The dynamics of the phytoplankton spring bloom in the Kattegat and the Baltic Sea studied using a FerryBox-system

TransPaper

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FerryBox systems in the Baltic Sea area SMHI

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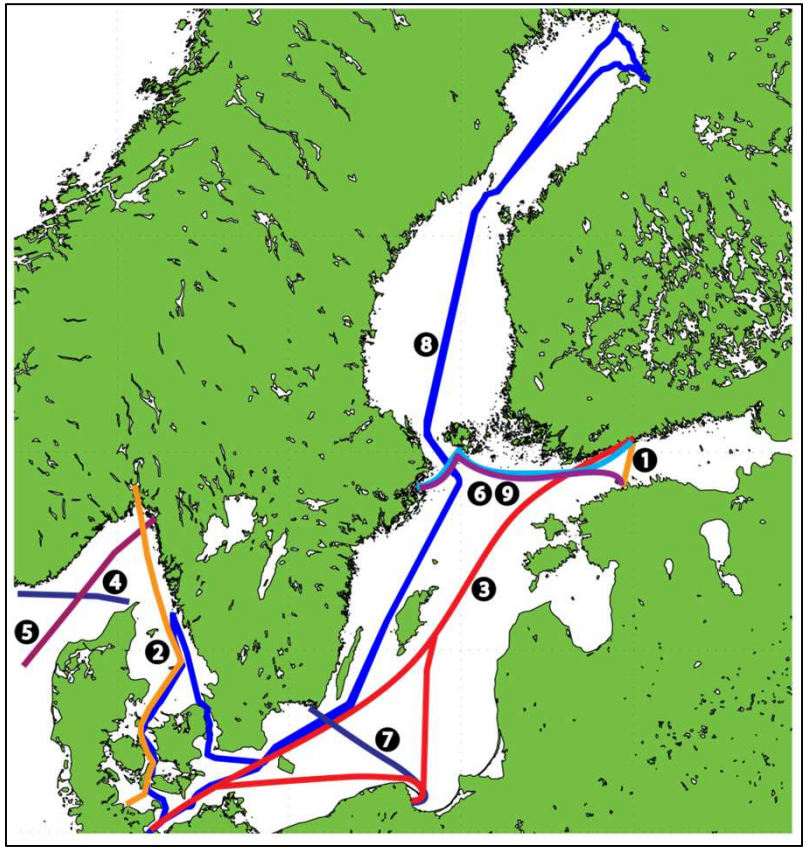

No. on map	Ship	Route	Institute
1	Baltic Princess	Tallinn-Helsinki	MSI
2	Color Fantasy	Oslo-Kiel	NIVA
3	Finnmaid	Helsinki-Lübeck-Gdynia-Helsinki	SYKE
4	MS Bergensfjord	Bergen-Hirtshals	NIVA
5	Lysbris	Hamburg-Immingham-Halden	NIVA and HZG
6	Silja Serenade	Helsinki-Mariehamn-Stockholm	SYKE
7	Stena Spirit	Gdynia-Karlskrona	IMGW-PIB
8	TransPaper	Gothenburg-Oulu-Kemi-Lübeck-Gothenburg	SMHI
9	Victoria	Tallinn-Mariehamn-Stockholm	EMI
10	Brahe	Along the coast of Finland	SYKE, KAS ELY, Helsinki City

Karlson, 2012
www.boos.org

About spring blooms

- Constitute a major input of organic material to the benthic ecosystem
  - Sink out of the water column becasue the zooplankton community does not respond fast enough
- Starts when the growth is higher than the respiration
  - Uses winter nutrients – regenerated nutrients, mixing of the water column
  - Light one controlling factor
  - Stratification on controlling factor
- Taxonomic composition
  - In our area the classic spring blooms consists of a mixture of
    - *Chaetoceros* spp, *Thalassiosira* spp., *Skeletonema marinoi*
  - In the Skagerrak, the Kattegat and the Belt Sea the fish killing flagellate *Pseudochattonella* has immediately followed the diatom bloom since year 2001
  - In the Baltic proper dinoflagellates constitue a large part of the bloom
- Traditional monitoring based on monthly sampling from research vessel may be too infrequent to observe the bloom
- Overcast weather makes the use of remote sensing of limited value

Sensors and water samplers

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Salinity, temperature, oxygen, chl. fluorescence, turbidity, phycocyanin flyúorescence and CDOM fluorescence

PAR, air temp and air pressure

pH

CO_2

Automatic water sampling for total alkalinity, chlorophyll phytoplankton, salinity and CDOM.

Parameters

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In water, 3 m depth

Flow rate
Temperature, intake
Salinity
Temperature, salinometer
Oxygen
Chlorophyll fluorescence
Turbidity
Phycocyanin fluorescence
CDOM fluorescence
pH
CO_2

In air

Air temperature
Air pressure
Irradiation, PAR
CO_2
Spectral radiation and irradiation (presentation by Stefan Simis)

Water samples

Salinity
Chlorophyll
CDOM
Alkalinity
Phytoplankton

Sampling frequency is every 20 seconds for most parameters

Some parameters from FerryBox systems useful for spring bloom studies

TransPaper

- Chlorophyll fluorescence – proxy for phytoplankton biomass
  - Calibration issues
  - Photo quenching
- Spectral irradiation and radiation (Stefan Simis presentation)
- pCO_2 gives information related to primary production
- pH gives information related to primary production
- O_2 gives information related to primary production
- Water samples
  - Phytoplankton biodiversity and biomass from micrsocopy
  - Chlorophyll a

