

Status and future plans of the new “Connector FerryBox-line” in the North Sea as a contribution to MSFD reporting on Eutrophication (*Follow-up - Genua 2019*)

- *Experiences from JMP-Eunosat, Jerico-S3, TNA project APHYMOSO and NORSOOP*

11th Ferrybox meeting
28-29 October 2022, Geesthacht

*Kees Borst, Machteld Rijkeboer (RWS, NL),
Kai Sørensen, Caroline Mengeot and
Pierre Jaccard (NIVA, NO)*



Jerico - S3 + TNA



BACKGROUND - Refresh

DG-ENV: Joint Monitoring Programme of the Eutrophication of the North Sea with Satellite data (**JMP-EUNOSAT**) 2017-2019

Policy frameworks: OSPAR and EU Marine Strategy Framework Directive (*use of FB-lines part of programme*)

Norwegian Ships of Opportunity Programme for marine and atmospheric research (**NORSOOP**) (2018-2023)



New Dutch Monitoring Strategy for Eutrofication (2019-2022)

Jerico-NEXT -- > **JERICO – S3/PSS** (2020-2024) + *TNA APHYMOSO* (2022)

- Drivers -

Why do we want joint monitoring?

- *policy*: improving **coherence of assessments** (MSFD, OSPAR). Art 11 reporting: **EC very keen on seeing improved coherence in marine regions !!**
- *money*: cost effective monitoring programmes while more data needed
- *technology push*: more/better data through new techniques
- *science*: improve understanding of ecosystem functioning

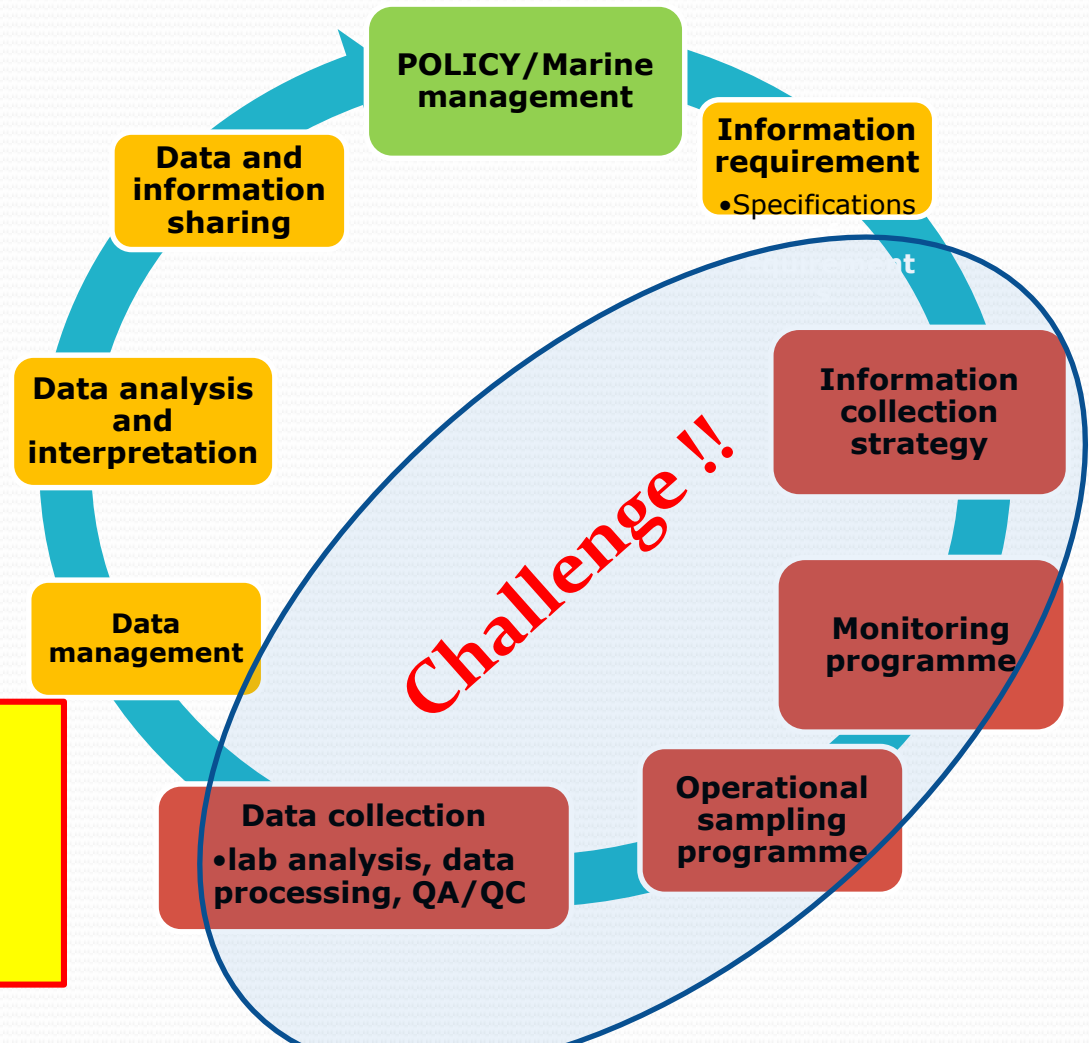
How can we ensure joint monitoring delivers (more) coherent MSFD assessments?

