

→ BALTIC FROM SPACE WORKSHOP

29–31 March 2017 | Helsinki, Finland



Water quality monitoring for WFD, MSFD and Helcom

Petra Philipson, Brockmann Geomatics, Sweden

With funding, collaborations and contributions from many sources...

...special thanks to Jenni Attila (SYKE), Diana Vaiciute (KU), Krista Alikas (TO) and Kertin Stelzer (BC)...

Conclusions

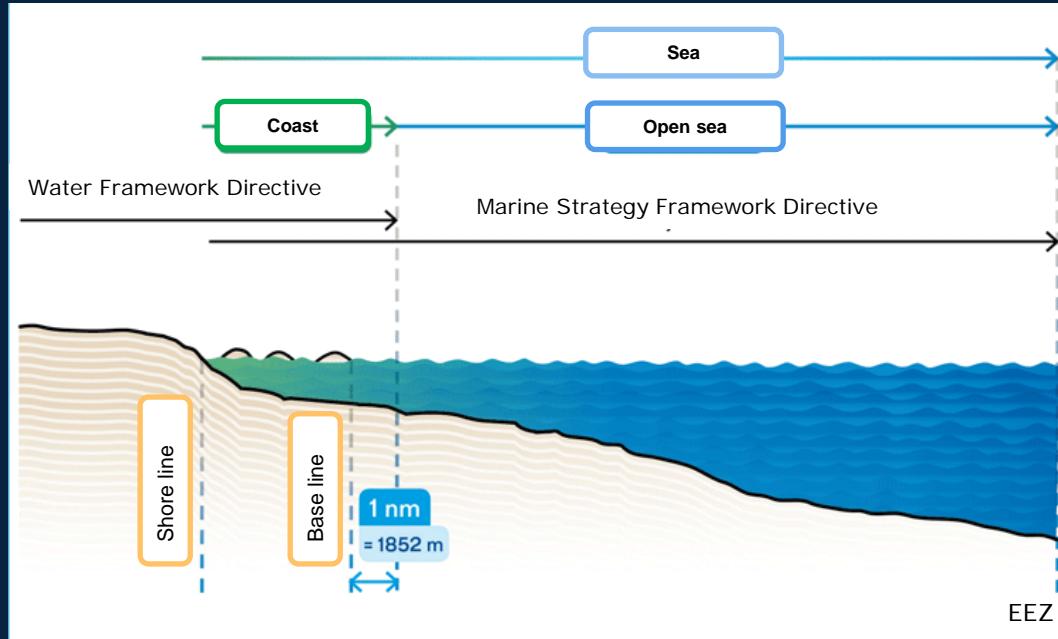
- There is a strong need for data to support WFD, MSFD and HELCOM status assessments
- To increase the use of EO data for this assessment a Baltic EO expert group should be established and support national monitoring agencies
- Such an expert group could help to overcome current scepticism for EO based estimations and formulate a uniform message on what is applicable and what needs more R&D
- We need to widen the focus from “high accuracy” and further explore the data that exhibit “high precision”

WFD, MSFD and HELCOM

- EU Water Framework Directive (WFD, 2000/60/EG) - Member States shall take the necessary measures to achieve or maintain good ecological status of freshwaters, rivers and coastal areas the by the year 2025 at the latest
- EU Marine Strategy Framework Directive (MSFD, 2008/56/EC) - Member States shall take the necessary measures to achieve or maintain good environmental status of the marine environment by the year 2020 at the latest
- HELCOM Baltic Sea Action Plan (HELCOM BSAP, 2007) - contains a set of actions to achieve a Baltic Sea in Good Environmental Status by 2021.

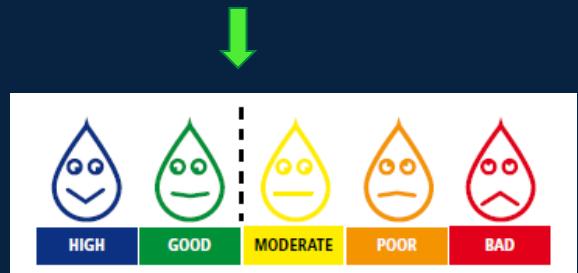


MSFD and WFD assessment areas



GOAL:

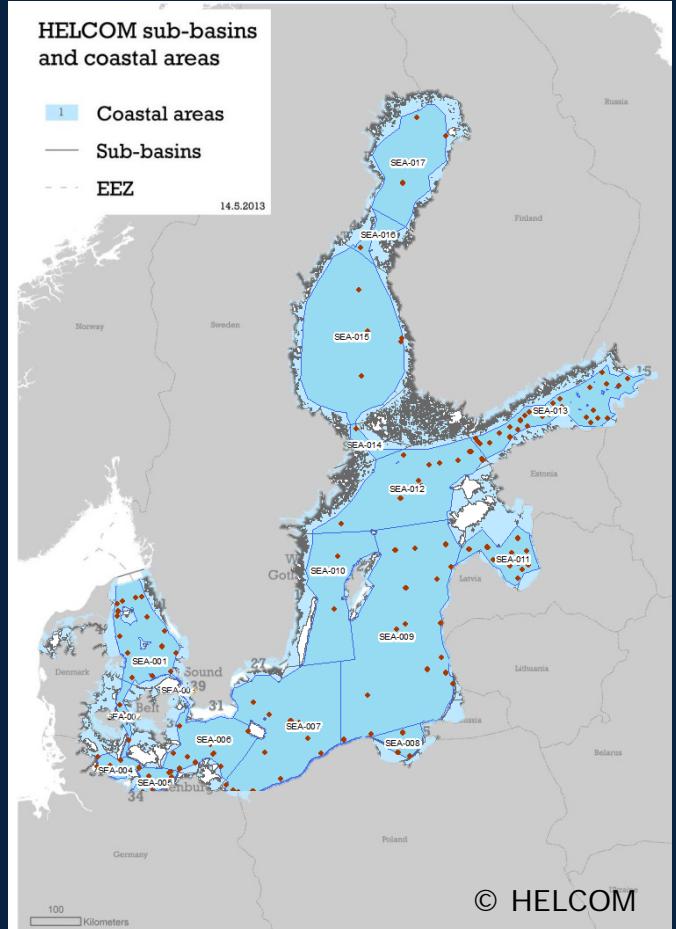
Good environmental status (GES) of
freshwaters, rivers,
coastal and open sea
areas



Baltic Sea division

The Baltic Sea is sub-divided for national and regional monitoring and assessment purposes.

