Ocean Products Using Multispectral Algorithms

Preliminary Results

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Outline

- The retrieval of chlorophyll concentration from HICO data at 90 meter spatial resolution using the SeaWiFS methods.

- The calculation of Diffuse Attenuation Coefficient, K_d490, from HICO data using MODIS methods.

- New approach for high chlorophyll concentrations in high latitude regions, such as Sea of Azov.

Chlorophyll-a Concentration Calculation

$$Chl\text{-}_A = 10^{(a_0+a_1*x+a_2*x^2+a_3*x^3+a_4*x^4)}$$

Where:

- $x = Log_{10}\{Max[Ref(\lambda_1)/ Ref(\lambda_3), Ref(\lambda_2)/ Ref(\lambda_3)]\}$

- $Ref(\lambda_i)$ is water leaving reflectance

- a_0, a_1, a_2, a_3, a_4 are constants

- selected HICO wavelength channels are:
  λ_1 = 491 nm, λ_2 = 508 nm, λ_3 = 554 nm

http://oceancolor.gsfc.nasa.gov

Diffuse attenuation coefficients (K_d490) Using MODIS methods

$$K_d(490)\_clear = K_w(490) + A[nLw(490)/nLw(555)]^B$$

Where $K_w(490) = 0$, $A = 0.1853$, $B = -1.348$ (Mueller model, 2000)

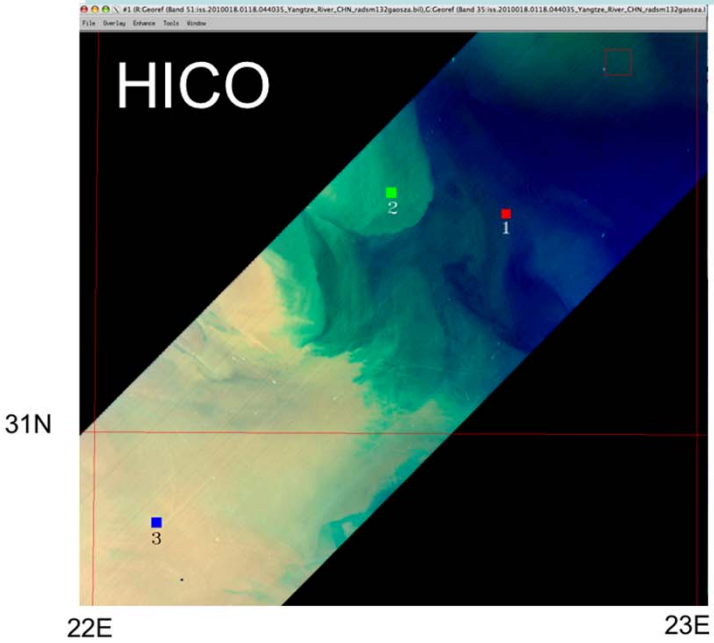
$$K_d(490)\_turbid = (-9.785)*10^{-4}/bwfl\_488 + 0.8321*bwfl\_645/bwfl\_488 + 4.18*[-2.54*10^{-3} + 2.1598 * bwfl\_645] *\{1-0.52 \exp[9.19*10^{-3} /bwfl\_488] - 7.81*[bwfl\_645/bwfl\_488]\}$$

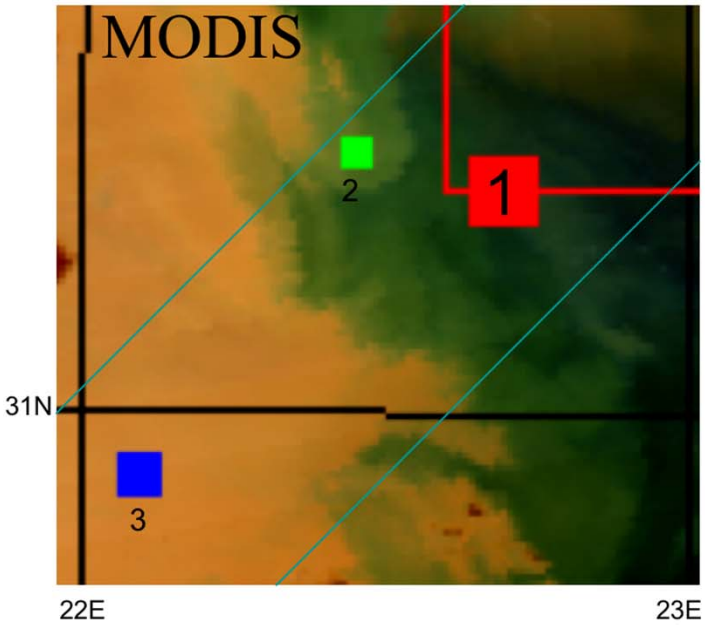
Wang, et al. Journal of Geophysical Research, 2009, Vol. 114, C10011

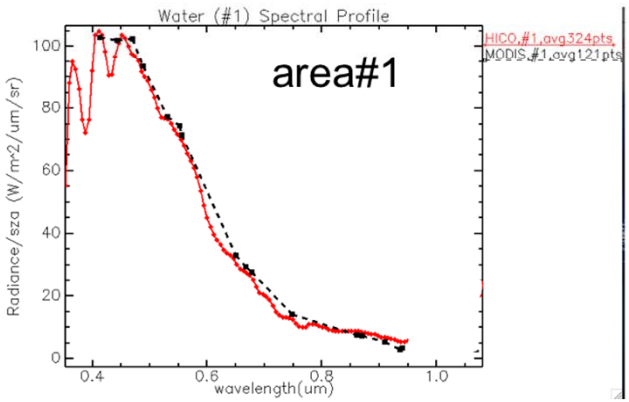
Comparison HICO with MODIS Over Yangtze River Scene, Jan. 18, 2010

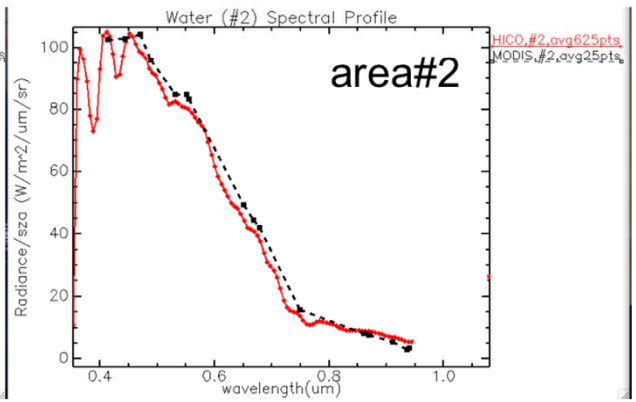
HICO
- pixel size = 90 m, fwhm = 10 nm (smoothed)
- Time: 04:40:35
- Solar zenith angle ~ 53^0
- View zenith angle ~ 15^0
- Radiances ($W/m^2/um/sr$) (v1.6)

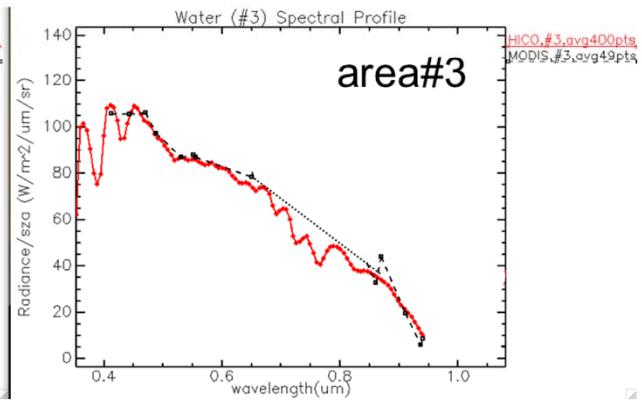
MODIS (Aqua)
- pixel size = 1000 m, fwhm = 10 nm
- Time: 05:00:00
- Solar zenith angle ~ 52^0
- View zenith angle ~ 8^0
- Radiances ($W/m^2/um/sr$) (v005)





