

CTD Data Documentation for cruise AMT19 (JC039) (13th Oct – 1st Dec, 2009)

Version 1.0 – June 2010

Chief Scientist

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Introduction

These notes refer to CTD data collected during the James Cook cruise (JC039) also referred to as AMT19, the second AMT cruise under Oceans 2025 funding of Theme 10 Sustained Observatory 1: Atlantic Meridional Transect. The cruise departed Falmouth (UK) on the 13th October 2009 and arrived into Punta Arenas (Chile) on the 1st December 2009.

CTD cast metadata

BODC Ref.	Originator's Ref.	Start Date & Time (GMT)	Latitude (+ve deg. N)	Longitude (+ve deg. E)	Water depth (m)
740112	CTD001S	13/10/2009 16:00	49.83269	-5.45688	85.5
740114	CTD002S	14/10/2009 04:34	49.567	-8.63352	143
740116	CTD003S	14/10/2009 12:43	49.43317	-10.53398	133
740118	CTD004S	15/10/2009 04:39	48.94855	-14.45995	4607.9
740120	CTD005S	15/10/2009 06:23	48.9485	-14.45992	4607.9
740122	CTD006T	15/10/2009 08:27	48.94839	-14.45985	4607.9
740124	CTD007T	16/10/2009 04:35	49.00153	-16.66594	4843.1
740126	CTD008S	16/10/2009 05:38	49.00611	-16.66355	4843.6
740128	CTD009S	16/10/2009 09:38	49.00545	-16.66316	4843.5
740130	CTD010T	17/10/2009 04:59	47.28715	-18.042	4392.6
740132	CTD011S	17/10/2009 05:56	47.28711	-18.04192	4392.7
740134	CTD012T	17/10/2009 13:41	46.33883	-18.80188	4524.2
740136	CTD013T	18/10/2009 04:40	44.24253	-20.40153	4000
740138	CTD014S	18/10/2009 05:40	44.24457	-20.40438	4000
740140	CTD015T	18/10/2009 13:47	43.21428	-21.17508	3931.1
740142	CTD016T	19/10/2009 04:44	41.25305	-22.60363	4000.2
740144	CTD017S	19/10/2009 05:49	41.25124	-22.60234	4000.1
740146	CTD018T	19/10/2009 13:33	40.32325	-23.27203	3557
740148	CTD019T	20/10/2009 04:38	38.32047	-24.66651	3380.8
740150	CTD020S	20/10/2009 05:44	38.31749	-24.66977	3372.9
740152	CTD021T	21/10/2009 13:07	37.10148	-26.48774	2512.3
740154	CTD022T	22/10/2009 05:36	35.45356	-28.64565	3451.1
740156	CTD023S	22/10/2009 06:38	35.44816	-28.64579	3452.4
740158	CTD024T	22/10/2009 13:59	34.72361	-29.58892	3605.1
740160	CTD025T	23/10/2009 05:39	33.41957	-31.25416	3364.7
740162	CTD026S	23/10/2009 06:41	33.419	-31.25023	3363.4
740164	CTD027T	23/10/2009 14:13	32.87076	-31.94577	3592.4
740166	CTD028T	24/10/2009 05:37	31.4286	-33.73678	4000
740168	CTD029S	24/10/2009 06:30	31.42969	-33.7377	4000
740170	CTD030T	24/10/2009 13:59	30.74503	-34.48403	4504.5

