BERING STRAIT NORSEMAN II 2025 MOORING CRUISE REPORT

Research Vessel Norseman II, Norseman Maritime Charters_*Nome-Nome, 2nd – 10th July 2025*

Rebecca Woodgate, University of Washington (UW), *woodgate@uw.edu*

Cecilia Peralta-Ferriz, Laramie Jensen, Katy Christensen, Robert Daniels, Miriam Hauer-Jensen, Léna Hardvillier

Funding from NSF Arctic Observing Network Program PLR-2153942

Chief Scientist: *Rebecca Woodgate,*
University of Washington (UW), USA.
Email: woodgate@uw.edu
Tel: +1-206-221-3268;
Co-PI: *Cecilia Peralta-Ferriz, UW*
Related PIs:
Marine Mammal Recorders: Kate Stafford, OSU, USA
Trace Metal Sampling: Laramie Jensen, Randi Bundy, UW
Glider : Kate Stafford, OSU; Seth Danielson &
Hank Statscewich, UAF
Imaging FlowCytobot for Harmful Algal Blooms:
Thomas Farrugia, AOOS
Phytoplankton sampling: Monica Orellana (UW)

Research vessel Norseman II during 2019 Nome on-load [Credit: Woodgate].

As part of the Bering Strait project funded by NSF-AON (Arctic Observing Network), in July 2025 a team of US scientists undertook a ~8 day cruise in the Bering Strait and southern Chukchi Sea region on the US vessel Norseman II, operated by Support Vessels of Alaska, Inc..

The primary goals/activities of the expedition were:

1) **recovery of 3 moorings** carrying physical and biogeochemical oceanographic instrumentation (Woodgate & Peralta Ferriz) and whale acoustic instrumentation (Stafford). These moorings were deployed in the Bering Strait region in 2024 from the Norseman II.

2) **deployment of 3 moorings** in the Bering Strait region, carrying physical and biogeochemical oceanographic instrumentation (Woodgate & Peralta Ferriz) and whale acoustic instrumentation (Stafford).

3) a set of **CTD sections** studying water properties in the region, with some **sampling for nutrients and salinities** (Woodgate & Peralta-Ferriz),

4) collection of **trace metal/nutrient water samples** using a pumped system at selected CTD casts (Jensen)

5) collection of accompanying ship's **underway data**, viz. surface water temperature and salinity, ADCP velocity data and meteorological data (Woodgate & Peralta-Ferriz),

6) deployment of **a glider** (Stafford, Danielson, Statscewich),

7) analysis of underway water with **an Imaging FlowCytobot (IFCB**) for Harmful Algal Blooms (Farrugia)

8) taking of opportunistic samples for delta-O18, to characterize freshwater sources (Jensen, Woodgate & Peralta-Ferriz); and

9) taking of opportunistic and exploratory samples for **phytoplankton studies** (Orellana).

The cruise loaded and offloaded gear and people in Nome, Alaska.

Key Statistics:

3 moorings recovered, 3 moorings deployed,
162 CTD casts on 6 CTD lines, with 194 nutrient samples, 6 salinity samples and 7 delta-O18 samples
trace metal/nutrient water samples taken on 32 stations, a few with accompanying sampling from the CTD.
1 glider deployed
8 samples for phytoplankton identification and 42 samples for phytoplankton quantification

SCIENCE BACKGROUND

The ~50m deep, ~ 85km wide Bering Strait is the only oceanic gateway between the Pacific and the Arctic oceans.

The oceanic fluxes of volume, heat, freshwater, nutrients and plankton through the Bering Strait are critical to the water properties of the Chukchi [*Woodgate et al.*, 2005a]; act as a trigger of sea-ice melt in the western Arctic [*Woodgate et al.*, 2010]; provide a subsurface source of heat to the Arctic in winter, possibly thinning sea-ice over about half of the Arctic Ocean [*Shimada et al.*, 2006; *Woodgate et al.*, 2010]; are ~ 1/3rd of the freshwater input to the Arctic [*Aagaard and Carmack*, 1989; *Woodgate and Aagaard*, 2005]; and are a major source of nutrients for ecosystems in the Arctic Ocean and the Canadian Archipelago [*Walsh et al.*, 1989]. In modeling studies, changes in the Bering Strait throughflow also influence the Atlantic Meridional Overturning Circulation [*Wadley and Bigg*, 2002] and thus world climate [*De Boer and Nof*, 2004].

Quantification of these fluxes (which all vary significantly seasonally and interannually) is critical to understanding the physics, chemistry and ecosystems of the Chukchi Sea and western Arctic, including sea-ice retreat timing and patterns, and possibly sea-ice thickness. The Bering Strait oceanic heat flux has been found to be the best predictor of Chukchi sea ice retreat [*Serreze et al.*, 2016]. Understanding the processes setting these fluxes is vital to prediction of future change in this region, in the Arctic, and beyond. The Bering Strait is the only Arctic gateway where observations currently show significant interannual change [*Østerhus et al.*, 2019].

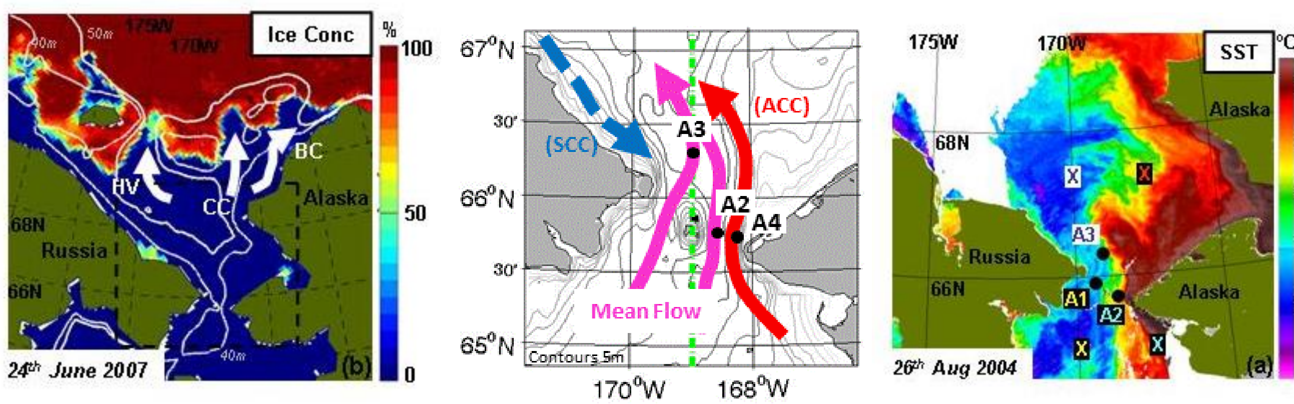


Figure 1: (Left) *Chukchi Sea ice concentration (AMSR-E) with schematic topography. White arrows mark three main water pathways melting back the ice edge [Woodgate et al., 2010].*
(Middle) *Detail of the Bering Strait, with schematic flows and mooring locations (black dots – A2, A3, A4). The main northward flow passes through both channels (magenta arrows). Topography diverts the western channel flow eastward near site A3. The warm, fresh Alaskan Coastal Current (ACC) (red arrow) is present seasonally in the east. The cold, fresh Siberian Coastal Current (SCC) (blue dashed arrow) is present in some years seasonally in the west. Green dashed line at 168º58.7'W marks the US-Russian EEZ (Exclusive Economic Zone) boundary. Note all moorings are in the US EEZ. Depth contours are from IBCAO [Jakobsson et al., 2000]. The Diomede Islands are in the center of the strait, shown here as small black dots on the green dashed line marking the US-Russian boundary.*
(Right) *Sea Surface Temperature (SST) MODIS/Aqua level 1 image from 26th August 2004 (courtesy of Ocean Color Data Processing Archive, NASA/Goddard Space Flight Center). White areas indicate clouds. Note the dominance of the warm ACC along the Alaskan Coast, and the suggestion of a cold SCC-like current along the Russian coast [Woodgate et al., 2006].*

Since 1990, year-round moorings have been maintained almost continually year-round in the Bering Strait region, supported by typically annual servicing and hydrographic cruises [*Woodgate et al.*, 2015; *Woodgate*, 2018]. These data have allowed us to quantify seasonal and interannual change in the physical water properties [*Woodgate et al.*, 2005b; *Woodgate et al.*, 2006; *Woodgate et al.*, 2010; *Woodgate et al.*, 2012; *Woodgate*, 2018; *Woodgate and Peralta-Ferriz*, 2021], and assess the strong contribution of the Alaskan Coastal Current (ACC) to the fluxes through the strait [*Woodgate and Aagaard*, 2005; *Woodgate*, 2018]. These data also show that the Bering Strait throughflow increased ~50% from 2001 (~0.7Sv) to 2011 (~1.1Sv), driving heat and freshwater flux increases [*Woodgate et al.*, 2012], with more recent fluxes also being high (e.g., 2014, 1.2Sv, [*Woodgate*, 2018; *Woodgate and Peralta-Ferriz*, 2021], see Figure 2).

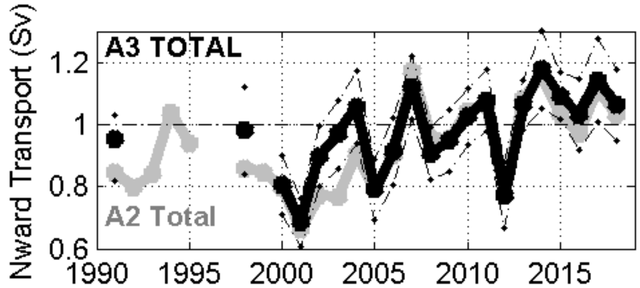


Figure 2: *Annual mean (x-axis, time in years) of Bering Strait mooring data from 1991 to 2018, showing transport for the whole strait, as estimated from A2 (grey) or A3 (black).*

Analysis [*Woodgate*, 2018] indicates this long term trend is driven by large scale changes between the Pacific and the Arctic oceans, with no significant trends in the winds in the strait. Thus, satellite-sensed data sets (winds, SST) prove insufficient for quantifying long-term variability, indicating interannual change can still only be assessed by in situ year-round measurements [*Woodgate et al.*, 2012]. The work to be accomplished on this cruise will extend this mooring time-series to mid-2023.

In addition, this cruise aims to provide a high resolution survey of the water properties of the strait and southern Chukchi Sea in early-summer. A particular goal is to quantify the early season heat and salt content of the waters, which have been unusually warm and fresh in the last 4 years (see Figure 3).

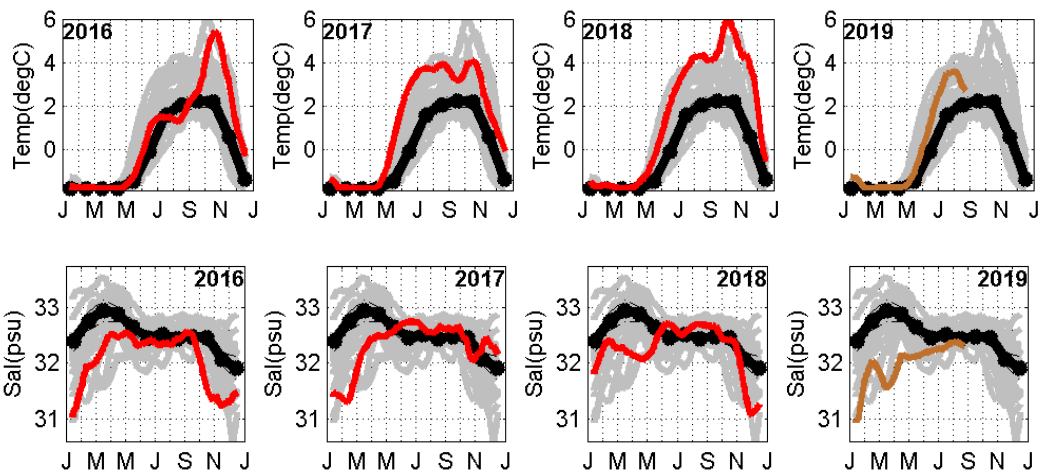


Figure 3: *30 day smoothed near-bottom A3 temperature **(top)** and salinity **(bottom)**, data for recent years **(columns)**, showing labeled year in color, climatology [Woodgate et al., 2005b] in black, and all prior years (1990-present) in grey. X-axis labels show month (J=January, etc.), [Woodgate and Peralta-Ferriz, 2021].*

The winter freshenings observed are particularly remarkable and suggest Pacific waters are entering the Arctic 50m shallower than before, and no longer refreshing the cold layer which historically protected the sea ice from warmer Atlantic waters below. The impacts of this on Arctic climate are currently unclear.

In a new addition to the project in 2022, we will also recover the third year-round biogeochemical measurements on the moorings, particularly to quantify the flux of oceanic nutrients through the strait. This effort will be supported by water sampling for nutrients during the cruise, to gain an understanding of the spatial variability of oceanic nutrients in the region. In addition to physical oceanographic goals, our work also supports long term marine mammal acoustic monitoring in the Strait (PI: Stafford).

International links: Maintaining the time-series measurements in Bering is important to several national and international programs, e.g., the Arctic Observing Network (AON), started as part of the International Polar Year (IPY) effort in 2007; various NSF, ONR and NPRB projects and missions in the region. For several years, the work was part of the RUSALCA (Russian-US Long Term Census of the Arctic). Some of the CTD lines are part of the international Distributed Biological Observatory (DBO) effort. The mooring work also supports regional studies in the area, by providing key boundary conditions for the Chukchi Shelf/Beaufort Sea region (a current focus on ONR Arctic programs); a measure of integrated change in the Bering Sea, and an indicator of the role of Pacific Waters in the Arctic Ocean.

2025 CRUISE SUMMARY (all times local = GMT-8):

The 2025 cruise took place in July, to allow hydrographic sections to be obtained from the start of the summer season.

The science team flew commercial to Nome on **Monday 30th June 2025**. On **Tuesday 1st July 2025** we accessed our container of equipment to complete instrument checks and start-ups. At the ship's suggestion, we completed most of the onload on Tuesday afternoon.

On **Wednesday 2nd July 2025**, we joined the ship around 9am and started equipment set up, particularly the installation of the IFCB In the aft lazaret. We left from Nome around 3:30pm, heading for the Bering Strait,and conducting test CTD casts soon after leaving port, including training in tag line operations. The ship steamed underway lines through the night, to arrive at our first mooring site (A2-24) the next morning.

Gloriously calm weather for the first days of the cruise allowed speedy completion of the mooring work. On **Thursday 3rd July 2025**, we recovered A2-24, A4-24 and A3-24, all without incident and redeployed A3-25 early evening. Through the night, the ship steamed underway lines, so as to be onsite at A2 again for deployment in the morning. On **Friday 4th July 2025**, we deployed A2-25 and A4-25 and steamed to the east end of the BS line, and started our CTD sections at 1517 local.

We ran the BS line westward at high resolution, with nutrient sampling and trace metal pumping, finishing at 2330 local, and immediately started the DL line heading north, at high resolution with nutrient sampling (but without trace metal sampling). This line was completed around 0800 local on **Saturday 5th July 2025**, when we continued CTDing the AL line towards the northeast with nutrients (and now again with trace metal pumping), which took until around 1700 local. At the east end of the AL line, we deployed the glider.

Although the weather was still wonderfully calm, the forecast was for gales from the north commencing in a few days. Hence, it was not viable to travel further north and still be able to sample and return to Nome on time. Thus, we instead ran underway lines back down towards the strait, aiming to complete the repeat of the BS line as the winds turned to be from the north.

We started the repeat of the BS line around 0500 on **Sunday 6th July 2025**, running again at high resolution and with trace metal pumping, but no other nutrient sampling, completing the line at BS22 at 1314 local and immediately starting the SBSnn line towards the southwest at high resolution, but with only low resolution nutrient sampling and no trace metal pumping. Progress was slowed by encountering a dead whale, the CTD hitting bottom and failing to spool correctly on the upcast, meaning we had to seek deeper water to restore the wire on the drum, and the CTD cable outercasting becoming frayed, requiring whipping. Thus, we swapped to lower station resolution, to complete the line and give time to fix the wire and run the BC line before the storm. At the end of the SBSnn line (~2200), we cut 150ft of damaged cable from the CTD wire, and reterminated. Although traditionally, this takes 24hrs to cure, we successfully restarted CTDing (the BC line, northwestward) at 0220 on **Monday 7th July 2025**, after only 2¾hrs, as the termination had set. This allowed us to complete the BC line at 1018, just as the weather was becoming too bad to work. Despite strong southward winds, we returned to the strait, which was unworkable for CTDs, so instead we made 4 crossings with the underway systems, tracking the westward movement of the Alaskan Coastal Current into the central strait. As winds and waves were still increasing, after these crossings we sought shelter off Tin City (southwest of the strait) for the night.

On **Tuesday 8th July 2025**, winds were still strongly from the north. A CTD cast at BC1, though manageable, showed we would be unable to do many stations on the line (which had worse conditions), thus we could only transit the line with the underway systems instead. At the end of the line we again returned to shelter off Tin City, anchoring the night. On **Wednesday 9th July 2025,** we completed one more cast at BC1, which showed remarkably changed conditions, and then headed for Nome, picking the route for weather. As we arrived in the vicinity of Nome with some spare time (although still not good enough condition to CTD), we ran another zigzag survey line south of Nome.

On **Thursday 10th July 2025**, we docked and offloaded in Nome, clearing the ship by ~1600.

Summary of CTD lines.

BS *(Bering Strait)* (US portion) – the main Bering Strait line, run at the start and the end of the cruise (under different wind conditions). This line has been occupied by past Bering Strait mooring cruises. US portion only run here. Run with station spacing of ~1nm to better resolve the structure in the strait. Previous runnings of this line have included two stations (BS23 and BS24) which fall south of the main line near Prince of Wales, extending the line along (rather than across) isobaths. Neither BS23 and BS24 were taken during this cruise**. CTD nutrient samples were taken only on the first running of this line in 2025. Pumped samples for trace metals/nutrients were taken on both runnings of this line in 2025.**

DLS and DLN *(Diomede Line)* (previously one line DL) – two consecutive lines running north from the Diomede Islands to A3, the southern portion DLS (stations DL1-12) at 1nm spacing, the northern portion DLN (stations DL13-A3) was previously run at 2.5nm spacing, but on this cruise a station spacing of 1.25nm was used. These lines study the hypothesized eddying and mixing region north of the islands.

AL *(A3 Line)* (US portion) – another previously-run line (previously run at ~ 1.7nm resolution, run this cruise once at 0.85nm resolution), just north of the Strait, running from the Russian coast, through the mooring site A3, to where the main channel of the strait shallows on the eastern (US) side. US portion only run here**. Run with trace metal/nutrient sampling, and CTD nutrient sampling.**

Repeat of the BS line (with trace metal sampling, but with no other bottle nutrients).

SBSnn – a previous line new in 2014, run only in 2014, 2015, 2017, 2019, and 2024, and then often only in part, just south of the strait, crossing the Alaskan Coastal Current before it enters the strait proper. This year run at 1.1nm (initially), then 2.2nm resolution. (Note some prior years start at BS24, and are called SBS.) Extended in 2024 and this year (2025) by ~5.8nm to chart high nutrient water encountered.

BC (Baituk Creek) – a new line in 2024, run roughly parallel to SBSnn but ~9nm to the east, to chart high nutrient content water encountered in 2024. Run here at~1.2nm resolution.

Repeat of BC1 during the storm.

Summary of ADCP/Underway data lines

The ship's ADCP and thermosalinograph (TSG) recorded for the duration of the cruise, and between lines steams were often positioned to give more useful underway information. The following were targeted underway surveys:

Start of cruise (late 2nd July/early 3rd July), BS towards Diomedes, and back to A2.
After A3-25 deployment (late 3rd July/early 4th July), A3 to NBS10-BS11-BS22-A2.
After Al CTD line (Late 5th July/early 6th July), AL line west to A3–NBS10-BS11
During termination (late 7th July/early 8th July), extension of SBSnn and BC lines
After BC line (7th July), 4 crossings of the BS line
The next am (8th July), SW along BC and back (slightly off set)
Off Nome (late 9th July/early 10th July)) – W pattern south of Nome.

See maps for details of these lines.

Prior lines not taken on this cruise:

SCS (to Point Hope). A new line, started 10nmSE of CS10 of the CS line, running towards Point Hope, run at low resolution (~9nm) due to ice and time constraints, although with higher resolution (4-2.5nm) near the coast. This year, replaced the CS line which was inaccessible in 2024 due to ice.

CS *(Cape Serdtse)* (US portion) – another cross strait line (~ 3.9nm resolution), run here from the US-Russian convention line (~168° 58.7'W) to Point Hope (US), but originally starting at Cape Serdtse-Kamen, in Russian waters. Also repeated during the cruise, both runnings adding stations to make station spacing ~1.9nm. First running done with trace metal/nutrient sampling in 2021. Not run in 2022.

NPH *(North Point Hope)* (US waters) - a line run before in 2016, and 2019, crossing from north of Point Hope to the WNW, at 1.25nm spacing near the coast, and 2.5nm spacing after NPH5, to chart the Alaskan Coastal Current transformation on its route along the Alaskan Coast. Extended in 2019 to the Convention Line (CCL). Run twice this cruise. First running westward only to station NPH13, second running (eastward) of complete line from CCL. Not run in 2022.

CD *(Cape Dyer)* (US waters) - a line new in 2016, taken also in 2017 and 2019, running west-east towards the Alaskan Coast, midway between Point Hope and Cape Lisburne, set just south of some apparent topographic irregularities, also to chart the Alaskan Coastal Current transformation on its route along the Alaskan Coast. Extended in 2019 to the Convention Line, but run in 2021 only from CD 14 to the coast. Not run in 2022.

LIS *(Cape Lisburne)* (US waters) – from Cape Lisburne towards the WNW, a previous RUSALCA line, run by us also in 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018 and 2019 and close to the CP line occupied in previous Bering Strait cruises in 2003 and 2004 (station spacing ~ 3.6nm). Note that due to the Quintillion cable, station Lis 9 is replaced by 2 new neighboring stations, Lis 8.5 and 9.5 . Run once during the 2021 cruise. Run with trace metal/nutrient sampling in 2021. Not run in 2022.

DLa and DLb – two other high resolution lines (1nm resolution), mapping the eddying/mixing region, parallel to DLS, allowing for a 2-dimensional mapping of the region.

AS – a line sampled only once before (2011) (although sometimes run for underway data), running from the eastern end of AL back towards the western end of the CS line, taken at variously 4nm or 2nm spacing (closer stations over steeper topography).

NNBS *(North North Bering Strait)* – a new line run only three times before (2015, 2017, 2019) west-east across the eastern strait, south of A3 and north of NBS, run at ~ 1.8nm resolution, to better map the Alaskan Coastal Current north of the Strait proper.

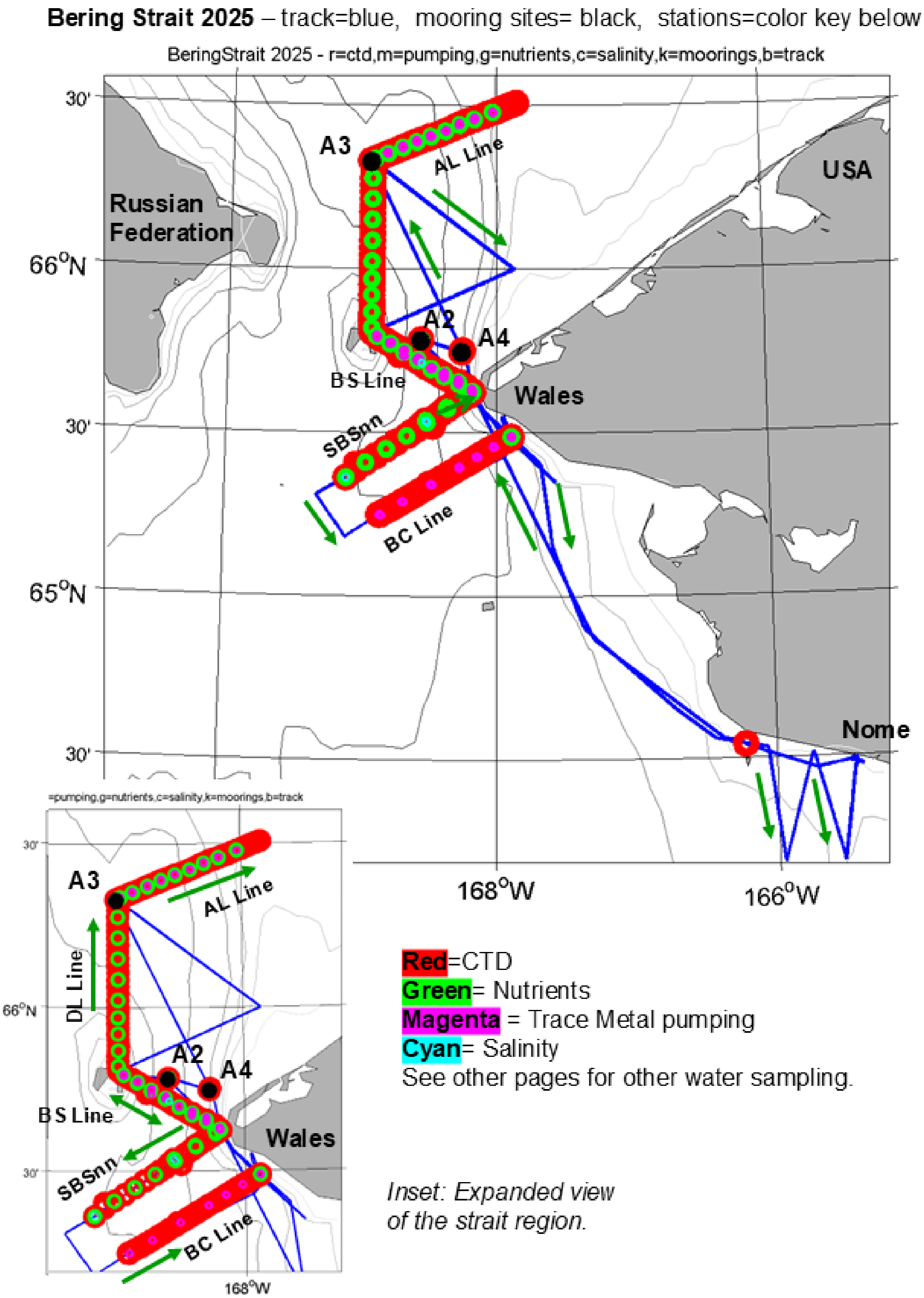
NBS *(North Bering Strait)* – an east-west cross-strait line ~ 8nm north of the Bering Strait line, run in previous years, with ~ 1.7nm resolution.

MBS *(Mid Bering Strait)* – an east-west cross-strait line ~ 10nm north of the Bering Strait line, run in previous years, with ~ 1.7nm resolution, with higher resolution near the coast

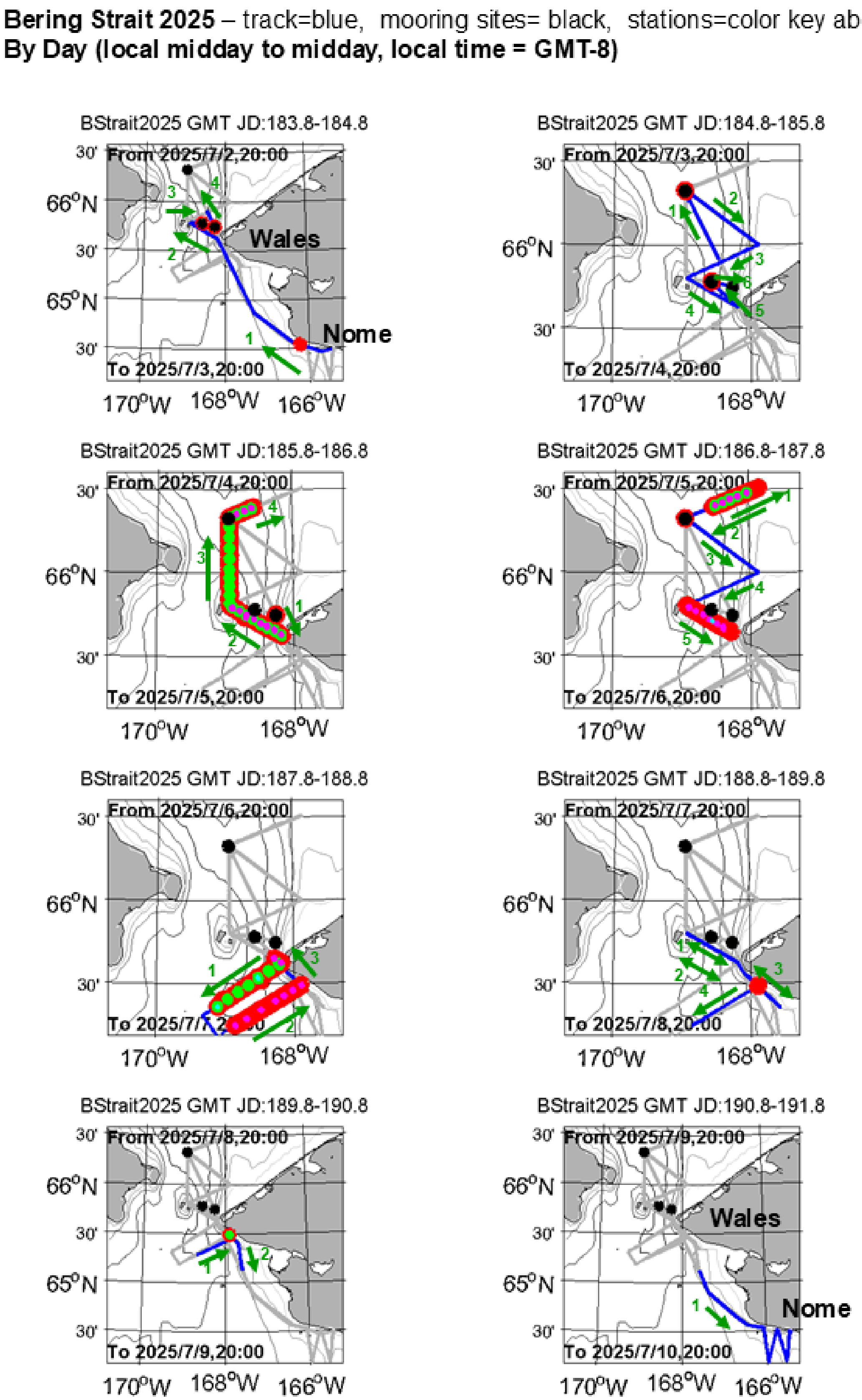
Parts of **CCL *(Chukchi Convention Line)*** (US waters) – a line running down the convention line from the end of the LIS line towards the Diomedes (also run in 2003, 2004, 2011, 2012, 2013, 2014, 2015, 2016, 2017 and 2018, and in part in 2022), typically incorporating a rerun of the high resolution DL line at the southern end, run variously at 10nm (typical) or 5nm (rarely) resolution. Run only in parts in 2021. Run in part in 2023.

CONTENTS

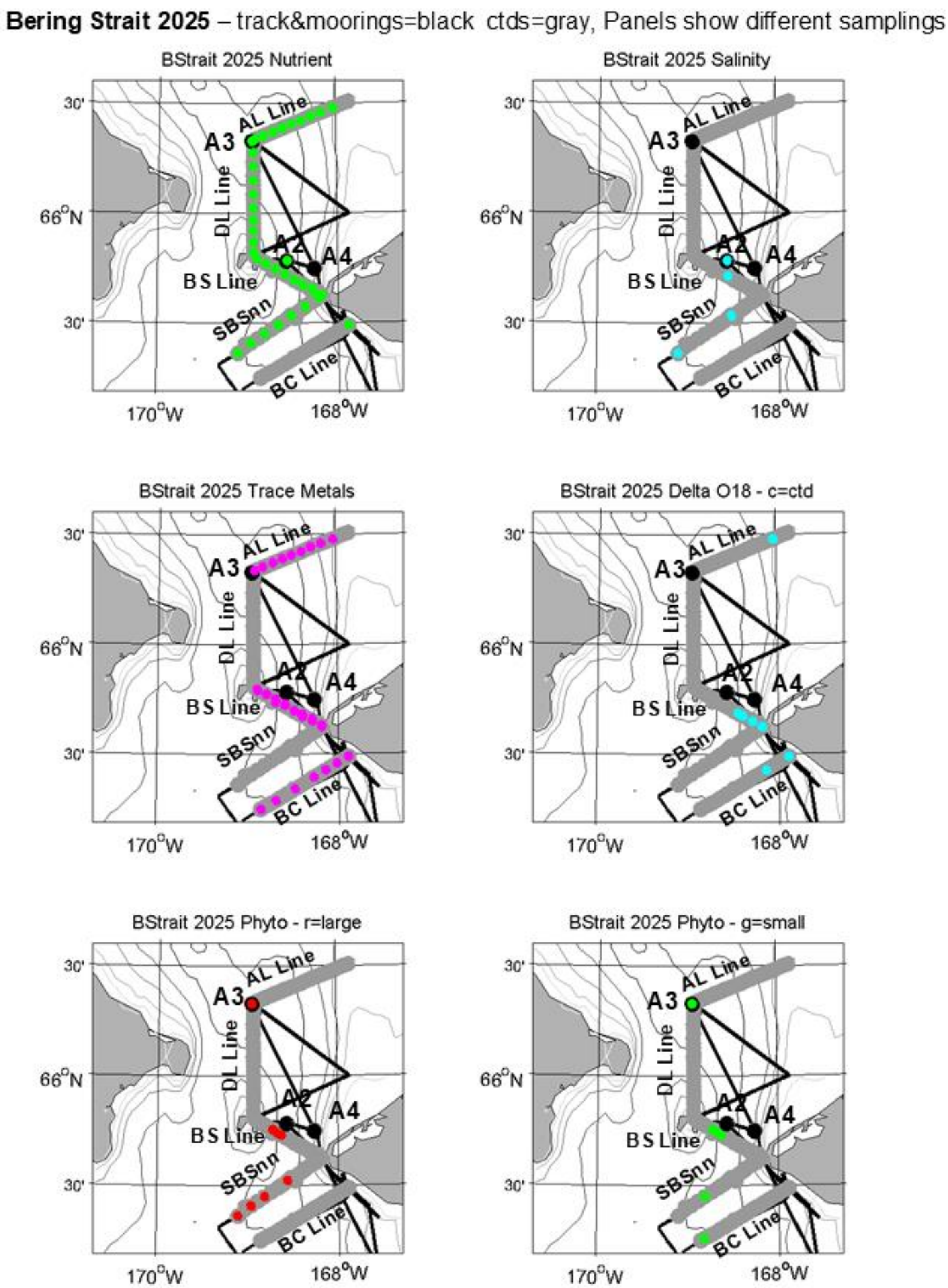
BERING STRAIT 2025 CRUISE MAPs: *Ship-track, blue. Mooring sites, black. CTD stations, red. Water samples color code as per key. Green arrows show direction of travel. Depth contours every 10m from IBCAO (International Bathymetric Chart of the Arctic Ocean [Jakobsson et al., 2000].*



BERING STRAIT 2025 CRUISE MAP BY DAY (local noon to noon): *Ship-track, blue. Mooring sites, black. CTD stations, red. Water samples color as per key on previous figure. Green arrows show direction of travel. Depth contours every 10m from IBCAO (International Bathymetric Chart of the Arctic Ocean [Jakobsson et al., 2000].*



BERING STRAIT 2025 CRUISE MAPs: *Ship-track, black, showing different water sampling undertaken.*



BERING STRAIT 2025 SCIENCE PARTICIPANTS

1. Rebecca Woodgate (F)	UW	*Chief Scientist and UW PI*
2. Cecilia Peralta-Ferriz (F)	UW	*Co-Chief Scientist and UW Co-PI*
3. Laramie Jensen (F)	UW	*UW postdoc & lead of trace metal sampling*
4. Katy Christensen (F)	UW	*UColorado Postdoc & UW for cruise*
5. Robert Daniels (M)	UW	*UW mooring technician*
6. Miriam Hauer-Jensen (F)	OSU	*OSU Graduate Student, marine mammals & CTD assist*
7. Léna Hardivillier (F)	OSU	*OSU Erasmus Student, marine mammals & CTD assist*

UW – University of Washington, US
OSU – Oregon State University
UColorado – University of Colorado

Cabin Allocations:

Main deck (Cabin 4) -	Robert
Lower deck, port aft (Cabin 8) -	Rebecca and Cecilia
Lower deck, starboard aft (Cabin 7) -	Laramie and Katy
Lower deck, starboard forward (Cabin 5) -	Miriam and Léna

BERING STRAIT 2025 NORSEMAN II CREW

1. Mike Hastings (M)	SVA	*Master*
2. Casey Coates (M)	SVA	*Mate*
3. Jim Wells (M)	SVA	*Chief Engineer & Bosun*
4. Lars Nelson (M)	SVA	*Chef*
5. Dakota Geagel (M)	SVA	*AB*
6. Richard Perry (M)	SVA	*AB*
7. Steve Hopwood (M)	SVA	*AB*
8. Tanner Graber (M)	SVA	*AB*

SVA – Support Vessels of Alaska, Inc. , https://www.supportvesselsofalaska.com

Ship contract arranged by:

CPS Polar Field Services, partner of Battelle ARO
Adelaide Rosic, adelaide@polarfield.com

MOORING OPERATIONS (Woodgate/Daniels, assisted by others)

Background: The moorings serviced on this cruise are part of a multi-year time-series (started in 1990) of measurements of the flow through the Bering Strait. This flow acts as a drain for the Bering Sea shelf, dominates the Chukchi Sea, influences the Arctic Ocean, and can be traced across the Arctic Ocean to the Fram Strait and beyond. The long-term monitoring of the inflow into the Arctic Ocean via the Bering Strait is important for understanding climatic change both locally and in the Arctic. Data from 2001 to 2023 suggest that heat and freshwater fluxes are increasing through the strait [*Woodgate et al.*, 2006; *Woodgate et al.*, 2010; *Woodgate et al.*, 2012; *Woodgate et al.*, 2015; *Woodgate*, 2018; *Woodgate and Peralta-Ferriz*, 2021], with 2012 being a year of low flow, but 2013 to 2016 returning to higher flow conditions [*Woodgate*, 2015; *Woodgate et al.*, 2015; *Woodgate*, 2018]. The data recovered this cruise will indicate if recent years show further increase or a return to older conditions.

An overview of the Bering Strait mooring work (including data access) is available at http://psc.apl.washington.edu/BeringStrait.html. Data are also permanently archived at the National Centers for Environmental Information, previously called the National Oceanographic Data Center (https://www.nodc.noaa.gov/ or https://ncei.noaa.gov).

A map of mooring stations is given above. Three UW moorings were recovered on this cruise. These moorings (all in US waters –A2-24, A4-24, and A3-24) were deployed from the Norseman II in September 2024, with mooring funding from NSF-AON (PIs: Woodgate and Peralta-Ferriz, *PLR2153942*).

Three UW moorings (A3-25, A2-25, A4-25) were deployed on this 2025 Norseman II cruise under funding from NSF-AON (PIs: Woodgate and Peralta-Ferriz, *PLR2153942*). All these deployments were replacements of recovered moorings at sites occupied since at least 2001 (A4) or 1990 (A2 and A3). Analysis of past data suggests data from these three moorings are sufficient to give reasonable estimates of the physical fluxes of volume, heat and freshwater through the strait, as well as a useful measure of the spread of water properties (temperature and salinity) in the whole strait [*Woodgate et al.*, 2015].

All moorings (recovered and deployed) carried upward-looking ADCPs (measuring water velocity in 2m bins up to the surface, ice motion, and medium quality ice-thickness); lower-level temperature-salinity sensors; and iscats (upper level temperature-salinity-pressure sensors in a trawl resistant housing designed to survive impact by ice keels). Both the recovered and deployed A3 moorings also carried marine mammal acoustic recorders. The A3-24 mooring also carried, instead of an iscat, the “Miscat”, a multiple instrument version of the iscat, designed to allow instruments to be lost sequentially from nearer the surface. For a full instrument listing, see the table below.

Our most recent NSF grant supports also biogeochemical measurements on the moorings. Thus A2 and A3 (recovered and deployed) carried also SUNA optical nitrate sensors, SBE37-ODO optical sensors for dissolved oxygen and WETLABS FLNTUSB optical sensors for fluorescence and turbidity. An additional WETLABS FLNTUSB sensor was also deployed on A4 (recovered and deployed).

This coverage should allow us to assess year-round stratification in and fluxes through the strait, including the contribution of the Alaskan Coastal Current, a warm, fresh current present seasonally in the eastern channel, and known to be a major part of the heat and freshwater fluxes [*Woodgate and Aagaard*, 2005; *Woodgate et al.*, 2006; *Woodgate et al.*, 2015; *Woodgate*, 2018]. The ADCPs (which give an estimate of ice thickness and ice motion) allow the quantification of the movement of ice through the strait [*Travers*, 2012]. The marine mammal recording time-series measurements should advance our understanding of the biological systems in the region. The first year of biogeochemical sensors (2022-2023) showed winter time replenishments of nutrients and suggest a long-term increase in the nutrient flux through the strait [*Woodgate et al.*, submitted 2024], and we look forward to establishing the importance of interannual variability in key biological parameters.

Calibration Casts: Biofouling of instrumentation has been an on-going problem in the Bering Strait. Prior to each mooring recovery, a CTD cast was taken to allow for *in situ* comparison with mooring data. Similarly, CTD casts were taken at each mooring site immediately after deployment. These post-deployment casts will allow us to assess how effective this process is for pre-recovery calibration. Since the strait changes rapidly, and CTD casts

are by necessity some 200m away from the mooring and may be as long as 1hr separated in time from the mooring reading, it is inevitable that there will be differences between the water measured by the cast and that measured by the mooring. **Action item: On recovery, check the post deployment casts to see how reliable the comparison is.**
This year (as in 2017, 2018, 2019, 2021, 2022, 2023 and 2024), an on-deck calibration tank was also used for recovered instruments. This is discussed below.

2025 Recoveries and Deployments:
Our standard procedure for mooring recoveries was the following:

First a pre-recovery CTD cast was taken starting at a safe (~200m) distance from the mooring position and drifting way. Next, for ranging, the ship positioned ~ 200m away from the mooring so as to drift towards the mooring site. Ranging was done from the port mid corner of the aft deck of the ship, with the hydrophone connecting to the deck box inside at the aft end of the port laboratory. **Action item: Re check position as regards to ship's propellers.** Once the ship had drifted over the mooring and the acoustic ranges had increased to >70m, the mooring was released**.** This procedure was followed to prevent the mooring being released too close (or underneath) the ship since in previous years the moorings have taken up to 15min to release. **Action item: Be sure to distinguish between slant and horizontal range during soundings.** As site A3 is ~0.6nm from the Russian border, prior to ranging on A3, the Norseman II's small boat was prepared for launching, to cover the eventuality that if the mooring had to be dragged, the mooring would surface and drift towards Russian waters before the ship was able to recover it. **Action item: Continue to prepare for small boat operations at site A3.**

On all moorings, we use double releases, with springs to assist the mooring release. For all moorings, our usual routine is to communicate and range with one release and then attempt to release the other release (to test both instruments).

Biofouling and other release issues have frequently resulted in the mooring release being unsuccessful. In these cases, dragging gear (around 6-8feet of weighted grapples, is attached to the ship's trawl wire. This is lowered to the sea floor and the trawl paid out as the ship drives a circle around the mooring position at a distance of ~100m (depending on the length of trawl wire used. Once this is laid, the ship steams slowly away, hauling in the trawl so as to catch the mooring with the retracting trawl. Our experience is that usually good pull on the mooring is sufficient to pull it free and typically the mooring surfaces before the trawl wire is recovered.

In all cases, once the mooring is on the surface, the ship repositions, bringing the mooring tightly down the starboard side of the ship. One boat hook and a pole with a quick releasing hook attached to a line are used to catch the mooring, typically on a pear link fastened to the chain between the float and the ADCP or on eyes welded to the float surface. The line from the hook is then passed back to through the stern A-frame, and tied with a "cat's paw" knot to a hook from the A-frame. This portion of the mooring is then elevated, allowing the second A-frame hook to be attached lower down the mooring chain, and tag lines to be attached if necessary. The iscat, if present, is recovered by hand at a convenient point in this operation, prior to recovery of most of the mooring. Then the entire mooring is then elevated, using both hooks from the aft A-frame, and recovered onto deck.

Recovery work is usually done by a deck team of 4 crew of the Norseman II – one on the A-frame controls, three on deck with on overhead safety lines ("dog runs") down each side of the deck (one of these working forward of the deck on tag lines), assisted by UW personnel further forward on the aft deck. Once on deck, the moorings are photographed to record biofouling and other issues.

Action items: Be sure to add pear-link to the chain between float and ADCP. Prepare loops of line for threading through chain/shackles to provide a lifting point. High A-frame or crane very helpful for recovery. Also helpful to review mooring movies at start of cruise. Bring extra tires for the recovered floats.

The A-frame of the Norseman II is atypically high (~ 26ft less block attachments). While this is extremely useful in fair weather, it allows for swinging of the load in rougher seas. **Action item: Continue to use tag line options for recovery in rougher weather.**

Good visibility (at least ~1nm) is required for mooring recoveries since the mooring may delay releasing due to biofouling, or the mooring may require dragging, as in previous years. Given the proximity of A3 to the US-

Russian border, small boat operations may also be necessary during a dragging operation to prevent the surfaced mooring drifting out of US waters. For these reasons, it was decided typically not to commence a new mooring operation after 5pm local time. **Action item: Continue to include weather days in the cruise plan; plan also for small boat operations (including sending a battery powered release unit), considering especially if small boat operations could be used in fog. Assess causes of foggy conditions, in order to predict best strategy for finding workable visibility.**

In 2025, all three moorings were successfully recovered without dragging. We attribute this to
(a) refurbishment of T-Shafts and O-rings in the releases used for releasing. And
(b) the moorings having only been deployed in September, i.e., after the 2024 growing season, and before the 2025 growing season, and thus having only light biofouling.

All moorings were on position, and all acoustics functioned well.

We did encounter some problems using our new deckset, which are most likely power issues, i.e., the deckset was not charging from where it was plugged into ship power, and the reserve deckset had to be used for release of A3. However, the troublesome deckset functioned well in deck checking releases once plugged into a different outlet, thus we conclude it was a charging issue.

All deployed and recovered releases used springs to aid latch opening, and this appeared to function well.

This year we also trialed use of a chain linkage below the releases, rather than our usual banana set up. Both set ups functioned well, although there was a small (~5s) pause on the release of the chain linkage (A4). This mooring is in the highest current, which may increase binding. However, as the banana linkages functioned well, we see no reason to abandon our banana design.

Action items:
- **Check out deckset and power cable once back in Seattle, especially find a way of checking the battery charge.**
- **Continue to bring spare deckset.**
- **Continue refurbishment plan on releases**
- **Do a Seattle test of biofouling on the Everslick used in the new release components.**
- **Continue using springs**
- **Continue using 'banana' linkages below the release.**

Biofouling was very light on the 2024-2025 moorings, as expected from instrumentation deployed in September (post bloom) and recovered in the following July (pre bloom). ADCP heads were generally clear of barnacles, and salinity cells, the SUNA slot and the Wetlabs faceplates were clear of biofouling. Note that the latch end of the releases was also clear of biofouling, which gives us no information as to how well the Ever Slick coating on the new release parts functions in these waters.

Mooring deployments were done through the aft A-frame, using the A-frame hooks for lifting. The height of the Norseman II A-frame was extremely advantageous for these deployments. Lacking such an A-frame, alternative ships might consider lifting the mooring with the crane, rather than the A-frame. The mooring was assembled completely within the A-frame. The ship positioned to steam slowly (~1 to 2knots) into the wind/current, starting between 500m and 600m from the mooring site, however this proved to be ~100m too little for the first deployment, as there were new people on deck. **Action item: Start with 700m away for the first mooring. .** At the start of the deployment, the iscat was deployed by hand and allowed to stream behind the boat, which steamed at ~ 2knots, fast enough to maintain headway and to trail the mooring behind the ship, but not so fast as to damage the equipment being towed or pull equipment off the deck. **Action item: Feed the iscat tether unwound to the person spooling it off the deck.** The first pick (from one of the hooks of the aft A-frame) was positioned below the ADCP, except in the case of A4, where the first pick was below the top float. The second pick (from the other hook of the aft A-frame) was lower down on the mooring allowing all the mooring except the anchor to come off the deck during the lift. Then, the A-frame boomed out to lower these instruments into the water. Tag lines were used to control the instruments in the air. **Action item: use deck cleats to fair tag**

lines. Be sure to position the lift point on the float so it does not cause the float to roll off. The first pick was released by a mechanical quick release, which was then repositioned to lift the anchor. (Previous years have shown that if the first pick was insufficiently high, the releases would still be on deck when the first package was in the water. The releases would then slip off the deck inelegantly. It was found that a higher lift of the instruments, and using both hooks of the A-frame, allowed the releases also to be lifted from the deck and then hang nicely behind the ship once the ADCP was placed in the water.) The anchor was lifted into the water just prior to arriving at the site. Positioning of this final pick very close to the anchor prevents the releases being pulled back over the lip of the ship when the anchor is lifted. **Action item: Make final pick as close as possible to the anchor.** When the ship arrived on site, the anchor was dropped using the mechanical quick release. Positions were taken from a hand-held GPS on the upper aft deck, some 5m from the drop point of the mooring. **Action item: Continue to bring own GPS unit. Note that due to mooring fall back, actual mooring position may be ~ 10m from this position in the opposite direction to the steaming direction during recovery.**

Some problems were encountered with the handheld GPS unit being unable to obtain position, and the backup GPS unit was used for deployment. This also appears to be a power issue (even though the unit showed 2 bars), as once the batteries were changed this GPS worked fine for other tasks for the rest of the cruise. **Action item: Continue to bring spare GPS. Put fresh batteries in the GPS at the start of the cruise.**

A team of 4-5 crew did the deployments, with one person on the A-frame, 3 on the "dog runs' assisting the instruments up into the air, and other members of the crew/science team assisting with tending the tag lines during lifting.

Action items: design pick points into the moorings for recover; continue to put 2 rings on the anchors for tag lines. Consider using chain, not line for the moorings (saves on splicing and gives extra pick points); Compute the best pick point, such that the releases are lifted free of the deck, rather than slipped over the edge. Add pick points to the mooring diagrams. Review the videos of mooring deployments before the operation.

Deployment Instrumentation issues: This year, to avoid needing a long preparation period in Nome, much of the instrumentation was started in Seattle and shipped on delayed start. (Note SBE37IM will not accept a delayed start longer than 30 days.) Exceptions were the biooptics instruments (SUNA, Wetlabs and ODOs) which have less battery endurance and so were started in Nome.

Iscat housings and tethers were assembled in Seattle, and ADCPs incorporated into the ADCP frames, leaving the only assembly work to be done in Nome/at sea the placing of the floats on the ADCP frames and the testing of the releases. **Action item: Consider in future if starting instruments in Seattle is a safe way of saving time in Nome. Note that releases could also be deck checked ashore to save time at sea.**

This year, the iscats were significantly redesigned, with the dog-bone floatation being replaced with a series of weak links to sacrificial floats, an extension of the Miscat design trialed in 2022-2023. This worked exactly to plan (see below).

For mooring recoveries and deployments, rather than use one central tool box, we make 5 bags of the most essential tools. This sped up deck operations significantly. **Action item: Keep, and slightly extend the tool bags (with nut drivers). Consider assigning 1 person the go for, who hands items needed to those seated on deck.**

Recovered Data and Instrumentation issues: Data recovery on the moorings was extremely good.

- ISCAT SBE37IMS AND LOGGERS:

Three iscats/miscat were deployed on the recovered moorings.

- A2-24– the upper iscat was recovered with full data record. The Logger (24) was also running on recovery, however had recorded no data. This lost us no data as the iscat was recovered, however, needs to be investigated.

ACTION ITEM: Investigate. (Is the card damaged? Was it incorrectly installed? Was it the coupler? Was it a format issue?

- A3-24 –logger recorded fine, but disc still had some 2017 data on it (in the wrong directory).

Both iscats were recovered and returned full data records. Records (see Figure below) show the top iscat starts at ~7m, and then descends to ~24m 30th Dec 2024, and descends again (to~30m)on 4th Feb 2025, exactly as planned with the next design

- A4-24 – iscat was not recovered, and last data on the logger is 16th Dec 2024, 17:29, but data also has some data glitches, suggesting issues with the coupler. The connection plug was ripped off at the ADCP.

Action items:

- Investigate coupler. .

- Investigate different connection, so as to not destroy the cable to the logger.

- Continue check of all couplers in Seattle; do final coupler test before deployment, bring spare couplers to cover any last minute failures.

- Continue to use Lithium battery on miscat in the future.

Preliminary results (before any correction for biofouling or post cruise calibration) are plotted below.

- *ADCPs:* The three recovered ADCPs were running on recovery and gave complete data records. These instruments were deployed with lithium batteries (and no external battery pack) and a conservative recording schedule and were expected to last the two years.

Preliminary results are plotted below.

- SBEs: A SBE37 was recovered from each mooring. None of these instruments were pumped. All instruments were running on recovery and returned full data records **Action items: Send for calibration.**

Preliminary results (before any correction for biofouling or post cruise calibration) are plotted below.

- Biooptics instrumentation (SUNA, Wetlabs, ODOs). All biotoptic instruments were running on recovery and appear to have returned complete data records. No issues have been identified to date.

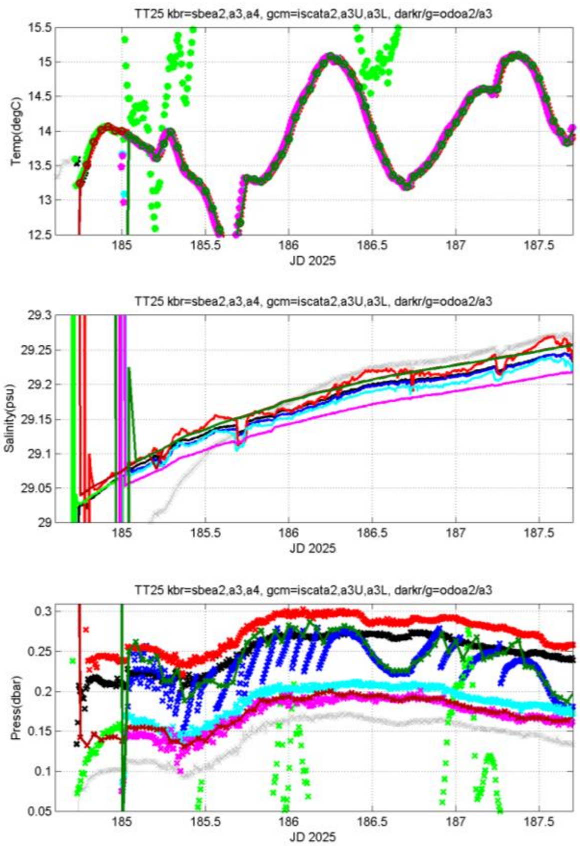
Post recovery tank calibrations: As an addition calibration test, uncleaned post-recovery SBE instruments were placed, for various periods after recovery in a large-plastic bin filled with salt water in conjunction with other recently calibrated SBE instruments. Previous versions of this test have used an SBE19 as the standard, however, frequently issues were encountered with this instrument – the external switch on the instrument made it vulnerable to being accidentally switched off; the high sampling rate required battery changes during the cruise; and the pumped system was vulnerable to air bubble issues. In 2024, this tank was redesigned to have an internal frame (made from two IKEA wine-racks) to keep instruments apart and upright. This system, which only takes SBE37, not SBE16s, was used again in 2025.

One recently calibrated instrument (an SBE37) was used as the standard. Recovered instruments were washed externally in a separate tote of salt water and then placed in the test tank for several days.

Last year's tank showed extreme warming (to ~30degC), likely relating to cooling issues with the pump. This year, we reverted to an older, weaker pump, but as discussed below, this proved too weak to mix the tank sufficiently.

While full conclusions must wait until the post cruise calibrations are available, some conclusions may be drawn already. In the following figures, – grey=newly calibrated SBE37 used as a standard

- Recovered SBE37s are black (A2), blue (A3) and red (A4)
- Recovered iscat SBE37s are green (A2), cyan (A3upper), magenta (A3lower)
- ODO-SBE37 are dark red(A2) and dark green (A3)



== Top Figure (temperatures) show good agreement for times when in the tank - note A2 iscat (green) is only in the tank at the start), BUT the iscats apear to be 20minutes fast compared to the ODOs or the SBE37s.

Action Item: Check time offsets with final calibrated data.

(Oct25Note: SBE37s appear to delay sampling due to polling from the logger. When this is taken into account, the time discrepancy identified here is resolved.)

== Bottom Figure (Pressure)

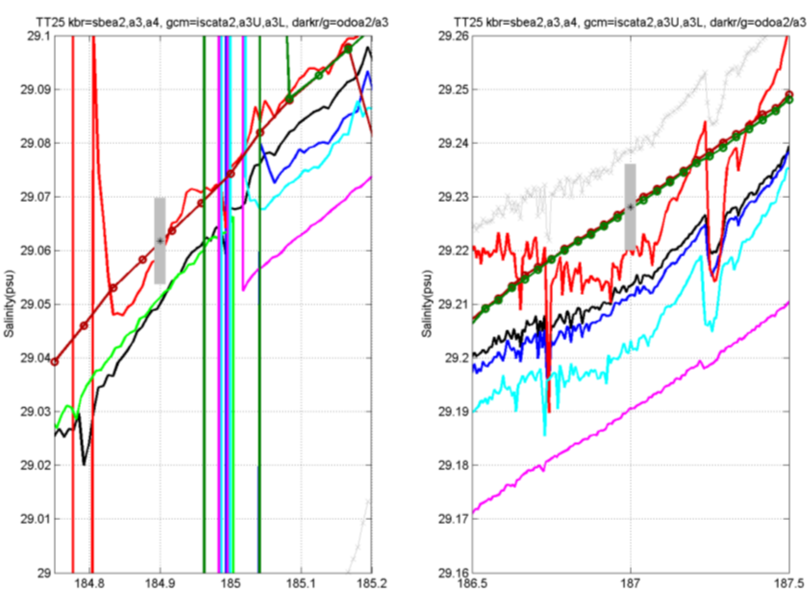
Shows strange variability, particularly in the SBE37 from A3 blue, of magnitude 0.05db, but this is less than the sensor accuracy (0.1% of full scale range, i.e., 0.1db).

== Middle Figure (salinity)

Very disappointing here is the behavior of the standard (grey), which shows much more drift than the other instruments.

This may be due to insufficient mixing or due to some conditioning of the cell, as this is the first time this instrument has been in water, likely the latter since the later part of the record shows much better agreement.

Figure below zooms into portions of the salinity record, with the vertical gray bar showing +- the instrument accuracy of 0.008psu.



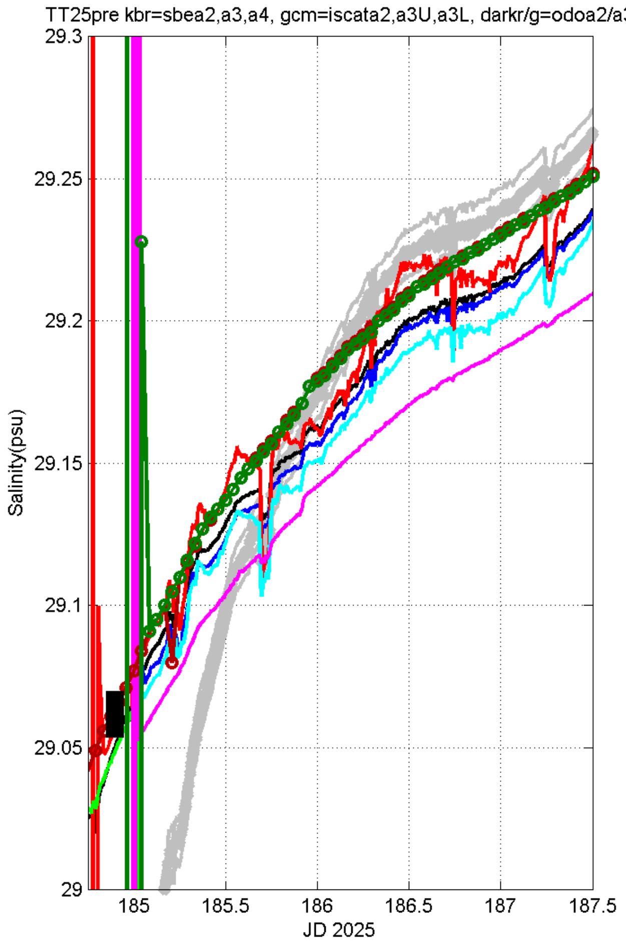
== there is considerable variability in salinity from various instruments showing mixing is insufficient in the tank. **Action item: Use stronger pump.**

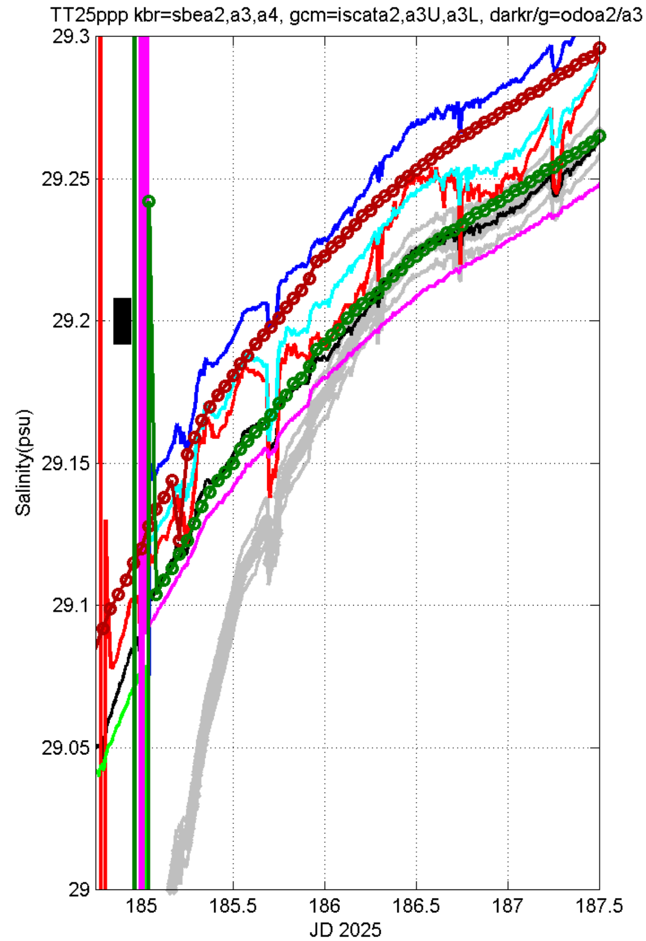
== ODOs show very good agreement (and past tests have shown them to have very litte drift). Thus, ODO salinities (once post-cruise calibrated) will likely be our best standard.

Other instruments are generally biased fresh, as is typical from these deployments, but using the precals, the largest difference is 0.035psu, which is well within expected changes in calibrations over the year.

Note that prior work suggests the accuracy of this tank test is only 0.01psu at best.

Oct 2025 note:





Left is pre cals – Right is postcals. Grey is the new instrument with thin greylines being ±0.008psu, the manufacturer's accuracy of the SBE37 sensor.

Postcals have moved everything to higher salinity, but not always resulting in better agreement.

SBE37 A2 (black) - agrees well now

A3 (blue) – is ~0.04psu saltier than the new instrument

A4((red) - has saltier excursions (to 0.03psu), but is within range of the new instrument other times

ISCAT A2(green) – is slightly fresher (~0.01psu) than the new instrument, but within range

A3U(cyan) – is 0.025psu saltier than the new instrument,

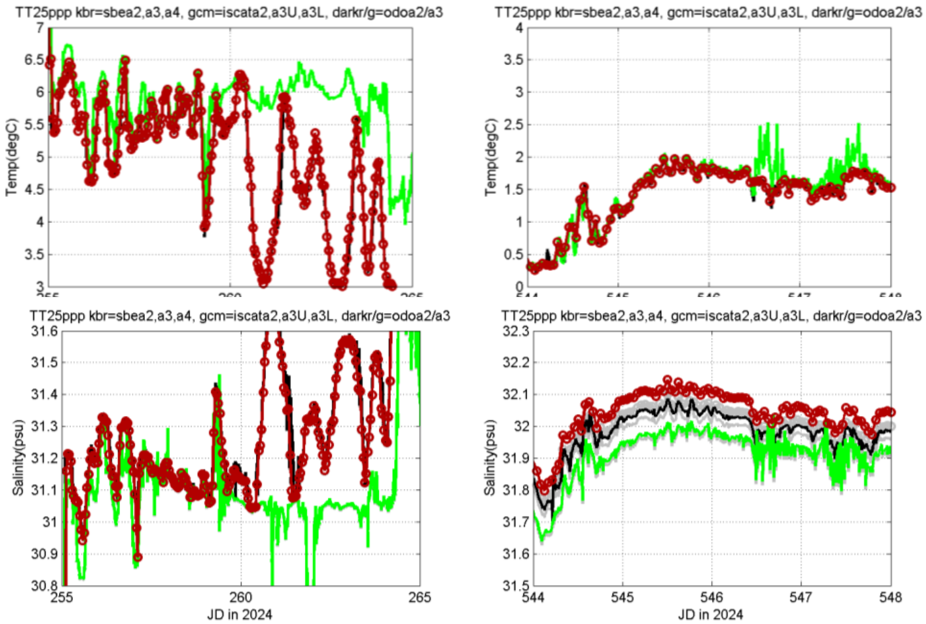
but agrees with red sometimes, so this could be tank offset

A3L(magenta) - is fresher by 0.007psu, i.e., within range

ODO A2 (dark red) – is saltier by 0.037psu

A3(dark green) – agrees well now

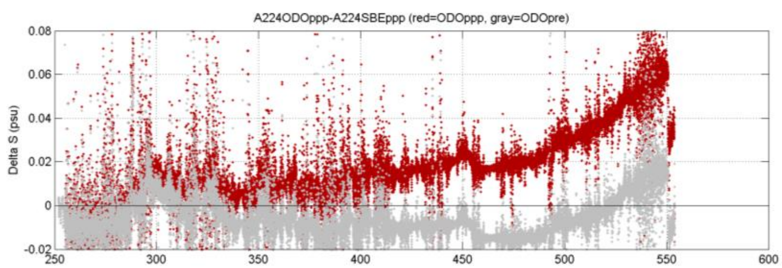
Examination by mooring shows some series discrepancies with the postcals:

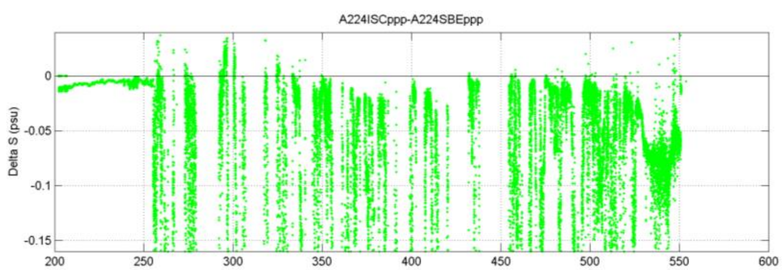


A2-24 post cals.
Upper = Temp, Lower = salinity at the start (left) and end (right) of the record. Color shows instrument. Grey gives precals.

Pre recovery CTD cast shows no stratificaiton in salinity at these depths. Thus, taking black (A2-SBE) as correct (as it agrees with the test tank standard, it appears for the postcals:
A2-24ODO is ~0.05psu too salty
A2-24 iscat maybe too fresh?

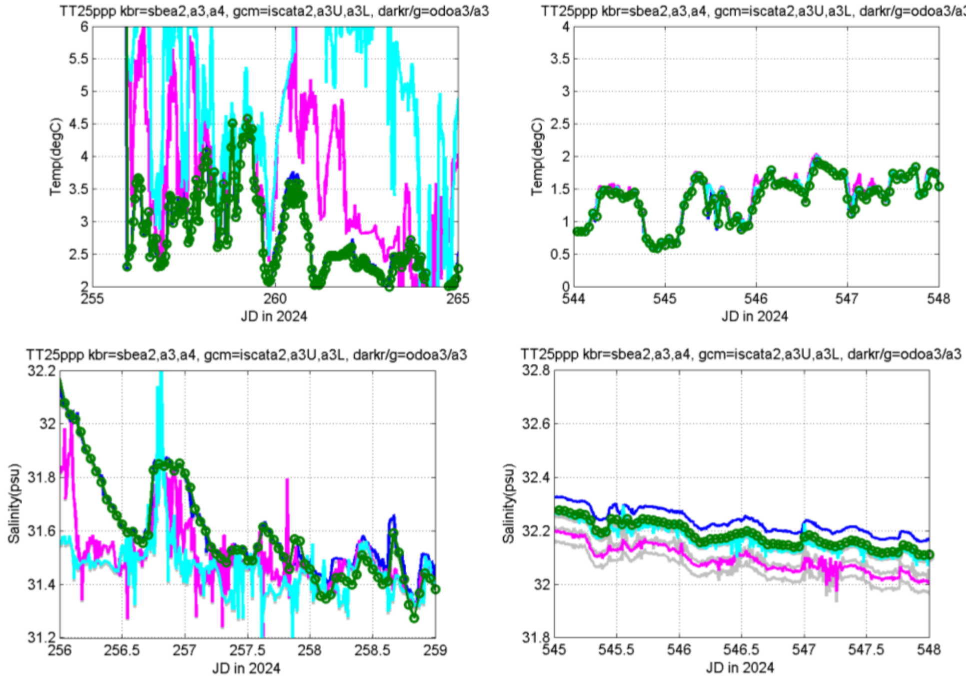
The ODO off set by the end of the deployment is clearly seen in the difference between the ODO and the SBE (dark red, with different to precal in grey). The iscat situation is less clear,with large discrepencies only from day 500 of the record.





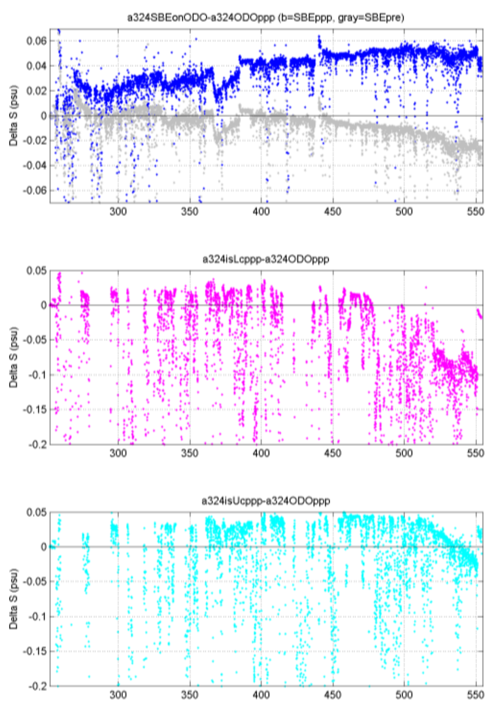
Action item: Revisit both these offsets when finalizing the ODO and iscat data.

A3-24:

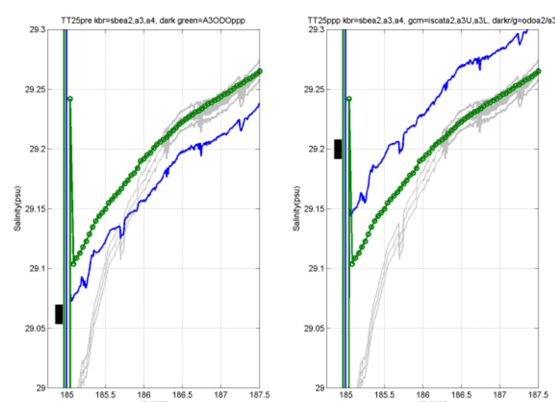


Now the ODO (dark g) shows the best agreement with the test tank. And again the CTD casts shows no stratification in salinity.

Thus implies
A3sbe(blue) is 0.05psu too salty
A3ISCLower (magenta) is 0.1psu too fresh
A2ISCUpper (cyan) is 0.01psu too fresh.



Comparing each to the ODO for the whole deployment (left) shows:
A3sbeppp(blue) trends to 0.05psu too salty.
But A3Sbepre (grey) does better for most of the deployment, but from day 450 onwards trends to 0.025psu too fresh.
This is confirmed in the test tank – the pre is closer than the ppp



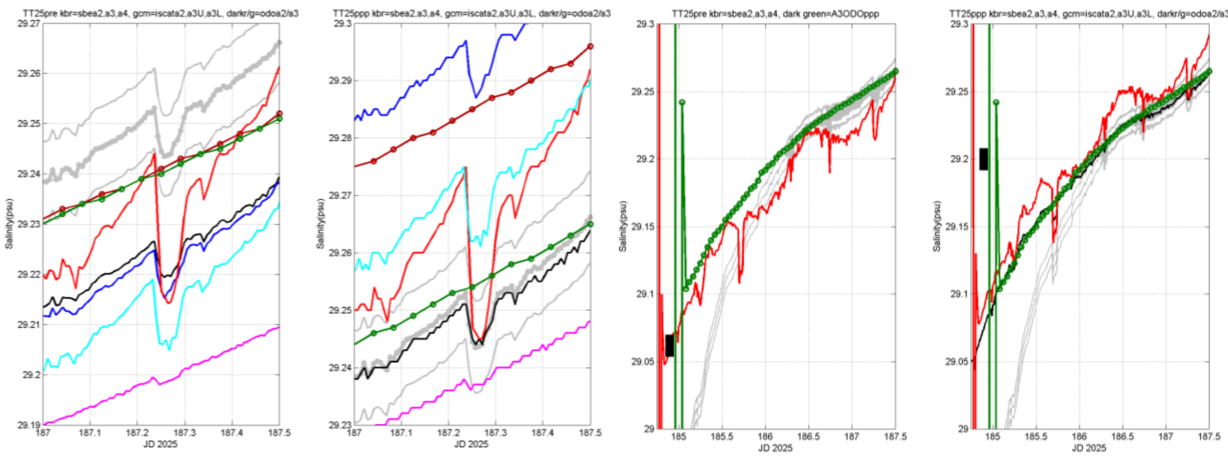
**** Use the A3- PRE for the final data, making the note as to the freshening**.

***The Iscat behaviour is more complex, but needs to be addressed before archiving.

For A4, the iscat was lost around JD 351, just as waters reached freezing, before biofouling is significant. And comparison to A2 and A3 show A4 to be almost always significantly fresher, suggesting the strait is not homogenized in winter. One event at JD508-510 shows all three timeseries to come together, and at this point there is no obvious problem with A4 ppp saliniities.

In the test tank, A4sbe (red) show major variability, but
(a) fresh event (captured below) shows the ppp version of A4 agrees best with the standard during this event.
(b) overall, pp agrees better with the standard.

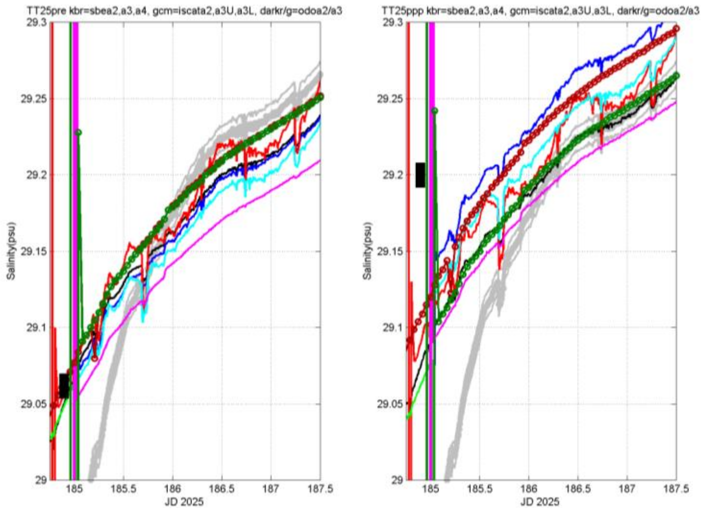
A4 pre | A4ppp | A4pre | A4ppp



Thus, we conclude A4 ppp is the most accurate salinity.

Oct 2025 – test tank update – SUMMARY BY MOORING

First look at test tank results from pre and post cals:



Here we learn:
-- standard (grey) is bad at the start.
-- a3ODOppp (darkg, right) & a2sbeppp (black, right) agree well with second part of standard.

So we can use those to compare with the others in the test thank for the full period.

We are asking, for each sensor, is pre or ppp best.

