National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

National Oceanography Centre

Cruise Report No. 44

RV *Walton Smith* Cruise WS16336

01 - 07 DEC 2016

Miami to Miami, USA

MerMEED microstructure cruise report

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2017

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DOCUMENT DATA SHEET

AUTHOR FRAJKA-WILLIAMS, E et al	*PUBLICATION DATE* 2017

TITLE

RV *Walton Smith* Cruise WS16336, 01 - 07 Dec 2016, Miami to Miami, USA. MerMEED microstructure cruise report.

REFERENCE

Southampton, UK: National Oceanography Centre, Southampton, 60pp.
(National Oceanography Centre Cruise Report, No. 44)

ABSTRACT

The MerMEED (Mechanisms responsible for Mesoscale Eddy Energy Dissipation) project is a NERC funded project (NE/N001745/1, 2015-2018) to investigate the levels of dissipation associated with eddies at a western boundary, in order to identify the mechanisms responsible. Mesoscale eddies are ubiquitous in the worlds oceans, and can be found in the subtropical Atlantic travelling slowly westward (at 4-5 cm/s), with a radius of about 100 km. These eddies are formed through baroclinic instability or wind forcing across the Atlantic, but when they reach the western boundary (east coast of the USA), they disappear from the satellite altimetry record. This disappearance of eddies occurs throughout the worldsí oceans at western boundaries, but from altimetry alone, it is not known whether they disappear because energy is transferred to other wave modes or the mean flow, or whether it is locally dissipated through eddy-topography interactions.

The purpose of this cruise was to make microstructure temperature and shear measurements in order to measure dissipation at the intersection of an anticyclonic eddy and the steep topography to the east of Abaco, Bahamas. During the 7 day cruise, 70 profiles of microstructure data were collected using a tethered microstructure profiler, and a shipboard 75 kHz ADCP collected concurrent measurements of ocean currents. This cruise is the first of several planned cruises for the MerMEED project, and the data collected are intended to complement additional field operations, including moored instruments added to the RAPID array (thermistors and ADCPs on the WB1 mooring) and glider deployments planned for the 2017/18 year.

KEYWORDS

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1 Scientific and Ship's Personnel

Name	*Institute*
Eleanor Frajka-Williams (PSO)	University of Southampton (UoS)
D. Gwyn Evans	UoS
Alex Forryan	UoS
Kurt Polzin	Woods Hole Oceanographic Institute
Paul Provost	National Marine Facilities Division (NMFD)
William Platt	NMFD
David Childs	NMFD
Matthew Tiahlo	NMFD

Table 1: Details of science personnel on cruise WS16336.

Name	*Position*
Shawn Lake	Master
Steve	1st mate
Cameron	2nd mate
Mike	Chief engineer
Carol	Engineer
Denis	Marine tech
Peter	Chef

Table 2: Details of ship's crew on cruise WS16336.

Scientific watches kept

	0–6	6–12	12–18	18–24
Microstructure	Alex	Eleanor	Gwyn	Kurt
	Eleanor	Gwyn	Kurt	Alex
Deck ops	Paul	Paul	Billy	Billy
	Matt	Matt	Dave	Dave

Table 3: A list of scientific watches kept during cruise WS16336.

2 *RV Walton Smith*

The *RV Walton Smith* is a UNOLS vessel managed by the University of Miami. It is a catamaran, with 3 main levels (lower level with engines and some cabins, main level with dry lab, wet lab, science cabins, galley and working deck, and 01 deck with bridge and captain's quarters). Due to the catamaran shape, the available working space was spacious for a vessel of its length. The back deck has an A-frame, strongpoints on an imperial grid, and both a moonpool and a notch in the stern (the latter two were not used during this cruise). The 01 deck has the winch cabin for the A-frame and two cranes. Power supply included both UPS (more stable) and non-UPS sockets with 110 V and American plugs. Internet was provided with a reasonable speed, but availability depended on the direction the vessel was facing. As a rule-of-thumb, when the vessel was heading east, internet was available.

Power supply to the VMP winches required a few modifications for compatibility. The ship supplied power at 415 V, 3 phase and 60 Hz. The UK power packs had been set up for 208 V, 3 phase and 50 Hz. After some investigation, it was determined that the power packs could be run at 60 Hz. The ship provided hydraulic power but at variable pressure, which was not suitable for the winches.

Operating characteristics were summarised from the www.rsmas.miami.edu website, see Table 4.

Length	96 feet
Beam	40 feet
Draft	7 feet
Laboratories	680 sq. feet
Cruising speed	10 knots*
Fuel capacity	10,000 gallons
Gross Tonnage	97 GRT
Complement	20 berths (7 crew and 12 scientists)

Table 4: Operating characteristics of the *RV Walton Smith*. *The cruising speed was noted as 10 knots, but we were advised to use 8.5 knots for planning purposes.

Computing

The Lenovo Thinkpad `Pstar01` computer was used to collect and process VMP and XCP data. It dual boots to windows (for XCP) and linux (for VMP) and has a Matlab license for processing. A USB dongle was used to transfer raw data from the collection PC (initially provided by NMFD, but then replaced with a second Thinkpad after computer problems) to the processing PC. Daily backups were made to an external harddrive.

A flatbed scanner was brought on the cruise for scanning of hand-written logsheets. The ship was equipped with a colour laser printer that could be used by the science party.

Underway ship data including the vessel mounted ADCP were provided at the end of cruise on a DVD by the Marine Tech.

3 Itinerary

Depart University of Miami dock (4600 Rickenbacker Causeway), 1^{st} of December 2016, arrive University of Miami, 7^{th} December 2016.

4 Introduction

The MerMEED (Mechanisms responsible for Mesoscale Eddy Energy Dissipation) project is a NERC funded project (NE/N001745/1, 2015–2018) to investigate the levels of dissipation associated with eddies at a western boundary in order to identify the mechanisms responsible. The purpose of this cruise was to make microstructure temperature and shear measurements in order to measure dissipation at the intersection of an anticyclonic eddy and the steep topography to the east of Abaco, Bahamas.

This cruise is the first of several planned cruises for the MerMEED project, and the data collected are intended to complement additional field operations, including moored instruments added to the RAPID array (thermistors and ADCPs on the WB1 mooring) and glider deployments planned for the 2017/18 year. The project website is https://generic.wordpress.soton.ac.uk/mermeed/.

4.1 Scientific background

Mesoscale eddies are ubiquitous in the worlds' oceans, and can be found in the subtropical Atlantic travelling slowly westward (at 4–5 cm/s), with a radius of about 100 km. These eddies are formed through baroclinic instability or wind forcing across the Atlantic, but when they reach the western boundary (east coast of the USA), they disappear from the satellite altimetry record. This disappearance of eddies occurs throughout the worlds' oceans at western boundaries, but from altimetry alone, it is not known whether they disappear because energy is transferred to other wave modes or the mean flow, or whether it is locally dissipated through eddy-topography interactions.

The thesis of Louis Clement investigated the behaviour of mesoscale eddies using the RAPID mooring array at $26.5°$N in the Atlantic, including their influence on the meridional overturning circulation [Clément et al., 2014] and observations of finescale shear variance over topography associated with anticyclones [Clement et al., 2016]. They found that shear variance was elevated in anticyclones (clockwise rotating eddies) compared to cyclones (anti-clockwise), suggesting that dissipation is stronger during anticyclones than cyclones. They additional found that in the anticyclones observed during the 18-month study period that bottom velocities were larger than during cyclones, and that there was a slight predominance of upward propagating internal waves over downward propagating lee waves. These strands of evidence could be explained by two phenomena–lee waves generated by flow over rough topography, or the arrest of southward propagating boundary waves by the northward flowing waters in an anticycylone [Hogg et al., 2011]. The MerMEED project seeks to determine whether observed dissipation at western boundary topography is a leading order term in the energy balance of mesoscale eddies, and also by what mechanisms the dissipation is occurring.

4.2 Fieldwork plans

The process cruises represent one of three approaches used by MerMEED to make observations of eddies, internal waves and mixing east of Abaco. A total of 4 cruises are planned, to capture the observed levels of dissipation during and near the tail end of both an anticyclone and a cyclone. In addition, underwater gliders will be used for a total of 6 months to map the mesoscale eddy and the evolution of its energy (potential energy, from density profiles, and kinetic energy, from geostrophic velocities derived from density profiles). Finally, additional instruments have been added to the WB1 mooring in the RAPID array in 1400 m of water including two 75 kHz profiling ADCPs (to insonify the full water column at a 1 hour time interval and 16 m vertical bins) and RBR thermistors to increase the vertical resolution of temperature data to 50 m (from the 4 MicroCATS included as part of the RAPID array). These observations will enable a finescale parameterization-based estimate of turbulent dissipation at this location, which can be compared to the shear-based estimates at the WBADCP mooring as used in Clement et al. [2016].

5 Diary of Events

E. Frajka-Williams.

Monday, November 28 - Travel
The NMFD technicians arrived in Miami on Nov 27. Gwyn, Alex and Eleanor arrived on Monday the 28th after a 3 hour delay in the flight. Kurt arrived earlier on Monday the 28th.

Tuesday, November 29 - MOB day 1
Just past 9am, scientists and technicians arrived at University of Miami, 4600 Rickenbacker Causeway. The day was spent moving items which had been shipped from their storage places under the parking structure and in Mark Graham's (a technician in Bill Johns' group at Univ of Miami) workshop to the vessel. The winch and power pack from WHOI were also unloaded.

Wednesday, November 30 - MOB day 2
From the previous day's mob, it was anticipated that the winches would be powered by the ship's hydraulic power. It turned out that this was deemed not feasible, and so most of Wednesday was spent evaluating options for power compatibility. The University of Miami electrician, ship's engineers, and NMFD technicians worked to ensure compatibility. In the end, two power packs were working – the WHOI power pack and the primary NERC power pack.

Wednesday, December 1 - Transit
We set sail around 7am (greater than half tide) from the Miami dock, arriving around 13:30 local time at Bimini to clear into and out of the Bahamas. This was accomplished by 15:27, when we resumed transit towards the study site east of Abaco. The vessel motion was a bit rocky during the Gulf Stream crossing.

Thursday, December 2
We started the ADCP survey around 08:30 local time, from $26°15.5'$N and $77°0.1'$W, transiting northwards, and then completing a series of sections normal to topography. The ADCP survey was completed at normal cruising speed (about 8.5 knots) so that 5-minute ensemble averages resulted in 1.5 km resolution. A VMP test cast was performed offshore during the ADCP survey (16:08 local) in order to have a test during daylight hours. Everything was successful, so the ADCP survey was resumed. The first VMP full section (station 2) was begun at 20:25 from $26°31.69'$N, $76°53.04'$W heading north-northeast. Heading in this direction meant the ship had a strong tail current (over 1 knot) which meant that slow speeds could not be maintained. As a consequence, much of this section was accomplished at speeds of 1.9 knots over ground (compared to the anticipated 0.2 knots through water planned for VMP sections normal to topography).

Several casts were aborted due to power problems. In the *RV Walton Smith* wet lab, where the VMP computer was set up, the nearest two UPS sockets were not operational. The VMP was then plugged into non-UPS sockets through the Utrans box. As it turned out, the deck radios tripped the non-UPS sockets, resulting in no power to the VMP profiler. This resulted in a rocky start to the VMP section, though data from casts 4–8 of this station were all recovered in the end.

Friday, December 3

VMP section 2 was continued through 01:16 local on December 3rd. Due to the difficulties in maintaining control at slow speeds with a tailing current, the next section was in the eastward direction (normal to the flow). VMP section 3 was started at the same place as section 2 (waypoint 8), around 02:25 local. Nine casts were completed by 11:05 local.

The next planned station was also to be normal to topography, but south of $26.5°$N. The transit was carried out from waypoint 8 to waypoint 9, to generate an ADCP section east of the previous meridional section and through the core northward currents. Due to difficulties at judging the ratio needed between wire out and maximum pressure achieved by the VMP (most casts were 100 m shy of the bottom depth), this section was started in the westward direction, from deep to shallow water, with the intent being that a few stations in deep water would enable determining how much wire out is needed to achieve a particular pressure before the shallower stations (less than 1000 m) were begun. However, it turned out that the vessel also had some trouble moving slowly westward, and so only 3 casts were completed before the vessel turned around to repeat along the section in the eastward direction. Cast depths reached within 80 m of the bottom depth, for water depths less than 1000 m. Section 4 was completed with cast 7 at 23:42, which represented the second consecutive cast which returned weaker values of dissipation.

Saturday, December 4

Another ADCP transit was accomplished between VMP sections 4 and 5, in the meridional direction (from waypoint 10 to waypoint 11), from 00:07 to 02:23. VMP section 5 was started at 02:58 local from $26°36.91'$N, $76°54.96'$W to just south of eastward. The velocities recovered during this section showed remarkably strong vertical and zonal gradients in meridional velocities, with high dissipation in regions of strong shear. The section was completed with 7 casts by 09:53 local. During the last 3 casts, the χ_1 sensor returned some sketchy micro temperature profiles, so a sensor was replaced after cast 7.

