

# Current measurements on the Faroe Shelf 2008 - 2009

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## Introduction

In the spring of 2008, the Faroese Marine Research Institute (FAMRI) received funding from the Faroese Oil Industry Group (FOIB) for a trawl resistant bottom mount (TRBM) and other necessary instrumentation intended for one of our ADCP current meters. The TRBM was required in the project Faroe Shelf Exchange (FASE) where the aim is to obtain temperature, salinity, and current measurements of shelf exchange at the Faroe Shelf Front.

In November 2008, the TRBM was deployed on the western part of the Faroe Shelf, equipped with a RDI Workhorse Sentinel ADCP current meter and a Seabird MicroCat, which records temperature, conductivity and pressure. At the same time, a Seabird MicroCat was deployed at one of FAMRI's coastal stations in the central part of the Shelf.

This report documents the data from this first deployment of the TRBM and also the data from the MicroCat at the coastal station. Details on the deployments are listed in Table 1. Both deployments are identified by an 8-character label where the first four characters indicate the site while the last characters show year and month of deployment. Figure 1 shows the location of the deployments.

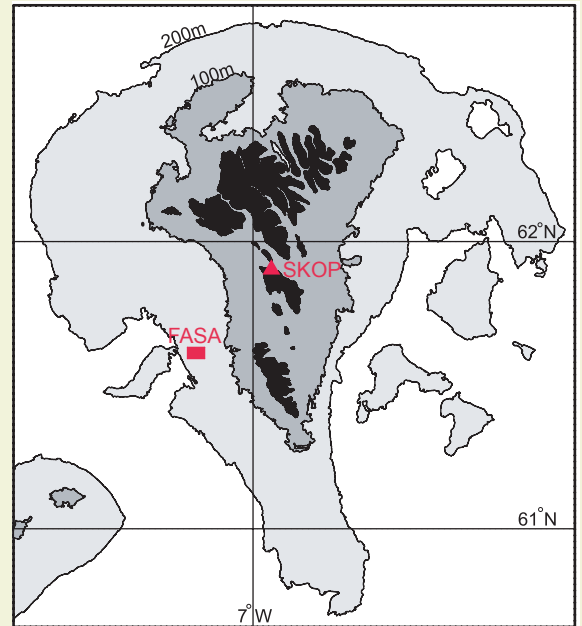


Figure 1. Map with the location of the TRBM deployment site (FASA) and the coastal station Skopun (SKOP).

Table 1. List of deployments with information on duration and range of valid data. All depths are in meters.

Deployment	Bottom depth	Int. min.	Valid data period	Dur. days	No. bins	Depthrange	Instrument type
FASA0811	157	20	2008 11 07 - 2009 06 07	211	26	150 - 50	ADCP
FASA0811	157	5	2008 11 07 - 2009 06 07	211	-	-	Microcat
SKOP0811	18	5	2008 11 13 - 2009 09 16	307	-	-	Microcat

# Quality control and calibration

The ADCP data have been quality controlled by a standard procedure based upon consideration of ADCP performance (error velocity etc.) and data variation with time in relation to neighbouring bins (spikes). The editing has been done manually using an interactive graphical software package developed by the FAMRI, based upon MATLAB. The editing has been done with a philosophy of minimal interference. Thus, only observations which were considered clearly erroneous were flagged. The serie has been edited up to the level where about 50% of the observations were found to be valid. Bins above this level have not been included. The velocity direction has been corrected for magnetic deviation, by adding a constant as indicated in the header of the data file (p. 9). The instrument depth at site FASA is found from the Microcat pressure measurement.

Data from the Microcat instruments have been quality controlled by a standard procedure based upon data variation with time in relation to neighbouring values (spikes). The editing has been done manually using an interactive graphical software package developed by the FAMRI, based upon MATLAB. Data were calibrated using calibration coefficients from the factory some months before deployment. The salinity measurements at FASAO811 had a stepwise decrease from 35 to 32 through the whole deployment period probably caused by accumulation of sand in the conductivity probe. These data must therefore be interpreted with caution.

## Report format

This report contains a section with some preliminary results from the data. Then comes a number of pages for each deployment where the first page has a drawing of the mooring and details of the deployment. After that, there are some pages describing the ADCP data (FASA only), beginning with a page with detailed error statistics for the deployment, which indicates also how many “long” (i.e. several consecutive ensembles) error gaps are for each bin. On the next page, there is for each

bin listed the average speed (scalar average) and velocity magnitude and direction (vectorial average) as well as the fraction of “good” ensembles (in parts per thousand). This is followed by a frequency distribution of speeds for each bin which lists the frequency (in parts per thousand) of speeds (scalar) exceeding specified values. Then there are some pages listing tidal constituents. These pages contain five tables with data for the constituents M<sub>2</sub>, S<sub>2</sub>, N<sub>2</sub>, O<sub>1</sub>, and K<sub>1</sub>. Each table lists for each bin the amplitude and Greenwich phase lag for the east and north velocity components and lists also major and minor semi-axes of the tidal ellipse for the constituent as well as its inclination (Fig. 2) and sense of rotation (cyclonic = C, anticyclonic = A). The tidal constants were computed by an adapted version of the Foreman FORTRAN package.

The Microcat data from each deployment are presented on two pages, the first page showing plots of temperature, salinity and depth (FASA only) time series, while the second is a T-S diagram of the recorded data.

## Preliminary results

The aim of the FASE project is to investigate exchange between shelf and off-shelf water and some preliminary results are presented here.

For a period of seven months, the data at FASA and SKOP overlap and in Figure 3 the data from the MicroCats for this period are plotted (the salinity data at FASA are omitted). During the whole winter the temperature at FASA is higher than in the central part of the shelf (SKOP), but from April and onwards the atmospheric warming of the shallow water is so efficient that in May the temperature at SKOP exceeds the temperature at FASA. On short timescales (hours - day) the temperature at FASA has larger variability than at SKOP and a few examples are of variations exceeding half a degree (f.ex. 10. February) indicating the presence of the Faroe Shelf Front at the bottom at FASA. On longer time scales the temperatures have similar variations and for instance they both have a large decline in early February. This decline in temperature is immediately followed by an increase in salinity at SKOP indicating an extreme exchange of shelf water. Also plotted in Figure 3 is the weekly chlorophyll *a* concentration at coastal station Skopun. The chlorophyll *a* levels were relatively



high during April and the spring bloom started ultimo April, only to decrease again in mid May. The temperature and salinity measurements at FASA and SKOP do not give any immediate explanation for the decline in the chlorophyll *a*.

