CRUISE REPORT

R/V Endeavor Cruise EN-663

RAPID/MOCHA/WBTS Program
February 27 - March 16, 2021
Port Everglades, FL to Port Everglades, FL

1. Introduction and Objectives

The RAPID/MOCHA/WBTS program is a joint research effort between the University of Miami's Rosenstiel School of Marine and Atmospheric Science (RSMAS), NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML), and the U.K.'s National Oceanography Centre (Southampton, U.K.). The objective of this program is to continuously observe the strength and structure of the Atlantic meridional overturning circulation at 26.5º N using a trans-basin observing system. The U.K. program is part of the U.K. Rapid Climate Change Program (RAPID) funded by the National Environmental Research Council (NERC). The U.S. program is referred to as "MOCHA" (Meridional Overturning Circulation and Heat-flux Array) and is funded by the National Science Foundation (NSF). NOAA contributes significantly to the effort through its Western Boundary Time Series (WBTS) Program.

The objectives of cruise EN-663 were to:

1. Service (recover and redeploy) 4 deep-sea moorings located off the eastern Bahamas along latitude 26.5°N.
2. Retrieve data from 6 pressure-equipped inverted echo sounders (PIES) by underwater acoustic telemetry, and recover and redeploy two PIES.
3. Conduct CTD (Conductivity-Temperature-Depth) and Lowered ADCP (Acoustic Doppler Current Profiler) sections across the Florida Current at 26ºN and 27ºN, the Northwest Providence Channel, and along the 26.5ºN RAPID-MOCHA western boundary line east of Abaco, Bahamas.
4. Perform additional deep water CTD casts to calibrate moored instrumentation.

2. Cruise Synopsis

The cruise departed from Port Everglades (Ft. Lauderdale), FL on February 27 at 0908 local time. All times reported in this summary are in local time (EST or DST; note the local time changed to DST on March 14th), unless denoted by Coordinated Universal Time (UTC). The ship steamed eastward toward Northwest Providence Channel, enroute to the 26.5ºN section off Abaco, Bahamas where the first station work would begin. While crossing the Gulf Stream, five SofarOcean wind/wave drifters were deployed in a tight cluster near the axis of the Gulf Stream as part of a trial seeding effort for these drifters in the North Atlantic. The ship then stopped for a short CTD test cast in Northwest Providence Channel at 1900 on Feb. 27th.

The Abaco 26.5ºN CTD/LADCP section was commenced at 0938 on February 28th, and completed at 1120 on March 5th (stations 001 to 023). The NOAA/AOML CTD/LADCP system was used throughout the cruise for all CTD/LADCP stations, with a hybrid 150/300 kHz LADCP system using a NOAA 300 kHz Workhorse ADCP looking upward from the CTD frame and a NOAA 150 kHz ADCP looking downward. During this cruise we tried electronic logging for all the CTD and LADCP logsheets (using ipads instead of paper logsheets), and after some fine tuning this worked well for the rest of the cruise. The CTD and LADCP logsheets were uploaded directly to the ship data server after each cast along with the initial plots of the CTD and LADCP profiles.

The same set of dual CTD sensors (for temperature, conductivity, and dissolved oxygen) were used for the entire cruise, and they all performed well with only small differences noted between the sensor pairs. There were some intermittent communication problems with the LADCPs early in the cruise, causing us to swap out the 300 kHz LADCP after station 3, and the LADCP star cable and download cable after station 10, which successfully resolved these communication issues for the rest of the cruise. No LADCP data was lost, but an unintentional swap of cables during station 11 caused the 300 and 150 kHz ADCPs to get the reverse set of commands, leading to a sub-optimal (but recoverable) LADCP velocity profile for this station. As is typically the case for the deep stations along the Abaco line, some stations showed relatively large uncertainties in their processed velocity profiles due to the weak backscattering environment at depth. Higher winds and seas on March 3rd and 4th also required us to stay on station to sample the rosette bottles at several stations, causing some loss of time. Some of the stations suffered from large wire angles due to the ship having to steam into the wind at higher than normal speeds to maintain heading, particularly on stations 18 and 19.

