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Report on the Quality Control of the IMOS East Australian Current (EAC) Deep Water moorings array. Version 1.1

Deployed: May 2021 to July 2022.

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February, 2023

IMOS
Integrated Marine Observing System

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Important disclaimer

IMOS data

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Version control information

Version	Date	Change information	Author
1.0	November, 2022	Initial version	Rebecca Cowley
1.1	February, 2023	Update some AQD QC information and plots for EAC3200 and EAC4800	Rebecca Cowley

Executive summary

The East Australian Current (EAC) is a complex and highly energetic western boundary system in the south-western Pacific off eastern Australia. It provides both the western boundary of the South Pacific gyre and the linking element between the Pacific and Indian Ocean gyres. The EAC deepwater moorings consisted of an array of full-depth current meter and property (CTD) moorings from the continental slope to the abyssal waters off Brisbane (27ºS).
This report details the quality control applied to the data collected from the EAC array (deployed from May, 2021 to July, 2022). The quality controlled datasets are publicly available via the AODN Data Portal. The data should be used in conjunction with this report.

Acknowledgments

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1 Introduction

The East Australian Current (EAC) is a complex and highly energetic western boundary system in the south-western Pacific off eastern Australia. It provides both the western boundary of the South Pacific gyre and the linking element between the Pacific and Indian Ocean gyres. The EAC deepwater moorings consisted of an array of full-depth current meter and property (CTD) moorings from the continental slope to the abyssal waters off Brisbane (27ºS). At this location, north of the high eddy variability, the EAC is approaching its maximum strength and its flow is relatively uniform and coherent. The aim of this observing system was to capture the mean and time-varying flow of the EAC. The array is a component of IMOS, and will provide an intensive reference set of measurements of the EAC flow over sustained period for monitoring EAC transport, improved understanding of the relationship of EAC and the South Pacific gyre and impact of the coastal marine ecosystem, and validation and interpretation of the current system in numerous climate and ocean models. This deployment continues the previous deployment of the mooring array (Cowley 2021; Lovell & Cowley, 2021a; Lovell & Cowley, 2021b; Cowley, 2022; Cowley 2022a). The original array was planned based on the existing long-term XBT transects, satellite altimetry and glider tracks.

The EAC moorings array consisted of 6 full-depth current meter/CTD moorings extending from the continental slope to the abyssal waters off Brisbane, Australia. Deployment was during May, 2021 on the Investigator voyage IN2021_V03 and recovery was during July, 2022 on the Investigator voyage IN2022_V06. Additional datasets from these voyages are available from the CSIRO Marine and Atmospheric Data Centre interface Marlin.

The quality control of the data from the instruments on each of the six moorings is covered in this report.

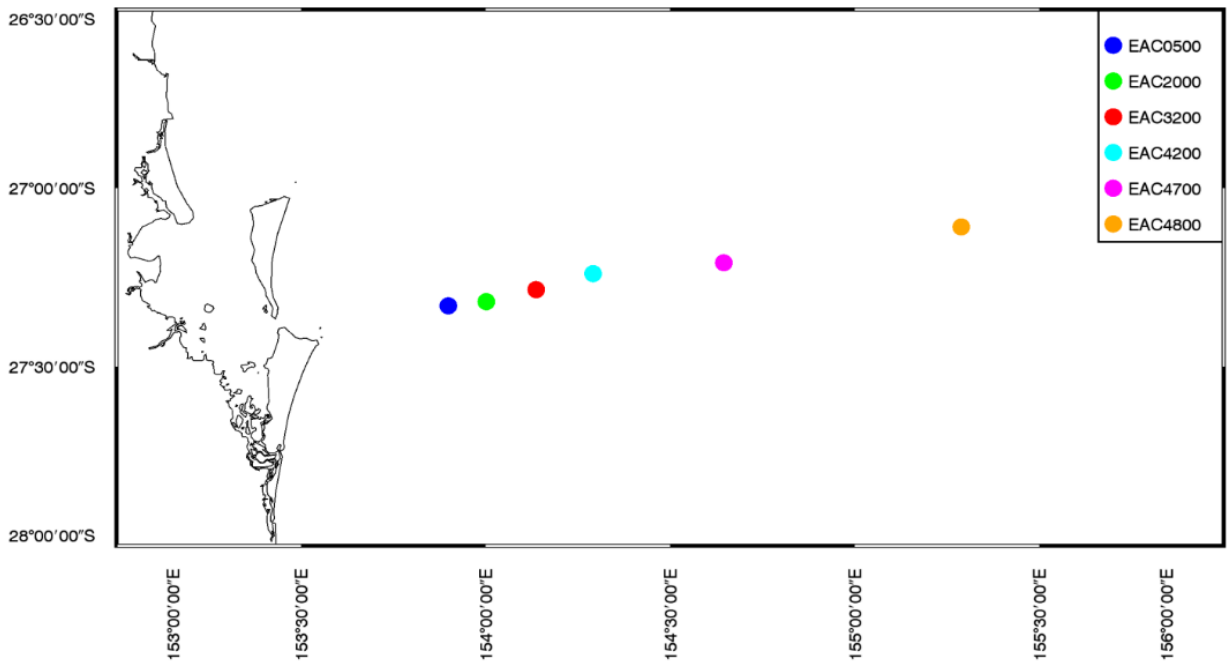
2 Moorings description

Table 1 summarises each mooring's location, depth and deployment times. Figure 1 shows the map of the mooring locations. Full information on the deployment and recovery voyages can be obtained from the CSIRO Marine and Atmospheric Data Centre (data interface: http://www.marine.csiro.au/marlin/). Voyages: IN2021_V03 and IN2022_V06.

Table 1. Summary of mooring deployment details

Mooring	Anchors Deployed (UTC)	Releases activated for retrieval (UTC)	Location		Depth (m)
			Latitude	Longitude	
EAC0500	01/06/2021 06:05	26/07/2022 02:51	-27.325	153.898	547
EAC2000	02/06/2021 04:08	25/07/2022 21:30	-27.312	154.002	1898
EAC3200	27/05/2021 04:00	24/07/2022 21:35	-27.281	154.134	3287
EAC4200	24/05/2021 04:29	18/07/2022 21:29	-27.244	154.286	4244
EAC4700	20/05/2021 06:40	17/07/2022 21:30	-27.201	154.638	4779
EAC4800	17/05/2021 05:45	15/07/2022 21:35	-27.102	155.306	4796

Figure 1. Location of the six EAC moorings.



The location of two of the EAC moorings in this deployment differs from the very first deployment (Cowley, 2021). The shallowest mooring was moved further inshore, while an additional mooring was added between the locations of EAC2000 and EAC4200. The relative locations and matchup of continuing mooring locations is summarised in **Error! Not a valid bookmark self-reference.**.

Note that while four of the mooring locations are coincident between deployments, the time series is not continuous as there was a gap of 21 months between the first and second deployments.

Table 2. Depths and naming conventions for all EAC mooring deployments.

Nominal Depth	500 m	1500 m	2000 m	3200 m	4200 m	4700 m	4800 m
EAC 2012-13	-	EAC1520 (EACM1)	EAC2000 (EACM2)	-	EAC4200 (EACM3)	EAC4700 (EACM4)	EAC4800 (EACM5)
EAC 2015-16	EAC0500	-	EAC2000	EAC3200	EAC4200	EAC4700	EAC4800
EAC 2016-18	EAC0500	-	EAC2000	EAC3200	EAC4200	EAC4700	EAC4800
EAC 2018-19	EAC0500	-	EAC2000	EAC3200	EAC4200	EAC4700	EAC4800
EAC 2019-21	EAC0500	-	EAC2000	EAC3200	EAC4200	EAC4700	EAC4800
EAC 2021-22	EAC0500	-	EAC2000	EAC3200	EAC4200	EAC4700	EAC4800

2.1 Major issues with moorings

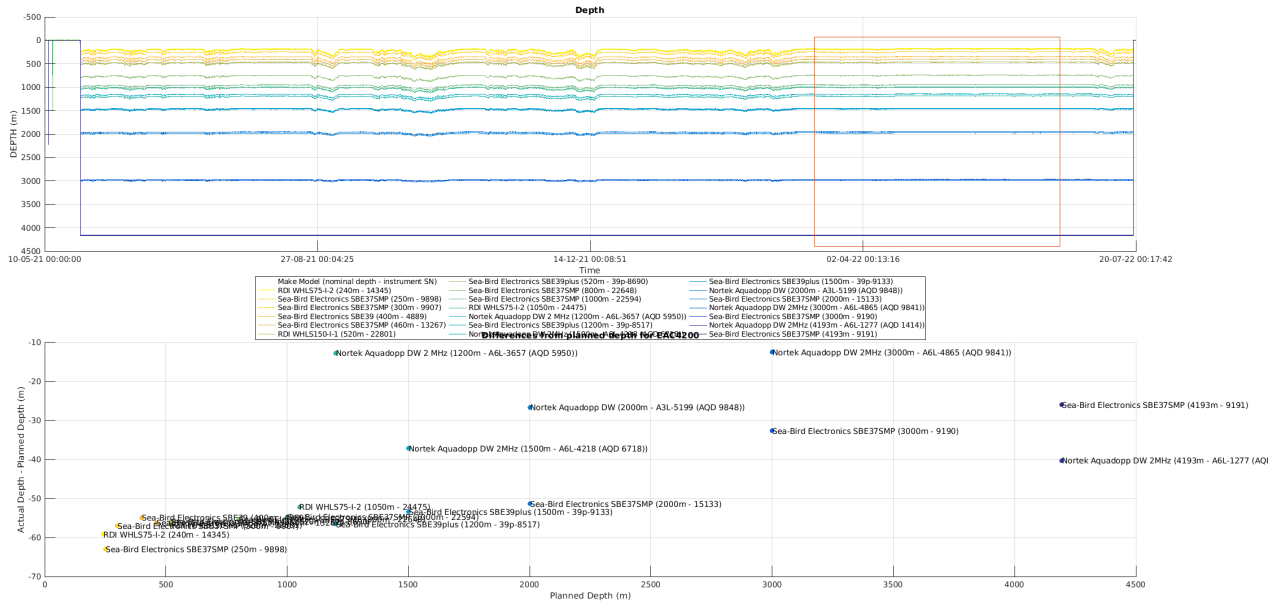
On the 21/12/2021, the iridium beacon on the top float of EAC4800 began transmitting indicating the mooring had broken the surface. On 28/04/2021, the top part of mooring EAC4800 broke away. The top float containing a seabird CTD was recovered and the data included in the dataset.
On approximately 10/6/2021, the iridium beacon on the top float of EAC4200 began transmitting regularly. On 24/4/2022, the mooring broke and began drifting. The instruments from the top part of the EAC4200 mooring were not recovered (see Table 7). The instrument depths calculated from the returned instruments on this mooring indicate there were two issues leading to the surfacing of the EAC4200 mooring:

- The mooring landed 12m shallower than planned, from bathymetry calculations
- There was an error in the lengths of dynex cut for the deeper parts of the mooring, in particular, there is approximately 10m extra length between the 3000m and 4200m instruments and approximately 20m extra length between the 2000 and 3000m instruments (see Figure 2). The dynex used in the mooring is also subject to stretch of approximately 3%.

The depth offsets from the Nortek instruments should be disregarded when looking at Figure 2, these are inaccurate due to the pressure sensor used on these instruments. The Seabird instruments offer reliable estimates of depth. The planned depths in this figure are based on the location depth being 4256m. Bathymetry indicates the mooring landed at 4244m (from triangulation data), while the bottom instrument indicates a depth of 4231m (approximately 25m shallower than planned).

The planned depths for EAC4200 (and all of the moorings) in the final QC'd files have been adjusted to allow for planned depth offsets. For this reason, the planned depths for the instruments will differ from those shown in the build drawings (figure 3).

Figure 2. Screen shot from IMOS Toolbox. Upper panel shows depths from instruments with time. Lower panel shows the difference between the actual depths and planned depths at the time period highlighted in the upper panel.



3 Summary of instrumentation

A total of 163 instruments were deployed on the six moorings. 156 instruments were recovered.

Table 3 shows the specifics of the instrument information for each mooring. The final mooring diagrams are shown in Figure 3 and Tables 4-9 summarise the instrumentation by mooring. Instruments that failed to return data are listed in Table 10.

Table 3. Summary of instrument types used.

Instrument Brand	Instrument model	Measurement types and manufacturer accuracy estimates
Seabird	SBE37 SMP (pumped unit)	Pressure (±0.1% max depth rating), temperature (±0.002°C), conductivity (±0.0003S/m)
Seabird	SBE39 Plus, measuring temperature and pressure	Pressure (±0.1% max depth rating), temperature (±0.002°C)
Seabird	SBE39, Temperature only measurements	Temperature (±0.002°C)
Star Oddi	Starmon Mini	Temperature (±0.05°C)
RDI	Longranger 75kHz	Pressure (±0.25% full scale), temperature (accuracy not stated, precision ±0.4°C), currents (stdev: 3.9cm/s @ settings used on the EAC; compass tilt max ±15°, tilt range ±50°)
RDI	Workhorse Quatermaster 150kHz	Pressure (±0.25% full scale), temperature (accuracy not stated, precision ±0.4°C), currents (stdev: 3.5cm/s @ settings used on the EAC; compass tilt max ±15°, tilt range ±50°)
RDI	Workhorse Sentinal 300kHz	Pressure (±0.25% full scale), temperature (accuracy not stated, precision ±0.4°C), currents (stdev: 3.6cm/s @ settings used on the EAC; compass tilt max ±15°, tilt range ±50°)
Nortek	Aquadopp DW	Pressure (0.25%), temperature (±0.1°C), currents (point source) (maximum tilt ±30°)

Figure 3. Mooring diagram summary.

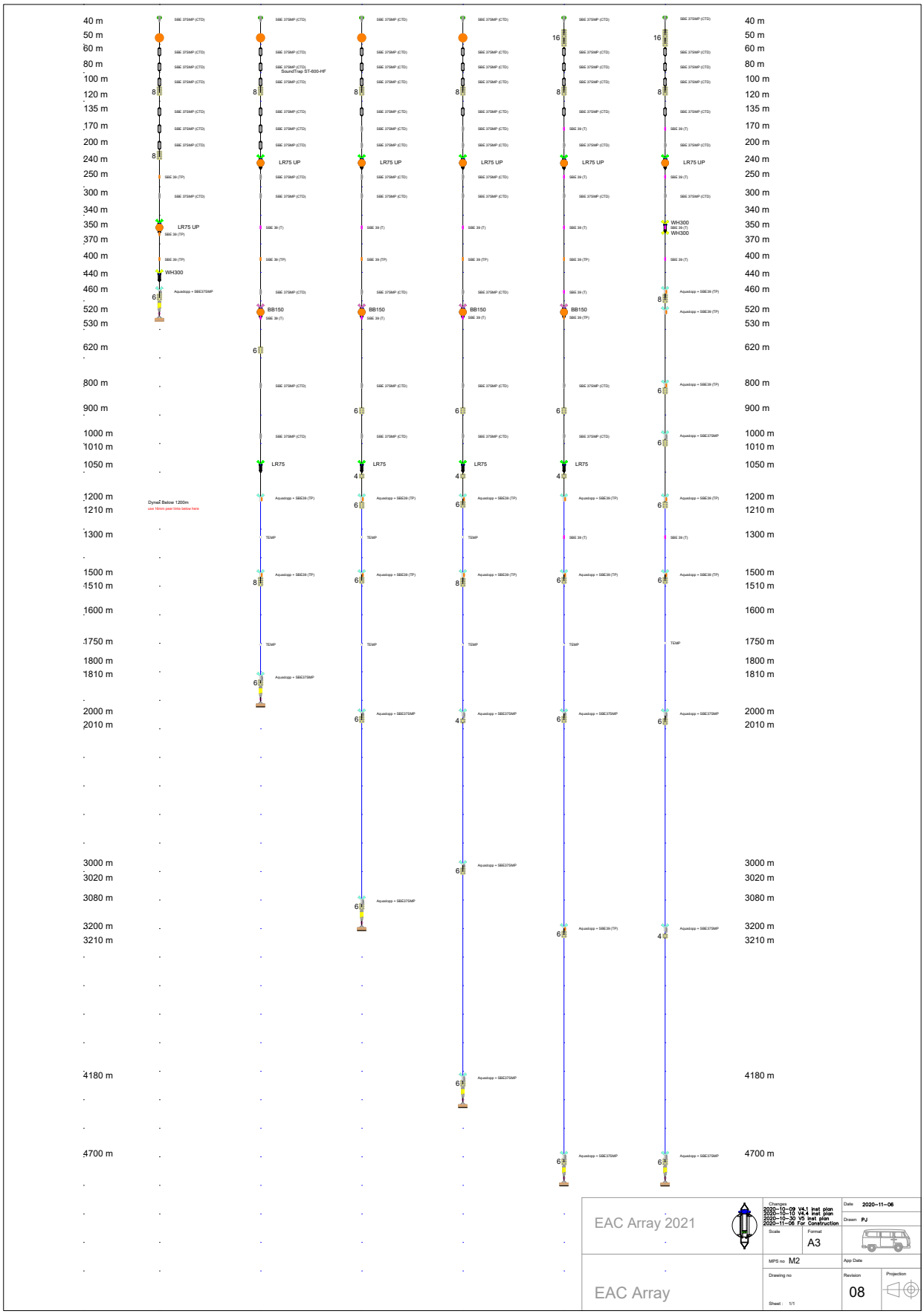


Table 4. Instrumentation summary for EAC0500 mooring.

