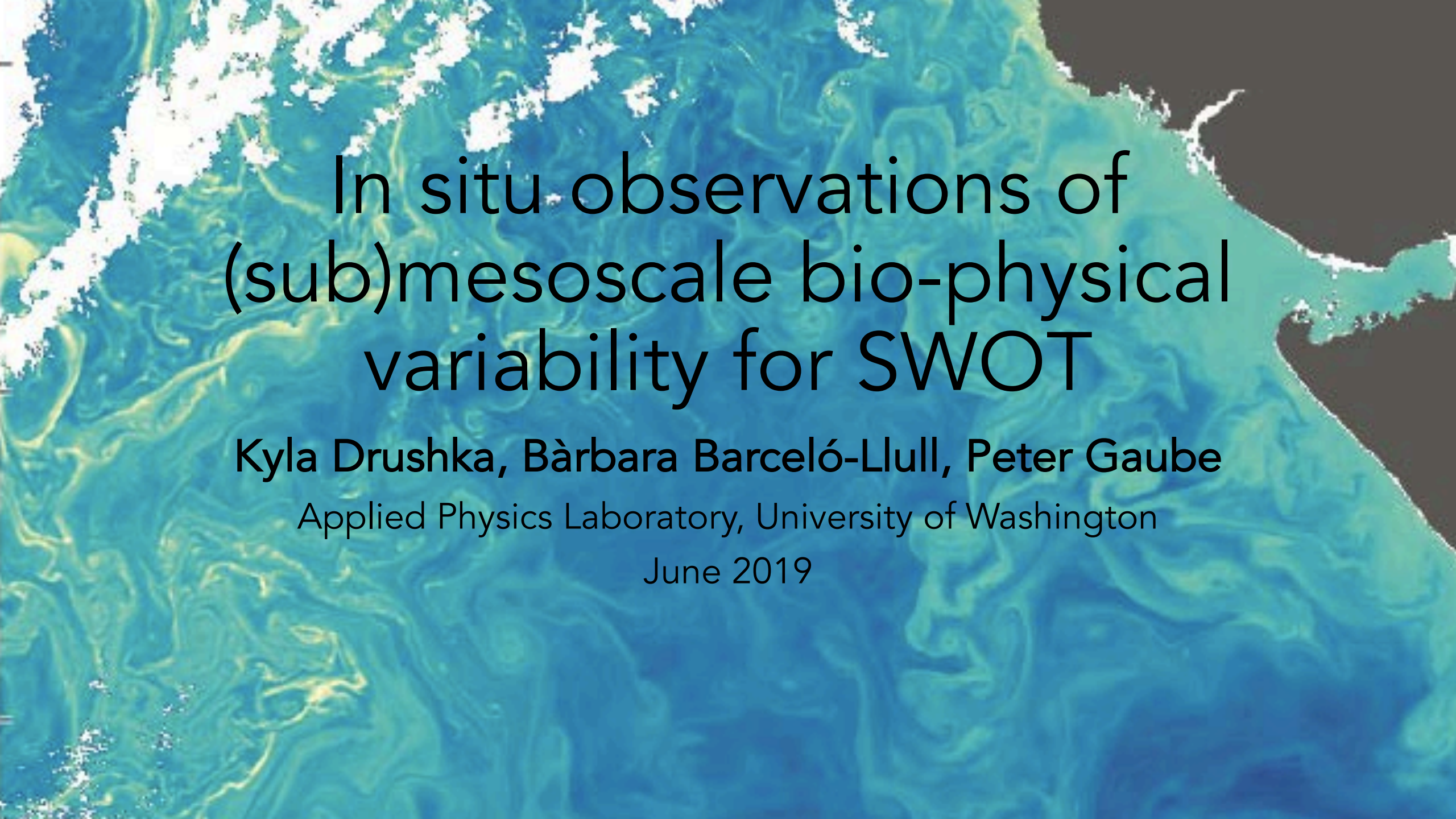


In situ observations of (sub)mesoscale bio-physical variability for SWOT

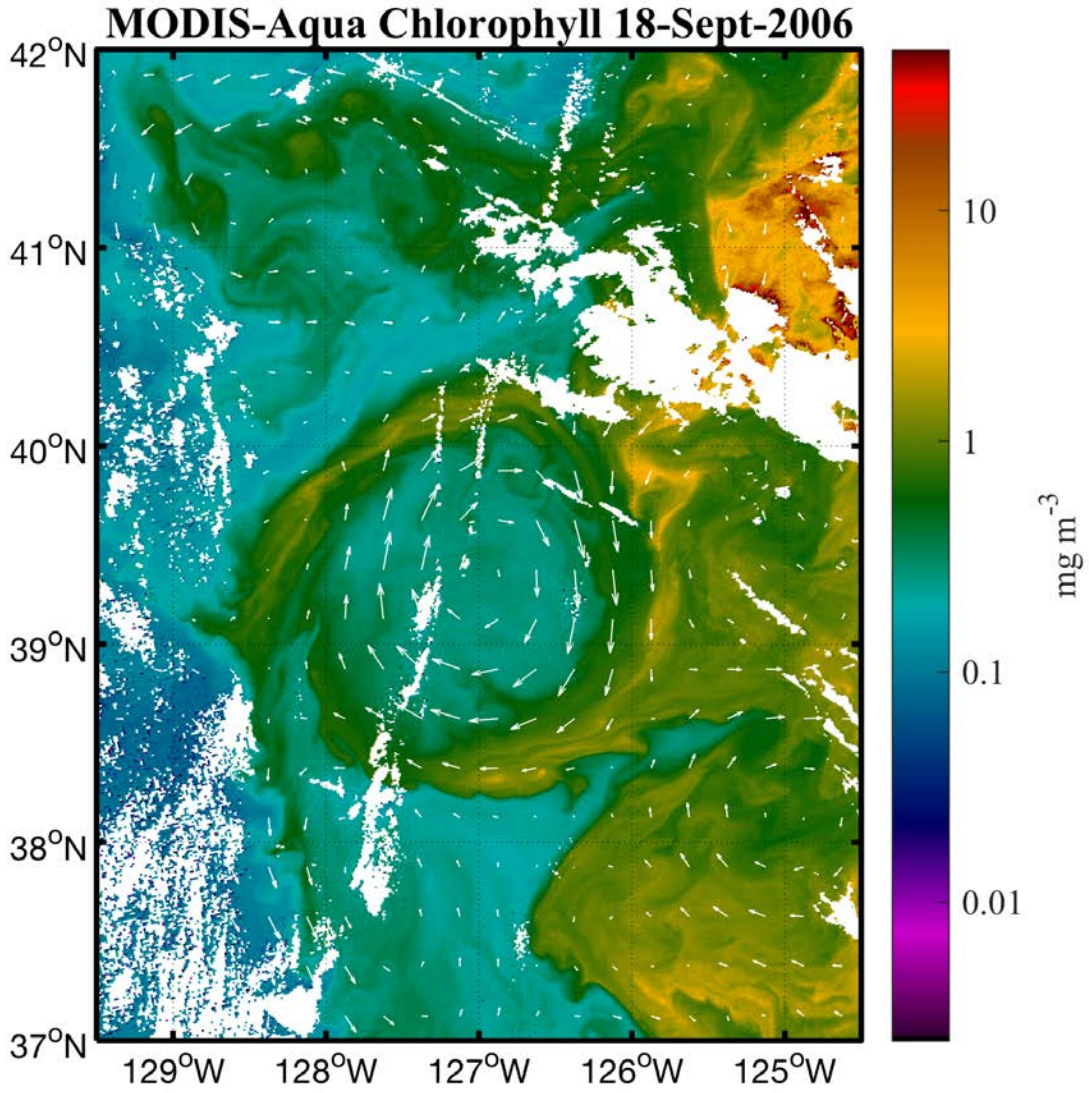
Kyla Drushka, Bàrbara Barceló-Llull, Peter Gaube

Applied Physics Laboratory, University of Washington

June 2019

