Comparison of MODIS and SeaWiFS Chlorophyll Products

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MODIS Science Team Meeting
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Collaborators and Team Members (*students)

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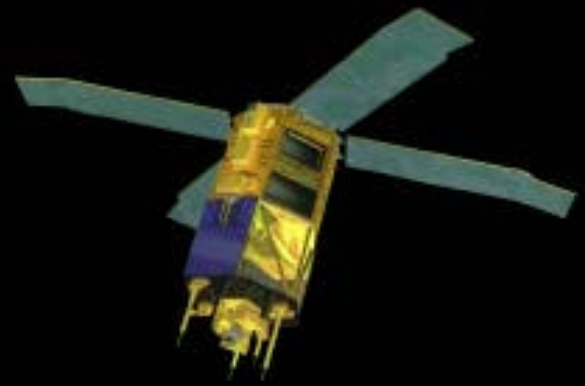
MODIS Chlorophylls:

- Chlor_MODIS (MOD19: Dennis Clark)
- Chlor_a_2 (MOD21:Janet Campbell)
- Chlor_a_3 (MOD21: Ken Carder)

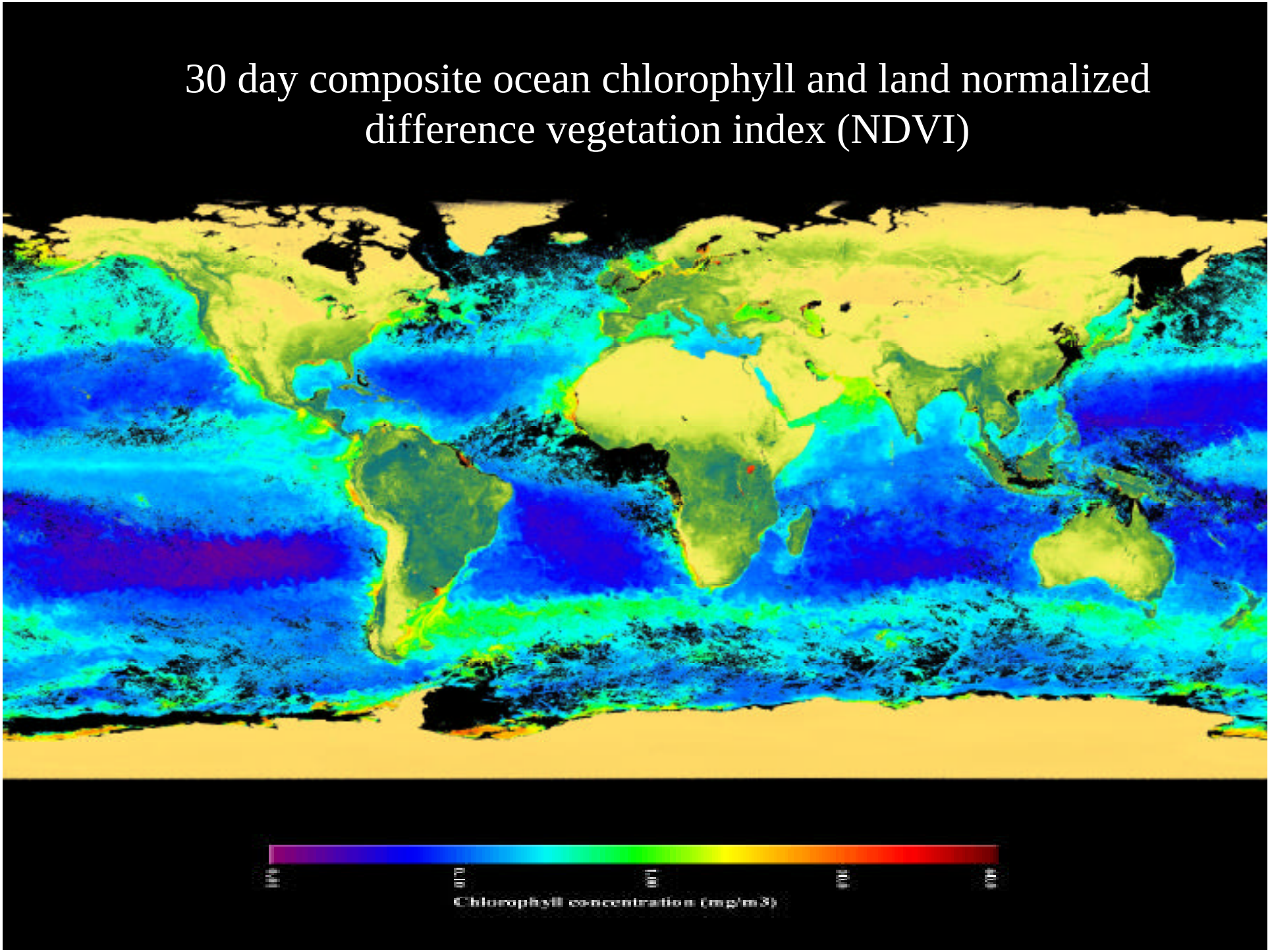
SeaWiFS Chlorophyll:

- OC4.v4 John E. O'Reilly
  (NASA TM 2000-206892, Vol. 11)

The Sea-viewing Wide Field-of-view Sensor (SeaWiFS) was launched in August 1997. It continues to operate and produce ocean color and land color data.



30 day composite ocean chlorophyll and land normalized difference vegetation index (NDVI)



Why so many MODIS chlorophylls? What's the difference?

Originally there were 2 algorithms:

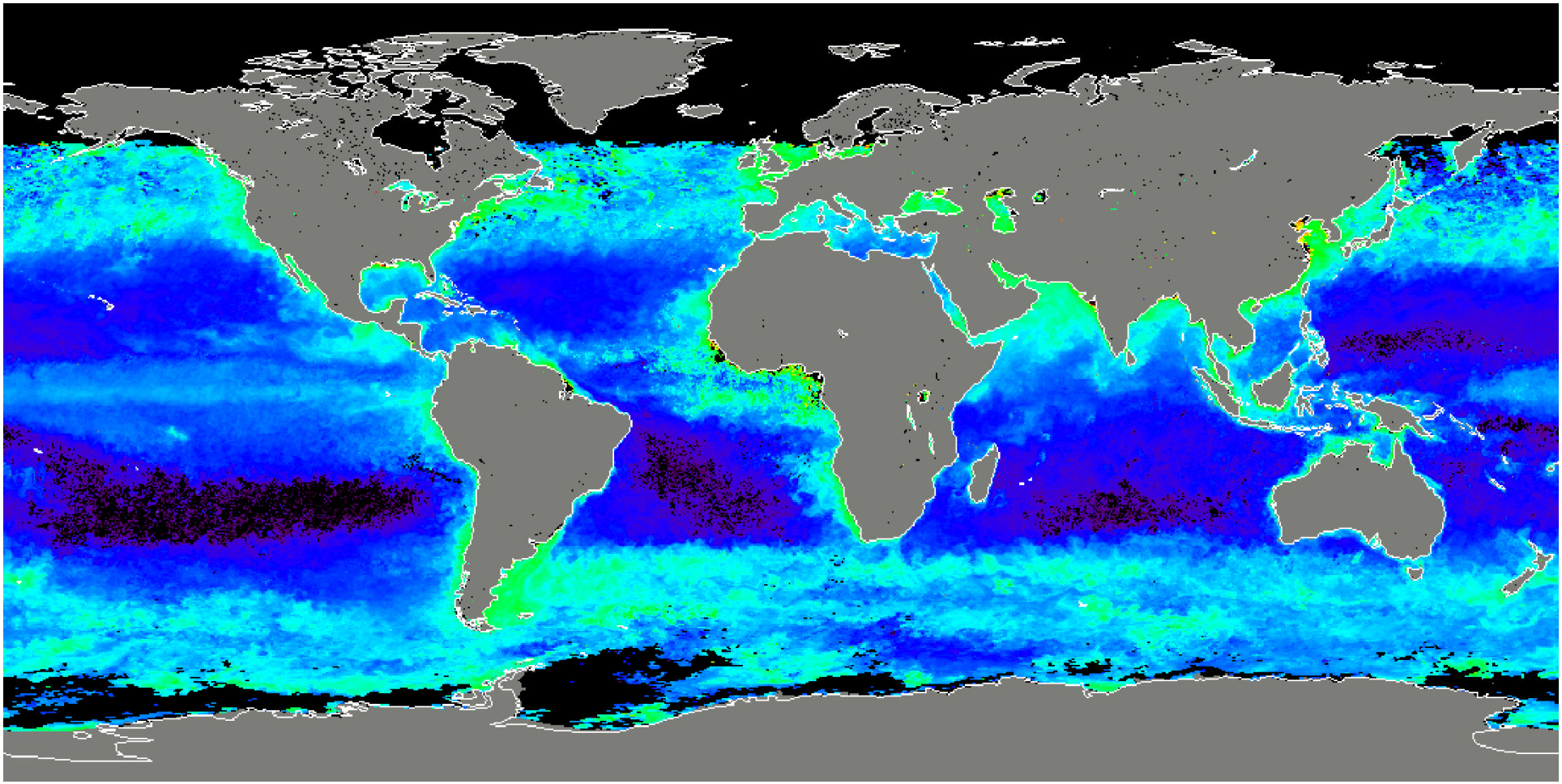
- "Case 1" waters: Chlor_MODIS (Clark)

