Presented at JERICO FerryBox workshop in Hamburg- Geesthacht 1-2 Sep. 2011

FerryBox on the route Gothenburg-Kemi-Oulu-Lübeck-Gothenburg – operational oceanographic and algal bloom monitoring of the Baltic Sea and the Kattegat

Underway system on R/V Argos since 1992

Bengt Karlson[1]
Fredrik Albertsson[1], Cia Hultcrantz[1], Marie Johansen[1], Henrik Lindh[2] Fredrik Waldh[2]
Agneta Fransson[3], Aron Hakonen[4], Leif Anderson[4], Stefan Hulth[4]
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[5]Marine Research Centre/State of the Marine Environment, Finnish Environment Institute (SYKE)

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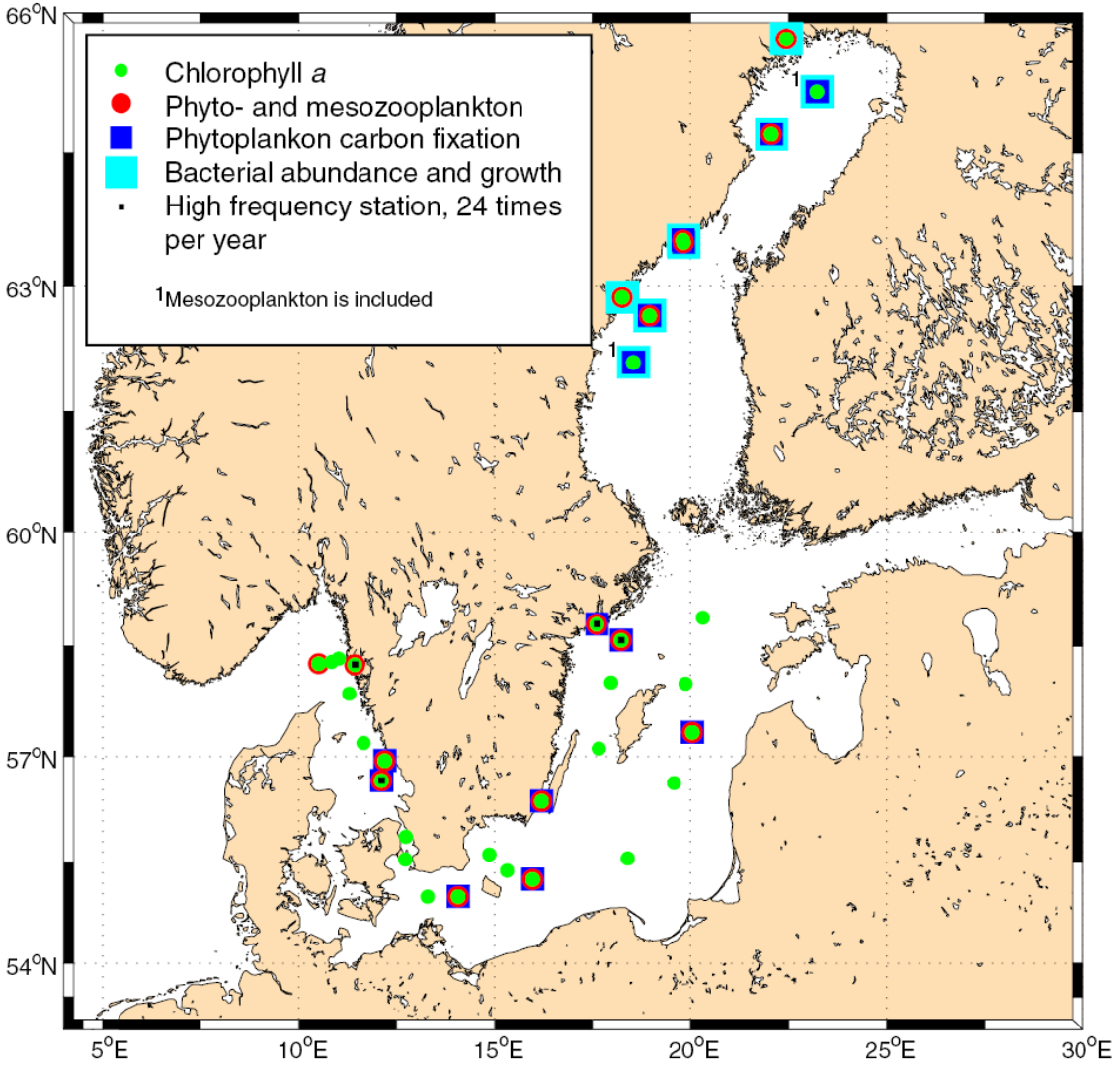
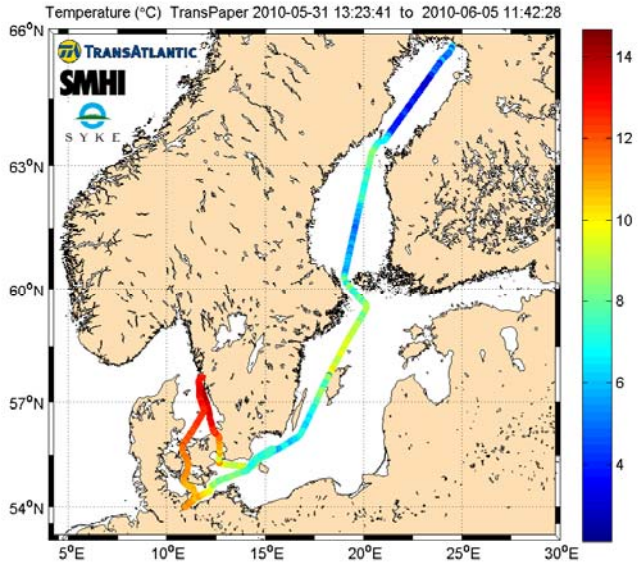
Stations with regular phytoplankton sampling in national monitoring programme



Frequency
monthly or
every two weeks

Collaboration between Sweden and Finland

Operation of FerryBox on TransPaper is a collaboration between the SMHI and Marine Research Centre of the Finnish Environment Institute SYKE and TransAtlantic AB.



Gothenburg-Kemi-Oulu-Lübeck-Gothenburg

TransPaper

- System established in 2009
- Operational since Feb. 2010
- Ship arrives in Gothenburg every Tuesday at present where service and collection of water samples is carried out

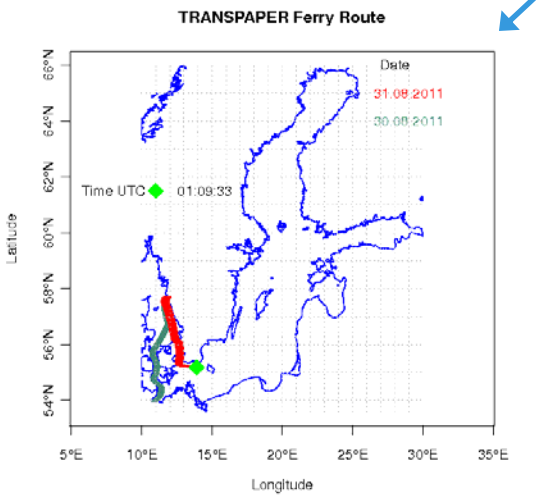
Data presented in near real time on the internet

