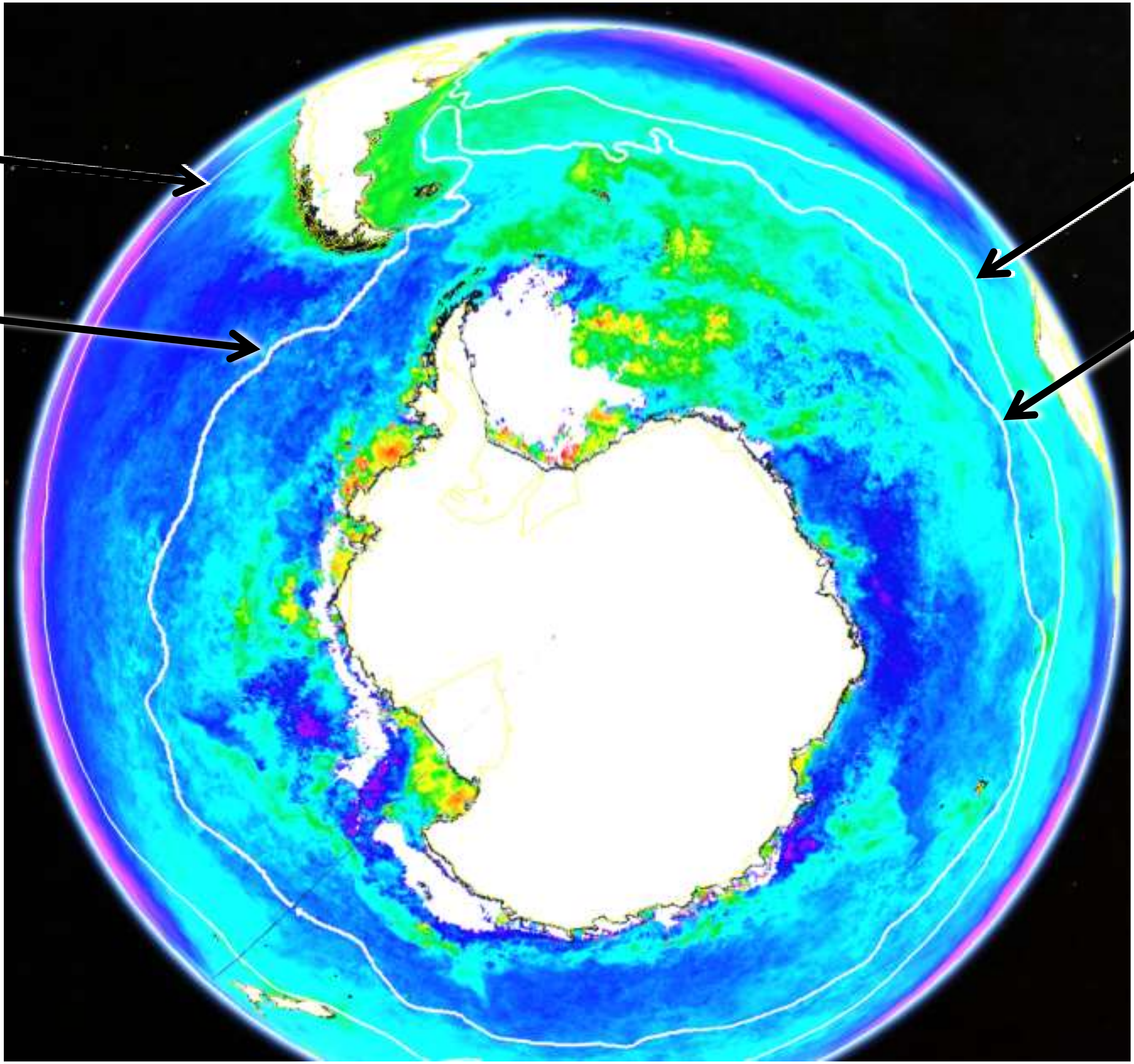
Experiences in building a Southern Ocean chlorophyll algorithm – *Mati Kahru, B. Greg Mitchell,* SIO



Sub-tropical front

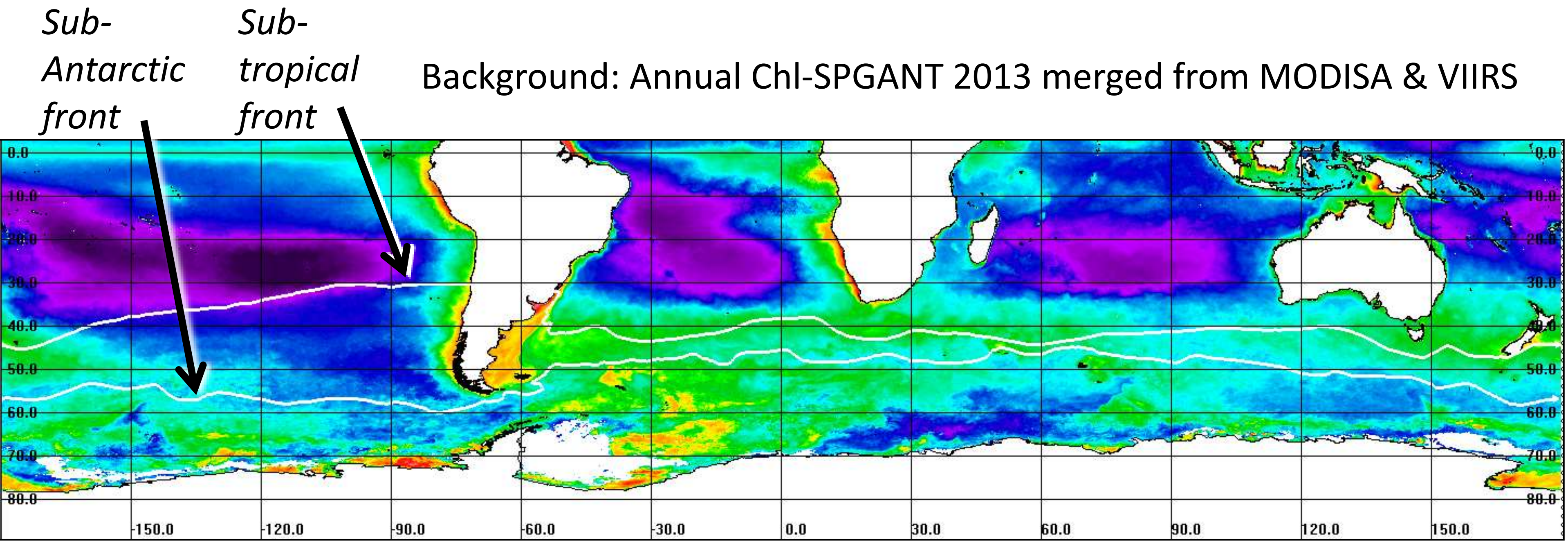
Sub-Antarctic front

Sub-tropical front

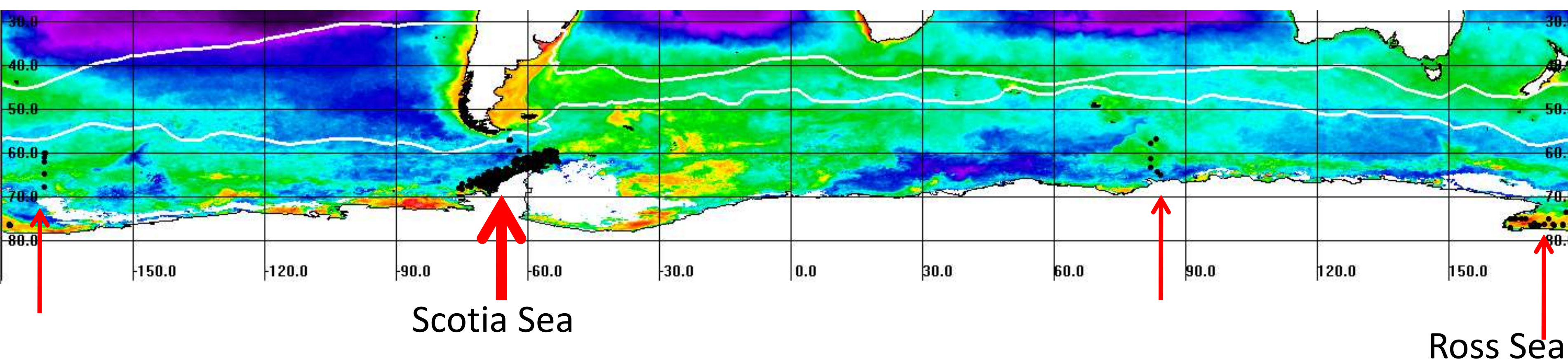
Sub-Antarctic front (Orsi et al. 1995)