We have many reasons for making *in situ* measurements of coupled physics-biology in the context of SWOT

Ocean biology is extremely energetic at scales that will be measured by SWOT.



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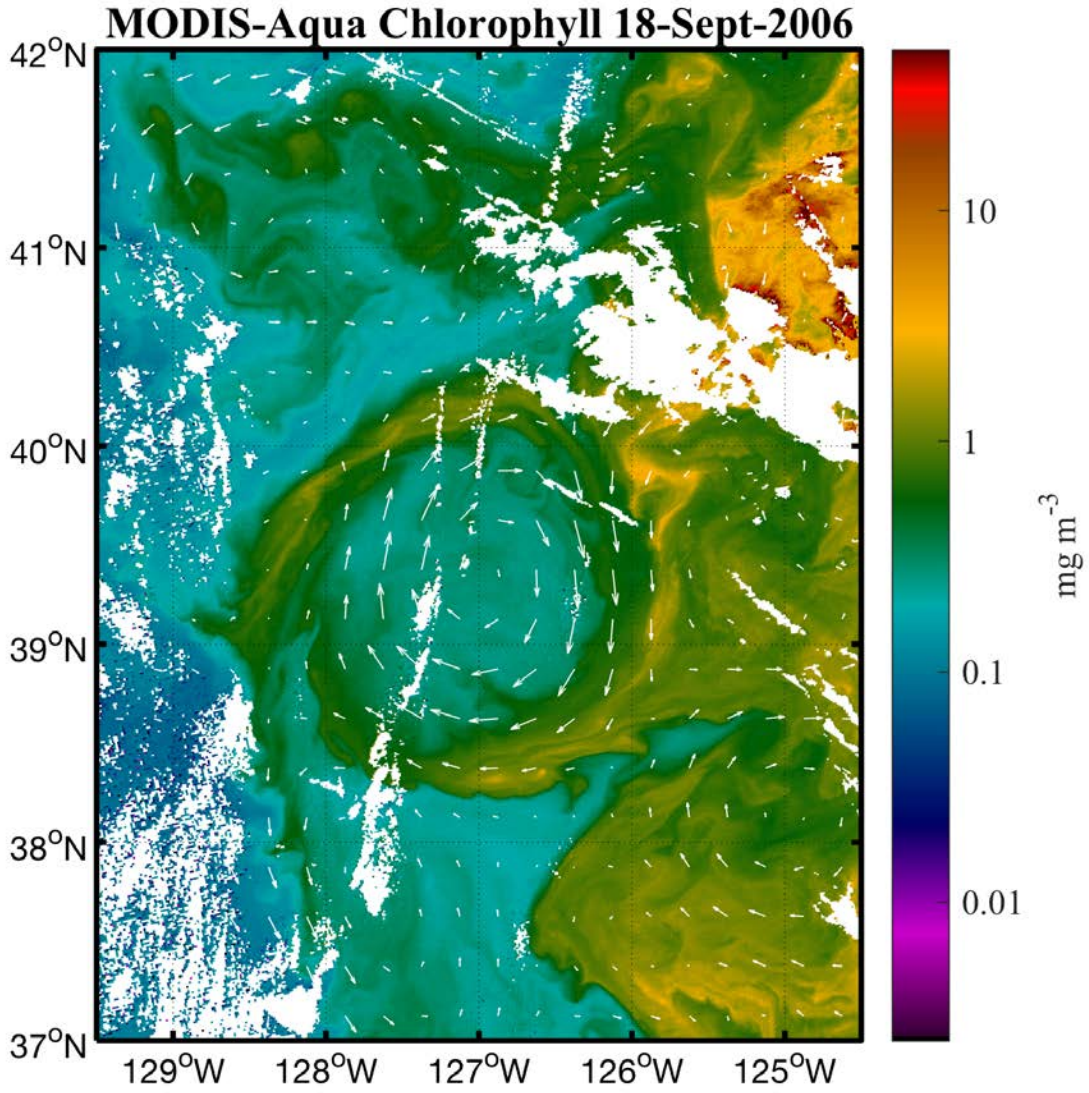