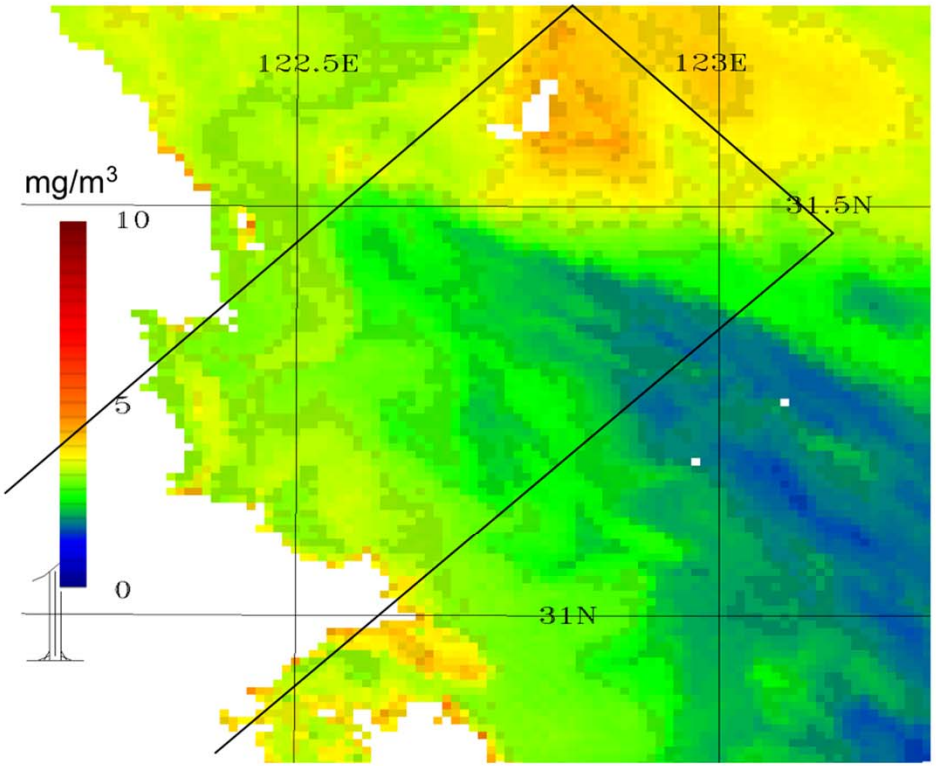




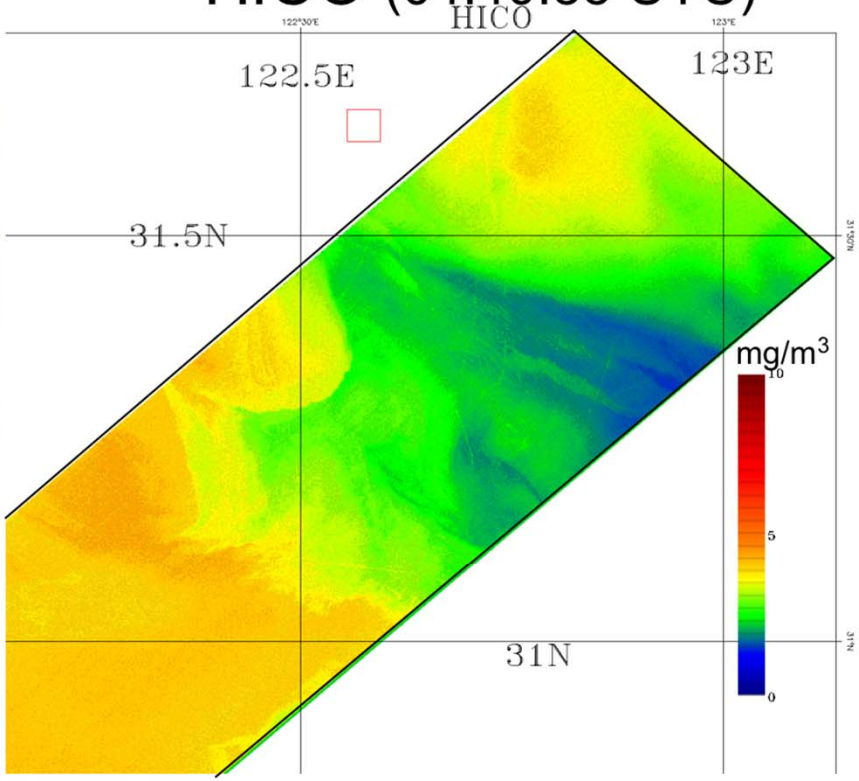


Chlorophyll-a Concentration retrievals Over Yangtze River (2010 Jan. 18)

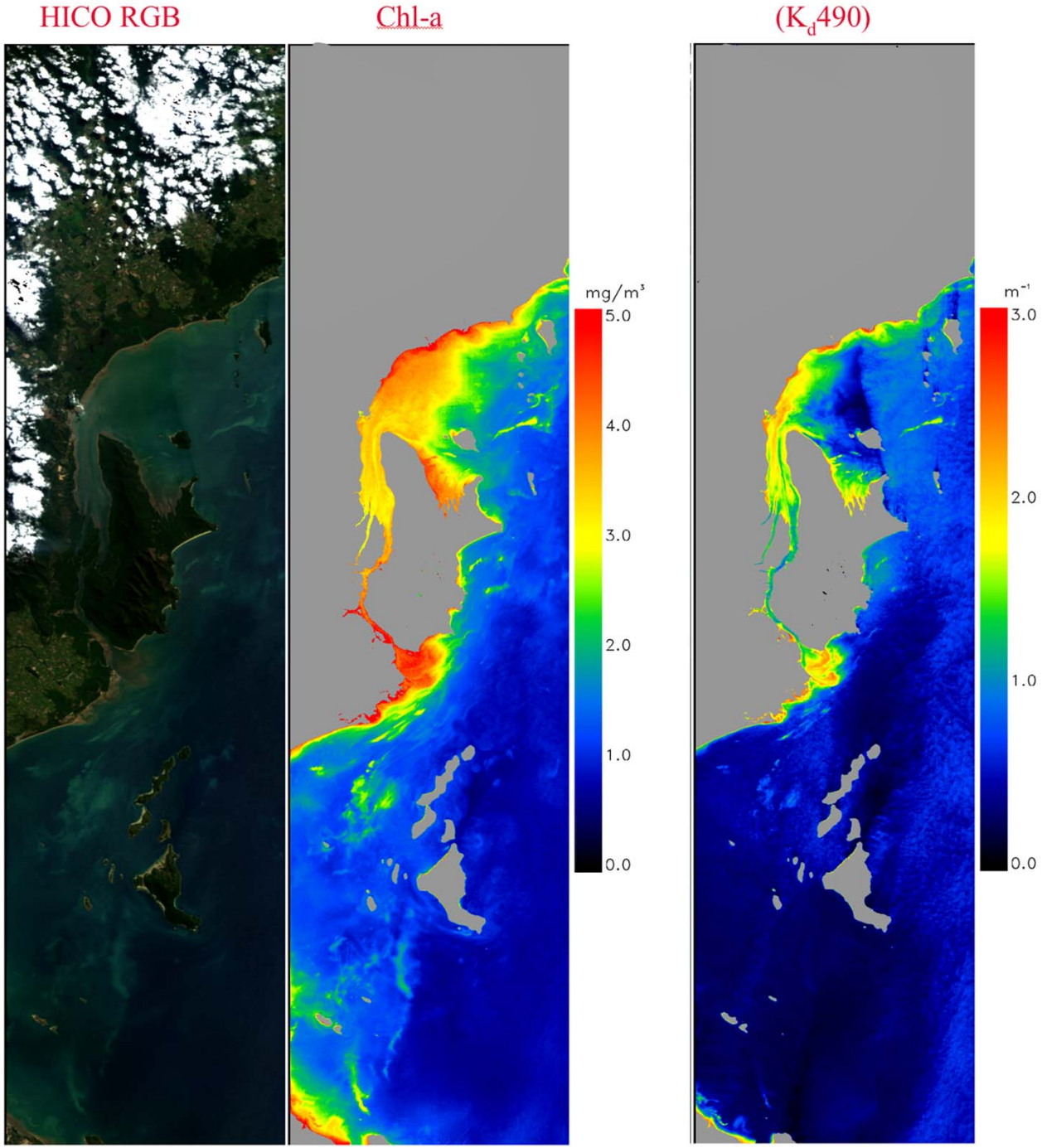
MODIS (05:00:00 UTC)



