Common use of new Ferry box-line data in the North sea as a contribution to the next MSFD reporting on Eutrophication

Experiences from JMP EUNOSAT and the NorSOOP project.

9th Ferrybox meeting
24 April 2019, Genua

Kees Borst (RWS, NL), Pierre Jaccard and Kai Sørensen (NIVA, NO)
Joint Monitoring Programme of the Eutrophication of the North Sea with Satellite data (JMP-EUNOSAT)


Grant: DG-ENV part of European Maritime and Fisheries Fund
3rd call- Implementation of the second cycle of the MSFD

- 2 year project, Febr 2017 – Febr 2019 - Finished
- Budget k€ 874 and 80% EU contribution
- 14 partners in all countries bordering the North Sea. RWS leading partner

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

* Kai will tell more about that in the next presentation
Drivers

Why do we want joint monitoring?

- policy: improving coherence of assessments (MSFD, OSPAR). Art 11 reporting: EC 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 coherent assessments?

Information cycle

Level of coherence:
- **Coherent**
- **Partly Coherent**
- **National**
JMP EUNOSAT aims

1. Coherent thresholds for assessments for chlorophyll across North Sea countries

2. Coherent and reliable satellite chlorophyll products for the entire North Sea

3. Options for North Sea wide operational collaboration (Programming/ common use of RS / Ferrybox-lines etc)
Elements for coherent assessment

Incoherent national assessments

- Coherent reference levels and thresholds
- Coherent assessment areas
- Reliable EO products, incl. match up data
- Reliable Ferrybox data
- Comparable in situ monitoring
- Methods to combine data from various sources
- Transparent data management

Pilot coherent assessment and reporting

- Options for operational collaboration
- Iterations with monitoring managers and OSPAR policy level

Coherent 2021 OSPAR/MSFD 2024 eutro assessment (after project)
1. Generate coherent satellite-based CHL product
Ocean Colour sensors and CHL algorithms for ALL water types

SeaWifs

MODIS

VIIRS

MERIS

Turbid coastal

Data Gap

Data Gap

CMEMS (OC5CI, GSM)

CMEMS (OC5CI, GSM)

CMEMS (OC4Baltic)

Clear waters

CMEMS (OC5CI, GSM)

CMEMS (OC5CI, GSM)

CMEMS (OC4Baltic)

Absorbing waters

CMEMS (OC4Baltic)

CMEMS (OC4Baltic)

CMEMS (OC4Baltic)

Chlorophyll product: blue green ratio / bio-optical models

Chlorophyll product: Neural Network, red/nir
Generate coherent satellite-based (merged) CHL product

Objective 1

Spectral band shift to make sensors comparable
Apply CHL algorithms (clear, turbid, CDOM-rich water)
Quality control on all CHL data products
Blend CHL data products based on water type
Coherent CHL satellite product

CLEAR water
TURBID water

Sequential merging process

S3+ MODIS-A/T VIIRS

MERGED
Evaluation of suitability of sat CHL products
Quality controlled coherent multi-mission CHL products for Greater North Sea area 1998-2017 compared to in situ data (dots)

Yearly mean

Yearly P90

[Maps and scatter plots showing data analysis]
Validation of growing season mean chlorophyll-a concentrations

Model results 2009 - 2013
Satellite data 2005 - 2010

(In situ data are represented as circles)
New assessment results

Assessment with satellite data (map) and in-situ data (circles)

Assessment with model data for recent years, Assuming only nutrient inputs from rivers and no stratification
### Foreseen form of assessment

1. High resolution map of satellite and in-situ 6-y season means divided by local assessment level

<table>
<thead>
<tr>
<th>zone</th>
<th>CHL_mean (µg/l)</th>
<th>average threshold (µg/l)</th>
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<tbody>
<tr>
<td># 1: Atlantic</td>
<td>0.84</td>
<td>2.36</td>
</tr>
<tr>
<td># 2: Atlantic Perm. Strat. (no data)</td>
<td>-1.00</td>
<td>-1.00</td>
</tr>
<tr>
<td># 3: Atlantic Seas. Start.</td>
<td>0.68</td>
<td>1.36</td>
</tr>
<tr>
<td># 4: Atlantic Seas. Start</td>
<td>0.88</td>
<td>1.59</td>
</tr>
<tr>
<td># 5: Channel Fr</td>
<td>1.66</td>
<td>1.87</td>
</tr>
<tr>
<td># 6: Channel UK</td>
<td>1.36</td>
<td>1.62</td>
</tr>
<tr>
<td># 7: Coastal No</td>
<td>1.86</td>
<td>2.03</td>
</tr>
<tr>
<td># 8: Coastal IR</td>
<td>1.66</td>
<td>2.18</td>
</tr>
<tr>
<td># 9: Coastal UK south</td>
<td>1.43</td>
<td>1.92</td>
</tr>
<tr>
<td># 10: Coastal UK North</td>
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<td># 11: Coastal BE</td>
<td>9.36</td>
<td>5.83</td>
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<tr>
<td># 12: Coastal NL</td>
<td>9.66</td>
<td>6.92</td>
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<tr>
<td># 13: Coastal GE</td>
<td>7.88</td>
<td>7.91</td>
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<tr>
<td># 14: Coastal DK</td>
<td>6.50</td>
<td>4.29</td>
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</table>