Ship has satellite internet conncetion

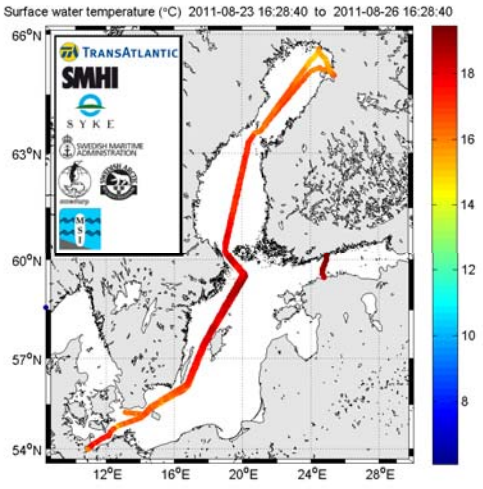
ftp transfer

SYKE

SMHI



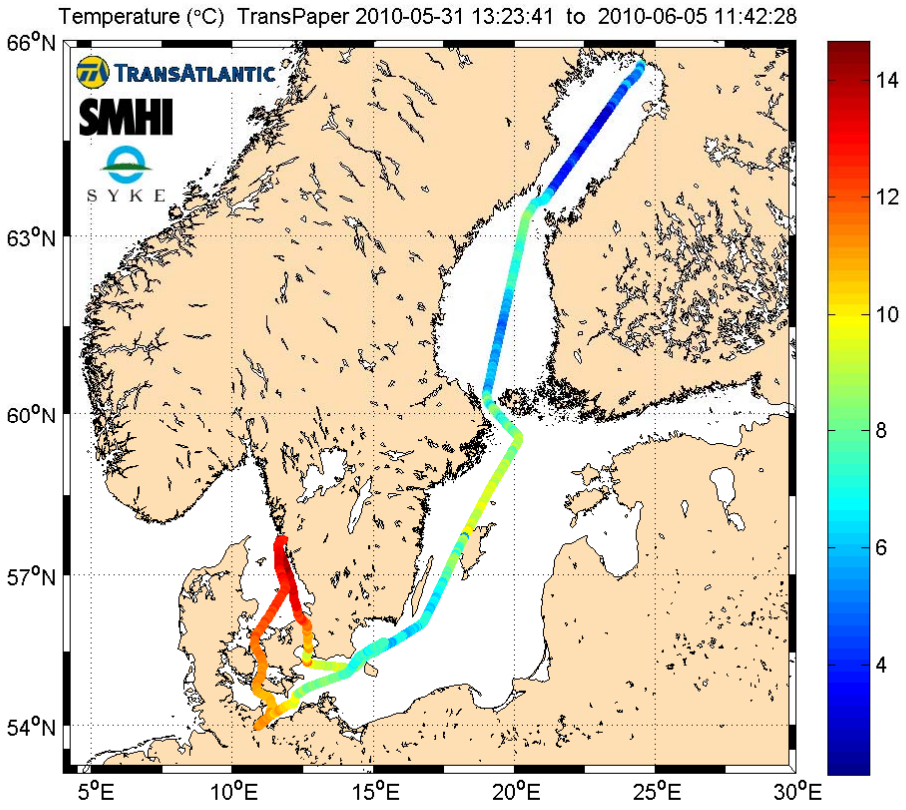
http://www.itameriportaali.fi/en/tietoa/algaline_seuranta/en_GB/mittaustulokset/



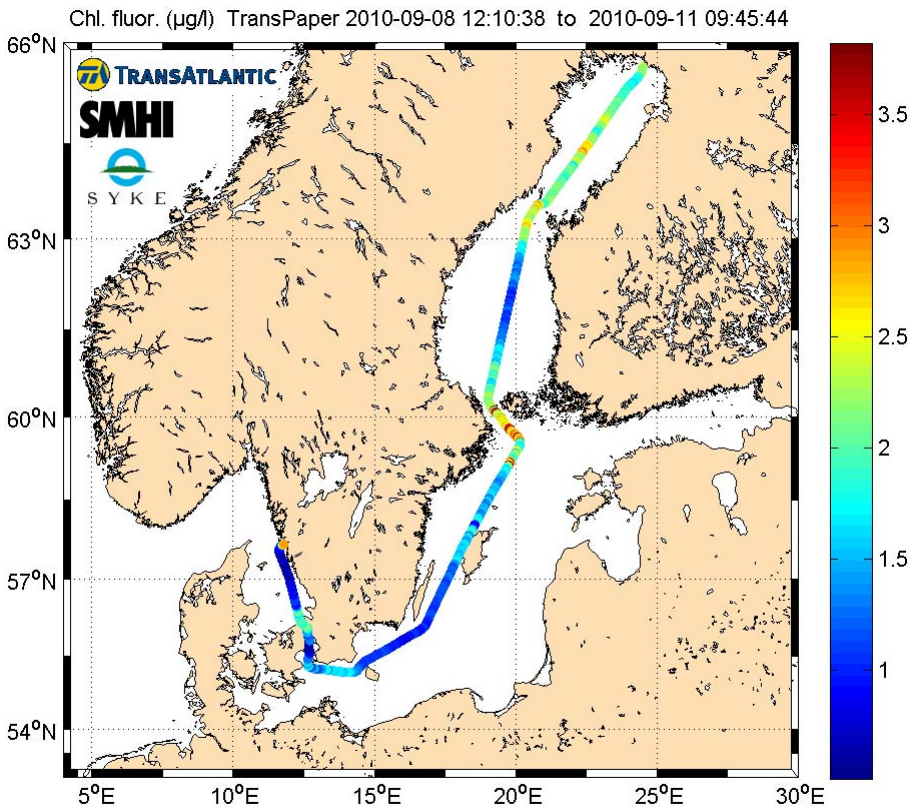
http://www.smhi.se

FerryBox TransPaper – routes 2010

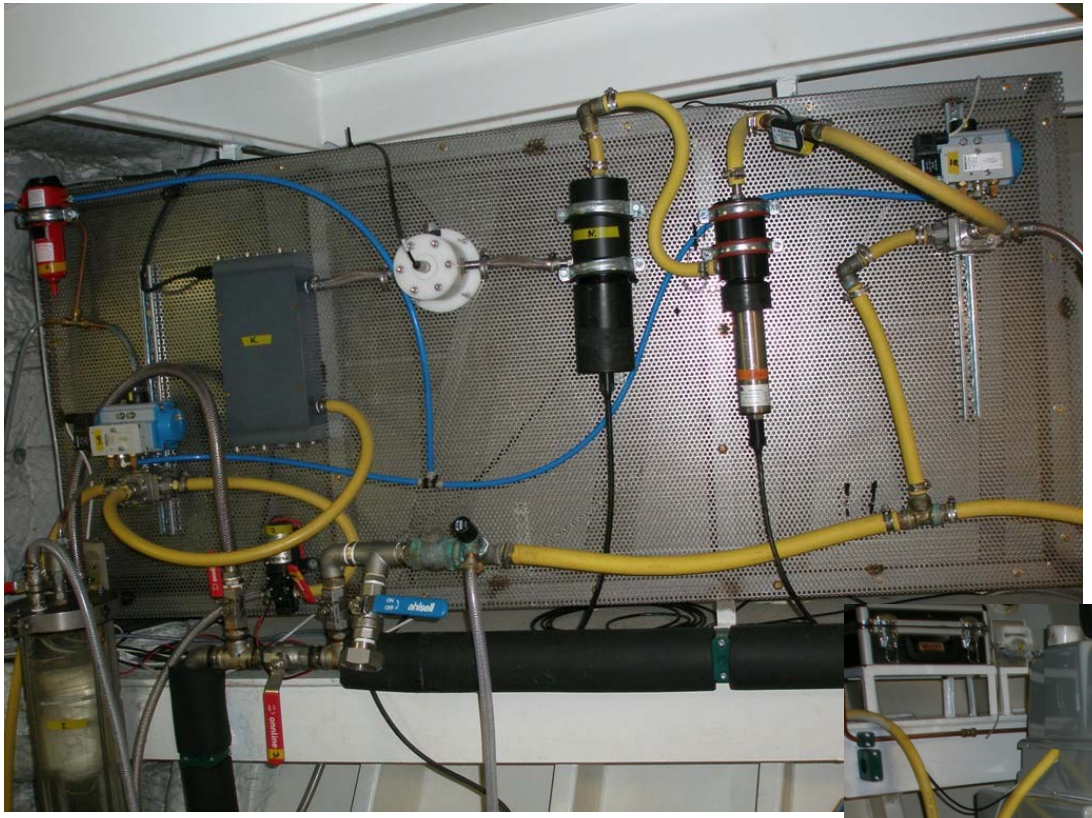
Jan-Aug



Sep-Dec



Flow through sensors and water samplers



pH and CO_2 system

General Oceanics CO_2-analyser

pH instrument (fluorescence based)