740172	CTD031T	25/10/2009 05:33	29.18393	-35.98698	4511.1
740174	CTD032S	25/10/2009 06:35	29.18025	-35.98314	4511.7
740176	CTD033T	25/10/2009 14:00	28.4788	-36.6794	4586.6
740178	CTD034T	26/10/2009 05:34	27.21605	-37.88457	4999
740180	CTD035S	26/10/2009 06:27	27.21503	-37.88666	4998.9
740182	CTD036T	26/10/2009 14:00	27.02293	-38.05326	4999.8
740184	CTD037T	27/10/2009 05:36	25.39152	-39.60149	4811.7
740186	CTD038S	27/10/2009 06:32	25.39139	-39.60274	4812.4
740188	CTD039T	27/10/2009 14:01	24.65197	-40.28332	4812.3
740190	CTD040T	28/10/2009 06:30	23.22094	-40.71806	5503.1
740192	CTD041S	28/10/2009 07:29	23.22528	-40.71944	5503.6
740352	CTDSURF01	29/10/2009 06:00	21.13353	-39.24202	5528.5
740194	CTD042T	29/10/2009 06:20	21.13323	-39.24283	5529.1
740196	CTD043T	29/10/2009 07:27	21.13195	-39.24878	5532.7
740354	CTDSURF02	29/10/2009 09:02	21.12636	-39.2537	5536.5
740356	CTDSURF03	29/10/2009 10:01	21.12106	-39.25885	5538.8
740358	CTDSURF04	29/10/2009 10:58	21.11984	-39.26352	5540.1
740360	CTDSURF05	29/10/2009 11:55	21.12027	-39.26296	5540
740362	CTDSURF06	29/10/2009 12:57	21.11987	-39.26865	5540.7
740364	CTDSURF07	29/10/2009 13:57	21.11985	-39.26866	5540.7
740198	CTD044T	29/10/2009 14:15	21.11991	-39.26871	5540.7
740366	CTDSURF08	29/10/2009 16:00	21.12182	-39.26919	5541.3
740368	CTDSURF09	29/10/2009 16:58	21.12009	-39.28067	5539
740370	CTDSURF10	29/10/2009 18:00	21.12091	-39.2912	5526.6
740200	CTD045T	29/10/2009 19:14	21.12063	-39.29303	5523.4
740372	CTDSURF11	29/10/2009 23:05	21.12421	-39.3092	5472
740374	CTDSURF12	30/10/2009 01:59	21.13369	-39.30617	5490
740376	CTDSURF13	30/10/2009 05:00	21.13117	-39.30583	5491.1
740378	CTDSURF14	30/10/2009 06:01	21.13258	-39.30722	5484
740202	CTD046T	30/10/2009 06:29	21.13254	-39.30719	5484.2
740204	CTD047T	30/10/2009 07:36	21.13265	-39.30563	5492.9
740380	CTDSURF15	30/10/2009 09:01	21.12354	-39.31681	5436
740382	CTDSURF16	30/10/2009 10:00	21.12371	-39.31717	5433.9
740384	CTDSURF17	30/10/2009 11:01	21.12262	-39.31731	5433.7
740386	CTDSURF18	30/10/2009 11:59	21.12098	-39.31981	5421
740206	CTD048T	30/10/2009 14:03	20.93632	-39.1673	5102.9
740208	CTD049T	31/10/2009 06:02	19.14397	-37.86389	5452.2
740210	CTD050S	31/10/2009 06:58	19.14395	-37.8639	5452.2
740212	CTD051T	31/10/2009 14:00	18.41835	-37.35939	5676.9
740214	CTD052T	01/11/2009 06:41	16.56915	-36.09775	4697.8
740216	CTD053S	01/11/2009 07:37	16.57296	-36.0996	4673
740218	CTD054T	01/11/2009 14:00	15.92581	-35.6611	4100.4
740220	CTD055T	02/11/2009 05:33	14.15283	-34.45679	5789
740222	CTD056S	02/11/2009 06:20	14.15608	-34.45739	5790.4
740224	CTD057T	02/11/2009 14:01	13.34807	-33.91508	5721.9
740226	CTD058T	03/11/2009 05:39	11.46615	-32.646	5497
740228	CTD059S	03/11/2009 06:25	11.46818	-32.64724	5497.1

