UW OTTERS of Puget Sound

Puget Sound Time Series: Leg 1 [30 May 2025]

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Overview

The Student Seaglider Center is a student-run lab dedicated to using refurbished Seagliders to establish large sets of in-situ data to answer novel research questions as well as make our data public and shareable for others' scientific research. The goal of this mission is to deploy two Seagliders North of Edmonds, WA to complete both North/South and East/West transects on a seasonal scale for two weeks at a time. SG194 and SG175 will be deployed for two week periods in the Spring and Autumn over at least a two-year timescale. The time series will result in a dataset informing the movement of surface and deep water on either side of the southern tip of Whidbey Island as it moves either deeper into the Main Basin or north through Admiralty Inlet.

Location

Deployment of SG194 and SG175 will occur out of Edmonds on May 230, 2025 and will require the transit of one small boat to the deployment coordinates. Gliders will be deployed at the same coordinates and at the same time. Average depth at the deployment location is 155 m. SG194 will follow an East/West path south of Whidbey Island where depth allows for near 100-200 m dives throughout the mission. SG175 will follow a general North/South transect down to Shillshole where depth allows for 150-250 m dives if not deeper. Some bathymetry to be aware of is the much shallower area just south of Whidbey that SG194 could encounter if it drifts from its course, here it would not be able to complete full depth dives. In addition, SG175 is in a relatively narrow zone between the shipping lanes and the land. Near its middle and south target, we will want to keep an eye on it to make sure it does not drift too close to shore.

Boat Launch: Edmonds Boat Launch

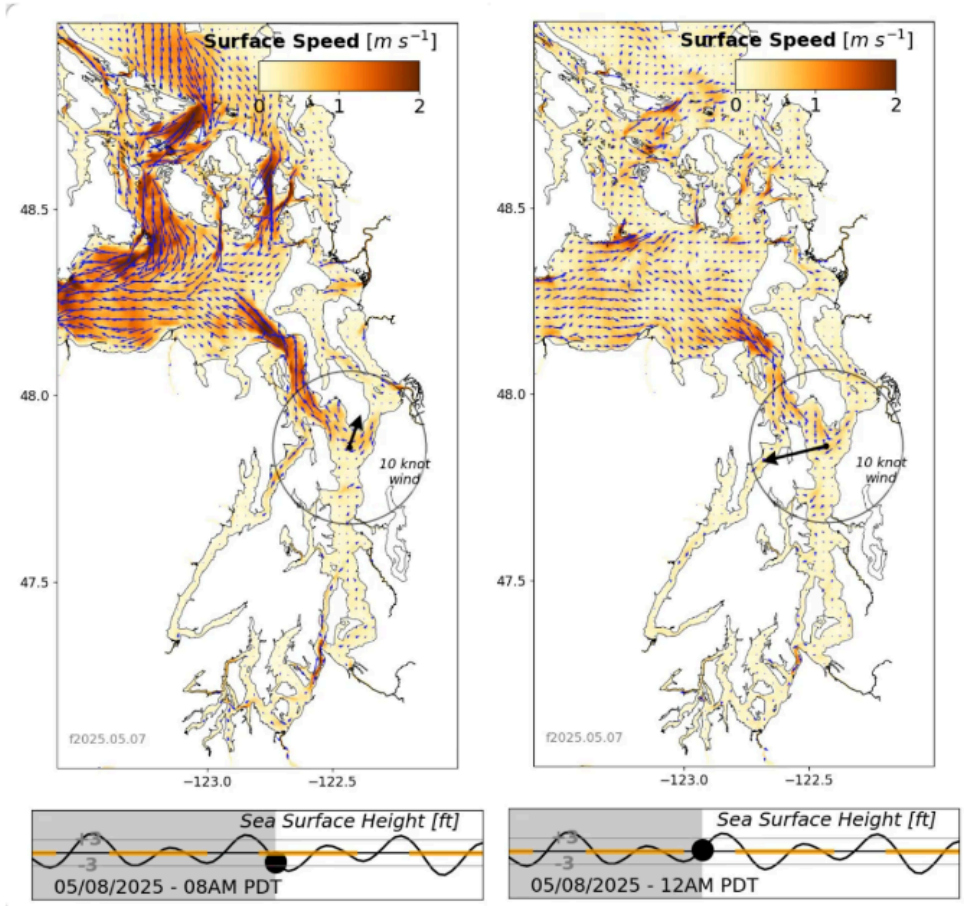

Figure 1: LiveOcean Model showing tidal flow in and out of Main Basin to Edmonds and South to Shillshole. Left panel shows maximum ebb tide with strong surface currents moving northwest by Whidbey Island. Right panel shows maximum flood tide with water moving south on either end of Whidbey.

