FerryBox - An Observation System for the Assessment of the Coastal and Shelf Sea Ecosystem

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Sensor Package
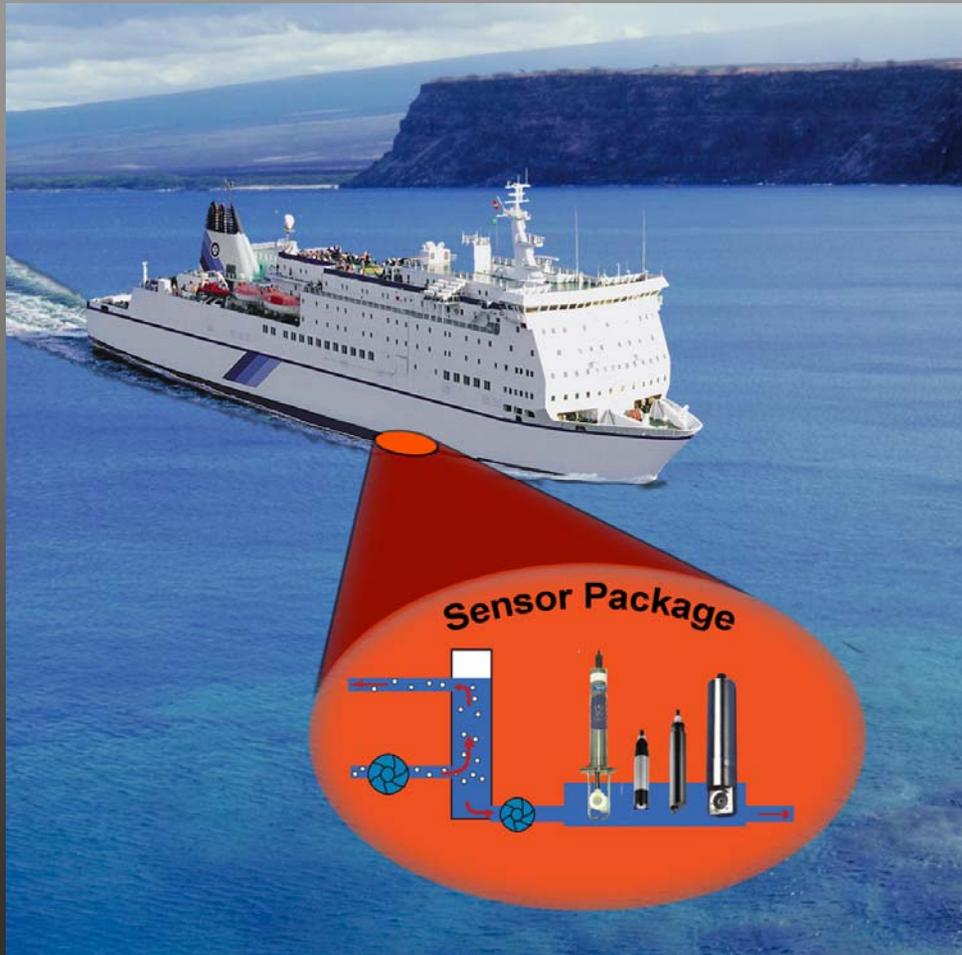
Co-ordination:
GKSS Research Centre

www.ferrybox.org

Outline

- Introduction

- Water Quality Monitoring by *FerryBoxes*

- Description of EU funded *FerryBox* project

- *FerryBox* System

- Examples of *FerryBox* Data

- Conclusion

Conventional Monitoring
Example German Monitoring Programme in the North Sea:

Ship cruises:

- \+ extensive Monitoring incl. toxic substances
- \- only a few times per year ==> only a snap shot
- \- high operational costs

Fixed Stations (Buoys, Light Ship):

- \+ depth profiles
- \+ high time resolution
- \- energy limited
- \- only point measurements (fixed localisation)
- \- high demand on the long time stability of the instruments
- \- maintenance difficult
  (e.g. difficulties accessing stations at bad weather conditions)
- \- expensive (maintenance by ship cruises)
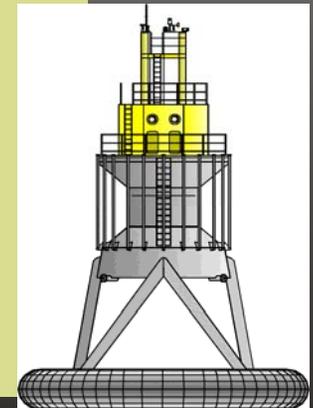
Coordination: Bundesamt für Seeschifffahrt und Hydrographie (BSH))

# Ferries and 'Ships of Opportunity (SOO)' as Monitoring Platform:

+ **high availability** (system is protected against harsh environment e.g. waves & currents)

+ **bio-fouling** can be more **easily prevented** (inline sensors)

+ **low running costs** (no cost of operation of the ship)

+ **no energy restrictions**

+ **easier maintenance** ('platform' comes back 'to your doorstep')

+ transect yield much **more information** compared to buoys

+ **high time resolution** of the data

- **only surface water**, no depth profiles

- currently **limited numbers of parameters** (ozeanography, nutrients, algae)

Oldest Application of SOO:
Continuous Plankton Recorder (CPR)
Long-term changes at the base of the food web

