Bio-optical properties of the Baltic Sea
-a comparison of coastal waters in the NW Baltic Proper and The Gulf of Bothnia

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Brockmann Geomatics Sweden AB
Rymdstyrelsen Swedish National Space Board
esa space for europe European Space Agency
EcoChange Ecosystem Dynamics in the Baltic Sea

Outline

1, Intro Baltic Sea and study sites

2, Bio-optical properties
- Chlorophyll a
- Suspended Particulate Matter, SPM
- Colour Dissolved Organic Matter, CDOM
- Salinity and Secchi dept

3, CDOM/DOC/CDOM Fluorescence relationships in the Gulf of Bothnia

4, Operational WQ monitoring of Swedish lakes and costal zone

5, Work in progress and future outlook

1, Intro - The Baltic Sea, CC 2

- Area of approx 415,000 km^2
  - Water volume of approximately 21,000 km^3
  - Mean depth of 55 m
- Five main regions
  - Western Baltic Sea
  - Baltic Proper
  - Gulf of Bothnia
  - Gulf of Finland
  - Gulf of Riga
- Catchment area
  - Drainage basin about 4,2 times as large as the Baltic Sea, from nine countries bordering to the Baltic Sea and five which are not.
  - 85 million people live in the catchment area and 40 million in the costal zone.

From: Leppäranta, M. *Physical Oceanography of the Baltic Sea*. (2008).

1, Intro - The Baltic Sea, CC 2

- **Brackish Sea**
  - low salinity ranging from 2‰ in the Bothian Bay to 28 ‰ in Kattegat, with a mean salinity around 7 ‰.
  - The low salinity is due to the restricted water exchange and the high freshwater input from the rivers.
  - Permanent halocline between 40-70 m depth, with heavier saline bottom water from the North sea.
  - Seasonal thermocline during spring and summer between 15-20 m depth.

From: Leppäranta, M. *Physical Oceanography of the Baltic Sea*. (2008).

1, Intro - The Baltic Sea, CC 2

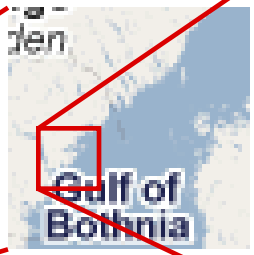
-from a Remote sensing perspective

Optically dominated by

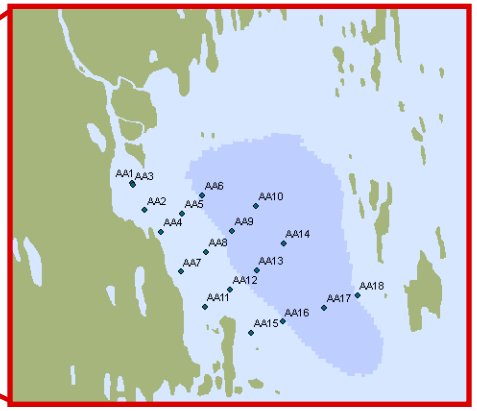
- a high load of **CDOM** which is inversely correlated with salinity ⟶ gradient from north to south.
- **Inorganic suspended matter** in the coastal zones
- **Phytoplankton** from March to September.
  - **Filamentous Cyanobacteria (*Nodularia spumigena and Aphanizomenom sp.*)** blooms with surface accumulations, which may occur during the summer season when the weather conditions are calm, stable and warm.

Cyanobacteria bloom on 13 July 2005. RGB-composite from MERIS full resolution data (ENVISAT), Kratzer and Tett 2009.

