The LOCNESS Project Research Update

Adam V. Subhas
Carbon to Sea Annual Convening
May 19-21, 2025

WOODS HOLE **OCEANOGRAPHIC** INSTITUTION

THE WHOI LOCNESS PROJECT:

Locking Ocean Carbon in the Northeast Shelf and Slope

20 WHOI scientists and engineers from all five departments
Colleagues from:
    Rutgers University
    Monterey Bay Aquarium Research Institute
    MRV Systems
    Environmental Defense Fund
    NOAA Northeast Fisheries Science Center

M B A R I

NOAA

MRV

RUTGERS
THE STATE UNIVERSITY
OF NEW JERSEY

WOODS HOLE **OCEANOGRAPHIC** INSTITUTION

Environmental
Defense
Fund

THE WHOI LOCNESS PROJECT:

Locking Ocean Carbon in the Northeast Shelf and Slope

WOODS HOLE **OCEANOGRAPHIC** INSTITUTION

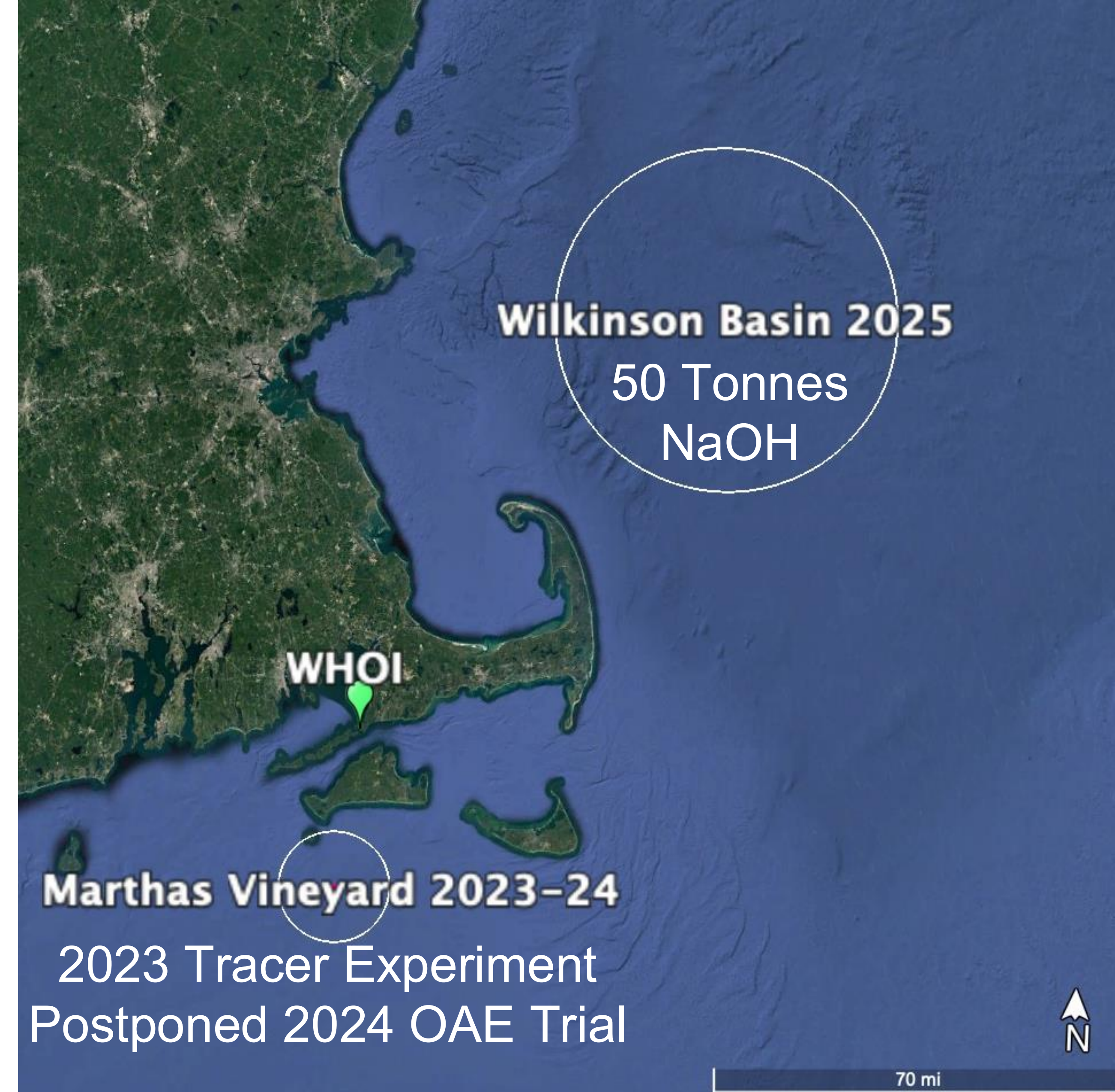# What we are (and are not)

LOCNESS IS:

- An interdisciplinary team of scientists, engineers, and communicators

- Committed to rigorous, transparent scientific evaluation of OAE

- Answering key questions about the effectiveness and potential environmental impacts of OAE

LOCNESS IS NOT:

- A company selling CO_2 credits

- Participating in the carbon credit market

- A pathway to deploying alkalinity enhancement at scale

WOODS HOLE **OCEANOGRAPHIC** INSTITUTION

2024-2025 snapshot

- Postponed 2024 alkalinity release

- Broad community engagement

- Holistic baseline analysis

- 2023 tracer-only study synthesis

- Large-scale tank tests

- Biological impacts work

- Permit approval for this summer

Wilkinson Basin 2025
50 Tonnes
NaOH

WHOI

Marthas Vineyard 2023–24

2023 Tracer Experiment
Postponed 2024 OAE Trial

70 mi

Hosting workshops, listening sessions, seminars, etc.