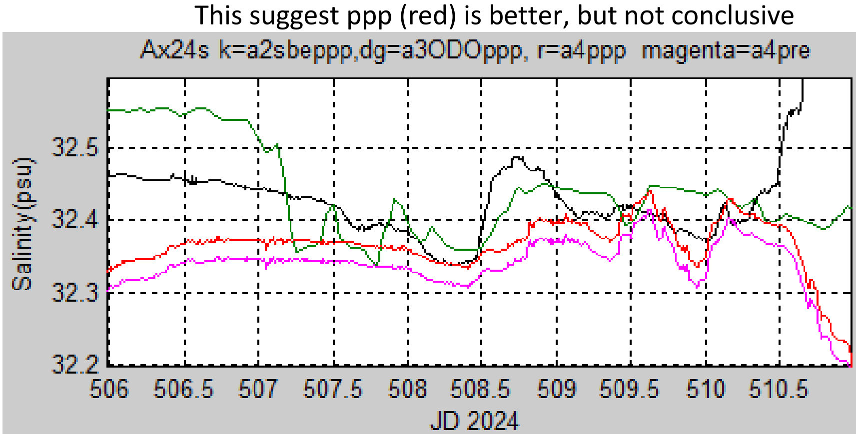
=== A4===

A4 iscat is lost at the start of winter, - no ppp available. Must use a4iscat pre

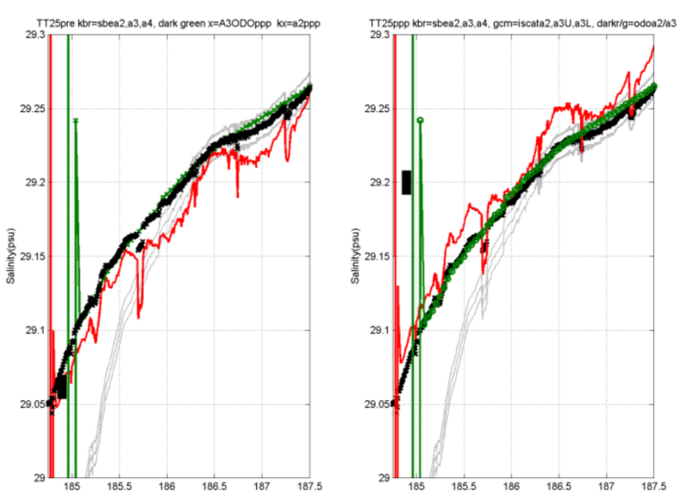
A4 sbe – difference pre to post is 0.03psu by the end of the record

- as iscat lost, so no useful comparison on the mooring
- can compare to other moorings. One point around JD508 when they seem to homogenisze

    This suggest ppp (red) is better, but not conclusive

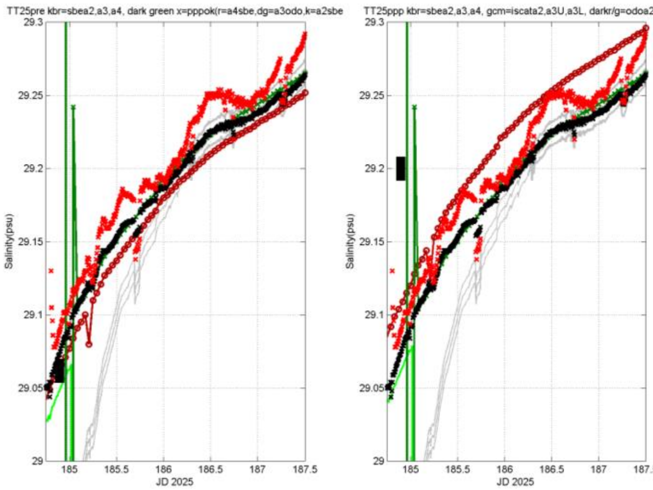


Look at test tank. Left is pre, right is post … and on the whole right agrees better:



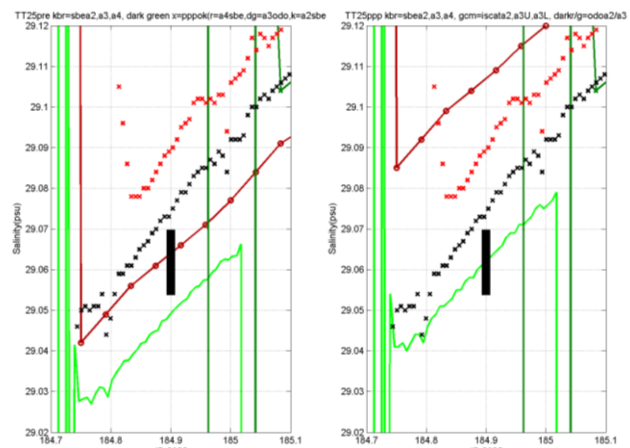
Conclude
- A4sbeppp is the best
- likely good to 0.005psu.
- lack of mixing in the testtank can result in 0.03psu difference.

=== A2 - test tank shows the a2sbeppp to be very good.
- so look at ODO and iscat

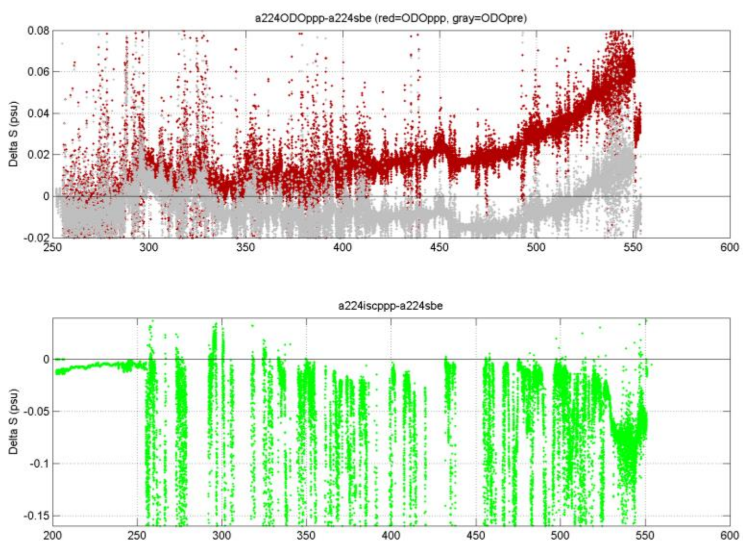


A2ODO (dark red)
- PRE is clearly better than ppp
- PRE is 0.013 fresher than standard
- PPP is >0.03 saltier than standard.
USE PRE AND NOTE IS Likley 0.013 too fresh.

A2iscat (light green)
we don't have very much of .. just the start.
(Match light green to the xs) ..ppp clearly better and within
0.01 – 0.015psu of the black



And if you look at the timeseries to check (or rather at the differences .. ODO-SBE, and ISCAT-SBE



-- ODOppp is a greater dfference
-- ODO pre is better, though starts to deviate from about JD500, suggesting SBE is drifting fresh at that time, maybe by 0.02psu (because the ODO is unlikely to drift salty)

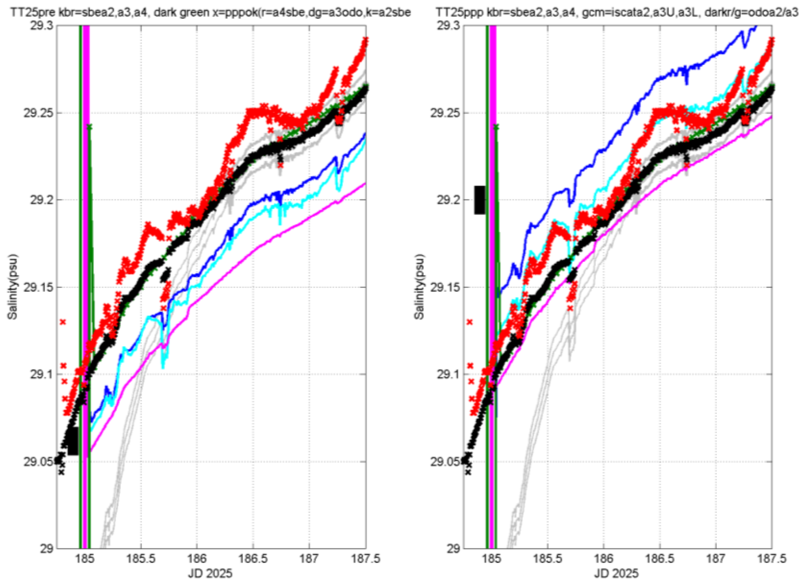
Conclude for A2:

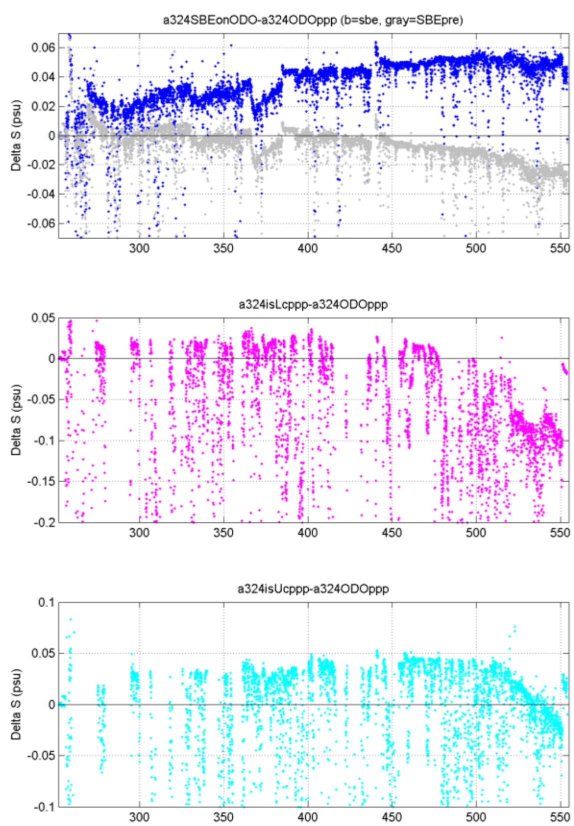
A2SBEppp is best, though maybe drifting fresh from JD 500 to be 0.02psu fresh by the end of the deployment in the water (though not in the test tank.

A2ODOpre is best. Is 0.013psu fresher than standard in test tank, but that is within the instrument error. But by time of postcal, the salinity seems to be significantly wrong (0.06psu) and the cell is replatinized. Perhaps some post-recovery issue.

A2ISCppp is best and is likely within specs.

== A3 – A3-ODOppp agrees well with the standard in the test tank.
A3-SBE (blue) – PRE is too fresh by about0.025 psu
But PPP is far too salty (by 0.04)
For the iscats, both were too fresh with PRE .. and are improved with PPP, although
A3Upper(cyan) is now perhaps 0.02 psu salty although agrees with A4, so maybe that is a test tank issue.
A3L (magenta) is 0.015 psu too fresh





Over the deployment (compared to the ODO which we believe is correct) ..
A3sbeppp (blue) becomes too salty
A3sbepre (grey) is better. only starting to deviate by JD450, when it trends too fresh, ending up 0.025 too fresh

CONCLUDE:
Use A3sbepre but put note about the trend.
Use A3odoppp for the transport calculations.

A324Lower iscat ppp (magenta) is 0.025psu salty for most of the deployment, but from JD 480 trends to too fresh, maybe to 0.07 too fresh, but this may be stratification, as only minimally too fresh (0.02 in the test tank.

A3024 upper iscat ppp (cyan) is 0.04psu salty for most of the deployment, but then trends fresh, which may also be stratification, as in the test tank, is still too salty (0.02psu)

For both use ppp, as closer to test tank data.

SUMMARY: Replat=replatenized after the recovery by the manufacturer.
New Cell – replaced after the recover by the manufacturer as salinity drift too great.

	A2-24 SBE black	A2--24 ODO d-red	A2-24 ISC l-green	A3-24 SBE blue	A3-24 ODO d-green	A3-24 ISCAT magenta	A3-24 U-ISC cyan	A4-24 SBE red	A4-24 ISC --
Type SN	*SBE37 24435 Cal ok*	*SBE37 24443 Replat*	*SBE37 24297 Cal ok*	*SBE37 24307I New Cell*	*SBE37 24444 Cal ok*	*SBE37 24426 Cal ok*	*SBE37 24425 Replat.*	*SBE37 23154 Cal ok*	*SBE37 LOST (20935)*
SAcc (psu)	*0.008*	*0.008*	*0.008*	*0.008*	*0.008*	*0.008*	*0.008*	*0.008*	*0.008*
Change (psu) between pre and post cal: indication of fouling, (which pushes data fresh), but this is corrected for									
Ppp (psu)	+ 0.02	+ 0.05	+ 0.01	+ 0.064	+ 0.01	+ 0.033	+ 0.049	+ 0.026	
Data minus test tank references – using PRE cal (so for interest only)									
TTPre (psu)	- 0.02	- 0.007	- 0.02	- 0.025	-0.008	-0.045	- 0.033	- 0.02 - 0	
Data minus test tank references (psu, -ve=data fresher) – using PPP data (good indicator of final data quality)									
TTpp (psu)	~zero	+0.037	- 0.01 i.e., too fresh	+ 0.04	~zero	- 0.015 i.e. too fresh	+0.02 matches with A4	+0.005 to 0.03	
Comparison to CTD cast at deployment (CTDD) and recovery (CTDR) – not very reliable as quality check									
CTDD									
CTDR									
Comparison to instruments on the same mooring (expect salinity greatest at greatest depth) – good indicator									
Other (psu)	**BEST**	**Ppp is 0.06 salty Pre is 0.01 salty.**	Unclear, as expect stratification.	Ppp +0.05 Pre – 0.025 ramping from JD 450.	**BEST**	**May be 0.02 salty for most of record, trending fresh at end**	**Maybe 0.04 salty for most of record, trending fresh at end**	Seems ok, with ppp slightly better.	Seems ok
Temperatures in winter compared to surface Tfreeze estimated from salinity – limited use (degC)									
Tfrz									
CONCLUDE (psu)	**Ppp OK Likely within manu spec. Maybe 0.02 psu fresh by end of in the water record**	**Use PRE, note although in specs in the test tank, is 0.01 saltier than sbe. Was replatinized - so perhaps post recovery issue**	**Ppp ok and likely good to manufacturer's specs**	**Use PRE and ramp from JD450 to end, adding 0.025psu by end. Or use ODO**	**OK, likely within manu spec**	**PPP, and note there is offset to test tank on recovery and maybe offset during rest of year**	**PPP, and note there is offset to test tank on recovery and maybe offset during rest of year**	**Ppp OK, and likely good to manu spec**	**Only pre available but is ok**

COMMENTS TO GO IN FILES 9 files – 3 sbe, 3 iscat, 1 logger, 2 odo

Note also the change in depth on the iscats as sacrificial floatation is lost to ice

A2-24SBE	Use ppp	Agrees in test tank to within 0.008psu, but other instruments suggest in water may be drifting up to 0.02psu fresh at the end of the deployment
A2-24 ODO	Use PRE	Pre cal gives better agreement (0.007psu fresh) than post cal (0.04psu salty) to test tank. Thus pre cal used here. Note however, 0.01 psu saltier than adjacent SBE on the mooring. Suggest use SBE salinity instead of ODO.
A2-24 ISC	Use ppp	In testtank, ppp may still be ~0.01psu too fresh, but this is close to manfacturer's specs. - this year, iscat falls to 22m on JD474 (18th April 2025)
A3-24 SBE	Use PRE	Post cal identified significant drift with the salinity cell Pre cal gives better agreement (0.025psu fresh) than post cal (0.04 salty) to test tank. Thus precal used here. Note however, data from adjacent ODO on the mooring suggests the SBE drifts fresh from JD450, ending up ~0.025psu too fresh at the end of the deployment. Either correct for this drift, or use the ODO salinity record.
A3-24 ODO	Use ppp	Agrees in test tank to within 0.008psu Salinity and Oxygen data likely incorrect from JD437-440 Oxygen data are also suspect for JD300-303 and 312-314
A3-24 ISC L	Use ppp	Test tank suggests ppp maybe 0.015psu too fresh (close to manufacturer's specs) Comparison to other instruments on the mooring implies a possible offset (ISC 0.02 psu too salty) for most of the deployment, trending fresh from JD480 - this year, iscat falls to 21m on JD401 (4th Feb 2025)
A3-24 ISC U	Use ppp	Test tank suggests ppp maybe 0.02 psu too salty. This may reflect stratification within the tank. However, comparison to other instruments on the mooring implies a possible offset (ISC 0.04 psu too salty) for most of the deployment, trending fresher from JD510 - this year, iscat falls to 23m on JD365 (30th Dec 2024) - this year, iscat falls to 30m on JD401 (4th Feb 2025)
A4-24 SBE	Use ppp	Test tank results show varying agreement, from 0.005psu saltier than standard at best to almost 0.03psu saltier. However, this may reflect mixing issues in the test tank, since comparison with other instruments on adjacent moorings suggest no significant issues
A4-24 ISC	Use pre	Instrument lost, no post cal available.

Other Recovered/Deployed Instrumentation: Other instruments on the moorings were recovered/deployed for other groups. These instruments are:

Recoveries: An ***Aural Marine Mammal Acoustic*** sensor on A3 was deployed by Kate Stafford, (UW). This instrument was cleaned and returned to Seattle for analysis.

Deployment: Only one ***Marine Mammal Acoustic*** sensor (placed on A3) was deployed this year. This instrument is deployed for Kate Stafford, UW.

Details of mooring positions and instrumentation are given below, along with schematics of the moorings, photos of the mooring fouling, and preliminary plots of the data as available.

BERING STRAIT 2025 CRUISE MOORING POSITIONS AND INSTRUMENTATION

ID	LATITUDE (N) (WGS-84)	LONGITUDE (W) (WGS-84)	WATER DEPTH /m (corrected)	INST.
2024 -2025 Mooring Recoveries				
A2-24	65 46.83	168 34.08	56	ISCAT, ADCP, SBE37ODO, FLNTUSB, SUNA SBE16
A4-24	65 44.76	168 15.75	49	ISCAT, ADCP, SBE16, FLNTUSB
A3-24	66 19.628	168 57.06	58	MISCAT, ADCP with SBE16, SBE37ODO, FLNTUSB, SUNA new MMR

ID	LATITUDE (N) (WGS-84)	LONGITUDE (W) (WGS-84)	WATER DEPTH /m (corrected)	INST.
2025 Mooring Deployments (to be recovered in 2026)				
A2-25	65 46.861	168 34.072	56	ISCAT, ADCP, SBE37ODO, FLNTUSB, SUNA SBE16
A4-25	65 44.764	168 15.750	49	ISCAT, ADCP, SBE16, FLNTUSB
A3-25	66 19.557	168 57.080	58	MISCAT, ADCP with SBE16, SBE37ODO, FLNTUSB, SUNA new MMR

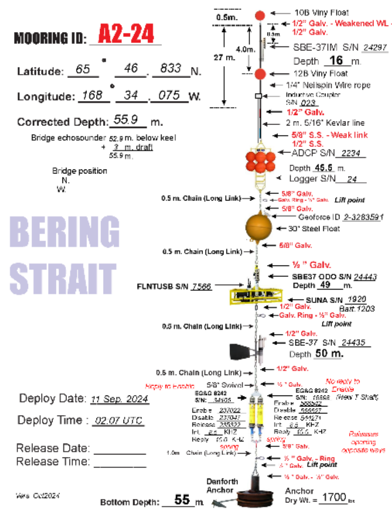
ADCP = RDI Acoustic Doppler Current Profiler
ISCAT = near-surface Seabird TS sensor in trawl resistant housing, with near-bottom data logger
MISCAT = ISCAT with two near-surface sensors (one at ~ 8m, one at ~ 16m)
SBE16 = Seabird CTD recorder, SBE37 = Seabird CTD recorder
MMR=Marine Mammal Recorder (new=new APL version)
SBE37ODO = Seabird CTD and dissolved oxygen recorder
FLNTUSB = Wetlabs fluorescence and turbidity recorder
SUNA = Seabird optical SUNA nitrate sensor

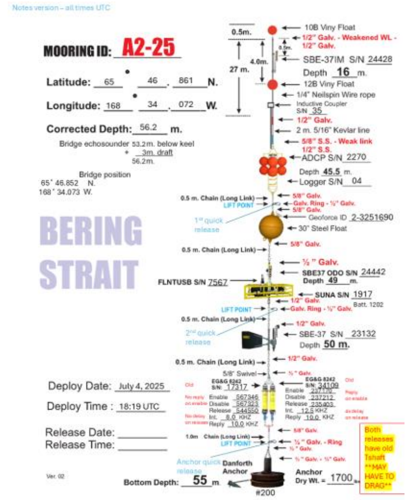
Water depths are assuming a ship's draft of 3m.

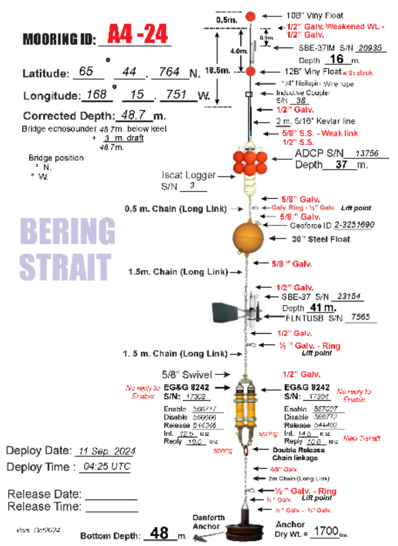
BERING STRAIT 2025 SCHEMATICS OF MOORING RECOVERIES AND DEPLOYMENTS

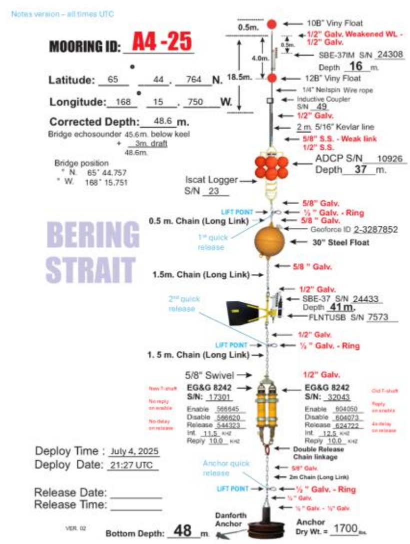
RECOVERED | **DEPLOYED**

= in the eastern channel of the Bering Strait

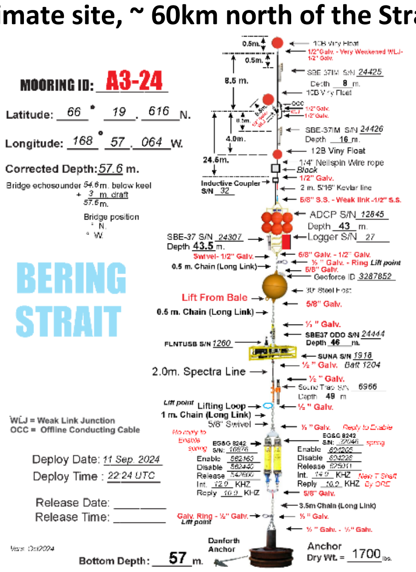


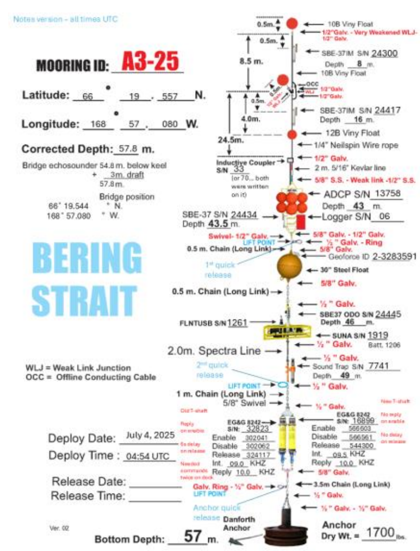






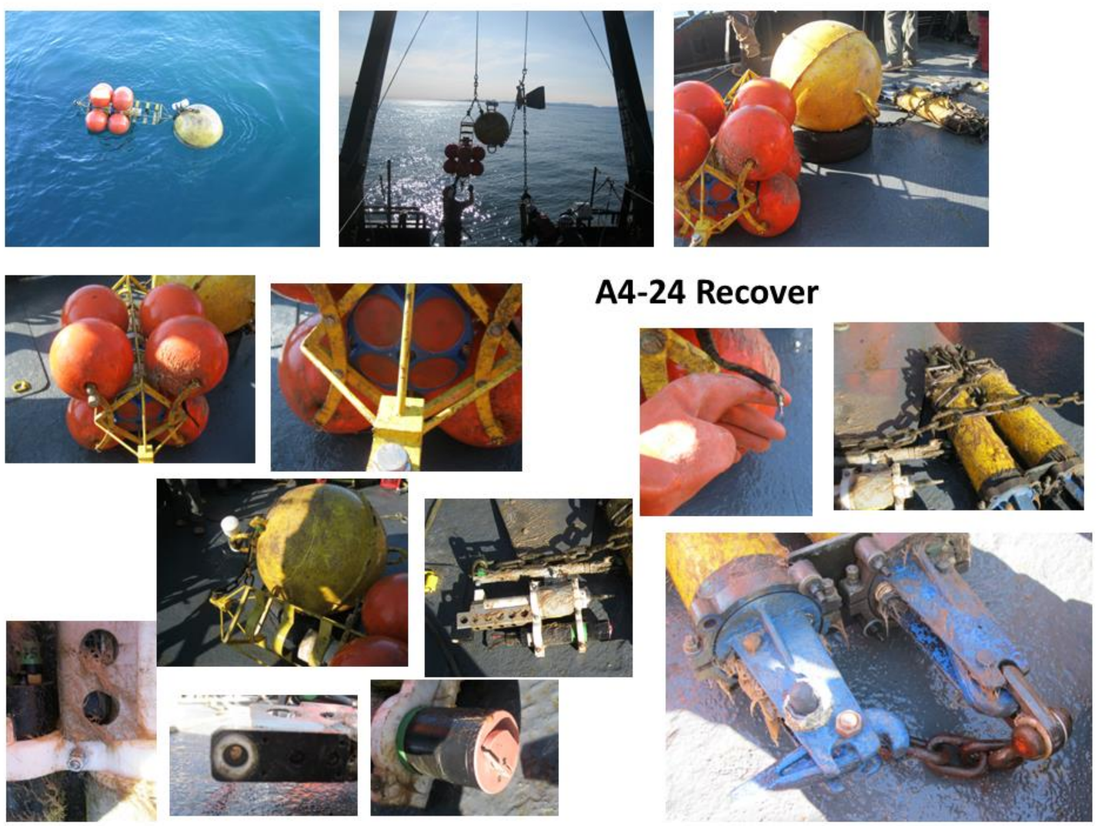
= at the climate site, ~ 60km north of the Strait





BERING STRAIT 2025 RECOVERY (Ax24s) PHOTOS

A2-24 Recover

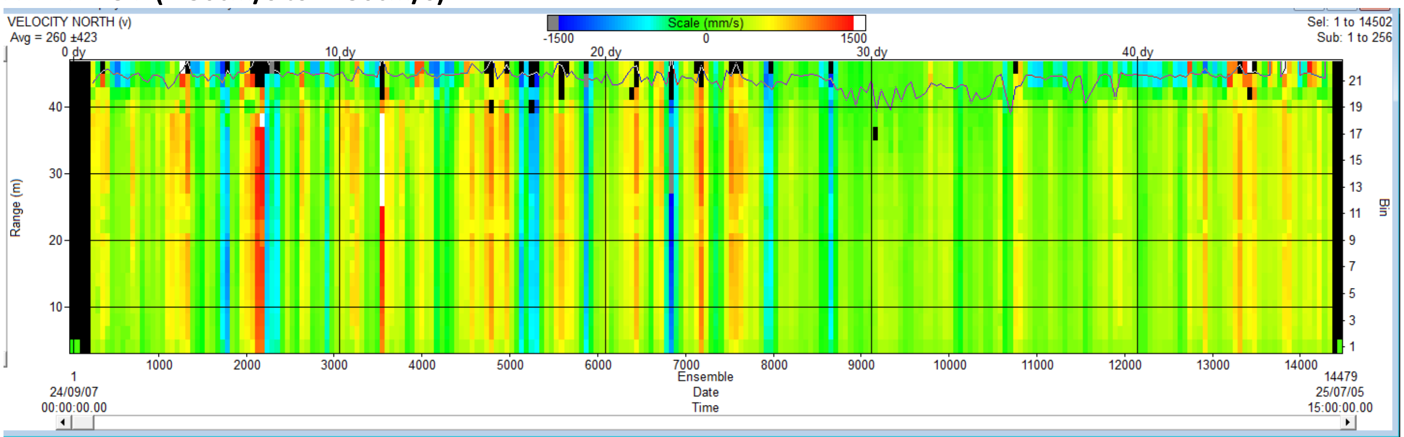


A4-24 Recover

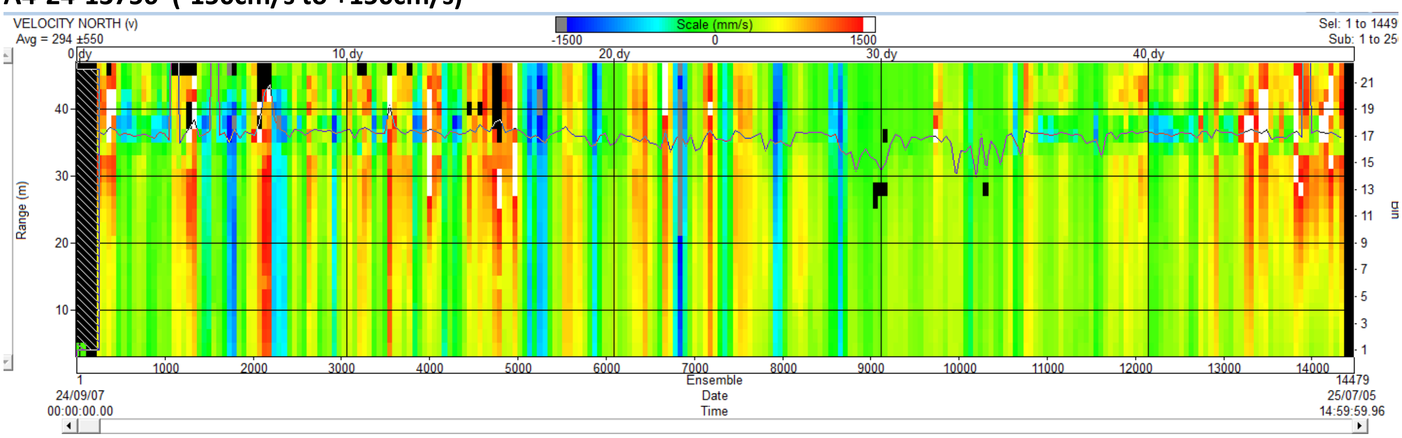

A3-24
Recover
iscat
cells
clear

<u>NORTHWARD VELOCITY from Bering Strait 2024-2025 ADCPs</u>

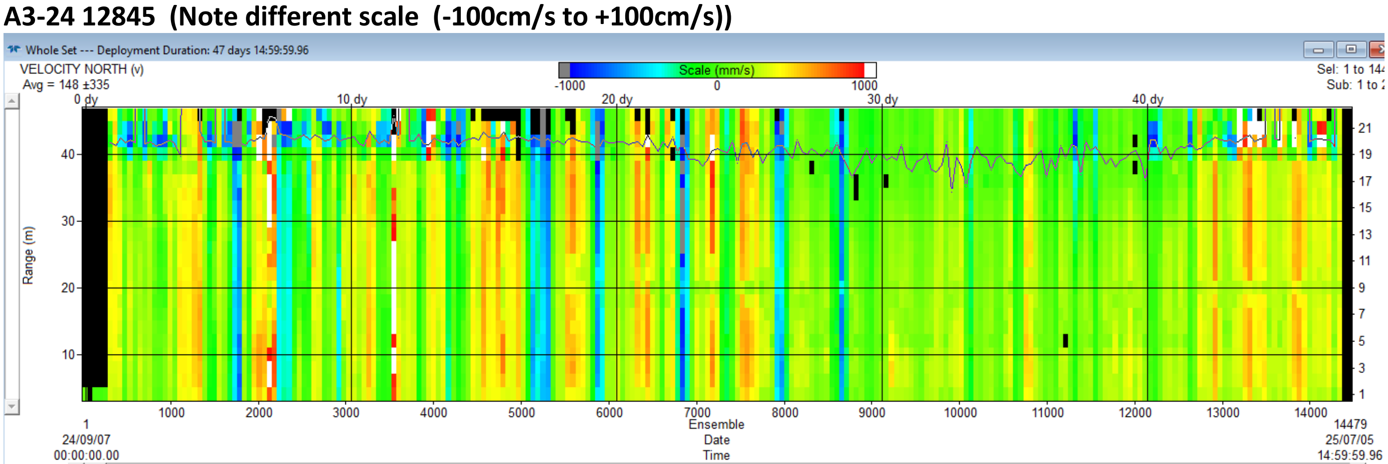
A2-24 2234 (-150cm/s to +150cm/s)



A4-24-13756 (-150cm/s to +150cm/s)



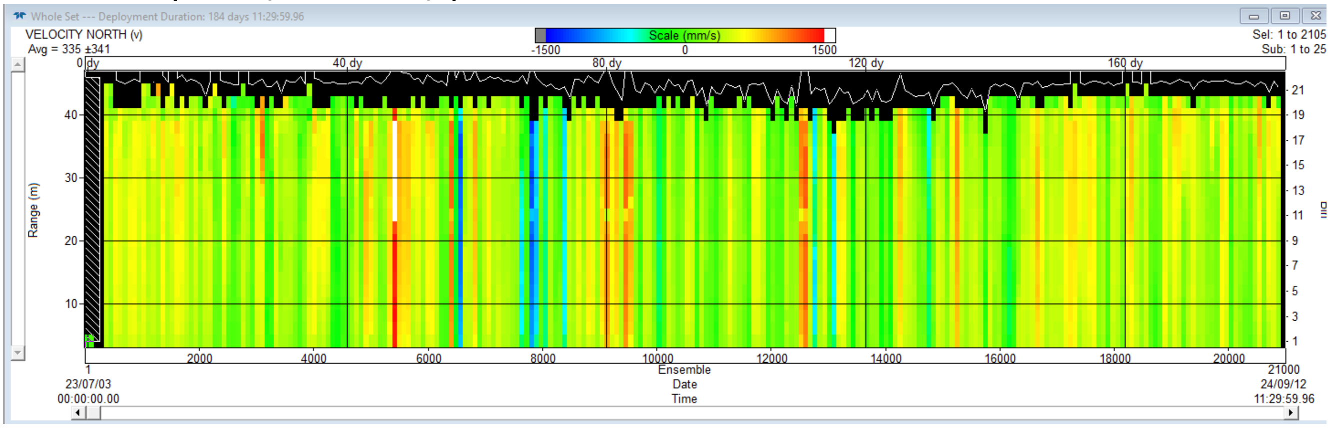
A3-24 12845 (Note different scale (-100cm/s to +100cm/s))



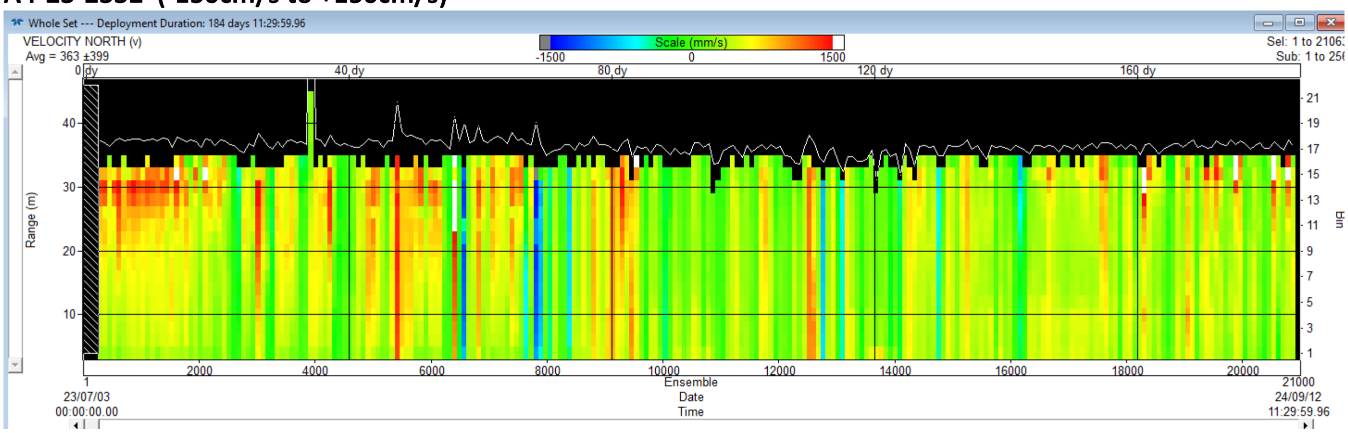
Note both more flow reversals and more strong northward flow events than last year.
Note also apparently thinner ice at A3, although perhaps thicker ice at A4.

2023-2024 data for comparison

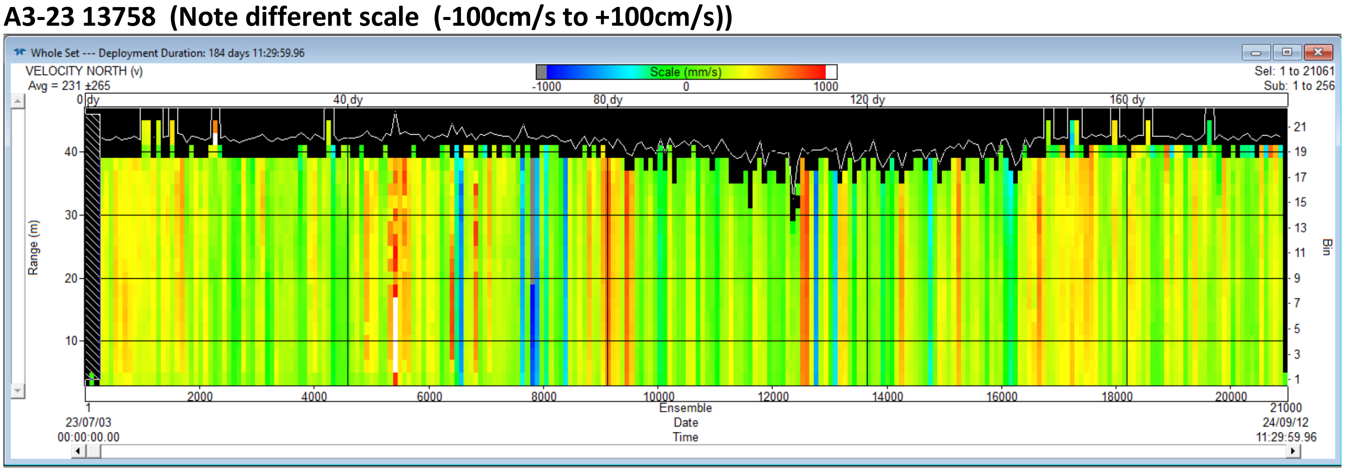
A2-23 10926 (-150cm/s to +150cm/s)



A4-23-2332 (-150cm/s to +150cm/s)



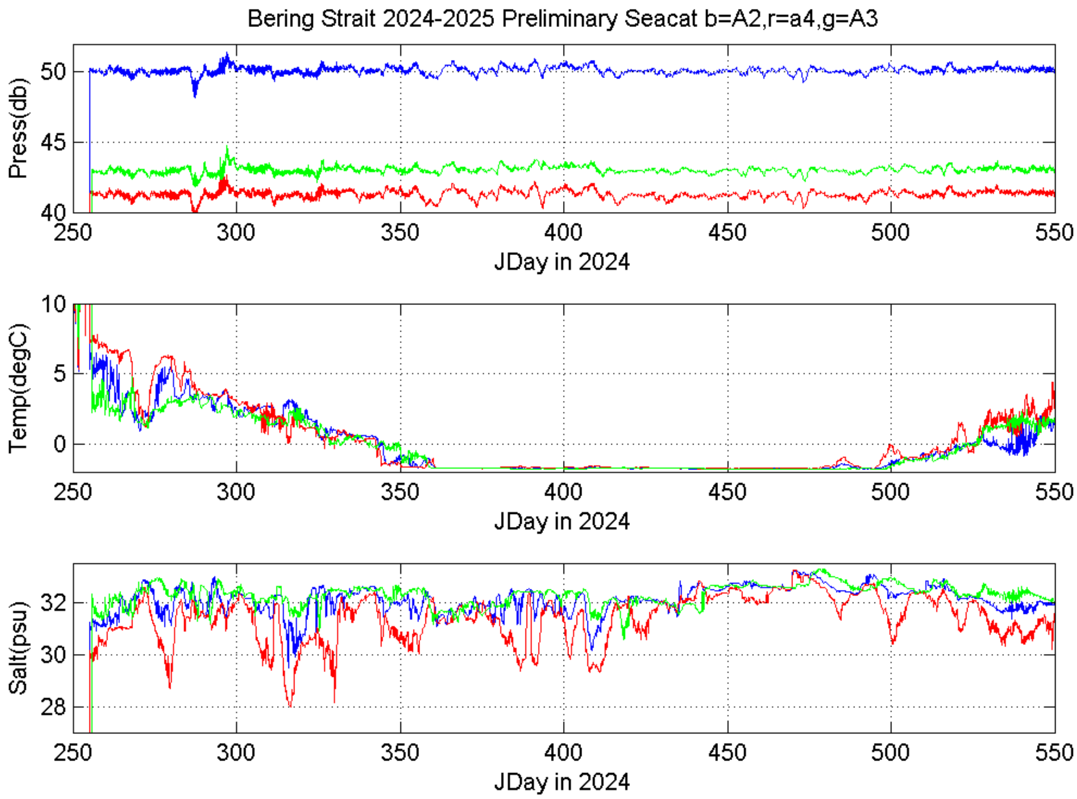
A3-23 13758 (Note different scale (-100cm/s to +100cm/s))

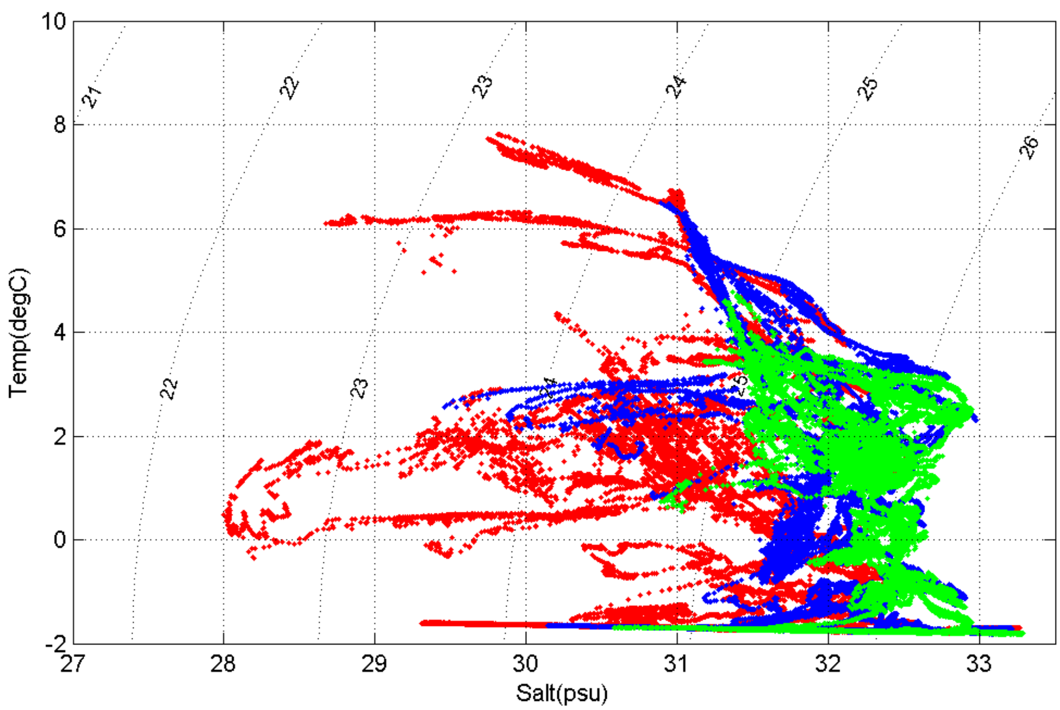


(Note large ice keels around 12000-13000, March 2024)

BERING STRAIT 2024-2025 SBE PRELIMINARY RESULTS (Ax24 data)

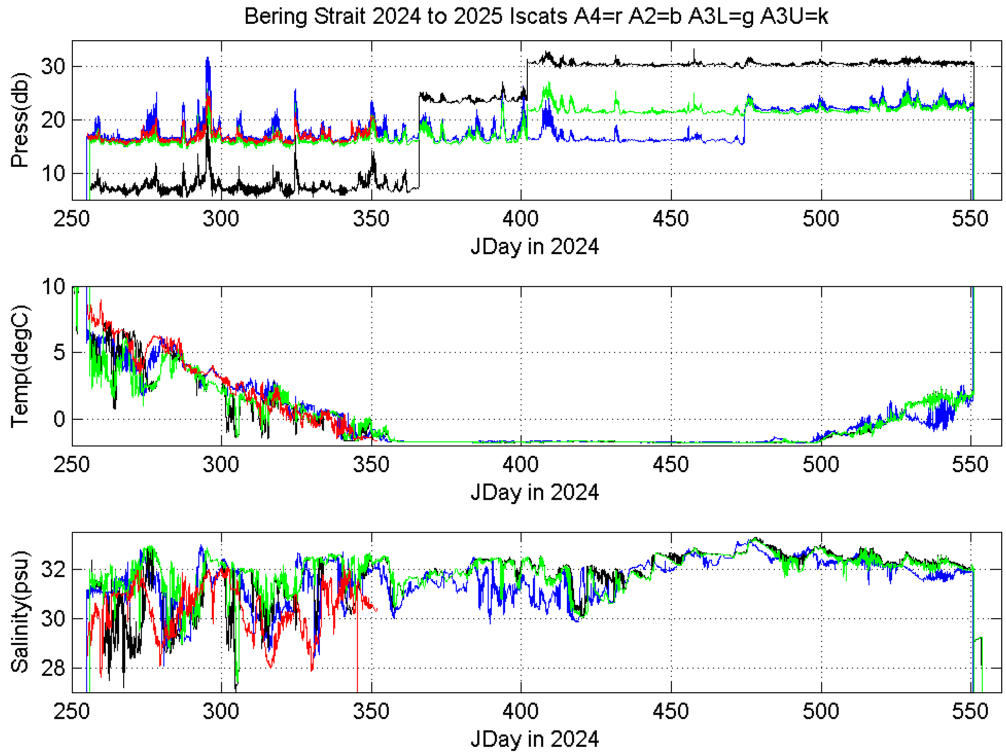
– all lower level TS Sensors

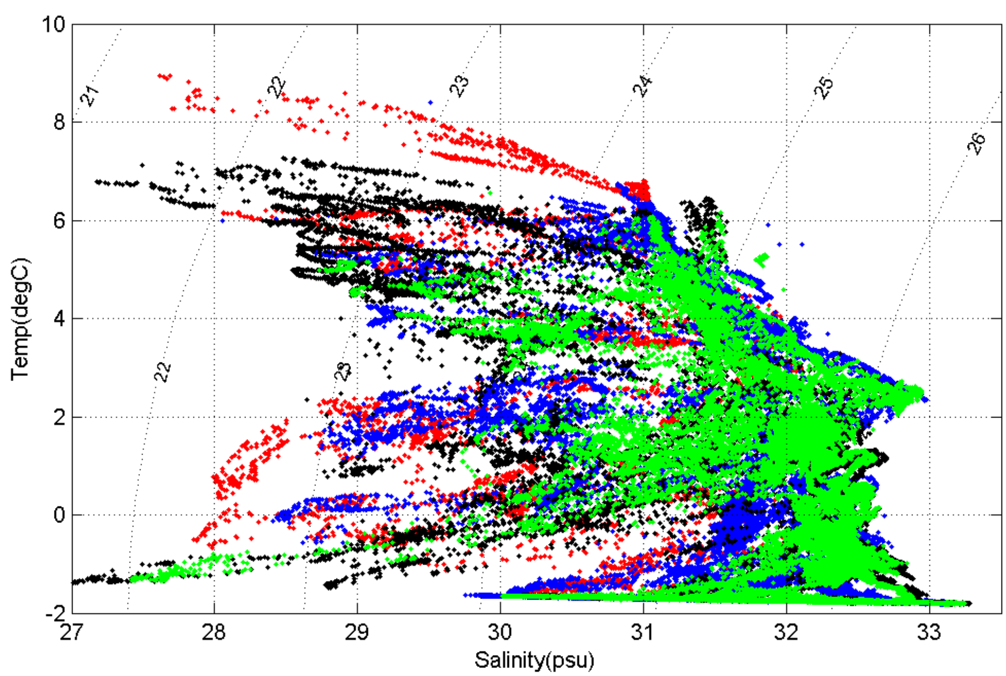




BERING STRAIT 2024-2025 ISCAT PRELIMINARY RESULTS (Ax24 data)

– all upper level TS Sensors



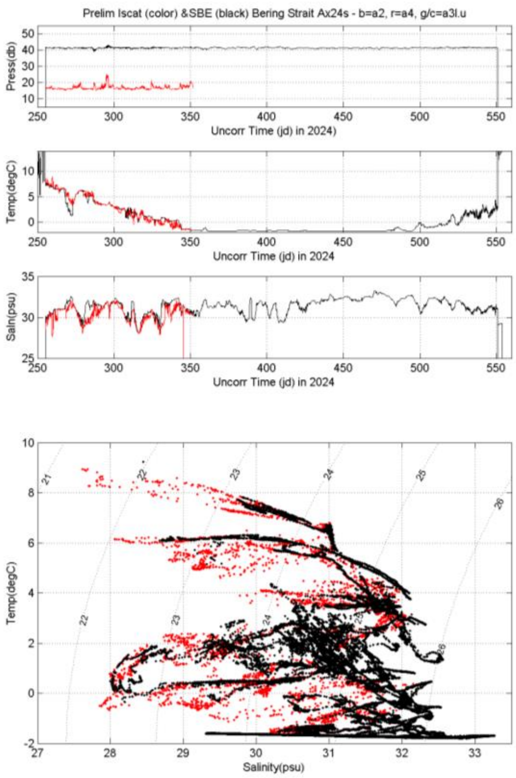


Note generally fresher than the last deployment.
Note also how the iscats move down the water column as floatation is lost.

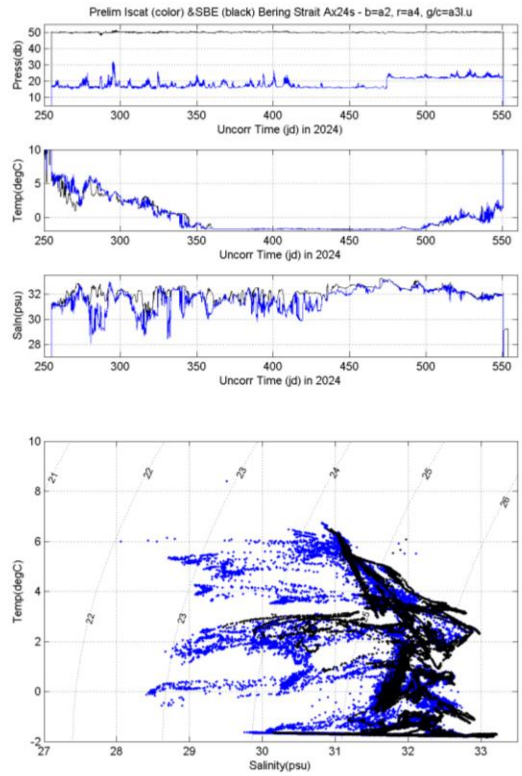
BERING STRAIT 2024-2025 ISCAT and SBE PRELIMINARY RESULTS (Ax24data)

–upper (color) and lower (black) TS sensors by mooring

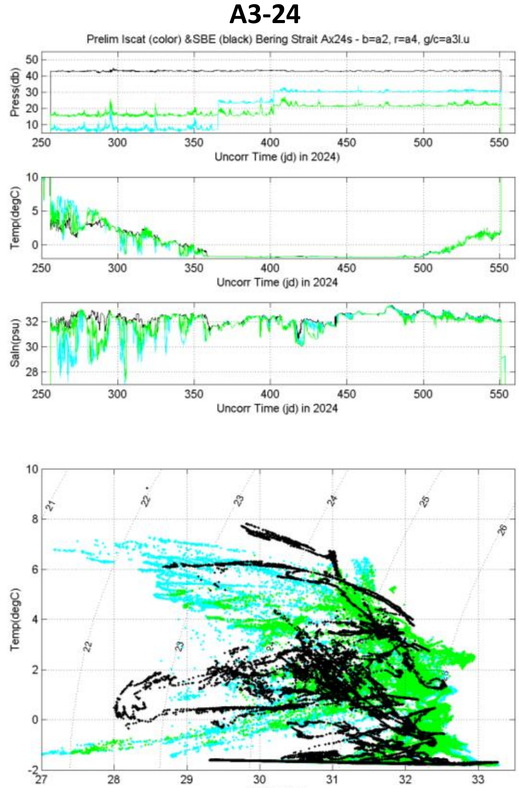
A4-24



A2-24



A3-24

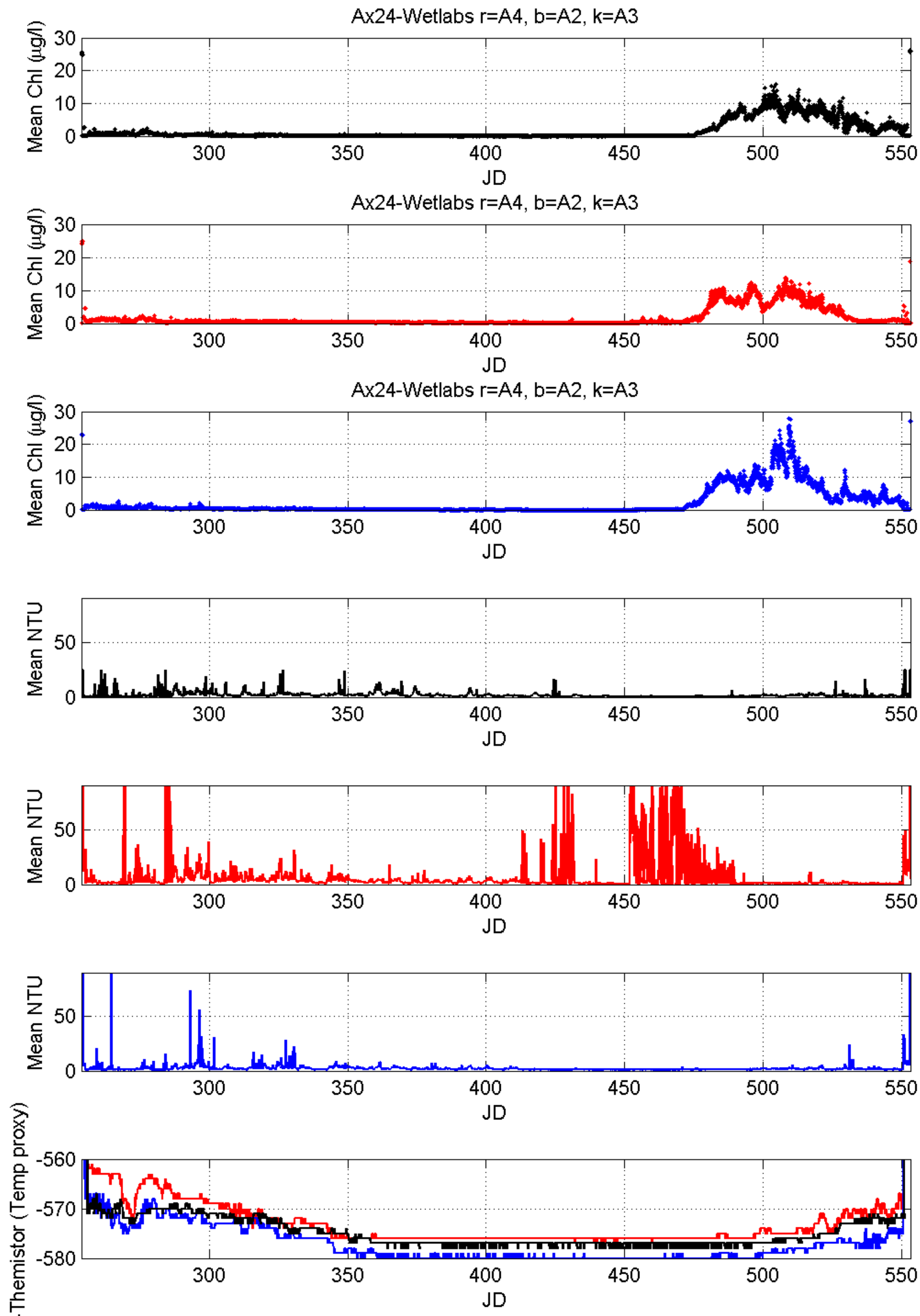


BERING STRAIT 2024-2025 WETLABS Chlorophyll (Fluorescence) and Turbidity
PRELIMINARY RESULTS (Ax24data)

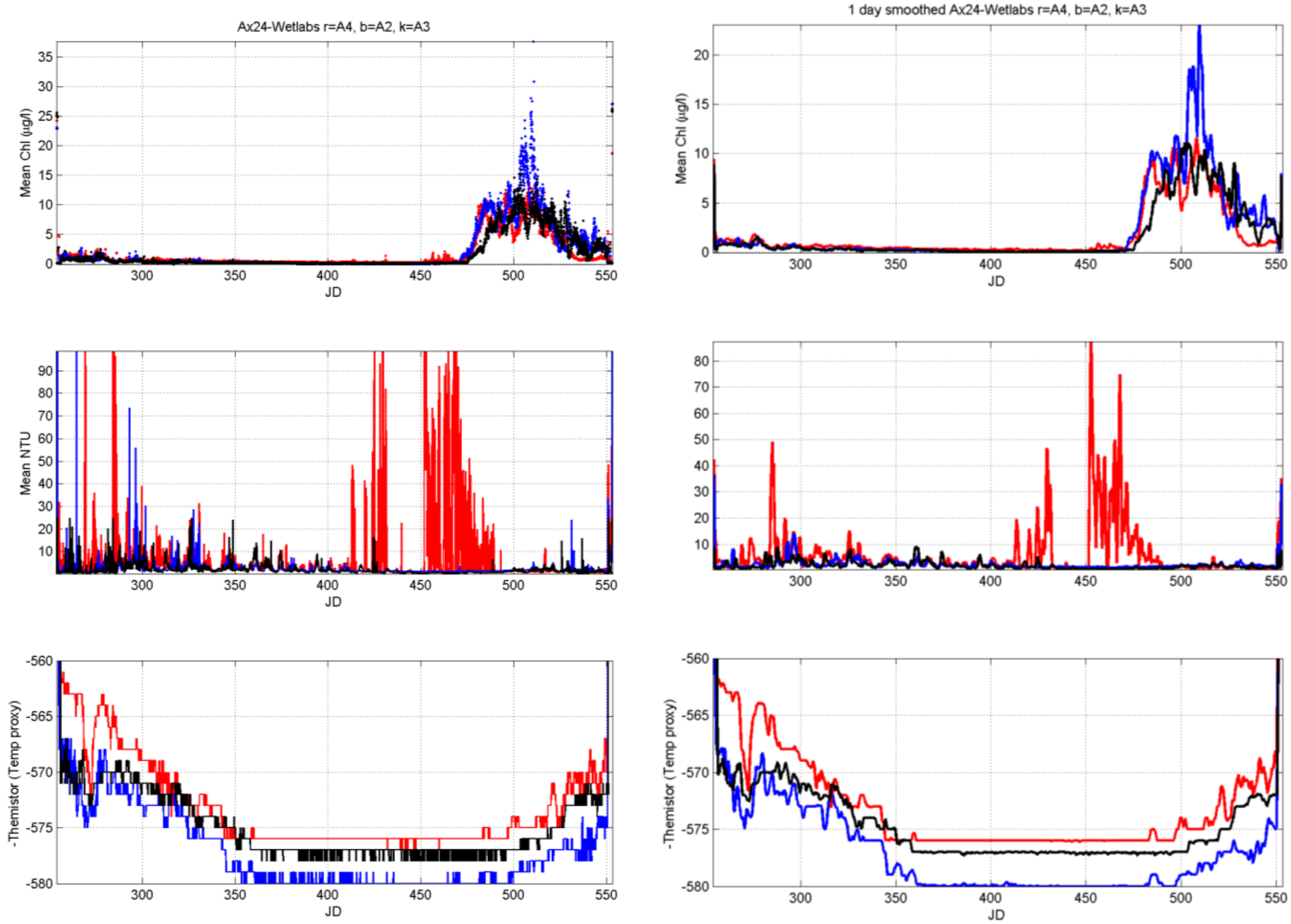
Feb2026 note:
Data given here are calibrated using the pre-cruise calibration.
Post calibrations were requested from Seabird, who provided the updates to the scaling factors. These are summarized in the following table, which includes (final column) the outcome for the data.
Note that the coefficients provided for 7566 are about a factor of two different to the pre-cruise scaling factor. As this is far greater than the expected instrument drift, viz (information from manufacturer)
- fluorescence drift per year: 5% of max signal or 2.6μ/L
- turbidity drift per year: 15% of max signal or 3.75NTU

we suspect there is a range error and the quote post-cruise coefficients for 7566 should be a factor of two smaller. Corrections that would result from that are also given in the table.

	Chl Dark Counts	Chl Scale Factor	NTU Dark Counts	NTU Scale Factor	Chl % change	NTU % change
A3 (black) 1260 -pre	47	0.0121	50	0.0061		
1260 post	47	0.0135	50	0.0062	11% higher So pre is 11% low	1.6% higher. So pre is 1.6% low
A4 (red) 7565-pre	50	0.0121	50	0.0242		
7565-post	50	0.0130	50	0.0245	7.4% higher So pre is 7% low	1.2% higher So pre is 1.2% low
A2 (blue) 7566-pre	49	0.0121	49	0.0242		
7566-post	49	0.0280	49	0.0462	230% higher	190% higher
If 2x off	49	0.0140	49	0.0231	16% higher, So pre is 16% low	5% lower. So pre is 5% high


Ax24-Wetlabs r=A4, b=A2, k=A3
Mean Chl (µg/l)
JD
Ax24-Wetlabs r=A4, b=A2, k=A3
Mean Chl (µg/l)
JD
Ax24-Wetlabs r=A4, b=A2, k=A3
Mean Chl (µg/l)
JD
Mean NTU
JD
Mean NTU
JD
Mean NTU
JD
-Themistor (Temp proxy)
JD

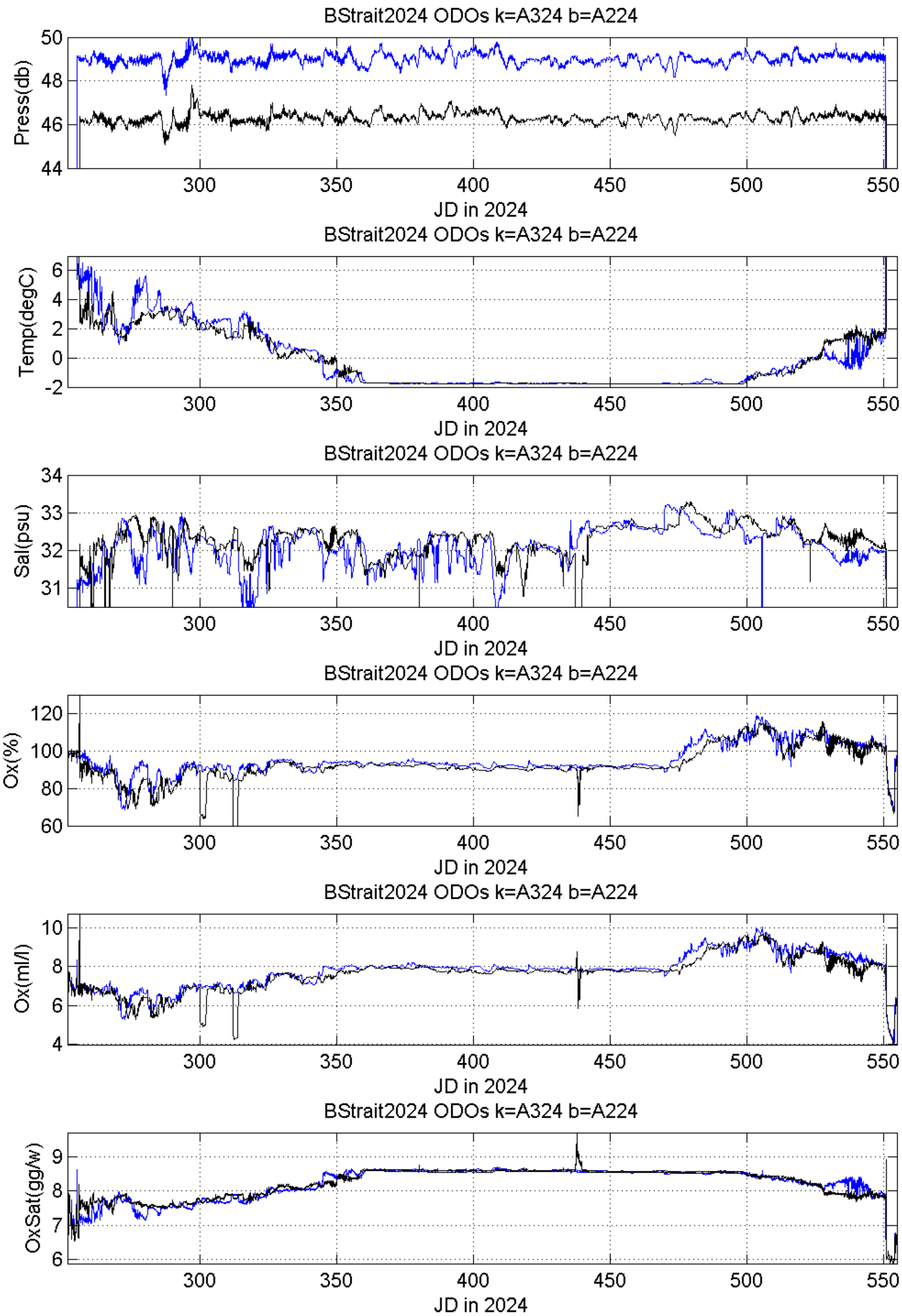
Hourly data　　　1 day smoothed



These preliminary data show a clear spring bloom, occurring while waters are still at freezing, suggesting an ice edge origin. This bloom appears stronger (1-day smoothed data, ~10 µg/l Chl) than last year (~6 µg/l Chl) and to last longer (>50 days, compared to <40 days last year).

A proper comparison with prior years is necessary however to draw firm conclusions.

BERING STRAIT 2024-2025 SBE37-ODO (Dissolved Oxygen)
PRELIMINARY RESULTS (Ax24data)



The dissolved oxygen (DO) timeseries show similar key features to those noted in Woodgate et al., [submitted 2024], viz:

- DO levels falling through summer (secondary production)
- DO levels replenishing in later fall, but not reaching 100%
- Modest decrease during ice covered times,
- And return to oversaturation with the spring bloom.

Notes on SUNA processing (to date only pre-cruise calibrated SBE data are available for this processing) This section will be amended when post cals and nutrient bottle data are available.

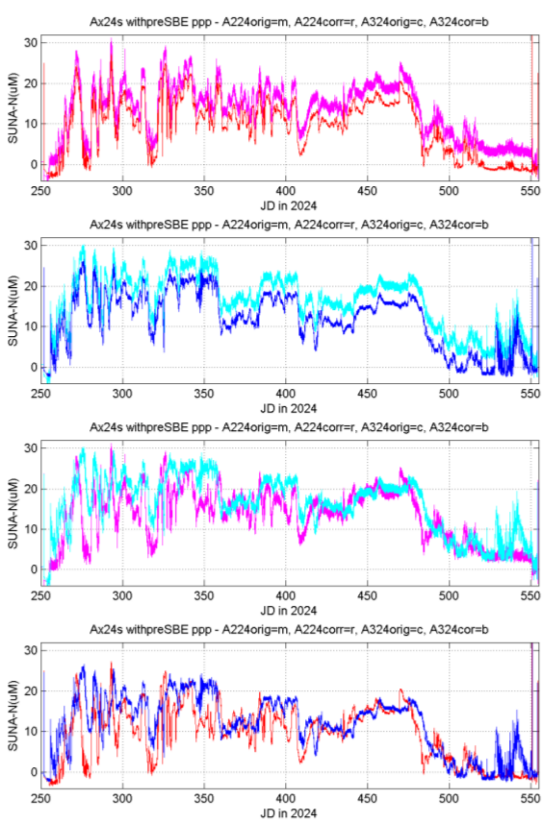
SUNAs on the mooring were processed by the following steps

- pre and post deployment, reference updates were run and stored to the instrument. During these tests a UW nitrate standard, (20.02-20.06µM) was used to test the SUNA readings. Full details are in plots below, but for all our instruments, we find TS corrected SUNA reading are ~22-24µM with this standard. The cause of this discrepancy is unknown.
- using temperature and salinity (TS) data from the preliminary SBE37ODO data file (interpolated to the SBE37 data from the same mooring at times of obvious spikes), SUNA files are corrected for TS [*Sakamoto et al.*, 2009] using the Seabird Software package UCI. This is a substantial correction, typically reducing the SUNA values by ~5µM. This processing is run for both the pre and post deployment references. The difference between the resultant records is a constant. In this year, ~1.2µM for A2 and -0.3µM for A3.

The final data file is created by ramping linearly with record number from the pre to the post deployment reference (For A2-24, 1920, cals D to E; for A3-24, 2018, cals H to I).

Final files are compared to the reference (i.e. distilled water) and standard runs, performed in Seattle pre shipping, in Nome pre cruise and on the ship after recovery, and will be compared to duplicate nutrient samples taken from CTD casts post deployment and prior to recovery when those data are available. (Note these casts do not always agree well with T and S, but agreement to nitrate values is generally encouraging.)

Manufacturer's estimated accuracy is 2µM. With this ramping, (and using precalibrations for the ODO data), SUNA data agree to <1µM for distilled water runs before and after deployment, although there is a larger discrepancy to the UW standard, as discussed above. More information on SUNA quality should be obtained once the nutrient bottle data are available.



LEFT: Comparison of raw to TS corrected data.

Red= A2final, Magenta = A2 before TS correction.
Blue = A3 final, Cyan = A3 before TS correction**.**

SEE NEXT PAGE FOR FEB 2026 update with postcals and bottles.

Feb 2026 update: FINAL MOORING SUNA PROCESSING

Now available are: - bottle samples from 2025
- final TS calibrations for the ODO files.

For A2-24, only precalibration ODO file is available (as postcal differed from the test tank).

For A3-24,

- postcal ODO file now available and used.
- Difference is max 0.01degC and 0.02psu, yielding a change of only 0.04µM in nitrate.
- ODO salinities have occasional problems (suspected biofouling), making the ODO density less than that at the overlying SBE. At those times the salinity data from the overlying SBE is used instead.

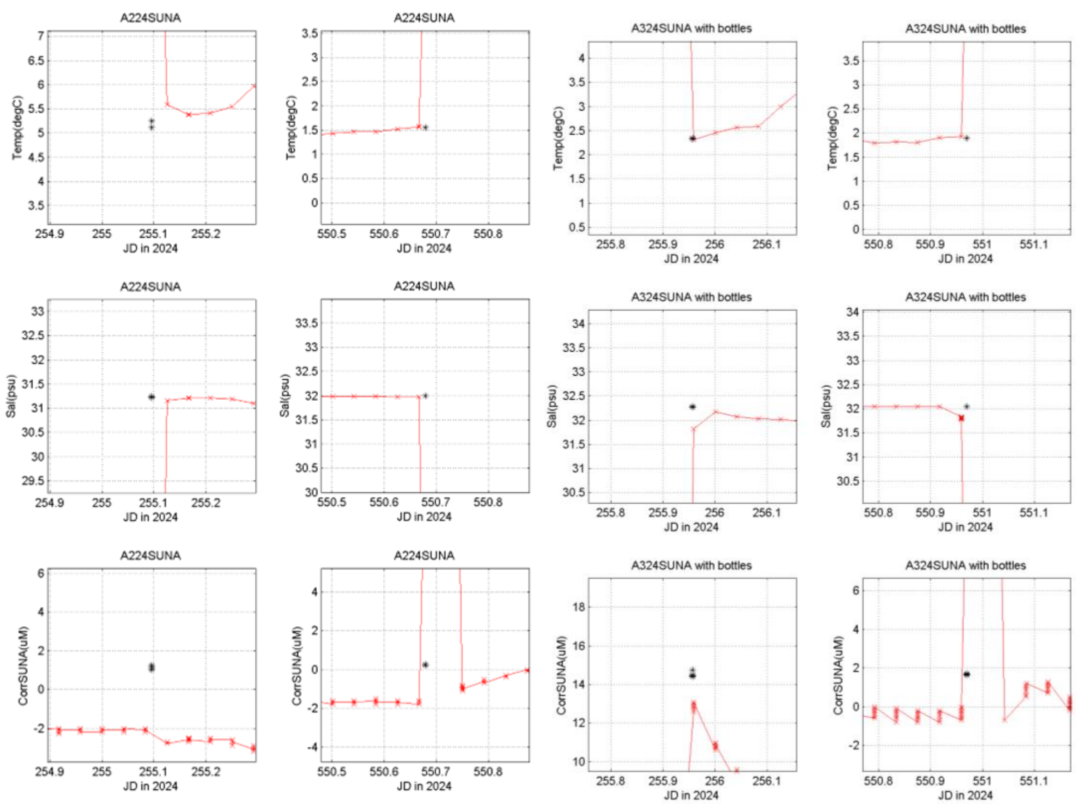
As in previous years, data are linearly interpolated from the pre cal to the post cal.

The resultant timeseries agrees well with the zeros of the distilled water/standard tests pre and post cruise:

What	**Nome**				**Post**		
Sample:	**0µM**	**20.02µM**	**0µM**		**0µM**	**20.06µM**	**0µM**
Difference (SUNA – sample) /µM							
A2-24 D to E	0	4-5	-1		0	2	0
A3-24 H to I	0	4-5	-0.5		0	1-2	-1-0

Note as happens every year, the readings of the 20µM standard are too high.

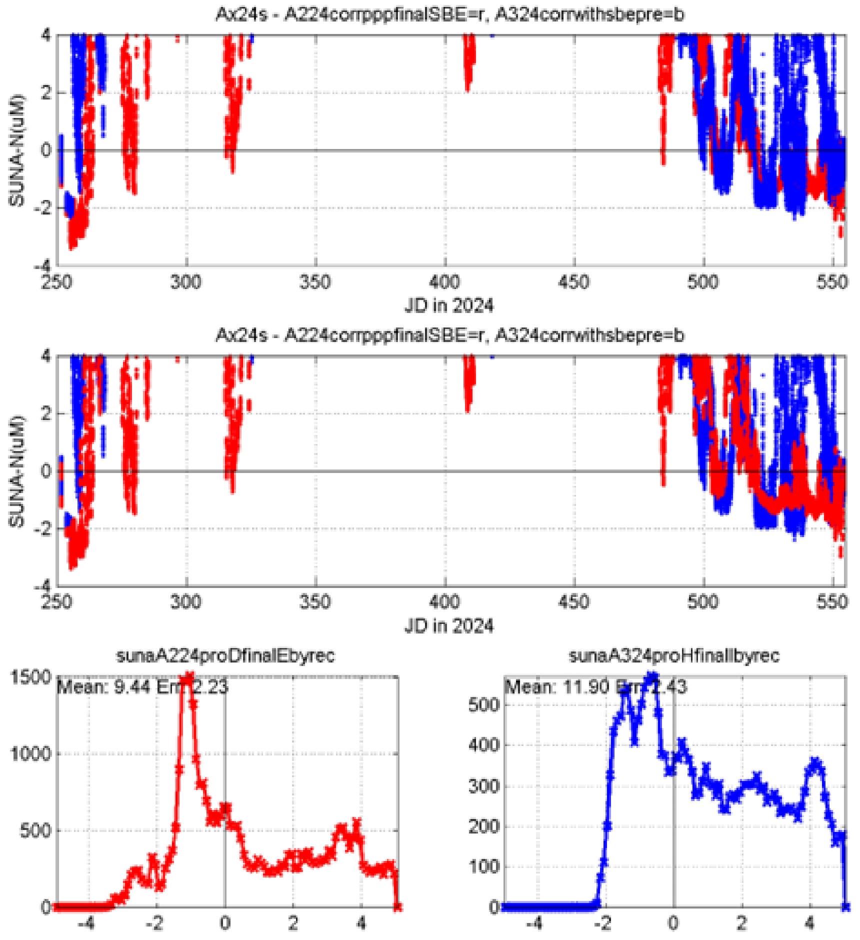
But this data product is low compared to the bottles samples taken just after deployment and before recovery



A2 – deploy – SUNA 3µM too low AT ODDS with ZEROS which was 0 and -1
- recovery – SUNA 2µM too low AT ODDS with ZEROS which was 0 and

A3 - deploy – SUNA 2µM too high AT ODDS with ZEROS which was 0 and -0.5
- recover – SUNA 2µM too high AT ODDS with ZEROS which was 0 and -1

Moreover, these final data sets have significant number of values that are below zero:



This discrepancy between ondeck calibration and in the water comparison to bottles is the same as found for the CTD-SUNA, with in-the-water samples suggesting the SUNA is 2µM too low.

