MERIS Reprocessing

Neural Net Algorithm

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MERIS: Aufnahme der Helgoländer Bucht

MERIS FR
16.4.2003

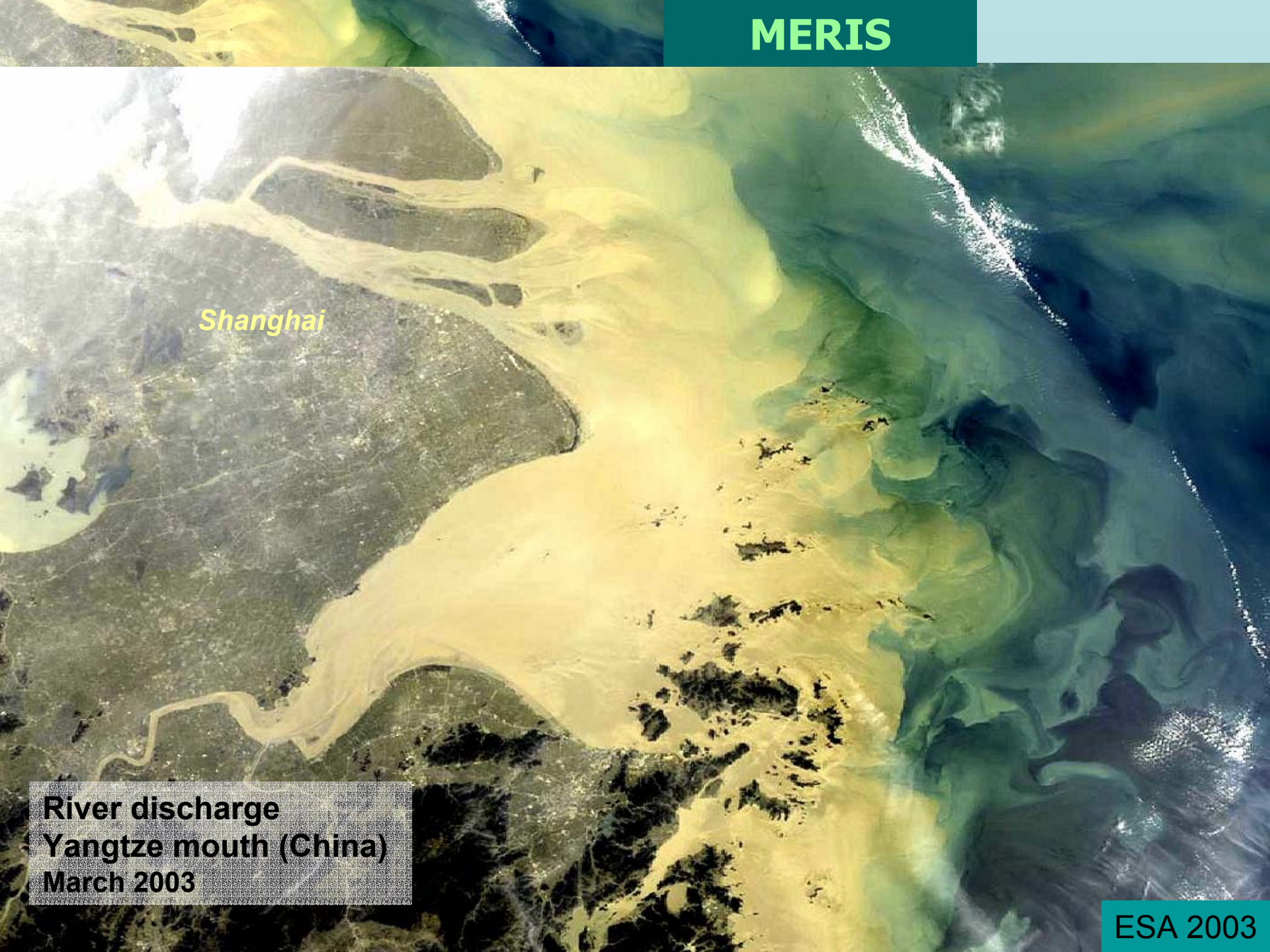
Helgoland Bight

Section
160 km

MERIS

Mouths of the Ganga
India - Bangladesh
Nov. 2003
Calcutta
ESA 2003

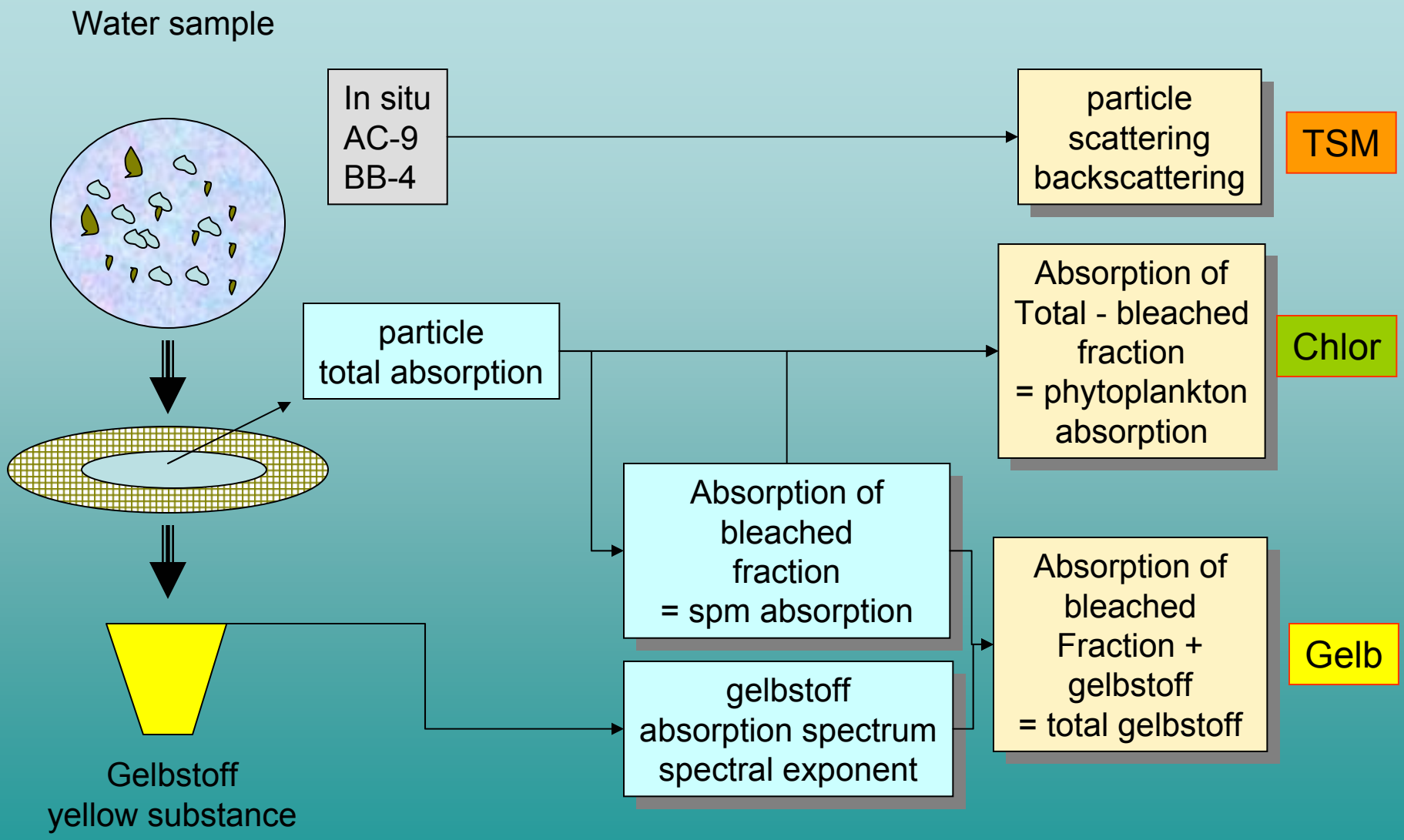
MERIS



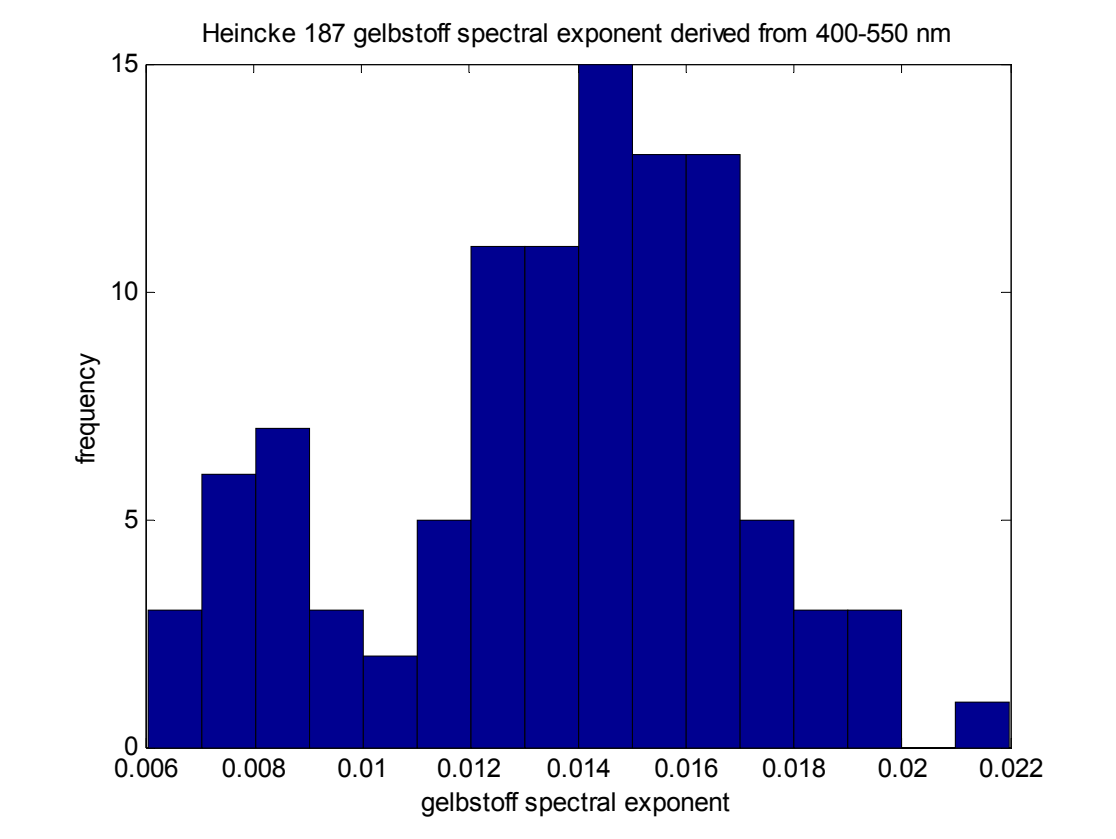
River discharge
Yangtze mouth (China)
March 2003

ESA 2003

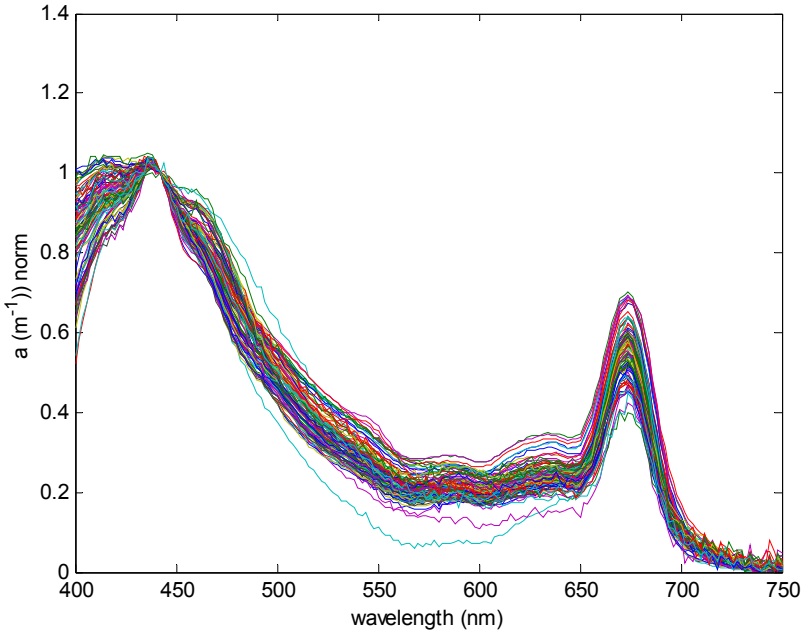
Scheme of a bio-optical model: optical components for MERIS

