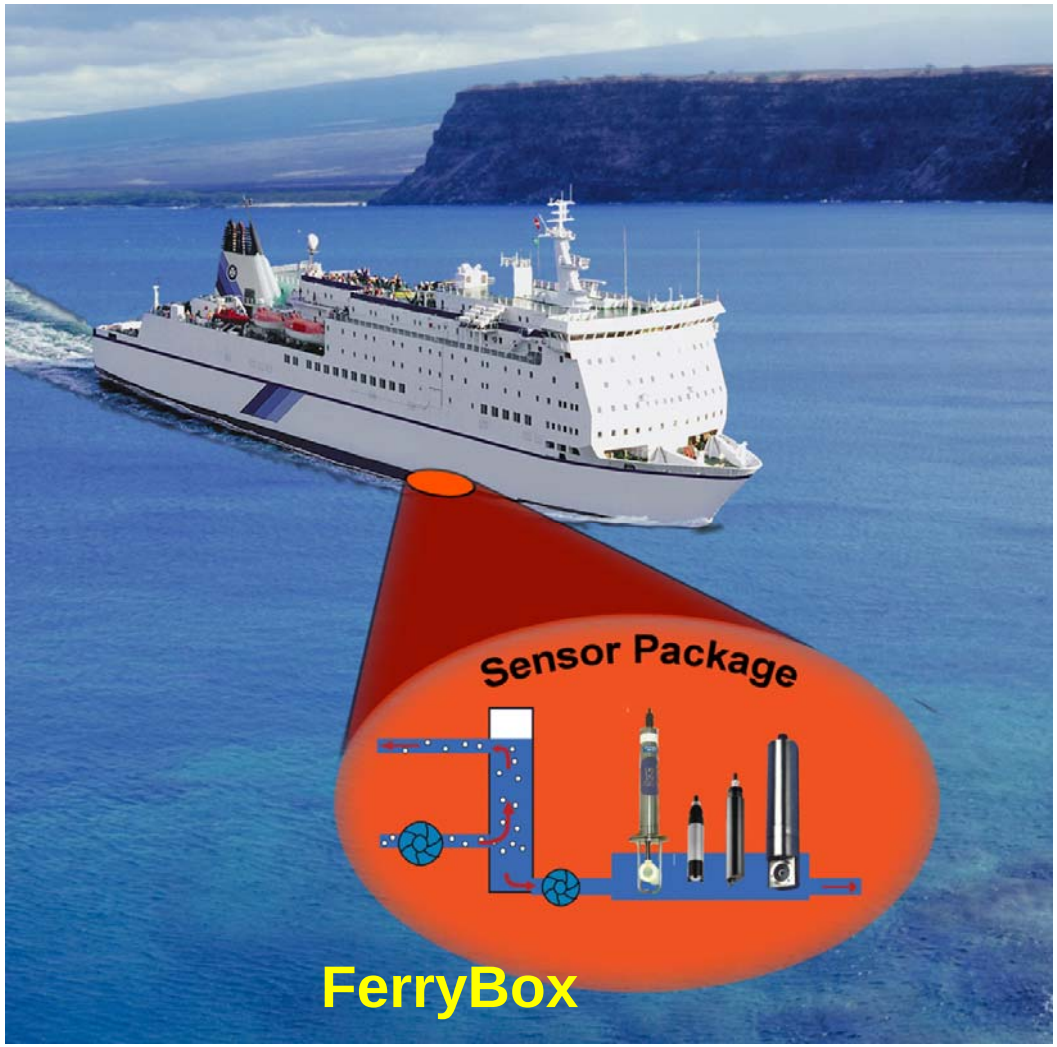
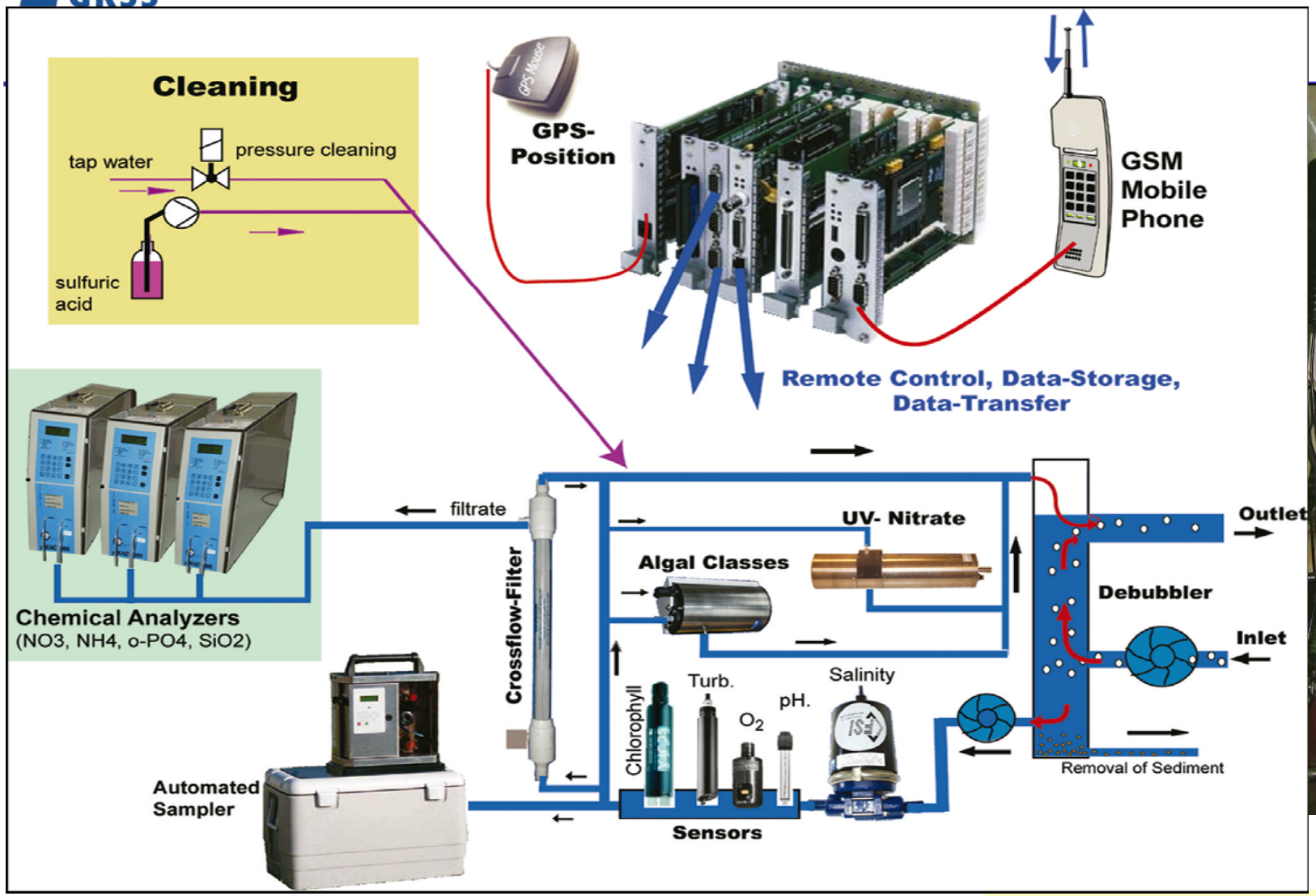
with FerryBox systems in the Southern North Sea

Wilhelm Petersen

GKSS Research Centre, Institute for Coastal Research, 21502 Geesthacht, GERMANY



FerryBox Flow-Through System



Measured Variables

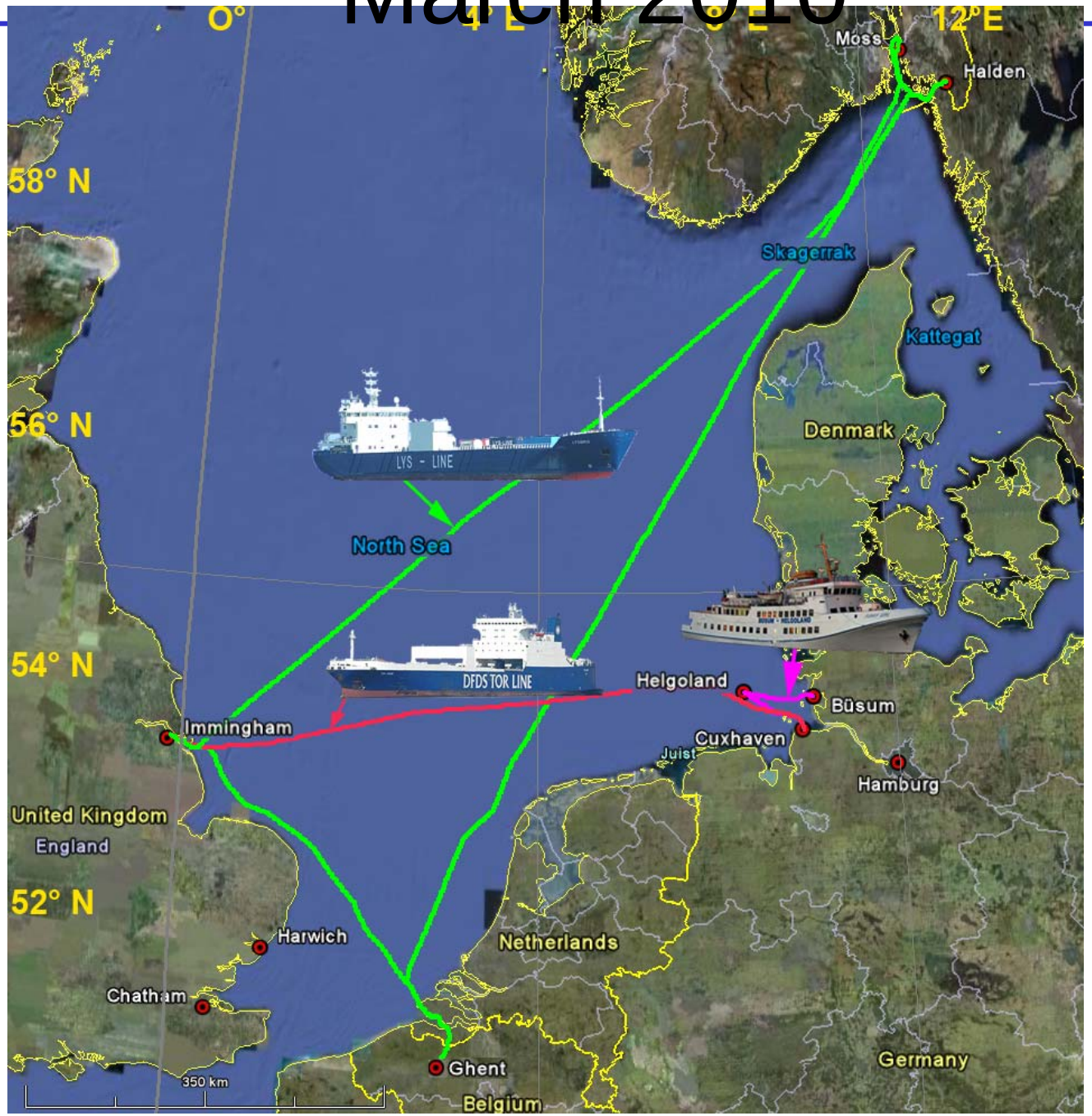
- temperature
- salinity
- turbidity
- chlorophyll
- oxygen,
- pH
- algal groups
- nutrients

Main Features:

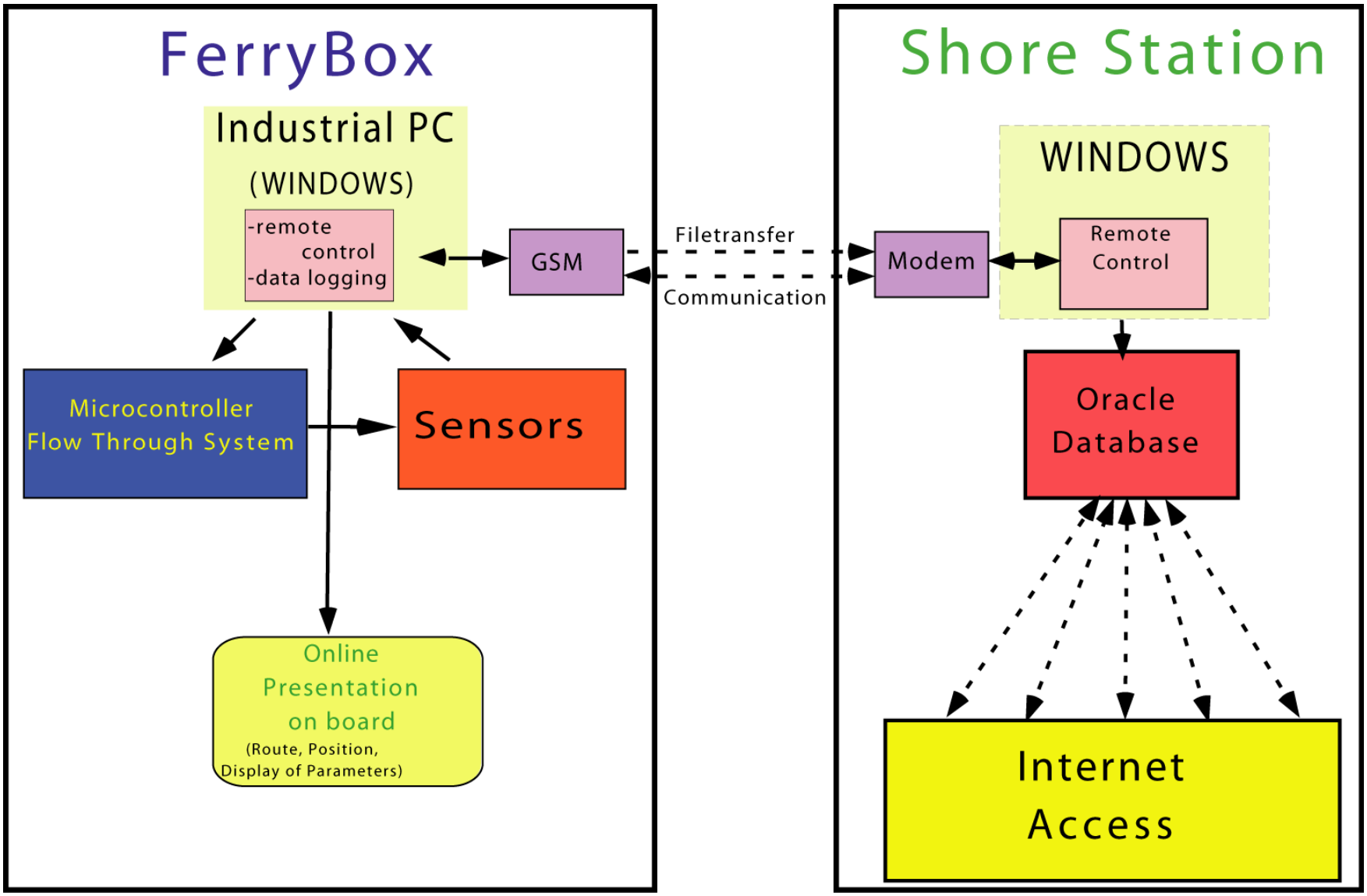
- running autonomously
- controlled by GPS position
- self cleaning (after each cruise)