Instrument	Serial number	Planned depth (m)	End of deployment time offset (s) (instrument - UTC)
Sea-Bird Electronics SBE37SMP	22652	40	28
Sea-Bird Electronics SBE37SMP	13263	60	1
Sea-Bird Electronics SBE37SMP	15105	80	3
Sea-Bird Electronics SBE37SMP	15884	100	2
Sea-Bird Electronics SBE37SMP	22597	135	14
Sea-Bird Electronics SBE37SMP	9175	170	-28
Sea-Bird Electronics SBE37SMP	9184	200	-40
Sea-Bird Electronics SBE39	4777	250	-66
Sea-Bird Electronics SBE37SMP	9899	300	-17
RDI ADCP LR75	9788	350	43
Sea-Bird Electronics SBE37SMP	4779	350	-65
Sea-Bird Electronics SBE39	4780	400	-72
RDI ADCP WH300	14254	440	64
Nortek Aquadopp DW	A6L-5009 (AQD 9890)	477	-51
Sea-Bird Electronics SBE37SMP	9911	477	-4

Table 5. Instrumentation summary for EAC2000 mooring.

Instrument	Serial number	Planned depth (m)	End of deployment time offset (s) (instrument - UTC)
Sea-Bird Electronics SBE37SMP	9333	51	32
Sea-Bird Electronics SBE37SMP	22646	71	-34
Sea-Bird Electronics SBE37SMP	15132	91	-5
Sea-Bird Electronics SBE37SMP	23198	111	-5
Sea-Bird Electronics SBE37SMP	22599	146	-21
Sea-Bird Electronics SBE37SMP	9176	181	37
Sea-Bird Electronics SBE37SMP	9185	211	49
RDI ADCP LR75	24659	251	237
Sea-Bird Electronics SBE37SMP	9895	256	24
Sea-Bird Electronics SBE37SMP	9900	311	23
Sea-Bird Electronics SBE39	4197	361	60
Sea-Bird Electronics SBE39	39p-8520	411	2
Sea-Bird Electronics SBE37SMP	11401	471	26

Instrument	Serial number	Planned depth (m)	End of deployment time offset (s) (instrument - UTC)
Sea-Bird Electronics SBE39	4596	531	62
RDI ADCP WH150	16413	531	129
Sea-Bird Electronics SBE37SMP	11405	811	13
Sea-Bird Electronics SBE37SMP	15022	1011	9
RDI ADCP LR75	14890	1061	-1076
Nortek Aquadopp DW	A6L-3641 (AQD 5938)	1211	39
Sea-Bird Electronics SBE39	39p-8436	1211	12
Star Oddi Starmon mini	T-4030	1311	0
Nortek Aquadopp DW	A6L-3653 (AQD 5976)	1511	62
Sea-Bird Electronics SBE39	4887	1511	78
Star Oddi Starmon mini	T-4031	1761	-900
Nortek Aquadopp DW	A6L-5477 (AQD 8461)	1835	54
Sea-Bird Electronics SBE37SMP	22645	1835	4

Table 6. Instrumentation summary for EAC3200 mooring.

Instrument	Serial number	Planned depth (m)	End of deployment time offset (s) (instrument - UTC)
Sea-Bird Electronics SBE37SMP	9335	169	-30
Sea-Bird Electronics SBE37SMP	22647	189	19
Sea-Bird Electronics SBE37SMP	15131	209	-2
Sea-Bird Electronics SBE37SMP	22593	229	16
Sea-Bird Electronics SBE37SMP	9166	264	-51
Sea-Bird Electronics SBE37SMP	9188	299	-35
Sea-Bird Electronics SBE37SMP	9186	329	-49
RDI ADCP LR75	14292	369	-268
Sea-Bird Electronics SBE37SMP	9897	371	-18
Sea-Bird Electronics SBE37SMP	9905	429	-11
Sea-Bird Electronics SBE39	4199	479	-84
Sea-Bird Electronics SBE39	39p-8522	529	-19
Sea-Bird Electronics SBE37SMP	11402	589	-4
Sea-Bird Electronics SBE39	4594	649	-59
RDI ADCP WH150	17959	649	984
Sea-Bird Electronics SBE37SMP	13266	929	9

Instrument	Serial number	Planned depth (m)	End of deployment time offset (s) (instrument - UTC)
Sea-Bird Electronics SBE37SMP	13080	1129	5
RDI ADCP LR75	24473	1179	-185
Nortek Aquadopp DW	A6L-3637 (AQD 5943)	1329	-36
Sea-Bird Electronics SBE39	39p-8516	1329	-4
Star Oddi Starmon mini	T-4033	1429	-1200
Nortek Aquadopp DW	A6L-3640 (AQD 5977)	1629	-13
Sea-Bird Electronics SBE39	4888	1629	-62
Star Oddi Starmon mini	T-4034	1879	-900
Nortek Aquadopp DW	A6L-4869 (AQD 9496)	2129	-78
Sea-Bird Electronics SBE37SMP	13265	2129	12
Nortek Aquadopp DW	A6L-1435 (AQD 1401)	3223	-170
Sea-Bird Electronics SBE37SMP	9182	3223	-32

Table 7. Instrumentation summary for EAC4200 mooring.

Instrument	Serial number	Planned depth (m)	End of deployment time offset (s) (instrument - UTC)
Sea-Bird Electronics SBE37SMP	9337	-20	Not recovered
Sea-Bird Electronics SBE37SMP	14035	0	Not recovered
Sea-Bird Electronics SBE37SMP	15121	20	Not recovered
Sea-Bird Electronics SBE37SMP	13083	40	Not recovered
Sea-Bird Electronics SBE37SMP	9171	75	Not recovered
Sea-Bird Electronics SBE37SMP	9183	110	Not recovered
Sea-Bird Electronics SBE37SMP	9193	140	Not recovered
RDI ADCP LR75	14345	180	-628
Sea-Bird Electronics SBE37SMP	9898	190	-13
Sea-Bird Electronics SBE37SMP	9907	240	6
Sea-Bird Electronics SBE39	4201	290	0
Sea-Bird Electronics SBE39	4889	340	-60
Sea-Bird Electronics SBE37SMP	13267	400	-122
RDI ADCP WH150	22801	460	-630
Sea-Bird Electronics SBE39	39p-8690	460	-6
Sea-Bird Electronics SBE37SMP	22648	740	15
Sea-Bird Electronics SBE37SMP	22594	940	22

Instrument	Serial number	Planned depth (m)	End of deployment time offset (s) (instrument - UTC)
RDI ADCP LR75	24475	990	-207
Nortek Aquadopp DW	A6L-3657 (AQD 5950)	1140	-78.8
Sea-Bird Electronics SBE39	39p-8517	1140	-155
Star Oddi Starmon mini	T-5297	1240	-900
Nortek Aquadopp DW	A6L-4218 (AQD 6718)	1440	-44.7
Sea-Bird Electronics SBE39	39p-9133	1440	-2
Star Oddi Starmon mini	T-5314	1690	-900
Nortek Aquadopp DW	A3L-5199 (AQD 9848)	1945	-90.5
Sea-Bird Electronics SBE37SMP	15133	1945	-15
Nortek Aquadopp DW	A6L-4865 (AQD 9841)	2970	-49.5
Sea-Bird Electronics SBE37SMP	9190	2970	-28
Nortek Aquadopp DW	A6L-1277 (AQD 1414)	4168	-176.9
Sea-Bird Electronics SBE37SMP	9191	4168	-47

Table 8. Instrumentation summary for EAC4700 mooring.

Instrument	Serial number	Planned depth (m)	End of deployment time offset (s) (instrument - UTC)
Sea-Bird Electronics SBE37SMP	9340	30	-18
Sea-Bird Electronics SBE37SMP	22649	50	31
Sea-Bird Electronics SBE37SMP	15134	70	-7
Sea-Bird Electronics SBE37SMP	22595	90	22
Sea-Bird Electronics SBE37SMP	9173	125	-42
Sea-Bird Electronics SBE39	4676	160	-65
Sea-Bird Electronics SBE37SMP	9882	190	-3
RDI ADCP LR75	14434	230	213
Sea-Bird Electronics SBE39	4169	236	-99
Sea-Bird Electronics SBE37SMP	9908	290	5
Sea-Bird Electronics SBE39	4326	340	-72
Sea-Bird Electronics SBE39	4890	390	-70
Sea-Bird Electronics SBE39	4592	450	-49
Sea-Bird Electronics SBE39	6273	510	-63
RDI ADCP WH150	24667	510	-655
Sea-Bird Electronics SBE37SMP	15021	790	-8

Instrument	Serial number	Planned depth (m)	End of deployment time offset (s) (instrument - UTC)
Sea-Bird Electronics SBE37SMP	13084	990	13
RDI ADCP LR75	3758	1040	-33
Nortek Aquadopp DW	A6L-3638 (AQD 5971)	1190	-92.1
Sea-Bird Electronics SBE39	39p-8518	1190	-6
Sea-Bird Electronics SBE39	4613	1290	-94
Nortek Aquadopp DW	A6L-5480 (AQD 8377)	1490	-63.7
Sea-Bird Electronics SBE39	39p-9134	3190	17
Star Oddi Starmon mini	T-5318	1740	-1200
Nortek Aquadopp DW	A6L-4864 (AQD 9840)	1990	-82.7
Sea-Bird Electronics SBE37SMP	13268	1990	3
Sea-Bird Electronics SBE39	1332	1490	-65
Nortek Aquadopp DW	A6L-5066 (AQD 9820)	3190	0
Nortek Aquadopp DW	A6L-1282 (AQD 1484)	4704	-115.7
Sea-Bird Electronics SBE37SMP	13078	4704	6

Table 9. Instrumentation summary for EAC4800 mooring.

Instrument	Serial number	Planned depth (m)	End of deployment time offset (s) (instrument - UTC)
Sea-Bird Electronics SBE37SMP	9341	10	-38
Sea-Bird Electronics SBE37SMP	22650	30	22
Sea-Bird Electronics SBE37SMP	15883	50	12
Sea-Bird Electronics SBE37SMP	22596	70	30
Sea-Bird Electronics SBE37SMP	9174	105	-37
Sea-Bird Electronics SBE39	4168	140	-69
Sea-Bird Electronics SBE37SMP	9889	170	-6
RDI ADCP LR75	14489	210	-916
Sea-Bird Electronics SBE39	4171	220	-55
Sea-Bird Electronics SBE37SMP	23200	270	22
Sea-Bird Electronics SBE39	4500	320	-58
RDI ADCP WH300	16432	320	-265
RDI ADCP WH300	16679	320	-303
Sea-Bird Electronics SBE39	4591	370	0
Nortek Aquadopp DW	A6L-3662 (AQD 5878)	430	-48.2

Instrument	Serial number	Planned depth (m)	End of deployment time offset (s) (instrument - UTC)
Sea-Bird Electronics SBE39	6272	430	-63
Nortek Aquadopp DW	A6L-3661 (AQD 5908)	490	-48.5
Sea-Bird Electronics SBE39	39p-8108	490	9
Nortek Aquadopp DW	A6L-3654 (AQD 5928)	770	-45.4
Sea-Bird Electronics SBE39	39p-8435	770	-10
Nortek Aquadopp DW	A6L-3656 (AQD 5937)	970	-33.9
Sea-Bird Electronics SBE37SMP	13082	970	-1
Nortek Aquadopp DW	A6L-3639 (AQD 5975)	1170	-59
Sea-Bird Electronics SBE39	39p-8519	1170	-1
Sea-Bird Electronics SBE39	4675	1270	-69
Sea-Bird Electronics SBE39	1331	1480	-171
Nortek Aquadopp DW	A6L-5478 (AQD 8448)	1480	-59.8
Star Oddi Starmon mini	T-5323	1730	-1200
Sea-Bird Electronics SBE37SMP	9187	1980	-13
Nortek Aquadopp DW	A3L-5175 (AQD 9964)	1980	-75.9
Nortek Aquadopp DW	A6L-5063 (AQD 9827)	3195	-27.5
Sea-Bird Electronics SBE37SMP	13081	3195	17
Nortek Aquadopp DW	A6L-1281 (AQD 1502)	4712	-103.7
Sea-Bird Electronics SBE37SMP	13087	4712	10

Table 10. Instruments deployed that returned no data

Instrument	Mooring	Serial Number	Planned depth (m)	Comment
Star Oddi	EAC2000	T-4030	1300	Water leaked into instrument. No data recovered.
Nortek Aquadopp DW	EAC4700	A6L-5066 (AQD 9820)	3190	Instrument not recording, not set up at start of deployment.

4 Instrument handling and data processing summary

Instrument setups were completed at CSIRO before shipping to be loaded on the *RV Investigator*. Before deployment, all instruments were re-checked to ensure they were operating prior to deployment. Setup of instruments was completed using automated scripts and the outputs from each instrument recorded. All setup procedures have extensive documentation and sign-off sheets requiring two persons to check. Appendix A contains samples of the setups for each instrument type.

All Seabird 39 CTDs were calibrated at the CSIRO Marine and Atmospheric Research Calibration Facility (or in the case of new instruments and those previously identified as having issues, by the manufacturer) prior to deployment. All Seabird 37 CTDs were calibrated at Seabird. Temperature calibration was performed at the CSIRO calibration facility on all Star Oddi instruments prior to deployment. Compass calibration was performed during the initial setup and configuration of the RDI ADCP instruments at CSIRO, Hobart.

Post-deployment, the Star Oddi and Seabird instruments were placed in a calibration bath on board the ship. After several hours, the bath temperature was changed by adding cooler seawater. The same, recently calibrated Seabird SBE37 was used in each bath to compare to the instruments retrieved from the mooring. In addition, the Star Oddi and Seabird instruments were all attached to the CTD rosette on the ship and a calibration 'dip' was performed both before and after deployment. The Seabird 911 rosette instrument was used to assess the salinity and temperature accuracy of these instruments at the end of the deployment (see section 5.5).

Processing and quality control of the data was completed using the IMOS toolbox version 2.6.13.

5 QC specifics

5.1 In/Out of water information for each mooring

The in water and out of water times are used to flag data outside these times automatically with a '4', indicating that the data is considered to be 'bad' since the mooring is out of the water. The in/out of water times were selected based on the mooring deployment time (the time the anchor is dropped from the back of the ship) and the mooring release time (the time the acoustic releases are activated to release the mooring to the surface), and are adjusted after reviewing the temperature and depth data for each instrument. These times are consistent for each instrument on each mooring (Table 11), with the exception of the EAC2000 mooring, where the top part of the mooring broke part way through deployment. Anchor deploy and release times are given in Table 1.

Table 11. Mooring in/out of water times.

Mooring	In water time (UTC)	Out water time (UTC)
EAC0500	1/6/2021 06:40	26/7/2022 02:37
EAC2000	2/6/2021 04:35	25/7/2022 21:30
EAC3200	27/5/2021 04:55	24/7/2022 21:35
EAC4200	24/5/2021 05:35	18/7/2022 21:29
EAC4200 (Broken section, not recovered)	24/5/2021 05:35	24/4/2022 01:30
EAC4700	20/5/2021 08:30	16/7/2022 21:30
EAC4800	17/5/2021 07:35	15/7/2022 21:35
EAC4800 (Broken section, recovered)	17/5/2021 07:35	24/4/2022 01:00

5.2 Timing adjustments

The instrument clocks were checked for offsets at the start and end of the voyage. All instrument clocks were synchronised to UTC before deployment. Even with careful synchronisation, instrument clocks can drift and sometimes errors with local/UTC time can occur. Visual checks of times in and out of water will also show clearly time offsets.
Tables 4 to 9 include the applied time adjustments determined from time checks at the end of the deployment. The time record of each instrument was adjusted linearly to account for the clock drift.

5.3 Quality issues for each instrument

Specific quality issues were found for some instruments. Table 12 contains a summary of these issues and the QC action for affected instruments.
All SBE37 instruments were calibrated by Seabird before and after deployment. In addition, calibration dips on the ship's CTD rosette were completed before and after deployment for all SBE37, SBE39 and Star Oddi instruments. Salinity offsets and drift were uncommon in this deployment, but some offsets can be identified in the data and in the calibration dip data.
The pressure performance of Nortek DW Aquadopp instruments has previously been investigated (Cowley, 2021). Many of these instruments record pressure that has a consistent offset. In all cases

for Aquadopp DW instruments, the pressure was flagged with 4 and the depth has been calculated from adjacent instruments.
All Star Oddi instruments record temperature only, so require a depth to be inferred from adjacent instruments.

Table 12. Quality issue details listed by instrument type

Instrument	Mooring	Serial Number	Planned depth (m)	Issue	QC action
Nortek AQD	EAC0500	9890	477	Depth offset from planned depth. And drifting over time.	Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4.
Nortek AQD	EAC2000	5938	1211	Depth offset from planned depth. And drifting over time. TEMP offset from adjacent SBE.	Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4. Flag TEMP with flag 3.
Nortek AQD	EAC2000	5976	1511	Depth offset from planned depth. And drifting over time. TEMP offset from adjacent SBE.	Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4. Flag TEMP with flag 3.
Nortek AQD	EAC2000	8461	1835	Depth offset from planned depth. And drifting over time. TEMP offset from adjacent SBE.	Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4. Flag TEMP with flag 3.
Nortek AQD	EAC3200	5943	1329	Depth offset from planned depth. And drifting over time. TEMP offset from adjacent SBE.	Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4. Flag TEMP with flag 3.
Nortek AQD	EAC3200	5977	1629	Depth offset from planned depth. And drifting over time. TEMP offset from adjacent SBE.	Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4. Flag TEMP with flag 3.
Nortek AQD	EAC3200	9496	2129	UCUR and VCUR appears incorrect compared to adjacent AQD instruments. Depth offset from planned depth. And drifting over time. TEMP offset from adjacent SBE.	Flag UCUR and VCUR with flag 3. Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4. Flag TEMP with flag 3.
Nortek AQD	EAC3200	1401	3223	Depth offset from planned depth. And drifting over time. TEMP offset from adjacent SBE.	Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4. Flag TEMP with flag 3.