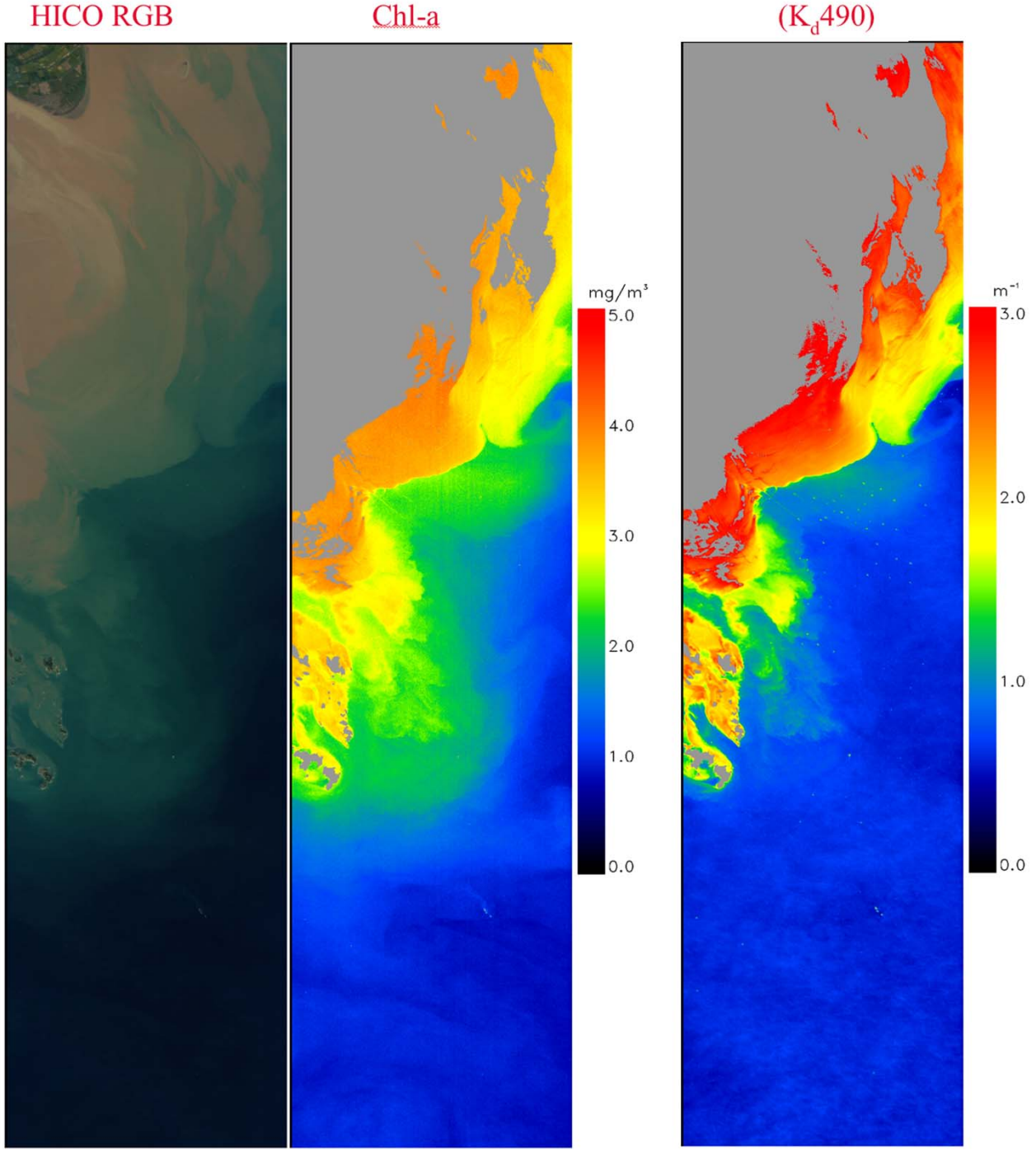
HICO (04:40:35 UTC)



