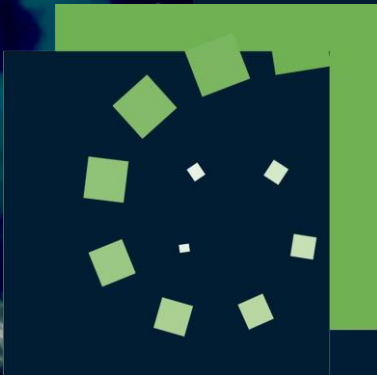


BROCKMANN CONSULT

Letzte Meilen Brockmann Consult

Schnittstellen zwischen Satellitendaten und Nutzern

Kerstin Stelzer, Jorrit Scholze, Carole Lebreton



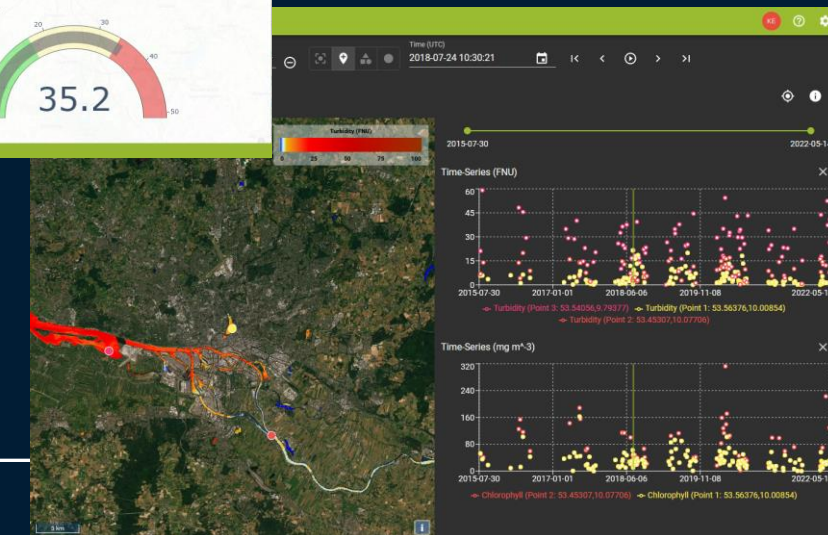
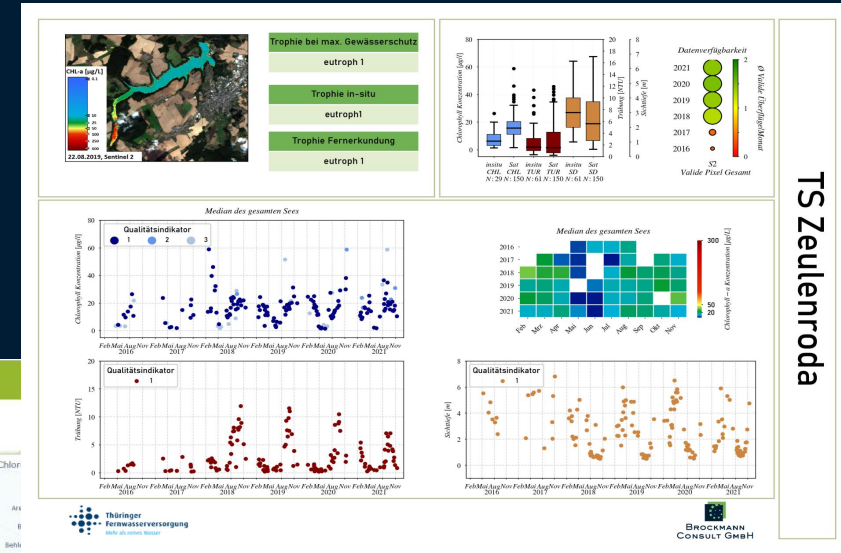
BIGFE – 2. Status Seminar | 14.06.2023

Letzte Meilen für die Wasserqualität

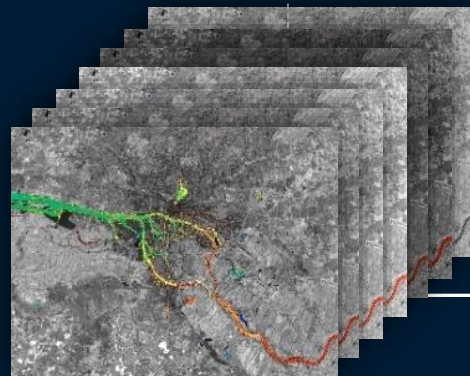
○ Gewässersteckbriefe

○ Alerts

○ Daten Viewer



Verarbeitungskette Satellitendaten - von der Messung zur Information



Am Sensor gemessenes
Signal

Idepix
(Wolken, Wolkenschatten...)

Atmosphärenkorrektur

Berechnung Wasserparameter

Cyanoindikator

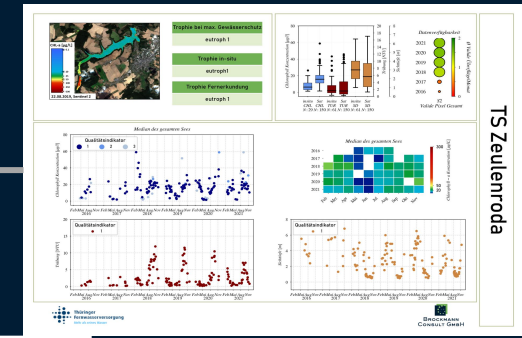
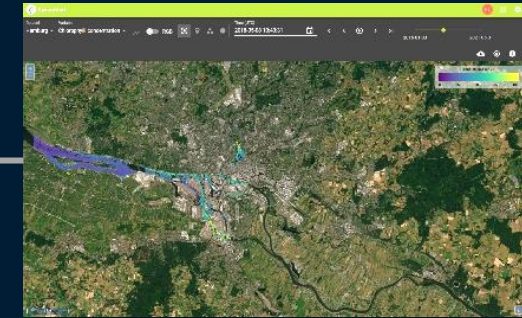
Ausmaskierung invalider
Pixel

Reflektanzen +
Wasserparameter

Cube generation

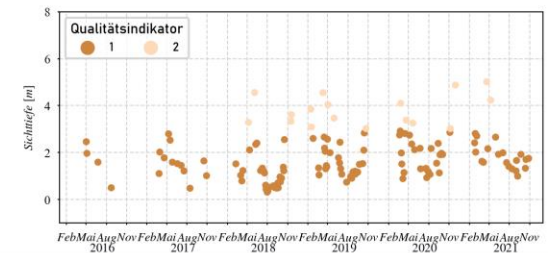
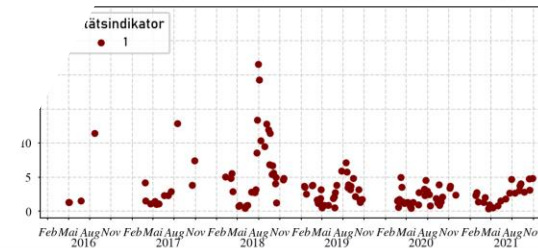
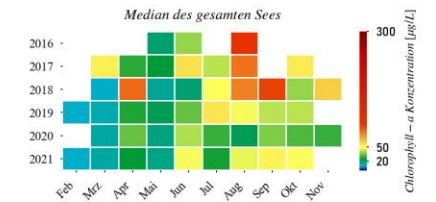
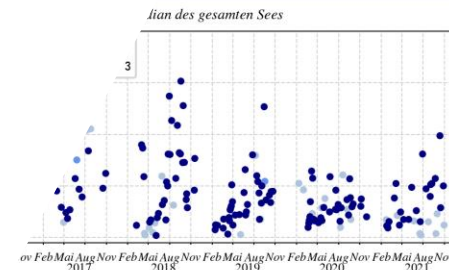
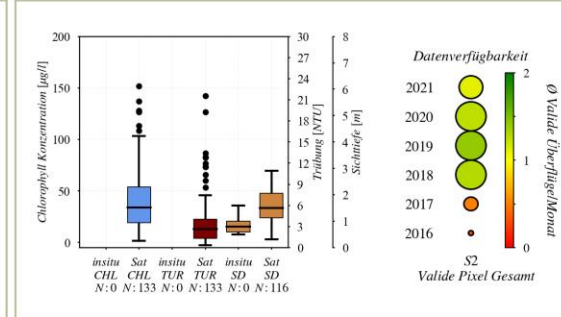
DataCube
Wasserparameter

Viewer - Darstellung und
Interpretation

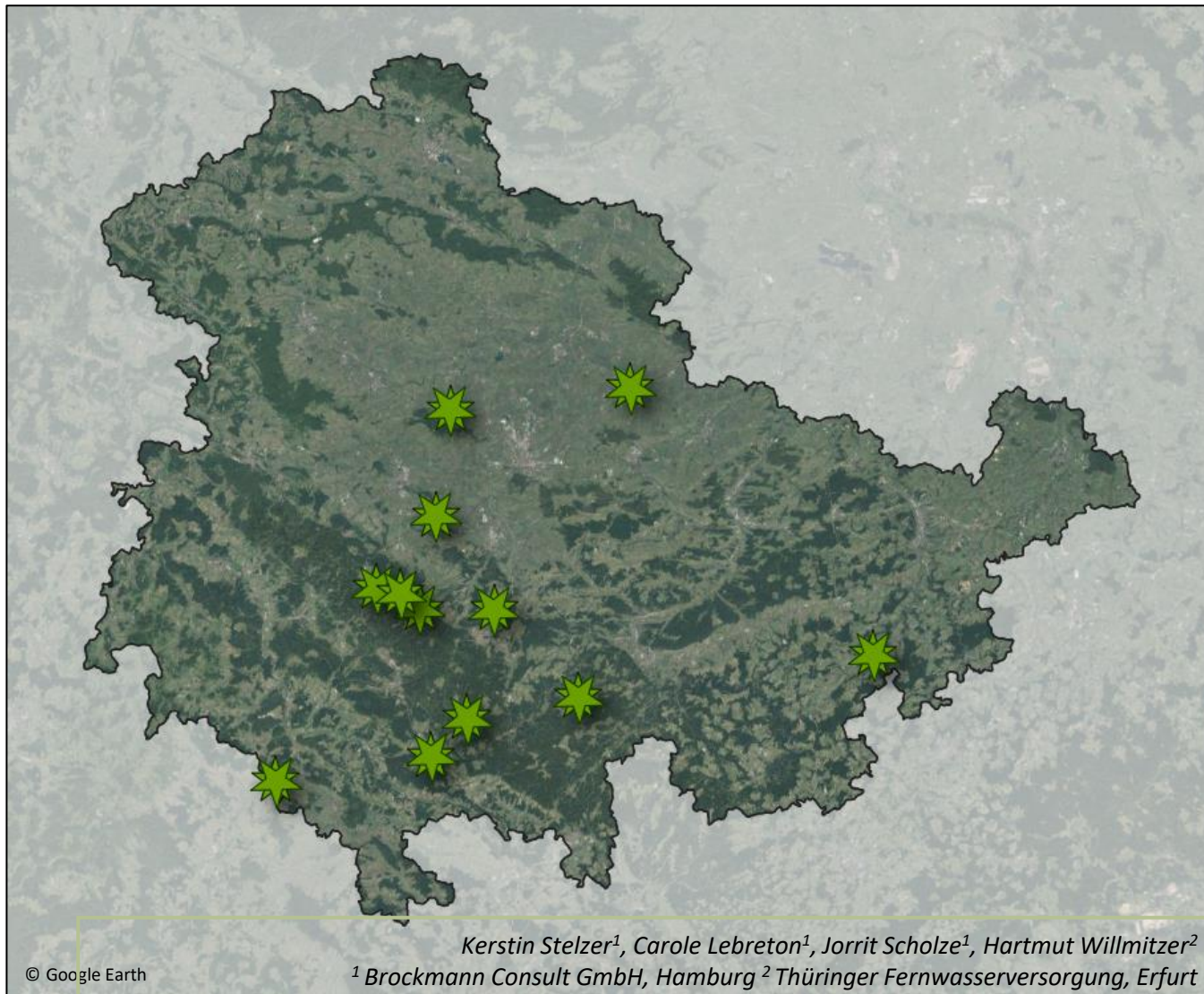


Gewässersteckbriefe

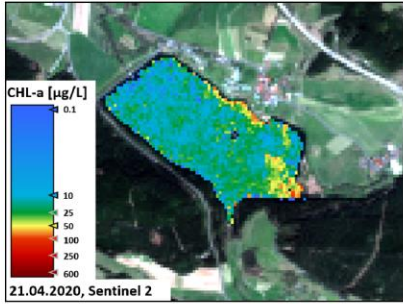
- Informationen zum Gewässer
- Extraktionen aus den Fernerkundungsdaten
- Kombination mit in-situ Messungen aus Monitoring Programmen



Steckbriefe Talsperren Thüringen



1. HRB Ratscher
2. TS Dachwig
3. TS Großbrennbach
4. TS Heyda
5. TS Leibis/Lichte
6. TS Lütsche
7. TS Ohra
8. TS Schmalwasser
9. TS Schönbrunn
10. TS Schwickershausen
11. TS Wechmar
12. TS Zeuenroda



Trophie bei max. Gewässerschutz

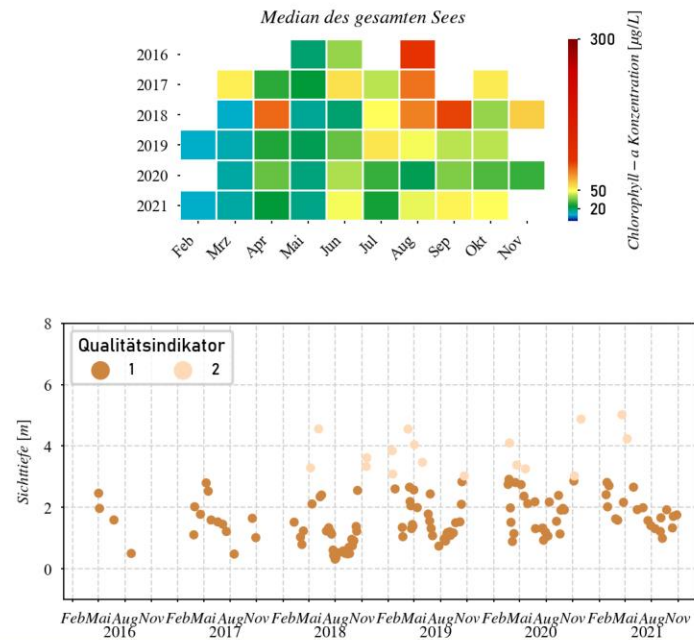
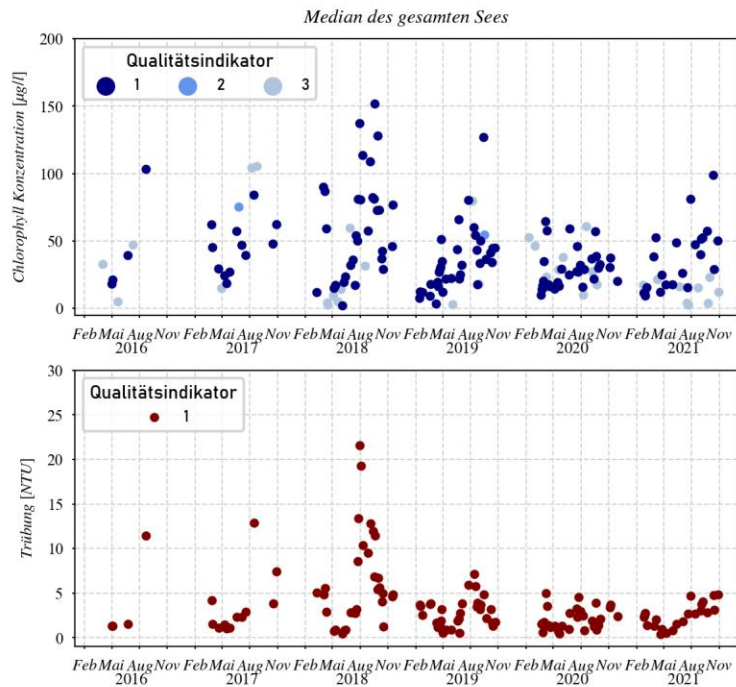
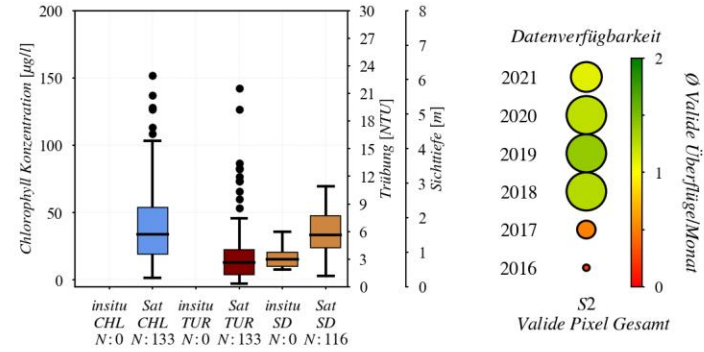
mesotroph

