Royal Netherlands Institute for Sea Research

IRIS International Research Institute of Stavanger

INSITE

Measuring the “SHADOW” of artificial structures in the North Sea and its effect on the surrounding soft bottom community

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Background

brief communications

Coral growing on North Sea oil rigs

These installations are home to thriving colonies of an endangered cold-water coral.

This summer the coral *Lophelia pertusa* was found growing on oil platforms in the North Sea and on the Brent Spar oil-storage buoy during its decommission-

The occurrence of the coral raises questions about how to deal with this species, which is listed under the Convention on International Trade in Endangered Species (CITES), when platforms are decommis-

Mytilus edilus

Metridium senile

Ron Tackett © 2006

Lophelia pertusa

Platform, currently in Den Helder

Artificial structures offer hard substrate for sessile epifauna

Biomass is estimated to be up to 500-fold the biomass as found on soft sediment *(Picken et al., 2000)*

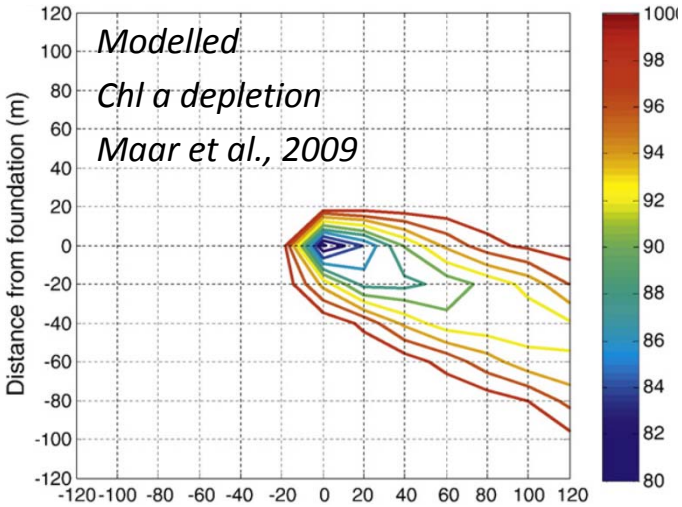
Community may act as biofilter and cast a “SHADOW” in immediate surroundings

Hypothesis

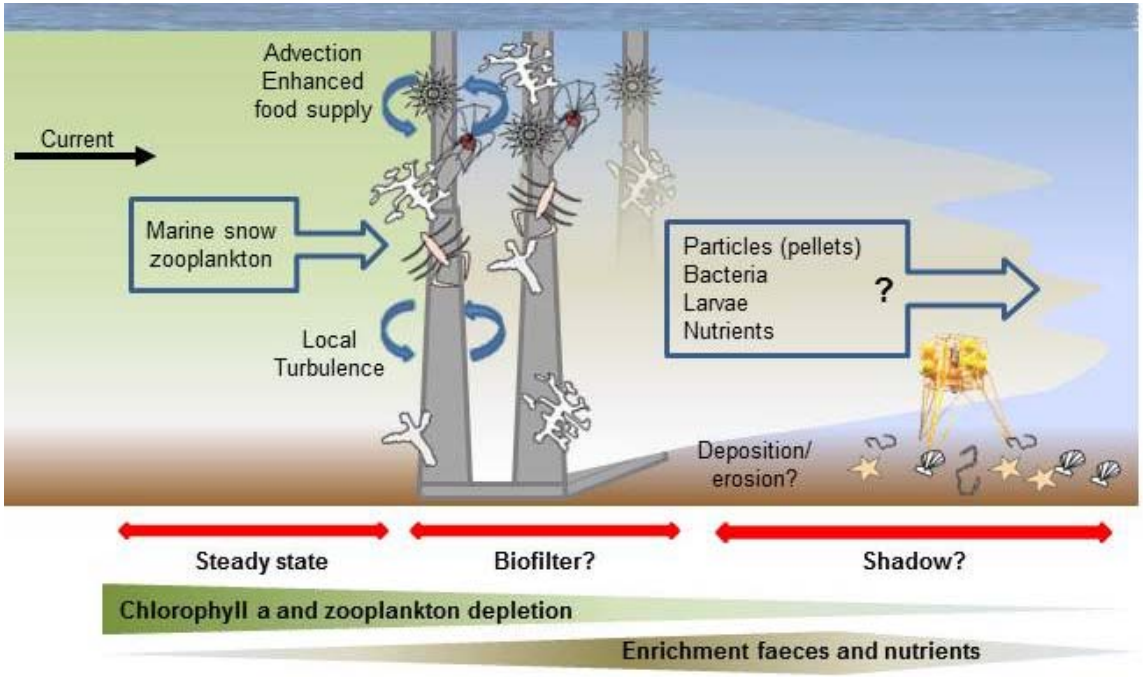
Through the presence of a rich epifaunal community, oil/gas platforms in the North Sea may act as:

1. **biofilters** creating a “SHADOW” affecting the water column and soft-bottom benthic surrounding.

2. **stepping stones** for species enhancing biodiversity in the wider North Sea.



Objectives “SHADOW”



1. Examine whether artificial structures act as biofilter and create a “SHADOW”
2. Examine whether the “SHADOW” has an impact on the surrounding benthic community
3. Model the “SHADOW” affect
4. Define whether platforms are stepping stones

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Relevance

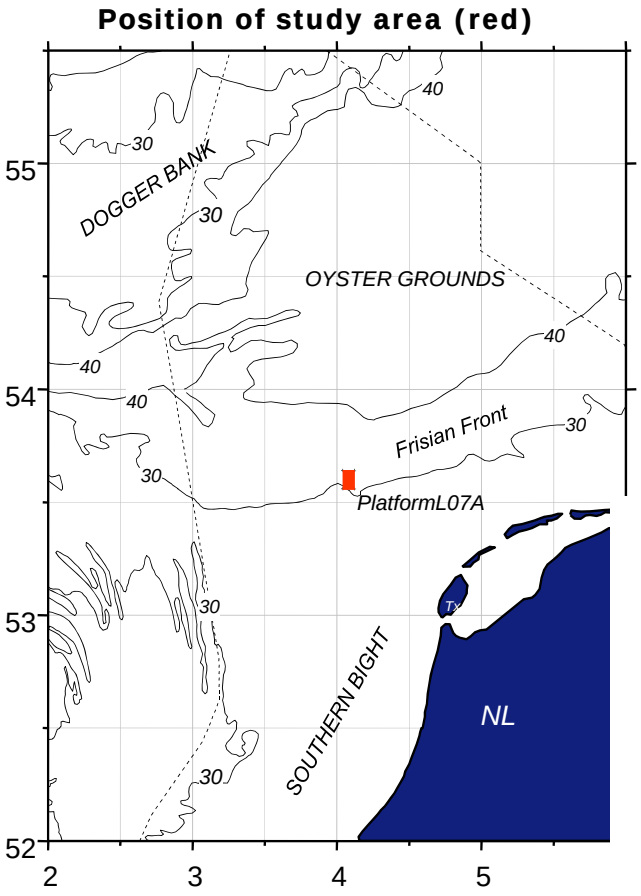
"establish the magnitude of the effects of man-made structures compared to the spatial and temporal variability of the North Sea ecosystem, considered on different time and space scales"

Following a multi-disciplinary approach, whereby biological, geological, physical and chemical data will be combined, the influence will be assessed of man-made structures on the benthic ecosystems surrounding these platforms in space and time. -> field data and models

"to what extent, if any, the man-made structures in the North Sea represent a large inter-connected hard substrate system"

Our data i.e. larvae and their barcodes, will be combined with barcode data collected by other consortia studying epifauna communities on several other platforms in the North Sea.

Study area



Platform L7-A

Facts and figures

- Location: 47 nautical miles northwest of Den Helder
- Platform is no longer in use
- Length x breadth: 20 m x 6 m
- Height of helideck: approx. 30 m
- Water depth: 40 m
- First gas produced: October 1988
- Last gas produced: February 1999

ICES Journal of Marine Science Advance Access published May 16, 2007

Effects of an area closed to fisheries on the composition of the benthic fauna in the southern North Sea

Gerard C. A. Duineveld, Magda J. N. Bergman, and Marc S. S. Lavaleye

Duineveld, G. C. A., Bergman, M. J. N., and Lavaleye, M. S. S. 2007. Effects of an area closed to fisheries on the composition of the benthic fauna in the southern North Sea – ICES Journal of Marine Science, 64.