2. Summary color per assessment area

3. Table representation

4. Time series of interesting areas

5. Text explaining observed trends in specific areas
Joint monitoring approaches

- Satellite data do not replace in-situ data
- High spatial and temporal resolution of satellite data allows for reduction of in-situ monitoring effort
- Ships of opportunity (Ferrybox) monitoring for validation and additional variables.
- Primary production can also be monitored with satellites and Ferryboxes.
- Transparent joint assessment (OSPAR/ICES COMPEAT) showed need for harmonisation of sampling design.

OSPAR interested in adopting this approach for next assessment (QSR 2023), after further refinement. Discussed in OSPAR ICG-EUT and HASEC
Start of new Ferrybox Line during JMP-Eunosat (as katalysator)

- RWS and NIVA *revives* the use of a FerryBox-system between Norway – Netherlands (*in the past pilot with Transcarrier*) during the JMP EUNOSAT project
- An agreement was set up with the cargo ship company “Seacargo” which have several routes in the North Sea.
- We plan now to use the cargo ship “**SC Connector**” that operate between Bergen (NO) – Odda (NO) - Tananger (NO) - Immingham (UK) - Rotterdam (NL)
- We have made a concept **MOU** between RWS and NIVA, to sign it before summer and hope to have the FerryBox-line operational second half of 2019.
Furthermore:

- We will use the datamanagement system in NorSOOP and export data to the European data network that already exists.

- We will start with the following standard sensors like:
  - Temperature
  - Oxygen
  - Chl-a fluorescence
  - Programmed automatic water sampler (making samples during a satellite pass !! )
  - Salinity
  - Turbidity
  - cDOM fluorescence

- For the second phase we foresee to bring also onboard more advanced sensors and analyzers.

- For satellite product validation above water radiance sensor can be installed later. The ship has a good design to try such installation.

- Further development, testing etc. also in JERICO-3

- We hope other countries/partners could join this initiative
SeaCargo Lines in the North Sea covering NO, UK, NL, DK

<table>
<thead>
<tr>
<th></th>
<th>Transfighter</th>
<th>Connector</th>
<th>Ahtela</th>
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<tr>
<td><strong>MON</strong></td>
<td>Rotterdam 0700-1500</td>
<td>Immingham 0700-1500</td>
<td>Husøy 0300-0400</td>
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<tr>
<td></td>
<td>Ålesund 1200-1300</td>
<td>Bergen 1000-</td>
<td></td>
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<tr>
<td><strong>TUE</strong></td>
<td>Ålesund -0200</td>
<td>Rotterdam 0700-1500</td>
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<tr>
<td><strong>WED</strong></td>
<td></td>
<td></td>
<td>Bergen 2100</td>
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<tr>
<td><strong>THU</strong></td>
<td>Sunndalsøra 1100-</td>
<td>Tønsberg 0700-1400</td>
<td>Tananger 1700-1900</td>
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<tr>
<td><strong>FRI</strong></td>
<td>Sunndalsøra -0600</td>
<td>Odda 0700-1800</td>
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<tr>
<td><strong>SUN</strong></td>
<td></td>
<td></td>
<td>Tananger 2200-2400</td>
</tr>
</tbody>
</table>

www.sea-cargo.no

kai.sorensen@niva.no
Some of the SC Connector route taken from Marine Traffic the last days.
Entrance to the room where the FB will be installed.
Photo taken inside the room.

In front we will build up the cabinets
Water intake from the sea chest

In Black-pipe the water intake to the FB will be installed

impressions
- 3 cabinet door shown
- a lab bench can be installed
- In back place for more cabinets and water sampler
Newest NIVA-FB version installed on MS Norønna will be used at SC Connector

Left: Electronic and PC cabinett
Mid wet optical cabinet

Mid: Optical cabinet with Chl-a Fluorescence, cDOM Fluro., Turbidity and other optional optical sensors

Right: The wet camber with CTD, O2 and deubler cabinett

Under: The flowmeter, space for sampler, pipes down to pump and water intake with inlet temp sensor.
Thank you! Kees and Kai

The JMP Eunosat Projectteam