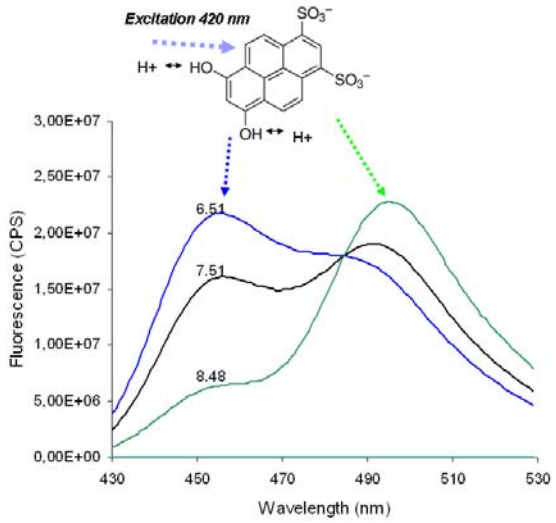
Reference gases for CO_2-analyser

A novel way to measure pH

SMHI

DHPDS fluorescence

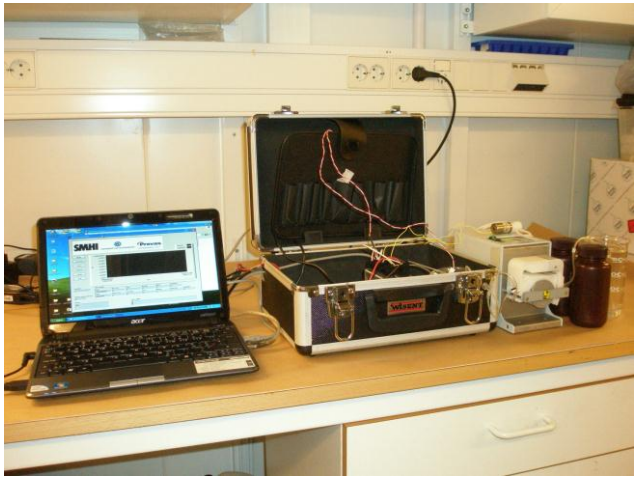
Excitation 405 nm



DHPDS = 6,8- dihydroxypyrene-1,3-disulfonic acid

Advantages with DHPDS

Wide dynamic range for pH
Wide salinity range
Single LED feature
Real and immediate fluorescence ratio with an RGB CMOS camera
pK_a^{app} ideal for seawater applications



System developed by Aron Hakonen, Leif Anderson and Stefan Hulth
Department of Chemistry, University of Gothenburg

Project focused on ocean acidification funded by the Swedish EPA

Sensors in air

In air measurements

- Air temperature
- Air pressure
- Irradiation (PAR, Photosynthetic Active Radiation)
- CO_2 content

Real time data

Flow through system

- Temperature near water inlet
- Conductivity
- Salinity (calculated)
- Chlorophyll fluorescence – phytoplankton biomass
- Phycocyanine fluorescence – cyanobacteria biomass
- CDOM fluorescence
- Turbidity
- Oxygen (optode)

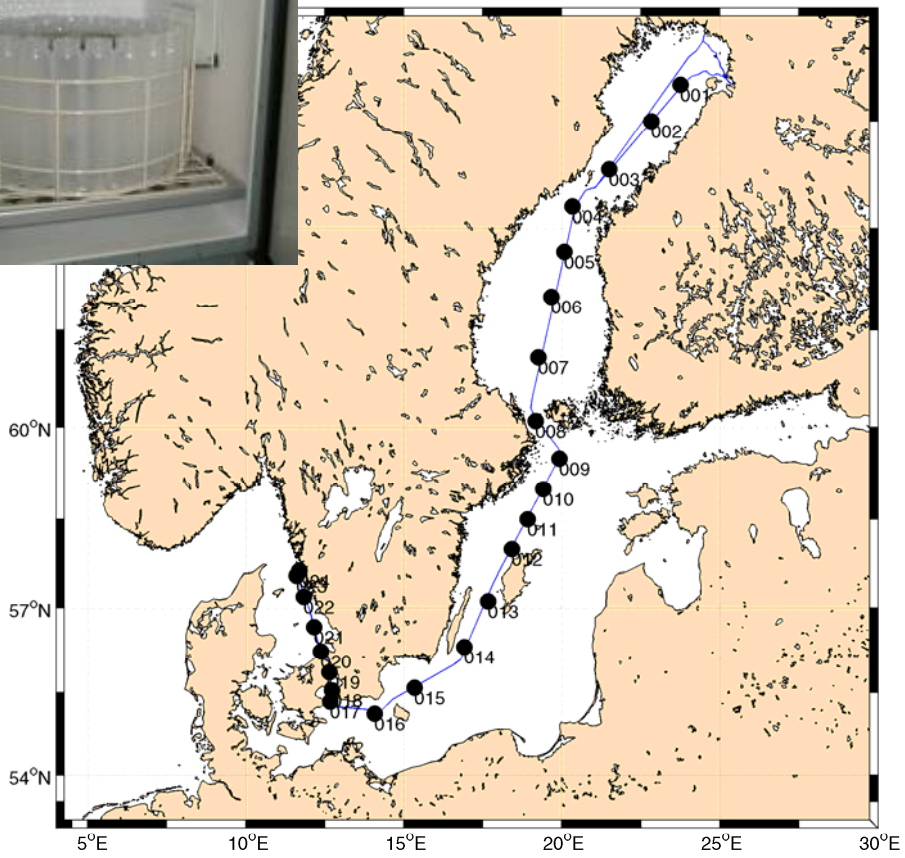
In air measurements

- Air temperature
- Air pressure
- Irradiation (PAR, Photosynthetic Active Radiation
- Position and time stamp (GPS)

- *Not yet operational*
- *High precision pH*
- *High precision pCO_2*

- CO_2 content

Automated water sampling



Sampling frequency

- Every two weeks

Parameters

12 locations (every 4 weeks)

- Salinity
- CDOM/humic substances

6 locations in the Kattegat-Öresund

- Chlorophyll a

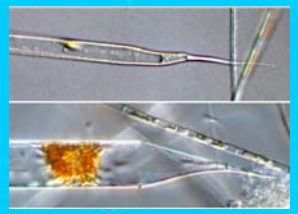
5 locations

- Phytoplankton
  (stations 7, 11, 13, 15 and 21)

Some harmful algal bloom species in Sweden

Photos: Bengt Karlson, Ann-Turi Skjevik, Lars Edler, Jahn Throndsen and Wenche Eikrem

not harmful



Pseudosolenia calcar-avis

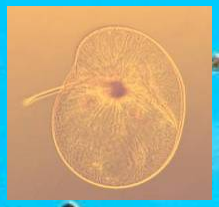
Nodularia spumigena

Chrysochromulina polylepis

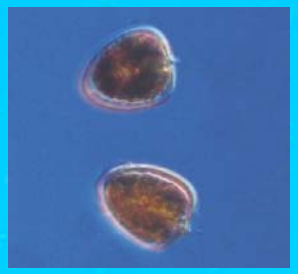
Pseudochattonella farcimen

Dinophysis spp.

