Technology development at NOC and some work in the Itchen River

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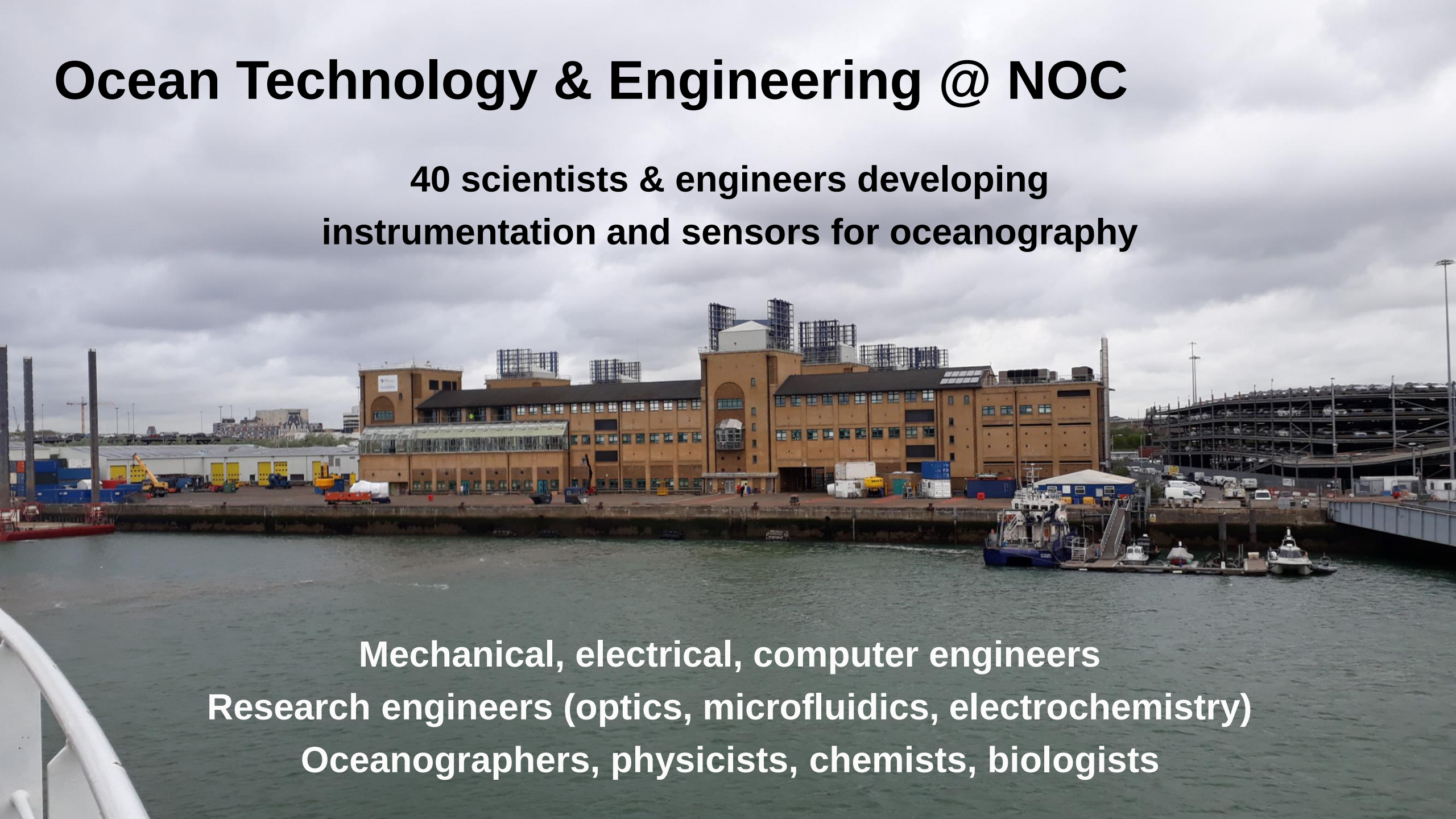
Ocean Technology & Engineering @ NOC

40 scientists & engineers developing instrumentation and sensors for oceanography



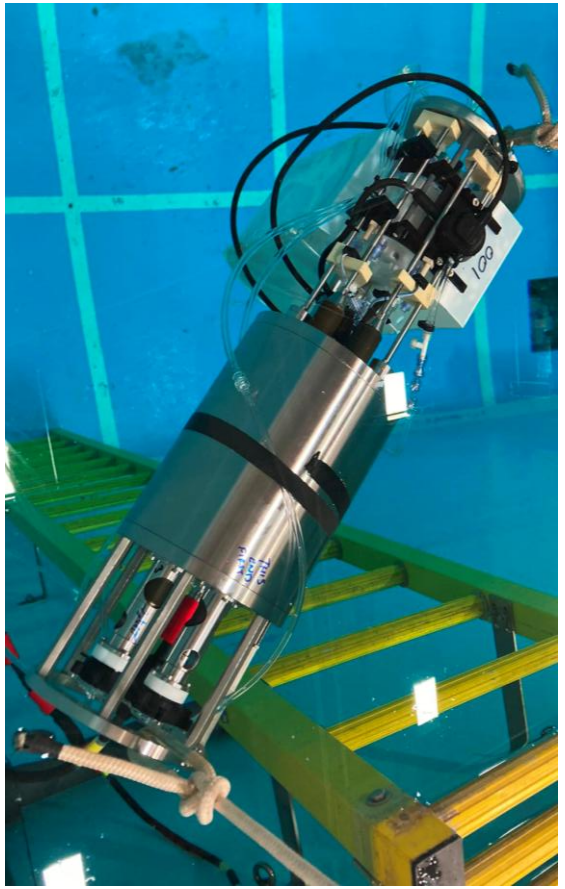
Mechanical, electrical, computer engineers

Research engineers (optics, microfluidics, electrochemistry)

