ALPHA HELIX CRUISE HX250
Tuesday 4th September 2001 - Sunday 16th September 2001
BERING STRAIT CRUISE REPORT

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CHIEF SCIENTIST: Rebecca Woodgate
University of Washington, Applied Physics Laboratory
1013 NE 40th Street, Seattle, WA 98105-6698.
Phone: 206-221-3268
Fax: 206-616-3142
Email: woodgate@apl.washington.edu

SCIENTIFIC PERSONNEL:

Rebecca Woodgate	APL, Moorings	(F, Chief Scientist)
Dale Hubbard	OSU, nutrients & CTD	(M)

SCIENTIFIC PURPOSE:

This cruise has two scientific goals.

The first (and foremost) is the recovery and redeployment of moorings in the Bering Strait. These moorings are part of a multi-year time-series (currently over 10 years long) of measurements of the flow through the Bering Strait. The properties of this flow not only influence the Chukchi and Beaufort Seas, but can also be traced across the Arctic 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.

Two moorings (A2, in the eastern channel of Bering Strait and A3, c.35nm north of Bering Strait), which were deployed from the Alpha Helix last year, are to be recovered and redeployed. In addition, a third mooring (A1) is planned to be deployed in the western channel, which lies in the Russian EEZ. If permission is denied, the third mooring (renamed A4) will be deployed instead in the eastern channel of Bering Strait, roughly half-way between A2 and the US shore.

All the moorings carry conventional instrumentation - current meters (RCM), temperature and salinity sensors (SBE16). In addition, moorings A2 and A3 carry Upward-Looking-Sonars (ULS), and mooring A3 also supports a prototype nutrient sampler from UAF. The current meters and ULSs allow the quantification of the movement of ice and water through the strait. The nutrient samplers, designed to yield a time-series of *in situ* nutrients measurements, are valuable new technology which should greatly advance our understanding of the biological system in the Bering Strait and Chukchi Sea.

The second aim of the cruise is to conduct a hydrographic and ADCP survey of the Bering Strait and the southern part of the Chukchi Sea, concentrating on sections in the vicinity of the moorings and the region north of the mooring sites. These CTD and nutrient measurements will be used to calibrate the moored instruments and to give a framework for the analysis of the data. Where possible, the hydrographic lines will be repeats of sections from previous years, thus allowing an interannual comparison.

Although the work on the US side of the strait is valuable in its own right, success of the pending EEZ application would greatly enhance the science of the cruise. Synoptic measurements of both sides of the Chukchi Sea have not been made since the early 1990s. The western part of the Strait carries the most nutrient-rich waters of the Chukchi Sea, and the properties and fate of these waters in the Chukchi Sea and in the Arctic Ocean have major implications for the local biological systems. The Chukchi Sea is one of the most productive oceanic regions and its ecosystem has undergone large changes in the last decade. Furthermore, the mooring proposed for the western channel is particularly timely, since measurements from the last 3 years indicate an increase in salinity in the eastern strait, and the waters of the western channel are, historically, saltier than those in the east. The depth to which these waters will sink in the Arctic Ocean is determined by their salinity, and the increase observed in the eastern channel could change the entry depth of the nutrient rich waters from 80m to 160m.

CRUISE SUMMARY:

Due to the restrictions of the EEZ application, the science party was limited to two scientists and one marine technician. Despite high winds and seas for three of the five days in the work area, two days of good weather allowed us to accomplish the main objectives of the cruise, i.e. the recovery and deployment of the moorings. The Russian EEZ application was never approved, so the third mooring was placed in the eastern Bering Strait at the end of the cruise. Bad weather prevented us completing all the proposed CTD sections. Instead, additional ADCP lines were run across the boundary current on the eastern side of the strait, and CTD measurements were made in the shallow waters north of the Seward Peninsular as far north as Kotzebue Sound.

Lee Cooper left Little Diomede by helicopter by the 11th September, and thus did not request to be picked up on our route south.

