Metanutsiving fra havbunnen

Overvåkingsteknologi og pågående arbeider.

Forum for offshore miljøovervåking 20 oktober 2021

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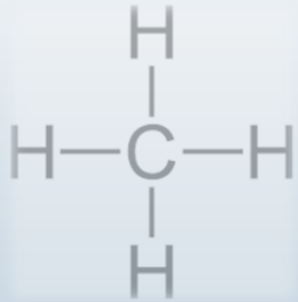
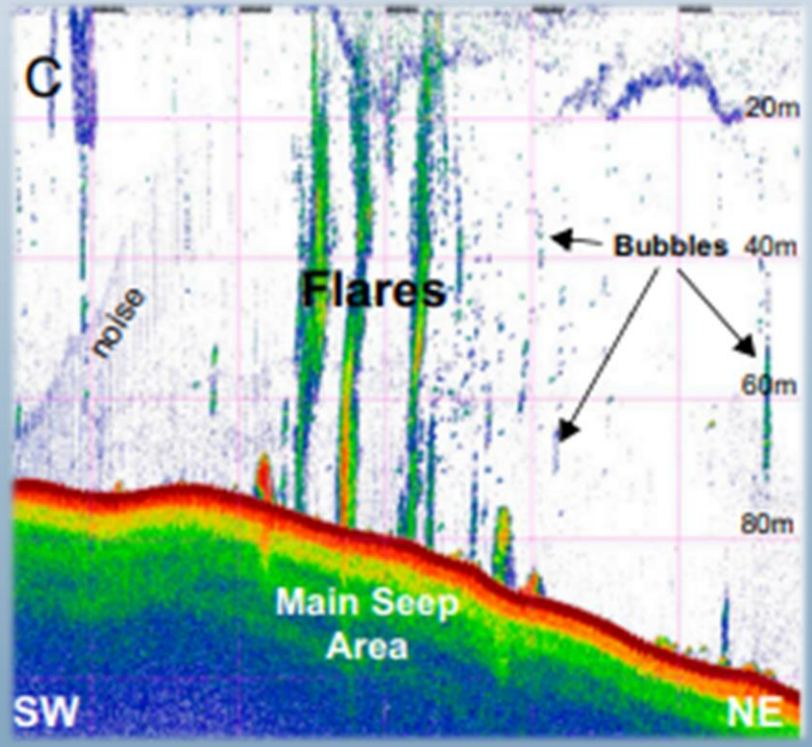
Bakgrunn



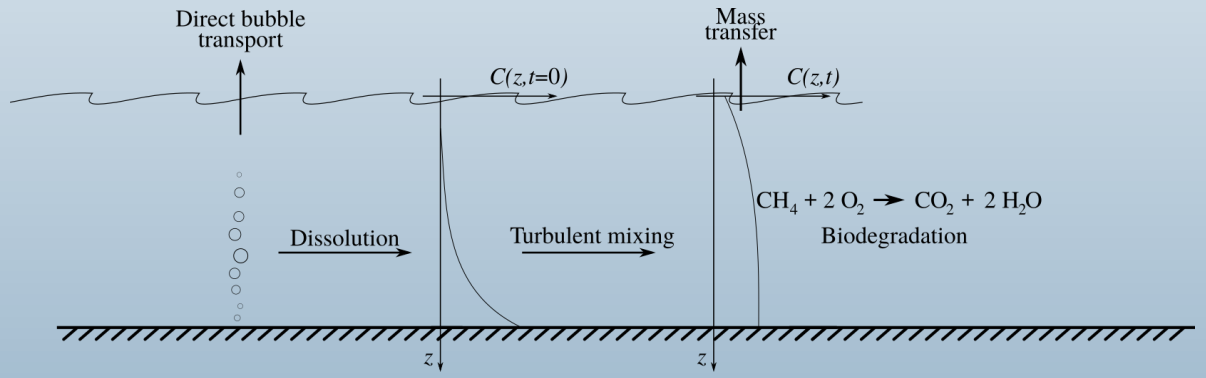
- NOROG arbeidsgruppe på metan,
  - Lundin, AkerBP, Connocophillips, Winthershall Dea og Equinor
- Metan er en potent klimagass I atmosfæren
- I de senere år har det vært en økt fokus på kilder til metan både på land og til havs.
- Naturlig frigis det mellom 8-65 mill tonn per år fra verdens kontinental sokkel til overliggende vannmasser (Pohlman et al- 2017).
- Nye kartlegginger i Barentshavet viser tusenvis av naturlige utsivinger og det er registrert flere områder med naturlig utsiving av metan i Norskehavet og Nordsjøen.
- Undergrunnen (fra havbunnen og dypere) har i ulik grad tilstedeværelse av gass. Dette kan være gass som har migrert naturlig fra dypere lag (thermogen) eller at organisk stoff er nedbrutt in situ (biogen).
- Det er observert metan utsiving assosiert med brønner som er boret for olje og gass utvinning.



Pohlman et al- 2017

Appearance of gas seepage from seabed

- Methane appears on the seabed as a mixture of bubbles and dissolved methane in fluid/porewater.
- Bubbles will rise in the water column towards the surface and dissolve into the surrounding water.
  - Bubbles can be detected just above the seepage either by acoustic devices or with visual inspection.
- Dissolved Methane can be detected with sensors or water samples.
  - Methane dilutes into surrounding waters and reduce concentration away from the source.