- Public education about mCDR
- Dispel mis- and disinformation about LOC-NESS
- Seek feedback from communities concerned about the project
- Incorporate that feedback where possible

Hosting workshops,
listening sessions,
seminars, etc.

- Public education about
  mCDR
- Dispel mis- and
  disinformation about LOC-
  NESS
- Seek feedback from
  communities concerned
  about the project
- Incorporate that feedback
  where possible

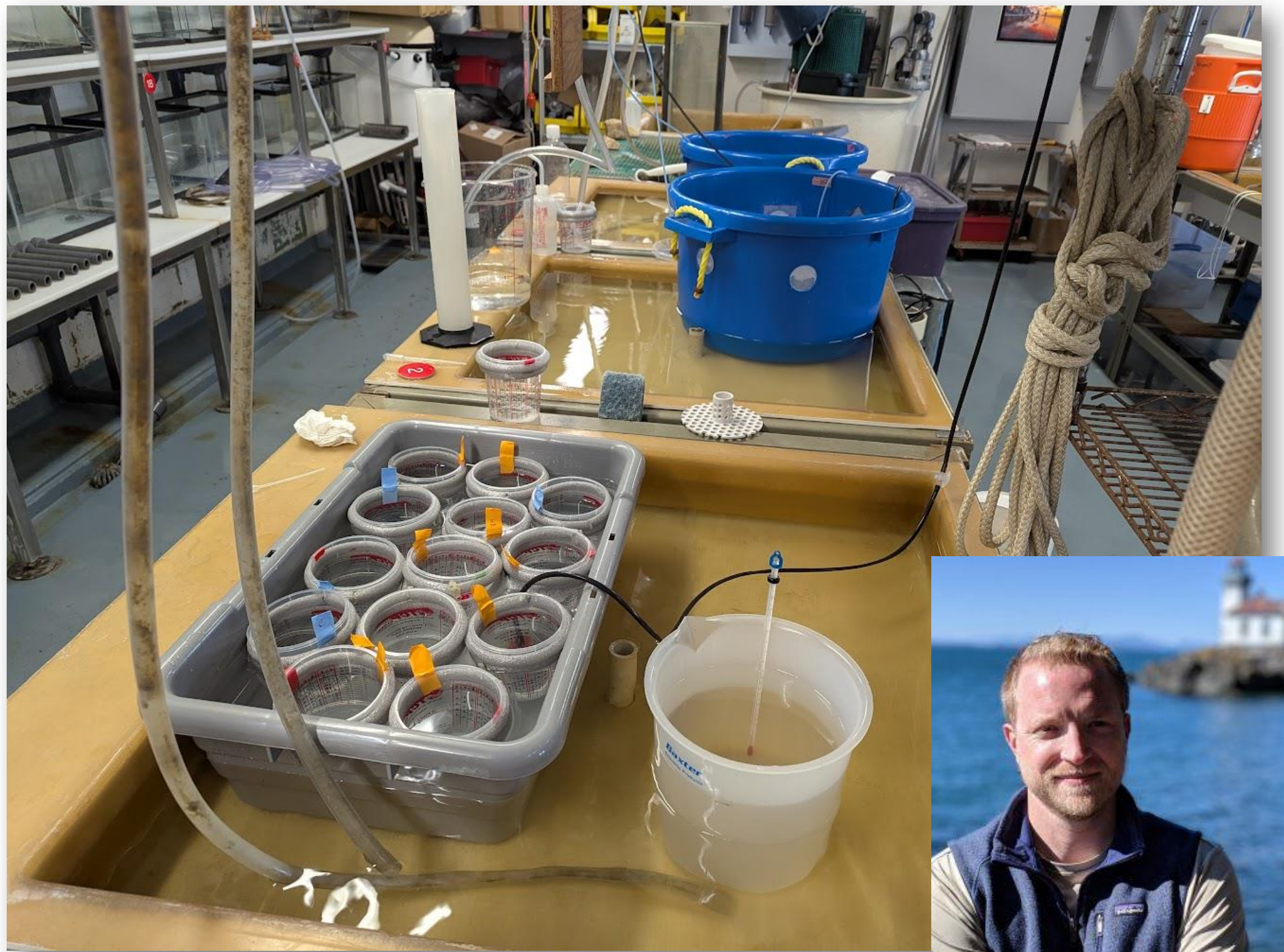# Shout-out to WHOI Communications, Peter Hill, Diane Hoskins, and Evergreen Strategy Group!