Instrument	Mooring	Serial Number	Planned depth (m)	Issue	QC action
Nortek AQD	EAC4200	5950	1140	Depth offset from planned depth. And drifting over time. TEMP offset from adjacent SBE.	Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4. Flag TEMP with flag 3.
Nortek AQD	EAC4200	6718	1140	Depth offset from planned depth. And drifting over time.	Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4.
Nortek AQD	EAC4200	9848	1945	Depth offset from planned depth. And drifting over time.	Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4.
Nortek AQD	EAC4200	9841	2970	Depth offset from planned depth. TEMP offset from adjacent SBE.	Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4. Flag TEMP with flag 3.
Nortek AQD	EAC4200	1414	4168	Depth offset from planned depth. TEMP offset from adjacent SBE.	Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4. Flag TEMP with flag 3.
Nortek AQD	EAC4700	5971	1190	Depth offset from planned depth and pressure is drifting. TEMP offset from adjacent SBE.	Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4. Flag TEMP with flag 3.
Nortek AQD	EAC4700	8377	1490	Depth offset from planned depth and pressure is drifting. TEMP offset from adjacent SBE.	Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4. Flag TEMP with flag 3.
Nortek AQD	EAC4700	9840	1990	Depth offset from planned depth and pressure is drifting. TEMP offset from adjacent SBE.	Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4. Flag TEMP with flag 3.
Nortek AQD	EAC4700	1484	4704	Depth offset from planned depth and pressure is drifting. TEMP offset from adjacent SBE.	Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4. Flag TEMP with flag 3.
Nortek AQD	EAC4800	5878	430	Depth offset from planned depth. And drifting over time.	Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4.
Nortek AQD	EAC4800	5908	490	Depth offset from planned depth. And drifting over time.	Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4.
Nortek AQD	EAC4800	5928	770	Depth offset from planned depth. And drifting over time.	Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4.
Nortek AQD	EAC4800	5937	970	Depth offset from planned depth and pressure is drifting. TEMP offset from adjacent SBE.	Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4. Flag TEMP with flag 3.

Instrument	Mooring	Serial Number	Planned depth (m)	Issue	QC action
Nortek AQD	EAC4800	5975	1170	Depth offset from planned depth and pressure is drifting. TEMP offset from adjacent SBE.	Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4. Flag TEMP with flag 3.
Nortek AQD	EAC4800	8448	1480	Depth offset from planned depth and pressure is drifting. TEMP offset from adjacent SBE.	Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4. Flag TEMP with flag 3.
Nortek AQD	EAC4800	9964	1980	Depth offset from planned depth and pressure is drifting. TEMP offset from adjacent SBE.	Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4. Flag TEMP with flag 3.
Nortek AQD	EAC4800	9827	3195	UCUR and VCUR appears incorrect compared to adjacent AQD instruments. Depth offset from planned depth and pressure is drifting. TEMP offset from adjacent SBE.	Flag UCUR and VCUR with flag 3. Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4. Flag TEMP with flag 3.
Nortek AQD	EAC4800	1502	4712	Depth offset from planned depth and pressure is drifting. TEMP offset from adjacent SBE.	Infer depth from adjacent SBE37 pressures. Flag all PRES_REL with flag 4. Flag TEMP with flag 3.
SBE37	EAC0500	13263	60	PSAL is offset from post-deployment calibration rosette comparison. Drift not identifiable in QC.	Keep PSAL flag 1.
SBE37	EAC0500	15884	100	PSAL is offset from post-deployment calibration rosette comparison. Drift not identifiable in QC.	Keep PSAL flag 1.
SBE37	EAC0500	22597	135	PSAL is offset from post-deployment calibration rosette comparison. Drift not identifiable in QC.	Keep PSAL flag 1.
SBE37	EAC2000	22599	146	PSAL is offset from post-deployment calibration rosette comparison. Drift not identifiable in QC.	Keep PSAL flag 1.

Instrument	Mooring	Serial Number	Planned depth (m)	Issue	QC action
SBE37	EAC2000	9185	211	PSAL is offset from post-deployment calibration rosette comparison. Drift not identifiable in QC.	Keep PSAL flag 1.
SBE37	EAC2000	15022	1011	PRES_REL drifting and PSAL drifting. Potentially correctable by inferring a pressure and re-calculating salinity.	Flag PRES_REL and PSAL with flag 3.
SBE37	EAC3200	9335	169	PSAL is offset from post-deployment calibration rosette comparison. Drift not identifiable in QC.	Keep PSAL flag 1.
SBE37	EAC3200	22647	189	PSAL is offset from post-deployment calibration rosette comparison. Drift not identifiable in QC.	Keep PSAL flag 1.
SBE37	EAC3200	15131	209	PSAL drifts after a large conductivity sensor event (30/10/2021).	Flag 4 applied to PSAL at start of offset event.
SBE37	EAC3200	22593	229	PSAL is offset from post-deployment calibration rosette comparison. Drift not identifiable in QC.	Keep PSAL flag 1.
SBE37	EAC3200	9188	299	PSAL is offset from post-deployment calibration rosette comparison. Drift not identifiable in QC.	Keep PSAL flag 1.
SBE37	EAC4200	9337	-20	Instrument lost when mooring broke.	No data.
SBE37	EAC4200	14035	0	Instrument lost when mooring broke.	No data.
SBE37	EAC4200	15121	20	Instrument lost when mooring broke.	No data.
SBE37	EAC4200	13083	40	Instrument lost when mooring broke.	No data.

Instrument	Mooring	Serial Number	Planned depth (m)	Issue	QC action
SBE37	EAC4200	9171	75	Instrument lost when mooring broke.	No data.
SBE37	EAC4200	9183	110	Instrument lost when mooring broke.	No data.
SBE37	EAC4200	9193	140	Instrument lost when mooring broke.	No data.
SBE37	EAC4200	15133	1945	PSAL and COND sensor drift across deployment. Started ~0.1 low and finished ~0.12 high in calibration dips.	Flag PSAL and COND with flag 4.
SBE37	EAC4700	9340	30	PSAL is offset from post-deployment calibration rosette comparison. Drift not identifiable in QC.	Keep PSAL flag 1.
SBE37	EAC4700	22649	50	PSAL is offset from post-deployment calibration rosette comparison. Drift not identifiable in QC.	Keep PSAL flag 1.
SBE37	EAC4700	15134	70	PSAL is offset from post-deployment calibration rosette comparison. Drift not identifiable in QC.	Keep PSAL flag 1.
SBE37	EAC4700	22595	90	PSAL is offset from post-deployment calibration rosette comparison. Drift not identifiable in QC.	Keep PSAL flag 1.
SBE37	EAC4700	9173	125	PSAL is offset from post-deployment calibration rosette comparison. Drift not identifiable in QC.	Keep PSAL flag 1.
SBE37	EAC4700	9882	190	PSAL is offset from post-deployment calibration rosette comparison. Drift not identifiable in QC.	Keep PSAL flag 1.

Instrument	Mooring	Serial Number	Planned depth (m)	Issue	QC action
SBE37	EAC4800	9341	10	Mooring broke on 24/4/2022 and the instrument drifted around for some time until retrieved.	Out of water date set to time mooring broke, 24/4/2022, 0100 UTC.
SBE37	EAC4800	22650	30	PSAL is offset from post-deployment calibration rosette comparison. Drift not identifiable in QC.	Keep PSAL flag 1.
SBE37	EAC4800	22596	70	PSAL is offset from post-deployment calibration rosette comparison. Drift not identifiable in QC.	Keep PSAL flag 1.
SBE37	EAC4800	9174	105	PSAL is offset from post-deployment calibration rosette comparison. Drift not identifiable in QC.	Keep PSAL flag 1.
RDI	EAC0500	14254	440	Battery failed early in deployment, no useable current data collected.	Some velocity data retained after automated QC at very start of deployment.
RDI	EAC4800	16679	320	Battery failed early in deployment, no useable current data collected.	All velocity data flagged as bad during automated QC routines. Retain temperature and pressure data for the short recording period.

5.4 ADCP Quality control

The ADCP data from the RDI instruments was collected in single-ping mode, and in BEAM coordinates for this deployment. The IMOS Toolbox was used to import, screen, convert to ENU coordinates, ensemble average and QC the data. The entire process is briefly described in Appendix B.

Quality control of the RDI ADCP instruments utilises the quality control data and current data output from the RDI ADCP instruments (echo amplitude, correlation magnitude, error velocity and velocities). Thresholds for each test are selected individually for each instrument, the goal being to flag as 'bad' (flag 4) current data that is above the surface, within the side-lobe reflection region and any that has a large error associated with it.

Matlab plotting routines were used to assess the data from each instrument and to inform the QC operator about what thresholds to choose. Several iterations may be required to select appropriate thresholds. Table 13 summarises the thresholds selected for the EAC mooring RDI instruments. Once thresholds were determined, they were applied in the IMOS Toolbox and the data exported to netcdf format. The files output from the Toolbox are FV00 (single ping, beam coordinates, time drifts corrected, no QC) and FV01 files (hourly ensemble averaged data in ENU coordinates with QC applied).

Nortek Aquadopp instruments measure currents at a single point near the instrument head. The tests run on these instruments were minimal, with horizontal and vertical velocity and tilt tests applied to some of the instruments.
Figure 4 shows the u and v velocities with depth for each mooring, after QC.

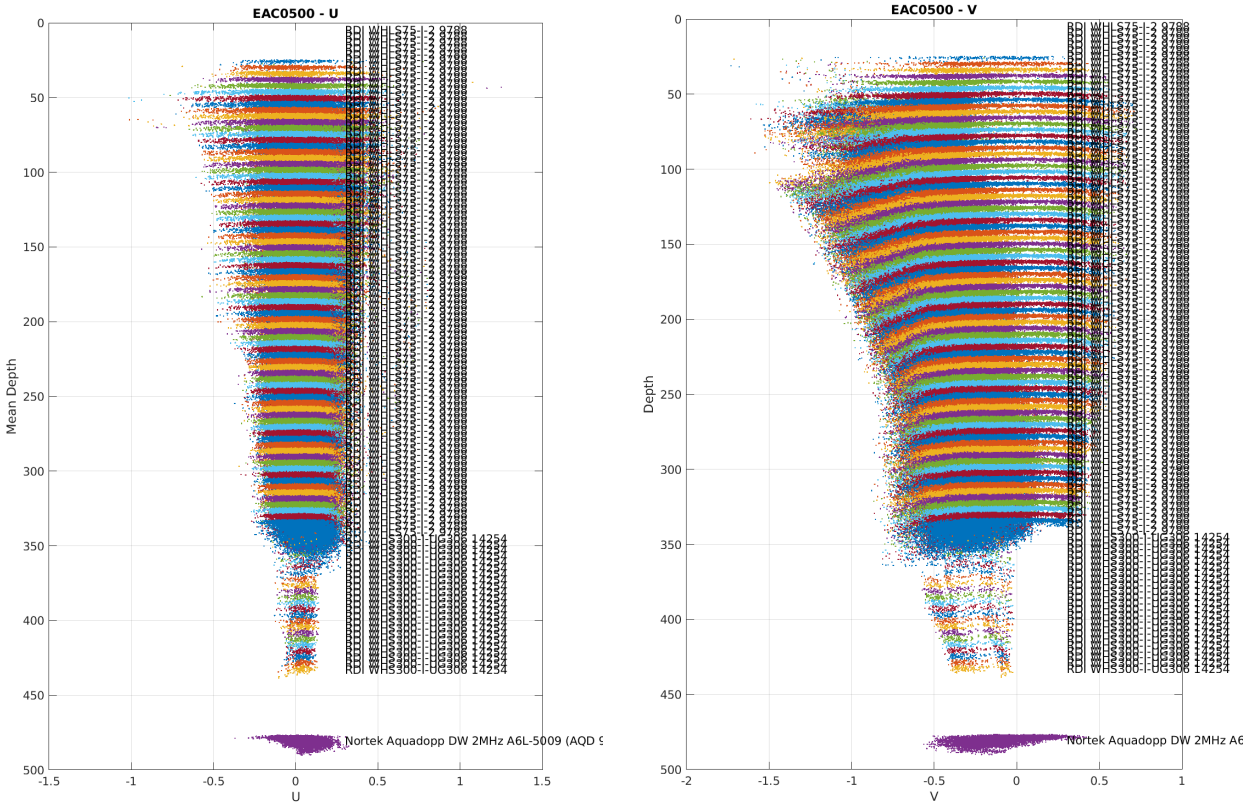
Table 13. ADCP QC thresholds

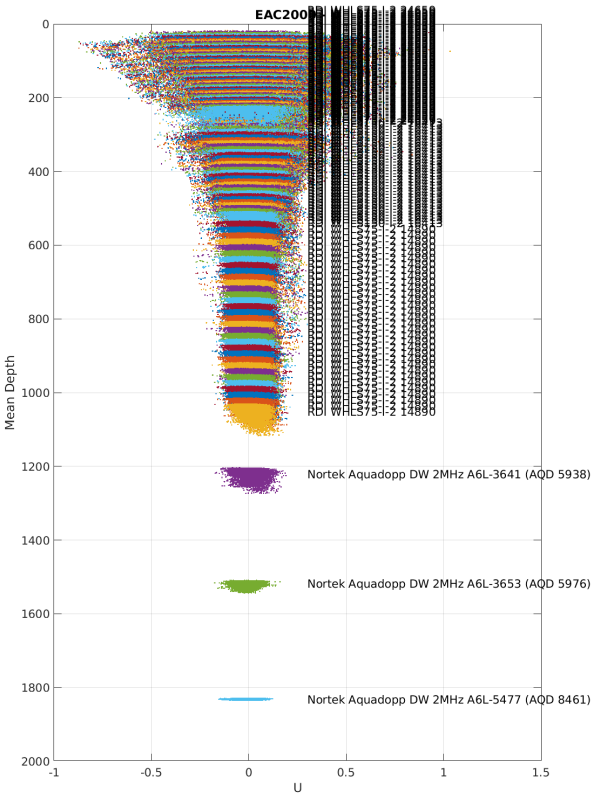
				Single Ping screening thresholds		Ensemble Averaged QC thresholds										
Serial No.	**kHz**	**Mooring**	**Orientation**	**Fish detection (Echo range)**	**Correlation Magnitude**	**Surface Detection imosEchoIntensitySetQC propagate = 1**				**Error Velocity**	**Horizontal Velocity**	**Vertical Velocity**	**Tilt**		**Correlation magnitude**	**Bin removed**
						Bound by Depth (d) or Index (i)	**Bound value**	**Echo amplitude**	**Side Lobe**				**Flag 2**	**Flag 3**		
9788	75	EAC0500	Up	-	-	d	80	20	1	0.3	3.5	0.4	40	50	100	-
14254	300	EAC0500	Up	-	-	NA	NA	NA	NA	0.04	1.5	0.1	40	50	64	1
24659	75	EAC2000	Up	-	-	d	80	20	1	0.3	3.5	0.2	40	50	100	-
16413	150	EAC2000	Up	-	-	NA	NA	NA	NA	0.05	1.0	0.05	40	50	100	-
14890	75	EAC2000	Up	-	-	NA	NA	NA	NA	0.05	0.8	0.05	40	50	80	-
14292	75	EAC3200	Up	-	-	d	80	20	1	0.2	3.5	0.1	40	50	100	-
17959	150	EAC3200	Up	-	-	NA	NA	NA	NA	0.05	0.6	0.08	40	50	80	-
24473	75	EAC3200	Up	-	-	NA	NA	NA	NA	0.1	0.5	0.05	40	50	100	-
14345	75	EAC4200	Up	-	-	d	80	20	1	0.1	3.0	0.1	40	50	100	-
22801	150	EAC4200	Up	-	-	NA	NA	NA	NA	0.1	1.5	0.05	40	50	64	-
24475	75	EAC4200	Up	-	-	NA	NA	NA	NA	0.1	1.5	0.05	40	50	80	-
14434	75	EAC4700	Up	-	-	d	80	20	1	0.1	2.5	0.1	40	50	80	-
24667	150	EAC4700	Up	-	-	NA	NA	NA	NA	0.1	0.6	0.1	40	50	64	-
3758	75	EAC4700	Up	-	-	NA	NA	NA	NA	0.1	0.6	0.07	40	50	120	-
14489	75	EAC4800	Up	-	-	d	80	20	1	0.15	2.5	0.15	40	50	100	-
16432	300	EAC4800	Up	-	-	NA	NA	NA	NA	0.04	1.5	0.04	40	50	64	-
16679	300	EAC4800	Down	-	-	NA	NA	NA	NA	0.04	1.5	0.04	40	50	64	-

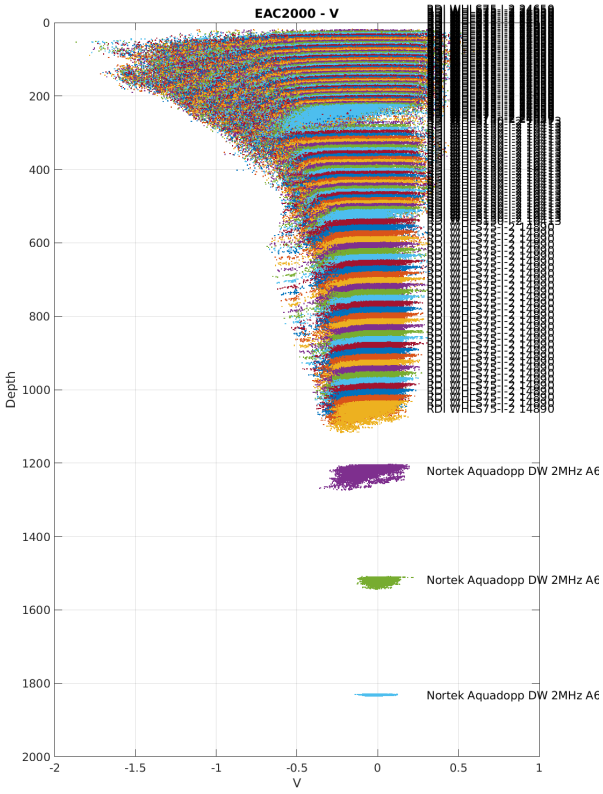
Table 14. Nortek Aquadopp QC thresholds.