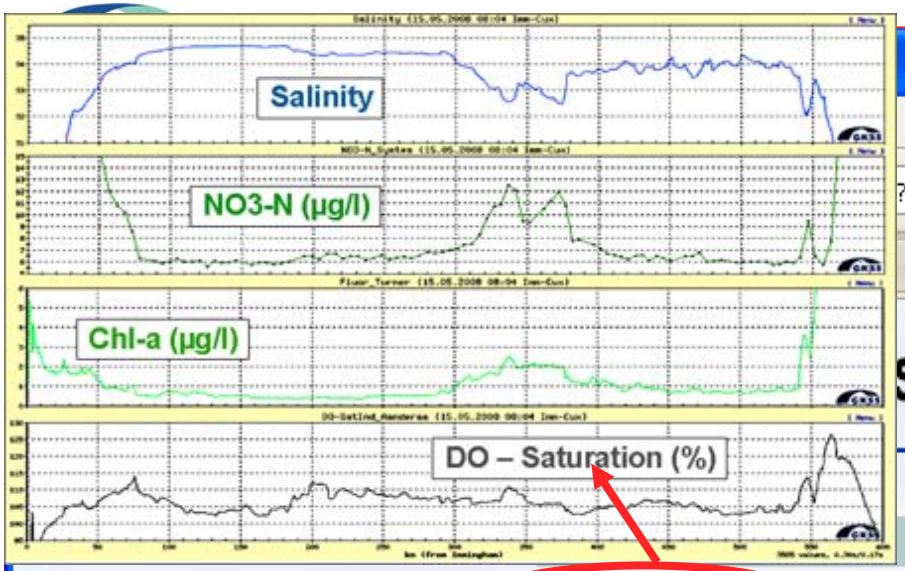
+ automatic water sampler for further lab analyis

GKSS FerryBox Routes March 2010



Data Management





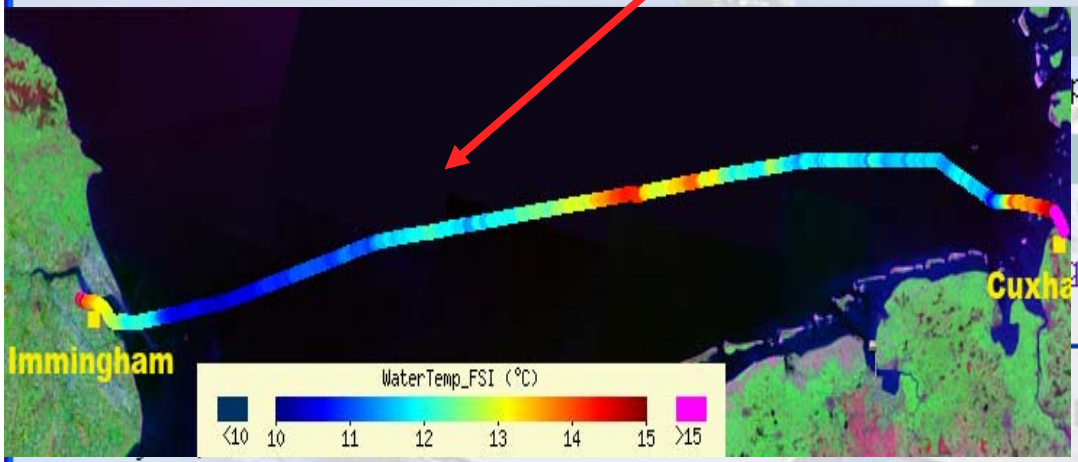
[Transect Plot I](#) Plot of *one* selec
variables/param

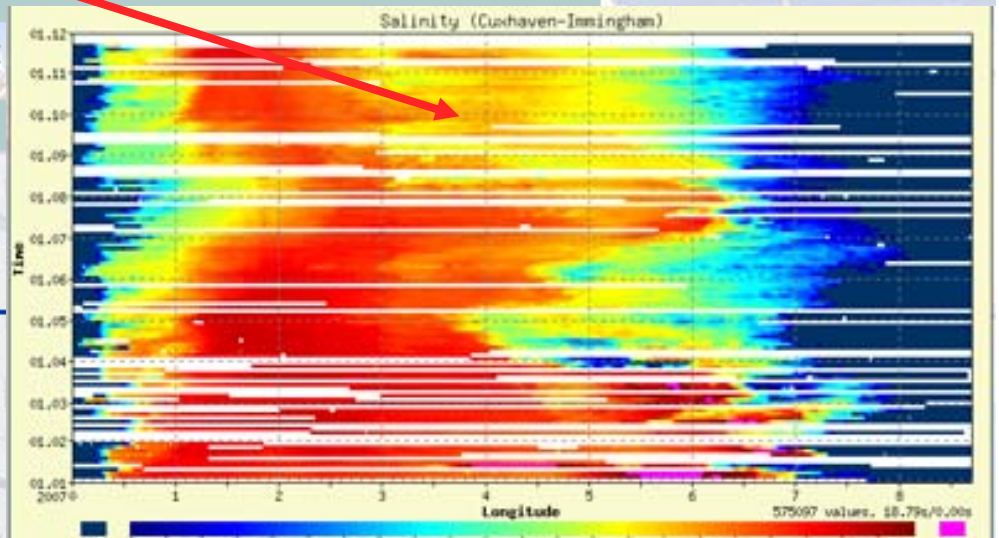
[Transect Plot II](#) Plot of *one or mo*
variable/parameter vs. distance

[Time-Series Plot](#) Plot at a selected position of the route: *One or more* variables/parameters vs. time

[Scatter Plot](#) Scatter Plot

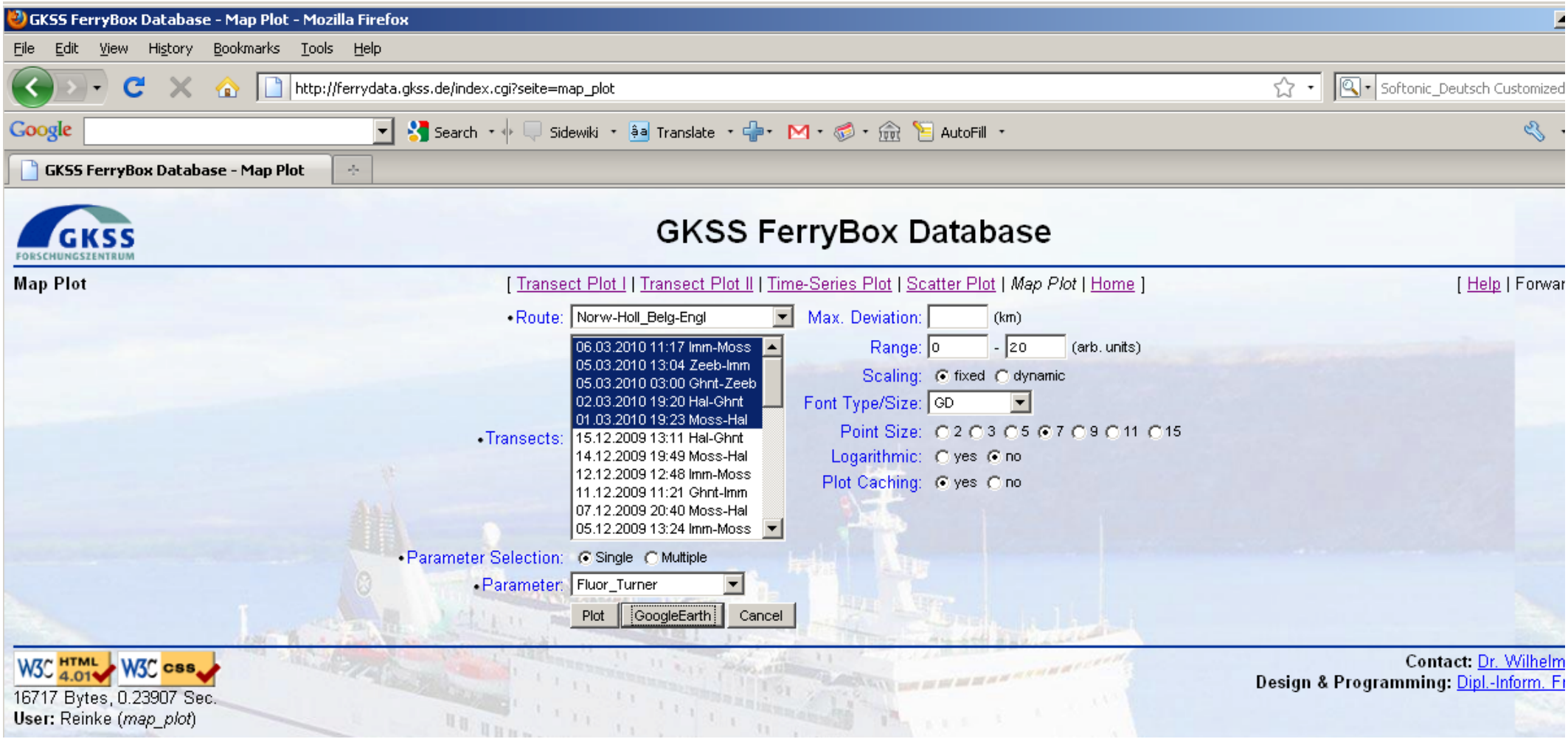
[Map Plot](#) Map Plot





User: start (*start*)

Creating coloured maps in GoogleEarth



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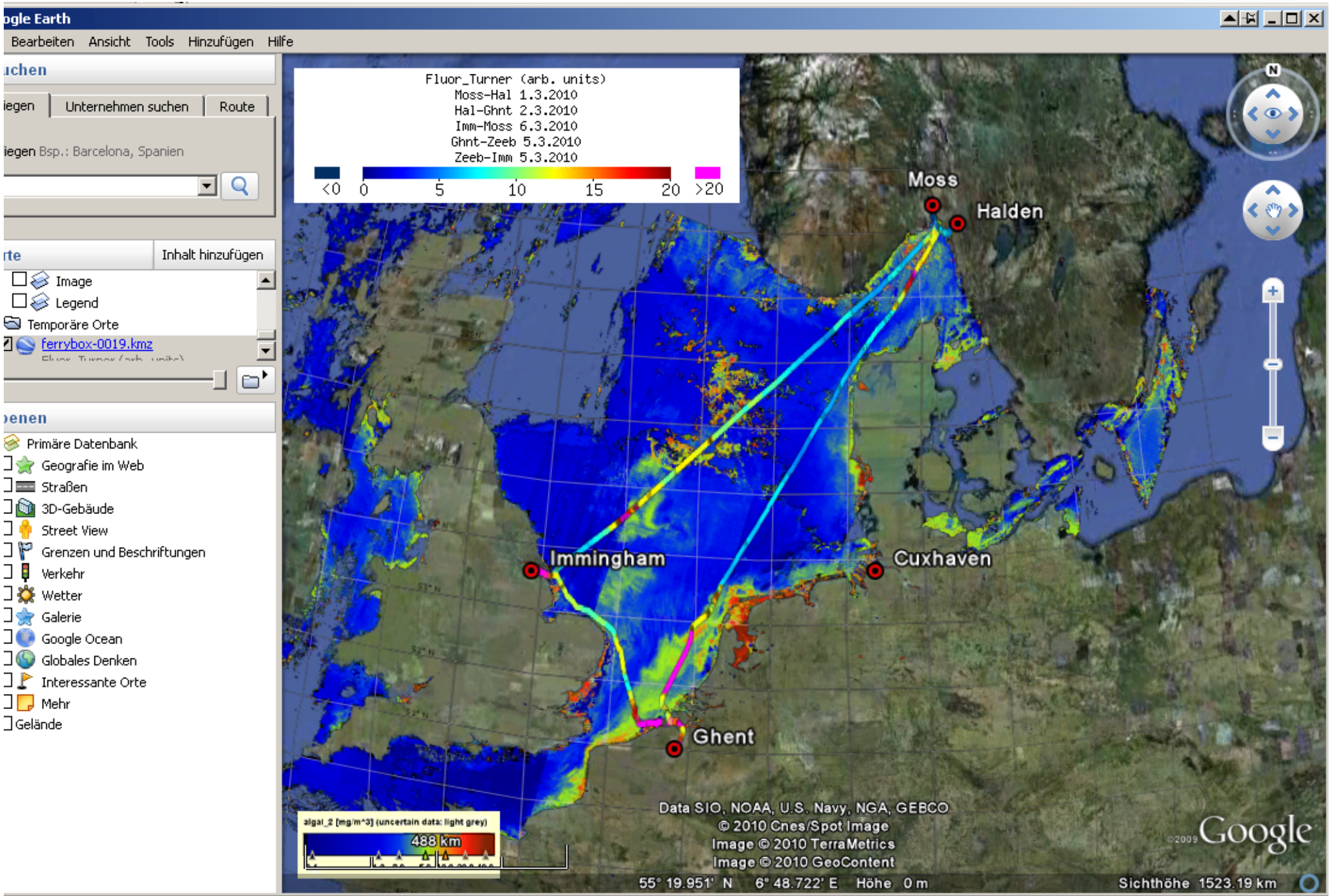
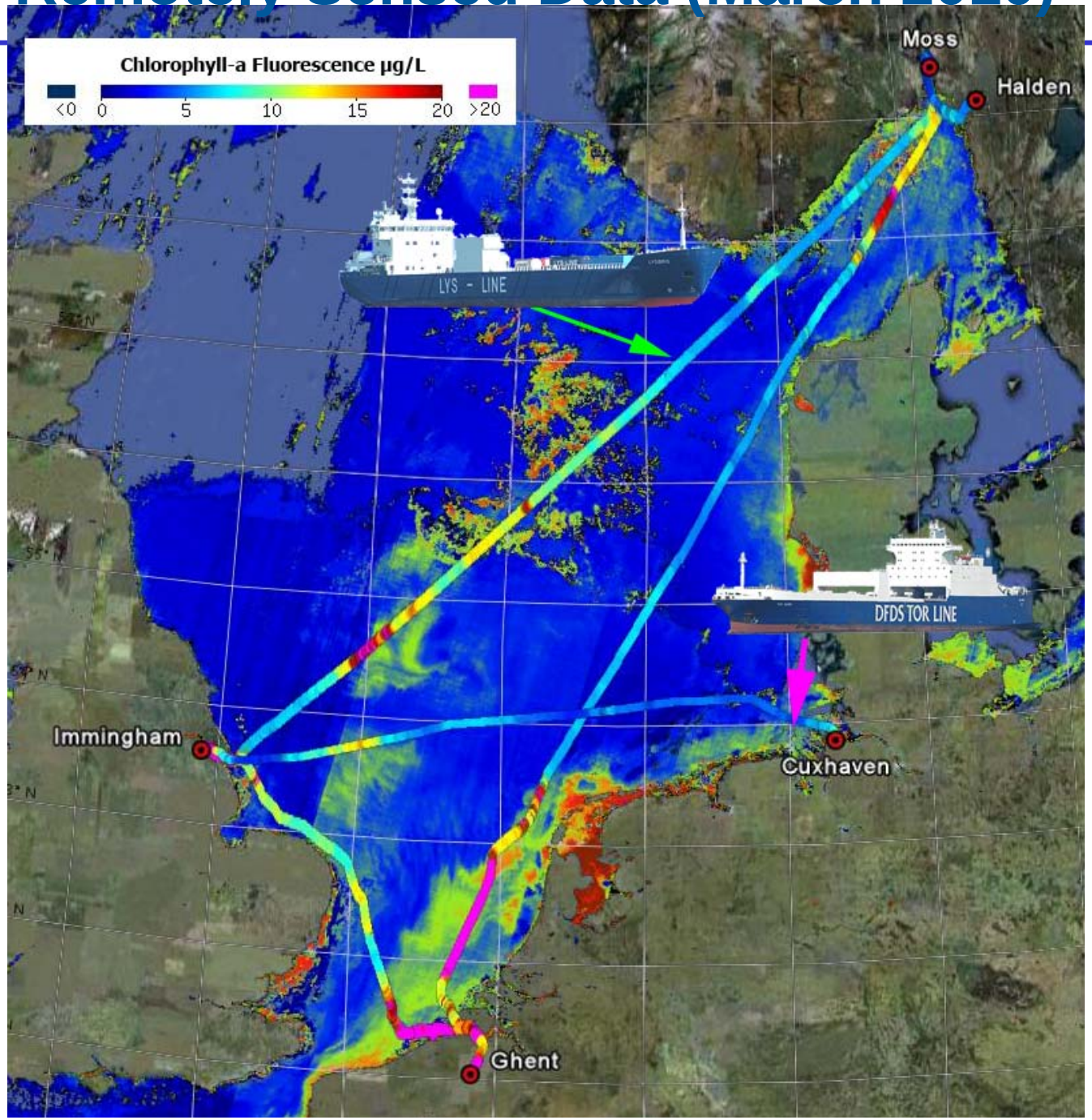
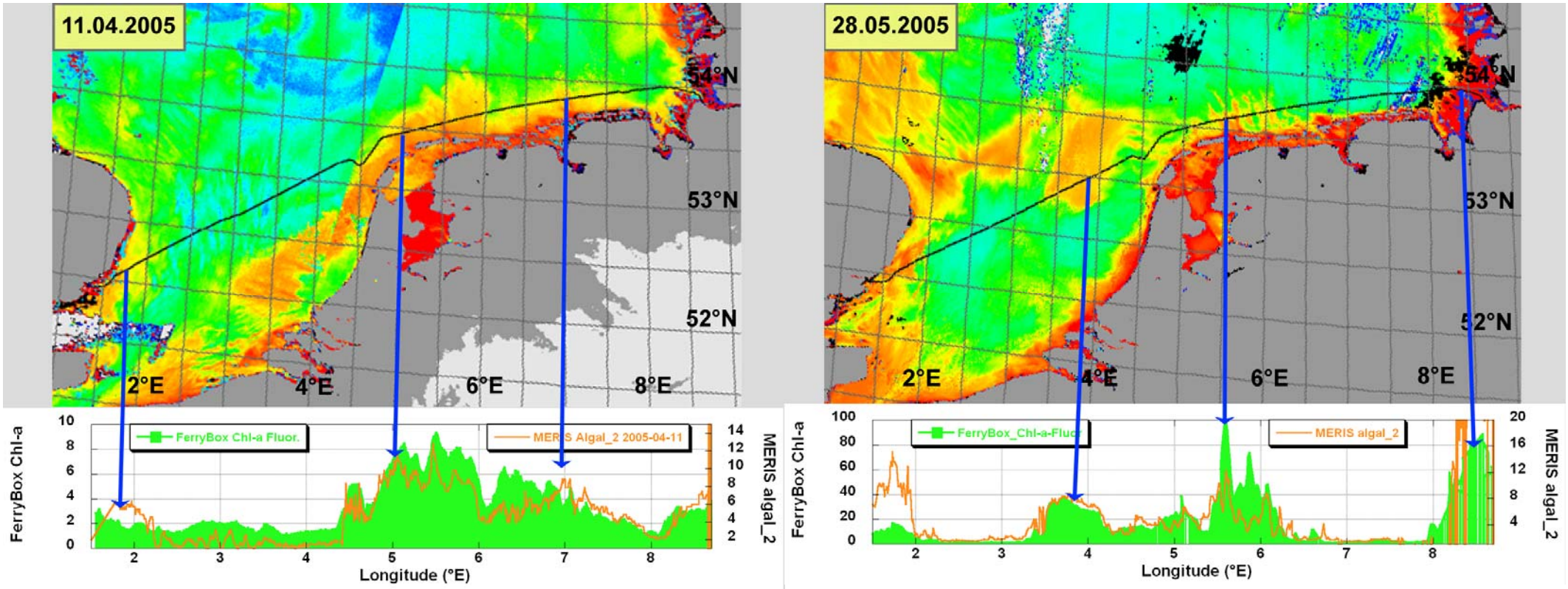


