

# Improving Methods to Detect and Map Baltic Sea Algae Blooms el. Bättre kunskap om algbloomingar med satellitdata

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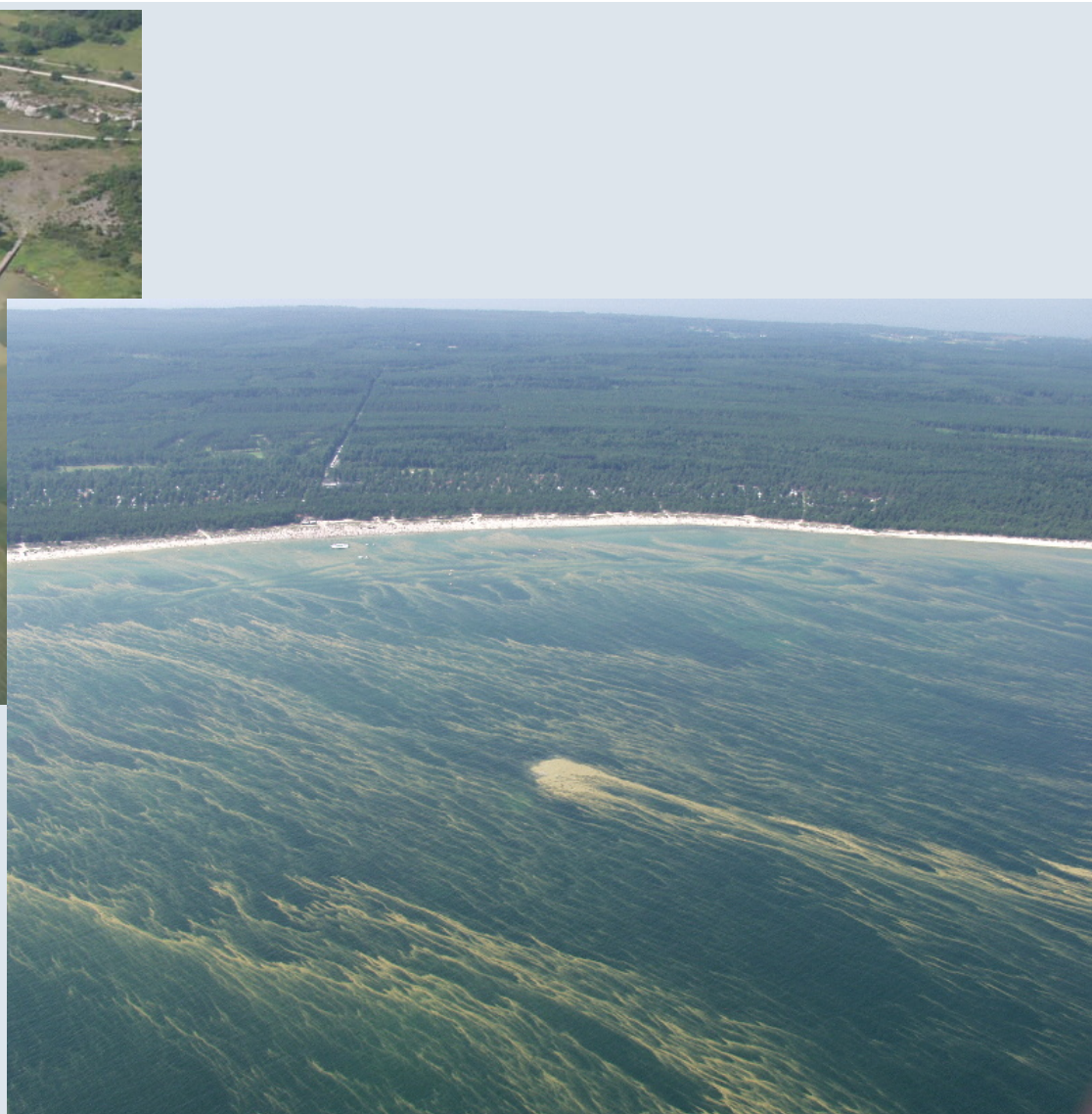
2005-07-10