The bridge advised that weather was expected to pick up later that evening. One of the upcoming plans was to complete a meridional section parallel to Abaco from north to south. Captain Shawn advised that this might be more difficult with higher (4–6 ft) seas, so based on the data in cast 7, it was decided to commence the meridional section in the early afternoon. So, VMP section 6 was begun at 10:31 local from $26°36.72'$N, $76°41.01'$W to the south. However, two casts returned dissipation profiles which were generally weak (with the exception of near the maximum pressure at the base of the strong shear layer). So rather than continuing the section at VMP towing speeds (1–2 knots), the VMP was recovered after the second cast, the ship repositioned further south for a 3rd cast, which showed much the same pattern of dissipation. The section was ended after cast 3 at 14:37 local in order to move back to more exciting regions.

VMP section 7 was planned to bound some of the exciting velocities and dissipations that had been observed north of the Bahamas islands. At the same time, the first XCP drop was planned to be in the region where large vertical shears in meridional velocity had been observed with concurrent high shear in the zonal velocities. Unfortunately, there were several glitches with the XCP deployment (see §**??**), so the transit was continued to the start of VMP section 7 at $26°36.90'$N, $76°54.91'$W (Waypoint 12). The transect was intended to be to the northeast to Waypoint 13. It turned out to again be difficult to maintain slow speeds on this heading, so after VMP cast 6, the VMP was recovered and the vessel repositioned at WP 13 ($26°42.10'$N, $76°48.38'$W) by 23:05 local and the VMP section resumed. As it turns out, during the transect, some of the highest meridional velocities of the cruise were encountered.

Sunday, December 5

VMP section 7 was continued through 04:24 local with cast 11, heading (from cast 7 to 11) in the south of eastward direction, which was a comfortable heading for the ship to maintain, with the VMP wire streaming out to the port, but away from the propellors. Due to the remarkably large observed meridional velocities, an additional cast 12 was planned, repositioning the vessel back towards the high velocities (but to the south of those previously encountered) at $26°42.03'$N, $76°49.83'$W (waypoint 14) by 05:22. The velocities at this location and time were not as high as previously noted, however. VMP section 7 was concluded at the end of this case, at 06:25.

An ADCP survey was planned from waypoint 15 (reached at 08:23 local) to waypoint 16 (10:38 local). The zonal section was intended to better resolve some of the upstream conditions to the RAPID moorings, and was completed at 3–5 knots to have higher spatial resolution in the 5-minute ensemble averages of the ADCP.

At waypoint 16, the second XCP was dropped (near the WB1 mooring). This XCP was released from the stern and shortly thereafter, the top float was observed to fall sideways in the water (resulting in no transmission recovered).

The final two stations (8 and 9) were planned as time series near the RAPID WB1 and WBADCP moorings. The sites were chosen to be north of the moorings so that any VMP wire streaming out would be carried by the local currents to the north and away from the moorings. A conservative distance of 2 km was planned away from the WB1 mooring (a taut wire mooring in 1400 m of water). Section 8 was commenced at 10:51 and completed at 23:17 after 12 hours of profiles. In general, the dissipation observed here was relatively weak compared to some other profiles recovered during this cruise.

Monday, December 6
The final station (near RAPID mooring WBADCP) was begun at WP 18 at 23:51 local and completed at 10:57 local. During this time, the ADCP only returned velocities from shallower than 600 m, due to the steeply sloping topography under the vessel. Water depth according to the swath data was greater than 700 m, and the ADCP returned some good beams down to near 800 m. Upward propagating lee waves were observed in the ADCP data (identified by downward propagating phase in the meridional and zonal velocity anomalies), while just below the reach of the ADCP data, enormous dissipation values were observed. Given the long duration of the station and the relatively shallow water depth (about 700–750 m) it was possible to better judge how much wire should be spooled out to achieve near bottom profiles of dissipation. From this, we could see that the high dissipation observed near the bottom was not at the bottom since there were 50–100 m of quiescent water below.

The spare VMP (S/N 023) was tested from 11:50 local, and it was determined that the wired connection through the WHOI winch was good, but upon recovering the VMP (winch pulling in) the pull was weak, and so further tests were abandoned. A final XCP was deployed at the end of this VMP section (at 12:37 local), revealing meridional velocity shear from strong northward to near zero bottom velocities (See Fig. 6). This concluded the primary science of WS16336, and at 12:41 local, we began the transit back to Miami.

Tuesday, December 7
The day was spent steaming back to Miami. We returned around 16:00 through Miami. Due to some complication with paperwork, the 4 NMFD technicians, Alex and Gwyn, had to go to the Port of Miami for a document check. This was completed by 19:00.

Wednesday, December 8
Demob & fly out.

6 Sea level anomaly and satellite geostrophic velocities

D. Gwyn Evans.

Gridded maps of sea level anomaly and geostrophic velocity were used target eddies approaching the

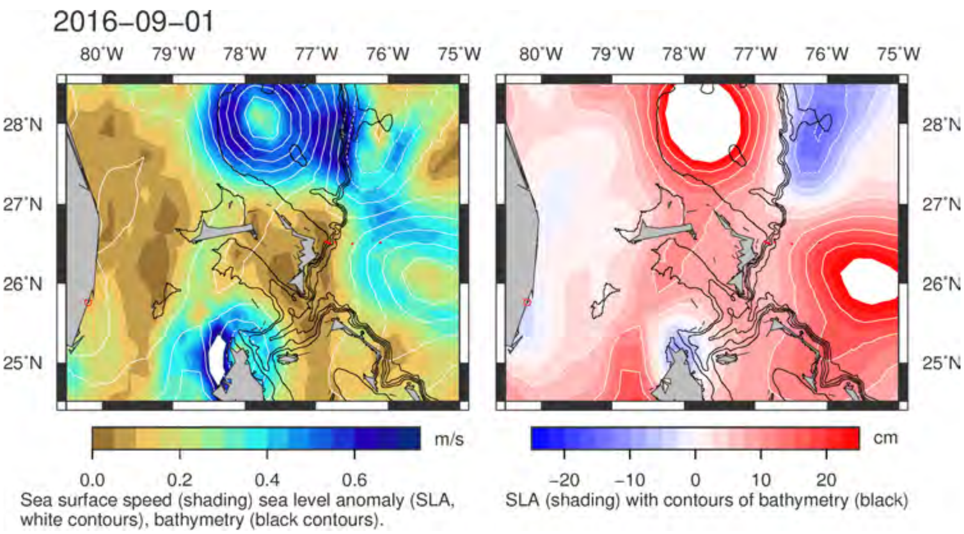

Figure 1: MSLA and UV estimated for September 1 2016.

MerMEED study region. Near-real time maps for mean sea-level anomaly (MSLA) and geostrophic velocity anomalies (UV) were accessed via `http://www.aviso.altimetry.fr` on a regular basis in the months leading up to WS16336. This analysis identified an anticyclonic mesoscale eddy (positive MSLA; Figure 1) approaching the study region that would contact the western boundary during September/October, and according to the lifespan of previous eddies, should remain for 2–3 months [Clement et al., 2016].

By the start of WS16336 the anticyclone had moved directly adjacent on to the shelf offshore of Grand Abaco, Bahamas (Figure 2). The magnitude of MSLA reduced in this time, from approximately 30 cm to 15 cm, but UV remained elevated in the along slope direction with a magnitude of approximately 0.6 m s^{-1}. This elevated northward velocity provided the conditions to test for elevated dissipation of kinetic energy due to the interaction of the flow with the topography along the shelf. Based on Figure 2 ADCP transects and VMP stations were planned along the shelf from the region of reduced UV northward into the region of elevated UV.

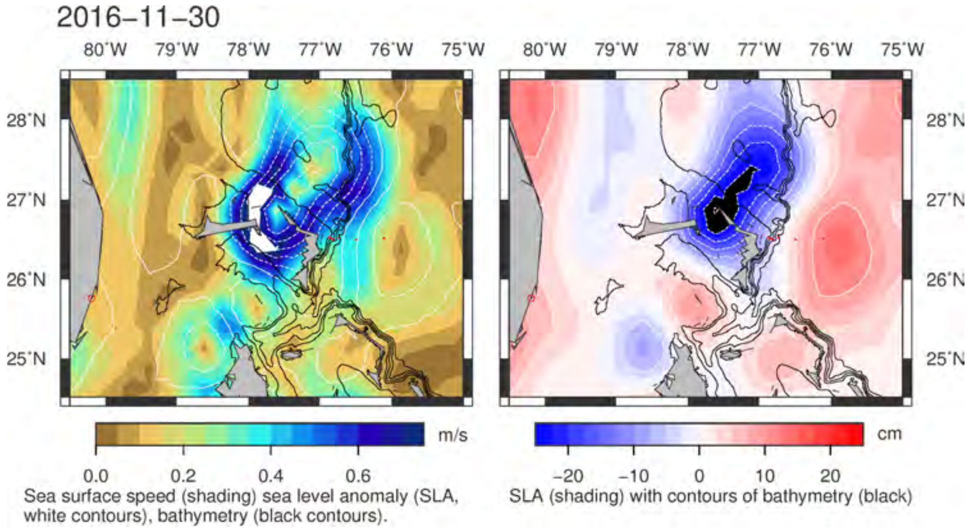

Figure 2: MSLA and UV estimated for September 1 2016.

7 VMP-2000 (Vertical Microstructure Profiler)

Eleanor Frajka-Williams, D. Gwyn Evans.

The tethered VMP-2000 vertical microstructure profiler manufactured by Rockland Scientific International was used as the primary instrument on the WS16336 cruise. This instrument measures profiles of temperature and velocity microstructure (i.e. on the length scales of dissipation of turbulent flows, typically a few millimetres to tens of centimetres), from which the rates of dissipation of turbulent kinetic energy (ϵ) and temperature variance (χ) are estimated using methodology based on Oakey [1982]; and finescale temperature, salinity and pressure with a pumped Seabird CTD mounted on the side of the instrument. The central goal of the cruise was to investigate the levels and processes involved in dissipating the anticyclone present during the cruise.

A total of 68 microstructure profiles were collected during the WS16336 cruise, between 02-Dec 21:15 and 06-Dec 15:16 (3.75 days). The VMP was used nearly continuously, with the exception of repositioning and for 1 hr 14 minutes, when the winch/powerpack overheated (station 4). There were a couple profiles (station 4, casts 4 and 5) when the Toshiba laptop used to receive data crashed, and during the early part of the

The reasoning behind the VMP stations chosen were to identify regions of high mixing near topography, and work offshore to deeper water (and lower levels of measured mixing). For the first 3 days of sampling, the VMP was used to make short sections at about 1–2 kts over ground (depending on currents), with about 1 hour per VMP cast. These sections were made primarily in the zonal direction (section 3, 4, 5), with two in the southwest to northeast direction (section 2, 7) and one meridional section (section 6). Following this, the last day was used to make two 12-hour time series with the VMP in 1390 m and 719 m of water. These locations were chosen to be to the north-northwest of the WB1 and WBADCP moorings, with a 2km distance from the WB1 mooring and a 1km distance from the WBADCP mooring. These moorings are instrumented with 75 kHz ADCPs, with the WB1 mooring additionally having $\sim$50 m spacing of thermistor/microCATs to resolve temporal variations in the vertical profile of temperature.

Due to the strong currents, substantially more wire was paid out than maximum pressure achieved, as the VMP was streaming behind the vessel. E.g., section 2, cast 5, with 600 m of wire out, the VMP achieved a maximum pressure of 315 dbar in 530 m of water. It was only on the last day of sampling, when the second of two 12-hour time series were made, that maximum pressures were regularly within 50 m of the bottom depth.

7.1 VMP-2000 deployment, recovery and winch operation

The VMP was stored on deck on stands, and strapped down with a rachet strap. The slack wire was wound on the winch to remove the hazard of loose wire on the deck. For deployment, the VMP was attached to the wire on the A-frame to lift it over the back deck. Two people steadied the VMP while it was being raised to protect the delicate sensors. Once it was over the back, the wire was taken in on the winch and the strop attaching the VMP to the A-frame was removed. The profiler was then lowered into the water and held at the surface until given the go-ahead by the person operating the recording computer. Once that message was received, the operator veered the winch and adjusted the speed of the winch and line puller to pay out wire at a sufficient rate so that the VMP was free falling (about 0.66 m/s). At a predetermined depth, judged based on previous casts and the surface currents/ship speed, the winch was halted and the VMP left to profile until the maximum pressure was achieved. In particularly strong currents, this was almost immediate. The time and position and maximum pressure were recorded, and then the winch hauled the profiler back to the surface. For the continuous sections (profiled in a toyo manner), the profiler returned at the surface until the next cast was started. When recovering the profiler, the winch was used to haul the profiler out of water where it could then be attached to the A-frame. The winch then paid out, and the A-frame hauled in to transfer the weight to the A-frame. Two people steadied the VMP as it came back on board, and was again lowered into the stands and strapped down until the next station.