From the current measurements at FASA, the daily averaged current directions are an indication of the residual flow at the location. The distribution of these is shown in Figure 4 for six selected bins. These show that the residuals are very steady and typically oriented towards north-northwest. A small clockwise veering of the residuals from bottom towards the surface may also be observed, consistent with the bottom Ekman layer theory. At the bottom (bin 1) a few days have an off shelf direction, which is less frequent in the upper layers.

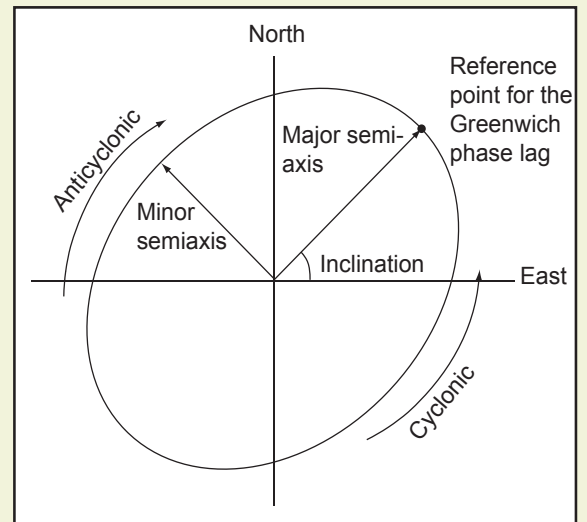


Figure 2. Parameters of the tidal ellipse for a given constituent. The reference point for the Greenwich phase lag is always chosen to be above the east-west axis.

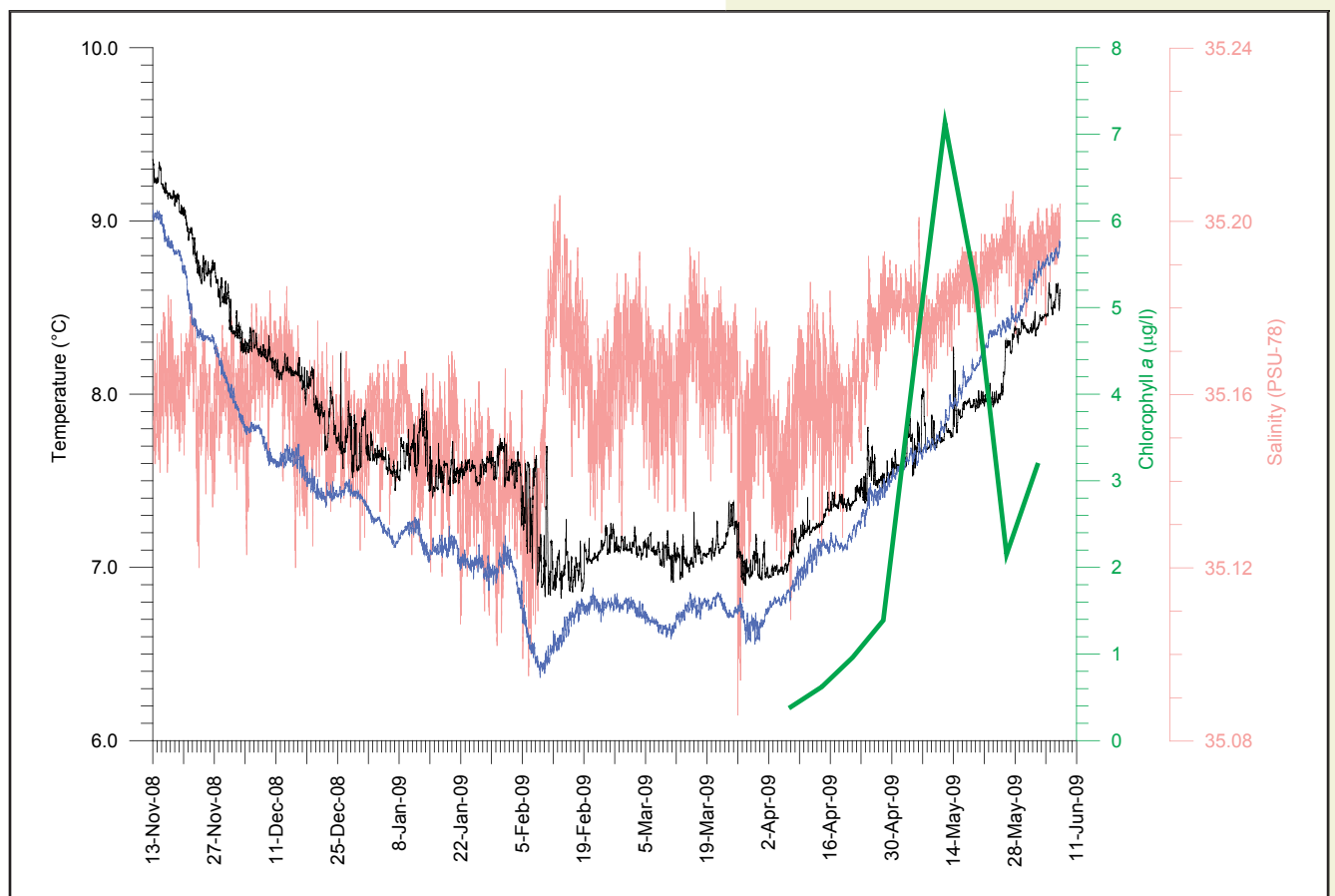


Figure 3. Temperature at FASA0811 (black) and temperature (blue), salinity (pink) and chlorophyll *a* (green) at coastal station Skopun for the period 13. November 2008 - 7. June 2009.