  This is an empirical algorithm based on the 443:551 band ratio …. following the CZCS approach

- "Case 2" waters: Chlor_a_3 (Carder)

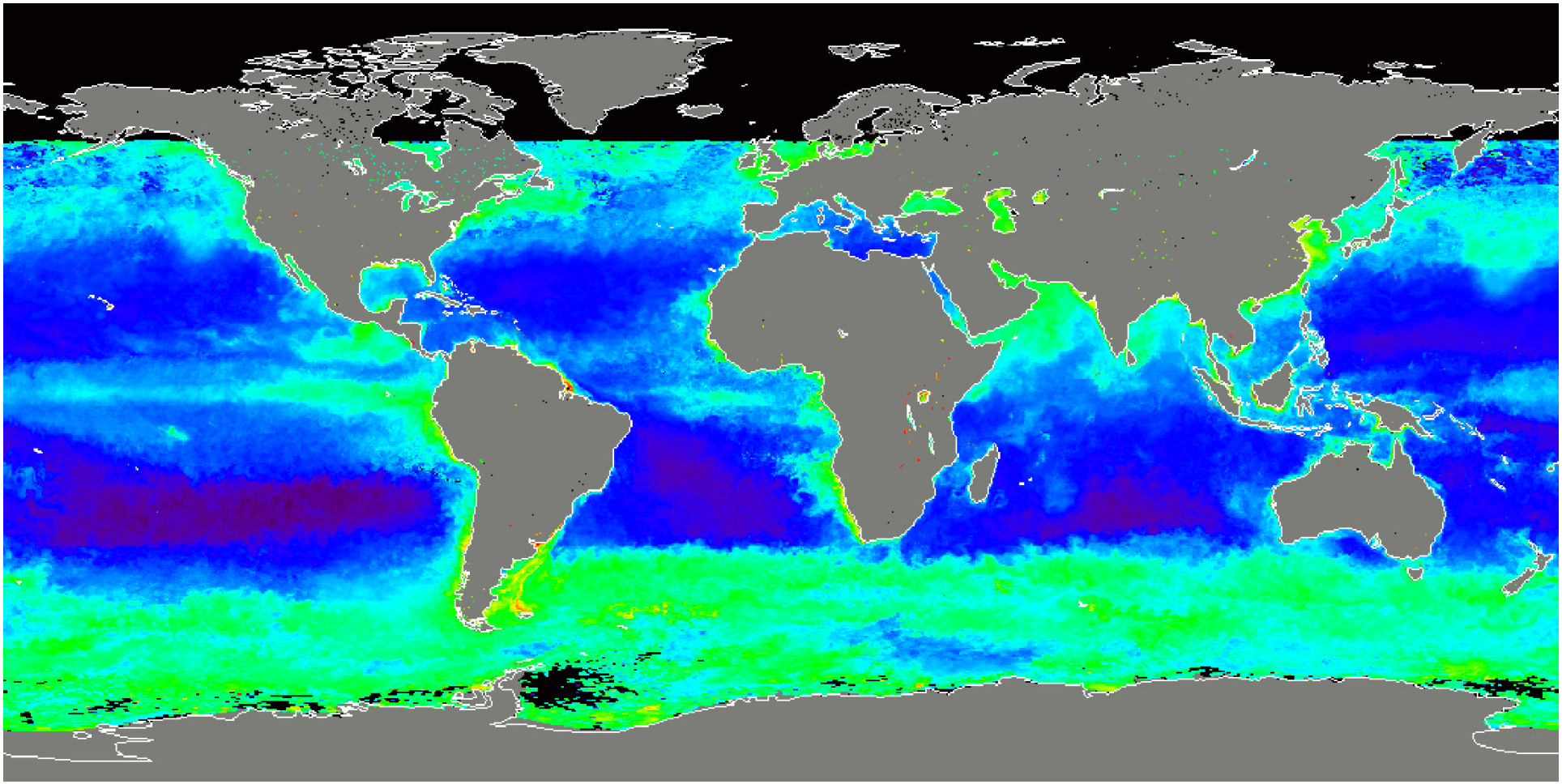
  This is a semi-analytic (model-based) inversion algorithm. This approach is required in optically complex "case 2" (coastal) waters.

Chlor_MODIS December 2000



This algorithm was based on regression involving HPLC chlorophyll(s). n=93, r^2=0.915, std error of estimate = 0.047.

Chlor_a_3 December 2000



This “semi-analytic” algorithm accounts for pigment packaging effects in nutrient-replete and nutrient-deplete conditions.

More recently a 3rd algorithm was added:

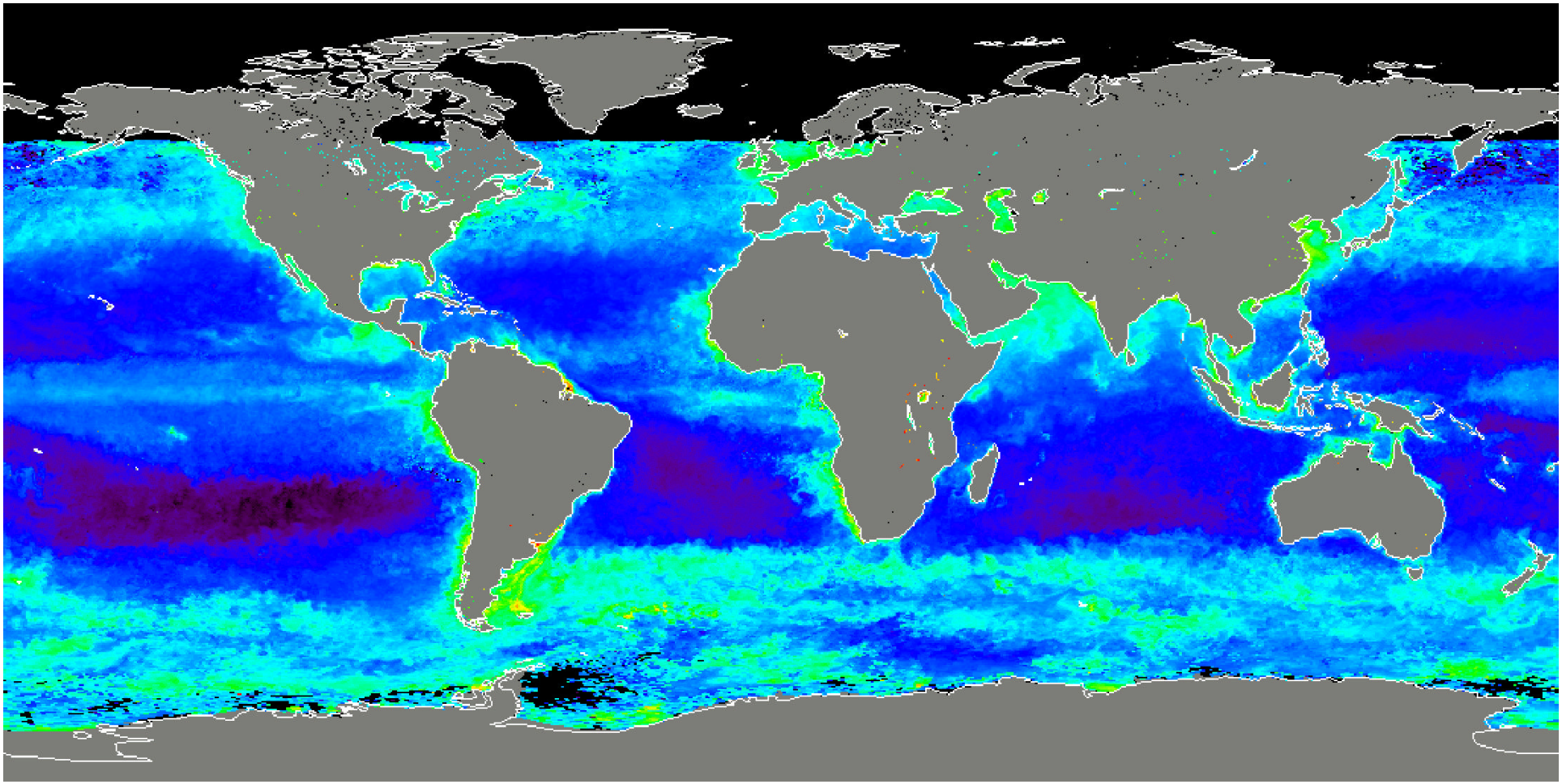
- “SeaWiFS-compatible” Chlor_a_2 (Campbell)

  This is an empirical algorithm using the 443:551 and 488:551 band ratios whichever is greater.

