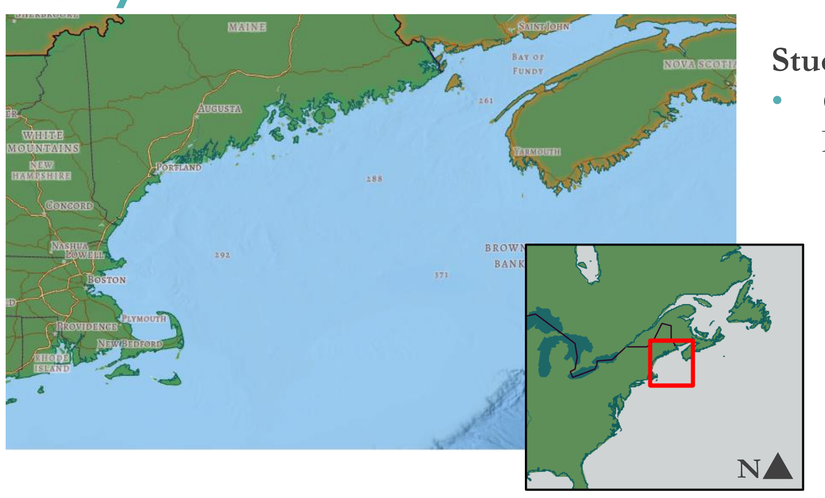
Assessing the Use of NASA Earth Observations for Identifying Harmful Algal Blooms of *Pseudo-nitzschia* in the Gulf of Maine

Abstract

The Gulf of Maine has a history of harmful algal blooms (HABs) that have been increasing in frequency and intensity in recent years, raising concerns in the community. Specifically, the *Pseudo-nitzschia* genus possesses harmful toxins that can induce food-borne illnesses and infect humans through ambient water. We observed *in-situ* data from known 2016 and 2020 *Pseudo-nitzschia* blooms as case studies to test the feasibility of using satellite data to track bloom events. We worked in partnership with the Woods Hole Oceanographic Institution (WHOI), Battelle Environmental Division, and the National Oceanic and Atmospheric Administration (NOAA) Stellwagen Bank National Marine Sanctuary. To map the frequency and distribution of *Pseudo-nitzschia* bloom events, we acquired satellite data from Aqua Moderate Resolution Imaging Spectroradiometer (MODIS) and Sentinel-3 Ocean and Land Color Instrument (OLCI). We utilized satellite data to calculate normalized fluorescence line height (nFLH) and visualize absorption due to phytoplankton (aph443), which we compared with *in-situ* observations to analyze ocean and algal color variations. The end products included daily, weekly, and monthly time-series maps for the 2016 and 2020 blooms; *in-situ* data and satellite imagery statistical analyses; and visualizations of the *in-situ* data.

Study Area



Study Area:

- Gulf of Maine, Buzzard's Bay, Nantucket Sound

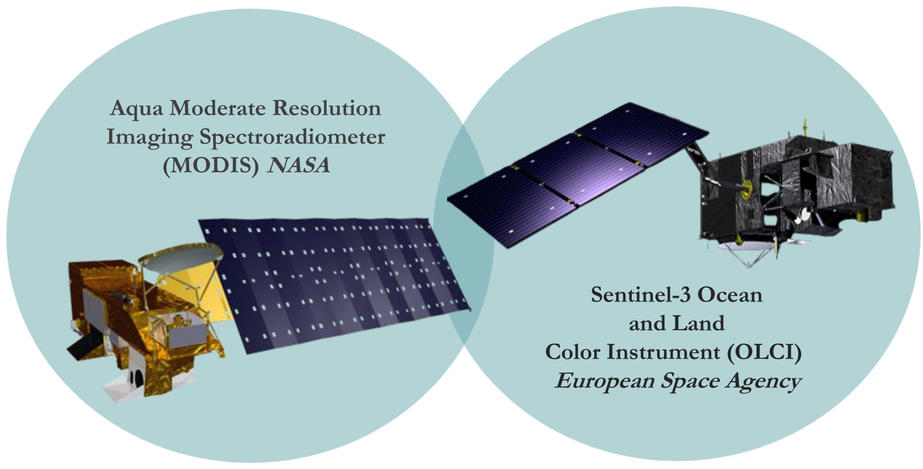
Study Period:

- August to December, 2016 and 2020

Objectives

- **Identify** and track two known *Pseudo-nitzchia* blooms
- **Validate** remotely sensed bloom data with *in-situ* data
- **Determine** if reflectance in a given pixel is caused by a diatom

