RUSALCA - BERING STRAIT AON 2012 MOORING CRUISE REPORT

Russian Research Vessel Professor Khromov (also called Spirit of Enderby)

Nome, 10th July 2012 – Nome, 20th July 2012

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and the RUSALCA 2012 Science Team

Funding from NOAA RUSALCA Program and NSF Arctic Observing Network Program ARC-0855748 and NSF ARC – 1023264 (OSU)

(Photo by Aleksey Ostrovskiy)

(Photo by R Woodgate)

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Science Coordinators: *Kathleen Crane, NOAA, USA, and Aleksey Ostrovskiy, Group Alliance, RF.*
Chief Scientist: *Rebecca Woodgate, University of Washington (UW), US.*

As part of the joint US-Russian RUSALCA (Russian US Long-term Census of the Arctic Ocean) Program and Bering Strait AON (Arctic Observing Network), a team of US and Russian scientists undertook a 10-day oceanographic cruise in July 2012 on board the Russian vessel 'Khromov', operated by Heritage Expeditions (under the name of Spirit of Enderby).

SUMMARY:

The major objective of the cruise was mooring work in the Bering Strait region, i.e., the recovery and redeployment of 11 moorings, a joint project by the University of Washington (UW), the University of Alaska, Fairbanks (UAF), and the Arctic and Antarctic Research Institute (AARI). The US portion of the mooring work is supported by an NSF-OPP AON (Arctic Observing Network) grant (PIs: Woodgate, Weingartner, Whitledge and Lindsay) with ship-time and logistical support from the NOAA RUSALCA (Russian-US Long-term Census of the Arctic) program. Eight of the moorings were deployed in US waters in the strait region in summer 2011. The other three moorings were deployed in the Russian channel of the strait in 2010.

As in years since 2007, the cruise planned to work both in US and in Russian waters. Such cruises operated successfully in years 2007-2010. In 2011, RUSALCA was not granted permission to work in Russian waters. Although it appears permission was available to recover the moorings in Russian waters in 2011, this would have required two Russian port calls, for which the ship did not have time, and thus 3 moorings were left in Russian waters for recovery in 2012. In 2012, science permission was granted for the work, but RUSALCA did not manage to obtain an exemption for the two required port calls, so this 2012 mooring cruise was also unable to access the moorings in Russian waters. Indeed, due to lack of clarity for requirements for ship-board instrumentation and personnel for access to the Russian EEZ, the 2012 cruise also remained in US waters.

During the 2012 cruise, the 8 moorings in US waters were successfully recovered. Six of these moorings were in the US channel of the Bering Strait, giving the best ever coverage of the flow in that channel. The 7th mooring was ~ 4nm north of the strait in a region hypothesized to have enhanced mixing to due eddies formed from the islands. The final 8th mooring was ~30nm north of the strait at site A3, hypothesized to give a useful average of the flow through both channels

The secondary objectives of the cruise were station work, primarily CTD work with sampling for nutrients, chlorophyll, DON (Dissolved Organic Nitrogen), and DIC (Dissolved Inorganic Carbon), pCO2, total Alkalinity, net and gross primary production, and HPLC (High Performance Liquid Chromatography) Pigments. In addition, the cruise took primary productivity casts and net tows for zooplankton, and bird and marine mammal observations were made from the bridge by dedicated observers.

Weather conditions were good for the majority of the cruise, although fog was relatively frequent and CTD operations were suspended for 9hrs due to sea state. Overall, the mooring operations went smoothly, leaving time for completing 10 CTD lines in a ~ 6 day period, as described below. To the best of our knowledge, this is the second extensive quasi-synoptic spatial survey of the Chukchi Sea in almost a decade (a similar survey was obtained from the Khromov in 2011 [*Woodgate and RUSALCA11ScienceTeam*, 2011]. Prior to that the last extensive surveys were in 2003 and 2004 from the Alpha Helix [*Woodgate*, 2003; *Woodgate*, 2004]). In addition to a large scale water mass survey of the region, the repeat of several lines (and several stations) during this or subsequent cruises this year will allow for quantification of temporal variability. In particular, the CS line is a DBO (Distributed Biological Observatory) line and was run by the CCGC Laurier just after to our occupation of it. The 2012 RUSALCA mooring cruise also completed the second high resolution (~ 1nm) survey of the eddying region just north of the Diomede Islands.

For full station coverage, see map and listings below.

Summary of CTD lines.

BS (US portion) – the main Bering Strait line, run at the start and at the end of the cruise. This line has been occupied by past RUSALCA mooring cruises. US portion only run here.

DI – a new high resolution line running north from the Diomede Islands to study the hypothesized eddy and mixing region north of the islands. This was run at the start and end of the cruise.

AL (US portion) – another previously-run line, 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.

CS (US portion) – another cross strait line, run here from the US-Russian convention line (~168deg 58.7'W) to Point Hope (US).

LIS – from Cape Lisburne towards the WNW, a previous RUSALCA line and close to the CP line occupied in previous Bering Strait cruises in 2003 and 2004

CCL – a line running down the convention line from the end of the LIS line towards the Diomedes (also run in 2003, 2004 and 2011), incorporating a rerun of the high resolution DI line at the southern end.

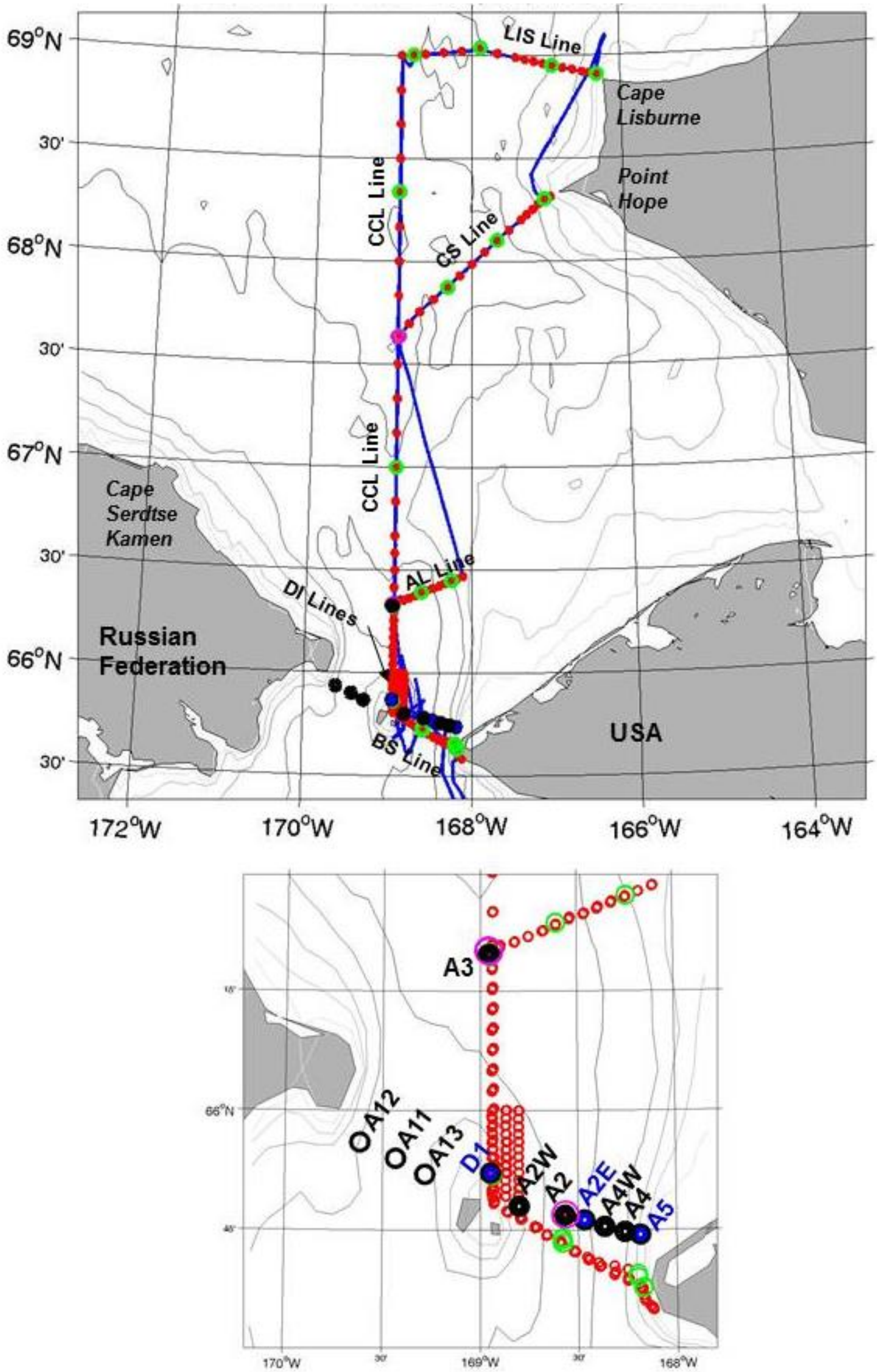
DIa and DIb – two more new high resolution lines, mapping the eddying/mixing region.

Finally, the US portion of the BS line was rerun at the end of the cruise.

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; NSF's Freshwater Initiative (FWI) and Arctic Model Intercomparison Project (AOMIP), and the international Arctic SubArctic Ocean Fluxes (ASOF) program. 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 measure of integrated change in the Bering Sea, and an indicator of the role of Pacific Waters in the Arctic Ocean. Furthermore, the Bering Strait inflow may play a role in Arctic Ocean ice retreat [*Woodgate et al.*, 2010] and variability (especially in the freshwater flux) is considered important for the Atlantic overturning circulation and possibly world climate [*Woodgate et al.*, 2005].

Contents:

RUSALCA 2012 MAP: *Ship-track, blue. Mooring sites, black. CTD stations, red. Zooplankton nets, green. Productivity casts, magenta. Depth contours every 10m from the International Bathymetric Chart of the Arctic Ocean [Jakobsson et al., 2000]. Lower panel mooring detail: - black solid=recovered and redeployed; black with blue center =recovered, not redeployed; black ring=not yet recovered.*



RUSALCA 2012 SCIENCE PARTICIPANTS

1.	Kathleen Crane (F)	NOAA	*Program Manager, NOAA*
2.	Vladimir Bakhmutov (M)	SRNHI	*Expedition Leader*
3.	Aleksey Ostrovskiy (M)	GA	*Liaison and translator*
4.	Rebecca Woodgate (F)	UW	*Chief Scientist*
5.	Jim Johnson (M)	UW	*UW Mooring lead*
6.	Cynthia Travers (F)	UW	*UW graduate student, CTD and moorings*
7.	An Nguyen (F)	UW/MIT	*MIT Modeler, CTD and moorings*
8.	Kathy Ellingson (F)	UW	*Physics Teacher, Shoreline School District, WA*
9.	David Leech (M)	UAF	*UAF Mooring lead*
10.	Chase Stoudt (M)	UAF	*UAF graduate student, CTD*
11.	Jonathan Whitefield (M)	UAF	*UAF graduate student, CTD*
12.	Dmitri Brazhnikov (M)	UAF	*UAF graduate student, CTD*
13.	Dan Naber (M)	UAF	*UAF moored sampler, moorings, water sampling*
14.	Mike Kong (M)	UAF	*UAF water sampling*
15.	Fred Prahl (M)	OSU	*OSU pH pCO2 mooring and water sampling*
16.	Marnie Zirbel (F)	OSU	*OSU pH pCO2 mooring and water sampling*
17.	Nikita Kusse-Tiuz (M)	AARI	*AARI Moorings and CTD*
18.	Maria Pisarev (F)	SIO	*SIO student, CTD and moorings*
19.	Heather McEachen (F)	UAF	*UAF Zooplankton Nets*
20.	Kate Stafford (F)	UW	*Marine Mammals & moored acoustic recorder*
21.	Kalyn MacIntyre (F)	UW	*Marine Mammals & moored acoustic recorder*
22.	Elizabeth Labunski (F)	FWS	*Bird Observer*
23.	Kevin Wood (M)	NOAA/UW	*NOAA Support*
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25.	Iouri Pashenko (M)	FERHRI	*Technical Support*

NOAA – National Ocean Atmosphere Administration, US
SRNHI – State Research Navigational Hydrographic Institute, RF
GA – Group Alliance, RF
UW – University of Washington, US
MIT – Massachusetts Institute of Technology
UAF – University of Alaska, Fairbanks, US
OSU – Oregon State University, US
AARI – Arctic and Antarctic Research Institute, RF
SIO – Shirshov Institute of Oceanology, RF
FWS – Fish and Wildlife Service, USA
FERHRI - Far Eastern Regional Hydrometeorological Research Institute, RF

RUSALCA 2012 CRUISE SCHEDULE (all times Alaskan Daylight Time in 24hour format)

Friday 6th July 2012	*UW mooring team (Rebecca, Jim, An, Cindy, Kathy E) arrive Nome.* *Ice in bay off Kotzebue.*
Saturday 7th July 2012	*UW Instrument prep.*
Sunday 8th July 2012	*UW Instrument prep, Fred, Marnie, Kevin, Aleksey, Heather arrive.*
Monday 9th July 2012	*Ship leaves Anadyr headed to Nome. Delayed slightly by ice in river.* *Rest of science party arrive. Visit Bob Metcalf, UAF Nome.* *6pm Science meeting, set up water plans.*
Tuesday 10th July 2012 (sunny, clear)	Ship due at noon. Takes pilot and tied up by 1145. Cleared customs ~ 1300. Zodiacs removed from ship and hand-loading of science gear. Start crane loading ~ 1530. All on-loaded ~ 1800. Secure for sea. Cast lines ~ 2000, transit to Strait in fine weather.
Wednesday 11th July 2012 (sunny, very very clear)	Opening meeting and boat drill 0830. Cal-cast at site A5-11 0945-1010. On site at A5-11 at 1045, finish recovery 1115. Cal-cast at site A4-11 1205-1225. On site at A4-11 at 1255, finish recovery 1320. Cal-cast at A4W-11 1355-1420. On site at A4W-11 at1440, finish recovery 1500. Cal-cast at A2E-11 1525-1550. On site at A2E-11 at 1605, finish recovery 1640. Cal-cast at A2-11 1715-1740. On site at A2-11 at 1755, finish recovery 1815. Run transit lines for bird/mammal observers, around Fairway Rock, then N past Little Diomede. Drift from ~2200. This drift takes us S and then W around L Diomede.
Thursday 12th July 2012 (foggy, especially by islands)	On site at A2W-11 at 0800, foggy. Cal-cast at A2W-11 0854-0935, still foggy. On site at D1-11 at 1030, foggy. Cal-cast at D1-11 1030-1000, still foggy. Test Net cast. Deploy A2-12 starting at 1440, anchor dropped 1451. Deploy A4-12 starting at 1625, anchor dropped at 1635. Deploy A4W-12 starting at 1745, anchor dropped at 1754. Return to A2W-11, still foggy. Drift overnight, return to A2W-11 for am.
Friday 13th July 2012 (mostly clear, fog in west)	On site at A2W-11 at 0810, finish recovery 0845. On site at D1-11 at 0935, finish recovery 1000. Cal-cast at A3-11 1225-1255. On site at A3-11 1320, finish recovery 1345. Deploy A3-12 starting at 1620, anchor dropped at 1637. Deploy A2W-12 starting at 2005, anchor dropped at 2022. Teaching CTD cast at A2. Drift overnight, then steam to A2 for am.
Saturday 14th July 2012 (clear, light/med wind)	Prod cast at A2 at 830am, then training cast for water sampling. Steam to US end of BS line. Run BS line east to west with nets at BS22 &16 -1230-2340. Start DI line, running to north, at 2355.

Sunday 15th July 2012 (generally clear, fog patches)	Finish DI line south of A3 at 1004. Prod cast at A3 at 1040am. Run A3 line to the east with nets at AI17&22: 1210-2150. (winch spooling issue 1930-2100). Talk with CCGC Laurier. Steam to start of US-CS line on US-Russian Convention Line.
Monday 16th July 2012 (often foggy) (stormy, foggy evening)	Run CS line to the east with nets at CS10, 12, 14, 17: 0400-1800. Transit to start of LIZ line, arriving 2200. Drift as sea state doubtful for CTDing.
Tuesday 17th July 2012 (wind drops, fog clears some)	Run LIS line to the west with nets at LIS 1,6,10 and 14n: 0700-1930. Start CCL line to south with nets at CCL 18,14,10: start 2030.
Wednesday 18th July 2012 (some swell, fog) -	Continue CCL line to south. Prod cast at CCL14 at 0905. Complete CCL line to south at A3 at 2120. Repeat net at A3. Start DI line to south at 2215, with net at DI4.
Thursday 19th July 2012 (often foggy, finally clear)	Finish DI line at 0700. Run DIa line to north – 0730-1245. Run Dib line to south – 1310-1810. Run BS line to east, with repeat nets at BS16 & 22, starting 1845. Break line to investigate unidentified float near BS14. Continue BS line.
Friday 20th July 2012 (grey, but generally clear)	Complete BS line at BS24 at 0310. Steam for Nome. Arrive off Nome 1300. Take Pilot ~ 2000, tied by by 2145. Fuel that night.
Saturday 21st July 2012 (v sunny and calm)	Crane off gear, 0820-0945. Finish science off load by 1030. Science party leave ship 1230 (except frozen samples taken off 1400). Ship leaves ~ 1600.
Sunday 22nd July 2012	*Science Party leaves Nome.*

10 days at sea (away from Nome) - ***8pm 10th July – 10pm 20th July 2012***
11 days on ship (including on/offload) ***1pm 10th July – 1pm 21st July 2012***

Moorings recovered/ deployed:	***8/5***
Calibration casts	***8***
CTD casts:	***161***
Primary Productivity stations:	***3***
Zooplankton Nets:	***20 + 1 test***

SCIENCE COMPONENTS OF CRUISE

The cruise comprised of the following science components:

- Mooring operations

Mooring operations were a joint UW, UAF, AARI operation, assisted by other cruise members.

- CTD operations

CTD operations were led by the UAF team, assisted by other cruise members.

-Water and Net sampling

Water samples were taken by UAF and OSU teams, assisted by other cruise members, at various sites for various components, as per the following table.

Line	**Nut.** *Naber/ Kong*	**Chl** *Naber/ Kong*	**DON** *Naber/ Kong*	**PP** *Kong*	**DIC** *Bates*	**pCO2, DIC & Total Alk.** *Prahl*	**Net & Gross PP** *Juranek*	**HPLC Pig.** *Prahl*	**ZNet** *Hopcroft*
Cal -casts	A2/A3	-	-	-	-	A3	-	-	-
Test Net	-	-	-	-	-	-	-	-	1
A2	A2	A2	-	A2		-	-	A2	-
BS (to W)	All	All	Half (even)		Half (even)	Half (odds)	Half (odds)	Half (odds)	2
DL (to N)	Half	-	-	-	-	-	-	-	-
AL (to E)	All	All	Half (even)	A3	Half (even)	Half (A3; then odds)	A3	Half (A3, then odds)	3
CS (to E)	All	All	Half (even)	-	-	-	-	-	4
LIS (to W)	All	All	-	-	-	-	-	-	4
CCL (to S)	All	All	-	CCL 14	-	CCL14, A3	CCL14	CCL14, A3	3+A3
DL (to S)	Half (even)	-	-	-	-	-	-	-	Repeat at test
Dla (to N)	Half (even)	-	-	-	-	-	-	-	-
Dlb (to S)	-	-	-	-	-	-	-	-	-
BS (to E)	All	Half (odd)	-	-	-	Half (odd)	-	Half (odd)	2
Total	**660**	**461**	**98**	**3**	**79**	**70**	**25**	**34**	**21**

From the CTD bottles:

Nutrients (Nut.), Chlorophyll (Chl), Dissolved Organic Nitrogen (DON), and Primary productivity (PP) were sampled by the UAF group, indicated here by Naber and Kong for PI Terry Whitledge, UAF.

Dissolved Inorganic Carbon (DIC) samples were taken for 2 groups

– Nick Bates of Bermuda (in an on-going effort in the strait), and

– Fred Prahl, since 2011, combining also pCO2 and Total Alkalinity (Alk.) measurements.

High Performance Liquid Chromatography (HPLC) Pigments were sampled by Fred Prahl, OSU

Water Samples for Net and Gross Primary Production (nicknamed "Eggs") were taken by Prahl on behalf of Laurie Juranek of OSU

Primary Productivity Casts were taken by Mike Kong, as part of his thesis project and a long=term timeseries from the region led by PI Terry Whitledge.

Zooplankton net tows (Bongo nets) were taken by Heather McEachen during the CTD lines as part of the thesis project of Elizaveta Ershova, for PI Russ Hopcroft, UAF.

- Whale Observations (including acoustic instruments on the moorings)

UW whale observers, Kate Stafford and Kalyn MacIntrye, took observations of marine mammal and were responsible for the moored acoustic whale recorders.

- **Bird Observations**

Elizabeth Labunski (FWS) took observations of birds from the bridge during the cruise.

MOORING OPERATIONS (Woodgate, Johnson, Leech, Kusse-Tiuz)

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 2004 and 2007 suggest that heat and freshwater fluxes are increasing through the strait [*Woodgate et al.*, 2006; *Woodgate et al.*, 2010]. The work completed this summer should tell us if this is a continuing trend.

An overview of the Bering Strait mooring work (including access to mooring and CTD data) is available at http://psc.apl.washington.edu/BeringStrait.html. A map of mooring stations is given above.

Eight moorings were recovered on this cruise. These moorings (all in US waters – D1-11, A2W-11, A2-11, A2E-11, A4W-11, A4-11, A5-11, and A3-11) were deployed from the Khromov in summer 2011. The other three moorings deployed by the Khromov in 2010 (A11-10, A12-10, A13-10) in Russian waters were unable to be recovered during this cruise, and remain in the water for later recovery. Since these latter moorings have been in the water now for over 2 years, the chances for successful recovery are reducing.

Five moorings (A2W-12, A2-12, A4W-12, A4-12, A3-12) were deployed on this cruise under funding from NSF-AON (Arctic Observing Network) (PIs: Woodgate, Weingartner, Whitledge, Lindsay, ARC-0855748) with ship-time and logistical support from RUSALCA-NOAA (Russian-American Long-term Census of the Arctic, http://www.arctic.noaa.gov/aro/russian-american/). All these deployments were replacements of recovered moorings at sites occupied since at least 2007. The 4 moorings in the strait aim to give an overview of the structure in the US channel of the strait, which contains the Alaskan Coastal Current, a seasonal fresh, warm current important for heat and freshwater fluxes to the Arctic. A final mooring (A3) was deployed ca. 35 nm north of the strait at a site proposed as a "climate" site, hypothesized to measure a useful average of the flow through both channels [*Woodgate et al.*, 2007]. Testing this hypothesis is one of the main aims of this work. Other science goals including understanding the physics forcing the flow, and quantifying fluxes of volume, heat, freshwater and nutrients.

All moorings (recovered and deployed) measure water velocity, temperature and salinity near bottom (as per historic measurements). Additionally, 7 of the total 11 moorings (i.e., the climate site mooring A3; the mooring central in the western channel, A11; and all eastern channel moorings except A5 and D1) also carried upward-looking ADCPs (measuring water velocity in 1-2 m bins up to the surface, ice motion, and medium quality ice-thickness) and Iscats (upper level temperature-salinity-pressure sensors in a trawl resistant housing designed to survive impact by ice keels). Bottom pressure gauges were also deployed on the moorings at the east-west mooring extremes of the US channel of the strait (A2W-11 and A4-11), and remaining mooring A12-10 (west side of the Russian Channel) also carries a bottom pressure gauge. In the redeployments, pressure gauges were included at 3 sites – A2W-12 and A4-12 spanning the eastern channel of the strait, and mooring A3-12 to the north. Within the moorings serviced on this cruise, two sites (A2, central eastern channel; and A3, the climate site) also carry ISUS nitrate sensors and biowiper Fluorometer/turbidity instruments (as does remaining mooring A12-10). Biowiper Fluorometer/turbudity instruments are also included on mooring A4-12. Moorings A2W-12 and A3-12 and A4W-12 carry whale acoustic recorders. Mooring A3-12 also carries a suite of instruments to measure the inorganic carbon chemistry system in the strait, namely 1) SAMI-pH; 2) SAMI-pCO2; and 3) SBE-37. For a full instrument listing, see the table below.

This coverage should allow us to assess year-round stratification in the strait and also to study the physics of the Alaskan Coastal Current, a warm, fresh current present seasonally in the eastern channel, and suggested to be a major part of the heat and freshwater fluxes [*Woodgate and Aagaard*, 2005; *Woodgate et al.*, 2006]. The current meters and ADCPs (which give an estimate of ice thickness and ice motion) allow the quantification of the movement of ice and water through the strait [*Travers*, 2012]. The nutrient sampler, the transmissometer, fluorometer and whale recording time-series measurements should advance our understanding of the biological systems in the region. This year also marks the second year of year-round measurements of pCO2 and pH in the strait.

2012 Calibration Casts: Biofouling of instrumentation has been an on-going problem in the Bering Strait. A water column water property profile and some water samples obtained at the end of the deployment before the mooring is recovered would prove advantageous for addressing instrument calibration issues. (Although SBE sensors are calibrated post deployment, this calibration occurs in Seattle, some weeks after recovery, and after the instrument has been somewhat cleaned for shipping.) The comparatively small deck of the Khromov is mostly filled with mooring equipment during the recovery and deployment part of the cruise. This means is it not practical to deploy the CTD system for calibration casts prior to mooring recovery. Thus, at each mooring site, prior to recovery, a "calibration cast" was performed, by lowering a SBE37IM microcat on the trawl wire off the aft A-frame. Where water samples were required, a niskin bottle was attached to the line ~ 2m above the microcat, and triggered by a messenger once the bottle and microcat had been lowered to depth. The fastest sampling rate of the microcat is about 6s. The trawl wire was spooled slowly, giving a ~ 1m resolution to the profile. Since the microcat is not a pumped instrument, the preliminary data show unrealistic readings at times when temperatures and salinities are changing rapidly. However, the casts did give consistent readings for the waters below ~ 30m, which is sufficient to check the accuracy of the deeper salinity sensors on the moorings. Use of the microcat also allowed us to place the bottle sample close to the depth of the ISUS meter on the moorings. Data from these casts have already been used to prove that some of the SBE sensors on A3 were reading 2-3 psu too fresh by the end of the deployment (see below). **Action item: Continue (and improve) these casts in future years.**

2012 Recoveries and Deployments: Mooring operations went smoothly in 2012. For recoveries, the ship positioned ~ 200m away from the mooring such as to drift over the mooring site. Ranging was done from the aft-deck adjacent to the wet-lab. Without exception, acoustic ranges agreed to within 30m of the expected mooring position. Once the ship had drifted over the mooring and the acoustic ranges had increased to > 100m, 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.

All the moorings were recovered without dragging operations, although some suboptimal performance was found with some releases on the 2 moorings with the Bottom Pressure Gauges, A4 and A2W. On A4, release 17301 replied to the release command with a code which meant the release had not activated, and indeed on deck, this was found to be the case. The 2nd release on the mooring successfully released the moorings. On A2W, release 32046 first replied to the release command with a code which again meant the release had not activated. In response to a second command to release, the release responded with a code confirming release, but the mooring didn't surface. Once on deck it was found that the release mechanism had turned, but the hook had not moved freely to release the mooring. In this case also, the 2nd release on the mooring functioned successfully and the mooring was recovered without dragging. The case of 17301 requires instrument testing back in Seattle. The case of 32046 may relate to minor biofouling. It is notable however that, in recent years, within the UW instrumentation, it is the releases on the bottom pressure gauge moorings which are showing issues. This may be coincidence, or may relate to torque on the set up while in the water, or damage to the releases during deployment. The moorings are "dropped" from the surface, and in the bottom pressure gauge case the releases are very close to the anchor and may be hitting it. Other releases all functioned well – some of the UAF releases were deployed with springs to assist the hook freeing from the release mechanism. This modification should be considered on all moorings. ***Action item: Investigate 17301, continue with biofouling paint on releases and with double releases, investigate releases hitting anchor on deployment. Recheck pin alignment on all releases. Investigate springs for use on moorings.***

No dragging operations were required this year, though in anticipation of problems with A3, we requested the ship stand-by with a small boat in case the A3 mooring drifted into Russian waters. To avoid such complications in the future (and to make the mooring accessible by dragging from a large vessel such as the Healy), the A3 mooring was moved east by 600m from its 2011 position (which was already 300m east of the previous long-term position). This site is now ~ 1200m from the US-Russian convention line of 168 58.7'N). ***Action item: Note moving of A3 mooring position 600m from A3-11 site towards the US.***

In all cases, once the mooring was on the surface, the ship repositioned, bringing the mooring tightly down the starboard side of the ship. One grapple and a pole with a quick releasing hook attached to a line were used to catch the mooring. The line from the hook was fastened onto an extension on the port-crane, and the mooring lifted aboard. If the pick was too long for the crane, a stopper chain on the starboard rail was used. Iscats (present only on the recovery of A4-11) were recovered by hand while the top float was lifted clear of the water by the crane.

Biofouling was moderate to light in the recoveries this year, with the heaviest biofouling (accompanied by fine slit) in the moorings nearest to Alaska. Photos of the recovered instrumentation are given below. This year, for the first time we can recall, small amphipods were brought up with the moorings. On mooring A2W-11, a basket star was brought up on the bottom pressure gauge. Moorings carried the usual load of barnacles and fine biological growth. Overall though, release hooks were generally clear of biofouling, and salinity cells were mostly clear.

Mooring deployments were initially done through the aft A-frame, using the ship's trawl wire and block for lifting. Part way through the cruise, we transitioned to using the crane instead of the A-frame as this gave greater height for the picks. The mooring was assembled completely within the A-frame. The ship positioned to steam slowly (~2 knots) into the wind/current. When the ship was approximately 700m from the mooring position, mooring deployment started. The Iscat was deployed by hand and streamed behind the ship. The top pick (usually float) was deployed using a quick release. Then the anchor was lifted into the water. When the ship arrived on site, the anchor was dropped using a mechanical quick release. Positions were taken using a hand-held GPS on the aft deck by the A-frame. As necessary, slip lines were used to lower equipment on the mooring between picks over the stern.

Action items: design pick points into the moorings for recover; 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); making a platform for the aft deck, to avoid the lip that hinders slipping equipment over the stern; welding a cleat into the deck from which a line could slip equipment

On the last day of the cruise, while running the Bering Strait line, a yellow float was sighted just north of the line. Due to its similarity in color to the mooring floats, we diverted to investigate. It turned out to be an inflatable float, about 2 feet in diameter. Its use remains unidentified, as we did not recover it.

Instrumentation issues: Most instrumentation was started in Nome or aboard ship in the days prior to sailing. All instrumentation was started successfully, although a test run was required to establish the timing of the biowipers. Assembling the iscat housings proved to be less straightforward than usual, likely as parts were being reused from old housings. Some problems remained with the contacts on the memory battery for the loggers, and some items were noted with spare instrumentation.

Action items: Make iscat housings to a more generic fit; revisit memory battery on logger, revisit battery power on logger; update memory in ADCPs to be larger.

