COOPERATIVE RESEARCH CENTRE FOR THE ANTARCTIC AND SOUTHERN OCEAN ENVIRONMENT
(ANTARCTIC CRC)

Amery Ice Shelf Experiment (AMISOR),
Marine Science Cruises AU0106 and AU0207
- Oceanographic Field Measurements and Analysis

MARK ROSENBERG
Antarctic CRC, GPO Box 252-80, Hobart, Australia

NATHAN BINDOFF
Antarctic CRC, GPO Box 252-80, Hobart, Australia

CLODAGH CURRAN
Antarctic CRC, GPO Box 252-80, Hobart, Australia

IAN HELMOND
CSIRO Division of Marine Research, Hobart, Australia

KEVIN MILLER
CSIRO Division of Marine Research, Hobart, Australia

DAN McLAUGHLAN
CSIRO Division of Marine Research, Hobart, Australia

JOHN CHURCH
CSIRO Division of Marine Research, Hobart, Australia

JIM RICHMAN
Oregon State University, Corvallis, USA

HEIDI LEFFANUE
Flinders University, Adelaide, Australia

Antarctic CRC Research Report No. 30
ISBN: 1 875796 26 6
ISSN: 1320-730X
September 2002
Hobart, Australia

LIST OF CONTENTS

LIST OF CONTENTS (continued)

LIST OF FIGURES

Page

PART 1

APPENDIX 1.2

LIST OF FIGURES (continued)

Page

LIST OF FIGURES (continued)

Page

PART 2

LIST OF FIGURES (continued)

Page

LIST OF TABLES

Page

PART 1

LIST OF TABLES (continued)

Page

Amery Ice Shelf Experiment (AMISOR), Marine Science Cruises AU0106 and AU0207 - Oceanographic Field Measurements and Analysis

ABSTRACT

Oceanographic measurements were conducted in the vicinity of the Amery Ice Shelf on two cruises, during the southern summers of 2000/2001 and 2001/2002. A CTD transect parallel to the front of the Amery Ice Shelf was occupied on both cruises, including repeat occupations on each cruise. A total of 100 CTD vertical profile stations were taken near the ice shelf, most to within 20 m of the bottom, and over 1150 Niskin bottle water samples were collected for the measurement of salinity, dissolved oxygen, nutrients, helium, tritium, oxygen 18 and biological parameters, using a 12 bottle rosette sampler mounted on either a 24 or 12 bottle frame. On the first cruise, an additional 39 CTD stations were occupied around an experimental krill survey area in the vicinity of Mawson. Additional CTD stations were taken at the end of each cruise for calibration of CTD instrumentation from borehole sites on the Amery Ice Shelf. Near surface current data were collected on both cruises using a ship mounted ADCP. An array of 9 moorings comprising current meters, thermosalinographs and upward looking sonars were deployed along the ice shelf front in February 2001 during the first cruise, and retrieved on the second cruise in February 2002. A summary of all data and data quality is presented in this report.

PART 1 OCEANOGRAPHIC FIELD MEASUREMENTS AND ANALYSIS

1.1 INTRODUCTION

The Amery Ice Shelf Oceanographic Research experiment (AMISOR) is comprised of two fieldwork components – the ongoing ice shelf based instrumentation deployments (Craven et al., Antarctic Division data report, in prep.), and the completed ship-based CTD and mooring work (Figure 1.1). This report describes the ship-based component, from the two Antarctic marine science cruises AU0106 and AU0207, conducted aboard the Australian Antarctic Division vessel RSV Aurora Australis.

The primary oceanographic aims of the experiment are :

* to describe the present distribution, in both space and time, of the meltwater from the Amery Ice Shelf cavity, as observed at the front of the ice shelf;

* to estimate the thermohaline circulation at the front of the ice shelf;

* to estimate the freshwater flux from underneath the ice shelf, and the heat flux into the ice shelf, including the seasonal cycle;

* to estimate the role of sea ice on the thermohaline circulation beneath the ice shelf;

* to determine appropriate oceanographic initial conditions for forward modelling of the thermohaline circulation beneath the ice shelf.

Part 1 of this reports describes the CTD, Niskin bottle, hull mounted ADCP and underway data and data quality. Part 2 describes the mooring data. Data and data quality for the CTD and thermosalinograph measurements made through the borehole on the Amery Ice Shelf are summarised in appendices.

AU0106

Cruise AU0106 took place from January to March 2001 (Figure 1.2), commencing the ship-based oceanographic component of AMISOR. The first major consituent of the cruise was a fine scale krill and hydroacoustic survey north of Mawson (principal investigators Graham Hosie, Tim Pauly and Steve Nicol, Australian Antarctic Division). CTD profiles were measured from south to north along 5 transect lines in a box survey area north of Mawson (Figure 1.2). (See Voyage 6 2000/2001 Voyage Leader's report for a summary of the programs and work completed on the cruise). The second major constituent of the cruise was the AMISOR program. CTD profiles were taken at 24 sites with an average spacing of ~5.3 miles along a 115 mile transect parallel to and approximately 2 to 3 miles from the front of the Amery Ice Shelf (Figure 1.2). The transect was occupied twice during an 8 day period. An array of 7 current meter/thermosalinograph moorings was deployed along the CTD transect line. In addition, 2 upward looking sonar (ULS) moorings (principal investigator Ian Allison, Australian Antarctic Division) were deployed, one just north of the centre of the transect line, the other closer to Davis Station (Figure 1.1). CTD profiles were obtained at all mooring locations.

AU0207

Cruise AU0207 took place from January to March 2002 (Figure 1.3), completing the ship-based AMISOR work. The AMISOR program was the major marine science component of the cruise. Heavy sea ice conditions made rapid sequential completion of the CTD transect difficult; over a 13 day period all CTD sites were occupied, with repeat measurements at 10 of the sites, and with 2 additional mini transects (Figure 1.3, Table 1.2). All 9 moorings were recovered successfully.

1.2 CRUISE ITINERARIES AND SUMMARIES

CTD station details are summarised in Table 1.2; mooring deployment and recovery details are summarised in Table 1.3. Principal investigators for CTD and water sampling measurements are listed in Table 1.4, while cruise participants are listed in Table 1.5.

AU0106

The ship departed south from Hobart on January 1st 2001, with a single test CTD en route. Problems with the ship's CTD winch hydraulics, CTD gantry and gantry control made this test cast an extended operation over 2 days, and resulted in damage to several Niskin bottles. After the equipment was fixed and the test CTD successfully completed, the ship continued south en route to the vicinity of Mawson, and the krill survey work commenced north of Mawson. During the course of the trawling and hydroacoustic work, 39 CTD's were completed around the krill survey box, using a 24 bottle rosette. Casts were taken to a maximum pressure of 500 dbar, or to the bottom over bathymetry shallower than this (Table 1.2). After completion of the krill box, and resupply at Mawson, the ship was diverted to assist the MV Polar Bird, beset in sea ice in the vicinity of Casey. The ships met on February 1st, and the Polar Bird was escorted through loosely packed heavy floes out into open water. The Aurora then returned west to Prydz Bay, stopping for trawling work en route; 3 CTD's were taken during a krill swarm experiment northwest of Casey, using a 12 bottle rosette (used for the remainder of the cruise). The planned eastern end of the AMISOR CTD transect was found to lie beneath the Publications Ice Shelf, so the transect commenced at the planned site 2 (Figure 1.1). After completion of the first CTD transect from east to west, the ship retraced the transect line from west to east for collection of underway ADCP data. Mooring work then commenced, with deployments from east to west. The CTD transect was then occupied a second time, from west to east. Lastly, the second ULS mooring at the eastern location towards Davis (Figure 1.1) was deployed. After completion of the oceanography work, intense hydroacoustic work commenced at a location north of Cape Darnley. The ship then visited Davis for resupply, including pickup of the Amery Ice Shelf drilling team and instrumentation. En route north back to Hobart, 2 CTD's were taken for calibration of the CTD used at the borehole location on the ice shelf (Appendix 1.2).

AU0207

The ship departed Hobart on January 26th 2002, a delayed departure from the original schedule. Delays to the overall season had been caused by the required diversion of the Aurora earlier in the season to once again assist the MV Polar Bird. The satellite ice images available prior to departure showed persistent heavy sea ice covering much of Prydz Bay, blocking easy access to the experiment area. Indeed the southeastern moorings appeared to be beneath fast ice, and the expectation at the time of sailing was that only some of the CTD work would be possible, and not all of the moorings would be recovered. In the end the delayed departure from Hobart proved to be advantageous, as the last of the mooring sites only became accessible on the last allowable day of marine science work before leaving the Amery Ice Shelf region.

En route south from Hobart, 2 test CTD's were done. On approaching the experiment region, the ship broke ice to reach mooring site AMISOR8 (ULS1). Communication was established with the mooring, but there was too much sea ice to attempt recovery. Satellite images showed the western end of the ice shelf to be accessible, so the ship headed for the western end of the CTD transect. CTD sites 24 and 25 (Figure 1.1) were under fast ice, so the section was commenced ~1 mile northeast of site 24. The section was completed as far as site 16, before heavy ice prevented further progress eastwards. The ship returned to site 18 for commencement of a CTD time series station. On the third cast at the site, the entire rosette package was lost during the recovery.

Mooring work then commenced, with straightforward recoveries of AMISOR5, AMISOR6 and AMISOR7. CTD work was resumed at the western end of the transect, using a 12 bottle frame, and repeating the line from west to east. After the CTD at site 16, mooring AMISOR4 was recovered, then AMISOR9 (ULS2) site was occupied. Initial communication with the acoustic release indicated the mooring was over 2 miles from the original deployment site. The mooring was tracked to the northwest by repeated communications, until a final location was calculated at 2.082 miles distance on a bearing of 318.5^{o} true from the deployment location, and in water ~85 m deeper. Recovery was

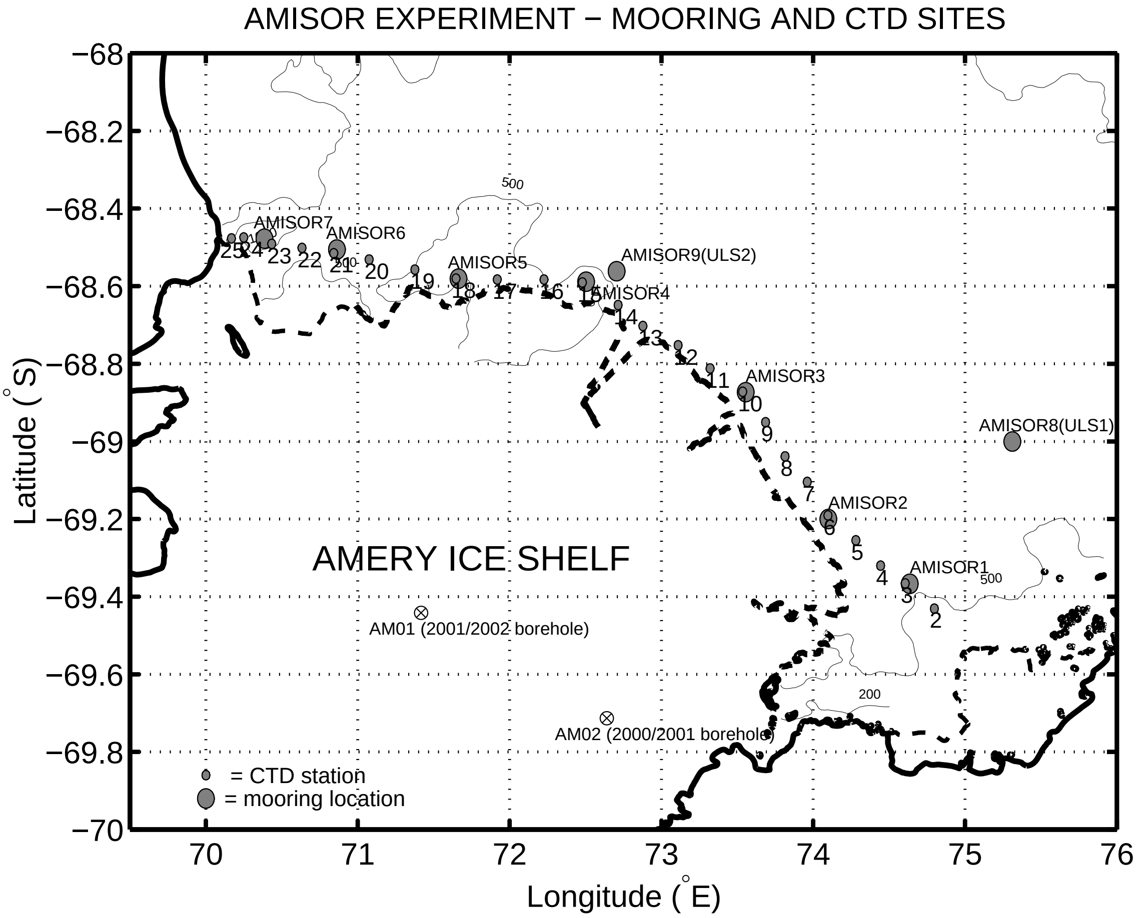


Figure 1.1: Mooring deployment locations from cruise AU0106, CTD station positions from leg1 on cruise AU0106, and ice shelf borehole sites.

Table 1.1: Summary of cruise itineraries

	AU0106	**AU0207**
Expedition Designation	AU0106, voyage 6 2000/2001 (cruise acronym KACTAS)	AU0207, voyage 7 2001/2002 (cruise acronym LOSS)
Chief Scientist	Nathan Bindoff (Antarctic CRC) Graham Hosie (Antarctic Division)	John Church (CSIRO)
Ship	RSV Aurora Australis	RSV Aurora Australis
Ports of Call	Hobart Mawson Polar Bird rendezvous (near Casey) Davis	Hobart Davis Mawson
Cruise Dates	January 1 – March 9, 2001	January 26 – March 8, 2002

not attempted at that time, due to ice conditions. CTD work resumed at site 15, continuing eastwards until site 8, and with a brief stop at AMISOR3 mooring (recovery not attempted due to ice). CTD site 7 was under fast ice, so a CTD was done ~3.5 miles to the northeast. The ship then left the transect line and headed northeast back to AMISOR8 (ULS1). A CTD was done near the site, then the mooring was recovered, in open water. Next, the ship headed as far south as possible, doing a mini CTD transect of 4 stations on the way (named the "east" transect). Another mini CTD transect of 5 stations was done offshore from the ice shelf, centered at site 15. The AMISOR9 (ULS2) mooring was then relocated and recovered (see Part 2 for details of position change of this mooring).

At this stage of the cruise, the difficult sea ice conditions meant that further marine science work was done on an opportunistic basis, alternating with logistical work for the Antarctic bases. Following the recovery of AMISOR9 and then 2 days of helicopter operations, AMISOR3 was reoccupied, but ice conditions remained too heavy for recovery. The ship then went to Davis for resupply work. After Davis, AMISOR3 site was occupied again, but ice still prevented recovery. Later that day, helicopter reconnaissance revealed the site had cleared, so the mooring was revisited and successfully recovered. The ship continued eastwards, and AMISOR2 was recovered. Returning to CTD site 8, the CTD transect was resumed, completing sites 8 to 4. An attempt was then made to reach the final mooring AMISOR1, covered by fast ice up till that time. Within the space of a few hours the ice opened enough to allow the site to be reached and the mooring to be recovered. The CTD transect was then ended by completing sites 3 and 2. Note that access to these last few mooring sites had only been possible with the assistance of helicopter reconnaissance. Following resupply work at Mawson, and en route north back to Hobart, 3 CTD's were done for calibration of the CTD instrument used at the borehole location on the Amery Ice Shelf (Appendix 1.3).

1.3 FIELD DATA COLLECTION METHODS

1.3.1 CTD instrumentation

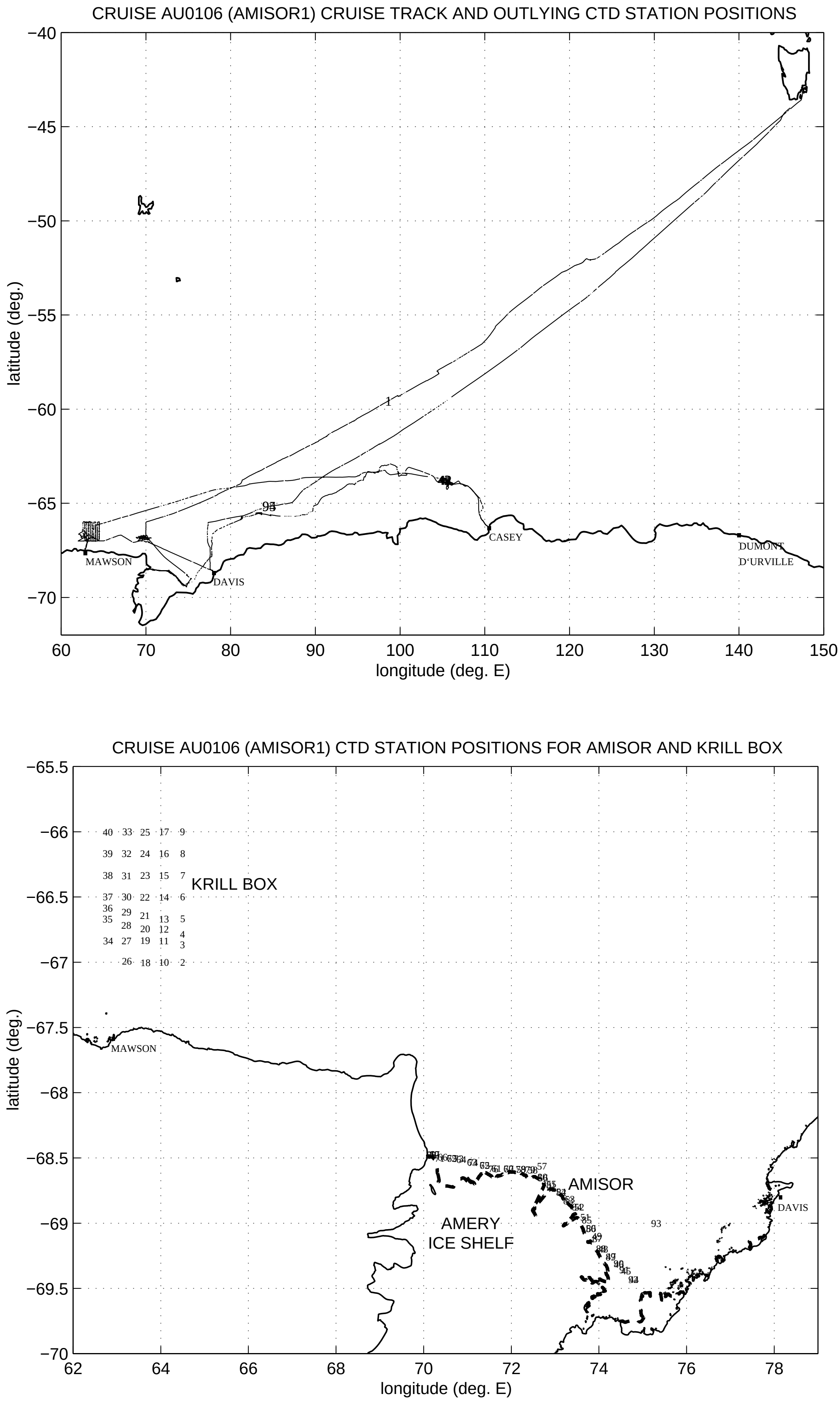
AU0106

General Oceanics Mark IIIC CTD serial 1193, including dissolved oxygen sensor, was used for the entire cruise, mounted on a 24 bottle rosette frame, together with a G.O. model 1015 pylon. For stations 1 to 40, a 24 position pylon was used to accommodate the high vertical density biological sampling from the Niskin bottles; a 12 position pylon was used for the remainder of the cruise (including the AMISOR work). 10 litre G.O. Niskin bottles were used for sample collection. A Benthos altimeter serial 142 was fitted for bottom location, and deep sea reversing thermometers, both mercury (Gohla-Precision) and digital (SIS model RTM4002X), were mounted for checks of CTD temperature calibration. A Sea Tech fluorometer was also mounted on the frame for all casts. For stations 94 and 95 an internally recording FSI 3" MicroCTD, from the borehole work on the ice shelf, was attached to the frame next to the G.O. CTD sensors (see Appendix 1.2).

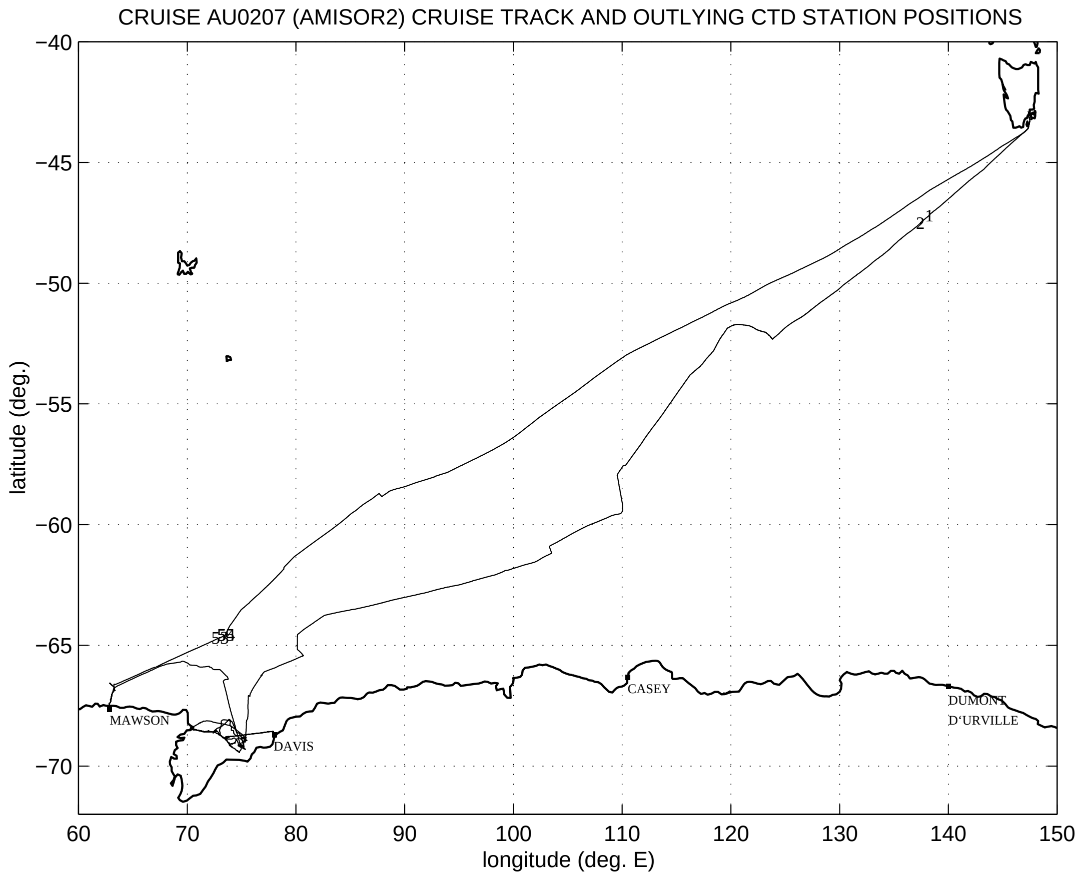
Bottle samples for salinity and dissolved oxygen were taken at all stations, except for stations 94 and 95 where salinity only was sampled. Nutrient samples were collected and frozen for most stations, but were never analysed. Stations where helium/tritium/^{18}O were sampled are listed in Table 1.6. Samples for various biological parameters, including methane, productivity, phytoplankton, bacteria and viruses, were collected throughout the cruise, with increased sampling density during the krill survey box work.

AU0207

For the first 16 stations of this cruise, the instrumentation used was G.O. CTD serial 1193 (including oxygen sensor) mounted on a 24 bottle frame, together with a 12 position rosette, 12x10 litre Niskin bottles, altimeter serial 142, fluorometer, and digital reversing thermometers. After losing the rosette package during station 16, a new package was assembled and used for the remainder of the cruise, with G.O. CTD serial 2568 (including oxygen sensor) mounted on a 12 bottle frame, together with a spare 12 position rosette, 12x10 litre Niskins, altimeter serial 137, and digital reversing thermometers. No spare fluorometer was available. For stations 53, 54 and 55 the FSI 3" MicroCTD, from the borehole work on the ice shelf, was attached to the frame next to the G.O. CTD sensors (see Appendix 1.3).



<u>Figure 1.2:</u> AU0106 cruise track and CTD station positions.



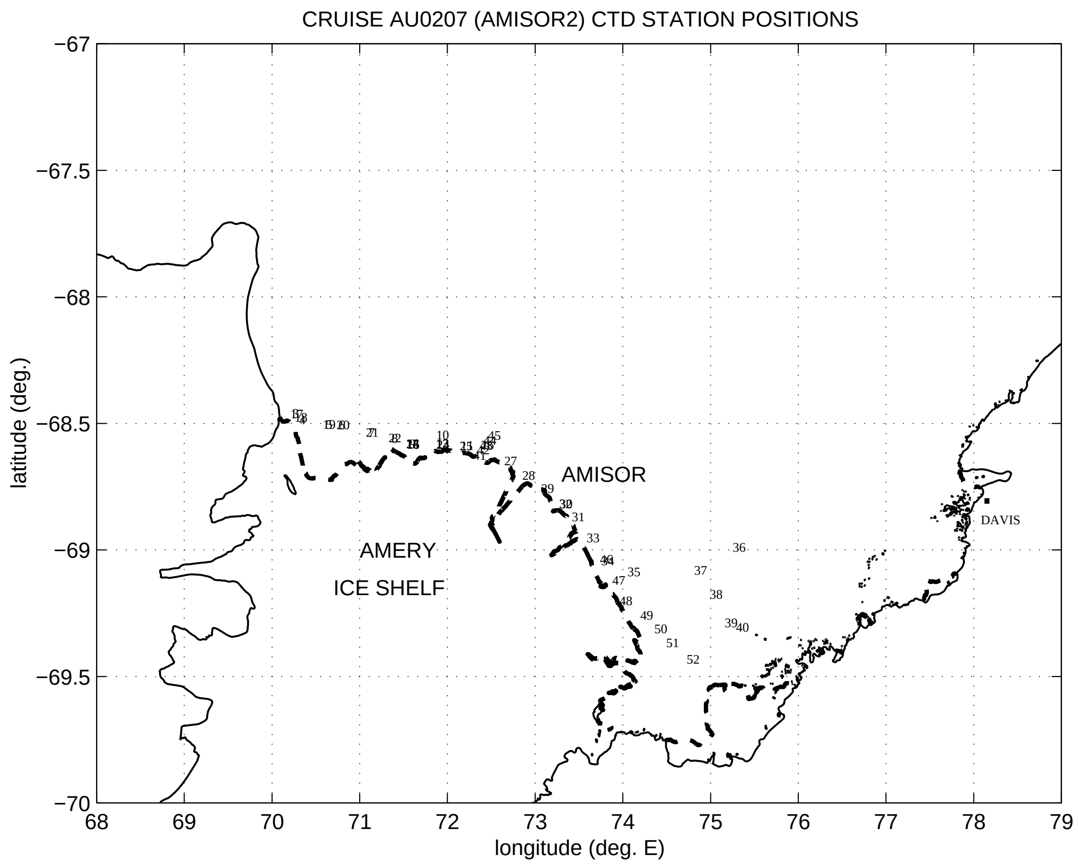


Figure 1.3: AU0207 cruise track and CTD station positions.

<u>Table 1.2a:</u> Summary of station information for cruise AU0106. All times are UTC. In the station naming, "kbox" is the krill survey box, "leg" refers to the AMISOR transect, and "FSI" is a calibration cast for the FSI MicroCTD.

station	START					maxP	BOTTOM					END			
number	time	date	latitude	longitude	depth(m)	(dbar)	time	latitude	longitude	depth(m)	altimeter	time	latitude	longitude	depth(m)
1 TEST	0950	9-JAN-01	59:33.61S	98:37.34E	4400	3000	1059	59:33.79S	98:37.13E	-	-	1231	59:34.15S	98:36.83E	4400
2 kbox	1518	14-JAN-01	66:59.95S	64:30.04E	185	182	1531	66:59.89S	64:29.74E	184	14.0	1559	66:59.63S	64:29.56E	177
3 kbox	1907	14-JAN-01	66:52.01S	64:29.72E	438	430	1923	66:52.00S	64:29.57E	435	13.2	1955	66:52.05S	64:29.35E	426
4 kbox	2242	14-JAN-01	66:47.10S	64:29.77E	-	502	2252	66:47.14S	64:29.56E	-	-	2334	66:47.08S	64:28.99E	-
5 kbox	0248	15-JAN-01	66:39.96S	64:30.12E	-	502	0301	66:39.90S	64:29.90E	-	-	0340	66:39.50S	64:29.08E	-
6 kbox	0717	15-JAN-01	66:30.01S	64:29.94E	-	504	0731	66:30.01S	64:29.80E	-	-	0816	66:30.11S	64:29.25E	-
7 kbox	1202	15-JAN-01	66:20.07S	64:30.35E	-	504	1213	66:20.07S	64:30.37E	-	-	1249	66:20.09S	64:29.94E	-
8 kbox	1618	15-JAN-01	66:10.04S	64:30.18E	-	504	1627	66:10.02S	64:30.21E	-	-	1700	66:09.97S	64:29.83E	-
9 kbox	1955	15-JAN-01	65:59.91S	64:29.80E	-	504	2007	65:59.80S	64:29.59E	-	-	2052	65:59.73S	64:28.75E	-
10 kbox	0908	16-JAN-01	66:59.97S	64:04.38E	143	146	0915	66:59.97S	64:04.35E	148	10.0	0938	66:59.80S	64:04.38E	143
11 kbox	1215	16-JAN-01	66:50.17S	64:04.17E	366	366	1225	66:50.14S	64:04.14E	367	10.0	1259	66:50.14S	64:03.54E	363
12 kbox	1633	16-JAN-01	66:44.76S	64:04.27E	-	502	1647	66:44.72S	64:04.03E	-	-	1723	66:44.54S	64:03.39E	-
13 kbox	1931	16-JAN-01	66:40.06S	64:04.42E	-	502	1945	66:39.97S	64:04.35E	-	-	2018	66:39.75S	64:04.14E	-
14 kbox	2304	16-JAN-01	66:30.05S	64:04.46E	-	502	2318	66:30.05S	64:04.69E	-	-	2346	66:29.92S	64:04.86E	-
15 kbox	0232	17-JAN-01	66:20.08S	64:04.44E	-	502	0244	66:19.99S	64:04.51E	-	-	0315	66:19.87S	64:04.92E	-
16 kbox	0628	17-JAN-01	66:10.03S	64:04.44E	-	500	0640	66:10.02S	64:04.57E	-	-	0714	66:09.96S	64:04.06E	-
17 kbox	1014	17-JAN-01	66:00.01S	64:04.62E	-	502	1029	66:00.01S	64:04.63E	-	-	1104	65:59.85S	64:04.69E	-
18 kbox	2119	17-JAN-01	67:00.21S	63:39.13E	134	128	2125	67:00.23S	63:38.97E	132	11.4	2141	67:00.35S	63:38.83E	129
19 kbox	0003	18-JAN-01	66:49.98S	63:38.71E	254	242	0011	66:50.02S	63:38.65E	252	19.7	0038	66:49.98S	63:38.68E	255
20 kbox	0301	18-JAN-01	66:44.53S	63:38.77E	545	500	0313	66:44.49S	63:38.52E	-	62.1	0345	66:44.43S	63:38.52E	-
21 kbox	0652	18-JAN-01	66:38.41S	63:38.43E	-	500	0705	66:38.34S	63:38.18E	-	-	0742	66:38.37S	63:38.04E	-
22 kbox	1046	18-JAN-01	66:30.03S	63:38.43E	-	502	1105	66:30.31S	63:38.13E	-	-	1139	66:30.55S	63:37.57E	-
23 kbox	1438	18-JAN-01	66:19.98S	63:38.71E	-	500	1450	66:19.95S	63:38.68E	-	-	1524	66:20.14S	63:38.73E	-
24 kbox	1856	18-JAN-01	66:10.06S	63:38.65E	-	500	1921	66:10.33S	63:37.97E	-	-	1951	66:10.47S	63:37.93E	-
25 kbox	2235	18-JAN-01	66:00.18S	63:38.66E	-	502	2247	66:00.16S	63:38.57E	-	-	2316	66:00.25S	63:38.62E	-
26 kbox	0839	19-JAN-01	66:59.44S	63:13.68E	115	112	0846	66:59.52S	63:13.55E	-	12.0	0907	66:59.70S	63:13.00E	115
27 kbox	1112	19-JAN-01	66:50.11S	63:12.99E	405	412	1125	66:50.19S	63:12.96E	410	6.0	1156	66:50.31S	63:13.26E	407
28 kbox	1503	19-JAN-01	66:42.98S	63:12.85E	-	502	1517	66:42.97S	63:12.63E	-	-	1550	66:42.84S	63:11.91E	-
29 kbox	1755	19-JAN-01	66:36.95S	63:13.06E	-	502	1806	66:36.98S	63:12.84E	-	-	1839	66:37.08S	63:12.14E	-
30 kbox	2155	19-JAN-01	66:29.89S	63:13.27E	-	502	2208	66:29.88S	63:13.22E	-	-	2242	66:29.94S	63:13.27E	-
31 kbox	0121	20-JAN-01	66:20.14S	63:13.27E	-	502	0132	66:20.18S	63:13.29E	-	-	0201	66:20.29S	63:13.35E	-
32 kbox	0444	20-JAN-01	66:10.07S	63:13.23E	-	500	0456	66:10.10S	63:13.32E	-	-	0523	66:10.17S	63:13.08E	-
33 kbox	0902	20-JAN-01	65:59.92S	63:14.19E	-	502	0917	65:59.88S	63:14.15E	-	-	0954	65:59.82S	63:13.68E	-
34 kbox	2349	20-JAN-01	66:50.18S	62:47.95E	105	96	2355	66:50.17S	62:47.88E	103	17.0	0008	66:50.22S	62:47.71E	104
35 kbox	0227	21-JAN-01	66:40.08S	62:47.22E	436	426	0237	66:40.08S	62:47.07E	436	19.3	0308	66:40.00S	62:46.85E	437
36 kbox	0508	21-JAN-01	66:35.18S	62:47.29E	-	502	0520	66:35.18S	62:47.13E	-	-	0552	66:35.22S	62:46.89E	-

Table 1.2a: (continued)

station	START					maxP	BOTTOM					END			
number	time	date	latitude	longitude	depth(m)	(dbar)	time	latitude	longitude	depth(m)	altimeter	time	latitude	longitude	depth(m)
37 kbox	0821	21-JAN-01	66:29.99S	62:47.51E	-	502	0835	66:30.01S	62:47.44E	-	-	0909	66:30.18S	62:47.16E	-
38 kbox	1203	21-JAN-01	66:20.06S	62:47.53E	-	502	1216	66:20.02S	62:47.40E	-	-	1249	66:20.07S	62:47.58E	-
39 kbox	1555	21-JAN-01	66:10.05S	62:47.46E	-	500	1608	66:10.05S	62:47.46E	-	-	1642	66:10.18S	62:46.93E	-
40 kbox	1922	21-JAN-01	66:00.13S	62:47.59E	-	502	1936	66:00.10S	62:47.46E	-	-	2010	66:00.13S	62:47.97E	-
41 swarm	0932	5-FEB-01	63:45.72S	105:20.49E	-	200	0939	63:45.72S	105:20.56E	-	-	1003	63:45.81S	105:20.83E	-
42 swarm	1100	5-FEB-01	63:45.69S	105:18.20E	-	200	1107	63:45.73S	105:18.17E	-	-	1131	63:45.78S	105:17.91E	-
43 swarm	1252	5-FEB-01	63:45.63S	105:12.79E	-	200	1301	63:45.71S	105:12.80E	-	-	1323	63:45.77S	105:12.81E	-
44 leg1.2	0611	13-FEB-01	69:25.86S	74:47.91E	314	304	0623	69:25.90S	74:47.86E	309	14.7	0644	69:25.85S	74:47.86E	311
45 leg1.3	0853	13-FEB-01	69:21.90S	74:37.24E	758	756	0912	69:21.93S	74:36.89E	760	14.5	0949	69:21.95S	74:36.36E	757
46 leg1.4	1139	13-FEB-01	69:18.90S	74:27.28E	776	772	1158	69:18.94S	74:27.12E	778	14.3	1233	69:19.20S	74:26.63E	775
47 leg1.5	1317	13-FEB-01	69:15.36S	74:16.48E	764	758	1337	69:15.28S	74:16.70E	764	14.9	1412	69:15.28S	74:16.84E	765
48 leg1.6	1527	13-FEB-01	69:11.94S	74:05.82E	670	662	1545	69:11.71S	74:05.53E	670	14.9	1615	69:11.44S	74:05.81E	670
49 leg1.7	1737	13-FEB-01	69:06.00S	73:57.25E	717	716	1755	69:06.08S	73:57.45E	719	9.8	1828	69:06.25S	73:57.63E	718
50 leg1.8	2019	13-FEB-01	69:02.29S	73:48.93E	701	700	2040	69:02.33S	73:48.90E	701	9.1	2107	69:02.32S	73:48.86E	702
51 leg1.9	2220	13-FEB-01	68:57.25S	73:41.29E	727	740	2242	68:57.14S	73:41.12E	736	8.6	2310	68:57.03S	73:41.16E	737
52 leg1.10	0201	14-FEB-01	68:52.47S	73:33.21E	765	770	0219	68:52.36S	73:32.84E	771	11.3	0254	68:52.33S	73:32.12E	771
53 leg1.11	0415	14-FEB-01	68:49.06S	73:20.44E	785	786	0436	68:48.93S	73:19.68E	787	10.0	0512	68:48.72S	73:19.24E	785
54 leg1.12	0635	14-FEB-01	68:45.53S	73:08.12E	791	780	0656	68:45.34S	73:07.30E	781	12.6	0726	68:45.14S	73:06.60E	774
55 leg1.13	0830	14-FEB-01	68:42.04S	72:54.80E	704	706	0850	68:42.00S	72:53.73E	710	13.0	0919	68:42.15S	72:52.69E	715
56 leg1.14	1004	14-FEB-01	68:39.04S	72:43.50E	525	516	1015	68:38.95S	72:43.29E	522	11.5	1041	68:38.93S	72:42.88E	518
57 ULS2	1312	14-FEB-01	68:33.71S	72:42.18E	545	544	1327	68:33.62S	72:41.98E	551	10.6	1358	68:33.63S	72:41.34E	562
58 leg1.15	1518	14-FEB-01	68:35.48S	72:29.32E	521	516	1532	68:35.48S	72:29.00E	518	13.0	1559	68:35.43S	72:28.75E	522
59 leg1.16	1642	14-FEB-01	68:35.20S	72:13.69E	491	482	1655	68:35.18S	72:13.69E	490	15.0	1721	68:34.98S	72:13.59E	497
60 leg1.17	1859	14-FEB-01	68:34.98S	71:56.19E	444	442	1913	68:34.99S	71:55.78E	446	11.8	1944	68:34.97S	71:55.12E	442
61 leg1.18	2143	14-FEB-01	68:34.71S	71:39.64E	459	472	2158	68:34.68S	71:39.07E	477	14.8	2230	68:34.82S	71:38.82E	469
62 leg1.19	2344	14-FEB-01	68:33.40S	71:23.57E	405	446	2358	68:33.43S	71:23.30E	426	12.7	0026	68:33.45S	71:22.57E	519
63 leg1.20	0154	15-FEB-01	68:31.92S	71:06.16E	629	646	0214	68:31.88S	71:05.38E	646	13.0	0248	68:31.89S	71:04.50E	660
64 leg1.21	0514	15-FEB-01	68:30.78S	70:51.61E	763	762	0532	68:30.78S	70:51.07E	764	14.9	0602	68:30.91S	70:50.52E	753
65 leg1.22	0656	15-FEB-01	68:30.05S	70:38.72E	891	888	0717	68:30.03S	70:38.37E	895	14.6	0751	68:30.08S	70:37.97E	900
66 leg1.23	1146	15-FEB-01	68:29.53S	70:25.87E	1103	1108	1211	68:29.49S	70:25.96E	1105	11.8	1248	68:29.47S	70:26.01E	1099
67 leg1.24	1504	15-FEB-01	68:28.39S	70:15.04E	327	308	1517	68:28.35S	70:15.00E	317	12.7	1541	68:28.47S	70:14.94E	340
68 leg1.25	1647	15-FEB-01	68:28.63S	70:10.27E	279	244	1657	68:28.65S	70:10.13E	251	13.5	1717	68:28.62S	70:10.10E	249
69 leg2.25	1336	18-FEB-01	68:28.46S	70:10.31E	321	290	1351	68:28.38S	70:10.18E	291	6.3	1414	68:28.21S	70:10.14E	302
70 leg2.24	1509	18-FEB-01	68:28.50S	70:14.49E	307	310	1518	68:28.54S	70:14.47E	323	10.0	1542	68:28.51S	70:14.74E	325
71 leg2.23	1742	18-FEB-01	68:30.07S	70:22.17E	1110	1122	1809	68:30.01S	70:22.17E	1110	10.5	1843	68:30.22S	70:22.13E	1090
72 leg2.22	1959	18-FEB-01	68:30.12S	70:38.70E	893	896	2022	68:30.03S	70:38.38E	896	8.4	2051	68:29.89S	70:37.95E	900
73 leg2.21	2211	18-FEB-01	68:30.31S	70:48.07E	767	756	2231	68:30.25S	70:47.64E	763	14.1	2305	68:30.14S	70:47.22E	778

Table 1.2a: (continued)

station number	START time	date	latitude	longitude	depth(m)	maxP (dbar)	BOTTOM time	latitude	longitude	depth(m)	altimeter	END time	latitude	longitude	depth(m)
74 leg2.20	0028	19-FEB-01	68:32.14S	71:07.80E	597	596	0047	68:32.15S	71:06.97E	597	14.0	0116	68:32.18S	71:06.32E	594
75 leg2.19	0231	19-FEB-01	68:33.41S	71:23.82E	392	444	0245	68:33.34S	71:23.52E	442	17.8	0312	68:33.15S	71:23.10E	539
76 leg2.18	0429	19-FEB-01	68:34.93S	71:35.49E	485	474	0444	68:34.91S	71:35.16E	485	15.5	0502	68:34.91S	71:34.96E	485
77 leg2.17	0652	19-FEB-01	68:34.93S	71:56.55E	441	438	0704	68:34.91S	71:56.32E	444	15.2	0728	68:34.98S	71:56.25E	445
78 leg2.16	0846	19-FEB-01	68:35.18S	72:12.91E	503	496	0859	68:35.14S	72:12.58E	505	14.8	0924	68:35.04S	72:12.09E	496
79 leg2.15	1107	19-FEB-01	68:35.29S	72:25.94E	496	488	1120	68:35.29S	72:25.03E	495	12.9	1144	68:35.34S	72:23.88E	497
80 leg2.14	1322	19-FEB-01	68:38.74S	72:42.62E	511	490	1335	68:38.57S	72:41.95E	499	12.3	1401	68:38.43S	72:40.73E	483
81 leg2.13	1531	19-FEB-01	68:42.54S	72:54.63E	708	702	1548	68:42.52S	72:54.10E	710	14.5	1619	68:42.46S	72:53.58E	714
82 leg2.12	1744	19-FEB-01	68:45.71S	73:08.57E	799	796	1805	68:45.73S	73:08.63E	800	13.0	1837	68:45.73S	73:08.97E	803
83 leg2.11	2036	19-FEB-01	68:49.67S	73:18.12E	791	784	2055	68:49.72S	73:18.28E	790	13.0	2126	68:49.80S	73:18.79E	774
84 leg2.10	2237	19-FEB-01	68:52.49S	73:29.98E	777	776	2300	68:52.41S	73:29.98E	775	11.0	2329	68:52.36S	73:30.41E	778
85 leg2.9	0102	20-FEB-01	68:58.44S	73:43.33E	738	736	0122	68:58.26S	73:43.29E	736	6.4	0151	68:58.11S	73:43.41E	734
86 leg2.8	0302	20-FEB-01	69:02.29S	73:49.35E	700	694	0323	69:02.20S	73:49.11E	701	13.5	0349	69:02.13S	73:49.14E	698
87 leg2.7	0507	20-FEB-01	69:07.05S	73:57.83E	713	706	0524	69:06.99S	73:57.78E	713	15.0	0554	69:06.76S	73:57.92E	715
88 leg2.6	0808	20-FEB-01	69:11.79S	74:02.98E	665	662	0824	69:11.77S	74:02.68E	669	10.1	0849	69:11.61S	74:02.43E	675
89 leg2.5	1006	20-FEB-01	69:15.57S	74:16.20E	760	754	1023	69:15.54S	74:15.88E	759	11.9	1051	69:15.39S	74:15.22E	754
90 leg2.4	1245	20-FEB-01	69:18.53S	74:27.24E	774	770	1302	69:18.40S	74:27.04E	776	15.1	1334	69:18.37S	74:27.12E	777
91 leg2.3	1436	20-FEB-01	69:21.44S	74:34.72E	768	762	1453	69:21.39S	74:34.57E	768	14.5	1525	69:21.24S	74:34.18E	768
92 leg2.2	1842	20-FEB-01	69:25.83S	74:47.21E	291	286	1850	69:25.82S	74:47.14E	293	10.8	1916	69:25.73S	74:46.79E	296
93 ULS1	0126	21-FEB-01	69:00.05S	75:18.49E	719	710	0150	69:00.05S	75:18.45E	718	15.4	0215	69:00.07S	75:18.74E	719
94 FSI	0243	28-FEB-01	65:09.66S	84:33.73E	-	702	0302	65:09.67S	84:33.77E	-	-	0331	65:09.78S	84:33.75E	-
95 FSI	0412	28-FEB-01	65:09.68S	84:33.96E	-	2002	0454	65:09.70S	84:33.96E	-	-	0545	65:09.82S	84:33.75E	-

<u>Table 1.2b:</u> Summary of station information for cruise AU0207. All times are UTC. In the station naming, "leg" refers to the main AMISOR transect, while "east" and "t" are the two mini transects. "FSI" is a calibration cast for the FSI MicroCTD.

station	START					maxP	BOTTOM					END			
number	time	date	latitude	longitude	depth(m)	(dbar)	time	latitude	longitude	depth(m)	altimeter	time	latitude	longitude	depth(m)
1 TEST	2248	27-JAN-02	47:11.23S	138:14.91E	3700	500	2309	47:11.35S	138:14.59E	-	-	2317	47:11.44S	138:14.47E	-
2 TEST	0249	28-JAN-02	47:29.50S	137:25.89E	3800	3002	0352	47:29.82S	137:25.83E	-	-	0459	47:30.21S	137:26.37E	-
3 leg1.23a	0204	9-FEB-02	68:27.58S	70:16.27E	380	352	0215	68:27.58S	70:16.20E	358	-	0247	68:27.84S	70:16.57E	379
4 leg1.23	0416	9-FEB-02	68:29.11S	70:20.85E	1138	1152	0439	68:29.11S	70:21.34E	1151	15.0	0522	68:29.05S	70:22.17E	1150
5 leg1.22	0722	9-FEB-02	68:30.24S	70:39.12E	886	884	0745	68:30.28S	70:39.18E	885	14.5	0822	68:30.25S	70:39.00E	887
6 leg1.21	1013	9-FEB-02	68:30.34S	70:47.86E	756	750	1039	68:30.37S	70:47.68E	752	13.6	1105	68:30.42S	70:47.26E	750
7 leg1.20	1257	9-FEB-02	68:32.16S	71:08.17E	593	592	1311	68:32.18S	71:08.14E	594	14.1	1340	68:32.09S	71:07.84E	603
8 leg1.19	1500	9-FEB-02	68:33.48S	71:23.95E	379	384	1510	68:33.40S	71:23.82E	389	14.9	1536	68:33.31S	71:23.35E	-
9 leg1.18	1639	9-FEB-02	68:34.80S	71:36.06E	484	482	1651	68:34.72S	71:35.74E	485	13.9	1719	68:34.72S	71:35.23E	480
10leg1.17a	1834	9-FEB-02	68:32.68S	71:56.71E	434	428	1848	68:32.59S	71:56.59E	433	15.0	1923	68:32.50S	71:56.64E	430
11 leg1.16	2032	9-FEB-02	68:35.11S	72:13.54E	494	486	2048	68:34.99S	72:13.60E	492	16.9	2119	68:34.78S	72:13.65E	496
12 leg1.17	0137	10-FEB-02	68:34.87S	71:56.62E	439	442	0151	68:34.87S	71:56.34E	440	11.5	0224	68:34.89S	71:56.19E	442
13 leg1.17	0402	10-FEB-02	68:34.72S	71:56.77E	442	428	0419	68:34.59S	71:56.65E	437	20.0	0448	68:34.56S	71:56.38E	437
14 leg1.18	0723	10-FEB-02	68:34.68S	71:36.18E	485	480	0736	68:34.66S	71:36.04E	485	11.5	0750	68:34.68S	71:36.03E	484
15 leg1.18	0837	10-FEB-02	68:34.81S	71:36.41E	485	474	0851	68:34.87S	71:36.52E	483	14.3	0904	68:34.84S	71:36.48E	481
16 leg1.18	0936	10-FEB-02	68:34.90S	71:36.52E	482	472	0950	68:34.87S	71:36.70E	481	10.0	1002	68:34.83S	71:36.82E	478
17leg2.23a	1530	11-FEB-02	68:27.67S	70:17.01E	423	498	1545	68:27.64S	70:17.21E	446	13.8	1615	68:27.61S	70:17.37E	467
18 leg2.23	1731	11-FEB-02	68:28.50S	70:19.84E	755	712	1751	68:28.45S	70:19.77E	733	-	1820	68:28.39S	70:19.70E	695
19 leg2.22	1931	11-FEB-02	68:30.13S	70:39.21E	887	878	1950	68:30.06S	70:39.18E	881	20.7	2026	68:30.01S	70:38.34E	893
20 leg2.21	2120	11-FEB-02	68:30.30S	70:48.64E	769	772	2149	68:30.07S	70:48.64E	775	14.4	2225	68:30.00S	70:47.68E	774
21 leg2.20	2349	11-FEB-02	68:32.14S	71:08.62E	591	590	0005	68:32.09S	71:08.41E	-	20.0	0036	68:31.99S	71:07.30E	608
22 leg2.19	0134	12-FEB-02	68:33.40S	71:24.13E	391	388	0145	68:33.34S	71:23.95E	400	20.1	0208	68:33.28S	71:23.68E	438
23 leg2.18	0259	12-FEB-02	68:34.77S	71:36.36E	480	474	0313	68:34.81S	71:36.04E	-	20.0	0342	68:34.74S	71:35.95E	486
24 leg2.17	0454	12-FEB-02	68:34.93S	71:56.97E	439	434	0506	68:34.93S	71:57.07E	436	14.5	0531	68:35.11S	71:57.09E	435
25 leg2.16	0717	12-FEB-02	68:35.28S	72:12.93E	498	500	0730	68:35.23S	72:12.85E	501	11.0	0750	68:35.14S	72:12.81E	500
26 leg2.15	1529	12-FEB-02	68:35.04S	72:27.36E	500	494	1542	68:35.02S	72:27.46E	502	13.7	1609	68:34.99S	72:27.76E	500
27 leg2.14	1729	12-FEB-02	68:38.82S	72:43.27E	510	500	1744	68:38.80S	72:43.20E	-	20.0	1812	68:38.86S	72:42.82E	510
28 leg2.13	1911	12-FEB-02	68:42.28S	72:55.63E	697	690	1931	68:42.16S	72:55.36E	700	20.5	1959	68:42.10S	72:54.61E	703
29 leg2.12	2148	12-FEB-02	68:45.40S	73:08.50E	788	780	2207	68:45.30S	73:08.25E	-	20.0	2237	68:45.19S	73:07.66E	782
30 -	2349	12-FEB-02	68:49.09S	73:21.19E	764	780	0005	68:49.03S	73:20.89E	781	22.2	0039	68:48.82S	73:20.55E	784
31 leg2.10	0315	13-FEB-02	68:52.12S	73:29.62E	774	770	0332	68:52.05S	73:29.26E	-	20.0	0406	68:51.96S	73:28.66E	778
32 leg2.11	0714	13-FEB-02	68:49.06S	73:20.85E	779	772	0730	68:49.02S	73:20.74E	778	18.6	0802	68:48.78S	73:20.56E	783
33 leg2.9	1220	13-FEB-02	68:57.07S	73:39.63E	733	736	1235	68:57.01S	73:39.43E	737	13.2	1307	68:57.00S	73:39.04E	743
34 leg2.8	1504	13-FEB-02	69:02.52S	73:49.81E	696	692	1518	69:02.53S	73:49.83E	696	13.7	1547	69:02.44S	73:49.63E	696
35 leg2.7a	1821	13-FEB-02	69:05.17S	74:07.63E	674	666	1839	69:05.17S	74:07.59E	-	20.0	1909	69:05.22S	74:07.51E	674
36 ULS1	0741	14-FEB-02	68:59.35S	75:19.57E	707	704	0756	68:59.40S	75:19.42E	707	13.4	0824	68:59.55S	75:19.09E	709

Table 1.2b: (continued)

station number	START time	date	latitude	longitude	depth(m)	maxP (dbar)	BOTTOM time	latitude	longitude	depth(m)	altimeter	END time	latitude	longitude	depth(m)
37 east1	1130	14-FEB-02	69:04.84S	74:53.28E	782	780	1148	69:04.78S	74:52.86E	783	13.4	1219	69:04.77S	74:52.81E	781
38 east2	1454	14-FEB-02	69:10.44S	75:03.85E	746	744	1511	69:10.39S	75:03.88E	745	13.5	1539	69:10.33S	75:03.69E	747
39 east3	1732	14-FEB-02	69:17.23S	75:14.05E	721	724	1750	69:17.26S	75:13.83E	740	19.2	1822	69:17.20S	75:13.54E	748
40 east4	1948	14-FEB-02	69:18.28S	75:21.84E	628	624	2004	69:18.20S	75:21.87E	632	20.0	2033	69:18.12S	75:21.52E	631
41 t1	1843	15-FEB-02	68:37.50S	72:22.15E	486	478	1854	68:37.50S	72:22.27E	488	20.0	1923	68:37.62S	72:22.12E	490
42 t2	2013	15-FEB-02	68:36.30S	72:24.60E	478	470	2027	68:36.27S	72:24.60E	478	20.0	2051	68:36.18S	72:24.70E	479
43 t3	2137	15-FEB-02	68:35.14S	72:26.52E	494	484	2150	68:35.11S	72:26.38E	493	19.8	2216	68:35.04S	72:26.14E	494
44 t4	0010	16-FEB-02	68:33.97S	72:29.14E	519	506	0022	68:33.91S	72:28.84E	514	18.5	0050	68:33.75S	72:28.11E	510
45 t5	0143	16-FEB-02	68:32.77S	72:32.16E	584	572	0157	68:32.71S	72:31.83E	579	20.5	0225	68:32.59S	72:31.17E	564
46 leg3.8	1714	21-FEB-02	69:02.23S	73:48.79E	695	692	1733	69:02.10S	73:48.55E	700	18.7	1806	69:01.92S	73:48.22E	702
47 leg3.7	1923	21-FEB-02	69:07.21S	73:57.30E	710	702	1940	69:07.17S	73:57.31E	710	18.9	2012	69:07.06S	73:57.49E	710
48 leg3.6	2129	21-FEB-02	69:12.00S	74:02.23E	668	662	2145	69:11.89S	74:02.09E	672	20.3	2215	69:11.79S	74:02.14E	672
49 leg3.5	2326	21-FEB-02	69:15.52S	74:16.37E	756	750	2344	69:15.39S	74:16.28E	-	19.7	0014	69:15.24S	74:16.09E	757
50 leg3.4	0201	22-FEB-02	69:18.70S	74:25.93E	773	766	0217	69:18.64S	74:25.69E	772	19.0	0242	69:18.61S	74:25.35E	774
51 leg3.3	0756	22-FEB-02	69:21.93S	74:34.02E	768	766	0813	69:21.96S	74:34.06E	768	14.0	0845	69:22.05S	74:34.15E	772
52 leg3.2	1000	22-FEB-02	69:25.89S	74:48.10E	321	332	1009	69:25.90S	74:48.12E	329	28.4	1027	69:25.92S	74:48.10E	327
53 FSI	0152	27-FEB-02	64:41.05S	73:01.27E	3490	2004	0228	64:41.11S	73:00.52E	3490	-	0335	64:41.02S	72:58.93E	-
54 FSI	0527	27-FEB-02	64:33.13S	73:36.04E	3500	2004	0612	64:33.13S	73:35.31E	-	-	0702	64:33.24S	73:34.66E	-
55 FSI	0739	27-FEB-02	64:32.41S	73:32.58E	3500	1504	0811	64:32.46S	73:32.25E	-	-	0857	64:32.29S	73:31.63E	-

Table 1.3: Summary of mooring deployments and recoveries. Note: for deployments, "release time" is the time final component released from trawl deck; for recoveries, "release time" is the time release command was sent to acoustic release at the base of the mooring. Also note, AMISOR9 was dragged by an iceberg on 07/05/2001 (see Part 2).

