CRUISE REPORT

No.51

RRS James Clark Ross Cruise JR196

NOVEMBER 28th – DECEMBER 26th 2007

ACCLAIM: Sea Level Measurements in the Drake Passage

J. P. Pugh and
M.A.M. Maqueda

2008

Proudman Oceanographic Laboratory
NATURAL ENVIRONMENT RESEARCH COUNCIL

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PROUDMAN OCEANOGRAPHIC LABORATORY

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ABSTRACT

ACCLAIM Bottom Pressure Recorders have been used for making measurements of the Antarctic Circumpolar Current (ACC) since 1988, initially in the Scotia Sea and then later across the Drake Passage between the Falkland Islands and the Antarctic peninsula. The two instruments deployed were both Bottom Pressure Recorders (BPRs).

The two instruments deployed in 2006 were not recovered this year but will be recovered in 2008. This is due to the Digi-Quartz device used in the BPR which can drift within the first year, then stabilizes, allowing a more accurate data to be recorded.

The Sea Level Recorders at Stanley, Falkland Islands, Vernadsky and Rothera Research Stations in Antarctica, were serviced.

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The authors would also like to thank the base personnel of the Ukranian Antarctic Research Station at Vernadsky for their continued help in the operation and maintenance of sea level equipment.

OVERVIEW

The remote island sea level stations provide valuable data for ACCLAIM (Antarctic Circumpolar Current Levels from Altimeter and Island Measurements) which is supplemented by Bottom Pressure Record (BPR) measurements.

The principal objective is to study variations in the flow of the Antarctic Circumpolar Current (ACC) on large time and space scales; however the ACCLAIM network is also a component of GLOSS (Global Sea Level Observing System). The BPRs have supplied sea level data that providing knowledge of tidal behaviour in this remote area.

ACCLAIM Bottom Pressure Recorders have been deployed since 1988, initially in the Scotia Sea and then later in the Drake Passage. The data is made available to the international research community through the Permanent Service for Mean Sea Level (PSMSL).

POL CRUISE OBJECTIVES

1) Service the Sea Level Recorder at Port Stanley, Falkland Islands.
2) Install a Meteosat Tide Gauge system and replace the existing Orbcomm system at Port Stanley, Falkland Islands.
3) Deploy two BPR's in the Drake Passage.
4) Service and repair the Sea Level Recorder at Vernadsky Antarctic Research Station.
5) Service the Sea Level Recorder at Rothera Antarctic Research Station.
6) Install a PORTUX base communication system to replace the existing GUMSTIX equipment again at Rothera Antarctic Research Station.
7) Collect downloaded data from the Signy Gauge and check installation
8) Supply and repair tide gauge equipment at King Edward Point Antarctic Research Station.

SHIP PREPARATION

POL personnel, Jeff Pugh and Miguel Maqueda, joined the RRS James Clark Ross at Port Stanley, Falkland Islands, on the November 22nd 2007. The ship was due sail on the morning of the 24th, but due to problems encountered on the previous cruise this was delayed until the 29th. The equipment for the Drake Passage was quickly located and set-up in the main lab area. Both the Bottom Pressure Recorder loggers were assembled and visually checked, they were then set-up and monitored. The acoustic releases were tested and the external battery packs assembled and voltages checked. The acoustic release serial number 69678 was opened and a load resistor fitted to the relay circuit, sealed and retested.

STANLEY SEA LEVEL RECORDER 22-25/11/2007

The TDS system was monitored and the time of the last scan recorded. Both the un-calibrated and calibrated data were downloaded; the system was then restarted and monitored. Note: On 23/11/2007, the system was stopped, powered down and a new battery fitted to the existing SRAM card, the system was then restarted.

The CF1 logger system was monitored and the timing of the scan recorded. The system was powered down and the main Persistor module, complete with CF1 card, replaced with an updated module and new CF1 card. A copy of the data on the existing CF1 card was taken. The existing US Robotics modem was replaced with a newer modem manufactured by Westermo (TDW-33). The replacement Persistor module was installed, which also contained the new configuration file to reflect the change of modem. The telephone line was then checked for noise and found to be clean, this was also confirmed by a Cable & Wireless engineer. Power was then reapplied to the CF1 system and the time and date set. The upgraded system and modem were monitored for correct operation.