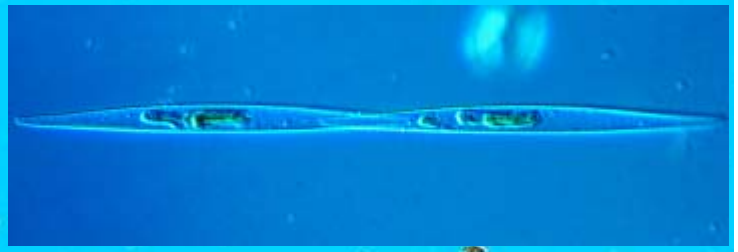
Alexandrium tamarense



Noctiluca scintillans



Prorocentrum minimum

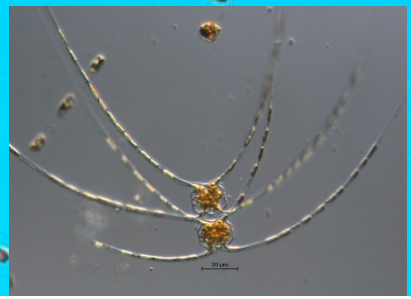


Pseudo-nitzschia sp.

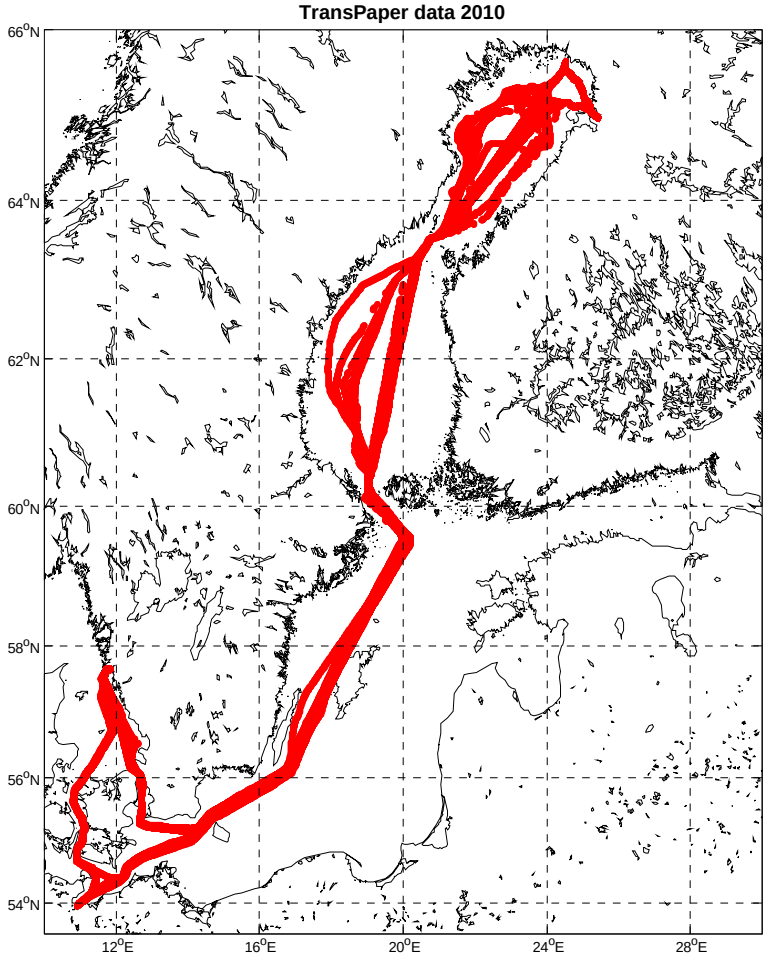
Karenia mikimotoi

Procentrum redfeldii