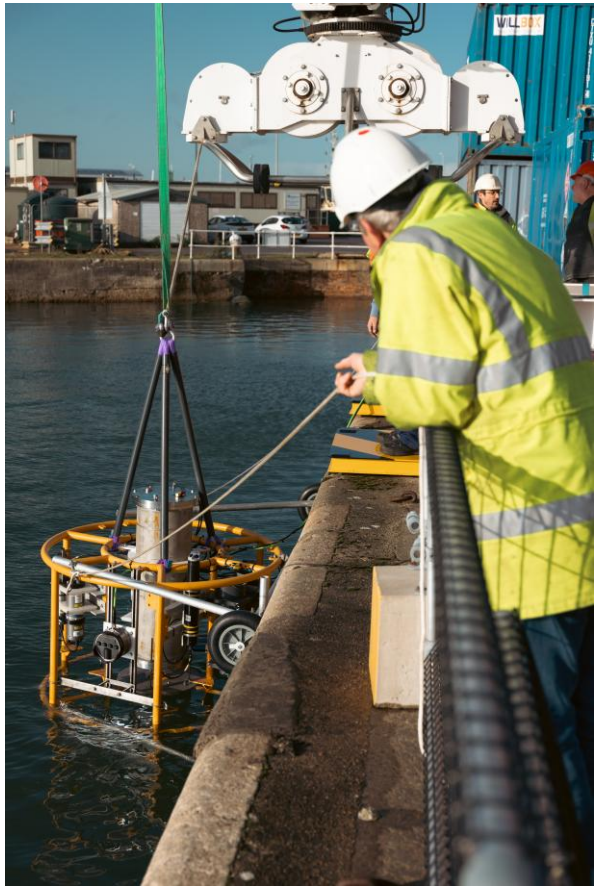
Oceanographers, physicists, chemists, biologists

What kind of things do we make?

In situ sensors to analyse ocean chemistry



Instruments for studying ocean biology



Large custom engineering; integration with platforms

Chemical sensors

We have invented sensors for…

Nutrients

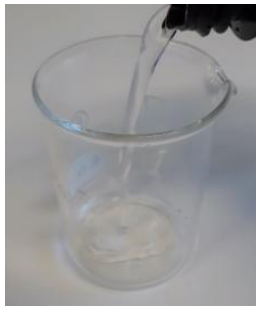
- Nitrate + nitrite
- Phosphate
- Iron
- Silicate
- Ammonia

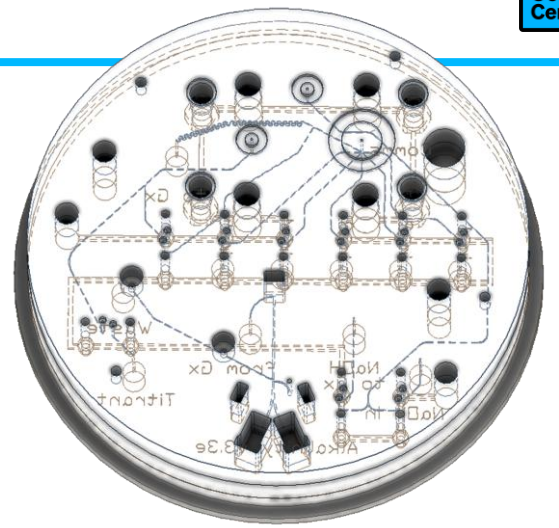
Carbonate parameters

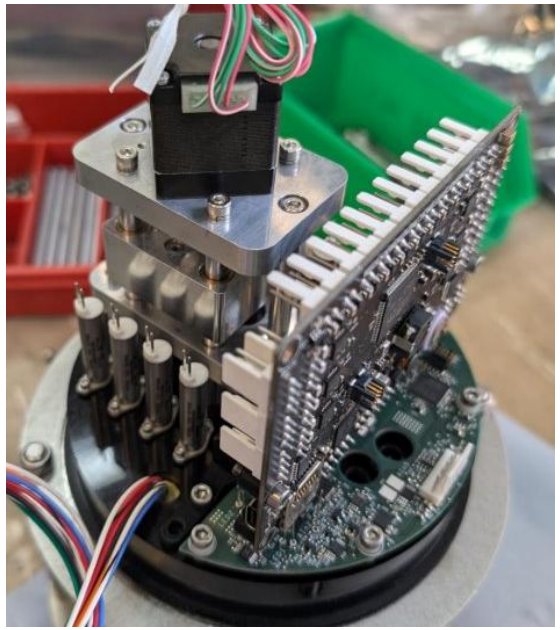
- pH
- Alkalinity
- Dissolved inorganic carbon