2008-07-31

Rymdstyrelsens  
Fjärranalysdagar  
2009-03-10 --11

# The Problem





# **Problem – Orsak – Åtgärder – Uppföljning från HELCOM rekommendationer till EU ansvar**

**Problem: Störd turism samt skaderisk för barn och mindre husdjur**

**Orsak: Övergödning & extra tillförsel av luftkväve**

**Åtgärder: BSAP + Vattendirektivets åtgärdsplaner**

**Uppföljning: HELCOM (Indikatorer)**

**Information och Varningar (BAWS)**

**Marine Strategy Framework Directive – MSFD (GES – Good Environmental Status Indicators / Descriptors)**

# Baltic Algal Watch System - BAWs

Algsituationen | SMHI - Windows Internet Explorer

http://www.smhi.se/cmp/jsp/polopoly.jsp?d=7826&l=sv

Arktiv Redigera Visa Favoriter Verktyg Hjälp

Algsituationen | SMHI

SMHI

Startsida Prognoser & Observationer Produkter & Tjänster Kontakt

Om SMHI Meteorologi Hydrologi Oceanografi Forskning Klimat

Sök:  Sök

Prognoser & Observationer

Varningar

Land

Fjäll

Kust & Hav

Sjöväder

Kuststräckor

Kustobservationer

Havs-vattenstånd

Vågor

Havsströmmar

Ytvattentemperatur

Havsbojar

Istjänster

Algsituationen

Tolka algsituationen

Högupplöst algsituation

Sjöar & Vattendrag

Satellitbilder

Radarbilder

UV-Index

Mer väder

## Algsituationen

### Ytansamlingar av alger i Östersjön

2008-08-01 kl 09.31 Dag | Vecka | Driftprognos

080831 För muspekaren över datumen för att se tidigare alginformation.

080831

080830

080829 Uppdateras dagligen under algsäsongen.

080828

080827

080826

080825

080824 Välj månad

080823

080822 Hämta

080821 >> Arkiv 2002-2005

080820

080819

080818 Mer om algsituationen finns hos de Marina Informationcentralerna:

080817

080816

080815

080814 Länkarna öppnas i egna fönster.

080813 >> Egentliga Östersjön

080812 >> Bottniska Viken

080811 >> Västerhavet

080810

080809

080808

080807

080806

080805

080804

080803

080802

080801

Algsituationen i Östersjön

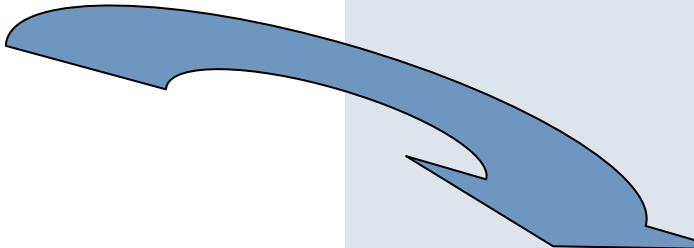
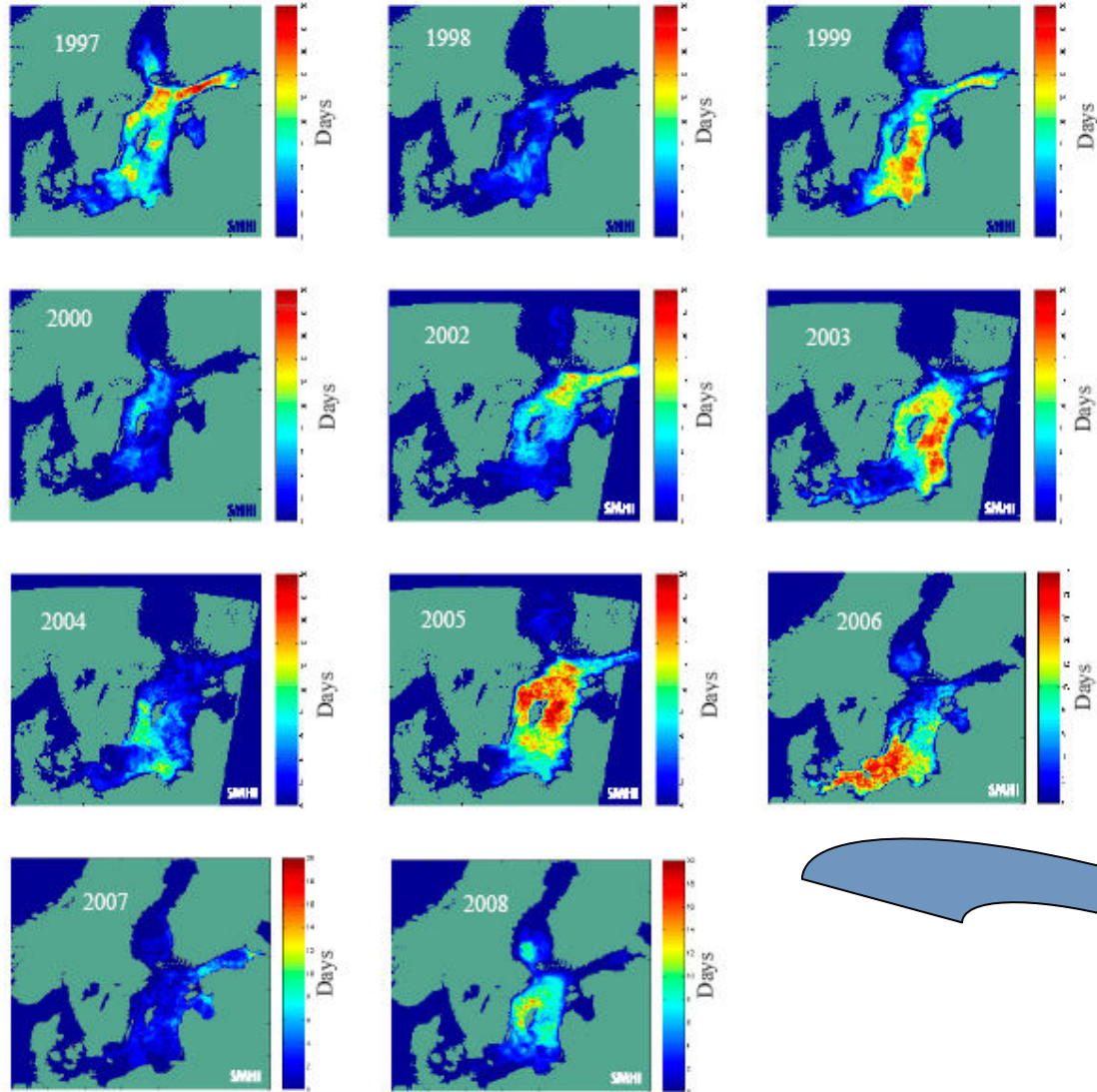
Ytansamlingar av cyanobakterier finns stort sett i hela Östersjön samt Finska Viken. Blomningarna i S halvan av Bottenhavet har inte kunnat observerats pga moln. De kraftigaste förekomsterna finns till havs ost och sydost om Gotland. För mer detaljerad bild, se Högupplöst algsituation i menyn till vänster.