Sintef report, Methane seeps a desk top study feb-21

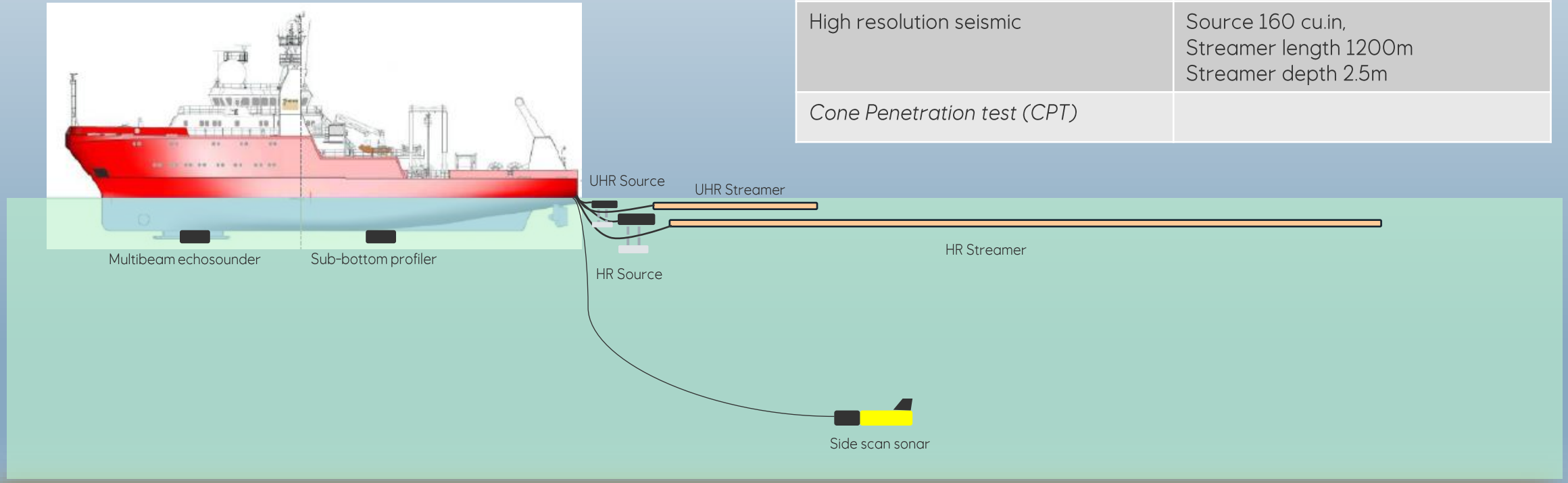
Visual inspection, ROV

- Observation class ROV can visually detect but challenging to quantify

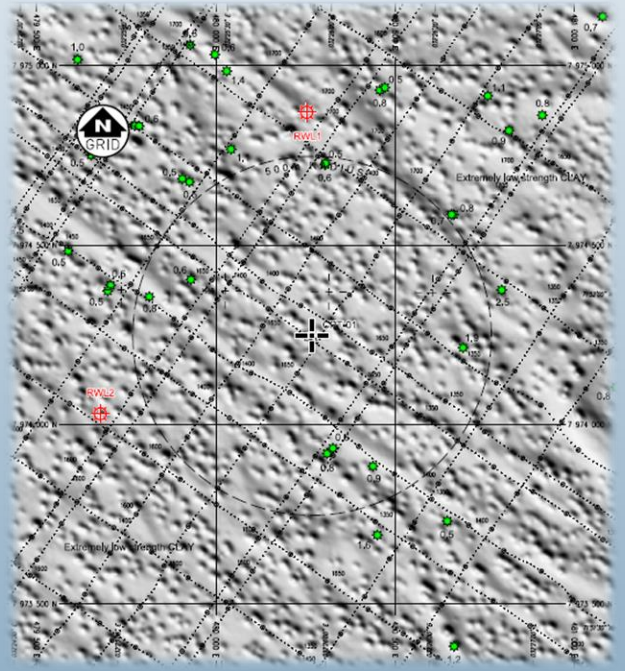
- ROV with proper tools can measure rate and sample for further analysis onshore. E.g. gas composition

Site Survey MBES data

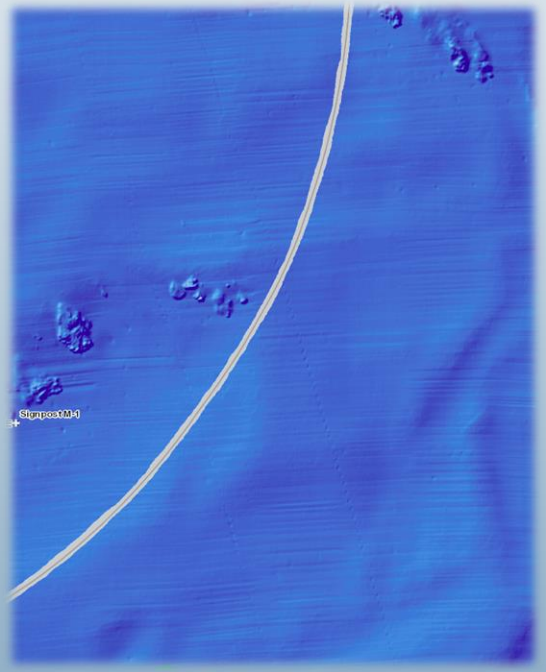
Equipment	Technical specifications
Multi-beam echo sounder	Frequency 70-100kHz
Side scan sonar	Frequency 120-410kHz
Sub-bottom profiler (pinger, chirp)	Peak frequency 3850Hz
Ultra high resolution seismic	Source 10 cu.in, Streamer length 100m Streamer depth 0.75m
High resolution seismic	Source 160 cu.in, Streamer length 1200m Streamer depth 2.5m
Cone Penetration test (CPT)	



Seabed Features

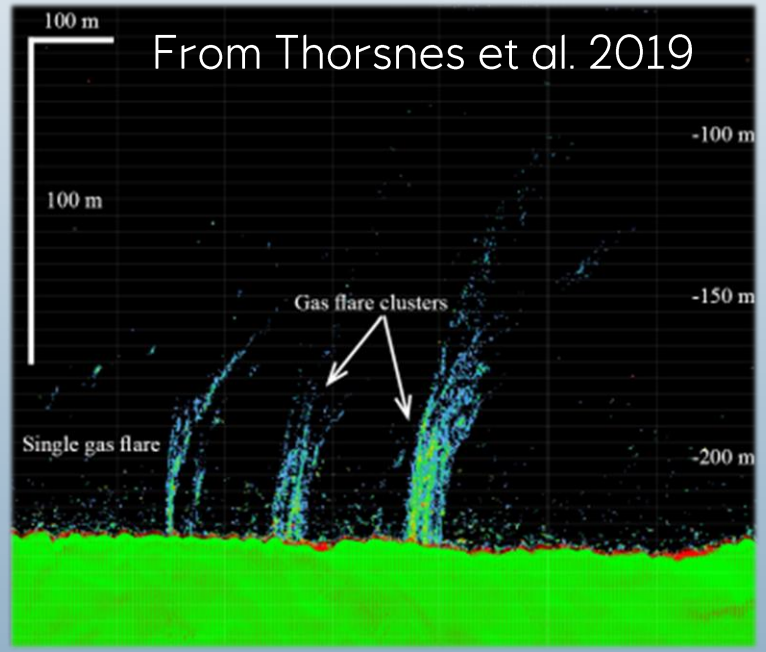


Pock Marks



Corals

Water column anomalies in 2D and 3D



Measurements of dissolved methane

- Methane can be measured by sensors e.g.
  - Methane sensor from Franatech has been tested out on different platforms and are currently in use at several fixed subsea installations.
  - Measure methane as volumetric parts per million, ppmV. Which can be converted into units of selection.

- Water samples can be analysed for content of dissolved Methane. Water samples stabilized (e.g. $HgCl_2$) and stored in suitable containers for analysis onshore.