While performing the Abaco CTD section, acoustic telemetry was attempted at each of the PIES sites along the section (PIES sites A, A2, B, C, D, and E) using the ship's hull-mounted 12 kHz transducers. Telemetry was successful at PIES sites A, D and E (only a telemetry test was performed at site A; full telemetry of its record was left until later in the cruise), however, communications were difficult with the other PIES and two of them (at sites B and C) did not appear to be sampling.

Due to an approaching front, and the expectation that we would have to recover and service more PIES than originally planned, the last five (easternmost) CTD/LADCP stations at the end of the 26.5ºN Abaco line were skipped to allow time for mooring operations to begin ahead of the incoming bad weather.

PIES E was recovered and redeployed on Mar. 5th after successful data telemetry.
The ship then steamed to the site of mooring WBC and it was successfully recovered and onboard by 1700 on Mar. 6th. PIES C was then recovered at 1914, and the ship steamed to PIES site A to attempt telemetry, but it was unsuccessful due to noisy conditions (or possibly too weak transmissions from PIES A). Telemetry was then attempted at PIES

A2 but was also difficult (noisy), and the PIES also showed signs of malfunction (breaking off its telemetry function unexpectedly when its sample burst time came). It was decided that PIES A2 should be recovered, and after a number of attempts release it, a release command was finally accepted and it was recovered at 1040 on Mar. 7th. The ship then moved back to PIES A for a re-try of the telemetry, but the telemetry failed again and PIES A was recovered at 1330 on Mar. 7th.

With the front now on us and northerly winds up to 30 knots, and with the forecast indicating no reasonable chance of conducting mooring operations until Tuesday Mar. 9, the ship turned southward and ran to Hole in the Wall to take shelter inside Northwest Providence Channel, so that respooling operations for the next tall mooring deployment could safely proceed.

The ship left Northwest Providence Channel at 1900 on Monday Mar. 8, arriving onsite at mooring WBC at 0630 Tuesday Mar. 9. Conditions were still rough (20-25 kt winds, 8' seas) but had come down enough to safely conduct mooring operations. Mooring WBC was successfully deployed at 1230 on Mar. 9, followed by recovery of PIES B at 1800 and redeployment of PIES B at 1850. The ship then headed to mooring WB0 for recovery, waiting onsite overnight. Conditions remained rough but mooring WB0 was successfully recovered at 0950 Mar. 10. Mooring WB0 was successfully redeployed at 1705 after respooling and preparing the deck. The ship then steamed to the site of PIES A2 and PIES A2 was successfully deployed at 2000 on Mar. 10.

Conditions on Thursday Mar. 11 were deemed too rough for operations involving tall moorings, so the day was spent recovering and redeploying the short bottom lander mooring (WBL3) and deploying a refurbished PIES C. By this time the NOAA/AOML team had recovered and redeployed 5 of the 6 PIES on the Abaco line, including three recovered PIES that had to be refurbished and redeployed.

On Friday morning Mar. 12, mooring WB3 was recovered in much improved conditions, and was safely onboard at 1205. The ship waited onsite for deployment while the mooring wire was respooled and the deck prepared, and a CTD "caldip" cast (CTD024) was conducted at 1900 to check the calibrations of the 16 SBE microcats that had been recovered from mooring WB3. The new mooring WB3 was successfully redeployed at 1445 on Saturday, Mar. 13. Having completed all the mooring and PIES operations on the Abaco line, the ship headed for the remaining CTD/LADCP stations in the Northwest Providence Channel and the Florida Current.

The Northwest Providence Channel section (CTDs 025-029) was completed on the morning and early afternoon of Mar. 14, followed by the Florida Current 27 ºN section (from east to west, CTDs 030-038) on the evening of Mar. 14 to early morning of Mar. 15. On CTD032, the third station along the 27 ºN section, the primary sensors became fouled with some jelly/salp material, causing noisy and biased data on the primary channels for that cast. Backflushing the sensors solved the problem for the next station. Two XCTDs were also fired on the 27 ºN section (at CTDs 033 and 035) to compare with the CTD station data.

After completion of the 27 ºN section, the remaining science time was evaluated and it appeared that there would be enough time to steam southward to the east end of the 26 ºN Florida Current section and complete that section from east to west before heading to Port Everglades for a 0900 arrival on Mar. 16, the scheduled arrival day for the cruise.

