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Author: Mr. Cameron Penne
Norwegian University of Science and Technology, Norway

Dr. Joseph Landon Garrett
NTNU, Norway
Prof. Milica Orlandic
NTNU, Norway

HYPERSPECTRAL CHANGE DETECTION FOR MONITORING HARMFUL ALGAE BLOOMS IN AQUATIC SCENES USING INDEPENDENT COMPONENT ANALYSIS

Abstract

Harmful algal blooms (HABs) are an aquatic phenomenon characterized by a rapid growth of toxin-producing algae which have detrimental impacts on marine ecosystems, aquaculture, and fresh water resources. As a result, monitoring HABs through change detection is critical, especially in regions with reoccurring HAB events. One tool for monitoring HABs are hyperspectral satellites which can observe spectral signatures from chlorophyll present in algae. However, most change detection methods for hyperspectral data focus on land-based scenes rather than aquatic scenes. In this work, we present an approach for monitoring HABs in aquatic scenes using Independent Component Analysis (ICA) for unsupervised change detection. ICA is used to extract distinct anomalous spectral features in bi-temporal hyperspectral datasets and the resulting spatial maps are used to generate change maps of the scene for analysis. Our work focuses on an area of the of the Norwegian coast known as Frohavet, where hyperspectral images were acquired in 2023 by HYPSO-1, a hyperspectral imaging small satellite operated by the Norwegian University of Science and Technology (NTNU). We compare results from the HYPSO-1 data with those predicted by SINMOD, an ocean simulation that models the biological and hydrological processes of Frohavet. The results demonstrate the utility of satellite hyperspectral imaging for HAB and water quality monitoring as well as the integration of remote sensing and modeling for environmental monitoring systems. Future work will focus on classification and distinguishing between different algal species.