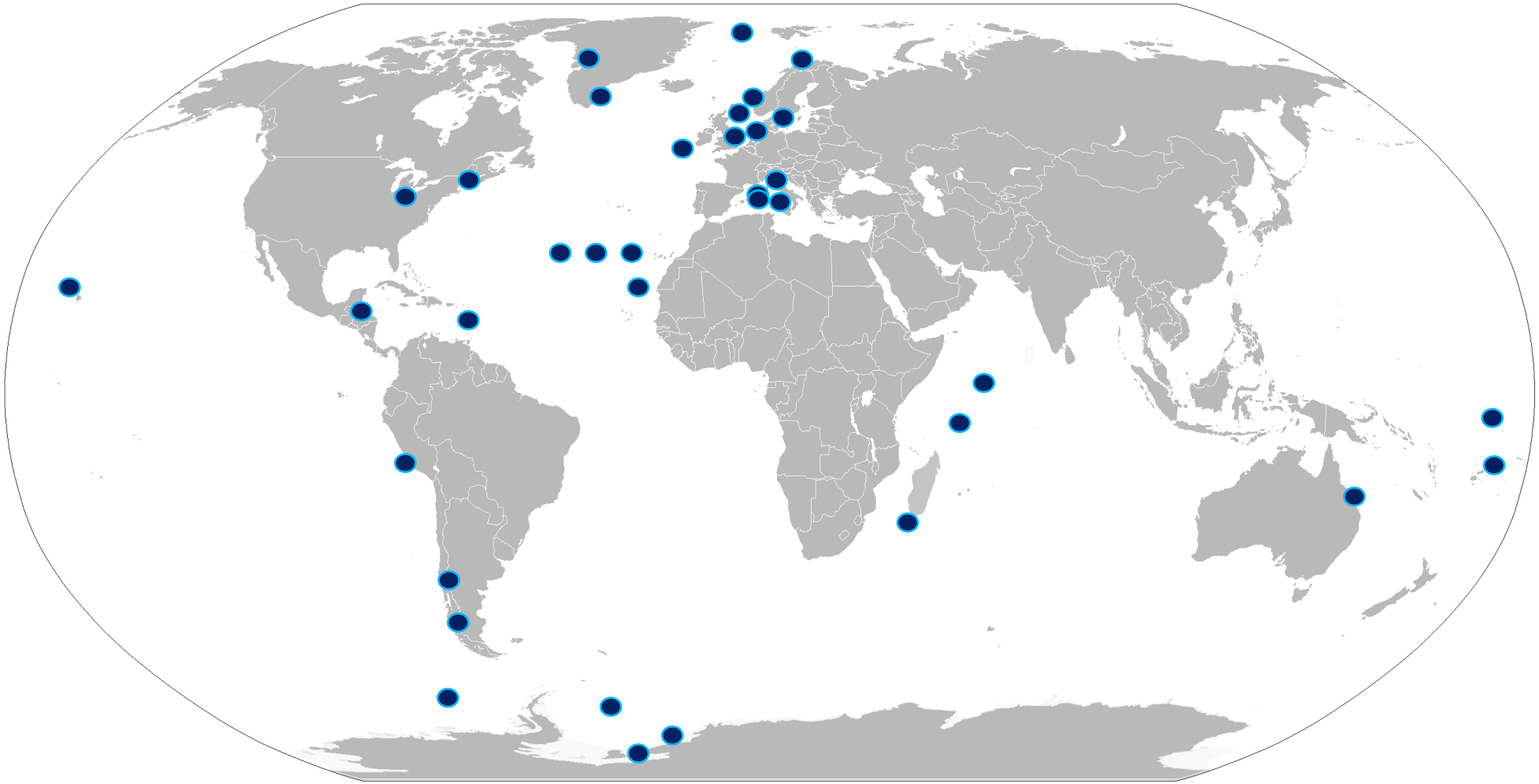
Other parameters

- Sulphide
- Conductivity, temperature
- Dissolved oxygen



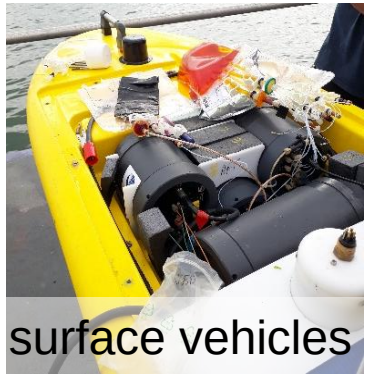






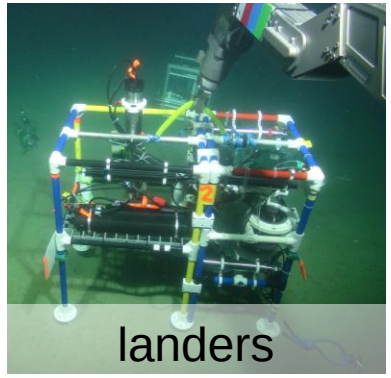

AUV’s


gliders


surface vehicles

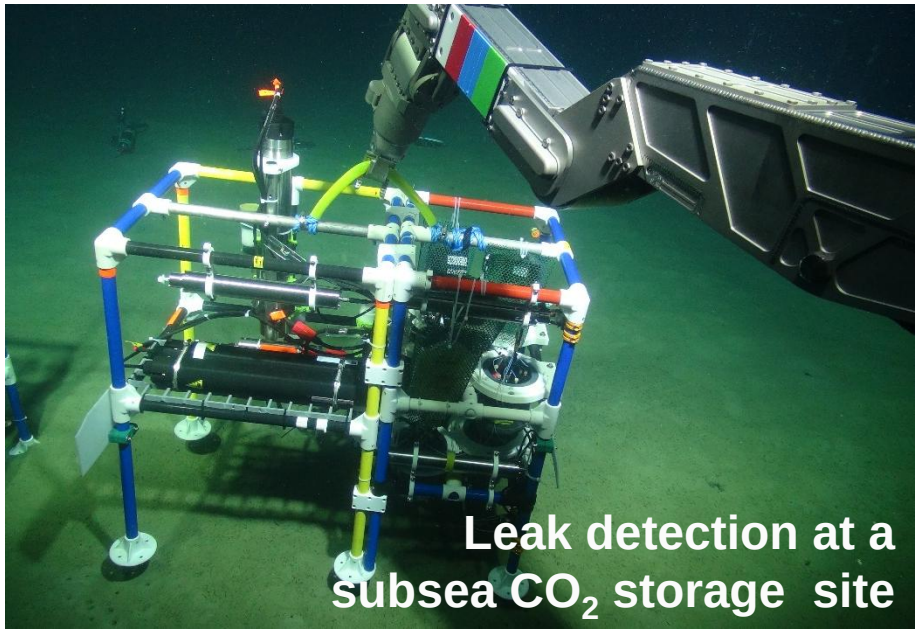

remote-operated vehicles

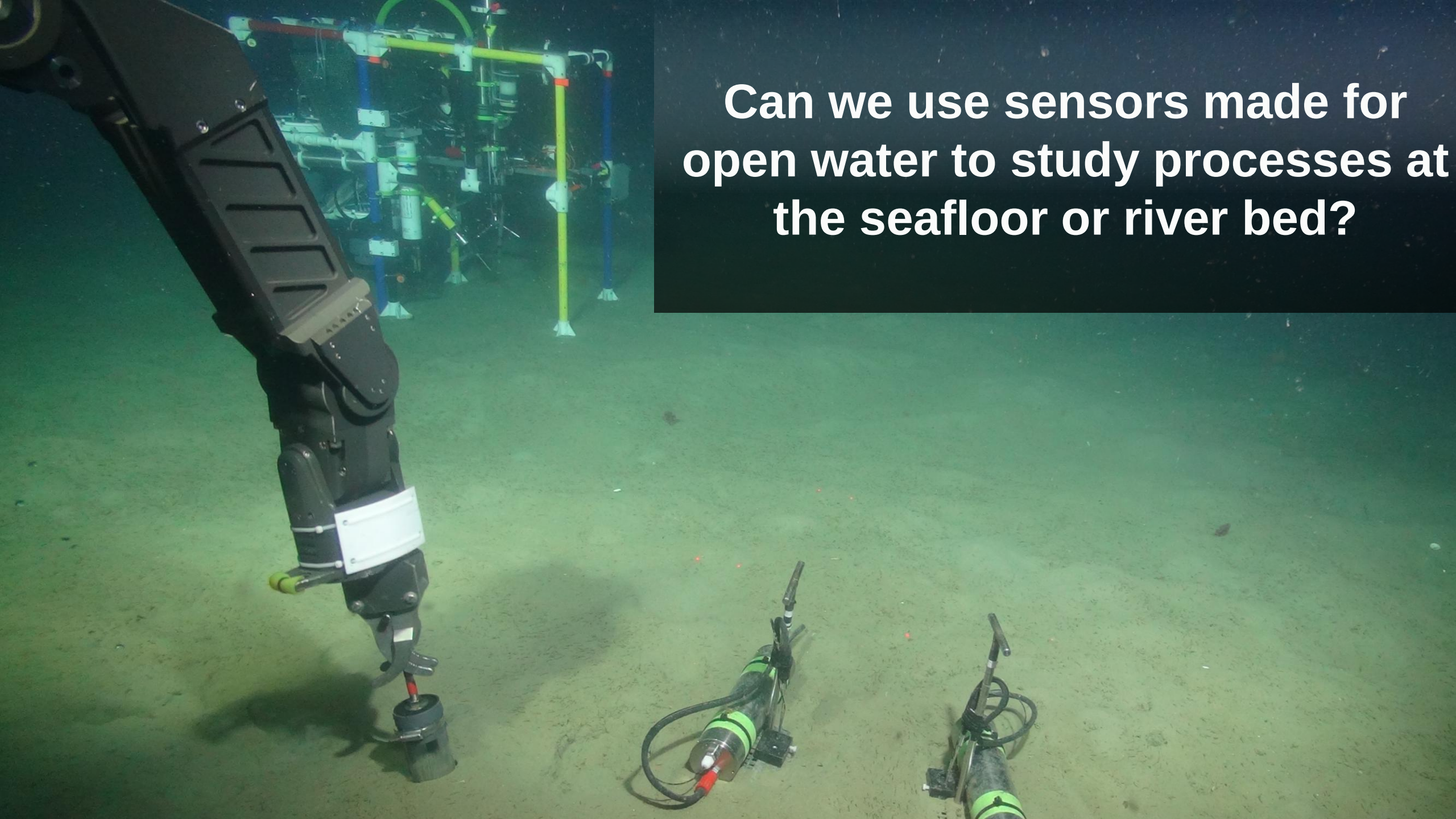

moorings


landers

Example applications of chemical sensors

Solent nutrient remediation studies @ the Hamble River




Can we use sensors made for open water to study processes at the seafloor or river bed?

Why study seafloor chemistry?