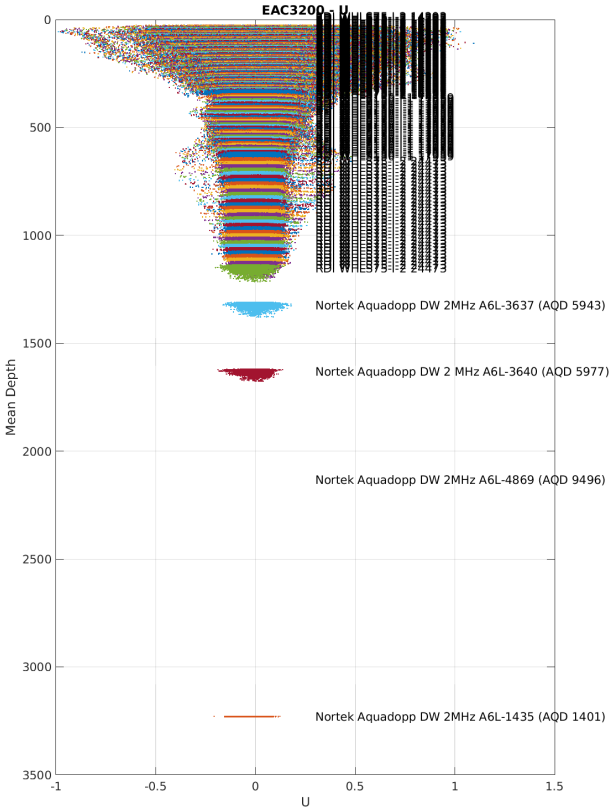
Serial No.	Mooring	Horizontal Velocity	Vertical Velocity	Tilt	
				Flag 2	Flag 3
9890	EAC0500	3.5	0.3	30	45
5938	EAC2000	1.5	0.1	30	45
5976	EAC2000	1.5	0.1	30	45
8461	EAC2000	1.5	0.1	30	45
5943	EAC3200	0.3	0.05	30	45
5977	EAC3200	0.3	0.05	30	45
9496	EAC3200	0.3	0.05	30	45
1401	EAC3200	0.3	0.05	30	45
5950	EAC4200	0.5	0.05	30	45
6718	EAC4200	0.5	0.05	30	45
9848	EAC4200	0.5	0.05	30	45
9841	EAC4200	0.5	0.05	30	45
1414	EAC4200	0.5	0.05	30	45
5971	EAC4700	0.5	0.05	30	45
8377	EAC4700	0.5	0.05	30	45
9840	EAC4700	0.5	0.05	30	45
1484	EAC4700	0.5	0.05	30	45
5878	EAC4800	1.5	0.1	30	45
5908	EAC4800	1.5	0.1	30	45
5928	EAC4800	1.5	0.1	30	45
5937	EAC4800	1.5	0.1	30	45
5975	EAC4800	1.5	0.1	30	45
8448	EAC4800	1.5	0.1	30	45
9964	EAC4800	1.5	0.1	30	45
9827	EAC4800	1.5	0.1	30	45
1502	EAC4800	1.5	0.1	30	45

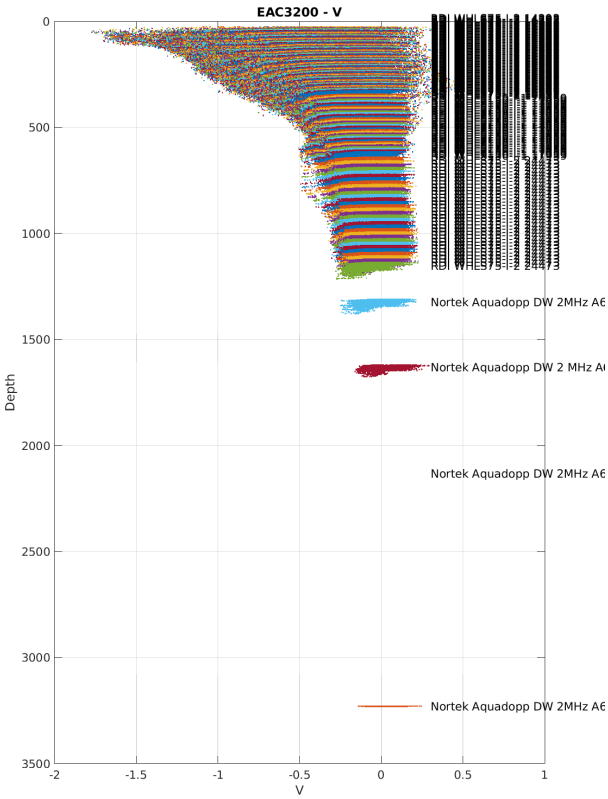
Figure 4. Hourly U and V velocities for each mooring after QC.

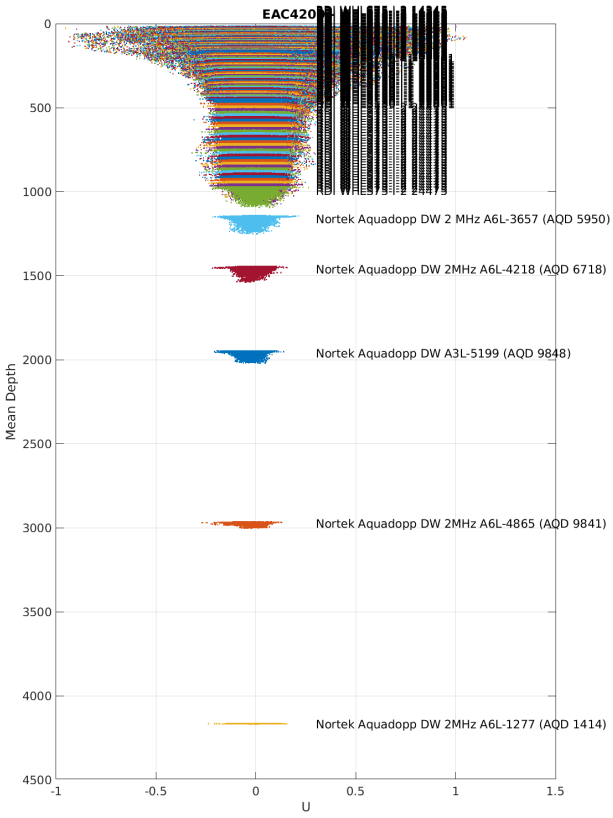


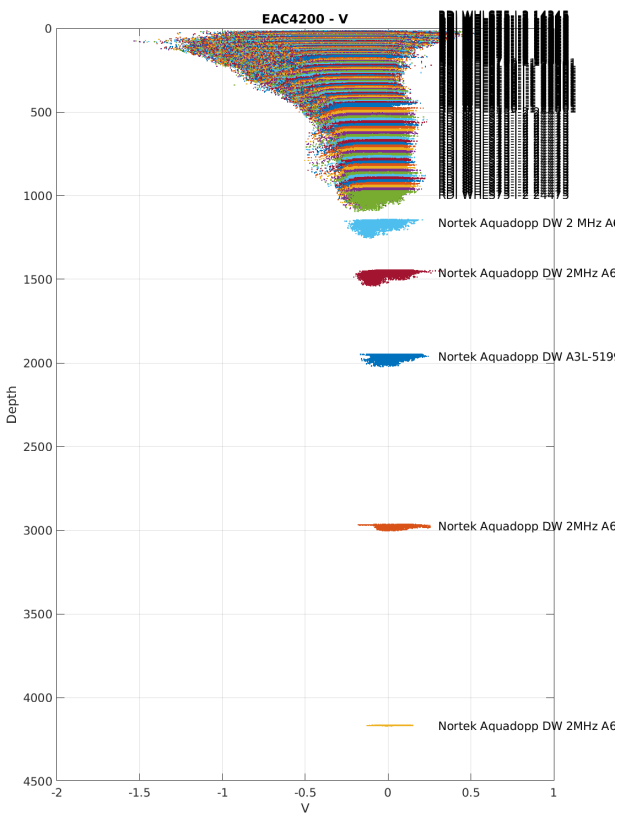

EAC2000 - U
Mean Depth
U
Nortek Aquadopp DW 2MHz A6L-3641 (AQD 5938)
Nortek Aquadopp DW 2MHz A6L-3653 (AQD 5976)
Nortek Aquadopp DW 2MHz A6L-5477 (AQD 8461)

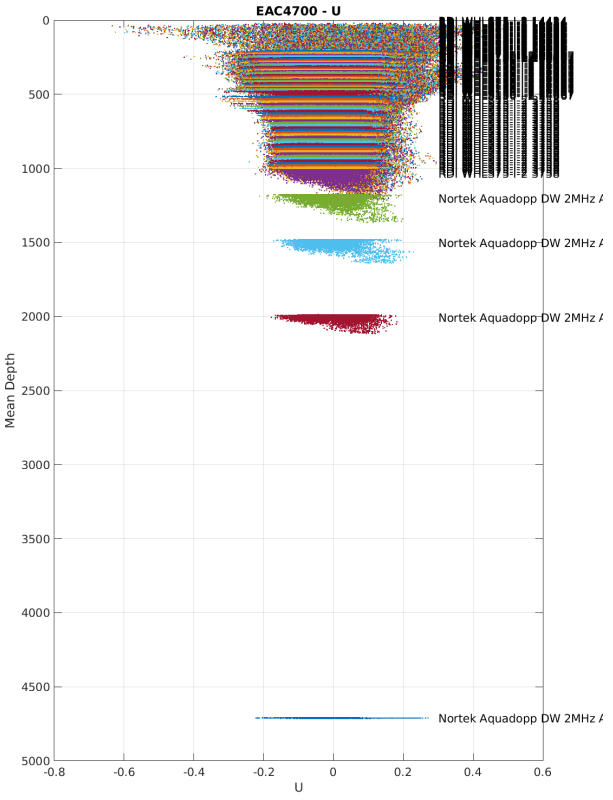

EAC2000 - V
Depth
V
Nortek Aquadopp DW 2MHz A6
Nortek Aquadopp DW 2MHz A6
Nortek Aquadopp DW 2MHz A6

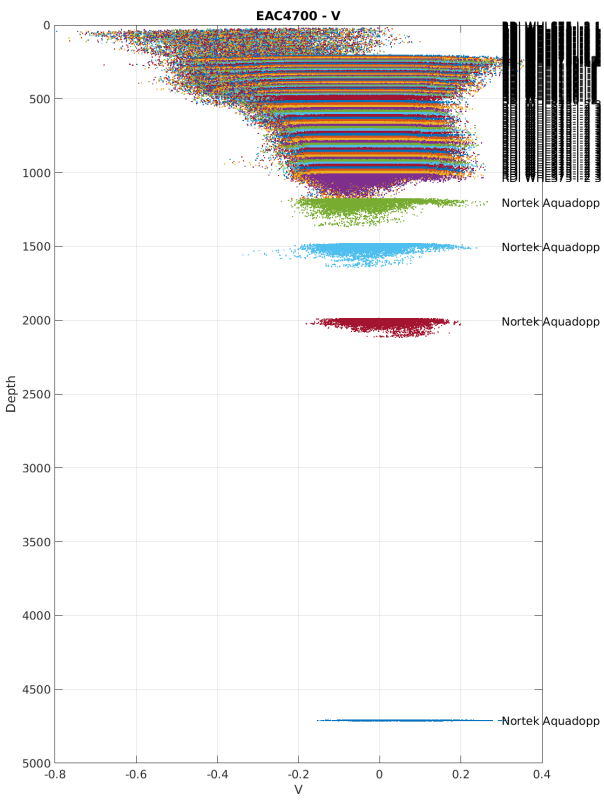

EAC3200 - U
Mean Depth
U
Nortek Aquadopp DW 2MHz A6L-3637 (AQD 5943)
Nortek Aquadopp DW 2 MHz A6L-3640 (AQD 5977)
Nortek Aquadopp DW 2MHz A6L-4869 (AQD 9496)
Nortek Aquadopp DW 2MHz A6L-1435 (AQD 1401)

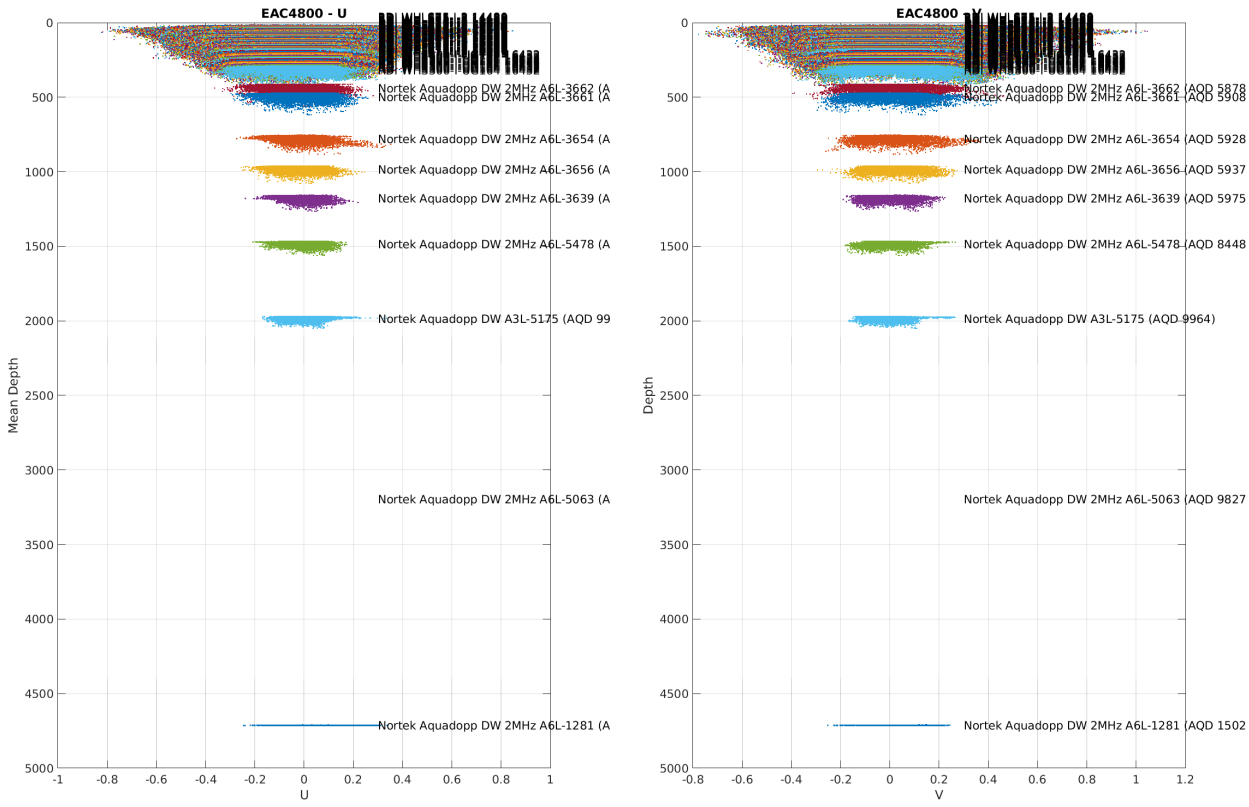

EAC3200 - V
Depth
V
Nortek Aquadopp DW 2MHz A6
Nortek Aquadopp DW 2 MHz A
Nortek Aquadopp DW 2MHz A6
Nortek Aquadopp DW 2MHz A6


Nortek Aquadopp DW 2 MHz A6L-3657 (AQD 5950)
Nortek Aquadopp DW 2MHz A6L-4218 (AQD 6718)
Nortek Aquadopp DW A3L-5199 (AQD 9848)
Nortek Aquadopp DW 2MHz A6L-4865 (AQD 9841)
Nortek Aquadopp DW 2MHz A6L-1277 (AQD 1414)
Mean Depth
U


EAC4200 - V
Depth
V


EAC4700 - U
Mean Depth
U


EAC4700 - V
Depth
V



5.5 Salinity and temperature CTD rosette calibrations

5.5.1 ROSETTE CALIBRATION FOR SALINITY AND TEMPERATURE

Prior to deployment and after retrieval and data download, the Star Oddi, Seabird 37 and 39 instruments were set to collect data every 30 seconds, attached to the CTD rosette and a calibration dip was conducted. At selected depths, the rosette was held at the location for 10 minutes to allow all the instruments to collect data at the same temperature and salinity and enable comparison of the data to the rosette Seabird 911 instrument.
Data from the time period of each 10 minute stop was collected together, placed onto the same time base and an average of the differences (instrument – SBE 911) at each stop calculated. The results are presented in Table 15. Instruments with large offsets are highlighted and were identified in the QC process as having bad salinities and these data are flagged appropriately.