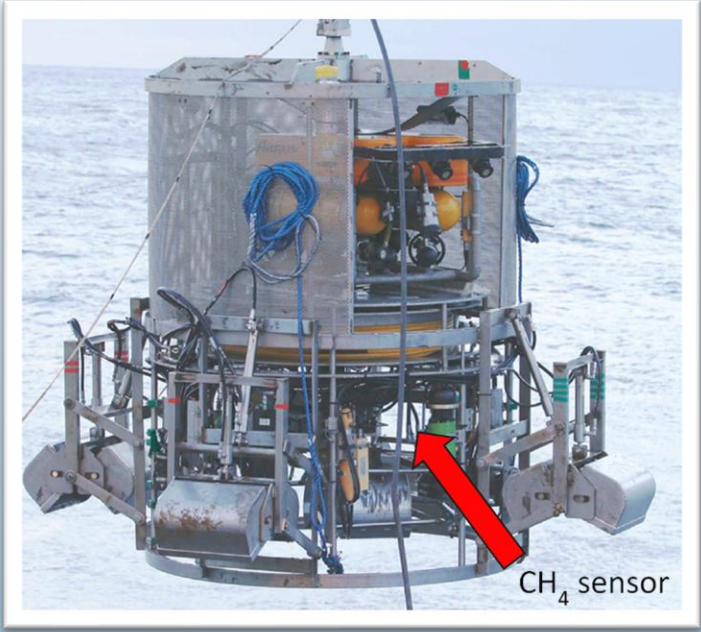
Equinor
Vår
AkerBP
OKEA
Wintershall
OMV
Lundin

Methane Monitoring projects at Haltenbanken 2021

Mapping of background levels of dissolved methane in the water column

Deep water survey 2021, (A-NIVA and IMR)

- Franatech sensor on Video Assisted Monitoring System (VAMS)

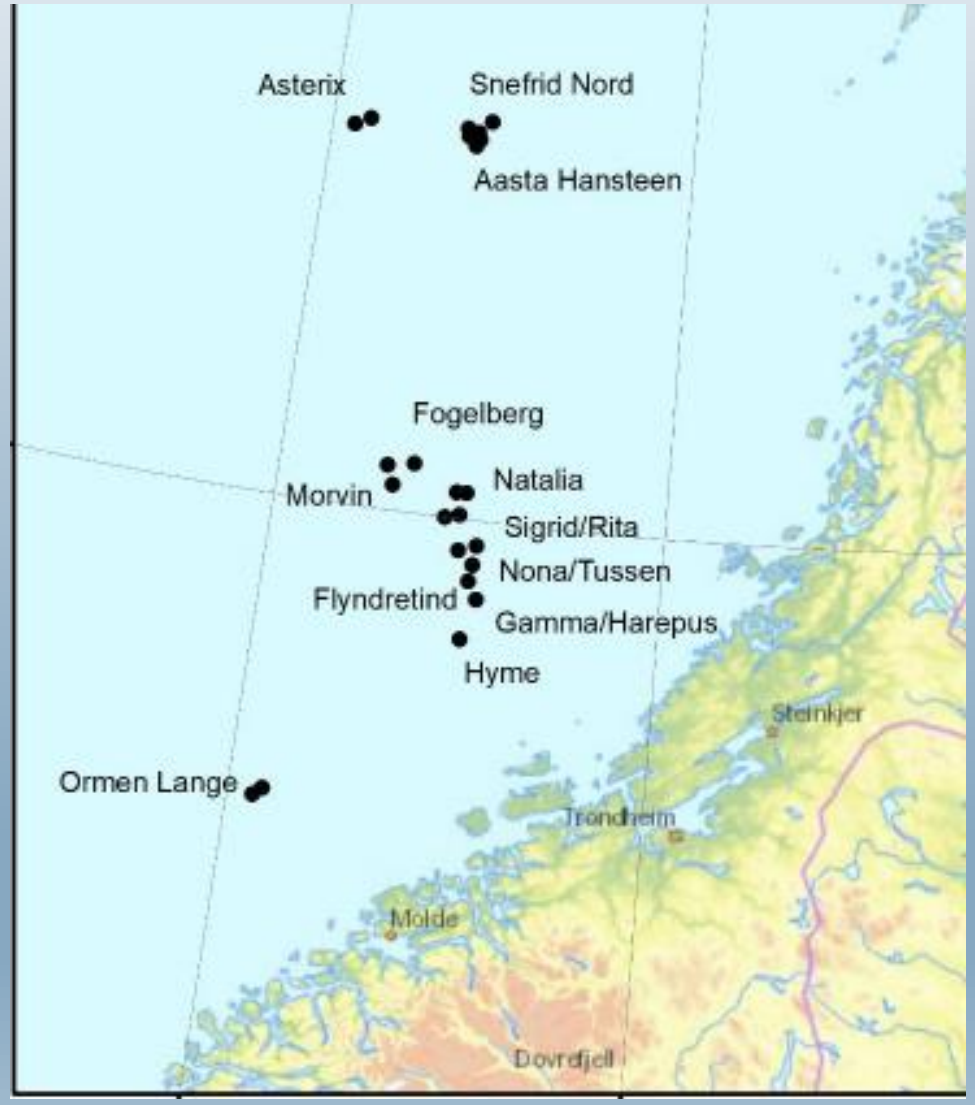


Sediment monitoring Survey, Region VI 2021 (DNV)

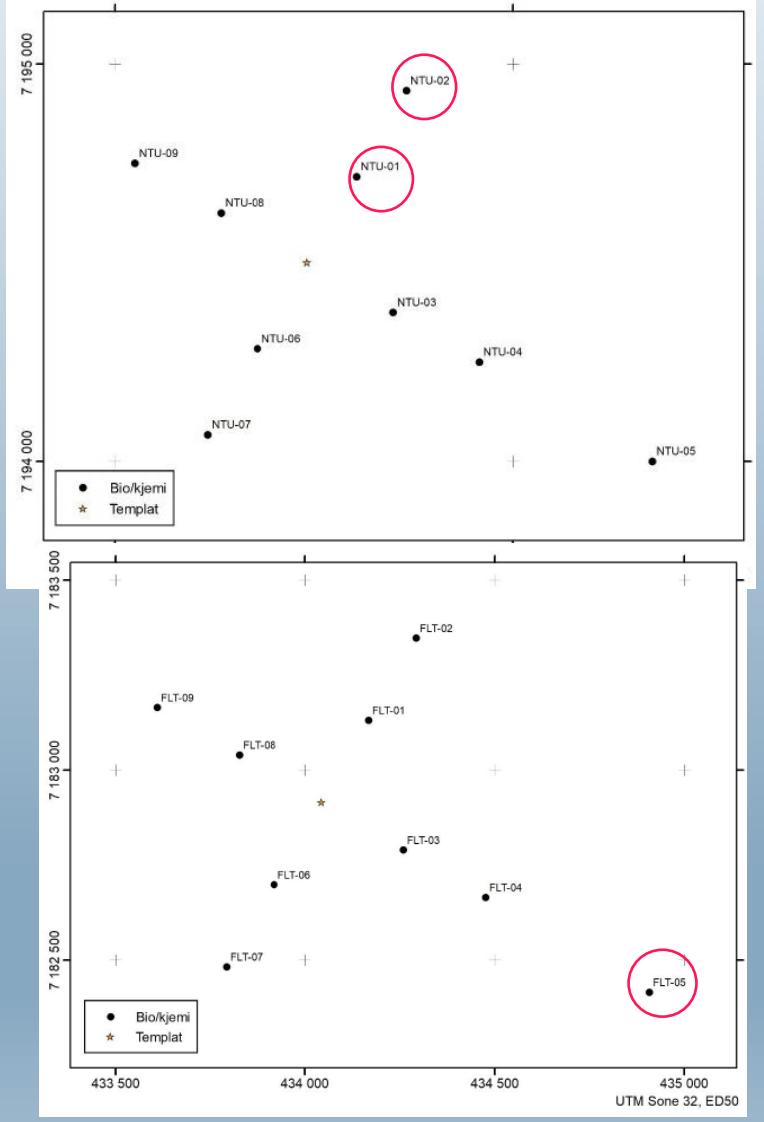
- Vår, AkerBP, OKEA, Winteshall DEA, OMV, Lundin and Equinor
- Franatech Methane sensor at selected locations, mainly regional stations
- Water samples for analysis of Methane concentration at selected locations
- SINTEF Norlabs in collaboration with SINTEF did the analysis for methane