Combination of FerryBox Data and Remotely Sensed Data (March 2010)

1.

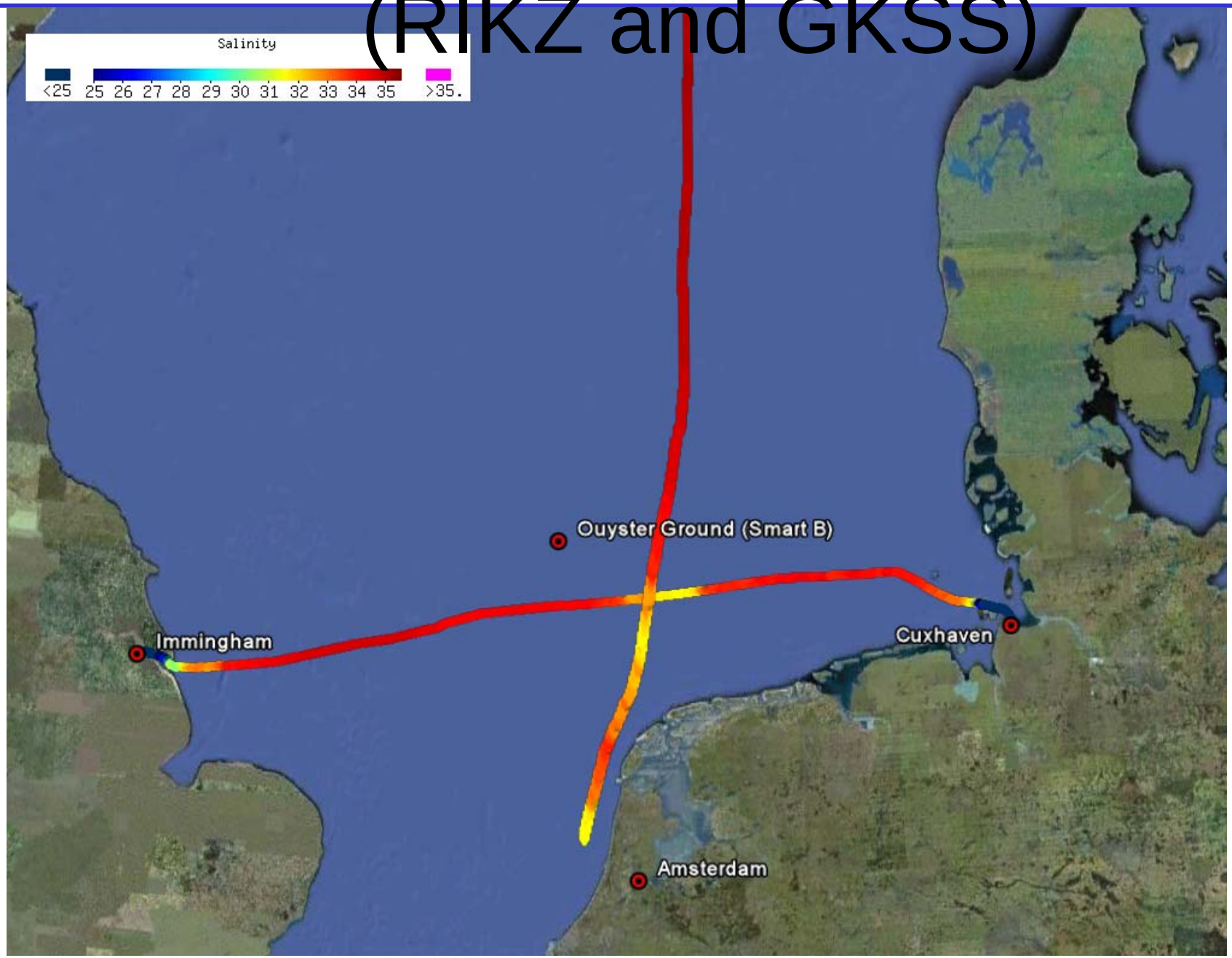


with Remote Sensing in April and May 2005



W. Petersen et al. 2008.
FerryBox and MERIS -Assessment of Coastal and Shelf sea Ecosystems by Combining In situ and Remote Sensed data. Estuarine Coastal and Shelf Science, 77, pp 296-307

Comparison Data From different Operators (RIKZ and GKSS)



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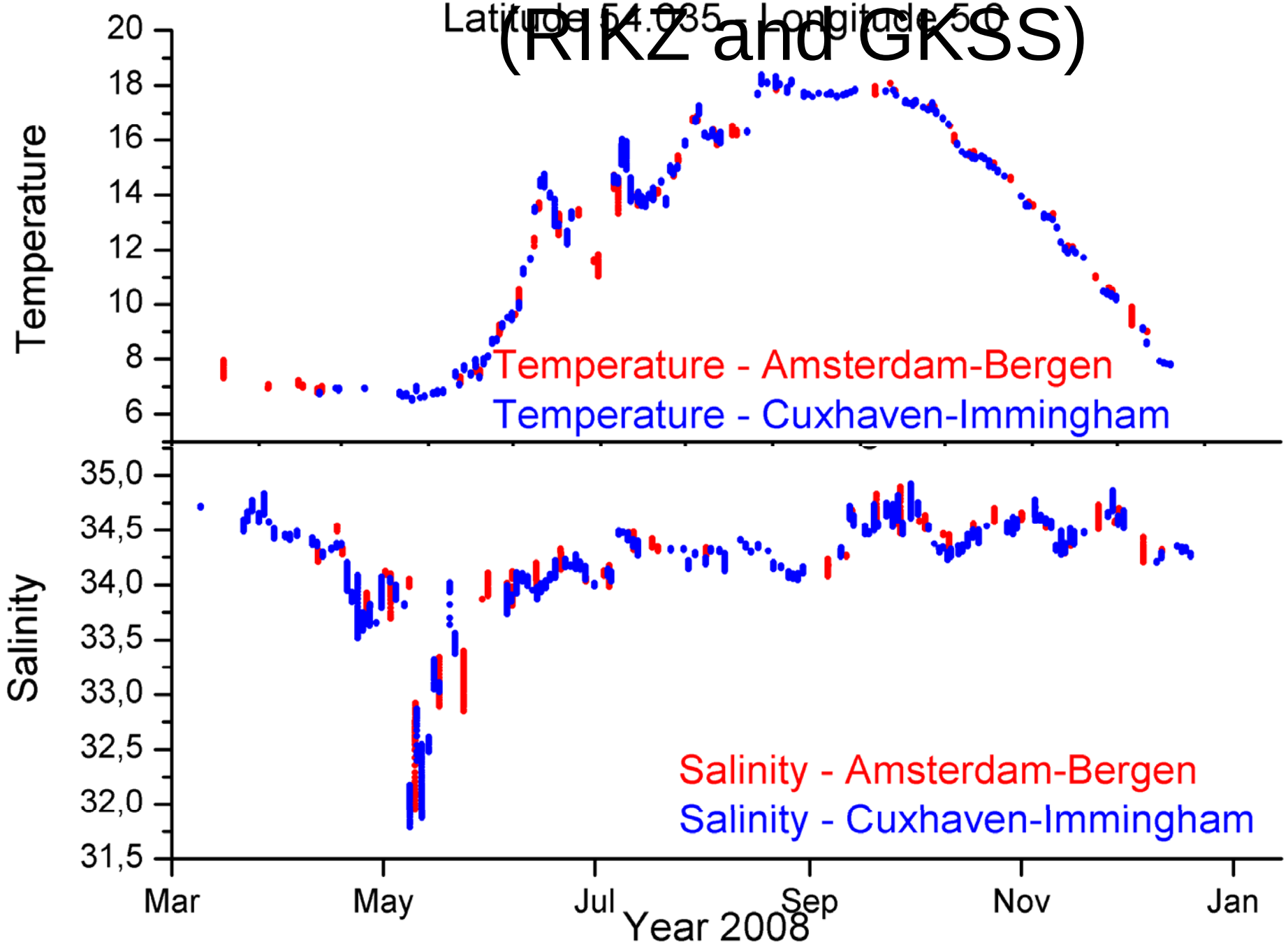
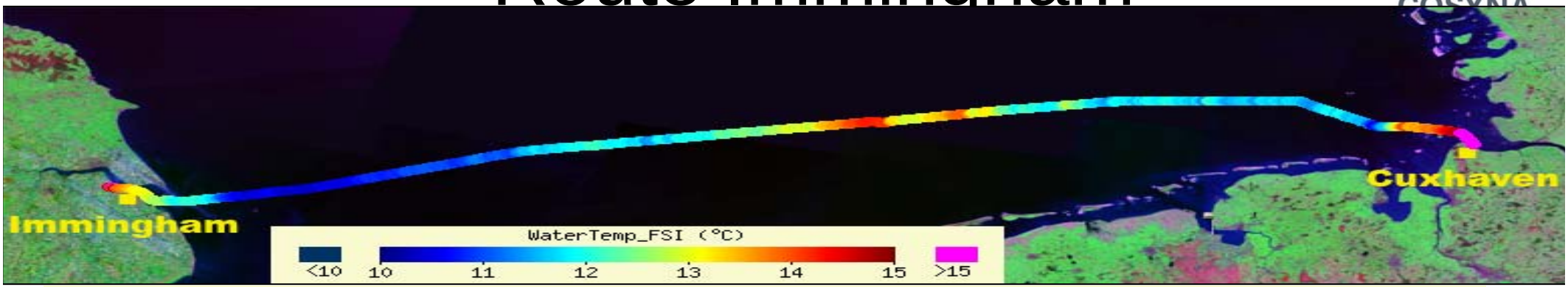
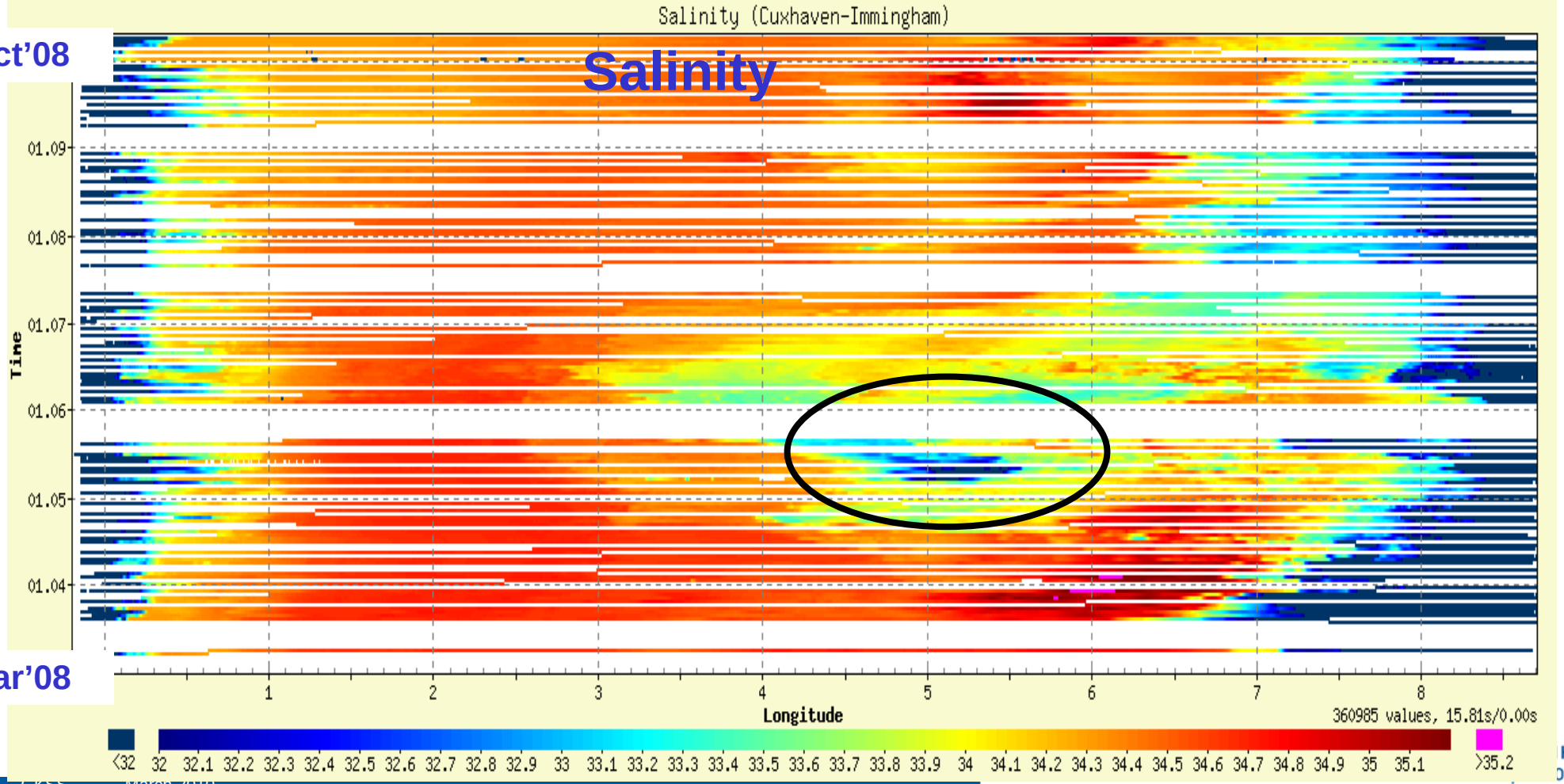