- Phytoplankton abundance in North Sea and NE Atlantic
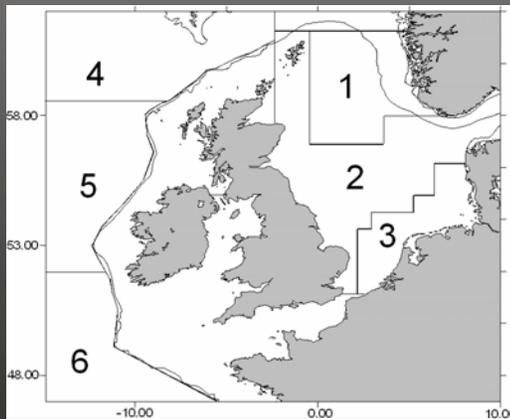
Reid et al. (1998) Nature
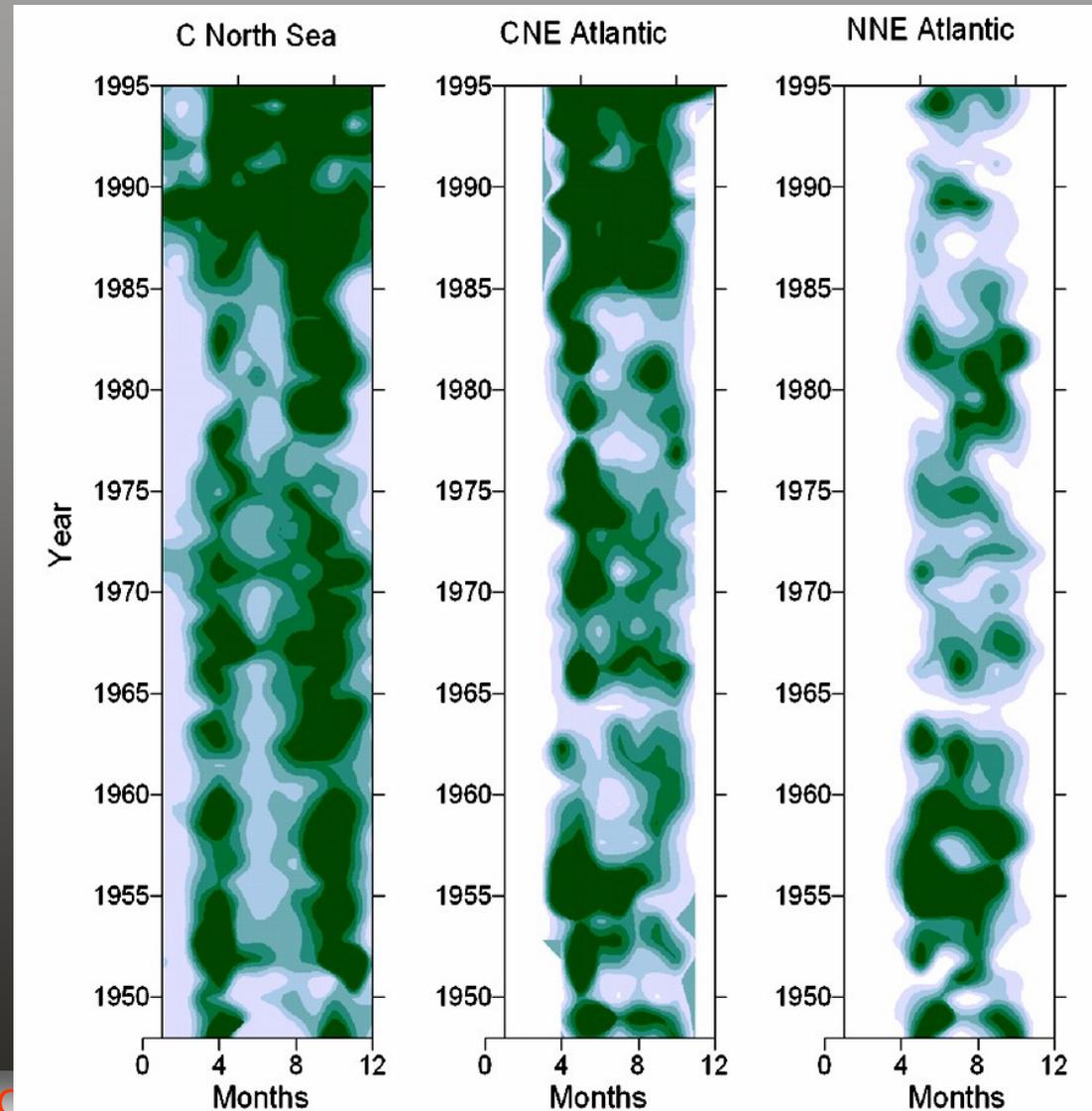
EU Project *FerryBox*
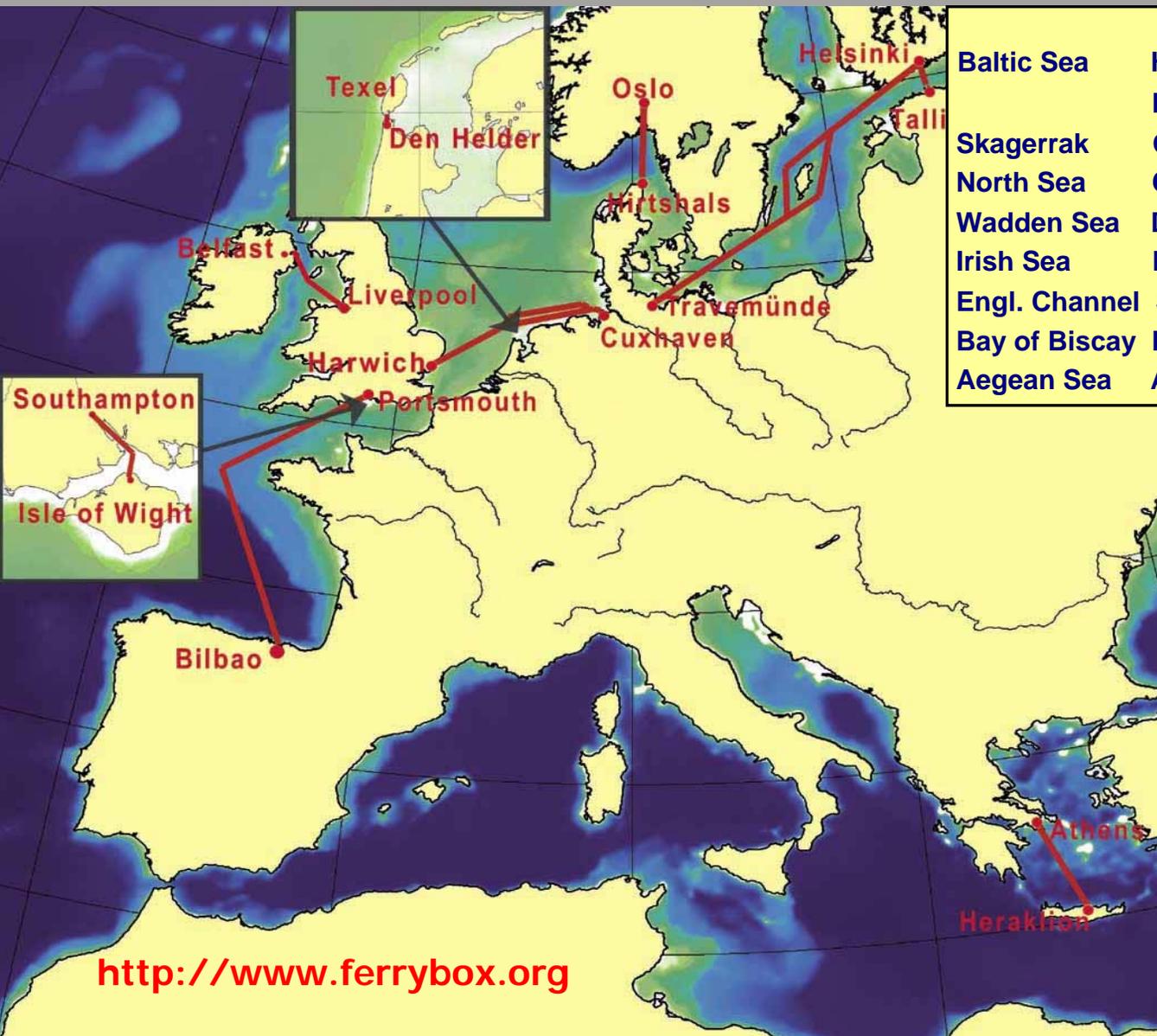
Baltic Sea	**Helsinki (FI) - Travemünde (D)**
	Helsinki (FI) - Tallinn (EE)
Skagerrak	**Oslo (N) - Hirtshals (DK)**
North Sea	**Cuxhaven (D) - Harwich (UK)**
Wadden Sea	**Den Helder – Texel (NL)**
Irish Sea	**Liverpool (UK) - Isle of Man (UK)**
Engl. Channel	**Southampton - Isle of Wight (UK)**
Bay of Biscay	**Portsmouth (UK) - Bilbao (ES)**
Aegean Sea	**Athens - Heraklion (GR)**

http://www.ferrybox.org

Project participants

GKSS Research Centre, Institute for Coastal Research, Germany	GKSS FORSCHUNGSZENTRUM
NERC – Southampton Oceanography Centre, UK	
NIOZ – Royal Netherlands Institute of Sea Research, the Netherlands	NIOZ
FIMR – Finnish Institute of Marine Research, Finland	
NCMR – National Centre for Marine Research, Greece	
NERC – Proudman Oceanographic Laboratory, United Kingdom	
NIVA – Norwegian Institute for Water Research, Norway	NIVA
HYDROMOD Scientific Consulting, Germany	HYDROMOD
CTG – Chelsea Technologies Group, United Kingdom	ctg
IEO – Spanish Institute of Oceanography, Spain	
EMI – Estonian Marine Institute, Estonia	EMI

Ferry Lines

Oslo-Hirtshals

Helsinki-Tallin

Helsinki-Travemünde

Cuxhaven-Harwich

DenHelder-Texel

Liverpool -Belfast

Southampton-Cowes

Portsmouth - Bilbao

Athens-Crete

Objectives of the EU *FerryBox* Project:

- comparison of different systems
  (reliability, availability ...)

- data quality assurance

- scientific analysis of FB data
  - eutrophication
  - water mass transport
  - sediment transport

- application of FerryBox data
  - remote sensing
  - numerical modelling

- cost-benefit analysis of FerryBox systems

- recommendations for operational oceanography

Operation of the *FerryBoxes*

- 9 Lines

- All FerryBoxes in operation since end of 2003

- Four core parameters on all systems:
  - Temperature
  - Salinity
  - Turbidity
  - Chlorophyll-Fluorescence

- Additional parameters:
  - Light (Skagerak)
  - Nutrients (Baltic Sea, North Sea, Atlantic)
  - Water Currents & Sediment by ADCP (DenHelder - Texel)

Data Availability in 2004
(core sensors)

Skagerrak (NIVA)
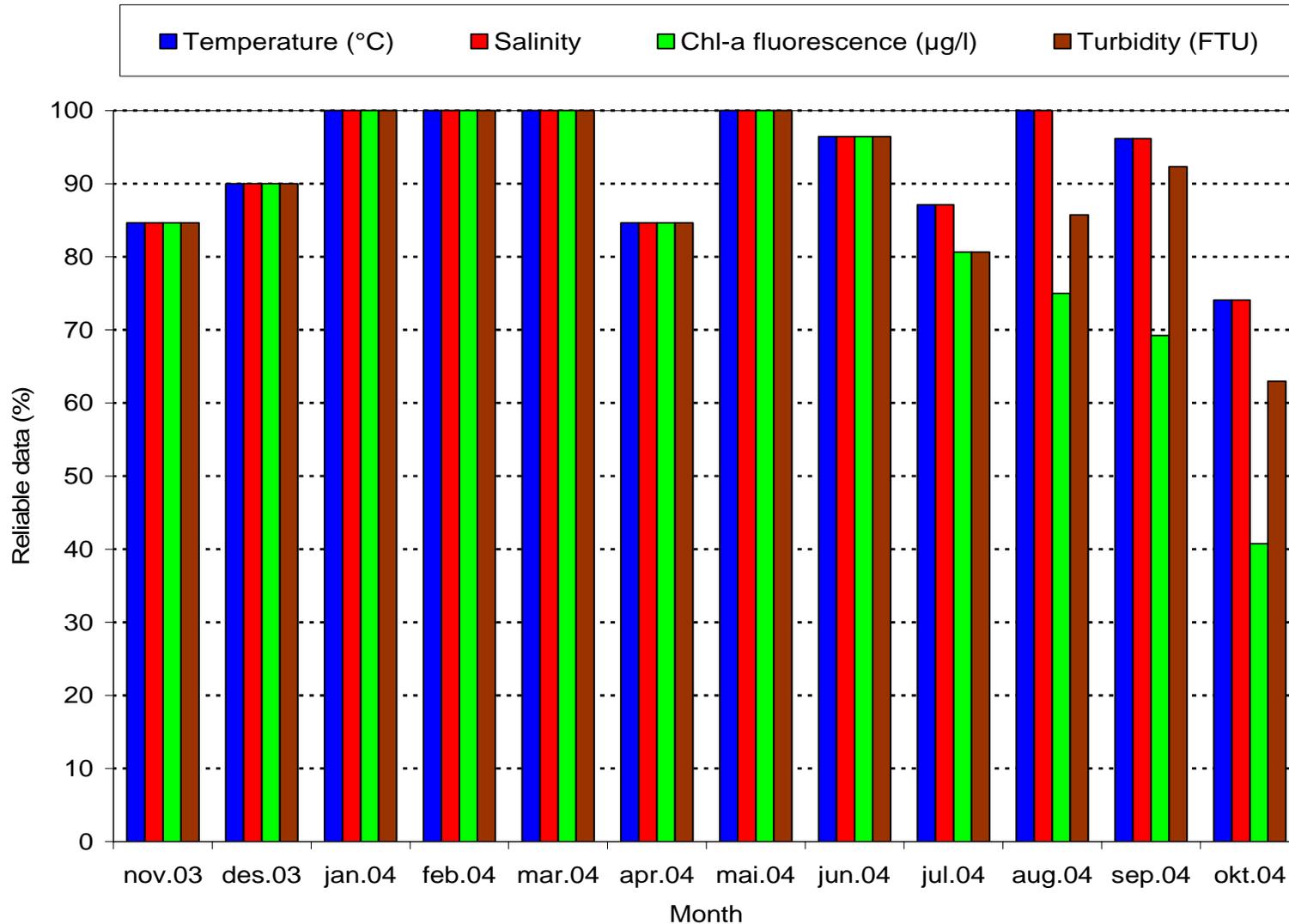
FerryBox
in the North Sea