Table 15. Salinity, pressure and temperature offsets (instrument – rosette CTD) from SBE 911 rosette calibration for Seabird 37. Highlighted cells indicate large offsets.

Serial Number	Pre-Deployment (D) or Post-Recovery (R)	CTD number	Salinity				Temperature				Pressure			
			Deep	Mid depth	Mixed Layer	Surface	Deep	Mid depth	Mixed Layer	Surface	Deep	Mid depth	Mixed Layer	Surface
9166	D	5	-0.001		-0.001	-0.001	0.002		0.009	0.000	1.123		-0.44	-0.69
	R	20	0.015		0.016	0.017	0.001		0.010	-0.001	0.779		-0.71	-1.38
9171	D	4	0.000		0.000	-0.004	0.000		0.007	0.087	-2.562		-1.76	-0.63
	Instrument lost													
9173	D	3	-0.001		-0.001	0.004	0.001		0.003	0.034	-3.158		-2.29	-1.08
	R	11	0.044	0.044	0.044	0.049	-0.001	0.000	0.000	-0.002	-3.290	-4.41	-2.01	-1.11
9174	D	3	-0.004		-0.004	0.003	0.001		0.004	0.039	-2.626		-2.02	-1.14
	R	10	0.051		0.048	0.058	0.000		-0.006	0.000	-2.482		-0.98	-1.07
9175	D	7	-0.008		-0.008	-0.005	0.002		-0.002	0.004	-1.470		-2.15	-1.33
	R	22	0.027		0.027	0.033	0.000		0.010	0.000	-1.564		-2.36	-1.17
9176	D	6	-0.005		-0.003	0.000	0.002		0.014	0.031	-2.123		-2.62	-0.82
	Not logging during cal dip													
9182	D	5	-0.001		-0.001	0.002	0.002		0.008	0.000	-2.818		-2.48	-0.91
	R	20	-0.003		-0.003	-0.001	0.001		0.011	0.000	-4.545		-2.99	-1.41
9183	D	4	0.003		0.003	0.001	0.001		0.008	0.089	-2.502		-2.01	-1.02
	Instrument lost													
9184	D	7	0.005		0.004	0.005	0.003		-0.001	0.004	-2.068		-2.26	-0.78
	R	22	0.019		0.019	0.022	0.001		0.009	0.000	-2.496		-2.58	-0.94
9185	D	6	0.002		0.003	0.002	0.003		0.016	0.029	-2.444		-2.55	-1.02
	R	22	0.035		0.034	0.037	0.001		0.009	0.000	-2.973		-2.71	-1.03
9186	D	5	0.003		0.002	-0.003	0.002		0.011	-0.003	-2.921		-2.35	-0.90

Serial Number	Pre-Deployment (D) or Post-Recovery (R)	CTD number	Salinity				Temperature				Pressure			
			Deep	Mid depth	Mixed Layer	Surface	Deep	Mid depth	Mixed Layer	Surface	Deep	Mid depth	Mixed Layer	Surface
	R	20	0.011		0.010	0.011	0.001		0.010	-0.001	-5.099		-3.08	-1.63
9187	D	3	0.002		0.002	0.007	0.001		0.004	0.051	0.576		-1.29	-1.26
	R	10	0.001		-0.002	0.004	0.000		-0.005	0.001	0.673		0.04	-0.51
9188	D	5	0.005		0.005	0.006	0.001		0.011	0.002	-0.399		-0.45	-0.79
	R	20	0.042		0.043	0.045	0.002		0.013	0.001	-0.383		-0.58	-1.31
9190	D	4	0.001		0.002	-0.004	0.003		0.008	0.088	1.063		-0.31	-0.37
	R	16	0.000		0.000	0.002	0.002		0.003	0.004	1.577		0.43	-0.19
9191	D	4	0.002		0.003	-0.006	0.000		0.005	0.081	0.035		-1.32	-1.42
	R	16	0.002		0.003	0.002	-0.001		0.001	0.004	0.838		-0.35	-0.55
9193	D	4	0.006		0.006	-0.006	0.000		0.002	0.086	-0.463		-0.40	-0.08
	Instrument lost													
9333	D	2	0.005			0.138	0.001			1.363	-0.879			-1.00
	R	21	0.030			0.027	0.018			-0.001	-1.095			-1.08
9334	D	2	-11.128			7.676	-0.002			1.361	-0.750			-1171.63
	Not deployed, replaced with 9333													
9335	D	2	0.004			0.136	0.001			1.362	-0.668			-1.00
	R	21	0.039			0.038	0.015			-0.002	-0.926			-1.07
9337	D	2	0.004			0.138	0.002			1.364	-0.993			-1.00
	Instrument lost													
9340	D	2	0.005			0.139	0.000			1.365	-1.045			-1.00
	R	21	0.037			0.036	0.015			-0.002	-1.208			-1.24
9341	D	2	0.005			0.138	0.002			1.362	-0.999			-1.00
	Instrument broke off, not included in recovery calibration dip													
9882	D	3	-0.005		-0.002	0.012	0.001		0.004	0.060	-2.165		-1.92	-1.34

Serial Number	Pre-Deployment (D) or Post-Recovery (R)	CTD number	Salinity				Temperature				Pressure			
			Deep	Mid depth	Mixed Layer	Surface	Deep	Mid depth	Mixed Layer	Surface	Deep	Mid depth	Mixed Layer	Surface
	R	11	0.039	0.038	0.039	0.052	0.000	0.000	0.001	-0.001	-2.240	-3.62	-1.62	-1.27
9889	D	3	0.002		0.002	0.004	0.000		0.003	0.034	-3.446		-1.91	-0.82
	R	10	0.020		0.016	0.020	-0.001		-0.005	0.001	-3.098		-0.86	-0.81
9895	D	6	0.002		0.003	0.002	0.000		0.012	0.022	-1.906		-2.57	-1.50
	R	22	0.016		0.016	0.016	-0.003		0.007	-0.003	-2.338		-2.79	-1.30
9897	D	5	0.003		0.004	0.001	0.002		0.010	-0.001	-2.377		-2.18	-0.94
	R	20	0.008		0.009	0.009	0.001		0.011	-0.001	-3.964		-2.70	-1.50
9898	D	4	0.002		0.002	-0.001	0.001		0.007	0.091	-3.294		-2.01	-0.72
	R	16	0.021		0.021	0.024	0.000		0.002	0.004	-2.579		-1.72	-0.82
9899	D	7	0.001		0.002	0.003	0.003		-0.001	0.003	-2.410		-2.61	-0.92
	R	22	0.007		0.007	0.009	0.001		0.010	0.000	-2.389		-2.76	-0.86
9900	D	6	0.001		0.003	0.002	0.002		0.015	0.025	-2.017		-2.53	-1.43
	R	22	0.006		0.007	0.007	0.000		0.010	0.000	-2.238		-2.57	-1.07
9905	D	5	0.002		0.002	0.000	0.002		0.010	-0.001	-2.880		-2.24	-0.86
	R	20	0.003		0.003	0.003	0.001		0.011	-0.002	-5.066		-2.97	-1.54
9907	D	4	0.003		0.004	0.000	0.001		0.005	0.086	-3.033		-2.13	-0.99
	R	16	0.017		0.017	0.019	0.000		0.002	0.003	-2.336		-1.91	-1.07
9908	D	3	0.002		0.001	0.007	0.001		0.005	0.052	-3.732		-2.32	-1.17
	R	11	0.015	0.014	0.013	0.015	-0.001	0.000	0.000	-0.002	-3.949	-4.74	-1.87	-1.08
9909	D	3	-34.706		-34.459	-35.542	-0.006		-0.002	0.034	-2.183		-2.02	-1.14
	Not deployed, replaced with 23200													
9911	D	7	0.006		0.006	0.007	0.002		-0.001	0.004	-2.275		-2.32	-0.96
	R	22	0.005		0.005	0.006	0.000		0.009	0.000	-2.357		-2.44	-0.88
11401	D	6	0.002		0.003	0.004	0.005		0.012	0.022	-1.357		-2.14	-0.88

Serial Number	Pre-Deployment (D) or Post-Recovery (R)	CTD number	Salinity				Temperature				Pressure			
			Deep	Mid depth	Mixed Layer	Surface	Deep	Mid depth	Mixed Layer	Surface	Deep	Mid depth	Mixed Layer	Surface
	R	22	-0.009		-0.010	-0.016	0.001		0.012	-0.001	-1.352		-2.20	-0.97
11402	D	5	0.002		0.002	0.004	0.002		0.009	-0.001	-1.745		-2.01	-1.25
	R	20	0.024		0.026	0.034	0.001		0.009	-0.001	-3.365		-2.50	-1.71
11405	D	6	-0.003		-0.002	0.001	0.000		0.012	0.030	-2.145		-2.24	-0.68
	R	22	-0.003		-0.003	0.001	-0.002		0.008	-0.001	-2.533		-2.30	-0.70
13078	D	3	0.001		0.001	0.005	0.001		0.003	0.051	0.217		-0.78	-0.02
	R	11	-0.008	-0.008	-0.007	-0.006	0.000	0.000	0.001	0.000	3.553	0.91	0.81	0.43
13080	D	5	-0.010		-0.010	-0.009	0.002		0.009	-0.004	-0.682		-0.89	-0.21
	R	20	0.001		0.003	0.006	0.002		0.010	0.000	-0.157		-0.92	-0.95
13081	D	3	0.003		0.003	0.008	0.000		0.003	0.050	0.962		-1.09	-0.98
	R	10	0.001		-0.002	0.004	-0.001		-0.006	0.000	1.570		0.80	0.00
13082	D	3	0.000		0.003	0.010	0.000		0.003	0.059	7.390		1.31	0.07
	R	10	0.002		0.002	0.008	-0.001		-0.006	0.002	6.713		2.91	0.10
13083	D	5	0.000		0.001	0.003	0.003		0.011	0.001	-1.027		-1.60	-1.40
	Instrument lost													
13084	D	4	-0.005		-0.003	-0.006	0.001		0.005	0.069	0.389		-0.47	0.47
	R	11	-0.006	-0.005	-0.004	-0.002	0.000	0.000	0.001	0.000	3.467	0.75	0.66	0.03
13087	D	3	0.001		0.000	0.005	0.001		0.004	0.046	-3.095		-1.78	-0.15
	R	10	0.002		-0.001	0.007	0.000		-0.005	0.002	-2.109		0.23	0.60
13263	D	6	-0.002		0.000	0.001	0.004		0.012	0.020	-0.420		-1.40	-0.73
	R	21	0.049			0.046	0.020			-0.002	-2.142			-0.72
13265	D	6	0.000		0.001	0.000	0.003		0.014	0.029	-1.522		-1.44	0.52
	R	20	-0.005		-0.004	-0.004	0.002		0.012	-0.001	-0.797		-0.72	-0.06
13266	D	6	-0.001		0.002	0.004	0.004		0.013	0.024	-0.601		-1.71	-1.20

Serial Number	Pre-Deployment (D) or Post-Recovery (R)	CTD number	Salinity				Temperature				Pressure			
			Deep	Mid depth	Mixed Layer	Surface	Deep	Mid depth	Mixed Layer	Surface	Deep	Mid depth	Mixed Layer	Surface
	R	20	-0.001		0.000	0.004	0.002		0.010	-0.002	-0.597		-1.39	-1.29
13267	D	5	0.000		0.001	0.002	0.002		0.012	0.001	-0.466		-1.07	-1.08
	R	16	0.013		0.014	0.014	0.000		0.002	0.004	1.586		-0.21	-0.73
13268	D	4	0.000		0.001	-0.002	0.001		0.006	0.070	0.432		-1.19	-0.69
	R	11	-0.008	-0.007	-0.006	-0.004	-0.001	-0.001	-0.001	-0.001	4.034	1.10	0.29	-0.42
14035	D	5	0.002		0.001	-0.002	0.002		0.010	0.000	-4.916		-2.90	-1.31
	Instrument lost													
15021	D	4	0.001		0.001	-0.002	0.000		0.004	0.071	-2.523		-2.03	-1.25
	R	11	0.008	0.007	0.008	0.011	-0.001	-0.001	-0.001	-0.001	-0.741	-2.91	-1.42	-1.53
15022	D	6	0.005		0.004	0.002	0.001		0.015	0.027	-11.376		-10.21	-8.64
	R	22	0.036		0.038	0.040	-0.001		0.009	0.000	-43.146		-42.87	-42.66
15105	D	7	0.009		0.009	0.006	0.004		-0.004	0.002	-2.057		-2.07	-0.97
	R	21	Data not recovered correctly from the instrument after calibration dip. No results.											
15121	D	5	0.000		0.001	0.002	0.003		0.009	-0.011	-2.177		-2.15	-1.22
	Instrument lost													
15131	D	6	0.002		0.003	-0.001	0.002		0.014	0.029	-1.852		-2.20	-0.85
	R	20	0.015		0.015	0.015	0.000		0.009	-0.002	-3.533		-2.38	-1.47
15132	D	6	0.003		0.004	0.002	0.002		0.016	0.027	-1.589		-2.04	-0.84
	R	21	0.056			0.057	0.017			-0.004	-1.468			-1.10
15133	D	4	-0.086		-0.081	-0.088	0.000		0.005	0.087	-2.707		-2.26	-1.16
	R	16	0.102		0.104	0.121	-0.001		0.001	0.003	-1.811		-1.80	-0.96
15134	D	4	0.000		0.001	-0.006	0.001		0.006	0.088	-2.126		-1.91	-1.01
	R	11	0.035	0.035	0.036	-3.378	-0.001	-0.001	-0.005	-0.001	-1.399	-3.17	-1.68	-1.28
15883	D	3	0.007		0.006	0.013	0.001		0.003	0.038	-1.988		-2.18	-1.31

Serial Number	Pre-Deployment (D) or Post-Recovery (R)	CTD number	Salinity				Temperature				Pressure			
			Deep	Mid depth	Mixed Layer	Surface	Deep	Mid depth	Mixed Layer	Surface	Deep	Mid depth	Mixed Layer	Surface
	R	10	-0.002		-0.009	0.003	0.000		-0.008	0.001	-1.819		-1.17	-1.20
15884	D	7	0.005		0.004	0.000	0.004		-0.003	0.002	-2.377		-2.24	-0.97
	R	21	0.042			0.030	0.021			-0.002	-1.463			-1.20
20272	D	7	310		-0.001	0.000	34.7		-0.003	0.003	-2795		-1.89	-0.99
	Not deployed, replaced with 23198													
22593	D	6	0.010		0.001	-0.006	0.005		0.012	0.022	-2.078		-2.43	-0.74
	R	20	0.034		0.032	0.038	0.003		0.005	-0.003	-3.857		-2.65	-1.43
22594	D	5	0.003		0.003	0.006	0.005		0.009	-0.024	-2.457		-2.12	-0.70
	R	16	0.002		0.001	0.001	0.000		0.001	0.003	-2.428		-1.74	-0.82
22595	D	4	0.002		0.003	0.002	0.000		0.001	0.066	-3.077		-2.01	-0.68
	R	11	0.038	0.038	0.037	0.044	-0.001	-0.001	0.000	-0.001	-2.756	-4.13	-1.77	-1.05
22596	D	3	0.003		0.002	0.010	0.001		0.005	0.059	-1.926		-1.87	-1.08
	R	10	0.047		0.039	0.054	0.000		-0.006	0.001	-2.038		-1.18	-1.22
22597	D	7	0.003		0.003	0.004	0.003		-0.001	0.003	-2.431		-1.99	-0.13
	R	21	0.053			0.033	0.029			-0.001	-2.240			-0.89
22599	D	7	0.005		0.003	0.003	0.002		-0.002	0.006	-2.185		-2.04	-0.35
	R	21	0.035			0.033	0.017			-0.001	-1.950			-0.85
22645	D	7	-0.018		-0.023	-0.030	0.002		-0.005	-0.010	-2.800		-2.27	-0.36
	R	22	-0.012		-0.013	-0.012	-0.002		0.009	-0.001	-2.836		-2.44	-0.60
22646	D	7	0.003		0.000	0.002	0.003		-0.003	0.006	-2.491		-2.26	-0.56
	R	21	0.019			0.013	0.015			-0.004	-1.854			-0.90
22647	D	6	0.009		0.000	-0.009	0.005		0.009	0.017	-2.491		-2.28	-0.05
	R	20	0.030		0.031	0.034	-0.001		0.010	-0.003	-4.263		-2.65	-1.31
22648	D	5	-0.001		-0.001	-0.007	0.004		0.008	-0.017	-2.218		-1.94	-0.45

Serial Number	Pre-Deployment (D) or Post-Recovery (R)	CTD number	Salinity				Temperature				Pressure			
			Deep	Mid depth	Mixed Layer	Surface	Deep	Mid depth	Mixed Layer	Surface	Deep	Mid depth	Mixed Layer	Surface
	R	16	0.000		0.000	0.003	-0.001		0.000	0.002	-1.958		-1.52	-0.64
22649	D	4	0.003		0.003	-0.011	0.000		0.000	0.067	-3.017		-2.07	-0.85
	R	11	0.065	0.064	0.062	0.068	-0.001	-0.001	-0.001	-0.002	-2.772	-4.16	-1.91	-1.02
22650	D	3	0.001		-0.002	0.007	0.001		0.004	0.065	-2.637		-1.79	-0.63
	R	10	0.047		0.038	0.052	0.000		-0.008	0.000	-2.492		-0.73	-0.58
22652	D	7	-0.002		-0.002	0.002	0.002		-0.001	0.006	-2.144		-2.15	-0.75
	R	21	0.024			0.026	0.023			-0.001	-1.648			-0.98
23198	D	7	-0.002		-0.008	-0.008	0.005		-0.002	0.000	-2.213		-2.18	-0.82
	R	21	0.024			-4.221	0.026			0.000	-1.679			-1.01
23200	D	7	-0.003		-0.003	0.002	0.003		-0.001	0.007	-2.399		-2.48	-1.02
	R	10	0.003		-0.003	0.008	0.001		-0.006	0.000	-2.808		-1.34	-1.13
23669	R	10	0.003		-0.004	0.003	0.001		-0.007	0.001	-3.273		-1.31	-0.79
	R	11	0.003	0.003	0.002	0.004	0.000	0.000	0.001	-0.002	-3.346	-4.71	-2.08	-0.96
	R	16	0.004		0.003	0.004	0.001		0.001	0.003	-3.025		-2.10	-0.87

Table 16. Pressure and temperature offsets (instrument – rosette CTD) from SBE 911 rosette calibration for Seabird 39.