IOCS, Lisbon, Portugal 16-May-2017

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



SeaBASS (2009): in situ Chl and Rrs south of 55S: 1247 stations



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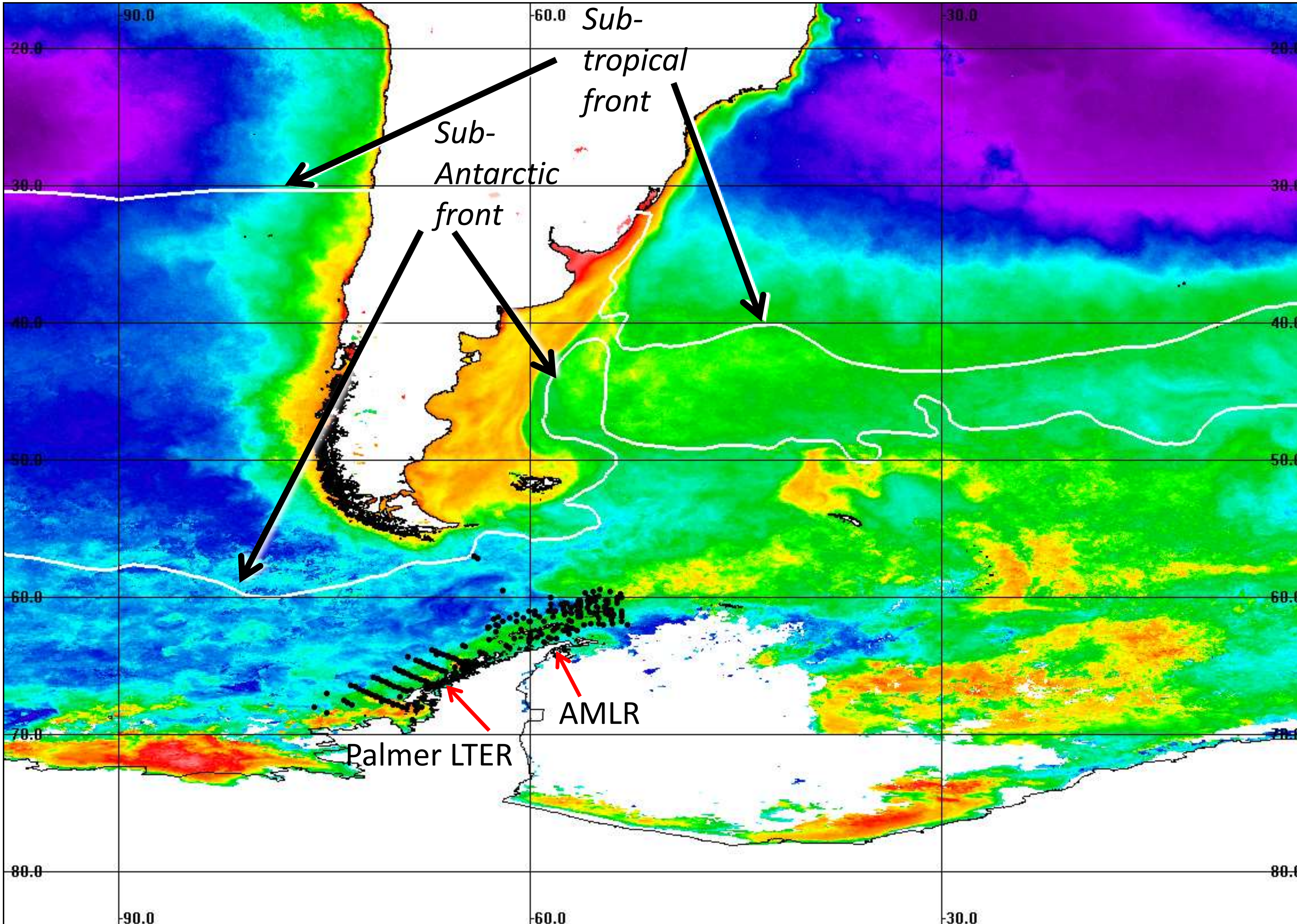
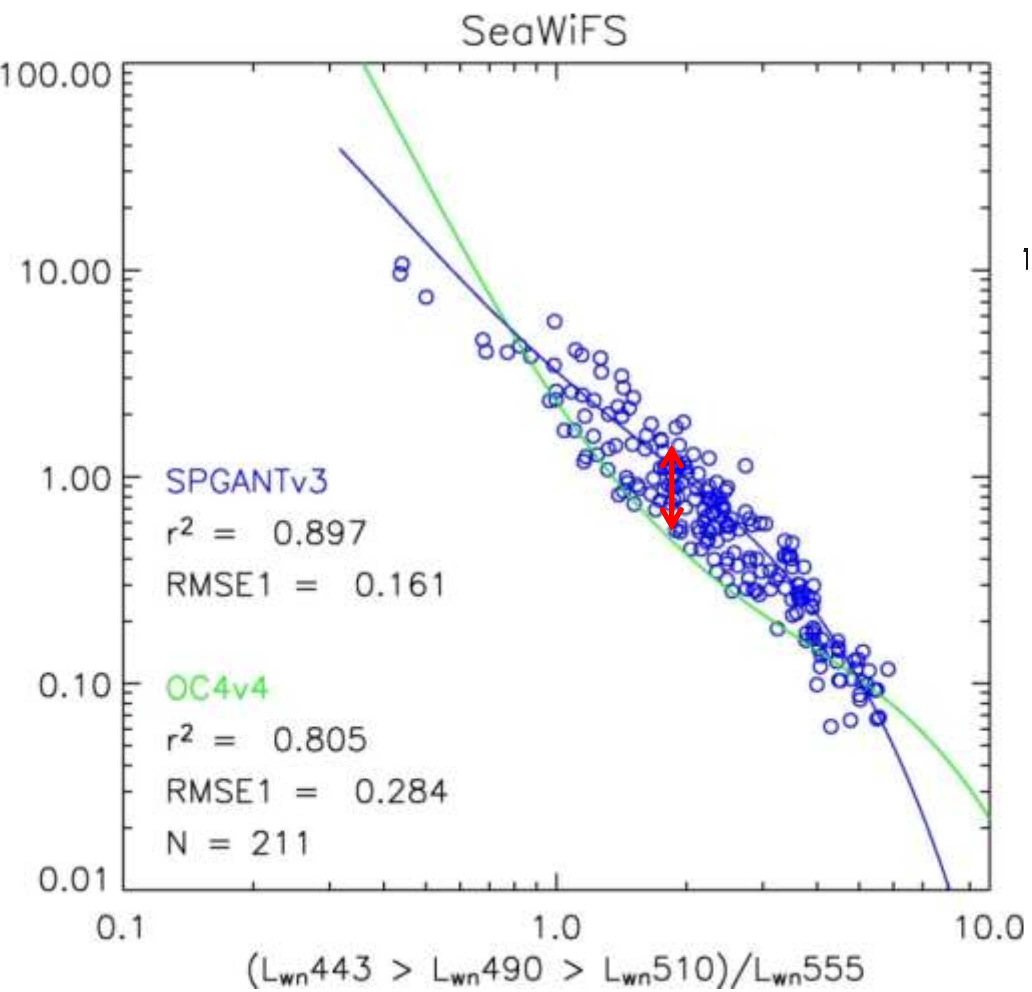


