THE JOINT RUSSIAN-AMERICAN LONG-TERM CENSUS OF THE ARCTIC
(RUSALCA)

Joint Bering/Chukchi Sea Expedition
9-24 August 2004
CTD Data Processing Report

A SeaBird model SBE911+ profiler from WHOI was equipped with a transmissometer, fluorometer, altimeter, SBE43 dissolved oxygen sensor, dual 300 KHz lowered ADCP, 21 position rosette with 10 liter Nisken bottles and a mini-video plankton recorder. Seventy five vertical profiles of temperature, conductivity, fluorescence, transmissivity, and nitrate and water samples along several transects of stations crossed major water masses in the northern Bering Sea, western and eastern channels of Bering Strait and several transects across the Chukchi Sea. The following table lists stations in the order they were taken along with summary information including position, time, and bottom depth.

Sequence Number	Station Number	Latitude Degrees N (GPS)	Long Degrees W (GPS)	Date (GMT)	Time (GMT)	Deepest Pressure (db)	CTD Serial #	Bottom Depth* (m)
1	6	65 40.369	168 17.740	10-Aug-04	15:37:54	45.2	576	47.6
2	7	65 47.283	168 34.405	10-Aug-04	22:53:55	51.1	576	53.9
3	8	65 52.479	169 6.129	11-Aug-04	8:09:06	42.6	576	45.2
4	9	65 56.671	169 27.479	11-Aug-04	10:33:45	50.0	576	50.3
5	10	66 0.242	169 36.208	11-Aug-04	12:26:20	48.9	576	49.8
6	10B	66 0.215	169 35.565	11-Aug-04	14:07:03	14.8	576	51.2
7	11	66 55.794	170 59.773	12-Aug-04	1:56:33	40.0	576	39.9
8	12	67 11.894	170 18.215	12-Aug-04	9:39:44	45.5	576	45.2
9	13	67 25.952	169 37.542	12-Aug-04	12:56:54	45.6	576	48.0
10	14	67 38.178	169 2.621	12-Aug-04	21:05:18	49.0	576	49.1
11	15	67 52.346	168 19.073	13-Aug-04	2:49:03	52.7	576	54.8
12	18	68 56.992	166 54.727	14-Aug-04	6:45:59	43.4	664	44.0**
13	19	69 1.352	167 55.346	14-Aug-04	15:11:47	48.2	664	48.7**
14	20	69 0.372	168 53.686	14-Aug-04	18:39:01	50.9	576	52.8
15	21	68 53.135	169 36.428	15-Aug-04	3:09:52	51.4	576	54.8
16	22	68 45.476	170 25.105	15-Aug-04	6:16:38	54.4	576	55.2
17	23	68 31.345	171 27.712	15-Aug-04	11:25:46	53.1	576	54.1
18	24	68 21.435	172 20.687	15-Aug-04	21:20:12	47.0	576	50.7
19	25	67 52.217	172 33.054	16-Aug-04	4:05:31	45.8	576	47.5
20	26	67 40.723	173 11.502	16-Aug-04	10:53:07	45.4	576	47.7
21	27	67 24.491	173 36.169	16-Aug-04	16:51:32	32.7	576	33.9
22	A1R	65 52.559	169 15.317	17-Aug-04	9:42:28	45.0	576	47.4
23	A1U	65 54.410	169 25.657	17-Aug-04	11:06:17	47.9	576	50.2
24	106	70 44.717	175 32.051	18-Aug-04	19:20:16	66.2	576	68.7
25	44	70 59.137	175 58.824	19-Aug-04	5:24:40	51.4	576	53.3
26	45	70 57.062	175 46.723	19-Aug-04	6:40:44	52.9	576	55.9
27	46	70 55.063	175 37.048	19-Aug-04	17:53:59	55.6	576	58.2
28	47	70 53.255	175 26.542	19-Aug-04	8:48:32	32.8	576	66.5
29	48	70 52.210	175 15.149	19-Aug-04	10:08:35	67.8	576	70.3
30	49	70 52.351	175 6.624	19-Aug-04	10:57:39	64.6	576	68.5
31	50	70 52.718	174 58.237	19-Aug-04	11:58:51	63.6	576	65.9
32	51	70 53.035	174 50.002	19-Aug-04	12:48:42	61.4	576	63.9
33	52	70 53.394	174 41.947	19-Aug-04	13:32:23	61.6	576	64.5
34	53	70 53.843	174 33.845	19-Aug-04	14:17:19	66.2	576	69.4
35	54	70 54.238	174 25.692	19-Aug-04	15:00:40	66.7	576	69.0
36	55	70 54.694	174 17.321	19-Aug-04	15:42:16	60.1	576	62.5
37	56	70 55.014	174 9.360	19-Aug-04	16:20:23	46.3	576	49.2
38	57	70 55.395	174 1.104	19-Aug-04	17:02:50	40.0	576	42.8
39	58	71 24.463	174 21.127	19-Aug-04	20:22:40	50.4	576	53.2
40	59	71 24.216	174 29.364	19-Aug-04	21:16:02	75.9	576	78.3
41	60	71 24.073	174 37.857	19-Aug-04	21:54:55	81.3	576	84.2
42	61	71 23.903	174 46.367	19-Aug-04	22:32:28	79.1	576	80.6
43	62	71 23.674	174 55.004	19-Aug-04	23:10:57	62.2	576	65.8
44	63	71 23.426	175 3.578	19-Aug-04	23:48:15	55.9	576	57.9
45	64	71 23.426	175 12.330	20-Aug-04	0:32:52	49.3	576	52.3
46	65	71 23.477	175 20.789	20-Aug-04	1:12:36	43.0	576	45.5
47	66	71 23.257	175 28.966	20-Aug-04	1:53:21	33.5	576	33.6
48	67	71 45.223	176 12.616	20-Aug-04	6:16:23	39.5	576	39.9
49	68	71 46.542	176 5.434	20-Aug-04	6:55:14	42.7	576	43.3
50	69	71 48.131	175 58.077	20-Aug-04	7:33:35	48.5	576	49.0
51	70	71 49.477	175 50.544	20-Aug-04	8:14:57	54.6	576	55.0

