

# WG4 – New methods / technology

## *Use of satellite observations – Swedish Case*



Swedish Agency  
for Marine and  
Water Management

BROCKMANN GEOMATICS  
SWEDEN AB



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# WFD Monitoring

1. **Surveillance monitoring** - To assess long-term changes in natural conditions and changes resulting from anthropogenic activity. Monitoring is performed at least once every management cycle (usually every 6 years).
2. **Operational monitoring** - To establish the status of water bodies identified as being at risk of failing to meet the WFD environmental objectives and assess effects of measures.
3. **Investigative monitoring** - To determine reasons for exceedances or predicted failure to achieve environmental objectives if the reasons are not already known.





# Data availability

## Copernicus satellites

### Sentinel-3

- 300 m
- Daily

### Sentinel-2

- 10-60 m
- Weekly

## Surveillance monitoring & Operational monitoring



## Operational monitoring





# EO supported WFD Monitoring in Sweden

## **Surveillance monitoring – National effort**

Cycle 1 – Coast – MERIS data collected 2009 – 2011

Cycle 2 – Coast – Sentinel-3 data collected 2016-2018

Cycle 3 – Coast & Lakes – Sentinel-3 data collected 2019-2023

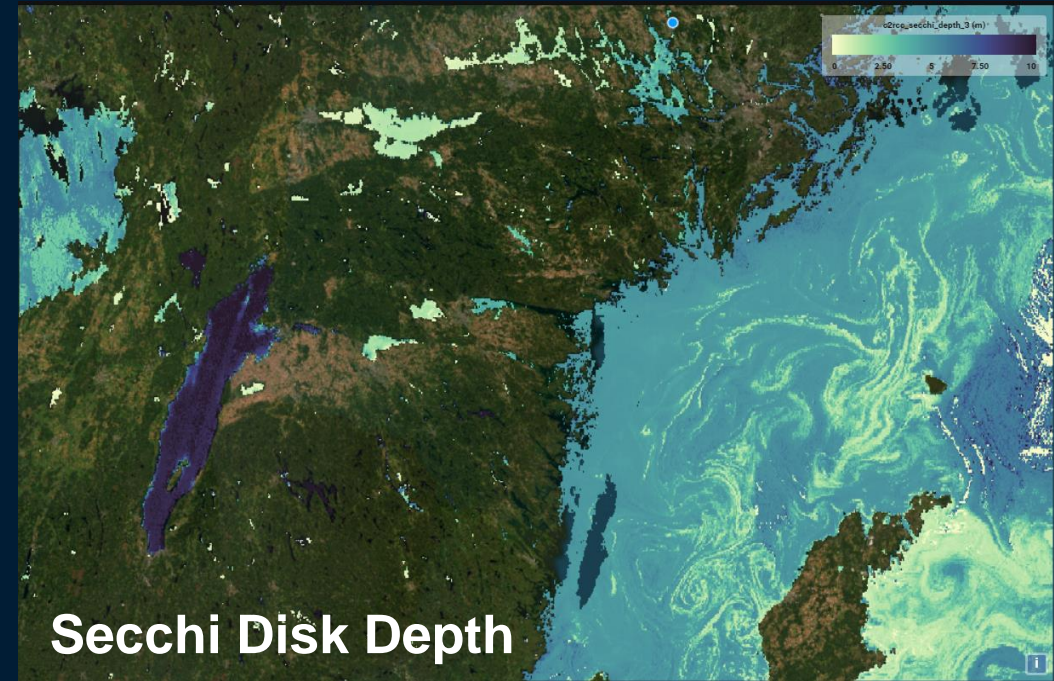
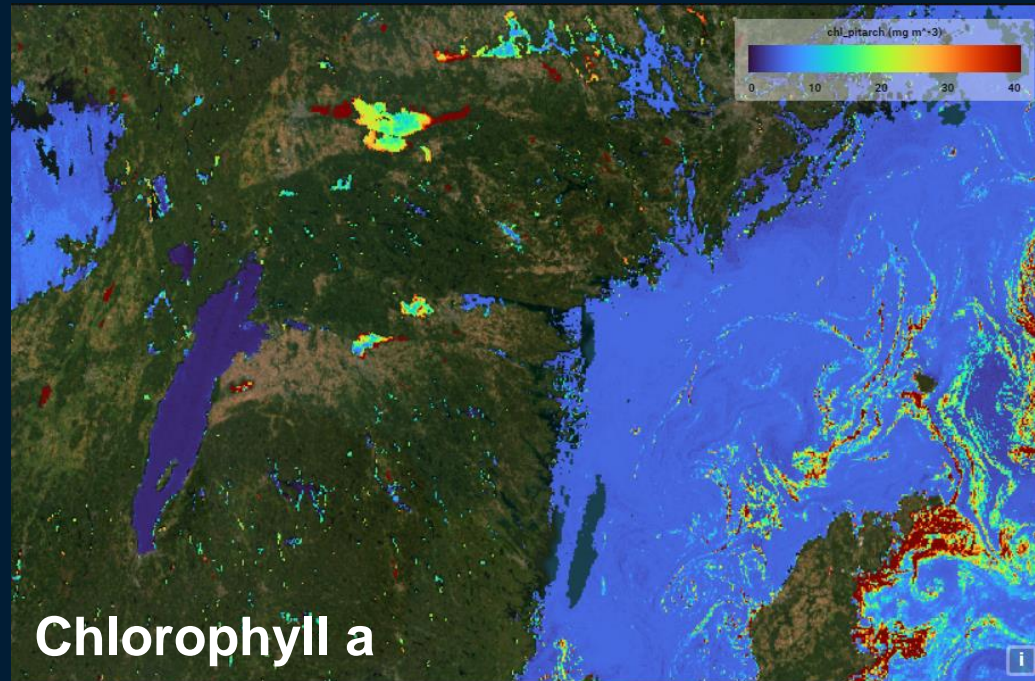
## **Operational monitoring – Regional / Local effort**