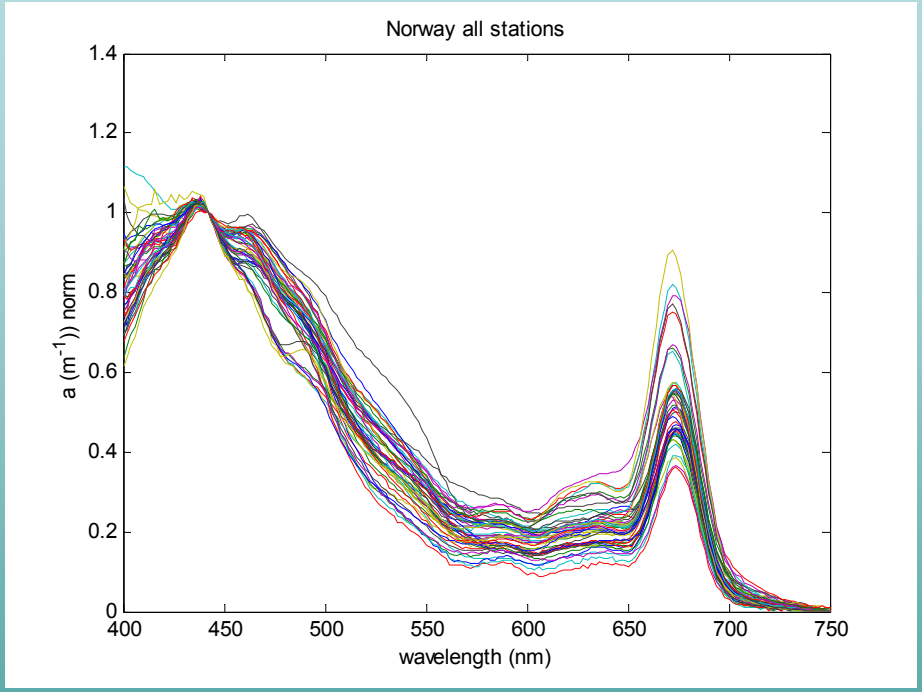


Gelbstoff absorption spectral exponent, H187

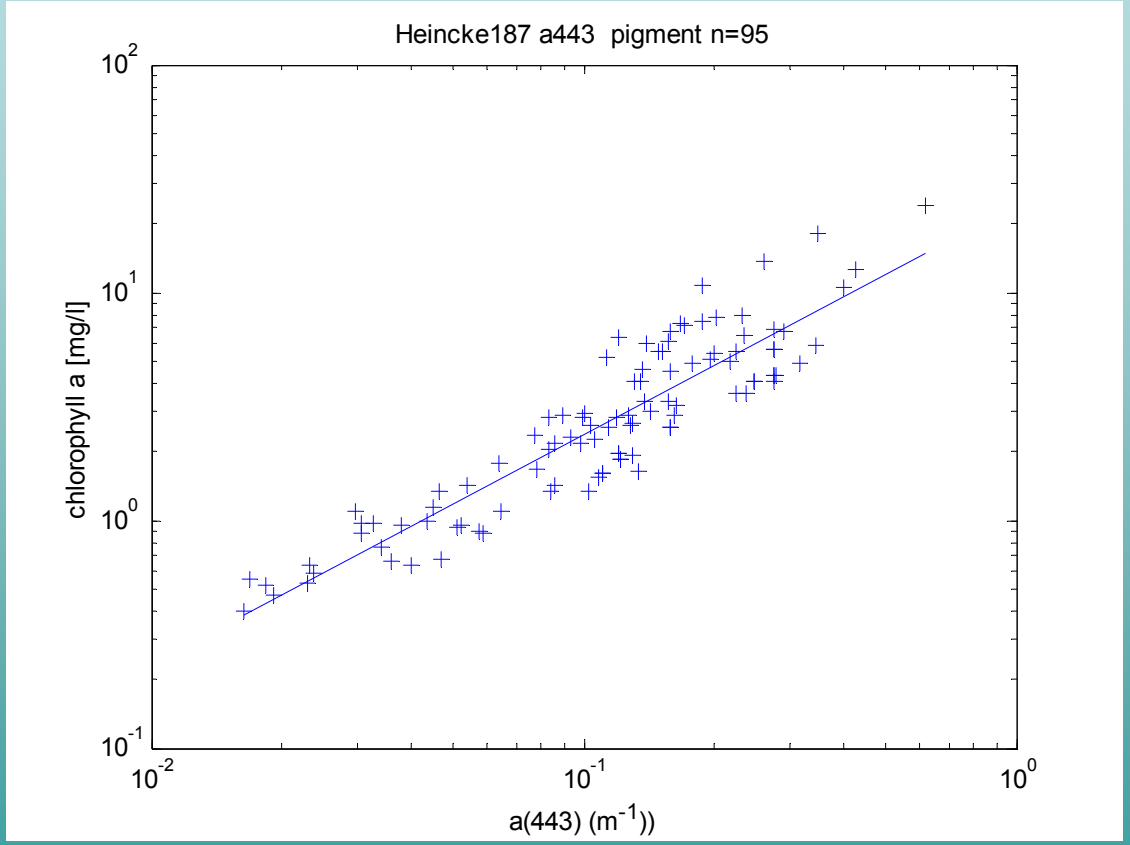


Pigment absorption spectra H187, Norway different locations

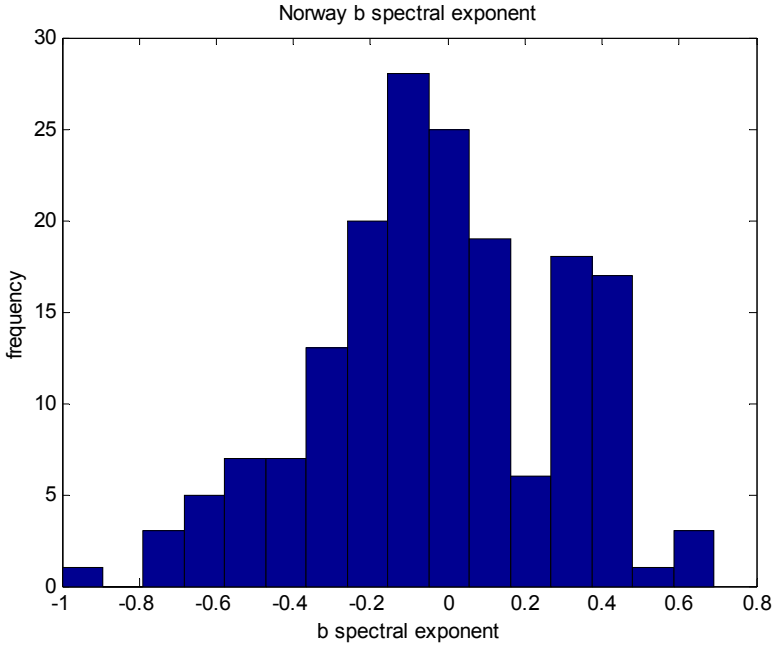


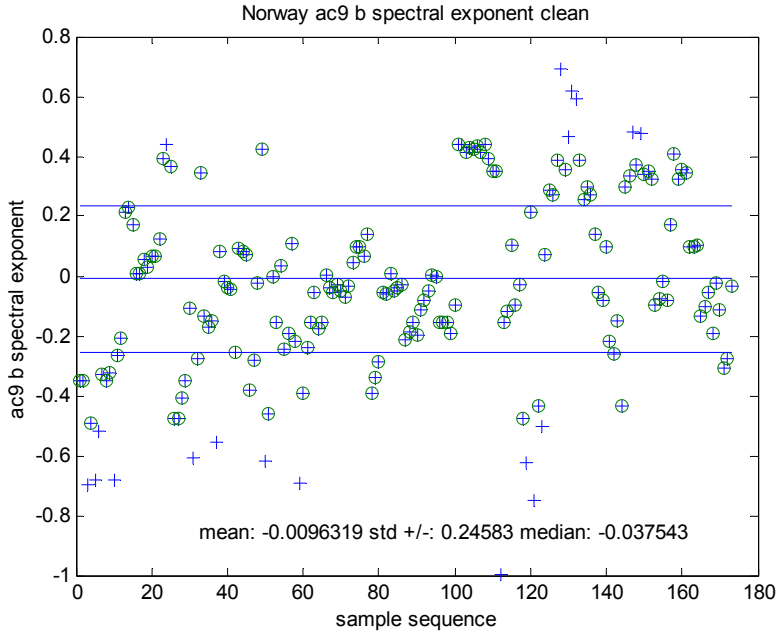


Pigment absorption – Chl. a, H187

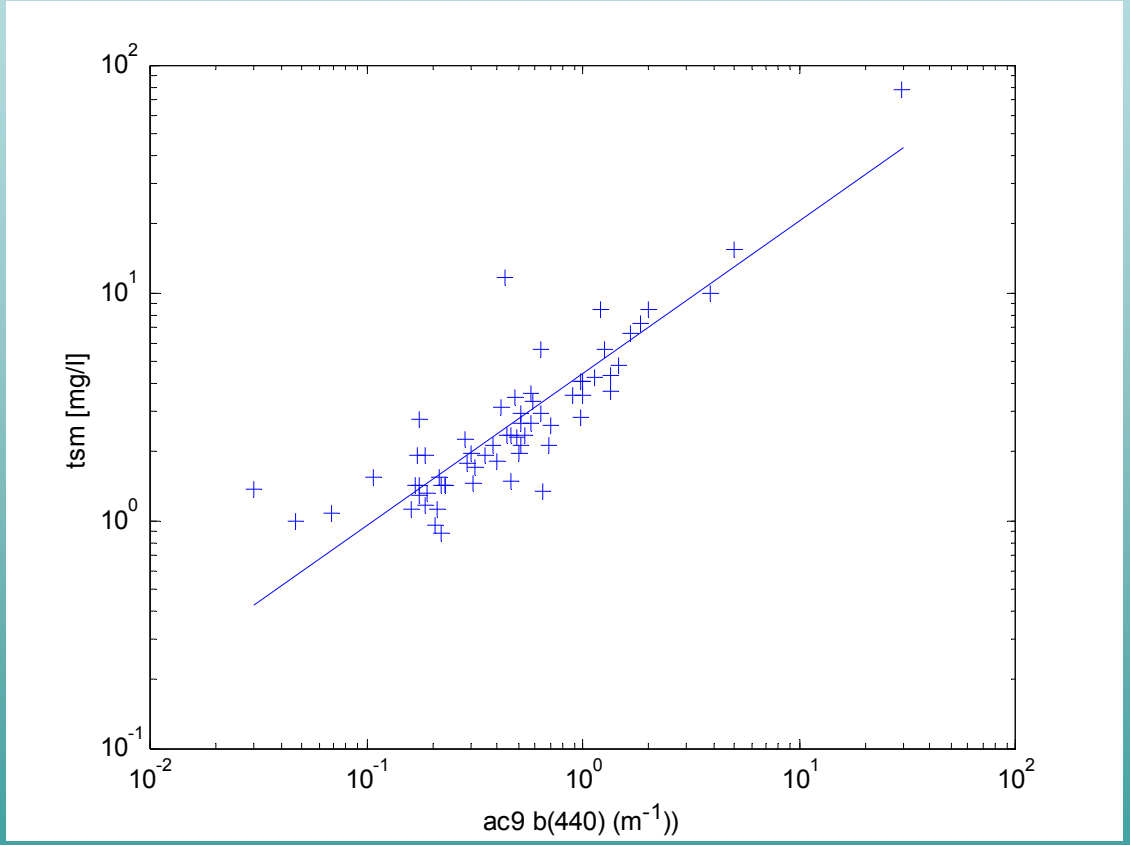


Spectral exponent particle absorption, Norway





Particle scattering,- TSM dry weight, H187



Bio-optical model

- Based on: MAVT North Sea / German Bight (GKSS), Norwegian waters (NIVA, Uni Oslo, NERSC), Baltic Sea (IOW), Recommendation by M. Babin

- Gelbstoff absorption exponent: 0.014 +- 0.002
- Bleached particle absorption exponent: 0.008 +- 0.005
- Particle scattering exponent: 0.4 +- 0.2
- White particle scattering exponent: 0.0
- Phytoplankton pigment absorption: > 200 spectra from different areas and seasons

- Gelbstoff absorption ays(443): 0.005 – 5.0 m-1
- Particle scattering bp(443): 0.005 – 30.0 m-1
- White particle scattering: 0.005 – 30.0 m-1
- Phytoplankton pigment absorption apig(443): 0.001 – 2.0 m-1
- Minimum particle scattering bp(443): 0.25*a_pig(443)
- Bleached particle absorption abp(443): 0.1*bp(443)+ran_gauss*0.03*bp(443)

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Status and Improvements of neural network (case 2 water) algorithm

- Presently data for the „normal“ user are processed with the algorithms of 2002, or with the pre-launch version of the case 2 water neural network

- Main problem:
- The NN uses 8 bands (412 nm – 709 nm). In some bands reflectances after atmospheric correction had/have a relative large error and are negative, the NN was not prepared to handle this problem

- Solutions in the reproc version:
  - If the reflectance of a MERIS band is below 0.003 the reflectance is set to this value and the NN is trained in the same way (with simulated reflectances)
  - Alternative: input to the net is not the log of the reflectance but the reflectance directly. By this low reflectances have less weight in the NN. The NN algorithm is more robust but less sensitive.

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Status and Improvements neural network (case 2 water) algorithm

- Further improvements:
  - yellow substance now coded in the 8bit word from the logarithmic scale (was linear), now shows details also in case 1 waters (where it was constant)
  - The bio-optical model used for Hydrolight to produce the directional water leaving radiance reflectances for training of the NN is now based on a much larger data set of different validation cruises (MAVT), however mainly North Sea, North Atlantik, Baltic Sea.
  - A white scatterer was introduced into the bio-optical model for the concentrations of coccolithophoride blooms

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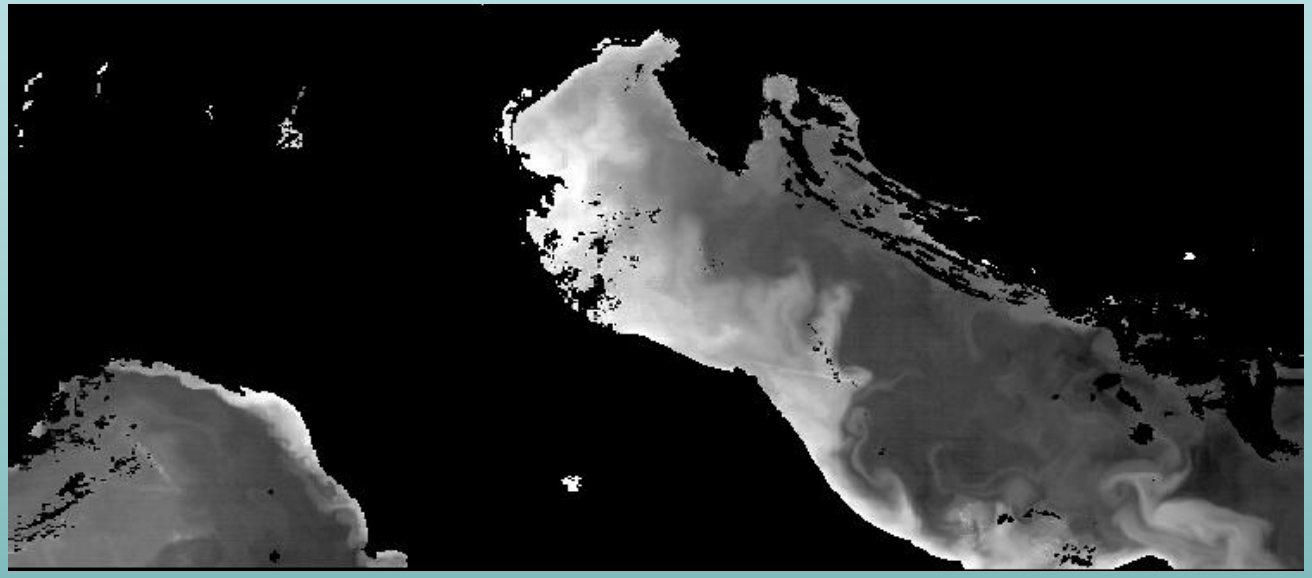
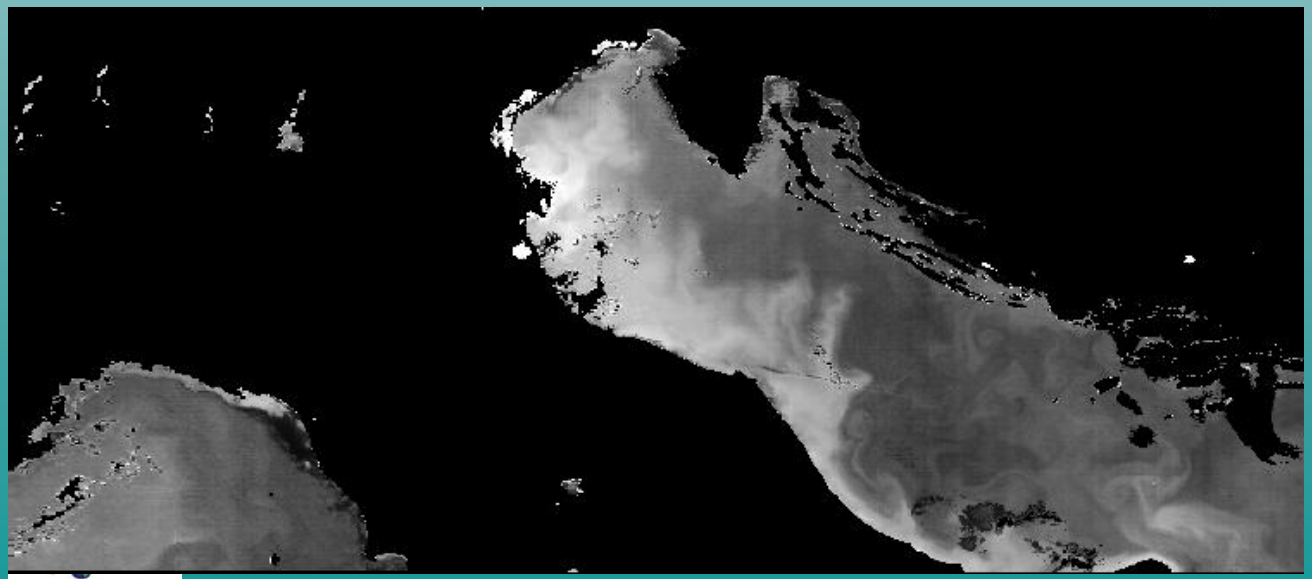
Comparison Case 1 / Case 2 Water Algorithm for Pigment