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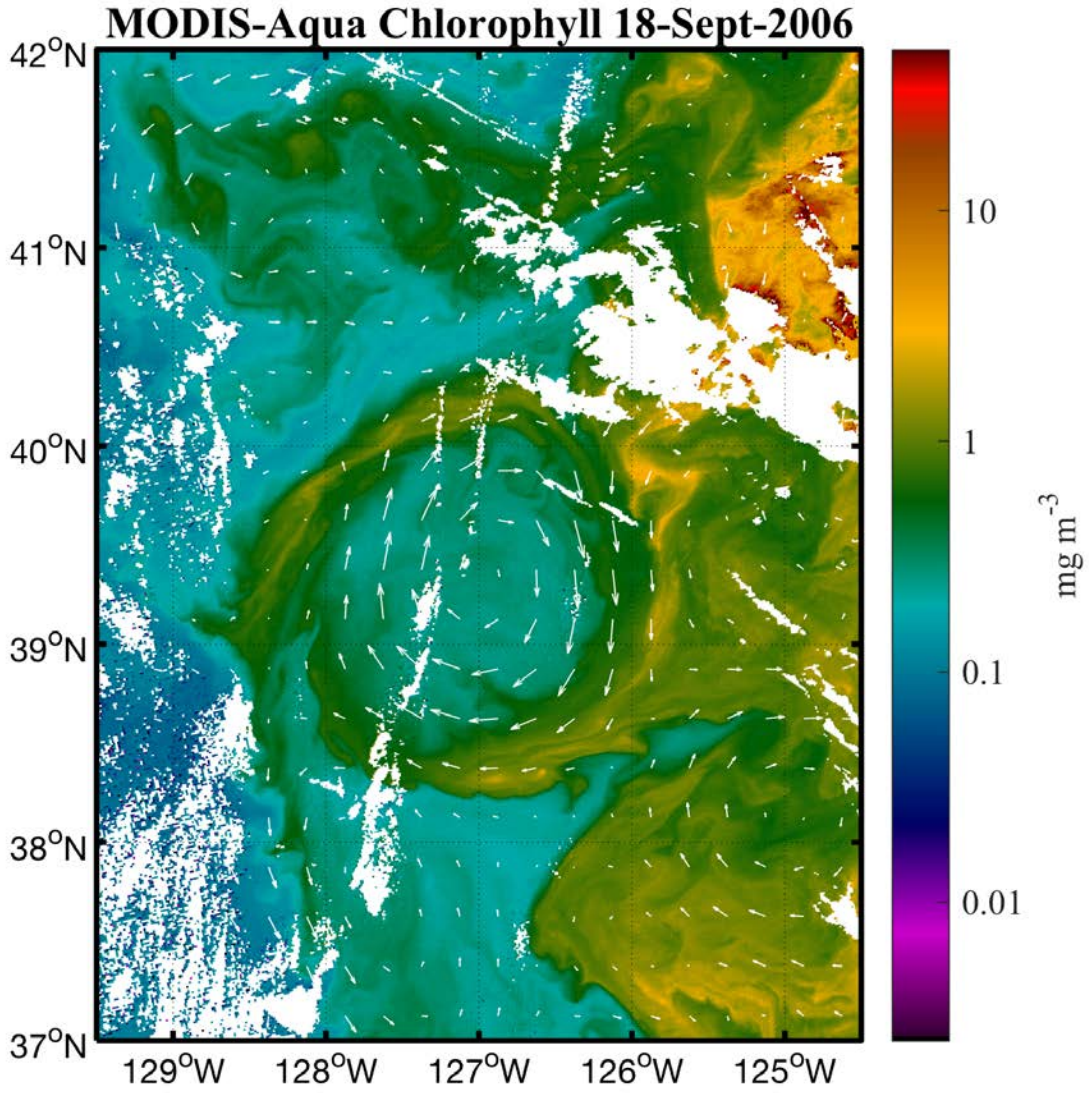