740230	CTD060T	03/11/2009 14:00	10.5626	-32.04051	5582.1
740232	CTD061T	04/11/2009 14:02	8.80552	-30.86546	4980.8
740234	CTD062T	05/11/2009 05:37	6.83187	-29.54659	4000.2
740236	CTD063S	05/11/2009 06:29	6.83909	-29.54397	4000.6
740238	CTD064T	05/11/2009 14:02	5.94874	-28.95789	4024.7
740240	CTD065T	06/11/2009 05:34	4.05244	-27.69437	4098.9
740242	CTD066S	06/11/2009 06:28	4.05411	-27.69409	4100.9
740244	CTD067T	06/11/2009 14:00	3.15594	-27.09746	4079.5
740246	CTD068T	07/11/2009 05:34	1.27088	-25.84738	3569.7
740248	CTD069S	07/11/2009 06:27	1.26984	-25.85031	3573.5
740250	CTD070T	08/11/2009 07:10	-2.0463	-24.99212	4795.8
740252	CTD071S	08/11/2009 08:07	-2.04146	-24.988	4796.2
740254	CTD072T	08/11/2009 14:01	-2.84719	-25.00128	5407.5
740256	CTD073T	09/11/2009 05:34	-3.84102	-25.00113	5555.1
740258	CTD074S	09/11/2009 06:23	-3.83833	-24.9989	5555.4
740260	CTD075T	09/11/2009 13:33	-4.85934	-25.00047	5154.4
740262	CTD076T	10/11/2009 05:35	-7.36655	-24.99154	5504.5
740264	CTD077S	10/11/2009 06:32	-7.36083	-24.98824	5504.8
740266	CTD078T	10/11/2009 13:30	-8.37998	-24.99593	5545.3
740268	CTD079T	11/11/2009 04:36	-10.65496	-24.99909	5503.9
740270	CTD080S	11/11/2009 05:24	-10.64816	-24.99657	5503.6
740272	CTD081T	11/11/2009 13:01	-11.72439	-24.99988	6023.8
740388	CTDSURF19	12/11/2009 05:01	-13.81391	-24.98134	5303.9
740274	CTD082T	12/11/2009 05:17	-13.81259	-24.98132	5300.7
740276	CTD083T	12/11/2009 06:25	-13.81348	-24.98567	5301.2
740390	CTDSURF20	12/11/2009 08:03	-13.82929	-25.01325	5326.3
740392	CTDSURF21	12/11/2009 08:58	-13.83576	-25.02272	5335.2
740394	CTDSURF22	12/11/2009 09:58	-13.84195	-25.03252	5341.9
740396	CTDSURF23	12/11/2009 10:56	-13.84668	-25.0432	5340.9
740398	CTDSURF24	12/11/2009 11:57	-13.85539	-25.05428	5344.3
740400	CTDSURF25	12/11/2009 12:54	-13.85582	-25.05728	5340.5
740278	CTD084T	12/11/2009 13:15	-13.85579	-25.05727	5340.4
740402	CTDSURF26	12/11/2009 15:02	-13.88349	-25.09006	5319.2
740404	CTDSURF27	12/11/2009 16:04	-13.88518	-25.09904	5302.7
740406	CTDSURF28	12/11/2009 17:02	-13.89128	-25.10171	5300.9
740280	CTD085T	12/11/2009 18:33	-13.90847	-25.11777	5277.8
740408	CTDSURF29	12/11/2009 22:02	-13.94471	-25.14497	5232.8
740410	CTDSURF30	13/11/2009 00:58	-13.97511	-25.15585	5206.8
740412	CTDSURF31	13/11/2009 04:00	-13.99855	-25.16785	5182.9
740414	CTDSURF32	13/11/2009 04:59	-14.00411	-25.17177	5176.5
740282	CTD086T	13/11/2009 05:19	-14.00395	-25.17176	5176.6
740284	CTD087T	13/11/2009 06:25	-14.00951	-25.17512	5170.7
740416	CTDSURF33	13/11/2009 08:01	-14.014	-25.17782	5166.2
740418	CTDSURF34	13/11/2009 08:57	-14.01896	-25.18452	5158.9
740420	CTDSURF35	13/11/2009 09:59	-14.02191	-25.18871	5154.5
740422	CTDSURF36	13/11/2009 10:59	-14.02575	-25.19442	5149
740286	CTD088T	13/11/2009 12:59	-14.02318	-25.17997	5159.2