Overall, data recovery on the moorings was very good. Many instruments were downloaded this year via a KeySpan USB-serial port converter, as the newer laptops did not have serial ports. This generally worked well with the newer computers, but when used with the older laptops (to allow for dual serial port operation) this resulted in errors being introduced to the data files for the Wetlabs and the SBE37IM. Downloading the SBE37IM via the serial port resulted in a good file. ***Action item: investigate downloading in various configurations. Redownload the Wetlabs.***

ISCATs: Of the 6 Iscats deployed on the recovered moorings, only 1 top sensor (that on A4-11) was recovered. Although deployed with 2 viny floats, that top sensor was recovered with the upper of the 2 floats missing. Investigation of the data suggests the package lost buoyancy within a few weeks of early May. The logger from that instrument stopped recording on the 24th May 2012, shortly after a major pull down event. Loggers from the other moorings stopped collecting data in the spring (A4-24th May; A4W – 19th March; A2E – 26th Feb; A2 – 17th March; A2W – 21st April; A3 – 8th Feb), though some of these may relate to low battery voltage, rather than ice damage. It should be possible to search the ADCP data for ice drafts that could potentially damage the iscat, or information indicating presence of the iscat above the ADCP head. ***Action item: investigate logger battery issues; compare iscat end dates with ice draft data***.

ADCPs: Of the 6 ADCPs recovered, 5 recorded full records. ADCP 9396 on A2W11 stopped on deck 2 days prior to deployment, but restarted automatically after about 1 hr and returned a complete record for the year-long deployment. ADCP 13756, however, returned only fragments of data. It ran for 4 days in the water, and then started to record new (short, often with no data content) files at erratic time intervals. The last attempt to write a file was in August 2011 and batteries were flat on recovery. ***Action item: Investigate ADCPs 9396 and 13756***. Data from the other ADCPs appear good (see below), and suggest a homogeneous flow within the strait, with surface intensification in the Alaskan Coastal Current. In November 2011, there was a particularly strong storm in the region, and this is reflected by velocities around 200 cm/s at all depths at all mooring sites within the strait proper. Measurements from 1990 have flows typically less than 100cm/s – only on 2 prior occasions has flow > exceeding 150cm/s been observed in the center of the strait.

SBEs: Seabird temperature-salinity sensors show typical annual cycles. Data are mostly clean with a few spikes, though instrument 1224 on A2W-11 has 2 periods of anomalously low salinity possibly relating to biofouling. The pressure sensor on 4639 on A3-11 failed half way through the deployment. Mooring A3-11 carried a total of 3 SBE sensors, and comparison of these data indicate 2 of the instruments were reading 2-3 psu low by the end of the deployment. The error is confirmed both by comparison with the overlying microcat and by comparing the temperature during winter with that calculated as the surface freezing temperature for the recorded salinities. This does not appear to be a biofouling issue, since the cells were poisoned and were clear on recovery. Both the troublesome instruments (SBE16plus 4639 and SBE37-7156) were mounted horizontally on the mooring, and we hypothesize that silt may have gathered in the cell affecting the calibration. This is being investigated further, though we note the manufacturer's recommendation that instruments be mounted at least 15 deg from the horizontal. Instrument 1700 on A4-11 was deployed by mistake with no poison cell – however, this does not appear to have harmed the salinity record. There was also confusion as to whether the ISCATs contained new poison cells, but again the records do not obviously suggest there is was a problem – the recovered ISCAT had poison and a clear cell. ***Action items: replace pressure sensor on 4639; investigate cause of erroneously low salinities at A3.***

BPG: Bottom pressure gauges (BPG) returned full records. Differencing pressures across the strait suggests flow anomalies of between -100 and + 150cm/s. Note that since the absolute depths of the instruments are not known, the BGPs can only be used alone to give flow anomaly, not total flow.

Turbidity/Fluorescence: The SBE instruments on A2 and A3 also carried optics sensors for PAR and fluorescence. A3 also measured reflective transmissivity. Standalone Wetlabs Biowipers were deployed on A2W11 and A411. While that on A2W shows a fluorescence peak in both autumn and spring, A3 suggests only a spring bloom. In both cases, the turbidity frequently exceeded the instruments range, significantly more so at A4.

Aanderaa RCMs: The current meters also returned good data for the deployment year, with the site at D1 having a distinctly weaker and more eddying flow than in the strait. One Aanderaa also returned turbidity information, but that is not plotted below.

Russian Current Meter: After the failure last year of the strength member of the AARI current meter, for 2011 the meter was deployed in a converted UW SBE vane. The instrument was recovered safely, but had obviously undergone substantial corrosion. On opening, it was found the instrument had also leaked significantly. The instrument is being returned to Russia for investigation. It is not clear yet if data will be obtainable from the instrument.

Other sensors on the moorings are described in individual cruise reports below. Of the **2 ISUS nitrate sensors** recovered, one returned a full year of data, while the other recorded only for 1 month. The **3 recovered whale recorders** yielded data for much of the year at two of the sites. The **Sami pH sensor** (including a thermistor and oxygen optode) acquired data for ~ 6.5 months. The **Sami-pCO2** and **SeaPhOx** sensors will be downloaded only when the instruments are returned to OSU.

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.

RUSALCA 2012 BERING STRAIT MOORING POSITIONS AND INSTRUMENTATION

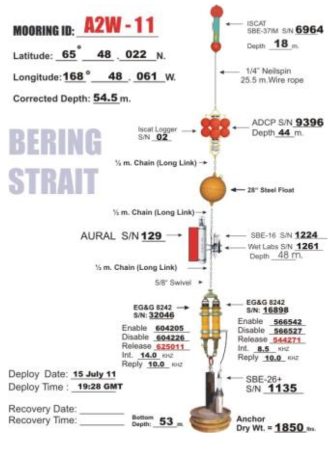
ID	LATITUDE (N) (WGS-84)	LONGITUDE (W) (WGS-84)	WATER DEPTH /m (corrected)	INST.
2012 Mooring Recoveries				
- US EEZ				
D1-11	65 52.173	168 56.807	47	AARI, RCM9, SBE37, WR
A2W-11	65 48.022	168 48.061	55	ISCAT, ADCP, SBE16, WR, FLT, BPG
A2-11	65 46.866	168 34.069	57	ISCAT, ADCP, SBE/TF, ISUS
A2E-11	65 46.254	168 28.064	57	ISCAT, ADCP, SBE37
A4W-11	65 45.423	168 21.954	56	ISCAT, ADCP, SBE16,
A4-11	65 44.762	168 15.770	50	ISCAT, ADCP, SBE16, FLT ,BPG
A5-11	65 44.397	168 11.081	45	RCM9T,SBE16
A3-11	66 19.594	168 57.502	59	ISCAT, ADCP, SBE37(2), pH, pCO2, AAOx,SeaPhox, ISUS, SBE/FPAR, WR

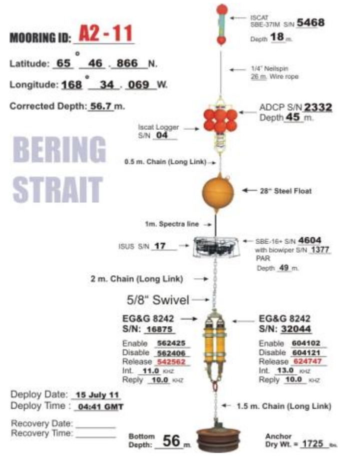
ID	LATITUDE (N) (WGS-84)	LONGITUDE (W) (WGS-84)	WATER DEPTH /m (corrected)	INST.
2012 Mooring Deployments (all in US EEZ)				
A2W-12	65 48.03	168 48.06	55	ISCAT, ADCP, SBE16, WR, BPG
A2-12	65 46.86	168 34.07	56	ISCAT, ADCP, SBE/FPAR, ISUS
A4W-12	65 45.42	168 21.95	56	ISCAT, ADCP, SBE16, WR
A4-12	65 44.75	168 15.77	50	ISCAT, ADCP, SBE16, FLT ,BPG
A3-12	66 19.61	168 57.05	59	ISCAT, ADCP, SBE37(2), pH, pCO2, SBE/TFPar, ISUS, WR, BPG, FLT
2010 Moorings still in the water (all in Russian EEZ)				
A11-10	65 54.001	169 25.985	52	ISCAT, ADCP, SBE37
A12-10	65 56.007	169 36.990	50	ISUS, SBE/TF, RCM9, BPG
A13-10	65 52.000	169 16.987	50	AARI, RCM9, SBE37

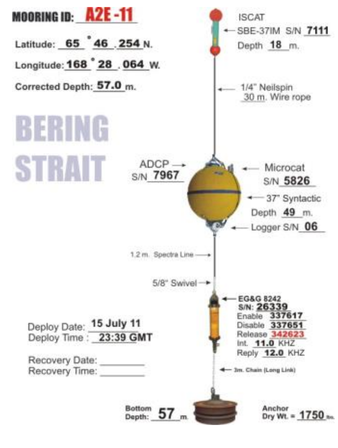
AARI = AARI Current meter
ADCP = RDI Acoustic Doppler Current Profiler
BPG=Seabird Bottom Pressure Gauge
FLT=Wetlabs Biowiper Fluoresence& Turbidity recorder
ISCAT = near-surface Seabird TS sensor in trawl resistant housing, with near-bottom data logger
ISUS= Nutrient Analyzer
RCM9= Aanderaa Acoustic Recording Current Meter
RCM9T = Aanderaa Acoustic Recording Current Meter with Turbidity
pCO2 = SAMI pCO2 sensor
pH = SAMI pH sensor
Ox=SeapHox sensor, AAOx=Aanderaa Oxygen sensor
SBE/TFPar = Seabird CTD recorder with transmissometer (T), fluorometer (F), PAR(Par)
SBE16 = Seabird CTD recorder
SBE37 = Seabird Microcat CTD recorder
WR=Whale Recorder

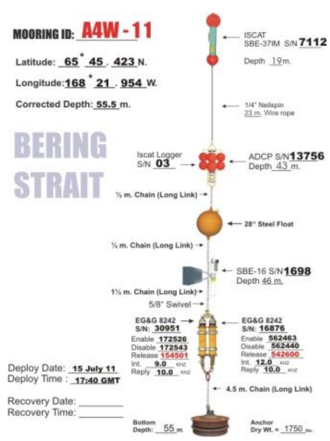
RUSALCA 2012 SCHEMATICS OF MOORING RECOVERIES

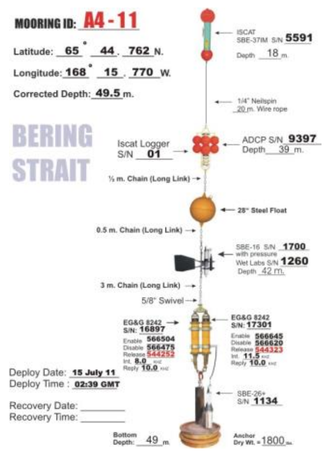
= in the eastern channel of the Bering Strait

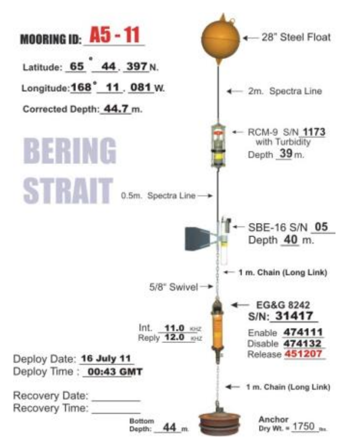




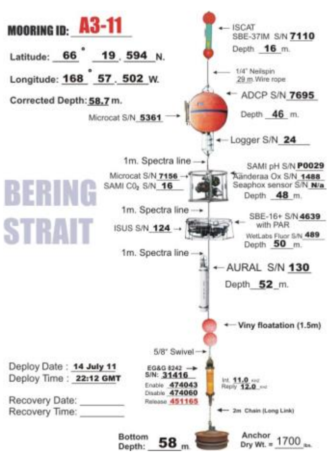




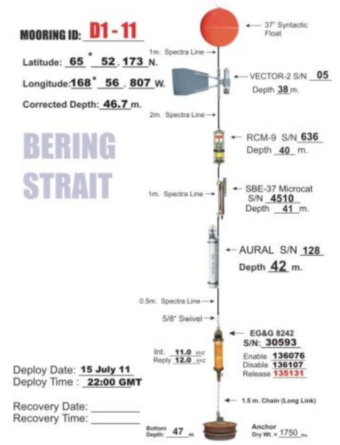




= at the climate site A3 north of the Strait

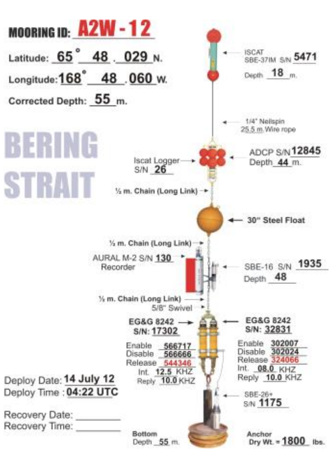


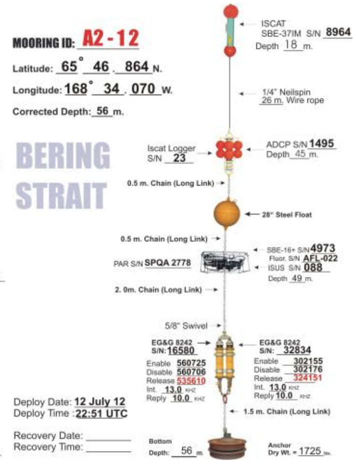
= at the mixing site north of the Diomede Islands

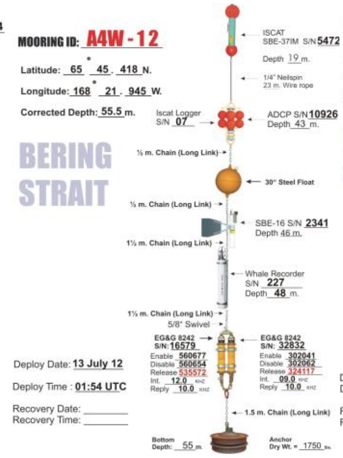


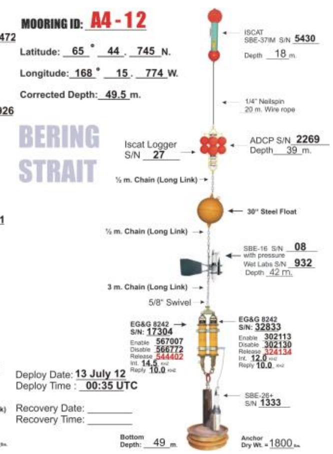
RUSALCA 2012 SCHEMATICS OF MOORING DEPLOYED

= in the eastern channel of the Bering Strait

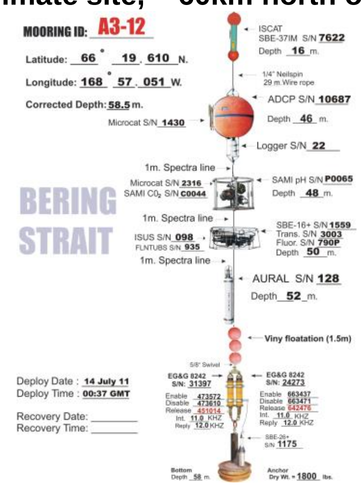






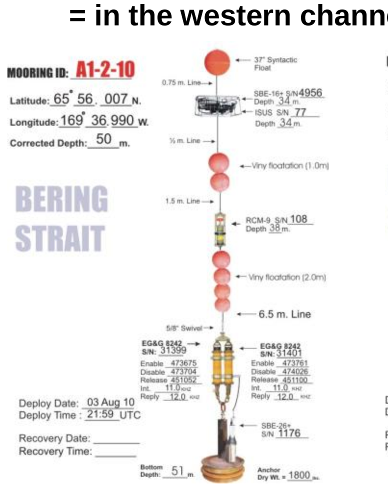


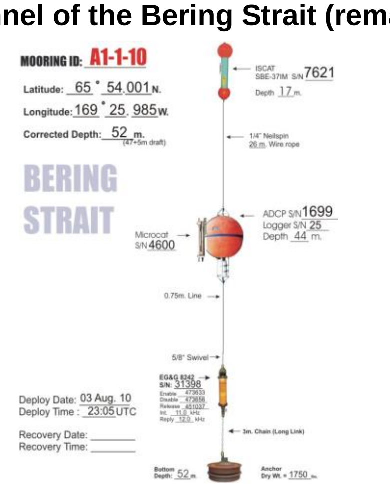
= at the climate site, ~ 60km north of the Strait

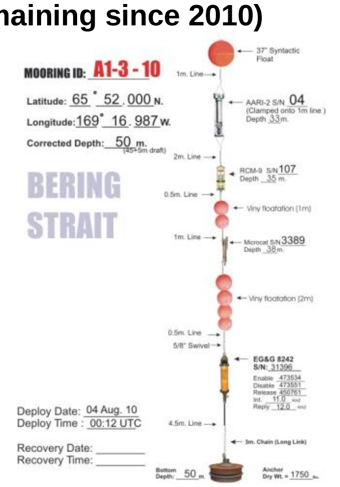


RUSALCA 2012 SCHEMATICS OF MOORINGS REMAINING SINCE 2010

= in the western channel of the Bering Strait (remaining since 2010)







RUSALCA 2012 RECOVERY PHOTOS (in order of from US toward the Diomedes)

RUSALCA 2012 RECOVERY PHOTOS (continued)

A4W-11

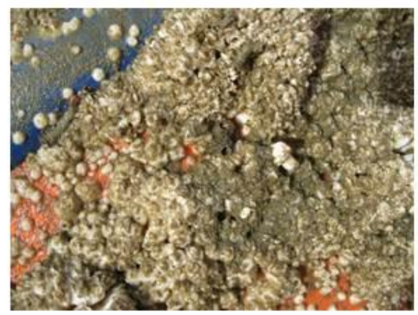
A2E-11

RUSALCA 2012 RECOVERY PHOTOS (continued)

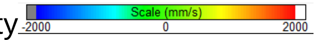
RUSALCA 2012 RECOVERY PHOTOS (continued)

RUSALCA 2012 RECOVERY PHOTOS (continued)

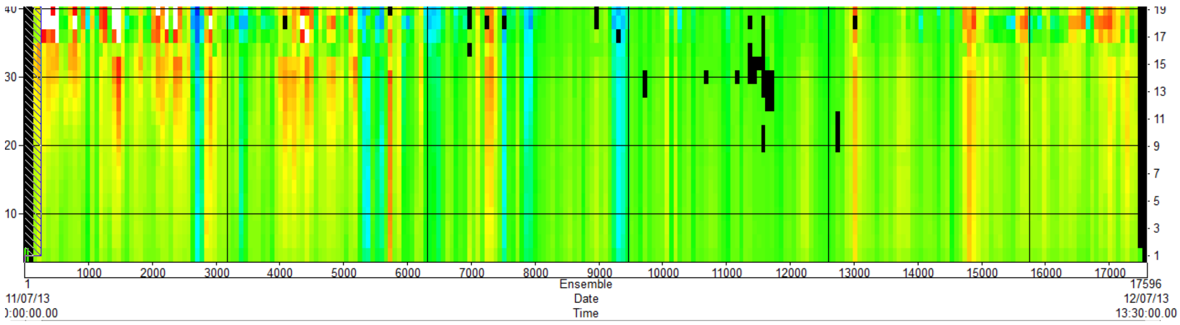
A3-11
(part 2)



RUSALCA 2012 – recovered ADCPs Northward velocity

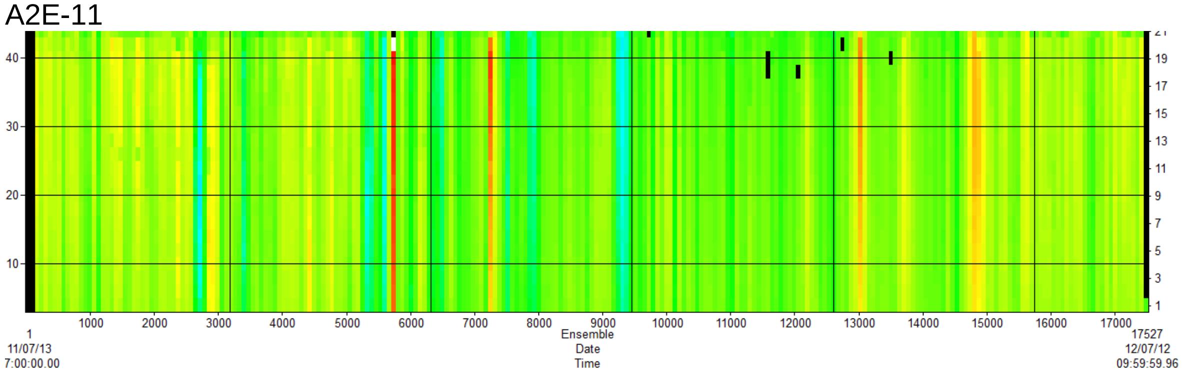


A4-11

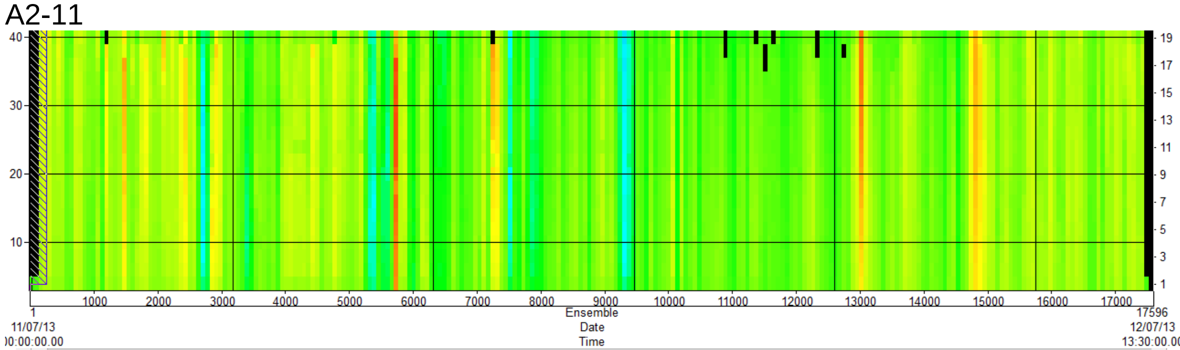


A4W-11 – BAD DATA

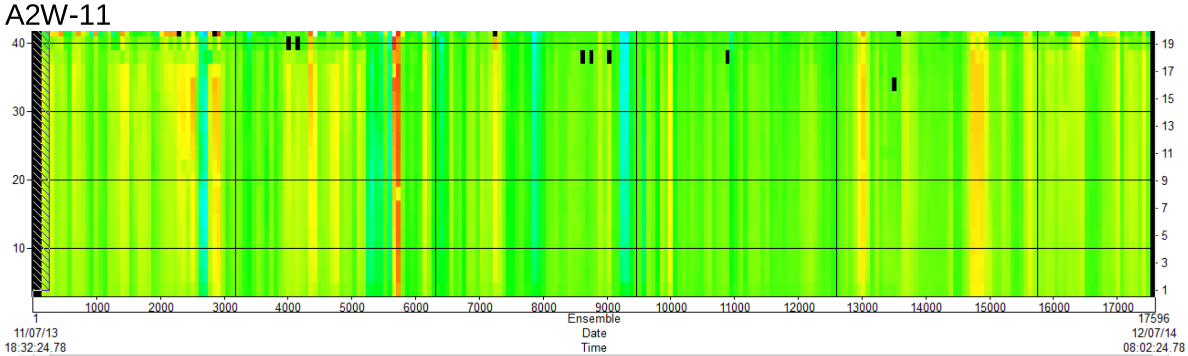
A2E-11



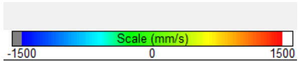
A2-11



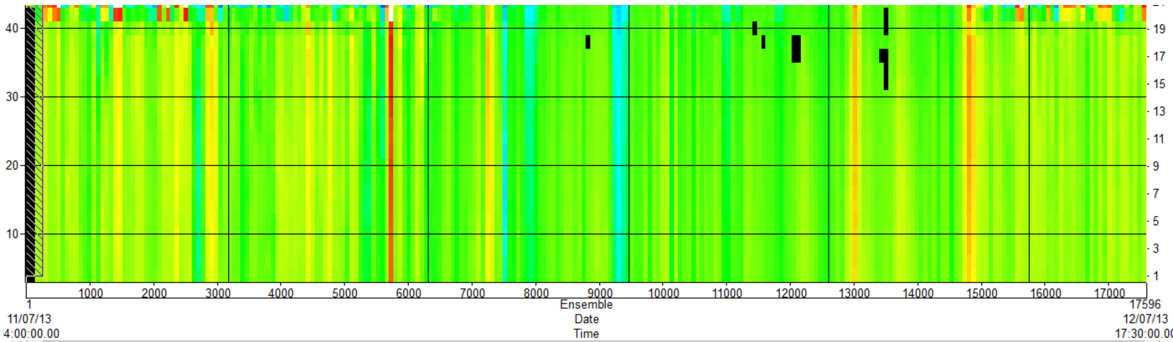
A2W-11



Note Different scale



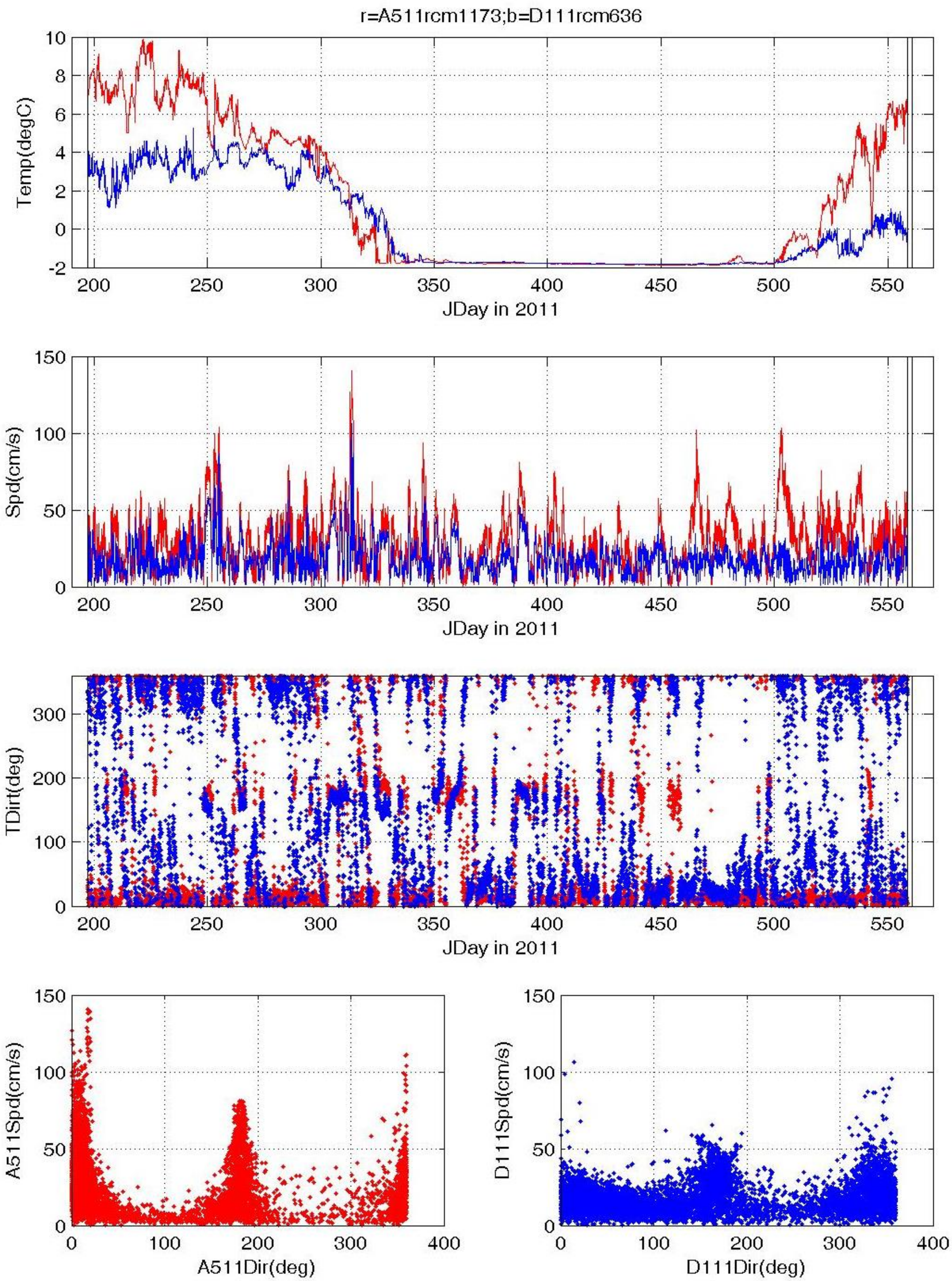
A3-11



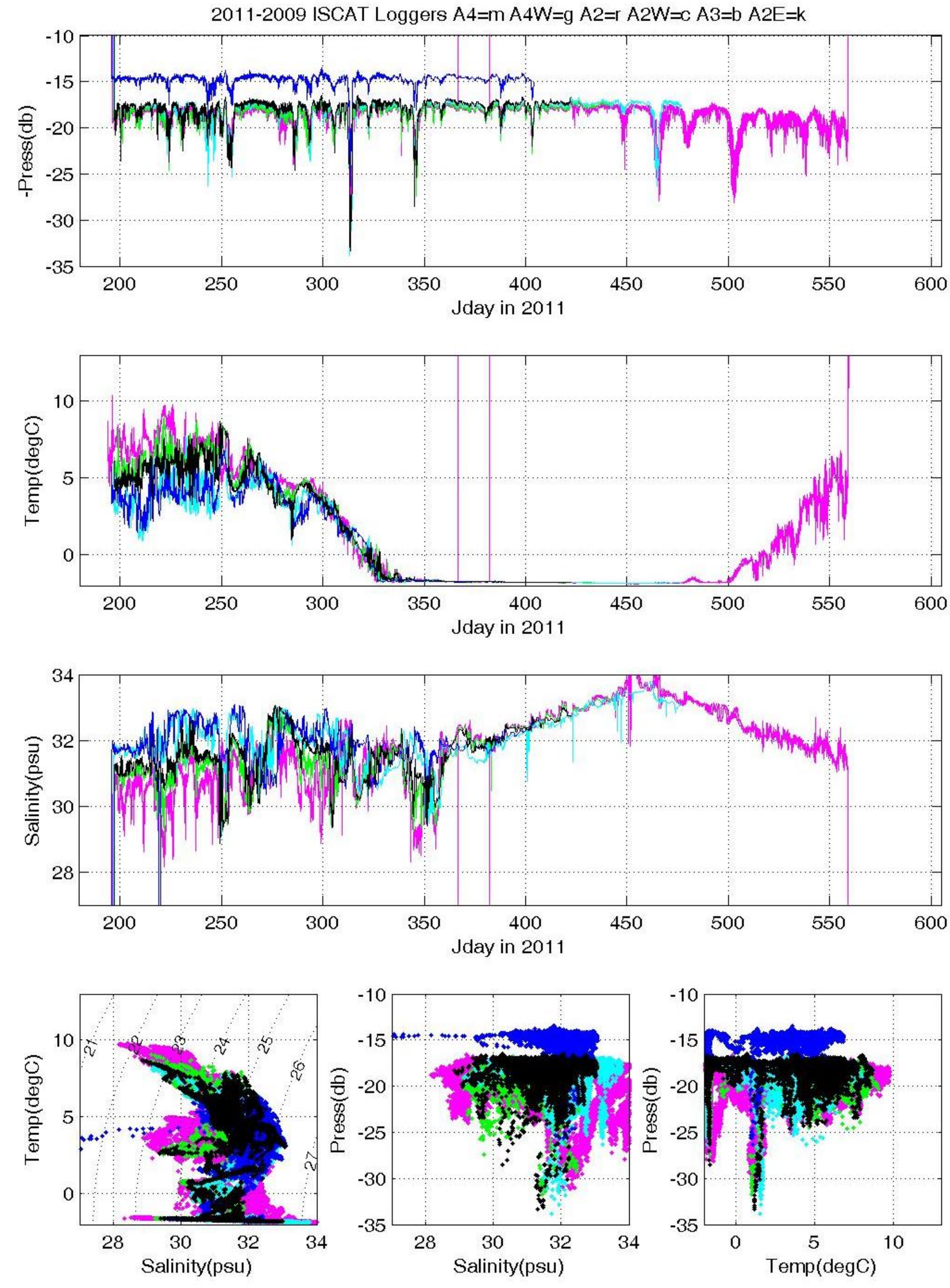
November 2011 storm
- A2E – about 200 cm/s
- A2 – about 200 cm/s
- A2W – about 200 cm/s
- A4 – about 200 cm/s
- A3 about 150 cm/s

