Ocean Color Applications in Fisheries Science and Management in the Northeast U.S.

Kimberly J. W. Hyde
Northeast Fisheries Science Center
Take Away Messages

The oceanographic conditions in the Northeast U.S. are changing and affecting all levels of the marine food web.

Changes in the abundance, productivity, phenology and community composition of phytoplankton can affect the marine food web and biogeochemical cycles.

The long-term time series of phytoplankton have multiple operational and fisheries management applications.
NOAA Fisheries is responsible for the stewardship of living marine resources through science-based conservation and management and the promotion of healthy ecosystems.

- Productive and sustainable fisheries
- Safe sources of seafood
- Recovery and conservation of protected resources
- Healthy ecosystems
Northeast Fisheries Science Center conducts ecosystem-based research and assessments to understand and predict changes to marine ecosystems and their subsystems affecting:

- living marine resources
- fisheries
- habitats
- ecosystem condition
- productivity
- aquaculture
Why ocean color satellites?

"Cell size is a master trait that shapes ecological niches of phytoplankton."
(Litchman & Klausmeier, 2008)
Project Overview

**Primary goal:** Comprehensively characterize the spatial and temporal variability of the phytoplankton community in the Northeast Shelf ecosystem over the 20+ year ocean color time series for operational fisheries applications.

**Primary questions:** Which algorithms perform best? Can they be regionally improved using local *in situ* observations? How do abundance and absorption-based algorithms compare?

**Primary objectives:** Collect *in situ* measurements of optical properties, phytoplankton imagery (IFCB), pigments (HPLC), and nutrients and evaluate and optimize the performance of satellite size class algorithms.
In situ Observations

- Temperature/Salinity
- Absorption/Attenuation/
- Scattering/Backscattering
- Chl, CDOM, Fluorescence
- Radiometry
Algorithm validation

Optimization and assessment of phytoplankton size class algorithms for ocean color data on the Northeast U.S. continental shelf

Kyle J. Turner, Colleen B. Mouw, Kimberly J.W. Hyde, Ryan Morse, Audrey B. Giochette
What are the **environmental drivers** of phytoplankton abundance and community size composition in the U.S. Northeast Continental Shelf?
Fisheries Applications
Ecosystem Reports & Products

Ecosystem and Socioeconomic Profiles

Black Sea Bass Ecosystem Processes
In New England and the Mid Atlantic

Recruits
(17 - 21°C, 50-200m [shell patches], 2-12cm)
• Determined by first winter survival

Eggs & Larvae
(10 - 25°C, 30-50m [upper water column], 1-15mm)
• June - Sept
• Possible gelatinous plankton predation

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Spawning
(20-50m [rocky reefs], >19cm)
• May - June
• Hermaphroditism
• Sneaker males can make up for fishery removals

Adults
(9 - 27°C, 2-60m [reef/structure], >19cm)
• Mature at 1-3 years old
• Temperature drives offshore migration

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Abigail Tyrell, Ricky Tabandera, & Scott Large

https://noaa-edab.github.io/ESP_docs/docs/
Research Assessment

Sarah Salois & Kimberly Hyde
Protected Species

Annual habitat use dynamics

P(habitat use)

(right whale)

(humpback whale)

(fin whale)

Date of peak habitat use

(right whale)

(humpback whale)

(fin whale)

1998

2018

Changing Phenology

Western GOM spring onset

Eastern GOM spring onset

Cape Cod Bay, MA

Decadal-scale phenology and seasonal climate drivers of migratory baleen whales in a rapidly warming marine ecosystem

Photo credit: Brigid McKenna, Center for Coastal Studies under NOAA research permit #19315-01
Protected Species

Spatial ecology of long-tailed ducks and white-winged scoters wintering on Nantucket Shoals

Timothy P. White, Richard R. Veit
Modeling

Upper Trophic Levels

Planktivores
Benthivores
Meso-Zooplankton
Deposit Feeding
Suspension Feeding
Micro-Zooplankton
Nano-picoplankton
Bacteria

Phytoplankton

Median Potential Yield

(Microbial Loop)
A northeast United States Atlantis marine ecosystem model with ocean reanalysis and ocean color forcing

Joseph C. Caracappa, Andrew Beet, Sarah Gaichas, Robert J. Gamble, Kimberly J. W. Hyde, Scott I. Large, Ryan E. Morse, Charles A. Stock, Vincent S. Saba
Modeling

SPIN UP CLIMATOLOGY

Diatoms (mg N m\(^{-2}\))

Dinoflagellates (mg N m\(^{-2}\))

Hicophytoplankton (mg N m\(^{-2}\))

Georges Bank
Gulf of Maine
Mid-Atlantic Bight

Maximum Depth Bin
0-60m
50-120m
120-300m
200m +
Regime shifts

Peretti et al. 2017
Fisheries Satellite Data Requirements

- Accurate, consistent, timely, climatological quality high-resolution ocean color data/products that can detect changes in the phytoplankton community
  - Merged (e.g. OC-CCI)/gap-filled (DINEOF) sensor agnostic products

- Hyperspectral data (i.e. PACE) for more accurate detection of phytoplankton functional groups

- High quality in situ validation data & optimized regional algorithms

- Near real-time data for dynamic ocean management

- High resolution geostationary imagery (GLIMER & GeoXO)
  - Aquaculture, HABs, Coastal Runoff
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Thank You