- SeaWiFS algorithm OC4.v4 (O’Reilly)

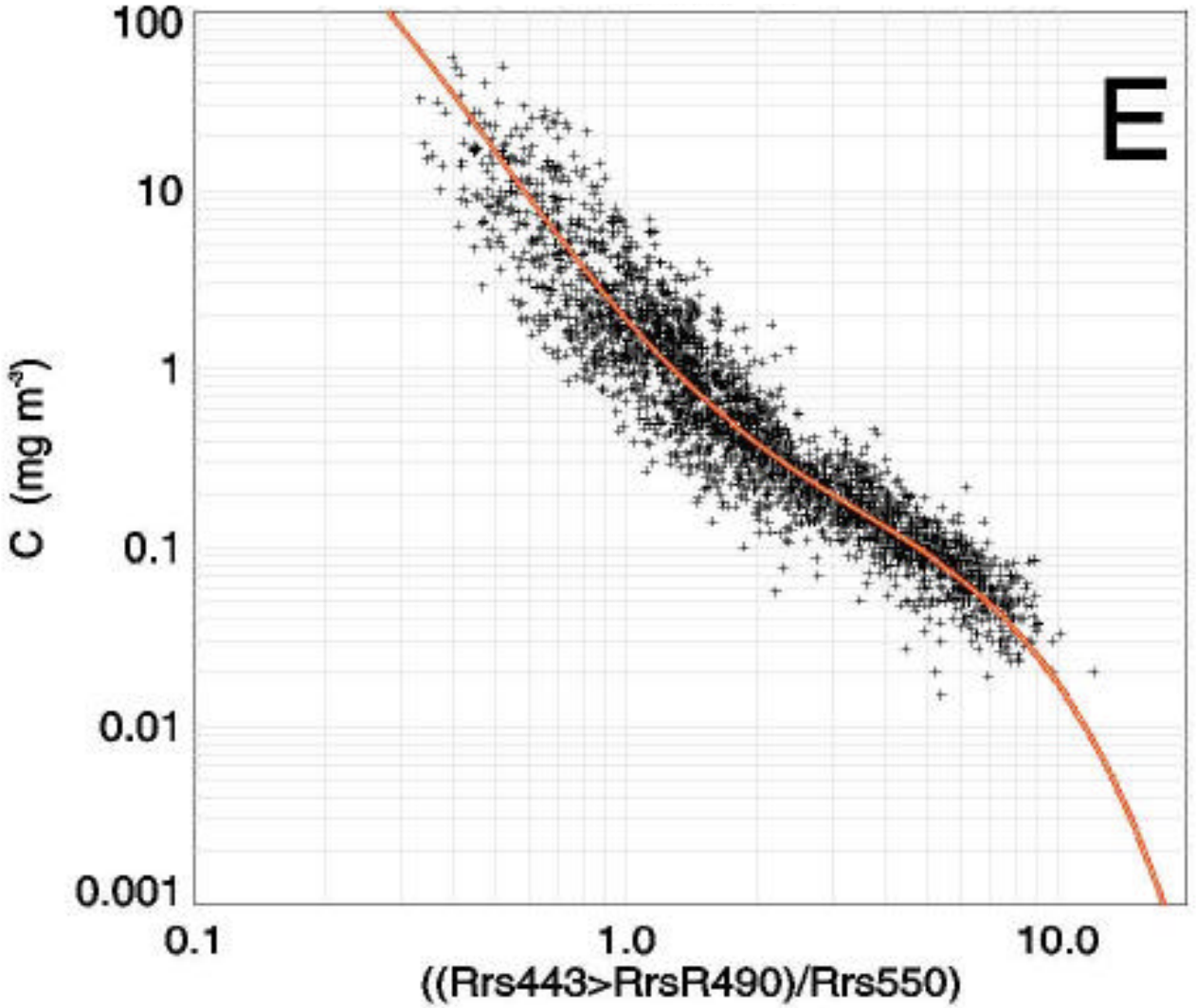
  This is an empirical algorithm using the 443:555, 490:555 and 510:555 band ratios whichever is greater.

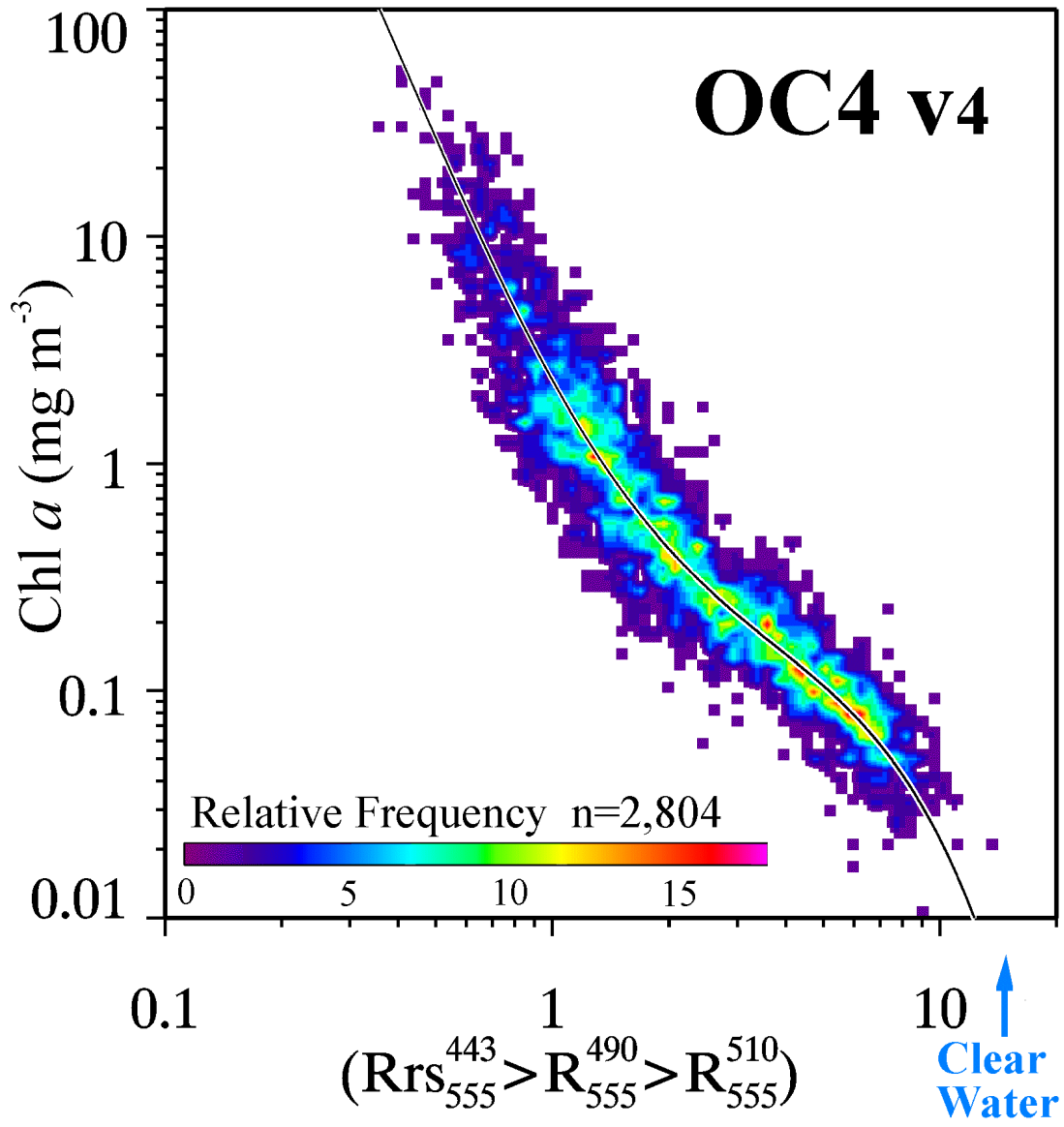
Chlor_a_2 December 2000



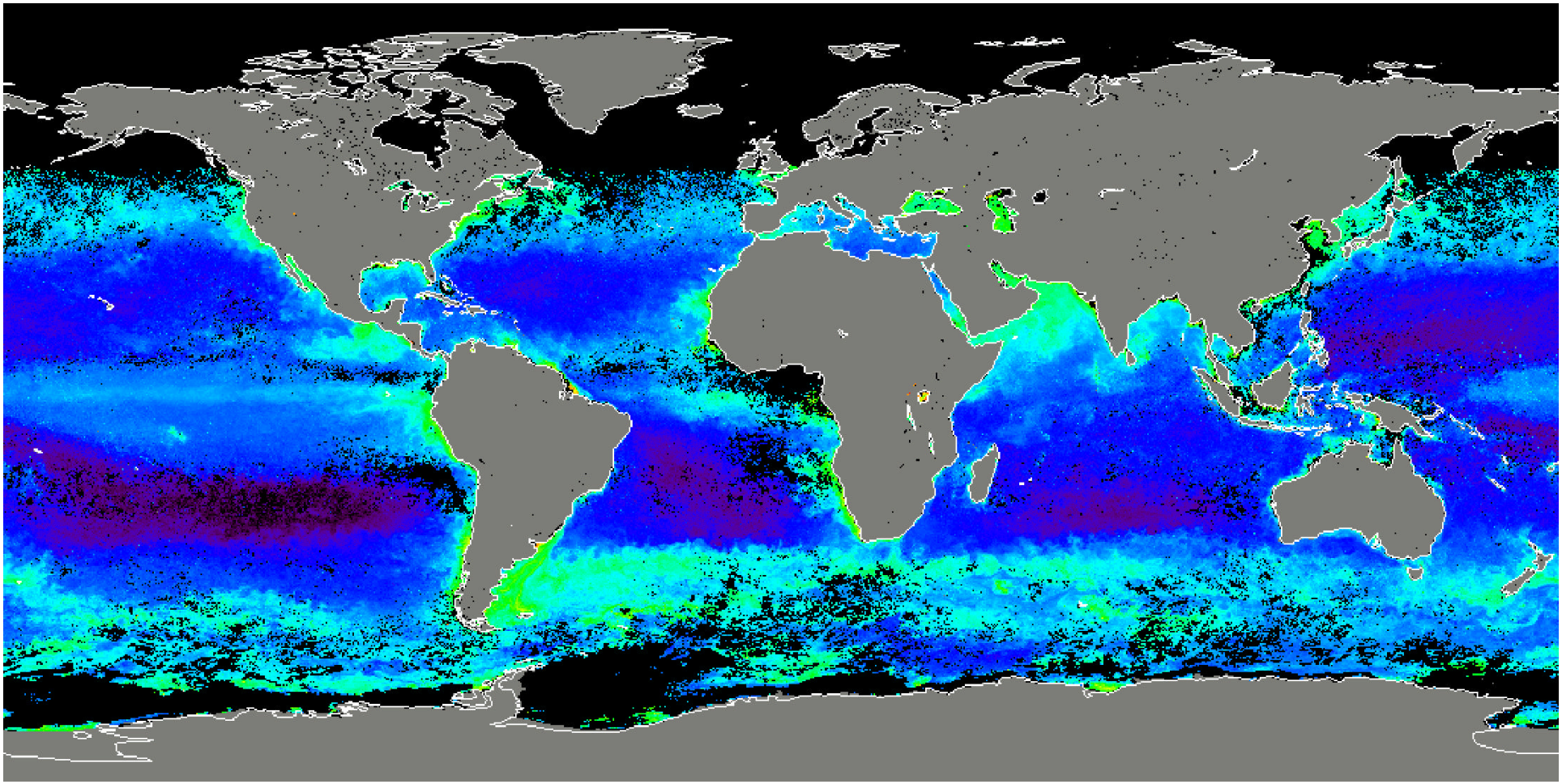
This “SeaWiFS compatible” algorithm is based on the same data set used to parameterize the SeaWiFS algorithm.