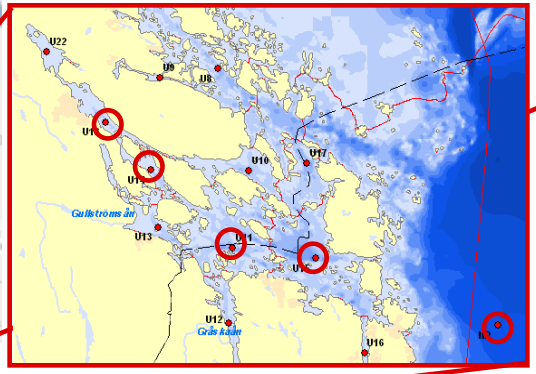
1, Intro - The Baltic Sea, CC 2 -study sites



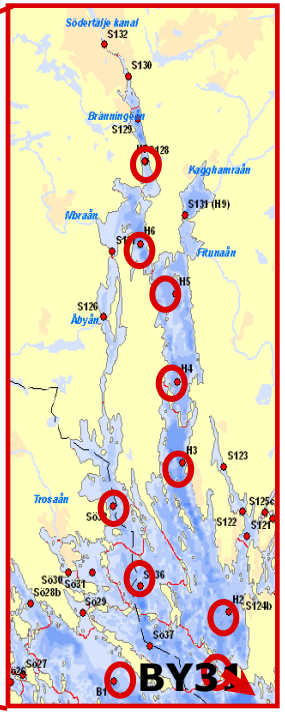
Örefjärden



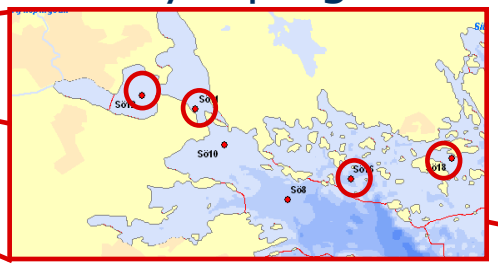
Östhammar



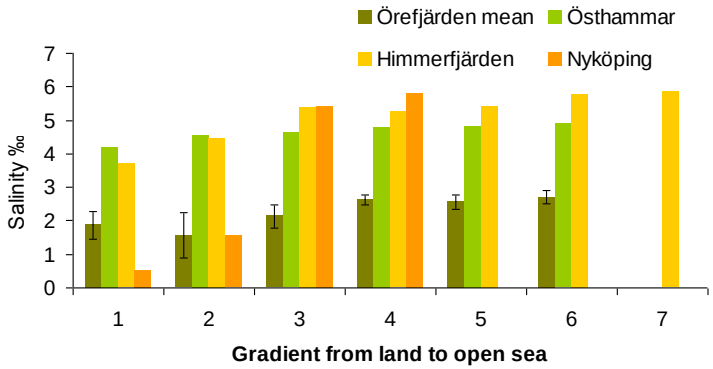