17 HELCOM sub-basins + 42 coastal/off shore areas + ? number of WFD coastal water bodies



MSFD Qualitative Descriptors

1. Biological diversity
2. Non-indigenous species
3. Commercial fish
4. Food webs
5. Eutrophication
6. Sea-floor integrity
7. Hydrographical conditions
8. Contaminants and pollution effects
9. Contaminants in fish and other seafood
10. Marin litter
11. Underwater noise/energy



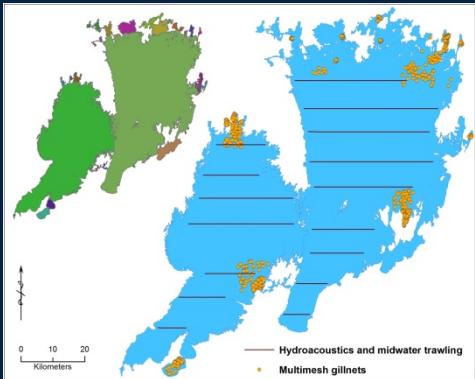
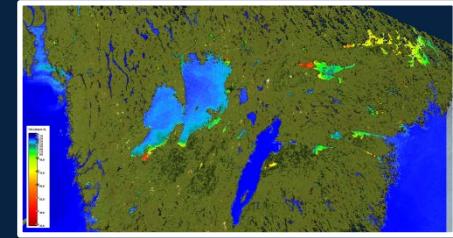
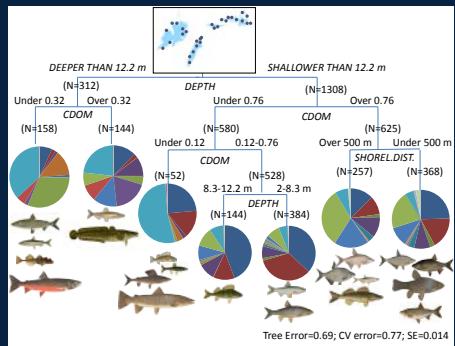
Each member state need to implement cost effective measures to protect and preserve GES based on these descriptors



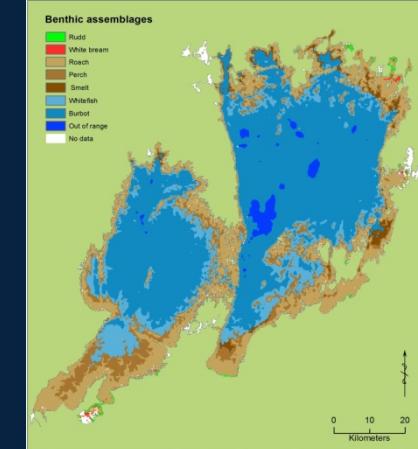
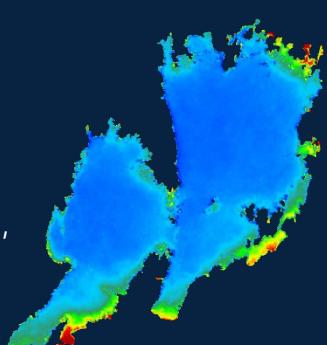
MSFD Qualitative Descriptors

1. Biological diversity

Multivariate tree analysis
on inshore fish
assemblage composition
based on catches in multi-
mesh gillnets.



Applied to Lake
Vänern map layers
containing depth,
distance to shoreline,
EO-Chl a and EO-
CDOM as predictors.



MSFD Qualitative Descriptors

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MSFD Descriptor 5: Eutrophication

5.1 Nutrient levels

5.2 Direct effects of nutrient enrichment

5.2.1 Chl a concentration

5.2.2 Water transparency related to increase in suspended algae

5.2.3 Abundance of opportunistic algae

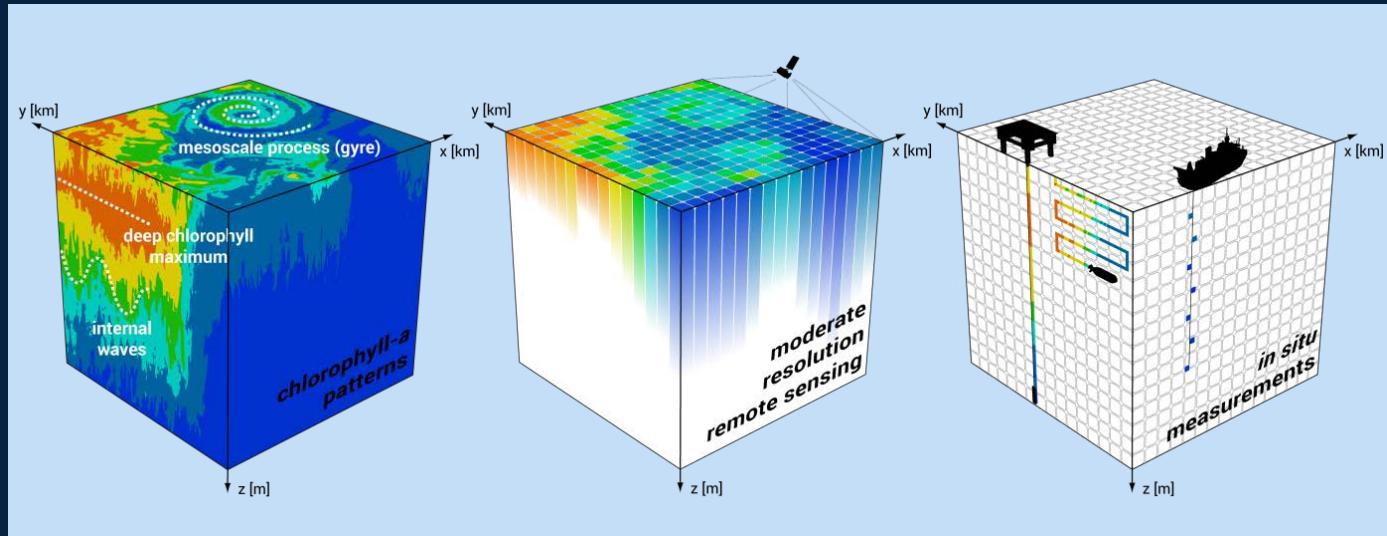
5.2.4 Species shift in floristic composition, as well as, bloom events