October 2008
Route Immingham - Cuxhaven



Oct'08

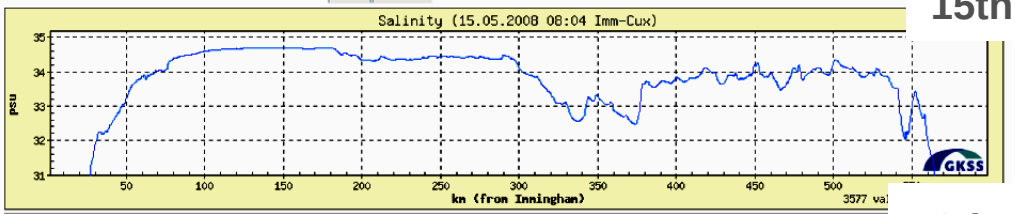


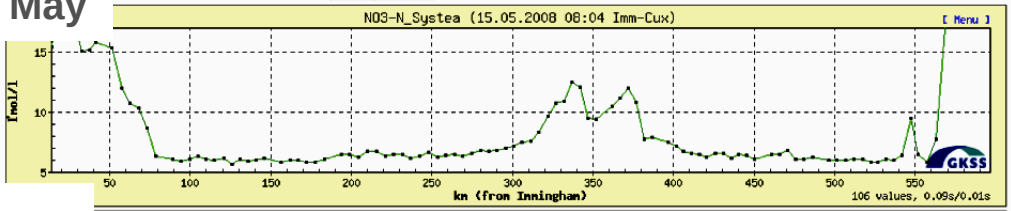
Mar'08

Intrusion of Freshwater along the Route 6th to 15th of May 2008

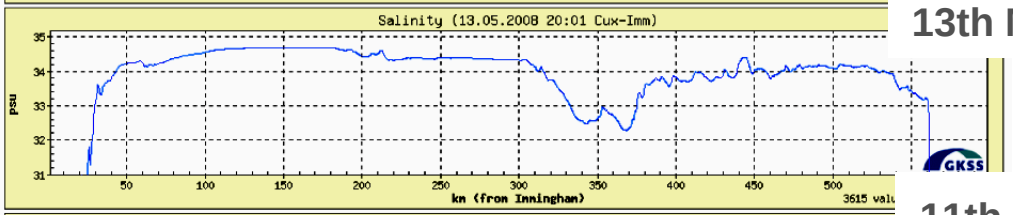
Salinity **Nitrate**

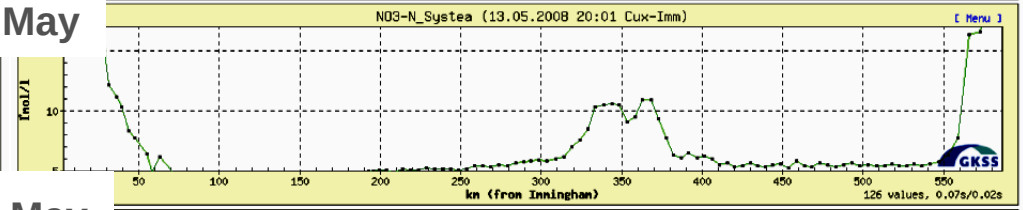
15th May



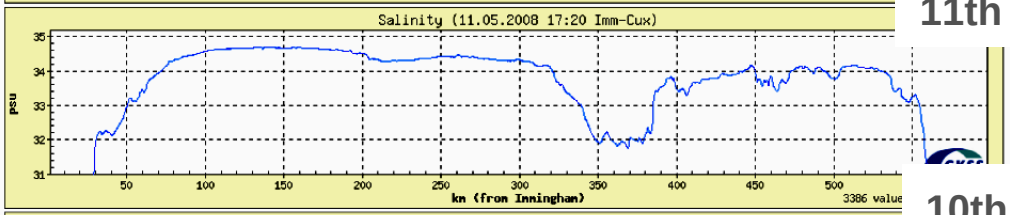


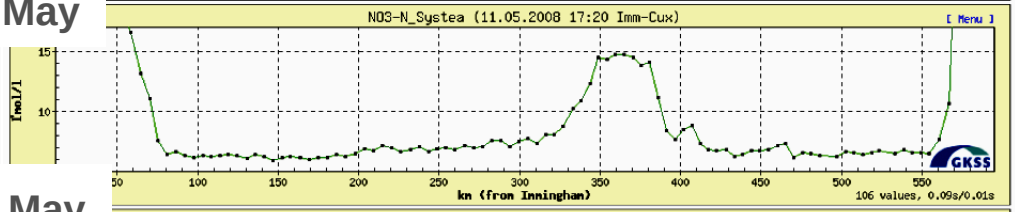
13th May



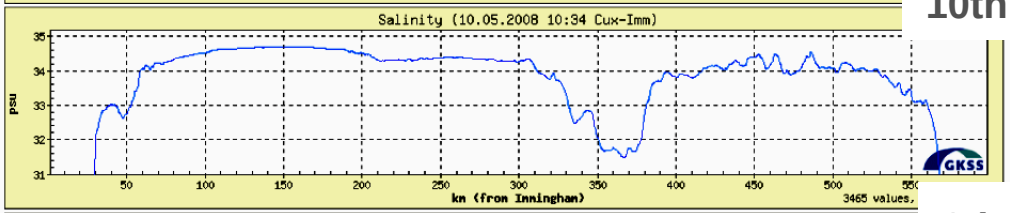


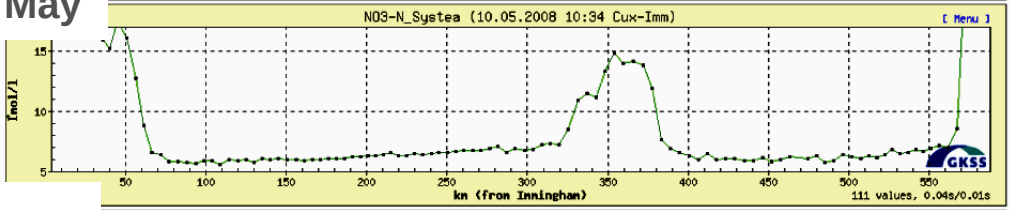
11th May



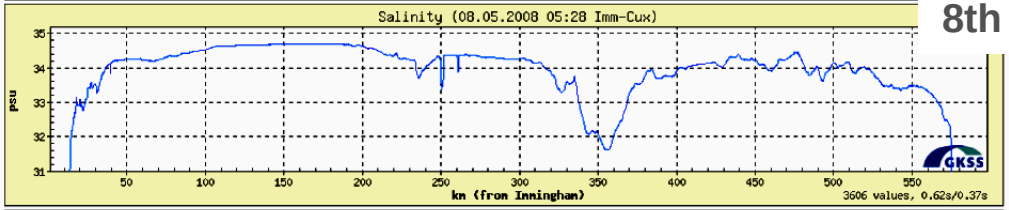


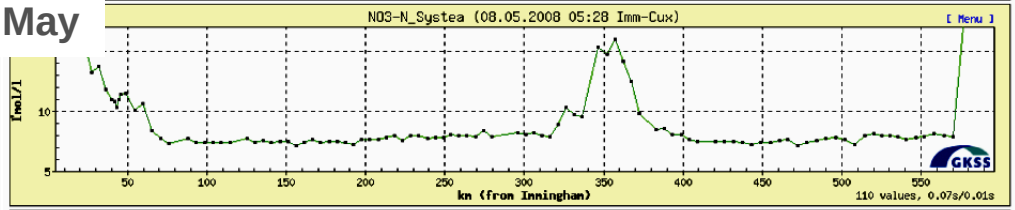