= P. triestinum

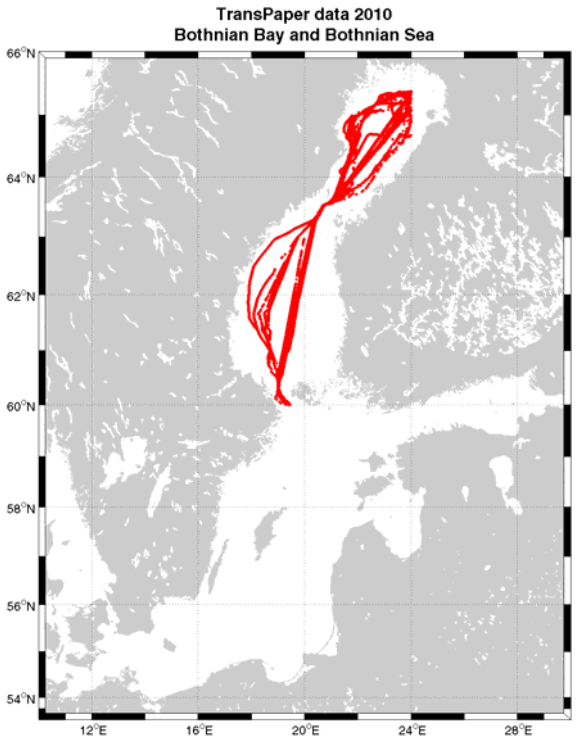
Chaetoceros concavicornis

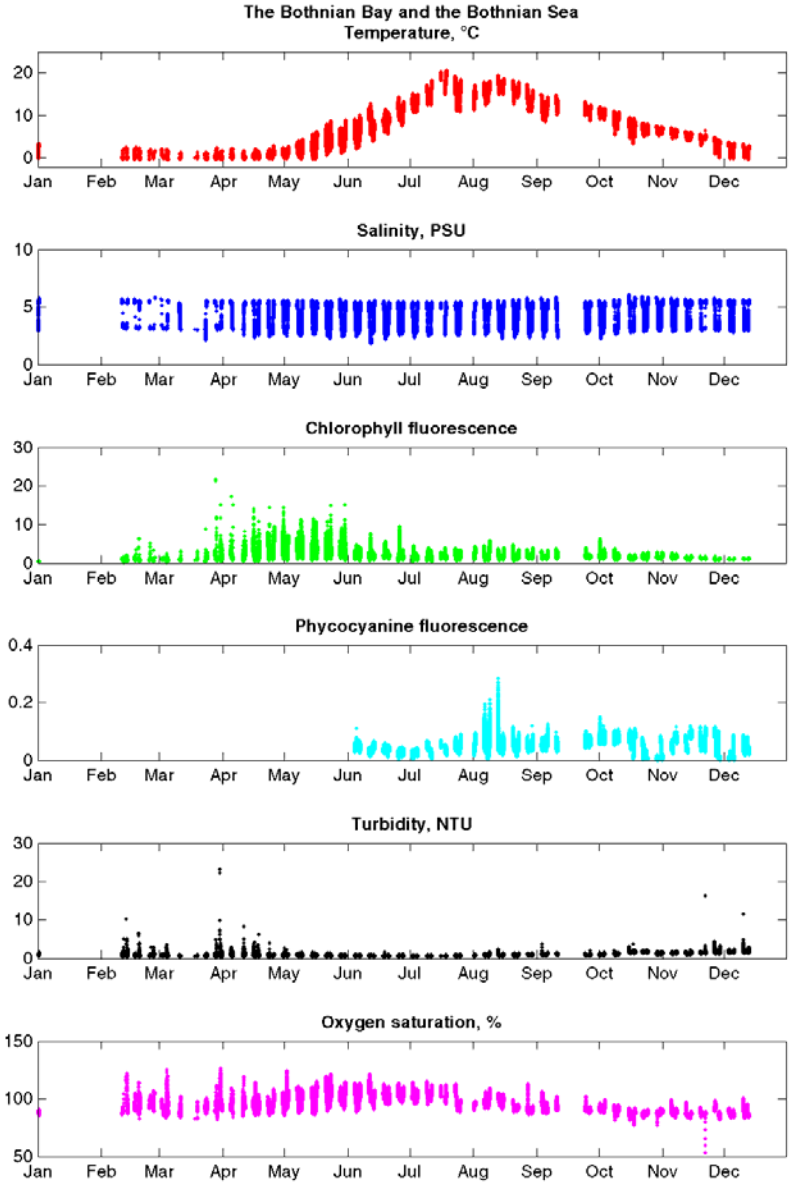


Real route 2010

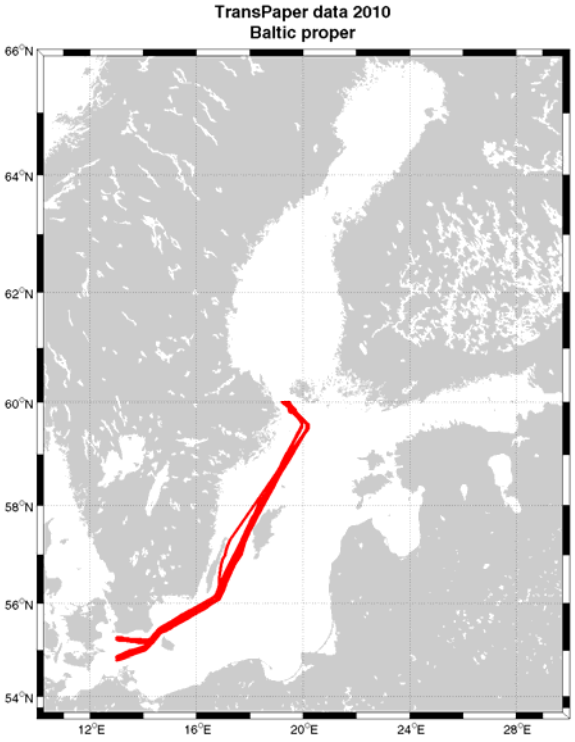


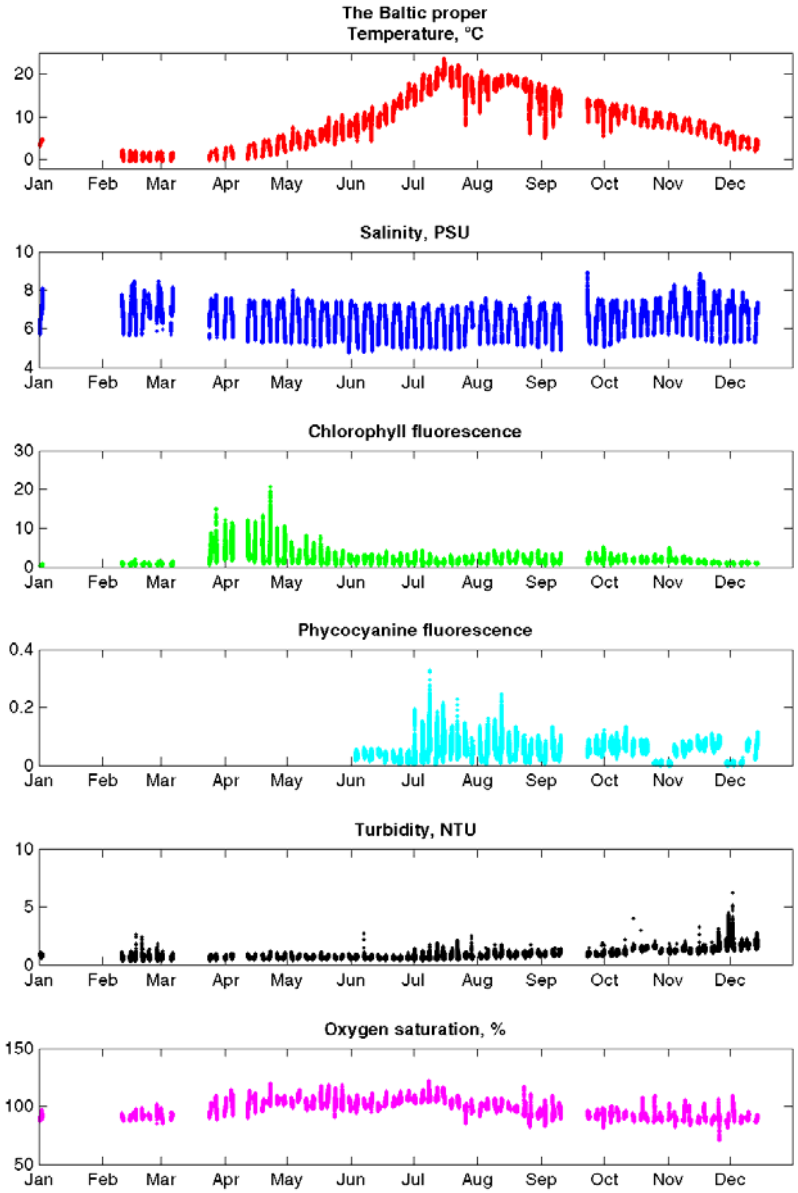
Overview of results the Bay of Bothnia 2010