Serial Number	Pre-Deployment (D) or Post-Recovery (R)		Temperature				Pressure			
		CTD number	Deep	Mid depth	Mixed Layer	Surface	Deep	Mid depth	Mixed Layer	Surface
1331	R	10	-0.001		-0.020	-0.002	1.64		1.16	0.14
	D	3	0.000		-0.002	0.037	1.62		-0.48	-0.28
1332	R	21	0.024			0.000	-0.99			-0.80
	D	2	0.019			1.354	-1.02			-1.00
4168	R	10	Data not retrieved, upload error							
	D	3	0.000		0.001	0.040				
4169	R	11	-0.001	-0.001	-0.001	-0.002				
	D	3	0.000		0.002	0.044				
4171	R	10	-0.001		-0.016	-0.001				
	D	3	0.000		0.001	0.045				
4197	R	22	0.000		0.010	-0.002				
	D	5	0.002		0.009	-0.005				
4199	R	20	0.002		0.011	-0.006				
	D	5	0.003		0.006	-0.008				
4201	R	16	0.000		-0.001	0.002				
	D	4	0.000		0.003	0.079				
4326	R	11	-0.001	-0.001	-0.001	-0.002				
	D	3	0.000		0.002	0.045				
4500	R	10	-0.002		-0.016	-0.001				
	D	3	-0.001		0.000	0.047				
4591	R	10	-0.002		-0.014	0.002				
	D	3	0.000		0.002	0.040				

Serial Number	Pre-Deployment (D) or Post-Recovery (R)		Temperature				Pressure			
		CTD number	Deep	Mid depth	Mixed Layer	Surface	Deep	Mid depth	Mixed Layer	Surface
	R	11	-0.001	0.000	-0.001	-0.002				
4592	D	4	0.000		0.004	0.057				
	R	20	0.002		0.012	-0.005				
4594	D	5	0.003		0.009	-0.004				
	R	22	0.001		0.011	-0.001				
4596	D	5	0.004		0.007	-0.006				
	R	11	0.000	0.000	0.000	-0.003				
4613	D	4	0.001		0.005	0.054				
	R	10	-0.001		-0.014	0.003				
4675	D	3	0.000		0.003	0.043				
	R	11	0.000	0.000	0.000	-0.002				
4676	D	4	0.001		0.005	0.056				
	R	22	0.002		0.009	-0.002	-3.11		-2.61	-0.85
4777	D	5	0.004		0.006	-0.012	-2.75		-2.17	-0.85
	R	22	0.000		0.009	-0.003	-1.47		-1.98	-1.03
4779	D	5	0.002		0.006	-0.006	-1.54		-1.59	-1.03
	R	22	0.001		0.009	-0.002	-0.75		-0.20	1.43
4780	D	6	0.002		0.012	0.022	-0.31		-0.06	1.50
	R	22	-0.001		0.008	-0.003	3.69		2.10	1.66
4887	D	5	0.001		0.006	-0.008	-1.56		-2.98	-6.37
	R	20	0.001		0.010	-0.006	2.53		0.53	-1.32
4888	D	5	0.002		0.007	-0.008	0.26		-1.92	-6.39
	R	16	Data not retrieved, upload error							
4889	D	4	-0.001		0.001	0.061	2.93		1.51	0.72

Serial Number	Pre-Deployment (D) or Post-Recovery (R)		Temperature				Pressure			
		CTD number	Deep	Mid depth	Mixed Layer	Surface	Deep	Mid depth	Mixed Layer	Surface
4890	R	11	-0.001	-0.001	-0.002	-0.003	2.67	-0.55	-1.43	-3.09
	D	4	0.000		0.003	0.077	-0.74		-2.91	-4.78
6272	R	10	0.000		-0.007	-0.001	2.54		2.67	-0.82
	D	3	0.000		0.004	0.042	2.57		1.08	-1.09
6273	R	11	-0.001	0.000	-0.001	-0.006	5.44	1.73	0.53	0.13
	D	4	0.001		0.006	0.067	1.42		-0.72	-0.34
8108	R	10	0.000		-0.006	0.000	-3.02		-0.74	-0.92
	R	10	0.000		-0.020	-0.002	-2.68		-0.84	-0.91
8436	D	5	0.003		0.008	-0.003	-2.17		-1.98	-1.07
	R	22	0.001		0.010	-0.001	-1.82		-2.09	-0.85
8516	D	5	0.003		0.008	0.000	-5.28		-3.14	-0.86
	R	20	0.001		0.012	-0.004	-8.09		-3.77	-1.28
8517	D	4	0.001		0.005	0.090	-7.43		-3.35	-1.07
	R	16	0.000		0.001	0.002	-6.75		-3.25	-1.04
8518	D	4	0.001		0.006	0.066	-6.83		-3.13	-0.98
	R	11	0.000	0.000	0.001	0.000	-8.45	-7.96	-3.11	-0.83
8519	D	3	0.001		0.005	0.042	-7.76		-3.36	-1.06
	R	10	0.000		-0.006	0.000	-7.02		-2.08	-0.76
8520	D	5	0.004		0.011	0.001	-2.31		-1.88	-1.23
	R	22	0.002		0.012	0.000	-2.30		-2.08	-1.09
8522	D	5	0.003		0.009	0.000	-2.93		-2.03	-1.04
	R	20	0.002		0.013	-0.002	-5.11		-2.78	-1.58
8690	D	4	0.000		0.003	0.051	0.95		-2.01	-2.39
	R	16	0.001		-0.001	0.003	1.52		-1.13	-1.87

Serial Number	Pre-Deployment (D) or Post-Recovery (R)		Temperature				Pressure			
		CTD number	Deep	Mid depth	Mixed Layer	Surface	Deep	Mid depth	Mixed Layer	Surface
9133	D	4	0.001		0.007	0.068	-1.78		-1.52	-0.70
	R	16	0.000		0.001	0.003	-1.11		-0.91	-0.70
9134	D	4	0.001		0.007	0.071	-2.02		-1.72	-0.79
	R	11	0.000	0.000	0.001	-0.001	-0.72	-2.67	-1.05	-0.11

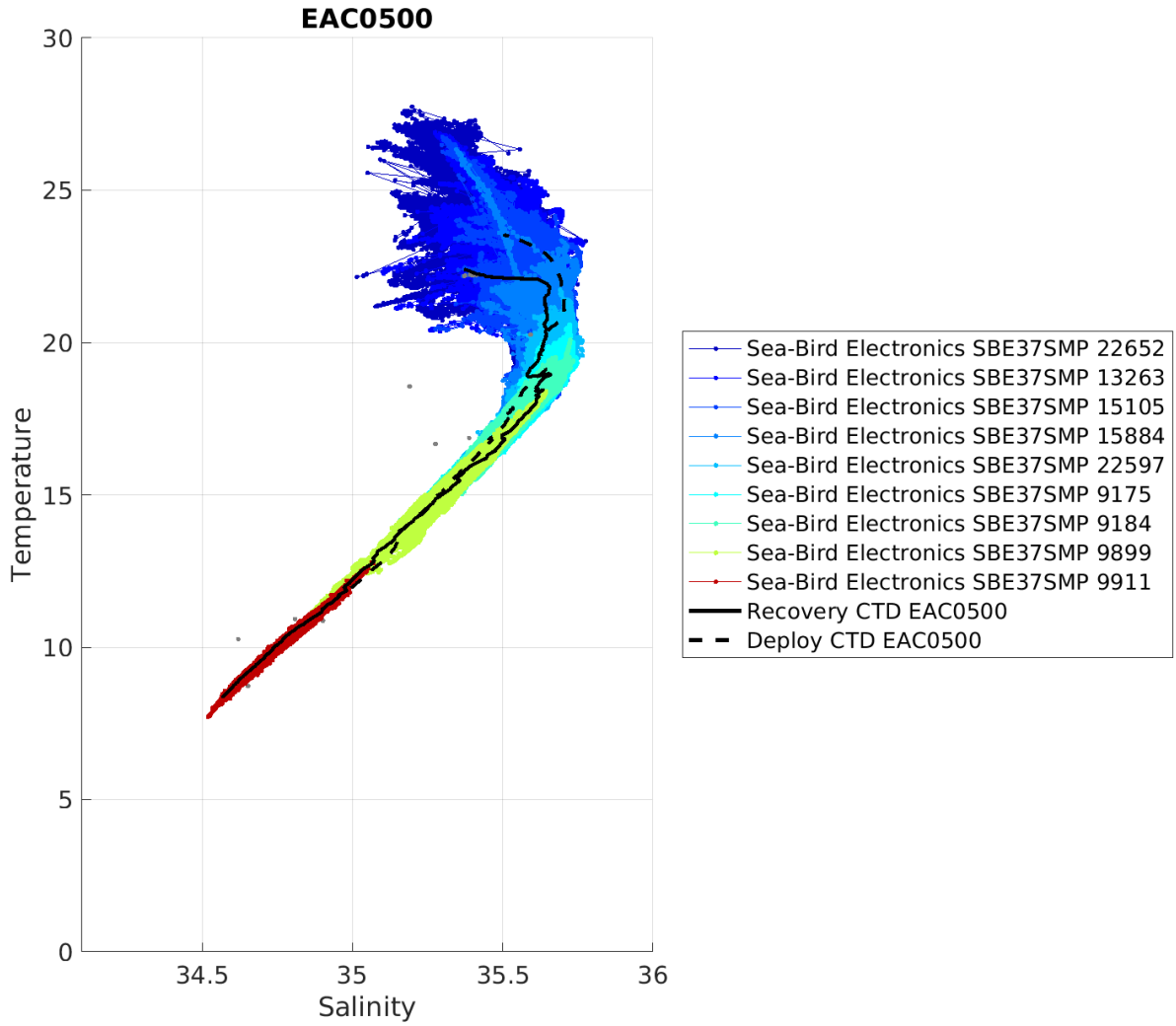
Table 17. Temperature offsets (instrument – rosette CTD) from SBE 911 rosette calibration for Star Oddi.

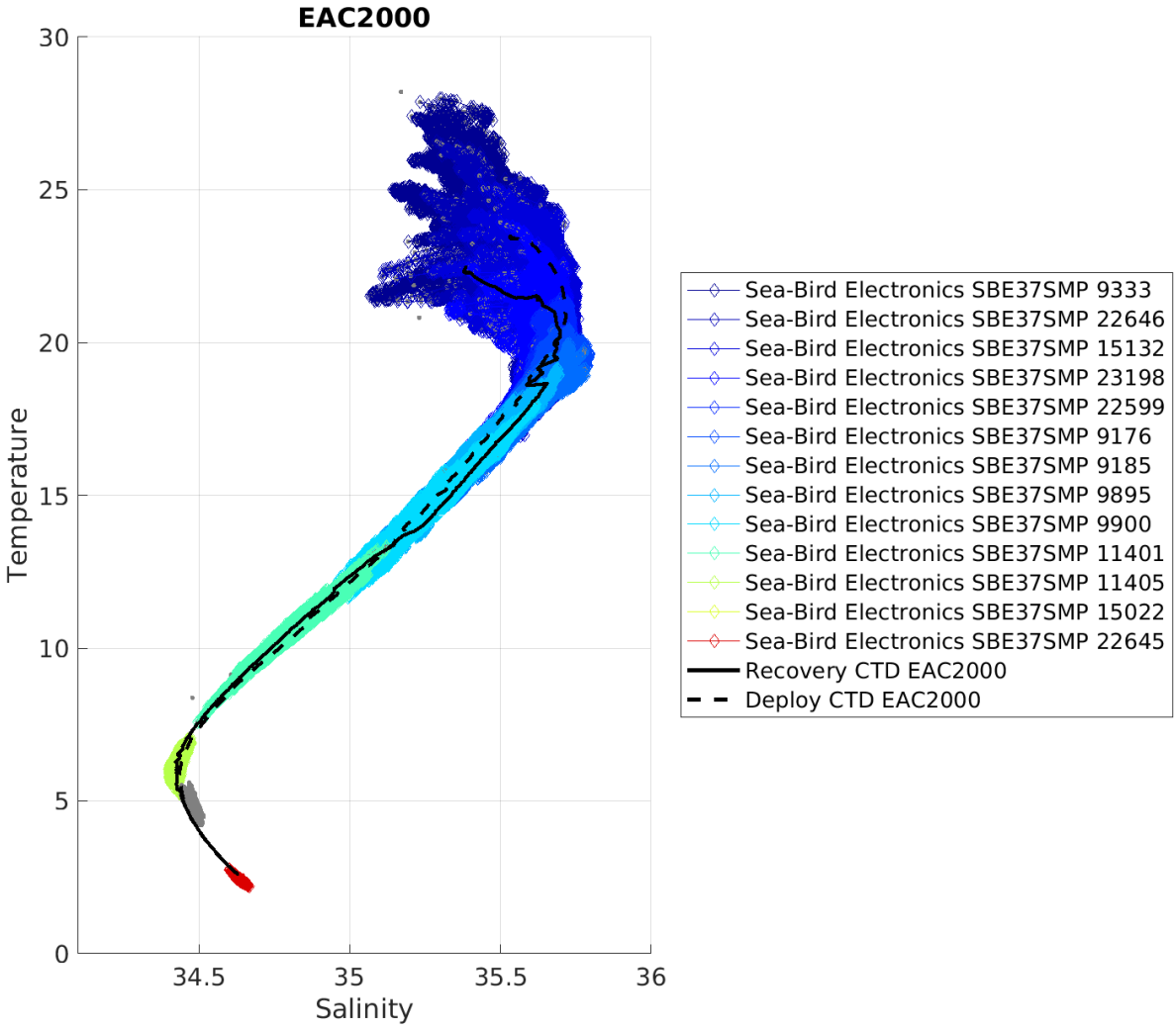
Serial Number	Pre-Deployment (D) or Post-Recovery (R)	CTD number	Temperature		
			Deep	Mixed Layer	Surface
4030	D	4	-0.007	-0.009	0.002
	R	22	Flooded, no data		
4031	D	4	-0.019	-0.014	0.012
	R	22	-0.022	-0.005	-0.014
4033	D	4	0.003	0.001	0.007
	R	22	-0.002	0.008	-0.004
4034	D	4	-0.029	-0.024	-0.011
	R	22	-0.032	-0.017	-0.034
5297	D	4	0.001	-0.003	0.014
	R	22	-0.002	0.010	0.003
5314	D	4	-0.007	-0.004	0.012
	R	22	-0.002	0.001	-0.004
5318	D	4	0.001	0.004	0.018
	R	22	-0.002	0.006	-0.004
5323	D	4	-0.017	-0.009	0.012
	R	22	-0.012	0.005	-0.004