The Chlor_a_2 algorithm was proposed by the developers of the OC4.v4 SeaWiFS algorithm. It was called OC3M (3 band, M for MODIS)



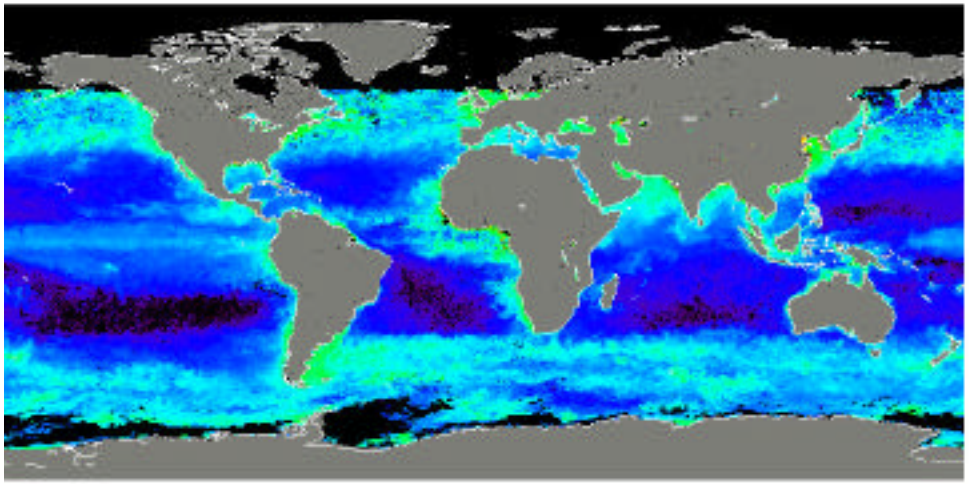

OC4 v4
100
10
1
0.1
0.01
Chl a (mg m-3)
Relative Frequency n=2,804
0
5
10
15
0.1
1
10
(Rrs443555>R490555>R510555)
Clear
Water

