NASA MUREP/SMD Ocean Biology and Biogeochemistry Awards (OCEAN)

Title: Extending the California Harmful Algae Risk Mapping (C-HARM) domoic acid model to the Pacific Northwest

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Summary: The health of Great Lakes ecosystems is linked to dynamic processes at the land-water interface, in which changes in hydrology can lead to large changes in coastal ecology, nutrient fluxes and near-shore water quality. Lake Huron, which is part of the largest surface freshwater reserve on Earth, has experienced rapid recent changes in water levels from record low levels in 2013 to record high levels in 2020. This provides an exceptional opportunity to investigate the responses of coastal ecosystems and their effects on nutrient processing and lake ecosystems. Mounting pressures on this system from climate change, rapid water level change, nutrient loading, and invasive plant species could switch coastal wetlands from being nutrient sinks to sources to the open waters. This in turn could alter nearshore production of submerged aquatic vegetation (SAVs) and phytoplankton. Because Lake Huron coastal ecosystems are experiencing more rapid water level changes than marine ecosystems, this proposed research provides some insights to future scenarios of coastal sea level rise. The overarching objective is to use remote sensing and linked Landscape Hydrology-Wetland Ecosystem-Biophysical Lake models to understand how the complex hydrology at the land-water interface affects coastal ecosystem function, and nutrient exchange with open waters, ultimately influencing whole system vulnerability. The specific objectives are to: Map the multi-decadal responses of aquatic ecosystems to shifting Lake Huron water levels and mounting invasion pressure; Link Landscape Hydrology-Wetland Ecosystem-Biophysical Lake models; Understand how Lake Huron water level changes affect coastal wetland ecosystem composition and nutrient cycling; Quantify the responses of open-water ecosystems to landscape inputs, buffered by coastal wetlands.

This multi-institutional project will combine remote sensing data products with landscape hydrology and wetland ecosystem models to assess changes in aquatic ecosystems around Lake Huron in response to pressures of nutrient loading, invasive vegetation, and water level changes over a 30-yr period. The outcomes of this project will increase our capacity to quantify and predict the climate- and human-induced changes in large lake aquatic ecosystems.