Information cycle

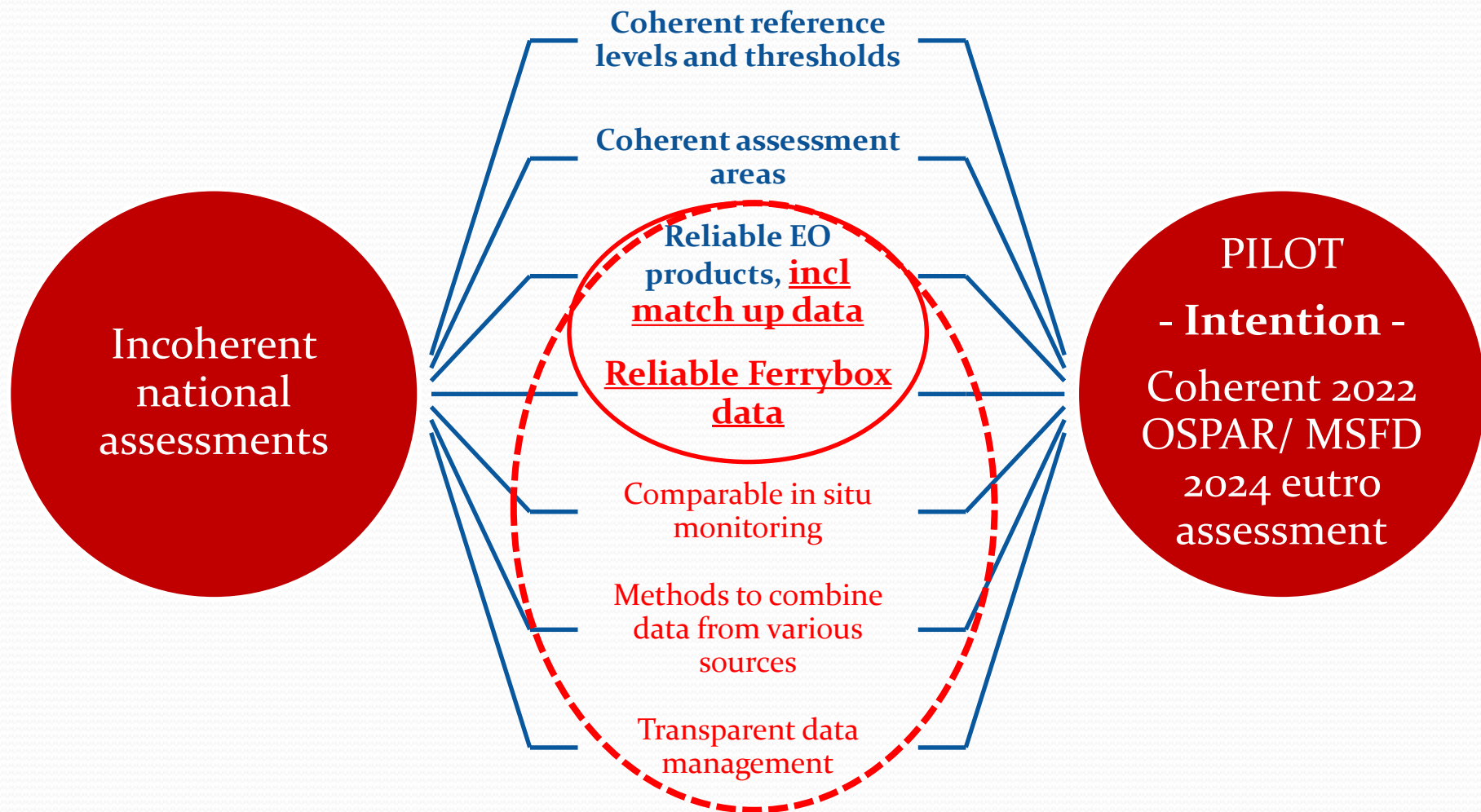
Level of coherence:

- **Coherent**
- **Partly Coherent**
- **National**

Options for North Sea wide operational collaboration
(Programming/ Common use of RS /
Ferrybox-lines etc)

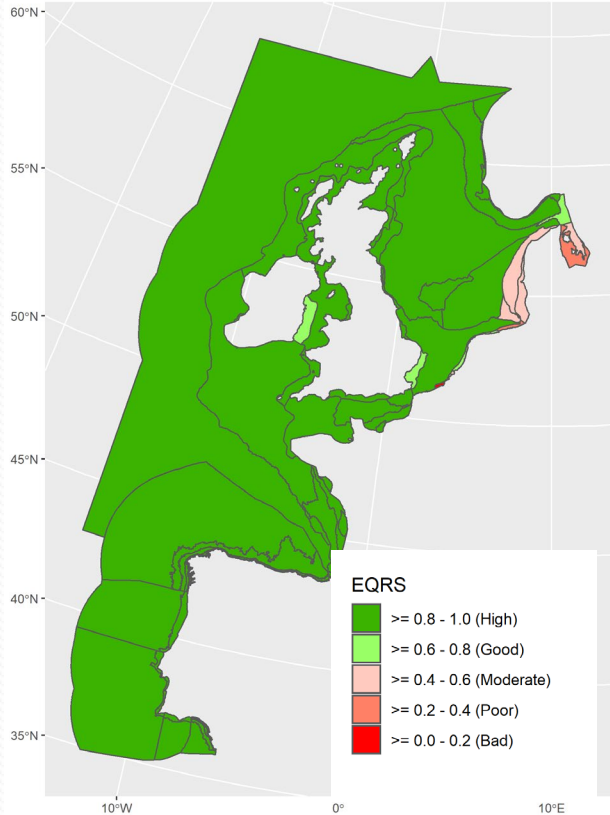


Elements for coherent assessment



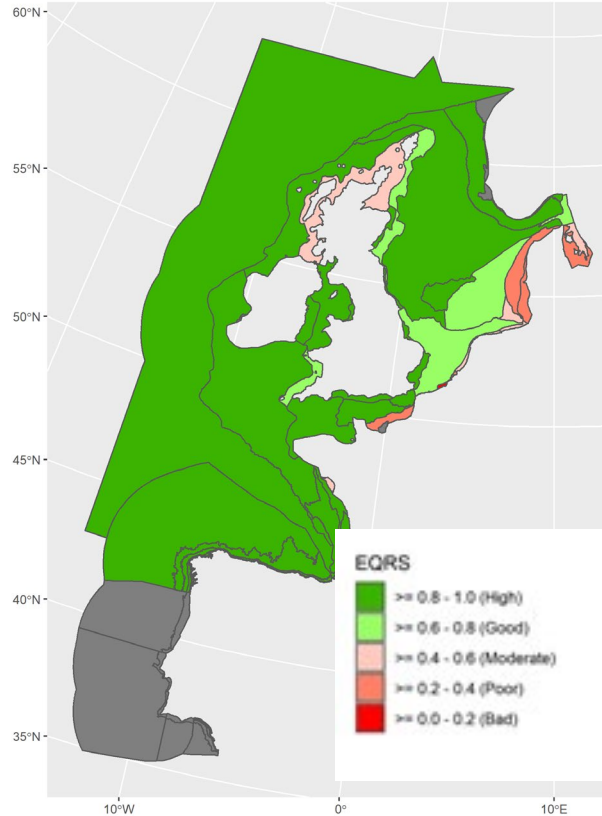
New assessment results

Eutrophication Status 2015-2020
Chlorophyll a (satellite) (CPHL-EO)
Months: 3-9, Depths: 0-10, Metric: Mean



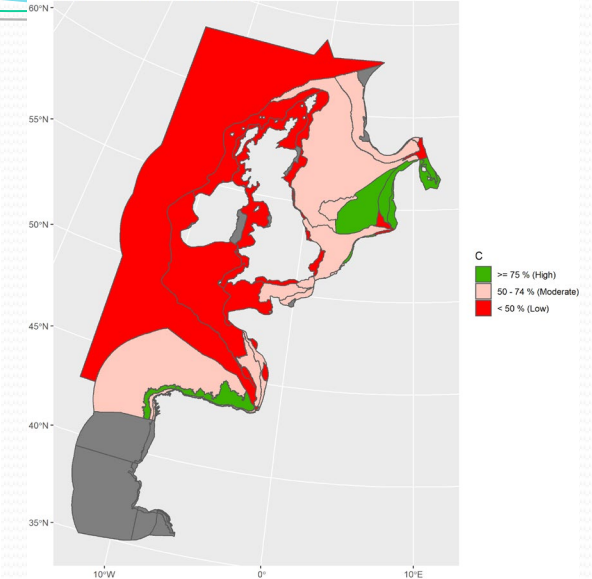
Assessment result based on **satellite** chlorophyll data

Eutrophication Status 2015-2020
Chlorophyll a (in-situ) (CPHL-IN-SITU)
Months: 3-9, Depths: 0-10, Metric: Mean