The existing Orbcomm satellite tide gauge was removed and replaced with a new OTT base system using the Meteosat satellite network. This allowed data to be transmitted more frequently e.g. every 15 minutes as opposed to every hour. The OTT system was fitted in place of the existing Orbcomm box, the GPS antenna was reused and the Meteosat antenna fitted in replacement of the Orbcomm. The system was powered up and the configuration file checked, the system was monitored locally for a while before contact was made with POL to confirm the data was being received correctly.

Note: A small tool box with some additional tools, a torch and a dip meter were left on top of the staging by the tide gauge cabinet.

DEPLOYMENT OF DRAKE PASSAGE NORTH BPR (POL 15) 30/11/2007

Latitude: -54 56.623 **Longitude:** -58 22.604

Timing:

18.50 GMT - Vessel on station

19.05 GMT - Released into the water

19.24 GMT - On the seabed

Depth: 1172 Meters

Barometer Reading: 999.6mb

Equipment :

Acoustics XT6000 – S/No. 63804	Rx.10.0	Tx. 12.0	CMD 'A'	B/Wire T/T
Acoustics XT6000 – S/No. 58434	Rx.14.5	Tx. 12.0	CMD 'B'	B/Wire T/T

Drake Passage North BPR Deployment Summary

The sea conditions were very good. Communication was achieved with the acoustic releases all the way down to the seabed. Moved to the position of the existing Drake North BPR and ranged successfully to it.

DEPLOYMENT OF DRAKE PASSAGE SOUTH BPR (POL 14) 4/12/2006

Latitude: -60 51.010 **Longitude:** -54 42.670

Timing:

22:06 GMT	Vessel on station
22:07 GMT	Released into the water
22:26 GMT	On the seabed

Depth: 989 Meters

Barometer Reading: 982.6sp

Equipment :

Acoustics XT6001 – S/No. 69678	Rx.13.0	Tx. 12.0	CMD En.'F' Rl 'D'	B/Wire T/T
Acoustics XT6000 – S/No. 46457	Rx.15.0	Tx. 12.0	CMD 'B'	B/Wire T/T

Drake Passage South Deployment Summary

Weather very good, everything went smoothly and the acoustics were monitored all the way down to the seabed. Moved to the position of the existing Drake South BPR and ranged successfully to it.

VERNADSKY 06/12/2007

POL personnel were transported from the JCR to the base via one of the ships cargo tenders. The first priority was to get the OTT HDR system up and working, an initially check of both installation cabinets for obvious signs of damage was performed. The transmitter unit mount in the Ozone loft was inspected and a loose connection found and repaired. The cabinet mounted in the tide gauge hut also showed some signs of damage. The LCD on the LogoSens2 unit was displaying incorrectly and the cabinet itself had an appreciable amount of water in the bottom, this was pointed out to the Ukrainians for them to investigate further. A spare LogoSens2 was fitted which resolved the faulty display but failed to solve main transmission issue. The wiring between the two cabinets was checked and the RS232 transmit and receive lines reversed. On reapplying the power, the LogoSens2 unit successfully initialised the transmitter, located in the loft area. The equipment was monitored through a transmission cycle, up to and including the sending of a message. The existing PS1 sensors were removed and replaced with two new titanium sensors, manufactured by KPSI. Instructions for fitting and positioning of the sensors in the well were given to the Ukrainians. The software for the OTT system was handed over to the onsite tide gauge personnel and a brief instruction given on its operation.

Due to the time constraints it was decided not to download the TDS data from the existing tide gauge, leaving it for the following year.

ROTHERA 08/12/2007

The ship arrived at Rothera at 19.30 GMT on 08th December, the ships personnel set about off loading the cargo from the aft deck. As the ship was not due to leave until the 12th, POL personnel also assisted. On the 10th a visit to the Rothera tide gauge was made, checking both of the TDS gauges and recording the drift of their respective clocks. The data was downloaded from the backup gauge first, as suspected the unit had jump out of its program, this was rectified by replacing the onboard firmware with a newer version. The data from the main TDS logger which was connected to the Gumstix unit was successfully downloaded. Once all the data had been retrieved the firmware on the main logger was upgraded and the Gumstix cabinet replaced with a new system based on a Portux device. Both of the SRAM cards were then replaced with new cards, with new batteries fitted on the 17/9/07, the gauges were then restarted and the timebase initialised for the correct sampling period.

