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LAND-SEA BIOCHEMICAL TRANSFER FROM EARTH OBSERVATION

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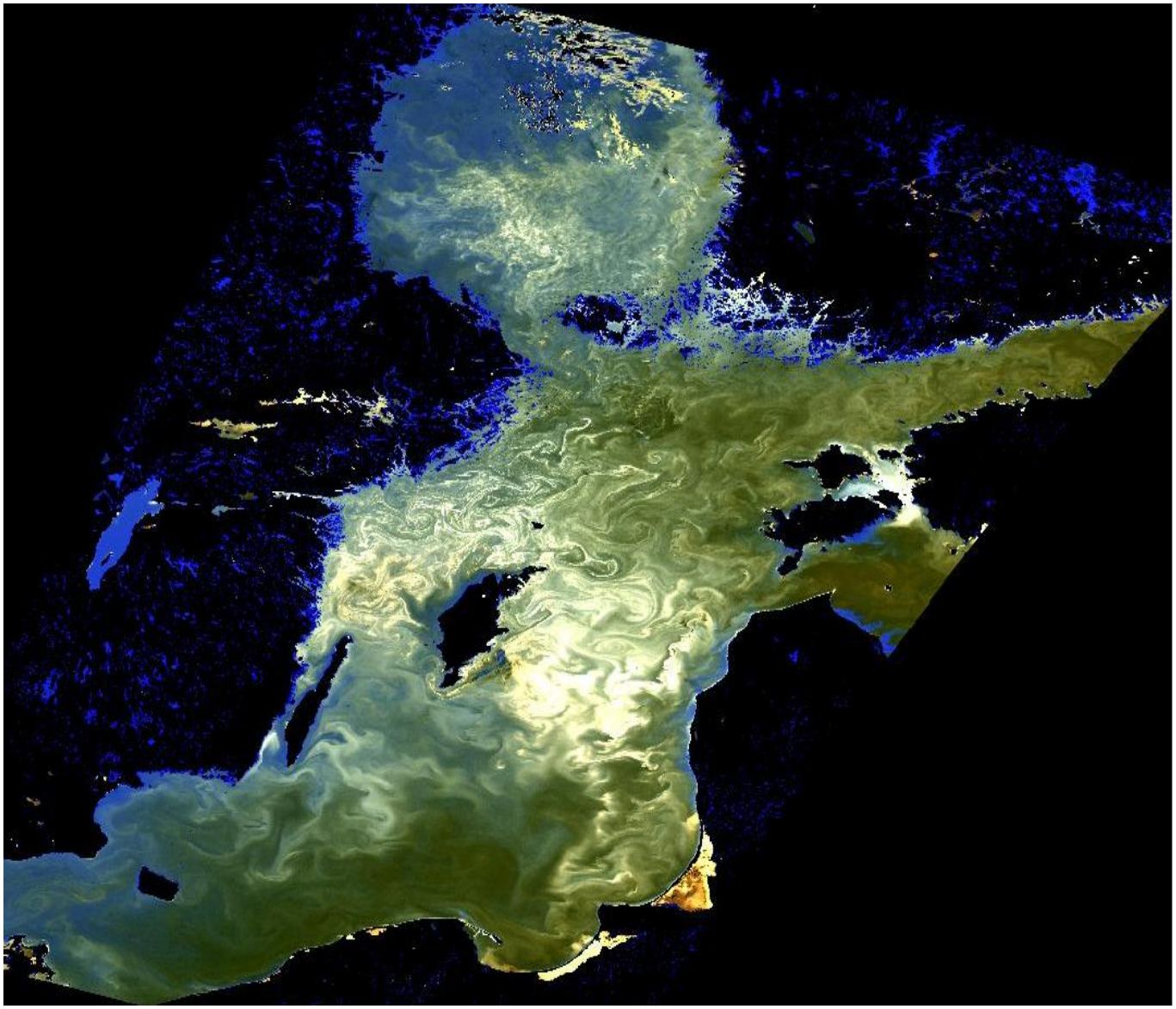
What do we want to observe?

* Eutrophication
* Acidification
* C N P cycles
* Primary production
* Terrestrial organic matter