- Wish list at the end of presentation

FerryBox systems

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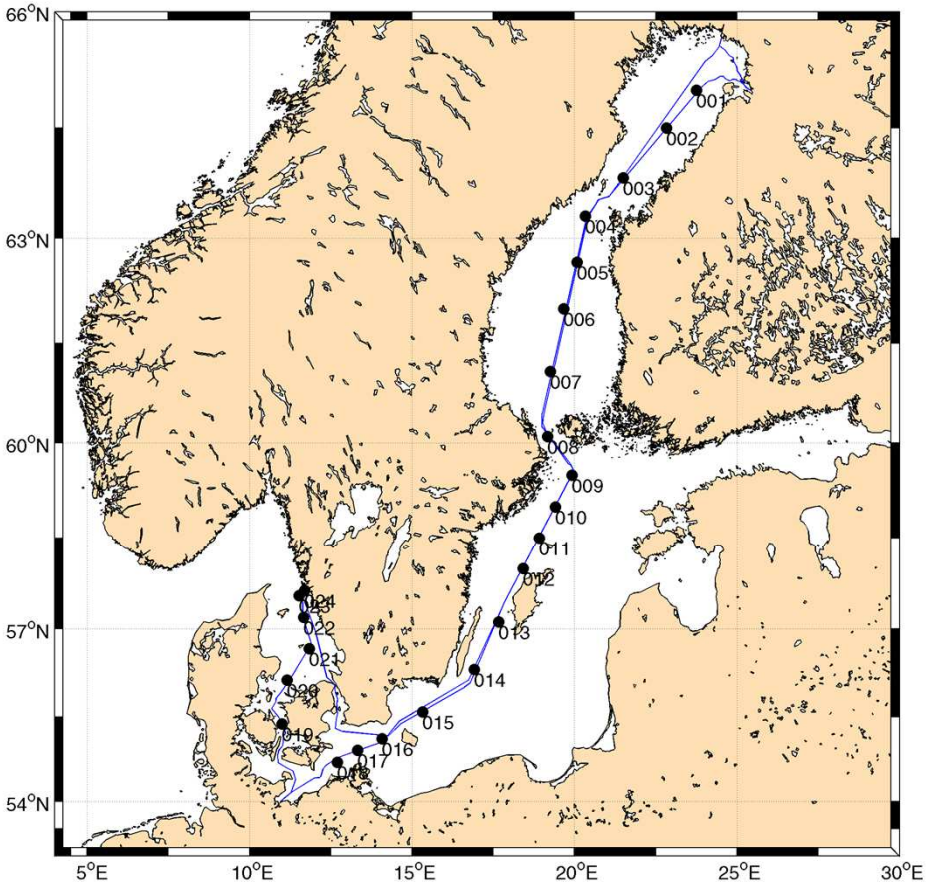
TransPaper water sampling locations



Sampling frequency

- Every two weeks

Parameters

12 locations

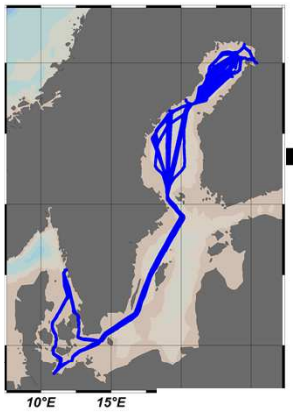
- Salinity
- CDOM/humic substances
- Alkalinity

6 locations in the Kattegat-Öresund

- Chlorophyll a

6 locations

- Phytoplankton



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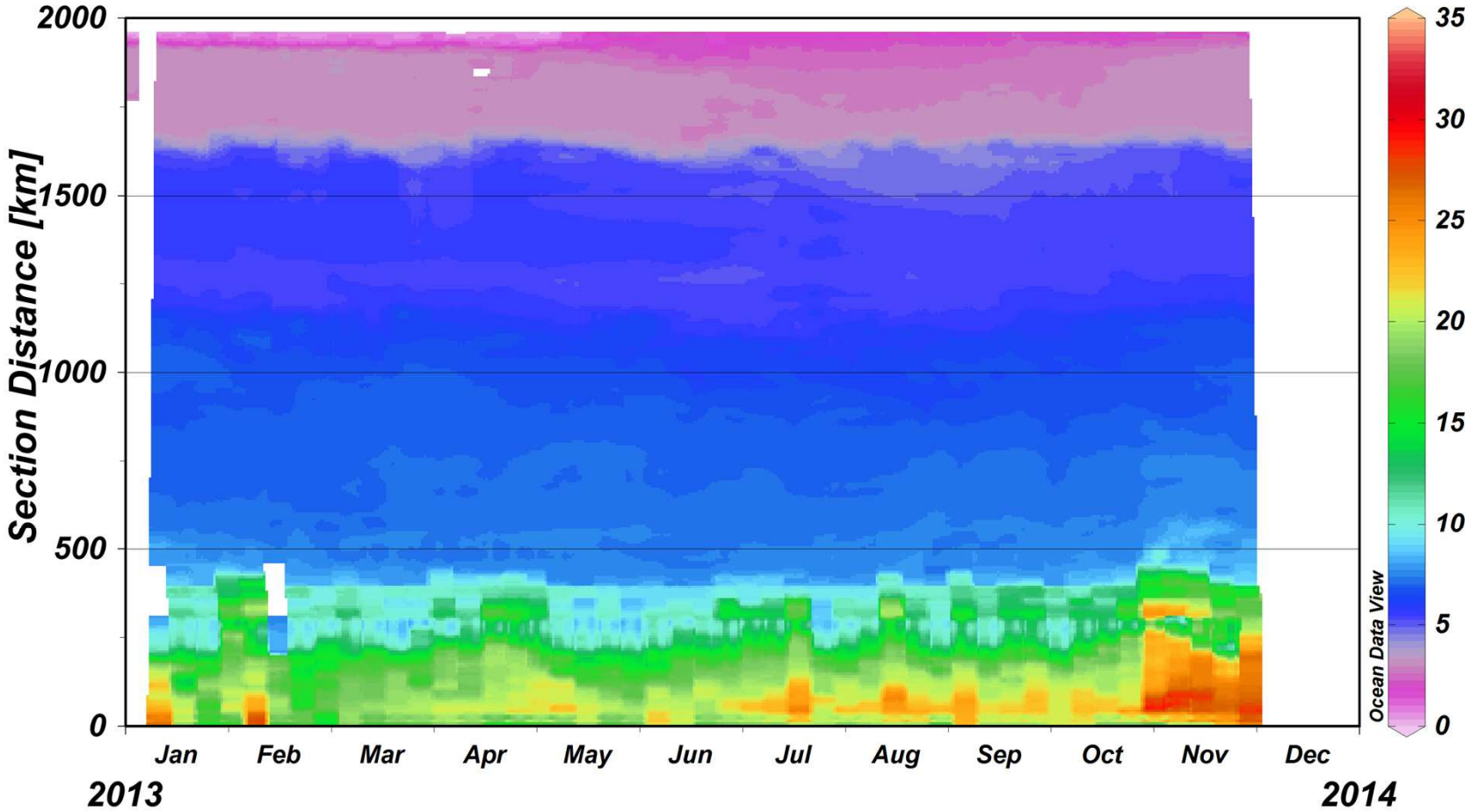
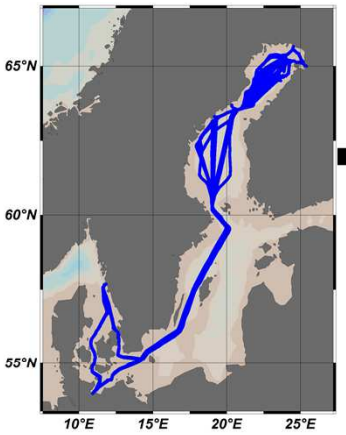
Salinity, psu





