Experiences in building a Southern Ocean chlorophyll algorithm – Mati Kahru, B. Greg Mitchell, SIO

Sub-tropical front
Sub-Antarctic front

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(Orsi et al. 1995)

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Background: Annual Chl-SPGANT 2013 merged from MODISA & VIIRS

SeaBASS (2009): in situ Chl and Rrs south of 55S: 1247 stations
Background: Annual Chl-SPGANT 2013 merged from MODISA & VIIRS
Southern Ocean Chl-a algorithm: Chl-SPGANT


Version 4, Kahru & Mitchell (2010), included all stations in SeaBASS south of 55S: total of 1247 stations

Conclusion: NASA OC4v4 chlor_a underestimates 2-3 x at $0.2 < \text{Chla} < 3 \text{ mg m}^{-3}$

Polynomial fits between log10 of Maximum Band Ratio (MBR) and Chla for SeaWiFS, MODISA, GLI, OCTS, MERIS
Southern Ocean Chl-a algorithm: SPGANT, continued...

• Where to apply SPGANT and where the standard OC algorithms?


• Combines MBR and location relative to STF

• South of STF for MBR > 5 use standard algorithm

• 3 < MBR < 5, \( w_{\text{MBR}} = (5.0 - \text{MBR})/2.0 \) and the weight of the standard algorithm is \( 1 - w_{\text{MBR}} \).

• ±500 km north-south of the mean STF: weight \( w_{\text{Geo}} \) changes from 1 in the south to 0 in the north

• Weight \( w = \min(w_{\text{Geo}}, w_{\text{MBR}}) \)

• \( \text{Chl}_{\text{Blended}} = \text{Chl}_{\text{SPGANT}} + (1 - w) \text{Chl}_{\text{OC}} \)
Blending of SO and standard algorithms

Example of application of the blending scheme. The white curves show the boundaries of the transition zone, ±500 km on either side of the mean position of the Subtropical Front (STF).

(a) Blending weight of the SO algorithm \((w)\) in a section of the Southern Ocean (December, 1997) depending on the maximum band ratio and distance from STF.

(b) Blended Chl-a map.

Blending of SO and standard algorithms

Example of application of the blending scheme: SeaWiFS, Dec-1997.

- Blended Chl-a

- Ratio SPGANT-blended/Standard Chl.
Some cruises/stations close to OC4 model!

Contemporaneous disequilibrium!

Note the Log/Log scale and in situ data! Contemporaneous disequilibrium of bio-optical properties
Thank you!
Obrigado!
HPLC total Chl-a vs fluorometric Chl-a

\[ Y = 0.011 + 0.853 \times X \]
\[ r^2 = 0.944, \text{ RMS} = 0.165 \]
\[ \text{BIAS} = -0.051 \]
\[ N = 838 \]

\[ Y = -0.056 + 0.988 \times X \]
\[ r^2 = 0.970, \text{ RMS} = 0.090 \]
\[ \text{BIAS} = -0.048 \]
\[ N = 838 \]
Chl-a: <0.1 \ldots 10, i.e. 100 x variation

\approx 1000 \text{ km} \times \approx 1000 \text{ km}

10 \times 10 \text{ km}
State of the art of retrieving IOPs from space. CDR?

A

Time series of GIOP-DC $aph443$ from MODISA (blue) and VIIRS (black) in the Pacific, Atlantic and Indian sectors of the Southern Ocean. Partition between $aph$ and $adg$ → similar issues with $adg$.
HPLC problems at CHORS

Correction is possible for total Chl-a. Duplicate samples were analyzed at Horn Point Labs and correction was applied by B.G. Mitchell

\[
y = 1.017x - 0.0114 \\
R^2 = 0.9148
\]
Absorption and Backscattering in the SO

Reynolds et al. 2001:

- Phytopankton absorption dominates at 443 nm, CDOM is low
- Absorption drives 75–85\% of the changes in $R_{rs}$ band ratios with Chla
- Differences in Chl-specific backscattering are the primary cause for regional differentiation between two sites in the S. Ocean