Himmerfjärden

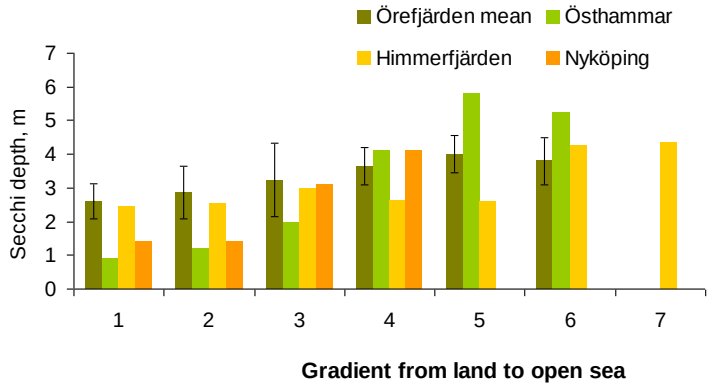


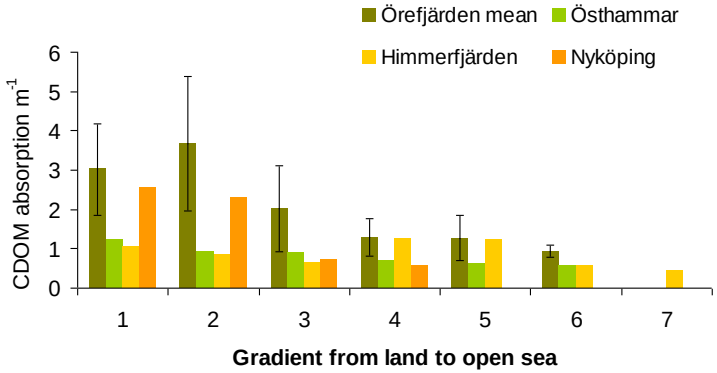
Nyköping

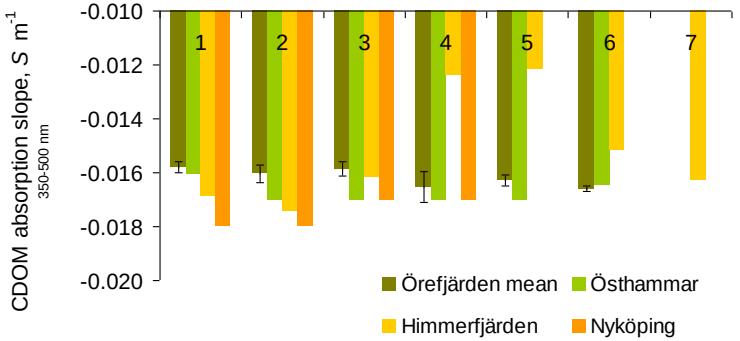


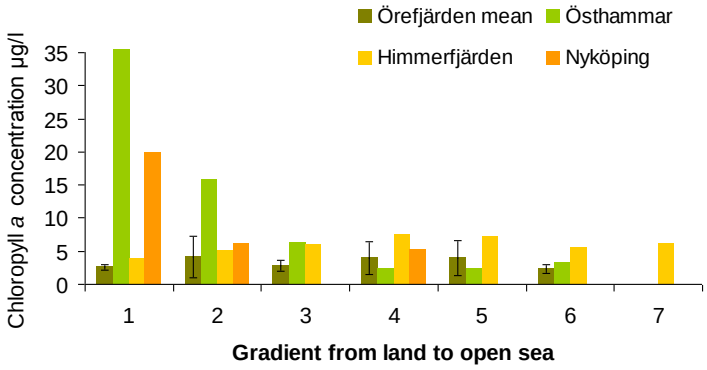
2, Bio-optical properties-Summary

