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Using Sentinels 2 and 3 in water quality monitoring

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COPERNICUS MARINE ENVIRONMENT MONITORING SERVICE

Providing PRODUCTS and SERVICES for all marine applications



Modelled products

Salinity

Temperature

Sea Level Height

Nutrients

Waves



Remote sensing products

Sea Level Height

Sea Surface Temperature

Water properties

**(chlorophyll-a, suspended
matter, CDOM,
transparency/turbidity)**



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Providing PRODUCTS and SERVICES for all marine applications



Remote sensing products



Global products

Sea Level Height
Sea Surface Temperature



Regional products

Water properties
(chlorophyll-a, suspended
matter, CDOM,
transparency/turbidity, etc.)



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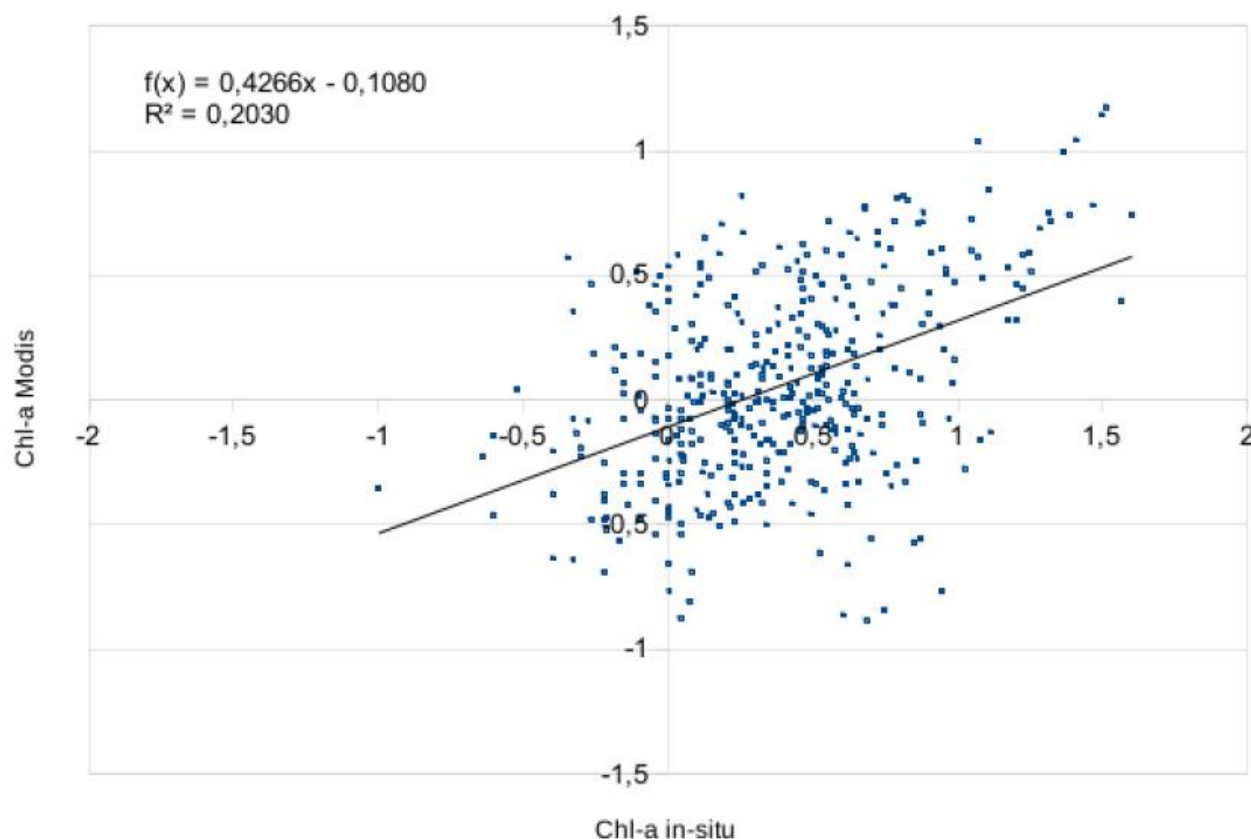