7.2 Data processing

All processing scripts used on this cruise were adaptations of those used in previous VMP cruises by the UoS group. All processing steps and calculations remain the same as those described in previous cruise reports [Garabato, 2009, Meredith and Cunningham, 2011, Watson, 2011, Sallée, 2013], with the most recent cruise being the May 2016 RidgeMix cruise. A summary of the processing steps is given below:

Function	*Description*
`vmp_firstlook4`	Reads in the VMP datafile and produces two matlab files, one containing the raw un-calibraded VMP data, and the other containing the extracted downcast data with all calibrations supplied in the `setup.cfg` file applied (`_cdc.mat`). Also produces a series of diagnostic plots for the raw un-calibrated VMP data.
`vmp_process_seabird3`	Processes the VMP seabird data and applies various corrections. Output is saved as a separate matlab file (`_dCTD.mat` and `_uCTD.mat` for the down- and upcasts, respectively).
`vmp_process_micro4`	Processes the VMP microstructure shear and temperature. Microstructure temperature are calibrated by regressing against the processed VMP seabird temperature. Output is saved as a separate matlab file (`_micro.mat`).

Table 5: Processing steps used for the VMP-2000 on cruise WS16336.

7.3 Station/section description

See the scanned logsheets (appendix 12) for detailed notes on each cast.

Section 1 (1 cast) was a test dip on day 2 (2 Dec), in an offshore relatively quiescent region. The cast was in 4000+ m of water, and a maximum pressure of 1200 dbar was achieved. The data were recovered successfully, so the VMP was recovered and the ADCP survey continued.

Section 2 (5/8 casts successful, casts 4–8) was from the north side of the ridge ($26°31.75'$N, $76°53.392'$W) to the northwest. There was a tailing current and winds, so that the ship needed to make 1.8 kts to maintain a solid heading. Several issues were encountered with power trips on the vessel. The VMP was initially plugged into a non-UPS socket since the UPS sockets near the VMP computer were not working. It turned out that using the ship's handheld UHF radios in the wetlab triggered the circuit breaker, causing a loss of power to the VMP. After several instances of power shortages with aborted casts, the VMP was plugged into a UPS socket on the opposite side of the wetlab using an extension cord. After this the profiling continued more smoothly.

Section 3 (9/9 casts successful) was from the same location as the start of section 2, but "crabbing" eastward. The vessel was pointed to the southeast, but made a course over ground just south of eastward. This proved to be a much more comfortable direction for the ship to travel, and slower speeds were attained. The slightly southward direction meant that the VMP wire could stream to port but behind the vessel, and well clear of the port-side prop. Station spacing of 0.6–2.5 km was achieved (average spacing of 1.8 km).

Section 4 (7/7 casts successul) was south of the RAPID array, running in a zonal direction. In an effort to achieve maximum pressures of the casts closer to bathymetry, the section was attempted from east to west. However, this direction was difficult for the ship to do at short station spacing, so after reaching shallow water, the direction was reverted to the west to east, and casts continued until 2 profiles with relatively low dissipation were returned.

Section 5 (7/7 casts successful) was north of the RAPID array/ridge at $26.5°$N, running from west to east over a region where Kurt noticed strong curvature in the meridional velocities (a fast, meridional flow localized in $\sim$100 m thick water layer around 200 m deep) with associated flow direction reversals in the zonal velocities. Profiles of dissipation showed elevated dissipation nicely aligned with regions of strong shear in the ADCP velocities. Due to the preference to make a course over ground slightly southward, WP 8 was used as the endpoint of section 5, rather than WP11.

Section 6 (3/3 casts successful) was from the end of section 6 (WP 8), and in a southward direction. This was started early as the captain informed us that weather was picking up slightly (with SWH of 6 feet) and that the ship would have more trouble working in a meridional direction once the seas increased. This section is east of the strongest meridional flows in the 200–600 m water layer, and tended to show elevated dissipation at the shear layer at the base of the meridional flow. After 2 casts with relatively weak dissipation (compared to stations nearer topography), the tow-yo was aborted, and a single additional cast was added to the south along the same line.

Section 7 (9/12 casts successful, casts 1 and 4–12) was from the west of section 5 but to the northwestward direction (WP 13) to try to delineate the western boundary of the active mixing. The course taken was slightly to the west of WP 13, so after cast X the ship was repositioned to WP13 for a profile, and then the section was continued crabbing south of westward. From the ADCP data, the largest northward velocities yet observed were during the repositioning, to an additional cast (12) was added back in the region of strong northward velocities. However, by this time and at the location of cast 12, the velocities had abated somewhat.

Station 8 (12/13 casts successful, casts 1–6 and 8–13) was at a position to the north of WB1 by 2 km, along the same isobaths. This location was maintained for 12 hours and 12 casts. The dissipation observed here was relatively weak.

Station 9 (15/15 casts successful) was at a position to the north of WBADCP by 1 km, at a deeper depth (719 m compared to 592 m for WBADCP). This location was maintained for 12 hours profiling with the VMP, and an additional 1.5 hours while the second VMP was tested. Station depths exceeded the water depth under the ship, since the VMP was drifting to the north in the currents, where bottom depth was deeper.

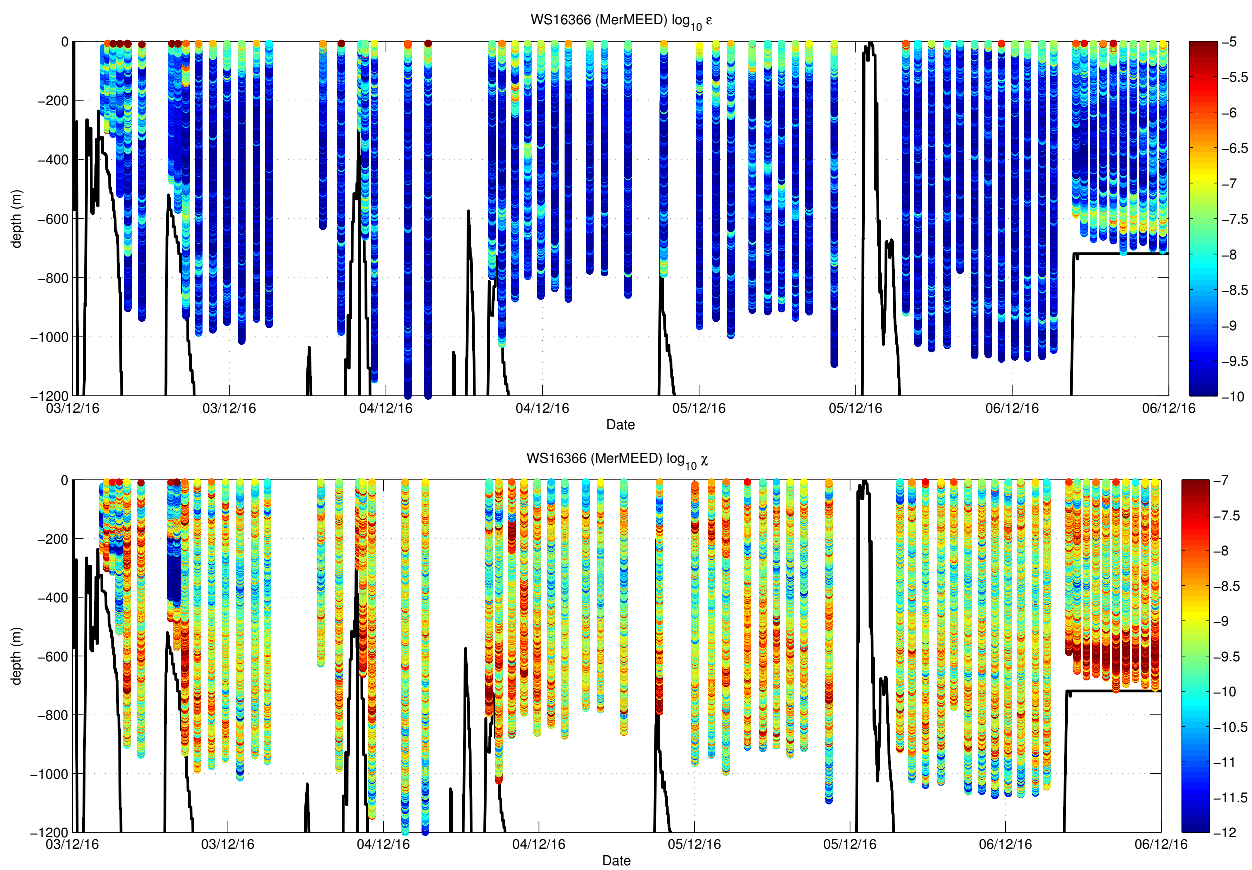

Figure 3: Profiles of turbulent dissipation (ϵ, top panel) and temperature variance (χ, bottom panel) collected during cruise WS16336.

7.4 Sensor and station list

Using VMP serial number 085. Sensor serial numbers were as given in Table 6. A copy of the config file is given in appendix §10. VMP 023 was tested after station 9, cast 15. It was reading numbers onto the recording computer, but the WHOI winch was having trouble hauling in, so the cast was aborted.

Instrument/sensor	Serial number	Notes
VMP	085	
T1	1166	through station 5, cast 7
T1	1167	from station 5, cast 8
T2	1165	
sh1	M1042	
sh2	M1043	
Pressure		calibration 14 June 2013
SBE temp	SN 5776	calibration 16 May 2013
SBE cond	SN 4169	calibration 3 May 2013

Table 6: Serial numbers for the VMP and sensors

7.5 Problems during casts and processing

VMP hardware issues

- Section 2, casts 1, 2 and 3: power shortage cut power to the VMP mid-cast. This was later determined to result from radio interference tripping the circuit breakers. The result was that when we used the handheld radio, the power would cut to the socket. The fix was to make sure the VMP was plugged into a UPS socket.
- Section 5, casts 5–7: $\chi 1$ was sketchy. We replaced the $\chi 1$ sensor after cast 7.
- Section 7, casts 2: winch overheated. File 003 was a double click of the recording button.
- Section 8, cast 5: max pressure was 776 (why did it stop early?) File 007 was a double click of the recording button, so there is no actual cast associated with this file.

Data issues (ϵ)

- Station 1, cast 1: $\epsilon 2$ had anomalous readings between 500 and 800 dbar, when shear1 and both χ sensors did not.
- Section 5, cast 3, $\epsilon 2$ has a spike at the bottom. $\epsilon 1$ does as well, but not as large.
- Section 5, cast 4, no data near surface. Perhaps due to inconsistent fall rate?
- Section 8, cast 5, `eps_good` drops out below 500 dbar, perhaps due to fall rate?
- Section 4, cast 4, data only available below 100 m. Perhaps due to fall rate?
- Section 4, cast 7, data only available below 90 m. Perhaps due to fall rate?
- Section 2, cast 5, $\epsilon 2$ data spikes below 150m

Data issues (χ)

- Section 5, cast 5: $\chi 1$ looks weird.
- Section 5, cast 7: $\chi 1$ looks broken.
- Section 5, cast 4: no data near surface
- Section 8, cast 5: no data below 500 dbar

Stn	Cast	Lat	Lon	Date/time	Depth	Max Pres	Notes
1	1	26°25.79′	76°42.46′	02-Dec 21:15	4508 m	1200 dbar	Test station.
2	2	26°31.75′	76°53.39′	03-Dec 01:28	577 m	XXX	220 m wire out (w/o), breaker tripped
	3	26°32.93′	76°52.88′	03-Dec 02:22	380 m	XXX	aborted, 600 m w/o
	4	26°33.28′	76°52.77′	03-Dec 02:40	434 m	320 dbar	500 m w/o
	5	26°33.98′	76°52.59′	03-Dec 03:06	573 m	315 dbar	600 m w/o, corrupt (but fixed by AF with manual editing)
	6	26°34.75′	76°52.32′	03-Dec 03:37	851 m	500 dbar	aborted, breaker tripped, but data recovered
	7	26°35.72′	76°51.96′	03-Dec 04:13	1292 m	880 dbar	all wire out, 2 bad buffers
	8	26°37.63′	76°51.17′	03-Dec 05:18	1452 m	917 dbar	1500 w/o
3	1	26°32.58′	76°52.1′	03-Dec 07:36	592 m	470 dbar	730 m w/o, 1 bad buffer
	2	26°32.6′	76°51.73′	03-Dec 08:04	681 m	573 dbar	930 w/o. breaker tripped on upcast (no upcast data), 1 bad buffer
	3	26°32.6′	76°51.16′	03-Dec 08:41	943 m	930 dbar	1700 w/o.
	4	26°32.65′	76°50.21′	03-Dec 09:39	1289 m	989 dbar	1500 m w/o, 1 bad buffer
	5	26°32.66′	76°49.05′	03-Dec 10:44	2108 m	977 dbar	1500 m w/o. At 670 m upcast, laptop failure
	6	26°32.69′	76°47.7′	03-Dec 11:49	3126 m	953 dbar	Loaded with wrong config - fixed file name later. 2 bad buffers. 1500 m w/o at 854 dbar.
	7	26°32.72′	76°46.29′	03-Dec 12:57	3596 m (3357)	1016 dbar	1 bad buffer at 270 dbar down, 1 bad buffer at 100 dbar up. 1500 m w/o at 840 dbar.
	8	26°32.81′	76°44.82′	03-Dec 14:05	3720 m	940 dbar	2.5 km from 7, 1500 m w/o at 820 dbar. 1 bad buffer at 914 dbar, 1 bad buffer at 100 dbar.
	9	26°32.83′	76°43.5′	03-Dec 15:03	3787 m	960 dbar	1 bad buffer at 27 dbar, 1 bad buffer at 407 dbar. 870 at w/o.
4	1	26°24.33′	76°52.04′	03-Dec 19:10	2990 m (2600)	620 dbar	1 bad buffer at 325 dbar, 1 bad buffer at 253 dbar. Boat running at 2 knots. Started towing fish.
	2	26°23.98′	76°54.25′	03-Dec 20:35	1492 m	984 dbar	1500 m w/o at 942 dbar.
	3	26°23.93′	76°55.29′	03-Dec 22:07	463 m (380 m)	300 dbar	440 m w/o. Turned ship for last dip at the end of line for a better position relative to weaker/seas (25 minutes between cast end + new start).