10th May



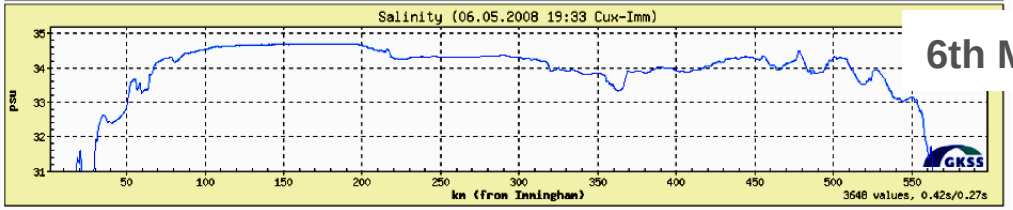


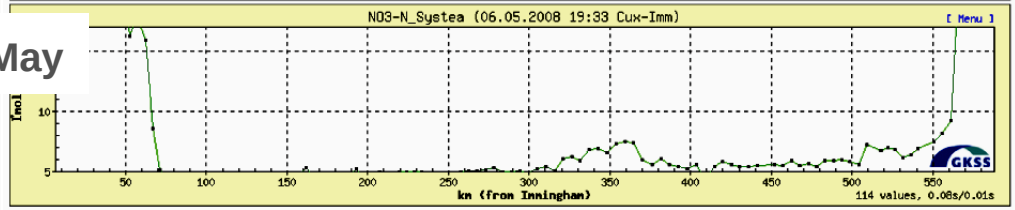
8th May





6th May

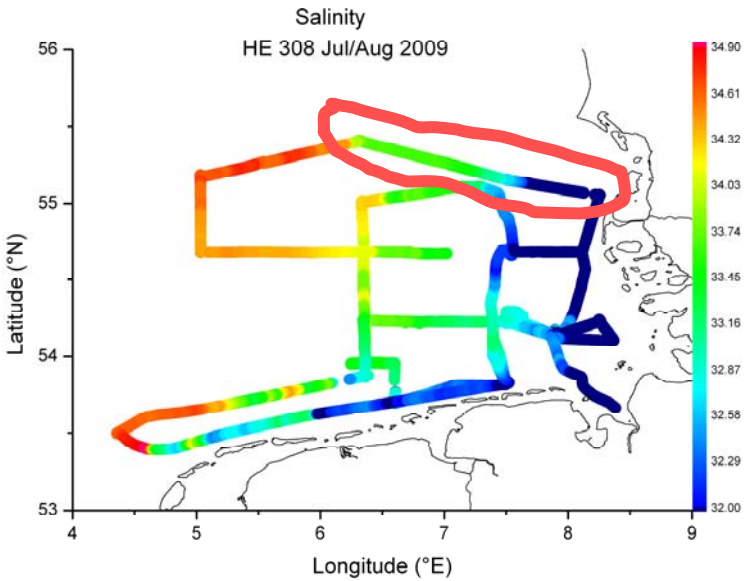


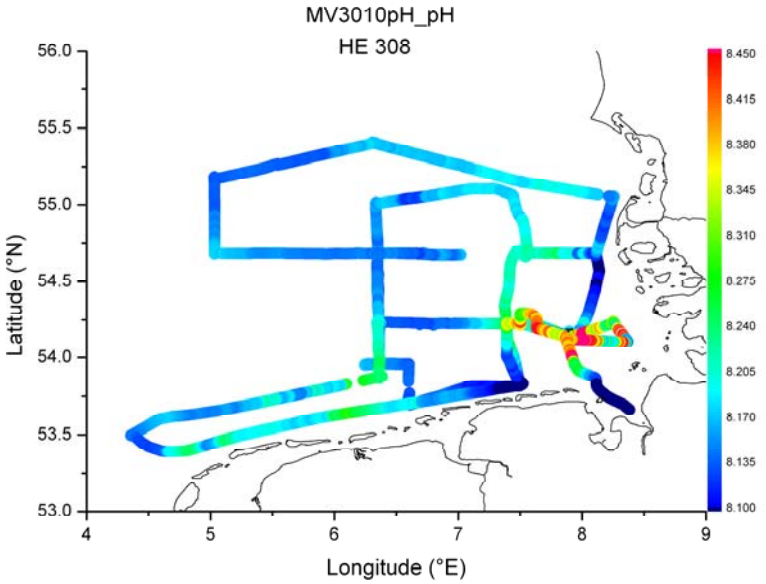


FerryBox Systems aboard Research Vessels

COSYNA Campaign in the German Bight

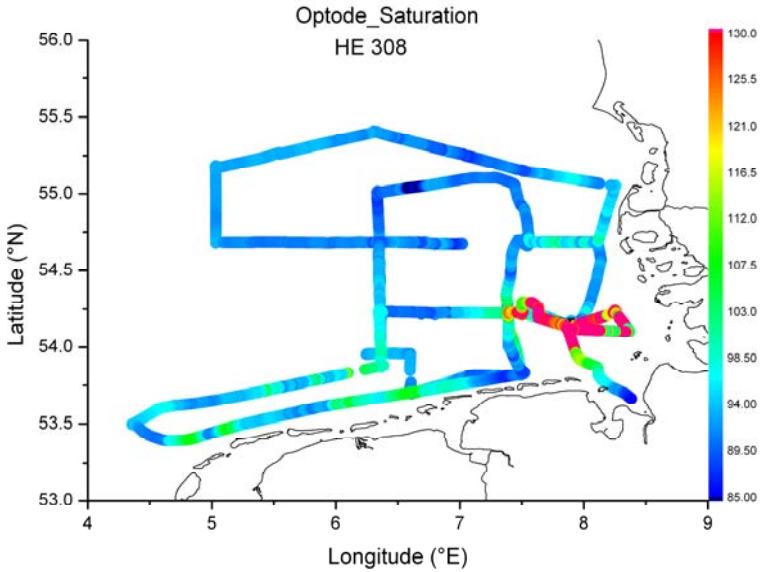
RV Heincke July/Aug 2009





FB & ScanFish

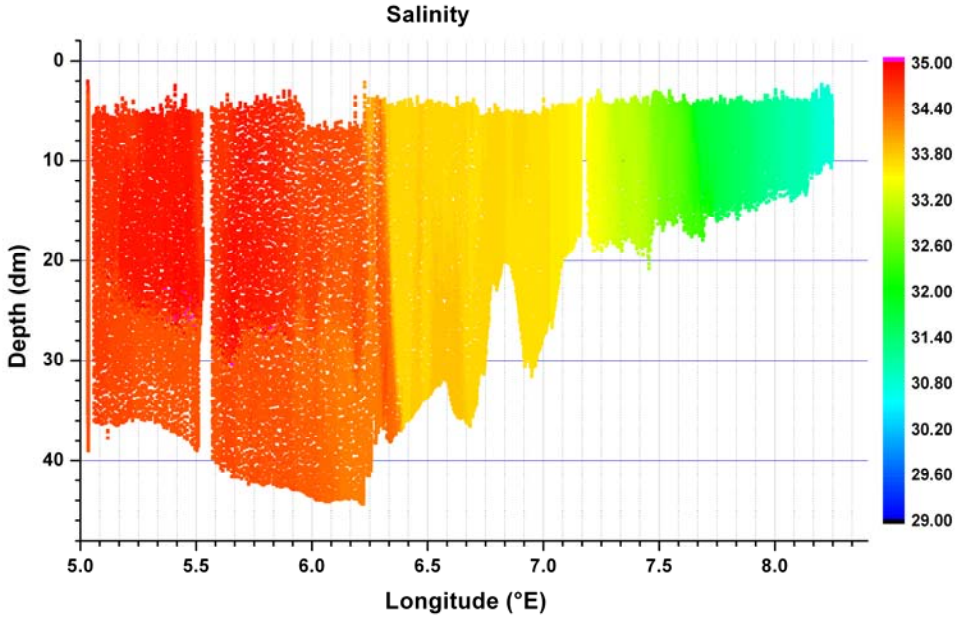
&

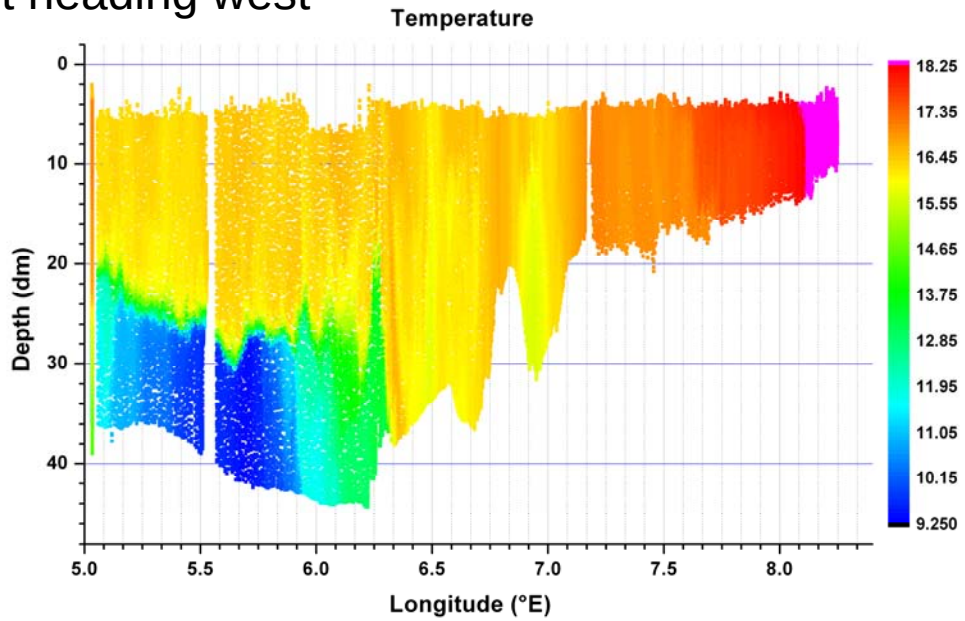


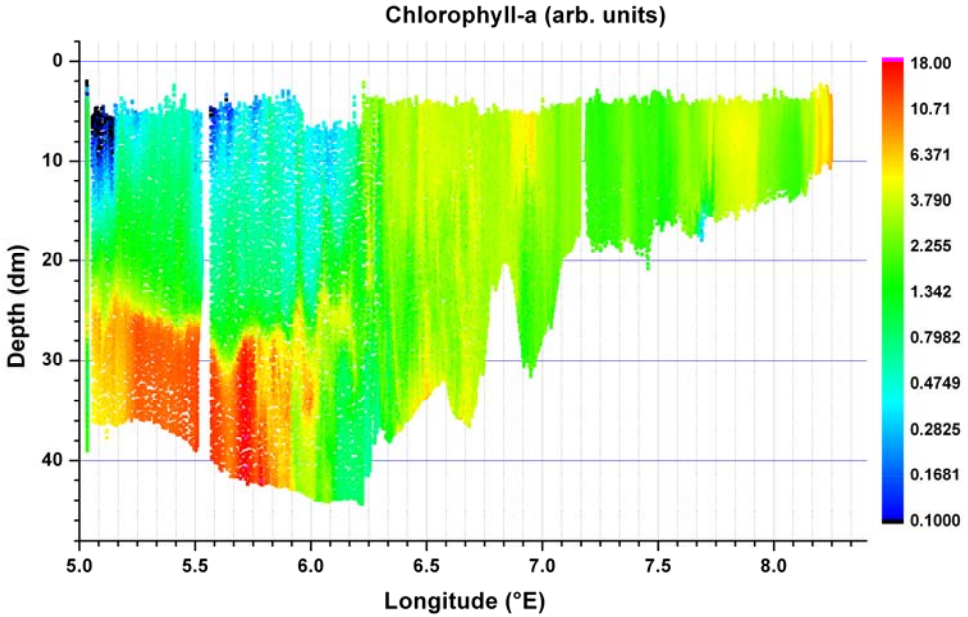
COSYNA Campaign in the German Bight

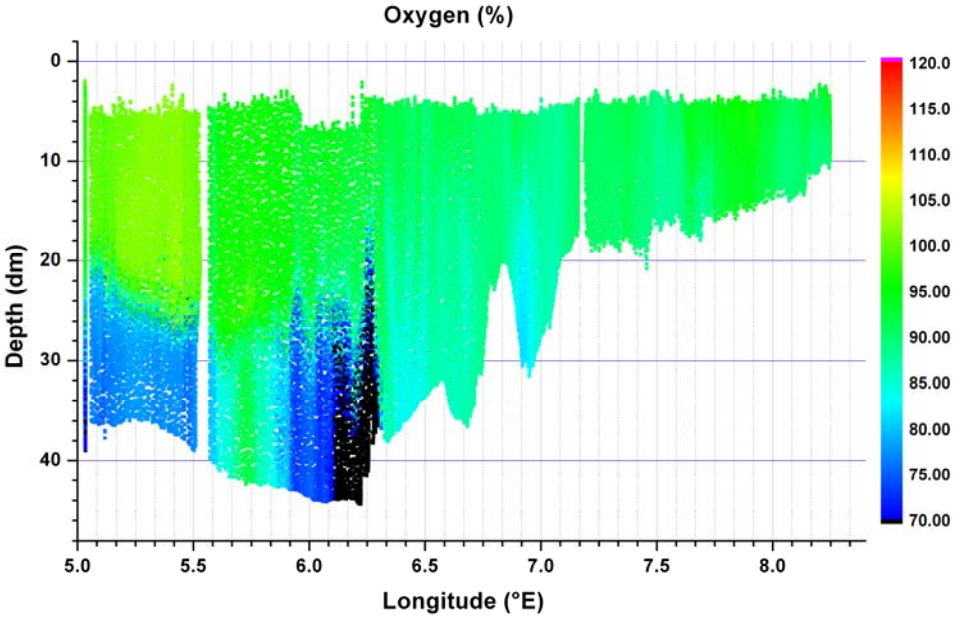
