The Role of a Cuddy in the Northeast Pacific in Driving Offshore Export and Retaining Nearshore Water

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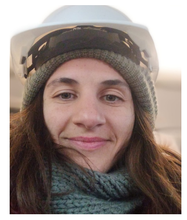

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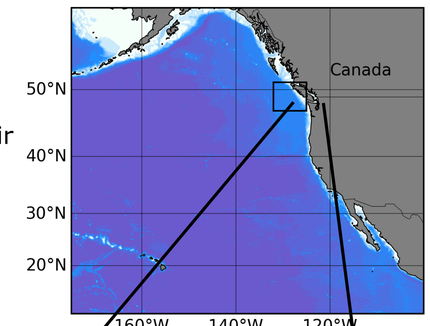
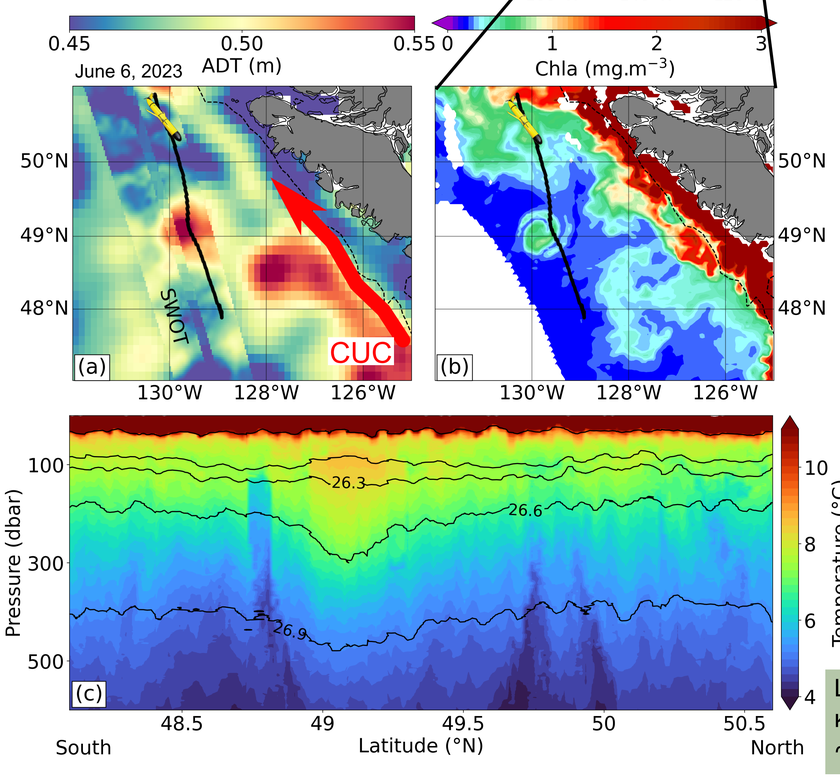
Introduction

Why it matters? Lateral mixing is key to ocean circulation, climate, and ecosystems.

What are Cuddies? Subsurface eddies associated with the California Undercurrent (CUC). They transport heat/salt and nutrients offshore (NE Pacific). Pelland et al. (2013) estimated that up to 44% of heat loss of the California Undercurrent could be to Cuddies.

Knowledge gap:
How do Cuddies transport and redistribute these properties spatially? Understanding of their 3D structure and lateral exchange mechanisms remain limited mainly because their strongest signal is below the surface (~200-250 m)