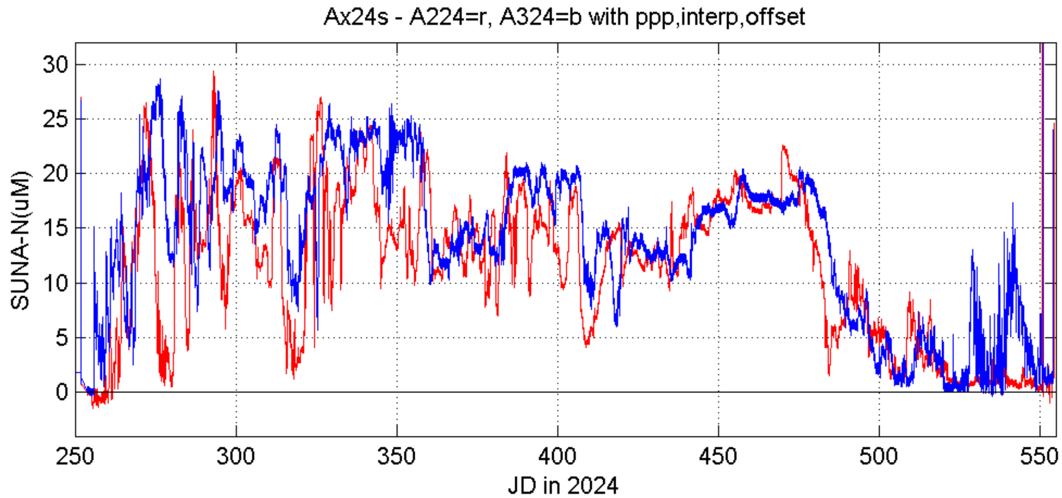
Given all these lines of evidence (primarily, agreement to the bottles AND the otherwise negative SUNA values for parts of the time-series, we chose to add 2µM to the pre-post interpolated data record to give the final data.

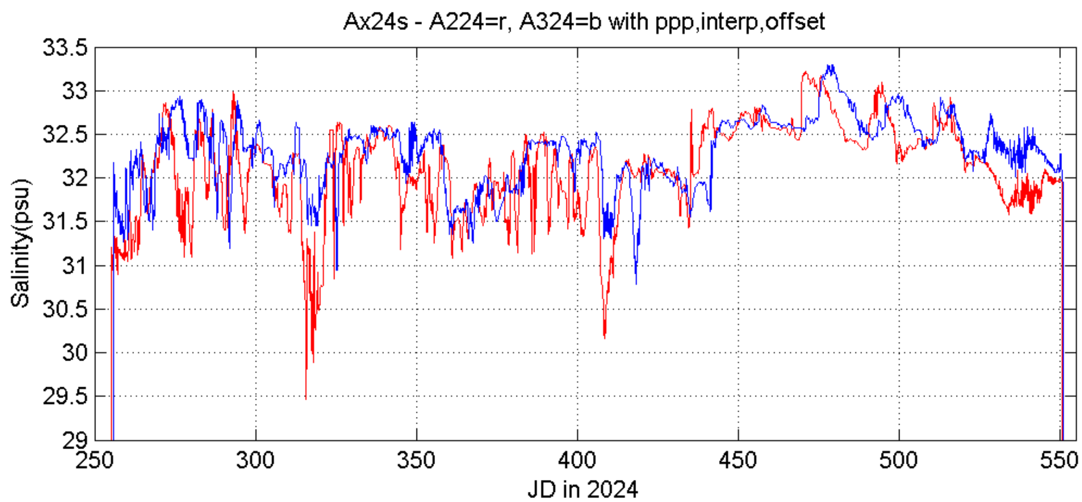
** WHEN COMPARING BETWEEN INSTRUMENT YEARS, BE SURE TO CHECK FOR THESE OFFSETS.

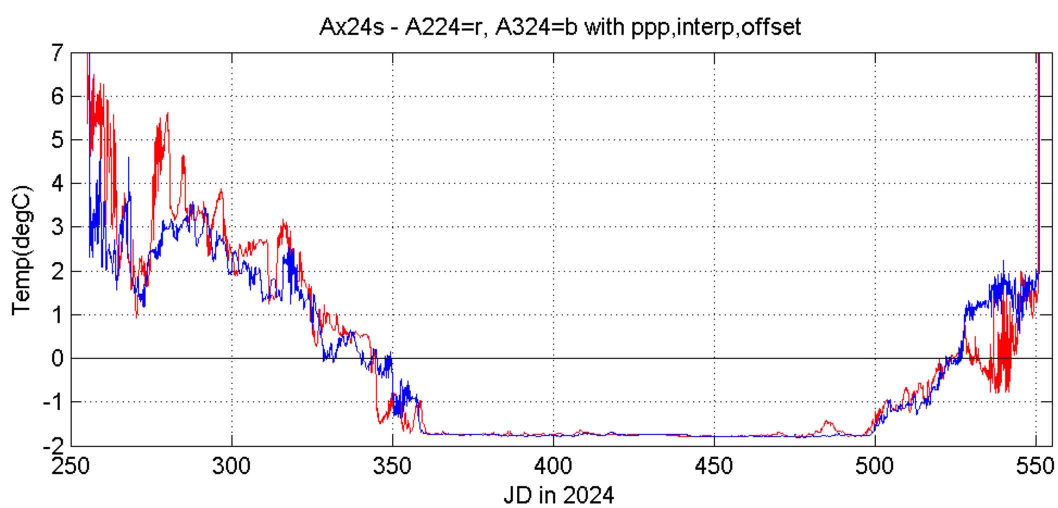
With these corrections, we take the final accuracy of the SUNA to be ~2µM.

BERING STRAIT 2024-2025 SUNA (Nitrate) - with final corrections described above

(Note record has been adjusted by 2uM to match bottles and remove negative nitrate concentrations







.

CTD OPERATIONS (Whole Science Team)

As in previous years, in 2025 the moorings were supported by annual CTD sections. This year, these sections were run with a CTD rosette system to allow bottle samples to be taken. This is in addition to the separate pumped system was used to take trace metal and nutrient samples.

The CTD rosette system used on this cruise was loaned from APL-UW and, used the same instrumentation as in previous years, other than the altimeter was replaced with a SUNA nitrate sensor with external battery pack (which required the space of one of the bottles of the rosette). Serial numbers and calibration dates are given here. The system was sent for calibration pre-cruise, in Winter24/Spring25 and these calibrations are used for the plots in this report.

one SBE9+ with pressure sensor
(SN26451 – calibration 17th June 2019 (Not calibrated pre cruise)
two SBE3 temperature sensors
(T1 = SN0843 – calibration 25th Feb 2025)
(T2 = SN0844 – calibration 4th March 2025)
two SBE4 conductivity sensors
(S1 = SN0484 – calibration 31st Jan 2025)
(S2 = SN0485 – calibration 5th Feb 2025)
two SBE43 oxygen sensors
(Ox1 = SN1753 – calibration 11th March 2025)
(Ox2 = SN1754 – calibration 17th April 2025)
one Wetlabs FLNTURT fluorescence/turbidity sensor (SN1622 – calibration 11th March 2010)
on SUNA nitrate sensor (SN1916, calibrated by Seabird January 2025, reference update pre cruise)
two Seabird pumps (believed to be SN50340, SN55236, but not confirmed)
one EG&G transponder (D-CAT SN31892, Interrogate: 11.0kHz, Reply: 13.5kHz)

The temperature, conductivity and oxygen probes were paired as last year, viz:

	Temperature	**Conductivity**	**Oxygen**	**Pump**
Primary	#843	#484	#1753	SN NA
Secondary	#844	#485	#1754	SN NA

With the rosette system, the sensors are mounted horizontally below the rosette. Care must be taken that they are installed the correct way around as the rosette frame is not symmetric, and only in one orientation are the sensors protected by the cage. **Action item Check mounting before shipping from Seattle**.

The CTD was connected to a conducting wire winch on the ship. This winch (Rapp Hydema NW, SOW 160 5000m capacity, with 3 conductor 0.322"diameter wire), was new on the Norseman II in 2014. Chris Siani, APL, assisted with wiring and CTD tests of this system while the ship was in Seattle in April 2014. In 2022, we found the termination had been changed by the prior cruise. We reterminated, but the test cast failed however, and eventually this was traced to a leak in the termination. A second retermination was successful. In 2023 and 2024, no retermination was necessary until near the end of the cruise, when it was found that the outer casing of the winch wire was starting to fray. This was noticed during the SBS line, and various mitigations were attempted (wrapping in tape – uneffective; whipping with twine – effective, but time consuming). Thus, at the end of the SBS line (which was moved to lower resolution to allow it and the BC line to be finished before the storm), 150ft of wire was cut off the CTD wire and the wire was reterminated. Although typical curing is 24hrs for this retermination, we found the compound was well set after 2hrs and we recommenced operations successfully after 2hrs 45minutes. **Action item: Bring several termination kits. Know that the termination may be sufficiently set after 2hrs.**

The winch was connected to an SBE11 deckbox, which in turn was linked via serial ports and USB-serial connectors to a dedicated PC, running the software package Seasave v7. Data were recorded in standard hexadecimal SBE format, incorporating NMEA GPS input from the Norseman II. **Action item: Check which GPS used, and that the date is not subject to the roll over error.** In 2024, jumpy mouse issues were resolved by unplugging the GPS cable from the ship's socket, restarting the computer, and then replugging in the GPS at the wall as the system was starting. In 2025, no such problems were encountered. **Action item: Write serial port numbers for the various components on the white board for reference**

An event log (copied attached at the end of this report) was maintained on the CTD computer, including comments on data quality and other issues. The log, the data files, and a screen dump of the end-of-cast Seasave image were copied to a thumb drive as a backup after each cast.

The CTD console was set on the port side of the interior lab. The package was deployed through the aft A-frame using a special block supplied by the ship. During the cruise, this block needs to be repeatedly lowered and remounted to accommodate other operations/to stow for transit. The block has hinged strain relief fairleads, and in 2024, we noticed that at times it has been mounted incorrectly so the wire wears on the fairlead metal rather than on the pulley on these fairleads, with the strain having bend the fairleads such that the wire can only be removed by prising the fairlead open. By removing the wire from the fairleads and lifting the block, one can swap the two hinged strait relief fairleads ensuring the wire runs on the pulleys, **Action Item: Check if block needs repair. Ensure block is correctly mounted for future operations**. Although a Pentagon ULT unit had been mounted inside by the CTD console for lowering and raising the CTD, in practice, the winch driving was done by a crew member on deck, directed by the CTD operator using radio commands. This was deemed more efficient given the shortness of the casts (50m or less).

As in previous years, in 2025 the crew operated the winch from a remote console on the deck by the A-frame. The lowering (and raising) rate we seek is ~30 or 40m/min. There is no readout of winch speed at the remote console and winch drivers had to estimate speed either from the sound of the winch or from feedback from the scientist in the lab. **Action item: Be sure to calibrate in winch speed early in the cruise, preferably with some scale on the winch so the speed is consistent between operators. Update ship's winch so as to provide a speed readout by the remote console. Also, train CTD driver to check winch speed on read-out beside CTD console both for lowering and raising.**

For the casts done during mooring operations, the CTD was hand-carried forward after each cast to the port-forward corner of the aft-deck, to clear the aft-deck for mooring work. Once all the mooring work was complete, the CTD package was kept on the aft deck.

After the penutlimate cast, the bottles were left cocked overnight and in the morning it was found that almost all the rubbers were loose. **Action item: Always close bottles unless actively running a line.**

Once mooring work was complete, CTD operations were run 24hrs, using a team (per watch) of 1 science team member driving the CTD, and up to 3 personnel (2 ship, 1 science) on deck - one (ship's crew) driving the winch, one ship's crew on starboard side of deck, one scientist on port side of deck. Since the aft doors were open so as to not lift the CTD too high, all personnel on deck wore harnesses and were attached to the "dog runs" overhead wires. Early in the cruise, we trained the team in tag-line operations, where the two people on deck (not driving the winch) used APL-supplied snap hooks on poles to get a line onto the frame of the rosette. **Action item: Continue to train this early in the cruise.**

A surface soak depth of ~5-7m has become standard for us, although some casts this year only used 2m. **Action item: Add target soak depth of 5-10m to CTD instructions**. (Two m is too shallow and could cause issues if we have heavy seas.)

The efficiency of the crew made for very speedy CTD operations, and combined with the fast winch speed, resulted in commendably fast times for running line, though significantly slower than using the non-rosette system. If pumped samples were to be taken, this operation followed on immediately after the CTD cast without the ship repositioning. **Action item: Make sure the CTD is recovered and out of the water before the pump system is deployed, otherwise ship's manoeuvrability is compromised**.

Prior to each cast the turbidity sensor was cleaned by rinsing with soapy water and freshwater and wiping.

On several casts, jellyfish (ono) became stuck in the seawater intake of the CTD, requiring flushing of the cell on deck using a syringe. **Action item: Continue to bring syringe with better fit for flushing the CTD cell.** Instigate a routine flushing of the cells with salt water at the start of the cruise and every 10 casts (and mark these flushings in the event log.

While bottles generally functioned well, there were some issues:

- internal rubbers had to be tightened on several bottles. **Action item: NEVER leave the CTD cocked for any length of time. Check these before shipping. Carry several spares. Continue to bring the spare bottle**

- spigots on some bottles became very hard to open. **Action item: Check out.**
- check vents at top of bottle, some needed to be done up very tight to be airtight. **Action item: Check out.**
- continue to bring the better CTD mat. **Action item: Order CTD mat**

Ship's draft was estimated at 2m, and this should be taken into account in viewing the data. Also given that sea states were often significant and the altimeter on the CTD (which usually rarely functioned) was not used this year, some casts stop 5m-6m above the bottom. **Action item: Investigate altimeter use in future years.**

NOTE: In calm weather, more focus was put on attempting to fly the CTD to the altimeter reading, believing that still to be 2m above bottom. However, on 2 of these attempts (cast 56 and cast 125), the CTD wire went slack indicating the CTD had hit bottom. (On the second of these, as the CTD was recovered with slack wire, the level wind failed and we had to seek deeper water to redeploy the CTD beyond this depth so the wire could be correctly respooled.

On cast 56, sounder readings were 55.3m before and after the cast, and the maximum pressure of the CTD was 55.57m

On cast 125, the sound reading before the cast was 56.6m, but 55.7m after, and the maximum pressure of the CTD was 56.3m.

If the sounder reading were accurate, both casts should not have hit bottom.. However, likely the sounder is using a speed of sound of 1500m/s, and local water conditions yield speeds of sound around 1450m/s. In 50m of water, this means, the sounder could be reading around 2m too deep, and thus the sounder reading likely is very close to the actual water depth (as this 2m is comparable to the ship's draft), and thus for a safe buffer, we should fly to the sounder reading -the buffer (say 2m).

Note also that Seasave's conversion of pressure to depth corrects only for latitude and assumes a density of water equivalent to 35psu, and 0 deg C, i.e. around 1028kg/m3, while our densities are generally less, around 1024kg/m3. Thus the depth output from seasave is erroneously low, by ~0.2m.

Lessons learnt and future plans:

- water depth is most likely close to the sounder reading, meaning our typical procedure (to stop 2m above the sounder reading) is likely bringing us to with 2m of the bottom.

- continue to follow this protocol (i.e., target depth = sounder depth -2m, or more in rough weather)

- follow PRESSURE (not depth) to decide when to stop the CTD,as in these waters pressure in db is closer to actual depth in m than the Seasave conversion

As in 2022, a SUNA nitrate sensor was added to the CTD package. As this requires significant current on start up, it was powered by an external, rechargeable battery, as per a design from Seth Danielson. When the CTD powers on, this activates a relay in the external battery which turns on power to the SUNA. Two battery packs were constructed so one could be charging while one was in use. A newly charged one of these SUNA battery packs is ~12.8V. We aim to swap the battery before it falls below 11.9V. We estimate that a safe usage time for the battery before reaching this threshold is 500minutes, and on-time of the SUNA is logged in the event log. In 2024, the SUNA battery was swapped after an on time of 316minutes and had a voltage of 12.3V. In 2025, the SUNA battery was swapped after an on time of 485 minute, and still had a high voltage.

Action item: Make summing of SUNA time automatic in event log, and record voltage when battery changed.

The SUNA returned a voltage to SeaSave, which gives a rough estimate of nitrate. Proper calibration of this data stream is still required. **Action item: Process SUNA data once CTD data final.** Plots in this report use the raw SUNA data as recorded In seasave. .

In 2025, the SUNA returned good data on all casts. In the past, the SUNA has failed to return good data on some casts and that problem was fixed by cleaning the connections on the cable between the CTD and the SUNA.

Overall, CTD data this year are very clean, although the following issues were encountered.

1) Jelly fish were a significant problem, not infrequently clogging one of the CTD systems, and sometimes (cast 21) requiring the CTD to be recovered and cleaned before the cast. Both systems encountered issues, but S1 had fewer problems. Thus we recommend using S1, other than on

casts 101 (upcast) and
up and down casts of 124 and 126 when S2 should be used.

2) Oxygen sensors agreed to within 1% typically, though Ox2 encountered issues on cast 19, so we recommend using Ox1 throughout.

3) Frequently upcasts were interrupted, either for normal bottle firing, or for fixings of the CTD wire. Thus, as small spatial scale variability is common in the region, we recommend using the down cast for the vertical profile.

The following interesting features were also observed:
1) High surface oxygen at BS13 and BS13.5
2) a thin (~5m) warm fresh surface layer from BS16 to coast and intermittently on SBSnn and BC lines
3) generally very little salinity gradients
4) interesting features during long surface soaks, including large temperature changes

BC3 – 2 deg
AL19 and BS18.5 – 4 deg
See also DL2 and BS15.5

Processing details (given below) are as in previous years, with the addition of the corrections of the SUNA data to be added once the post-cruise CTD calibration is complete.

BStrait 2025 CTD PROCESSING – 11th August 2025 – using pre cruise calibrations:

Last column shows restrictions for BAD (Bin Average Down) ; 1st Col green = with nutrient samples

Cast	Stat	T1	S1	Ox1	T2	S2	Ox2	Notes	For BAD
0								Deck check can be discarded	
1								In water test – also can be discarded	
19	BS16.5				XA	XA	XA	T2, S2 bad after surface soak, T1, S1 ok . Ox 2 bad	USE S1
21								Aborted due to T1, T2 disagreement - discard	
23	BS15							Yoyoed at surface – but processes ok	
33	DL2							Up and down T very different	
36	DL5							SUNA bad until return to surface – check prob ok	
56	DL18.5							Hit Bottom	
59	A3					XU		S2 bad on way up, S1 ok	
60	Al12.5					XA		S2 bad all cast (prob missed from previous	USE S1
73	AL19							T changes 4 deg during long surface soak for jelly	
78	AL21.5							First S change, and only at surface	
83						XU	XA	S2 bad on up, Ox2 bad on all	USE Ox1
84							XA	Ox2 bad on all	USE Ox1
89	AL27							Interesting T profile – subsurface T Max	
96	BS13							Hi Ox in surface layer	
97	BS13.5							Hi Ox in surface layer	
101	BS15.5		XU					S1 bad for pt on up, and v different T structure	
102	BS16							Very thin warm fresh surface layer	
103	BS16.5							Very thin warm fresh surface layer	
104								Very thin warm fresh surface layer	
105								Very thin warm fresh surface layer	
106	BS18							Very thin warm fresh surface layer	
107	BS18.5							Soak 4deg T var. + thin warm fresh surface layer	
108	BS19							Very thin warm fresh surface layer	
115	SBSnn1.6							Very thin warm fresh surface layer. Bot wire fix	
116								Very thin warm fresh surface layer	
117	SBSnn2.5					XD		Very thin warm fresh surface layer. S2 bad down	USE S1
120	SBSnn3.5							Long waits to fix the wire	
124	SBSnn5.5		XA					Long wire fix. S1 suspect all cast	USE S2
125	SBSnn6							Very thin warm fresh surface layer. Hit bottom	
126			XA					To fix wire. Off SBS, not to bottom. S1 0.2psufresh	USE S2
127	SBSnn6.5							Yoyoed upcast – but processes ok	
128								Long wire fixing	
130								Long wire fixing	
135	SBSnn13.5E							Finally some signal in SUNA	
152	BC4.5							Very thin warm fresh surface layer	
153	BC4							Very thin warm fresh surface layer	
155	BC3					Xp		S2 prob, fixed before down. T oscill on soak	
159	BC1							Odd T structure at Bottom (shallow)	

REST OF CASTS OK. X=bad data; U=upcast; D=Downcast; A=both up and down; p=pre going down.

Summary of casts:

0 deck check 1 in water test cast

2,3,4 – recovery 5,6,7 – deployment

8-31 – BS22 – BS11 (Skip 21 - recast

31- 59 – BS11 through DL to A3

59- 90 – A3 and AL line

91 – A3 again

92-114 – BS11-BS22

114 -135 – BS22 down SBSnn with 126 being off the line deep wire fix

136 –159 - BC12.5 to BC1

159-162 – repeat casts at BC1

<u>NOTES ON BERING STRAIT 2025 CTD PROCESSING</u> Rebecca Woodgate (based on 2019processing)

Start with files from SeaSave for each cast, i.e.,

BStrait25nnnn.hex and BStrait25nnnn.hdr

Then run through 9 steps (8 of them with SBEDataProcessing program from Seabird).

=== 1) First make up a file to be used for quick plotting. This contains all variables, but is not corrected in any way.

IN SBEDATA PROCESSING, RUN: DATA CONVERSION

(PSA file for this = 001_DatCnvBStrait2025_allvarswithSUNA.psa)

Inputs are: BStrait25nnnn.hex and BStrait25nnnn.hdr

*In FILE SETUP

-- CHECK box on match instrument to configuration file

-- Choose input file (should be .HEX) and directory

-- Name append .rw1

-- Choose output directory

*In DATA SETUP

-- Convert data from:UP and downcast *(Last year we just did down as we were firing no bottles. Here we do both, noting that upcasts may differ because of water being swept up with the CTD.)*

-- Create file types: data (.CNV) only *** NOW Cast and bottle data ... *** USING .BL File

...—Merge Header file

-- Select output variables... we use

-- 1) Pressure, Digiquartz (db)

-- 2) Temperature (ITS-90, degC)

-- 3) Temperature,2 (ITS-90, degC)

-- 4) Conductivity (S/m)

-- 5) Conductivity, 2 (S/m)

-- 6) Oxygen raw, SBE 43 (Volts)

-- 7) Oxygen, SBE 43 (saturation)

-- 8) Oxygen raw, SBE 43, 2(Volts)

-- 9) Oxygen, SBE 43, 2(saturation)

-- 10) Fluorescence WET Labs WET star (mg/m^3)

-- 11) Upoly 0, FLNTURT

12) Scan Count % This was done in 2018, but not recorded in the write up

-- 13) Salinity, Practical (PSU)

-- 14) Salinity, Practical, 2 (PSU)

-- 15) Time, NMEA (seconds)

-- 16) Latitude (deg)

-- 17) Longitude (deg)

-- 18) Altimeter (m) *** NOW USER POLY 2, which is SUNA

-- 19) Pump Status

-- Source for start time in output .cnv header: Select NMEA time

*In MISCELLANEOUS

-- Keep all defaults. Note the Oxygen is Window size (2s), Apply Tau Correction, Apply Hysteresis.

But now we want

A) to replace Alt with SUNA ...in col 18

b) to do bottle file also. ... so ---- do bottle and data

--- source is bl file

THIS GIVES files called: BStrait25nnn.rw1.cnv

BStrait25nnn.rw1.ros – for casts with fired bottles

=== 2) Do first basic quality control by plotting everything in Matlab**

Matlab master code = **testplotsBStrait2018RW.m** which calls subroutine **CTDQCpump.m**

Inputs are: BStrait18nnn.rw1.cnv

Checks here include:

--- that the pump comes on

--- that the altimeter is working

--- that T1=T2, S1=S2 and Ox1=Ox2

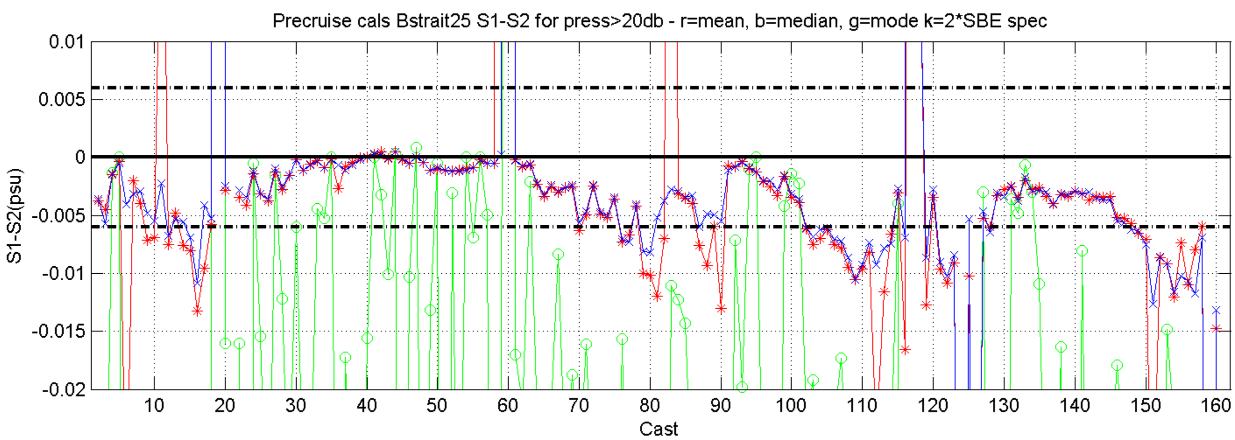
--- preliminary identification of spikes and other issues.

.. mostly ok – see summary of notes above.

Next Look at the difference between salinity sensors:

Feb2026Note: Spec is mislabelled here.

SBE3/4 have specs of 0.001degC and is 0.0003S/m, but when converted to a salinity of 0.008psu at these Temperatures/salinity. Thus, to agree within specs, the sensors should agree to 0.011psu.

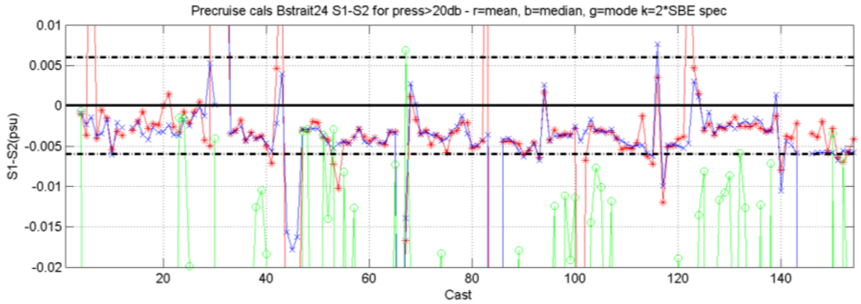


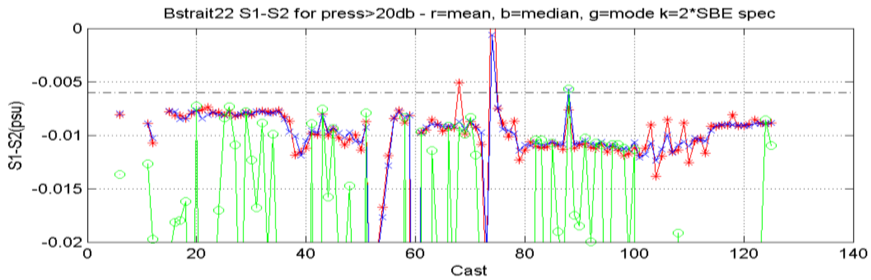
Sensors were flushed at the following casts (according to event log, which may miss some flushings)

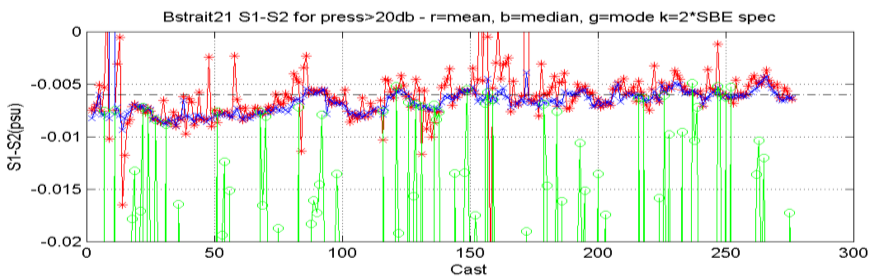
6 – S1
11 both
16 – S1
17 -both
19 S2
20 – both
21 – both
60 S2
83 S2
97- both
112 – both
113 – both
124 both.

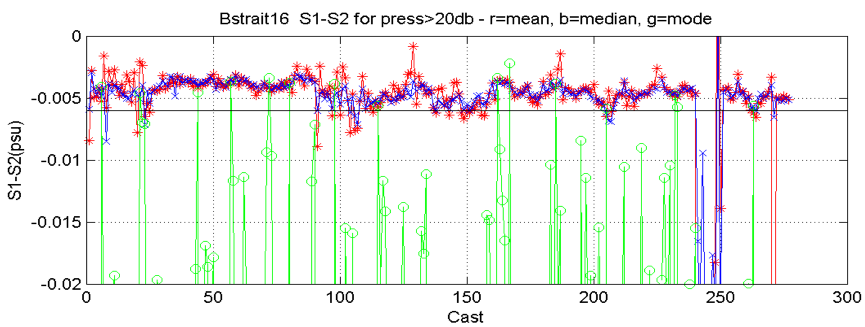
Action item: In future, flush system at start of cruise and every 10 casts.

Here are older ones to compare









=== 3) Now work through the 7 steps of SBEDataConversion. Start by applying the calibrations to get the converted files, but this time excluding all the derived variables.
IN SBEDATA PROCESSING, RUN: DATA CONVERSION
(PSA file for this = DatCnvBStrait2025_CTDforprocess.psa)
Inputs are: BStrait25nnnn.hex and BStrait25nnnn.hdr
*In FILE SETUP
-- CHECK box on match instrument to configuration file
-- Choose input file (should be .HEX) and directory
-- Name append NONE
-- Choose output directory
*In DATA SETUP
-- Convert data from:UP and downcast *(Last year as here, we do both, noting that upcasts may differ because of water being swept up with the CTD.) *** ADD WiTH BOTTLES AND ** ADD .BT FILE*
-- Create file types: data (.CNV) only
...—Merge Header file
-- Select output variables... for 2018 we use
-- 1) Pressure, Digiquartz (db)
-- 2) Temperature (ITS-90, degC)
-- 3) Temperature,2 (ITS-90, degC)
-- 4) Conductivity (S/m)
-- 5) Conductivity, 2 (S/m)
-- 6) Oxygen raw, SBE 43 (Volts)
-- 7) Oxygen raw, SBE 43, 2(Volts)
-- 8) Fluorescence WET Labs WET star (mg/m^3)
-- 9) Upoly 0, FLNTURT
-- 10) Scan Count
-- 11) Time, NMEA (seconds)
-- 12) Latitude (deg)
-- 13) Longitude (deg)
-- 14) Altimeter (m) ** REPLACE WITH SUNA (UPoly2)
-- 15) Pump Status
** 16) BOTTLES FIRED
-- Source for start time in output .cnv header: Select NMEA time
*In MISCELLANEOUS
-- Keep all defaults. Note the Oxygen is Window size (2s), Apply Tau Correction, Apply Hysteresis.
THIS GIVES files called: BStrait25nnnn.cnv and BStrait25nnn..ros

=== 4) Second step of SBEDataProcessing. Apply a time filtering to the data.
This step allows us to time-filter (i.e., smooth) the data. Routine allows us to select two filters, A and B. In 2014, we used A = 0.5 sec and B=0.15 sec, but in 2015 this appeared to remove too much variability.
Manual for the SBE9plus suggests to not filter Temperature and Conductivity, but to filter pressure at 0.15s. So set A=0, and B=0.15 and then only filter pressure *(this is now the same as 2015, but different to 2014).*
Note these filters should be applied to the raw data (e.g., Ox voltage, Conductivities), not the derived data (e.g., salinity, oxygen saturation, etc).
IN SBEDATA PROCESSING, RUN: FILTER
(PSA file for this = FilterBStrait2025_CTDforprocess.psa)
**** Might filter SUNA here ... and not sure what to do about bottle files**

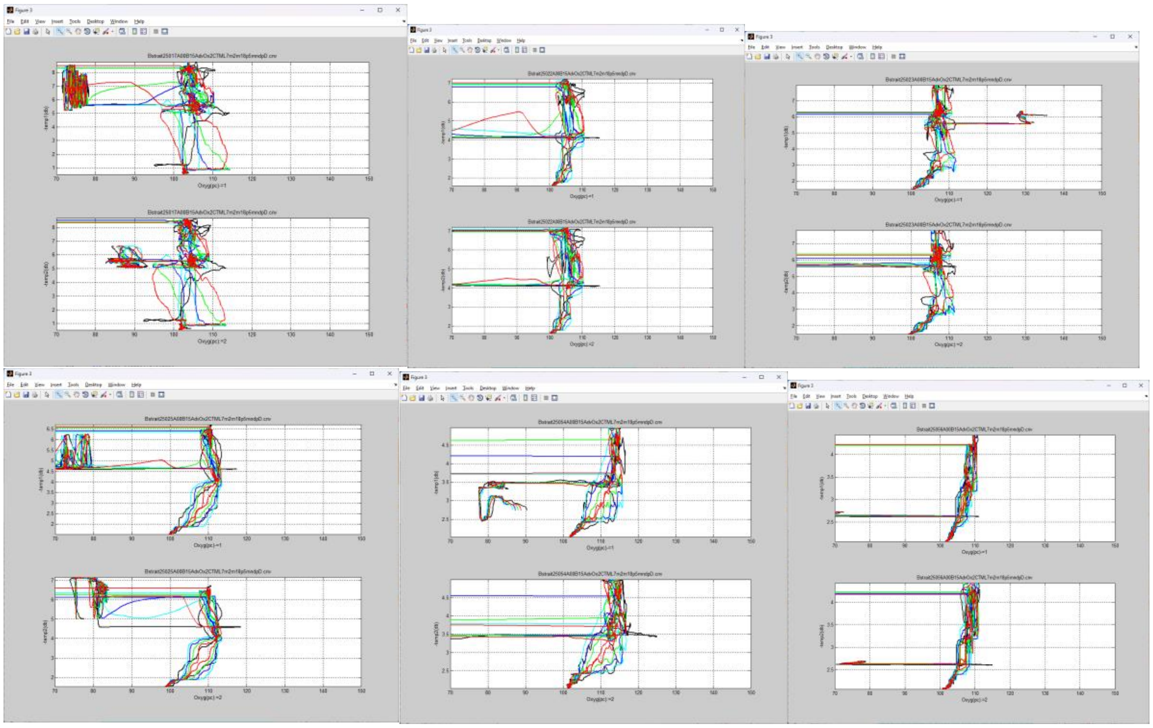
Inputs are: BStrait25nnnn.cnv

*In DATA SETUP
-- Lowpass filter A(sec): 0.0 *(was 0.5 in 2014, but this seemed too smooth in 2015, so used 0, as here)*
-- Lowpass filter B(sec): 0.15 *(This is as per the manual for SBE9plus)*
--> SPECIFY FILTERS
-- Pressure: Lowpass filter B
-- Temperature: None
-- Temperature, 2: None
-- Conductivity: None
-- Conductivity,2: None
-- Oxygen raw: None
-- Oxygen raw,2: None
-- All others: None ... including SUNA
*In FILE SETUP
-- Name append = A00B15 *... this indicates data was filtered (Note: makes only small changes to the data)*
THIS GIVES files called: BStrait22nnnnA00B15.cnv

=== 5) Third step of SBEDataProcessing. Align the timeseries in time.
This step is to compensate for the delay between the water passing the various sensors in the pumped pathway. For the SBE9plus, the manuals suggest that
- the temperature advance relative to pressure =0
- that the salinity advance relative to pressure is 0.073s, but this advance is set in the SBE11plus by factory settings, and thus for this program we use conductivity advance =0. ***Action item: Check this is what is set in the SBE11 plus.***
- that the oxygen advance should be between +2and +5. This should be done on the Oxygen voltage.

IN SBEDATA PROCESSING, RUN: ALIGN
(PSA file for this = AlignCTDBStrait2025_CTDforprocessOx2.psa)
Inputs are: BStrait25nnnnA00B15.cnv
*In DATA SETUP
--> Enter Advance values
-- Oxygen: 2 *(as recommended in SBE9+ manual (2 to 5), and tests suggest in 2014 and 2015)*
-- All others: 0
*In FILE SETUP
-- Append added = AdvOx5
THIS GIVES files called: BStrait22nnnnA00B15AdvOx2.cnv

So, of these, it is suggested we investigate the various oxygen options. This we run this step with various values for the oxygen advance (2-5) and, by plotting oxygen against temperature, see which advance value gives the most consistent reading comparing the up and down casts.
RUN 04Align, 05CTM, 06LoopEdit, 07Derive, and then plot in matlab to get this
R=2,g=3,b=4,c=5



Ox range small again, and so often hard to tell. However, in general red (Offset 2) generally gives better agreement over the water column. See examples above.
GO WITH RED (Offset2) for both channels as in previous years (apart from 2020), but remember spread between up and down cast is easily 5% or more.

=== 6) Fourth step of SBEDataProcessing. Correct for thermal mass of the cell
This is a standard SBE correction to compensate for thermal mass of the cell. Assumes the pump is at 3000 rpm. ***Action Item: Check this.*** Then manual suggests for SBE9+ Alpha=0.03, 1/beta=7.
IN SBEDATA PROCESSING, RUN: CELL THERMAL MASS
(PSA file for this = CellTMBStrait2025_CTDforprocess.psa)
Inputs are: BStrait25nnnnA00B15AdvOx2.cnv
*In DATA SETUP (correct both Primary and Secondary values)
-- Thermal anomaly amplitude [alpha]: 0.03 *(suggested for SBE9+)*
-- Thermal anomaly time constant [1/beta]: 7 *(suggested for SBE9+)*
*In FILE SETUP
-- Append added = CTM
THIS GIVES files called: BStrait25nnnnA00B15AdvOx2CTM.cnv

== 7) Fifth step of SBEDataProcessing. Remove pressure loops from the casts.
This step is to take out pressure looping, stalls in lowering, and the surface soak. To run this, you must have filtered the pressure first (as we did above). This does not remove any data, it just marks looped data with a bad data flag of -99e-26.
In 2015, we instigated a 5m depth for the initial surface soak, returning after that soak to the surface to start the downcast. Thus the used values were L5m2m6m (soak, min, max) and were used including deck pressure, and that seemed to work well with this routine. Prior years just used a 2m soak depth and that might be less successful with this routine.
In 2016 the soak was about 4m .. checks show this works with this routine and these settings.

In 2017, soak is about 7m, but sometimes much deeper. Previous settings (L5m2m6m) did not work well with this data set. After investigation, we learn the following:
- likely best not to include the deck pressure as offset - our system is never on while in air, and thus this will just introduce a non-intuitive offset.
- the max must be deeper than the deepest soak, yet shallower than the maximum depth of the shallowest cast. In 2017, the shallowest casts were (Cast1 and 2, tests, and thus not considered; 113(19.6m), 114(19.6m), 115(19.5m), 117(18.7m). Our deepest soaks were cast 20(18.25m), cast 31(16m). Thus, we set max to be 18.5m
- the min must be deep enough to separate the going-in-the-water oscillations from the soak. 2m and 3m were found to be too shallow in 2017, but by inspection 4m works well.
Finally settings for 2017 were thus: 7m soak, min 4m, max 18.5m. (Note if you specify max and min, the program is not supposed to use soak depth at all.)
In2018 these settings gave a good result and were used without further testing.
In 2022 and 2022, we again adopted these settings
In 2025, some casts (46 and 103-113) only went to 2m to soak, but this can be adapted for using 2m minimum soak depth. (Use Matlab to check this is doing what it should.
In 2025, these parameters are successful, but plots show it is best to use the DOWN CAST for interpretation as sometimes there are long stops on the up cast

IN SBEDATA PROCESSING, RUN: LOOP EDIT
(PSA file for this = LoopEditBStrait2025_CTDforprocess.psa)
Inputs are: BStrait25nnnnA00B15AdvOx2CTM.cnv
Must run filter on pressure first. Flag surface soak with -9.99e-26 ..
*In DATA SETUP
-- Minimum ctd velocity (m/s) = 0.25
--> Check box Remove Surface soak
-- Surface soak depth (m) = 7
-- Minimum soak depth (m) = 2 THIS FOR 2025 (was 4 previously)
-- Maximum soak depth (m) = 18.5
--> UNCheck box Use deck pressure as pressure offset
--> Check box Exclude scans marked bad
*In FILE SETUP
-- Append added = L7m2m18p5mndp
THIS GIVES files called: BStrait22nnnnA00B15AdvOx2CTM L7m2m18p5mndp.cnv

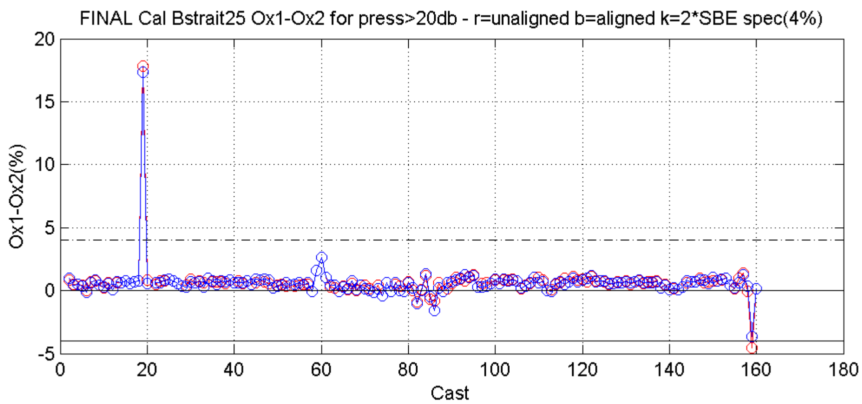
=== 8) Sixth step of SBEDataProcessing. Derive the parameters you want.
This step takes the raw data and calculates derived parameters, such as salinity, density, oxygen values, etc.
IN SBEDATA PROCESSING, RUN: DERIVE
(PSA file for this = DeriveCTDBStrait2025_CTDforprocess.psa)
Inputs are: BStrait25nnnnA00B15AdvOx2CTML7m2m18p5mndp.cnv
-- CHECK box on match instrument to configuration file (Prior notes says to check this box, however, in 2016 this crashed if the box was checked, so instead uncheck the box, **BUT MUST MAKE SURE IS USING A CURRENT CALIBRATION FILE**). If ever change sensors during cruise, will have to do something different here. Check these files to make sure the .con files are consistent.
*In DATA SETUP
--> Select derived variables... add:
-- Salinity (psu)
-- Salinity,2 (psu)
-- Salinity difference

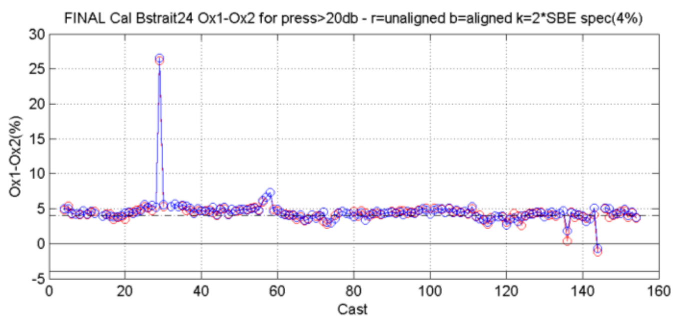
-- Sigma theta (kg/m3)
-- Sigma theta,2 (kg/m3)
-- Sigma theta difference
-- Oxygen, SBE 43 (ml/l)
-- Oxygen, SBE 43 (saturation)
-- Oxygen, SBE 43, 2 (ml/l)
-- Oxygen, SBE 43, 2 (saturation)
*In FILE SETUP
-- Append added = D

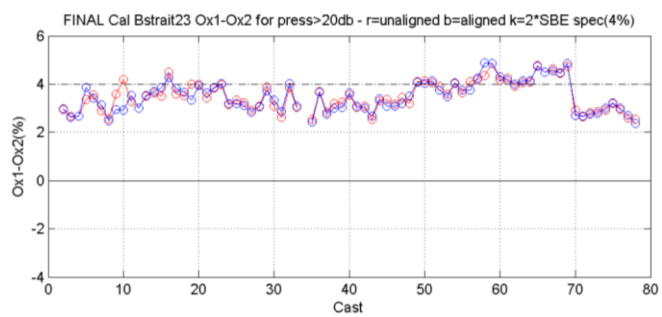
THIS GIVES files called: BStrait25nnnnA00B15AdvOx2CTM L7m2m18p5mndp D.cnv

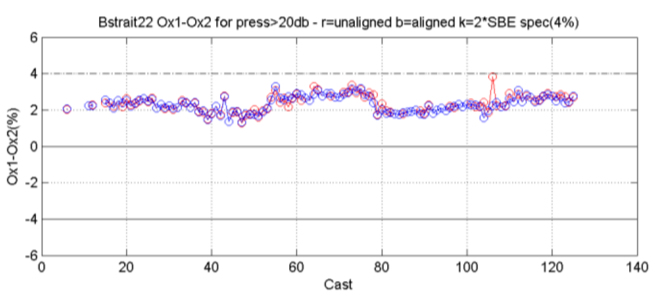
Difference between Oxygen sensors .. In 2025, in contrast to previous years, the difference between the oxygen sensors (see Figure) is almost always very small, ~1%, and (with one exception) less than the manufacturer's specifications of 4%. Cast 19 shows a greater difference, but this cast is already identified as having bad Ox2. Cast 159 shows a lot of small space scale variability and misalignment between sensors leads to the larger intersensor difference. Note the Ox2 noise issue found in 2024 is not present in 2025. **Thus, we recommend use of Ox1**, while still remembering that up and down casts my differ by 5-10% as in previous years**.**

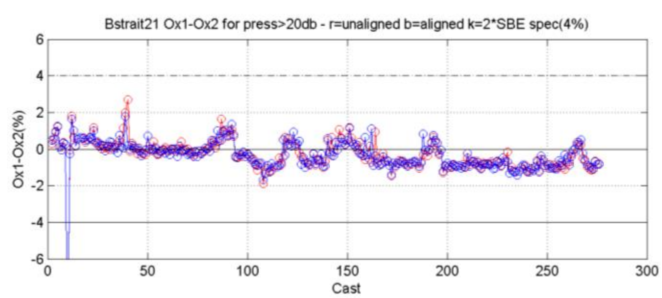
Oxygen sensor comparisons from prior years for information.











Could stop here, and use these files, but to be more useful want to have Bin averages and despike, and the combination of the two of those processes. So, first look at the despiking options. SBEDataProcessing includes a file called "Wild Edit", but the manual describes that as "not the faint of heart" and says much trial and error is necessary to get good results. Thus, instead use something more automatic, Window Filter.

=== 9) Twelfth step of SBEDataProcessing. Use Window Filter to despike.

This is an attempt at automatic despiking. If just try so smooth over a spike, you will flatten it, but the bad data will still remain. Here we make one basic attempt, as outlined in the manual. This takes a window of data points, and for each window, replaces the central (?) point with the median of all the points. In some way thus, this is smoothing over the data points, but one that neglects extreme values. Their example suggests 17 points, and we have used that. Sampling rate is 24Hz. Drop rate is ~ 1m/s. So this is roughly equivalent to smoothing at 0.7 sec, or 70cm.

IN SBEDATA PROCESSING, RUN: WINDOW FILTER
(PSA file for this = W_FilterCTDBStrait2025_CTDforprocess_MF17.psa)
Inputs are: BStrait25nnnnA00B15AdvOx2CTM L7m2m18p5mndp D.cnv

*In DATA SETUP
--> Select Exclude scans marked bad
--> Specify Window Filters:
Type: Median   Parameters: 17
For variables: Temp1, Temp2, Cond1, Cond2, Oxraw1, Oxraw2, Fluorescence, Upoly (Turbidity/Transmissivity), Latitude, Longitude, Salinity1, Salinity2, Density1, Density2, Ox1ml/l, Ox1%, Ox2ml/l, Ox2%,Upoly2(rawSUNA)
-- Append added = MF17

THIS GIVES files called: BStrait25nnnnA00B15AdvOx2CTM L7m2m18p5mndpDMF17.cnv

=== 10) Seventh step of SBEDataProcessing. Bin average all the data.

All data files prior to this have been the 24Hz data up and down casts. Here we separate out the downcasts only, exclude the data marked bad by loop edit, and create 1m bin averages. We chose here to create a surface sample, however often the number of scans in that sample is small and in any case surface stirring by the ship must also be considered.

IN SBEDATA PROCESSING, RUN: BIN AVERAGE
(PSA file for this = BinAvgBStrait2025_CTDforprocess.psa)
Inputs are: ~~BStrait25nnnnA00B15AdvOx2CTM L7m2m18p5mndp.cnv &~~
BStrait25nnnnA00B15AdvOx2CTM L7m2m18p5mndpDMF17.cnv

*In DATA SETUP
-- Bin type = Pressure
-- Bin size = 1
--> Select Exclude scans marked bad
→ Select include number of scans per bin
-- Scans to skip over = 0
-- Cast to process = **Downcast**
-> Include surface bin 0,1,0
*In FILE SETUP
-- Append added = BADCS010

THIS GIVES files called: ~~BStrait22nnnnA00B15AdvOx2CTM L7m4m18p5mndpDBADCS010.cnv &~~
BStrait25nnnnA00B15AdvOx2CTM L7m2m18p5mndp DMF17BADCS010.cnv

When have final SUNA data – will re do these

==== 11) Eighth step ... do Bin average Up also as this is needed for the bottle samples?

No BAU is NOT needed, but we will use the upcast, so we need to know where there are issues
So revisit the casts that have up cast problems:
Cast 59 – S2 bad on way up
Cast 60 – S2 bad all cast
Cast 124 – S1 bad all cast.
There are more upcast issues, but only these ones intersect with the nutrient samples.
So use S1 for the nutrient data, apart from cast 124.

~~THIS GIVES files called: BStrait22nnnnA00B15AdvOx2CTM L7m4m18p5mndpDBADCS010.cnv &~~
~~BStrait22nnnnA00B15AdvOx2CTM L7m4m18p5mndp DMF17BADCS010.cnv~~

In 2025 this marks the end of the CTD pre processing.
This file will be appended with SUNA information and bottle data processing when the post-cruise calibrations and the bottle data are available.

We copy below next CTD operating instruction, as updated at the end of the cruise.

Feb 2026 – Note on bottle processing

- during cast, seasave writes .bl file, which has bottle fire scan number, and that plus 36 (1.5s)
- seabird dataconversion, creates a .ros file from .bl .. (option of how long for averaging bottle (2s)

    This is extracted lines from .cnv for 2s after bottle files
- bottle summary, ..takes the .ros file and makes a .btl using 49 scans per bottle

    Options: Select all averaged variables

    Apply Tau correction

So one could extract bottle information from either:

- the bottle summary (Advantage: Standard. Disadvantage: Does not include correction)
- or from a separate program which extracts the same data from the final calibrated data.

We opt to do the second, in matlab, allowing us to easily combine the bottle information with the nutrient (and where taken, salinity) sample data into one ascii file.

<u>Feb 2026 – Notes on CTD SUNA processing</u>

AT SEA Suna 1916

- deployed on profiling SBE 9-11 CTD
- using a custom battery set up, modelled on that used by Seth Danielson,
    - power up voltage from SBE9 switches on power to SUNA from independent battery
    - prevents large current draw required for SUNA overpowering CTD
- preliminary data are recorded in Seasave .. however
    - this uses just a nominal calibration and a linear fit to voltage
        (these data are ~5=8µM higher than bottle data)
- raw data are recorded at full resolution on the SUNA itself
    - **- ** VERY IMPORTANT to ensure SUNA is on NMEA TIME ****
- pre and post cruise, run SUNA checks including:
    - **- updating the reference spectra using DI water ** VERY IMPORTANT****
    - **- running a standard solution (made at UW to 20µM concentration)**
- water samples taken at standard depths, during cruise and analysed for standard nutrients
    - - **** THESE TURN OUT TO BE VERY IMPORTANT FOR THE FINAL CORRECTIONS****

- SUNA is recording Nitrate+some function of nitrite. As nitrite values are low (<0.2µM this year, with 2 readings nearer 0.3µM), the SUNA can be considered to effectively be reading nitrate. .

- SUNA data are corrected for temperature and salinity effects using Seabird's UCI software, applying the correction of Sakamoto et al., [2009]. The conversion is run for the pre-cruise (cal S) and post cruise (cal T)

- This processing showed there to be artefacts (positive and negative) in the processed SUNA data at low nitrate values as the SUNA passed through extreme gradients of temperature and salinity (delta T ~10degC, delta S~2psu over a few (<5-10) seconds), This suggests the clocks are misaligned, consistent with the observation that the CTD SUNA was 2.5s slower than a laptop synced to time.gov on recovery. However, it proved impossible to greatly reduce these artefacts using the UCI software. Note the option to include a time offset appears only to work intermittently, with the value not always being applied (and as it is not noted in the file header, it is hard to establish when it has been applied or not!). Most success was obtained by always restarting the UCI program for each time offset investigated. Positive offsets were found to make the artefacts worse. Negative offsets of -1s slightly improved some of the artefacts, and a negative offset of -2s show a change in the sign of the artifacts, suggesting that was too great a time correction. However, results were not consistently better and thus in the end no time correction was applied. We note that in any case this only affected nitrate values at low concentrations (around zero to 2µM)

**** recognise that small vertical scale peaks in SUNA-nitrate near strong gradients in T and S are not real, but are artefacts of the processing ****

- As before, we found the only difference between the reference updates was an offset (here ~2.1µM).
- Compared to bottle samples, both these processed data sets showed a drift of ~3µM (increasing values) over the course of the cruise.
- Linearly interpolating from the pre-cruise reference update (S) to the post cruise (T) on record number removed this drift entirely, but left the data sets on average 1.8µM less than the bottles. Thus this offset was added to the data, bringing the mean of the data set to agree with the mean of the bottle samples.

This is the same procedure as used in 2024.

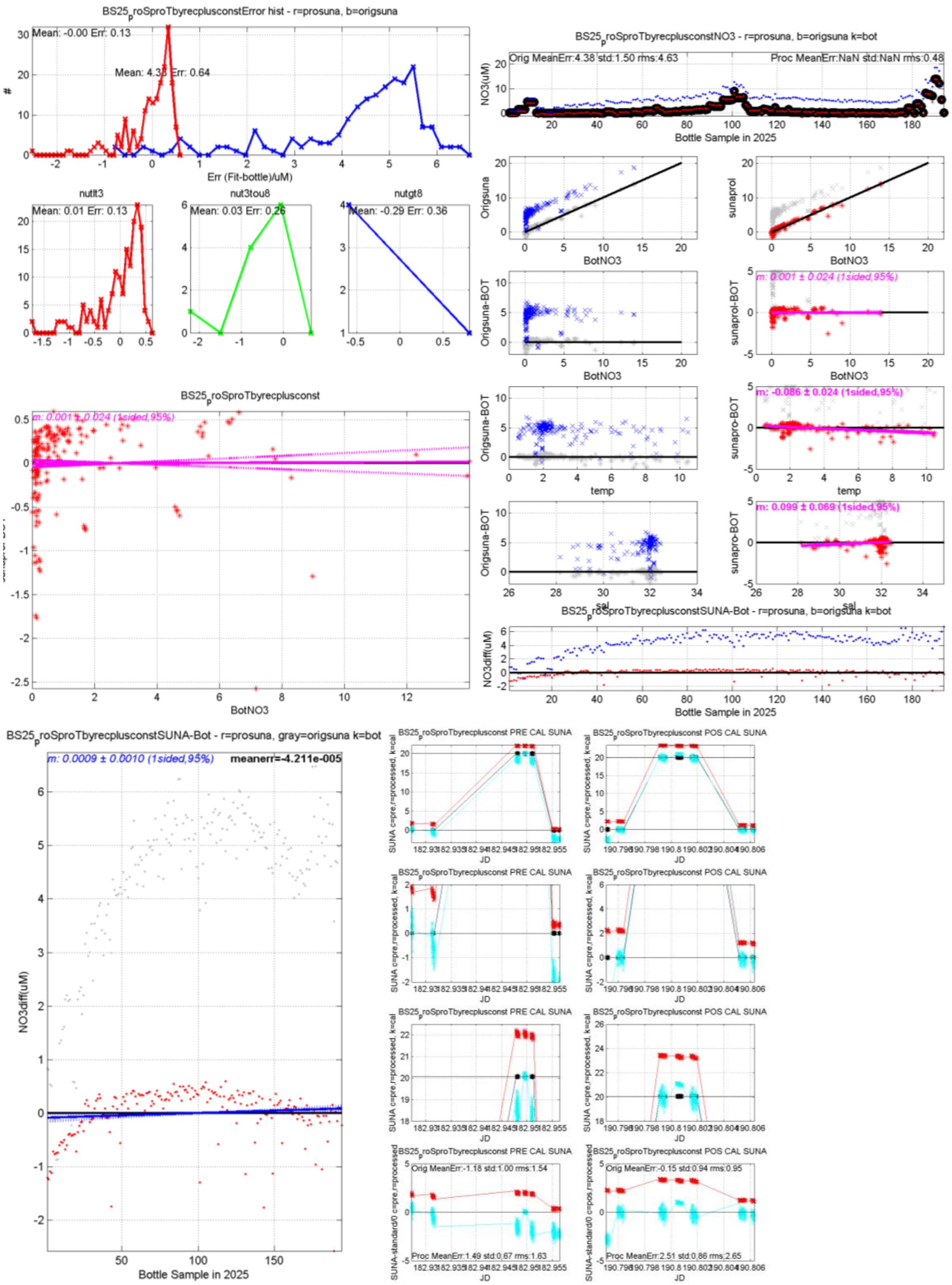
**** SUNA data are linearly interpolated by record number between pre and post cruise reference updates, and adjusted (up) by 1.8µM to match the mean of bottle samples.**

Note this left offsets to distilled water and the UW standard pre and post deployment (see table below). However, the fitting to water samples was taken as being the more relevant measure.

**** Continue to take water samples to calibrate the SUNA offset.**

The 4 plots below summarize the fit of the final data to the bottles. Note that while the spread of the data is small, (standard error 0.1µM), this likely underestimates the reliability of any particular reading, which is probably closer to 1-2µM.

These corrected data are included in the final processed CTD files for cast time resolution data and Bin Average down, file names including CorrSUNA, with the data in the column marked User Poly 2.



Norseman2 – CTD operation notes **Version 10th July 2025**

0. Coming onto station
    - pre fill Event Log (Excel file)
    - In Seasave - Real time data, Start, Begin archiving data immediately
        - Select Output Data File Name: Bstrait25nnn.hex, *** NOTE NAME 25, not 2025
        - Start
        - fill in header
            - Ship: N2, Station name (e.g., BS24), Operator
    - then WAIT
    - **Driver to Deck:** "**Is the Wetlabs sensor clean and are the bottles prepped??**"
    - **Deck to Driver:** "**sensor cleaned and bottles prepped**"
1. On station confirmed from bridge "**on station**",
    - **Driver to deck**, "**Ready to Deploy**"
    CTD in the water (**Deck to Driver**: "**CTD in water and at 8m**") (**Driver: double click radio**)
        - Power on CTD Deck Unit, check get readout of "10" (01<u>10</u>)
        - OK on SeaSave header, wait until SeaSave gray windows close
        - Real-time Control, Pump on (to turn pump on manually)
        - Fill out rest of Event log (Excel file) for deployment (including time).
            ** CHECK SOAK IS 5-10m **
    - WAIT until –"11", "Pump on", Data ok (incl S and position),
        ** CHECK Temperature, salinities and Oxygens AGREE
    - DECIDE ON <u>initial target depth</u>, i.e. water depth under keel -2m in good weather (-3 in bad weather)
    - **Driver to Deck**: "**return to surface and go down to xxx meters**"
    - **Deck to Driver**: "**Going down**"
    - ** CHECK (a) they come up to surface and (b) lower speed (want 0.7 to 1m/s)
3. Be prepared to, as CTD lowers,
        - watch pressure ...*(not depth, pressure) (resist temptation to analyze cast) .. focus only on the pressure*
        - double check bottom depth has not changed. Adjust target depth if it has.
    - **Driver to Deck**: "**3 2 1 stop**" for target depth
    - **Deck to Driver**: "**CTD stopped**"

4.**<u>IF NO BOTTLES TO FIRE</u>**:	**IF BOTTLES TO FIRE:**
- wait ~ 1s, - **Driver to Deck**: "**Return to surface**" ** CHECK CTD COMES UP	- start counting up to 10 - realtime control, fire bottle control. - after 10s of wait, fire bottle(s). - **Driver to Deck**: "**Come up XXX m**" ** CHECK CTD COMES UP - **Driver to Deck**: "**3 2 1 stop**" for bottle depth **(REPEAT UNTIL NO MORE BOTTLES TO FIRE)**

If time, ** COMPARE SENSOR PAIRS - decide if data good enough to leave

5. When at surface (**Deck to Driver: "At surface"**) (**Driver: double click radio**)
    - real time control – Pump off; real time data – STOP
    - Power off CTD Deck Unit
    - **Driver to deck**: "**Recover the CTD and"...**
        "proceed to the next station" OR "stay on station (for pumping or CTD issues)"
6. Fill in Event Log for up cast (including time), while
    - **Driver to Deck** "**What were wave height(m), clear or fog, and depth lose sight of ctd"**
    - **Deck to Driver** "**CTD recovered SUNA off, bottle issues**, **wave height, fog, depth seeing ctd**."
    - screen dump to paint (PrntScrn, Cntrl V, save as BStrait25nnn.png); QUIT paint.
    - Copy the 5 files (.hex, .hdr, .xmlcon, .png) to USB Backup file directory
        **CHANGE SUNA BATTERY AT 500min CLOSE BOTTLES IF LEAVING FOR ANY TIME

Deck responsibilities every cast:

- checking sensor cleaned and bottles correctly primed, including
  caps correctly position, spigots out and vent plugs tight.
- clean wetlabs sensor just prior to going in the water
- checking depth of surface soak
- watch wire (out aft is ok, under ship is not, far to side near ship not)
- keep winch operator focused
- count CTD as it goes down, listen for 3 2 1 stop and make sure winch stops

- At Bottom, make sure winch comes UP (e.g., watch wheel)
- Watch for tape on way up,

- Observe and report surface issues (e.g., broke surface, ask for repeat soak if out of water for more than 4 sec)
- report - clarity of water (max range at which you can see CTD in m)
    - fog
    - wave height if exciting
- report bottle issues once CTD is on deck.
- report if jelly fish remains on salinity cells

- make sure secure on deck after each cast
- every 10 casts, flush both systems and make sure that it marked on logs
- every 50 casts, check all CTD bolts

- do water sampling as required
- report any bottle problems (e.g. leaking).
- if bottle is leaking, do not sample from it unless it is the surface bottle.

BERING STRAIT 2025 CTD LINES

Six CTD lines, including rerunning of the BS line, were run on the cruise

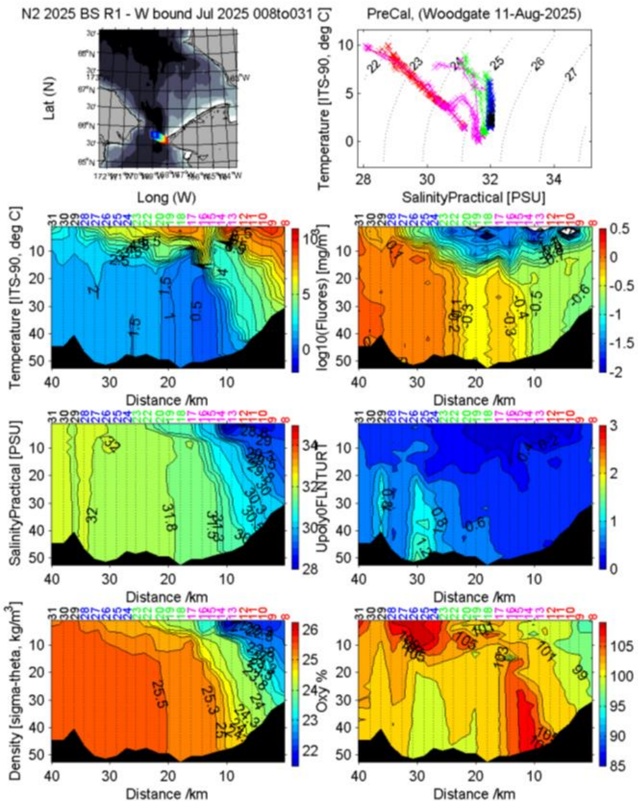
Sections were plotted using code from An Nguyen from the processed data and the quality control procedures outlined above to give 1m bin averages for plotting.

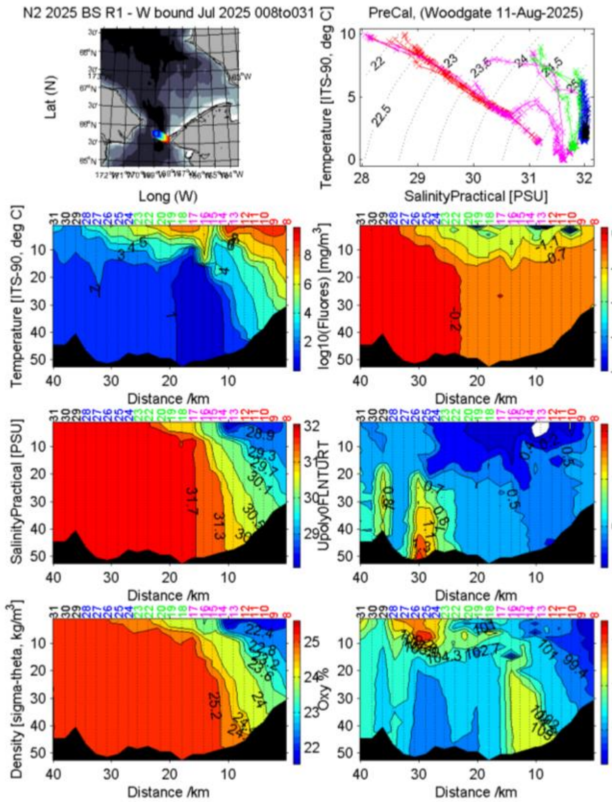
The plots below give all sections on the same scales (left) and on a scale for that section (right), presented in order of data acquisition. Note that:
- this uses the S1 and Ox1 data, processed to 1m bin averages from the down cast, other than casts 101 (BS 15.5) and 124 (SBSnn5.5) which use T2, S2 and Ox2 data due to issues with S1 on these casts
- typically stops 2m above the sounder reading, which (see discussion above), means the CTD stops ~2m above bottom.

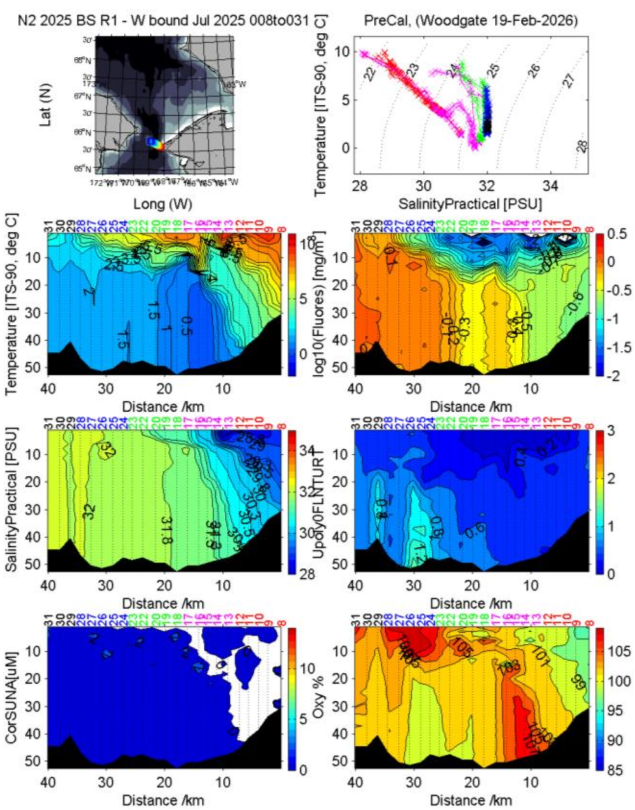
For full positions and times see event log and data file headers.

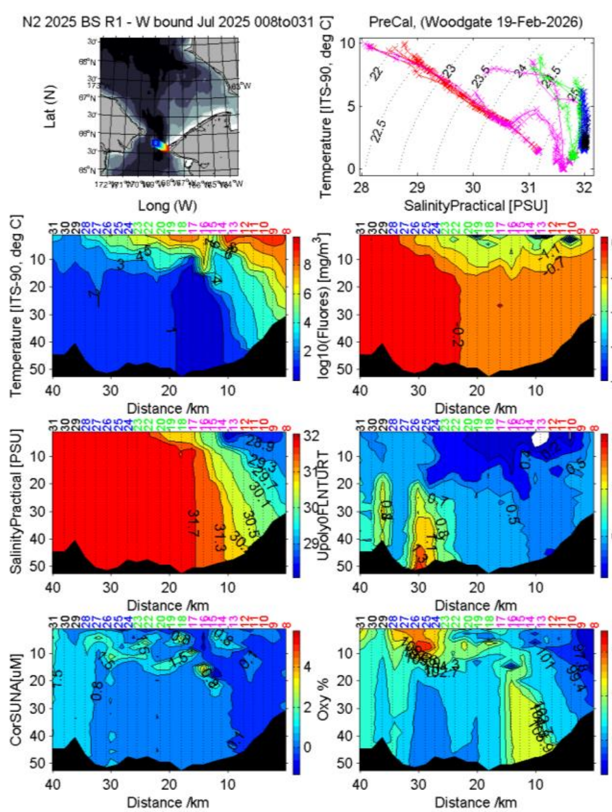
Plots have been updated with corrected SUNA data.
Please note that small vertical scale features near thermo/haloclines are artefacts from the SUNA processing.