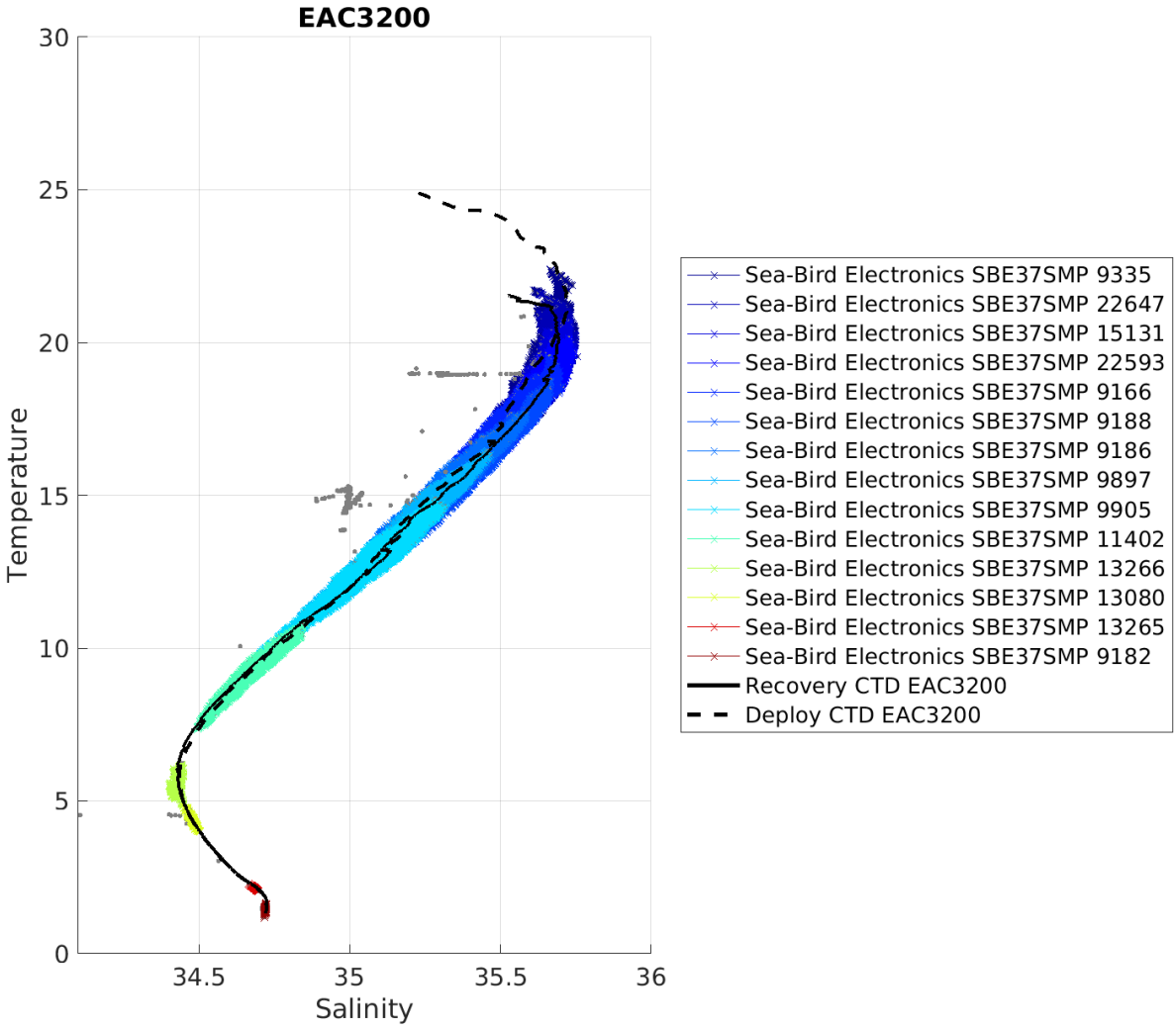
5.5.2 COMPARISON WITH DEPLOYMENT AND RECOVERY CTDS

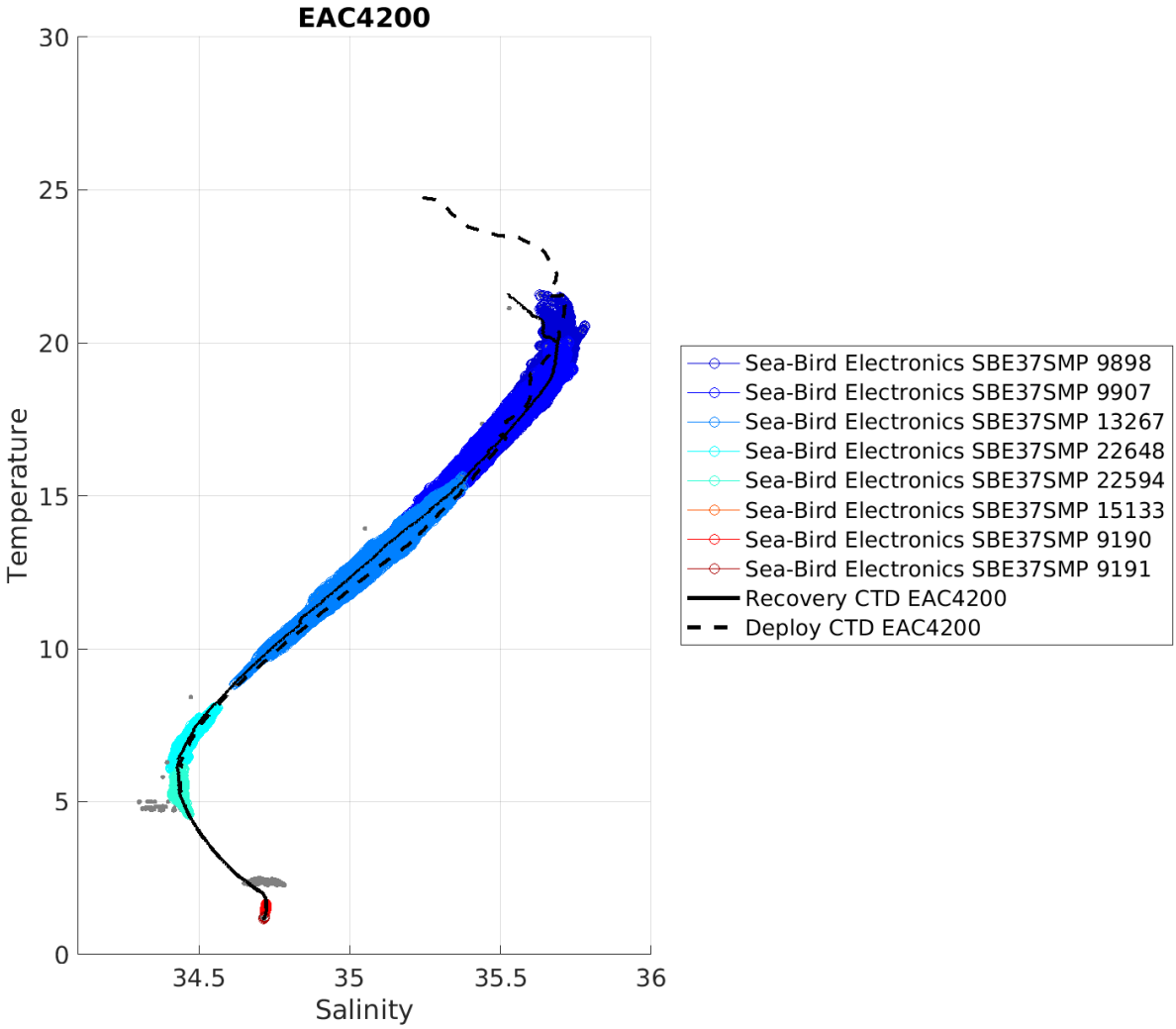
Figure 5 shows a TS plot for each mooring. The deployment and recovery CTDs are shown on the plots for comparison. Data flagged with flag 3 or 4 are shown in grey. After quality control, the TS plots compare well with the CTDs. It might be possible to retrieve some of the PSAL data where simple offsets in salinity were observed. However, the decision was made to flag all data (offset or drifting) with a flag 3 or 4.

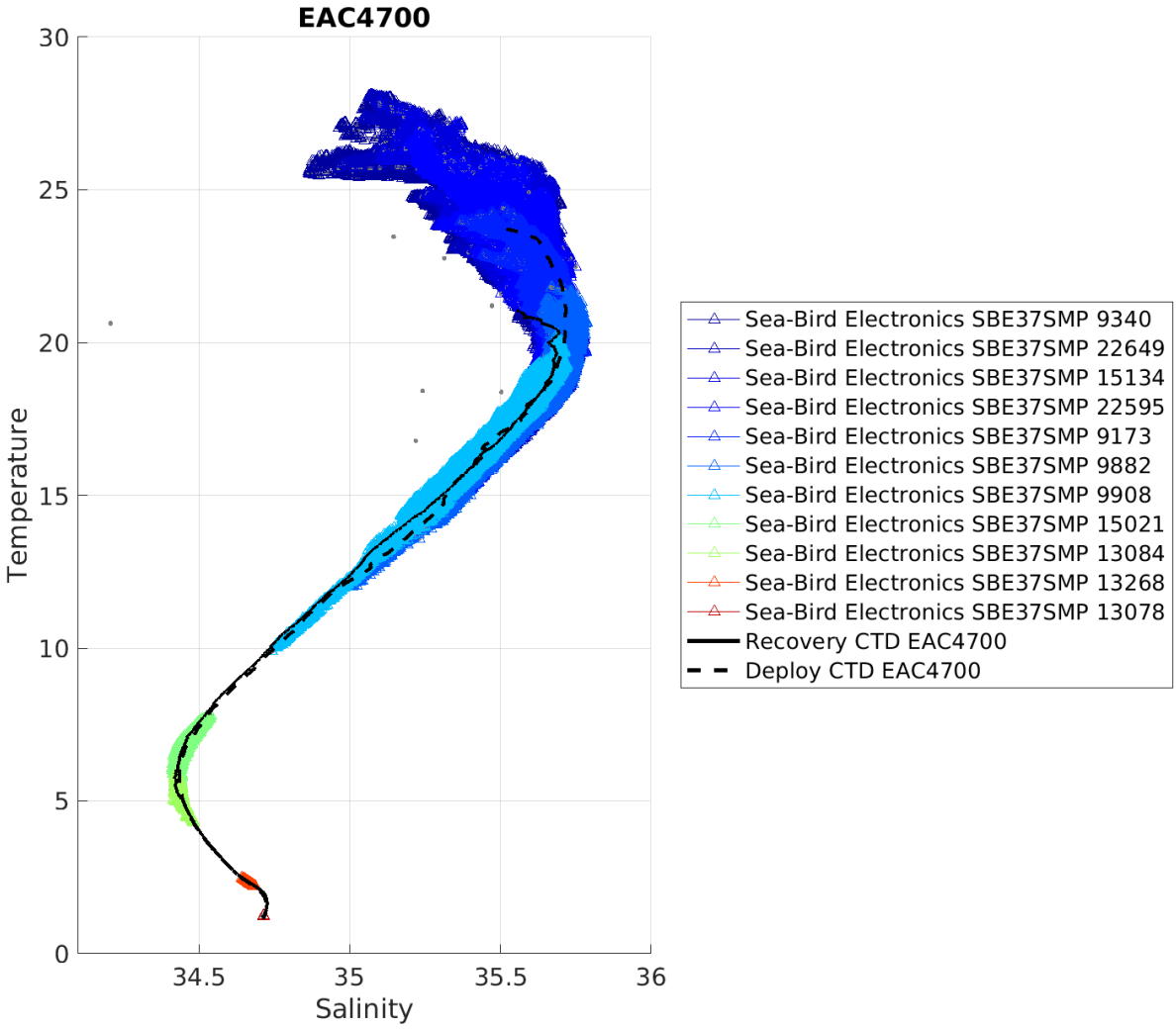
Figure 5. TS plots for each mooring with coloured datapoints indicating good data and grey indicating bad data.

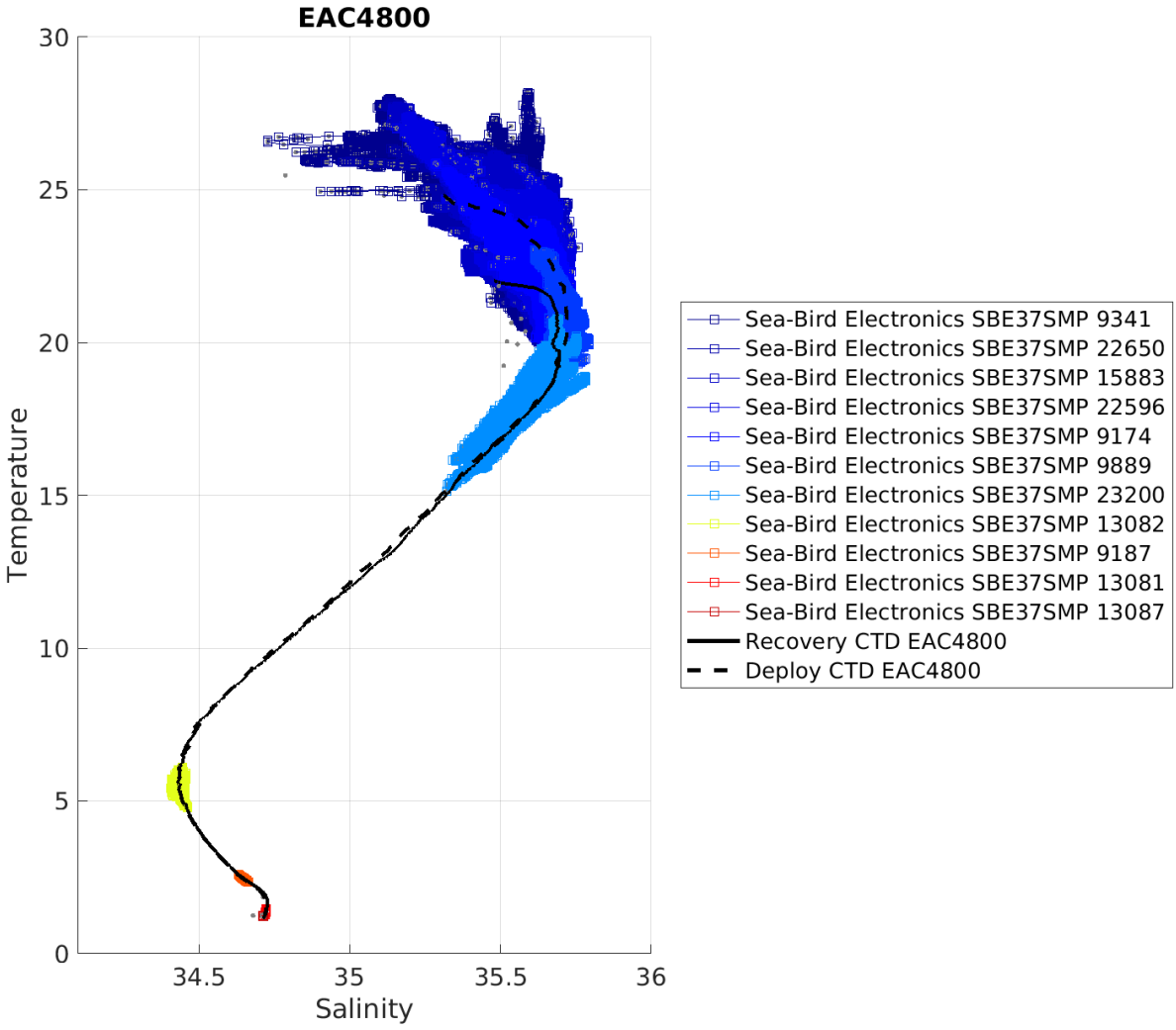



EAC2000
30
25
20
15
10
5
0
Temperature
34.5
35
35.5
36
Salinity
Sea-Bird Electronics SBE37SMP 9333
Sea-Bird Electronics SBE37SMP 22646
Sea-Bird Electronics SBE37SMP 15132
Sea-Bird Electronics SBE37SMP 23198
Sea-Bird Electronics SBE37SMP 22599
Sea-Bird Electronics SBE37SMP 9176
Sea-Bird Electronics SBE37SMP 9185
Sea-Bird Electronics SBE37SMP 9895
Sea-Bird Electronics SBE37SMP 9900
Sea-Bird Electronics SBE37SMP 11401
Sea-Bird Electronics SBE37SMP 11405
Sea-Bird Electronics SBE37SMP 15022
Sea-Bird Electronics SBE37SMP 22645
Recovery CTD EAC2000
Deploy CTD EAC2000


EAC3200
Temperature
Salinity
30
25
20
15
10
5
0
34.5
35
35.5
36
Sea-Bird Electronics SBE37SMP 9335
Sea-Bird Electronics SBE37SMP 22647
Sea-Bird Electronics SBE37SMP 15131
Sea-Bird Electronics SBE37SMP 22593
Sea-Bird Electronics SBE37SMP 9166
Sea-Bird Electronics SBE37SMP 9188
Sea-Bird Electronics SBE37SMP 9186
Sea-Bird Electronics SBE37SMP 9897
Sea-Bird Electronics SBE37SMP 9905
Sea-Bird Electronics SBE37SMP 11402
Sea-Bird Electronics SBE37SMP 13266
Sea-Bird Electronics SBE37SMP 13080
Sea-Bird Electronics SBE37SMP 13265
Sea-Bird Electronics SBE37SMP 9182
Recovery CTD EAC3200
Deploy CTD EAC3200


EAC4200
30
25
20
15
10
5
0
Temperature
34.5
35
35.5
36
Salinity
Sea-Bird Electronics SBE37SMP 9898
Sea-Bird Electronics SBE37SMP 9907
Sea-Bird Electronics SBE37SMP 13267
Sea-Bird Electronics SBE37SMP 22648
Sea-Bird Electronics SBE37SMP 22594
Sea-Bird Electronics SBE37SMP 15133
Sea-Bird Electronics SBE37SMP 9190
Sea-Bird Electronics SBE37SMP 9191
Recovery CTD EAC4200
Deploy CTD EAC4200


EAC4700
30
25
20
15
10
5
0
Temperature
34.5
35
35.5
36
Salinity
Sea-Bird Electronics SBE37SMP 9340
Sea-Bird Electronics SBE37SMP 22649
Sea-Bird Electronics SBE37SMP 15134
Sea-Bird Electronics SBE37SMP 22595
Sea-Bird Electronics SBE37SMP 9173
Sea-Bird Electronics SBE37SMP 9882
Sea-Bird Electronics SBE37SMP 9908
Sea-Bird Electronics SBE37SMP 15021
Sea-Bird Electronics SBE37SMP 13084
Sea-Bird Electronics SBE37SMP 13268
Sea-Bird Electronics SBE37SMP 13078
Recovery CTD EAC4700
Deploy CTD EAC4700


EAC4800
30
25
20
15
10
5
0
Temperature
34.5
35
35.5
36
Salinity
Sea-Bird Electronics SBE37SMP 9341
Sea-Bird Electronics SBE37SMP 22650
Sea-Bird Electronics SBE37SMP 15883
Sea-Bird Electronics SBE37SMP 22596
Sea-Bird Electronics SBE37SMP 9174
Sea-Bird Electronics SBE37SMP 9889
Sea-Bird Electronics SBE37SMP 23200
Sea-Bird Electronics SBE37SMP 13082
Sea-Bird Electronics SBE37SMP 9187
Sea-Bird Electronics SBE37SMP 13081
Sea-Bird Electronics SBE37SMP 13087
Recovery CTD EAC4800
Deploy CTD EAC4800

6 Accessing the data

The final datasets are available via the AODN portal: https://portal.aodn.org.au/. The datasets are labelled as the IMOS Deep Water Moorings, Deepwater Arrays (DA), the IMOS facility was formerly known as "Australian Bluewater Observing System." The data are also available from the THREDDS catalog at http://thredds.aodn.org.au/thredds/catalog/IMOS/DWM/DA/catalog.html.