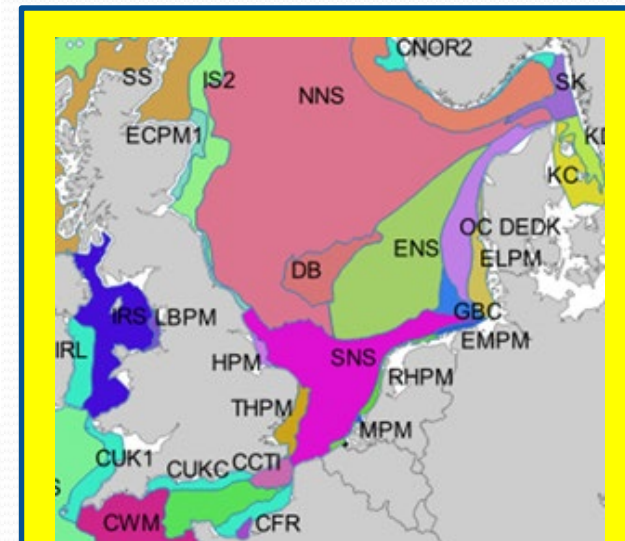


Assessment result based on **in-situ** chlorophyll data

Eutrophication Confidence 2015-2020
Chlorophyll a (in-situ) (CPHL-IN-SITU)
Months: 3-9, Depths: 0-10, Metric: Mean



Confidence in-situ chl-a data



Oskar (ecological relevant)
Assessment Area's

Joint monitoring approaches

- Transparent joint assessment (OSPAR/ ICES COMPEAT) showed need for more and more harmonized observation data.
- Satellite data complement (but do not replace) in-situ data for chlorophyll-a
- Ferrybox data not (yet *fully*) used for OSPAR assessments. Can be used in future for:
 - Cost-efficient observations of additional variables at high spatial resolution
(Primary production, phytoplankton species composition, salinity, turbidity, nutrients)
 - Validation of chlorophyll-a from satellites?

OSPAR was interested in adopting this approach for assessment (**QSR 2023**), Discussed in OSPAR ICG-EUT and HASEC. More or less common support. Some steps has been made. Not used completely in this round. (Mostly match-ups)

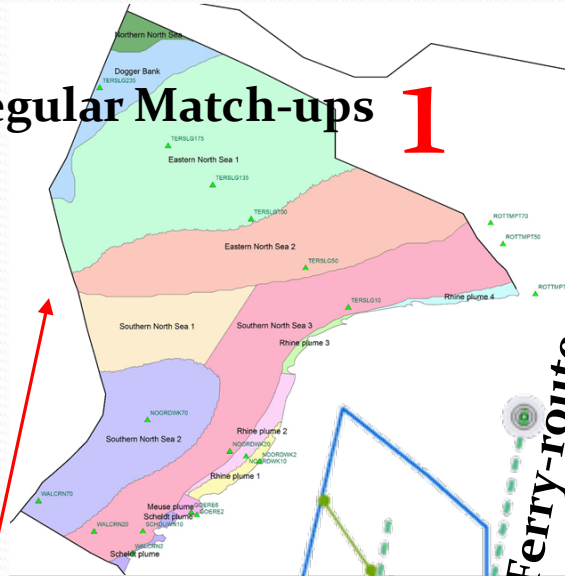
HOW do we want joint monitoring for Eutrophication? (NEW Dutch Monit. Strategy)



Old in-situ (every month)

- 1. New sampling 3 x year
- 2. Earth. Obs + validation
- 3. Ferry-data + Autosampler

Regular Match-ups 1

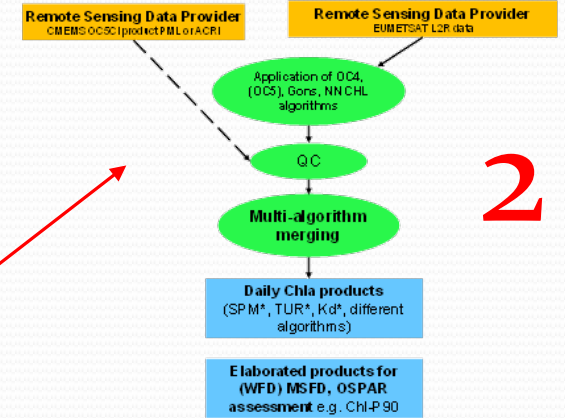


Ferry-route

3 Auto-sampler



RBINS/Brockmann Consult processing chain for S3/OLCI



2

Satellite-procedure with validation

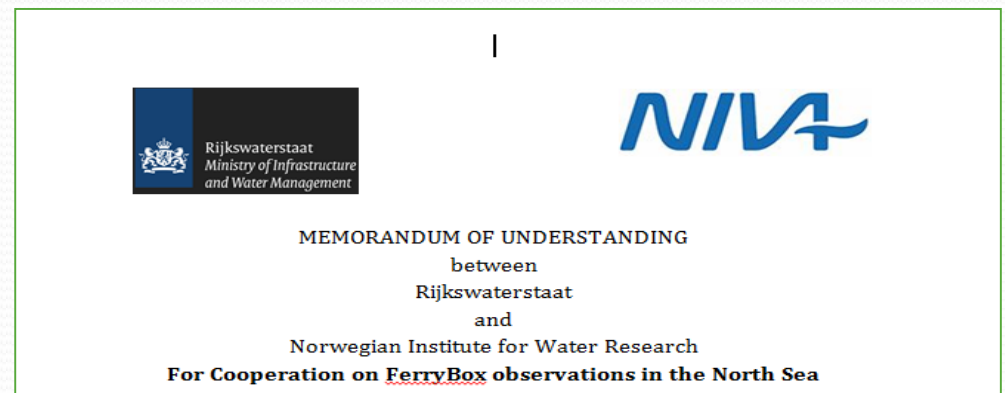


2

AERONET –sensor on windplatform

that's why... Start of new Ferrybox Line during JMP-Eunosat (as katalysator) + STATUS in 2022 + FUTURE PLANS

- RWS and NIVA **revives** the use of a FerryBox-system between Norway – Netherlands (in the past pilot with Transcarrier) during the JMP EUNOSAT project (2017)
- NIVA has set up an agreement with the cargo ship company “Seacargo” which have several routes in the North Sea.
- We make use the cargo ship **“SC Connector”** that operates between Bergen (NO) – Odda (NO) - Tananger (NO) - Immingham (UK) - Rotterdam (NL)
- We have signed a **MOU** between RWS and NIVA in 2019
- Stagnation of Process during Covid (2020, 2021)
- 2nd Revival in 2022.... First Installation with TEST-results of online sensor + Parallel TEST on manned Color Fantasy for new sensors for 2nd Phase. (2023 - ...)
- 2022-2023 Full Online Test and Automatic Sampler (as match-up and transect validation)



Furthermore:

