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

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FerryBox systems in the Baltic Sea area

TransPaper

Karlson, 2012
www.boos.org

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

- Constitute a major input of organic material to the benthic ecosystem
  - Sink out of the water column because 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 constitute 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

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

PAR, air temp and air pressure

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

pH

CO₂
Parameters

<table>
<thead>
<tr>
<th>In water, 3 m depth</th>
<th>In air</th>
<th>Water samples</th>
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<tbody>
<tr>
<td>Flow rate</td>
<td>Air temperature</td>
<td>Salinity</td>
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<tr>
<td>Temperature, intake</td>
<td>Air pressure</td>
<td>Chlorophyll</td>
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<tr>
<td>Salinity</td>
<td>Irradiation, PAR</td>
<td>CDOM</td>
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<tr>
<td>Temperature, salinometer</td>
<td>CO₂</td>
<td>Alkalinity</td>
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<tr>
<td>Oxygen</td>
<td>Spectral radiation and irradiation (presentation by Stefan Simis)</td>
<td>Phytoplankton</td>
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<tr>
<td>Chlorophyll fluorescence</td>
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<td>Turbidity</td>
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<td>Phycocyanin fluorescence</td>
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<td>CDOM fluorescence</td>
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<tr>
<td>pH</td>
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<td>CO₂</td>
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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)
- pCO₂ gives information related to primary production
- pH gives information related to primary production
- O₂ gives information related to primary production
- Water samples
  - Phytoplankton biodiversity and biomass from microscopy
  - Chlorophyll a

- Wish list at the end of presentation
FerryBox systems

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
Fransson et al. in prep
Sampling frequency 2011

Measurements ferrybox samples 2011

Station

FA10+11
TP21 / FA7
TP15
TP13
TP11
TP7

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Phytoplankton analysis method - Utermöhl
Diatomophyceae Biovolume AU+MX ferrybox samples 2011

Bothnian Sea TP7

Baltic Proper TP11

Baltic Proper TP13

Baltic Proper TP15

Kattegat TP21 / FA7
Pseudochattonella Biovolume ferrybox samples 2011

Bothnian Sea TP7

Baltic Proper TP11

Baltic Proper TP13

Baltic Proper TP15

Kattegat TP21 / FA7

Pseudochattonella farcimen
Some parameters from FerryBox systems useful for spring bloom studies

Wish list

- Fast Repetition 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