Tidal patterns in this area are of special interest and concern. The path of SG194 has been placed on a diagonal to avoid going too far north on the western side so as to not be pulled up north during the transition from a high-high to a low-low. Daily cycles will need to be monitored to establish whether or not SG194 should complete a whole or half transect.

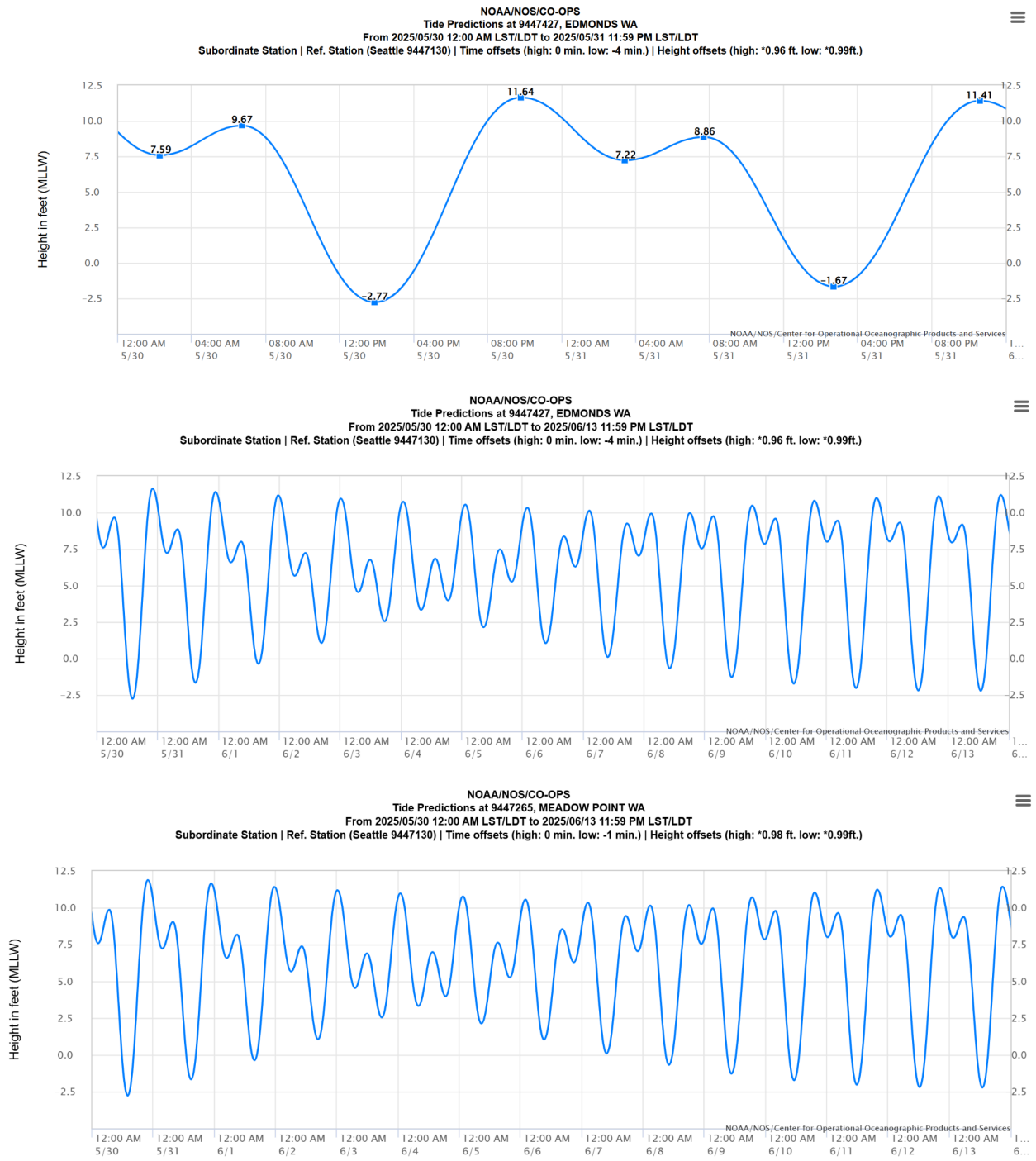

Figure 2: Tidal cycles for day of deployment (top panel) at Edmonds, the two-week cycle at Edmonds, (middle panel), and the two-week cycle near Shillshole (bottom panel). Figures taken from NOAA Tide Predictions.

Main Science Question:

Estuarine flow near the south tip of Whidbey Island and further south towards Seattle is a prime example of the unique mixing dynamics we see in Puget Sound and throughout many

other estuaries. On the Eastern side of the island, there is a large freshwater river input from the Stillaguamish and the Skagit further north. During each flood cycle, this water meets colder and saltier water flowing