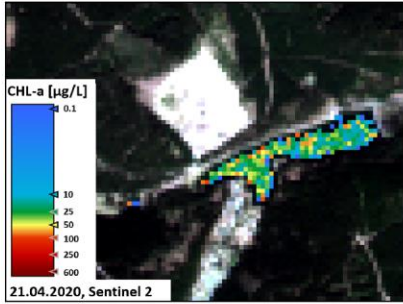
Trophie in-situ

polytroph 1

Trophie Fernerkundung

polytroph 1





Trophie bei max. Gewässerschutz

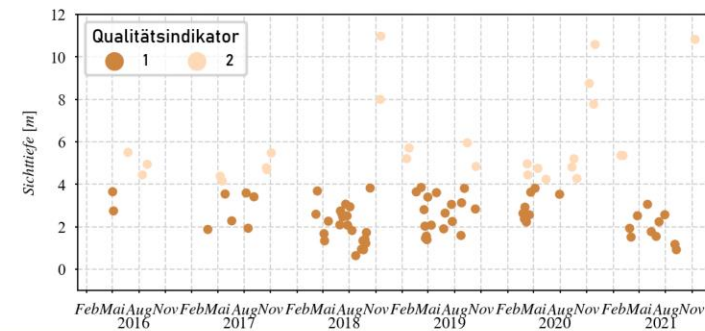
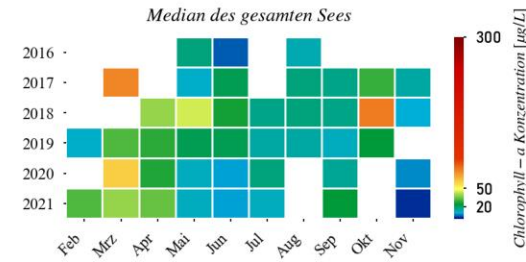
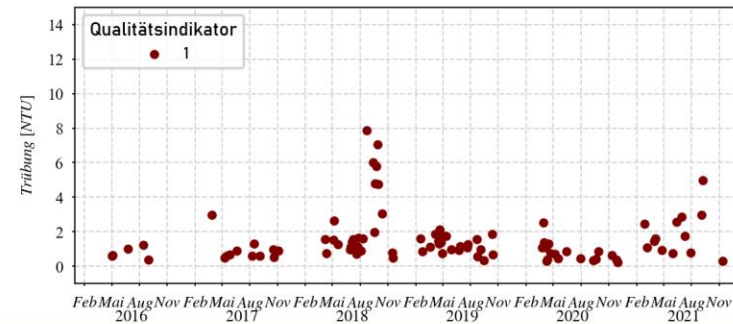
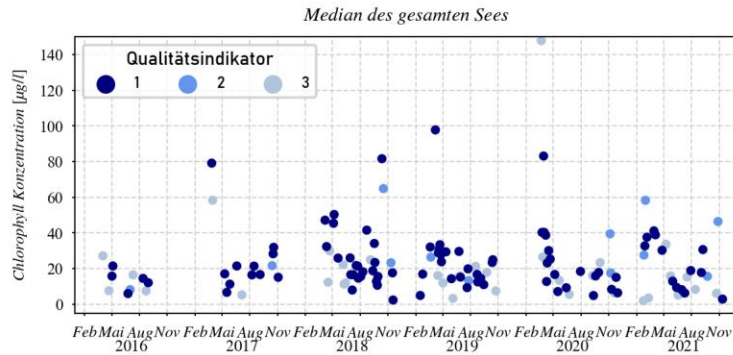
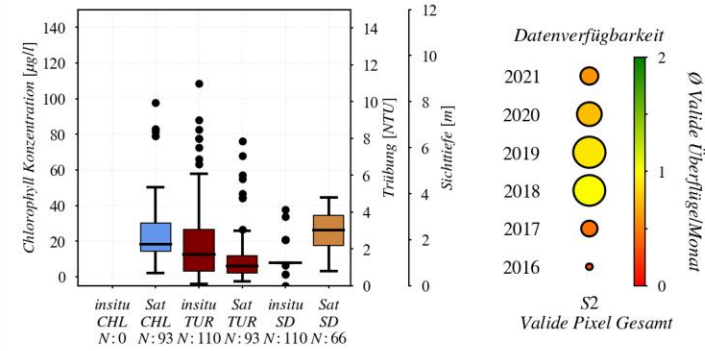
oligotroph

Trophie in-situ

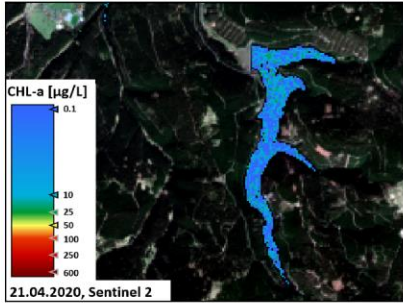
polytroph 1

Trophie Fernerkundung

polytroph 1



TS Lüttsche



Trophie bei max. Gewässerschutz

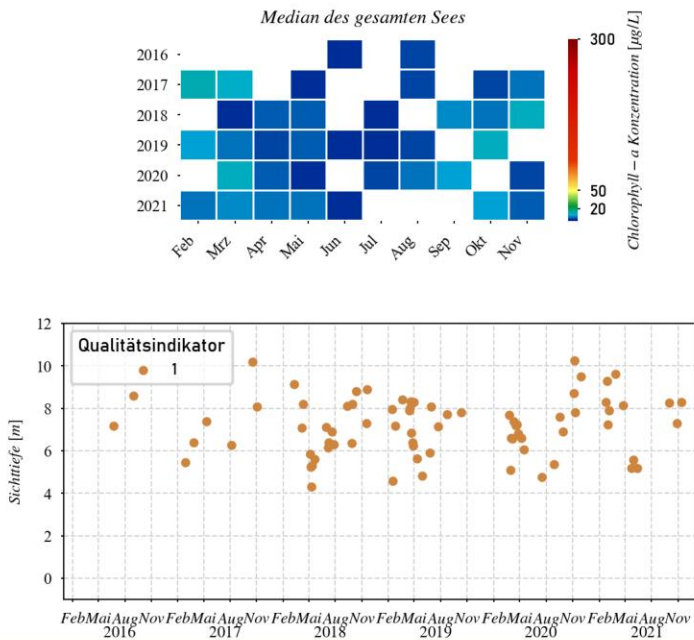
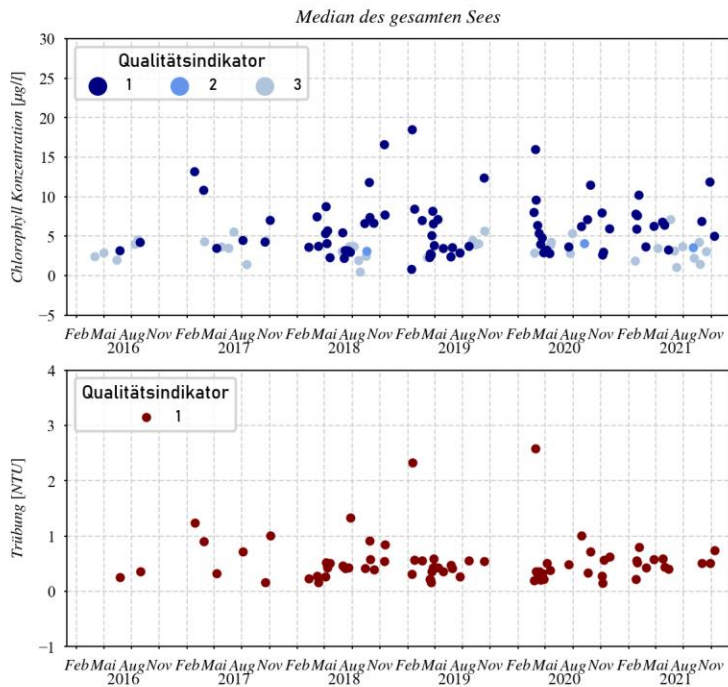
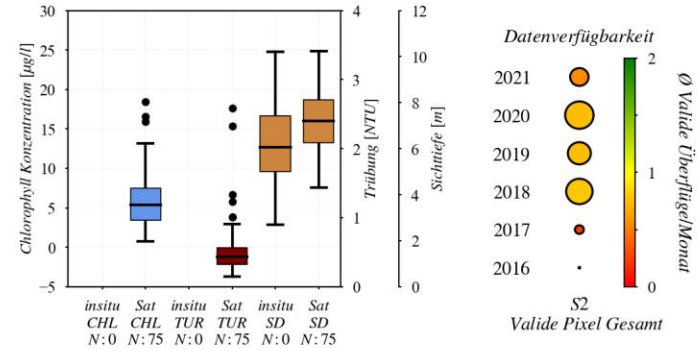
oligotroph

Trophie in-situ

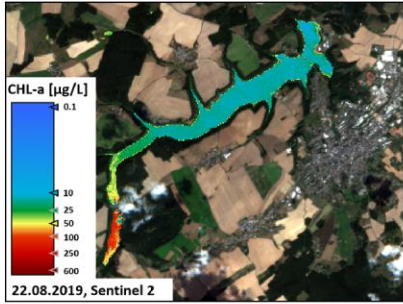
oligotroph

Trophie Fernerkundung

oligotroph



TS Schmalwasser



Trophie bei max. Gewässerschutz

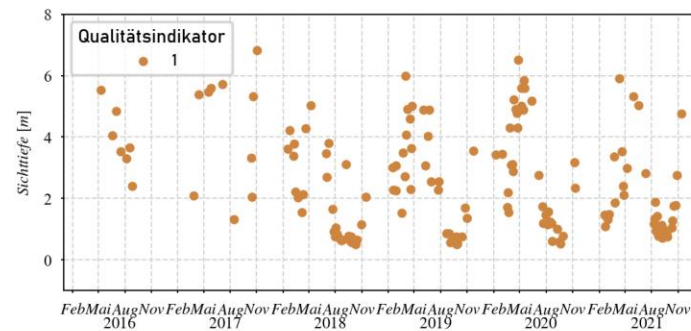
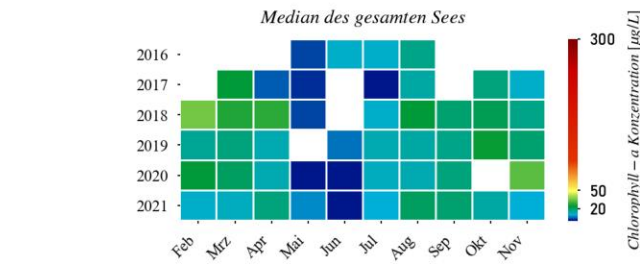
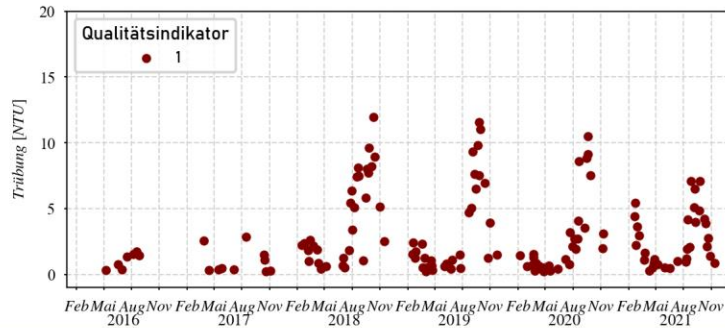
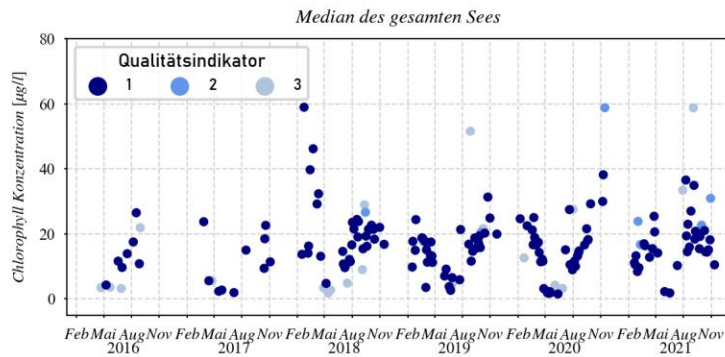
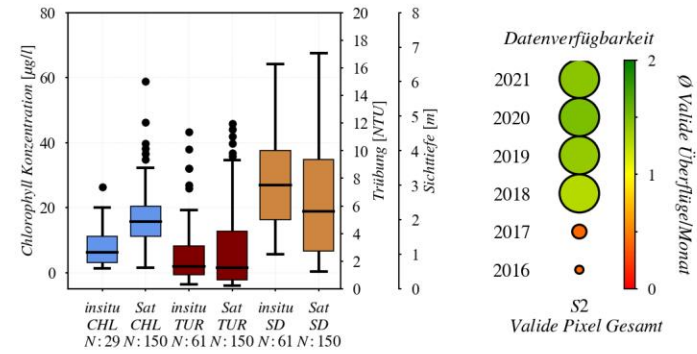
eutroph 1

