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Status of FerryBox Systems in Europe

Franciscus Colijn and Wilhelm Petersen HZG

History of using Ships of Opportunity (SoOs) for Ocean Monitoring

- **1853 Brussels Conference: systemizing reporting of marine weather and sea conditions initiated by marine meteorology.**
- **Use of S-T thermosalinographs on the Hurtigruten in Norway, since 1930**
- **Continuous Plankton Recorder (CPR) started in 1931**
- **since 1993 first application of FerryBoxes for monitoring in the Baltic Sea (Alg@line, SYKE (former Finnish Marine Institute)**
- **EU Project "FerryBox" 2003-2005 (after 2 refusals)**
  → European FerryBox consortium
- **Continuous operation by most of the partners since that time (individual funding mostly by research money)**
- **Setup of new lines**
- **Commercially FerryBox systems on the market**
- **EuroGOOS FerryBox TaskTeam (2015)**

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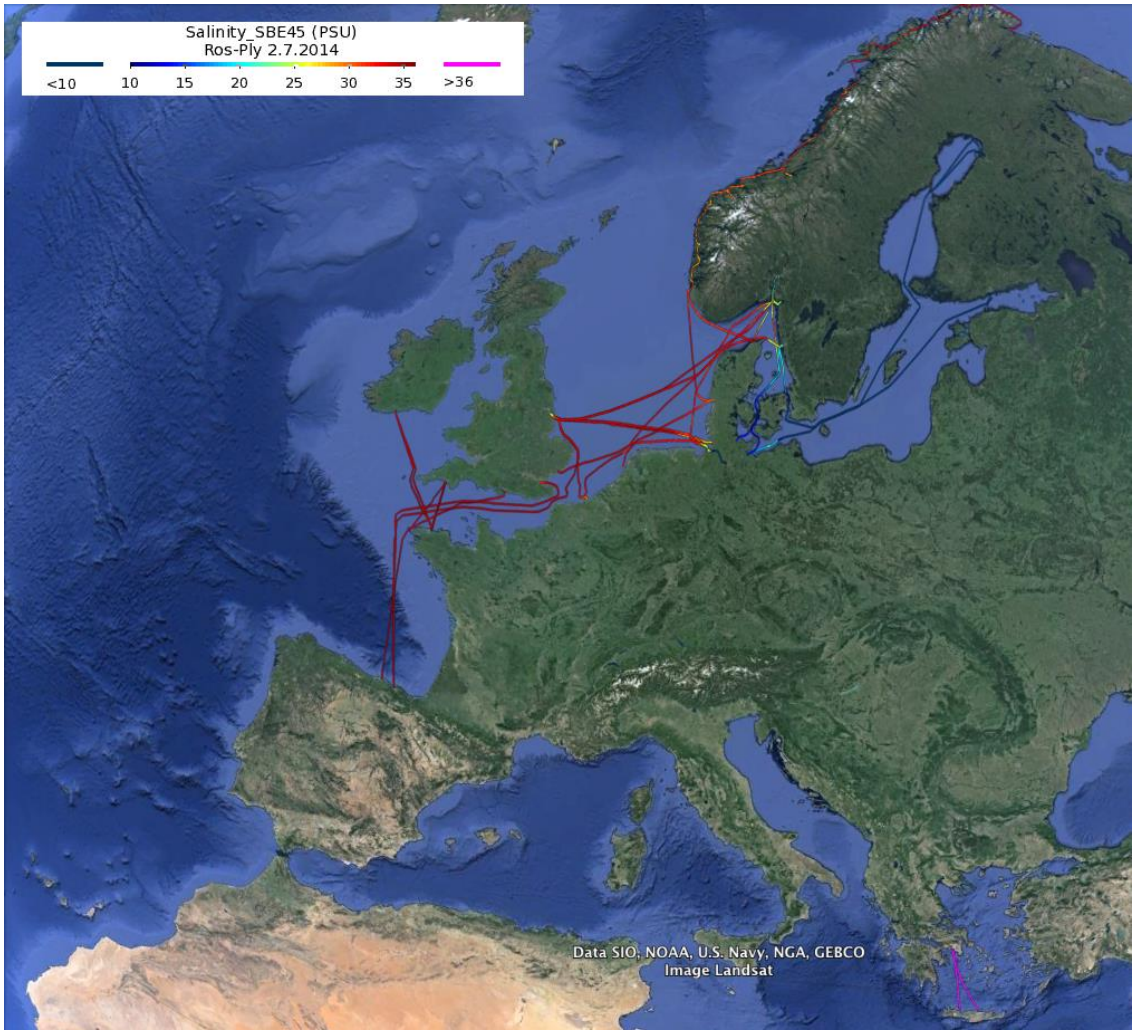
Status of FerryBox Systems in Europe

