An aerial photograph of a riverbed composed of numerous smooth, rounded grey and brown stones. A small yellow boat is positioned in the center of the frame, with a thin yellow line extending from it towards the right side of the image. The water is clear, revealing the texture and color of the rocks beneath. Two semi-transparent grey text boxes are overlaid on the image: one at the top center containing the title, and one at the bottom center containing the author's name and contact information.

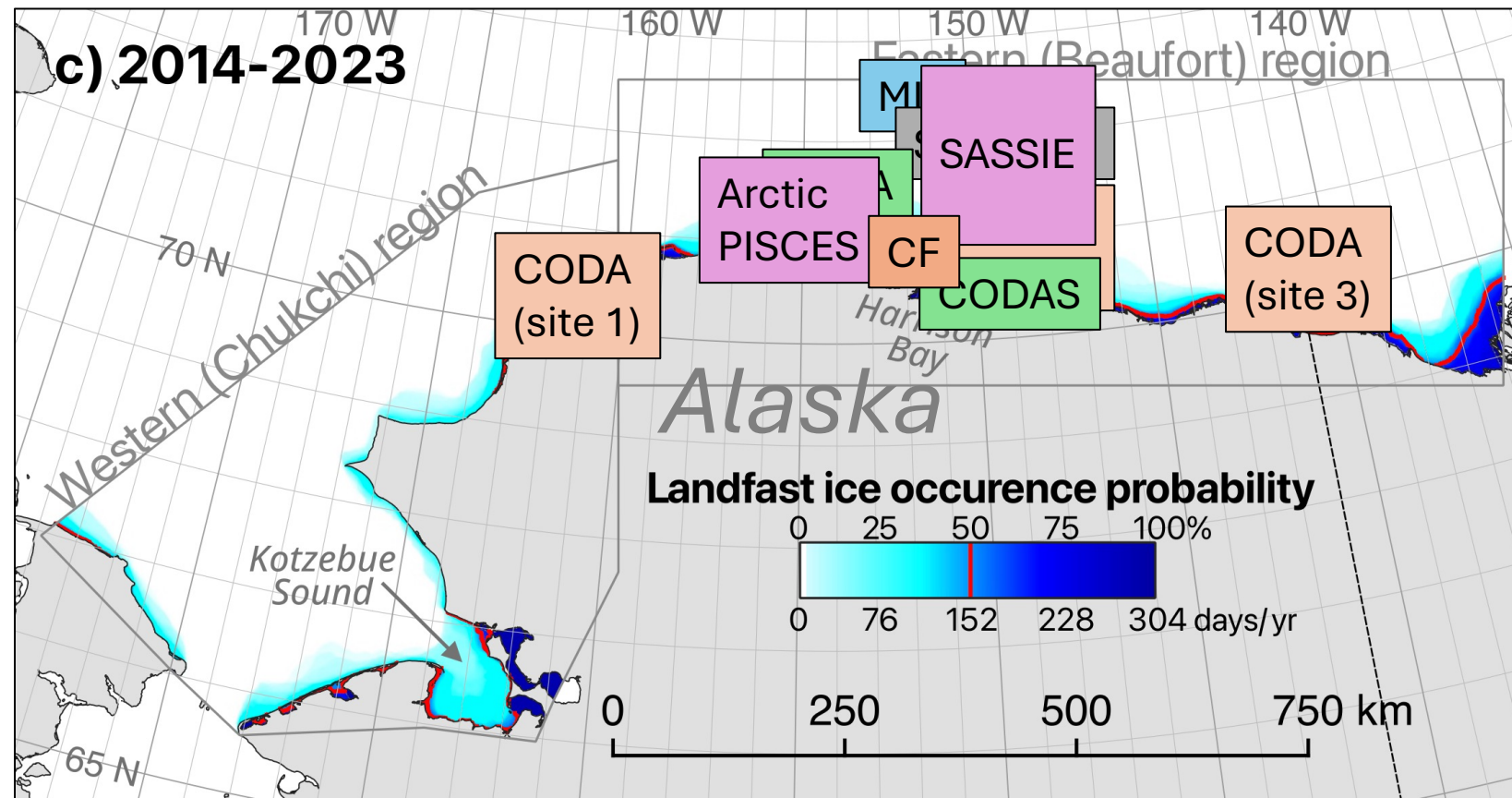
Drifting and Moored Observations of Coastal River Plumes Along the North Slope of Alaska

Jim Thomson (and friends)
Applied Physics Lab, U. Washington
jthomson@apl.washington.edu

Relevant previous and ongoing projects

- 2014 Marginal Ice Zone (ONR)
- 2015 Arctic Sea State (ONR)
- 2018 Stratified Ocean Dynamics in the Arctic “SODA” (ONR)
- 2019-2020 Coastal Ocean Dynamics in the Arctic “CODA” (ONR,NSF)
- 2021-2023 Coastal Ocean Distributed Acoustic Sensing “CODAS” (NSF)
- 2022 SASSIE (NASA)
- 2025-2026 Coastal Freeze (NSF)
- 2025-2028 Arctic-PISCES (ONR)

Mahoney & Einhorn 2026



Seasonal sea ice cycles along the North Slope



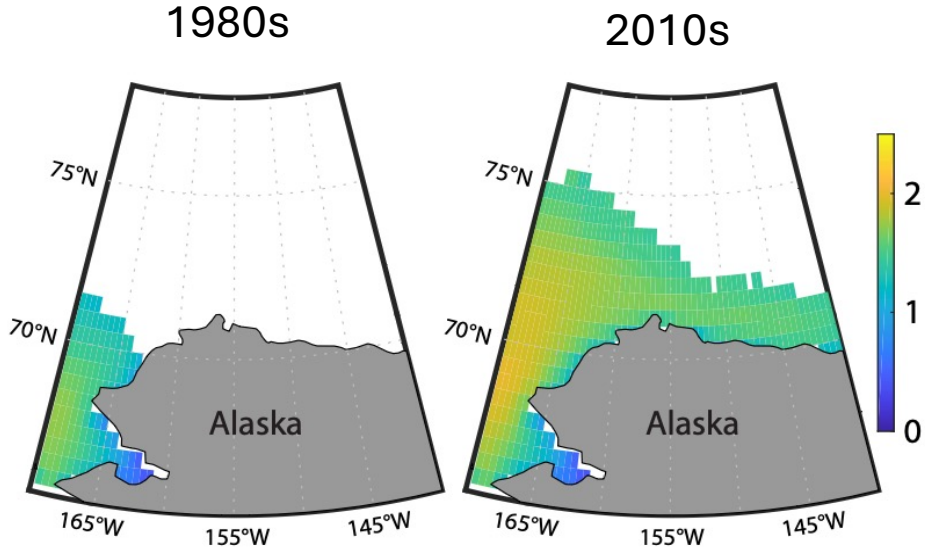
Gibbs et al (2019)

(recent years)