M. Hansson

Om webbplatsen Kunskapsbanken

Internet 100%

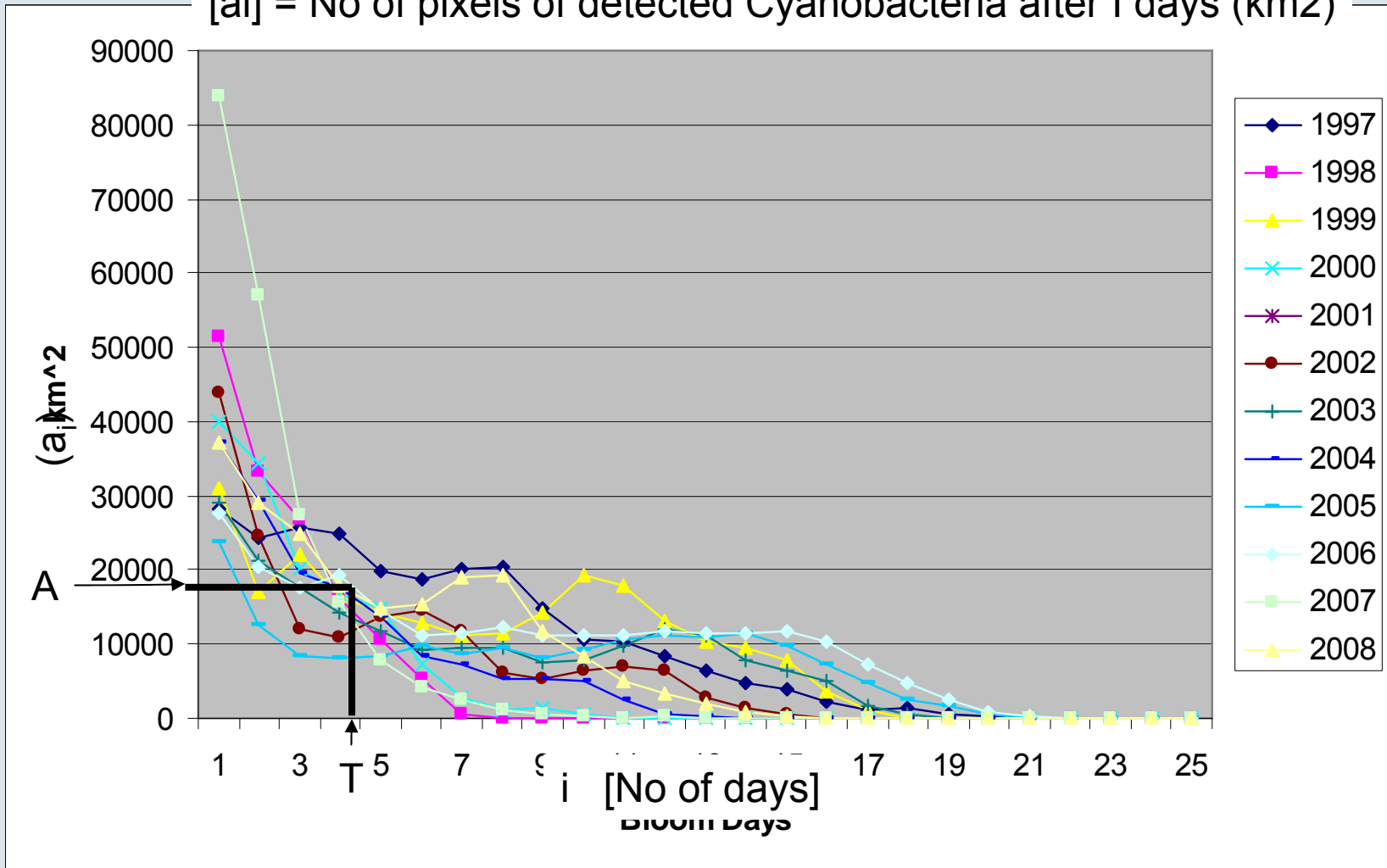
# Time Series of Cyanobacteria Ackumulations



# Cyanobacteria accumulation structure functions - CASF

$[i]$  = No of days of detected Cyanobacteria (days)

$[a_i]$  = No of pixels of detected Cyanobacteria after  $i$  days (km<sup>2</sup>)



# Definitions of macro-parameters from CASF

$a_i$  = number of pixels with detected cyanobacteria during (i) days

$$\text{Duration} \longrightarrow T = \frac{\sum a_i \times i}{\sum a_i} \quad [\text{Days}]$$

$$\text{Area} \longrightarrow A = \frac{\sum a_i \times i}{\sum i} \quad [\text{km}^2]$$

Intensity  $\longrightarrow T = A * I \quad [\text{km}^2 \text{ days}]$

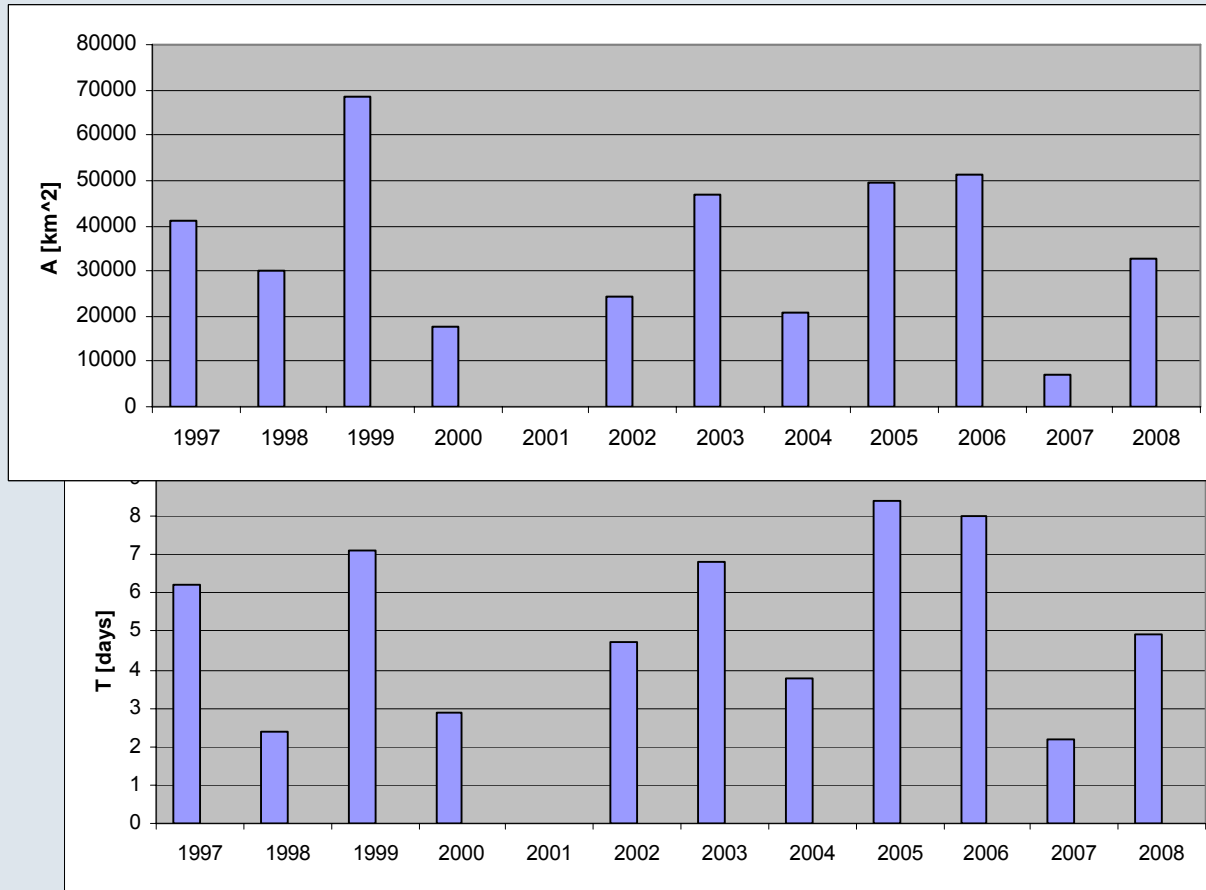
Ref: Hansson & Håkansson (2007)