map with FB routes



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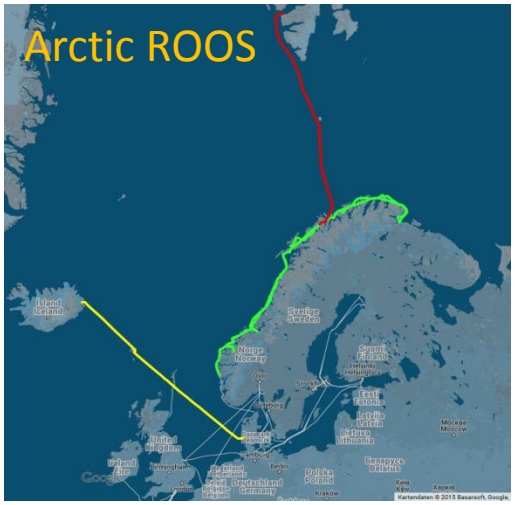
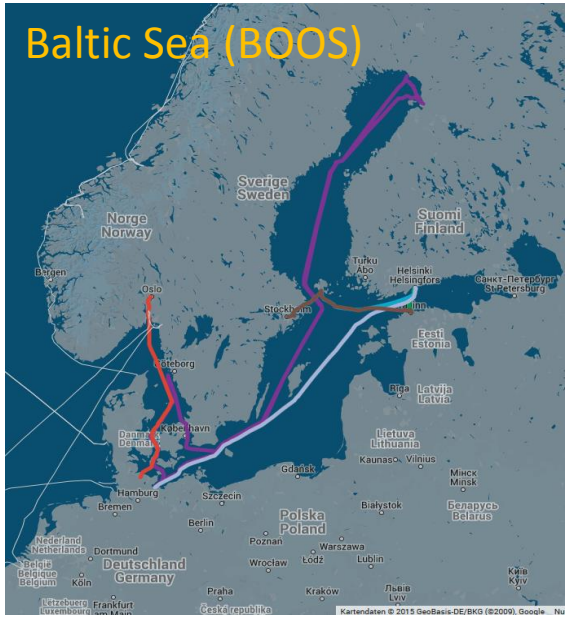
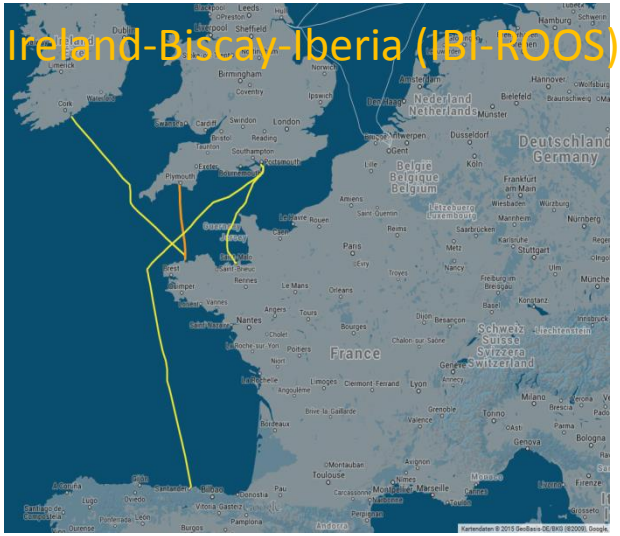
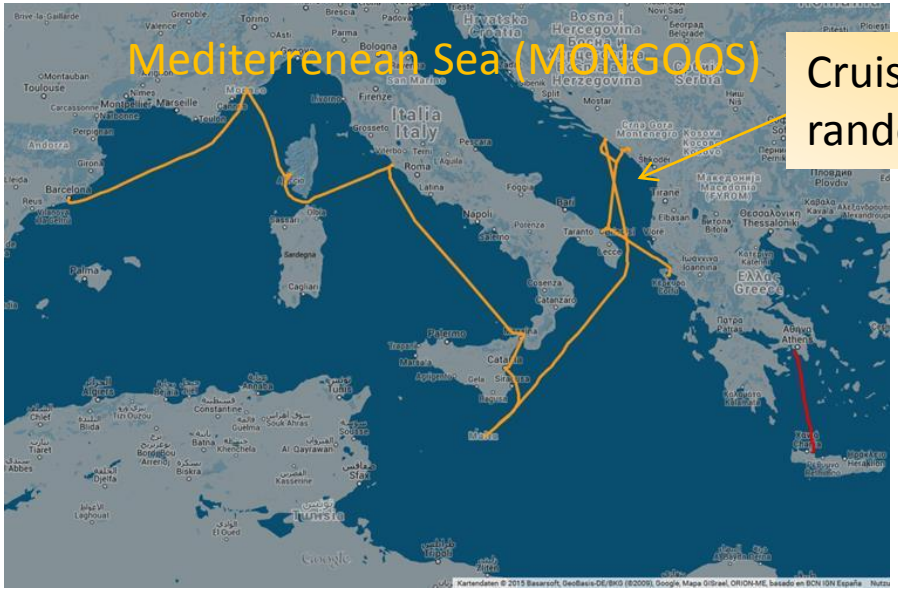
FerryBoxes in Europe within the 'ROOSes"









Cruise liner “MeinSchiff3“
Recent Chlorophyll-a Data from April 2015

Date range: 28.03.2015 - 28.04.2015

Modify size: − + Click and drag for panning. <SHIFT>-click and drag for zooming.

☑ Show stations

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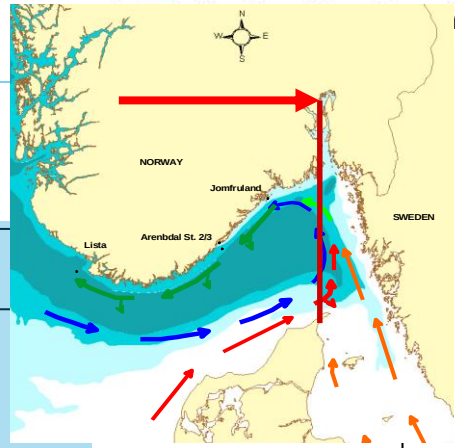
Platforms:

☑ show **Ferrybox on MeinSchiff3 provided by TUI and HZG**

High frequent measurements compared to routine sampling

Helmholtz-Zentrum Geesthacht



Chl-a (mg/m3)

