ABSTRACT

In recent years, much attention has been given to the role of organic carbon in the nutrient cycle and carbon cycle. Organic carbon plays a key role in the cycling of nutrients, energy, and carbon. The objective of this study is to monitor the distributions of dissolved organic carbon (DOC) and CDOM (chlorophyll-derived absorption) in the coastal ocean from rivers and bays, and to develop algorithms to retrieve these properties from MODIS and SeaWiFS observations. The methodology involves the use of coastal ocean observations to derive relationships between satellite-derived CDOM and DOC and field measurements collected between the Chesapeake Bay mouth and the continental shelf. By using algorithms for transitional periods (late Spring to early Summer and Summer to Fall), we will be able to apply satellite observations to investigate interannual and decadal-scale variability in surface aCDOM and DOC concentrations within the Mid-Atlantic Bight and quantify the DOC reservoir.

OBJECTIVES

• Develop algorithms to retrieve aCDOM and DOC with MODIS and SeaWiFS observations.
• Apply algorithms and in situ data to examine the seasonal and interannual distributions of DOC & CDOM to the continental margin.
• Contribute to the modeling activity to derive carbon budgets for the U.S. Eastern Continental Shelf.

METHODS

The instrumentation is based on the FRR-800 series manufactured by Biospherical Instruments (San Diego, CA). The accurate profile, which measures dissolved substances, LAB, as well as scattering and absorption, is collected in 1-m vertical segments. The PAR-800 series was used for fluorescence measurements. Oceanic surface water samples were collected with Niskin bottles and then filtered through GF/F filters directly into sample containers for analysis of DOC and CDOM absorption. Particles are collected on 20 mm GF/F filters for analyses of DOC and CDOM absorption (Cottingham et al. 2001). DOC is analyzed in triplicate (300-20000 ppb) by high temperature combustion oxidizing using a Shimadzu TOC-5000. The fugacity of each factor (in situ DOC) is used daily to verify the accuracy of DOC and maintain an accurate error to within 10%. Absorption spectra of CDOM (after filtration through 0.2 µm Nuclepore or GF/F filters) are collected at a UV-Visible spectrophotometer (Spectroline-200 DMS) using a UV-coated M4H 0-1400 nm transmittance technique (Michaud et al. 2001).

FIELD CAMPAIGN

Fig. 1. Station locations sampled during multiple cruises in 2005-2006.

SUMMARY & CONCLUSIONS

• Meteorological variability & ecosystem productivity result in seasonal & interannual variability in coastal ocean DOC and CDOM.
• DOC and aCDOM can be retrieved from coastal ocean waters with MODIS-Aqua (±10% and ±20% mean APD, respectively).
• Satellite retrieval of DOC requires 2-3 more seasonal algorithms due to the variable DOC concentration and reflectance.
• Satellite observations can be applied to quantify the entire DOC reservoir for the southern Mid-Atlantic Bight during spring-summer.

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REFERENCES


CB Plume July 2-5, 2005

CB Plume July 2-6, 2006

Spring

Summer

Fig. 2. Vertical distributions of dissolved organic carbon (DOC) at select stations from the CB Plume, May 9-12, 2006. 

Fig. 3. Seasonal and interannual variability in surface DOC, aCDOM and CDOM spectral slope (a) across the continental margin of the Southern MAB. Excerpt for the Delaware Bay (DB) region (B)-488/551 ratio algorithm. DOC (mM) increases from Spring to Summer in most impacted regions of the mid-Atlantic Bight (MAB). DOC and aCDOM decrease from the bay to the continental slope. DOC increases from Spring to Summer in coastal regions across the shelf to continental margin. DOC in marine CDOM. The skill of 10% to 15% error and a stabilized data column is inserted to prevent overestimation.

Fig. 4. Seasonal variability and interannual variability of the DOC to aCDOM relationship derived from field measurements collected between the Chesapeake Bay and adjoining watersheds on the seasonal and interannual distributions of DOC & CDOM to the continental margin.

CB & MAB Summer ’05

CB & MAB Winter ’05

Fig. 5. CDOM algorithms derived from in situ measurements of aCDOM(355) and reflectance band ratios (Rrs) collected in the 2005 cruises. Several non-linear and linear curve fits were used to develop the algorithms, with the data set only being used to develop the algorithm for the exponential decay Rrs488/551 ratio algorithm.

Fig. 6. Validation matches of aCDOM(355) and DOC in situ measurements versus data derived from MODIS-Aqua: (a) aCDOM(355) with BRDF f/Q correction, (b) aCDOM(355) without BRDF f/Q correction, (c) DOC with BRDF f/Q correction, (d) DOC without BRDF f/Q correction, (e) aCDOM(355) mean absolute percent difference (APD) and (f) DOC mean APD evaluated for 5 algorithms. The validation matches indicated by Basher and Woodwell (2005) were applied with the exception that 3x3 1km pixel arrays were analyzed rather than 5x5 arrays.

Fig. 7. MODIS-Aqua derived a) aCDOM(355) and b) DOC products using the exponential decay Rrs488/551 ratio algorithm. DOC data derived from MODIS may be compared to results from the SeaWiFS MODIS Science Team's near-real time data product. DOC data from SeaWiFS, obtained via cycle 5, is used in the SeaWiFS MODIS Science Team's near-real time data product.