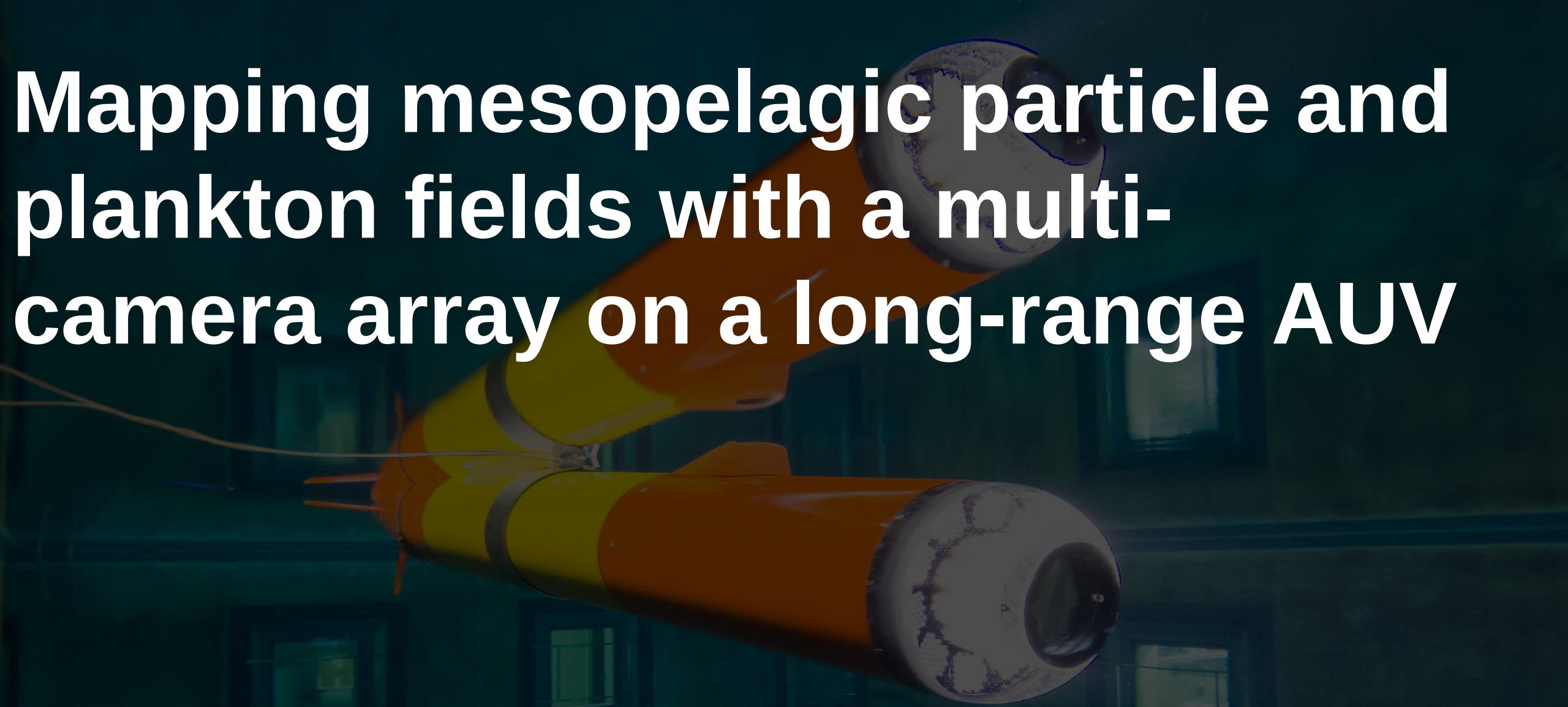
Mapping mesopelagic particle and plankton fields with a multi-camera array on a long-range AUV



Eric Orenstein, Paul Roberts*, Brett Hobson, Alana Sherman, Colleen Durking, Henry Ruhl, Kakani Katija

OSM2024 – Feb. 22, 2024

Monterey Bay Aquarium Research Institute

CENTRAL & NORTHERN CALIFORNIA OCEAN OBSERVING SYSTEM

GORDON AND BETTY MOORE FOUNDATION

Grant #: **7583**

Introduction

THE BIOLOGICAL CABRON PUMP IS REAL IMPORTANT LIKE [insert graphic]

Introduction

THE BIOLOGICAL CABRON PUMP IS REAL IMPORTANT LIKE [insert graphic]

Drawing physical samples

Imaging the pump


Smith et al., 2013 - PNAS

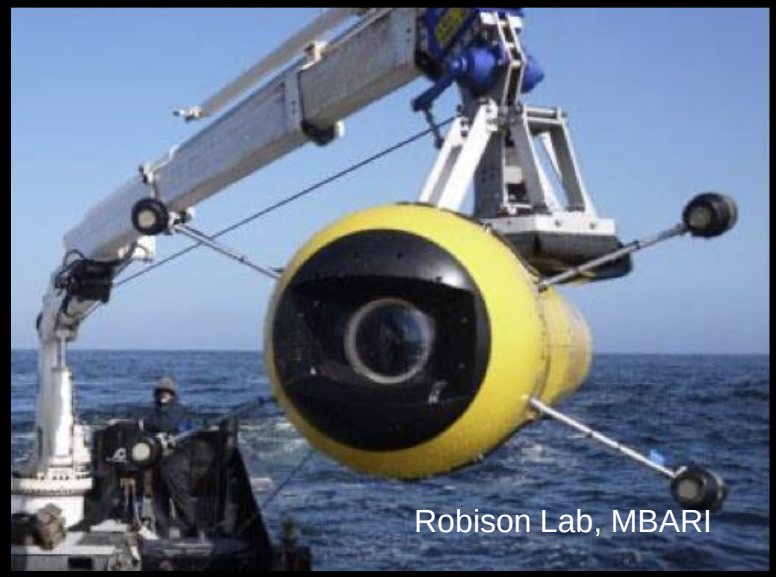

Sosik & Olson, 2007 – L & O.

BellaMare, Inc.