Can be done only if related to water colour

Eutrophication



Chlorophyll-a

There are no Chl-a algorithms that work reliably over the Baltic Sea

Copernicus Marine Environment Monitoring Service Chl-a product

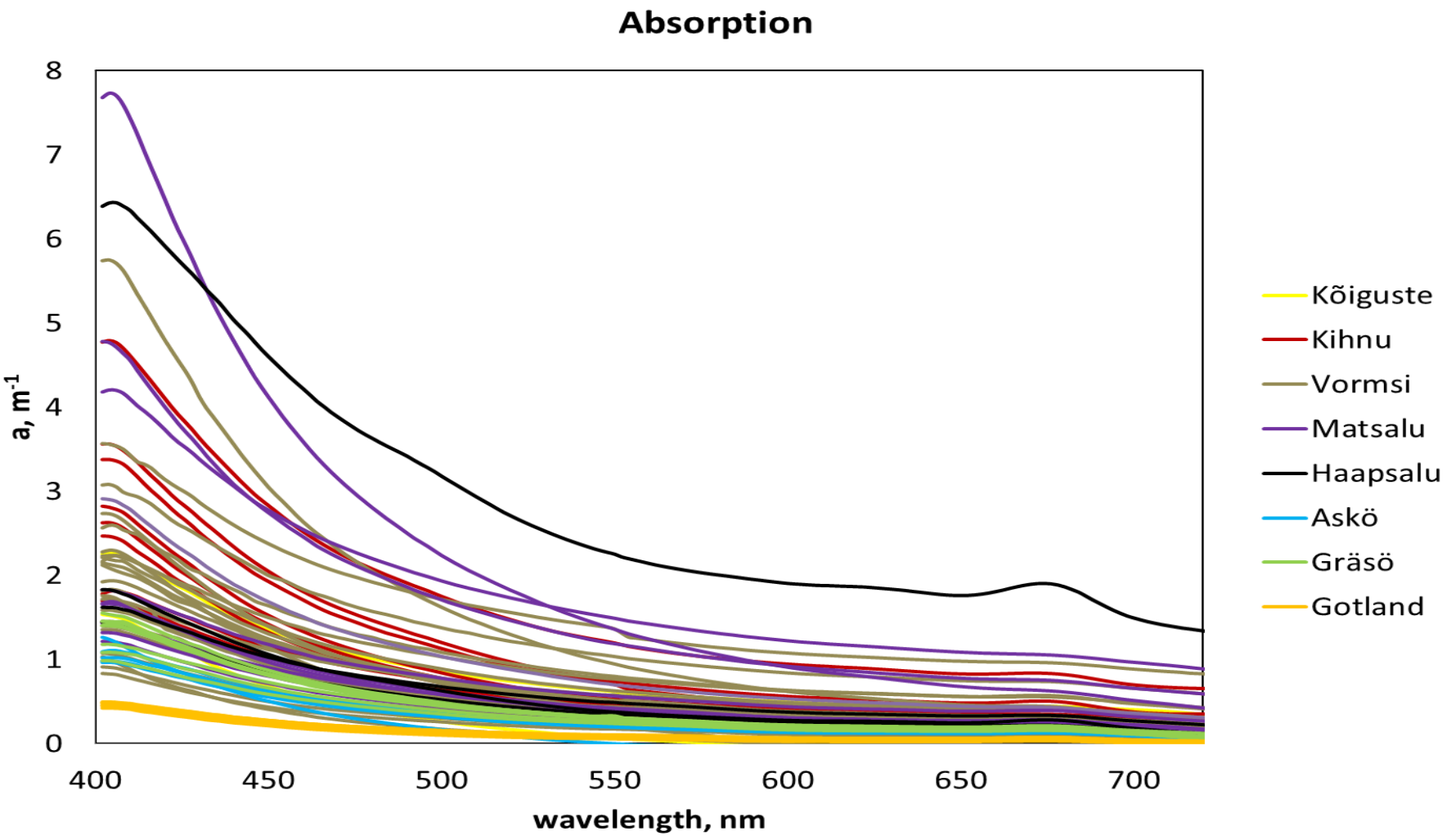
$R^2 = 0.203$

Chlorophyll-a

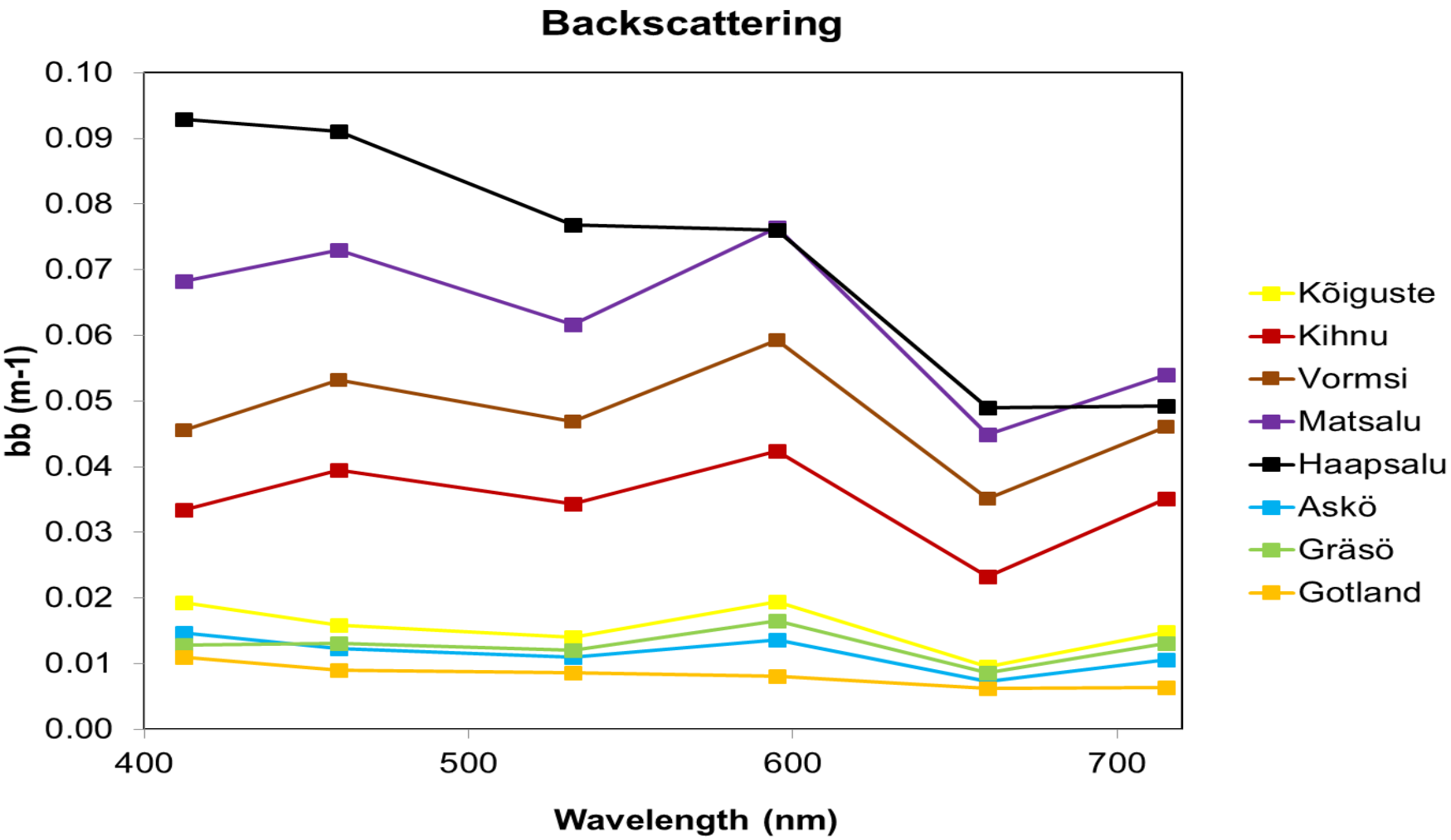
* Atmospheric correction

* Differences in optical properties

Big differences in optical properties



Big differences in optical properties



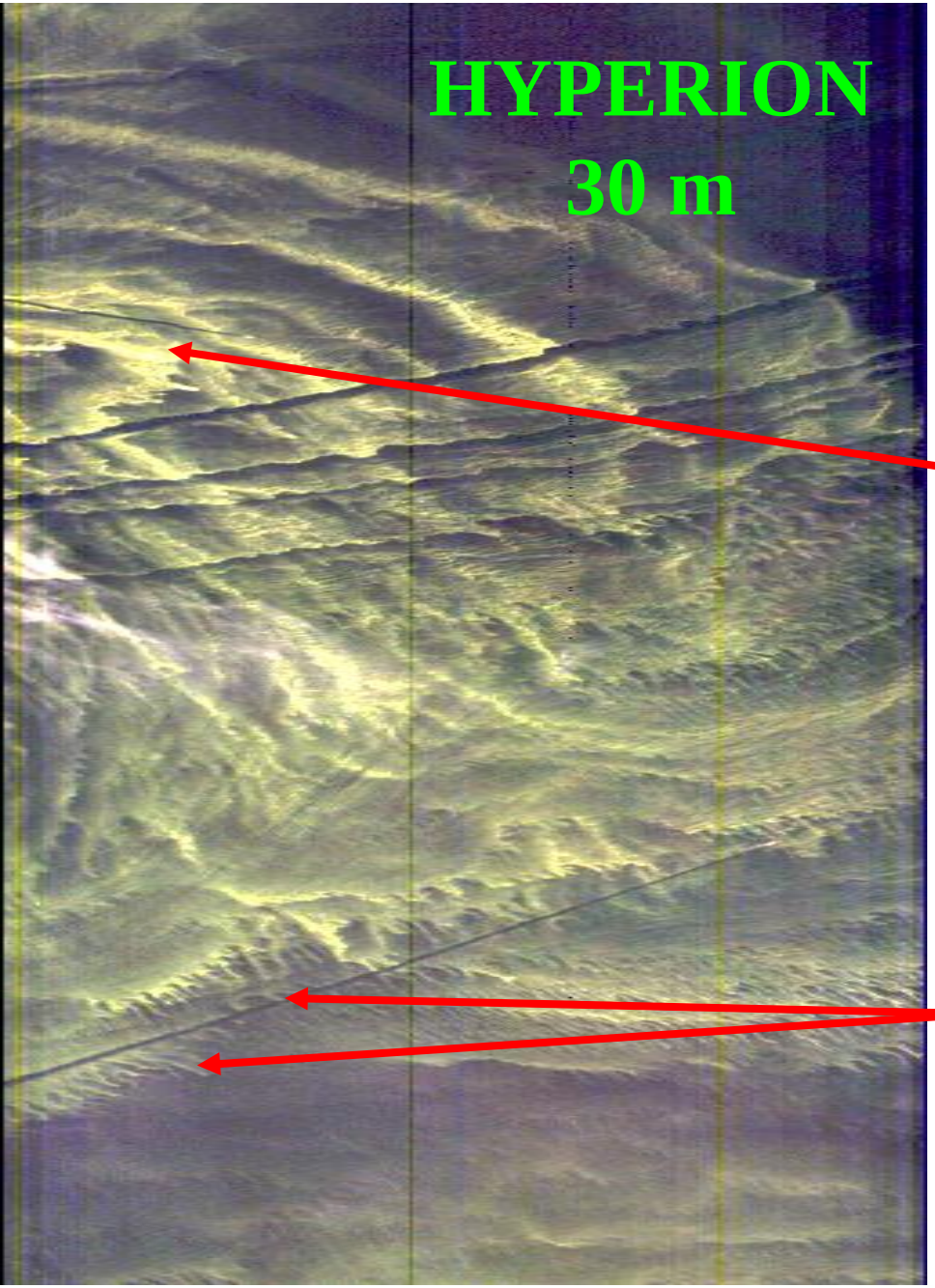
Chlorophyll-a

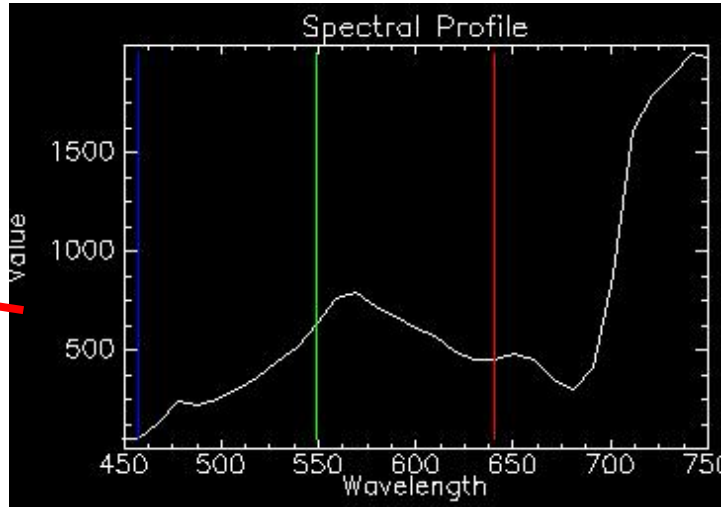
Seasonality due to huge differences between optical properties of phytoplankton assemblages

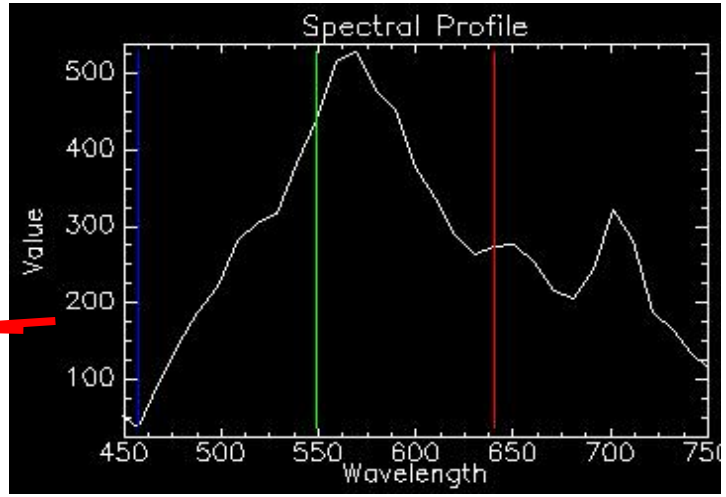
Empirical algorithms with seasonal coefficients?