Adriatic Sea,
May 3, 2002

Algal_1



Algal_2

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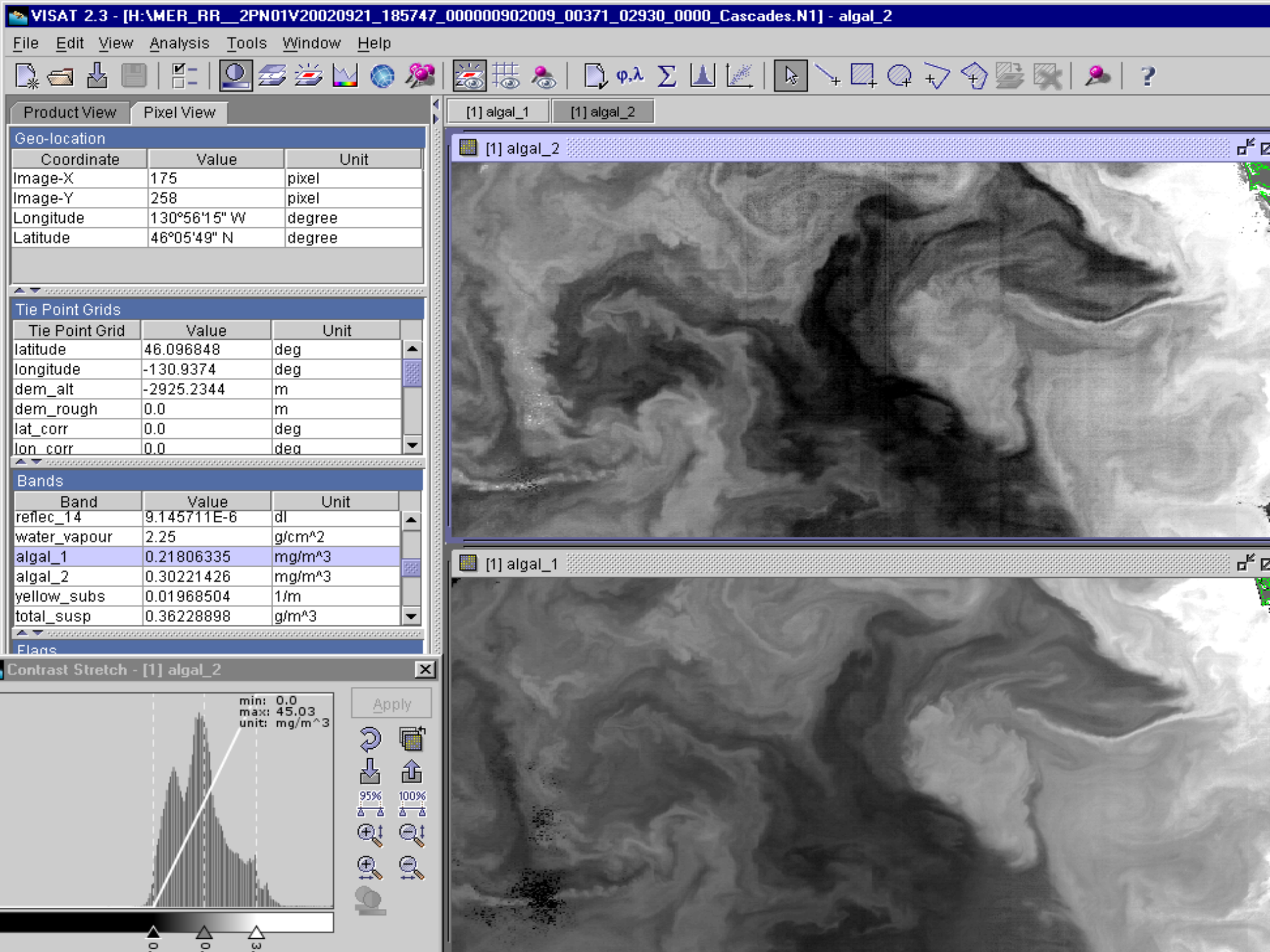
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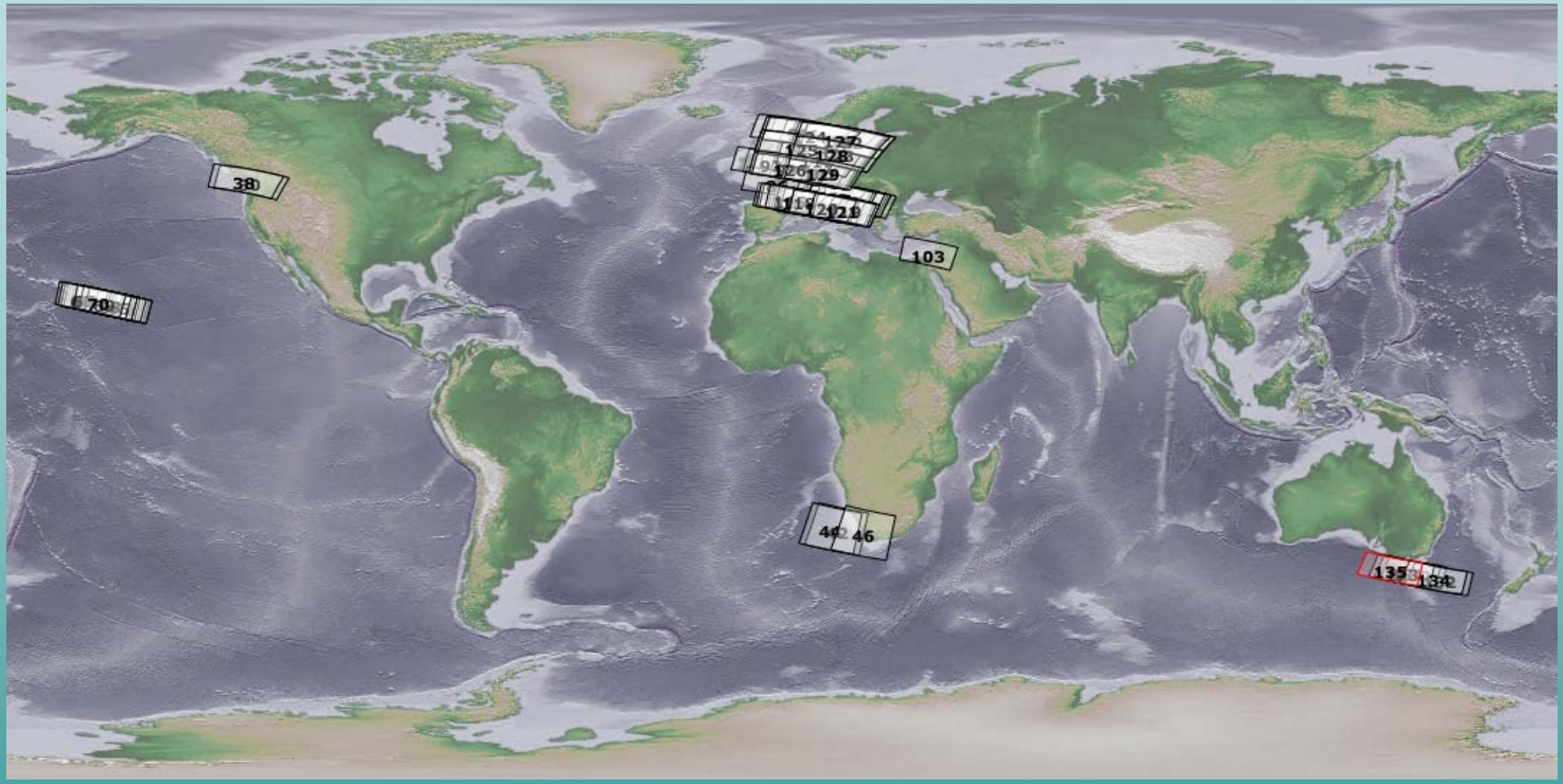
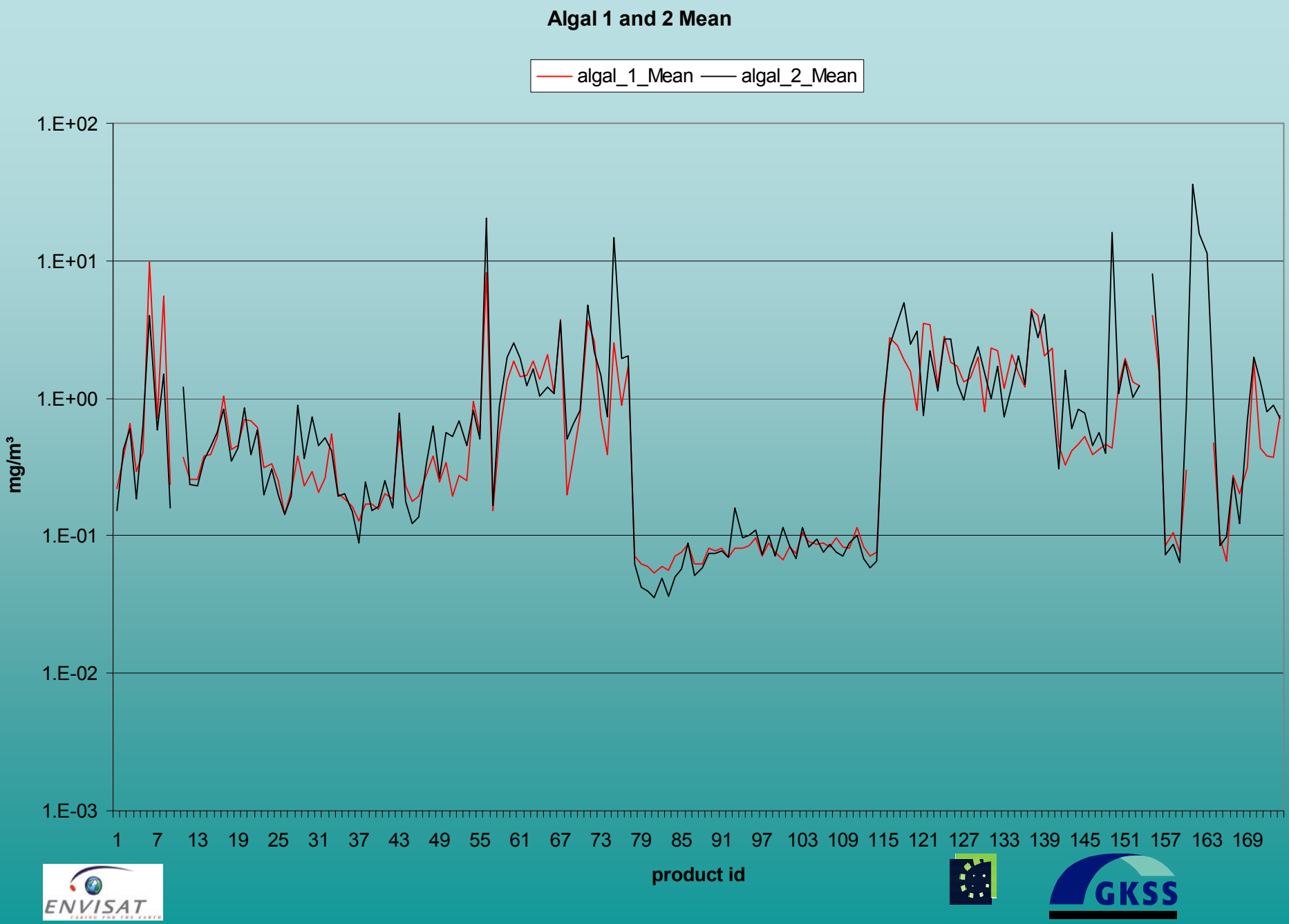
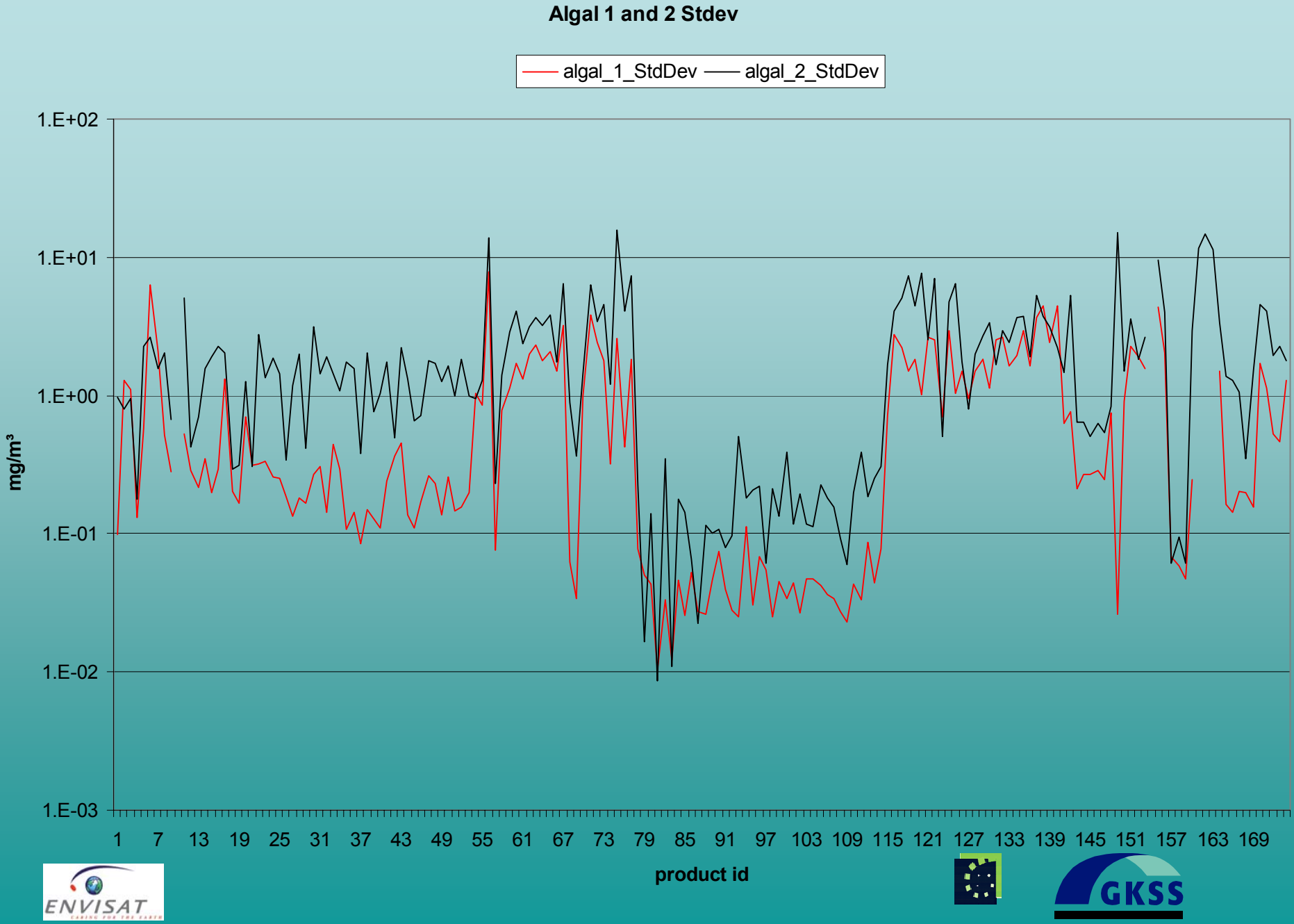
File Edit View Analysis Tools Window Help
Product View
Pixel View
Geo-location
Coordinate Value Unit
Image-X 175 pixel
Image-Y 258 pixel
Longitude 130°56'15" W degree
Latitude 46°05'49" N degree
Tie Point Grids
Tie Point Grid Value Unit
latitude 46.096848 deg
longitude -130.9374 deg
dem_alt -2925.2344 m
dem_rough 0.0 m
lat_corr 0.0 deg
lon_corr 0.0 deg
Bands
Band Value Unit
reflec_14 9.145711E-6 dl
water_vapour 2.25 g/cm^2
algal_1 0.21806335 mg/m^3
algal_2 0.30221426 mg/m^3
yellow_subs 0.01968504 1/m
total_susp 0.36228898 g/m^3
Flags
Contrast Stretch - [1] algal_2
min: 0.0
max: 45.03
unit: mg/m^3
Apply
95%
100%
[1] algal_1
[1] algal_2
[1] algal_2
[1] algal_1