Cuxhaven - Harwich

FerryBox
Cuxhaven - Harwich
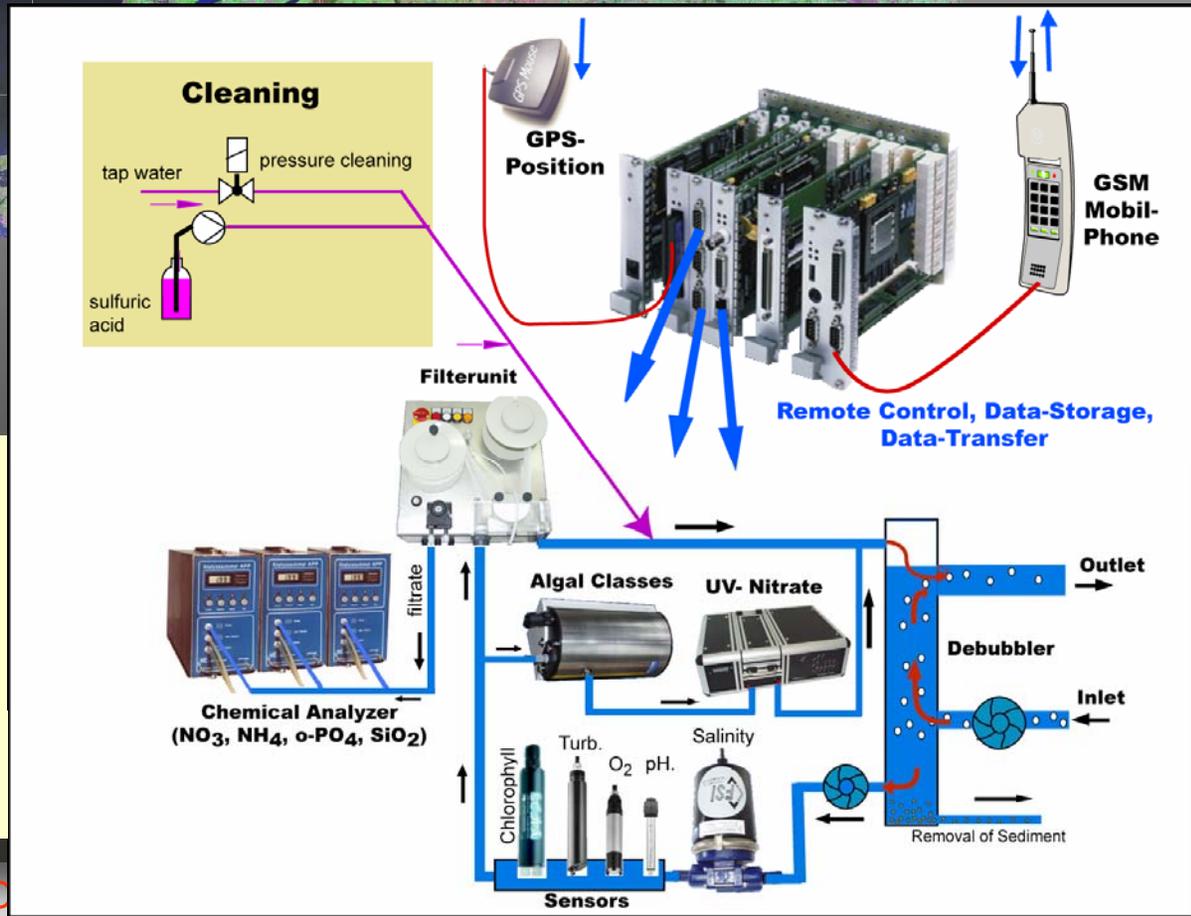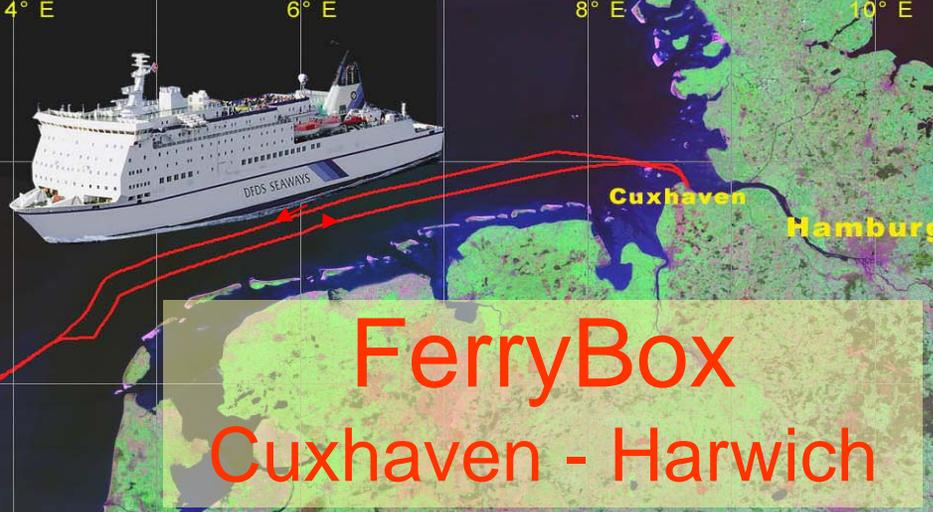
Measured Variables