Analytical methods with two sets of SIOPs?

© vastavalo.net:491534

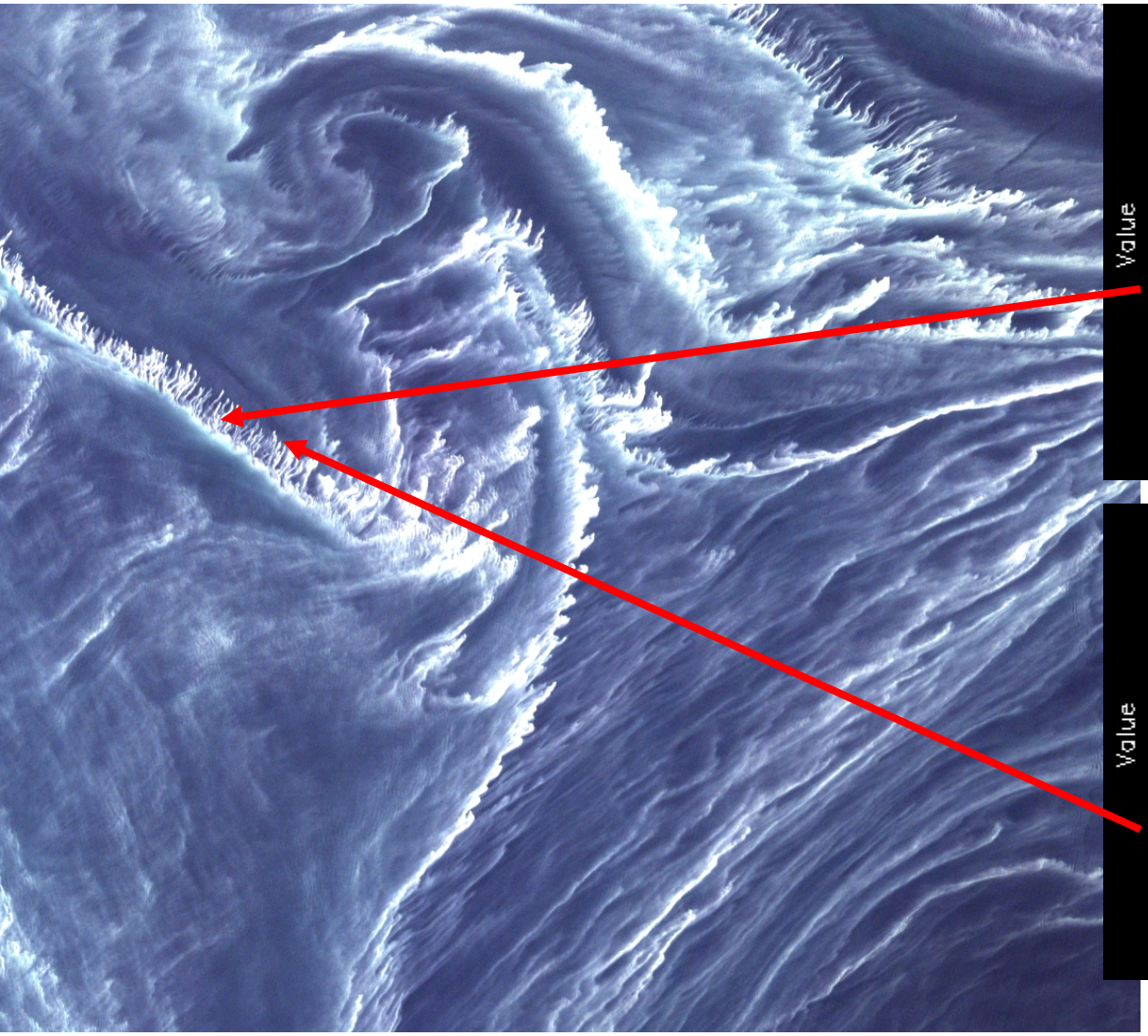


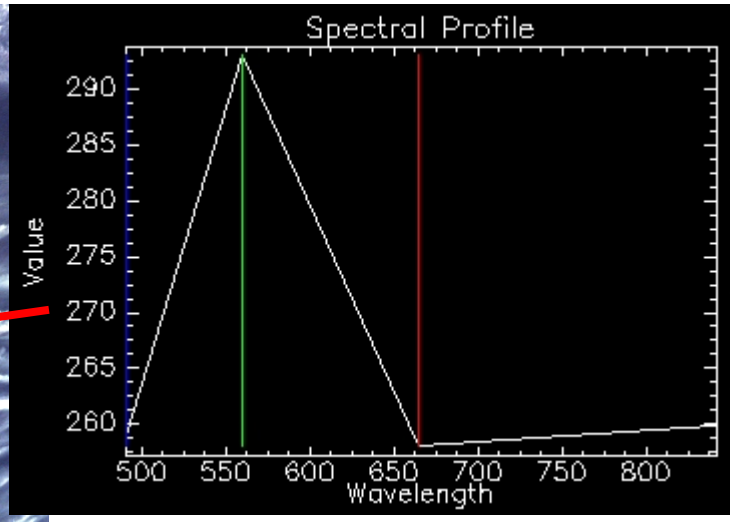


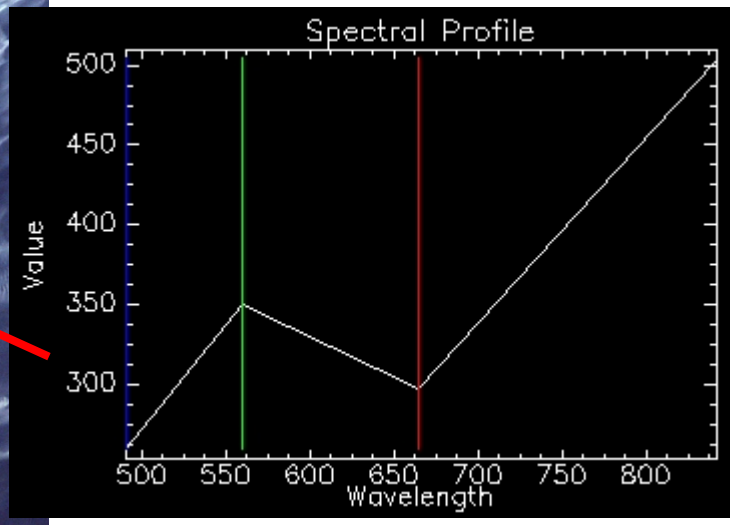


Kutser 2004, L&O

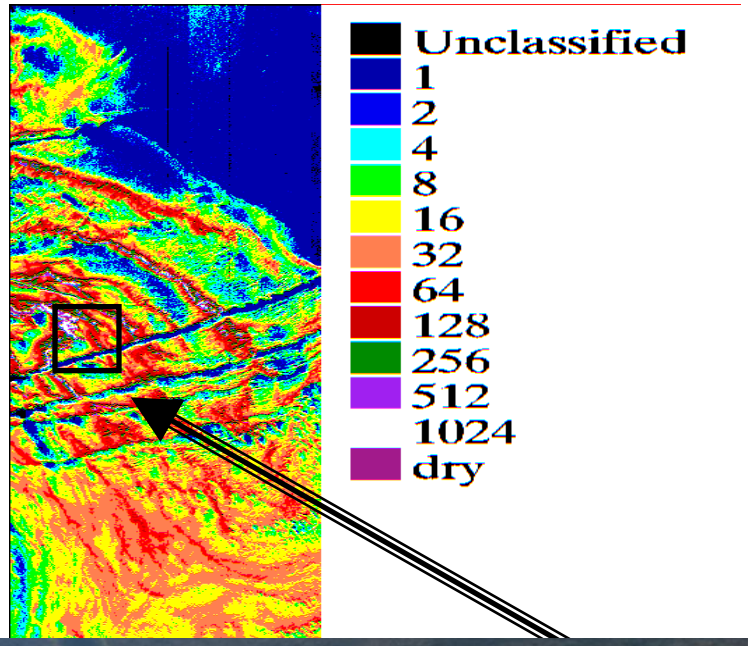
10 m resolution not sufficient?

