Approach for the long-term spatial and temporal evaluation of ocean color data products in the coastal environment

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goal: develop an infrastructure for working with the community to rapidly evaluate long-term regional time-series of satellite ocean color data products
demonstrated via a Chesapeake Bay $C_a$ algorithm round robin initiated by the Chesapeake Bay Program, executed by the NASA OBPG, with additional participation by NOAA, the U. of Maryland, and Old Dominion U.

note ~ the approach is independent of the data product and region of interest
1. remove atmosphere from total signal to derive estimate of light field emanating from sea surface (water-leaving radiance, $L_w$)

2. relate spectral $L_w$ to $C_a$ (or geophysical product of interest)

3. spatially / temporally bin and remap satellite $C_a$ observations

the satellite views the spectral light field at the top-of-the-atmosphere

NASA Ocean Biology Processing Group ~ PJW, SSAI, 11 Apr 2007
**ALGORITHMS**

**empirical (statistical) approaches**
- OC4   operational SeaWiFS
- OC3   operational MODIS
- OC2
- OC3-CB tuned to Bay (ODU)
- Clark tuned to Bay (NOAA)
- Carder operational VIIRS

**semi-analytical approaches**
- GSM01
- GSM01-CB tuned to Bay (UMD)

**GROUND TRUTH**

SIMBIOS/Harding (3,000 stations)
CBP (15,000 stations)
stratification following Magnuson et al. 2004
PROCESSING

5,000 SeaWiFS MLAC files acquired
processed using MSL12 5.4.1 ~ 3 runs / file
statistical and visual QC applied
900 final files considered from 1998 to 2005

COMPARISON TO GROUND TRUTH

data distributions via histograms
time-series (monthly averages)
match-ups with Level-2 data

STRATIFICATION

spatially: upper, middle and lower Bay
temporally: Winter, Spring, Summer, Fall

QUALITY CONTROL

eliminate scenes with high sat zenith
require >25% of Bay ocean pixels to be cloud free
visual inspection
consider only 0.1 < C_a < 100 mg m^{-3}
require >200 valid pixels per scene
the histograms, time-series, scatter plots, and maps convey comparative information in rather different ways.

Trade-offs in specific coverage needs and accuracy requirements drive the selection of the best algorithm(s) and processing approach(es).
Chesapeake Bay SeaWiFS Chlorophyll-a

Following the Chesapeake Bay Remote Sensing Symposium in January 2006, NASA’s Ocean Biology Processing Group evaluated the performance of several chlorophyll-a algorithms for the Chesapeake Bay. Details of the algorithms and their performance can be found at: [http://seabass.gsfc.nasa.gov/eval/cbp_eval.cpl](http://seabass.gsfc.nasa.gov/eval/cbp_eval.cpl). As a result, the OC4v5 algorithm was recommended for experimental daily processing of SeaWiFS data at the East Coast Node. SeaWiFS Level 1A data are processed using SeaDAS 5.0 software. Mapped chlorophyll-a images are available below, however, the Level 2 data are password protected. For data access, please send requests to Paul DiGiacomo, CoastWatch Program Manager.

March 2007

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No Data Available
1. remove atmosphere from total signal to derive estimate of light field emanating from sea surface (water-leaving radiance, $L_w$)

2. relate spectral $L_w$ to $C_a$ (or geophysical product of interest)

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the satellite views the *spectral light field* at the top-of-the-atmosphere
some challenges to remote sensing of coastal and inland waters:

temporal and spatial variability
  limitations of satellite sensor resolution and repeat frequency
  validity of ancillary data (reference SST, wind)
  varied resolution requirements and binning options

straylight contamination from land

non-maritime aerosols (dust, pollution)
  region-specific models required
  absorbing aerosols

suspended sediments and CDOM
  complicates estimation of \( L_w (\text{NIR}) \), model not a function of \( C_a \)
  complicates correction for non-uniform subsurface light field \((f/Q)\)
  saturation of observed radiances

anthropogenic emissions (NO\(_2\) absorption)
the MODIS-Aqua SWIR (250-m) atmospheric correction was evaluated (preliminary results):
please visit two OCRT posters that discuss the application of an \textit{NO}_2\ correction\ and\ regionally\ derived\ aerosol\ models:

W. Robinson, Z. Ahmad, B.A. Franz, S.W. Bailey, and C.R. McClain,
“\textit{NO}_2\ data\ use\ for\ ocean\ color\ processing”

Z. Ahmad, E. Kwiatkowska, B.A. Franz, and C.R. McClain,
“Aerosol\ optical\ thickness\ from\ the\ SeaWiFS\ and\ MODIS\ sensors\ over\ the\ Chesapeake\ Bay”