2010 Jun. 12
Lucinda Jetty,
Australia



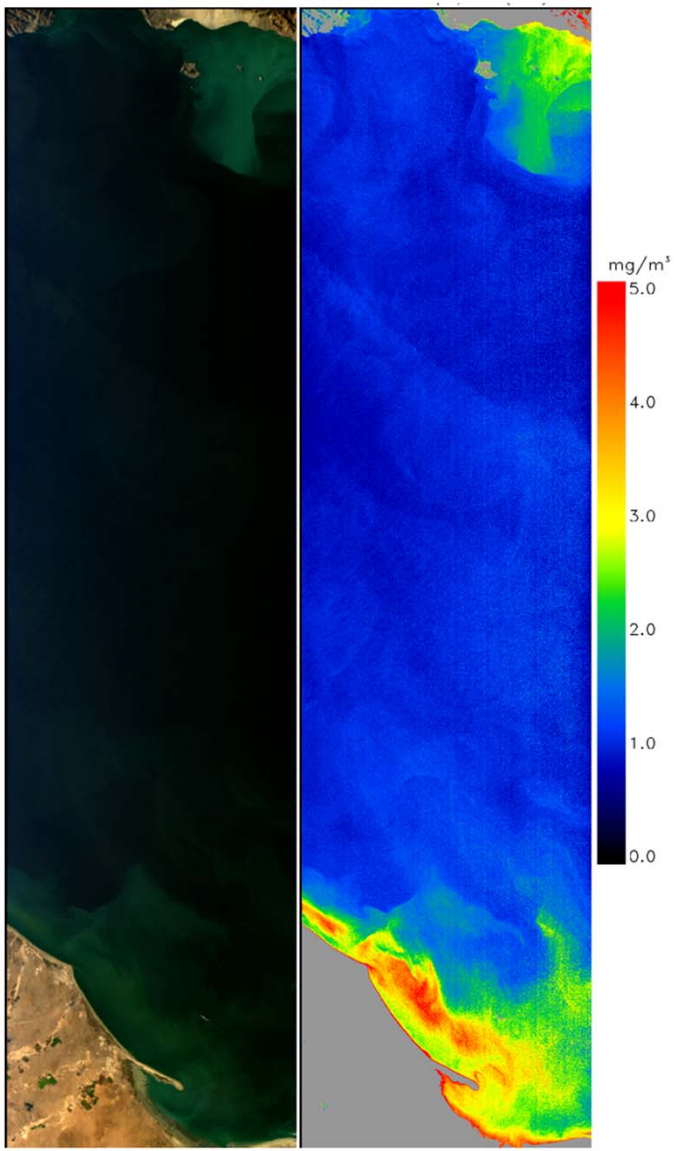
2009 Oct. 20
Yangtze River, China



Gulf of California

2009 Dec. 1

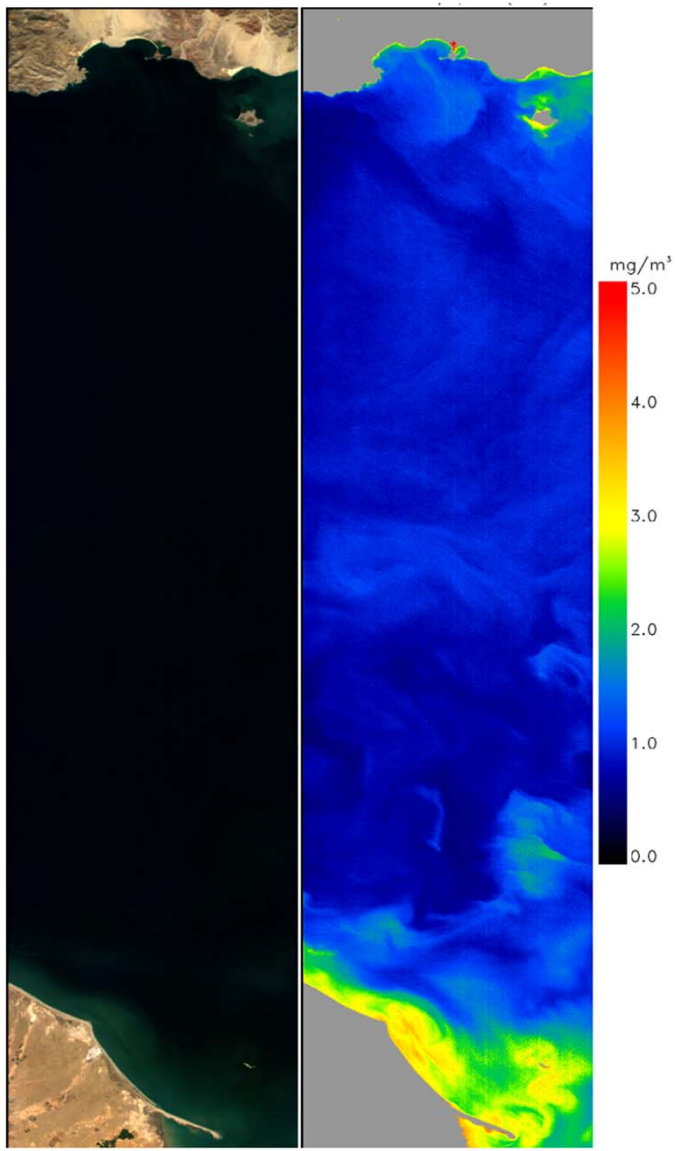
RGB Chl-a



Gulf of California

2010 Mar. 14