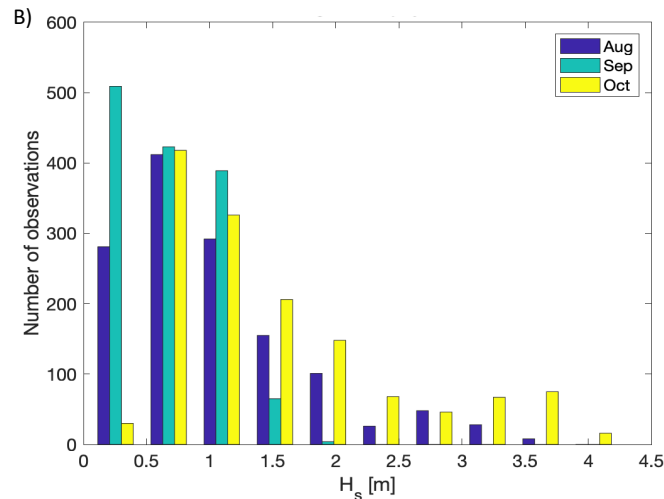
Cape Halkett to Flaxman Island: <i>No shorefast ice</i> (incl. Prudhoe Bay)	06/27	07/14	06/27	07/05	07/06
20 nmi Offshore Cape Halkett to Flaxman Island: <i>< 3/10 coverage</i> (incl. Prudhoe Bay)	08/20	0	08/13	09/14	07/15
20 nmi Off Shore Cape Halkett to Flaxman Island: <i>Ice free or open</i> (incl. Prudhoe Bay)	08/31	0	08/22	09/16	07/24
Harrison Bay to Flaxman Island to 75N: <i>< 3/10 coverage</i> (incl. Prudhoe Bay)	08/31	0	09/14	10/02	0
Harrison Bay to Flaxman Island to 75N: <i>Ice free or open</i> (incl. Prudhoe Bay)	09/07	0	09/19	0	0

Michael Lawson,
Alaska Sea Ice Program

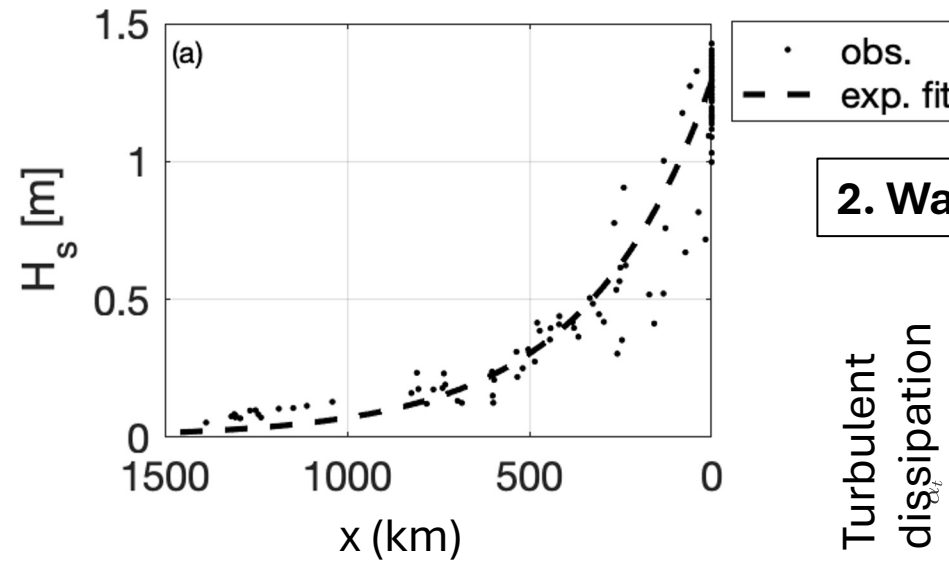
Surface waves in the Arctic coastal ocean



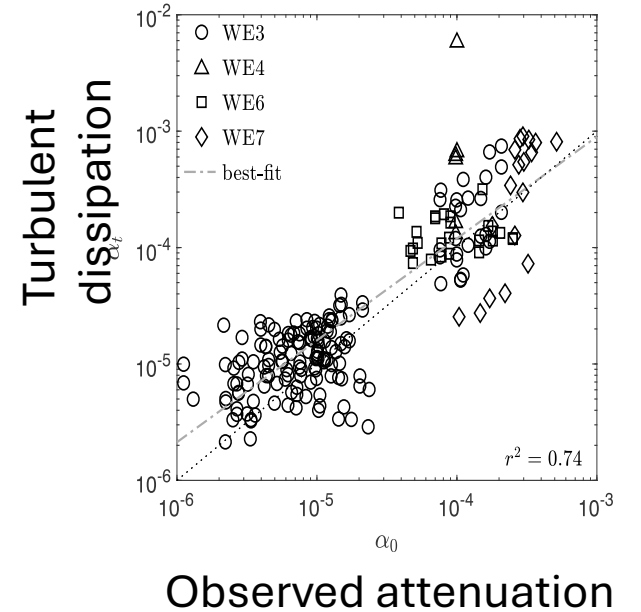
1. Waves are increasing



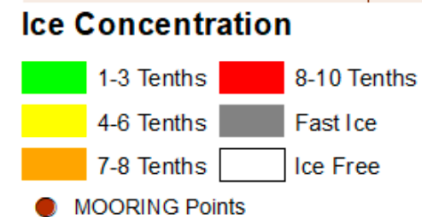
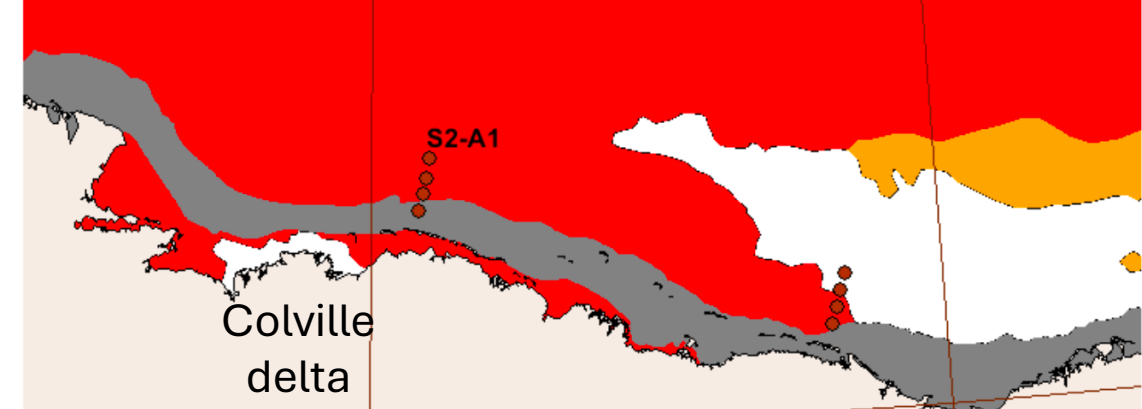
Thomson et al, 2022