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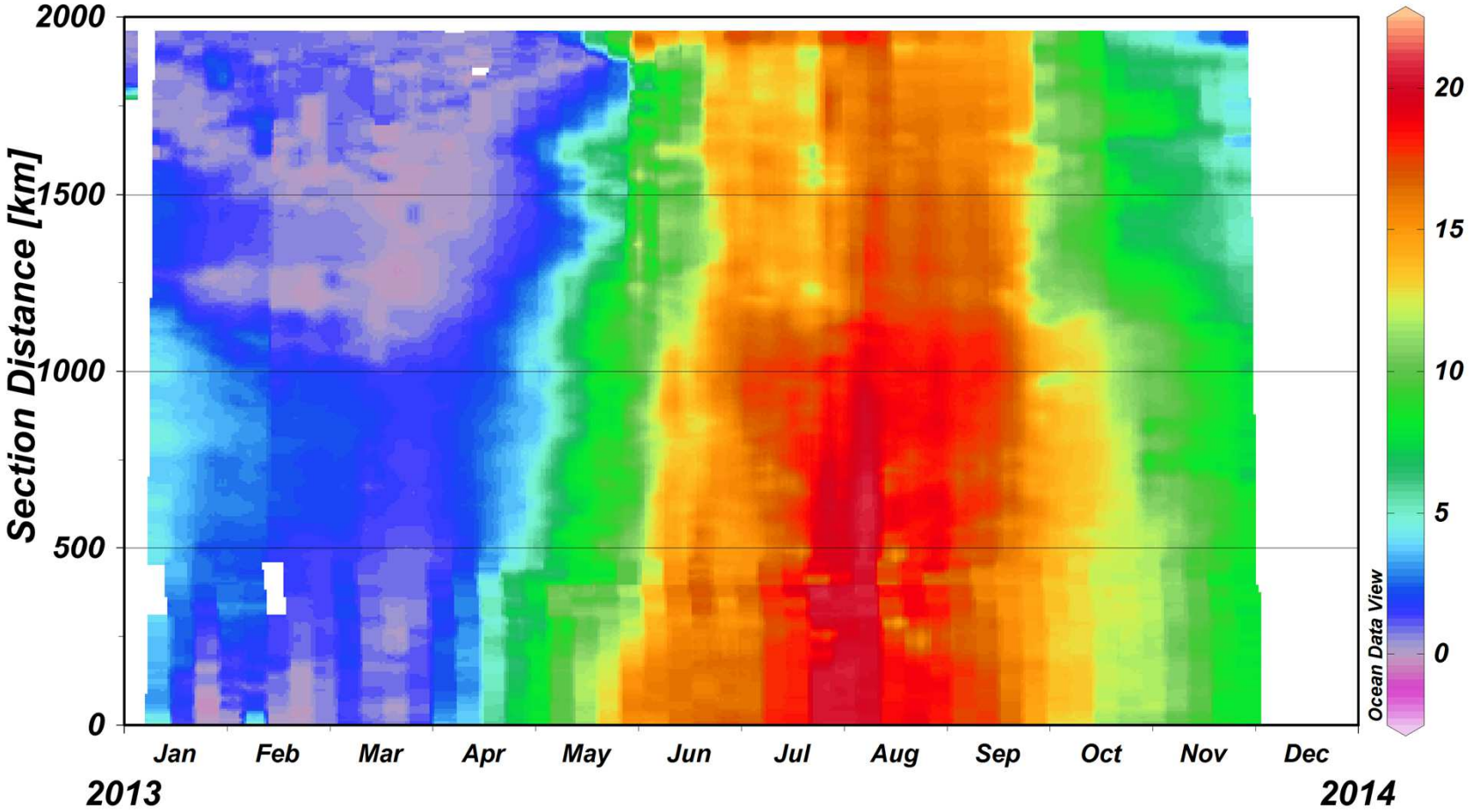
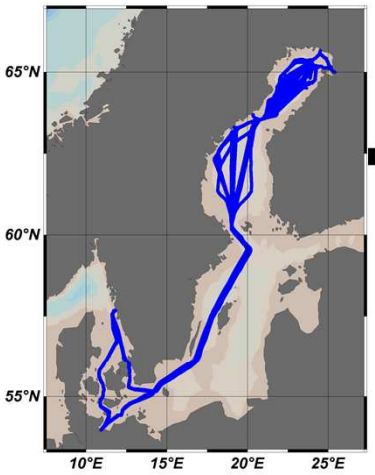
Temperature, °C





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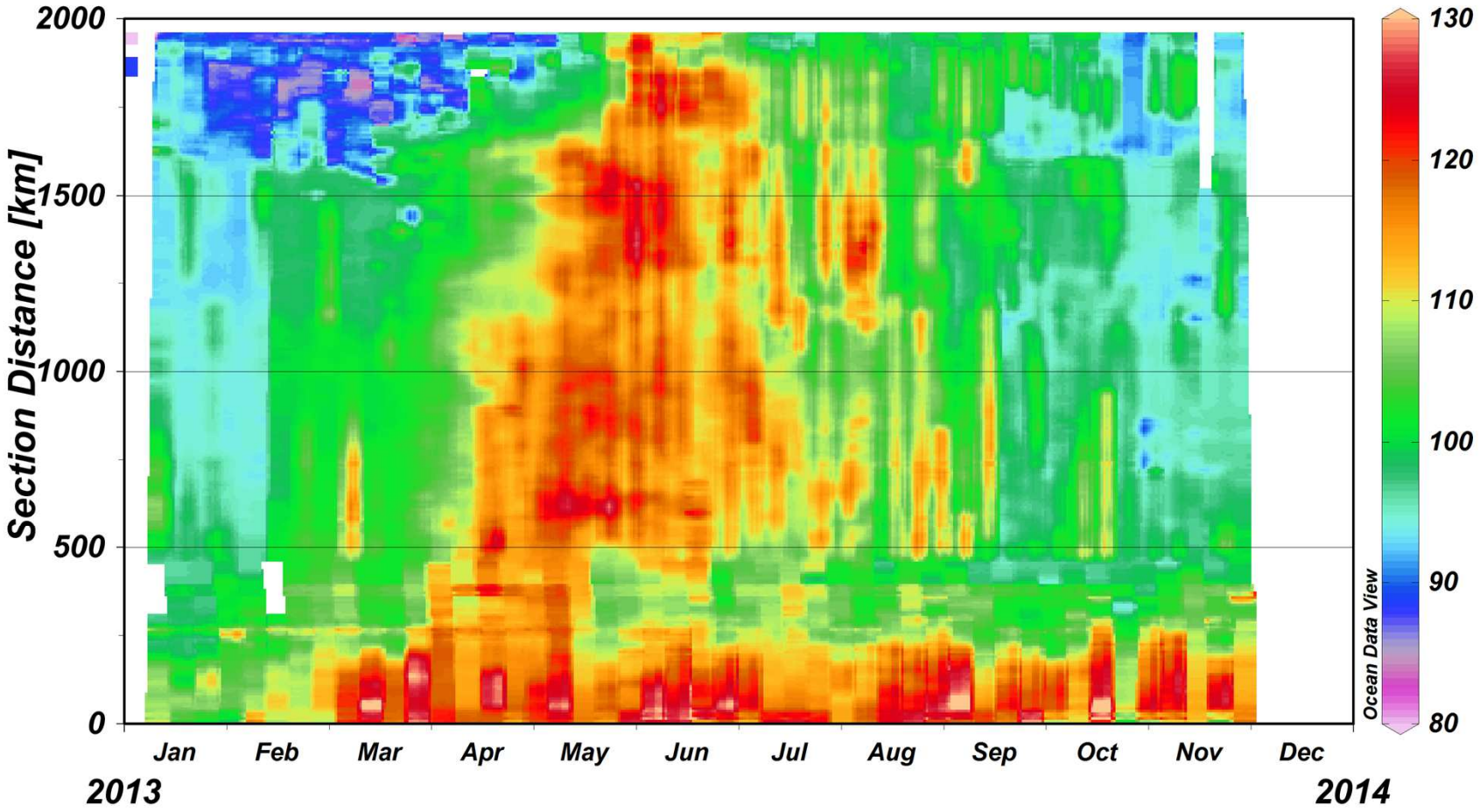
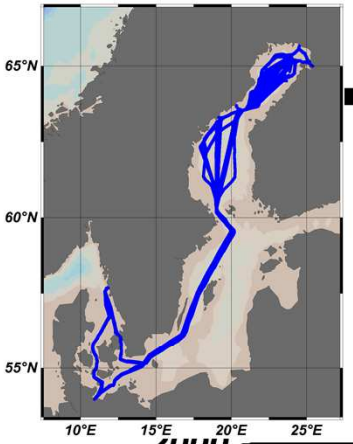
Oxygen Saturation, %





