Comparison of MODIS and SeaWiFS Chlorophyll Products

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

mg/m³
- 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 sapol
Both are 36-km products from the DAAC.
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 ($n = 366$)
In-situ chlorophyll (mg m$^{-3}$)

<table>
<thead>
<tr>
<th>Chlorophyll (OC3M)</th>
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<tbody>
<tr>
<td>0.01</td>
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<tr>
<td>0.1</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>100</td>
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</tbody>
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SeaBAM
CoastLOOC
AMT

Bias = -0.03
RMS = 0.29

In-situ chlorophyll (mg m$^{-3}$)
SeaWiFS Chlorophyll (OC4.v4)

In-situ chlorophyll (mg m\(^{-3}\))

Bias = -0.05
RMS = 0.27
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.