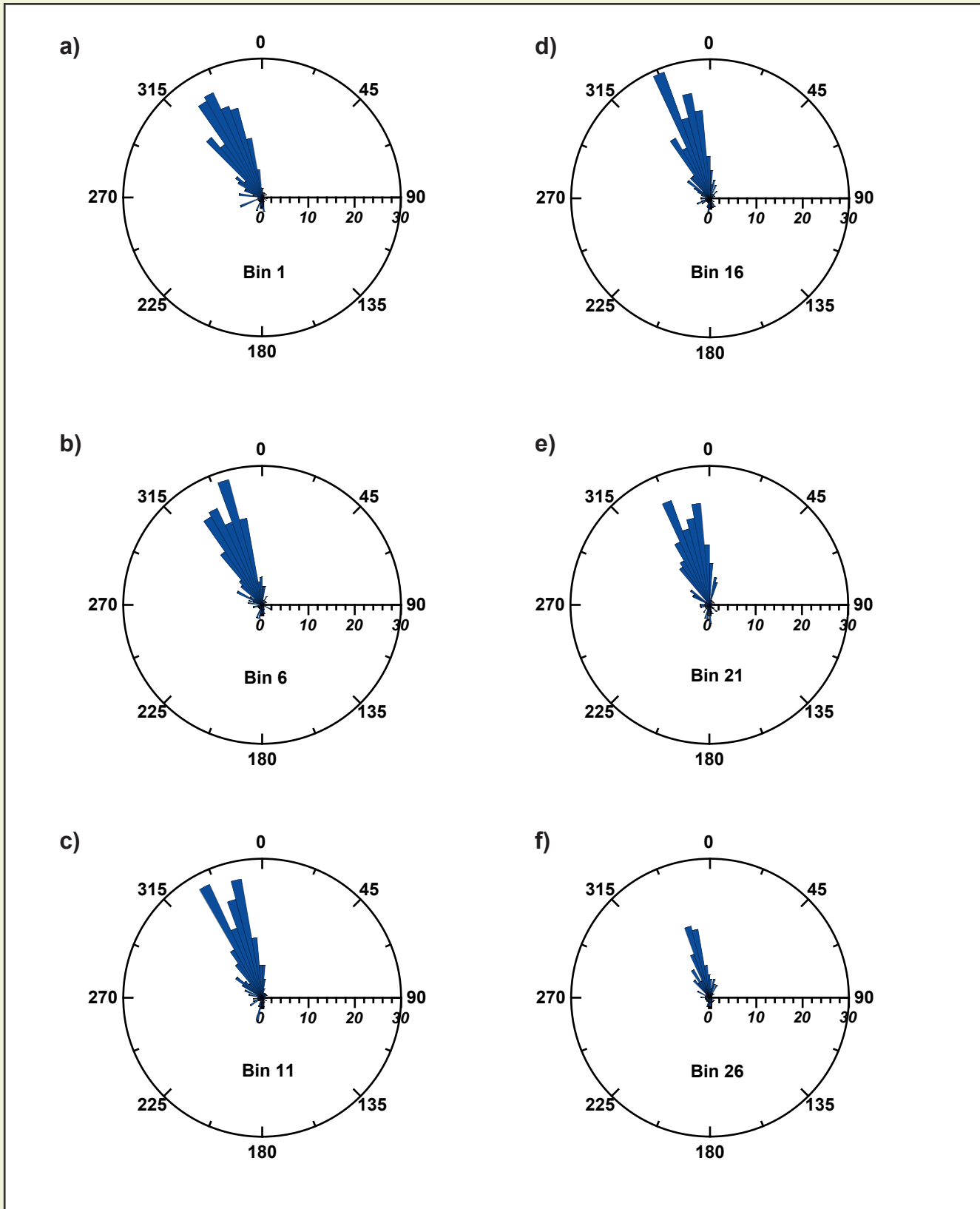


Figure 4. Distribution of daily averaged current direction for 6 selected bins: a) Bin 1 at 150 m depth, b) Bin 6 at 130 m depth, c) Bin 11 at 110 m depth, d) Bin 16 at 90 m depth, e) Bin 21 at 70 m depth, and f) Bin 26 at 50 m depth. Each directional interval covers 5 degrees and the x-axis shows the number of days with those direction values. 5 days are missing in e) and 89 days in f) due to large gaps in the data.

## FASAO811 data

**Latitude:** 61°37.200'N

**Longitude:** 007°24.100'W

**Echo sound depth:** 156 m

**Bottom depth corr.:** 157 m

**Time of deployment:** 7/11 - 2008 2146 UTC

**Time of recovery:** 7/6 - 2009 1614 UTC

### ADCP:

**Instrument no.:** RDI WH Sentinel ADCP 0936

**Instrument frequency:** 300 kHz

**Height above bottom:** 1 m

**Depth:** 156 m (corr.)

**Time of first data:** 7/11 - 2008 2200 UTC

**Time of last data:** 7/6 - 2009 1500 UTC

**Sample interval:** 20 min

**No. of ensembles:** 15244

**Pings per ens.:** 25

**Binlength:** 4 m

**Depth of first bin:** 150 m (corr.)

**No. of bins:** 32

### Micro Cat:

**Instrument no.:** 6094

**Height above bottom:** 1 m

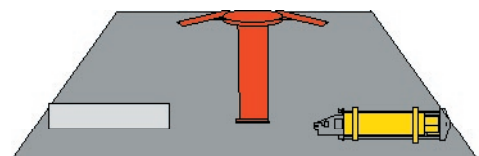
**Time of first data:** 7/11 - 2008 2150 UTC

**Time of last data:** 7/6 - 2009 1535 UTC

**Sample interval:** 5 min

**No. of ensembles:** 60982

**Instrument depth:** 156 m



### Data:

**OK, but the MicroCat salinity data have a drift from 35 to 32 over the whole deployment period.**

## FASA0811 ADCP 0936

Error statistics for deployment: FASA0811 updated 2009/09/30

Surface distance invalid due to range limitation  
 Heading, pitch and roll not edited  
 Temperature edited by KMHL in Sep 2009  
 Velocity edited up to and including bin 26 by KMHL in Sep 2009  
 Intensity edited up to and including bin 32 by KMHL in Sep 2009

Total number of ensembles: 15244  
 Interval between ensembles: 20 min  
 Original number of bins: 32  
 Number of acceptable velocity bins: 26  
 Number of acceptable intensity bins: 26

Flagged values have been replaced by error codes: -999.99 for temperature, -999 for velocity and intensity. For observations where velocity is flagged, error codes have been inserted into speed, direction and vertical velocity files

Number of temperature ens. flagged: 0

Below are for each bin listed ensembles flagged for intensity in number and for velocity in number and % of total ens.number. For velocity is also shown the number of gaps of various lengths (gap length = number of consecutive flagged ens.)

