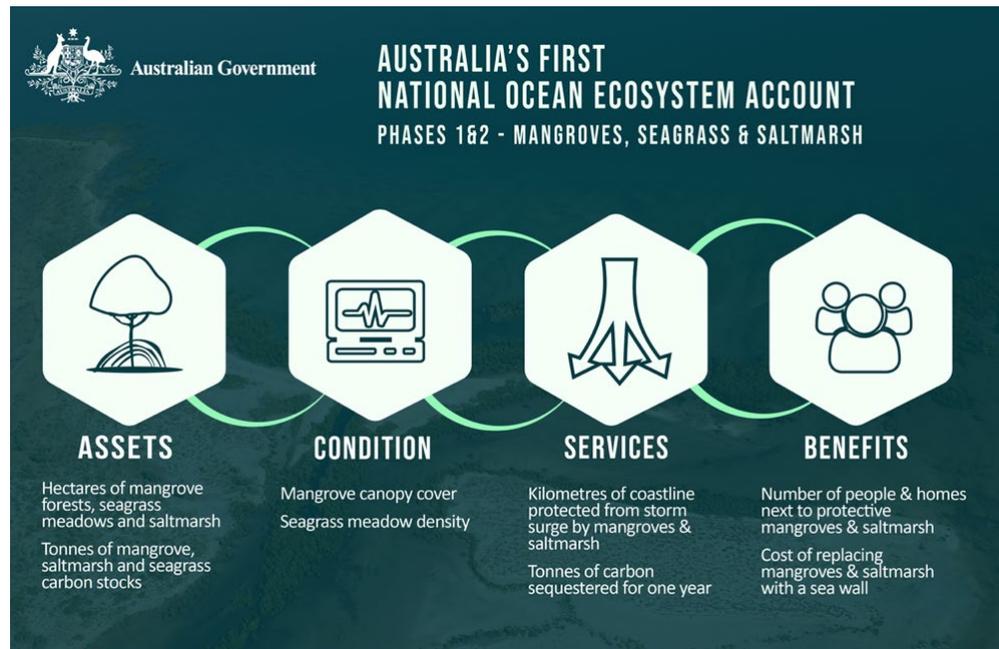
Data Article | [Open Access](#) | |

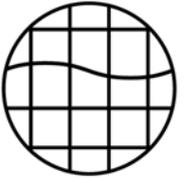
### Seagrass spatial data synthesis from north-east Australia, Torres Strait and Gulf of Carpentaria, 1983 to 2022

A Carter ✉, S McKenna, MA Rasheed, H Taylor, C van de Wetering, K Chartrand, C Reason, C Collier, L Shepherd, J Mellors, L McKenzie, NC Duke, A Roelofs, N Smit, R Groom, D Barrett ... [See all authors](#)

# Coastal Ecosystem Mapping for Australia: Implementing a Multi Ecosystem Model on Digital Earth Australia

- Satellite remote sensing and machine learning modes





**UNSW**  
Centre for  
Sustainable  
Development Reform



**Digital Earth**  
AUSTRALIA



Mitchell Lyons, Nicolas Murray, Stephen Sagar, Claire Phillips, Vanessa Newey, Robbie Bishop-Taylor, Alejandro Navarro Otero, Robert Canto, Yannick Tidou

# Conclusions

- Assessment of global and local seagrass extent are improving
- Assessment of carbon stocks and fluxes have also increased since 2013 for a range of activities (including restoration)
- Threats to seagrass are high
- Time to revisit IPCC Guidelines



Photo Alex Carter, JCU

# Mapping threats

- >25% loss from 2000-2010
- Poor water quality
- Direct disturbance (development, trawling)
- Climate



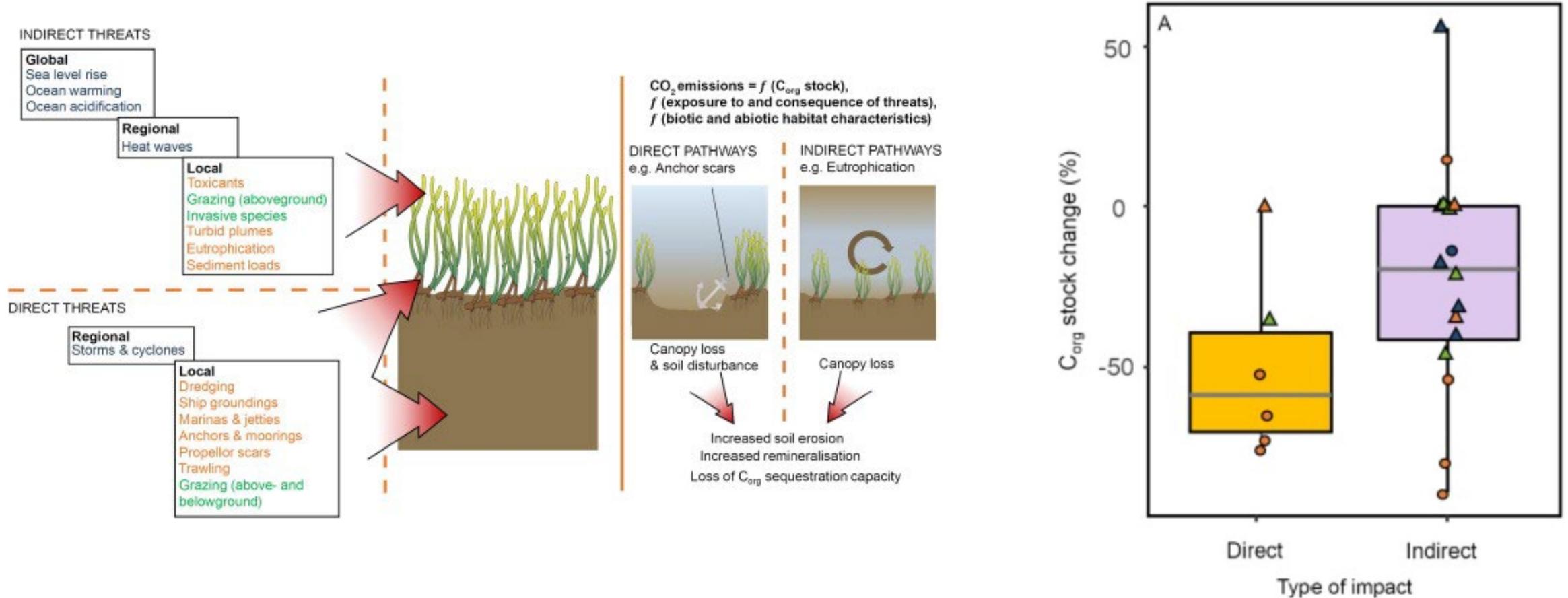
Image Richard Unsworth

Turchwell et al. 2021

<https://www.pnas.org/doi/abs/10.1073/pnas.2110802118>

Dunic et al. 2021, Global Change Biology

# Threats result in loss of carbon stocks and sequestration and enhance GHG emissions



Dhal et al. 2023. Global Environmental Change

<https://www.sciencedirect.com/science/article/pii/S0959378022001704>