52	71	71 50.996	175 43.895	20-Aug-04	8:55:38	56.9	576	57.3
53	72	71 52.469	175 36.559	20-Aug-04	9:33:26	62.2	576	62.5
54	73	71 53.956	175 29.294	20-Aug-04	10:13:40	66.8	576	67.4
55	74	71 55.398	175 22.040	20-Aug-04	10:57:40	69.4	576	70.0
56	75	71 57.004	175 14.969	20-Aug-04	11:59:36	72.7	576	73.1
57	76	71 58.451	175 7.446	20-Aug-04	12:40:55	70.1	576	70.5
58	77	72 0.022	175 0.198	20-Aug-04	13:21:28	68.2	576	68.6
59	78	72 1.424	174 52.588	20-Aug-04	14:01:18	64.4	576	64.7
60	79	72 2.908	174 45.454	20-Aug-04	14:40:51	57.7	576	58.2
61	80	72 21.193	175 15.229	20-Aug-04	17:35:52	48.3	576	47.8
62	81	72 20.506	175 23.837	20-Aug-04	18:22:11	57.9	576	58.3
63	82	72 20.030	175 32.707	20-Aug-04	19:06:40	78.2	576	78.3
64	83	72 19.710	175 41.432	20-Aug-04	19:52:20	79.7	576	79.9
65	84	72 19.241	175 50.333	20-Aug-04	20:44:50	90.5	576	90.5
66	85	72 18.881	175 59.058	20-Aug-04	21:44:22	98.4	576	98.3
67	86	72 18.491	176 7.908	20-Aug-04	22:58:27	81.9	576	82.0
68	87	72 18.064	176 16.800	20-Aug-04	23:49:11	72.0	576	72.2
69	88	72 17.839	176 25.682	21-Aug-04	0:47:00	72.6	576	72.5
70	89	72 17.419	176 30.735	21-Aug-04	1:57:18	70.0	576	70.1
71	85B	72 19.427	175 59.957	21-Aug-04	8:46:27	96.4	576	98.2
72	73B	71 55.460	175 28.645	21-Aug-04	16:34:39	68.6	576	69.2
73	62B	71 23.513	174 52.271	22-Aug-04	1:26:48	73.8	576	74.6
74	58B	71 24.529	174 21.672	22-Aug-04	5:13:58	53.8	576	54.6
75	107	70 54.442	172 46.349	22-Aug-04	14:56:02	37.1	576	39.2