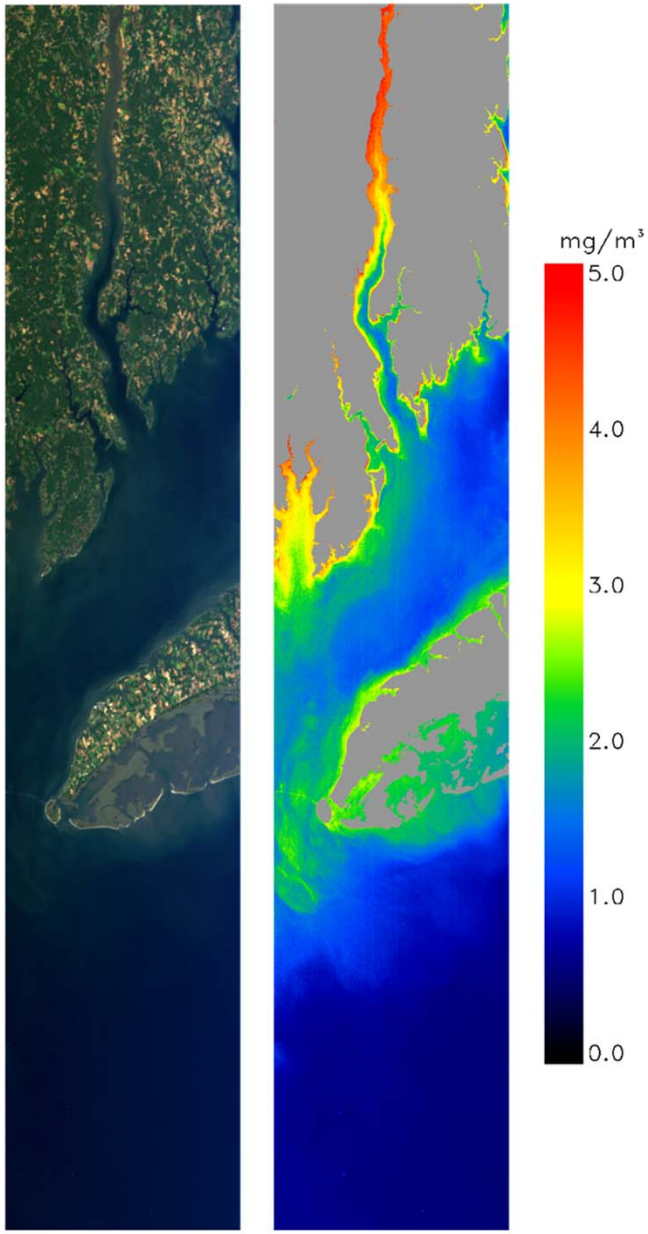
RGB Chl-a



Chesapeake Bay

2009 Oct. 7

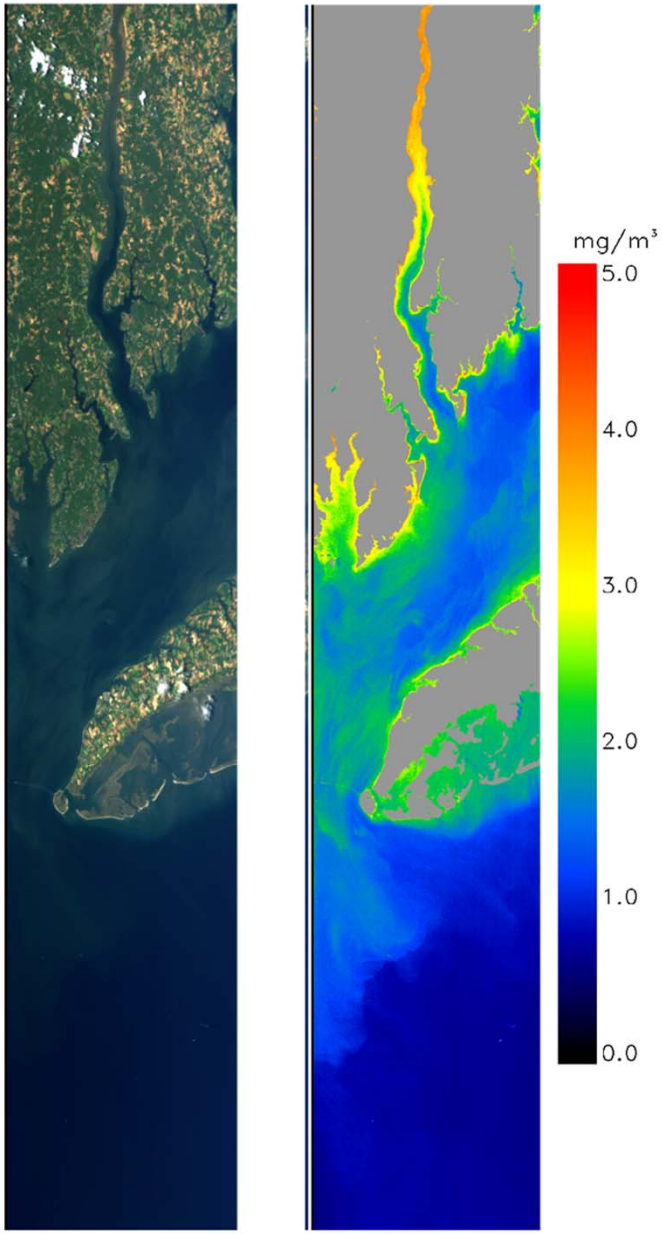
RGB Chl-a



Chesapeake Bay

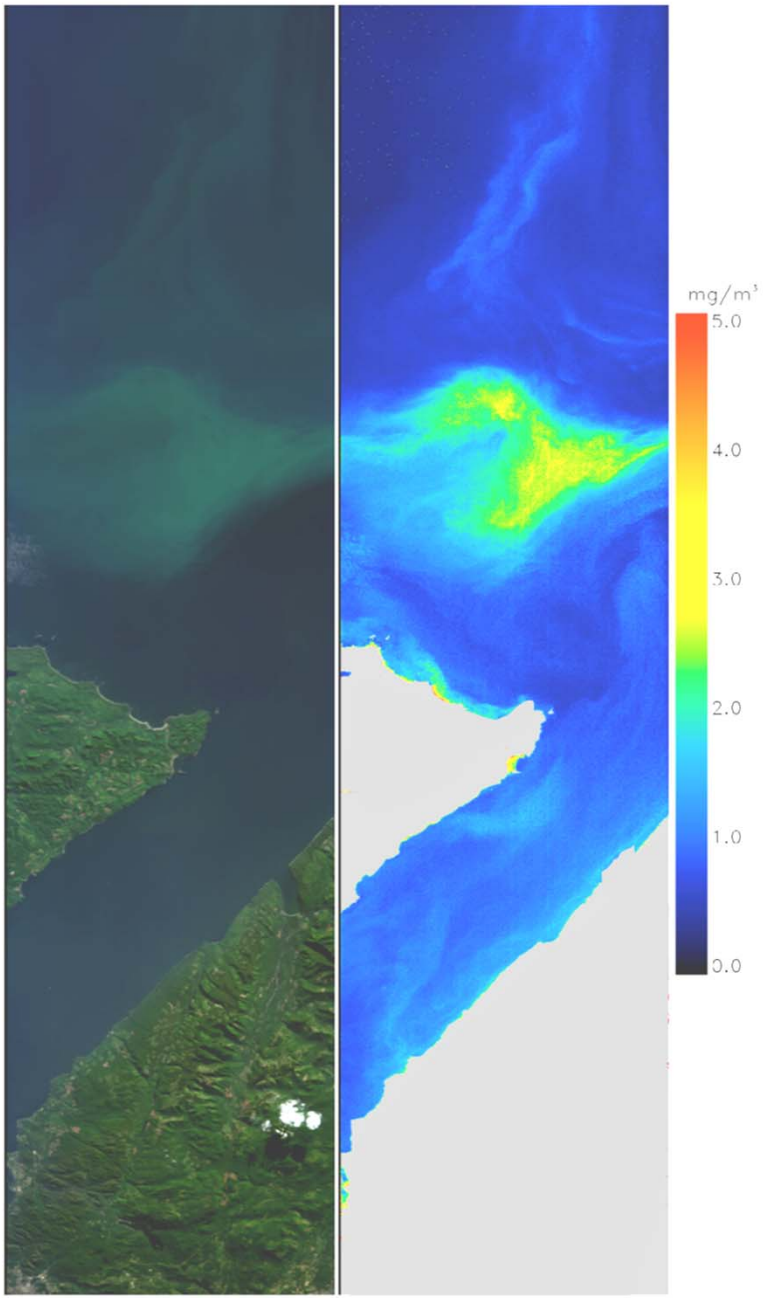
2009 Oct. 9

RGB Chl-a



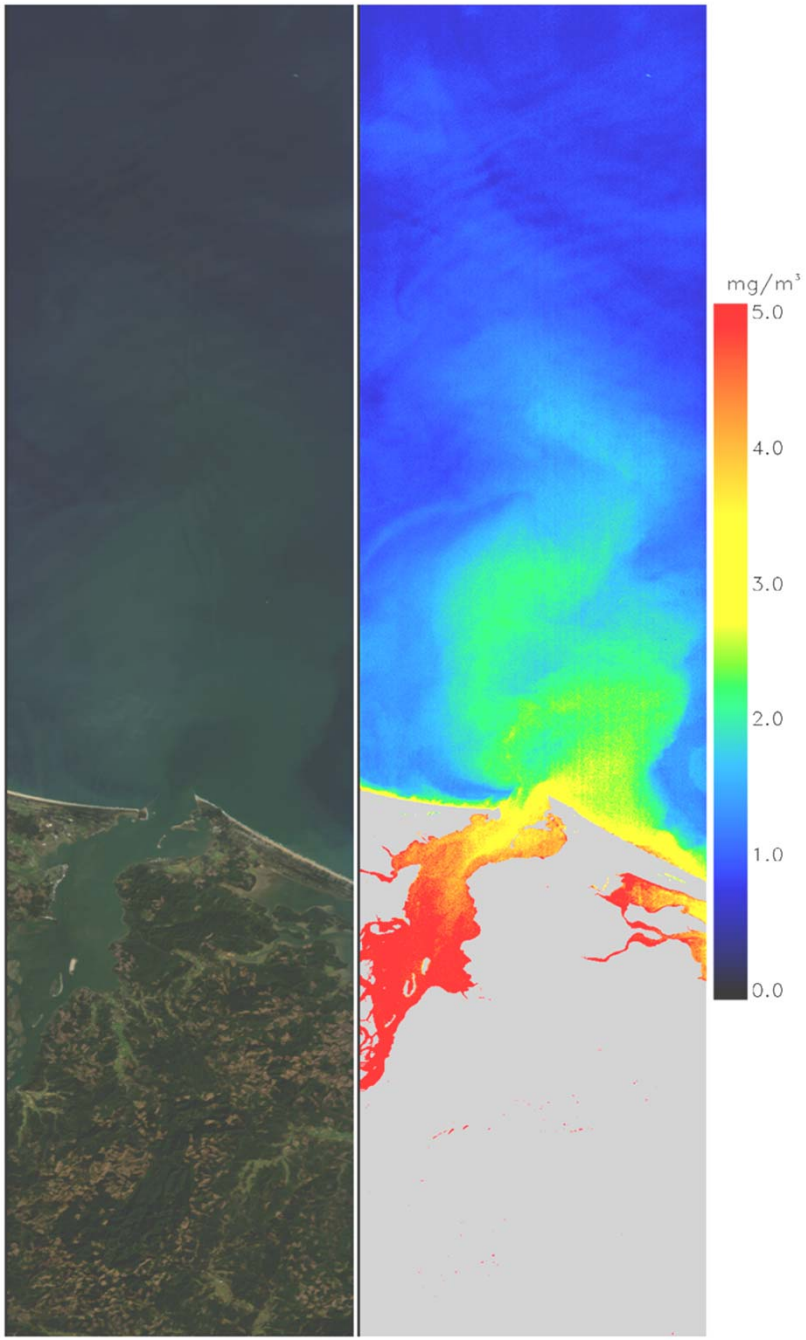