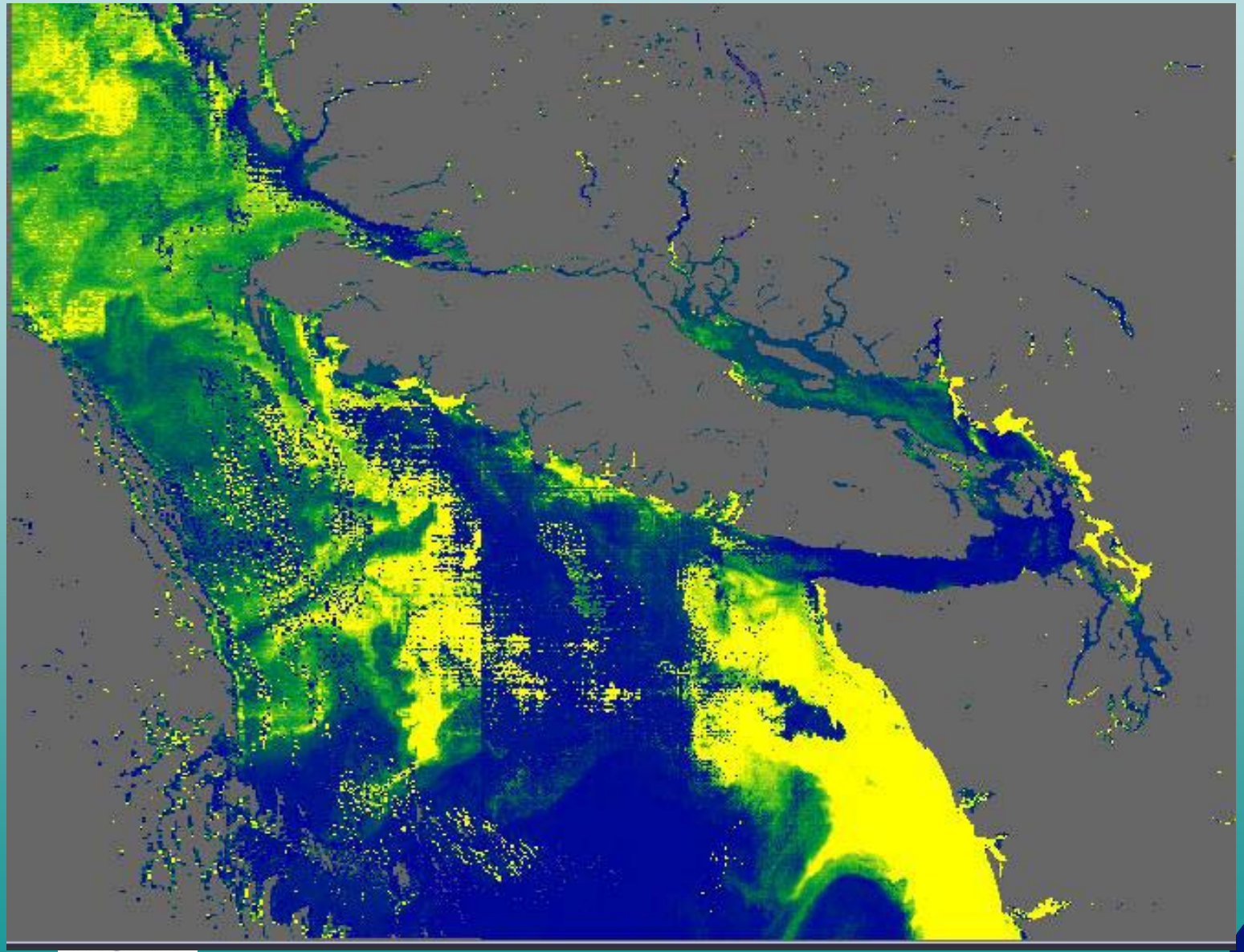
Test products: Ocean parameters




Algal 1 and 2 Mean
algal_1_Mean
algal_2_Mean
1.E+02
1.E+01
1.E+00
1.E-01
1.E-02
1.E-03
mg/m³
1 7 13 19 25 31 37 43 49 55 61 67 73 79 85 91 97 103 109 115 121 127 133 139 145 151 157 163 169
product id


Algal 1 and 2 Stdev
algal_1_StdDev
algal_2_StdDev
1.E+02
1.E+01
1.E+00
1.E-01
1.E-02
1.E-03
mg/m³
1 7 13 19 25 31 37 43 49 55 61 67 73 79 85 91 97 103 109 115 121 127 133 139 145 151 157 163 169
product id

West Canada_ferry 20020814 algal_2



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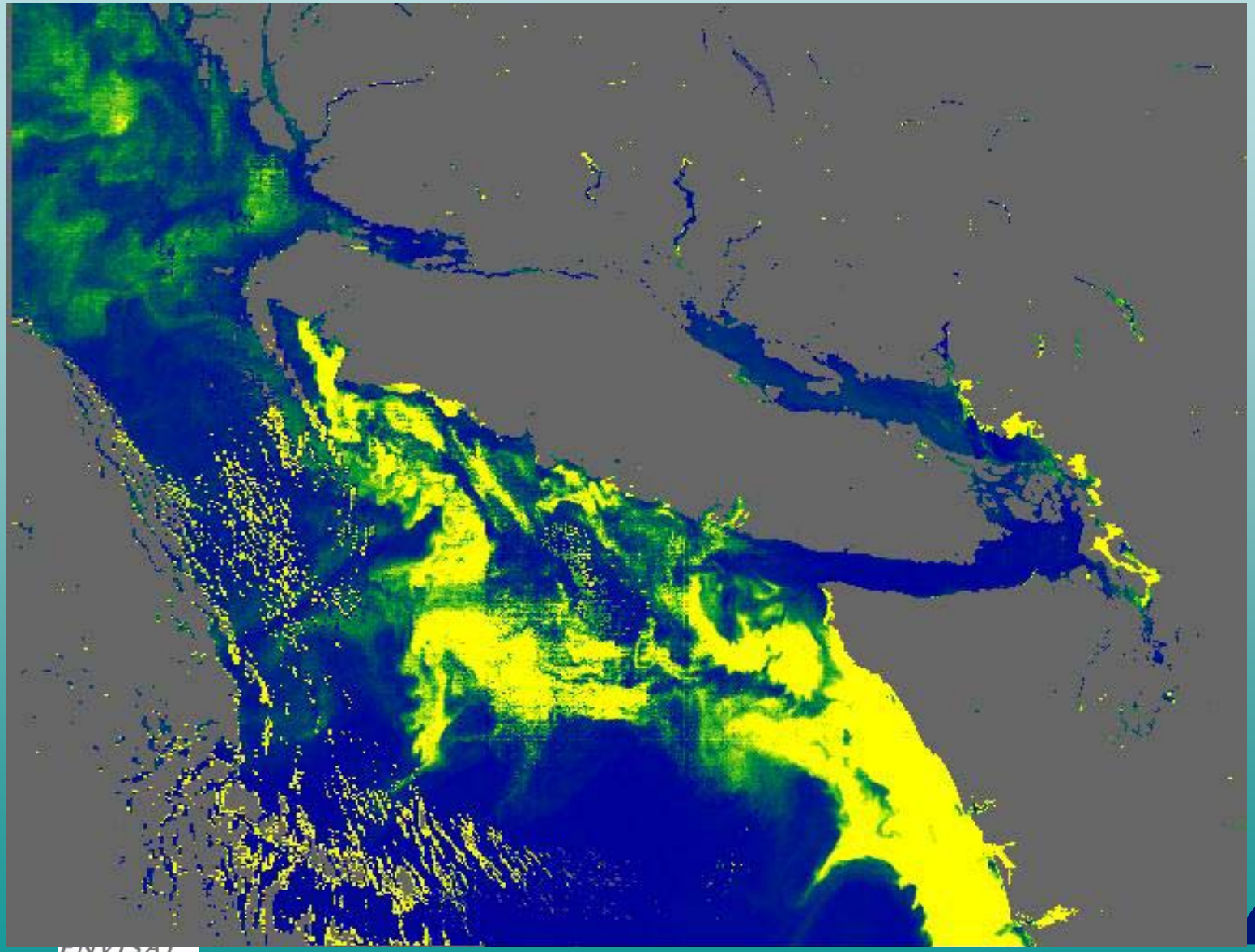
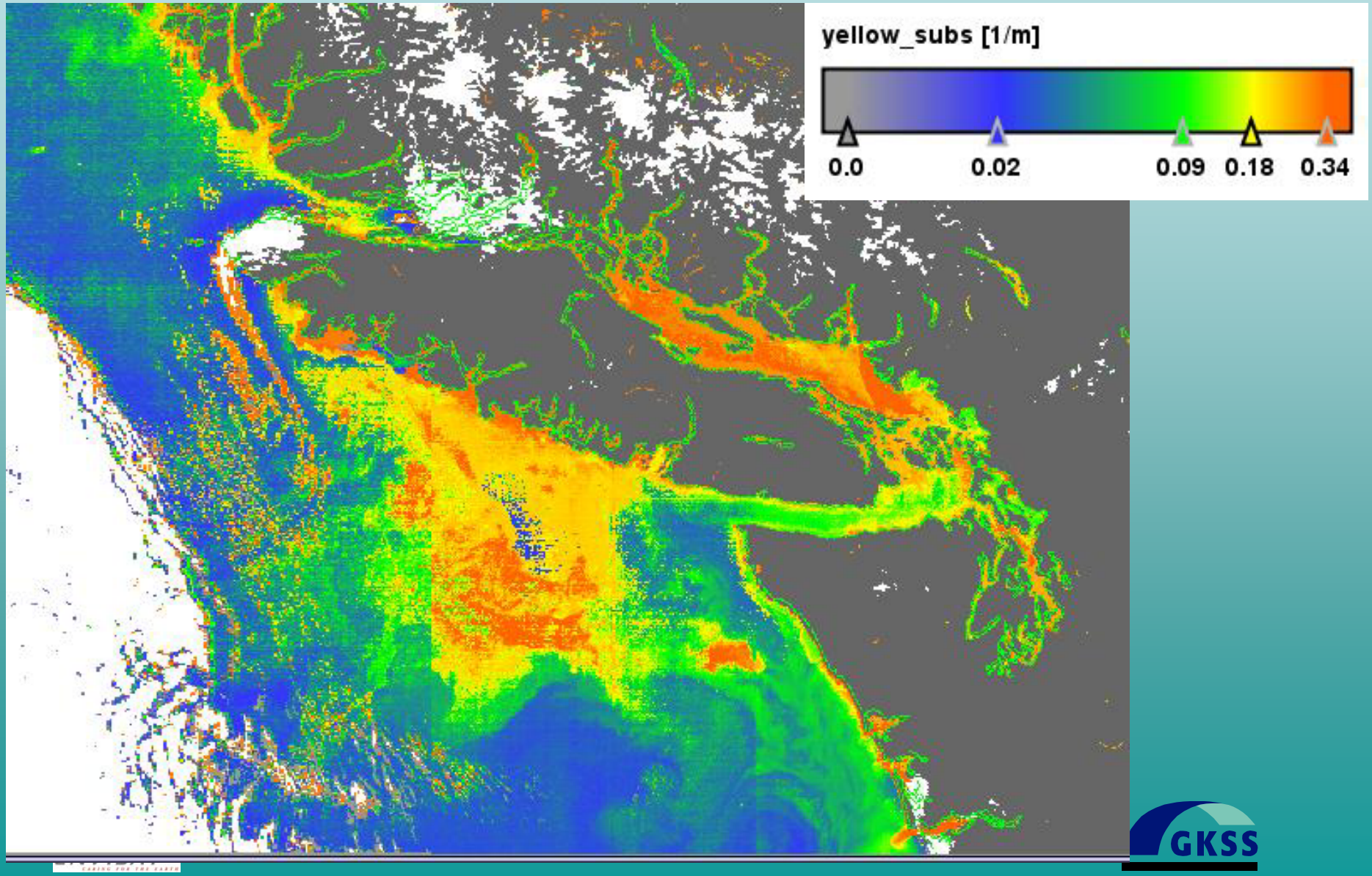
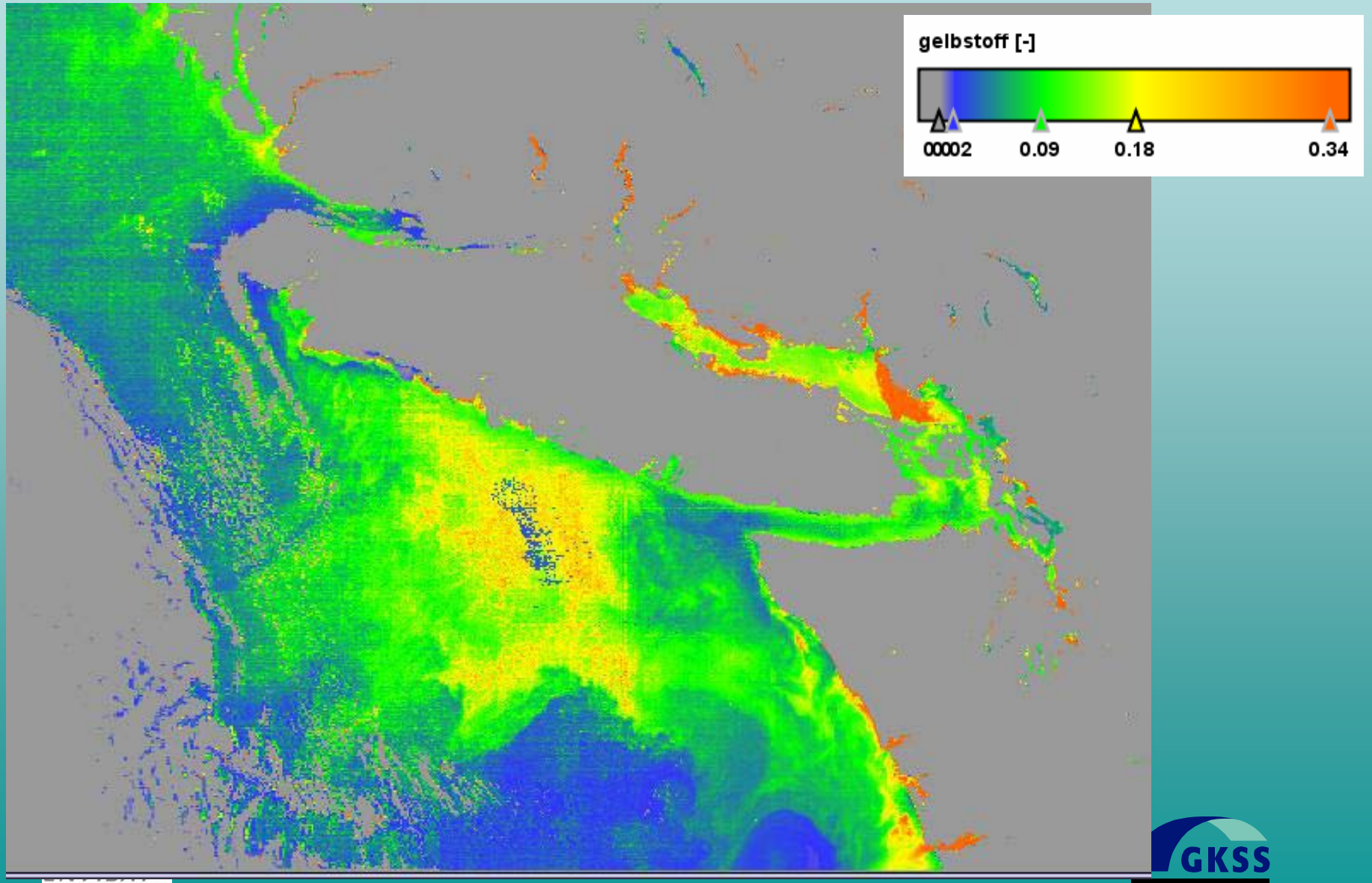
West Canda_ferry 20020814 algal_2 lin reflectance input no threshold