Bin	Int. ens. flgd	Velocity ens. flgd	%	Number of velocity gaps of length										
				1	2	3	4	5	6-10	11-20	21-30	31-50	>50	
1	0	32	0	30	1	0	0	0	0	0	0	0	0	0
2	0	38	0	38	0	0	0	0	0	0	0	0	0	0
3	0	26	0	26	0	0	0	0	0	0	0	0	0	0
4	0	27	0	23	2	0	0	0	0	0	0	0	0	0
5	0	20	0	20	0	0	0	0	0	0	0	0	0	0
6	0	25	0	25	0	0	0	0	0	0	0	0	0	0
7	0	13	0	13	0	0	0	0	0	0	0	0	0	0
8	0	18	0	18	0	0	0	0	0	0	0	0	0	0
9	0	22	0	22	0	0	0	0	0	0	0	0	0	0
10	0	20	0	18	1	0	0	0	0	0	0	0	0	0
11	0	19	0	19	0	0	0	0	0	0	0	0	0	0
12	0	20	0	20	0	0	0	0	0	0	0	0	0	0
13	0	24	0	24	0	0	0	0	0	0	0	0	0	0
14	0	33	0	27	3	0	0	0	0	0	0	0	0	0
15	0	51	0	43	4	0	0	0	0	0	0	0	0	0
16	0	236	2	133	25	6	6	1	1	0	0	0	0	0
17	0	501	3	191	66	9	15	6	7	1	0	0	0	0
18	0	692	5	212	66	15	10	6	10	4	1	2	0	0
19	0	968	6	236	67	22	20	8	18	7	2	3	0	0
20	0	1272	8	261	74	32	13	6	26	10	2	5	1	1
21	0	1754	12	246	85	37	17	16	18	15	5	3	6	6
22	0	2767	18	309	107	45	34	18	42	22	8	2	9	9
23	0	4230	28	348	99	64	30	20	58	37	10	11	14	14
24	0	5842	38	271	82	38	32	26	45	40	6	5	23	23
25	0	6897	45	258	86	48	25	12	44	49	13	9	21	21
26	0	8321	55	177	62	34	17	14	34	33	16	8	27	27

## FASA0811 ADCP 0936

Deployment: FASA0811 updated 2009/09/30  
 Instrument no.: 936  
 Instrument freq.: 300  
 Latitude: 61 37.168 N  
 Longitude: 07 24.058 W  
 Bottom depth: 157  
 Instrument depth: 156  
 Center depth of first bin: 150  
 Bin length: 4  
 Number of bins: 26  
 Number of first ensemble: 169  
 Time of first ensemble: 2008 11 07 22 00  
 Number of last ensemble: 15412  
 Time of last ensemble: 2009 06 07 15 00  
 Time between ensembles (min.): 20  
 All directions have been corrected by adding: 15.0

Below is listed for each bin the average speed (scalar average) and the average velocity magnitude and direction formed as a vectorial average of non-flagged (Good) observations. The last column shows the number of good values used in parts per thousand

Bin no.	Depth m	Height m	Speed mm/s	Vel mm/s	Dir deg	Good ppt
1	150	7	194	81	328	998
2	146	11	206	85	329	998
3	142	15	215	88	330	998
4	138	19	222	90	331	998
5	134	23	229	92	332	999
6	130	27	236	93	333	998
7	126	31	241	94	333	999
8	122	35	247	94	334	999
9	118	39	252	95	335	999
10	114	43	257	95	335	999
11	110	47	261	95	336	999
12	106	51	265	94	336	999
13	102	55	269	94	337	998
14	98	59	273	94	337	998
15	94	63	277	93	338	997
16	90	67	280	93	338	985
17	86	71	284	93	339	967
18	82	75	288	92	339	955
19	78	79	292	92	340	936
20	74	83	295	92	340	917
21	70	87	298	92	341	885
22	66	91	302	93	342	818
23	62	95	306	96	342	723
24	58	99	309	97	341	617
25	54	103	311	95	341	548
26	50	107	314	98	342	454

# FASA0811 ADCP 0936

Deployment: FASA0811

Frequency of high speeds.

Frequency (in parts per thousand) of speeds equal to or exceeding specified vales.

Bin Depth		Speed (cm/s)																		
no.	m	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	
1	150	839	432	133	28	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	146	856	485	172	43	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	142	869	517	199	54	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0
4	138	877	545	224	66	13	1	0	0	0	0	0	0	0	0	0	0	0	0	0
5	134	883	568	248	77	17	2	0	0	0	0	0	0	0	0	0	0	0	0	0
6	130	889	588	267	90	21	3	0	0	0	0	0	0	0	0	0	0	0	0	0
7	126	895	607	284	100	26	4	0	0	0	0	0	0	0	0	0	0	0	0	0
8	122	901	623	301	108	31	6	0	0	0	0	0	0	0	0	0	0	0	0	0
9	118	905	640	317	117	36	7	0	0	0	0	0	0	0	0	0	0	0	0	0
10	114	911	653	329	126	40	8	0	0	0	0	0	0	0	0	0	0	0	0	0
11	110	917	667	342	134	44	10	1	0	0	0	0	0	0	0	0	0	0	0	0
12	106	921	678	353	143	47	11	1	0	0	0	0	0	0	0	0	0	0	0	0
13	102	925	689	363	151	51	13	1	0	0	0	0	0	0	0	0	0	0	0	0
14	98	928	696	375	158	54	14	2	0	0	0	0	0	0	0	0	0	0	0	0
15	94	931	705	387	165	57	16	2	0	0	0	0	0	0	0	0	0	0	0	0
16	90	922	708	392	169	60	18	3	0	0	0	0	0	0	0	0	0	0	0	0
17	86	910	705	396	173	63	19	4	0	0	0	0	0	0	0	0	0	0	0	0
18	82	900	706	403	178	66	21	4	0	0	0	0	0	0	0	0	0	0	0	0
19	78	886	701	405	184	69	22	5	0	0	0	0	0	0	0	0	0	0	0	0
20	74	868	692	406	186	71	22	5	0	0	0	0	0	0	0	0	0	0	0	0
21	70	839	673	399	185	73	23	5	0	0	0	0	0	0	0	0	0	0	0	0
22	66	780	629	380	178	71	23	5	0	0	0	0	0	0	0	0	0	0	0	0
23	62	689	563	344	165	66	23	5	0	0	0	0	0	0	0	0	0	0	0	0
24	58	589	482	302	147	60	20	4	0	0	0	0	0	0	0	0	0	0	0	0
25	54	523	426	267	135	55	19	4	0	0	0	0	0	0	0	0	0	0	0	0
26	50	434	357	228	115	48	16	3	0	0	0	0	0	0	0	0	0	0	0	0

## FASA0811 ADCP 0936

Harmonic constants for constituent M2 for deployment FASA0811.