20
15
10
5
0

Sampling from Ferrybox

Sampling from traditional research cruises/monitoring program

Jan Feb Mar Apr Mai Juni Juli Aug Sep Okt Nov Des

Courtesy Kai Sorensen, NIVA

Status of FerryBox Systems in Europe

- FB with common sensors: salinity, temperature, oxygen, turbidity, chlorophyll fluorescence,
- FB as testsystem for new sensors: PSICAM, spectral analysis for group detection, pCO2, pH, nutrients
- FB systems in combination with new techniques (flowcytometry, biological molecular measurements, species combination

Status of FerryBox Systems in Europe

Characteristics of the FB Whitebook:

Chapter 1: Regional and global long term time series based on FB observations
Chapter 2: FB measurements as ground truth for satellite observations
Chapter 3: Use of FB measurements for the fishing and aquaculture community
Chapter 4: Use of FB data by the scientific community including the use of FB data by modelers
Chapter 5: Use of FB systems as an efficient alternative to current monitoring strategies
Chapter 6: Link between FB operators and the shipping industry

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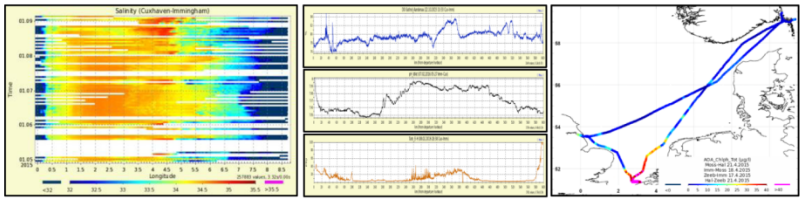
Status of FerryBox Systems in Europe

- Chapter 7: Development of new sensors for (coastal) oceanographic observations (innovation)
- Chapter 8: Operational and investment costs of systems including maintenance
- Chapter 9: Integration between different observational methods (HF Radar, moorings, gliders, Euro-Argo) and FB
- Chapter 10: Need for environmental data from FB systems
- Chapter 11: FerryBox data management
- Chapter 12: Role of FB data in ocean acidification and impact of (coastal) oceans for CO2 uptake from the atmosphere
- Chapter 13: Link between FB systems, other international organizations and FB governance
- Chapter 14: Participating institutes and groups with their specific expertise
- Chapter 15: Summary, conclusions and recommendations

Proposed Scheme for a Common European FerryBox Data Management

European FerryBox Data Portal



- free choose to set a parameter as public or private
- all web based tools are also available for private parameters (e.g. for sensor development, testing etc.)

From Operator/Institute or via ROOSs

FB-1 Sensors
FB-2 Sensors
FB-3 Sensors
FB-n Sensors

QC
QC
QC
QC

near real-time data including QFs
→
complete transects in defined formats

FTP Server

Common European FerryBox Database

Export Service (netCDF)

Backup

GoSUD Data Portal

CMENS Copernicus Service

EMODnet Portal

FerryBox – (Near) Real Time Quality Check

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Centre for Materials and Coastal Research

Hafnia Seaways (20 sec.)

LysBris (20 sec.)

Funny Girl (20 sec.)

Fixed Transects

Near Real Time Quality Check after each cruise

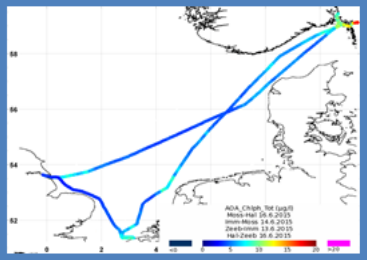
ftp: File Transfer

900k Data points/week

ferrydata.hzg.de

Ø 20 Parameter
+ 3 - 6 house keeping

timestamp, coordinates, quality flag and statistical information (min, max, var, counts)



Polarstern (AWI) (5 Min.)

Mein Schiff 3 (1Min.)

Ludwig Prandl (1 Min.)

Variable Transects

Real Time Quality Check

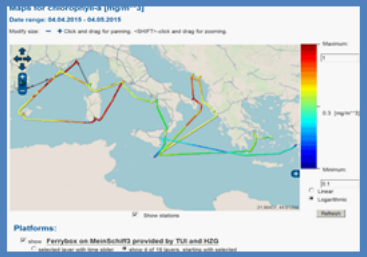
http: Transfer

400k Data points/week

survey.data.hzg.de

Ø 20 Parameter
+ 6 - 21 house keeping

timestamp, coordinates, quality flag and statistical information (min, max, var, counts)



Cuxhaven (10 Min.)

Fino 3 (10 Min.)

Helgoland (AWI) (10 Min.)

Spitsbergen (AWI) (10 Min.)

Fixed Position

Real Time Quality Check

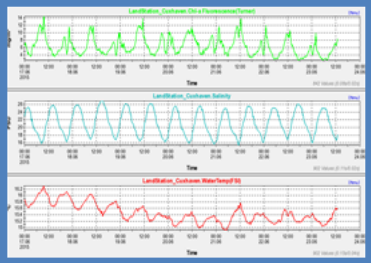
http: Transfer

130k Data points/week

tsdata.hzg.de

Ø 20 Parameter
+ 12 - 19 house keeping

timestamp, quality flag and statistical information (min, max, var, counts)