Southern Ocean Chl-a algorithm: Chl-SPGANT

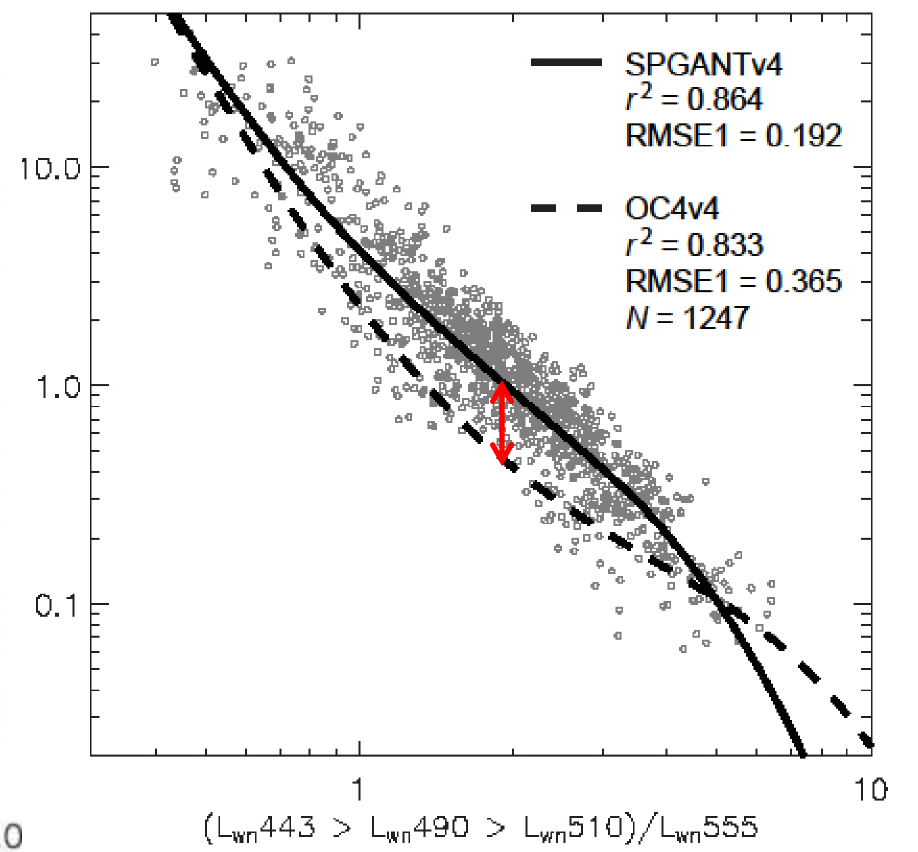
Version 3, 2006, Mitchell & Kahru (2009) using *in situ* *Lwn* and *Chla* (both fluorometric and HPLC) from cruises NBP9711, REV9801, REV9802, AMLR2000, AMLR2001, AMLR2004, LMG0402, AMLR2006; N = 211

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 < Chla < 3 mg m^{-3}

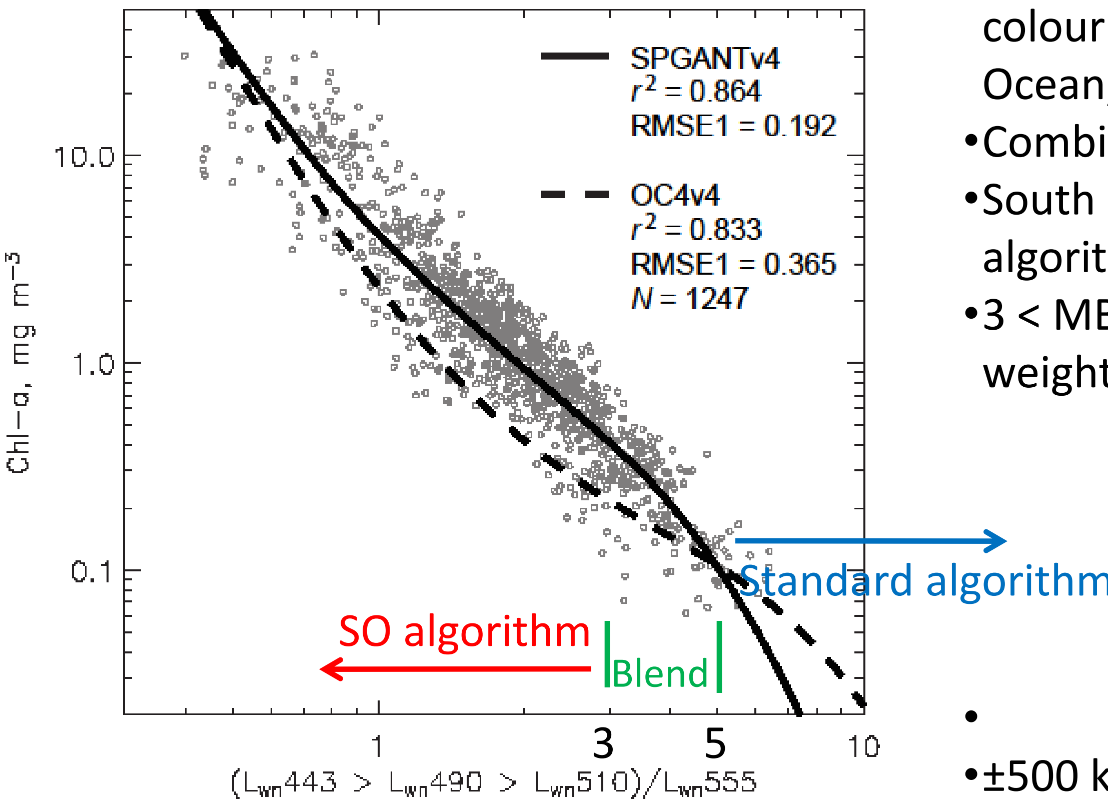


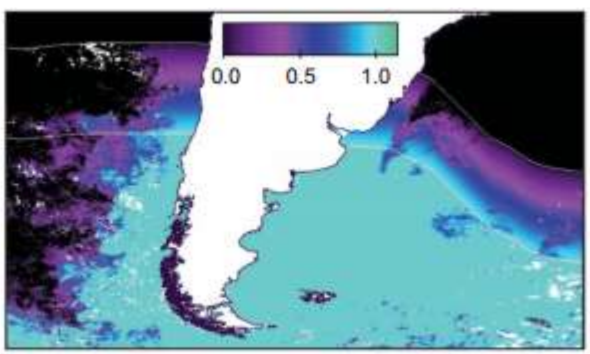
Polynomial fits between log10 of Maximum Band Ratio (MBR) and Chla for SeaWiFS, MODISA, GLI, OCTS, MERIS