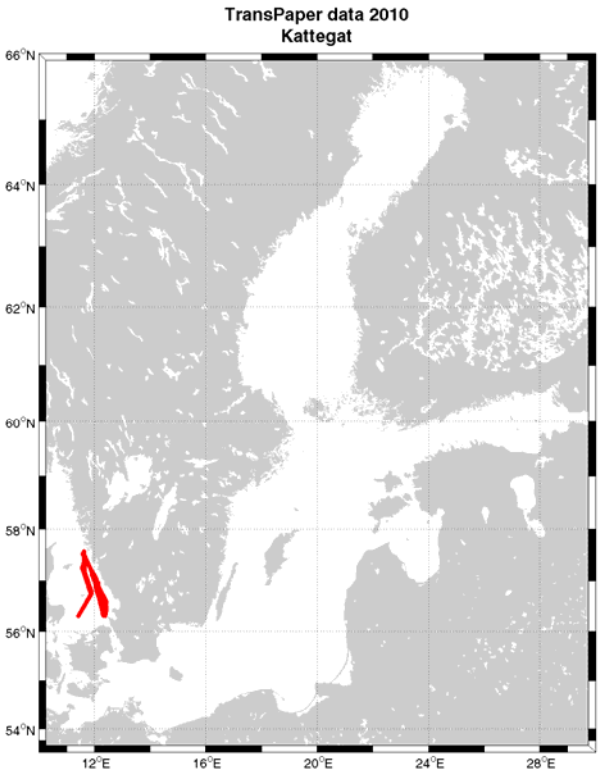


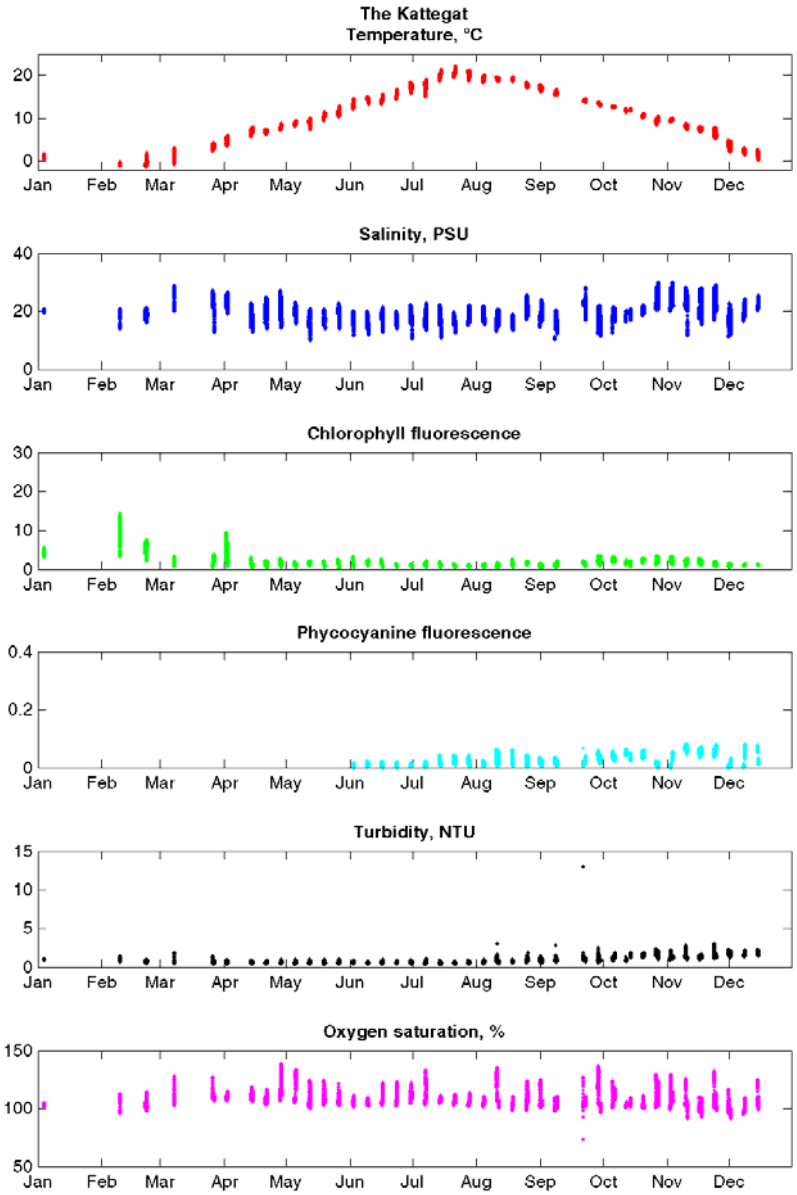
Overview of results the Baltic proper 2010





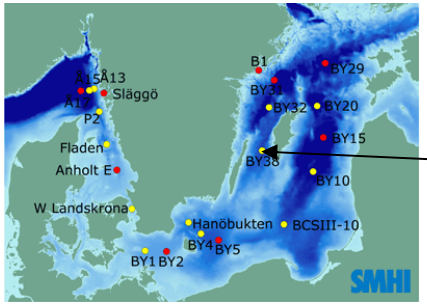
Overview of results the Kattegat 2010

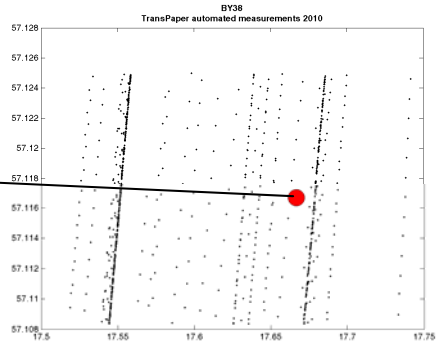


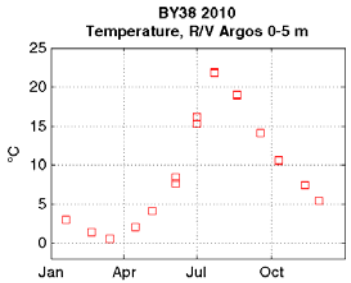


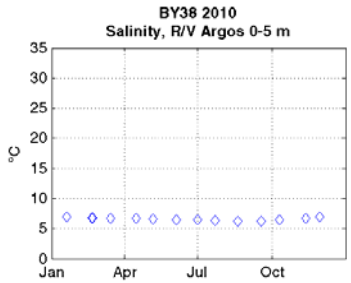
FerryBox results compared to data from water samples from research vessel

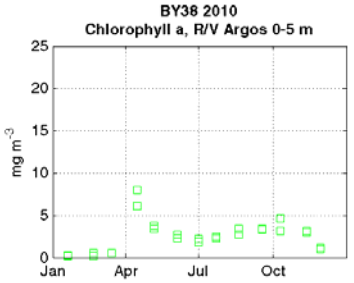
BY38 Karlsö deep

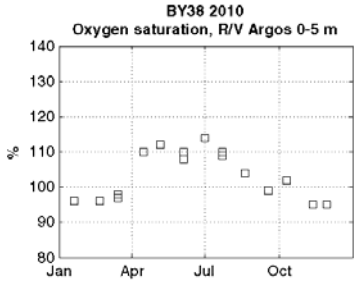


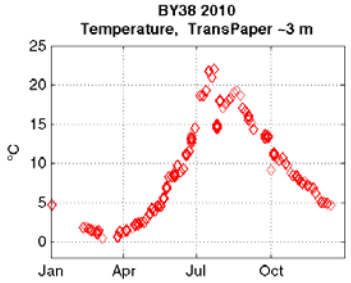


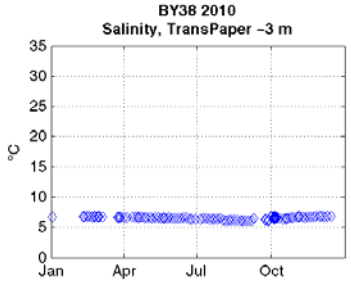


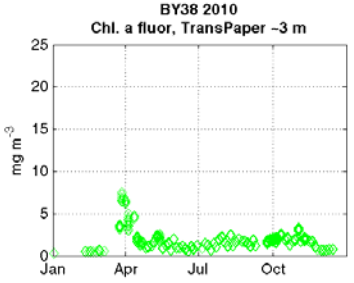


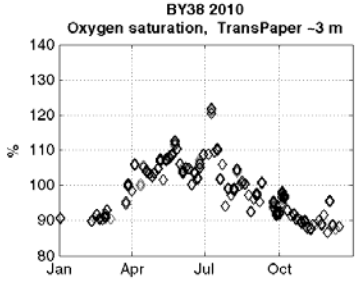






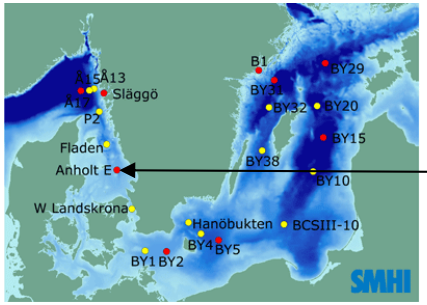


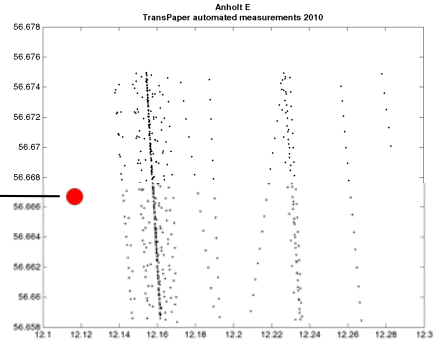


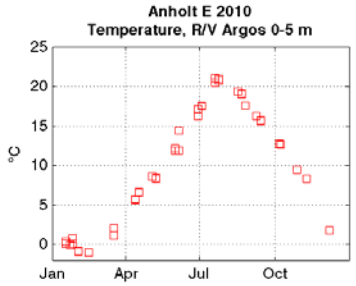


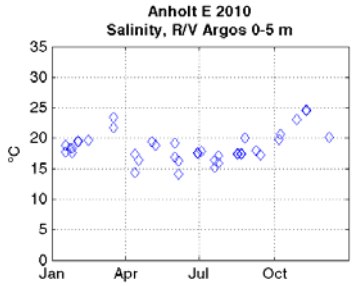
FerryBox results compared to data from water samples from research vessel