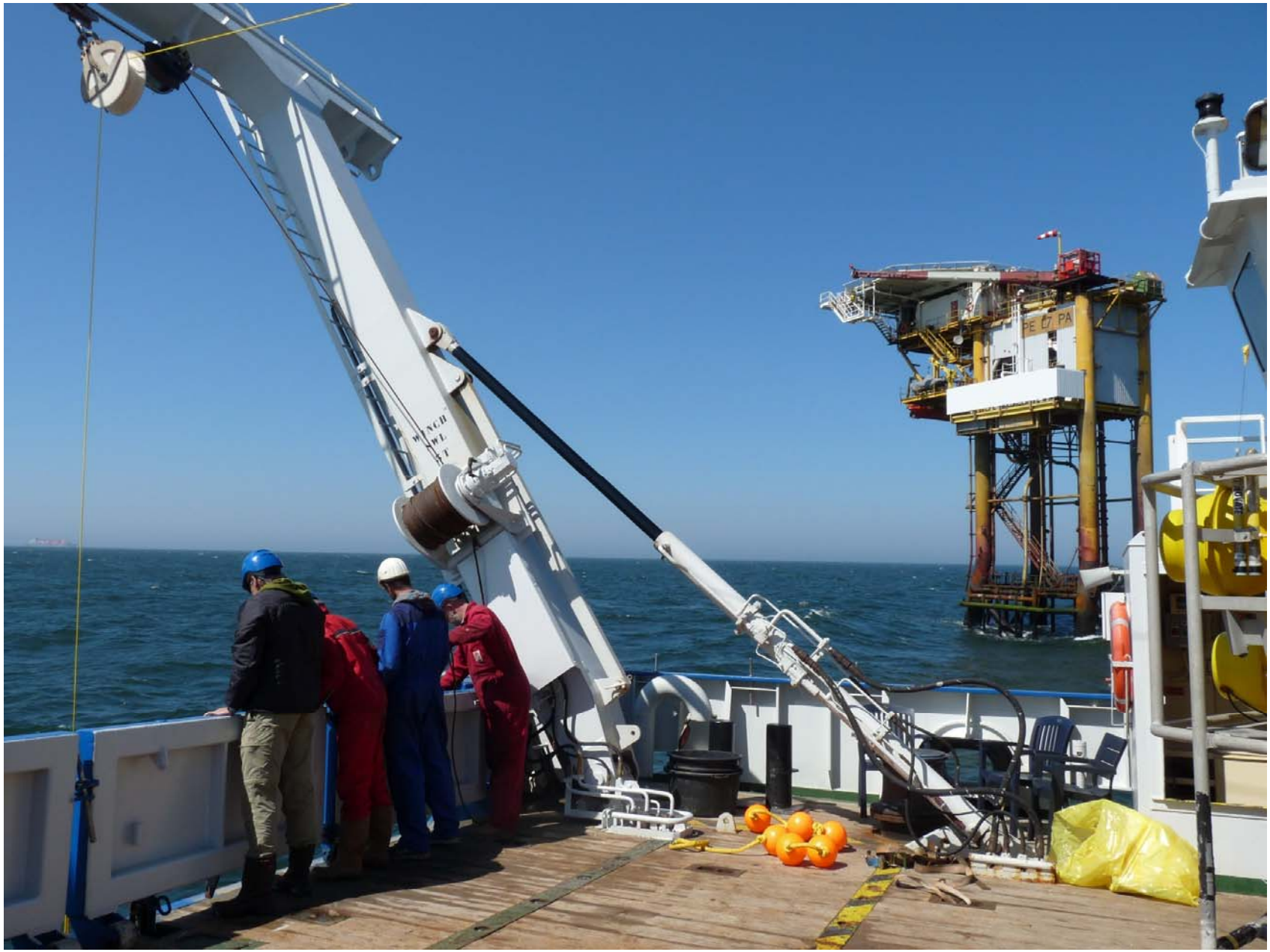
The effects of fishery exclusion on the composition of the macrofauna were determined by comparing the fishery-exclusion zone around a gas production platform in the southern North Sea (Frisian Front) with nearby regularly fished areas. A Triple-D dredge

Platform L7A

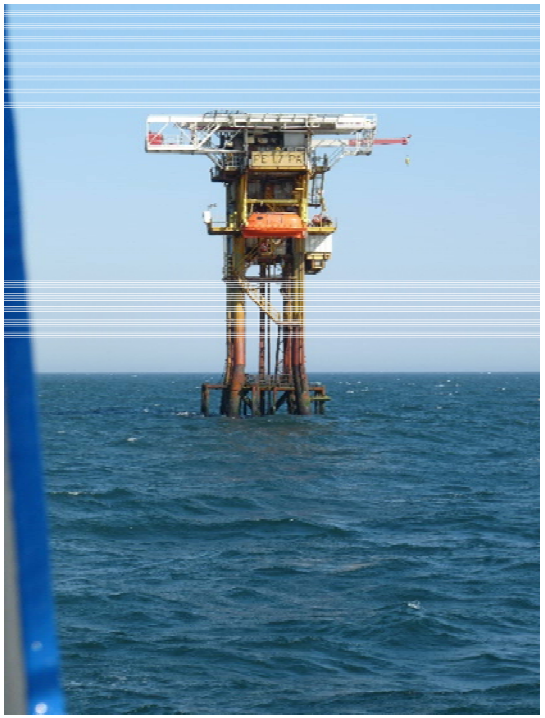
- Platform clear of discharge of toxic waste
- Non trawling zone of 500 m

