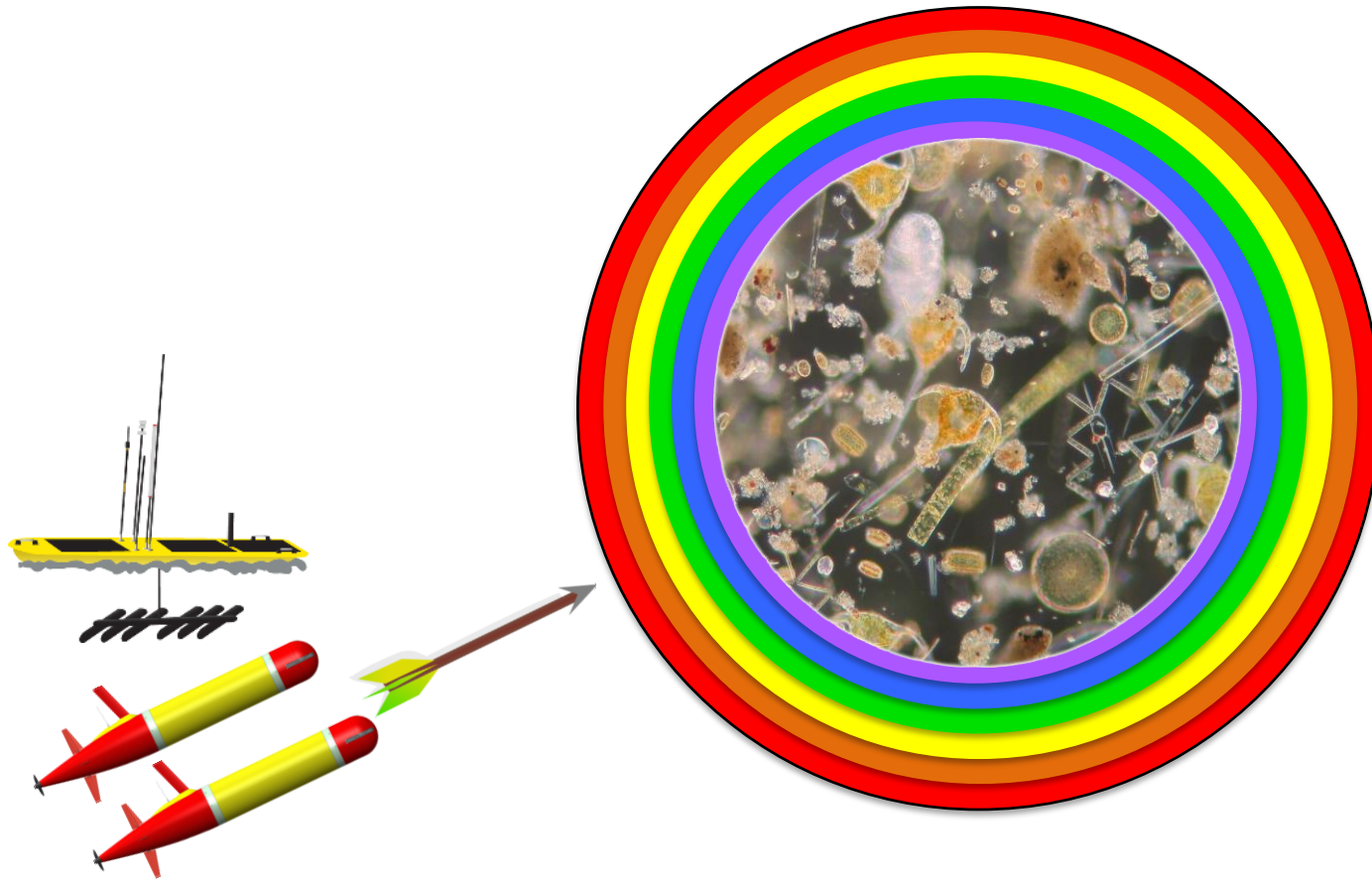# Targeted Sampling Enhanced by Multi-Vehicle Collaboration

Yanwu Zhang, Brian Kieft, Brett Hobson, Tom O'Reilly, and John Ryan

Monterey Bay Aquarium Research Institute

M B A R I

Plankton image from http://orma.com/sea-life/plankton-facts/

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Outline

- Motivation: Multi-vehicle collaboration improves efficiency and persistence of targeted sampling of oceanographic features.