SeaWiFS December 2000

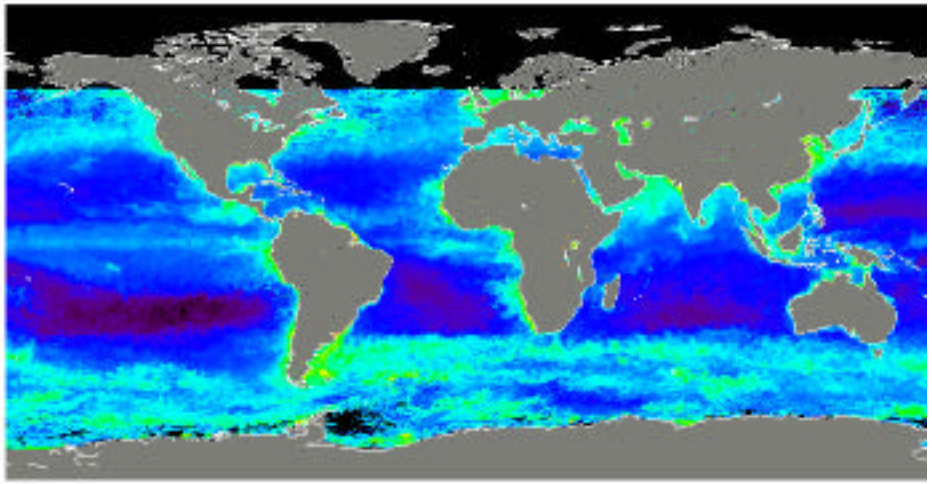


chlorophyll - DAAC

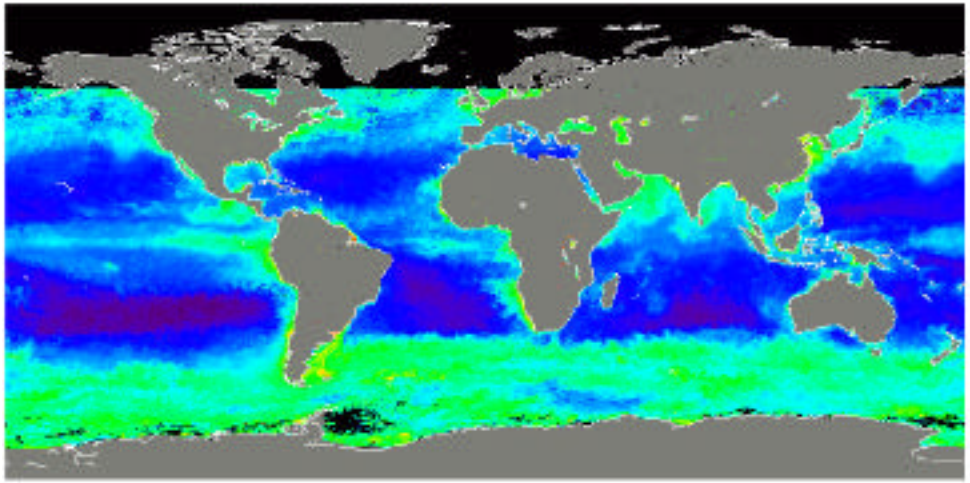
Chlor_modis



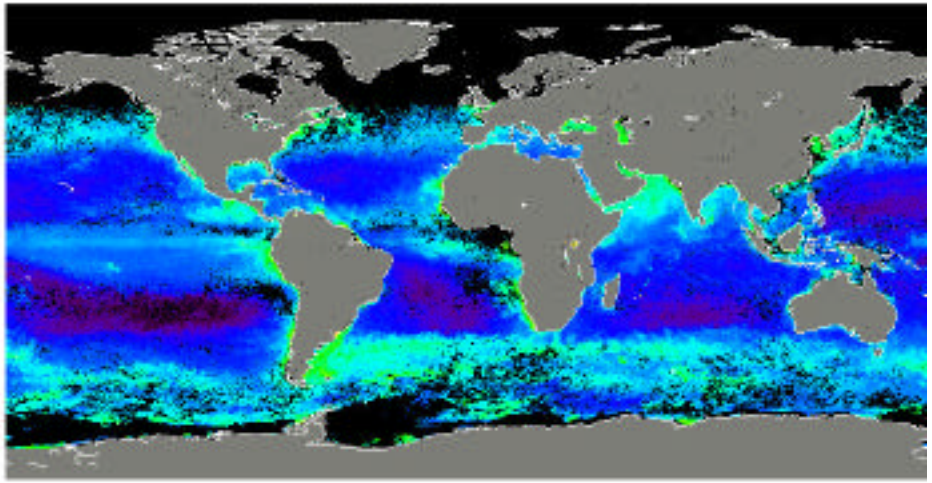
Chlor_a2



Chlor_a3



SeaWiFS



December 2000

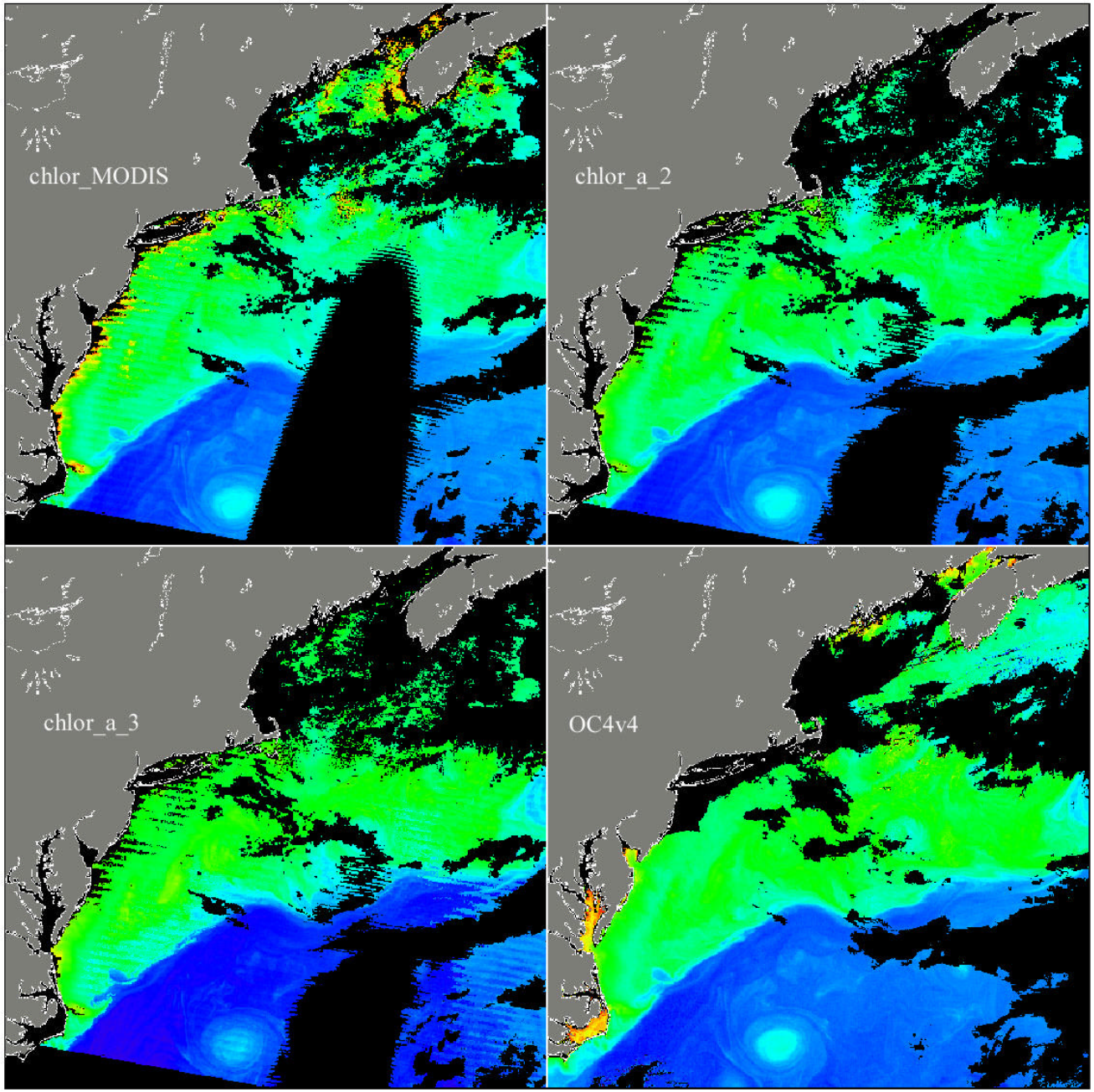
Chloroophyll

mg/m^3

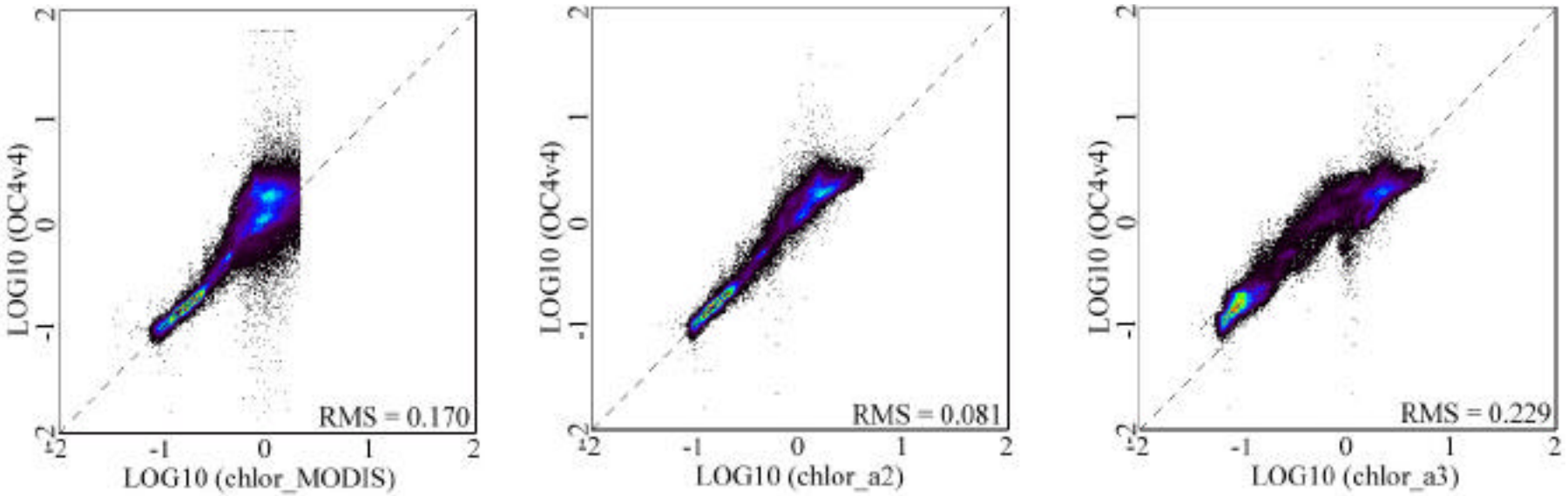
- 0.05
- 0.2
- 0.5
- 1.0
- 2.0
- 5.0
- 10
- 20
- >30