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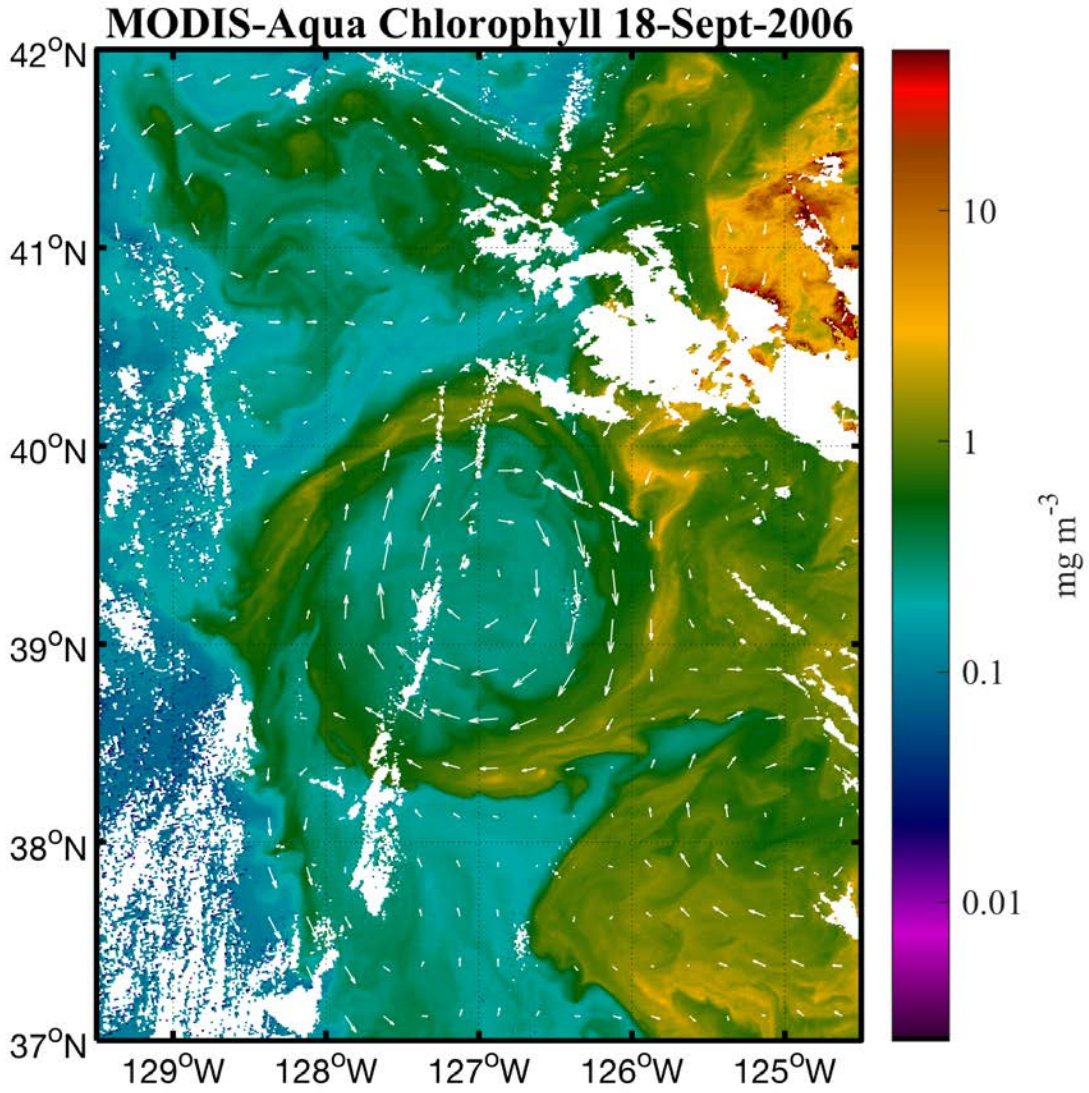
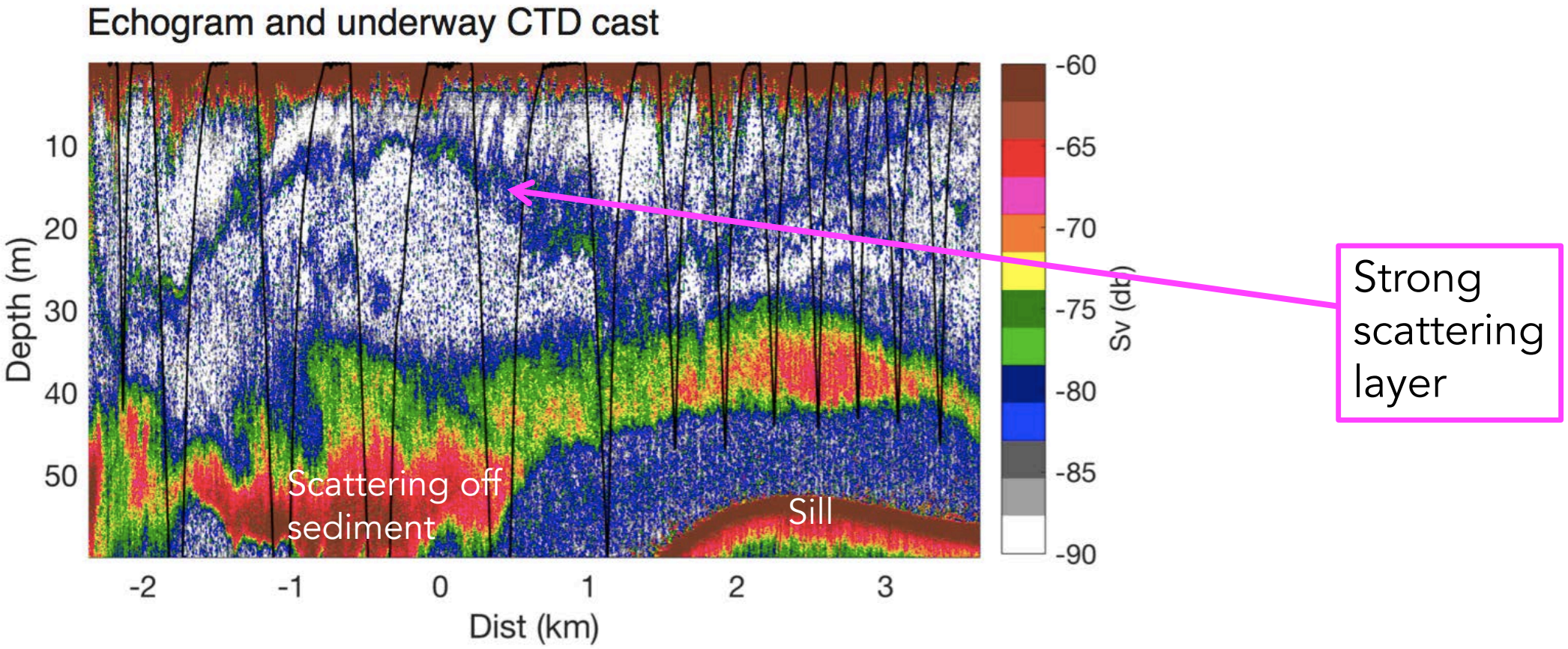
"Biological" measurements can be used to infer physics.