Scientific Applications

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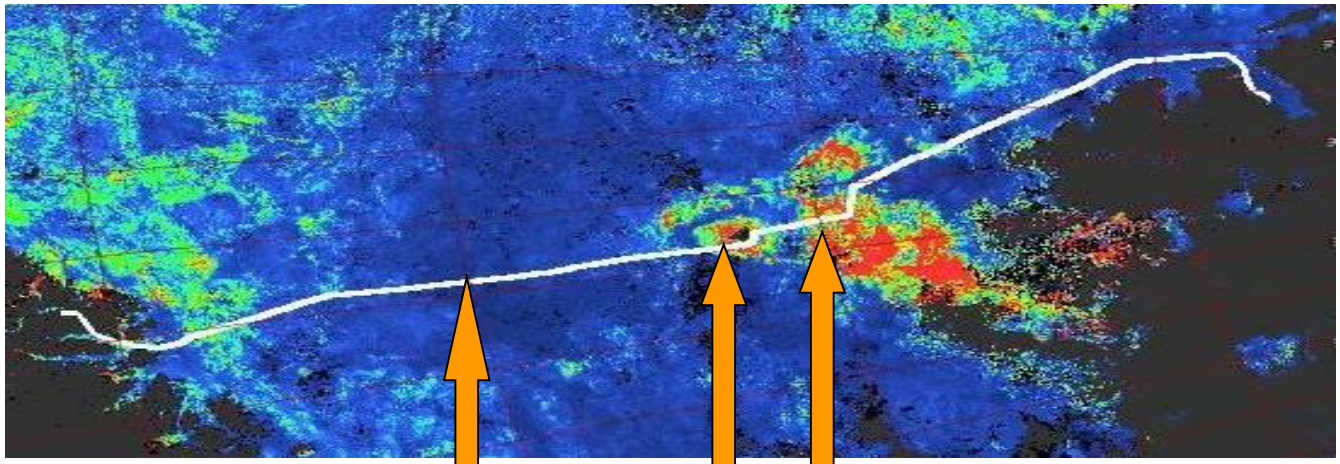
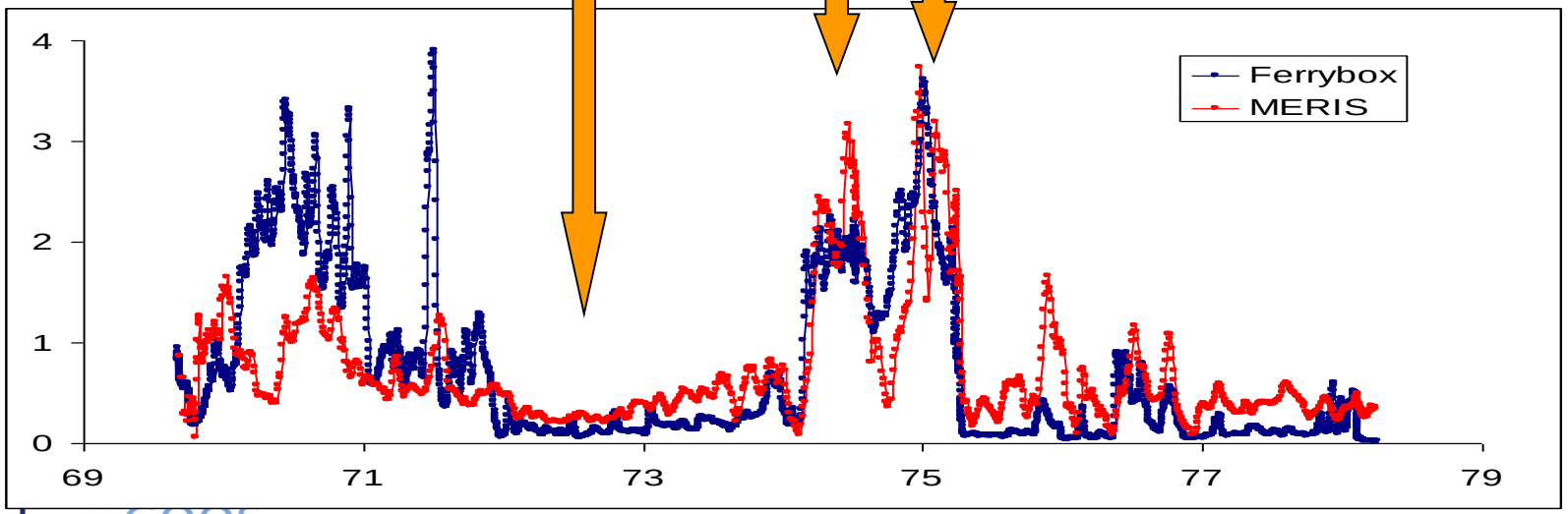
Combining satellitdata Algal products with and ship transect Chl-a fluorescence data





Combination of Chlorophyll-a data from Satellite (MERIS) and FerryBox (May 2011)