Iscat
- A4
- A2E – maybe 28m, till 12050
- A2 – maybe 25m, till 11000, maybe 12000
- A2W – maybe 25m till 13000
- A4 – not really that clear
- A3 not evident

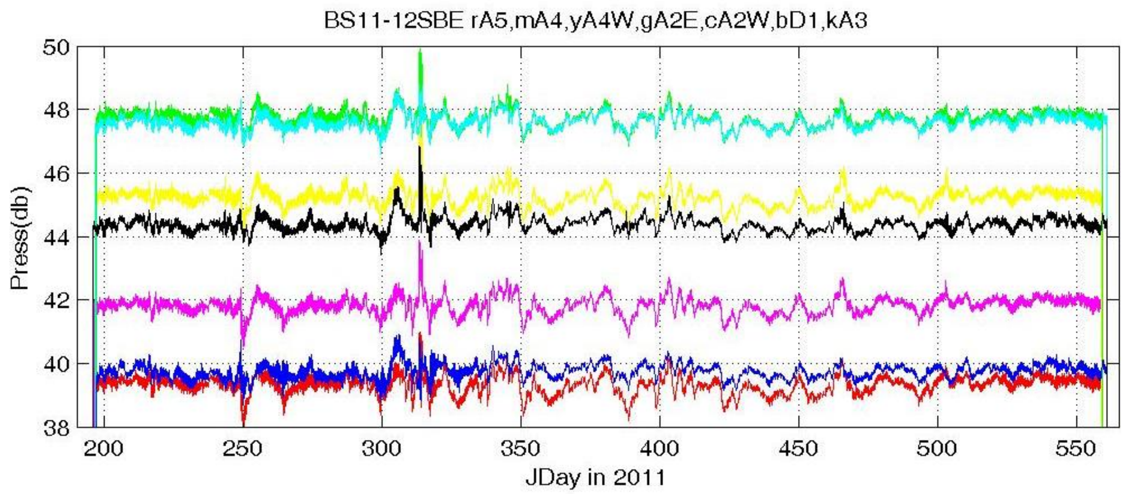
RUSALCA 2012 PRELIMINARY RCM RESULTS (Turbidity not shown here)

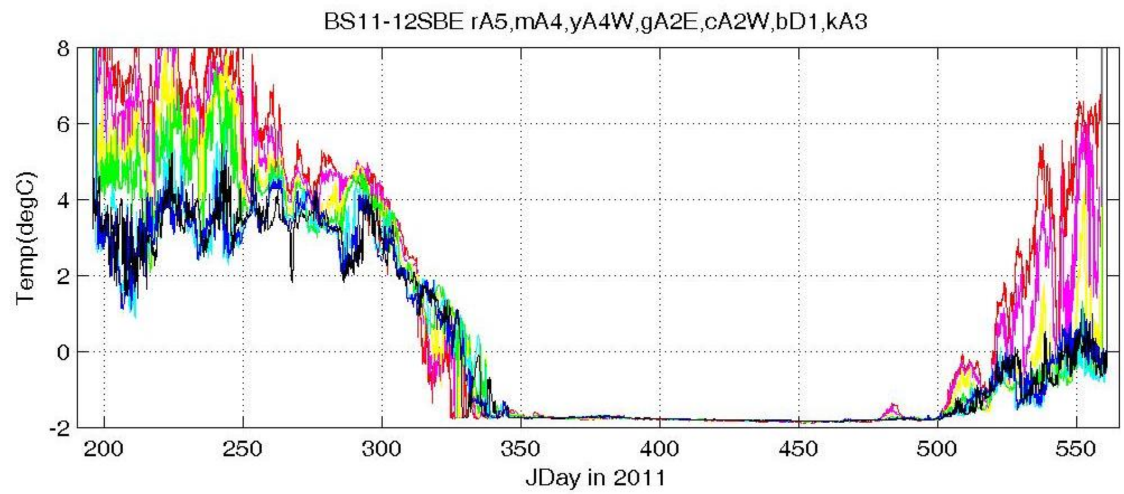


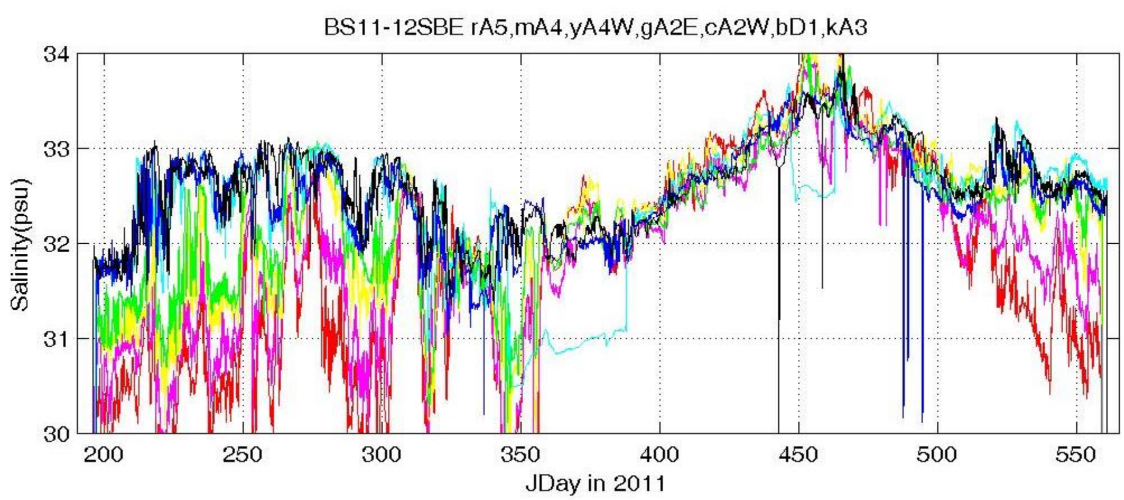
RUSALCA 2012 PRELIMINARY ISCAT RESULTS



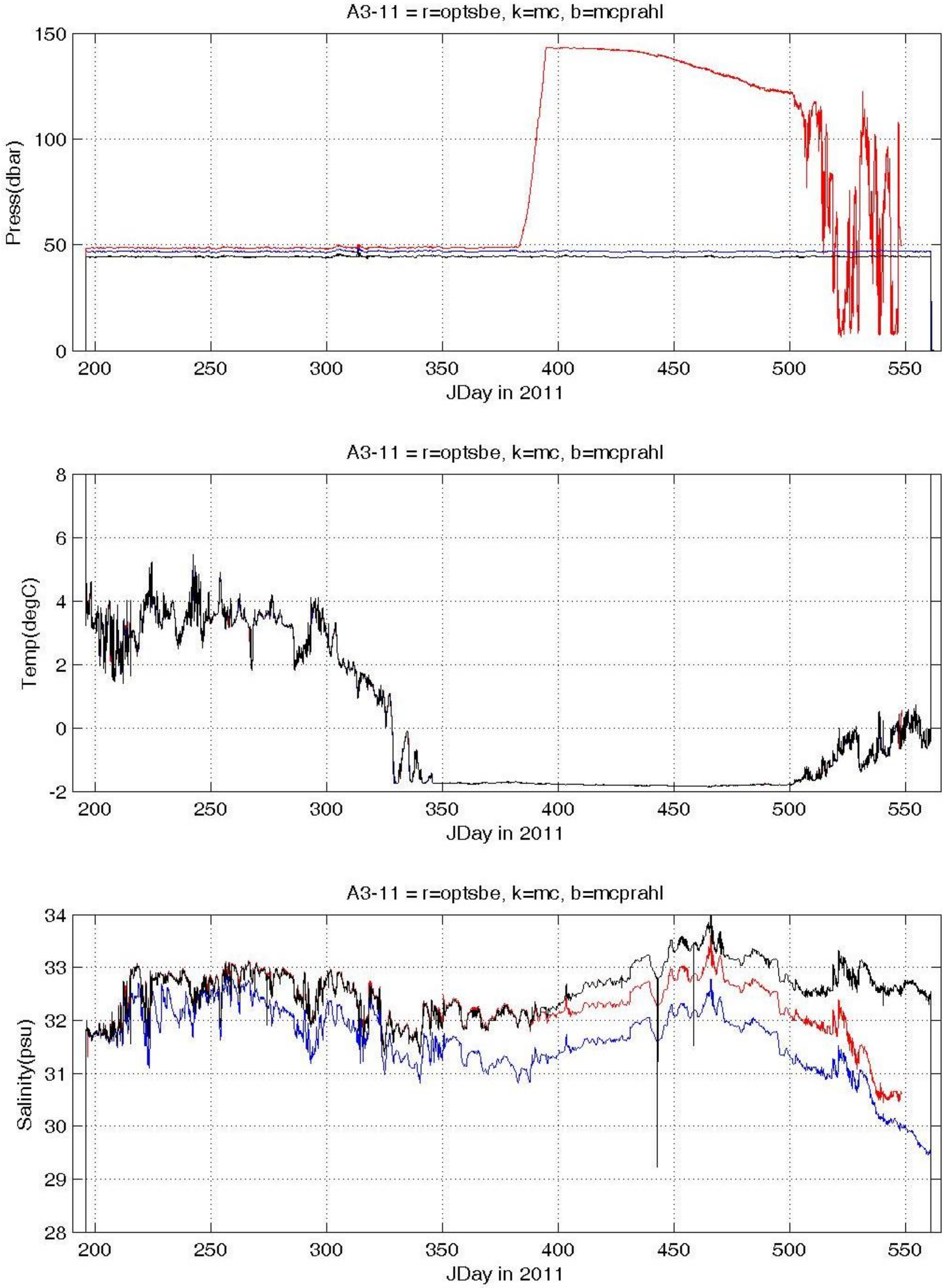
RUSALCA 2012 PRELIMINARY SBE RESULTS (Optics data not shown here)



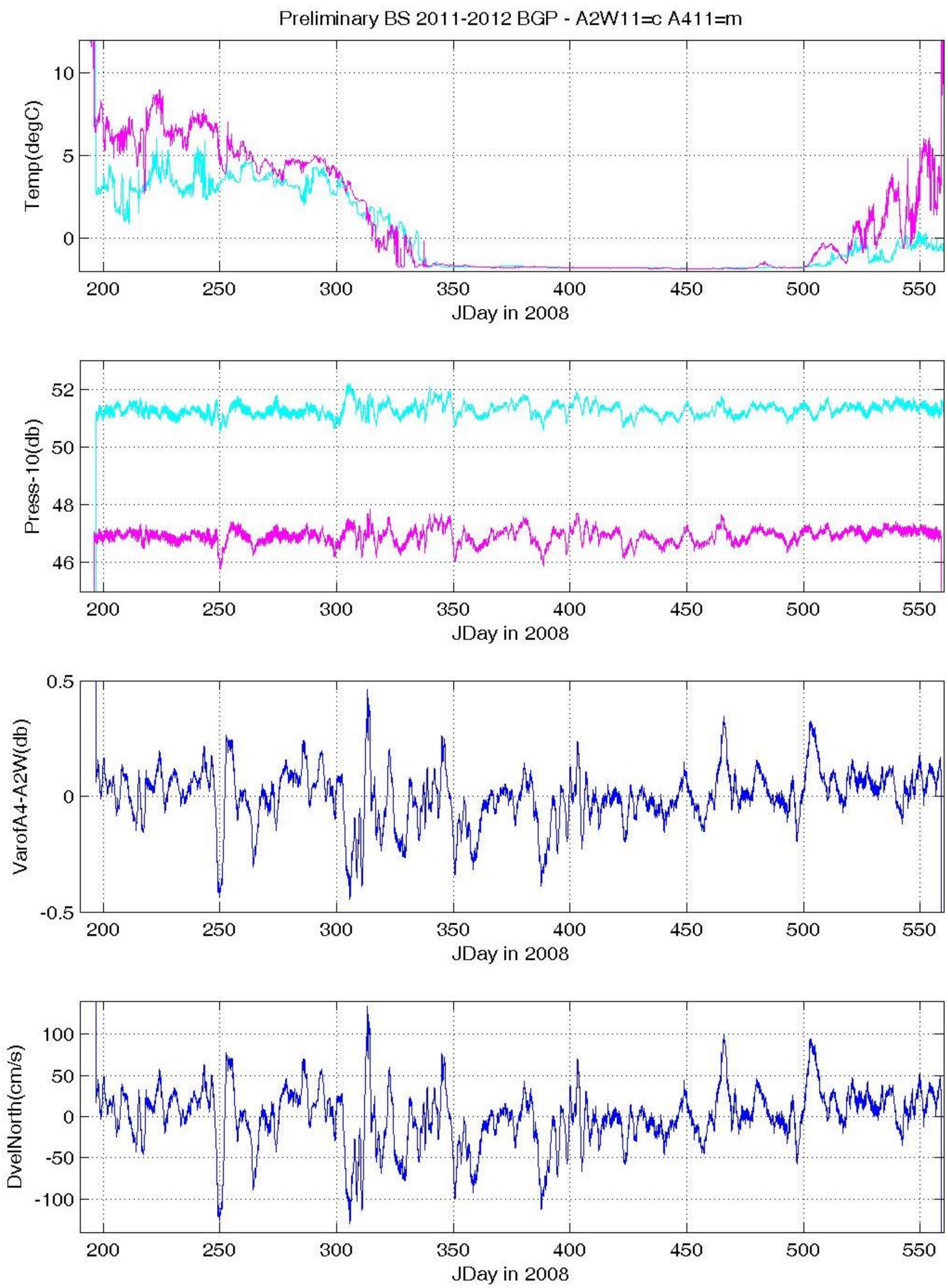




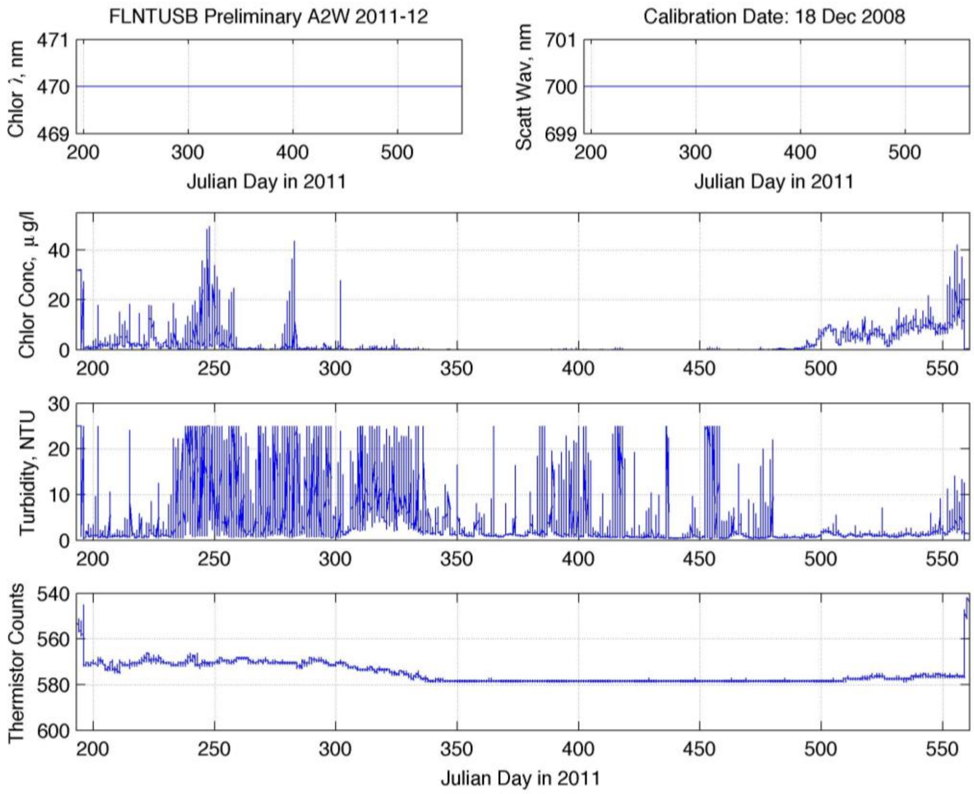
RUSALCA 2012 PRELIMINARY A311 SBE RESULTS

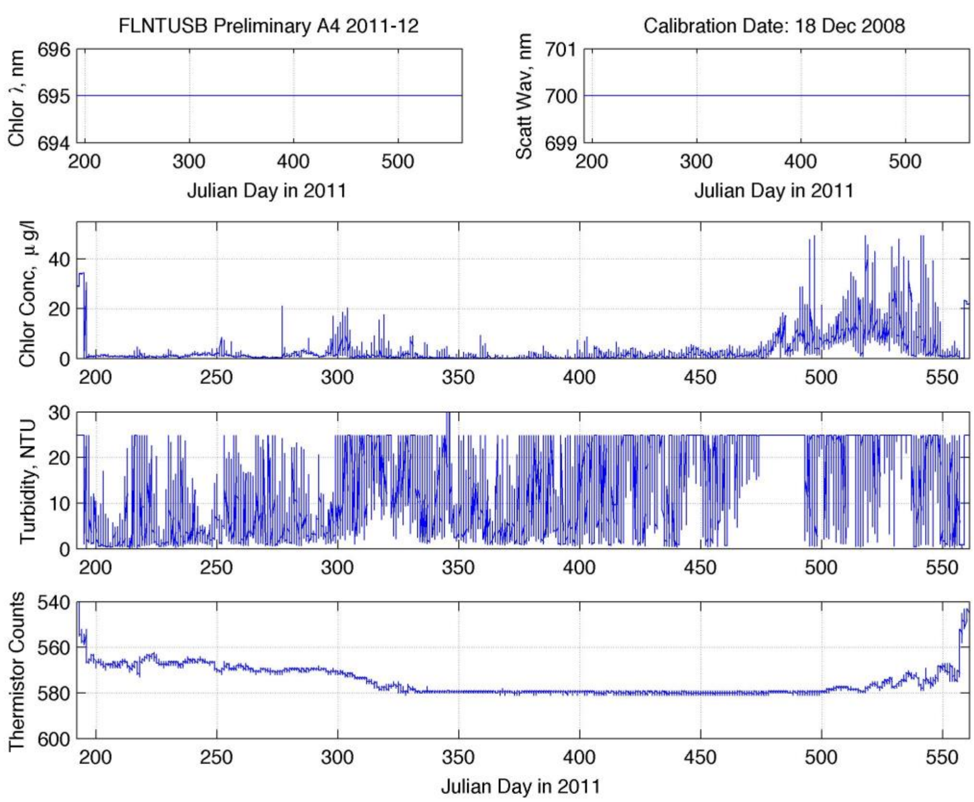


RUSALCA 2012 PRELIMINARY BOTTOM PRESSURE GAUGES RESULTS



RUSALCA 2012 PRELIMINARY FLUORESENCE/TURBIDITY RESULTS – (Cynthia Travers)





CTD OPERATIONS (Whitefield, Stoudt, Travers, Pisareva, Brazhnikov, Nguyen, Leech)

The moorings are usually supported by annual CTD sections, with water samples for various projects as described below.

The CTD sections for RUSALCA 2012 were taken by a CTD rosette system with the setup described below, controlled by a SBE-11*plus* deck-unit, running the software package Seasave v7. The lowering and raising was done by the ship's conducting cable winch, at a rate of ~ 0.3 m/s. Bottles were fired by the operator at the deck-unit on the up-cast. Data were recorded in standard hexadecimal SBE format, and preliminarily processed in to 2db averaged files using the Seabird data processing software.

Configuration Date: June 15 2012 – known instrument calibration dates in parentheses

- SBE 11*plus* Carousel Deck Unit
- SBE Carousel
- SBE 5T Pump
- Seapoint Flurometer SN:2460 (Voltage0)
- Biospherical QCP2300 SN:4497 (Voltage2)
- Teledyne Benthos PSA-916 Altimeter:SN688 (Voltage6)
- SBE Primary Temp 1771 (Frequency0; Oct 28 2011)
- SBE Secondary Temp 1772 (Frequency3; Oct 28 2011)
- SBE Primary Conductivity 2251 (Frequency1; Oct 28 2011)
- SBE Secondary Conductivity 2272 (Frequency4; Oct 28 2011)
- SBE Pressure 0438 (Frequency2; Jan 29 2004)
- SBE Oxygen 0503 (Voltage4; May 24 2011)
- Garmin 17xHVS GPS SN:1BN021515

The rosette carried twelve 5.0l bottles. The CTD was deployed through the stern A-frame using the ship's 01 deck starboard 9 mm EM conducting cable, winch and slip rings. The electrical termination from last year remained on the winch cable, and was found to be in working condition at the beginning of the cruise, meaning a new termination was not necessary.

The positioning of a freezer container on the 01 deck, just aft of the winch controls made visibility of the A-frame difficult, but just workable.

Cameras were set up to give the CTD operator oversight of A-frame and winch operations. In future years, ***bringing more camera cable*** would allow this system to be extended to the bridge and alternative camera viewpoints can be used. The vessel now has a wireless access point in the bar/lounge area, designed for customers to access personal emails. As the DVR that records the camera images has a LAN port, it could be worth investigating the possibility of transmitting pictures to the bridge wirelessly.

An additional computer with serial port should be brought on the cruise for next year, as a UW mooring computer was borrowed on this cruise to run a GPS package and store the event log.

On one occasion, the CTD power breaker was tripped, but the UPS system brought for the CTD supported the deck box, cameras, two monitors and two computers for 10minutes without issue.

Handheld radios brought for CTD operations were powered by non-rechargeable AA batteries of which we had limited supply. Rechargeable ship's radios were employed to reduce the drain on the AA battery supply. ***Consider bringing rechargeable radios, or more batteries for next year.***

Note also no chair is provided by the ship for the CTD operator.

CTDs were run using 5 people – 1 CTD operator, 1 winch driver, 1 A-frame driver, 2 persons on deck to catch the rosette. (In good weather, 1 person may have been sufficient.) The 2 deck persons also assisted with water sampling. CTDs were run 24hrs using a 2 or 3 watch system. Pallets were stacked under the A-frame to bring the rosette to a comfortable height for sampling.

CTD operations went smoothly, and a total of 161 casts were made (see below for positions). (Note in the event log, times are taken from the camera system, which was ~ 5min fast for the duration of the cruise. Times in the CTD files are taken from GPS and are thus accurate. ***For the next cruise, reset***

the camera system time before the cruise starts.) The issues last year with the altimeter were not reproduced, and the altimeter readout was comparable to the depths given by the bridge echo sounder.

There were occasional bottles which failed to fire, but since two bottles were fired at each requested depth on most casts, an explanation for this was not pursued. However, bottles #1 and #2 both had occasions where the release hook did not even trip. This was remedied by adding a small cable tie to the lanyard. This shifted the angle of tension applied sufficiently for the arm to release. Bottle 6 also often failed to close properly at the bottom cap, so it was replaced with a spare nisken bottle.

A likely challenge on data processing will be the oxygen data, which showed significant hysteresis between the down and up casts. No bottle oxygens were taken to calibrate the CTD sensor.

Generally the ship drifted during CTD operations, with screws still turning, but feathered for no thrust. Ship's draft is 5m, and this should be taken into account in viewing the data. ***Ship drift was at times substantial, particularly in the stations nearest to the Alaskan Coast, and this might be investigated to get some idea of water velocity*** (combined with wind-driven drift of the ship).

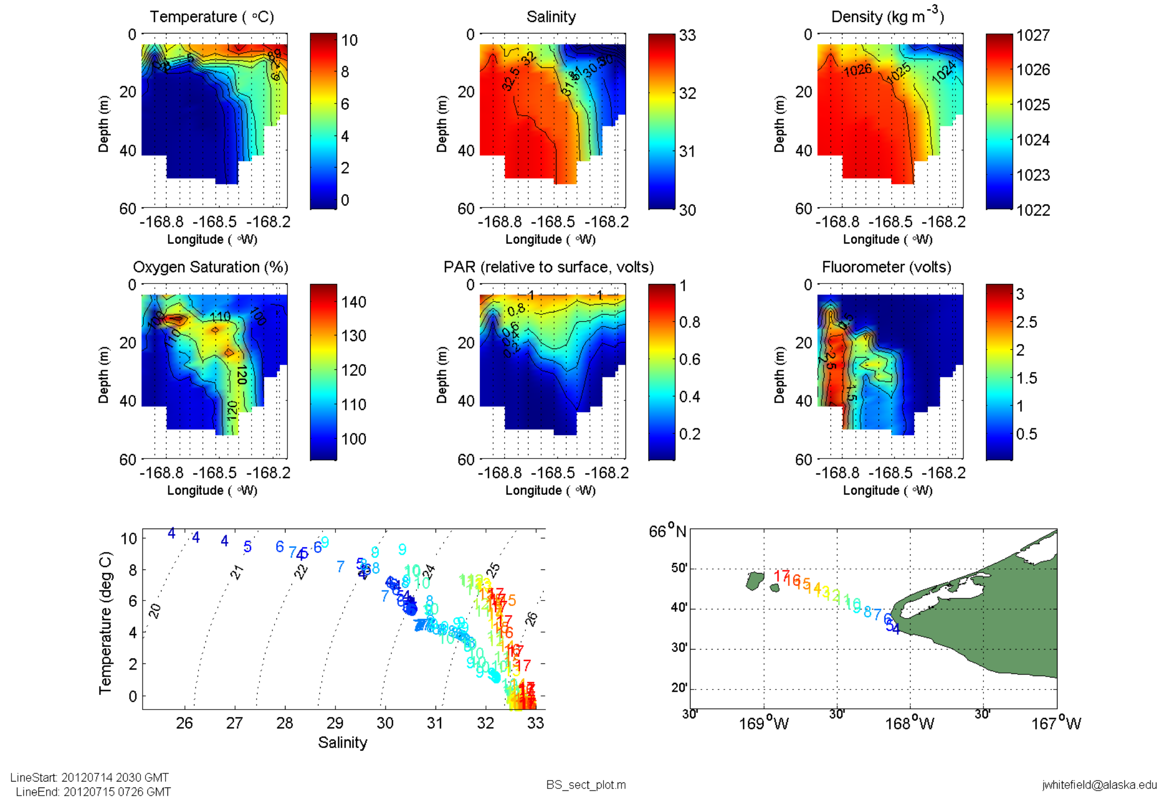
As with last year, CTD work was 24 hr, and at some stage operations were done during the dark. Based on the effects of the A-frame light was affecting the PAR sensor in 2010, the A-frame light were kept off for all deployments.

A total of 10 CTD lines were run on the cruise – preliminary sections are given below. Exceptional weather meant there were almost no weather delays for CTD operations, with a 9 hr exception at the start of the LIS line. On arrival at the east end of this line, winds and seas were building, and we waited for both to calm somewhat before running the line. If the ship pitches significantly, or there are sufficiently large waves or swell, the CTD cable can become slack on the deck. Since the winch operator cannot see the CTD package while in the water, this makes CTD recovery tricky ***Likely call off CTD operations when pitching is sufficiently bad to bring the CTD cable to almost slack on deck between pitches.***

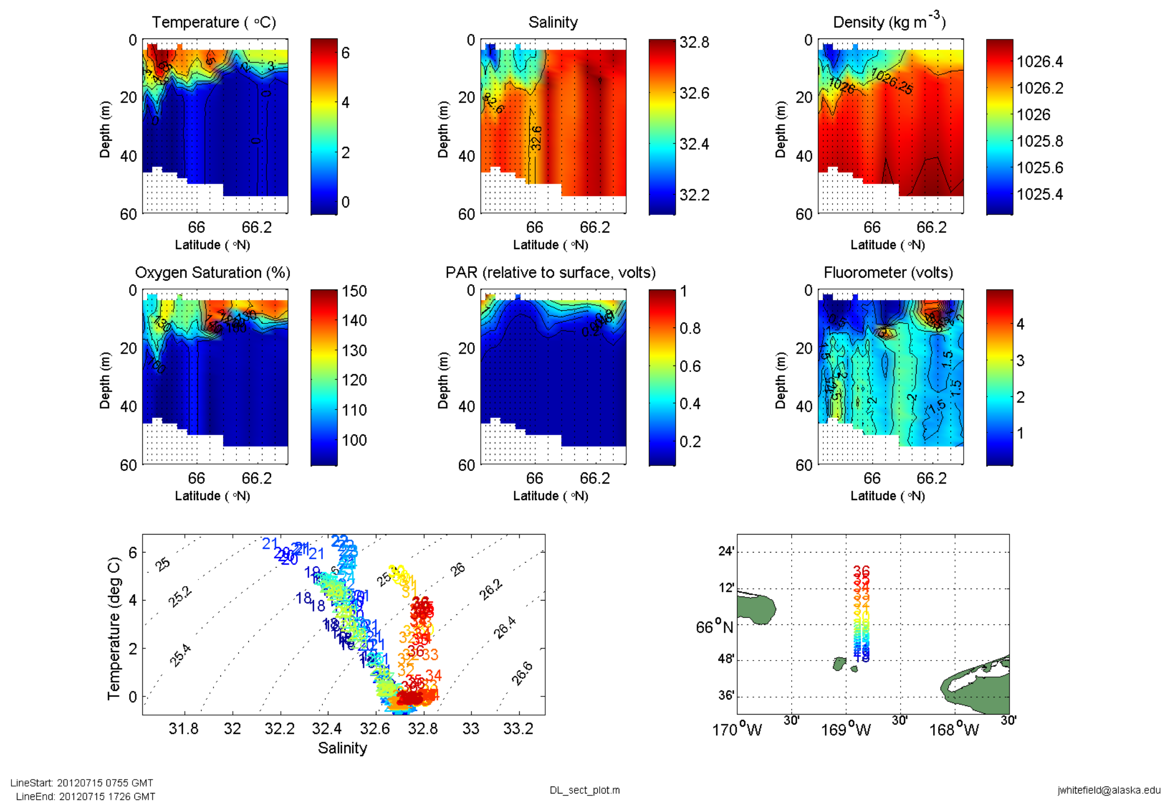
Preliminary CTD sections are given below plotted by J. Whitefield from 2m averaged data. Vertical grid lines on contour plots represent station locations. The fresh warm Alaskan Coastal Current is evident near the US coast in several of the plots.

Various repeat stations were run during the cruise, after intervals of hours and of days. In addition, the CCGC Laurier ran the CS line very shortly after our occupation of it. Study of these co-located stations will give insight into the temporal variability of the region.