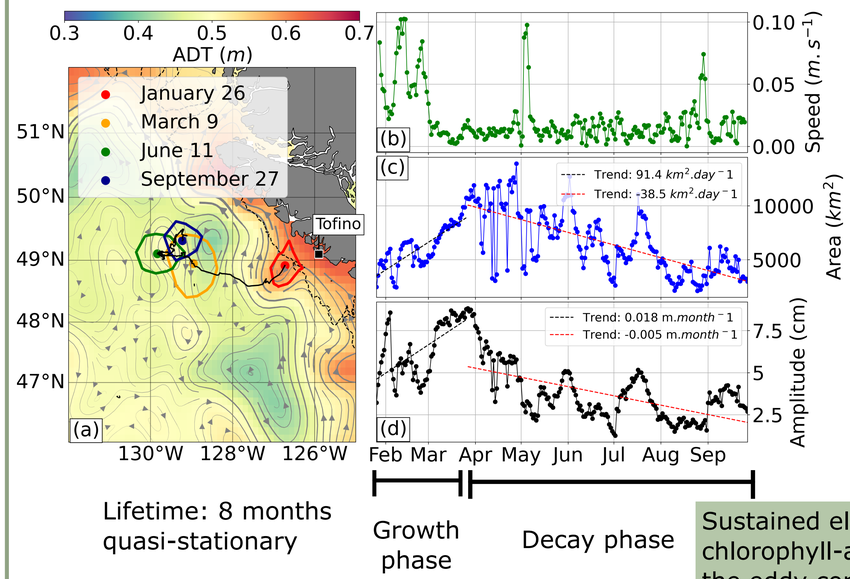


Data and Methodology

Platform	Specifications
Glider	Slocum G3 Deep (C-PROOF, Klymak & Ross, 2025) 0–1000 m depth Temperature, salinity, density (σθ) profiles
SWOT	Surface Water and Ocean Topography 2km resolution | Daily (Cal/Val phase: April–July 2023) Absolute Dynamic Topography (ADT), geostrophic velocities
DUACS	Multi-satellite (AVISO+) 14km resolution | Daily Absolute Dynamic Topography (ADT), eddy tracking
Ocean Color	MODIS - Aqua 4 km resolution | Daily (cloud cover) Chlorophyll-a concentration (Chla)

The Cuddy's journey from nearshore export to offshore retention

Subthermocline eddy exports high-productivity nearshore waters and mantain high productivity in its core.