* bottom depth computed by converting deepest pressure that had a good altimeter reading
to depth and adding the altimeter reading to that depth
** marks stations with no altimeter; bottom = deepest pressure converted to depth + 1 meter

Salinity and Temperature Quality Control

At sea, CTD data were run through standard post-acquisition SeaBird processing routines. At WHOI, the resulting files were then processed with a series of Matlab scripts to review sensor performance, produce a one-decibar-averaged series, and to remove bad conductivity and/or temperature values as indicated by density inversions. Bottles were not used to calibrate the conductivity sensors, since few bottles were taken and the ones that were taken, were close to the surface and therefore not useful for calibration purposes.

Profiles of salinity, temperature, and density versus pressure were created for each ctd station. These were reviewed for density inversions of greater than .002 kg/m^3. If an inversion was detected, salinity derived from the primary conductivity sensor was linearly interpolated between the bounding good salinity values. Density was recalculated and plotted, and, if inversions were still detected, temperature from the primary temperature sensor was de-spiked at that point in the profile. Very few points required this kind of editing. They are listed in the following table.

CTD Station Number	Pressures where Conductivity Was interpolated	Pressures where Temperature Was interpolated
6	12;13;bottom	
7	23;26;28;30;31;33;35;38;bottom	26;28;30;33;35
8	29;38	
9		
10	10	
15	17;18;19	
18		
19	3;4;16;17	3;4;15;16
25	34	4
26	10;11	11
A1R	3	
A1U	4	
52	52	
55	42	4
64	17	
69	1;2;22	
73	5;6;7	
75	67;68	
76	28;30;31	30
81	6	
87	8;9;33;36	
88	33	
89	32	
62B	26	

Bottom records were manually removed from stations 6 and 7 since they could not be interpolated.

Oxygen Quality Control

Profile plots of one-decibar-averaged oxygen versus depth were made and reviewed. It was noticed that occasionally the values recorded for Oxygen Current (oxcur), Oxygen Current Slope (docdt), and Oxygen all zeroes. These zeroes did not appear in the two-decibar-averaged profiles, so were introduced either due to too few points for a correct oxygen to be determined or a glitch in the averaging routine. To correct them, Oxygen was linearly interpolated, a -9.00000 bad value was placed in docdt and oxcur and a code 7 for interpolation inserted in column 8 of the quality word at the end of the record.

Locations of Oxygen interpolation:

Station	Pressure where Oxygen Was interpolated
10	31
74	57
82	64, 71
83	74
84	3, 76
85	3

Turbidity Quality Control

Using a similar process as described for Oxygen, turbidity was reviewed for data quality. Where a turbidity value changed dramatically from the one before or after it, and where no such dramatic change was noted in any other measured value at the same location, turbidity was linearly interpolated and a 7 for interpolation placed in column 10 of the quality word at the end of the record.

Locations of turbidity interpolation:

Station	Pressure where Turbidity Was interpolated
45	37
78	54
85B	64, 65

Samples of the format of the final downcast series for each of the instrument configurations follow:

For all stations, except 18-19;

Khormov Final Conductivity and Temperature Station:6
Latitude: 65.6728 Longitude: -168.2957 Date: 081004

Pres	T90(1)	T90(2)	Sal(1)	Sal(2)	OxCur	docdt	OXYG	Flur	Turbidity	Altimeter	nscans	wocecode
1.0	13.58850	13.66290	27.66650	27.59560	2.665900	-0.035060	5.299	1.5058	0.2480	49.91	32	22222111111
2.0	13.55660	13.54910	27.70390	27.72430	2.658200	-0.008860	5.284	1.3970	0.2370	49.54	54	22222111111
3.0	13.31840	13.31210	27.96700	27.97160	2.658500	-0.001010	5.301	1.3074	0.2430	46.80	86	22222111111