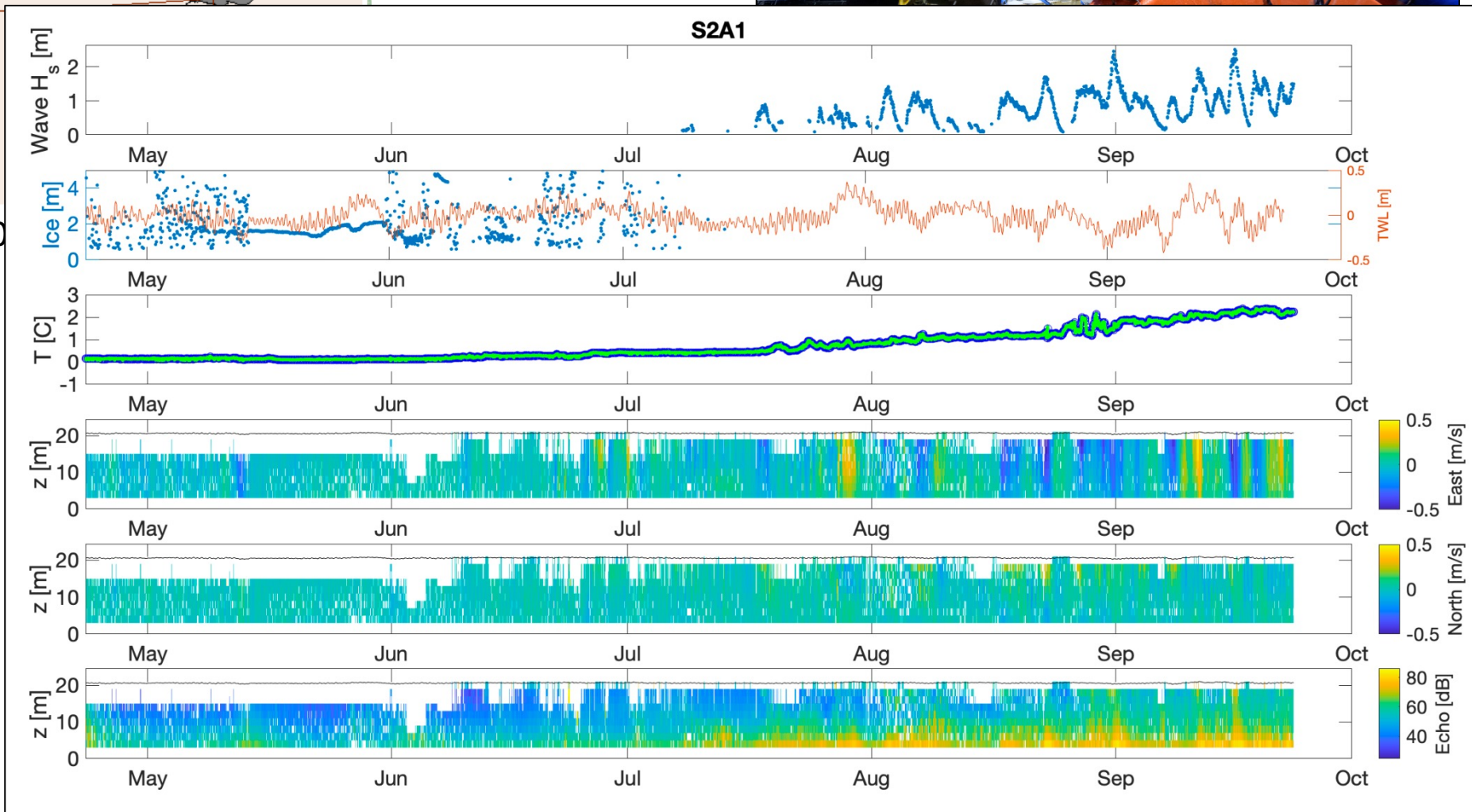
2. Waves attenuate in ice



CODA moorings and tripods



26 Jun 2020



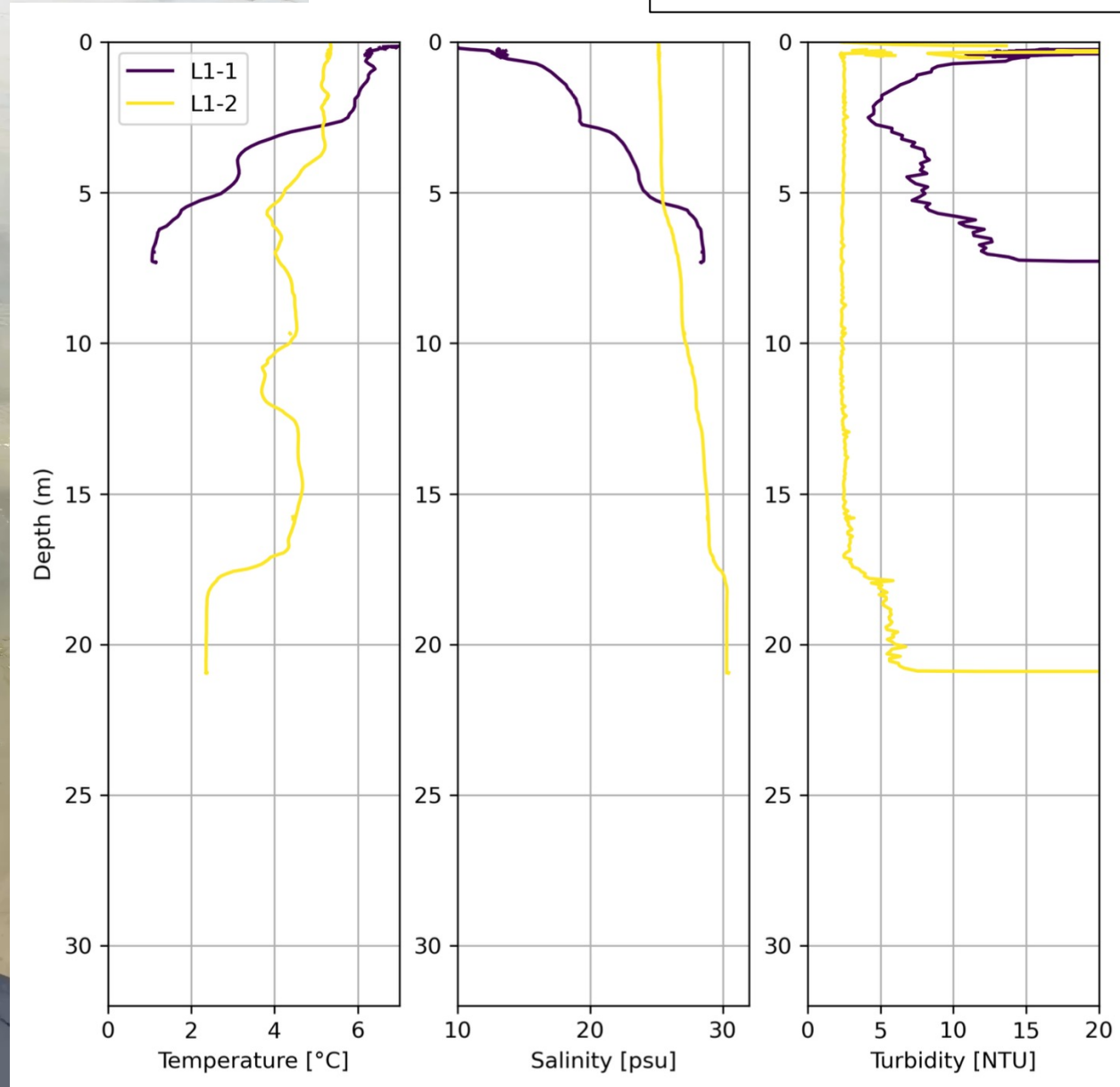
River plumes in the Arctic coastal ocean