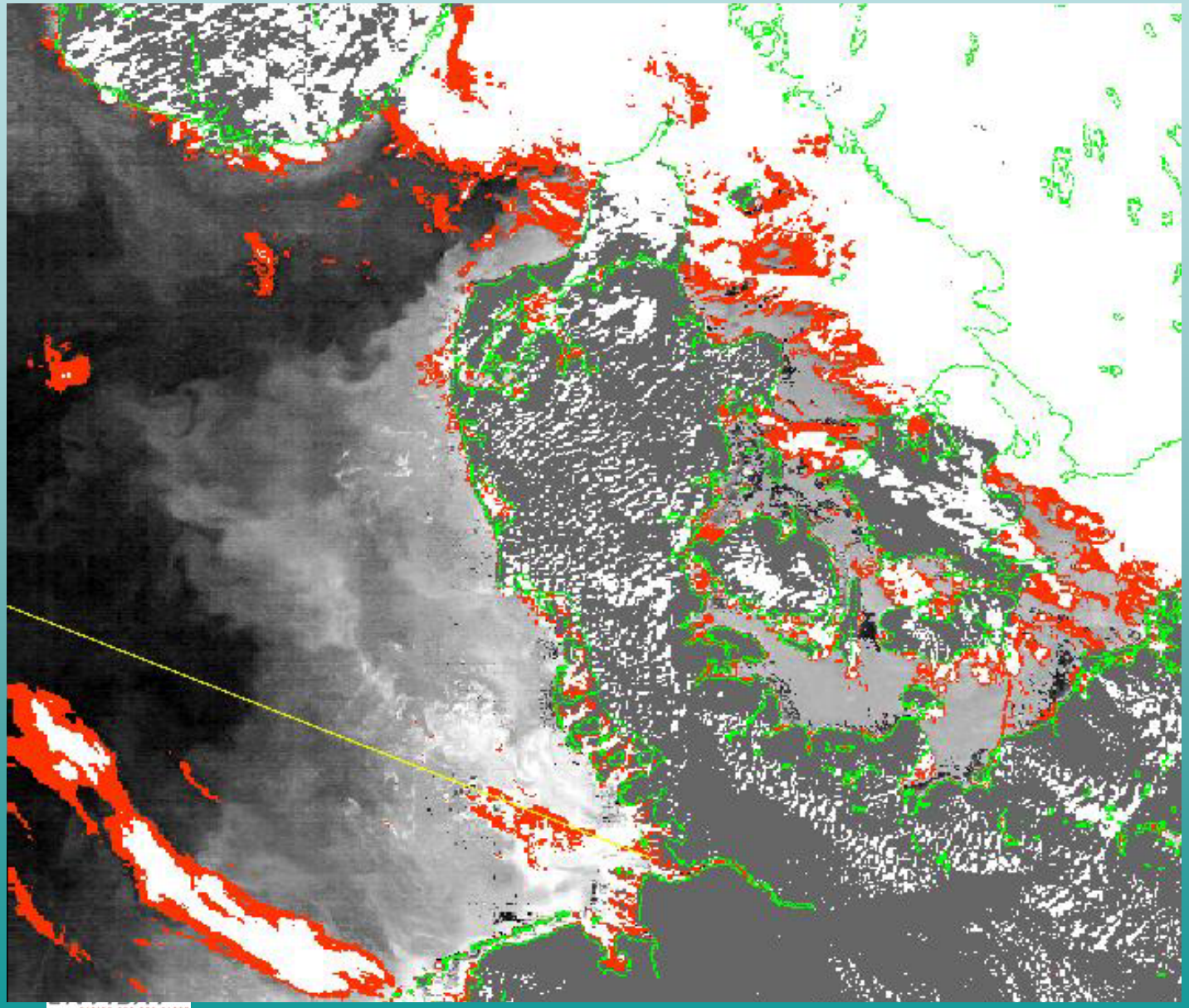
West Canda_ferry 20020814 yellow_subs



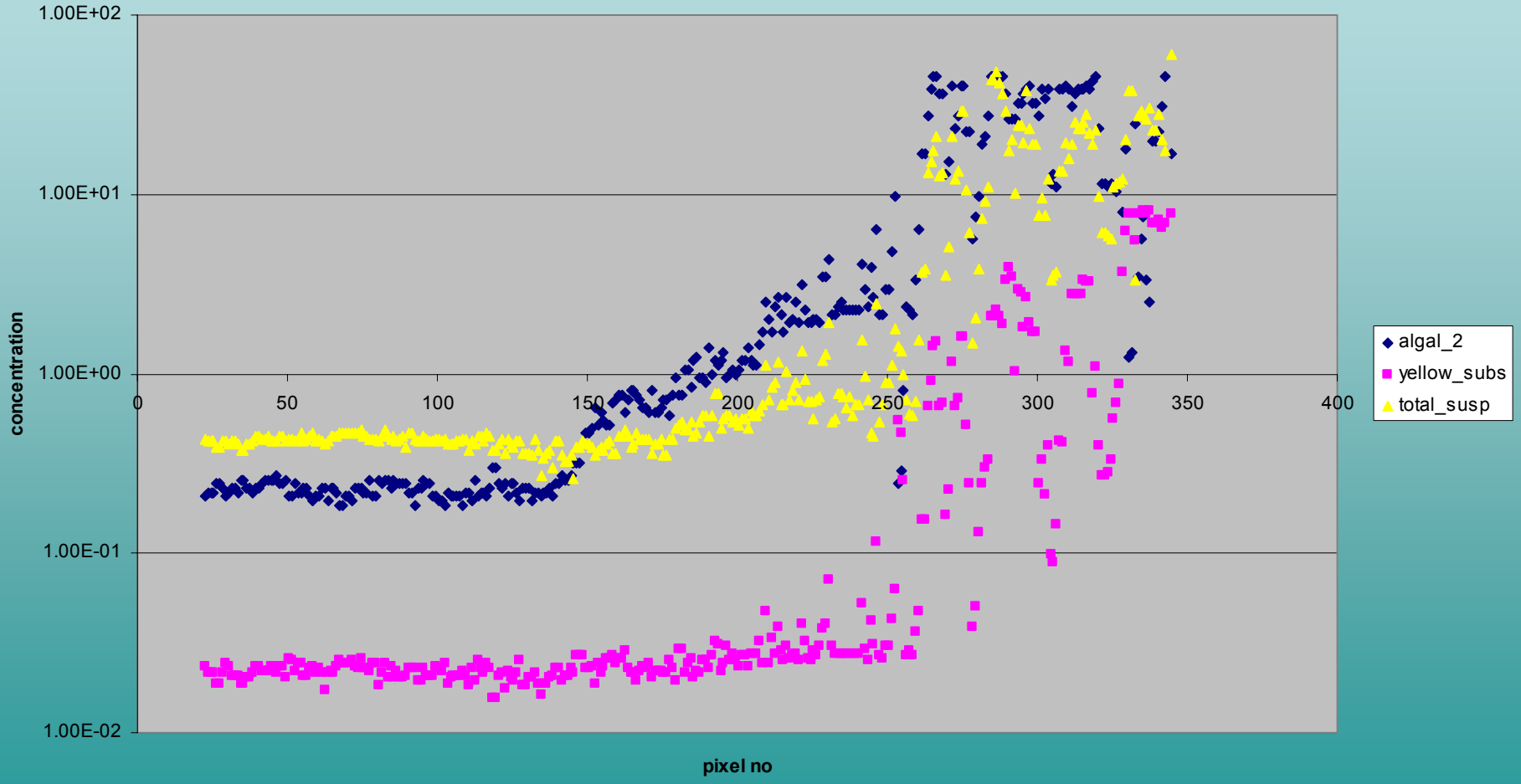
West Canda_ferry 20020814 yellow_subs linear reflectance input



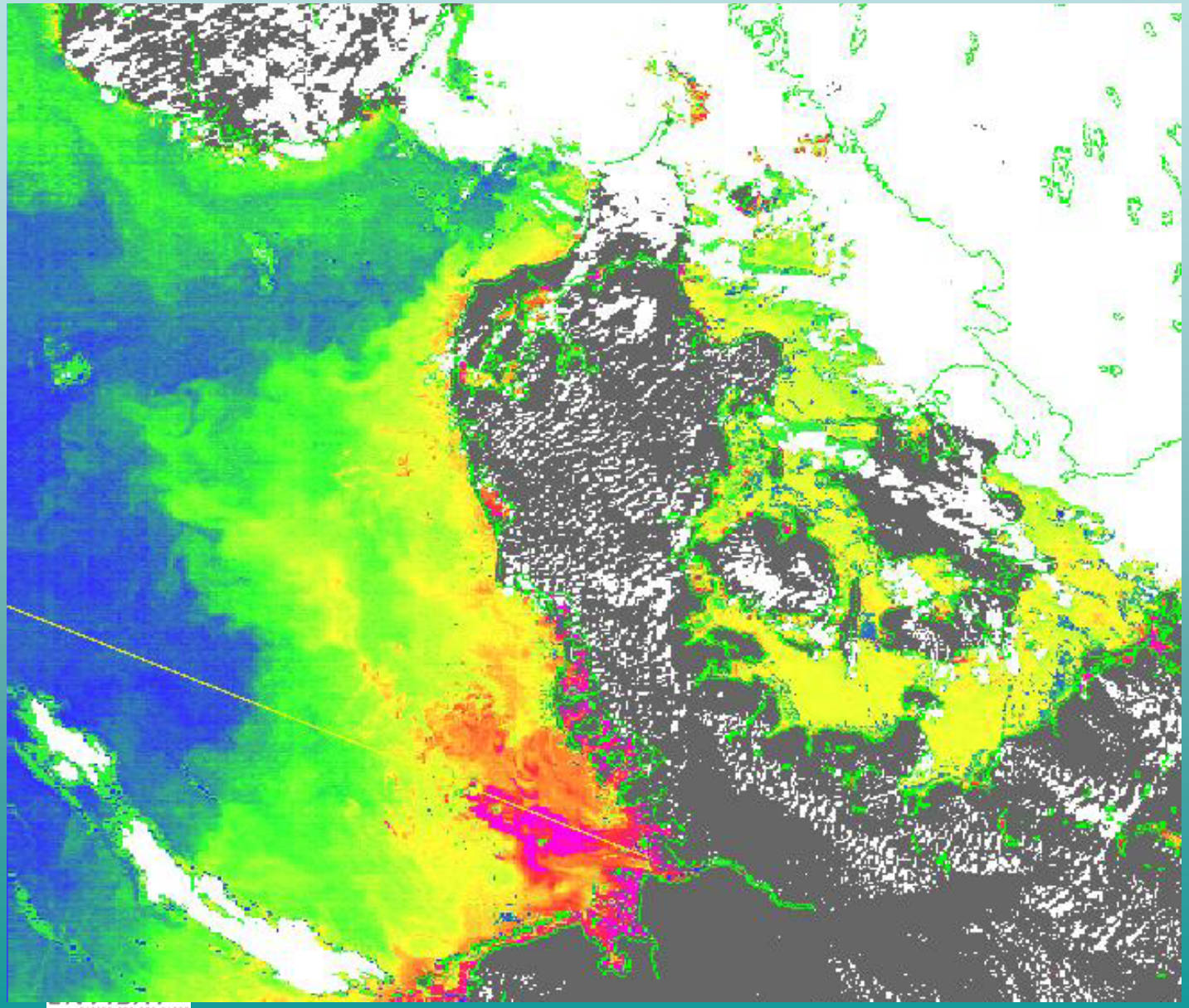
German Bight 20030803 algal_2 with algal_2 flag

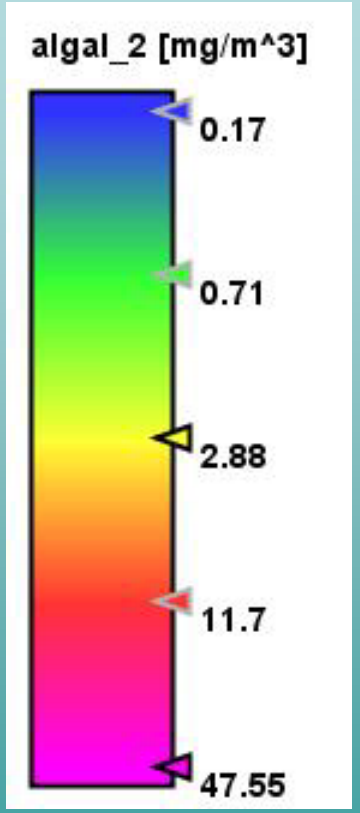


Transect


1.00E+02
1.00E+01
1.00E+00
1.00E-01
1.00E-02
concentration
0
50
100
150
200
250
300
350
400
pixel no
algal_2
yellow_subs
total_susp

German Bight 20030803 algal_2





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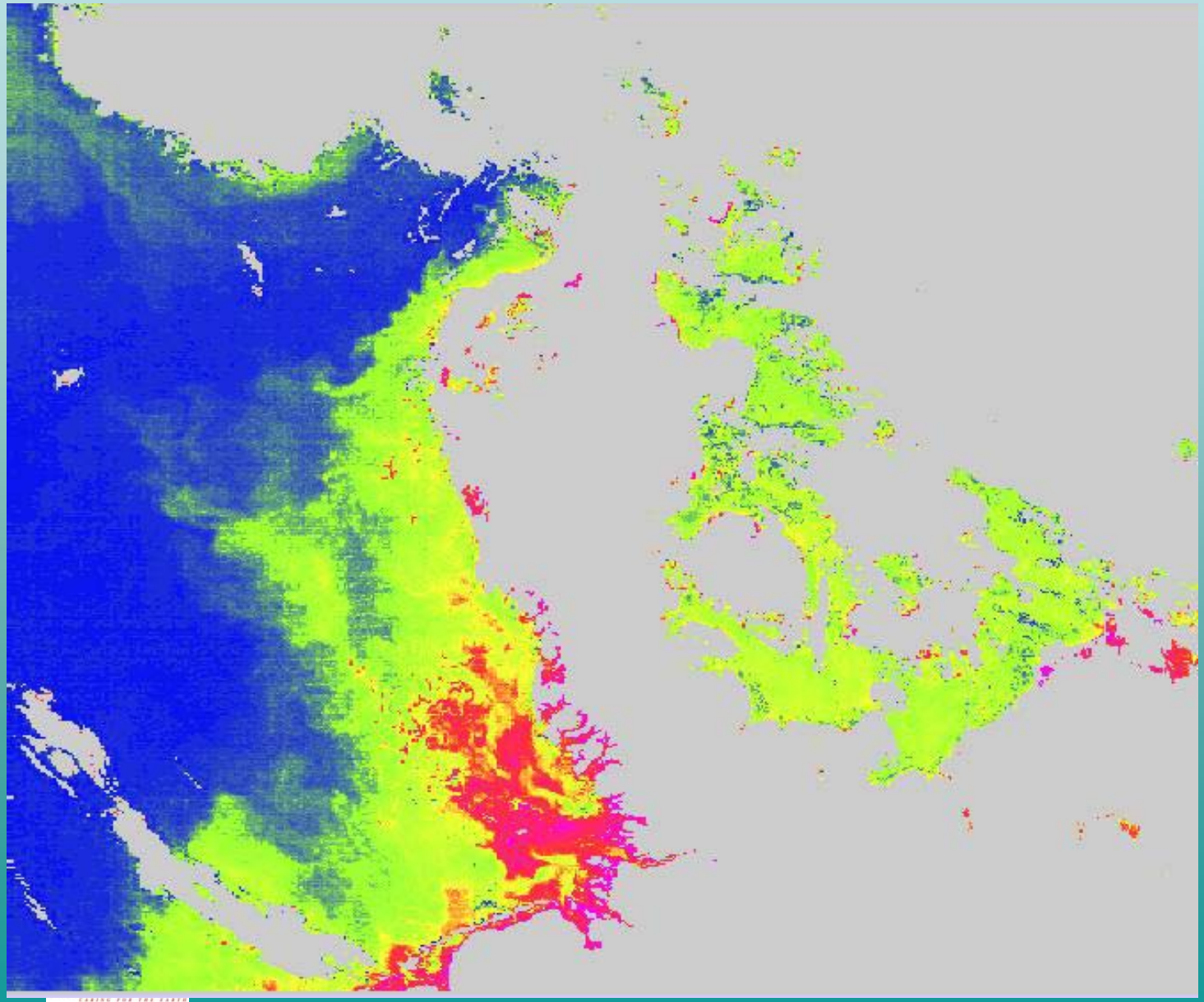
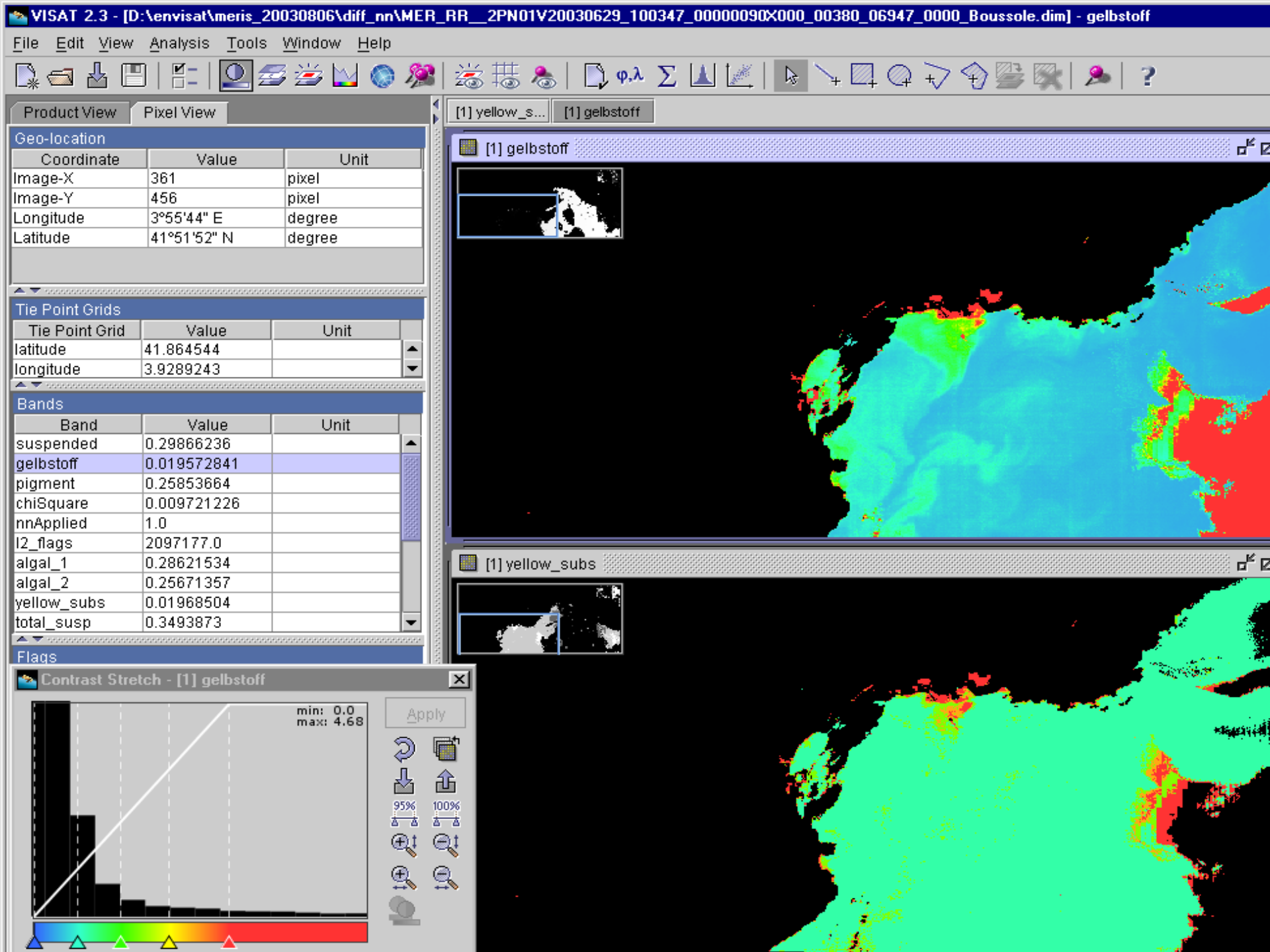
German Bight 20030803 algal_2, lin reflectance