- **temperature**
- **salinity**
- **turbidity**
- **chlorophyll**

- **oxygen,**
- **pH**
- **algae groups**
- **nutrients**

+ automatic water sampler for further lab analyis

Data from one Transect March 2004
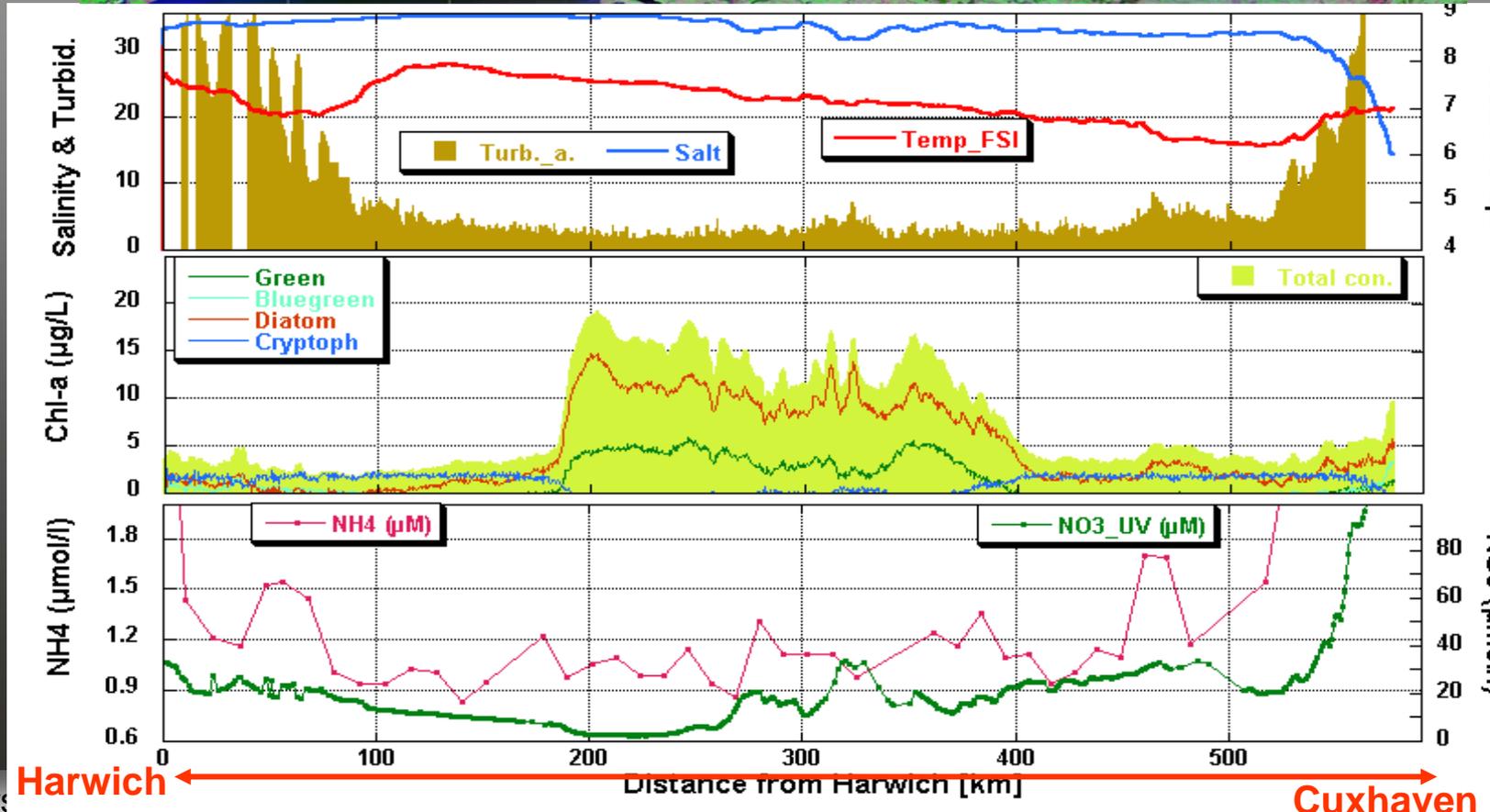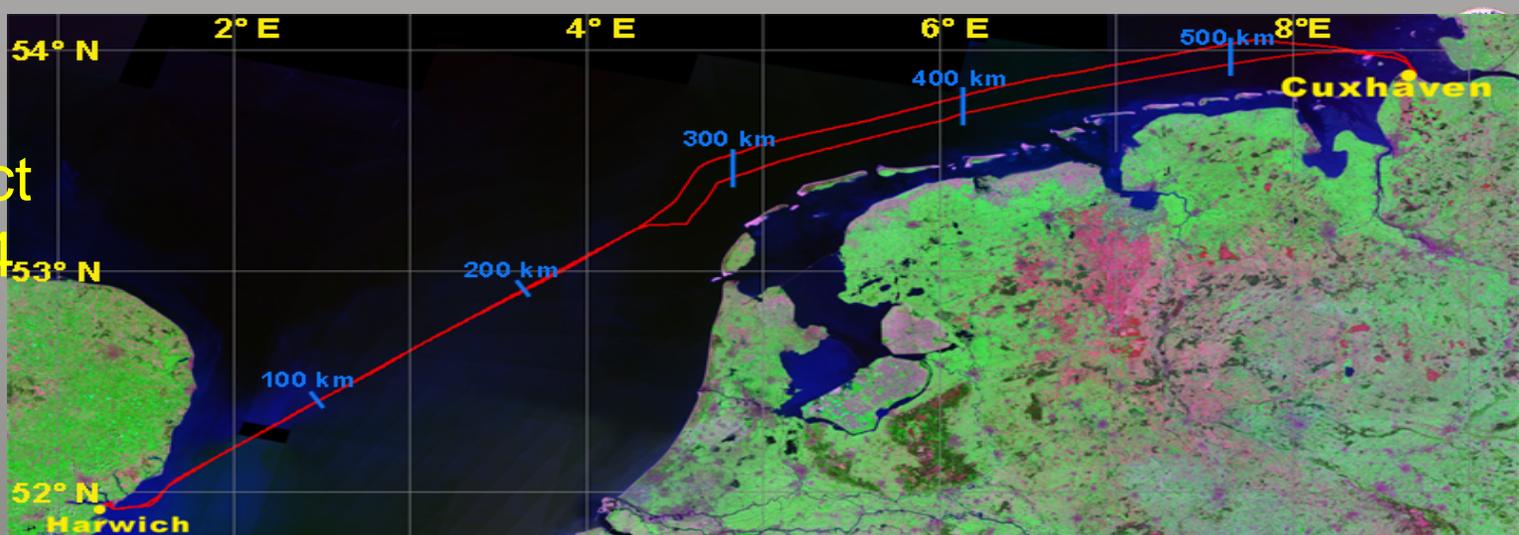
Remote Sensing and FerryBox

Red Tide (myrionecta rubra) in the German Bight August 2004

MERIS Algal 2

55°

Chl-a µg/l

24.75
6.0
3.0
1.1
0.5
0.33

6°   7°   8°   9°

MERIS Red Tide Index
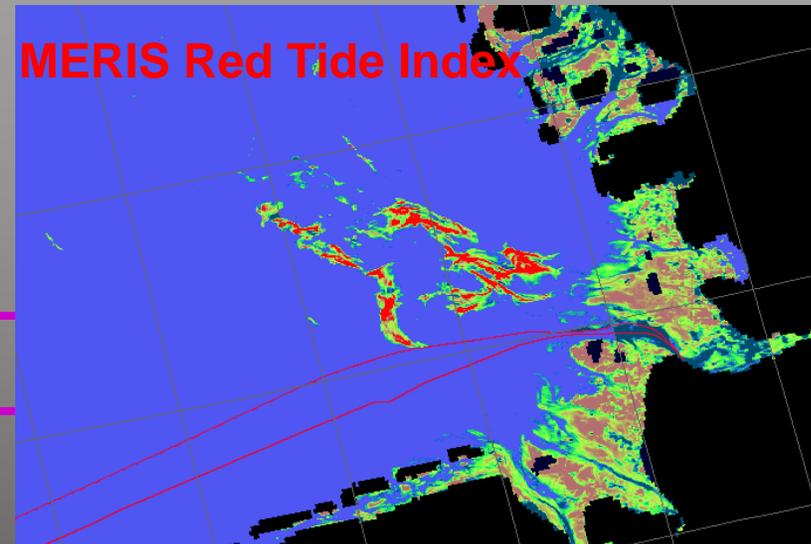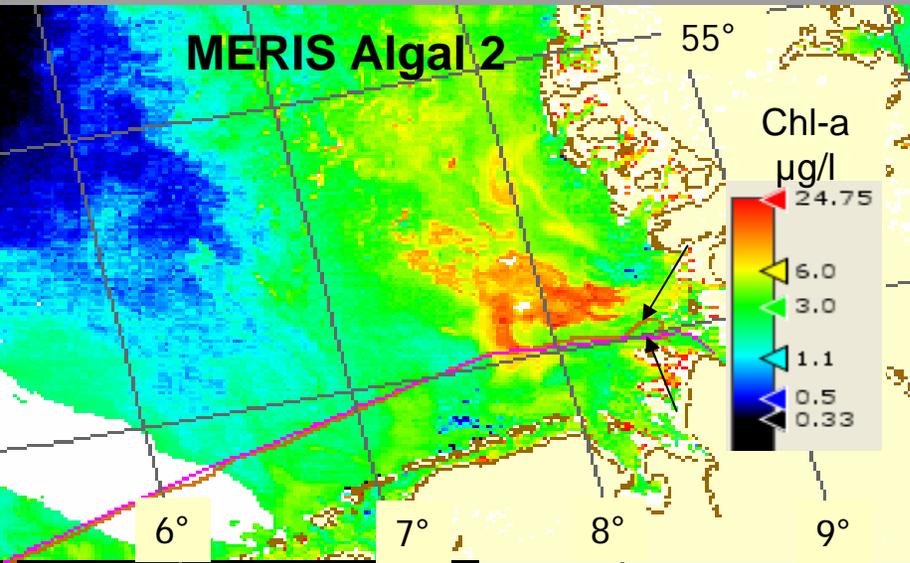
Comparison Algal_2 MERIS & Chl-a Fluor. FerryBox
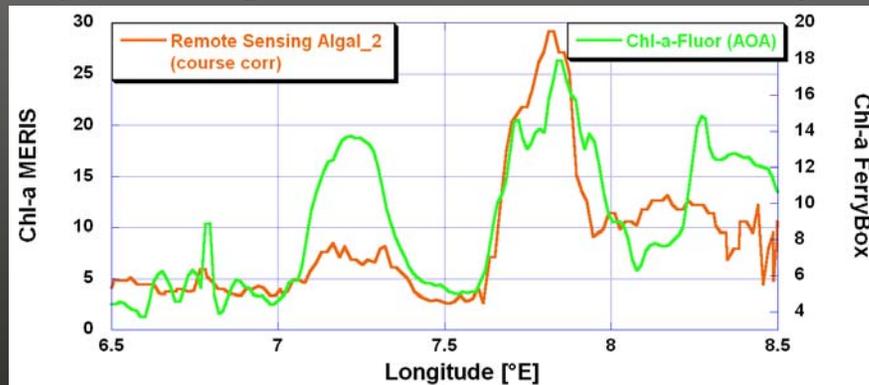
Oxygen & pH on the FerryBox Route
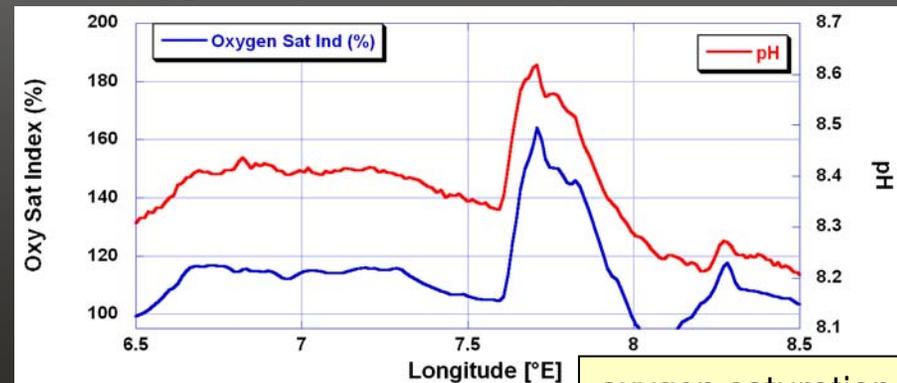
oxygen saturation up to 190%!