5.3 Indirect effects of nutrient enrichment

Potentially monitored by remote sensing



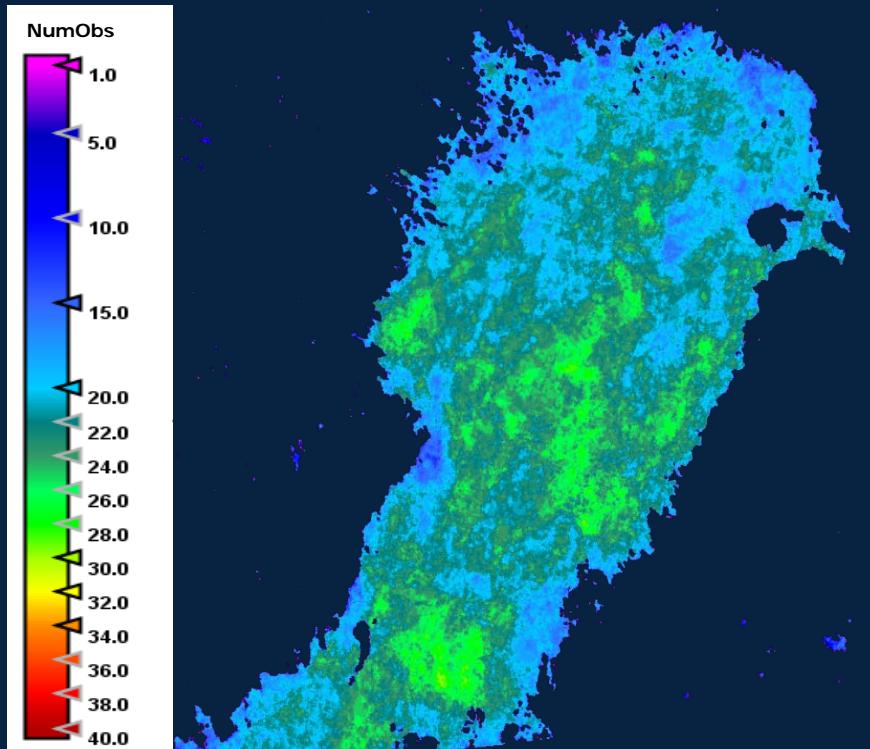
EO for MSFD



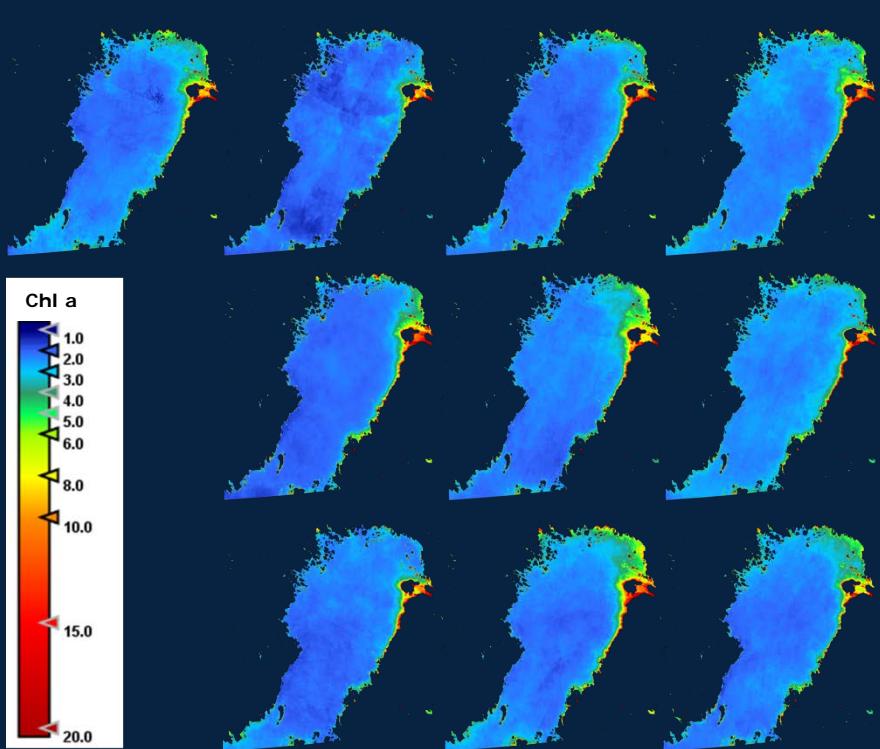
Data with higher temporal frequency and spatial coverage is essential!



Increasing the temporal frequency and spatial coverage...



2007



Chl a ($\mu\text{g/l}$), 2 month averages, 2002-2011



WFD Factors & Parameters for estimating ecological status

Biological factors

- Phytoplankton
- Macrophytes
- Benthic fauna
- (Fish)

Physical-Chemical factors

- Nutrients
- Secchi Depth
- Oxygen
- Acidification

Parameters & Indices

- Abundance
- Biomass
- Taxonomic composition
- Frequency and intensity of blooms

In Sweden (presently)