- We use the datamanagement system in NorSOOP and HEREON-hub to export data to the European data networks that already exists. (*Emodnet*)
- We have started with the following standard sensors like (*results Kai/Pierre*)
 - Temperature inlet
 - Oxygen
 - Chl-a fluorescence
 - Programmed automatic water sampler (*samples during a satellite pass and/or transects !!*)
 - Salinity
 - Turbidity
 - cDOM fluorescence
- For the second phase we foresee to bring also onboard more advanced sensors and analyzers. (*first were tested in TNA-pilot; see later*)
- For satellite product validation above water radiance sensor can be installed later. The ship has a good design to try such installation. .
- Further development and testing are done in JERICO – S₃ etc.
- We can broaden the cooperation with UK

Seacargo Line SC Connector
(*now modern sailing ship;
first in the world*)

Implementation
First – tests
And
TNA results

SC Connector arrived in Rotterdam on Tuesday

11 January 2021 **11 January 2021**



The SC Connector arrived at Matrans Rotterdam Terminal in Eemhaven on Tuesday, 12 January, at 7:00 a.m. Last year, this vessel from the shipping company Sea-Cargo was converted into a modern sailing ship. On behalf of Sea-Cargo, it is deployed on a scheduled service with other RoRo and breakbulk vessels between Western Norway, Denmark and the Netherlands, and since last week also Sweden and Poland.

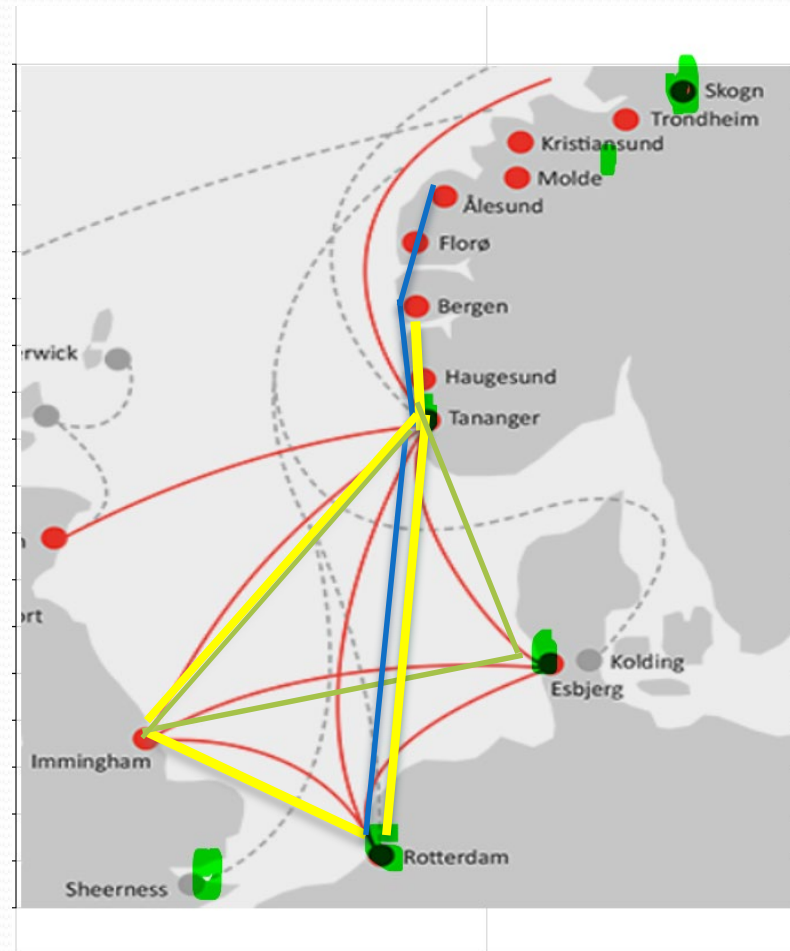


Photo: Ries van Wendel de Joode

SeaCargo Lines in the North Sea covering NO, UK, NL, DK

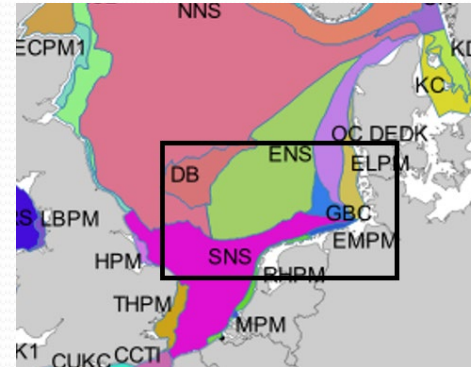
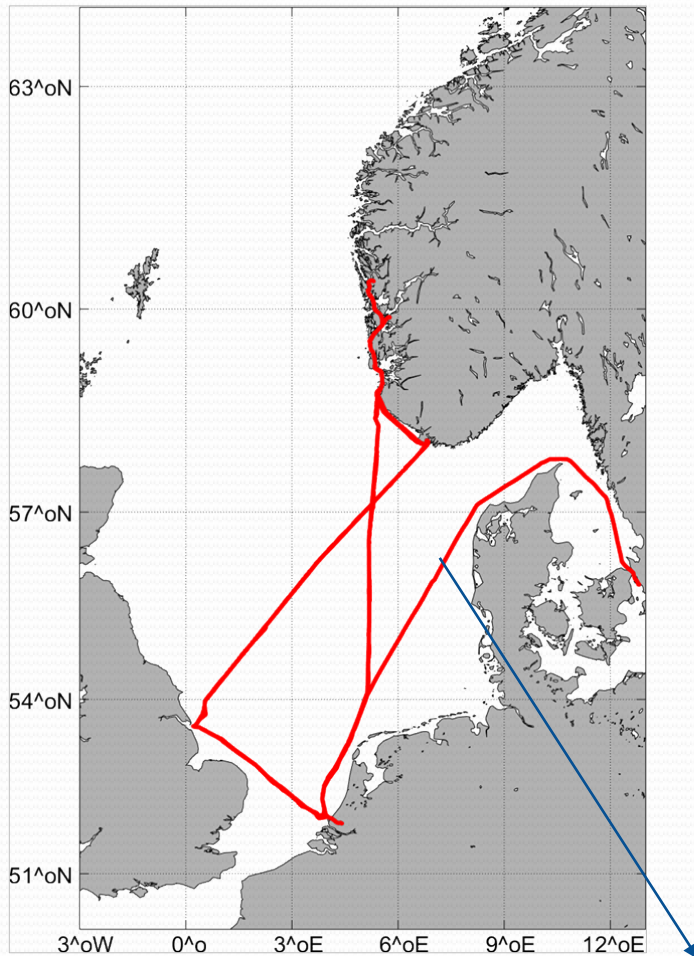
...Transcarrier **Connector** Ahtela

	SUNNDAL TRADE		SC C CONNECTOR	AHTELA
	TRANSFIGHTER			
MON	ROTTERDAM	0700 - 1500	IMMINGHAM	0700 - 1500
				HUSOY 0300 - 0400 BERGEN 1000 -
TUE	ALUCHEMIE	1800 -		
	ALUCHEMIE	- 0200	ROTTERDAM	0700 - 1500
WED				BERGEN -2100
				KARMOY 0700 - 1400 TANANGER 1700 - 1900
THU			TANANGER	0200 - 0400
	SUNNDALSØRA	1100 -	HUSNES	1000 - 1500
FRI			BERGEN	1900 - 2200
	SUNNDALSØRA	- 0600	ODDA	0700 - 1800
SAT			HUSOY	0300 - 0500
	TANANGER	0900 - 1300	KARMOY	0600 - 0900
SUN			TANANGER	1200 - 1600
				IMMINGHAM 0000 - 1500
				TANANGER 2200 - 2400