Baltic Sea water quality products



Only chlorophyll-a

QUALITY INFORMATION DOCUMENT

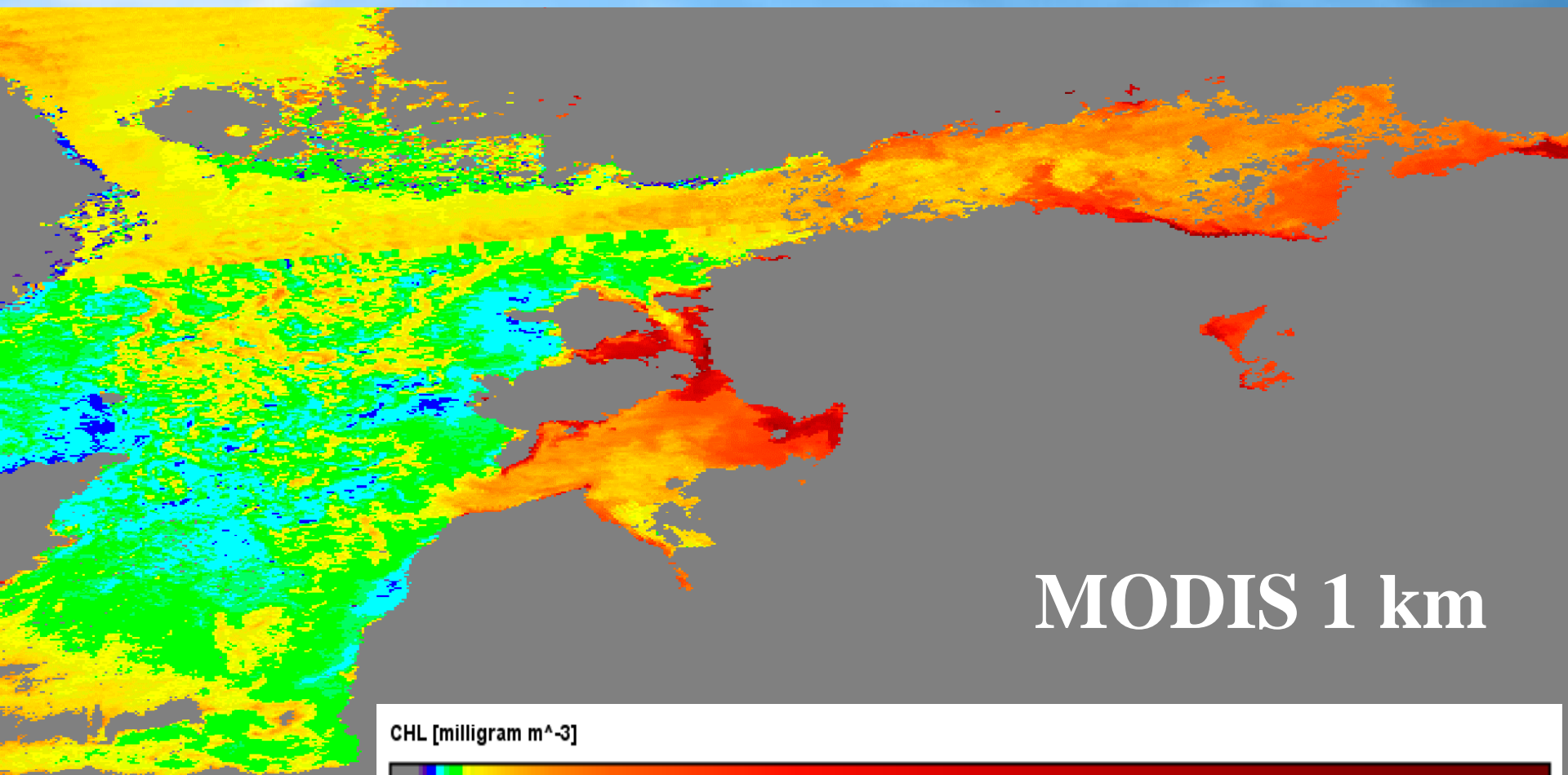


**No correlation with *in situ* data =
The only