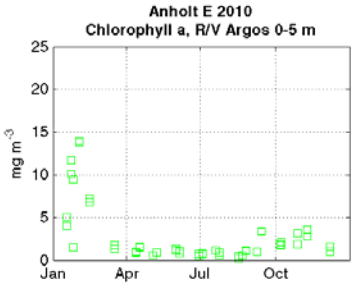
Anholt E

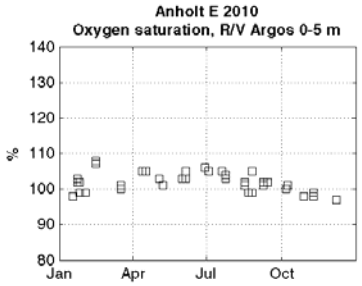


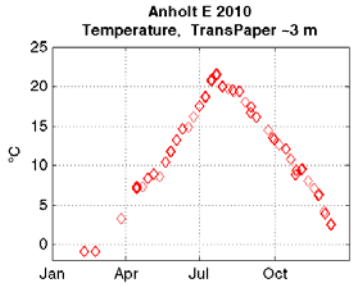


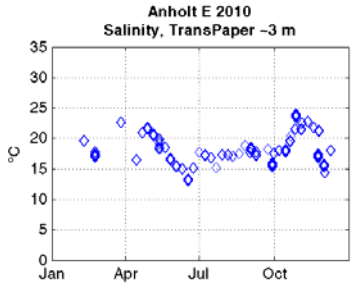


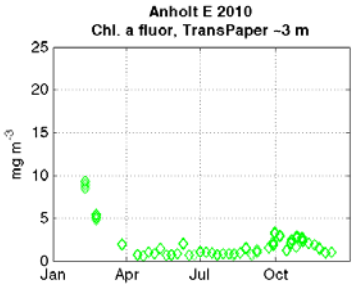


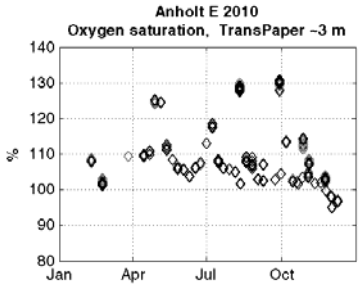












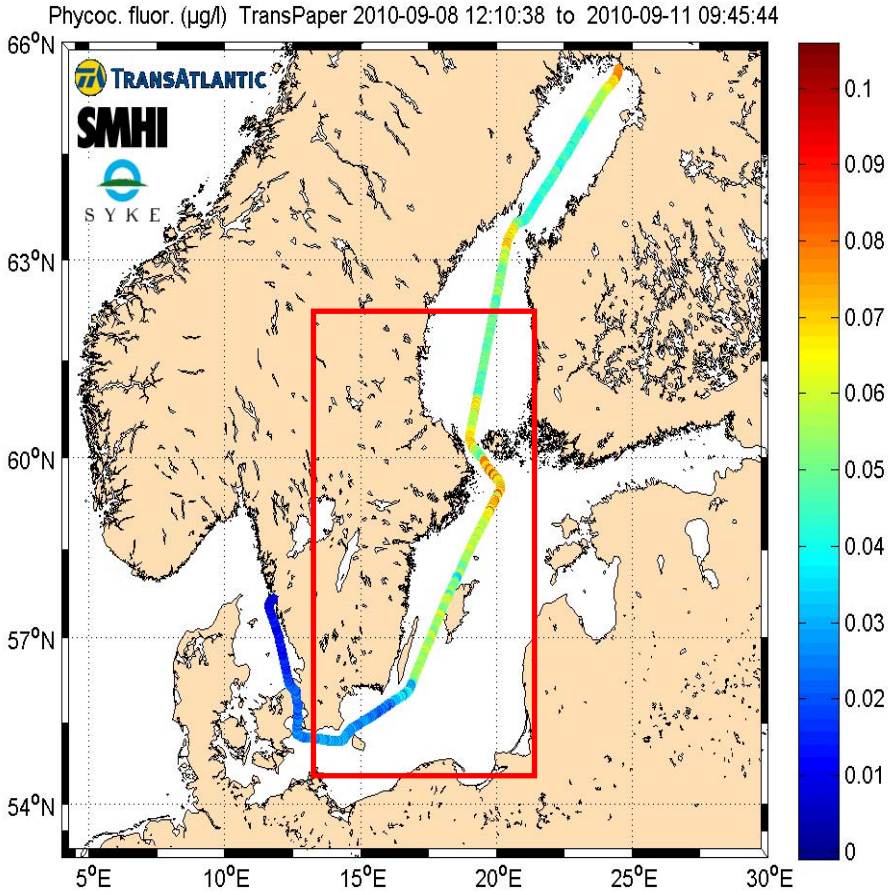
Cyanobacteria monitoring using FerryBox

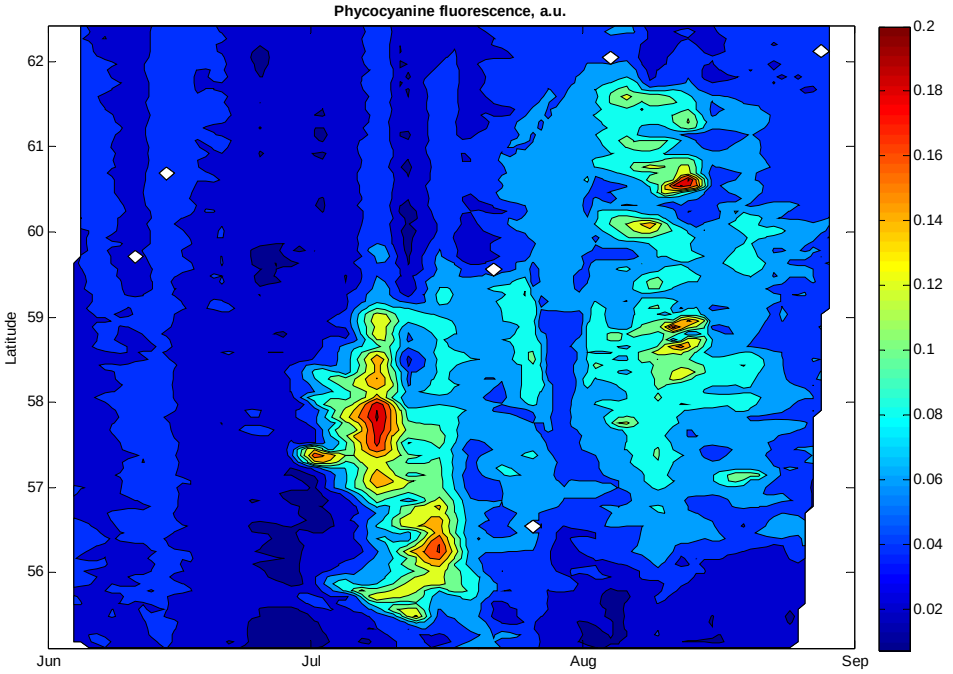
- Automated water sampling for microscope analysis of phytoplankton
- Phycocyanin fluorescence – a proxy for cyanobactieria biomass
- Temperature
- Phosphate concentration (not yet implemented)