MODIS scene A2000.129.1545
SeaWiFS scene S2000129165158

v7.2 5apol

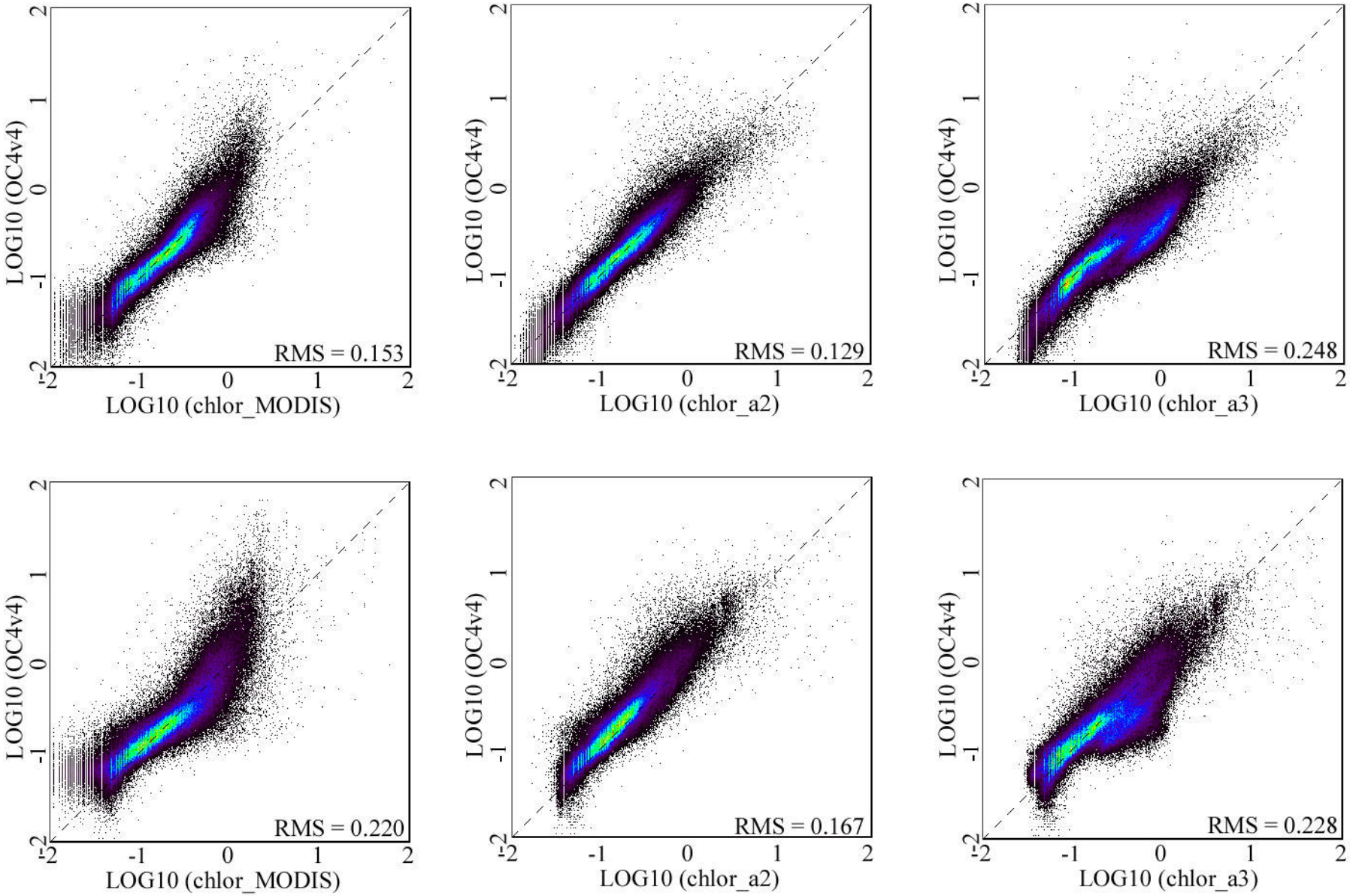


SeaWiFS Chlorophyll



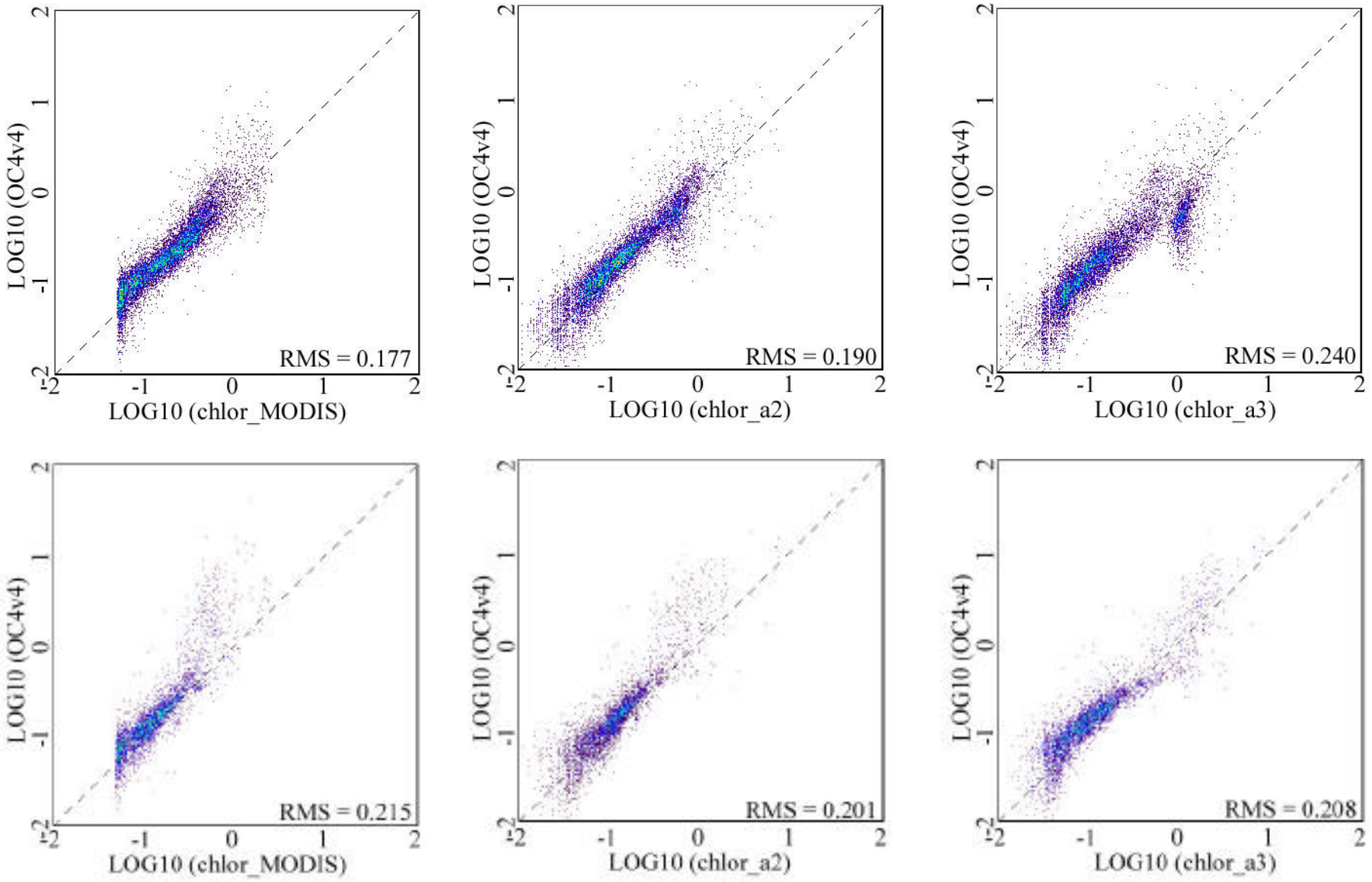
May 8, 2000. Full-resolution (1-km) scene off U.S. East Coast.

SeaWiFS Chlorophyll



Top row: Global Dec. 2000. Bottom row: Global Aug. 2001.
Both are 36-km products from the DAAC.

SeaWiFS Chlorophyll



Top row: Dec. 4, 2000. Bottom row: June 10, 2001.
Both are global daily 36-km products.

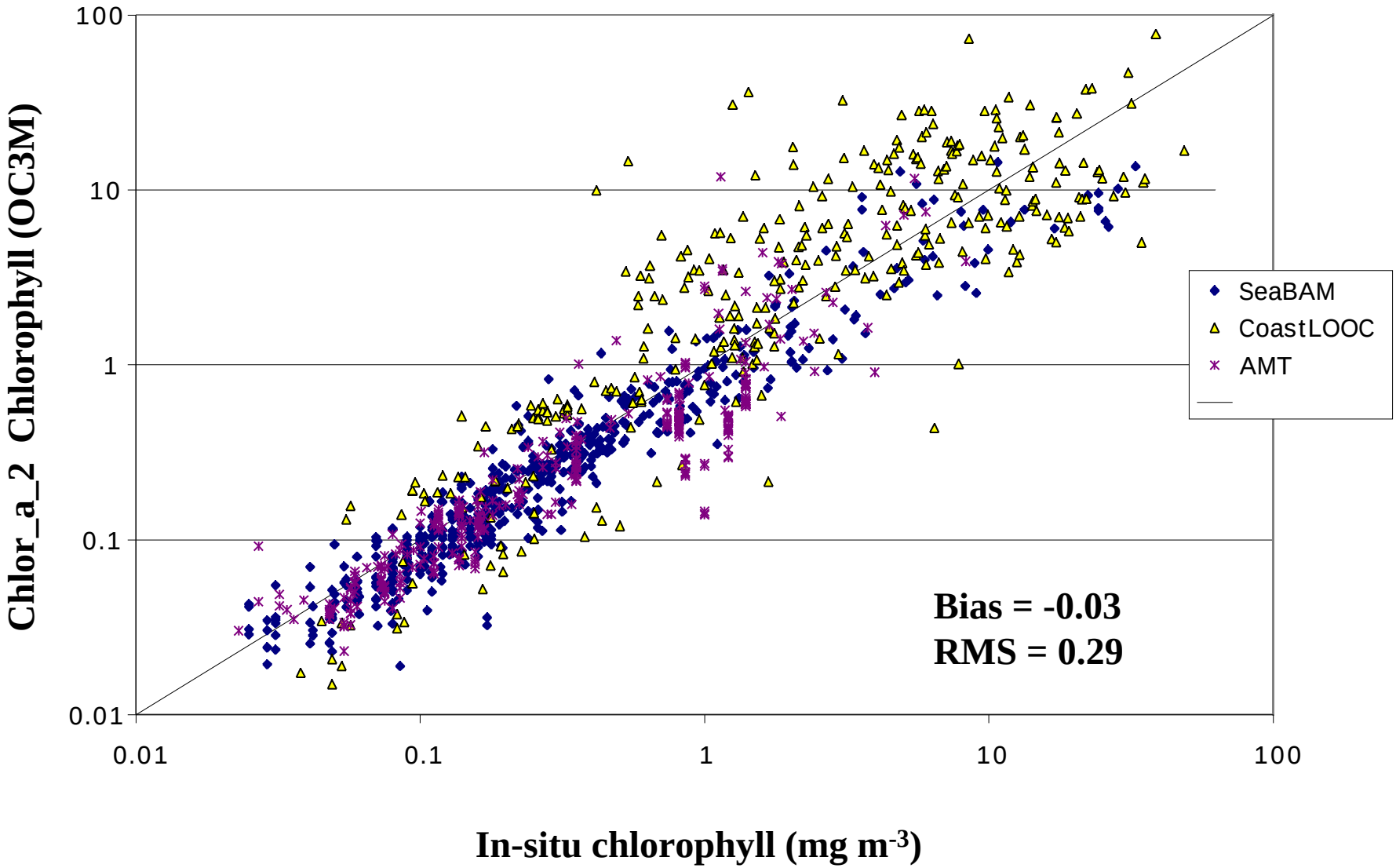
Our approach is to test algorithms using in-situ data