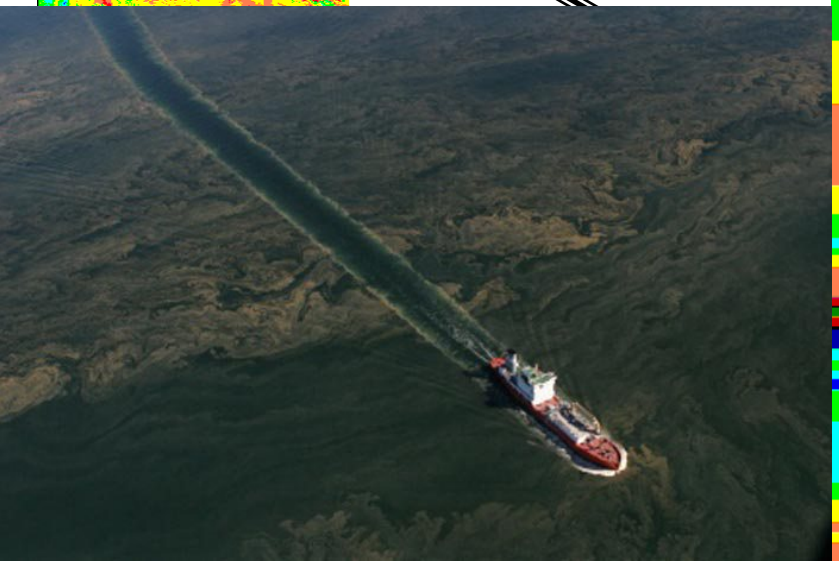


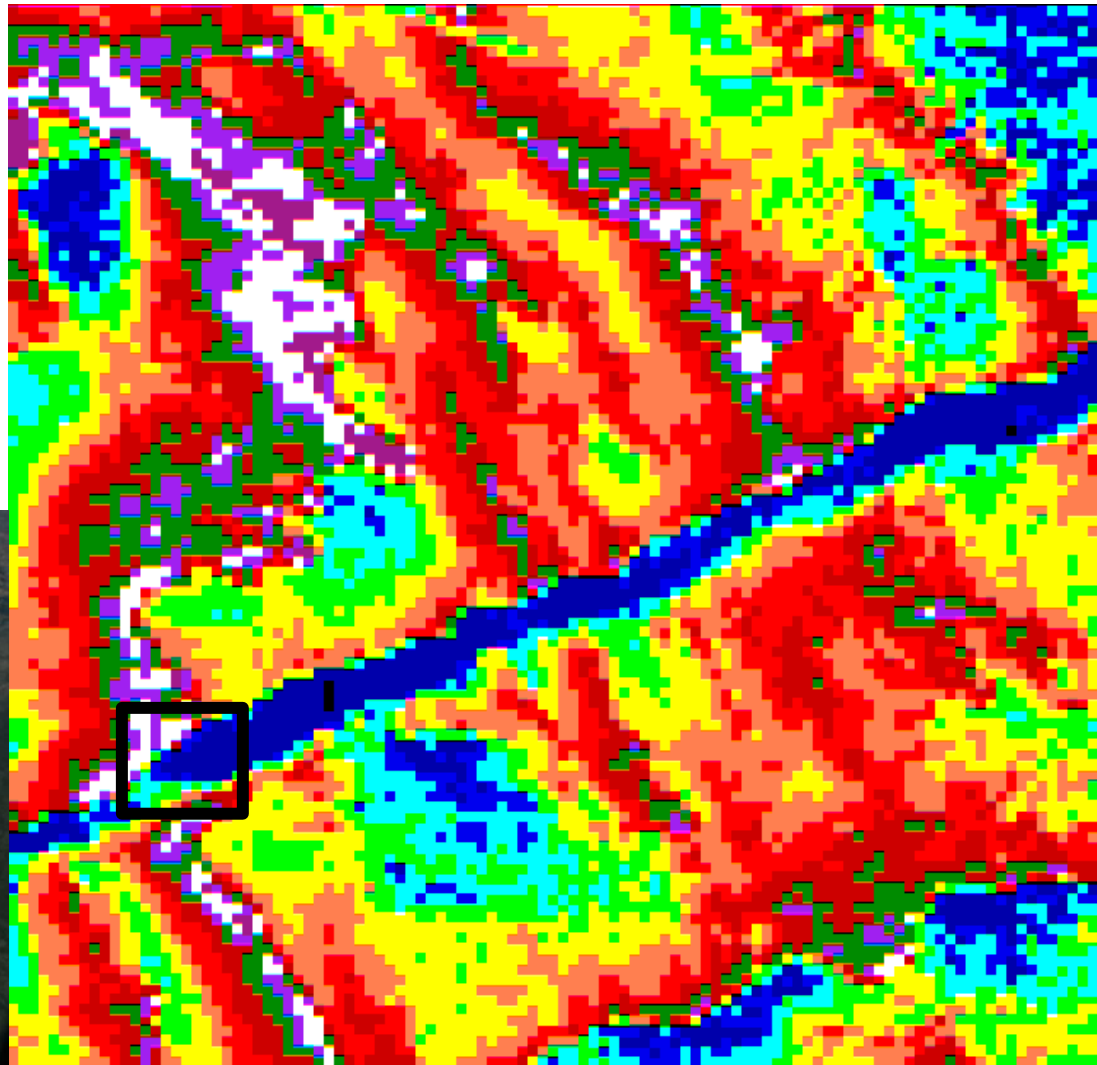




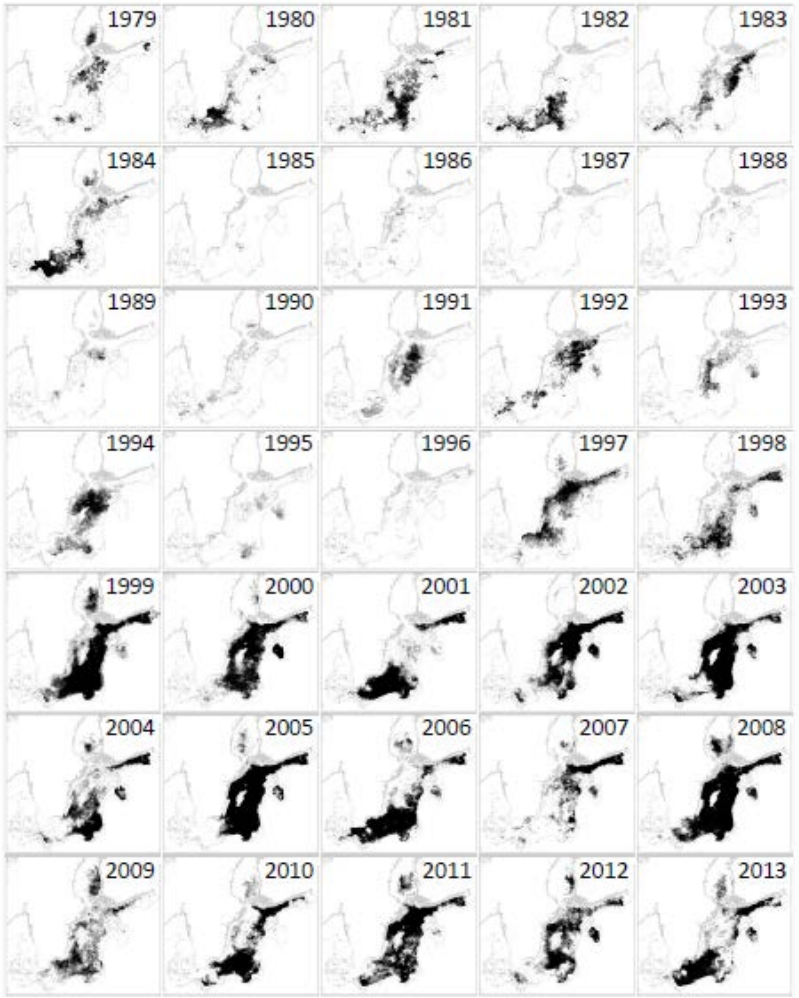
OLCI pixel size





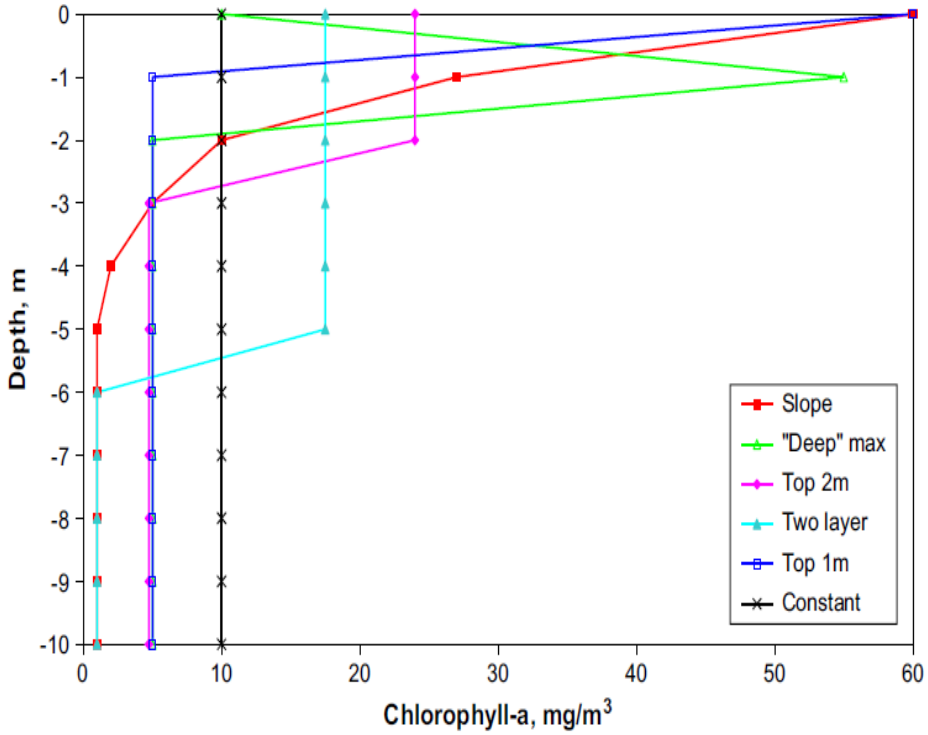


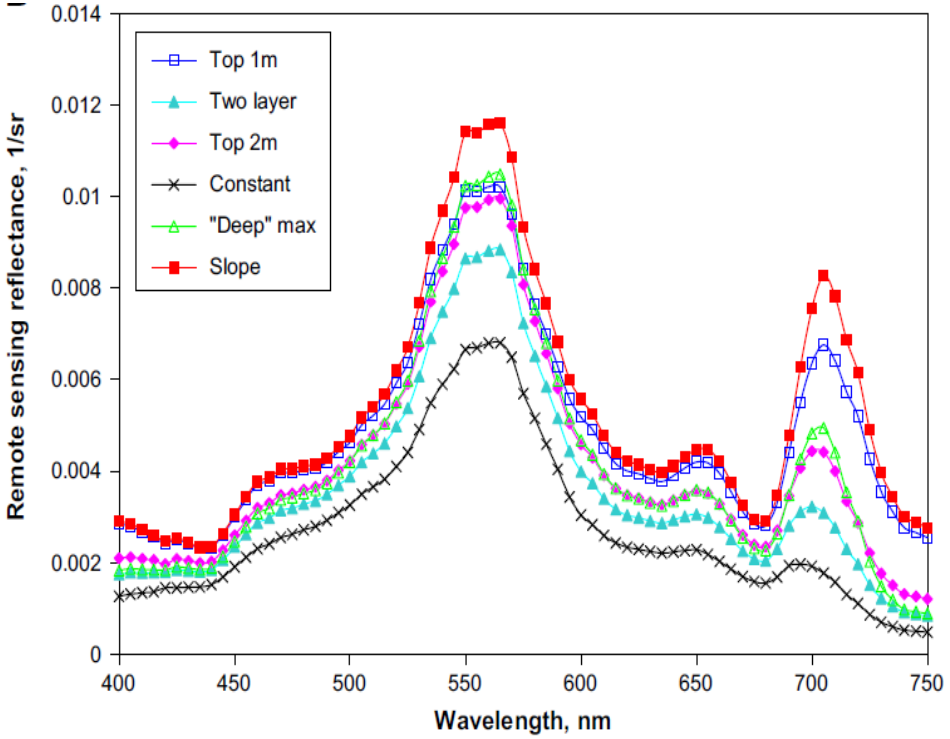
Can we map bloom extent changes if we cannot get biomass?



Kahru and Elmgren 2014