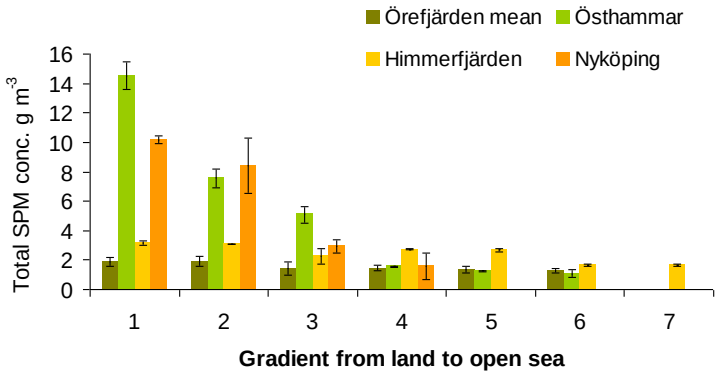








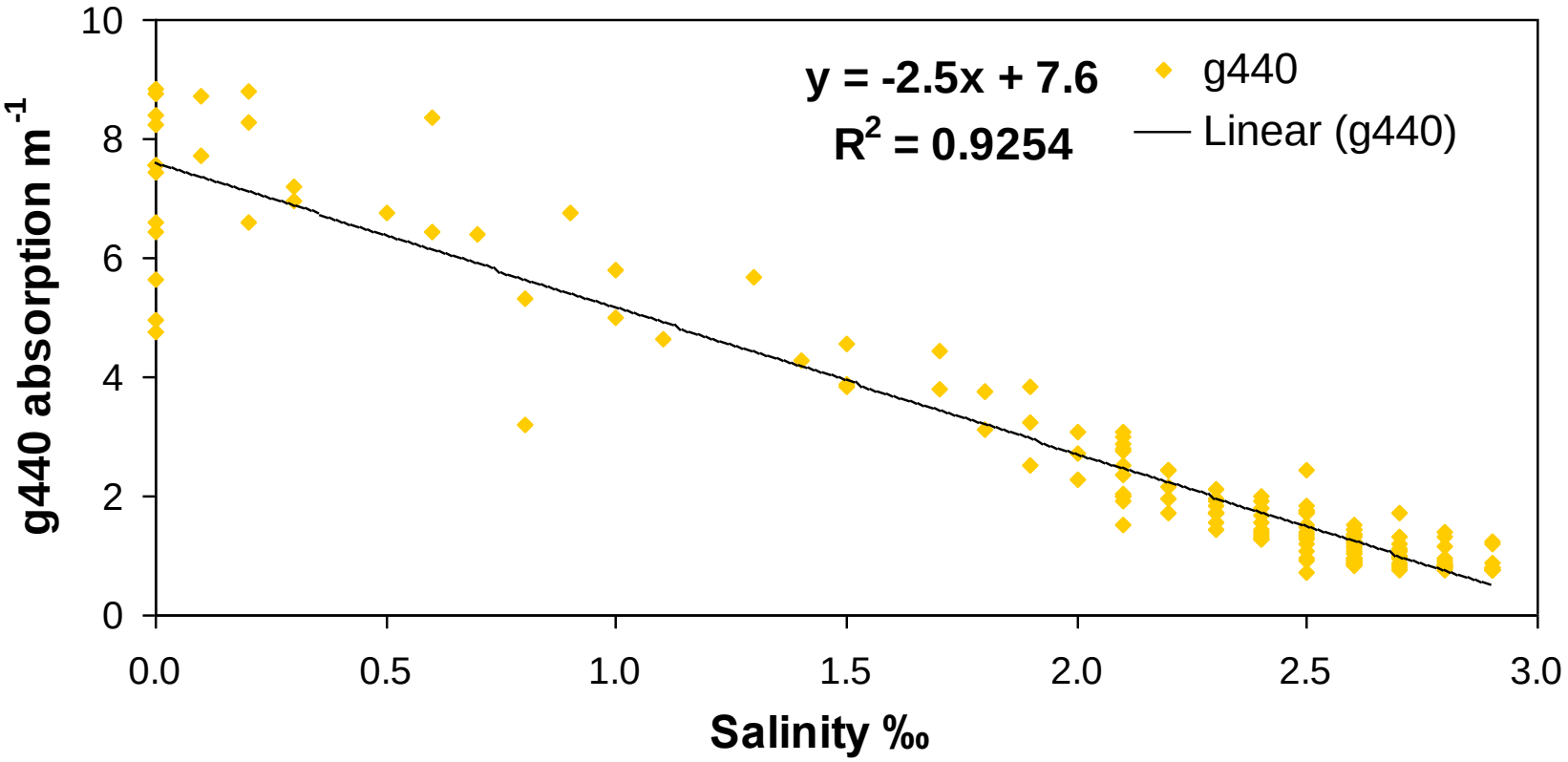




3, Relationships in the Gulf of Bothnia

Stockholm University

g440 absorption as a function of salinity, Örefjärden 2010



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