A new interface cable was used to connect the main logger to the new Portux cabinet; power was then applied to the new cabinet and checked to ensure that it was seeing the correct data string from the main TDS logger. Finally the Portux unit was confirmed as fully operational by POL based personnel who were receiving real time data in the form of emails every 5 minutes.

The Gumstix system was left at the tide gauge hut in case any problems were encountered with the new Portux. Both cabinets were sealed and equipment and tools taken back to the

ship.

The Dash7 flew out of Rothera on the morning 12/12/07 with myself, Jeff Pugh onboard, Miguel Maqueda remained on the ship which also left on the morning of the 12th.

Note: The Portux unit was not fitted with an inline fuse on the battery supply, this should be fitted on the next trip. A small tool box with some additional tools and a dip meter were left in the Pump room. The Bas personnel have agreed to do some additional dipping on our behalf.

SIGNY 16/12/2007

Miguel arrived at Signy on the 16th of December. A visual inspection was made of the tide gauge and pipe work running out to the sensors. These were all found to be in good condition. A new set of lithium batteries was supplied to replace of the existing ones and a laptop provided to enable the base personnel to talk to and download data from the gauge. There was no exchange of data, as it had already been downloaded by the BAS personnel and forwarded onto POL.

KING EDWARD POINT 22/12/2007

The ship arrived at the BAS base, King Edward Point (KEP) which is situated on South Georgia on the 22nd December. The tide gauge equipment and sensors had previously been sent out on the JCR and were delivered on the first call to KEP back in November. The base personnel had already installed and partially test the cabinet and associated sensors. This had shown that there was an issue with regard to the interface board and the sensors.

Fortunately as this equipment had been fitted in November these issues were known about and Miguel was able to bring with him, a replacement module which solved the issues associated with the sensors. The KEP tide gauge is now successfully reporting back 1 minute data at 5 minute intervals.

CONCLUSIONS

The two Bottom Pressure Recorders were both deployed successfully at Drake North (near Burdwood Bank) and Drake South (near Elephant Island). The position of the two existing BPR's deployed in 2006 were also confirmed.

The island gauges at Port Stanley, Vernadsky, Rothera, Signy and King Edward Point were all visited and successfully downloaded and where necessary repaired updated or replaced.

All the scientific objectives for this cruise were met.

APPENDIX 1 – SLR & BPR TECHNICAL INFORMATION

STANLEY SEA LEVEL RECORDER INFORMATION

The Sea Level Recorder at Stanley consists of three independent logging systems. The first two systems use high precision pressure sensors to measure pressure and temperature of the sea water, whilst the third system uses radar technology to measure water height.

Each of the logging systems use pressure sensors; a 'full tide' sensor, a 'half tide' sensor and a barometric sensor. The full tide sensor is mounted such that it is permanently below the water level, even at the extreme low tide event. The half tide sensor is mounted alongside the full tide sensor and is fitted with a feed pipe to the pressure inlet port, taken from a point at the middle of the tidal range. As the tide falls below this point, the pressure measured by the sensor should remain constant, with a value equal to the head of water retained in the feed pipe. This then provides a datum level for determining the full tide level. The barometric sensor is used to measure air pressure and temperature. This information is used to correct the full and half tide pressure measurements, removing the barometric influences.

The output from these six sensors is fed into two independent logging systems. The first system (TDS Logger) continuously integrates the frequency output of the sensors and stores this information every fifteen minutes to a Static RAM (SRAM) card. The second logging system (CF1 Logger) differs in that the information is stored every second, thus allowing wave data to be collected and analysed. This second logger also sends data back to the UK in quasi real time, via the telephone network, in the form of an email. This system can also be dialled-up and data collected manually.