validated CMEMS product is useless**



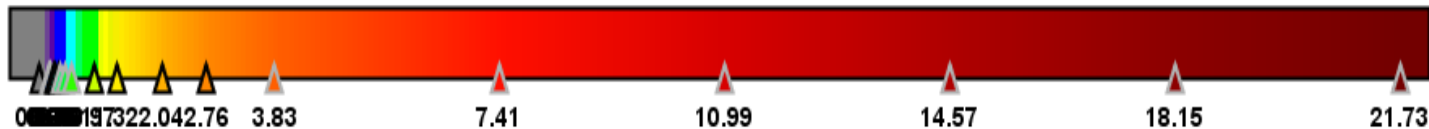
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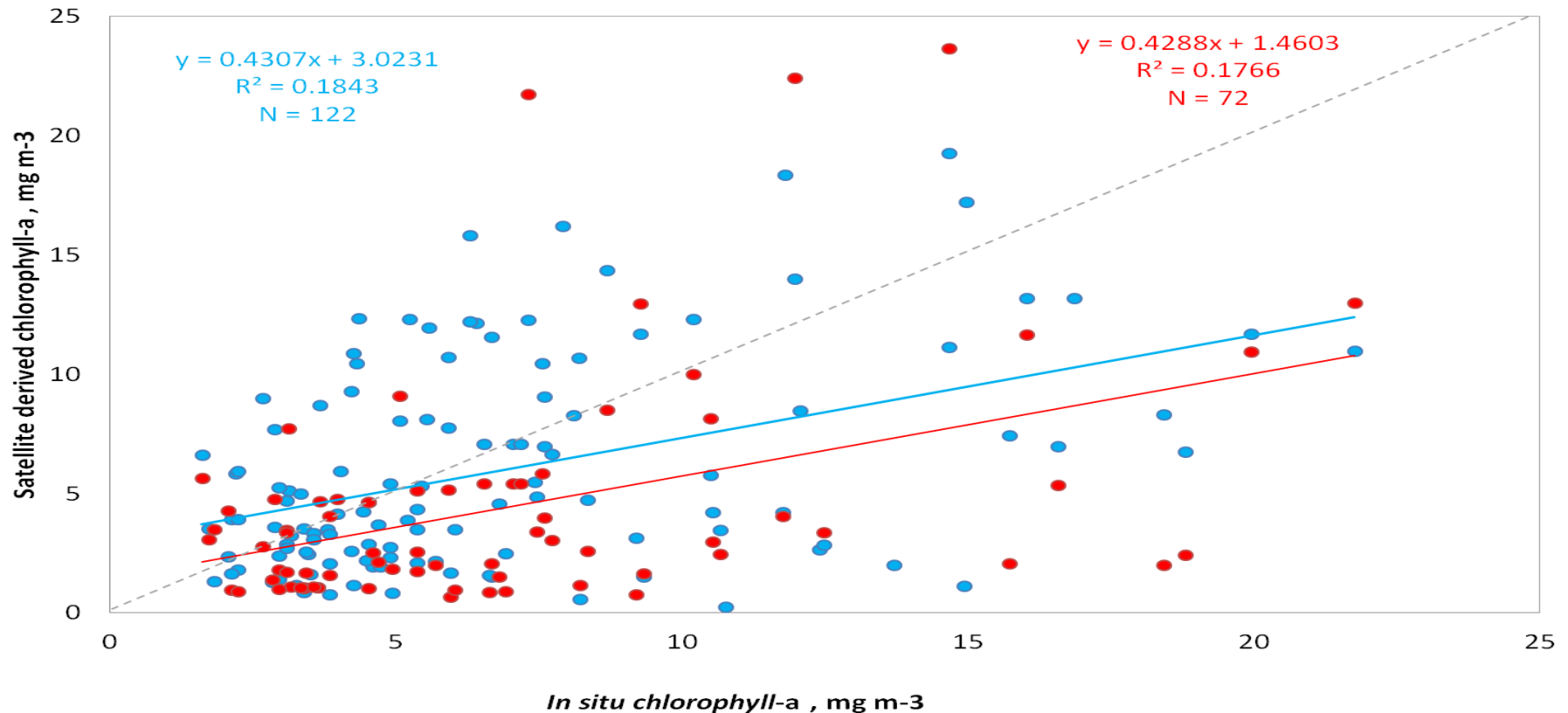
MODIS 1 km