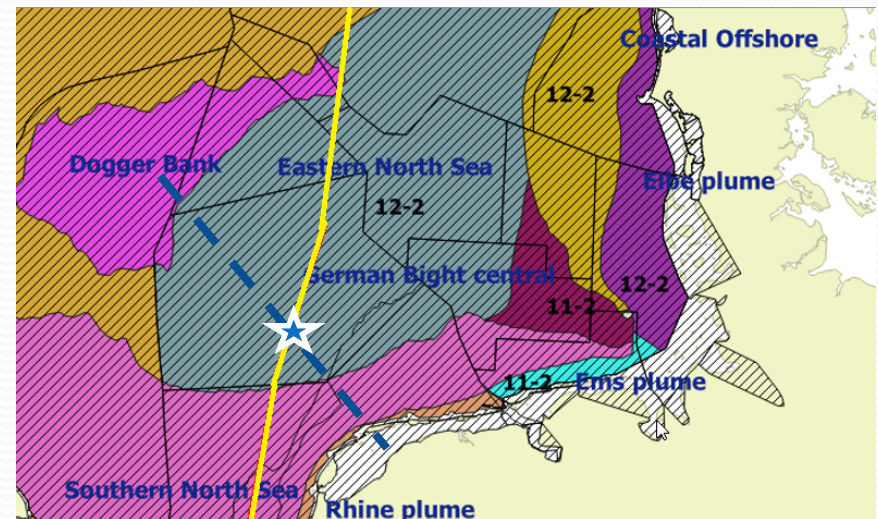


Connector part of the SEA-CARGO family

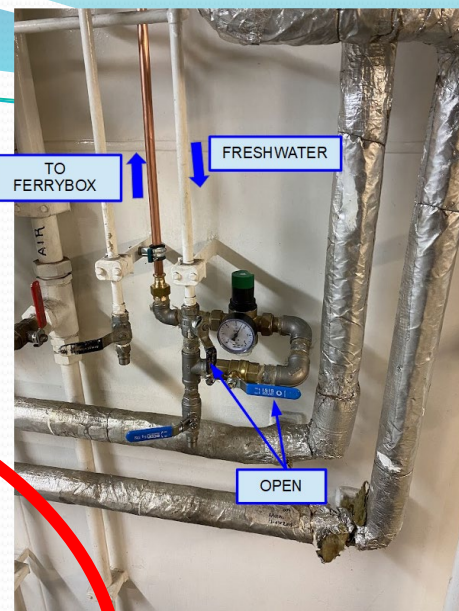
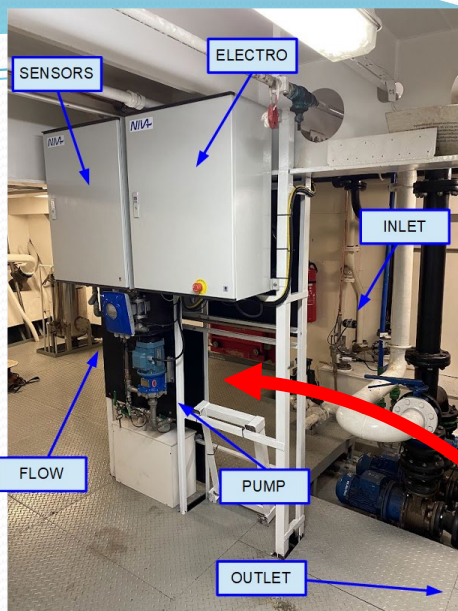
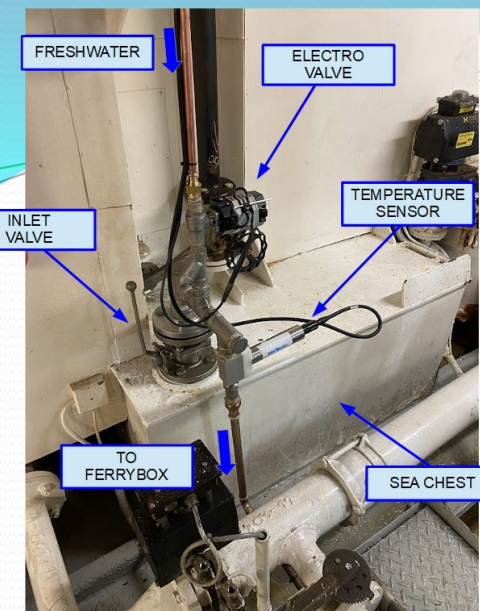
Connector Track between May and September 2022



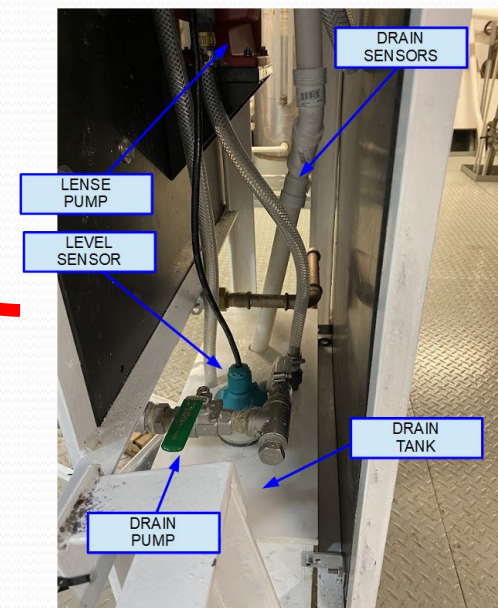
Ospar (*ecological*) Assessment Area's (colored)



“Pitstop” in Poland for Maintenance



- Wet cabinet with basic sensors
- Pump, pressure and flow sensors below
- Electro cabinet
- Automatic and manual freshwater rinsing
- Installed in a dry room: drain tank, level sensor and automatic lensing through outlet
- More space for sensors on the other side (water piping and space for auxiliary pump planned for that)