south on the western side of Whidbey. According to modeled data from LiveOcean, these two water masses show major differences in not just temperature and salinity, but also oxygen, phytoplankton abundance, and nutrient concentrations (Fig. 3). The purpose of this time series is to establish a long term data set that will allow for the tracking of these two water masses as they move south, deeper into the main basin. The data will allow scientists to answer questions regarding stratification and primary productivity potential in the water column and how it changes with the tidal cycle over a seasonal period.

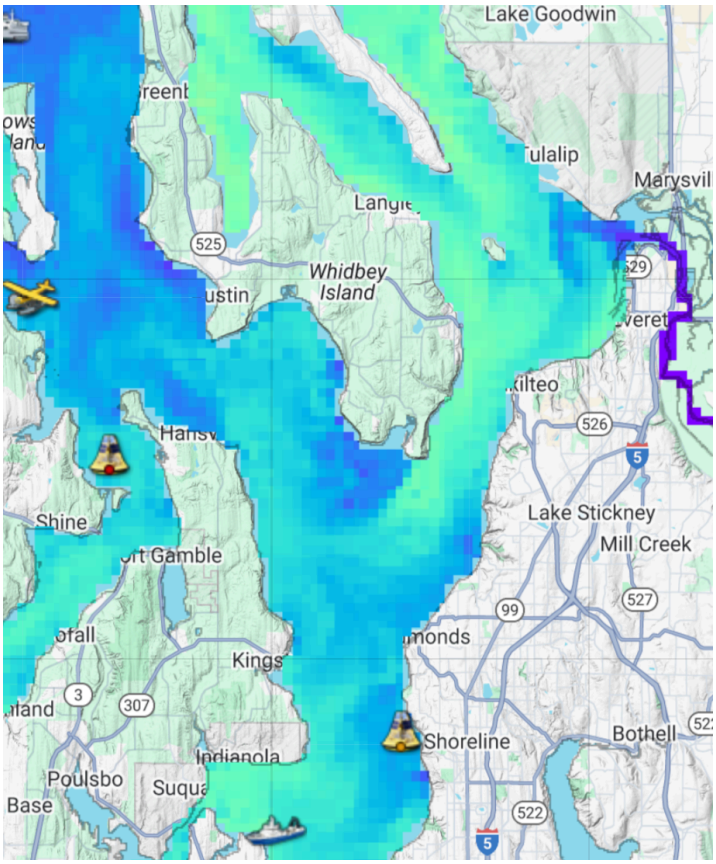

Figure 3. LiveOcean model data showing surface phytoplankton distribution on either side of Whidbey Island in May.

Instrumentation/Measurements:

This mission will utilize SG194 and SG175. Both gliders are equipped with CT sails measuring conductivity and temperature. SG194 has optode and wet lab sensors allowing us to collect dissolved oxygen, fluorescence, and backscatter.