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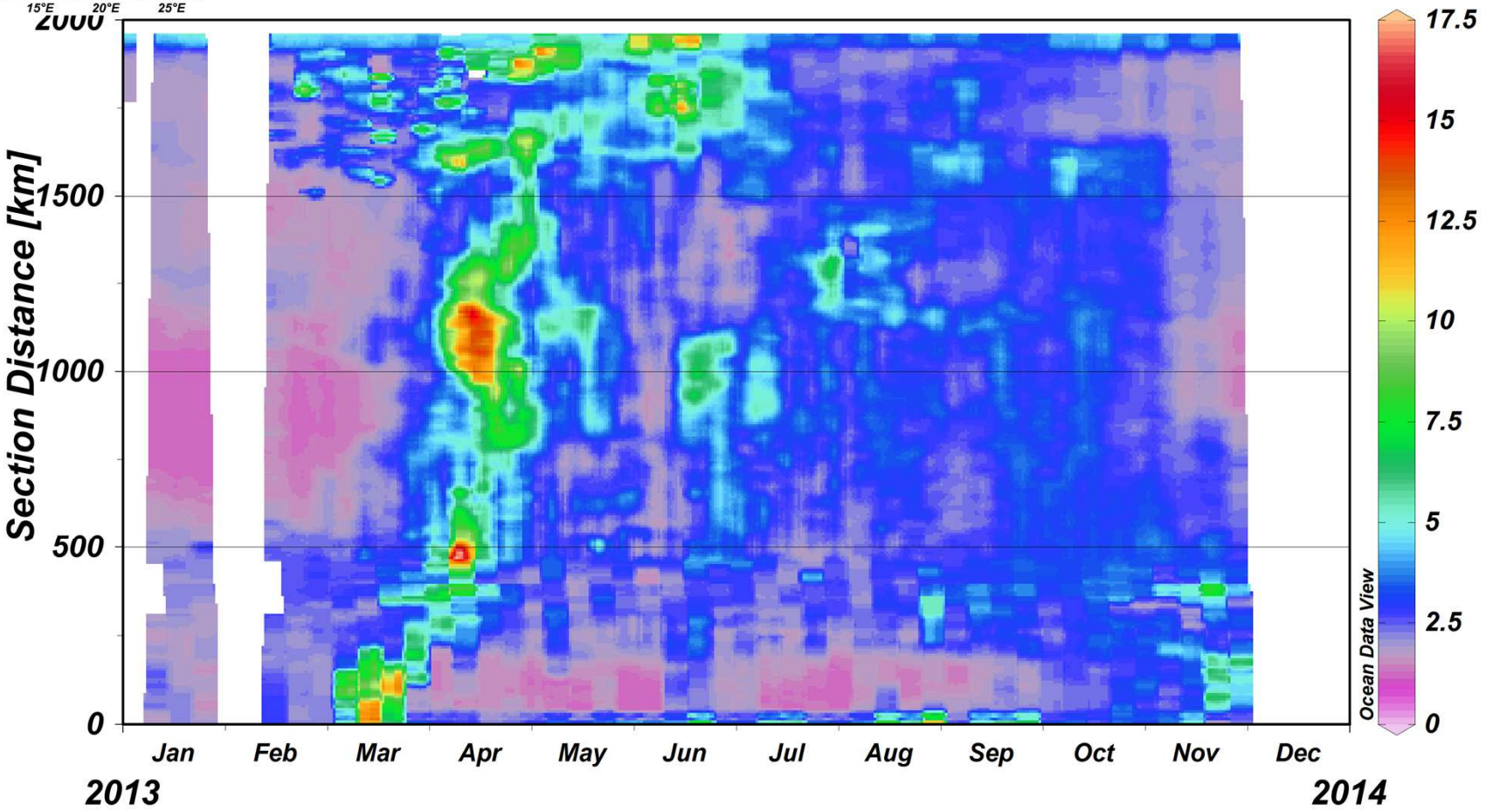
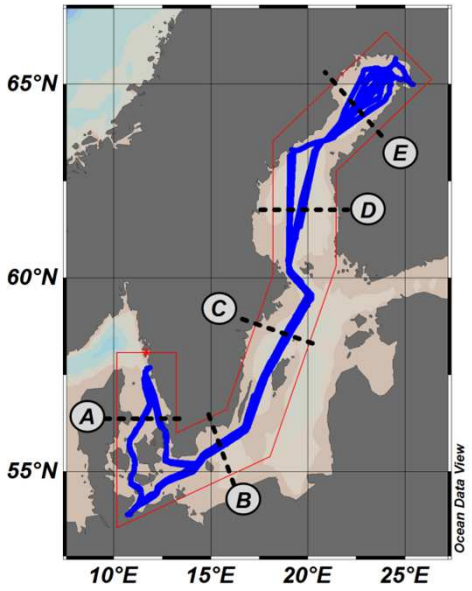
Chlorophyll fl., a.u.