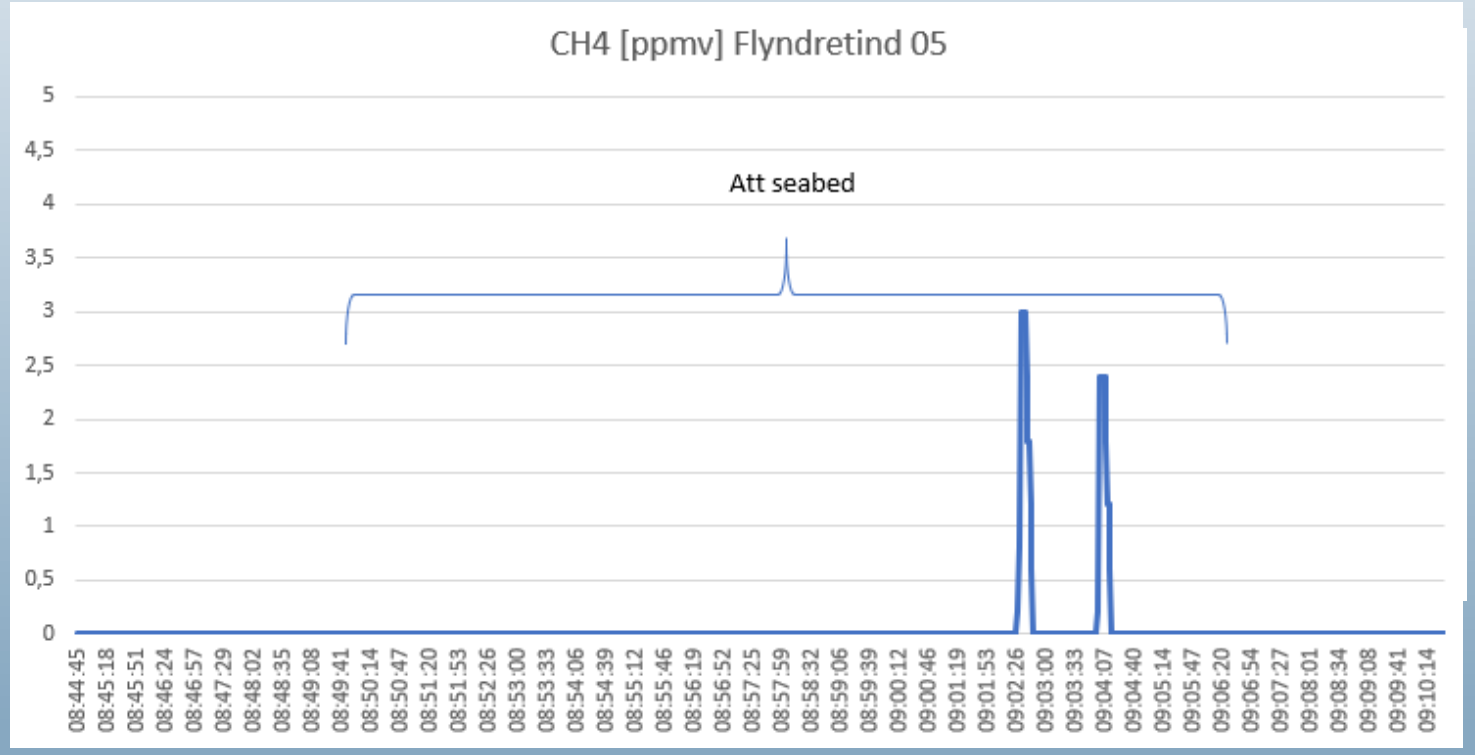
Area investigated Deep Water survey,
Video Assisted Monitoring System (VAMS)

- Aasta Hansteen
  - Template D, 2 drops
  - Template C, 8 drops
  - Asterix, 9 drops
- Regional stations:
  - Reg7-05 and Reg7-03
- Snefrid Nord, 9 drops
- Morvin, 2 drops
- Nona Tussen, 9 drops
- Flyndretind, 9 drops
- In total 51 vertical drops
  - 3 with detected Methane