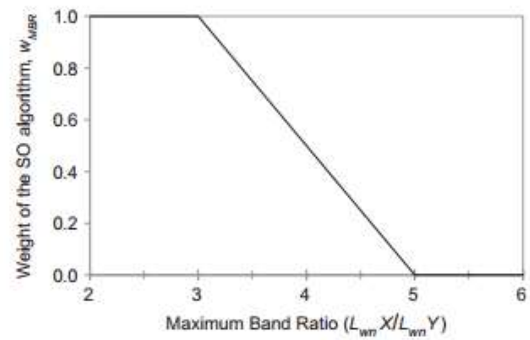
Southern Ocean Chl-a algorithm: SPGANT, continued…

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



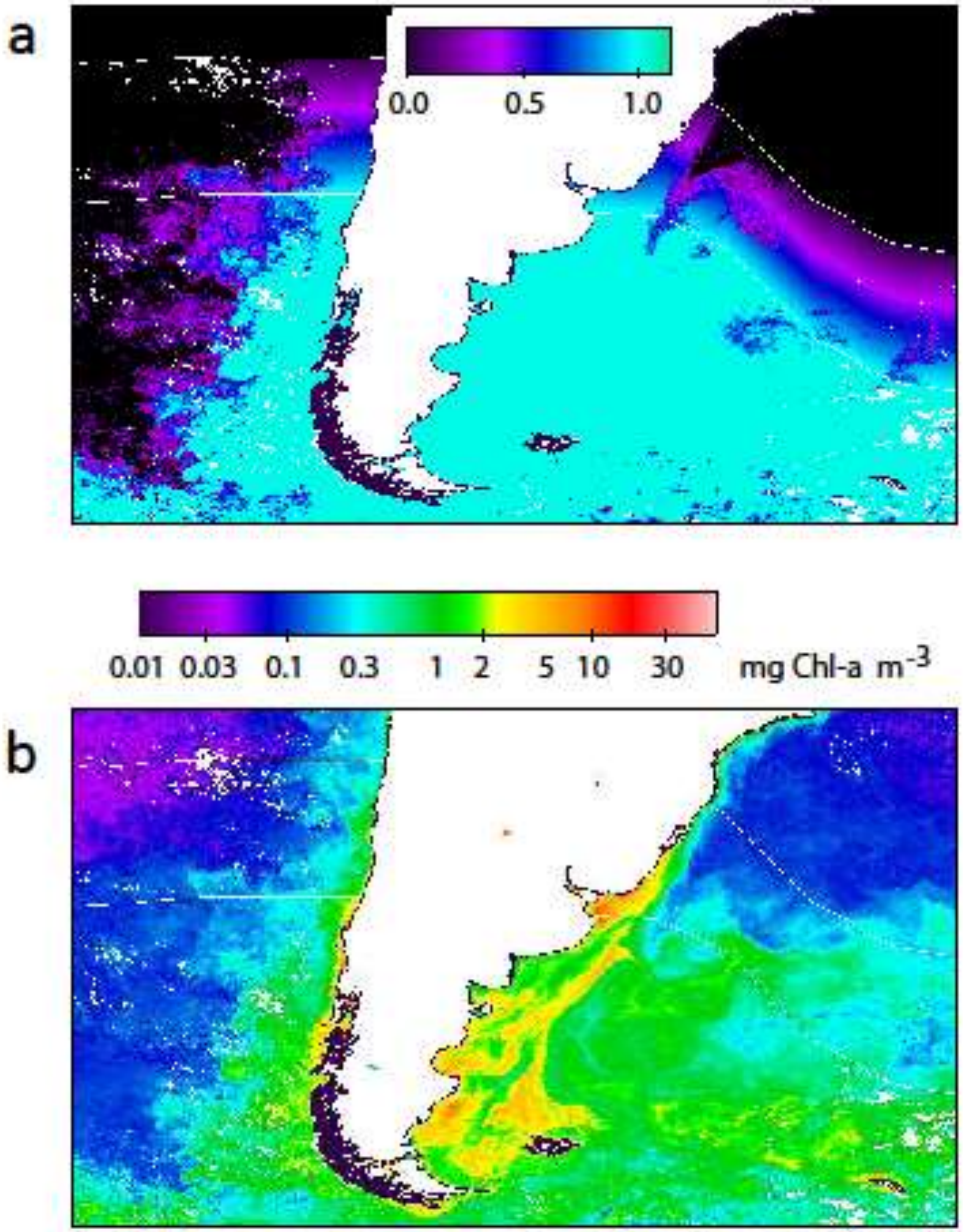


- Kahru & Mitchell (2010), Blending of ocean colour algorithms applied to the Southern Ocean, *Remote Sensing Letters*, 1: 2, 119-124
- Combines MBR and location relative to STF
- South of STF for MBR > 5 use standard algorithm
- 3 < MBR < 5, w_{MBR} = (5.0 - MBR)/2.0 and the weight of the standard algorithm is1 - w_{MBR} .



- ±500 km north-south of the mean STF: weight w_{Geo} changes from 1 in the south to 0 in the north
- Weight w = min(w_{Geo} ,w_{MBR})
- $Chl_{Blended} = Chl_{SPGANT} + (1 - w)\ Chl_{OC}$

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.

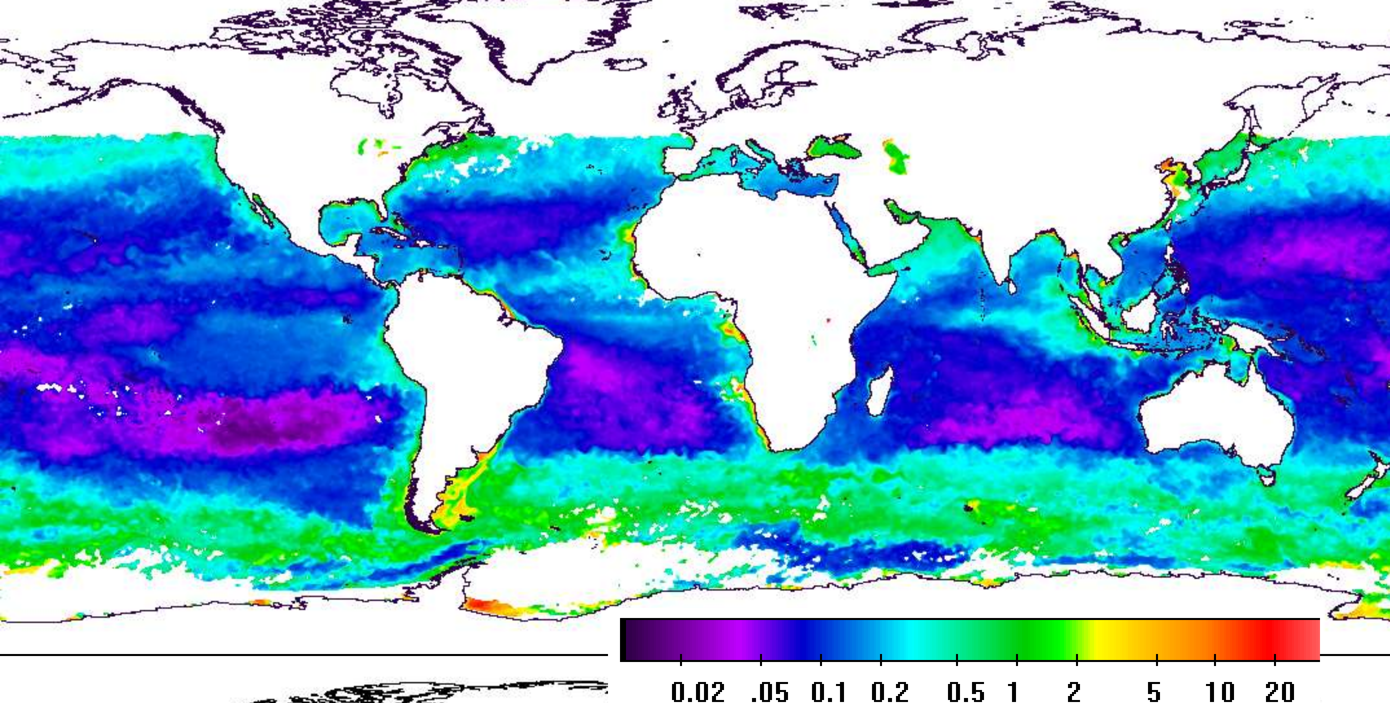
(b) Blended Chl-a map.