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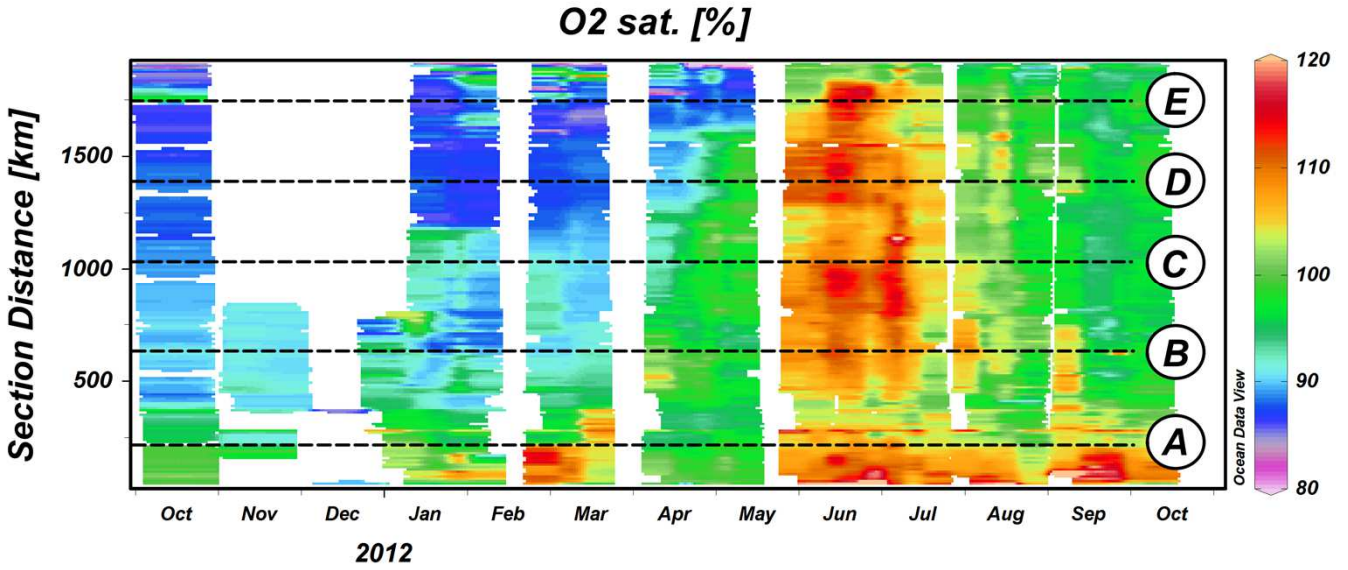