National Oceanography Centre


Ohman et al., 2019 – L&O: Methods

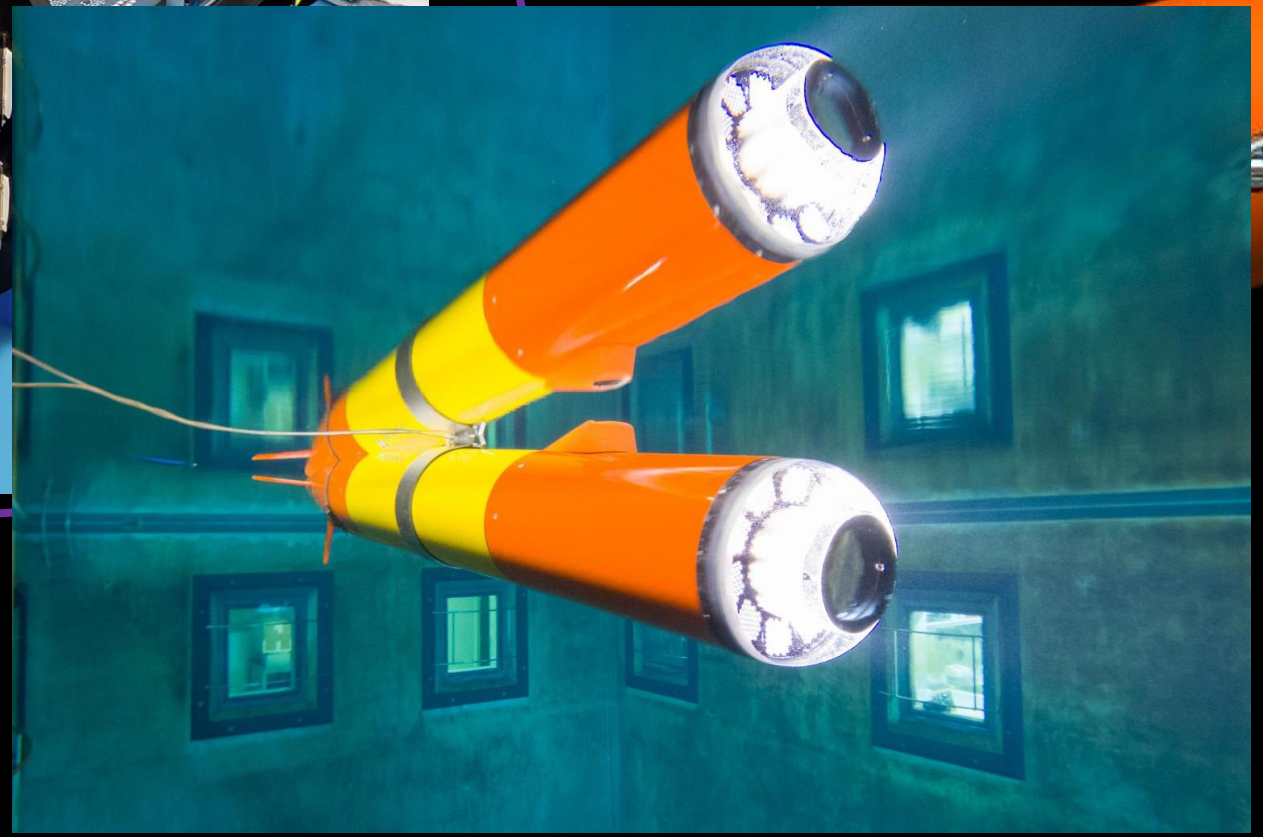

Picheral et al., 2021 – L&O: Methods

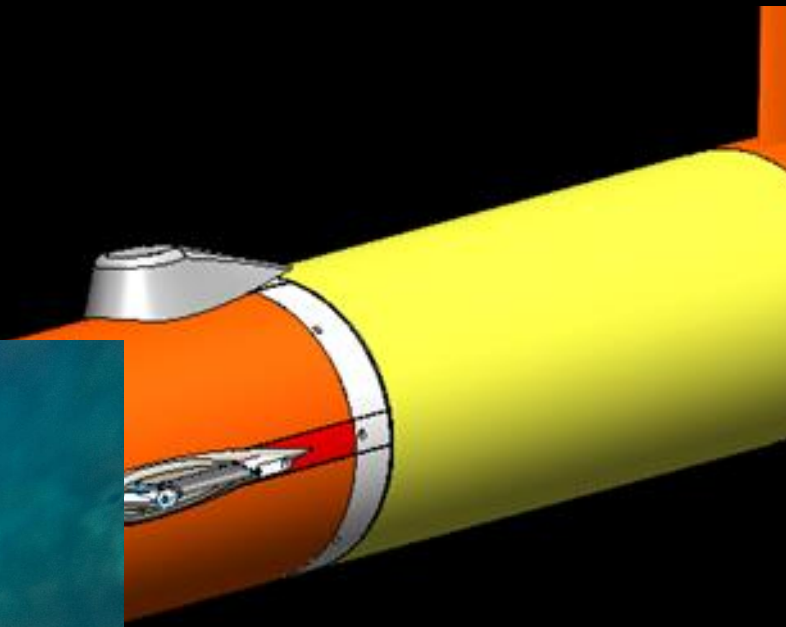

Robison Lab, MBARI

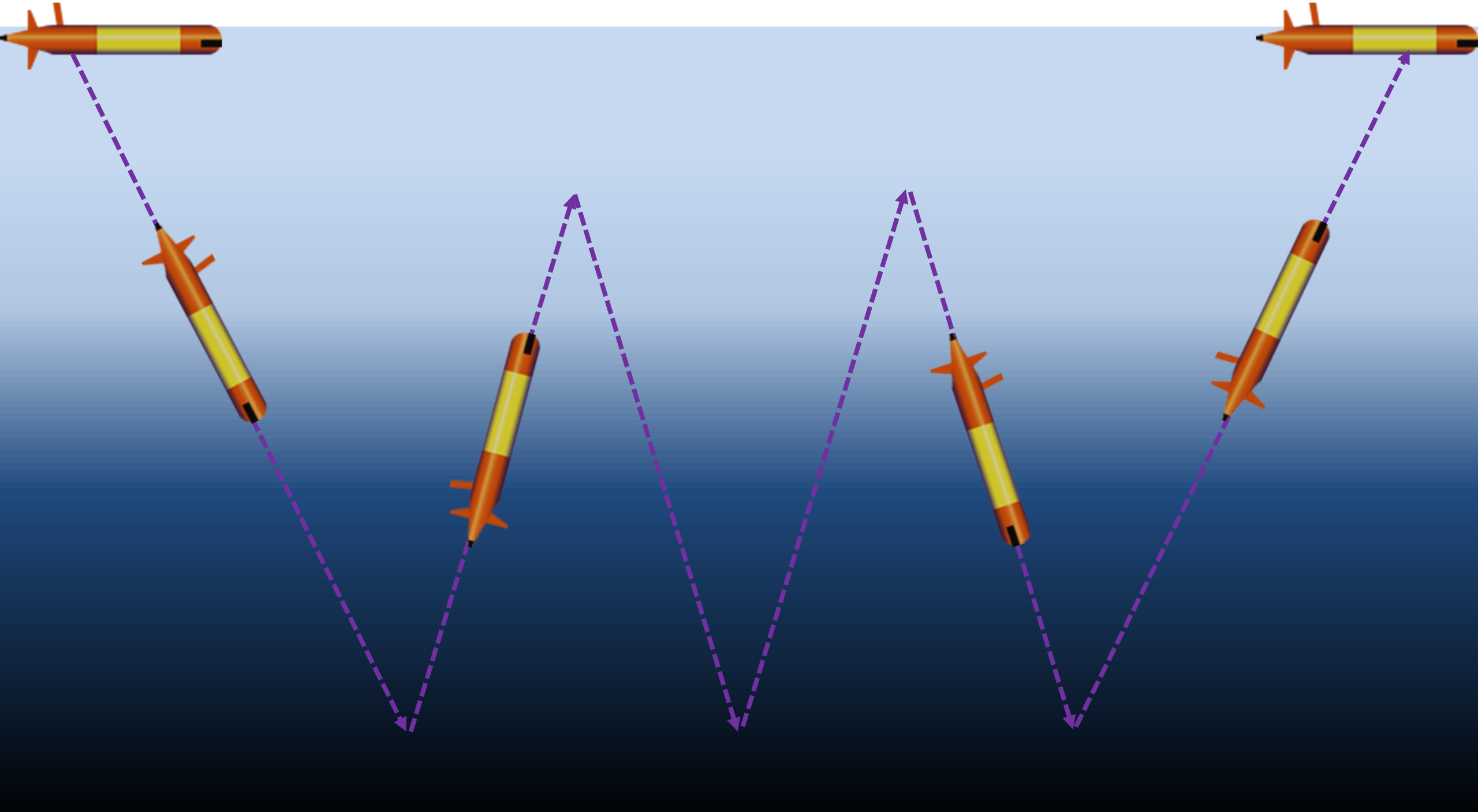
Chiton imaging system

- Seven cameras, 140 megapixels, ~50 um/px
- ~2 L per frame
- Two NVIDIA TX-2s

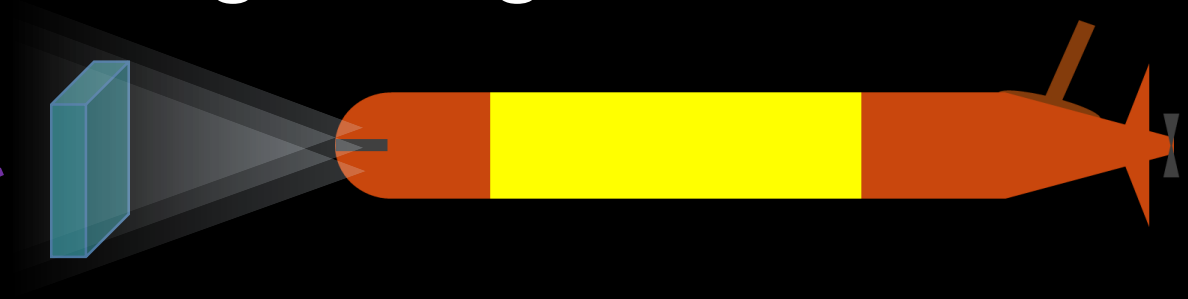
Chiton on the Long Range AUV



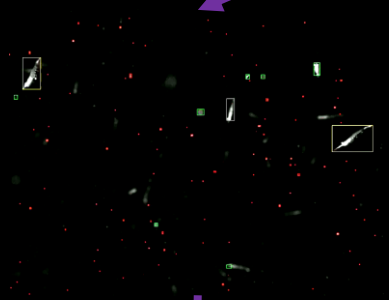




Chiton on the Long Range AUV

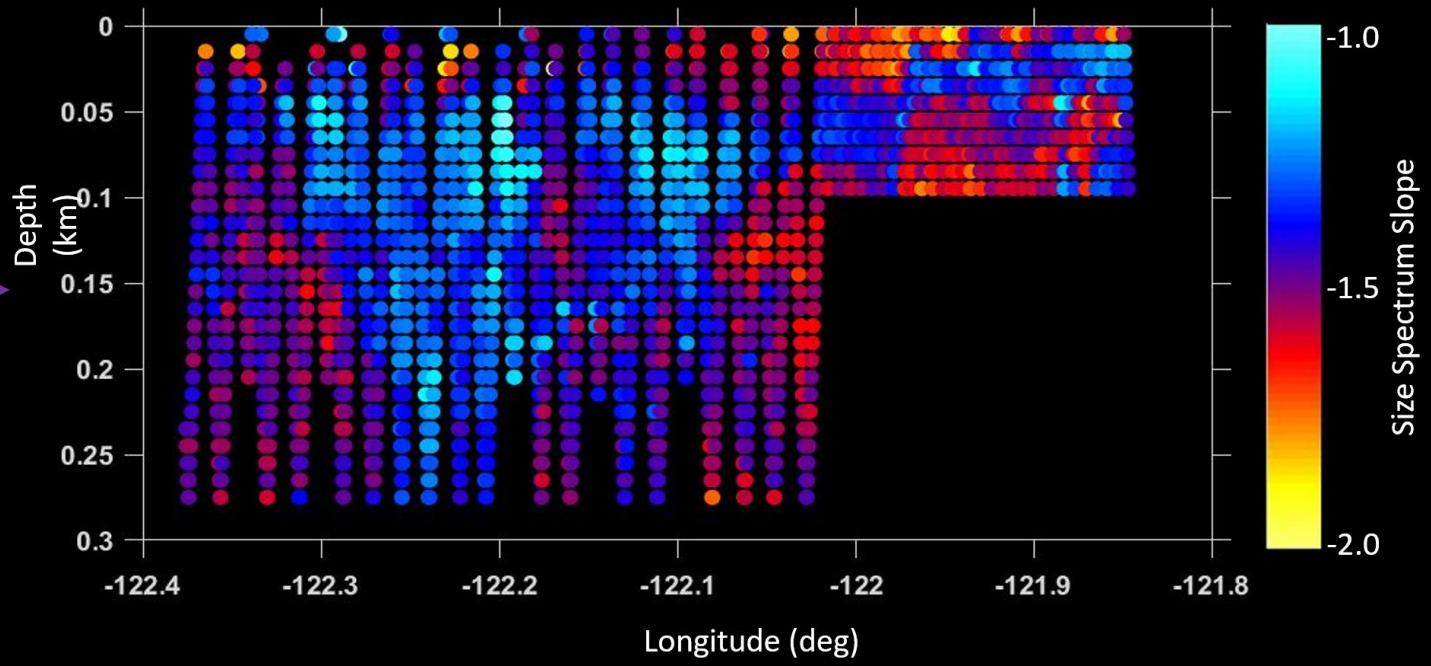