High-resolution mixed-layer depth & mixing from an acoustic echosounder (2017 Hood Canal Experiment)



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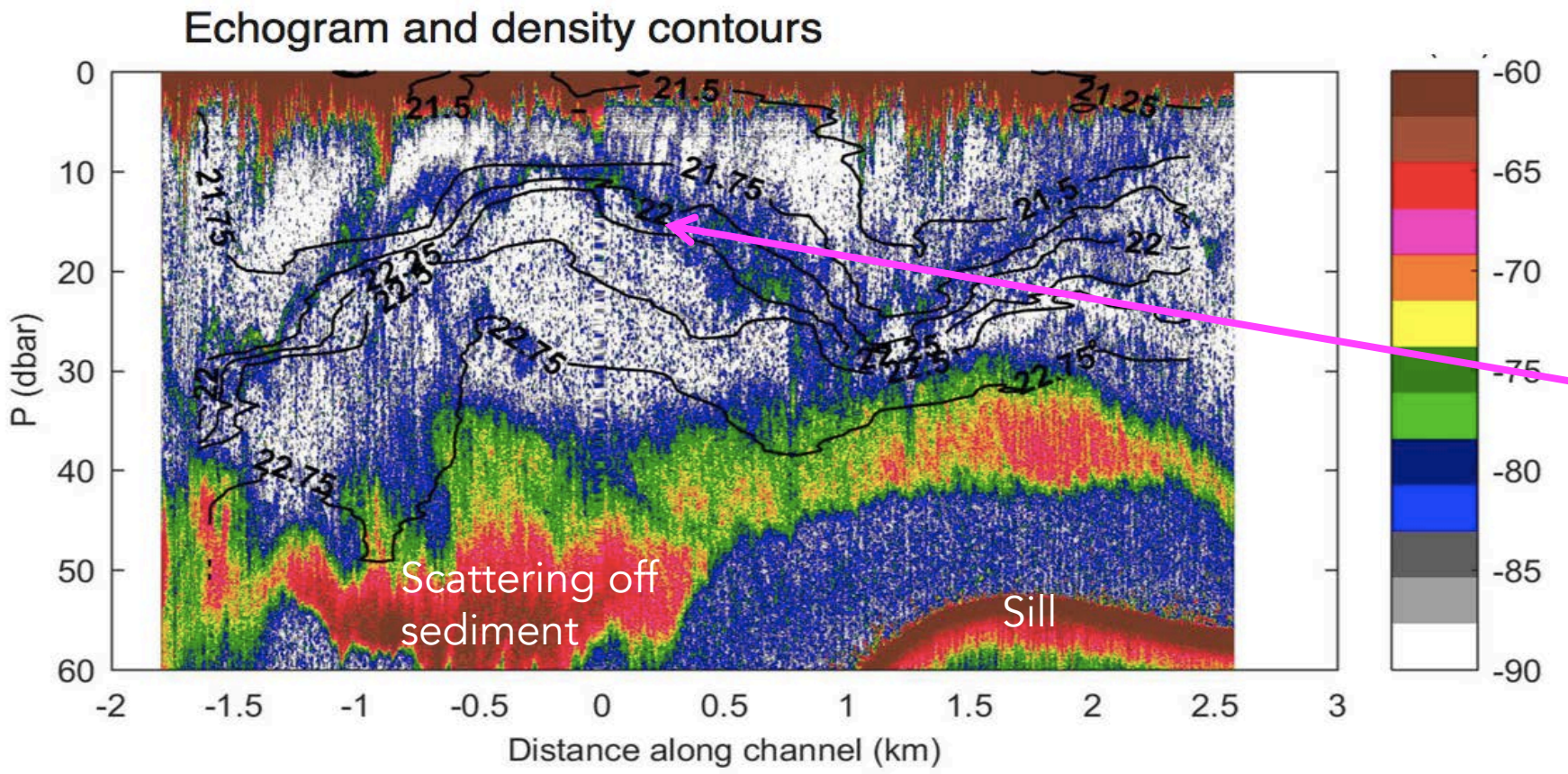

Contours: density from underway CTD

Sharp density gradient

Acoustic data could capture MLD at ~1 m horizontal resolution

See also Stranne et al. *Ocean Science*, 2018.

Some SWOT-relevant physical-biological topics to consider

- Link between primary productivity and the physical structure and dynamics at (sub)mesoscale fronts
  - E.g., upwelling and downwelling of nutrients vs phytoplankton

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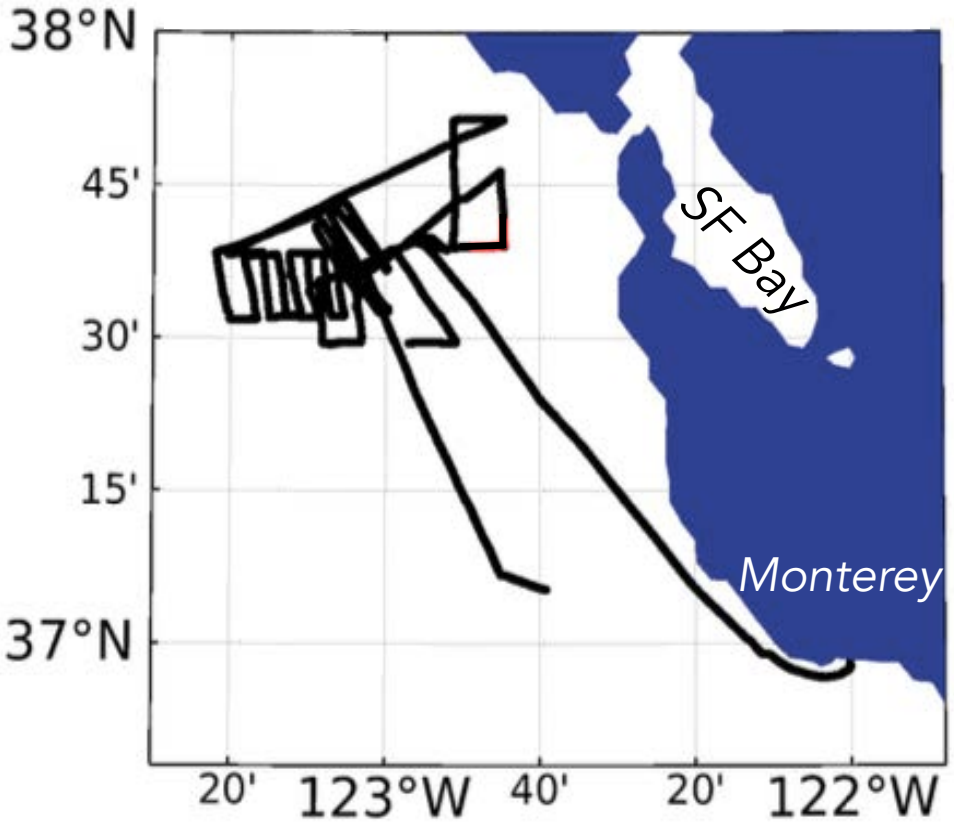
Drivers of (sub)mesoscale mixed-layer dynamics and how this affects productivity