Stn	Cast	Lat	Lon	Date/time	Depth	Max Pres	Notes
4	4	26°23.94′	76°55.02′	03-Dec 22:25	746 m	664 dbar	Heading back toward WP9 with VMPs. Only 3 profiles were retrieved during WP7 and WP9. Accidentally opened the p file between 100 and 150 dbar. Computer died at 450 dbar.
	5	26°23.94′	76°54.46′	03-Dec 23:07	1339 m	1147 dbar	1 bad buffer near surface. At 900 dbar, computer died. Reopened computer.
	6	26°24.04′	76°53.37′	04-Dec 01:41	2013 m	1362 dbar	Seawater supply to hydropack cooler went belly up. Pulled fish out and repositioning while waiting for repair. Also swapped out logging computer. 1 bad buffer. (1 hour and 14 minutes to sort out the hydropack cooler.)
	7	26°24.3′	76°52.16′	04-Dec 03:14	2961 m (2191 m)	1217 dbar	1 bad buffer
5	1	26°36.84′	76°54.84′	04-Dec 08:09	926 m	797 dbar	12– , at 623 dbar, fell to 797 dbar. Ship was going 1.2 kts over ground.
	2	26°36.87′	76°53.99′	04-Dec 08:54	1011 m	1026 dbar	1600 m w/o.
	3	26°36.84′	76°52.88′	04-Dec 09:54	1247 m	872 dbar	Funky subsurface velo. 1600 m w/o at 800 dbar (fell to 872 dbar). 1 bad buffer.
	4	26°36.7′	76°51.7′	04-Dec 10:52	1438 m	792 dbar	1860 m w/o = max
	5	26°36.59′	76°50.44′	04-Dec 11:52	1498 m	863 dbar	1784 m w/o at 800 dbar. 1 bad buffer. micro T is strange near the surface during first look processing.
	6	26°36.47′	76°49.13′	04-Dec 12:56	1561 m (1557 m)	838 dbar	
	7	26°36.33′	76°47.89′	04-Dec 13:59	1579 m (1617 m)	873 dbar	Recovering to replace micro T.
6	1	26°36.63′	76°48.03′	04-Dec 15:37	1573 m	770 dbar	1800 m w/o, 735 dbar
	2	26°35.89′	76°48.28′	04-Dec 16:45	1599 m	784 dbar	1800 m w/o, 738 dbar
	3	26°32.72′	76°49.33′	04-Dec 18:33	1881 m	860 dbar	No bad buffers

Stn	Cast	Lat	Lon	Date/time	Depth	Max Pres	Notes
7	1	26°36.9′	76°54.91′	04-Dec 21:18	926 m	791 dbar	1200 m w/o.
	2	26°37.95′	76°53.64′	04-Dec 23:51	1278 m		Short test dip for winch (200 m wire out, 10 minutes)
	3	26°38.16′	76°53.46′	05-Dec 00:01	1296 m		Double click of the recording - no data
	4	26°38.16′	76°53.46′	05-Dec 00:02	1296 m	960 dbar	
	5	26°39.86′	76°52.17′	05-Dec 01:18	1835 m	936 dbar	
	6	26°41.8′	76°50.78′	05-Dec 02:26	1675 m	997 dbar	After this cast, picked up and move to WP 13
	7	26°42.11′	76°48.37′	05-Dec 04:05	1879 m	911 dbar	
	8	26°42.03′	76°48.29′	05-Dec 05:16	1879 m	916 dbar	All wire out, when 780 dbar
	9	26°41.99′	76°47.68′	05-Dec 06:19	1987 m	904 dbar	
	10	26°41.88′	76°46.98′	05-Dec 07:23	1988 m	938 dbar	
	11	26°41.87′	76°46.08′	05-Dec 08:26	2172 m (2042)	916 dbar	1 bad buffer
	12	26°42.03′	76°49.84′	05-Dec 10:22	1692 m	1093 dbar	
8	1	26°31′	76°48.82′	05-Dec 15:51	1390 m	920 dbar	1600 m w/o at 745 dbar
	2	26°30.99′	76°48.82′	05-Dec 16:46	1390 m	1023 dbar	1700 m w/o at 840 dbar
	3	26°31′	76°48.81′	05-Dec 17:49	1390 m	1041 dbar	max w/o at 1028 dbar
	4	26°31′	76°48.82′	05-Dec 19:01	1390 m	1030 dbar	
	5	26°30.99′	76°48.82′	05-Dec 20:00	1390 m	1036 dbar	Profile stopped at 20:20, just before max press.
	6	26°30.99′	76°48.82′	05-Dec 21:07	1390 m	1065 dbar	1700 m at 995 dbar
	7	26°30.99′	76°48.82′	05-Dec 21:07	1390 m		NO DATA - NO CAST - was a double click
	8	26°31′	76°48.81′	05-Dec 22:10	1390 m	1062 dbar	1700 m w/o at 941 dbar.
	9	26°31′	76°48.8′	05-Dec 23:10	1390 m	1075 dbar	1050 dbar at full stop
	10	26°31′	76°48.81′	06-Dec 00:12	1390 m	1070 dbar	1060 dbar at w/o
	11	26°30.97′	76°48.83′	06-Dec 01:10	1390 m	1073 dbar	1 bad buffer at 860 dbar
	12	26°30.99′	76°48.81′	06-Dec 02:18	1390 m	1068 dbar	1052 dbar at wire out.
	13	26°30.99′	76°48.81′	06-Dec 03:10	1390 m	1047 dbar	960 dbar at w/o

Stn	Cast	Lat	Lon	Date/time	Depth	Max Pres	Notes
9	1	26°32.31′	76°51.61′	06-Dec 04:53	719 m	589 dbar	1020 w/o
	2	26°32.32′	76°51.61′	06-Dec 05:31	719 m	652 dbar	1200 w/o
	3	26°32.33′	76°51.61′	06-Dec 06:14	719 m	670 dbar	1250 w/o
	4	26°32.35′	76°51.61′	06-Dec 06:58	719 m	640 dbar	1306 w/o
	5	26°32.33′	76°51.61′	06-Dec 07:45	719 m	676 dbar	1288 w/o
	6	26°32.32′	76°51.62′	06-Dec 08:31	719 m	715 dbar	1340 w/o
	7	26°32.33′	76°51.61′	06-Dec 09:17	719 m	697 dbar	1290 w/o
	8	26°32.32′	76°51.61′	06-Dec 10:01	719 m	680 dbar	1290 w/o
	9	26°32.33′	76°51.61′	06-Dec 10:46	719 m	703 dbar	1300 w/o
	10	26°32.33′	76°51.62′	06-Dec 11:32	719 m	710 dbar	1302 w/o
	11	26°32.35′	76°51.62′	06-Dec 12:16	719 m	711 dbar	1303 w/o
	12	26°32.32′	76°51.61′	06-Dec 12:57	719 m	754 dbar	1302 w/o
	13	26°32.36′	76°51.6′	06-Dec 13:50	719 m	710 dbar	1 bad buffer at 674 up
	14	26°32.31′	76°51.62′	06-Dec 14:35	719 m	737 dbar	1300 w/o
	15	26°32.32′	76°51.61′	06-Dec 15:16	719 m	735 dbar	Last cast

7.6 Sensor choice

- Based on vibration spectrum for shear 2: Initially picking shear 1 as primary.
- Based on reliable $\chi 2$ (and no swap of the micro temperature 2 sensor: initial choice to use $\chi 2$ as primary.

7.7 Notes for future VMP work in the region

Choosing locations where the VMP can drift to deeper water in the mean currents will mean that a higher maximum pressure can be achieved without the VMP hitting the bottom.

Notes on logging: it would be useful to add an operator column to the logsheet as well as a column for wireout and possibly surface currents/ship speed through water, to better evaluate how much wire can be let out to achieve maximum pressure closer to the bottom.

Logsheets for VMP processing would be handy to keep track of which profiles were processed and any issues encountered during processing, and to quickly tabulate how many good profiles were achieved compared to the number of casts attempted. Several corrupt files were recovered through manual editing, and some profiles did not have an upcast.

8 Expendable Current Profilers (XCP)

Dafydd Gwyn Evans, Eleanor Frajka-Williams.

8.1 Overview

Three Lockheed Martin Sippican expendable current profilers (XCPs) were deployed during WS16336. Each XCP measures profiles of zonal and meridional velocity as well as temperature at a vertical resolution of 2 meters (as output by the software from John Dunlap, Applied Physics Lab, University of Washington) to a maximum depth of 1700 m. During WS16336 the XCPs were validated by the velocity measured using the vessel mounted 75 kHz narrowband ADCP, but provided data below the maximum depth reached by the ADCP (typically 600–750 m). Various issues during the XCP deployments resulted in mixed fortunes in terms of output.

The XCP probes are deployed within a float that transmits data across various radio frequency (RF) channels. The XCPs used on this cruise use channel 14, which corresponds to 172 MHz. The signal is received aboard the vessel using an AOR AR5001D digital processing (RF) communications receiver tuned to the appropriate frequency. The audio signal output by the RF receiver is fed directly into both the MK21 ethernet deck unit supplied by Lockheed Martin Sippican and a Marantz solid state recorder (model PMD620MKII, based on a recommendation by Roger Anderson, Applied Physics Lab, University of Washington). The deck unit communicates with a Windows laptop via an ethernet cable and network switch, and displays realtime profiles using the Windows-based WinMK21 data acquisition software. The audio recording of the probe deployment is also processed using separate Matlab based software (`xcpdsp.m`) provided by John Dunlap and accessible at `https://ohm.apl.uw.edu/~dunlap/xcpdsp/`. All the information outlined here is described in full within the manuals provided with MK21 deck unit and the WinMK21 software.

8.2 Equipment setup

- *Required equipment:* Antenna, RF cable, vhf radio receiver, headphone-to-headphone cable, audio recorder, and headphones.
- *Optional equipment:* MK21 deck unit, headphone-to-headphone cable to connect the radio receiver to deck unit, and WinMK21 software for windows, with an ethernet cable to connect the deck unit to computer, and—if required—a network switch.

Steps to set up the equipment and probe are outlined in the XCP deployment checklist shown below (Fig. 4). Ideally, equipment should be set up in view of a GMT clock and GPS position information.

All equipment should be set up and ready to receive the RF signal from the XCP, prior to commencing approach. The XCP probe should be prepared, removing the 3 specified pieces of tape (over the antenna, over the electrodes and around the flap at the base of the canister). The agar should be inspected to ensure that it hasn't dried-up. The probe can be tested with the deck unit by closing the seawater switch (generally using a screwdriver or knife to bridge the gap across the pale yellow strip.

Ship-side hardware includes a directional antenna (Laird Technologies 4-Element Economy Yagis). This should be installed in an elevated position with a clear line of sight off the stern of the vessel. It should be oriented with the 4 posts vertical, and the face of the antenna towards the aft of the vessel. The antenna is connected to the radio receiver in the rack box using the coaxial cable. The length of the coaxial cable connecting the antenna to the RF receiver should be limited in length to less than 15m and any kinks or sharp bends should be avoided. The exposed connectors were covered using a self vulcanising tape and regular electrical tape, see photos below.

Output from the radio receiver is connected to the MK21 deck unit and to the Marantz recorder, so that the recorder can make a copy of the signal in the event of any failure of the deck unit. The Marantz recorder should be set to record in 16-bit Mono `.wav` format. The deck unit should be connected to the computer running the WinMK21 software using an ethernet cable. During this cruise, a network switch was required between the deck unit and computer due to incompatibility between the deck unit and network card on the cruise laptop. The WinMK21 software should be opened and communication to the deck unit verified. Once communication between WinMK21 and the deck unit is established a new XCP drop can be set up. Rather than using the calibration information provided for each probe, we used the default APL corrections on advice from John Dunlap that the calibration corrections introduced more noise to the signal.

The WInMK21 software can be left idle until the XCP is deployed. The RF receiver should be turned on and tuned to the appropriate channel/frequency. The receiver should be outputting radio static. The sound output by the receiver should by output to both the deck unit and the recorder. The recorder should be turned on just prior to XCP deployment. The audio signal from the probe can be listened to in realtime using headphones connected to the recorder.

8.3 Deployment and data acquisition

XCP deployment generally requires at least two people, one to deploy and a second to operate the computer, recorder and RF receiver and to complete the log sheet.

