Doctoral Dissertation Defense Announcement

MODELING THE DYNAMICS OF HYPOXIA AND ITS INTERACTION WITH OPTICALLY ACTIVE WATER QUALITY CONSTITUENTS USING REMOTE SENSING AND REGRESSION ANALYSIS

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ABSTRACT

Elucidating the drivers and dynamics of coastal water quality is a modern challenge. Diverse waterbodies, from freshwater streams to large bays are stressed by industrialization, population growth, and a changing climate. Hypoxia, or depressed dissolved oxygen, is one of the most ubiquitous symptoms of poor surface water quality. The ability to understand the complex interactions affecting dissolved oxygen concentration is diminished by the low availability, resolution, and quality of observable data. Thus, understanding measures of water quality and their change in near real-time is tantamount for addressing hypoxia. In this dissertation, a novel protocol was developed to extract water quality from a rich spatiotemporal database for Houston coincident with remote sensing reflectance, to produce robust regression relationships that are applicable in diverse waterbodies. Bio-optical relationships between measured water quality and above-water reflectance were investigated via laboratory analysis, infield ground-truthing, and remotely sensed satellite imagery. The resulting regression algorithm predicts total suspended solids (TSS) and chlorophyll-*a* concentrations over an 18-year period. Seasonal differences were observed for both constituents. Conventional assumptions about elevated nutrient loads producing hypoxic conditions were shown to be false. Rather, hypoxia was shown to be more strongly associated with urban development stress and elevated chlorophyll-*a* concentrations. The developed database provided valuable insights into water quality dynamics and temporal trends. A strong decreasing trend was observed over the 18-year period for TSS in Lake Houston, a primary drinking water source. This improvement in water quality may be impeded by a weaker, but still significant, increasing TSS trend in Lake Livingston, from which additional drinking water will be obtained. The research further demonstrated the value of remotely quantified water quality by applying the developed methodology to imagery collected in the aftermath of Hurricane Harvey. The application focused specifically on sediment loading and deposition of sediment and their potential impacts on the Houston Ship Channel and Galveston Bay riverine-estuarine system. Record flows delivered unprecedented suspended sediment loads to the Gulf of Mexico at concentrations well above the tolerance level for most aquatic life. Results showed that it took up to 11 days after the storm for sediment transport to abate.