DEPLOYMENTS

Mooring	position		depth	release time (UTC)
AMISOR1	69^o 22.014'S	74^o 38.153'E	750 m	13:13:29 16/02/2001
AMISOR2	69^o 12.001'S	74^o 05.962'E	672 m	16:06:40 16/02/2001
AMISOR3	68^o 52.386'S	73^o 33.310'E	768 m	05:44:00 17/02/2001
AMISOR4	68^o 35.314'S	72^o 30.236'E	538 m	12:47:59 17/02/2001
AMISOR5	68^o 34.840'S	71^o 39.816'E	472 m	15:46:19 17/02/2001
AMISOR6	68^o 30.330'S	70^o 51.770'E	786 m	04:23:15 18/02/2001
AMISOR7	68^o 28.659'S	70^o 23.118'E	1135 m	09:44:32 18/02/2001
AMISOR8(ULS1)	69^o 00.020'S	75^o 18.680'E	717 m	04:17:35 21/02/2001
AMISOR9(ULS2)	68^o 33.693'S	72^o 42.297'E	544 m	09:04:21 17/02/2001

RECOVERIES

Mooring	position		depth	release time (UTC)
AMISOR1	69^o 22.014'S	74^o 38.153'E	750 m	0600, 22/02/2002
AMISOR2	69^o 12.001'S	74^o 05.962'E	672 m	1208, 21/02/2002
AMISOR3	68^o 52.386'S	73^o 33.310'E	768 m	0748, 21/02/2002
AMISOR4	68^o 35.314'S	72^o 30.236'E	538 m	0903, 12/02/2002
AMISOR5	68^o 34.840'S	71^o 39.816'E	472 m	2355, 10/02/2002
AMISOR6	68^o 30.330'S	70^o 51.770'E	786 m	0440, 11/02/2002
AMISOR7	68^o 28.659'S	70^o 23.118'E	1135 m	0742, 11/02/2002
AMISOR8(ULS1)	69^o 00.020'S	75^o 18.680'E	717 m	0854, 14/02/2002
AMISOR9(ULS2)	68^o 32.135'S	72^o 38.536'E	629 m	0508, 16/02/2002

Table 1.4: Principal investigators (*=cruise participant) for CTD water sampling programs.

Measurement	name	affiliation
AU0106		
CTD, salinity, O_2, nutrients	*Nathan Bindoff	Antarctic CRC
Helium, tritium, ^{18}O	Peter Schlosser	Lamont-Doherty Earth Observatory, USA
Biological sampling	Simon Wright and Harvey Marchant	Antarctic Division
Methane	*Tsuneo Odate	National Institute of Polar Research, Japan
AU0207		
CTD, salinity, O_2, nutrients	Nathan Bindoff	Antarctic CRC
Helium, tritium, ^{18}O	Peter Schlosser	Lamont-Doherty Earth Observatory, USA
Biological sampling	Simon Wright	Antarctic Division

<u>Table 1.5a:</u> Scientific personnel (cruise participants) for cruise au0106.

Nathan Bindoff	CTD	Antarctic CRC
Clodagh Curran	Hydrology, CTD	Antarctic CRC
Sarah Howe	Hydrology, CTD	Antarctic CRC
John Hunter	CTD	Antarctic CRC
Ian Helmond	CTD, moorings	CSIRO
Mark Rosenberg	CTD, moorings	Antarctic CRC
Stevie Davenport	krill, moorings, CTD	Antarctic Division
Liz Foster	krill, CTD	Antarctic Division
Graham Hosie	krill, voyage leader	Antarctic Division
Lyn Irvine	Mawson, krill	Antarctic Division
John Kitchener	krill	Antarctic Division
Mark Schultz	krill, CTD	Antarctic Division
Patti Virtue	krill, CTD	Antarctic CRC
Tim Lancaster	hydroacoustics	Antarctic Division
Tim Pauly	hydroacoustics	Antarctic Division
David Wanless	hydroacoustics	Antarctic Division
Esmee van Wijk	hydroacoustics	Antarctic Division
Akira Ishikawa	biological sampling	Antarctic Division
Chad Marshall	Davis, biological sampling	Antarctic Division
Karen Westwood	biological sampling	Antarctic Division
Tsuneo Odate	methane	National Institute of Polar Research, Japan
Osamu Yoshida	methane	National Institute of Polar Research, Japan
Ari Friedlaender	whales	Duke University, USA
Paul Hodda	whales	Ocean Research Foundation
Brett Jarret	whales	Ocean Research Foundation
Vic Peddemors	whales	Ocean Research Foundation
Helen Achurch	birds	Antarctic Division
Ben Sullivan	birds	Antarctic Division
Andrew Cawthorn	gear officer	Antarctic Division
Helen Cooley	doctor	Antarctic Division
Ruth Lawless	dotzapper	Antarctic Division
Andrew McEldowney	gear officer,deputy voyage leader	Antarctic Division
Bryan Scott	computing	Antarctic Division
Tim Shaw	electronics	Antarctic Division
Tony Veness	electronics	Antarctic Division

<u>Table 1.5b:</u> Scientific personnel (cruise participants) for cruise au0207.

John Church	CTD	CSIRO
Clodagh Curran	Hydrology	Antarctic CRC
John Hunter	CTD	Antarctic CRC
Kevin Miller	CTD, moorings	CSIRO
Lindsay Pender	hydrology, moorings	CSIRO
Mark Rosenberg	CTD, moorings	Antarctic CRC
Marijke de Boer	whales	Ocean Research Foundation
Karen Evans	whales	Ocean Research Foundation
Paul Hodda	whales	Ocean Research Foundation
Julie Oswald	whale hydroacoustics	Scripps Institute of Oceanography, USA
Eduardo Secchi	whales	Ocean Research Foundation
Kate Stafford	whale hydroacoustics	NOAA, USA
Debra Glasgow	artist	Antarctic Division
Lisa Roberts	artist	Antarctic Division
Fred Alonzo	trawling	Antarctic CRC
Brian Hunt	trawling	Antarctic Division
Trevor Bailey	lab manager, biological sampling	Antarctic Division
Kelvin Cope	electronics	Antarctic Division
Rob Easther	voyage leader	Antarctic Division
Gerry Nash	CTD, deputy voyage leader	Antarctic Division
Graeme Snow	radio officer	Antarctic Division
Peter Wiley	computing	Antarctic Division
Ken Wilson	doctor	Antarctic Division
Muhammad Lukman	biological sampling	BPPT (Indonesia)
Agus Supangat	biological sampling	BPPT (Indonesia)

<u>Table 1.6:</u> AMISOR CTD stations sampled for helium, tritium and ^{18}O, where 1 = sampled and 0 = not sampled.

AU0106

station	helium	tritium	^{18}O
leg 1.2	0	0	1
leg 1.3	1	1	1
leg 1.4	0	0	1
leg 1.5	0	0	1
leg 1.6	1	1	1
leg 1.7	0	0	1
leg 1.8	0	0	1
leg 1.9	1	1	1
leg 1.10	0	0	1
leg 1.11	0	0	1
leg 1.12	1	1	1
leg 1.13	0	0	1
leg 1.14	1	1	1
leg 1.15	0	0	1
leg 1.16	1	1	1
leg 1.17	0	0	1
leg 1.18	1	1	1
leg 1.19	0	0	1
leg 1.20	0	0	1
leg 1.21	0	0	1
leg 1.22	1	1	1
leg 1.23	1	1	1
leg 1.24	1	1	1
leg 1.25	0	0	1

AU0207

station	helium	tritium	^{18}O
leg 1.23a	1	1	1
leg 1.23	1	1	1
leg 1.22	1	1	1
leg 1.21	1	1	1
leg 1.20	1	1	1
leg 1.19	1	1	1
leg 1.18	1	1	1
leg 1.17	1	1	1
leg 1.16	1	1	1
leg 2.15	1	1	1
leg 2.14	1	1	1
leg 2.13	1	1	1
leg 2.12	1	1	1
leg 2.11	1	1	1
leg 2.10	1	1	1
leg 2.9	1	1	1
leg 2.8	1	1	1
leg 2.7a	1	1	1
east 1	1	1	1
east 2	1	1	1
east 3	1	1	1
east 4	1	1	1

Station 1 was a test cast only, with no Niskin bottles or frame. Bottle samples for salinity, dissolved oxygen and nutrients were collected on all remaining stations, except for stations 36, 53, 54 and 55, where salinity only was sampled. Nutrient samples were frozen and analysed back in Hobart. Stations where helium/tritium/^{18}O were sampled are listed in Table 1.6. Samples for various biological parameters were collected throughout the cruise.

CTD Sensor calibrations

Pre cruise pressure, platinum temperature and pressure temperature calibrations (October 2000 for AU0106, October 2001 for AU0207) were performed at the CSIRO Division of Marine Research calibration facility (Table 1.9). For AU0106 an old Antarctic Division calibration (from 1996) was used to scale the fluorometer data. For AU0207, a new shipboard calibration obtained in November 2001 (Table 1.9) was used to scale the fluorometer data for stations 1 to 16. Complete conductivity and dissolved oxygen calibration results for both cruises, derived from in situ Niskin bottle samples, are listed later in this report. Hydrology laboratory methods are discussed in Appendix 1.1. Full details of CTD data processing and calibration techniques can be found in Appendix 2 of Rosenberg et al. (1995), with the following updates to the methodology:

(i) The 10 seconds of CTD data prior to each bottle firing are averaged to form the CTD upcast burst data for use in calibration.

(ii) In the conductivity calibration for cruise au0207 stations 46 to 52, an additional term was applied to remove the pressure dependent conductivity residual.

(iii) For most au0207 stations, the surface pressure offset used was at the commencement of logging.

1.3.2 ADCP

The hull mounted ADCP on the Aurora Australis is described in Rosenberg (unpublished report, 1999). Logging parameters for both cruises are summarised in Table 1.7. Current vectors for both cruises are plotted in Figures 1.4a and b; the apparent vertical current shear error for different ship speed classes, discussed in Rosenberg (unpublished report, 1999), is plotted in Figures 1.5a and b.

Table 1.7: ADCP logging and calibration parameters for cruises au0106 and au0207.

ping parameters		*bottom track ping parameters*	
no. of bins:	60	no. of bins:	128
bin length:	8 m	bin length:	4 m
pulse length:	8 m	pulse length:	32 m
delay:	4 m		
ping interval:	minimum	ping interval:	same as profiling pings

reference layer averaging:	bins 8 to 20
XROT:	822
ensemble averaging duration:	3 min. (for logged data) 30 min. (for final processed data)

calibration

cruise	α ($\pm$ standard deviation)	$1+\beta$ ($\pm$ standard deviation)	no. of calibration sites
au0106	2.382 ± 0.558	1.0764 ± 0.021	301
au0207	2.397 ± 0.613	1.0733 ± 0.015	76

1.3.3 Underway measurements

Underway data were logged to an Oracle database on the ship. For more information, see the AADC (Antarctic Division Data Centre) website, and the cruise dotzapper reports:

Marine Science Support Data Quality Report, RSV Aurora Australis Season 2000-2001 Voyage 6 (KACTAS), Ruth Lawless, Antarctic Division unpublished report.
(report at web address http://www-aadc2.aad.gov.au/Metadata/mar_sci/Dz200001060.html)

Marine Science Support Data Quality Report, RSV Aurora Australis Season 2001-2002 Voyage 7 (LOSS), Ruth Lawless, Antarctic Division unpublished report.
(report at web address http://www-aadc2.aad.gov.au/Metadata/mar_sci/Dz200102070.html)

For both cruises, a sound speed of 1463 ms^{-1} was used for ocean depth calculation, and the ship's draught of 7.3 m was accounted for. For cruise au0106, the 12 kHz sounder was not active during the krill work – depth data during this period were logged from the 38 kHz sounder, and depths below ~500 m are therefore not available. The 12 kHz sounder was used during the AMISOR work, and depth data are available during this period of cruise au0106. For cruise au0207, there was a problem with logging of bathymetry and all bathymetry data were lost. Water depths assigned to CTD and mooring stations during this cruise are as noted on the field sheets at the time, from the sounder display.

Underway data were dumped from the AADC website and are in the following files:

AU0106

10 sec. instantaneous values, text format:	kactas.ora
10 sec. instantaneous values, matlab format:	kactasora.mat

AU0207

1 min.instantaneous values, text format:	loss.ora
1 min. instantaneous values, matlab format:	lossora.mat

1.3.4 Sediment grab

Shipek sediment grab samples were collected from the AMISOR CTD transect during both cruises (principal investigators Mark Hemer and Peter Harris, Antarctic CRC) (Table 1.8). The grab was deployed from the CTD room, on the aft CTD winch wire. Samples were bagged and refrigerated for analysis in Hobart.

Table 1.8: Site numbers on the main AMISOR CTD transect line (Figure 1.1) where a Shipek sediment grab sample was collected.

AU0106

CTD site	grab number
2	AA01/06GR11
4	AA01/06GR10
6	AA01/06GR2
7	AA01/06GR1
9	AA01/06GR3
12	AA01/06GR4
14	AA01/06GR5
17	AA01/06GR6
20	AA01/06GR7
23	AA01/06GR8
25	AA01/06GR9

AU0207

CTD site	grab number
3	AA02/07GR11
4	AA02/07GR12
8	AA02/07GR10
10	AA02/07GR9
11	AA02/07GR8
13	AA02/07GR7
15	AA02/07GR6
16	AA02/07GR5
18	AA02/07GR4
19	AA02/07GR3
21	AA02/07GR2
22	AA02/07GR1

1.3.5 Moorings

Mooring deployments and recoveries are summarised in Table 1.3. Mooring data are described in detail in Part 2 of this report.

1.4 CTD AND HYDROLOGY RESULTS

CTD and hydrology data quality are discussed in this section. When using the data, the following data quality tables are important:

Table 1.16 – questionable CTD data
Table 1.17 – questionable nutrient data

1.4.1 CTD data

1.4.1.1 Conductivity/salinity

AU0106
The conductivity cell on CTD1193 (used for the entire cruise) calibrated well (Figures 1.6 and 1.7). Note the following parameter definitions for the figures:

c_{cal} = calibrated CTD conductivity from the CTD upcast burst data
c_{btl} = 'in situ' Niskin bottle conductivity, found by using CTD pressure and temperature from the CTD upcast burst data in the conversion of Niskin bottle salinity to conductivity
s_{cal} = calibrated CTD salinity
s_{btl} = Niskin bottle salinity value

Very good salinity calibrations were obtained up to station 40, with CTD salinites accurate to less than 0.002 (PSS78). For stations 41 to 95, bottle salinity scatter was increased, with the bottle/CTD salinity calibration accurate to 0.0021 (PSS78). The most likely cause for this increase in scatter is that for the AMISOR CTD profiles, small locally sharp vertical gradients were encountered, particularly where ice shelf water was found. These gradients would increase the scatter between Niskin bottle and CTD measurements.

For station 67, layers of ice crystals in the water, detectable to both the 12 kHz sounder and the altimeter, resulted in bad conductivity data for much of the cast.

For station 80, fouling of the conductivity cell resulted in bad downcast data. Upcast salinity (and temperature and fluorescence) data were used for this station. Note that the oxygen data for this station are from the downcast.

AU0207

The conductivity cell on CTD1193 (used for station 1 to 16) calibrated very well (Figures 1.6 to 1.7). The calibration scatter between CTD and bottles increased slightly after station 16, where CTD2568 was used (stations 17 to 55). Sharp local vertical gradients resulted in the rejection of many of the shallowest bottles for the conductivity calibration, particularly for rosette positions 10, 11 and 12. Crystallisation of ice inside Niskin bottles was also a problem at some stations e.g. rosette positions 6 to 12 at station 27.

For stations 12, 20 and 51, the CTD sensors froze during deployment, resulting in bad downcast data. For these stations, upcast data (including temperature, salinity and fluorescence) were used.

For station 30, the CTD data file was accidentally overwritten at the end of the cast, and all data were lost. Station 32 was a repeat of the site.

After initial calibration of conductivity data, a pressure dependent conductivity residual was noted for stations 46 to 52, probably due to light fouling of the conductivity cell. The residual was removed by the following steps:

(a) CTD conductivity was initially calibrated to derive conductivity residuals (c_{btl} - c_{cal}), where c_{btl} and c_{cal} are as defined above, and noting that c_{cal} is the conductivity value after the initial calibration only i.e. prior to any pressure dependent correction.

(b) Next, for each station grouping (Table 1.11), a linear pressure dependent fit was found for the conductivity residuals i.e. for station grouping i, fit parameters α_i and β_i (Table 1.11) were found from

$$(c_{btl} - c_{cal})_n = \alpha_i \, p_n + \beta_i \qquad \text{(eqn 1.1)}$$

where the residuals $(c_{btl} - c_{cal})_n$ and corresponding pressures p_n (i.e. pressures where Niskin bottles fired) are all the values accepted for conductivity calibration in the station grouping.

(c) Lastly, the conductivity calibration was repeated, this time fitting ($c_{ctd} + \alpha_i \, p + \beta_i$) to the bottle values c_{btl} in order to remove the linear pressure dependence for each station grouping i (for uncalibrated conductivity c_{ctd}).

A good conductivity calibration was obtained for stations 46 to 52 using this method (Figures 1.6 and 1.7). Overall the bottle/CTD salinity calibration for the whole cruise is accurate to within 0.002 (PSS78).

1.4.1.2 Temperature

For au0106, the usual two point platinum temperature laboratory calibration was used (at the triple points of water and phenoxybenzene). For au0207, for the first time a full multi point laboratory temperature calibration was performed, with points between the triple point of water and the melting point of gallium, and also including several subzero points down to ~-1.4^{o}C. This is judged to be a significant improvement to CTD temperature accuracy, in particular for the subzero temperatures. Thus there may be a small inconsistency (of order 0.001^{o}C) for CTD temperature data between the two cruises.

Both linear and quadratic fits were attempted for the au0207 temperature calibration data, to obtain the best fit results. For CTD2568 (stations 17-55), a linear fit to the calibration data was used (Table 1.9). For CTD1193 (stations 1 to 16), a quadratic fit was used. Except for the two test casts, all CTD data for cruise au0207 was collected in subzero water temperatures. So this temperature calibration for CTD1193 was improved by using a quadratic fit to the colder calibration points only (≤ 5^{o}C) (and thus data for the two test casts in warmer waters are not reported in the final data set).

Reversing thermometers were fitted to some Niskins (Table 1.19) as a check on the CTD platinum temperature sensor performance, and CTD temperatures appeared to be stable for both cruises. For au0106, both digital and mercury thermometers were fitted to give comparison data for the two types of thermometer. A large consistent difference was found between CTD and digital thermometer temperatures for most of the cruise, with thermometers higher than the CTD by ~0.0025^{o}C (Figure 1.8a). After station 82 the offset gradually increased to ~0.006. An equivalent increase is not seen in the mercury thermometer to CTD comparison, thus the increase is assumed due to a shift in the digital thermometer used (serial 1624), rather than to a shift in CTD platinum temperature calibration. Mercury thermometer offsets to CTD data were ~-0.002^{o}C for the krill box work (stations 1 to 43), and ~-0.006^{o}C for AMISOR. The larger offset value for the AMISOR work is due to colder water temperatures, reflecting the poorer calibration of the mercury thermometers at lower temperature values. Thus although the digital thermometers are more desirable to use and have more up to date calibrations, they may be more susceptible to calibration shifts than mercury thermometers.

For au0207, all the reversing thermometers were digital. Thermometers 1625, 1682 and 1683, fitted for the first 16 stations using CTD1193, show good agreement on average with the CTD temperature (Figure 1.8b). Thermometer 1624 was fitted for the entire cruise: although this thermometer shows an obvious calibration offset error (Figure 1.8b), the offset is fairly consistent between the thermometer and the 2 different CTD's (CTD1193 for stations 1 to 16, CTD2568 for stations 17 to 55).

1.4.1.3 Pressure

As described in previous data reports, noise in the pressure signal for CTD1193 (used for all of au0106, and for stations 1 to 16 of au0207) was high, with spikes of up to 1 dbar amplitude occurring, and with a reasonable number of missing 2 dbar bins resulting from the 2 dbar averaging. To reduce the number of missing bins, the minimum number of data points required in a 2 dbar bin to form an average was set to 8 for au0106, and 7 for au0207. For most remaining missing bins, values were linearly interpolated between surrounding bins (Table 1.15), except where the local temperature gradient was too high. Further missing 2 dbar bins (Table 1.14) are due to quality control of the data.

For CTD2568 (au0207 stations 17 to 55) any noise in the pressure signal was very low, and the minimum number of data points required in a 2 dbar bin to form an average was set to 10.

For au0207, the cold conditions meant that great care was needed to prevent freezing of the CTD sensors when exposed to the air during deployment. For most stations, the CTD sensor caps were filled with hypersaline water, and the sensor caps were not removed till the very last moment. Usually, the surface pressure offset is obtained automatically as the 3rd data point after the instrument enters the water, as determined by the conductivity exceeding 10 mS/cm. With hypersaline water still in the sensor caps when logging commenced, the surface pressure offset values obtained in this case were the pressure values at the commencement of logging (Table 1.10).

For au0106 stations 36, 62 and 74, the surface pressure offset was obtained by manual inspection of the data. For au0207 station 23, the pressure reading at commencement of logging was a little high, so the offset value was again obtained by manual inspection of the data.

1.4.1.4 Dissolved oxygen

Two oxygen sensors were used over cruise au0106 (stations 1 to 70 and stations 71 to 95), both sensors calibrating well against dissolved oxygen bottle data (Figure 1.9a, Table 1.20). For many of the stations using the first sensor, a bad data spike occurred somewhere between 100 and 200 dbar (Table 1.14). For station 80, where upcast salinity, temperature and fluorescence data were used, downcast CTD oxygen data was merged in with the upcast data.

For cruise au0207, the two oxygen sensors used were those fitted on the two CTD's (i.e. stations 1 to 16 and stations 17 to 55). The sensors calibrated well against the bottle data (Figure 1.9b, Table 1.20).

For both cruises, much of the near surface part of the CTD dissolved oxygen profiles are highly suspicious, in particular for the top 20 dbar. For au0106, much of these data have been removed (Table 1.14); for au0207, these data are noted as questionable (Table 1.16). In general, transient errors are common when CTD dissolved oxygen sensors (on General Oceanics CTD's) enter the water, and near surface oxygen data should be treated with caution. For the bulk of the water column the data are good, and the standard deviation values for the CTD to bottle comparison are within 1% of full scale values (where full scale is approximately 380 μmol/l).

1.4.1.5 Fluorescence

All fluorescence data have preliminary calibrations only, to convert sensor output into voltages. These data should not be used quantitatively other than for linkage with primary productivity data. Some very large fluorescence peaks were measured on cruise au0106, in particular at the southest corner of the krill survey box, and along the Amery Ice Shelf.

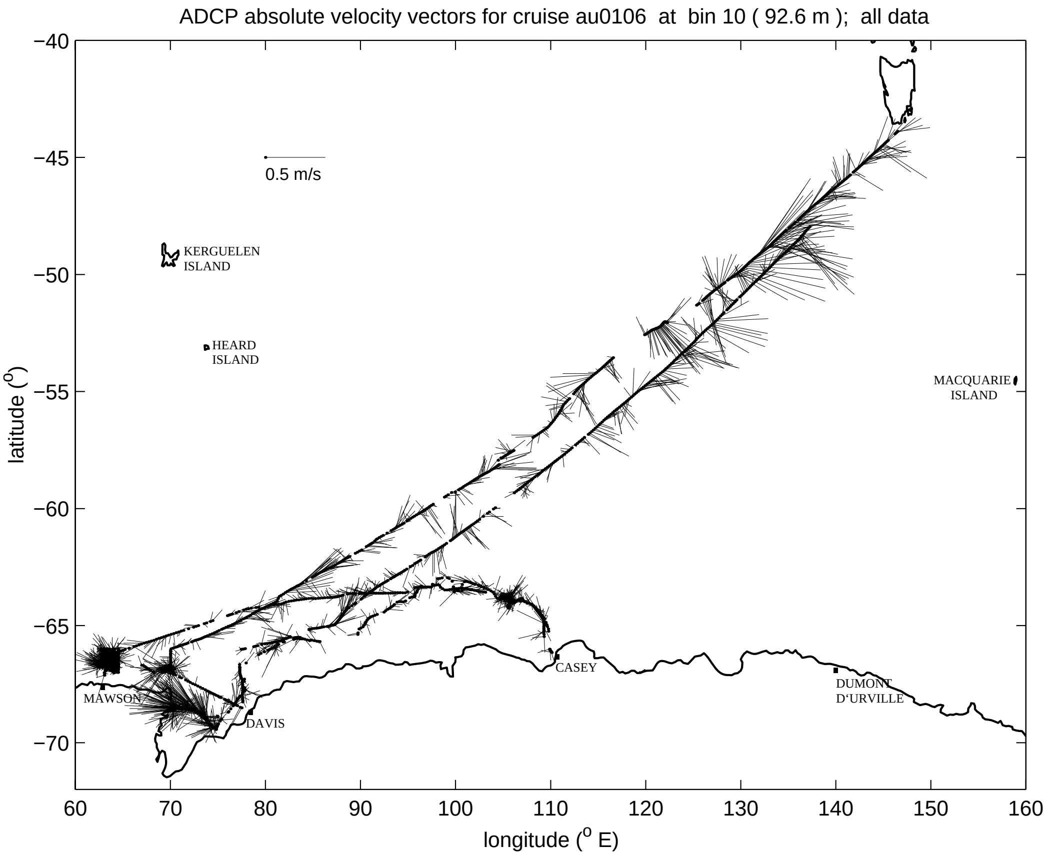
1.4.2 Hydrology data

A Guildline 'Autosal' salinometer serial no. 62549 was used for analysis of all salinity bottle samples on both cruises. International Standard Seawater batch numbers used are detailed in Appendix 1.1. As mentioned previously, some salinity bottle samples collected during very cold conditions were affected by freezing of the water in the Niskin bottles during recovery, the worst case being station 27 on au0207. Ice crystals in the water compromised the salinity samples for au0106 station 67. For stations 16 and 17 on au0106, the laboratory temperature was high, affecting performance of the Autosal, and many of the salinity bottle analyses were bad, in particular for station 17.

Bottle oxygen data for both cruises were mostly good. Only one suspicious value remains in the files (Table 1.18). For au0106 station 52 bottles 10 to 12, and all of stations 53 and 54, bottle oxygen values were bad due to incorrect preparation of the sodium thiosulphate reagent used immediately after drawing the samples.

For au0106, nutrient samples were collected and frozen for most stations, but were never analysed. Onboard analyses were attempted for nutrients on au0207, however contamination of the nutrient system (Appendix 1.1) forced the postponement of nutrient analyses. The samples were stored frozen for analysis in Hobart. A reasonable number of nutrient values have been flagged as questionable (Table 1.17), mostly for silicate and phosphate. Nitrate+nitrite versus phosphate data for au0207 are shown in Figure 1.10.

The nutrient values for au0207 station 47, bottles 7, 8 and 9, are different to any values in surrounding stations. They have not been flagged as questionable in Table 1.17 as there is no evidence for any problems.



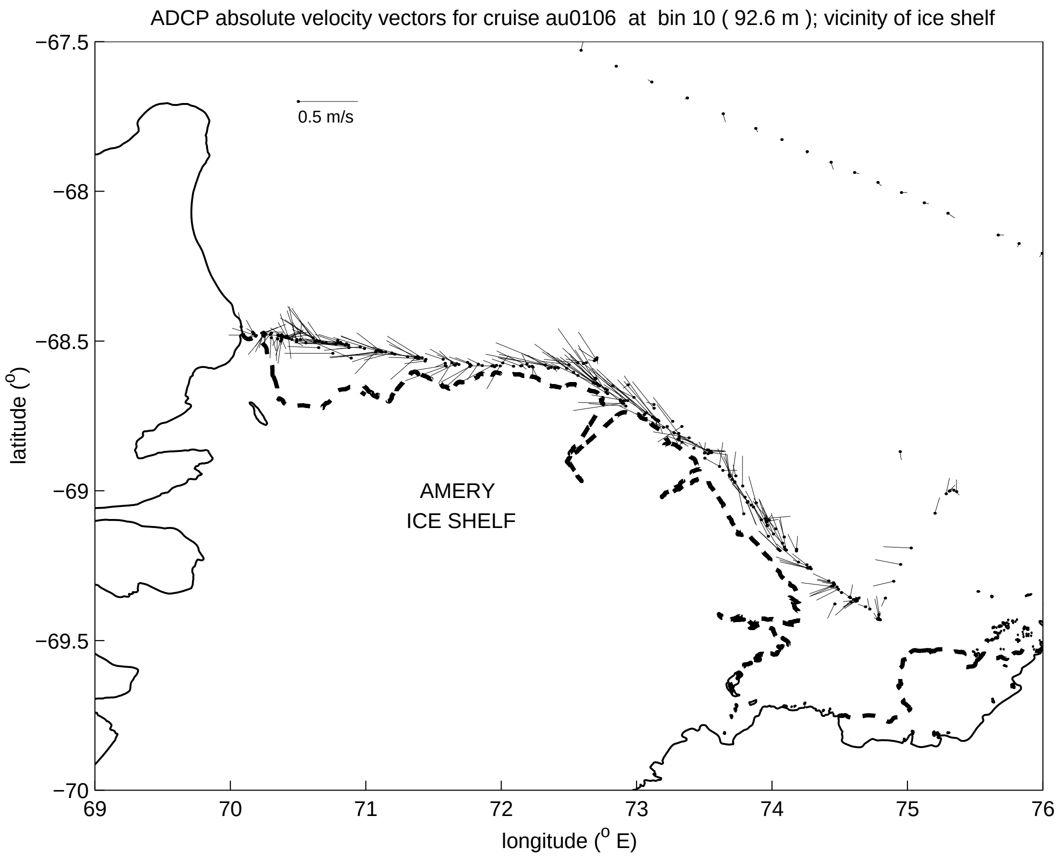
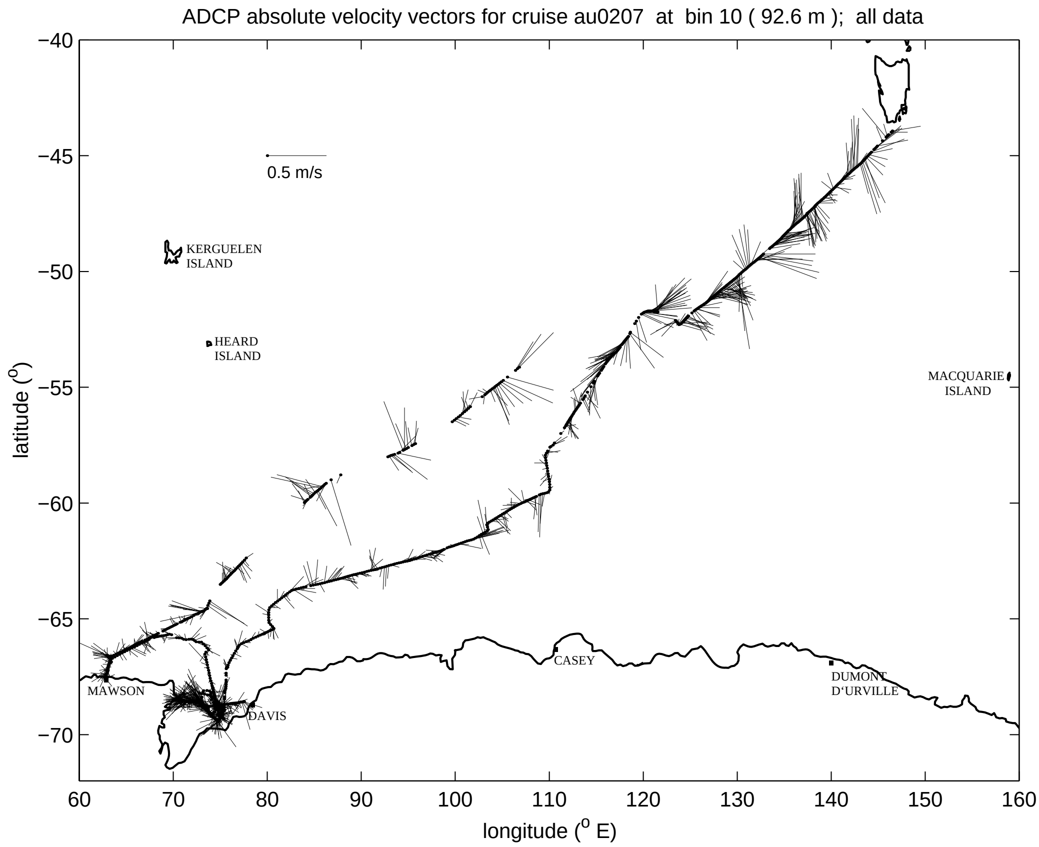


Figure 1.4a: ADCP 30 minute ensemble data for cruise au0106.



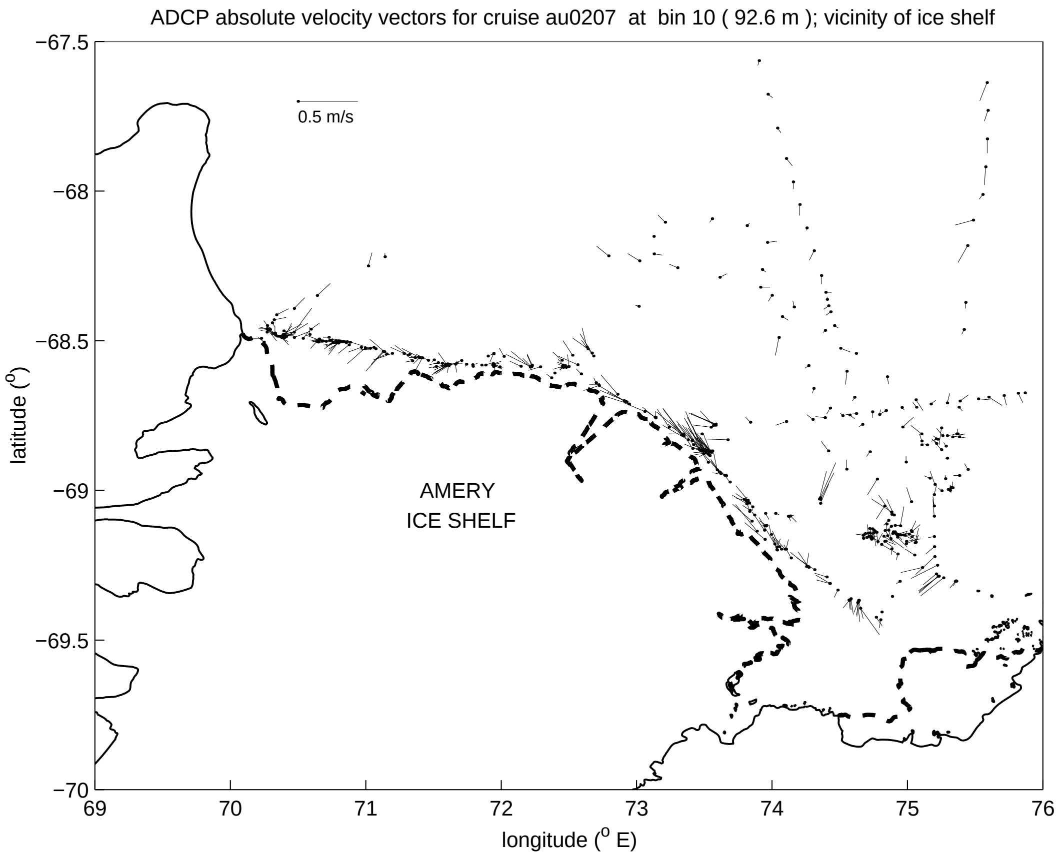
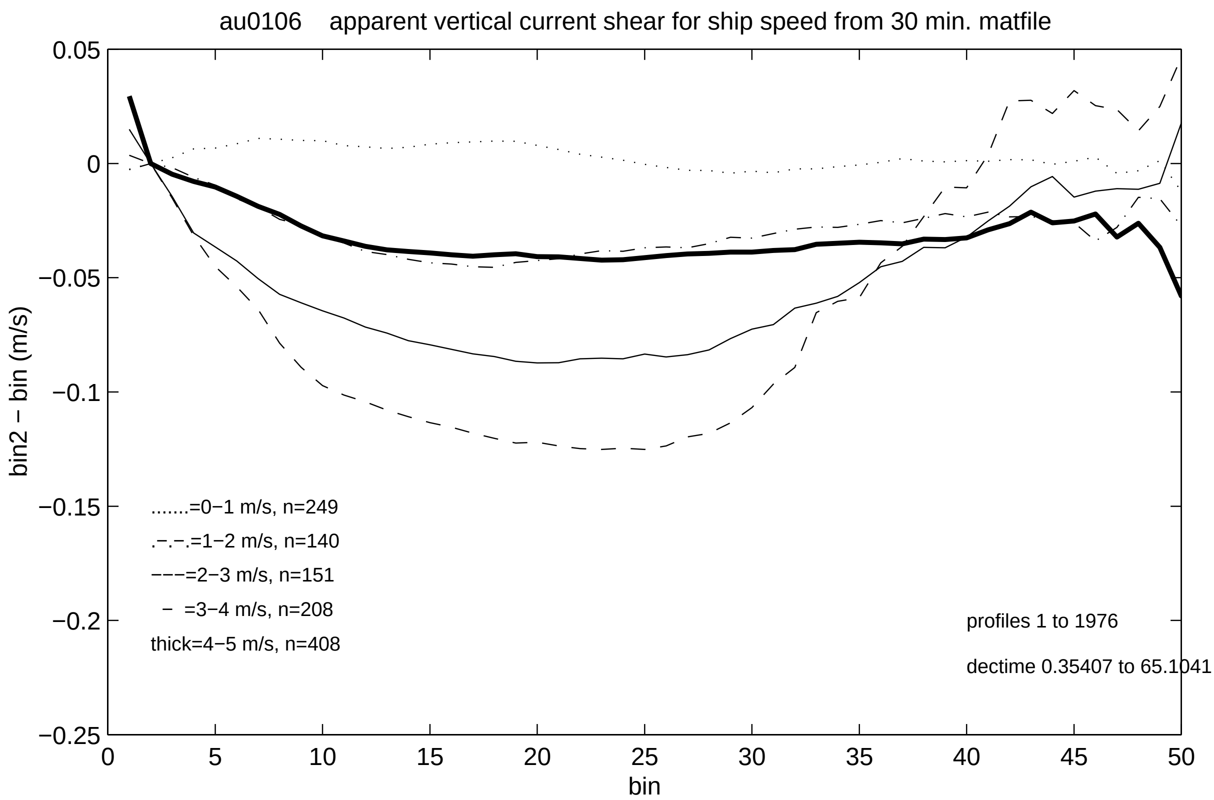


Figure 1.4b: ADCP 30 minute ensemble data for cruise au0207.


au0106 apparent vertical current shear for ship speed from 30 min. matfile
0.05
0
−0.05
−0.1
−0.15
−0.2
−0.25
bin2 − bin (m/s)
0
5
10
15
20
25
30
35
40
45
50
bin
.......=0−1 m/s, n=249
.−.−.=1−2 m/s, n=140
−−−=2−3 m/s, n=151
− =3−4 m/s, n=208
thick=4−5 m/s, n=408
profiles 1 to 1976
dectime 0.35407 to 65.1041

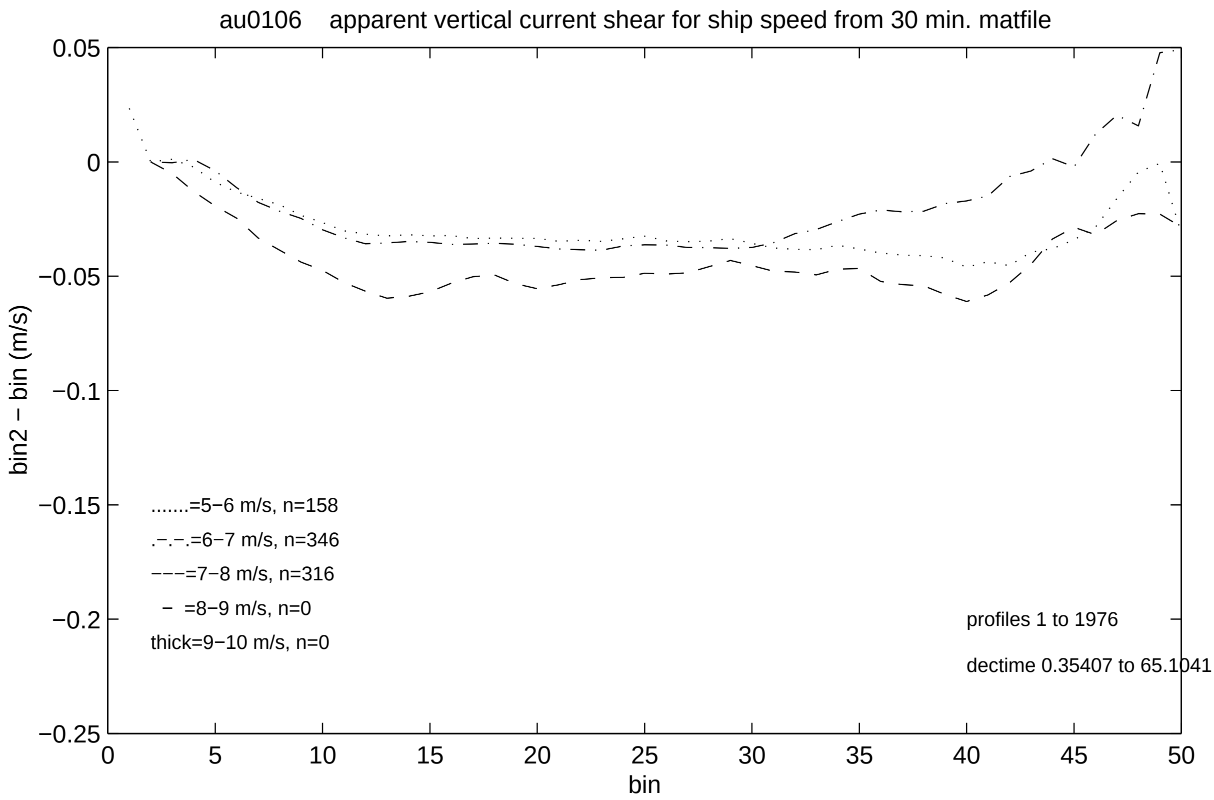
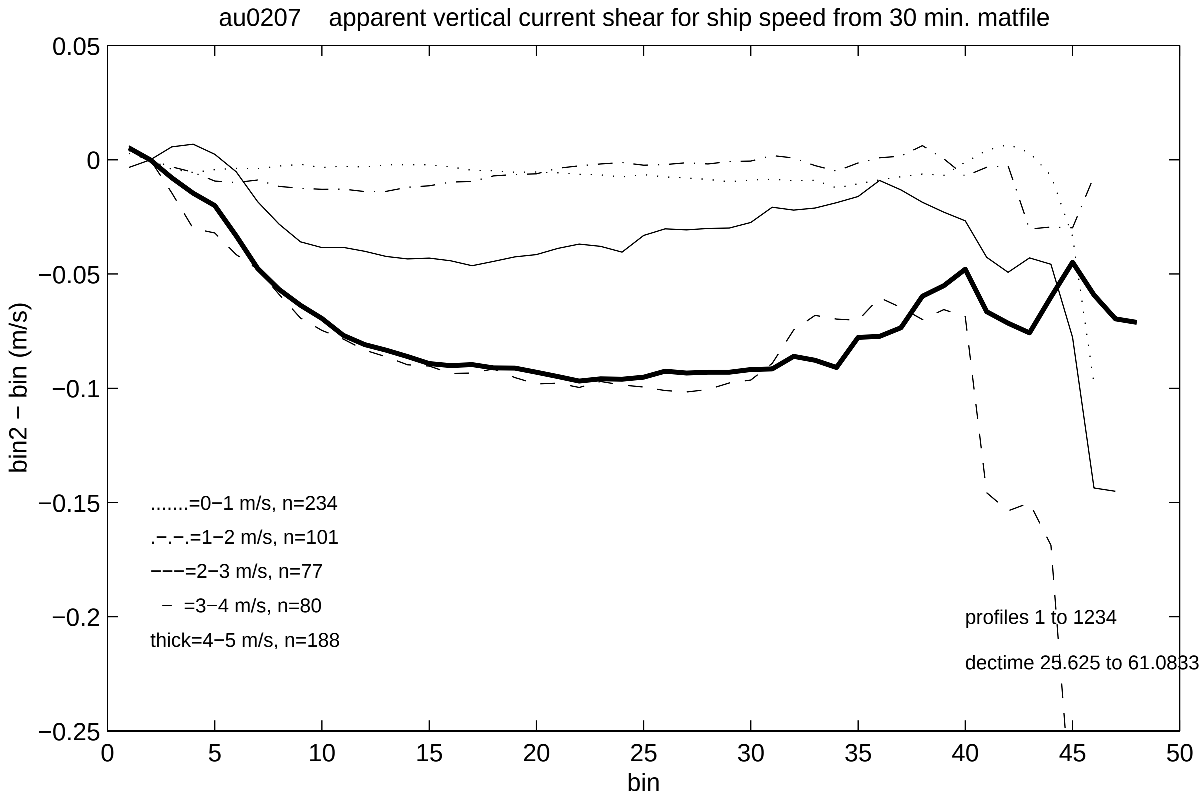
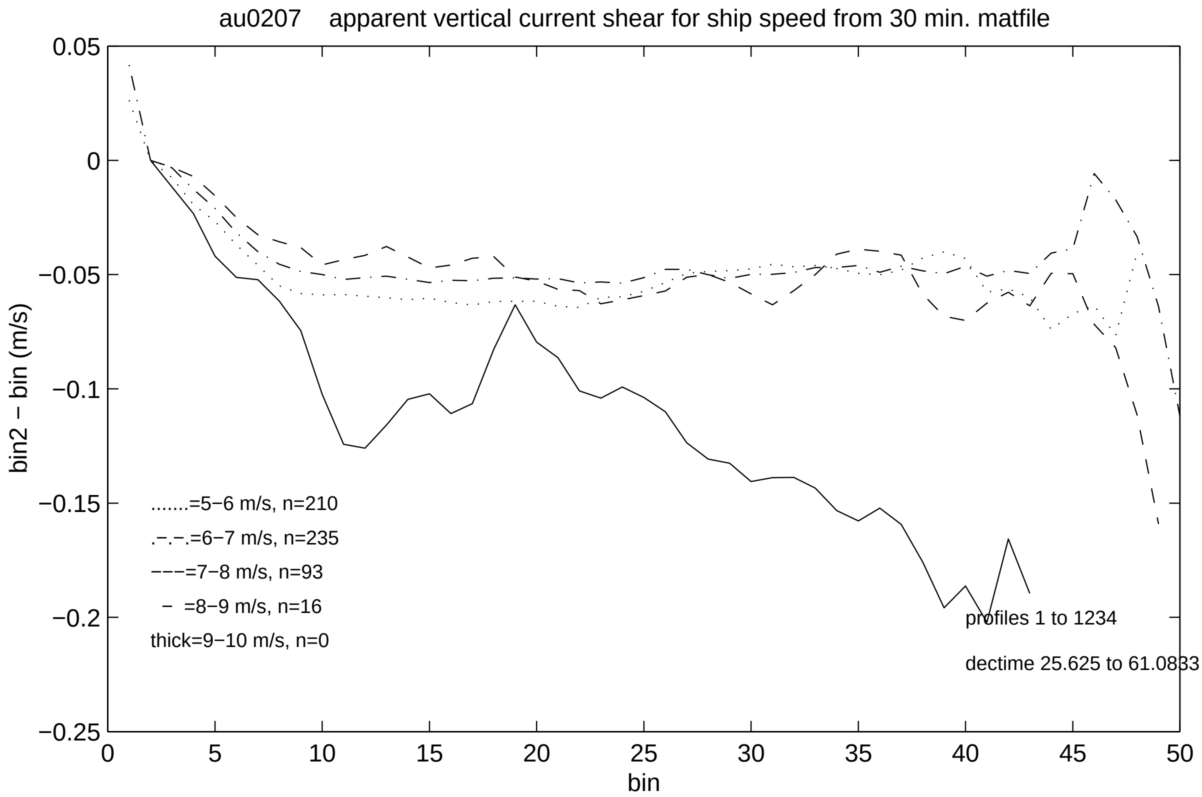
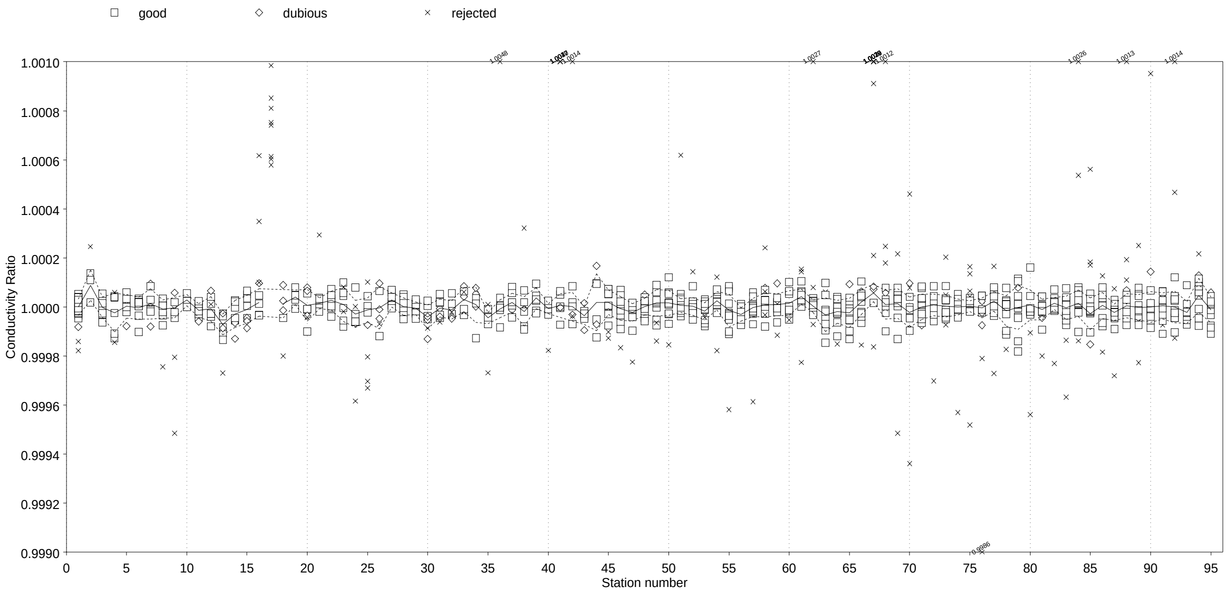

au0106 apparent vertical current shear for ship speed from 30 min. matfile
0.05
0
−0.05
−0.1
−0.15
−0.2
−0.25
bin2 − bin (m/s)
0
5
10
15
20
25
30
35
40
45
50
bin
.......=5−6 m/s, n=158
.−.−.=6−7 m/s, n=346
−−−=7−8 m/s, n=316
− =8−9 m/s, n=0
thick=9−10 m/s, n=0
profiles 1 to 1976
dectime 0.35407 to 65.1041

Figure 1.5a: **Apparent vertical current shear calculated from uncorrected (i.e. ship speed included) ADCP velocities for cruise au0106.**





<u>Figure 1.5b:</u> Apparent vertical current shear calculated from uncorrected (i.e. ship speed included) ADCP velocities for cruise au0207.