The 26 ºN section (CTDs 039-049) was started at 1700 on Mar. 15 and completed at 0600 on Mar. 16. The ship docked in Port Everglades at 0900 on Mar. 16.

All planned science operations were successfully accomplished except for five CTD/LADCP stations at the eastern end of the Abaco 26.5 ºN that had to be skipped due to weather and time concerns. Extra work accomplished on the cruise included the servicing of three additional PIES beyond those that were planned for replacement, and the completion of the 26 ºN Florida Current CTD/LADCP section.

3. Scientific Personnel

Name	Position	Organization
Bill Johns	Ch. Scientist	RSMAS/ U. Miami
Adam Houk	Scientist	RSMAS/ U. Miami
Mark Graham	Technician	RSMAS/ U. Miami
Eduardo Jardim	Technician	RSMAS/ U. Miami
Manish Devana	Student	RSMAS/ U. Miami
Christian Saiz	Technician	CIMAS/U. Miami
Grant Rawson	Technician	CIMAS/U. Miami
Pedro Pena	Technician	NOAA/ AOML
Ulises Rivero	Technician	CIMAS/U. Miami
James Hooper	Technician	CIMAS/U. Miami

4. Cruise Operations

4.1 Mooring Operations

Mooring Recoveries

Four subsurface moorings were successfully recovered from the locations listed in Table 1 and shown in Figure 1. These moorings contained a mixture of current meters, Acoustic Doppler Current Profilers (ADCPs), and temperature/salinity/pressure recorders. Site WBL3 is a short "bottom lander" mooring containing only a high precision bottom pressure sensor and releases.

Table 1. Mooring Recoveries

Mooring Site	Mooring Number	Latitude (ºN)	Longitude (ºW)	Depth (m)	Date of Recovery
WB0	M477	26° 30.54'	76° 50.52'	1006	03/10/2021
WB3	M478	26° 29.72'	76° 30.07'	4840	03/12/2021
WBC	M480	26° 30.70'	76° 06.44'	4819	03/06/2021
WBL3	M479	26° 29.50'	76° 29.20'	4846	03/11/2021

Mooring Deployments

Four moorings (3 taut-wire moorings and 1 bottom lander) were deployed at the locations listed in Table 2 and shown in Figure 1. Acoustic surveying of the on-bottom position of all moorings was successfully completed after each mooring deployment.

Table 2. Mooring Deployments

Mooring Site	Mooring Number	Latitude (ºN)	Longitude (ºW)	Depth (m)	Date of Deployment
WB0	M481	26° 30.55'	76° 50.51'	1004	03/10/2021
WB3	M482	26° 29.98'	76° 30.08'	4843	03/13/2021
WBC	M484	26° 30.89'	76° 06.59'	4816	03/09/2021
WBL3	M483	26° 29.52'	76° 29.02'	4846	03/11/2021

4.2 PIES Operations

In addition to the tall mooring and hydrographic operations completed on this cruise, the array of NOAA-funded pressure-equipped inverted echo sounders (PIES) operations were also completed (Table 3 and Fig. 2).

There were two scheduled recovery/deployments for this cruise, Sites A and E, and only telemetry planned for sites A2, B, C, and D. However, we found that the instruments at sites B and C were neither sampling nor transmitting and we also found that the PIES at site A2 was malfunctioning. Therefore, besides the planned turnarounds of PIES A and PIES E, The PIES at sites A2, B, and C also had to be recovered and redeployed. We brought two spare anchors and two sets of spare batteries but having only two sets of spares, we had to reuse batteries from the recovered PIES at Site A2. The ship provided two lead weights that we used as an anchor for the PIES at Site A2.

All telemetry and burst telemetry was conducted using the Benthos UTS-9425M deck unit S/N 71363 connected to the ship's hull mounted transducer via the Benthos Hull Mounted Transducer Interface (HMTI) box S/N 49668. Both hull mounted transducers were used at one point or another for telemetry. All of the deployed PIES were verified to be functioning correctly via burst telemetry sessions.