1) Bering Strait (BS) line – first running, Westward



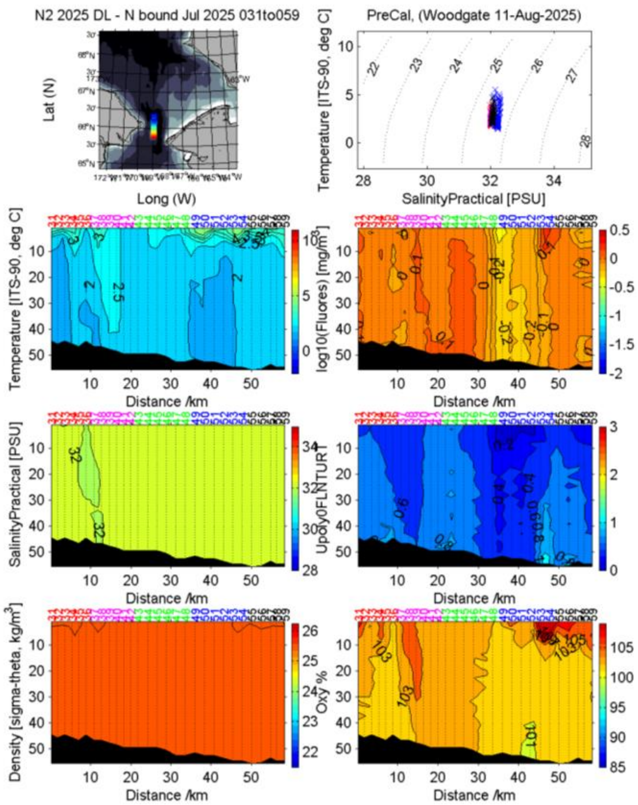


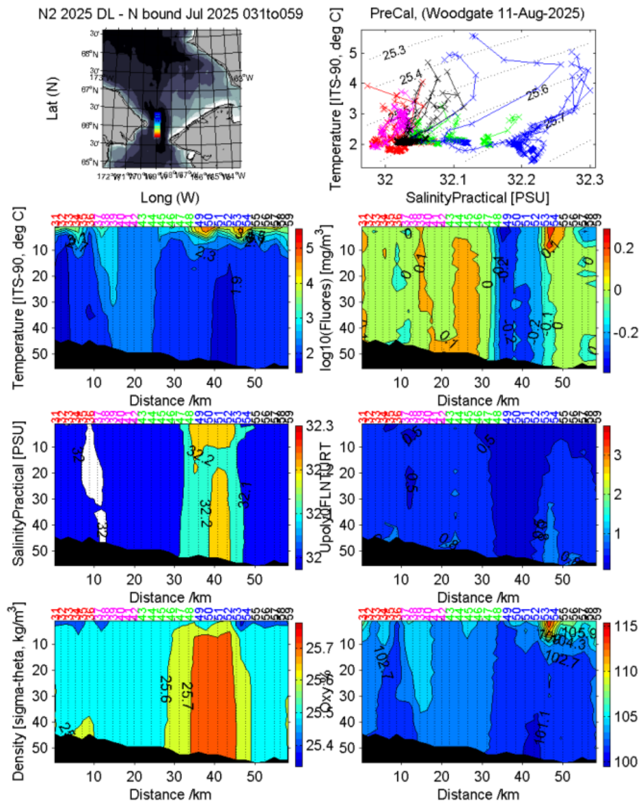


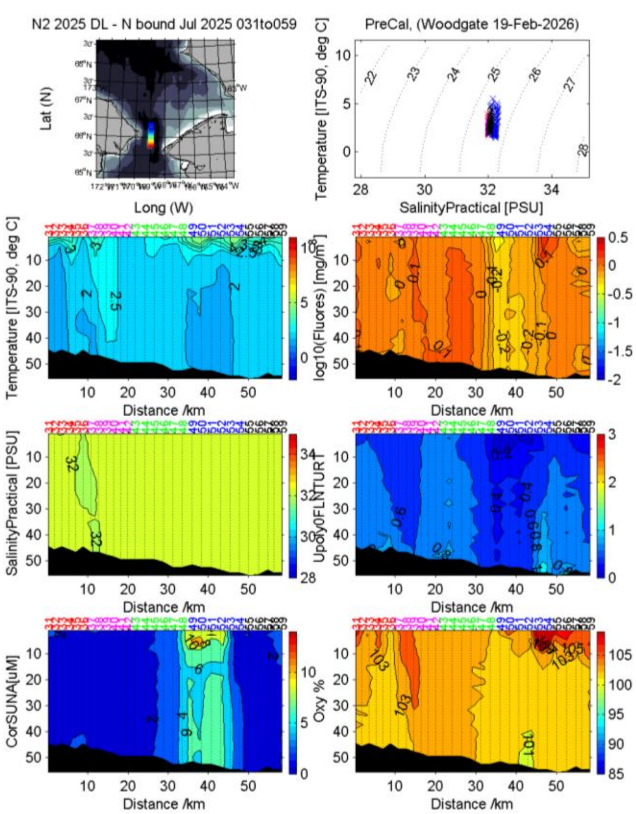


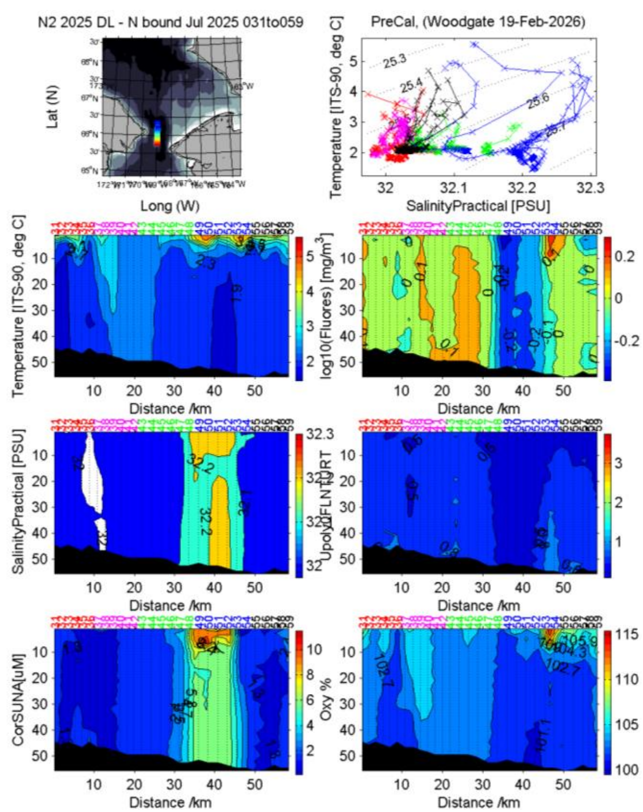
2) Diomede Island (DL) line – only running, Northward

(Note extremely small density gradients)

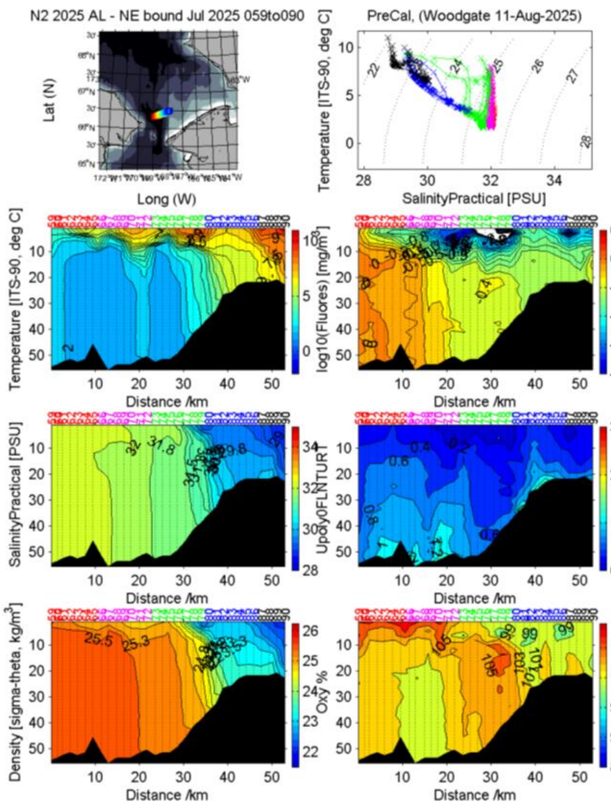


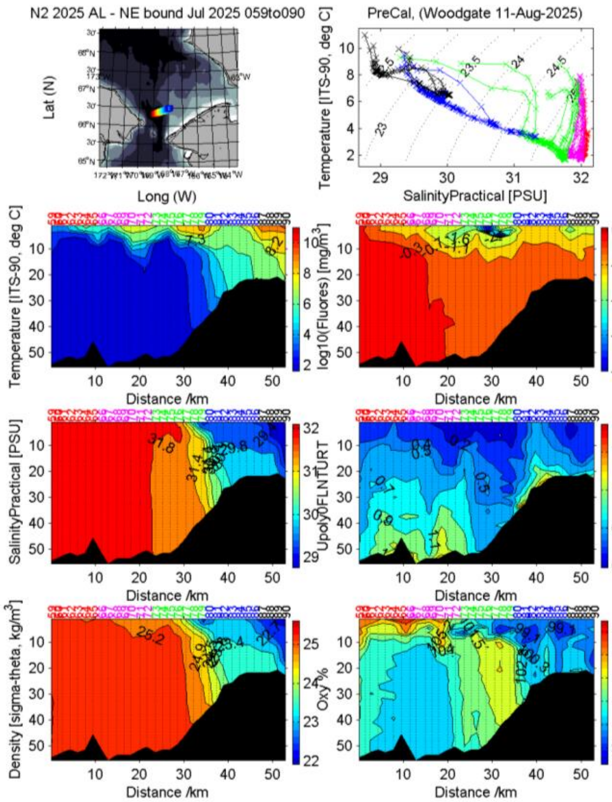


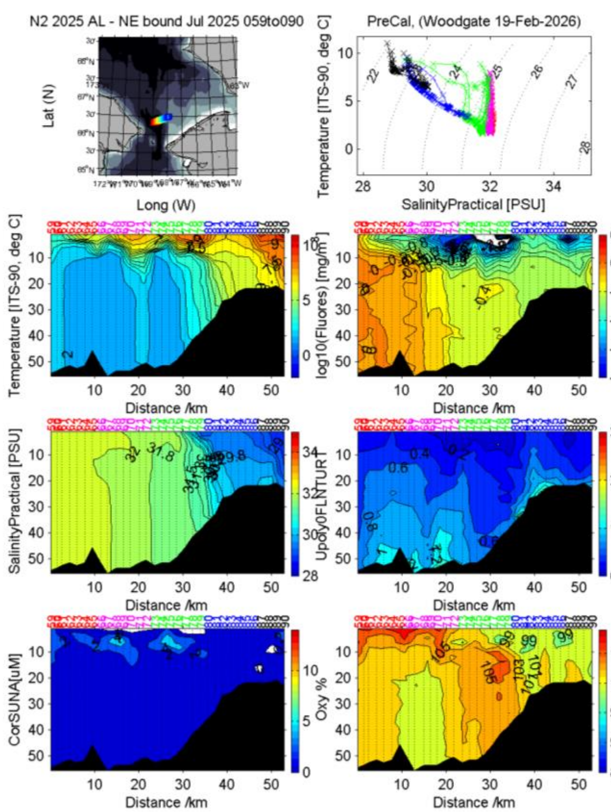


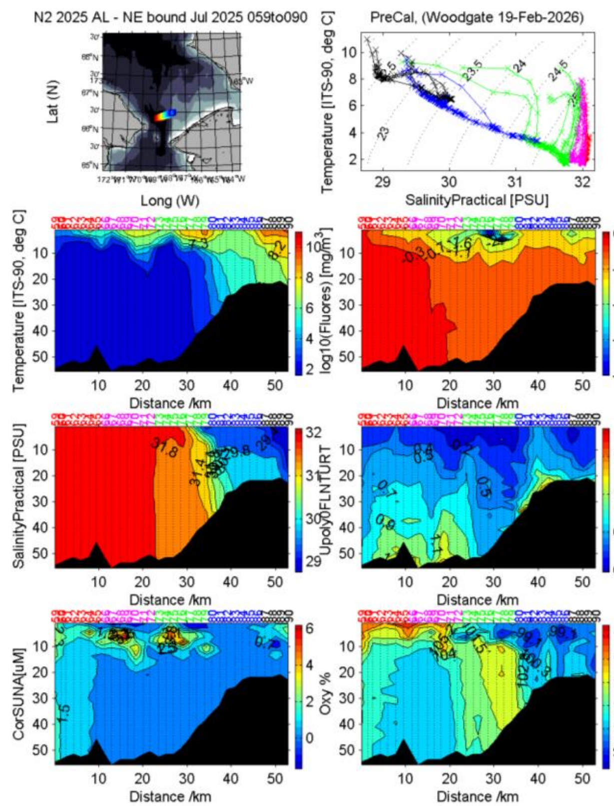


3) A3 line (AL) – only running, Northeastward

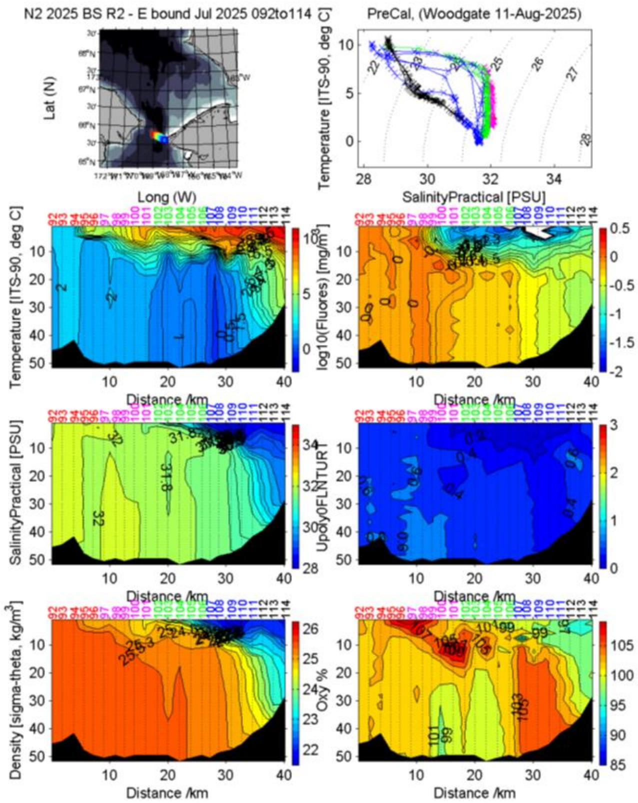


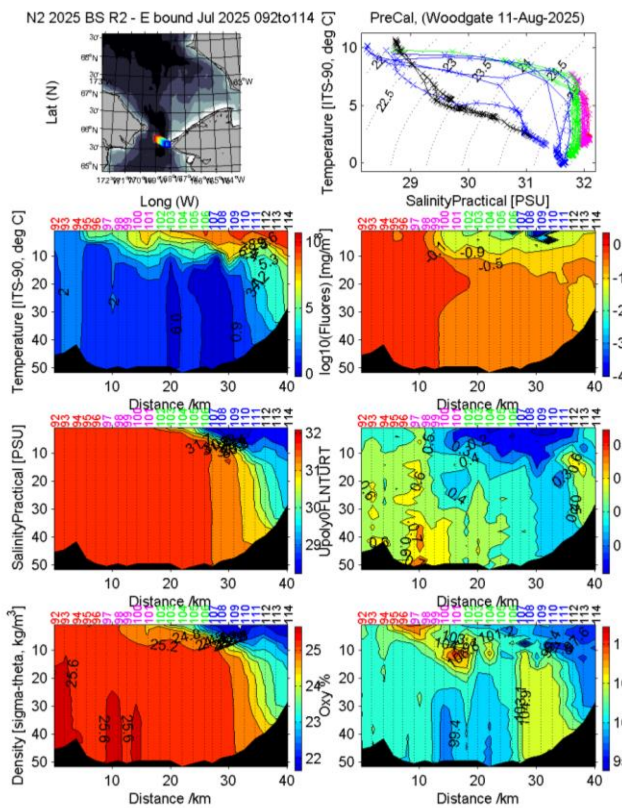


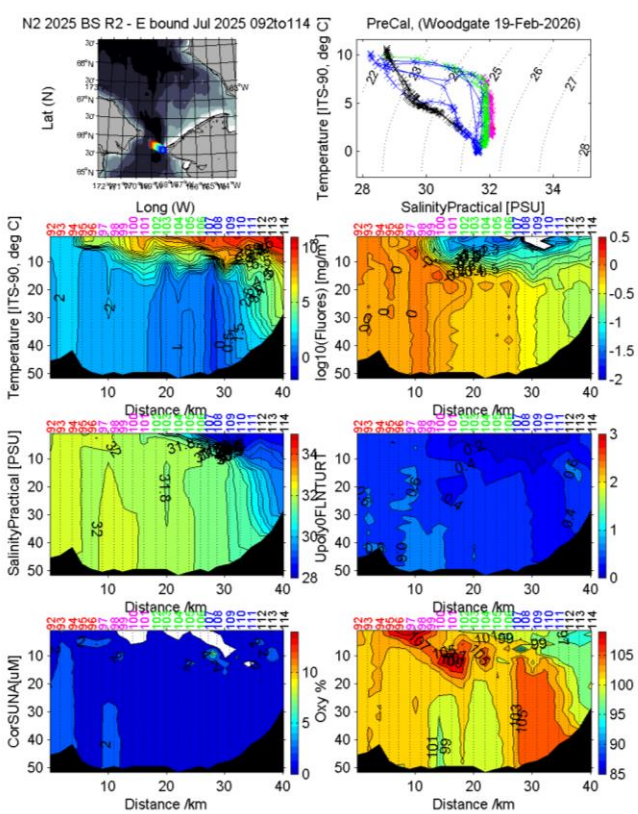


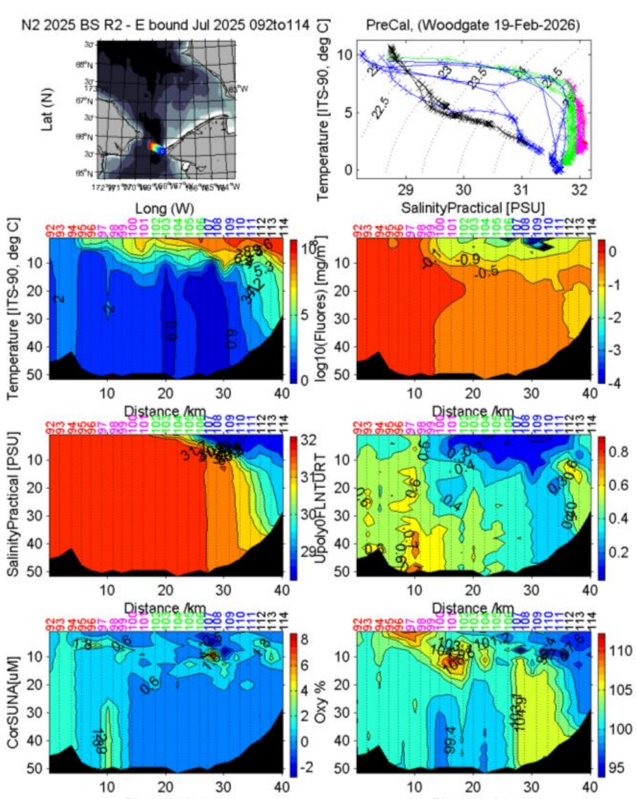


4) Bering Strait (BS) line – second running, Eastward

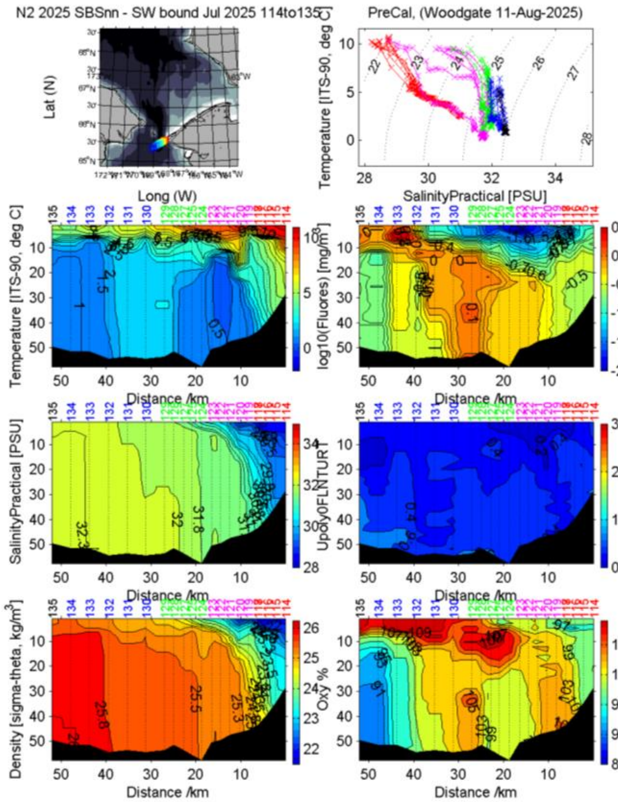


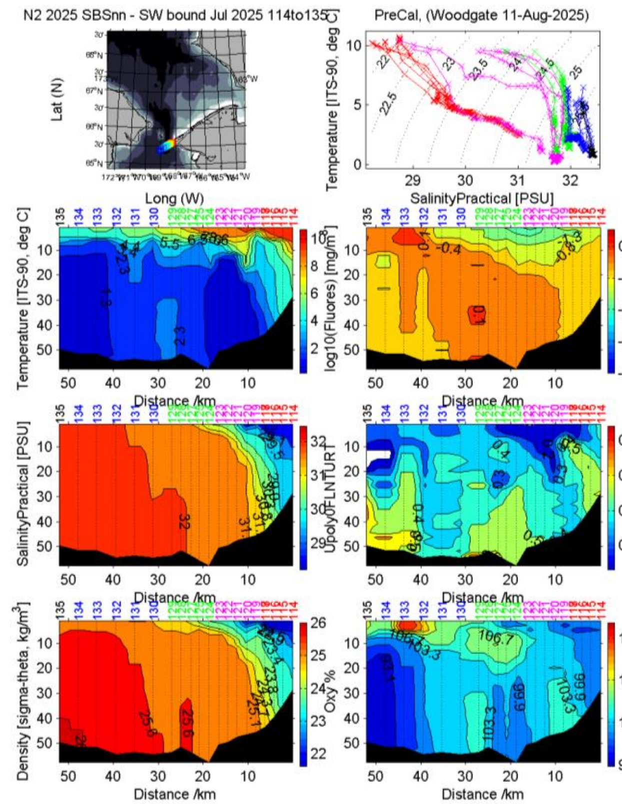


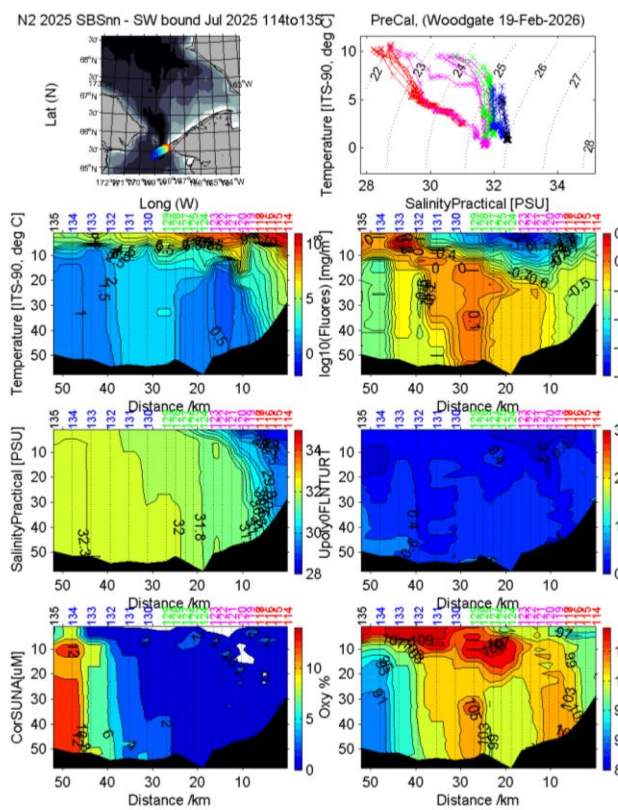


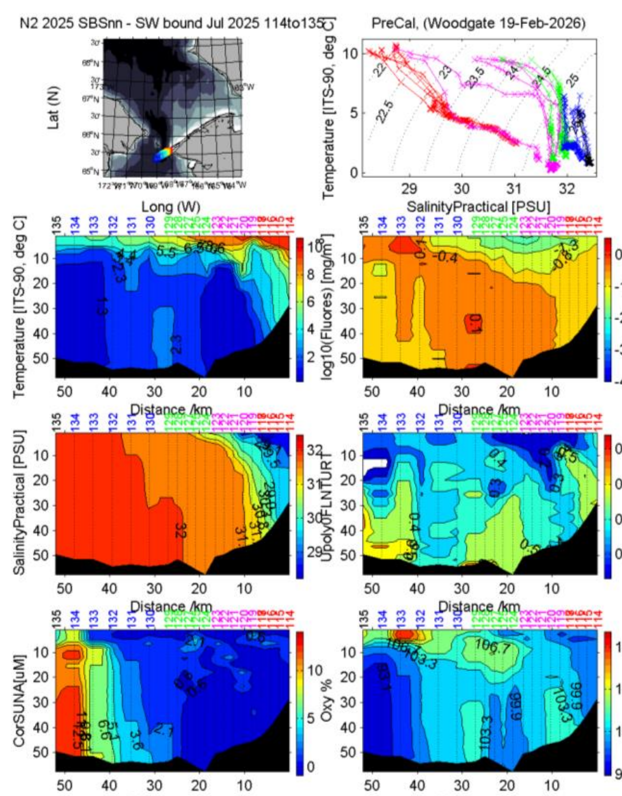


5) South Bering Strait (new) (SBSnn) line – only running, Southwestward

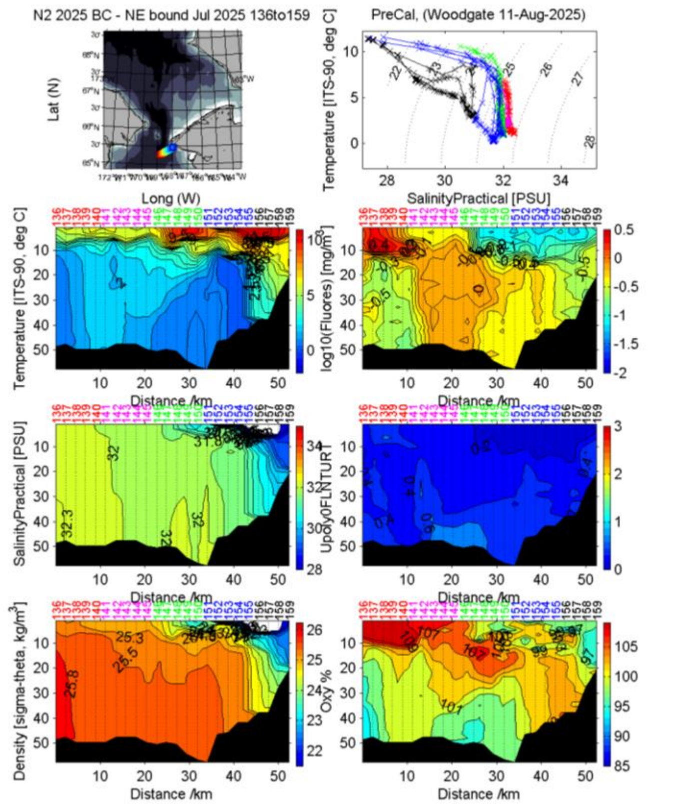


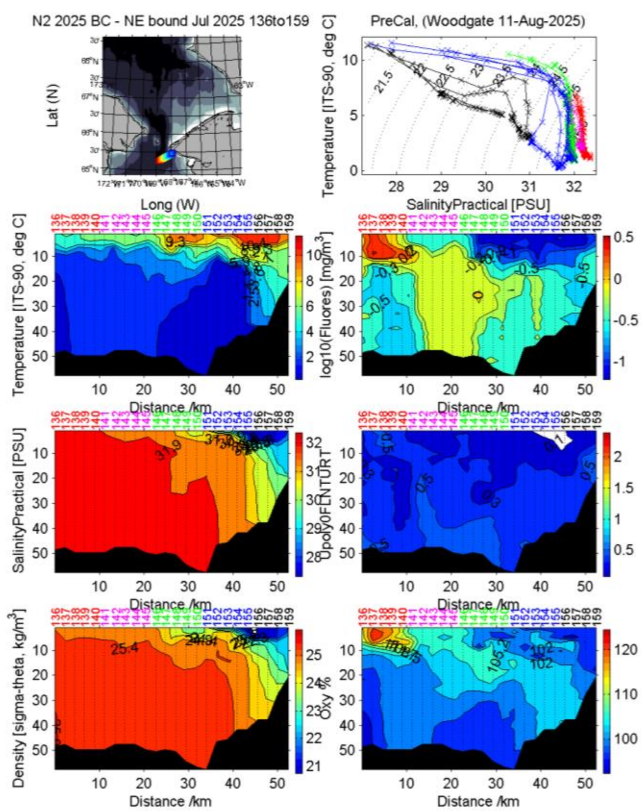


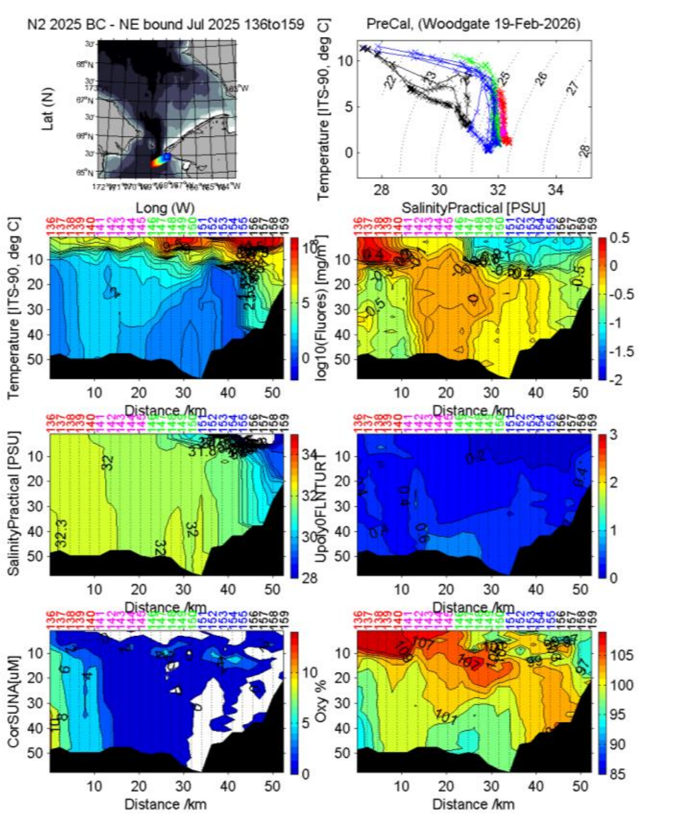


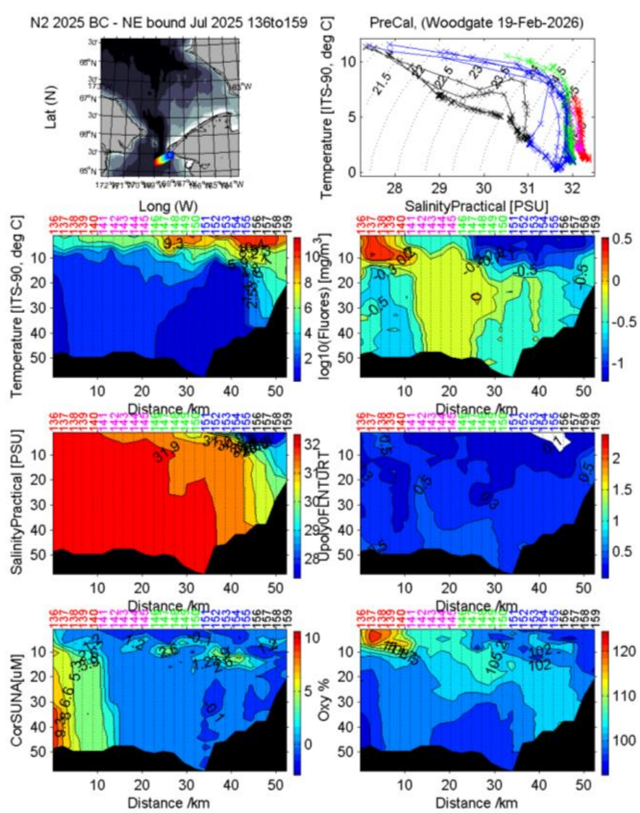


6) Baituk Creek (BC) line – only running, Northeastward



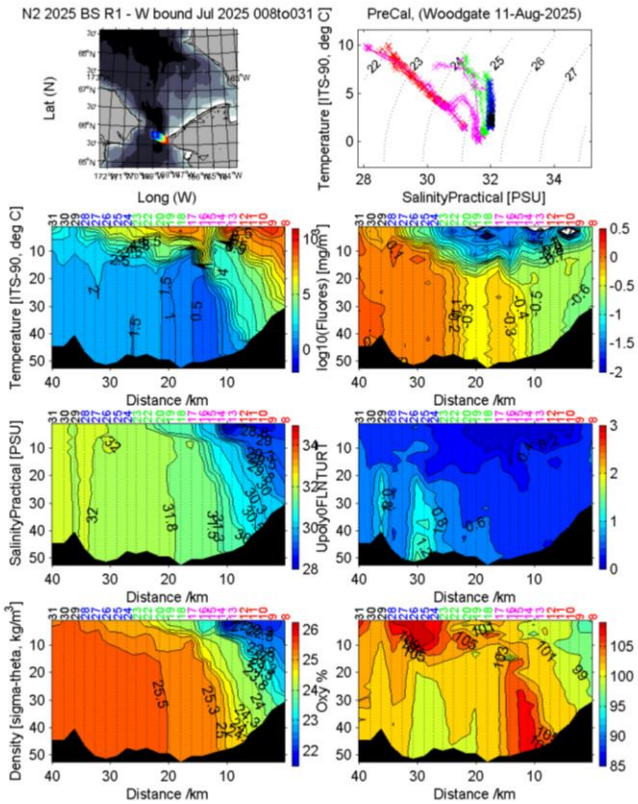




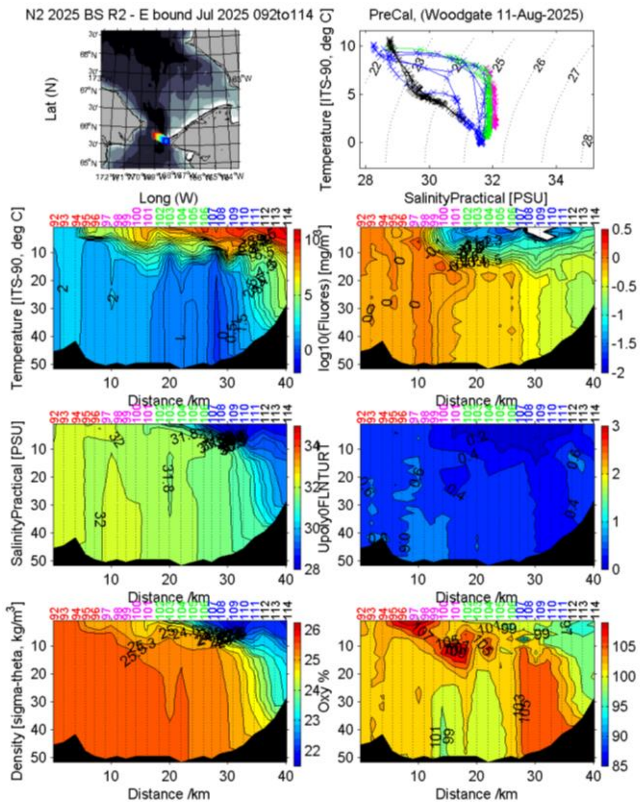


xx) Comparison of the two runnings of the Bering Strait line (BS) – same scales

FIRST RUNNING



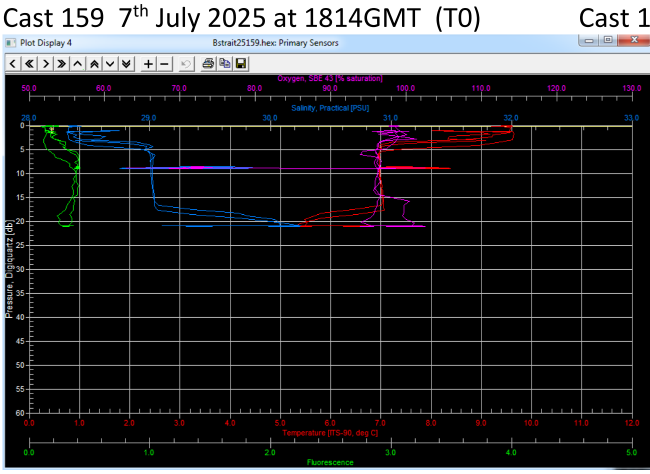
SECOND RUNNING



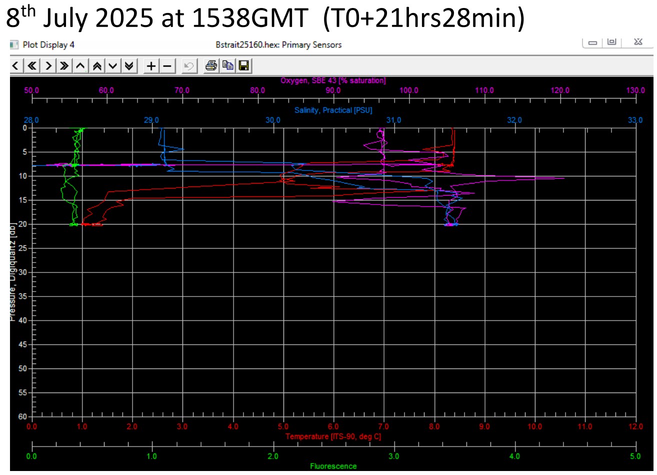
Note westward excursion of warm fresh Alaskan Coastal Water at the surface and eastward excursion of saltier, nutrient rich Anadyr water at depth, although changes are modest as winds had only just reversed.

xx) Comparison of 4 repeated casts at BC1 in 2025

Cast 159 7th July 2025 at 1814GMT (T0)

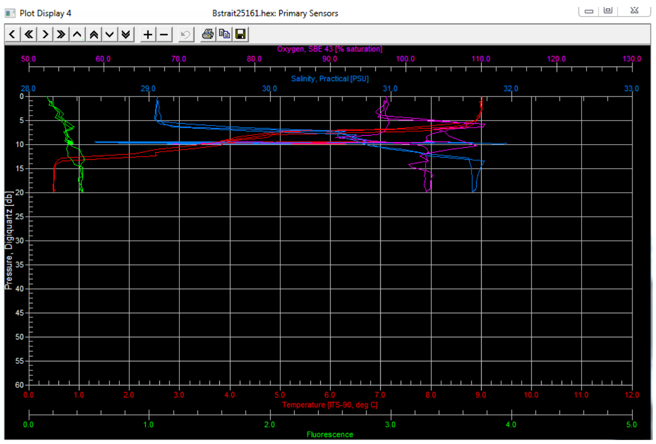


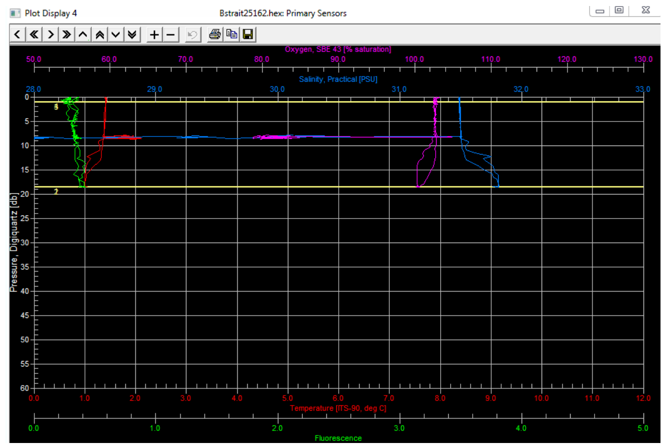
Cast 160 8th July 2025 at 1538GMT (T0+21hrs28min)



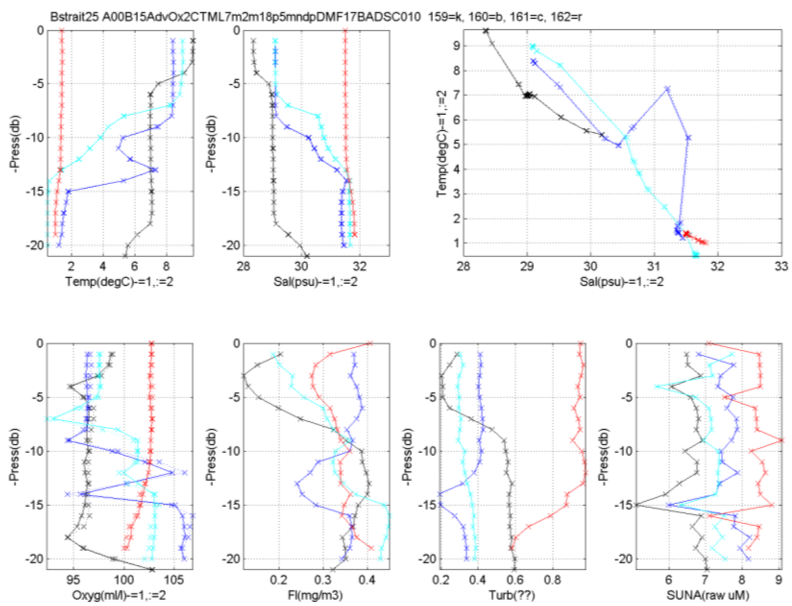
Cast 161 9th July 2025 at 0023GMT (T0+30hrs 9min)

Cast 162 9th July 2025 at 1649 GMT (T0+46hrs35min)



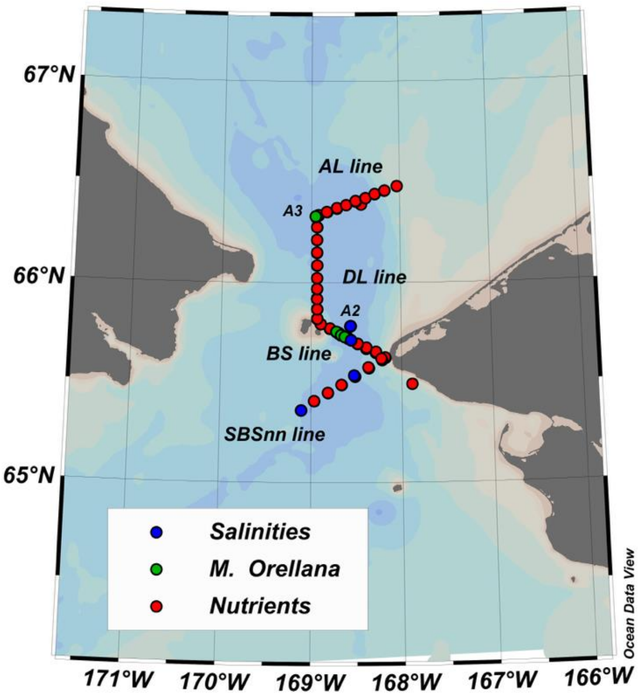


Three layer structure evolves to two layer, with strong salinization (30-31.8psu) at depth, and surface cooling (9.5 deg C to 1.5 deg C). (Progression in figure below: cast 159=black, 160=blue, 161=cyan, 162=red). Salinity change suggests that, even with surface cooling, change is mostly advective.



BERING STRAIT 2025 WATER SAMPLING: CTD nutrient and salinity samples.

Rebecca Woodgate, Cecilia Peralta Ferriz and Laramie Jensen (UW)



Map of nutrient samples taken in 2025. Blue dots indicate salinities were also taken. Green marks samples taken for M. Orellana (PSC-APL_. (For final positions, see maps at start of cruise report.)

Starting in 2022, nutrient sampling became a standard part of the Bering Strait Mooring Program alongside the new addition of Seabird SUNA sensors (2022-2024 moorings and the accompanying hydrographic sections) to measure nitrate in the water column. Water samples were again taken in 2025 for nitrate, nitrite, ammonium, silicate, and phosphate to be analyzed at the UW Marine Chemistry Lab. Additionally, salinity samples were taken in order to check sensor calibration at select stations.

Water was taken from the rosette on select CTD casts **as shown in the map (left, and at start of cruise report) for a total of 194 filtered nutrient samples, including 8 duplicates, and 6 salinity samples**. These nutrient stations also overlapped with trace metal pumping stations, allowing for comparison between "pumped" nutrients and "bottle" nutrients.

A 12-position rosette fitted with 11 x 1.5L Niskin bottles (position 6 remained open to accommodate the SUNA instrument and battery) was deployed from the aft as described in the CTD report. Bottles were fired (tripped) on the upcast, after waiting 10s at the desired depth (see 2022 cruise report for justification of this wait time). At most, six total depths (at 10m intervals) were chosen, depending on bottom depth. For example, if the bottom depth was 54m then bottles were tripped at 52m, 40m, 30m, 20m, 10m, and 0m. Generally, two bottles were fired at each depth and one at the surface, to allow for any bottle leaks.

Samples were taken along the BS line (first running), the DL and AL lines, and at lower resolution on the SBSnn line. A final sample was taken on the last occupation of site BC1 at the end of the cruise. At mooring sites A2 and A3, where SUNA nitrate sensors are deployed on the moorings, duplicate nutrient samples were taken 1m above and 1m below the expected SUNA depth at the mooring recovery and deployment CTDs (16 samples total)

Nutrients: Upon recovery bottles were checked for signs of leaking from the bottom and by opening the spigot without loosening the gas valve to ensure that the bottle was airtight. A 60 CC plastic syringe was then rinsed with water from the desired bottle three times and fitted with a 0.45um Sterlitech syringe filter (luer lock). The 60 mL HDPE sample bottle was then rinsed three times with filtered water (~5-10 mL) and filled to approximately 45 mL. Immediately upon collection, samples were logged and bagged in sets of 4 (which fits best in our freezer racks) and put into a -22degC freezer upright. After they were frozen, samples were combined into larger bags and transported in a cooler back to Seattle as hold luggage and placed in UW freezers until being transferred to UW Marine Chemistry on the 24th July 2025 for analysis as soon as possible.

Salinities: Six Salinity samples were taken during the cruise, to check the CTD calibration and resolve discrepancies between the CTD sensor pairs. For CTD calibration, samples were taken in homogeneous layers at the start (cast 2) and middle (cast 103) of the cruise. Samples were also taken on cast 124 and 135, where the primary and secondary conductivity sensors disagreed, in order to be able to ascertain which was correct.

Samples were taken into traditional salinity bottles, supplied by UW Marine Chemistry and stored cap-down until sampling. For sampling, each bottle was well shaken, rinsed three times with unfiltered water from the sampled

Niskin (about 1/3rd volume of sample bottle per rinse), and then filled to the shoulder, and the cap securely fastened. Prior years has found odd anomalies in these salinity samples. We note that sample 244 (a duplicate on cast 103) had a dirty seal – it will be informative if this affects the salinity. These samples were handcarried back to Seattle and transferred to UW Marine Chemistry for analysis.

Issues encountered at sea:

== Niskin bottles leaking is a perennial problem (see event log and bottle logs). The usual approaches of twisting or retying the rubbers inside the niskins were tried to fix issues. Niskin 5 presented more problems that the other bottles. Leaked bottles were generally not sampled from, with the exception of nutrient samples

- 3234 taken on cast 44 from niskin 11 (target depth 10m), which showed a slight leak at the bottom.
- 3261 taken on cast 60 from niskin 12 (target depth surface – hence leak probably not relevant),

By mid cruise, cast 85, most leaks were solved, except for one Niskin 5 leak, and the final cast, where all but one of the bottles leaks. This latter event was due to the bottles being left cocked overnight when temperatures dropped dramatically.

Action items: Consider doing rubbers at the start of the cruise, rather than shipping them set up. Move faster to address leaky bottles. NEVER leave the bottles cocked unless actively running a line.

Consider location of blocks on CTD frame, which sometimes prevents a bottle (12?) closing.

Be specific about the direction in which the bottles should be cocked.

== Nisken spigots being extremely hard to open, particularly, bottle 7.

Action item: Revisit the spigots – they are not all in identically. Are some of them the wrong way around?

== Presence of jellyfish caused build-up of biological material on CTD rosette and bottles and multiple cases of blocked pumps for the salinity sensors (evident by diverging values for C1 and C2).

- Solution: Using a syringe of salt water to flush each system. Done this cruise on casts as listed above.

Action item: Flush the sensors at the start of the cruise and every 10 casts (as even without jelly fish the sensors are diverging)

== Keeping track of nutrient bottles.

Action item: Use a small, long cardboard box to arrange nutrient bottles in order ready to be filled. (Saves time compared to picking them from the bags).

Rigorously bag in sets of 4, even when that means rebagging from previous casts.

Bring sponge or packing paper to keep nutrient bottles upright in freezer.

== Weight of samples when hand-carrying back to Seattle. In previous years, this often exceeded the checked baggage limit of 50 lbs.

- Solution this year: Mechanical kitchen scale (limit 350 lbs) was brought and assembled on deck. Once all nutrient samples were collected and frozen, coolers were assembled and weighed on deck.

SUMMARY TABLES OF WATER SAMPLES. (Full details given in Appendices)

=============NUTRIENT SAMPLES: 194 samples

Date (GMT)	Time (GMT)	Cast	Site Name	Lat (N) (deg)	Long(W) (deg)	Niskin	Target Depth (m)	Sample number
20250703	1617	**2**	A2-24 Recovery	65.78	168.57	1	50	65
20250703	1617	**2**	A2-24 Recovery	65.78	168.57	1	50	66
20250703	1617	**2**	A2-24 Recovery	65.78	168.57	8	48	67
20250703	1617	**2**	A2-24 Recovery	65.78	168.57	8	48	68
20250703	2315	**4**	A3-24 Recovery	66.33	168.95	2	47	69
20250703	2315	**4**	A3-24 Recovery	66.33	168.95	2	47	70
20250703	2315	**4**	A3-24 Recovery	66.33	168.95	8	45	71
20250703	2315	**4**	A3-24 Recovery	66.33	168.95	8	45	72
20250704	503	**5**	A3-25 Deploy	66.33	168.95	4	47	73
20250704	503	**5**	A3-25 Deploy	66.33	168.95	4	47	74
20250704	503	**5**	A3-25 Deploy	66.33	168.95	8	45	75
20250704	503	**5**	A3-25 Deploy	66.33	168.95	8	45	76
20250704	1832	**6**	A2-25 Deploy	65.78	168.57	1	50	77
20250704	1832	**6**	A2-25 Deploy	65.78	168.57	1	50	78
20250704	1832	**6**	A2-25 Deploy	65.78	168.57	8	48	79
20250704	1832	**6**	A2-25 Deploy	65.78	168.57	8	48	80
20250704	2317	**8**	BS22	65.62	168.18	1	30.1	81
20250704	2317	**8**	BS22	65.62	168.18	3	20	82
20250704	2317	**8**	BS22	65.62	168.18	5	10	83
20250704	2317	**8**	BS22	65.62	168.18	8	0	84
20250705	15	**11**	BS20.5	65.65	168.28	1	44.3	85
20250705	15	**11**	BS20.5	65.65	168.28	3	30	86
20250705	15	**11**	BS20.5	65.65	168.28	5	20	87
20250705	15	**11**	BS20.5	65.65	168.28	8	10	88
20250705	15	**11**	BS20.5	65.65	168.28	10	0	89
20250705	121	**14**	BS19	65.67	168.39	1	50.4	90
20250705	121	**14**	BS19	65.67	168.39	3	40	91
20250705	121	**14**	BS19	65.67	168.39	5	30	92
20250705	121	**14**	BS19	65.67	168.39	8	20	93
20250705	121	**14**	BS19	65.67	168.39	10	10	94
20250705	121	**14**	BS19	65.67	168.39	12	0	95
20250705	224	**17**	BS17.5	65.69	168.49	1	52.9	96
20250705	224	**17**	BS17.5	65.69	168.49	3	40	97
20250705	224	**17**	BS17.5	65.69	168.49	7	30	98
20250705	224	**17**	BS17.5	65.69	168.49	8	20	99
20250705	224	**17**	BS17.5	65.69	168.49	10	10	100
20250705	224	**17**	BS17.5	65.69	168.49	12	0	101
20250705	327	**20**	BS16	65.72	168.59	1	50.2	102
20250705	327	**20**	BS16	65.72	168.59	3	40	103
20250705	327	**20**	BS16	65.72	168.59	7	30	104
20250705	327	**20**	BS16	65.72	168.59	8	20	105
20250705	327	**20**	BS16	65.72	168.59	10	10	106
20250705	327	**20**	BS16	65.72	168.59	12	0	107
20250705	448	**24**	BS14.5	65.75	168.69	1	50.5	108

20250705	448	**24**	BS14.5	65.75	168.69	3	40	109
20250705	448	**24**	BS14.5	65.75	168.69	5	30	110
20250705	448	**24**	BS14.5	65.75	168.69	8	20	111
20250705	448	**24**	BS14.5	65.75	168.69	10	10	112
20250705	448	**24**	BS14.5	65.75	168.69	12	0	113
20250705	551	**27**	BS13	65.77	168.79	1	50.3	114
20250705	551	**27**	BS13	65.77	168.79	3	40	115
20250705	551	**27**	BS13	65.77	168.79	7	30	116
20250705	551	**27**	BS13	65.77	168.79	8	20	117
20250705	551	**27**	BS13	65.77	168.79	10	10	118
20250705	551	**27**	BS13	65.77	168.79	12	0	119
20250705	652	**30**	BS11.5	65.79	168.90	1	45	120
20250705	652	**30**	BS11.5	65.79	168.90	3	30	121
20250705	652	**30**	BS11.5	65.79	168.90	7	20	122
20250705	652	**30**	BS11.5	65.79	168.90	8	10	123
20250705	652	**30**	BS11.5	65.79	168.90	10	0	124
20250705	738	**32**	DL1	65.82	168.93	1	45	125
20250705	738	**32**	DL1	65.82	168.93	3	30	126
20250705	738	**32**	DL1	65.82	168.93	5	20	127
20250705	738	**32**	DL1	65.82	168.93	8	10	128
20250705	738	**32**	DL1	65.82	168.93	10	0	3201
20250705	828	**35**	DL4	65.87	168.93	1	46	3202
20250705	828	**35**	DL4	65.87	168.93	3	40	3203
20250705	828	**35**	DL4	65.87	168.93	7	30	3204
20250705	828	**35**	DL4	65.87	168.93	8	20	3205
20250705	828	**35**	DL4	65.87	168.93	10	10	3206
20250705	828	**35**	DL4	65.87	168.93	Bucket	0	3207
20250705	931	**38**	DL7	65.92	168.94	1	47	3208
20250705	931	**38**	DL7	65.92	168.94	3	40	3209
20250705	931	**38**	DL7	65.92	168.94	7	30	3210
20250705	931	**38**	DL7	65.92	168.94	8	20	3211
20250705	931	**38**	DL7	65.92	168.94	10	10	3212
20250705	931	**38**	DL7	65.92	168.94	Bucket	0	3213
20250705	1029	**41**	DL10	65.97	168.94	1	50	3223
20250705	1029	**41**	DL10	65.97	168.94	3	40	3224
20250705	1029	**41**	DL10	65.97	168.94	5	30	3225
20250705	1029	**41**	DL10	65.97	168.94	8	20	3226
20250705	1029	**41**	DL10	65.97	168.94	10	10	3227
20250705	1029	**41**	DL10	65.97	168.94	Bucket	0	3228
20250705	1124	**44**	DL12.5	66.02	168.94	1	50	3229
20250705	1124	**44**	DL12.5	66.02	168.94	3	40	3230
20250705	1124	**44**	DL12.5	66.02	168.94	7	30	3231
20250705	1124	**44**	DL12.5	66.02	168.94	8	20	3232
20250705	1124	**44**	DL12.5	66.02	168.94	11	10	3234*
20250705	1124	**44**	DL12.5	66.02	168.94	Bucket	0	3235
20250705	1222	**47**	DL14	66.08	168.94	1	53	3236
20250705	1222	**47**	DL14	66.08	168.94	3	40	3237
20250705	1222	**47**	DL14	66.08	168.94	7	30	3238
20250705	1222	**47**	DL14	66.08	168.94	8	20	3239

20250705	1222	**47**	DL14	66.08	168.94	9	10	3240
20250705	1222	**47**	DL14	66.08	168.94	Bucket	0	3241
20250705	1316	**50**	DL15.5	66.15	168.94	1	52.8	3242
20250705	1316	**50**	DL15.5	66.15	168.94	3	40	3243
20250705	1316	**50**	DL15.5	66.15	168.94	7	30	3244
20250705	1316	**50**	DL15.5	66.15	168.94	8	20	3245
20250705	1316	**50**	DL15.5	66.15	168.94	9	10	3246
20250705	1316	**50**	DL15.5	66.15	168.94	Bucket	0	3247
20250705	1412	**53**	DL17	66.21	168.94	1	54	3248
20250705	1412	**53**	DL17	66.21	168.94	3	40	3249
20250705	1412	**53**	DL17	66.21	168.94	7	30	3250
20250705	1412	**53**	DL17	66.21	168.94	8	20	3251
20250705	1412	**53**	DL17	66.21	168.94	9	10	3252
20250705	1412	**53**	DL17	66.21	168.94	Bucket	0	3253
20250705	1510	**56**	DL18.5	66.28	168.94	1	55.3	3254
20250705	1510	**56**	DL18.5	66.28	168.94	3	40	3255
20250705	1510	**56**	DL18.5	66.28	168.94	7	30	3256
20250705	1510	**56**	DL18.5	66.28	168.94	8	20	3257
20250705	1510	**56**	DL18.5	66.28	168.94	9	10	3258
20250705	1510	**56**	DL18.5	66.28	168.94	12	0	3259
20250705	1604	**59**	A3-25	66.33	168.95	1	54.7	3214
20250705	1604	**59**	A3-25	66.33	168.95	3	40	3215
20250705	1604	**59**	A3-25	66.33	168.95	5	30	3216
20250705	1604	**59**	A3-25	66.33	168.95	8	20	3217
20250705	1604	**59**	A3-25	66.33	168.95	10	10	3218
20250705	1604	**59**	A3-25	66.33	168.95	12	0	3219
20250705	1628	**60**	AL12.5	66.33	168.92	1	54.8	3220
20250705	1628	**60**	AL12.5	66.33	168.92	3	40	3221
20250705	1628	**60**	AL12.5	66.33	168.92	7	30	3222
20250705	1628	**60**	AL12.5	66.33	168.92	9	20	3233
20250705	1628	**60**	AL12.5	66.33	168.92	11	10	3260
20250705	1628	**60**	AL12.5	66.33	168.92	12	0	3261*
20250705	1732	**63**	AL14	66.35	168.82	1	53.5	3262
20250705	1732	**63**	AL14	66.35	168.82	3	40	3263
20250705	1732	**63**	AL14	66.35	168.82	7	30	3264
20250705	1732	**63**	AL14	66.35	168.82	8	20	5000
20250705	1732	**63**	AL14	66.35	168.82	10	10	5001
20250705	1732	**63**	AL14	66.35	168.82	12	0	5002
20250705	1836	**66**	AL15.5	66.37	168.71	1	51.2	5003
20250705	1836	**66**	AL15.5	66.37	168.71	3	40	5004
20250705	1836	**66**	AL15.5	66.37	168.71	7	30	5005
20250705	1836	**66**	AL15.5	66.37	168.71	8	20	5006
20250705	1836	**66**	AL15.5	66.37	168.71	10	10	5007
20250705	1836	**66**	AL15.5	66.37	168.71	12	0	4000
20250705	1926	**69**	AL17	66.39	168.61	1	54.2	4001
20250705	1926	**69**	AL17	66.39	168.61	3	40	4002
20250705	1926	**69**	AL17	66.39	168.61	5	30	4003
20250705	1926	**69**	AL17	66.39	168.61	8	20	4004
20250705	1926	**69**	AL17	66.39	168.61	10	10	4005

20250705	1926	**69**	AL17	66.39	168.61	12	0	4006
20250705	2016	**72**	AL18.5	66.40	168.50	1	52.1	4007
20250705	2016	**72**	AL18.5	66.40	168.50	3	40	4008
20250705	2016	**72**	AL18.5	66.40	168.50	7	30	4009
20250705	2016	**72**	AL18.5	66.40	168.50	9	20	4010
20250705	2016	**72**	AL18.5	66.40	168.50	11	10	4011
20250705	2016	**72**	AL18.5	66.40	168.50	12	0	4012
20250705	2110	**75**	AL20	66.42	168.39	2	51.5	4013
20250705	2110	**75**	AL20	66.42	168.39	4	40	4014
20250705	2110	**75**	AL20	66.42	168.39	5	30	4015
20250705	2110	**75**	AL20	66.42	168.39	8	20	4016
20250705	2110	**75**	AL20	66.42	168.39	10	10	4017
20250705	2110	**75**	AL20	66.42	168.39	12	0	4018
20250705	2158	**78**	AL21.5	66.44	168.28	1	42.8	4019
20250705	2158	**78**	AL21.5	66.44	168.28	4	30	4020
20250705	2158	**78**	AL21.5	66.44	168.28	8	20	4021
20250705	2158	**78**	AL21.5	66.44	168.28	10	10	4022
20250705	2158	**78**	AL21.5	66.44	168.28	12	0	4023
20250705	2247	**81**	AL23	66.46	168.17	1	32	4024
20250705	2247	**81**	AL23	66.46	168.17	3	20	4025
20250705	2247	**81**	AL23	66.46	168.17	5	10	4026
20250705	2247	**81**	AL23	66.46	168.17	8	0	4027
20250705	2341	**85**	AL25	66.48	168.03	1	22.4	4028
20250705	2341	**85**	AL25	66.48	168.03	3	10	4029
20250705	2341	**85**	AL25	66.48	168.03	5	0	4030
20250706	2126	**115**	SBSnn1.5	65.61	168.21	1	37	4031
20250706	2126	**115**	SBSnn1.5	65.61	168.21	3	20	4032
20250706	2126	**115**	SBSnn1.5	65.61	168.21	5	0	4033
20250706	2304	**120**	SBSnn3.5	65.57	168.36	1	47.4	4034
20250706	2304	**120**	SBSnn3.5	65.57	168.36	3	20	4035
20250706	2304	**120**	SBSnn3.5	65.57	168.36	5	0	4036
20250707	14	**124**	SBSnn5.5	65.53	168.51	1	58.3	4037
20250707	14	**124**	SBSnn5.5	65.53	168.51	4	40	4038
20250707	14	**124**	SBSnn5.5	65.53	168.51	7	20	4039
20250707	14	**124**	SBSnn5.5	65.53	168.51	8	0	4040
20250707	300	**129**	SBSnn7.5	65.49	168.66	1	54.6	4041
20250707	300	**129**	SBSnn7.5	65.49	168.66	3	40	4042
20250707	300	**129**	SBSnn7.5	65.49	168.66	7	20	4043
20250707	300	**129**	SBSnn7.5	65.49	168.66	8	0	4044
20250707	410	**131**	SBSnn9.5	65.45	168.81	1	54.7	4045
20250707	410	**131**	SBSnn9.5	65.45	168.81	3	40	4046
20250707	410	**131**	SBSnn9.5	65.45	168.81	5	20	4047
20250707	410	**131**	SBSnn9.5	65.45	168.81	10	0	4048
20250707	507	**133**	SBSnn11.5	65.41	168.96	1	54.7	4049
20250707	507	**133**	SBSnn11.5	65.41	168.96	3	40	4050
20250707	507	**133**	SBSnn11.5	65.41	168.96	8	20	4051
20250707	507	**133**	SBSnn11.5	65.41	168.96	10	5	4052*
20250707	606	**135**	SBSnn13.5	65.36	169.11	1	51	4053
20250707	606	**135**	SBSnn13.5	65.36	169.11	3	40	4054

20250707	606	**135**	SBSnn13.5	65.36	169.11	9	20	4055
20250707	606	**135**	SBSnn13.5	65.36	169.11	11	0	4056
20250709	1649	**162**	BC1	65.49	167.89	2	21	4057

3234* small leak at bottom of bottle; 3261* leaked, but sampled anyway as surface; 4052* at Chl Max, not surface

============SALINITY SAMPLES: 6 samples. All taken from Niskin 1. Tar.Dep.=Target Depth

Date (GMT)	Time (GMT)	Cast	Site Name	Lat (N) (deg)	Long(W) (deg)	Niskin	Target Depth (m)	Sample number
20250703	1617	**2**	A2-24 Recovery	65.78	168.57	1	50	241
20250703	1617	**2**	A2-24 Recovery	65.78	168.57	1	50	242
20250706	1710	**103**	BS16.5	65.71	168.56	1	49	244
20250706	1710	**103**	BS16.5	65.71	168.56	1	49	245
20250707	14	**124**	SBSnn5.5	65.53	168.51	1	56	247
20250707	606	**135**	SBSnn13.5	65.36	169.11	1	49	248

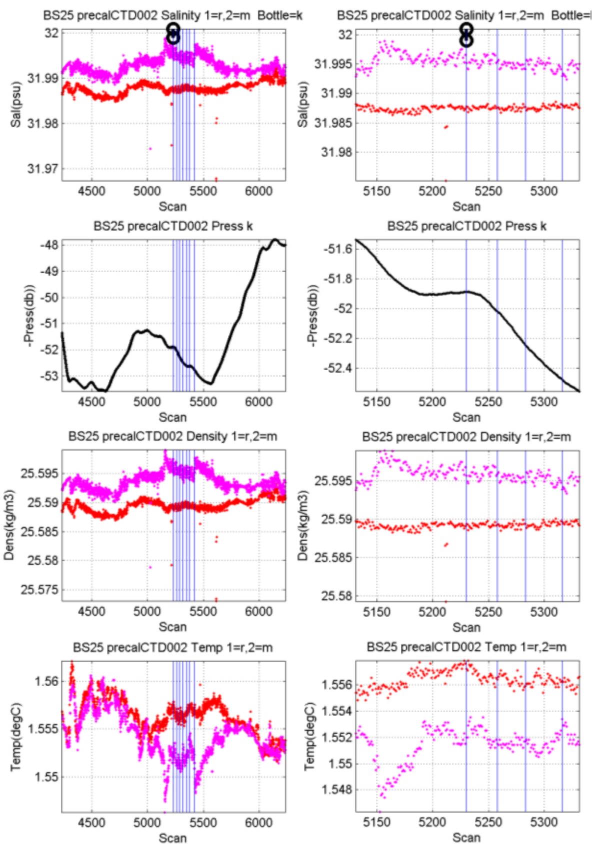
241 & 242 – duplicates for start of cruise
244 – slightly dirty seal
244 & 245 – duplicates for middle of cruise
247 & 248 – to resolve S1-S2 discrepancies

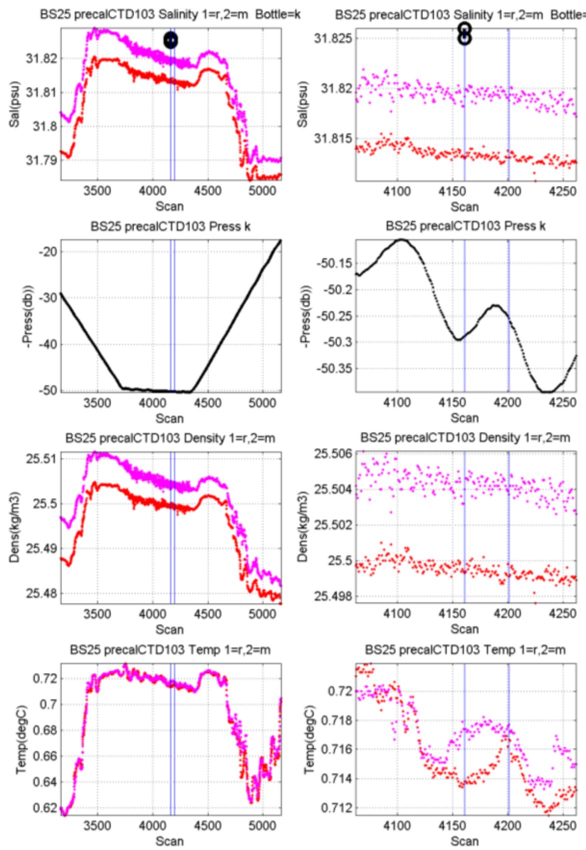
Feb 2026 Note: Salinity sample results were finally obtained from UW in Feb 2026,
And are given here, and in plots below.

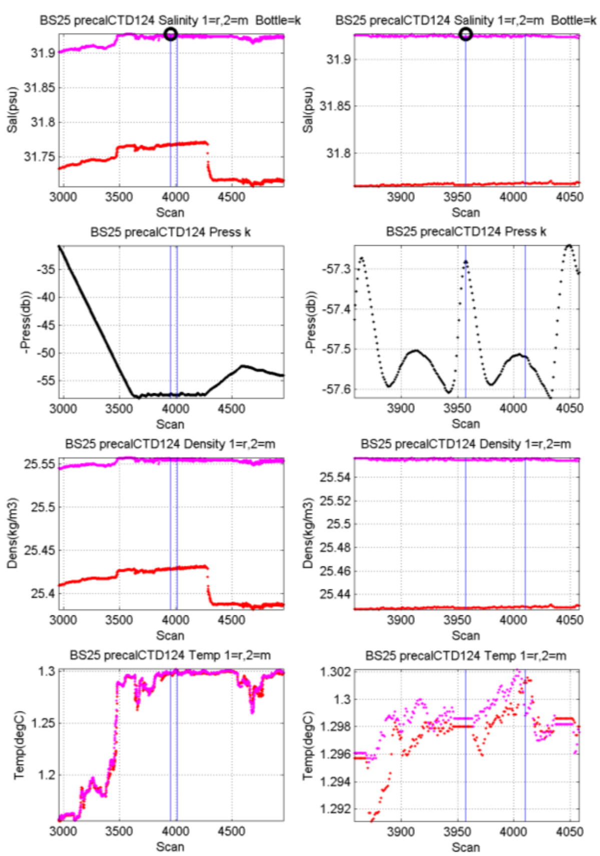
Cast	Site Name	Tar. Dep. (m)	Sam -ple num	Bot. Sal (psu)	S1 (psu)	S2 (psu)	S1-S2 (psu)	Bot-S1 (psu)	Bot-S2 (psu)	
2	A2-24 Rec	50	241	32.001	31.987	31.996	-0.009	0.014	0.005	
2	A2-24 Rec	50	242	31.999	ditto	ditto		0.012	0.003	
103	BS16.5	49	244	31.825	31.814	31.819	-0.005	0.011	0.006	
103	BS16.5	49	245	31.826	ditto	ditto		0.012	0.007	
124	SBSnn5.5	56	247	31.927	31.766	31.924	-0.158	0.161	0.003	S1 fouled
135	SBSnn13.5	49	248	32.470	32.464	32.468	-0.004	0.006	0.002	

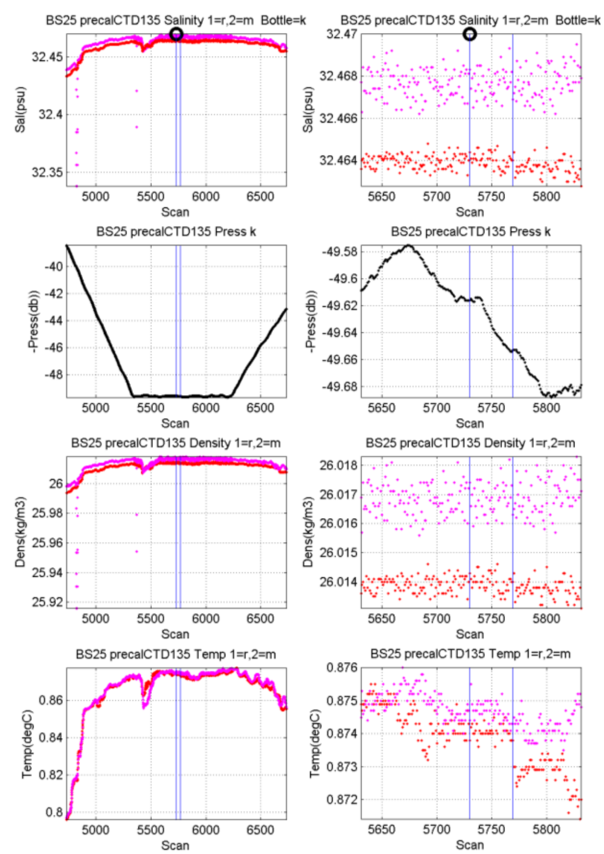
From these we conclude:
-- duplicates agree to 0.001psu
-- S1 is generally 0.01psu fresher than the samples and fresher than S2
-- S2 is slightly noisy, but is in better agreement with the salinity samples than S1, which is often 0.01psu too fresh.
-- for cast 124, S1 was reading far fresher due to fouling.