The third measuring system uses radar which bounces electromagnetic waves off the sea surface. The radar is positioned so that it points vertically downwards and several readings are taken, the average of these being logged. These measurements are transmitted via the Meteosat satellite communication network, data is available on the Meteosat web site as well as being forwarded onto the GTS system.

<u>TDS Logger</u>
Timebase scan (LED)

Expected	Actual
13.45.00 GMT on 22/11/2007	13.45.11 GMT on 22/11/2007

TDS time displayed

Expected	Actual
14.16.00 GMT on 22/11/2007	14.17.56 GMT on 22/11/2007

The calibrated and raw data were downloaded from the memory card and stored as

Stanley_tds.txt.

Sensors fitted.
Full Tide DQ 47594
Half Tide DQ 47598
Barometer DQ 39239

The data appeared to download correctly with no corruption or blanks.

The timebase was restarted at 17.00.00 GMT on 22/11/2007
The existing SRAM was used, as a replacement could not be located at the time. On 23/11/2007, the tide gauge was visited again as a replacement SRAM card was found.

The timebase scanned at 12.00.00 GMT on 23/11/2007.

The timebase was then restarted at 12.15.00 GMT on 23/11/2007
The first scan was at 12.30.00 GMT on 23/11/2007

CF1 Logger
Timebase Scan reading

Expected	Actual
19.49.00 GMT on 22/11/2007	19.49.49 GMT on 22/11/2007

The CF1 logger was stopped and the Persistor board and compact flash card removed, a copy of this was made and stored on a laptop. The modem used for dialling into the system was replaced with a new Westermo modem. A new Persistor board and compact flash card was fitted which contained the correct setup files for talking to the new modem. The system was then restarted.

CF1 Logger
Timebase Set
20.24.00 GMT on 22/11/2007

The system appeared to start correctly, however, the modem did not activate. The gauge was then restarted and the timing checked, this time the modem initialised the line and started its call sequence. POL was contacted to ensure that the data was being received correctly.

Sensors fitted
Full Tide QX 99099
Half Tide QX 99450
Barometer QX 97890

Meteosat
The Meteosat system was observed over a period of a couple of days, with regard to the GPS and the transmission. The GPS functioned extremely well, receiving a GPS fix in approximately 1.55 seconds from wake up. All transmissions observed went through without

error and were successfully received at POL.

DRAKE PASSAGE NORTH DEPLOYMENT INFORMATION (POL 15)

Location details	-	***Latitude 54°56.62' S***
		Longitude 058°22.67' W
		Depth 1172m
		Baro 999.6mb
On station	-	18.50 GMT on 30/11/2007
Release into the water	-	19.05 GMT
On the seabed	-	19.24 GMT

Acoustic Information

Benthos XT6000 (63804)	-	Rx 10.0kHz, Tx 12.0kHz, Release A
Benthos XT6000 (58434)	-	Rx 14.5kHz, Tx 12.0kHz, Release B

63804 fitted with a TT burnwire, 58434 fitted with a TT burnwire.
63804 fitted with an external backup battery supply.

Logger
Logger with sensors DQ 68483 0-10,000 PSIA
Timebase started at 11.45.00 GMT on 27/11/2007
First scan at 12.00.00 GMT on 27/11/2007

Recovery Equipment

Benthos radio beacon	-	Nominal frequency - 154.585 MHz, Channel A.

New Battery Information

Logger	-	(Red) 14.60V (Orange) 14.60V
Acoustics Battery Tube	-	(Red) 14.67V (Orange) 14.66V

DRAKE PASSAGE SOUTH DEPLOYMENT INFORMATION (POL 14)

Location details	-	***Latitude 60°51.01' S***
		Longitude 054°42.64' W
		Depth 989m
		Baro 982.6mb
On station	-	22.06 GMT on 04/12/2007
Release into the water	-	22.07 GMT
On the seabed	-	22.26 GMT

Acoustic Information

Benthos XT6000 (46457)	-	Rx 15.0kHz, Tx 12.0kHz, Release B
Benthos XT6001 (69678)	-	Rx 13.0kHz, Tx 12.0kHz, Enable F, Release D

Release 46457 is fitted with a TT burnwire. Release 69678 is fitted with a TT burnwire.
Release 46457 is fitted with the extra battery pack.