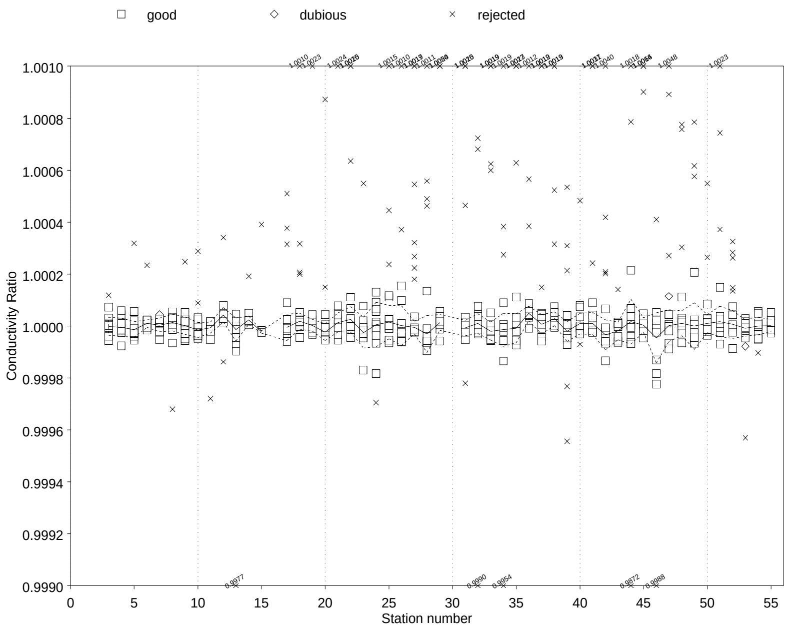


Calibration data for cruise : Au0106

Calibration file : a0106.bot

Conductivity s.d. = 0.00005

Number of bottles used = 781 out of 952 Mean ratio for all bottles = 1.00000



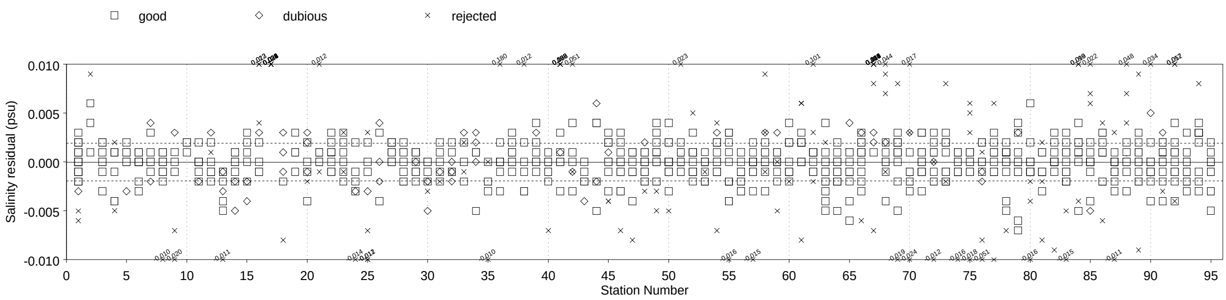
Calibration data for cruise : Au0207

Calibration file : a0207.bot

Conductivity s.d. = 0.00004

Number of bottles used = 462 out of 583 Mean ratio for all bottles = 1.00000

Figure 1.6: **Conductivity ratio c_{btl}/c_{cal} versus station number for cruises au0106 and au0207. The solid line follows the mean of the residuals for each station; the broken lines are ± the standard deviation of the residuals for each station.**

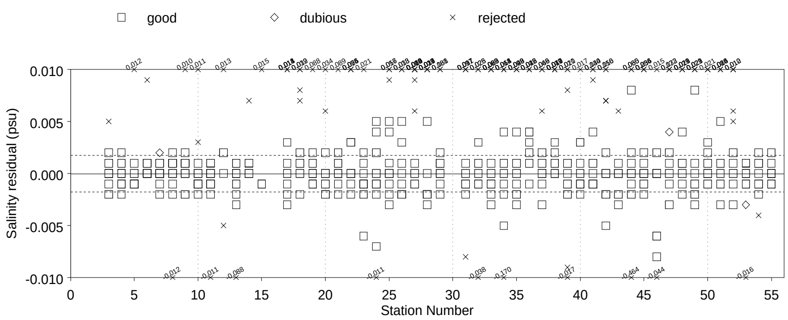


Calibration data for cruise : Au0106

Calibration file : a0106.bot

Mean offset salinity = 0.0000psu (s.d. = 0.0019 psu)

Number of bottles used =   781 out of   952



Calibration data for cruise : Au0207

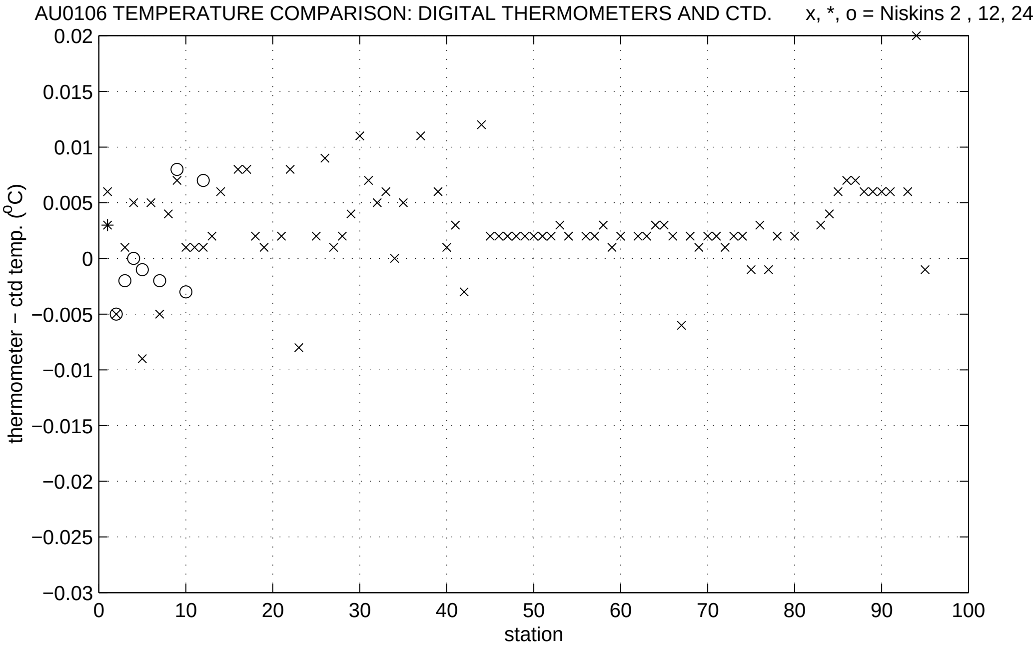
Calibration file : a0207.bot

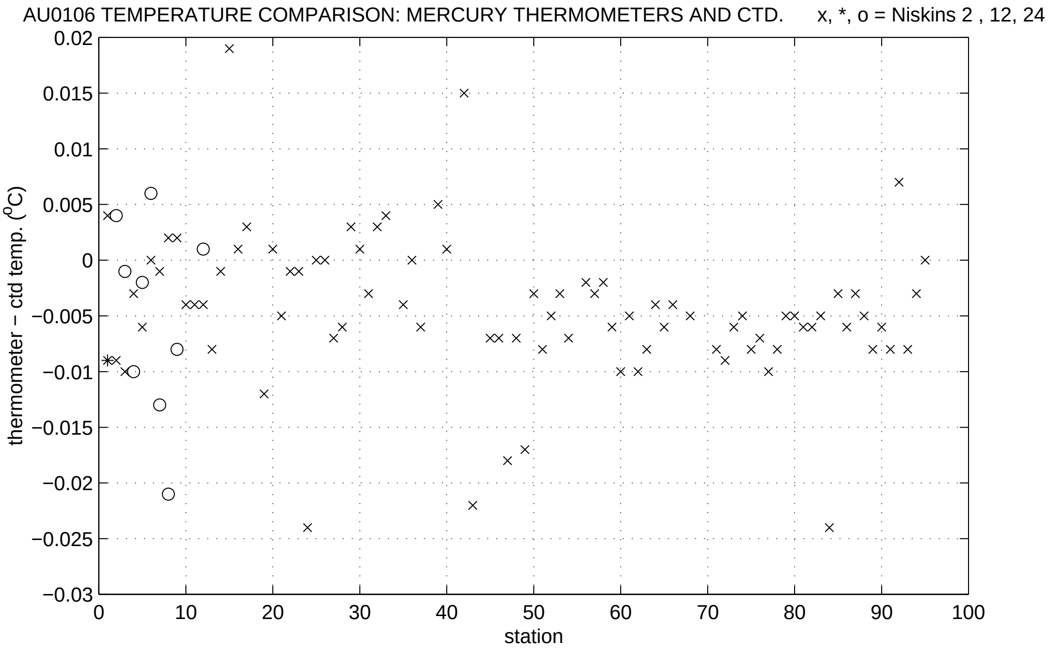
Mean offset salinity = 0.0000psu (s.d. = 0.0018 psu)

Number of bottles used =   462 out of   583

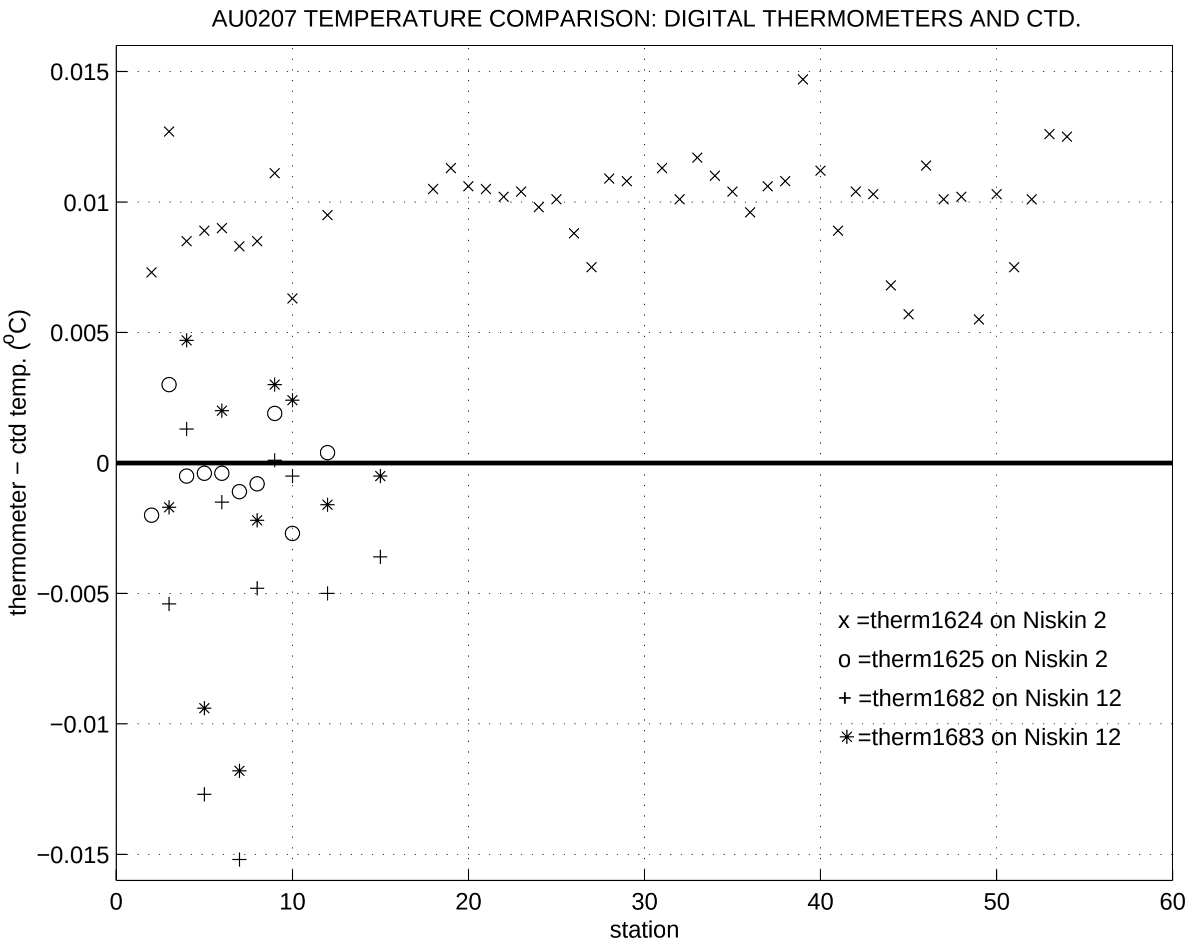
Comment: n

Figure 1.7: **Salinity residual (s_{btl} - s_{cal}) versus station number for cruises au0106 and au0207. The solid line is the mean of all the residuals; the broken lines are ± the standard deviation of all the residuals.**

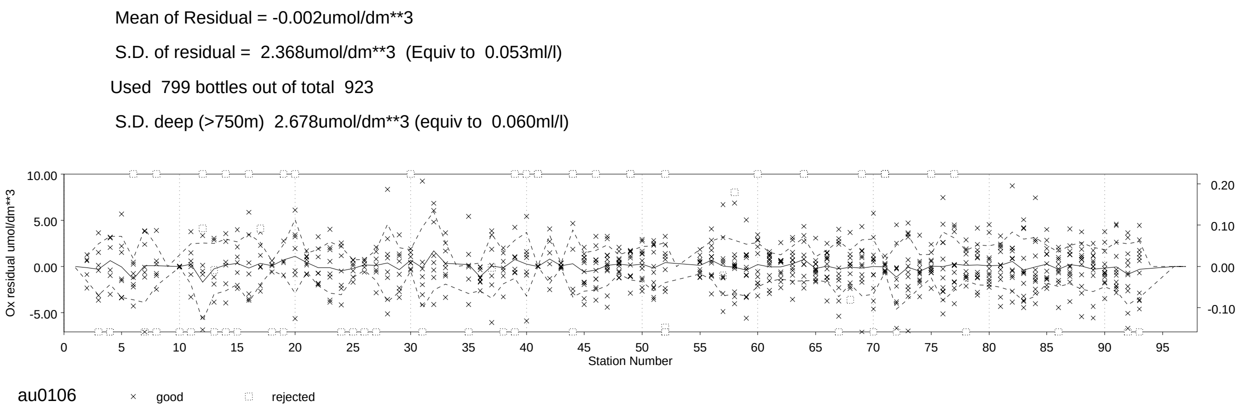




<u>Figure 1.8a:</u> Comparison between CTD platinum temperature and digital and mercury reversing thermometers for cruise au0106.



<u>Figure 1.8b:</u> Comparison between CTD platinum temperature and digital reversing thermometers for cruise au0207.



<u>Figure 1.9a:</u> Dissolved oxygen residual (o_{btl} - o_{cal}) versus station number for cruise au0106. The solid line follows the mean residual for each station; the broken lines are ± the standard deviation of the residuals for each station.

Mean of Residual = 0.016umol/dm**3

S.D. of residual = 2.136umol/dm**3 (Equiv to 0.048ml/l)

Used 468 bottles out of total 538

S.D. deep (>750m) 2.155umol/dm**3 (equiv to 0.048ml/l)

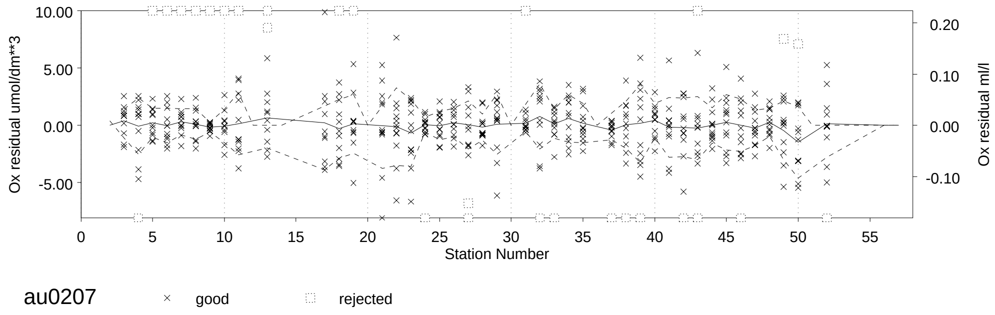


Figure 1.9b: **Dissolved oxygen residual (o_{btl} - o_{cal}) versus station number for cruise au0207. The solid line follows the mean residual for each station; the broken lines are ± the standard deviation of the residuals for each station.**

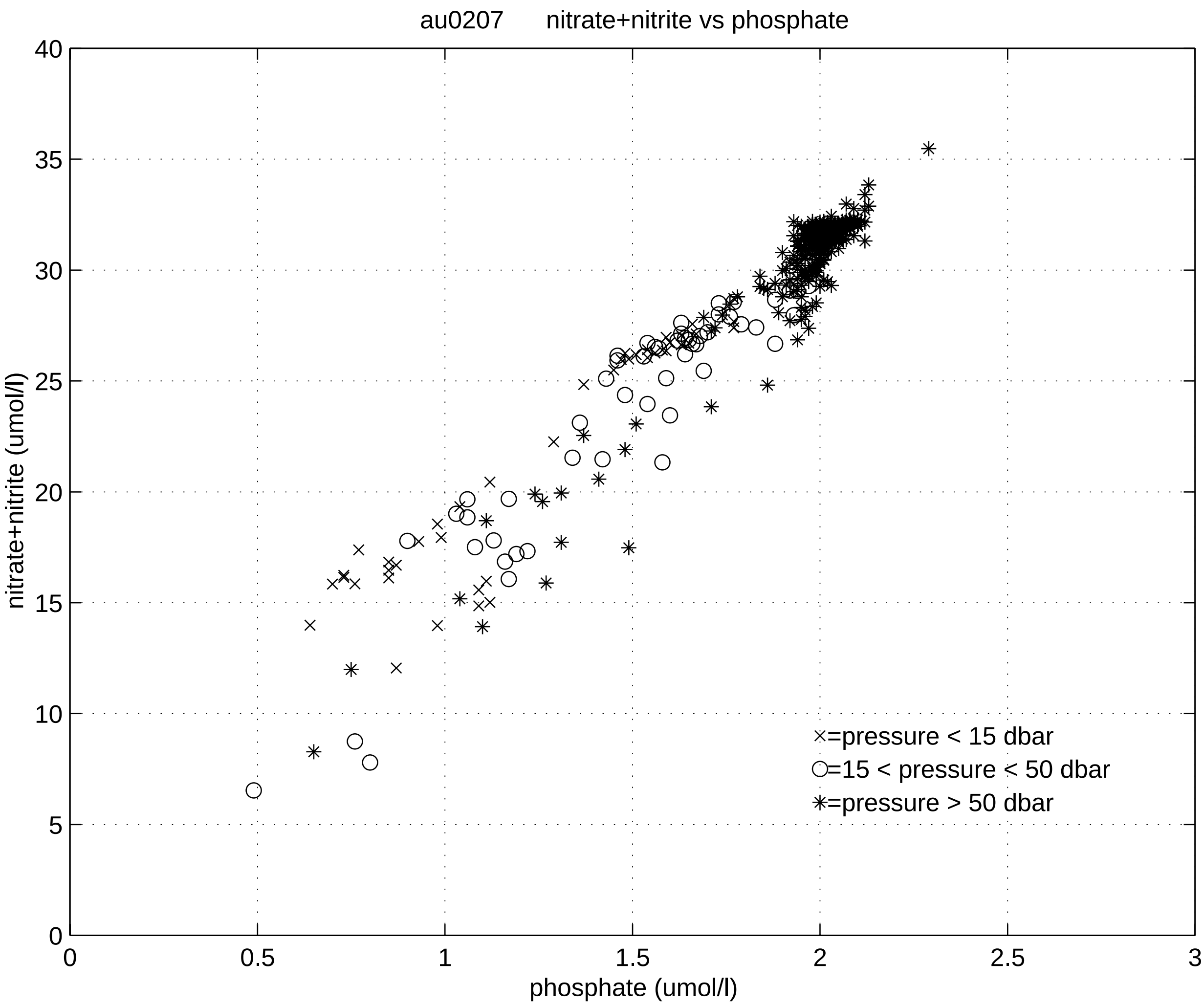


Figure 1.10: **Nitrate+nitrite versus phosphate data for au0207.**

<u>Table 1.9:</u> Calibration coefficients and calibration dates for CTD's used during the different cruises. Note that platinum temperature calibrations are for the ITS-90 scale.

coefficient	value of coefficient	coefficient	value of coefficient
AU0106			
CTD serial number 1193 (unit no. 5)			
pressure calibration coefficients		*pressure temperature calibration coefficients*	
CSIRO Calibration Facility – 31/10/2000		*CSIRO Calibration Facility - 31/10/2000*	
pcal0	-1.097208e+01	Tpcal0	6.09660e+01
pcal1	1.006787e-01	Tpcal1	1.06055e-03
pcal2	8.340696e-09	Tpcal2	-5.41822e-08
pcal3	-1.728089e-13	Tpcal3	0.0
pcal4	1.246311e-18	Tpcal4	0.0
platinum temperature calibration coefficients		*coefficients for temperature correction to pressure*	
CSIRO Calibration Facility – 19-25/10/2000		*CSIRO Calibration Facility - 31/10/2000*	
Tcal0	-5.23383e-02	T_0	20.00
Tcal1	4.98706e-04	S_1	-1.66731e-05
Tcal2	2.75412e-12	S_2	-1.25251e-01
preliminary polynomial coefficients applied to fluorescence (Antarctic Division, Jan. 1996)raw counts:			
f0	-1.115084e+01		
f1	3.402400e-04		
f2	0.0		
AU0207			
CTD serial number 1193 (unit no. 5) (stations 1-16)			
pressure calibration coefficients		*pressure temperature calibration coefficients*	
CSIRO Calibration Facility – 08/10/2001		*CSIRO Calibration Facility - 08/10/2001*	
pcal0	-1.112466e+01	Tpcal0	8.43604e+01
pcal1	1.007841e-01	Tpcal1	-3.15992e-04
pcal2	2.329940e-09	Tpcal2	-3.25000e-08
pcal3	-6.068648e-14	Tpcal3	0.0
pcal4	5.809276e-19	Tpcal4	0.0
platinum temperature calibration coefficients		*coefficients for temperature correction to pressure*	
CSIRO Calibration Facility – 02/10/2001		*CSIRO Calibration Facility - 08/10/2001*	
Tcal0	-5.368220e-02	T_0	20.00
Tcal1	4.996903e-04	S_1	-1.88557e-05
Tcal2	-6.508000e-11	S_2	-1.08758e-01
preliminary polynomial coefficients applied to fluorescence raw digitiser counts (calibration date 22/11/2001, Aurora Australis):			
f0	-5.57687		
f1	1.70179e-04		
f2	0.0		
CTD serial number 2568 (unit no. 6) (stations 17-55)			
pressure calibration coefficients		*pressure temperature calibration coefficients*	
CSIRO Calibration Facility – 15/10/2001		*CSIRO Calibration Facility - 15/10/2001*	
pcal0	-4.024268e+01	Tpcal0	5.44748e+01
pcal1	1.074928e-01	Tpcal1	5.43036e-04
pcal2	-5.854930e-11	Tpcal2	-7.32189e-08
pcal3	2.219546e-14	Tpcal3	0.0
pcal4	-2.334224e-19	Tpcal4	0.0
platinum temperature calibration coefficients		*coefficients for temperature correction to pressure*	
CSIRO Calibration Facility – 08/10/2001		*CSIRO Calibration Facility - 15/10/2001*	
Tcal0	3.585551e-02	T_0	20.00
Tcal1	5.000857e-04	S_1	-6.73288e-06
Tcal2	0.00	S_2	-8.01679e-02

<u>Table 1.10:</u> Surface pressure offsets. ** indicates value estimated from manual inspection of data.

stn no.	surface p offset(dbar)	stn no.	surface p offset(dbar)	stn no.	surface p offset(dbar)	stn no.	surface p offset(dbar)	stn no.	surface p offset(dbar)
AU0106									
1	-0.21	20	-0.15	39	-0.28	58	-0.66	77	-0.97
2	0.20	21	-0.33	40	-0.40	59	-0.34	78	-0.30
3	0.01	22	-0.75	41	0.21	60	-0.57	79	0.01
4	0.40	23	-0.66	42	-0.58	61	-0.40	80	-1.13
5	0.04	24	-0.51	43	0.03	62	-0.30**	81	-0.17
6	-0.33	25	-0.44	44	0.04	63	-0.59	82	-0.50
7	-0.26	26	0.12	45	-0.43	64	-0.88	83	-1.03
8	-0.41	27	0.22	46	0.33	65	-0.28	84	-0.59
9	0.01	28	-0.62	47	-0.23	66	-0.47	85	-1.23
10	0.31	29	0.09	48	-0.27	67	-0.66	86	-0.96
11	-0.55	30	-1.01	49	-0.24	68	-0.34	87	-0.39
12	-0.24	31	-0.22	50	-0.80	69	-0.11	88	-0.67
13	-0.70	32	-0.20	51	-0.36	70	-0.78	89	-0.40
14	0.38	33	0.55	52	-0.27	71	-0.25	90	-0.78
15	-0.20	34	0.08	53	-0.32	72	-0.28	91	-0.61
16	-0.67	35	-0.80	54	-0.32	73	-1.09	92	-0.62
17	-0.52	36	-0.20**	55	-0.42	74	-0.70**	93	-0.56
18	-0.34	37	-0.15	56	-0.34	75	-0.82	94	0.35
19	-0.59	38	-0.53	57	-0.70	76	-0.90	95	0.27
AU0207									
1	0.80	12	0.54	23	1.50**	34	0.76	45	1.33
2	0.65	13	0.96	24	1.61	35	0.75	46	0.80
3	0.66	14	1.16	25	0.97	36	1.09	47	1.48
4	0.73	15	0.97	26	0.85	37	0.64	48	1.44
5	0.08	16	1.35	27	1.89	38	0.44	49	1.51
6	1.19	17	0.40	28	1.41	39	1.47	50	1.98
7	0.85	18	1.60	29	1.44	40	0.97	51	1.12
8	1.26	19	1.77	30	1.44	41	0.53	52	0.83
9	1.11	20	0.22	31	1.12	42	1.52	53	1.09
10	-0.30	21	1.45	32	0.60	43	0.96	54	1.69
11	-0.29	22	1.93	33	1.00	44	1.05	55	1.09

Table 1.11: **CTD conductivity calibration coefficients. F_1 , F_2 and F_3 are respectively conductivity bias, slope and station-dependent correction calibration terms. n is the number of samples retained for calibration in each station grouping; σ is the standard deviation of the conductivity residual for the n samples in the station grouping. α and β are the pressure dependent conductivity residual slope and offset corrections, applied to cruise au0207 stations 46 to 52 only.**

stn grouping	F_1	F_2	F_3	n	σ	α	β
AU0106							
001	0.29199982E-01	0.96552168E-03	0	21	0.001039		
002 to 021	0.46265417E-01	0.96492371E-03	-0.10179157E-08	119	0.001393		
022 to 040	0.49815656E-01	0.96474660E-03	0.13564129E-08	124	0.001336		
041 to 044	0.50817530E-01	0.96492963E-03	-0.51052707E-08	23	0.001949		
045 to 049	0.11267496	0.96415484E-03	-0.32197336E-07	50	0.001306		
050 to 060	0.76393887E-01	0.96382061E-03	0.80956231E-09	111	0.001186		
061 to 068	0.75251733E-01	0.96364365E-03	0.46410114E-08	72	0.001528		
069 to 076	0.74441386E-01	0.96373763E-03	0.41028423E-08	73	0.001260		
077 to 080	0.56141702E-01	0.96525940E-03	-0.65236485E-08	42	0.001858		
081 to 085	0.81697290E-01	0.96330495E-03	0.37859426E-08	46	0.001199		
086 to 089	0.85053519E-01	0.96057685E-03	0.33327864E-07	37	0.001254		
090 to 092	0.62027939E-01	0.96452760E-03	-0.25511704E-08	31	0.001563		
093 to 095	0.41095515E-01	0.96146076E-03	0.39174215E-07	34	0.001772		
AU0207							
001 to 010	-0.11032272E-01	0.94823520E-03	-0.83159275E-08	94	0.000741		
011 to 016	0.24291716E-01	0.94676769E-03	0.13706639E-07	34	0.000898		
017 to 021	-0.90952579E-02	0.94724982E-03	0.28458745E-08	47	0.000990		
022 to 026	-0.37164695E-01	0.94768151E-03	0.28659630E-07	49	0.001758		
027 to 043	0.76177998E-01	0.94443666E-03	-0.87654884E-09	129	0.001243		
044 to 051	-0.13029335	0.95130970E-03	0.77596009E-08	66	0.001000	-7.988E-06	0.0027647
052 to 055	-0.32095878E-02	0.94683601E-03	0.57372785E-08	41	0.000894	-7.998E-06	0.0027647

Table 1.12: Station-dependent-corrected conductivity slope term ($F_2 + F_3 . N$), for station number N, and F_2 and F_3 the conductivity slope and station-dependent correction calibration terms respectively.

station number	($F_2 + F_3 . N$)	station number	($F_2 + F_3 . N$)	station number	($F_2 + F_3 . N$)	station number	($F_2 + F_3 . N$)
AU0106							
1	0.96552168E-03	25	0.96478051E-03	49	0.96257717E-03	73	0.96403714E-03
2	0.96492168E-03	26	0.96478187E-03	50	0.96386109E-03	74	0.96404124E-03
3	0.96492066E-03	27	0.96478322E-03	51	0.96386190E-03	75	0.96404535E-03
4	0.96491964E-03	28	0.96478458E-03	52	0.96386271E-03	76	0.96404945E-03
5	0.96491862E-03	29	0.96478594E-03	53	0.96386352E-03	77	0.96475708E-03
6	0.96491760E-03	30	0.96478729E-03	54	0.96386433E-03	78	0.96475056E-03
7	0.96491659E-03	31	0.96478865E-03	55	0.96386514E-03	79	0.96474403E-03
8	0.96491557E-03	32	0.96479001E-03	56	0.96386595E-03	80	0.96473751E-03
9	0.96491455E-03	33	0.96479136E-03	57	0.96386676E-03	81	0.96392553E-03
10	0.96491353E-03	34	0.96479272E-03	58	0.96386757E-03	82	0.96393312E-03
11	0.96491252E-03	35	0.96479408E-03	59	0.96386838E-03	83	0.96394071E-03
12	0.96491150E-03	36	0.96479543E-03	60	0.96386919E-03	84	0.96394831E-03
13	0.96491048E-03	37	0.96479679E-03	61	0.96392675E-03	85	0.96395590E-03
14	0.96490946E-03	38	0.96479815E-03	62	0.96393139E-03	86	0.96344305E-03
15	0.96490844E-03	39	0.96479950E-03	63	0.96393603E-03	87	0.96347638E-03
16	0.96490743E-03	40	0.96480086E-03	64	0.96394067E-03	88	0.96350970E-03
17	0.96490641E-03	41	0.96472031E-03	65	0.96394531E-03	89	0.96354303E-03
18	0.96490539E-03	42	0.96471521E-03	66	0.96394996E-03	90	0.96429799E-03
19	0.96490437E-03	43	0.96471010E-03	67	0.96395460E-03	91	0.96429544E-03
20	0.96490335E-03	44	0.96470500E-03	68	0.96395924E-03	92	0.96429289E-03
21	0.96490234E-03	45	0.96270596E-03	69	0.96402073E-03	93	0.96510397E-03
22	0.96477644E-03	46	0.96267376E-03	70	0.96402483E-03	94	0.96514314E-03
23	0.96477780E-03	47	0.96264157E-03	71	0.96402894E-03	95	0.96518232E-03
24	0.96477916E-03	48	0.96260937E-03	72	0.96403304E-03		
AU0207							
1	0.94822688E-03	15	0.94697329E-03	29	0.94441124E-03	43	0.94439896E-03
2	0.94821857E-03	16	0.94698699E-03	30	0.94441036E-03	44	0.95463785E-03
3	0.94821025E-03	17	0.94729820E-03	31	0.94440948E-03	45	0.95464099E-03
4	0.94820193E-03	18	0.94730105E-03	32	0.94440861E-03	46	0.95464413E-03
5	0.94819362E-03	19	0.94730389E-03	33	0.94440773E-03	47	0.95464727E-03
6	0.94818530E-03	20	0.94730674E-03	34	0.94440685E-03	48	0.95465041E-03
7	0.94817699E-03	21	0.94730959E-03	35	0.94440598E-03	49	0.95465355E-03
8	0.94816867E-03	22	0.94831203E-03	36	0.94440510E-03	50	0.95465669E-03
9	0.94816036E-03	23	0.94834069E-03	37	0.94440422E-03	51	0.95465982E-03
10	0.94815204E-03	24	0.94836935E-03	38	0.94440335E-03	52	0.94713435E-03
11	0.94691846E-03	25	0.94839800E-03	39	0.94440247E-03	53	0.94714008E-03
12	0.94693217E-03	26	0.94842666E-03	40	0.94440159E-03	54	0.94714582E-03
13	0.94694587E-03	27	0.94441299E-03	41	0.94440072E-03	55	0.94715156E-03
14	0.94695958E-03	28	0.94441211E-03	42	0.94439984E-03		

Table 1.13: CTD raw data scans deleted during data processing. For raw scan number ranges, the lowest and highest scan numbers are not included in the action (except for scan 1).

station no.	raw scan nos.	reason	stn no.	raw scan nos.	reason
AU0106			***AU0207***		
3, upcast	3269-3274	P spike	16	1-6100	yoyo to unblock cond. cell
10, upcast	2314-2317	P spike	19	2716-2767	fouling of cond. cell
19, upcast	871-874	P spike	21	1469-1649	fouling of cond. cell
19, upcast	2118-2121	P spike	25	1-8234	yoyo to unfreeze cond. cell
36	1-550	CTD deck unit not warmed up			
36, upcast	5042-5049	P spike			
47, upcast	2110-2220	suspect data			
62	1,1500	CTD deck unit not warmed up			
59, upcast	1367-1370	P spike			
59, upcast	2821-2824	P spike			
74	1-1800	CTD deck unit not warmed up			
64, upcast	2200-2210	P spike			
89, upcast	408-411	P spike			

Table 1.14: Missing data points in 2 dbar-averaged files. "1" indicates missing data for the indicated parameters: T=temperature; S=salinity, σ_T , specific volume anomaly and geopotential anomaly; O=oxygen; F=fluorescence.

station no.	pressure (dbar) where data missing	T	S	O	F
AU0106					
1	whole stn			1	
1	1344-1346				1
2	2-14			1	
3	2-20			1	
4	2-48, 304-320			1	
5	2-24			1	
6	2-22			1	
6	236				1
7	2-24			1	
8	2-26			1	
8	264	1	1	1	1
9	whole stn			1	
9	84				1
10	2-24			1	
11	2-56, 124-144			1	
12	2-20, 106-134			1	
12	468			1	
13	2-32, 114-142			1	
14	2-24, 110-156			1	
15	2-26			1	
15	254				1
15	360	1	1	1	1
16	2-24, 124-176			1	
17	2-22, 112-150			1	
18	whole stn			1	
19	2-12, 226-240			1	
20	2-24, 94-144, 346-364			1	
21	2-24, 110-132			1	
22	2-30, 118-142			1	
23	2-22, 126-142			1	
24	82-106			1	
25	2-18, 128-142			1	
26	2-20			1	
27	2-38, 82-104			1	
28	2-22			1	
29	2-24, 114-136			1	
30	2-12, 96-116			1	
31	2-24			1	
31	156				1
32	2-24			1	
33	2-18			1	
34	whole stn			1	
35	2-12			1	
35	292				1
36	2-46, 254-262			1	
37	2-20, 84-120			1	
37	218				1
38	2-28, 94-130			1	
39	2-16, 104-130			1	
40	2-24, 106-132			1	
41	2-12, 68, 76-114			1	
42	2-4, 44-70			1	
43	2-6, 72-74			1	
44	2-6, 34-86			1	

Table 1.14: (continued)

station no.	pressure (dbar) where data missing	T	S	O	F
AU0106					
45	2-6			1	
45	98-100		1		
46	2-6, 92-114			1	
47	2-4, 102-122			1	
47	754				1
48	2-10			1	
49	2-6, 94-116			1	
50	2-10			1	
50	346				1
51	2-10, 92-114			1	
52	2-136			1	
53	whole stn			1	
54	whole stn			1	
55	2-10			1	
56	2-12, 84-86, 120-124			1	
57	2, 134-142			1	
58	2-8, 104-124			1	
59	2-6, 100-110			1	
60	2, 78-98			1	
61	2-4			1	
62	2-12			1	
63	2-12			1	
64	2-6			1	
64	36	1	1	1	1
64	740				1
65	2-12			1	
65	440				1
66	2-10			1	
67	2, 76-306			1	
67	146-306		1		
68	2-4			1	
69	2-6, 76-106			1	
70	2, 60			1	
70	100				1
71	428			1	
72	2-10			1	
76	2-4, 330-348			1	
76	132				1
77	396-398				1
78	2-20			1	
79	2			1	
80	2			1	
80	424				1
81	2			1	
81	260, 614				1
82	2-6			1	
83	2-4			1	
84	2, 548			1	
85	614-632		1		
85	684				1
86	2-18			1	
87	2-4			1	
88	2			1	
89	2			1	1
89	4			1	
89	380				1

Table 1.14: **(continued)**

station no.	pressure (dbar) where data missing	T	S	O	F
AU0106					
90	2-6			1	
90	58	1	1	1	1
91	2, 596-608			1	
92	2-12			1	
94	whole stn			1	
95	whole stn			1	
AU0207					
1	whole stn	1	1	1	1
2	whole stn	1	1	1	1
3	292-300		1	1	
4	1096-1108, 1134-1152			1	
12	whole stn			1	
14	whole stn			1	
15	whole stn			1	
16	whole stn			1	
16	2-6	1	1	1	1
20	whole stn			1	
21	6	1	1	1	
25	2-4	1	1	1	
30	whole stn	1	1	1	
36	whole stn			1	
41	448-456			1	
42	444-456			1	
51	whole stn			1	
53	whole stn			1	
54	whole stn			1	
55	whole stn			1	

Table 1.15: **2 dbar averages interpolated from surrounding 2 dbar values, for the indicated parameters: T=temperature; S=salinity, σ_T , specific volume anomaly and geopotential anomaly; F=fluorescence.**

station no.	interpolated 2 dbar values	parameters interpolated
AU0106		
4	434	T, S, F
7	350	T, S, F
31	58	T, S, F
77	426	T, S, F
AU0207		
54	1782	T, S

Table 1.16: **Suspect 2 dbar averages for the indicated parameters: T=temperature; S=salinity, σ_T , specific volume anomaly and geopotential anomaly; O=oxygen.**

stn no.	questionable 2 dbar value(dbar)	parameters	stn no.	questionable 2 dbar value (dbar)	parameters
AU0106					
10	96-98	O	54	2-4	S
11	2	T, S	55	2	S
16	2	T, S	56	2-4	S
23	2	S	65	2	S
26	2	T, S	66	2	S
30	2	S	67	2	S
40	2	S	68	2-4	S
42	2-4	S	72	2	S
44	2	S	85	2-4	S
50	2	S	90	2	S
AU0207					
3	2-18	O	29	2-10	O
4	2-14	O	32	2-24	O
5	2-52	O	33	2-22	O
6	2-64	O	35	2-24	O
7	2-42	O	37	2-28	O
8	2-32	O	38	2-28	O
9	2-50	O	39	2-12	O
10	12-46	O	40	2-20	O
11	2-22	O	42	2-18	O
13	2-46	O	43	2-18	O
17	2-24	O	44	2-20	O
18	2-18	O	45	2-20	O
19	2-22	O	46	2-22	O
21	2-20	O	47	2-26	O
22	2-20	O	48	2-24	O
23	2-24	O	49	2-20	O
26	2-30	O	50	2-10	O
27	2-24	O	52	2-20	O

<u>Table 1.17:</u> Questionable nutrient sample values (not deleted from hydrology data file).

PHOSPHATE		NITRATE		SILICATE	
station number	rosette position	station number	rosette position	station number	rosette position
AU0207					
4	3	4	3	4	3
5	8				
9	9				
11	4			11	3
				13	whole station
17	5	17	5		
				20	6
				24	7
26	2,3,10				
27	7	27	7	27	7
				29	5
				30	5,6,7,8
34	8				
				39,40,41	whole station
				47	1
				48	6

<u>Table 1.18:</u> Questionable dissolved oxygen bottle values (not deleted from hydrology data file).

AU0106

station number	rosette position
18	1

<u>Table 1.19:</u> Reversing protected thermometers used: serial numbers are listed; M=mercury, D=digital.