RV Heincke Jul/Aug 2009

track from island Sylt heading west

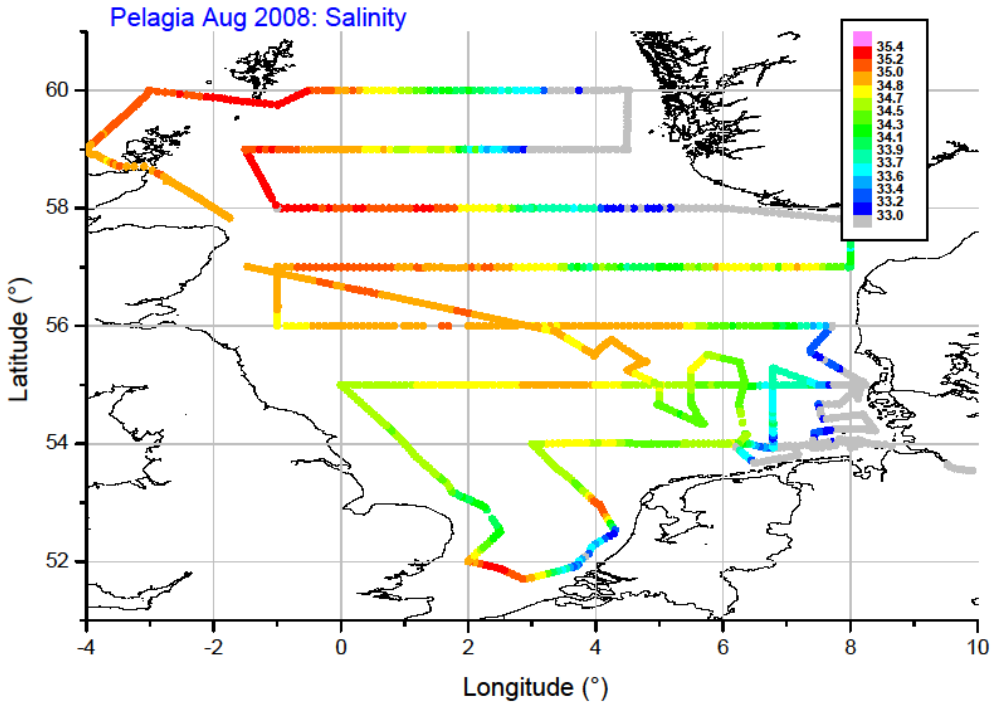


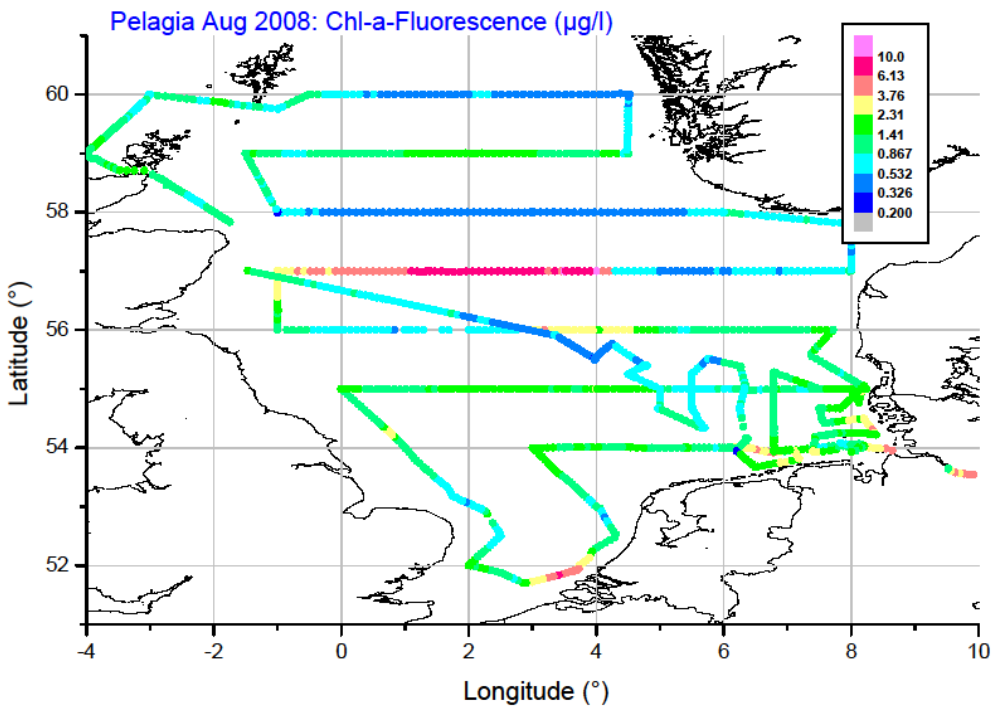




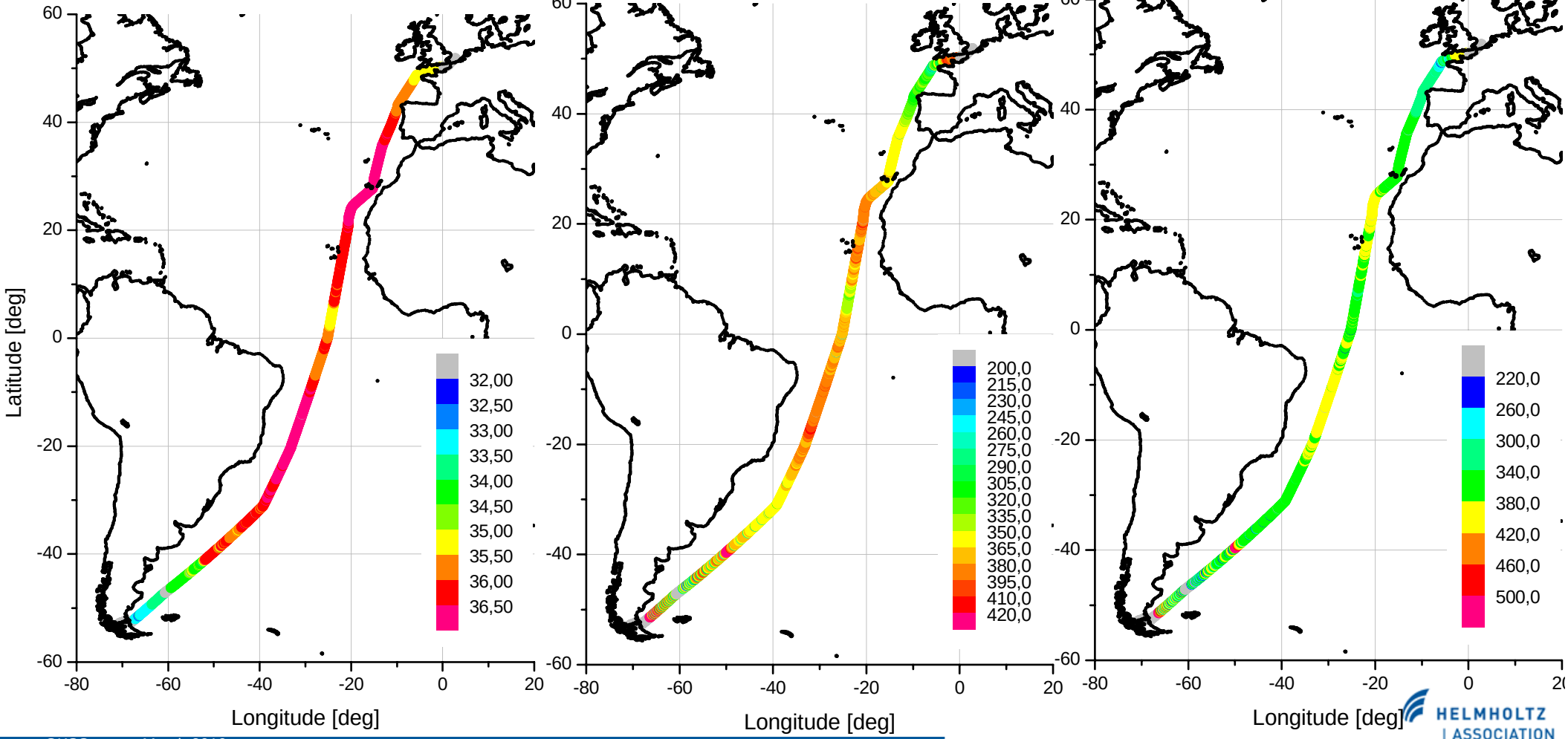


BSH North Sea Monitoring FerryBox System aboard RV Pelagia

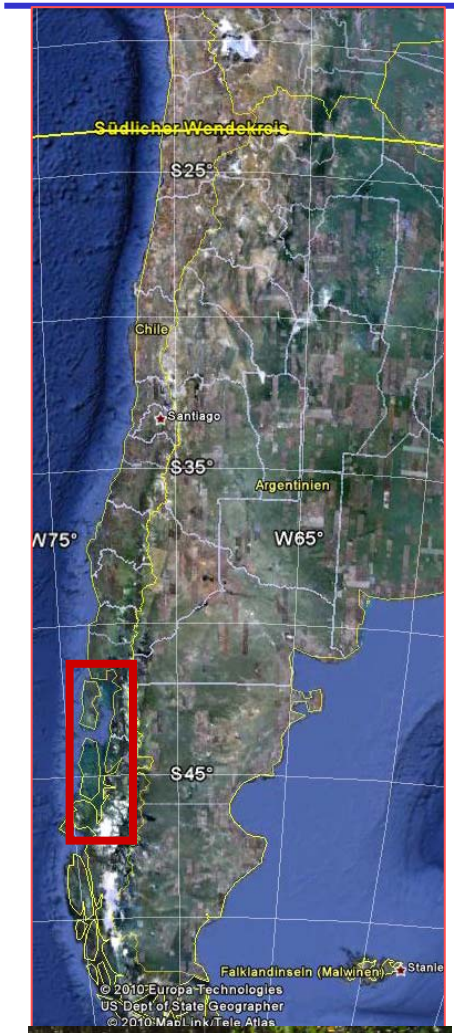


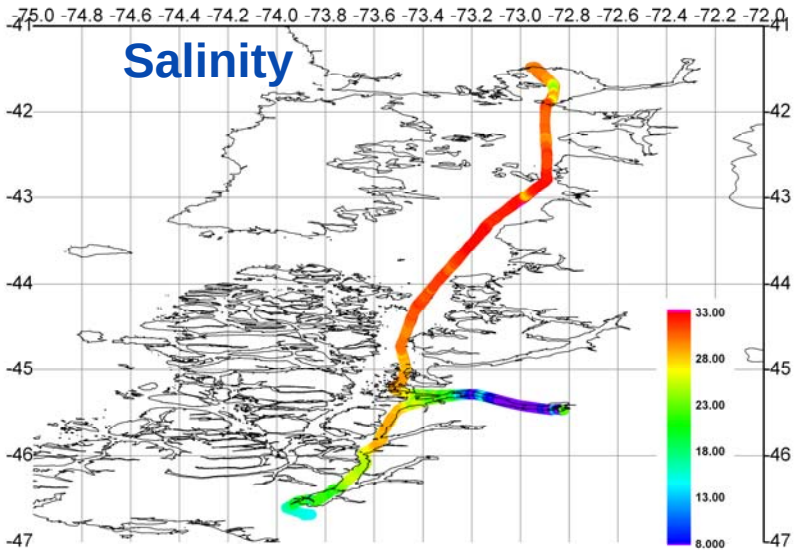


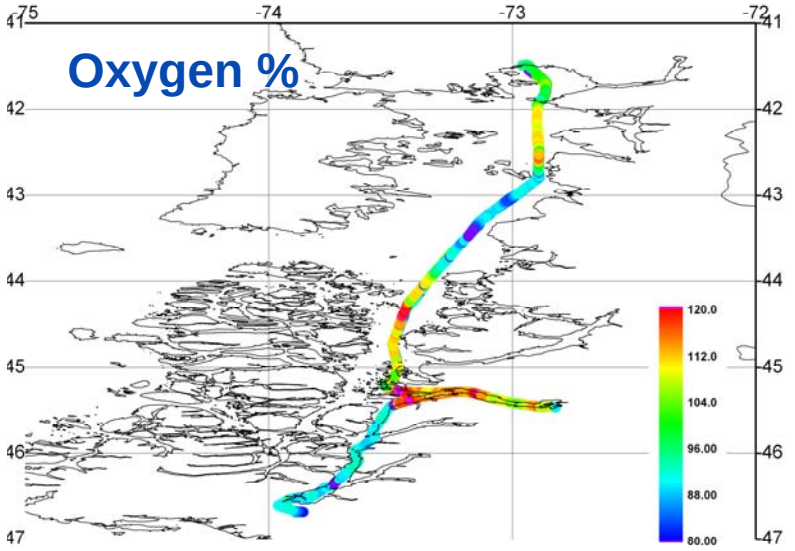
aboard RV Polarstern

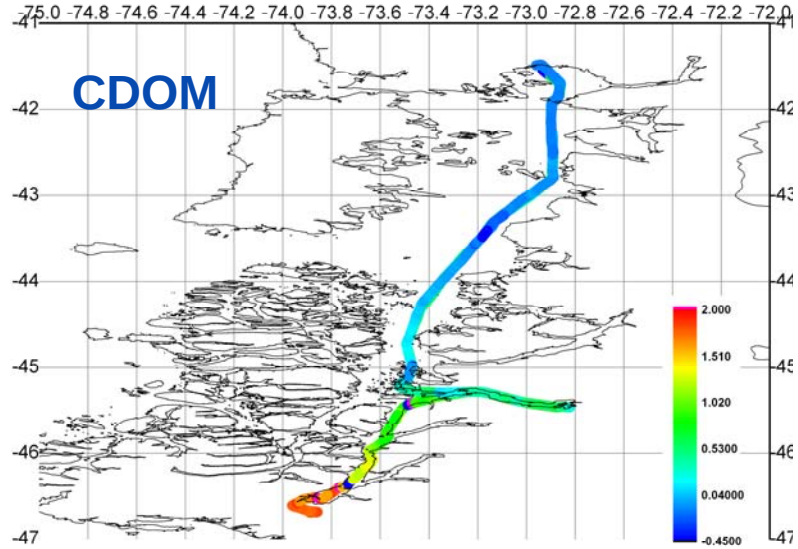


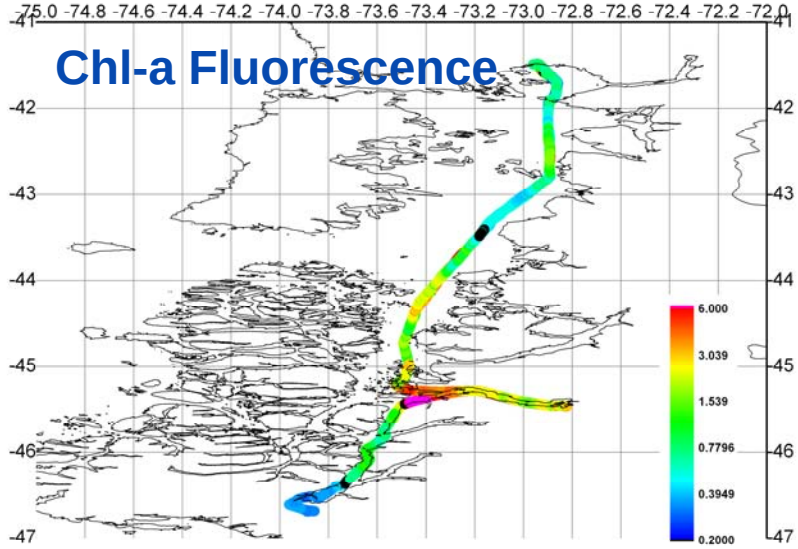
(Patagonia) Car&Passenger Ferry









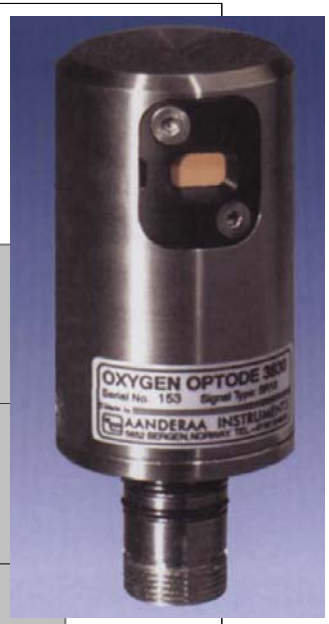


Scientific Application:

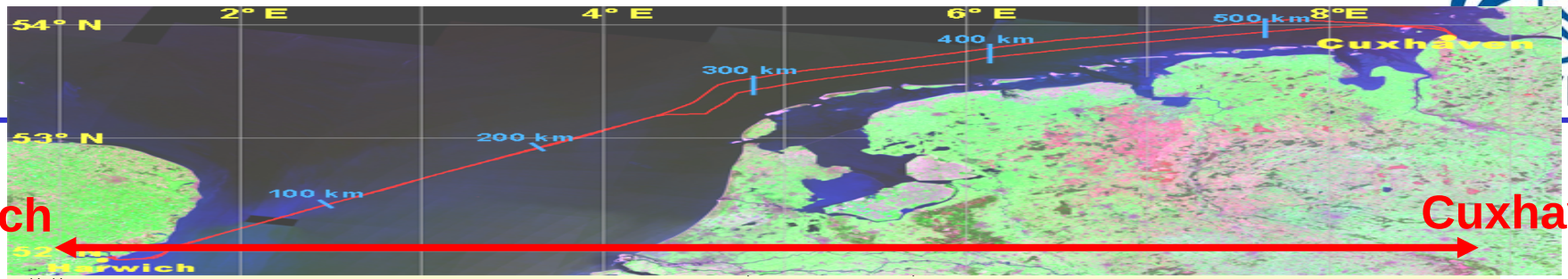
Oxygen

→New Production

Oxygen Data compared with Winkler titration
HE308 Jul/Aug 2009



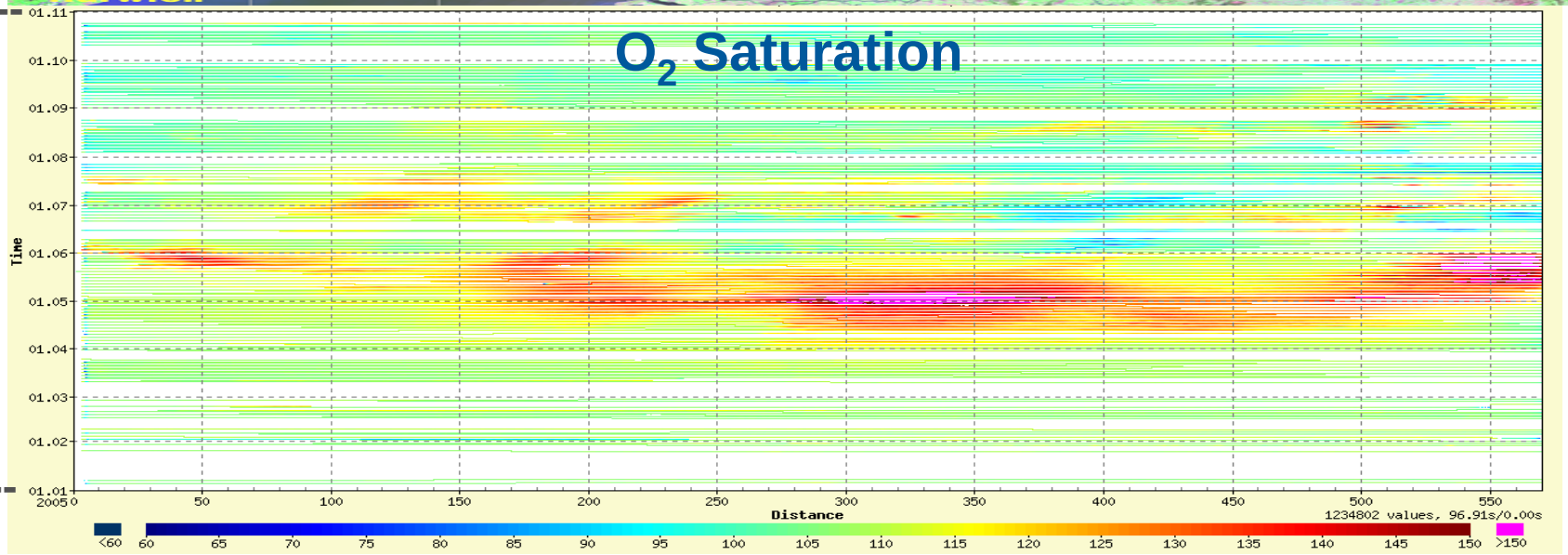
Comparison Oxygen and



Harwich ⟷ Cuxhaven

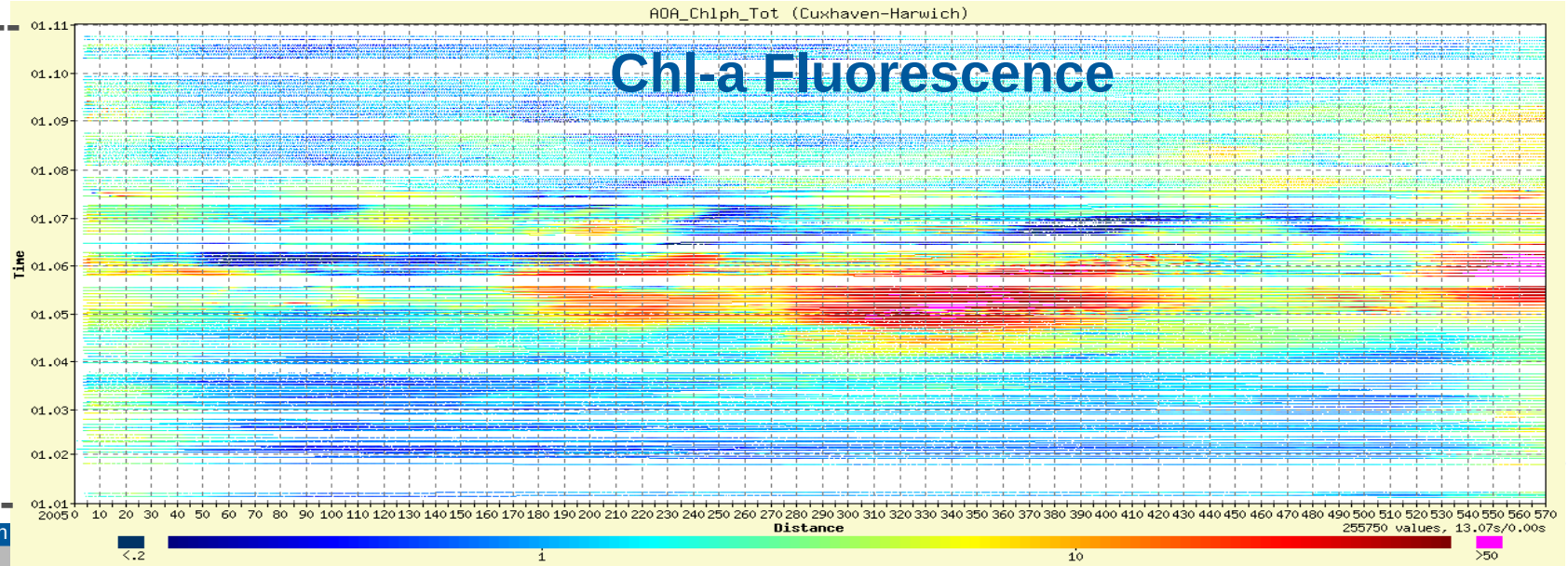
Nov'05--

Jan'05--



Nov'05--

Jan'05--



HELMHOLTZ ASSOCIATION

Estimation of Primary Production

- **Quantification of biomass production (primary production)**

- Common method:
  - observation of chlorophyll-a by chlorophyll-a fluorescence
  - Conversion of chlorophyll-a signal in biomass (carbon biomass)
- Problems:
- chlorophyll-a fluorescence signal is influenced by:
  - light conditions of the algal (e.g. differences between day and night)
  - physiological status of the algal cell
  - species of the algal
- conversion factor chlorophyll-a → carbon depends on algal species and physiological status

Chlorophyll-a fluorescence can be "easily" measured. However, for estimates of productivity it is a proxy with high uncertainties

The Oxygen Method

- Dissolved oxygen has a direct stoichiometric relationship with carbon
  - C = 0.77 •O_2 (Redfield)
- O_2 diffuses to surface and can be measured
- measurements of oxygen can provide quantitative estimates of productivity.

FerryBox Data in the North Sea

Data:

- Observations from the FerryBox along the transect:
  - oxygen
  - salinity & temperature
- Wind fields (re-analysed data from a regional model)

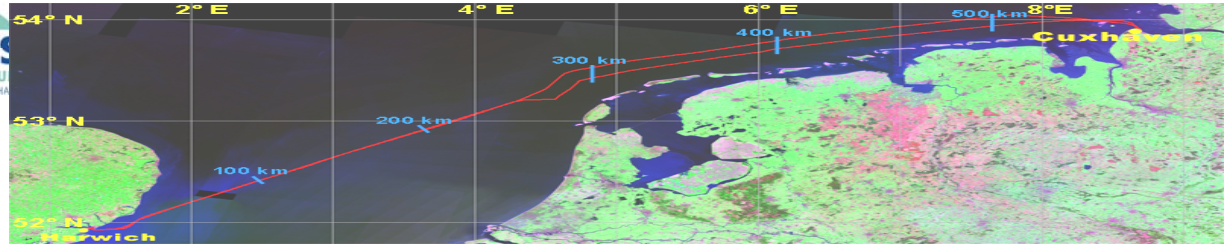
Procedure for flux calculation along the transect

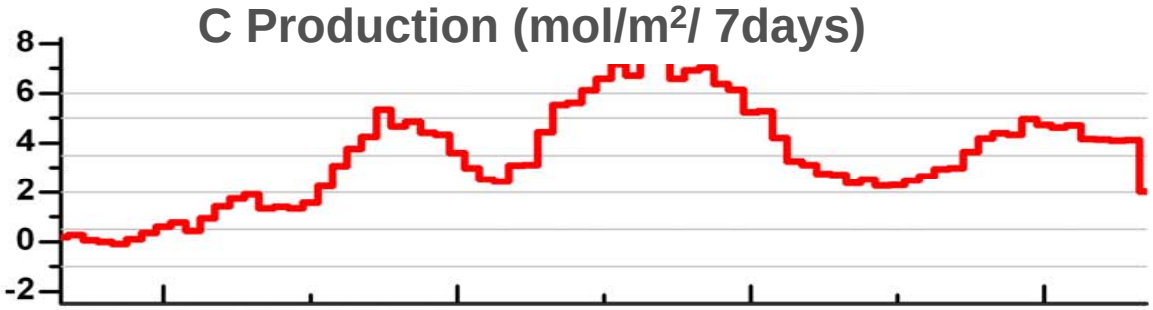
(averaged values with ~6km spatial resolution):

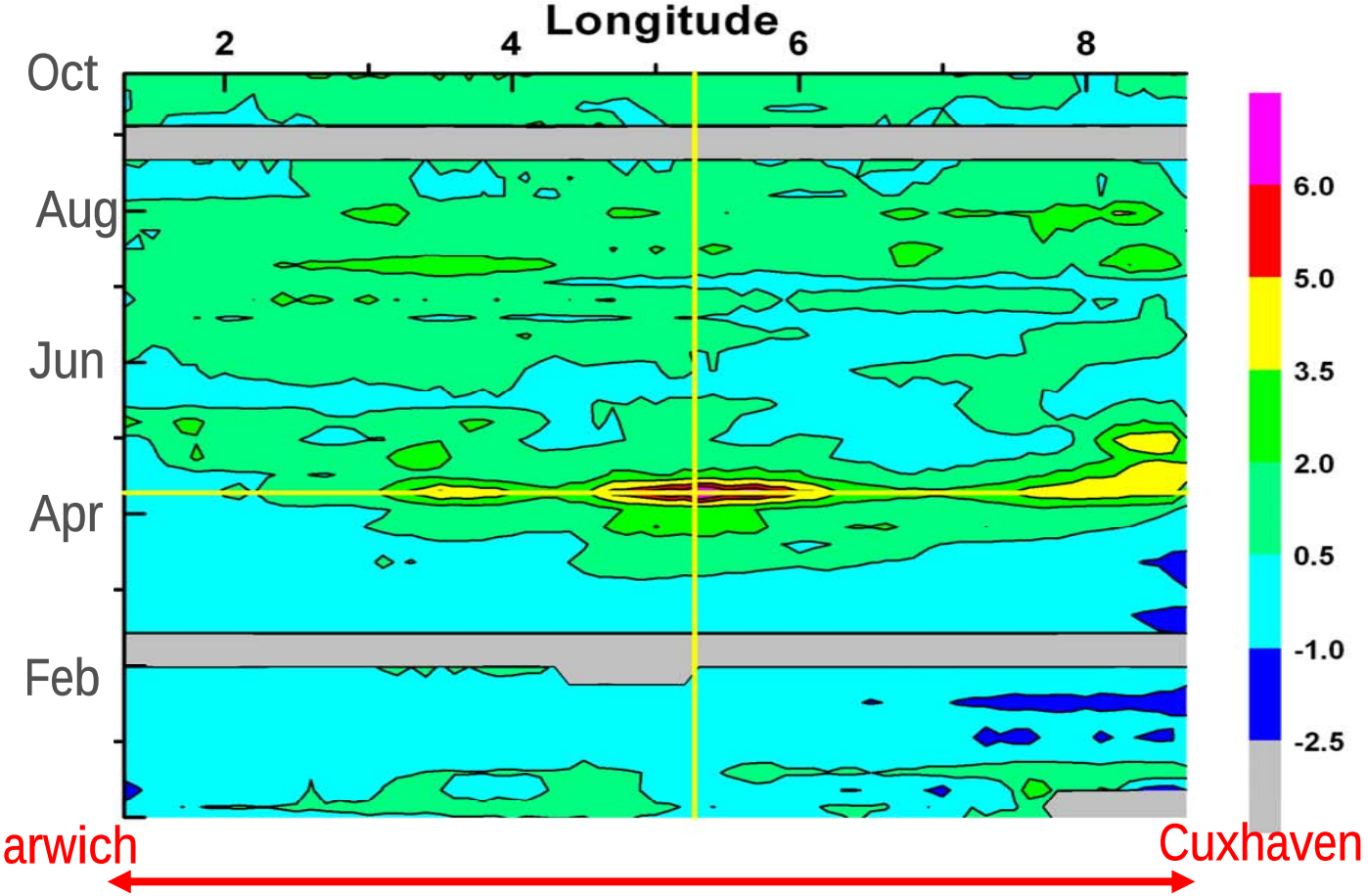
- calculation of oxygen anomaly from temperature and salinity and O_{2obs}
- calculation of weekly average of oxygen anomaly ($\Delta[O_2]$)
- calculation of transfer velocity k_{O2} from wind speed
- calculation of the flux from $\Delta[O_2]$ and k_{O2}
- correction for the thermal component of the flux

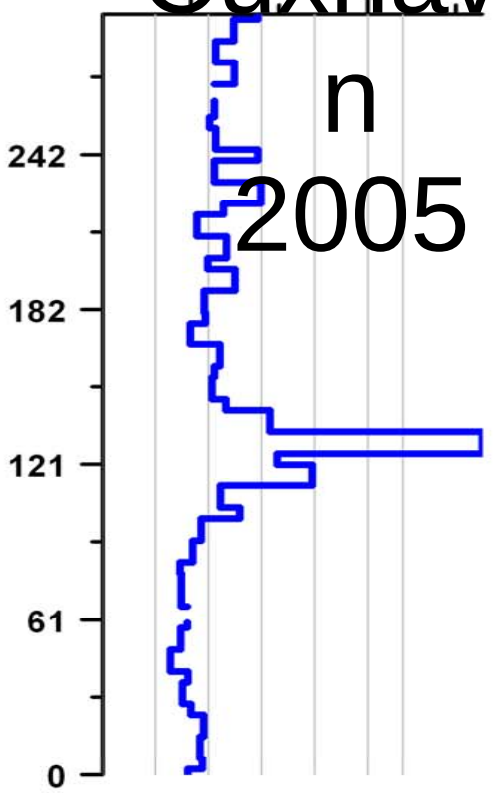
→ biologically induced flux (C Production)