CHL [milligram m^{-3}]



CMEMS is still using ageing MODIS

What about using OLCI?



Red dots – CMEMS product based on MODIS

Blue dots – Sentinel-3 OLCI using C2RCC processor

***In situ* data from Estonian National Monitoring Program (2017)**

Optical complexity of the Baltic Sea

- * High latitude = low signal**

- * CDOM dominated = low signal**

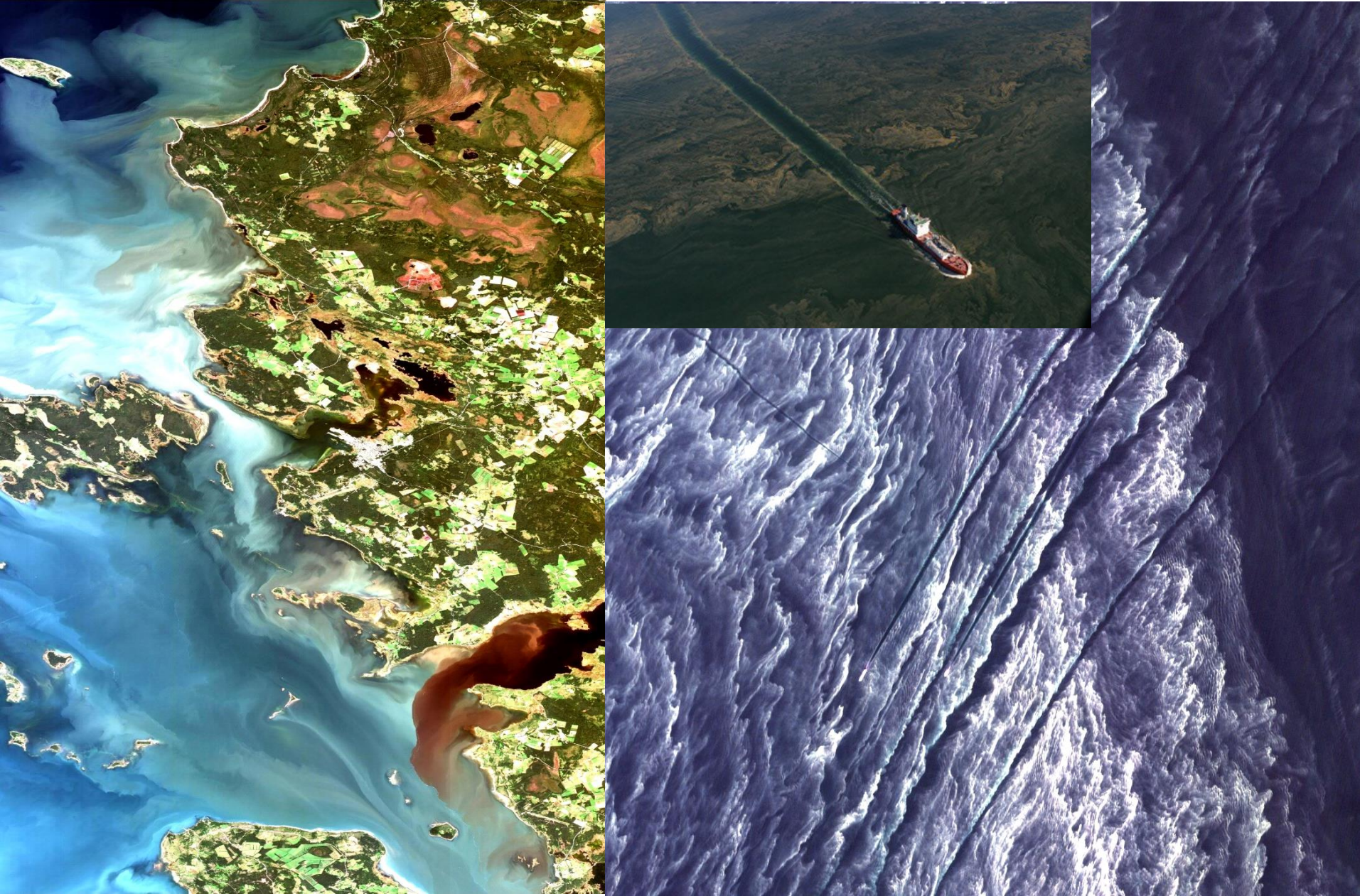
- * Low signal =**

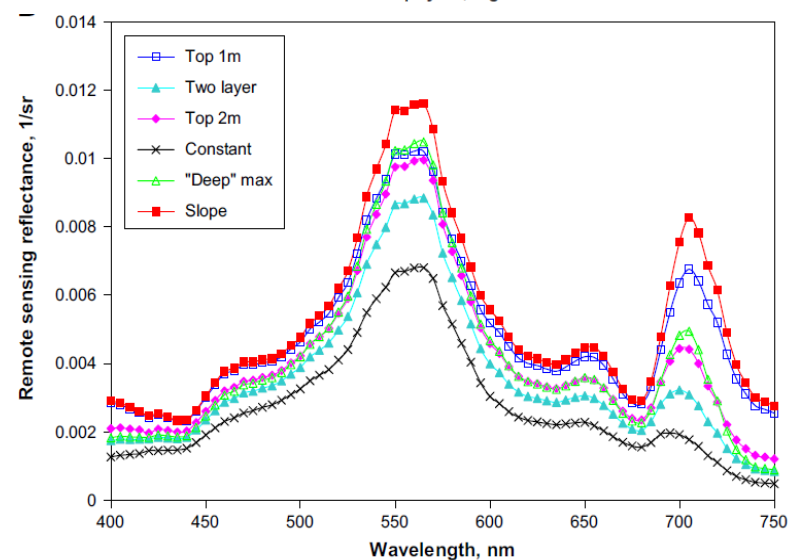
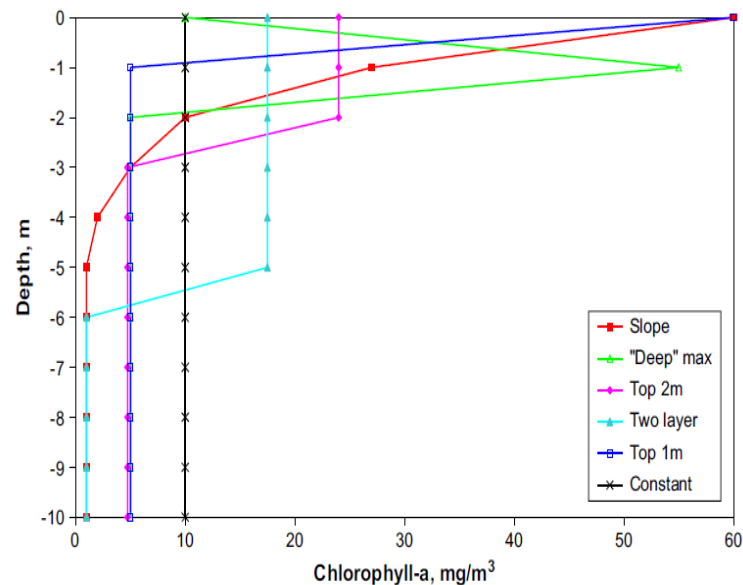
atmospheric correction more difficult

- * 1-2 orders of magnitude difference
in optical water properties**

- * Different phytoplankton groups =
Seasonal algorithms may be needed**

Optical complexity of the Baltic Sea





**HELCOM standard is
integral sample**

**Remote sensing increases
significantly spatial and temporal
coverage of data about the sea**

BUT

**Developing reliable methods
requires *in situ* data from a
particular waterbody collected
during different seasons**

E
U
R
O
P
E

MyOcean-1 and MyOcean-2

>100 000 000 €

out of EU „Space“ budget

$\frac{3}{4}$ modeling $\frac{1}{4}$ remote sensing

Little left for remote sensing

R
E
G
I
O
N

BONUS Program

15:1 competition in RS call

No funded projects (CMEMS)