Coast & Lakes – Sentinel-3 and -2 based services since 2020



# Satellite based water quality information

The starting point is quality screened daily raster products



The WFD assessment was preceded by validation efforts, when in situ and EO was compared and algorithms are selected.



# EO supported WFD surveillance monitoring

After validation, WQ information per water body and date was extracted, **tabulated**, plotted and used as a basis for expert judgment.

MS_CD	Namn	Datum	Antal pixlar per FK	Klorofyll - Antal	Klorofyll - % täckning av	Klorofyll Arit mMedel	Klorofyll Std av	Klorofyll Ge omMedel	Klorofyll_10-percentil	Klorofyll_25-percentil	Klorofyll_Median	Klorofyll_75-percentil	Klorofyll_90-percentil
WA86165154	Ö sydkustens kustvatten	2016-05-03	2176	1481	68,1	1,13	0,45	1,05	0,64	0,86	1,09	1,38	1,57
WA86165154	Ö sydkustens kustvatten	2016-05-04	2185	1994	91,3	1,42	0,64	1,32	0,95	1,12	1,29	1,50	2,04
WA86165154	Ö sydkustens kustvatten	2016-05-05	2221	1949	87,8	1,67	0,62	1,56	1,00	1,32	1,58	1,92	2,33
WA86165154	Ö sydkustens kustvatten	2016-05-07	2164	2025	93,6	1,34	0,51	1,28	1,00	1,14	1,26	1,38	1,57

## Data selection for classification

- Chl a (median) from July-Aug (+June for WD5)
- Observations corresponding to >20% of the WB