Object
Detection
ROI extraction



Collections
of Objects

Collation /
Coordination into
real-time
statistics

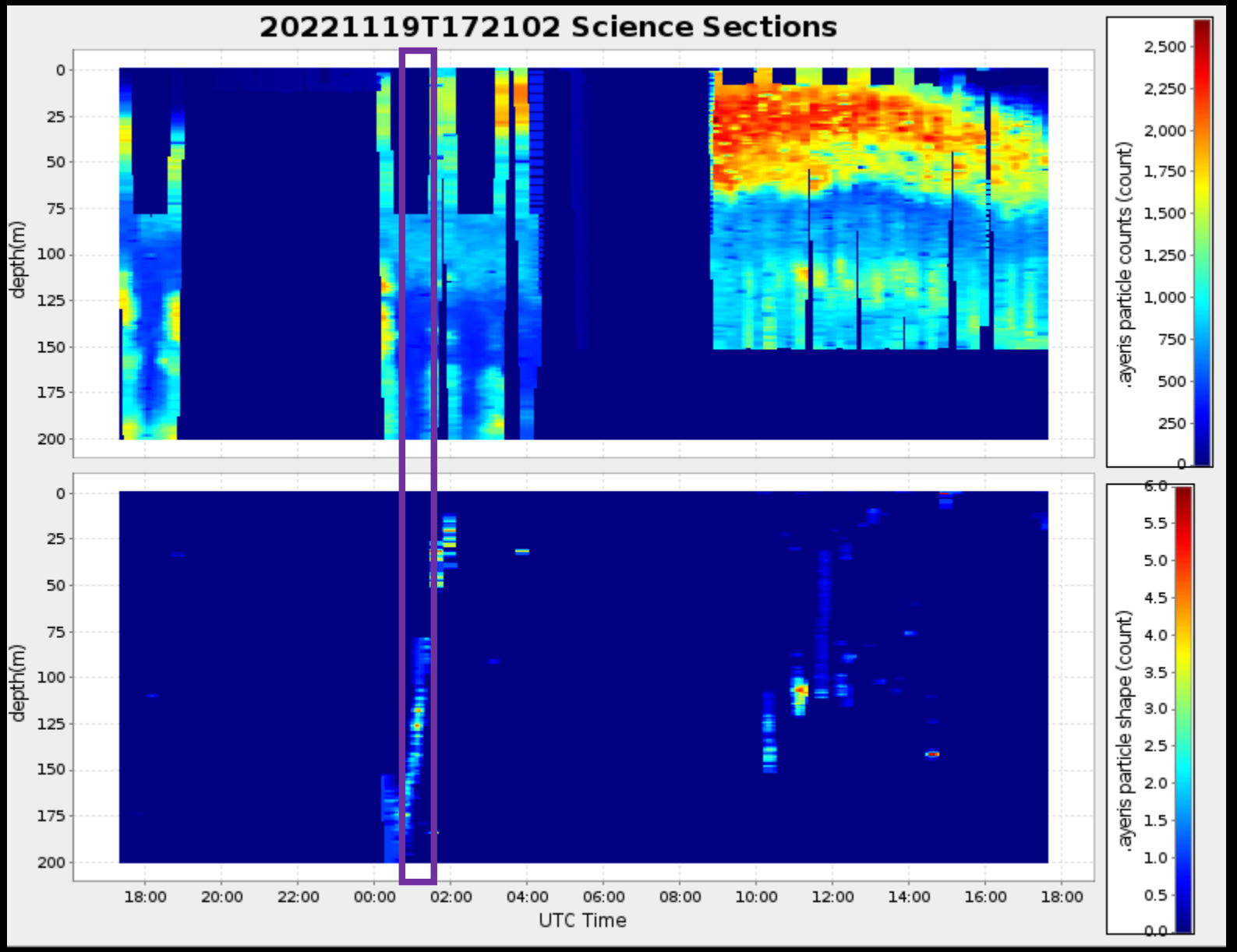


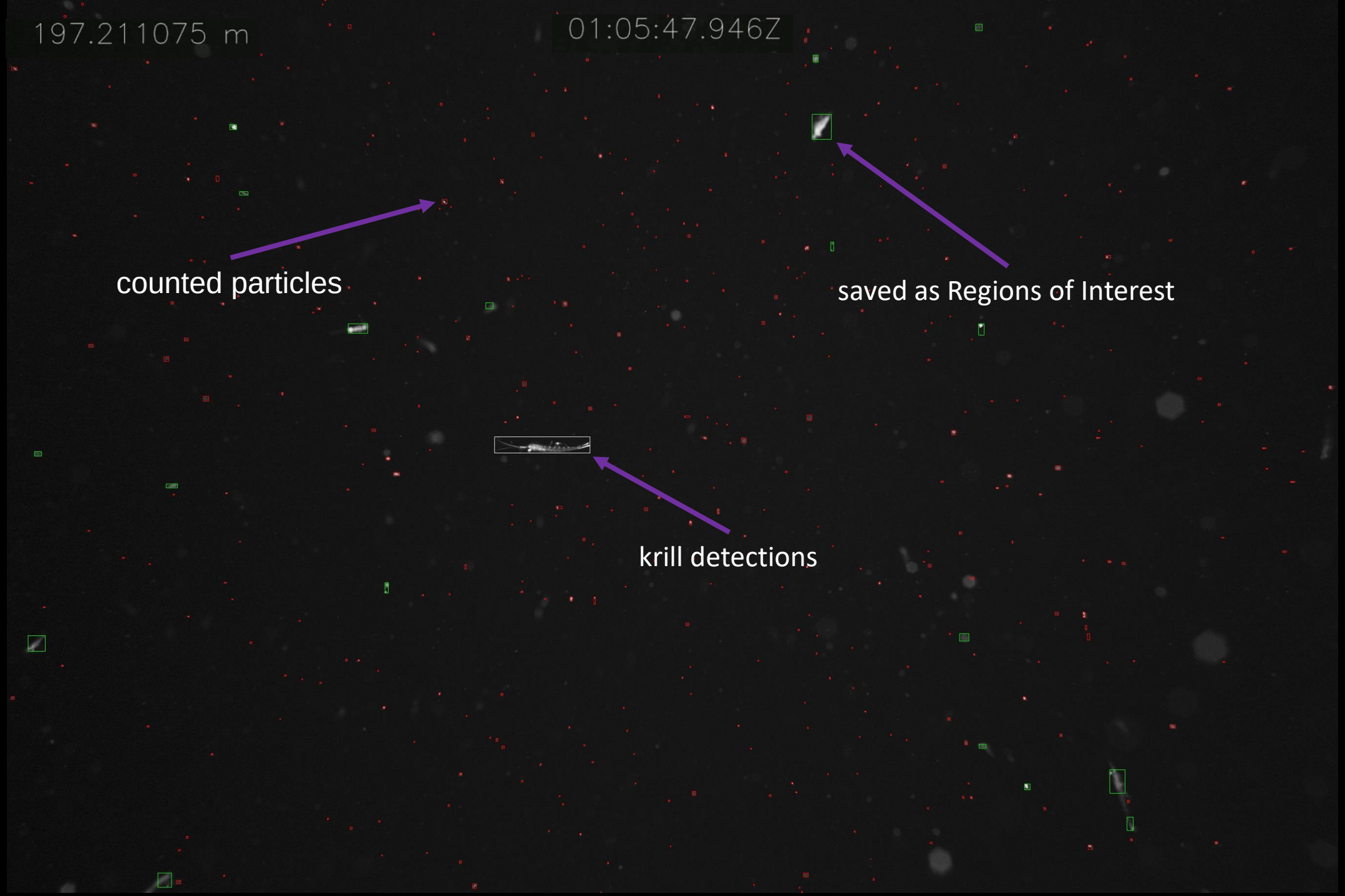
Long transects

Insert screen grab of particle size spectra from CENCOOS portal

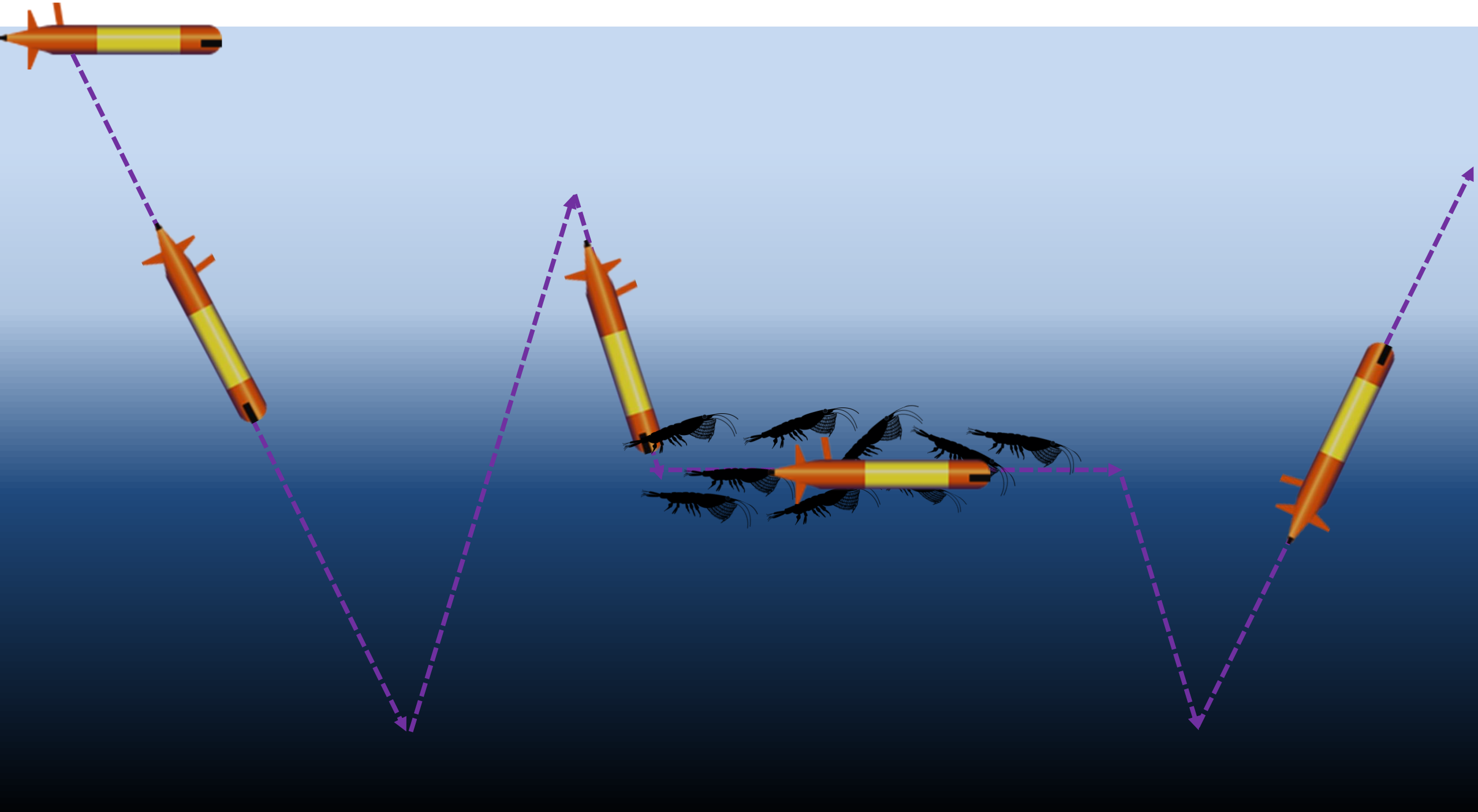
Classifying krill

Real time summary data




197.211075 m
01:05:47.946Z
counted particles
saved as Regions of Interest
krill detections


197.211075 m
01:05:47.946Z



Summary and the future