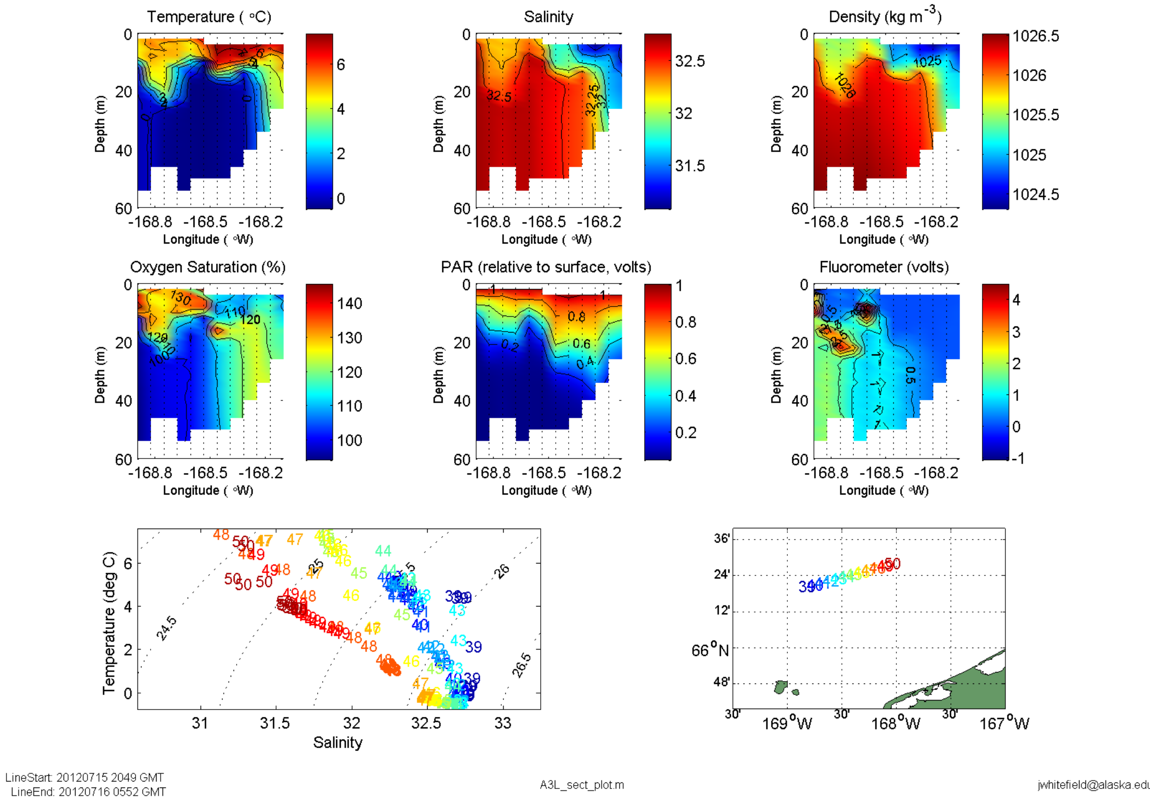
BS Line - GMT 14th July 2012 2030 to GMT 15th July 2012 0736



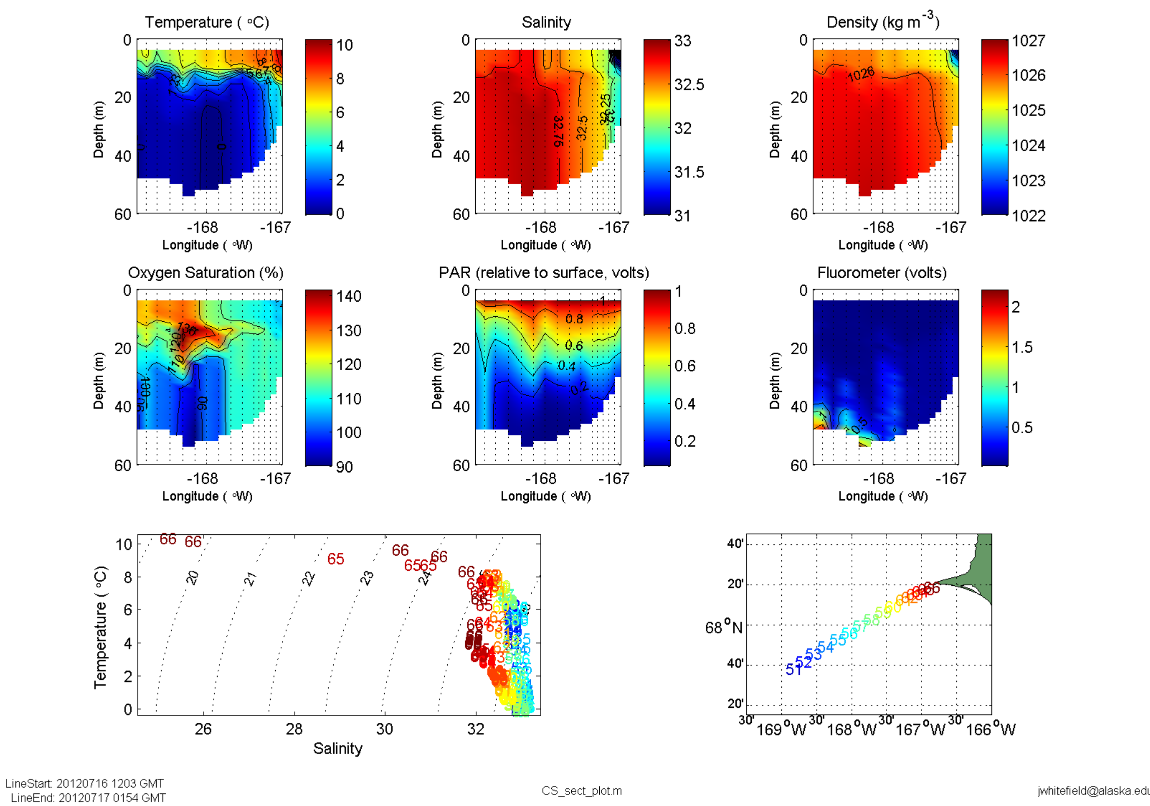
DL Line (slightly east of 2011's DI line) – GMT 15th July 2012 0755 to 1735



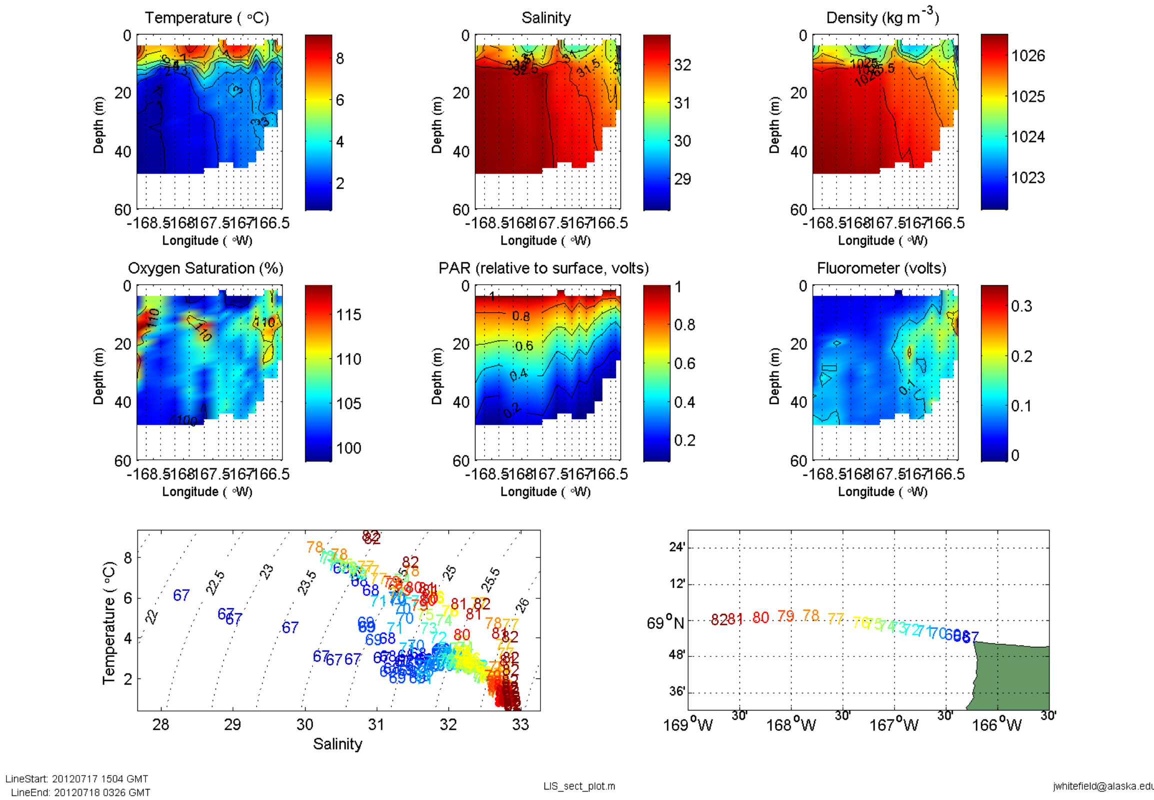
A3 Line – GMT 15th July 2012 2007 to GMT 16th July 2012 0600



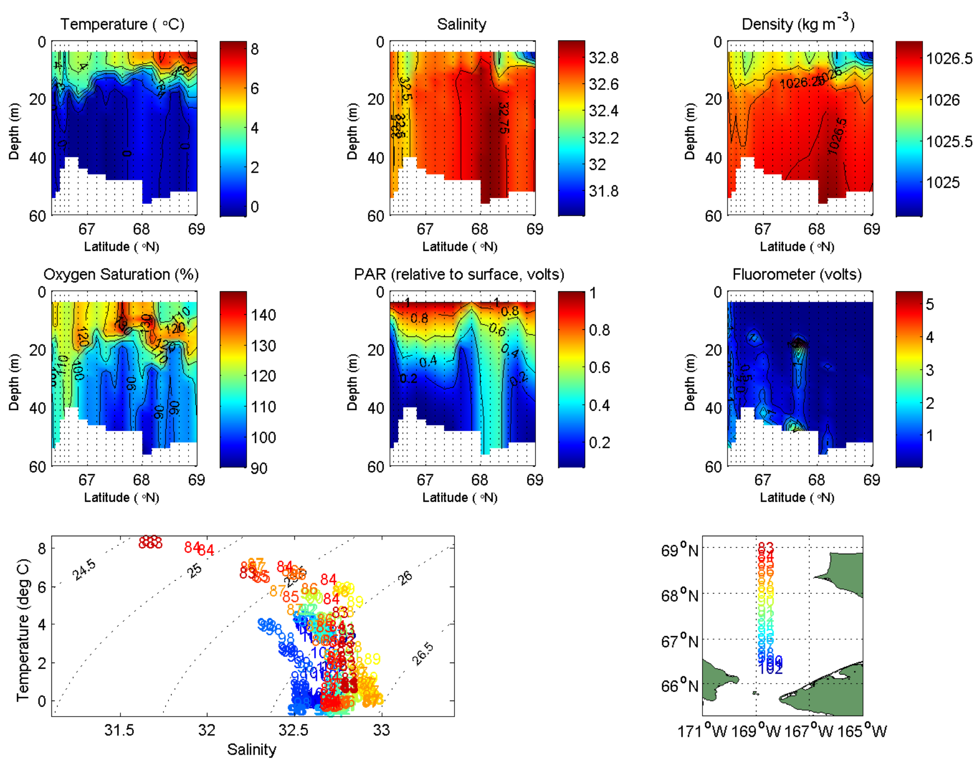
CS Line – GMT 16th July 2012 1203 to GMT 17th July 2012 0201



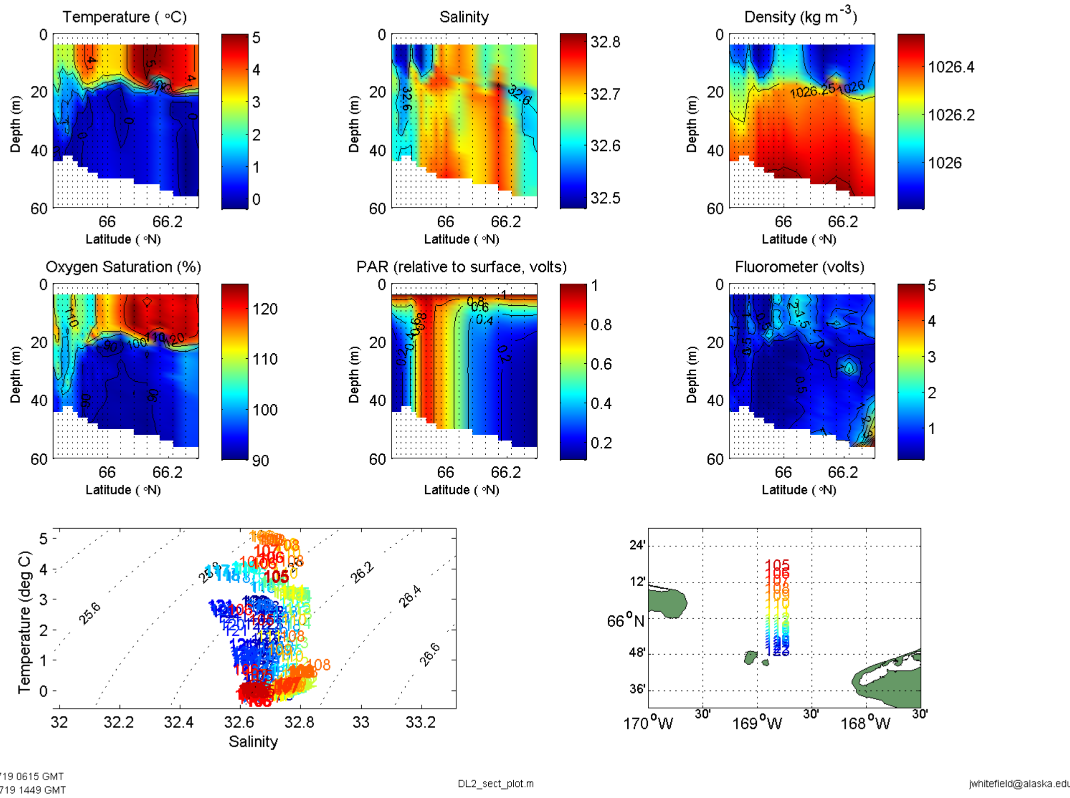
LIS Line – GMT 17th July 2012 1504 to GMT 18th July 2012 0323



CCL Line – GMT 18th July 2012 0434 to GMT 19th July 2012 0530

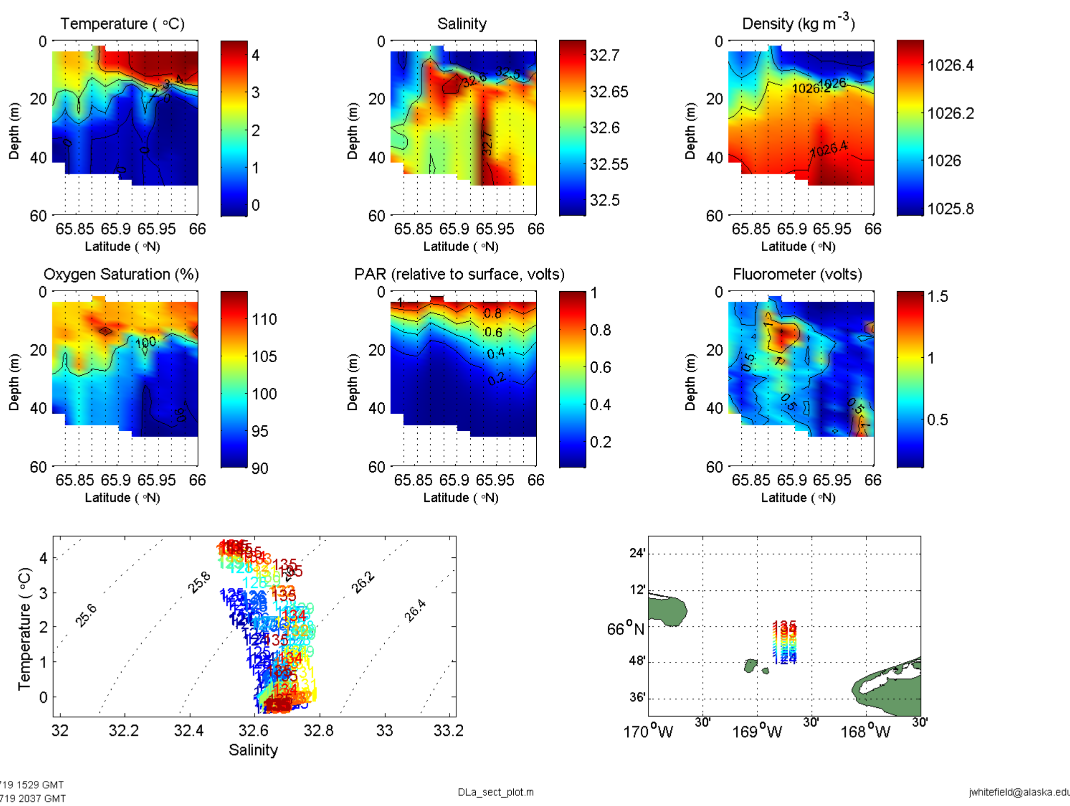


DL line (second occupation) - GMT 19th July 2012 0615 to 1457

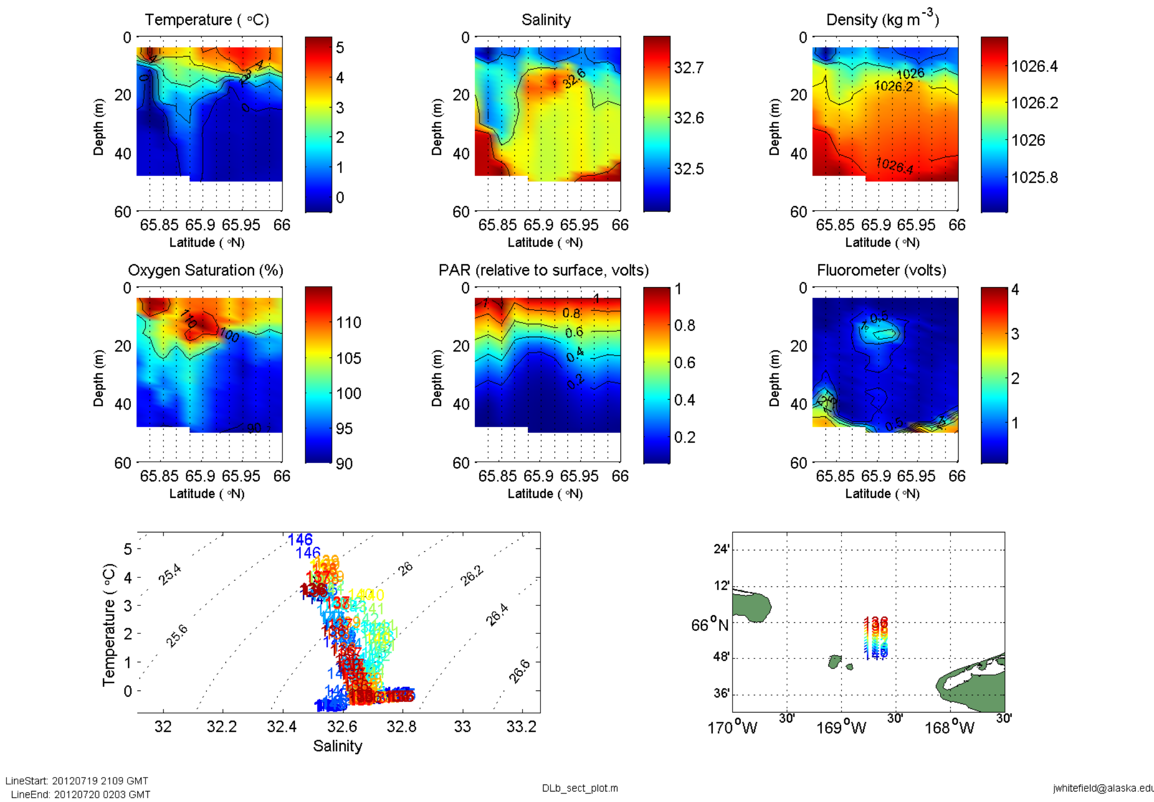


Note that the high PAR relative to surface at ~65.9°N is due to the CTD being deployed in the dark, rather than a signal in the water

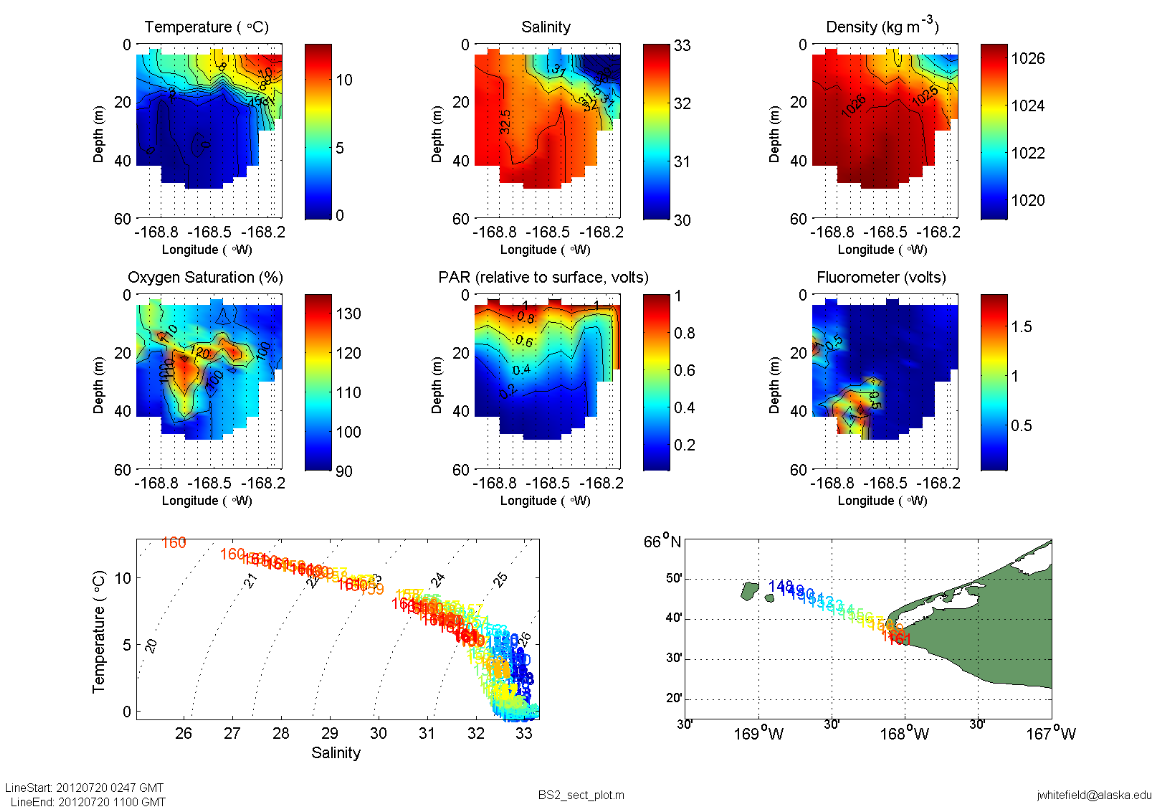
DLa Line – GMT 19th July 2012 1529 to 2047



DLb Line – GMT 19th July 2012 2109 to GMT 20th July 2012 0207



BS Line (second occupation) – GMT 20th July 0247 to 1107



RUSALCA 2012 TARGET CTD POSITIONS

The following lists give the target positions of the CTD lines. The full RUSALCA event log (as noted by the CTD operators) is included below.

RUSALCA 12 - Sat 14th July 2012
================================

===8:15am Prod Cast at site A2

=== After sampling, return to site A2, for 2nd CTD
(water to be used for water sampling training)

=== Steam to BS24 (see below)

=== Run Bering Strait line from Alaska to Diomedes
(BS24 to BS11)
with nets at stations BS22 and BS16

(about 10 hrs?)

```
% Lat (N) Long (W)   Lat (N)     Long (W)
%                deg min    deg   min
  65.582  168.117   65  34.91   168   7.00 %*24 %BS24
  65.599  168.161   65  35.96   168   9.66 %*23 %BS23
  65.625  168.177   65  37.48   168  10.63 %*22 %BS22 + net
  65.642  168.250   65  38.53   168  14.97 %*21 %BS21
  65.655  168.318   65  39.29   168  19.09 %*20 %BS20
  65.672  168.391   65  40.35   168  23.44 %*19 %BS19
  65.686  168.449   65  41.18   168  26.94 %*18 %BS18
  65.704  168.521   65  42.23   168  31.28 %*17 %BS17
  65.722  168.591   65  43.29   168  35.46 %*16 %BS16 + net
  65.739  168.663   65  44.35   168  39.80 %*15 %BS15
  65.755  168.721   65  45.28   168  43.29 %*14 %BS14
  65.772  168.794   65  46.33   168  47.64 %*13 %BS13
  65.788  168.860   65  47.26   168  51.62 %*12 %BS12
  65.805  168.933   65  48.31   168  55.96 %*11 %BS11
```

RUSALCA 12 - Sun 15th July 2012 ++
=================================

== Complete BS line at BS11

== Run DL line north to A3
(NB moved to be 1nm east of the border)

```
%  Lat (N)   Long (W)   Latdeg    Lat min  Lon deg   Lon min

DL1     65   49.28 168   56.2
DL2     65   50.26 168   56.2
DL3     65   51.23 168   56.2
DL4     65   52.21 168   56.2
DL5     65   53.18 168   56.2 - no bottles
DL6     65   54.15 168   56.2
DL7     65   55.13 168   56.2 - no bottles
```

DL8 65 56.10 168 56.2
DL9 65 57.08 168 56.2 - no bottles
DL10 65 58.05 168 56.2
DL11 65 59.03 168 56.2 - no bottles
DL12 66 0.00 168 56.2
DL13 66 2.55 168 56.2 - no bottles
DL14 66 5.10 168 56.2
DL15 66 7.65 168 56.2 - no bottles
DL16 66 10.19 168 56.2
DL17 66 12.74 168 56.2 - no bottles
DL18 66 15.29 168 56.2
DL19 66 17.84 168 56.2 - no bottles

== Then casts at A3-12 (prod cast, net, CTD)
A3-12 66 19.61 168 57.05
** stay at least 200m away **

-- Prod cast first if later than 8am,
otherwise net first.

-- CTD cast

== Then run AL line towards Alaska with nets at Al17 and AL22

% Lat (N)	Long (W)	Latdeg	Lat min	Lon deg	Lon min	
66.3398	168.8952	66.0000	20.3867	168.0000	53.7092	%*36 %AL13
66.3516	168.8233	66.0000	21.0933	168.0000	49.3983	% 35 %AL14
66.3633	168.7515	66.0000	21.8000	168.0000	45.0875	%*34 %AL15
66.3751	168.6796	66.0000	22.5067	168.0000	40.7767	% 33 %AL16
66.3869	168.6078	66.0000	23.2133	168.0000	36.4658	%*32 %AL17 + net
66.3987	168.5359	66.0000	23.9200	168.0000	32.1550	% 31 %AL18
66.4104	168.4641	66.0000	24.6267	168.0000	27.8442	%*30 %AL19
66.4222	168.3922	66.0000	25.3333	168.0000	23.5333	% 29 %AL20
66.4340	168.3204	66.0000	26.0400	168.0000	19.2225	%*28 %AL21
66.4458	168.2485	66.0000	26.7467	168.0000	14.9117	% 27 %AL22 + net
66.4576	168.1767	66.0000	27.4533	168.0000	10.6008	%*26 %AL23
66.4693	168.1048	66.0000	28.1600	168.0000	6.2900	%*25 %AL24

RUSALCA 12 - end Sunday 15th July, Monday 16th July
==

=== Complete A3L at Al22 (as per previous)

=== STEAM (2 engines) north to CS line.
RUN CS line towards USA (Point Hope)

67	38.1	168	56.2	%*58 % CS10US + net
67	41.7	168	48.1	% CS10.5 - no bottles
67	45.3	168	39.9	% 59 % CS11
67	48.9	168	29.4	% CS11.5 - no bottles
67	52.5	168	18.8	%*60 % CS12 + net
67	55.9	168	9.1	% CS12.5 - no bottles
67	59.3	167	59.4	% 61 % CS13

68 2.7 167 49.7 % CS13.5 - no bottles
68 6.1 167 39.9 %*62 % CS14 + net
68 9.1 167 30.7 % CS14.5 - no bottles
68 12.1 167 21.4 % 63 % CS15
68 13.6 167 16.8 % CS15.5 - no bottles
68 15.0 167 12.2 % 64 % CS16
68 16.6 167 7.6 % CS16.5 - no bottles
68 18.0 167 2.9 %*65 % CS17 + net
68 18.9 166 57.6 % 66 % CS18
68 19.9 166 52.3 %*67 % CS19 - DON"T DO THIS ON KHROMOV

RUSALCA 12 - end Monday 16th July, Tuesday 16th July
===

== Complete CS line at CS19

== Steam north to LIS line

== Run LIS line away from the USA (Cape Lisburne)

68 54.40 166 19.80 % LIS 1 + net
68 54.80 166 25.15 % LIS 2
68 55.20 166 30.51 % LIS 3
68 55.80 166 38.54 % LIS 4
68 56.40 166 46.57 % LIS 5
68 57.00 166 54.60 % LIS 6 + net
68 57.60 167 1.95 % LIS 6.5 - no bottles
68 58.20 167 9.30 % LIS 7
68 58.80 167 16.65 % LIS 7.5 - no bottles
68 59.40 167 24.00 % LIS 8
69 0.60 167 38.70 % LIS 9
69 1.80 167 53.40 % LIS 10 + net
69 1.35 168 7.95 % LIS 11
69 0.90 168 22.50 % LIS 12
69 0.45 168 37.05 % LIS 13
69 0.23 168 46.62 % LIS 14n + net
69 0.00 168 56.20 % CCL22n

RUSALCA 12 - Tuesday 17th July/ Wed 18th July
==

== Complete LIS line at CCL22n, doing

-- the normal CTD cast
-- Then a second CTD cast (Prod cast for Mike)

== RUN CCL line south to A3

% LAT(N,deg, min) LONG(W,deg,min)
69 0.0 168 56.0 % CCL22
68 50.0 168 56.0 % CCL21
68 40.0 168 56.0 % CCL20

```
   68    30.0     168  56.0 % CCL19
   68    20.0     168  56.0 % CCL18 + Net
   68    10.0     168  56.0 % CCL17
   68    00.0     168  56.0 % CCL16
   67    50.0     168  56.0 % CCL15
   67    38.0     168  56.0 % CCL14 also called CS10US + Net + Prod
%
   67    30.0     168  56.0 % CCL13
   67    20.0     168  56.0 % CCL12
   67    10.0     168  56.0 % CCL11
   67    00.0     168  56.0 % CCL10 + Net
   66    50.0     168  56.0 % CCL9
   66    40.0     168  56.0 % CCL8
   66    35.0     168  56.0 % CCL7
   66    30.0     168  56.0 % CCL6
   66    25.0     168  56.0 % CCL5
   66    22.3     168  56.0 % CCL4


RUSALCA 12 - Wed 18th/Thurs 19th July
==========================================
== complete CCL line at CCL4.(late Wed)

== Then - cast and net at A3
%  LAT(N,deg, min) LONG(W,deg,min)
A3-12   66 19.61   168 57.05  ** stay at least 200m away **

== Then - run DL line back down to Diomedes:
%  LAT(N,deg, min) LONG(W,deg,min)
DL19   66   17.84 168   56.2 - no bottles
DL18   66   15.29 168   56.2
DL17   66   12.74 168   56.2 - no bottles
DL16   66   10.19 168   56.2
DL15   66    7.65 168   56.2 - no bottles
DL14   66    5.10 168   56.2
DL13   66    2.55 168   56.2 - no bottles
DL12   66    0.00 168   56.2
DL11   65   59.03 168   56.2 - no bottles
DL10   65   58.05 168   56.2
DL9    65   57.08 168   56.2 - no bottles
DL8    65   56.10 168   56.2
DL7    65   55.13 168   56.2 - no bottles
DL6    65   54.15 168   56.2
DL5    65   53.18 168   56.2 - no bottles
DL4    65   52.21 168   56.2 + net
DL3    65   51.23 168   56.2
DL2    65   50.26 168   56.2
DL1    65   49.28 168   56.2

== Then - some of DLa and DLb
% Northbound leg
  65   49.30    168   52.2 % DLa 1
  65   50.27    168   52.2 % DLa 2
  65   51.25    168   52.2 % DLa 3
```

65 52.22 168 52.2 % DLa 4
65 53.19 168 52.2 % DLa 5
65 54.16 168 52.2 % DLa 6
65 55.14 168 52.2 % DLa 7
65 56.11 168 52.2 % DLa 8
65 57.08 168 52.2 % DLa 9
65 58.05 168 52.2 % DLa 10
65 59.03 168 52.2 % DLa 11
66 0.00 168 52.2 % DLa 12
% Southbound leg
66 0.00 168 48.2 % DLb 12
65 59.03 168 48.2 % DLb 11
65 58.05 168 48.2 % DLb 10
65 57.08 168 48.2 % DLb 9
65 56.11 168 48.2 % DLb 8
65 55.14 168 48.2 % DLb 7
65 54.16 168 48.2 % DLb 6
65 53.19 168 48.2 % DLb 5
65 52.22 168 48.2 % DLb 4
65 51.25 168 48.2 % DLb 3
65 50.27 168 48.2 % DLb 2
65 49.30 168 48.2 % DLb 1
% breaking off Thursday afternoon to be able
% to Run the BS line before leaving from Nome
% (likely 6am Friday)

RUSALCA 12 - ThursFri 19th/20th July
===
== complete DLa line at DLa1

== FINAL CTD line is repeat of the BStrait line
(with bottles)

% LAT(N,deg, min) LONG(W,deg,min)
65 48.31 168 55.96 %*11 %BS11
65 47.26 168 51.62 %*12 %BS12
65 46.33 168 47.64 %*13 %BS13
65 45.28 168 43.29 %*14 %BS14
65 44.35 168 39.80 %*15 %BS15
65 43.29 168 35.46 %*16 %BS16 + net
65 42.23 168 31.28 %*17 %BS17
65 41.18 168 26.94 %*18 %BS18
65 40.35 168 23.44 %*19 %BS19
65 39.29 168 19.09 %*20 %BS20
65 38.53 168 14.97 %*21 %BS21
65 37.48 168 10.63 %*22 %BS22 + net
65 35.96 168 9.66 %*23 %BS23
65 34.91 168 7.00 %*24 %BS24

ending ~ 6am

Then steam for Nome, pilot due 8pm Friday

UAF RUSALCA 2012 (July 10-20) Cruise Report--Moorings

-Daniel Naber, Michael Kong--Whitledge Lab University of Alaska, Fairbanks.