** USE S2.


BS25 precalCTD002 Salinity 1=r,2=m Bottle=k
BS25 precalCTD002 Press k
BS25 precalCTD002 Density 1=r,2=m
BS25 precalCTD002 Temp 1=r,2=m
Sal(psu)
-Press(db))
Dens(kg/m3)
Temp(degC)
Scan

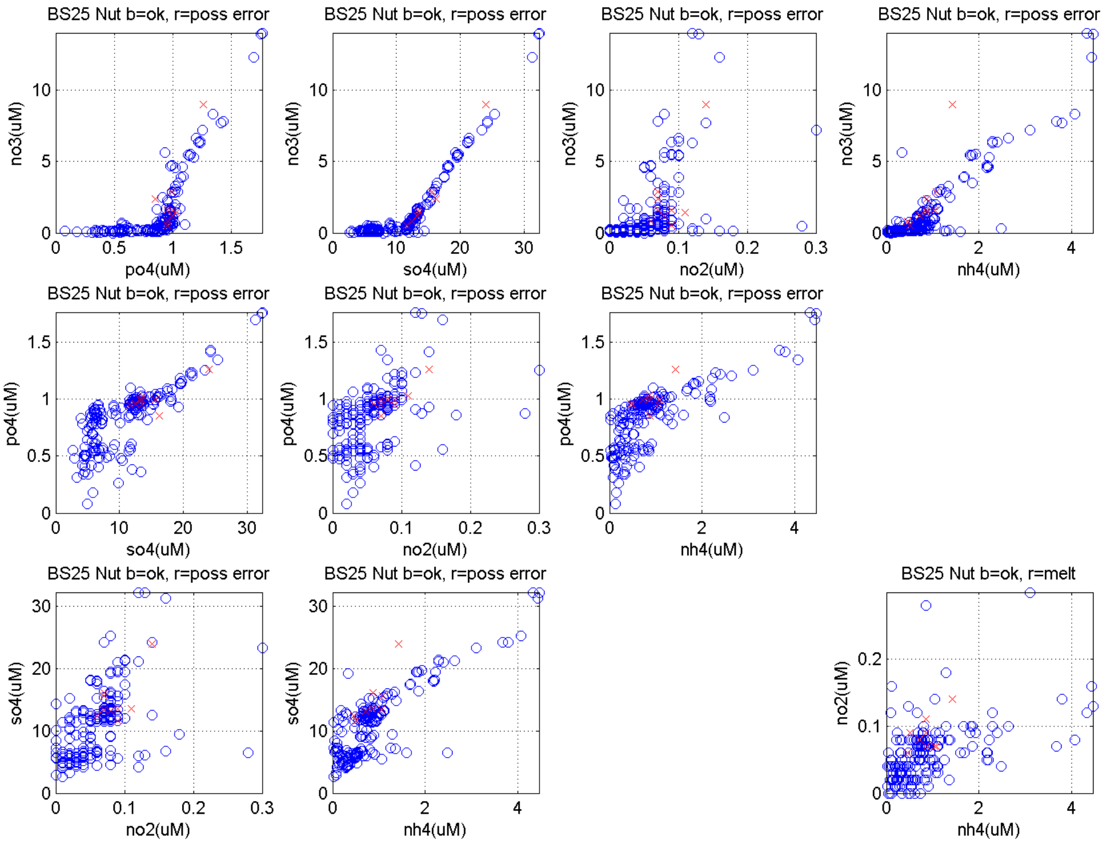

BS25 precalCTD103 Salinity 1=r,2=m Bottle=k
BS25 precalCTD103 Press k
BS25 precalCTD103 Density 1=r,2=m
BS25 precalCTD103 Temp 1=r,2=m
Sal(psu)
-Press(db))
Dens(kg/m3)
Temp(degC)
Scan


BS25 precalCTD124 Salinity 1=r,2=m Bottle=k
BS25 precalCTD124 Press k
BS25 precalCTD124 Density 1=r,2=m
BS25 precalCTD124 Temp 1=r,2=m
Sal(psu)
-Press(db))
Dens(kg/m3)
Temp(degC)
Scan


BS25 precalCTD135 Salinity 1=r,2=m Bottle=k
BS25 precalCTD135 Press k
BS25 precalCTD135 Density 1=r,2=m
BS25 precalCTD135 Temp 1=r,2=m
Sal(psu)
-Press(db))
Dens(kg/m3)
Temp(degC)
Scan

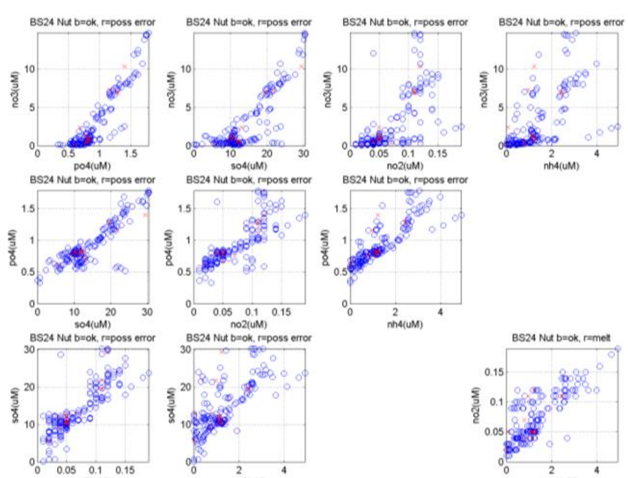
Feb 2026 – update on nutrient results

2025 (July)

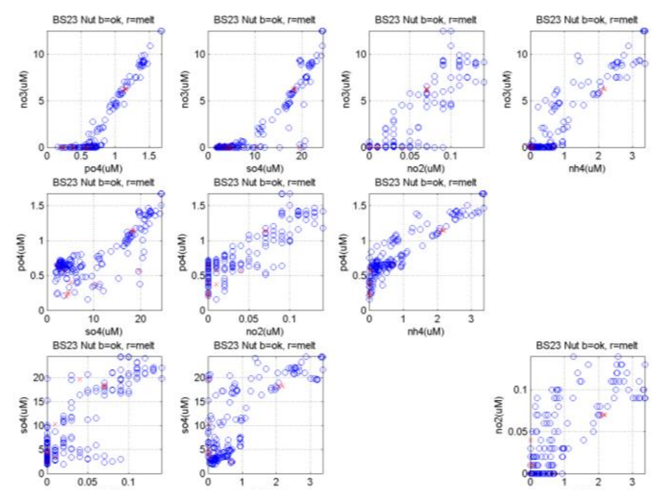


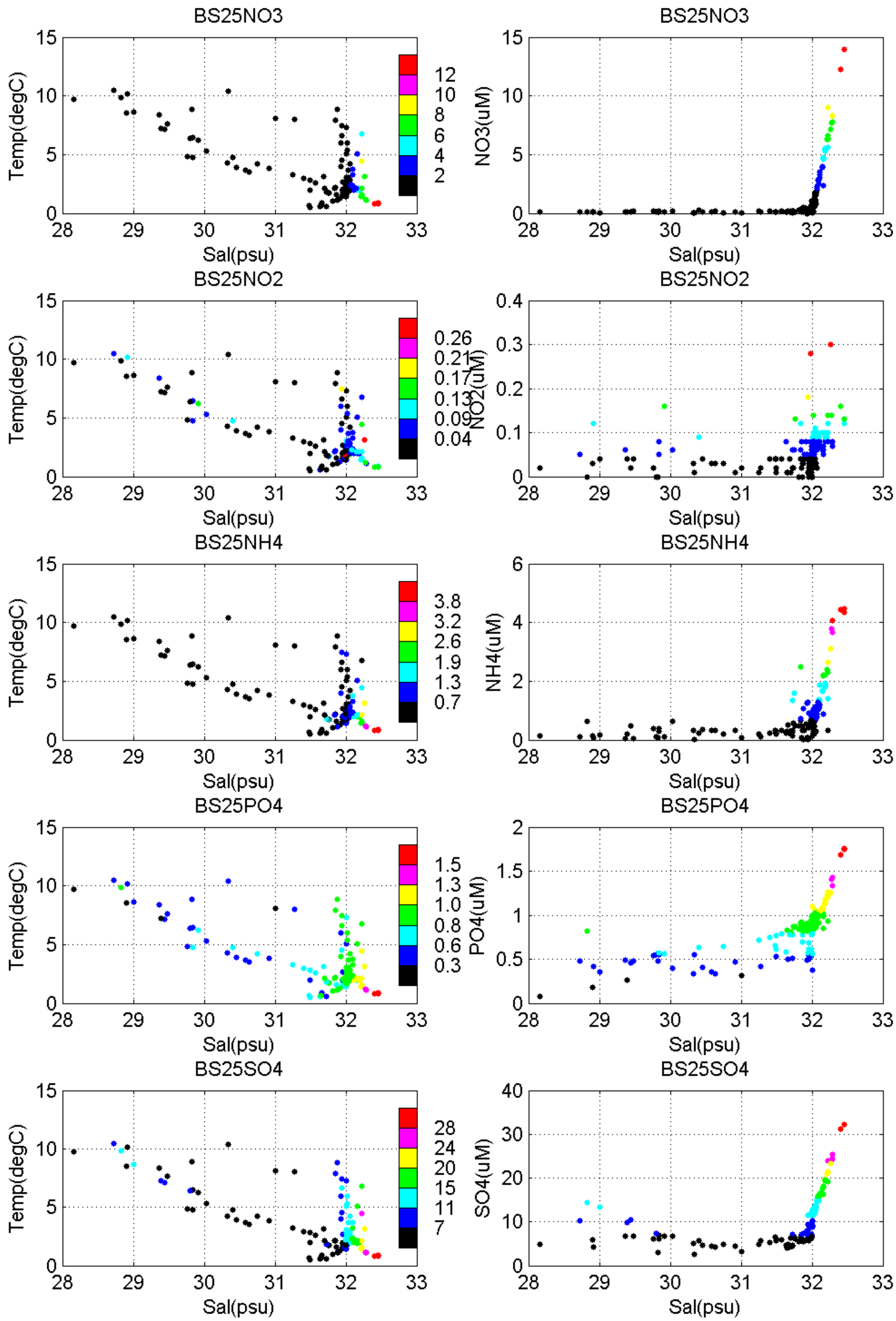
Compare to:

2024 (Sept)

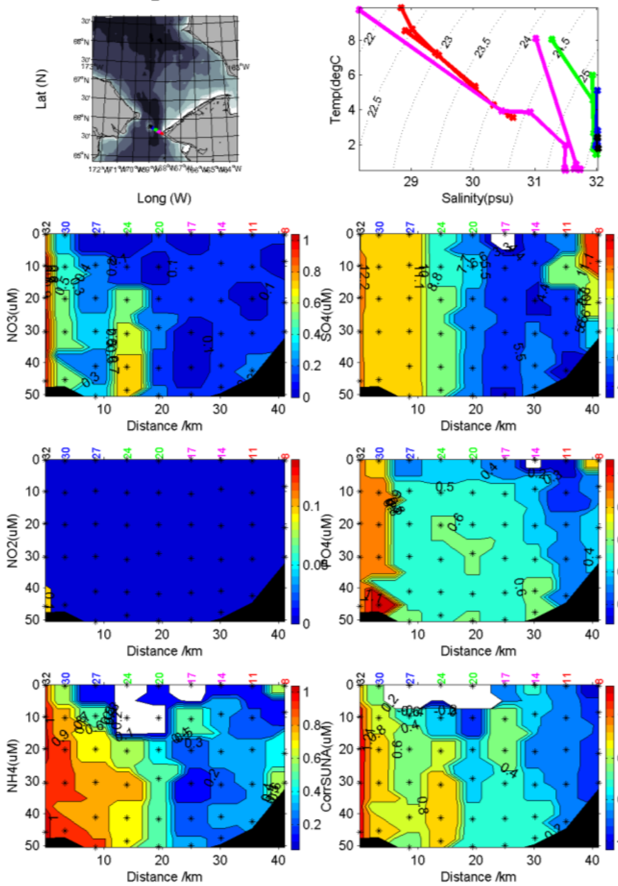


2023 (July)

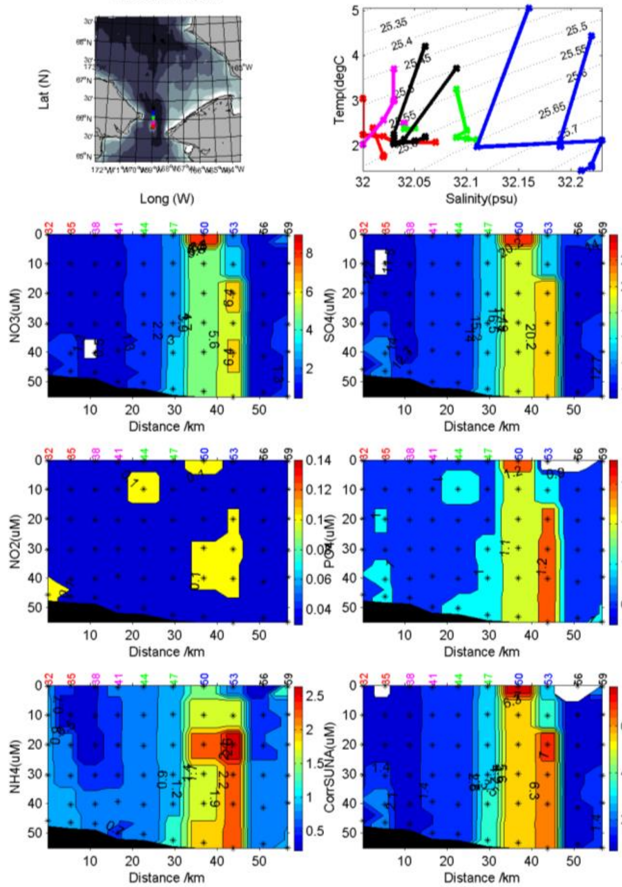



BS25NO3
Temp(degC)
Sal(psu)
12
10
8
6
4
2
NO3(uM)
BS25NO2
0.26
0.21
0.17
0.13
0.09
0.04
NO2(uM)
BS25NH4
3.8
3.2
2.6
1.9
1.3
0.7
NH4(uM)
BS25PO4
1.5
1.3
1.0
0.8
0.6
0.3
PO4(uM)
BS25SO4
28
24
20
15
11
7
SO4(uM)

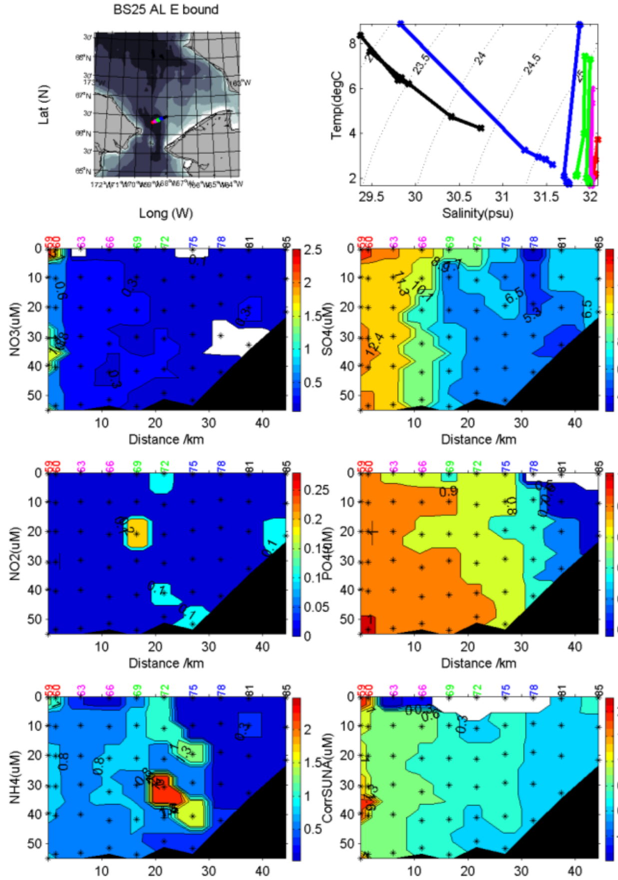
BS25 BS_R1 W bound



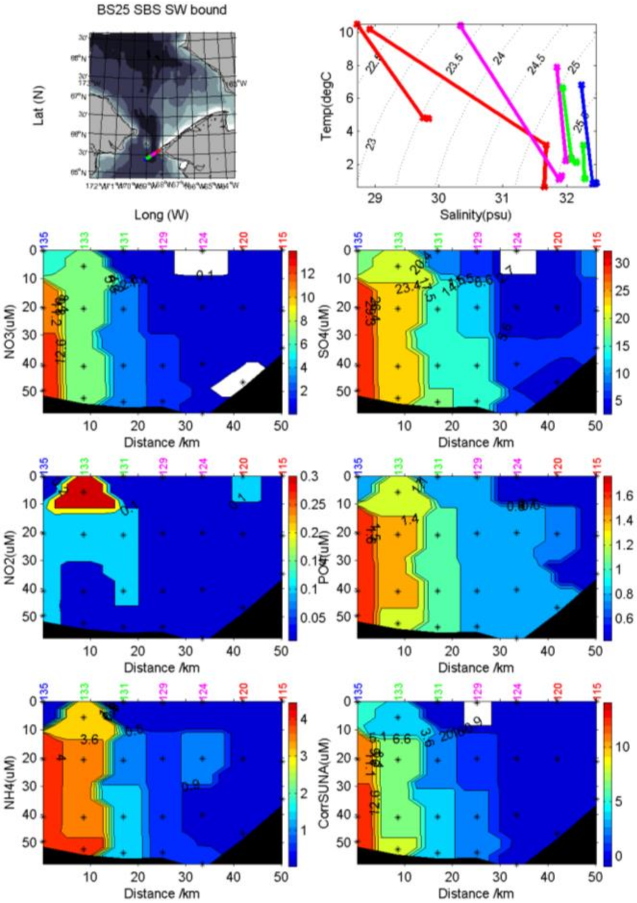
BS25 DL N bound

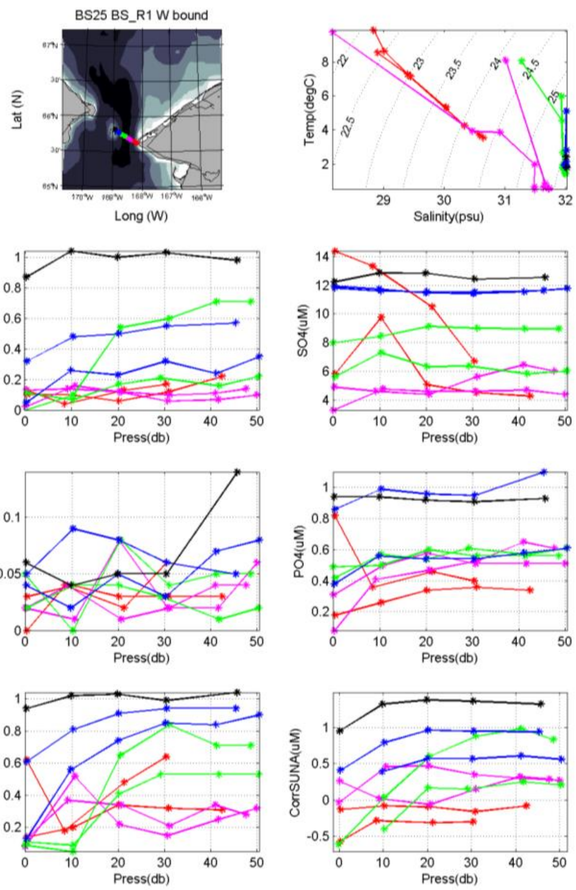


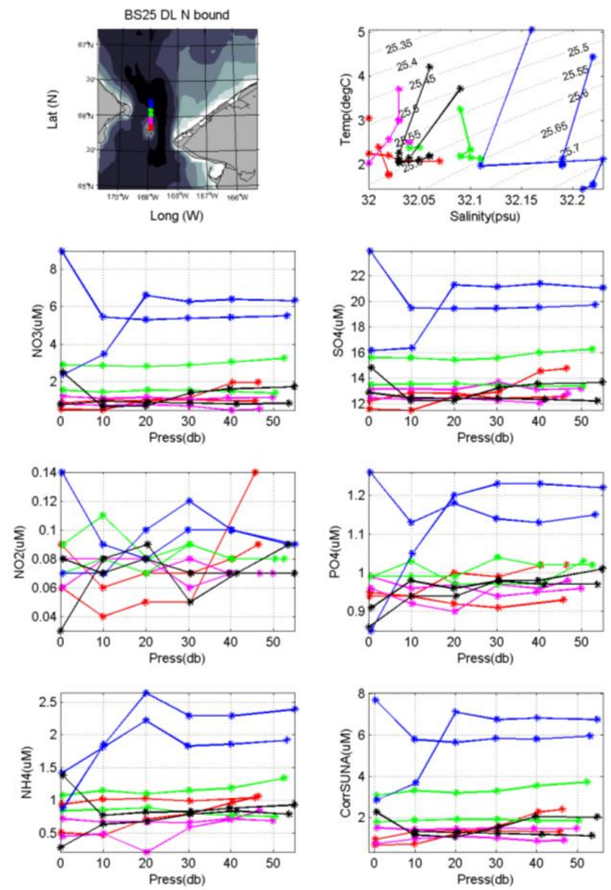
BS25 AL E bound

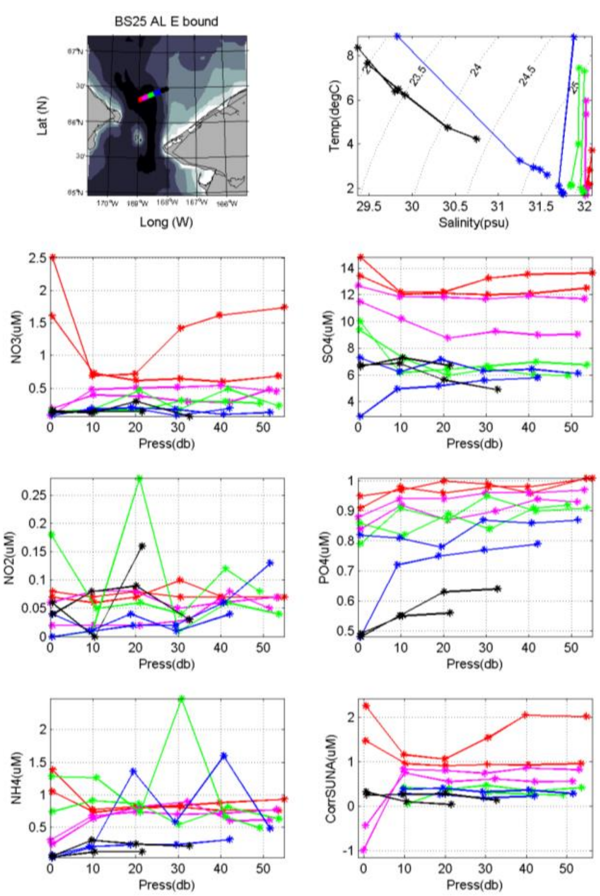


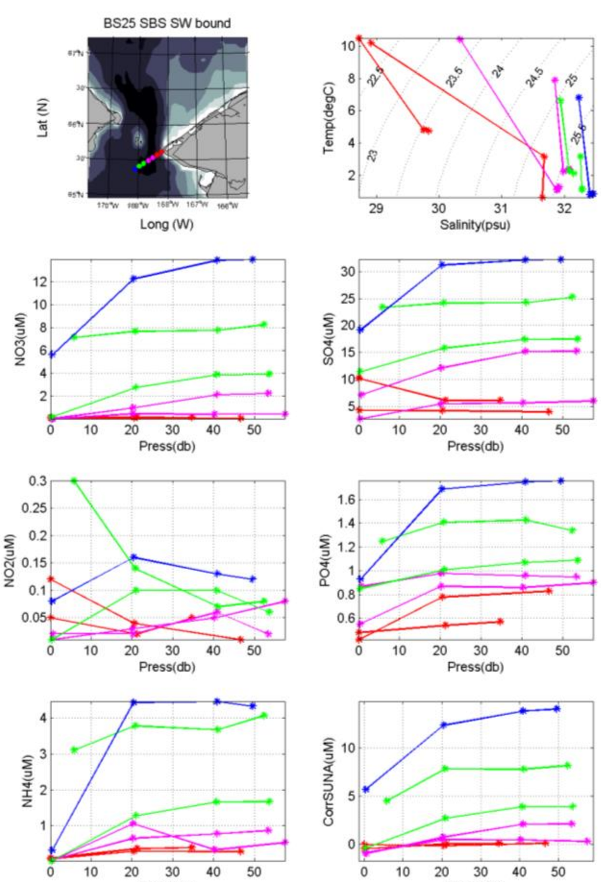
BS25 SBS SW bound

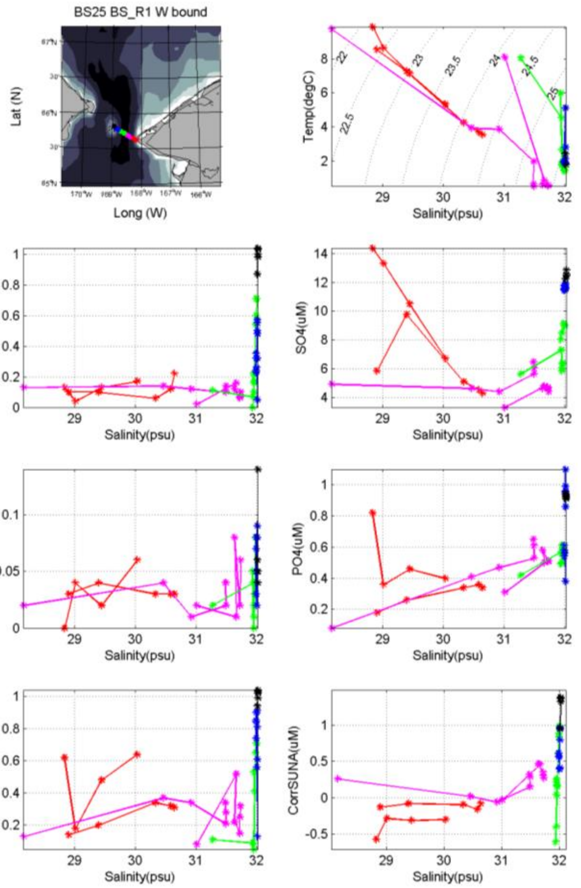


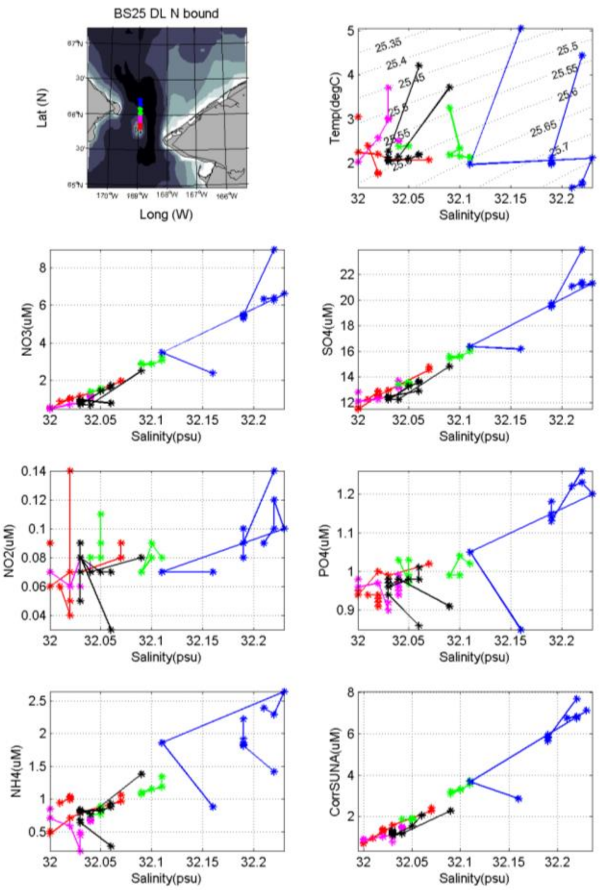

BS25 BS_R1 W bound
Lat (N)
Long (W)
Temp(degC)
Salinity(psu)
NO3(uM)
SO4(uM)
NO2(uM)
PO4(uM)
NH4(uM)
CorrSUNA(uM)
Press(db)

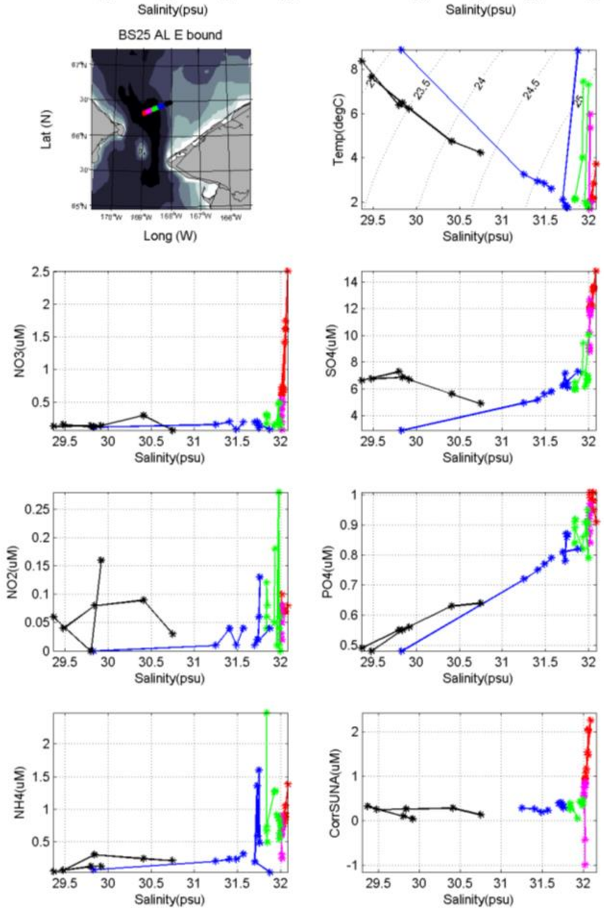

BS25 DL N bound
Lat (N)
Long (W)
Temp(degC)
Salinity(psu)
NO3(uM)
SO4(uM)
NO2(uM)
PO4(uM)
NH4(uM)
CorrSUNA(uM)
Press(db)

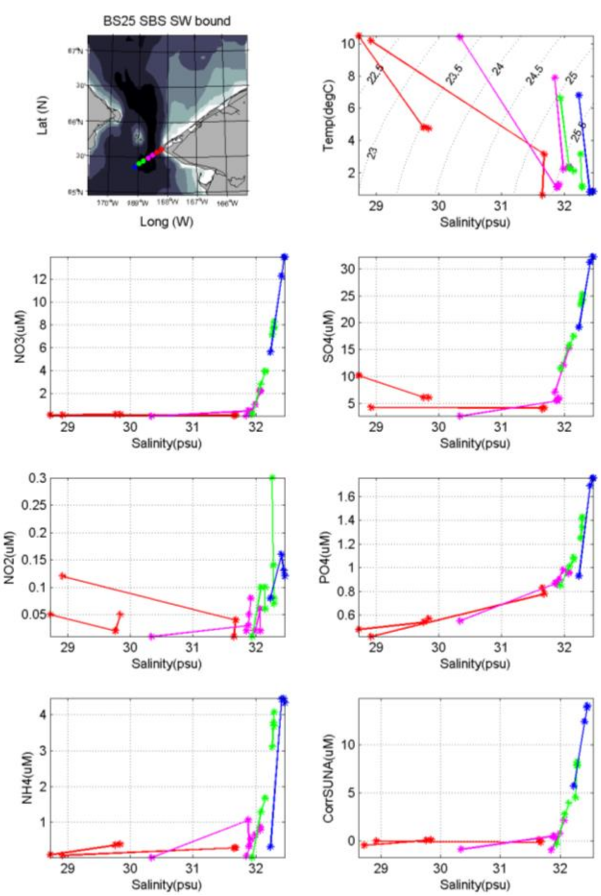

BS25 AL E bound
Lat (N)
Long (W)
Temp(degC)
Salinity(psu)
NO3(uM)
SO4(uM)
NO2(uM)
PO4(uM)
NH4(uM)
CorrSUNA(uM)
Press(db)


BS25 SBS SW bound
Lat (N)
Long (W)
Temp(degC)
Salinity(psu)
NO3(uM)
SO4(uM)
NO2(uM)
PO4(uM)
NH4(uM)
CorrSUNA(uM)
Press(db)


BS25 BS_R1 W bound
Lat (N)
Long (W)
Temp(degC)
Salinity(psu)
NO3(uM)
SO4(uM)
NO2(uM)
PO4(uM)
NH4(uM)
CorrSUNA(uM)


BS25 DL N bound
Lat (N)
Long (W)
Temp(degC)
Salinity(psu)
NO3(uM)
SO4(uM)
NO2(uM)
PO4(uM)
NH4(uM)
CorrSUNA(uM)


BS25 AL E bound
Lat (N)
Long (W)
Temp(degC)
Salinity(psu)
NO3(uM)
SO4(uM)
NO2(uM)
PO4(uM)
NH4(uM)
CorrSUNA(uM)


BS25 SBS SW bound
Lat (N)
Long (W)
Temp(degC)
Salinity(psu)
NO3(uM)
SO4(uM)
NO2(uM)
PO4(uM)
NH4(uM)
CorrSUNA(uM)

BERING STRAIT 2025 TRACE METAL (plus nutrients and delta O18) PUMPING REPORT

Laramie Jensen (UW) -

At the time of writing, the 2025 Trace Metal and delta O18 sampling report is not available, but this will be added to the report at a later date. For the most recent version of this report, please visit: psc.apl.washington.edu/BeringStrait.html

Meanwhile, we include:

a) a preliminary table of the delta O18 sampling (positions are at start time of the cast)

Date	Start Time	Cast	Bottom Depth (m)	Lat (deg)	Lat (min)	Lon (deg)	Lon (min)	Niskin	Target depth (m)	Oxygen isotope sample number	Cast name
20250705	2341	**85**	22.4	66	28.771	168	1.932	5	0	OX1	Al25
20250706	1810	**106**	51.2	65	41.05	168	26.725	2	0	OX2	BS18
20250706	1845	**108**	50.9	65	40.3	168	23.449	3	0	OX3	BS19
20250706	1958	**111**	44.3	65	38.826	168	16.882	3	0	OX4	BS20.5
20250706	2103	**114**	29.8	65	37.431	168	10.586	3	0	OX5	BS22
20250707	1608	**153**	46.7	65	25.512	168	8.559	2	0	OX6	BC4
20250707	1808	**159**	23.3	65	29.255	168	53.442	2	0	OX7	BC1

b) a copy of the 2024 report, which used very similar method.
Trace metal stations are marked in the event log, included at the end of this report.
Nutrient samples were taken from the trace metal pump for each trace metal sample.

2024 Trace metal report – methods:

Background: The objective of this sampling is to take high quality/high resolution trace metal (iron, zinc, nickel, copper, cadmium, manganese, lead) and macronutrient (nitrate, phosphate, silicate) samples alongside the CTD and mooring temperature and salinity sampling. Trace metals (found in small or trace concentrations, ~10^{-9}mol/L) may be useful in deciphering water mass circulation or provenance. Many, like iron, are biologically important for phytoplankton in the surface waters. Importantly, the Bering and Chukchi shelves provide a large source of these trace metals to the Western Arctic Ocean.
Moreover, the inventory of these trace metals appears to increase moving from the North Pacific/Bering Sea through the Bering Strait and onto the Chukchi Shelf. Sources for these metals are primarily sediment resuspension (export of organic matter to the sediments release trace metals through diagenesis or non-reductive dissolution) or riverine input. Freshwater intrusions (salinity <30psu) were observed throughout the CTD transects close to the Alaskan Coast (lines BS, AL, SCS, BC). Rivers may act as a source or diluent for metals and nutrients. Variations in temperature and salinity indicate the presence of multiple water masses observed along the CTD lines sampled. The major objective of this high-resolution sampling is to assess if or to what extent trace metals and nutrients vary across these different water masses feeding into the Bering Strait. Trace metals could be used to trace water mass movement further north where currents are complicated by bathymetric features and become more difficult to track. The BS line was sampled twice (13th September and 17th September) after a storm on the 16th September. Preliminary CTD showed surface freshwater feature near BS11.5 rpt (near Little Diomede), indicating possible detachment of ACC due to winds.
Pump sampling of trace metals: Sampling was done using a trace metal clean PTFE double diaphragm pump (Wilden, see picture below) with a max flow capacity at 56 liters/minute at 125 psi air supply. Tubing both in and out of the water was Grainger 1/2in OD (polyethylene) connected to the pump with PVDF 1/2in compression

fittings (all acid cleaned prior to the cruise). Tubing was cut to ~70m and marked with tape up to 60m from the surface and attached to 3/8in Nylon line. An 8lb kettleball weight was attached directly to the Nylon rope and a RBR Concerto[3] CTD was lashed to the rope with Dynacon line (see figure). Thus the tubing sat approximately 1m above the kettleball weight.

Air was supplied by the ship service air connection on the starboard side and pressure was ultimately controlled using an air regulator (see picture) before entering the pump. Pumping at max capacity, pump was cleared in 80 seconds, estimated by introducing a bubble before surface cast to mark "new water" being sampled. Thus, before each surface and deep sample the pump was flushed for at least 90 seconds at max capacity/speed. Larger capacity Acropaks were used (Acropak-1500 0.2 μm filter) again this year instead of the Acropak-200 used in 2021. These filters did not clog (one was used, LL, as back-up JJ had a potential issue during sampling) and thus there was very little pressure on the pump and tubing. Additionally, the same acid clean Masterflex L/S 24 tubing implemented in 2022 was used rather than the C-flex tubing from 2021 that has a thinner outer diameter and thus "wears out" more easily in response to any back pressure. Both the filtered and unfiltered flow were attached to the main Grainger tubing via a plastic wye split and the Masterflex tubing connection was reinforced by zipties. Flow between the filtered and unfiltered tubing was controlled by plastic hose clamps. After flushing the system, flow was reduced to ~60 psi via the regulator to comply with the pressure ratings on the filter and alleviate back pressure.

Filtered samples (trace metals and nutrients) were filtered directly into 250 mL (TMs) and 60 mL (nuts) Nalgene bottles (pre-cleaned) following 2-3 10% volume rinses as water budget allowed. Nutrients were only filled to approximately 45 mL. Samples were bagged in two poly bags. Nutrient samples were placed in -20°C freezer inside one poly bag within 10 minutes of sampling. Trace metal samples were double bagged in poly bags in increments of 12 and nutrient samples in increments of 5. Nutrient samples remained frozen until they could be analyzed in the Marine Chemistry Lab at the University of Washington. Trace metal samples were all acidified to pH 1.8 using 500 μL of Optima HCl (12M) under a Class 100 laminar flow hood (OSB 443) on 09/23/24. Note that volume was estimated for incomplete samples (clearly less than 250 mL volume) and acidification volume was adjusted accordingly (i.e., if only 50 mL of seawater was collected, 100 μL of Optima HCl was used).

Oxygen-18 isotope samples (opportunistic) were collected in 60 mL Nalgene bottles (pre-cleaned) supplied by the Marine Chemistry Laboratory. 29 samples were collected total (see table below).

Issues encountered during sampling and possible modifications:

New in 2024:

- **Ease of sampling:** The past four years have yielded successful and rapid sample collection. However, it would be easier to sample with a few simple additions such as a filter rig/filter holder that could be secured on deck and hold the filter and unfiltered lines in place. This would allow sampling with both hands and less potential contamination of samples (dropping filter, using "dirty" hand to turn the pump on and off, etc.).
  - **Solution in 2024:** Modified to "hang" tubing through release handles (taped with black electrical tape to mitigate contamination) allowing filtered and unfiltered flow to hang freely. Thus, sampler's hands were free while sampling rather than holding both the filter and the sample bottle.
  - **In the future:** Build a filter rig or modify existing rigs such as the "SBE Stand" used by PI Woodgate to hold instruments during mooring data download or calibration. Ideally, a slot for the 1500 Acropak and potentially a space for the unfiltered flow to be secured. Pressure through the pump causes tubes to wiggle or bounce and this would help that situation.
- **Oxygen sensor wet-connection on RBR CTD:** On the BC line (station BC2.5, see table below), the oxygen sensor wet connection to the oxygen electrode came undone while in the water. No oxygen data collected on this cast.
  - **Solution at sea:** Robert Daniels helped to dry off connections on deck and apply a light layer of silicone grease to both ends. The connection was repaired, the cover to the connection tightened, and the mount for the oxygen electrode tightened as well. RBR data showed no error in oxygen casts after this reconnection.

Consistent since 2021:

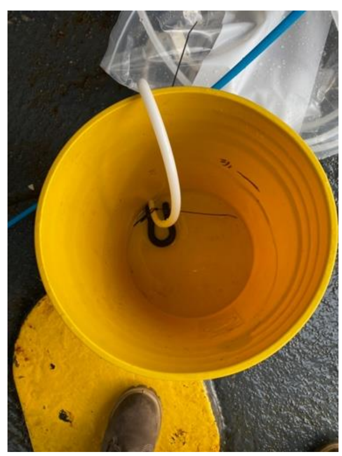
- **Hauling in the apparatus:** One 8lb weight plus the 1.5 kg (3.3 lbs) RBR CTD was about at the limit for one person to haul in comfortably and repeatedly. However, sometimes the weight was not enough to get the tubing down to desired depth.

- **In the future:** Discussion September 17th with Robert Daniels (APL-OE, on-board) about procuring davit and suitable block for next year from APL stock.

- **Flow recirculation between filtered and unfiltered lines:** During sampling, the wye split allowed for flow to recirculate between the filtered and unfiltered tubing, i.e., the pulses of water back-flowed into the wye split and into the other side. To minimize the chance that water that touched the "dirty" unfiltered tube came into contact with the clean tubing and filter, the clamp was placed directly below the wye split. This way, the flow recirculation.
  - **In the future:** Continue to clamp conservatively. Also, ensure that all tubing is acid washed prior to field sampling.
- **Back pressure on filters**: As described above, the max pressure output of 125 psi from the Wilden pump was too strong for the Acropak capsule filters.
  - **Solution(s) at sea:** Reduced pressure to ~80 psi when actively sampling. Also, only slightly closed the unfiltered tubing so that some pressure was relieved that way. Tubing was reinforced with zipties rather than plastic hose clamps. Larger capacity filters were used this year (1500 vs 200) and this was a prodigious solution for backpressure due to clogging. Stronger tubing (Masterflex L/S 24) were also used to great effect.
- **End of tubing staying clean:** The ship's crew did an excellent job of making sure the end of the tubing attached to the Nylon rope did not hit the side of the ship upon recovery. However, this meant that when recovering the weight/CTD/end of the tubing one must lean out over the side of the ship and not use the ship railing as a counterbalance.
  - **In the future:** Results from 2021 suggest very minimal contamination of samples, so end of tubing is likely not a major contamination source if it stays clean during sampling effort.
- **Trace metal cleanliness:** Ideally, sampling would be done in a clean, positive pressure environment. Occasionally, filter apparatus and sample bottles were exposed to seaspray, water on the deck, surfaces inside the ship, or ungloved hands.
  - **Solutions at sea:** Using plastic bags and gloves as much as possible to protect samples from potential contamination.
  - **In the future:** Trying to set up a small environment on the ship where samples could be re-bagged or sorted in a clean way. Even better, creating a way for the entire sampling process to be done indoors in a clean space. Some ideas for this include having the tubing go through a window or other opening and sampling into the sink in a small "bubble" environment.

Pump set up during sampling in 2024. *Picture credit: K. Kohlman.*

Modified filter set up (before sampling BS, BC, and BS repeat lines) in 2024. Notice that the release handle has been wrapped in black electrical tape and the filtered and unfiltered lines now hang from this handle, allowing more hands-free sampling. Bella Payne pictured sampling here.



View of coiled rope and tubing with tape markings (left) and mini RBR CTD (red, white, black). Bucket used to collect unfiltered flow during flushing with shackle attached to restrict the "bouncing" of the white C-flex tubing that occurs due to the pump pressure.

Close up of pump with air regulator and air hose (blue) sitting on the mooring release pallets. It was necessary to use a ratchet strap to stabilize the pump so it did not move during sampling. Plastic bags were used as an extra precaution against contamination.

Picture of weight (blue), RBR CTD (red, white) being secured to the rope roughly 2m and 0.5m from the bottom of the tubing (far right), respectively.

BSTRAIT 2025 WATER SAMPLING: Opportunistic samples for Phytoplankton, for Monica Orellana (UW)
Report by Cecilia Peralta-Ferriz for Monica Orellana.

During this cruise we supported a preliminary research study on phytoplankton on behalf of Dr. Monica Orellana, a Biological Oceanographer at PSC/APL/UW. For this effort, we collected a total of 50 water samples:
- 8 water samples (25-30ml) for identification of phytoplankton species, and
- 42 water samples (2.5-3ml) for quantification of phytoplankton cells.

The 8 larger samples (25-30ml each) for species identification were collected unfiltered from Niskin bottles, or sometimes, when the sample was taken from the surface, from a surface sample collected by bucket. These samples were collected into bottles containing ~20ml of nutrient media (i.e., enriched artificial sea water medium (ESAW, Berges et al. 2001)) to enhance cell growth. The media was added in the bottle prior to the addition of the water sample. The samples were kept cold in a fridge and transported in a cooler with icepacks back to Seattle immediately after the cruise.

The 42 smaller samples (~2.5-3ml each) for quantification of cells were also collected unfiltered, directly from the Niskin bottle with slow flow to minimize cell rupture and disturbance as water entered the vial. These samples were preserved in 0.002% gluteraldehyde solution, which had been added to the vial prior to sampling, and then frozen at -23°C. These samples were bagged and frozen and transported back to Seattle immediately after the cruise in a cooler with icepacks. These samples are expected to be analyzed using an Influx flow cytometer/sorter.

Surface light flux was measured (3 consecutive readings) at most sampling locations using a light meter (brand LICOR). The sampling date/time, location, station ID, depth, light measurement and corresponding comments were included in the hydrography bottle log and are listed below in Tables I and II for the larger and smaller samples, respectively.

Table I. Large (25-30ml) samples for identification of phytoplankton species. Light absorbance is measured in µmol photons per m^2/s. Postions and times given are at end of CTD cast.
X=Chl max

Sample No.	Date (UTC)	Time (UTC)	Lat. Deg (N)	Lat. min	Long. Deg (W)	Long. min	Cast #	Niskin #	Target Depth (m)	Light 1	Light 2	Light 3	
ML 1	7/6/2025	05:40	66	19.82	168	57.22	**91**	5	20X	40.01	29.5	30.8	A3-25
ML 2	7/6/2025	15:05	65	45.35	168	43.24	**98**	8	15X	14.26	12.76	7.47	BS14
ML 3	7/6/2025	16:11	65	44.33	168	40.12	**100**	8	15X	26.37	24.01	30.08	BS15
ML 4	7/6/2025	16:33	65	43.82	168	37.79	**101**	7	12.5X	29.43	33.32	30.68	BS15.5
ML 5	7/7/2025	01:10	65	31.39	168	33.63	**125**	3	25X	n/m	n/m	n/m	SBSnn6
ML 6	7/7/2025	04:20	65	26.99	168	48.90	**131**	8	10X	n/m	n/m	n/m	SBSnn9.5
ML 7	7/7/2025	05:17	65	24.51	168	57.91	**133**	10	5X	30.21	31.11	29.32	SBSnn11.5
ML 8	7/7/2025	6:15	65	21.72	168	6.41	**135**	10	5X	18.81	18.94	17.36	SBSnn13.5

Table I. Continued.

Sample No.	Comments
ML 1	Sample taken at the Chl Max (~1.3 mg/l), at 20m. TSG: S=32.03; T=3.53°C.
ML 2	Sample taken at the Chl Max (~2.8 mg/l) at 15m. TSG: S=31.92; T=6.08°C.
ML 3	Sample taken at/near the Chl Max (~1.6mg/l), at 15m. TSG: S=31.879; T=7.03°C.
ML 4	Sample taken at the Chl Max (~1.3 mg/l) at 12.5m. TSG: S=31.76; T=7.905°C.
ML 5	Sample taken at the Chl Max (~1.2 mg/l) at 25m. TSG: S=31.9; T=8.51°C.
ML 6	Sample taken at the Chl Max (~1mg/l) at 10m. TSG: S=32; T=7.38°C.
ML 7	Sample taken at the Chl Max (~3.6mg/l) at 5m. TSG: S=32.2psu; T=5.48°C.
ML 8	Sample taken at the Chl Max (~1.4 mg/l) at 5m. TSG: S=32.2psu; T=6.81°C.

Table II. Samples for quantification of phytoplankton cells. *n/m* = not measured. X=Chl max

Sample No.	Date (UTC)	Time (UTC)	Lat. Deg (N)	Lat. min	Long Deg (W)	Long. min	Cast #	Niskin #	Target Depth (m)	Light 1	Light 2	Light 3	Station ID
MS 1	7/6/2025	5:40	66	19.82	168	57.22	91	1	40	40.05	29.5	30.8	A3-25
MS 2	7/6/2025	5:40	66	19.82	168	57.22	91	1	40	40.05	29.5	30.8	A3-25
MS 3	7/6/2025	5:40	66	19.82	168	57.22	91	5	20X	40.05	29.5	30.8	A3-25
MS 4	7/6/2025	5:40	66	19.82	168	57.22	91	5	20X	40.05	29.5	30.8	A3-25
MS 5	7/6/2025	5:40	66	19.82	168	57.22	91	10	0	40.05	29.5	30.8	A3-25
MS 6	7/6/2025	5:40	66	19.82	168	57.22	91	10	0	40.05	29.5	30.8	A3-25
MS 7	7/6/2025	15:05	65	45.35	168	43.24	98	1	50	14.26	12.76	7.47	BS14
MS 8	7/6/2025	15:05	65	45.35	168	43.24	98	1	50	14.26	12.76	7.47	BS14
MS 9	7/6/2025	15:05	65	45.35	168	43.24	98	3	35	14.26	12.76	7.47	BS14
MS 10	7/6/2025	15:05	65	45.35	168	43.24	98	3	35	14.26	12.76	7.47	BS14
MS 11	7/6/2025	15:05	65	45.35	168	43.24	98	5	22	14.26	12.76	7.47	BS14
MS 12	7/6/2025	15:05	65	45.35	168	43.24	98	5	22	14.26	12.76	7.47	BS14
MS 13	7/6/2025	15:05	65	45.35	168	43.24	98	8	15x	14.26	12.76	7.47	BS14
MS 14	7/6/2025	15:05	65	45.35	168	43.24	98	8	15x	14.26	12.76	7.47	BS14
MS 15	7/6/2025	15:05	65	45.35	168	43.24	98	11	0	14.26	12.76	7.47	BS14
MS 16	7/6/2025	15:05	65	45.35	168	43.24	98	11	0	14.26	12.76	7.47	BS14
MS 17	7/6/2025	16:11	65	44.33	168	40.12	100	4	25	26.37	24.01	30.08	BS15
MS 18	7/6/2025	16:11	65	44.33	168	40.12	100	4	25	26.37	24.01	30.08	BS15
MS 19	7/6/2025	16:11	65	44.33	168	40.12	100	8	15x	26.37	24.01	30.08	BS15

MS 20	7/6/2025	16:11	65	44.33	168	40.12	100	8	15x	26.37	24.01	30.08	BS15
MS 21	7/6/2025	16:11	65	44.33	168	40.12	100	11	5	26.37	24.01	30.08	BS15
MS 22	7/6/2025	16:11	65	44.33	168	40.12	100	11	5	26.37	24.01	30.08	BS15
MS 23	7/6/2025	16:33	65	43.82	168	37.80	101	1	30	29.43	33.32	30.68	BS15.5
MS 24	7/6/2025	16:33	65	43.82	168	37.80	101	1	30	29.43	33.32	30.68	BS15.5
MS 25	7/6/2025	16:33	65	43.82	168	37.80	101	7	12.5x	29.43	33.32	30.68	BS15.5
MS 26	7/6/2025	16:33	65	43.82	168	37.80	101	7	12.5x	29.43	33.32	30.68	BS15.5
MS 27	7/6/2025	16:33	65	43.82	168	37.80	101	8	5	29.43	33.32	30.68	BS15.5
MS 28	7/6/2025	16:33	65	43.82	168	37.80	101	8	5	29.43	33.32	30.68	BS15.5
MS 29	7/7/2025	4:20	65	26.99	168	48.90	131	3	40	n/m	n/m	n/m	SBSnn9.5
MS 30	7/7/2025	4:20	65	26.99	168	48.90	131	3	40	n/m	n/m	n/m	SBSnn9.5
MS 31	7/7/2025	4:20	65	26.99	168	48.90	131	8	15x	n/m	n/m	n/m	SBSnn9.5
MS 32	7/7/2025	4:20	65	26.99	168	48.90	131	8	15x	n/m	n/m	n/m	SBSnn9.5
MS 33	7/7/2025	4:20	65	26.99	168	48.90	131	10	0	n/m	n/m	n/m	SBSnn9.5
MS 34	7/7/2025	4:20	65	26.99	168	48.90	131	10	0	n/m	n/m	n/m	SBSnn9.5
MS 35	7/7/2025	10:57	65	15.61	168	48.81	137	1	15	0.15	0.15	0.15	BC12
MS 36	7/7/2025	10:57	65	15.61	168	48.81	137	1	15	0.15	0.15	0.15	BC12
MS 37	7/7/2025	10:57	65	15.61	168	48.81	137	4	7x	0.15	0.15	0.15	BC12
MS 38	7/7/2025	10:57	65	15.61	168	48.81	137	4	7x	0.15	0.15	0.15	BC12
MS 39	7/7/2025	10:57	65	15.61	168	48.81	137	4	7x	0.15	0.15	0.15	BC12
MS 40	7/7/2025	10:57	65	15.61	168	48.81	137	8	0	0.15	0.15	0.15	BC12
MS 41	7/7/2025	10:57	65	15.61	168	48.81	137	8	0	0.15	0.15	0.15	BC12
MS 42	7/7/2025	10:57	65	15.61	168	48.81	137	8	0	0.15	0.15	0.15	BC12

Table II. Continued.

Sample No.	Comments
MS 1	Taken at 40m (Chl~0.8 mg/l), below Chl Max.
MS 2	Taken at 40m (Chl~0.8 mg/l), below Chl Max.
MS 3	Taken at 20m, at the Chl Max (~1.3 mg/l).
MS 4	Taken at 20m, at the Chl Max (~1.3 mg/l).
MS 5	Taken at the surface (Chl ~0.4mg/l), above the Chl Max.
MS 6	Taken at the surface (Chl ~0.4mg/l), above the Chl Max.
MS 7	Taken at the bottom at 50m (at Chl ~1.4 mg/l)
MS 8	Taken at the bottom at 50m (at Chl ~1.4 mg/l)
MS 9	Taken at 35m (at Chl ~1.5 mg/l)
MS 10	Taken at 35m (at Chl ~1.5 mg/l)
MS 11	Taken at 22m (Chl~1.2mg/l), below Chl Max.
MS 12	Taken at 22m (Chl~1.2mg/l), below Chl Max.
MS 13	Taken at 15m, at Chl Max (~2.7 mg/l).
MS 14	Taken at 15m, at Chl Max (~2.7 mg/l).
MS 15	Taken at the surface (Chl ~0.4 mg/l), above Chl Max.
MS 16	Taken at the surface (Chl ~0.4 mg/l), above Chl Max.
17	Taken at 25m (Chl~0.7mg/l), below the Chl Max.
18	Taken at 25m (Chl~0.7mg/l), below the Chl Max.
19	Taken at 15m, at about Chl Max (~1.5mg/l).
20	Taken at 15m, at about Chl Max (~1.5mg/l).
21	Taken at 5m (Chl~0.1mg/l), above the Chl Max.
22	Taken at 5m (Chl~0.1mg/l), above the Chl Max.
23	Taken below Chl Max at 30m (Chl ~0.6 mg/l).
24	Taken below Chl Max at 30m (Chl ~0.6 mg/l).
25	Sample taken at the Chl Max (~1.3 mg/l) at 12.5m.
26	Sample taken at the Chl Max (~1.3 mg/l) at 12.5m.
27	Taken above Chl Max at 5m (Chl ~0.2 mg/l).
28	Taken above Chl Max at 5m (Chl ~0.2 mg/l).
29	Taken below Chl Max at 40m (~0.4 mg/l)
30	Taken below Chl Max at 40m (~0.4 mg/l)
31	Sample taken at the Chl Max (~1mg/l) at 10m. TSG: S=32; T=7.38^{o}C.
32	Sample taken at the Chl Max (~1mg/l) at 10m. TSG: S=32; T=7.38^{o}C.
33	Taken at surface (Chl ~0.1mg/l), above Chl Max
34	Taken at surface (Chl ~0.1mg/l), above Chl Max
35	Taken at 15m in a Chl minimum
36	Taken at 15m in a Chl minimum
37	Taken at Chl Max of ~4.02 mg/l (7m)
38	Taken at Chl Max of ~4.02 mg/l (7m)
39	Taken at Chl Max of ~4.02 mg/l (7m)
40	Taken at surface, above Chl Max
41	Taken at surface, above Chl Max
42	Taken at surface, above Chl Max

Reference:

Berges, J.A., Franklin, D.J. and Harrison, P.J. (2001), EVOLUTION OF AN ARTIFICIAL SEAWATER MEDIUM: IMPROVEMENTS IN ENRICHED SEAWATER, ARTIFICIAL WATER OVER THE LAST TWO DECADES. Journal of Phycology, 37: 1138-1145. https://doi.org/10.1046/j.1529-8817.2001.01052.x

BERING STRAIT 2025 UNDERWAY DATA REPORT – Woodgate (UW)

Underway CTD, ADCP and some meteorological data were collected during the cruise using the Norseman II's ship-based systems. These systems are usually set up by the Norseman II crew at the start of the cruise, but as described below, this was problematic this year. **Action item: Pre-cruise, develop checksheets for the setup of these instruments to ensure settings are as desired. Check the setups as soon as the ship leaves port.**

ADCP: This year, as last year, we collected data from the Norseman II's Teledyne RD Instruments 300kHz Workhorse Mariner ADCP (SN 19355), which is equipped with high accuracy bottom tracking. The ADCP is mounted 3m below the water line. After initial problems, this system was operational for the cruise, running with 1m bins and bottom track. The following file types are available for processing (file information copied from http://po.msrc.sunysb.edu/SBI/Healy_ADCPs.htm)

*.ENR – raw binary ADCP data which contains every ping
*.ENS – Binary ADCP data after the data has been preliminarily screened for backscatter and correlation
*.ENX - Binary ADCP data after screening and rotation to earth coordinates
*.STA - Binary ADCP ensemble data that has been averaged into short term averages
*.LTA - Binary ADCP ensemble data that has been averaged into long term averages
*.N1R - Raw NMEA ASCII data from the primary navigation source
*.N2R - Raw NMEA ASCII data from the secondary navigation source, if available, and which should include Ashtech heading data
*.NMS - Binary screened and averaged navigation data
*.VMO - This ASCII file is a copy of the *.ini options file that was used during the data collection
*.LOG - ASCII file containing a log of any errors the ADCP detected during the session

Preliminary data plots will be added to this report once available. Bottom track data was logging during this deployment. **Action item: Ensure that bottom tracking is turned on. Process ADCP data.** Note also that since heading information is given by the ship's GPS position, it is not necessary to correct for magnetic declination. **Action item: Check prior data for magnetic declination issue.**

This year (2025), on initializing these systems on leaving port, several problems were found – including that the system was no longer logging position or time, and the alignment angle within the ship had been set to zero. It appear that when the system was serviced this year, no-one reset the software to the set ups used by the ship. To solve this, it was necessary to revisit the options of VMDAS. We reloaded the old options file (1m bins with bottom track, high resolution), and reassigned com ports that had been deleted, and reinstalled the link to WinADCP to keep track of the data. A fuller description of the steps of set up are given at the end of the underway write up. We believe the system should have recorded good data from 3rd July 2025 0115AM GMT.
Action item: At start of cruise, check this set up for logging position and time, bottom track and heading alignment.

MET DATA: The Norseman2 had South Central Radar install a new Meteorological sensor package in 2021, as the previous sensors failed. The new version is an Airmar 220WX instrument Weather caster 153 (https://www.airmar.com/weather-description.html?id=153, https://www.airmar.com/uploads/InstallGuide/17-461-01.pdf) running WeatherCaster 3 software. Trouble shooting of these sensors in 2021 (and comparison to ERA, JRA and NCEP data) concluded that the unit was reading:
- too high for wind speed (by about 2m/s on average, i.e., about 4 knots)
- too low for temperature (by about 2degC on average)
- too low for pressure (by ~ 2hPa).

These differences are all greater than the stated accuracy of the sensor https://www.airmar.com/weather-description.html?id=153 (0.5m/s for speed; 1.1degC for temperature, 0.5hPa for pressure).

Note the instrument calculates true wind direction and speed (and this is not reproducible exactly from relative wind and ship heading. In 2021, a compass calibration was performed off Nome in less than ideal conditions, and this may have contributed to the errors in the 2021 data. For 2022, a better calibration was performed pre cruise, in suitable conditions. It is not clear if the system has been calibrated subsequently. It is possible thus that the 2023 and 2024 and 2025 data are of higher quality than in 2021 but this should be confirmed with comparison to the model wind products: Note that the temperature and wind chill temperature reported remain identical, which is clearly erroneous. **Action item: Repeat comparison to ERA, JRA and NCEP wind data.**

As can be seen in the plots below, winds were strong (and southward) at the end of the cruise, (causing us to shelter near Tin City). Wind direction should be taken into account when considering the hydrographic sections. Particularly note the strong southward winds at the end of the cruise displaced the Alaskan Coastal Current into the western part of the eastern strait. **Action item: Add wind direction to the CTD and underway sections. .**

UNDERWAY TEMPERATURE AND CONDUCTIVITY DATA: The Norseman II used an Seabird SBE21 temperature conductivity sensor mounted 3.4m below the water line (slightly to port of the ship's ADCP, in the center of the ship) to collect underway data throughout the cruise, also logging position information and depth. A separate temperature sensor (SBE38) is placed closer to the intake to measure the temperature (recorded as temperature 2) before it is warmed by the ship. **Action item: Ensure depth is always logged in this file.**
Initially, the inlet valve was shut, resulting in erroneous data, but this problem was quickly identified and fixed 40minutes into the cruise. These erroneous data have been replaced with dummy values in the data file. **Action item: Ensure valves are open at the start of the cruise.** Raw depth data were frequently noisy, and fliers over 65m depth have been removed in the data file. An hourly watch was kept on these data to ensure no loss of data. **Action item: Continue hourly monitoring of underway data while at sea. Check the temperature and salinity data to the CTD casts.**
Data were logged every 3 seconds.

Preliminary plots of the underway temperature and salinity data are given below

.

Note the NMEA data string logged by the underway temperature and salinity SB21 shows the same GPS roll over error that was present in 2021, the result of which is that the raw date is incorrect by several years and months, although the time (GMT) is correct. The date is corrected in post processing. **Action item: Correct this problem with the GPS**

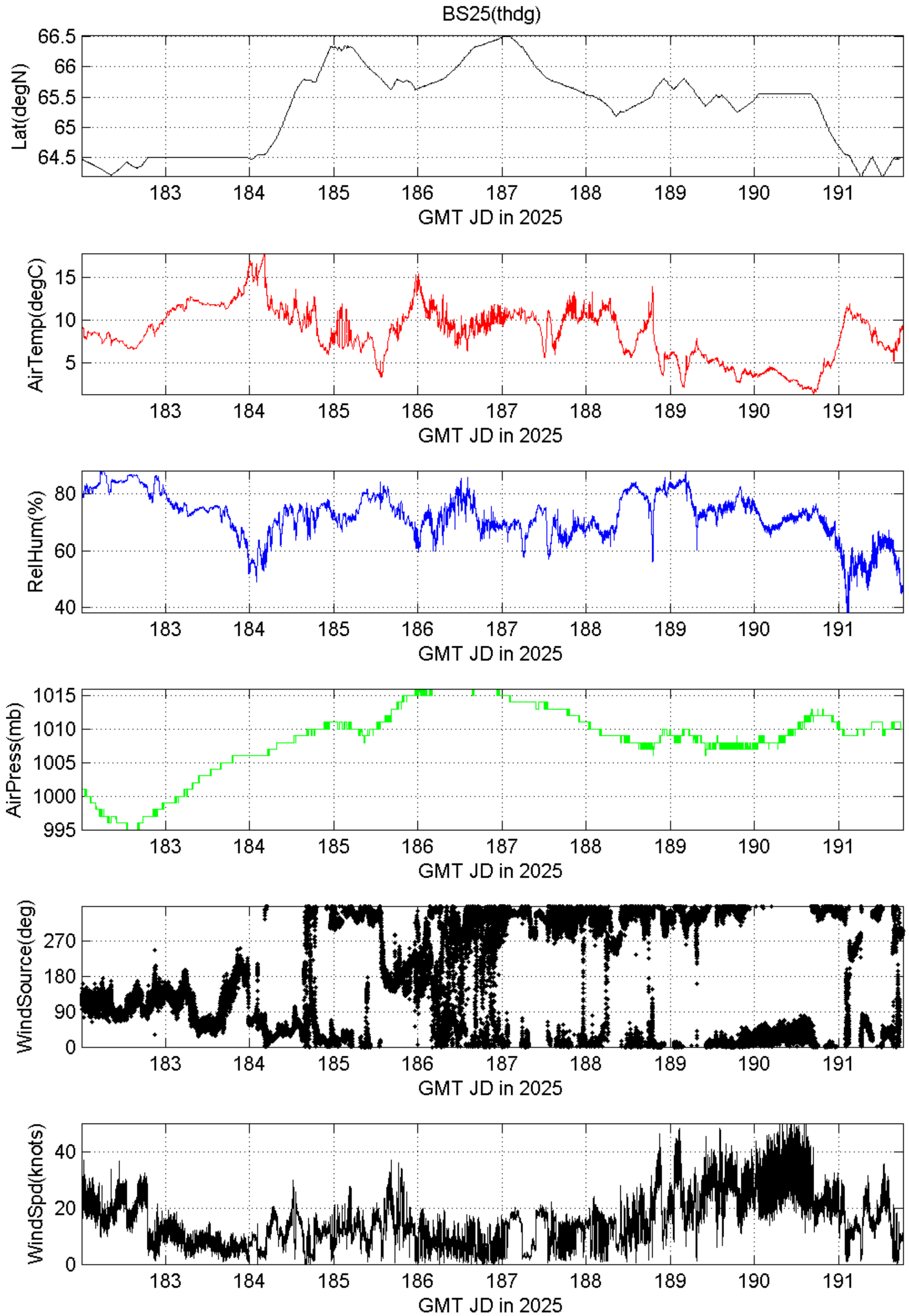
It is very important to remember when interpreting these data, that they are taken over the many days of the cruise, and the oceanographic conditions change significantly during this time, as is evidenced by the plots of the various crossings of the Bering Strait. **Action item: Examine surface salinities and temperatures, especially in conjunction with prior data.**

Once CTD data are final, a comparison of underway values to surface CTD values will be completed. **Action item: Do this.**

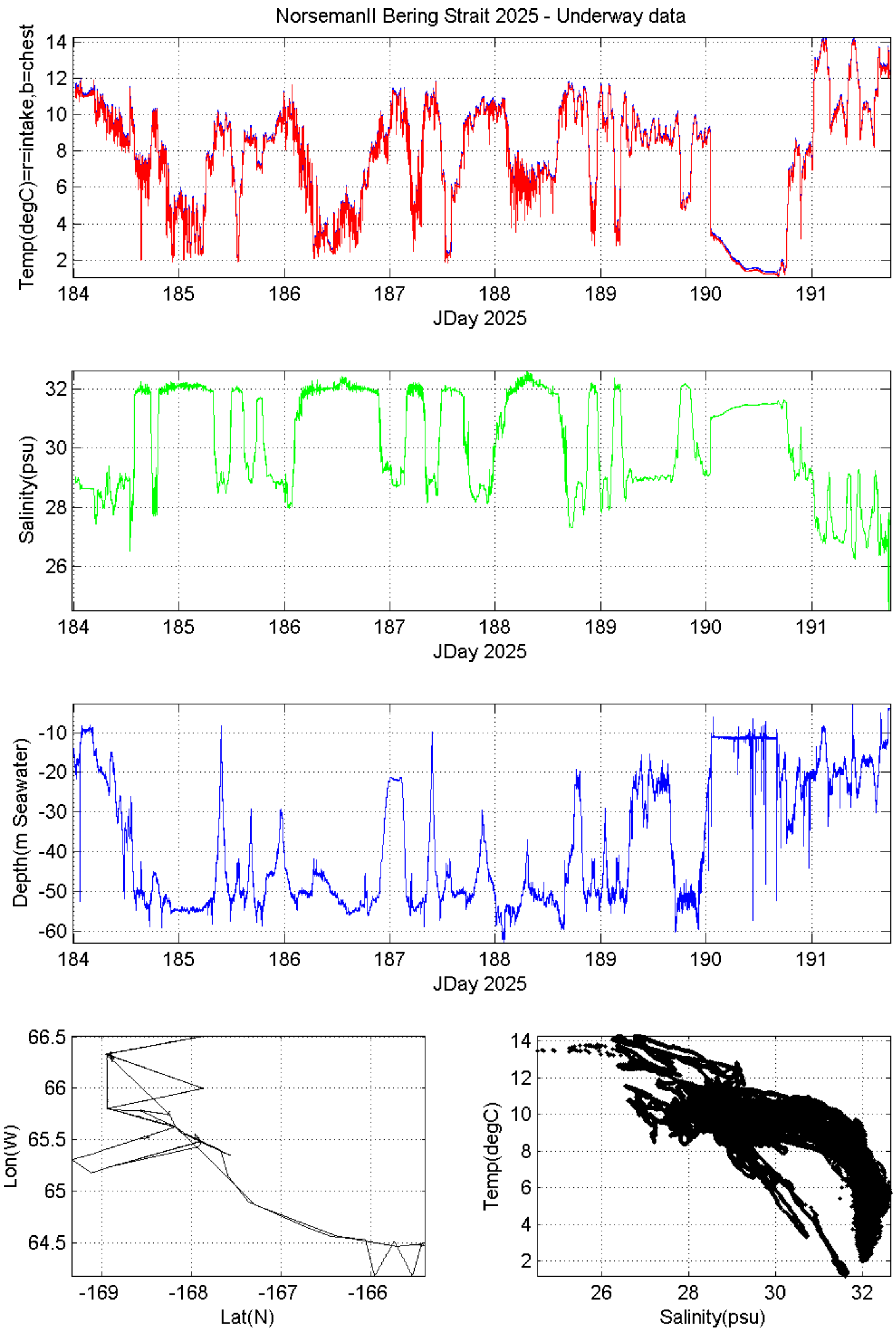
For dates and times, see cruise schedule at start of report.

BERING STRAIT 2025 METEOROLOGICAL DATA PLOTS

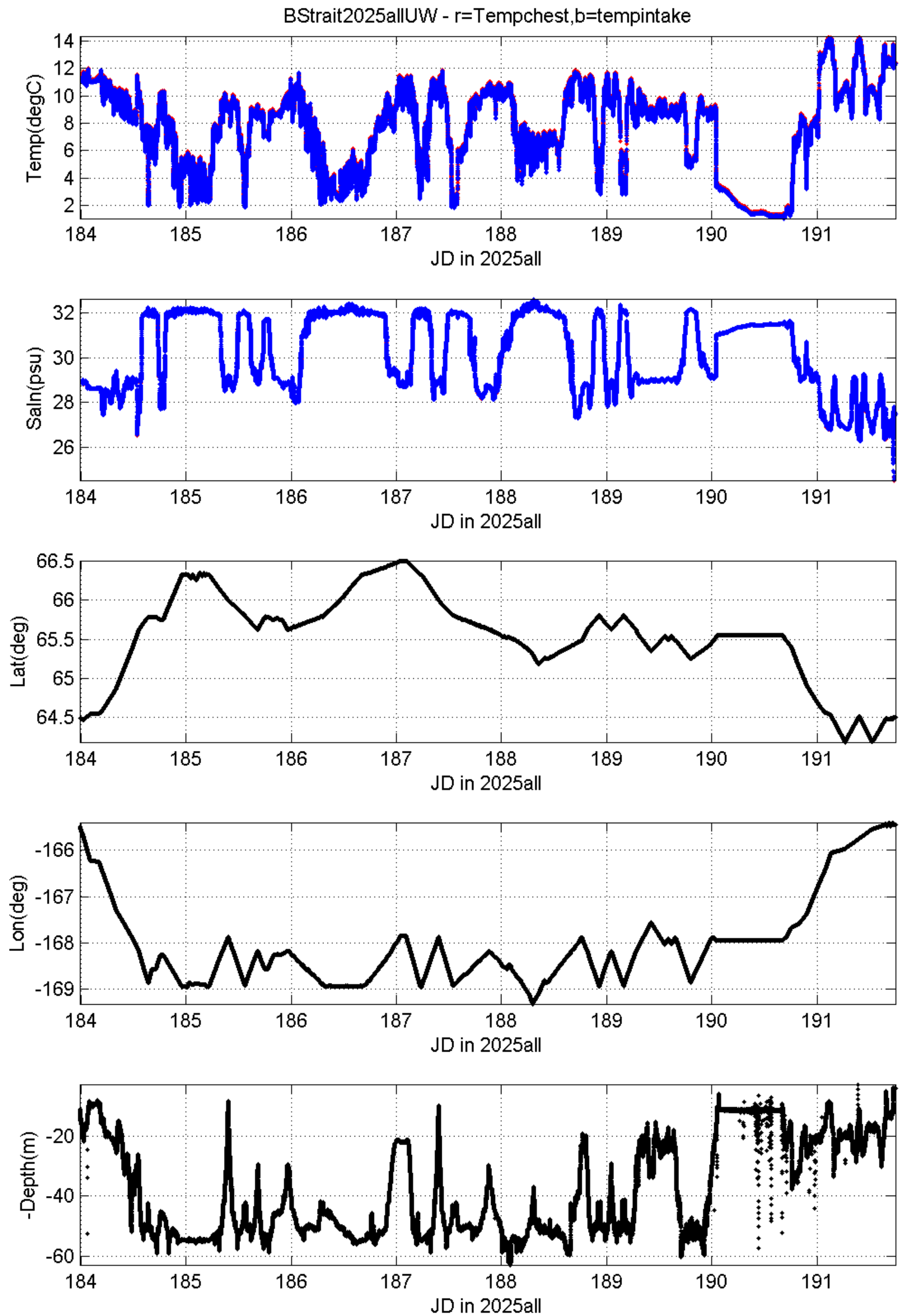
Stated accuracy of the sensor https://www.airmar.com/weather-description.html?id=153 (0.5m/s for speed; 1.1degC for temperature, 0.5hPa for pressure), but 2021 analysis suggests these accuracies are over optimistic. Note the instrument calculates true wind direction and speed (and this is not reproducible exactly from relative wind and ship heading.



BERING STRAIT 2025 UNDERWAY TEMPERATURE SALINITY DATA
Note waters are generally warmer, but saltier than during the 2024 cruise.



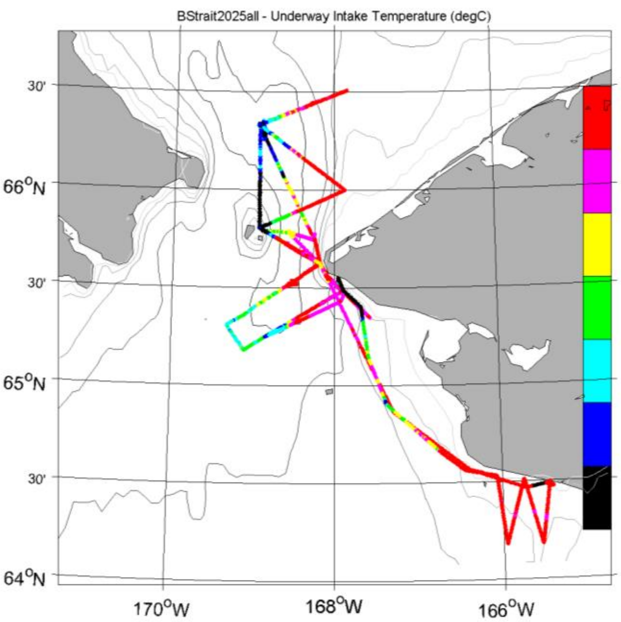
BERING STRAIT 2025 UNDERWAY TEMPERATURE SALINITY DATA (continued)



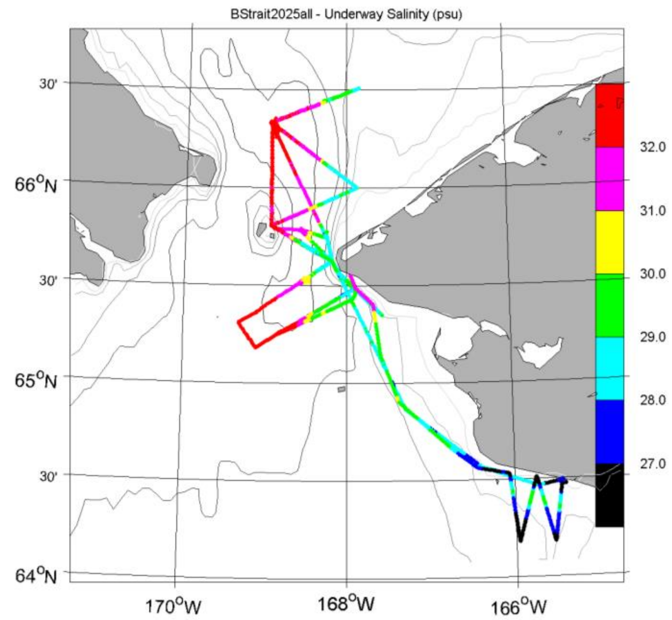
BERING STRAIT 2025 UNDERWAY TEMPERATURE SALINITY DATA (continued)

(Note multiple runnings of the Bering Strait (and other) lines are masked in these plots.)

Temperature (deg C)

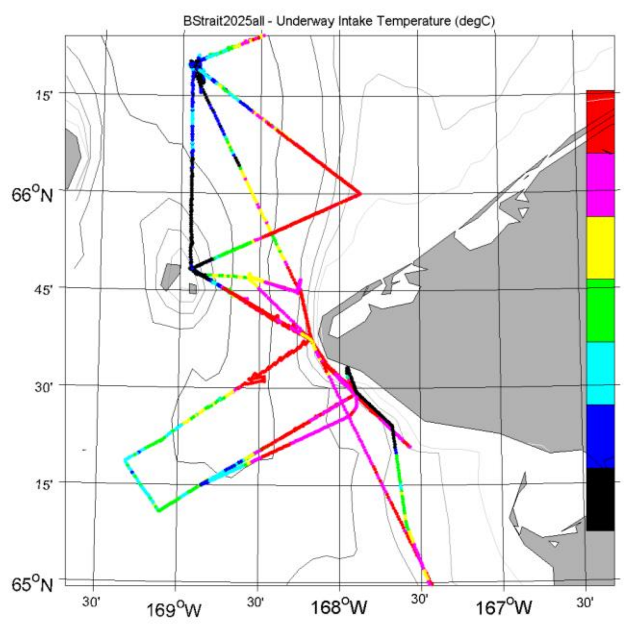


Salinity (psu)

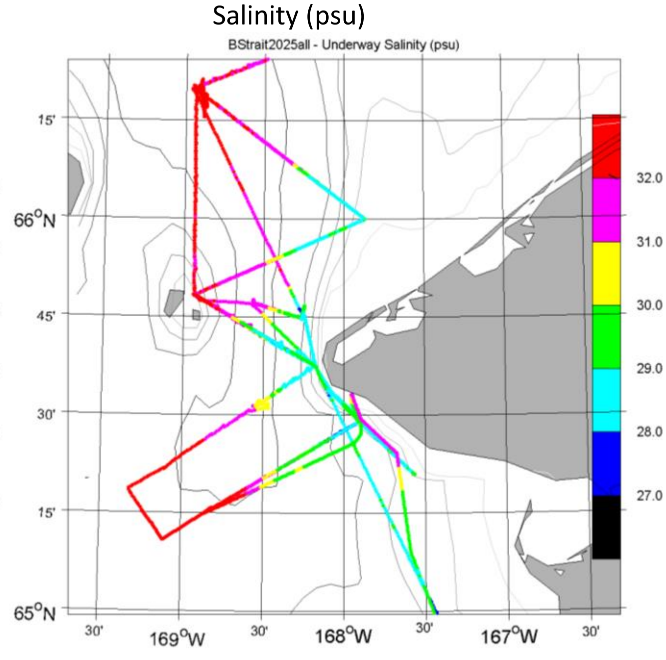


Focus on Strait region

Temperature (deg C)



Salinity (psu)



CRUISE NOTES FOR SET UP OF Norseman 2 ADCP system:

This is to start the ADCP for a Woodgate cruise.
Notes from July 2025 (by Rebecca Woodgate, woodgate@uw.edu

SHORT VERSION:

Turn on ADCPpower
Start vmdas
Go to File, select Collect data
Click Blue triangle
WAIT till it opens winADCP window (about 1min .. patience, patience ,,,)
WAIT again until data appears in winADCP window (about another minute)
Check in the WinADCP window:
    BinSize 1m (top left)
    Bottom right – time and position are correct

If you get that, you are probably ok.

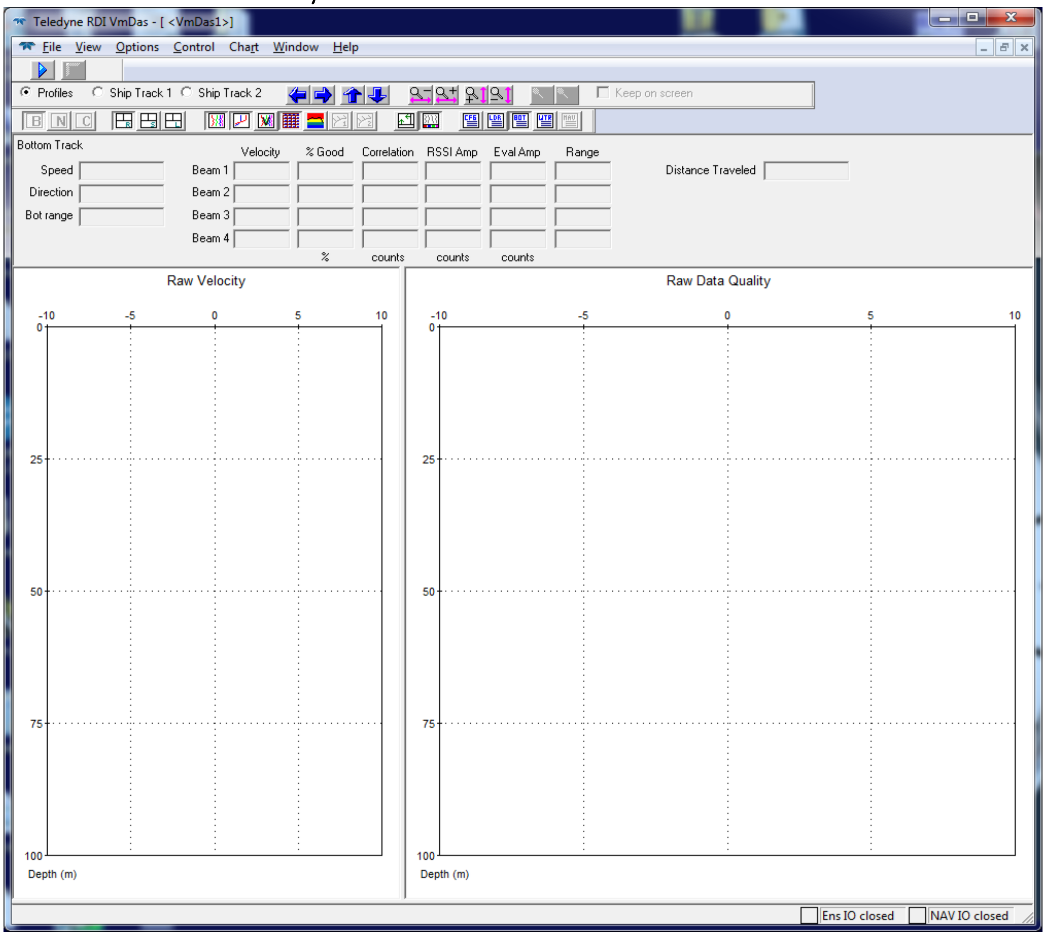
Then to stop at the end of the cruise

- write down root name in the header of the winADCP window (e.g., ADCP025 ….)
- click the blue square at top left of main window
- close all the windows
- copy files of the root name from C:\Measurements

LONGER VERSION:

Start vmdas (link on desktop)

Option 'File', select Collect data. Gets you to here:

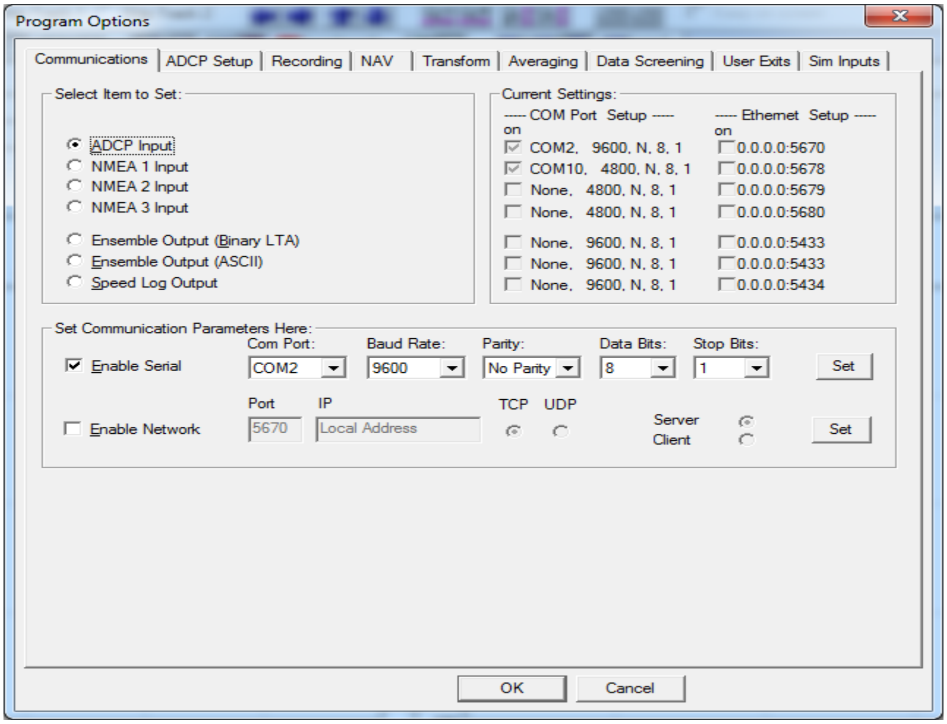


Go to OPTIONS

- select VIEW to look at options without changing. Select EDIT if you need to change things.