Can we map bloom extent changes if we cannot get biomass?





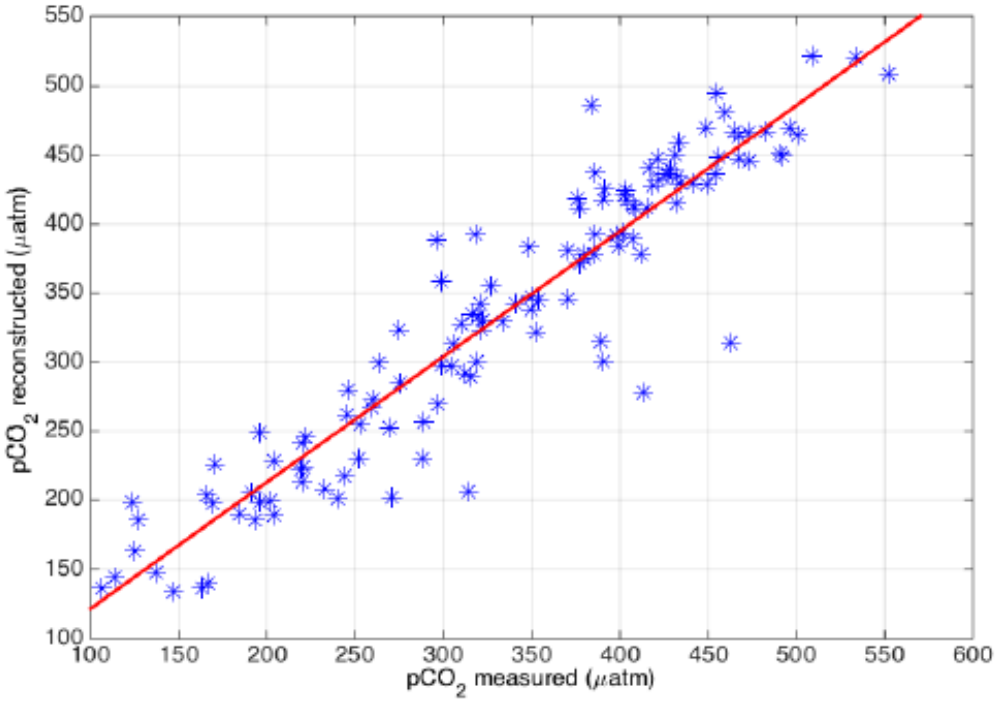
Kutser et al. 2008

Acidification

Uptake of CO_2

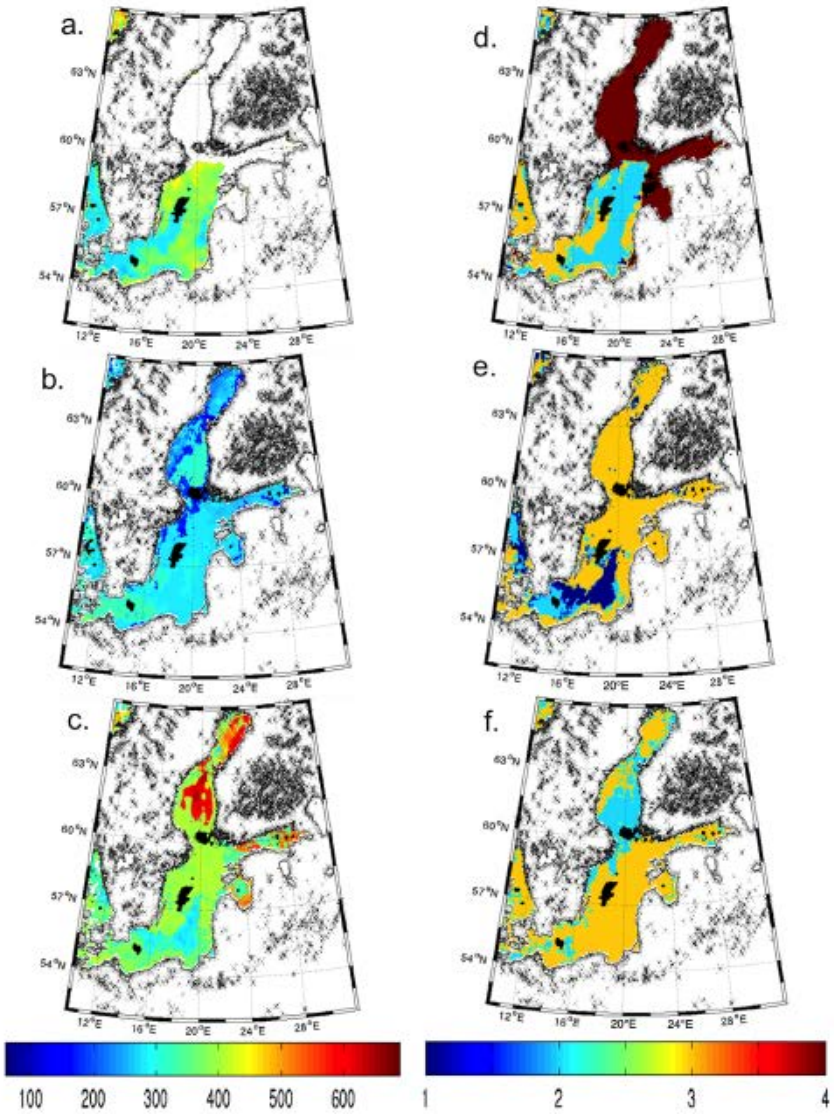
* In ocean waters correlated to chlorophyll-a or temperature
* In lake waters corelated to DOC (and CDOM that has optical signatuure)