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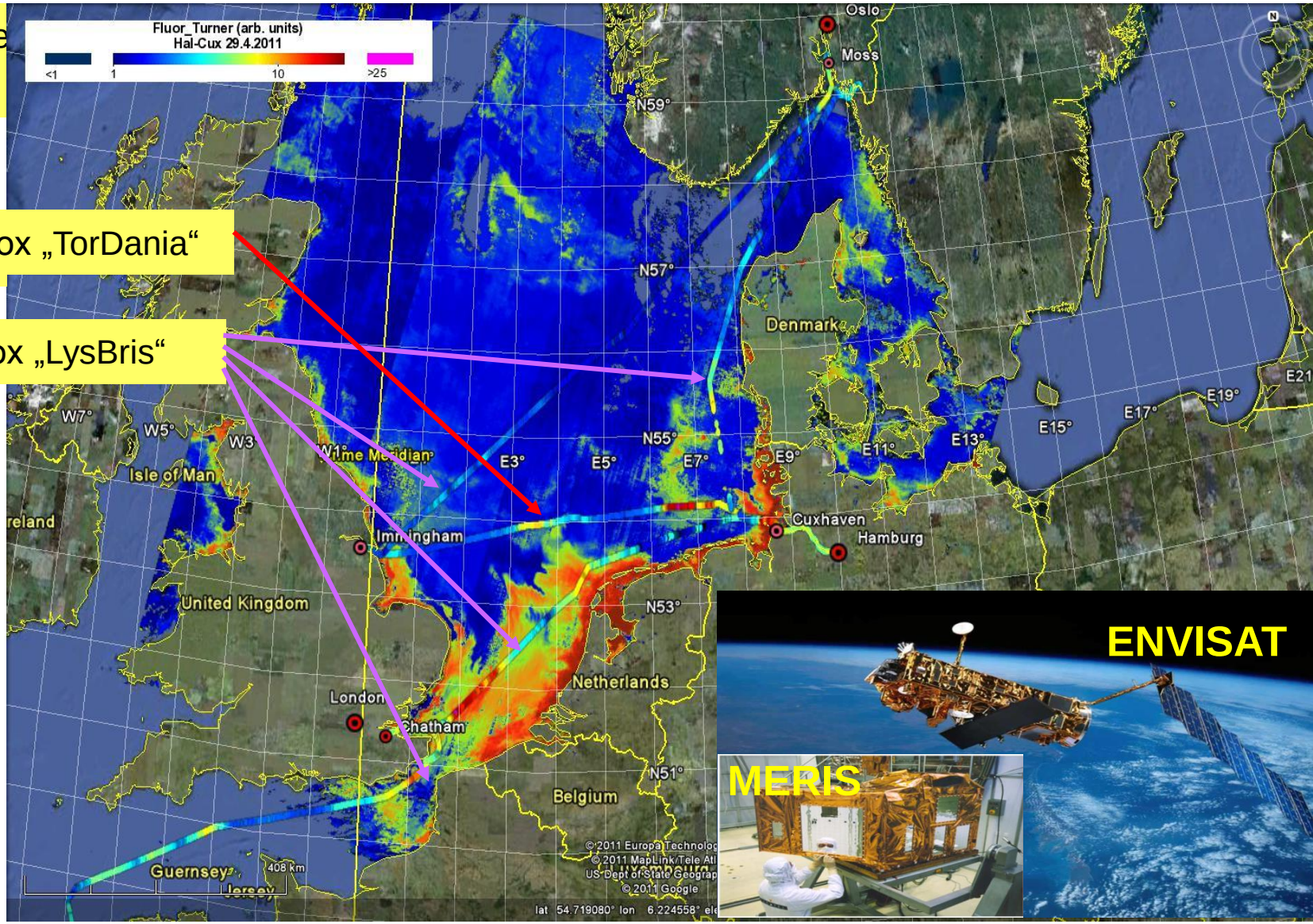
Centre for Materials and Coastal Research

Chl-a Satellite (MERIS)

Chl-a FerryBox „TorDania“

Chl-a FerryBox „LysBris“



Analysis of Short-Term Events from Drift Data

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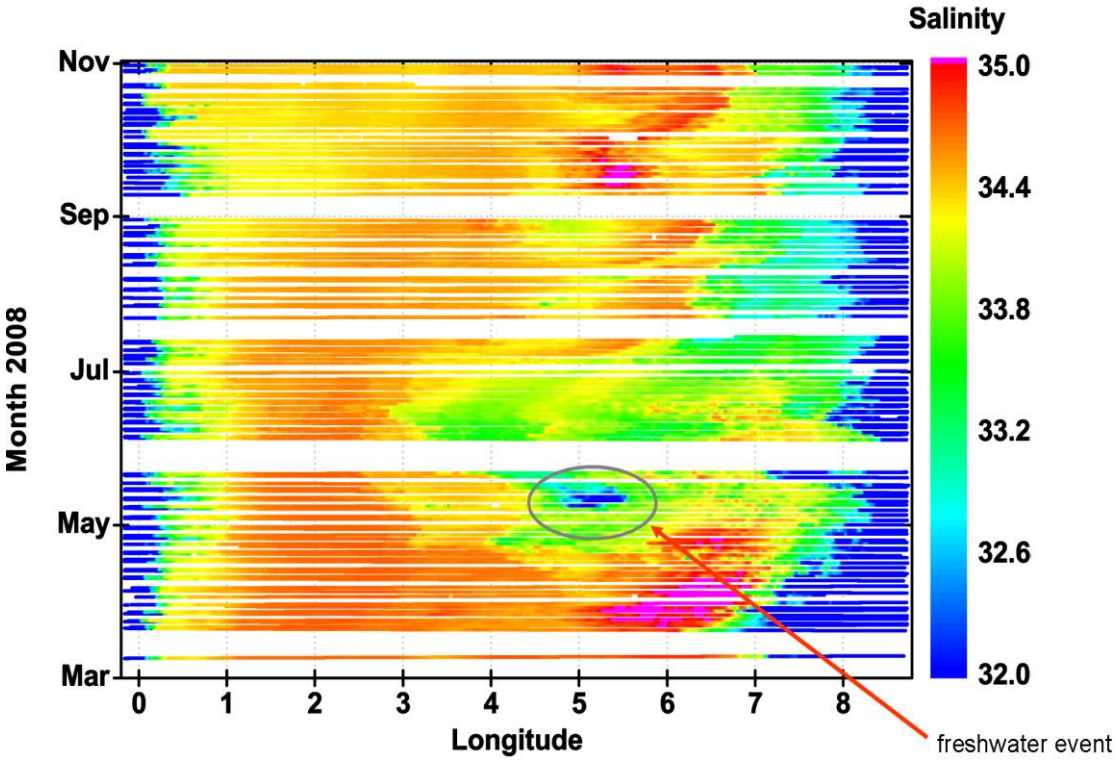