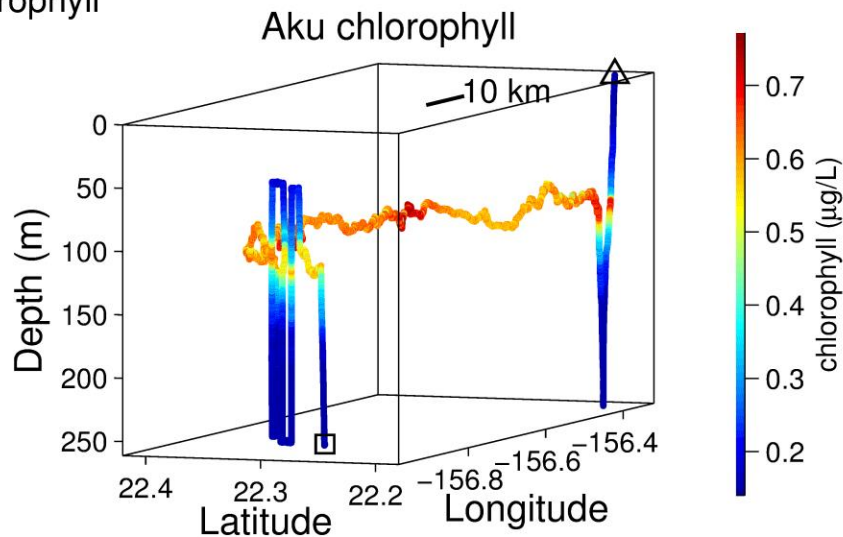- Application example: March/April 2018 Hawaii experiment
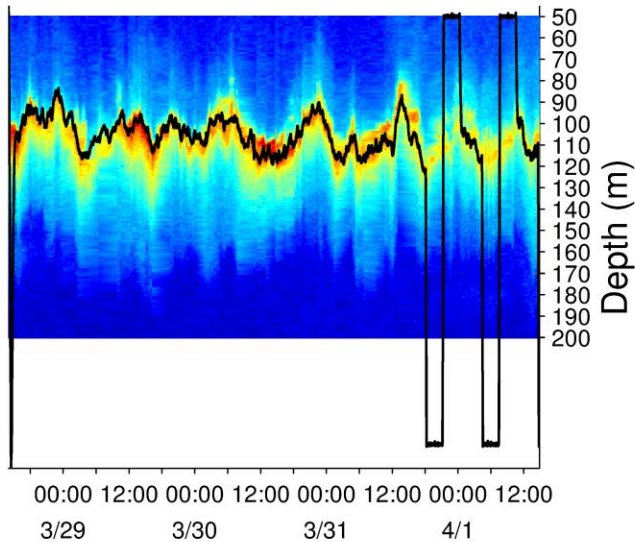
- Ongoing and future work