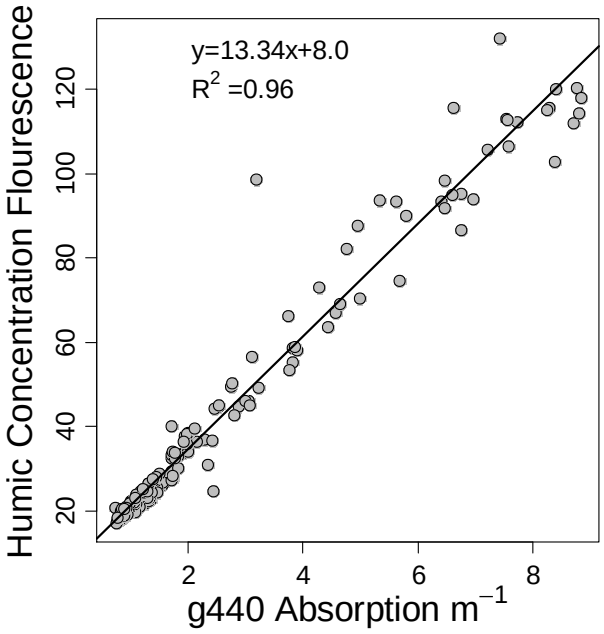
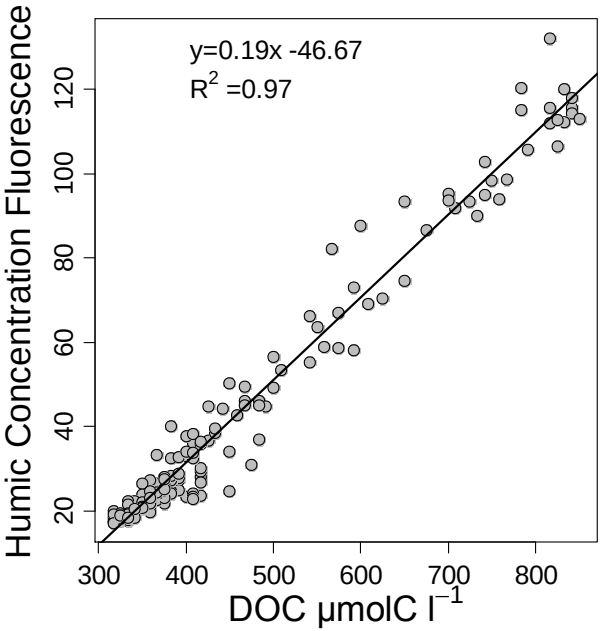
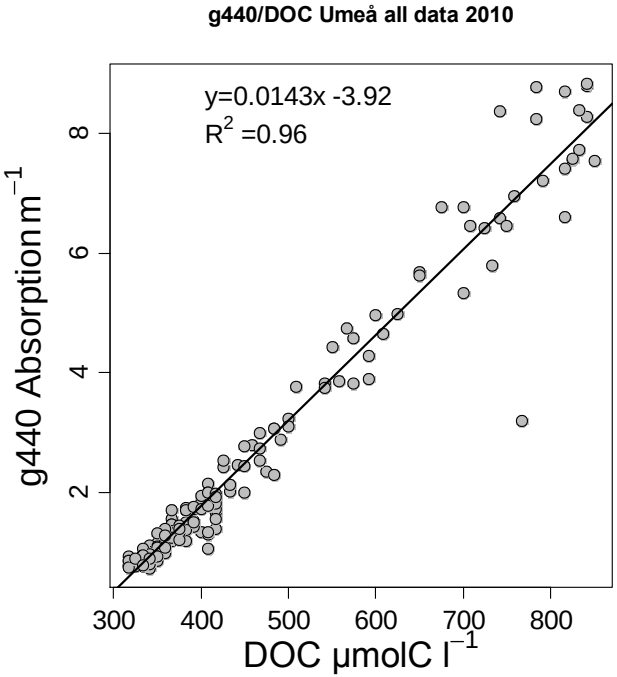
3, …



-when g440 = 0 there is 8 units of florescence on the y-axis

-CDOM under-estimated / other groups? Errors?