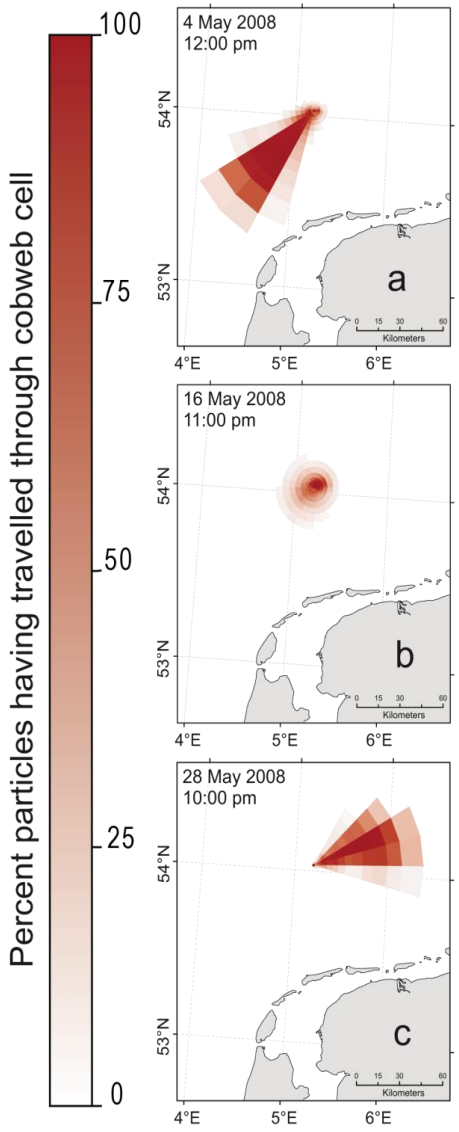

SSS Validation of Data Assimilation (DA) vs. MARNET Station “German Bight”

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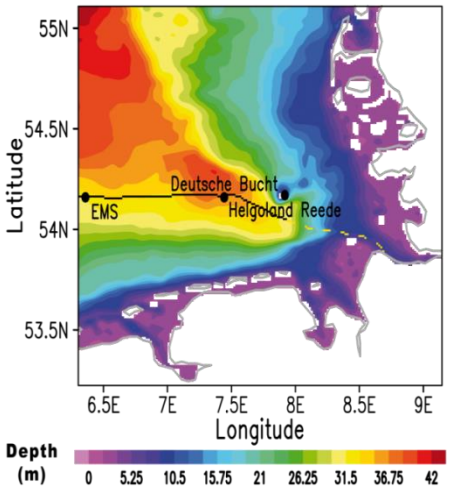
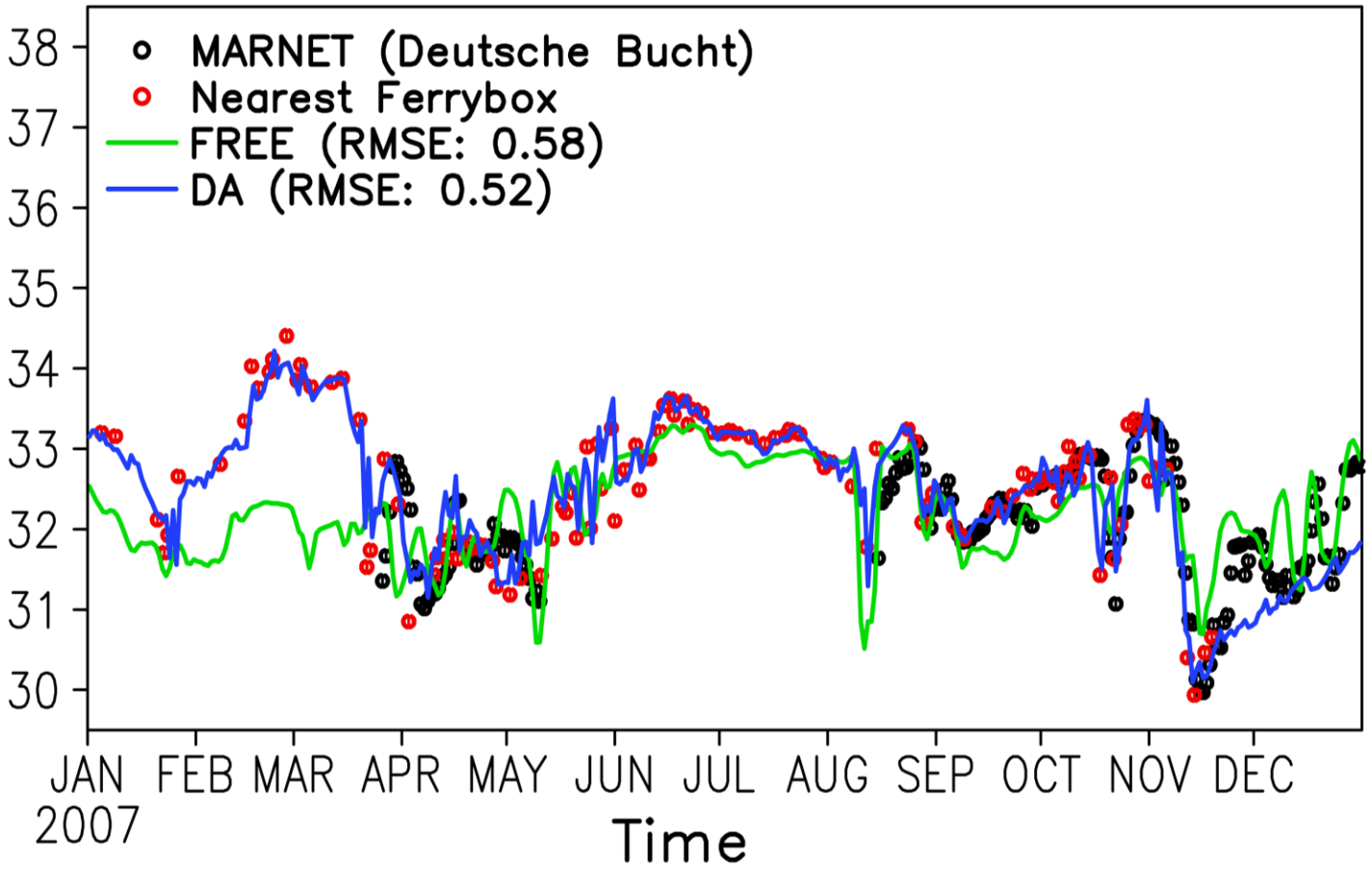
Centre for Materials and Coastal Research