CRUISE SCHEDULE:

4th September	Sail from Dutch Harbor c.0910, leaving sheltered waters c.1100 Transit to Bering Strait
5th September	Transit to Bering Strait
6th September	Transit to Bering Strait
7th September	Arrive Bering Strait c.1300 Recover A2-00 and deploy A2-01 Transit to A3-00 Recover A3-00 and deploy A3-01 CTD A3L line, ADCP CHUK line
8th September	(Start of proposed EEZ period) Abort ADCP line at CHUK3 due to weather Run ADCP lines to the east and south of A3L, CTD EEXT stations, until work stopped by weather
9th September	Attempt to run ADCP lines in north eastern part of Strait Abort all operations and battle back to east for weather cover
10th September	(End of proposed EEZ period) Hiding from 30-40 knot winds in Bering Strait Run CTDs from Seward Peninsular to Kotzebue Sound
11th September	(Day of World Trade Center attacks) ADCP and CTD NBS line Deploy A4-01 CTD BS and MBS lines ADCP MBS and BS lines
12th September	Leave Bering Strait c.0930, Transit to Dutch Harbor
13th September	Transit to Dutch Harbor
14th September	Transit to Dutch Harbor
15th September	Arrive Dutch Harbor c.0800
16th September	End of Cruise

MOORING WORK:

Table 1 and Figure 1 give details and locations of the moorings. All mooring work went smoothly and efficiently. Both recoveries were at the stated positions. Three out of the four releases functioned perfectly. Mooring A2-00 was moderately fouled with hydriods and barnacles. Mooring A3-00 was severely fouled with both the current meter rotor and the inflow tubes to the SBE and the nutrient sampler obstructed.

The current meters and SBEs ran well, (see Figures 2 and 3). The fouling of the rotors did not severely impact the speed data. The anomalously low salinity at the end of the A3 RCM record, however, is in disagreement both with the SBE and the CTD station taken on recovery, and is most likely due to the excessive fouling of the cell.
The ULSes were still running on recovery. The ULS data from A3-00 looks reasonable, whilst that from A2-00 has some questionable ice drafts.
The nutrient analyzer on A3-00 appears not to have started. The instrument contained no data and the reagent bags were approximately as full as on deployment. The tubes running to the outer bags of reagent were squashed flat against the frame, constricting or blocking the flow. The frame of the instrument was bent, though structurally sound. This probably occurred on deployment when lifting the NAS and the releases together.

The deployments went smoothly. The NAS has a different, bigger frame, and the reagents are secured inside a double-walled, insulated picnic box, which is hose-clamped to the instrument and the frame. This chest was sewn inside a fishing net to contain the reagent bags if the box were to fail. On deployment, a loop of rope was attached half way down the frame as a lifting point, which greatly eased the deployment procedure, given that all the instruments are very close together on these moorings. For mooring purposes, the old frame is far preferable. It is significantly smaller and will add less drag to the mooring. On long moorings, this instrument makes pull-down a definite problem. Even on these short moorings, we have increased the anchor weight significantly. The new frame could be shortened by c.30cm. It should also have brackets attached to prevent it rolling on deck. The positioning of the bottom connection within the frame should also be altered since it restricts access to the connection, a setup which risks injury to personnel and instruments on deployment and recovery. For instrument purposes, the clamping of the instrument in the frame with hose-clamps and duct-tape leads to substantial risk of accidentally choking the small tubing that carries the reagents, as was the case on A3-00. It would be also greatly advantageous to have some indication that the instrument is running immediately prior to deployment.

The moorings were lowered to the sea floor, raised a meter, and then released using the automatic pelican hook attached to the deep-sea winch. On two of the deployments, the mooring had to be lowered and lifted one or more times to make the hook release, suggesting that the drop link in the pelican hook is jamming and that a larger ring should be used.

HYDROGRAPHIC WORK:

In total, 54 hydrographic stations were taken (see Table 2 and Figure 1). Preliminary CTD sections are included in an appendix. Regrettably, due to time limitations, a calibration cast was not run at A2 on deployment. The first CTD section run was a repeat of the A3L line of last year, and was sampled immediately after the mooring deployment. Weather prevented any more CTD casts until the next day, when the three stations of EEXT were run. CHUK10 could not be repeated at the end of the EEXT line due to bad weather. High winds and seas prevented CTDing in the strait for the next three days. While hiding from the weather in the lee of the Seward Peninsular, we occupied eleven CTD stations, (NBS11-14, SP1-7) in shallow waters along the coast north towards Kotzebue Sound. The majority of the CTD work was accomplished on the 11th September. The NBS and BS lines were completed, and a third section (MBS), half way between the other two, was also sampled. This gives a good indication of along strait variability.