740288	CTD089T	14/11/2009 04:43	-16.37067	-24.99758	5051.7
740290	CTD090S	14/11/2009 05:35	-16.36485	-24.99655	5051.5
740292	CTD091T	14/11/2009 13:02	-17.34691	-24.99926	5360.1
740294	CTD092T	15/11/2009 04:33	-19.49999	-24.9965	5483.6
740296	CTD093S	15/11/2009 05:27	-19.49748	-24.99873	5484.3
740298	CTD094T	15/11/2009 13:02	-20.59048	-25.00052	5331.2
740300	CTD095T	16/11/2009 04:33	-22.8539	-24.99621	5503.6
740302	CTD096S	16/11/2009 05:25	-22.85391	-24.99621	5503.6
740304	CTD097T	16/11/2009 13:02	-23.76289	-25.00227	5635.7
740306	CTD098T	17/11/2009 04:42	-26.11265	-25.0052	4995.5
740308	CTD099S	17/11/2009 05:34	-26.11062	-25.0048	4995.5
740310	CTD100T	17/11/2009 13:01	-27.16853	-25.00124	4497.2
740312	CTD101T	18/11/2009 04:38	-28.78799	-26.14155	5003.5
740314	CTD102S	18/11/2009 05:35	-28.79038	-26.13587	5003.8
740316	CTD103T	18/11/2009 13:03	-29.39157	-27.03451	4759
740318	CTD104T	19/11/2009 04:34	-30.83383	-29.18385	2384.1
740320	CTD105S	19/11/2009 05:22	-30.8338	-29.18382	2384.1
740322	CTD106T	19/11/2009 13:02	-31.5468	-30.25459	3861.4
740324	CTD107T	21/11/2009 05:42	-33.41075	-34.25543	4141.9
740326	CTD108S	21/11/2009 06:45	-33.41665	-34.24699	4142.8
740328	CTD109T	21/11/2009 14:02	-33.88372	-34.97463	4115.8
740424	CTDSURF37	22/11/2009 05:03	-35.29888	-37.11494	4622.3
740330	CTD110T	22/11/2009 05:16	-35.29786	-37.11378	4621.8
740332	CTD111T	22/11/2009 06:25	-35.29463	-37.11174	4620.5
740426	CTDSURF38	22/11/2009 07:59	-35.28486	-37.11552	4619.1
740428	CTDSURF39	22/11/2009 08:56	-35.27424	-37.12511	4618.6
740430	CTDSURF40	22/11/2009 09:59	-35.26531	-37.13924	4620
740432	CTDSURF41	22/11/2009 10:57	-35.26044	-37.15559	4622.8
740434	CTDSURF42	22/11/2009 11:58	-35.25732	-37.17279	4626.6
740436	CTDSURF43	22/11/2009 13:00	-35.25809	-37.18416	4630.1
740334	CTD112T	22/11/2009 13:11	-35.25809	-37.18413	4630.1
740438	CTDSURF44	22/11/2009 14:55	-35.25811	-37.1842	4630.2
740440	CTDSURF45	22/11/2009 15:57	-35.26889	-37.21367	4640.5
740442	CTDSURF46	22/11/2009 17:00	-35.27154	-37.21508	4641.4
740444	CTDSURF47	22/11/2009 18:01	-35.27479	-37.21474	4641.9
740336	CTD113T	22/11/2009 19:31	-35.27925	-37.21509	4642.9
740446	CTDSURF48	22/11/2009 23:00	-35.28247	-37.21327	4643
740338	CTD114T	24/11/2009 05:36	-37.29768	-40.18971	4982.9
740340	CTD115S	24/11/2009 06:25	-37.29772	-40.18959	4982.9
740342	CTD116T	24/11/2009 14:00	-37.86608	-41.09102	5029
740344	CTD117T	25/11/2009 05:33	-39.31499	-43.39233	5137.9
740346	CTD118S	25/11/2009 06:26	-39.31498	-43.39235	5137.9
740348	CTD119T	25/11/2009 14:02	-39.96817	-44.44106	5147
740350	CTD120T	26/11/2009 14:00	-42.24922	-48.22895	5458.5

A total of 168 CTD casts were completed during the cruise.

120 casts were conventional profiling casts with water sampling. Both a stainless steel (SS) and a titanium CTD system were used. The SS frame was normally deployed daily at ~0530 ship time. The titanium frame was normally deployed daily at ~0430 and ~1300 ship time; however there were some additional profiling casts during the diel stations. CTD cast numbers were of the form CTDxxxS for SS casts and CTDxxxT for titanium, where xxx was the cast number. A total of 82 titanium and 38 stainless steel profiles were completed.