- Biovolume
- Chlorophyll a

....as an estimation of total biomass



WFD Status classification

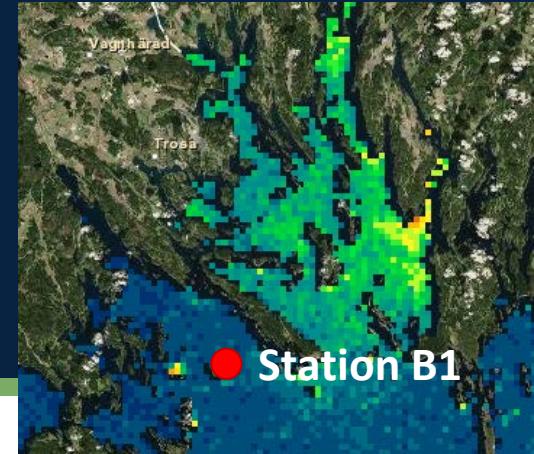
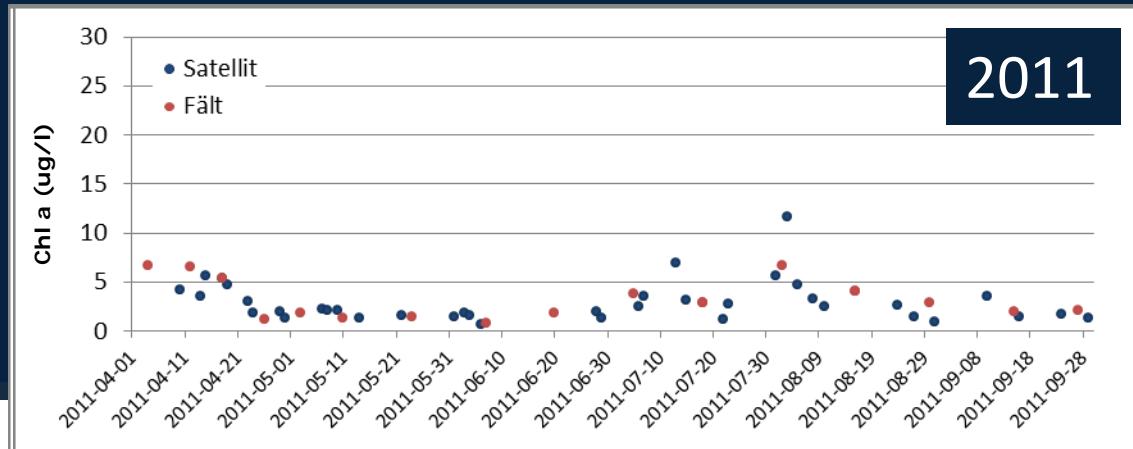
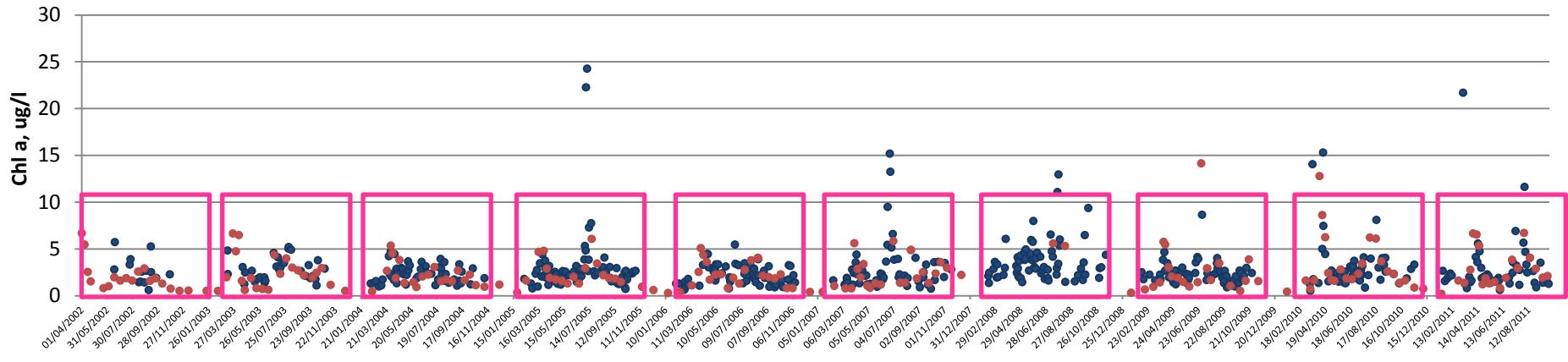
Data requirements - Phytoplankton

- Data from June-August
 - Data from 3 years within a 6 years period
 - 3-5 samples per water body/yr
-

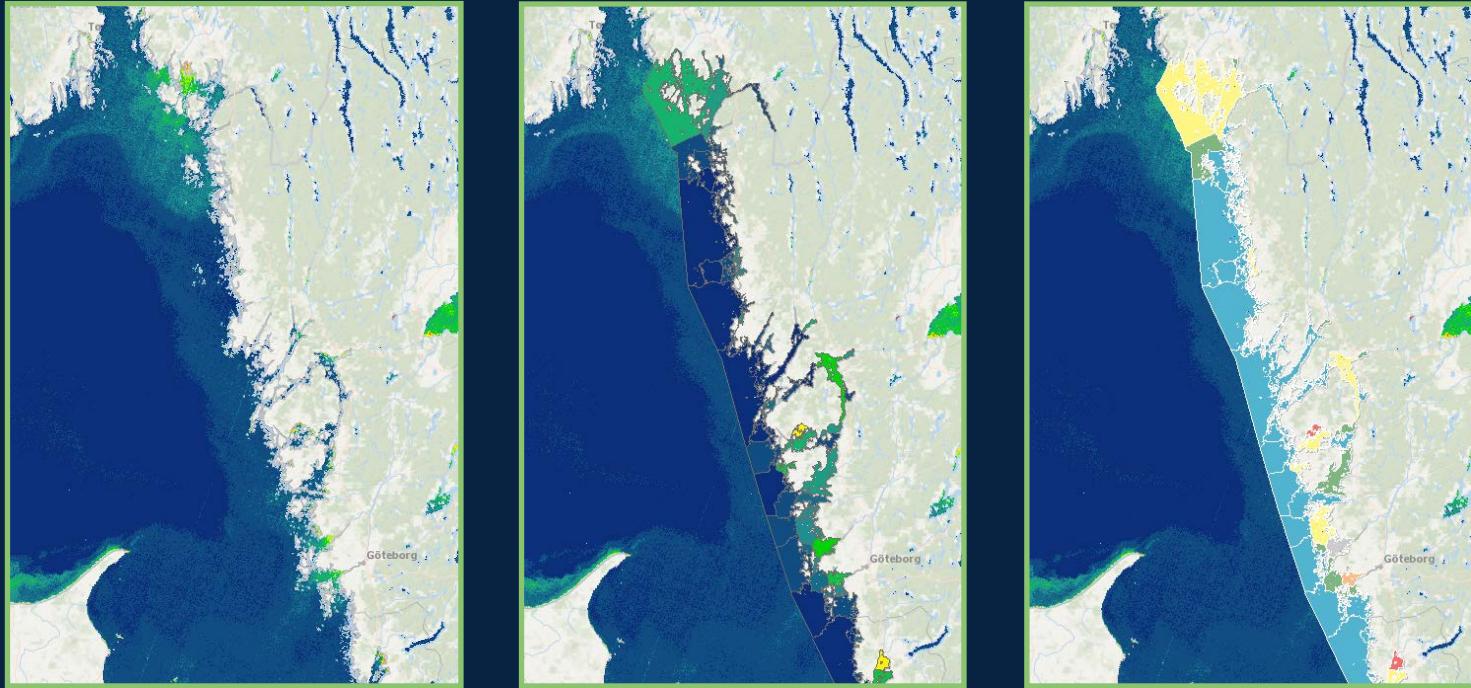
Data requirements – Secchi depth

- Data from June-August (September)
- Data from 3 years within a 6 years period
- Monthly samples