Coastal Freeze project
with Maddie Smith and
Emily Eidam



Colville
delta

31 Aug 2025

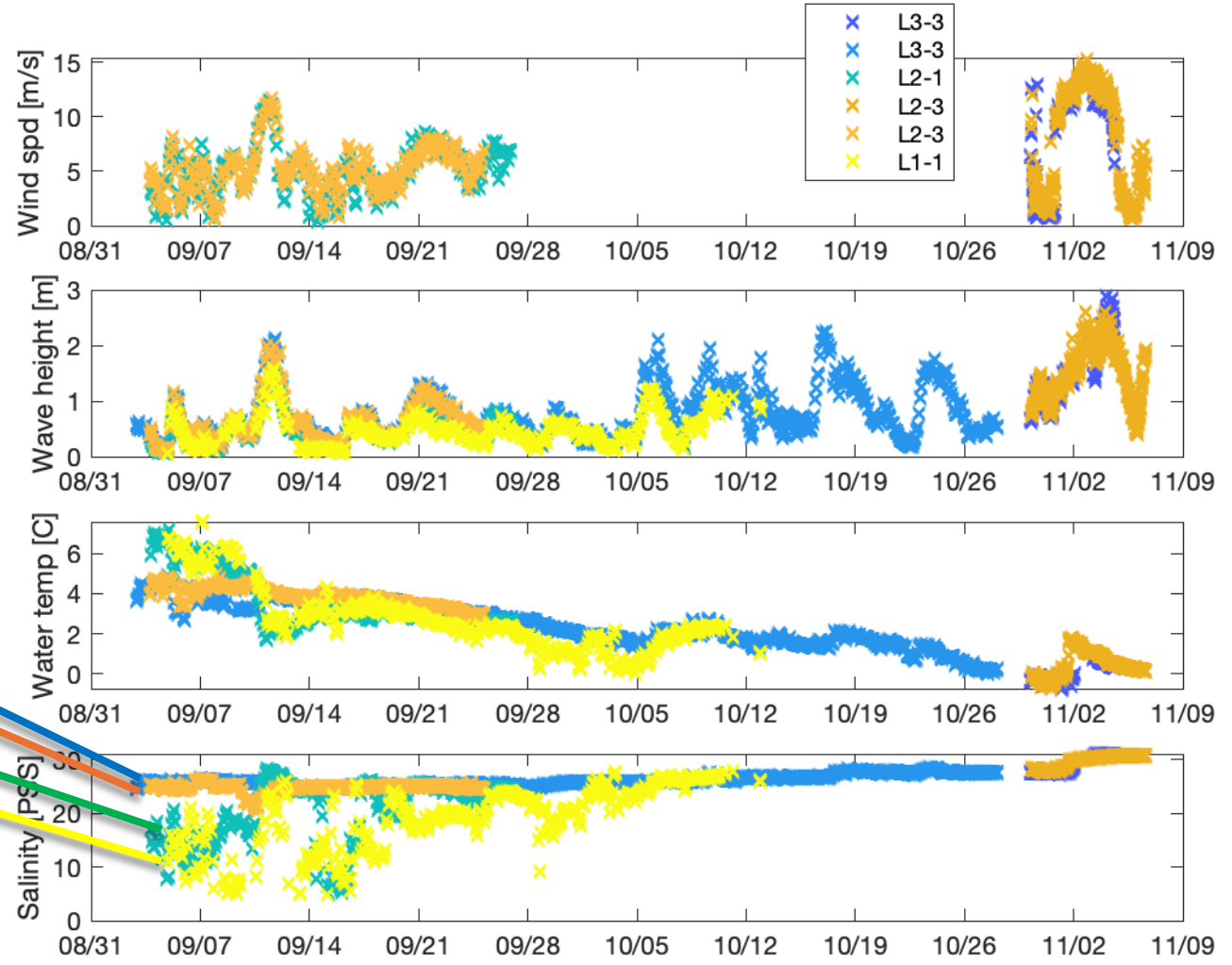


River plumes in the Arctic coastal ocean

Coastal Freeze project
with Maddie Smith and
Emily Eidam



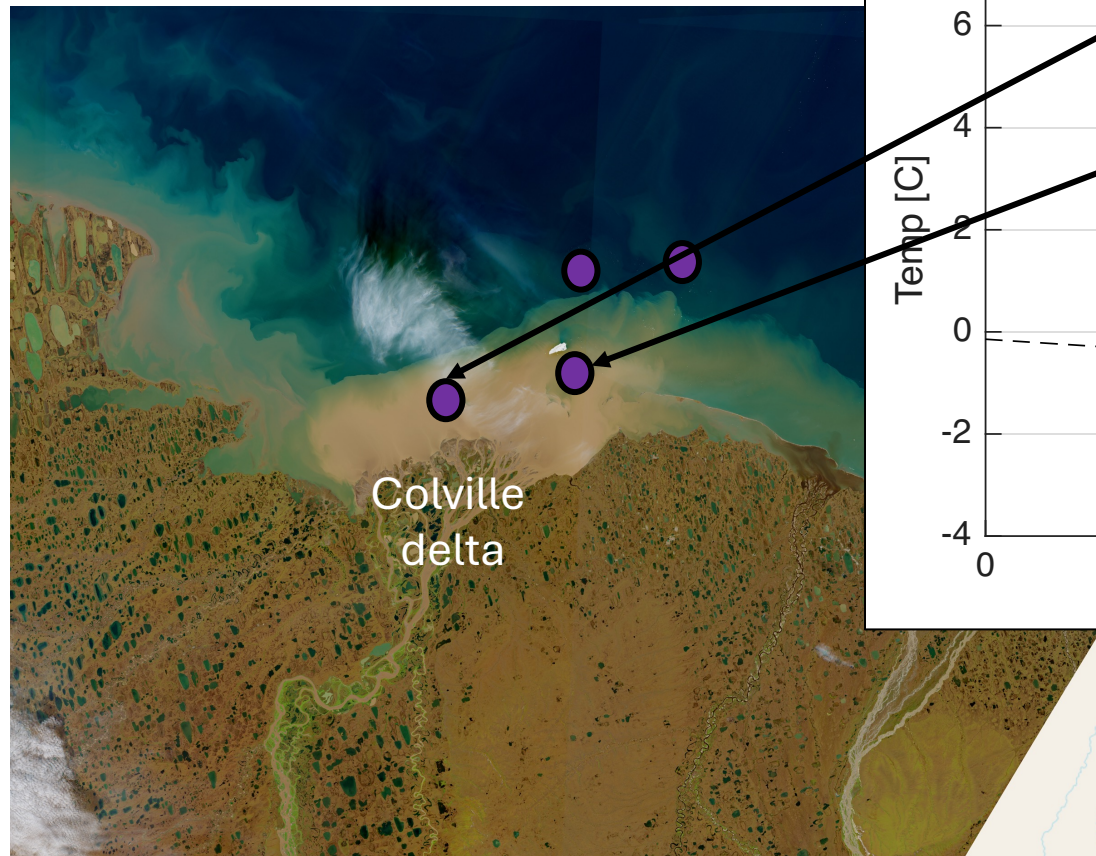
31 Aug 2025



Coastal Freeze moored SWIFTs (2025)

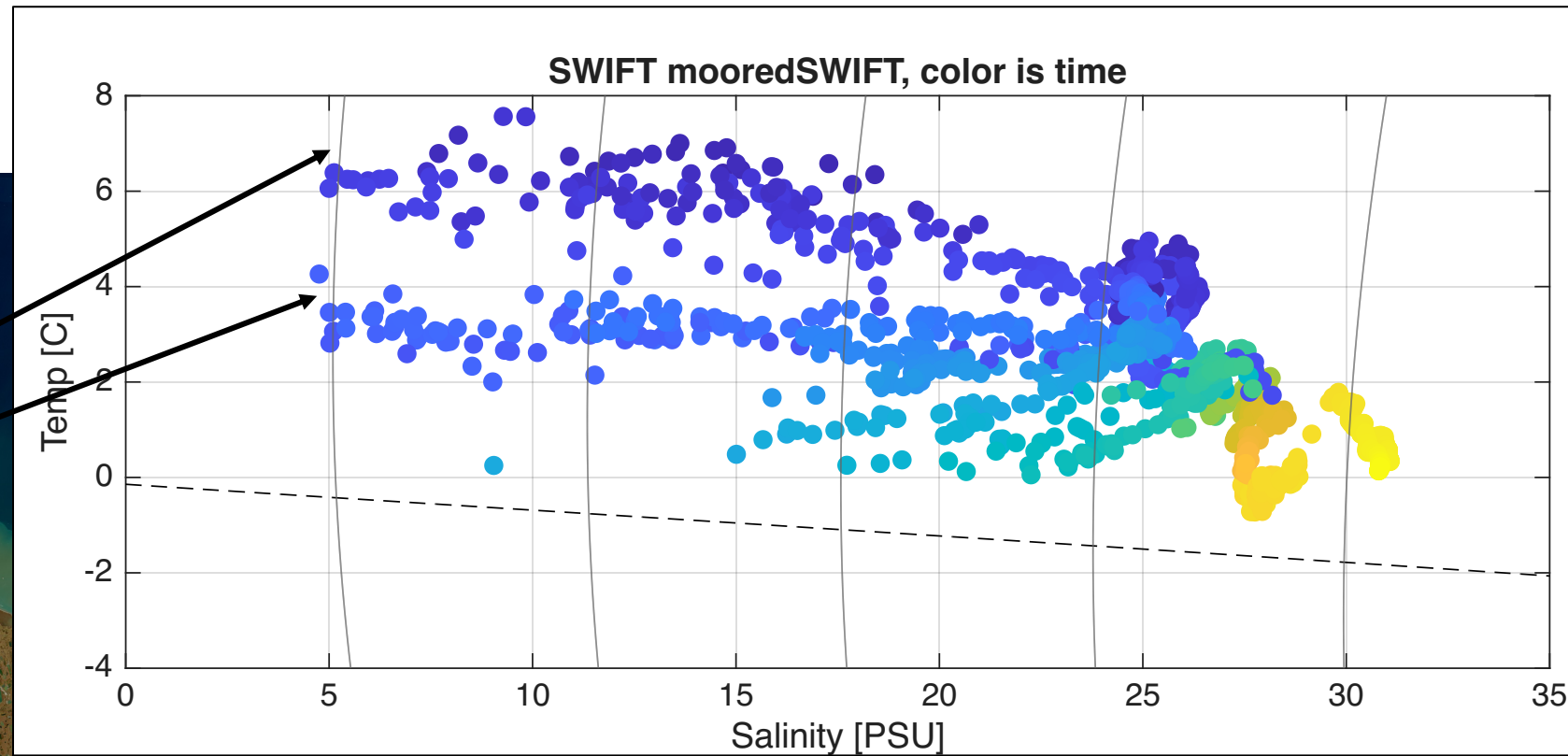
River plumes in the Arctic coastal ocean