A further 48 casts were used for surface sampling at ~5m during the three 30 hour diel stations, with bottles fired from the 11+ front panel. No data was acquired for these 48 surface casts. These cast numbers were of the form CTDSURFxx, where xx was the cast number.

Flags Definitions

M = Suspect data

T = Interpolated data (used where temperature and salinity are input parameters and are suspect over a particular bin)

N = Null data (no data available)

Content of data series

Parameter	BODC code	units	Comments
Pressure	PRESPR01	decibars	Manufacturer's calibration applied
Temperature – fin mounted sensor	TEMPCU01	°C	Fin mounted sensor temperature channel - manufacturer's calibration applied
Temperature – frame mounted sensor	TEMPCU02	°C	Frame mounted temperature channel - manufacturer's calibration applied
Salinity – fin mounted sensor	PSALCC01	PSU	Fin mounted salinity channel - calibrated using salinometer data
Salinity – frame mounted sensor	PSALCC02	PSU	Frame mounted salinity channel - calibrated using salinometer data
Sigma-theta	SIGTPR01	kg m ⁻³	Computed using UNESCO SVAN function
Potential temperature	POTMCV01	°C	Computed using UNESCO POTEMP
Fluorescence	CPHLPM01	mg m ⁻³	Nominal manufacturer's calibration only (Not calibrated using sample data)
Fluorescence - Not yet available	CPHLPS01	mg m ⁻³	Calibration with sample data.
Downwelling PAR irradiance	DWIRPP01	Watts m ⁻²	Manufacturer's calibration applied - Stainless steel casts only
Upwelling PAR irradiance	UWIRPP01	Watts m ⁻²	Manufacturer's calibration applied - Titanium casts only
Transmittance	POPTDR01	%	Transmittance measured by a 25cm path length red light transmissometer manufacturer's calibration applied.

Attenuance	ATTNMR01	m ⁻¹	Attenuance measured by a 25cm path length red light transmissometer manufacturer's calibration applied.
Oxygen Concentration	DOXYSC01	μmol L ⁻¹	Calibrated using oxygen concentration from sample data
Oxygen saturation	OXYSSC01	%	Calibration against sensor data and computation using Benson & Krause algorithm

Instrumentation

There were no major operational issues with the CTD suites during the cruise.

However there were some issues with fluorometer drop-outs on the two main CTD fluorometers during up-casts. These were diagnosed as having worn bulkhead connectors, and were to be returned for service and calibration post-cruise. As a result the fluorometer on the stainless steel rig was replaced during the cruise. Similar problems from the titanium rig mounted fluorometer resulted in the fluorometers being switched between rigs later in the cruise. The sensor changes are noted below and in the fluorometer screening notes below.

The frame mounted conductivity sensor on the titanium frame also failed on cast 109 and was replaced with a spare.

Stainless Steel CTD Frame

Sea-Bird 911*plus* CTD System with SBE 32 Carousel fitted with 24 x 20 litres Ocean Test Equipment External Spring water samplers.

The main unit was composed of:

- SBE 9 *plus* Underwater unit s/n 09P-19817-0528
- SBE 3P Temperature Sensor s/n 03P-4116 (primary – frame mounted)
- SBE 4C Conductivity Sensor s/n 04C-2580 (primary – frame mounted)
- Digiquartz Temperature Compensated Pressure Sensor s/n 73299
- SBE 3P Temperature Sensor s/n 03P-2919 (secondary – fin mounted)
- SBE 4C Conductivity Sensor s/n 04C-2450 (secondary – fin mounted)
- SBE 5T Submersible Pump s/n 05T-3609 (primary – frame mounted)
- SBE 5T Submersible Pump s/n 05T-3085 (secondary – fin mounted)
- SBE 32 Carousel 24 Position Pylon s/n 32-19817-0243
- SBE 11 *plus* Deck Unit s/n 11P-34173-0676 Main Unit with Powertecnic UPS s/n n/a
- SBE 11 *plus* Deck Unit s/n 11P-24680-0589 Spare Unit

Auxiliary sensors suite was composed of:

- SBE 43 Oxygen s/n 43-0862 (primary duct - 9+ mounted)
- Chelsea MKIII Aquatracka Fluorometer
 - Casts 1 – 50 s/n 088244
 - Casts 53 - 91 s/n 09-7117-001
 - Casts 93 – 120 s/n 88-2960-163
- Benthos PSA-916T Altimeter s/n 41302
- 2PI PAR (DWIRR) s/n PML10
- 2PI PAR (UWIRR) s/n PML9
- Wetlabs BBRTD backscatter s/n 182

- Chelsea MKII Alphasacka 25cm path Transmissometer s/n 07-6075-001

The additional self-logging instruments were configured as follows:

- RDI Workhorse 300 KHz Lowered ADCP (down-looking master configuration) s/n 12920
- RDI Workhorse 300 KHz Lowered ADCP (up-looking slave configuration) s/n 4275

Titanium CTD Frame

Sea-Bird 911*plus* CTD System with SBE 32 Carousel fitted with 24 x 10 litres custom Ocean Test Equipment trace-metal free external spring water samplers.

The main unit was composed of:

- SBE 9 *plus* Underwater unit s/n 09P-39607-0803(T)
- SBE 3P Temperature Sensor s/n 03P-4593(T) (primary – frame mounted)
- SBE 4C Conductivity Sensor s/n 04C-3272(T) (primary – frame mounted) replaced with s/n 3567 from cast 110
- Digiquartz Temperature Compensated Pressure Sensor s/n 93896
- SBE 3P Temperature Sensor s/n 03P-2729 (secondary – fin mounted)
- SBE 4C Conductivity Sensor s/n 04C-2858 (secondary – fin mounted)
- SBE 5T Submersible Pump s/n 05T-3090 (primary – frame mounted)
- SBE 5T Submersible Pump s/n 05T-3088 (secondary – fin mounted)
- SBE 32 Carousel 24 Position Pylon s/n 32-24680-0346(T)
- SBE 11 *plus* Deck Unit s/n 11P-34173-0676 Main Unit with Powertec UPS
- SBE 11 *plus* Deck Unit s/n 11P-24680-0589 Spare Unit

Auxiliary sensors suite was composed of:

- SBE 43 Oxygen s/n 43-0363 (primary duct - 9+ mounted)
- Chelsea MKIII Aquatracka Fluorometer
 - Casts 1 – 91 s/n 88-2960-163
 - Casts 92 – 120 s/n 09-7117-001
- Tritech PA-200 Altimeter s/n 6196.112522
- 2PI PAR Titanium (DWIRR) s/n 02
- 2PI PAR Titanium (UWIRR) s/n 03
- Wetlabs BBRTD backscatter s/n 167
- Chelsea MKII Alphasacka 25cm path Transmissometer s/n 161-2642-002

The additional self-logging instruments were configured as follows:

- RDI Workhorse 300 KHz Lowered ADCP (down-looking master configuration) s/n 10607(T)

Originator's data processing

CTD casts were recorded using the SeaBird data collection software Seasave-Win32. The software outputs were then processed using SBE Data Processing-Win32 v7.18; the processing routines are named after each stage in brackets. The software applied the calibrations as appropriate through the instrument configuration file to the data in engineering units output by the CTD hardware. Due to an oversight in post cruise processing only one PAR channel was transferred for each profile. As the voltage channels were inverted for the PAR sensors on the stainless steel rig compared with the titanium rig, the transferred data were the data from the down-welling PAR sensor for the stainless steel rig and data for the up-welling PAR sensor for the titanium rig. The Altimeter and Wetlabs BBRTD backscatter data streams were not transferred during processing.

A binary file including the 24 Hz data for up and down casts was generated along with a bottle file containing all the information from the instant the bottle was fired for each cast (DatCnv). The oxygen sensor was then shifted relative to the pressure by 5 seconds, to compensate for the lag in the sensor response time (AlignCTD). Pressure spikes were removed (WildEdit), the effect of thermal 'inertia' on the conductivity cells was removed (CellTM) and then the binary files were converted to ascii so they could be read in PSTAR format (translate).

The CTD files produced from SeaBird processing were converted from 24 Hz ascii files into PSTAR format. The data were then averaged into a 1 Hz file. A file was created for each cast containing the mean values of all the variables at the bottle firing locations. Bench salinometer data were collected during the cruise from a range of depths from each CTD cast. The salinometer data was compared with CTD values from the frame and fin mounted sensors during processing and a calibration applied. Details of these calibrations are given in the Cruise Report.