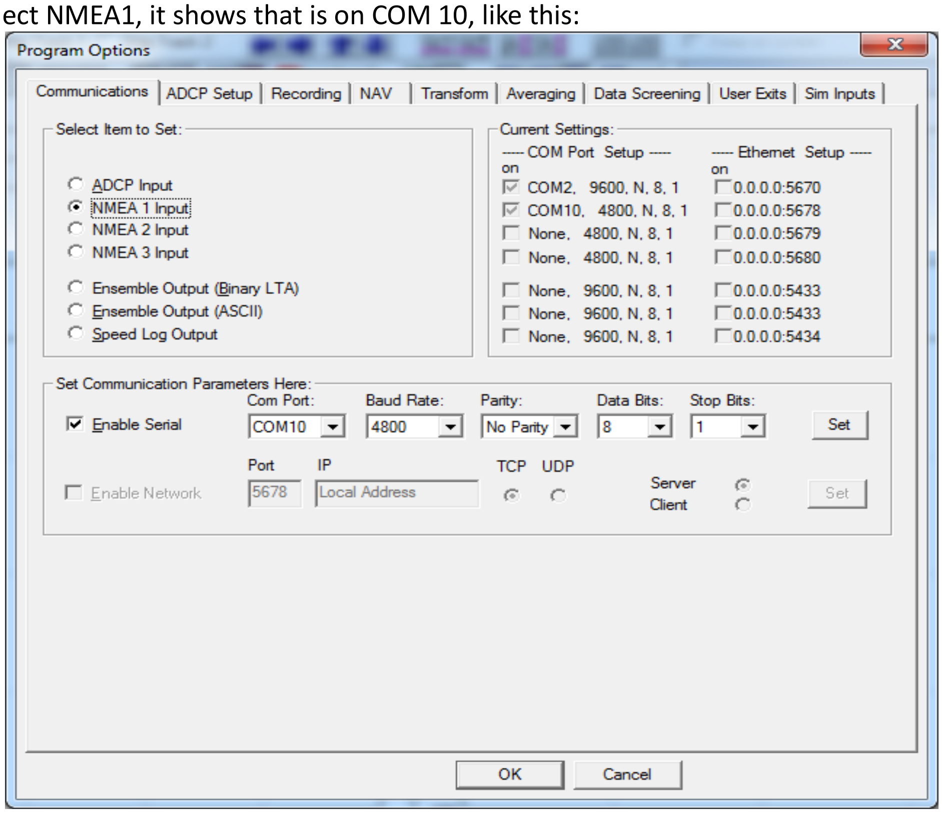
There are 9 tabs which should look like the screendumps below.

1) COMMUNICATIONS TAB:



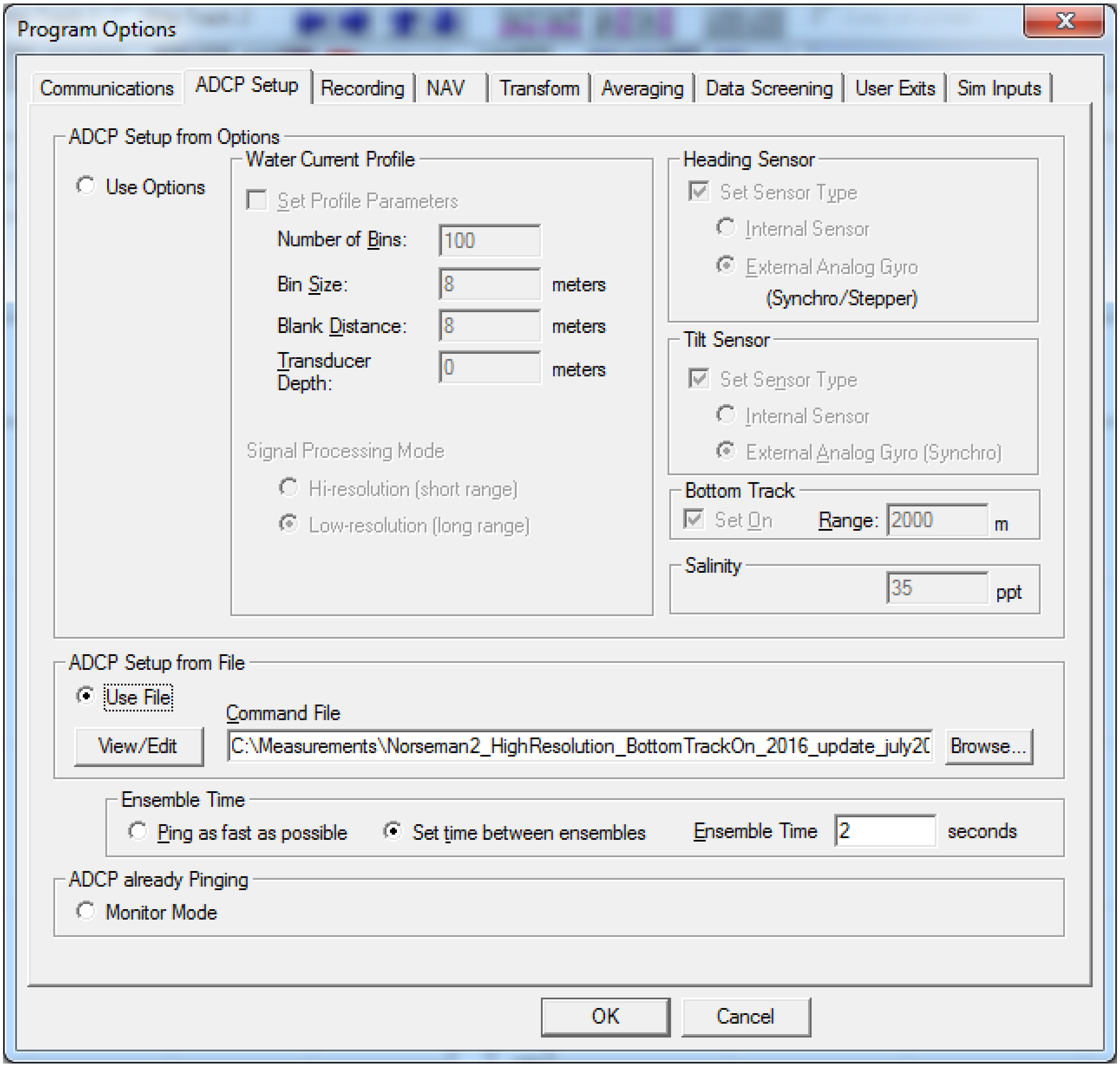
Note

- ADCP input is selected and shows COM2
-
- If you select NMEA1, it shows that is on COM 10, like this:



-

2) ADCP SET UP

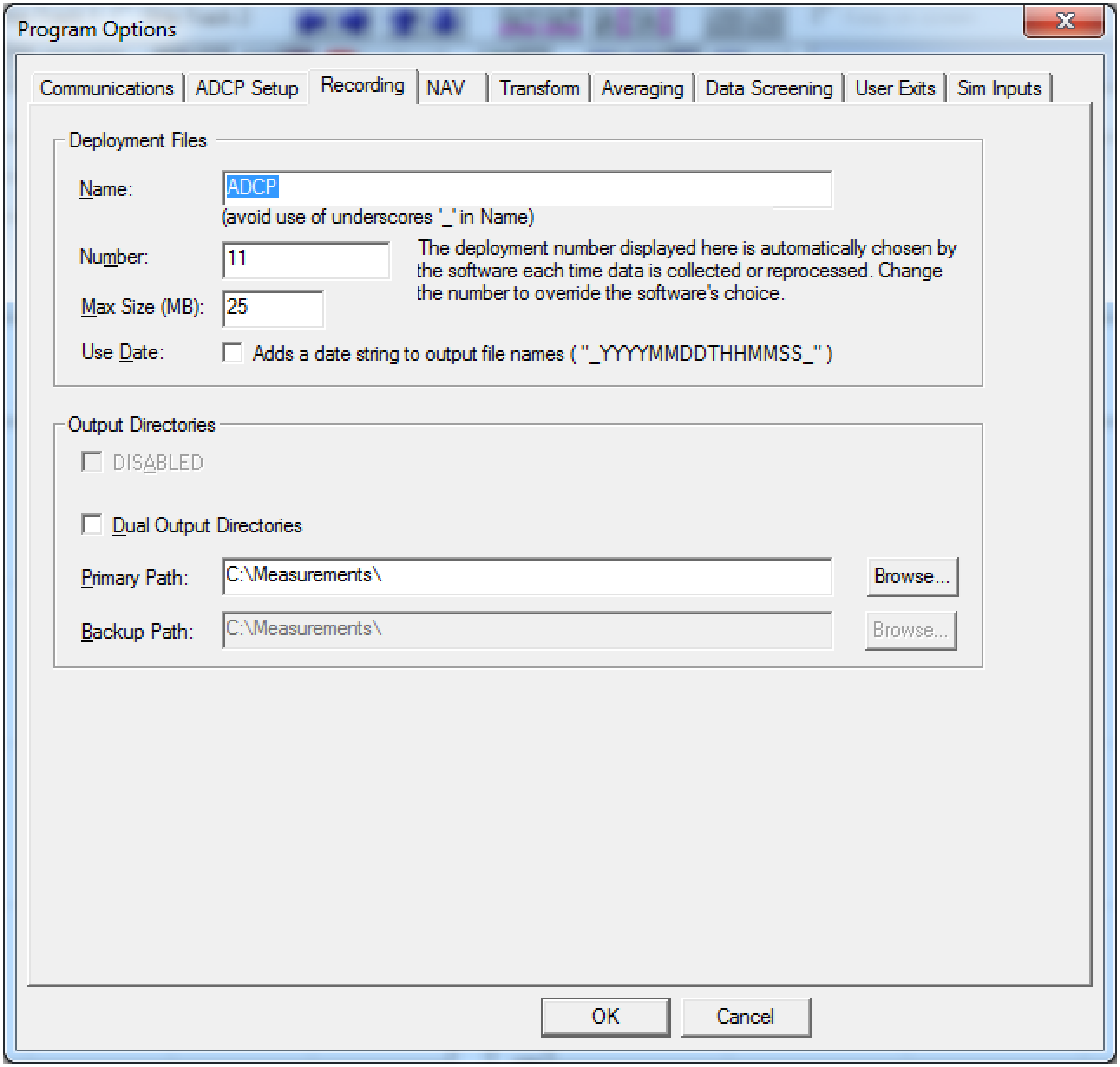


Here you can set options for bin size etc … BUT we instead use the set up file we used before.
See second part of screen = ADCP set up from file.
Ihave copied the command file we used before, and added 'july2025copy' to the name.
Thus, we use:
Norseman2_HighResolution_BottomTrackOn_2016_update_july2025copy.txt
which is in c:Measurements

NOTE THIS HAS BOTTOM TRACK, 1m BINS, but only records to 65m.

For other settings, either change options (risky) or copy one of the other old command files to c:/measurements
They are at: C:\Users\User\Documents\Older ADCP Config Files

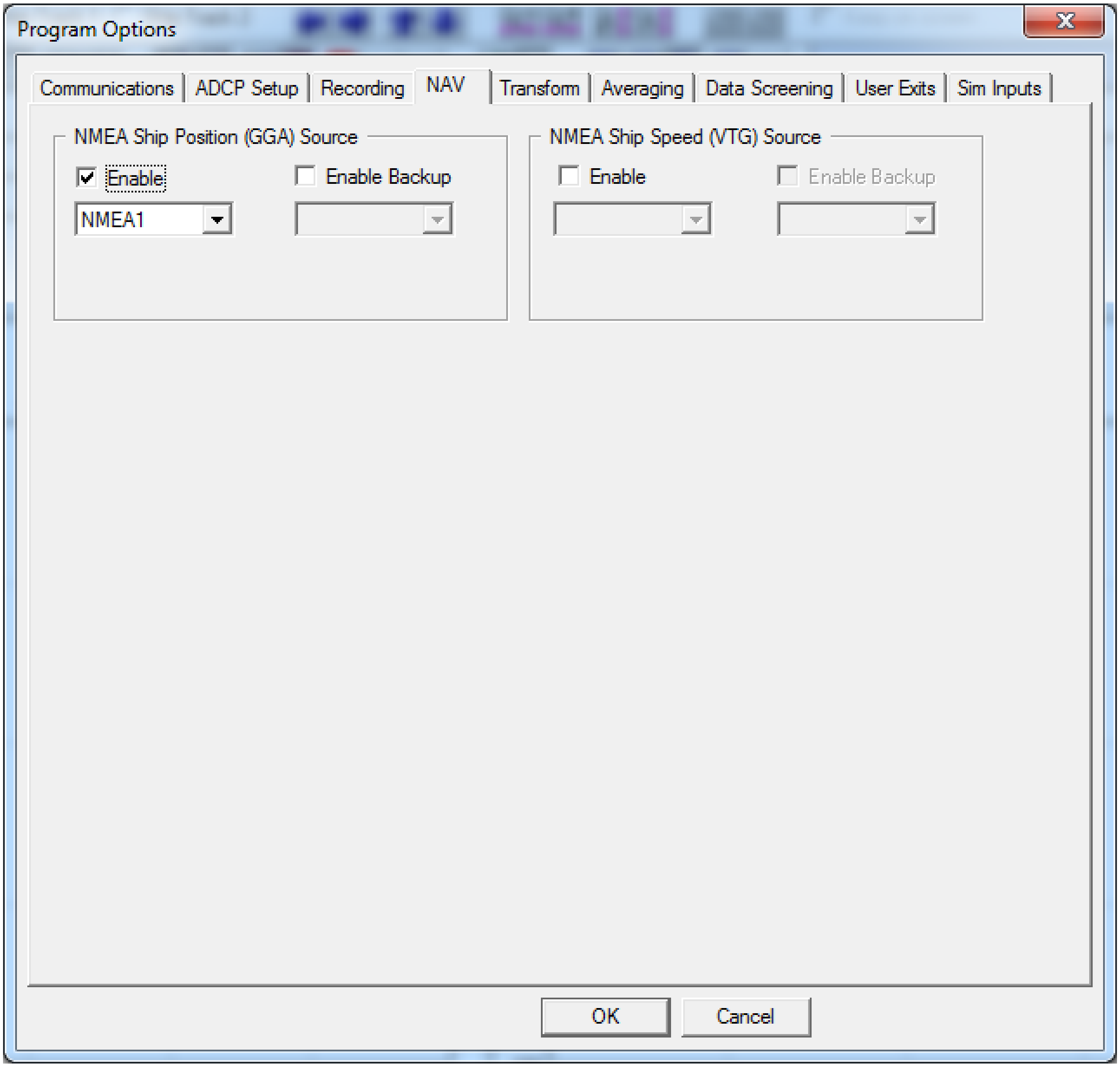
3) RECORDING



Here you name the files.
Eaiest just to leave this as default, and you will get new sets of files for each time you turn the instrument on.
This gives the ROOT of the name (e.g., ADCP014 was last woodgate cruise). To copyoffthe data you need all files that start with this. (There will be .ENS, .STA etc and root names ADCP014_0000 and ADCP014_0001 .. etc.

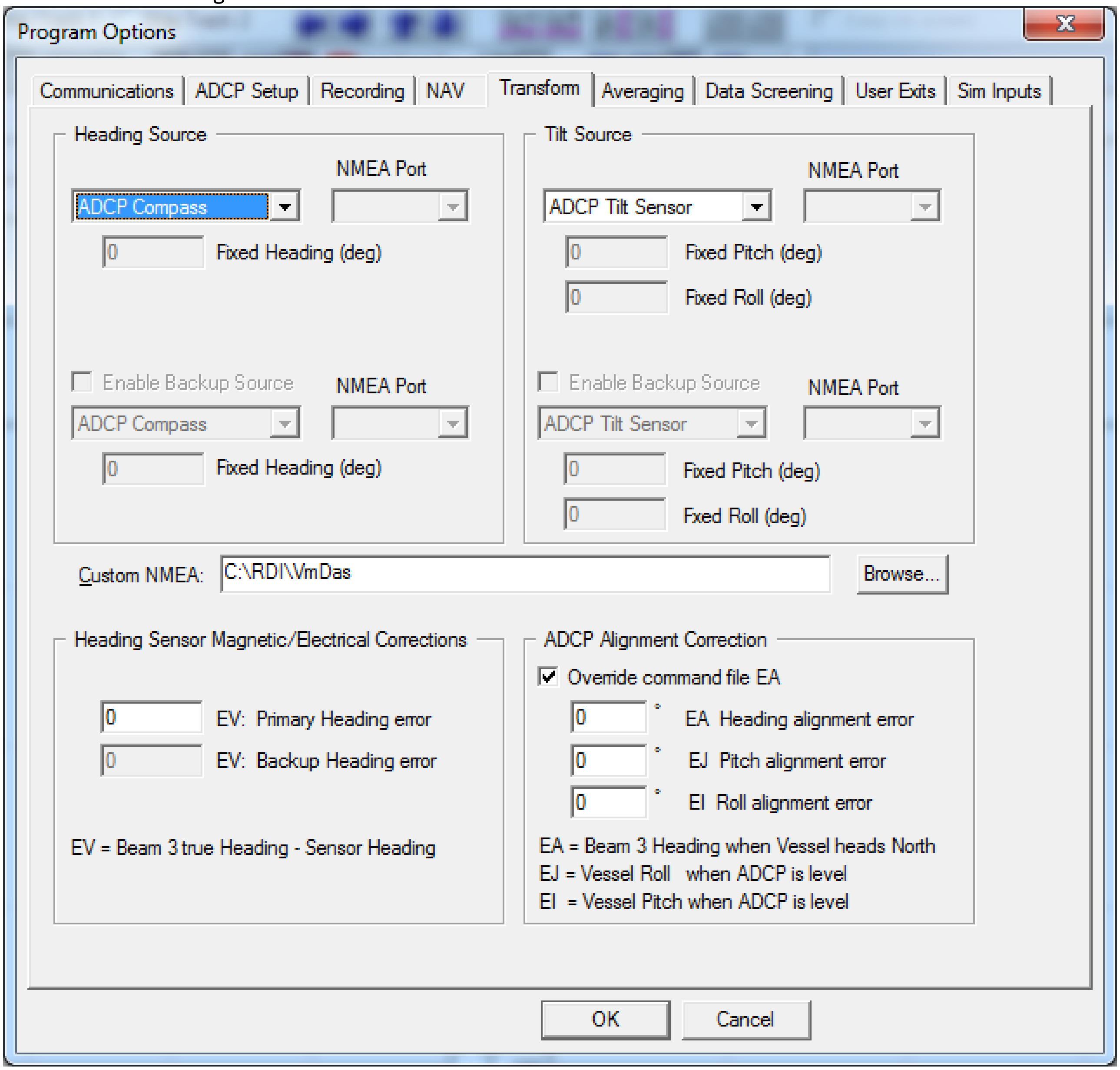
This is writing to the disc at c:measurements .... which is a good place

4)NAV

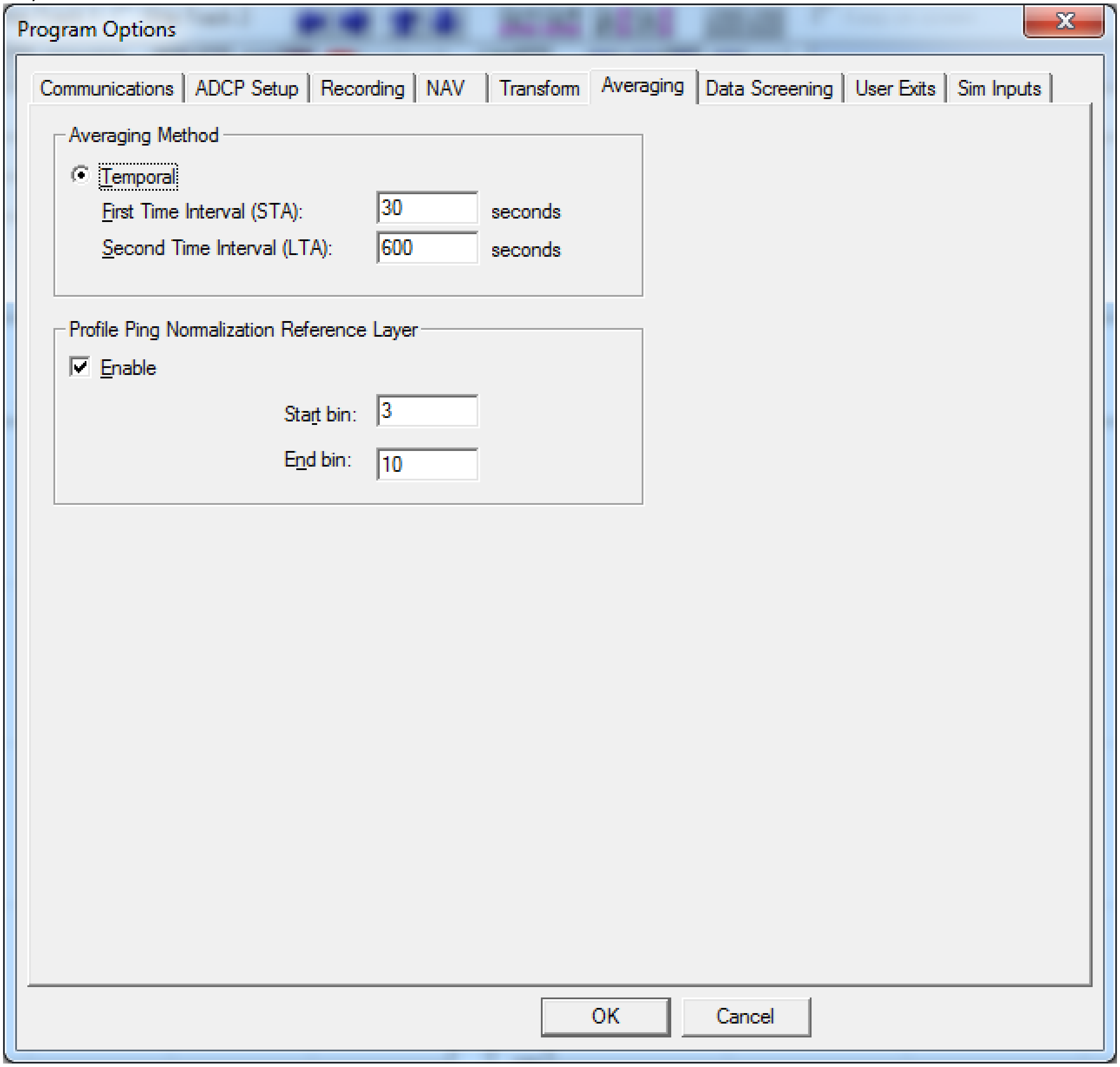


Here you have to have the nmea enabled to get the position

5) TRANSFORM (I hope this is all loaded by the command file we use). So don't change anything here without reading the manual

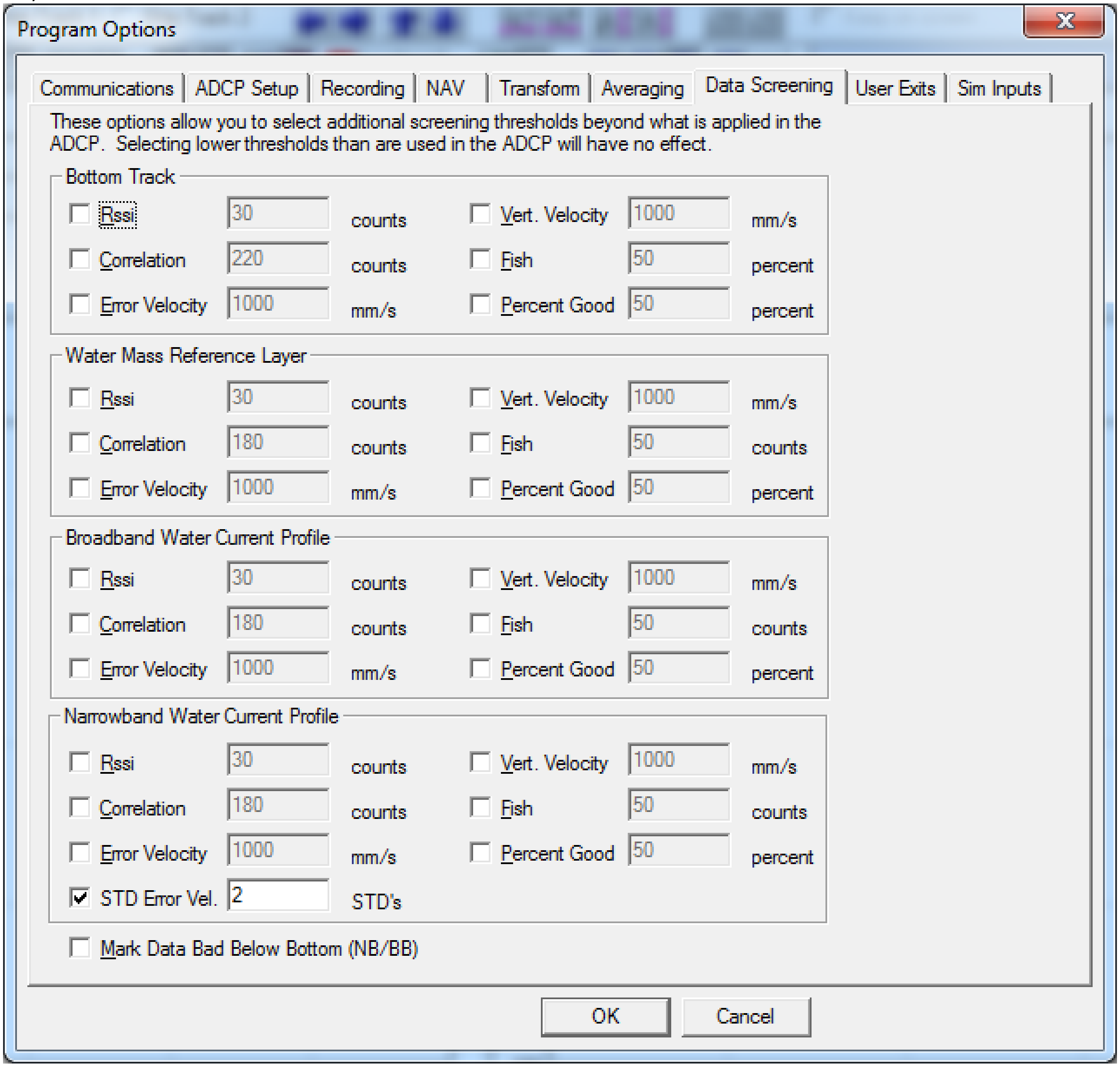


6) AVERAGING



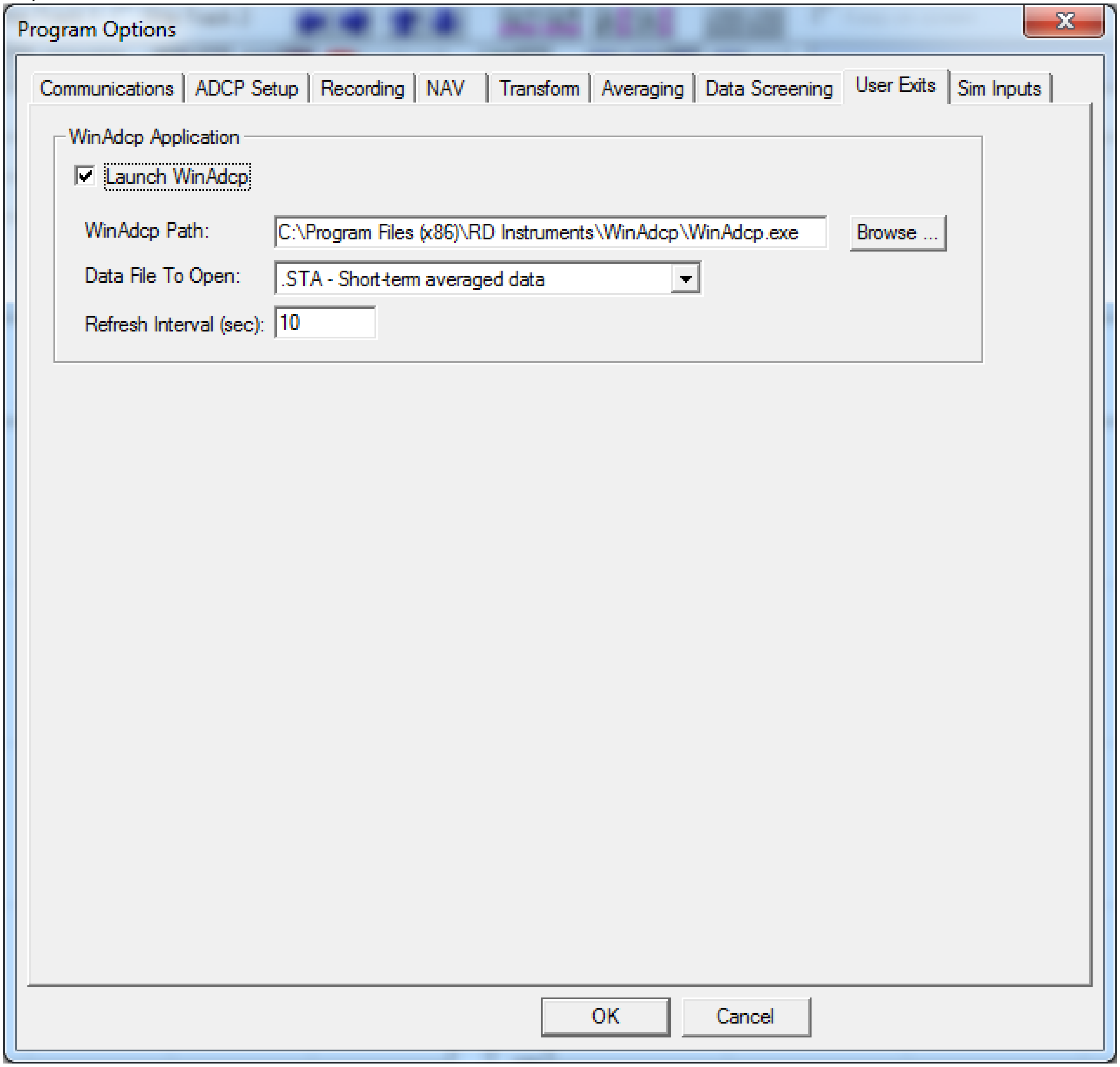
we use these settings

7) DATA SCREEENING



Another one not to change without reading the manual

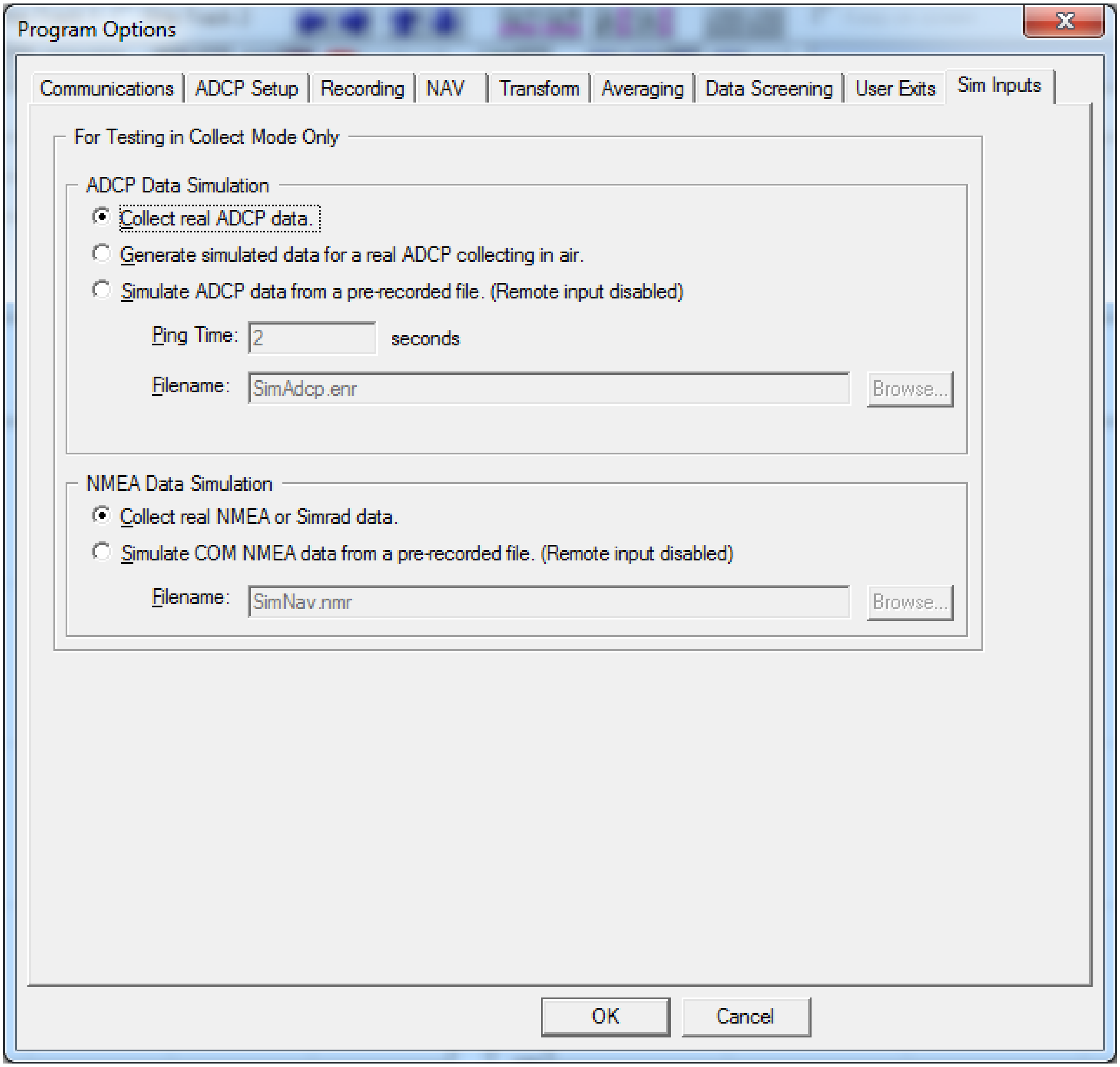
8) USER EXITS



This sets the opening of WinADCP

- if you close WinADCP during running, I don't know how to restart it without stopping and restarting the ADCP (wich makes data processing harder I think). So don't close Win ADCP once you have started.
- WinADCP settings are to show speed … if you want to change that, you need to do that BEFORE you start the VM-ADCP

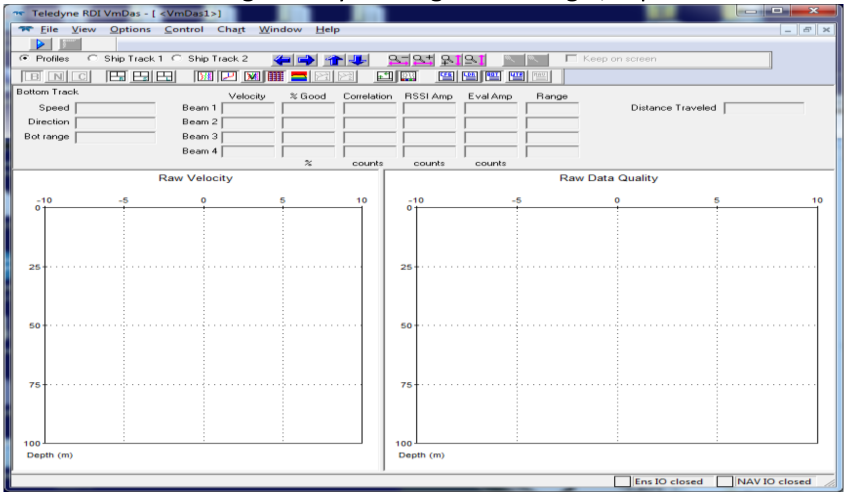
9) SIM INPUTS



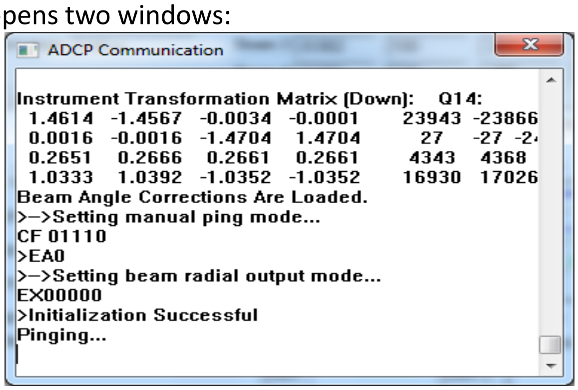
– again, don't change without reading the manual.

ONCE THOSE ARE ALL SET

- start recording data by clicking blue triangle, top left on this screen:

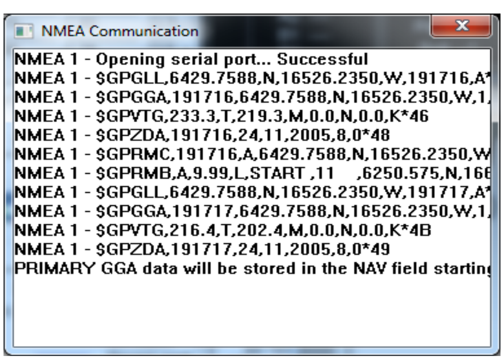


It opens two windows:



- this is the commands sent to the ADCP. Should end up with 'Pinging' like this.
- You can review this file – go to main window, then view, then adcp comms.
  - For our settings, it needs to have in this file
    - WP0001 (go to top of window … 4th line down from parameters set)
    - BP001 (9th line)

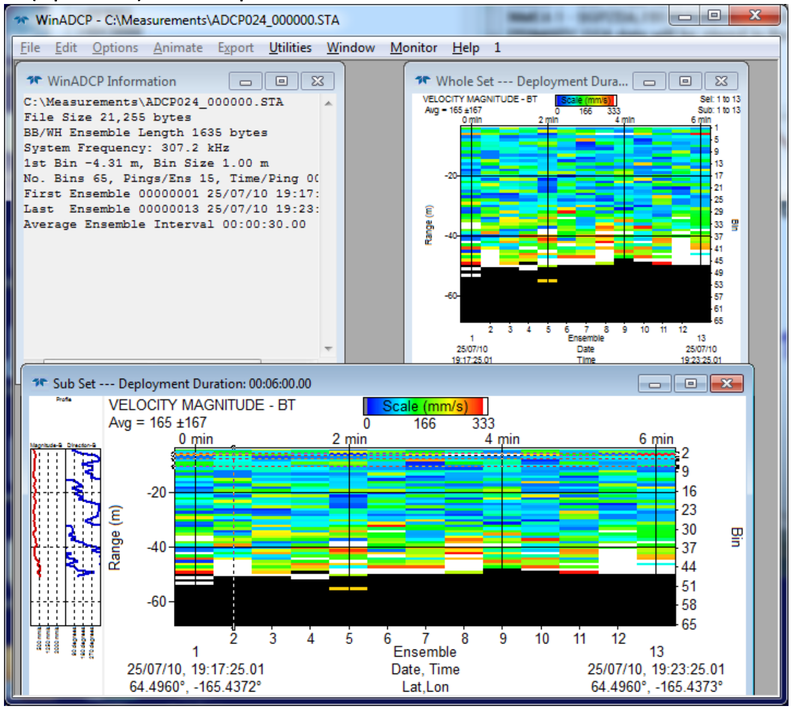
if it doesn't, go back and check is is loading the correct setup file.



This shows it is getting the NMEA – if it doesn't, check the com ports.

- You can review this file – go to main window, then view, then nmea comms.

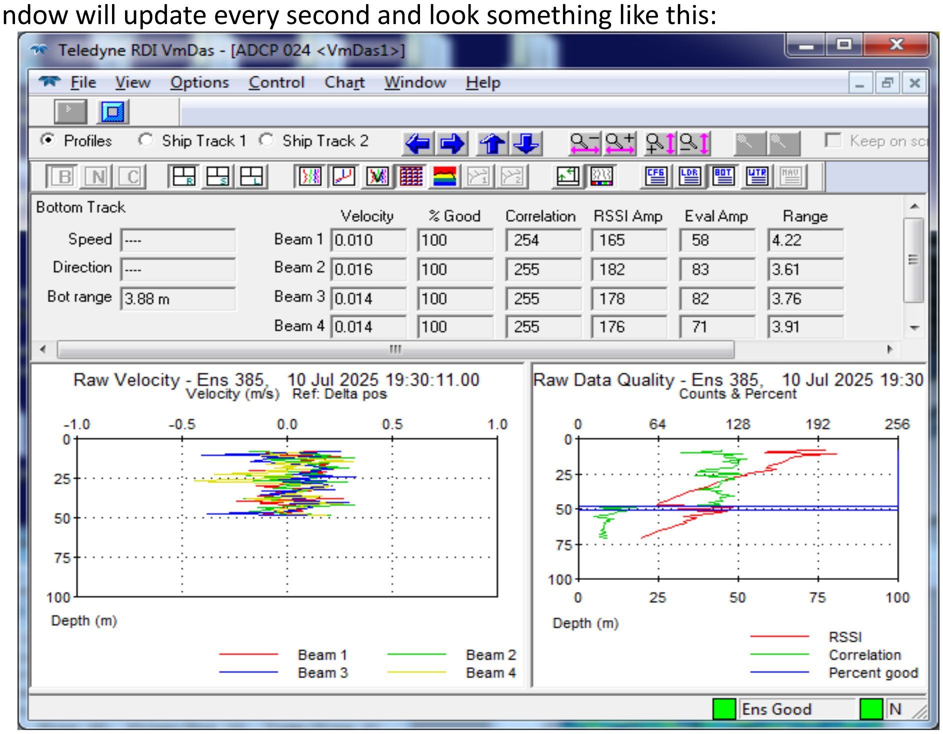
Then after a few seconds (up to 20) it will open WinADCP:



Check here

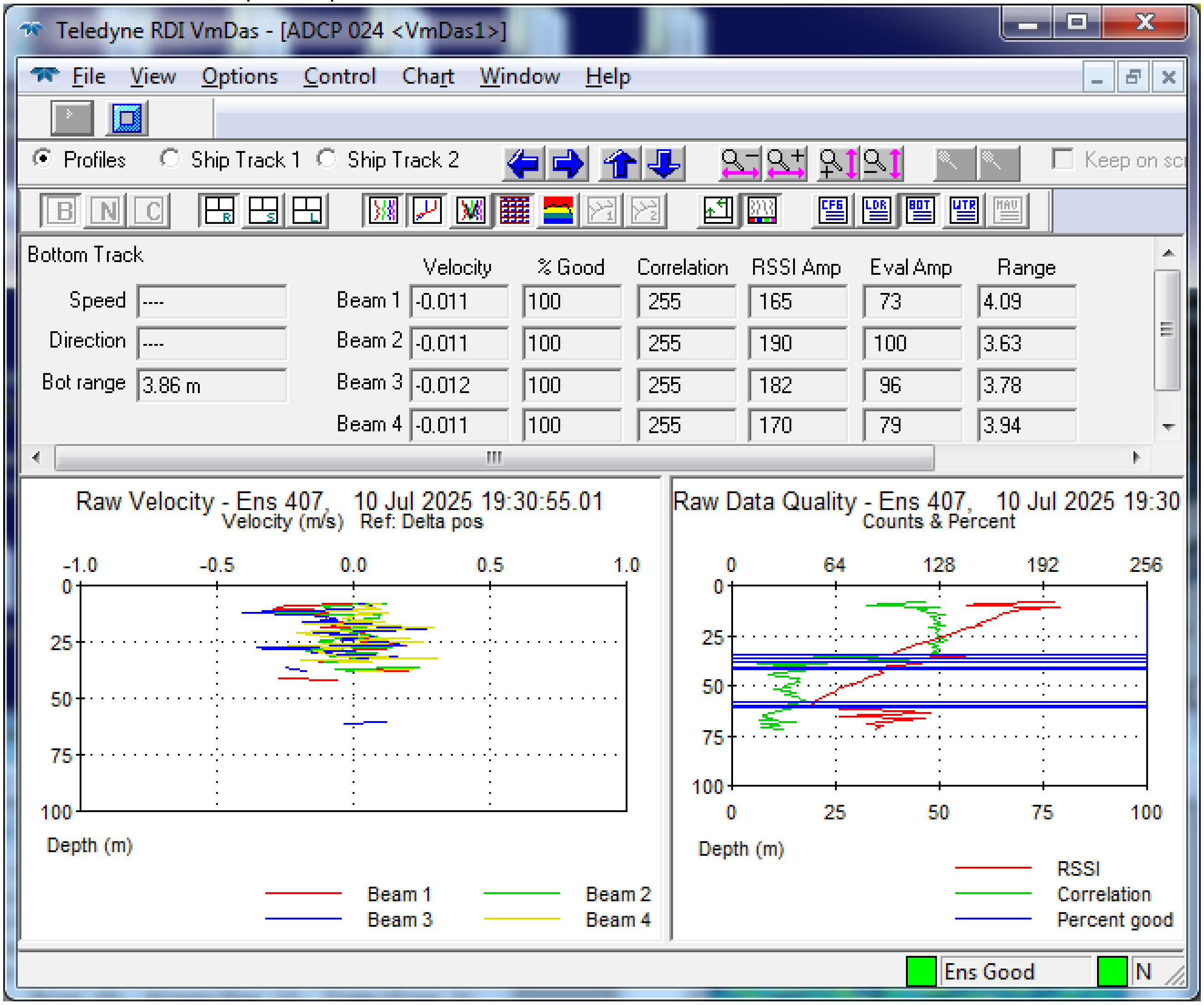
- top left box, line 5 – it says 1m bins, and First ensemble date matches when you started it
- this should update every 30s , check bottom right time and position make sense.

And the main window will update every second and look something like this:



Then at the end of the cruise:

- NOTE THE NAME AT THE TOP OF TE WINDOW – here ADCP024 -this isyour root name
- click the blue square top left of this:



... and close this window and the WinADCP

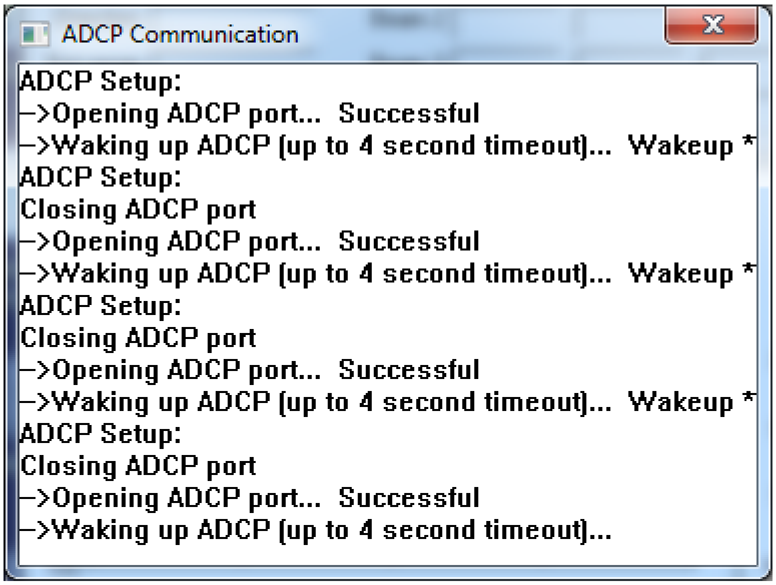
And find all the files
(link on desk top, top left, 6th icon over ... ADCPdata_July2025 .. which takes you to:
C:\Measurements

Copy all the files with the root name (or find all ones after a certain dat)
If you have restarted the system, there might be several root file names to copy.

GETTING OUT OF TROUBLE:

1) Says – can't get NAV
   - if the comm ports are corrrect (10 for NMEA) … check to see if system is already running (ie, check on bottom tool bar for what is running. THIS HAS A DULL ICON … hover over each to see what window it is)

2) Gets stuck in loop saying this: - means POWER IS NOT ON.!!



BERING STRAIT 2025 MARINE MAMMAL REPORT –

Miriam Hauer-Jensen & Léna Hardivillier, Oregon State University

The marine mammal survey was conducted aboard the ship Norseman II from the ship's 'Bird Box' area, an observational platform immediately above the bridge. Observations were only undertaken after consultation with the ship's bridge watch, who deactivated the ship's radars for the duration of the observational period. Observations were carried out visually using two pairs of Fujinon Fujifilm 7x50 FMTRC-SX Field 7° 30' binoculars (deliver light transmissions above 95%, 23 mm eye relief, minimum focus distance of 9.8 m) and two cameras (EOS M10 up to 300 mm zoom & Canon EOS 50D 100 to 400 mm zoom) to document sightings, both during transit times and during CTD surveying. The time is given in ship's time (UTC – 8 hours) and the ship's geographic position was recorded at the start and end of each observation session from the GPS on the ship's bridge before and after visiting the Bird Box. Geographic positions below are N and W respectively. Observers are indicated by their initials (MH, LH). Ice cover, sea state, weather conditions and visibility were noted to provide context for sighting conditions. For each sighting, observers recorded species, number of individuals, and observation time. An asterisk (*) indicates that a photo is associated with the sighting.

Total survey effort: 21h40min, 13 sessions

Species	Total Number
Unidentified pinniped	22
Harbor porpoise	25
Minke Whale	1
Gray whale	1 alive + 1 dead
Humpback whale	1

- **Session 1:** 2025-07-03 (1h)

Observer: MH and LH

Ice = 0%; Beaufort = 0; Weather = clear; Visibility = unlimited

Start : 9h45 (65°45.72N ; 168°22.56W)

Species	Number	Time
Unidentified pinniped	1	10h00
Harbor porpoise	1	10h10
Harbor porpoise	3	10h15

Stop : 10h45 (65°9.14N ; 168°15.64W)

- **Session 2:** 2025-07-03 (55min)

Observer: MH and LH

Ice = 0%; Beaufort = 0; Weather = clear; Visibility = unlimited

Start : 11h05 (65°97.50N; 168°18.20W)

Species	Number	Time
Harbor porpoise	1	11h21
Harbor porpoise	2	11h27

Stop : 12h00 (not recorded)

- **Session 3:** 2025-07-03 (2h30min)

Observer: MH and LH

Ice = 0%; Beaufort = 0; Weather = clear; Visibility = unlimited

Start : 12h35 (66°0.03N; 168°33.20W)

Species	Number	Time
No sightings	/	/

Stop : 15h05 (66°19.62N ; 168°57.06W)

- **Session 4:** 2025-07-04 (1h)

Observer: MH and LH

Ice = 0%; Beaufort = 0; Weather = clear; Visibility = unlimited

Start : 14h25 (65°42.38N; 168°13.24W)

Species	Number	Time
Harbor porpoise	1	14h35
Unidentified pinniped	~15	14h40
Harbor porpoise	5	14h47
Unidentified pinniped	1	14h50
Harbor porpoise *	5	14h55
Humpback whale **	1	14h55-15h25

Stop : 15h25 (65°37.88N; 168°11.11W)

*

**


The humpback whale exhibited foraging behaviour, as its fluke was not visible and the whale frequently changed its direction of swimming, indicating it was most likely following the food source, krill.

- **Session 5:** 2025-07-05 (2h)

Observer: LH

Ice = 0%; Beaufort = 0; Weather = clear; Visibility = unlimited

Start : 9h28 (66°21.05N; 168°49.40W)

Species	Number	Time
Unidentified pinniped	1	9h48

Stop : 11h28 (66°23.35N; 168°36.53W)

- **Session 6:** 2025-07-05 (2h)

Observer: MH

Ice = 0%; Beaufort = 0; Weather = clear; Visibility = unlimited

Start : 13h21 (66°25.32N; 168°23.28W)

Species	Number	Time
Unidentified pinniped	1	13h54

Stop : 15h21 (66°28.08N; 168°5.80W)

Session 7: 2025-07-05 (2h)
Observer: LH
Ice = 0%; Beaufort = 0; Weather = clear; Visibility = unlimited
Start : 19h15 (66°26.96N; 168°13.13W)

Species	**Number**	**Time**
Unidentified pinniped	1	20h58

Stop : 21h15 (not recorded)

- **Session 8:** 2025-07-05 (1h30min)

Observer: LH
Ice = 0%; Beaufort = 0; Weather = clear; Visibility = unlimited
Start : 22h10 (66°17.21N; 168°48.10W)

Species	**Number**	**Time**
Harbor porpoise	1	22h35
Unidentified pinniped	1	23h18
Harbor porpoise	1	23h34

Stop : 23h40 (66°9.63N; 168°23.38W)

- **Session 9:** 2025-07-06 (2h05min)

Observer: MH
Ice = 0%; Beaufort = 0; Weather = clear; Visibility = unlimited
Start : 2h10 (65°57.96N; 168°3.18W)

Species	**Number**	**Time**
Unidentified pinniped	1	3h50

Stop : 4h15 (65°50.70N; 168°43.02W)

- **Session 10:** 2025-07-06 (1h40)

Observer: LH
Ice = 0%; Beaufort = 0; Weather = clear; Visibility = unlimited
Start : 9h50 (65°41.86N; 168°29.20W)

Species	**Number**	**Time**
/	/	/

Stop : 11h30 (65°39.25N; 168°19.06W)

- **Session 11:** 2025-07-06 (1h)

Observer: MH
Ice = 0%; Beaufort = 0; Weather = clear; Visibility = unlimited
Start : 13h05 (65°37.42N; 168°10.57W)

Species	**Number**	**Time**
Harbor porpoise	3	13h08

Stop : 14h05 (65°35.62N; 168°17.03W)

+ LH on the deck during sighting 11

Species	**Number**	**Time**
Minke whale	1	13h30
Dead gray whale*	1	14h00 > 14h40

Minke whale (65°37.23N ; 168°13.38W)

Dead gray whale, male, calf about 5 m long, no other animals in the vicinity of the dead whale (65°35.54N; 168°18.82W)

*

- **Session 12:** 2025-07-06 (2h)

Observer: LH
Ice = 0%; Beaufort = 0; Weather = clear; Visibility = unlimited
Start : 22h30 (65°20.40N; 169°12.20W)

Species	Number	Time
Harbor porpoise	2	23h30
Gray whale*	1	23h40 > 00h25

Stop : 00h30 (65°11.05N; 169°5.64W)

*

- **Session 13:** 2025-07-07 (2h)

Observer: MH and LH
Ice = 0%; Beaufort = 3; Weather = clear (fog at 11h30); Visibility = unlimited
Start : 10h00 (65°29.01N; 167°54.28W)

Species	Number	Time
No sightings	/	/

Stop : 12h00 (65°39.45N; 168°18.87W)

BERING STRAIT 2025 – GLIDER

At the NE end of the AL line, the cruise deployed a glider for PIs Kate Stafford, OSU; Seth Danielson & Hank Statscewich, UAF. This operation was coordinated through Whats App with Hank ashore in Alaska.
The process included
- removing the glider from its box a few hours before deployment,
- deck testing, performed by Hank from shore, with the ship team merely confirming rudder movement etc.
- deployment from the aft deck, using 2 lifting straps and the aft A-frame.
- waiting for ~1hr while the glider performed test dives, so as to be on site for recovery in case there were issues.

This year, everything went very smoothly, although on the long test dive, the ship drifted in the same direction as the test dive and when the glider surfaced it was only a few m off the ship.
ACTION ITEM: Obtain from the glider control team the direction and distance of the test dive and hold the ship a suitable distance away (rather than just allow the ship to drift).

BERING STRAIT 2025 – IMAGING FLOWCYTOBOT (IFCB)

This year, as a first for this cruise although not for the ship, an Imaging FlowCytoBot (IFCB) was deployed by Thomas Farrugia of AOOS. This instrument samples seawater from an underway system, and identifies and provides images of phytoplankton in the water. It is particularly of use for detecting harmful algal blooms (HABs).

Pre-cruise, a synopsis of the effort and set up was provided by Thomas and this is included below, but briefly, the instrument draws a small (5ml) sample every 25minutes from a sea water intake, and images the phytoplankton found in that sample.

Thomas came to Nome on the 1st July, and on the 2nd July, prior to sailing, installed the instrument in the aft lazaret of the ship. While the instrument functioned fully, with wireless connection to a monitoring laptop during testing on the bench/freezer lid in the lazaret, when in position under the stairway, this connectivity failed. Thus, as time was pressing, we sailed without this wireless connection being active. This meant we were unable to monitor the data during the cruise, although we could ascertain the instrument was still functioning, at some level, by measuring the amount of fluid pumped out.

The instrument remained on the ship after the cruise until Homer, where it was disembarked by AOOS colleagues.

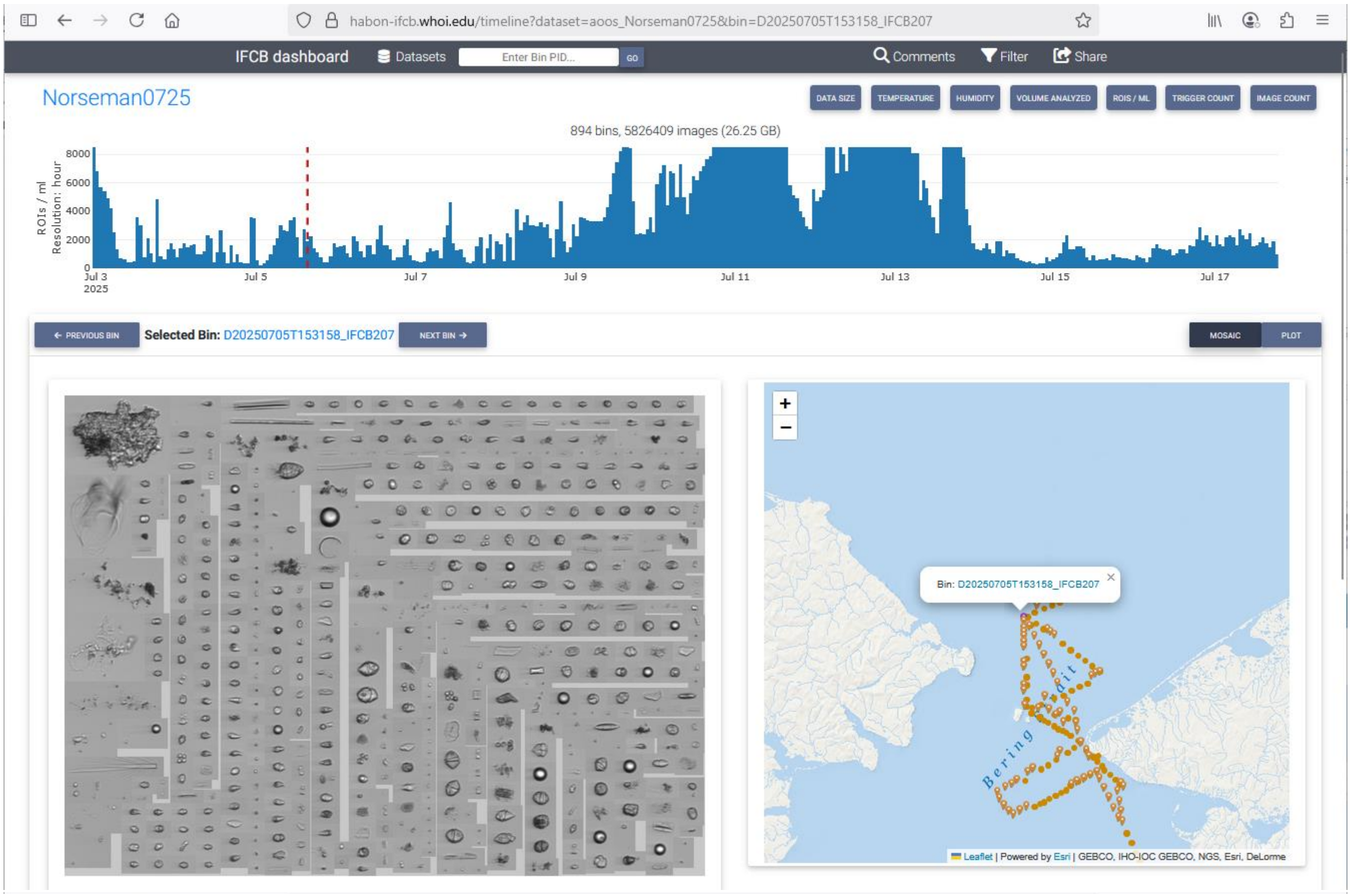
It was found that the instrument had functioned well throughout the cruise and the subsequent transit back to Homer, and had successfully recorded data throughout the cruise time.

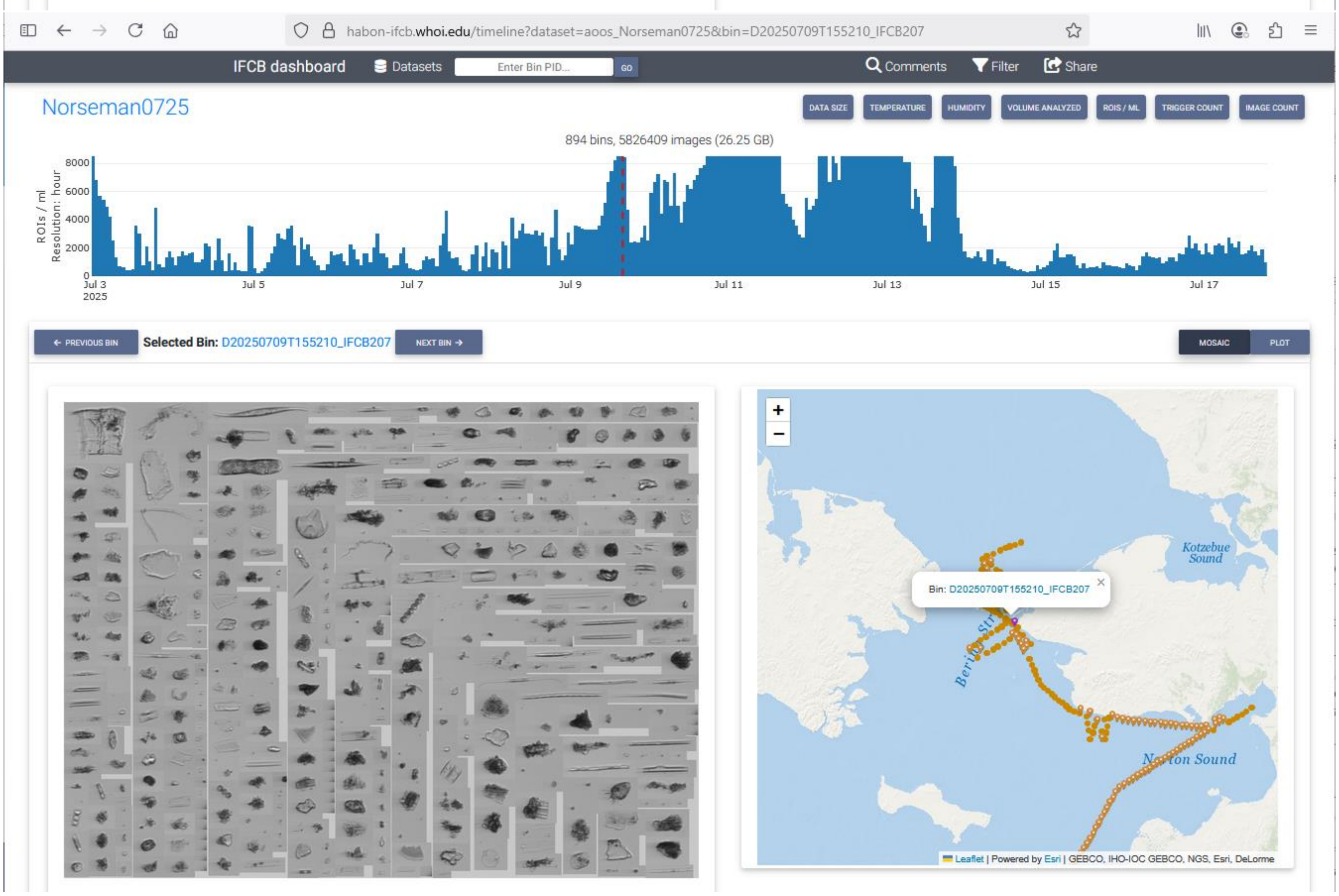
Data are available for public viewing at: https://habon-ifcb.whoi.edu/timeline?dataset=aoos_Norseman0725. Some examples are included below.

Post cruise, a HAB was identified on the transit to Homer. The public release about this bloom is copied also below, along with some preliminary plots of the water properties in that region.

Action items for a future deployment: Overall, the instrument was mostly non-invasive for the cruise, however, the pump that was used was remarkably loud (although below safe levels for long term exposure) in the aft cabins, in part due to the intrinsic noise level of the pump and in part due to vibration being transmitted through the bulkheads. As the IFCB was a last minute addition for the cruise, we were fortunate that the N2 could find any pump that worked for the system at such short notice, but for future use, it would be best to investigate:
a) use of a much smaller pump (e.g., perhaps a Gulper 220 Pump, simple and marine grade)
b) use of sound deadening material, (e.g., vibration damping pads for heavy machinery) to reduce transfer to the rest of the ship.

Below – example results from the website:


habon-ifcb.whoi.edu/timeline?dataset=aoos_Norseman0725&bin=D20250705T153158_IFCB207
IFCB dashboard
Datasets
Comments
Filter
Share
Norseman0725
DATA SIZE
TEMPERATURE
HUMIDITY
VOLUME ANALYZED
ROIS / ML
TRIGGER COUNT
IMAGE COUNT
894 bins, 5826409 images (26.25 GB)
ROIs / ml
Resolution: hour
Selected Bin: D20250705T153158_IFCB207
Bin: D20250705T153158_IFCB207
Bering Strait


habon-ifcb.whoi.edu/timeline?dataset=aoos_Norseman0725&bin=D20250709T155210_IFCB207
IFCB dashboard
Norseman0725
894 bins, 5826409 images (26.25 GB)
Selected Bin: D20250709T155210_IFCB207
Bin: D20250709T155210_IFCB207
Kotzebue Sound
Norton Sound

Deployment info for the Imaging FlowCytoBot (IFCB) on the R/V Norseman II from Thomas Farrugia, May 2025

Proposed Dates: Mooring Survey July 1 – July 10, 2025 (Nome to Nome)
Contacts: Thomas Farrugia (AOOS) and Mrun Pathare (WHOI)
Cost: The total cost of the IFCB and other supplies is $160,000. This is being provided by AOOS and AOOS has insurance on the IFCB.

Motivation: The IFCB is an important tool for the detection of harmful algal blooms (HABs). Having it deployed on as many vessels or opportunity as possible will provide important information to researchers and coastal communities that rely on marine resources for subsistence foods.

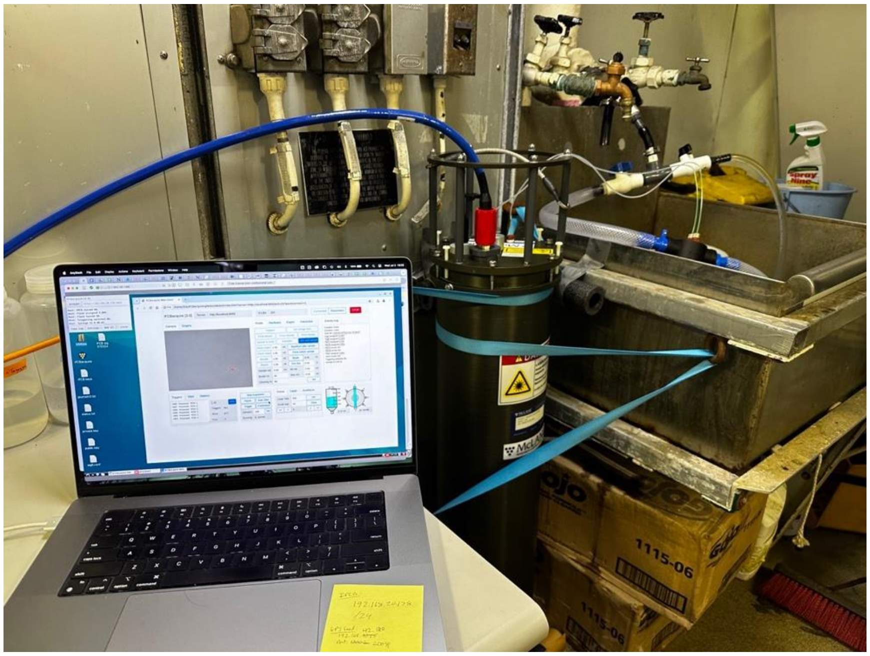
Description of the Imaging FlowCytobot (IFCB):

- The IFCB is a flow cytometer that is contained within a waterproof cylinder.
- There is an intake and exhaust tube coming out of the top, along with a waterproof blue cable that attaches to a white powerbox (not waterproof) and the ethernet connection.
- The IFCB requires access to a flow-through seawater system from which it can sample 5 mL about every 25 minutes, and 120V AC power.
- The flow-through seawater can just be a sink with a seawater input where a filter and settling cup can be installed.
- The IFCB functions by sampling 5mL of water, which it then runs through a flow cell slowly, taking images of individual particles. The images are then uploaded to a dashboard for monitoring, classification and archiving. Running the sample takes about 20 minutes, plus a few minutes of cycling and cleaning, so a sample is taken every 23-25 minutes.
- If it is possible to connect the IFCB to the ship’s internet through the ethernet cable, this would allow for remote monitoring and troubleshooting, and would allow real-time detection of any harmful algal blooms.
- If connection to the internet is not possible, a local router can be connected to allow for a local laptop to monitor the IFCB on the vessel. This local network would be separate from the ship’s internet.

Shipboard Configuration:

- The R/V Norseman II had an IFCB on board in 2022. It was set up (along with other sampling equipment) under the stairwell of the lazaret.
- A pump was installed to bring water to the IFCB, with the water accumulating in a holding bucket. This bucket will need to be drained occasionally to prevent overflow.
- The duties required by the science team will be:
  - Empty the holding bucket (once a day)
  - Check that the IFCB is running by checking the computer. If stopped running, the IFCB should be turned off and turned back on (via the external switch coming from the white power box).
  - Check the sediment filter to see if it needs a quick clean (once a day)

Picture of an IFCB on the USCGC Healy in July 2024:



Picture of the IFCB set-up on Norseman II in 2022 (the IFCB is just the large black cylinder on the left of the picture). None of the other equipment pictured here is required for the IFCB to function, other than the white bucket for the water to be gathered:

An Advisory of high cell counts of the algal species *Alexandrium catenella* from the Imaging FlowCytoBot (IFCB) onboard the R/V NORSEMAN II – July 14th, 2025, from Thomas Farrugia, AOOS

The Imaging FlowCytoBot (IFCB) aboard the R/V NORSEMAN II detected high concentrations of a type of algae called *Alexandrium catenella* in the southeastern Bering Sea . This *Alexandrium* species is known to produce a suite of biotoxins called saxitoxins. Maximum concentrations of *Alexandrium catenella* were estimated to be >8,000 cells per liter of seawater, on 14-JUL-25 approximately 160 nautical miles / 180 miles offshore east of St. Paul Island (see Figure 1). High cell counts (>1,000 cells/L) persisted as the ship traveled south for approximately 100 nautical miles.

Please remember the data reported here are preliminary estimated *Alexandrium* densities; water samples were not collected, thus there can be no laboratory confirmation of species identity nor any information as to the toxicity of these *Alexandrium* cells.

The cell concentrations of *Alexandrium catenella* in the southeastern Bering Sea reported here are considered high enough to trigger this advisory which will be sent to key contacts in the nearby coastal communities to be cautious when consuming marine wildlife resources, such as clams, crabs, tunicates, etc.

Marine wildlife that have consumed the *Alexandrium* algae or that have obtained the toxin through food web transfer may contain a high concentration of saxitoxin that could affect human and animal health. For example, marine wildlife will ingest the saxitoxin when they eat clams containing the biotoxin. They can also accumulate toxins by feeding on zooplankton, filter-feeding fish, tunicates, and other animals within the food web. As the current health risks are unknown to seabirds and marine mammals, or to humans who consume those resources, it is best to be cautious and remain vigilant.

Next steps to be taken:

- These data were collected by an IFCB that was not connected to the internet, and therefore these data were not accessible until we retrieved the instrument recently. No other data are available for this area (Figure 1) as the R/V NORSEMAN II and the IFCB are no longer in the area.
- Another IFCB is currently on the R/V SIKULIAQ conducting a different science mission. This research vessel will be transiting near the bloom area as well as near St. Paul Island during the week of 3-August. This IFCB has an internet connection and the IFCB data will be monitored in near real-time.
- The levels of harmful algae will continue to be reported to this distribution list as the new research cruise aboard R/V SIKULIAQ samples seawater in the eastern and northern Bering Sea until its 9-August arrival to Nome (Figure 2).

Disclaimer: The opinions, findings, and conclusions, or recommendations expressed are those of the authors and do not necessarily reflect the views of any funding organisation.