**No need in national remote sensing
funding as CMEMS will do everything**

N P
O R
O
B D
A U
L C
T T
I S
C



≠ Copernicus Program



Perspectives of using remote sensing in coastal (and inland water) monitoring

**Most previous satellites (e.g. MERIS)
were one-off scientific missions**

**Copernicus Program designed
for decades of continuous data**

OLCI on Sentinel-3 MSI on Sentinel-2

**300 m resolution
Daily (1-2 images)**

**10 and 20 m resolution
every 2-3 days**

Sentinel-3 OLCI



CMEMS water
quality products
will be based on
OLCI only



Sentinel-3



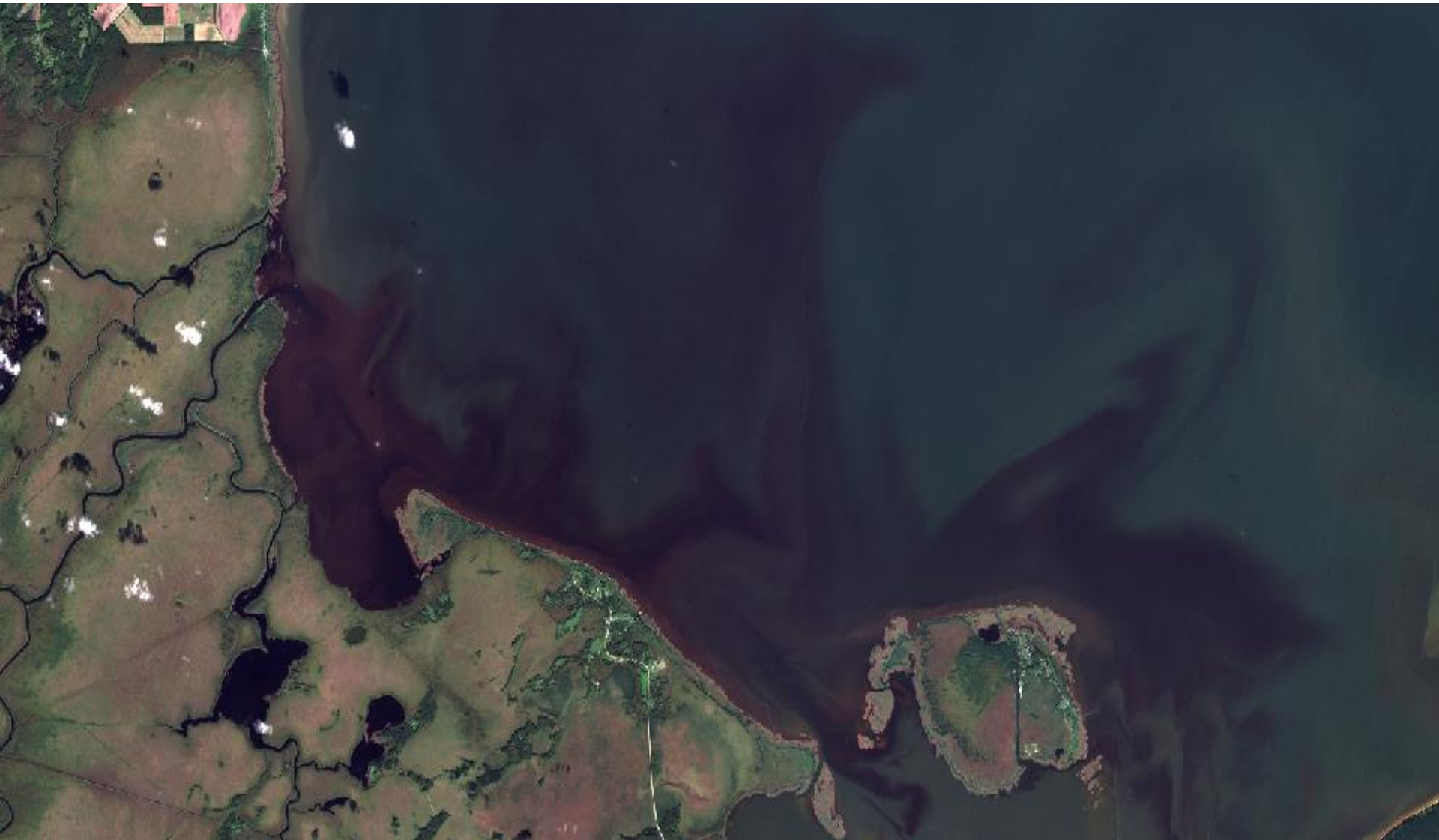
Sentinel-2



Lake Peipsi, Sentinel-2



Lake Peipsi, Sentinel-2

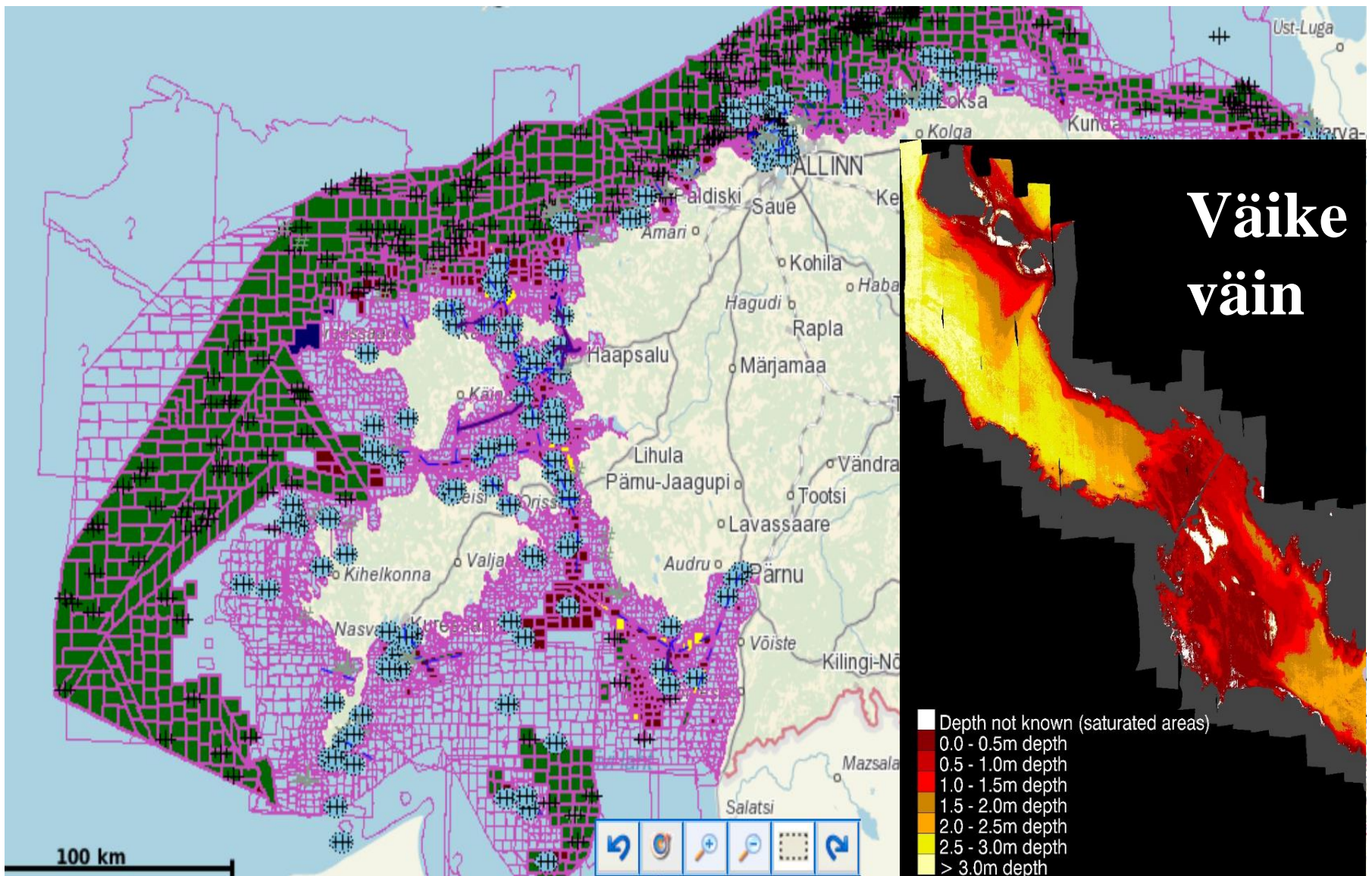




**CMEMS will be only water
quality remote sensing**

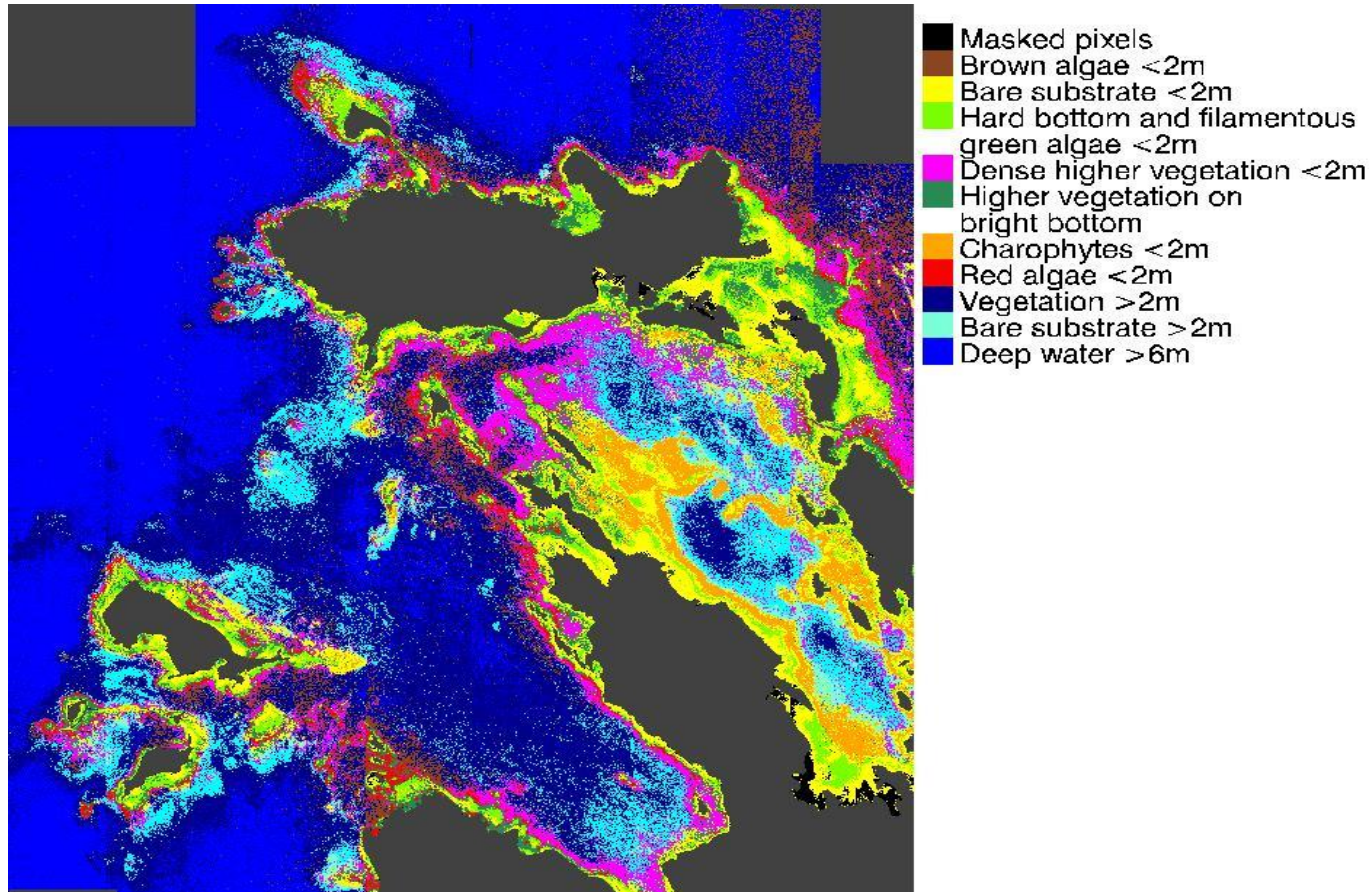
**Copernicus Program can
provide much more**

