Algal bloom modelling based on satellite data

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Abstract: The excessive growth of macroalgae negatively affect the estuarine ecosystems by shading, depleting oxygen and significantly decreasing the attractiveness of the area for fishing or recreation. The causes of macroalgal blooms are poorly understood, although elevated water temperatures and nutrient concentrations are considered important prerequisites for the bloom. However, to identify the conditions underpinning algal blooms, their temporal and spatial dynamics must be documented and quantified. Observing and quantifying macroalgal blooms can be a challenge, especially for large or remote areas. Satellite imagery provides a relatively cheap and efficient way of detecting, quantifying and monitoring macroalgal blooms using GIS mapping.

We analyzed the images of the target area (Tuggerah Lakes estuary on the Central Coast of NSW, Australia) from Sentinel 2 satellite for 2019–2023.

Multispectral images were processed with Floating Algae Index (FAI) and Floating MacroAlgae Index (FMAI) which detect a chlorophyll fluorescence in near infra-red diapason. This so-called "red-edge effect" is used to detect photosynthetic organisms on the water surface. A specific challenge in image processing is determining quantitative criteria by which blooms are identified from the index value in the resulting raster file. Several machine learning algorithms (logistic regression, SVM and others) were utilized for binary classification into bloom and non-bloom areas. They were trained using the results of both, FAI and FMAI implementation. Then these algorithms were validated and compared to select the optimal one for future use in monitoring algal blooms.

The selected algorithm will be used for future monitoring and quick detection of algal blooms at a range of environmental conditions. It will be employed as a tool for bloom prediction for remote areas in which direct observations are not possible.

Keywords: *Algal blooms, remote sensing, multispectral images, machine learning algorithm*