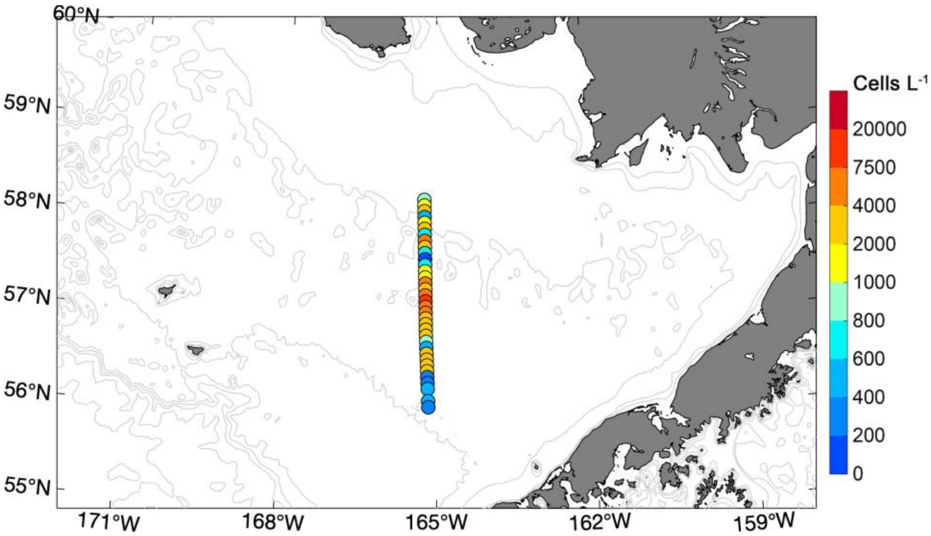


Figure 1. Estimated cell concentrations of the marine algae Alexandrium catenella sampled on 14-JUL-25 based on data collected by an Imaging FlowCytobot. This instrument was onboard the R/V NORSEMAN *II collecting imagery of the plankton community as the ship traveled 180 miles offshore southward between the Pribilof Islands and Bristol Bay in the southeastern Bering Sea. Map by Evie Fachon (WHOI).*

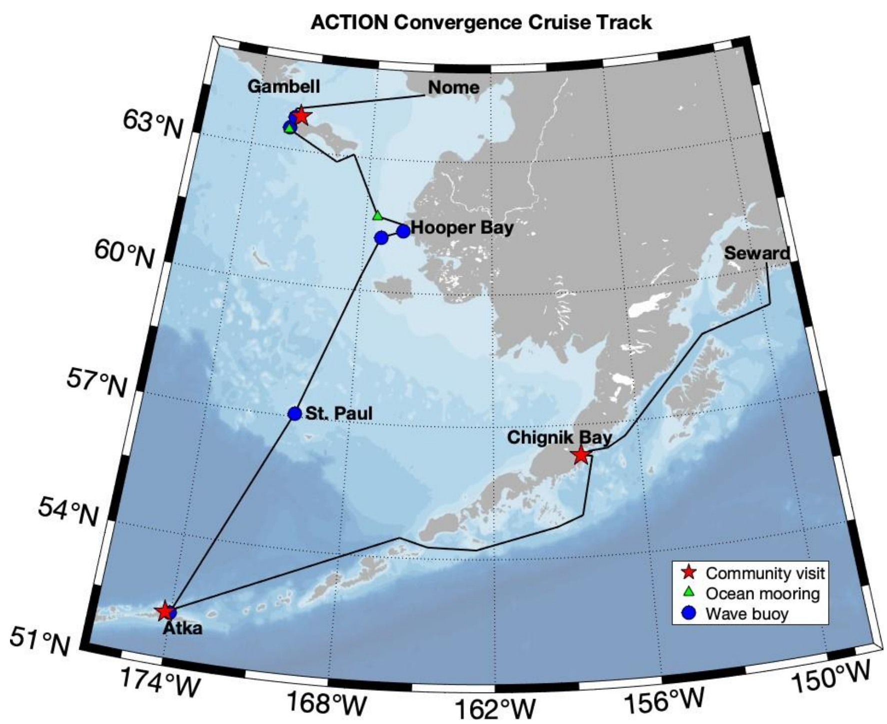


Figure 2. Track of the current NSF Polar Programs funded research cruise onboard R/V SIKULIAQ led by UAF researchers Chris Maio and Kay McMonigal titled the "Alaska Coastal Cooperative Convergence Science Cruise", set to arrive in Nome of August 9, 2025.

Thoughts on subsistence uses of marine wildlife:

- Paralytic shellfish poisoning (caused by ingesting saxitoxin) in Alaska and the U.S. is generally associated with the consumption of contaminated shellfish (e.g., clams, crabs). Thus, **eating clams, crab guts/butter, and/or other shellfish has always carried a risk of ingesting algal toxins,** whether shellfish are gathered from the beach or from the stomach of a walrus or bearded seal.
- Unlike the crab guts/butter, crab meat has not been found to contain saxitoxins.
- Based on our understanding of toxin uptake and storage in shellfish and fish elsewhere in the world, muscle and blubber are not likely to accumulate saxitoxin at levels that pose a human health hazard, although these tissues have not yet been fully tested.
- Thorough cleaning of the inside of marine mammal intestines and stomach contents with water is an important aspect of traditional and customary food preparation methods. We do not know if these food preparation practices safeguard against ingesting saxitoxin when consuming marine mammal intestines or stomach contents. Consuming intestine, stomach, and/or their contents in areas with known biotoxins likely has the same risk as consuming shellfish from those areas.
- Other known vectors for saxitoxin are filter feeding fish like herring or other fish that consume zooplankton (e.g., sand lance) or small fish (mackerel). Likewise, tunicates (sea squirts) are known vectors for saxitoxin.
- Remember: you cannot see, smell, or taste algae toxins. Cleaning, cooking or freezing these foods will not lessen the toxin's effects.
- We know that some clams can retain saxitoxin for long periods (months to years), so clams taken from guts of walruses or seals carry the same risks as any other harvested clams.

If you feel sick from eating clams, crab guts/butter, other shellfish, tunicates, and/or the organs of marine mammals and seabirds, please contact your health care provider immediately.

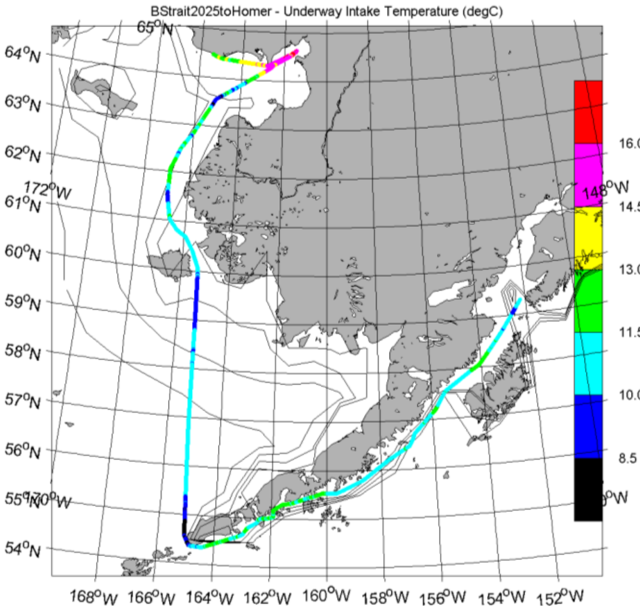
- For more information on harmful algae toxins in humans —symptoms, treatment, etc.— **call the Alaska Section of Epidemiology at: (907) 269-8000 Mon-Fri during business hours or (800) 478-0084 after hours**
- **Remain vigilant**: if you see any marine wildlife acting in an unusual manner or dead please contact:

    - **Aleut Community of St Paul Island, ECO (St Paul)** - Lauren Divine (907) 891-3031
    - **Norton Sound Health Corp. OEH Dept. (Nome)** - Austin Ahmasuk (907) 443-3308
    - **UAF Alaska Sea Grant (Nome)** - Gay Sheffield: **(907) 434-1149**
    - **Nome Eskimo Community (Nome)** - Emma Pate **(907) 434-2246**
    - **Kawerak (Nome)** - Charles "Chuck" Menadelook: **(907) 443-4265**

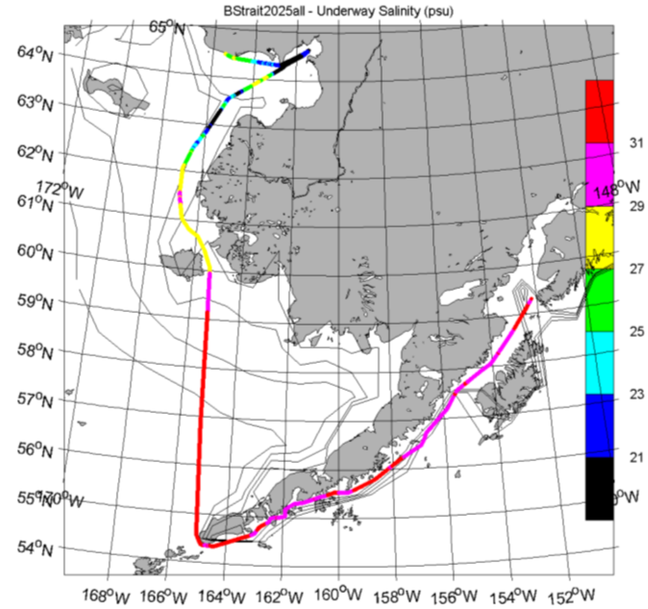
- NOAA Alaska Marine Mammal Stranding Network (Juneau): (877) 925-7773
    - **US Fish and Wildlife Service** – Marine Mammals Management (Anchorage): (800) 362-5148

Bering Strait 2025 – Preliminary TSG plots relevant to identified HAB en route to Homer

Temperature (degC)



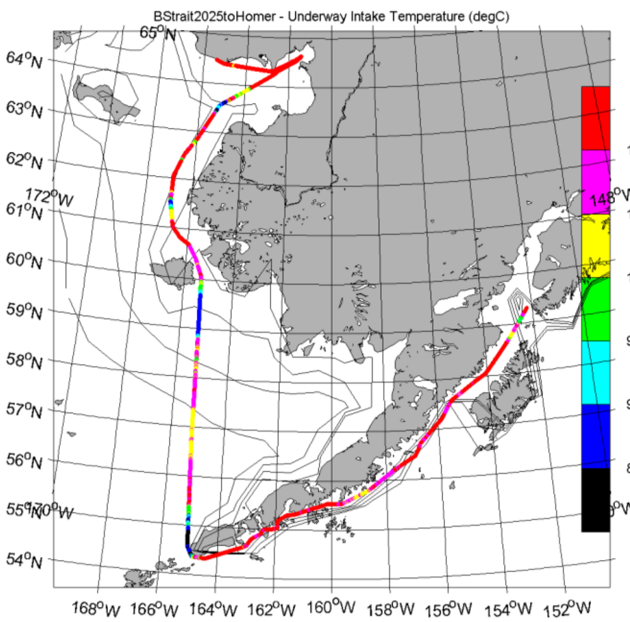
Salinity (psu)

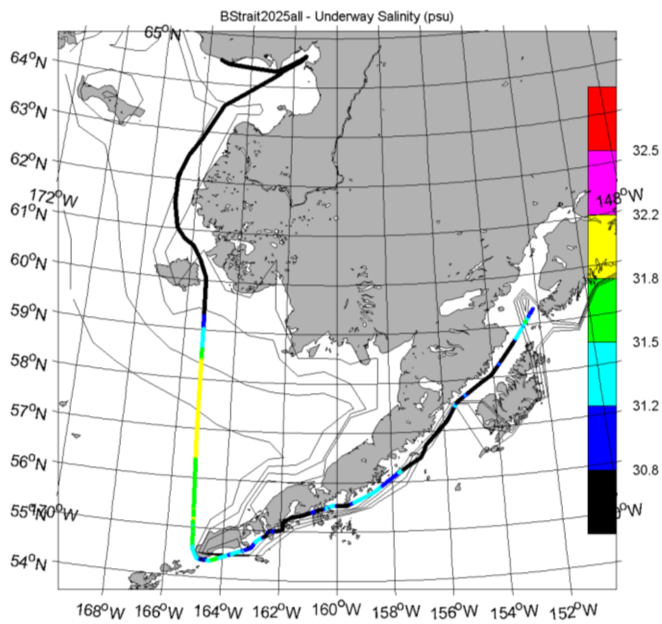


Temperature (degC)

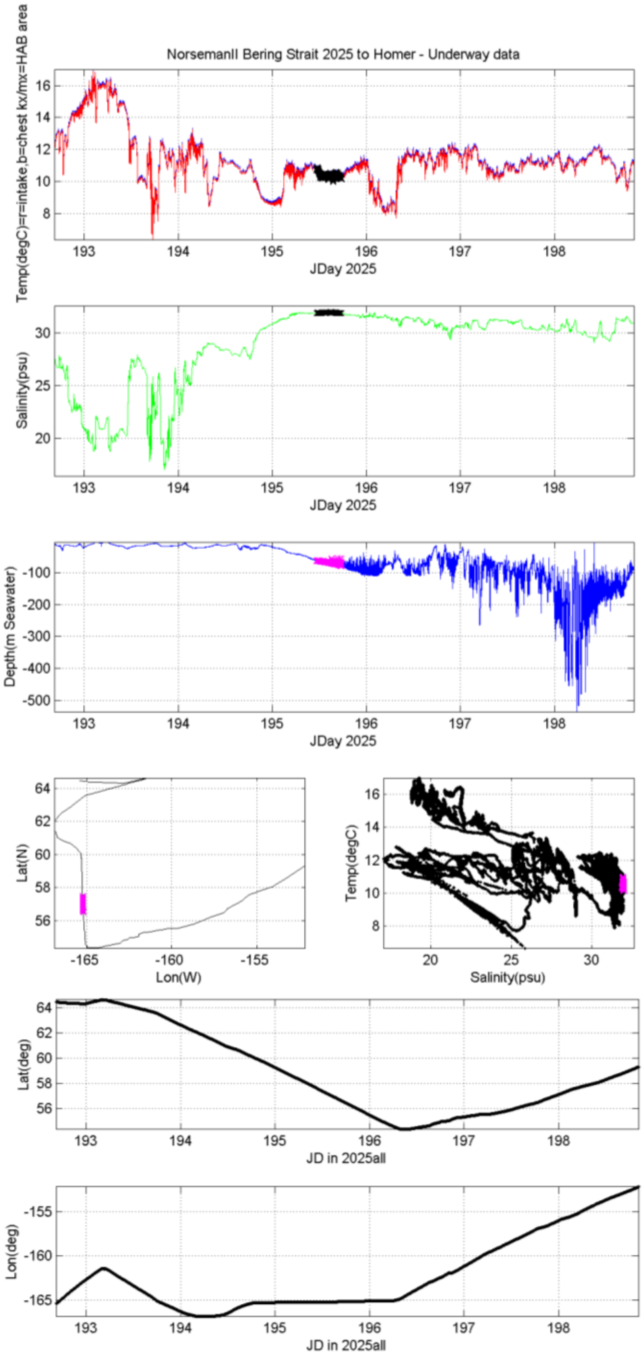
Salinity (psu)

With scales selected to highlight variability near where the HAB was found, i.e., ~56.5-57.5N

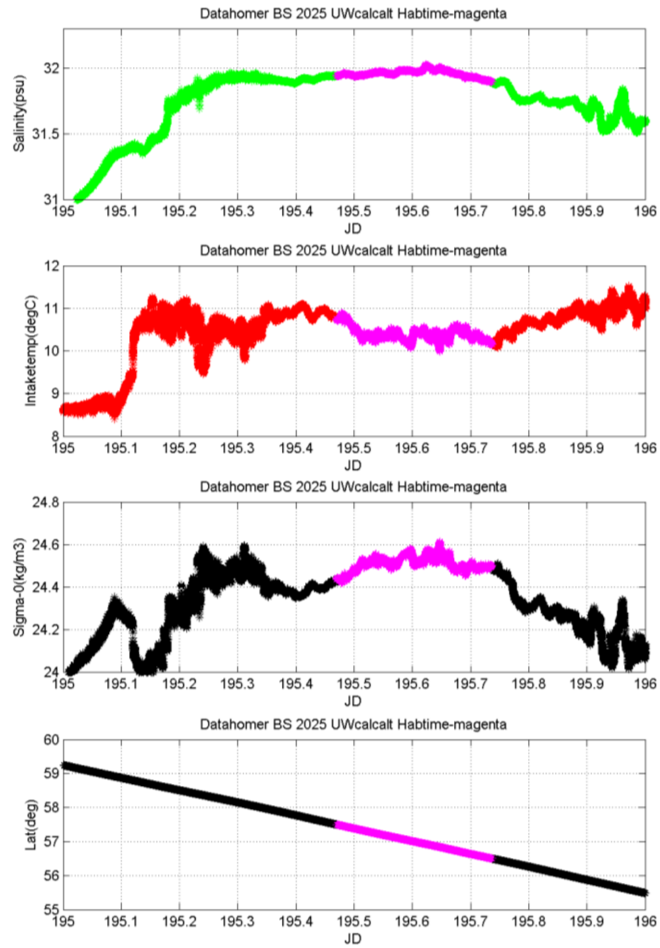




Time series of TSG parameters for Whole transit



Region of the HAB



BERING STRAIT 2025 TARGET CTD POSITIONS
(BS2025_Norseman2_PlannedStations_CTDmoorings_12thAugust2025.txt)

```
%=========================================================
% Stations for BStrait Mooring Cruise 2025 NorsemanII
%=========================================================
% Vers: 12th August 2025
%
% US-Russian convention line is at 168deg 58.7'W.
% All stations in this file are in US waters.
% (Let me know if any points are too close to border for you.)
%
% Time estimates are based on the 2013 NorsemanII cruise.
%=========================================================
% INCLUDING NEW LINES FROM 2017 CRUISE, viz
% - higher res DL north
% - higher res A3L
% - higher res SBS
% - LIS redone to avoid cable at LIS9
% INCLUDING NEW LINES (BC and SBSnnn extension) FROM 2024 CRUISE
%=========================================================
% *****   MOORING POSITIONS *****
%=========================================================
% In likely order of servicing, i.e.,
% - recoveries from east to west in strait, then northern site;
% - deployments northern site, the west to east in strait.
% == 3 moorings to recover
% == 3 moorings to deploy
%-----------------------------------------
% RECOVERIES of moorings deployed in 2024
%-----------------------------------------
%NAME      Lat(N)       Long (W)     Water   Top
%          deg min      deg min      depth   Float
% A2-24    65  46.833   168  34.075   56m    16m
% A4-24    65  44.764   168  15.751   49m    16m
% A3-24    66  19.616   168  57.064   58m     8m
%--------------------------------
% DEPLOYMENTS for this 2025 cruise
%--------------------------------
% Target same as 2012 positions.
%NAME     Lat(N)       Long (W)     Water
%         deg min      deg min      depth
% A3-25   66  19.61    168  57.05    58m
% A2-25   65  46.86    168  34.07    56m
% A4-25   65  44.75    168  15.77    49m
%
%----------------------
% INTERMOORING DISTANCES
%----------------------
% A2 - A4 ~ 8nm
```

```
%------------
% To A3 from
%------------
%   A2  - 34nm
%   A4  - 39nm
%-------------
% To Nome from
%-------------
%   A4 - 120nm
%   CS1 - 200-220nm
%=======================================================
% EAST POINT OF ADCP LINE RUN FROM BS11 THROUGH MOORINGS
%NAME      Lat(N)        Long (W)
%         deg min       deg min
              65  44.1           168   8.6
%
%=======================================================
% *****   HISTORIC CTD SECTIONS *****
%=======================================================
% There are 19 historic CTD lines here.
% These are the same positions as suggested in 2017, with
% the addition of 3 lines run in 2017 and the moving of
% one line (a change also made on the 2017 cruise).
% and the extension of SBSnn and the new line BC run in 2024.
% We will not have time for all of these, so
% we will do a subset.  But I've included
% them all, so you have the positions in advance.
% If operations/science dictate, then there
% might be different lines proposed while at sea.
%
% Some lines are given here at a high resolution and low
% resolution.  Time permitting we will run lines at high
% resolution.
%
% Naming is based on historic data.
% "+net" also refers to historic operations and
% is not relevant for this cruise.
% "no bottles" refers to historic operations and
% is not relevant for this cruise.
%
% On this cruise we will take CTD bottles
% a) for nutrients on lines BS, DI and AL lines only, and only on the
% first running.  These stations are marked *NUT22

% b) for salinity on approx 6 stations, to be decided in real time
% c) for delta O18, to be decided in real time

% Additionally, at ~32 stations on the BS, AL, CS and LIS lines,
% after some casts, we will take trace metal samples using the
% hand lowered pumped system. These stations are marked *PUMP22
```

```
% Known Hazards are indicated.
%
% Stay a safe distance (300m?) from all deployed
% moorings.
%
% Except for around moorings or for mooring work,
% within 200m is ok for positions.
%
%
%=================================================================
% BS = Bering Strait Line (US portion)
%=================================================================
% - 15 stations
% - station spacing generally ~ 2nm
% Distances: - BS11-BS22 21.7nm
%           - BS22-BS24  3.1nm
% Total length 24.8nm
%--
% Time from NorsemanII, 6 hrs running W, 5 hrs running E
% Time from Khromov 10.5hrs
%-------------------------------------------------
% Lat (N) Long (W)   Lat (N)    Long (W)    Name
%                deg min     deg   min
%-------------------------------------------------
% LOW RESOLUTION VERSION
%-------------------------------------------------
  65.805  168.933   65  48.31   168  55.96  % BS11
  65.788  168.860   65  47.26   168  51.62  % BS12
  65.772  168.794   65  46.33   168  47.64  % BS13
  65.755  168.721   65  45.28   168  43.29  % BS14
  65.739  168.663   65  44.35   168  39.80  % BS15
  65.722  168.591   65  43.29   168  35.46  % BS16 + net
  65.704  168.521   65  42.23   168  31.28  % BS17
  65.695  168.486   65  41.70   168  29.16  % BS17S
  65.686  168.449   65  41.18   168  26.94  % BS18
  65.672  168.391   65  40.35   168  23.44  % BS19
  65.655  168.318   65  39.29   168  19.09  % BS20
  65.642  168.250   65  38.53   168  14.97  % BS21
  65.625  168.177   65  37.48   168  10.63  % BS22 + net
  65.599  168.161   65  35.96   168   9.66  % BS23
  65.582  168.117   65  34.91   168   7.00  % BS24
%-------------------------------------------------
% HIGH RESOLUTION VERSION (with nutrient sampling plan)
%-------------------------------------------------
%65.805	168.933	65	48.31	168	55.96	%	BS11
65.797	168.897	65	47.79	168	53.79	%	BS11.5 *NUT22 *PUMP22
65.788	168.86	65	47.26	168	51.62	%	BS12
65.780	168.827	65	46.8	168	49.63	%	BS12.5
```

```
65.772  168.794         65      46.33   168     47.64   %       BS13    *NUT22 *PUMP22
65.764  168.758         65      45.81   168     45.47   %       BS13.5
65.755  168.721         65      45.28   168     43.29   %       BS14
65.747  168.692         65      44.82   168     41.55   %       BS14.5 *NUT22 *PUMP22
65.739  168.663         65      44.35   168     39.8    %       BS15
65.731  168.627         65      43.82   168     37.63   %       BS15.5
65.722  168.591         65      43.29   168     35.46   %       BS16    *NUT22 *PUMP22
65.713  168.556         65      42.76   168     33.37   %       BS16.5
65.704  168.521         65      42.23   168     31.28   %       BS17
65.695  168.486         65      41.7    168     29.16   %       BS17.5 *NUT22 *PUMP22
65.686  168.449         65      41.18   168     26.94   %       BS18
65.679  168.42  65      40.77   168     25.19   %       BS18.5
65.672  168.391         65      40.35   168     23.44   %       BS19    *NUT22 *PUMP22
65.664  168.355         65      39.82   168     21.27   %       BS19.5
65.655  168.318         65      39.29   168     19.09   %       BS20
65.649  168.284         65      38.91   168     17.03   %       BS20.5 *NUT22 *PUMP22
65.642  168.25  65      38.53   168     14.97   %       BS21
65.634  168.214         65      38.01   168     12.8    %       BS21.5
65.625  168.177         65      37.48   168     10.63   %       BS22    *NUT22 *PUMP22
65.599  168.161         65      35.96   168     9.66    %       BS23
65.582  168.117         65      34.91   168     7       %       BS24
%
%
%==================================================================
% DL = Diomede Line (US only, 1nm east of border)
%==================================================================
% This line is to map eddying area north of the Diomedes
% - 19 stations
% - station spacing ~ 1nm in South,
%                ~ 2.5nm in north
% Distance: - DL1 to DL19  28.7nm
%--
% Time from NorsemanII - 5.5 hrs running N; 9hrs running S
% Time from Khromov to DL19 ~10hrs
%--------------------------------------------------
%    Lat (N)     Long (W)     Name
%    deg min      deg   min
%--------------------------------------------------
% LOW RESOLUTION VERSION
%--------------------------------------------------
0 0  65   49.28   168   56.2  % DL1  *NUT22
0 0  65   50.26   168   56.2  % DL2
0 0  65   51.23   168   56.2  % DL3
0 0  65   52.21   168   56.2  % DL4  *NUT22 + net
0 0  65   53.18   168   56.2  % DL5 - no bottles
0 0  65   54.15   168   56.2  % DL6
0 0  65   55.13   168   56.2  % DL7  *NUT22 - no bottles
0 0  65   56.10   168   56.2  % DL8
0 0  65   57.08   168   56.2  % DL9 - no bottles
0 0  65   58.05   168   56.2  % DL10 *NUT22
```

```
0 0  65   59.03    168   56.2  % DL11- no bottles
0 0  66    0.00    168   56.2  % DL12
%-----
0 0  66    2.55    168   56.2  % DL13- no bottles
0 0  66    5.10    168   56.2  % DL14
0 0  66    7.65    168   56.2  % DL15- no bottles
0 0  66   10.19    168   56.2  % DL16
0 0  66   12.74    168   56.2  % DL17- no bottles
0 0  66   15.29    168   56.2  % DL18
0 0  66   17.84    168   56.2  % DL19- no bottles
%-------------------------------------------------
% HIGH RESOLUTION VERSION (with nutrient sampling plan)
%-------------------------------------------------
0 0  65   49.28    168   56.2  % DL1  *NUT22
0 0  65   50.26    168   56.2  % DL2
0 0  65   51.23    168   56.2  % DL3
0 0  65   52.21    168   56.2  % DL4  *NUT22 + net
0 0  65   53.18    168   56.2  % DL5 - no bottles
0 0  65   54.15    168   56.2  % DL6
0 0  65   55.13    168   56.2  % DL7  *NUT22 - no bottles
0 0  65   56.10    168   56.2  % DL8
0 0  65   57.08    168   56.2  % DL9 - no bottles
0 0  65   58.05    168   56.2  % DL10 *NUT22
0 0  65   59.03    168   56.2  % DL11- no bottles
0 0  66    0.00    168   56.2  % DL12
%--
0 0  66    1.28    168   56.2  % DL12.5  *NUT22
0 0  66    2.55    168   56.2  % DL13
0 0  66    3.83    168   56.2  % DL13.5
0 0  66    5.10    168   56.2  % DL14    *NUT22
0 0  66    6.38    168   56.2  % DL14.5
0 0  66    7.65    168   56.2  % DL15
0 0  66    8.92    168   56.2  % DL15.5  *NUT22
0 0  66   10.19    168   56.2  % DL16
0 0  66   11.47    168   56.2  % DL16.5
0 0  66   12.74    168   56.2  % DL17    *NUT22
0 0  66   14.02    168   56.2  % DL17.5
0 0  66   15.29    168   56.2  % DL18
0 0  66   16.57    168   56.2  % DL18.5  *NUT22
0 0  66   17.84    168   56.2  % DL19
0 0  66   18.73    168   56.2  % DL19.5
% Ending at A3
 0 0  66  19.61    168   57.05  % A3mooring  *NUT22
% *** Adjust this first position to be safe distance (300m?) from A3 mooring
%
%
%=================================================================
% DL A and B lines (Diomede A and B lines)
%=================================================================
% These lines, with DL, form a grid to map
```

```
% eddying N of the Diomedes.
% - each line 12 stations
% - station spacing ~ 1nm
% Distances: - each line ~ 11nm
%--
% Estimate for NorsmanII for each line ~3.5hrs
% Time from Khromov for each line ~5hrs
%-----------------------------------------
%    Lat (N)      Long (W)     Name
%    deg min      deg   min
% Northbound leg
0 0   65   49.30    168   52.2  % DLa 1
0 0   65   50.27    168   52.2  % DLa 2
0 0   65   51.25    168   52.2  % DLa 3
0 0   65   52.22    168   52.2  % DLa 4
0 0   65   53.19    168   52.2  % DLa 5
0 0   65   54.16    168   52.2  % DLa 6
0 0   65   55.14    168   52.2  % DLa 7
0 0   65   56.11    168   52.2  % DLa 8
0 0   65   57.08    168   52.2  % DLa 9
0 0   65   58.05    168   52.2  % DLa 10
0 0   65   59.03    168   52.2  % DLa 11
0 0   66    0.00   168   52.2  % DLa 12
% Southbound leg
0 0   66    0.00   168   48.2  % DLb 12
0 0   65   59.03    168   48.2  % DLb 11
0 0   65   58.05    168   48.2  % DLb 10
0 0   65   57.08    168   48.2  % DLb 9
0 0   65   56.11    168   48.2  % DLb 8
0 0   65   55.14    168   48.2  % DLb 7
0 0   65   54.16    168   48.2  % DLb 6
0 0   65   53.19    168   48.2  % DLb 5
0 0   65   52.22    168   48.2  % DLb 4
0 0   65   51.25    168   48.2  % DLb 3
0 0   65   50.27    168   48.2  % DLb 2
0 0   65   49.30    168   48.2  % DLb 1
%
%
%=================================================================
% AL = A3 Line (US portion)
%=================================================================
% Hazards on this line:
% == First station on this line is at mooring A3-17, so exact
% position needs to be altered to be a safe distance (300m?)
% from mooring A3-17 site.
%---------------------------------------------------
% - 13 stations including cast at A3mooring site
% - station spacing ~ 1.9nm
% Distance: - A3 to AL24 = 22.2nm
% --
```

```
% Time from NorsemanII ~5.5hrs
% Time from Khromov ~9hrs
%-----------------------------------------------------
% Lat (N) Long (W)   Lat (N)      Long (W)     Name
%                 deg min      deg   min
%-------------------------------------------------
% LOW RESOLUTION VERSION
%-------------------------------------------------
  66.327  168.951   66  19.61   168   57.05  % A3-17
% *** Adjust this first position to be safe distance (300m?) from A3-17
  66.340  168.895   66  20.39   168   53.71  % AL13
  66.352  168.823   66  21.09   168   49.40  % AL14
  66.363  168.752   66  21.80   168   45.09  % AL15
  66.375  168.680   66  22.51   168   40.78  % AL16
  66.387  168.608   66  23.21   168   36.47  % AL17 + net
  66.399  168.536   66  23.92   168   32.16  % AL18
  66.410  168.464   66  24.63   168   27.84  % AL19
  66.422  168.392   66  25.33   168   23.53  % AL20
  66.434  168.320   66  26.04   168   19.22  % AL21
  66.446  168.249   66  26.75   168   14.91  % AL22 + net
  66.458  168.177   66  27.45   168   10.60  % AL23
  66.469  168.105   66  28.16   168    6.29  % AL24
%-------------------------------------------------
% HIGH RESOLUTION VERSION (with nutrient sampling plan)
%-------------------------------------------------
  66.3270  168.9510   66   19.6100  168   57.0500   % A3 mooring
% *** Adjust this first position to be safe distance (300) from A3 mooring
  66.3335  168.9230   66   20.0000  168   55.3800   % new AL12.5  *NUT22 *PUMP22
  66.3400  168.8950   66   20.3900  168   53.7100   % AL13
  66.3460  168.8590   66   20.7400  168   51.5550   % new AL13.5
  66.3520  168.8230   66   21.0900  168   49.4000   % AL14       *NUT22 *PUMP22
  66.3575  168.7875   66   21.4450  168   47.2450   % new AL14.5
  66.3630  168.7520   66   21.8000  168   45.0900   % AL15
  66.3690  168.7160   66   22.1550  168   42.9350   % new AL15.5  *NUT22 *PUMP22
  66.3750  168.6800   66   22.5100  168   40.7800   % AL16
  66.3810  168.6440   66   22.8600  168   38.6250   % new AL16.5
  66.3870  168.6080   66   23.2100  168   36.4700   % AL17       *NUT22 *PUMP22
  66.3940  168.5657   66   23.6400  168   33.9400   % new AL17.5  % AND MOVED OFF Q CABLE
  66.3990  168.5360   66   23.9200  168   32.1600   % AL18
  66.4045  168.5000   66   24.2750  168   30.0000   % new AL18.5  *NUT22 *PUMP22
  66.4100  168.4640   66   24.6300  168   27.8400   % AL19
  66.4160  168.4280   66   24.9800  168   25.6850   % new AL19.5
  66.4220  168.3920   66   25.3300  168   23.5300   % AL20       *NUT22 *PUMP22
  66.4280  168.3560   66   25.6850  168   21.3750   % new AL20.5
  66.4340  168.3200   66   26.0400  168   19.2200   % AL21
  66.4400  168.2845   66   26.3950  168   17.0650   % new AL21.5  *NUT22 *PUMP22
  66.4460  168.2490   66   26.7500  168   14.9100   % AL22
  66.4520  168.2130   66   27.1000  168   12.7550   % new AL22.5
  66.4580  168.1770   66   27.4500  168   10.6000   % AL23       *NUT22 *PUMP22
  66.4635  168.1410   66   27.8050  168    8.4450   % new AL23.5
```

```
  66.4690  168.1050  66   28.1600  168    6.2900   % AL24
  66.4745  168.0690  66   28.5150  168    4.1350   % new AL24.5
  66.4800  168.0330  66   28.8700  168    1.9800   % AL25       *NUT22 *PUMP22
  66.4855  167.9970  66   29.2250  167   59.8200   % new AL25.5
  66.4910  167.9610  66   29.5800  167   57.6650   % AL26
  66.4965  167.9250  66   29.9350  167   55.5100   % new AL26.5
  66.5020  167.8890  66   30.2900  167   53.3550   % AL27
  66.5075  167.8530  66   30.6450  167   51.2000   % new AL27.5
%
%
%==================================================================
% AS = from AL to CS Line
%==================================================================
% Across-topography line linking Al line with CS
% - 20 stations (counting first of CS line)
% - station spacing
%       AS1-7 at ~ 4nm spacing.
%       AS7-14 at 2nm spacing,
%       A14 to end 4nm
% Distances: - AS1 to CS10 64.7nm
%--
% Time from Khromov (12casts, odds+2&18) ~11hrs
% Estimate for NorsmanII 20 casts ~ 12hrs
% Estimate for Khromov 20 casts ~ 14hrs
%--------------------------------------------
%    Lat (N)      Long (W)      Name
%    deg min       deg   min
0 0   66   41.47    167   38.86   % AS 1
0 0   66   45.01    167   43.78   % AS 2-no bottles
0 0   66   48.55    167   48.70   % AS 3
0 0   66   52.09    167   53.62   % AS 4-no bottles
0 0   66   55.63    167   58.55   % AS 5
0 0   66   59.17    168    3.47   % AS 6-no bottles
0 0   67    2.71    168    8.39   % AS 7
%                   (2nm spacing over slope)
0 0   67    4.48    168   10.85   % AS 8-no bottles
0 0   67    6.25    168   13.31   % AS 9
0 0   67    8.02    168   15.77   % AS 10-no bottles
0 0   67    9.78    168   18.23   % AS 11
0 0   67   11.55    168   20.69   % AS 12-no bottles
0 0   67   13.32    168   23.15   % AS 13
0 0   67   16.86    168   28.07   % AS 14
%                   (back to 4nm spacing)
0 0   67   20.40    168   32.99   % AS 15-no bottles
0 0   67   23.94    168   37.92   % AS 16
0 0   67   27.48    168   42.84   % AS 17-no bottles
0 0   67   31.02    168   47.76   % AS 18
0 0   67   34.56    168   52.68   % AS 19-no bottles
0 0   67   38.10    168   56.00   % CS10US
%
```

```
%
%=================================================================
% SAS = S extension of AS line
%=================================================================
% Adding another 8 stations at 4nm spacing south
% from AS1 to the coast.
%--
% Estimate for NorsemanII 8 casts ~ 4hrs
% Not run yet
%------------------------------------------
%    Lat (N)       Long (W)      Name
%    deg min       deg   min
0 0  66  37.91    167  34.00  % SAS 1
0 0  66  34.35    167  29.14  % SAS 2
0 0  66  30.79    167  24.29  % SAS 3
0 0  66  27.23    167  19.43  % SAS 4
0 0  66  23.68    167  14.57  % SAS 5
0 0  66  20.12    167   9.72  % SAS 6
0 0  66  16.56    167   4.86  % SAS 7
0 0  66  13.00    167   0.00  % SAS 8
%
%
%=================================================================
% CS = Cape Serdtse Kamen to Point Hope Line (US portion)
%=================================================================
% Hazards on this line:
% == Final station CS19 is shallow.  Check on
% modern charts to see if deep enough for NorsemanII.
% (this station was too shallow for the Khromov, but
% was ok for the NorsemanII in 2013).
% == NOAA mooring at:
%        67 54.712N, 168 11.628W
%-------------------------------------------------------
% - 16 or 17 stations
% - station spacing ~ 5nm in the central Chukchi,
%               ~ 2.2nm near the coast
% Distances: - CS10US to CS18 60.8nm
%          - CS18 to CS19    2.2nm
%--
% Time from NorsemanII (toCS19) ~ 10.5 hrs
% Time from Khromov (toCS18) ~12hrs
%-------------------------------------------------------
%    Lat (N)    Long (W)      Name
%    deg min    deg   min
%-----------------------------------------------
% LOW RESOLUTION VERSION
%-----------------------------------------------
0 0  67  38.1  168  56.0   % CS10US + net
0 0  67  41.7  168  48.1   % CS10.5  - no bottles
0 0  67  45.3  168  39.9   % CS11
```

```
0 0   67   48.9   168   29.4    % CS11.5  - no bottles
0 0   67   52.5   168   18.8    % CS12 + net
0 0   67   55.9   168    9.1    % CS12.5  - no bottles
0 0   67   59.3   167   59.4    % CS13
0 0   68    2.7   167   49.7    % CS13.5  - no bottles
0 0   68    6.1   167   39.9    % CS14 + net
0 0   68    9.1   167   30.7    % CS14.5  - no bottles
0 0   68   12.1   167   21.4    % CS15
0 0   68   13.6   167   16.8    % CS15.5  - no bottles
0 0   68   15.0   167   12.2    % CS16
0 0   68   16.6   167    7.6    % CS16.5  - no bottles
0 0   68   18.0   167    2.9    % CS17 + net
0 0   68   18.9   166   57.6    % CS18
0 0   68   19.9   166   52.3    % CS19 *** SHALLOW **
%              CS19 too shallow for Khromov.
%------------------------------------------------
% HIGH RESOLUTION VERSION (with nutrient sampling plan)
%------------------------------------------------
% - 27 stations
% - station spacing ~ 2.5nm in the central Chukch (0.25 stations)
%                ~ 2.2nm near the coast
% Distances: - CS10US to CS18 60.8nm
%          - CS18 to CS19    2.2nm
% Time from NorsemanII (toCS19) ~ 11hrs
%--------------------------------------------------------
%    Lat (N)    Long (W)      Name
%    deg min    deg   min
0 0   67   38.1   168   56.0    % CS10US + net *PUMP22
0 0   67   39.9   168   52.0  % new CS10.25
0 0   67   41.7   168   48.1    % CS10.5  - no bottles
0 0   67   43.5   168   44.0  % new CS10.75
0 0   67   45.3   168   39.9    % CS11       *PUMP22
0 0   67   47.1   168   34.6  % new CS11.25
0 0   67   48.9   168   29.4    % CS11.5  - no bottles
0 0   67   50.7   168   24.1  % new CS11.75
0 0   67   52.5   168   18.8    % CS12 + net   *PUMP22
0 0   67   54.2   168   13.9  % new CS12.25
0 0   67   55.9   168    9.1    % CS12.5  - no bottles
0 0   67   57.6   168    4.2  % new CS12.75
0 0   67   59.3   167   59.4    % CS13       *PUMP22
0 0   68    1.0   167   54.5  % new CS13.25
0 0   68    2.7   167   49.7    % CS13.5  - no bottles
0 0   68    4.4   167   44.8  % new CS13.75
0 0   68    6.1   167   39.9    % CS14 + net   *PUMP22
0 0   68    7.6   167   35.3  % new CS14.25
0 0   68    9.1   167   30.7    % CS14.5  - no bottles
0 0   68   10.6   167   26.0  % new CS14.75
0 0   68   12.1   167   21.4    % CS15       *PUMP22
0 0   68   13.6   167   16.8    % CS15.5  - no bottles
0 0   68   15.0   167   12.2    % CS16       *PUMP22
```

```
0 0   68   16.6   167    7.6    % CS16.5  - no bottles
0 0   68   18.0   167    2.9    % CS17 + net   *PUMP22
0 0   68   18.9   166   57.6    % CS18
0 0   68   19.9   166   52.3    % CS19 *** SHALLOW ** %
%
%
%=================================================================
% LIS = Cape Lisburne Line (redone to avoid Qcable at Lis9)
%=================================================================
% - 18 stations (including first of CCL line)
% - station spacing ~ 2nm near coast,
%           ~ 3nm and ~ 5nm away from coast
% Distances: - LIS1 to CCL22 57.2nm
%--
% Time from NorsemanII, ~ 10hrs
% Time from Khromov ~11hrs
% (Times different now added stations)
%-------------------------------
%    Lat (N)       Long (W)    Name
%    deg min      deg   min
  0   0        68   54.40   166   19.80  % LIS 1 + net *PUMP22
  0   0        68   54.80   166   25.15  % LIS 2      *PUMP22
  0   0        68   55.20   166   30.51  % LIS 3      *PUMP22
  0   0        68   55.80   166   38.54  % LIS 4
  0   0        68   56.40   166   46.57  % LIS 5
  0   0        68   57.00   166   54.60  % LIS 6 + net
  0   0        68   57.60   167    1.95  % LIS 6.5 - no bottles *PUMP22
  0   0        68   58.20   167    9.30  % LIS 7
  0   0        68   58.80   167   16.65  % LIS 7.5 - no bottles
  0   0        68   59.40   167   24.00  % LIS 8      *PUMP22
  0   0        69   00.20   167   33.8   % NEW ** LIS 8.5
%DO NOT DO LIS 9
% 69    0.60    167   38.70  % LIS 9  ** on Q cable - do not do
%DO NOT DO LIS 9
  0   0        69    1.00   167   43.60  % NEW ** LIS 9.5
  0   0        69    1.80   167   53.40  % LIS 10 + net
  0   0        69    1.35   168    7.95  % LIS 11     *PUMP22
  0   0        69    0.90   168   22.50  % LIS 12
  0   0        69    0.45   168   37.05  % LIS 13     *PUMP22
  0   0        69    0.23   168   46.62  % LIS 14n + net
  0   0        69    0.00   168   56.00  % CCL22n % was 56.2  *PUMP22
%
%
%=================================================================
% CCL = Chukchi Convention Line
%=================================================================
% Hazards on this line:
% == First station on this line is the same as last station
% included in the LIS line above.  It does not need to be
% repeated.
```

```
% == Last station on this line is at mooring A3-14, so exact
% position needs to be altered to be a safe distance (300m?)
% from mooring A3-14 site.
% == There are 2 JAMSTEC moorings ~ 3nm east of station
% CCL16 on this line.  Those positions are:
% SCH13  68 2.002N   168 50.028W
% SCH13w 68 3.006N   168 50.003W
%--------------------------------------
% Line running from northern most point
% due south, ~ 1nm US side of conventionline
% - 20 stations (counting arriving at A3-14)
% - station spacing ~ 10nm until CCL8,
%     then reducing to ~5nm and ~2.5nm
% Distances: - CCL22 to A3-13 ~ 161nm
%--
% Time from NorsemanII, 21.5hrs
% Time from Khromov ~26hrs
%---------------------------------------
% MAIN LINE STARTS IN N WITH THESE
%---------------------------------------
%     Lat (N)       Long (W)     Name
%     deg   min     deg   min
0 0   69    0.0    168  56.0   % CCL22
0 0   68   50.0    168  56.0   % CCL21
0 0   68   40.0    168  56.0   % CCL20
0 0   68   30.0    168  56.0   % CCL19
0 0   68   20.0    168  56.0   % CCL18 + Net
0 0   68   10.0    168  56.0   % CCL17
0 0   68   00.0    168  56.0   % CCL16
0 0   67   50.0    168  56.0   % CCL15
0 0   67   38.1    168  56.0   % CCL14 (same as CS10US) + Net + Prod
%-------------------------------------------------
% THEN EITHER - LOW RESOLUTION VERSION
%-------------------------------------------------
0 0   67   30.0    168  56.0   % CCL13
0 0   67   20.0    168  56.0   % CCL12
0 0   67   10.0    168  56.0   % CCL11
0 0   67   00.0    168  56.0   % CCL10 + Net
0 0   66   50.0    168  56.0   % CCL9
0 0   66   40.0    168  56.0   % CCL8
%       - spacing now 5nm
0 0   66   35.0    168  56.0   % CCL7
0 0   66   30.0    168  56.0   % CCL6
0 0   66   25.0    168  56.0   % CCL5
%       - spacing now 2.5nm
0 0   66   22.3    168  56.0   % CCL4
0 0   66   19.61   168  57.05  % A3-17
% *** Adjust this position to be safe distance (300m?) from A3-17
%-------------------------------------------------
%  - OR HIGH RESOLUTION VERSION
```

```
% (halves from 8.5 to 13.5 are new)                    73nm ..
%------------------------------------------------
0 0   67   35.0    168  56.0   % CCL13.5
0 0   67   30.0    168  56.0   % CCL13
0 0   67   25.0    168  56.0   % CCL12.5
0 0   67   20.0    168  56.0   % CCL12
0 0   67   15.0    168  56.0   % CCL11.5
0 0   67   10.0    168  56.0   % CCL11
0 0   67   05.0    168  56.0   % CCL10.5
0 0   67   00.0    168  56.0   % CCL10 + Net
0 0   66   55.0    168  56.0   % CCL9.5
0 0   66   50.0    168  56.0   % CCL9
0 0   66   45.0    168  56.0   % CCL8.5
0 0   66   40.0    168  56.0   % CCL8
%         - spacing now 5nm
0 0   66   35.0    168  56.0   % CCL7
0 0   66   30.0    168  56.0   % CCL6
0 0   66   25.0    168  56.0   % CCL5
%         - spacing now 2.5nm
0 0   66   22.3    168  56.0   % CCL4
0 0   66   19.61    168  57.05  % A3-17
% *** Adjust this position to be safe distance (300m?) from A3-17
%
%
%==================================================================
% MBSn = Mid Bering Strait line
%==================================================================
% Just north of the Bering Strait line
% - 14 stations
% - station spacing 1.7nm, less near coast
% Distance: - 21.0nm total
%--
% Time from Helix (8casts only) ~2.5hrs
% - Estimate NorsemanII (8 casts only) ~ 4hrs
% - Estimate NorsemanII (14 casts)  ~ 6hrs
% - Estimate Khromov (8casts only)~5.5hrs
% - Estimate Khromov (14casts) ~7hrs
%-------------------------------------
%     Lat (N)       Long (W)     Name
%     deg   min      deg   min
0 0   65   52.1    168  56.0   % MBSn1 % was 57.0
0 0   65   52.0    168  52.5   % MBSn1.5
0 0   65   51.9    168  49.1   % MBSn2
0 0   65   51.8    168  45.0   % MBSn2.5
0 0   65   51.7    168  40.9   % MBSn3
0 0   65   51.6    168  36.4   % MBSn3.5
0 0   65   51.5    168  31.9   % MBSn4 % was 51.6
0 0   65   51.4    168  27.5   % MBSn4.5
0 0   65   51.3    168  23.0   % MBSn5 % was 51.4
0 0   65   51.2    168  18.5   % MBSn5.5
```

```
0 0    65    51.1     168  13.9   % MBSn6
0 0    65    51.1     168  10.4   % MBSn6.5
0 0    65    51.0     168   6.9   % MBSn7
0 0    65    50.9     168   5.0   % MBSn8
%
%
%===================================================================
% NBS - North Bering Strait line
%===================================================================
% Hazards on this line:
% == Section crosses shallow waters.
% Beware of shallows from NBS9 and eastwards.
% (Helix diverted N to avoid shallows between
% stations NBS10 and NBS11)
% == Consider terminating line at NBS9
%----------------------------------------
% Another cross strait line, run previously
% at lower resolution (i.e. without the 0.5 stations).
% - stations 9 (NBS1-9) to 16 (NBS1-9 with 0.5s)
%    to 21 (full section, including shallows).
% - station spacing (with 0.5s) ~ 1.7nm
% Distance: - NBS1-9  25.8nm
%          - NBS1-14 44.1nm
%--
% Time from Helix to NBS9, 9 casts ~5.5hrs
% - Estimate for NorsemanII to NBS9, 9 casts, 6hrs
% - Estimate for NorsemanII to NBS9, 16 casts, 7.5hrs
% - Estimate Khromov to NBS9, 9 casts ~6.5hrs
% - Estimate Khromo to NBS9, 16 casts ~8hrs
% Time from Helix to NBS14, 14 casts ~8.5hrs
% - Estimate for NorsemanII to NBS14, 14 casts, 9hrs
% - Esimate for NorsemanII to NSB14, 21 casts, 10.5hrs
% - Estimate Khromov to NBS14, 14 casts ~10hrs
% - Estimate Khromov to NBS14, 21 casts ~13hrs
%-----------------------------------------
%     Lat (N)       Long (W)     Name
%     deg   min      deg   min
0 0    66     0.0     168  56.0   % NBS1 % was 58.1
0 0    66     0.0     168  53.0   % NBS1.5
0 0    66     0.0     168  49.9   % NBS2
0 0    66     0.0     168  45.8   % NBS2.5
0 0    66     0.0     168  41.6   % NBS3
0 0    66     0.0     168  37.4   % NBS3.5
0 0    66     0.0     168  33.2   % NBS4
0 0    66     0.0     168  29.1   % NBS4.5
0 0    66     0.0     168  25.0   % NBS5
0 0    66     0.0     168  20.7   % NBS5.5
0 0    66     0.0     168  16.4   % NBS6
0 0    66     0.0     168  12.4   % NBS6.5
0 0    66     0.0     168   8.4   % NBS7
```

```
0 0    66     0.0     168   4.2   % NBS7.5
0 0    66     0.0     168   0.0   % NBS8 - 34m water
0 0    66     0.0     167  55.1   % NBS9 - 20m water
%  (consider terminating line here)
0 0    66     0.0     167  52.0   % NBS10 - 12m water
% (Helix diverted N to avoid shallows between these stations)
0 0    66     0.0     167  40.1   % NBS11 - 15m water
0 0    66     0.0     167  29.1   % NBS12 - 18m water
0 0    66     0.0     167  18.1   % NBS13 - 13m water
0 0    66     0.0     167  10.2   % NBS14 - 10m water
%
%
%=====================================================================
% North North Bering Strait Line (NNBS)
%=====================================================================
% A section across the ACC and main flow between
% the A3L line and the NBS line.
% With the 0.5s, at 1.76nm spacing
% 22.8nm length
%----------------------------------
% Run for the first time in 2015 - check water depths on
% the eastern (NNBS7.5) end)
% Dovetails with DL line.  NNBS1 is the same as DL16
% Now has one extra shallower station in the east NNBS8

 66.170 168.937   66   10.19 168   56.20  %NNBS1
 66.170 168.865   66   10.19 168   51.88  %NNBS1.5
 66.170 168.793   66   10.19 168   47.55  %NNBS2
 66.170 168.721   66   10.19 168   43.23  %NNBS2.5
 66.170 168.648   66   10.19 168   38.91  %NNBS3
 66.170 168.576   66   10.19 168   34.58  %NNBS3.5
 66.170 168.504   66   10.19 168   30.26  %NNBS4
 66.170 168.432   66   10.19 168   25.94  %NNBS4.5
 66.170 168.360   66   10.19 168   21.62  %NNBS5
 66.170 168.288   66   10.19 168   17.29  %NNBS5.5
 66.170 168.216   66   10.19 168   12.97  %NNBS6
 66.170 168.144   66   10.19 168    8.65  %NNBS6.5
 66.170 168.072   66   10.19 168    4.32  %NNBS7
 66.170 168.000   66   10.19 168    0.00  %NNBS7.5
 66.170 168.000   66   10.19 167   55.70  %NNBS8   *** NEW
%
%
%=====================================================================
% NPH - North Point Hope Line
%=====================================================================
%  Crossing from Point Hope to the ENE roughly.
% - 11 stations,
%     from 1-5 and 1.25nm spacing
%     for the rest of the line at 2.5nm
% - Distance 21nm
```

```
% - new in 2016
%   - ** CHECK DEPTH OF SHALLOWEST  NPH1
%
% Run from east (NPH1) to west (NPH11)
% - estimate 3hrs 15min
%---------------------------------------------
%    Lat (N)     Long (W)     Name
%    deg min      deg min
0 0   68  22.40    167  07.93   % NPH1
0 0   68  22.64    167  11.31   % NPH2
0 0   68  22.87    167  14.68   % NPH3
0 0   68  23.11    167  18.06   % NPH4
0 0   68  23.35    167  21.44   % NPH5
0 0   68  23.83    167  28.19   % NPH6
0 0   68  24.30    167  34.95   % NPH7
0 0   68  24.77    167  41.71   % NPH8
0 0   68  25.25    167  48.46   % NPH9
0 0   68  25.73    167  55.22   % NPH10
0 0   68  26.20    168  01.97   % NPH11
%-- with extension to the west (20nm, 8 stations, 4hrs)
0 0   68  26.68    168  08.72   % NPH11.5
0 0   68  27.15    168  15.47   % NPH12
0 0   68  27.63    168  22.23   % NPH12.5
0 0   68  28.10    168  28.98   % NPH13
0 0   68  28.58    168  35.74   % NPH13.5
0 0   68  29.05    168  42.49   % NPH14
0 0   68  29.53    168  49.25   % NPH14.5
0 0   68  30.00    168  56.00   % CCL19
%
%
%=================================================================
% CD- Cape Dyer
%=================================================================
%  Crossing east west, midway between Point Hope
% and Cape Lisburne (near Cape Dyer) and trying
% to avoid some topographic irregularites just
% N of the line on the charts.
% - originally 14 stations, 2nm spacing
% - Distance 26nm
% - new in 2016
%   - ** CHECK DEPTH OF SHALLOWEST  CD1
%---------------------------------------------
% extended to the west, by angling to meet CCL20
% at the Convention line.
% - Total distance 54nm, 27 stations
%    Lat (N)     Long (W)     Name
%    deg min      deg min
%---------------------------------------------
% STARTING FROM WEST EXTENSION
%---------------------------------------------
```

```
0 0   68  40.00    168  56.0   % CCL20
%**NEW
0 0   68  39.79    168  50.6   % CD27
0 0   68  39.57    168  45.3   % CD26
0 0   68  39.36    168  39.9   % CD25
0 0   68  39.14    168  34.6   % CD24
0 0   68  38.93    168  29.2   % CD23
0 0   68  38.71    168  23.9   % CD22
0 0   68  38.50    168  18.5   % CD21
0 0   68  38.29    168  13.1   % CD20
0 0   68  38.07    168   7.8   % CD19
0 0   68  37.86    168   2.4   % CD18
0 0   68  37.64    167  57.1   % CD17
0 0   68  37.43    167  51.7   % CD16
0 0   68  37.21    167  46.4   % CD15
%---------------------------------------
%*END OF NEW, carry on with orig stations
0 0   68  37.00    167  41.0   % CD14
0 0   68  37.00    167  35.5   % CD13
0 0   68  37.00    167  29.9   % CD12
0 0   68  37.00    167  24.4   % CD11
0 0   68  37.00    167  18.8   % CD10
0 0   68  37.00    167  13.3   % CD9
0 0   68  37.00    167   7.8   % CD8
0 0   68  37.00    167   2.2   % CD7
0 0   68  37.00    166  56.7   % CD6
0 0   68  37.00    166  51.2   % CD5
0 0   68  37.00    166  45.6   % CD4
0 0   68  37.00    166  40.1   % CD3
0 0   68  37.00    166  34.5   % CD2
0 0   68  37.00    166  29.0   % CD1
%
%
%===============================================================
%  NCD - North Cape Dyer Line
%===============================================================
%  2nm near the coast NCD1-16
%  2.5nm on out to CCL21 (which is NCD 26)
%-------------------------------------------------
% Length to CCL21 is 55.4nm
%-------------------------------------------------------------
% Lat(N)   Lon  (W)   Lat (N)      Lon (W)     NAME
% decdeg  decdeg    deg     min    deg   min
 68.753 166.422     68   45.20    166   25.30  %NCD1
 68.757 166.513     68   45.39    166   30.78  %NCD2
 68.760 166.604     68   45.59    166   36.26  %NCD3
 68.763 166.696     68   45.78    166   41.74  %NCD4
 68.766 166.787     68   45.97    166   47.22  %NCD5
 68.769 166.878     68   46.17    166   52.70  %NCD6
 68.773 166.970     68   46.36    166   58.18  %NCD7
```

```
 68.776 167.061     68   46.55    167    3.66  %NCD8
 68.779 167.152     68   46.75    167    9.14  %NCD9
 68.782 167.244     68   46.94    167   14.62  %NCD10
 68.786 167.335     68   47.13    167   20.10  %NCD11
 68.789 167.426     68   47.33    167   25.58  %NCD12
 68.792 167.518     68   47.52    167   31.06  %NCD13
 68.795 167.609     68   47.71    167   36.54  %NCD14
 68.798 167.700     68   47.91    167   42.02  %NCD15
 68.802 167.792     68   48.10    167   47.50  %NCD16  2nm up to here, 2.5nm after
 68.805 167.906     68   48.29    167   54.35 %NCD17
 68.808 168.020     68   48.48    168    1.20 %NCD18
 68.811 168.134     68   48.67    168    8.05 %NCD19
 68.814 168.248     68   48.86    168   14.90 %NCD20
 68.817 168.363     68   49.05    168   21.75 %NCD21
 68.821 168.477     68   49.24    168   28.60 %NCD22
 68.824 168.591     68   49.43    168   35.45 %NCD23
 68.827 168.705     68   49.62    168   42.30 %NCD24
 68.830 168.819     68   49.81    168   49.15 %NCD25
 68.833 168.933     68   50.00    168   56.00 %NCD26
%
%
%=================================================================
% - South Bering Strait section  (NOW REPLACED BY SBSnn)
%=================================================================
% First ran in 2014 and 2015 and then only partly
% Run in full in 2017
% To catch ACC before it enters the strait
%  - 22.5nm long
%  - 21 stations including halves
%--------------------------------------------------------------
% Lat(N)   Lon  (W)       Lat (N)       Lon (W)      NAME
% decdeg  decdeg       deg     min    deg   min
 65.5818  168.1167       65        34.91    168        7.00     % SBS1 = BS24
 65.5736  168.1571       65        34.42    168        9.43     %  SBS1.5
 65.5655  168.1975       65        33.93    168       11.85     % SBS2
 65.5573  168.2379       65        33.44    168       14.28     %  SBS2.5
 65.5491  168.2784       65        32.95    168       16.70     % SBS3
 65.5409  168.3188       65        32.45    168       19.13     %  SBS3.5
 65.5327  168.3592       65        31.96    168       21.55     % SBS4
 65.5245  168.3997       65        31.47    168       23.98     %  SBS4.5
 65.5163  168.4401       65        30.98    168       26.40     % SBS5
 65.5081  168.4805       65        30.49    168       28.83     %  SBS5.5
 65.5000  168.5209       65        30.00    168       31.26     % SBS6
 65.4918  168.5614       65        29.51    168       33.68     %  SBS6.5
 65.4836  168.6018       65        29.02    168       36.11     % SBS7
 65.4754  168.6422       65        28.52    168       38.53     %  SBS7.5
 65.4672  168.6826       65        28.03    168       40.96     % SBS8
 65.4590  168.7231       65        27.54    168       43.38     %  SBS8.5
 65.4508  168.7635       65        27.05    168       45.81     % SBS9
 65.4426  168.8039       65        26.56    168       48.24     %  SBS9.5
```

```
 65.4345  168.8444      65       26.07    168      50.66    % SBS10
 65.4263  168.8848      65       25.58    168      53.09    %  SBS10.5
 65.4181  168.9252      65       25.09    168      55.51    % SBS11
%
%
%=================================================================
% - South Bering Strait section  redone - SBSnn
%=================================================================
% First ran in 2014 and 2015 and then only partly
% Run in full in 2017
% Re aligned in 2019 to start from BS22
% 2019 stations slightly off this (SBSn)
% To catch ACC before it enters the strait
%  - 22.5nm long
%  - 21 stations including halves
% Extended in 2024 to SBSnn13.5
%----------------------------------------------------------------
% Lat(N)   Lon  (W)    Lat (N)       Lon (W)     NAME
% decdeg  decdeg    deg     min    deg   min
 65.625 168.177     65   37.48    168   10.63 % SBSnn 1 = BS22
 65.614 168.215     65   36.86    168   12.87 % SBSnn 1.5
 65.604 168.252     65   36.24    168   15.12 % SBSnn 2
 65.594 168.289     65   35.62    168   17.36 % SBSnn 2.5
 65.583 168.327     65   35.00    168   19.61 % SBSnn 3
 65.573 168.364     65   34.38    168   21.85 % SBSnn 3.5
 65.563 168.402     65   33.76    168   24.09 % SBSnn 4
 65.552 168.439     65   33.14    168   26.34 % SBSnn 4.5
 65.542 168.476     65   32.52    168   28.58 % SBSnn 5
 65.532 168.514     65   31.90    168   30.83 % SBSnn 5.5
 65.521 168.551     65   31.29    168   33.07 % SBSnn 6
 65.511 168.589     65   30.67    168   35.31 % SBSnn 6.5
 65.501 168.626     65   30.05    168   37.56 % SBSnn 7
 65.490 168.663     65   29.43    168   39.80 % SBSnn 7.5
 65.480 168.701     65   28.81    168   42.05 % SBSnn 8
 65.470 168.738     65   28.19    168   44.29 % SBSnn 8.5
 65.459 168.776     65   27.57    168   46.53 % SBSnn 9
 65.449 168.813     65   26.95    168   48.78 % SBSnn 9.5
 65.439 168.850     65   26.33    168   51.02 % SBSnn 10
 65.428 168.888     65   25.71    168   53.27 % SBSnn 10.5
 65.418 168.925     65   25.09    168   55.51 % SBSnn 11
% extended in 2024
 65.408 168.965     65      24.48      168   57.89     % SBSnn 11.5
 65.385 169.039     65   23.09     169          2.33     % SBSnn 12.5
 65.360 169.109     65      21.61     169         6.55     % SBSnn 13.5  (note line ends within a few nm of the EEZ line)
```

%==
% - Baituk Creek Line (BC)
%==
% Roughly parallell to SBSnn line, but ~9nm to the east.
% Run first in 2024 at ~1.2nm resolution
% = run in 8.5hrs (with trace metal sampling) in 2024
% ~28nm
%---

% Lat(N)	Lon (W)	Lat (N)		Lon (W)			NAME
% decdeg	decdeg	deg	min	deg	min		
65.2494	168.8587	65	14.97	168	51.52	%	BC12.5
65.2602	168.8125	65	15.61	168	48.75	%	BC12
65.2686	168.7695	65	16.11	168	46.17	%	BC11.5
65.2789	168.7298	65	16.74	168	43.79	%	BC11
65.2892	168.6844	65	17.35	168	41.06	%	BC10.5
65.3003	168.6460	65	18.02	168	38.76	%	BC10
65.3096	168.6045	65	18.58	168	36.27	%	BC9.5
65.3204	168.5648	65	19.22	168	33.89	%	BC9
65.3308	168.5222	65	19.85	168	31.33	%	BC8.5
65.3417	168.4797	65	20.50	168	28.78	%	BC8
65.3517	168.4387	65	21.10	168	26.32	%	BC7.5
65.3625	168.3949	65	21.75	168	23.69	%	BC7
65.3734	168.3516	65	22.40	168	21.09	%	BC6.5
65.3829	168.3122	65	22.97	168	18.73	%	BC6
65.3934	168.2704	65	23.61	168	16.23	%	BC5.5
65.4037	168.2302	65	24.22	168	13.81	%	BC5
65.4150	168.1890	65	24.90	168	11.34	%	BC4.5
65.4257	168.1499	65	25.54	168	8.99	%	BC4
65.4373	168.1094	65	26.24	168	6.57	%	BC3.5
65.4483	168.0662	65	26.90	168	3.97	%	BC3
65.4577	168.0265	65	27.46	168	1.59	%	BC2.5
65.4660	167.9901	65	27.96	167	59.41	%	BC2
65.4784	167.9381	65	28.70	167	56.29	%	BC1.5
65.4871	167.8967	65	29.23	167	53.80	%	BC1

REFERENCES

Aagaard, K., and E. C. Carmack (1989), The role of sea ice and other fresh water in the Arctic circulation, *J. Geophys. Res.*, *94*(C10), 14485-14498, doi: 10.1029/JC094iC10p14485.

De Boer, A. M., and D. Nof (2004), The Bering Strait's grip on the northern hemisphere climate, *Deep-Sea Res., Part I*, *51*(10), 1347-1366, doi: 10.1016/j.dsr.2004.05.003.

Jakobsson, M., C.Norman, J.Woodward, R. MacNab, and B.Coakley (2000), New grid of Arctic bathymetry aids scientists and map makers, *Eos Trans.*, *81*(9), 89, 93, 96.

Østerhus, S., R. Woodgate, H. Valdimarsson, B. Turrell, L. de Steur, D. Quadfasel, S. M. Olsen, M. Moritz, C. M. Lee, K. M. H. Larsen, S. Jónsson, C. Johnson, K. Jochumsen, B. Hansen, B. Curry, S. Cunningham, and B. Berx (2019), Arctic Mediterranean exchanges: a consistent volume budget and trends in transports from two decades of observations, *Ocean Sci.*, *15*(2), 379-399, doi: 10.5194/os-15-379-2019.

Sakamoto, C. M., K. S. Johnson, and L. J. Coletti (2009), Improved algorithm for the computation of nitrate concentrations in seawater using an in situ ultraviolet spectrophotometer, *Limnology and Oceanography: Methods*, *7*(1), 132-143, doi: 10.4319/lom.2009.7.132.

Serreze, M. C., A. D. Crawford, J. Stroeve, A. P. Barrett, and R. A. Woodgate (2016), Variability, trends, and predictability of seasonal sea ice retreat and advance in the Chukchi Sea, *J. Geophys. Res. -Ocean*, 18pp, doi: 10.1002/2016jc011977.

Shimada, K., T. Kamoshida, M. Itoh, S. Nishino, E. Carmack, F. McLaughlin, S. Zimmermann, and A. Proshutinsky (2006), Pacific Ocean inflow: Influence on catastrophic reduction of sea ice cover in the Arctic Ocean, *Geophys. Res. Lett.*, *33*, L08605, doi: 10.1029/2005GL025624.

Sy, A., and H.-H. Hinrichsen (1986), The influence of long-term storage on the salinity of bottled seawater samples, *Deutsche Hydrographische Zeitschrift*, *39*, 35-40, doi: 10.1007/BF02330522.

Travers, C. S. (2012), Quantifying Sea-Ice Volume Flux using Moored Instrumentation in the Bering Strait, 85 pp, Master of Science Thesis, University of Washington, available at http://psc.apl.washington.edu/HLD.

Wadley, M. R., and G. R. Bigg (2002), Impact of flow through the Canadian Archipelago and Bering Strait on the North Atlantic and Arctic circulation: an ocean modelling study, *Quarterly Journal of the Royal Meteorological Society*, *128*(585), 2187-2203, doi: 10.1256/qj.00.35.

Walsh, J. J., C. P. McRoy, L. K. Coachman, J. J. Goering, J. J. Nihoul, T. E. Whitledge, T. H. Blackburn, P. L. Parker, C. D. Wirick, P. G. Shuert, J. M. Grebmeier, A. M. Springer, R. D. Tripp, D. A. Hansell, S. Djenidi, E. Deleersnijder, K. Henriksen, B. A. Lund, P. Andersen, F. E. Müller-Karger, and K. Dean (1989), Carbon and nitrogen cycling within the Bering/Chukchi Seas: Source regions for organic matter effecting AOU demands of the Arctic Ocean, *Prog. Oceanogr.*, *22*(4), 277-259, doi: 10.1016/0079-661(89)90006-2.

Woodgate, R. A. (2015), 25 years (1990-2015) of year-round measurements in the Bering Strait - what do we know, and what do we still NOT know?, paper presented at Arctic Observing Network Meeting, available at http://psc.apl.washington.edu/BeringStrait.html, Seattle, November 2015.

Woodgate, R. A. (2018), Increases in the Pacific inflow to the Arctic from 1990 to 2015, and insights into seasonal trends and driving mechanisms from year-round Bering Strait mooring data, *Prog. Oceanogr.*, *160*, 124-154, doi: 10.1016/.pocean.2017.12.007.

Woodgate, R. A., and K. Aagaard (2005), Revising the Bering Strait freshwater flux into the Arctic Ocean, *Geophys. Res. Lett.*, *32*(2), L02602, doi: 10.1029/2004GL021747.

Woodgate, R. A., and C. Peralta-Ferriz (2021), Warming and Freshening of the Pacific Inflow to the Arctic From 1990-2019 Implying Dramatic Shoaling in Pacific Winter Water Ventilation of the Arctic Water Column, *Geophys. Res. Lett.*, *48*(9), e2021GL092528, doi: 10.1029/2021GL092528.

Woodgate, R. A., K. Aagaard, and T. J. Weingartner (2005a), A year in the physical oceanography of the Chukchi Sea: Moored measurements from autumn 1990-1991, *Deep-Sea Res., Part II*, *52*(24-26), 3116-3149, doi: 10.1016/j.dsr2.2005.10.016.

Woodgate, R. A., K. Aagaard, and T. J. Weingartner (2005b), Monthly temperature, salinity, and transport variability of the Bering Strait throughflow, *Geophys. Res. Lett.*, *32*(4), L04601, doi: 10.1029/2004GL021880.

Woodgate, R. A., K. Aagaard, and T. J. Weingartner (2006), Interannual Changes in the Bering Strait Fluxes of Volume, Heat and Freshwater between 1991 and 2004, *Geophys. Res. Lett.*, *33*, L15609, doi: 10.1029/2006GL026931.

Woodgate, R. A., T. J. Weingartner, and R. W. Lindsay (2010), The 2007 Bering Strait Oceanic Heat Flux and anomalous Arctic Sea-ice Retreat, *Geophys. Res. Lett.*, *37*, L01602, doi: 10.1029/2009GL041621.

Woodgate, R. A., T. J. Weingartner, and R. Lindsay (2012), Observed increases in Bering Strait oceanic fluxes from the Pacific to the Arctic from 2001 to 2011 and their impacts on the Arctic Ocean water column, *Geophys. Res. Lett.*, *39*(24), 6, doi: 10.1029/2012gl054092.

Woodgate, R. A., K. M. Stafford, and F. G. Prahl (2015), A Synthesis of Year-Round Interdisciplinary Mooring Measurements in the Bering Strait (1990–2014) and the RUSALCA Years (2004–2011), *Oceanography*, *28*(3), 46-67, doi: 10.5670/oceanog.2015.57.