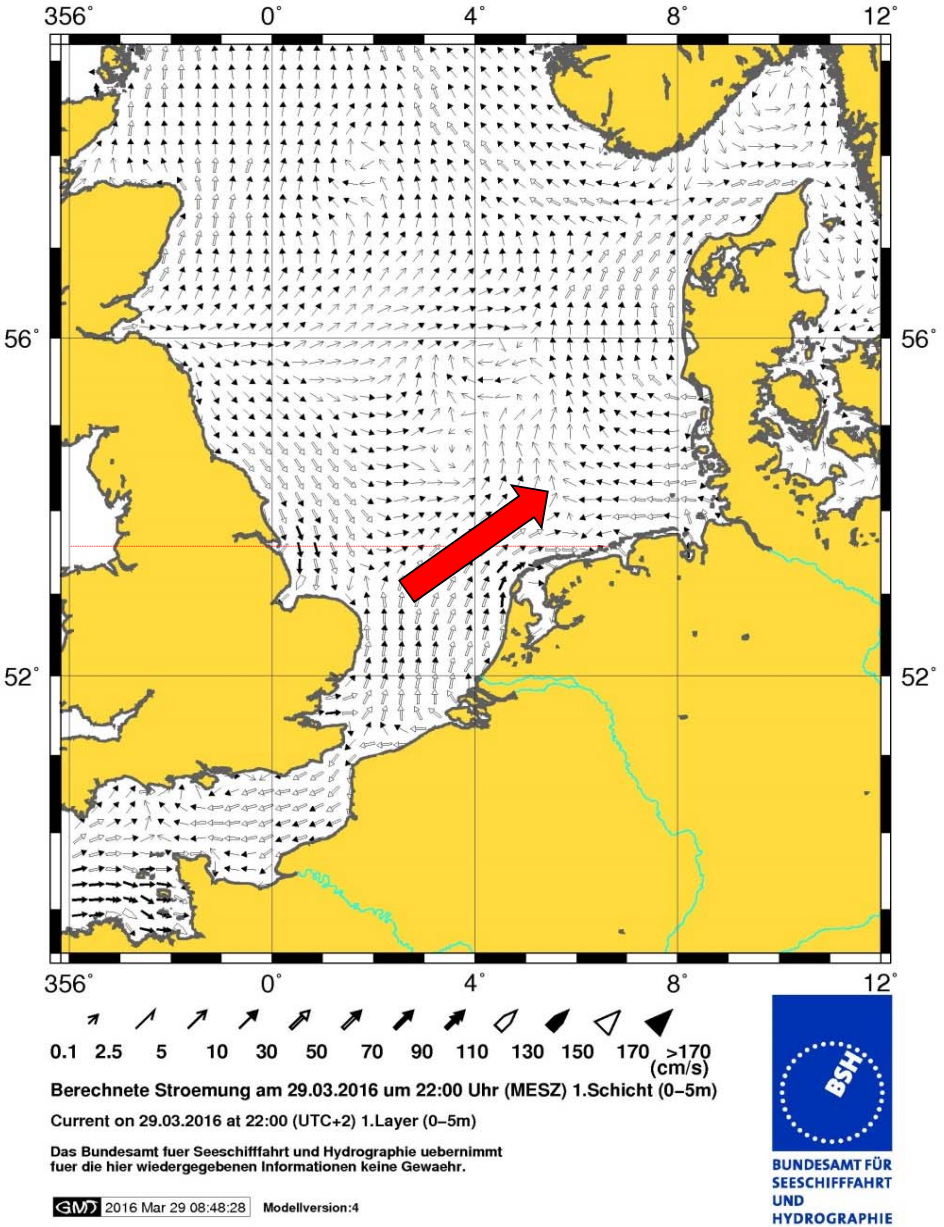
Cruise with the RV Pelagia

7-12 May 2016

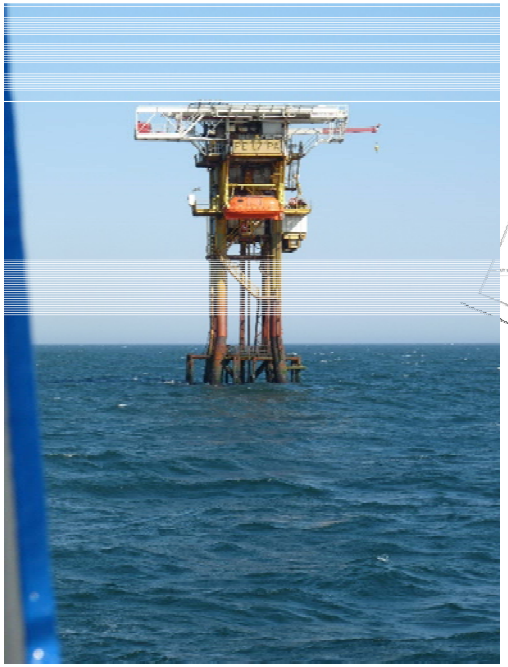


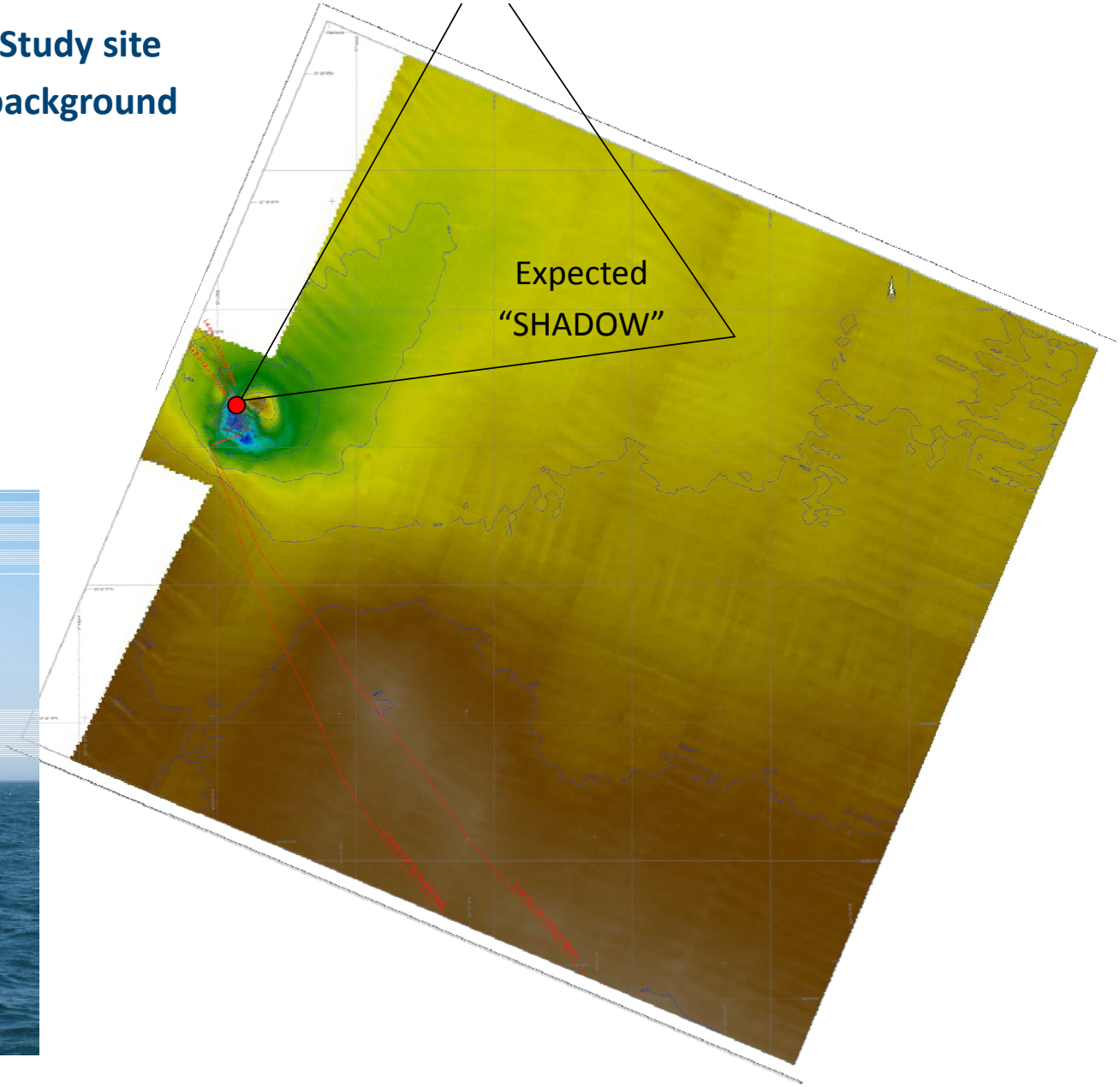
Study site background





Study site background



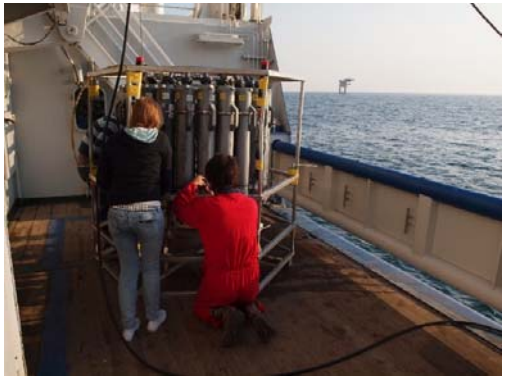


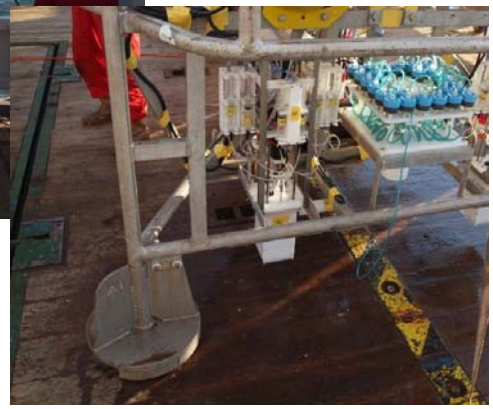
Objective 1

Examine whether artificial structures act as biofilter and create a "SHADOW"

- **Hydrodynamics**
- **Biogeochemistry (particulate and dissolved)**

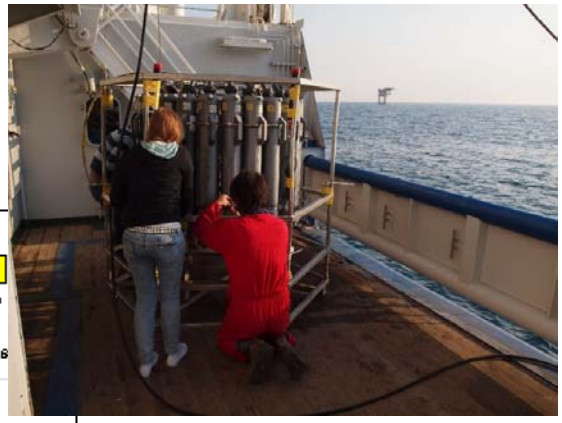
Water column profiling and sampling (POM, nutrients, DOC, DIC, DNA) with the CTD/Rosette