- The seafloor is a giant bioreactor, and part of the global cycling of elements
- Elements get stored, processed, biological matter decomposed into constituent parts….
- Sediments also accumulate and give us a historical record of earth's state

Estimates of how much carbon is stored in the seafloor

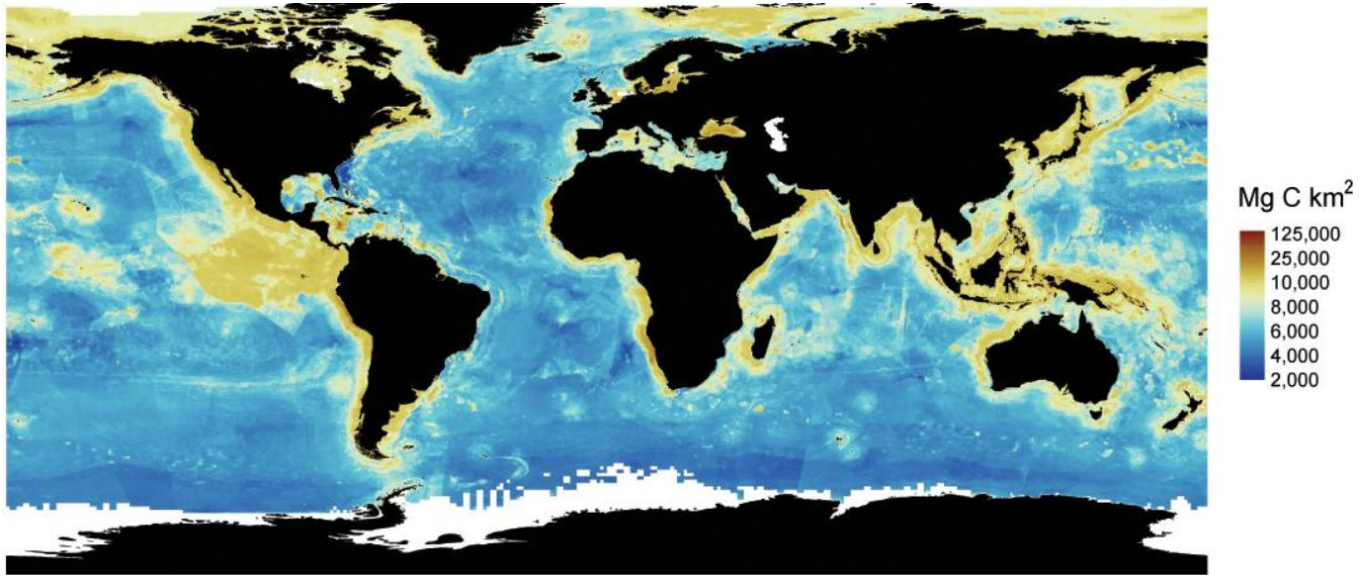


Image from Atwood et al., *Front. Mar. Sci.* 2020, *7*.
https://doi.org/10.3389/fmars.2020.00165.

Loads of complicated biogeochemical processes

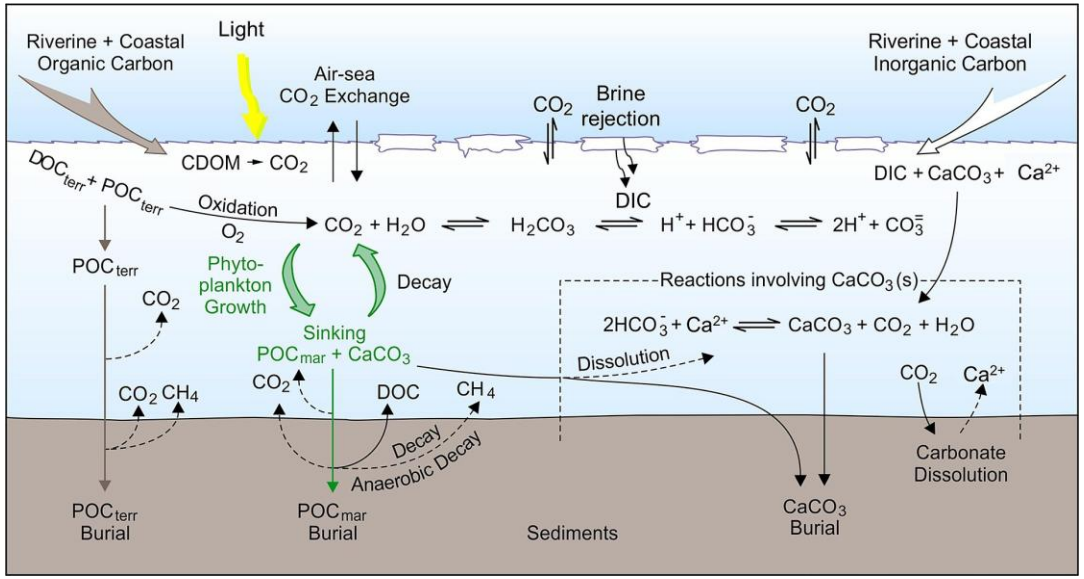


Image from Capelle et al., *Progress in Oceanography* 2020, *185*, 102319.
https://doi.org/10.1016/j.pocean.2020.102319.