Logger

Logger with sensors DQ 105443 0-10,000 PSI
Timebase started at 12.30.00 GMT on 27/11/2007
First scan at 12.45.00 GMT on 27/11/2007

Recovery Equipment

Benthos radio beacon	-	Nominal frequency - 154.585 MHz, Channel A.

New Battery Information

Logger	-	(Red) 14.49V (Orange) 14.52V
Acoustics Battery Tube	-	(Red) 14.67V (Orange) 14.66V

VERNADSKY SEA LEVEL RECORDER INFORMATION

The tide gauge at Vernadsky consists of three independent systems. The oldest tide gauge being the Munro float tide gauge and chart recorder. This consists of a float down a stilling well which rises and falls with the tide. A line is drawn on chart paper by a pen, recording the tidal variation. The paper is advanced using a mechanical clock

The second tide gauge is a TDS electronic system using digiquartz pressure sensors and storing the data on an EPROM card. The card has the capacity to store four years of data.

The third system is a commercial system from OTT that uses strain gauge pressure sensors and transmits the data back via the GOES East satellite.

The priority for this visit was to ensure that the OTT system was made operational which was successful done. Due to the time constrains, it was decided not to download and replace the EPROM card on the TDS system, this will be done on the next visit.

Sensors Fitted to OTT System:

KPSI 500 Full Tide	S/No. 707716
KPSI 500 Half Tide	S/No. 707713

ROTHERA LEVEL RECORDER INFORMATION

The tide gauge at Rothera consists of three pressure sensors, a full tide sensor, a half tide sensor and a barometer. The full tide sensor is positioned to be permanently submerged, whilst the half tide sensor is positioned above the full tide sensor, at the middle of the tidal range. The half tide sensor act as a reference point for the full tide sensor and allows accurate surveying of the installation to be undertaken.

The output signals from these sensors are fed into two independent logging systems. Logger 1 is the main logging system. It is this system the base meteorologists interact with to recover the tide data and email it back to POL. In addition to this the data from this gauge is relayed to another unit which transmits the data back to POL using the BAS VSAT communications system in near real time. Logger 2 is a backup system recording the same information as Logger 1. Both systems use a TDS logger and store data to a SRAM card.

Sensors fitted	
Full tide	DQ 47942
Half tide	DQ 47452
Barometer	DQ 65487

Logger 1 timebase scan

Expected	Actual
12.45.00 GMT on 10/12/2007	12.44.20 GMT on 10/12/2007

Data were downloaded to Roth_TG1.txt

The timebase was restarted at 17.30.00 GMT on 10/12/2007
The first scan was at 17.45.00 GMT on 10/12/2007

Logger 2 timebase scan

Expected	Actual
13.12.00 GMT on 10/12/2007	13.15.00 GMT on 10/12/2007

Data were downloaded to Roth_TG2.txt

The EPROM firmware was updated on both gauges and a new real time system installed to relay the data back to POL over the internet.

