Machine Learning Classifiers to Predict Red Tide in Florida

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Over the past few decades, Harmful Algal Blooms (HABs), or commonly known as red tide, have increased in their frequency and magnitude around the world. HABs can cause massive fish kills and create human health problems by poisoning seafood, contaminating water supplies, and producing aerosolized toxins. In 2017 and 2018, blooms of the toxic dinoflagellate Karenia brevis swept over West Florida coast, resulting in thousands of tons of dead fish and marine life, numerous respiratory-related hospitalizations, and hundreds of millions dollars in economic damage. There is an urgent need to understand what drives HABs and predict their outbreaks. In my research, I analyzed long-term monitoring data and developed machine learning classifiers to predict Karenia brevis blooms. I explored three machine learning algorithms: Support Vector Machine (SVM), Naive Bayes classifier (NB), and Artificial Neural Networks (ANN). Three metrics were used to quantify the classification accuracy: accuracy during HAB events, accuracy during non-HAB events, and the total accuracy. SVM had the highest classification accuracy (63%; 85%; 78%), followed by ANN (41%; 76%; 65%) and NB (64%; 56%; 58%). My analysis shows that northerly winds and high river flows produce a favorable condition for the blooms. Northerly winds generate coastal upwelling and onshore transport of Karenia brevis in the bottom Ekman Layer, while large river flows deliver a huge amount of nutrients to coastal waters. I further showed that reducing riverine nitrogen and phosphorus loading will lower the HABs occurrence but climate change will increase the risk of HABs.

Awards Won:

Fourth Award of $500