Trophie in-situ

eutroph1

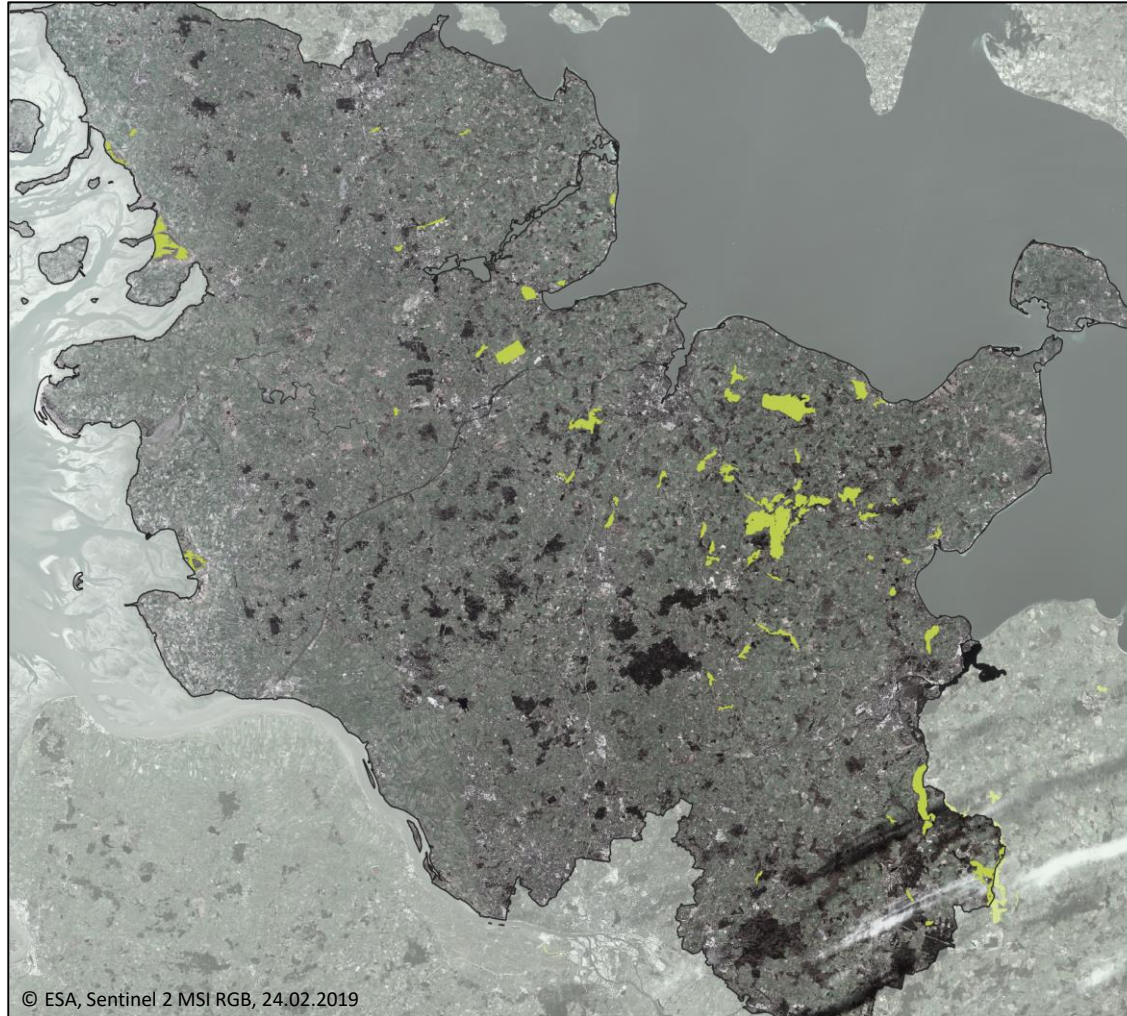
Trophie Fernerkundung

eutroph 1



TS Zeulenroda

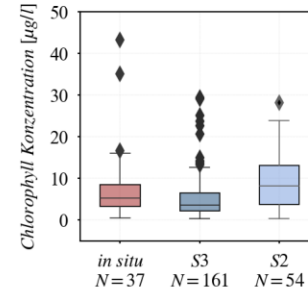
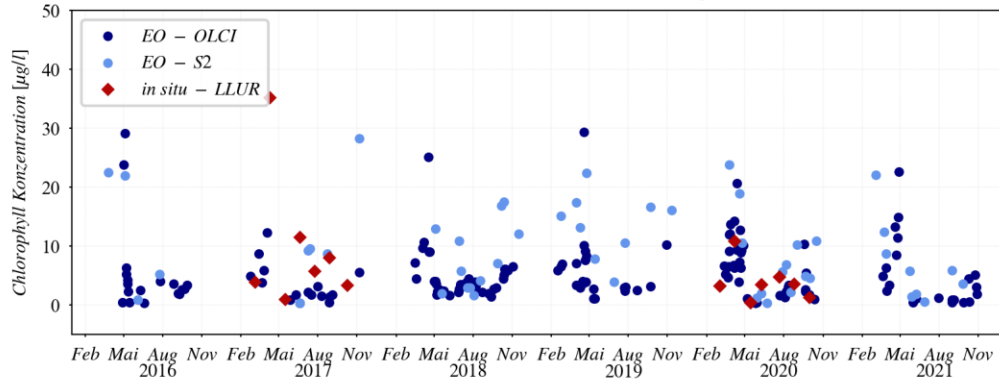
Steckbriefe Seen Schleswig-Holstein



- | | | |
|-------------------------------|--|-------------------------------------|
| 1. Ahrensee | 33. Lagune | 53. Schaalsee -
Nordwestteil |
| 2. Arenholzer See | Beltringharder
Koog | 54. Schluensee |
| 3. Barkauer See | 34. Langsee, | 55. Schmalensee |
| 4. Behlendorfer See | Süderfahrenstedt | 56. Schöhsee |
| 5. Behler See | 35. Lanker See | 57. Schwansener See |
| 6. Belauer See | 36. Lüttmoorsee | 58. Schwentinese |
| 7. Bistensee | 37. Mözener See | 59. Seedorfer See |
| 8. Bordesholmer See | 38. Neustädter
Binnenwasser | 60. Sehlendorfer
Binnensee |
| 9. Bornhöveder See | 39. Neversdorfer See | 61. Selenter See |
| 10. Bothkamper See | 40. Passader See | 62. Sibbersdorfer See |
| 11. Bottschlotter See | 41. Postsee | 63. Speicherbecken,
Arlau |
| 12. Brahmsee | 42. Rantumbecken | 64. Speicherbecken
Bongsiel Nord |
| 13. Dieksee | 43. Rickelsbüller
Koogsee | 65. Speicherbecken
Bongsiel Süd |
| 14. Dobersdorfer See | 44. Sankelmarker See | 66. Speicherbecken,
Miele |
| 15. Drüsensee | 45. Schaalsee -
Bernstorfer
Binnensee (MV) | 67. Stendorfer See |
| 16. Einfelder See | 46. Schaalsee -
Borgsee (MV) | 68. Stocksee |
| 17. Großensee | 47. Schaalsee -
Dutzower See
(MV) | 69. Stolper See |
| 18. Großer Binnensee | 48. Schaalsee -
Lassahner See
(MV) | 70. Südensee |
| 19. Großer Eutiner
See | 49. Schaalsee -
Rethwiesentief | 71. Süseler See |
| 20. Großer Küchensee | 50. Schaalsee -
Techiner See (MV) | 72. Suhrer See |
| 21. Großer Plöner See | 51. Schaalsee -
Zarrentiner
Becken (MV) | 73. Trammer See |
| 22. Großer Pönitzer
See | 52. Schaalsee -
Niendorfer
Binnensee | 74. Tresdorfer See |
| 23. Großer
Ratzeburger See | | 75. Vierer See |
| 24. Großer
Segeberger See | | 76. Wardersee, Krems
II |
| 25. Gudower See | | 77. Wardersee,
Warder |
| 26. Hemmelmarker
See | | 78. Westensee |
| 27. Hemmeldorfer
See | | 79. Windebyer Noor |
| 28. Hohner See | | 80. Wittensee |
| 29. Holmer See, Arlau | | |
| 30. Kellersee | | |
| 31. Kleiner Plöner See | | |
| 32. Kronenloch | | |

Dieksee

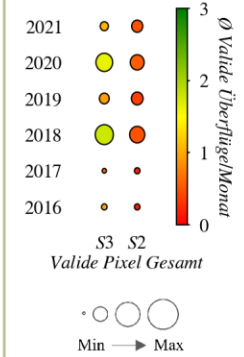
Kombination Sensoren, Arithmetisches Mittel des gesamten Sees



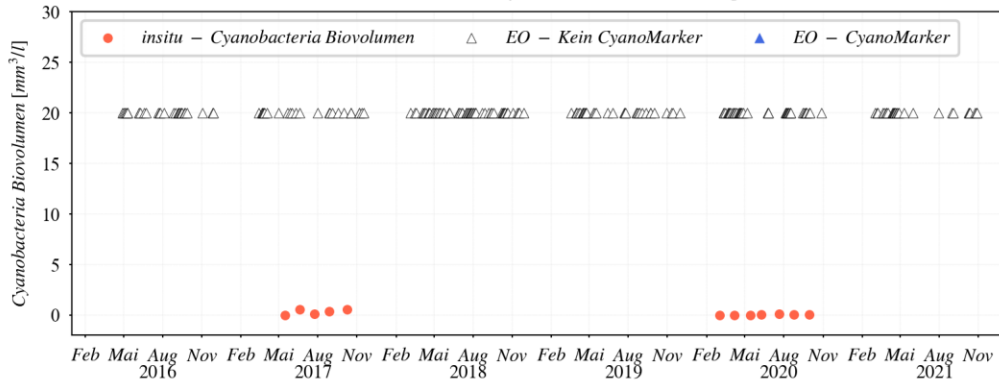
Max. valide Pixel

Sentinel 3 OLCI	Sentinel 2 MSI
43	8939

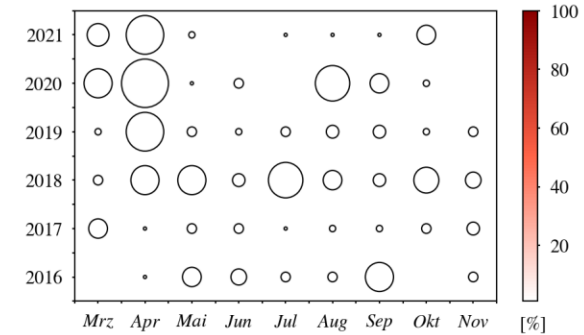
Datenverfügbarkeit



Sentinel 3 OLCI, Cyanobakterien Erkennung

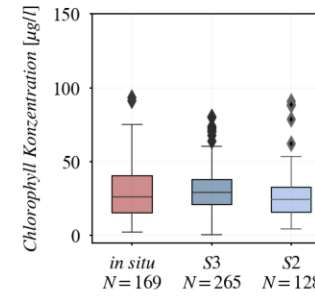
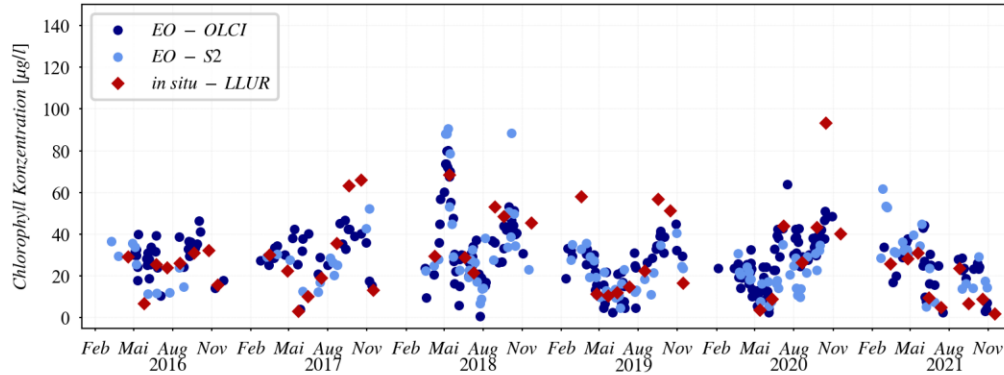


Cyanobakterien Beobachtungen/Valide Überflüge



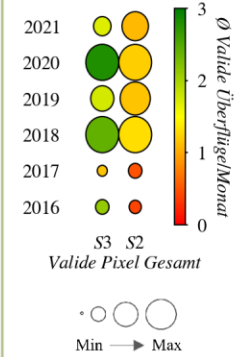
Dobersdorfer See

Kombination Sensoren, Arithmetisches Mittel des gesamten Sees

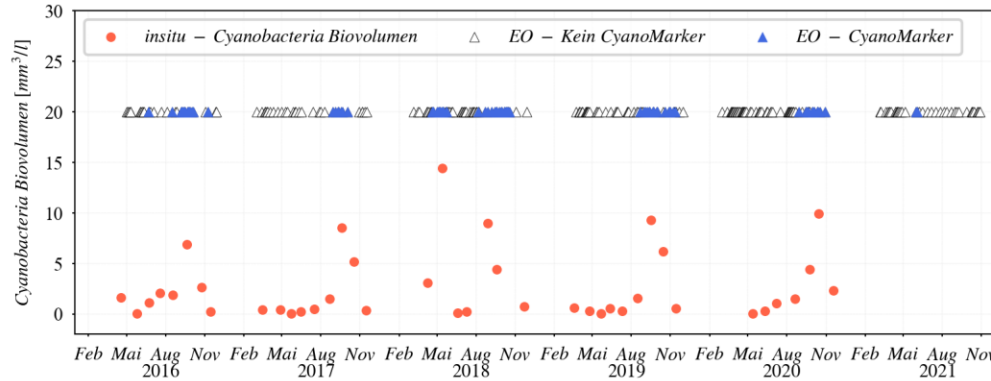


Max. valide Pixel	
Sentinel 3 OLCI	Sentinel 2 MSI
32	7413

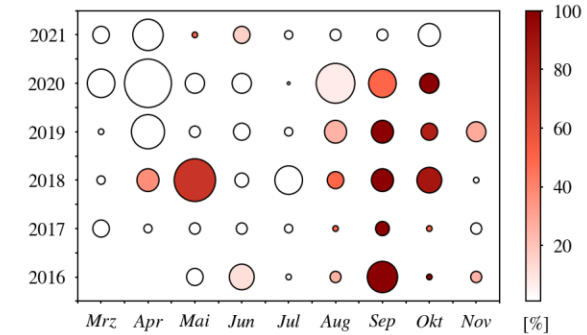
Datenverfügbarkeit



Sentinel 3 OLCI, Cyanobakterien Erkennung

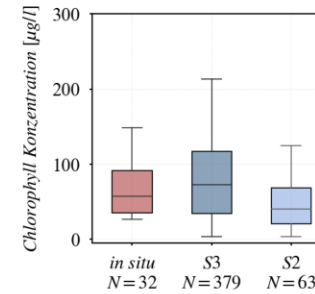
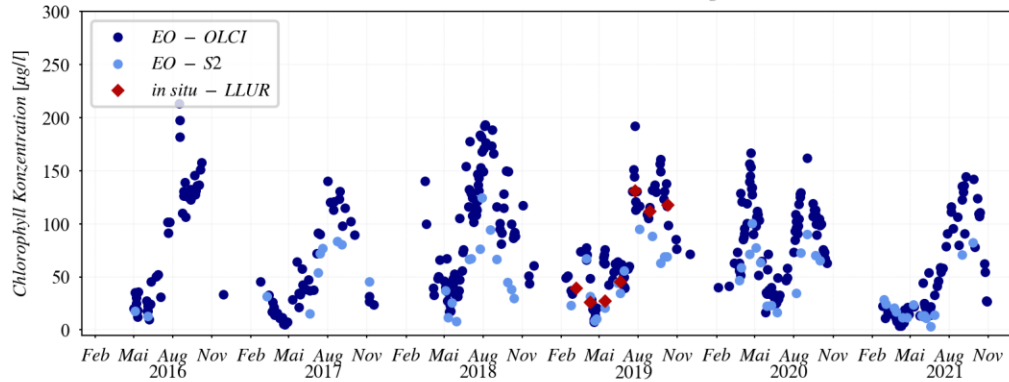