Modeling: Check out Jennie's poster!
Chemistry, biology, physics

Predicted patch motion and dispersal

WOODS HOLE **OCEANOGRAPHIC** INSTITUTION
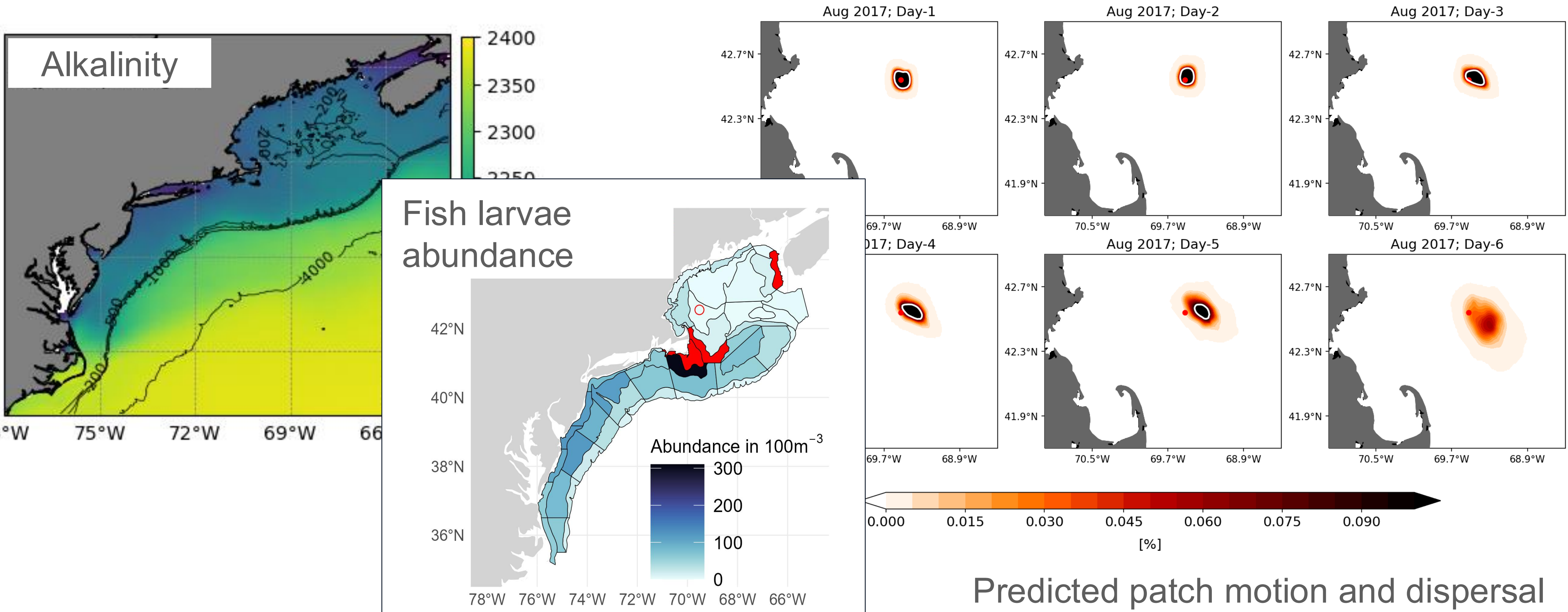
Biological impact studies
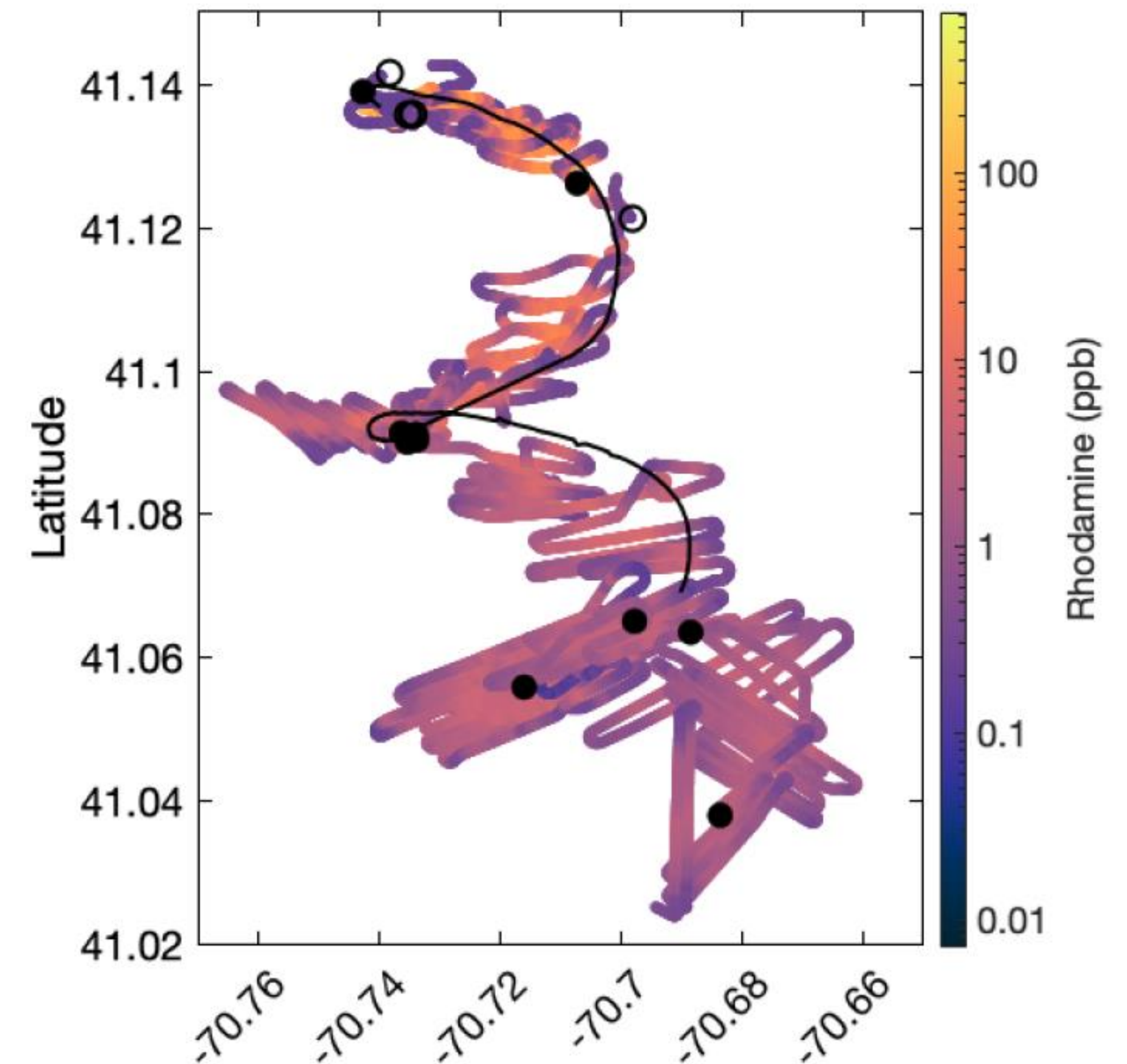in the lab and via shipboard experiments.