Woodgate, R. A., C. Peralta-Ferriz, and L. Jensen (submitted 2024), Pacific-to-Arctic oceanic nitrate fluxes: First Bering Strait overwinter nitrate time-series (2022-2023) show winter replenishment and suggest decadal flux increase, *Geophys. Res. Lett.*

% Bering Strait 2025 NORSEMAN2 log CTD

%Please fill in all data for every event (CTD/net tow) % knots (m) 0 = clear; 1= fog (m) depthwecanseeCTD

%There should be one line for the beginning of the event and one line for the end %

%Date is GMT and has the format yyyymmdd %

%Time is GMT and has the format hhmm %

%Ty=Type: 1=CTD | 2=Net tow | 4=prod cast x | 5=LaramieTM | 6=CTD w Nuts | 7=CTD w Sal | 8=CTD w Sal + Nuts | 9=Monica | 10=Bella w pump | 11=CTD w Nuts + Bella | 12=CTD w Nuts + Bella+Sal | 13=Monica and Nut | 14=Monica + Nuts + SALT

%#,Number is consecutive for that event type %

%In/out (I/O): 1=In / 2=Out %

%Dep=waterdepth(m) from Furuno readout by CTD which is depth below keel, keel is 3m (10ft)

%LatD and LatM are Latitude Degrees and Minute and are positive N %

%LonD and LonM are Longitude Degrees and Min and are positive W %

%St is the name of the station (Line ID then station number) %

% SS = CTD operator estimate of sea state (Beaufort Scale)

%WSp=wind speed in m/s; WD=Wind direction from bridge

%Op=CTD operator

% when 3 lines for NET, dep indicates wire out for net

% Altimeter = 0 if complete rubbish, 0.5 if some good readings, 1 if good both up and down

%Fill in any comments if needed. % KNOTS

%%%%%%%%%% STARTING HERE FOR 2025 AND GET A WIRE TO CLEAN PUMPS WHEN NEEDED Changeat500min SUNA BATTERY

SET LAPTOP TIME TO GMT

%Date	Time	Type	Cast NO	Down(1),Up(2)	Depth (m)	Lat (deg)	Lat (min)	Lon (deg)	Lon(min)	%	StationID	SUNA bat s/n	Min SUNA on	Total time	Windspeed	Winddir	Operator	Wave H (m)	Clear(0) or Fog(1	Water clarity	Comments
20250702	1958	1	**0**	1	0	64	29.777	165	26.238	%	NomeDock	2					RW				
20250702		1	**0**	2	0	64	29.777	165	26.238	%	NomeDock	2					RW				
20250703	226	1	**1**	1	9.5	64	32.488	166	13.333	%	Test1	2			4.6	61.6	KC	0.5	0		Fired all bottles to test for leaks. Left bottles soaking overnight.
20250703	230	1	**1**	2	9.5	64	32.505	166	13.389	%	Test1	2	4	4	4.7	63	KC	0.5	0		The clock was not synchronized to UTC until after this cast (0430 July 3) - clock behind by ~3 minutes
20250703	1617	8	**2**	1	53.7	65	46.978	168	33.963	%	A2-24 Recovery	2			7.7	287.1	KC	0.5	0	5	
20250703	1623	8	**2**	2	54.1	65	47.038	168	33.854	%	A2-24 Recovery	2	6	10	5.2	324.3	KC	0.5	0	5	Bottle 4 leaked
20250703	1819	1	**3**	1	45.3	65	44.825	168	15.51	%	A4-24 Recovery	2			16.7	95.4	KC	0.25	0		
20250703	1823	1	**3**	2	45.5	65	45.051	168	15.515	%	A4-24 Recovery	2	4	14	9.1	76.8	KC	0.25	0		Fired bottles 1-4 to test for leaks. All bottles okay
20250703	2315	6	**4**	1	54.6	66	19.691	168	56.926	%	A3-24 Recovery	2			5.4	57.6	KC	0.25	0		
20250703	2322	6	**4**	2	54.8	66	19.744	168	56.95	%	A3-24 Recovery	2	7	21	5	337.7	KC	0.25	0		
20250704	503	6	**5**	1	54.7	66	19.58	168	56.991	%	A3-25 Deployment	2			8.3	45.5	KC	0.5	0	5	
20250704	510	6	**5**	2	54.8	66	19.615	168	56.998	%	A3-25 Deployment	2	7	28	11.9	356.7	KC	0.5	0	5	
20250704	1832	6	**6**	1	52.9	65	46.921	168	34.015	%	A2-25 Deployment	2			21.6	219.5	MHJ	1	0	2	
20250704	1841	6	**6**	2	54.1	65	47	168	33.6	%	A2-25 Deployment	2	9	37	11.1	236.6	MHJ	1	0	2	S1 jellyfish at bottom, syringe clean on deck
20250704	2141	1	**7**	1	45.8	65	44.85	168	15.714	%	A4-25 Deployment	2					LH	0.5	0	3	
20250704	2151	1	**7**	2	45.4	65	45.135	168	15.233	%	A4-25 Deployment	2	10	47	19.8	197.4	LH	0.5	0	3	Practice firing bottles, no samples taken
20250704	2317	6	**8**	1	30.1	65	37.427	168	10.752	%	BS22	2			9	182.1	KC	0.25	0	3	
20250704	2323	6	**8**	2	30.8	65	37.594	168	10.886	%	BS22	2	6	53	8.5	193.6	KC	0.25	0	3	
20250704	2328	5	**1**	1	30.9	65	37.775	168	10.998	%	BS22 Laramie						rw				humpback whale feeding between here and land, many porpoise
20250704	2332	5	**1**	2	30.9	65	37.904	168	11.095	%	BS22Laramie			53			rw				Recovery depth not recorded, set to deploy depth
20250704	2344	1	**9**	1	37.4	65	38.135	168	12.979	%	BS21.5	2			6.5	142	MHJ	0.25	0	4	
20250704	2350	1	**9**	2	37.9	65	38.405	168	13.176	%	BS21.5	2	6	59	5.3	132.1	MHJ	0.25	0	4	
20250705	1	1	**10**	1	40.8	65	38.459	168	15.068	%	BS21	2			7.6	154.8	MHJ	0.5	0	5	
20250705	5	1	**10**	2	41.1	65	38.679	168	15.18	%	BS21	2	4	63	3.2	138.4	MHJ	0.5	0	5	
20250705	15	6	**11**	1	44.3	65	38.95	168	16.94	%	BS20.5	2			12.2	234.2	lh	0	0	5	
20250705	24	6	**11**	2	44.6	65	39.303	168	16.982	%	BS20.5	2	9	72	12.9	198.5	lh	0	0	5	S1 diverged from S2 syringe clean on deck. Kept going up at 10 m before bottles were fired so went back down
20250705	25	5	**2**	1	44.6	65	39.366	168	16.993	%	BS20.5 Laramie						LH				
20250705	36	5	**2**	2	45.6	65	39.775	168	17.053	%	BS20.5 Laramie			72			LH				
20250705	49	1	**12**	1	47	65	39.213	168	18.999	%	BS20	2			10.7	141.5	LH	0	0	8	
20250705	54	1	**12**	2	47.3	65	39.516	168	19.023	%	BS20	2	5	77	19.2	190.2	LH	0	0	8	
20250705	106	1	**13**	1	49.1	65	39.738	168	21.196	%	BS19.5	2			17.9	175.3	LH	0	0	8	
20250705	111	1	**13**	2	49.2	65	39.966	168	21.219	%	BS19.5	2	5	82	17.4	144.4	LH	0	0	8	
20250705	121	6	**14**	1	50.4	65	40.217	168	23.376	%	BS19	2			18.5	175.3	LH	0	0	8	
20250705	129	6	**14**	2	50.6	65	40.582	168	23.332	%	BS19	2	8	90	19.4	197.3	LH	0	0	8	
20250705	130	5	**3**	1	50.8	65	40.645	168	23.327	%	BS19 Laramie						LH				
20250705	137	5	**3**	2	51.2	65	40.95	168	23.274	%	BS19 Laramie			90			LH				
20250705	154	1	**15**	1	51.3	65	40.65	168	25.255	%	BS18.5	2			10.1	176.5	LH	0	0	6	
20250705	158	1	**15**	2	51.6	65	40.84	168	25.226	%	BS18.5	2	4	94	1.5	295.7	LH	0	0	6	
20250705	208	1	**16**	1	52.1	65	41.165	168	26.831	%	BS18	2			15.8	235.4	LH	0	0	6	
20250705	213	1	**16**	2	52	65	41.335	168	26.739	%	BS18	2	5	99	3.2	209.1	LH	0	0	6	S1 jellyfish, syringe clean on deck
20250705	224	6	**17**	1	52.9	65	41.597	168	29.138	%	BS17.5	2			10.3	272	LH	0	0	5	
20250705	232	6	**17**	2	52.4	65	41.744	168	29.108	%	BS17.5	2	8	107	13.2	258.4	LH	0	0	5	S1 and S2 jellyfish; both systems flushed
20250705	234	5	**4**	1	52.5	65	41.791	168	29.083	%	BS17.5 Laramie						LH				
20250705	241	5	**4**	2	52.4	65	41.943	168	28.997	%	BS17.5 Laramie			107			LH				
20250705		1	**18**	1	53.3	65	42.067	168	31.262	%	BS17	2			10	206	RW	0	0	6	Bottle 5 leaked - top misalighned
20250705	258	1	**18**	2	52.5	65	42.208	168	31.1	%	BS17	2		107	7	176	RW	0	0	6	
20250705	309	1	**19**	1	50.7	65	42.679	168	33.34	%	BS16.5	2			9	198	RW	0	0	5	t2 & s2 way off on both up and down;, but t1 and s1 ok so no recast; typo in recovery position - replaced 2 with 42
20250705	314	1	**19**	2	50.7	65	42.793	168	33.312	%	BS16.5	2	5	112	7.5	215	rw	0	0	5	flushed both systems
20250705	327	6	**20**	1	50.2	65	43.198	168	35.246	%	BS16	2			9	239	rw	0	0	4	
20250705	335	6	**20**	2	50	65	43.363	168	35.116	%	BS16	2	8	120	5	252	RW	0	0	4	Big jelly on ctd on recovery; flushed both systems as salinity slighly dubious but agrees
20250705	338	5	**5**	1	50	65	43.426	168	35.061	%	BS16 Laramie						rw				
20250705	352	5	**5**	2	50.3	65	43.718	168	34.89	%	BS16 Laramie			120			rw				
20250705	407	1	**21**	1	50.2	65	43.755	168	37.6	%	BS15.5	2			7.5	166.2	lh				
20250705	410	1	**21**	2	50.2	65	43.805	168	37.581	%	BS15.5	2	3	123	7.3	170.8	lh				cast aborted as T1 and T2 0.5 deg different, flushed both system
20250705	415	1	**22**	1	50.5	65	43.894	168	37.523	%	BS15.5	2			10.9	147.7	lh	0	0	5	
20250705	420	1	**22**	2	50.3	65	43.979	168	37.452	%	BS15.5	2	5	128	10.4	101.2	lh	0	0	5	Jellyfish on CTD at surface, so long pause at surface
20250705	432	1	**23**	1	49.8	65	44.221	168	39.804	%	BS15	2			8.2	151.9	lh	0	0	5	
20250705	438	1	**23**	2	50.4	65	44.327	168	39.741	%	BS15	2	6	134	8.3	116.2	lh	0	0	5	
20250705	448	6	**24**	1	50.5	65	44.704	168	41.542	%	BS14.5	2			10.7	156.1	lh	0	0	5	
20250705	458	6	**24**	2	50.5	65	44.886	168	41.462	%	BS14.5	2	10	144	7.6	180.9	lh	0	0	5	
20250705	500	5	**6**	1	50.6	65	44.925	168	41.453	%	BS14.5 Laramie						lh				
20250705	508	5	**6**	2	50.7	65	44.072	168	41.398	%	BS14.5 Laramie			144			lh				
20250705	520	1	**25**	1	51	65	44.188	168	43.309	%	BS14	2			8.2	168.5	KC	0	0	5	
20250705	525	1	**25**	2	51.3	65	44.282	168	43.305	%	BS14	2	5	149	7.2	217.5	KC	0	0	5	
20250705	536	1	**26**	1	51.4	65	45.715	168	45.485	%	BS13.5	2			6.3	92.4	KC	0	0	3	

20250705	540	1	**26**	2	51.1	65	45.802	168	45.472 %	BS13.5	2	4	153	1.8	162.1	KC	0	0	3	
20250705	551	6	**27**	1	50.3	65	46.19	168	47.627 %	BS13	2			7.5	134	KC	0	0	2	Bottle 5 leaked.
20250705	558	6	**27**	2	50.6	65	46.304	168	47.445 %	BS13	2	9	162	11	29.7	KC	0	0	2	
20250705	601	5	**7**	1	50.5	65	46.343	168	47.393 %	BS13 Laramie						KC				
20250705	607	5	**7**	2	50.1	65	46.484	168	47.235 %	BS13 Laramie			162			KC				
20250705	623	1	**28**	1	48	65	46.735	168	49.652 %	BS12.5	2			3.2	168	ACPF	0	0	3	
20250705	627	1	**28**	2	48.2	65	46.827	168	49.579 %	BS12.5	2	4	166	15	25	ACPF				
20250705	638	1	**29**	1	42.7	65	47.134	168	51.687 %	BS12	2			5.3	219	ACPF	0	0	4.5	
20250705	641	1	**29**	2	42.7	65	47.173	168	51.692 %	BS12	2	3	169	4	148	ACPF				
20250705	652	6	**30**	1	45.7	65	47.678	168	53.755 %	BS11.5	2			6	238	ACPF	0	0	4.5	Bottle 5 leaked again.
20250705	659	6	**30**	2	45.8	65	47.588	168	53.643 %	BS11.5	2	7	176	6.8	303	ACPF				
20250705	701	5	**8**	1	45.5	65	47.544	168	53.634 %	BS11.5 Laramie						ACPF				
20250705	709	5	**8**	2	45.6	65	47.418	168	53.596 %	BS11.5 Laramie			176			ACPF				
20250705	725	1	**31**	1	45.5	65	48.336	168	55.929 %	BS11	2			4	142	ACPF			3	
20250705	729	1	**31**	2	45.8	65	48.451	168	55.797 %	BS11	2	4	180	7	16	ACPF				End of BS line.
20250705	738	6	**32**	1	46	65	49.185	168	56.094 %	DL1	2			12	51	ACPF	0		4	Bottle 5 leaked again. Start of DL line.
20250705	744	6	**32**	2	46	65	49.242	168	56.019 %	DL1	2	6	186	9.5	60	ACPF				
20250705	758	1	**33**	1	45.6	65	50.167	168	56.188 %	DL2	2			5.6	327	ACPF	0		4.5	
20250705	802	1	**33**	2	45.6	65	50.175	168	56.26 %	DL2	2	4	190	8.1	263	ACPF				
20250705	813	1	**34**	1	46.2	65	51.157	168	56.186 %	DL3	2			6.9	358	ACPF	0		4	
20250705	817	1	**34**	2	46.5	65	51.142	168	56.259 %	DL3	2	4	194	5	326	ACPF				
20250705	828	6	**35**	1	47	65	52.083	168	56.081 %	DL4	2			4.7	209	ACPF	0	0	4.5	Bottle 5 and 12 leaked. Surface sample taken from bucket
20250705	836	6	**35**	2	47	65	52.038	168	55.93 %	DL4	2	8	202	7.3	179	ACPF				
20250705	859	1	**36**	1	46.1	65	53.099	168	56.027 %	DL5	2			6	212	ACPF	0	0	3	
20250705	906	1	**36**	2	46	65	53.095	168	55.894 %	DL5	2	7	209	5	224	ACPF	0		3	
20250705	916	1	**37**	1	47	65	54.154	168	56.124 %	DL6	2			7.7	281	ACPF		0	5	
20250705	921	1	**37**	2	47	65	54.167	168	56.065 %	DL6	2	5	214	8.5	330	ACPF				
20250705	931	6	**38**	1	47.4	65	55.161	168	56.234 %	DL7	2			7.5	279	ACPF	0	0	3.5	
20250705	939	6	**38**	2	47.4	65	55.158	168	56.196 %	DL7	2	8	222	9	338	ACPF				
20250705	1000	1	**39**	1	48.1	65	56.15	168	56.121 %	DL8	2			5	335	ACPF	0	1	3.5	
20250705	1005	1	**39**	2	48.3	65	56.18	168	56.092 %	DL8	2	5	227	5	335	ACPF				
20250705	1015	1	**40**	1	49.1	65	57.107	168	56.241 %	DL9	2			3	211	ACPF	0	1	5	
20250705	1020	1	**40**	2	49.2	65	57.18	168	56.179 %	DL9	2	5	232	4.5	332	ACPF				
20250705	1029	6	**41**	1	50.1	65	58.087	168	56.225 %	DL10	2			6.5	325	ACPF	0	1	4.5	
20250705	1036	6	**41**	2	50.1	65	58.162	168	56.138 %	DL10	2	7	239	5	280	ACPF				
20250705	1054	1	**42**	1	50.5	65	59.054	168	56.157 %	DL11	2			5.4	289	ACPF	0	0	5	
20250705	1059	1	**42**	2	50.4	65	59.111	168	56.073 %	DL11	2	5	244	1	217	ACPF				
20250705	1108	1	**43**	1	50.8	66	0.014	168	56.211 %	DL12	2			5	310	ACPF	0	0	4	
20250705	1113	1	**43**	2	50.8	66	0.073	168	56.1 %	DL12	2	5	249	12	322	ACPF				
20250705	1124	6	**44**	1	50.3	66	1.292	168	56.229 %	DL12.5	2			6	310	ACPF	0	0	4	Bottles 5, 12, 10 and 11 leaking, but 10m sample still taken from 11 (leak at bottom once spigot&valve open)
20250705	1131	6	**44**	2	50.2	66	1.358	168	56.16 %	DL12.5	2	7	256	13	328	ACPF				whereas bottle 10 leaked from the start (when pushing spiget in).
20250705	1149	1	**45**	1	51.2	66	2.545	168	56.139 %	DL13	2			3	100	ACPF	0	0	4	
20250705	1154	1	**45**	2	51.2	66	2.62	168	56.108 %	DL13	2	5	261	7	45	ACPF				
20250705	1205	1	**46**	1	51.5	66	3.826	168	56.233 %	DL13.5	2			8	290	ACPF	0	0	5	
20250705	1210	1	**46**	2	51.8	66	3.859	168	56.123 %	DL13.5	2	5	266	6	301	ACPF				
20250705	1222	6	**47**	1	53.1	66	5.098	168	56.221 %	DL14	2			8	300	ACPF	0	0	5	Bottles 5, 10, 11, 12 leaking. Bottle 12 came up EMPTY!
20250705	1228	6	**47**	2	52.8	66	5.165	168	56.041 %	DL14	2	6	272	5	130	ACPF				
20250705	1244	1	**48**	1	53	66	6.345	168	56.133 %	DL14.5	2			4	154	ACPF	0	0	5	
20250705	1249	1	**48**	2	53.2	66	6.416	168	56.008 %	DL14.5	2	5	277	5	292	ACPF				
20250705	1301	1	**49**	1	52.8	66	7.679	168	56.246 %	DL15	2			6	314	ACPF	0	0	6	
20250705	1305	1	**49**	2	52.7	66	7.716	168	56.188 %	DL15	2	4	281	7	296	ACPF				
20250705	1316	6	**50**	1	52.8	66	8.924	168	56.202 %	DL15.5	2			9	306	ACPF	0	0	6	Bottle 5, 11 and 12 leaked. 12 comes up EMPTY. Bottle 10 was good!
20250705	1323	6	**50**	2	53.2	66	9.004	168	56.194 %	DL15.5	2	7	288	12	338	ACPF				
20250705	1340	1	**51**	1	53.5	66	10.195	168	56.292 %	DL16	2			2	235	ACPF	0	0	5	
20250705	1345	1	**51**	2	53.4	66	10.268	168	56.313 %	DL16	2	5	293	5	277	ACPF				
20250705	1356	1	**52**	1	54.4	66	11.47	168	56.208 %	DL16.5	2			11	283	ACPF	0	0	5	
20250705	1401	1	**52**	2	54.4	66	11.507	168	56.154 %	DL16.5	2	5	298	9	270	ACPF				
20250705	1412	6	**53**	1	55.6	66	12.742	168	56.218 %	DL17	2			8.5	274	ACPF	0	0	3	
20250705	1419	6	**53**	2	55.6	66	12.804	168	56.229 %	DL17	2	7	305	13	311	ACPF				
20250705	1435	1	**54**	1	55	66	13.984	168	56.266 %	DL17.5	2			7	284	ACPF	0	0	4	
20250705	1441	1	**54**	2	55.2	66	14.034	168	56.275 %	DL17.5	2	6	311	15	305	ACPF				
20250705	1452	1	**55**	1	55.9	66	15.26	168	56.224 %	DL18	2			16	302	ACPF	0	0	4	
20250705	1457	1	**55**	2	56	66	15.278	168	56.267 %	DL18	2	5	316	13	315	ACPF				
20250705	1510	6	**56**	1	55.3	66	16.551	168	56.21 %	DL18.5	2			14.2	305.5	KC	0	0	3	
20250705	1518	6	**56**	2	55.3	66	16.606	168	56.344 %	DL18.5	2	8	324	13.9	318.6	KC	0	0	3	Bottle 12 fixed, but deployed without bottle 5 for repairs. Line slack at bottom (though depth>echosounder. Hit bottom?
20250705	1535	1	**57**	1	55	66	17.813	168	56.068 %	DL19	2			12.7	358.6	MHJ	0	0	3	
20250705	1541	1	**57**	2	54.9	66	17.889	168	56.174 %	DL19	2	6	330	14.4	356	MHJ	0	0	3	
20250705	1549	1	**58**	1	55	66	18.646	168	55.923 %	DL19.5	2			13.3	307.6	MHJ	0	0	3	
20250705	1554	1	**58**	2	55	66	18.678	168	55.949 %	DL19.5	2	5	335	13.7	332	MHJ	0	0	3	Sent 11 removed and replaced, testing to see if all repairs work next cast
20250705	1604	6	**59**	1	54.7	66	19.626	168	56.728 %	A3-25	2			14.8	327.7	MHJ	0	0	3	Processing shows S2 bad on the way up (not noticed at time, thus cast 60 also bad)
20250705	1613	6	**59**	2	54.7	66	19.718	168	56.869 %	A3-25	2	9	344	9.5	41.1	MHJ	0	0	3	All bottles good. End of DL line and Start of AL line
20250705	1628	6	**60**	1	54.8	66	20.077	168	55.147 %	AL12.5	2			6.2	48.6	MHJ	0	0	3	0.5psu offset in S1:S2, byt deployed anyway.
20250705	1638	6	**60**	2	54.8	66	20.2	168	55.211 %	AL12.5	2	10	354	4.2	291.7	MHJ	0	0	3	Post cast, jellyfish found on flushing S2 with syringe. All bottles ok except 12 (seated incorrectly)
20250705	1640	5	**9**	1	54.7	66	20.211	168	55.218 %	AL12.5 Laramie						MHJ				
20250705	1646	5	**9**	2	54.5	66	20.26	168	55.233 %	AL12.5 Laramie			354			MHJ				
20250705	1658	1	**61**	1	54.8	66	20.295	168	53.791 %	AL13	2			13.9	344	MHJ	0	0	3	
20250705	1704	1	**61**	2	54.5	66	20.36	168	53.95 %	AL13	2	6	360	14.4	364.4	MHJ	0	0	3	
20250705	1716	1	**62**	1	53.4	66	20.69	168	51.44 %	AL13.5	2			14.9	337.4	MHJ	0	0	3	
20250705	1721	1	**62**	2	52.6	66	20.725	168	51.612 %	AL13.5	2	5	365	16.3	20.2	MHJ	0	0	3	
20250705	1732	6	**63**	1	53.5	66	21.064	168	49.384 %	AL14	2			14.1	331.2	MHJ	0	0	4	
20250705	1740	6	**63**	2	53.7	66	21.131	168	49.643 %	AL14	2	8	373	12.7	356.2	MHJ	0	0	4	
20250705	1742	5	**10**	1	53.6	66	21.155	168	49.695 %	AL14 Laramie						MHJ				
20250705	1749	5	**10**	2	53.6	66	21.26	168	49.876 %	AL14 Laramie			373			MHJ				
20250705	1806	1	**64**	1	53.8	66	21.411	168	47.281 %	AL14.5	2			8.9	315.9	MHJ	0	0	3	
20250705	1811	1	**64**	2	53.5	66	21.439	168	47.476 %	AL14.5	2	5	378	10.1	25.3	MHJ	0	0	3	Increase winch speed on descent
20250705	1822	1	**65**	1	46	66	21.772	168	45.114 %	AL15	2			9.6	296.3	MHJ	0	0	4	

20250705	1826	1	**65**	2	46.3	66	21.778	168	45.237	**%**	AL15	2	4	382	9.1	304.8	MHJ	0	0	4	
20250705	1836	6	**66**	1	51.2	66	22.144	168	42.795	**%**	AL15.5	2			4.7	239.3	MHJ	0	0	4	
20250705	1842	6	**66**	2	50.9	66	22.28	168	42.737	**%**	AL15.5	2	6	388	7.4	26.6	MHJ	0	0	4	
20250705	1844	5	**11**	1	50.4	66	22.303	168	42.757	**%**	AL15.5 Laramie						MHJ				
20250705	1850	5	**11**	2	50	66	22.415	168	42.847	**%**	AL15.5 Laramie			388			MHJ				
20250705	1859	1	**67**	1	55.9	66	22.483	168	40.938	**%**	AL16	2			10	337.4	MHJ	0	0	4	
20250705	1903	1	**67**	2	56.1	66	22.556	168	41.009	**%**	AL16	2	4	392	4.8	344.8	MHJ	0	0	4	
20250705	1913	1	**68**	1	55.2	66	22.861	168	38.468	**%**	AL16.5	2			4.5	1.5	MHJ	0	0	4	
20250705	1917	1	**68**	2	55.8	66	22.963	168	38.488	**%**	AL16.5	2	4	396	5.1	345.4	MHJ	0	0	4	
20250705	1926	6	**69**	1	54.2	66	23.19	168	36.455	**%**	AL17	2			5.3	354	MHJ	0	0	4	
20250705	1932	6	**69**	2	54.2	66	23.343	168	36.535	**%**	AL17	2	6	402	7	23.4	MHJ	0	0	4	Typo in recover position - corrected to 26.35 from 36.535
20250705	1933	5	**12**	1	54.2	66	23.355	168	36.533	**%**	AL17 Laramie						MHJ				
20250705	1939	5	**12**	2	53.8	66	23.458	168	36.58	**%**	AL17 Laramie			402			MHJ				
20250705	1949	1	**70**	1	53.4	66	23.526	168	34.698	**%**	AL17.5	2			8.2	4.7	MHJ	0	0	4	
20250705	1953	1	**70**	2	53.4	66	23.601	168	34.767	**%**	AL17.5	2	4	406	4.8	10.5	MHJ	0	0	4	
20250705	2004	1	**71**	1	52	66	23.884	168	32.106	**%**	AL18	2			2.4	195.4	MHJ	0	0	4	
20250705	2008	1	**71**	2	51.8	66	23.961	168	31.96	**%**	AL18	2	4	410	3.5	199.9	MHJ	0	0	4	
20250705	2016	6	**72**	1	52.1	66	24.218	168	30.035	**%**	AL18.5	2			7.1	9.6	MHJ	0	0	4	
20250705	2023	6	**72**	2	52.1	66	24.353	168	30.155	**%**	AL18.5	2	7	417	12.4	355.8	MHJ	0	0	4	
20250705	2025	5	**13**	1	52.2	66	24.39	168	30.173	**%**	AL18.5 Laramie						MHJ				
20250705	2031	5	**13**	2	52.2	66	24.467	168	30.223	**%**	AL18.5 Laramie			417			MHJ				Typo in recover position - corrected to 30 from 20
20250705	2044	1	**73**	1	52.6	66	24.544	168	27.696	**%**	AL19	2			3	245	rw	0	0	6	wait at surface for jelly to clear, during which 5m temperature drops ~4deg!
20250705	2049	1	**73**	2	52.7	66	24.62	168	27.549	**%**	Al19	2	5	422	0.2	215	rw	0	0	6	
20250705	2058	1	**74**	1	51.7	66	24.875	168	25.557	**%**	AL19.5	2			6	277	rw	0	0	6	
20250705	2101	1	**74**	2	51.6	66	24.914	168	25.429	**%**	AL19.5	2	3	425	3	100	rw	0	0	6	
20250705	2110	6	**75**	1	51.5	66	25.265	168	23.464	**%**	AL20	2			8	306.3	KC	0	0	6	
20250705	2115	6	**75**	2	51.6	66	25.259	168	23.35	**%**	AL20	2	5	430	1	87	KC	0	0	6	Bottles 1, 3, and 12 leaked. Sampled from 2, 4 and 12 (since surface)
20250705	2117	5	**14**	1	51.6	66	25.282	168	23.323	**%**	AL20 Laramie						KC				
20250705	2123	5	**14**	2	51.5	66	25.37	168	23.328	**%**	AL20 Laramie			430			KC				
20250705	2133	1	**76**	1	50.3	66	25.598	168	21.359	**%**	AL20.5				7.7	304.1	KC	0	0	6	
20250705	2137	1	**76**	2	50.3	66	25.628	168	21.435	**%**	AL20.5	2	4	434	10.4	51.9	KC	0	0	6	
20250705	2147	1	**77**	1	46.8	66	26.044	168	19.107	**%**	AL21				3.9	247.5	KC	0	0	7	
20250705	2150	1	**77**	2	46.6	66	26.116	168	18.997	**%**	AL21	2	3	437	2.8	191.1	KC	0	0	7	
20250705	2158	6	**78**	1	42.8	66	26.357	168	17.001	**%**	AL21.5				10.4	320.4	KC	0	0	7	
20250705	2203	6	**78**	2	42.8	66	26.451	168	17.09	**%**	AL21.5	2	5	442	10.3	354.4	KC	0	0	7	All bottles good - note: do not over tighten the white valve stopper
20250705	2205	5	**15**	1	42.6	66	26.508	168	17.108	**%**	AL21.5 Laramie						KC				
20250705	2211	5	**15**	2	42.4	66	26.664	168	17.09	**%**	AL21.5 Laramie			442			KC				
20250705	2222	1	**79**	1	39.6	66	26.788	168	14.881	**%**	AL22				5.1	36.1	KC	0	0	8	
20250705	2225	1	**79**	2	39.4	66	26.891	168	14.879	**%**	AL22	2	3	445	3.9	41	KC	0	0	8	
20250705	2234	1	**80**	1	36.4	66	27.067	168	12.77	**%**	AL22.5				13.5	330.8	KC	0	0	8	
20250705	2237	1	**80**	2	36.3	66	27.156	168	12.829	**%**	AL22.5	2	3	448	14	343.6	KC	0	0	8	
20250705	2247	6	**81**	1	32	66	27.413	168	10.414	**%**	AL23				9.4	305.8	KC	0	0	5	
20250705	2251	6	**81**	2	31.8	66	27.458	168	10.296	**%**	AL23	2	4	452	8.2	331.8	KC	0	0	5	
20250705	2252	5	**16**	1	31.6	66	27.475	168	10.253	**%**	AL23 Laramie						KC				
20250705	2258	5	**16**	2	30.9	66	27.62	168	10.043	**%**	AL23 Laramie			452			KC				
20250705	2306	1	**82**	1	28.6	66	27.712	168	8.652	**%**	AL23.5				13.7	323.5	KC	0	0	5	
20250705	2309	1	**82**	2	28.6	66	27.742	168	8.643	**%**	AL23.5	2	3	455	13.1	330.2	KC	0	0	5	
20250705	2319	1	**83**	1	26	66	28.05	168	6.203	**%**	AL24				8.4	300.5	KC	0	0	5	
20250705	2322	1	**83**	2	25.9	66	28.064	168	6.072	**%**	AL24	2	3	458	2.8	9.5	KC	0	0	5	Jellyfish caught in S2 on the upcast, syringed clean on deck; Ox 2 also problematic all cast
20250705	2330	1	**84**	1	23.9	66	28.424	168	4.093	**%**	AL24.5				8.4	303.3	KC	0	0	4	
20250705	2332	1	**84**	2	23.8	66	28.421	168	3.988	**%**	AL24.5	2	2	460	7.7	323	KC	0	0	4	Ox 2 problematic all cast (not noticed at the time)
20250705	2341	6	**85**	1	22.4	66	28.771	168	1.932	**%**	AL25				10.5	305.7	KC	0	0	4	
20250705	2344	6	**85**	2	22.4	66	28.743	168	1.854	**%**	AL25	2	3	463	15.6	322.3	KC	0	0	4	
20250705	2346	5	**17**	1	22.4	66	28.74	168	1.833	**%**	AL25 Laramie						KC				
20250705	2351	5	**17**	2	22.3	66	28.745	168	1.758	**%**	AL25 Laramie			463			KC				
20250706	0	1	**86**	1	21.6	66	29.051	167	59.895	**%**	AL25.5				14.7	321.6	KC	0	0	4	
20250706	3	1	**86**	2	21.7	66	29.013	167	59.891	**%**	AL25.5	2	3	466	14.9	336.6	KC	0	0	4	
20250706	14	1	**87**	1	21.4	66	29.469	167	57.623	**%**	AL26				9.1	310.1	KC	0	0	6	
20250706	16	1	**87**	2	21.3	66	29.432	167	57.59	**%**	AL26	2	2	468	15.4	326.7	KC	0	0	6	
20250706	26	1	**88**	1	21.4	66	29.81	167	55.56	**%**	AL26.5				7.9	320.6	KC	0	0	6	
20250706	29	1	**88**	2	21.4	66	29.791	167	55.536	**%**	AL26.5	2	3	471	13.1	327.1	KC	0	0	6	
20250706	39	1	**89**	1	21.7	66	30.129	167	53.309	**%**	AL27				8.1	314.3	KC	0	0	5	Strange temperature structure (subsurface local Tmax)
20250706	42	1	**89**	2	21.7	66	30.1	167	53.248	**%**	AL27	2	3	474	7.8	308.2	KC	0	0	5	
20250706	52	1	**90**	1	21.9	66	30.448	167	51.147	**%**	AL27.5				8.7	309.1	KC	0	0	5	
20250706	54	1	**90**	2	21.9	66	30.423	167	51.108	**%**	AL27.5	2	2	476	14.2	333.2	KC	0	0	5	End of AL line. Closed all bottles so they can soak. No samples taken.
20250706	531	9	**91**	1	54.8	66	19.692	168	57	**%**	A3-25 mooring				13.9	356.1	LH	0	0	3.5	
20250706	540	9	**91**	2	54.8	66	19.816	168	57.223	**%**	A3-25 mooring	2	9	485	14.1	17.8	LH	0	0	3.5	Monica sampling (40m - below, 20m - in Chl, surface - above). Change SUNA battery now.
20250706	1304	1	**92**	1	46	65	48.388	168	55.72	**%**	BS11				5	305	ACPF	0	0	4	
20250706	1310	1	**92**	2	46	65	48.443	168	55.519	**%**	BS11	1	6	6	6	308	ACPF				
20250706	1320	1	**93**	1	45.8	65	47.765	168	53.825	**%**	BS11.5				1.5	353	ACPF	0	0	4	
20250706	1325	1	**93**	2	46.3	65	47.776	168	53.714	**%**	BS11.5	1	5	11	1.5	0	ACPF				
20250706	1327	5	**18**	1	46.3	65	47.776	168	53.678	**%**	BS11.5						ACPF				
20250706	1333	5	**18**	2	46.2	65	47.773	168	53.62	**%**	BS11.5			11			ACPF				
20250706	1345	1	**94**	1	43.2	65	47.2	168	51.631	**%**	BS12				4	342	ACPF	0	0	5	
20250706	1349	1	**94**	2	43.3	65	47.164	168	51.577	**%**	BS12	1	4	15	4	13	ACPF				
20250706	1358	1	**95**	1	48.1	65	46.773	168	49.593	**%**	BS12.5				19	343	ACPF	0	0	4	
20250706	1403	1	**95**	2	48	65	46.801	168	49.545	**%**	BS12.5	1	5	20	17	352	ACPF				
20250706	1413	1	**96**	1	51.1	65	46.297	168	47.734	**%**	BS13				16	345	ACPF	0	0	3	NB hi oxygen in surface layer
20250706	1418	1	**96**	2	50.9	65	46.327	168	47.815	**%**	BS13	1	5	25	18	356	ACPF				
20250706	1420	5	**19**	1	50.7	65	46.342	168	47.816	**%**	BS13						ACPF				
20250706	1426	5	**19**	2	50.8	65	46.394	168	47.765	**%**	BS13			25			ACPF				
20250706	1439	1	**97**	1	51.1	65	45.787	168	45.619	**%**	BS13.5				12	341	ACPF	0	0	3	Temps a bit different at times. After cast we flushed both sensors. NB high oxygen in surface layer
20250706	1444	1	**97**	2	51.3	65	45.838	168	45.694	**%**	BS13.5	1	5	30	13	354	ACPF				
20250706	1457	9	**98**	1	51.1	65	45.252	168	43.338	**%**	BS14				15.7	336.7	MHJ	0.5	0	4	
20250706	1505	9	**98**	2	51.3	65	45.345	168	43.239	**%**	BS14	1	8	38	16.5	315.5	MHJ	0.5	0	4	
20250706	1519	1	**99**	1	50.7	65	44.767	168	41.722	**%**	BS14.5				10.6	359.2	MHJ	0	0	4	On way up, cutting cable loose wires

20250706	1542	1	**99**	2	50.6	65	45.007	168	41.386	%	BS14.5	1	23	61	6.4	299.5	MHJ	0	0	4	5 m 2 bottles for Laramie
20250706	1543	5	**20**	1	50.6	65	45.021	168	41.368	%	BS14.5 Laramie						MHJ				
20250706	1550	5	**20**	2	50.7	65	45.091	168	41.269	%	BS14.5 Laramie			61			MHJ				
20250706	1603	9	**100**	1	50.6	65	44.192	168	39.939	%	BS15				13.9	338.9	MHJ	0.5	0	4	jellyfish
20250706	1611	9	**100**	2	50.1	65	44.325	168	40.12	%	BS15	1	8	69	9.4	45.8	MHJ	0.5	0	4	
20250706	1625	9	**101**	1	50.3	65	43.741	168	37.67	%	BS15.5				14.4	339.1	MHJ	0	0	6	bottle 5 leaked, jellyfish
20250706	1633	9	**101**	2	50.2	65	43.823	168	37.797	%	BS15.5	1	8	77	14.1	343	MHJ	0	0	6	
20250706	1645	1	**102**	1	50.1	65	43.22	168	35.362	%	BS16				14.9	343.1	MHJ	0	0	6	jellyfish; v warm fresh thin surface layer
20250706	1649	1	**102**	2	50.3	65	43.262	168	35.445	%	BS16	1	4	81	13.4	14.8	MHJ	0	0	6	
20250706	1650	5	**21**	1	50.2	65	43.284	168	35.451	%	BS16 Laramie						MHJ				
20250706	1656	5	**21**	2	50.4	65	43.396	168	35.44	%	BS16 Laramie			81			MHJ				
20250706	1710	7	**103**	1	50.8	65	42.712	168	33.395	%	BS16.5				13.4	352.5	MHJ	0	0	6	v thin warm fresh surface layer
20250706	1714	7	**103**	2	50.8	65	42.796	168	33.51	%	BS16.5	1	4	85	14.9	18.2	MHJ	0	0	6	
20250706	1726	1	**104**	1	53.1	65	42.175	168	31.166	%	BS17				13.5	344	MHJ	0	0	9	
20250706	1730	1	**104**	2	54.1	65	42.227	168	31.28	%	BS17	1	4	89	12.4	1.6	MHJ	0	0	9	
20250706	1742	1	**105**	1	52.6	65	41.617	168	29.032	%	BS17.5				12.8	355.4	MHJ	0	0	9	
20250706	1748	1	**105**	2	52.3	65	41.724	168	29.176	%	BS17.5	1	6	95	14.5	12.7	MHJ	0	0	9	
20250706	1749	5	**22**	1	52.1	65	41.759	168	29.181	%	BS17.5 Laramie						MHJ				
20250706	1755	5	**22**	2	52.2	65	41.869	168	29.165	%	BS17.5 Laramie			95			MHJ				
20250706	1810	1	**106**	1	51.2	65	41.05	168	26.725	%	BS18				12	349.6	MHJ	0	0	9	
20250706	1815	1	**106**	2	52.7	65	41.194	168	26.884	%	BS18	1	5	100	16.5	33.4	MHJ	0	0	9	
20250706	1826	1	**107**	1	51.6	65	40.664	168	25.138	%	BS18.5				13.9	343.4	MHJ	0.5	0	9	waited for swarm of jellyfish
20250706	1832	1	**107**	2	51.9	65	40.838	168	25.296	%	BS18.5	1	6	106	17.5	45.7	MHJ	0.5	0	9	
20250706	1845	1	**108**	1	50.9	65	40.3	168	23.449	%	BS19				14.4	351.6	MHJ	0.5	0	9	
20250706	1851	1	**108**	2	51.4	65	40.482	168	23.602	%	BS19	1	6	112	14.3	20.1	MHJ	0.5	0	9	
20250706	1852	5	**23**	1	51.4	65	40.13	168	23.6	%	BS19 Laramie						MHJ				
20250706	1859	5	**23**	2	51.5	65	40.725	168	23.626	%	BS19 Laramie			112			MHJ				
20250706	1916	1	**109**	1	49.1	65	39.748	168	21.139	%	BS19.5				14.7	336.2	MHJ	0.5	0	9	
20250706	1920	1	**109**	2	49.2	65	39.866	168	21.326	%	BS19.5	1	4	116	16	41.7	MHJ	0.5	0	9	
20250706	1934	1	**110**	1	47.1	65	39.242	168	18.98	%	BS20				12.5	345	MHJ	0.5	0	9	
20250706	1938	1	**110**	2	47.6	65	39.379	168	19.179	%	BS20	1	4	120	14.2	11.6	MHJ	0.5	0	9	retape wire, left station at 1945
20250706	1958	1	**111**	1	44.3	65	38.826	168	16.882	%	BS20.5				13.8	325.5	MHJ	0.5	0	9	
20250706	2003	1	**111**	2	44.8	65	38.96	168	17.075	%	BS20.5	1	5	125	15	347.7	MHJ	0.5	0	9	
20250706	2005	5	**24**	1	44.9	65	39.004	168	17.103	%	BS20.5 Laramie						MHJ				
20250706	2011	5	**24**	2	45.2	65	39.208	168	17.158	%	BS20.5 Laramie			125			MHJ				
20250706	2027	1	**112**	1	40.6	65	38.429	168	14.944	%	BS21				13.8	330	rw	0	0	7	
20250706	2031	1	**112**	2	41	65	38.484	168	15.129	%	BS21	1	4	129	12.7	330	rw	0	0	7	both systems off on upcast. Flushed once back on deck.
20250706	2046	1	**113**	1	37.4	65	37.994	168	12.841	%	BS21.5				15	353	rw	0	0	7	
20250706	2049	1	**113**	2	37.6	65	38.089	168	12.99	%	BS21.5	1	3	132	15.9	346	rw	0	0	7	both systems off on upcast. Flushed once back on deck.
20250706	2103	1	**114**	1	29.8	65	37.431	168	10.586	%	BS22				14.7	340	KC	0.5	0	6	
20250706	2107	1	**114**	2	30.9	65	37.482	168	10.819	%	BS22	1	4	136	14.1	352.1	KC	0.5	0	6	End of BS line. Start of SBSnn line
20250706	2108	5	**25**	1	31.2	65	37.511	168	10.886	%	BS22 Laramie						KC				
20250706	2114	5	**25**	2	32	65	37.611	168	11.085	%	BS22 Laramie			136			KC				
20250706	2126	6	**115**	1	37	65	36.776	168	12.887	%	SBSnn1.5				15.1	342.1	KC	0.5	0	6	
20250706	2145	6	**115**	2	37.7	65	37.232	168	13.377	%	SBSnn1.5	1	19	155	13.7	326.7	KC	0.5	0	6	Stopped near bottom to fix the line (21:30-21:42). Minke whale!
20250706	2158	1	**116**	1	40.3	65	36.216	168	15.09	%	SBSnn2				14.9	355.1	KC	0.5	0	6	
20250706	2201	1	**116**	2	40.6	65	36.314	168	15.318	%	SBSnn2	1	3	158	14.8	0.6	KC	0.5	0	6	
20250706	2213	1	**117**	1	43.9	65	35.582	168	17.309	%	SBSnn2.5				13.6	359.1	KC	0.5	0	6	
20250706	2217	1	**117**	2	44.2	65	35.717	168	17.602	%	SBSnn2.5	1	4	162	14.2	352.4	KC	0.5	0	6	Salinity diverged on the downcast, but fixed itself on the upcast. Redo cast without recovering from the water.
20250706	2218	1	**118**	1	44.4	65	35.717	168	17.602	%	SBSnn2.5 redo				14	348.6	KC	0.5	0	6	
20250706	2223	1	**118**	2	44.6	65	35.804	168	17.787	%	SBSnn2.5 redo	1	5	167	14.1	344	KC	0.5	0	6	Cast redone, salinities agree. Dead whale in the distance, went to photograph and investigate.
20250706	2248	1	**119**	1	46.5	65	35.02	168	19.687	%	SBSnn3				13.6	354.1	KC	0.5	0	6	
20250706	2252	1	**119**	2	46.4	65	35.135	168	19.829	%	SBSnn3	1	4	171	13.7	353.4	KC	0.5	0	6	
20250706	2304	6	**120**	1	47.4	65	34.362	168	21.756	%	SBSnn3.5				6.5	20.2	KC	0.5	0	6	
20250706	2316	6	**120**	2	47.7	65	34.657	168	22.1	%	SBSnn3.5	1	12	183	4.1	261.1	KC	0.5	0	6	Stopped near 20m to fix the line (23:09-23:15)
20250706	2329	1	**121**	1	48.9	65	33.714	168	24.08	%	SBSnn4				8.8	18.8	KC	0.5	0	9	
20250706	2333	1	**121**	2	48.7	65	33.817	168	24.164	%	SBSnn4	1	4	187	12.8	32.9	KC	0.5	0	9	
20250706	2344	1	**122**	1	50	65	33.054	168	26.218	%	SBSnn4.5				15.2	11.3	KC	0.5	0	9	
20250706	2348	1	**122**	2	50.4	65	33.132	168	26.369	%	SBSnn4.5	1	4	191	14.3	342.8	KC	0.5	0	9	Fewer jellyfish
20250706	2358	1	**123**	1	52	65	32.475	168	28.265	%	SBSnn5				14.6	1.2	KC	0.5	0	9	
20250707	2	1	**123**	2	52.4	65	32.542	168	28.462	%	SBSnn5	1	4	195	16.7	11.5	KC	0.5	0	9	
20250707	14	8	**124**	1	58.3	65	31.842	168	30.813	%	SBSnn5.5				14.4	4.2	KC	0.5	0	9	Stops on way up to fix line (Bottom, 53m, 30m). S1:S2 salinity difference not resolved - sampled Bot1 to check
20250707	43	8	**124**	2	54	65	32.216	168	31.526	%	SBSnn5.5	1	29	224	15	354.5	KC	0.5	0	9	Bottle 3 and 5 leaked. Syringe S1 and S2 after cast
20250707	103	9	**125**	1	56.5	65	31.328	168	33.414	%	SBSnn6				16.7	356.6	KC	0.5	0	9	
20250707	110	9	**125**	2	55.7	65	31.389	168	33.626	%	SBSnn6	1	7	231	15.1	346.5	KC	0.5	0	9	Line slack (CTD at 55m), possible bottom hit. Data/instrument shows no sign of damage. Warm fresh thin surface layer
20250707	154	1	**126**	1	60.8	65	31.155	168	28.316	%	DeepWireFix				15.5	336.8	KC	0.5	0	8	
20250707	158	1	**126**	2	61.2	65	31.207	168	28.401	%	DeepWireFix	1	4	235	15.3	332	KC	0.5	0	8	Fixing a wire issue from the last cast. Did not go all the way to the bottom. Problems with S1
20250707	220	1	**127**	1	55	65	30.618	168	35.155	%	SBSnn6.5				2.5	333.7	KC	0.5	0	7	Up cast stops and goes down again for a bit … maybe wire fixing?
20250707	225	1	**127**	2	54.9	65	30.682	168	35.192	%	SBSnn6.5	1	5	240	7.3	340.3	KC	0.5	0	7	
20250707	238	1	**128**	1	53.8	65	29.965	168	37.553	%	SBSnn7				9.1	356.8	KC	0.5	0	6	Stopped to fix the line on the way up (30m - starting 02:41).
20250707	248	1	**128**	2	53.7	65	30.059	168	37.718	%	SBSnn7	1	10	250	4.1	325	KC	0.5	0	6	
20250707	300	6	**129**	1	54.6	65	29.365	168	39.776	%	SBSnn7.5				7	7	rw	0.5	0	6	
20250707	309	6	**129**	2	54.3	65	29.408	168	39.894	%	SBSnn7.5	1	9	259	9	391	RW	0.5	0	6	5 leaked
20250707	328	1	**130**	1	58.2	65	28.158	168	44.309	%	SBSnn8.5				2.2	350	rw	0	0	5	
20250707	350	1	**130**	2	56.3	65	28.283	168	44.523	%	SBSnn8.5	1	22	281	9.4	294.3	rw	0	0	5	stopped on way up to fix cable
20250707	410	13	**131**	1	54.7	65	26.926	168	48.774	%	SBSnn9.5				2.4	23	lh	0	0	5	
20250707	420	13	**131**	2	55.7	65	26.993	168	48.904	%	SBSnn9.5	1	10	291	2.2	333.2	lh	0	0	5	
20250707	440	1	**132**	1	56.7	65	25.678	168	53.299	%	SBSnn10.5				5.2	57.1	lh	0	0	4	
20250707	447	1	**132**	2	56.8	65	25.722	168	53.354	%	SBSnn10.5	1	7	298	5.8	314	lh	0	0	4	
20250707	507	13	**133**	1	54.7	65	24.47	168	57.854	%	SBSnn11.5				3.2	56.1	lh	0	0	3	
20250707	517	13	**133**	2	55	65	24.506	168	57.909	%	SBSnn11.5	1	10	308	6.6	311	lh	0	0	3	surface nutrient taken at 5m instead at chl max
20250707	538	1	**134**	1	53.3	65	24.114	169	2.301	%	SBSnn12.5				1.6	152	lh	0	0	5	
20250707	545	1	**134**	2	53.3	65	23.167	169	2.24	%	SBSnn12.5	1	7	315	1	170.1	lh	0	0	5	mislabeled as SBSnn11.5 in the file header; comb jellies? In surface water
20250707	606	14	**135**	1	51	65	21.663	169	6.489	%	SBSnn13.5				1.5	174	lh	0	0	5	
20250707	615	14	**135**	2	51	65	21.721	169	6.414	%	SBSnn13.5	1	9	324	1.4	237.7	lh	0	0	5	End of SBSnn line. Reterminating the line to repair fraying.
20250707	1019	1	**136**	1	52.1	65	14.937	168	51.937	%	BC12.5				10	327	ACPF	0.5	0	2	Start of the BC line

20250707	1027	1	**136**	2	52.2	65	14.92	168	51.305	%	BC12.5	1	8	332	8	325	ACPF	0.5	0	2	
20250707	1030	5	**26**	1	52.1	65	14.914	168	51.277	%	BC12.5						ACPF				
20250707	1036	5	**26**	2	52	65	14.901	168	51.209	%	BC12.5			332			ACPF				
20250707	1050	9	**137**	1	50.4	65	15.595	168	48.876	%	BC12				17	325	ACPF	0.5	0	2	glitch in the .hex and .hdr file, needed glitch deleting to replay
20250707	1057	9	**137**	2	50.2	65	15.61	168	48.812	%	BC12	1	7	339	19	324	ACPF	0.5	0	2	Corrected files= Bstrait25137.hex .hdr, (Originals at Bstrait25137Original.hdr .hex)
20250707	1109	1	**138**	1	53.4	65	16.169	168	46.234	%	BC11.5				10.5	308	ACPF	0.5	0	2	
20250707	1115	1	**138**	2	53.4	65	16.13	168	46.126	%	BC11.5	1	6	345	4.5	324	ACPF	0.5	0	2	
20250707	1125	1	**139**	1	53.1	65	16.731	168	43.936	%	BC11				10	315	ACPF	0.5	0	2	
20250707	1130	1	**139**	2	53.2	65	16.7	168	43.842	%	BC11	1	5	350	1.5	25	ACPF	0.5	0	2	
20250707	1141	1	**140**	1	51.7	65	17.366	168	41.322	%	BC10.5				23	331	ACPF	0.5	0	2	
20250707	1146	1	**140**	2	51.7	65	17.33	168	41.36	%	BC10.5	1	5	355	20	343	ACPF	0.5	0	2	
20250707	1148	5	**27**	1	51.7	65	17.334	168	41.353	%	BC10.5						ACPF				
20250707	1154	5	**27**	2	51.7	65	17.326	168	41.278	%	BC10.5			355			ACPF				
20250707	1209	1	**141**	1	53	65	17.986	168	38.979	%	BC10				12	330	ACPF	0.5	0	5	
20250707	1214	1	**141**	2	52.8	65	17.915	168	38.987	%	BC10	1	5	360	11	340	ACPF	0.5	0	5	
20250707	1227	1	**142**	1	51.1	65	18.624	168	36.306	%	BC9.5				12	332	ACPF	1	0	3	
20250707	1232	1	**142**	2	51.1	65	18.581	168	36.285	%	BC9.5	1	5	365	11	339	ACPF	1	0	3	
20250707	1244	1	**143**	1	50.7	65	19.258	168	33.894	%	BC9				9.7	20	ACPF	1	0	3.5	
20250707	1249	1	**143**	2	50.6	65	19.26	168	33.947	%	BC9	1	5	370	11	327	ACPF	1	0	3.5	
20250707	1302	1	**144**	1	51.4	65	19.896	168	31.348	%	BC8.5				20	356	ACPF	1	0	2.5	
20250707	1307	1	**144**	2	51.4	65	19.882	168	31.336	%	BC8.5	1	5	375	19	343	ACPF	1	0	2.5	
20250707	1320	1	**145**	1	53.4	65	20.565	168	29.913	%	BC8				23	347	ACPF	1	0	3	
20250707	1325	1	**145**	2	53.4	65	20.545	168	28.932	%	BC8	1	5	380	19	338	ACPF	1	0	3	
20250707	1328	5	**28**	1	53.6	65	20.527	168	28.899	%	BC8						ACPF				
20250707	1334	5	**28**	2	53.6	65	20.493	168	28.809	%	BC8			380			ACPF				
20250707	1349	1	**146**	1	52.5	65	21.146	168	26.344	%	BC7.5				20	12.4	ACPF	1	0	3	
20250707	1354	1	**146**	2	52.6	65	21.143	168	26.301	%	BC7.5	1	5	385	19	348	ACPF	1	0	3	
20250707	1407	1	**147**	1	54.3	65	21.756	168	23.888	%	BC7				18	5.3	ACPF	1	0	7	
20250707	1412	1	**147**	2	54.3	65	21.754	168	23.915	%	BC7	1	5	390	15	340	ACPF	1	0	7	
20250707	1426	1	**148**	1	55.5	65	22.404	168	21.367	%	BC6.5				24	352	ACPF	1	0	8	
20250707	1431	1	**148**	2	55.1	65	22.382	168	21.426	%	BC6.5	1	5	395	24	346	ACPF	1	0	8	
20250707	1446	1	**149**	1	57.9	65	23.001	168	18.835	%	BC6				10	22	ACPF	1	0	6	
20250707	1451	1	**149**	2	57.8	65	22.976	168	18.938	%	BC6	1	5	400	9	355	ACPF	1	0	6	
20250707	1506	1	**150**	1	58.6	65	23.697	168	16.257	%	BC5.5				20	349	ACPF	1	0	4	
20250707	1510	1	**150**	2	58.8	65	23.687	168	16.364	%	BC5.5	1	5	405	20	342	ACPF	1	0	4	
20250707	1511	5	**29**	1	58.7	65	23.684	168	16.387	%	BC5.5						ACPF				
20250707	1518	5	**29**	2	59.1	65	23.654	168	16.512	%	BC5.5			405			ACPF				
20250707	1535	1	**151**	1	57.8	65	24.268	168	13.607	%	BC5				24.3	349.5	MHJ	1	0	4	
20250707	1539	1	**151**	2	57.9	65	24.279	168	13.671	%	BC5	1	4	409	23.7	337.5	MHJ	1	0	4	
20250707	1552	1	**152**	1	46.9	65	24.866	168	11.116	%	BC4.5				20.1	8.2	MHJ	1	0	5	
20250707	1555	1	**152**	2	47.3	65	24.892	168	11.186	%	BC4.5	1	3	412	21.2	336	MHJ	1	0	5	
20250707	1608	1	**153**	1	46.7	65	25.512	168	8.559	%	BC4				15.7	349.8	MHJ	1	0	5	
20250707	1613	1	**153**	2	46.9	65	25.551	168	8.643	%	BC4	1	5	417	22	331.7	MHJ	1	0	5	
20250707	1614	5	**30**	1	47	65	25.557	168	8.669	%	BC4 Laramie						MHJ				
20250707	1621	5	**30**	2	47.3	65	25.582	168	8.819	%	BC4 Laramie						MHJ				
20250707	1639	1	**154**	1	45.2	65	26.113	168	6.088	%	BC3.5				13.9	334.5	MHJ	1	0	9	
20250707	1642	1	**154**	2	41.9	65	26.162	168	6.197	%	BC3.5	1	3	420	9.1	355.2	MHJ	1	0	9	
20250707	1655	1	**155**	1	42.2	65	26.758	168	3.602	%	BC3				13.7	345.9	MHJ	1	0	9	jellyfish from pump/bottle 2
20250707	1700	1	**155**	2	42.3	65	26.812	168	3.76	%	BC3	1	5	425	12.7	335.2	MHJ	1	0	9	
20250707	1712	1	**156**	1	39.5	65	27.384	168	1.1018	%	BC2.5				12.5	348	MHJ	1	0	9	
20250707	1716	1	**156**	2	40	65	27.419	168	1.138	%	BC2.5	1	4	429	12.7	339	MHJ	1	0	9	
20250707	1718	5	**31**	1	40.4	65	27.423	168	1.209	%	BC2.5 Laramie						MHJ				
20250707	1723	5	**31**	2	40.9	65	27.44	168	1.405	%	BC2.5 Laramie						MHJ				
20250707	1738	1	**157**	1	39.5	65	28.019	167	58.483	%	BC2				12.8	341	MHJ	1	0	9	
20250707	1741	1	**157**	2	39.4	65	28.057	167	58.59	%	BC2	1	3	432	9.2	331.8	MHJ	1	0	9	
20250707	1753	1	**158**	1	31	65	28.609	167	55.961	%	BC1.5				9.3	38.1	MHJ	1	0	7	
20250707	1756	1	**158**	2	30.9	65	28.623	167	55.959	%	BC1.5	1	3	432	11.6	56.2	MHJ	1	0	7	
20250707	1808	1	**159**	1	23.3	65	29.255	167	53.442	%	BC1				13.4	12.6	MHJ	0.5	0	5	closed all bottles and put cap back on wet lab; Strange T structure at bottom
20250707	1811	1	**159**	2	23.1	65	29.289	167	53.455	%	BC1	1	3	435	10.1	7.5	MHJ	0.5	0	5	end of BC line
20250707	1814	5	**32**	1	23.2	65	29.294	167	53.464	%	BC1 Laramie						MHJ				
20250707	1819	5	**32**	2	23.3	65	29.276	167	53.553	%	BC1 Laramie						MHJ				
20250708	1538	1	**160**	1	25	65	29.09	167	53.595	%	BC1				21.9	17.7	MHJ	1.5	0	0	Start of BC1 - redo in bad weather
20250708	1542	1	**160**	2	26.1	65	29.024	167	53.658	%	BC1	1	4	439	23.7	18.3	MHJ	1.5	0	0	stopped here bc of bad weather
20250709	23	1	**161**	1	23.9	65	29.283	167	53.593	%	BC1				30.5	16.6	KC	1.5	0		
20250709	26	1	**161**	2	23.9	65	29.264	167	53.618	%	BC1	2	3	3	35.5	12	KC	1.5	0		taken to compare to previous cast after ~12 hours. Depth about 1m different from winds.
20250709	1649	6	**162**	1	23.3	65	29.3	167	53.46	%	BC1				33.4	1.2	KC	1.5	0	1	
20250709	1653	6	**162**	2	23.3	65	29.237	167	53.476	%	BC1			3	22.3	21.2	KC	1.5	0	1	repeat cast to compare. Final CTD. All bottles are very loose (except bottle 2) .

% NUTRIENT SAMPLES FOR WOODGATE & PERALTA FERRIZ (total 194)

CastType 6=CTD w Nuts | 8=CTD w Sal + Nuts | 13=Monica and Nut | 14=Monica + Nuts + SALT

%Date	Time	CastType	Cast Numb	Start=1	Depth (m	Lat(deg)	Lat(min)	Long(deg)	Lon(min)	Niskin	Target depth	Sample #			
20250703	1617	8	**2**	1	53.7	65	46.978	168	33.963	1	50	65		%	A2-24 Recovery
20250703	1617	8	**2**	1	53.7	65	46.978	168	33.963	1	50	66		%	A2-24 Recovery
20250703	1617	8	**2**	1	53.7	65	46.978	168	33.963	8	48	67		%	A2-24 Recovery
20250703	1617	8	**2**	1	53.7	65	46.978	168	33.963	8	48	68		%	A2-24 Recovery
20250703	2315	6	**4**	1	54.6	66	19.691	168	56.926	2	47	69		%	A3-24 Recovery
20250703	2315	6	**4**	1	54.6	66	19.691	168	56.926	2	47	70		%	A3-24 Recovery
20250703	2315	6	**4**	1	54.6	66	19.691	168	56.926	8	45	71		%	A3-24 Recovery
20250703	2315	6	**4**	1	54.6	66	19.691	168	56.926	8	45	72		%	A3-24 Recovery
20250704	503	6	**5**	1	54.7	66	19.58	168	56.991	4	47	73		%	A3-25 Deployment
20250704	503	6	**5**	1	54.7	66	19.58	168	56.991	4	47	74		%	A3-25 Deployment
20250704	503	6	**5**	1	54.7	66	19.58	168	56.991	8	45	75		%	A3-25 Deployment
20250704	503	6	**5**	1	54.7	66	19.58	168	56.991	8	45	76		%	A3-25 Deployment
20250704	1832	6	**6**	1	52.9	65	46.921	168	34.015	1	50	77		%	A2-25 Deployment
20250704	1832	6	**6**	1	52.9	65	46.921	168	34.015	1	50	78		%	A2-25 Deployment
20250704	1832	6	**6**	1	52.9	65	46.921	168	34.015	8	48	79		%	A2-25 Deployment
20250704	1832	6	**6**	1	52.9	65	46.921	168	34.015	8	48	80		%	A2-25 Deployment
20250704	2317	6	**8**	1	30.1	65	37.427	168	10.752	1	30.1	81		%	BS22
20250704	2317	6	**8**	1	30.1	65	37.427	168	10.752	3	20	82		%	BS22
20250704	2317	6	**8**	1	30.1	65	37.427	168	10.752	5	10	83		%	BS22
20250704	2317	6	**8**	1	30.1	65	37.427	168	10.752	8	0	84		%	BS22
20250705	15	6	**11**	1	44.3	65	38.95	168	16.94	1	44.3	85		%	BS20.5
20250705	15	6	**11**	1	44.3	65	38.95	168	16.94	3	30	86		%	BS20.5
20250705	15	6	**11**	1	44.3	65	38.95	168	16.94	5	20	87		%	BS20.5
20250705	15	6	**11**	1	44.3	65	38.95	168	16.94	8	10	88		%	BS20.5
20250705	15	6	**11**	1	44.3	65	38.95	168	16.94	10	0	89		%	BS20.5
20250705	121	6	**14**	1	50.4	65	40.217	168	23.376	1	50.4	90		%	BS19
20250705	121	6	**14**	1	50.4	65	40.217	168	23.376	3	40	91		%	BS19
20250705	121	6	**14**	1	50.4	65	40.217	168	23.376	5	30	92		%	BS19
20250705	121	6	**14**	1	50.4	65	40.217	168	23.376	8	20	93		%	BS19
20250705	121	6	**14**	1	50.4	65	40.217	168	23.376	10	10	94		%	BS19
20250705	121	6	**14**	1	50.4	65	40.217	168	23.376	12	0	95		%	BS19
20250705	224	6	**17**	1	52.9	65	41.597	168	29.138	1	52.9	96		%	BS17.5
20250705	224	6	**17**	1	52.9	65	41.597	168	29.138	3	40	97		%	BS17.5
20250705	224	6	**17**	1	52.9	65	41.597	168	29.138	7	30	98		%	BS17.5
20250705	224	6	**17**	1	52.9	65	41.597	168	29.138	8	20	99		%	BS17.5
20250705	224	6	**17**	1	52.9	65	41.597	168	29.138	10	10	100		%	BS17.5
20250705	224	6	**17**	1	52.9	65	41.597	168	29.138	12	0	101		%	BS17.5
20250705	327	6	**20**	1	50.2	65	43.198	168	35.246	1	50.2	102		%	BS16
20250705	327	6	**20**	1	50.2	65	43.198	168	35.246	3	40	103		%	BS16
20250705	327	6	**20**	1	50.2	65	43.198	168	35.246	7	30	104		%	BS16
20250705	327	6	**20**	1	50.2	65	43.198	168	35.246	8	20	105		%	BS16
20250705	327	6	**20**	1	50.2	65	43.198	168	35.246	10	10	106		%	BS16
20250705	327	6	**20**	1	50.2	65	43.198	168	35.246	12	0	107		%	BS16
20250705	448	6	**24**	1	50.5	65	44.704	168	41.542	1	50.5	108		%	BS14.5

20250705	448	6	**24**	1	50.5	65	44.704	168	41.542	3	40	109	%	BS14.5	
20250705	448	6	**24**	1	50.5	65	44.704	168	41.542	5	30	110	%	BS14.5	
20250705	448	6	**24**	1	50.5	65	44.704	168	41.542	8	20	111	%	BS14.5	
20250705	448	6	**24**	1	50.5	65	44.704	168	41.542	10	10	112	%	BS14.5	
20250705	448	6	**24**	1	50.5	65	44.704	168	41.542	12	0	113	%	BS14.5	
20250705	551	6	**27**	1	50.3	65	46.19	168	47.627	1	50.3	114	%	BS13	
20250705	551	6	**27**	1	50.3	65	46.19	168	47.627	3	40	115	%	BS13	
20250705	551	6	**27**	1	50.3	65	46.19	168	47.627	7	30	116	%	BS13	
20250705	551	6	**27**	1	50.3	65	46.19	168	47.627	8	20	117	%	BS13	
20250705	551	6	**27**	1	50.3	65	46.19	168	47.627	10	10	118	%	BS13	
20250705	551	6	**27**	1	50.3	65	46.19	168	47.627	12	0	119	%	BS13	
20250705	652	6	**30**	1	45.7	65	47.678	168	53.755	1	45	120	%	BS11.5	
20250705	652	6	**30**	1	45.7	65	47.678	168	53.755	3	30	121	%	BS11.5	
20250705	652	6	**30**	1	45.7	65	47.678	168	53.755	7	20	122	%	BS11.5	
20250705	652	6	**30**	1	45.7	65	47.678	168	53.755	8	10	123	%	BS11.5	
20250705	652	6	**30**	1	45.7	65	47.678	168	53.755	10	0	124	%	BS11.5	
20250705	738	6	**32**	1	46	65	49.185	168	56.094	1	45	125	%	DL1	
20250705	738	6	**32**	1	46	65	49.185	168	56.094	3	30	126	%	DL1	
20250705	738	6	**32**	1	46	65	49.185	168	56.094	5	20	127	%	DL1	
20250705	738	6	**32**	1	46	65	49.185	168	56.094	8	10	128	%	DL1	
20250705	738	6	**32**	1	46	65	49.185	168	56.094	10	0	3201	%	DL1	
20250705	828	6	**35**	1	47	65	52.083	168	56.081	1	46	3202	%	DL4	
20250705	828	6	**35**	1	47	65	52.083	168	56.081	3	40	3203	%	DL4	
20250705	828	6	**35**	1	47	65	52.083	168	56.081	7	30	3204	%	DL4	
20250705	828	6	**35**	1	47	65	52.083	168	56.081	8	20	3205	%	DL4	
20250705	828	6	**35**	1	47	65	52.083	168	56.081	10	10	3206	%	DL4	
20250705	828	6	**35**	1	47	65	52.083	168	56.081	Bucket	0	3207	%	DL4	
20250705	931	6	**38**	1	47.4	65	55.161	168	56.234	1	47	3208	%	DL7	
20250705	931	6	**38**	1	47.4	65	55.161	168	56.234	3	40	3209	%	DL7	
20250705	931	6	**38**	1	47.4	65	55.161	168	56.234	7	30	3210	%	DL7	
20250705	931	6	**38**	1	47.4	65	55.161	168	56.234	8	20	3211	%	DL7	
20250705	931	6	**38**	1	47.4	65	55.161	168	56.234	10	10	3212	%	DL7	
20250705	931	6	**38**	1	47.4	65	55.161	168	56.234	Bucket	0	3213	%	DL7	
20250705	1029	6	**41**	1	50.1	65	58.087	168	56.225	1	50	3223	%	DL10	
20250705	1029	6	**41**	1	50.1	65	58.087	168	56.225	3	40	3224	%	DL10	
20250705	1029	6	**41**	1	50.1	65	58.087	168	56.225	5	30	3225	%	DL10	
20250705	1029	6	**41**	1	50.1	65	58.087	168	56.225	8	20	3226	%	DL10	
20250705	1029	6	**41**	1	50.1	65	58.087	168	56.225	10	10	3227	%	DL10	
20250705	1029	6	**41**	1	50.1	65	58.087	168	56.225	Bucket	0	3228	%	DL10	
20250705	1124	6	**44**	1	50.3	66	1.292	168	56.229	1	50	3229	%	DL12.5	
20250705	1124	6	**44**	1	50.3	66	1.292	168	56.229	3	40	3230	%	DL12.5	
20250705	1124	6	**44**	1	50.3	66	1.292	168	56.229	7	30	3231	%	DL12.5	
20250705	1124	6	**44**	1	50.3	66	1.292	168	56.229	8	20	3232	%	DL12.5	
20250705	1124	6	**44**	1	50.3	66	1.292	168	56.229	11	10	3234	%	DL12.5	% Small leak at bottom of bottle
20250705	1124	6	**44**	1	50.3	66	1.292	168	56.229	Bucket	0	3235	%	DL12.5	
20250705	1222	6	**47**	1	53.1	66	5.098	168	56.221	1	53	3236	%	DL14	
20250705	1222	6	**47**	1	53.1	66	5.098	168	56.221	3	40	3237	%	DL14	

20250705	1222	6	**47**	1	53.1	66	5.098	168	56.221	7	30	3238	%	DL14	
20250705	1222	6	**47**	1	53.1	66	5.098	168	56.221	8	20	3239	%	DL14	
20250705	1222	6	**47**	1	53.1	66	5.098	168	56.221	9	10	3240	%	DL14	
20250705	1222	6	**47**	1	53.1	66	5.098	168	56.221	Bucket	0	3241	%	DL14	
20250705	1316	6	**50**	1	52.8	66	8.924	168	56.202	1	52.8	3242	%	DL15.5	
20250705	1316	6	**50**	1	52.8	66	8.924	168	56.202	3	40	3243	%	DL15.5	
20250705	1316	6	**50**	1	52.8	66	8.924	168	56.202	7	30	3244	%	DL15.5	
20250705	1316	6	**50**	1	52.8	66	8.924	168	56.202	8	20	3245	%	DL15.5	
20250705	1316	6	**50**	1	52.8	66	8.924	168	56.202	9	10	3246	%	DL15.5	
20250705	1316	6	**50**	1	52.8	66	8.924	168	56.202	Bucket	0	3247	%	DL15.5	
20250705	1412	6	**53**	1	55.6	66	12.742	168	56.218	1	54	3248	%	DL17	
20250705	1412	6	**53**	1	55.6	66	12.742	168	56.218	3	40	3249	%	DL17	
20250705	1412	6	**53**	1	55.6	66	12.742	168	56.218	7	30	3250	%	DL17	
20250705	1412	6	**53**	1	55.6	66	12.742	168	56.218	8	20	3251	%	DL17	
20250705	1412	6	**53**	1	55.6	66	12.742	168	56.218	9	10	3252	%	DL17	
20250705	1412	6	**53**	1	55.6	66	12.742	168	56.218	Bucket	0	3253	%	DL17	
20250705	1510	6	**56**	1	55.3	66	16.551	168	56.21	1	55.3	3254	%	DL18.5	
20250705	1510	6	**56**	1	55.3	66	16.551	168	56.21	3	40	3255	%	DL18.5	
20250705	1510	6	**56**	1	55.3	66	16.551	168	56.21	7	30	3256	%	DL18.5	
20250705	1510	6	**56**	1	55.3	66	16.551	168	56.21	8	20	3257	%	DL18.5	
20250705	1510	6	**56**	1	55.3	66	16.551	168	56.21	9	10	3258	%	DL18.5	
20250705	1510	6	**56**	1	55.3	66	16.551	168	56.21	12	0	3259	%	DL18.5	
20250705	1604	6	**59**	1	54.7	66	19.626	168	56.728	1	54.7	3214	%	A3-25	
20250705	1604	6	**59**	1	54.7	66	19.626	168	56.728	3	40	3215	%	A3-25	
20250705	1604	6	**59**	1	54.7	66	19.626	168	56.728	5	30	3216	%	A3-25	
20250705	1604	6	**59**	1	54.7	66	19.626	168	56.728	8	20	3217	%	A3-25	
20250705	1604	6	**59**	1	54.7	66	19.626	168	56.728	10	10	3218	%	A3-25	
20250705	1604	6	**59**	1	54.7	66	19.626	168	56.728	12	0	3219	%	A3-25	
20250705	1628	6	**60**	1	54.8	66	20.077	168	55.147	1	54.8	3220	%	AL12.5	
20250705	1628	6	**60**	1	54.8	66	20.077	168	55.147	3	40	3221	%	AL12.5	
20250705	1628	6	**60**	1	54.8	66	20.077	168	55.147	7	30	3222	%	AL12.5	
20250705	1628	6	**60**	1	54.8	66	20.077	168	55.147	9	20	3233	%	AL12.5	
20250705	1628	6	**60**	1	54.8	66	20.077	168	55.147	11	10	3260	%	AL12.5	
20250705	1628	6	**60**	1	54.8	66	20.077	168	55.147	12	0	3261	%	AL12.5	% Leaked, but sampled anyway as surface
20250705	1732	6	**63**	1	53.5	66	21.064	168	49.384	1	53.5	3262	%	AL14	
20250705	1732	6	**63**	1	53.5	66	21.064	168	49.384	3	40	3263	%	AL14	
20250705	1732	6	**63**	1	53.5	66	21.064	168	49.384	7	30	3264	%	AL14	
20250705	1732	6	**63**	1	53.5	66	21.064	168	49.384	8	20	5000	%	AL14	
20250705	1732	6	**63**	1	53.5	66	21.064	168	49.384	10	10	5001	%	AL14	
20250705	1732	6	**63**	1	53.5	66	21.064	168	49.384	12	0	5002	%	AL14	
20250705	1836	6	**66**	1	51.2	66	22.144	168	42.795	1	51.2	5003	%	AL15.5	
20250705	1836	6	**66**	1	51.2	66	22.144	168	42.795	3	40	5004	%	AL15.5	
20250705	1836	6	**66**	1	51.2	66	22.144	168	42.795	7	30	5005	%	AL15.5	
20250705	1836	6	**66**	1	51.2	66	22.144	168	42.795	8	20	5006	%	AL15.5	
20250705	1836	6	**66**	1	51.2	66	22.144	168	42.795	10	10	5007	%	AL15.5	
20250705	1836	6	**66**	1	51.2	66	22.144	168	42.795	12	0	4000	%	AL15.5	
20250705	1926	6	**69**	1	54.2	66	23.19	168	36.455	1	54.2	4001	%	AL17	

20250705	1926	6	**69**	1	54.2	66	23.19	168	36.455	3	40	4002	**%**	AL17
20250705	1926	6	**69**	1	54.2	66	23.19	168	36.455	5	30	4003	**%**	AL17
20250705	1926	6	**69**	1	54.2	66	23.19	168	36.455	8	20	4004	**%**	AL17
20250705	1926	6	**69**	1	54.2	66	23.19	168	36.455	10	10	4005	**%**	AL17
20250705	1926	6	**69**	1	54.2	66	23.19	168	36.455	12	0	4006	**%**	AL17
20250705	2016	6	**72**	1	52.1	66	24.218	168	30.035	1	52.1	4007	**%**	AL18.5
20250705	2016	6	**72**	1	52.1	66	24.218	168	30.035	3	40	4008	**%**	AL18.5
20250705	2016	6	**72**	1	52.1	66	24.218	168	30.035	7	30	4009	**%**	AL18.5
20250705	2016	6	**72**	1	52.1	66	24.218	168	30.035	9	20	4010	**%**	AL18.5
20250705	2016	6	**72**	1	52.1	66	24.218	168	30.035	11	10	4011	**%**	AL18.5
20250705	2016	6	**72**	1	52.1	66	24.218	168	30.035	12	0	4012	**%**	AL18.5
20250705	2110	6	**75**	1	51.5	66	25.265	168	23.464	2	51.5	4013	**%**	AL20
20250705	2110	6	**75**	1	51.5	66	25.265	168	23.464	4	40	4014	**%**	AL20
20250705	2110	6	**75**	1	51.5	66	25.265	168	23.464	5	30	4015	**%**	AL20
20250705	2110	6	**75**	1	51.5	66	25.265	168	23.464	8	20	4016	**%**	AL20
20250705	2110	6	**75**	1	51.5	66	25.265	168	23.464	10	10	4017	**%**	AL20
20250705	2110	6	**75**	1	51.5	66	25.265	168	23.464	12	0	4018	**%**	AL20
20250705	2158	6	**78**	1	42.8	66	26.357	168	17.001	1	42.8	4019	**%**	AL21.5
20250705	2158	6	**78**	1	42.8	66	26.357	168	17.001	4	30	4020	**%**	AL21.5
20250705	2158	6	**78**	1	42.8	66	26.357	168	17.001	8	20	4021	**%**	AL21.5
20250705	2158	6	**78**	1	42.8	66	26.357	168	17.001	10	10	4022	**%**	AL21.5
20250705	2158	6	**78**	1	42.8	66	26.357	168	17.001	12	0	4023	**%**	AL21.5
20250705	2247	6	**81**	1	32	66	27.413	168	10.414	1	32	4024	**%**	AL23
20250705	2247	6	**81**	1	32	66	27.413	168	10.414	3	20	4025	**%**	AL23
20250705	2247	6	**81**	1	32	66	27.413	168	10.414	5	10	4026	**%**	AL23
20250705	2247	6	**81**	1	32	66	27.413	168	10.414	8	0	4027	**%**	AL23
20250705	2341	6	**85**	1	22.4	66	28.771	168	1.932	1	22.4	4028	**%**	AL25
20250705	2341	6	**85**	1	22.4	66	28.771	168	1.932	3	10	4029	**%**	AL25
20250705	2341	6	**85**	1	22.4	66	28.771	168	1.932	5	0	4030	**%**	AL25
20250706	2126	6	**115**	1	37	65	36.776	168	12.887	1	37	4031	**%**	SBSnn1.5
20250706	2126	6	**115**	1	37	65	36.776	168	12.887	3	20	4032	**%**	SBSnn1.5
20250706	2126	6	**115**	1	37	65	36.776	168	12.887	5	0	4033	**%**	SBSnn1.5
20250706	2304	6	**120**	1	47.4	65	34.362	168	21.756	1	47.4	4034	**%**	SBSnn3.5
20250706	2304	6	**120**	1	47.4	65	34.362	168	21.756	3	20	4035	**%**	SBSnn3.5
20250706	2304	6	**120**	1	47.4	65	34.362	168	21.756	5	0	4036	**%**	SBSnn3.5
20250707	14	8	**124**	1	58.3	65	31.842	168	30.813	1	58.3	4037	**%**	SBSnn5.5
20250707	14	8	**124**	1	58.3	65	31.842	168	30.813	4	40	4038	**%**	SBSnn5.5
20250707	14	8	**124**	1	58.3	65	31.842	168	30.813	7	20	4039	**%**	SBSnn5.5
20250707	14	8	**124**	1	58.3	65	31.842	168	30.813	8	0	4040	**%**	SBSnn5.5
20250707	300	6	**129**	1	54.6	65	29.365	168	39.776	1	54.6	4041	**%**	SBSnn7.5
20250707	300	6	**129**	1	54.6	65	29.365	168	39.776	3	40	4042	**%**	SBSnn7.5
20250707	300	6	**129**	1	54.6	65	29.365	168	39.776	7	20	4043	**%**	SBSnn7.5
20250707	300	6	**129**	1	54.6	65	29.365	168	39.776	8	0	4044	**%**	SBSnn7.5
20250707	410	13	**131**	1	54.7	65	26.926	168	48.774	1	54.7	4045	**%**	SBSnn9.5
20250707	410	13	**131**	1	54.7	65	26.926	168	48.774	3	40	4046	**%**	SBSnn9.5
20250707	410	13	**131**	1	54.7	65	26.926	168	48.774	5	20	4047	**%**	SBSnn9.5
20250707	410	13	**131**	1	54.7	65	26.926	168	48.774	10	0	4048	**%**	SBSnn9.5

20250707	507	13	**133**	1	54.7	65	24.47	168	57.854	1	54.7	4049	**%**	SBSnn11.5		
20250707	507	13	**133**	1	54.7	65	24.47	168	57.854	3	40	4050	**%**	SBSnn11.5		
20250707	507	13	**133**	1	54.7	65	24.47	168	57.854	8	20	4051	**%**	SBSnn11.5		
20250707	507	13	**133**	1	54.7	65	24.47	168	57.854	10	5	4052	**%**	SBSnn11.5	% Mistakenly taken at ChlMax, not Surface	
20250707	606	14	**135**	1	51	65	21.663	169	6.489	1	51	4053	**%**	SBSnn13.5		
20250707	606	14	**135**	1	51	65	21.663	169	6.489	3	40	4054	**%**	SBSnn13.5		
20250707	606	14	**135**	1	51	65	21.663	169	6.489	9	20	4055	**%**	SBSnn13.5		
20250707	606	14	**135**	1	51	65	21.663	169	6.489	11	0	4056	**%**	SBSnn13.5		
20250709	1649	6	**162**	1	23.3	65	29.3	167	53.46	2	21	4057	**%**	BC1	**TOTAL NUTRIENT SAMPLES FOR WOODGATE**	194