AU0106

station 1	M12095, M12105 on pos. 24; D1625, M12104 on pos. 12; D1624,M12119 on pos. 2	
stations 2 to 12	D1625, M12104 on pos. 24;	D1624, M12119 on pos. 2
stations 13 to 95	D1624, M12119 on pos. 2	

AU0207

stations 2 to 12	D1682, D1683 on pos. 12	D1624, D1625 on pos. 2
stations 13 to 16	D1682, D1683 on pos. 12	
stations 17 to 55	D1624 on pos. 2	

Table 1.20: CTD dissolved oxygen calibration coefficients. K_1, K_2, K_3, K_4, K_5 and K_6 are respectively oxygen current slope, oxygen sensor time constant, oxygen current bias, temperature correction term, weighting factor, and pressure correction term. dox is equal to 2.8σ (for σ as defined in Rosenberg et al., 1995); n is the number of samples retained for calibration in each station or station grouping.

station number	K_1	K_2	K_3	K_4	K_5	K_6	dox	n
AU0106								
2	4.494	9.00	-0.239	-0.10574	0.83781	0.21763E-03	0.09373	5
3	8.141	5.00	-1.172	-0.02861	0.74359	0.11070E-03	0.17491	6
4	10.297	4.50	-1.738	-0.06922	0.63877	0.28891E-03	0.16129	6
5	6.392	8.50	-0.795	-0.03475	0.14857	0.47479E-04	0.20807	7
6	7.105	10.00	-0.952	-0.05771	0.38020	0.22007E-04	0.13418	7
7	6.870	4.00	-0.946	-0.03185	0.16342	0.11084E-03	0.24847	7
8	6.310	7.00	-0.783	-0.03574	0.40731	0.25652E-04	0.13530	6
10	4.604	7.50	-0.299	-0.03399	0.72633	0.11829E-03	0.00463	4
11	4.891	7.50	-0.287	-0.11288	0.87836	0.91929E-04	0.13548	7
12	4.077	4.00	-0.180	-0.00335	0.72104	0.40774E-05	0.26049	6
13	8.029	4.00	-1.213	-0.02264	0.05819	0.14155E-03	0.17151	6
14	8.075	6.40	-1.160	-0.08662	0.80695	0.39974E-06	0.17662	6
15	8.213	4.00	-1.294	-0.10568	0.46760	0.50358E-03	0.14285	7
16	7.226	7.00	-1.082	-0.05999	0.10652	0.44531E-03	0.23100	7
17	6.848	4.50	-0.928	-0.03701	0.11955	0.94530E-04	0.14523	7
18	6.834	4.00	-0.975	-1.72390	0.70000	0.13007E-01	0.03266	4
19	4.299	4.50	-0.118	-0.08382	0.99546	0.99674E-04	0.10442	4
20	7.025	9.50	-1.035	-0.65624	0.47075	0.36326E-03	0.25064	7
21	5.240	4.00	-0.544	-0.05822	0.14968	0.86153E-04	0.06532	8
22	8.585	10.00	-1.364	-0.09392	0.52380	0.37796E-03	0.12321	8
23	6.769	10.00	-0.871	-0.03572	0.27213	0.12471E-04	0.17393	8
24	7.188	4.00	-0.984	-0.06441	0.42273	0.63989E-04	0.15997	7
25	7.499	7.50	-1.095	-0.02550	0.04924	0.14430E-03	0.06104	7
26	7.219	4.00	-1.038	-0.00135	0.67808	0.40597E-03	0.03856	5
27	5.041	4.00	-0.360	-0.19117	0.66649	0.18050E-03	0.10325	7
28	6.102	4.00	-0.748	-0.12501	0.37126	0.14756E-03	0.26203	8
29	6.540	4.00	-0.865	-0.05991	0.22797	0.17151E-03	0.14825	8
30	7.575	4.00	-1.144	-0.15715	0.39379	0.42708E-03	0.06358	7
31	6.377	5.50	-0.789	-0.03026	0.57144	0.21489E-05	0.27712	7
32	6.773	7.00	-0.883	-0.03164	0.43893	0.12814E-04	0.26785	8
33	6.439	10.00	-0.806	-0.05680	0.44195	0.12863E-04	0.14257	8
35	5.037	4.00	-0.400	-0.03900	0.82331	0.48308E-04	0.19764	6
36	6.931	10.00	-0.905	-0.04509	0.47848	0.17131E-05	0.09769	8
37	6.344	4.00	-0.783	-0.03392	0.33117	0.37737E-04	0.21715	7
38	6.715	10.00	-0.862	-0.03583	0.40369	0.47109E-04	0.10970	7
39	6.909	4.50	-0.903	-0.08464	0.62875	0.81151E-04	0.12885	6
40	4.916	4.50	-0.463	-0.05203	0.05110	0.29316E-04	0.21421	7
41	5.799	9.00	-0.700	-0.03566	0.42621	0.16616E-03	0.00211	4
42	5.668	5.50	-0.619	-0.00212	0.72339	0.11190E-04	0.16545	6
43	6.497	4.00	-0.800	-0.02293	0.71910	0.90512E-05	0.02102	6
44	3.458	10.00	0.001	-0.02279	0.96560	0.23631E-03	0.22617	4
45	3.536	6.50	0.017	-0.05361	0.72818	0.64078E-04	0.12994	12
46	2.543	7.50	0.290	-0.03614	0.99703	0.43755E-04	0.13566	11
47	2.500	10.00	0.301	-0.23919	0.57241	0.37505E-04	0.13874	12
48	4.347	7.00	-0.210	-0.04330	0.79302	0.13075E-03	0.06438	12
49	6.167	9.00	-0.708	-0.01044	0.75465	0.17267E-03	0.09801	10
50	6.440	4.00	-0.766	-0.00236	0.82437	0.15659E-03	0.11758	12
51	5.285	6.50	-0.463	-0.01574	0.79007	0.14334E-03	0.15205	12
52	4.796	10.00	-0.279	-0.05812	0.92884	0.12471E-03	0.13415	8
55	5.058	4.00	-0.389	-0.03685	0.72421	0.11764E-03	0.05976	12

Table 1.20: (continued)

station number	K_1	K_2	K_3	K_4	K_5	K_6	dox	n
AU0106								
56	7.037	6.00	-0.957	-0.00431	0.22740	0.23279E-03	0.12593	12
57	1.411	4.00	0.615	-0.06252	0.99782	0.51437E-04	0.20029	10
58	0.929	4.00	0.729	-0.06526	0.87758	0.92644E-06	0.18206	11
59	5.991	4.50	-0.648	-0.00243	0.77873	0.13627E-03	0.17484	12
60	5.490	4.00	-0.498	-0.05476	0.70060	0.16975E-03	0.14955	11
61	6.019	6.50	-0.662	-0.01380	0.80440	0.20610E-03	0.09887	12
62	4.020	7.00	-0.118	-0.03672	0.84404	0.14402E-03	0.08328	12
63	6.327	10.00	-0.746	-0.00249	0.77285	0.21029E-03	0.11717	12
64	4.271	9.50	-0.240	-0.01138	0.08743	0.12092E-03	0.14510	10
65	6.188	8.00	-0.689	-0.01720	0.77901	0.14464E-03	0.07895	12
66	4.603	10.00	-0.276	-0.02774	0.82031	0.94361E-04	0.10744	12
67	3.393	5.50	0.050	-0.45057	0.56281	0.31285E-03	0.18923	11
68	2.697	4.00	0.253	-0.05107	0.84232	0.90226E-04	0.11526	10
69	1.547	10.00	0.551	-0.05594	0.96992	0.89954E-04	0.19063	11
70	2.336	4.00	0.347	-0.04798	0.91139	0.60984E-04	0.18635	11
71	6.928	5.50	-0.815	-0.00626	0.75484	0.14341E-03	0.03878	8
72	3.852	4.00	-0.009	-0.03416	0.99839	0.88005E-04	0.22006	10
73	3.075	7.50	0.177	-0.04246	0.98551	0.90608E-04	0.21553	12
74	3.489	5.50	0.094	-0.03555	0.99792	0.55967E-04	0.10856	11
75	4.012	5.00	-0.057	-0.17371	0.58973	0.93304E-04	0.07857	11
76	8.163	4.00	-1.111	-0.08099	0.52124	0.20943E-03	0.23257	12
77	7.765	6.50	-1.059	-0.00858	0.83216	0.34381E-03	0.17744	11
78	7.962	9.50	-1.088	-0.02689	0.59625	0.27684E-03	0.10222	11
79	4.278	4.00	-0.128	-0.04123	0.96149	0.16101E-03	0.13643	12
80	5.332	4.00	-0.413	-0.02321	0.87802	0.17364E-03	0.13393	12
81	3.513	4.00	0.065	-0.04261	0.98631	0.10118E-03	0.14755	12
82	5.609	4.00	-0.455	-0.03326	0.97024	0.13211E-03	0.19940	12
83	8.287	4.00	-1.149	-0.00906	0.80193	0.20969E-03	0.20914	12
84	5.504	4.00	-0.419	-0.09819	0.66859	0.12473E-03	0.19804	12
85	7.188	4.00	-0.883	-0.02618	0.66460	0.19322E-03	0.12843	12
86	6.228	10.00	-0.627	-0.02684	0.83415	0.16836E-03	0.11759	11
87	2.930	4.00	0.223	-0.06422	0.89488	0.10432E-03	0.12989	12
88	5.651	4.00	-0.509	-0.02285	0.84308	0.15530E-03	0.15855	12
89	2.804	4.00	0.263	-0.05156	0.92487	0.55337E-04	0.15043	12
90	5.624	4.00	-0.449	-0.02527	0.91729	0.91838E-04	0.12638	12
91	5.947	9.00	-0.553	-0.01402	0.76633	0.10549E-03	0.16487	12
92	6.764	5.50	-0.779	-0.00091	0.92124	0.15776E-03	0.20886	11
93	4.700	9.00	-0.276	-0.01906	0.76632	0.12551E-03	0.18835	11
AU0207								
3	7.859	10.00	-1.063	-0.03303	0.46219	0.37136E-03	0.09176	10
4	8.126	6.00	-1.070	-0.02787	0.10215	0.11533E-03	0.15313	11
5	3.242	4.50	0.111	-0.02890	0.70917	0.81475E-04	0.08035	11
6	4.109	10.00	-0.094	-0.03617	0.75658	0.10402E-03	0.09585	11
7	2.490	6.50	0.303	-0.02707	0.71318	0.59463E-04	0.07093	11
8	3.018	6.50	0.184	-0.03038	0.72185	0.47992E-04	0.08330	11
9	3.423	5.50	0.101	-0.03687	0.75149	0.72625E-04	0.02413	11
10	6.333	4.00	-0.579	-0.03135	0.73545	0.11472E-03	0.09120	10
11	8.379	4.00	-1.053	-0.03260	0.75047	0.15599E-03	0.16996	11
13	4.022	4.00	0.137	-0.11080	0.97287	0.50469E-04	0.16432	10
17	2.967	5.50	0.097	-0.02815	0.69110	0.10057E-03	0.25627	10
18	3.194	4.50	0.080	-0.05411	0.78816	0.75553E-04	0.16060	11
19	2.673	4.00	0.192	-0.03720	0.76595	0.78480E-04	0.16046	11
21	4.156	5.00	-0.209	-0.03373	0.72777	0.13164E-03	0.23288	12

Table 1.20: (continued)

station number	K_1	K_2	K_3	K_4	K_5	K_6	dox	n
AU0207								
22	4.702	9.50	-0.379	-0.03785	0.76966	0.26685E-03	0.21261	12
23	4.880	9.50	-0.584	-0.12339	0.18692	0.34676E-03	0.18013	12
24	3.063	6.50	0.177	-0.07580	0.90287	0.70309E-04	0.04107	11
25	7.429	6.50	-1.098	-0.03742	0.86538	0.30474E-03	0.07801	12
26	3.620	4.00	-0.092	-0.03892	0.77166	0.17549E-03	0.07618	11
27	3.805	10.00	-0.082	-0.03825	0.77374	0.64142E-04	0.13152	10
28	4.947	7.00	-0.451	-0.03240	0.31959	0.15374E-03	0.07419	12
29	4.383	4.00	-0.266	-0.03437	0.74376	0.11301E-03	0.16528	12
31	3.390	6.00	-0.001	-0.03271	0.70840	0.79299E-04	0.04173	10
32	4.851	7.00	-0.279	-0.10037	0.92694	0.11089E-03	0.17938	11
33	4.894	4.50	-0.401	-0.03380	0.73706	0.12089E-03	0.07944	11
34	2.353	4.00	0.472	-0.61617	0.57987	0.64212E-06	0.13090	12
35	4.428	10.00	-0.289	-0.03218	0.70814	0.13269E-03	0.10740	12
37	3.318	10.00	-0.007	-0.00126	0.66255	0.78714E-04	0.04884	11
38	2.668	10.00	0.207	-0.03447	0.72714	0.27970E-04	0.13035	11
39	6.580	5.00	-0.926	-0.06571	0.29660	0.19237E-03	0.21421	11
40	3.908	9.00	-0.101	-0.02854	0.69251	0.88327E-05	0.09081	12
41	2.455	4.00	0.342	-0.07352	0.92911	0.36730E-04	0.16276	11
42	6.972	10.00	-0.958	-0.01620	0.75026	0.19117E-03	0.16087	11
43	5.000	7.00	-0.379	-0.05373	0.86348	0.14143E-03	0.17112	10
44	4.322	7.00	-0.459	-0.11526	0.12669	0.28477E-03	0.09800	12
45	4.207	4.00	-0.242	-0.02896	0.75060	0.16056E-03	0.15113	12
46	3.435	4.00	0.004	-0.03424	0.73617	0.61044E-04	0.14303	11
47	4.466	8.50	-0.318	-0.02725	0.25168	0.98322E-04	0.09665	12
48	3.540	9.50	-0.026	-0.02846	0.69181	0.57214E-04	0.07605	12
49	4.318	4.00	-0.248	-0.03376	0.38881	0.54600E-04	0.16218	11
50	2.391	4.00	0.365	-3.31690	0.50344	0.11329E-04	0.19863	11
52	3.626	10.00	-0.045	-0.03225	0.62679	0.15236E-04	0.18080	11

APPENDIX 1.1 HYDROCHEMISTRY CRUISE LABORATORY REPORTS

A1.1.1 AU0106 HYDROCHEMISTRY LABORATORY REPORT

Clodagh Curran and Sarah Howe

Seawater samples for salinity and dissolved oxygen concentrations were analysed on this cruise. Nutrient samples were collected in quadruplicate, two frozen at –80°C and two refrigerated at 4°C, for intended analysis on return to Hobart. Samples were collected from 96 stations: 40 from the Mawson coast krill box survey, 3 from the Casey area on return to the Amery Ice Shelf, 50 off the Amery Ice Shelf, 1 from the Amery Ice Shelf itself and 2 Calibration CTD's at the end of the voyage. The methods used are described in the Antarctic CRC hydrochemistry manual (Eriksen, 1997). Additional samples were also collected for the AMISOR project, as described later in this report.

Number of samples analysed
Salinities : 1152
Dissolved oxygens : 1116
Nutrients (collected): 4464 (2232 frozen, 2232 frigerated for comparison study)

Salinity

Salinities were analysed by Clodagh Curran in Lab 3.
A Guildline salinometer, SN 62549 was used.
Ocean Scientific IAPSO standard seawater, batch P133 (11 Nov 1997), was used to standardise the salinometer throughout the cruise.
Repeat standardisations, ie P133 measured against P133, showed no difference (ie 2R of <0.0 0000) over 33 repeats during the cruise.
Three P130 standards were measured. They showed no difference, average being 0.0000 psu.
Four 35N1 standards were measured. They showed no difference, average being 0.0000 psu.
One P126 and and one P128 were also measured. The P126 was 0.0005 psu units higher than its nominal value; the P128 was significantly higher than its nominal value, ie. 0.00248.

There were some problems controlling the temperature of Lab 3 for two days during the krill study. PID temperature controller was used to control the temperature, however the ship's air conditioning was a bit warmer than required as other parts of the ship were very cold. The temperature was finally lowered by a few degrees, which was enough for the temperature controller to step in and maintain the temperature at 21 degrees. Two days were lost due to unstable temperature in the lab, and in addition some salinity analyses from stations 16 and 17 were compromised.

During the AMISOR project the salinometer ran very well and there were no temperature control or other problems.

* Files updated:
sal_std_check.xls
sal62549.xls

Dissolved oxygen

Dissolved oxygen analyses were performed by Sarah Howe.
There were no major problems, only minor operational problems which were sorted out at the time.
Simple familarity with the system was all that was required, particularly with the software. It is a bit quirky.
Standardisation and blank values were collated and plotted from this and previous cruises, to help identify outlying or suspicious values.
The average standardisation value and average standard deviation was 4.425 +/- 0.002 ml of thiosulfate. This is 297.7 +/- 0.14 μmol/L of oxygen, or 0.04%.

The average blank value and average standard deviation was 0.006 +/- 0.001 ml of thiosulfate.

Files:
do_std&blank.xls, a9901
do_std&blank.xls, all   collation of DO standardisation values
do_std&blank.xls, charts   charts of standardisation values
do.xls, variable summary
do.xls, hydro_calc_check

General data handling

Plots were made of property vs station to check for suspicious data, or wrongly entered data. These plots were based on the data in the CSV file, and can be opened via the macro CSV in A0106.XLM. Data was backed up to 250MB Iomega Zip disks.

Laboratories

The salinometer was in Lab3, and the DO and MQ systems were in the photolab. The salinometer was in the middle of the lab equal distance from the porthole, door and to the side of the fume cupboard; the DO system was on the port side bench of the photolab. The MQ system was in the photolab on the forward bulkhead.

Temperature monitoring and control

Temperature was controlled by the ships air conditioner, and by a CAL Controls Ltd ‘CAL 9900’ proportional derivative plus integral (PID) temperature controller in lab 3. The photolab had no temperature controller. The ship’s heating inlets above the saliniometer were taped closed for the first few days of analysis, however it became too warm in lab 3. Two days of analysis time were lost due to variable temperature reading in the lab. The door of the lab was tied opened and the cool air from the corridor allowed in. The ship’s heating was turned down but the inlet in the lab was covered over to prevent a draft. The temperature then stabilised in lab 3 and analyses resumed. The photolab was heated by the ship’s heating, however it still fluctuated a little as the wet lab trawl deck door was open allowing cool air into the ship and cooling the aft part of the ship on the E deck.

The laboratory temperature was recorded by two Tinytalk units. One was positioned beside the salinometer, while the other was positioned beside the DO system. The temperature was also measured by a mercury thermometer in the photolab and the temperature monitored by the PID controller in lab 3. 'Indoor/outdoor' electronic thermometers were used to measure the fridge.

The air temperature about the salinometer was generally 21.0 +/- 1 °C.

Purified water

About 280L (~14 x 20L carboys) of water was produced for this cruise.
The water system did not need any cartridges or tanks changed. Two 13 litre leased mixed bed deioniser (MBDI) tanks were used.

Additional samples collected

A number of different samples were collected, as described below:

*** Underway samples for Martin Lourey**
Collected by Clodagh Curran and Sarah Howe.
Samples collected for: salinity, nutrients, N-15, C-14 and 1.5L for diatoms, at 8 sites (approximately every 2 degrees) on the south and north legs. The nutrient and N-15 samples were frozen at –80

degrees. A 50ml sample of filtered seawater was acidified with 50µl of 50% HCl for N-15. A 250ml sample of filtered seawater was poisioned with 100µl for C-14. And a 1.5L filtered seawater sample was poisioned with 2ml of Lugols solution for Diatom analysis every second station.

*** Underway size fractionation for Martin Lourey**
Underway water was filtered through 142mm dia Whatman GF/F, 5µm 20µm, 70µm, 200µm and 1000µm at 8 sites (approximately every 2 degrees) on the south and north legs of the cruise. The filters were collected and frozen at -80°C for Marty too. This filtered water was used for the underway samples.

A1.1.2 AU0207 HYDROCHEMISTRY LABORATORY REPORT

Clodagh Curran and Lindsay Pender.

This hydrochemistry was part of the repeat AMISOR program on Voyage 7 on the Aurora Australis. Seawater samples were analysed for salinity, nutrients (NO2, NO3, Si and P) and dissolved oxygen concentrations. Samples were collected from 55 stations in total, including 51 CTD's along the Amery Ice Shelf and 4 Test Casts in deep water in the Southern Ocean. The methods used are described in the CSIRO hydrochemistry manual (Cowley, 2001), and in Cowley and Johnston (1999).

Number of samples analysed
Salinities : 607
Dissolved Oxygens : 467
Nutrients : 600 taken in duplicate (none analysed on board); 218 PSI samples analysed from V3.

Salinity

Salinities were analysed by Clodagh Curran over a 12 hour period each day in the wet lab. A Guildline salinometer, SN 62549 was used. Ocean Scientific IAPSO standard seawater, batch P140 (10 Nov 2000), was used to standardise the salinometer throughout the cruise. Repeat standardisations, ie P140 measured against P140, showed no difference (ie 2R of <0.0 0000) over 10 repeats during the cruise.

During the AMISOR program there were no problems controlling the temperature of the wet lab due to the cold outside temperatures. The temperature ranged between 18.5 and 20.5 degrees in the lab. A PID temperature controller was used to control the temperature and an independent airconditioner in the wet lab.

* Files updated:
sal_std_check.xls
sal62549.xls

Dissolved oxygen

Dissolved oxygen analyses were performed by Lindsay Pender in the wet lab.
There were no problems with the DO system. Standardisation and blank values were collated from this and previous cruises, and plotted, to help identify outlying or suspicious values.
The average standardisation value and average standard deviation was 4.425 +/- 0.002 ml of thiosulfate. This is 297.7 +/- 0.14 µmol/L of oxygen, or 0.04%.
The average blank value and average standard deviation was 0.006 +/- 0.001 ml of thiosulfate.

Files:

do_std&blank.xls, a9901	
do_std&blank.xls, all	collation of DO standardisation values
do_std&blank.xls, charts	charts of standardisation values
do.xls, variable summary	
do.xls, hydro_calc_check	

Nutrients

Initial nutrient analyses were conducted by Clodagh Curran over a 12-14 hour period each day. The analyser was shutdown overnight for safety reasons. Phosphate, silicate, nitrite and nitrate methods were used as per CSIRO methods. A new automatic switching valve system was used to change over from reagents to MQ and carrier etc and included a baseline calibration. Standards were made up every couple of days in low nutrient seawater (collected from Maria Island and filtered and autoclaved before going on the cruise). The carrier was artificial seawater (or sodium chloride in MQ). New software "Winflow" was also used, and it proved to be user friendly and flexible. A standard run included a baseline calibration using the switching valves which took approximately 45 mins, followed by a set of standards, some SRM's (Standard Reference Material from Ocean Scientific) and QC's (LNSW spiked with nutrients) followed by samples (up to 48) followed by a second set of standards, SRM's and QC's. A run normally took about 3 hours to complete.

At the beginning of the cruise particulate silicate samples (taken from V3 and digested before going on V7) were analysed for silicate. The other two systems nitrate/nitrite and phosphate were running, but were ignored for these samples. These samples were made up in ASW so a few things were changed in the system. The carrier was ASW, LNSW was replaced with ASW and the standards/SRM's were made up in ASW. These analyses went well and the results were sent back to Dr. Tom Trull in Hobart.

Once these samples were completed, the system was thoroughly washed, pump tubes replaced and the three mixing blocks dismantled and cleaned in MQ in the ultrasonic bath. A new batch of reagents were made up, as well as new Standards/SRMs made up in LNSW (which was filtered 0.45μm and autoclaved). Silicate ran well, but phosphate and nitrate didn't. The phosphate channel was a little unstable, with the problems only minor and easily fixed - phosphate then ran well. The nitrate system was also unstable, giving poor peak height and shape. Sensitivity was lost, and baselines were high for ASW compared to MQ and LNSW. The Cd coil was removed to simplify fixing the problems. A normal run was done to see what the baselines were doing. There was a significant increase in baseline from MQ to ASW and from LNSW to ASW. The ASW had a pink tinge to it when run with the colour reagent. This suggested contamination in the system.

A number of experiments were then undertaken to determine the cause of the contamination. Firstly the MQ was tested with ship MQ and Uni MQ (stored in the net store). There was no change in the system, so this suggested that the cause was not the MQ system. The NaCl was then tested: different batches and brands of NaCl were tested with no change in the system, so this suggested that the cause was not the NaCl. This left the reagents as the possible cause. New reagents were made up with new acid and new surfactant, Brij-35, still with no change to the system. This suggested that the cause was either NEDD, Sulphanilamide or Imidazole. There was no way of testing these chemicals on board the Aurora, as all the reagent packets were from the same batch.

The system was thoroughly cleaned again with 10% HCl and MQ, then surfactant, and tested again. Problems were still serious, so no further nutrients were analysed on the ship, and samples were stored for analysis in Hobart (analysis completed in May 2002).

General data handling

Data for Dissolved Oxygen and Salinity was entered in to HYDRO as per normal. Plots were made of property vs station to check for suspicious data or wrongly entered data. They are based on the data in the CSV file, and can be opened via the macro CSV in A0103.XLM. Data was backed up to 250MB Iomega Zip disks.

Laboratories

The Salinometer, DO system and nutrient systems were all in the wet lab. The MQ system was in the photolab. The systems were set up on voyage 3 (October 2001), and remained on the ship till voyage 7. The salinometer was on the aft bench, starboard side near the porthole. The nutrient system was on the remaining aft bench. The DO system was on the starboard sorting bench. The port side bench near the door to the trawl deck was used to prepare reagents and runs for the nutrients. The fish bowl contained the data computer, stationary and manuals.

Temperature monitoring and control

Temperature in the wet lab was controlled by an independent air conditioner on the starboard side bulkhead and by a CAL Controls Ltd ‘CAL 9900’ proportional derivative plus integral (PID) temperature controller. The photolab had no temperature controller. The ship’s heating inlets above the salinometer were taped closed. The temperature from the air conditioner fluctuated from 16 to 18 degrees, allowing good temperature stability in the wet lab. The cold temperatures experience outside the ship during the cruise allowed for a fairly cool interior ship temperature. The air conditioner was monitored regularly to reduce large fluctuations in temperature. The photolab was heated by the ship’s air conditioning, and maintained a steady temperature.

The laboratory temperature was recorded by two Tinytalk units. One was positioned beside the salinometer, while the other was positioned beside the DO system. The temperature was also measured by a digital thermometer above the salinometer and the temperature monitored by the PID controller in the wetlab. 'Indoor/outdoor' electronic thermometers were used to measure the fridge and freezer. The air temperature about the salinometer was generally 20.0 +/- 1 °C.

Purified water

A new RO system was bought before voyage 3 instead of using the MBDI tanks. The system seemed to work ok so it remained on the ship for Voyage 7. However, due to the contamination in the nutrient system, the MQ filters were all changed mid-way through the cruise. About 500L (~25 x 20L carboys) of water was produced for this cruise.

Additional samples analysed.

218 particulate silicate samples, taken on Voyage 3, were analysed successfully for silicate, and the results forwarded to Dr. Tom Trull during the cruise.

APPENDIX 1.2 AMERY ICE SHELF BOREHOLE AM02 CTD DATA, 2000/2001 SEASON - DATA PROCESSING AND QUALITY

Mark Rosenberg (data processor)
Amery Ice Shelf borehole drill team (data collectors)

A1.2.1 INTRODUCTION

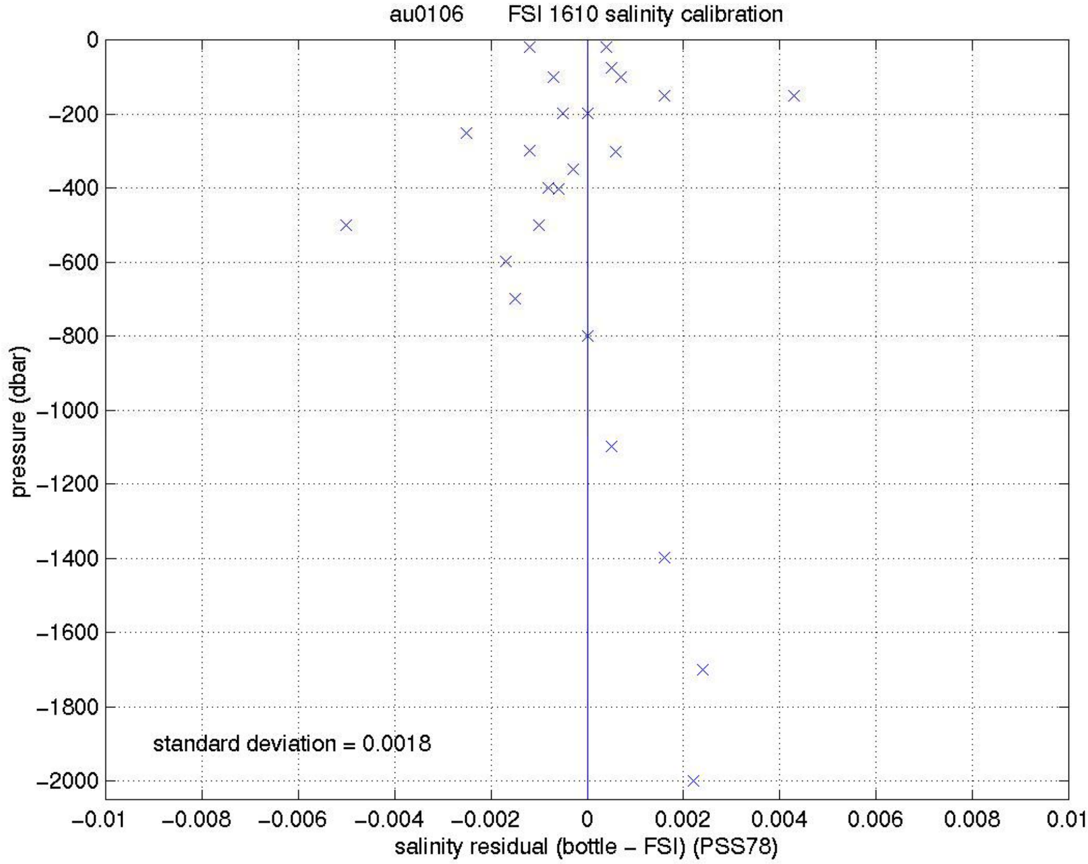
Eight CTD casts were taken through a borehole in the Amery Ice Shelf during the 2000/2001 season (M. Craven et al., AMISOR borehole field reports, in preparation), using an FSI 3" MicroCTD, serial 1610. Following the ice shelf field work, FSI MicroCTD calibration checks were performed on two CTD casts aboard the Aurora Australis, cruise au0106, en route back to Hobart. This appendix details processing and calibration of the data, and describes data quality. It is important to acknowledge the Amery Ice Shelf borehole drilling team for their successful data collection efforts under difficult field conditions. This acknowledgement applies to the data described in Appendices 1.2, 1.3 and 1.4.

A1.2.2 DATA CALIBRATION

Data were output from the FSI CTD in engineering units, with manufacturer supplied calibration coefficients (May, 2000) applied for temperature, pressure and conductivity. With these calibrations alone the data are not sufficiently accurate to be useful, and further calibration steps are required. In particular, CTD conductivity calibrations are usually obtained using in situ salinity bottle samples. Unfortunately the bottle samples collected were not useful, due to malfunction of the new Niskin bottle system deployed through the borehole along with the CTD. Final conductivity calibrations for the borehole data were therefore obtained from 2 casts aboard the Aurora Australis. For these 2 casts the FSI MicroCTD, in internally recording battery-powered mode, was attached to the ship's main rosette system, and 2 routine 12 bottle casts were taken (Table A1.2.1) with GO (i.e. General Oceanics) CTD serial 1193.

<u>Table A1.2.1:</u> CTD station details for Amery Ice Shelf Borehole AM02 CTD's, and Aurora Australis cruise au0106 FSI calibration CTD's. Note: depth to water surface=distance from top of borehole down to water surface in the borehole; bottom depth=total water depth from water surface to ocean bottom; max.P=maximum pressure of CTD cast; elevation=CTD elevation above bottom at the bottom of the cast.

station	time	date	latitude	longitude	borehole depth (m)	depth to water surf. (m)	bottom depth (m)	max.P (dbar)	elev. (m)
Borehole CTD									
1	1010	01-JAN-2001	69:42.80S	72:38.40E	380	46	790	800	0
3	1925	01-JAN-2001	69:42.80S	72:38.40E	380	46	790	256	537
4	0632	02-JAN-2001	69:42.80S	72:38.40E	372	47	790	788	11
5	1622	02-JAN-2001	69:42.80S	72:38.40E	372	47	790	768	31
6	0728	03-JAN-2001	69:42.80S	72:38.40E	372	47	790	778	21
7	0122	04-JAN-2001	69:42.80S	72:38.40E	372	47	790	778	21
8	0817	05-JAN-2001	69:42.80S	72:38.40E	372	47.5	790	778	21
9	1253	05-JAN-2001	69:42.80S	72:38.40E	372	47.5	790	778	21
au0106 CTD									
94	0243	28-FEB-2001	65:09.55S	84:33.84E			-	702	-
95	0412	28-FEB-2001	65:09.68S	84:34.04E			-	2002	-



<u>Figure A1.2.1:</u> Salinity residual (bottle – FSI) for au0106 data, after application of ship-derived conductivity correction to FSI data.

au0106 FSI CTD processing and calibration

The following processing steps were followed for the two au0106 casts to obtain calibration corrections for the FSI pressure and conductivity:

* Surface pressure offset was found by averaging the 20 pressure points previous to the CTD entering the water. This offset was then removed from FSI pressure data.

* Upcast burst data were formed by retaining the 30 sec. of data previous to each bottle firing, then averaging these 30 sec. bursts. Burst averages were then merged with GO upcast burst averages, and salinity bottle data.

* Separate pressure monotonic files were formed for downcast and upcast data.

* The upcast pressure burst averages for the FSI CTD were linearly fitted to the GO pressure burst averages. The following linear correction was then applied to all FSI pressure data:

$$p_{cal} = 1.00306\ p_{raw} + 0.24599 \qquad \text{(eqn A1.2.1)}$$

where p_{cal} and p_{raw} are respectively the corrected and uncorrected FSI pressure. Note that when obtaining the best fit, equal weight was given to both a fit through 0 pressure at the surface, and to the rest of the pressure data. However, application of this pressure correction still causes a small error of ~0.3 dbar to pressures near the surface.

* FSI conductivity was calibrated using the salinity bottle data (Figure A1.2.1), as per the method described in Rosenberg et al. (1995). Both stations were grouped together to provide a single calibration fit (i.e. no station dependent term). The linear correction obtained was:

$$c_{cal} = 0.99192\, c_{raw} + 0.080047 \qquad \text{(eqn A1.2.2)}$$

where c_{cal} and c_{raw} are respectively the corrected and uncorrected FSI conductivity; this correction was applied to all FSI conductivity data.

* 2 dbar averages were formed for temperature, corrected pressure and corrected conductivity, from the pressure monotonic downcast and upcast files. Note that a minimum attendance of 2 data points was required to form each 2 dbar bin. A salinity value for each 2 dbar bin was then calculated from these averages.

Borehole FSI CTD processing and calibration

* Data logged as station 2 was the upcast for station 1, and was appended to station 1 data (therefore no station 2).

* Surface pressure offsets were found and applied as described above.

* Separate pressure monotonic files were formed for downcast and upcast data, and the pressure and conductivity corrections found above were applied.

* 2 dbar averaged files were formed for downcast and upcast data, as described above. Note that for the borehole data, a minimum attendance of 3 data points was required to form each 2 dbar bin.

A1.2.3 DATA QUALITY

au0106 FSI and GO CTD comparisons

Data comparisons between the FSI and GO CTD's for the 2 calibration casts on cruise au0106 are shown in Figures A1.2.3 to A1.2.6.

From Figure A1.2.5, there is a temperature calibration difference between the two instruments, as follows:

above 0°C $t_{fsi} > t_{GO}$ by ~0.003°C

below -0.4°C $t_{fsi} < t_{GO}$ by ~0.005°C

-0.4 to 0°C transition zone between above two ranges

There appears to be a calibration offset between the two instruments at positive temperatures; at sub-zero temperatures, the response of the two instruments is different. This comparison alone does not indicate which instrument is in error, and the FSI temperature data can therefore only be assumed accurate to 0.005°C.

From Figure A1.2.6, FSI and GO CTD salinities compare well, to within ~0.002 (PSS78); the exception is the downcast data in the steep vertical gradients down to ~500 dbar, where FSI salinities are greater than GO values (Figure A1.2.6a).

Borehole FSI CTD data

Downcast FSI CTD data for borehole AM02 are shown in Figures A1.2.7 and A1.2.8. Note that data inside the borehole (i.e. top 300 dbar) are not shown in the figures.

Downcast and upcast temperature data agree well, and all 8 stations are consistent for temperature (Figure A1.2.7). Note that at station 1, the CTD was accidentally laid on the bottom, however this does not appear to have affected temperature data.

Salinity data for stations 1 to 5 (Figure A1.2.8) are unrealistically high when compared to ship-based measurements from the region (Figure A1.2.10), thus station 1 to 5 salinity data are assumed to be bad. Note that conductivity values dropped after the bottom contact during station 1, however values soon returned to normal on the upcast. The precision of salinity data for stations 6 to 9 is good, with good agreement between downcast and upcast data. Without salinity bottle data to provide in situ calibrations, these data cannot be considered up to the usual accuracy. In fact data from later seasons (Appendices 1.3 and 1.4) indicate that these salinities may be low by ~0.03 (PSS78) (i.e. conductivity low by ~0.02 mS/cm). The reason for the anomalously high salinity (i.e. conductivity) data for stations 1 to 5 is not known, however the most likely cause is physical interference with the field surrounding the inductive conductivity cell (i.e. an object too close to the sensor, but no longer there after station 5).

Summary of borehole CTD data

parameter	**accuracy**	**good data**	**bad data**
temperature	**0.005°C**	**station 1-9**	**-**
salinity	**possibly low by ~0.03 (PSS78)**	**station 6-9**	**station 1-5**

au0106 AMISOR leg 1 CTD data

Ship-based CTD data from cruise au0106 AMISOR leg 1 are shown in Figures A1.2.9 and A1.2.10. Note that only the stations closest to the borehole site (Figure A1.2.2) are plotted. Overall these ship-based data provide qualitative confirmation of the borehole CTD data.

A1.2.4 DATA FILE FORMATS

2 dbar averaged CTD data from borehole AM02 are contained in ascii and matlab format files, as follows:

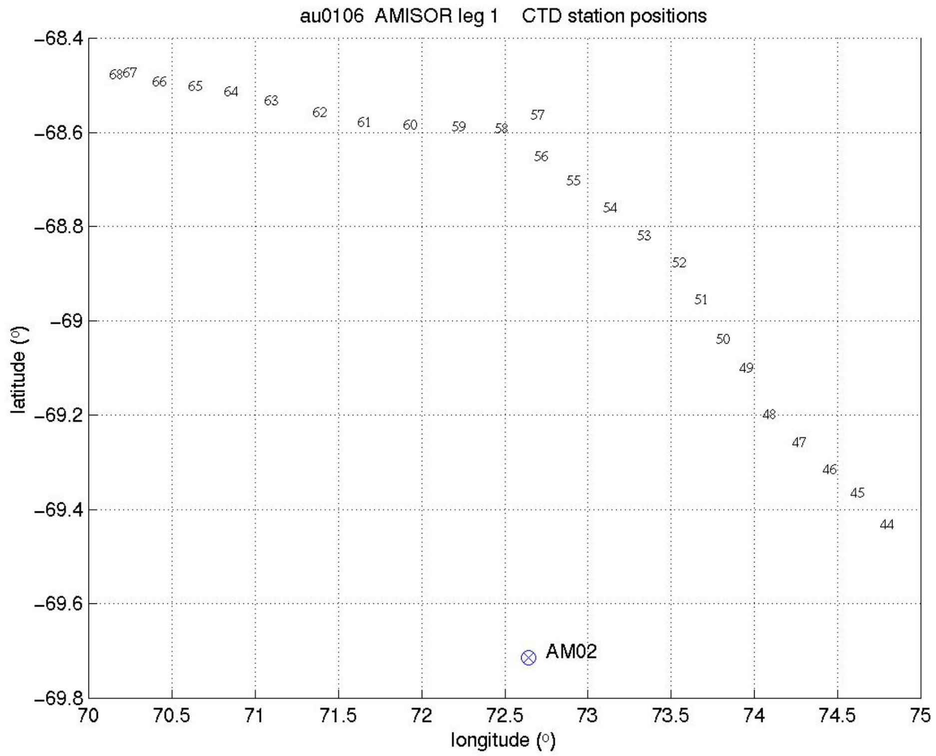
ascii

am02dxxx.dwc_av	downcast data
am02dxxx.upc_av	upcast data

where xxx=station number, and “c” indicates calibrated data. The files contain 2 header lines, followed by the data in column format. Note that there is a line of data for each 2 dbar bin, and missing values are filled by blanks.

matlab

am02dwn.mat	downcast data
am02up.mat	upcast data



<u>Figure A1.2.2:</u> CTD station positions for cruise au0106 AMISOR leg 1, and Amery Ice Shelf borehole AM02.

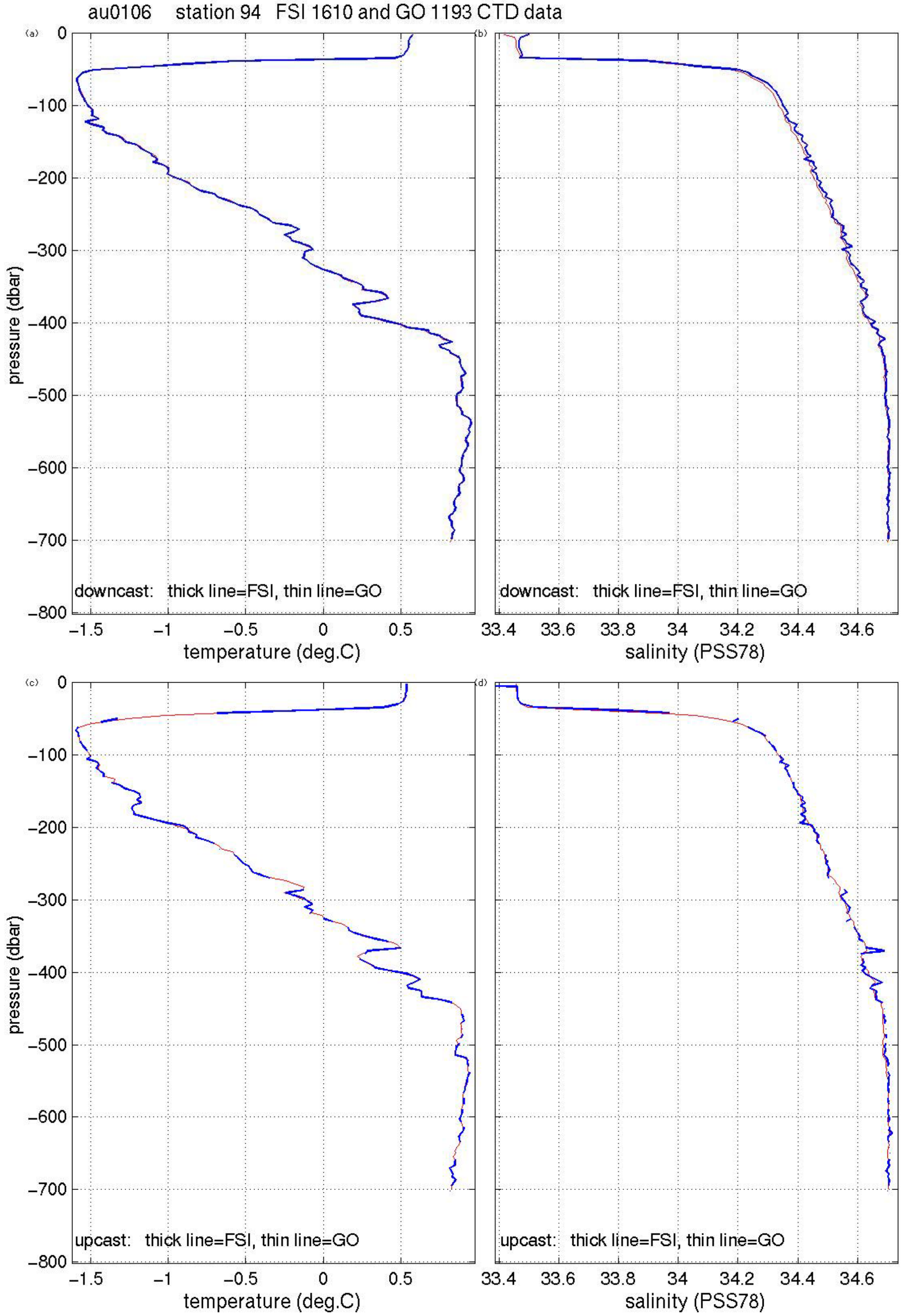
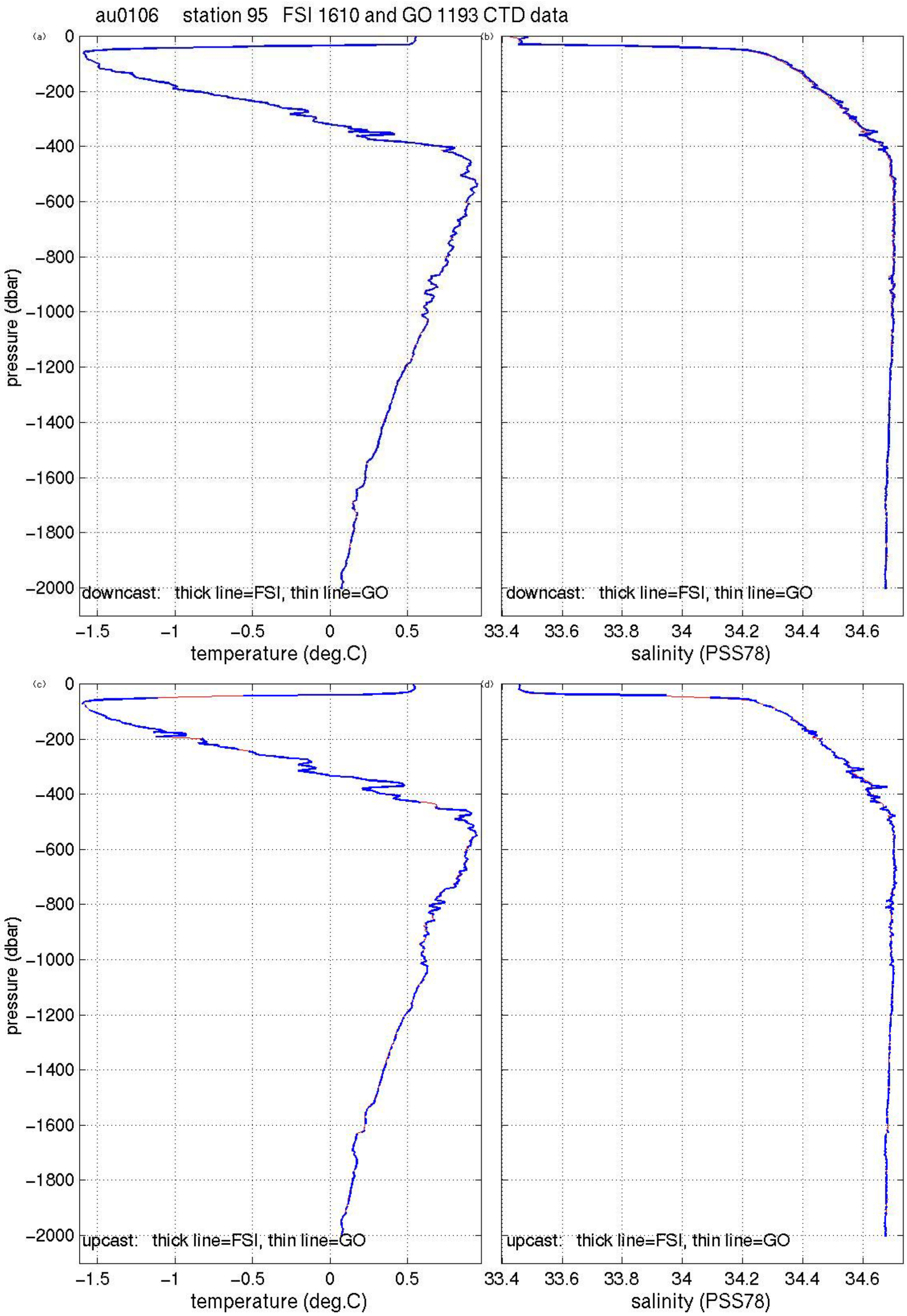


Figure A1.2.3: **Comparison of FSI and GO CTD data, cruise au0106, station 94.**



<u>Figure A1.2.4:</u> Comparison of FSI and GO CTD data, cruise au0106, station 95.

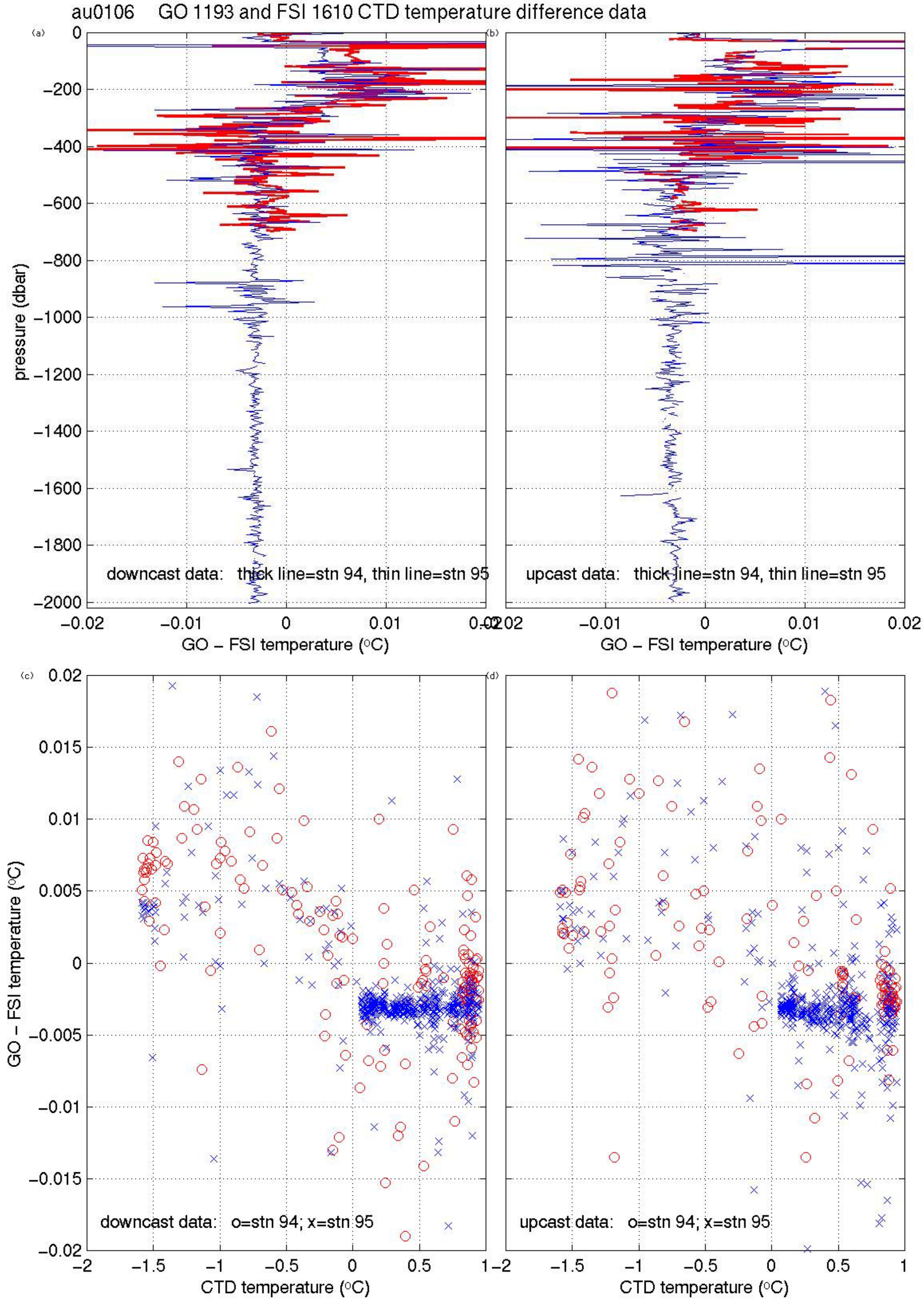
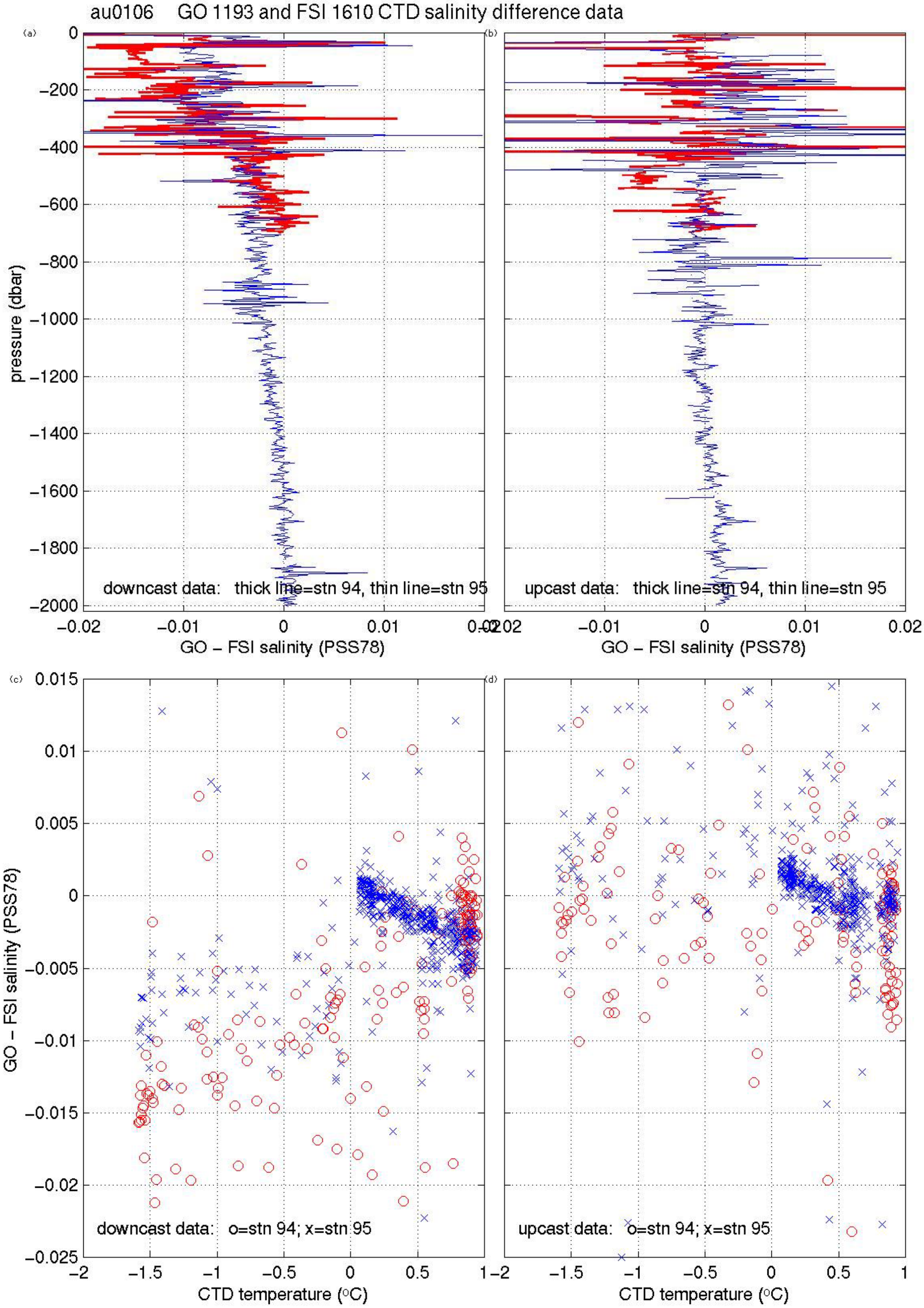


Figure A1.2.5: Difference between GO and FSI CTD temperature data, cruise au0106, stations 94 and 95. (a) difference for downcast data versus pressure; (b) difference for upcast data versus pressure; (c) difference for downcast data versus GO CTD temperature; (d) difference for upcast data versus GO CTD temperature.



<u>Figure A1.2.6:</u> Difference between GO and FSI CTD salinity data, cruise au0106, stations 94 and 95. (a) difference for downcast data versus pressure; (b) difference for upcast data versus pressure; (c) difference for downcast data versus GO CTD temperature; (d) difference for upcast data versus GO CTD temperature.

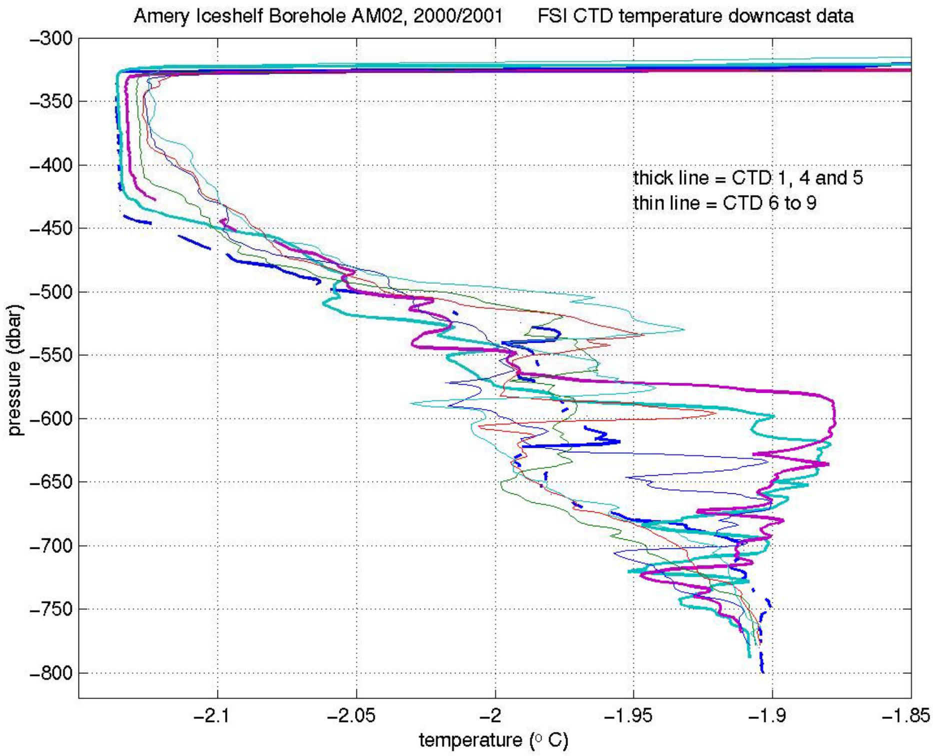


Figure A1.2.7: Amery Ice Shelf borehole AM02 CTD data: downcast temperature data below 300 dbar.