Copepod *(Calanus finmarchicus)* exposures, expanding to fish and lobster larvae

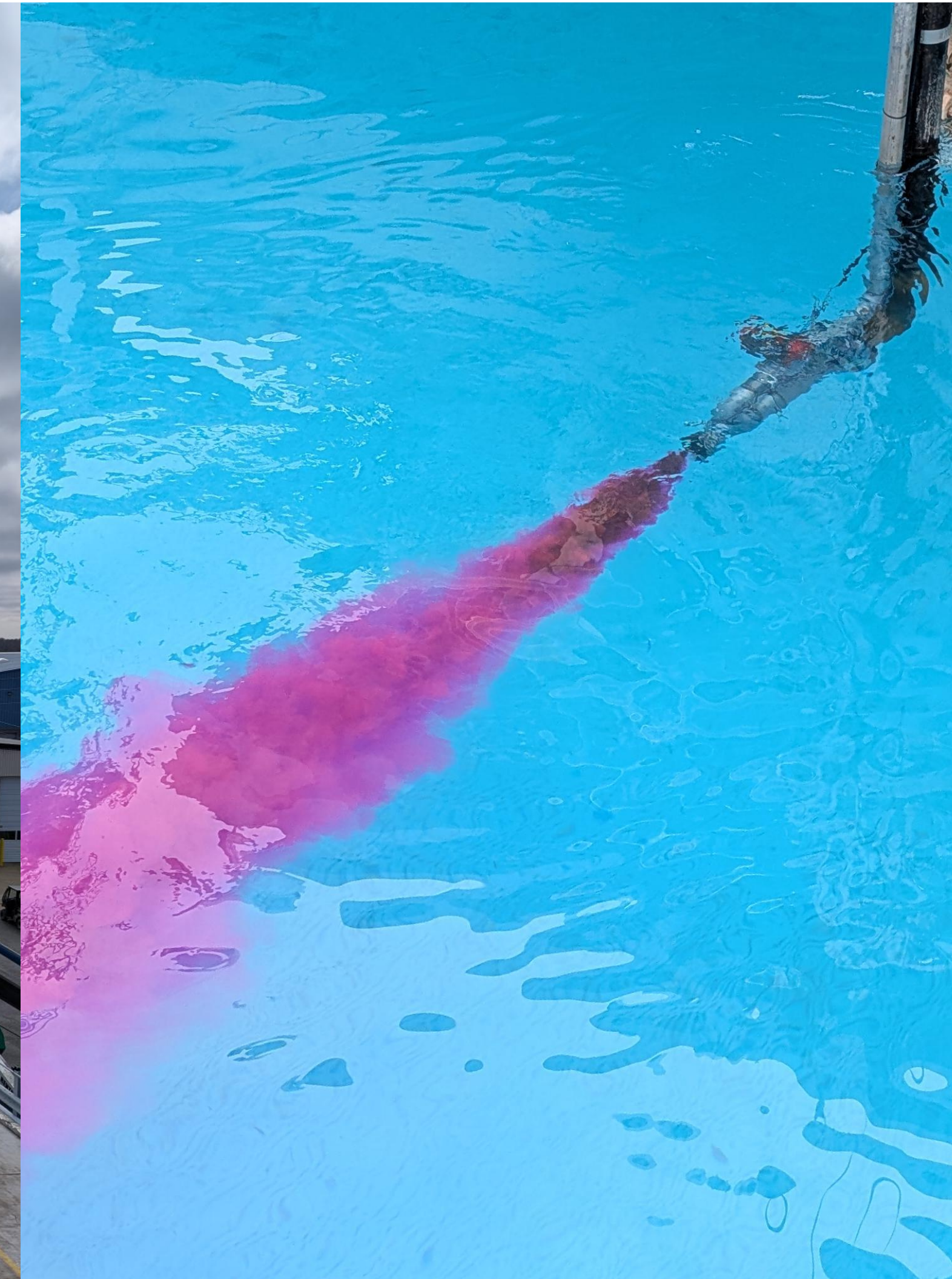Diatoms and coccolithophores, in the lab and at sea across bloom states

"LOC-01" Tracer Study Synthesis

We can disperse and track alkalinity in the ocean at high precision

WOODS HOLE **OCEANOGRAPHIC** INSTITUTION

At-scale chemical engineering validation

- 10 million liter open-air test tank
- ~2T NaOH (50 wt%)
- Full sensor suite analysis

Gulf of Maine alkalinity dispersal

Releasing ~50 metric tons of sodium hydroxide in a ~800m diameter area

pH will be ~8.39 (background 8.0-8.1)

Gulf of Maine alkalinity dispersal

Dispersal area
4-12 hours

Port of Quincy, MA
(68.5 n.m. to site)

Port of Portsmouth, NH
(64 n.m. to site)

Patch size at site
(0.19 sq. mi.)