Acidification

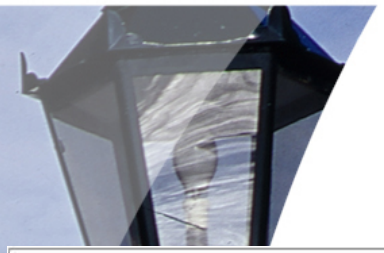


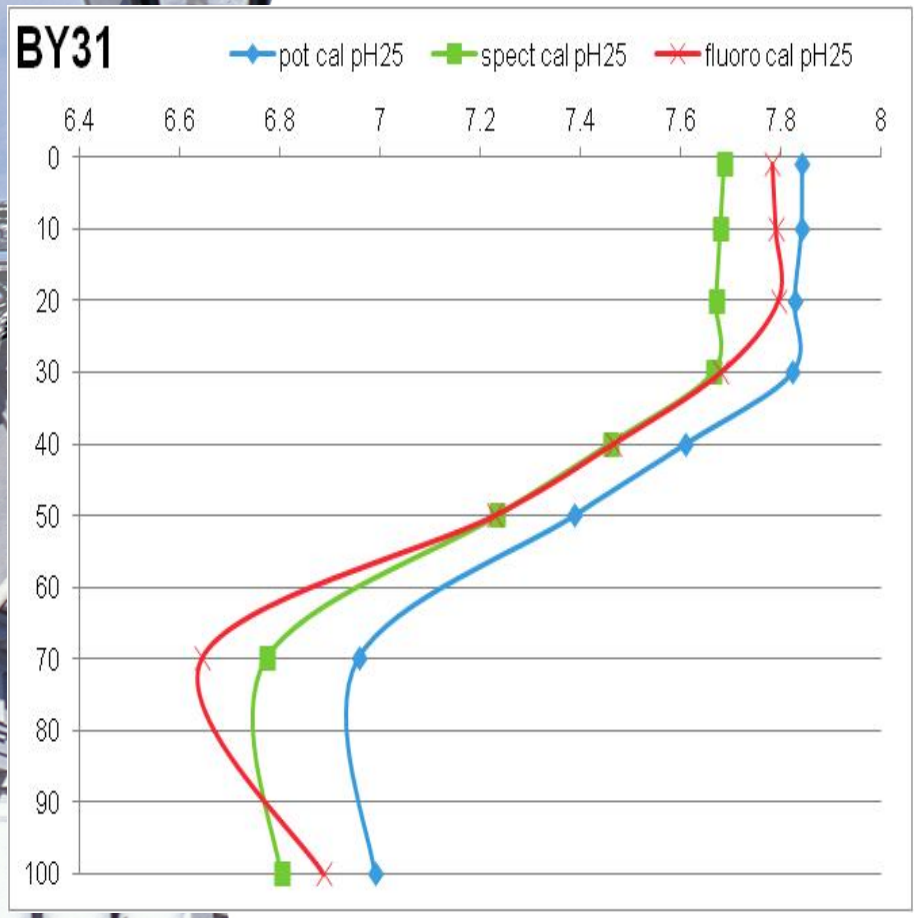
Neural Net combining SST, Chl-a, CDOM, NPP, MLD.

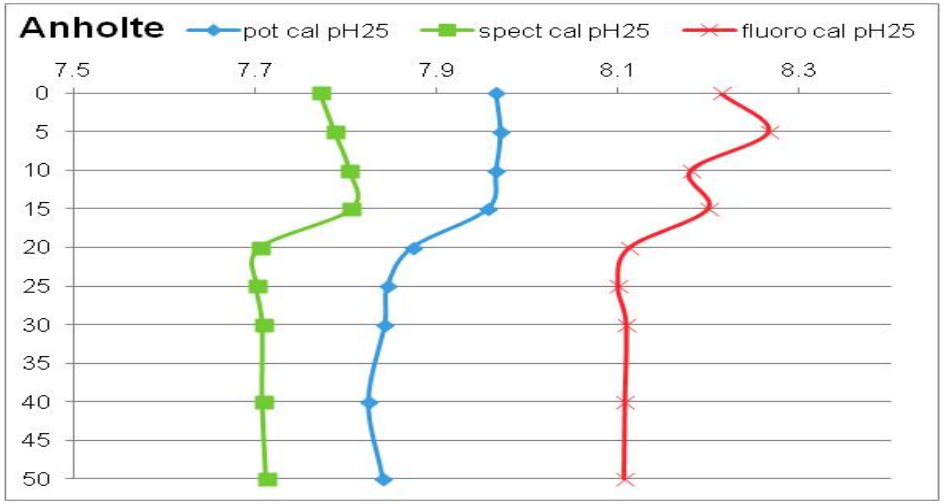
Parard et al. 2015



In situ pH measurements







S. Lainela
Personal communication

Carbon
Nitrogen
Phosphorus

Total phosphorus remote sensing

Lakes: Kutser et al. 1995
Song et al. 2012

Rivers: Wu et al. 2010
Anderson 2012

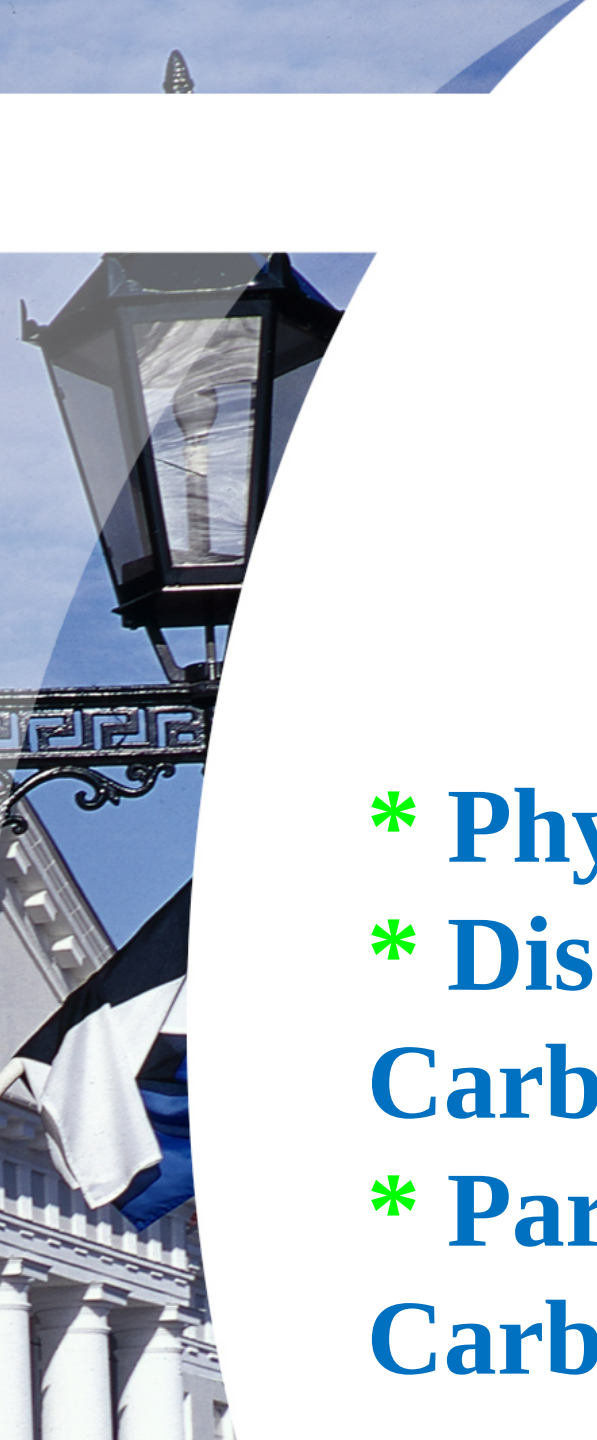
Baltic Sea: ?

Carbon
Nitrogen
Phosphorus

Nitrogen remote sensing

Lakes: Chen and Quan 2012

Baltic Sea: ?