Olympic Beaches, WA 2010 Jul. 9

RGB Chl-a

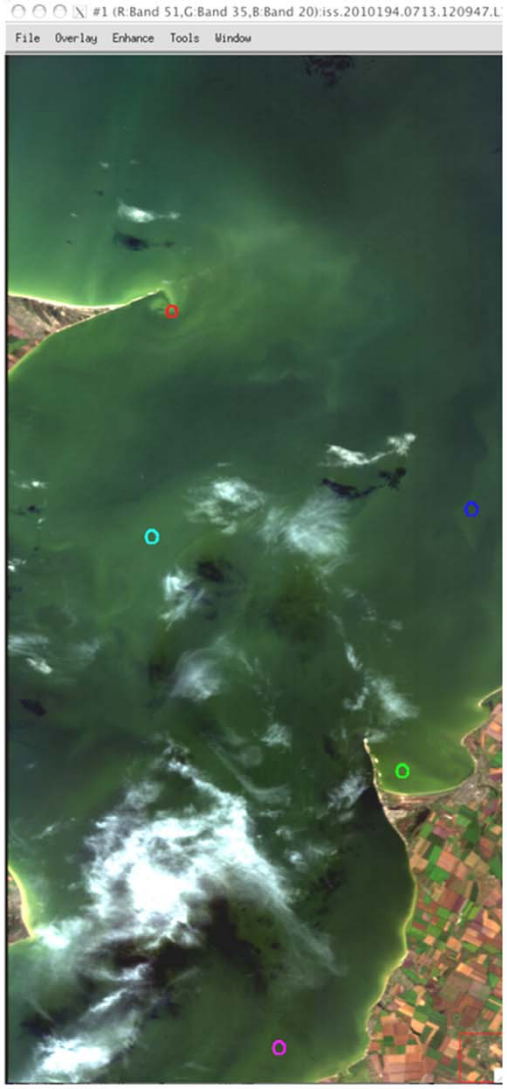


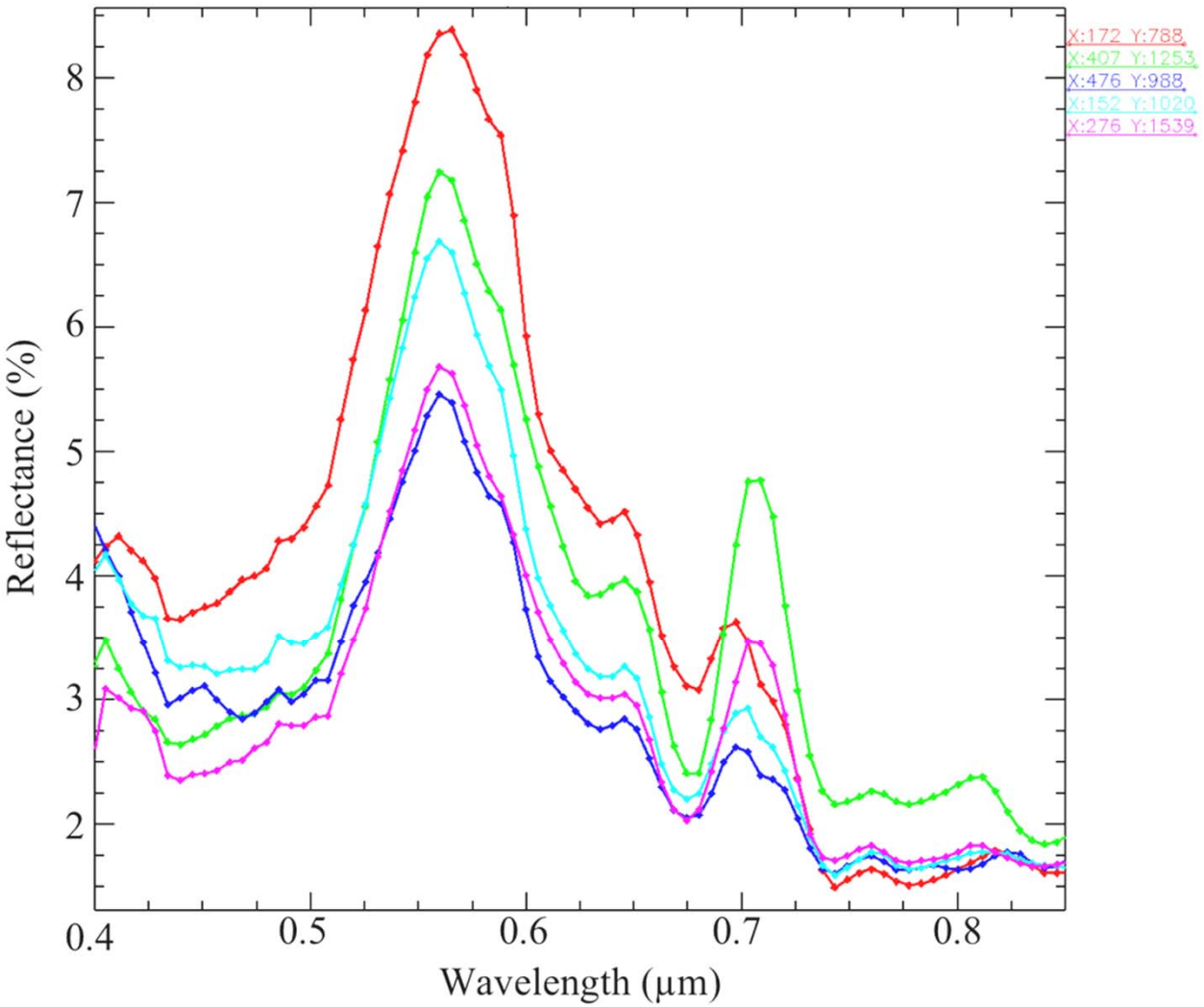
Mouth of Columbia River, WA 2010 Mar. 19

RGB Chl-a



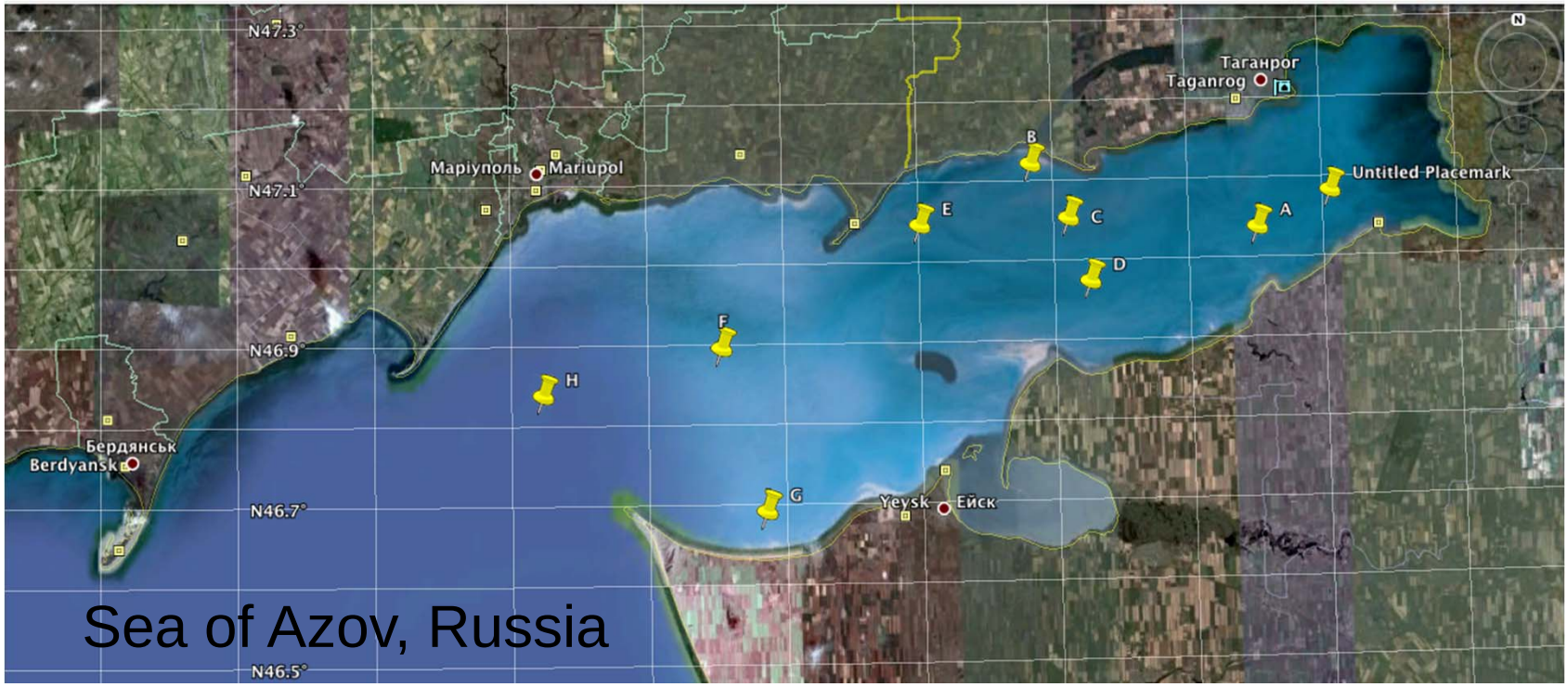
HICO, Sea of AZOV (2010 July 13)