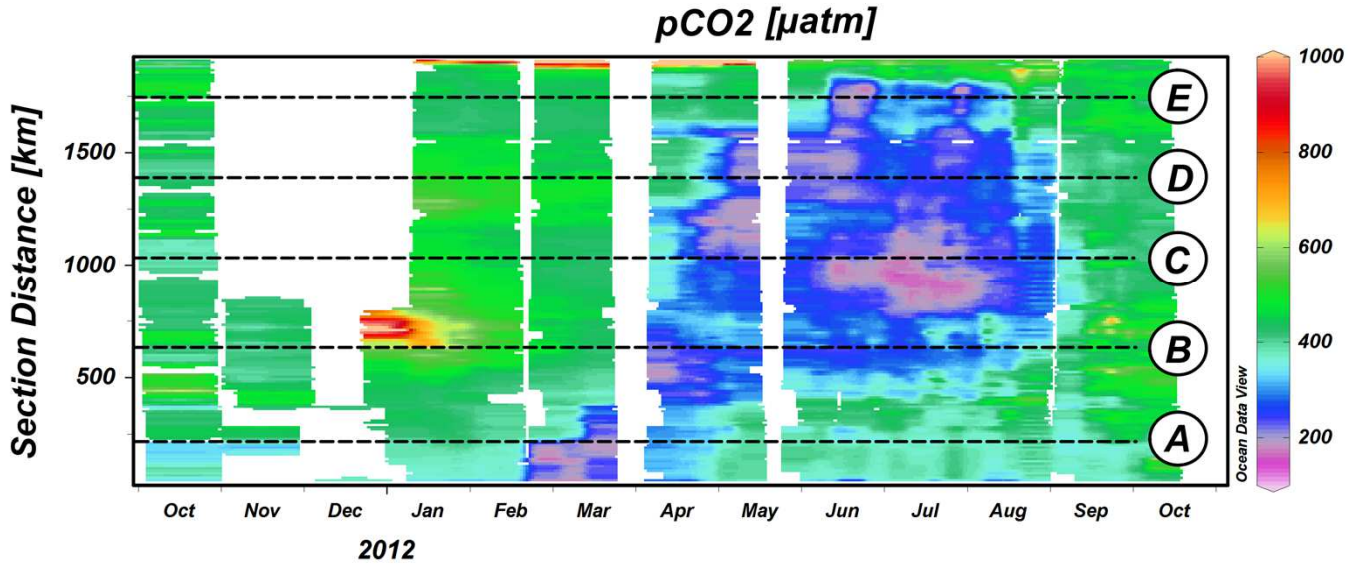
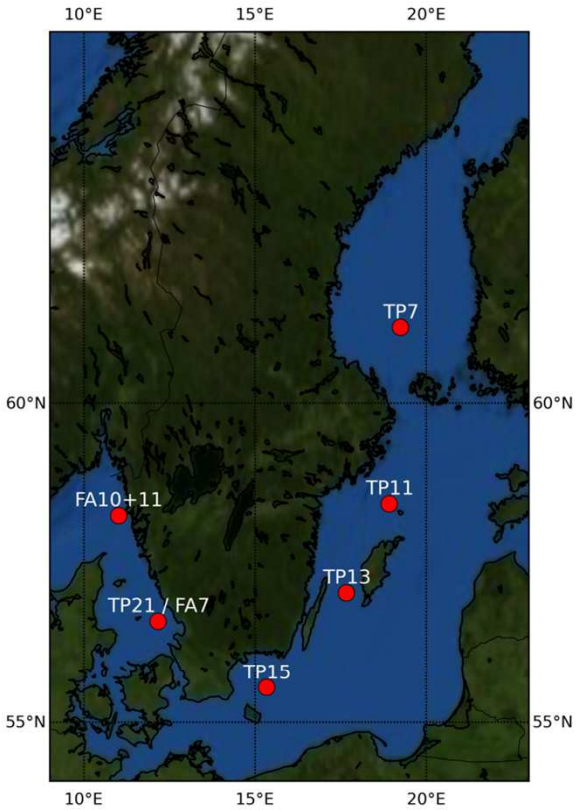
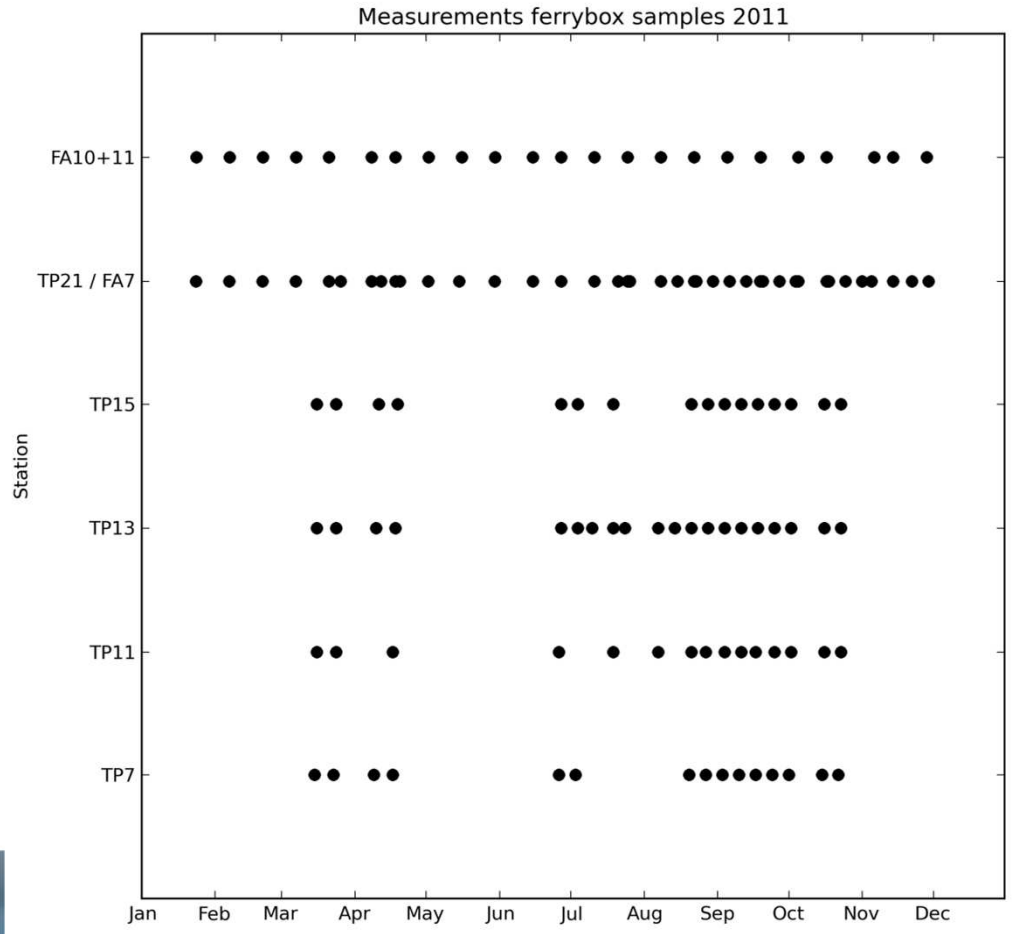