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File Edit View Analysis Tools Window Help
Product View
Pixel View
Geo-location
Coordinate Value Unit
Image-X 361 pixel
Image-Y 456 pixel
Longitude 3°55'44" E degree
Latitude 41°51'52" N degree
Tie Point Grids
Tie Point Grid Value Unit
latitude 41.864544
longitude 3.9289243
Bands
Band Value Unit
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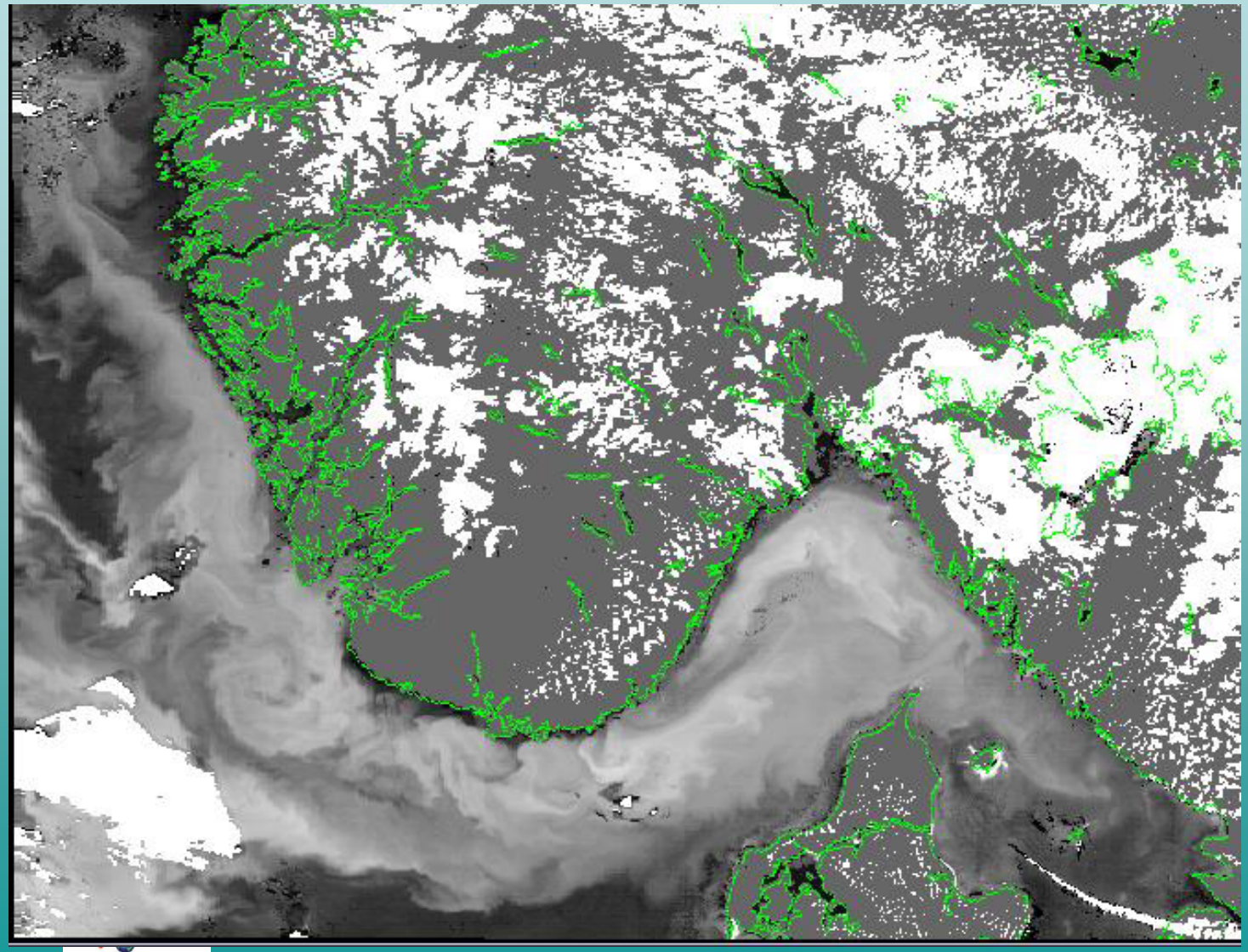
gelbstoff 0.019572841
pigment 0.25853664
chiSquare 0.009721226
nnApplied 1.0
l2_flags 2097177.0
algal_1 0.28621534
algal_2 0.25671357
yellow_subs 0.01968504
total_susp 0.3493873
Flags
[1] yellow_s...
[1] gelbstoff
[1] gelbstoff
[1] yellow_subs
Contrast Stretch - [1] gelbstoff
min: 0.0
max: 4.68
Apply
95%
100%

Skagerrak 20030616 total_susp



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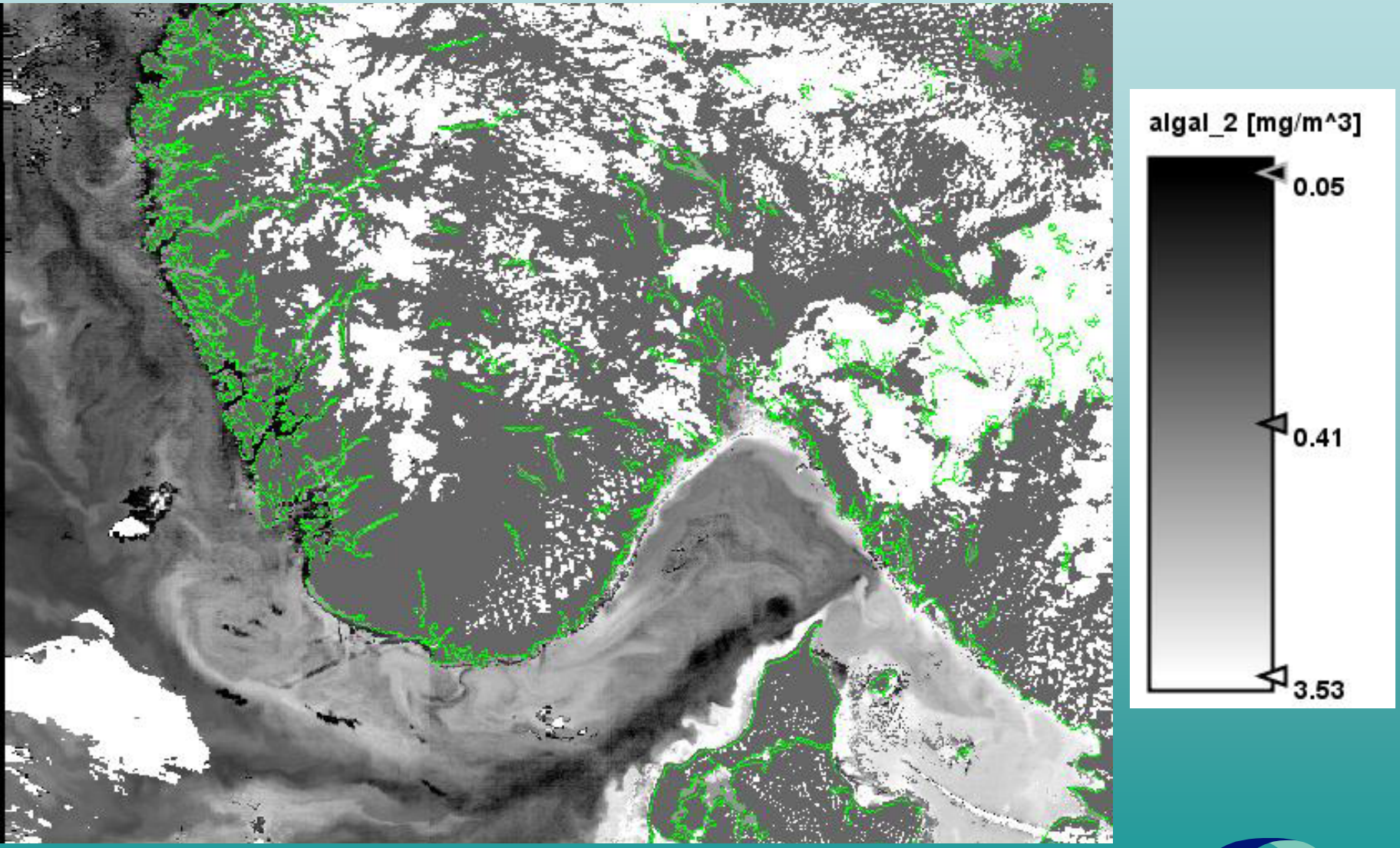
Skagerrak 20030616 algal_2



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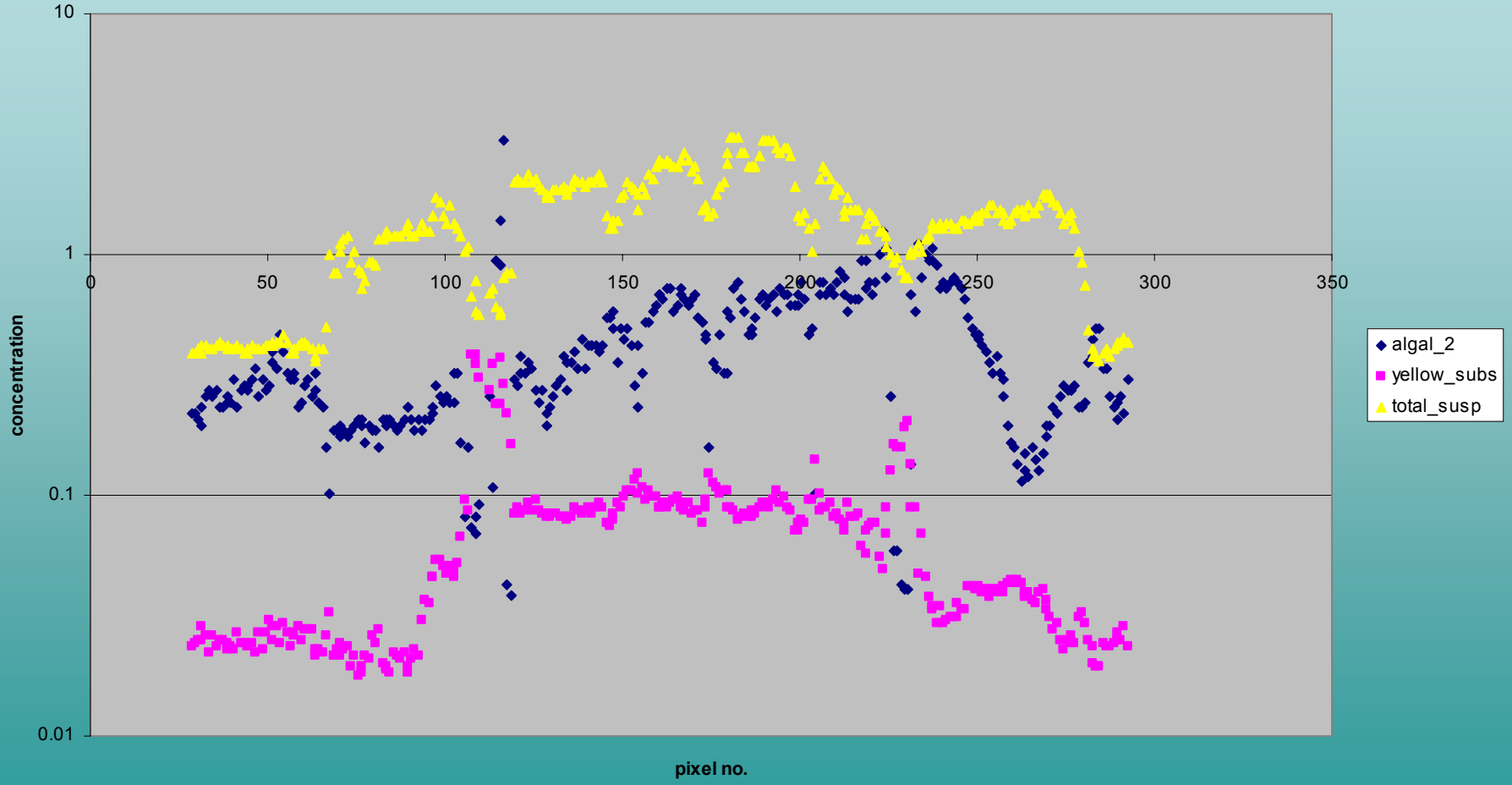
Transect Skagerrak



Conclusion

- NN algorithm products significantly improved by introduction of threshold and modification of atmospheric correction
- Some (but rare) problems with constant threshold of 0.003
- Alternative: Neural network with linear reflectance input
- Distribution of yellow substance now visible also at low concentrations
- Coccolithophoride distribution improved by white scatterer

Before reprocessing

- Chi2 threshold for flag have to be adjusted
- NN input linear reflectance or log reflectance + threshold for constant has to be trained and compared, and decided