Bin	Depth m	E-ampl mm/sec	E-gpl deg	N-ampl mm/sec	N-gpl deg	Major mm/sec	Minor mm/sec	Incl deg	Grphl deg	R
01	150	105	248	199	172	201	101	81	177	A
02	146	115	249	211	172	213	111	80	177	A
03	142	123	249	220	172	222	119	80	177	A
04	138	130	250	228	172	231	126	80	177	A
05	134	137	250	236	172	239	133	81	177	A
06	130	143	251	244	172	246	139	81	177	A
07	126	149	252	250	172	253	145	81	177	A
08	122	155	252	256	172	259	151	81	178	A
09	118	160	253	262	173	265	156	81	178	A
10	114	165	253	268	173	270	161	81	178	A
11	110	170	254	273	173	275	166	81	179	A
12	106	174	255	278	174	280	171	81	179	A
13	102	178	256	282	174	284	175	82	179	A
14	98	182	256	287	174	289	179	82	179	A
15	94	186	257	291	175	293	183	82	180	A
16	90	189	257	295	175	296	186	82	180	A
17	86	192	258	299	175	301	189	82	180	A
18	82	195	259	303	176	304	193	82	180	A
19	78	198	259	306	176	308	195	83	181	A
20	74	201	260	308	177	310	198	83	181	A
21	70	203	260	311	177	313	201	83	181	A
22	66	206	261	315	177	316	204	83	181	A
23	62	207	262	317	177	318	205	84	181	A
24	58	208	262	324	178	325	207	84	182	A
25	54	210	262	322	178	323	208	84	182	A
26	50	214	263	323	178	324	212	84	182	A

Harmonic constants for constituent S2 for deployment FASA0811.

Bin	Depth m	E-ampl mm/sec	E-gpl deg	N-ampl mm/sec	N-gpl deg	Major mm/sec	Minor mm/sec	Incl deg	Grphl deg	R
01	150	35	280	70	211	72	32	77	217	A
02	146	38	280	75	211	77	34	77	217	A
03	142	40	280	78	211	80	37	77	217	A
04	138	43	280	81	211	83	39	76	218	A
05	134	45	280	84	211	86	41	76	218	A
06	130	47	280	86	211	88	43	75	219	A
07	126	49	281	88	212	91	45	75	219	A
08	122	51	281	90	212	93	47	75	219	A
09	118	53	282	92	212	95	49	75	220	A
10	114	55	282	94	212	97	51	74	220	A
11	110	57	283	96	212	99	52	74	221	A
12	106	59	283	98	212	101	54	74	221	A
13	102	61	284	100	212	103	57	74	221	A
14	98	62	285	102	213	104	58	75	221	A
15	94	64	286	103	213	106	59	75	222	A
16	90	65	287	105	213	107	61	75	222	A
17	86	66	288	106	213	108	63	75	222	A
18	82	68	288	107	214	109	64	75	222	A
19	78	68	289	108	214	111	65	76	223	A
20	74	70	289	110	214	113	67	76	223	A
21	70	71	290	111	215	113	67	75	224	A
22	66	72	290	109	215	112	68	74	225	A
23	62	74	290	110	216	113	70	73	226	A
24	58	74	292	112	215	114	71	77	223	A
25	54	75	294	114	216	115	72	77	224	A
26	50	73	293	117	216	118	70	77	223	A

## FASA0811 ADCP 0936

Harmonic constants for constituent N2 for deployment FASA0811.

Bin	Depth m	E-ampl mm/sec	E-gpl deg	N-ampl mm/sec	N-gpl deg	Major mm/sec	Minor mm/sec	Incl deg	Grphl deg	R
01	150	20	219	43	147	44	19	80	151	A
02	146	22	219	46	147	46	20	80	152	A
03	142	23	219	47	147	48	21	80	151	A
04	138	24	219	48	146	49	23	79	151	A
05	134	25	219	49	146	50	24	79	151	A
06	130	27	219	51	146	51	25	79	152	A
07	126	28	219	51	146	52	26	78	152	A
08	122	29	219	52	146	53	27	78	152	A
09	118	30	220	53	146	54	28	77	153	A
10	114	31	220	54	146	55	29	77	153	A
11	110	32	220	55	146	56	30	77	153	A
12	106	32	220	56	146	57	31	77	153	A
13	102	33	220	57	146	58	32	77	153	A
14	98	34	220	58	146	59	32	77	153	A
15	94	35	221	58	146	59	33	77	153	A
16	90	36	221	60	146	61	34	77	153	A
17	86	36	221	60	146	61	35	77	153	A
18	82	37	221	60	146	61	35	77	153	A
19	78	38	222	61	146	62	36	78	153	A
20	74	39	223	62	147	63	37	77	154	A
21	70	40	224	62	147	63	38	77	155	A
22	66	39	226	64	149	65	37	78	156	A
23	62	40	229	63	151	64	39	78	159	A
24	58	40	228	67	152	68	38	78	159	A
25	54	38	226	65	152	66	36	77	159	A
26	50	39	232	67	156	68	38	79	162	A

Harmonic constants for constituent O1 for deployment FASA0811.

Bin	Depth m	E-ampl mm/sec	E-gpl deg	N-ampl mm/sec	N-gpl deg	Major mm/sec	Minor mm/sec	Incl deg	Grphl deg	R
01	150	20	46	37	261	41	10	116	254	A
02	146	21	46	40	261	44	11	115	254	A
03	142	21	45	41	261	45	11	115	254	A
04	138	22	44	43	261	46	12	114	255	A
05	134	22	44	44	261	48	12	113	255	A
06	130	22	44	45	261	49	13	113	255	A
07	126	22	42	46	261	49	13	112	255	A
08	122	22	42	47	261	50	13	112	255	A
09	118	22	40	48	261	51	14	111	255	A
10	114	23	39	48	261	51	14	111	255	A
11	110	23	38	48	260	51	14	111	254	A
12	106	23	38	49	260	52	14	110	254	A
13	102	23	38	49	260	52	14	110	254	A
14	98	23	37	49	260	52	15	110	254	A
15	94	23	36	49	260	52	15	110	254	A
16	90	23	37	50	260	52	15	110	254	A
17	86	22	36	49	260	52	15	110	254	A
18	82	22	35	49	259	52	15	110	253	A
19	78	23	34	48	259	51	15	110	253	A
20	74	22	34	49	258	52	15	110	252	A
21	70	22	36	48	260	51	14	110	254	A
22	66	22	34	49	261	51	15	109	255	A
23	62	22	34	48	258	51	14	110	252	A
24	58	20	28	46	261	47	15	107	255	A
25	54	17	25	44	254	46	13	106	250	A
26	50	19	28	47	254	49	13	107	249	A