# Nutrients: Nitrate by UV-Detection

**Single transect
4. April 2005**
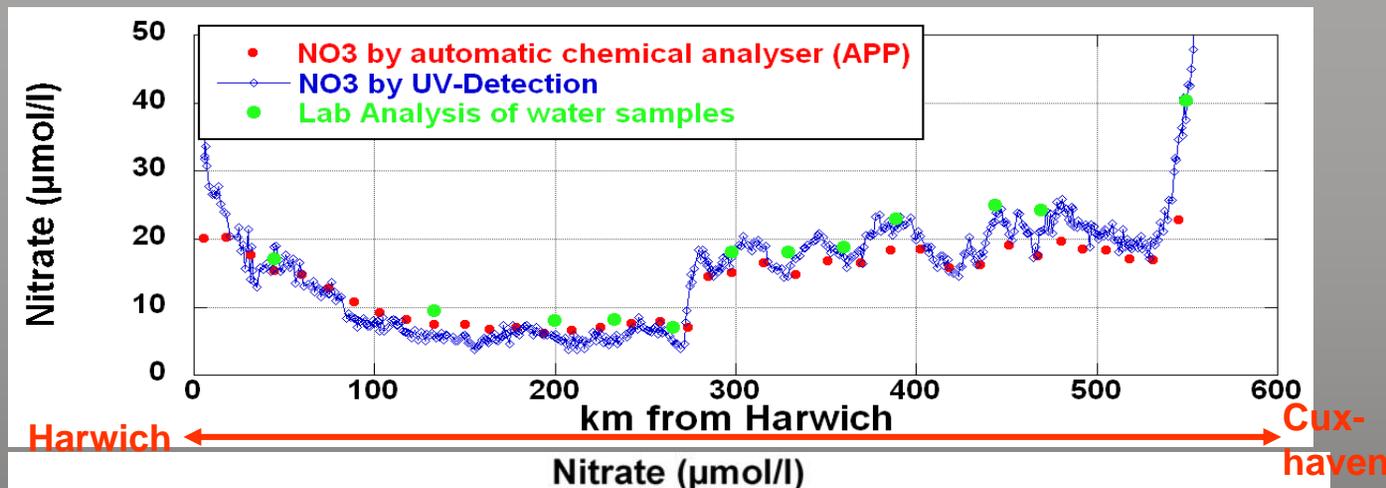
**Contour plot of
all NO3 transects
from March - April**

Algae Dynamic Spring 2005 I

Chlorophyll-a Fluorescence (µg/l)