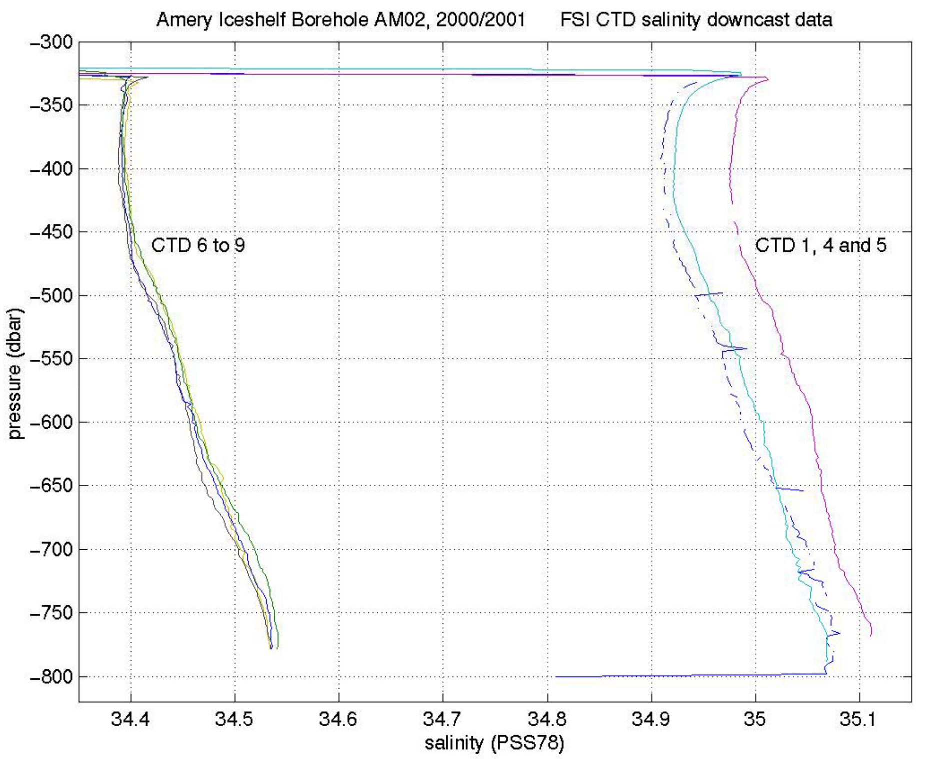


Figure A1.2.8: Amery Ice Shelf borehole AM02 CTD data: downcast salinity data below 300 dbar.

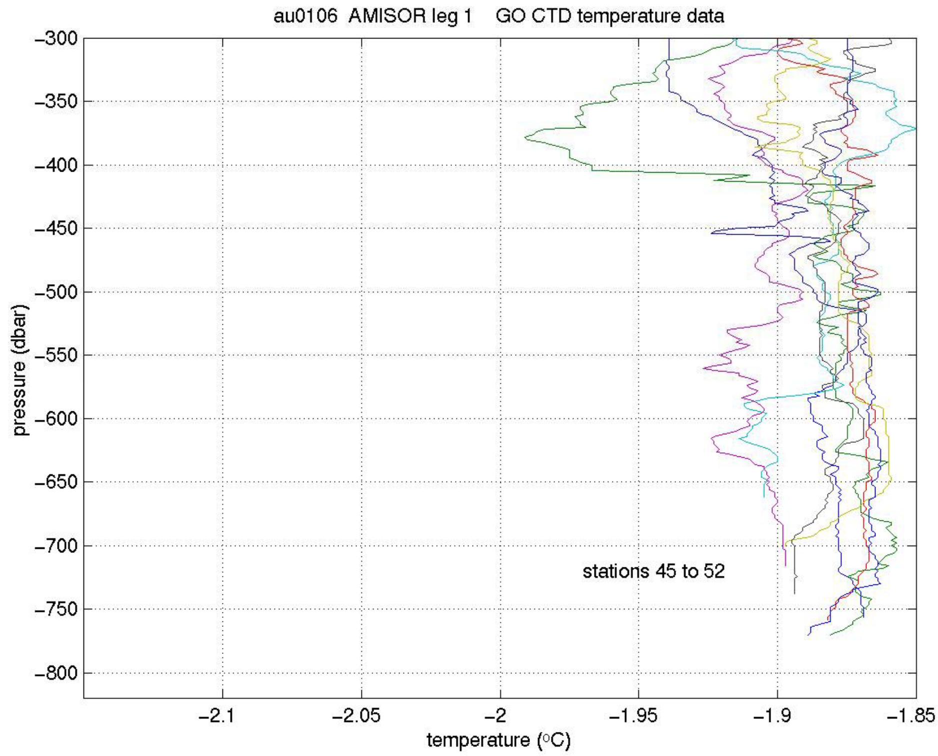


Figure A1.2.9: **Cruise au0106 AMISOR leg 1 CTD data: downcast temperature data below 300 dbar.**

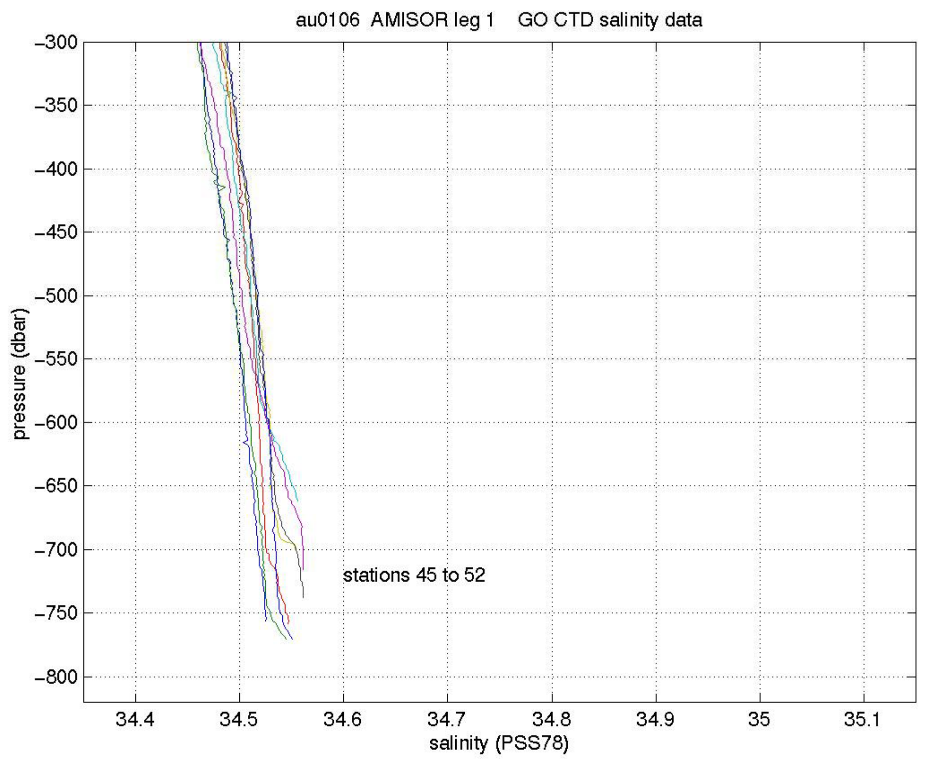


Figure A1.2.10: **Cruise au0106 AMISOR leg 1 CTD data: downcast salinity data below 300 dbar.**

APPENDIX 1.3 AMERY ICE SHELF BOREHOLE AM01 CTD DATA, 2001/2002 SEASON - DATA PROCESSING AND QUALITY

Mark Rosenberg (data processor)
Amery Ice Shelf borehole drill team (data collectors)

A1.3.1 INTRODUCTION

Seven CTD casts were taken through a borehole in the Amery Ice Shelf during the 2001/2002 season (M. Craven et al., AMISOR borehole field reports, in preparation), using an FSI 3" MicroCTD, serial 1610. Following the ice shelf field work, FSI MicroCTD calibration checks were performed on three CTD casts aboard the Aurora Australis, cruise au0207, en route back to Hobart. This appendix details processing and calibration of the data, and describes data quality.

A1.3.2 DATA CALIBRATION

Pre-season laboratory calibrations of the FSI CTD temperature, pressure and conductivity sensors were done at CSIRO (August 2001). In the field, data were output from the FSI CTD in engineering units, with CSIRO calibration coefficients applied for temperature, pressure and conductivity. Further corrections for pressure and conductivity were obtained from in situ measurements, as detailed in the next section. For conductivity, the initial correction for the borehole data was obtained from 3 casts aboard the Aurora Australis. For these 3 casts the FSI MicroCTD, in internally recording battery-powered mode, was attached to the ship's main rosette system, and 3 routine 12 bottle casts were taken (Table A1.3.1) with GO (i.e. General Oceanics) CTD serial 2568. FSI and GO CTD data were then compared, and FSI conductivity data was calibrated against the bottle samples obtained. A final offset correction for the FSI conductivity data was obtained using in situ salinity samples collected from Niskin bottles deployed through the borehole on the ice shelf along with the CTD. These samples were analysed on the ship on the return to Hobart.

Table A1.3.1: CTD station details for Amery Ice Shelf Borehole AM01 CTD's, and Aurora Australis cruise au0207 FSI calibration CTD's. Note: depth to water surface=distance from top of borehole down to water surface in the borehole; bottom depth=total water depth from water surface to ocean bottom; max.P=maximum pressure of CTD cast; elevation=CTD elevation above bottom at the bottom of the cast. Also note that the borehole depth given is the depth to the base of the porous ice/slush layer below the solid ice shelf.

station	time	date	latitude	longitude	borehole depth (m)	depth to water surf. (m)	bottom depth (m)	max.P (dbar)	elev. (m)
Borehole CTD									
1	0928	10-JAN-2002	69°26.5'S	71°25.0'E	478	56.5	783	782	10
2	0110	11-JAN-2002	69°26.5'S	71°25.0'E	478	56.5	783	772	20
3	1748	11-JAN-2002	69°26.5'S	71°25.0'E	478	56.5	783	780	12
4	1136	12-JAN-2002	69°26.5'S	71°25.0'E	478	57.4	783	776	16
5	1531	12-JAN-2002	69°26.5'S	71°25.0'E	478	56.6	783	776	16
6	0902	13-JAN-2002	69°26.5'S	71°25.0'E	478	56.5	783	786	6
7	1143	14-JAN-2002	69°26.5'S	71°25.0'E	478	56	783	772	20
au0207 CTD									
53	0152	27-FEB-2002	64°41.05'S	73°01.27'E			3490	2004	-
54	0527	27-FEB-2002	64°33.13'S	73°36.04'E			3500	2004	-
55	0739	27-FEB-2002	64°32.41'S	73°32.58'E			3500	1504	-

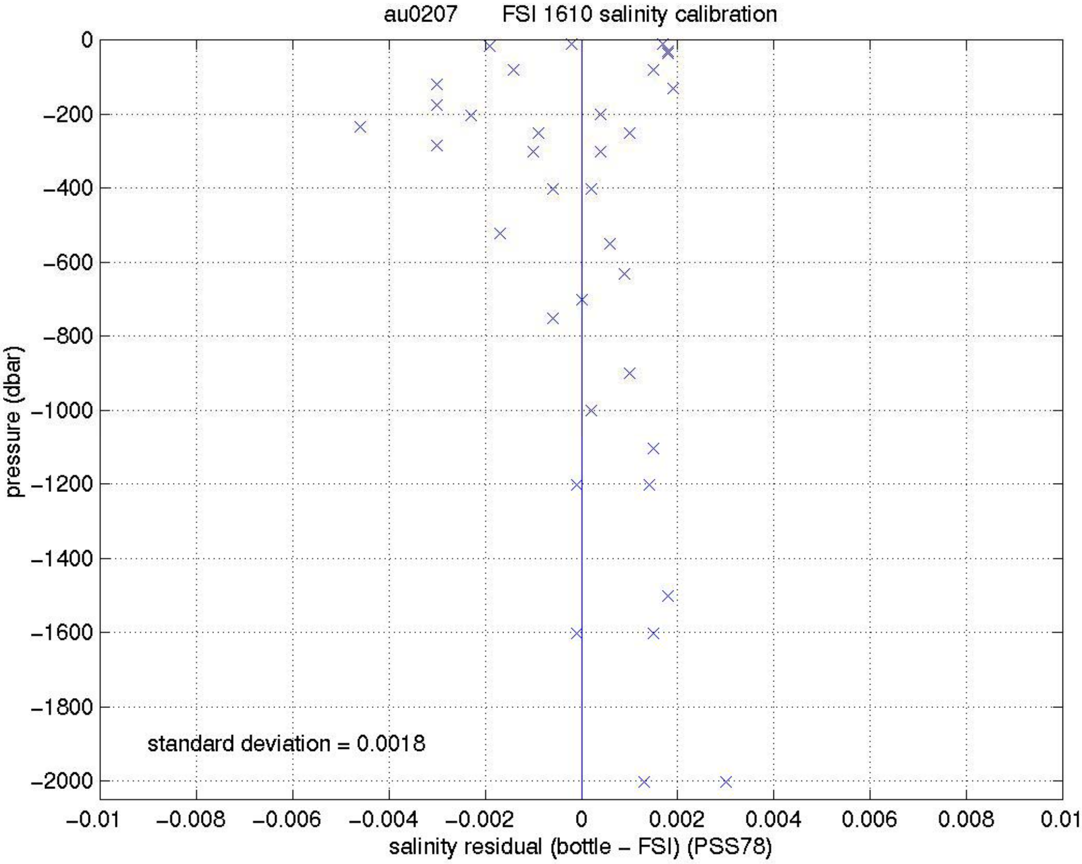


Figure A1.3.1: Salinity residual (bottle – FSI) for au0207 data, after application of ship-derived conductivity correction to FSI data.

au0207 FSI CTD processing and calibration

The following processing steps were followed for the three au0207 casts to obtain calibration corrections for the FSI pressure and conductivity:

* Surface pressure offset was found by averaging the 20 pressure points previous to the CTD entering the water. This offset was then removed from FSI pressure data.

* Upcast burst data were formed by retaining the 30 sec. of data previous to each bottle firing, then averaging these 30 sec. bursts. Burst averages were then merged with GO upcast burst averages, and salinity bottle data.

* Separate pressure monotonic files were formed for downcast and upcast data.

* Comparison of FSI and GO pressure data revealed a small calibration difference, of the order 4 dbar over 2000 dbar. Assuming GO pressure as the more accurate, a correction was found for FSI pressure as follows. The upcast pressure burst averages for the FSI CTD were linearly fitted to the GO pressure burst averages. The following linear correction was then applied to all FSI pressure data:

$$p_{cal} = 1.0020\, p_{raw} + 0.2506 \qquad \text{(eqn A1.3.1)}$$

where p_{cal} and p_{raw} are respectively the corrected and uncorrected FSI pressure. Note that when obtaining the best fit, equal weight was given to both a fit through 0 pressure at the surface, and to the rest of the pressure data. However, application of this pressure correction still causes a small error of ~0.3 dbar to pressures near the surface.

* FSI conductivity was calibrated using the salinity bottle data (Figure A1.3.1), as per the method described in Rosenberg et al. (1995). The 3 stations were grouped together to provide a single calibration fit (i.e. no station dependent term). The linear correction obtained was:

$$c_{cal} = 0.99662\, c_{raw} + 0.080084 \qquad \text{(eqn A1.3.2)}$$

where c_{cal} and c_{raw} are respectively the corrected and uncorrected FSI conductivity; this correction was applied to all FSI conductivity data.

* 2 dbar averages were formed for temperature, corrected pressure and corrected conductivity, from the pressure monotonic downcast and upcast files. Note that a minimum attendance of 2 data points was required to form each 2 dbar bin. A salinity value for each 2 dbar bin was then calculated from these averages.

Borehole FSI CTD processing and calibration

* Surface pressure offsets were found and applied as described above.

* Separate pressure monotonic files were formed for downcast and upcast data, and the pressure and conductivity corrections found from the ship comparisons, described above, were applied.

* The physical mounting of the FSI CTD on the borehole seacable and on the ship's rosette frame in both cases resulted in physical objects lying within the interference range of the conductivity cell. As a consequence, the ship-based conductivity correction was not expected to give the most accurate conductivity data for the borehole measurements. Good salinity samples were however obtained from the Niskin bottles deployed through the borehole, allowing an additional correction to be applied to FSI conductivity data. Salinity ranges below the ice shelf were small enough (~0.2 PSS78, Figure A1.3.6) that a simple offset correction was adequate. Comparison CTD and bottle salinities, the following offset correction was obtained:

$$c_{newcal} = c_{cal} + 0.0205 \qquad \text{(eqn A1.3.3)}$$

where c_{cal} is the conductivity from equation 2 above, and c_{newcal} is the final corrected conductivity value (equivalent to a salinity correction of ~0.028 PSS78). This final correction was applied to all borehole CTD conductivity data.

* 2 dbar averaged files were formed for downcast and upcast data, as described above. Note that for the borehole data, a minimum attendance of 1 data point was required to form each 2 dbar bin.

* Communication problems up the seacable were encountered when deploying the CTD through the borehole, and all stations were logged at ~0.3Hz. Note that the CTD was lowered and raised at slower rates than the previous season, to compensate for the decreased data frequency. For stations 6 and 7, the data were logged internally at 1.83 Hz. These internally logged data, at the higher sampling rate, were used for stations 6 and 7.

A1.3.3 DATA QUALITY

au0207 FSI and GO CTD comparisons

Data comparisons between the FSI and GO CTD's for 1 of the 3 calibration casts on cruise au0207 are shown in Figures A1.3.3 to A1.3.5.

From Figure A1.3.4, the temperature calibration difference between the two instruments appears to be ~0.003°C for the downcast, and ~0.005°C for the upcast, with significantly greater differences at low temperatures around the temperature minimum (Figure A1.3.3). Closer inspection of the vertical temperature profiles for the two CTD's reveals the large temperature difference around the temperature minimum is in fact due to pressure calibration differences causing vertical offset of the two profiles. And the larger temperature difference apparent on the upcast (Figure A1.3.4b) is again due to pressure calibration differences – in this case there is hysteresis of the pressure sensor for one of the two CTD's, causing increased vertical offset of the upcast temperature profiles for the two instruments. So temperature values for the two CTD's agree to within 0.003°C.

From Figure A1.3.5, FSI and GO CTD salinities compare reasonably well, to within ~0.003 (PSS78). As above for temperature, the pressure calibration differences exaggerate the salinity difference around steep vertical gradients.

Borehole FSI CTD data

Downcast FSI CTD data for borehole AM01 are shown in Figure A1.3.6. Note that data inside the borehole (i.e. top 300 dbar) are not shown in the figures. Downcast and upcast temperature and salinity data agree well, and in general the data are good for all 7 stations. Application of the additional conductivity offset correction derived from comparison with the Niskin bottle salinity samples, as described above, makes the FSI salinity data more accurate than data from the 2000/2001 borehole (AM02).

The profiles (Figure A1.3.6) clearly show the transition between the solid ice shelf and the porous layer at ~325 dbar. The next transition between the porous layer and clear water can be seen at ~420 dbar. Most stations then show a fairly homogeneous layer of ice shelf water below this, with a layer thickness of between 50 and 80 dbar.

Summary of borehole CTD data

* good data for all 7 stations

* data logged at ~0.3 Hz for stations 1 to 5

* internally logged data, at the higher sampling rate of 1.83 Hz, used for stations 6 and 7

* data accuracy: temperature <0.005°C
  salinity <0.004 (PSS78)
  pressure ~2dbar

* The complete CTD data (i.e not averaged into 2 dbar bins) for the time series station (logged as station 3a) are in the file am01d03a.cc

* The complete CTD data (i.e. not averaged into 2 dbar bins) for station 7, including 2 partial down and upcasts, plus stops at several depths for current measurements, are in the file am02d07a.cc

au0207 ship based CTD data

Ship-based CTD data from cruise au0207 (Figure A1.3.2) along the Amery Ice Shelf front are shown in Figure A1.3.7. Note that only the stations 46 to 52 are plotted. Overall these ship-based data provide qualitative confirmation of the borehole CTD data.

A1.3.4 DATA FILE FORMATS

2 dbar averaged CTD data from borehole AM01 are contained in ascii and matlab format files, as follows:

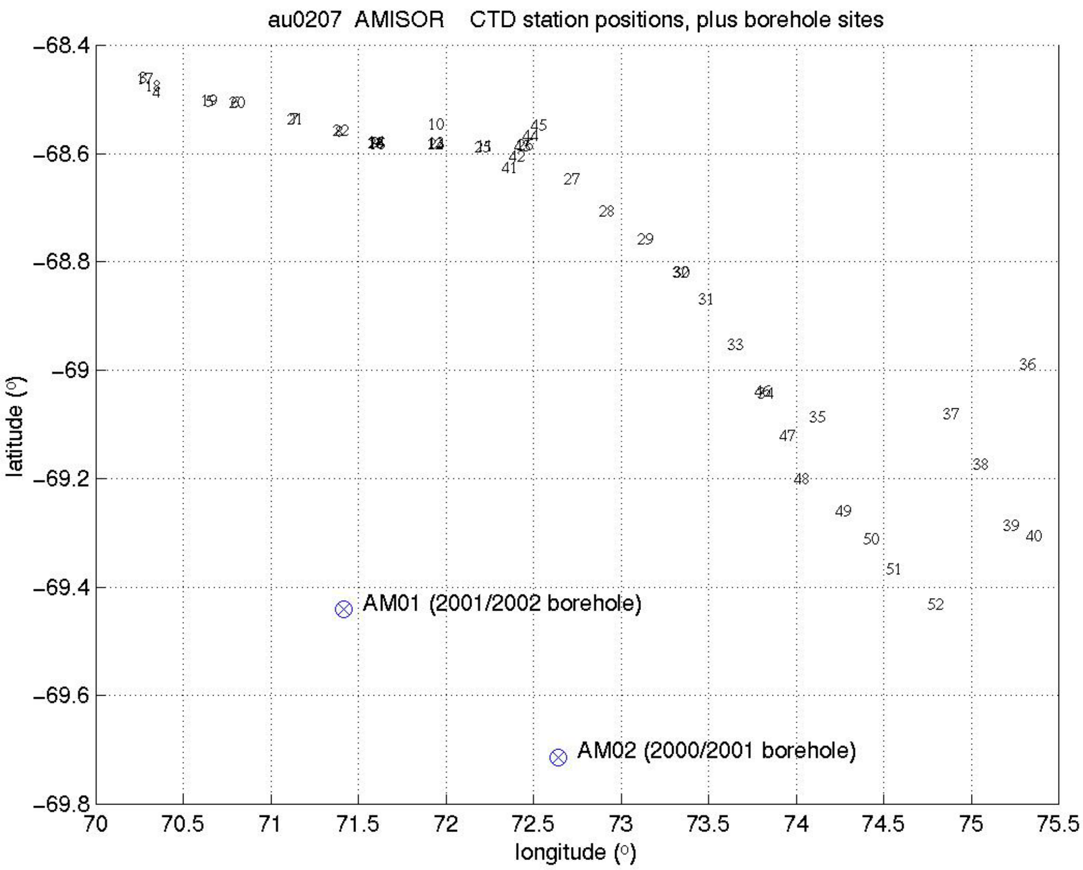
ascii

am01d00x.dcc_av	downcast data
am01d00x.ucc_av	upcast data
am01d0xa.cc	complete data (i.e. not averaged into 2 dbar bins)

where x=station number, and “cc” indicates calibrated data. The files contain 2 header lines, followed by the data in column format. Note that for 2 dbar averaged data there is a line of data for each 2 dbar bin, and missing values are filled by blanks.

matlab

am01dwn.mat	downcast data
am01up.mat	upcast data



<u>Figure A1.3.2:</u> CTD station positions for cruise au0207, and Amery Ice Shelf boreholes AM01 and AM02 from 2001/2002 and 2000/2001 seasons respectively.

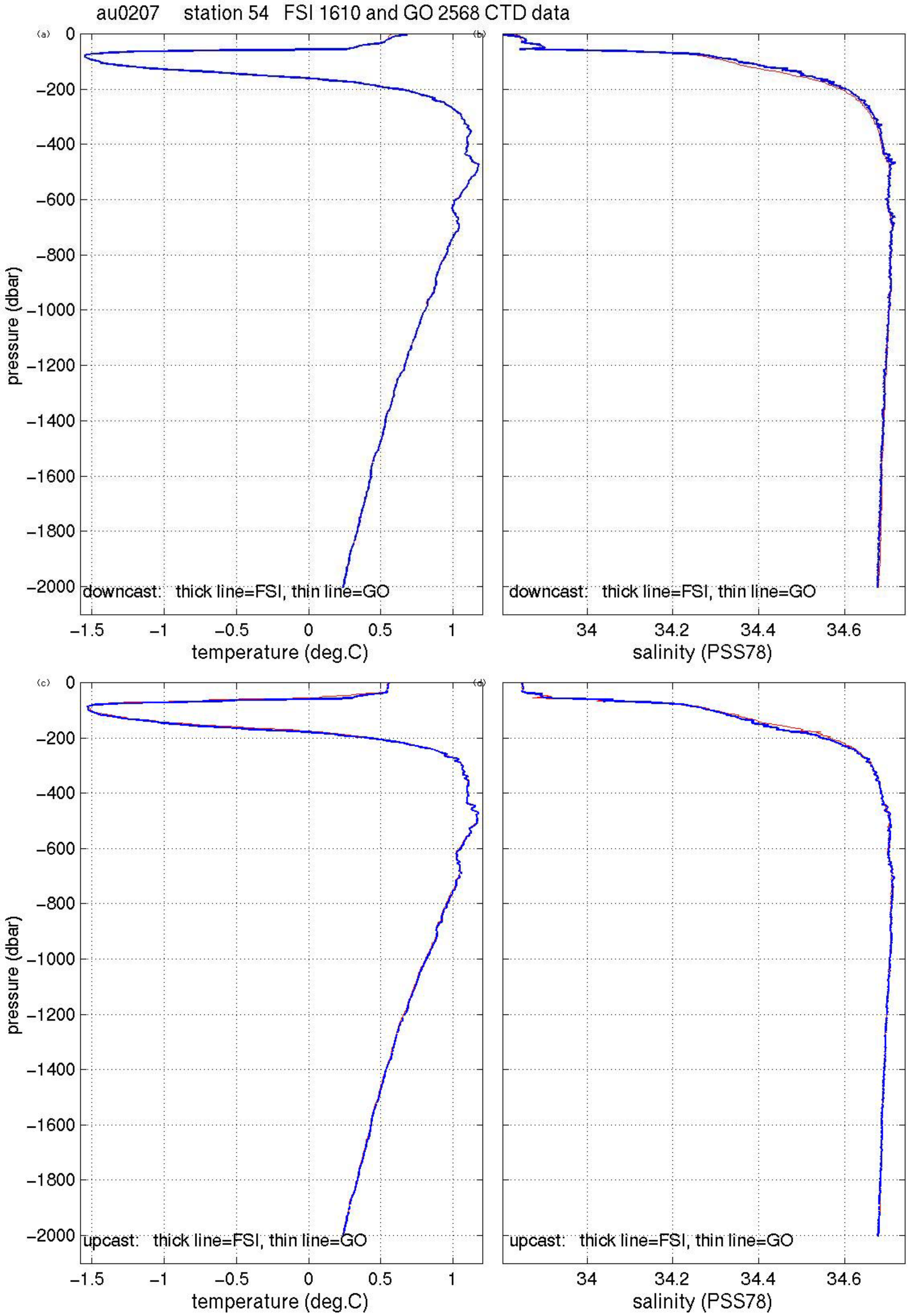


Figure A1.3.3: Comparison of FSI and GO CTD data, cruise au0207, station 54.

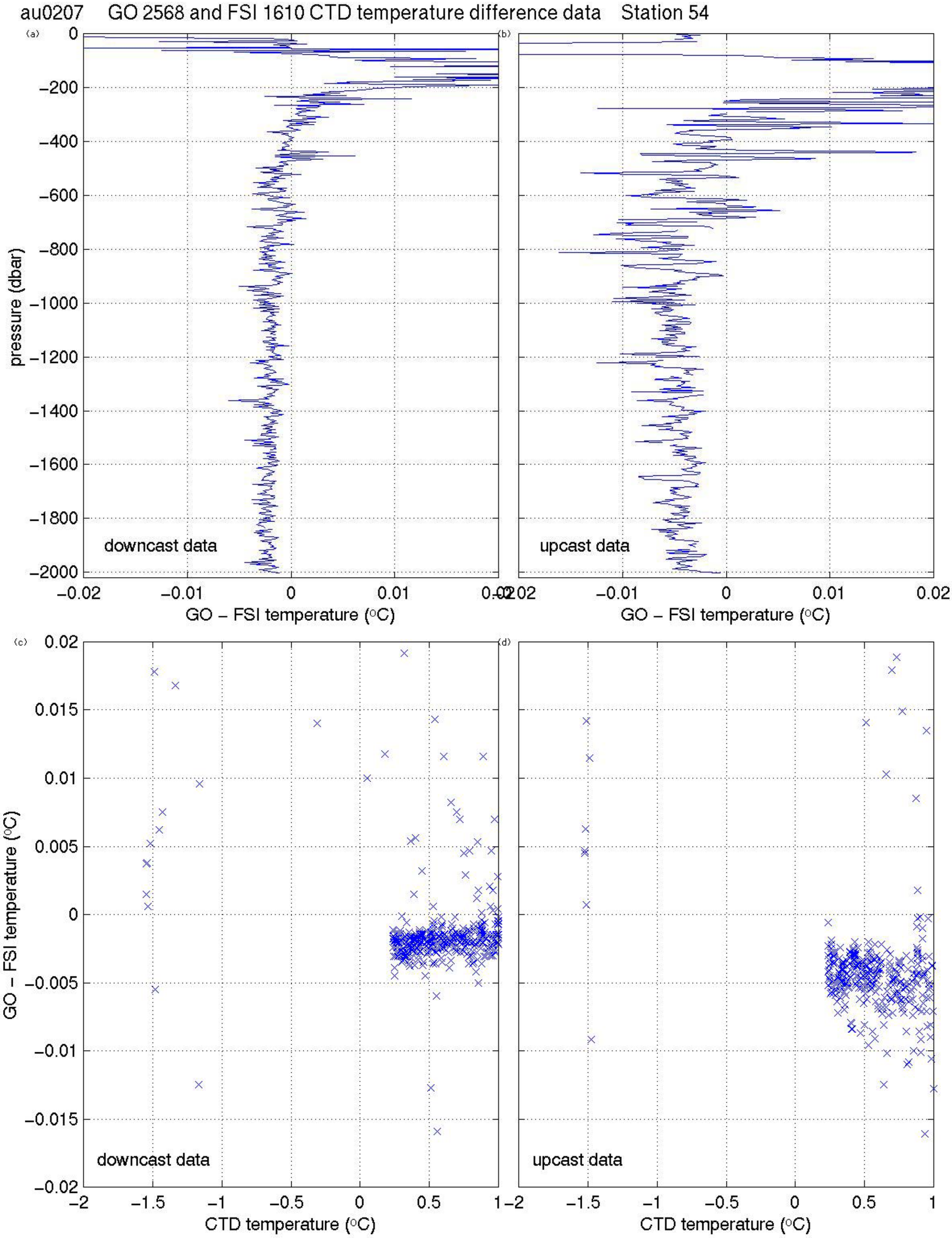


Figure A1.3.4: Difference between GO and FSI CTD temperature data, cruise au0207, station 54. (a) difference for downcast data versus pressure; (b) difference for upcast data versus pressure; (c) difference for downcast data versus GO CTD temperature; (d) difference for upcast data versus GO CTD temperature.

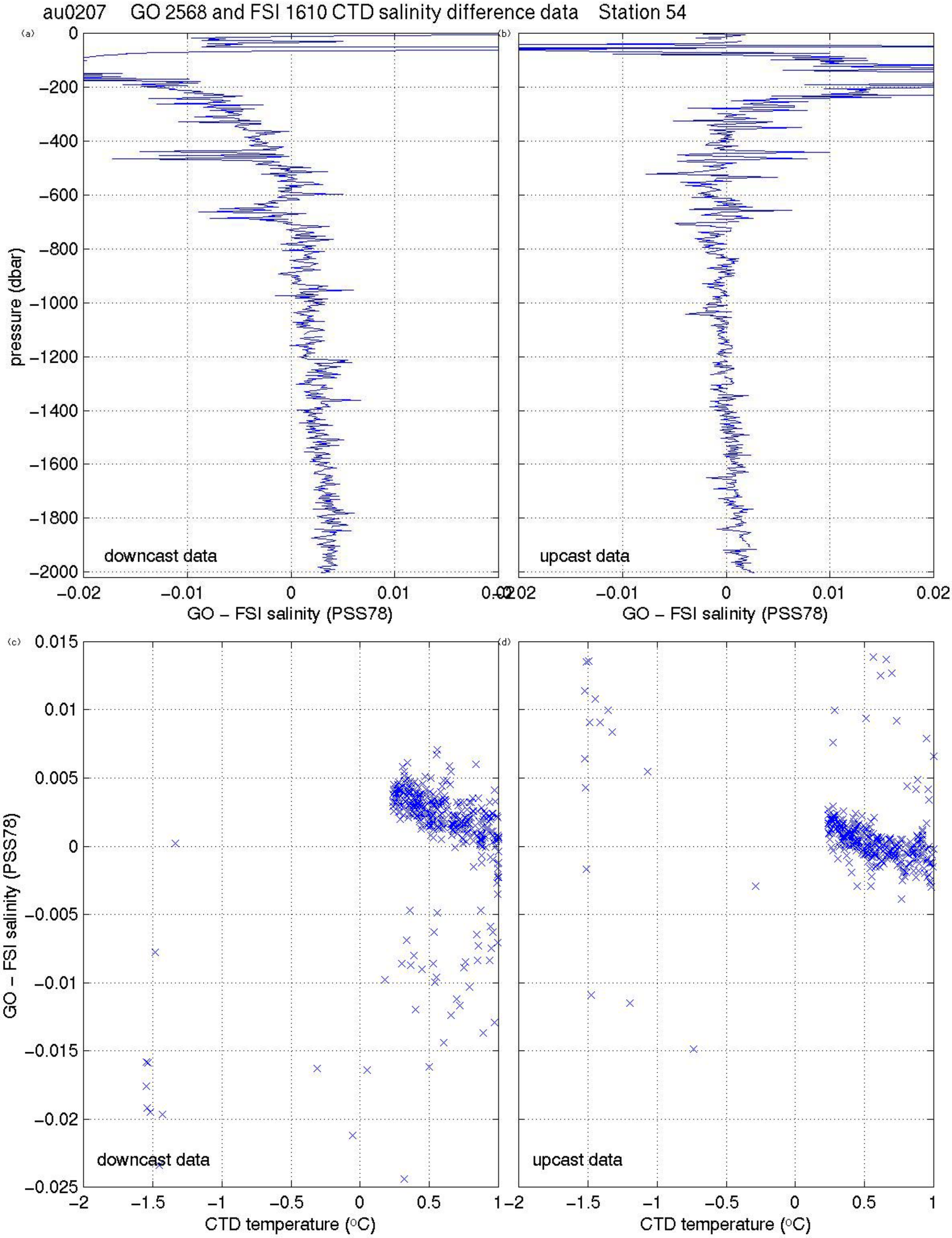
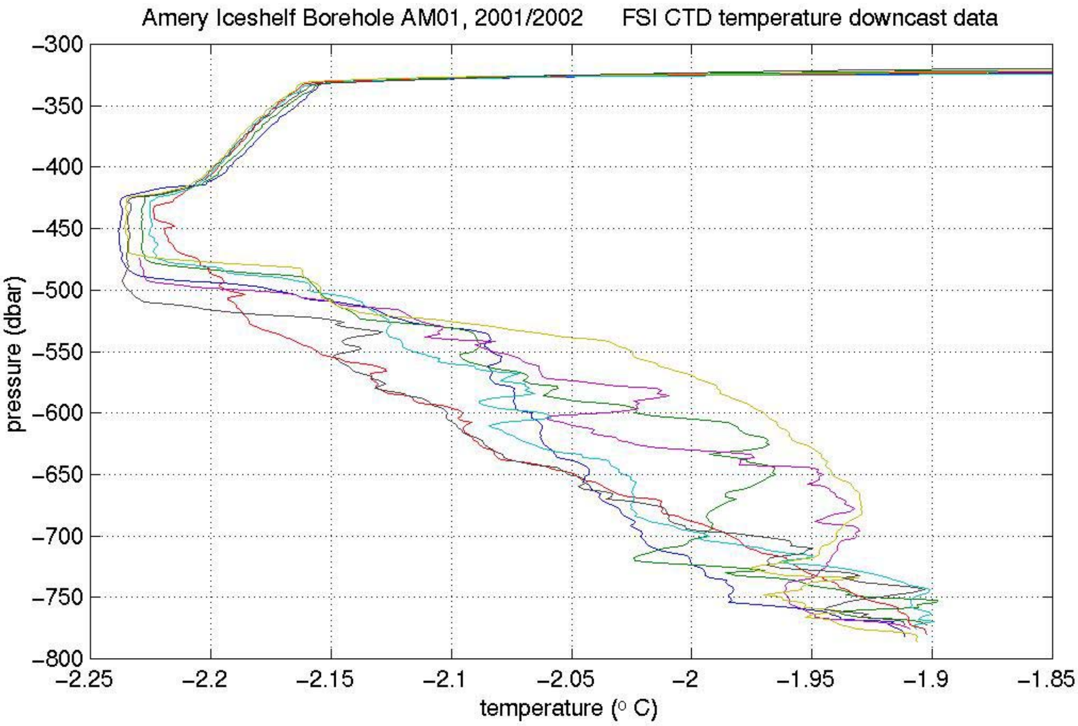
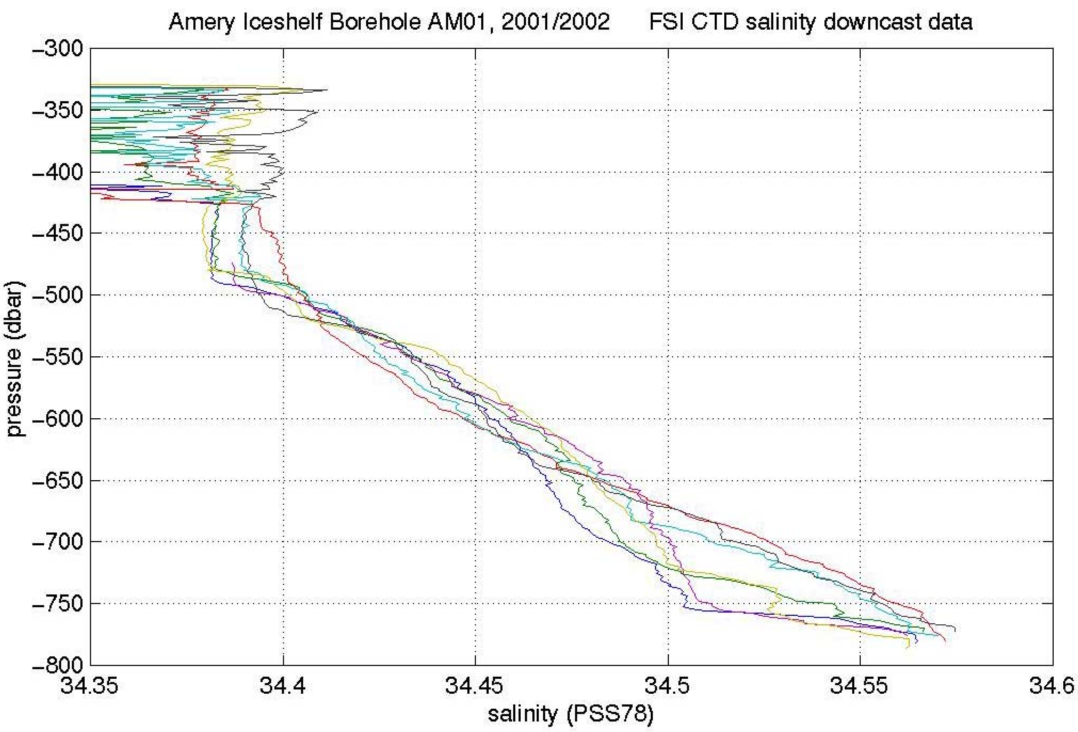
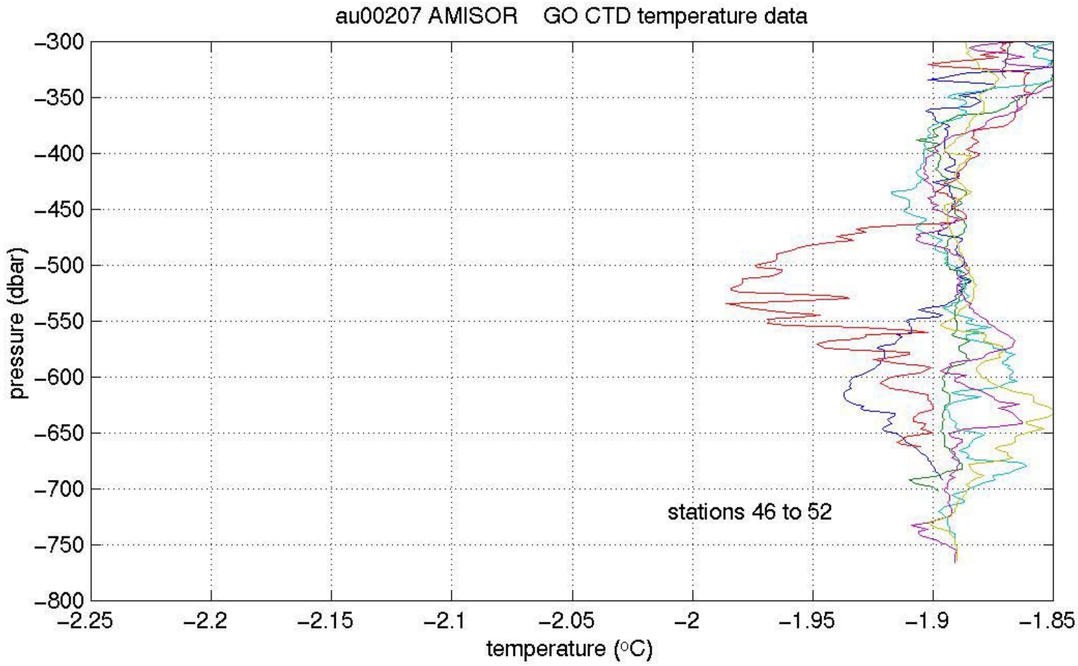


Figure A1.3.5: **Difference between GO and FSI CTD salinity data, cruise au0207, station 54. (a) difference for downcast data versus pressure; (b) difference for upcast data versus pressure; (c) difference for downcast data versus GO CTD temperature; (d) difference for upcast data versus GO CTD temperature.**





<u>Figure A1.3.6:</u> Amery Ice Shelf borehole AM01 CTD data: downcast temperature and salinity data below 300 dbar.



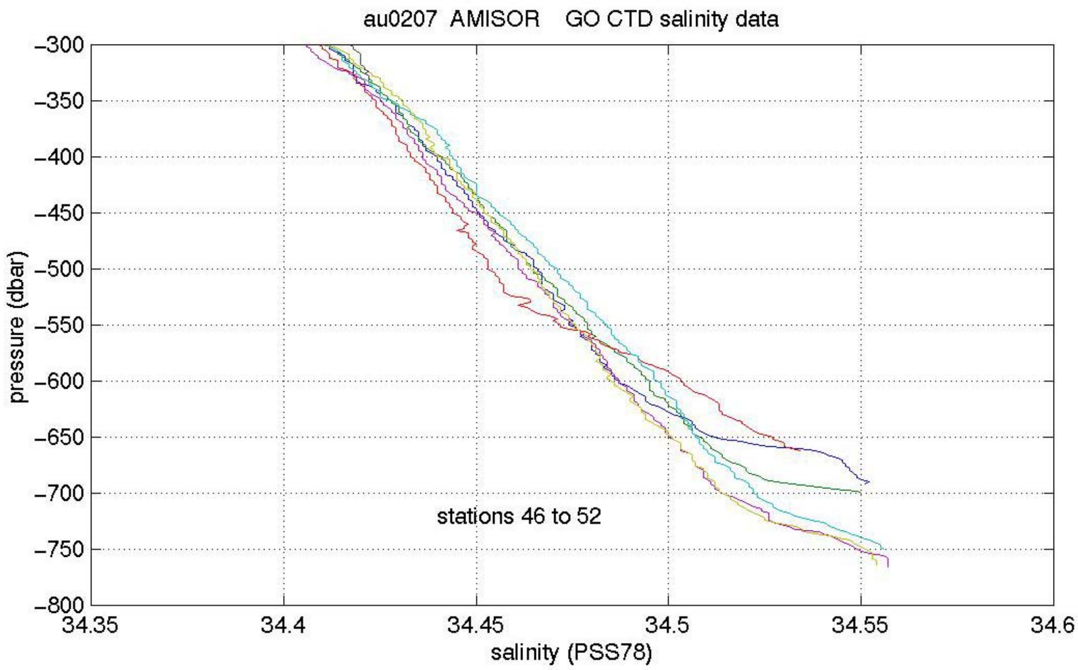


Figure A1.3.7: **Cruise au0207 CTD data: downcast temperature and salinity data below 300 dbar.**

APPENDIX 1.4 AMERY ICE SHELF BOREHOLES AM01 AND AM02 MICROCAT DATA - DATA PROCESSING AND QUALITY

Mark Rosenberg (data processor)
Amery Ice Shelf borehole drill team (data collectors)

Three SeaBird SBE37IM inductive modem microcats were deployed at each of the Amery Ice Shelf boreholes AM01 and AM02, hanging suspended from the base of the ice shelf and frozen in (M. Craven et al., AMISOR borehole field reports, in preparation). This appendix describes the data processing and data quality.

All microcat data were assigned a consistent decimal time scheme, using decimal days as counted from midnight on December 31st 2000. So, e.g. midday on January 1st 2001 = 0.5 decimal time; midday on January 1st 2002 = 365.5. Note that this time scheme is consistent with all the AMISOR oceanographic mooring data (Part 2 of this report).

The microcats recorded temperature, conductivity and pressure (note that the microcats on the 9 oceanographic moorings offshore from the ice shelf did not have pressure sensors). The instruments were all set to a recording interval of 30 minutes. Station information for the moorings at the two borehole locations are is in Appendices 1.2 and 1.3, at the time of deployment. These locations change in time, as the ice shelf is in motion.

Table A1.4.1: Borehole microcat details. Mean instrument positions are over the recording period (~13 months for AM02, ~8 days for AM01).

borehole	microcat	mean instrument position		time (days) between start and clock check	no. of sec. fast
		depth (m)	pressure (dbar)		
AM02	1623	334.9	338.6	401.5	120
AM02	1624	556.6	563.0	401.5	300
AM02	1174	762.8	772.0	401.5	120
AM01	1969	436.1	441.0	8.0	0
AM01	1970	574.5	581.2	8.0	0
AM01	1971	733.5	742.3	8.0	0

The microcats were downloaded by Al Elcheikh using the SeaBird terminal program Seaterm (version 1.22), and instrument clock errors were noted at the time (Table A1.4.1). These errors were only noted to the nearest minute. In addition, the exact day when the instrument clocks were set had to be estimated. Therefore after correction for clock drift error, instrument times in the final data can only be considered accurate to one minute.

Communication was made with the microcats on several occasions for the mooring at AM02. After each communication, logging commenced at a different part of the hour, and as a consequence there are several time discontinuities through the time series. For the mooring at AM02, these discontinuities are at the following times:

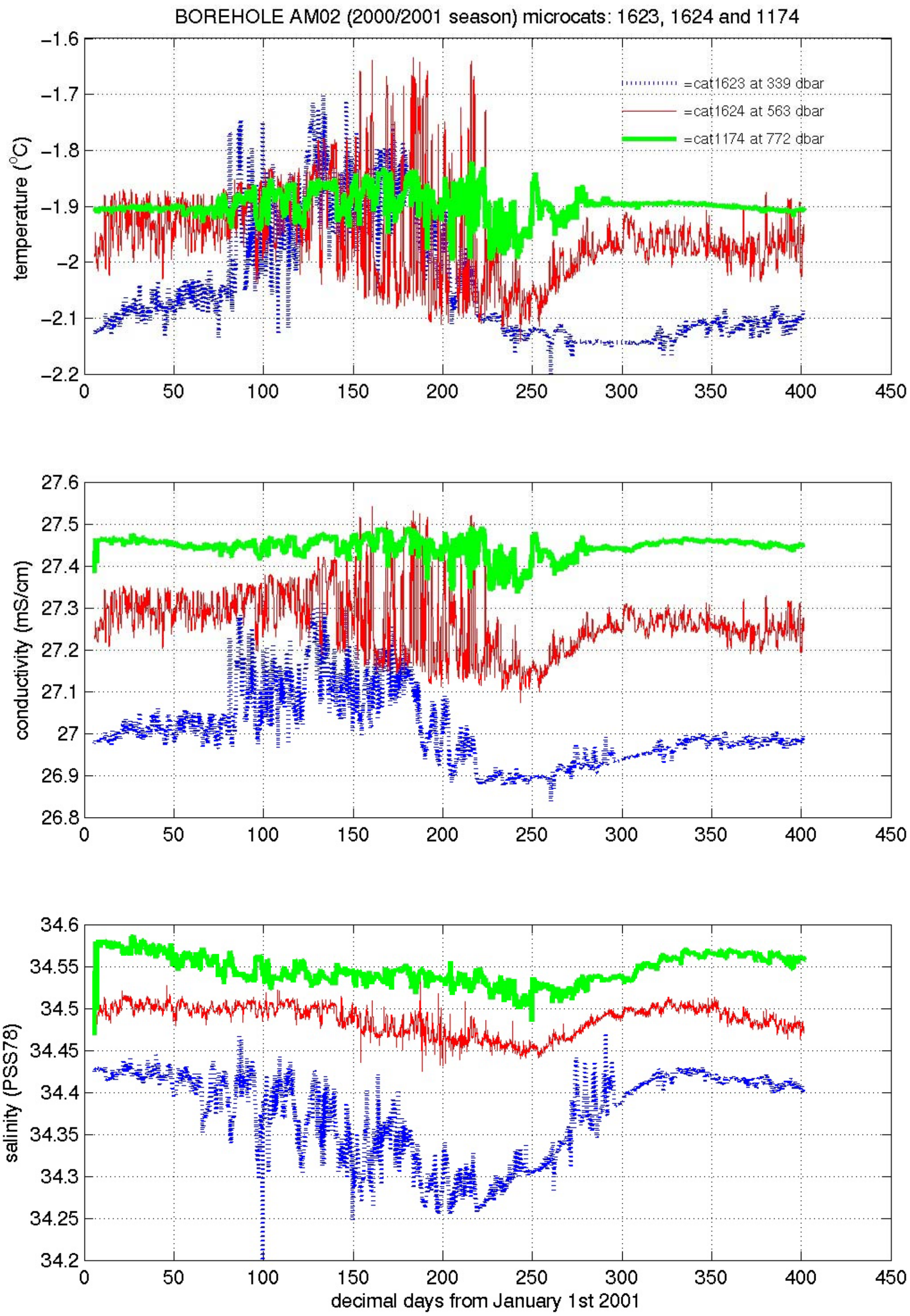
microcat 1623: ~1630 on 9/1/2001; ~0430 on 16/1/2001; ~0630 on 14/2/2001
microcat 1624: ~1700 on 9/1/2001; ~0500 on 16/1/2001; ~0730 on 14/2/2001
microcat 1174: ~1700 on 9/1/2001; ~0500 on 16/1/2001; ~0800 on 14/2/2001

No discontinuities are present in the first download of microcat data from AM01.

Manufacturer supplied calibrations (July/August/September 2000 for AM02 instruments, May/June 2001 for AM01 instruments) were applied internally by the microcats, and calibrated data were output. The data were then processed as follows:

* The raw files were manually edited to remove data where the microcats were being deployed.
* The files were padded at the start and end, and data gaps were checked for and filled; decimal times were also calculated.
* Decimal times were “compressed” linearly throughout the time series to correct for clock error. No compression was required for AM01 microcats at this stage, due to the short initial time series of ~8 days. After this time correction for AM02 microcats, the data are therefore at irregular record intervals. Reinterpolation onto regular time intervals was not undertaken, due to the assumed resulting errors.