Coastal Freeze project
with Maddie Smith and
Emily Eidam



Colville
delta

31 Aug 2025



Coastal Freeze moored SWIFTs (2025)

River plumes in the Arctic coastal ocean

Coastal Freeze project
with Maddie Smith and
Emily Eidam

Remnant ice in the domain: reduced SSTs... and mooring risk



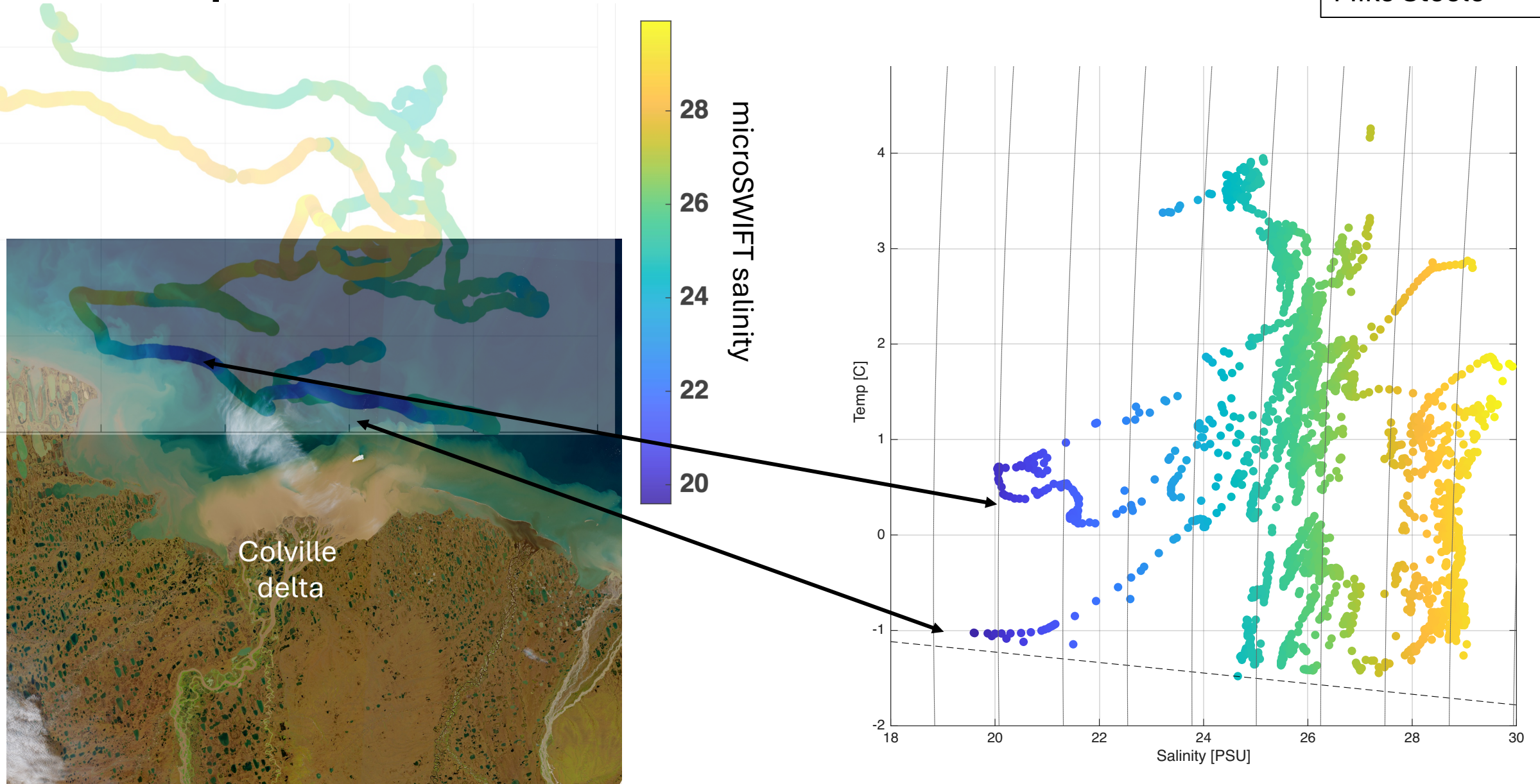
31 Aug 2025



SWIFT 09 recovered from the barrier islands

River plumes in the Arctic coastal ocean

SIZRS project with
Mike Steele

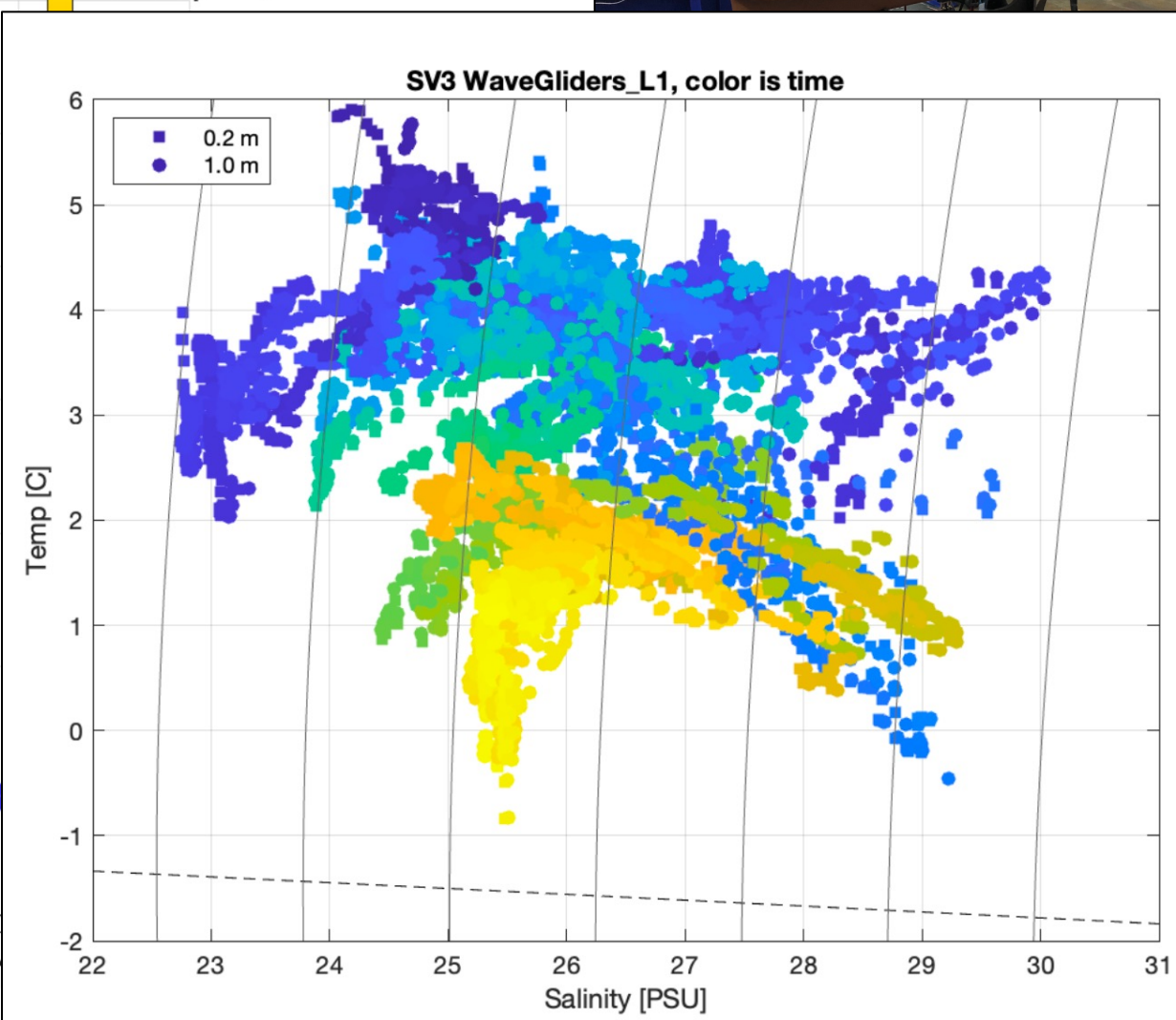
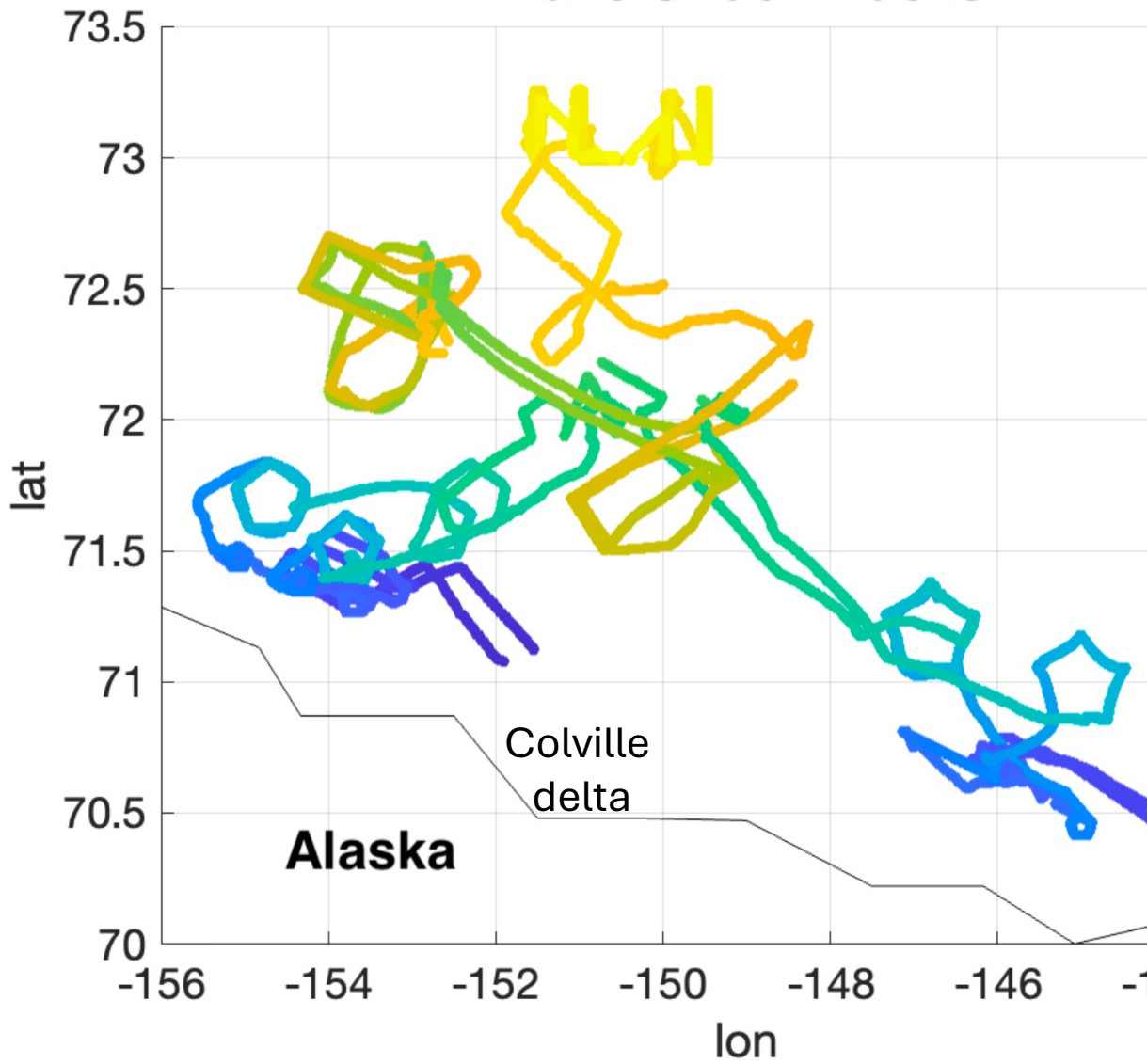


Onshore-offshore connections (SASSIE 2022)



Wave Glider Tracks

26-Sep-2022



FORTE measurements

- Sep 2026 deployments of seafloor moorings
 - 4 with temperature, pres., OBS, DO
 - collaboration with OSU
- June 2027 aerial deployments of drifting microSWIFTs
 - 30 each year with temperature, drift velocity, waves, and PAR
 - 10 also have salinity (costly)
 - Chl-A and OBS pending
- August 2027 vessel deployments of moored SWIFTs (v4) + WW
 - 6 each year with temperature, salinity, velocity profiles, waves, dissolved oxygen, met.



FRESH measurements

- Sep 2027 shipboard surveys
- Sep 2027 drifting SWIFTs (v3)
 - surface & 1 m temperature, salinity
 - current profiles
 - surface met, waves
- Sep 2027 Wave Glider survey
 - surf. & 1 m temperature, salinity
 - current profiles
 - surface met, waves
- Sep 2027 moored SWIFT+ WW recoveries
 - 6 each year with temperature, salinity, velocity profiles, waves, dissolved oxygen, met.

FORTE science targets

- Map the coastal plumes of North Slope rivers **during the spring freshet** and distinguish their freshwater signal from the meltwater of landfast ice.
- Quantify mixing **during the freshet** and the heating of coastal waters.
- Quantify the surface wave forcing and seawater temperatures that drive erosion of the permafrost coastline.
- Constrain land-ocean fluxes by measuring optical backscatter along surface pathways from the rivers and deltas to the coastal ocean.
- Measure vertical profiles in the coastal ocean to infer settling and mixing.
- Measure PAR and Chl-a fluorescence throughout the domain to inform phytoplankton studies.