$$\text{Ack area} = \sum_i a_i \quad - \text{ total area coverage of Cyanobacteria (km}^2\text{)}$$

FCA = defined as the ratio of counts of detected cyanobacterial bloom scenes to counts of valid ocean scenes (Kahru et al 2007)

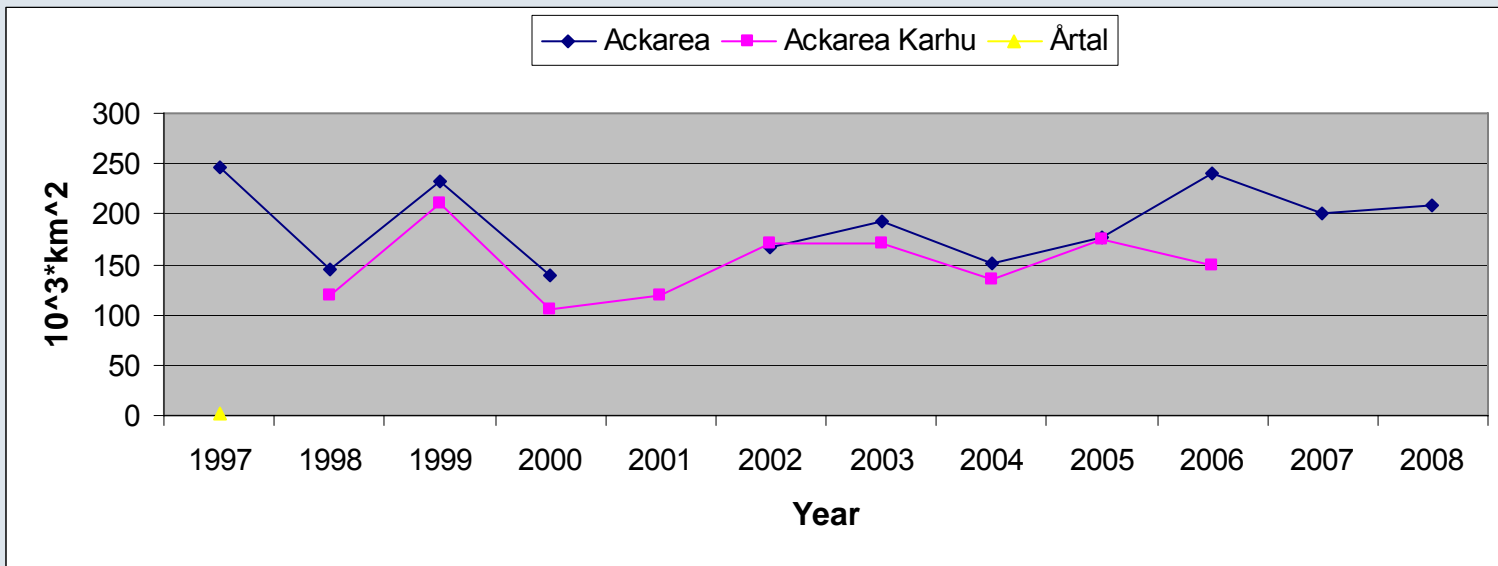
# Results: Duration (T) and Area (A)

