Carbon in Seas
From first assessments via variability and vulnerability to manageability
Perspectives for the Institute of Carbon Cycles (KC)

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- Scientific challenges
- Understanding from 1st Assessments (short)
- Understanding Variability
- Vulnerability and Manageability
Two (of more) Takeaways from the 2022 IPCC Climate Change Mitigation Report

1. Global GHG emissions have continued to rise, but in pathways that limit warming to 1.5°C, they peak before 2025.

2. ...

3. ...

4. ...

5. Limiting global temperature rise to 1.5 degrees C will be impossible without carbon removal.

6. ...

Not in the report but in the news on 10.05.2022: We will hit the 1.5°C bar with 50% probability before 2025 (WMO).

2: Scientific challenges and perspectives

KC’s future challenges:
Can we deliberately manage C-reservoirs in the coastal zone?

➢ Are the coastal zones able to supply this required negative emissions?
➢ Which deliberate approaches might appear worth considering?
➢ How to verify and attribute deliberate measures?
➢ What are the transport pathways and ultimate sinks?
➢ Are there collateral benefits/caveats (price tag)?
➢ How does coastal engineering affect the environment, and how does the environment affect coastal engineering?

Negative emissions in the marine realm
Understanding from 1st Assessments – the role of alkalinity

Why does the $pCO_2$ remain low in the southern Bight?

- Lateral and vertical sources into shallow North Sea appear to contribute approx. equally to $A_T$ inputs.
  (Burt, Thomas et al., 2014, 2016)
- Anaerobic control
- See also Voynova et al., 2019, L&O, ferrybox paper

The metabolic switch: $O_2$
Understanding Variability - local/regional control

ΔpCO$_2$ in 2001

Changes in ΔpCO$_2$ 2005-2001

Thomas et al., 2007

Declining CO$_2$ uptake? Trend or Variability?
Both in the North Sea and the North Atlantic?

Macovei et al., 2021

Trend or variability?
For comparison:
Open ocean pH decreases approx. 0.001-0.003 yr⁻¹

One example:
Eutrophication and CO₂/pH conditions

Deliberate human control

Burt, Thomas… et al., 2016, NO3 run-off: Pätsch and Lenhardt, 2011, pH after Provoost et al., 2010
Vulnerability and Manageability - alkalinity input from rivers

Deliberate human control

Lines = differences
Bars = absolute changes

M. Norbisrath, PhD thesis
Thank you very much for your attention!

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