Production Transect: Harwich – Cuxhaven 2005

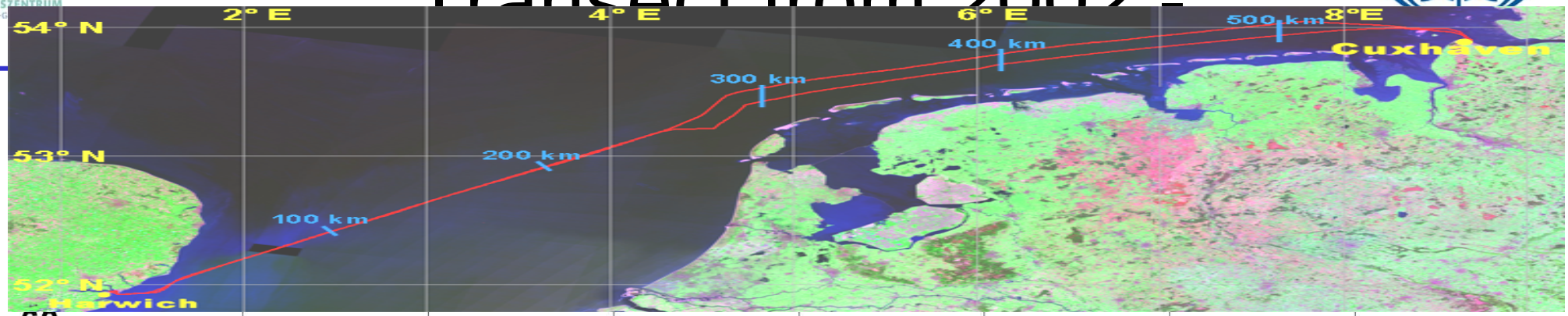


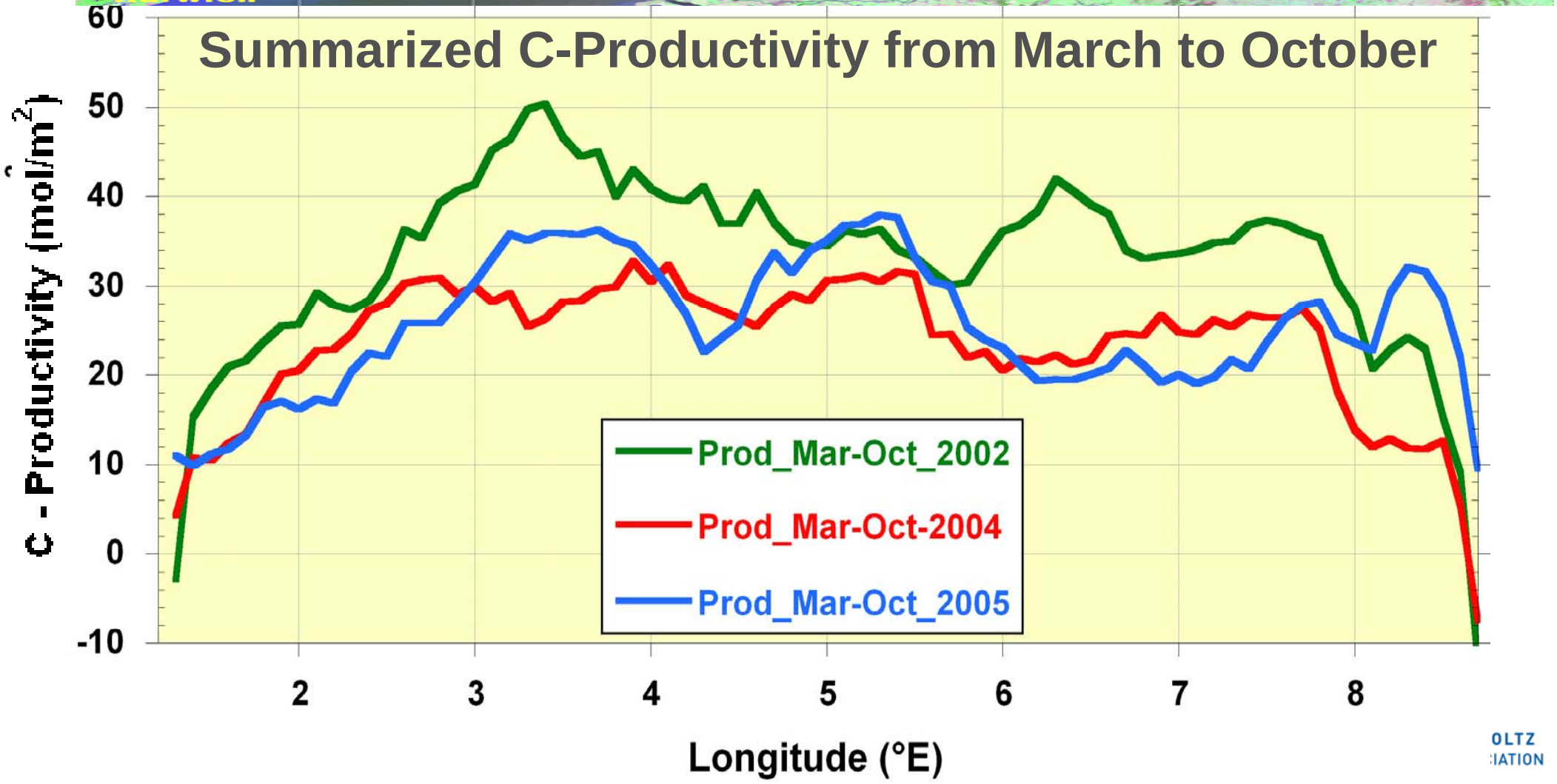






Productivity along the Transect from 2002 -





Scientific Application:

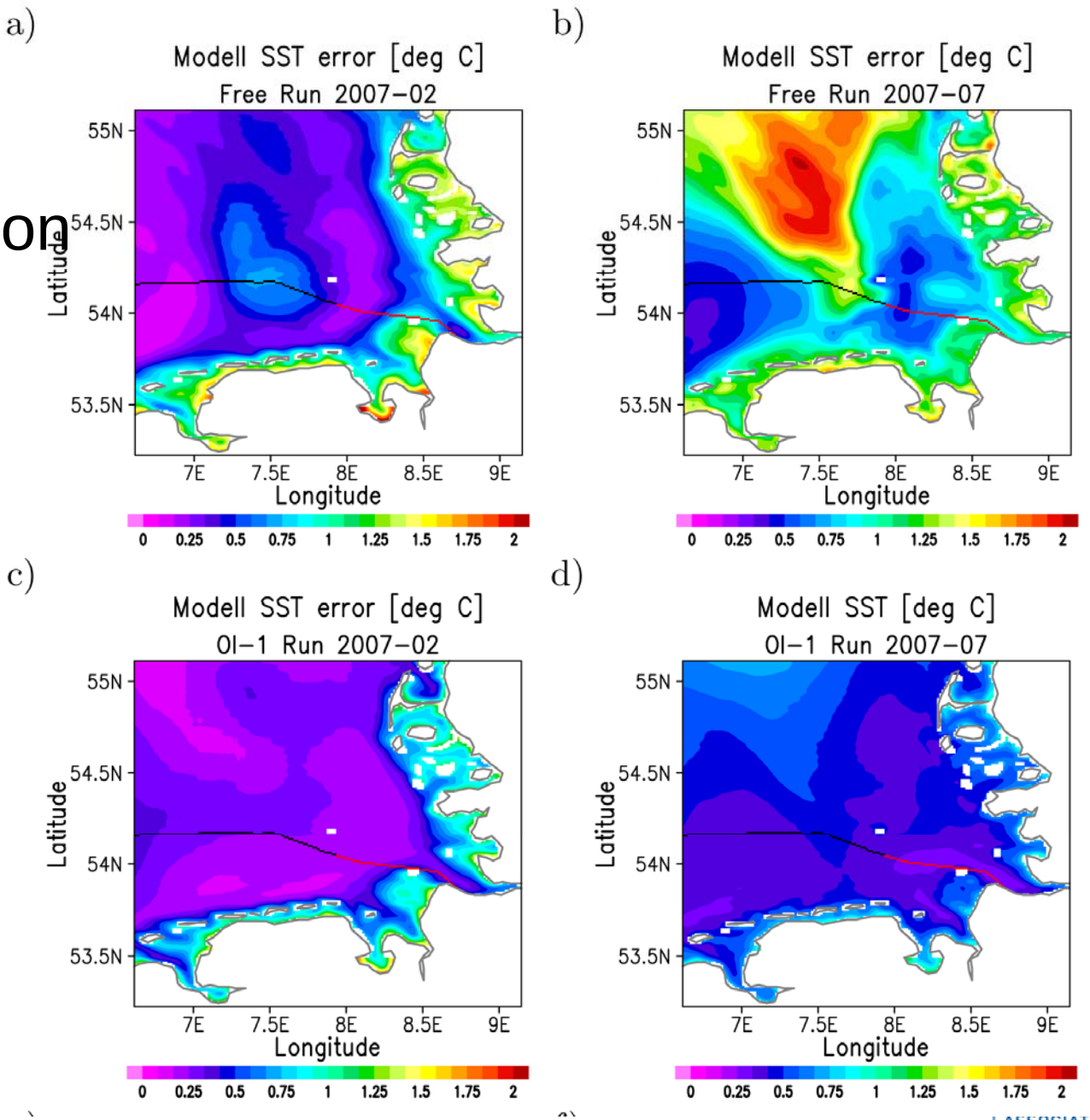
Data Assimilation

Data Assimilation of FB Data

Mo(

Without Data-Assimilation

With Data-Assimilation



Grayek et al. submitted to Journal of Marine Systems

Future:

Expansion of FerryBox data for biogeochemical and acidification processes :

- p-CO2 Sensor (Pro Oceanic) in spring 2010
- new sensors (under development) for automatic more precise pH + alkalinity measurements
- PSICam (point-source integrating-cavity absorption meter) for better quantification of chlorophyll-a and detection of algal species
- Automated GenProbe System (under development)

Conclusion

FerryBox System:

- The *FerryBox* systems provide high recovery of reliable highfrequent data
- Effective anti-fouling methods are much easier to apply and improve the long-term stability and reliability of the data

- Automatically taken water samples for lab analysis provide further information (e.g. microscopic analysis of algae)
- Operation of FerryBoxes on merchant ships is more difficult than on ferries (irregular schedule times, depend on cargo, change of ships…)

Applications:

- Continuous observations of oxygen data along a transect can be used to estimate new productivity
- Short-term processes (e.g. algal blooms) can be better quantified
- Assimilation of FB data in models reduces the model error

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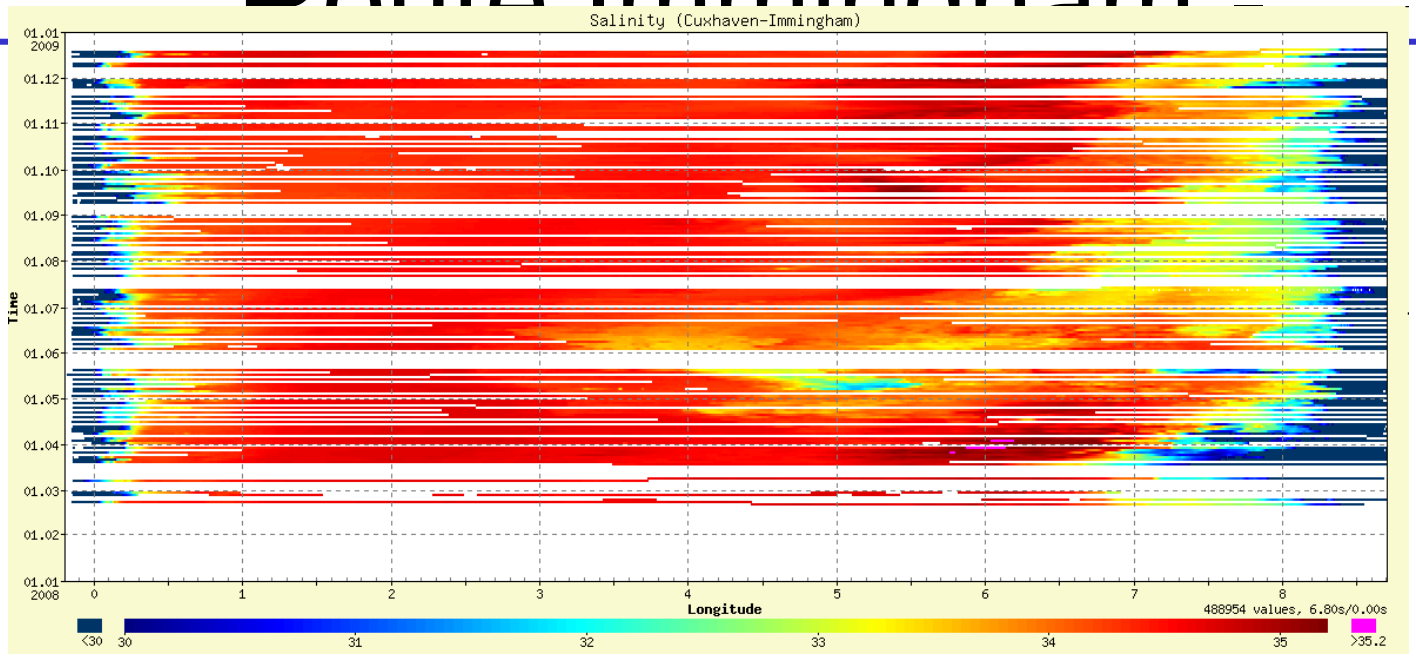
- Hendrik Rust
- Maik Grunwald
- .....

<u>further information:</u>
http://www.ferrybox.org

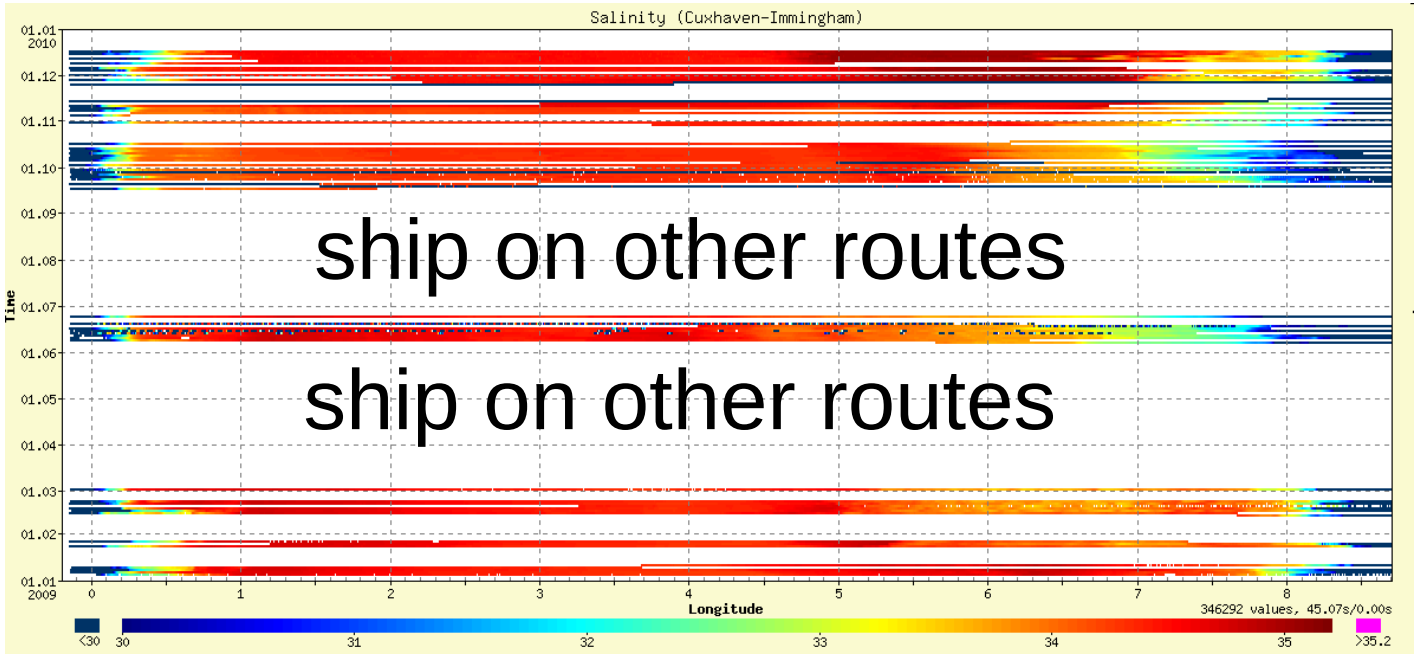
<u>access to actual FerryBox data:</u>
http://ferrydata.gkss.de

Availability Route Immingham

2008



2009



ship on other routes

ship on other routes

Advantages and Disadvantages of the-existing Monitoring

Monitoring with Research Ships:

+ many parameters, including toxic trace substances
- only few cruise per year
- high running costs (ship charter)

Automatic Systems (buoys, platforms, light ships etc.):

+ depth profiles possible (e.g., thermistor chains)
+ high temporal resolution
- energy-limited
- data from only one location (stationary carrier systems)
- great demand on sensor stability (maintenance)
- high maintenance costs, maintenance problems (ship cruises)