Mapping water depth



Benthic habitat mapping

**< 1.5 km² or 0.00003% of territorial waters
mapped with video**

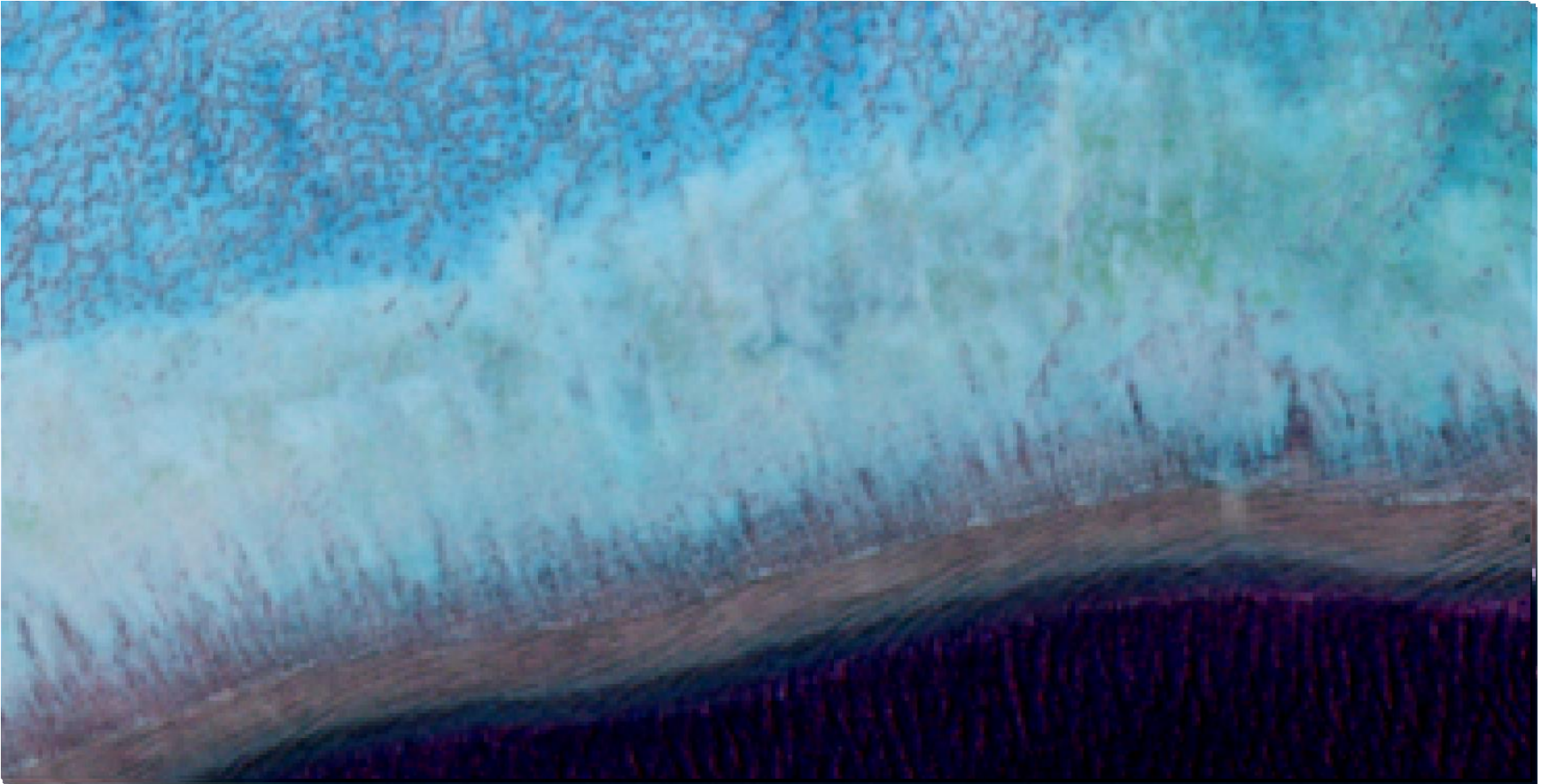




Sentinel-2

**Benthic
habitat,
bathymetry,
and human
impact**

30 October 2016



ESA SEOM Sen2coral Project
John Hedley

Current developments in Estonia




remote sensing



Article

Mapping Water Quality Parameters with Sentinel-3 Ocean and Land Colour Instrument Imagery in the Baltic Sea

Kaire Toming ^{1,2,3} , Tiit Kutser ^{1,*}, Rivo Uiboupin ⁴, Age Arikas ⁴, Kaimo Vahter ⁴ and Birgot Paavel ¹

C2RCC processor (OLCI standard)

Chlorophyll-a $r^2=0.006$ (up to 0.31 for some cruises)