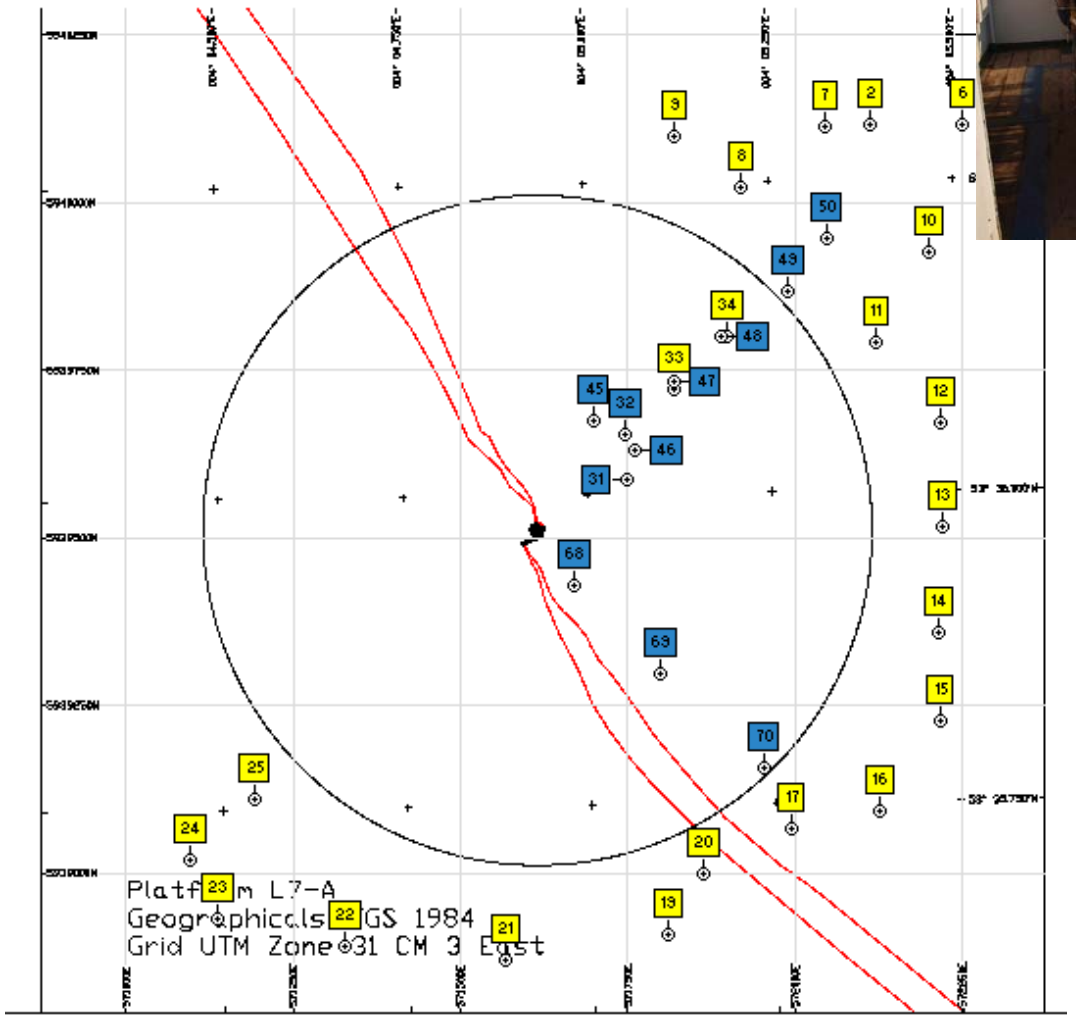




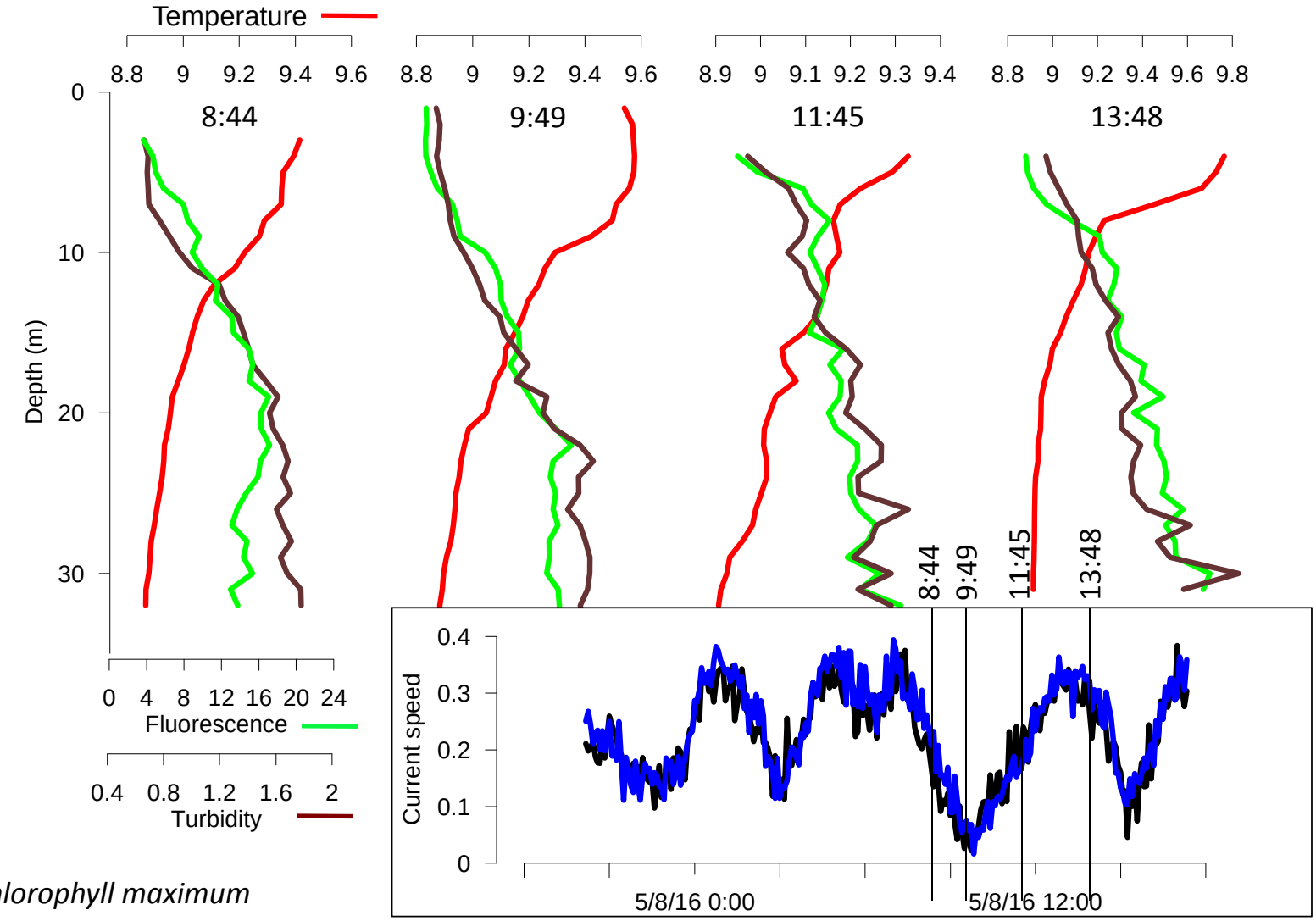
NIOZ in-house designed benthic observatories: platforms for multitude of sensors