## AVHRR-data

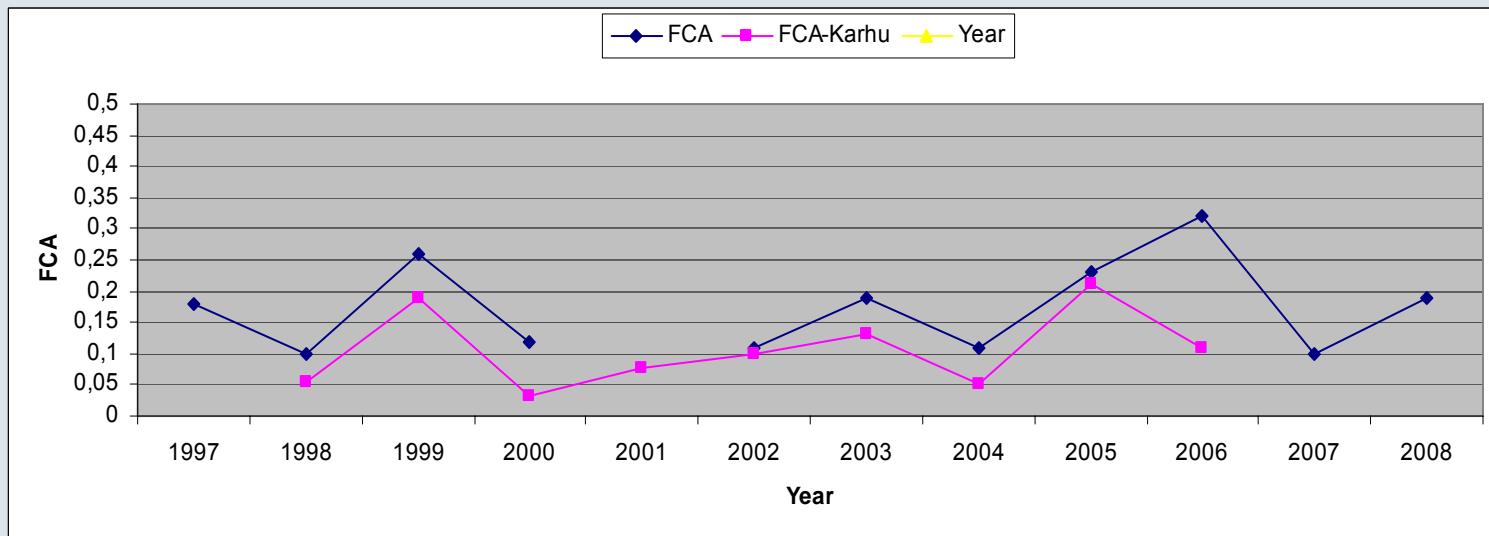


# Comparison – Cyanobacteria accumulations and FCA but different satellite data sets (AVHRR versus SeaWiFS + MODIS)

$Y = 1,04 * X - 24,03$   
 $R^2 = 0,875$

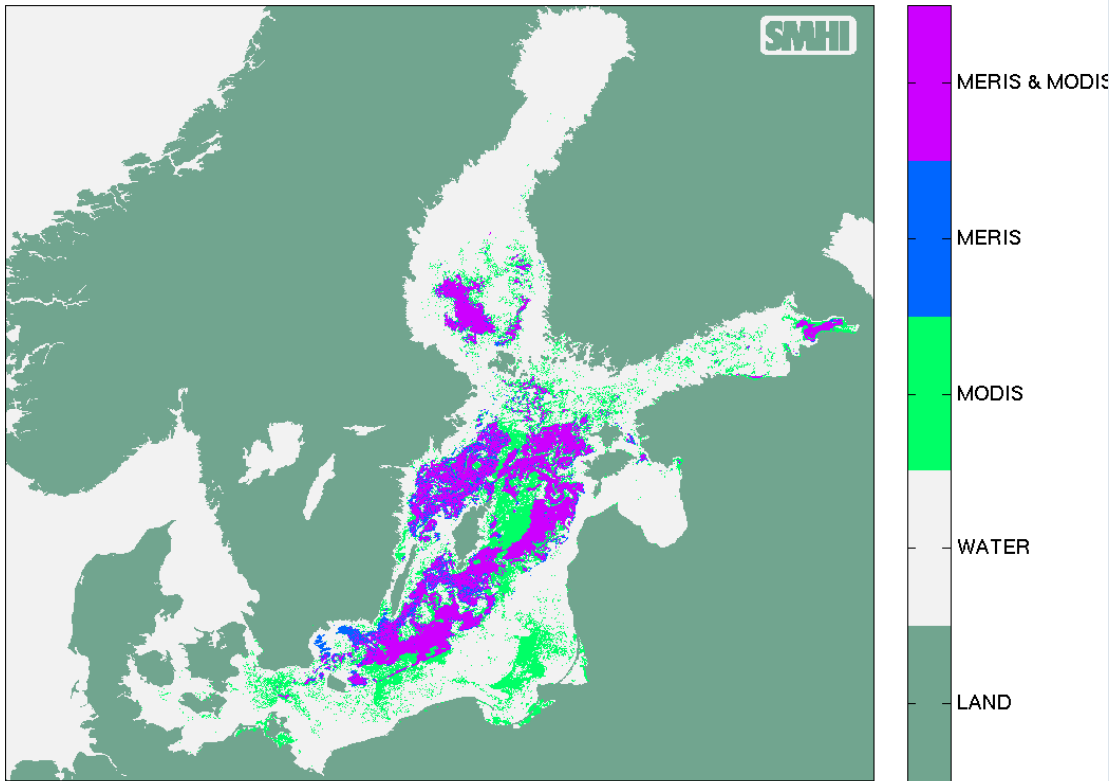


$Y = 0,98 * X - 0,05$   
 $R^2 = 0,848$



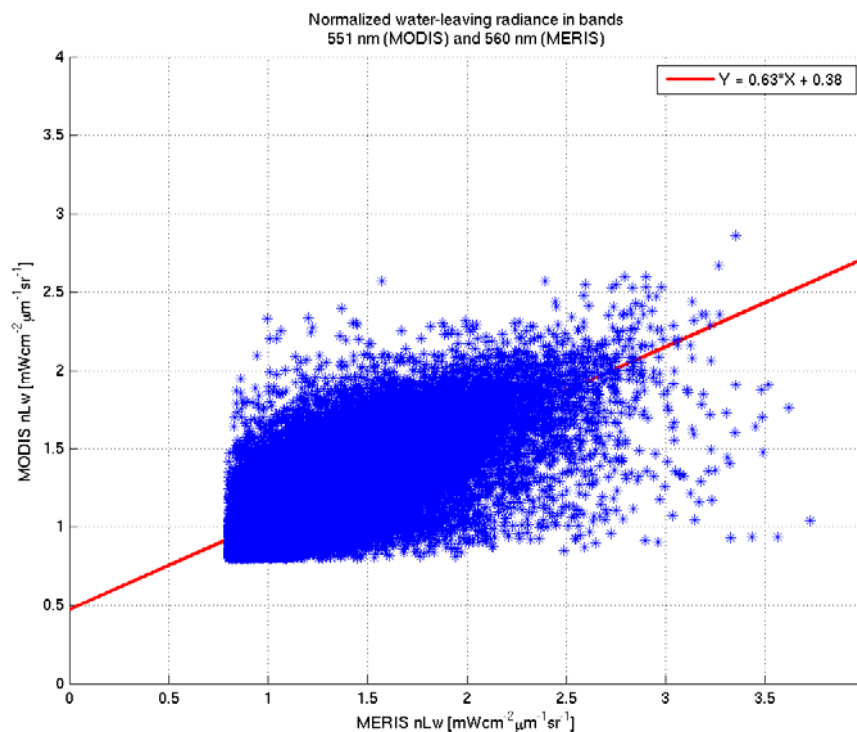
# Comparison of MODIS and MERIS of classification according to Kahru et al.