ISUS Mooring

The Whitledge lab was in charge of recovering and deploying a total of four ISUS (nitrate analysis) instruments. Specific information regarding recovery and deployment are as follows:

Recovery

Mooring Site	Date	Latitude	Longitude	ISUS #	Duration
A2-11	07/12/12	65°46.866N	168°34.069W	17	Only one month of data (up to Julian Day 230, 2011). Unknown problem with power source.
A3-11	07/13/12	66°19.594N	168°57.502W	124	Good data for duration of deployment.

Deployment

Mooring Site	Date	Latitude	Longitude	ISUS #
A2-12	07/12/12	65°46.864N	168°34.070W	88
A3-12	07/14/12	66°19.610N	168°57.051W	98

Additionally, we took triplicate water samples (20 ml) at 49 m (A2) and 50 m (A3) as calibration points both prior to recovery and after deployment. We froze samples immediately at -20°C for analysis at the University of Alaska, Fairbanks.

UAF RUSALCA 2012 (July 10-20) Cruise Report--Water Sampling

-Michael Kong, Daniel Naber-- Whitledge Lab University of Alaska, Fairbanks

The Whitledge lab, represented on the cruise by Daniel Naber and Michael Kong, were responsible for a variety of different water samples. These samples consisted of the following: Dissolved Inorganic Carbon (DIC), Dissolved Organic Nitrogen (DON), Nutrients (nitrate, nitrite, ammonium, urea, phosphate and silica) and total chlorophyll *a*. All samples were taken at the following standard depths: 0 m, 10 m, 20 m, 30 m, 40 m and bottom.

Dissolved Inorganic Carbon

We took DIC samples at every other station in the BS and AL lines beginning with station BS24 and ending at AL24. All DIC samples were taken at standard depths and transferred directly into 225 ml glass bottles. Each sample was subsequently spiked with 100 µl of mercuric chloride ($HgCl_2$) to halt biological activity. We took a total of 79 samples. We sent samples to Dr. Nicolas Bates (Bermuda Institute of Ocean Sciences) for analysis.

Dissolved Organic Nitrogen

We took DON samples at every other station on the BS, AL and CS lines beginning at BS24 and ending at CS18. DON samples were taken at standard depths and filtered directly from the rosette into 25 ml polycarbonate bottles using 47 mm Whatman GF/F microfibre glass filters. We took a total of 98 samples from the combined BS/AL/CS lines. We froze samples at -20°C and shipped them to the University of Alaska, Fairbanks for analysis.

Nutrients

We took nutrient samples at every station during the duration of the cruise with the exception of the DL and DLa lines in which we took samples at every even numbered station. We did not take any nutrient samples on the DLb line. Nutrient samples were taken at standard depths and transferred into 20 ml scintillation vials. We took a total of 660 samples. We froze samples at -20°C and shipped them to the University of Alaska, Fairbanks for analysis.

Total Chlorophyll a

We took total chlorophyll *a* samples at every station with the following exceptions:

-DL, DLa and DLb lines--no samples

-Second pass through BS line--every other station beginning at BS11.

We took samples at standard depths and transferred them into 250 ml bottles. We immediately filtered the samples using 25mm Whatman GF/F microfibre glass filters. We took a total of 461 samples. We stored filters in 10 ml glass test tubes, froze at -20°C and sent to the University of Alaska, Fairbanks for analysis.

UAF RUSALCA 2012 (July 10-20) Cruise Report--Primary Productivity

-Michael Kong--Whitledge Lab University of Alaska, Fairbanks

We ran dual isotope primary productivity experiments on three days during the research cruise. Primary productivity station names and locations are as follows:

Station	Cast #	Date	Latitude	Longitude
A2	2	07/14/12	65°46.92N	168°34.02W
A3-12	37	07/15/12	66°19.61N	168°57.05W
CCL14	92	07/18/12	67°38.00N	168°56.00W

The following illustrates the amount and purpose of primary productivity water samples:

Sample	Amount (ml)	Purpose
^{13}C + $^{15}NO_3^-$	1000 per sample depth	Productivity incubation
$^{15}NH_4^-$	1000 per sample depth	Productivity incubation
Particulate Organic Carbon (POC)	250 per sample depth	Natural abundance of stable isotopes
Total Chlorophyll *a*	250 per sample depth	Chlorophyll biomass
Fractionated Chlorophyll *a*	1000 per sample depth	Size fractionated chlorophyll biomass
Nutrients	20 per sample depth	Nutrient concentration at sample depths

Sample depths corresponded to the following light levels: 100%, 50%, 30%, 12%, 5% and 1%. These light depths were determined via the photosynthetically available radiation (PAR) trace. We sampled water in 1000 ml polycarbonate bottles covered in neutrally buoyant metal screens corresponding to the above light levels. We spiked one set with 1 ml of ^{13}C stable isotope solution and 0.5 ml of $^{15}NO_3^-$. We spiked another set with 0.5ml of $^{15}NH_4^+$ stable isotope solution. In total, two sets (one set constitutes six bottles--one for each light depth) of screened bottles were used for the productivity experiments: one for $^{15}NO_3^-$ experiments and one for $^{15}NH_4^+$ experiments. Each set was placed into a deck incubator filled with cold flowing seawater for approximately four to six hours (depending on cloudiness). After incubation, 500 ml of each sample were filtered through 25mm Whatman GF/F microfibre glass filters. We placed filters in 47 mm petri dishes, froze at -20°C and sent to the University of Alaska, Fairbanks for analysis. POC samples followed the same procedure as the stable isotope sets minus the introduction of the stable isotope solutions. We treated Total chlorophyll and nutrient samples in the same manner as described in the "water sampling" section.

We filtered fractionated chlorophyll samples through a series of three 47 mm filters. The pore size of each filter is as follows according to largest to smallest pore size: 20 µm Nucleopore, 5 µm Nucleopore, 0.7 GFF. We stored filters in 10 ml glass test tubes, froze at -20°C and sent to the University of Alaska, Fairbanks for analysis.

OSU RUSALCA12 Cruise Report (July 27, 2012) Fred Prahl, Marnie Zirbel

Fred Prahl and Marnie Jo Zirbel (both from CEOAS/OSU) participated on RUSALCA12 cruise (July 10-20, 2012) for two purposes:

1) to retrieve a set of sensors (SAMI-pH – SN: P0029 with Aanderaa Oxygen Optode – SN: 3835; seapHox – SN?; SAMI-pCO2 SN:16; SBE37SM microcat – SN: 7156) deployed for one-year at ~47m water depth on the A3-11 mooring and

2) to deploy a new set of sensors (SAMI-pH – SN: P0065; SAMI-pCO2 – SN: C0044; SBE37SM – SN: 2316) for a second one-year time series at the same mooring site (A3-12) and depth.

As for the first year, the SAMI-pH and SAMI-pCO2 sensors were set to acquire data at a rate of one measurement every 3 hours until the mooring is recovered in the summer of 2013. However, the SBE37SM was set to acquire data at a rate of once per hour, i.e., three times faster than the previous year. The A3-12 mooring with this new sensor package attached was deployed successfully at ~00:30 (GMT) on July 13, 2012.

Water samples for measurement of dissolved carbon dioxide (pCO2), total dissolved inorganic carbon (DIC) and total titration alkalinity were collected along two sampling transects (Bering Strait {BS} and A3Line {AL} lines) using a CTD package with its attached rosette bottle sampler. The BS line was sampled twice – from east to west at the beginning of the cruise and from west to east at the end. Water samples were also taken at the A3 mooring site at two different times during RUSALCA2012 as a way to check calibration of the in situ SAMI-pH and SAMI-pCO2 sensors. pCO2, DIC and total titration alkalinity analyses will be made as soon as possible after the cruise once the samples have been shipped from Nome AK (end point of the cruise) to Oregon State University. The inventory of all samples collected is summarized in Table 1:

Table 1. Summary of OSU Samples Collected on RUSALCA2012 Leg1 Cruise

Site	CTD Cast#	Carbonate Chemistry	HPLC Pigments	New & Gross Primary Production	Comment
A2	2	x			Niskin Btl w/ messenger
BS23	5	S,M,B (see*)	S	S	*Surface, Mid, Bottom water
BS21	7	S,M,B	S	S,M,B	
BS19	9	S,M,B	S	S	
BS17	11	S,M,B	S	S,M,B	
BS15	13	S,M,B	S	S	
BS13	15	S,M,B	S	S,M,B	
BS11	17	S,M,B	S	S	
A3	37	x	x	x	UAF Prod Cast – 6 depths
AL13	39	S,M,B	S		
AL15	41	S,M,B	S		
AL17	43	S,M,B	S		
AL19	45	S,M,B	S		
AL21	47	S,M,B	S		
AL23	49	S,M,B	S		
CCL14	92	X	x	x	UAF Prod Cast – 6 depths
BS13	150	S,M,B	S		
BS15	152	S,M,B	S,B		
BS17	154	S,M,B	S,B		
BS19	156	S,M,B	S,B		
BS21	158	S,M,B	S		
BS23	160	S,M,B	S		

In addition, samples for analysis of photosynthetic pigments (chlorophyll and carotenoids) by high performance liquid chromatography (HPLC) and measures of net (ratio of dissolved oxygen to argon concentration) and gross (stable isotopic composition {Δ17} of dissolved oxygen) primary production were also collected at select sites. The latter gas samples, obtained in containers referred to as 'eggs', were collected opportunistically for Dr. Laurie Juranek (CEOAS, OSU), a new CEOAS/OSU faculty member. Note: inorganic carbon, HPLC pigment and 'egg' samples were also taken in conjunction with primary productivity casts done by Mike Kong (UAF) at two sites (A3, CCL14) in the study area. The collection locations and CTD cast numbers for all of these samples are also summarized in Table 1.

2011 A3 Times Series: Preliminary Results

SBE37: A complete year of data for temperature (T), salinity (S) and pressure (P) was obtained and downloaded from the SBE37 microcat deployed on the A3-11 mooring. Figure 1 illustrates the record acquired for each of these properties (T, S – left; P – right). See also comments above re this salinity record.

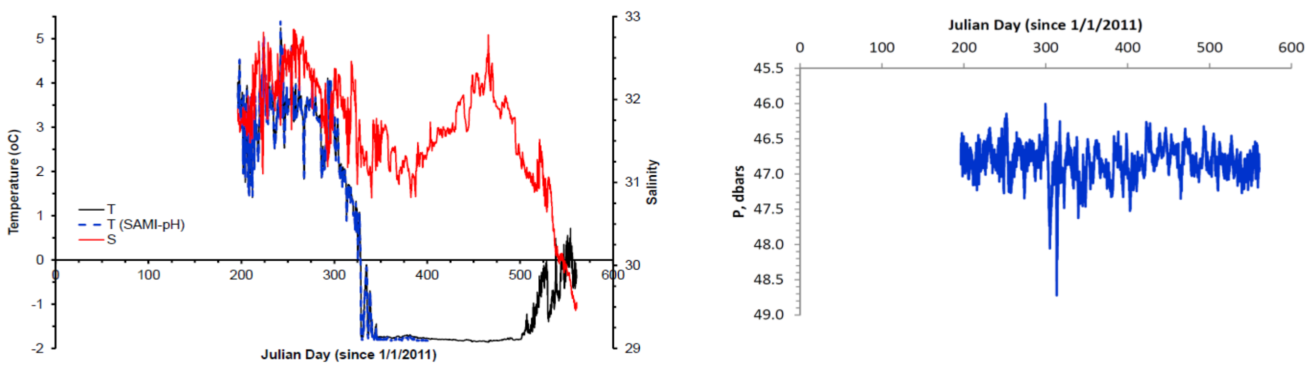


Figure 1

SAMI-pH (with associated thermistor and Aanderaa Oxygen Optode): Data acquisition by this sensor package did not span the full year of mooring deployment. In early February 2012, ~6.5 months after deployment, instrument battery power fell below a critical threshold and all data acquisition then ceased. However, during the ~6.5 m period of operation, T and dissolved oxygen (DO) data was acquired.

The record for T and %DO (dissolved oxygen, as percent saturation) are illustrated in Figure 2. Warmest but most variable T values on a daily to weekly temporal basis were observed in summer (onset of time series) to mid-fall (early November). %DO was also most highly variable in this time interval.

The time series record for T obtained by the thermistor on the SAMI-pH sensor and the SBE37 are compared in Figure 1 (left). This comparison shows results obtained by these two sensors are essentially equivalent. Linear regression analysis defined the quantitative relationship: $T_{SBE} = 0.9958\ T_{SAMI} + 0.0515$ ($r^2 = 0.9988$). Confirmation of an ~1:1 relationship provides assurance that the data from both T sensors are of equivalent high quality.

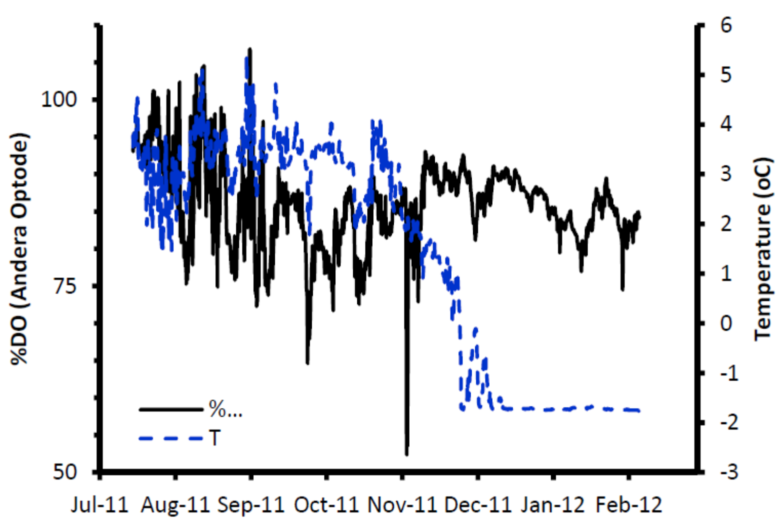


Figure 2

At present, we cannot gauge the accuracy of the %DO data obtained by the Aanderaa optode on the SAMI-pH. An SBE43 oxygen sensor was deployed on A3-11 as a component of the seapHox sensor. However, the cable required to download any data from the seapHox sensor package was not onboard the ship during RUSALCA2012. Once the equipment is returned to OSU (currently in transit from Nome), we will download the data acquired by that instrument and, if a time series for DO from the SBE43 of equivalent length to that obtained by the SAMI-pH sensor is obtained, compare the two data sets to provide an objective sense of our DO data integrity.

During the ~6.5 m period of operation for the SAMI-pH sensor, only ~1 month of potentially reliable pH data was obtained. The reason why the amount of pH data acquired was so much less than that for T and %DO (components of the same instrument package) remains unclear and is currently under investigation.

Figure 3 illustrates the complete set of pH data (raw) acquired and provides a comparison of the pH and T time series. A general positive correlation between pH and T is apparent.

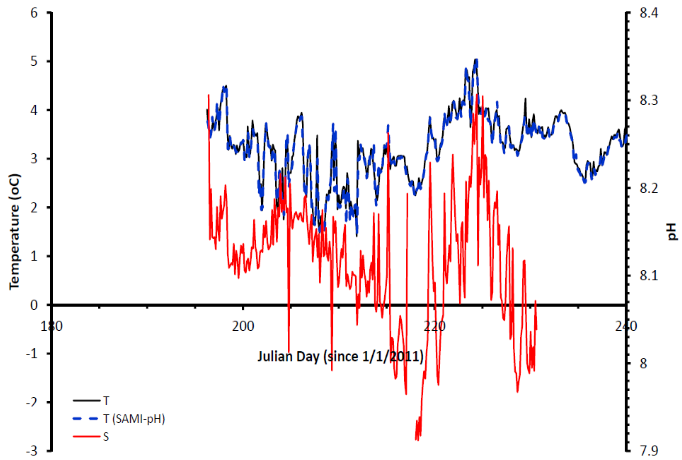


Figure 3

Figure 4 puts the eyeball-o-metrically apparent positive correlation between pH and T into a better quantitative perspective. The correlation between these properties is quite strong for the latter half of the one month period in which pH data was acquired. In contrast, these properties are only weakly correlated (or perhaps not at all) in the first half of the time series.

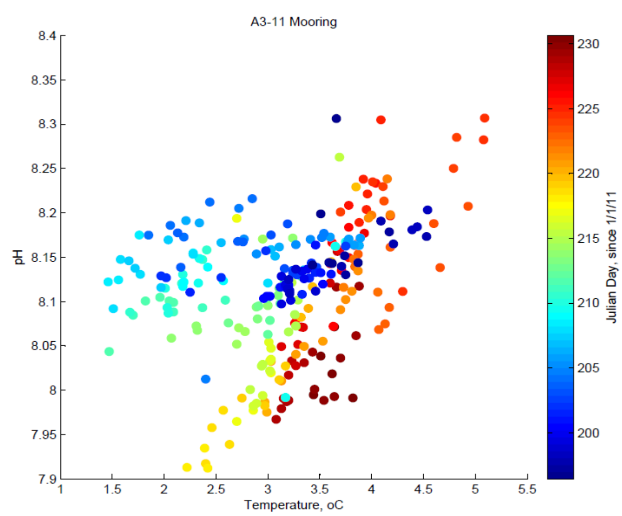


Figure 4

Figure 5 (left) compares the %DO and T data obtained by the SAMI-pH sensor package. A similar temporal pattern to that just described for pH versus T is evident. That is, %DO correlates positively and quite strongly with T in the latter half of the one month period in which pH data was acquired and little to not at all in the first half.

Figure 5 (right) assembles these observations, showing that %DO and pH are positively well-correlated with one another throughout the entire one month time frame in which the SAMI-pH sensor operated as intended. The environmental significance of this finding remains to be determined. At the moment, we await the arrival of the seapHox instrument at which time the data can be downloaded, allowing us to assess whether (or not) the patterns just described are analytically sound and thereby warrant oceanographic / biogeochemical interpretation or merely happenstance. With luck, the seapHox package operated as intended and we will gain a first-order perspective on T - %DO – pH variations at the A3-11 site over an annual cycle and a greater impetus to determine the physical oceanographic / biogeochemical drivers for these variations.

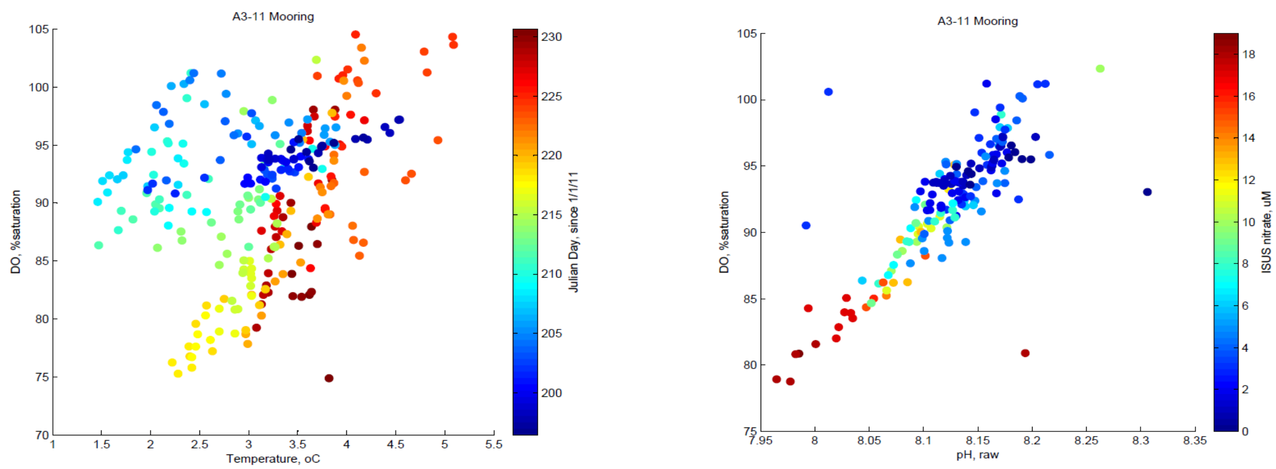


Figure 5

SAMI-pCO2: As for the seapHox, the cable required to download data from the vintage SAMI-pCO2 sensor deployed on A3-11 was not available onboard ship during RUSALCA2012. We await arrival of this instrument at OSU when the data it acquired can be accessed and analyzed in perspective with results from the other sensors.

Appendix to Bering Strait 2012 cruise report –Fred Prahl – Feb 2015
(Update of 2012 cruise report with post-cruise sample processing)

In summer 2012, we successfully recovered the first year's mooring from the A3 site (see Figure P1). Complete annual records of T and S (from an SBE37 microcat sampling at hourly resolution) and pH (from a seapHox sampling at 3 hr resolution) were obtained. The seapHox instrument was a prototype 'field effect transistor' (or FET) design loaned by Todd Martz (UCSD – SIO) to us for this project. A pH record (from a SAMI-pH operated at 3 hr resolution) was also obtained but it was only ~1mo in length due to data corruption caused by biofouling at the pump inlet to the sensor. The SAMI-pH instrument was purchased for this project by us new from Sunburst. And no record for pCO2 (from a SAMI-pCO2) was obtained. The latter instrument was an early proto-type, loaned to us by Mike deGrandpre (University of Montana) for purposes of this project. The unit failed to 'activate' after deployment for a reason that remains unclear.

On the 2012 recovery cruise, we also successfully deployed the second year's mooring at the A3 site. Our instrument package included a new SAMI-pCO2 and pH unit purchased from Sunburst (using financial resources in this grant) and anotherSBE37 microcat.

Figure P2 (top graph) provides a comparison of pH data sets acquired remotely with the two sensors (SAMI and FET) on our first year's (July 2011 – July 2012) mooring package. Because of a biofouling problem with the SAMI-pH sensor, an instrument inter-comparison of only ~1 month was possible. As illustrated, these two, independent sensors tracked each other quite well over this common period of operation albeit with an unexplainable offset of ~0.1 pH unit at the beginning of the time series (see Figure P3 for further temporal perspective on the correlation). The average pH measured by these instruments (~8.25) was ~0.1 pH unit higher than the value predicted from measurement of pCO2 / TCO2 on a discrete bottom water sample collected at the time of mooring deployment (see * on left graph in Figure P4).

The FET instrument (seapHox) acquired pH data over the entire first year's deployment period (Figure P2, bottom graph) and was retrieved with sufficient battery power to continue operation. The battery package on the SAMI-pH instrument, however, fell below its minimum operating voltage by mid-winter (i.e. February, ~6 months into the total deployment period). Bottom water temperatures at that time were -1.8^{o}C, i.e. the freezing point of seawater. The time series record for temperature obtained by the SBE37 microcat indicates that the source region for bottom waters at the mooring site had been 'iced over' since late December (Figure P2, bottom graph). At the time of recovery, another discrete bottom water sample was collected for analysis of its carbonate chemistry. From measurement of its pCO2 and TCO2 content, an estimate of pH was made using CO2sys. Once again, the estimate for this check sample was ~0.1 pH unit lower than that recorded by the FET (see # on middle graph in Figure P4).

The range of pH observed over the one-year FETseapHox time series was ~8.0 to 8.4, averaging ~8.1 (Figure P2, bottom graph). Temporal variability in pH measurement by the sensor was smallest during the period when surface waters in the Bering Strait were 'iced over' and the temperature of bottom waters was maintained at a constant value corresponding to the freezing point of seawater (~ -1.8^{o}C). pH determinations were much more variable during periods when surface water was ice-free and particularly post-winter, during the 'spring transition' (Figure P2, bottom graph). Variability in the pH of bottom waters during periods of ice-free surface waters most likely reflects the impact of primary production in the euphotic zone on carbonate chemistry and consequently pH and biogeochemical coupling between surface and bottom waters through particle settling - remineralization and circulation.

In all three summers of instrument deployment / recovery (2011, 2012, 2013), water samples were collected from various depths in the water column at seven sites (BS23, 21, 19, 17, 15, 13, 11) along a common transect of the Bering Strait extending from the Alaskan coast to the Diomedes (see Figure P1). Each was analyzed for its pCO2 and TCO2 content.

Using these data, along with T and S measures, pH was estimated using pCO2sys. Results in Figure P4 show that, in both summers, surface waters in the Alaskan coastal current (BS23, 21) were ~0.2 pH unit more acidic than those farther west in the interior of the Bering Strait. With one exception (BS19 – Summer 2012, beginning survey), the pH of deep waters at all sites was most acidic and displayed a reasonably consistent value (~8.15).

Given these compositional data and corresponding T and S measures, CO2sys was employed to define depth profiles for the saturation state of aragonite (Ω_A) at each sampling site. Omega values for surface and bottom waters along the Bering Strait survey transect are plotted in Figure P5 (top) and Figure P6. These graphical aids show that all waters along this transect, surface and bottom, are supersaturated with respect to aragonite. Indeed, in our data all waters along this transect, regardless of year or sampling depth, were supersaturated with respect to aragonite. Ω_A values were greatest in surface waters and least in bottom waters, averaging 2.1 (±0.5) and 1.7 (±0.4), respectively, in the complete data set.

Results from 2012 field sampling are summarized in Figure P5. Along the BS Line transect, surface waters to the east in the Alaskan Coastal Current (ACC, represented by BS23, 21) displayed the lowest Ω_A values (~1.7) while the spatial trend was opposite for bottom waters (top graph). Those sampled toward the center of the Bering Strait (BS11, 13, 15, 17) had lowest values (~1.3). Notably, the difference between Ω_A values measured in surface and bottom waters was least in the ACC and greatest farther west toward the central Bering Strait. This feature of the carbonate chemistry seems counter-intuitive given water column stratification was least in the ACC and increased with distance west (Figure P5, bottom left). A clear explanation for this feature is not now evident. Nonetheless, the distributional pattern seems real and characteristic of the study region in mid-summer as it was mimicked by results from analysis of water samples collected along the BS Line in 2013 and to a lesser extent in 2011.

Note that repeat sections taken 5 days apart (Figure P6) show the same pattern albeit with up to 0.5 units change in Ω_A.

High resolution Ω_A calculations cannot be made for the pH time series results (Figure P2) that were obtained for the first year's mooring deployment at the A3 site (Figure P1). The reason is because the SAMI-pCO2 sensor that was included in that mooring package failed to 'activate' and collect any data.

Dissolved oxygen data were obtained for 6 months from the SAMI-pH sensor and one year from the SeapHox sensor (Figure P7), however there is poor agreement between these records, and no available bottle data for calibration, so we consider both records as suspect.

Summary of mooring deployments

A3-11

SAMI-pCO2	– failed to turn on on deployment, no data
SAMI-pH, with Aanderaa Ox	pH: 1month of continuous data. Within ~ 0.1 of bottle data. Offset for some period to SeapHox pH data, but otherwise reasonable agreement. Deemed ok. Ox: 6months of data. No agreement with SeapHox data. Deemed suspect Batteries ran out after ~ 6 months.
SeapHox	pH: 1 year of continuous data. Within ~ 0.1 of bottle data. Offset for some period to SAMI pH data, but otherwise reasonable agreement. Deemed ok. Ox: 1 year of data. No agreement with SAMI data. Deemed suspect
SBE37	T,S: 1 year of data. Suspect clogging of salinity cell. Use other TS on the mooring instead.

A3-12

SAMI-pCO2	Ran for 1 year, but data 2x bottle samples at start and drifting to unrealistically high numbers. Deemed no good data.
SAMI-pH	pH: about 500 pts of pH data spread intermittently over 6 months. pH values of 4-10 are unrealistic. Deemed no good data. Batteries ran out after ~ 6 months.
SBE37	T,S: 1 year of data. Very bad clogging of salinity cell. Temperature data ok, but salinity data very strong and erroneous drift. Use other TS on the mooring instead.

So in terms of reliable data we have:
- 1year pH from Seaphox July 2011-2012
- 1month pH from SAMI July 2011-August 2011
+ sections in 2011, 2012, 2013, for pCO2, DIC and Total alkalinity.

Figure P1

- A3 – mooring site for in situ chemical sensors (@ ~50m water depth)
- BS11 – BS23: US side of Bering Strait transect routinely surveyed on RUSALCA mooring deployment / recovery cruises

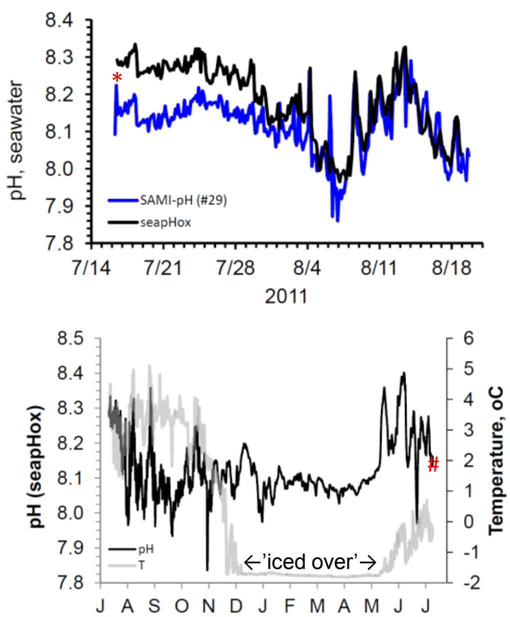


Figure P2

- SAMI-pH and seapHox instruments displayed offset (~0.1 unit) at start of time series but converged at ~2 weeks and remained consistent with one another for the remaining period of SAMI operation
- Average pH measured at the start by these two instruments (~8.25) was ~0.1 unit higher than value estimated from pCO2/TCO2 measured on a discrete water sample (~50m) collected synoptically at the A3 mooring site (see* on lefthand graph, Figure. P4)
- pH measures were obtained by seapHox over the complete 1 yr deployment period. Value measured just before recovery (~8.16) was again ~0.1 unit higher than that estimated from pCO2/TCO2 analysis of a discrete water sample collected synoptically (see # on middle graph, Figure P3).