pH_Value

Algae Dynamic Spring 2005 II

Chlorophyll-a Fluorescence (µg/l, log. scale)
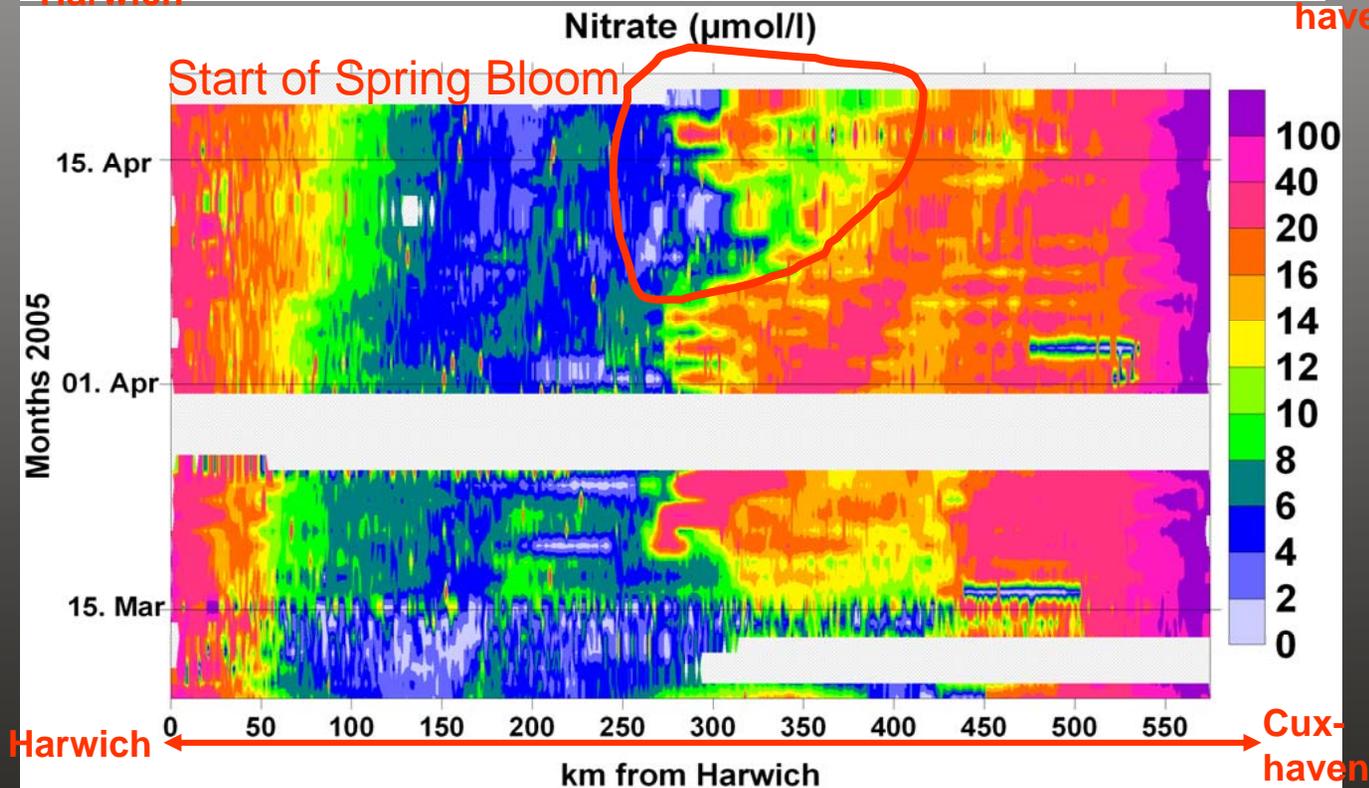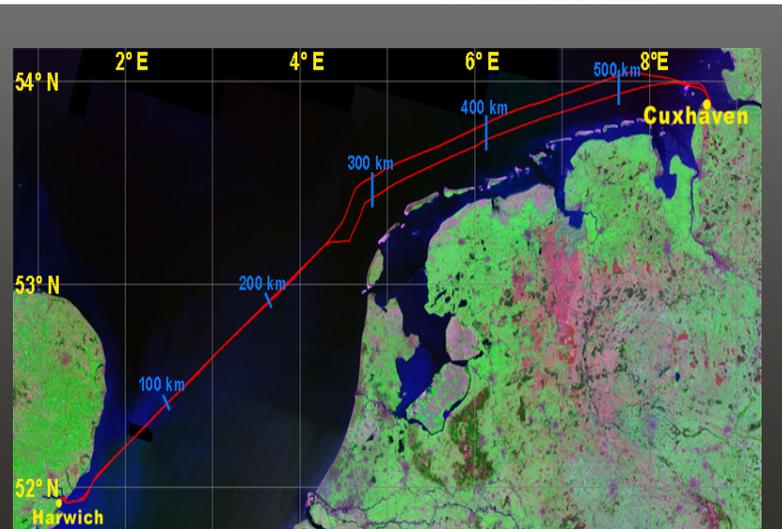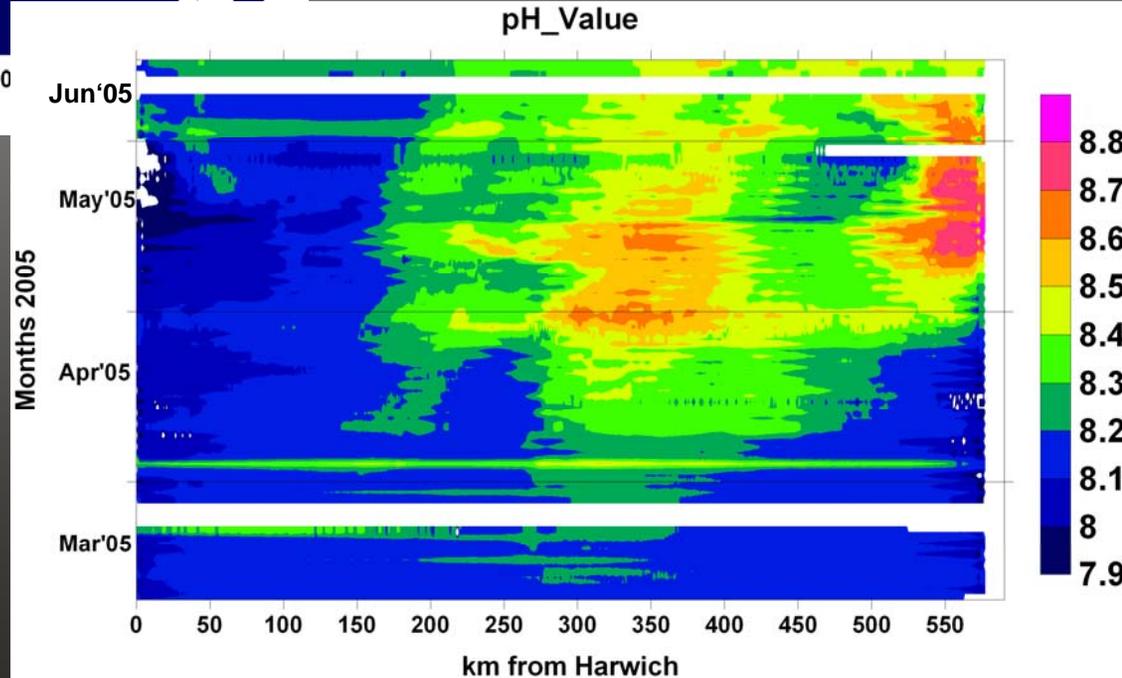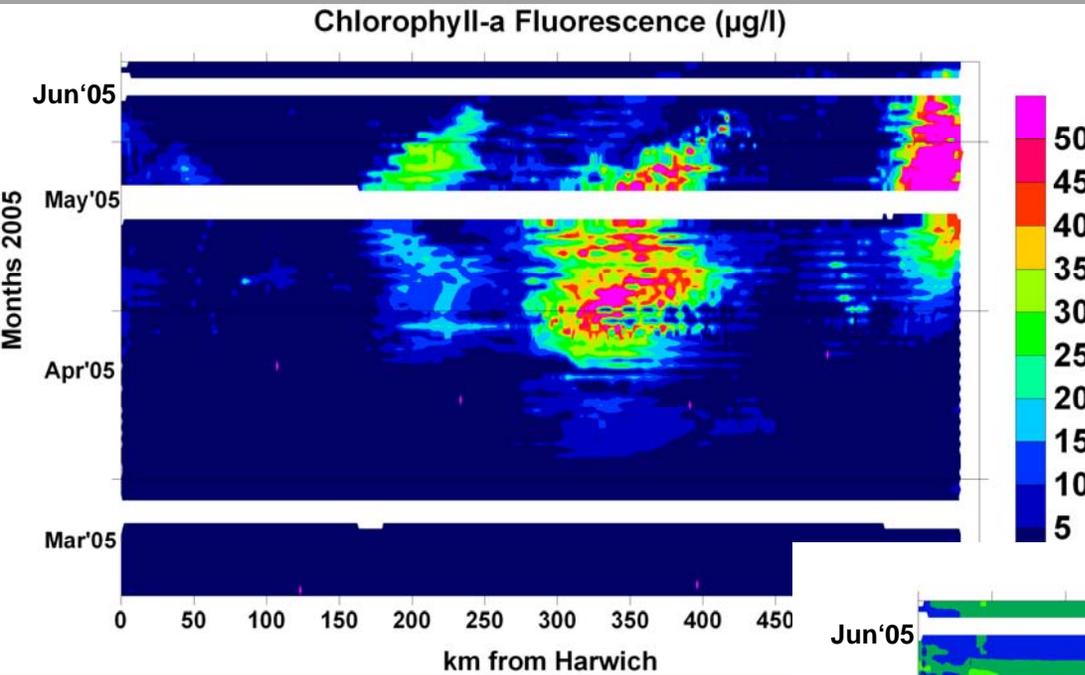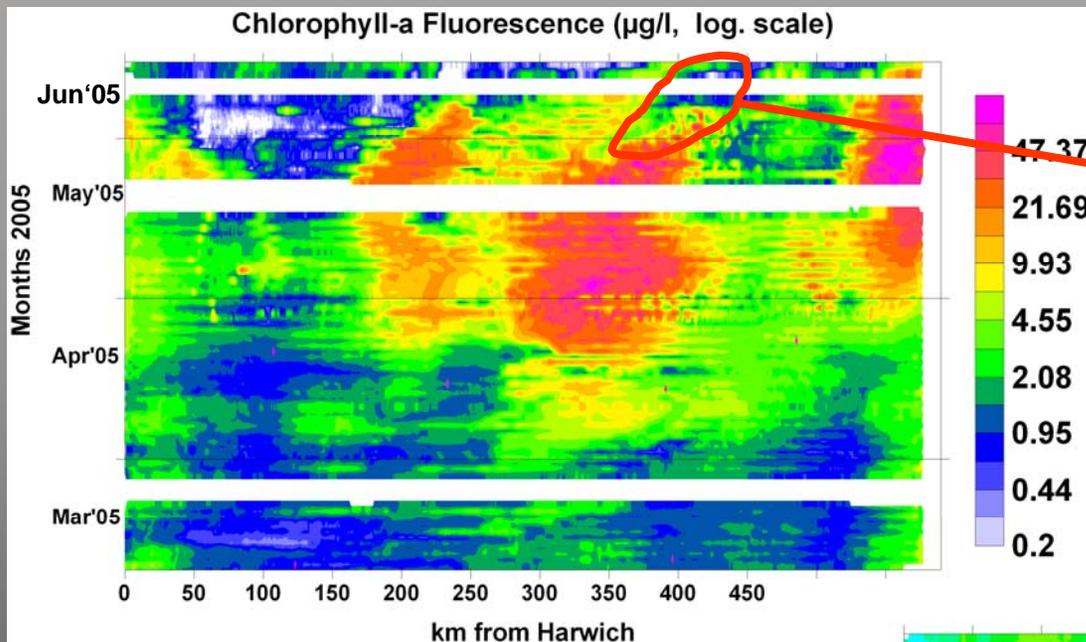
algae break-down ==> oxygen depletion