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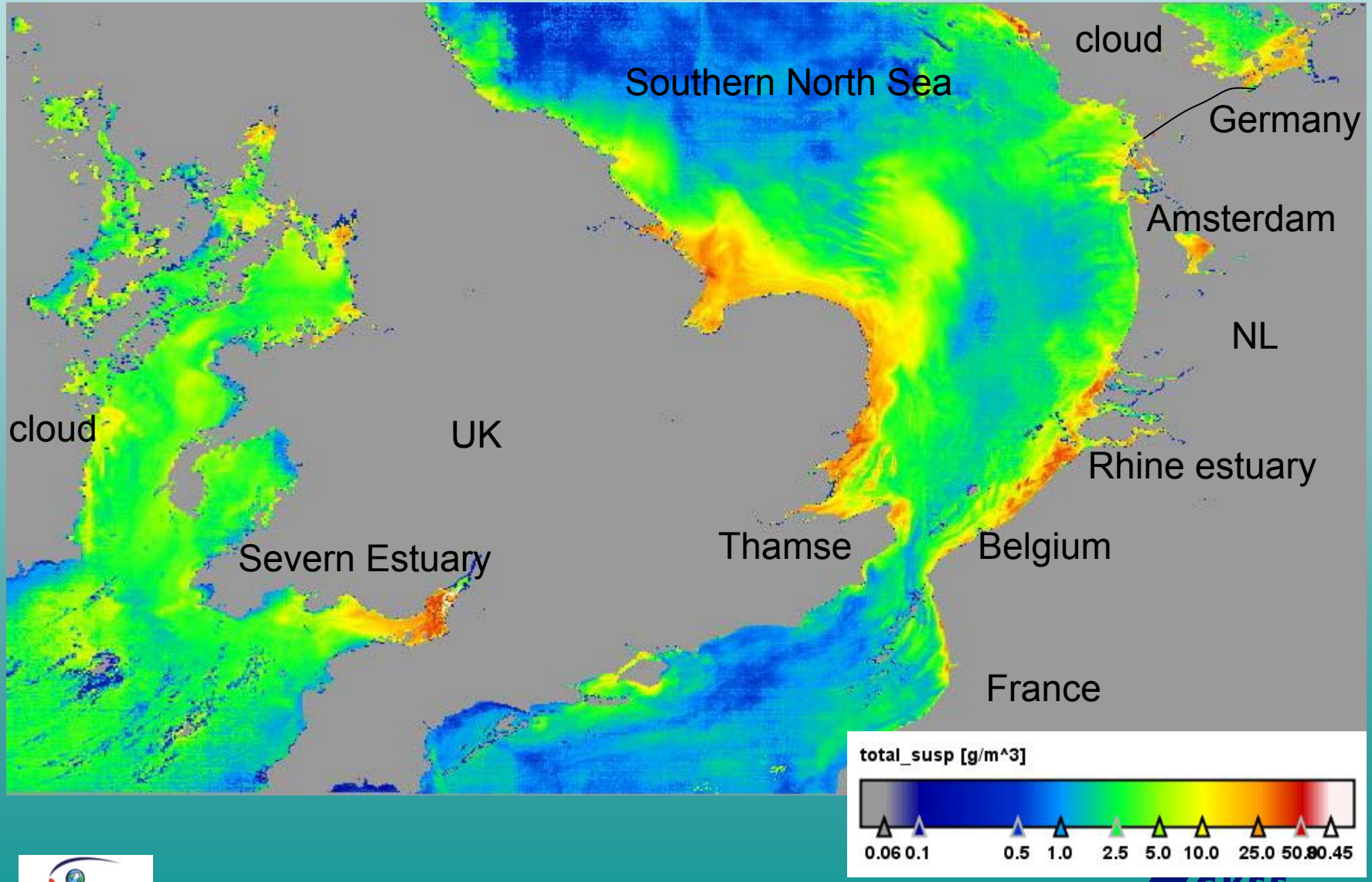
Total Suspended Matter (TSM)



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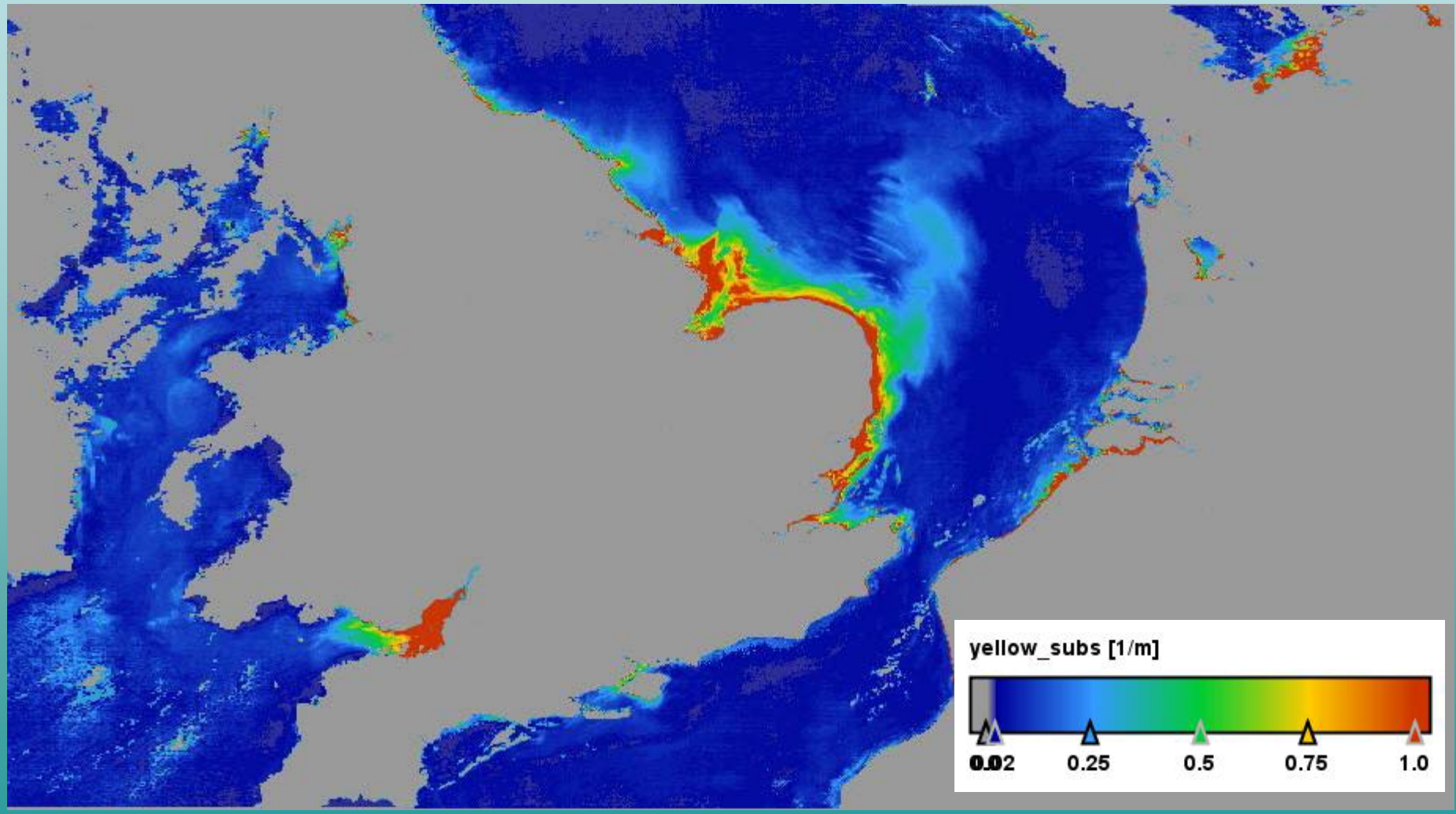
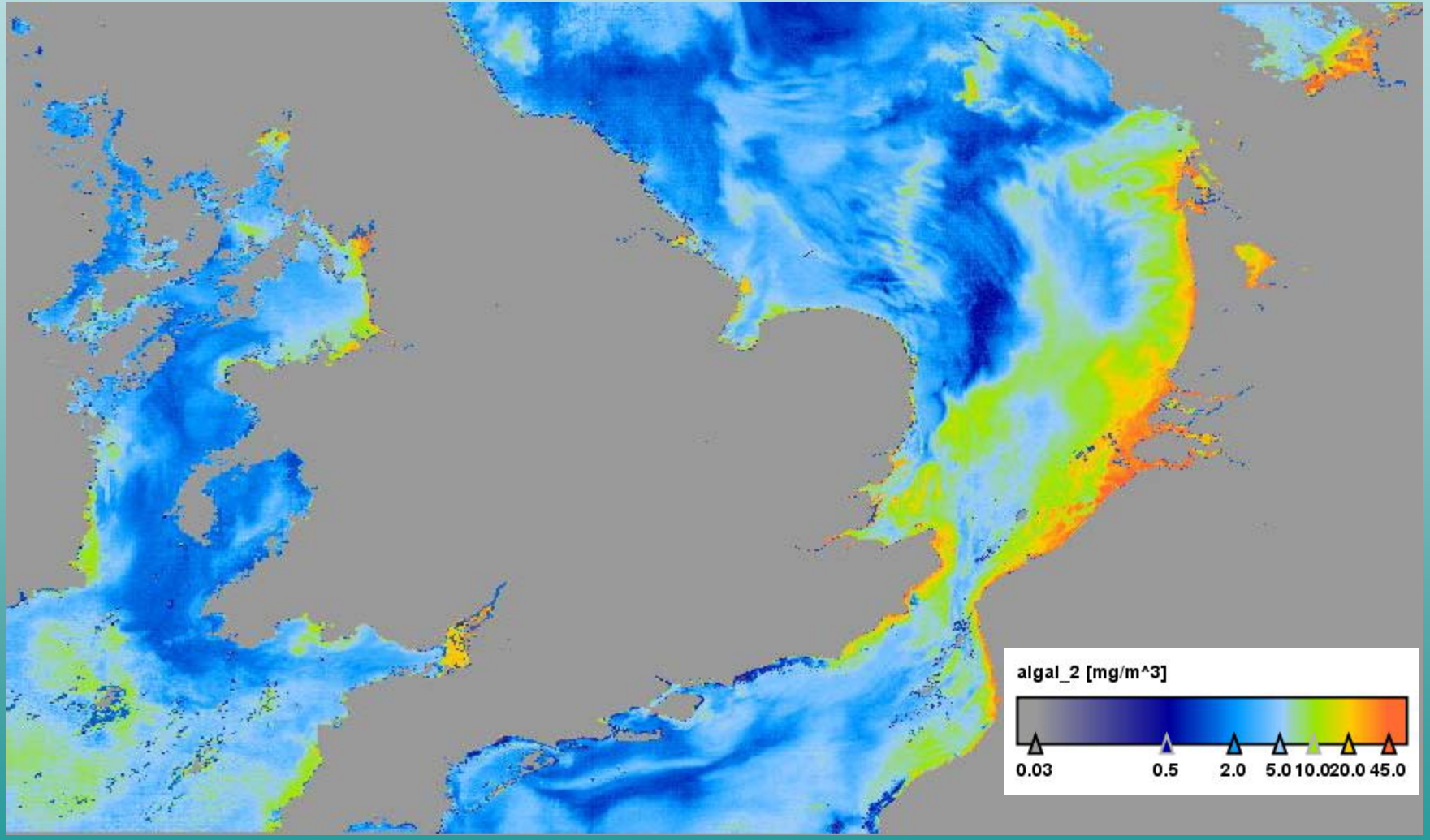
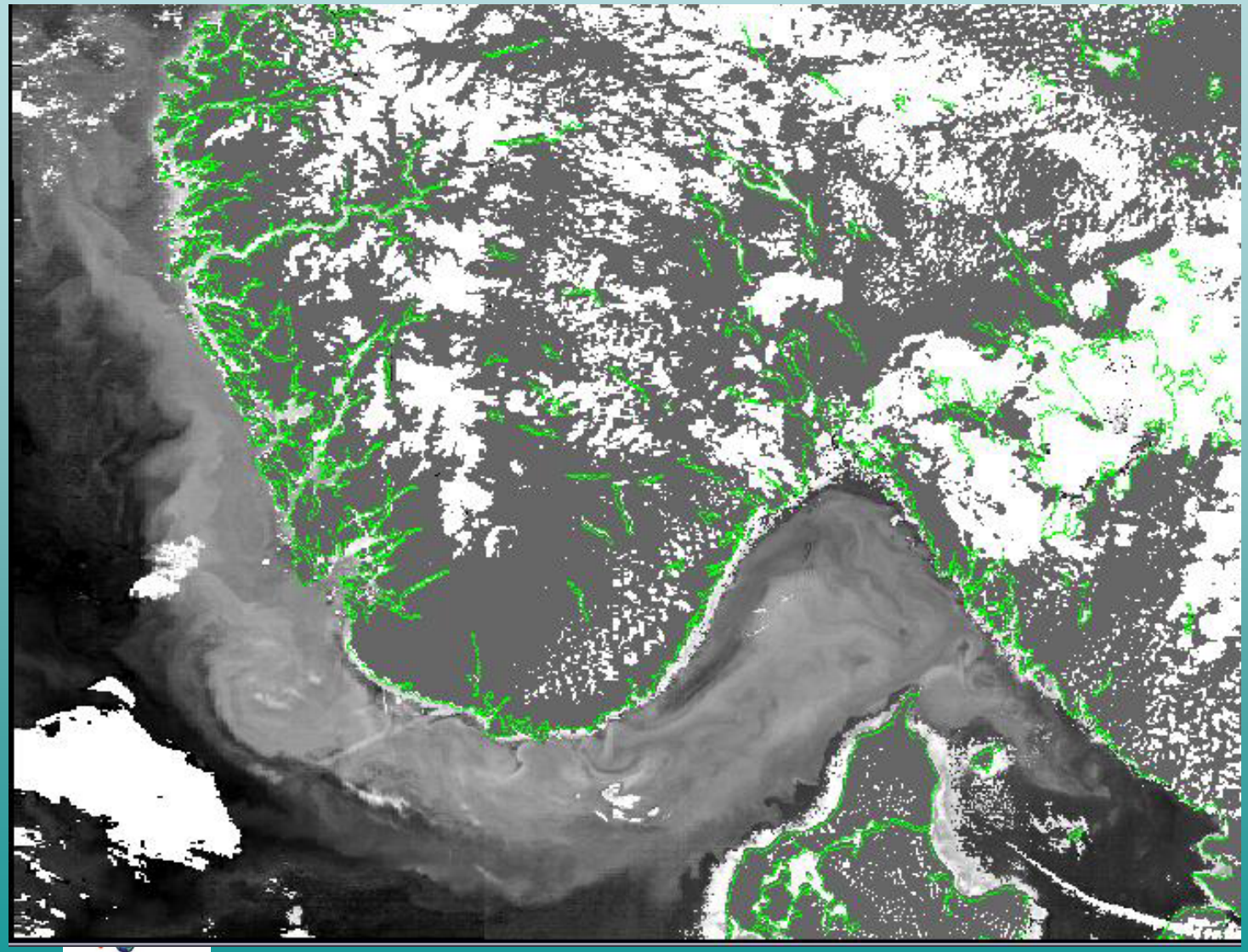
Gelbstoff (a443)



Pigment (Algal_2)