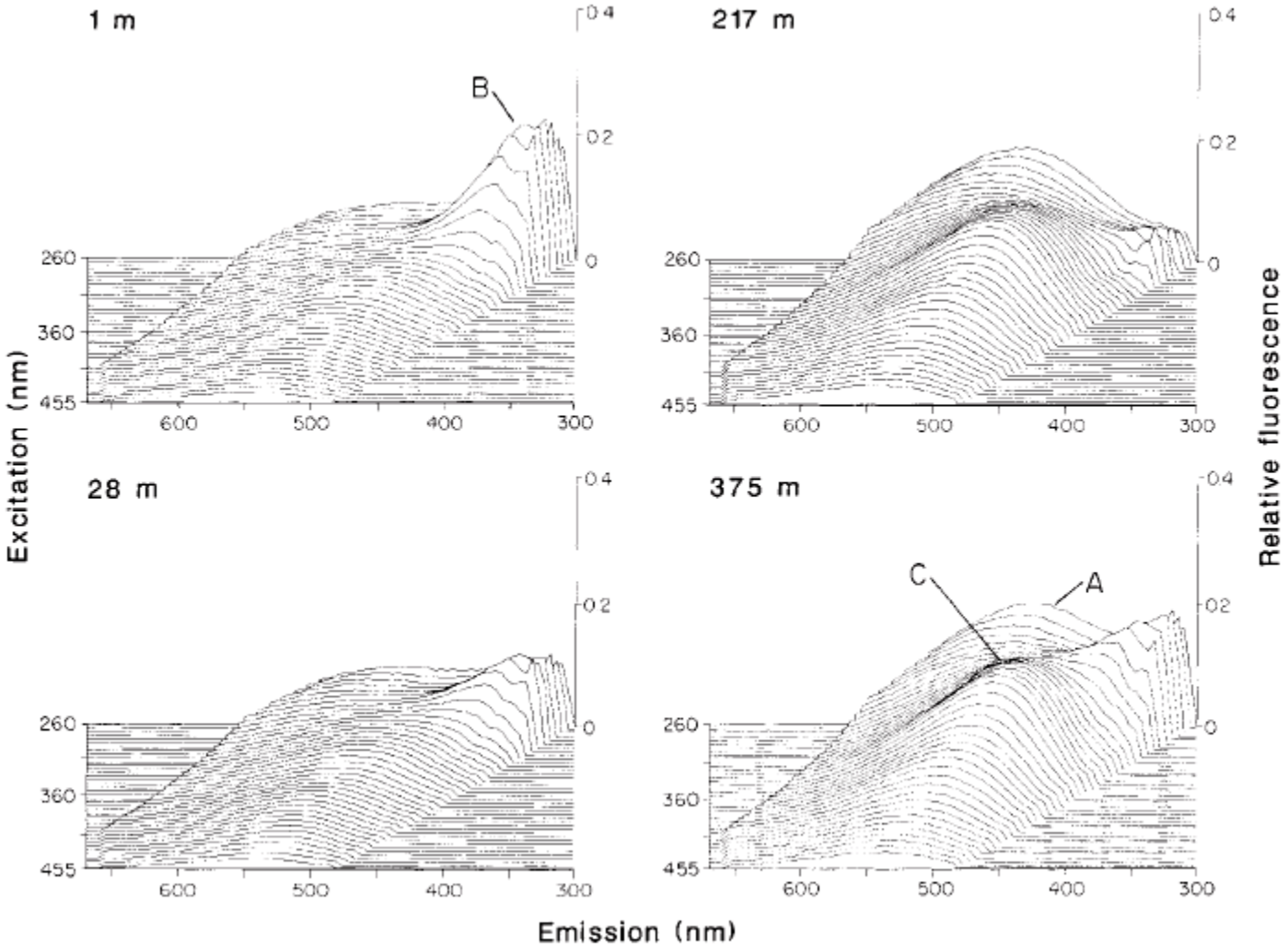




This relationship can be used to calculate the CDOM absorption from older Fluorescence measurements in this area!

- when g440 and humic fluorescence= 0 there is still ~250-270 µmol C/l in the sample (non CDOM fraction of the DOC pool)