From: *Kahru & Mitchell* (2010), Blending of Ocean Colour algorithms applied to the Southern Ocean, *Int. J. of Rem. Sens.*

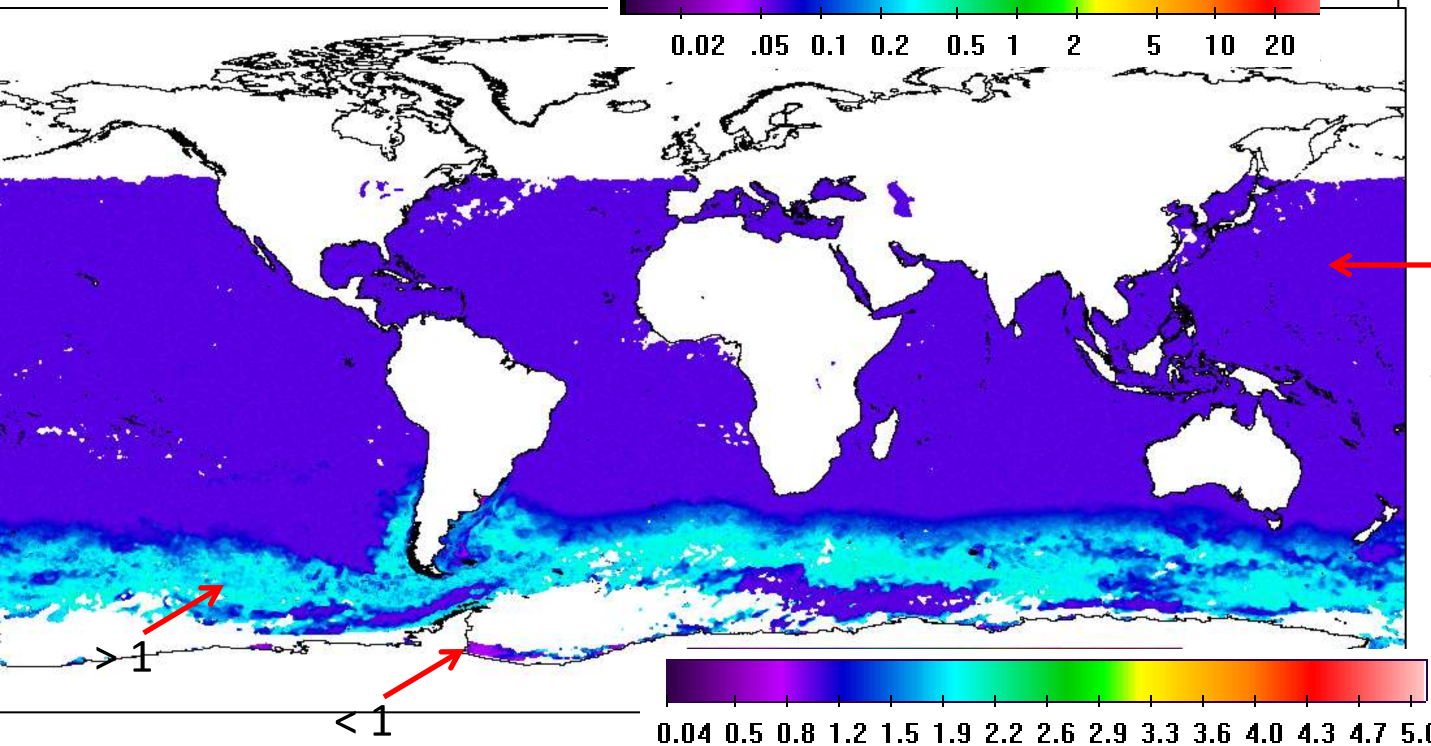
Blending of SO and standard algorithms

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

- **Blended Chl-a**



- **Ratio SPGANT-blended/Standard Chl.**