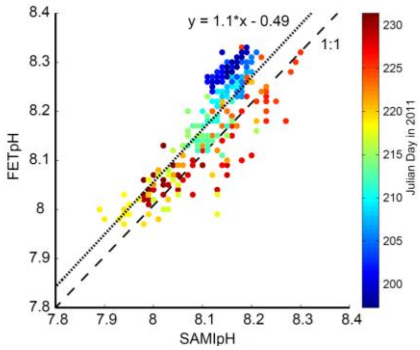
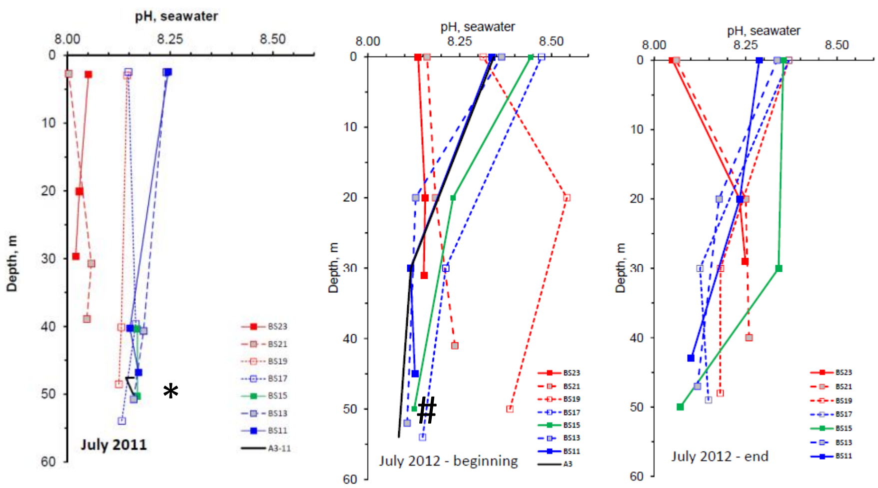


Figure P3. Scatter plot of pH from seapHox (FETpH , on y-axis) and SAMI (on x-axis) colored with Julian day.. Black dashed line marks 1:1 correspondence. Black dotted line marks best fit line of the data. Note the high correlation in variability, but also the drift in time, as seen in Figure P2.

Figure P4. pH profiles (assessed from analysis of pCO2 and TCO2 measurements using CO2sys) documented for sites along the BS line and at A3, the location for the sensor deployment on first year's mooring (2011-2012) (see Google map in Fig. 1 for site locations).



*, # ≡ symbols explained in Fig. 1

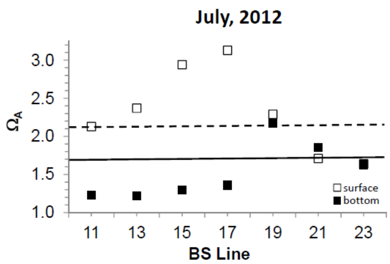
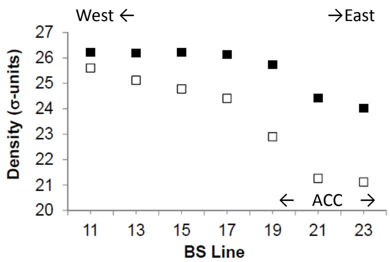
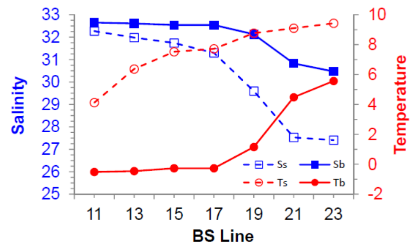


Figure P5. Saturation state for aragonite (Ω_A) estimated from pCO2 / TCO2 data for water samples collected in July 2012 along the BS Line (top left). The dashed and solid line depicts the average Ω_A value for all surface and bottom samples, respectively, collected at the same set of sites in three consecutive summers (2011, 2012, 2013). Water column along the BS Line became more dense and less stratified from east to west (bottom left). The location of the Alaskan Coastal Current (ACC) along the transect is indicated. ACC waters are warmer and fresher than those in the Bering Strait farther to the west (bottom right).





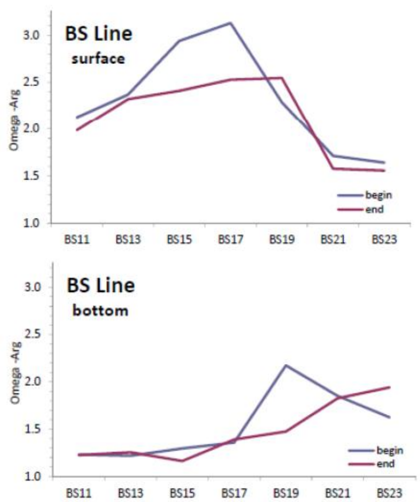


Figure P6. Variation in the saturation state for aragonite estimated from pCO2 / TCO2 measurements made on discrete samples of surface (0m, upper graph) and bottom (45-50m, lower graph) waters collected in July 2012 along the BS line extending from the Alaskan coast (BS23) to the Diomedes (BS11) (see map in Figure P1 for orientation). Section marked “Begin” was taken on 14th July 2012. Section marked “End” was taken on 19th July 2012.

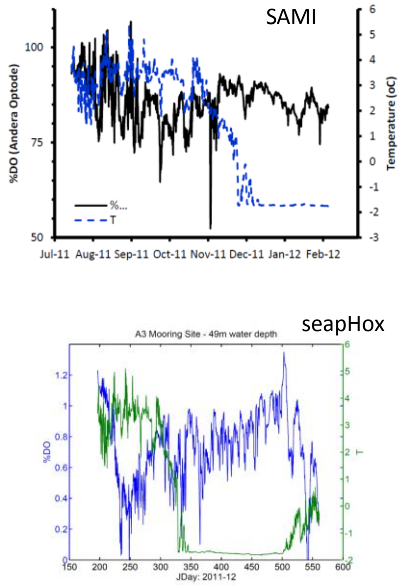


Figure P7. Dissolved oxygen and temperature data from (top panel) SAMI-pH on A311 (in % saturation and deg C), record ~ 6months long ; and (bottom panel) seapHox sensor on A311 (in saturation fraction and deg C).

The two records are in poor agreement
In the absence of bottom data for calibration, we consider both records as suspect.

Zooplankton Net Sampling for RUSALCA 2012 – Heather McEachen

Zooplankton sampling for the RUSALCA 2012 cruise was conducted by Heather McEachen, a PhD student at UAF, as a contribution to the ongoing doctoral research of fellow UAF graduate student, Elizaveta Ershova. The main objective in the collection of these samples is the continuation of a long-term time series describing pelagic ecosystems of the Chukchi Sea and Bering Strait. Net samples from this cruise will be processed for taxonomic composition of zooplankton and biomass, providing information on regional zooplankton species diversity and abundance.

Methods

Primary sampling efforts were focused on three lines, which have been repeatedly sampled during previous years within this project: the Bering Strait (BS) line, the Cape Serdtse / Chukchi South (CS) line, and the Cape Lisburne (LIS) line to the north. Additional samples of opportunity were taken along the A3 mooring line (AL), the Chukchi Convention Line (CCL), and the Diomede Islands (DI) line for comparison. Some stations (A3; DI; BS line) were sampled twice, on separate dates, to provide data for the analysis of potential short term regional changes (Table 1).

Quantitative samples of mesozooplankton were collected using paired standard Bongo nets with a mesh size of 150 µm and opening diameter of 60 cm (Figure 1a). Use of this type of net allows the comparison of data collected during this cruise with data collected during other years of the RUSALCA project, and other programs which conduct zooplankton surveys of the area, such as SBI (Shelf Basin Interaction Project) and OE (Ocean Exploration), as well as earlier databases. The described arrangement of paired net was towed vertically from the seafloor to the surface at each station. The wire speed for lowering and raising the net was 0.5m/sec. Net sampling during Leg 1 of the 2012 RUSALCA cruise focused on US stations only, with a total of 21 samples, including the initial test cast (Table 1). Nets were rinsed and samples concentrated using filtered seawater from the R/V Khromov's deck hose (Figure 1c-d). Samples were preserved using 10% formalin at all stations and 95% ethanol for sample duplicates at those stations which had been sampled in previous years (BS, CS, and LIS lines).

Preliminary Findings and Discussion

Specimens of ctenophores, copepods, decapods, pteropods (thecosome and gymnosome), amphipods, chaetognaths, crab zoea, and larvaceans from the LIS line were temporarily isolated and identified for educational display during the cruise (Figure 1e).

General inspection of net contents during sample collection throughout the cruise suggests zooplankton abundance and diversity to be highest in Alaska coastal regions, dominated by calanoid (*Neocalanus* and *Calanus spp*.) and chaetognath (*Parasagitta* and *Eukrohnia spp*.) species in the nearshore and northernmost waters. Samples were increasingly inundated by large quantities of phytoplankton, possibly diatom species, towards the Diomede Islands and southern CCL. These phytoplankton blooms corresponded with chlorophyll maximums on the CTD. A higher proportion of shelled pteropods (*Limacina helicina*) and small copepods (*Oithona spp.)* was noted in the more phytoplankton-rich net samples, whereas occurrences of naked pteropods (*Clione spp.*), ctenophores (*Beröe*, *Mnemiopsis*, and *Mertensia spp.*), and larvacean (*Oikopleura spp.)* houses were more commonly observed in areas without as much phytoplankton. This observation may however be an artifact of increased net pressure, caused by phytoplankton-clogged mesh, reducing the chances of obtaining intact specimens of the more gelatinous species. Taxonomic lab analysis of the collected samples will further illuminate any such trends.

Figure 1. (a) Zooplankton sampling nets hanging from the starboard side a-frame. (b) Bongo nets being hauled onboard after vertical tow. (c) Nets rinsed with filtered sea water to flush complete sample into cod-ends. (d) Sieving excess water from cod-ends to concentrate sample. (e) Isolated specimens of ctenophores, copepods, decapods, pteropods, amphipods, and chaetognaths on display for crew and science team.

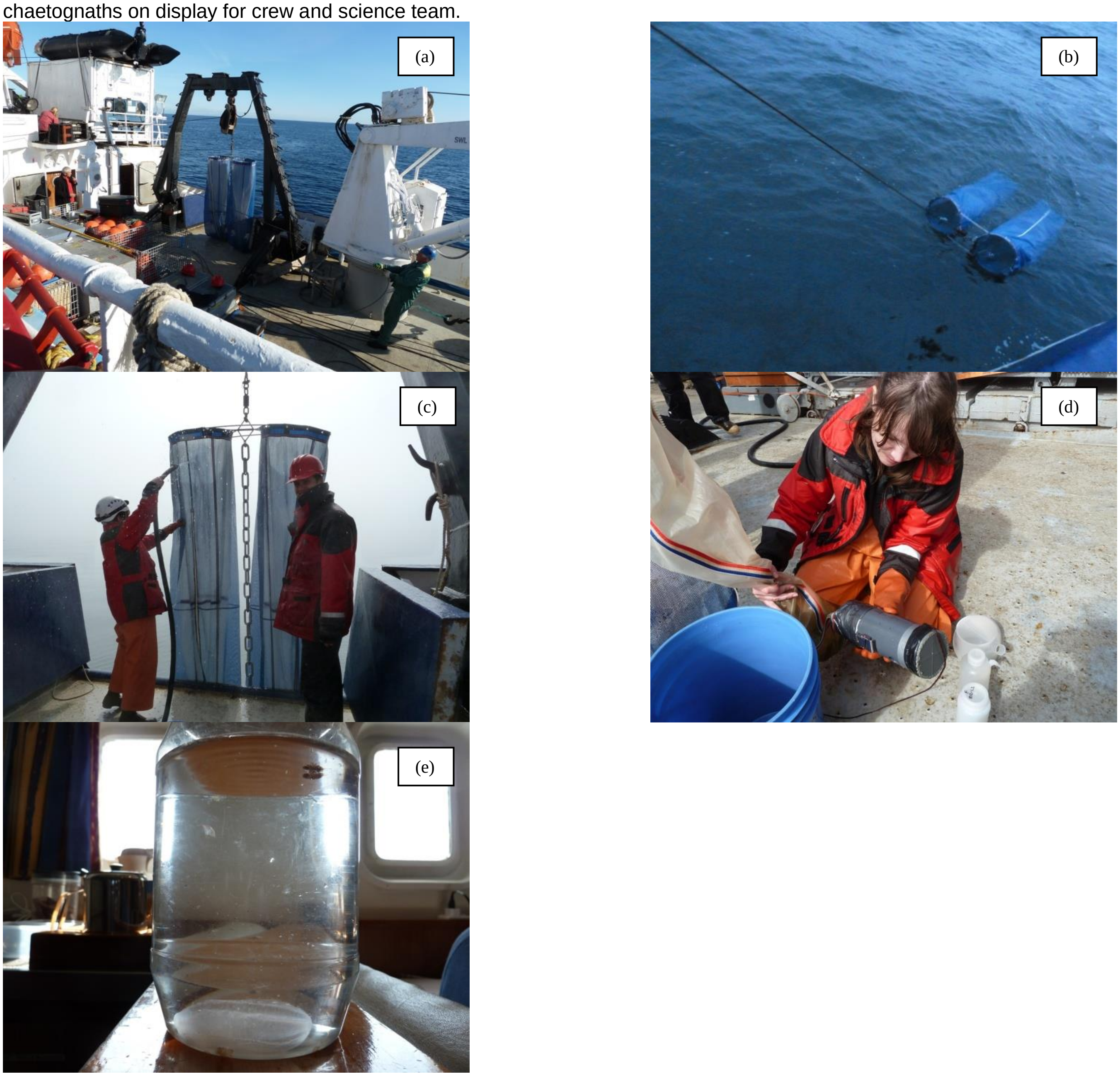


Table 1. Zooplankton net casts during Leg 1 of RUSALCA 2012.

Stn_name	Net Number	Date	Time	In(1)/Out(2)	Stn_depth (m)	Cast_depth (m)	Lat_deg	Lat_min	Lon_deg	Lon_min
DI-4T	**TEST CAST**	20120712	2000	1	48	45	65	51.948	168	56.316
BS-22	**1**	20120714	2255	1	40	36	65	39.030	168	11.907
		20120714	2303	2	40	36	65	39.460	168	11.912
BS-16	**2**	20120715	0343	1	46	42	65	43.810	168	34.993
		20120715	0350	2	46	42	65	44.016	168	34.89
A3-12	**3**	20120715	1804	1	58	44	66	19.721	168	56.652
		20120715	1815	2	58	44	66	19.823	168	56.986
AL-17	**4**	20120715	2348	1	57	53	66	23.527	168	36.471
		20120715	2354	2	57	53	66	23.607	168	36.483

AL-22	**5**	20120716	0308	1	42	38	66	26.942	168	14.585
		20120716	0313	2	42	38	66	27.022	168	14.525
CS-10	**6**	20120716	1219	1	53	48	67	38.158	168	55.258
		20120716	1228	2	53	48	67	38.183	168	54.929
CS-12	**7**	20120716	1617	1	58	55	67	52.496	168	18.427
		20120716	1625	2	58	55	67	52.479	168	18.235
CS-14	**8**	20120716	2029	1	55	51	68	6.169	167	39.992
		20120716	2032	1.5	51	51	68	6.182	167	39.985
		20120716	2035	2	55	51	68	6.191	167	39.979
CS17	**9**	20120717	0115	1	40	35	68	18.135	167	2.829
		20120717	0117	1.5	35	35	68	18.190	167	2.765
		20120717	0119	2	40	35	68	18.174	167	2.850
LIS-1	**10**	20120717	1516	1	29	25	68	54.430	166	19.274
		20120717	1520	1.5	25	25	68	54.420	166	19.155
		20120717	1524	2	29	25	68	54.410	166	19.035
LIS-6	**11**	20120717	1847	1	49	45	68	57.046	166	55.024
		20120717	1851	1.5	45	45	68	57.057	166	55.112
		20120717	1857	2	49	45	68	57.073	166	55.210
LIS-10	**12**	20120717	2337	1	52	48	69	2.309	167	52.835
		20120717	2340	1.5	48	48	69	2.342	167	52.757
		20120717	2342	2	52	48	69	2.372	167	52.689
LIS-14n	**13**	20120718	0326	1	44	40	69	0.200	168	46.572
		20120718	0329	1.5	40	40	69	0.194	168	46.542
		20120718	0332	2	44	40	69	0.186	168	46.506
CCL-18	**14**	20120718	1017	1	58	54	68	20.211	168	56.345
		20120718	1020	1.5	54	54	68	20.260	168	56.442
		20120718	1024	2	58	54	68	20.332	168	56.579
CCL-14	**15**	20120718	1634	1	53	48	67	38.223	168	55.495
		20120718	1638	1.5	48	48	67	38.310	168	55.289
		20120718	1642	2	53	48	67	38.325	168	55.289
CCL-10	**16**	20120718	2244	1	51	45	66	59.953	168	55.961
		20120718	2049	1.5	45	45	66	59.921	168	55.954
		20120718	2253	2	51	45	66	59.908	168	55.955
A3-12 (II)	**17**	20120719	0535	1	59	55	66	19.359	168	56.91
		20120719	0538	1.5	55	55	66	19.341	168	56.919
		20120719	0542	2	55	55	66	19.284	168	56.947
DI-4 (II)	**18**	20120719	1332	1	48	44	65	51.969	168	56.250
		20120719	1338	1.5	44	44	65	51.907	168	56.358
		20120719	1342	2	48	44	65	51.859	168	56.442
BS-16 (II)	**19**	20120720	0606	1	53	49	65	43.370	168	34.873
		20120720	0608	1.5	49	49	65	43.397	168	34.692
		20120720	0611	2	53	49	65	43.426	168	34.509
BS-22 (II)	**20**	20120720	0947	1	33	28	65	37.720	168	10.330
		20120720	0949	1.5	28	28	65	37.764	168	10.269
		20120720	0952	2	33	28	65	37.815	168	10.201

Marine mammal sightings RUSALCA 2012

Kathleen Stafford and Kalyn MacIntyre

In order to document marine mammal species seen along the trackline of the Professor Khromov during the 2012 Rusalca mooring cruise, a marine mammal watch was kept on the bridge from ~0600-2200 daily. The watch was halted during mooring operations and heavy fog. Watches consisted of one person stationed primarily on the port side of the bridge (to stay out of the way of bridge operations), scanning roughly 60° to either side of the bow with a pair of Steiner 7 x 50 binoculars. When sightings were made the time, location, species and number of animals as well as any notes on observations were logged (Tables 1 and 2). When possible photographs were taken of mammals to confirm identification. The assistance of the officers and crew of the Khromov in sighting animals was greatly appreciated. We did not keep track of sea bird sightings this year as the US Fish and Wildlife Service provided a sea bird observer for the cruise (Liz Labunski).

The first few days of the cruise coverage was spotty as mooring operations were in full swing. Once the marine mammal hydrophones were recovered and redeployed, the visual survey was conducted from 0600-~2200 daily. A total of 124 sightings of 193 individual animals were obtained representing 11 species (Table 1).

Sightings for all sightings are shown in Figure 1.

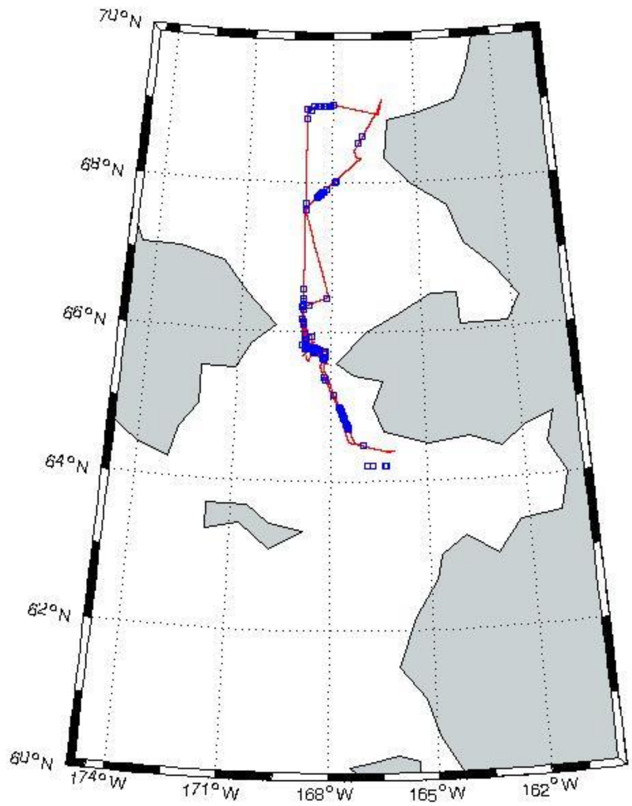


Figure 1. Trackline and all marine mammal sightings from RUSALCA 2012

Overall, there were many more marine mammal sightings and species seen on the 2012 cruise when compared to the 2011 cruise. Part of the interannual discrepancy is likely due to the generally excellent weather during the 2012 cruise. Very little time was lost to fog or high seas this year. The majority of sightings from 2012 were gray whales, totaling over half of the sightings (Figure 2). Additionally, most of the unidentified large whales were likely gray whales. At least 6 cow-calf pairs were identified during this cruise; this should be considered a minimum as we never closed on animals to confirm age or length.

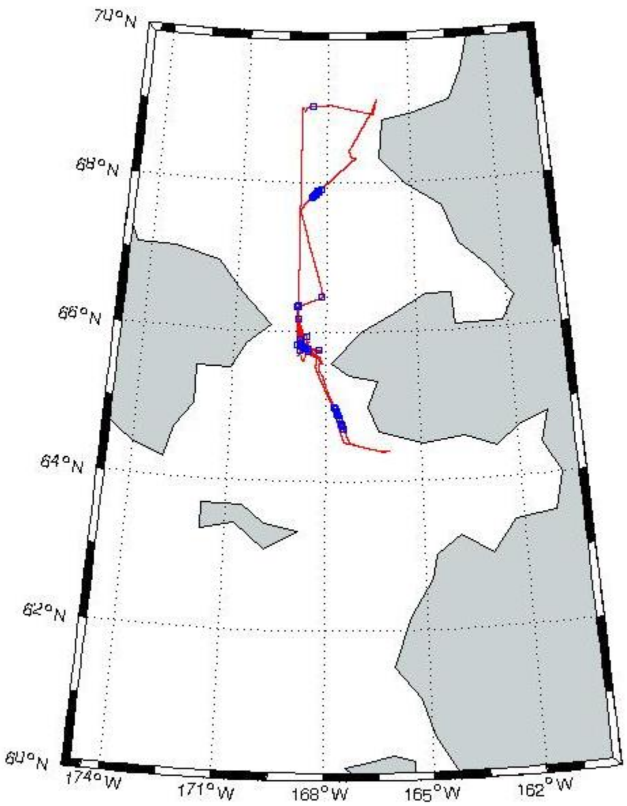


Figure 2. Locations of all gray whales sighted on Rusalca 2012 cruise.

Table 1. Marine mammal sightings by species.

Species	#sightings	number animals
Harbor porpoise	3	3
Like minke whale	1	1
Killer whale	1	6-7
Dall's porpoise	2	2
Phoca spp	29	29
Gray whale	53	110
Ringed seal	8	8
Ribbon seal	1	1
Spotted seal	2	2
Fin whale	1	1
Humpback whale	2	4
Unid baleen whale	22	28
sum	124	192-193

Table 2. Locations, times and counts for all marine mammal sightings.

#	Date time	Lat	Long	Sea	Sky	Vis	Species	#
1	7/11/12 15:53	65.36	-168.17	1	PC	ex	Phoca spp	1
2	7/11/12 16:05	65.39	-168.21	2	PC	ex	Phoca spp	1
3	7/11/12 19:34	65.74	-168.18	1	OV	ex	Ring seal	1
4	7/11/12 20:34	65.75	-168.24	2	OV	ex	Gray whale	2
5	7/11/12 22:49	65.76	-168.36	2	pc	ex	Phoca spp	1
6	7/12/12 0:25	65.77	-168.47	2	PC	ex	Unid large whale	1
7	7/12/12 3:00	65.78	-168.57	2	pc	ex	Unid large whale	1
8	7/12/12 3:07	65.78	-168.57	2	pc	ex	Gray whale	1
9	7/12/12 4:10	65.74	-168.60	1	sunny	ex	Gray whale	1
10	7/12/12 6:28	65.76	-168.87	2	sunny	ex	Gray whale	1
11	7/13/12 16:40	65.81	-168.79	2	OV	ex	Gray whale	1
12	7/13/12 20:07	66.11	-168.93	3	PC		Unid large whale	1
13	7/13/12 20:15	66.14	-168.94	3			Unid large whale	1
14	7/13/12 20:28	66.17	-168.94	3			Gray whale	1
15	7/13/12 21:57	66.34	-168.95	4	cloudy		Gray whale	2
16	7/14/12 4:40	65.85	-168.80	2	OV	good	Gray whale	1
17	7/14/12 5:23	65.80	-168.80	1	OV	good	Gray whale	2
18	7/14/12 5:45	65.79	-168.70	1	PC	good	Gray whale	2
19	7/14/12 16:30	65.93	-168.65	2	OV	very good	Gray whale	2
20	7/14/12 18:34	65.79	-168.56	1	cloudy	very good	Ring seal	1
21	7/14/12 19:36	65.75	-168.50	1	cloudy	very good	Ring seal	1
22	7/14/12 20:24	65.66	-168.29	1	PC	very good	Phoca spp	1
23	7/14/12 20:33	65.65	-168.26	1	PC	very good	Phoca spp	1
24	7/14/12 20:40	65.64	-168.24	1		ex	Ring seal	1
25	7/14/12 20:45	65.63	-168.22	1		ex	Phoca spp	1
26	7/15/12 0:06	65.66	-168.20	3	OV	good	Phoca spp	1
27	7/15/12 0:51	65.65	-168.25	3	OV	good	Phoca spp	1
28	7/15/12 4:04	65.71	-168.56	1	pc	ex	Phoca spp	1
29	7/15/12 4:31	65.73	-168.54	1	pc	ex	Phoca spp	1
30	7/15/12 17:44	66.09	-168.94	2	pc	ex	Humpback	1
31	7/15/12 18:16	66.30	-168.94	2	pc	very good	Ring seal	1
32	7/15/12 18:45	66.33	-168.94	1	pc	ex	Gray whale	1
33	7/15/12 19:00	66.33	-168.95	1	pc	ex	Gray whale	7
34	7/15/12 19:16	66.33	-168.95	1	pc	ex	Gray whale	2
35	7/15/12 19:22	66.33	-168.96	1	pc	ex	Gray whale	2
36	7/15/12 22:52	66.36	-168.77	2	OV	good	Unid large whale	5
37	7/16/12 6:09	66.46	-168.18	2	pc	ex	Gray whale	1
38	7/16/12 15:43	67.80	-168.52	2	OV	good	Gray whale	2
39	7/16/12 15:48	67.81	-168.50	2	OV	good	Gray whale	1
40	7/16/12 15:52	67.81	-168.50	2	OV	good	Gray whale	4
41	7/16/12 15:59	67.81	-168.49	2	OV	good	Gray whale	1
42	7/16/12 16:18	67.83	-168.45	2	OV	good	Gray whale	8

43	7/16/12 16:25	67.84	-168.41	2	OV	good	Gray whale	9
44	7/16/12 16:31	67.85	-168.38	2	OV	good	Gray whale	3
45	7/16/12 16:32	67.86	-168.38	2	OV	good	Gray whale	3
46	7/16/12 16:46	67.88	-168.33	2	OV	good	Gray whale	5
47	7/16/12 16:49	67.88	-168.32	2	OV	good	Gray whale	3
48	7/16/12 17:01	67.87	-168.31	2	OV	good	Gray whale	6
49	7/16/12 17:48	67.91	-168.22	2	OV	good	Gray whale	2
50	7/16/12 17:50	67.91	-168.21	2	OV	good	Gray whale	1
51	7/16/12 19:39	68.01	-167.93	2		very good	Phoca spp	1
52	7/16/12 19:48	68.02	-167.89	2		very good	Phoca spp	1
53	7/17/12 4:31	68.52	-167.06	5	OV	good	spotted seal	1
54	7/17/12 4:58	68.61	-166.92	4	some fog	fair	Phoca spp	1
55	7/18/12 1:00	69.03	-167.99	1	pc	ex	spotted seal	1
56	7/18/12 1:11	69.02	-168.08	1	pc	ex	Phoca spp	1
57	7/18/12 1:17	69.02	-168.14	1	pc	ex	Phoca spp	1
58	7/18/12 2:00	69.02	-168.25	1	pc	ex	Phoca spp	1
59	7/18/12 2:02	69.02	-168.27	1	pc	ex	Phoca spp	1
60	7/18/12 2:47	69.01	-168.42	0	pc	ex	Phoca spp	1
61	7/18/12 2:59	69.01	-168.52	0	pc	ex	Gray whale	2
62	7/18/12 3:05	69.01	-168.57	0	pc	ex	Phoca spp	1
63	7/18/12 3:46	69.01	-168.70	0	pc	ex	Unid large whale	1
64	7/18/12 4:48	68.97	-168.81	0	pc	ex	Phoca spp	1
65	7/18/12 5:08	68.98	-168.92	0	pc	ex	harbor porpoise	1
66	7/18/12 5:49	68.98	-168.93	0	pc	ex	Phoca spp	1
67	7/18/12 5:54	68.97	-168.93	0	PC	very good	ring seal	1
68	7/18/12 6:33	68.85	-168.93	0	OV	very good	Ribbon seal	1
69	7/18/12 16:27	67.72	-168.94	2	fog	fair	harbor porpoise	1
70	7/18/12 18:00	67.63	-168.93	1	OV	good	Phoca spp	1
71	7/18/12 18:16	67.63	-168.93	1	OV	good	Phoca spp	1
72	7/19/12 3:29	66.57	-168.94	4	OV, fog	good	Killer whale	5 to 7
73	7/19/12 4:39	66.45	-168.93	3	OV, fog	fair	Fin whale	1
74	7/19/12 4:46	66.42	-168.93	3	OV, fog	fair	Dall's porpoise	1
75	7/19/12 5:38	66.35	-168.94	3	OV, fog	fair	Gray whale	2
76	7/19/12 6:00	66.34	-168.94	3	OV, fog	fair	Unid large whale	1
77	7/19/12 15:56	65.83	-168.94	2	MC	very good	Gray whale	1
78	7/19/12 15:56	65.83	-168.94	2	MC	very good	Gray whale	1
79	7/19/12 16:00	65.83	-168.94	2	MC	very good	Unid large whale	1
80	7/19/12 16:26	65.82	-168.87	2	PC	very good	Gray whale	1
81	7/19/12 18:10	65.88	-168.86	3	MC	very good	Phoca spp	1

82	7/19/12 18:43	65.90	-168.87	3	OV	good	Gray whale	2
83	7/19/12 20:44	65.97	-168.87	3	OV	good	ring seal	1
84	7/20/12 1:28	65.87	-168.80	1	OV	very good	ring seal	
85	7/20/12 5:45	65.77	-168.69	3	MC	very good	Gray whale	2
86	7/20/12 5:54	65.77	-168.69	3	MC	very good	Gray whale	1
87	7/20/12 15:03	65.16	-167.90	2	OV	good	Phoca spp	1
88	7/20/12 16:05	65.00	-167.74	2	OV	good	Gray whale	1
89	7/20/12 16:10	64.99	-167.72	2	OV	good	Gray whale	2
90	7/20/12 16:15	64.97	-167.71	2	OV	good	Gray whale	1
91	7/20/12 16:16	64.97	-167.71	2	OV	good	Gray whale	2
92	7/20/12 16:20	64.96	-167.70	2	OV	very good	Unid large whale	1
93	7/20/12 16:24	64.95	-167.69	2	OV	very good	Humpback	3
94	7/20/12 16:34	64.94	-167.66	2	OV	very good	Gray whale	1
95	7/20/12 16:41	64.91	-167.65	2	OV	very good	Gray whale	3
96	7/20/12 16:43	64.90	-167.64	2	OV	very good	Gray whale	1
97	7/20/12 16:43	64.90	-167.64	2	OV	very good	Unid large whale	1
98	7/20/12 16:45	64.90	-167.64	2	OV	very good	Gray whale	1
99	7/20/12 16:50	64.88	-167.62	2	OV	very good	Gray whale	1
100	7/20/12 16:58	64.86	-167.60	2	OV	very good	Unid large whale	1
101	7/20/12 17:03	64.85	-167.59	2	OV	very good	Unid large whale	1
102	7/20/12 17:05	64.85	-167.58	2	OV	very good	Gray whale	2
103	7/20/12 17:07	64.84	-167.58	2	OV	very good	Gray whale	1
104	7/20/12 17:07	64.84	-167.58	2	OV	very good	Gray whale	1
105	7/20/12 17:12	64.83	-167.56	2	OV	very good	Unid large whale	2
106	7/20/12 17:32	64.78	-167.52	2	OV	very good	Unid large whale	1
107	7/20/12 17:32	64.78	-167.52	2	OV	very good	Gray whale	1
108	7/20/12 17:35	64.77	-167.51	2	OV	very good	Unid large whale	1
109	7/20/12 17:39	64.76	-167.50	2	OV	very good	Unid large whale	2
110	7/20/12 17:39	64.76	-167.50	2	OV	very good	Gray whale	1
111	7/20/12 17:39	64.76	-167.50	2	OV	very good	Unid large whale	1
112	7/20/12 17:46	64.74	-167.48	2	OV	very good	Gray whale	1
113	7/20/12 17:46	64.74	-167.48	2	OV	very good	Unid large whale	1
114	7/20/12 17:49	64.73	-167.47	2	OV	very good	Unid large whale	1
115	7/20/12 17:49	64.73	-167.47	2	OV	very good	Unid large whale	1
116	7/20/12 17:55	64.72	-167.45	2	OV	very good	Unid large whale	1
117	7/20/12 17:59	64.71	-167.44	2	OV	very good	Gray whale	1
118	7/20/12 19:59	64.48	-166.97	2	OV	ex	harbor	1

							porpoise	
119	8/17/12 6:36	64.21	-166.87	1	OV	ex	Phoca spp	1
120	8/17/12 0:50	64.21	-166.84	1	OV	ex	Phoca spp	1
121	8/15/12 23:24	64.21	-166.69	1	OV	good	Phoca spp	1
122	8/13/12 14:31	64.21	-166.32	2	OV	good	Phoca spp	1
123	8/13/12 4:26	64.21	-166.27	2	OV	very good	Dall's porpoise	1
124	7/20/12 10:50						Unid large whale	1

Marine mammal hydrophones

During RUSALCA 2012, 3 hydrophone packages were recovered and 3 deployed. The recoveries were at sites A2W-11 (65.80N 168.798W) and A3-11 (66.327N 168.965W) and D1-11 (65.869N 168.945W). The instrument at A2W-11 did not write to disk for no apparent reason, this will be examined in detail back in the lab. Each instrument was on a duty cycle whereby the first 10 minutes of every hour were recorded at a sample rate of 8192 (10-4096 Hz bandwidth). The instrument at D1-11 recorded from 1 October 2011 to 7 July 2012 and the instrument at A3-11 recorded from 1 October 2011 to 25 May 2012. No analysis of these data has occurred to date but a cursory exam of both instruments showed that the following species were recorded on each: humpback whale, bowhead whale, beluga whale, walrus, and bearded seal. The three instruments redeployed were on A3-12, A2W-12 and A4W-12 (65.75N 168.365W). Each of the three instruments was set to sample at 16384 Hz for 10 minutes every 60 starting 1 September 2012.