Cyanobakterien Beobachtungen/Valide Überflüge



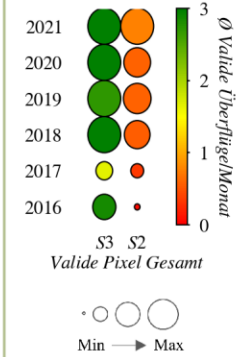
Großer Binnensee

Kombination Sensoren, Arithmetisches Mittel des gesamten Sees

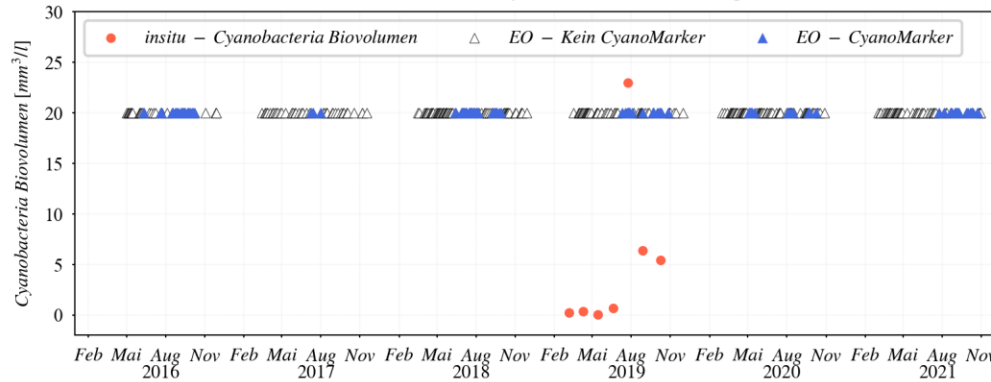


Max. valide Pixel	
Sentinel 3 OLCI	Sentinel 2 MSI
52	9744

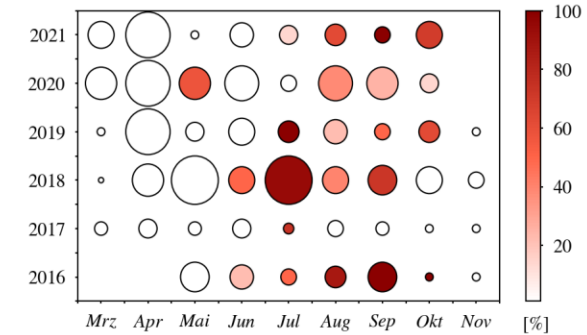
Datenverfügbarkeit



Sentinel 3 OLCI, Cyanobakterien Erkennung

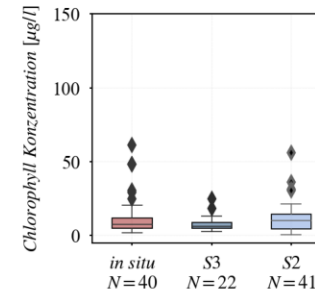
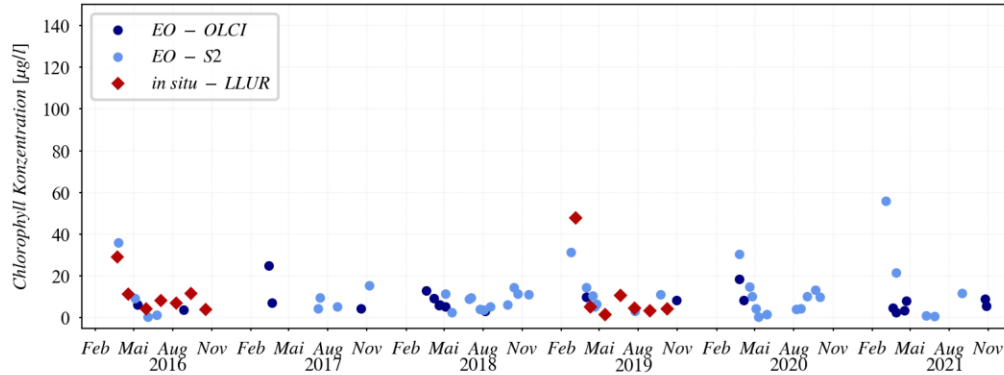


Cyanobakterien Beobachtungen/Valide Überflüge



Großer Segeberger See

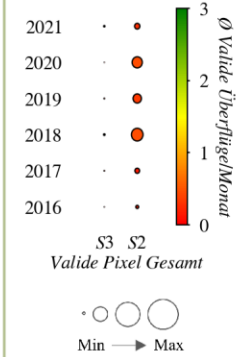
Kombination Sensoren, Arithmetisches Mittel des gesamten Sees



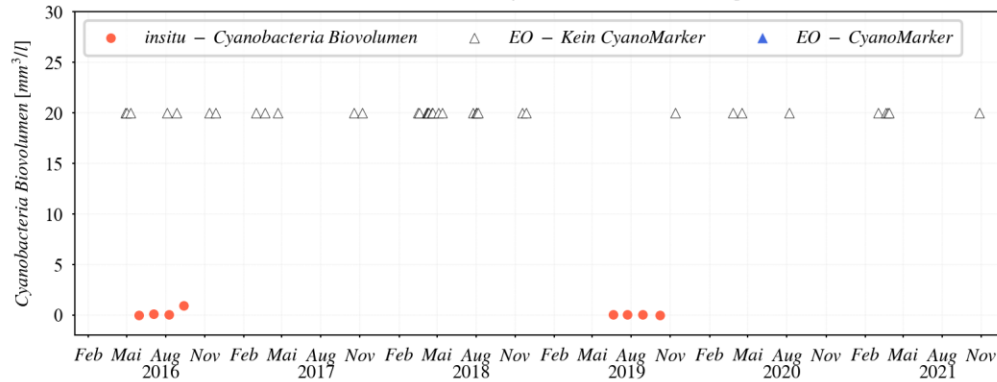
Max. valide Pixel

Sentinel 3 OLCI	Sentinel 2 MSI
21	4005

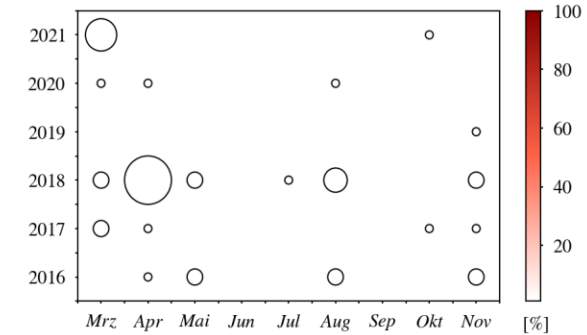
Datenverfügbarkeit



Sentinel 3 OLCI, Cyanobakterien Erkennung

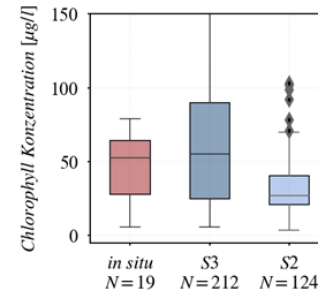
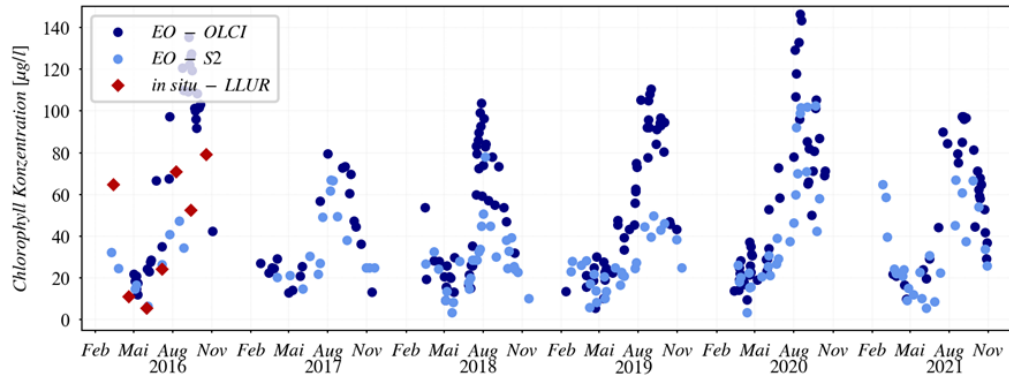


Cyanobakterien Beobachtungen/Valide Überflüge



Passader See

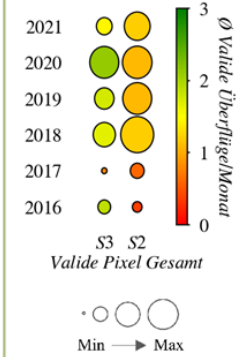
Kombination Sensoren, Arithmetisches Mittel des gesamten Sees



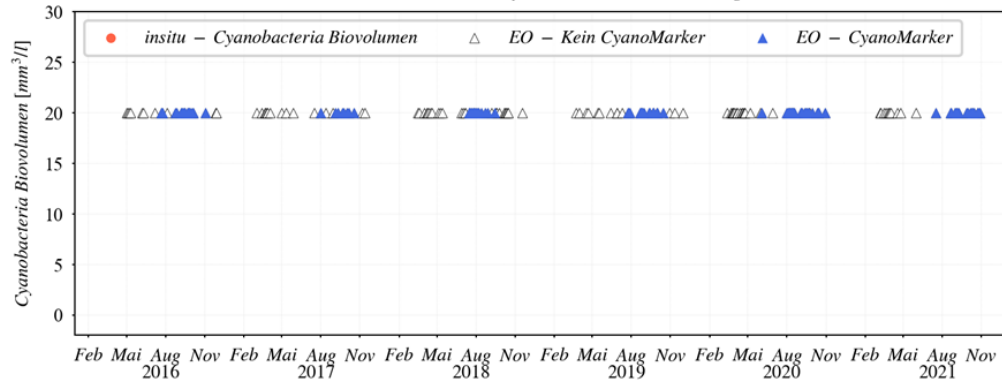
Max. valide Pixel

Sentinel 3 OLCI	Sentinel 2 MSI
30	6162

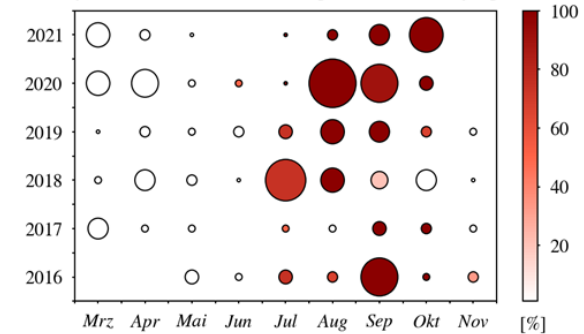
Datenverfügbarkeit



Sentinel 3 OLCI, Cyanobakterien Erkennung



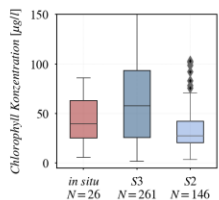
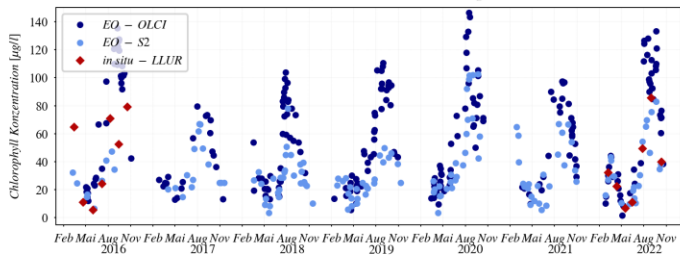
Cyanobakterien Beobachtungen/Valide Überflüge



- Layer
- Wasserkörper_SH_Trophie_sortiert_noBR_WGS84_v2_hyperlinks
- Grundkarte
- Weltweite Bilddaten