Water samples were taken at standard depths (Bottom, Bottom-3m, 40m, 30m, 20m, 15m, 10m, 5m, surface) for nutrients, which were run on board and also frozen for land analysis by Terry Whitledge, University of Alaska Fairbanks. Water samples for O18 were taken on the four sections crossing Bering Strait (A3L, NBS, MBS, BS) and at the northern stations near Kotzebue Sound (see Table 2). These samples were taken at Bottom, 40m, 30m, 20m, 5m. These will be shipped to Lee Cooper, University of Tennessee, for analysis. Salinity samples were taken from all bottles sampled for O18 (to check for misfires and leakage), and duplicate salinity samples (for CTD calibration) were taken from bottles fired in a homogeneous layer at circa every third station. These samples will be analyzed in Seward. In total, 199 salinity samples, 182 O18 samples and 372 nutrient samples were taken. Bottle 3 failed to shut properly on three casts, suggesting the rigging may need adjusting. Similarly, bottle 8 and bottle 6 each shut improperly once, but these failures were probably due to operator tiredness.

ADCP MEASUREMENTS:

A particularly interesting result of last year's cruise was the ADCP velocity sections. Where possible these were rerun in conjunction with the CTD sections, although weather and scheduling often prevented the ADCP and CTD sections being run consecutively. The A3L line was never run solely for ADCP. The CHUK line was run for ADCP only, not CTD, and was aborted at CHUK3 due to increasing rolling and pitching of the ship. The NBS line was run immediately prior to the CTD line. The MBS line was run immediately subsequent to the CTD line. The BS line was run c. 8 hours after the CTD line, although the CTD line itself was run at 7 knots. On the bad weather days of 8th and 9th, ADCP lines were run where possible with a following wind. Generally, although the ship was rolling, the ADCP reported 100% good data. It will be interesting to compare the quality of the final data with the quantity of ship's motion, to assess the limitations for reasonable ADCP data.

TABLE 1: Mooring positions and instrumentation.

ID	LATITUDE (N)	LONGITUDE (W)	WATER DEPTH /m	INST.
Recovered				
A2-00	65° 46.72' 65° 46.729'	168° 34.76' (Northstar) 168° 34.766' (Trimble)	55	ULS RCM7 SBE16
A3-00	66° 19.61' 66° 19.66'	168° 58.01' (Northstar) 168° 58.00' (Trimble)	58	ULS RCM7 SBE16 NAS-2E
Deployed				
A2-01	65° 46.76'	168° 34.52'	56	ULS RCM7 SBE16
A3-01	66° 19.58'	168° 58.03'	57	ULS RCM9 SBE16 NAS-2E
A4-01	65° 44.73'	168° 15.83'	48	RCM7 SBE16

TABLE 2: CTD stations and water sampling.

N= number of nutrient samples.

#	Name	Lat (N)		Long (W)		# N	O18 Bottles	O18 bottle Depths /dbar					
1	A3	66	19.65	168	57.97	8	2 4 5 8	47.0		30.0	19.9		2.6
2	A3L2	66	21.32	168	48.44	8	1 4 5 7	49.8		30.1	20.0	5.0	
3	A3L3	66	22.81	168	39.89	8	1 4 5 7	52.9		29.9	20.0	5.0	
4	A3L4	66	24.20	168	30.05	8	1 4 5 7	48.9		29.9	20.4	5.2	
5	A3L5	66	26.15	168	18.62	7	1 3 4 6		44.6	30.8	20.6	5.6	
6	A3L6	66	28.08	168	06.29	4	1 4				23.1	5.4	
7	A3L7	66	29.68	167	56.89	5	1 4				18.4	5.3	
8	A3L8	66	31.77	167	42.78	6	1 2 3 5		22.2	19.2	12.8	5.8	
9	A3L9	66	34.75	167	25.37	6	1 3 5			25.5	14.8	5.6	
10	A3L10	66	37.45	167	09.22	7	1 3 4 6		29.6	19.1	14.4	5.4	
11	CHK10	66	39.10	167	00.80	6	1 3 4 5		29.3	19.3	11.6	5.7	
12	EEXT3	66	35.02	166	11.35	4							
13	EEXT2	66	36.67	166	33.82	5							
14	EEXT1	66	37.58	166	43.81	6							
15	NBS11	66	00.04	167	39.73	4							
16	NBS12	66	00.01	167	28.82	4							