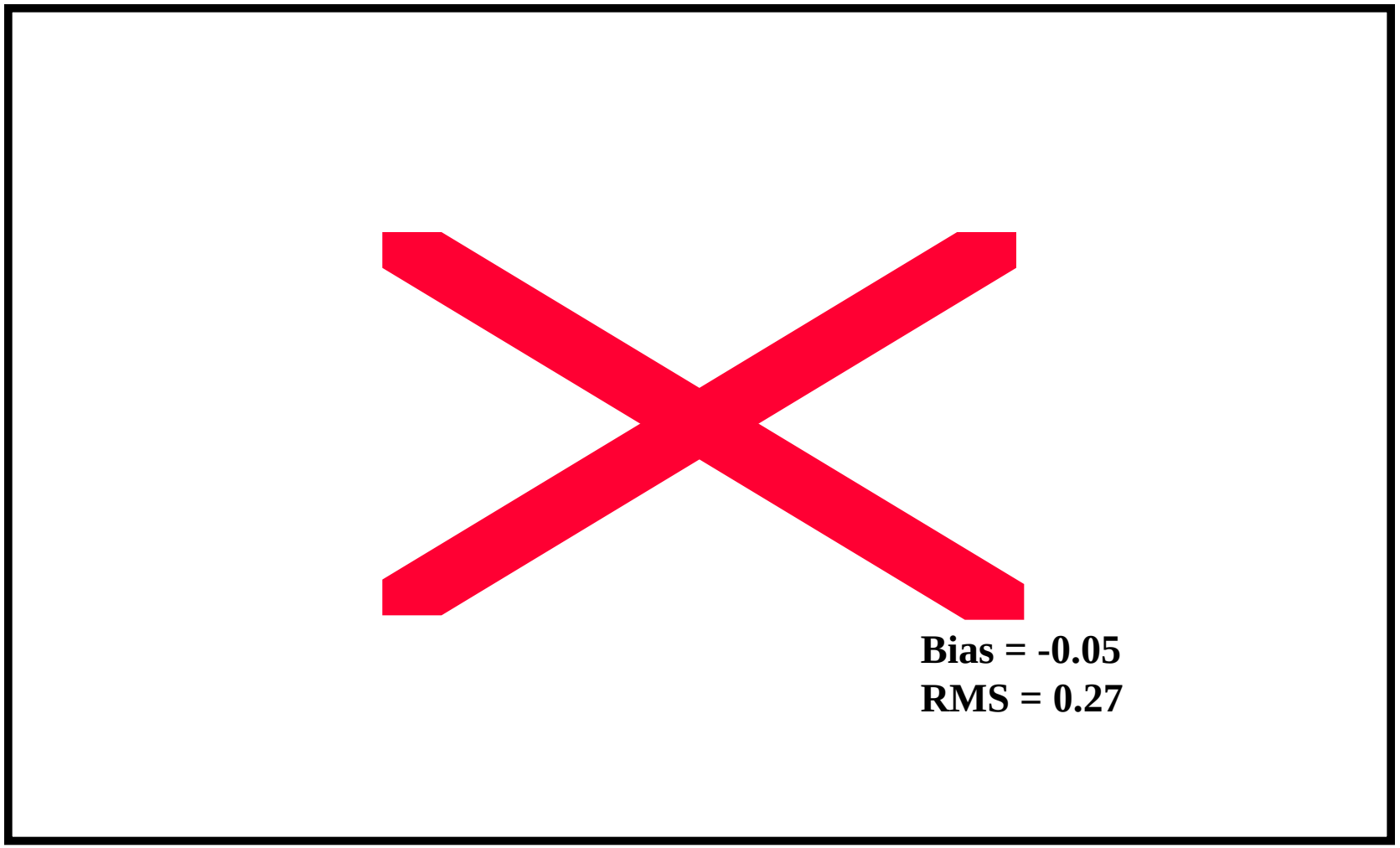
In-situ Data: We have combined three in-situ data sets of reflectance and chlorophyll data for a total of n = 1,229 stations.

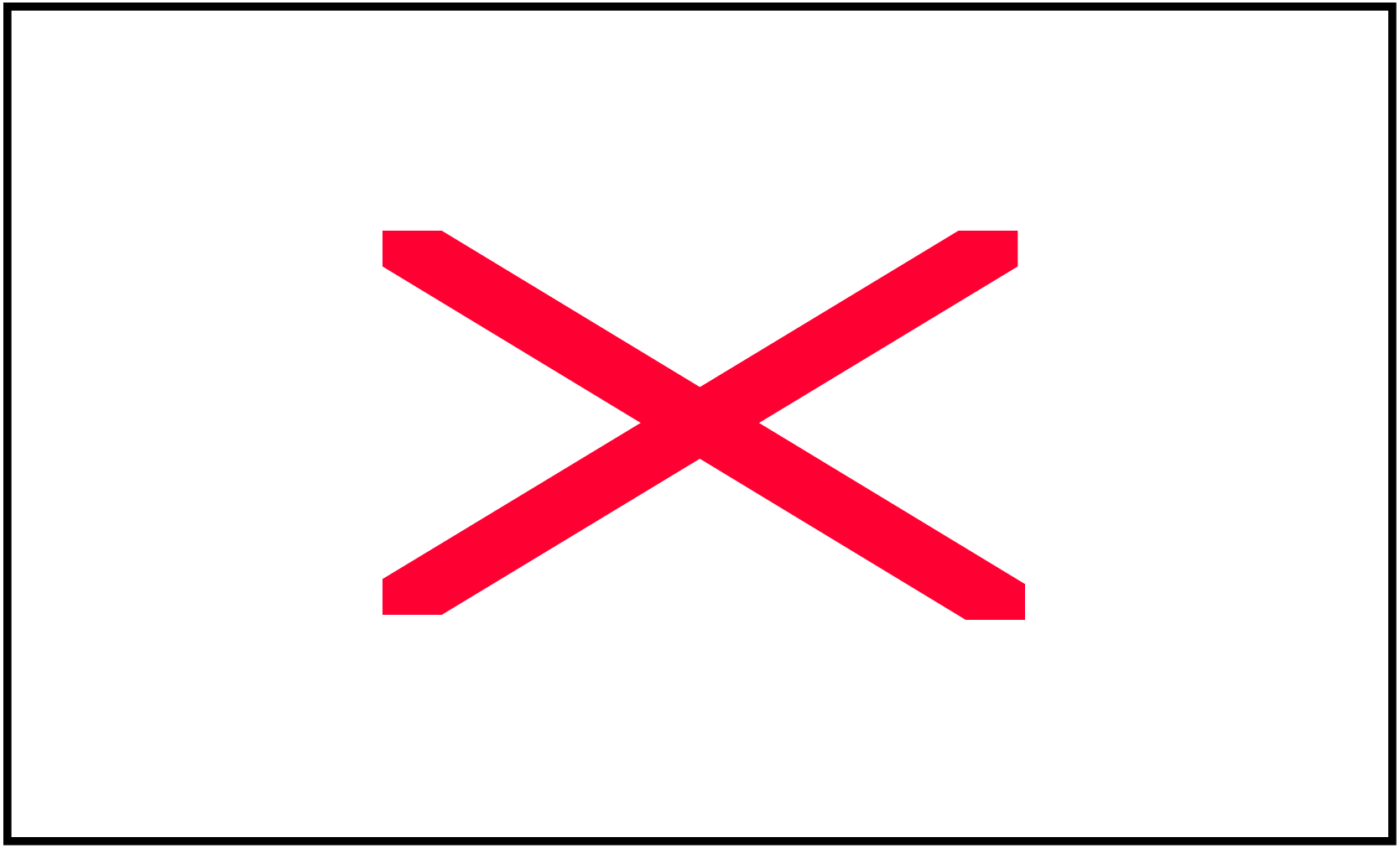
1. Subset of the original SeaBAM data which had measurements at 443, 490, and 510 nm (n = 539)

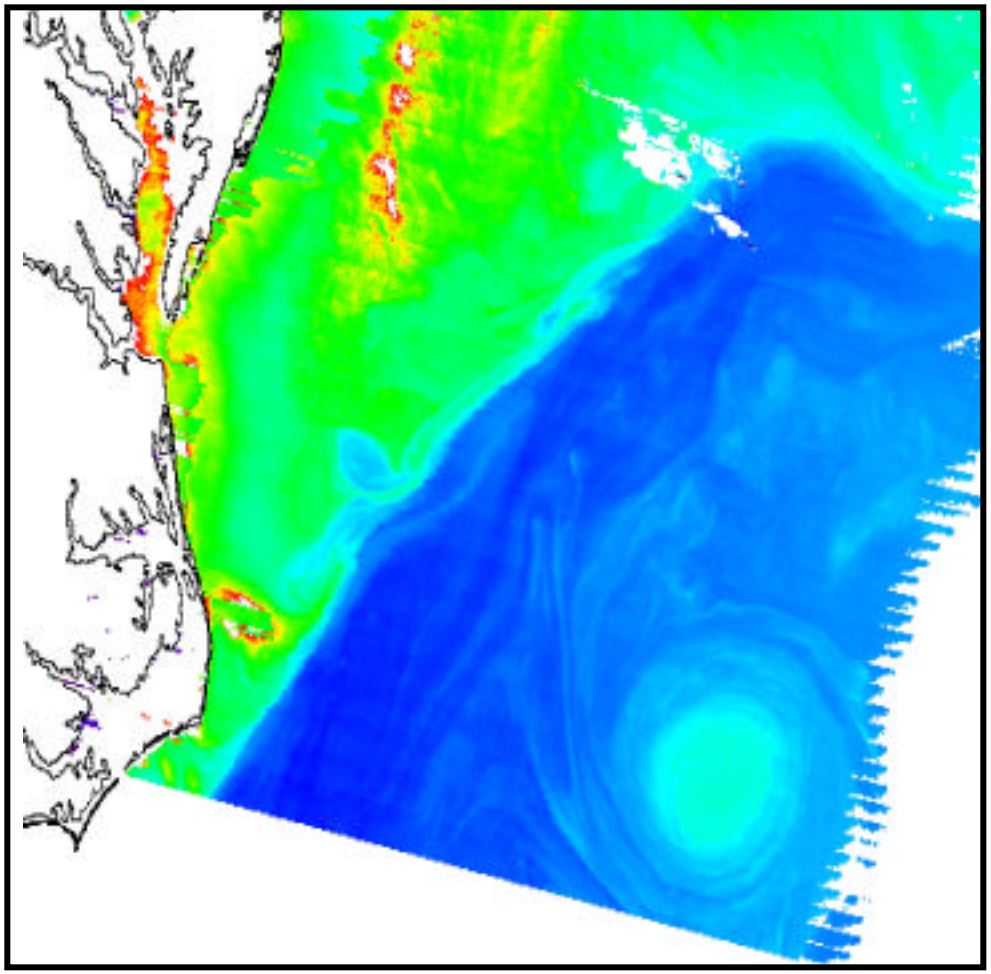
2. COASTLOOC data from European coastal waters (n = 324)