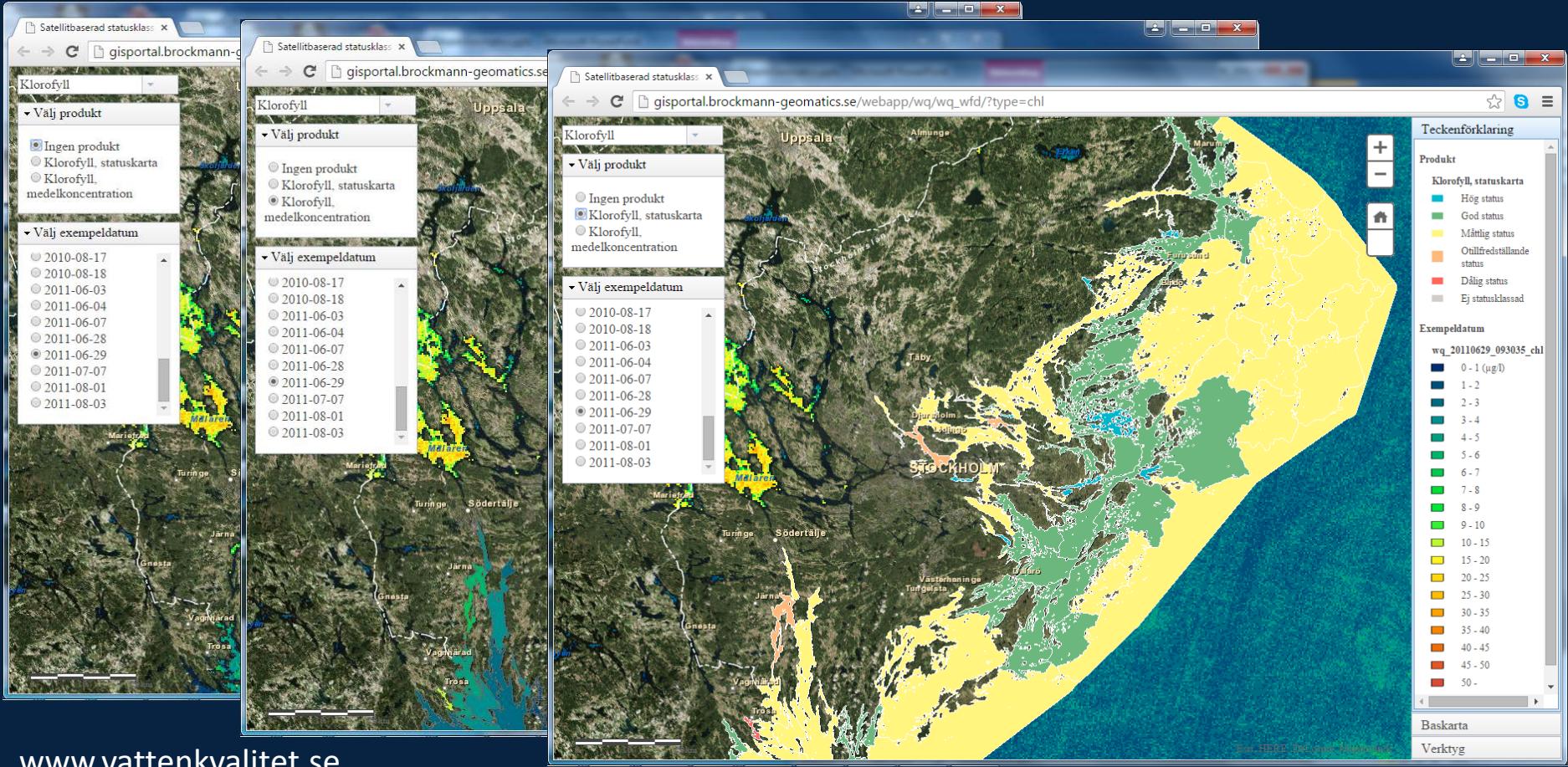
WFD classification of Swedish coastal waters (2013)



MERIS based estimations of Chl a (FUB) and Secchi depth*, from June-August, 2009-2011, was used to calculate 3 years averages and corresponding status class. 75% of the water bodies could be mapped.

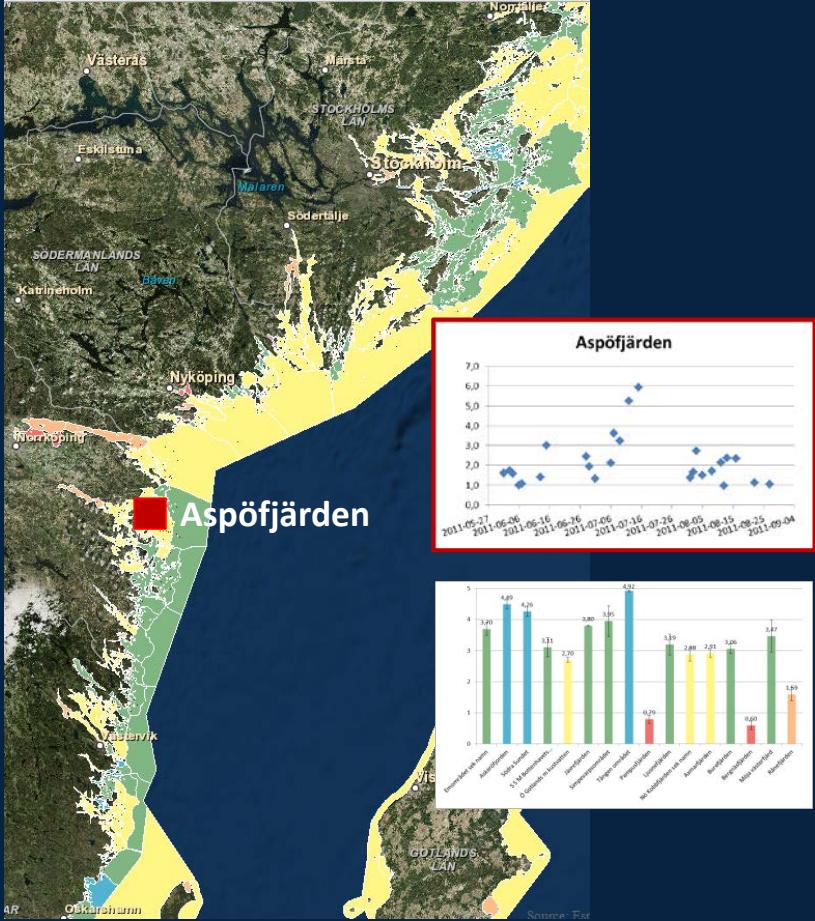
*Florén, K., Philipson, P., Strömbeck, N., Nyström Sandman, A., Isaeus, M. and Wijkmark, N. (2012). Satellite derived Secchi depth for improvement of habitat modeling in archipelagic areas 2010-2011 – Project Report , Swedish National Space Board, Dnr 164/09.