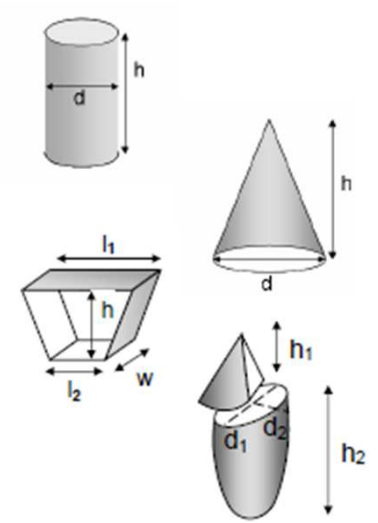
Fransson et al. in prep

Sampling frequency 2011

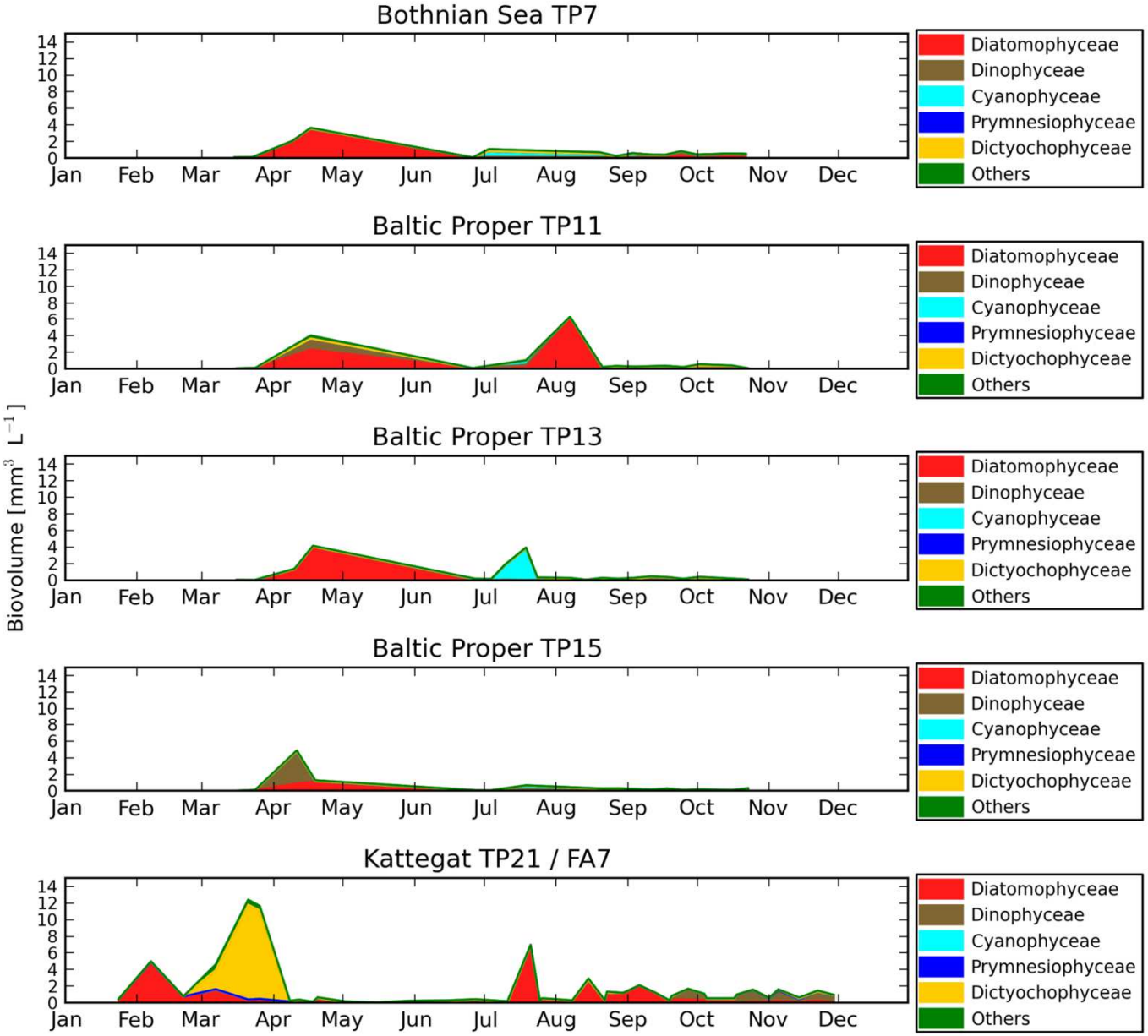




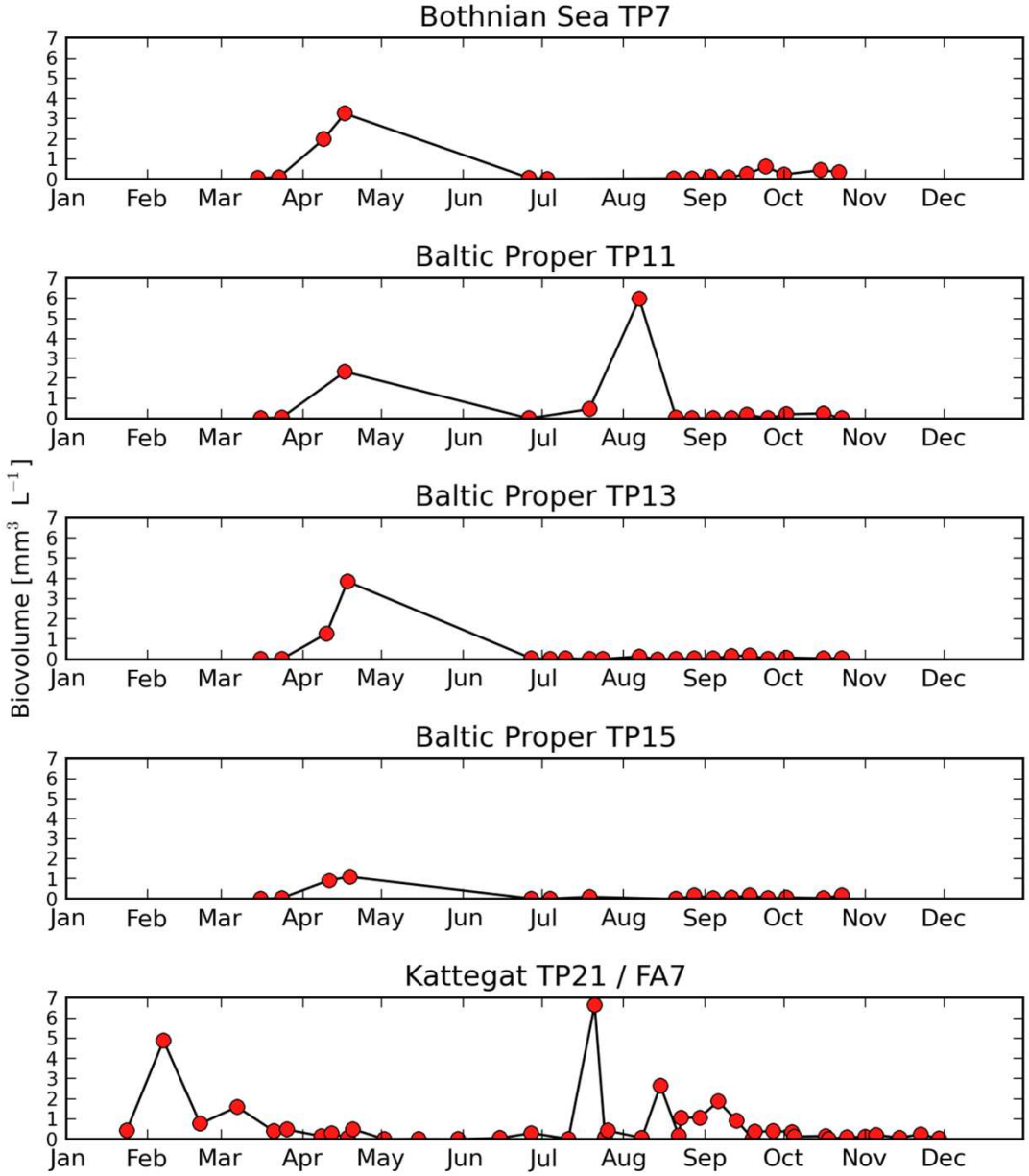
Phytoplankton analysis method - Utermöhl