Right: Electronic and PC cabinet

Left: Wet sensor cabinet

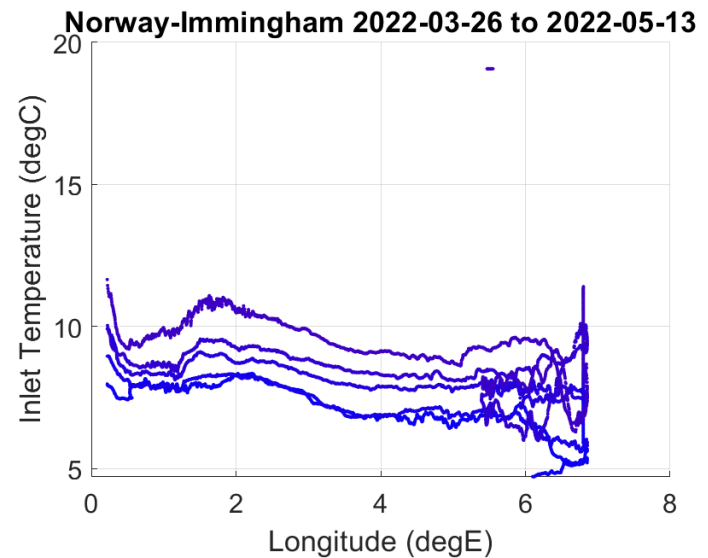
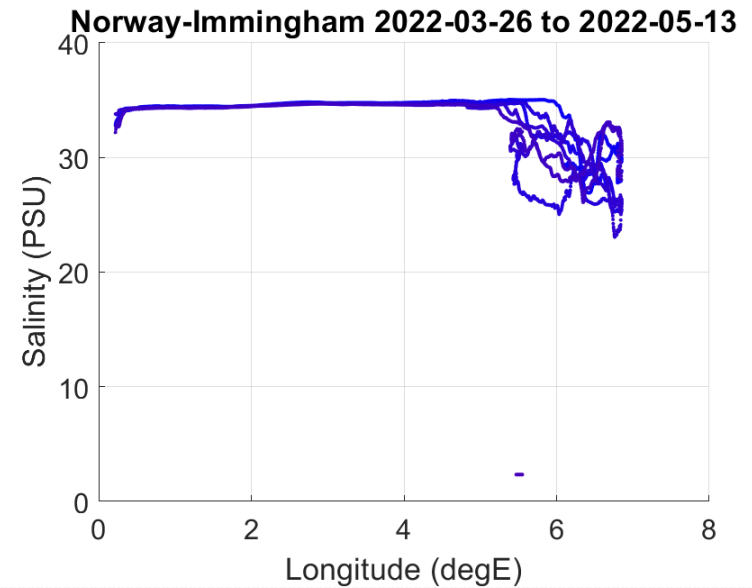
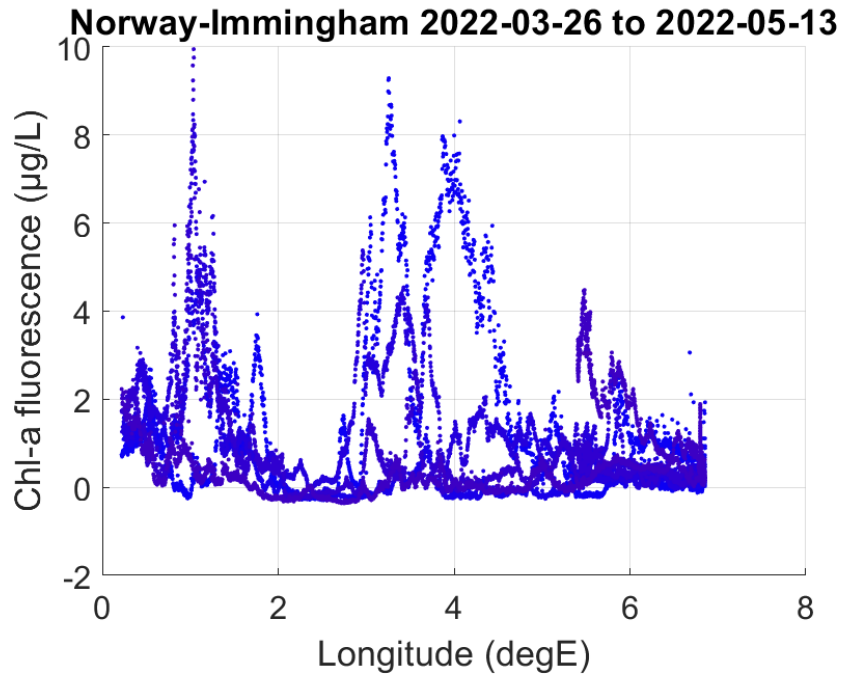
Under: The flowmeter, space for sampler, pipes to pump and water inlet that have a Inlet temp sensor SBE 38



Wet cabinet with:

- Debubbler
- Valves for water sampling and for calibration
- TS - SBE 45
- Oxygen Aanderaa optode
- Turner Design C₃ sensor
 - Chl-a
 - Turbidity
 - fDOM

(The flowcuvette can easily be removed for use of SoliDCal)



First operational data of the
SC Connector for

- Chlorophyll-a
- Temperature
- Salinity

TNA - TEST

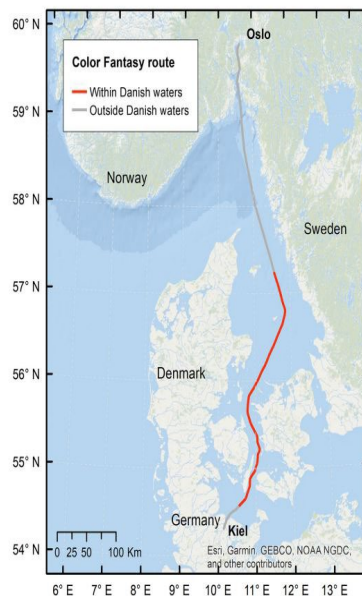
APHYMOSO

Automated PHYtoplankton
MOnitoring at Ship of
Opportunity at (ms Fantasy) as

Test for 2 Phase on Connector

Machteld Rijkeboer en Nicole Dijkman

CIV-Laboratory for Hydrobiological
analyses





main aim is to **test** whether the monitoring of:

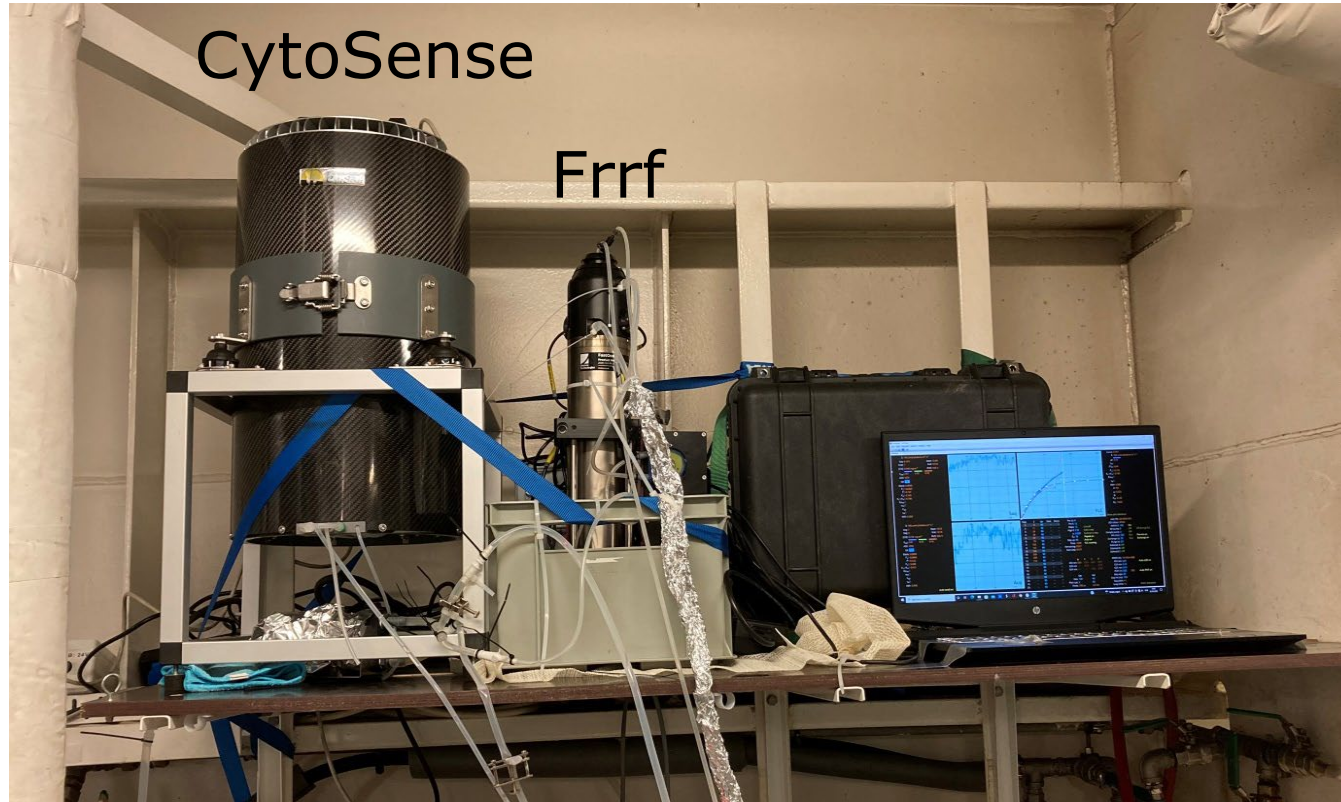
- **plankton composition (with Flow CytoMeter) and**
- **primary production (Fast Repetition Rate Fluorometry)**

is feasible in an un-attended Ferrybox environment.

The obtained results will be used to define the conditions needed for installation on a SOP like the C/S **Connector (2nd Phase)**.

Questions to answer:

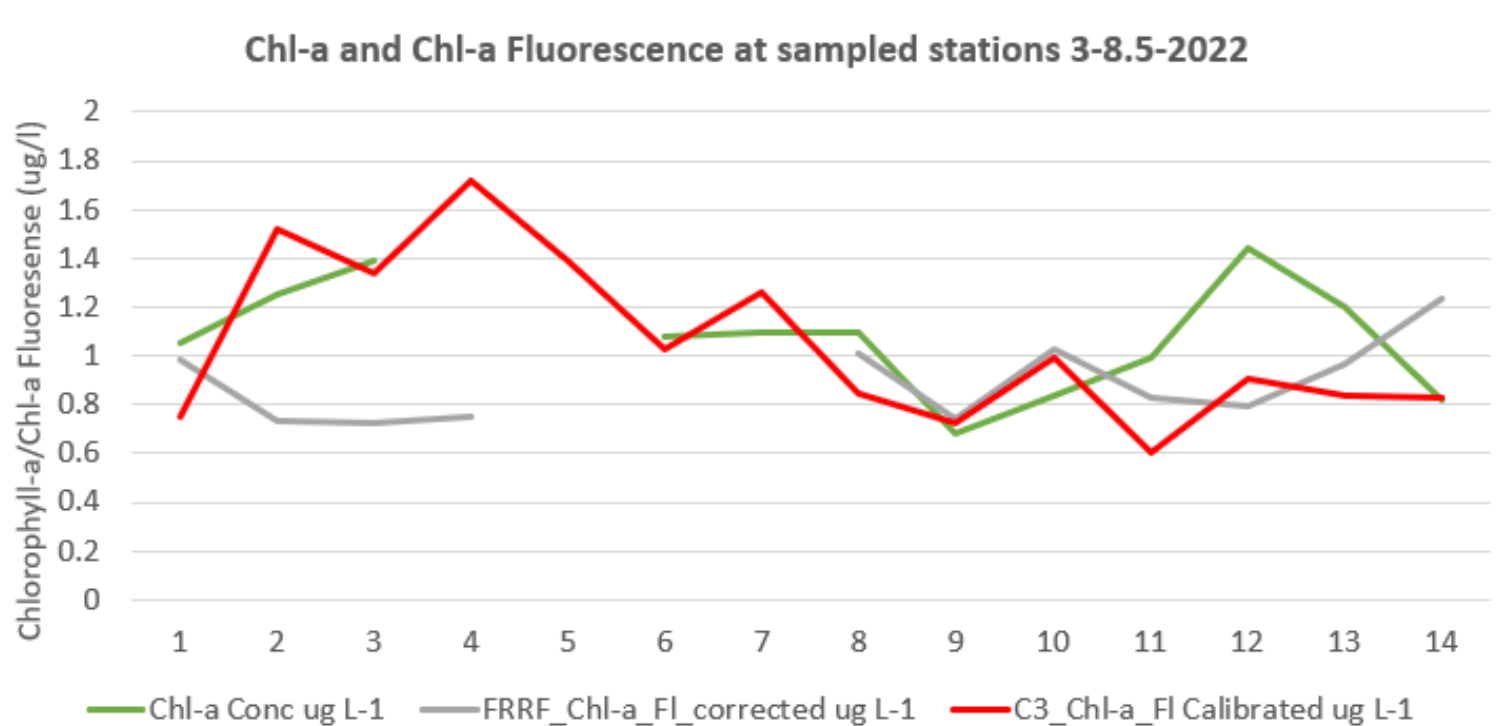
- Can we operate these delicate instruments (FCM, FRRf) in an **unattended environment** like a Ferry line or a bulk container?
- Can we **full automatically** let the instruments do the measurements ?
- Can we automatically **upload** our data to the **internet**, so the operator and stakeholders can follow the measurements and results online (*near-real time*) on a dashboard?