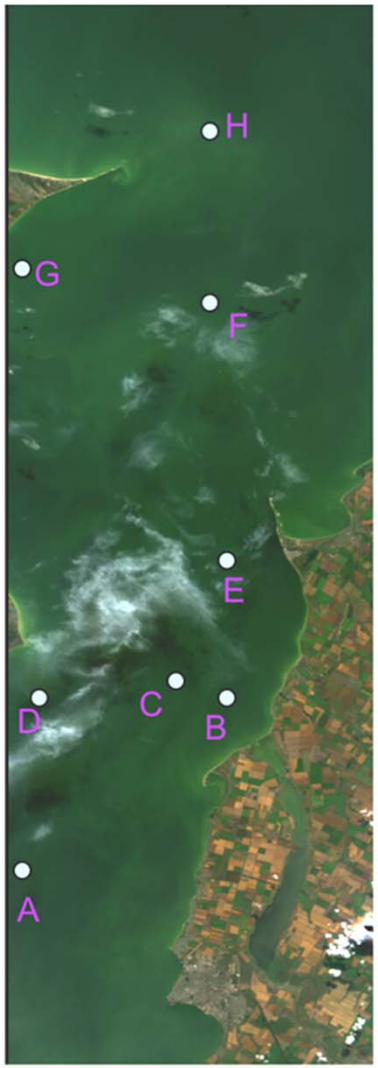


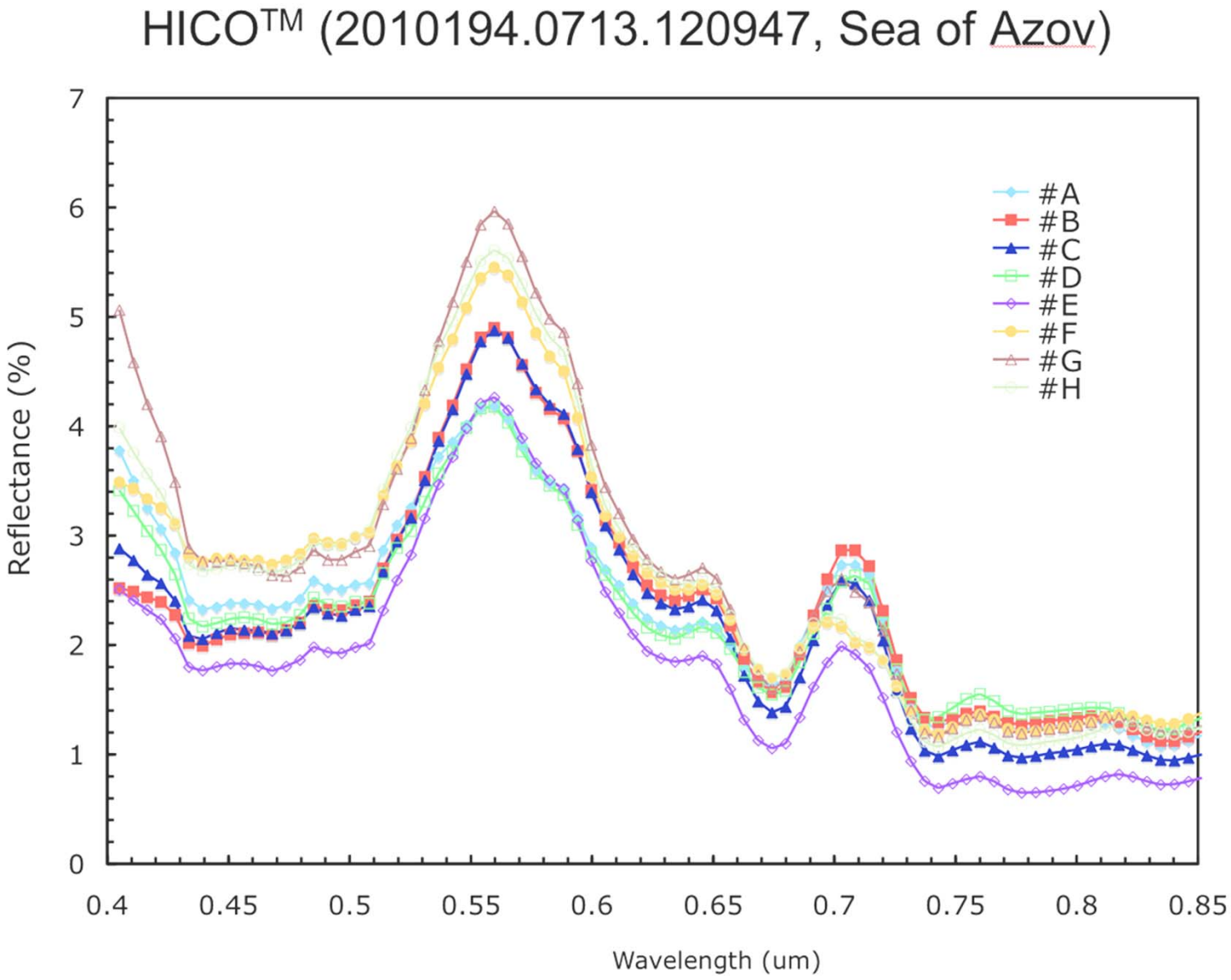


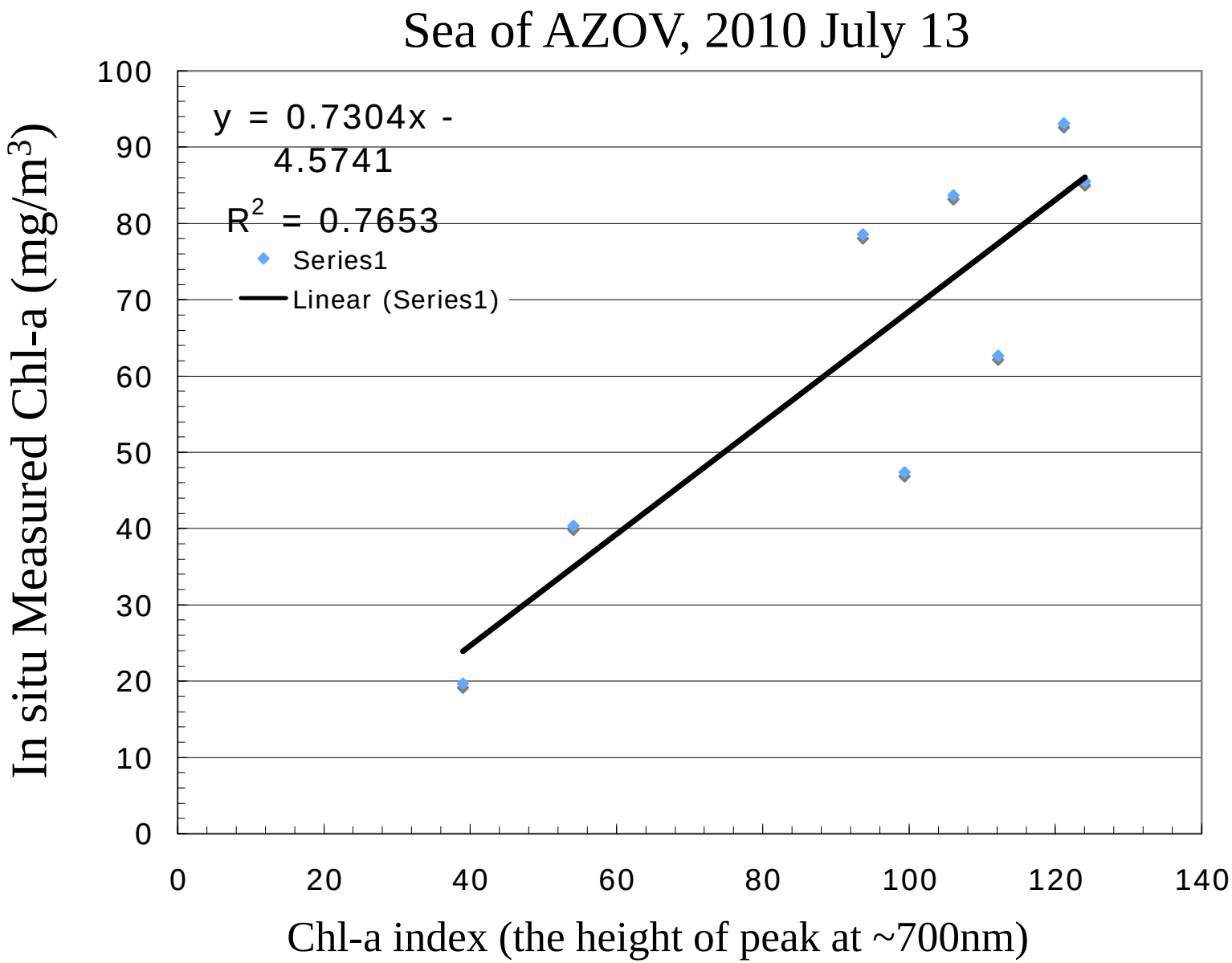
- Coincidently, there was a field campaign over sea of Azov by Russian scientists and HICO just collected data in the same regions. There was no prior coordination between the field campaign and HICO data acquisition.
- Field data collection campaign: July 13 to 15 , 2010 over Taganrog Bay and the Azov Sea

- The chlorophyll-a concentration was measured through extraction in hot ethanol by the crew at Southern Scientific Center of Russian Academy of Sciences, Russia.
- The measured chlorophyll-a data was provided by professor Anatoly Gitelson at the University of Nebraska-Lincoln