Economic & policy motivations

Business

Property experts welcome news that house building in Hampshire can start again after agreement in nitrates ruling

By Kimberley Barber

Com

Published 28th May 2020, 07:00 GMT | Updated 28th May 2020, 16:28 GMT

https://www.portsmouth.co.uk/business/property-experts-welcome-news-that-house-building-in-hampshire-can-start-again-after-agreement-in-nitrates-ruling-2866369

Fig. 1: Ocean alkalinity enhancement through benthic carbonate dissolution.

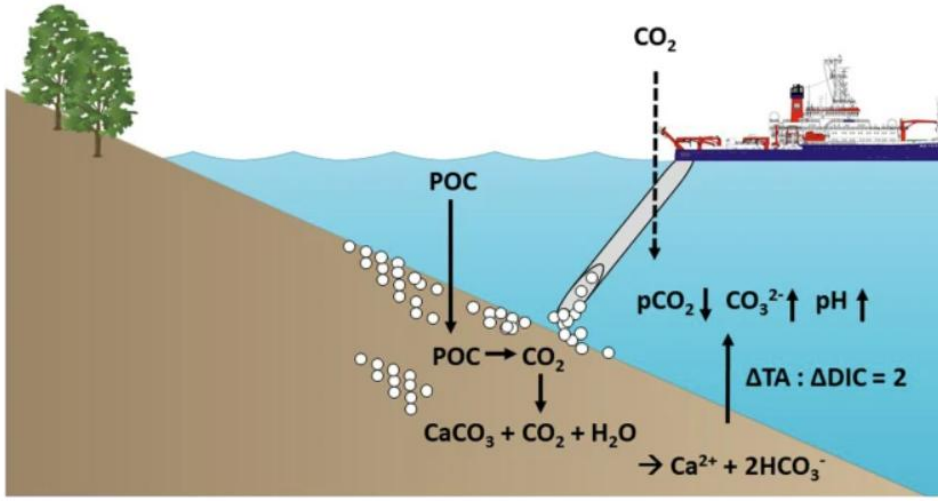


Image from Dale, et al, *Commun Earth Environ* 5, 452 (2024).