- Chiton on the LRAUV enables dense sampling of particle size slopes over large areas
- Coarse on-board classification in the experimental phase
- On-going work to classify particles on shore
- Fully leveraging 3D localization will enable improved size estimates and distance measurements

Thank you!

Paul Roberts
proberts@mbari.org

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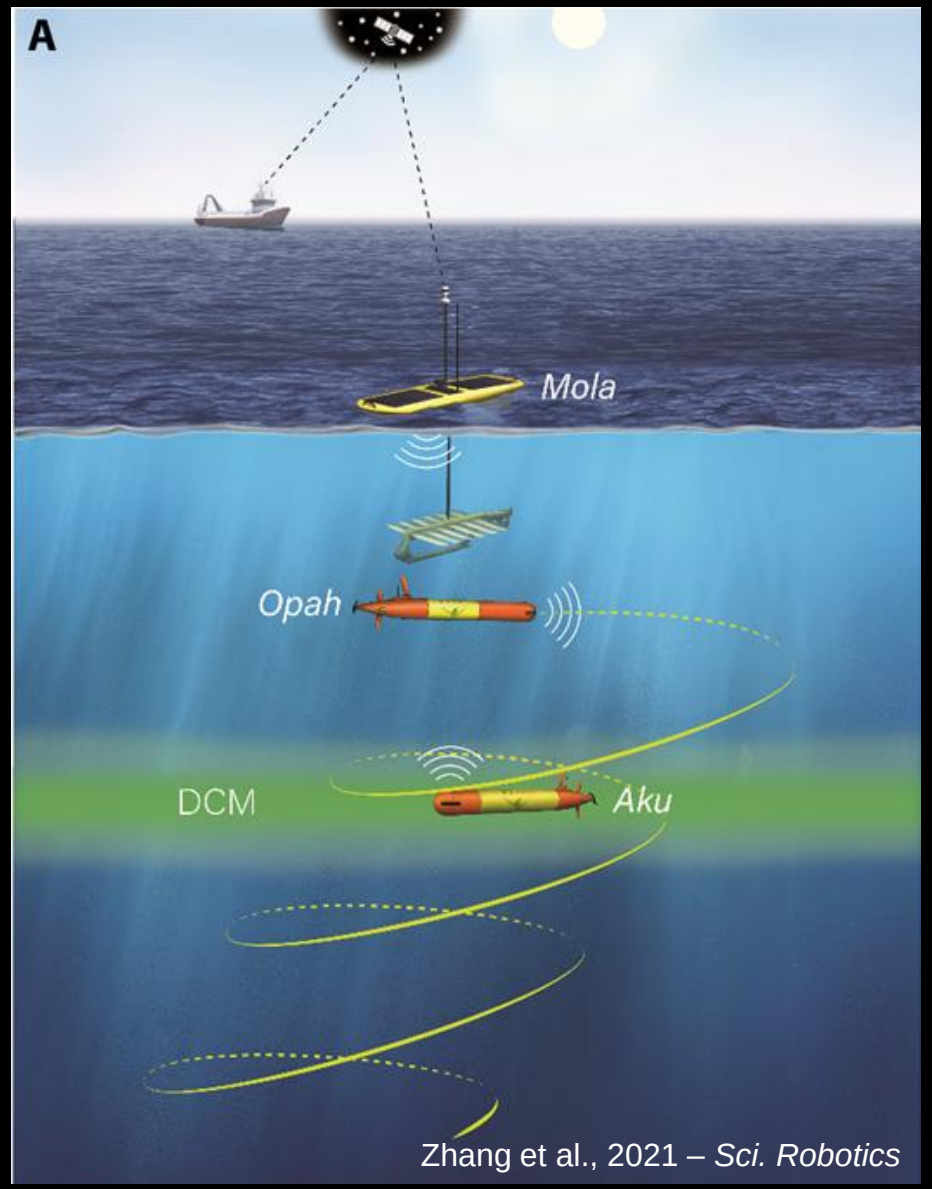
Grant #: **7583**

Monterey Bay Aquarium Research Institute

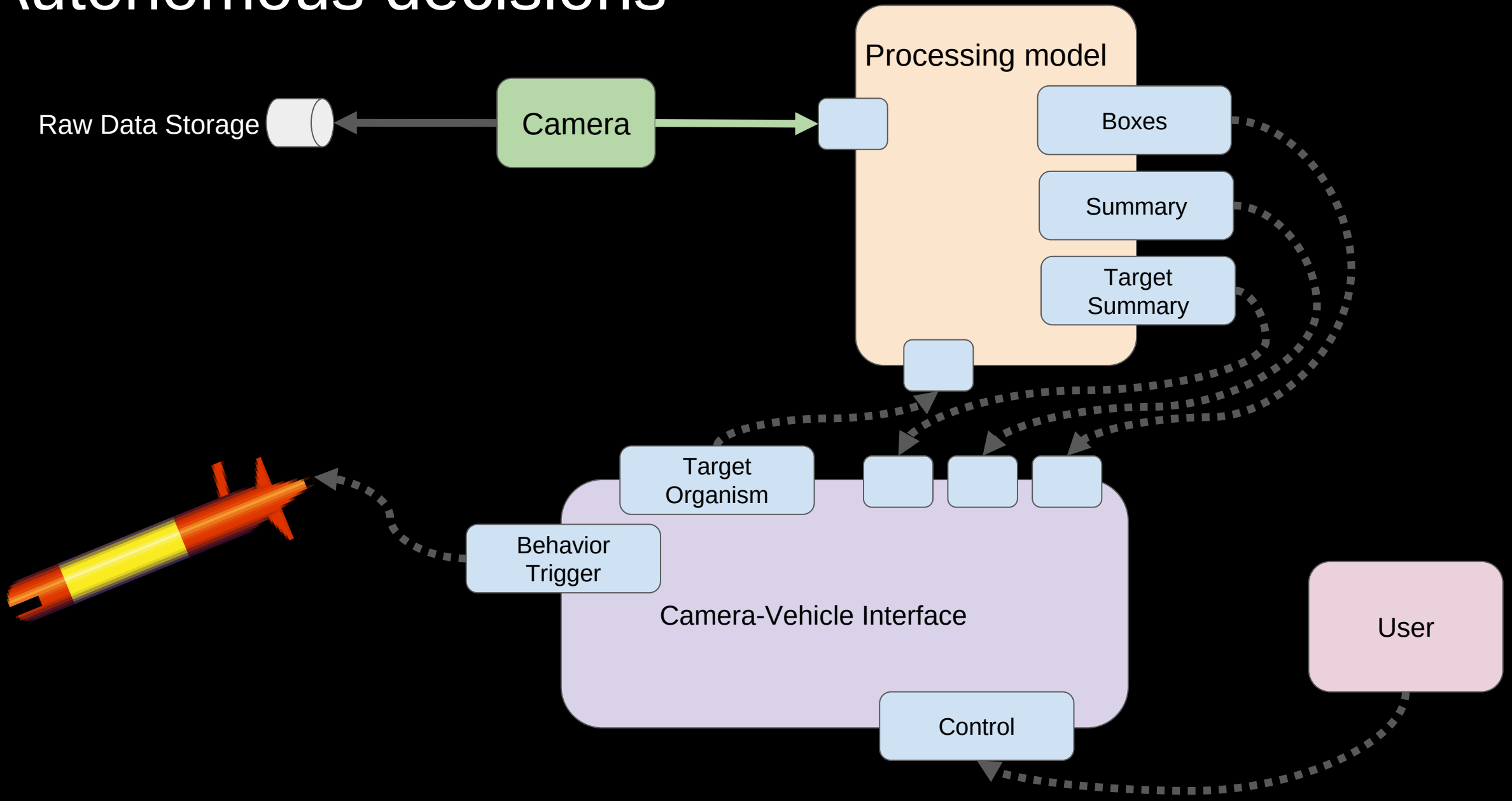
CENTRAL & NORTHERN CALIFORNIA OCEAN OBSERVING SYSTEM