Oxygen-Saturation Index (%)
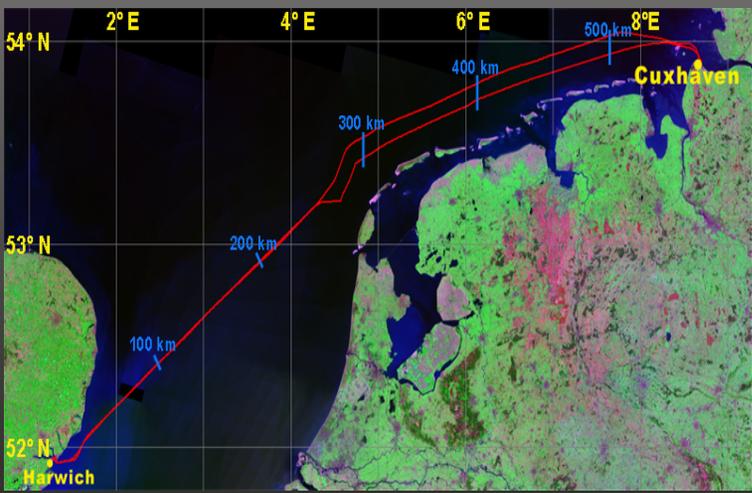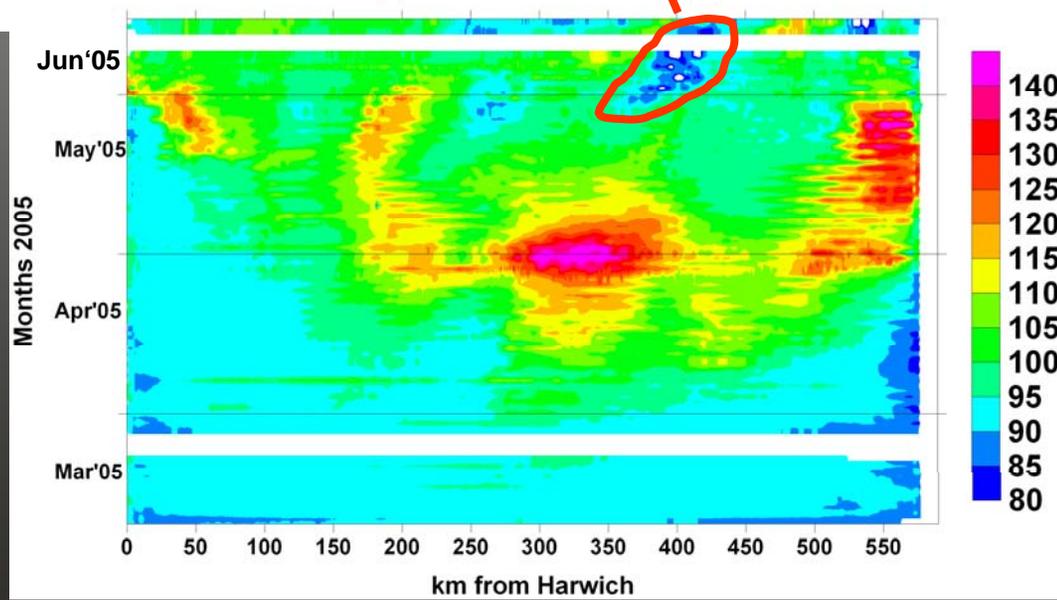
Remote Sensing & FB Data May 2005 I
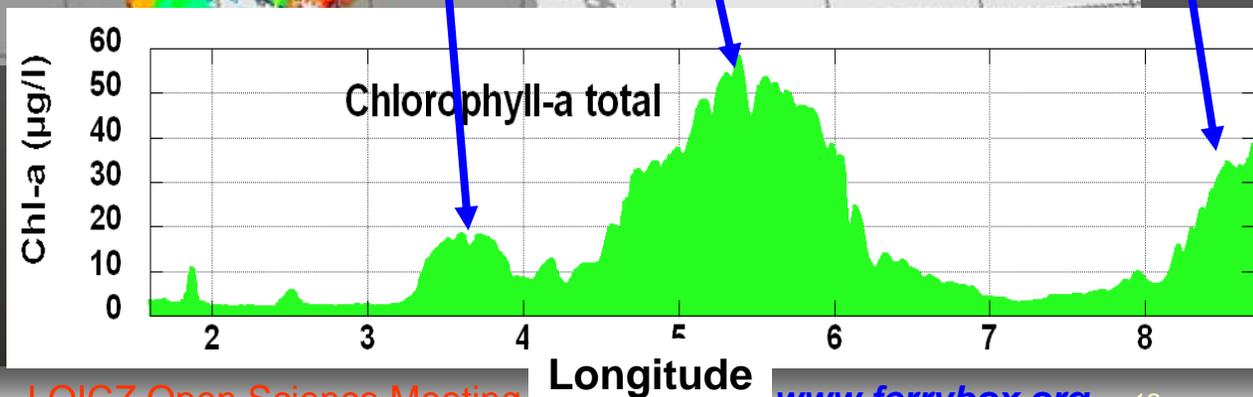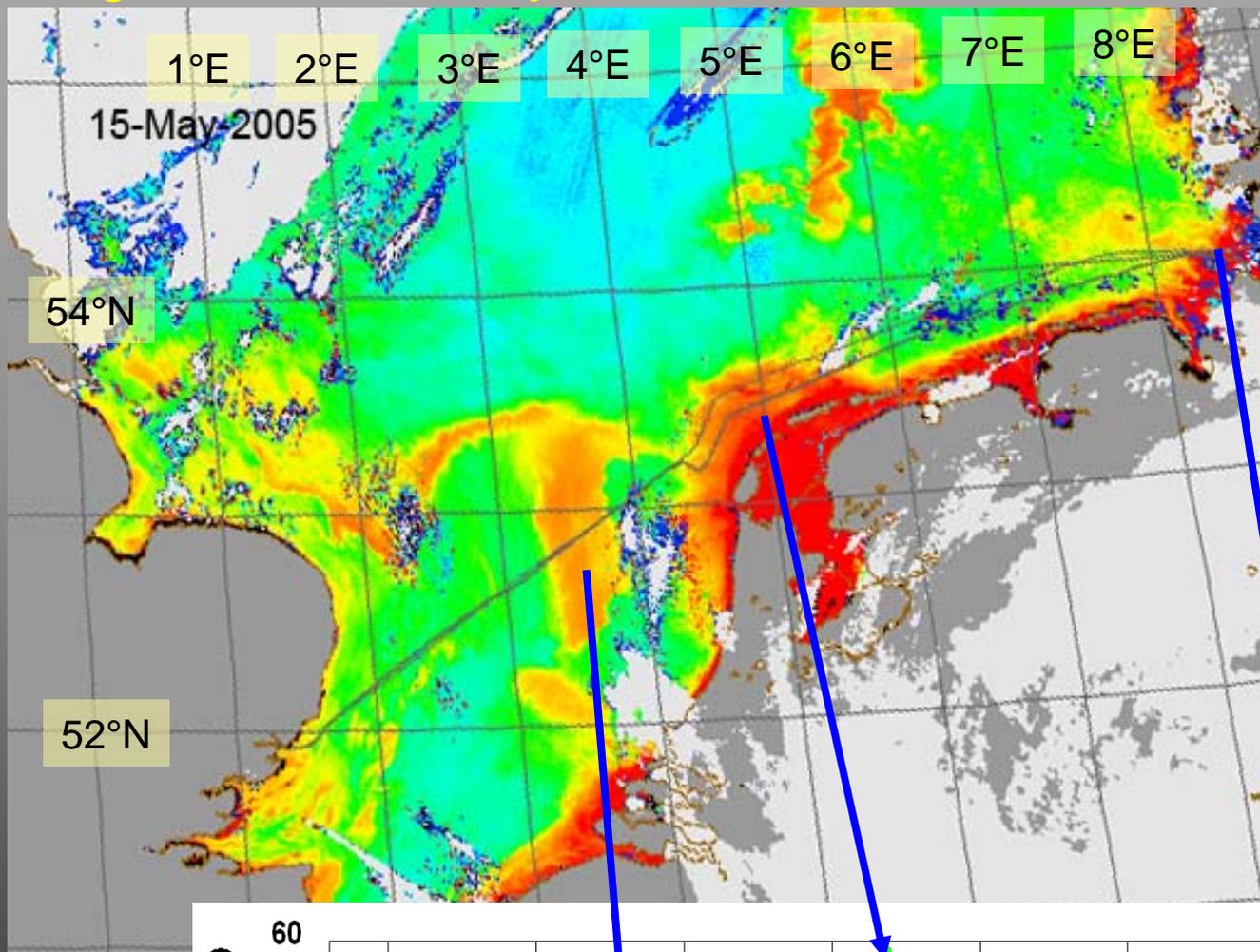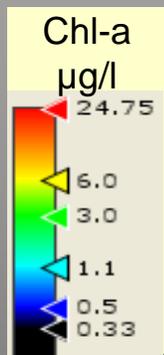

FerryBox
Chl-a Fluorescence

Comparison of Ferrybox Data with Fixed Stations by Application of a Hydrodynamic Model

### Position of fixed Stations in the Southern North Sea
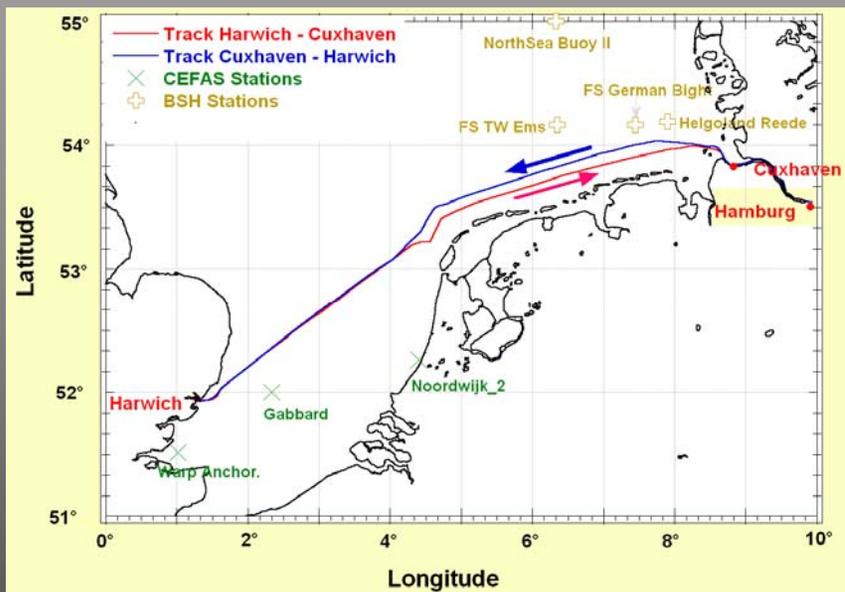
BAW Model
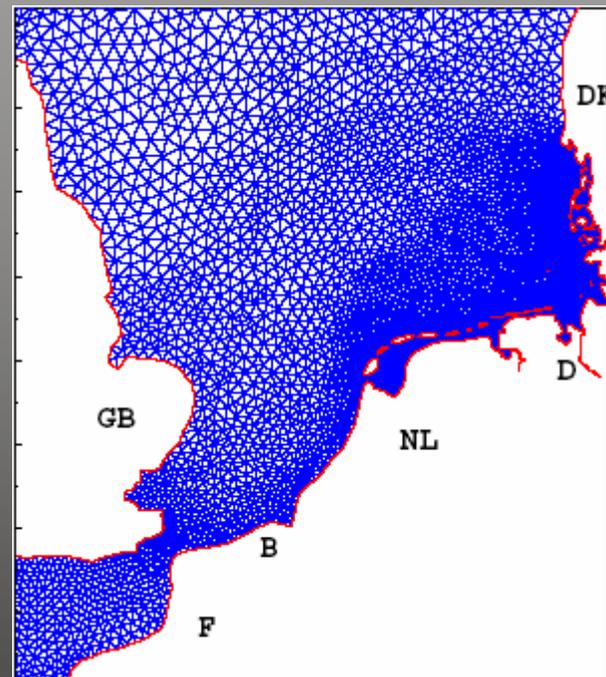
- two dimensional with triangle grid (Plüß, 1999)
- forcing with variable wind, Tides and coriolis force
- coupled nesting for estuary regions
- highest resolution of model southern German Bight 80 m
- lowest resolution of model Northern North Sea 3 km