7-day monitoring area
(22 mi. radius)

Stellwagen National
Marine Sanctuary

7-day potential monitoring area
No restrictions on vessel activity

Google Earth

Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image U.S. Geological Survey
Image Landsat / Copernicus

30 mi

Successful EPA Permitting through MPRSA

- Permitting discussions began January 1, 2023
- Two public comment periods (Summer 2024, Spring 2025)
- Modifications based on engagement, comments, and additional analyses
- Consultation with NOAA for EFH and ESA, USFWS for ESA
- **Final permit issued late April 2025**

EPA Project Page

The geographic jurisdiction of the Marine Protection, Research, and Sanctuaries Act (MPRSA) begins at the U.S. baseline from which the territorial sea is measured and extends seaward. The baseline consists of the closing lines across bays, harbors, and river mouths and the mean lower low water line (MLLW) along the coast.

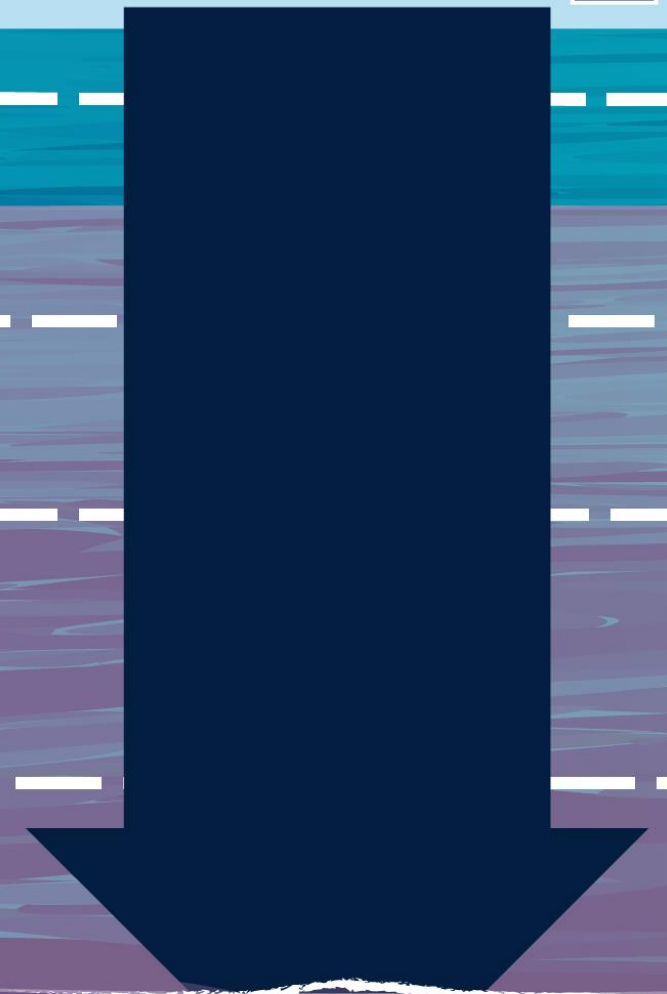WOODS HOLE **OCEANOGRAPHIC** INSTITUTION

Engineered rapid, intense mixing in wake of discharge vessel
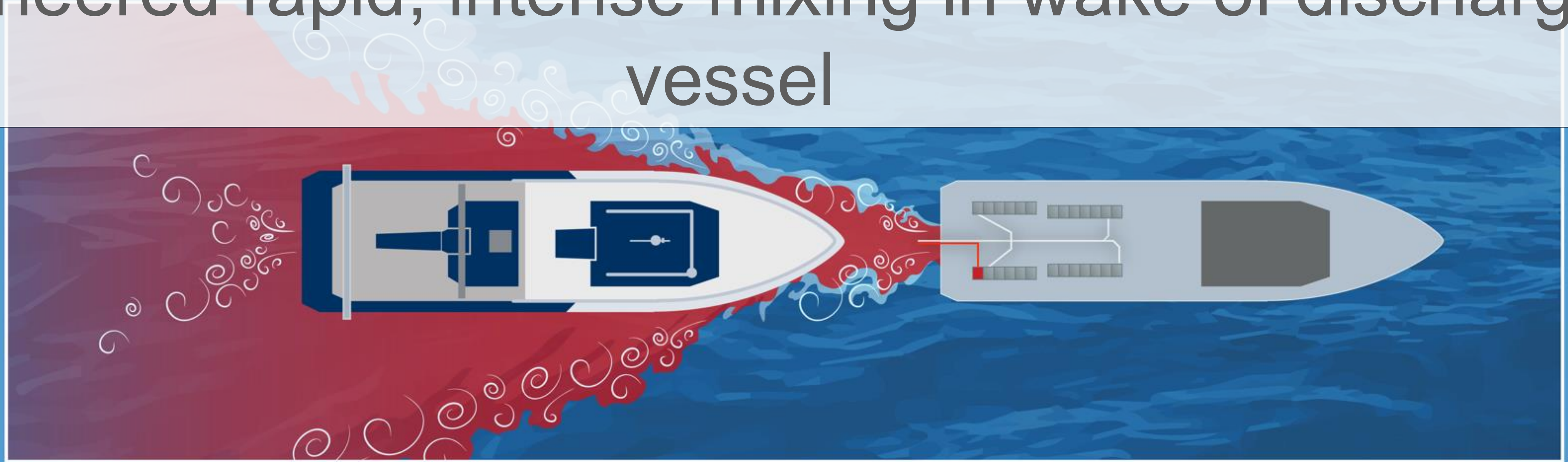
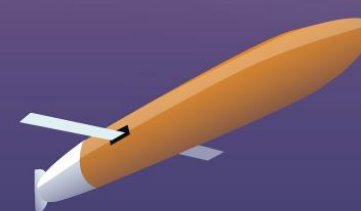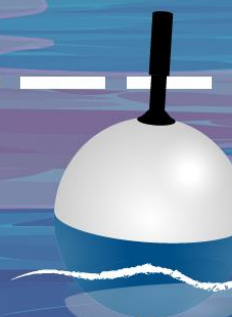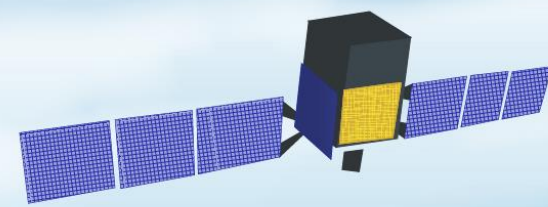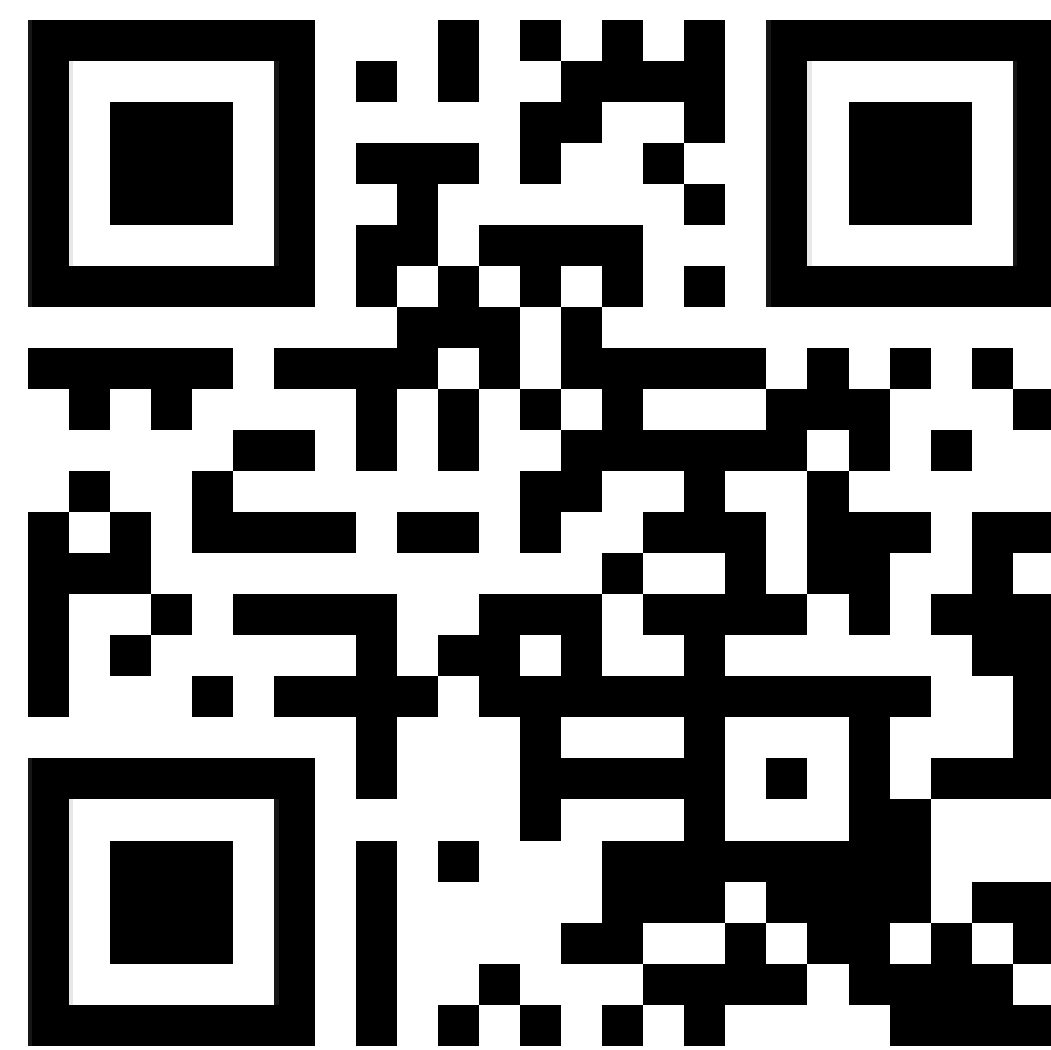Protected Species Observers on board