Passader See

Kombination Sensoren, Arithmetisches Mittel des gesamten Sees

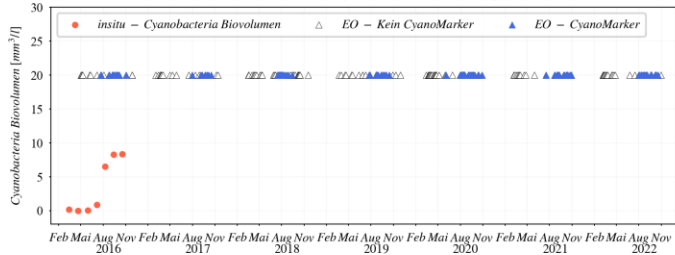


Max. valide Pixel	
Sentinel 3 OLCI	Sentinel 2 MSI
30	6162

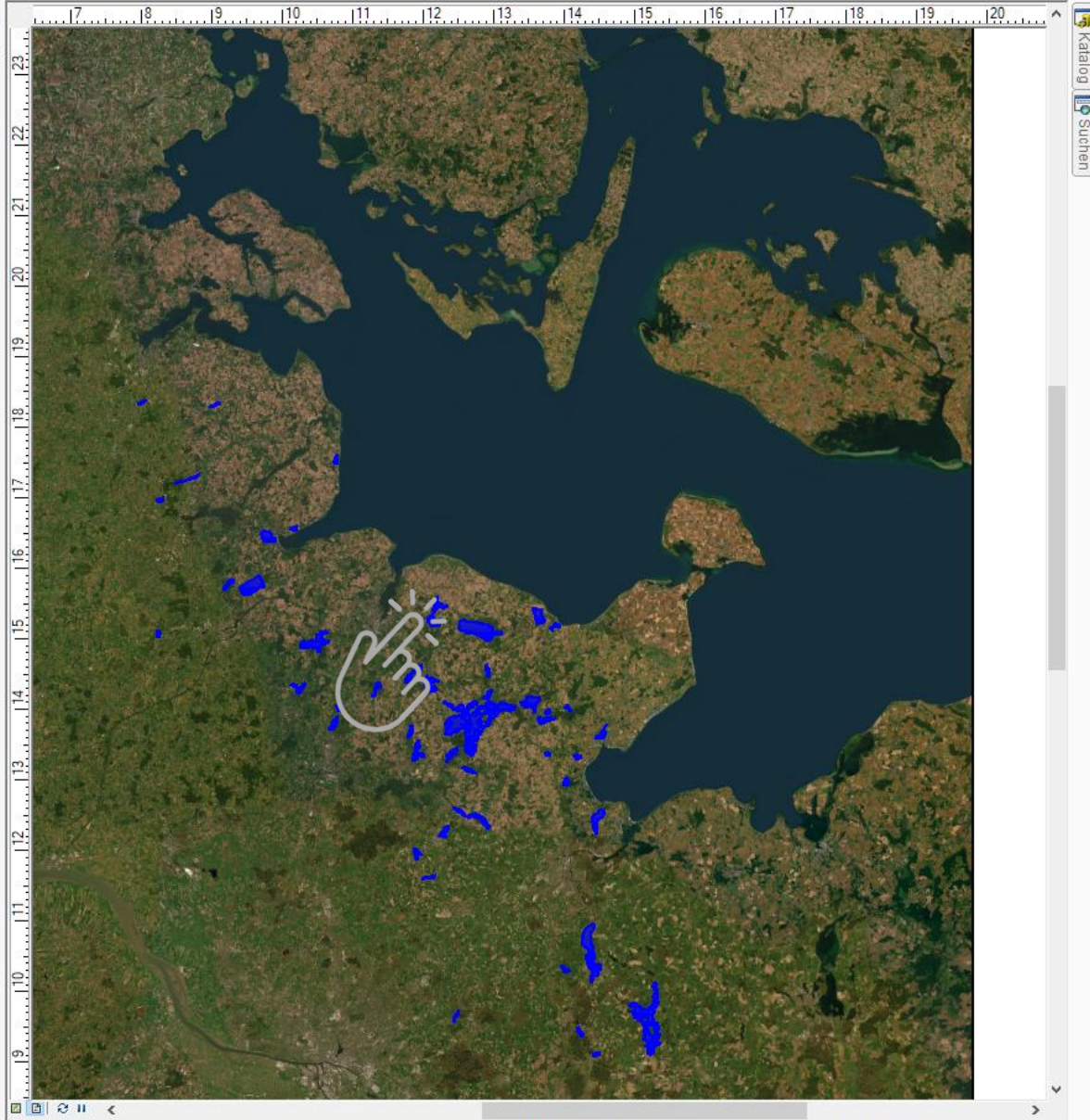
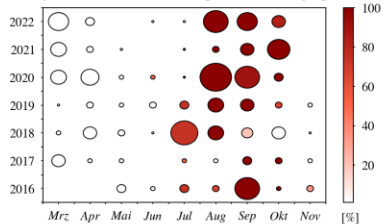
Datenverfügbarkeit	
Year	Valid Pixel Gesamt
2022	3
2021	2
2020	2
2019	1
2018	1
2017	1
2016	0

Legend: S3 S2
 Valide Pixel Gesamt
 Min → Max

Sentinel 3 OLCI, Cyanobakterien Erkennung



Cyanobakterien Beobachtungen/Valide Überflüge

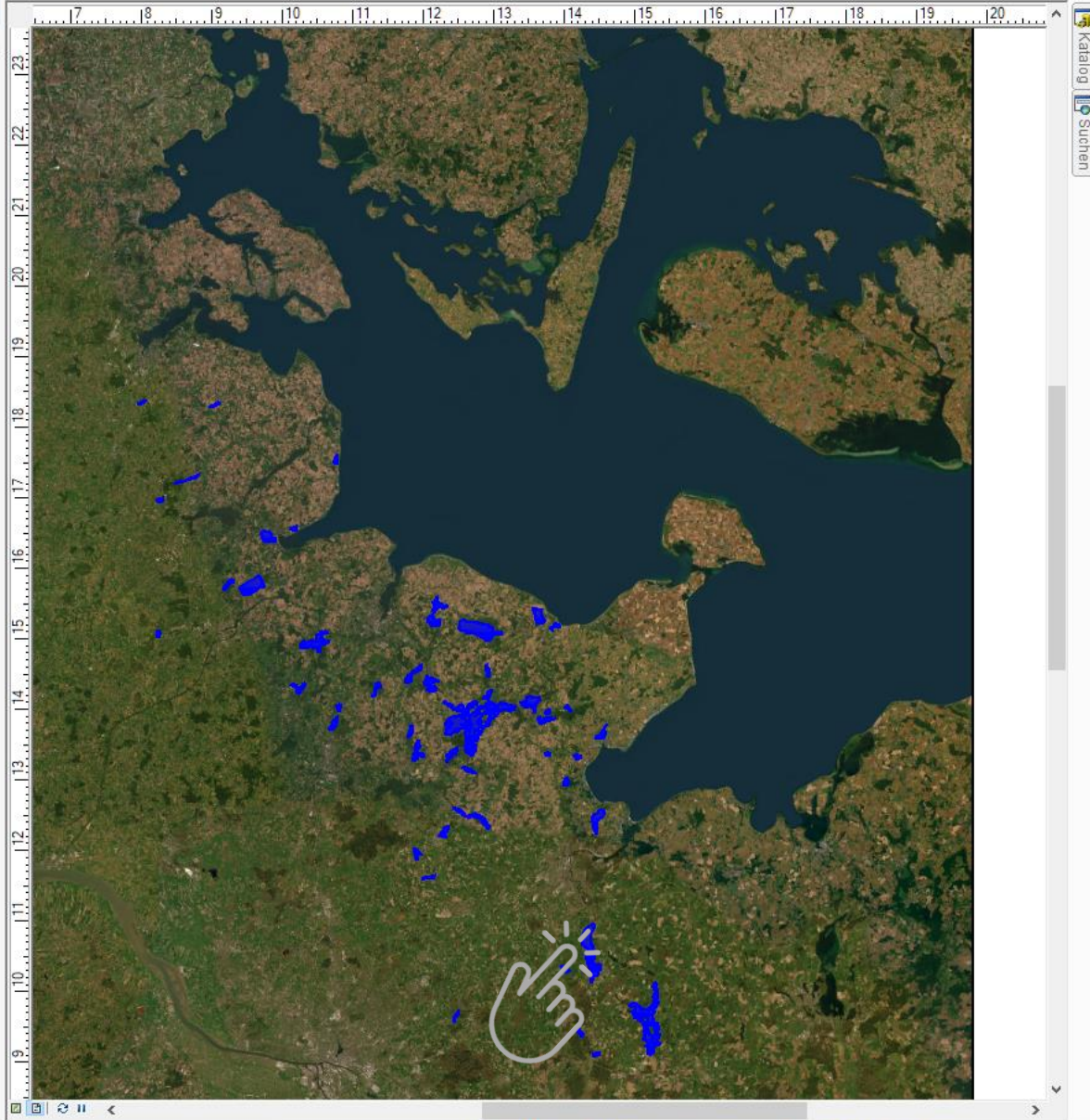
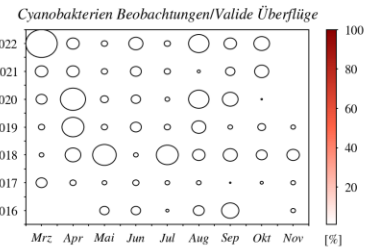
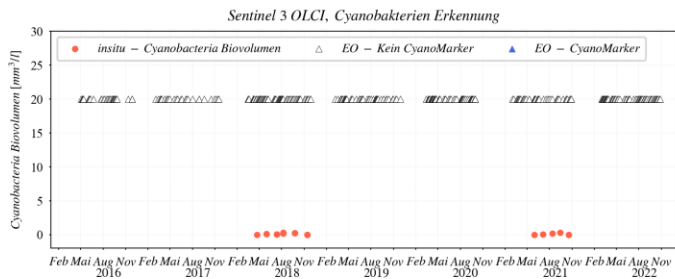
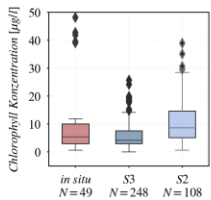
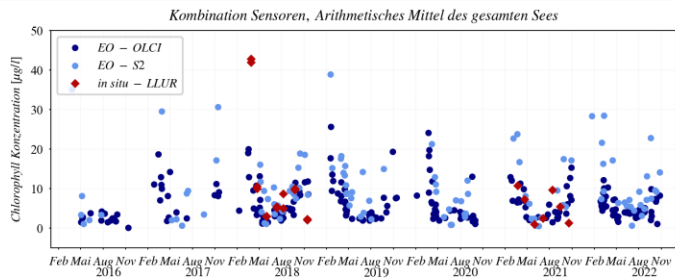


- Layer
 - Wasserkörper_SH_Trophie_sortiert_noBR_WGS84_v2_hyperlinks
 - Grundkarte
 - Weltweite Bilddaten

Großer Ratzeburger See

Max. valide Pixel	
Sentinel 3 OLCI	Sentinel 2 MSI
140	31907

Datenverfügbarkeit	
Year	Valid Overflights
2022	3
2021	2
2020	1
2019	1
2018	1
2017	1
2016	1



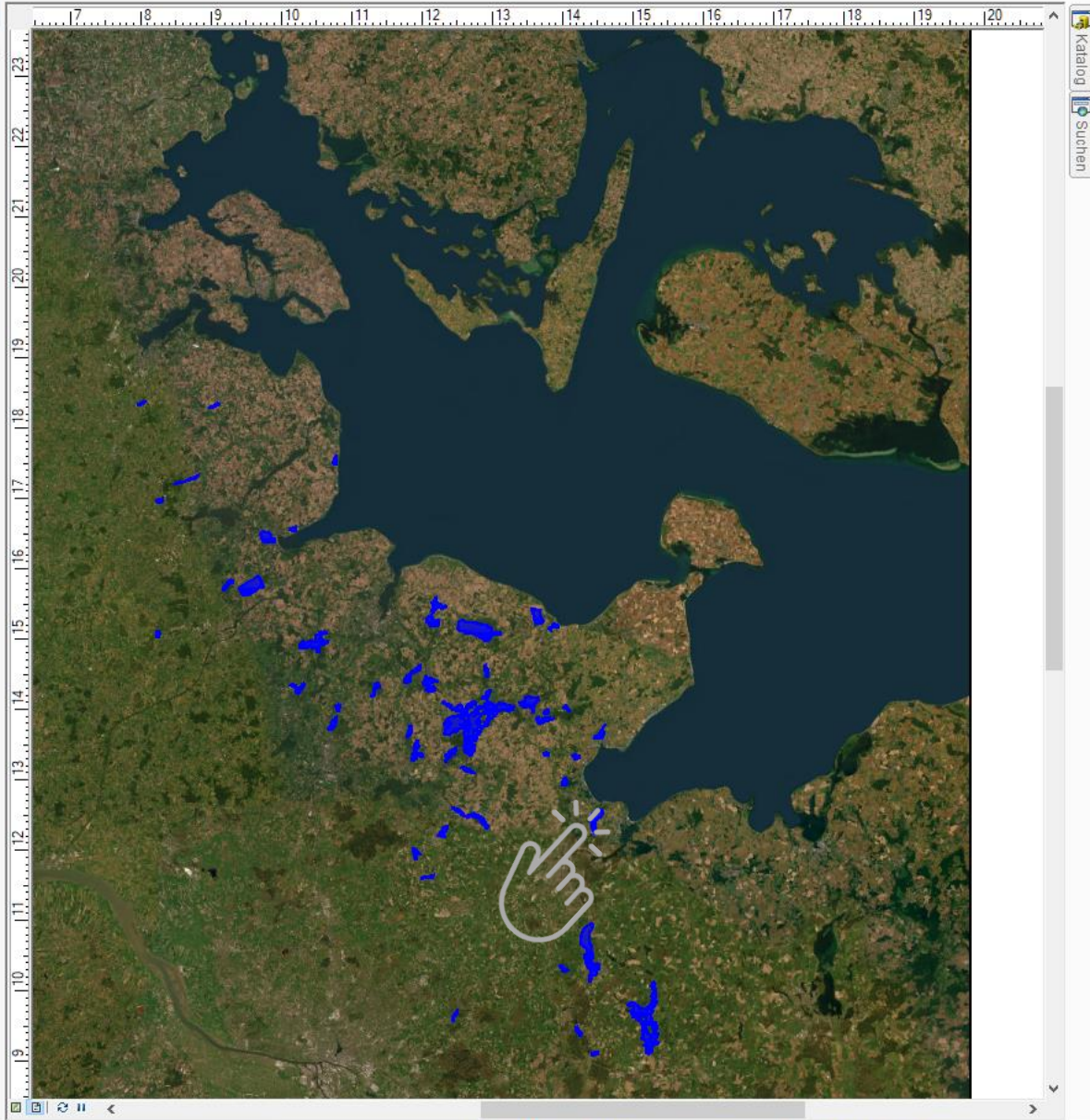
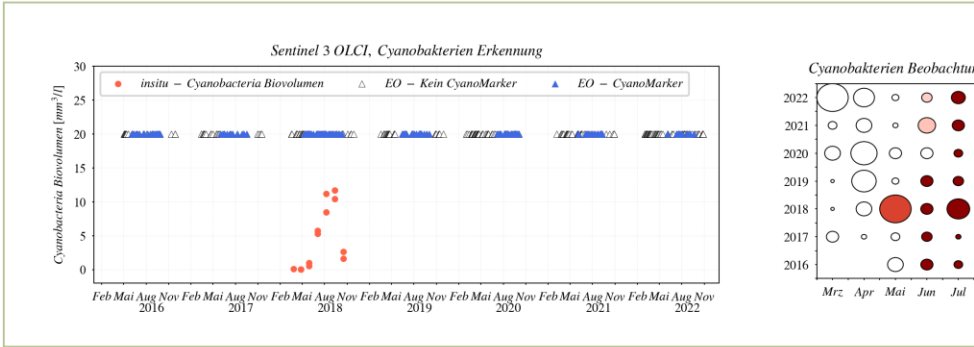
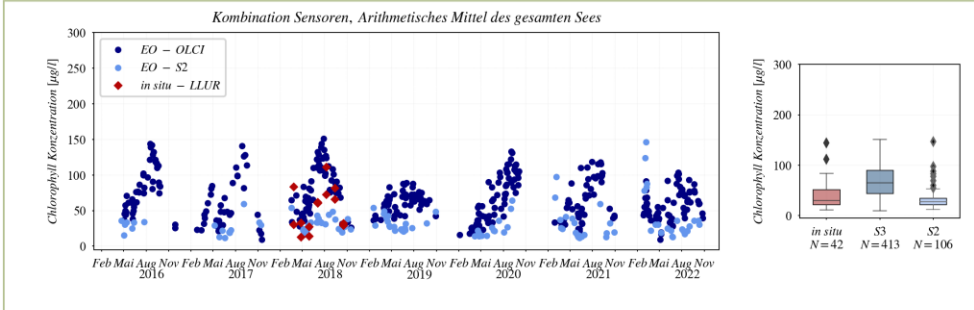
- Layer
- Wasserkörper_SH_Trophie_sortiert_noBR_WGS84_v2_hyperlinks
- Grundkarte
- Weltweite Bilddaten

Hemmelsdorfer See

Max. valide Pixel	
Sentinel 3 OLCI	Sentinel 2 MSI
52	10806

Datenverfügbarkeit	
Year	Valid Overflights
2022	3
2021	3
2020	3
2019	3
2018	3
2017	3
2016	3

Valid Pixel Gesamt
 S3 S2
 Min → Max



Alerts

- Überprüfung täglicher Chlorophyll Konzentration und Cyanobaktierenvorkommen
- Erhalt von automatischen Mails
- Mobile App
- Dashboard über Seenzustand