Modelling Conservative Tracers by a Hydrodynamic Model (BAW North Sea Model)

Calculated watermass transport from Gabbard station to the FerryBox transect

Possible trajectories

Gabbard Buoy
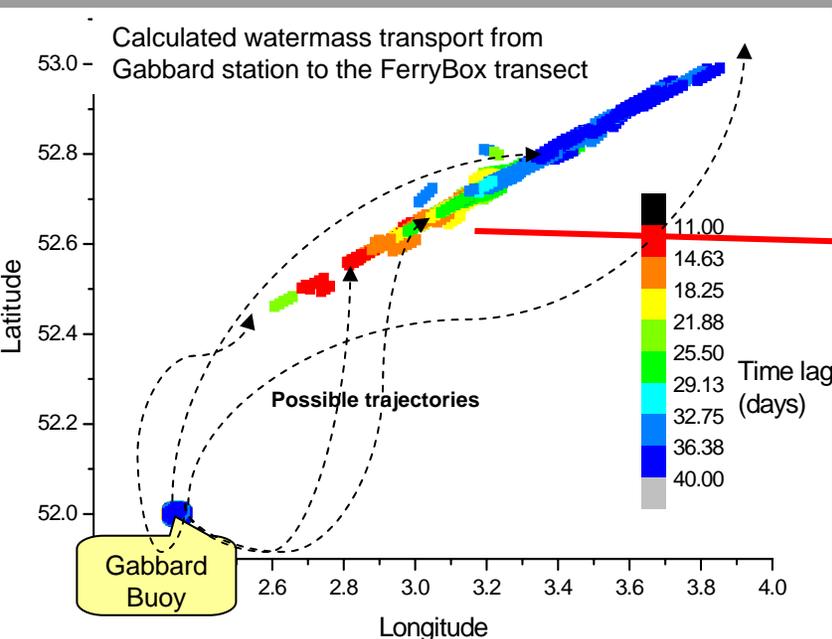
Comparsion of salinity at Gabbard Station with FerryBox data

Salinity (PSS78) at Gabbard Station

-coloured dots: Salinity data measured by the FerryBox in water masses coming from Gabbard station - (transport calculated by BAW model)
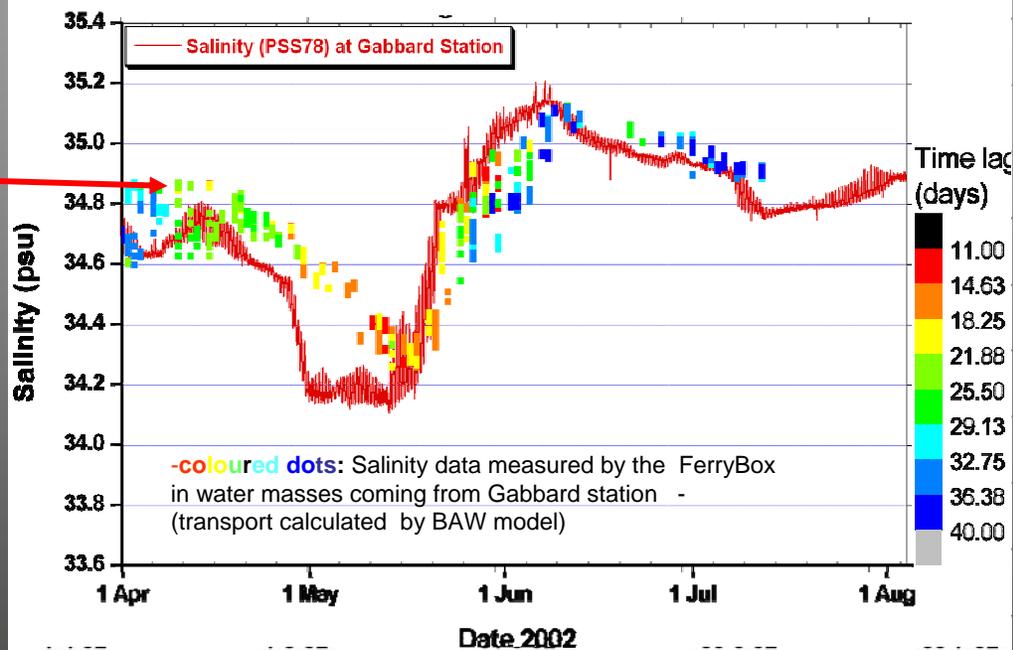
==> hydrodynamic models can be used to expand observations from a 'one-dimensional' FerryBox transect to a more spatial view

Time-Series Plot
Selection of the position on the map

FerryBox Database

Time-Series at selected position

Time-Series Plot
Plot of selected Parameter
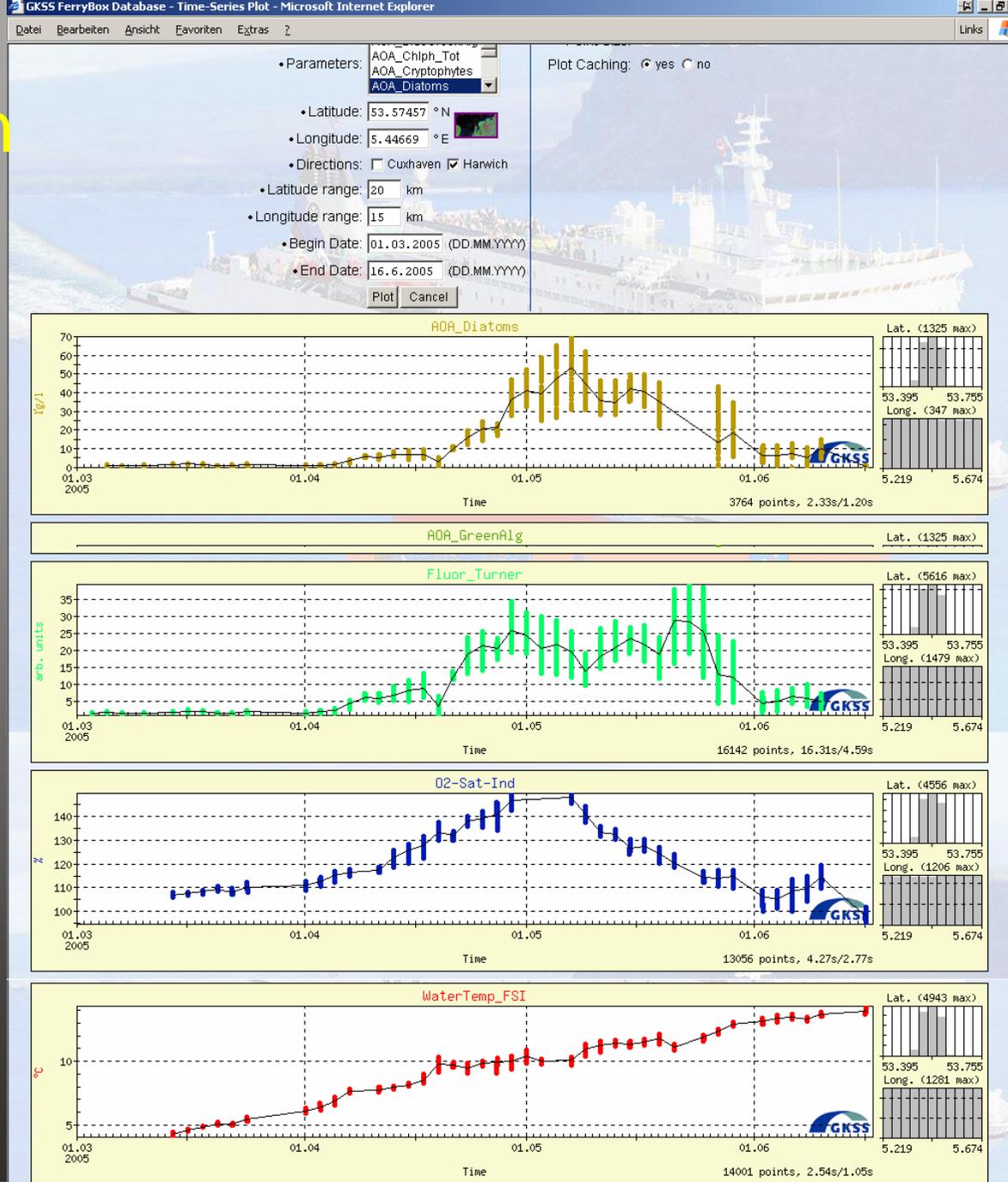
Conclusions

- The *FerryBox* systems within the EU project provide cost effectively high recovery of reliable highfrequent water quality data
- Automatically taken water samples for lab analysis provide further information (e.g. microscopic analysis of algae)

- Combination of *FerryBox* data with remote sensing and numerical models provides deeper insight in coastal processes

- Ferry Box systems can complement "conventional" monitoring from research ships, fixed stations and remote sensing