Adaptive sampling

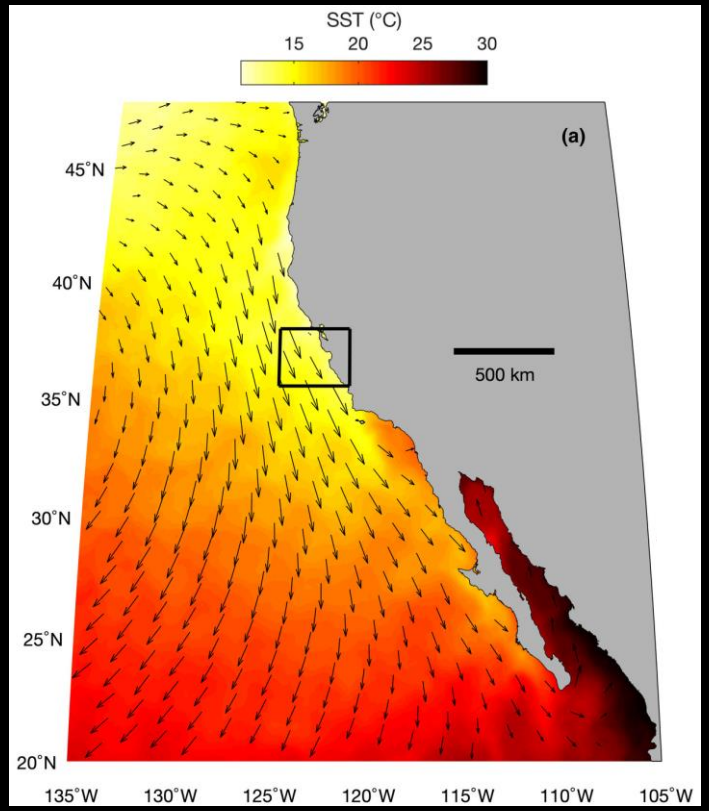


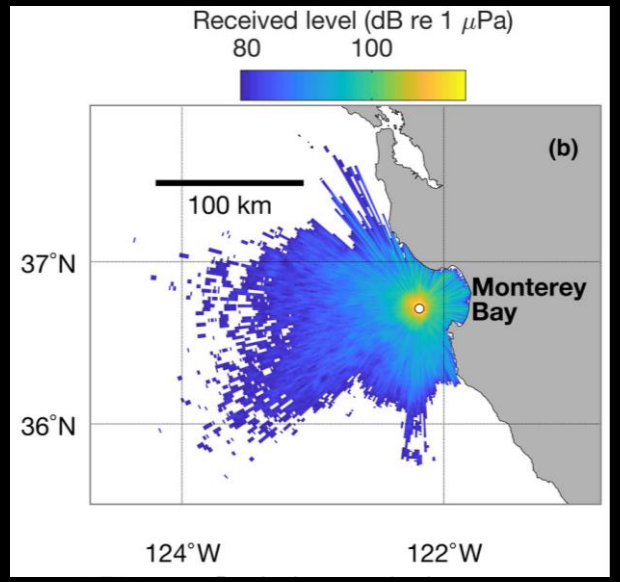
Zhang et al., 2021 – *Sci. Robotics*

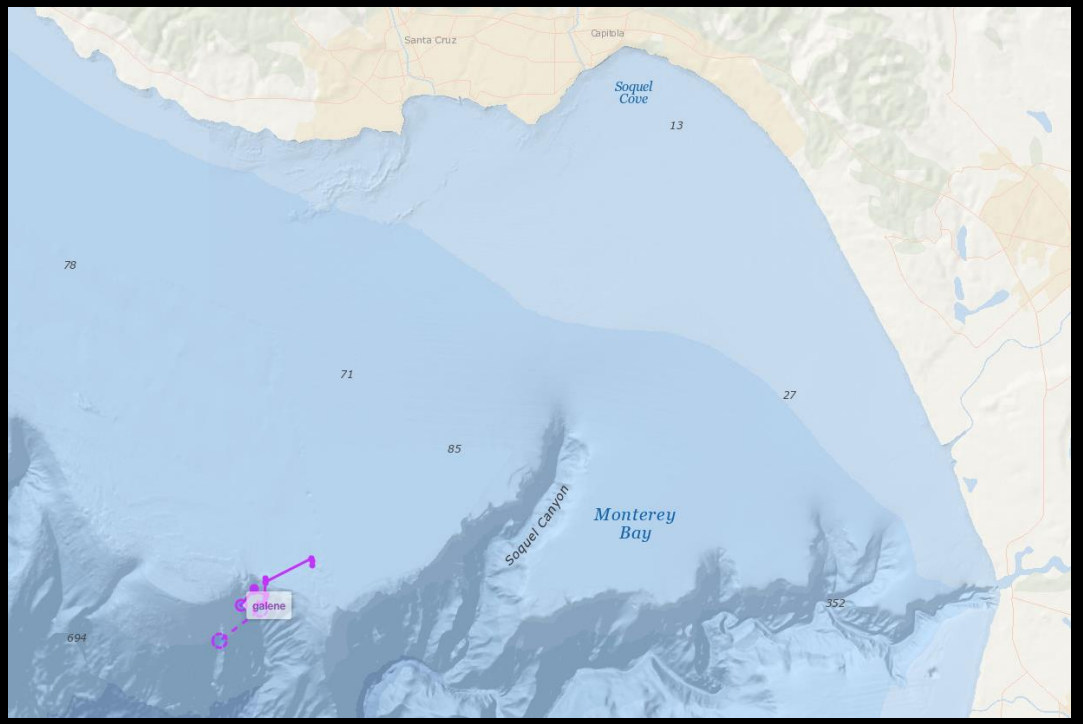
Autonomous decisions



Blue Whale Observatory

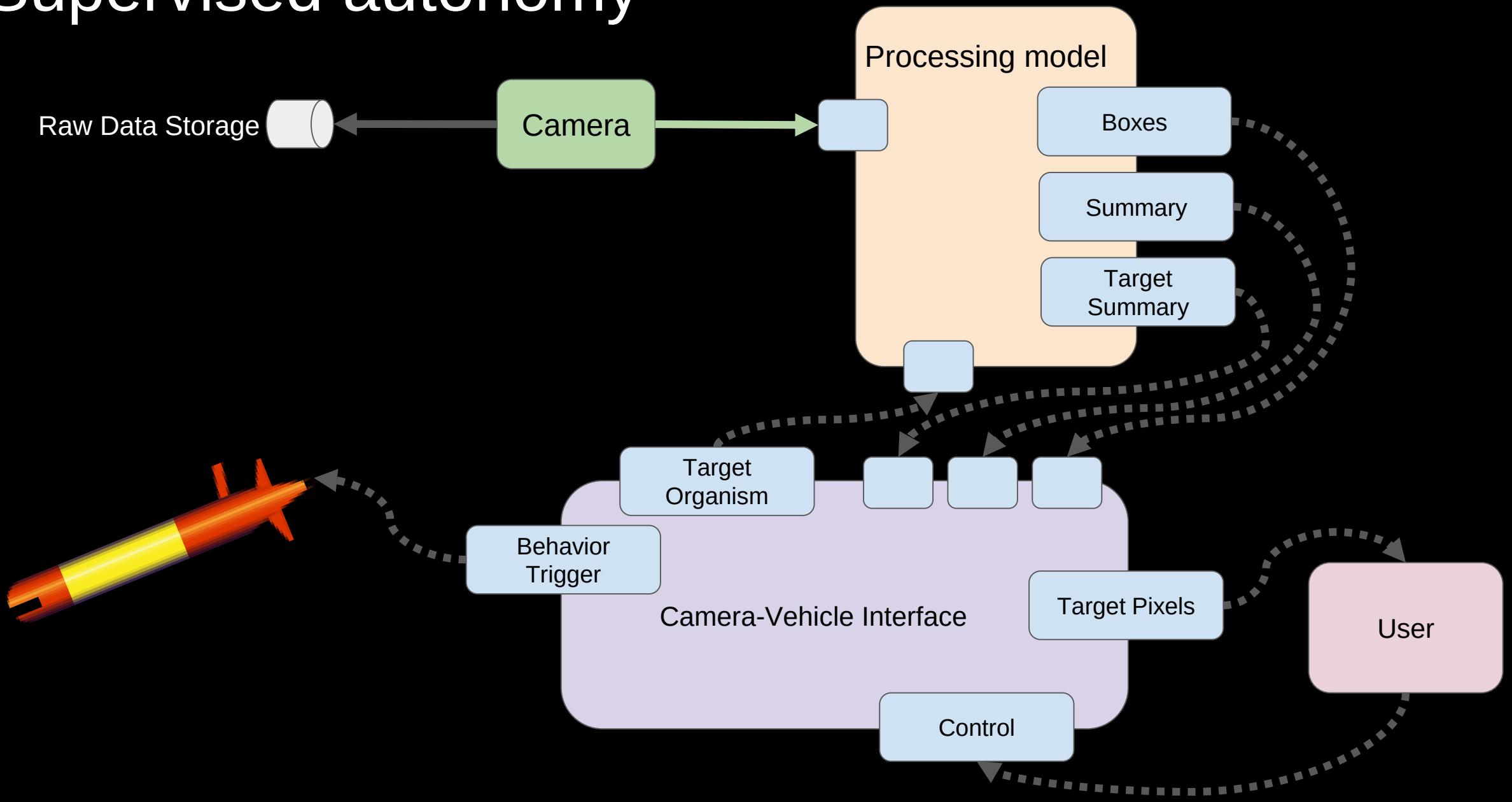






Adapted from: Oestreich et al., 2022 - Functional Ecology

Supervised autonomy



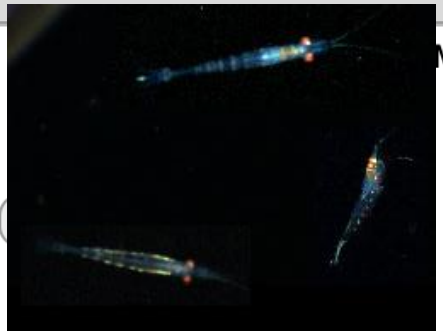
Supervised autonomy

New image from galene-hotspot3 7 messages

From: supervised ayeris

To: Ivan Masmitja

Cc: Ivan Masmitja | ivan masmitja | Paul Roberts | Kakani Katija | Eric Orenstein | Tom O'Reilly