# EO supported WFD status assessment

## Tabulated Status class per observation (SMHI Ecostat Calculator)

- High, Good, Moderate, Poor and Bad

SDATE	YEAR	MONTH	STATN	VISS_EU_CD	WATER_BODY_NAME	WATER_DISTRICT_NAME	WATER_TYPE_AREA	CPHL_SAT	SALT	MS_CD	REFERENCE_VALUE				
2016-07-03	2016	7	SE633000-195000	SE633000-195000	Örefjärden	Bottenvikens vattendistrikt	Norra Kvarkens inre kustvatten	4,05	3,83	WA59485772		1,3			
2016-07-09	2016	7	SE633000-195000	SE633000-195000	Örefjärden	Bottenvikens vattendistrikt	Norra Kvarkens inre kustvatten	2,81	3,83	WA59485772		1,3			
2016-07-16	2016	7	SE633000-195000	SE633000-195000	Örefjärden	Bottenvikens vattendistrikt	Norra Kvarkens inre kustvatten	2,18	3,83	WA59485772		1,3			
2016-07-19	2016	7	SE633000-195000	SE633000-195	HG_VALUE_LIMIT	GM_VALUE_LIMIT	MP_VALUE_LIMIT	PB_VALUE_LIMIT	CPHL_SOURCE	WATER_TYPE_AREA_CODE	EQR	NORM EQR	STATUS	1,3	
2016-07-20	2016	7	SE633000-195000	SE633000-195	1,805556	2,280702	4,642857	10,83333	CPHL_SAT		20	0,32	0,43	MODERATE	1,3
2016-07-21	2016	7	SE633000-195000	SE633000-195	1,805556	2,280702	4,642857	10,83333	CPHL_SAT		20	0,46	0,53	MODERATE	1,3
2016-07-23	2016	7	SE633000-195000	SE633000-195	1,805556	2,280702	4,642857	10,83333	CPHL_SAT		20	0,60	0,64	GOOD	1,3
2016-07-24	2016	7	SE633000-195000	SE633000-195	1,805556	2,280702	4,642857	10,83333	CPHL_SAT		20	0,69	0,76	GOOD	1,3
2016-07-25	2016	7	SE633000-195000	SE633000-195	1,805556	2,280702	4,642857	10,83333	CPHL_SAT		20	0,59	0,62	GOOD	1,3
2016-07-27	2016	7	SE633000-195000	SE633000-195	1,805556	2,280702	4,642857	10,83333	CPHL_SAT		20	0,51	0,56	MODERATE	1,3
2016-07-29	2016	7	SE633000-195000	SE633000-195	1,805556	2,280702	4,642857	10,83333	CPHL_SAT		20	0,74	0,82	HIGH	1,3
2016-07-31	2016	7	SE633000-195000	SE633000-195	1,805556	2,280702	4,642857	10,83333	CPHL_SAT		20	0,57	0,60	GOOD	1,3
2016-08-01	2016	7	SE633000-195000	SE633000-195	1,805556	2,280702	4,642857	10,83333	CPHL_SAT		20	0,40	0,48	MODERATE	1,3
2016-08-01	2016	8	SE633000-195000	SE633000-195	1,805556	2,280702	4,642857	10,83333	CPHL_SAT		20	0,56	0,59	MODERATE	1,3
2016-08-03	2016	8	SE633000-195000	SE633000-195	1,805556	2,280702	4,642857	10,83333	CPHL_SAT		20	0,35	0,45	MODERATE	1,3
2016-08-05	2016	8	SE633000-195000	SE633000-195	1,805556	2,280702	4,642857	10,83333	CPHL_SAT		20	0,45	0,51	MODERATE	1,3
<div><div>Continued:</div></div>					1,805556	2,280702	4,642857	10,83333	CPHL_SAT		20	0,35	0,45	MODERATE	ment
					1,805556	2,280702	4,642857	10,83333	CPHL_SAT		20	0,40	0,48	MODERATE	
					1,805556	2,280702	4,642857	10,83333	CPHL_SAT		20	0,39	0,48	MODERATE	
					1,805556	2,280702	4,642857	10,83333	CPHL_SAT		20	0,66	0,72	GOOD	
					1,805556	2,280702	4,642857	10,83333	CPHL_SAT		20	0,41	0,49	MODERATE	

Continued:



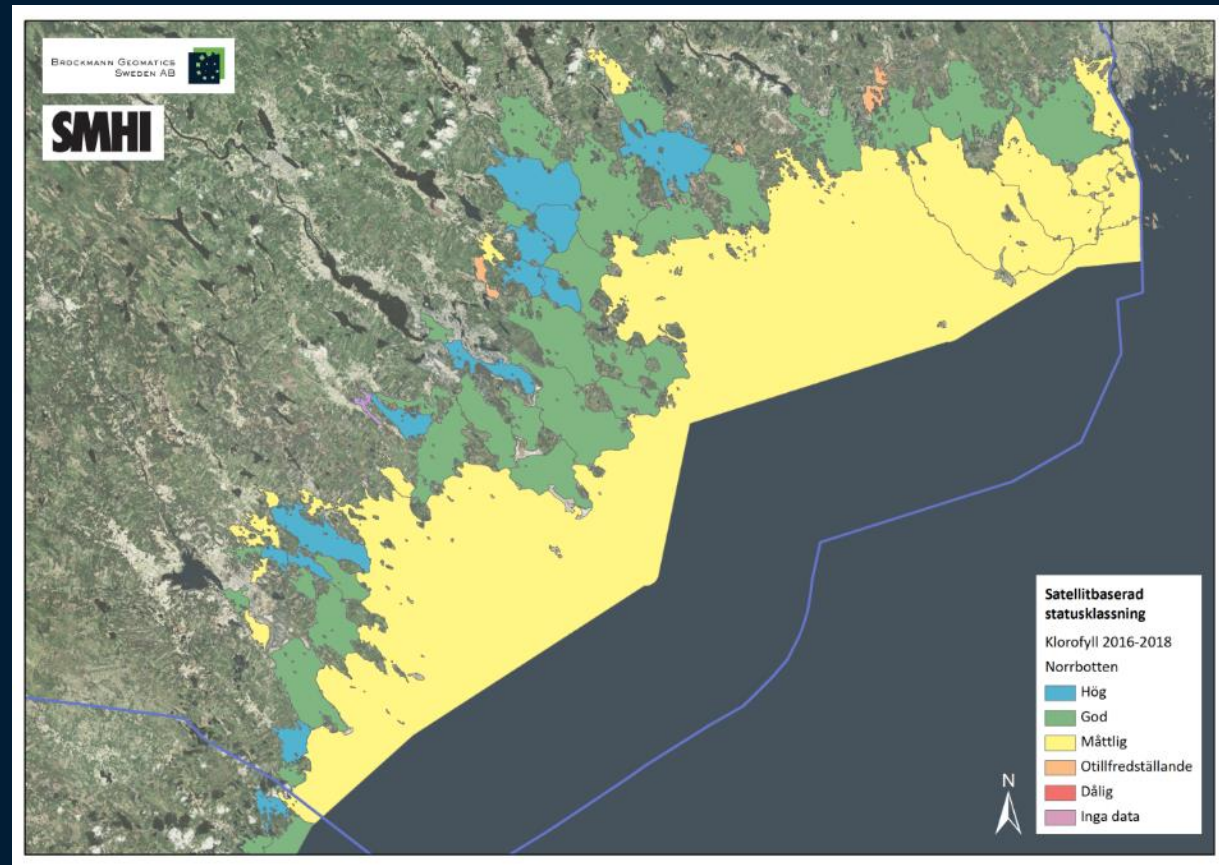


# EO supported WFD status assessment

Aggregated status class for the full period

## Output

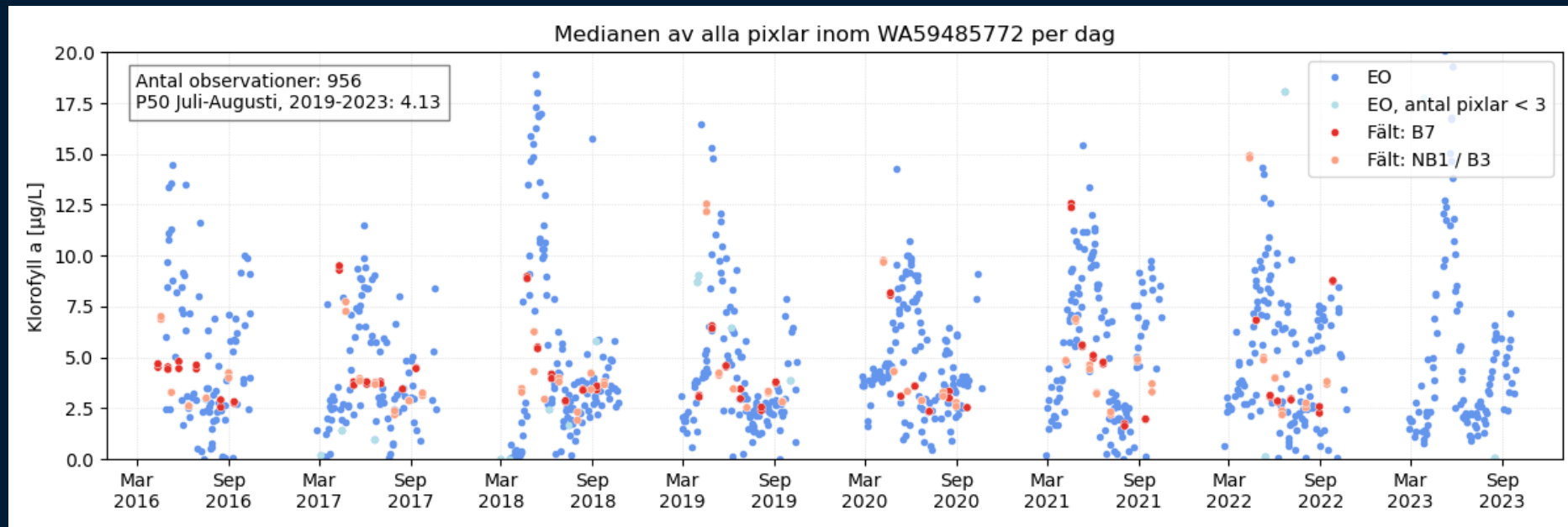
- Tabulated status class
- GIS-files (.shp)
- Maps (.png)