For stations 18-19, which did not have a fluorometer, altimeter, or turbidity sensor:

Khormov Final Conductivity and Temperature Station:19
Latitude: 69.0272 Longitude: -167.9062 Date: 081404

Pres	T90(1)	T90(2)	Sal(1)	Sal(2)	OxCur	docdt	OXYG	nscans	wocecode
1.0	8.92370	8.92280	31.04170	30.73750	3.241300	-0.019010	6.376	55	22222111
2.0	8.92430	8.92350	31.07170	31.03810	2.998700	-0.062820	5.815	31	22222111
3.0	8.92380	8.92320	31.06950	31.05100	2.775600	-0.072760	5.300	49	27272111
4.0	8.92363	8.92220	31.06730	31.05360	2.648800	-0.050400	5.011	61	27272111
5.0	8.92347	8.92230	31.06510	31.05480	2.785500	0.037630	5.324	71	27222111

Note: Quality Code 7 was inserted in the wocecode column associated with the variable that was interpolated.

Since the upcast (.cup) was not quality-controlled to the extent that the downcast was, these data remained in the 1-decibar-averaged Seabird format. A sample follows:

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* Sea-Bird SBE 9 Data File:
* FileName = D:\Data\CTD\KH_006.dat
* Software Version Seasave Win32 V 5.31a
* Temperature SN = 2271
* Conductivity SN = 1860
* Number of Bytes Per Scan = 37
* Number of Voltage Words = 4
* Number of Scans Averaged by the Deck Unit = 1
* System UpLoad Time = Aug 10 2004 15:24:02
* NMEA Latitude = 65 40.37 N
* NMEA Longitude = 168 17.74 W
* NMEA UTC (Time) = Aug 10 2004  15:23:44
* Store Lat/Lon Data = Append to Every Scan and Append to .NAV File When <Ctrl F7> is Pressed
** Ship:  Khromov
** Cruise:   Rusalca Leg 2
# nquan = 18
# nvalues = 44
# units = specified
# name 0 = prDM: Pressure, Digiquartz [db]
```

name 1 = t090C: Temperature [ITS-90, deg C]
name 2 = t190C: Temperature, 2 [ITS-90, deg C]
name 3 = c0mS/cm: Conductivity [mS/cm]
name 4 = c1mS/cm: Conductivity, 2 [mS/cm]
name 5 = sbeox0V: Oxygen Voltage, SBE 43
name 6 = sbeox0dOC/dT: Oxygen, SBE 43 [doc/dt]
name 7 = flECO-AFL: Fluorescence, Wetlab ECO-AFL/FL [mg/m^3]
name 8 = oxsatML/L: Oxygen Saturation [ml/l]
name 9 = depSM: Depth [salt water, m]
name 10 = altM: Altimeter [m]
name 11 = seaTurbMtr: OBS, Seapoint Turbidity [FTU]
name 12 = scan: Scan Count
name 13 = sbeox0ML/L: Oxygen, SBE 43 [ml/l], WS = 2
name 14 = nbin: number of scans per bin
name 15 = sal00: Salinity [PSU]
name 16 = sal11: Salinity, 2 [PSU]
name 17 = flag: flag
span 0 =   1.000,   44.000
span 1 =   10.5155,   13.7871
span 2 =   10.5135,   13.7882
span 3 = 33.528124, 34.325735
span 4 = 33.526975, 34.329369
span 5 =   2.6961,   3.0539
span 6 =   -0.00519,   0.01022
span 7 =   0.6845,   1.6241
span 8 =   6.10857,   6.42315
span 9 =   0.983,   43.570
span 10 =   3.45,   46.58
span 11 =   0.157,   0.238
span 12 =   20239,   39563
span 13 =   5.37291,   6.51908
span 14 =   27,   109
span 15 =   27.4387,   30.6136
span 16 =   27.4368,   30.6176
span 17 = 0.0000e+00, 0.0000e+00
interval = decibars: 1
start_time = Aug 10 2004 15:24:02