www.vattenkvalitet.se



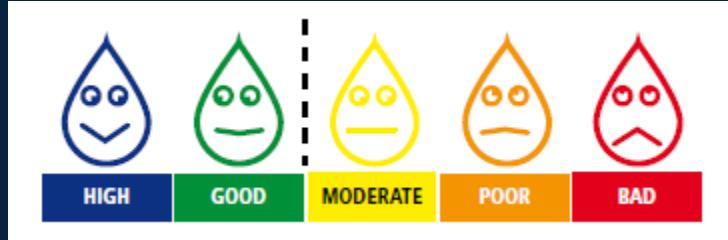


Name	Nklass-mean	Nklass-Stdev	Status 2009	Status 2010	Status 2011	3 yr mean,
			G	M	M	
Arköfjärden sek namn	3,12	0,30				G
Arkösund	2,47	0,27	M	M	M	M
Aspöfjärden	3,00	0,17	G	M	M	M
Bosöfjärden sek namn	2,30	0,24	M	M	M	M
Bråvikens kustvatten	2,83	0,02	M	M	M	M
Edsviken						
Finnfjärden	3,18	0,31	G	M	G	G
Flisdjupet	3,35	0,04	G	G	G	G
Gropviken	3,15	0,61	G	M	G	M
Gryts skärgårds kustvatten	3,19	0,20	G	G	M	G
Håsköfjärden sek namn	3,69	0,16	G	G	G	G
Inre Bråviken	1,05	0,27	O	D	D	O
Inre Slätbaken	1,48	0,33	O	O	O	O
Inre Valdemarsviken						
Kaggebofjärden	2,35	0,31	M	M	M	M
Korsfjärden	2,73	0,34	M	M	G	M
Kullskärsdjupet	2,99	0,08	M	G	G	M
Kvädfjärden	3,40	0,30	G	G	M	G

Used by regional experts for the status assessment as a compliment to field data



Gulf of Bothnia



1. In situ data collected in Aug vs. EO estimates from June-Aug
2. Surface EO estimate vs. integrated in situ samples
3. Full coverage EO data vs. in situ sample from one (the deepest) part of the water body
4. Algorithm not appropriate for the water type



New recommendations made by:

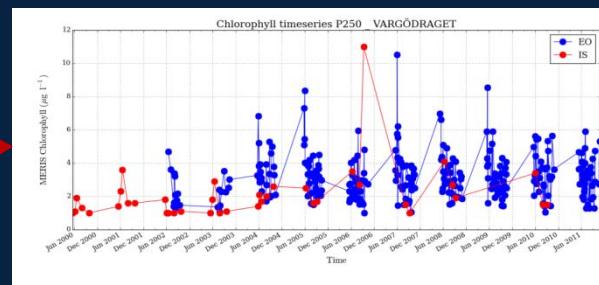
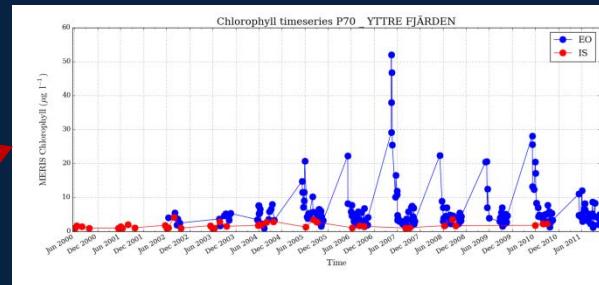
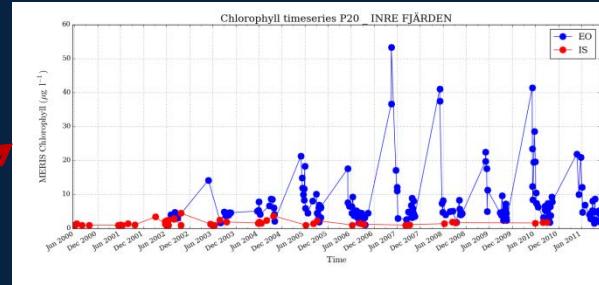
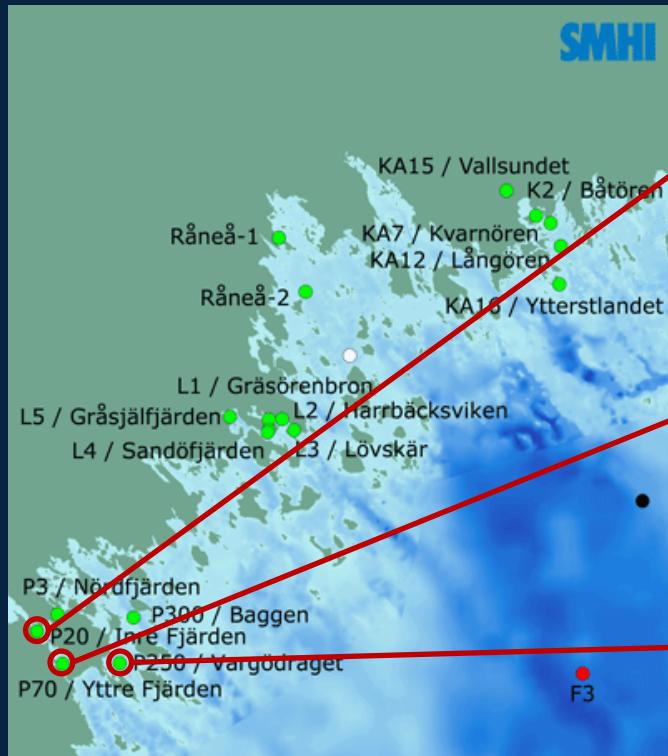


www.waters.gu.se

To develop and improve the criterias used to classify the status of the Swedish coastal and inland waters under the EU Water Framework Directive.



