Abstract:

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Title: Validation of MODIS FLH and in situ chlorophyll a from Tampa Bay, Florida (USA).

Satellite observation of phytoplankton concentration or chlorophyll-a (chla) is an important characteristic, critically integral to monitoring coastal water quality. However, the optical properties of estuarine and coastal waters are highly variable and complex and pose a great challenge for accurate analysis. Constituents such as suspended solids and dissolved organic matter and the overlapping and uncorrelated absorptions in the blue region of the spectrum renders the blue-green ratio algorithms for estimating chl-a inaccurate. Measurement of sun-induced chlorophyll fluorescence, on the other hand, which utilizes the near infrared portion of the electromagnetic spectrum may, provide a better estimate of phytoplankton concentrations. While modelling and laboratory studies have illustrated both the utility and limitations of satellite algorithms based on the sun induced chlorophyll fluorescence signal, few have examined the empirical validity of these algorithms or compared their accuracy against blue-green ratio algorithms . In an unprecedented analysis using a long term (2003-2011) in situ monitoring data set from Tampa Bay, Florida (USA), we assess the validity of the FLH product from the Moderate Resolution Imaging Spectrometer against a suite of water quality parameters taken in a variety of conditions throughout this large optically complex estuarine system. . Overall, the results show a 106% increase in the validity of chla concentration estimation using FLH over the standard chla estimate from the blue-green OC3M algorithm. Additionally, a systematic analysis of sampling sites throughout the bay is undertaken to understand how the FLH product responds to varying conditions in the estuary and correlations are conducted to see how the relationships between satellite FLH and in situ chlorophyll-a change with depth, distance from shore, from structures like bridges, and nutrient concentrations and turbidity. Such analysis illustrates that the correlations between FLH and in situ chla measurements increases with increasing distance between monitoring sites and structures like bridges and shore. Due probably to confounding factors, expected improvement in the FLH- chla relationship was not clearly noted when increasing depth and distance from shore alone (not including bridges). Correlations between turbidity and nutrient concentrations are discussed further and principle component analyses are employed to address the relationships between the multivariate data sets. A thorough understanding of how satellite FLH algorithms relate to in situ water quality parameters will enhance our understanding of how MODIS's global FLH algorithm can be used empirically to monitor coastal waters worldwide.