Prior to deployment, instructions were given to the bridge to approach a mark at a speed of 2–3 knots. After a countdown of 5 minutes and 1 minute, the bridge would signal the arrival at the mark to deploy the XCP.

The XCPs were deployed by hand on each occasion. During the first deployment it was thrown as described in the provided product manual. During the second deployment it was dropped from as low a high as possible off the stern. During the third deployment it was lowered off the starboard side using a string harness. The first and third deployment resulted in useable profiles, but the second deployment failed. The exact reason for this failure is unclear, but the float appeared to tip over once deployed, suggesting an issue with the weight.

At mark, the computer operator should start the audio recorder and note the ship's position and GMT time on the log sheet. Once the XCP operator confirms deployment with the bridge, the boat should maintain course for approximately 30 seconds (with the stern pointed in the direction of the float), aiming to slow to a stop at distance of 100 m from the mark. To aid the bridge, it is useful to suggest that a MOB waypoint mark is dropped once the XCP is deployed.

Once the XCP enters the water and the seawater switch is closed, the RF operator should hear an RF quieting (when the static is replaced by a relatively quiet signal) for approximately 20–40 secs. After the 40 second delay from closing the seawater switch, the probe is deployed from the XCP canister with the float (with antenna) remaining at the surface. On the headphones, the quieting is replaced by a low warble indicating data transmission. The transmission continues for 10 minutes, though the probe will finish falling within 4–5 minutes. The WinMK21 software should recognise the end of the cast and finish the probe drop data acquisition process. Once the transmission is complete, the recording can be stopped and the WinMK21 software exited. Instructions can be passed to the bridge to continue.

8.4 Individual deployments

The location of each deployment is shown in Table . Below details of each deployment and the resultant data are discussed.

XCP Deployment Log Sheet

Cruise		XCP serial #	
Ship name		Latitude	
Date (YYYYMMDD)		Longitude	
Time GMT (HHMM)		Operator	

Calibration data	
Compass voltage gain (GCCA)	
Correction voltage gain (GCORA)	
Electric field voltage gain (GEFA)	
Electric field deviation (GEVFA)	
Compass deviation (GCVFA)	

Pre-deployment check		**Comments**
Remove tape from antenna	❑	
Remove electrode tape	❑	
Inspect agar jelly	❑	
Remove probe retainer tape	❑	
Dry test probe transmission (20 secs)	❑	

Recording and WinMK21 set-up		**Comments**
<New Drop Express>	❑	
<UW APL defaults>	❑	
Turn on recorder	❑	

Deployment		**Comments**
Time in water		
Latitude in water		
Longitude in water		
Begin recording	❑	
Confirm RF quieting	❑	
Confirm probe release	❑	
Confirm probe signal data acquisition	❑	
End time		
End latitude		
End longitude		
Select **<Exit Probe Drop>**	❑	

Comments:

Figure 4: XCP deployment check list from WS16336

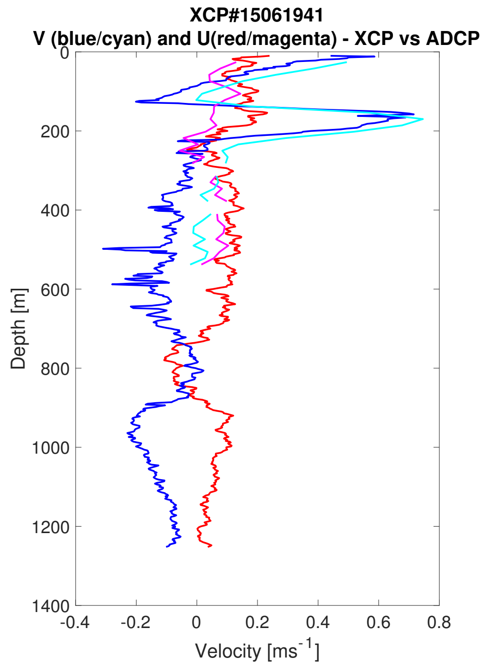

Figure 5: XCP deployment 1

8.4.1 Deployment 1

Immediately prior to this deployment power was lost to the deck unit, network switch and RF receiver. It was established that the UHF handsets used to communicate with the bridge tripped the breakers on the available power sockets. The equipment was connected to different power sockets and the deployment was restarted. Care was taken to use the UHF handsets away from the plug sockets. However, immediately upon deployment the power to the deck unit failed as the signal changed from radio static to RF quieting. The recorder remained operational and therefore a velocity profile (Figure 5) was recovered using the sound file and `xcpdsp.m`.

8.4.2 Deployment 2

Upon entry into the water RF quieting was confirmed, but it seems that the probe was immediately released from the canister. Visually, the float was seen to tip sideways, suggesting an issue with the weight. The exact reason for this failure is unclear, but the float appeared to tip over once deployed, suggesting an issue with the weight. The WinMK21 software also appeared to begin recording a profile as soon as the probe entered the water suggesting a premature deployment. (During this deployment, additional tape strips were removed from the XCP unit, including a tape strip between the weight and the canister. It is possible that the tape strip is intended to help stabilise the weight.) No data was recovered from this deployment.

8.4.3 Deployment 3

Due to concern that the probe released prematurely during deployment 2, the XCP was lowered more gently into the water. However, before the probe entered the water the WinMK21 software began recording an apparent profile. It seems that interference from the ship somehow initiated the deployment process in WinMK21. The recorder remain operational, and a velocity profile (Figure 6) was acquired using

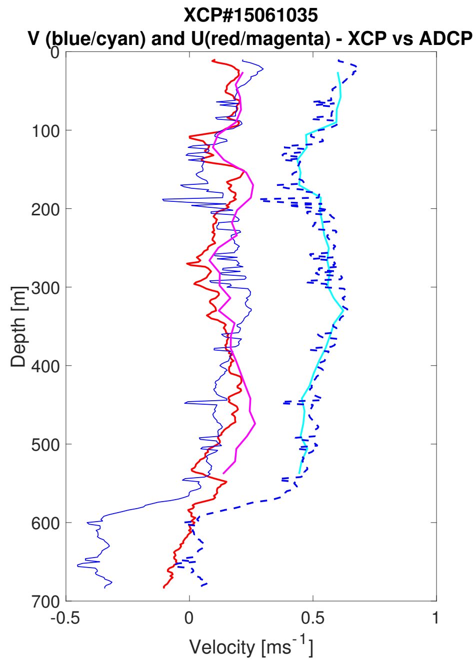

Figure 6: XCP deployment 2

`xcpdsp.m`.

8.5 Data processing

The sound files acquired using the recorder were processed using `xcpdsp.m`. This is designed to process data in realtime and to reprocess existing sound files. For WS16336, `xcpdsp.m` was used in the latter mode, using the options for no pilot tone and to process at the highest quality level. Data are output as `.mat` files, with supporting figures saved as `.png` files. As an input, the software requires a file listing the name of the sound file, the name of the output `.mat` file and the horizontal and vertical magnetic field components. These can be computed using matlab functions downloadable from IGRF.

9 Vessel Mounted ADCP

Alex Forryan.

The R.V. Wa;ton Smith has two Acoustic Doppler Current Profilers (ADCP) installed; an RDI 600kHz Workhorse (WH600) and an RDI 75 kHz Ocean Surveyor (OS75). The BB600 has a typical range of 10-20m in the best of conditions, while the OS75 can reach to 750 m in good weather in its deep-profiling ("narrowband") mode. The configuration of each instrument is given below.

ADCP was configured and run through the University of Hawaii Data Acquisition System (UHDAS), a suite of programs for ADCP data acquisition and automated processing. ADCP data was available to download in 5 minuter averages in netcdf format during the cruise from an onboard webserver (`http://10.106.30.66`) accessible on the *RV Walton Smith* wireless network.

After conversation with Jules of the University of Hawaii, the default configuration (switching between narrowband and broadband) for the 75 kHz ADCP was switched to be narrowband (deeper reaching) only.

trajectory	
uship	Ship meridional velocity.
u	Meridional water velocity.
vship	Ship zonal velocity.
v	Zonal water velocity
tr_temp	ADCP transducer temperature.
pg	percentage good pings.
pflag	Editing flags.
lon	Longitude (degrees E)
lat	latitude (degrees N).
heading	Ship heading.
depth	Depth (m).
amp	Received signal strength.

Table 7: Fields in the processed ADCP netcdf file.

Examples of the near-realtime plots produced by UHDAS during the cruise are shown below.

Instrument Configuration

OS150 The instrument was configured to run in narrowband mode with 60 x 16 m bins and no bottom track. See Table 8 for command settings.

WH600 The instrument was configured to run in broadband mode with 40 x 2 m bins and no bottom track. See Table 8 for command settings.

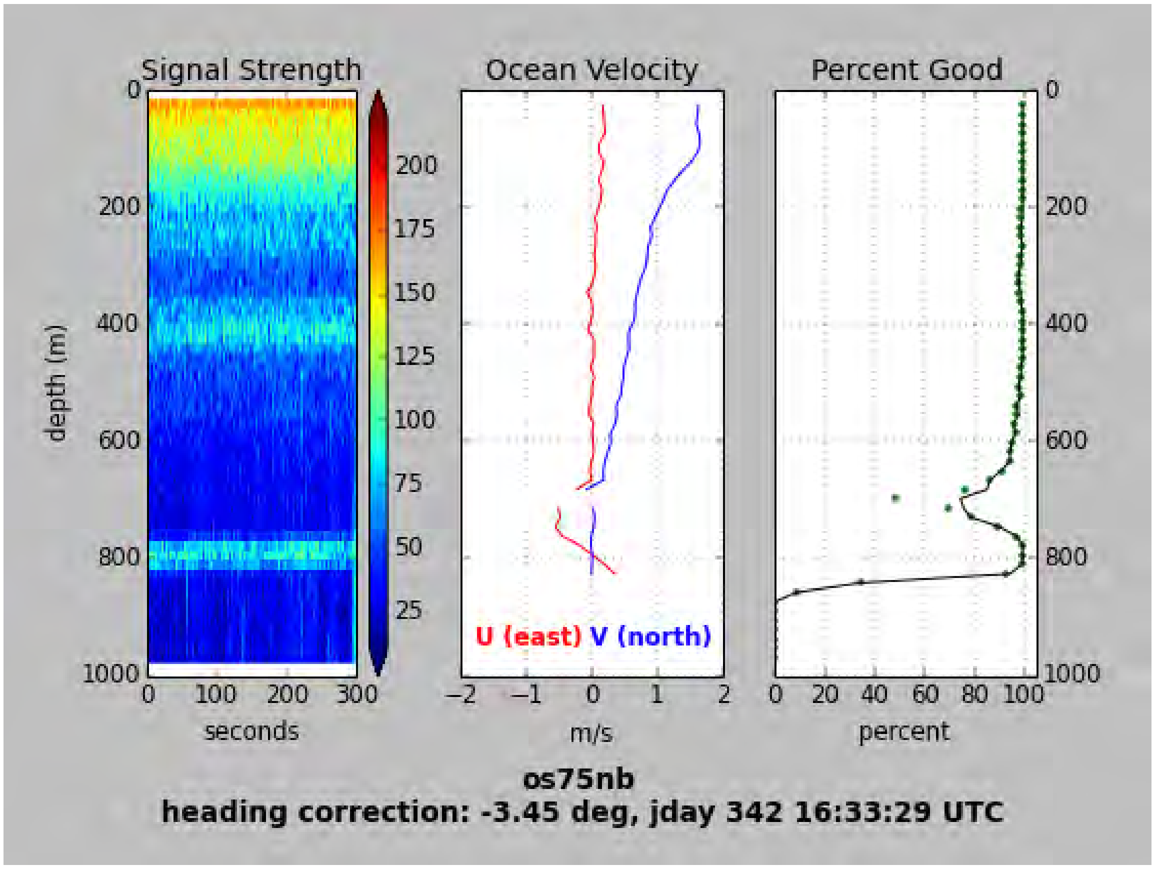

Figure 7: OS75 five minute average velocity profile.

OS75 RDI	*WH600 RDI*
NP1	WP1
NN60	WN40
NS1600	WS200
NF800	WF300
WP0	BP0
WN80	BX2000
WS800	WB0
WF800	WV550
BP0	TP00:00.80
BX1000	
TP00:01.80	
CX0,0	

Table 8: (left) OS75 RDI command settings used on cruise WS16336. (right) WH600 RDI command settings used on cruise WS16336.