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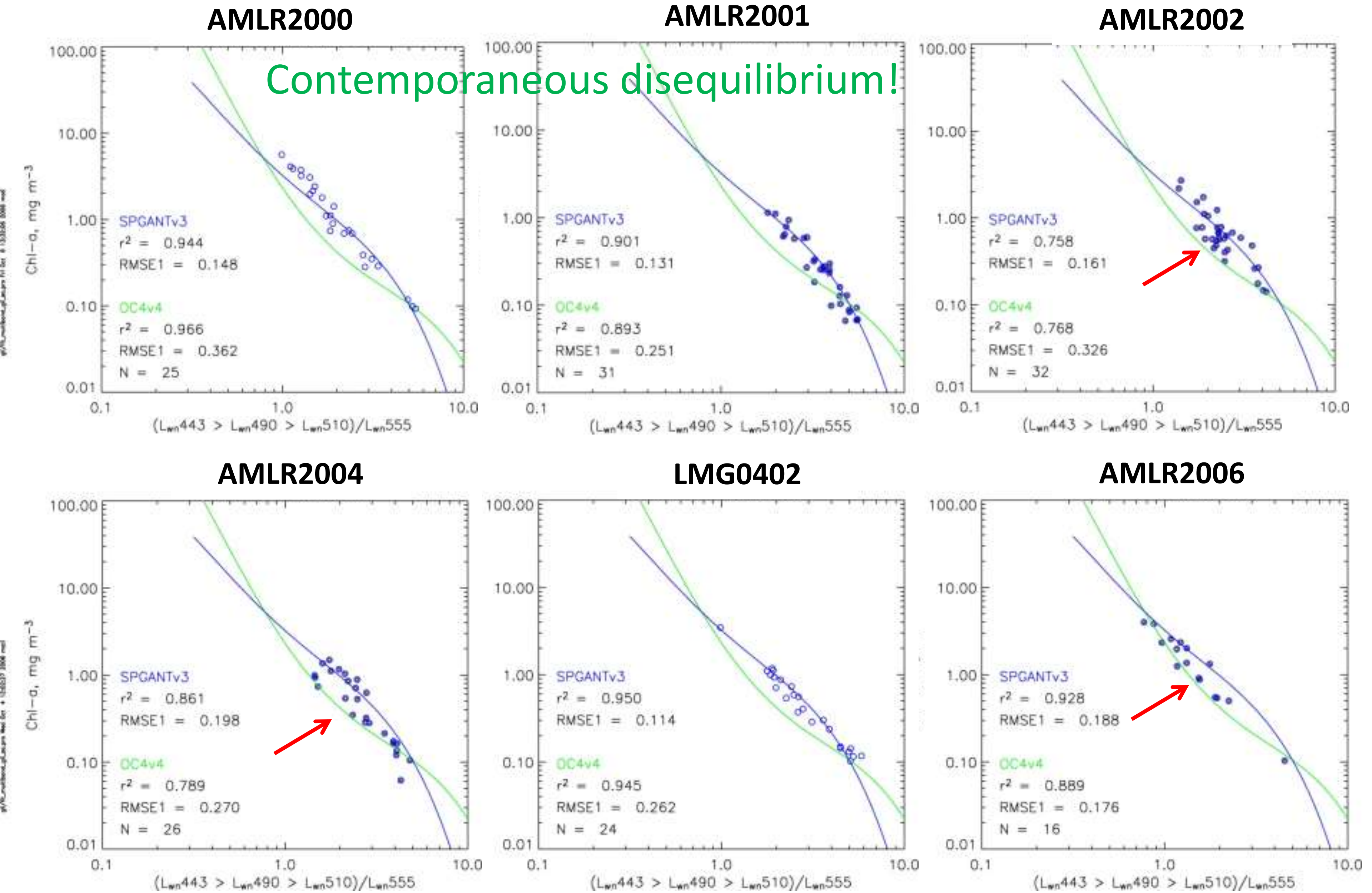
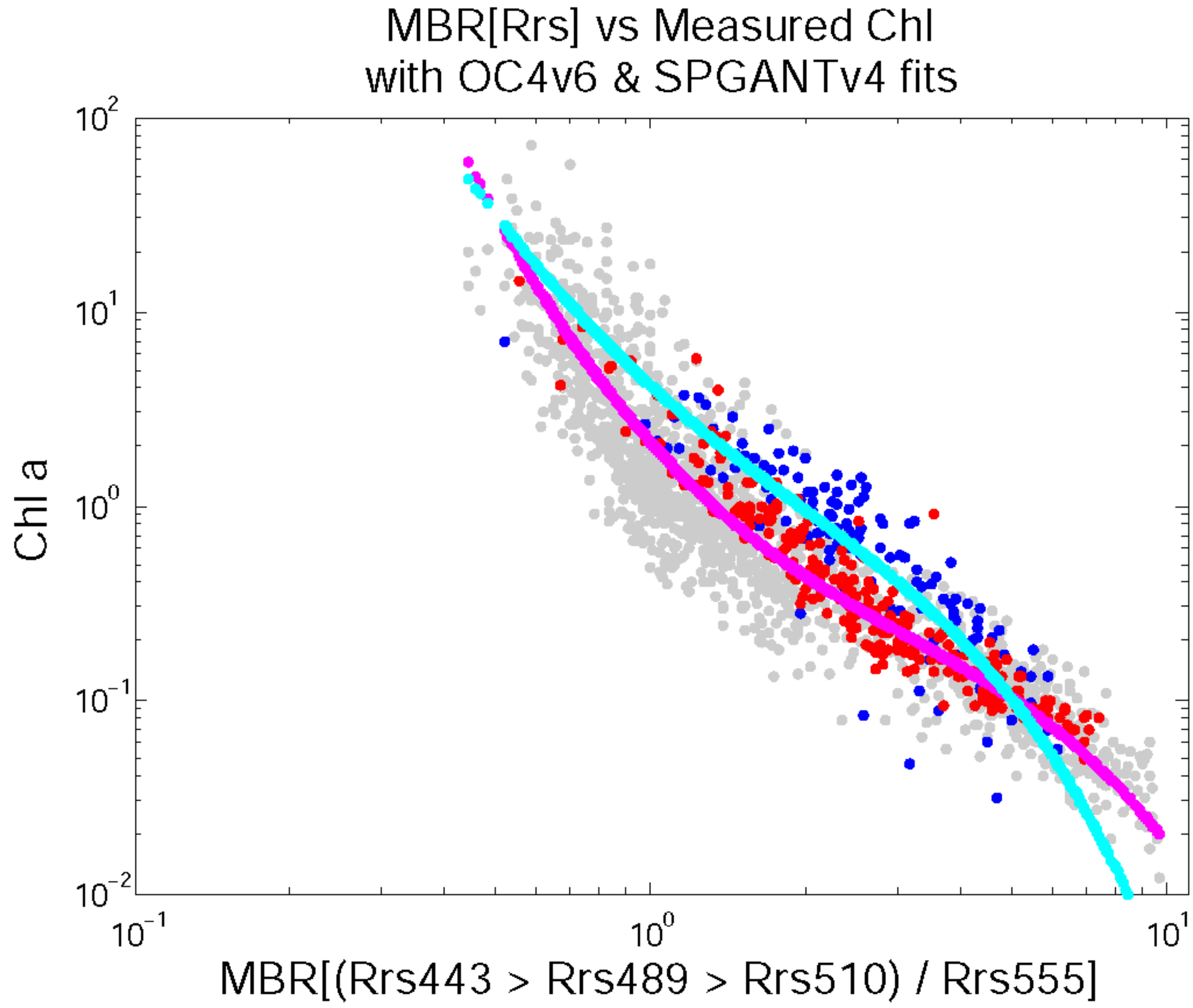
Some cruises/stations close to OC4 model!

Contemporaneous disequilibrium!



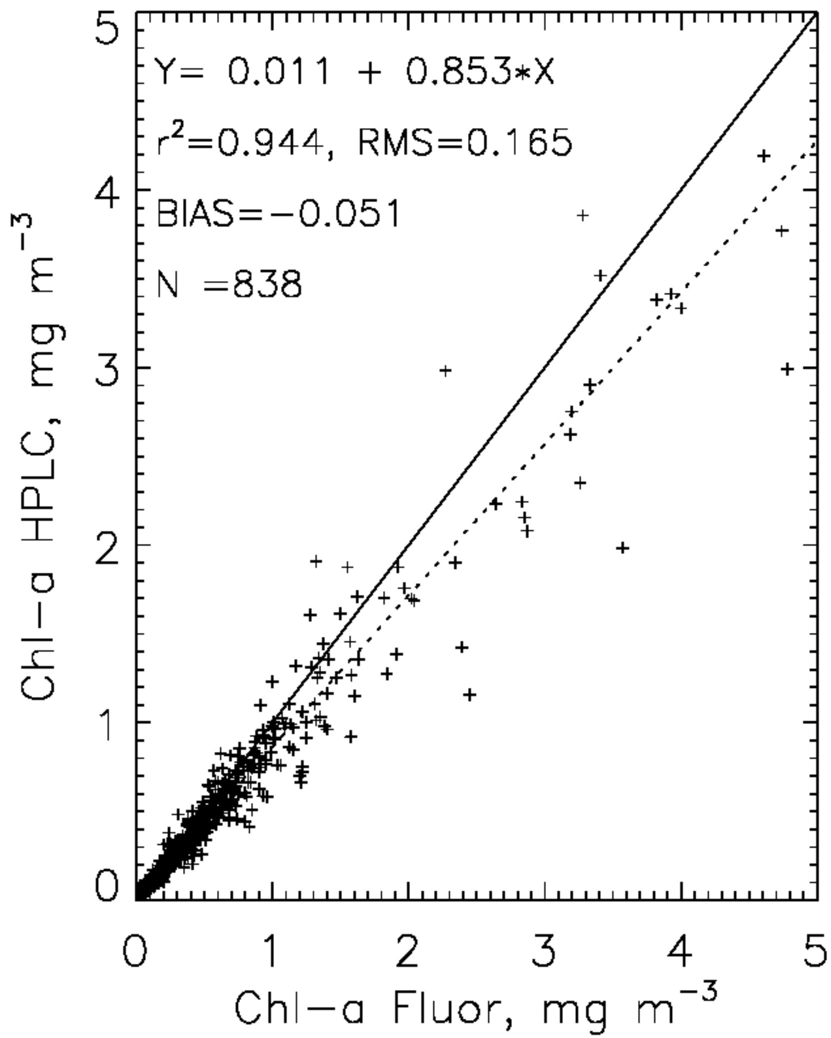
Note the Log/Log scale and in situ data! Contemporaneous disequilibrium of bio-optical properties