Carbon
Nitrogen
Phosphorus

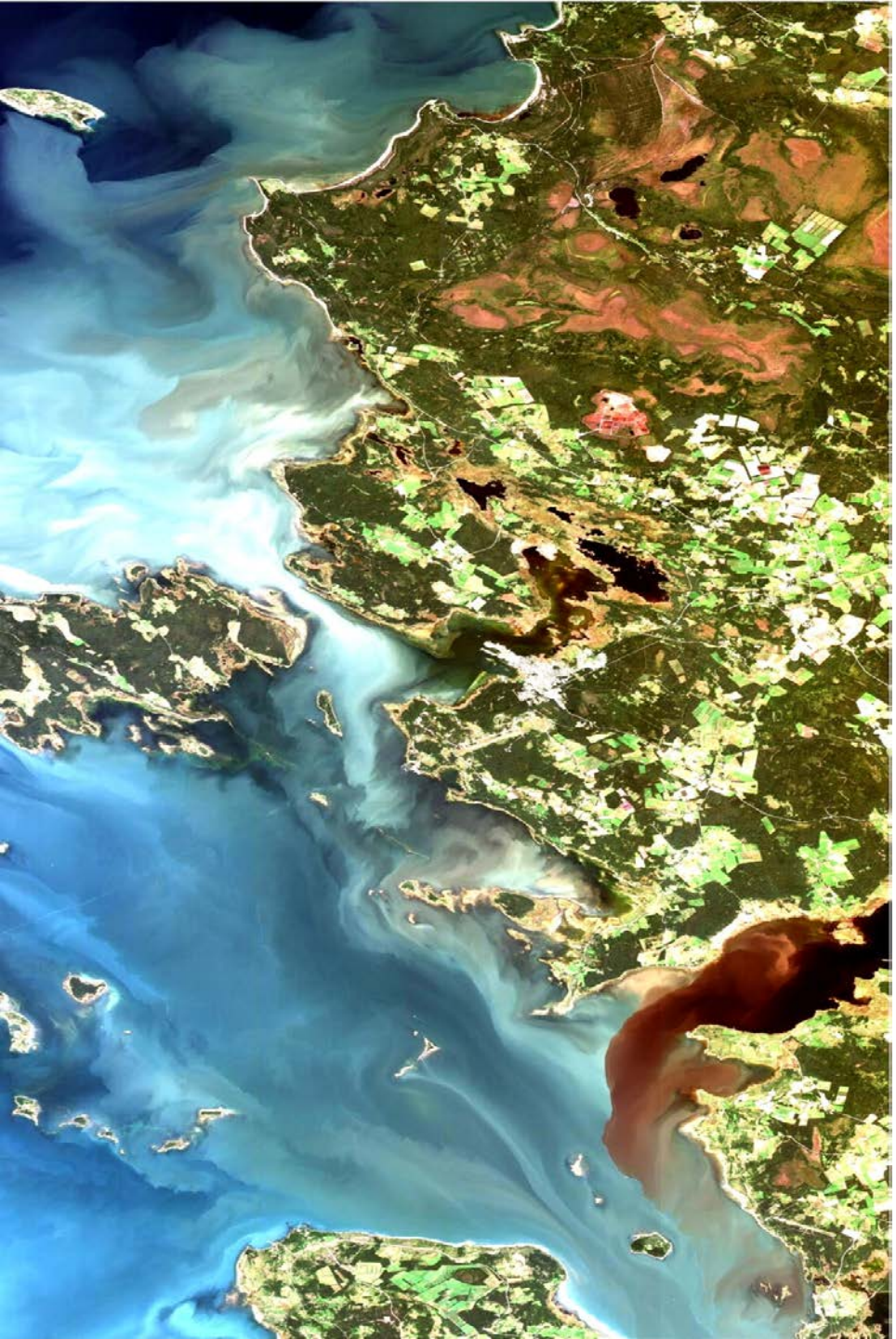
Carbon remote sensing

* Phytoplankton
* Dissolved Organic/Inorganic Carbon
* Particulate Organic/Inorganic Carbon

Carbon
Nitrogen
Phosphorus

Carbon remote sensing

* **Phytoplankton Functional Types**
  - **absorption spectra (pigments)**
  - **backscattering signal (size)**



Terrestrial organic matter

Dissolved Organic Carbon

Coloured Dissolved Organic Matter

Particulate Organic Carbon

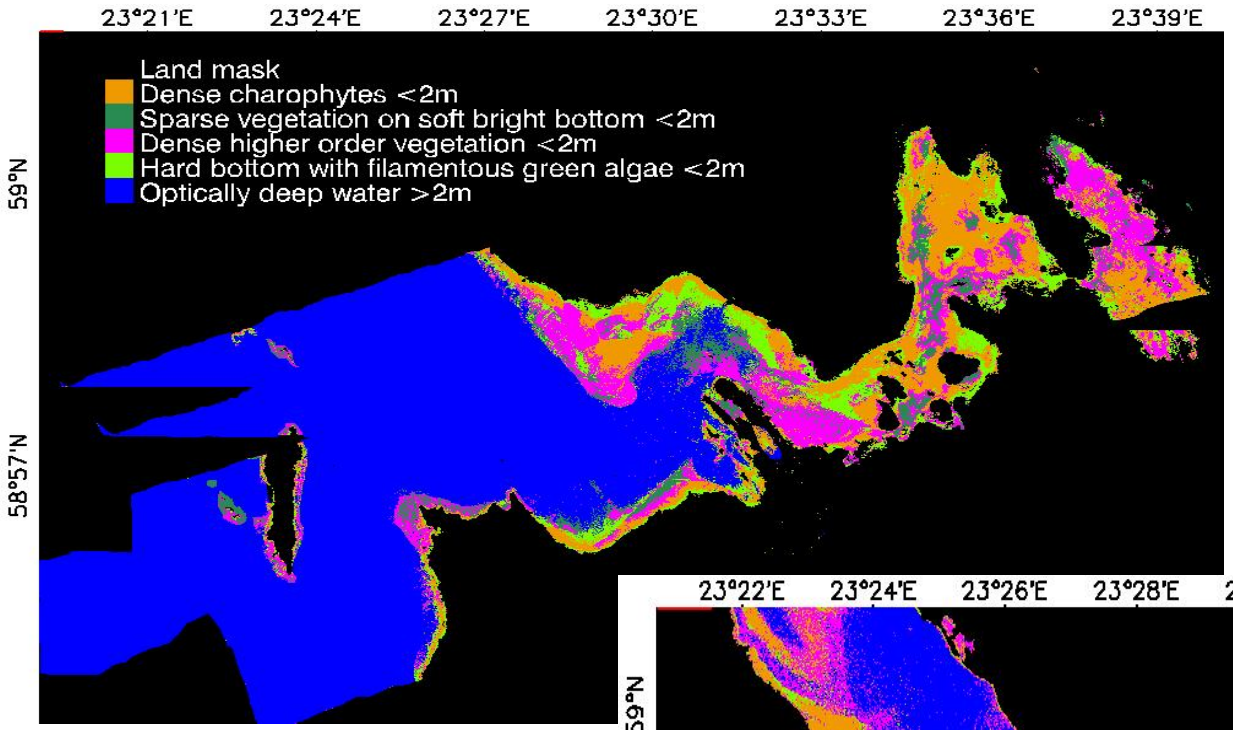
Absorption similar to CDOM

Terrestrial organic matter

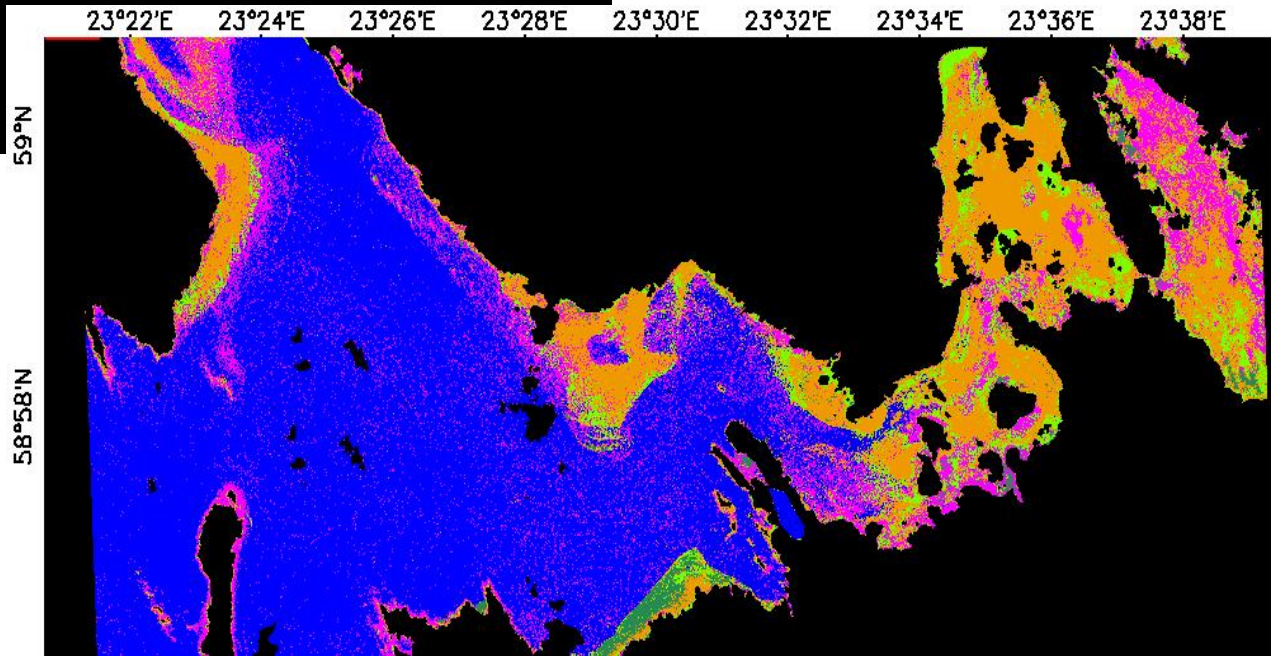
Large amount of carbon is fixed by benthic vegetation