Menu

AQUACULTURE

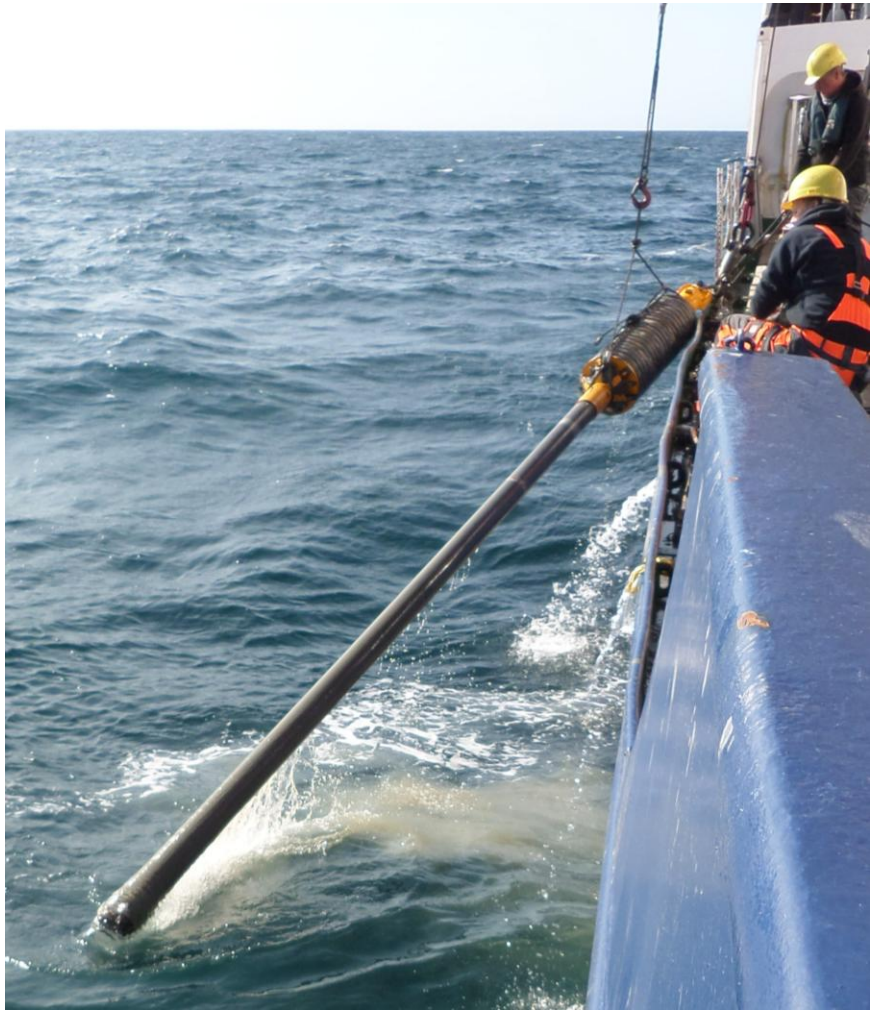
Nutrient Impacts of Finfish Aquaculture

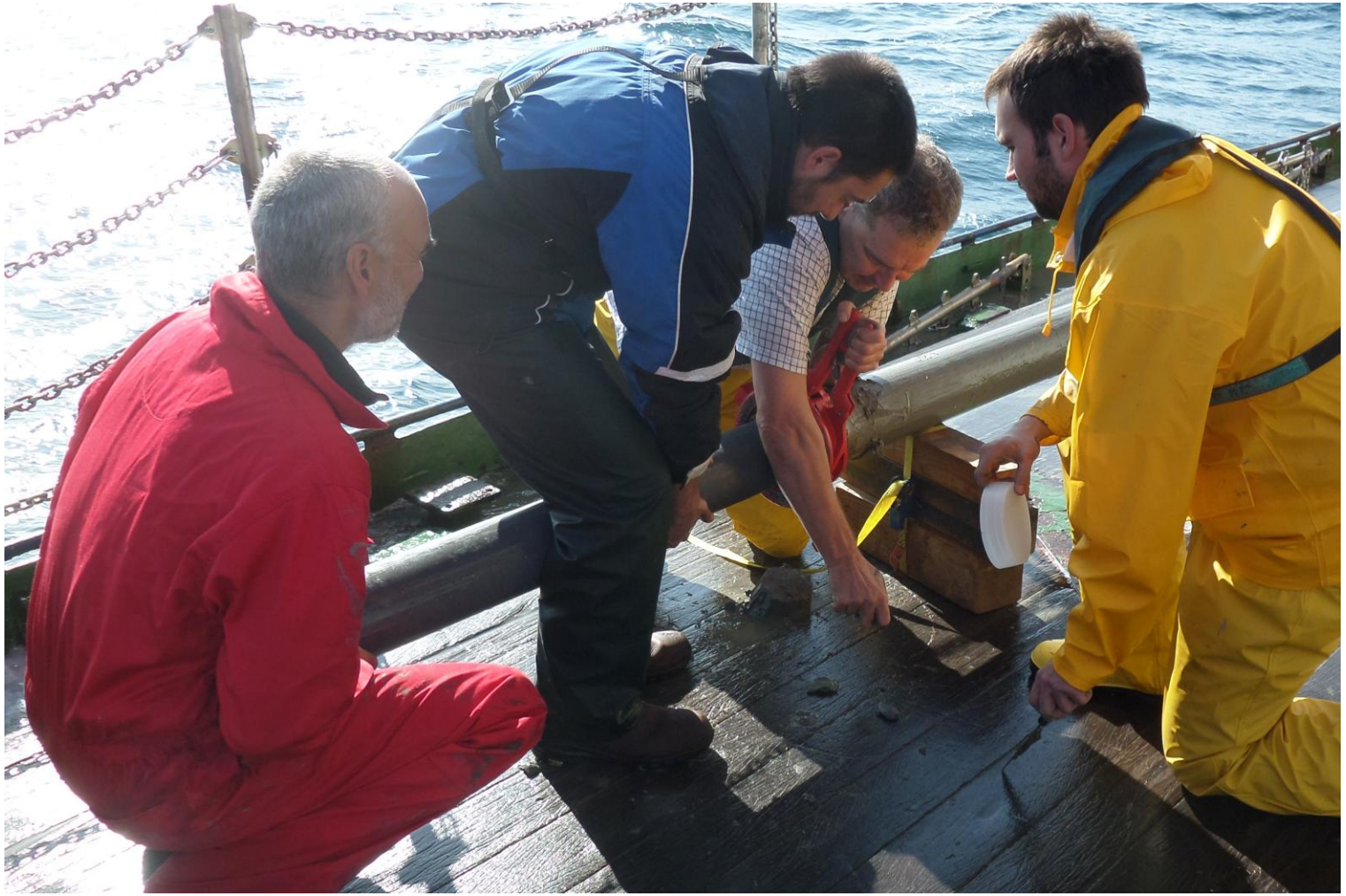
Impacts to the environment around finfish farms can occur when nutrient inputs exceed the capacity of the ecosystem to assimilate them. Uneaten feed and fish wastes are the main sources of excess organic nutrients from finfish farms. However, many potential environmental impacts and risks can be avoided with prudent farm siting, proper management, and modern technologoies. Modeling interactions between farm production and environmental processes can guide decisions about industry location and practices to prevent exceeding a site's ecological carrying capacity.

NOAA Fisheries: https://www.fisheries.noaa.gov/aquaculture/nutrient-impacts-finfish-aquaculture

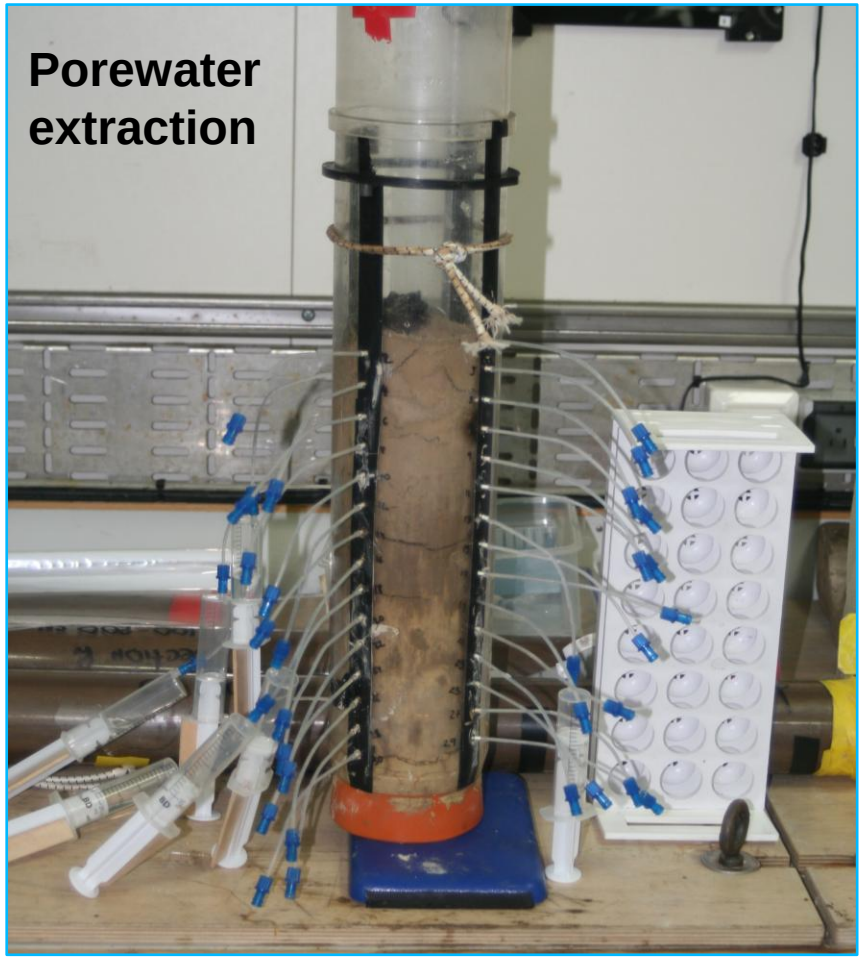
How to (currently) analyse porewater

National Oceanography Centre





How to (currently) analyse porewater



Lab analysis

The challenge

How can we do this autonomously, and over time?