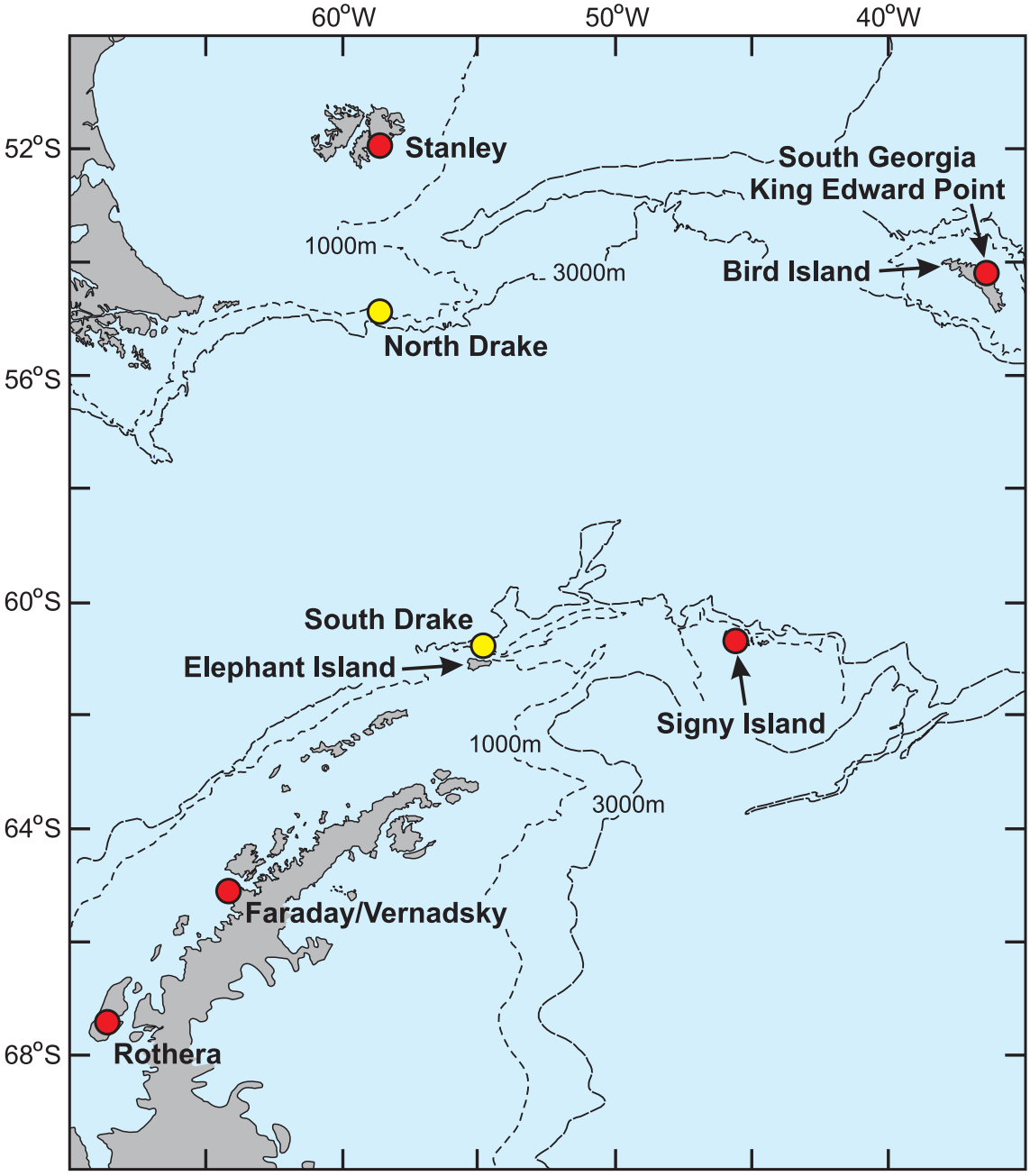
KING EDWARD POINT (KEP) LEVEL RECORDER INFORMATION

The Sea Level Recorder at KEP consists of a Portux telemetry system talking to two KPSI strain gauge type pressure sensors, one ‘full tide’ and one ‘half tide’, each providing a pressure and a temperature value. The Portux requests and stores this data from each sensor very minute, which is then emailed back to POL every 5 minutes using the BAS VSAT communications system providing near real time data.

Sensors Fitted:

KPSI 500 Full Tide	S/No. 707715
KPSI 500 Half Tide	S/No. 707717

MAP OF DEPLOYMENT POSITIONS



GLOSSARY

ACCLAIM	-	Antarctic Circumpolar Current levels from Altimeter and Island Measurements
ADC	-	Analogue to Digital Converter
BPR	-	Bottom Pressure Recorder
BAS	-	British Antarctic Survey
EPROM	-	Erasable Programmable Memory
GLOSS	-	Global Sea Level Observing System
GMT	-	Greenwich Mean Time
GPS	-	Global Positioning System
HDR	-	High Data Rate Satellite Transmitter (OTT)
IES	-	Inverted Echo Sounder
Logosens	-	OTT sensor logger
PSMSL	-	Permanent Service for Mean Sea Level
POL	-	Proudman Oceanographic Laboratory
SLR	-	Sea Level Recorder
SRAM	-	Static Random Access Memory
TDS	-	Triangle Digital Services