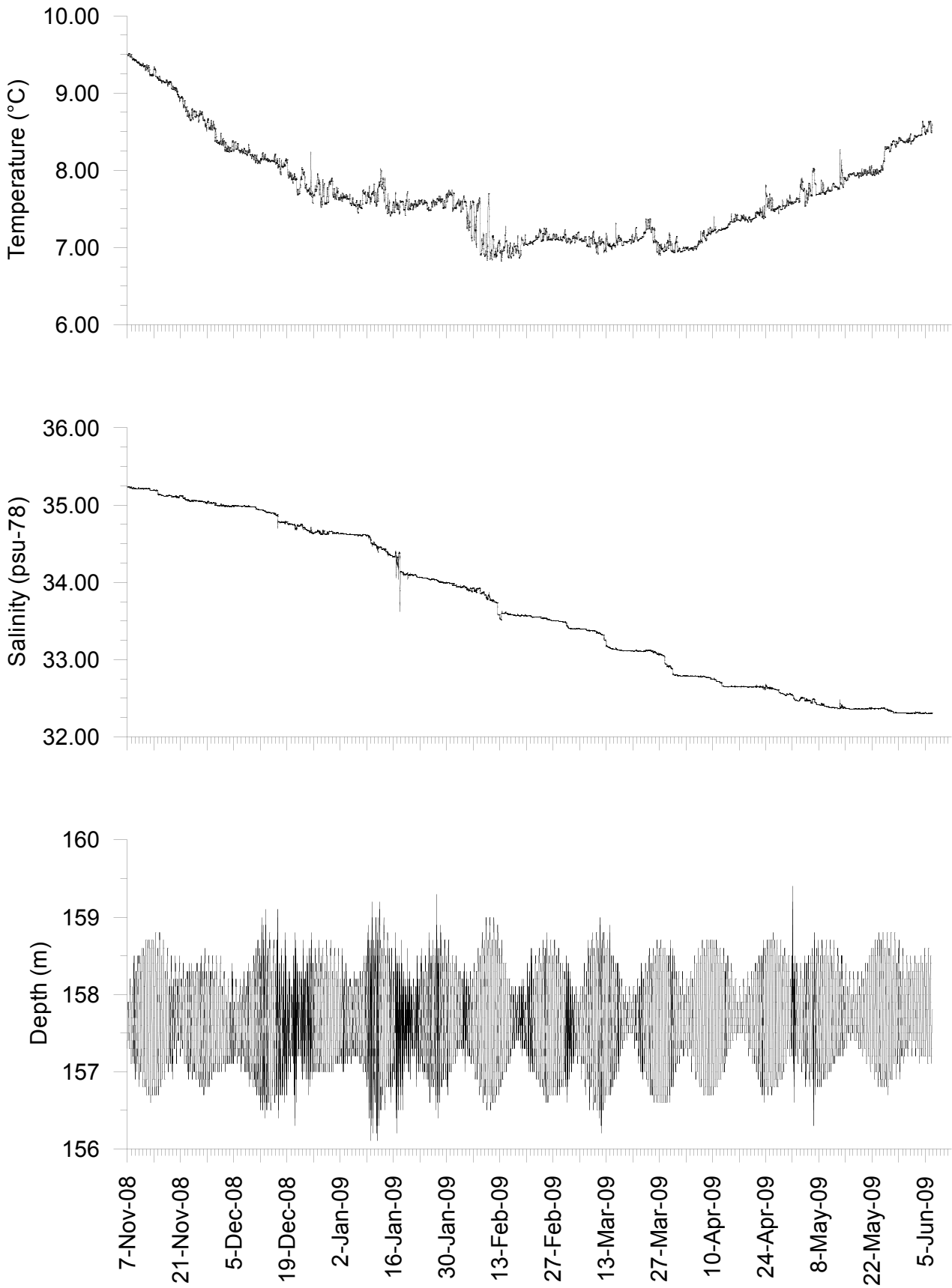


## FASA0811 ADCP 0936

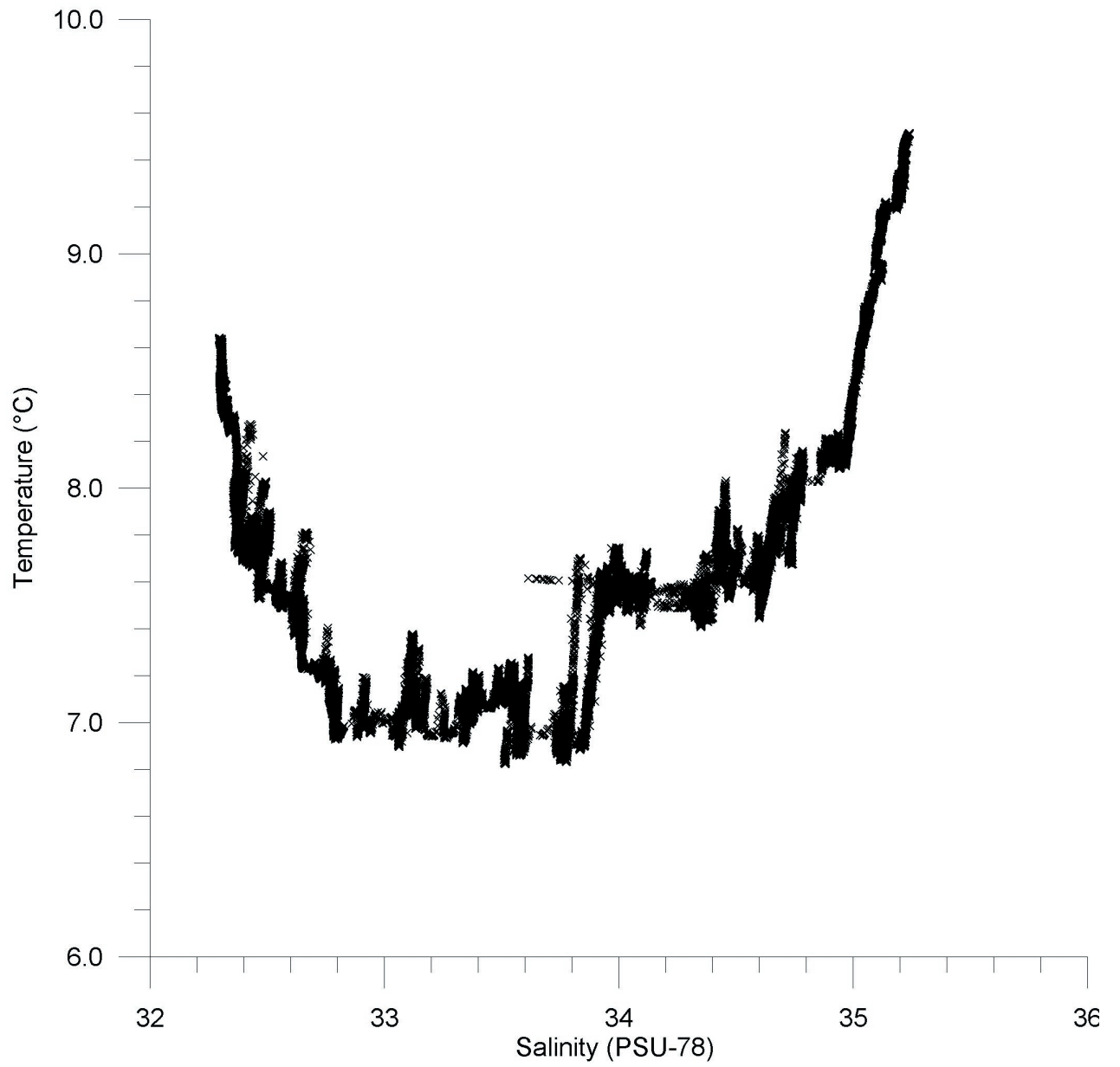
Harmonic constants for constituent K1 for deployment FASA0811.