SSS Station ‘German Bight’ (psu)



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Harmful algae bloom (HAB) in the Kattegat (eastern part of the North Sea)

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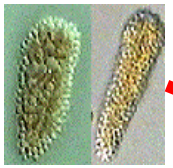
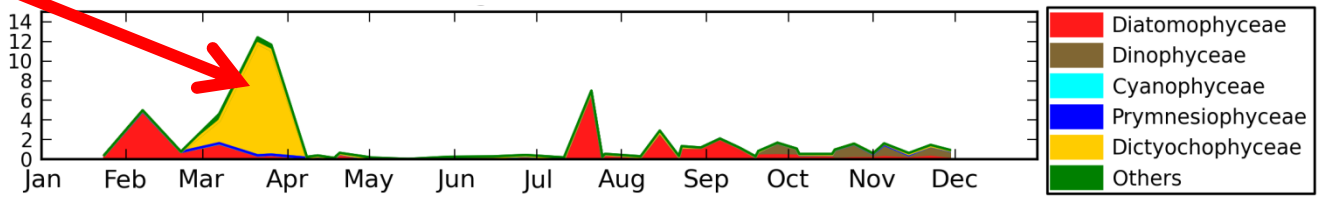
Key methods
Chlorophyll *a* fluorescence
Automated water sampling
Microscope analysis

Harmful algal bloom detected
Fish killing flagellate *Pseudochattonella* sp. observed directly after diatom spring bloom



Pseudochattonella farcimen

Biomass of phytoplankton at the class level at station Anholt E



Karlson et al. in prep

SMHI

New Sensors for More Biogeochemical Parameters

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Continuous pCO2, pH and AT Measurements by Underway Systems (e.g. FerryBoxes)

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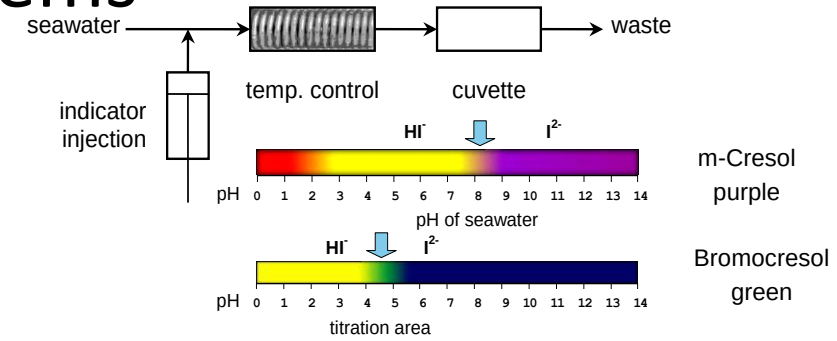
Expected Outcome:

- → Spatially and seasonally resolved sources and sinks of CO2 along a certain transect
- → Alkalinity transport from the shore into the North Sea
- → CO2 air-sea fluxes
- → ocean acidification
- → quantification of production rates
  - → comparison of productivity with estimates derived from other variables (DO, Chl-a, winter nutrient stocks….)
- → impact of phytoplankton dynamics (e.g. seasonality…)

Development of New Sensors for Underway Systems

pH and Alkalinity (A_T)

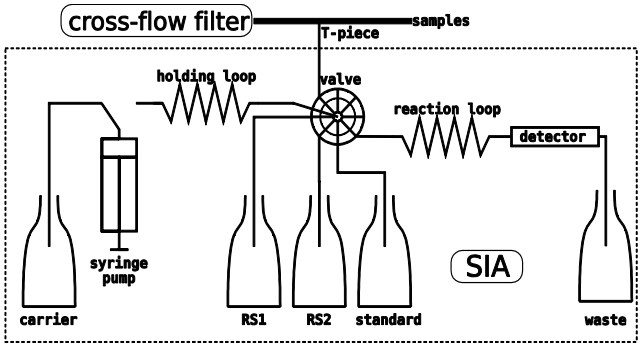
SIA systems,
spectrophotometric
detection



Nutrients (PO4, NOx)