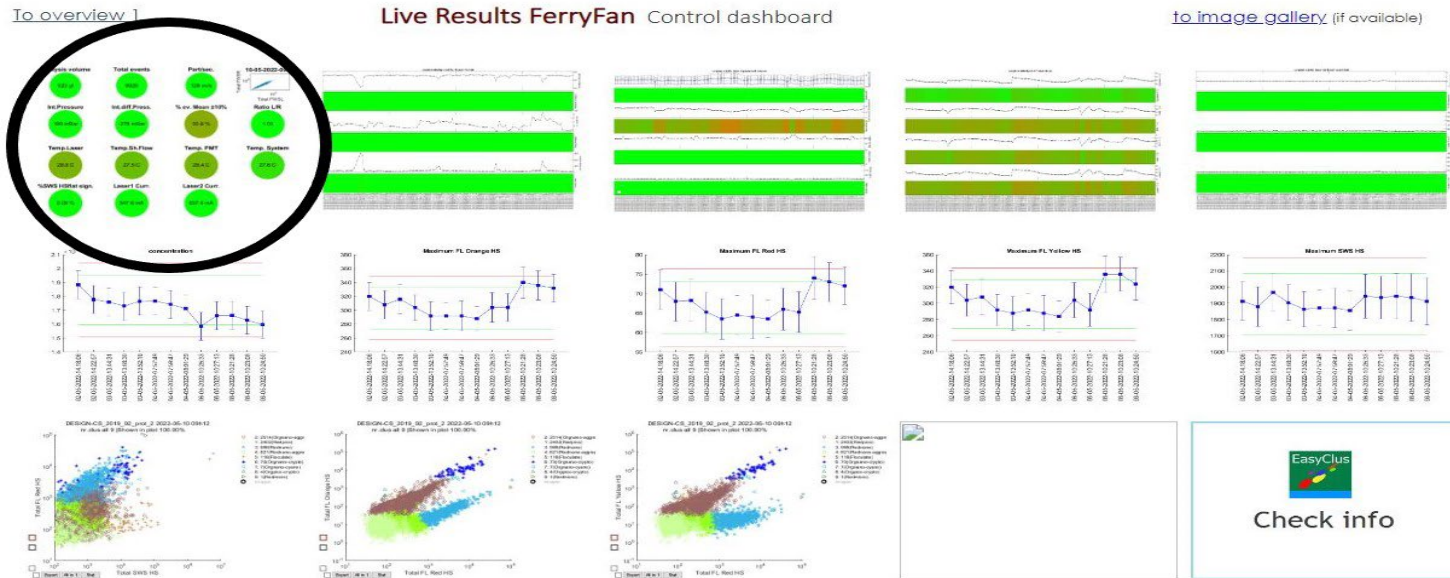
CytoSense (at the left) and the FRRf with notebook (at the right)
on MS Color Fantasy



Plankton concentration during the TNA cruise measured as Chl-a and Chl-a fluorescence



online dashboard for operator



- The **traffic light panel** from the latest sample, showing if the FCM is working properly or not.
- The **overview** in time of the **most important parameters**, like number of particles and volume measured, alignment of the FCM, pressure in the fluidics, temperature in the FCM, plus some dotplots of the clustered data.



online FCM data for stakeholders and public

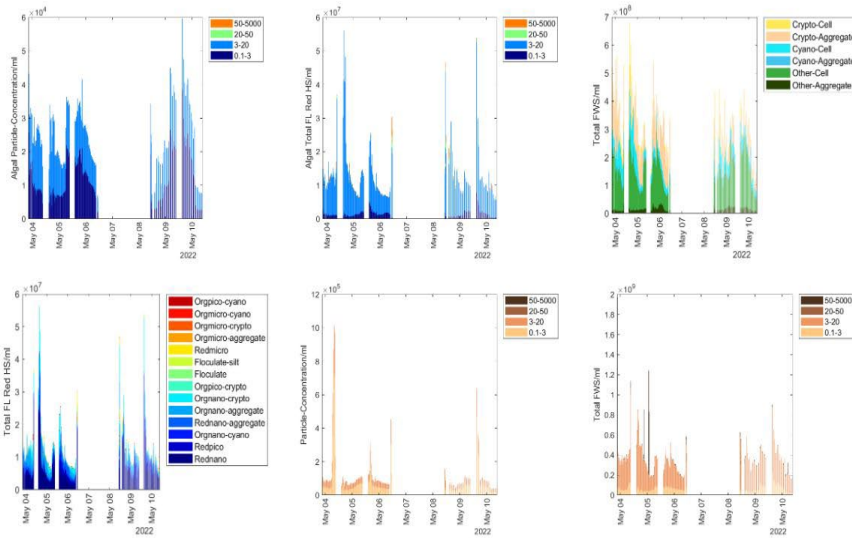
PhytoplanktonLIVE.com

Online automatic phytoplankton monitoring at several locations performed by flowcytometry (CytoSense-CytoSub)

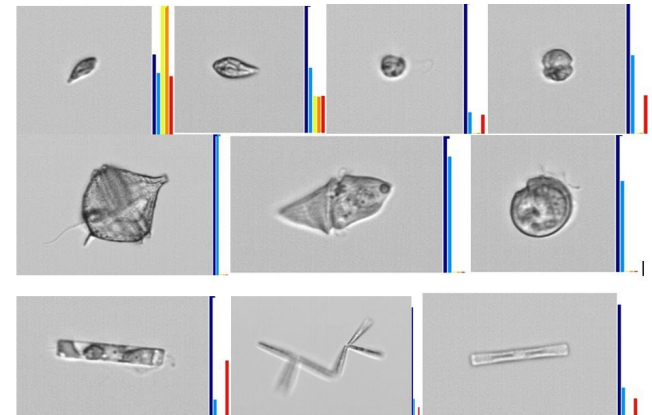
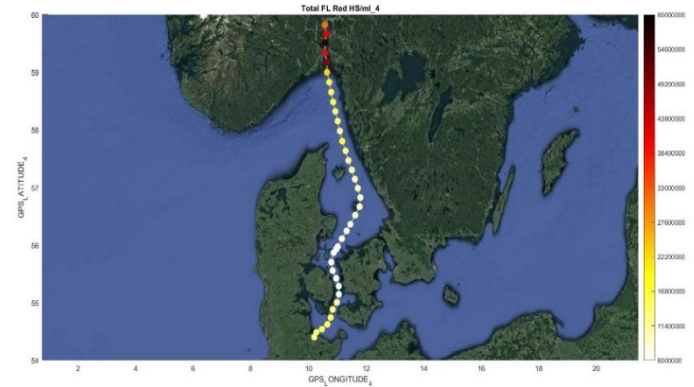


Live Results FerryFan

[to image gallery](#) (if available)



[data-raw](#)
[data-total](#)



Data measured in time, like concentration and red fluorescence of the phytoplankton per ml (CHL-a) per size class.



TNA Conclusions and Requirements for un-manned" operation on Connector (2nd Phase)

- **FCM** and **FRRf** generate reliable data in **unattended** (non laboratory) environment but devices are temperature sensitive !
- FCM and FRRf can run **fully automatically** and stop/start at GPS indicated locations
- Data are **near-real time on line** available for the operator and stakeholders

Requirements + recommodations

- **Temperature controlled** cupboards for FCM and FRRf
- Good IT-infrastructure
- Irradiation sensors on the ship is recommended
- A continues water inlet and drainage must be assured



OVERALL COMMON CONCLUSIONS

- Ferrybox route-data (*autom+sampler*) are/can be used for **MSFD monitoring and assessment** (... it takes some time to accept)
- It is good to have a **MOU** for longer cooperation (*also important for management*)
- New techniques (RS+Model+Ferry) were trigger to change **national monitoring strategy**
- First test results of MS - Connector are promising
- **JERICO-TNA** facility on “**manned Ferry’s**” good to test new generation of sensors
- Good cooperation on regional scale is basis for **JOINT MONITORING**



Thank you for your attention!

*Kees Borst, Machteld Rijkeboer, Nicole Dijkman, Marc Hartogs,
Lisette Enserink (RWS)*

*Kai Sorenson, Pierre Jaccard, Andrew King, Caroline Mengeot,
Helene Frigstad (NIVA)*



Anouk Blauw (Deltares)