Bin	Depth m	E-ampl mm/sec	E-gpl deg	N-ampl mm/sec	N-gpl deg	Major mm/sec	Minor mm/sec	Incl deg	Grphl deg	R
01	150	15	269	28	117	31	7	117	111	A
02	146	16	269	30	117	33	7	116	111	A
03	142	16	267	31	117	34	7	116	111	A
04	138	16	268	31	117	35	7	116	111	A
05	134	17	266	33	118	36	8	115	112	A
06	130	17	264	33	118	36	8	114	112	A
07	126	17	263	34	118	37	9	113	112	A
08	122	17	262	34	118	37	9	113	112	A
09	118	17	260	35	118	37	10	112	112	A
10	114	17	258	35	117	38	10	112	111	A
11	110	17	256	35	117	38	10	112	111	A
12	106	17	255	35	117	38	11	112	110	A
13	102	17	254	36	117	38	11	112	110	A
14	98	18	252	35	116	38	11	112	109	A
15	94	18	252	35	116	38	12	112	109	A
16	90	18	251	35	116	37	12	113	108	A
17	86	19	249	34	116	37	13	113	108	A
18	82	19	249	34	116	37	13	114	107	A
19	78	19	247	34	115	37	13	114	106	A
20	74	19	246	34	117	37	14	113	108	A
21	70	20	243	34	113	36	14	114	103	A
22	66	20	244	34	114	37	14	115	104	A
23	62	18	242	34	116	36	14	111	108	A
24	58	20	237	34	107	37	14	114	97	A
25	54	23	233	36	113	38	18	113	101	A
26	50	24	237	40	121	42	20	109	112	A

FASA0811 MicroCat 6094



FASA0811 MicroCat 6094



## SKOPo811 data

**Latitude:** 61°54.438'N

**Longitude:** 006°52.830'W

**Bottom depth:** 18 m

**Time of deployment:** 13/11 - 2008 1027 UTC

**Time of recovery:** 16/9 - 2009 0925 UTC

### Micro Cat:

**Instrument no.:** 4568

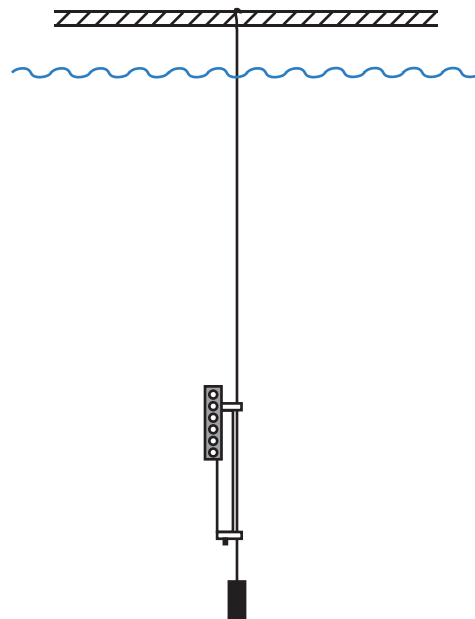
**Time of first data:** 13/11 - 2008 1035 UTC