More details of the processing routines can be found in the Cruise Report.

BODC data processing

Reformatting

The data files were sent to BODC in the NOCS PSTAR format. The *.CTU PSTAR format files containing 1 Hz downcast and up-cast data were converted to QXF, a BODC internal format. The PSTAR data channels were mapped to BODC parameter codes and units were converted where applicable as part of the transfer. The oxygen concentration was converted from millilitres per litre to micromoles per litre using a conversion factor of 44.66 and the conductivity from milliSiemens per cm to Siemens per metre using a conversion factor of 0.1. The PSTAR header details reported the PAR data as %, after checking with the data originator and the calibration sheets the units were confirmed to be Wm^{-2} .

Screening

The QXF data were compared with the original data files to ensure that no errors had been introduced during the conversion process. The data channels were then screened on a graphics workstation using in-house visualisation software (EDSERPLO). This allows multiple channels to be viewed simultaneously. The beginning and end-points of the down-cast were marked and only down-cast data were quality controlled. Up-cast data were only used to help with quality control checks. Suspect and impossible data were flagged with BODC quality control flags ('M' and 'N' respectively).

From visual screening of the 1Hz data profiles, it was clear that on occasion the profiles suffered from the problem of ship's heave/entrainment, which has now become conspicuous on most cruises. The frame mounted temperature and conductivity sensors were located within the rig and the fin mounted temperature and conductivity sensors were deployed on an external fin and the entrainment features were greatly reduced in the data from the fin mounted sensors. Therefore the data from the fin mounted sensor channels were considered more reliable and anomalies

on the fin mounted sensor channels were flagged systematically whenever it was believed that they would affect the quality of the 1dbar-binned data. The frame mounted sensor data has been left unflagged (except in cases of obviously bad data) and can be used as a reference for what the profile, once averaged into 1 or 2 dbar bins, would be like had the anomalies not been flagged and sensors not been placed on a fin external to the main rig.

Screening notes regarding specific casts:

Temperature and salinity:

CTD001 profiles are noisy in the surface 10 db and flagged 'M' for both sensors. CTD021 salinity profile trend has repeated entrainment pattern but scale is ~0.01 PSU. Trend is present in both sensor profiles and on the up-cast. Binning will likely remove the feature. CTD060-64 had low surface salinities. CTD109 the frame sensor failed and this can be seen in the profile at 480m. The sensor on the fin continued to return reasonable data.

Oxygen sensors:

The channel shows variation for the majority of casts, whether this reflects natural variability or entrainment is not always clear. For some casts where the variation is minimal the entrainment problem where obvious has been flagged, however the variability on most casts makes it difficult to distinguish. CTD021 – profile shows repeated entrainment below 50 db. CTD024 – profile shows entrainment feature below 460 db. CTD027 – profile shows entrainment feature 70-170m. CTD028 – profile shows entrainment feature below 50m. CTD034 – profile shows entrainment features below 40 db. CTD107, 108 & 120 suffer from a large amount of variation as it appears the rig spirals down through the water column. CTD109 shows a step increase at 410 db on the down-cast of 20 μmol per litre and data below these depths have been flagged 'M'. The step remains during the up-cast and are likely explained as this was the cast where the conductivity sensor was found to be faulty and replaced before the next cast.

Fluorometers:

No obvious problem with entrainment for the fluorometer channels. Some small observations follow but limited additional flagging has taken place at this stage. CTD001 noisy at surface 2-3 db. CTD029 some data values less than 0 and CTD038, and 50 all data less than 0 mg per cubic metre. Once sample calibration applied this should be rectified. CTD041 downcast flagged 'M' below 50 db as data appear unreliable in comparison to the up-cast and the profiles from casts before and after. CTD117 & 120 noisy for the surface 50 db.

Cruise documentation indicates a problem with the SS fluorometer during the up-cast of CTD026s which was also apparent on cast CTD029, so a connecting cable was changed. The problem returned as soon as the CTD was submerged for CTD038s. The cable was changed prior to cast CTD050s and while the signal was good on-deck, data dropped to 0v once in the water. The fluorometer was changed prior to CTD053s and instrument S/N 09-7117-001 replaced instrument S/N 088224.