./AOP/galene-ho…3851/shore9056.jpg (2.6 KB) Download | Briefcase | Remove

```
This is an email with the latest .jpg obtained from the LRAUV using the Wave Glider
Hotspot system:
From: galene-hotspot3
Timestamp: 20211216T033851
Index: Courier9056
File size: 2703 bits
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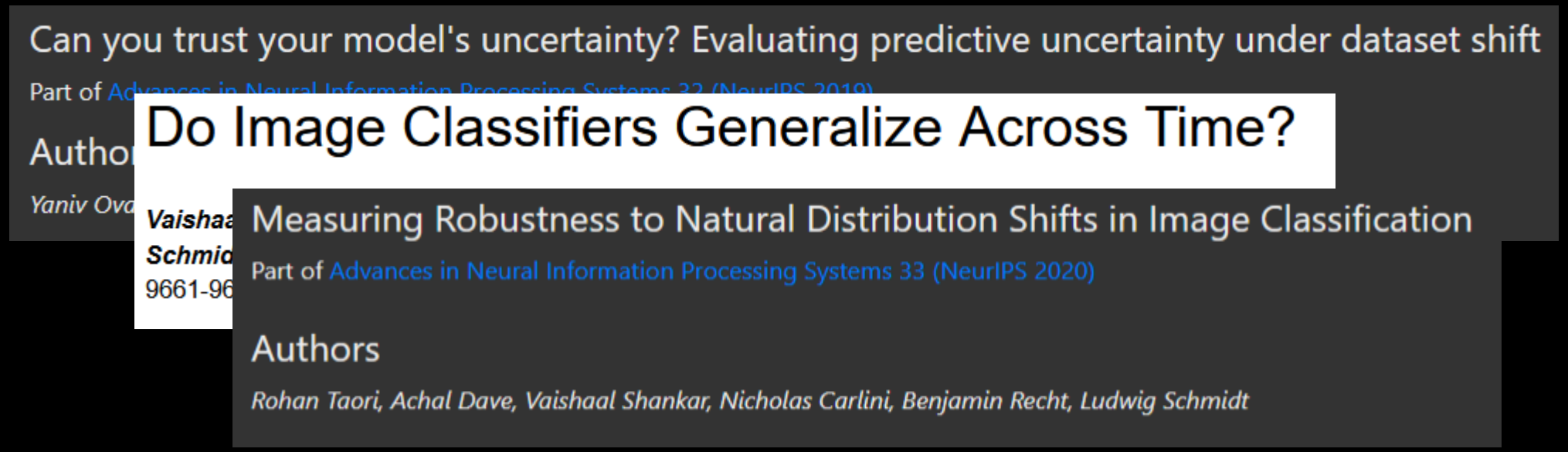