Glider:		**SG175**	**SG194**

Appx Length		1.2 m	1.2 m
Total Mass:		51902g	53609g
CT Sail	*last calibrated*	09-Oct-24	09-Oct-24
	SN	(unknown)	236
Aanderaa Optode	*last calibrated*	N/A	NA
	SN	N/A	NA
Wetlabs	*last calibrated*	N/A	NA
	SN	N/A	NA

Gliders will sample every 5 seconds in the first 20 m and then every 10 seconds below 20 m for all sensors equipped (CT sail, optodes, and wetlabs). This goes for dives and climbs of the gliders. Gliders will sit at the surface after each dive for 2 min to connect to the basestation.

Boat Traffic:

Along both the North/South and East/West transects, there are shipping and ferry lanes that will need to be taken into account. SG194 will be crossing shipping lanes south of Whidbey on the west side of the basin between its middle and westernmost target point. SG175 will be travelling north/south near the shipping lanes as well as through two ferry lanes: Kingston/Seattle (Kingston Fast Ferry) and Edmonds/Kingston (Spokane and Suquamish). The ferry and shipping lanes will need to be monitored for both gliders throughout the two week deployment using AIS tracking systems such as https://www.marinevesseltraffic.com/2013/06/vessel-cruise-finder.html and https://wsdot.com/ferries/vesselwatch/ to ensure the gliders are not disrupted and that field teams remain safe on deployments and recoveries. Looking at marine vessel traffic, the main concern is the recreational traffic in the area which looks to be quite busy. Consistent monitoring of these boats will have to take place over the deployment.

	Live map	Ships	Duration	Estimated Time	Estimated Time
Kingston/Seattle (affects NS 175 and EW 194 transects)		Kingston Fast Ferry	40 mins, M-F 6am - 7:24pm Sa 10am - 11:54pm	Southeast (K -> S) 5:25- 6:04am 7:05- 7:44am 8:45- 9:24am 2:30- 3:09pm 4:10- 4:49pm 5:55- 6:34pm *Saturdays:* *9:20- 9:59am* *11:00- 11:39am* *12:45- 1:24pm* *2:25- 3:04pm* *5:20- 5:59pm* *7:05- 7:44pm* *8:45- 9:24pm* *10:25-11:04pm*	Northwest (S -> K) 6:15- 6:54am 7:55- 8:34am 10:45-11:24am 3:20- 3:59pm 5:00- 5:39pm 6:45- 7:24pm *Saturdays:* *10:10- 10:49am* *11:50- 12:29pm* *1:35- 2:14pm* *4:25- 5:04pm* *6:15- 6:54pm* *7:55- 8:34pm* *9:35- 10:14pm* *11:10- 11:54pm*
Edmonds/Kingston (affects NS 175 transect)	https://wsdot.com/ferries/vesselwatch/default.aspx?view=3	Spokane and Suquamish	30 mins, departs every 40 mins from each location, 4:45am - 11:45pm	East (K -> E) 4:45am*(M-Sa) 5:30am*(M-F) 6:25am 7:00am 7:55am 8:40am 9:35am 10:20am 11:05am 11:55am 12:45pm 1:30pm 2:30pm 3:10pm 4:00pm 4:40pm 5:30pm 6:10pm 7:00pm 7:45pm 8:20pm 9:10pm*(F-Su) 9:40pm 10:30pm*(F,Su) 11:10pm	West (E -> K) 5:35am*(M-Sa) 6:15am*(M-F) 7:10am 7:55am 8:50am 9:35am 10:20am 11:05am 11:55am 12:40pm 1:35pm 2:25pm 3:15pm 3:55pm 4:45pm 5:25pm 6:15pm 7:00pm 7:40pm 8:30pm 9:05pm 9:50pm*(F-Su) 10:25pm 11:10pm*(F,Su) 11:45pm

Mission Targets:

SG194				SG175			
Name	Lat (°)	Lon (°)	Radius	Name	Lat (°)	Lon (°)	Radius
EAST_194	47° 51' 47.52" N	122° 20' 39.34" W	200 m	**NORTH_175**	47° 50' 17.27" N	122° 24' 48.24" W	200 m
MID_N_194	47° 51' 9.79" N	122° 24' 53.71" W	400 m	**MID_175W**	47° 46' 4.8" N	122° 25' 8.4 "W	300 m
MID_S_194	47° 51' 00" N	122° 24' 53.71" W	400 m	**MID_175E**	47° 46' 4.8" N	122° 24' 39.6" W	300 m
WEST_194	47° 50' 31.78" N	122° 29' 8.38" W	200 m	**SOUTH_175**	47° 42' 15.12" N	122° 25' 49.87" W	200 m

Note: Highlighted targets are locations for deployment on May 30, 2025 for SG194 and SG175

Deployment Day Piloting Plan: SG194 will begin going west during the first day to see if we can make it all the way to WEST_194. During that transit it will most likely fight surface currents and cross the shipping lane so it is best to have it go to WEST_194 when there is the most monitoring happening/overnight shifts. SG175 will start going South. Besides the ferry tracks, it should not have too many obstacles or issues with currents/tides.

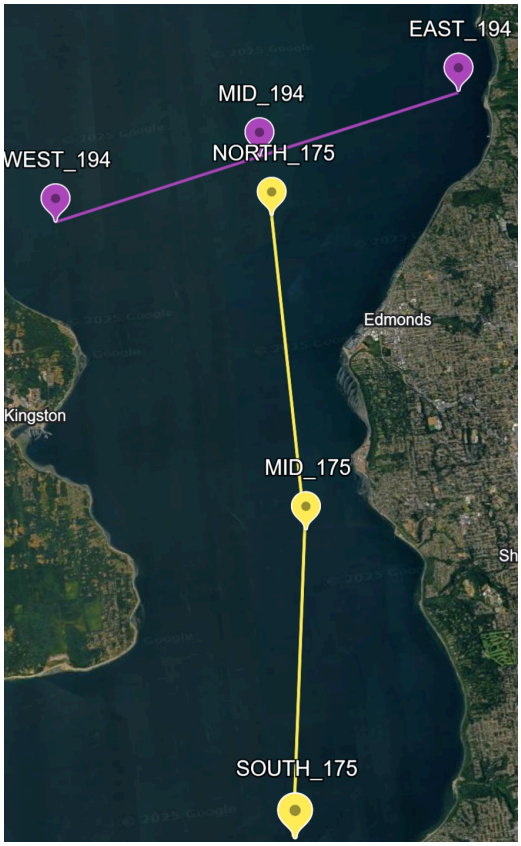

Figure 4. Map of glider routes of SG194 and SG175. SG194 will complete the east/west transect (yellow) and hit three targets. SG175 will complete the north/south route (purple) and hit three targets along the way.

Particle tracker on LiveOcean says approximately 12 hours from Shillshole area up to Whidbey. Some particles much longer and some much shorter. Surface circulation is consistently north, although not very strong.

Travel time to Shilshole is roughly 17 hours, if the glider is moving at 0.5 kt. The East/West transect will take approximately 12 hours to complete a transect.. The middle target is there to allow the glider to complete smaller or ‘half’ transects during maximum ebb tides where we may have concern about the glider being pushed north or not making it back east. MID_194 has an increased radius with no target angle.

Field Logistics:
Field POC: Nadia
Field Team for 05/2025:

- Nadia
- Abbey

On Call Field Team:
https://docs.google.com/spreadsheets/d/1qDUqkoNk3kKKzq_VzQk2K1OLPDwF00GQmlUIB5Hcb2k/edit?gid=0#gid=0
Rick Phone: (206)453-9110

- Text and Call!!!

Pre-mission

SSC students will have ballasted the gliders for approximate density changes off Edmonds Boat Launch and down to Shillshole. Trim/Ballasting Date?

Transportation:

Field team and gliders will be transported by truck to Edmonds Boat Launch. From there, Cap. Andrew and the 'Dadliest Catch' will service the team to and from the deployment site. Both gliders will be deployed off this boat at the same location.