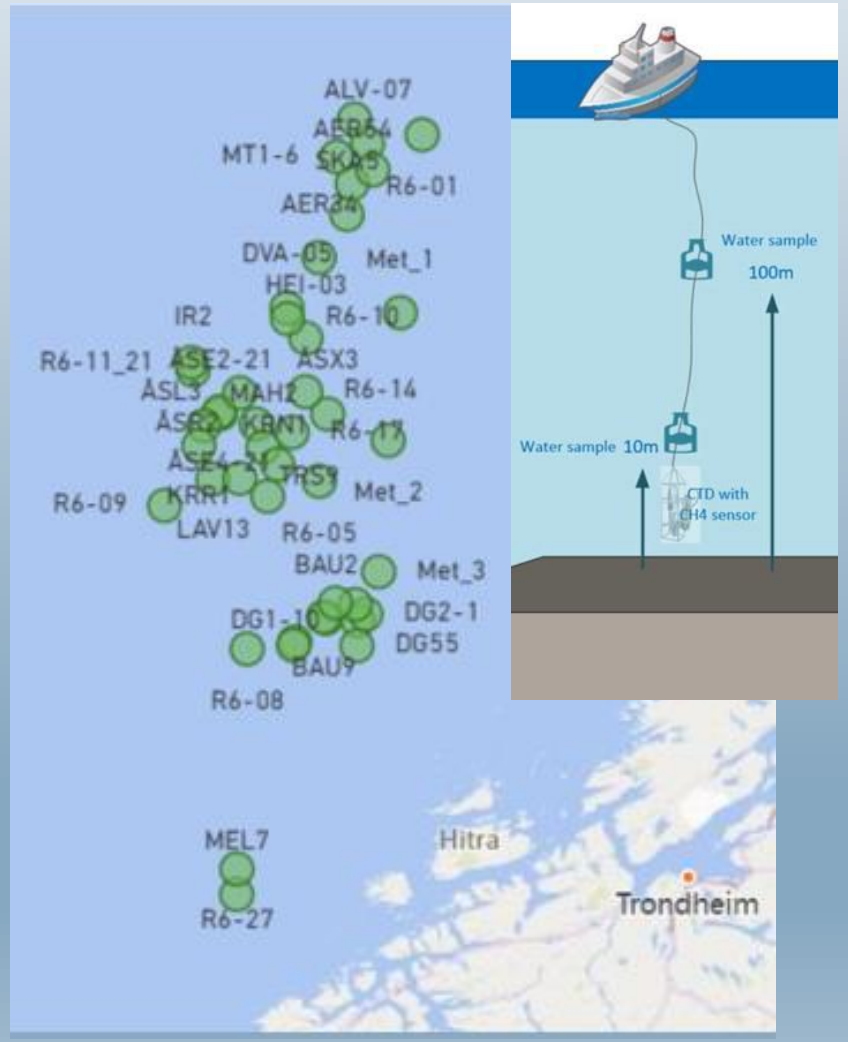
Nona Tussen and Flyndretind

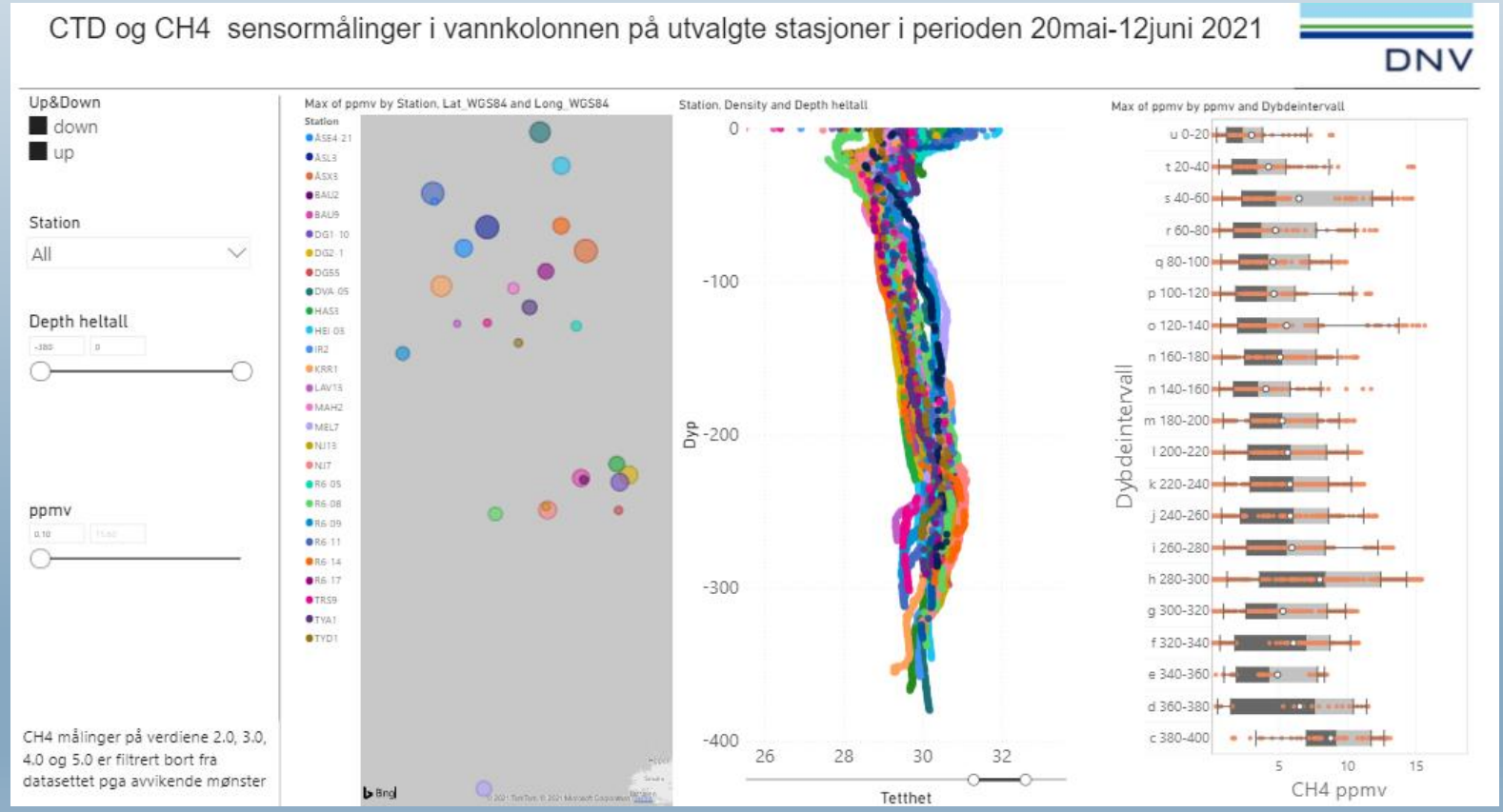