**Time of last data:** 16/9 - 2009 0920 UTC

**Sample interval:** 5 min

**No. of ensembles:** 88402

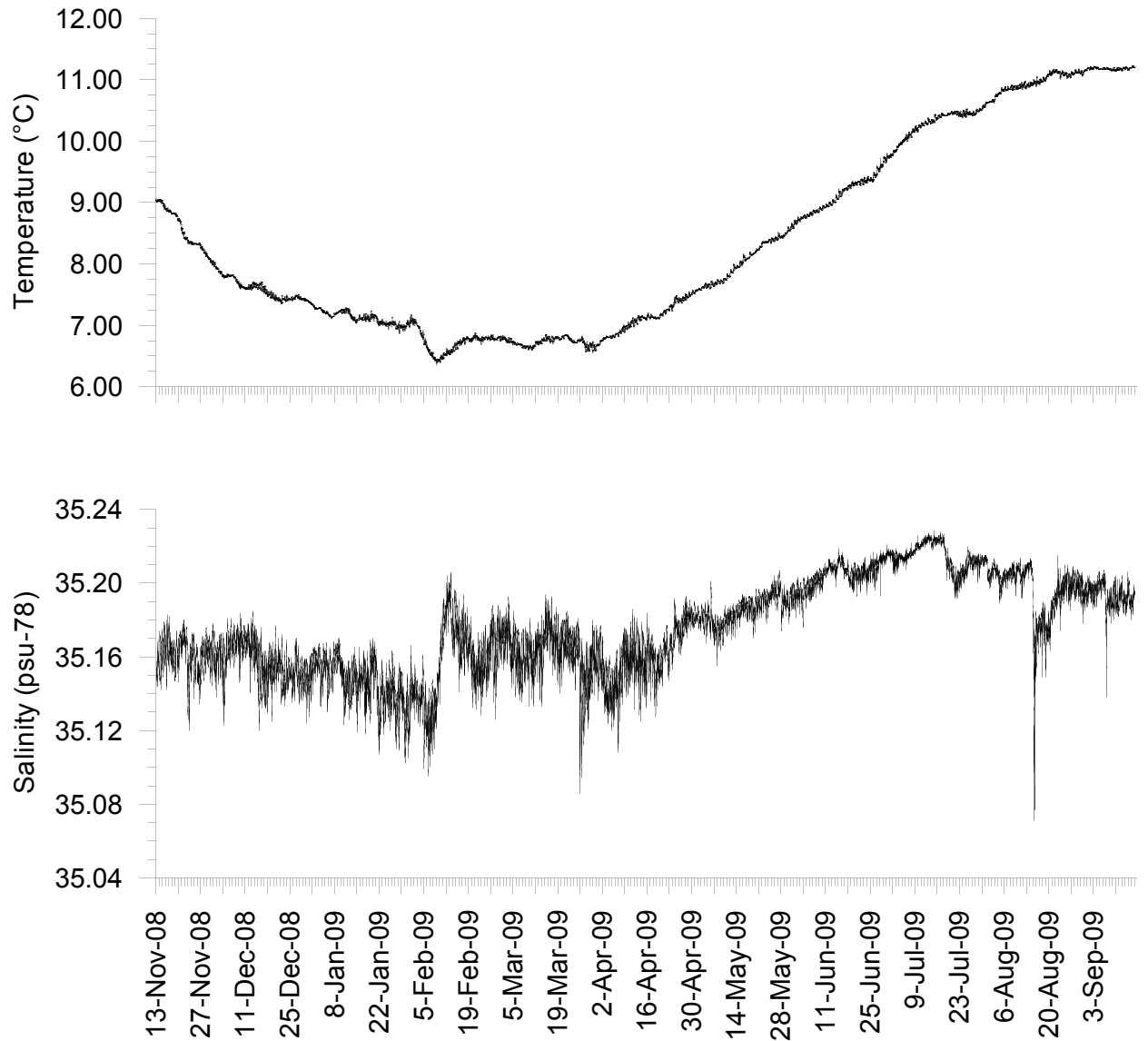
**Instrument depth:** 4 m



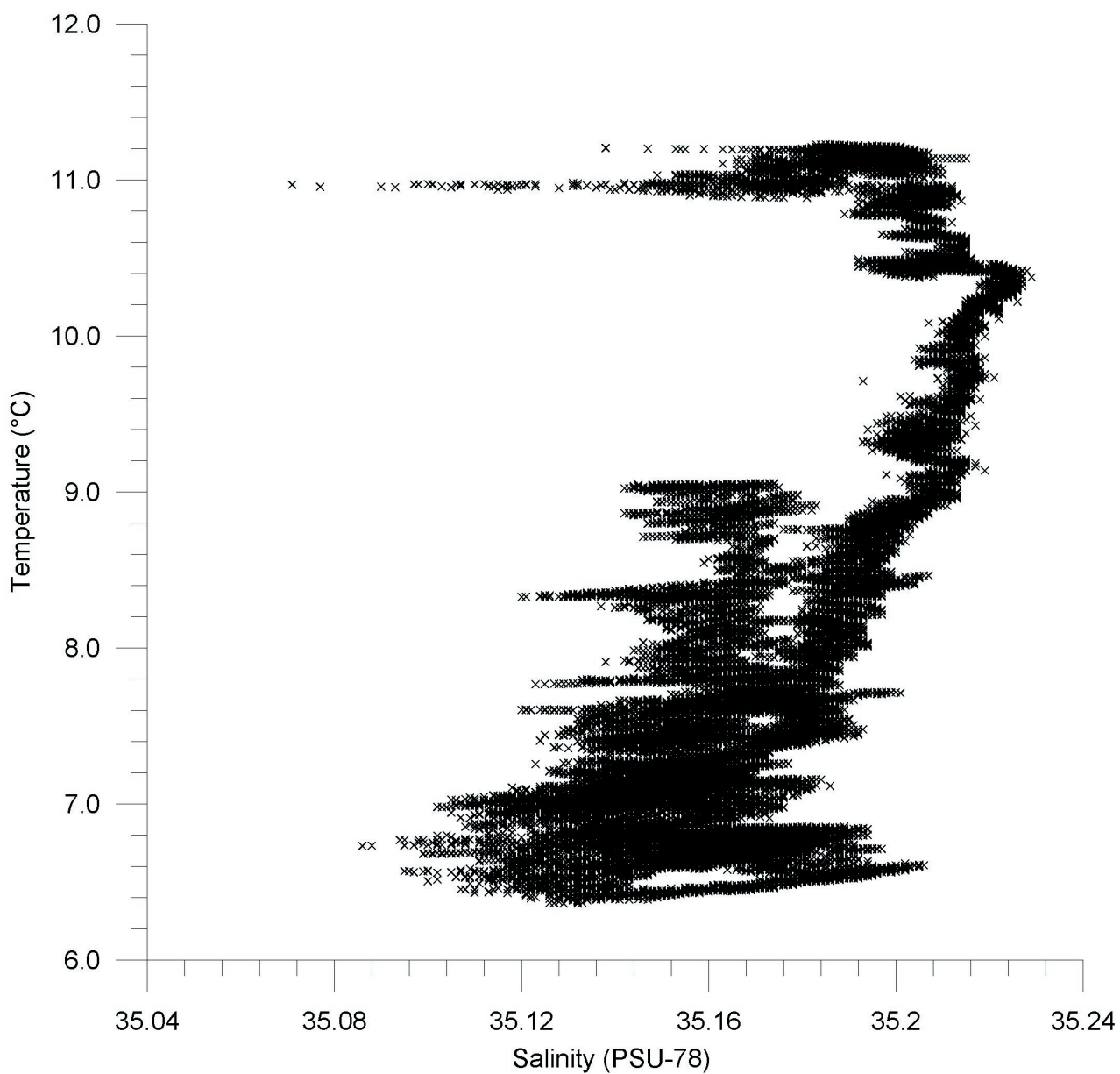
### Data:

**The data are OK**

# SKOP0811 MicroCat 4568



SKOP0811 MicroCat 4568







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