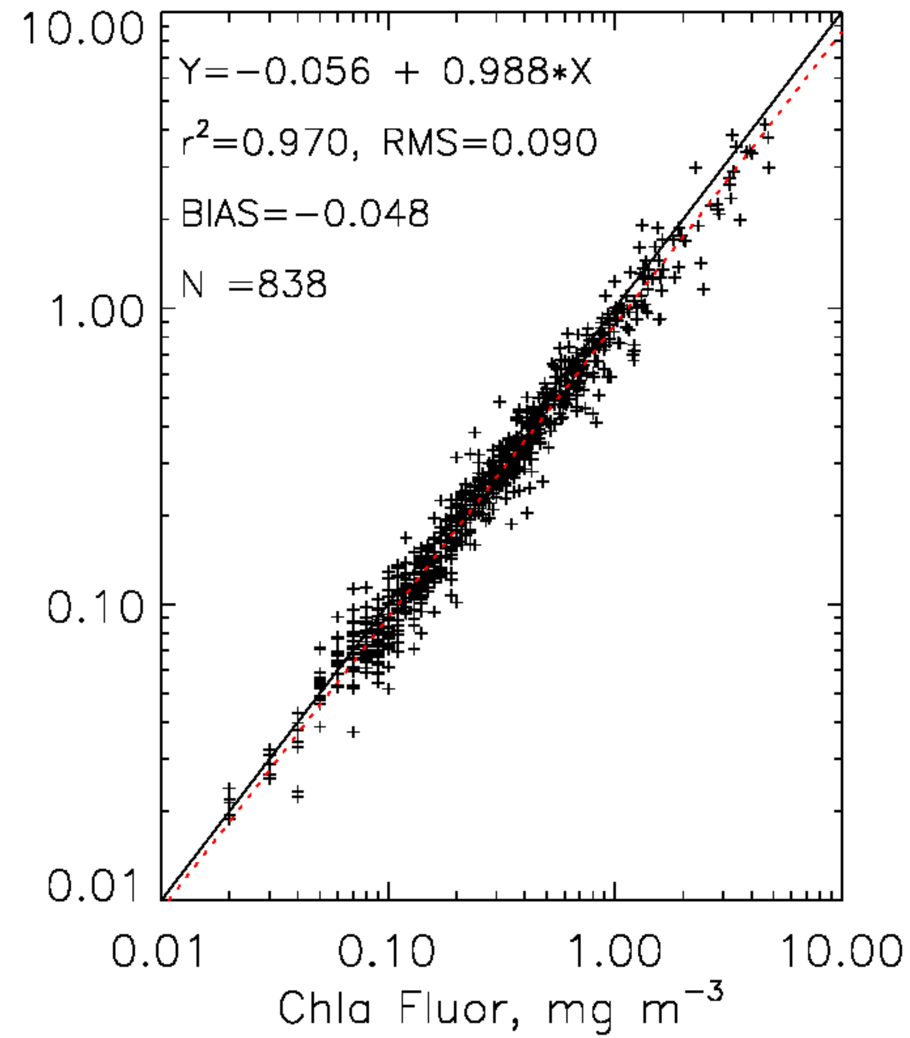
Thank you!
Obrigado!