Sampling approach: CTD





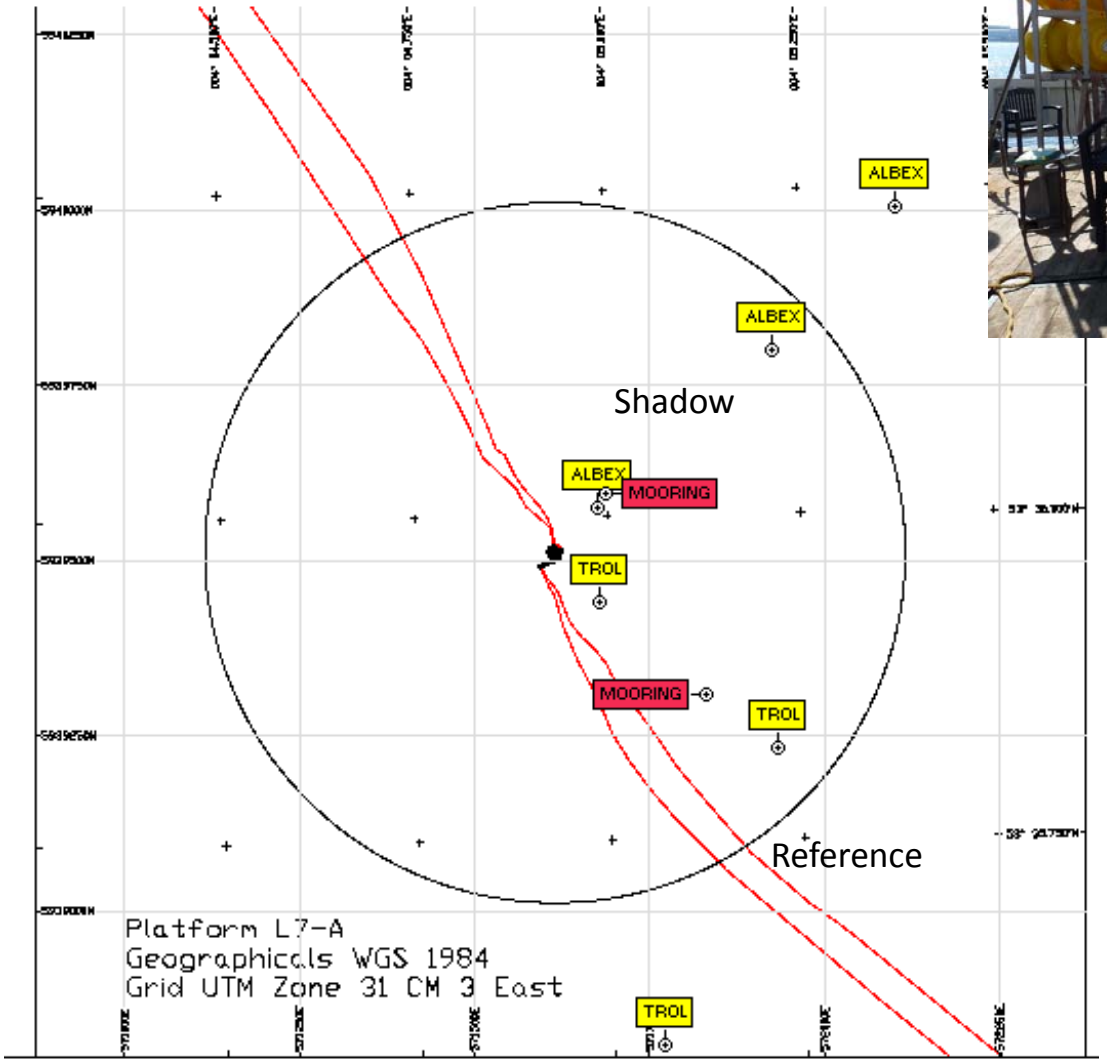
Results – Water column profiling

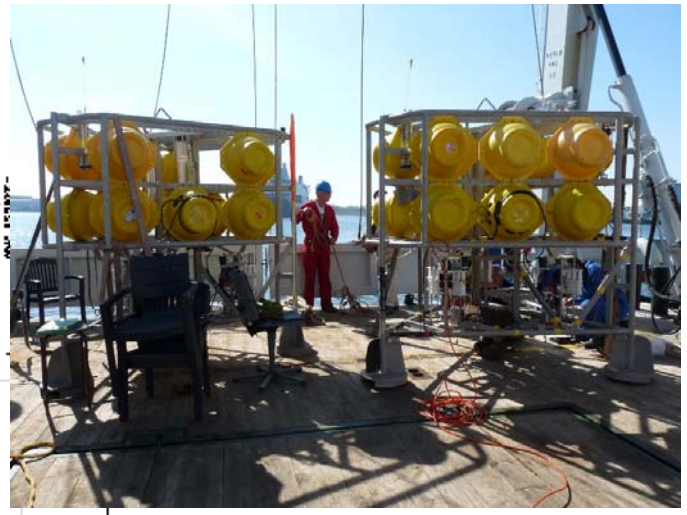


Chlorophyll maximum

is situated below 10 m water depth

Sampling approach: landers





Monitoring with bottom landers:

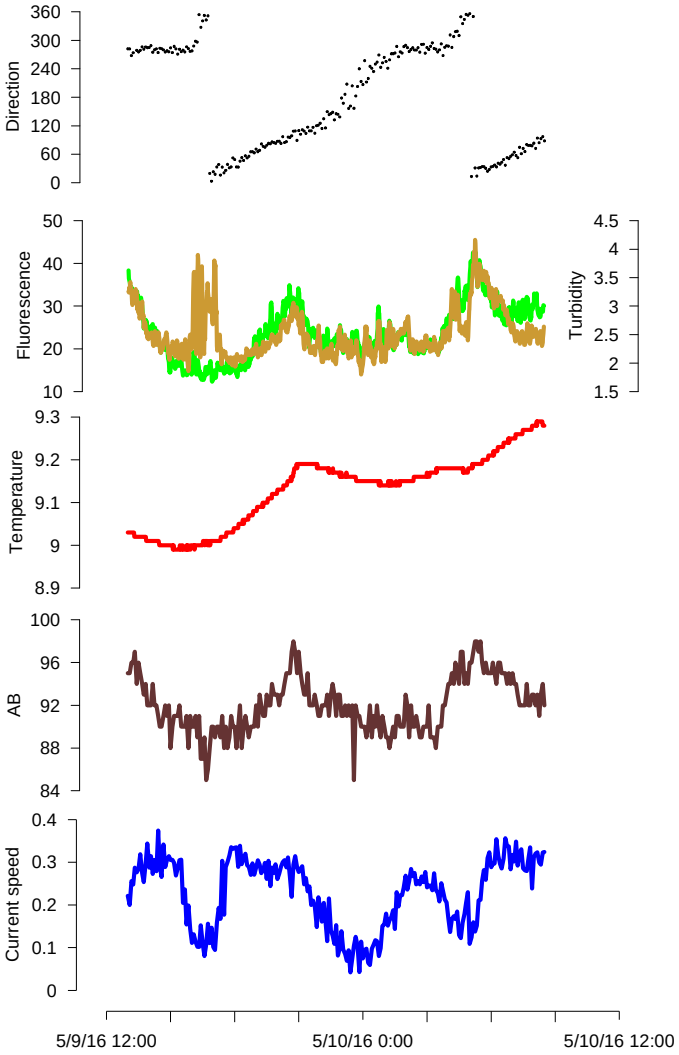
3 deployments of ~24 hours

- 100 m
- 300 m
- 700 m

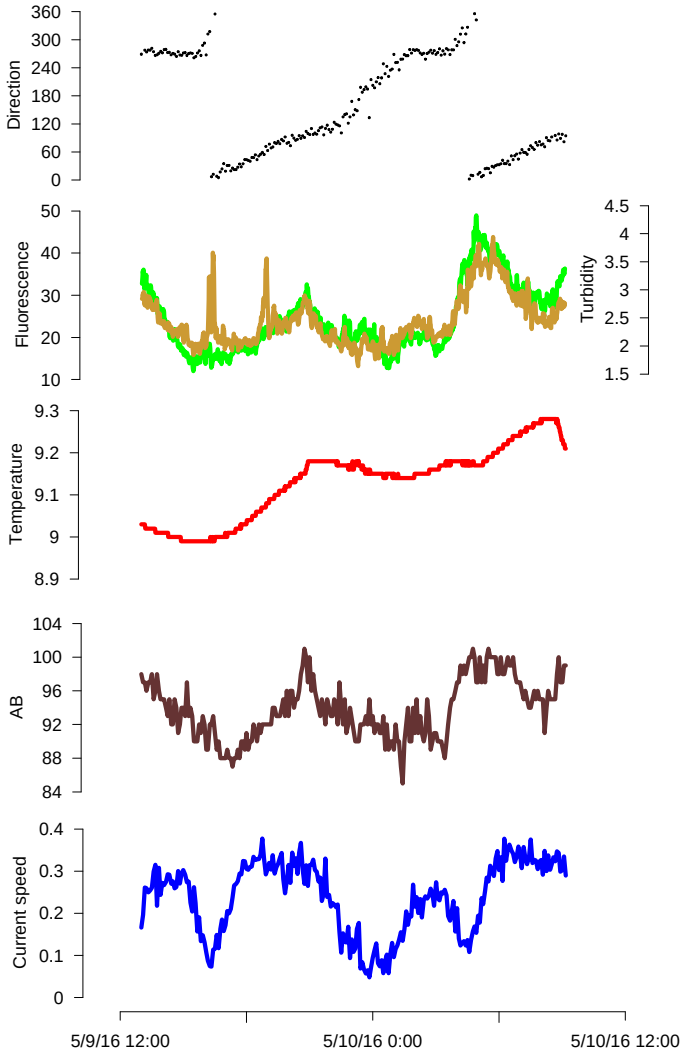
Moorings - long term

Results -> Landers at 100 m from platform

Shadow



Reference



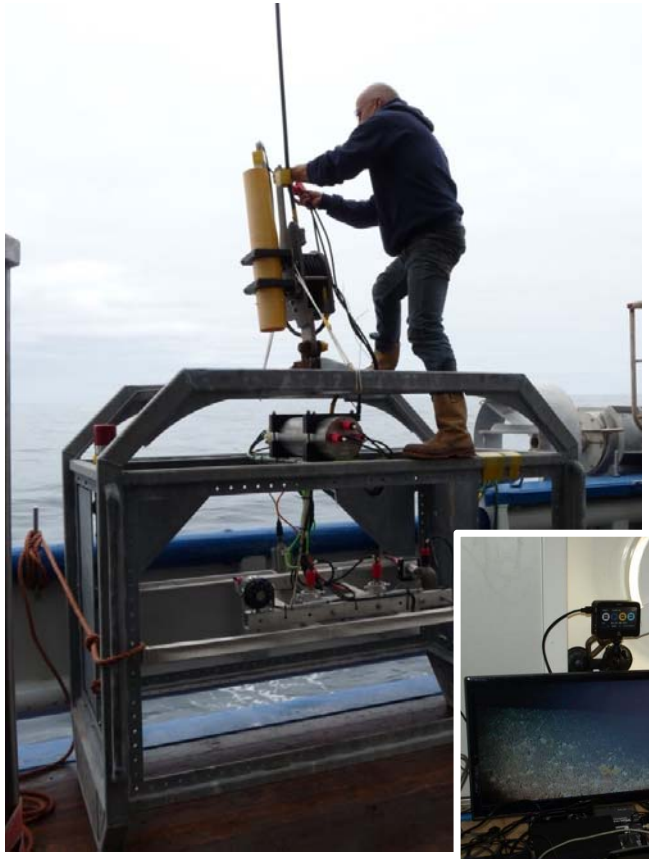
Long term monitoring

Two moorings deployed -> to capture impact of meteorological forcing, spring and neap tidal cycles and seasonal changes

Moorings will be recovered 10-15 December 2016

Objective 2

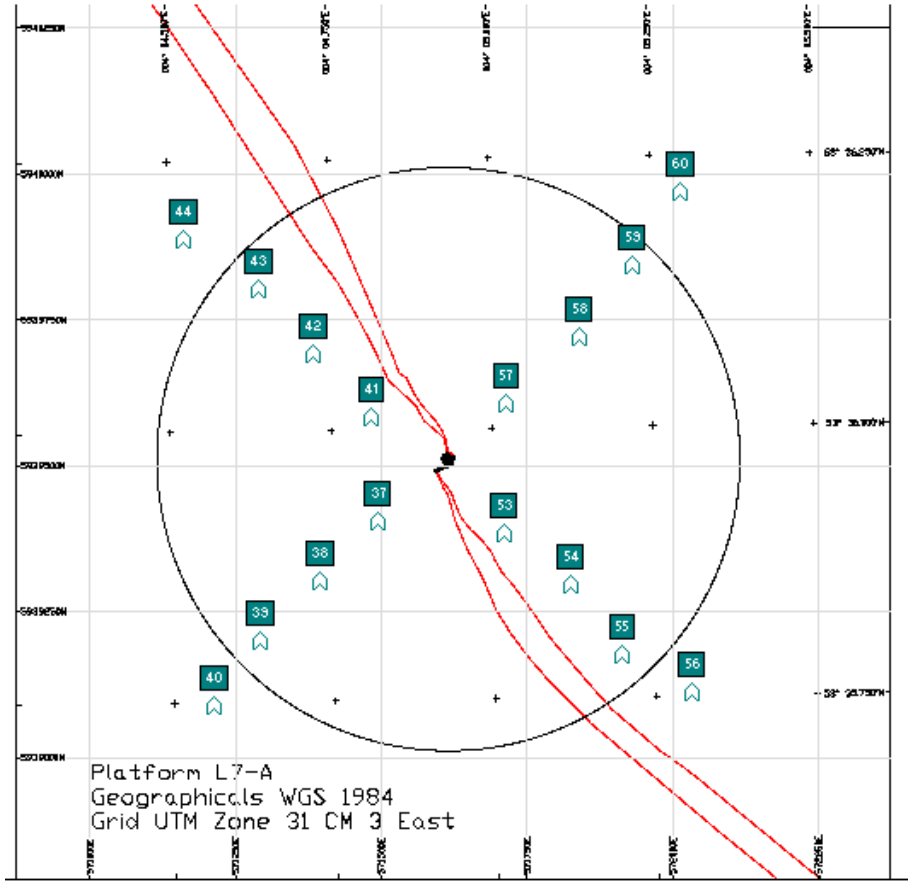
Examine whether the “SHADOW” has an impact on the surrounding benthic community



