Using Satellites to Analyze Temperature, Chlorophyll and Salinity in Narragansett Bay

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Narragansett Bay is the largest estuary in New England and is therefore of great environmental and economic importance. Not only does it support a biologically diverse ecosystem, but it also helps to filter the air we breathe and the water we drink. Since the start of the 20th century, Narragansett Bay has experienced above average increases in water temperature and significant pollution. Quantifying how different components of the Bay have changed over time in response to climate change, regionally specific anthropogenic actions, and natural processes, is critical to understanding the future of the Bay. There are a number of buoys in the region that collect data at a high temporal resolution, but this data is limited to only certain months of the year and to the specific locations of the buoys. In this study, we use remotely-sensed data from the Landsat 5, 7, and 8 satellites to expand the record of sea-surface temperature (SST) to the entirety of the Bay over a 38-year period (1984-2022), and we make progress towards being able to measure chlorophyll (Chl) and sea-surface salinity (SSS) from satellite imagery. For SST, we calibrate the thermal bands of the three satellites against the in-situ buoy measurements using two different methods of bias corrections, one that uses the entire dataset and another that splits the data at different temperature thresholds and calculates a different bias for each side of this split. For Chl, we use two different multi-band algorithms to extract chlorophyll readings from the blue and green bands of the satellites and compare their respective accuracies. For SSS, we test for correlations between individual Landsat bands and buoy measurements to see if salinity is connected to color. In the future, we will use our record of SST to quantify how different parts of the Bay have changed over time and measure the amount of warming that has taken place over the past 38 years. We also plan to use Extended Empirical Orthogonal Function (EEOF) analyses, a pattern recognition technique, to improve our calibrations for Chl and SSS. In addition to improving our understanding of the physical and biological processes that govern Narragansett Bay, these records of SST, Chl, and SSS could be useful for evaluating climate models of the region that predict future climatic trends.

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