Suspended matter $r^2=0.11$

Absorption and scattering products $r^2=0.02-0.2$

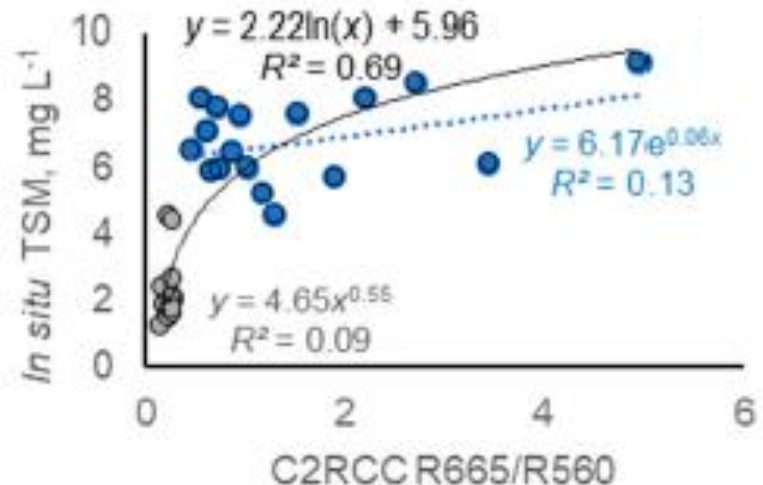
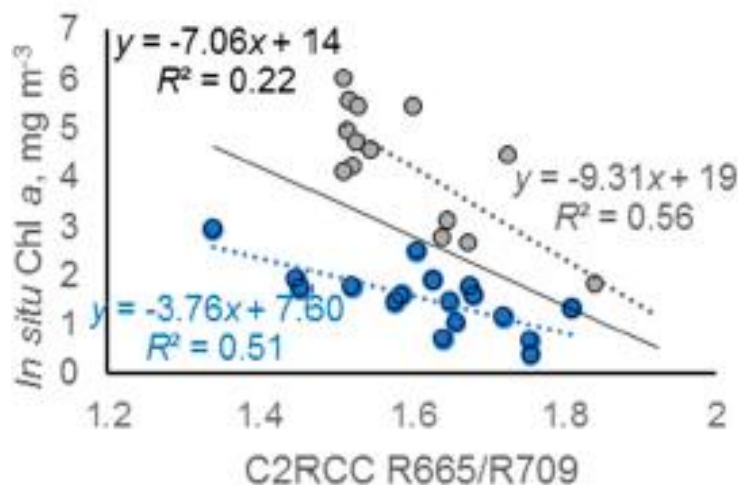
Current developments in Estonia

Empirical algorithms

Chlorophyll-a up to $r^2=0.61$ for some cruises
and some algorithms

Suspended matter up to $r^2=0.69$

CDOM up to $r^2=0.63$



Current developments in Estonia



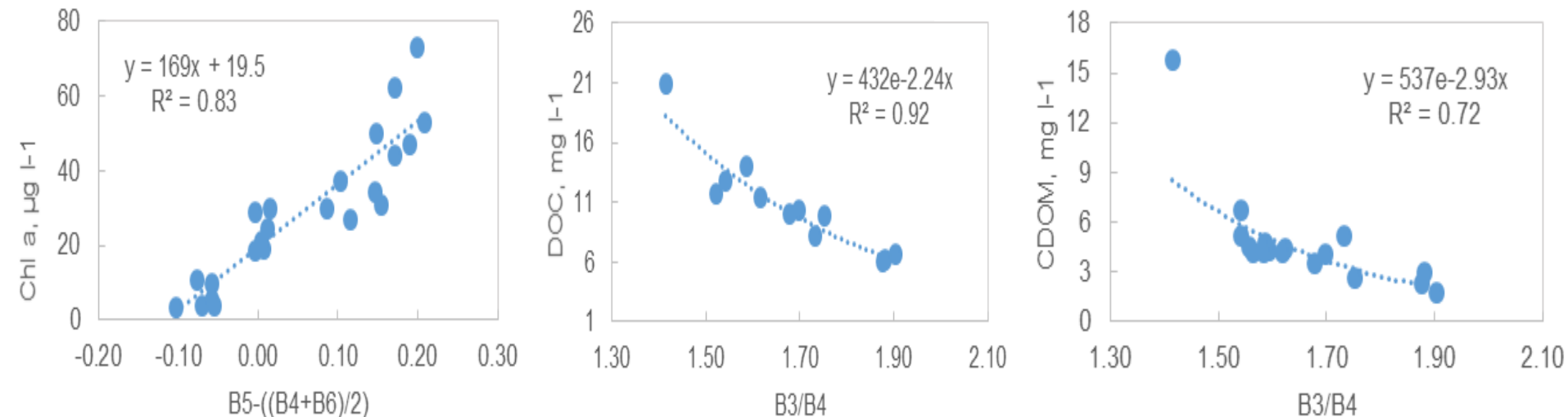
remote sensing



Article

First Experiences in Mapping Lake Water Quality Parameters with Sentinel-2 MSI Imagery

Kaire Toming ^{1,2}, Tiit Kutser ^{1,*}, Alo Laas ², Margot Sepp ², Birgot Paavel ¹ and Tiina Nõges ²



Conclusions

- * **CMEMS does not provide any water quality remote sensing products for the Baltic Sea**
- * **Copernicus program opened great new potential for aquatic research and monitoring using remote sensing**
- * **The list of possible remote sensing products goes far beyond CMEMS plans (e.g. coastal and benthic products)**



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**Thank you
for your attention!**