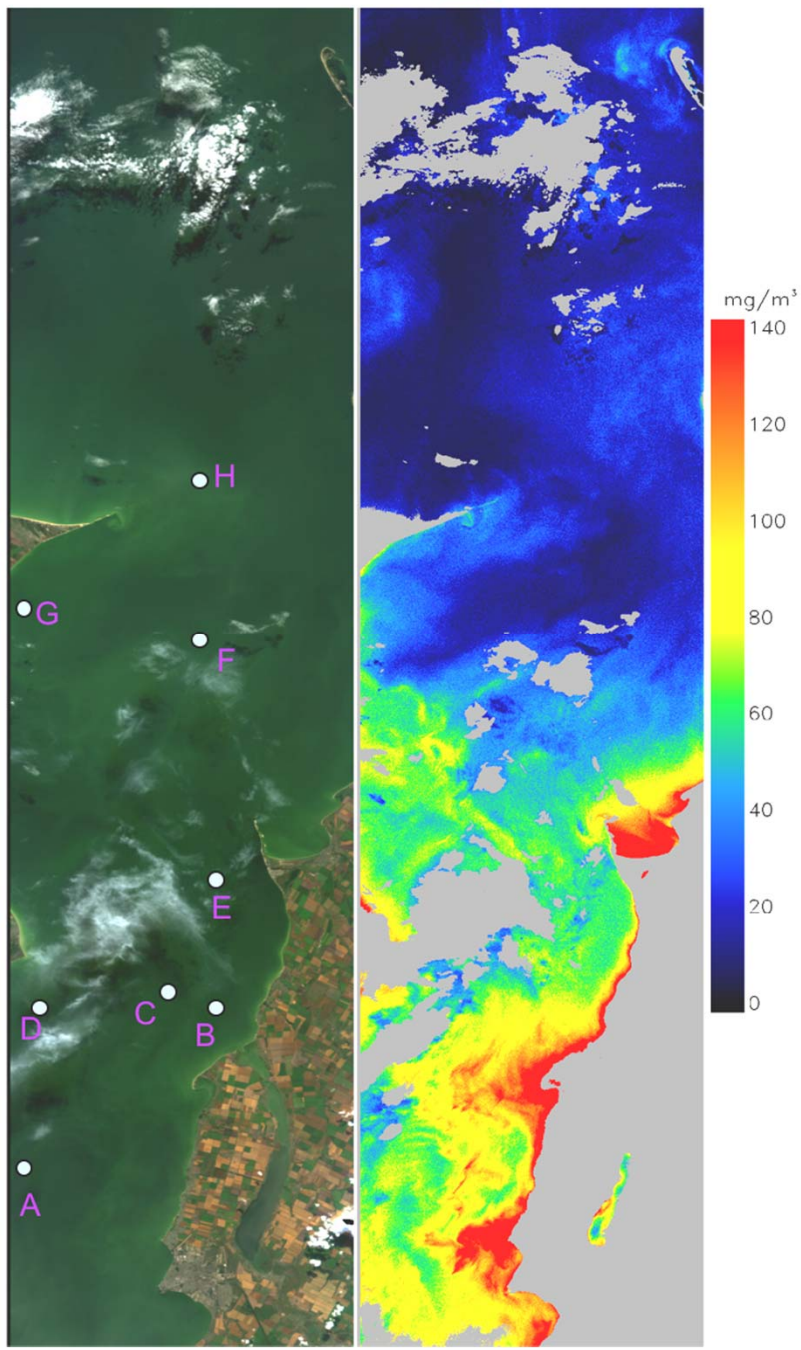


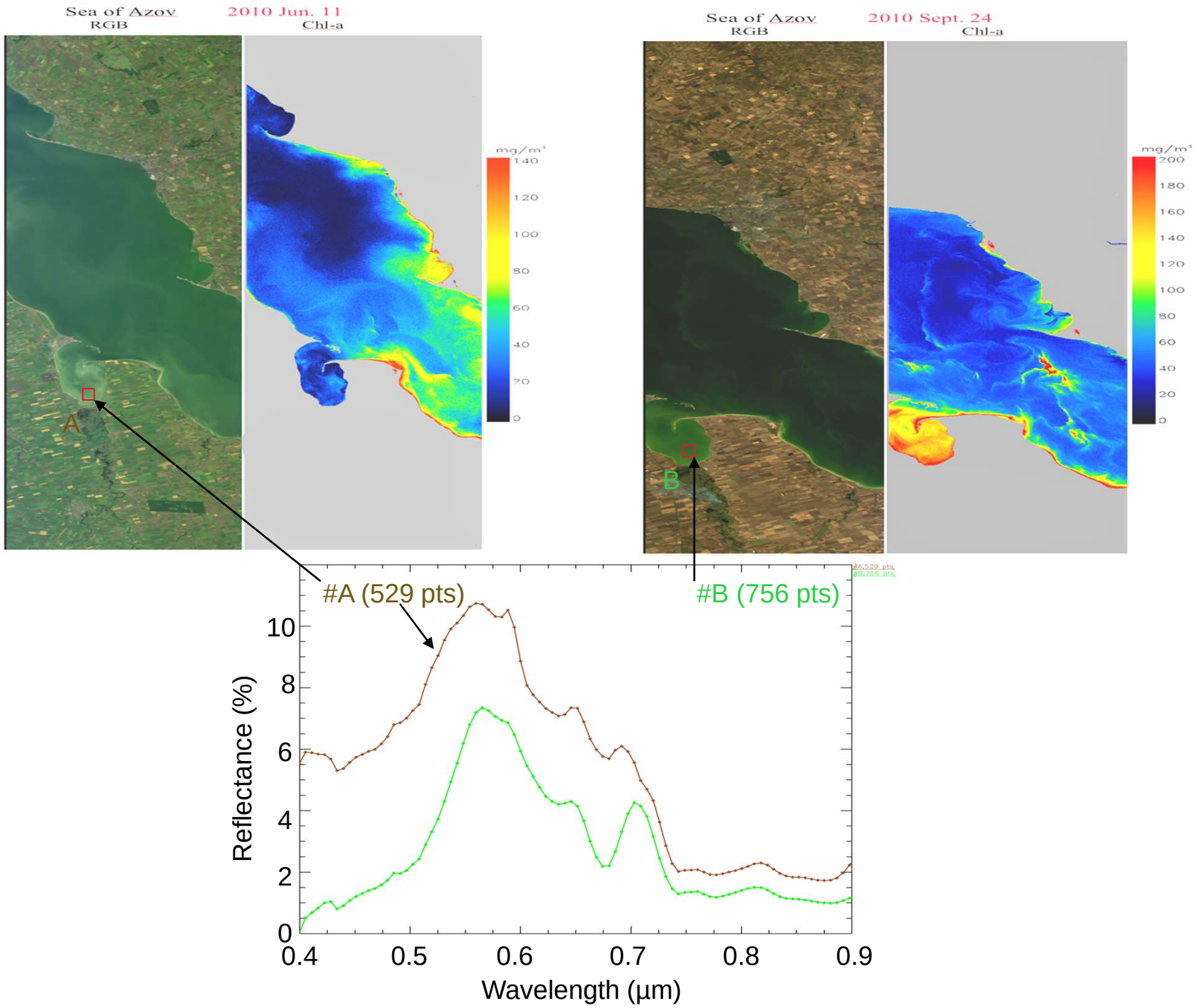

H
G
F
E
D
C
B
A


HICO™ (2010194.0713.120947, Sea of Azov)
Reflectance (%)
Wavelength (um)
0
1
2
3
4
5
6
7
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
#A
#B
#C
#D
#E
#F
#G
#H


Sea of AZOV, 2010 July 13
y = 0.7304x - 4.5741
R2 = 0.7653
Series1
Linear (Series1)
In situ Measured Chl-a (mg/m3)
Chl-a index (the height of peak at ~700nm)
0
10
20
30
40
50
60
70
80
90
100
0
20
40
60
80
100
120
140

Sea of Azov 2010 July 13




Sea of Azov
RGB
2010 Jun. 11
Chl-a
mg/m³
140
120
100
80
60
40
20
0
A
Sea of Azov
RGB
2010 Sept. 24
Chl-a
mg/m³
200
180
160
140
120
100
80
60
40
20
0
B
#A (529 pts)
#B (756 pts)
Reflectance (%)
0
2
4
6
8
10
0.4
0.5
0.6
0.7
0.8
0.9
Wavelength (µm)

Summary

- High spatial resolution ocean color products, such as chlorophyll-a concentration and diffuse attenuation coefficients (Kd490) are generated from HICO data sets.
- The algorithm can be used to generate the ocean color products for HICO in near real time.
- Refinement and validation of these ocean color products are needed to improve accuracies and precisions.
- A new model for high chlorophyll-a concentration in the high latitude region is presented. A larger data sets are needed to adjust the model parameters and to verify the results.

Thank You!