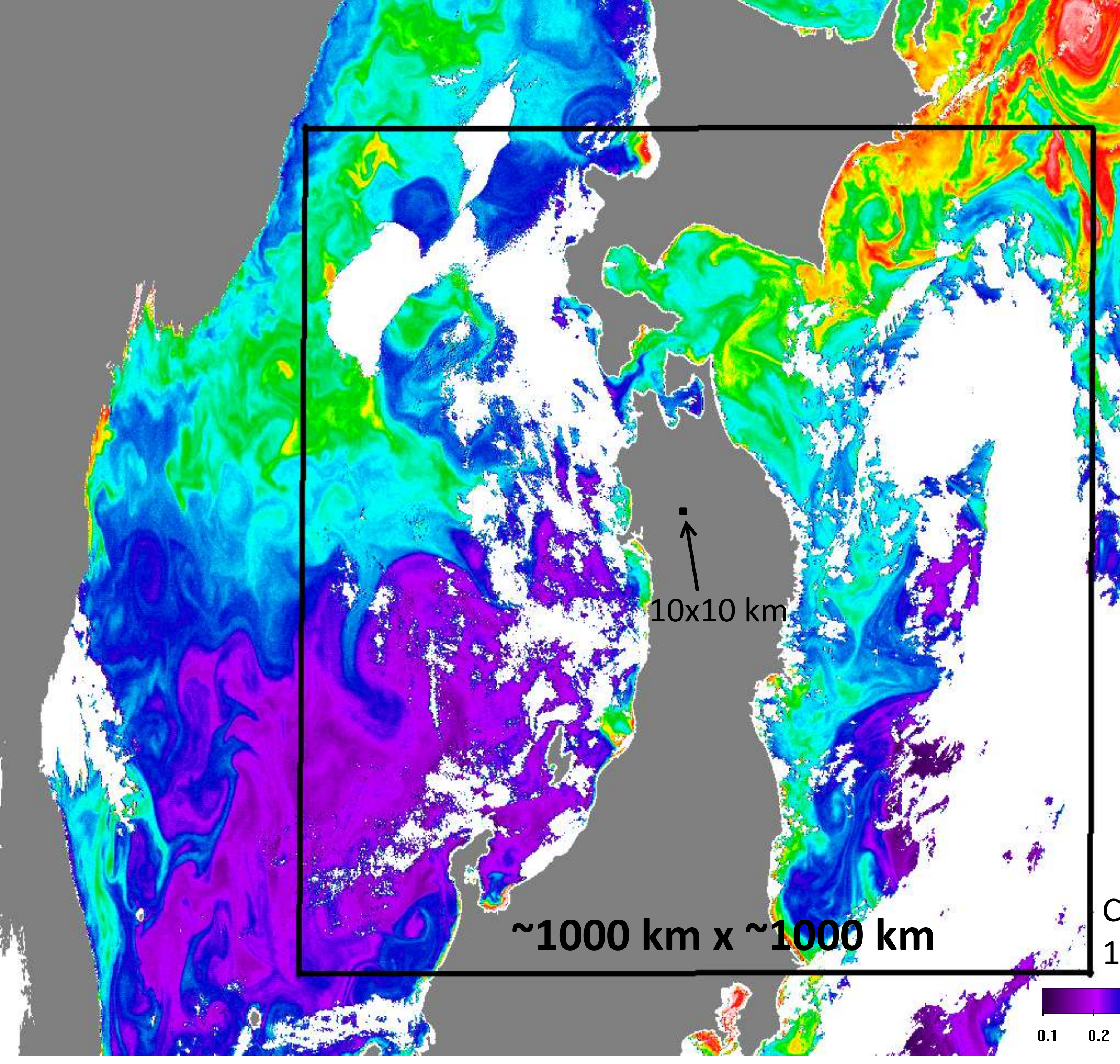


Blue = SO, Red = CalCOFI, Gray = other SeaBASS

HPLC total Chl-a vs fluorometric Chl-a

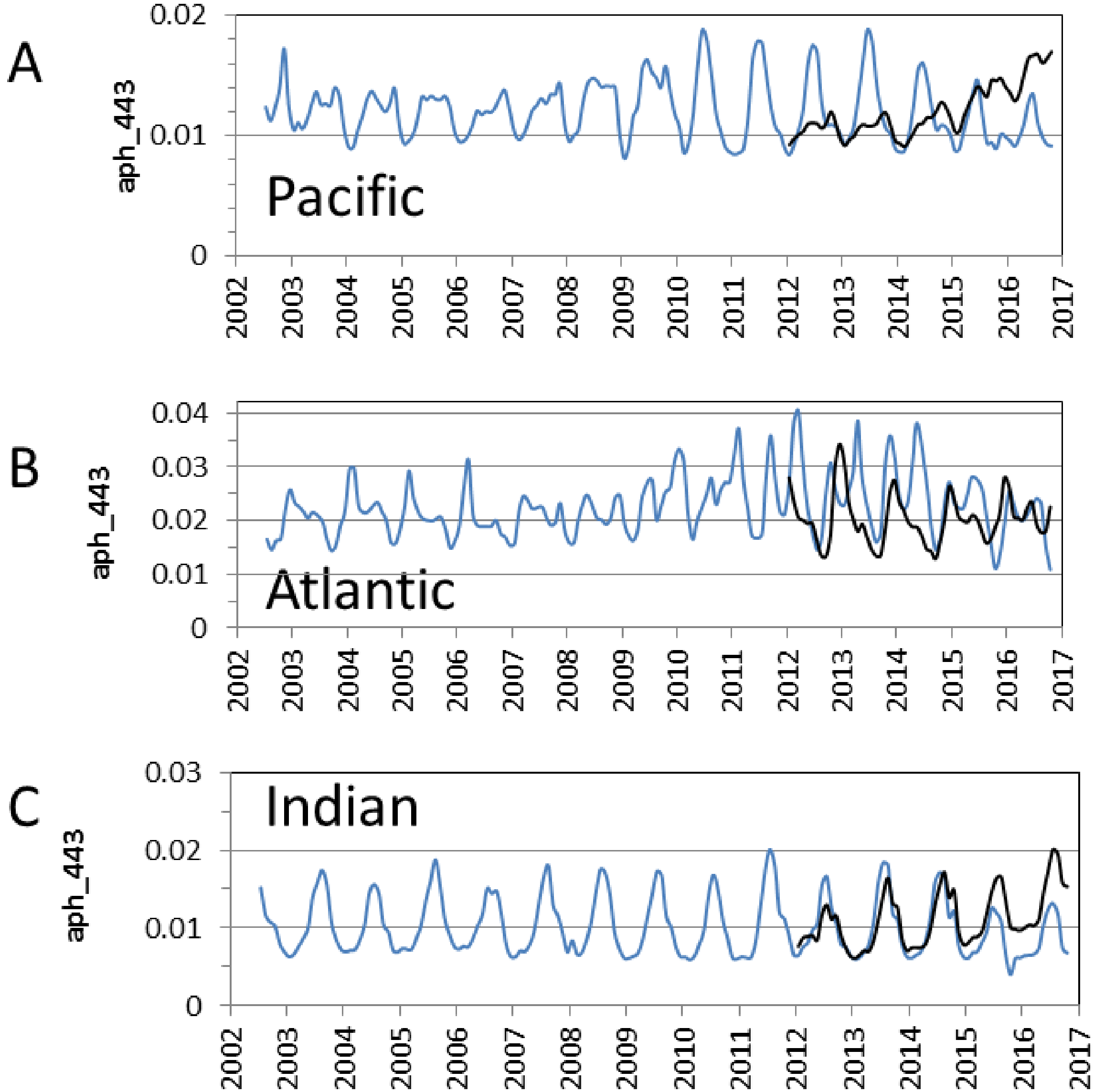






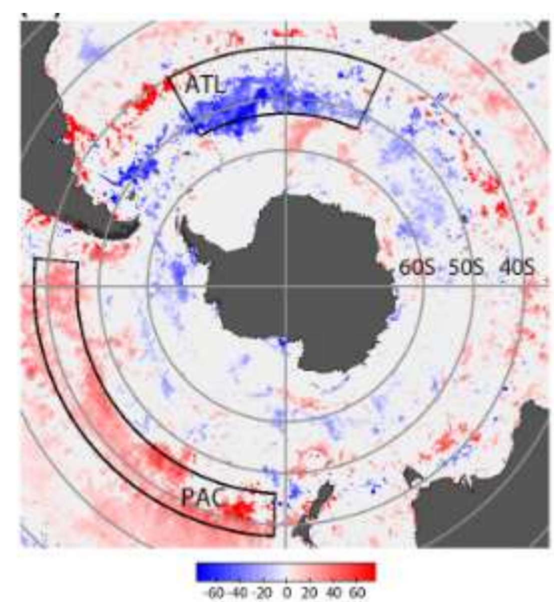
Chl-a: <0.1 … 10, i.e.
100 x variation

poor State of the art of retrieving IOPs from space.. CDR?



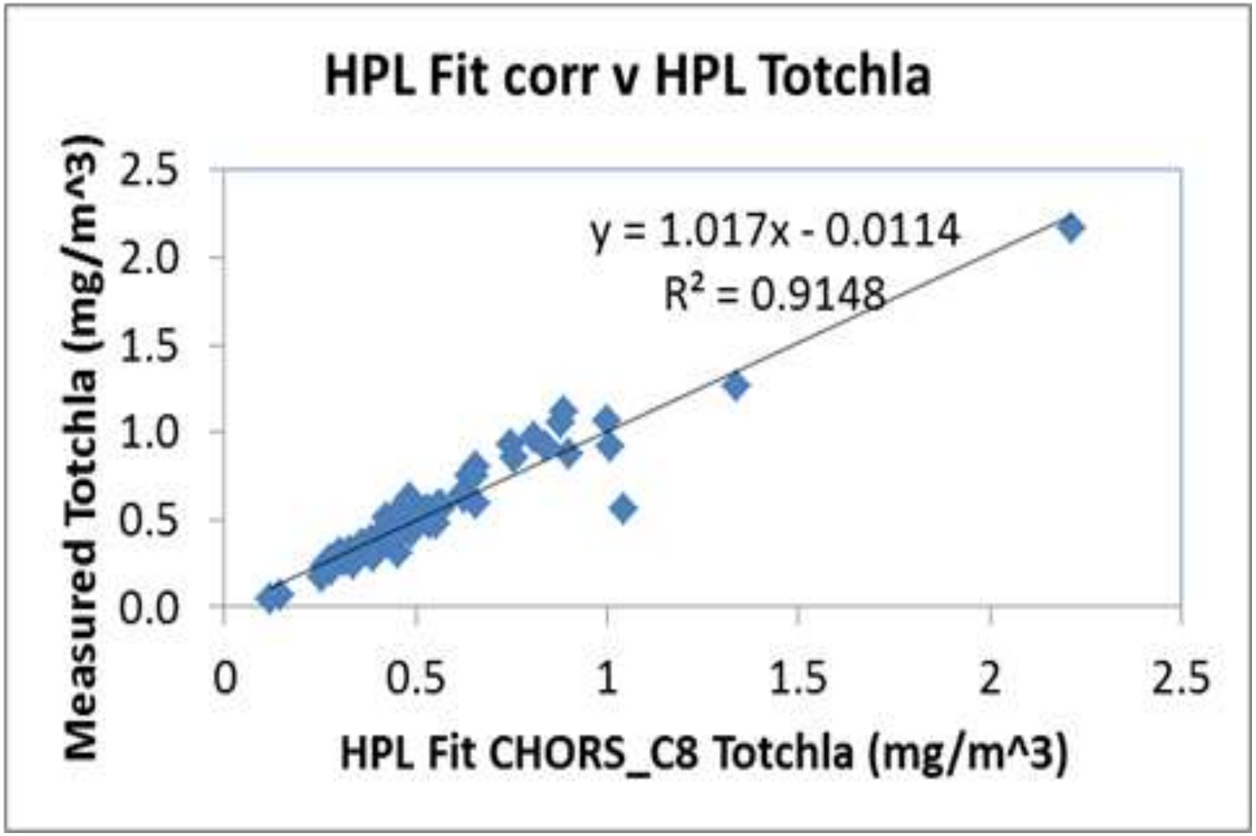
Time series of GIOP-DC *aph443* from MODISA (blue) and VIIRS (black) in the Pacific, Atlantic and Indian sectors of the Southern Ocean

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



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