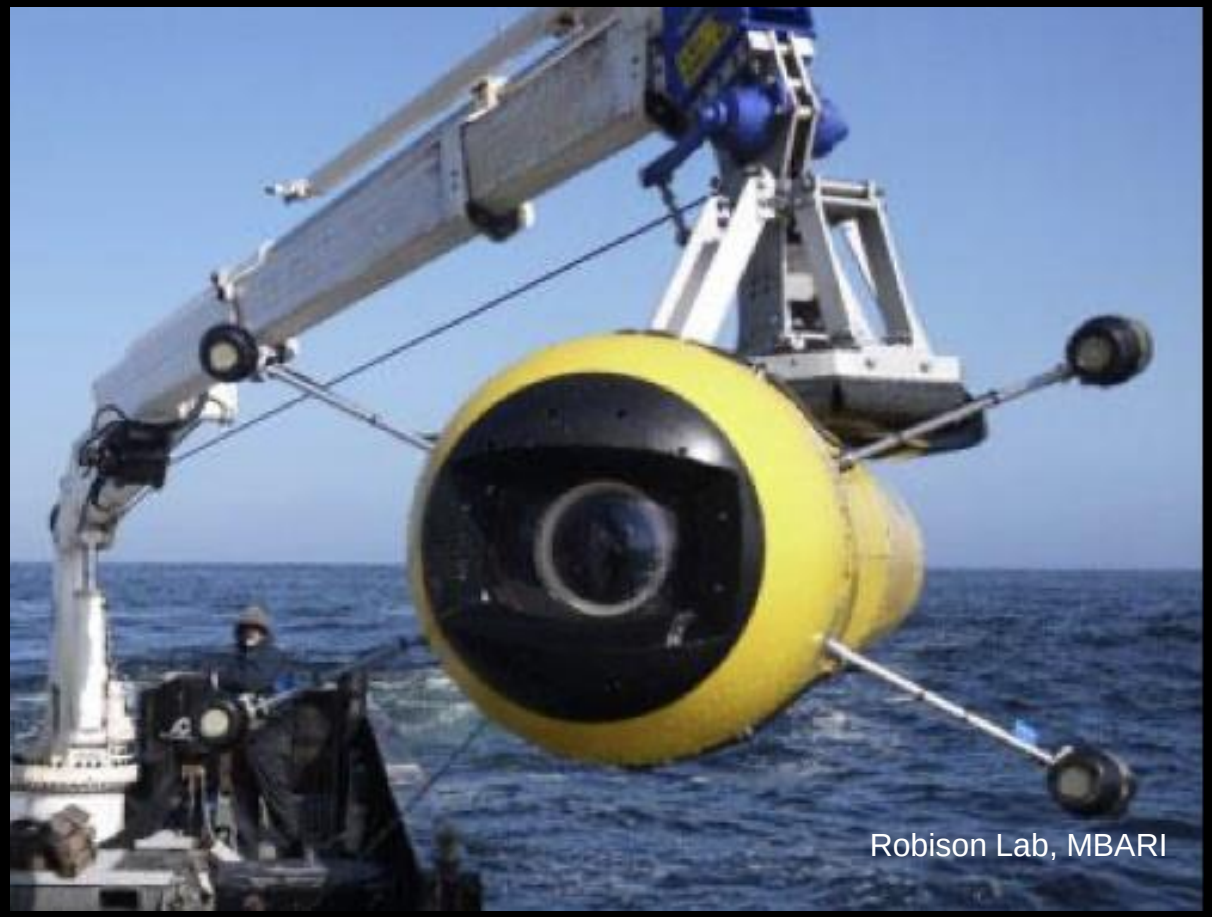
Masmitja et al., 2023 – Sci. Robotics

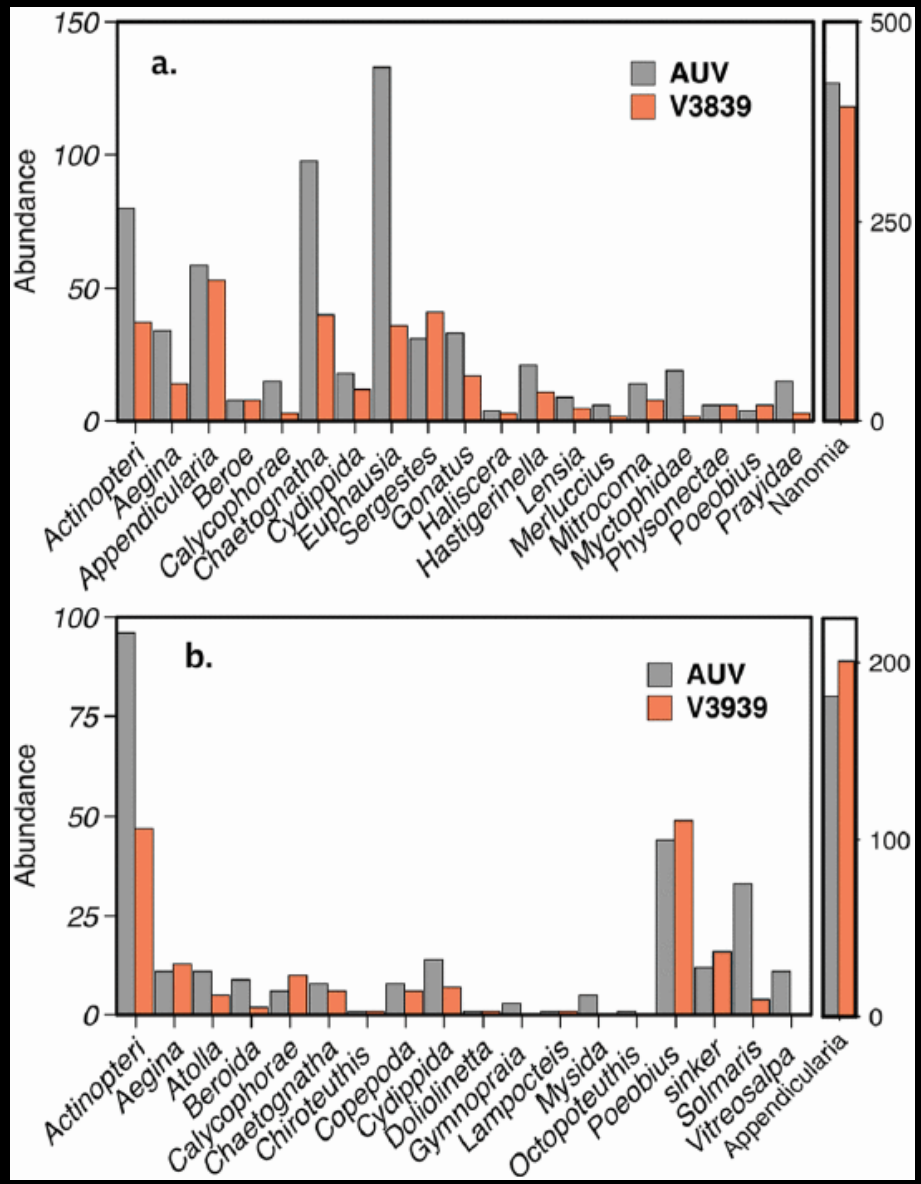
Big machine learning question

How trustworthy are these models in new environments and as populations fluctuate?

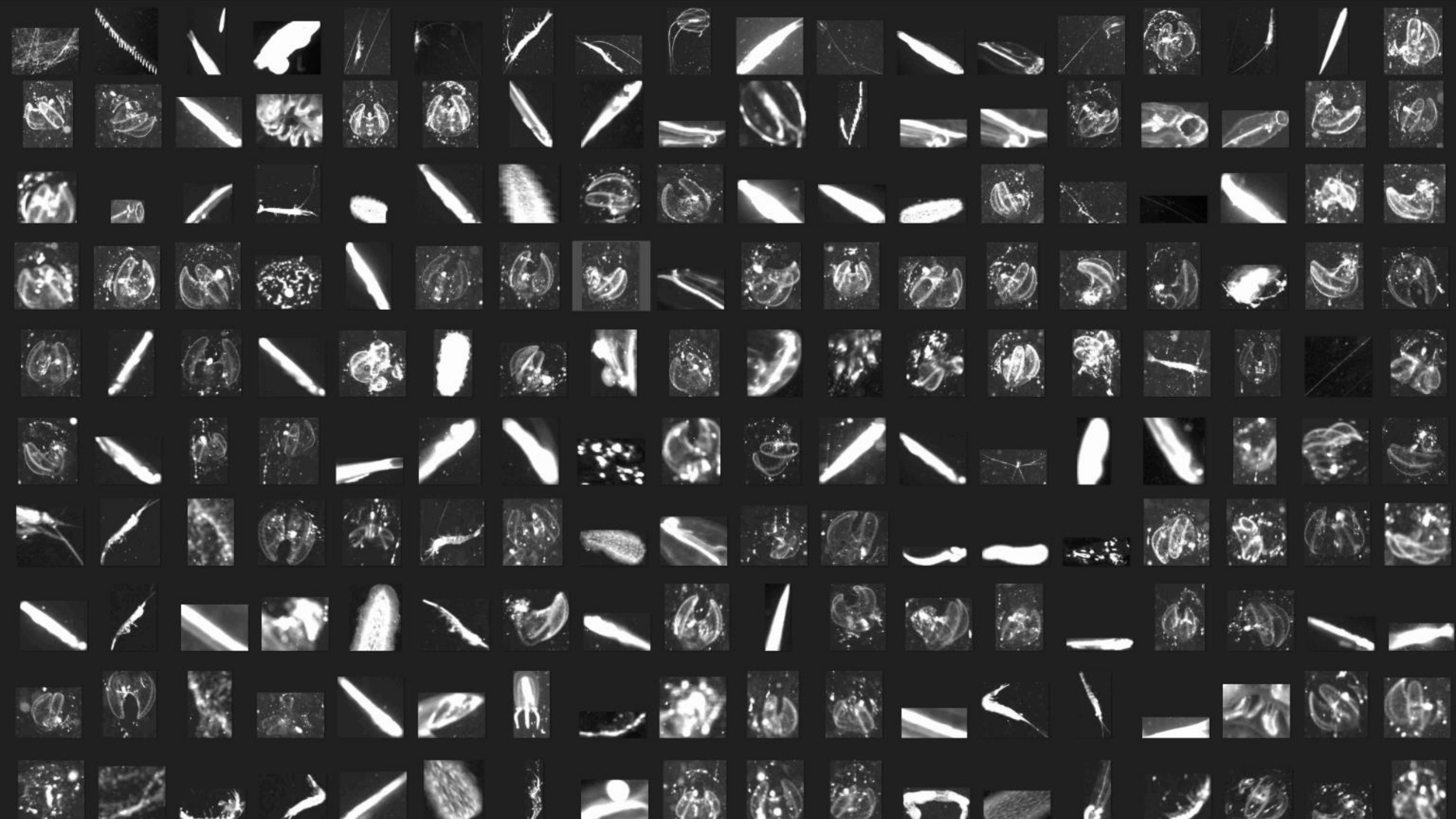


Evolving tools