Gulf of Bothnia



Satellite data

2002-2012:

ENVISAT - MERIS (300 m)

2016+ :

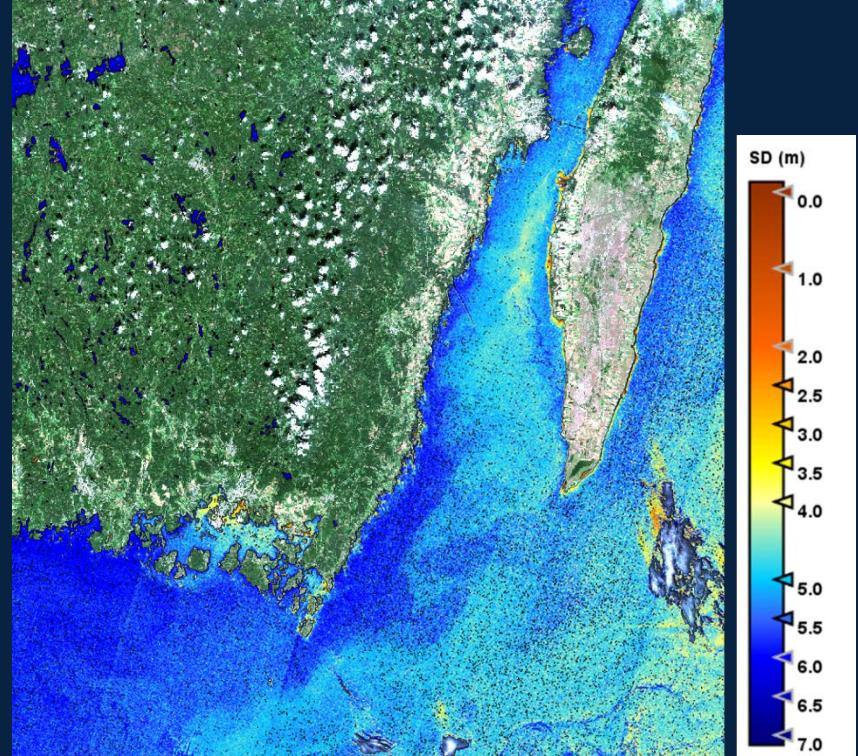
Sentinel-3 - OLCI (300 m)

2015+ :

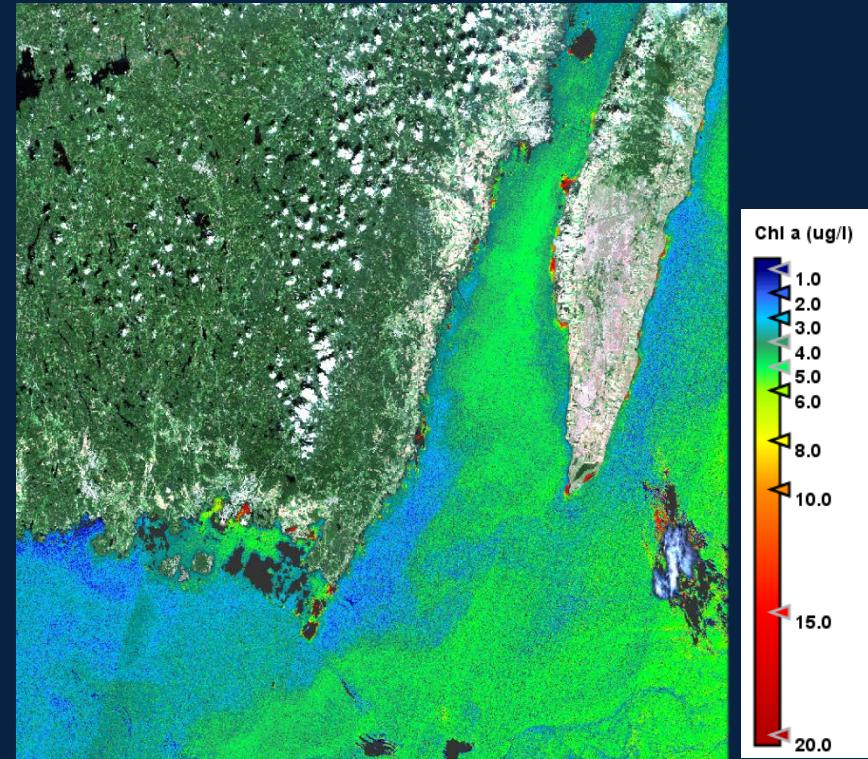
Sentinel-2 - MSI (10-20 m)