Sediment cores ->
fauna and sedimentology

HD camera observations to define substrate and faunal abundance

Sampling approach

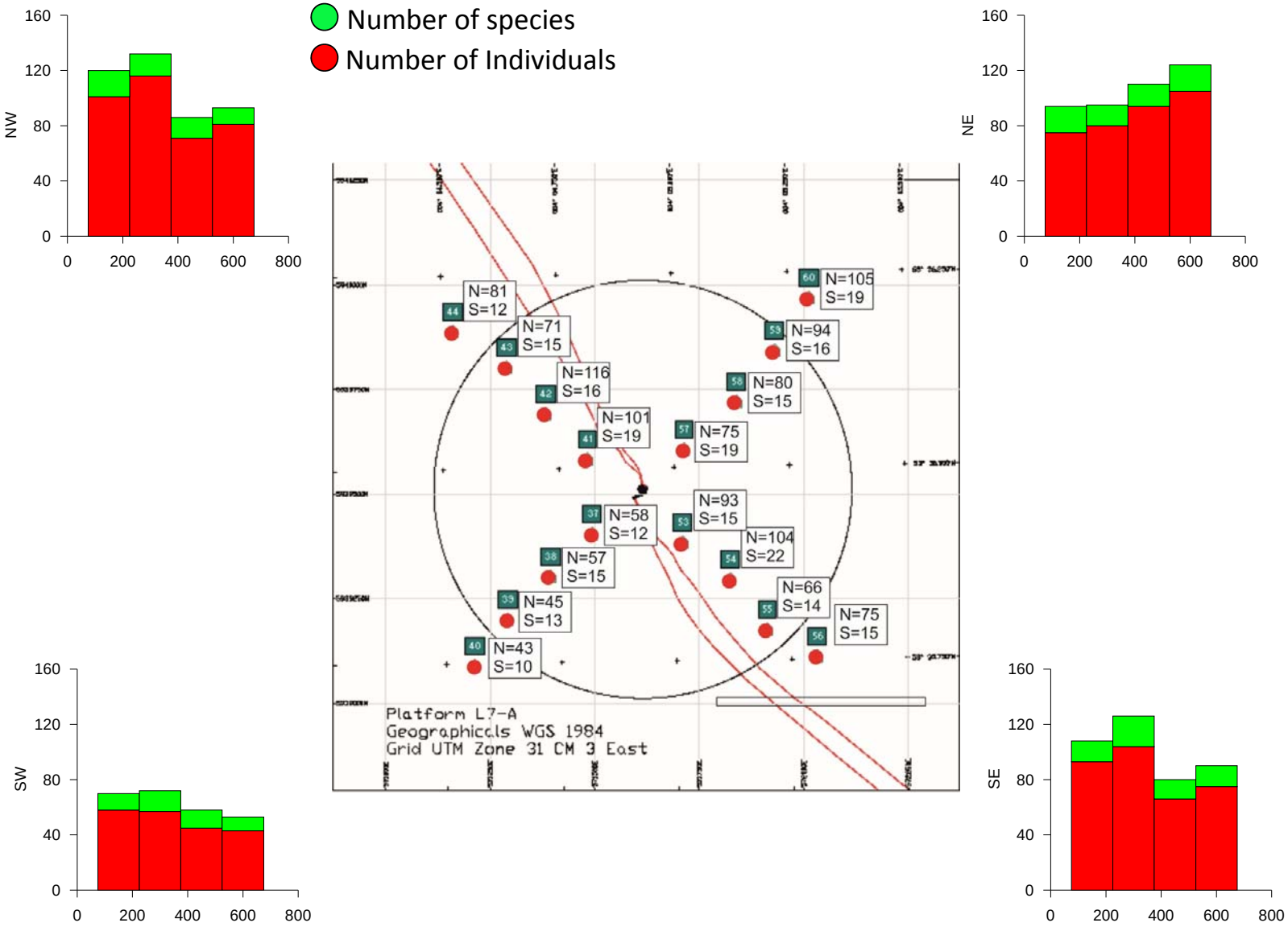


4 BC transects

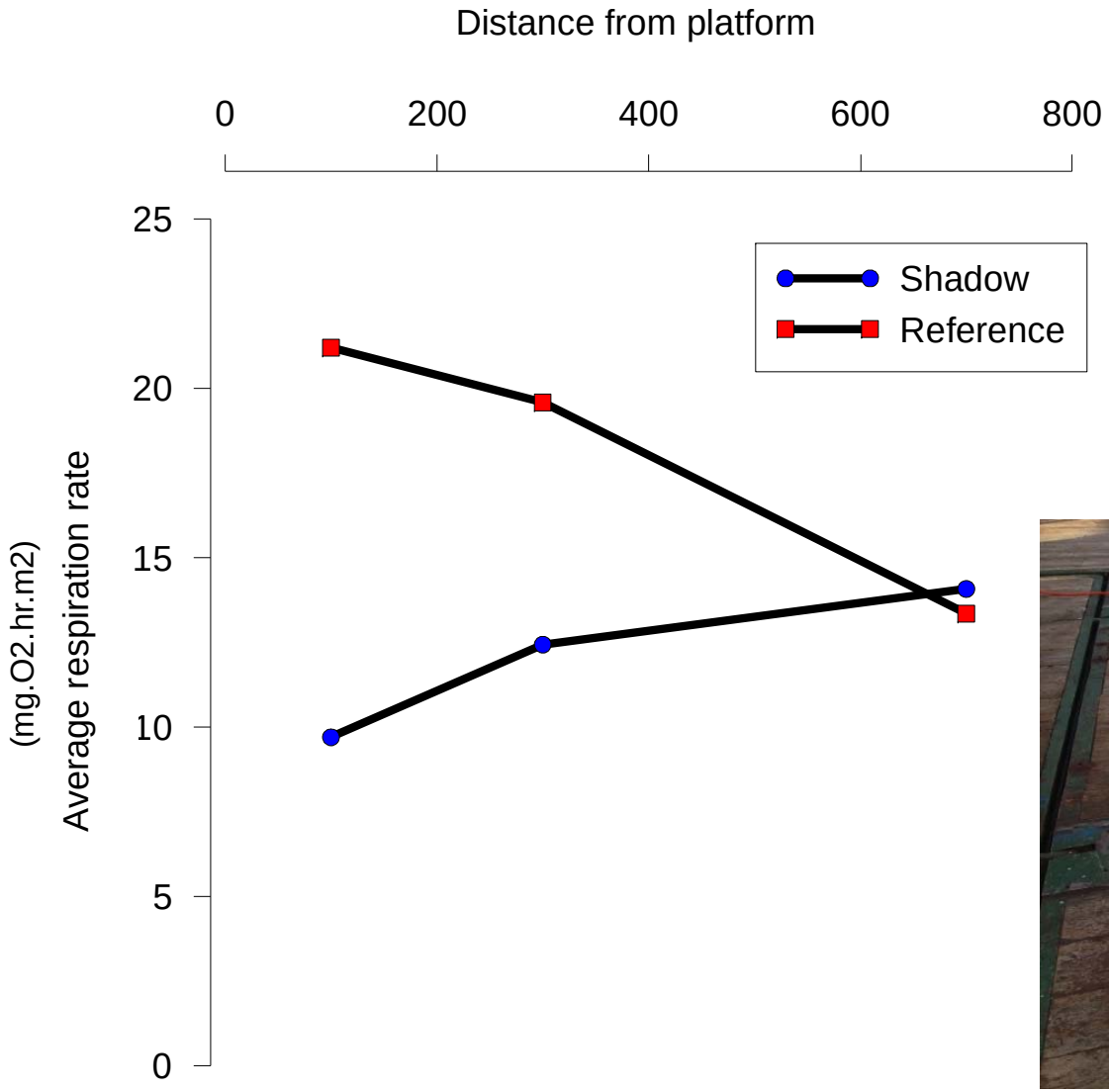
Samples taken for barcoding, sedimentology and fauna

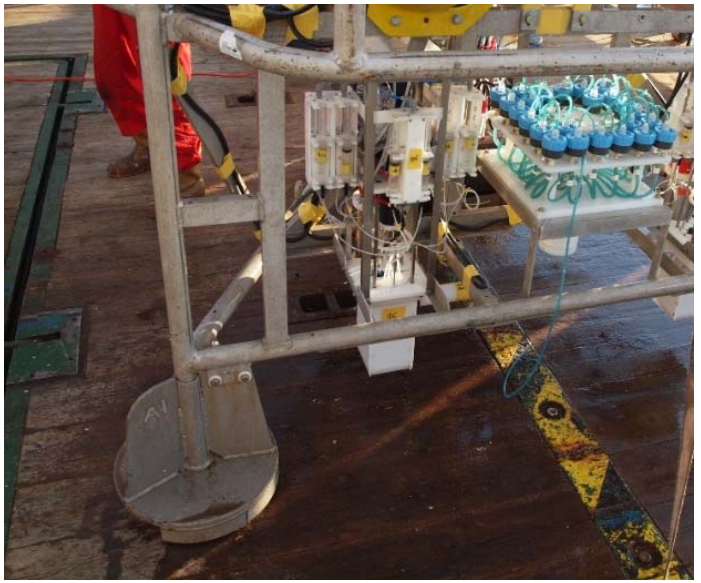
Results-> bottom sampling

Species name	SumOfNumber		
Amphiura filiformis	641	brittle star	filterfeeder
Lumbrineris spec.	116	bristle worm	carnivore
Phoronida	101	phoronid (special phylum)	filterfeeder
Callianassa subterranea	87	burrowing shrimp	deposit feeder
Corbula gibba	42	small bivalve	filterfeeder
Ophiodromus flexuosus	35	bristle worm	carnivore
Nucula nitidosa	26	small bivalve	deposit feeder
Nereis longissima	23	bristle worm	carnivore
Upogebia deltaura	23	burrowing shrimp	deposit feeder


Number of species
Number of Individuals
NW
NE
SW
SE
0
40
80
120
160
0
200
400
600
800
N=81
S=12
N=71
S=15
N=116
S=16
N=101
S=19
N=58
S=12
N=57
S=15
N=45
S=13
N=43
S=10
N=105
S=19
N=94
S=16
N=80
S=15
N=75
S=19
N=93
S=15
N=104
S=22
N=66
S=14
N=75
S=15
Platform L7-A
Geographicals WGS 1984
Grid UTM Zone 31 CM 3 East

Results -> respiration experiments





Objective 3

Model the “SHADOW”

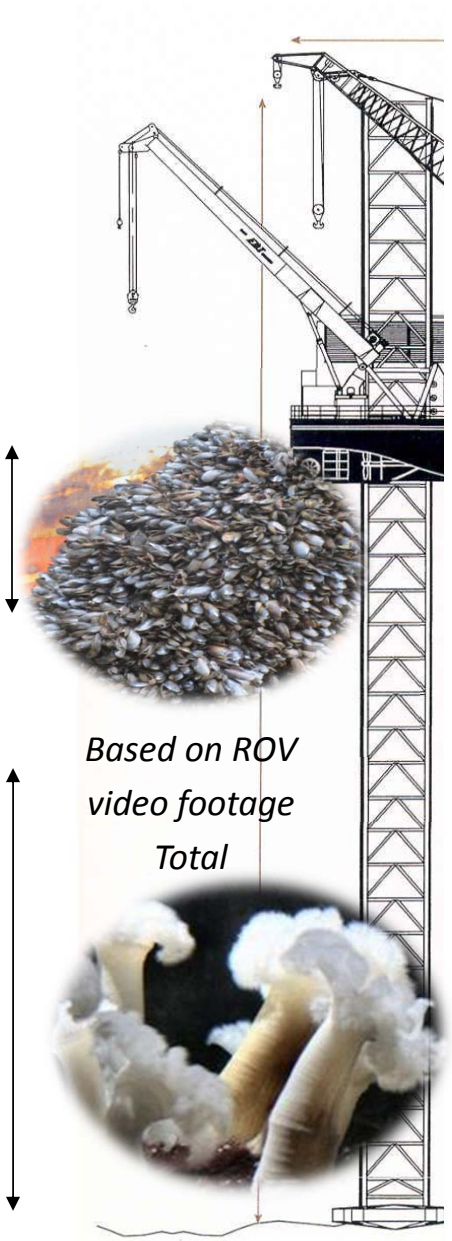
To investigate the extent of the SHADOW and potential food alteration.