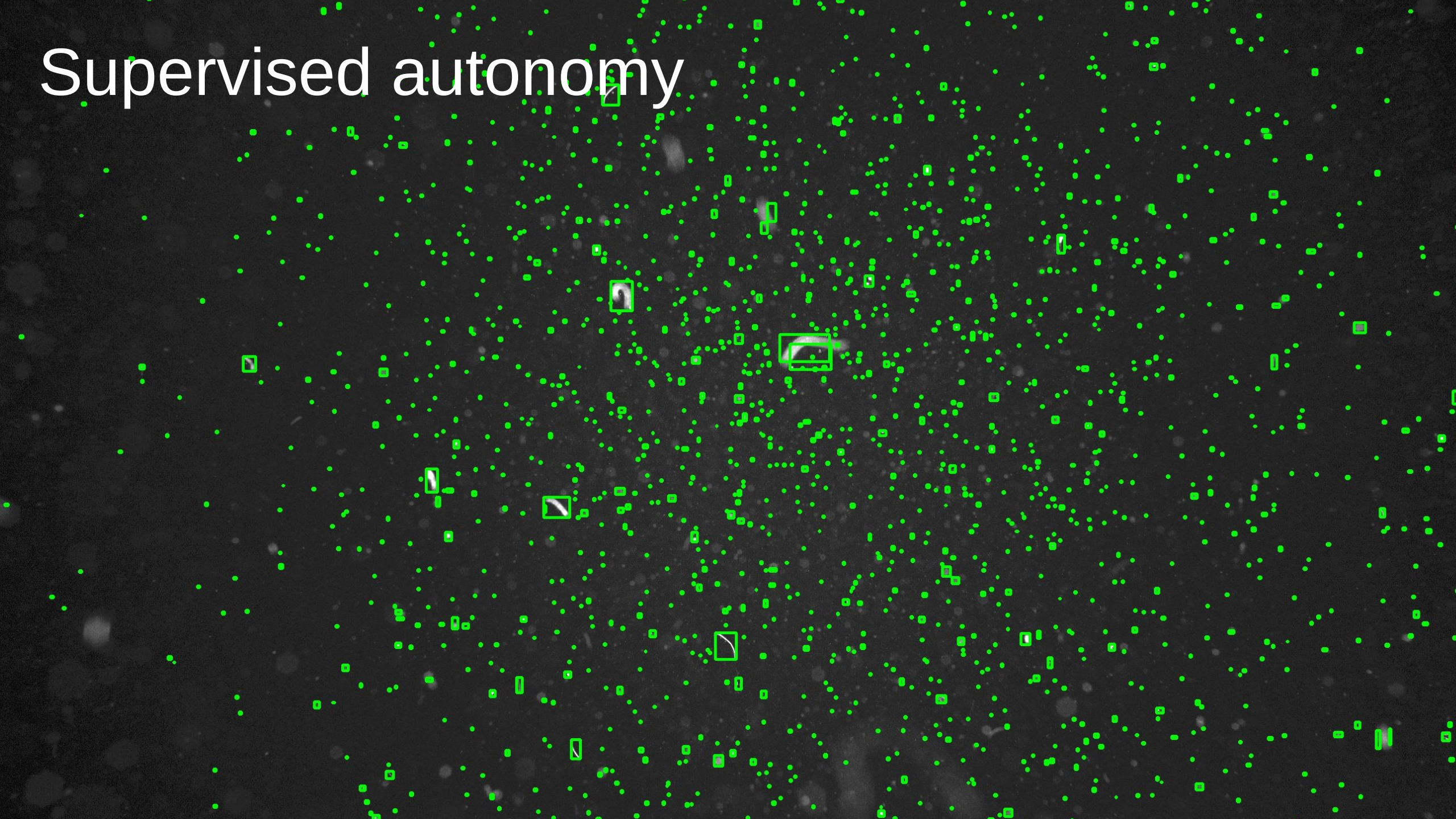




Reisenbichler et al., 2016 - *IEEE OCEANS*

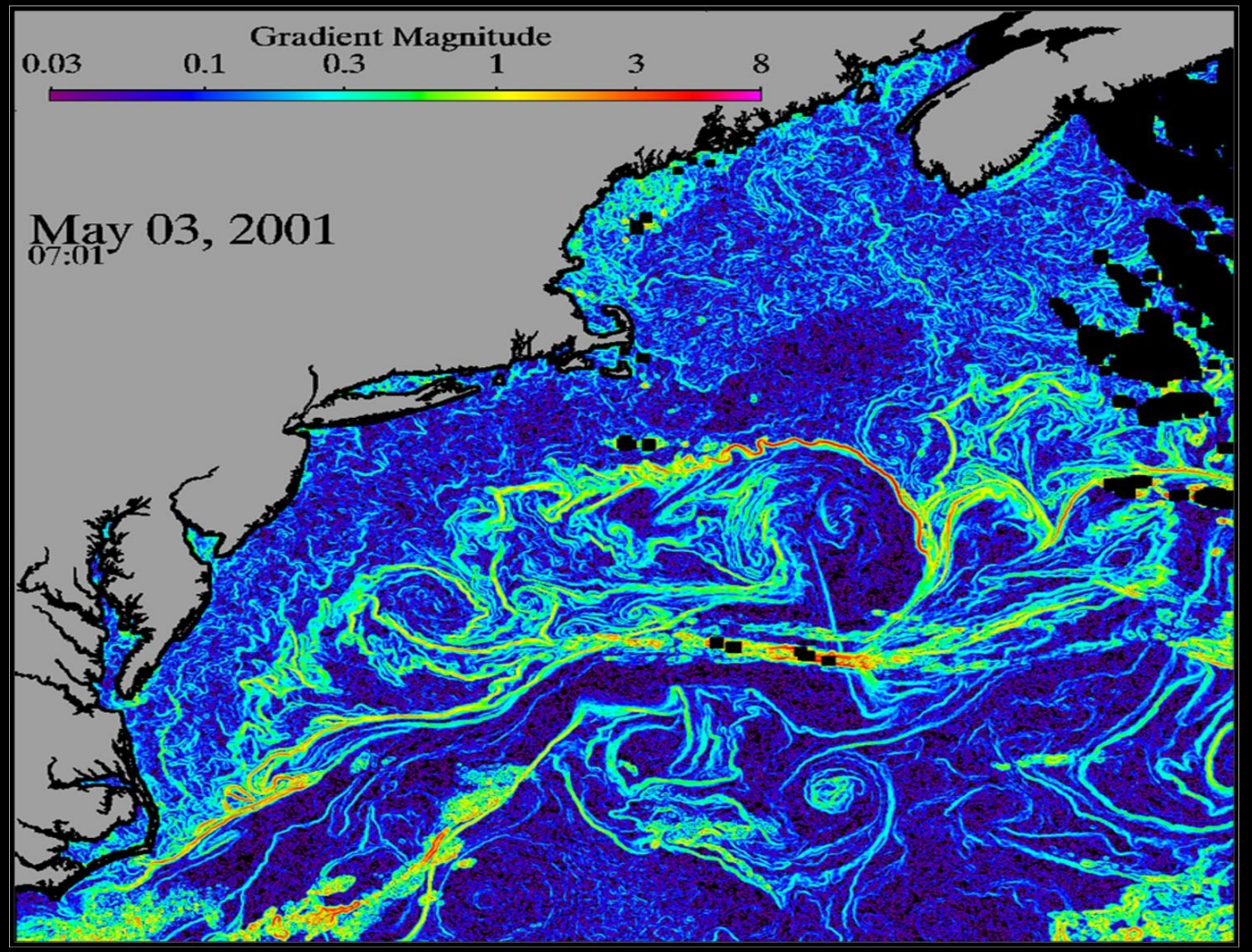


Supervised autonomy



Imaging across scales

Sosik & Olson, 2007 – L & O.



Belkin, 2021- Remote Sens.

Imaging across scales

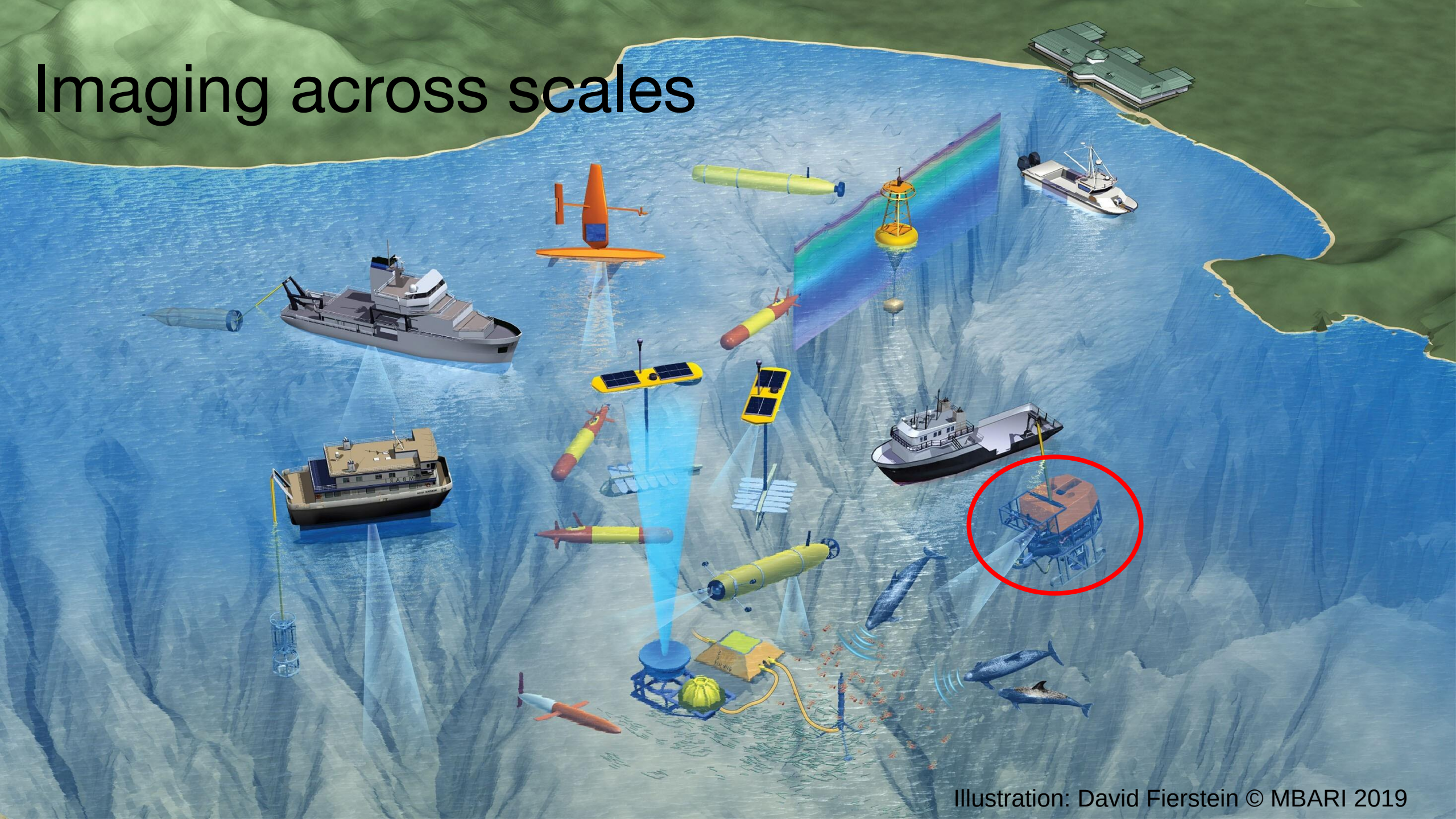


Illustration: David Fierstein © MBARI 2019