Photos taken by Elisha Wood-Charlson

Trajectories of Aku (red), Mola (white), and Opah (green) from 3/28 13:57 to 4/1 14:34 overlaid on 3/31 14:00 CMEMS SLA and surface current velocity map
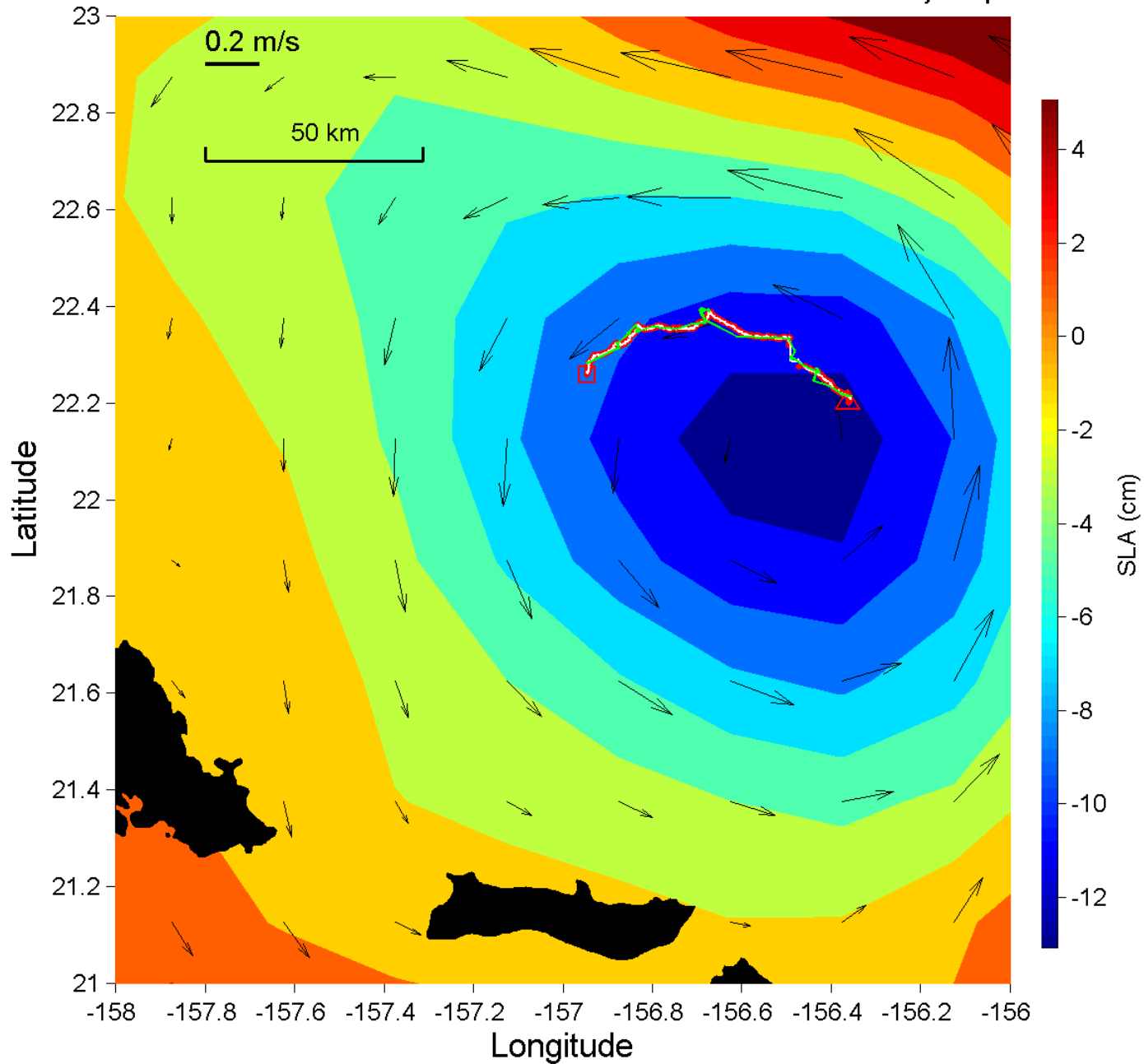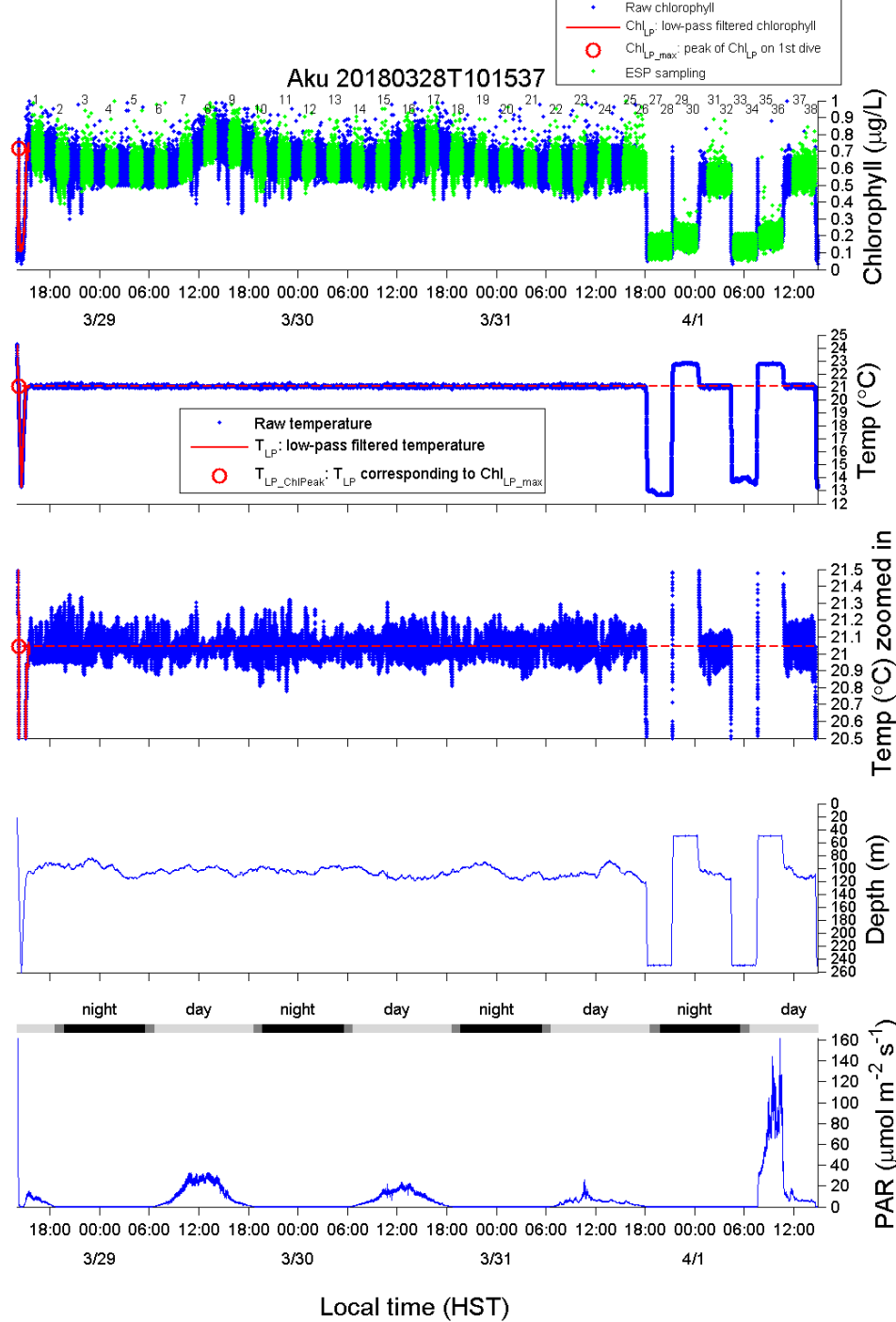
Aku's trajectory (black) overlaid on Opah contextual chlorophyll