CyanoAlert Dashboard



Warnungen aktuell - Binnengewässer Schleswig-Holstein

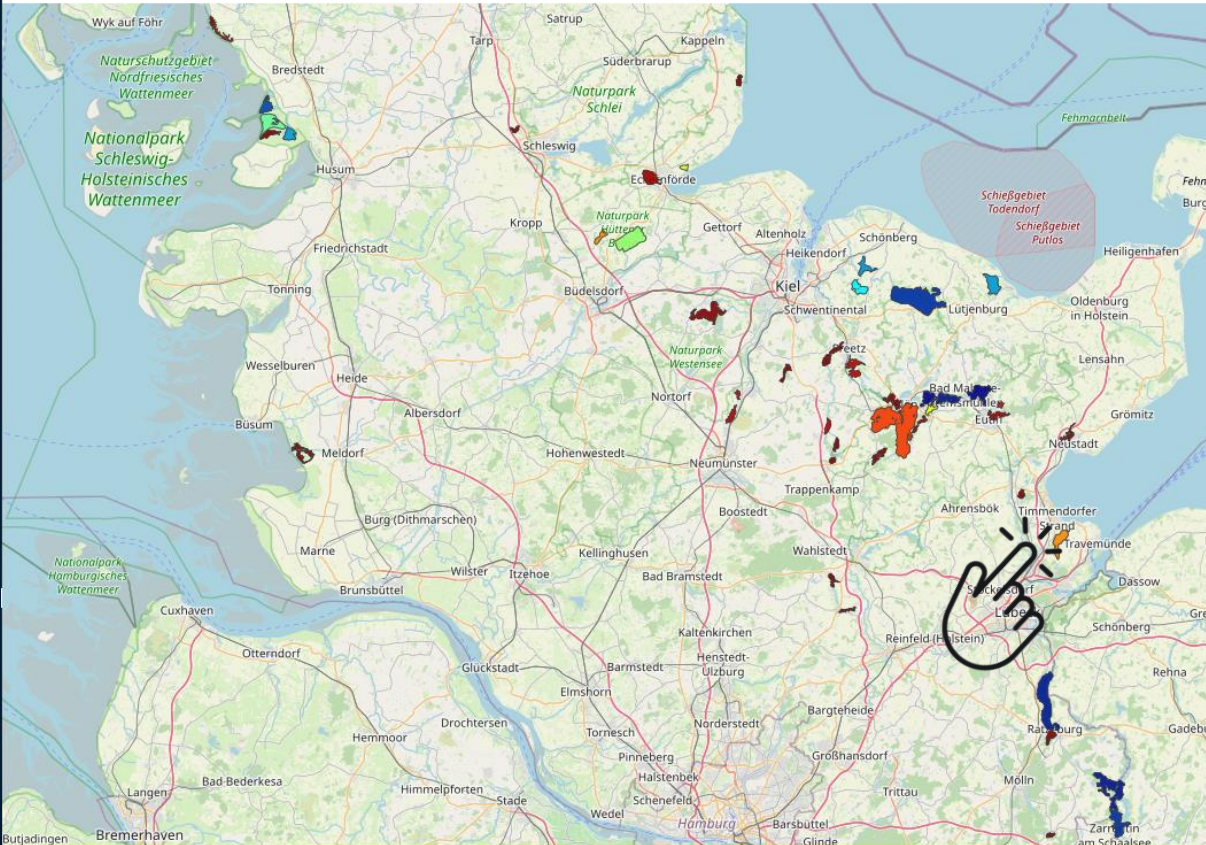


Seen

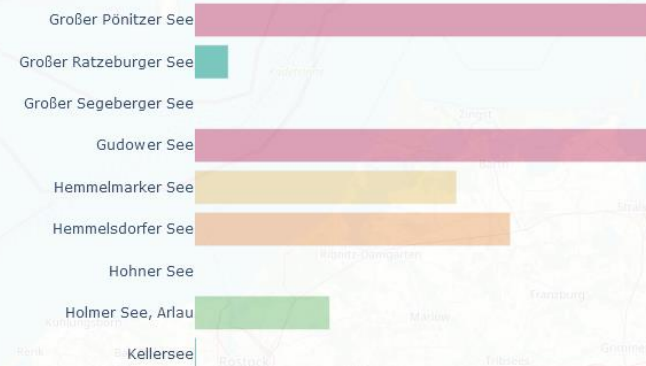
Hemmelsdorfer See

Parameter

Chlorophyll-a



Schwellenwertdistanz in [%] für Chlorophyll, 08.06.2023



Hemmelsdorfer See, seeabhängiger Schwellenwert: 51.0 [µg/L],

08.06.2023



© Brockmann Consult GmbH



CyanoAlert Dashboard



Warnungen aktuell - Binnengewässer Schleswig-Holstein

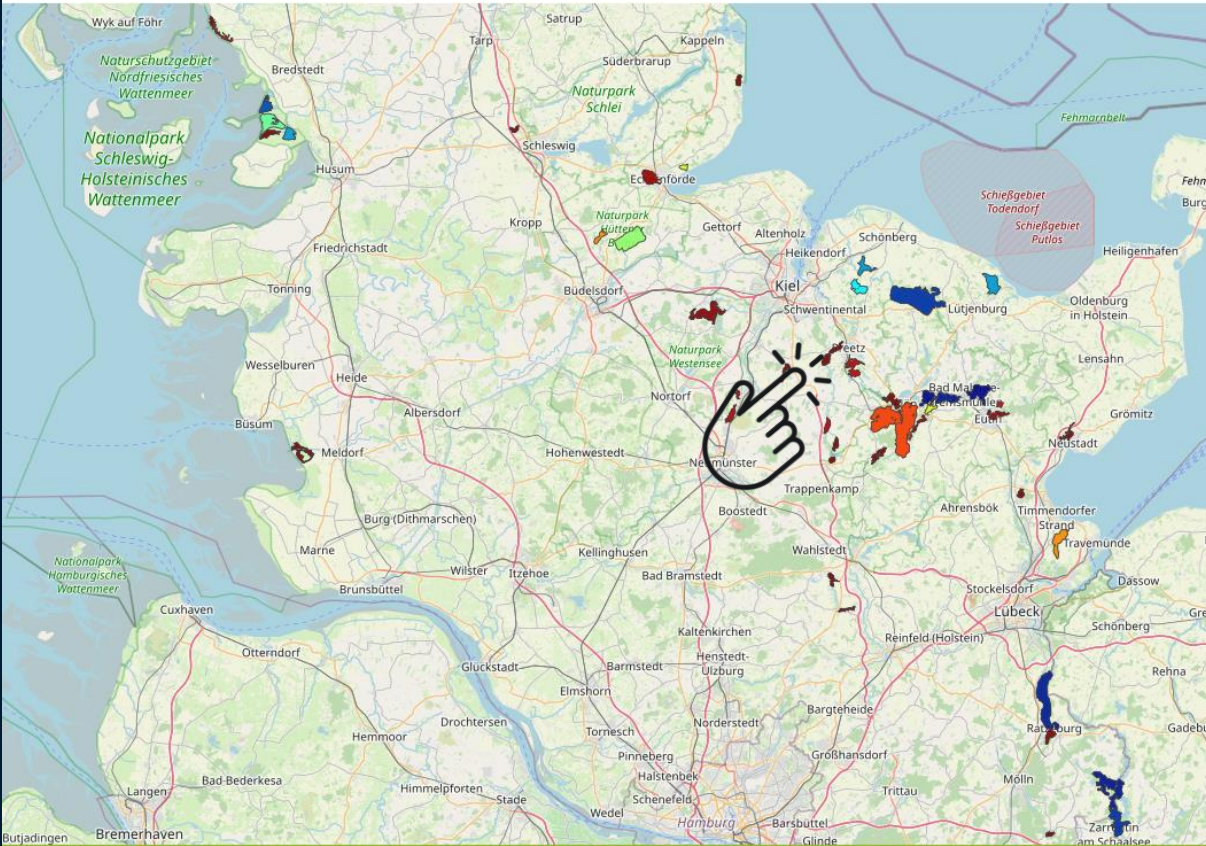


Seen

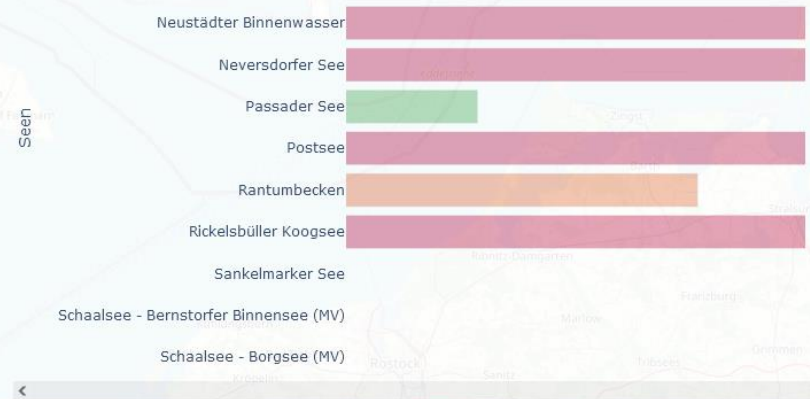
Postsee

Parameter

Chlorophyll-a



Schwellenwertdistanz in [%] für Chlorophyll, 08.06.2023



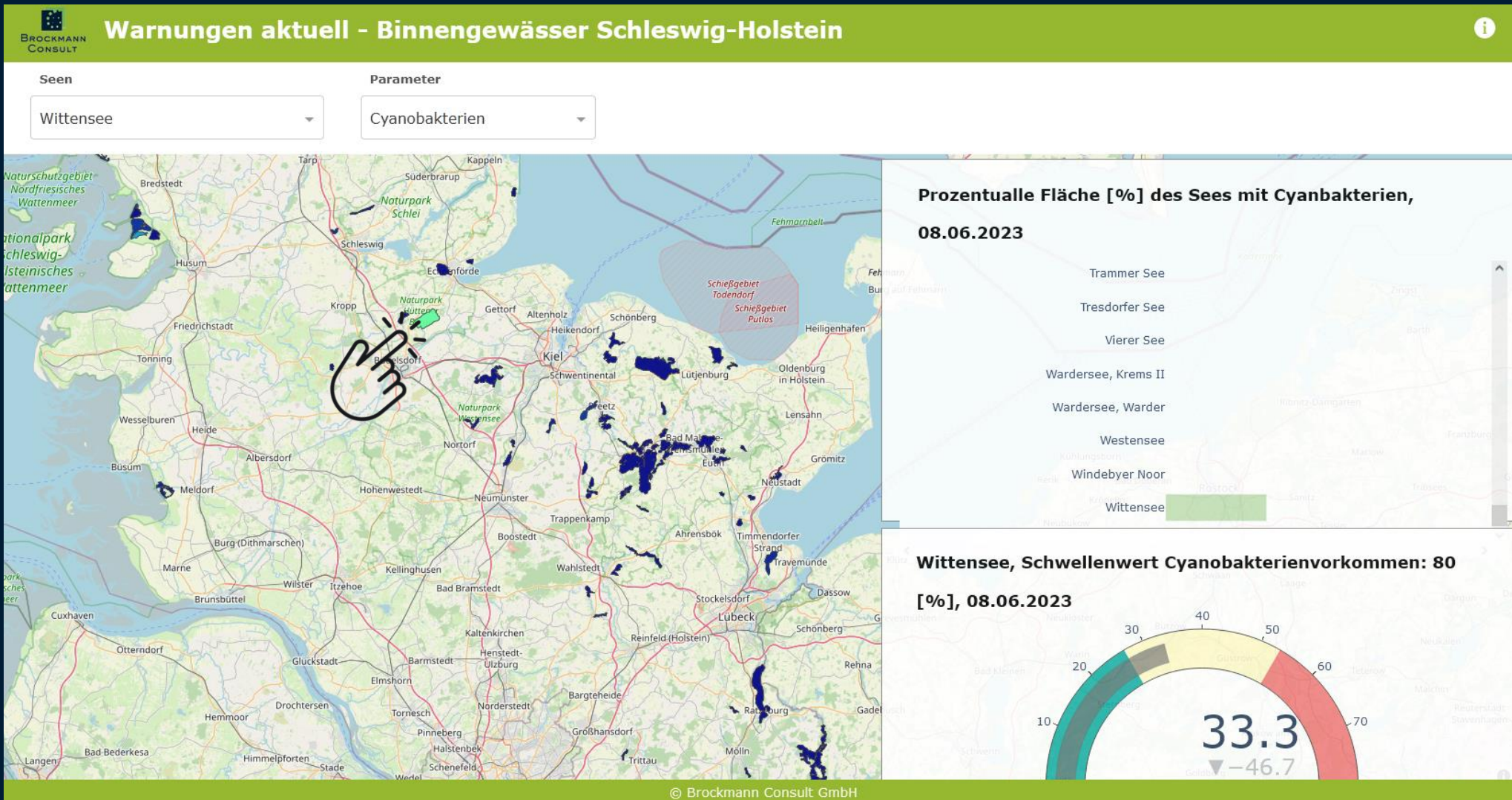
Postsee, seeabhängiger Schwellenwert: 28.0 [µg/L], 08.06.2023



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CyanoAlert Dashboard



Alert E-mails



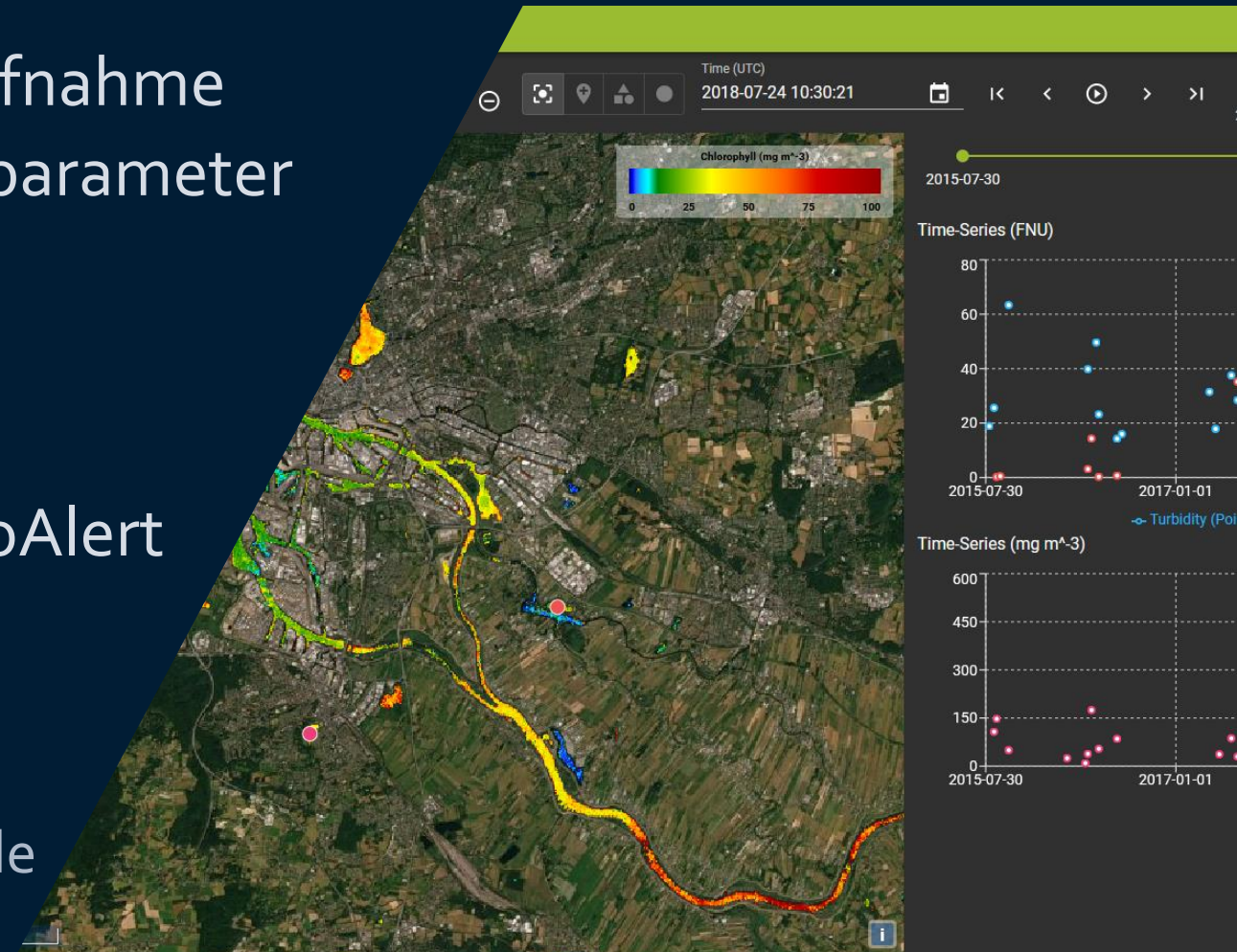
Guten Tag,
Satellitenbasierte Risikoeinschätzung für Cyanobakterienvorkommen
in den Badegewässern für den 29 Apr 2023 (im Anhang).
Mit freundlichen Grüßen,
Ihr CyanoAlert Team

