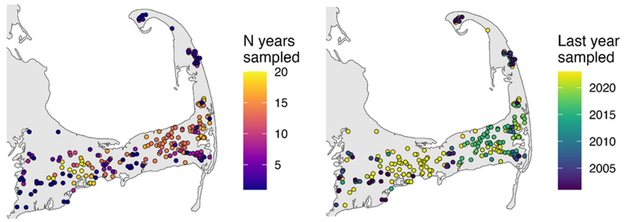
# Development of Automated Remote Sensing Methods for Water Quality Mapping

TO BETTER UNDERSTAND CHANGING CONDITIONS IN CAPE COD AND RHODE ISLAND LAKES AND PONDS

## Introduction

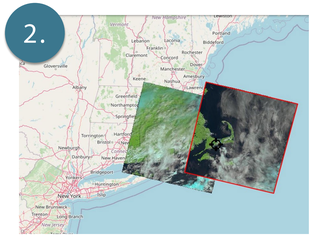
Cape Cod has 890 ponds that are integral to the region's water resources and economic vitality. Healthy ponds provide valuable ecosystem services. Assessing pond health is important for our communities, however, physically monitoring all ponds is not attainable. On Cape Cod there are historical and current efforts to monitor approximately 230 ponds, but many of these monitoring efforts occur once a year providing a snapshot of the pond water quality. Additionally, the methodology of the monitoring is inconsistent from year to year and from pond to pond. Similar gaps in lake monitoring exist throughout the SNEP region.




Monitoring has been going on for 20+ years on Cape Cod, but many ponds have not been monitored for more than five years (left map). Some ponds have been monitored in the past five year (right map), while most haven't been monitored for 10 years or more.

## Methods and Process

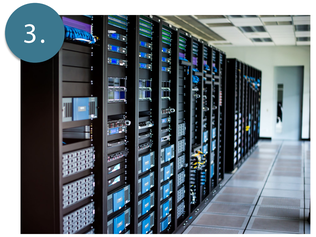
1. Download satellite imagery from Sentinel 2, Landsat 8 & 9



2. Image tiles for study region from satellite



3. Process satellite imagery

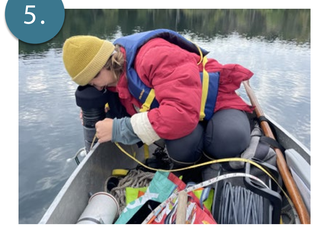


4. Improve atmospheric correction and masking

Test different machine learning methods

Prepare images with automated processes

5. Measure and compile water quality data for Cape Cod and Rhode Island from 2017-2026



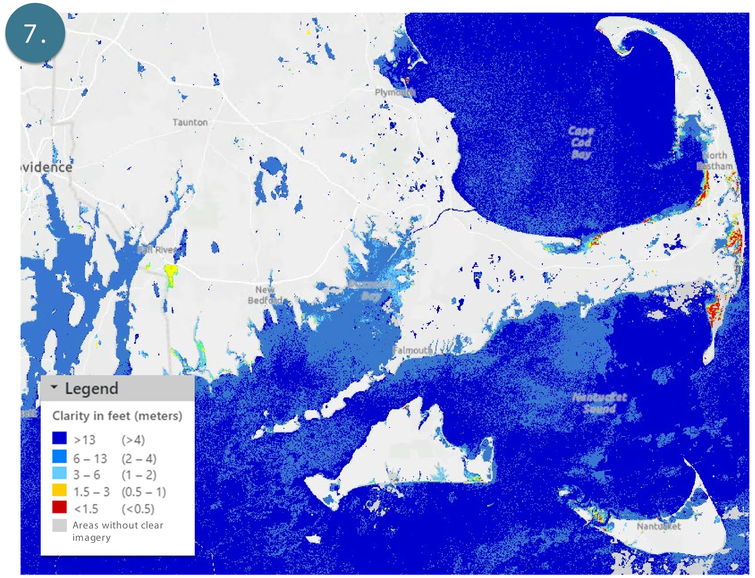
6. Chlorophyll

Water Clarity

CDOM

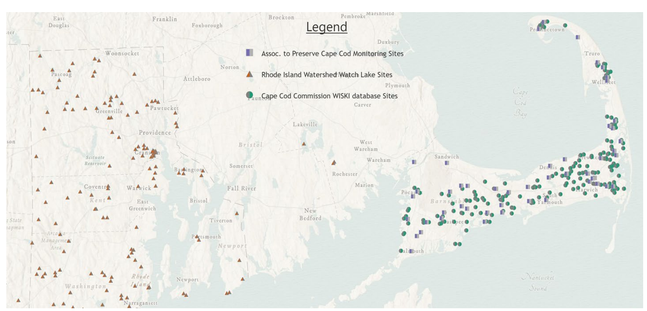
Apply water quality models to satellite images using field validation data

7. Generate remotely sensed water quality data throughout the SNEP Region, available via an online interactive map. Similar to the figure above, which is showing water clarity derived from satellite imagery.




## Overview

Project partners are aggregating existing and historical water quality data (water clarity, chlorophyll-a, and colored dissolved organic matter (CDOM)) from Cape Cod and Rhode Island, as well as supplemental data for the SNEP region that is available through the National Water Quality Portal. Monitoring efforts will continue through the project lifespan (2026). Utilizing an automated pipeline built in a high-performance computing environment, satellite data products will be generated to analyze and predict pond water quality. Secchi disk depth, chlorophyll-a, and CDOM measurements will be used to calibrate satellite imagery to the region.




**536 MONITORING LOCATIONS USED TO CALIBRATE SATELLITE ANALYSIS**

Rhode Island Watershed Watch will contribute data from 176 locations; for Cape Cod the Pond and Lake Stewards and Cape Cod Regional Monitoring Program monitor a combined 230 ponds; APCC's Cyanobacteria Program monitors 130 ponds.

## Goals

Establish a predictive relationship between satellite observations and water clarity and chlorophyll.

Generate monthly estimates of water clarity, chlorophyll-a, CDOM.

Explore indicators that support cyanobacteria growth to assess predictive capabilities.

Make results available publicly through an interactive web viewer.


PROJECT PARTNERS

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CAPE COD COMMISSION

UNIVERSITY OF MINNESOTA Driven to Discover℠

THE UNIVERSITY OF RHODE ISLAND

APCC Association to Preserve Cape Cod


**Reference**

Olmanson, L. D. Porter. 2023. Advanced Water Quality Monitoring of Optically Variable Lake Systems Using Landsat 8 OLI and Sentinel 2 MSI Imagery in an Automated High-Performance Computing Environment. UNM Water Council.