# EO supported WFD surveillance monitoring

After validation, WQ information per water body and date was extracted, tabulated, **plotted** and used as a basis for expert judgment.

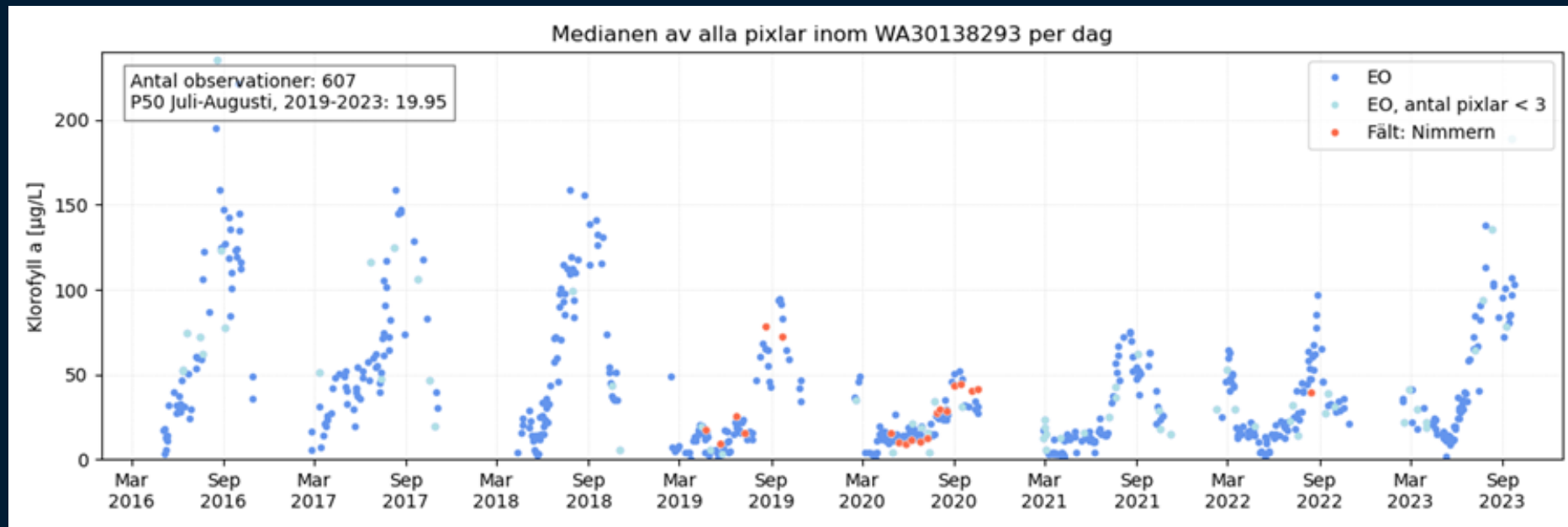


Water body "Örefjärden" (WA59485772) and station B7 and NB1/B3



# EO supported WFD surveillance monitoring

After validation, WQ information per water body and date was extracted, tabulated, **plotted** and used as a basis for expert judgment.