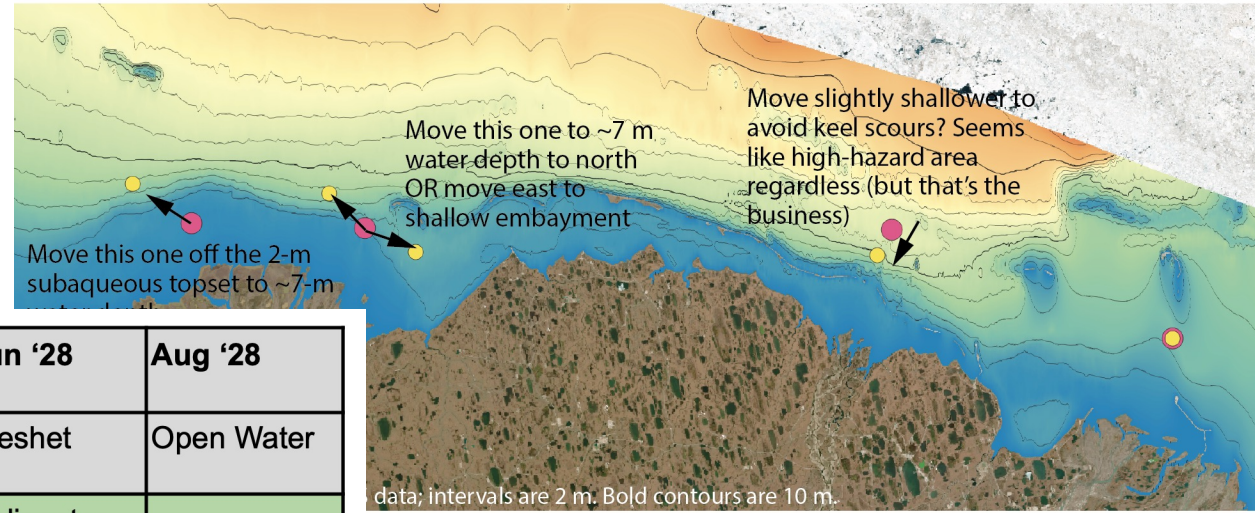
FRESH science questions to target

- Determine the fate of river water entering the coastal Arctic ocean
- Map the offshore extent of momentum-driven river plume transport and the transition to buoyancy-driven plume spreading.
- Understand wind and wave influence on the plume extent, especially in fetch/ice-limited conditions.
- Quantify the mixing processes important to river waters entering the coastal Arctic ocean.
- Understanding the impact of river water on the summer ice minimum and **subsequent autumn freeze up**

Planning UW + OSU joint over-winter moorings for FORTE

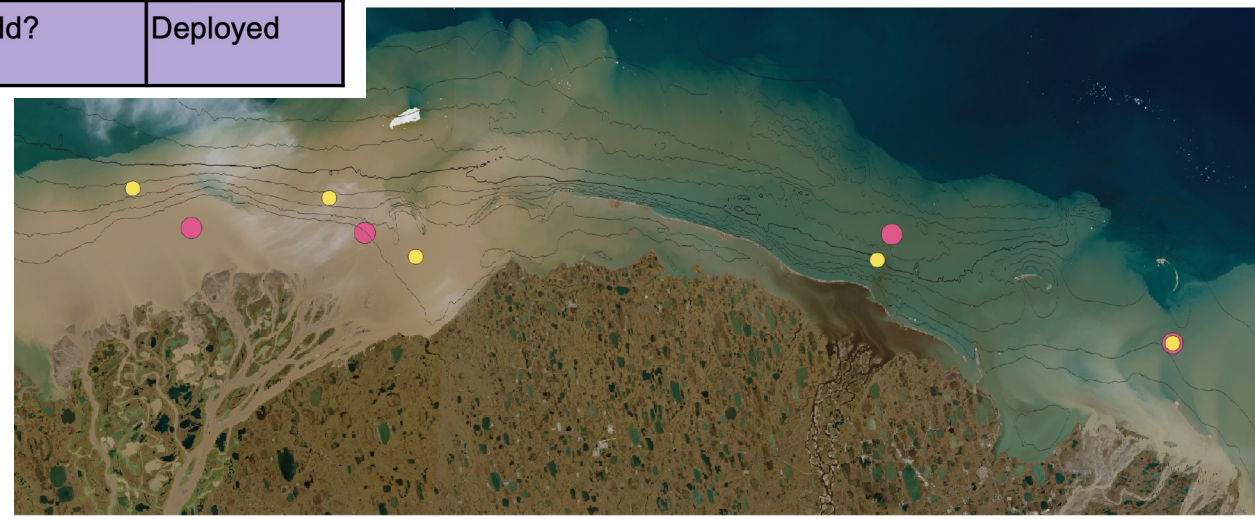
Pink = suggestion in 2025/05/07 email

Yellow = suggested revised location



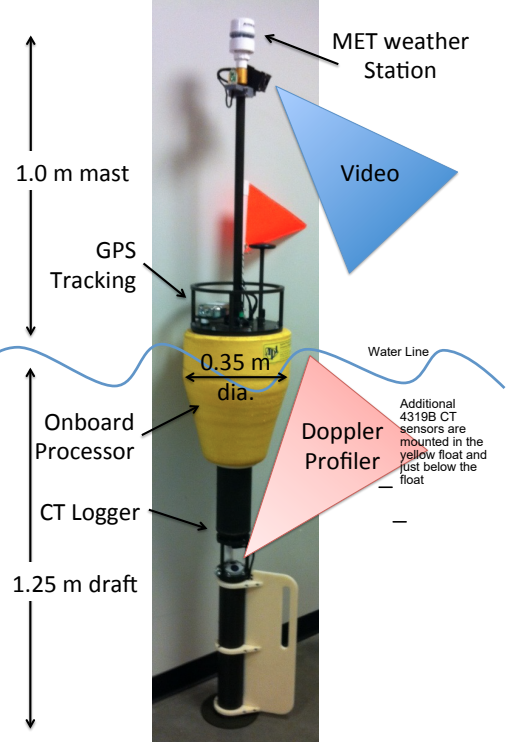
Time:	Sep '26	June '27	Jul '27	Aug '27	Sep '27	Oct '27 - May '28	Jun '28	Aug '28
Condition:	Pre freshet	Freshet	Post-freshet	Open Water	Open water	Overwinter	Freshet	Open Water
Surface drifters:	Not feasible	Helicopter		Not needed	Not needed	Not feasible	Helicopter	
Surface moorings:	Not feasible	Not feasible	Not feasible	Ukpik deploy	Ukpik recover	Not feasible	Not feasible	Ukpik deploy (Sep recover)
Seafloor moorings:	Ukpik deploy	Add?	Deployed	Deployed	Ukpik turnaround	Deployed	Add?	Deployed

bove superimposed on Aug 2025 image of flood plume for

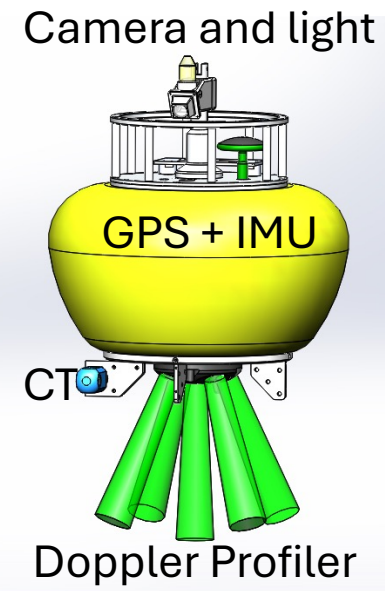


SWIFTs (moored and drifting)

