World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:16, No:06, 2022

A West Coast Estuarine Case Study: A Predictive Approach to Monitor Estuarine Eutrophication

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Abstract : Estuaries are wetlands where fresh water from streams mixes with salt water from the sea. Also known as “kidneys of our planet”- they are extremely productive environments that filter pollutants, absorb floods from sea level rise, and shelter a unique ecosystem. However, eutrophication and loss of native species are ailing our wetlands. There is a lack of uniform data collection and sparse research on correlations between satellite data and in situ measurements. Remote sensing (RS) has shown great promise in environmental monitoring. This project attempts to use satellite data and correlate metrics with in situ observations collected at five estuaries. Images for satellite data were processed to calculate 7 bands (SIs) using Python. Average SI values were calculated per month for 23 years. Publicly available data from 6 sites at ELK was used to obtain 10 parameters (OPs). Average OP values were calculated per month for 23 years. Linear correlations between the 7 SIs and 10 OPs were made and found to be inadequate (correlation = 1 to 64%). Fourier transform analysis on 7 SIs was performed. Dominant frequencies and amplitudes were extracted for 7 SIs, and a machine learning(ML) model was trained, validated, and tested for 10 OPs. Better correlations were observed between SIs and OPs, with certain time delays (0, 3, 4, 6 month delay), and ML was again performed. The OPs saw improved R^2 values in the range of 0.2 to 0.93. This approach can be used to get periodic analyses of overall wetland health with satellite indices. It proves that remote sensing can be used to develop correlations with critical parameters that measure eutrophication in situ data and can be used by practitioners to easily monitor wetland health.

Keywords : estuary, remote sensing, machine learning, Fourier transform
Conference Title : ICEECCB 2022 : International Conference on Ecology, Ecosystem Conservation and Conservation Biology
Conference Location : Dubai, United Arab Emirates
Conference Dates : June 27-28, 2022