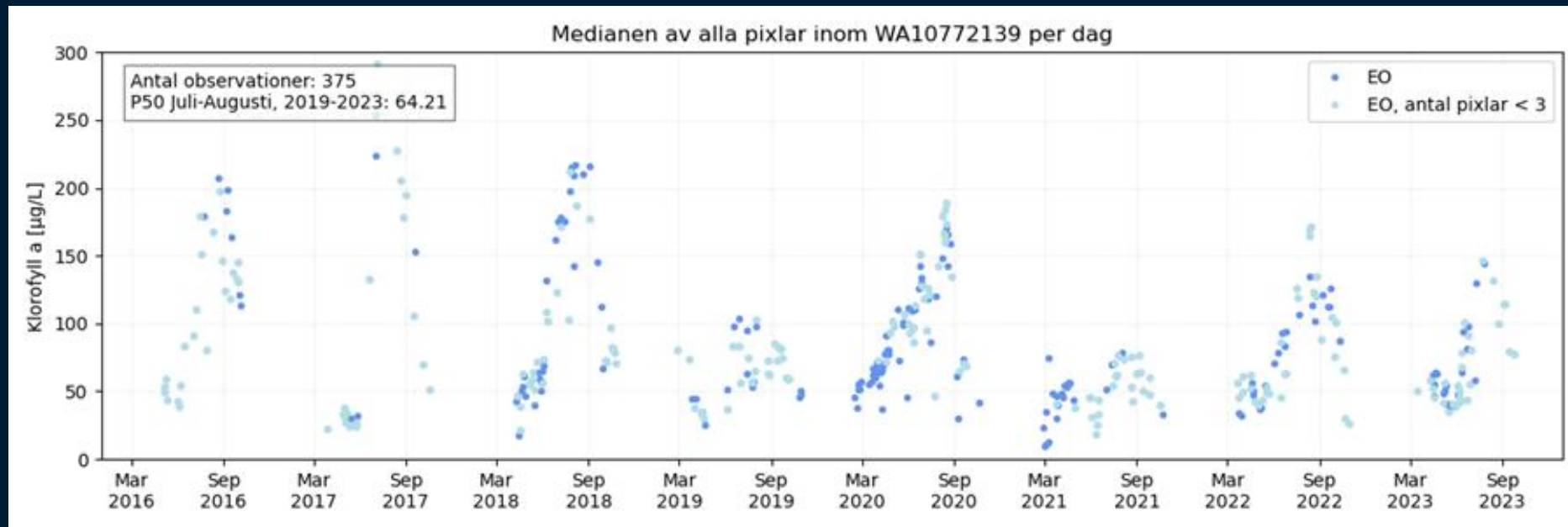
Water body "Nimmern" (WA30138292) and station Nimmern





# EO supported WFD surveillance monitoring

After validation, WQ information per water body and date was extracted, tabulated, **plotted** and used as a basis for expert judgment.



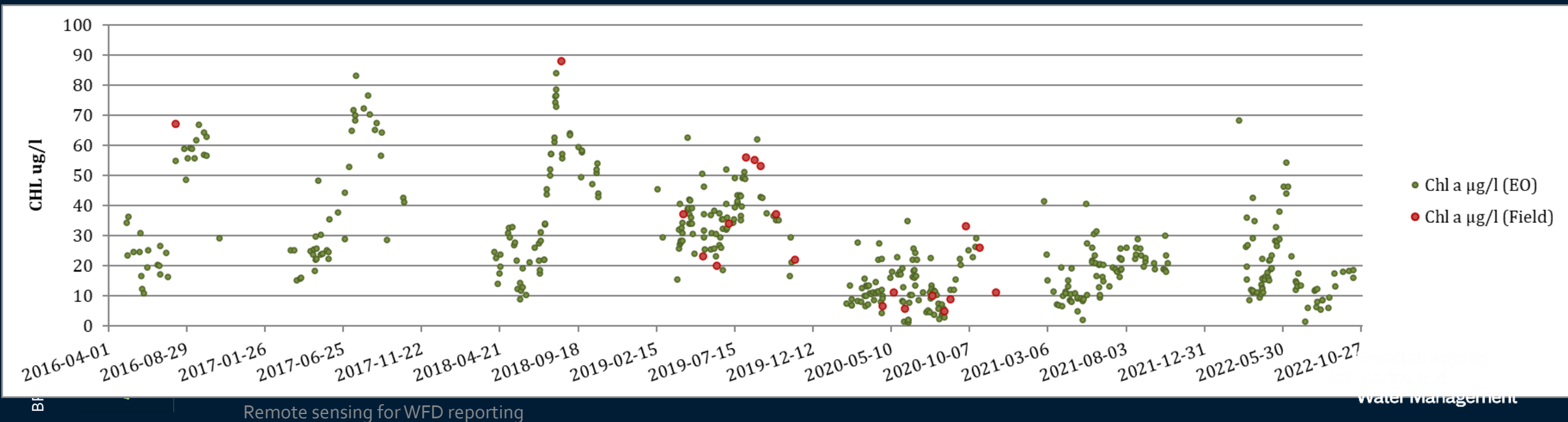
Water body "Mungasjön" (WA10772139), no station data available