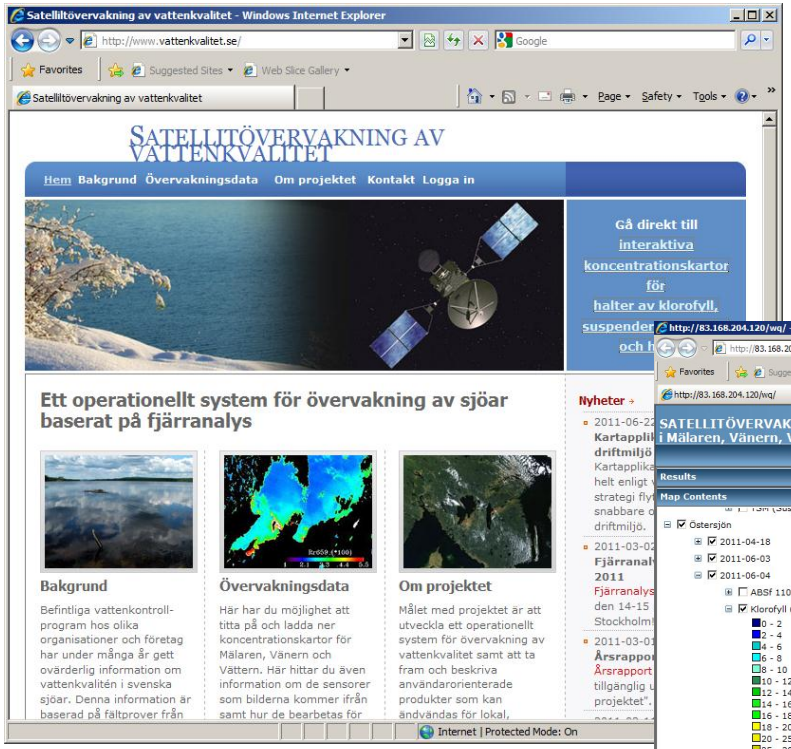
FIG. 2 Corrected EEM spectra for concentrated DOM samples from the Black Sea at depths of 1 m, 28 m, 217 m and 375 m. Spectra are the same as in Fig. 1 after correction for instrumental configuration. The procedural blank was also corrected before subtraction from samples. Data below 300 nm are lost because the correction routine is not valid below that wavelength.