Skagerrak 20030616 yellow_sub



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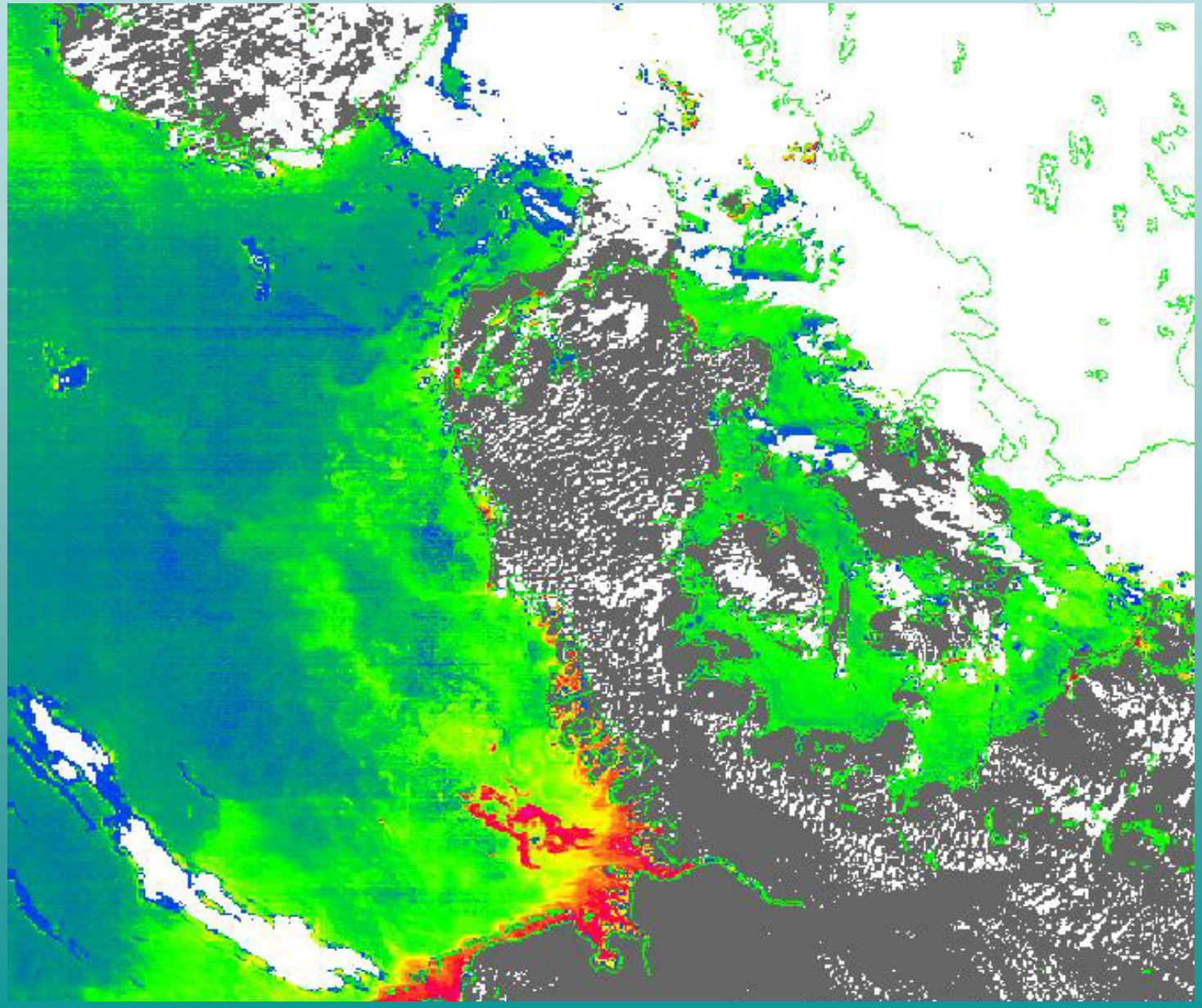
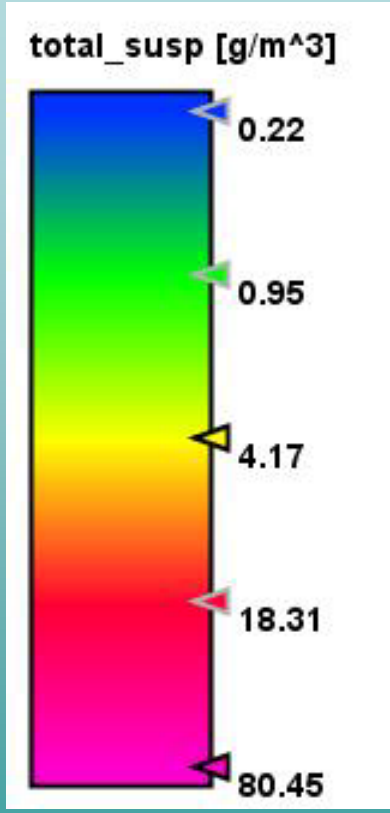
German Bight 20030803 total_susp.





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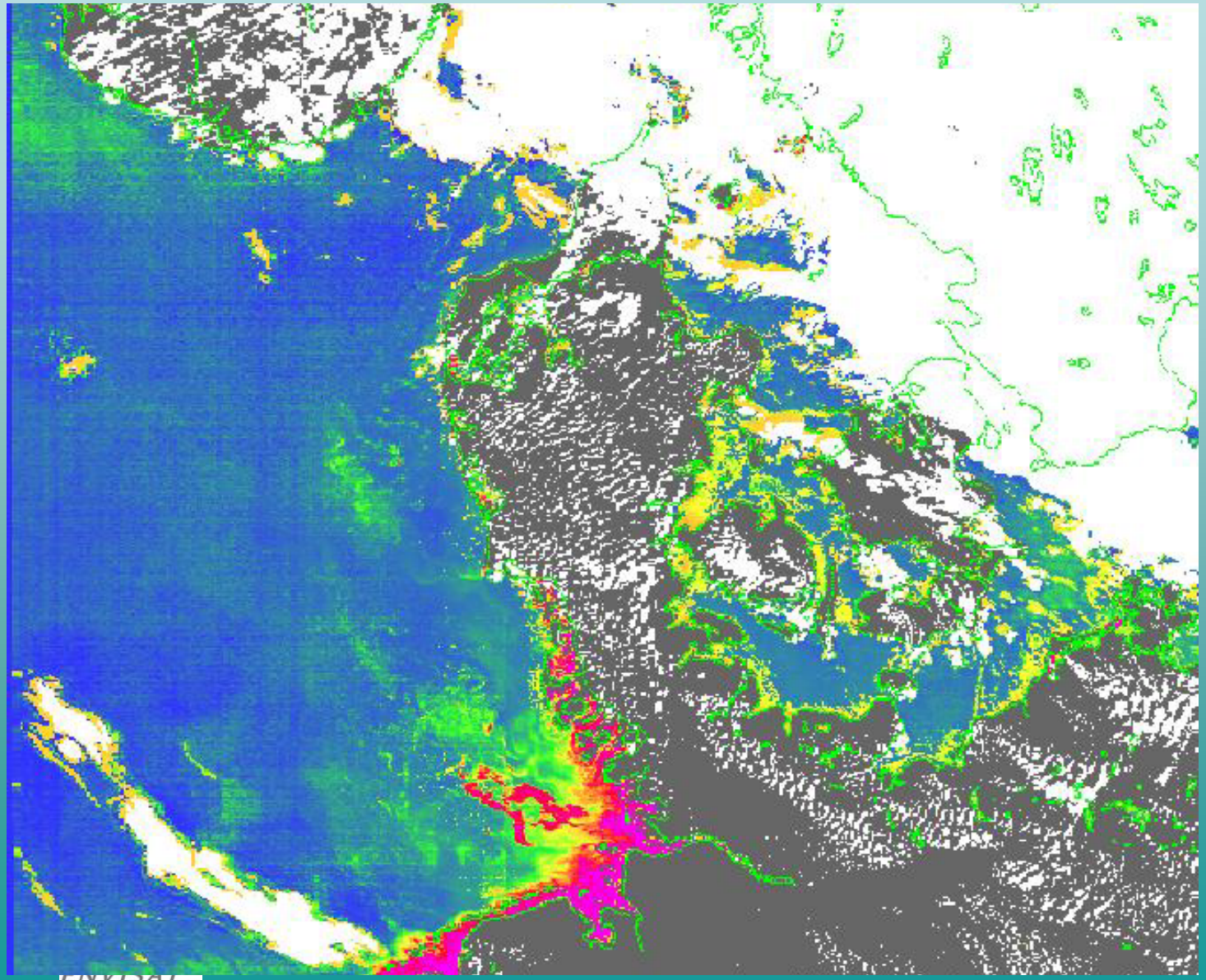
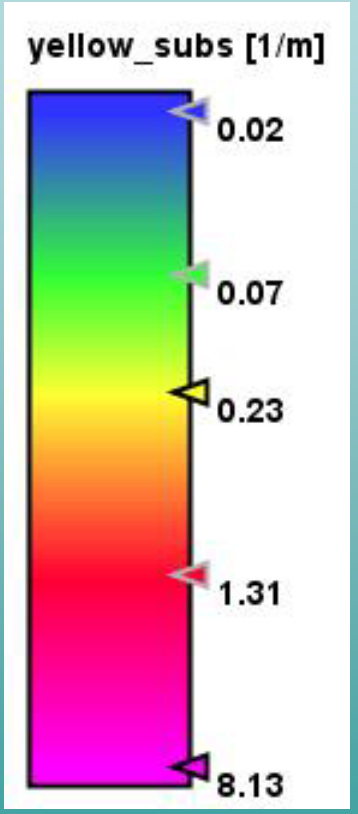
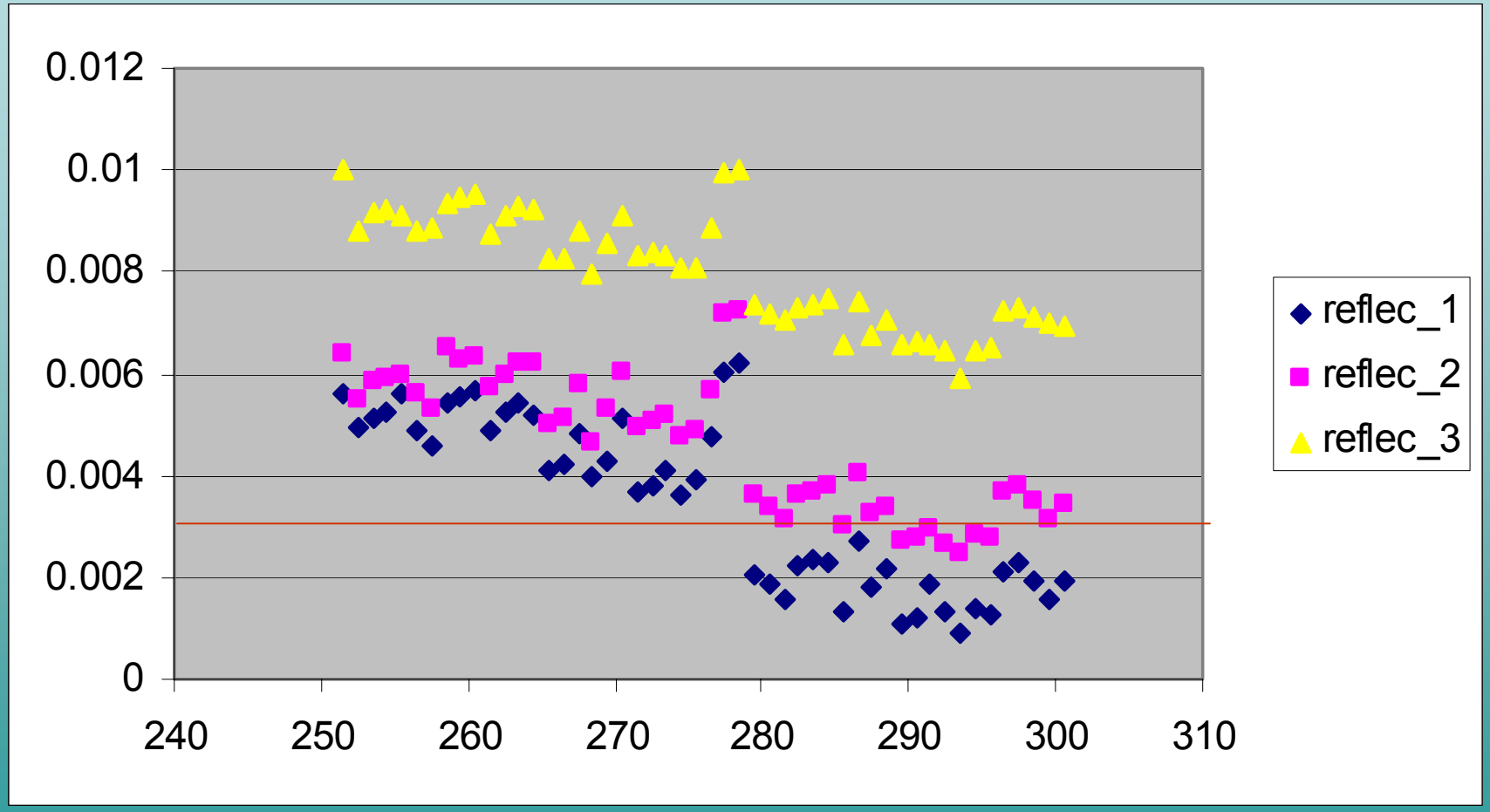
German Bight 20030803 yellow_sub





Transect


0.012
0.01
0.008
0.006
0.004
0.002
0
240
250
260
270
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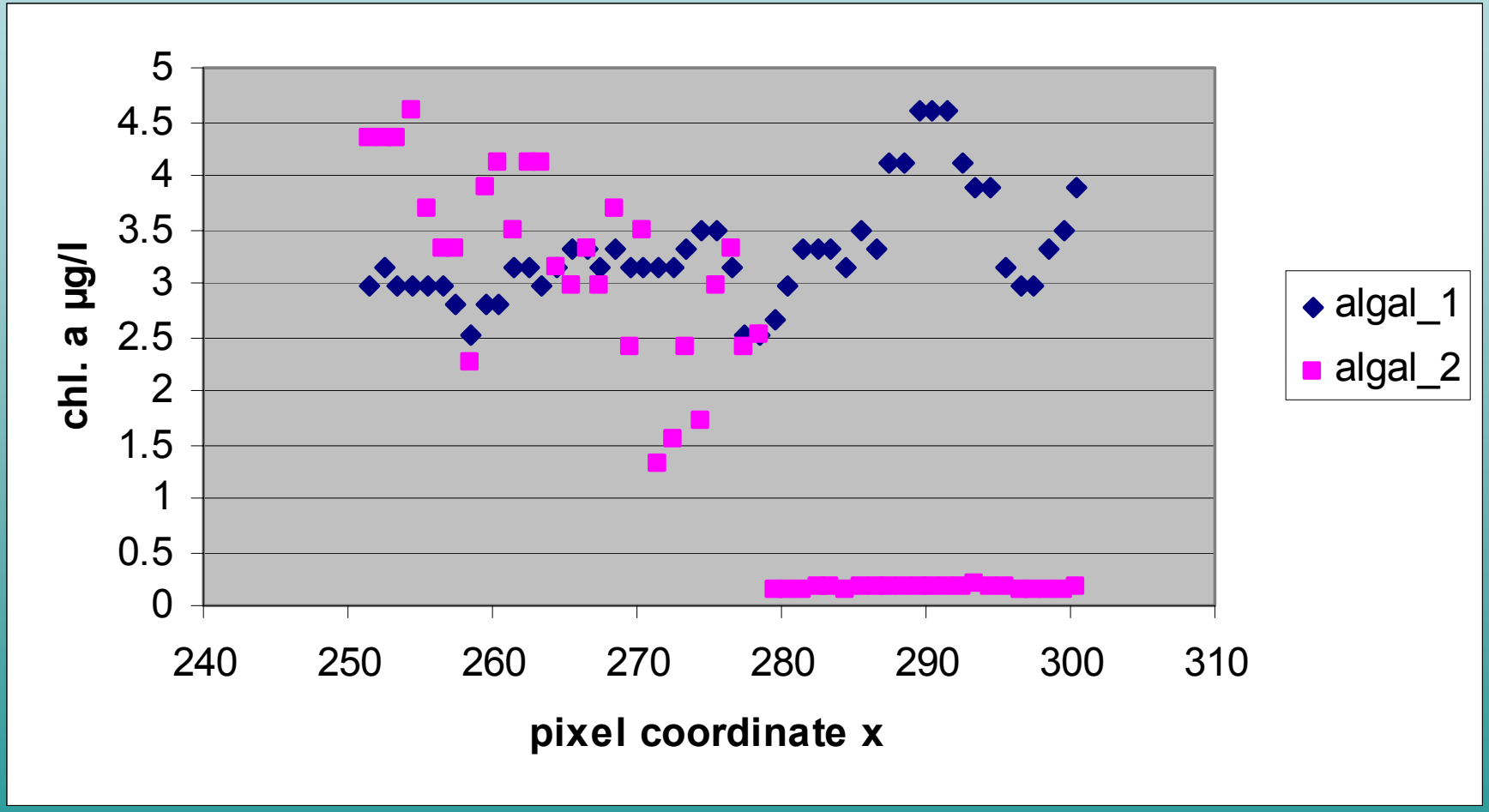
290
300
310
reflec_1
reflec_2
reflec_3

Transect chlorophyll