3. AMT cruise data obtained from SeaBAS (n = 366)

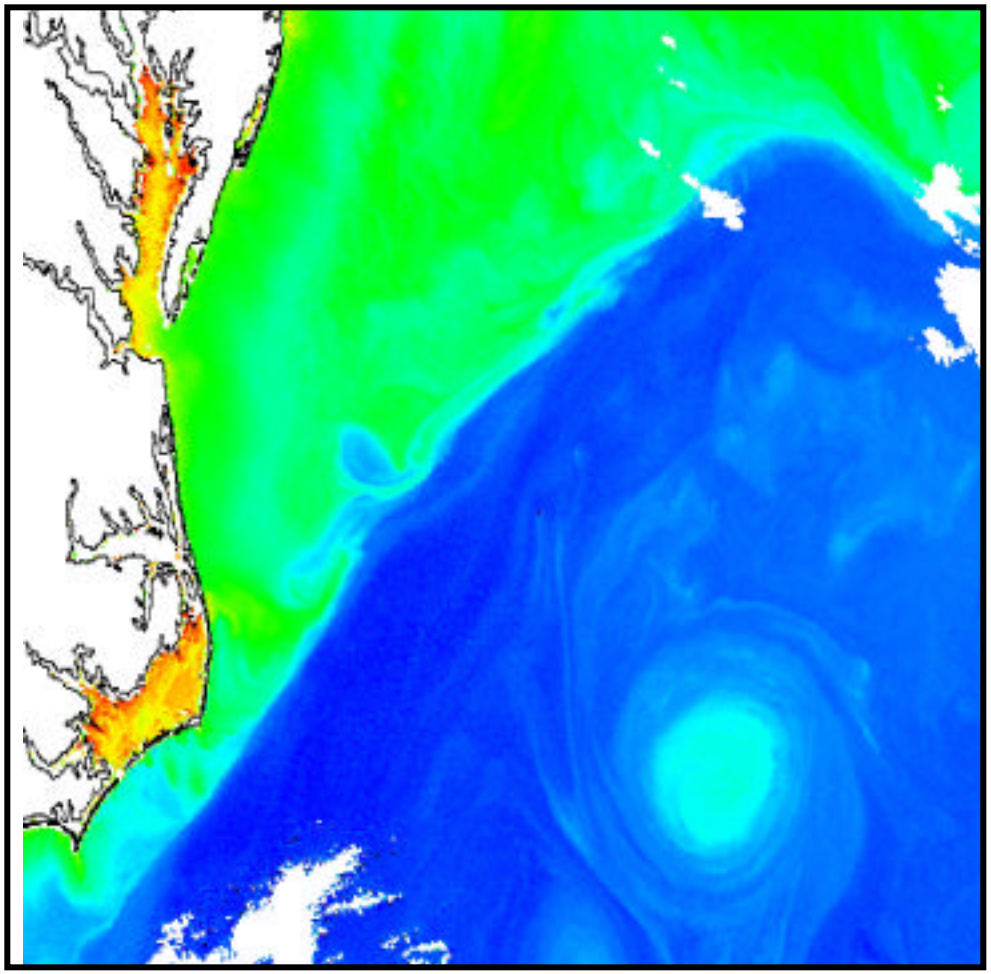

Chlor_a_2 Chlorophyll (OC3M)
100
10
1
0.1
0.01
0.01
0.1
1
10
100
In-situ chlorophyll (mg m-3)
SeaBAM
CoastLOOC
AMT
Bias = -0.03
RMS = 0.29


SeaWiFS Chlorophyll (OC4.v4)
Bias = -0.05
RMS = 0.27
In-situ chlorophyll (mg m-3)

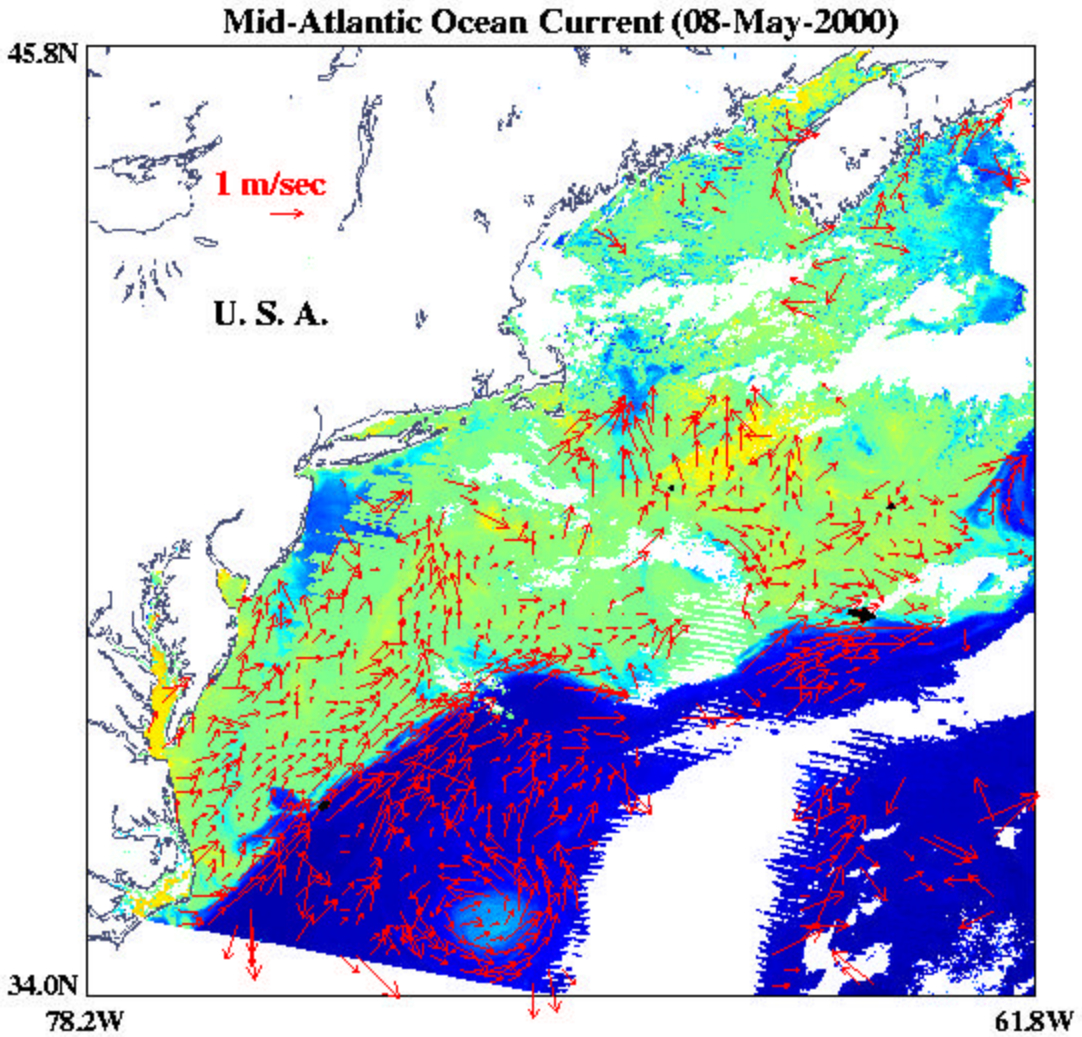

Chlor_a_2 Chlorophyll (OC3M)
SeaWiFS Chlorophyll



MODIS Chlorophyll: May 8, 2000 10:45 am



SeaWiFS Chlorophyll: May 8, 2000 11:51 am



“Ocean Surface Layer Drift Revealed by Satellite Data”

Antony K. Liu, Yunhe Zhao, Wayne E. Esaias,
Janet W. Campbell and Timothy S. Moore

(in press, EOS Transactions Newsletter)

CONCLUSIONS

- MODIS and SeaWiFS chlorophylls agree reasonably well. RMS ~ 0.2 log units
- RMS ~ 0.3 log units when comparing MODIS or SeaWiFS with in-situ chlorophyll measurements.
- The differences (Chlor_a_3 vs. SeaWiFS) can be explained in terms of pigment packaging, or surface layer drift (e.g. Liu et al. 2001).
- The Chlor_a_2 product is ready to be validated after the next reprocessing. By definition, if it is compatible with SeaWiFS, then it is valid.