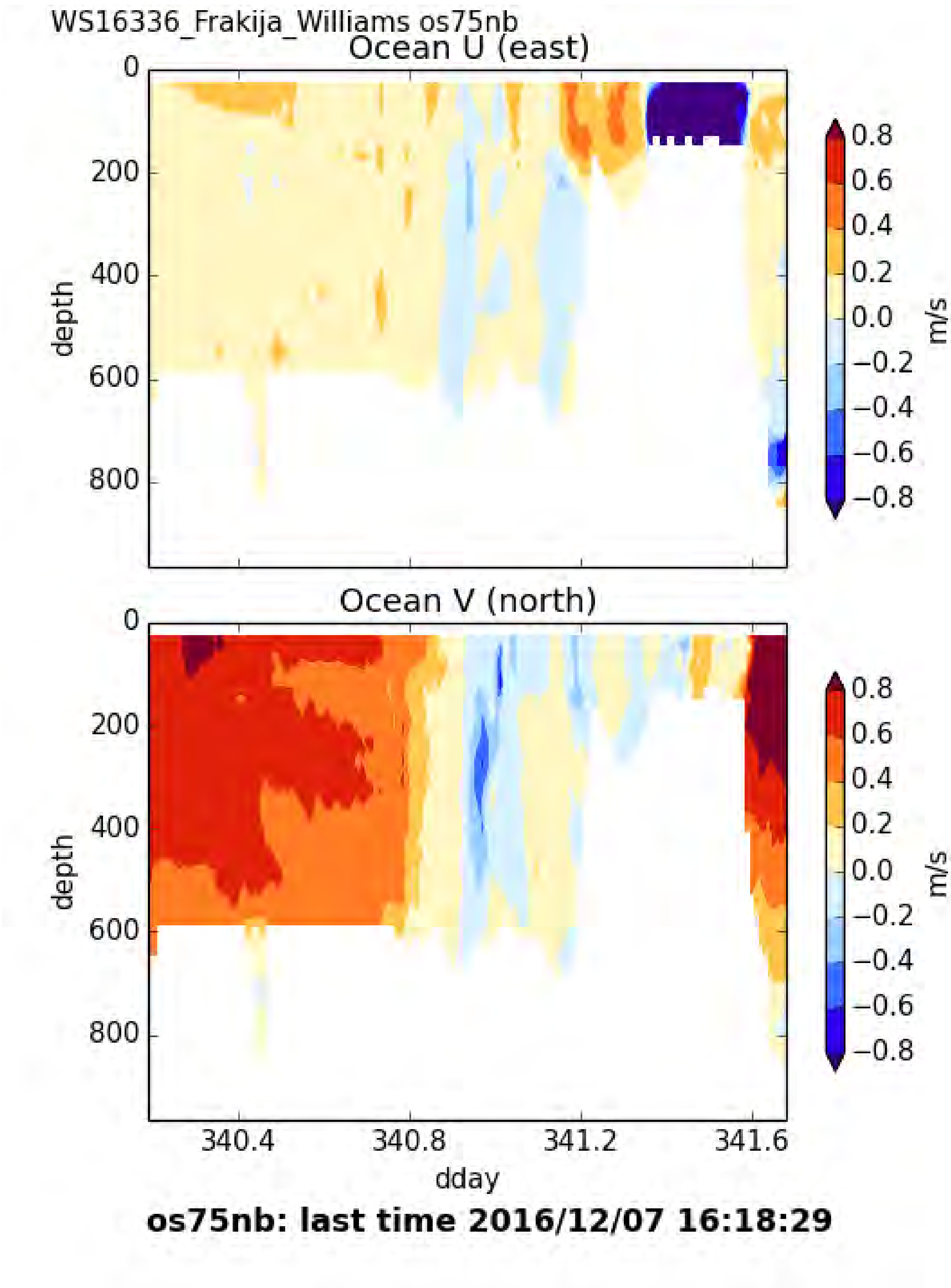

Figure 8: OS75 velocity contour (decimal day axis).

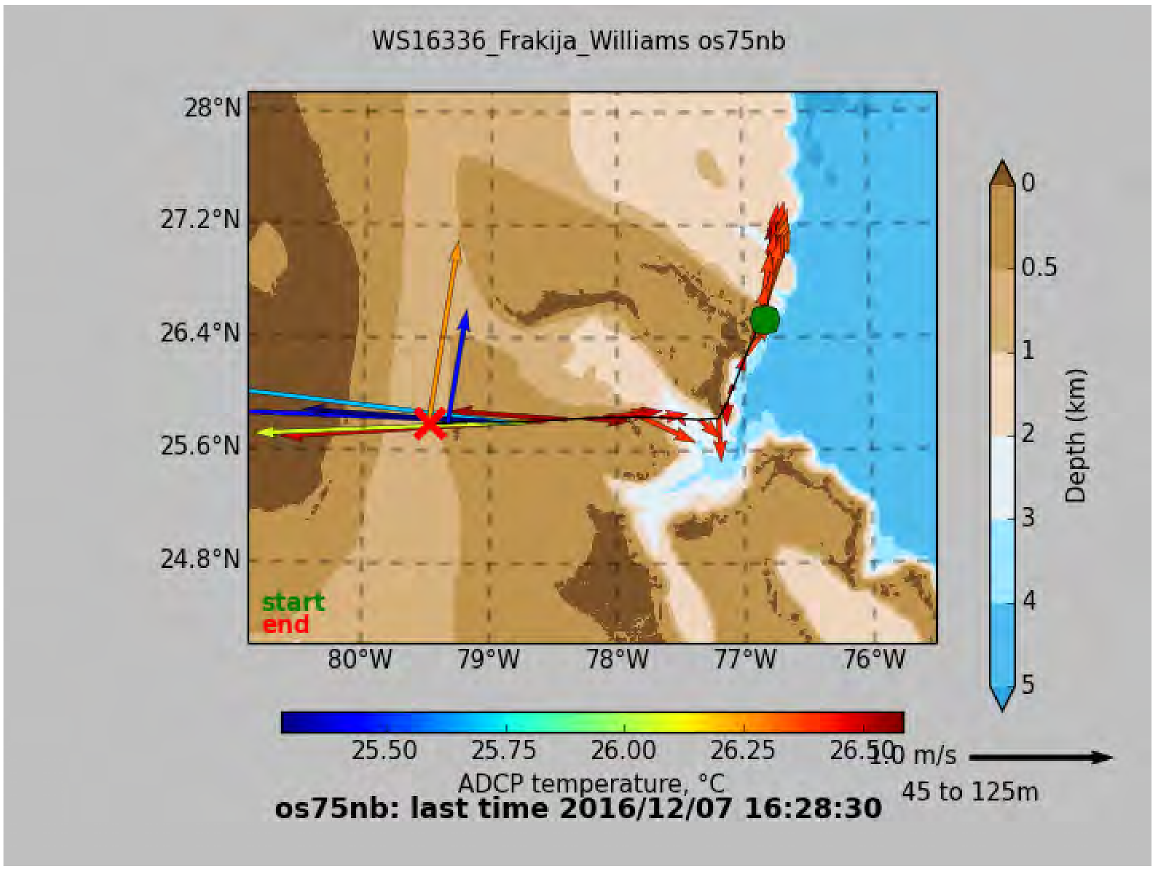

Figure 9: OS75 velocity vector plot.

10 VMP config file

```
; VMP-2000 setup file for MerMeed 04-December-2016
; Original instrument calibrations
; Calibration Certificate 14-06-2013
rate=512
prefix=WS16336_S07_
disk=
recsize=1
man_com_rate=4
profile=vertical
no-fast=6
no-slow=2

; fast channels 512/s
; slow channels 64/s
[matrix]
num_rows=8
row01= 255 0 1 2 5 7 8 9
row02= 32 40 1 2 5 7 8 9
row03= 41 42 1 2 5 7 8 9
row04= 4 6 1 2 5 7 8 9
row05= 10 11 1 2 5 7 8 9
row06= 12 0 1 2 5 7 8 9
row07= 16 17 1 2 5 7 8 9
row08= 18 19 1 2 5 7 8 9

[identification]
instrument=VMP-2000
sn=085
operator=BP/PP/DC

[channel]
id=0
type=gnd
name=Gnd
coef0=0

[channel]
id=1
type=accel
name=Ax
coef0=0
coef1=1
display=false

[channel]
id=2
```

```
type=accel
name=Ay
coef0=0
coef1=1
display=false

[channel]
id=4
type=therm
name=T1
adc_fs=4.096
adc_bits=16
a=-13
b=0.99882
G=6
E_B=0.68209
SN=T1167
beta=3143.55
T_0=289.301
units=[C]

[channel]
id=5
type=therm
name=T1_dT1
adc_fs=4.096
adc_bits=16
a=-13
b=0.99882
G=6
E_B=0.68209
beta=3143.55
T_0=289.301
diff_gain=0.93
display=false

[channel]
id=6
type=therm
name=T2
SN=T1165
adc_fs=4.096
adc_bits=16
a=-15
b=0.99831
G=6
E_B=0.68201
beta=3143.55
```

```
T_0=289.301
units=[C]

[channel]
id=7
type=therm
name=T2_dT2
adc_fs=4.096
adc_bits=16
a=-15
b=0.99831
G=6
E_B=0.68201
beta=3143.55
T_0=289.301
diff_gain=0.94
display=false

[channel]
id=8
type=shear
name=sh1
diff_gain=0.96
SN=M1042
sens=0.0745
adc_fs=4.096
adc_bits=16
display=false

[channel]
id=9
type=shear
name=sh2
diff_gain=0.96
SN=M1043
sens=0.0724
adc_fs=4.096
adc_bits=16
display=false

; pressure
; calibration 14-06-2013
[channel]
id=10
type=poly
name=P
coef0=7.28
coef1=0.12671
```

```
coef2=5.114e-8
units=[dBar]

; differentiated pressure
; calibration 14-06-2013
[channel]
id=11
type=poly
name=P_dP
coef0=7.05
coef1=0.12668
coef2=5.214e-8
diff_gain=20.17
display=false

[channel]
id=12
type=poly
name=PV
coef0=4.094
coef1=1.25e-4
units=[V]

; SBE temperature SN 5776
; calibration 16-5-2013
[channel]
id_even=16
id_odd=17
name=SBT1
type=sbt
coef0=4.38464568e-3
coef1=6.35487092e-4
coef2=1.93184296e-5
coef3=1.17635320e-6
coef4=1000
coef5=24e6
coef6=128
SN=5776
date=2013-04-19
units=[C]

; SBE cond SN 4169
; calibration 03-May-2013
[channel]
id_even=18
id_odd=19
name=SBC1
type=sbc
```

```
coef0=-9.86460693e0
coef1=0
coef2=1.39963442e0
coef3=-7.21250545e-4
coef4=1.09299904e-4
coef5=24e6
coef6=128
SN=4169
date=2013-05-03
units=[mS/cm]

[channel]
id=32
type=voltage
name=V_Bat
G=0.1
adc_fs=4.096
adc_bits=16
units=[V]

[channel]
id=40
type=inclxy
name=Incl_Y
coef0=0
coef1=0.025
units=[o]

[channel]
id=41
type=inclxy
name=Incl_X
coef0=0
coef1=0.025
units=[o]

[channel]
id=42
type=inclt
name=Incl_T
coef0=624
coef1=-0.47
units=[C]
```

11 Event Log

WS 12-2016 Event Log

#	Date/time	Longitude	Latitude	Event
1	7a 1 Dec	80° 11'	25° 42'	left dock
2	1 Dec 1330 local	79° 18.84'	25° 42.46	Captain → Bimini
3	1 Dec 1527 local	79° 18.92	25° 42.40	to clear there
~~4~~	1 Dec 2334 GMT	78° 53.374	25° 50.136	PSO Goes to bed.
4	2 Dec 0833 local	77° 01W	26° 15.5N	ADCP section 1 start
5	0910 local			Request eastward repositioning
6	1034 local		WP 2	to water > 300m
7	1110 local			test antenna + XCP
8	1123 local			WP 3 (North of end ADCP line)
9	1240 local			WP4
10	1427 local			WP5
11	1554 local	76° 42.55	26° 26.03	WP6
12	1608 local	76° 42.49	26° 25.85	VMP in water
13	1724 local	76 42.91	26° 25.57	~~head to WP7~~ VMP out
14	1735 local	"	"	head to WP7
15	1903 local		~~26 31.4314~~	WP 7
16	2004 local	76 53.5831	26 31.4314	@ WP 2/5
17	2025	76 53.4207	26 31.6897	@ VMP ST #2
18	2100	76 53.0429	26 32.612	VMP aboard (dry)
19	2122	76 52.880	26 32.912	VMP STA #2, cast 2
20	2132			cast 3 aborted
21	2140	76 52.7458	26 33.3356	cast 4
22	2206	76 57.6056	26 33.9314	cast 5
23	2237 local	76 52.3237	26 34.737	cast 6