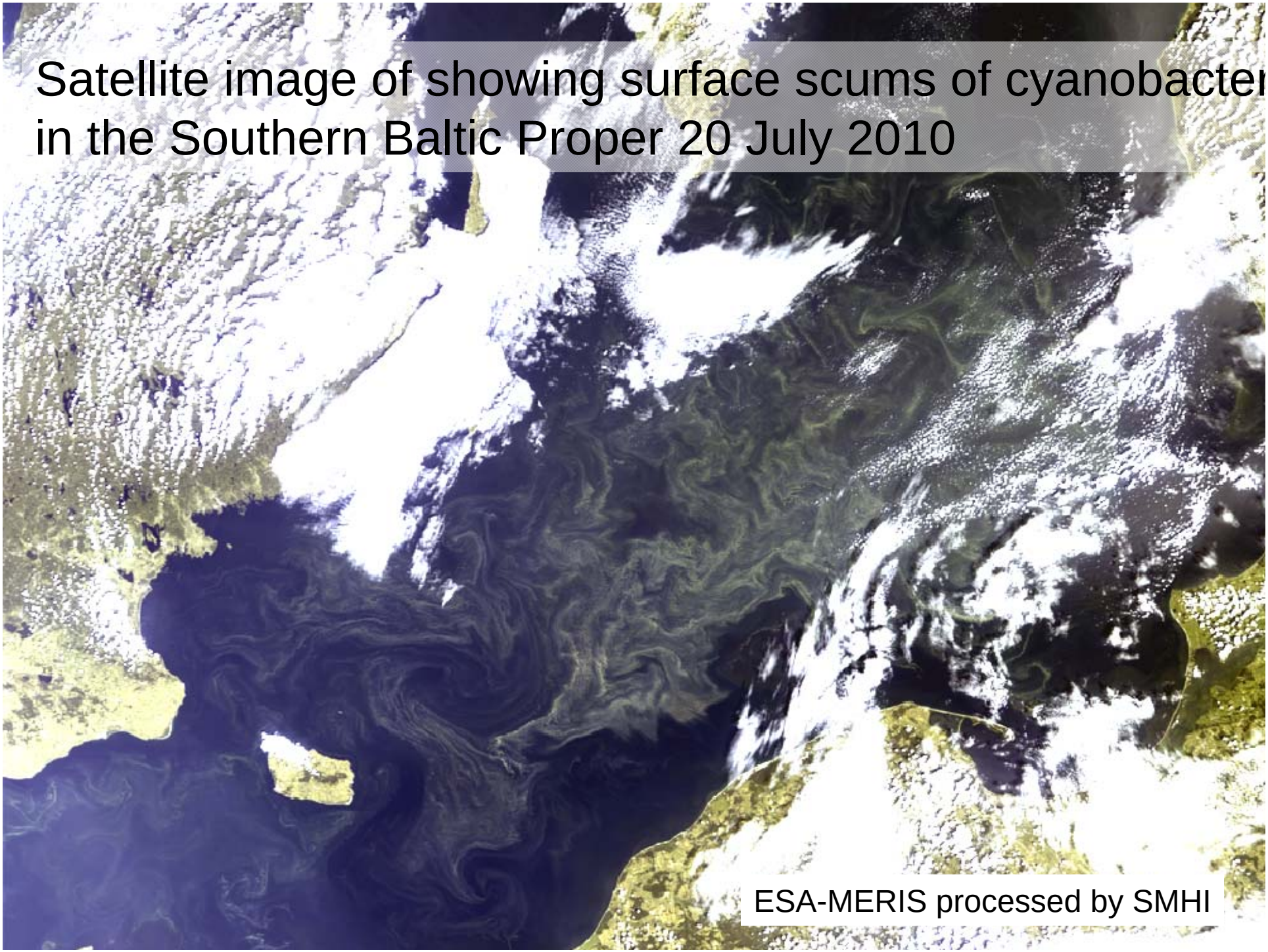
Cyanobacteria bloom at north cape of Öland 2006

Photo by Swedish Coast Guard, Air Patrol

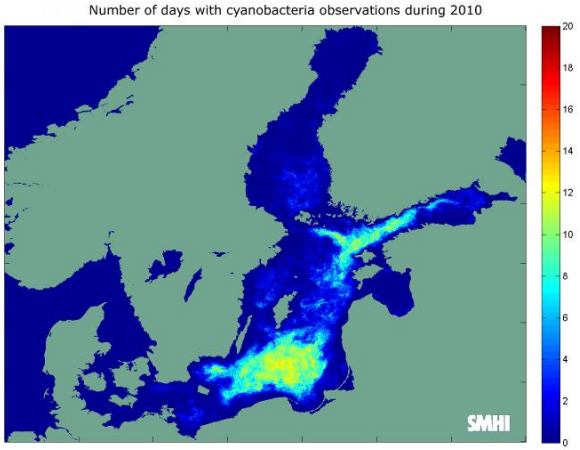
Distribution of cyanobacteria 1 June-30 August 2010 as indicated by phycocyanine fluorescence

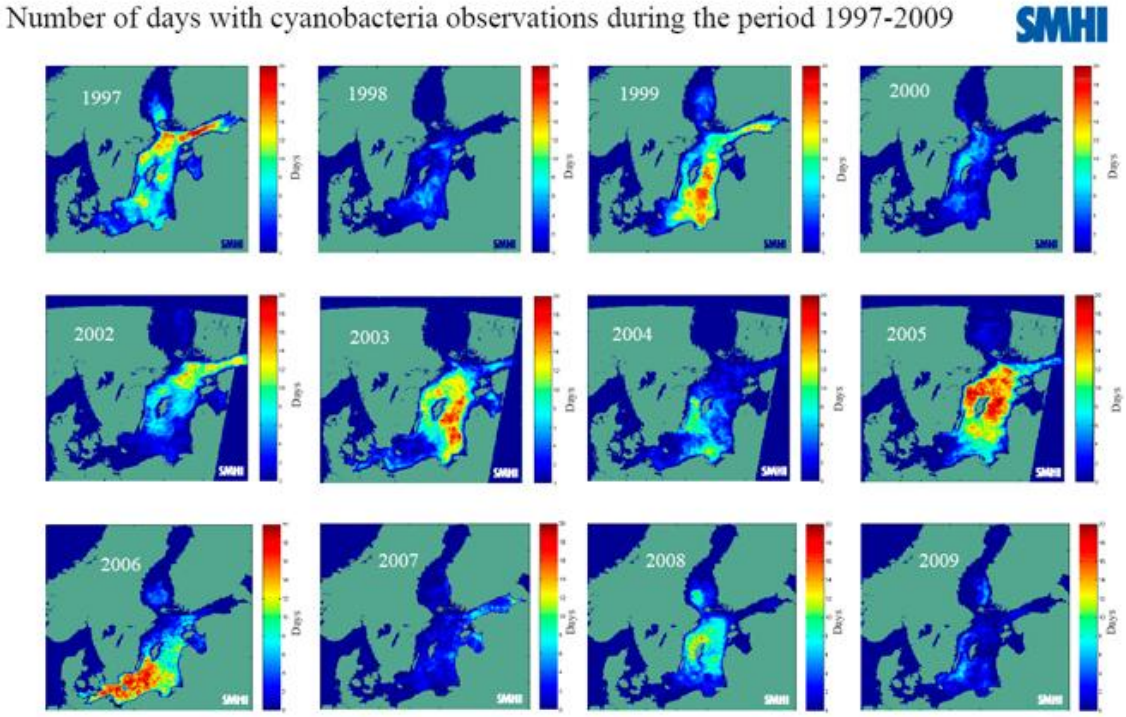





Satellite image of showing surface scums of cyanobacter
in the Southern Baltic Proper 20 July 2010
ESA-MERIS processed by SMHI

BAWS – Baltic Algae Watch System - satellite observations of surface accumulations of cyanobacteria blooms





Hansson & Öberg, Cyanobacterial blooms in the Baltic Sea, HELCOM Indicator Fact Sheets 2009

Thank you for your attention

Contact:
bengt.karlson@smhi.se

SMHI
Oceanographic unit
Gothenburg