Benthic carbon can probably be estimated from satellites

Terrestrial organic matter



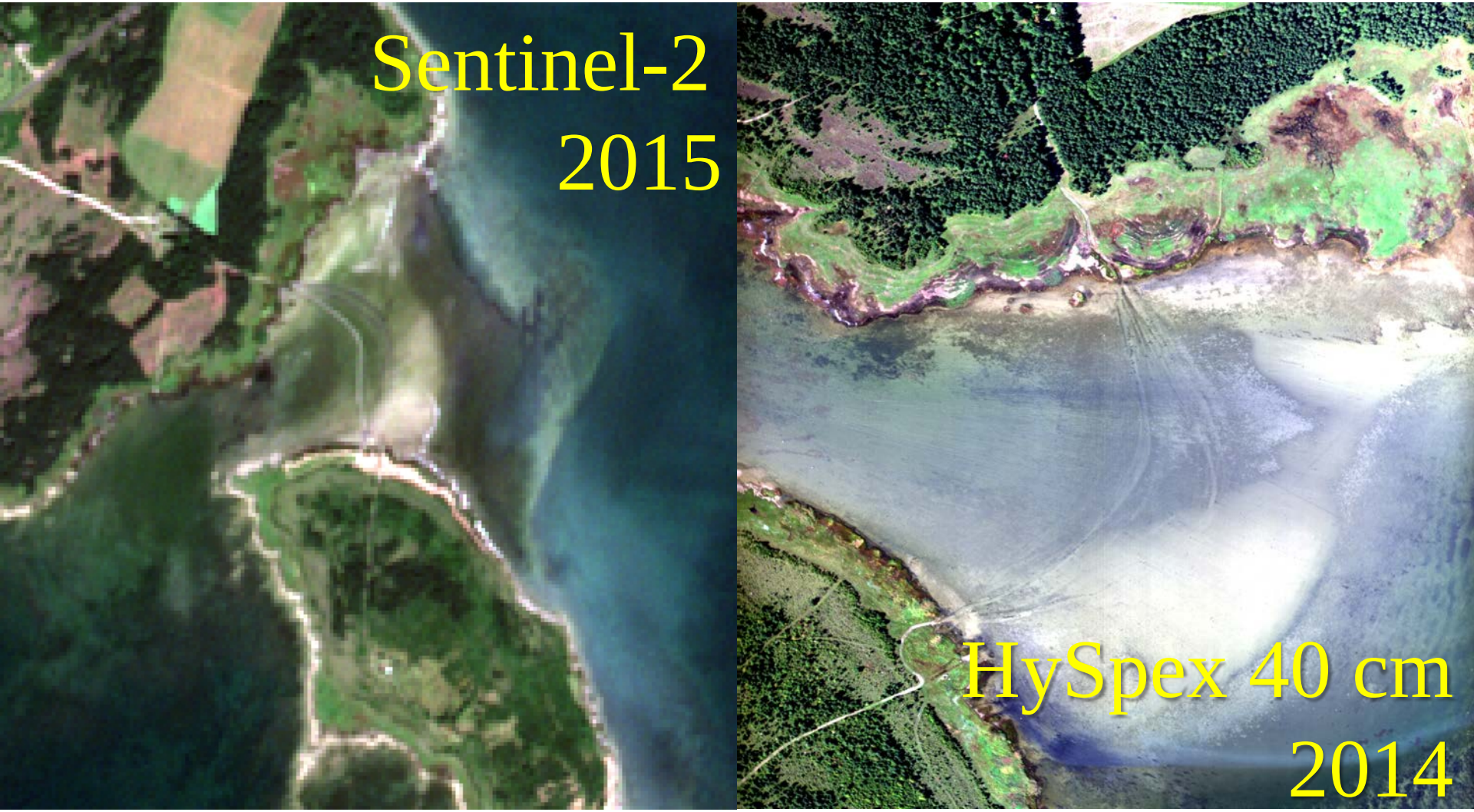
CASI



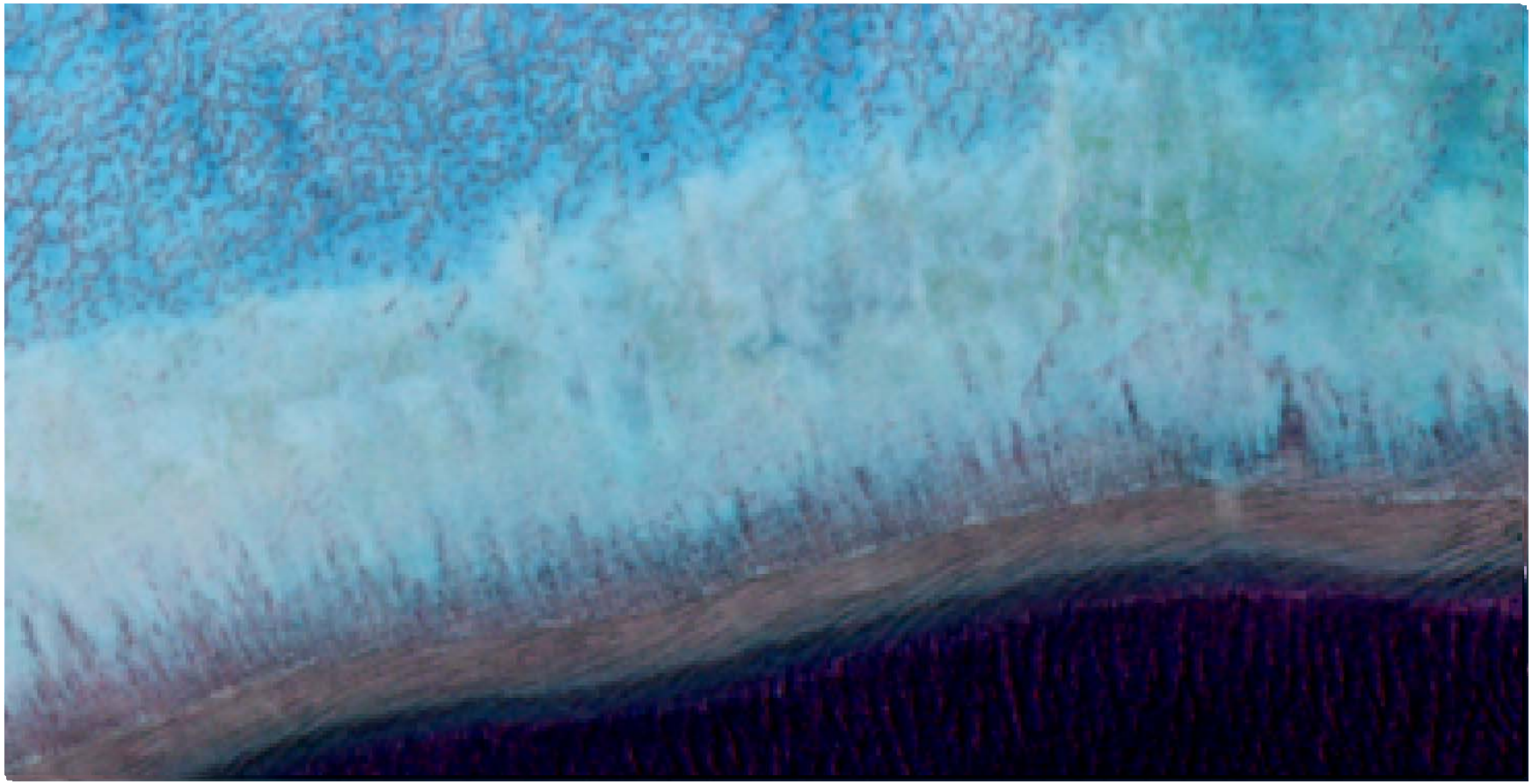
WorldView-2

Vahtmäe and Kutser 2013

Terrestrial organic matter



30 October 2016



ESA SEOM Sen2coral Project

John Hedley

Primary production

Baltic Sea PP

Wozniak et al. 1995

Wozniak and Olszewksi 1995

Chlorophyll-a

E_d(PAR)

SST

Primary production

There are methods to estimate PP in large lakes from satellite data (Kauer et al. 2015)

MERIS

Chlorophyll-a
K_d(PAR)
E_d(PAR)

Discussion points

* Do we need a coordinated effort to get robust ocean colour products for the Baltic Sea?

* Can we estimate pCO_2 routinely?

* Is the accuracy sufficient to detect acidification?

Discussion points

* Relationships between diferent carbon fractions and water colour?

* Relationships between nitrogen and water colour?

* Relationships between phosphorus and water colour?

Discussion points

* Is there strong enough relationship between DOC and CDOM to allow mapping carbon flux from rivers to the sea?

* Can we estimate POC and DOC separately?

Discussion points

* Is recognising phytoplankton functional types realistic in the Baltic Sea?

* Can we estimate primary production in the Baltic Sea?

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Thank you!