- E.g., ocean dynamics versus surface forcing

Key measurements for a phys/bio experiment

Physical	Biological
Temperature & **salinity** (dynamic height, fronts, mixed-layer depth)	**Oxygen** and **nutrients** (related to production)
Horizontal currents & shear (dynamics)	**Acoustic backscatter** (zooplankton and higher trophic levels; mixed-layer depth?)
Vertical currents (up/downwelling)	**Optical backscatter** (particle size structure and distribution)
Turbulence (dynamics)`	**Light absorption/attenuation and fluorescence** (CHL and other pigments)
	Flow cytometry (community composition: who is there?)

2018 San Francisco DopplerScatt Experiment
Aug 20-24, 2018



*Data analyzed by Bàrbara Barceló-Llull

Ship-based physics & biology

Drushka & Gaube*

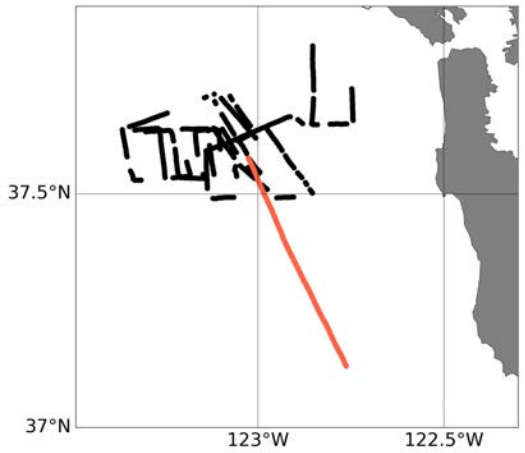
DopplerScatt & MASS aircraft

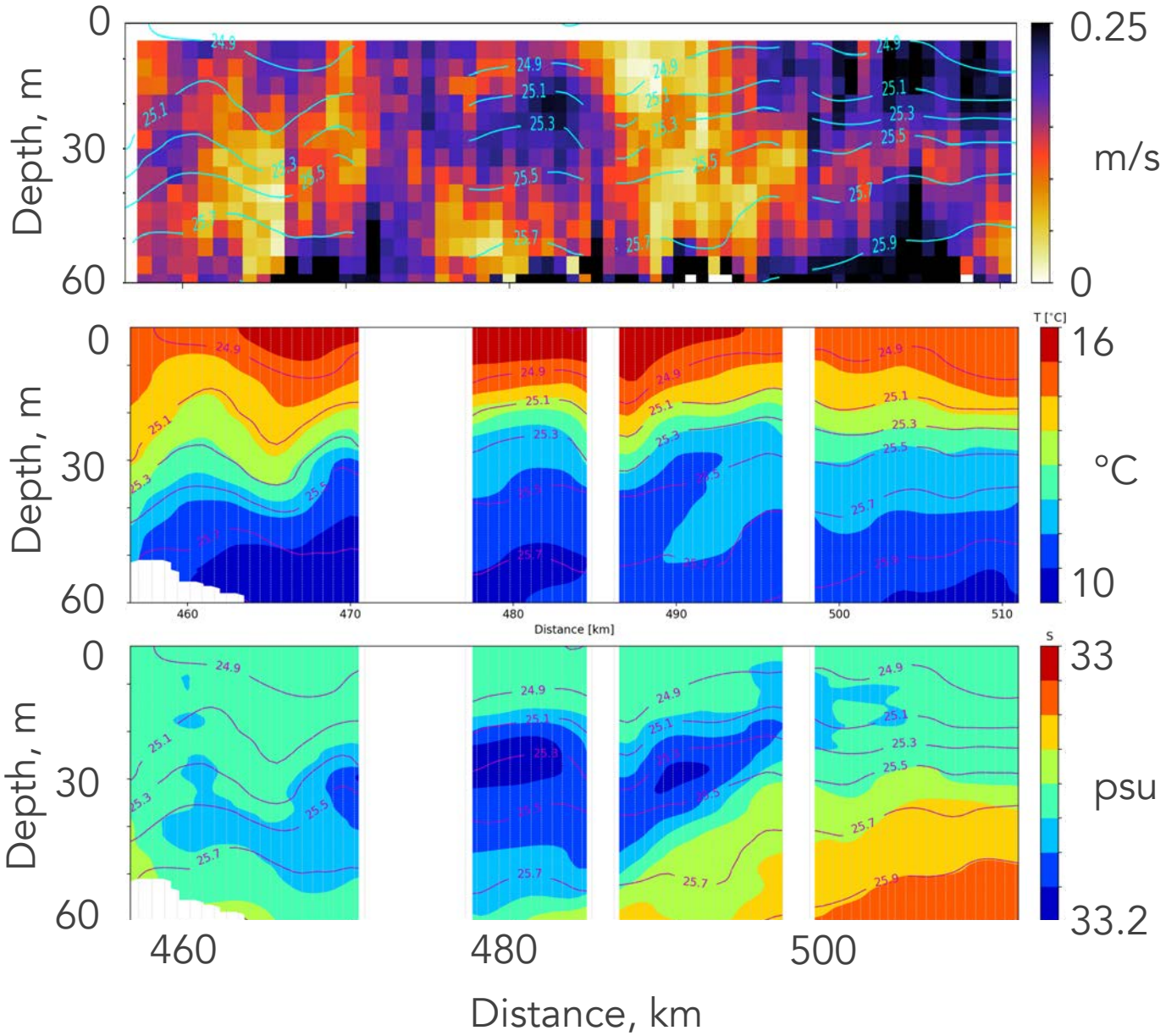
Rodriguez & Lenain

Near-surface drifters

Morey

60-km transect on Aug 24





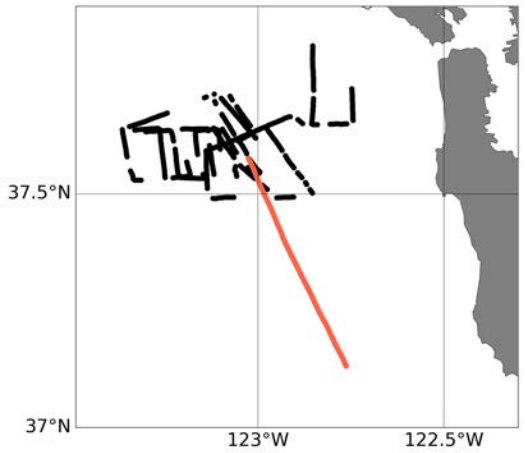
Current speed

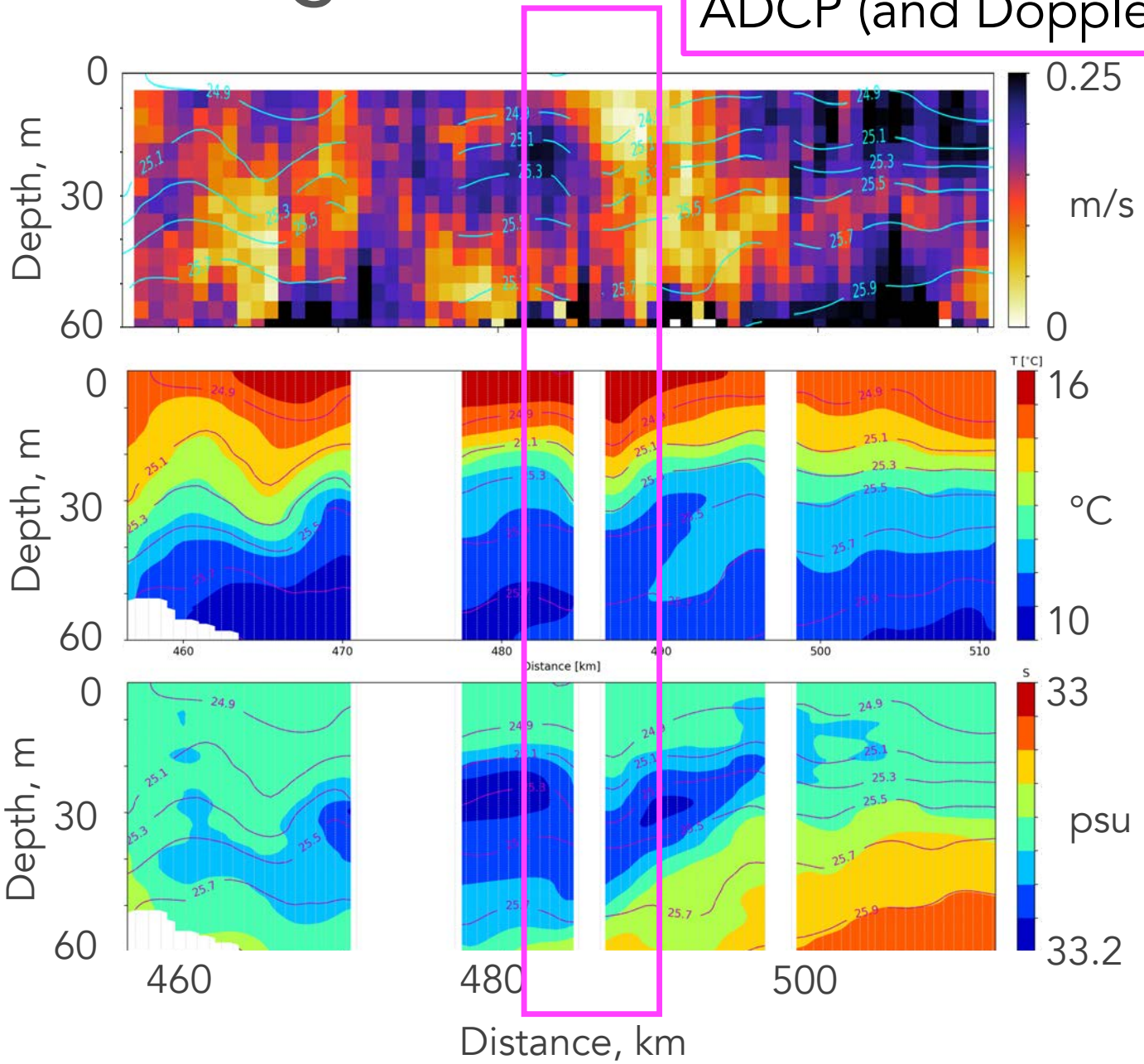
Temperature

Salinity

60-km transect on Aug 24

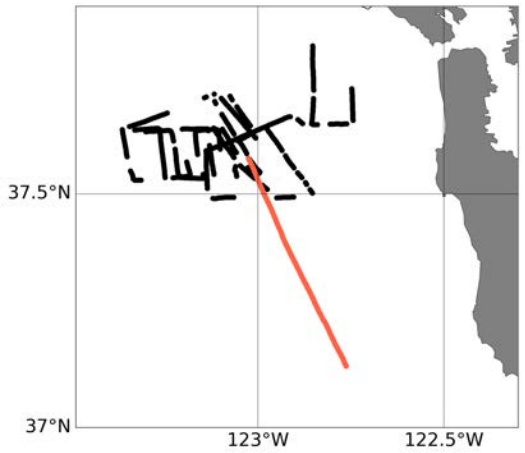
Strong front observed with ADCP (and DopplerScatt)



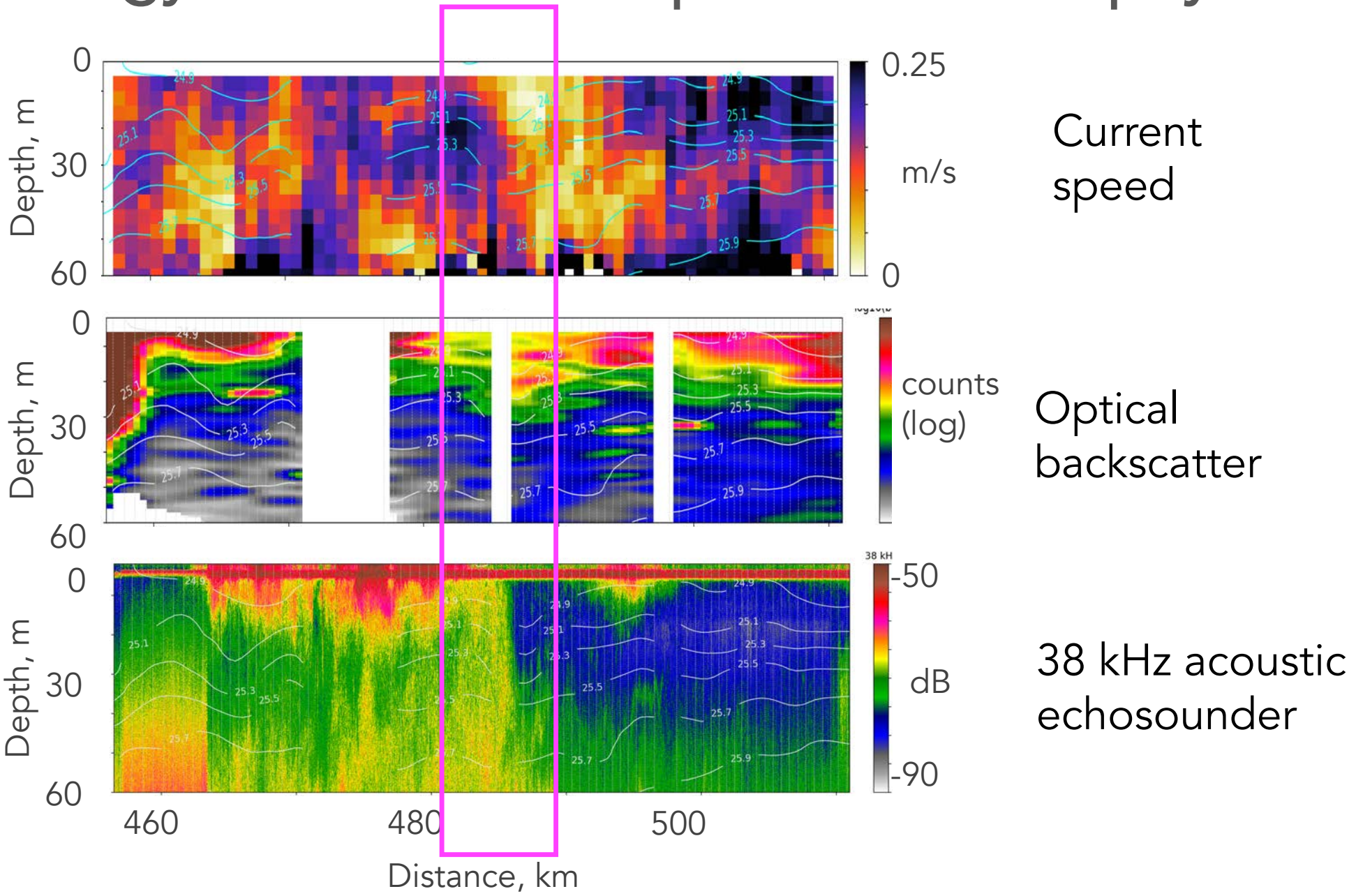


T & S have interesting vertical structure at the front

Structure in biology reflects the sharp front seen in physics



High-resolution acoustic data reveal a very sharp front



Current speed

Optical backscatter

38 kHz acoustic echosounder

Summary

SWOT experiments will benefit from biological measurements, to:

- Advance our understanding of **how (sub)mesoscale ocean dynamics impact ecological dynamics** and the carbon cycle
- Gain insights into physical dynamics
- Develop **strategies for using satellite ocean color** to help interpret SWOT data
- **Entrain other funding sources** (e.g., US Ocean Color & Biogeochemistry)

Acoustic backscatter data, combined with in situ density profiles, can provide an exceptionally high-resolution picture of horizontal and vertical density structure (e.g., MLD, mixing).

In situ optical sensors complement satellite color and airborne hyperspectral imagery.

Additional measurements (oxygen, nutrients, light absorption/attenuation, phytoplankton imagery) will further fill in details about **community structure and biogeochemical cycling**.