Table 3. PIES Operations

Site	Latitude	Longitude	Date GMT	Operation	S/N
A	26º 30.945’ N	076º 50.044’ W	7 Mar 2021 06:40	telemetry-failed	324
A	26º 30.945’ N	076º 50.044’ W	7 Mar 2021 18:30	recovery-success	324
A	26º 30.963’ N	076º 50.040’ W	7 Mar 2021 19:35	deploy-success	248
A2	26º 29.600’ N	076º 28.400’ W	28 Feb 2021 19:48	telemetry-failed	400
A2	26º 29.600’ N	076º 28.400’ W	7 Mar 2021 09:04	telemetry-failed	400
A2	26º 29.600’ N	076º 28.400’ W	7 Mar 2021 15:40	recovery-success	400
A2	26º 30.088’ N	076º 44.806’ W	11 Mar 2021 01:07	deploy-success	301
B	26º 29.467’ N	076º 28.187’ W	1 Mar 2021 10:14	telemetry-failed	301
B	26º 29.467’ N	076º 28.187’ W	9 Mar 2021 23:00	recovery-success	301
B	26º 29.523’ N	076º 28.218’ W	9 Mar 2021 23:51	deploy-success	324
C	26º 30.000’ N	076º 05.600’ W	2 Mar 2021 01:27	telemetry-failed	413
C	26º 30.000’ N	076º 05.600’ W	6 Mar 2021 00:14	recovery-success	413
C	26º 30.000’ N	076º 05.624’ W	11 Mar 2021 23:04	deploy-success	335
D	26º 30.112’ N	075º 42.318’ W	2 Mar 2021 12:39	telemetry	323
E	26º 30.067’ N	072º 00.000’ W	5 Mar 2021 12:55	telemetry-success	335
E	26º 30.067’ N	072º 00.000’ W	5 Mar 2021 13:00	recovery-success	335
E	26º 30.070’ N	071º 59.982’ W	5 Mar 2021 18:31	deploy-success	402

4.3 CTD/LADCP Stations

A total of 49 CTD stations were conducted during the cruise (Table 4, Figure 3a,b). At each station, profiles of temperature, salinity (conductivity), and dissolved oxygen concentration were collected from the surface to within nominally 10 m of the bottom, using a dual Sea-Bird SBE-911plus CTD system. Two of these stations were performed to provide calibration data for SBE microcat instruments to be deployed on (or recovered from) the moorings (CTDs 021 and 024). During these casts, the mooring instruments were attached to the CTD frame by straps and the CTD package was lowered to its target depth, with 5 minute bottle stops at 12 selected depths during the package retrieval. The outer Niskin bottles did not need to be removed from the frame to attach the microcats. This allowed the first dip cast to be done at station 21 with the regular CTD cast. The second was done after recovery of the moorings as a standalone cast. These casts are indicated by an asterisk (*) in Table 4.

Water samples for calibration of the salinity and dissolved oxygen profiles were collected using a 24-bottle Rosette system containing 12 liter Niskin bottles. Salinity samples were analyzed on a Guildline Auto-Sal salinometer, while dissolved oxygen samples were titrated using a modified Winkler technique with automated electrical endpoint determination. A high-precision, slow-response thermistor (SBE-35RT, sampling at the bottle stops) was also used on the CTD package for all the stations on this cruise to enable more accurate calibration of the CTD temperature sensors.

Water velocity profiles were also measured at the stations using a paired downward-looking 150 kHz and upward-looking 300 kHz Workhorse Acoustic Doppler Current Profiling 'hybrid" system (LADCP). Details on setup and operation of the dual LADCP system are contained in Appendix 1 of this report.

