Adding remote sensing data products to the nutrient management decision support toolbox

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Introduction

Some of the primary issues that manifest from nutrient enrichment and eutrophication (Figure 1) may be observed from satellites.

For example, remotely sensed estimates of chlorophyll a (chl-a), total suspended solids (TSS), and light attenuation (Kd) or water clarity, which are often associated with elevated nutrient inputs, are data products collected daily and globally for coastal systems from satellites such as NASA’s MODIS (Figure 2).

Figure 1. Conceptualization of the impacts of nutrient over-enrichment on coastal ecosystems (Brintner et al. 2007).

Figure 2. MODIS natural color image of the southeastern U.S. and coastal waters.

The objective of this project is to inform water quality decision-making activities using remotely sensed water quality data. In particular, we seek to inform the development of numeric nutrient criteria. In this poster we demonstrate an approach for developing nutrient criteria based on remotely sensed chl-a.

Materials and methods

The overall project approach includes:

• Assess the potential methods and data requirements for developing numeric nutrient criteria
• Collect optical data at study sites (Figure 3) and use found data from the estuarine and oceanographic community for calibrating imagery
• Develop time-series data (mid-1980s to the present) of remotely sensed chl-a, TSS, and Kd at spatial resolutions of 500-1000 m for each study system
• Implement methods for numeric nutrient criteria (EPA 2001) using remote sensing data products
• Benchmark GOMA’s sense of the use, usefulness, and usability of the implemented methods

Figure 3. (a) Study sites. Optical instrumentation used includes (b) AC-s, (c) HyperPRO, and (d) optical water quality monitor.

Results

Monthly optical and chemical data are being collected in the Florida panhandle estuaries (Figure 4) and are used to calibrate remote sensing products for chl-a, TSS, colored dissolved organic matter (CDOM), and light attenuation (Kd).

Figure 4. Field observations of chlorophyll a, suspended sediment (TSS), colored dissolved organic matter (CDOM), and light attenuation (Kd).

The “reference” condition method (EPA 2001) was applied to the coastal segments of Florida’s state waters (Figure 5a) using calibrated remote sensing estimates of chl-a (Schaeffer et al. in review). Field measurements of chl-a data, used for calibration, were obtained from various sampling programs (Figure 5).

Figure 5. (a) Field measurements of chlorophyll a (Chl-a) and FL coastal segments. (b) Remotely sensed chlorophyll a (Chl-a).

The satellite observations provided an accurate estimate of chl-a for the coastal segments within Florida’s state waters (Figure 5c).

Figure 5. (c) Relationship between field and remotely sensed estimates within 3 nautical miles and (d) for all the stations in panel (a).

Subsequently, the remotely sensed estimates of chl-a were extracted as 8-day averages from each segment for the period of the satellite record (1997 to 2009). This process generated a large sample size (n = 593) for each coastal segment. The statistical distributions of chl-a in each segment are presented in Figure 6.

Figure 6. Chl-a boxplots for the coastal segments using data from 1997 to 2006. Boxplots present the median (black line), the 25th and 75th percentiles (boxes), the 10th and 90th percentiles (whiskers), and minimum and maximum (black dots).

Conclusions

For many coastal systems, satellite observations are available and provide continuous spatial and temporal coverage. These observations may be used to implement criteria development methods such as the reference condition approach, or where accurate loading estimates are available, the empirical stressor-response approach (EPA 2001). The success of this project will be measured by our ability to demonstrate and transfer these approaches to decision-makers.

Literature cited


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For further information

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