Classification according to Kahru *et al*,  
2008-07-31

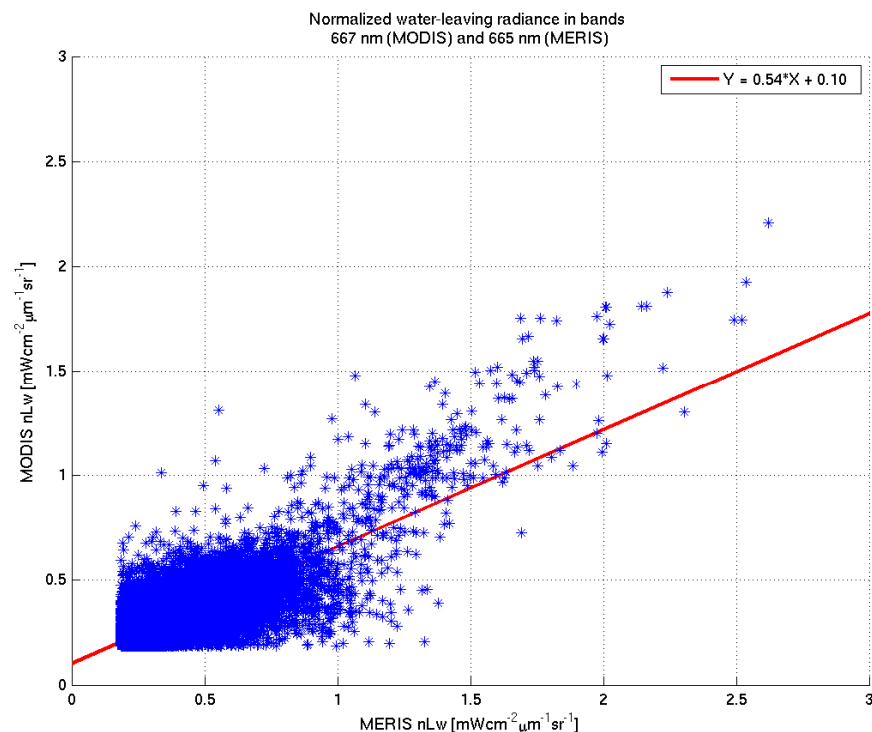


# Normalized water-leaving radiance in MODIS versus MERIS

## MODIS 555 nm versus MERIS 560 nm

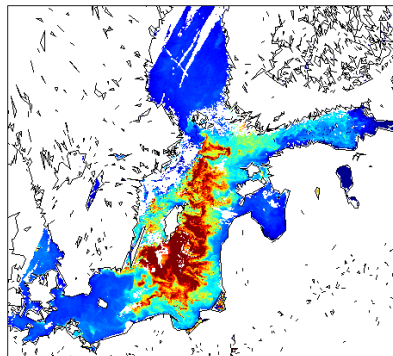


## MODIS 667 nm versus MERIS 665 nm

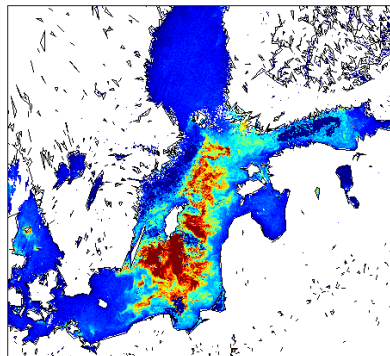


# Effects of using flags in MODIS and MERIS

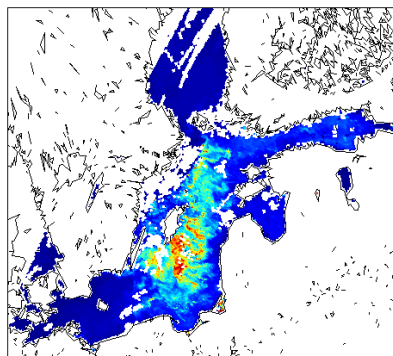
MODIS nLw(551), 20050710  
[mWcm<sup>-2</sup> μm<sup>-1</sup> sr<sup>-1</sup>]



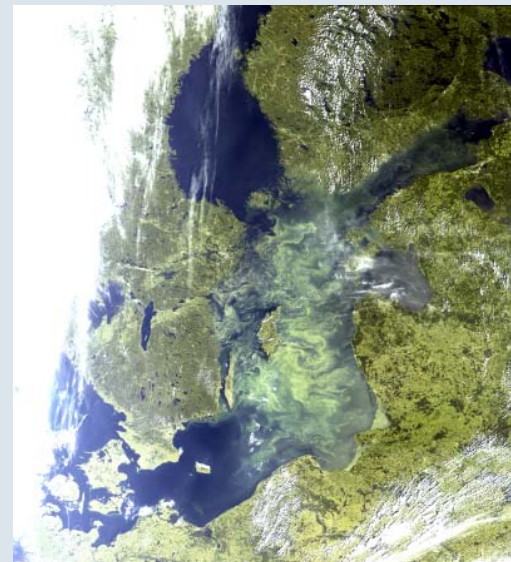
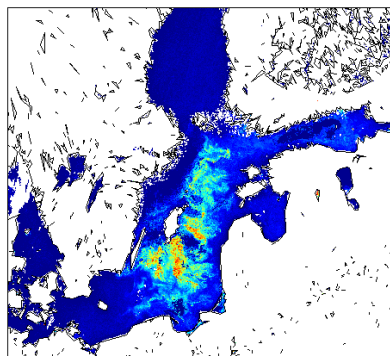
MERIS nLw(560), 20050710  
[mWcm<sup>-2</sup> μm<sup>-1</sup> sr<sup>-1</sup>]



MODIS nLw(667), 20050710  
[mWcm<sup>-2</sup> μm<sup>-1</sup> sr<sup>-1</sup>]



MERIS nLw(665), 20050710  
[mWcm<sup>-2</sup> μm<sup>-1</sup> sr<sup>-1</sup>]



Water leaving radiance [mWcm<sup>-2</sup>μm<sup>-1</sup>sr<sup>-1</sup>] for 2005-07-10 from MODIS band 551 nm (top left), MERIS band 560 nm (top right), MODIS band 667 nm (bottom left) and MERIS band 665 (bottom right). Clouds and land have been masked out of the images.