Table 4. CTD /LADCP Stations

Station	Date	Time (UTC)	Latitude (N)	Longitude (W)	Bottom Depth (m)	Max. CTD Depth (m)
1	02/28/21	1440	26 31.567	76 53.001	471	448
2	02/28/21	1610	26 31.018	76 49.777	1306	1292
3	02/28/21	1914	26 29.639	76 44.739	3823	3813
4	03/01/21	0004	26 29.801	76 39.673	4599	4588
5	03/01/21	0504	26 29.971	76 33.787	4833	4823
6	03/01/21	1002	26 30.295	76 28.862	4847	4840
7	03/01/21	1454	26 30.290	76 21.185	4845	4836
8	03/01/21	1953	26 29.875	76 12.980	4813	4803
9	03/02/21	0115	26 30.011	76 05.299	4803	4794
10	03/02/21	0654	26 29.937	75 53.952	4746	4736
11	03/02/21	1231	26 30.033	75 42.383	4692	4683
12	03/02/21	1734	26 29.980	75 30.008	4686	4679
13	03/02/21	2230	26 30.025	75 17.986	4639	4629
14	03/03/21	0326	26 30.029	75 05.053	4609	4606
15	03/03/21	0848	26 30.038	74 47.921	4541	4533
16	03/03/21	1410	26 30.127	74 31.130	4493	4488
17	03/03/21	1930	26 29.991	74 13.912	4545	4534
18	03/04/21	0147	26 29.804	73 52.014	4771	4754
19	03/04/21	0931	26 30.086	73 30.083	4954	4940
20	03/04/21	1719	26 30.007	73 08.229	5052	5041
21*	03/05/21	2336	26 29.974	72 46.118	5137	5127
22	03/05/21	0635	26 30.048	72 22.986	5183	5178
23	03/05/21	1243	26 29.959	71 59.420	5289	5279
24*	03/13/21	2358	26 41.842	76 24.263	4886	4837
25	03/14/21	1131	26 03.978	78 50.982	305	295
26	03/14/21	1250	26 10.066	78 48.049	456	447

27	03/14/21	1405	26 14.897	78 46.039	520	510
28	03/14/21	1528	26 19.843	78 42.848	676	662
29	03/14/21	1708	26 26.018	78 40.068	761	752
30	03/14/21	2313	27 00.019	79 11.879	473	466
31	03/15/21	0032	27 00.024	79 17.029	614	605
32	03/15/21	0154	27 00.194	79 22.847	691	681
33	03/15/21	0327	27 00.185	79 29.857	761	752
34	03/15/21	0631	27 00.211	79 36.632	678	665
35	03/15/21	0802	27 00.356	79 40.621	547	534
36	03/15/21	0943	27 00.242	79 46.844	394	382
37	03/15/21	1100	27 00.275	79 51.911	271	259
38	03/15/21	1210	27 00.211	79 55.921	151	141
39	03/15/21	2135	26 03.034	79 13.967	336	327
40	03/15/21	2234	26 03.041	79 18.750	490	480
41	03/15/21	2341	26 03.115	79 23.879	592	581
42	03/16/21	0051	26 03.109	79 28.904	680	670
43	03/16/21	0208	26 03.104	79 33.992	768	758
44	03/16/21	0328	26 03.085	79 39.869	702	693
45	03/16/21	0448	26 03.343	79 45.670	608	590
46	03/16/21	0624	26 03.275	79 50.946	325	315
47	03/16/21	0748	26 03.229	79 55.996	282	272
48	03/16/21	0844	26 03.195	79 59.812	251	240
49	03/16/21	0940	26 03.126	80 03.813	149	137

* Instrument calibration casts

5. Underway Measurements

Thermosalinograph

Values of surface temperature and salinity were continuously monitored using a Sea-Bird temperature-conductivity recorder installed in the ship's seawater intake line, and logged by the vessel's underway recording system.

Shipboard Acoustic Doppler Current Profiler

Upper ocean currents were continuously measured with a dual vessel-mounted Acoustic Doppler Current Profiler (ADCP) system consisting of a 300 kHz WH-ADCP and a 75 kHz Ocean Surveyor ADCP system. The depth range of good velocity data from the 300 kHz system typically extended to 80 m below the vessel, and for the 75 kHz system to 750-800 m. Data were processed onboard in real time using the UHDAS acquisition system. Gyrocompass data were continuously corrected by a Trimble ABX-2 inertial navigation system.

6. Preliminary Results

The velocity structure along the Abaco section showed typical features of the long-term mean flow observed here: a northward Antilles Current in the top 1000 m close to Abaco Island and a southward Deep Western Boundary Current (DWBC) below 1000 m just offshore of the Bahamas escarpment (Fig. 4a). A large, strong anticyclonic eddy was also present in the upper 1000-1500 m, centered at about 300 km seaward of Abaco Island. This eddy was also clearly evident in satellite-derived sea-surface height maps during the time of the cruise. As indicated by the westward zonal flow along the section (Fig. 4b) and the shipboard ADCP vectors (Fig. 5), the section crossed through the southern side of this eddy. The eddy also has the appearance of reaching to the bottom, but there is often a band of northward flow between 150-250 km on the Abaco section related to northward recirculation of the DWBC, so the alignment of the upper ocean and deep ocean flows within the eddy may be coincidental. Another band of deep northward flow was observed at the end of the Abaco line that may also be related to DWBC recirculation.