17	NBS13	66	00.05	167	17.92	4						
18	NBS14	65	59.98	167	10.04	3						
19	SP1	66	12.01	166	43.93	3						
20	SP2	66	27.01	166	17.95	4						
21	SP3	66	33.04	165	57.04	4						
22	SP4	66	43.51	165	27.92	5						
23	SP5	66	52.51	165	01.87	6	1 5				23.9	5.2
24	SP6	67	06.14	164	35.67	6	1 5				25.3	5.7
25	SP7	67	10.06	164	25.00	5	1 4				26.7	4.9
26	NBS1	66	00.10	168	57.73	10	1 3 4 6 9	48.8	40.3	30.1	20.0	5.0
27	NBS2	66	00.10	168	49.73	9	1 3 4 5 8	48.6	40.0	29.0	19.4	5.9
28	NBS3	66	00.10	168	41.43	9	1 3 4 5 8	48.0	40.3	30.0	20.3	5.5
29	NBS4	66	00.05	168	33.13	9	1 3 4 5 8	49.6	40.9	30.8	20.9	6.1
30	NBS5	66	00.06	168	24.82	9	1 3 4 5 8	52.8	40.9	30.2	19.9	4.8
31	NBS6	66	00.13	168	16.52	8	1 2 4 5 8	48.9	45.5	30.5	21.6	6.2
32	NBS7	66	00.17	168	08.07	8	1 2 3 4 7	44.1	40.7	30.7	20.2	6.1
33	NBS8	66	00.02	167	59.90	7	1 3 6			29.4	19.7	5.1
34	NBS9	65	59.98	167	55.00	5	1 3 4			17.3	10.5	5.3
35	NBS10	66	00.07	167	52.00	3	1 2				8.1	5.2

36	BSL6	65	41.30	168	10.96	7	1 3 5 6		27.3	20.4	10.4	5.1	
37	BSL5.5	65	41.64	168	15.05	8	1 3 4 6 7	42.2	30.4	20.6	9.9	5.7	
38	BSL5	65	41.96	168	19.30	8	1 2 4 5 8	50.5	46.1	30.1	20.9	6.0	
39	BSL4.5	65	42.48	168	23.69	9	1 4 5 6 9	50.7	39.6	31.3	19.7	5.5	
40	BSL4	65	42.91	168	27.97	9	1 4 5 6 9	50.8	39.8	30.3	21.7	5.8	
41	BSL3.5	65	43.27	168	32.27	9	1 4 5 6 9	50.8	39.7	31.2	20.3	5.4	
42	BSL3	65	43.68	168	36.71	9	1 4 5 6 9	47.2	40.3	29.9	20.4	5.5	
43	BSL2.5	65	43.85	168	40.81	9	1 4 5 6 9	47.4	40.3	30.5	20.2	5.5	
44	BSL2	65	44.18	168	44.93	9	1 4 5 6 9	48.0	40.2	30.7	20.3	5.3	
45	BSL1.5	65	44.88	168	48.56	9	1 4 5 6 9	48.2	40.2	30.1	19.7	5.2	
46	BSL1	65	45.59	168	51.99	9	1 4 5 8		38.0	29.7	19.4	5.2	
47	MBS1	65	52.05	168	56.90	8	1 2 3 4 6 7	40.1	37.0	29.9	19.9	10.3	5.4
48	MBS2	65	51.97	168	48.96	9	1 3 4 5 8	47.2	40.3	30.3	20.0	5.2	
49	MBS3	65	51.78	168	41.04	9	1 3 4 5 8	49.5	40.4	30.3	20.4	5.4	
50	MBS4	65	51.56	168	31.97	9	1 3 4 5 8	48.2	39.9	30.5	20.1	5.2	
51	MBS5	65	51.55	168	22.93	8	1 3 4 5 7	49.0	40.3	31.1	21.6	10.0	
52	MBS6	65	51.26	168	13.90	7	1 3 4 7 8		44.6	30.4	19.4	5.7	2.7
53	MBS7	65	50.95	168	07.04	8	1 3 4 5 7	35.7	29.8	20.5	15.8	5.3	
54	MBS8	65	50.90	168	05.14	7	1 3 4 5 6	27.5	20.1	14.4	10.4	5.6	

FIGURE 1: Map of working area for HX250.
Moorings (A2, A3, A4) are marked in green, CTD stations in red, ADCP lines in blue.