bad_flag = -9.990e-29
sensor 0 = Frequency 0 temperature, primary, 2271, 06/17/2004
sensor 1 = Frequency 1 conductivity, primary, 1860, 06/11/2004, cpcor = -9.5700e-08
sensor 2 = Frequency 2 pressure, 75639, 12/21/2002
sensor 3 = Frequency 3 temperature, secondary, 2534, 06/11/2004
sensor 4 = Frequency 4 conductivity, secondary, 2710, 06/11/2004, cpcor = -9.5700e-08
sensor 5 = Extrnl Volt 0 userpoly 0, ISUS017_N2
sensor 6 = Extrnl Volt 1 userpoly 1
sensor 7 = Extrnl Volt 2 altimeter
sensor 8 = Extrnl Volt 3 seapoint turbidity meter, 1648
sensor 9 = Extrnl Volt 5 WET Labs, ECO_AFL
sensor 10 = Extrnl Volt 6 Oxygen, SBE, primary, 263, 07/01/2004
datcnv_date = Apr 06 2005 13:53:42, 5.31a
datcnv_in = c:\cruise\kh_proc\kh_006.dat c:\cruise\kh_proc\kh_006.con
datcnv_skipover = 15500
alignctd_date = Apr 06 2005 13:53:46, 5.31a
alignctd_in = c:\cruise\kh_proc\kh_006.cnv
alignctd_adv = c1mS/cm 0.073, sbeox0V 2.000
wildedit_date = Apr 06 2005 13:53:52, 5.31a
wildedit_in = c:\cruise\kh_proc\kh_006.cnv
wildedit_pass1_nstd = 2.0
wildedit_pass2_nstd = 20.0
wildedit_pass2_mindelta = 0.000e+000
wildedit_npoint = 100

wildedit_vars = prDM t090C t190C c0mS/cm c1mS/cm sbeox0V sbeox0dOC/dT flECO-AFL oxsatML/L depSM altM seaTurbM
wildedit_excl_bad_scans = yes
celltm_date = Apr 06 2005 13:53:58, 5.31a
celltm_in = c:\cruise\kh_proc\kh_006.cnv
celltm_alpha = 0.0300, 0.0300
celltm_tau = 7.0000, 7.0000
celltm_temp_sensor_use_for_cond = primary, secondary
filter_date = Apr 06 2005 13:54:03, 5.31a
filter_in = c:\cruise\kh_proc\kh_006.cnv
filter_low_pass_tc_A = 0.030
filter_low_pass_tc_B = 0.150
filter_low_pass_A_vars = c0mS/cm c1mS/cm flECO-AFL altM seaTurbMtr
filter_low_pass_B_vars = prDM
loopedit_date = Apr 06 2005 13:54:13, 5.31a
loopedit_in = c:\cruise\kh_proc\kh_006.cnv
loopedit_minVelocity = 0.100
loopedit_excl_bad_scans = yes
Derive_date = Apr 06 2005 13:54:21, 5.31a
Derive_in = c:\cruise\kh_proc\kh_006.cnv c:\cruise\kh_proc\kh_006.con
derive_time_window_docdt = seconds: 2
binavg_date = Apr 06 2005 13:54:27, 5.31a
binavg_in = c:\cruise\kh_proc\kh_006.cnv
binavg_bintype = decibars
binavg_binsize = 1
binavg_excl_bad_scans = yes
binavg_skipover = 0
binavg_surface_bin = no, min = 0.000, max = 0.000, value = 0.000
Derive_date = Apr 06 2005 13:54:32, 5.31a
Derive_in = c:\cruise\kh_proc\kh_006.cnv c:\cruise\kh_proc\kh_006.con
split_date = Apr 06 2005 13:54:32, 5.31a
split_in = c:\cruise\kh_proc\kh_006.cnv
split_excl_bad_scans = yes
file_type = ascii
END

44.000	10.5322	10.5344	34.224431	34.228062	3.0493	-9.990e-29	0.7933	6.42121	43.570
43.000	10.5264	10.5264	34.222754	34.225631	3.0507	7.4793e-11	0.8079	6.42189	42.567
42.000	10.5155	10.5135	34.219808	34.222094	3.0539	-9.990e-29	0.7896	6.42315	41.583
41.000	10.5374	10.5376	34.225775	34.228963	3.0529	0.00122	0.7885	6.42056	40.586

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