WS 12-2016 Event Log

#	Date/time	Longitude	Latitude	Event
24	2313 local	76 51.954	26 35.729	cast 7
25	225 local 725 gmt	76°52.31	26° 32.57	Start VMP sxn 3
26	3 Dec 1605 gmt	76°42.24	26°32.85	end VMP sxn 3 (9 casts)
27	3 Dec 1120 local			Heading to WP8 for ADCP start
28	3 Dec 12:13(L)	76°42.1'	26° 36.4'	ADCP sxn from WP8
29	13:54(L)	76° 51.97	26° 24.09	@ WP#9
30	14:10 L	76° 52.18	26° 24.33	START VMP stn 4 — did 2 casts going W, turned around
31	2350	76° 52.19	26° 24.37	all to STN #5
32	0007 local ~~1207~~	76° 54.55	26° 23.97	ADCP sxn (WP#10) S to N
33	0223 L	76° 49.71	26° 37.01	WP# 11 end ADCP sxn
34	0758 g	76° 54.96	26° 36.91	VMP sxn 5 start
35	1011	76° 52.50	26° 36.82	funky V velo
36	1453	76° 47.04	26° 36.26	End VMP sxn 5
37	1531	76° 48.01	26° 36.72	Start VMP sxn 6 N to S
38	1437 local	76° 49.421	26° 32.337	End STN #6 P/U moved
39	1446 local	76° 49.449	26° 32.295	To XCP site
40	1538:30	76 52.592	26 36.946	XCP #1
41	1548	76 52.652	26 37.111	to VMP sxn 7; WP#12
42	1618	76 54.910	26 36.903	start VMP sxn #7
43	2236	76 49.577	26 43.786	pick VMP up & move to WP#13
44	2302(L)	76 48.365	26° 42.109	@ WP# 13
45	12/5 0520(L)			@ WP# 14 for VMP
46	0630(L)	26°42.01	76°49.13'	VMP finished
47	0634(L)			Transit to WP15

WS16336 Event Log

#	Date/time	Longitude	Latitude	Event
48	5/12 0752 l			let in ADCP
49	1323(g)			WP 15 - start ADCP W to E
50	1538(g)	WP16		XCP
51	1551(g)			VMP 8 start
52	2317(L)			VMP 8 end
53	2345(L)			@ WP#18
54	2351(l)			Start VMP 9@ WP18
55	1557(g)			End VMP 9
56	1150(l)			Test VMP spare
57	1737(g)			XCP
58	1741(g)			end XCP

Aim for ~1km/h over ground /1000db

MERMEED VMP 2000 LOG # 1

St. No.	Date (jday)		Latitude	Longitude	Time (GMT)	Water Depth	Max. Press.	File	Notes
S1	02/12	start	~~[illegible]~~		21:15	~4000	1200	WS16336_S01_001	Test station SW85 wire out
		max	26 26	76 42	21:48				
		end	26°25.72	76°42.69	22:24				
~~S2~~		start	26°25.52 ~~26 31.14~~	76° 42.91 ~~76 53.59~~		~~345~~			
		max							
		end							
S2	02/03	start	26 31.750	26 53.392	01:28	~275			cast #1 / lay 220 m wire out
		max			0				
		end			01:56	gave as deeply out. fish hooked			fish near surface breaker trips!
		start			02:00				
		max							
		end							
S3	02/03	start	26 32.912	76 52.880	02:22	>600		WS16336-S02-003	cast #2 lay 600 m out missing first 20 meters
		max			aborted 02:32	= 344 on lbs 00 on lbs			aborted 0232 breaker trips
		end							

MERMEED VMP 2000 LOG # 2

St. No.	Date (jday)		Latitude	Longitude	Time (GMT)	Water Depth	Max. Press.	File	Notes
S2	03/12	start	26 33.3356	76 52.7458	0240	sub bottom = ~~880~~ 450 m		WS16336-S02-004	try, try again
		max	26 33.59	76 52.166	0257		320		~500m wire out
		end	26 33.9314	76 52.6056	0306				
		start	26 33.9314	76 52.6056	0306	530	315	WS16336-S02-005	~600m wire out
		max	26 34.3225	76 52.494	0320				corrupt
		end	26 34.7218	76 52.3315	0337				
		start	26 34.737	76 52.3237	0337	~~[illegible]~~ 770	~500	WS16336-S02-006	~ wire out
		max	26 35.24	76 52.15	0355		=		aborted
		end	26 35.687	76 51.9675	0412		0bar		breaker tripped
		start	26 35.729	76 51.954	0413	deep	880	WS16336-02.007	all wire out
		max	26 36.478	76 51.643	0438	1280	=		2 bad buffers
		end	26 37.55	76 51.224	0518				
		start	26 37.64	76 51.17	0518	1300	917	WS16336-02.008	1500 wire out.
		max	26 38.417	76 50.766	0543	swath says			
		end	26 39.36	76 50.27	0616	1450m			

825
8

200 db = 300 m
260 db = 400 m
360 db = 600 m

MERMEED VMP 2000 LOG # 3

St. No.	Date (jday)		Latitude	Longitude	Time (GMT)	Water Depth	Max. Press.	File	Notes
S3	03/12	start	26° 32.57	76° 52.18	07:36	ADCP 400-600 swath 571m	470	WS16336_S3_001	730m 1 bad buffer
		max	26°32.599	76 51.905	07:50				
		end	26° 32.60	76° 51.75	08 02				360 db = 600 m
		start	26°32.60	76° 51.72	08:04	681m swath	573	WS16336_ S3_002	930 wire out 380 dbar = 600 m wire
		max	26°32.61	76°51.48	08:19				550 @ wire out. 1 bad buff
		end	26°32.61	76° 51.25	08:38				power breaker on upcast → no upcast
		start	26 32.6	76 51.197	08:41	888 m swath	930 dbar	~ S3-003	500 m wire = 230 dbar 800 m wire = 390 dbar
		max	26°32.62	76° 50.71	09:06				>1700 m wire out
		end	26° 32.65	76° 50.25	09:35				
		start	26 32.651	76 50.192	09:39	1248 m swath	989 dbar	~ S3_004	1500 m wire ~ 750 dbar
		max	26°32.65	76°49.73	10:04				905d stop paying
		end	26°32.66	76°49.10	10:41				1 bad buffer
		start	26°32.66	76°49.03	10 44	2100m swath	977	~ S3_005	1500 m wire ~ 860 dbar
Pos/time fail		max	26°32.68	76°48.51	1109				@670 m upcast
Surface Recover pos/time		end	26°32.69 26°32.70	76°47.85 76°47.73	1140 1146				failure with laptop

MERMEED VMP 2000 LOG # 4

St. No.	Date (jday)		Latitude	Longitude	Time (GMT)	Water Depth	Max. Press.	File	Notes
S3	03/12	start	26°32.70	76°47.68	1149	3126m Swath	953	WS16336_S02-009.p renamed S03-006a	Loaded with wrong config should be ~S03_006a.p 1500 m @ 854 db
		max	26°32.68	76°47.15	1214				1 bad buffer ~360dbar and ~10dbar
		end	26°32.76	76°46.37	1255				Fall rate=0.65/incl-x = 1.0±0.5°
		start	26°32.71	76°46.33	1257	3357m swath	1016	WS16336-S03-006p renamed -007a	should be S03-007p
		max	26°32.81	76°45.74	1323				1 bad buff ~270 dbr down
		end	26°32.82	76°44.88	1400				1500 m wire @ 840 dbar bad buff @ 100 up
		start	26°32.82	76°44.77	1405	3720 m Swath	940	WS16336-S03-008p	2.5km from 7
		max	26°32.82	76°44.20	1429				1500 m wire @ 820 db
		end	26°32.83	76°43.56	1500				1 bad buffer @ 914 dbar 1 bad buffer @ ~100 dbar
		start	26°32.83	76°43.50	1503	3787m Swath	960 m	WS16336-S03-009p	1 bad buff @ 27.
		max	26°32.80	76°42.98	1528				" @ 407
		end	26°32.85	76°42.24	1665.				870 @ wire out
S4	03/12	start	26 24.334	76 52.920	~~1909~~ ~~1910~~ 1910	2600m	620 db	WS16336-S04-001 p	1 bad Buffer @ 325 dbar
		max	26° 24.09	76° 52.79	1932				Boat running at 2knots started towing fish.
		end	26° 23.97	76° 54.25	2033				1 bad buffer @ 253 dbar

MERMEED VMP 2000 LOG # 5

St. No.	Date (jday)		Latitude	Longitude	Time (GMT)	Water Depth	Max. Press.	File	Notes
4	3/12	start	26° 23.971	76°54.280	2035	1492m	984	~ S04_002.p	1500m w/o @ 942 db
		max	26° 24.01	76° 54.66	2101				
		end	26° 23.68	76° 55.38	2142				Turning ship for last dip/end
		start	26° 23.931	76° 55.30	2207	380m	300	S04_003.p	of line for better pos relative to weather/seas.
		max	26° 23.93	76° 55.16	2215				440m
		end	26° ~~23.98~~ 23.984	76° 55.02	2223				Heading back toward wp9
		start	26° 23.94	76° 55.00	2225	746m		S04_004.p	with VMPs → only 3 prof between wp9 and current position.
		max	26 23.941	76 54.749	2242				→ opened accidentally the .p file may have confused software between ~100 and 150 db
		end	26° 23.95	76° 54.55	2255		664		@ 150 db comp died/reopened comp seems fine now
		start	26° 23.946	76° 54.46	2307	1339m	1147	S04_005.p	1x Bad buffer near surface
		max	26° 23.924	76° 54.069	2337				@ ~900 dBar ↑ comp died.
		end	26 23.764	76° 53.362	0027				reopened computer
		start	26° 24.024	76° 53.391	0141	2013	136x	S04_006.p	Sea water supply to hydro pack coolant goes well up.
		max	26 24.162	76° 52.963	0216		2?		pulled fish out & repositioned while waiting for repair
		end	26 24.293	76 52.231	0308				also swapped out logging computer.

one bad buffer

26 23.937
76 55.000

MERMEED VMP 2000 LOG # 6

St. No.	Date (jday)		Latitude	Longitude	Time (GMT)	Water Depth	Max. Press.	File	Notes
4	4/12	start	26° 24.299	76° 52.158	0314	2191	1217	S04_007.p	! NO BAD NEWS !! (1 Bad Buffer)
		max	26 24.357	76 51.735	0346				
		end	26 24.371	76 52.116	0442				
5	4/12	start	26° 36.84	76° 54.83	0809	926m swath	797	WS16336_S05_001.p	1200 m ~ 623 dbar + to 797 m ship @ 1.2kt → .6 kt
		max	26° 36.82	76° 54.41	0831				
		end	26° 36.87	76° 54.02	08 52				
		start	26° 36.87	76° 53.97	0854	1011m swath	1026 dbar	WS16336-S05_002.p	1600 m wire out
		max	26° 36.85	76° 53.45	0921				
		end	26° 36.84	76° 52.92	0951				
		start	26° 36.84	76° 52.86	0954	1247 swath	872 dbar	S05_003.p.	funky subsurface velo 1600m wire (@ 800dbar) 1 bad buffer
		max	26° 37.80	76° 52.37	1017				
		end	26° 36.72	76° 51.79	1048				
		start	26° 36.70	76° 51.71	1052	1438 m	792 dbar	S05_004.p	1860 m w/o = max
		max	26° 36.62	76° 51.24	1115				
		end	26° 36.60	76° 50.55	1148				

MERMEED VMP 2000 LOG # 7

St. No.	Date (jday)		Latitude	Longitude	Time (GMT)	Water Depth	Max. Press.	File	Notes
5	4/12	start	26° 36.59	76° 50.47	1152	1498m (swath)	863	_S05_005.p	~~17~~84m w/o @ 800dbar; 1 bad buffer; microT2 - strange near surface during processing (first look)
		max	26° 36 56	76° 49.96	1215				
		end	26° 36.50	76° 49.24	1252				
		start	26° 36.48	76° 49.16	1256	1557m swath	838	~~S06~~ -S05-006	
		max	26° 36.40	76° 48.68	1319				
		end	26° 36.33	76° 47.95	1355				
		start	26° 36.33	76° 47.87	1359	1617m swath	873	_S05_007	Recovering to replace microT out 1166 in 1165? 67?
		max	26° 36.25	76° 47.39	1422				
		end	26° 36.26	76° 47.05	1453				
6	4/12	start	26° 36.62	76° 48.02	1537	1573m swath	770	-S06-001.p	1800m w/o 735m
		max	26° 35.35	76° 48.11	1600				
		end	26° 35.93	76° 48.26	1638				
		start	26° 35.86	76° ~~48~~ 48.28	1645	1599m	784	_S06_002.p	1800 w/o @ 738m
		max	26° 35.63	76° 48.33	1705				
		end	26° 35.172	76° 48.511	1752				

MERMEED VMP 2000 LOG # 8

St. No.	Date (jday)		Latitude	Longitude	Time (GMT)	Water Depth	Max. Press.	File	Notes
6	4/12	start	26° 32.718	76 49.326	1833	1881		.506.003.p	No Bad Buffer
		max	26° 32.51	76° 49.40	1856		860		
		end	26° 32.337	76° 49.421	1937				
7	4/12	start	26° 36.903	76° 54.910	2118	926	791		1200 m wire out
		max	26 37.167	76° 54,579	2139	21 down		~507.001.p	
		end	26 38.350	76 53.454	2246	67 up garbage			
	5/12	start	26 37.915	76 53.668	2351			507.002.p	short test dip for winch
		max			0	7.KP			200 m wire out
		end	26 38.106	76 53.507	0001 ~~35~~			507003	
		start	26 38.113	76 53.498	00:02 +1	1296m (swath)		507.004.p	AOK
		max	26 38.179	76 53.013	0029		960		
		end	26 39.797	76 52.222	0116				
		start	26 39.847	76 52.178	0118	Deeper		507.005.p	AOK
		max	26 ~~40.500~~	76 51.663	0143		936		
		end	26 41.626	76 51.900	0222				