(Anna Lichtschlag ->)

Our approach, using lab-on-chip sensors

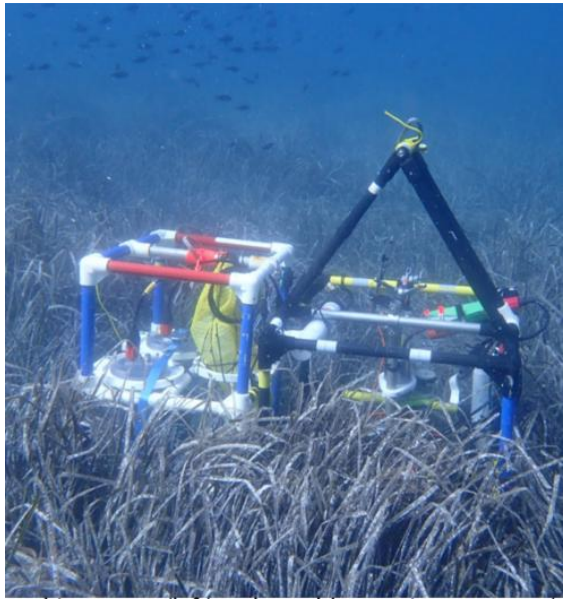
Lab on chip sensors

Autonomous, field-deployable devices for chemical analysis

integrated with existing methods to create new capabilities

Benthic chambers for measuring small & slow fluxes

Cadland Estate,
New Forest



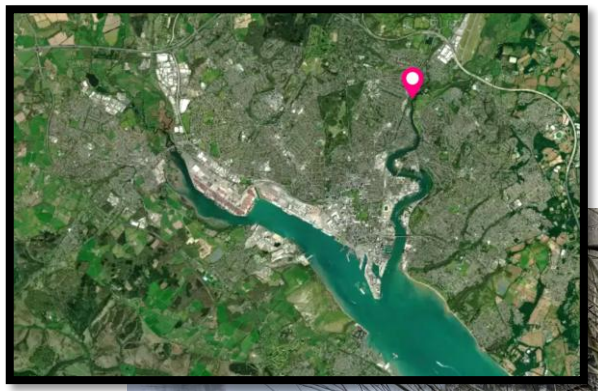
Eddy covariance for fast measurements of ecosystem function

