



Sullivan, C., Ali, K.A., "Characterizing Water Quality of Saginaw Bay Using Satellite Data."

Camille Sullivan Research Statement:

The Saginaw Bay is a productive bay that is an extension of Lake Huron in the Great Lakes. There are high levels of algal production and turbidity in this bay, which contribute to a water quality crisis that has several negative effects on the surrounding area. Increased agricultural and industrial activity in the watershed has intensified this issue as well. A result of this increased activity is Harmful Algal Bloom (HABs). HABs and the dead zones that develop from them are the main environmental issues for this area. HABs can produce toxins that are poisonous to humans and other animals and can contaminate drinking water sources. As the algal bloom decomposes, it forms a dead zone where aquatic animals cannot survive due to extremely low oxygen levels. Despite this urgent situation, there is not much information available about the HAB events in the Saginaw Bay. This lack of information means that it is necessary to monitor changes efficiently in water quality since this region of the lake serves as a resource through fishing and recreation industries, as well as a source for the local drinking water supply. Many HAB events occurring in bays such as in Saginaw are typically patchy or have a small spatial coverage. These events are often unpredictable and happen quickly, which makes satellite-based monitoring more difficult. UAVs have proven useful for environmental remote sensing due to their flexibility, cost effectiveness, and high spatial resolution due to their low flying height. The objective of this study is to develop bio-optical model for both satellites and UAVs for monitoring HABs. Model development will be carried out by collecting field and lab-based analysis of water quality parameters. This work will address a significant research gap, as rapidly tracking the structures and patterns in HABs in bays has been difficult due to lack of timely shipboard measurements and lack of spatial resolution from current ocean color satellites. Field data will be collected during the summer of 2021 in Saginaw Bay. Water samples will also be analyzed for chlorophyll, sediment content and colored dissolved organic matter. Both research-grade field-based bio-optical instrumentation and laboratory instrumentation will be used to collect high-quality data. Field based instrumentations will also measure in-situ conventional water quality parameters including dissolved organic material. Lab analysis will be done using existing laboratory protocols. Satellite imagery, acquired from NASA and ESA, and UAV data both captured during sampling overpass will be used to develop a robust regionally calibrated bio-optical model. Images will be processed using NASA ocean color processing software. Algorithms will be developed using machine learning and semi analytical methods. Timeline: March to May: literature review May/June: Field sampling/data analysis June/July: Image/data processing August: Algorithm development If COVID restricts travel, we have existing data that we can work with, including pre- and post-processing satellite images, for developing satellite based ocean color models to monitor water quality in Saginaw Bay. Since I have experience with programming, I will approach this project from a multidisciplinary perspective through my experiences with geology and computer science. Working on this project will provide me with the unique opportunity to work in the field and lab while using state of the art research instrumentations, as well as working with satellite data and learning modelling approach. Developing these research skills will help me solidify my career interests, and provide future experiences to enhance my college career, such as other research projects and internship opportunities. After graduating from the College of Charleston Honors College, I plan to attend graduate school for geology or hydrology, and these skills will make my application more competitive.

I conducted research with Professor Lande Affonso during the Summer 2019 semester on data acumen and the use of data science in the classroom. I received a \$4,000 SSM research grant for this work, and presented a virtual poster during the following Summer 2020 semester since I was unable to present in person during the Spring 2020 semester due to COVID.