	Aufnahmetag:					
	Berichtstag:					
Gewässername	Risiko für Cyanobakterien	Anzahl Risikoklasse 1	Anzahl Risikoklasse 2	Anzahl valider Pixel	Max Anzahl valider Pixel	Chlorophyll Konzentration
Allermoeher See		1	4	139	224	11.19
Alte Suederelbe		56	15	376	1497	99.69
Aussenalster		0	1	3292	4172	39.17
Aussenmuehlenteich		14	3	365	537	33.9
Binnenalster		0	0	303	435	40.66
Boberger See		0	0	6	173	1.53
Bunthaus	Risiko	116	2	272	274	39.77
Eichbaumsee		13	6	138	575	4.2
Hohendeicher See		5	0	450	1514	3.05
Neulaender See		66	41	620	1024	23.56
Oejendorfer See		11	0	738	1073	19.65
Ostender Teich		0	0	47	115	15.24
Regattastrecke		75	25	907	1670	15.51
See hinterm Horn		0	0	0	221	
Seemannshoef		0	0	152	171	15.07
Sommerbad Farmsen		0	0	3	44	10.84
Stadtparksee		9	1	103	165	46.24
Zollenspieker	Risiko	71	9	146	153	56.64



Viewer

- Darstellung von jeder einzelnen Aufnahme
 - Visualisierung der Wasserqualitätsparameter
 - Räumliche Verteilung
 - Zeitserien
- Es folgte eine Live Demo des CyanoAlert Viewers
 - für einen Eindruck kann unser Demo-viewer angesehen werden:
<https://bc-viewer.brockmann-consult.de>



Dataset: Hamburg
Variable: Chlorophyll concentration

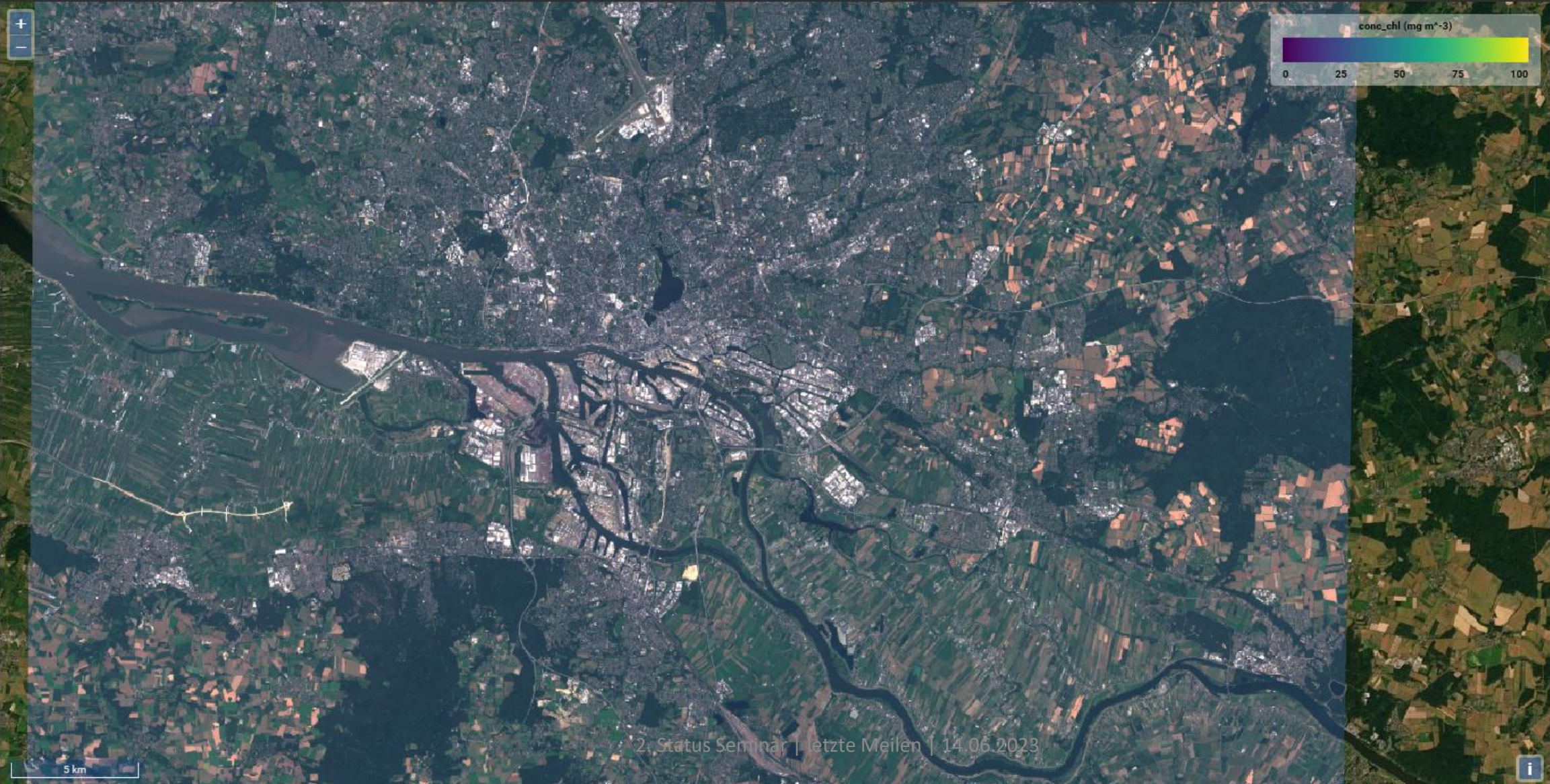
RGB [Map Controls]

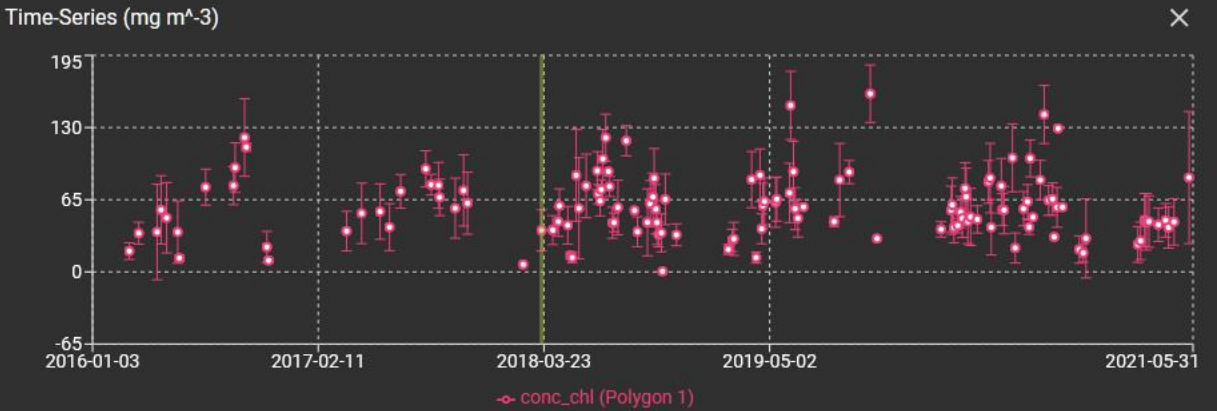
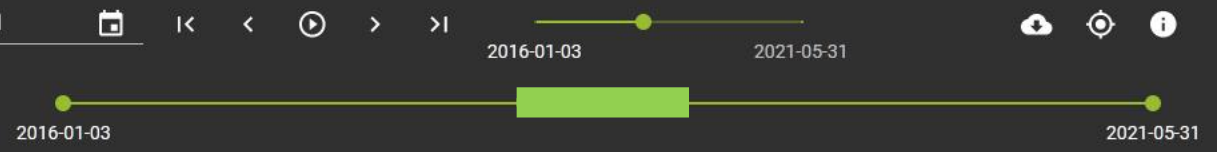
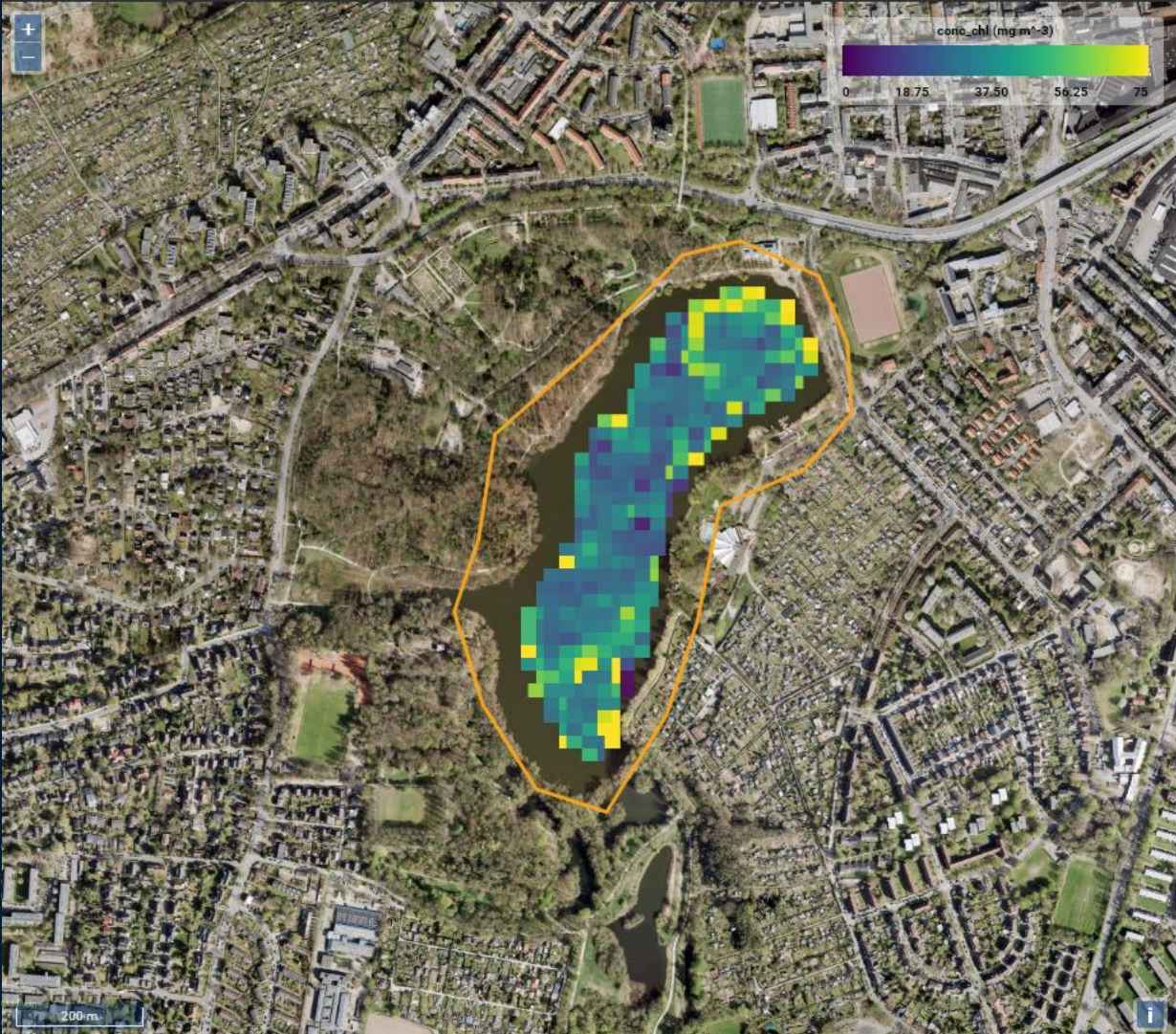
Time (UTC): 2018-07-04 10:30:21

[Calendar] [Navigation]