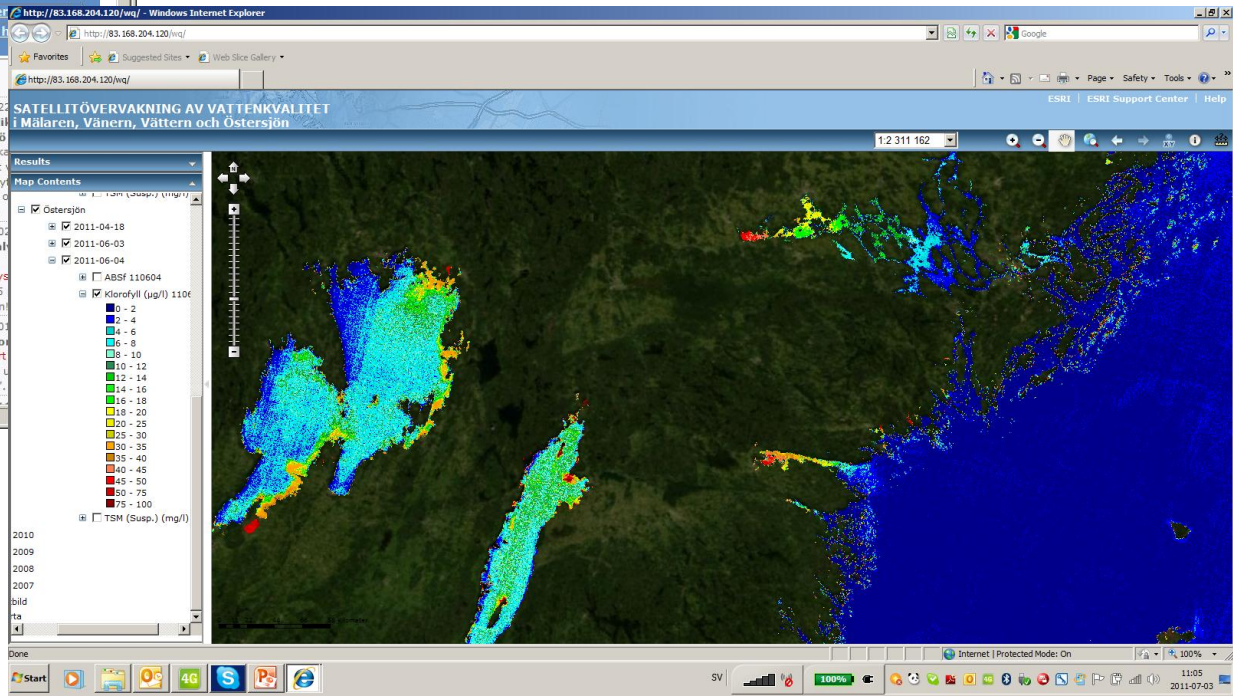


From Coble et. al. Nature 1990

4, Operational WQ monitoring of Swedish lakes and costal zone

Stockholm University



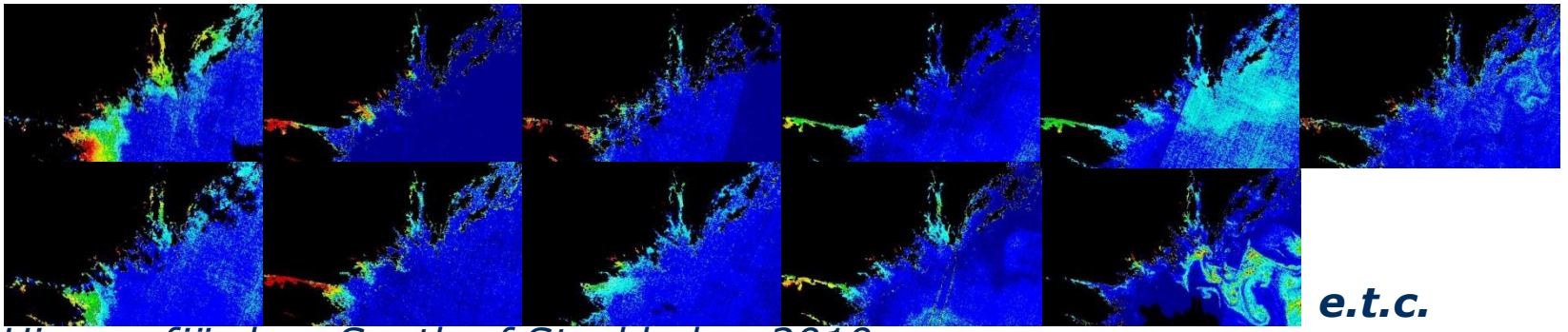


www.vattenkvalitet.se - ”waterquality.se”

WQ service by Brockmann Geomatics, Sweden, between April-September with focus on Swedish end users.

4, Service contents

1. NRT water quality maps delivered through service web – www.vattenkvalitet.se

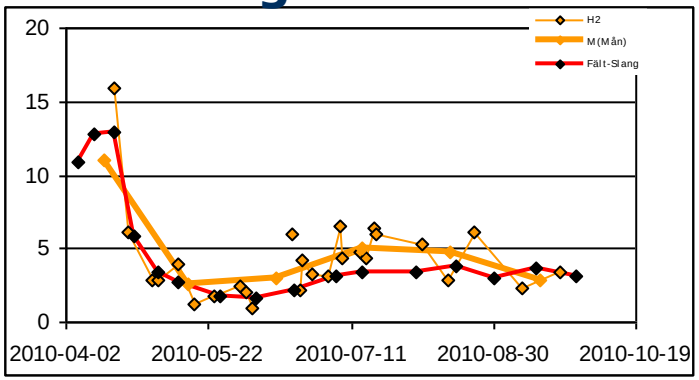


e.t.c.

Himmerfjärden, South of Stockholm, 2010

2. Statistics corresponding to existing control stations and WFD basins

- All available dates
- Monthly means
- Seasonal trends



- MERIS FUB Chl

- Field data

Himmerfjärden Station H2, 2010

3. Annual report with a summary of data and results. Validation of results based on existing field data (e.g. Swedish national monitoring data)

5, Work in progress and future outlook

- Processing and analysing bio-optical data from 2011 (including possible HPLC measurements for Chl a?)
- MERIS validation campaign during spring/summer 2012 and 2013 (including Gulf of Bothnia)
- Evaluation of the operational system by comparing the MERIS monthly means with monitoring data (paper in progress)
- Inverse Distance Weighting- spatial patterns of g440 CDOM absorption and CDOM slope values

Acknowledge to the Monitoring group at Stockholm University

Front Picture:

http://visibleearth.nasa.gov/
Sensor: SeaWiFS
Sattelite: OrbView-2

This Picture:
Christian Vinterhav
Sensor: MERIS
Sattelite: ENVISAT

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