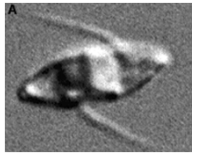


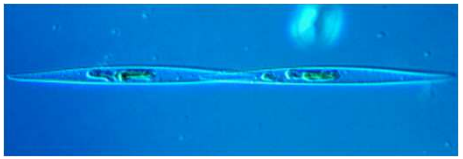
Biovolume AU+MX ferrybox samples 2011



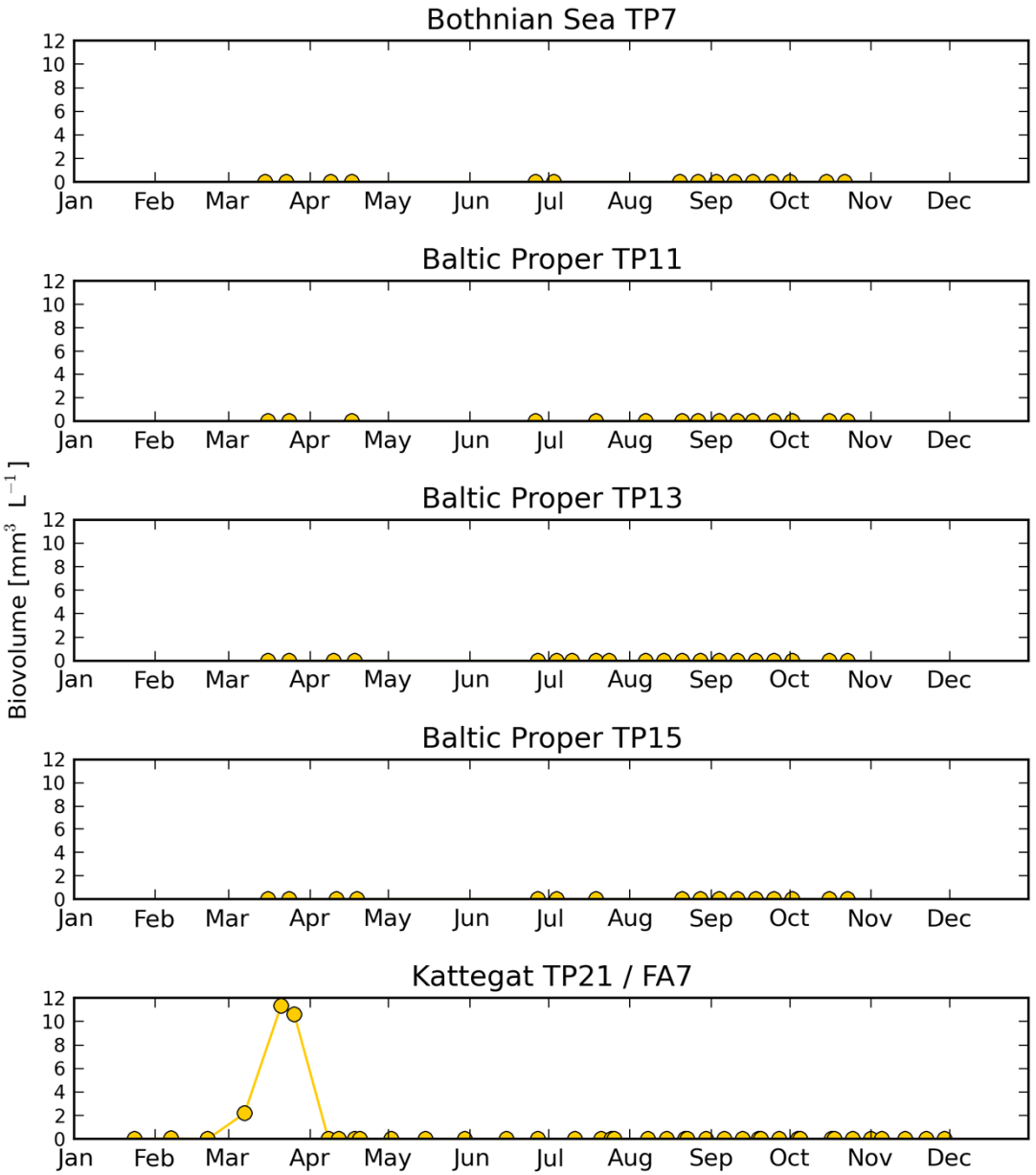
Diatomophyceae Biovolume AU+MX ferrybox samples 2011







Pseudochattonella Biovolume ferrybox samples 2011

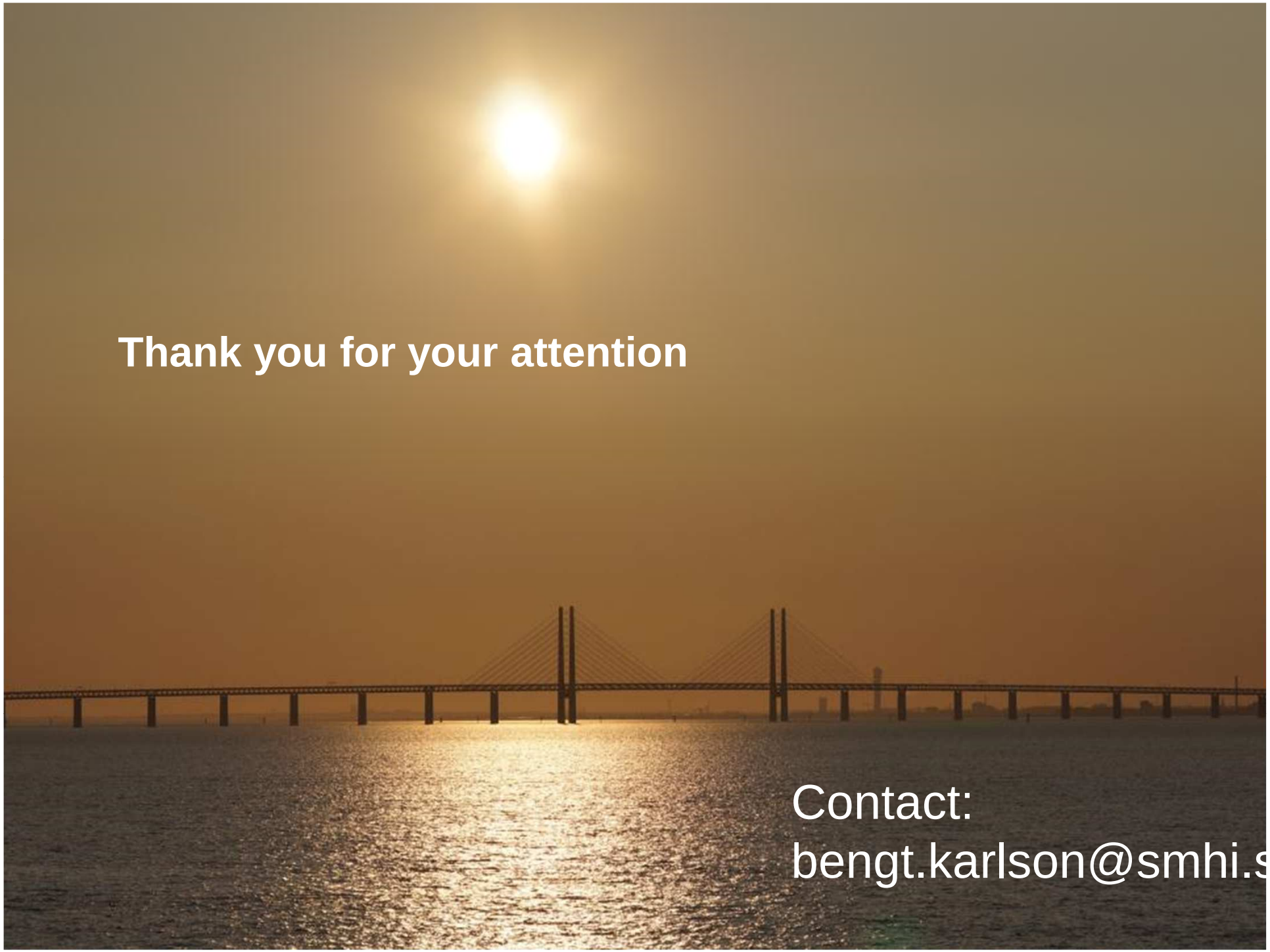


Pseudochattonella farcimen

Some parameters from FerryBox systems useful for spring bloom studies

Wish list

- Fast Repetiton Rate Fluorometry
  - Primary production related parameters
- Automated Imaging Flow Cytometry
  - Phytoplankton biodiversity and biomass
- rDNA sequencing – molecular genetics
  - Phytoplankton diversity
- Spectral fluorescence
  - Proxy for biodiversity - biomass of some algal classes
- Spectral absorbance
  - Proxy for biodiversity - biomass of some algal classes


Thank you for your attention
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