MERMEED VMP 2000 LOG # 9

St. No.	Date (jday)		Latitude	Longitude	Time (GMT)	Water Depth	Max. Press.	File	Notes
7	05/12	start	26 41.741	76 50.819	0226	Deep	997	S07.006.p	pick up & move to WP # 13
		max	26 42.454	76 50.336	0252				
		end	26 413.450	76 49.772	0325				
		start	26 42.104	76 48.382	0405		911	S07.007.p	
		max	26 42.068	76 48.383	0430				
		end	26° 42.05	76° 48.34	0511				
		start	26° 42.04	76° 48.30	0516	1879 swath	916	S07-008	all wire ~ 780db m
		max	26° 42.01	76° 48.01	0541				
		end	26° 41.99	76° 47.70	0616				
		start	26° 41.99	76° 47.66	0619	-	904	S07-009	
		max	26 41.937	76 47.413	0644				
		end	26° 41.88	76° 47.04	0718				
		start	26° 41.88	76° 46.97	0723	1988 m	938 db	S07_010	
		max	26° 41.88	76° 46.59	0748				
		end	26° 41.88	76° 46.16	0821				

MERMEED VMP 2000 LOG # 10

St. No.	Date (jday)		Latitude	Longitude	Time (GMT)	Water Depth	Max. Press.	File	Notes
7	5/12	start	26°41.88	76°46.10	0826	2042 swath	916	S07_010.p	1 bb
		max	26°41.83	76° 45.85	0850				
		end	26°41.72	76°45.49	0924				
		start	26°42.03	76°49.83	1022	1692 swath	1093	S07_012.p	
		max	26°42.05	76°49.61	1051				
		end	26°42.00	76°49.19	1125				
8	5/12	start	26° 31.00	76°48.81	1551	1390 m	920	S08_001.p	1600 m w/o @ 745db
		max	26° 31.00	76° 48.81	1615				
		end	26° 30.99	76° 48.81	1643				
		start	26° 30.98	76°48.81	1646	1390 m	1023	S08_002.p	1700 m w/o 840
		max	26° 30.99	76° 48.81	1713				
		end	26° 31.000	76°48.814	1746				
		start	26 30.991	76 48.809	1749	[illegible]	1041	S08_003.p	max w/o @ 1028
		max	26° 30.998	76 48.814	1817				
		end	26° 30.987	76 48.811	1857				

MERMEED VMP 2000 LOG # 11

St. No.	Date (jday)		Latitude	Longitude	Time (GMT)	Water Depth	Max. Press.	File	Notes
8	5/12	start	26 30.991	76 48.819	1901	1390	1030	S08_004.p	
		max	26 30.988	76 48.812	1928				
		end	26 30.987	76 48.814	1957				
		start	26 30.993	76 48.816	2000	1390	1036	S08_005.p	Profile stopped at 2020 just before max press.
		max	26 31.000	76 48.825	2028				
		end	—	—	—				
		start	26° 30.99	76° 48.82	2107	1390	1065	S08_006.p	1700 m @ 995db
		max	26° 31.00	76° 48.81	2135				
		end	26° 31.00	76° 48.81	2206				
		start	26° 30.99	76° 48.81	2210	1390	1062	S08_008.p	1700 m @ 941 db
		max	26° 31.00	76° 48.80	2237				#7 was a mistake
		end	26 30.998	76 48.803	2307				
		start	26 31.003	76 48.809	2310	1390	1075	S08-009.p	1059 @ full stop dBAR
		max	26 30.997	76 48.813	2338				
		end	26 30.991	76 48.816	0007				

0450 Start VMP 9

MERMEED VMP 2000 LOG # 12

St. No.	Date (jday)		Latitude	Longitude	Time (GMT)	Water Depth	Max. Press.	File	Notes
8	6/12	start	26 31.001	76 48.814	0012	~1390	1070	S08-010.p	1060 dBar @ wire out
		max	26 30.998	76 48.815	0040				
		end	26 30.968	76 48.827	0107				
		start	26 30.970	76 48.818	0110	~1390	1073	S08-011.p	1 Bad Buffer @ ~860 dBar
		max	26 30.977	76 48.818	0137				
		end	26 30.989	76 48.809	0213				
		start	26 30.993	76 48.815	0218	~1390	1068	S08-012.p	1052 dBar @ wire out
		max	26 30.987	76 48.812	0245				
		end	26 30.990	76 48.803	0309				
		start	26 30.990	76 48.805	0310	~1390	1047	S08-013.p	960 dBar @ wire out
		max	26 30.990	76 48.822	0338				
		end	26 30.972	76 48.804	0406				
9	6/12	start	26°32.31	76°51.61	0453	719	589	S09.001.p	1020 wire out
		max	26°32.31	76°51.62	0509				
		end	26°32.33	76°51.62	0526				

MERMEED VMP 2000 LOG # 13

St. No.	Date (jday)		Latitude	Longitude	Time (GMT)	Water Depth	Max. Press.	File	Notes
9	6/12	start	26°32.32	76°51.61	0531	719	652 dbar	S09_002p	1200 wire out
		max	26°32.32	76 51.61	0548				
		end	26°32.33	76° 51.61	0607				
		start	26°32.33	76° 51.61	061~~4~~	719	670 dbar	S09-003p	1250 wire out
		max	26° 32.32	76° 51.61	0631				
		end			0655				
		start			0658	719	640 dbar	S09_004p	1306
		max	26 32.332	76 51.612	07:18				
		end	26 32.33	76 51.61	07:41				
		start	26 32.331	76 51.608	07:45	719	676	S04-005.p	wire out of sheath at start of cast. 1288
		max			08 07				
		end	26 32.325	76 51.6179	08:28				
		start	26 32.321	76 51.612	08:31	719	715	S04-006.p	1340 strong bottom ε, separated from bottom
		max			08:51				
		end	26 32.326	76 51.613	09:12				

MERMEED VMP 2000 LOG # 14

St. No.	Date (jday)		Latitude	Longitude	Time (GMT)	Water Depth	Max. Press.	File	Notes
9	6/12	start	26 32.332	76 51.614	09:17	719	697 d6	S09-007.p	1290 wire out
		max			09:35				
		end	26 32.324	76°51.606	09:57				
		start	26 32.339	76°51.616	10:01	719	680	S09-008.p	1290 wire out
		max	26 32.314	76 51.614	10:19				
		end	26 32.327	76 51.607	10.43				
		start	26 32.332	76 51.611	10:46	719	703	S09-009.p	1300
		max	26° 32.33	76°51.61	11 05				
		end	26° 32.322	76°51.601	11 28				
		start	26° 32.322	76°51.601	1132	719m	710	S09-010.p	1302
		max			1150				
		end			1213				
		start	26°32.340	76°51.612	1216	719 m	711	S09-011.p	1303
		max	32.		1235				
		end	26° 32.342	76° 51.605	1255				

MERMEED VMP 2000 LOG # 13

St. No.	Date (jday)		Latitude	Longitude	Time (GMT)	Water Depth	Max. Press.	File	Notes
		start	26° 32.327	76°51.607	1257	719m	754	_S09_012.p	1302m w/o
		max	26° 32.374						
		end	↓	76°51.570	1344				
		start	26°32.346	76°51.599	1350	719	710	_S09_013.p	1 bb @ 674 upcast
		max	26° 32.313	76° 51.620	1409				
		end	26° 32.31	76° 51.618	1433				
		start	26° 32.32	76° 51.615	1435	719	737	_S09_14.p	1300 w/o
		max	26° 32.30	76°51.597	1455				
		end	26° 32.32	76° 51.61	1513				
		start	26° 32.314	76° 51.603	1516	719	735	_S09_15.p	
		max	26° 32.31	76° 51.61	1536				
		end	26° 32.32	76° 51.61	1557				
		start							
		max							
		end							

13 Logsheets - XCP

XCP Deployment Log Sheet

Cruise	WS16336	XCP serial #	15061041
Ship name	RV Walton Smith	Latitude	26 36.946 \ 2 min after
Date (YYYYMMDD)	20161204	Longitude	76 52.591 / deploy
Time GMT (HHMM)	20:38:30	Operator	EFW / ~~D~~GE / KP

Calibration data	
Compass voltage gain (GCCA)	1835.99
Correction voltage gain (GCORA)	909.60
Electric field voltage gain (GEFA)	24945.88
Electric field deviation (GEVFA)	500.51 Hz/V
Compass deviation (GCVFA)	495.11 Hz/V

Pre-deployment check		Comments
Remove tape from antenna	☑	
Remove electrode tape	☑	
Inspect agar jelly	☑	
Remove probe retainer tape	☑	
Dry test probe transmission (20 secs)	☑	done @ start of cruise

Recording and WinMK21 set-up		Comments
<New Drop Express>	☑	
<UW APL defaults>	☑	
Turn on recorder	☑	

Deployment			Comments
Time in water	2038		
Latitude in water	26°36.8253		
Longitude in water	76°52.5817		
Begin recording		☑	
Confirm RF quieting		☑	
Confirm probe release		☐	see below
Confirm probe signal data acquisition		☐	" "
End time	2044		" "
End latitude	~		" "
End longitude	~		" "
Select **<Exit Probe Drop>**		☐	" "

Comments: Power tripped twice during attempted deployment. The first time we delayed the deployment, it seems the radio tripped the breaker. Plugged everything into a different socket for second attempt, but when the probe hit the water ~~it tripped the~~ the radio signal from the probe seemed to trip the socket powering the DU so connection to computer was lost, but we still recorded the signal with the marantz.

Notes for next deployment

~ 4 nts steaming = 100 m @ 40 secs after deploy

Don't forget instructions to slow at 100 m

→ Helps if bridge puts mark on nav system so they can guage distance and stop at 100 m

→ Tell them it should take about 10 mins.

→ Leave enough time to input info into winMK21 before deploy → the numbers are largely irrelevant because we will extract data from recording.

→ Turn on recorder and make sure it doesn't auto-off → Perhaps record as soon as software loads and reciever is on.

→ Make sure the recorder is set to 16-bit .WAV and in mono.

→ Comp and recorder should be set up and turned on ~~long~~ before ~~the~~ making approach then all that needs to be done is put it in the water.

→ Make sure the audio cable is plugged into the front of the reciever

→ Listen to sound using headphones attached to Marantz

XCP Deployment Log Sheet

Cruise	WS16336	XCP serial #	15061003
Ship name	WALTON SMITH	Latitude	
Date (YYYYMMDD)	20161205	Longitude	
Time GMT (HHMM)	153807	Operator	DGE / EFW

Calibration data

Compass voltage gain (GCCA)	1835.90
Correction voltage gain (GCORA)	909.42
Electric field voltage gain (GEFA)	24914.73
Electric field deviation (GEVFA)	500
Compass deviation (GCVFA)	494.61

Pre-deployment check		Comments
Remove tape from antenna	☑	
Remove electrode tape	☑	
Inspect agar jelly	☑	
Remove probe retainer tape	☑	
Dry test probe transmission (20 secs)	☐	didnt pretest

Recording and WinMK21 set-up		Comments
<New Drop Express>	☑	
<UW APL defaults>	☑	
Turn on recorder	☐	

Deployment		Comments
Time in water		153807
Latitude in water		
Longitude in water		
Begin recording	☑	
Confirm RF quieting	☑	
Confirm probe release	☐	} float tipped over
Confirm probe signal data acquisition	☐	
End time		
End latitude		
End longitude		
Select **<Exit Probe Drop>**	☐	

Comments:

XCP Deployment Log Sheet

Cruise	WS16336	XCP serial #	15061035
Ship name	WALTON SMITH	Latitude	26°
Date (YYYYMMDD)	20161206	Longitude	76°
Time GMT (HHMM)	~~2045~~ 1729	Operator	DGE / EFW

Calibration data	
Compass voltage gain (GCCA)	1836.52
Correction voltage gain (GCORA)	914
Electric field voltage gain (GEFA)	25031.29
Electric field deviation (GEVFA)	500.99
Compass deviation (GCVFA)	494.60

Pre-deployment check		Comments
Remove tape from antenna	☑	
Remove electrode tape	☑	
Inspect agar jelly	☑	
Remove probe retainer tape	☑	
Dry test probe transmission (20 secs)	☐	

Recording and WinMK21 set-up		Comments
<New Drop Express>	☑	
<UW APL defaults>	☑	
Turn on recorder	☑	

Deployment		Comments
Time in water		12/6 17:37 (?)
Latitude in water		
Longitude in water		
Begin recording	☑	
Confirm RF quieting	☑	
Confirm probe release	☑	
Confirm probe signal data acquisition	☑	
End time		17:41
End latitude		26° 32.260
End longitude		76° 51.578
Select **<Exit Probe Drop>**	☑	

Comments:

14 Acknowledgements

We would like to thank the officers and crew of the *RV Walton Smith* for their expert and cheerful work in safely operating during VMP operations, and the Marine Operations department at University of Miami for their efficiency and enthusiasm in cruise preparations. The NMFD technicians were efficient, energetic, and expert in their operation of the VMP probes and winches, directly leading to the successful recovery of a high quality dataset.

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