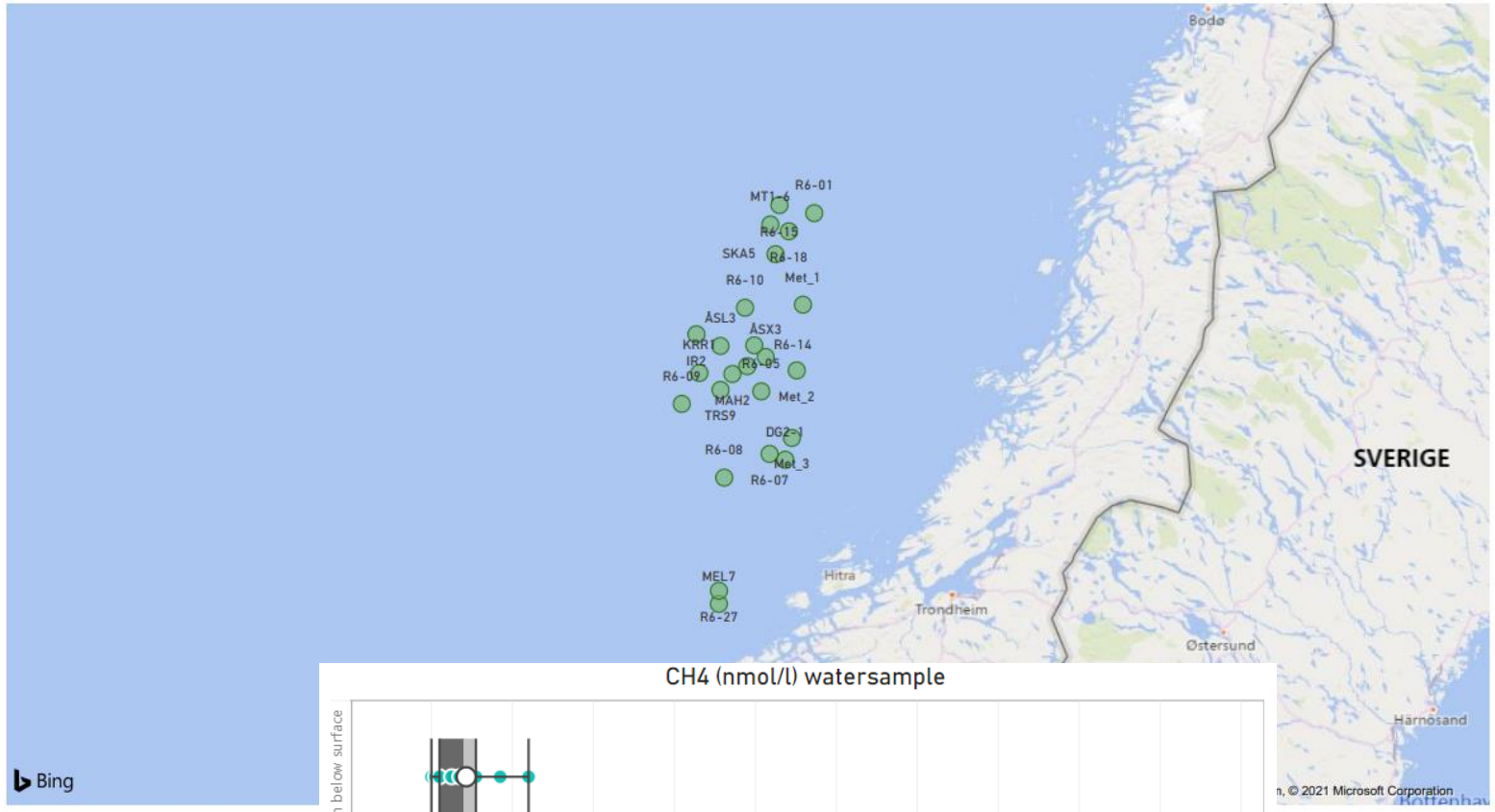
CTD with Methane Sensor locations: preliminary results from DNV