Aku chlorophyll

Aku's trajectory (black) overlaid on Opah contextual temperature

Aku temperature

Local time (HST)

Aku 20180328T101537
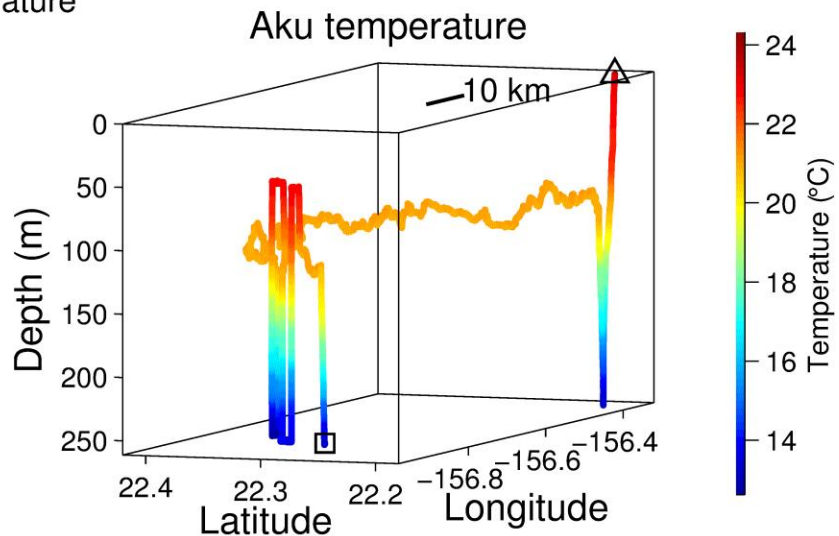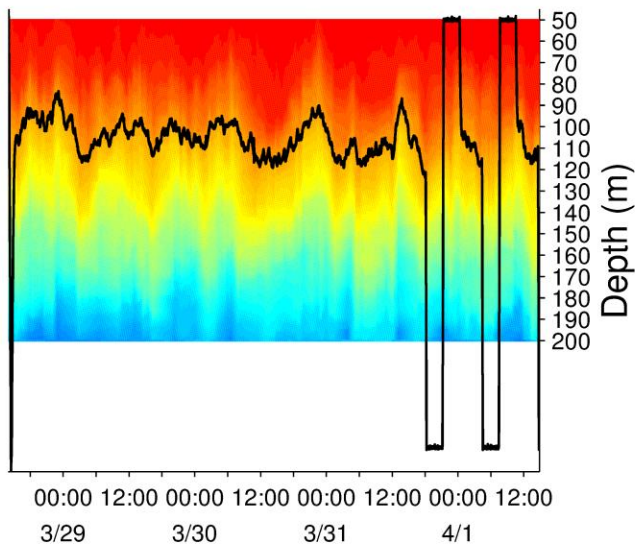
Multi-vehicle collaboration for tracking and sampling phytoplankton patches

AUV#1 drifts with a chlorophyll patch and observes it from boom to bust.

AUV#2 yo-yos in the neighborhood to search for other patches.

AUV #1

AUV #2

The chlorophyll patch tracked by AUV#1 fades out.

AUV#2 finds a new chlorophyll patch some distance away. AUV#2 transmits to AUV#1 the following key information via acoustic communications:
i) chlorophyll signal level in the new patch.
ii) latitude/longitude of the center of the new patch.

AUV#1 compares the chlorophyll signal levels of the old and new patches, and determines that the new patch is stronger and more worthy of being tracked. AUV#1 flies to the new patch center and starts to drift with the new patch and observe its variation.

Wave gliders and satellites can provide supplementary communication channels.