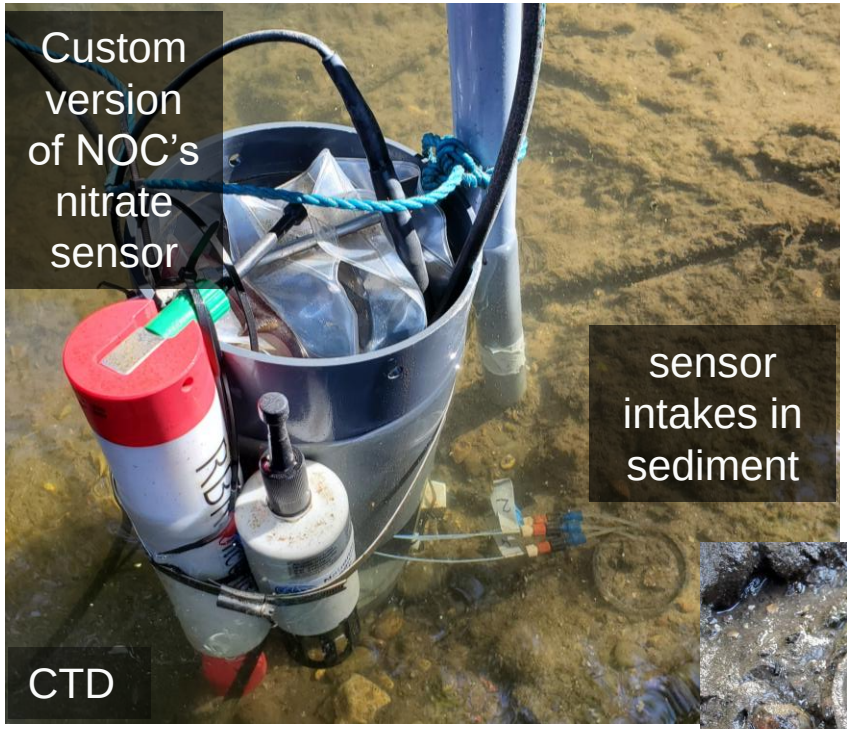
Studland Bay

Measuring pore water chemistry directly in the sediments

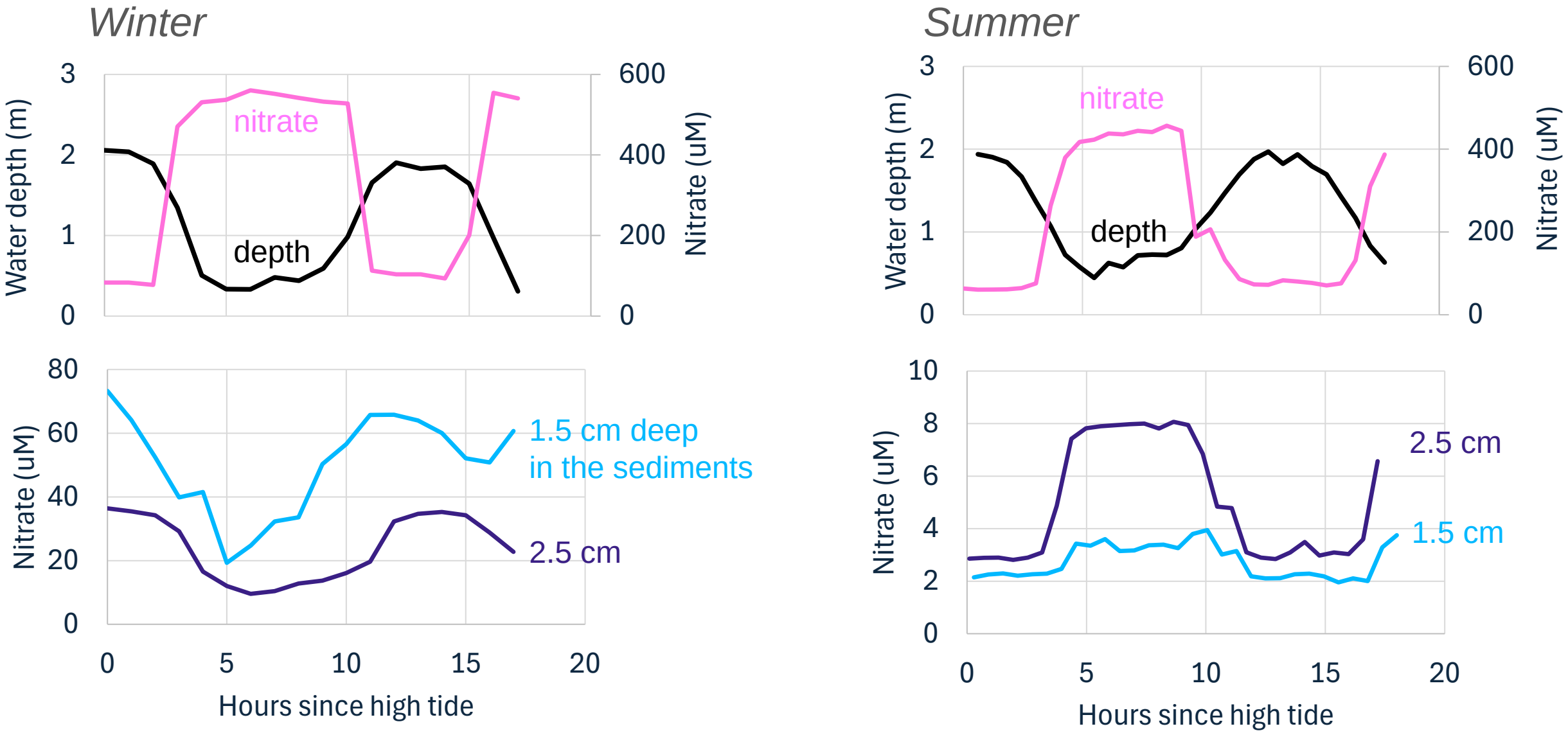
Itchen River
near Woodmill

Field site: the Itchen River



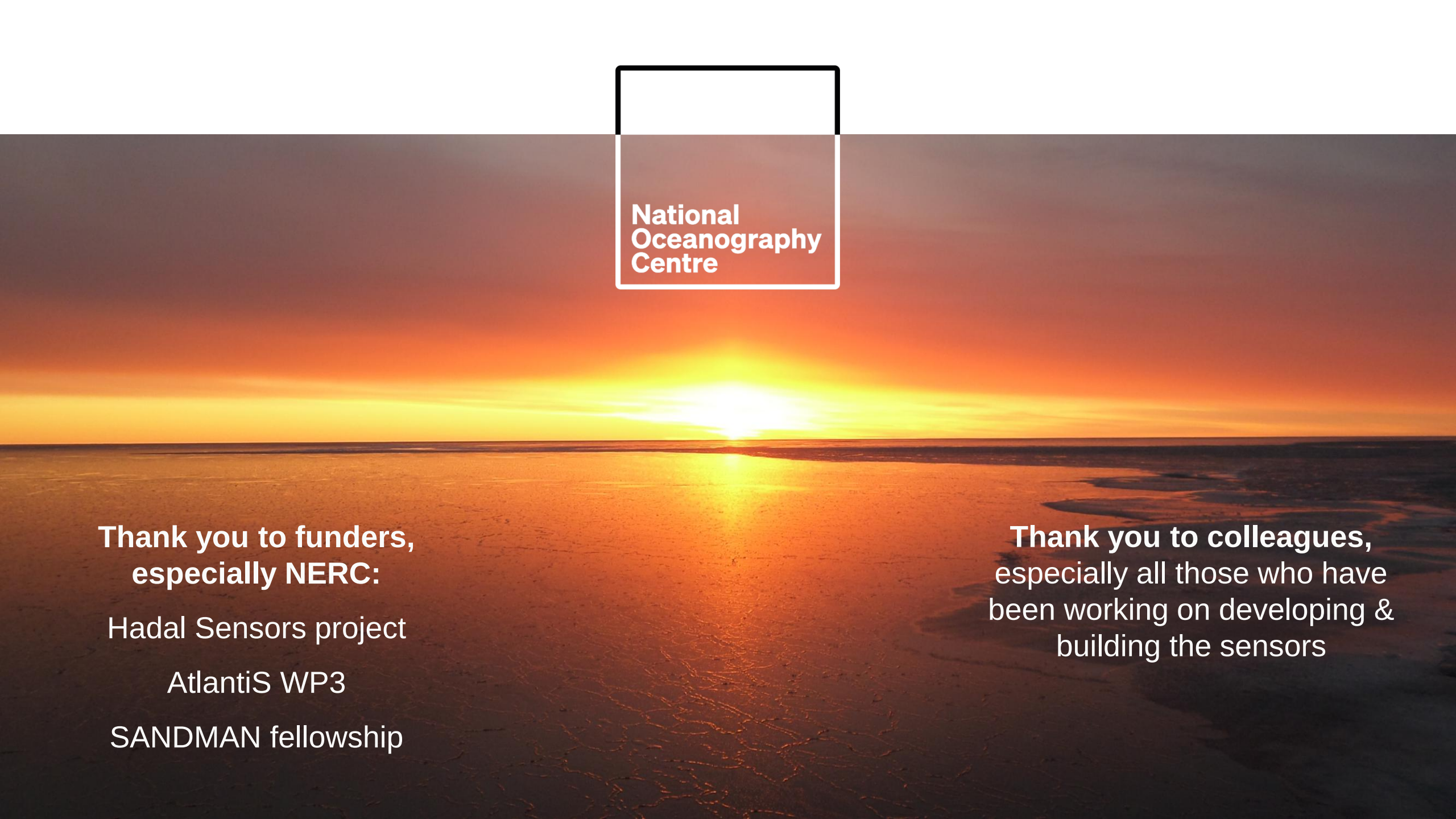


What did we see?



What does it mean?

- Lots of nutrients in the sediment, undergoing rapid cycling
- Concentrations change with the tides and sediment properties
- We can use autonomous sensors to study dynamic coastal processes in ways that aren’t possible with traditional techniques



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Hadal Sensors project

AtlantiS WP3

SANDMAN fellowship

Thank you to colleagues, especially all those who have been working on developing & building the sensors