Real-time data readouts for rapid decision making

CO₂

Stored Carbon

pH
9.5

7.5
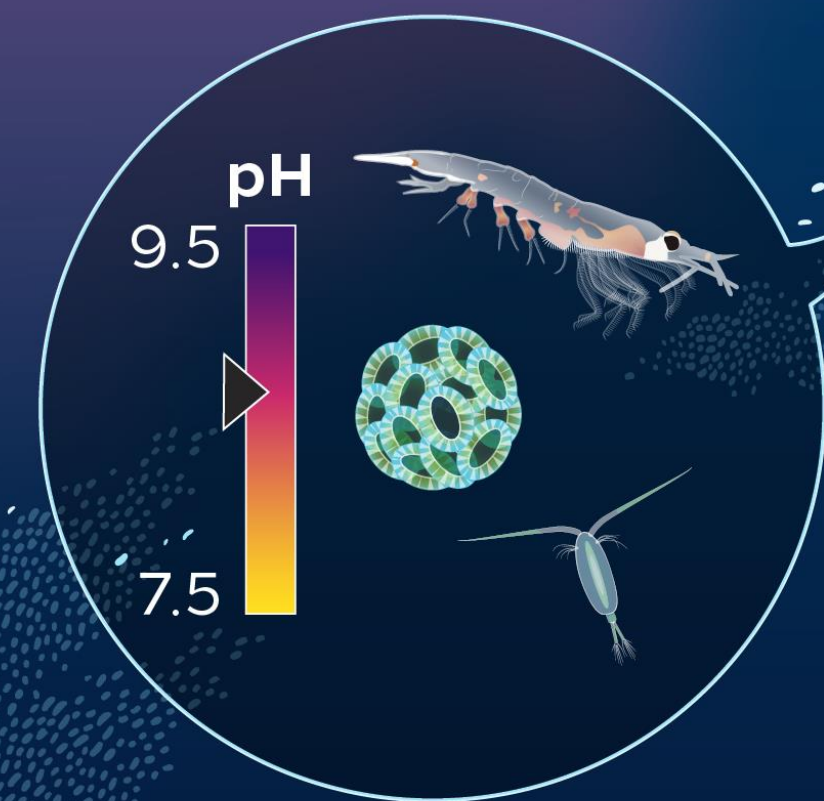
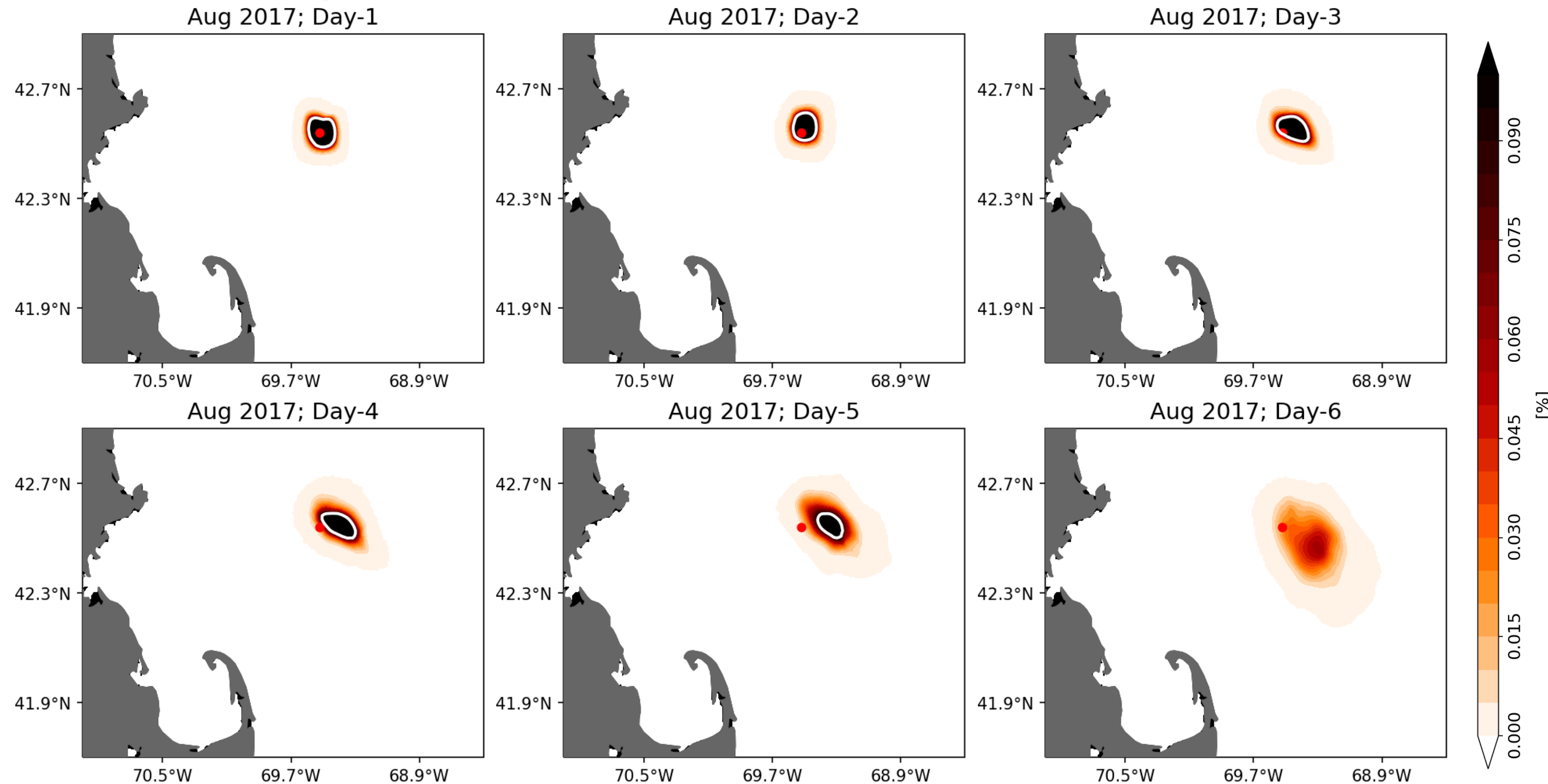**Check our website for updates, publications, datasets, etc.**