AUV #1

AUV #2

Succinct acoustic communications

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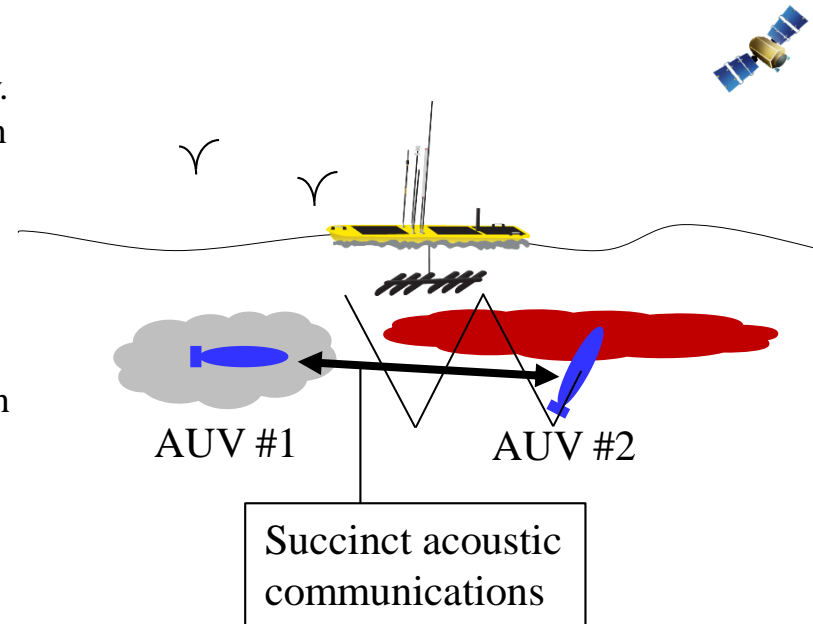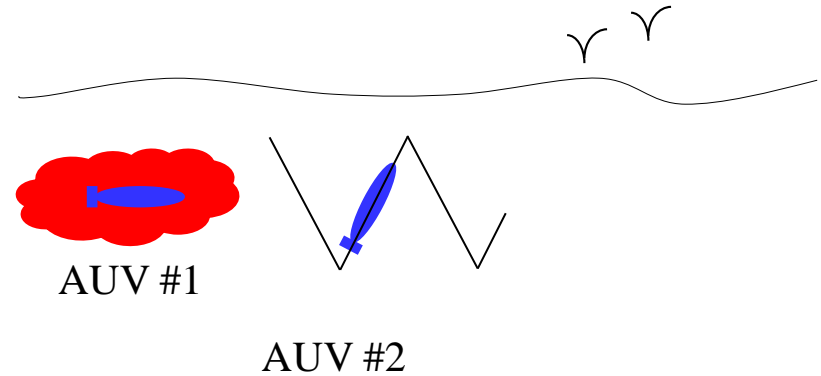
Multi-AUV collaborative targeted ecogenomic sensing
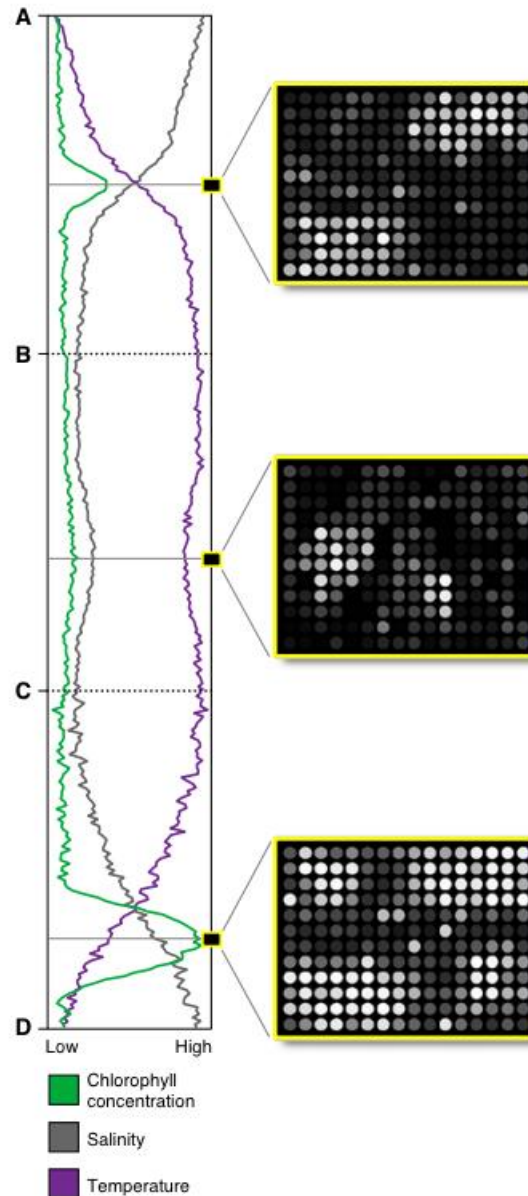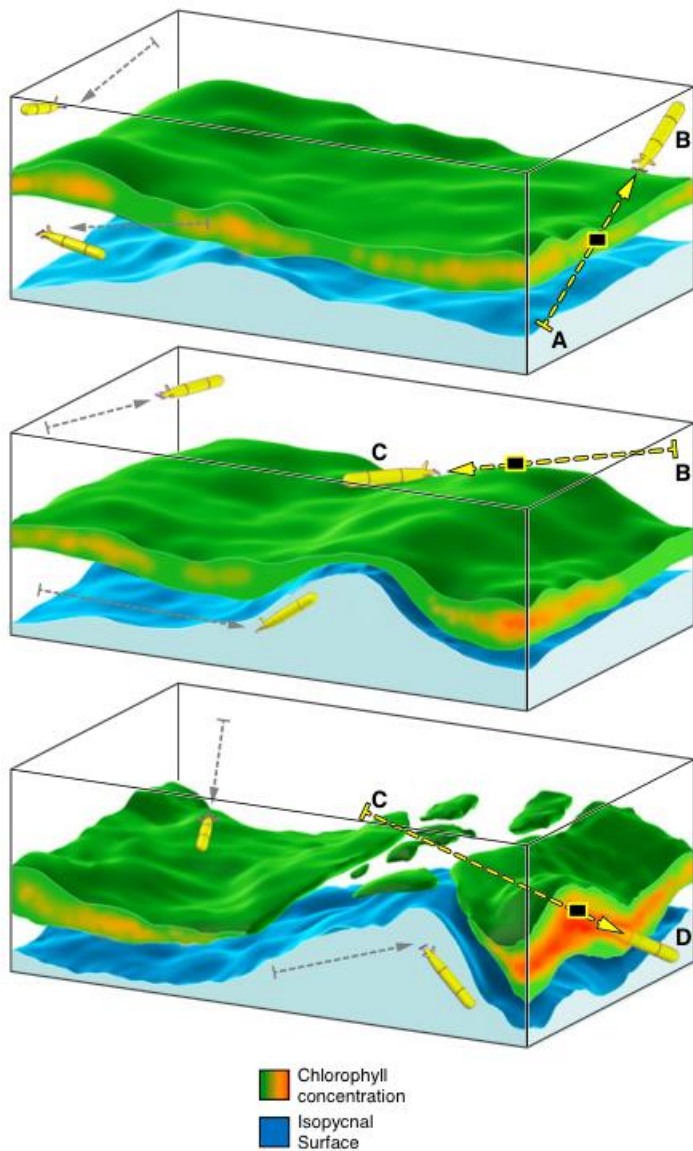
Scholin's vision:

- A fleet of AUVs characterize water column properties and biological community's response in a volumetric fashion.

- Inter-vehicle communications will enable collaborative operations aiming at revealing time and space relationships that ultimately unite environmental forcing and organism function and activity.

C. Scholin, *Ecogenomic sensors. In Encyclopedia of Biodiversity, Volume 2 (Levin S. A. (ed.))*, 2nd ed.

MBARI founder David Packard:

"Send instruments to sea, not people.

Return information to shore, not samples"