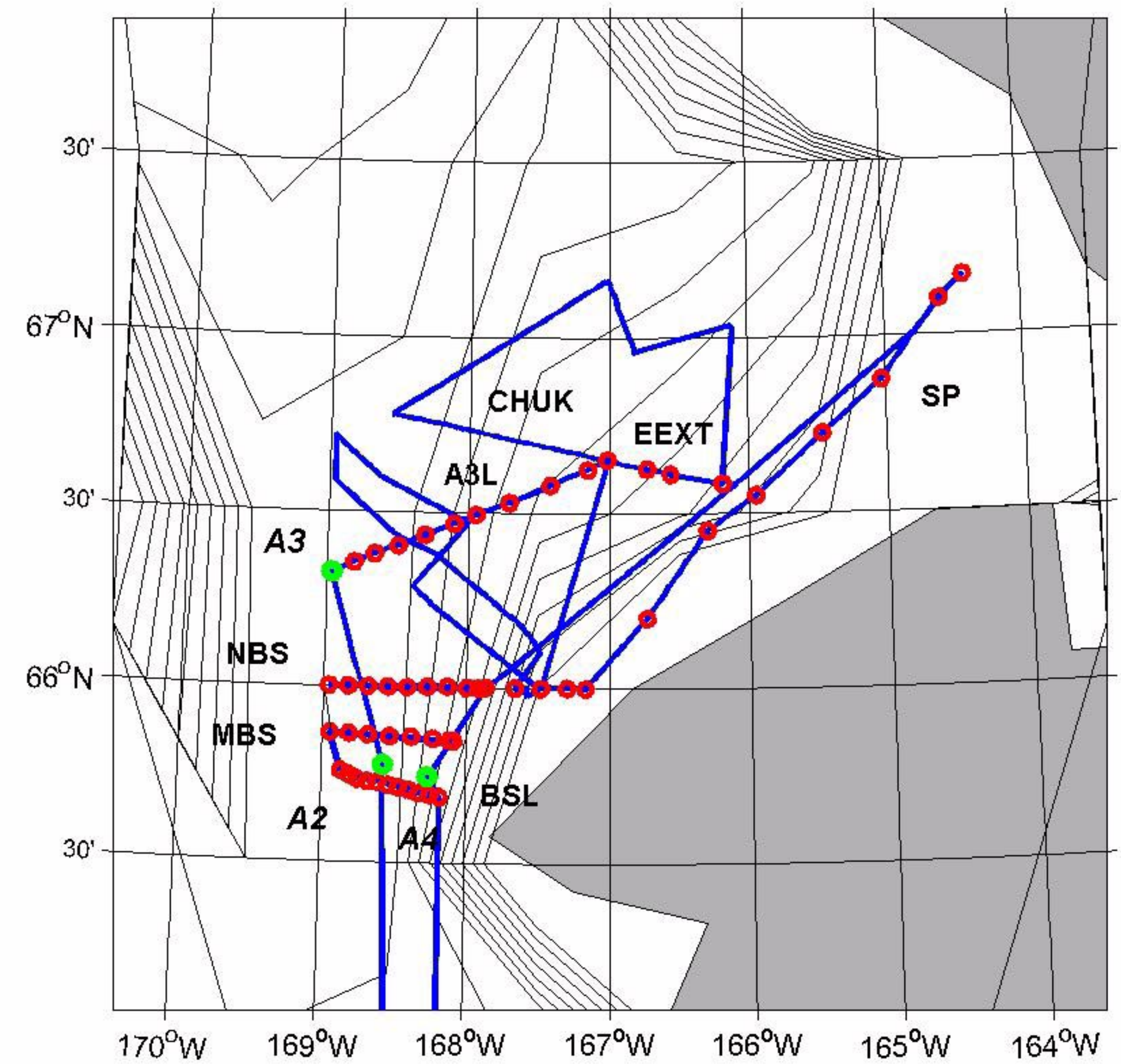

FIGURE 2: SBE timeseries A2-00 and A3-00 (pre cals)
from August 2000 to September 2001.