## MCI index

(by Gower, King and Goncalves 2008)

the measure of the radiance peak at 709nm in water-leaving radiance, *indicates the presence of a high surface concentration of chlorophyll a (above 30 mg m<sup>-3</sup> and up to several hundred mg m<sup>-3</sup>)* against a scattering background.

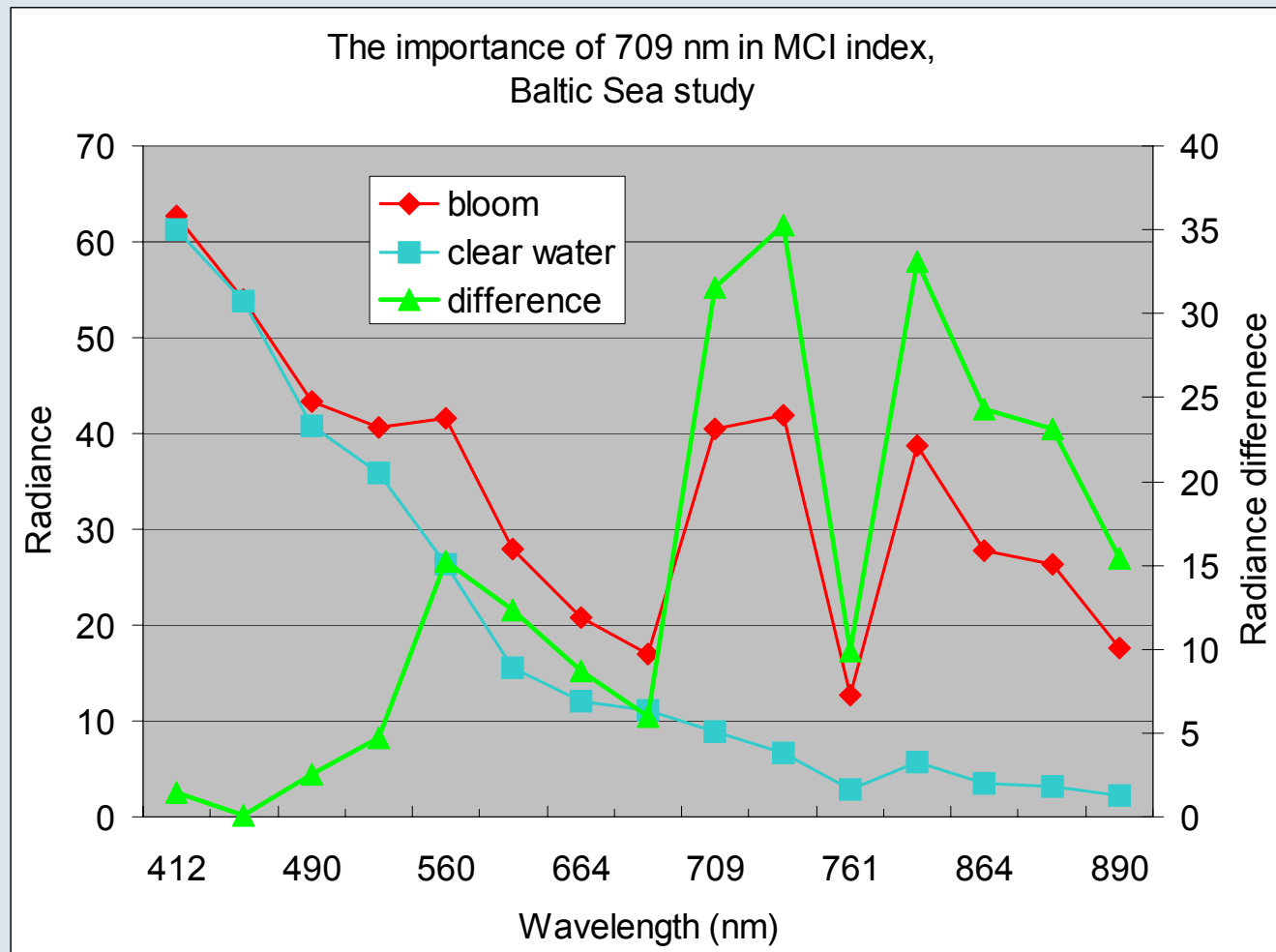
Calculation from TOA radiance (MERIS Level1)

$$\text{MCI} = L_{709} - L_{681} - 0.389(L_{753} - L_{681})$$

The index is high in 'red tide' conditions (intense, visible, surface, plankton blooms) and is raised when aquatic vegetation is present.

# Importance of band 709 –

Example of Radiance spectra in **bloom conditions** and in clear water conditions – **maximal difference in NIR**



# Cyanobacterial bloom by AVHRR (left) and MERIS (right)

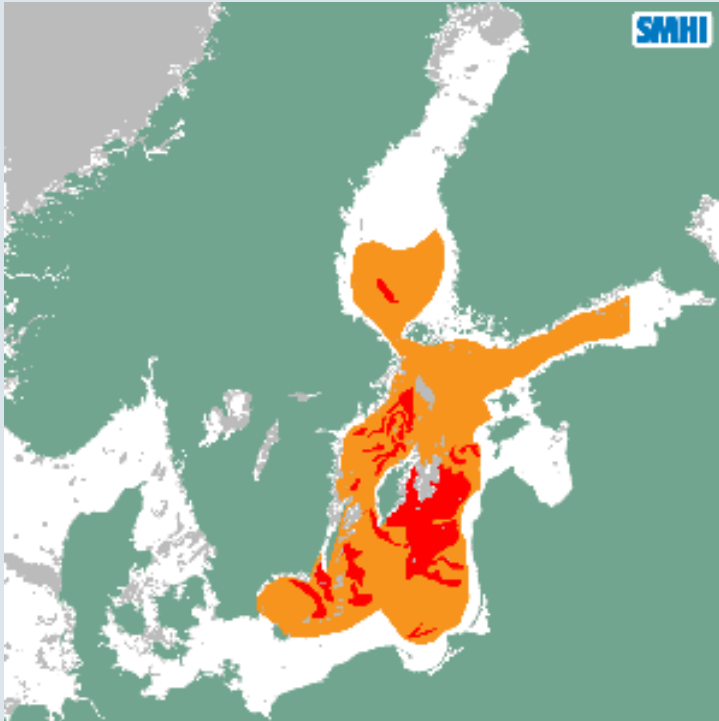


Figure 1 Cyanobacteria bloom estimated from AVHRR

([http://www.smhi.se/weather/baws\\_ext/balt/2008/BAWSDag\\_en\\_0807.htm#](http://www.smhi.se/weather/baws_ext/balt/2008/BAWSDag_en_0807.htm#))