A brief comparison was made between borehole microcat and CTD temperature and salinity data. Although no simultaneous microcat and CTD measurements exist, the time difference was only of the order of several days, and a valid comparison can still be made in TS space. Fairly good agreement was found between the CTD and microcat data for borehole AM01 (Figure A1.4.4) in the 2001/2002 season. For the earlier borehole AM02 in the 2000/2001 season, temperatures agree fairly well, but CTD salinities are on average ~0.03 (PSS78) lower than microcat salinities (Figure A1.4.3). Note that for AM02, no borehole Niskin bottle samples were available to correct the CTD data (Appendix 1.2). However the correction found for the AM01 CTD salinities from the borehole Niskins was +0.028 (Appendix 1.3). This value is very close to the above microcat/CTD salinity difference for AM02. It is therefore assumed that the microcat data are correct, and the AM02 CTD salinity values are low by ~0.03.



<u>Figure A1.4.1:</u> Borehole AM02 (2000/2001 season) microcat data.

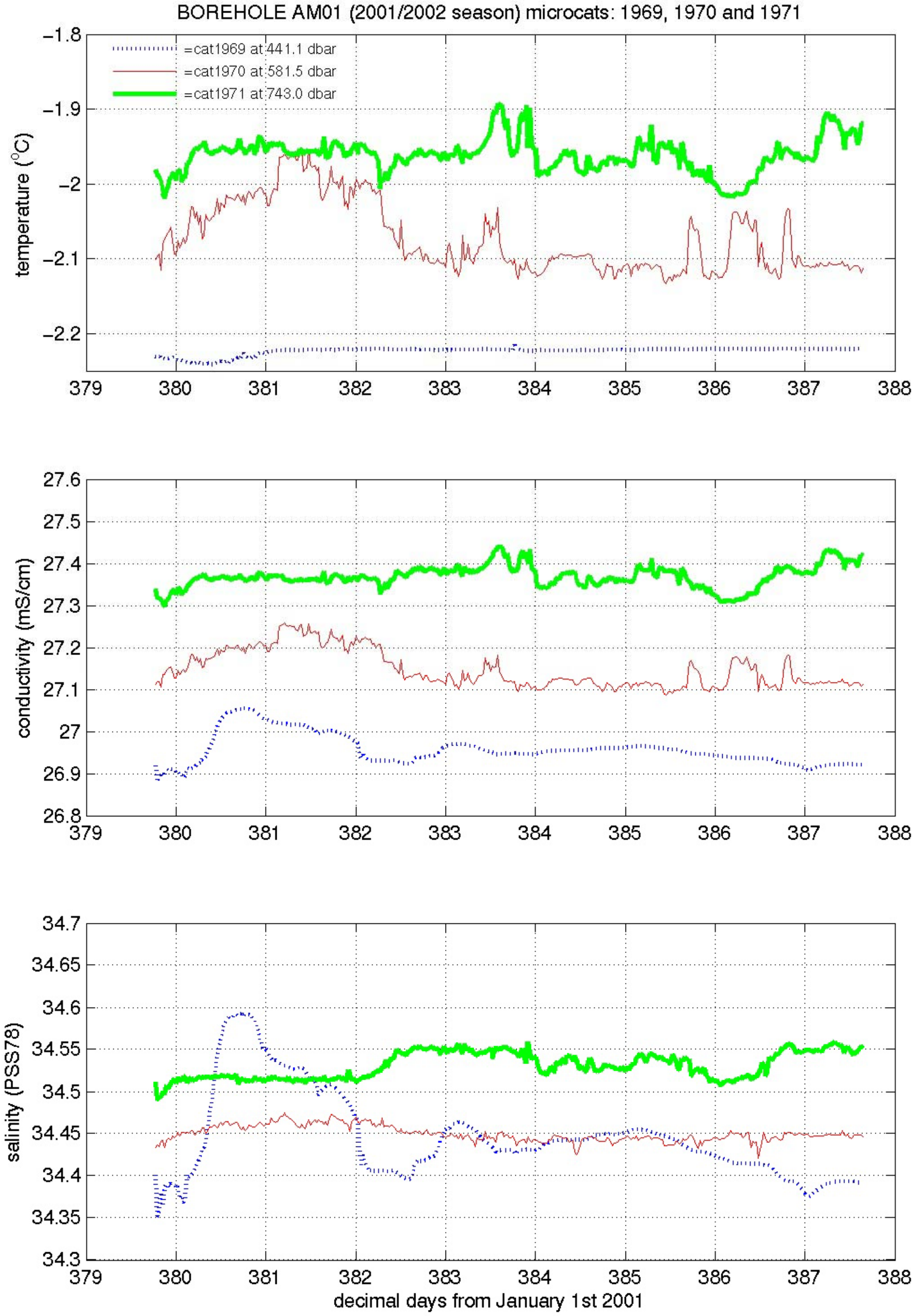


Figure A1.4.2: Borehole AM01 (2001/2002 season) microcat data.

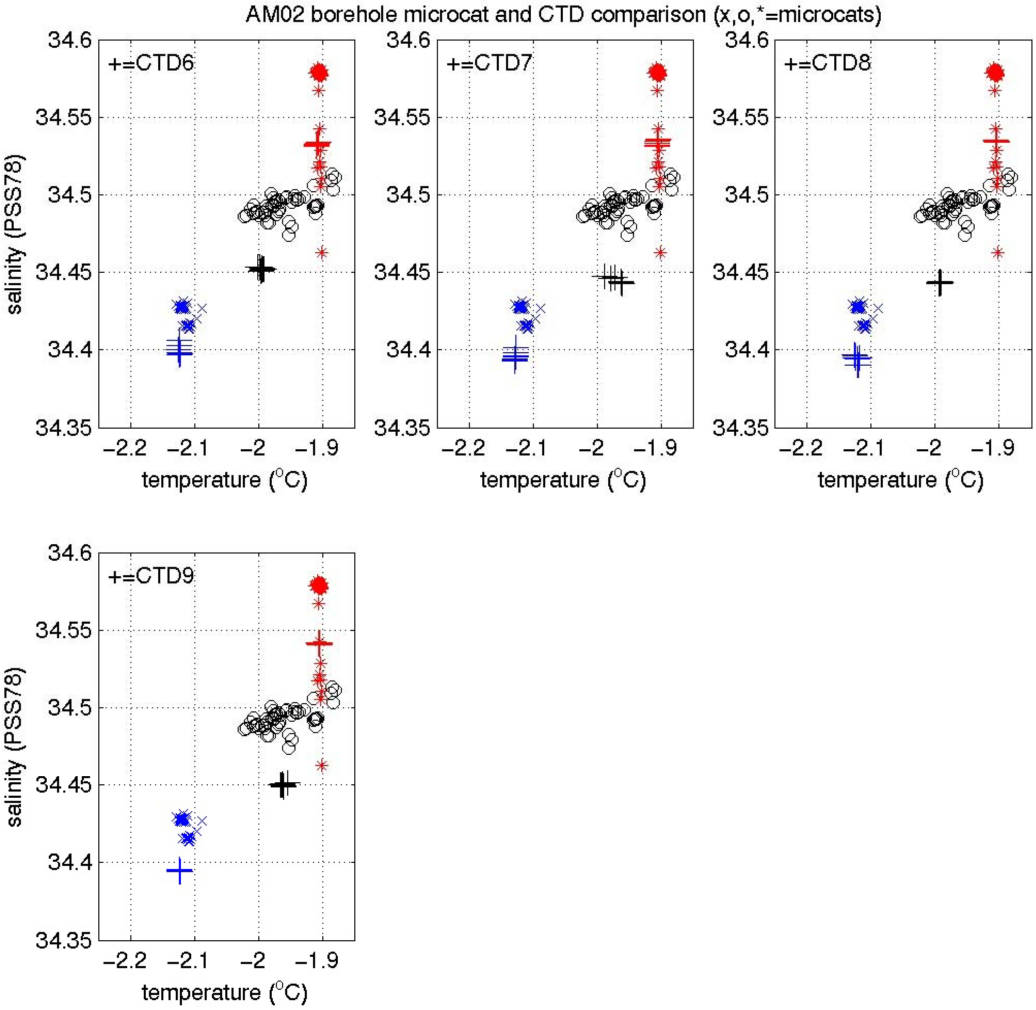


Figure A1.4.3: Borehole AM02 (2000/2001 season) – comparison of CTD and microcat data at the depth of the microcats; 8 days of microcat data.

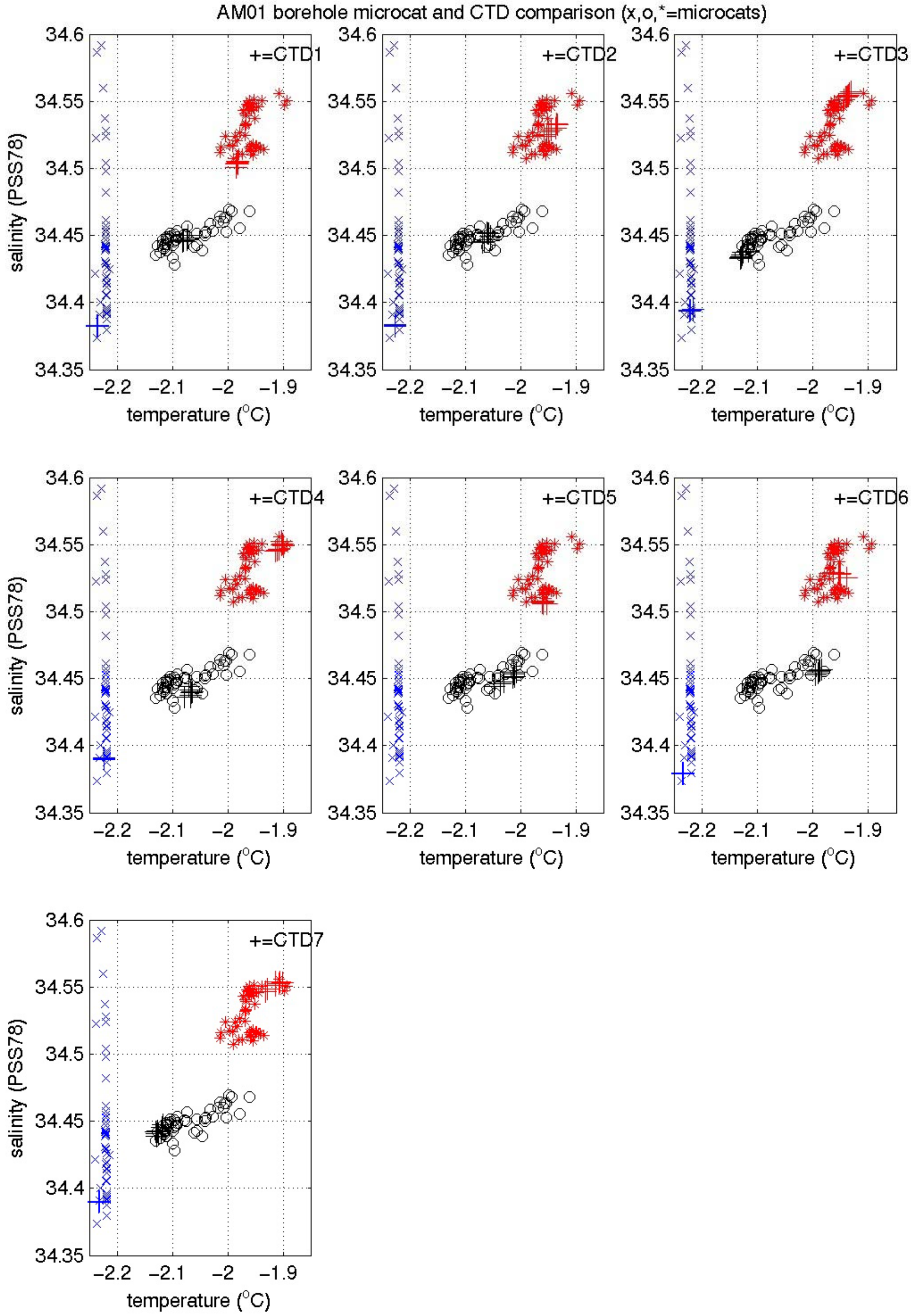


Figure A1.4.4: Borehole AM01 (2001/2002 season) – comparison of CTD and microcat data at the depth of the microcats; 8 days of microcat data.

PART 2 OCEANOGRAPHIC MOORING DATA

2.1 INTRODUCTION

An array of 9 moorings (Figure 1.1 earlier in the report, and Figure 2.1) was deployed along the front of the Amery Ice Shelf as part of the AMISOR program, outlined in Part 1 of this report. Mooring instrumentation included 27 thermosalinographs, 5 temperature loggers, 25 rotor current meters, 1 acoustic current meter, 4 acoustic Doppler current profilers (ADCP) and 2 upward looking sonars (ULS). This section describes data processing and data quality for the AMISOR oceanographic moorings, and the data are summarised graphically. Deployment and recovery details are described in unpublished cruise reports. Data from the Amery Ice Shelf borehole microcat moorings are discussed earlier in the report in Appendix 1.4.

Mooring diagrams are shown in Figures 2.2 to 2.4, and mooring details are summarised in Tables 2.1 and 2.2. Data file formats are summarised in Appendix 2.1.

Table 2.1: Instrument types used on AMISOR moorings. For parameters, T=temperature, C=conductivity, P=pressure, SPD=current speed, DIR=current direction,Tu=turbidity. For the RCM5's and RCM8's, not all instruments include P, and C is included only on RCM5's serials 8662, 8663 and 8670 (Table 2.4).

instrument type	parameters measured	recording interval
SeaBird SBE37SM microcat	T,C	5 minutes
SeaBird SBE39	T	5 minutes
Aanderaa RCM5 current meter	SPD,DIR,T,P	60 minutes
Aanderaa RCM8 current meter	SPD,DIR,T,P	60 minutes
Aanderaa RCM9 current meter	SPD,DIR,T,P,C,Tu	20 minutes
RDI Broadband 150kHz ADCP, upward looking orientation, convex 4 beam pattern	SPD,DIR,T,roll,pitch	60 minutes
Upward looking sonar, Curtin University of Technology, Western Australia	ice thickness, T, P, tilt	varied bursts, according to season

2.2 INITIAL DATA PROCESSING

2.2.1 General

All mooring data were assigned a consistent decimal time scheme, using decimal days as counted from midnight on December 31st 2000. So, e.g., midday on January 1st 2001 = 0.5 decimal time; midday on January 1st 2002 = 365.5.

Proximity of instruments to the south magnetic pole makes magnetic variation significant for current measurements. An average magnetic declination value was calculated for each mooring site, using

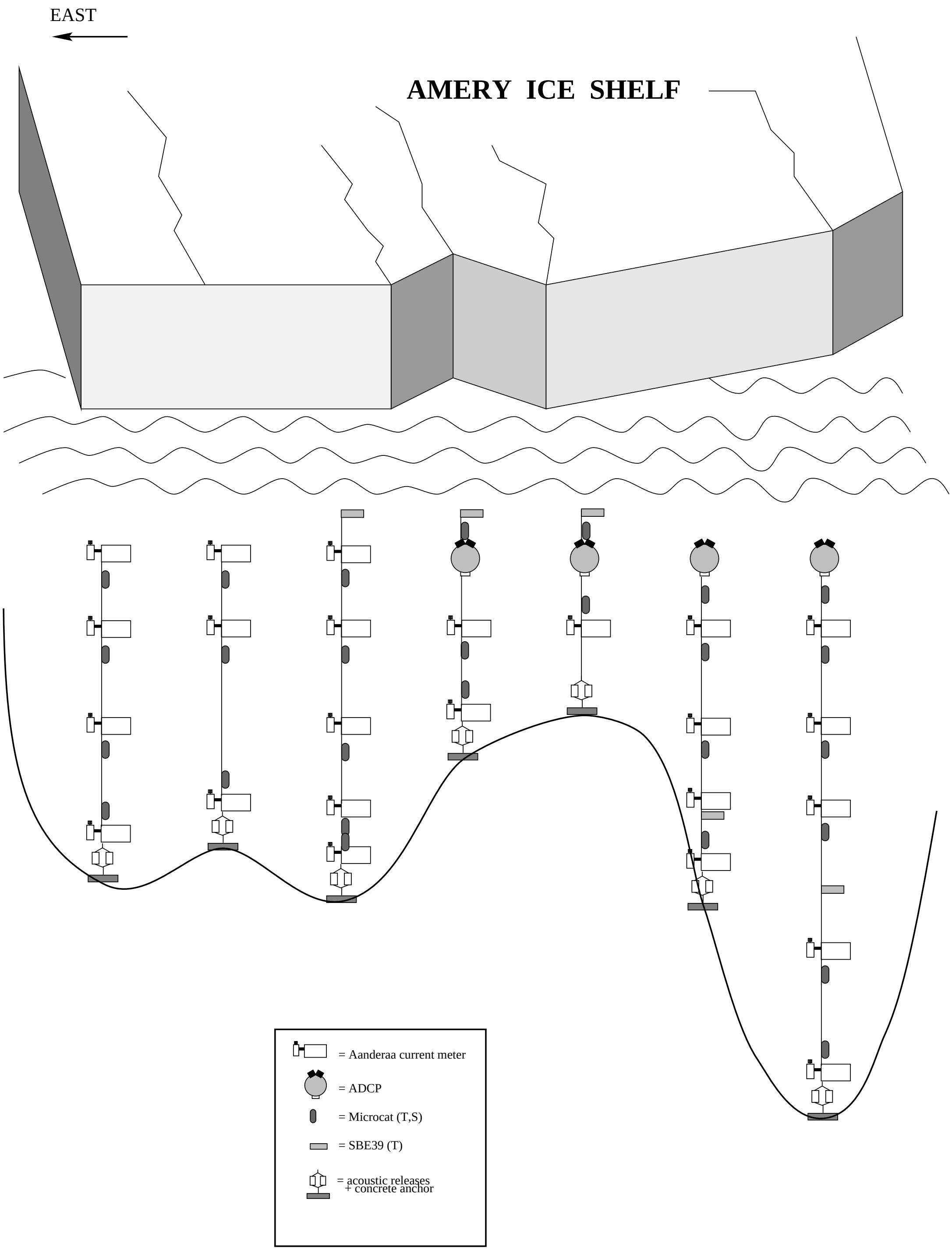


Figure 2.1: Schematic of mooring array along the front of the Amery Ice Shelf (the 2 offshore ULS moorings are not shown).

the International Geomagnetic Reference Field - 2000, as modelled by the International Association of Geomagnetism and Aeronomy Division V, Working Group 8. The program geomag31 was downloaded from the NOAA website www.ngdc.noaa.gov, and for each mooring location the program was run over the time interval 15th February 2001 to 15th February 2002, in 2 month time steps; an average at each location was calculated from the 2 month values. These average values (Table 2.2) were then applied as a constant correction to current meter measurements (Aanderaas and moored ADCP's).

The various instrumentation types are summarised in Table 2.1. Data from the upward looking sonars (ULS) (principal investigator Ian Allison, Australian Antarctic Division) are not discussed further in this report.

2.2.2 Microcat and SBE39

During the recovery of mooring AMISOR2, a yellow protective plug was found still fitted to the lower end of the conductivity cell on microcat 321. As a result optimum flushing of the cell may have been impeded during the time in the water, however from initial inspection of the record the conductivity/salinity data appear to be okay.

Microcat and SBE39 data were dumped from the instruments at sea (cruise au0207), using the SeaBird terminal program Seaterm (version 1.22). When first communicating with each instrument, clock error was noted (Table 2.3). All instruments recorded successfully, however faulty sensors caused significant data loss for 3 of the microcats (see data quality section). Note that the raw downloaded files were much “cleaner” (i.e. less data stream errors) than the equivalent downloaded files from the Mertz Polynya deployments (Rosenberg et al., 2001).

Manufacturer supplied pre-deployment calibrations (August 2000) were applied internally by the microcats, and calibrated data were output. The output files were manually edited to remove out of water data at the start and end of files, then the program “catfixamisor” was run to pad files at the start and end, calculate decimal times, check for and fill data gaps, fix bad temperature reads due to data stream problems, recalculate conductivity (for microcats only) using the correct deployment pressure, and calculate salinity (for microcats only). Note that there were no pressure sensors on any of these microcats, and a constant pressure value was used for all conductivity and salinity calculations. All files were padded to start from the first record on on 1st February 2001, and to end at the last record on 27th February 2002.

Prior to deployment the microcats and SBE39’s were all setup to start recording at exactly 1200 UTC on 14th February 2001. For an unknown reason, data recording for all the instruments commenced at various times between 1 and 2 minutes after the hour, thus first records for the different instruments are not simultaneous. Note that this unexplained delay in commencement of logging was unrelated to clock drift over the deployment period. After recovery of the instruments, the microcat clocks were typically running 1 to 4 minutes fast; SBE39 clocks were running ~1 minute slow (Table 2.3). The program “catstretchamisor” was run to compress (or stretch) all decimal times to correct for this clock drift. The correction was applied linearly throughout the time series. After this correction the data were **not** reinterpolated onto regular time intervals – this would have led to aliasing problems. Thus the recording intervals in the final data set are irregular, with different intervals for the different time series. These differences are however very small, only a few minutes over a year; and they are insignificant between successive data records.

2.2.3 Aanderaa RCM’s

Aanderaa RCM data were dumped from the instruments at sea on cruise au0207. Clock error to the nearest minute was noted when first communicating with each instrument (Table 2.3). 25 of the 26 RCM’s recorded successfully - of these, 5 instruments stopped logging good data 4 to 5 months prior to recovery; the 26th instrument (RCM8-10284) failed to log any good data.

The Aanderaa program DSU5059 was used to apply calibration coefficients (see Table 2.4 for calibration dates) and to add time stamps to the raw data files. The files output by the program were then edited to change some of the undesirable format features created by DSU5059. Next, the program “aand_amisorfix” (“aand_rcm9fix” for the RCM9) was run to reformat the data, apply the local magnetic declination correction (Table 2.2), calculate u and v current components, and convert the pressure sensor units to dbar. Files output at this stage were edited to remove out of water data

Table 2.2: **Summary of mooring details. Note: magdec=average magnetic declination.**

mooring	position	deployment time (UTC)	recovery (release) time (UTC)	ocean depth (m)	magdec (deg)	d(magdec)/dt (deg/year)	instrument	instrument position depth (m)	instrument position pressure (dbar)
amisor1	69° 22.014'S, 74° 38.153'E	1313, 16/02/2001	0600, 22/02/2002	750	-76.46	-0.14	RCM8-10867	367	371.2
							microcat-315	368	372.2
							RCM8-10919	459	464.4
							microcat-316	460	465.4
							RCM8-10282	571	577.8
							microcat-317	572	578.8
							microcat-318	725	733.9
							RCM5-7837x	735	744.0
amisor2	69° 12.001'S, 74° 05.962'E	1607, 16/02/2001	1208, 21/02/2002	672	-75.88	-0.14	RCM8-10868	370	374.2
							microcat-319	371	375.3
							RCM8-10993	462	467.4
							microcat-320	463	468.4
							microcat-321	647	654.8
							RCM8-10917	657	665.0
amisor3	68° 52.386'S, 73° 33.310'E	0544, 17/02/2001	0748, 21/02/2002	768	-75.16	-0.14	SBE39-089	324	327.7
							RCM8-10914	347	351.0
							microcat-322	348	352.0
							RCM8-10869	439	444.1
							microcat-323	440	445.1
							RCM8-10996	551	557.5
							microcat-324	552	558.5
							RCM8-10311	663	671.0
							microcat-325	664	672.0
							microcat-326	743	752.1
							RCM5-8670x	753	762.3
amisor4	68° 35.314'S, 72° 30.236'E	1248, 17/02/2001	0903, 12/02/2002	538	-74.09	-0.14	SBE39-107	347	350.9
							microcat-327	366	370.2
							ADCP-0136	367	371.2
							RCM8-10915	459	464.3
							microcat-328	460	465.4
							microcat-329	513	519.0
							RCM8-10768	523	529.2

Table 2.2: (continued)

mooring	position	deployment time (UTC)	recovery (release) time (UTC)	ocean depth (m)	magdec (deg)	d(magdec)/dt (deg/year)	instrument	instrument position depth (m)	instrument position pressure (dbar)
amisor5	68^o 34.840'S, 71^o 39.816'E	1546, 17/02/2001	2355, 10/02/2002	472	-73.43	-0.14	SBE39-112	345	348.9
							microcat-330	364	368.2
							ADCP-1136	365	369.2
							microcat-332	447	452.2
							RCM8-10704	457	462.3
amisor6	68^o 30.330'S, 70^o 51.770'E	0423, 18/02/2001	0440, 11/02/2002	786	-72.76	-0.14	ADCP-0135	365	369.2
							microcat-380	366	370.2
							RCM8-10916	457	462.3
							microcat-908	458	463.3
							RCM8-10284	569	575.8
							microcat-909	570	576.8
							RCM8-10701	681	689.3
							SBE39-111	682	690.3
							microcat-911	761	770.4
							RCM8-10703	771	780.5
amisor7	68^o 28.659'S, 70^o 23.118'E	0945, 18/02/2001	0742, 11/02/2002	1135	-72.36	-0.14	ADCP-1143	378	382.3
							microcat-912	379	383.3
							RCM8-10918	470	475.5
							microcat-913	471	476.5
							RCM8-7838x	582	588.9
							microcat-914	583	589.9
							RCM8-10998	694	702.4
							microcat-1119	695	703.5
							SBE39-115	805	815.5
							RCM8-10702	906	917.5
							microcat-1120	907	918.5
							microcat-1121	1110	1124.6
							RCM9-597_9	1120	1134.7
amisor8 (uls1)	69^o 00.020'S, 75^o 18.680'E	0418, 21/02/2001	0854, 14/02/2002	717	-76.64	-0.14	ULS3-SOFAR	172	173.9
							RCM5-8662x	199	201.2
amisor9 (uls2)	68^o 33.693'S, 72^o 42.297'E (position at deployment)								
	68^o 32.135'S, 72^o 38.536'E	0904, 17/02/2001	0508, 16/02/2002	629	-74.15	-0.14	ULS5 –SO-ON	253	255.8
	(position at recovery)						RCM5-8663x	278	281.1

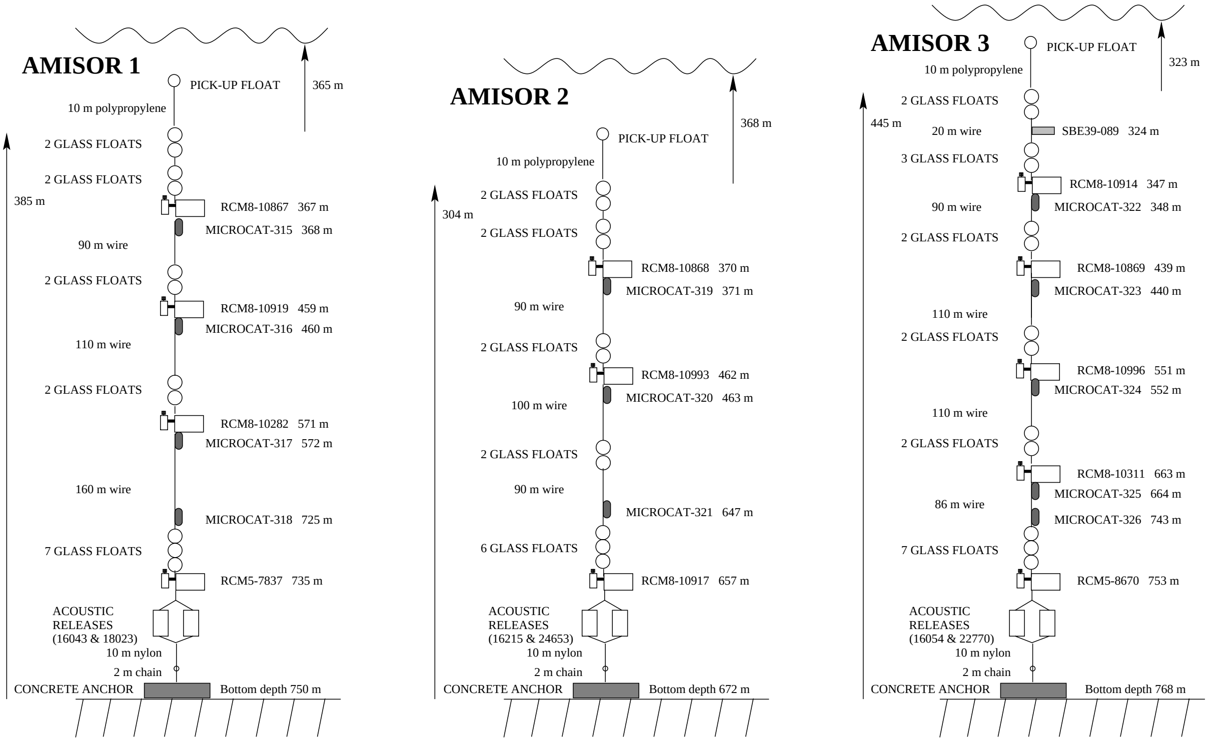


Figure 2.2: AMISOR moorings 1, 2 and 3.

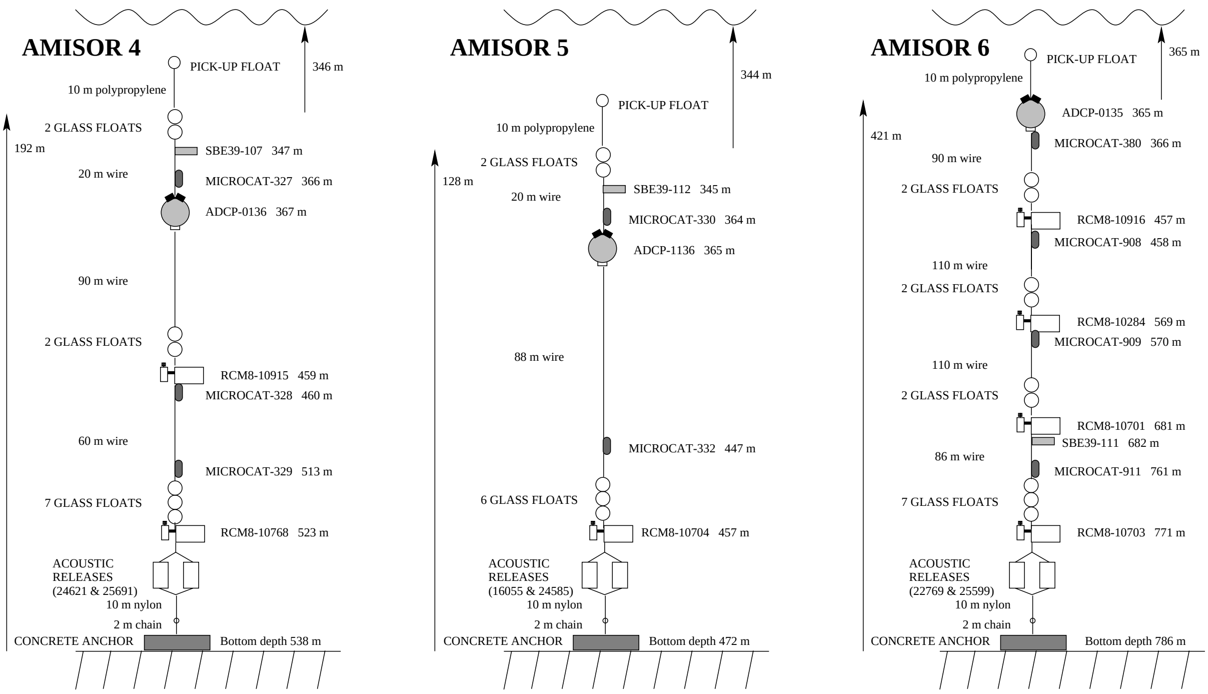


Figure 2.3: AMISOR moorings 4, 5 and 6.

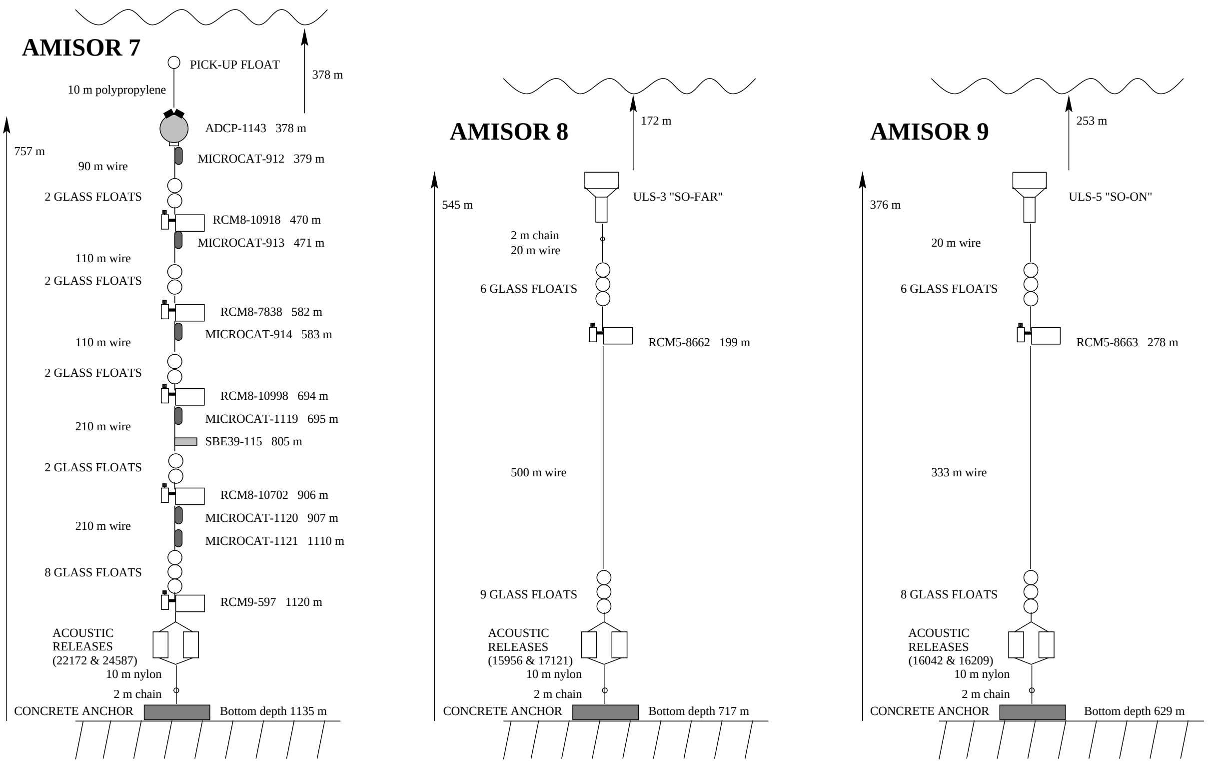


Figure 2.4: AMISOR moorings 7, 8 and 9. For AMISOR9 diagram, depths are after mooring was moved by an iceberg.

at the start and end. The program "aand_amisordectime" ("aand_rcm9dectime" for the RCM9) was then run to pad files at the start and end, calculate decimal times, and check for and fill data gaps. All files were padded to start from 0030 UTC on 1st February 2001, and to end at the last record on 27th February 2002.

After recovery of the instruments, the RCM clocks were typically running 10 to 15 minutes slow (Table 2.3). The program "aand_stretch" ("aand_rcm9stretch") was run to stretch all decimal times to correct for the clock drift. The correction was applied linearly throughout the time series; data were **not** then reinterpolated onto regular time intervals. As a consequence the recording intervals in the final data set are irregular. For the 5 RCM's which stopped recording several months early (serials 10703, 10915, 10993, 10282 and 10311), the clock drift value was estimated based on the measured values for the other RCM's. For instrument 10311, logging recommenced when the instrument was retrieved. The clock drift however could still not be directly measured, so an estimate was required.

2.2.4 Moored ADCP

The moored ADCP's were set up with the following logging parameters:

no. of bins=40
bin length=8.0 m
blank after transmit=2.0 m
distance to centre of first bin=11.0 m
pings per ensemble=20
time between pings=2.00 s

When the ADCP's were checked several days prior to deployment, 0135 had failed. The instrument was opened up and the circuit boards and batteries reseated. The instrument was then reprogrammed for deployment.

Data from the ADCP's were dumped on cruise au0207, using the RDI program BBtalk. Of the 4 instruments, 0136 and 1136 recorded data for the full deployment time; 0135 failed after ~10 weeks in the water, including a gap of 24 days of no recording after only 6 days in the water; and 1143 failed during deployment (i.e. no data).

An accurate clock drift could only be determined for instrument 0136. The clock drift for 0135 and 1136 had to be estimated (Table 2.3), and as a result the times for these two instruments can only be considered accurate to ~5 minutes.

The raw data were initially converted to matlab format using the RDI program WINADCP by Bernadette Heaney at CSIRO. The files were then processed as follows:

(a) Files were manually edited to remove several small time recording errors.

(b) The program "adcpfixamisor" was run to reformat the matlab matrices and vectors.

<u>Table 2.3:</u> Instrument clock errors. Note: time fast in seconds for microcat and SBE39, in minutes for RCM and ADCP. For RCM's and ADCP's, * indicates estimated value.

instrument	no. of sec. fast	time (days) between start and clock check	instrument	no. of min. fast	time (days) between start and clock check
microcat			***RCM***		
315	117	441.1785	10282	-10*	388.4063*
316	134	441.2674	10284	-	-
317	199	441.3354	10311	-12*	390.5979
318	127	441.4028	10701	-15	391.1146
319	181	440.2000	10702	-12	390.3625
320	230	440.3042	10703	-15*	391.1146*
321	189	440.3792	10704	-15	388.4063
322	5	440.4458	10768	-12	390.4042
323	55	440.6181	10867	-15	389.1563
324	156	440.6958	10868	-22	389.3278
325	73	440.7806	10869	-14	390.3639
326	175	441.1090	10914	-12	390.3625
327	62	437.1646	10915	-12*	390.3625*
328	166	437.0986	10916	-13	391.1132
329	144	436.0424	10917	-15	389.3229
330	128	435.5875	10918	-12	390.5292
332	135	435.3785	10919	-16	389.1569
380	228	435.2632	10993	-9*	389.3188*
908	70	433.3424	10996	-9	389.3188
909	157	433.4556	10998	-8	390.5264
911	230	433.5160	7837	-9	389.1525
912	234	433.6660	7838	-10	390.5278
913	137	433.7347	8662	-9	390.1942
914	229	434.0604	8663	-9	390.1942
1119	248	434.5347	8670	-9	389.3192
1120	244	435.1215	597	-10	391.2778
1121	130	435.1917			
SBE39			***ADCP***		
0089	-52	437.3389	0135	-10*	-
0107	-65	436.2382	0136	-9	636.0326
0111	-60	437.0938	1136	-10*	-
0112	-75	436.4583	1143	-	-
0115	-71	437.2118			

<u>Table 2.4:</u> Aanderaa RCM5, 8 and 9 sensor calibration dates. T=temperature, P=pressure, DIR=direction, C=conductivity. For RCM9-597, a turbidity sensor was included (calibration date Sep 2000).

instrument	sensor calibration date			
	T	P	DIR	C
10282	Apr 1991	Feb 1998	Feb 1998	no C sensor
10284	Apr 1991	Feb 1993	Apr 1991	no C sensor
10311	Jul 1999	Feb 1998	Feb 1998	no C sensor
10701	Apr 1992	Mar 1994	Apr 1992	no C sensor
10702	Apr 1994	Jan 1996	Apr 1994	no C sensor
10703	Apr 1992	no P sensor	Apr 1992	no C sensor
10704	Apr 1992	no P sensor	Apr 1992	no C sensor
10768	May 1992	no P sensor	May 1992	no C sensor
10867	unknown	Feb 1998	Feb 1998	no C sensor
10868	unknown	Feb 1998	Feb 1998	no C sensor
10869	Oct 1992	Oct 1992	Oct 1992	no C sensor
10914	Jul 1999	Jul 1999	Feb 1993	no C sensor
10915	Jul 1999	Jul 1999	Feb 1993	no C sensor
10916	Feb 1993	Jan 1996	Feb 1993	no C sensor
10917	Feb 1993	no P sensor	Feb 1993	no C sensor
10918	Feb 1993	Feb 1993	Feb 1993	no C sensor
10919	Feb 1993	Feb 1993	Feb 1993	no C sensor
10993	Sep 2000	Sep 2000	Sep 2000	no C sensor
10996	Sep 2000	Sep 2000	Sep 2000	no C sensor
10998	Feb 1993	Feb 1993	Feb 1993	no C sensor
7837	Jun 1999	May 1998	Sep 1997	no C sensor
7838	Jun 1999	May 1998	Sep 1997	no C sensor
8662	Jul 1999	Jul 1999	Feb 1998	no calibration
8663	Jul 1999	Jul 1999	Feb 1998	no calibration
8670	May 1988	no P sensor	May 1988	May 1988
597	Sep 2000	Sep 2000	Sep 2000	Sep 2000

(c) The program "adcptimeamisor" was run to remove out of water data at the start and end, check for and fill data gaps, and pad the files to start at the first record on 1st February 2001.

(d) The program "adcpcalamisor" was run to convert data to engineering units, apply data quality control, and apply the local magnetic declination correction (Table 2.2). The following quality controls were applied to the direction, speed and velocity component data:

* If PG4 < 80% (where PG4 is the percent good of 4 beam solutions used in making the ensemble), flag bin as bad.
* If average beam correlation < 70, flag bin as bad.
* Flag bins 35 to 40 of each ensemble as bad due to side lobe contamination.
* If orientation flag = 0, flag the entire ensemble as bad.

The bins and ensembles flagged as bad were converted to null data (NaN) in the matlab files.

(e) Lastly, the program "adcpstretchamisor" was run to correct decimal times for clock drift, applying the correction linearly throughout the record. Data were **<u>not</u>** reinterpolated onto regular time intervals after this correction.

Note that in the final matlab files, rows 1 to 40 in the matrices and vectors correspond to vertical bins 40 to 1 (noting that vertical bin 1 is the deepest bin for an upward looking ADCP).

2.3 DATA QUALITY AND FURTHER DATA PROCESSING

Microcat and SBE39 temperature and salinity data are plotted in Figures 2.5a to n. Aanderaa current meter velocity vectors are plotted in Figures 2.6a to h, including moored ADCP velocity vectors from bin 2. This section outlines data quality from the instruments. Table 2.6 provides a summary of cautions to data quality.

2.3.1 Microcat and SBE39 data

Data comparisons were made between the different instruments on each mooring, and between the moored instruments and CTD data from cruises au0106 and au0207 (Table 2.5). In general, most of the microcat data are consistent with CTD measurments. For the 3 microcats serials 318, 322 and 323, the temperature sensor failed during the deployment. Conductivity sensor measurments were okay for these instruments, however the conductivity data could not be converted to engineering values without temperature data.

For the microcat conductivity/salinity data in general, the largest spikes which are obviously bad data have been removed. Numerous smaller salinity spikes occur which have not been removed, falling into 2 categories: smaller spikes possibly due to fouling; and during times of increased temperature and salinity variability, spiking most likely due to insufficient flushing of the conductivity cell resulting in mismatch of temperature and conductivity data. It may be possible to use temperature-salinity plots to confirm the plausibility of outlying data points, however no attempt has been made here to quality control these numerous periods of spiking.

The following suspect microcat data were removed from the files (for the parameters, T=temperature, C=conductivity, S=salinity):

microcat	*parameter*	*data point numbers*	*comments*
315	C,S	9001-9002	spiking
315	C,S	48113-48159	offset possibly due to fouling
317	C,S	32221-32323	offset possibly due to fouling
318	T,C,S	18994-111239	T sensor failed
319	C,S	105187	spiking
320	C,S	4515-4519	transient error at start of deployment
320	C,S	20831	spiking
320	C,S	102011-102760	offset possibly due to fouling
321	C,S	4515-4619	transient error at start of deployment
322	T,C,S	whole record	T sensor failed
323	T,C,S	whole record	T sensor failed
324	C,S	12658-19961	offset possibly due to fouling
326	C,S	22606-22615	spiking
326	C,S	53297-53314	offset possibly due to fouling
328	C,S	4765-14976	C data ramping up for first few weeks
332	C,S	29204	spiking
380	C,S	57322; 57323; 57326	spiking
908	C,S	101459-101460	spiking
909	C,S	52633-52634; 107144-107150	spiking
911	C,S	43503-43524; 43535-43536; 43538; 43546-43548	spiking
912	C,S	17670-17676	spiking
914	C,S	100668-100669	spiking
1120	C,S	18917; 19640	spiking

The following suspect microcat data were not removed from the files:

microcat	*parameter*	*data point numbers*
332	C,S	15676-15680

For the SBE39 measurements, temperature data from sbe39-111 and sbe39-115 appear to be ~0.005^{o}C lower than microcat and CTD data. This same difference was found for SBE39 data from the earlier Mertz Polynya deployments (Rosenberg et al., 2001). The remaining 3 SBE39's, serials 089, 107 and 112, were at shallower depths (Table 2.2) where temperatures were more variable: the existence of a similar temperature difference for these 3 instruments could not be determined, although note that the same difference value was found for these instruments on the Mertz Polynya deployments.

Table 2.5: CTD stations suitable for comparison with mooring microcat data.

mooring	CTD cruise	nearest CTD station	distance between CTD station and mooring (nautical miles)
1	au0106	91 (lap2.3)	1.40
1	au0106	45 (lap1.3)	0.45
1	au0207	51 (lap3.3)	1.44
2	au0106	88 (lap2.6)	1.19
2	au0106	48 (lap1.6)	0.33
2	au0207	48 (lap3.6)	1.38
3	au0106	84 (lap2.10)	1.20
3	au0106	52 (lap1.10)	0.17
3	au0207	31 (lap2.10)	1.50
4	au0106	79 (lap2.15)	1.90
4	au0106	58 (lap1.15)	0.48
4	au0207	26 (lap2.15)	1.06
5	au0106	76 (lap2.18)	1.70
5	au0106	61 (lap1.18)	0.32
5	au0207	23 (lap2.18)	1.38
5	au0207	9 (lap1.18)	1.49
6	au0106	73 (lap2.21)	1.52
6	au0106	64 (lap1.21)	0.52
6	au0207	20 (lap2.21)	1.18
6	au0207	6 (lap1.21)	1.50
7	au0106	71 (lap2.23)	1.40
7	au0106	66 (lap1.23)	1.33
7	au0207	18 (lap2.23)	1.25
7	au0207	4 (lap1.23)	0.79

2.3.2 Aanderaa RCM data

Most of the RCM current data appears to be good. The temperature data from the RCM's should not be used, as sensor calibrations are often very old (Table 2.4), and data are not as accurate as data from the adjacent microcats and SBE39's. Pressure data from the RCM's are often incorrect, and in general they should not be used quantitatively. Pressure records can however be useful for qualitative assessment of changes in mooring tilt throughout the deployment. In particular, pressure data from RCM5-8663 shows the exact time mooring AMISOR9 was dragged by an iceberg (Figure 2.8). Dragging appears to have commenced after 0030 on 07/05/2001 UTC, and ended before 0530 on 07/05/2001 UTC.

For 3 of the RCM's, serials 10868, 10914 and 8670, there is a small range of compass directions which do not occur (Figure 2.9), due to a hardware problem with the compass. Data records where this occurs do have direction values assigned, however the inaccuracy will be according to the width of this "shadow" in direction values (Figure 2.9).

The following suspect RCM data were removed from the files (for the parameters SPD=current speed and direction, T=temperature, P=pressure, C=conductivity):

RCM	*parameter*	*data point numbers*	*comments*
10282	T	whole record	bad data
10282	SPD,P	4849-end	good data ends on 22/08/2001
10311	T	whole record	bad data
10311	SPD,P	5161-end	good data ends on 04/09/2001
10702	SPD,T,P	8883-end	good data ends on 06/02/2002
10703	SPD,T	5125-end	good data ends on 02/09/2001
10768	SPD,T	8667-end	good data ends on 28/01/2002
10915	SPD,T,P	5746-end	good data ends on 28/09/2001
10993	SPD,T,P	5576-end	good data ends on 21/09/2001
10998	SPD	7949-end	speed data goes bad on 29/12/2001
7837	T	whole record	bad data

The following suspect RCM data were not removed from the files:

RCM	*parameter*	*data point numbers*	*comments*
10867	P	most of record	starts at plausible value then drifting to lower values
10868	P	most of record	starts at plausible value then drifting to lower values
10869	P	whole record	drifting to lower values
7837	P	whole record	too low by ~80 dbar
8662	P	whole record	too high by ~200 dbar
8662	C	whole record	calibration unreliable
8663	C	whole record	drifting values
8670	C	whole record	calibration unreliable

2.3.3 Moored ADCP data

Moored ADCP current speed and direction values were compared with adjacent Aanderaa RCM current speed and direction - reasonably good correspondence was found, with the currents in phase (no figures are presented). A comparison was also made between moored ADCP data and ship-based ADCP data, from both marine science cruises (Figure 2.7a to c). Although mooring and ship-based measurements exactly coincident in space and time were not available, the measurements were close enough to assess compatibility. Current magnitude, direction and profile shape are in general agreement between the two data sources for cruise au0106. There is more variability for cruise au0207, due in part to the increased variability of the ship-based ADCP measurements, in particular for the measurements near mooring AMISOR4 (Figure 2.7a).