7 References

Cowley, R. (2022). Report on the Quality Control of the IMOS East Australian Current (EAC) Deep Water moorings array. Version 1.0. Deployed: September 2019 to May 2021. CSIRO Oceans and Atmosphere, Australia. DOI: https://doi.org/10.26198/rgns-v363

Cowley, R. (2022a). Report on the Quality Control of the IMOS East Australian Current (EAC) Deep Water moorings array. Version 1.3. Deployed: April/May 2018 to September, 2019. CSIRO Oceans and Atmosphere, Australia. DOI: 10.26198/5r16-xf23

Cowley, R. (2021) Report on the Quality Control of the IMOS East Australian Current (EAC) Deep Water moorings array. Deployed: April 2012 to August, 2013. Version 3.0. CSIRO Oceans and Atmosphere, Australia. DOI: 10.26198/N3XJ-SY16 (https://doi.org/10.26198/N3XJ-SY16)

Lovell, J & Cowley, R. (2021a). Report on the Quality Control of the IMOS East Australian Current (EAC) Deep Water moorings array. Deployed: May 2015 to November 2016. Version 3.1. CSIRO, Australia. DOI:10.26198/5d3fb95821dda (https://doi.org/10.26198/5d3fb95821dda)

Lovell, J. and Cowley, R. (2021b). Report on the Quality Control of the IMOS East Australian Current (EAC) Deep Water moorings array. Version 1.2. Deployed: November 2016 to May, 2018. CSIRO Oceans and Atmosphere, Australia. DOI: 10.26198/5ec1df4b25cca (https://doi.org/10.26198/5ec1df4b25cca)

Teledyne RD Instruments (2010). ADCP coordinate transformation: Formulas and calculations. Teledyne RD Instruments Inc. Tech. Rep. P/N 951-6079-00 (January 2010), 32 pp.

Appendix A. Setup information for each instrument type

Nortek DW

```
============================================================
Deployment   : 1490
Current time : 5/06/2019 12:45:51 AM
Start at     : 1/09/2019
Comment:
EAC2019 Mooring 1-500 @ 460
------------------------------------------------------------
Measurement interval  (s) : 1800
Average interval      (s) : 60
Blanking distance     (m) : 0.50
Measurement load      (%) : 4
Power level               : HIGH
Diagnostics interval(min) : 720:00
Diagnostics samples       : 20
Compass upd. rate     (s) : 600
Coordinate System         : ENU
Speed of sound      (m/s) : MEASURED
Salinity            (ppt) : 35
Analog input 1            : NONE
Analog input 2            : NONE
Analog input power out    : DISABLED
Raw magnetometer out      : OFF
File wrapping             : OFF
TellTale                  : OFF
AcousticModem             : OFF
Serial output             : OFF
Baud rate                 : 9600
------------------------------------------------------------
Assumed duration   (days) : 540.0
Battery utilization   (%) : 78.0
Battery level         (V) : 14.0
Recorder size        (MB) : 33
Recorder free space  (MB) : 32.973
Memory required      (MB) : 1.9
Vertical vel. prec (cm/s) : 1.4
Horizon. vel. prec (cm/s) : 0.9
------------------------------------------------------------
Instrument ID             : AQD 1490
Head ID                   : A6L 1278
Firmware version          : 1.21
------------------------------------------------------------
Aquadopp Deep Water Version 1.40.16
Copyright (C) Nortek AS
```

RDI 75kHz

```
CQ = 255 ----------------- Xmt Power (0=Low, 255=High)>
CF = 11101 --------------- Flow Ctrl (EnsCyc;PngCyc;Binry;Ser;Rec)>
EA = +00000 -------------- Heading Alignment (1/100 deg)>
EB = +00000 -------------- Heading Bias (1/100 deg)>
ED = 00000 --------------- Transducer Depth (0 - 65535 dm)>
ES = 35 ------------------ Salinity (0-40 pp thousand)>
EX = 00111 --------------- Coord Transform (Xform:Type; Tilts; 3Bm; Map)>
EZ = 1111101 ------------- Sensor Source (C;D;H;P;R;S;T)>
```

```
WA 255,255 ------------ False Target Threshold (Max)(0-255),[Start Bin]>
WB 0 ------------------ Bandwidth Control (0=Wid,1=Nar)>
WC 000 ----------------- Correlation Threshold>
WD 111100000 ----------- Data Out (Vel;Cor;Amp  PG;St;P0  P1;P2;P3)>
WE 0000 ---------------- Error Velocity Threshold (0-5000 mm/s)>
WF 0704 ---------------- Blank After Transmit (cm)>
WN 054 ----------------- Number of depth cells (1-255)>
WP 00001 --------------- Pings per Ensemble (0-16384)>
WS 0800 ---------------- Depth Cell Size (cm)>
WV 175 ----------------- Mode 1 Ambiguity Vel (cm/s radial)>
TE 00:03:45.00 --------- Time per Ensemble (hrs:min:sec.sec/100)>
TP 03:45.00 ------------ Time per Ping (min:sec.sec/100)>
TG 2021/05/10,00:00:00 - Time of First Ping (CCYY/MM/DD,hh:mm:ss)>
TS 21/02/14,00:36:29 --- Time Set (yr/mon/day,hour:min:sec)>
```

RDI 150kHz

```
CQ = 255 ----------------- Xmt Power (0=Low, 255=High)>
CF = 11101 --------------- Flow Ctrl (EnsCyc;PngCyc;Binry;Ser;Rec)>
EA = +00000 -------------- Heading Alignment (1/100 deg)>
EB = +00000 -------------- Heading Bias (1/100 deg)>
ED = 00000 --------------- Transducer Depth (0 - 65535 dm)>
ES = 35 ------------------ Salinity (0-40 pp thousand)>
EX = 00111 --------------- Coord Transform (Xform:Type; Tilts; 3Bm; Map)>
EZ = 1111101 ------------- Sensor Source (C;D;H;P;R;S;T)>
WA 255,255 ------------ False Target Threshold (Max)(0-255),[Start Bin]>
WB 1 ------------------- Bandwidth Control (0=Wid,1=Nar)>
WC 000 ----------------- Correlation Threshold>
WD 111100000 ----------- Data Out (Vel;Cor;Amp  PG;St;P0  P1;P2;P3)>
WE 0000 ---------------- Error Velocity Threshold (0-5000 mm/s)>
WF 0352 ---------------- Blank After Transmit (cm)>
WN 038 ----------------- Number of depth cells (1-255)>
WP 00001 --------------- Pings per Ensemble (0-16384)>
WS 0800 ---------------- Depth Cell Size (cm)>
WV 175 ----------------- Mode 1 Ambiguity Vel (cm/s radial)>
TE 00:01:12.00 --------- Time per Ensemble (hrs:min:sec.sec/100)>
TP 01:12.00 ------------ Time per Ping (min:sec.sec/100)>
TG 2021/05/10,00:00:00 - Time of First Ping (CCYY/MM/DD,hh:mm:ss)>
TS 21/02/14,06:53:20 --- Time Set (yr/mon/day,hour:min:sec)>
```

RDI 300kHz

```
CQ = 255 ----------------- Xmt Power (0=Low, 255=High)>
CF = 11101 --------------- Flow Ctrl (EnsCyc;PngCyc;Binry;Ser;Rec)>
EA = +00000 -------------- Heading Alignment (1/100 deg)>
EB = +00000 -------------- Heading Bias (1/100 deg)>
ED = 00000 --------------- Transducer Depth (0 - 65535 dm)>
ES = 35 ------------------ Salinity (0-40 pp thousand)>
EX = 00111 --------------- Coord Transform (Xform:Type; Tilts; 3Bm; Map)>
EZ = 1111101 ------------- Sensor Source (C;D;H;P;R;S;T)>
WA 255,255 ------------ False Target Threshold (Max)(0-255),[Start Bin]>
WB 0 ------------------- Bandwidth Control (0=Wid,1=Nar)>
WC 000 ----------------- Correlation Threshold>
WD 111100000 ----------- Data Out (Vel;Cor;Amp  PG;St;P0  P1;P2;P3)>
WE 0000 ---------------- Error Velocity Threshold (0-5000 mm/s)>
WF 0176 ---------------- Blank After Transmit (cm)>
WN 030 ----------------- Number of depth cells (1-255)>
WP 00001 --------------- Pings per Ensemble (0-16384)>
WS 0400 ---------------- Depth Cell Size (cm)>
WV 175 ----------------- Mode 1 Ambiguity Vel (cm/s radial)>
TE 00:01:12.00 --------- Time per Ensemble (hrs:min:sec.sec/100)>
TP 01:12.00 ------------ Time per Ping (min:sec.sec/100)>
TG 2021/05/10,00:00:00 - Time of First Ping (CCYY/MM/DD,hh:mm:ss)>
TS 21/02/14,06:53:20 --- Time Set (yr/mon/day,hour:min:sec)>
```

Star Oddi

```
Filename: C:\SeaStar\Starmon mini\T3864\T3864.RDT
SeaStar 7.91
-----------------------------------------------
Recorder type               : Starmon mini
Recorder number             : T3864
Recorder version            : 17  CRC8/19200
Recorder measures           : Temperature
Recorder memory(byte/meas.) : 524063 / 349375
Measurement sequence number : 7
Recorder started from PC    : 6/06/2019 02:58:06 AM
-----------------------------------------------

Measurement interval def.   : Single interval = 00:05:00


Measurement start time     : 1/09/2019 12:00:00 AM
-----------------------------------------------

Measurement settings:  [dd:hh:mm:ss] x number

-----------------------------------------------
Start delay          :  86:21:01:54
1. interval period   :     00:05:00  x  65520
2. interval period   :     00:05:00  x  65520

Estimated time duration and battery usage for NMS
-------------------------------------------------

Battery energy at start (%):  67.5
-------------------------------------------------

Cycle 1                                                        Meas.taken
Seq/Inr      Date&Time      Batt.used(%)  Mem.used(%)        Temp
 1/1   15/04/2020 12:00:00 PM       2          18           65521
 2/2   29/11/2020 12:00:00 AM       5          37          131041

Cycle 2                                                        Meas.taken
Seq/Inr      Date&Time      Batt.used(%)  Mem.used(%)        Temp
 1/1   14/07/2021 12:00:00 PM       7          56          196561
 2/2   27/02/2022 12:00:00 AM      10          75          262081

Cycle 3                                                        Meas.taken
Seq/Inr      Date&Time      Batt.used(%)  Mem.used(%)        Temp
 1/1   12/10/2022 12:00:00 PM      12          93          327601

Memory full                : 27/12/2022 02:30:00 AM
    After (days:hours)     : 1213:2
    In Cycle               : 3
    In sequence            : 2
    In Interval            : 1
    In measurement         : 21774
    Total meas. taken      : 349375
    Battery used (%)       :  13.7
    Battery left (%)       :  53.9
```

Seabird 37

```
SBE37SM-RS232 4.0  SERIAL NO. 9336  09 Aug 2019 04:04:26
vMain = 13.03, vLith =  2.92
samplenumber = 0, free = 559240
not logging, waiting to start at 01 Sep 2019 00:00:00
```

```
sample interval = 600 seconds
data format = raw Decimal
transmit real-time = no
sync mode = no
pump installed = yes, minimum conductivity frequency = 3110.3
```

Seabird 39

```
SBE 39 V 3.1b   SERIAL NO. 6281    06 Jun 2019  23:47:42
battery voltage = 9.0
not logging: waiting to start at  01 Sep 2019  00:00:00
sample interval = 300 seconds
samplenumber = 0, free = 3655452
serial sync mode disabled
real-time output disabled
SBE 39 configuration = temperature and pressure
binary upload does not include time
temperature = 24.25 deg C
```

Seabird 39 Plus

```
SBE39plus v4.3.0  SERIAL NO. 03908077  25 Jun 2019 05:24:24
battery voltage = 6.95, back-up voltage = 3.21
not logging: waiting to start at 01 Sep 2019 00:00:00
sample interval = 300 seconds
samplenumber = 0, free = 5592405
serial sync mode disabled
real-time output disabled
configuration = temperature and pressure
data format = converted engineering
output temperature, Celsius
output pressure, Decibar
output sample number
temperature = 20.78 deg C
```

Appendix B. Description of RDI ADCP (Teledyne) single ping data processing.

The collection of single ping ADCP data in beam-coordinates allows the data to be used in many ways. Most users want the most robust, lowest uncertainty data, which is achieved by ensemble averaging and then transformation to ENU coordinates. The single-ping data from all instruments on this deployment were processed following standard RDI procedures for on-board processing (Teledyne RD Instruments, 2010):

1. **Adjustment for incorrect sound speed.** Can be performed out of sequence. We assume correct sound speed is calculated with the on board temperature sensor.
2. **Depth cell mapping** of velocity on each ping (last bit of EX command in on-board processing).
    a. Depth cell mapping in the RDI process is done by choosing the range cell in each beam calculated to lie closest to the nominal position of the depth cell (no interpolation is done). Following Ott, 1992, the IMOS toolbox bin mapping algorithm uses linear interpolation for this step.
    b. We also cell map the echo intensity and correlation magnitude values.
3. **Screening** of the single ping velocity data to identify bad cells and eliminate these from ensemble averaging. *Screening step of single ping data not used for this deployment.*
    a. Correlation magnitude (BC/WC command in on-board processing).
    b. Fish rejection (WA command in on-board processing).
4. **Transformation** of beam radial velocities to orthogonal (instrument) components, including the use of three beam solutions. If exactly one beam has been marked bad in the screening step due to low correlation or fish detection (step 3) then a three-beam solution is calculated. Error velocity is calculated during this step, but cannot be calculated in for 3-beam solutions.
5. **Rotation** of velocity to Earth coordinates.
6. **Ensemble Averaging.**
7. **Screening** of ensemble averaged velocity data to flag out-of water and poor quality data points:
    a. In/out water test
    b. Surface detection tests using:
        i. Echo intensity
        ii. Side-lobe detection
    c. Error velocity
    d. Correlation magnitude (optional if screening in step 3 is effective)
    e. Horizontal velocity
    f. Vertical velocity
    g. Tilt
    h. Percent good (not used as percent good is not calculated by the IMOS toolbox from single-ping data).

The RDI ADCP threshold quality control tests used in steps 3 and 7, above are completed using the IMOS toolbox. Step 3 screening is completed as a pre-processing function and step 7 tests are autoQC functions. The descriptions below give an overview of some of the tests.

Error Velocity test: Error velocity is a measure of the disagreement in velocity measurements in opposite beams. Error velocity is derived from two independent beams and is therefore two

independent measurements of vertical velocity. If error velocity is greater than the threshold, the test is failed.

Fail if mean abs(error velocity) > threshold

If one beam fails for some reason, and a 3-beam solution is calculated, no error velocity value is calculated. Therefore, data points where error velocity values are missing and a 3-beam solution was calculated are not failed, but given flag 2 (probably good). Typical thresholds for error velocity are around 0.15 to 0.2 cm/s.

Correlation Magnitude test: The correlation magnitude is a measure of the pulse-to-pulse correlation in a ping for each cell. Low correlation magnitude values are an indicator of low data accuracy.

Step 1: Fail if correlation magnitude <= threshold

Step 2: Fail if 3 or more beams fail step 1

For Longranger 75kHz, the typical threshold is 64, Sentinal 300kHz and 150kHz, 110.

Vertical Velocity test: A global range test to look for large outliers in velocities. Usually the threshold for this test is set to larger than the maximum during deployment.

Fail if abs(vertical velocity) >= threshold

Horizontal Velocity test: A global range test to look for large outliers in velocities. Usually the threshold for this test is set to larger than the maximum during deployment.

Fail if abs(horizontal velocity) >= threshold

Surface detection test: A mix of Echo Amplitude and sidelobe tests, described below.

1. **Echo amplitude test:** The echo amplitude values can be used to detect the surface or bottom. Values in bins beyond the failure point are also failed. The test is based on the differences in echo amplitude between consecutive bins, and is usually only applied to the centre bin to the furthest bin from the ADCP head. In some cases, where the instrument is set closer to the surface/bottom, the starting bin requires adjustment.

   Fail all bins > bin_n if (bin_{n+1} – bin_n) >= threshold

   The threshold for this test is typically 30 counts. The echo amplitude test should be used in conjunction with the side-lobe test to ensure all data beyond the surface or bottom is flagged.
2. **Side lobe test:** Tests for bins affected by reflections from the surface or the bottom (or any solid object).

   Surface = depth – (depth * cos(beam_angle*pi/180) – binsize)

   Fail all bins >= surface

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