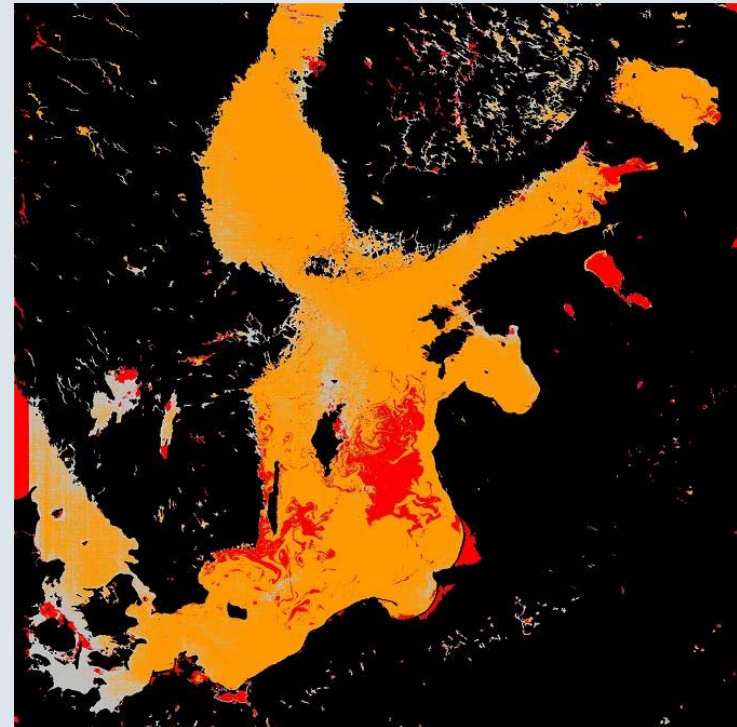
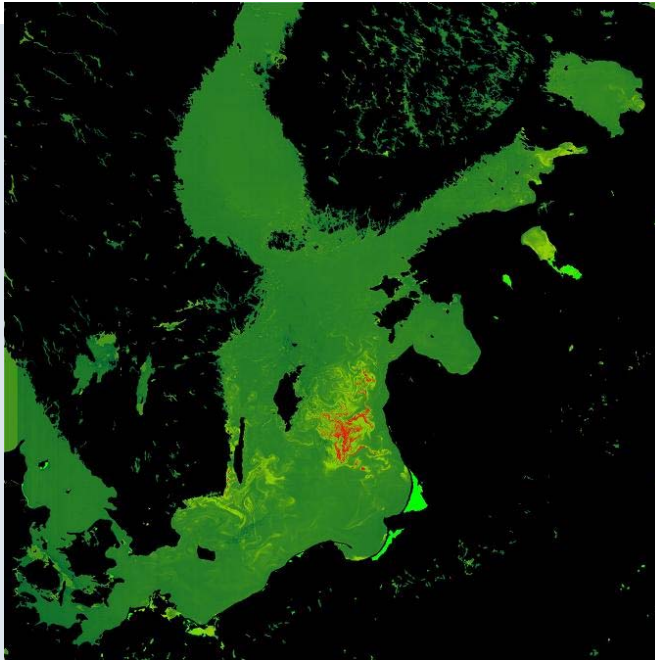


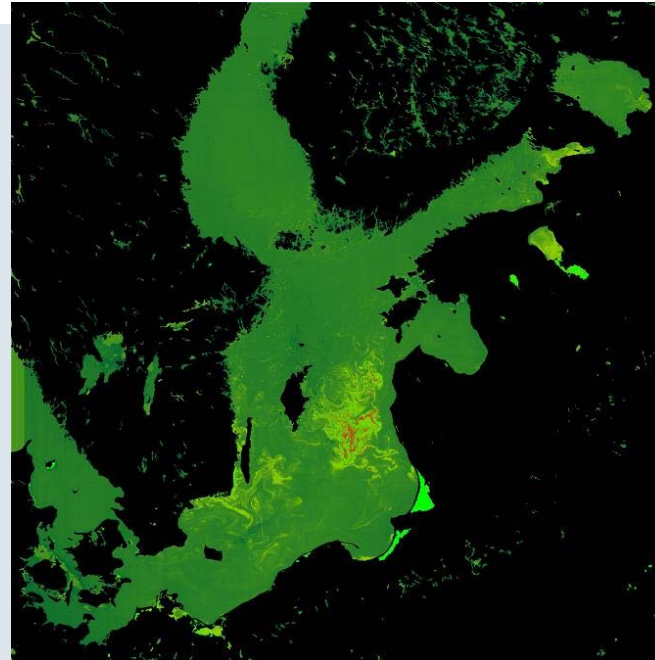
Figure 2. MERIS MCI index above 0.

Red- heavy bloom

## MERIS FR MCI 2008-07-31



MCI&gt;4



MCI&gt;6

We need to clarify which value of MCI accord the best for surface bloom of cyanobacteria – this will be adjusted by comparion of MODIS, AVHRR and MERIS derived area estimates – **preliminary suggestion MCI 6**

MCI	>0	>1	>2	>3	>4	>5	>6	>7	>8	>9	>10	>11	>12
AREA km <sup>2</sup>	25369	8543	49233	3290	2308	1665	1220	896	655	438	357	264	192

## Summary and future work during 2009

**Manually analysed algae blooms versus the automatic method (Kahru et al. 2007) do agree in terms of macro-parameters.**

**More comparisons of Kahru et al method for MERIS and MODIS is needed to clarify differences and similarities.**

**New methods will be further studied (i.e. Gower et al. 2008) to surfacing Cyanobacteria axkumulations.**