Glider Deployment Instructions:

Field Checklist

Instrumentation	**Notes**
Glider(s) with cradle(s) - **SG175** - **SG194**	
Glider toolbox - **Specific to each glider**	

Field laptop (x2)	
Deckbox	

CTD cast after both deployments:

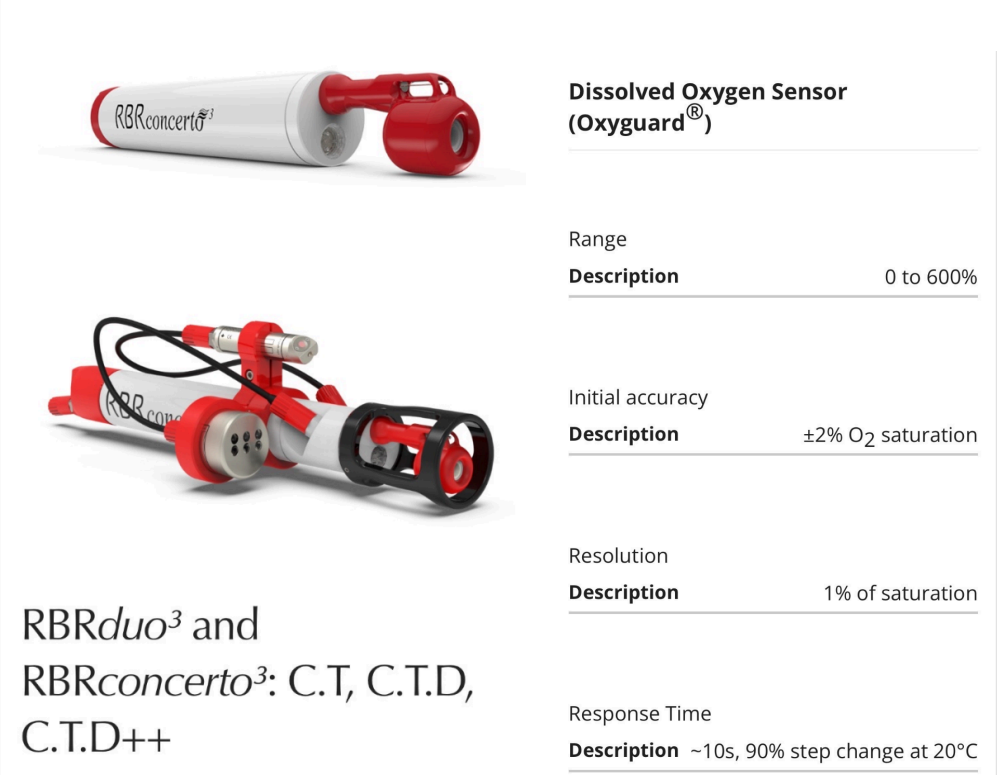

Figure 5. RBR CTD Concerto with Optode. Left panel describes dissolved oxygen sensor information.

Self-Test

Prior to Starting Self-Test:

1. Secure glider: Make sure the Glider is propped up against the rail and secure. May need to use ratchet straps if unstable.

2. Attach Antenna: Make sure the side of the antenna with holes on it is between the rudder and holes of glider fairing. Slide rudder into slot (may need adjusting around wires). Hand tighten screws to secure rudder & antenna.
3. Connect to the glider: Set up laptop in dry/protected area. Plug comms cable into computer via USB. Open terminal (ensure that minicom is not already open!) and open minicom by typing 'minicom' in terminal. Press **ctrl + A**, release then **L** to open the capture file. Name capture file "SG###Data_LastNameofUser_inserttask (ie. deployment).txt". Connect the other end of comms to **yellow** plug on antenna of glider
4. Turn on glider: Turn on glider with Shorting plug (attached on glider for SG194 and SG195) or wand for (SG175). Within a minute of turning the glider on, talk to the glider (via terminal) or else the glider will go to sleep.
5. Check internal pressure and battery readings in terminal: Check internal pressure (should be around 8.5-9.15 PSI), if not notify the pilot. Check battery gauges (should be around 24 W), if not notify the pilot.

Start Self-Test:

1. In the terminal, go to the last option on the menu. Select autonomous self-test (if it prompts for phone numbers, press *enter*). Alert pilot that self-test has started & wait.