RUSALCA I 2012 - Marine Bird and Mammal Surveys - July 10-20, 2012

Elizabeth Labunski and Kathy Kuletz (Principal Investigator)
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Background

As part of the joint RUSALCA monitoring project, E. Labunski surveyed marine birds and mammals in conjunction with oceanographic and biological sampling conducted onboard the *R/V Khromov*. Surveys were conducted while the ship transited from Nome, through the Bering Strait and north to Cape Lisburne. Processed data will be archived in the North Pacific Pelagic Seabird Database (USFWS and USGS, Anchorage, Alaska) and with the Bureau of Ocean Energy Management (BOEM). These surveys are funded by BOEM under project title 'Seabird Distribution and Abundance in the Offshore Environment'.

Methods

Surveys were conducted using U.S. Fish and Wildlife Service North Pacific Pelagic Seabird Observer Protocols. Observations were made from the port side of the bridge during daylight hours while the ship was underway. The observer scanned the water ahead of the ship using hand-held 10x binoculars when necessary for identification. The observer recorded all birds and mammals within a 300-m- 90^o arc from the bow to the beam. All observations were recorded using strip transect methodology and three distance bins extending from the vessel: 0-100 m, 101-200 m, and 201-300 m. Unusual sightings beyond 300 m were recorded for rare birds, large bird flocks, and mammals. In addition we recorded the animal's behavior (flying, on water, on ice). Birds on the water were counted continuously, whereas flying birds were recorded during quick 'Scans' of the transect window. Scan periods were based on ship speed and were typically about 1/min. Observations were entered directly into a GPS-integrated laptop computer using the program DLOG3 (Ford Ecological Consultants, Inc.). A handheld GPS unit was used to acquire location data that was automatically recorded in 20 second intervals, and included continuous records on weather conditions, Beaufort Sea State, and glare conditions.

Results

Surveys were conducted 10-20 July 2012. Thirty-six transects were surveyed totaling 965 km. A total of 5,113 birds were recorded on transect with 96% identified to species for a total of 18 species (Table 1). The majority of birds observed during the survey were auklets (*Aethia spp;* primarily least auklets*, A. pusilla*), red phalaropes (*Phalaropus fuliceria*) and murres (*Uria spp;* primarily thick-billed murres*, U. lomvia*). The auklets and phalaropes are primarily planktivores and the murres are primarily piscivores, although euphausiids can be a large proportion of the diet of thick-billed murres in some locations.

Most of the auklets were observed in the Bering Strait and around Little Diomede Island (Fig. 1). Little Diomede is a known breeding colony for *Aethia* auklets. Auklets can range far from their colonies, but their foraging areas shift with ocean conditions. Red phalaropes (mainly in breeding plumage), also prevalent in this region (Fig. 2), breed inland on the tundra and these were likely post-breeding, pre-migratory feeding aggregations. Because red phalaropes are the more pelagic of the phalaropes, little is known about their post-breeding marine distribution and habitat use, so this information will be of interest. Murres (Fig. 3) and puffins (*Fratercula spp*.; Fig. 4), which tend to be more piscivorous, were more widely distributed within the survey area extending from Cape Wales north to Cape Lisburne, where there are breeding colonies. The relatively high densities for all of these key species groups (auklets, murres, phalaropes, puffins) in the Bering Strait region is indicative of abundant food resources in the area.

The 148 eiders observed were off transect, and included common eiders (*Somateria mollissima*), king eiders (*S. spectabilis*) and one spectacled eider (*S. fischeri*); the latter is listed as threatened under the ESA. A total of 26 marine mammals of 7 species were recorded, including whales, seals, and porpoise (Table 2). The majority of marine mammal observations were seals. Notable observations included a pod of killer whales, and a single ribbon seal observed off of the Seward Peninsula.

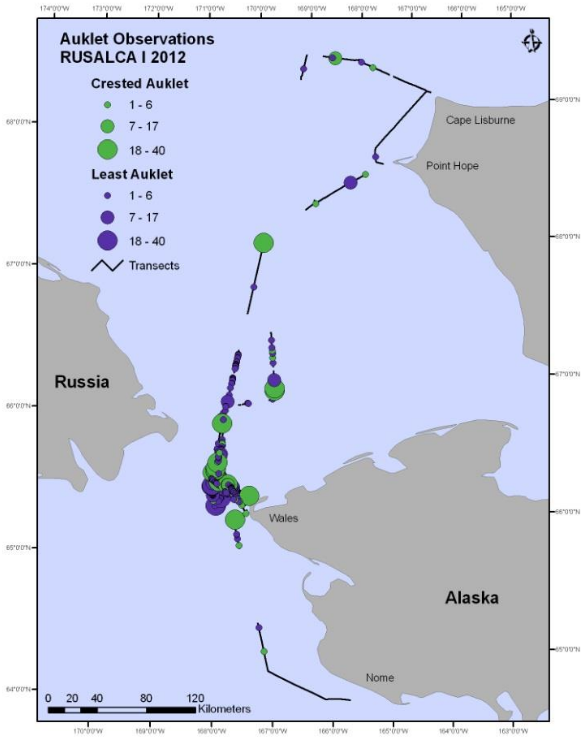

Figure 1. Distribution of crested and least auklets during RUSALCA I (July 2012).

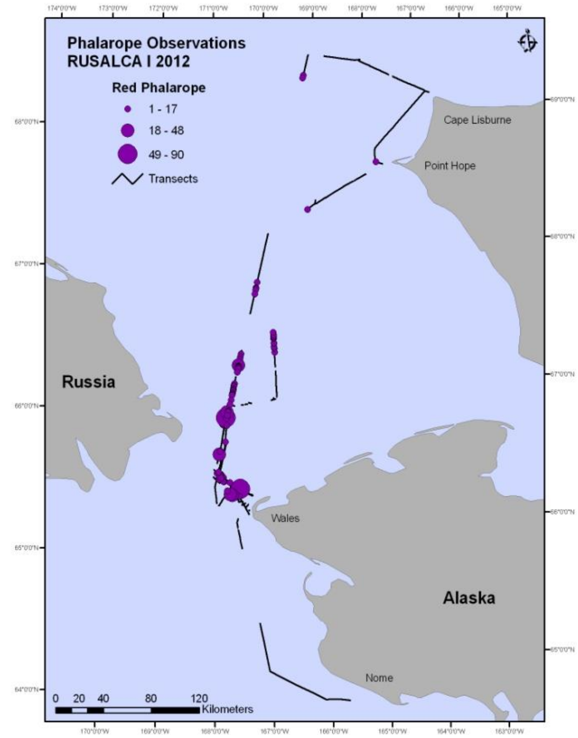

Figure 2. Distribution of red phalaropes on transect during RUSALCA I (July 2012).

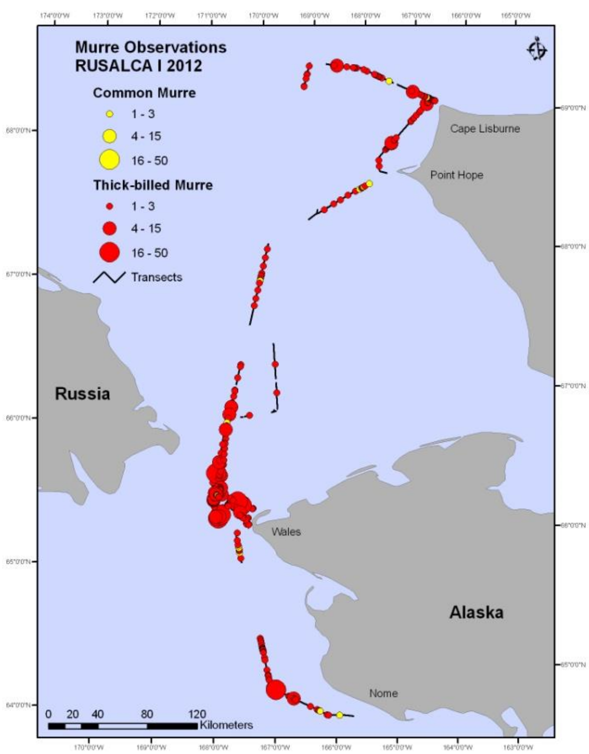

Figure 3. Distribution of common and thick-billed murres observed on transect during RUSALCA I (July 2012).

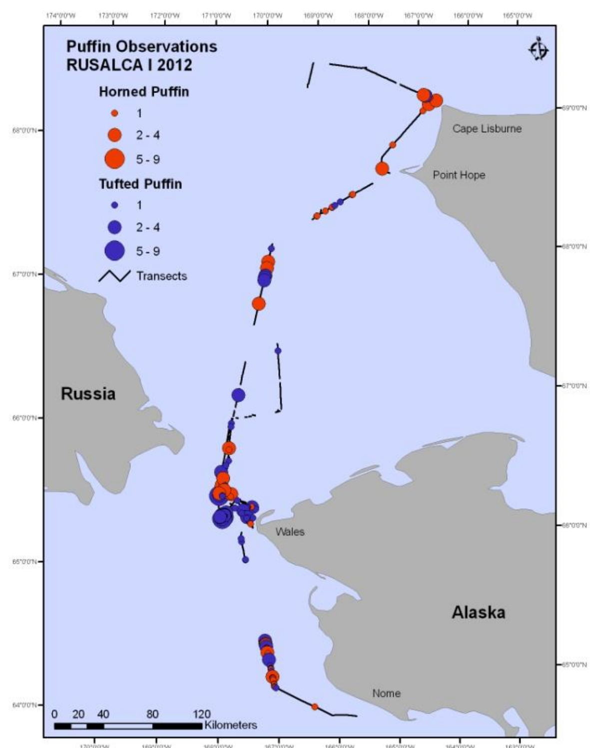

Figure 4. Distribution of horned and tufted puffins on transect during RUSALCA I (July 2012).

Table 1. Marine bird observations during RUSALCA I (July 10- 20, 2012).

		On Transect		Off Transect
Common Name	Scientific Name	Count	Percent of total	Count
Northern Fulmar	*Fulmaris glacialis*	348	6.81	20
Red-faced Cormorant	*Phalacrocorax urile*	1	0.02	
Long-tailed Duck	*Clangula hyemalis*			3
Common Eider	*Somateria mollissima*			124
King Eider	*Somateria spectabilis*			3
Spectacled Eider	*Somateria fischeri*			1
Unid. Eider	*Somateria/Polysticta spp*			20
Red Phalarope	*Phalaropus fulicaria*	979	19.15	1
Unid. Phalarope	*Phalaropus spp.*	18	0.35	
Unid. Shorebird	Charadrii (suborder)	14	0.27	
Pomarine Jaeger	*Stercorarius pomarinus*	4	0.08	13
Long-tailed Jaeger	*Stercorarius longicaudus*	2	0.04	4
Unid. Jaeger	*Stercorarius spp.*	2	0.04	4
Herring Gull	*Larus argentatus*	5	0.1	
Glaucous Gull	*Larus hyperboreus*	69	1.35	1
Unid. Gull	Family *Laridae*	2	0.04	
Black-legged Kittiwake	*Rissa tridactyla*	204	3.99	2
Sabine's Gull	*Xema sabini*			1
Arctic Tern	*Sterna paradisaea*	1	0.02	
Common Murre	*Uria aalge*	32	0.63	
Thick-billed Murre	*Uria lomvia*	897	17.54	39
Unid. Murre	*Uria spp.*	101	1.98	204
Black Guillemot	*Cepphus grylle*	5	0.1	1
Pigeon Guillemot	*Cepphus columba*	6	0.12	1
Unid. Guillemot	*Cepphus spp.*	1	0.02	
Parakeet Auklet	*Aethia psittacula*	226	4.42	
Crested Auklet	*Aethia cristatella*	472	9.23	621
Least Auklet	*Aethia pusilla*	1393	27.24	189
Unid. Auklet	*Aethia spp.*	42	0.82	18
Horned Puffin	*Fratercula corniculata*	81	1.58	6
Tufted Puffin	*Fratercula cirrhata*	163	3.19	
Unid. Puffin	*Fratercula spp.*	1	0.02	
Unid. Alcid	Family *Alcidae*	44	0.86	

Table 2. Marine mammal observations during RUSALCA I (July 10- 20, 2012).

Common Name	Latin Name	On Transect Count	On Transect Percent of total	Off Transect Count
Dall's Porpoise	*Phocoenoides dalli*	1	6.25	1
Killer Whale	*Orcinus orca*			6
Grey Whale	*Eschrichtius robustus*	1	6.25	8
Fin Whale	*Balaenoptera physalus*			1
Unid. Whale	*Cetacea spp*			3
Ribbon Seal	*Histriophoca fasciata*	1	6.25	
Ringed Seal	*Pusa hispida*	2	12.5	
Spotted Seal	*Phoca largha*	1	6.25	
Unid. Seal		10	62.5	1

RUSALCA 12 – Teacher at Sea Outreach Summary

This year, a physics teacher, Kathy Ellingson from Shorecrest High School in Shoreline, WA, near Seattle, took part in the cruise. Ship-to-shore communications on the Khromov are limited and expensive. Thus, instead of the traditional "cruise blog", we targeted the taking of video footage. This footage will be used to make some short educational videos, and to provide material for editing for the classes of Shorecrest High School. A video camera was loaned to the project by Don Porter of the Applied Physics Laboratory, UW.

My role was to video record everything and anything associated with this RUSALCA cruise. The video will be used by the Applied Physics Lab at UW. It will also be used by me for community outreach to teach about the project and its participants, and inspire students to pursue science in high school and college.

I would encourage anyone video recording subsequent cruises to:

- Use a UV filter on the lens.
- Prepare for some of the limitations of shooting on a ship; it is noisy (engines and wind), crowded, everyone is moving, spaces are sometimes small, backlighting from portholes is sometimes hard to avoid, and if you are blessed with sunshine it can be hard to see your video screen.
- Be sure to get as much audio as video. Video people as they work and ask questions about their work afterwards.
- Use a waterproof camera in case of rain.

I did my initial shooting from above the deck where I could get a feel for what was going on without getting in anyone's way.

There are interesting things going on 24 hours a day so it is easy to accumulate lots of video. Bring a computer, video editing software and an external hard drive.

RUSALCA 2012 – Taking a modeler to Sea Outreach Summary

The oceanographic community has long recognized the challenge of bridging the gap between observational and modeling studies. As one step towards this, An Nguyen, a modeler from MIT, took part in the cruise this year. In addition to working with mooring and CTD data collection, she brought with her results from a 4km resolution model of the region, and preliminary work was done comparing the model fields, especially sections and T-S plots with new data fresh from the ocean. There interactions led to insights on both sides, and is the basis of a talk to be presented at the 2012 AOMIP (Arctic Ocean Model Intercomparison Project) meeting in October 2012.

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Khromov Mooring cruise 2012 CalibrationCasts - taken with SBE37IM lowered by trawl wire (8 casts total)

CAST 1	**A5-11**								
Water=39+5=44m	**wire 42m**	**GMT Date**	**Time**		**lat deg**	**Lat min**	**Long deg**	**Long min**	**(N&W)**
	In water	11th July 2012	1749		65	44.5	168	10.93	
	At Bot		1802		65	44.859	168	10.285	
	Drop Mess				65	44.908	168	10.195	
	Mess Hit				65	44.889	168	10.222	
	Start up		1804		65	44.887	168	10.232	
	Surface		1809		65	45.044	168	9.944	

CAST2	**A4-11**								
Water=44+5=49m	**wire 47m**	**GMT Date**	**Time**		**lat deg**	**Lat min**	**Long deg**	**Long min**	**(N&W)**
	In water	11th July 2012	2008		65	44.87	168	15.664	
	At Bot		2015		65	45.059	168	15.482	
	Drop Mess		2016		65	45.069	168	15.474	
	Mess Hit		2016		65	45.075	168	15.468	
	Start up		2016		65	45.081	168	15.459	
	Surface		2021		65	45.182	168	15.333	

CAST 3	**A4W-11**								
Water=50+5=55m	**wire 52m**	**GMT Date**	**Time**	**mfromMooring**	**lat deg**	**Lat min**	**Long deg**	**Long min**	**(N&W)**
	In water	11th July 2012	2159		65	45.458	168	22.029	
	At Bot		2207	600	65	45.744	168	22.149	
	Drop Mess								
	Mess Hit								
	Start up		2209		65	45.813	168	22.165	
	Surface		2216		65	46.06	168	22.164	

CAST 4	**A2E-11**								
Water=51+5=56m	**wire 54m**	**GMT Date**	**Time**		**lat deg**	**Lat min**	**Long deg**	**Long min**	**(N&W)**
	In water	11th July 2012	2329		65	46.302	168	28.021	
	Start down		2331	132	65	46.319	168	28	
	At Bot		2338	300	65	46.386	168	27.848	
	Drop Mess								
	Mess Hit								
	Start up		2340	375	65	46.41	168	27.762	
	Surface		2347	628	65	46.496	168	27.502	
	Out		2349	745	65	46.535	168	27.403	

CAST 5	A2-11									
Water=52+5=57m	**wire 51m**	**GMT Date**	**Time**		**lat deg**	**Lat min**	**Long deg**	**Long min**	**(N&W)**
	In water	12th July 2012	118	137	65	46.929	168	33.99	
	Start down								
	At Bot		127		65	46.98	168	33.793	
	Drop Mess		128		65	46.987	168	33.746	
	Mess Hit		128	335	65	46.988	168	33.756	
	Start up		129		65	46.992	168	33.74	
	Surface		137	578	65	47.059	168	33.454	
	Out								

CAST 6	A2W-11								
Water=49.5+5=54.5	**wire 51m**	**GMT Date**	**Time**		**lat deg**	**Lat min**	**Long deg**	**Long min**	**(N&W)**
	In water	12th July 2012	1654	89	65	48	168	47.964	
	Start down		1656	178	65	47.993	168	47.856	
	At Bot		1712	877	65	47.916	168	46.946	
	Start up		1714	991	65	47.901	168	46.798	
	Surface		1731	1680	65	47.815	168	45.924	
	Out		1733	1770	65	47.806	168	45.805	

CAST 7	D1-11								
Water=42+5=47m	**wire 45m**	**GMT Date**	**Time**		**lat deg**	**Lat min**	**Long deg**	**Long min**	**(N&W)**
	In water	12th July 2012	1836	196	65	52.136	168	57.045	
	Start down		1838	218	65	52.108	168	57.038	
	At Bot		1848	310	65	52.01	168	56.748	
	Start up		1851	346	65	51.997	168	56.669	
	Surface		1857	515	65	51.959	168	56.386	
	Out		1859	561	65	51.948	168	56.316	

CAST 8	A3-11								
Water=53.5+5=58.5	**wire 52m**	**GMT Date**	**Time**		**lat deg**	**Lat min**	**Long deg**	**Long min**	**(N&W)**
	In water	12th July 2012	2026	236	66	19.715	168	57.496	
	Start down		2029	346	66	19.775	168	57.471	
	At Bot		2037	804	66	20.019	168	57.388	
	Drop Mess		2039		66	20.048	168	57.373	
	Mess Hit		2039		66	20.059	168	57.366	
	Start up		2040	895	66	20.068	168	57.362	
	Surface		2050	1360	66	20.315	168	57.229	
	Out		2051	1390	66	20.327	168	57.218	

%RUSALCA 2012 CTD and NET log %
%
%Please fill in all data for every event (CTD/net tow) %
%There should be one line for the beginning of the event and one line fc %
%Date is GMT and has the format yyyymmdd %
%Time is GMT and has the format hhmm (times are ~ 5min off GMT) %
%Ty=Type: 1=CTD / 2=Net tow/4=prod cast %
%#,Number is consecutive for that event type %
%In/out (I/O): 1=In / 2=Out %
%Dep=waterdepth(m) from bridge, including 5m ship's draft
%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, after CTD 5
%Op=CTD operator
% when 3 lines for NET, dep indicates wire out for net
%Fill in any comments if needed. %
%NOTE: Times on this log were taken from the video system, which wa %

% Date	**Time**	**Ty**	**#**	**I/O**	**Dep**	**LatD**	**LatM**	**LonD**	**LonM**	**%**	**St**	**SS**	**WSp**	**WD**	**Op**	**Comments (DO NOT USE COMMAS!!)**
20120714	0512	1	**1**	1	58	65	47.200	168	33.990	%	A2	unk	unk	unk	JW	Test cast for learning to drive CTD
20120714	0537	1	**1**	2	58	65	47.401	168	34.229	%						
20120714	1635	4	**2**	1	57	65	46.922	168	34.017	%	A2	1	5	SE	JW	prod
20120714	1650	4	**2**	2	57	65	46.939	168	33.845	%						finished sampling at 17:27
20120714	1752	1	**3**	1	57	65	46.915	168	34.202	%	A2	1	5	SE	CAS	water sampling school
20120714	1810	1	**3**	2	57	65	47.148	168	34.295	%						Bottle 8 did not close
20120714	2030	1	**4**	1	28	65	35.060	168	7.410	%	BS24	1	5	SE	CT	Times from computer instead of video
20120714	2043	1	**4**	2	28	65	35.441	168	8.156	%						3.5 knot current
20120714	2133	1	**5**	1	33	65	36.209	168	9.664	%	BS23	2	10	SE	CT	3.3 knot current
20120714	2145	1	**5**	2	33	65	36.758	168	10.016	%						lion's mane jellyfish on CTD (CAS)
% Above here, Wind Spd=CTD operator estimates; Below=From Bridge readout																
20120714	2230	1	**6**	1	34	65	37.710	168	11.180	%	BS22	2	8	160	CT	
20120714	2242	1	**6**	2	34	65	38.140	168	11.550	%						
20120714	2255	2	**1**	1	40	65	39.030	168	11.907	%						
20120714	2303	2	**1**	2	40	65	39.460	168	11.912	%						
20120714	2350	1	**7**	1	44	65	38.953	168	14.914	%	BS21	2	7	160	CT	3.7 knot current
20120715	0009	1	**7**	2	44	65	40.014	168	15.000	%						

20120715	0049	1	**8**	1	50	65	39.497	168	19.084	%	BS20	1	5	160	MNP	3.7 knot current
20120715	0111	1	**8**	2	50	65	40.471	168	19.041	%						bottle 1 leaking
20120715	0135	1	**9**	1	54	65	40.372	168	23.447	%	BS19	1	4	190	MNP	3.1 knot current
20120715	0150	1	**9**	2	54	65	40.897	168	23.780	%						
20120715	0211	1	**10**	1	56	65	41.270	168	27.040	%	BS18	1	1	190	MNP	1.8 knot current
20120715	0223	1	**10**	2	56	65	41.580	168	27.290	%						
20120715	0244	1	**11**	1	57	65	42.240	168	31.290	%	BS17	1	calm	190	MNP	0.9 knot current
20120715	0257	1	**11**	2	57	65	42.427	168	31.333	%						
20120715	0324	1	**12**	1	54	65	43.321	168	35.609	%	BS16	1	calm	190	MNP	1.5 knot current
20120715	0336	1	**12**	2	54	65	43.598	168	35.279	%						Bottle 7 leaking
20120715	0343	2	**2**	1	46	65	43.810	168	34.993	%			calm			
20120715	0350	2	**2**	2	46	65	44.016	168	34.890	%						
20120715	0454	1	**13**	1	53	65	44.338	168	39.728	%	BS15	0	calm		BD	
20120715	0502	1	**13**	2	53	65	44.467	168	39.622	%						
20120715	0530	1	**14**	1	55	65	45.307	168	43.298	%	BS14	0	calm		BD	
20120715	0538	1	**14**	2	55	65	45.482	168	43.229	%						
20120715	0609	1	**15**	1	55	65	46.422	168	47.664	%	BS13	0	calm		BD	Lanyard Bot8 broken (06:00). Deployed as is
20120715	0619	1	**15**	2	55	65	46.668	168	47.763	%						Repaired and bottle replaced for next cast
20120715	0649	1	**16**	1	47	65	47.311	168	51.681	%	BS12	0	calm		BD	cloudy water
20120715	0657	1	**16**	2	47	65	47.392	168	51.966	%						
20120715	0726	1	**17**	1	49	65	48.397	168	55.773	%	BS11	0	calm		BD	clear water
20120715	0736	1	**17**	2	49	65	48.665	168	55.539	%						
20120715	0755	1	**18**	1	50	65	49.382	168	55.226	%	DL1	0	calm		BD	nward drift at ~1.5kts… bottle leaking
20120715	0805	1	**18**	2	50	65	49.546	168	56.413	%						murky again
20120715	0822	1	**19**	1	49	65	50.245	168	56.066	%	DL2	1	calm		atn	
20120715	0833	1	**19**	2	49	65	50.182	168	55.706	%						
20120715	0854	1	**20**	1	47	65	51.210	168	56.050	%	DL3	1	calm		atn	
20120715	0906	1	**20**	2	47	65	51.323	168	55.581	%						
20120715	0926	1	**21**	1	48	65	52.219	168	56.131	%	DL4	1	calm		atn	
20120715	0934	1	**21**	2	48	65	52.341	168	55.655	%						
20120715	0950	1	**22**	1	50	65	53.195	168	56.052	%	DL5	1	calm		atn	No bottles
20120715	1000	1	**22**	2	50	65	53.225	168	55.481	%						
20120715	1017	1	**23**	1	51	65	54.148	168	56.191	%	DL6	0	calm		atn	
20120715	1027	1	**23**	2	51	65	54.204	168	55.772	%						
20120715	1045	1	**24**	1	51	65	55.121	168	56.234	%	DL7	0	calm		atn	No bottles
20120715	1054	1	**24**	2	51	65	55.227	168	56.025	%						
20120715	1110	1	**25**	1	51	65	56.154	168	56.221	%	DL8	0	calm		atn	