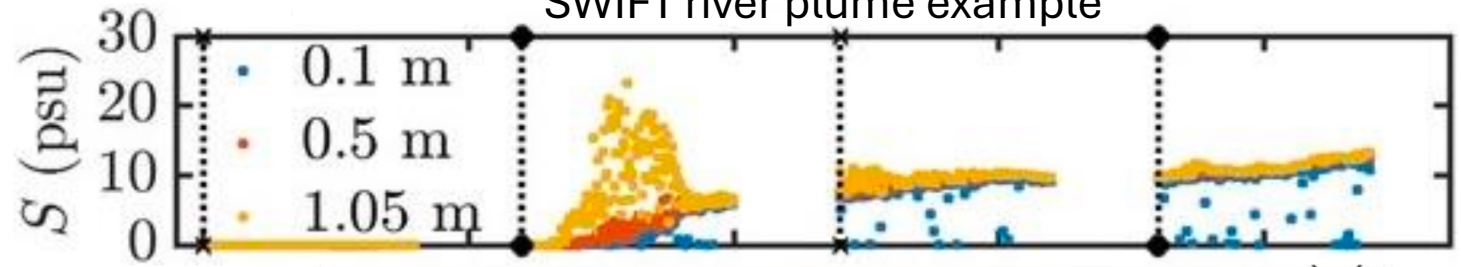
v3



v4



SWIFT river plume example



Public (open) API for hourly telemetry data access-- easy to integrate and automate in variety of online systems, including Backyard Buoys



microSWIFTs (drifting)

Measurements:

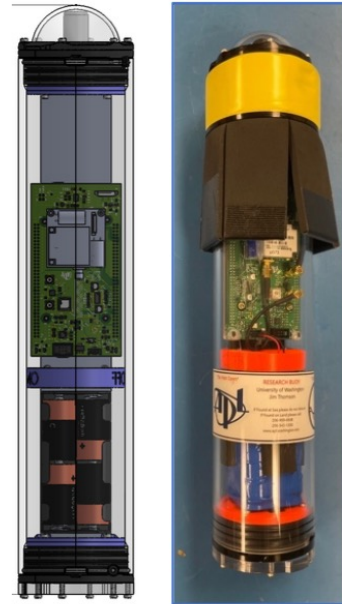
- Iridium telemetry
- Waves (including spectra)
- Temp and salinity
- OpenOBS (with E. Eidam)
- Radiance (with B. Light)
- Chl-A (pending RBR integration)



A-sized tube deployment

Highlights

- Developed and produced at APL (Thomson et al, 2023)
- two-month endurance
- 225 produced to-date
- 25 hurricane deployments
- 55 ice deployments



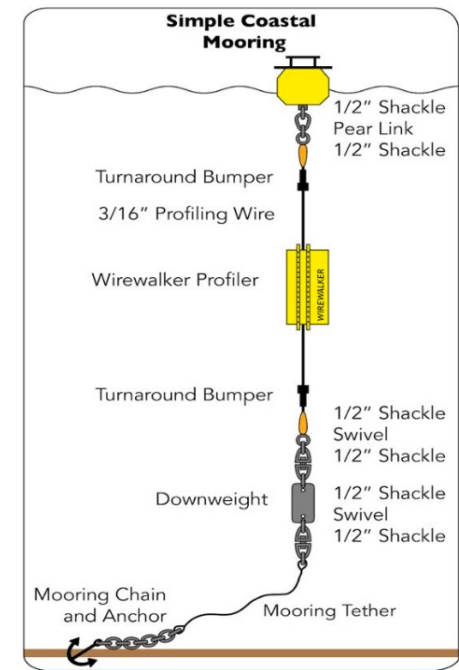
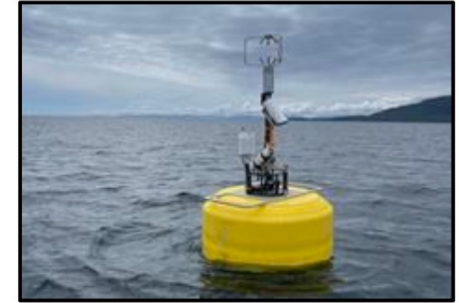
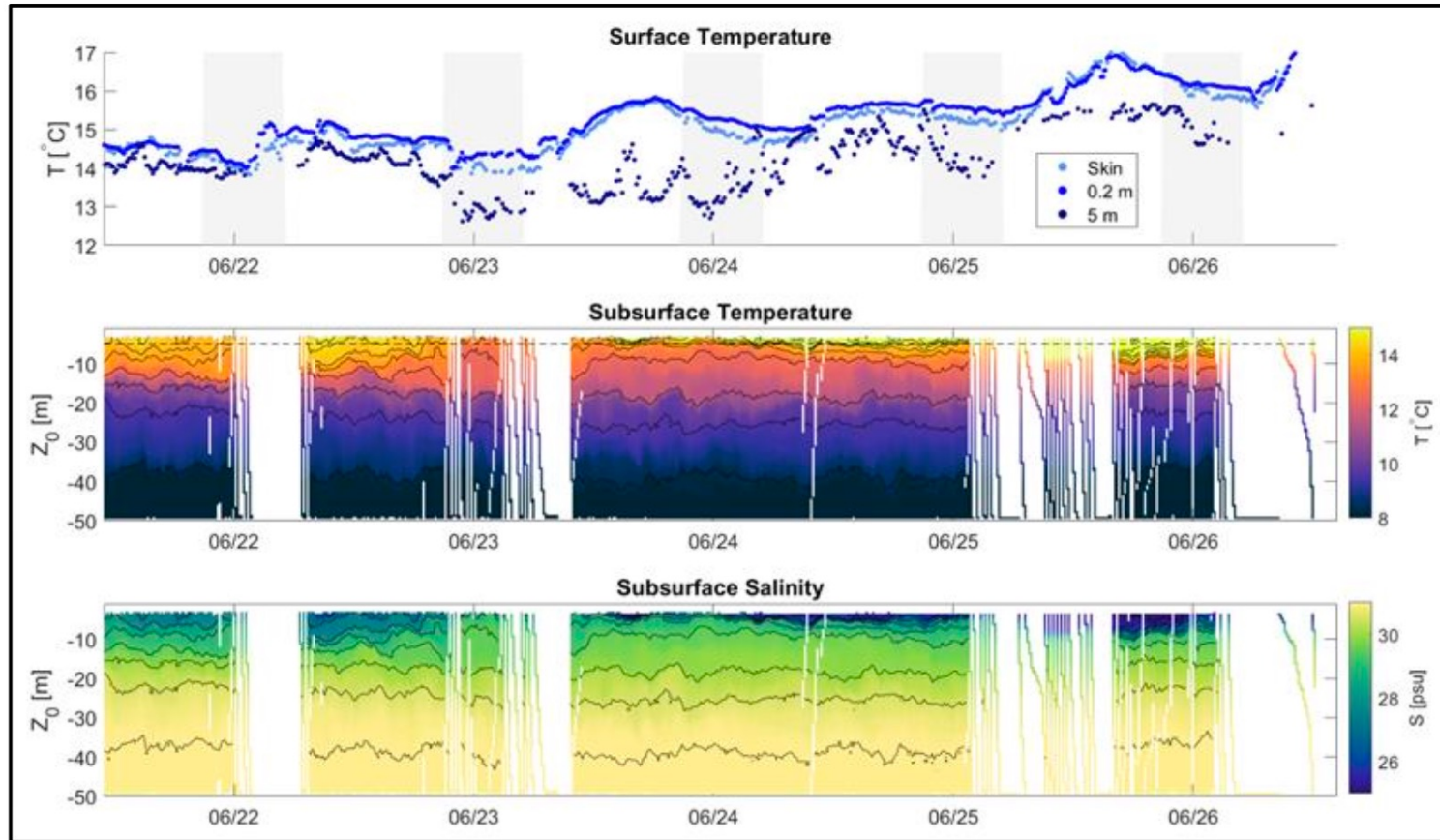
Drone deployment option

Public (open) API for hourly telemetry data access-- easy to integrate and automate in variety of online systems, including Backyard Buoys



WireWalker x SWIFT (moored)

SWIFT and WireWalker mooring



1-2 profiles per hour in 20 m depth with moderate wind-waves. SWIFT telemetry via public API (excludes CTD profiles).