44 locations: Sensor drop from surface to seabed.

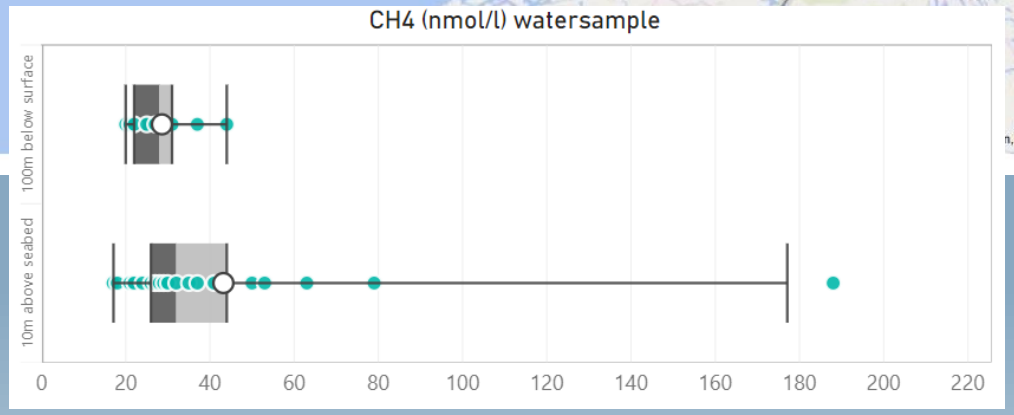




Water sample locations - regional baseline

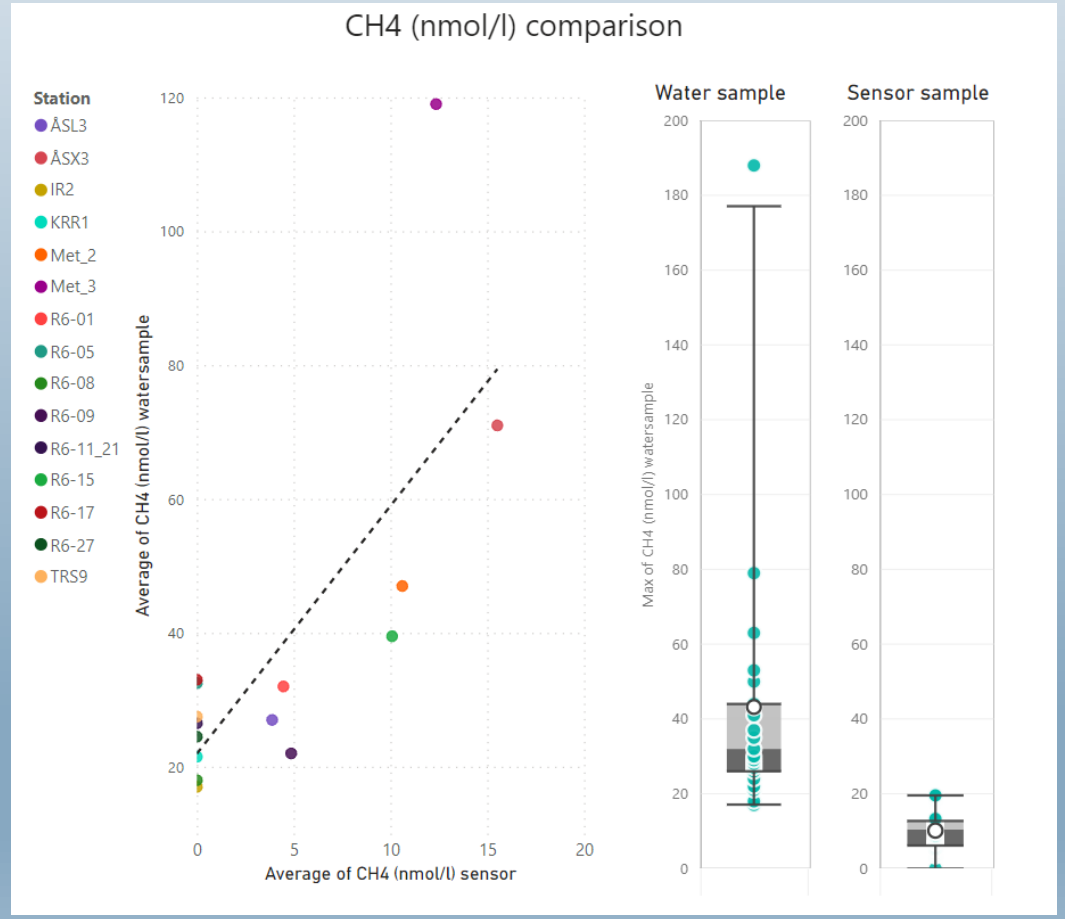


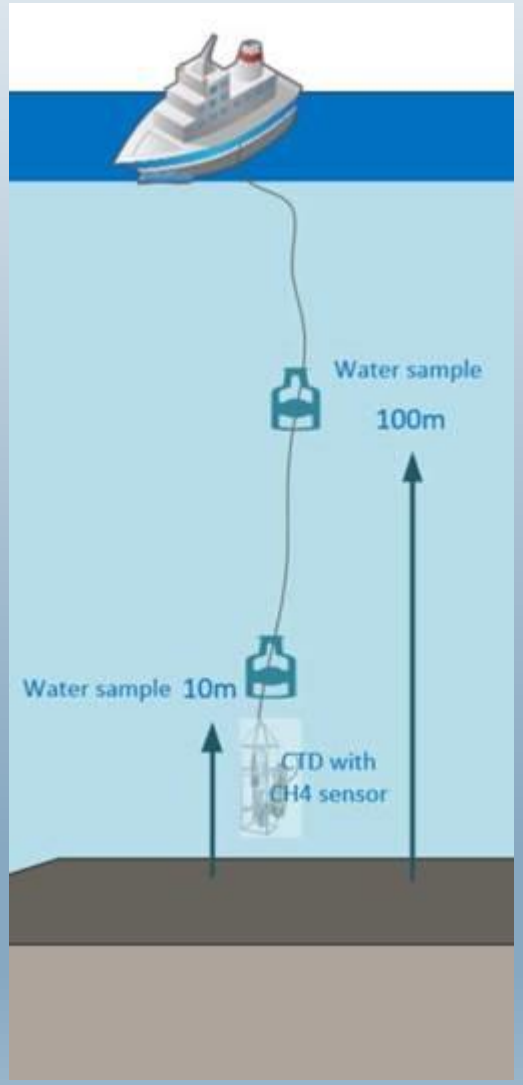
Station	Vannprøver
ÅSL3	3
ÅSX3	3
DG2-1	1
IR2	3
KRR1	3
MAH2	1
MEL7	1
Met_1	3
Met_2	3
Met_3	3
MT1-6	3
R6-01	3
R6-05	4
R6-07	1
R6-08	1
R6-09	3
R6-10	3
R6-14	3
R6-15	3
R6-17	3
R6-18	3
R6-27	2
SKA5	3
TRS9	3
Totalt	**62**



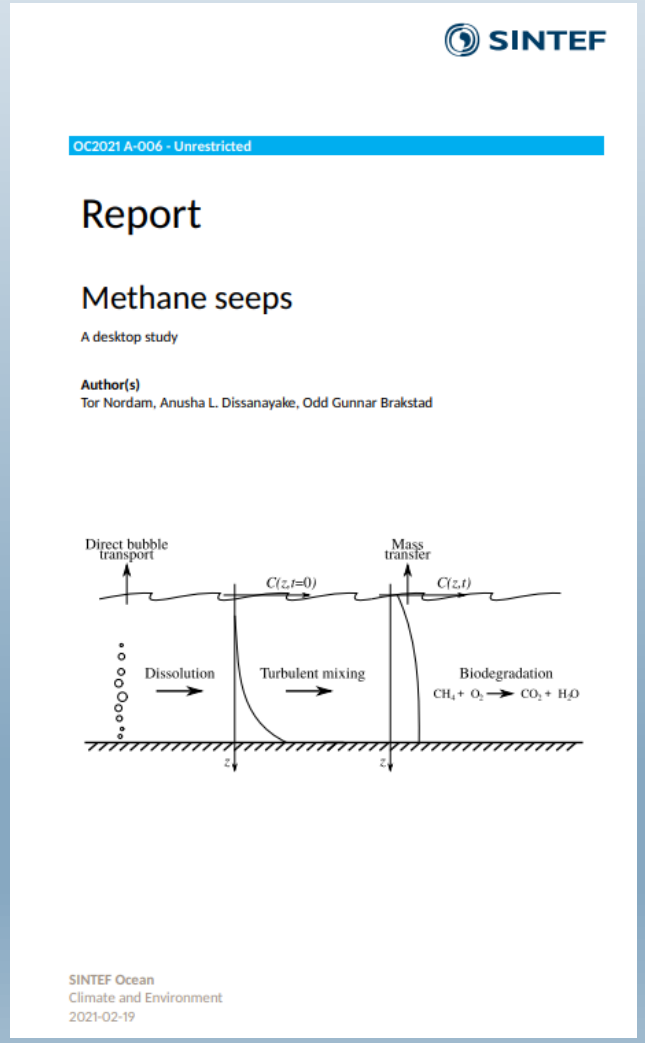
Water sample vs sensor, preliminary results from DNV

10 m above seabed





Literature review – Methane Seeps, A desktop study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OC2021 A-006 - Unrestricted