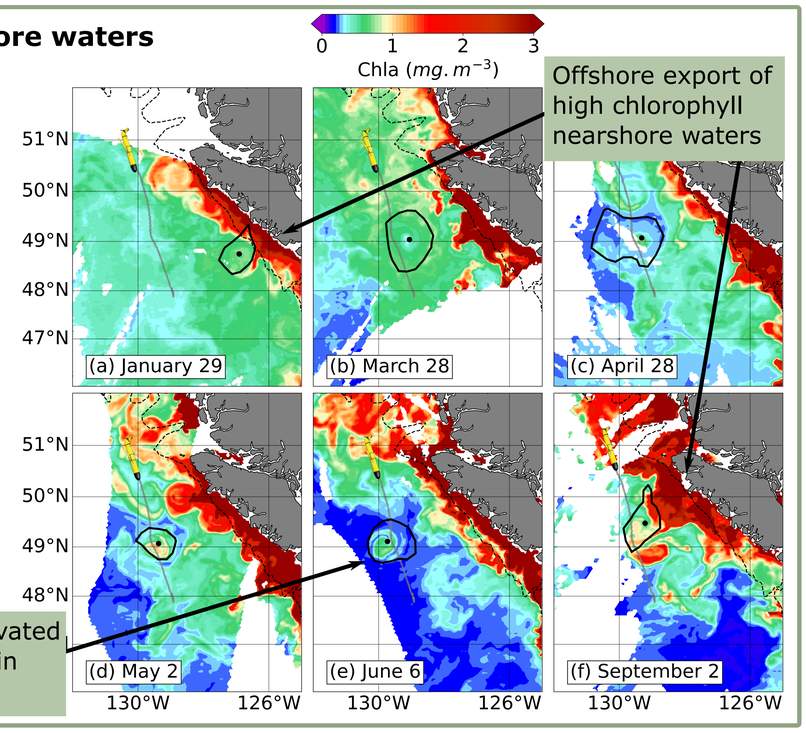


Lifetime: 8 months
quasi-stationary

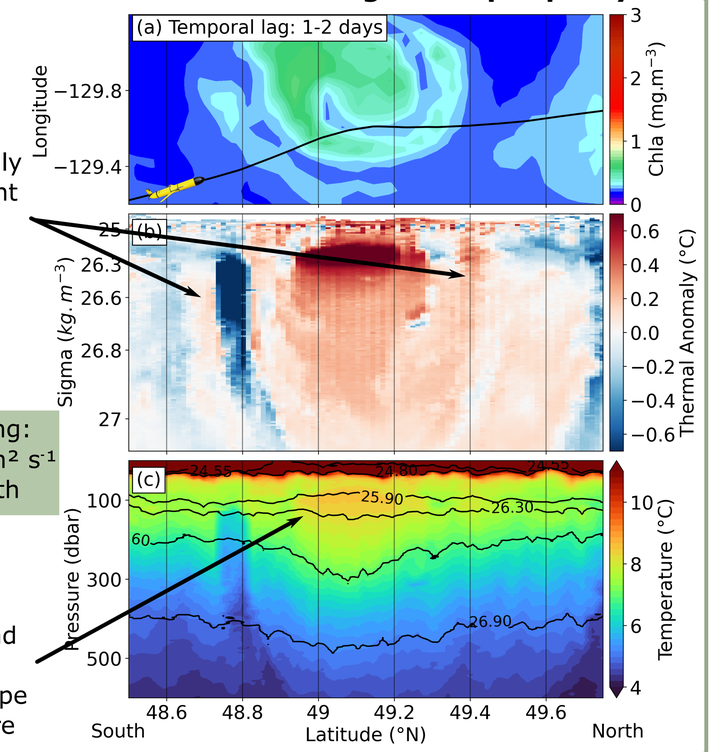
Growth phase

Decay phase

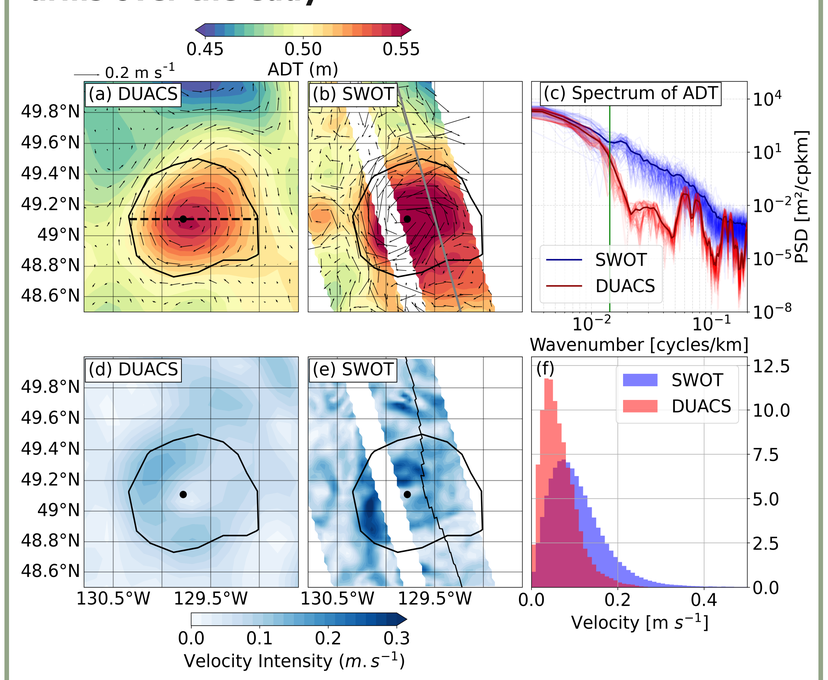
Sustained elevated chlorophyll-a in the eddy core



Offshore heat export (9.9 × 10^{16} J) and regional redistribution via lateral mixing at the periphery



SWOT resolves submesoscale jets and dynamical arms over the eddy



Indicates SWOT will be useful for tracking the life cycle of mesoscale features (e.g., size evolution and filamentation)

Conclusions

- **A large anticyclonic subthermocline eddy (Cuddy) was detected by glider data, altimetry (SWOT and conventional), and satellite chlorophyll-a**
- **The Cuddy exports high productivity nearshore waters offshore and maintains the high productivity in its core.**
- **The Cuddy transports heat from nearshore to offshore, losing heat through lateral mixing (κ ≈ 16–142 m² s^{-1}) over time**
- **The Cuddy periphery exhibits dynamical arms (not only passive advection) that SWOT's high resolution can resolve to investigate the eddy decay mechanism.**

References

Klymak, J., & Ross, T. (2025). C-PROOF Underwater Glider Deployment Datasets [Data set]. Canadian-Pacific Robotic Ocean Observing Facility. doi:10.82534/44DS-K310.

Pelland, N. A., C. C. Eriksen, and C. M. Lee, (2013): Subthermocline Eddies over the Washington Continental Slope as Observed by Seagliders, 2003–09. J. Phys. Oceanogr., 43, 2025–2053.