# EO supported WFD operational monitoring

## Aluminum treatment of Lake Örlången (Poor status) – Follow up of measures

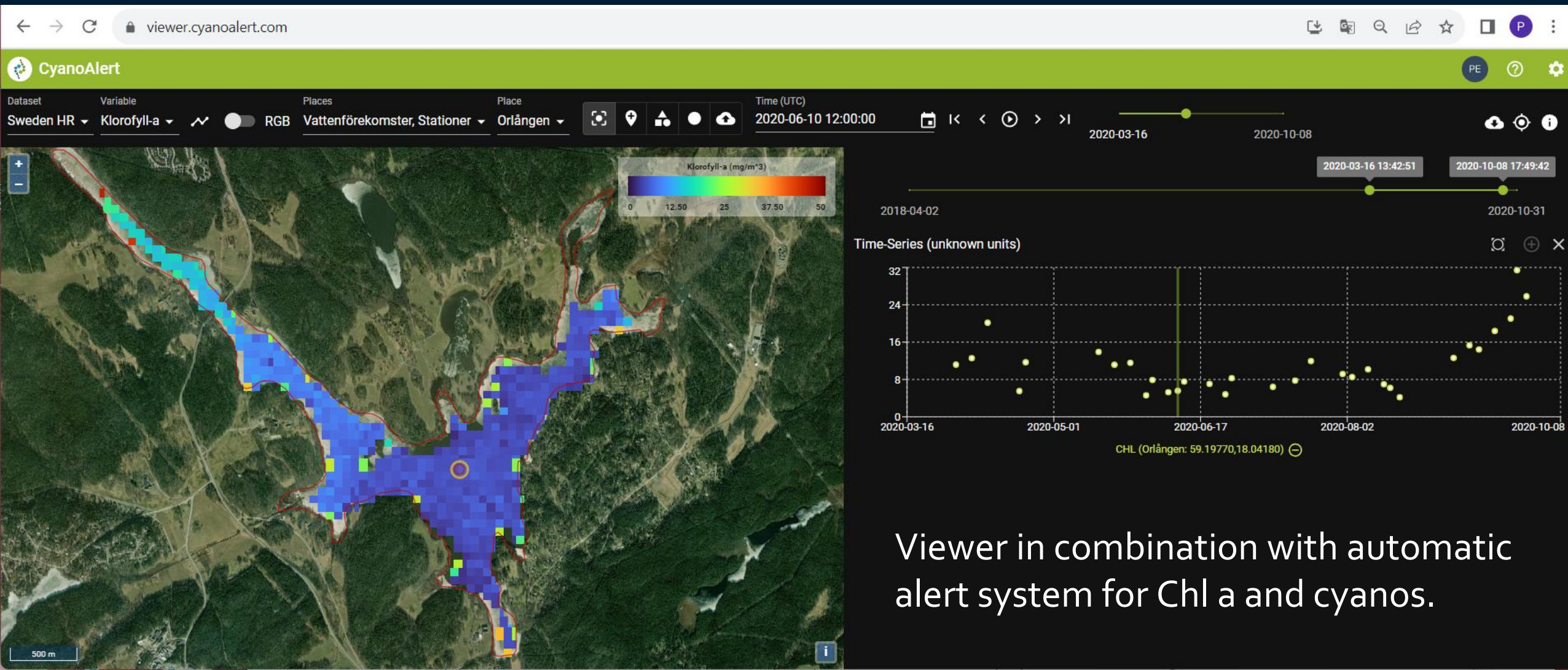
A heavily fertilized lake due to the impact of stormwater, leachate, flooding of waste water and many individual drains. During the summer of 2019, aluminum treatment was carried out to precipitate phosphorus in the sediment. The lake's chlorophyll-a levels dropped after the treatment was carried out and the measure consequently had a great effect.





# EO supported WFD operational monitoring

Viewer to support Near Real Time monitoring



Viewer in combination with automatic alert system for Chl a and cyanos.

# Thank you!

**Swedish Agency  
for Marine and  
Water Management**

In collaboration with:





# EO supported WFD Monitoring in Sweden

## Surveillance monitoring – National effort

EO based information generated for Cycle 1 – 3

## Operational monitoring – Regional / Local effort

Coast & Lakes – Sentinel-3 and -2 based services since 2020