Thank you, OAE R&D Community!

On behalf of the entire LOC-NESS team

Baseline Modeling: Physics

Predicted patch motion and dispersal

Surface expression and spreading is necessary for monitoring effects and CO_2 uptake
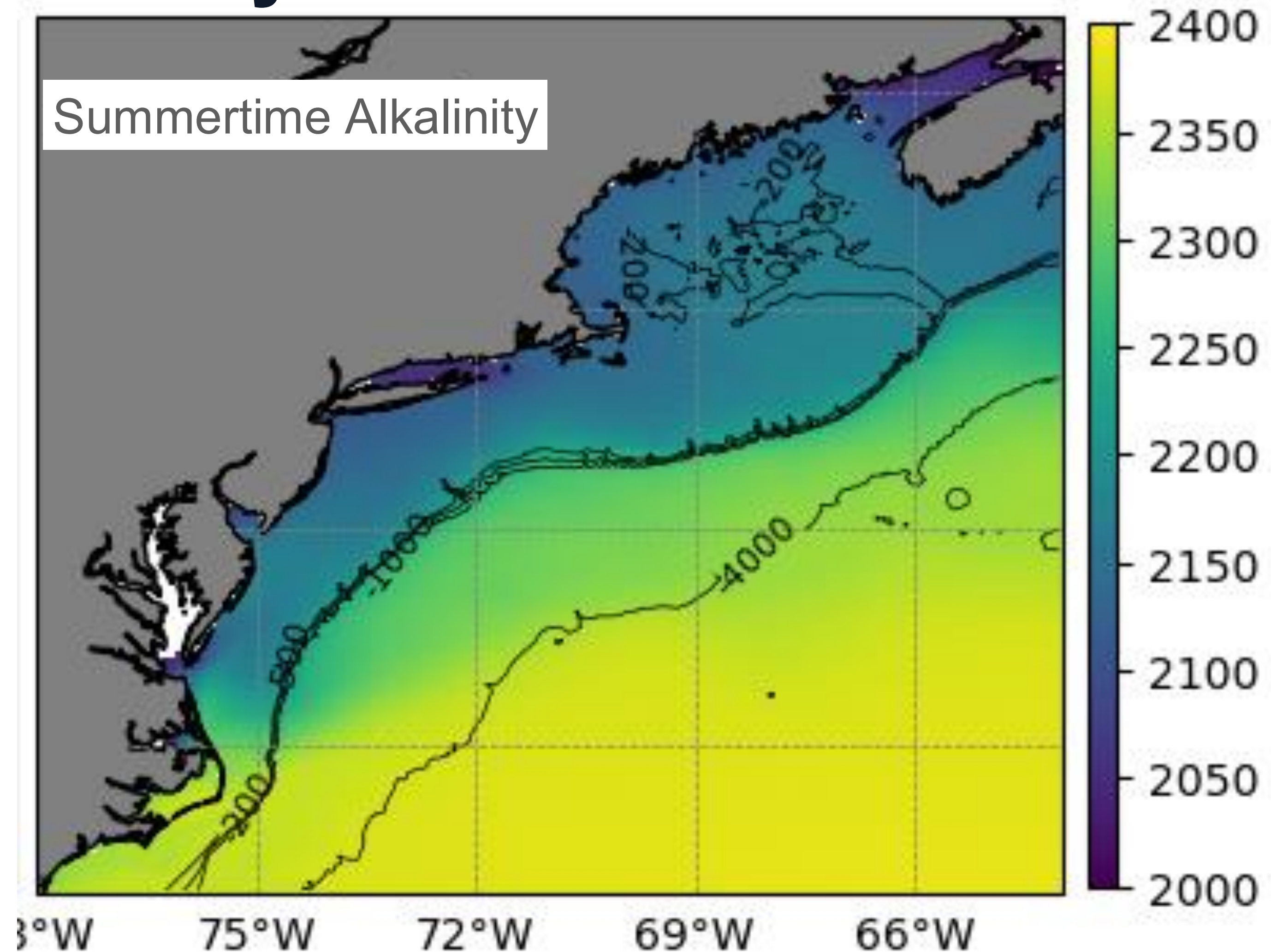
Guo et al., *in revision*

Baseline Modeling: Chemistry

Chemistry via machine learning

Shelf waters are:

- More sensitive to OA

- Alkalinity enhancement is more effective

- Carbon dioxide uptake is faster

Summertime Alkalinity

Rheuban et al., *in review*

Baseline Modeling: Ecology

Long-term ecological timeseries data are essential

Marx et al., *submitted*