Table 2.6: **Summary of cautions to mooring intrument data quality. For parameters, T=temperature, C=conductivity, S=salinity, P=pressure.**

instrument	mooring	parameters	caution
microcat-321	2	C,S	optimum flushing of C cell may have been impeded: initial inspection of data reveals no problems
microcat-326	3	C,S	data points 53297-53314 are suspect
microcat-332	5	C,S	data points 15676-15680 are suspect
all microcats	all	C,S	periods of increased T and S variability may include implausible salinity values as small spikes
sbe39-111 & 115	6 & 7	T	appear to be ~0.005°C low
sbe39-089,107 & 112	3,4 & 5	T	no direct evidence for values being too low, but treat data with caution when considering accuracies better than 0.005°C
RCM8-10282,10993, 10311,10915 & 10703	1,2,3,4 & 6	time	clock drift estimated
all RCM's	all	T, P	use T data from adjacent microcats/SBE39's; use P data qualitatively only
RCM5-8670 & 8662	8 & 3	C	unreliable conductivity calibrations
RCM5-8663	9	C	drifting values
ADCP-1136 & 0135	5 & 6	time	clock drift estimated - time only accurate to ~ 5 minutes

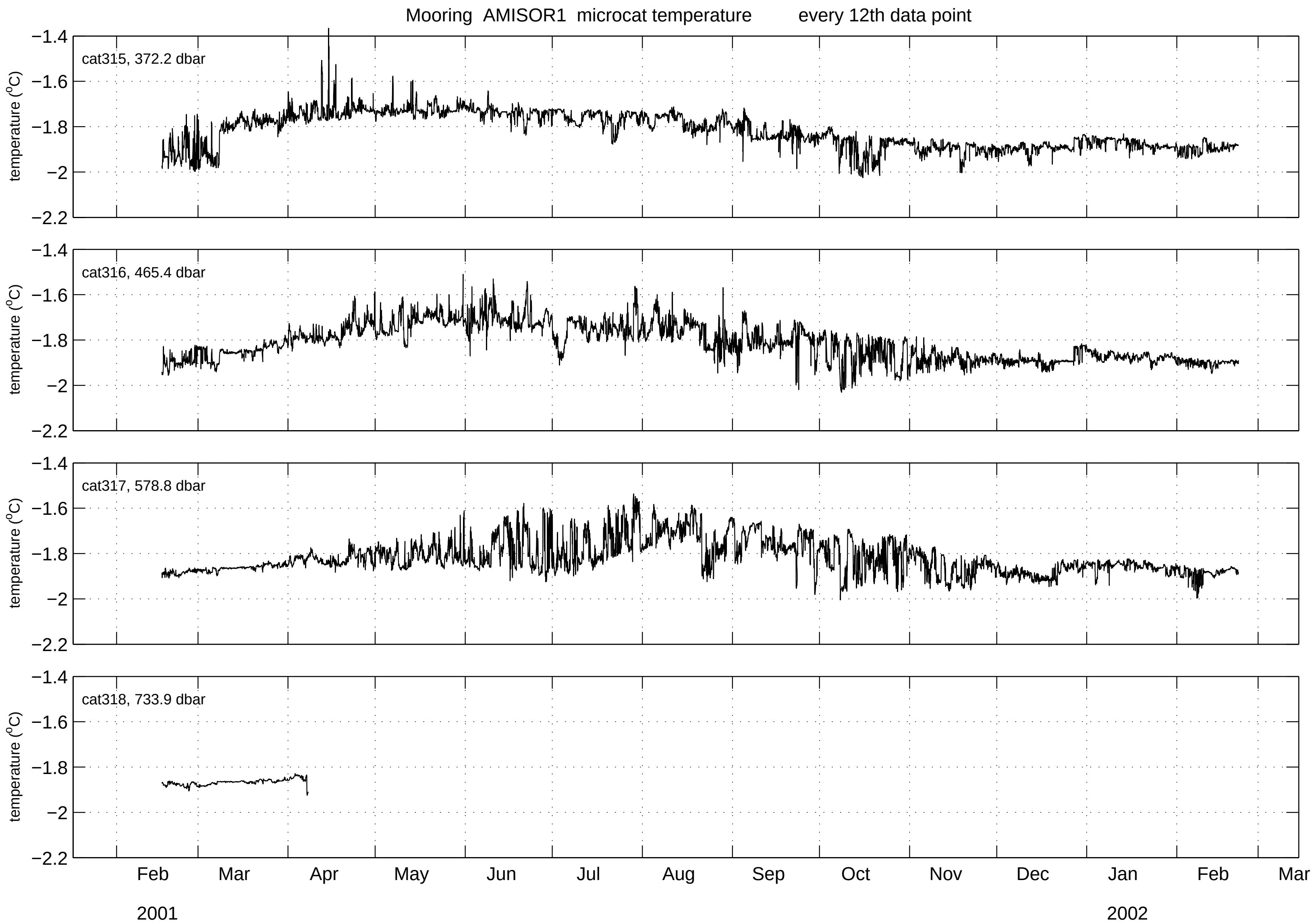
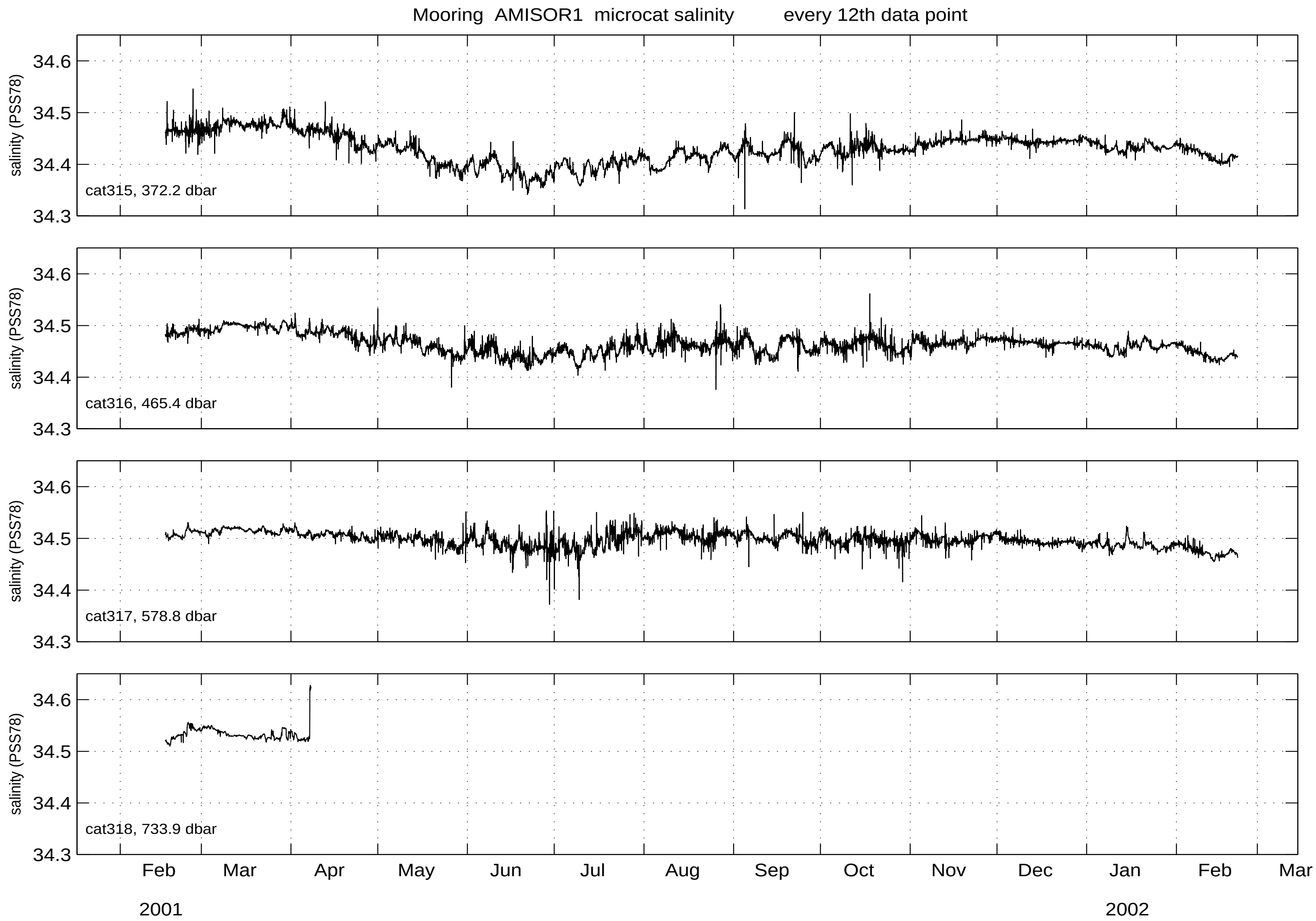


Figure 2.5a: **Microcat temperature data for mooring AMISOR1.**



<u>Figure 2.5b:</u> Microcat salinity data for mooring AMISOR1.

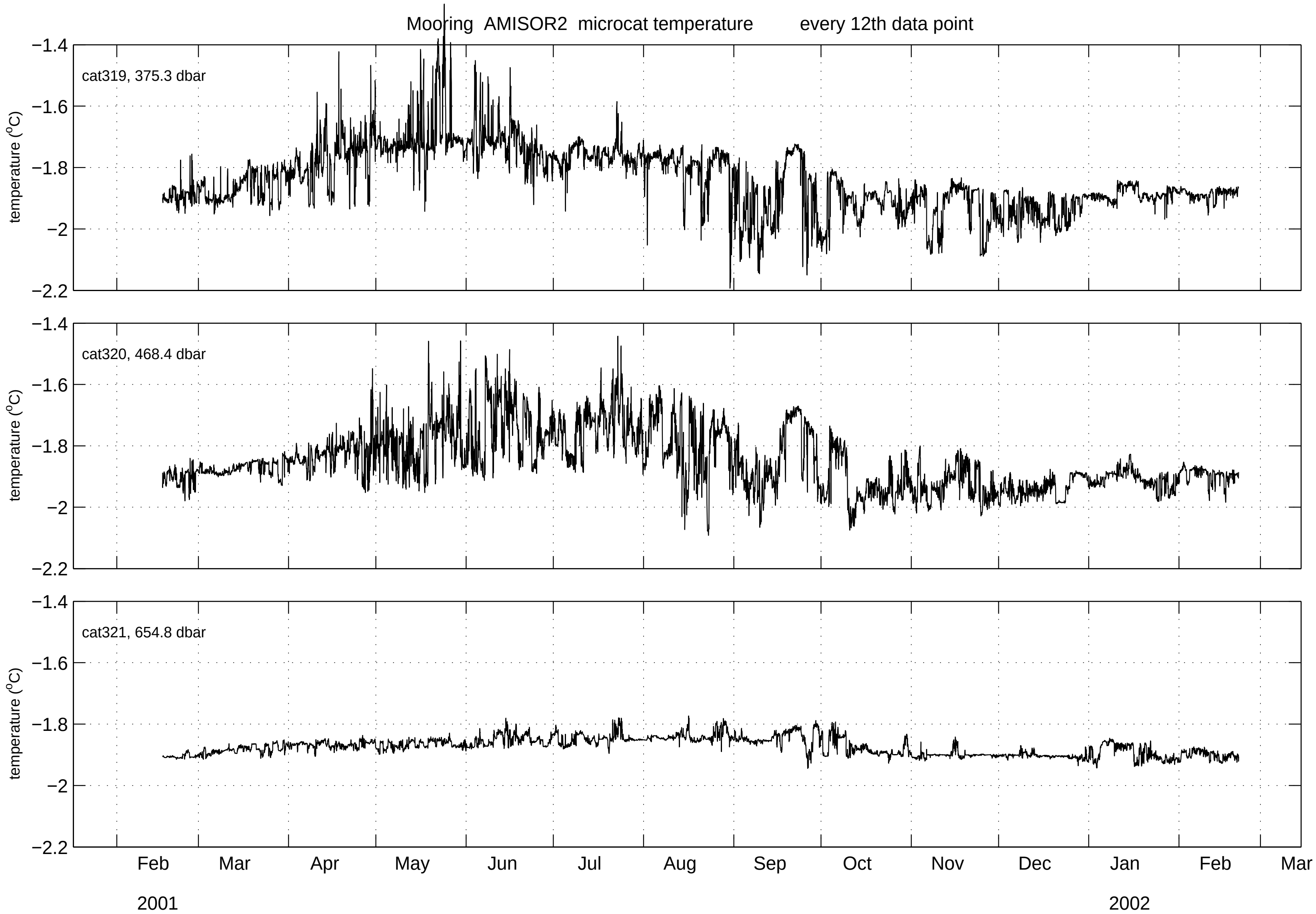
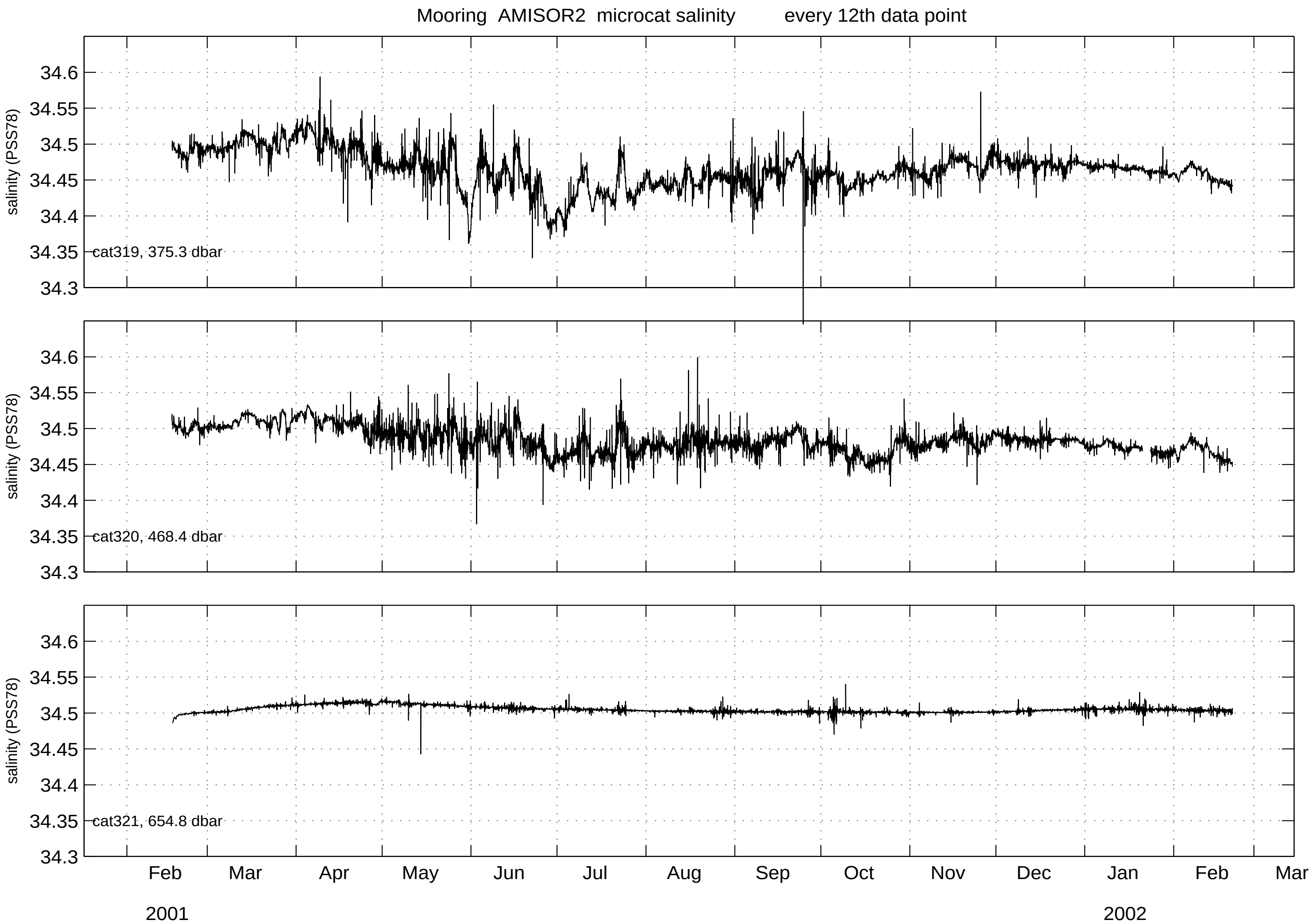


Figure 2.5c: **Microcat temperature data for mooring AMISOR2.**



<u>Figure 2.5d:</u> **Microcat salinity data for mooring AMISOR2.**

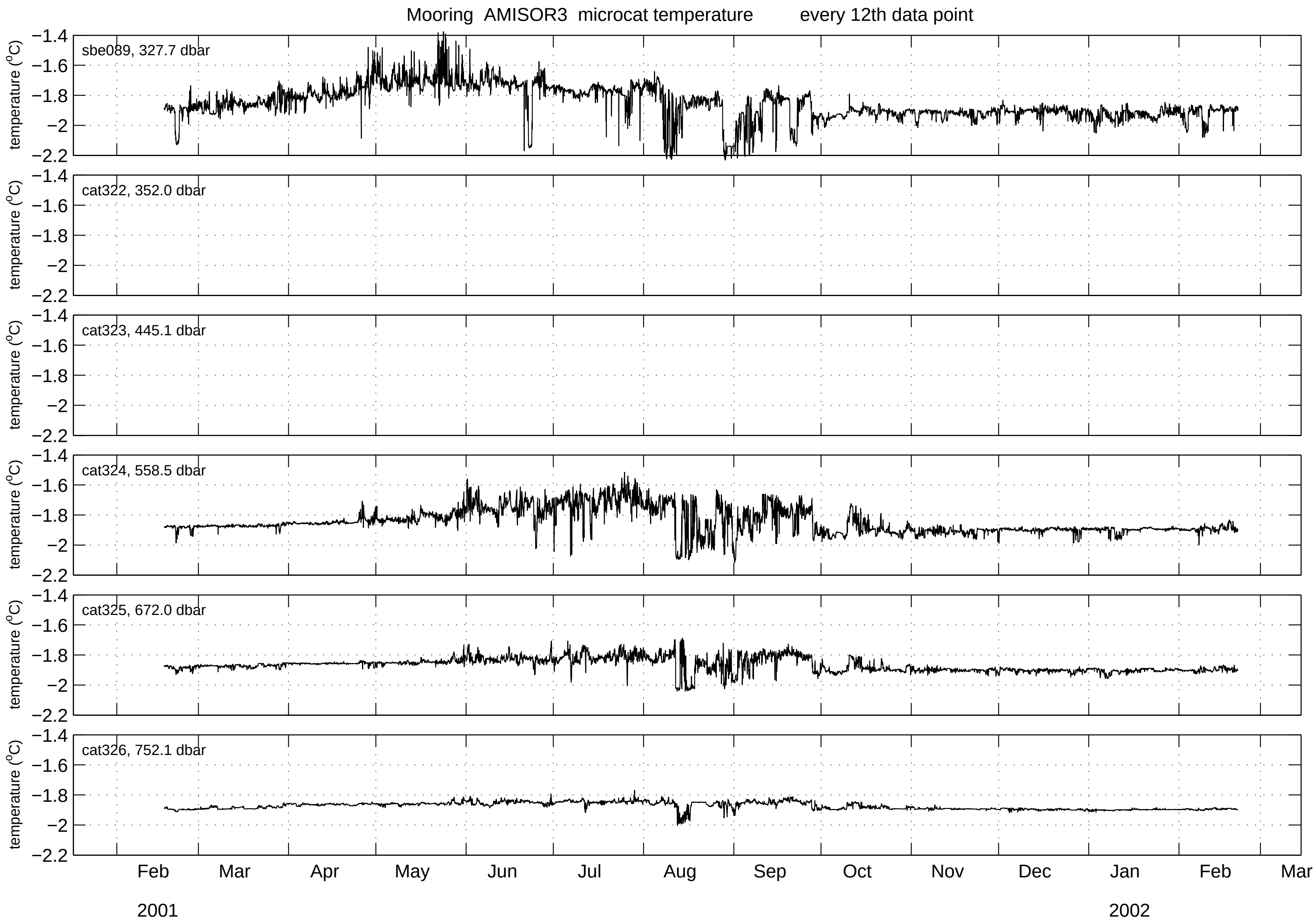


Figure 2.5e: **Microcat and SBE39 temperature data for mooring AMISOR3.**

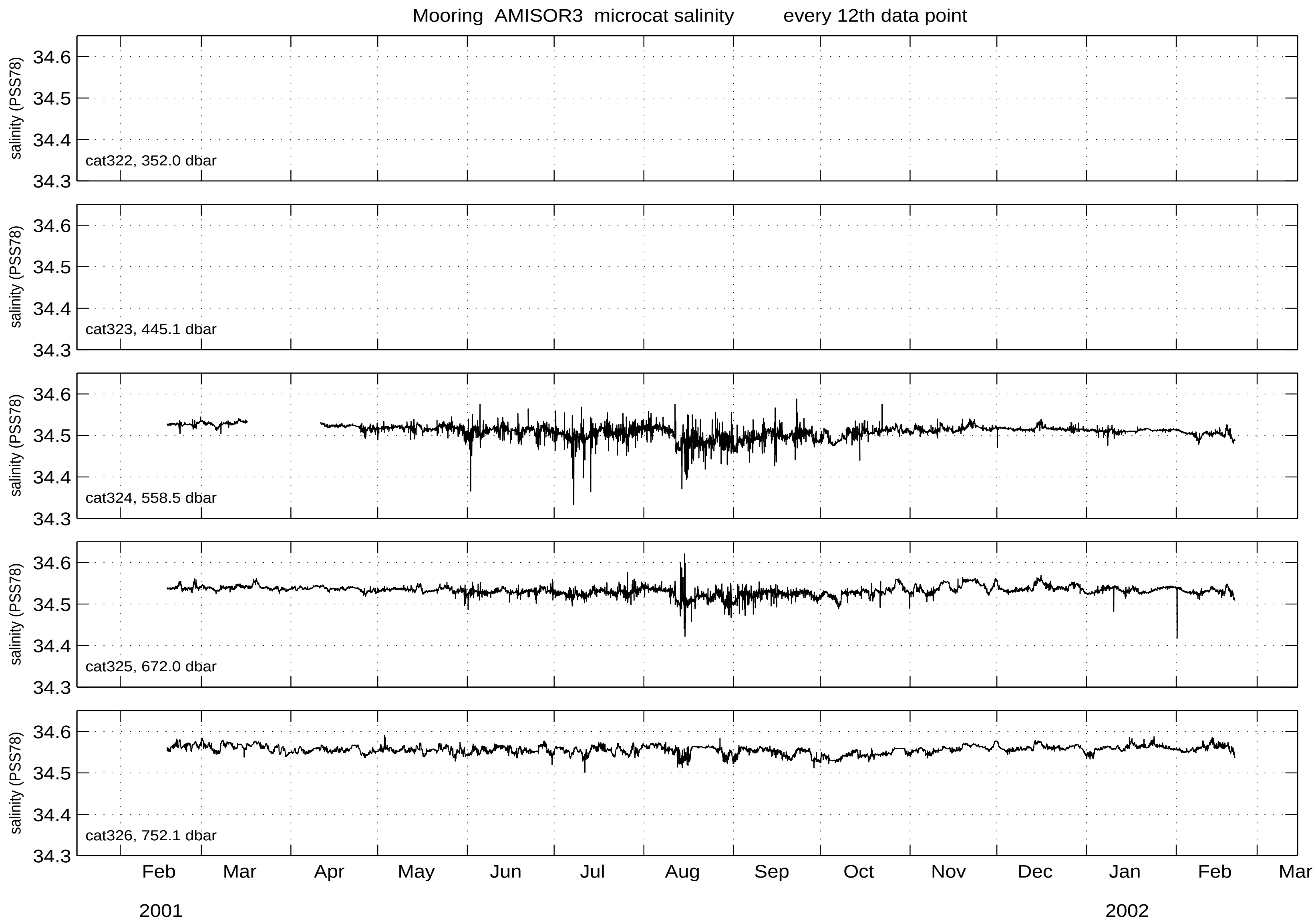
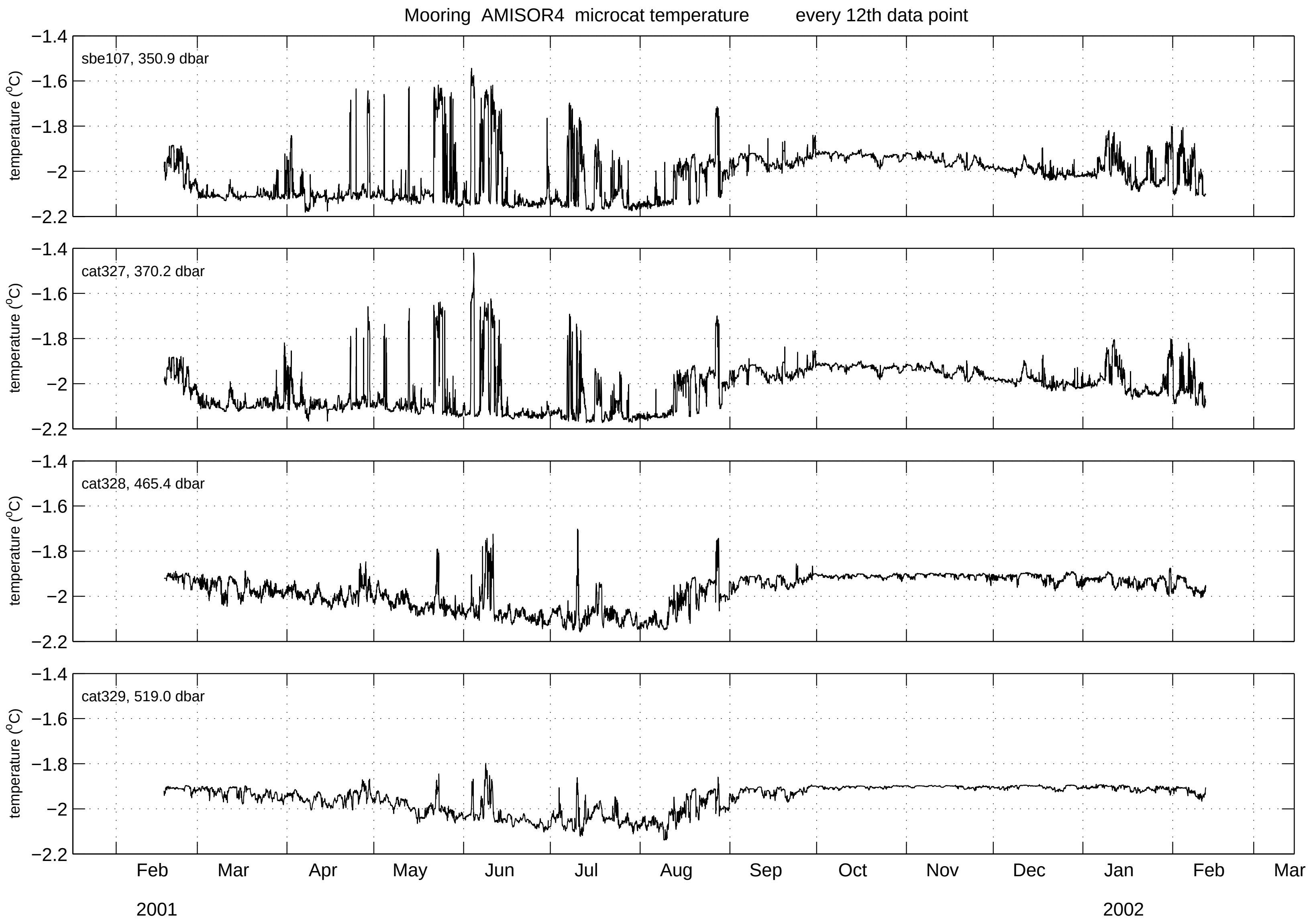
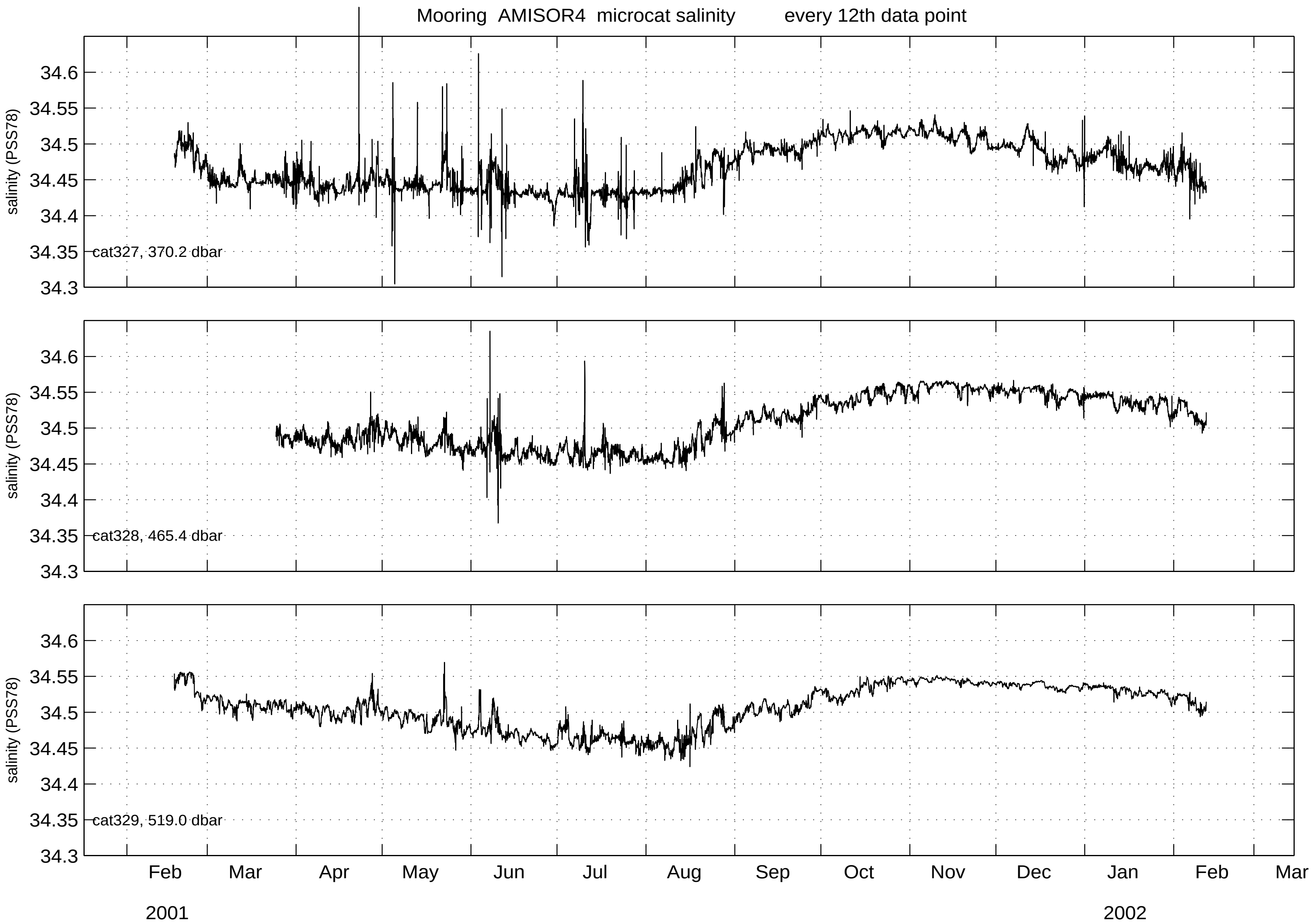


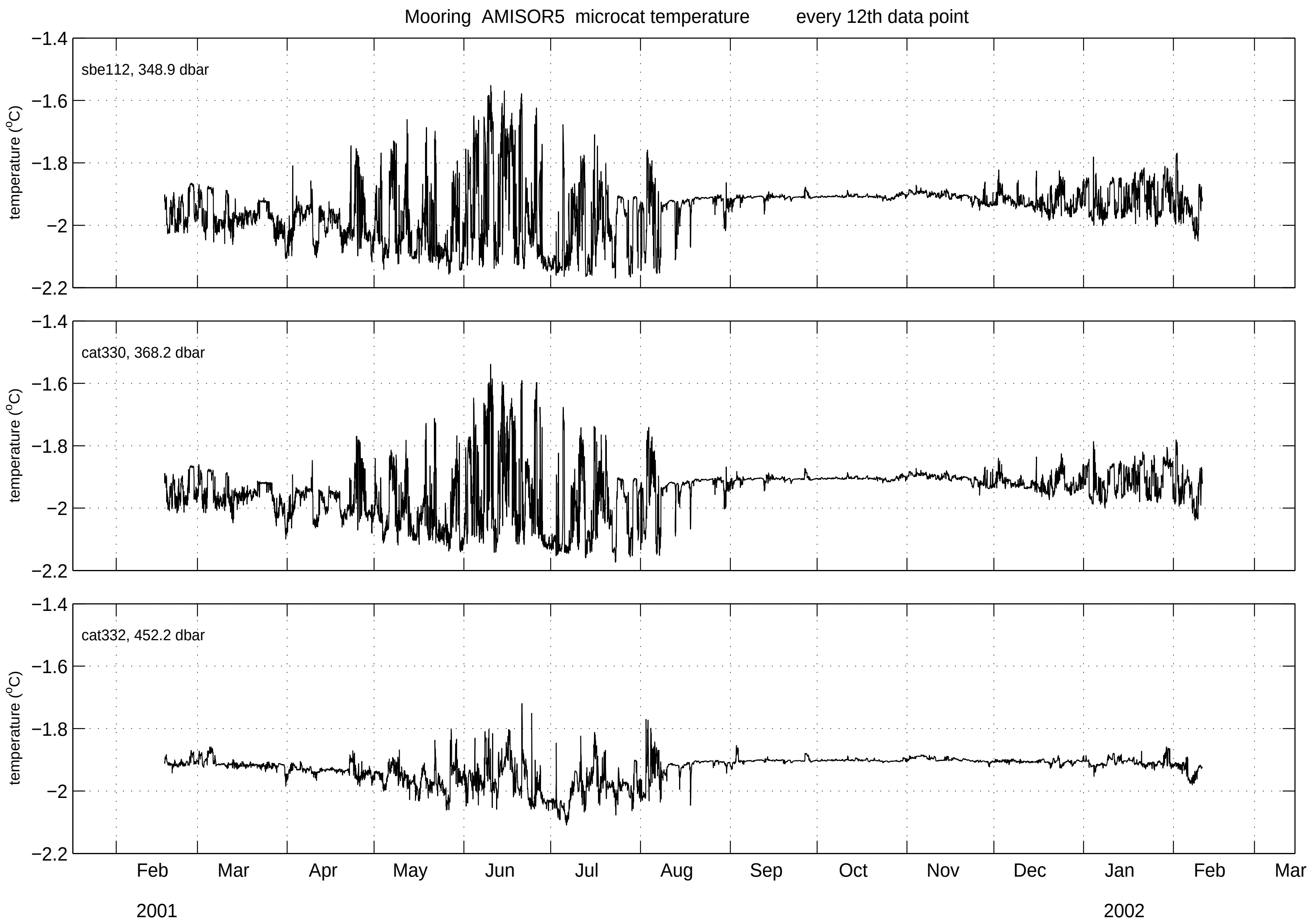
Figure 2.5f: Microcat salinity data for mooring AMISOR3.



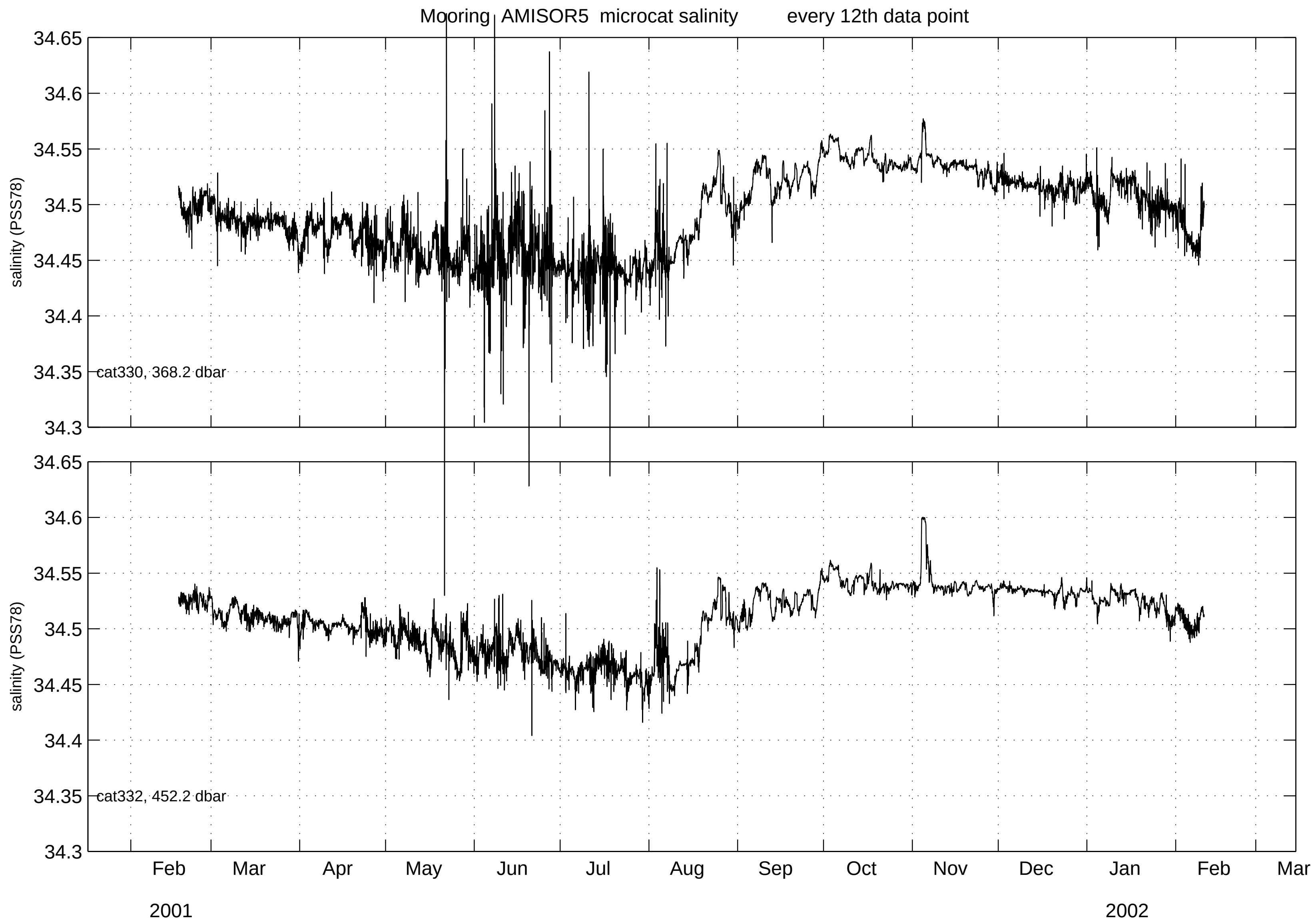
<u>Figure 2.5g:</u> Microcat and SBE39 temperature data for mooring AMISOR4.



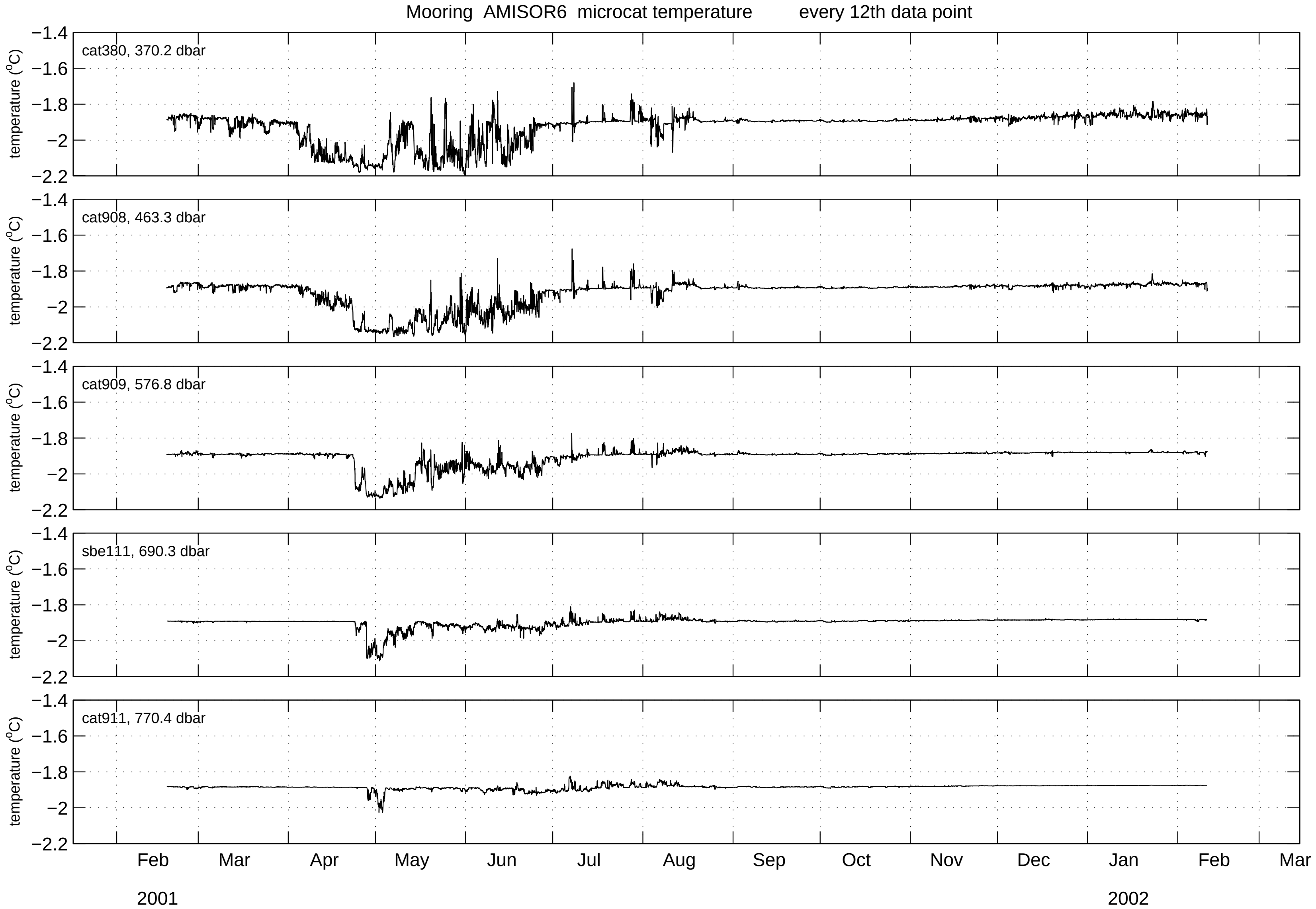
<u>Figure 2.5h:</u> Microcat salinity data for mooring AMISOR4.



<u>Figure 2.5i:</u> Microcat and SBE39 temperature data for mooring AMISOR5.



<u>Figure 2.5j:</u> Microcat salinity data for mooring AMISOR5.



<u>Figure 2.5k:</u> Microcat and SBE39 temperature data for mooring AMISOR6.

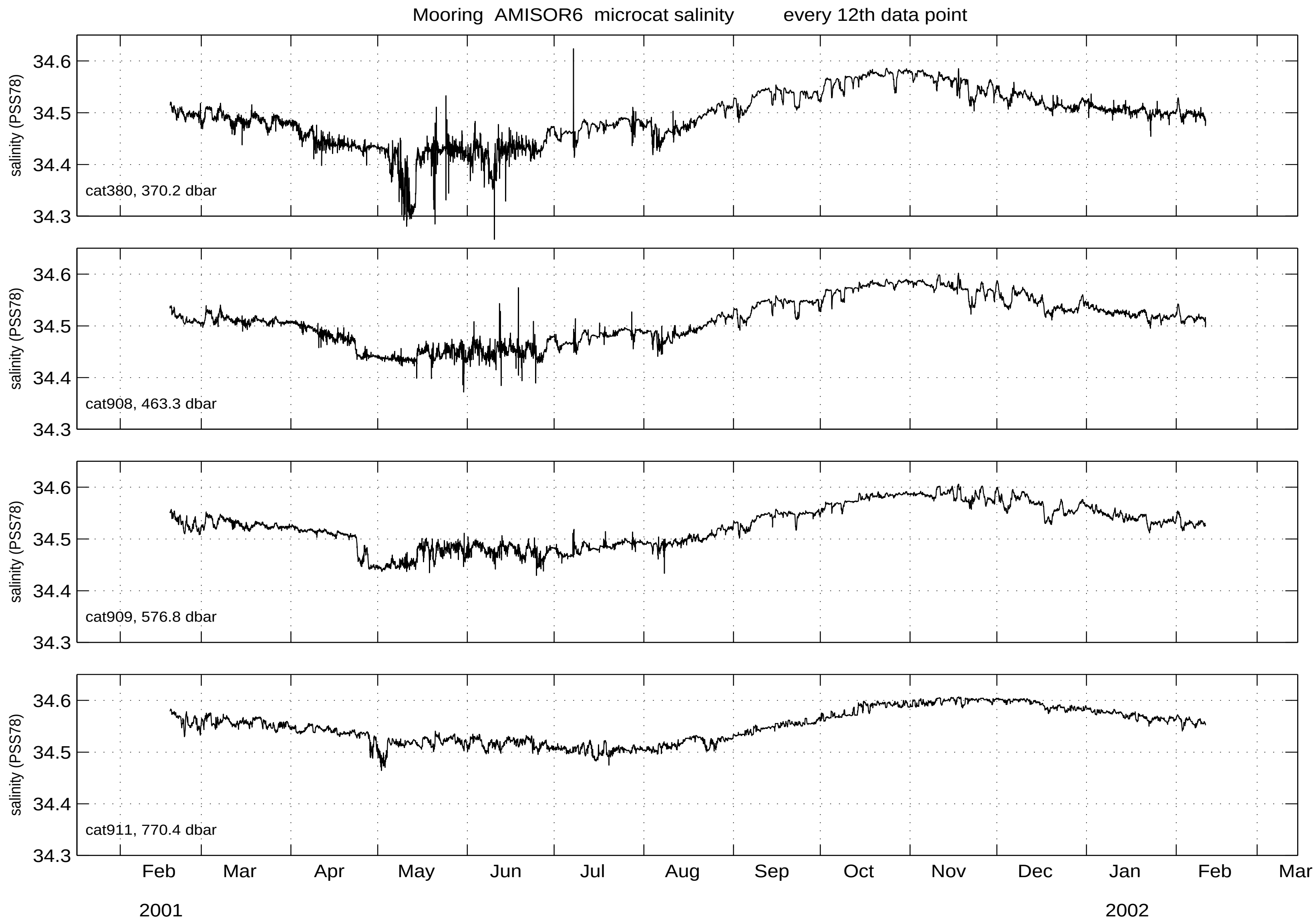


Figure 2.5l: Microcat salinity data for mooring AMISOR6.

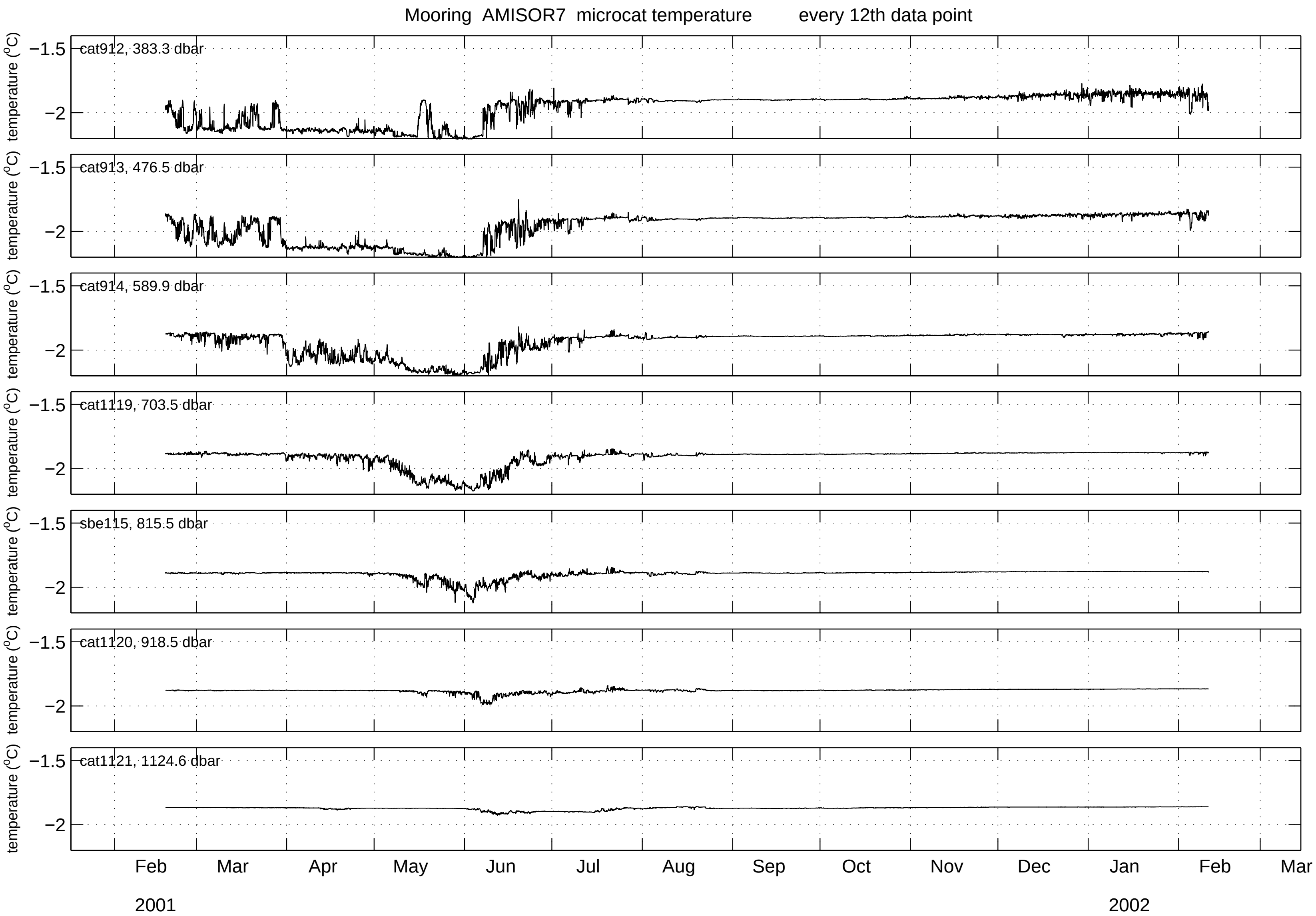
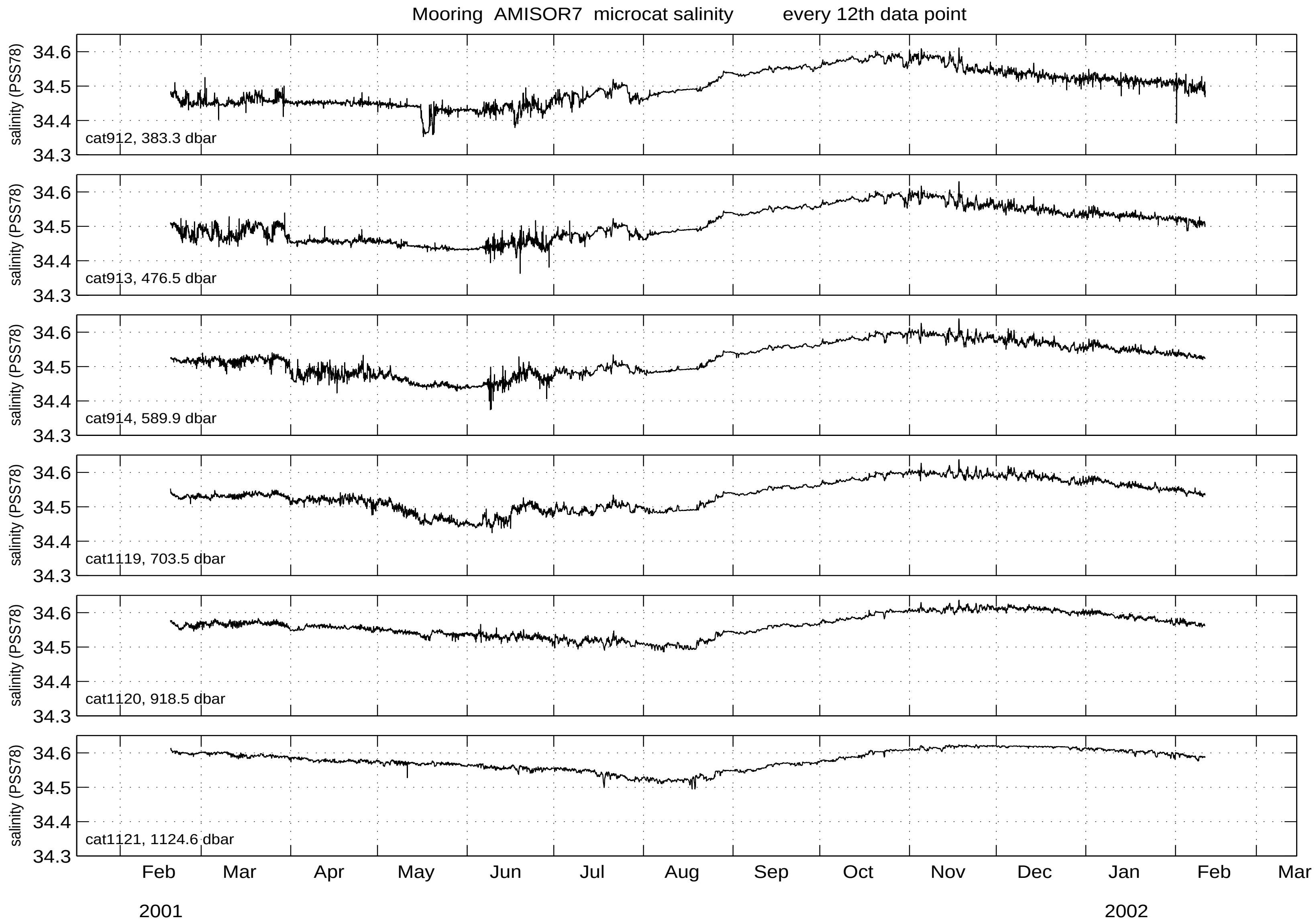
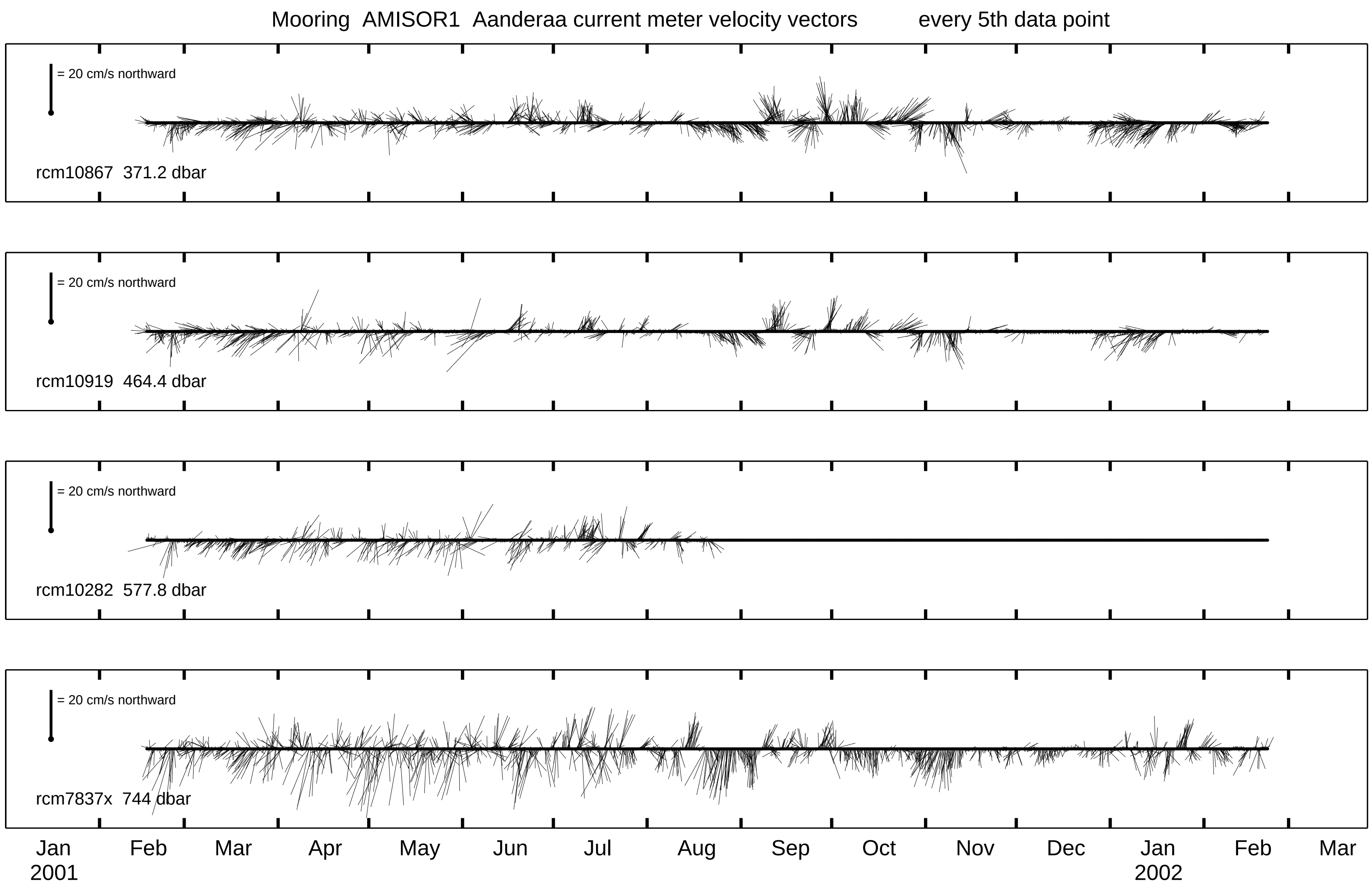


Figure 2.5m: Microcat and SBE39 temperature data for mooring AMISOR7.