Wet chemical Analyzer

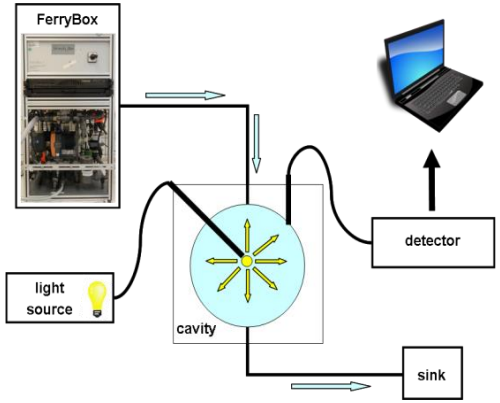
SIA system, photometric detection



Absorption of Water Constituents (PSICAM)

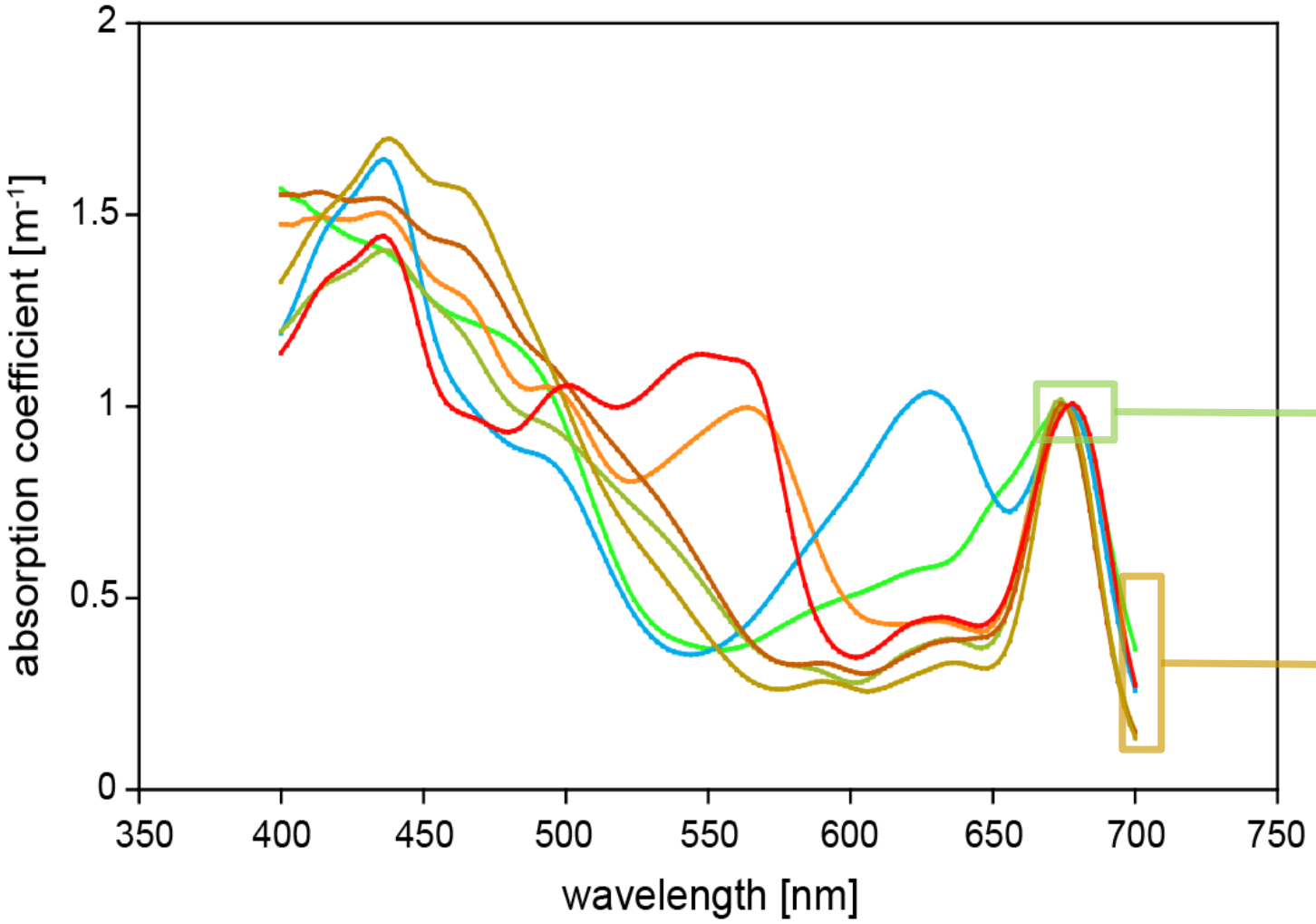
measuring absorption spectra leads to

- more reliable quantification of chl-a and SPM
- detection of phytoplankton groups



Parameters derived from absorption spectra

Hyperspectral absorption data provide various information:



Phytoplankton groups by comparison with reference spectra

Chlorophyll a (chl-*a*)

Total suspended matter (TSM)

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Conclusions

FerryBox systems for monitoring water quality parameter:

- deliver cost-effective continuous time-series of physical and biogeochemical observations with high resolution in space and time →detection of short-term events and long-term changes
- Data can be used to improve the quality of numerical models
- FerryBox are an ideal platform for newly developed biogeochemical sensors (space, power, accessibility…)
- Long-term biogeochemical data fill serious gaps of biogeochemical knowledge and will improve the understanding of different biogeochemical processes (e.g. occurrence of algae blooms, HABs, ocean acidification….) and
- helps to further develop ecosystem models

However, most of FerryBox activities still missing sustainable funding!!

Status of FerryBox Systems in Europe

We need:

FB systems as part of a European observation system, EOOS

Funding and governance comparable with EU ARGO (EMODNET)

Initial investment 2 Mill €, annual maintenance 1 Mill €, national contributions through regular marine monitoring programmes

Establishment of a European data portal for FB data