Coupling pelagic and benthic processes (e.g. GETM)

Main processes:

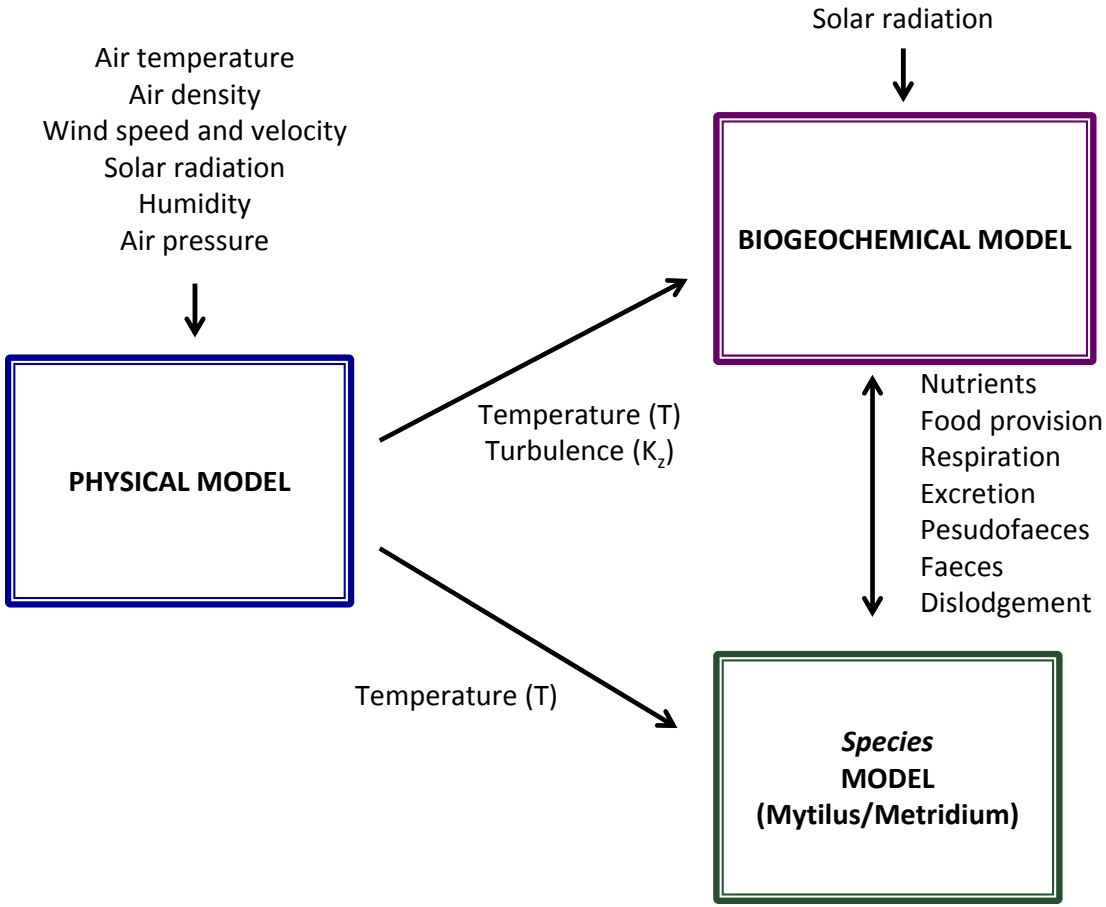
- primary production
- transport with currents and turbulence
- passive sinking
- (bio)deposition and resuspension
- uptake by benthic organisms
- pelagic decay
- ?

Mechanistic description of three main sessile feeding groups: filter feeders, passive suspension feeders, and deposit feeders



One-dimensional model

Three sub-models

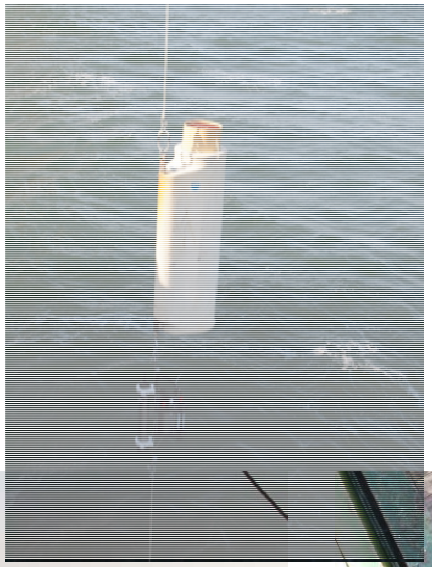


Solved with ReacTran (Soetaert and Meysman, 2009)

Meire et al. (2009)

Objective 4

Define if platforms are stepping stones



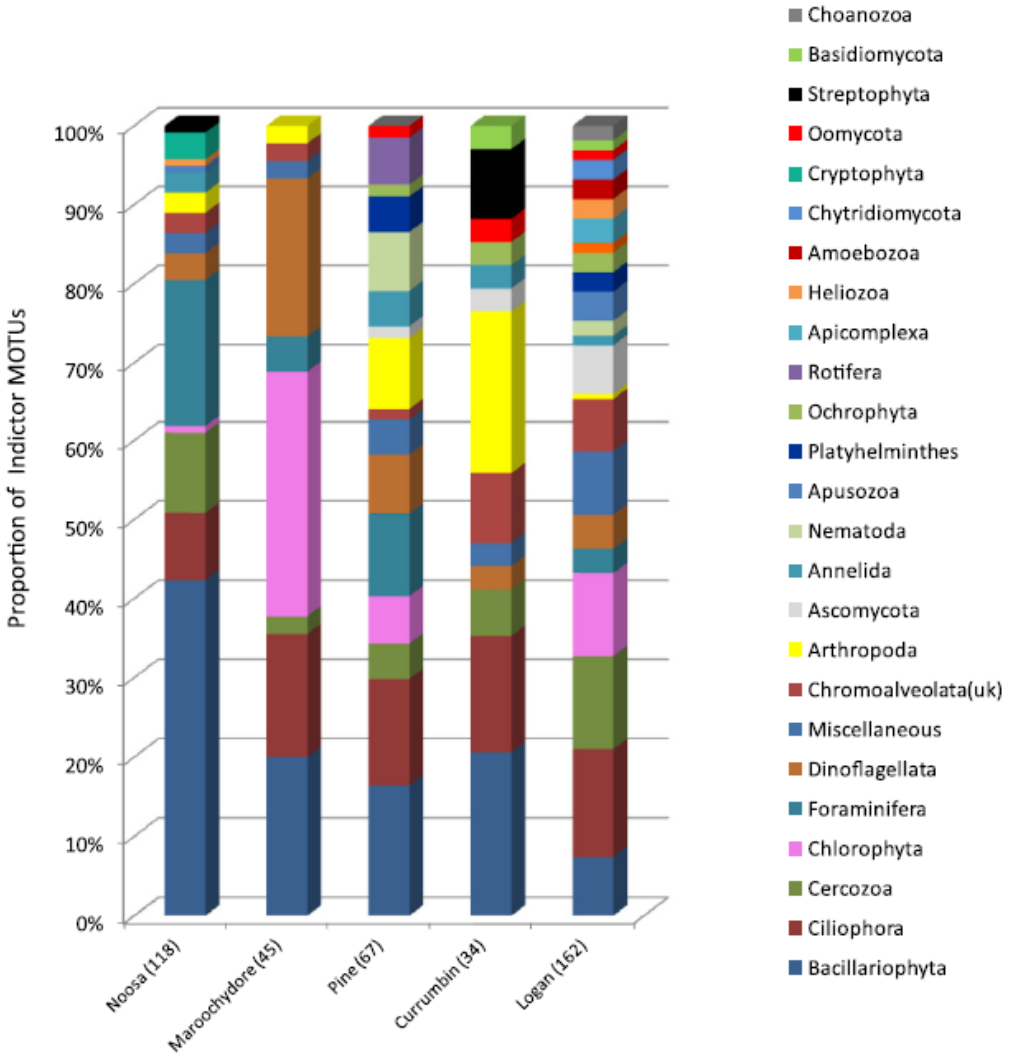
Samples from the environment

- *Water column*
- *Sediment*

Analyse with Next Gen Sequensing

Progress so far

Sampling



Testing DNA extraction methods for the metabarcoding of marine (macro)benthic species (RECON)

Outlook

- Entangle natural variability from platform related variability
- Make a comparison between shallow and deep site (FRYGG-> Norwegian partners) in the North Sea

- Development of monitoring strategies (environmentals, key species, recovery potential)
- Learn from models and fill in data gaps -> improved models

SWL
t/T