Report

Methane seeps

A desktop study

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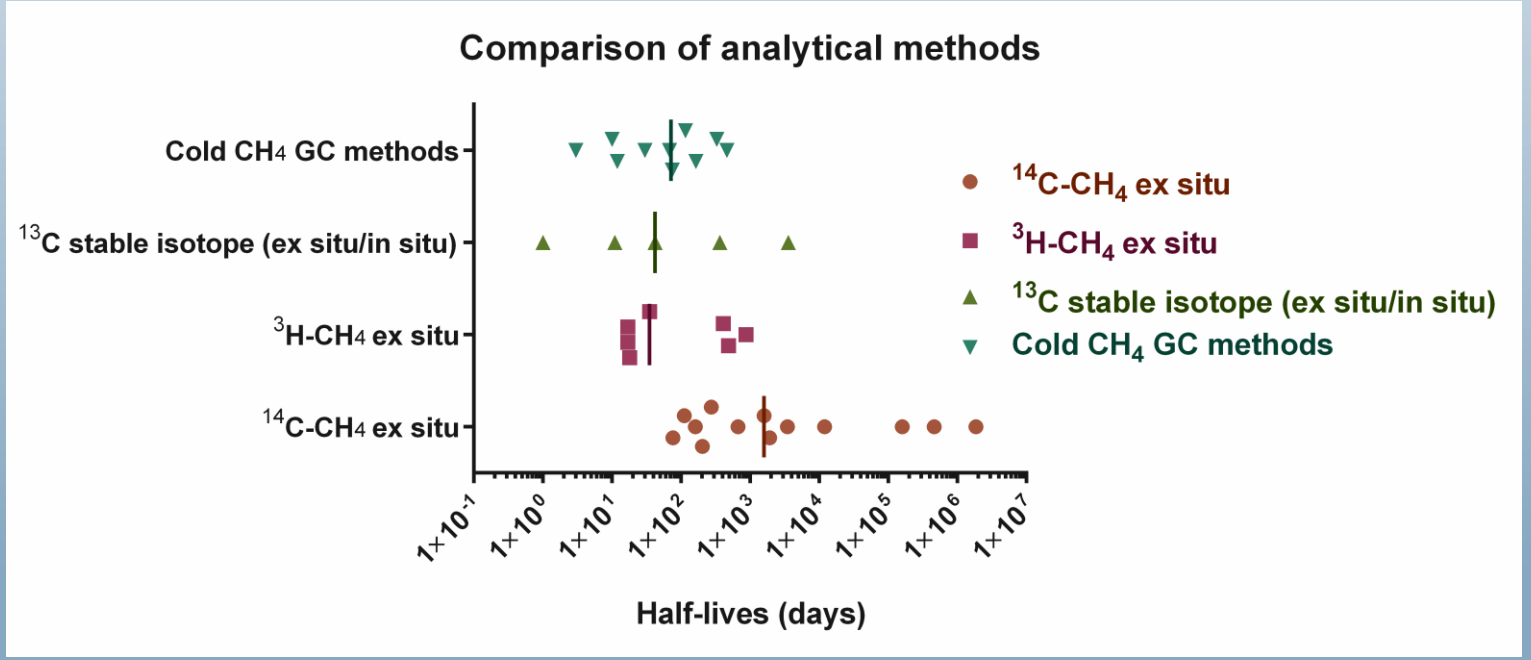
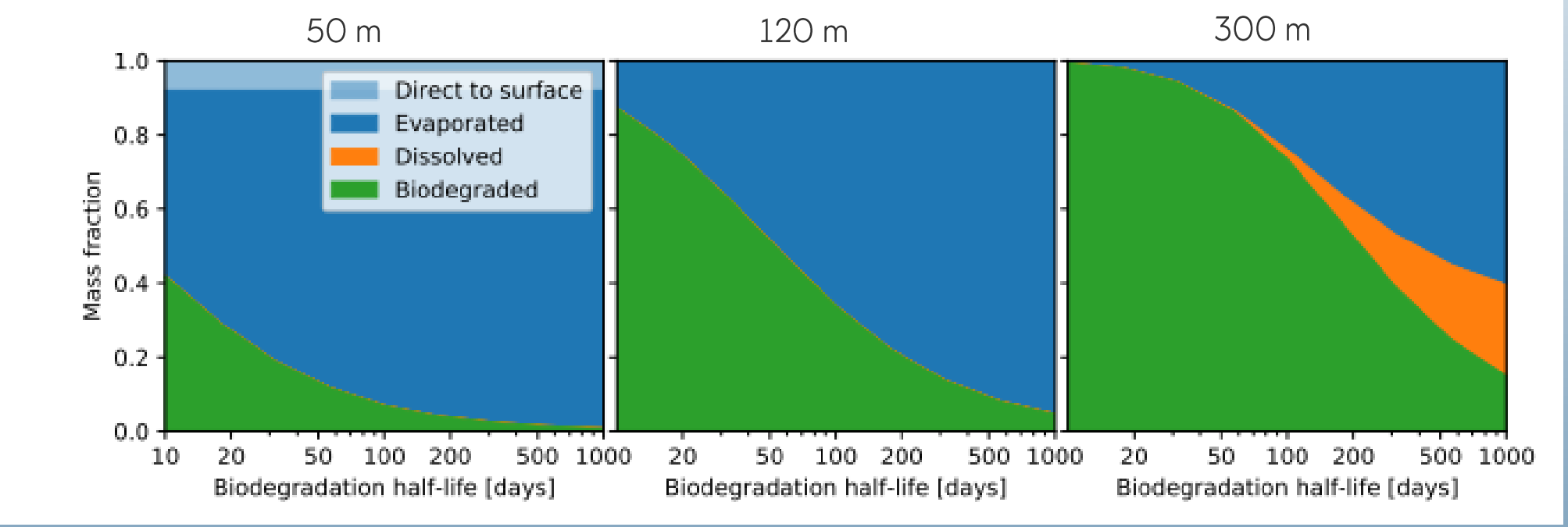
SINTEF Ocean
Climate and Environment
2021-02-19

JIP: NOROG, Lundin, AkerBP, Winthershall Dea and Equinor



Fraction of Methane biodegraded at different depths



Findings:

- degradation rate essential to understand the fate of methane
- Degradation rate depending on concentration of methane

Oxidation of methane in Seawater, SINTEF study

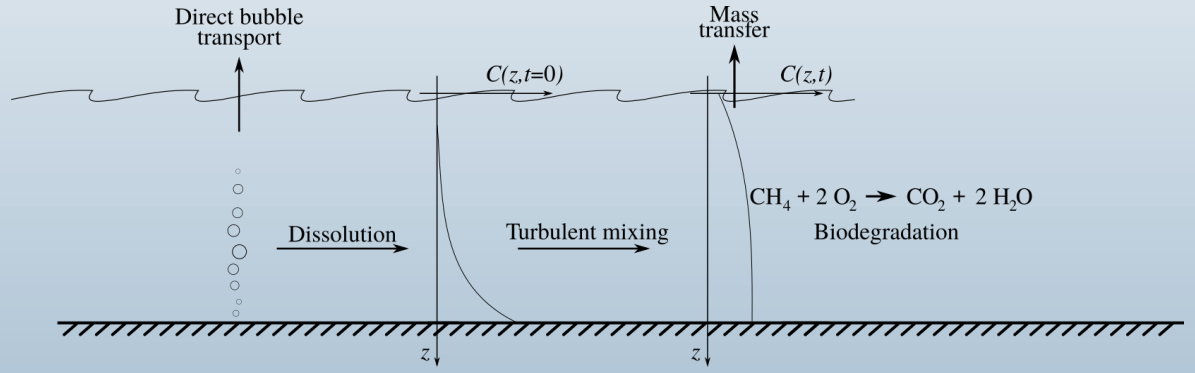
- **JIP: NOROG, Lundin, AkerBP, Winthershall Dea and Equinor**
- **Started July -21, finished end of -21 early -22.**

SINTEF will investigate and determine:

- the incubation time needed for the oxidation methods
- decide, and compare oxidation rates at different methane concentrations at two SW temperature (4-5°C and 13-15°C).

The final objective of the project will be to provide methane oxidation rates for modelling the potential atmospheric emissions of methane to the atmosphere from gas seeps at different SW depths.

In addition, a review of some selected publications is suggested for comparison of different mathematical models for growth of bacteria and oxidation of methane.



- Experiments will be performed by spiking SW with labelled methane and determine oxidation rates by two methods, Spiking of SW with 3H-labelled CH4 and the measurement of 3H-H2O as a measure of CH4 oxidation
- Spiking of SW with methane gas in combination stable isotope (13C-labelled CH4)to determine the δ13C-CH4 from the changed ratio between 13C and 12C during oxidation.
- Oxidation rates will be determined as first-order rates and half-lives.

Oppsummering

- Det er tilgjengelig teknologi for å kartlegge utsivinger av gass fra havbunnen
  - Skrogmontert flerstråle ekkolodd (MBES) detekterer selv de minste utsivinger
  - ROV gir god visuell beskrivelse av utsiving og kvantifisering av rate samt gass analyse er i dag mulig å få til.
- Det er tilgjengelig teknologi for å finne og analysere oppløst metan i vannsøylen
  - Sensor teknologien er god, men trenger fremdeles mer uttesting for å kunne gi etterprøvbare resultater
  - Vannprøver og påfølgende analyser på land er mulig å gjennomføre på lik linje med andre vannprøver
- Behov og utfordringer
  - Forståelse av nedbrytning av oppløst metan
  - Forståelse av spredning av oppløst metan i tid og rom
  - Forståelsen av mekanismene bak naturlig utsiving av metan fra undergrunnen og utsiving assosiert med brønner
  - Kartlegging og overvåking av utsivinger er kostnadskrevende.

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