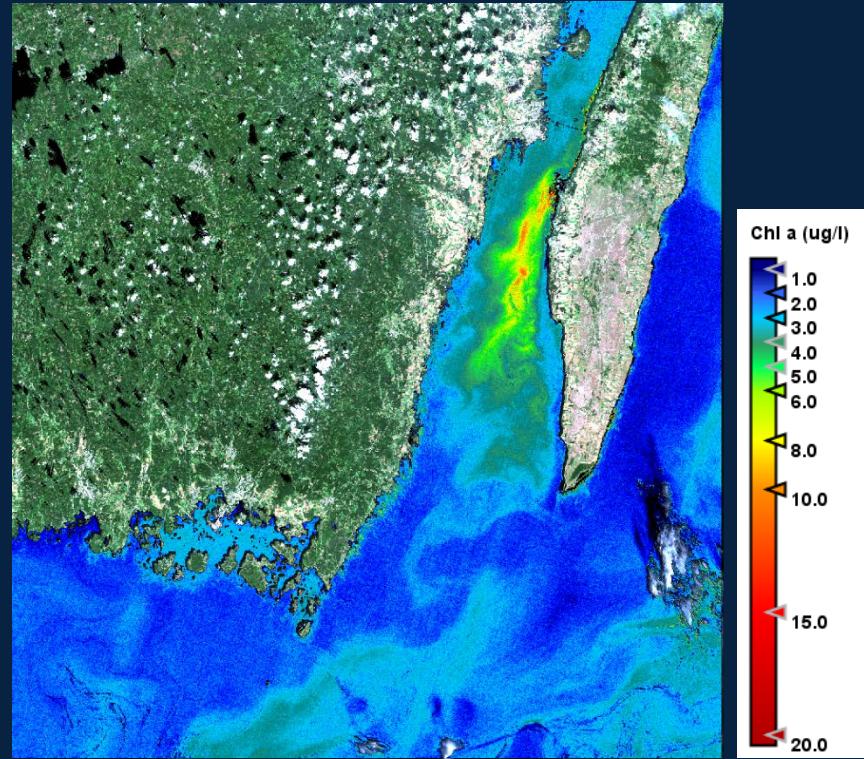
Sentinel-2 – Secchi Disk Depth



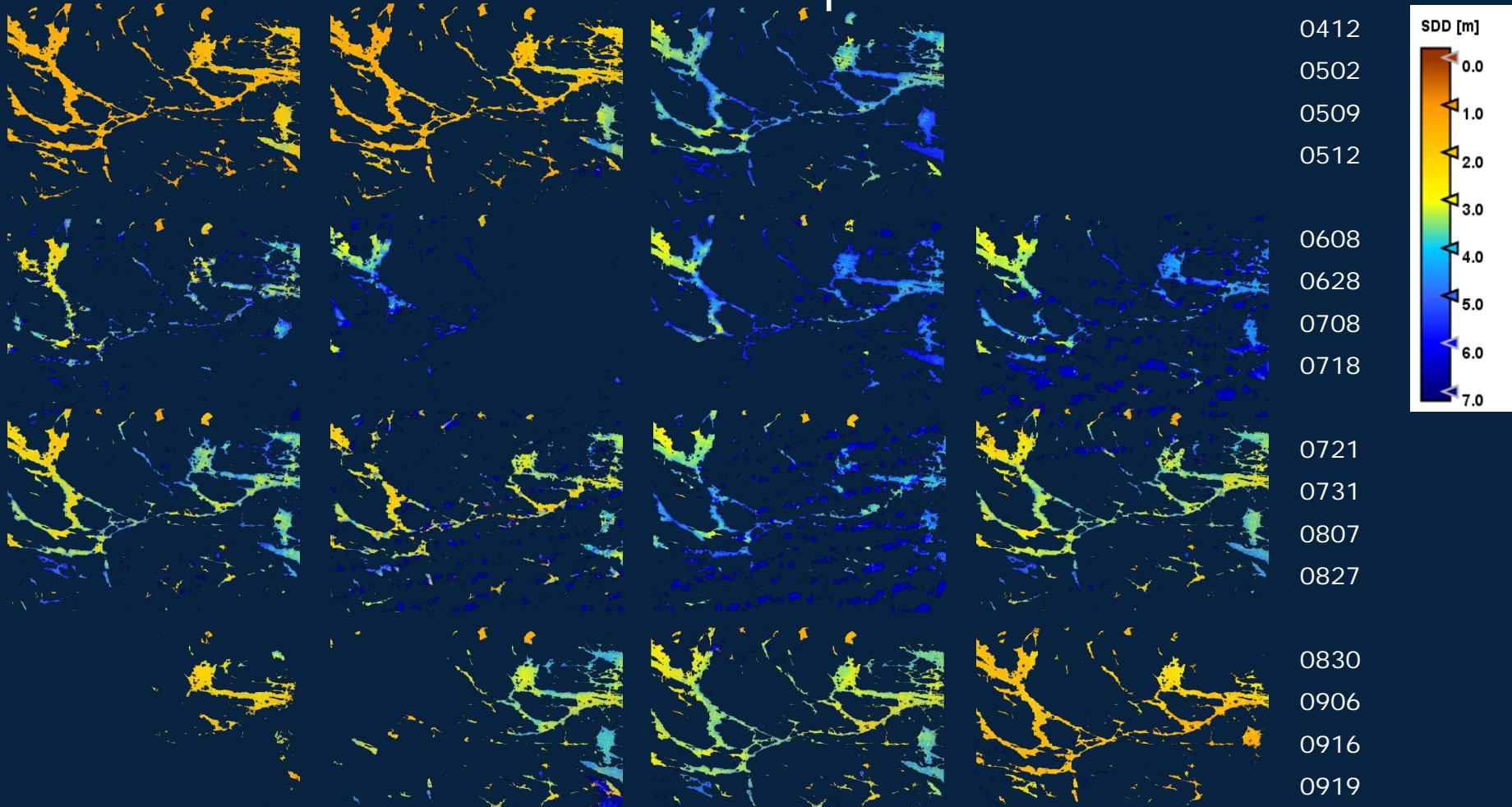
Sentinel-2 – Chl a and/or Chl a indicator



Sentinel-2 – Chl a and/or Chl a indicator



Sentinel-2 – Secchi Disk Depth



S2 overpass

2017-07-04 T10:22:08
2017-07-07 T10:32:06
2017-07-08 T10:02:13
2017-07-11 T10:12:11
2017-07-14 T10:22:08
2017-07-17 T10:32:06
2017-07-18 T10:02:13
2017-07-21 T10:12:11
2017-07-24 T10:22:08
2017-07-27 T10:32:06
2017-07-28 T10:02:13
2017-07-31 T10:12:11
2017-08-03 T10:22:08
2017-08-06 T10:32:06
2017-08-07 T10:02:13
2017-08-10 T10:12:11
2017-08-13 T10:22:08
2017-08-16 T10:32:06
2017-08-17 T10:02:13
2017-08-20 T10:12:11
2017-08-23 T10:22:08
2017-08-26 T10:32:06
2017-08-27 T10:02:13
2017-08-30 T10:12:11



The screenshot shows a Google Earth window with a map of Sweden. A red grid overlay covers the entire map. A green box labeled "34WET" is located in the central part of the country. A pink box highlights a specific location on the map, corresponding to the area shown in the satellite image above. The Google Earth interface includes a search bar, a placemark list, and a layer list.



Conclusions

- There is a strong need for data to support WFD, MSFD and HELCOM status assessments
- To increase the use of EO data for this assessment a Baltic EO expert group should be established and support national monitoring agencies
- Such an expert group could help to overcome current scepticism for EO based estimations and formulate a uniform message on what is applicable and what needs more R&D
- **We need to widen the focus from “high accuracy”, further explore data that exhibit “high precision”**



Thank you!

In collaboration with:



Funded by:



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och Vatten
myndigheten