<u>Figure 2.5n:</u> Microcat salinity data for mooring AMISOR7.



<u>Figure 2.6a:</u> Aanderaa current meter velocity vectors for mooring AMISOR1.

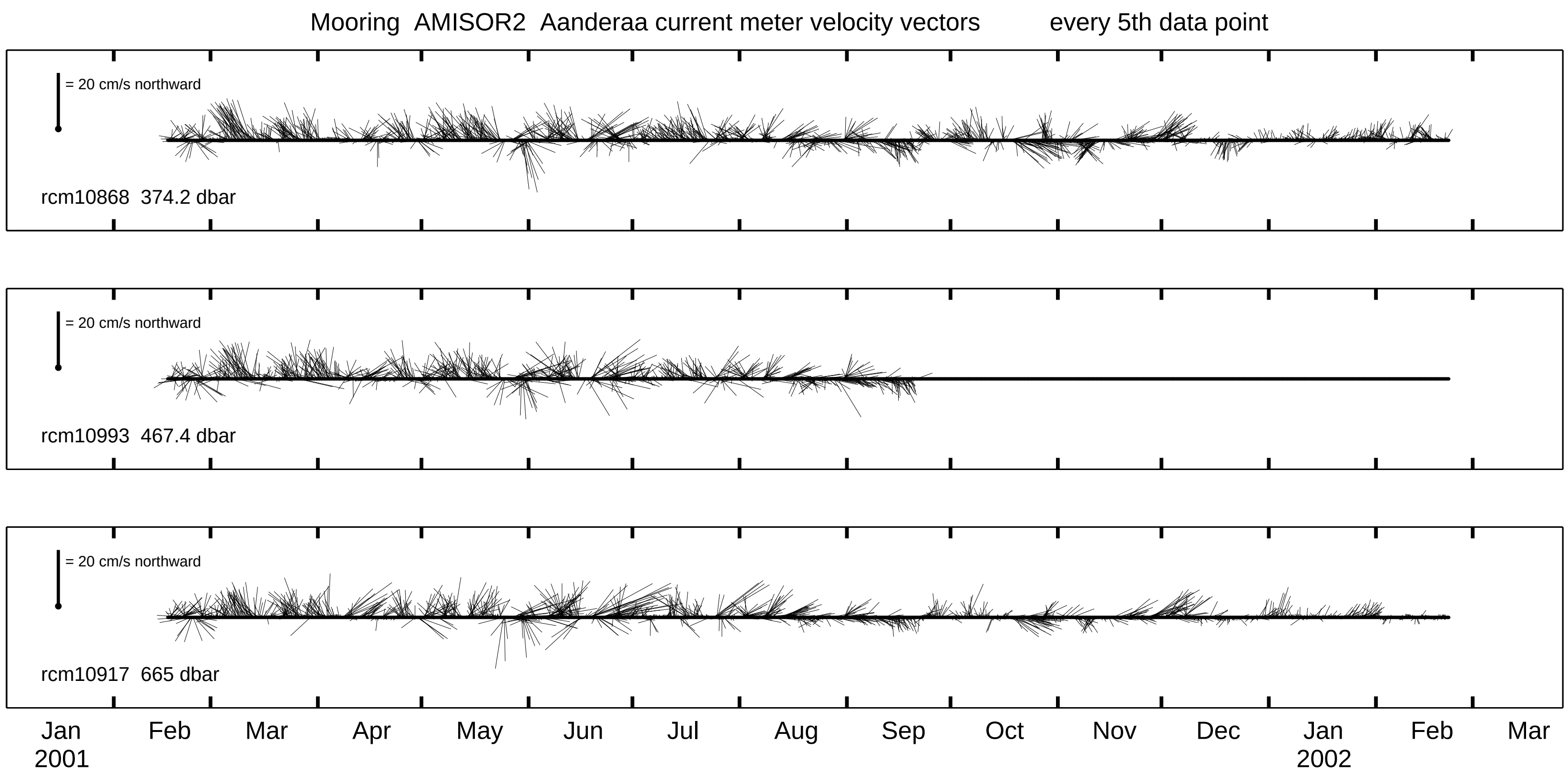


Figure 2.6b: Aanderaa current meter velocity vectors for mooring AMISOR2.

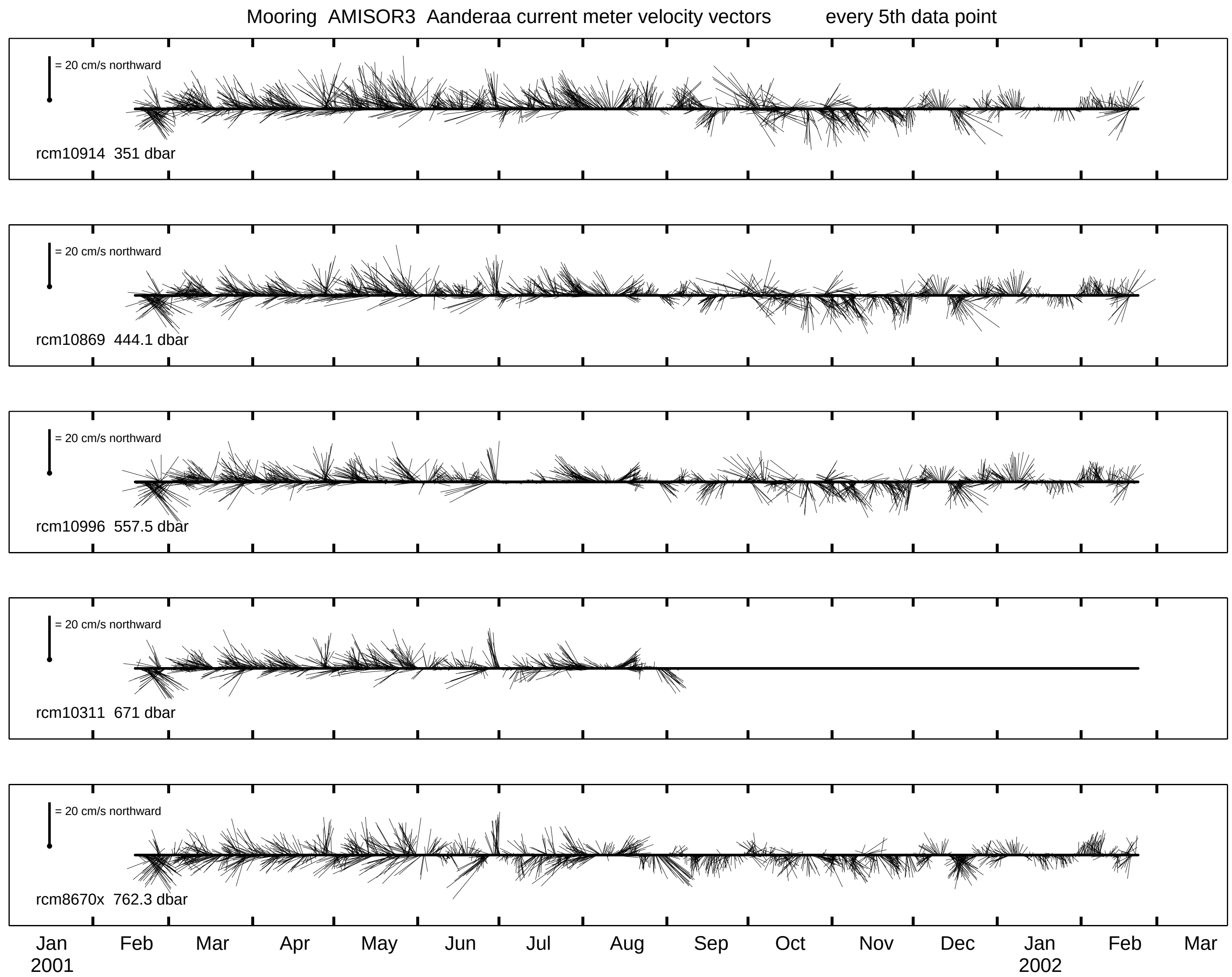
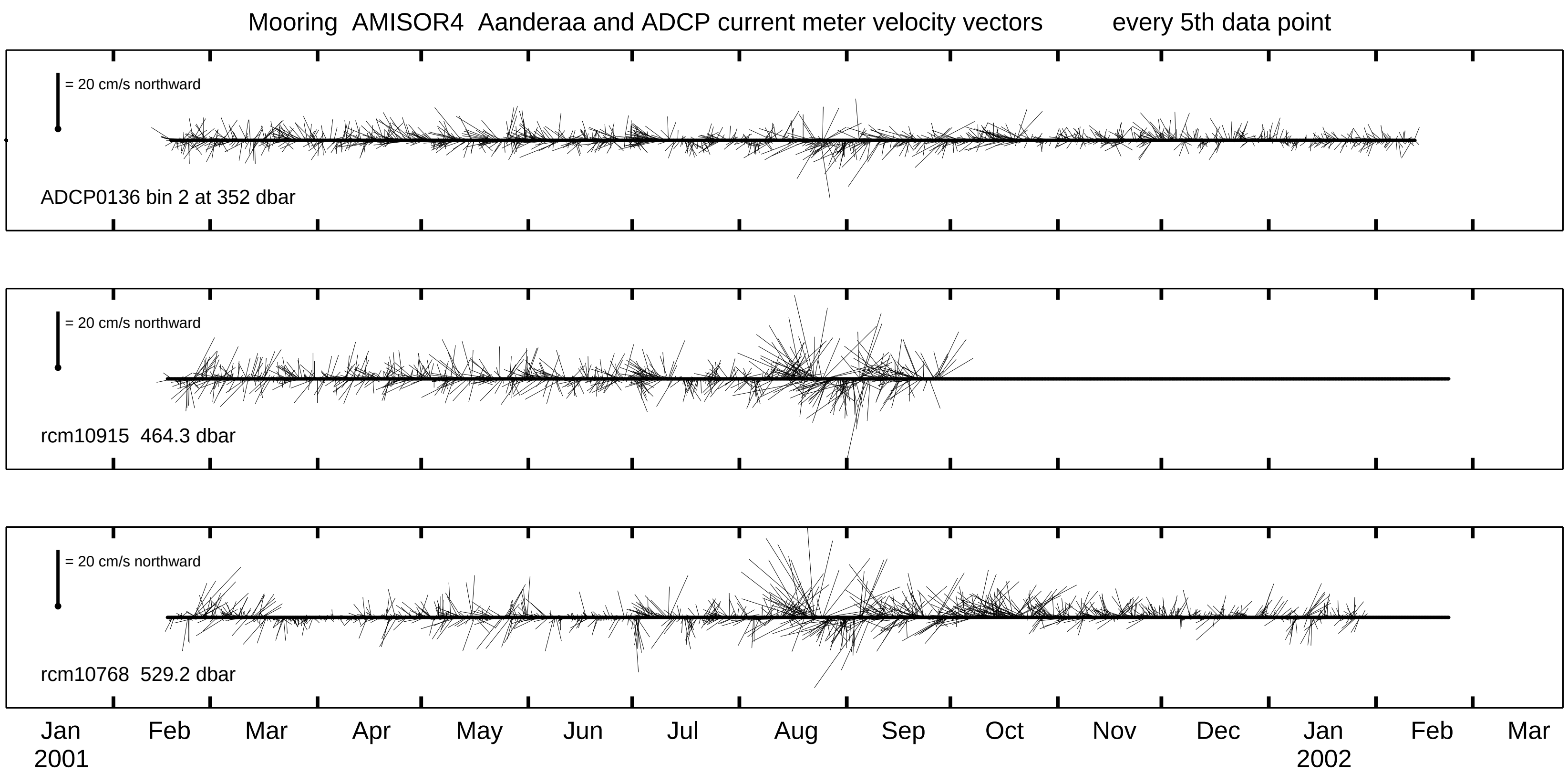


Figure 2.6c: Aanderaa current meter velocity vectors for mooring AMISOR3.



<u>Figure 2.6d:</u> Aanderaa and ADCP current meter velocity vectors for mooring AMISOR4.

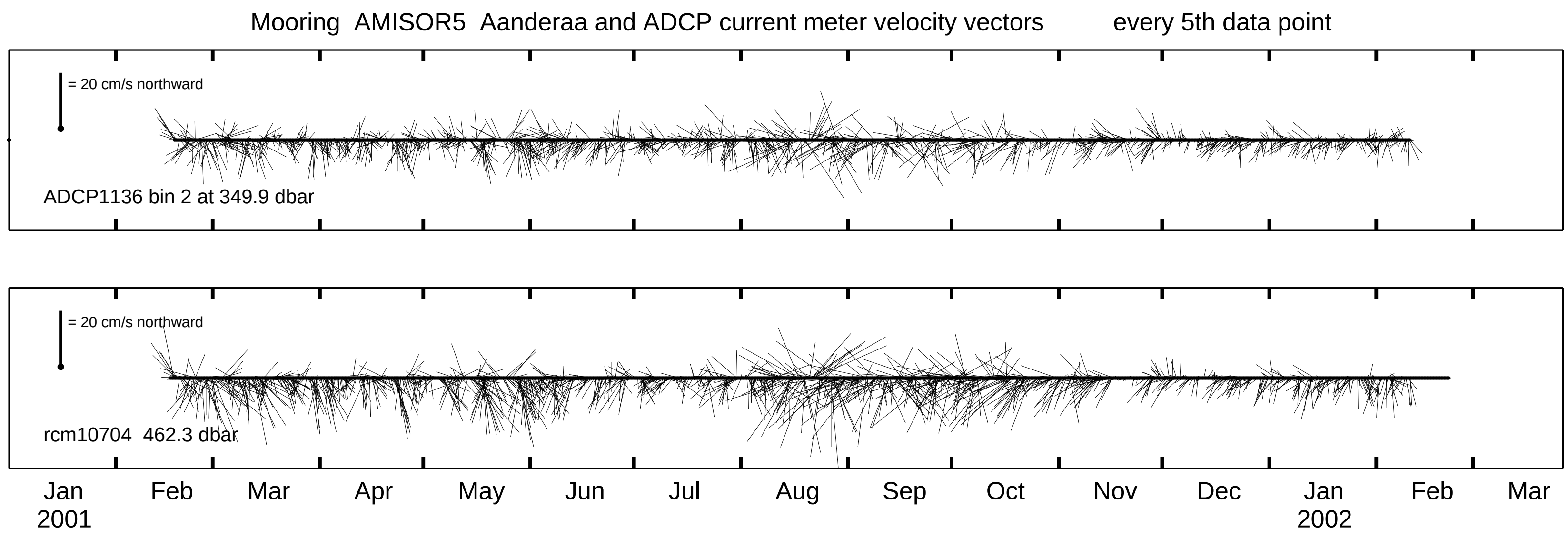
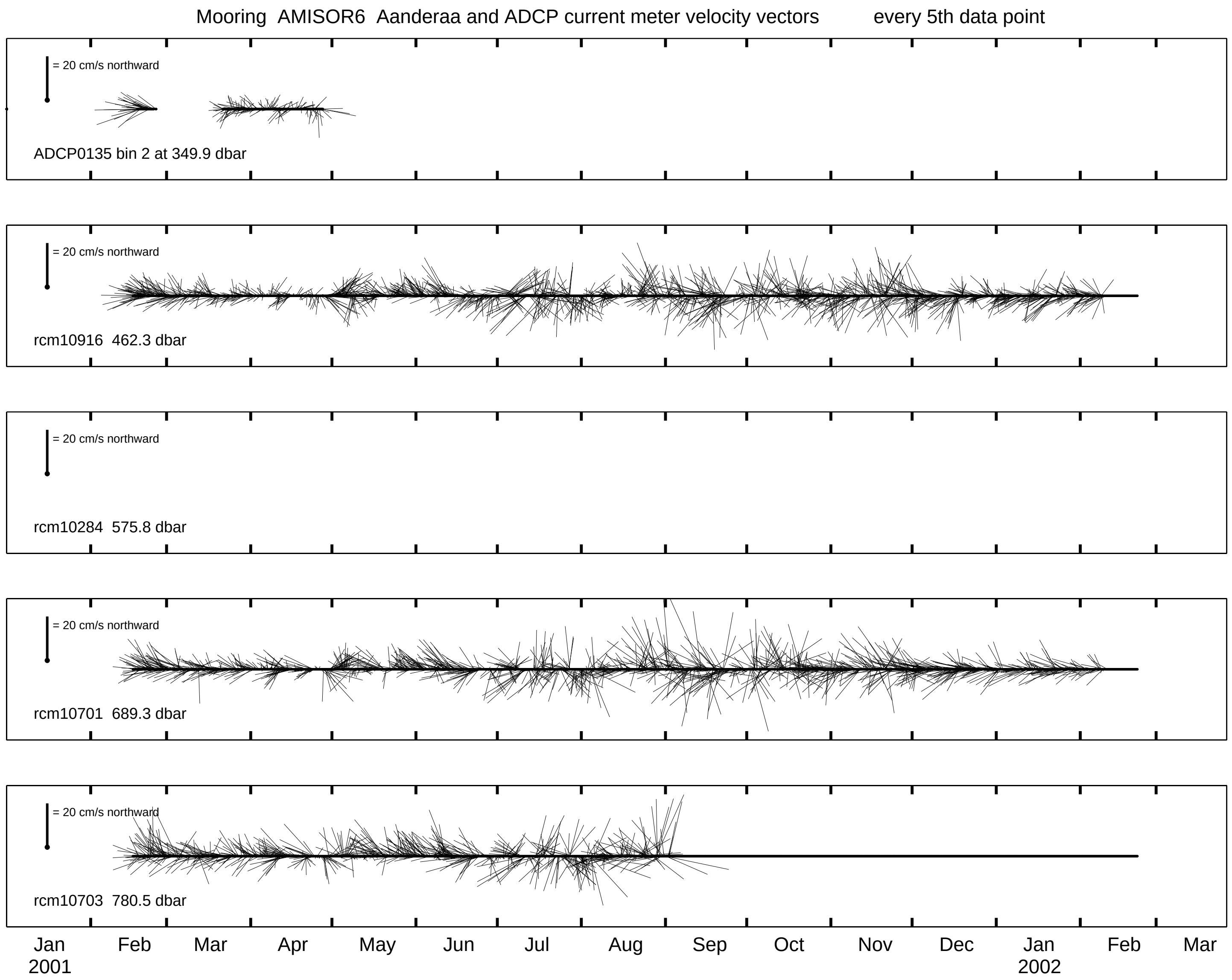
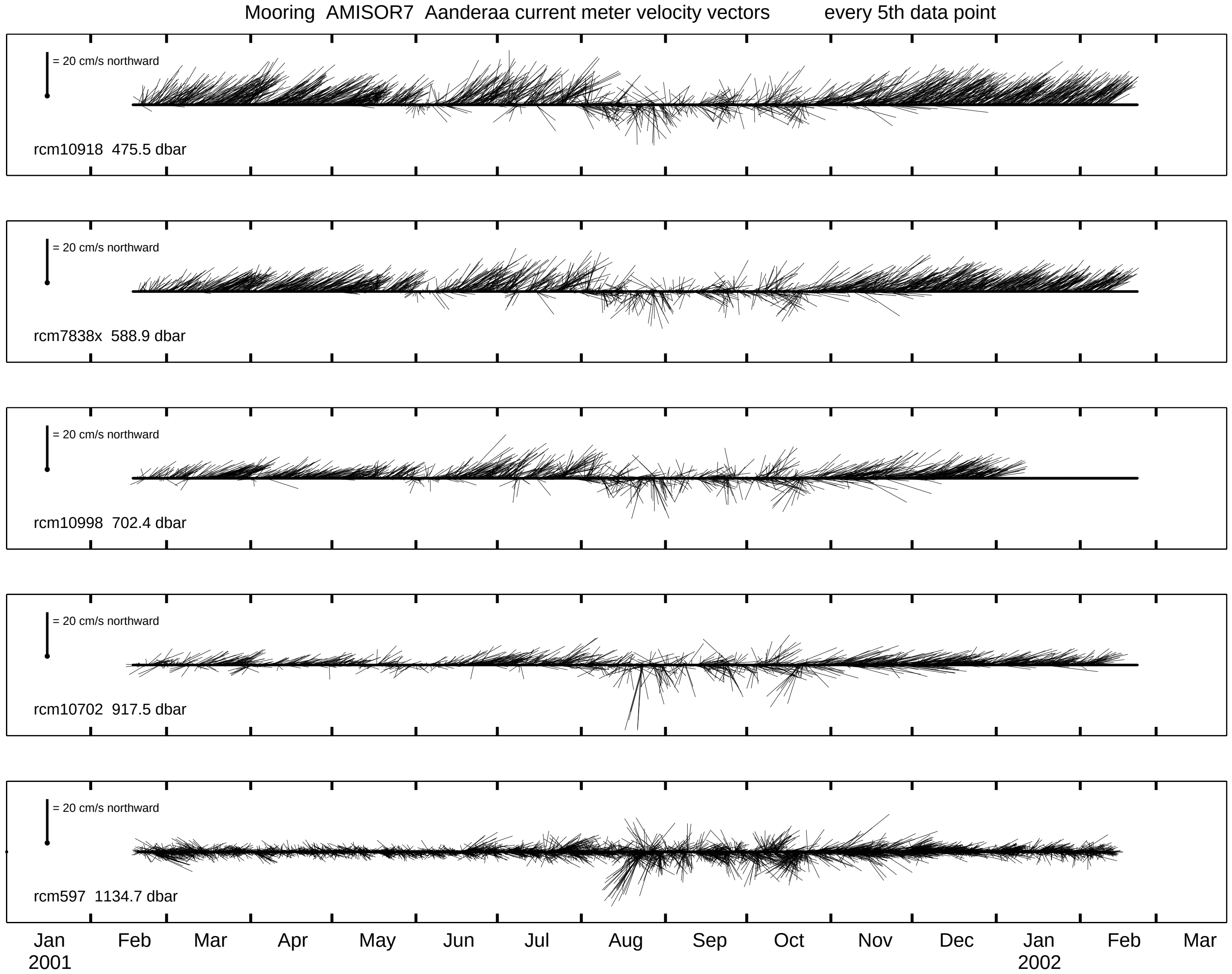


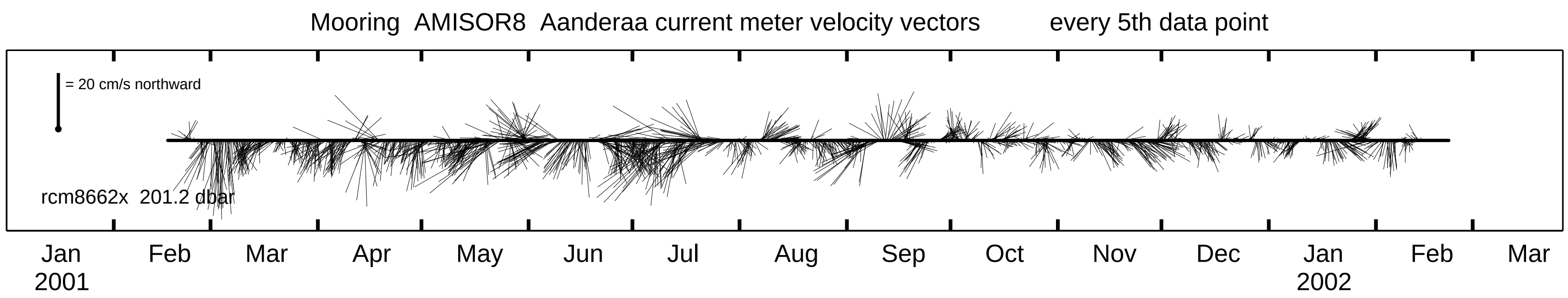
Figure 2.6e: Aanderaa and ADCP current meter velocity vectors for mooring AMISOR5.

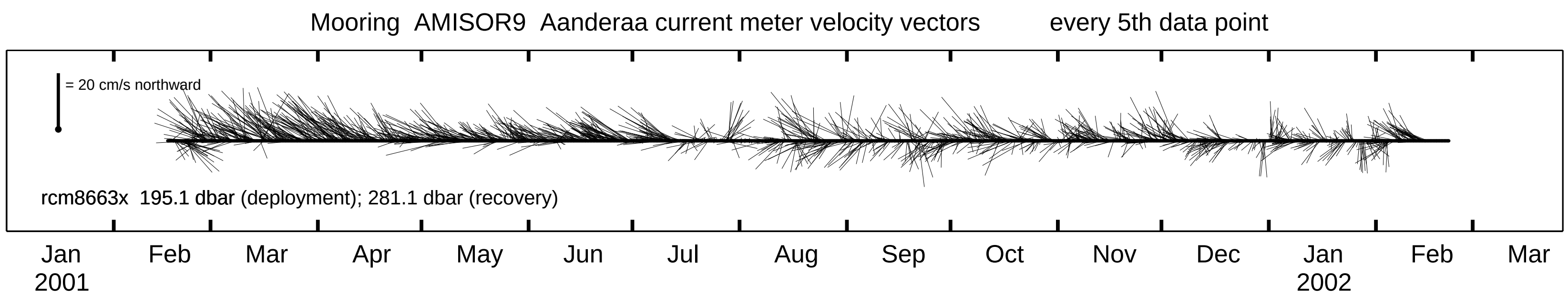


<u>Figure 2.6f:</u> Aanderaa and ADCP current meter velocity vectors for mooring AMISOR6.

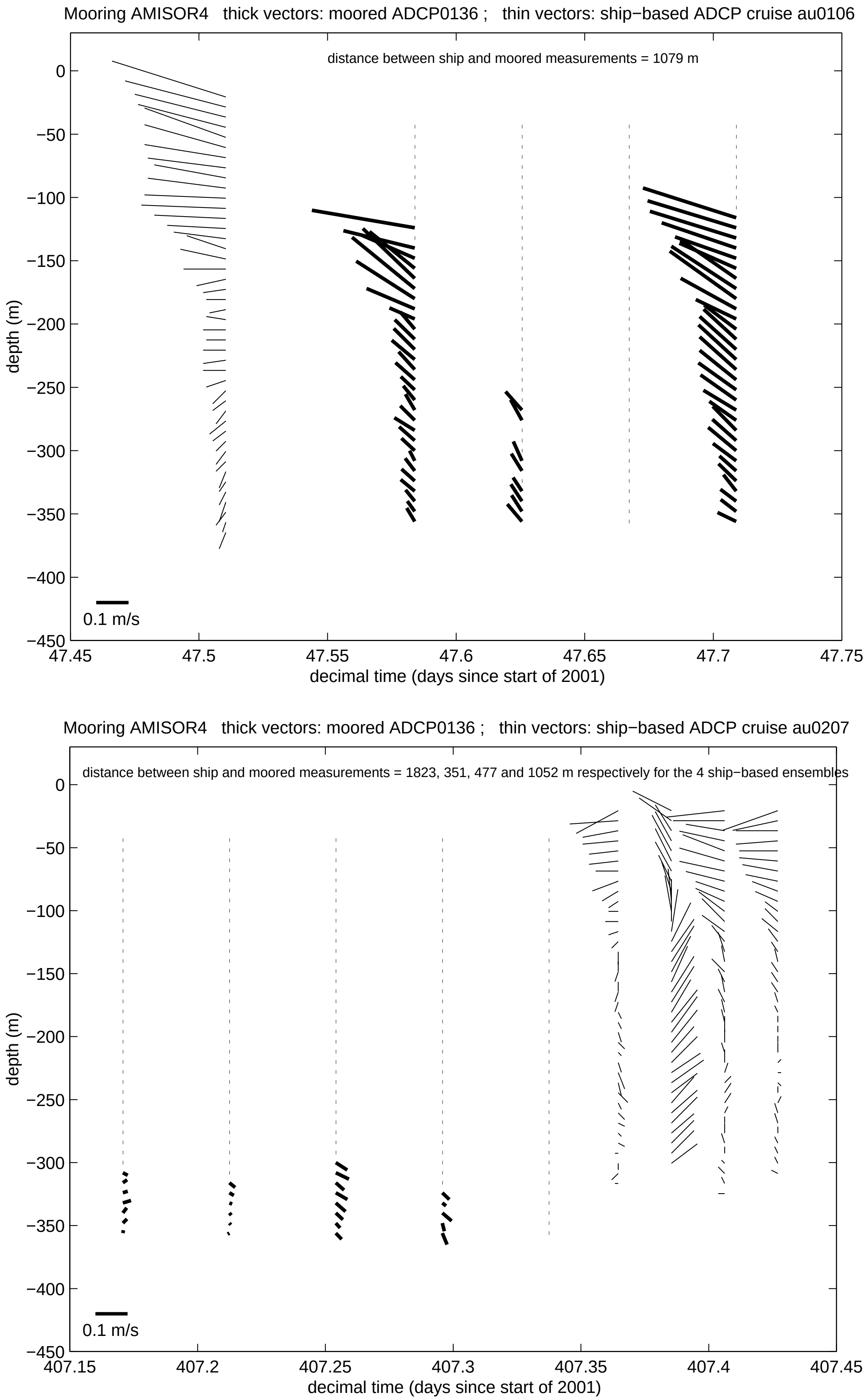


<u>Figure 2.6g:</u> Aanderaa and ADCP current meter velocity vectors for mooring AMISOR7.

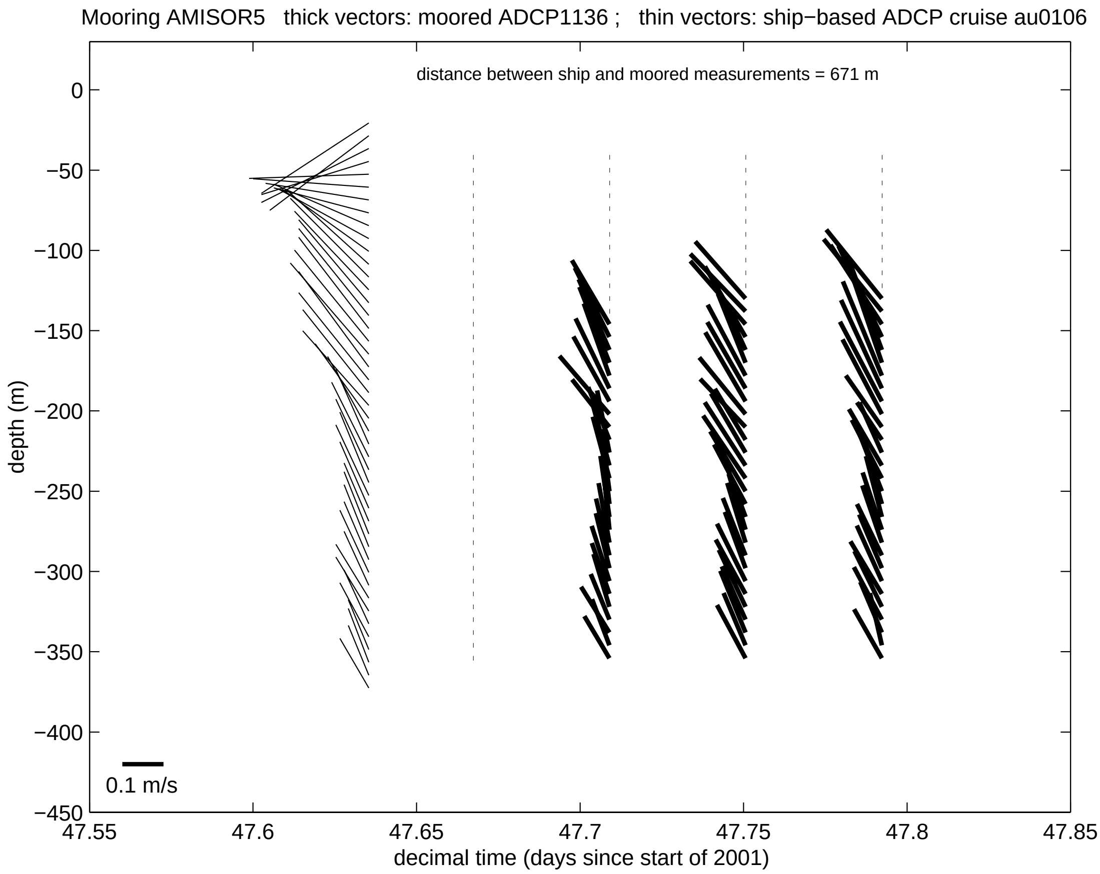


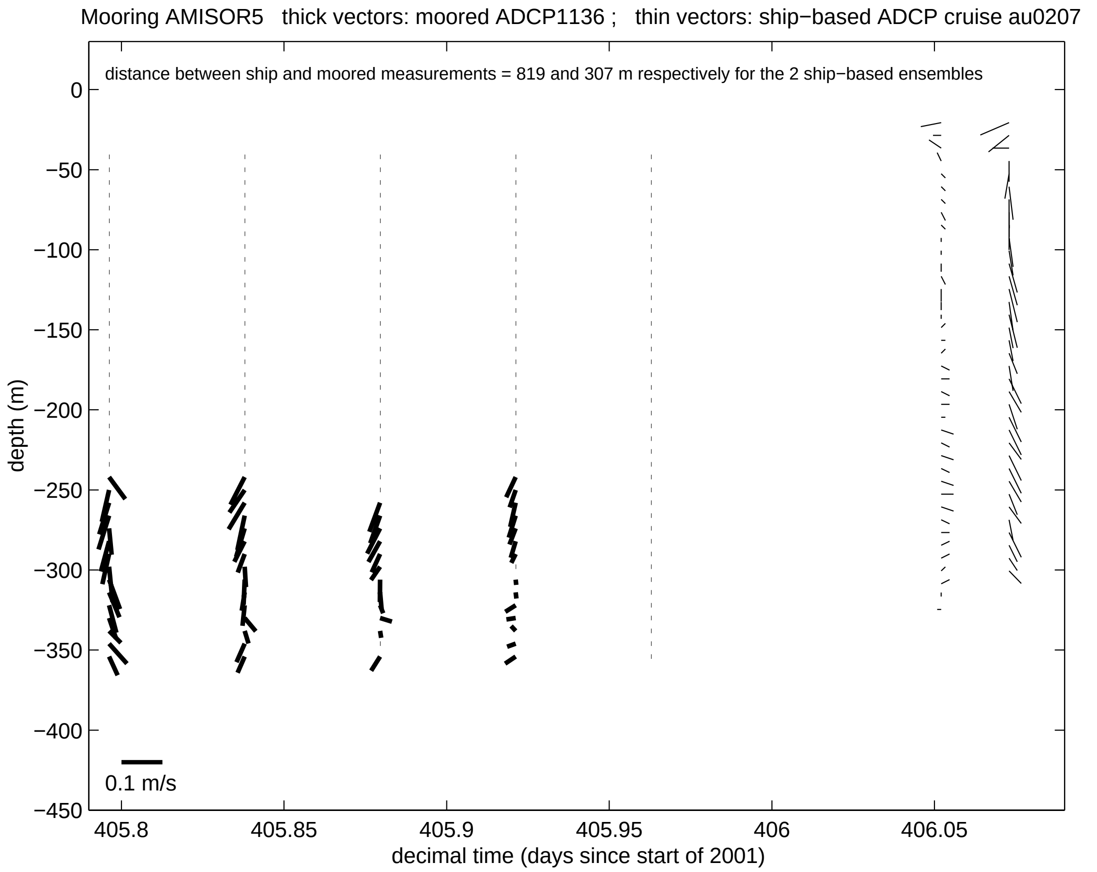


<u>Figure 2.6h:</u> Aanderaa current meter velocity vectors for moorings AMISOR8 and 9.



<u>Figure 2.7a:</u> Comparison of moored ADCP-0136 (AMISOR4) data and ship-based ADCP data.





<u>Figure 2.7b:</u> Comparison of moored ADCP-1136 (AMISOR5) data and ship-based ADCP data.

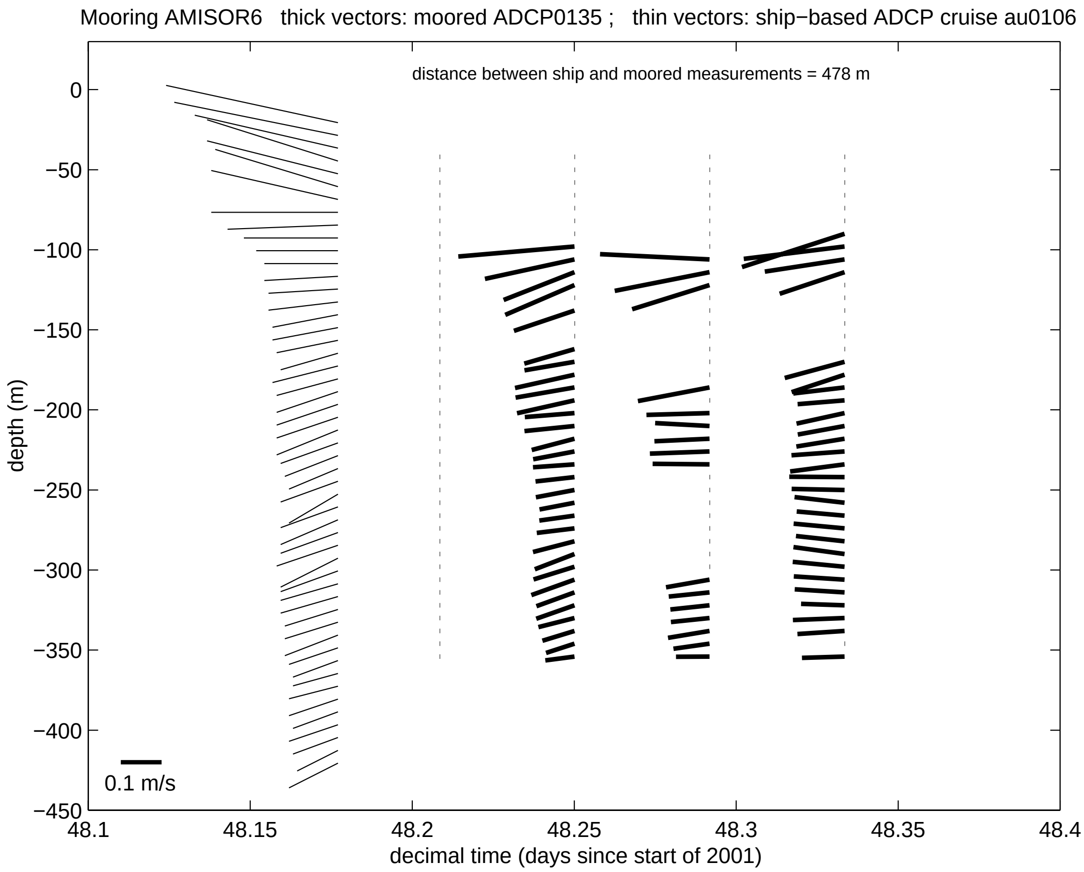


Figure 2.7c: Comparison of moored ADCP-0135 (AMISOR6) data and ship-based ADCP data.

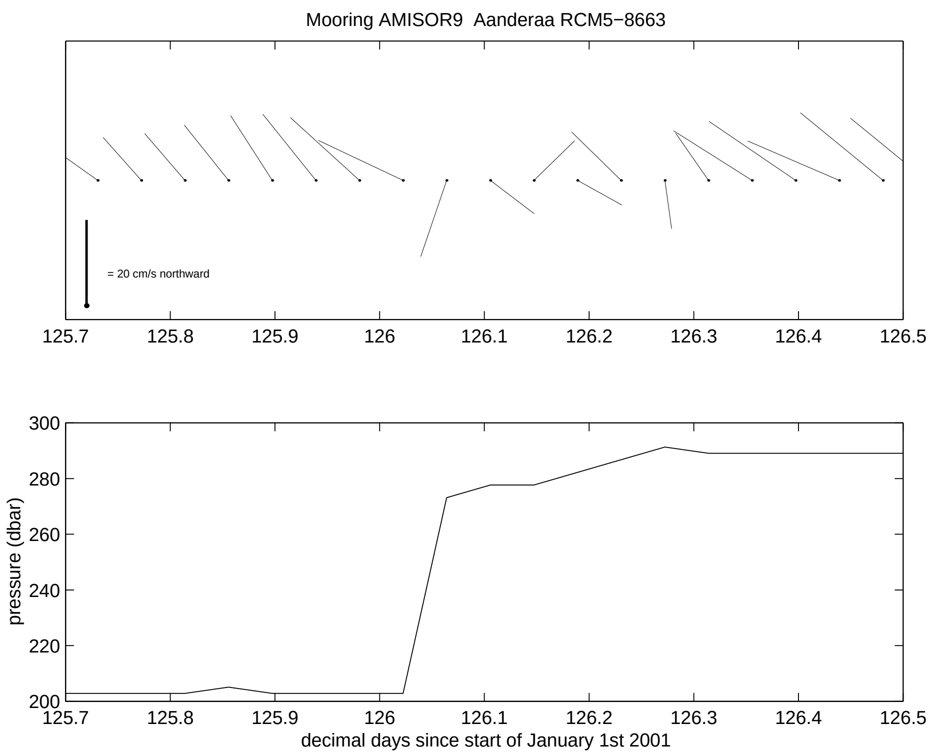


Figure 2.8: Velocity vectors and pressure data from RCM8-8663 around the time mooring AMISOR9 was dragged by an iceberg.

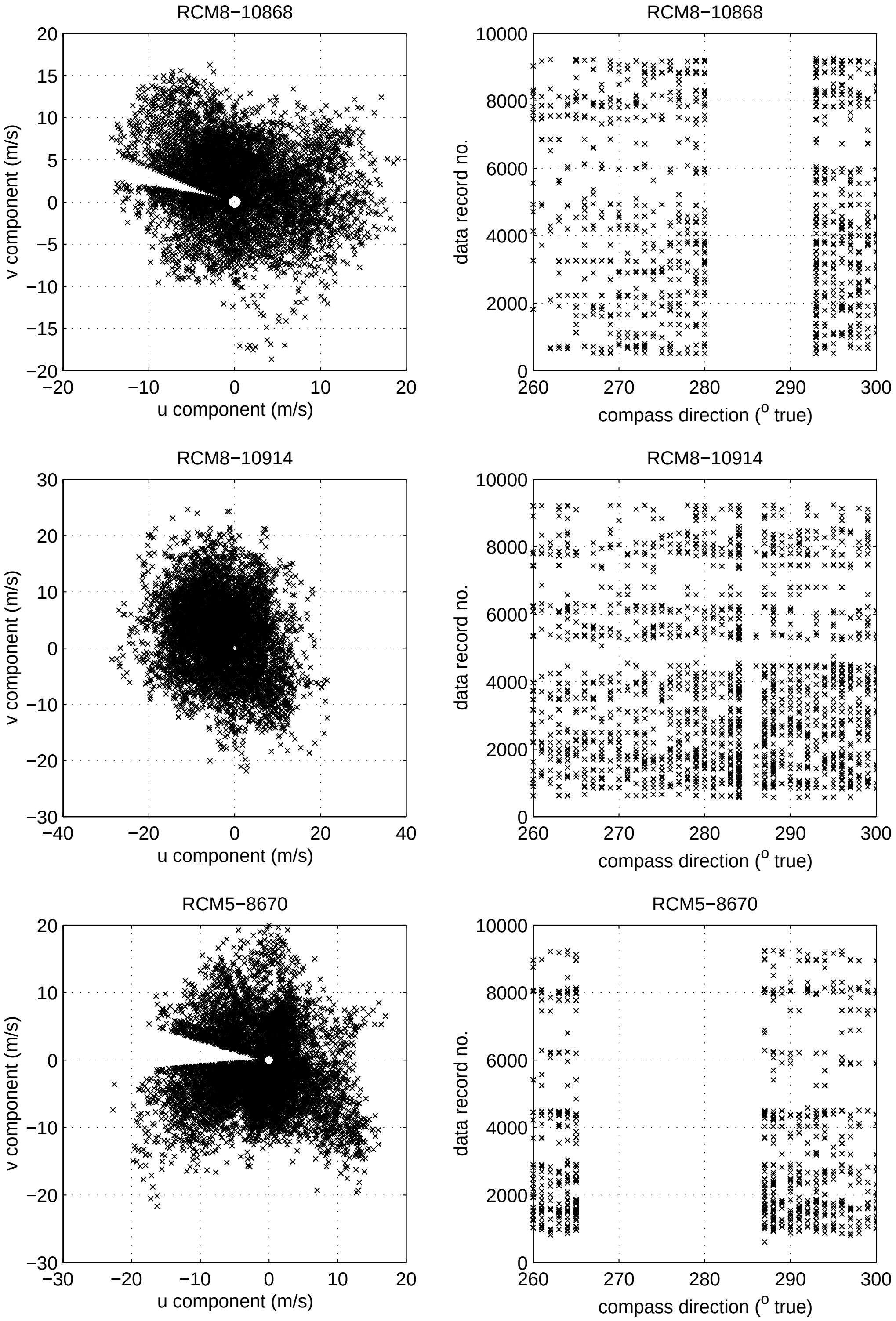


Figure 2.9: "Shadow" in compass data for 3 of the Aanderaa RCM's.

APPENDIX 2.1 MOORING DATA FILE FORMATS

For all instruments, the following definitions apply for matlab vectors (where xxx=instrument, e.g. cat318, rcm10915, d0136):

xxx_dectime	= decimal time (decimal days from midnight on December 31st 2000; so, e.g.,midday on January 1st 2001 = 0.5 decimal time; midday on January 1st 2002 = 365.5)
xxx_cond	= conductivity (mS/cm)
xxx_sal	= salinity (PSS78)
xxx_temp	= temperature (^{o}C, ITS90)
xxx_press	= pressure (dbar)
xxx_spd	= current speed (cm/s)
xxx_dir	= current direction (^{o} true, towards which the current is flowing)
xxx_u	= E/W current component (cm/s, +ve towards the east)
xxx_v	= N/S current component (cm/s, +ve towards the north)

Note that the above decimal time convention applies to the whole AMISOR data set, including ship-based CTD and ADCP data, mooring data, and borehole CTD and microcat data.

For the moored ADCP matlab files, the following additional definitions apply:

xxx_ampy (for y=1-4)	= echo amplitude (counts) of beams 1, 2, 3 and 4
xxx_avbeamcor	= average beam correlation (counts)
xxx_bindep	= depth (m) (from surface) to centre of each vertical bin
xxx_ensemble	= ensemble number
xxx_errv	= RMS error velocity (cm/s)
xxx_heading	= instrument heading (^{o} true) - not to be confused with current direction
xxx_orien	= instrument orientation flag
xxx_pcntgd4	= average percentage of good 4 beam solutions used in making the bin
xxx_pitch	= pitch (^{o}) of instrument
xxx_roll	= roll (^{o}) of instrument
xxx_w	= vertical velocity (cm/s, +ve upwards)

Note that for moored ADCP data:
* rows 1 to 40 in matlab matrices and vectors correspond to vertical bins 40 to 1 (i.e. row 40 = bin 1, the deepest bin for an upward looking ADCP);
* all currents are in earth co-ordinates (i.e. absolute current values).

For mooring header information matlab files, the following definitions apply (where mmm=mooring number, e.g. amisor7; xxx defined as above):

xxx_d	= instrument depth (m)
xxx_p	= instrument pressure (dbar)
mmm_botd	= bottom depth (m) at mooring site
mmm_lat	= latitude of mooring site (decimal degrees, -ve = south)
mmm_lon	= longitude of mooring site (decimal degrees, +ve = east)

REFERENCES

Cowley, R., 2001*. A practical manual for the determination of salinity, dissolved oxygen, and nutrients in seawater.* CSIRO Division of Marine Research report, 2001.

Cowley, R. and Johnston, N., 1999*. Investigations into the chemistry used for orthophosphate analysis in seawater.* CSIRO Division of Marine Research report, July 1999.

Eriksen, R., 1997. *A practical manual for the determination of salinity, dissolved oxygen, and nutrients in seawater.* Antarctic CRC Research Report No. 11, January 1997, 83 pp.

Rosenberg, M., Eriksen, R., Bell, S., Bindoff, N. and Rintoul, S., 1995. *Aurora Australis marine science cruise AU9407 - oceanographic field measurements and analysis*. Antarctic Cooperative Research Centre, Research Report No. 6, July 1995. 97 pp.

Rosenberg, M., unpublished. *Aurora Australis ADCP data status.* Antarctic Cooperative Research Centre, unpublished report, November 1999. 51 pp.

Rosenberg, M., Bindoff, N., Bray, S., Curran, C., Helmond, I., Miller, K., McLaughlan, D. and Richman, J., 2001. *Mertz Polynya Experiment, marine science cruises AU9807, AU9801, AU9905, AU9901 and TA0051 - oceanographic field measurements and analysis*. Antarctic Cooperative Research Centre, Research Report No. 25, June 2001. 89 pp.

ACKNOWLEDGEMENTS

Thanks to all scientific personnel who participated in the cruises, and to the crew of the RSV Aurora Australis. Special thanks also to the Amery Ice Shelf drilling team, for successful work in difficult conditions. The work was supported by the Antarctic Cooperative Research Centre, the Australian Antarctic Division (ASAC Project 1058), the Department of Environment, Sports and Territories through the CSIRO Climate Change Research Program, and the National Science Foundation (USA).