2. Once the self-test is completed, you will get notification whether or not the self-test has passed. If not passed, re-run and alert the pilot.

3. Look at warnings and errors (i.e., common errors are iridium registration, SMS, and bathymaps and are O.K., just alert the pilot). Other errors will need to be cleared before continuing.
4. Alert pilot that self-test in complete
    1. Anything else let science know and call Ellie or Caleb or Charlie/science
5. When Selftest is done, alert pilot, and wait for the go ahead to start Sea-Launch

Start Sealaunch:

1. Once pilot gives go ahead to start sealaunch, go back to main menu then go into last option again. Click Sealaunch option. Hit enter for phone options that show up.
2. Wait until it asks you if the pilot has given the go ahead for sea launch.
3. Ask pilots if its O.K. to say yes. THIS IS TRANSFER OF COMMUNICATION TO PILOT.
4. Type yes or just Y and hit enter when the pilot gives O.K.

Disconnect from Glider:

1. DO NOT DISCONNECT SHORTING (clear) PLUG!!

2. Disconnect Comms cable from **yellow** plug. Plug the black dummy plug into the yellow plug (the one that is hanging on the antenna).
3. Remove all three sensor caps (2 on the CTD and 1 on the Optode). Remove the ratchet strap. Get the go ahead from the pilot to deploy.

Deploy Glider by slowly lowering glider & cradle into water. Check to make sure it is buoyant, and the antenna is out of water (should be sitting at ~45^{o} angle to water surface).

Field Schedule	
7:00 am	**Arrival at OSB (checklist and load truck)**
8:00 am	**Depart to Edmonds**
8:30 am	**Arrive at Edmonds boat launch, meet Andrew and help with boat setup/run self-test**
8:50 am	**Depart to EAST_194**
9:40 - 10:00 am	**Deploy SG194 + RBR CTD cast**
10:00 - 10:45 am	**Watch first dive, transit to NORTH_175**
10:50 - 11:10 am	**Deploy SG175 + RBR CTD cast, watch 1st dive**
11:10 - 11:30 am	**Transit to boat launch**
11:30 - 11:50 am	**Unload gear and help get boat out of water**
11:50 - 12:40 am	**Transit back to OSB**

Deploying Lydia's Project when??

Communication:

Communication will occur primarily between the pilot room and field team by telephones, and mainly through the Discord channel.

Budget:

Day rate of private boat: $835
Total cost: $835

Personnel/Pilot Schedule (First Two days of Deployment)

Pilot schedule:

https://docs.google.com/spreadsheets/u/1/d/1gYb7pm1VeUjvrOXE5VkK9knjcyjTkIOChfiWsO4anw0/edit?usp=drive_web&ouid=106033501350639381069

Diversity, Equity, and Inclusion Goals

The purpose of the SSC is to train undergraduate students to become familiar with ocean technology (specifically gliders) and to better understand how in situ data is collected. This mission will serve as a teaching tool to allow more students to learn how to pilot and gain ample amounts of experience sitting in the "hot seat" and increase their communication skills. Students in the field will learn how to "talk" to the gliders via ethernet cables, deployment techniques, and communication skills. As this is an undergraduate lab, the turnover rate is quite rapid. All seniors are gaining experience teaching the younger undergraduates to pass on skills so that the lab can continue to grow.

Safety

Safety is the most important goal of the field team. The undergraduate teams consist of one student with experience and one student learning. The procedure to deploy and recover a Seaglider requires students to handle ~120 lbs of the glider using a deployment cradle in and out of the water.

Small Boat Operations

The captain of the boat has the appropriate training experience as documented by a WA state boater card (http:/www.boat-ed.com/washington). Personal floatation devices will be worn by field team members at all times.

In an event that the glider is in the path of a ferry or vessel of any kind and the field team notices, under no circumstances should the field team attempt a recovery.

Incident response

The boat is equipped with first aid for minor injuries (i.e., cuts or scrapes). In the event of an emergency, the field team will immediately communicate to shore via VHF radios. If transportation to a medical site is required, the small boats can transit to downtown Seattle and transit via land to Kindred Hospital Seattle. 911 service is available in the region.