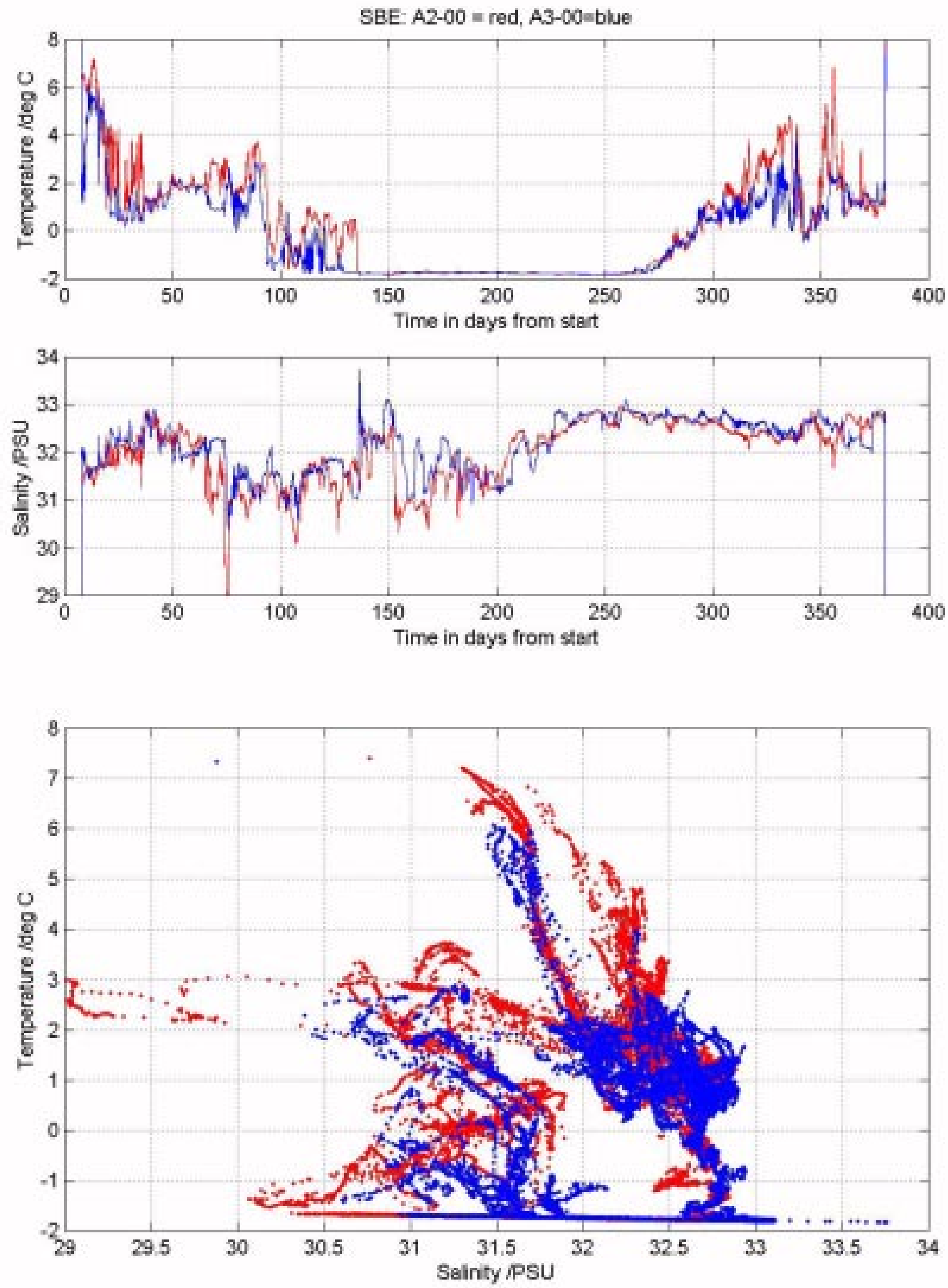

FIGURE 3: RCM timeseries A2-00 and A3-00 (pre cals)
from August 2000 to September 2001.
Note low salinities at end of A3 probably due to fouling of the salinity cell.