**Pre-Launch Performance Assessment of the VIIRS Ocean Color / Chlorophyll Algorithm**

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**Introduction**

The Carder semi-analytical ocean color algorithm [1] was employed as the initial ocean color algorithm for use with MODIS on EOS-Terra and Aqua [2]. This algorithm has, with only minor modifications, been selected by NGST as the ocean color algorithm for the VIIRS sensor on NPP/NOOPS. This poster will report on the testing and pre-launch performance assessment of the current VIIRS Ocean Color Chlorophyll (OCC) algorithm, based on application of the OCC algorithm to both global in situ and synthetic datasets. Performance results are presented for the retrieval of chlorophyll-a as well as the retrieval of the key absorption and scattering inherent optical properties (IOP), which are frequently overlooked in ocean color retrievals but potentially provide the best approach to improved retrieval of bio-geochemical parameters, like chlorophyll.

**VIIRS Ocean Color Algorithm (Carder et al., 1999)**

Remote-sensing reflectance can be spectrally partitioned into components due to water, b_water, and particles, b(part), i.e., 

\[ R(\lambda) = b_{water}(\lambda) + b_{part}(\lambda) \]

b_water is modeled using the Ångström law

\[ b_{water}(\lambda) = \frac{b(\lambda_0)}{\lambda^{b_{water}}(\lambda_0)} \]

where \(X, Y, \lambda_0\), and \(b\) are empirical constants derived using linear regression.

Absorption coefficient can be spectrally partitioned into components due to water, a_water, phytoplankton, a_phytoplankton, and Dissolved Organic Matter (detritus and gelbstoff), a_CDOM.

\[ a(\lambda) = a_{water}(\lambda) + a_{phytoplankton}(\lambda) + a_{CDOM}(\lambda) \]

Dissolved absorption coefficient, a_CDOM, is determined from measured b (in situ) or a synthetic remote-sensing reflectance spectra without the added error due to imperfect atmospheric correction or sensor noise and bias, which will obviously make the retrieval error worse.

\[ \text{Algorithms for IOP-a on IOCCG In Situ Dataset} \]

The IOCCG in situ dataset [5] is an extraction from NASA’s SeaWiFS Bio-Optical Archive and Storage System (SeaBASS).

• The dataset of 656 samples provides values for the R in VIIRS bands M1-M4 (i.e., SeaWiFS wavelengths of 411, 443, 490 and 555 nm), as well as Chl-a and band-dependent values of IOP-a.

• Ancillary SST values were predicted using global monthly mean OISST data obtained from the Distributed Oceanographic Data System (DOOC).

**Generating Realistic Ocean R_b**

- H-BRDF computes ocean BRDF on a tabular format suitable for input to atmospheric RTMs (e.g., MODTRAN, DISORT, and 6SV).
- Uses core codes of HydroLight, a validated, “industry standard” ocean RTM employed by oceanographers for over a decade, to compute in-water radiance distributions.
- Given a set of ocean IOP and the near-surface wind speed, H-BRDF outputs separate BRDFs for computing the upwelling, leaving, reflected, and total upwelling radiance at the ocean surface.

**Testing with NOMAD**

• Used NASA bio-optical Marine Algorithm (NOMAD), Version 1.3

• Dataset of 3,500 samples was filtered to select 877 with valid values for the spectral water leaving radiance and surface irradiance in VIIRS bands M1-M4 (i.e., NOMAD wavelengths of 411, 443, 489 and 555 nm).

• R_b was generated for each sample, along with “truth” Chl-a and ancillary data (Chl-b and Chl-c). The on-set of NOMAD’s performance is given by Morel (1974) and S(0,0), where \(\text{RMSE} = 0.178\)

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• Error measures used to report performance of the chlorophyll-a retrieval are the mean normalized bias in percent for accuracy error.

\[ \text{Mean} = \frac{1}{N} \sum_{i=1}^{N} \frac{b_i - b_i^*}{b_i} \]

where \(b_i\) is the measured absorption coefficient and \(b_i^*\) is the modeled absorption coefficient.

**Testing with MODIS and VIIRS OCC Algorithms for VIIRS In Situ Ocean Color Dataset**

• The measured absorption coefficient at a wavelength of 555 nm is given by Morel (1974) and \(S(0,0)\), \(S(440,555)\), and \(S(485,555)\). The semi-analytic chlorophyll-a algorithm is from Pope and Fry (1997) \(\text{RMSE} = 0.190\)

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**Testing with In Situ Datasets**

• Testing with IOCCG In Situ Dataset from SeaBASS

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**Can Use Water-Leaving BRDF to Assess OCC Performance for Perfect Case R_b**

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**References**


