Bio-optical retrieval of Chl-a from complex waters: the lower Chesapeake Bay case

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Retrieval of biogeochemical properties from remote sensing of ocean color frequently fails in coastal waters, due to the contributions from riverine run off and sediment re-suspension to seawater absorption and scattering. The mouth of the Chesapeake Bay is an optically complex environment, with discontinuous riverine discharge (peaks: early spring, late summer) counteracted by semi-diurnal tidal mixing, creating a primary frontal zone. The presence of suspended particles and dissolved matter in these mainly case II waters varies, depending upon season (wet vs. dry) and tide cycles. Our research aims at developing in situ, regional, bio-optical relationship to be applied to satellite ocean color observations of the Chesapeake Bay.

OBSERVATION PLATFORMS

The Chesapeake Light Tower (CLT)

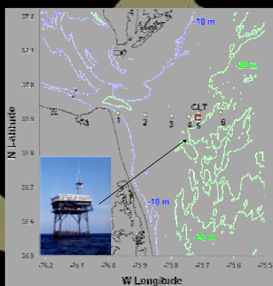
-75.713ºE, 36.90 ºN

Offshore from the mouth of the Chesapeake Bay, 25 km East of Cape Henry.

Mean depth c.a=11m.

Daily observations:

- Above-water R_{rs} (L_t, E_d, L_{sky})



The R/V Fay Slover (Old Dominion University)

Monthly observations:

- **Above-water spectral *Rrs* (L_t, L_i, E_d)**
- **Underwater IOPs (spectral *a*, *c*, *b*)**
- **Phytoplankton pigments**
- **Total Suspended Matter**

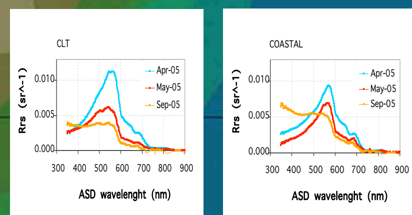
The MODIS spectroradiometry on NASA/EOS satellite Aqua

Direct Observations:

-spectral nL_w

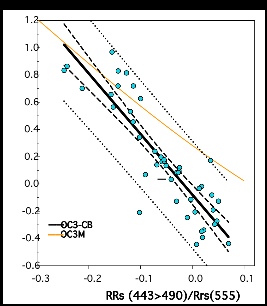
Derived Observations

-Chl-a (O'Reilly et al. 2003)



Evidence of strong variations in water components, according to proximity of the coast & season.

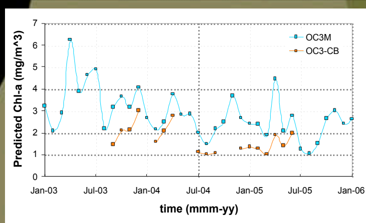
RESULTS



Empirical algorithm OC3-CB

$$Chl\text{-}a = 10^{(-0.115-3.678*R)}$$

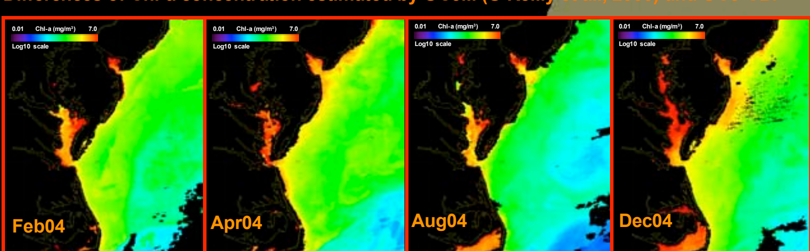
where:
$R = \log10(R_{rs}443>R_{rs}490/R_{rs}555)$
$n = 60$
$r = 0.889$
$n(95\%) = 52$



Monthly time series of Chl-a (mg/m³), from:

- MODIS-A, 9-km resolution, by O C3M (in blue)
- CLT data of Rrs, through OC3-CB (orange)

Differences of Chl-a concentration estimated by OC3M (O'Reilly et al., 2000) and OC3-CB.



OC3-CB corrects Chl-a retrieval in the lower Chesapeake Bay, as well as other coastal areas. The differences in Chl-a retrieval rapidly attenuate eastwards, and become negligible out of the continental shelf area, where the Gulf Stream Current is present.

CONCLUSIONS

- A regional algorithm is necessary for the correct retrieval of Chl-a in the lower Chesapeake Bay
- OC3-CB estimates of Chl-a in the lower Chesapeake Bay study area are lower than OC3M, and more accurate.
- CLT time series will be a useful tool for the confident use of our algorithm in these highly variable, optically complex waters.

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