20120715	1122	1	**25**	2	51	65	56.360	168	56.078	%						
20120715	1135	1	**26**	1	53	65	57.096	168	56.283	%	DL9	0	calm		atn	No bottles
20120715	1146	1	**26**	2	53	65	57.286	168	56.294	%						
20120715	1200	1	**27**	1	53	65	58.043	168	56.217	%	DL10	1	calm		atn	
20120715	1212	1	**27**	2	53	65	58.290	168	56.027	%						
20120715	1229	1	**28**	1	54	65	59.075	168	56.230	%	DL11	1	calm		JW	No bottles
20120715	1238	1	**28**	2	54	65	59.299	168	56.456	%						
20120715	1255	1	**29**	1	54	66	0.065	168	56.132	%	DL12	1	4	0	JW	
20120715	1305	1	**29**	2	54	66	0.275	168	55.775	%						
20120715	1333	1	**30**	1	55	66	2.606	168	56.165	%	DL13	1	6	0	JW	No bottles
20120715	1342	1	**30**	2	55	66	2.798	168	55.841	%						
20120715	1412	1	**31**	1	57	66	5.104	168	56.202	%	DL14	1	6	0	JW	
20120715	1424	1	**31**	2	57	66	5.297	168	55.962	%						
20120715	1453	1	**32**	1	56	66	7.683	168	56.175	%	DL15	1	6	0	JW	No bottles
20120715	1503	1	**32**	2	56	66	7.832	168	55.907	%						
20120715	1528	1	**33**	1	57	66	10.207	168	56.190	%	DL16	1	6	0	JW	Water murky on deployment, clear on recovery
20120715	1540	1	**33**	2	57	66	10.444	168	55.918	%						
20120715	1605	1	**34**	1	57	66	12.808	168	56.194	%	DL17	1	6	0	CAS	No bottles
20120715	1614	1	**34**	2	57	66	12.969	168	55.932	%						
20120715	1644	1	**35**	1	59	66	15.342	168	56.250	%	DL18	1	5	354	CAS	
20120715	1656	1	**35**	2	59	66	15.497	168	56.047	%						
20120715	1726	1	**36**	1	58	66	17.841	168	56.230	%	DL19	1	5	354	CAS	No bottles
20120715	1735	1	**36**	2	58	66	18.000	168	56.179	%						
20120715	1804	2	**3**	1	58	66	19.721	168	56.652	%	A3-12	1	5	340	CAS	STAY 200 METERS FROM MOORING... Net Tow
20120715	1815	2	**3**	2	58	66	19.823	168	56.986	%						
20120715	1826	4	**37**	1	58	66	19.959	168	57.241	%	A3-12	1	5	340	CAS	Prods Cast...Huge Chl max at 16 meters
20120715	1838	4	**37**	2	58	66	20.110	168	57.486	%						0.8 knot current
20120715	2007	1	**38**	1	58	66	19.826	168	56.699	%	A3-12	1	5	340	CT	Bottle 10 leaking
20120715	2019	1	**38**	2	58	66	20.064	168	56.510	%						
20120715	2049	1	**39**	1	55	66	20.473	168	53.918	%	AL13	1	5	340	CT	Bottle 1 did not close
20120715	2101	1	**39**	2	55	66	20.786	168	53.815	%						
20120715	2132	1	**40**	1	57	66	21.120	168	49.410	%	AL14	1	5	340	CT	
20120715	2143	1	**40**	2	57	66	21.220	168	49.214	%						
20120715	2210	1	**41**	1	49	66	21.837	168	45.094	%	AL15	1	calm		CT	
20120715	2220	1	**41**	2	49	66	21.868	168	45.019	%						
20120715	2247	1	**42**	1	59	66	22.513	168	40.712	%	AL16	0	calm		CT	Fog
20120715	2300	1	**42**	2	59	66	22.600	168	40.256	%						

20120715	2328	1	**43**	1	58	66	23.257	168	36.502	%	AL17	0	calm		CT	Continued fog
20120715	2340	1	**43**	2	58	66	23.405	168	36.437	%						
20120715	2348	2	**4**	1	57	66	23.527	168	36.471	%						
20120715	2354	2	**4**	2	57	66	23.607	168	36.483	%						
20120716	0029	1	**44**	1	56	66	24.005	168	32.390	%	AL18	0	calm		MNP	continued fog and 1.6 knots north current
20120716	0040	1	**44**	2	56	66	24.267	168	32.111	%						
20120716	0105	1	**45**	1	56	66	24.631	168	27.882	%	AL19	0	3	250	MNP	continued fog and 1.4 knots north current
20120716	0116	1	**45**	2	56	66	24.777	168	27.608	%						
20120716	0144	1	**46**	1	55	66	25.330	168	23.580	%	AL20	0	3	250	MNP	continued fog and 1.2 knots north current
20120716	0154	1	**46**	2	55	66	25.587	168	23.262	%						
20120716	0218	1	**47**	1	50	66	26.063	168	19.227	%	AL21	0	3	250	MNP	continued fog and 1.4 knots north current
20120716	0230	1	**47**	2	50	66	26.269	168	18.958	%						
20120716	0254	1	**48**	1	43	66	26.737	168	14.907	%	AL22	1	6	250	MNP	continued fog and 1.3 knots north current
20120716	0304	1	**48**	2	43	66	26.886	168	14.649	%						
20120716	0308	2	**5**	1	42	66	26.942	168	14.585	%						fog dissapeared
20120716	0313	2	**5**	2	42	66	27.022	168	14.525	%						
% Winch Cable unwound on spool; Rewound by hand (delay 1hr 20min)																
20120716	0510	1	**49**	1	36	66	27.501	168	10.571	%	AL23	0-1	5	200	BD	Extra Bots fired at surface to catch unid floating obj
20120716	0521	1	**49**	2	36	66	27.495	168	10.662	%						Bot11 leaks
20120716	0552	1	**50**	1	30	66	28.178	168	6.281	%	AL24	0-1	6	200	BD	The creatures are back
20120716	0600	1	**50**	2	30	66	28.266	168	6.091	%						Bottle 12 couldn't close
20120716	1203	1	**51**	1	53	67	38.109	168	55.960	%	CS10U	1	6	230	JW	
20120716	1214	1	**51**	2	53	67	38.146	168	55.470	%						
20120716	1219	2	**6**	1	53	67	38.158	168	55.258	%						
20120716	1228	2	**6**	2	53	67	38.183	168	54.929	%						
20120716	1317	1	**52**	1	52	67	41.720	168	48.015	%	CS10.5	1-2	11	250	JW	
20120716	1325	1	**52**	2	52	67	41.888	168	47.788	%						
20120716	1409	1	**53**	1	52	67	45.266	168	39.926	%	CS11	1-2	6	250	JW	Bot 1 did not close - arm got stuck in carousel again
20120716	1419	1	**53**	2	52	67	45.380	168	39.459	%						…screw needs to be retightened
20120716	1504	1	**54**	1	53	67	48.878	168	29.419	%	CS11.5	1	5	270	JW	
20120716	1513	1	**54**	2	53	67	48.924	168	28.931	%						
20120716	1601	1	**55**	1	58	67	52.501	168	18.851	%	CS12	1	5	250	CAS	feeding pod of ~25-30 grey whales around/on horizon
20120716	1614	1	**55**	2	58	67	52.501	168	18.542	%						
20120716	1617	2	**7**	1	58	67	52.496	168	18.427	%	CS12	1	5	250	CAS	
20120716	1625	2	**7**	2	58	67	52.479	168	18.235	%						
20120716	1720	1	**56**	1	61	67	55.900	168	9.220	%	CS12.5	1	5	250	CAS	
20120716	1729	1	**56**	2	61	67	55.878	168	8.953	%						

20120716	1817	1	**57**	1	57	67	59.317	167	59.524	%	CS13	1	5	250	CAS	
20120716	1829	1	**57**	2	57	67	59.317	167	59.374	%						
20120716	1914	1	**58**	1	58	68	2.766	167	49.858	%	CS13.5	1	6	250	CAS	0.3 knots to the north current
20120716	1922	1	**58**	2	58	68	2.806	167	49.813	%						
20120716	2014	1	**59**	1	55	68	6.104	167	40.021	%	CS14	1	6	250	CT	
20120716	2025	1	**59**	2	55	68	6.144	167	40.003	%						
20120716	2029	2	**8**	1	55	68	6.169	167	39.992	%	CS14	1	6	250	CT	
20120716	2032	2	**8**	2	51	68	6.182	167	39.985	%						Dep in this row is wire length out when net deployed
20120716	2035	2	**8**	2	55	68	6.191	167	39.979	%						
20120716	2126	1	**60**	1	51	68	9.132	167	30.693	%	CS14.5	1	6	250	CT	No bottles
20120716	2132	1	**60**	2	51	68	9.166	167	30.638	%						
20120716	2223	1	**61**	1	50	68	12.159	167	21.329	%	CS15	2	7	250	CT	Bottle 1 did not close… fixed with zip-tie trick
20120716	2233	1	**61**	2	50	68	12.211	167	21.232	%						
20120716	2306	1	**62**	1	48	68	13.662	167	16.754	%	CS15.5	2	6	220	CT	No bottles
20120716	2313	1	**62**	2	48	68	13.747	167	16.567	%						
20120716	2343	1	**63**	1	48	68	15.083	167	12.125	%	CS16	2	7	200	CT	
20120716	2352	1	**63**	2	48	68	15.222	167	11.856	%						
20120717	0025	1	**64**	1	44	68	16.700	167	7.590	%	CS16.5	2	6	190	MNP	No bottles
20120717	0031	1	**64**	2	44	68	16.820	167	7.656	%						
20120717	0101	1	**65**	1	40	68	16.820	167	7.660	%	CS17	2	6	190	MNP	
20120717	0109	1	**65**	2	40	68	18.084	167	2.846	%						
20120717	0115	2	**9**	1	40	68	18.135	167	2.829	%	CS17	2			MNP	
20120717	0117	2	**9**	2	35	68	18.190	167	2.765	%						Dep in this row is wire length out when net deployed
20120717	0119	2	**9**	2	40	68	18.174	167	2.850	%						
20120717	0154	1	**66**	1	36	68	18.940	166	57.740	%	CS18	2	9.5	200	MNP	
20120717	0201	1	**66**	2	36	68	19.015	166	57.918	%						
20120717	1504	1	**67**	1	30	68	54.411	166	19.759	%	LIS1	3	7	220	atn	0618 - wait for better weather
20120717	1512	1	**67**	2	30	68	54.441	166	19.417	%						
20120717	1516	2	**10**	1	29	68	54.430	166	19.274	%	LIS1	3	7	220	atn	
20120717	1520	2	**10**	2	29	68	54.420	166	19.155	%						
20120717	1524	2	**10**	2	29	68	54.410	166	19.035	%						
20120717	1556	1	**68**	1	35	68	54.786	166	25.099	%	LIS2	3	7	220	atn	
20120717	1604	1	**68**	2	35	68	54.935	166	25.076	%						
20120717	1631	1	**69**	1	36	68	55.197	166	30.579	%	LIS3	2	5	220	CAS	Bot4 not confirmed, Bot4&5 fired at 10m
20120717	1643	1	**69**	2	36	68	55.238	166	30.806	%						Bot4&5 had fired by recovery; Bot6 (surface) leaking
20120717	1712	1	**70**	1	44	68	55.800	166	38.565	%	LIS4	1	0	0	CAS	Very Foggy. Wind dropped to 0... 1 knot current to N
20120717	1723	1	**70**	2	44	68	55.902	166	38.934	%						

20120717	1751	1	**71**	1	48	68	56.387	166	46.632	%	LIS5	1	5	330	CAS	1 knot current to the north
20120717	1802	1	**71**	2	48	68	56.341	166	47.069	%						
20120717	1832	1	**72**	1	49	68	57.000	166	54.634	%	LIS6	1	5	330	CAS	0.8 knot current to the north... bottle 6 leaking
20120717	1843	1	**72**	2	49	68	57.030	166	54.925	%						
20120717	1847	2	**11**	1	49	68	57.046	166	55.024	%	LIS6	1	5	330	CAS	
20120717	1851	2	**11**	2	45	68	57.057	166	55.112	%						
20120717	1857	2	**11**	2	49	68	57.073	166	55.210	%						
20120717	1928	1	**73**	1	49	68	57.625	167	2.134	%	LIS6.5	1	3	330	CAS	
20120717	1936	1	**73**	2	49	68	57.685	167	2.555	%						
20120717	2005	1	**74**	1	49	68	58.248	167	9.468	%	LIS7	1	calm		CT	1-2 foot swells. Bot 6 leaking when air vent opened.
20120717	2014	1	**74**	2	49	68	58.356	167	9.977	%						chip in bot near o-ring at bottom inside of carousel
20120717	2044	1	**75**	1	49	68	58.823	167	16.752	%	LIS7.5	1	3	000	CT	1-3 foot swells… 7 bott fired for test (no samples)
20120717	2051	1	**75**	2	49	68	58.879	167	17.101	%						Bot 6 replaced with spare (labeled bottle 2) after c.
20120717	2119	1	**76**	1	50	68	59.435	167	24.187	%	LIS8	1	2	000	CT	1-3 ft swells. New bot 6 perhaps slight leak from bot?
20120717	2128	1	**76**	2	50	68	59.539	167	24.716	%						will check again following next cast
20120717	2215	1	**77**	1	51	69	0.633	167	38.674	%	LIS9	1	3	020	CT	1-3 ft swells. Bot1 only half closed (bad) Bot6 ok
20120717	2226	1	**77**	2	51	69	0.719	167	38.813	%						
20120717	2313	1	**78**	1	52	69	1.852	167	53.372	%	LIS10	1	calm		CT	Continued swells
20120717	2324	1	**78**	2	52	69	2.020	167	53.333	%						
20120717	2337	2	**12**	1	52	69	2.309	167	52.835	%	LIS10	1	calm		CT	
20120717	2340	2	**12**	2	48	69	2.342	167	52.757	%						
20120717	2342	2	**12**	2	52	69	2.372	167	52.689	%						
20120718	0037	1	**79**	1	52	69	1.340	168	7.850	%	LIS11	1	calm		MNP	Continued swells
20120718	0047	1	**79**	2	52	69	1.428	168	7.853	%						
20120718	0135	1	**80**	1	53	69	0.900	168	22.440	%	LIS12	1	calm		MNP	Continued swells
20120718	0144	1	**80**	2	53	69	0.932	168	22.453	%						
20120718	0230	1	**81**	1	54	69	0.440	168	37.080	%	LIS13	1	calm		MNP	Continued swells
20120718	0239	1	**81**	2	54	69	0.438	168	37.171	%						
20120718	0316	1	**82**	1	55	69	0.230	168	46.640	%	LIS14n	1	calm		MNP	Continued swells.. Bottle 4 leaks
20120718	0323	1	**82**	2	55	69	0.208	168	46.608	%						
20120718	0326	2	**13**	1	55	69	0.200	168	46.572	%	LIS14n	1	calm		MNP	
20120718	0329	2	**13**	2	40	69	0.194	168	46.542	%						
20120718	0332	2	**13**	2	55	69	0.186	168	46.506	%						
20120718	0434	1	**83**	1	55	68	59.992	168	56.041	%	CCL22	1	calm		BD	
20120718	0443	1	**83**	2	55	69	0.033	168	56.073	%						
20120718	0555	1	**84**	1	56	68	49.976	168	56.069	%	CCL21	1	3	130	BD	
20120718	0604	1	**84**	2	56	68	49.882	168	56.551	%						

20120718	0720	1	**85**	1	55	68	40.013	168	56.029	%	CCL20	1	4	130	BD	
20120718	0731	1	**85**	2	55	68	39.935	168	56.451	%						
20120718	0843	1	**86**	1	56	68	30.036	168	56.045	%	CCL19	1	3	130	JW	
20120718	0852	1	**86**	2	56	68	29.966	168	56.194	%						
20120718	1005	1	**87**	1	56	68	20.046	168	56.053	%	CCL18	1	5	130	JW	
20120718	1015	1	**87**	2	56	68	20.178	168	56.286	%						
20120718	1017	2	**14**	1	58	68	20.211	168	56.345	%						
20120718	1020	2	**14**	2	58	68	20.260	168	56.442	%						
20120718	1024	2	**14**	2	58	68	20.332	168	56.579	%						
20120718	1147	1	**88**	1	60	68	10.019	168	56.005	%	CCL17	calm			JW	Bottle 2 release looks like it didn't fire! Cable tie time
20120718	1157	1	**88**	2	60	68	9.990	168	56.363	%						
20120718	1312	1	**89**	1	60	68	0.028	168	56.020	%	CCL16	1	3	150	atn	Bottle 2 closed with no problem
20120718	1325	1	**89**	2	60	67	59.982	168	55.895	%						
20120718	1440	1	**90**	1	53	67	50.028	168	55.998	%	CCL15	1	3	170	atn	
20120718	1452	1	**90**	2	53	67	50.007	168	55.990	%						
20120718	1618	1	**91**	1	53	67	38.022	168	55.973	%	CCL14	1	6	160	CAS	1.1 knot current to the north
20120718	1631	1	**91**	2	53	67	38.180	168	55.601	%						
20120718	1634	2	**15**	1	53	67	38.223	168	55.495	%	CCL14	1	6	160	CAS	
20120718	1638	2	**15**	2	49	67	38.310	168	55.289	%						
20120718	1642	2	**15**	2	53	67	38.325	168	55.289	%						
20120718	1705	4	**92**	1	53	67	38.022	168	55.601	%	CCL14	1	0	0	CAS	Prod Cast. Tripped ship breaker. Shut down recording
20120718	1715	4	**92**	2	53	67	38.076	168	56.116	%						to save UPS battery while fixing. Closed seasave
%																to avoid losing data.No data lost.
20120718	1816	1	**93**	1	52	67	30.010	168	55.992	%	CCL13	1	5	320	CAS	
20120718	1827	1	**93**	2	52	67	30.010	168	56.081	%						
20120718	1938	1	**94**	1	52	67	20.012	168	55.970	%	CCL12	1	5	130	CAS	
20120718	1951	1	**94**	2	52	67	19.942	168	55.944	%						
20120718	2103	1	**95**	1	51	67	9.985	168	55.968	%	CCL11	2	7	320	CT	Few whitecaps distant fog
20120718	2113	1	**95**	2	51	67	9.923	168	56.057	%						
20120718	2230	1	**96**	1	51	67	0.028	168	55.953	%	CCL10	3	10	340	CT	Fog… Bottle 6 leaking slightly when air valve opened
20120718	2240	1	**96**	2	51	66	59.976	168	55.974	%						
20120718	2244	2	**16**	1	51	66	59.953	168	55.961	%	CCL10	3	10	340	CT	
20120718	2049	2	**16**	2	45	66	59.921	168	55.954	%						
20120718	2253	2	**16**	2	51	66	59.908	168	55.955	%						
20120719	0012	1	**97**	1	51	66	49.988	168	55.954	%	CCL9	4	9	310	CT	
20120719	0019	1	**97**	2	51	66	49.914	168	56.004	%						
20120719	0132	1	**98**	1	46	66	40.028	168	56.021	%	CCL8	3	8	350	MNP	

20120719	0139	1	**98**	2	46	66	39.924	168	56.112	%							
20120719	0223	1	**99**	1	48	66	34.954	168	56.134	%	CCL7	3		9	350	MNP	
20120719	0230	1	**99**	2	48	66	34.846	168	56.250	%							
20120719	0313	1	**100**	1	58	66	29.997	168	56.017	%	CCL6	3		7	340	MNP	Yahoo!
20120719	0323	1	**100**	2	58	66	29.873	168	56.216	%							
20120719	0405	1	**101**	1	59	66	25.006	168	56.004	%	CCL5	3		7	340	BD	
20120719	0413	1	**101**	2	59	66	24.892	168	56.188	%							
20120719	0448	1	**102**	1	62	66	20.693	168	56.113	%	CCL3.!	3		7	340	BD	Passed CCL4 new point - CCL3.5
20120719	0457	1	**102**	2	62	66	20.874	168	56.260	%							Bottle 7 did not close properly
20120719	0520	1	**103**	1	59	66	19.513	168	56.845	%	A3-12	3		7	330	BD	Forgot to fire bottle at surface.
20120719	0530	1	**103**	2	59	66	19.441	168	56.884	%							Bottle 7 did not close properly
20120719	0532	1	**104**	1	59	66	19.410	168	56.890	%	A3-12-	3				BD	Cast to fire bottle at surface
20120719	0532	1	**104**	2	59	66	19.392	168	56.899	%							
20120719	0535	2	**17**	1	59	66	19.359	168	56.910	%		3				BD	
20120719	0538	2	**17**	2	55	66	19.341	168	56.919	%							
20120719	0542	2	**17**	2	55	66	19.284	168	56.947	%							
20120719	0615	1	**105**	1	59	66	17.821	168	56.204	%	DL19	3		7	330	BD	Fire only bottle 7 at bottom
20120719	0621	1	**105**	2	59	66	17.708	168	56.315	%							Bottle 7 is closed
20120719	0650	1	**106**	1	60	66	15.275	168	56.164	%	DL18	3		7	330	BD	Bottle 1 is leaking
20120719	0656	1	**106**	2	60	66	15.172	168	56.291	%							
20120719	0726	1	**107**	1	60	66	12.735	168	56.196	%	DL17	3		7	330	BD	
20120719	0732	1	**107**	2	60	66	12.652	168	56.302	%							
20120719	0756	1	**108**	1	58	66	10.195	168	56.195	%	DL16	3		8	330	JW	
20120719	0804	1	**108**	2	58	66	10.071	168	56.351	%							
20120719	0830	1	**109**	1	58	66	7.635	168	56.189	%	DL15	3		6	340	JW	
20120719	0836	1	**109**	2	58	66	7.549	168	56.289	%							
20120719	0900	1	**110**	1	57	66	5.095	168	56.212	%	DL14	3-4		8	350	JW	
20120719	0909	1	**110**	2	57	66	4.985	168	56.433	%							
20120719	0934	1	**111**	1	56	66	2.529	168	56.205	%	DL13	4		8	10	JW	
20120719	0941	1	**111**	2	56	66	2.443	168	56.365	%							
20120719	1007	1	**112**	1	55	66	0.000	168	56.179	%	DL12	3-4		8	10	JW	
20120719	1014	1	**112**	2	55	65	59.910	168	56.278	%							
20120719	1029	1	**113**	1	55	65	59.037	168	56.211	%	DL11	3-4		8	10	JW	
20120719	1035	1	**113**	2	55	65	58.975	168	56.289	%							
20120719	1051	1	**114**	1	54	65	58.046	168	56.200	%	DL10	3		8	0	JW	
20120719	1059	1	**114**	2	54	65	57.958	168	56.351	%							
20120719	1116	1	**115**	1	53	65	57.070	168	56.162	%	DL9	3		6	0	JW	

20120719	1122	1	**115**	2	53	65	57.008	168	56.199	%						
20120719	1137	1	**116**	1	51	65	56.100	168	56.228	%	DL8	3	6	0	JW	
20120719	1146	1	**116**	2	51	65	56.020	168	56.394	%						
20120719	1203	1	**117**	1	51	65	55.135	168	56.191	%	DL7	3	6	340	JW	
20120719	1208	1	**117**	2	51	65	55.065	168	56.225	%						
20120719	1225	1	**118**	1	51	65	54.160	168	56.179	%	DL6	3	7	340	atn	
20120719	1236	1	**118**	2	51	65	54.025	168	56.345	%						
20120719	1253	1	**119**	1	50	65	53.124	168	56.106	%	DL5	3	7	340	atn	
20120719	1302	1	**119**	2	50	65	53.007	168	56.136	%						
20120719	1321	1	**120**	1	48	65	52.169	168	56.107	%	DL4	3	10	340	atn	
20120719	1331	1	**120**	2	48	65	52.009	168	56.186	%						
20120719	1332	2	**18**	1	48	65	51.969	168	56.250	%						
20120719	1338	2	**18**	2	44	65	51.907	168	56.358	%						
20120719	1342	2	**18**	2	48	65	51.859	168	56.442	%						
20120719	1359	1	**121**	1	50	65	51.206	168	56.219	%	DL3	2	7	340	atn	
20120719	1407	1	**121**	2	50	65	51.065	168	56.031	%						
20120719	1424	1	**122**	1	49	65	50.226	168	56.208	%	DL2	2	5	340	atn	bottle 6 is leaking
20120719	1435	1	**122**	2	49	65	50.026	168	56.412	%						
20120719	1449	1	**123**	1	50	65	49.188	168	56.165	%	DL1	1-2	5	340	atn	
20120719	1457	1	**123**	2	50	65	49.039	168	56.169	%						
20120719	1529	1	**124**	1	47	65	49.293	168	52.261	%	DLa1	1-2	5	340	atn	
20120719	1536	1	**124**	2	47	65	49.254	168	52.137	%						
20120719	1557	1	**125**	1	50	65	50.254	168	52.219	%	DLa2	1-2	5	340	CAS	
20120719	1608	1	**125**	2	50	65	50.227	168	52.018	%						
20120719	1627	1	**126**	1	49	65	51.270	168	52.297	%	DLa3	1-2	6	320	CAS	
20120719	1635	1	**126**	2	49	65	51.257	168	52.177	%						
20120719	1652	1	**127**	1	52	65	52.211	168	52.173	%	DLa4	1-2	6	330	CAS	
20120719	1705	1	**127**	2	52	65	52.151	168	51.775	%						
20120719	1721	1	**128**	1	52	65	53.200	168	52.179	%	DLa5	1-2	7	340	CAS	Replaced Bot 1 with 12 because bot lanyard broke.
20120719	1732	1	**128**	2	52	65	53.116	168	51.859	%						Bot12 slot empty
20120719	1749	1	**129**	1	52	65	54.136	168	52.147	%	DLa6	1-2	8	340	CAS	Bottle 1 aka "12" did not fire. Bottle 6 is leaking.
20120719	1802	1	**129**	2	52	65	54.043	168	51.769	%						Made new bottom lanyard for bottle
20120719	1821	1	**130**	1	53	65	55.133	168	52.146	%	DLa7	1-2	7	360	CAS	
20120719	1831	1	**130**	2	53	65	55.087	168	51.946	%						
20120719	1847	1	**131**	1	55	65	56.106	168	52.090	%	DLa8	1-2	7	360	CAS	
20120719	1901	1	**131**	2	55	65	56.050	168	51.692	%						
20120719	1918	1	**132**	1	54	65	57.076	168	52.144	%	DLa9	1	6	20	CAS	

20120719	1925	1	**132**	2	54	65	57.035	168	51.944	%						
20120719	1943	1	**133**	1	55	65	58.129	168	52.332	%	DLa10	1	6	350	CAS	
20120719	1954	1	**133**	2	55	65	58.150	168	52.055	%						
20120719	2012	1	**134**	1	55	65	59.063	168	52.119	%	DLa11	1	5	000	CT	No bottles
20120719	2018	1	**134**	2	55	65	59.033	168	51.959	%						
20120719	2037	1	**135**	1	55	66	0.033	168	52.124	%	DLa12	1	5	010	CT	
20120719	2047	1	**135**	2	55	66	0.059	168	51.804	%						
20120719	2109	1	**136**	1	56	65	59.999	168	48.192	%	DLb12	1	3	340	CT	No bottles on DLb line. 1-2 ft swells. fog is returning
20120719	2116	1	**136**	2	56	65	59.999	168	47.984	%						
20120719	2137	1	**137**	1	56	65	59.003	168	48.200	%	DLb11	1	3	250	CT	Continued fog… approx. 2 foot swells
20120719	2144	1	**137**	2	56	65	58.937	168	48.289	%						
20120719	2201	1	**138**	1	56	65	58.021	168	48.203	%	DLb10	1	calm		CT	
20120719	2208	1	**138**	2	56	65	57.929	168	48.202	%						
20120719	2225	1	**139**	1	55	65	57.062	168	48.196	%	DLb9	1	calm		CT	Diminishing swells… approx. 1 foot
20120719	2232	1	**139**	2	55	65	57.008	168	48.313	%						
20120719	2250	1	**140**	1	55	65	56.129	168	48.191	%	DLb8	1	calm		CT	Visibility improving…
20120719	2257	1	**140**	2	55	65	56.071	168	48.133	%						
20120719	2316	1	**141**	1	55	65	55.167	168	48.184	%	DLb7	1	4	190	CT	1-2 foot swells
20120719	2322	1	**141**	2	55	65	55.180	168	48.284	%						
20120719	2343	1	**142**	1	55	65	54.179	168	48.192	%	DLb6	1	4	190	CT	Fog continues…
20120719	2350	1	**142**	2	55	65	54.193	168	48.319	%						
20120720	0011	1	**143**	1	55	65	53.237	168	48.202	%	DLb5	1	5	190	MNP	Fog continues
20120720	0016	1	**143**	2	55	65	53.206	168	48.227	%						
20120720	0039	1	**144**	1	54	65	52.240	168	48.189	%	DLb4	1	4	230	MNP	
20120720	0043	1	**144**	2	54	65	52.228	168	48.137	%						
20120720	0108	1	**145**	1	53	65	51.278	168	48.200	%	DLb3	1	4	230	MNP	Sunshine
20120720	0113	1	**145**	2	53	65	51.268	168	48.124	%						
20120720	0136	1	**146**	1	53	65	50.279	168	48.187	%	DLb2	1	7	230	MNP	
20120720	0141	1	**146**	2	53	65	50.262	168	47.986	%						
20120720	0203	1	**147**	1	52	65	49.326	168	48.209	%	DLb1	1	7	210	MNP	
20120720	0207	1	**147**	2	52	65	49.379	168	48.305	%						
20120720	0247	1	**148**	1	49	65	48.340	168	55.860	%	BS11	1	7	190	MNP	
20120720	0253	1	**148**	2	49	65	48.464	168	55.816	%						
20120720	0320	1	**149**	1	46	65	47.268	168	51.653	%	BS12	1	7	190	MNP	
20120720	0326	1	**149**	2	46	65	47.244	168	51.395	%						
20120720	0351	1	**150**	1	54	65	46.346	168	47.575	%	BS13	1	6	200	MNP	
20120720	0400	1	**150**	2	54	65	46.440	168	47.118	%						

20120720	0423	1	**151**	1	55	65	45.294	168	43.172	%	BS14	1	8	210	JW	
20120720	0434	1	**151**	2	55	65	45.339	168	42.556	%						Float seen on surface… break line to investigate
% Buoy is inflatable with no markings on… lift bag perhaps? Recovery not made… return to CTD line.																
20120720	0526	1	**152**	1	52	65	44.346	168	39.699	%	BS15	1	9	230	JW	
20120720	0533	1	**152**	2	52	65	44.355	168	39.444	%						
20120720	0555	1	**153**	1	54	65	43.310	168	35.415	%	BS16	2	8	230	JW	
20120720	0602	1	**153**	2	54	65	43.347	168	35.032	%						
20120720	0606	2	**19**	1	54	65	43.370	168	34.873	%						
20120720	0608	2	**19**	2	54	65	43.397	168	34.692	%						
20120720	0611	2	**19**	2	54	65	43.426	168	34.509	%						
20120720	0640	1	**154**	1	58	65	42.256	168	31.197	%	BS17	2	8	230	JW	
20120720	0648	1	**154**	2	58	65	42.250	168	30.800	%						
20120720	0714	1	**155**	1	56	65	41.231	168	26.896	%	BS18	2	7	230	JW	Bottom cap of Bot1 not seated corrrectly
20120720	0721	1	**155**	2	56	65	41.288	168	26.533	%						Keep firing 2 at the bottom!
20120720	0743	1	**156**	1	55	65	40.391	168	23.380	%	BS19	2	7	230	JW	1.5 - 2kt drift @ 045T
20120720	0751	1	**156**	2	55	65	40.532	168	22.988	%						
20120720	0821	1	**157**	1	51	65	39.345	168	19.062	%	BS20	2	7	220	JW	2.5-3kt drift @ 025T. Drifted 0.5nm during cast
20120720	0832	1	**157**	2	51	65	39.750	168	18.603	%						
20120720	0901	1	**158**	1	44	65	38.603	168	14.943	%	BS21	2	8	230	JW	CTD deployed 0.6nm N of point due to drift on set up
20120720	0909	1	**158**	2	44	65	38.831	168	14.675	%						2-3kt drift @ 025T.Drifted another 0.25nm from station
																Caught lions mane jelly on recovery
20120720	0937	1	**159**	1	34	65	37.494	168	10.678	%	BS22	2	9	230	JW	1.5 - 2kt drift @ 030T
20120720	0943	1	**159**	2	34	65	37.633	168	10.454	%						
20120720	0947	2	**20**	1	33	65	37.720	168	10.330	%						
20120720	0949	2	**20**	2	33	65	37.764	168	10.269	%						
20120720	0952	2	**20**	2	33	65	37.815	168	10.201	%						
20120720	1022	1	**160**	1	33	65	36.066	168	9.755	%	BS23	1	9	230	JW	2.5-3kt drift@345T. Drifted 0.4nm off stat.during cast
20120720	1029	1	**160**	2	33	65	36.353	168	9.964	%						
20120720	1100	1	**161**	1	28	65	34.995	168	7.181	%	BS24	1	8	250	JW	2.5-3kt drift@350T.Drifted 0.4nm off stat. during cast
20120720	1107	1	**161**	2	28	65	35.240	168	7.440	%						END OF CTD OPS. Turn for Nome