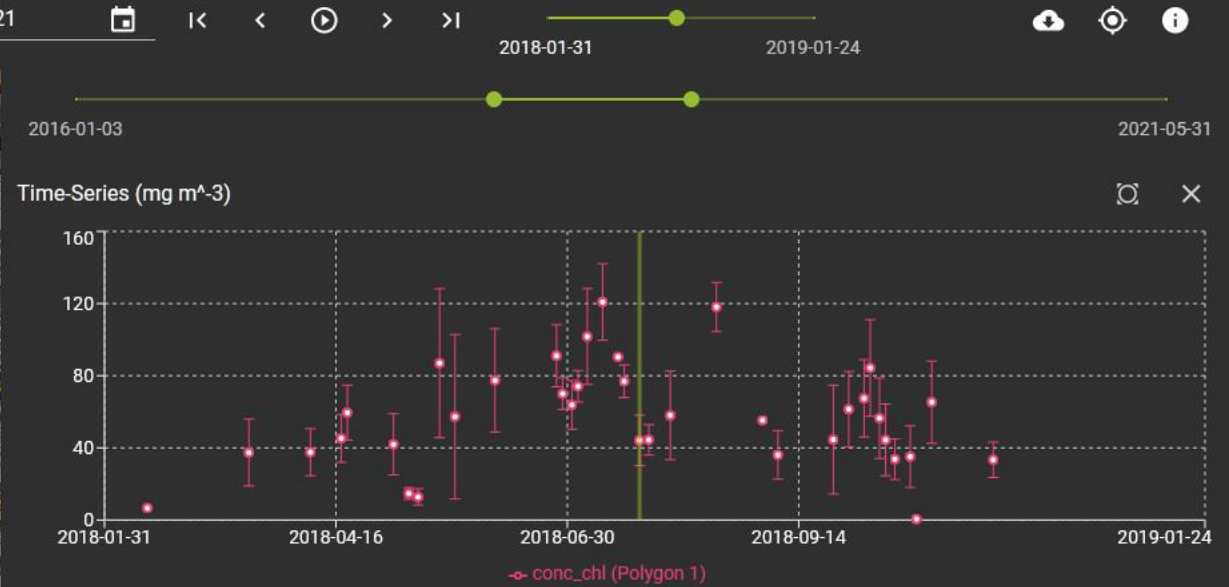
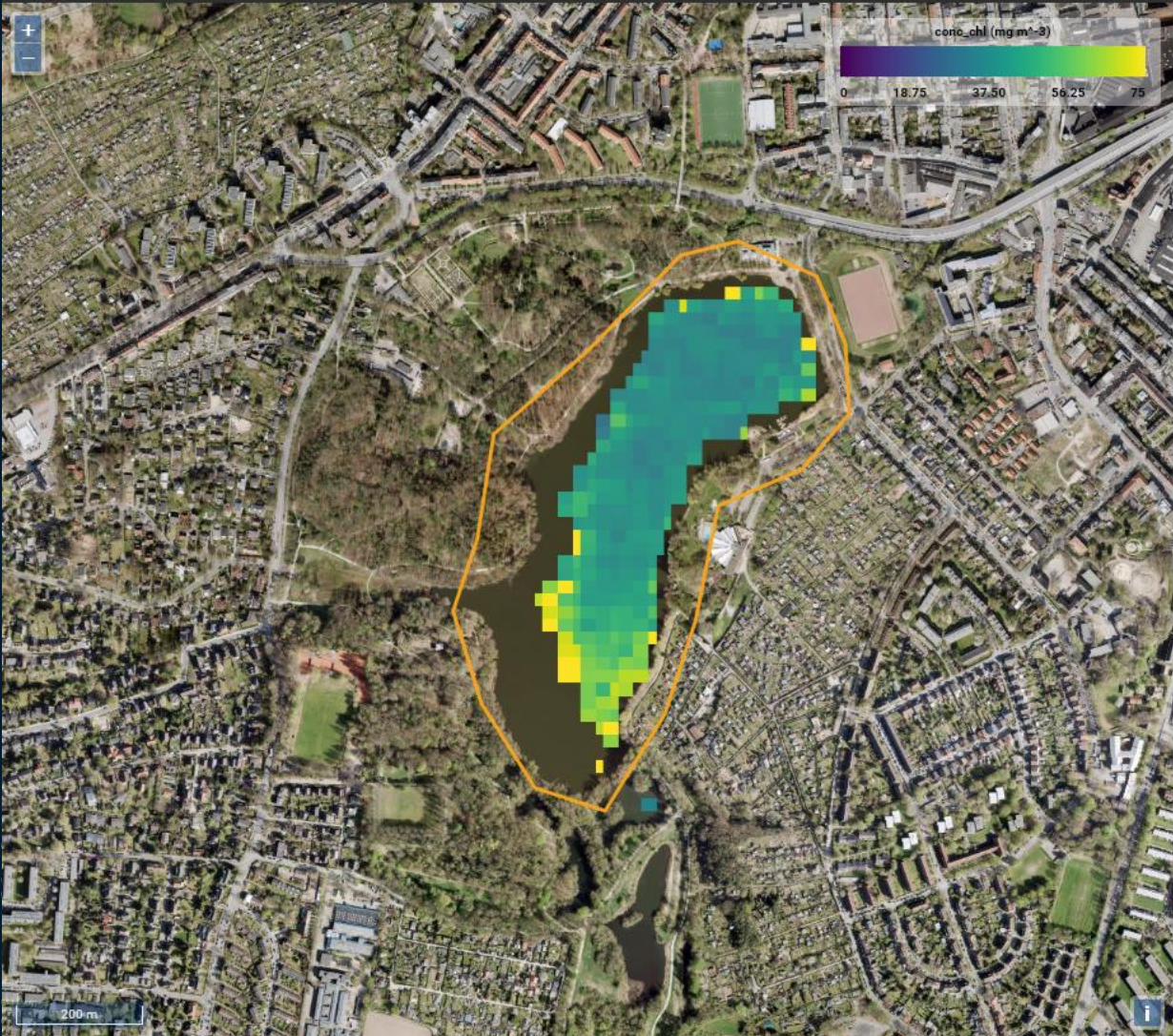
2016-01-03 to 2021-05-31

[Download] [Full Screen] [Info]



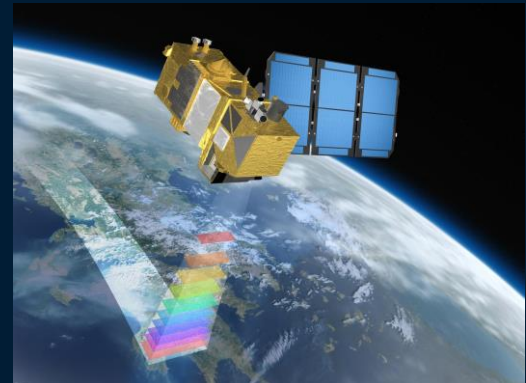
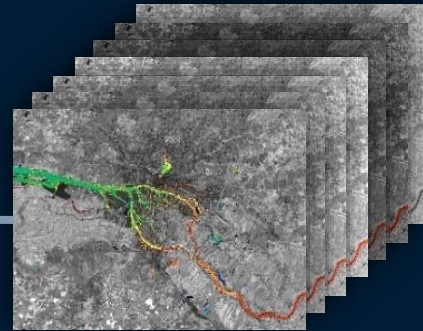


Außenmühlenteich



Außenmühlenteich

NRT Verknüpfung in-situ und Satellit



```

3) Auswahl der Messstation

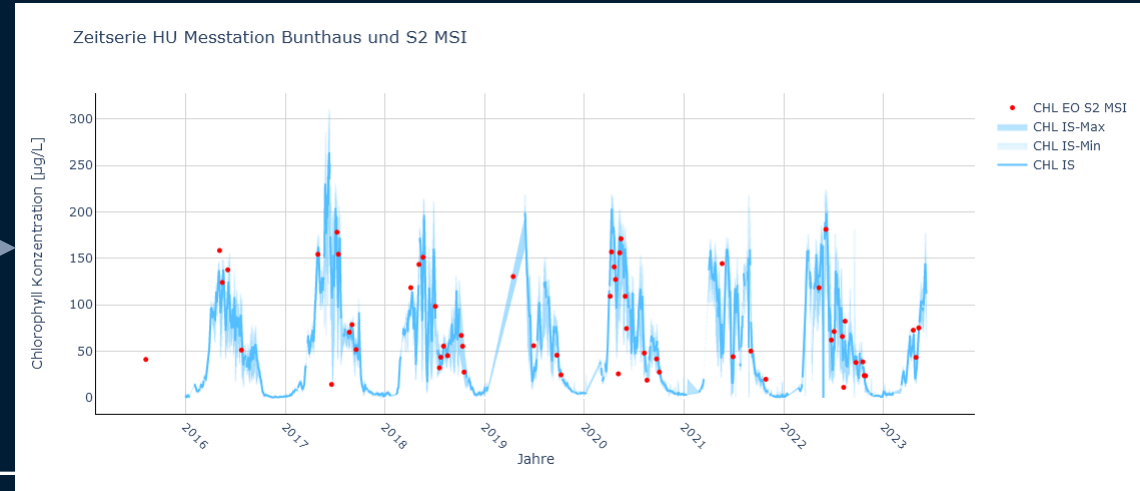
# select a station
stations = ["Lombardsbrücke", "Seemannshöft", "Bunthaus"]
station = widgets.Dropdown(options=stations, value="Lombardsbrücke", description="Station: ")
station

Station: Seemannshöft

4) Qualitätskontrolle der Daten

Der zscore jedes Pixels (3x3) wird berechnet und Pixel mit einem zscore > 1.5 werden herausgenommen.

# preparation of data
df_station, lon, lat, param_eo, label = preparation_df(station.value, parameter.value)
# get lat lon and x and y position
lat = cube.sel(lat=lat, lon=lon, method='nearest').lat.values
lon = cube.sel(lat=lat, lon=lon, method='nearest').lon.values
x = np.where(cube.lat == lat)[0].astype(int).item(0)
y = np.where(cube.lon == lon)[0].astype(int).item(0)
# select pixel area
cube_sub = cube.isel(lat=slice(x-1,x+2), lon=slice(y-1,y+2))
mean = cube_sub[param_eo].groupby('time.day').mean(['lat', 'lon'])
std = cube_sub[param_eo].groupby('time.day').std(['lat', 'lon'])
# calculate zscore and drop outliers
cube_sub['zscore'] = (abs(cube_sub[param_eo] - mean)/std)
cube_sub[param_eo]['nooutliers'] = cube_sub[param_eo].where(cube_sub.zscore < 1.5, np.nan)
ts_values = cube_sub[param_eo]['nooutliers'].groupby('time.day').mean(['lat', 'lon']).to_dataframe()
    
```



Life-Link zu den Chlorophyllmessungen

Zeitreihe Hamburg WGMN - Near Real Time

Dieses Notebook erzeugt Zeitserien für die gemessenen Daten des Gewässergütemessnetz in Hamburg und Sentinel-2 Satellitendaten. Daten können für die 3 Stationen Bunthaus, Seemannshöft and Lombardsbrücke angezeigt werden. Auf die in situ data wird direkt über einen ftp server zugegriffen, die Satellitedndaten kommen von data cubes, die täglich mit den neuesten Daten aktualisiert werden. Für die Satellitendaten werden die Daten von 3x3 Pixel um die Messstation verwendet. Dabei werden Ausreißer herausgefiltern.

1. Aufbau des Notebooks:

1. Parameter Auswahl
2. Zugang zu in-situ Daten und Fernerkundungsdaten.
3. Stationsauswahl
4. Qualitätskontrolle der Daten
5. Darstellung der Zeitserie

1) Parameter Auswahl

```
# select a parameter
parameter = ["Chlorophyll", "Trübung", "Cyanobakterien"]
parameter = widgets Dropdown(options=parameter, value="Chlorophyll", description='Parameter: ')
parameter
```

Parameter: ▼



Life-Link zu den Chlorophyllmessungen

3) Auswahl der Messstation

```
# select a station
stations = ["Lombardsbrücke", "Seemannshöft", "Bunthaus"]
station = widgets.Dropdown(options=stations, value="Lombardsbrücke", description='Station: ')
station
```

Station:

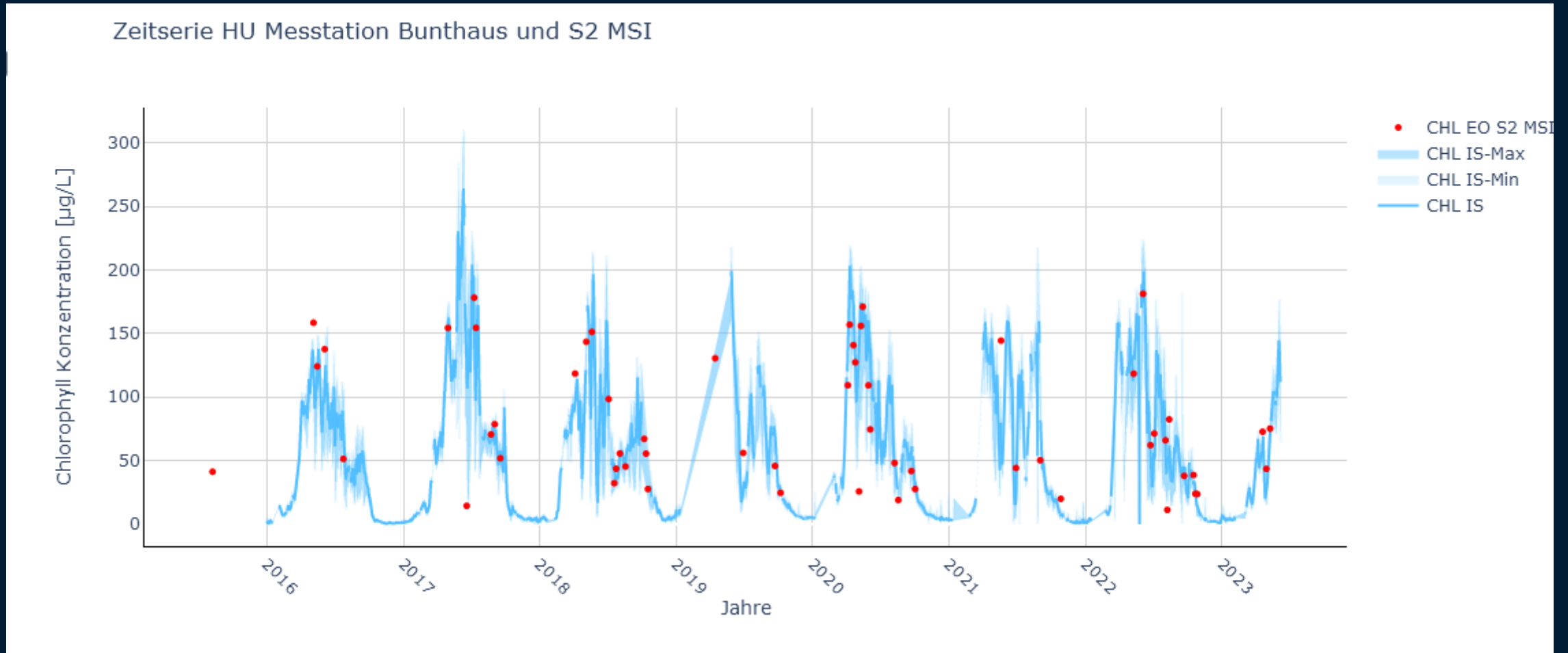
4) Qualitätskontrolle der Daten

Der zscore jedes Pixels (3x3) wird berechnet und Pixel mit einem zscore > 1.5 werden herausgenommen.

```
# preparation of data
df_station, lon, lat, param_eo, label = preparation_df(station.value, parameter.value)
# get lat lon and x and y position
lat = cube.sel(lat=lat, lon=lon, method='nearest').lat.values
lon = cube.sel(lat=lat, lon=lon, method='nearest').lon.values
x = np.where(cube.lat == lat)[0].astype(int).item(0)
y = np.where(cube.lon == lon)[0].astype(int).item(0)
# select pixel area
cube_sub = cube.isel(lat=slice(x-1,x+2), lon=slice(y-1,y+2))
mean = cube_sub[param_eo].groupby('time.day').mean(['lat', "lon"])
std = cube_sub[param_eo].groupby('time.day').std(['lat', "lon"])
# calculate zscore and drop outliers
cube_sub["zscore"] = (abs(cube_sub[param_eo] - mean)/std)
cube_sub[param_eo+'_nooutliers'] = cube_sub[param_eo].where(cube_sub.zscore < 1.5, np.nan)
ts_values = cube_sub[param_eo+'_nooutliers'].groupby('time.day').mean(['lat', "lon"]).to_dataframe()
```



Life-Link zu den Chlorophyllmessungen



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