SATELLITE RETRIEVAL OF CHLA IN SMALL INLAND WATERS VIA LOCALLY-TRAINED MACHINE LEARNING MODELS: RECOMMENDATIONS BASED ON A PRAIRIE LAKE WORKFLOW

Amir Chegoonian, University of Waterloo; Peter R. Leavitt, Department of Biology, University of Regina, Saskatchewan, Canada - Claude R. Duguay, Department of Geography and Environmental Management, University of Waterloo, Ontario, Canada

The use of locally-trained machine learning (LML) models for chlorophyll-a (Chla) retrieval in small inland waters (SIWs) has been challenging due to the lack of standardization in the various parameters involved, which can affect the accuracy of Chla estimation. To address this challenge, a paired dataset of 38-year (1984-2021) Chla measurements and near-coincident satellite-derived reflectance of various satellites (i.e., Landsat 5, 7, 8; Sentinel 2, 3) for nine representative eutrophic prairie lakes in Canada was analyzed and recommendations were made for developing LML models. Our findings show ML models can be developed using in-situ Chla derived from multiple sources (i.e., HPLC, spectrophotometry, field fluorometry). Results also revealed that a local mixture density network (LMDN) significantly outperformed other ML models in estimating Chla. Further a threshold of 250-300 lake-satellite matchups was required to well train local ML models, regardless of the sensor type. Going beyond this threshold led to a decline in model performance, particularly when time differences between satellite overpass and in-situ data collection were increased. Models based in Sentinel-2, then Sentinel-3, data significantly outperformed Landsat missions, showing the high potential of the Ocean and Land Colour Instrument (OLCI) for Chla retrieval from small lakes of only 1-3 kilometers in diameter. Processes outlined in this workflow can be employed in developing LML models for SIWs in other regions, allowing quantification of regional variability in lake production.