The same problem appeared on the TT rig for the deeper casts from CTD92t and CTD093s swapping the fluorometers between rigs solved this problem.

Transmissometers:

The transmissometer data are not correctly calibrated and the attenuation and transmission values should not be used as absolute values. Casts 007, 017 and 049 have had spikes and anomalous data flagged 'M' in the mid-water column. From cast 058 onwards the transmissometer starts behaving suspiciously, showing large but smooth attenuation maximum at depth as well as strong drifts (e.g. cast 056). The problem is evident on both SS and TIT frame profiles which suggests a transmissometer problem related to environmental conditions such as for example if temperature or temperature gradients were beyond an acceptable threshold. It is telling that the anomalies are not depth or sensor related but seems to be invariably related to the depth of the thermocline i.e. anomalies are consistently observed at the base of the strong thermocline. The anomalies disappear later in the cruise. The anomalies observed during AMT 19 are likely due to a severe case of hysteresis produced by air and water temperature in excess of the instruments operating range (1 to 25 degree C). This has been observed on AMT cruises before and reported by Jeff Benson (e.g. AMT12).

Irradiance sensors:

For the down- and up-welling PAR profiles, spiky data were generally associated with movement when the package was going down too slowly and "bouncing" in the surface layer. However the majority of casts were not flagged given that the variation can be the result of variation in surface conditions (e.g. changing cloud cover).

Loading into the BODC database

Once screened and audited, the data were loaded into the BODC database under the Oracle RDBMS. The start and end times of each cast were taken from the original data files and loaded in the database. A program was then run to calculate the average position of each cast based on data from BODC's fully processed and quality controlled version of the underway master navigation file. Average and maximum variation of latitude and longitude were calculated and stored in BODC's database.

Calibrations

- **Temperature**

Temperature readings from the two temperature sensors were almost identical outside of entrainment features and no other independent measurements of better quality were available. No further correction was therefore applied to the data.

- **Salinity**

The salinity channels have been calibrated by the originators and no further correction was applied to the data. 281 salinity samples were taken during the cruise from a range of CTD casts and depths.

- **Dissolved oxygen**

The oxygen sensors were calibrated using the sensor readings from the up-cast at the point when the bottles were fired and the dissolved oxygen data measured using the Winkler titration methodology on water samples collected from bottles. The samples collected were from a range of depths on a number of casts throughout the cruise. The data from CTD109 were removed from the calibration dataset due to the problem with

the conductivity sensor on the up-cast. The reduction in the RMS residual indicates an improved match to the Winkler titration dataset after calibration.

	Stainless steel		Titanium	
	Uncalibrated	Calibrated	Uncalibrated	Calibrated
n	142	142	99	99
mean	8.96	0.00	16.35	-0.01
SD	2.56	2.48	4.13	3.47
max(res)	13.30	5.78	30.37	11.84
min(res)	0.99	-8.21	7.44	-5.07
SS(res)	12332	865	28143	1177
RMS(res)	9.32	2.47	16.86	3.45

Casts	Calibration Equation	BODC Cal. No.	N	R ²
SS	DOXYSC01 = 1.0274 * DOXYSU01 + 3.3505	6434	142	99.41
TT	DOXYSC01 = 1.0896 * DOXYSU01 - 0.9260	6435	99	98.85

- **Chlorophyll-a and Fluorescence**

The fluorometer will be calibrated once the HPLC pigment dataset have been submitted to BODC.

Casts	Calibration Equation	BODC Cal. No.	N	R ²
	n/a			

- **Downwelling PAR sensor**

The downwelling PAR was calculated from the manufacturer's calibration equation applied to the sensor voltage. No further calibration has been carried out during BODC processing.

- **Upwelling PAR sensor**

The upwelling PAR was calculated from the manufacturer's calibration equation applied to the sensor voltage. No further calibration has been carried out during BODC processing.

- **Transmittance and Attenuance**

The transmittance was calculated from the manufacturer's calibration equation applied to the sensor voltage. No further calibration has been carried out during BODC processing.

Additional notes

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