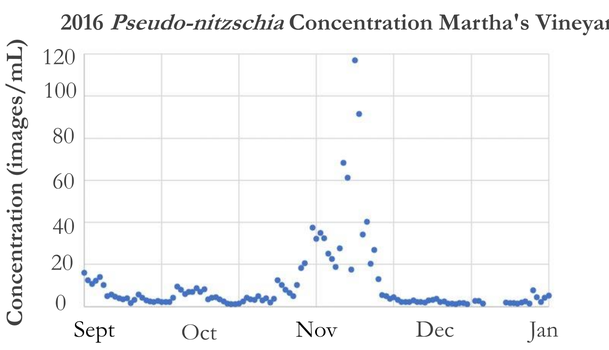
Earth Observations

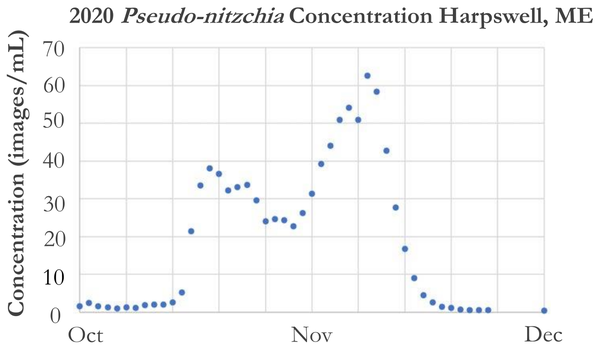


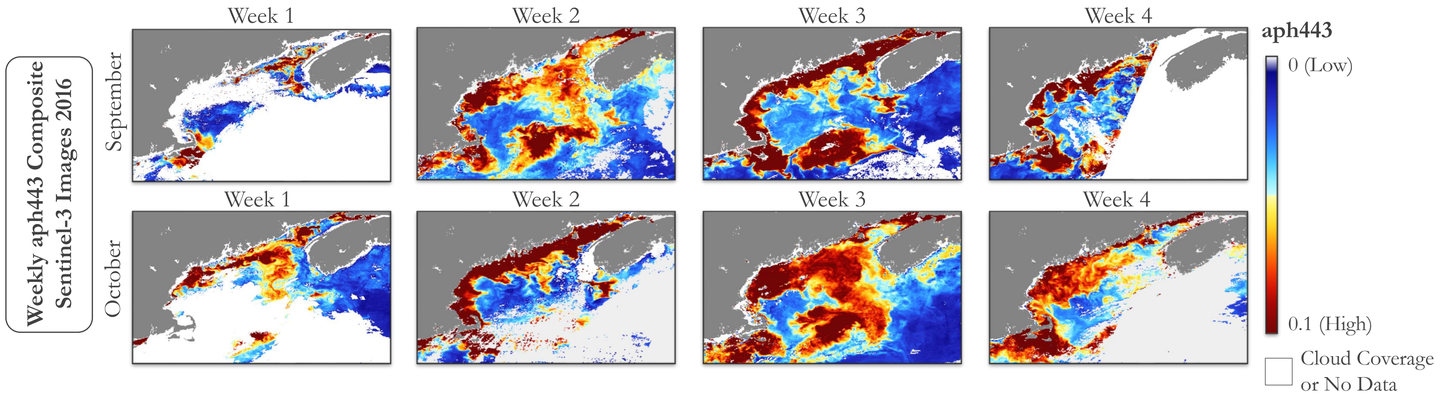
Methodology

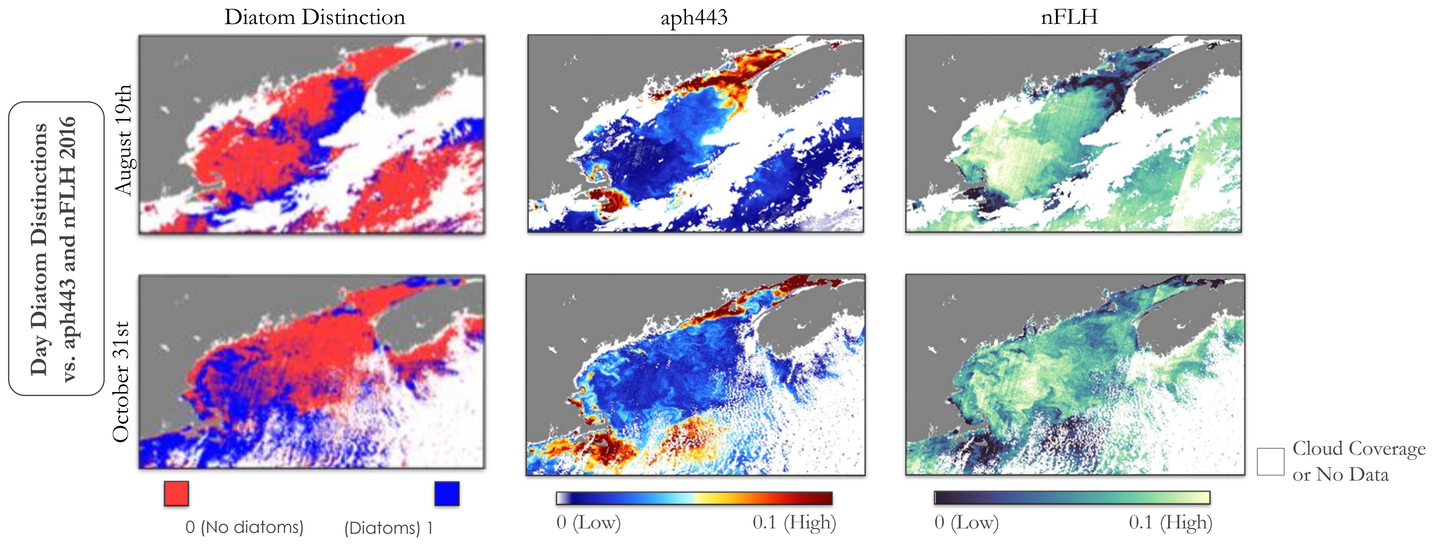
1. Process WHOI IFCB *in situ* 2016 & 2020 bloom data
2. Process MODIS and Sentinel-3 imagery for nFLH and aph443 products
3. Cross-reference *in-situ* data with remote sensing products & calculate diatom distinction using imagery

Results









Conclusions

- The satellite imagery aligns with the *in-situ* data, indicating that Earth observations can be utilized to track *Pseudo-nitzschia* events in the Gulf of Maine.
- Diatoms can be distinguished in satellite imagery from other types of algal species present in a bloom.
- Acquired Earth observations can help partners monitor and track *Pseudo-nitzschia* blooms in near real-time.

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Project Partners

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This material contains modified Copernicus Sentinel-3 data (2016, 2020), processed by ESA.

Gulf of Maine Water Resources