The Florida Straits and Northwest Providence Channel sections (not shown) revealed fairly typical flow conditions in both channels, with maximum speeds in the surface core of the Florida Current of about 2 m/s, and northwestward flow in NW Providence Channel of up to 0.6 m/s that was subsurface intensified on the southern side of the channel.

7. Release of Project Data

In accordance with the provisions specified in the cruise prospectus and application for Bahamian clearance, the full data results from this experiment will be provided to the Commonwealth of the Bahamas according to the following schedule:

Shipboard Measurements
All shipboard measurements, including underway data records and CTD/LADCP station data, will be provided in preliminary form within 60 days of the termination of the cruise (May, 2021).

Moored Instrumentation
Time series data records from the moored instruments will be provided within 2 years of recovery of the instruments (nominally March, 2023).

8. Acknowledgements

The support and able assistance provided by the Captain and crew of the *R/V Endeavor* is gratefully acknowledged. Support for the scientific research was provided by the U.S. National Science Foundation and the NOAA Climate Program Office. The Commonwealth of the Bahamas graciously granted privileges to conduct scientific research in their territorial waters.

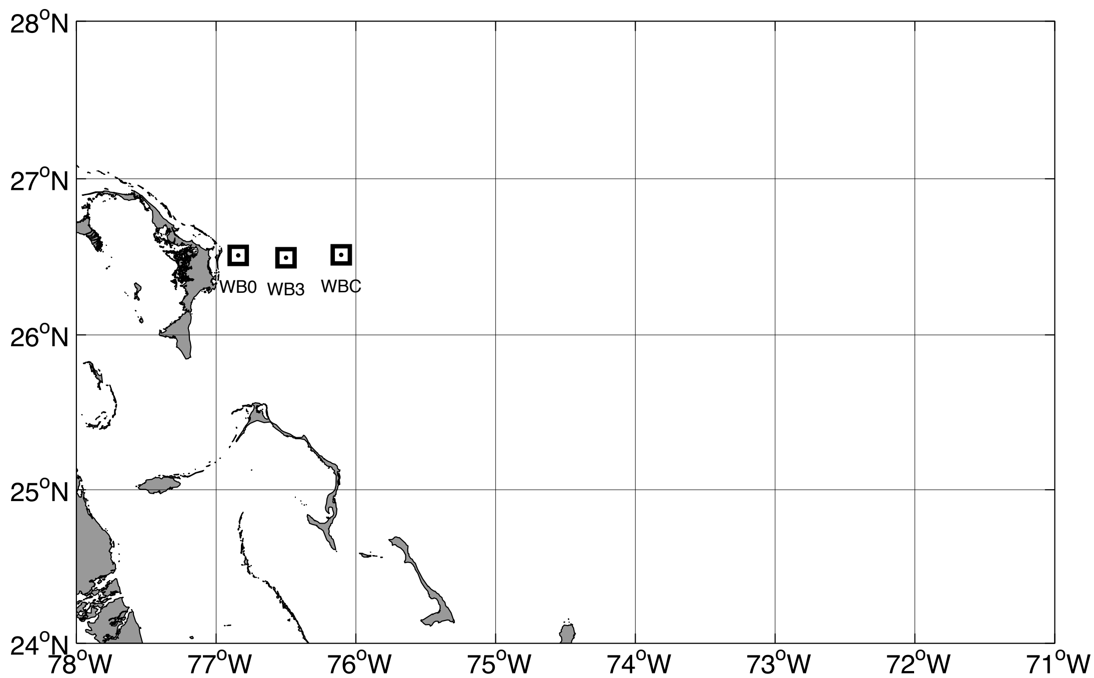

Figure 1. Current meter moorings recovered and deployed on EN-663. An additional "bottom lander" mooring (WBL3, not shown on map) was deployed near mooring WB3.

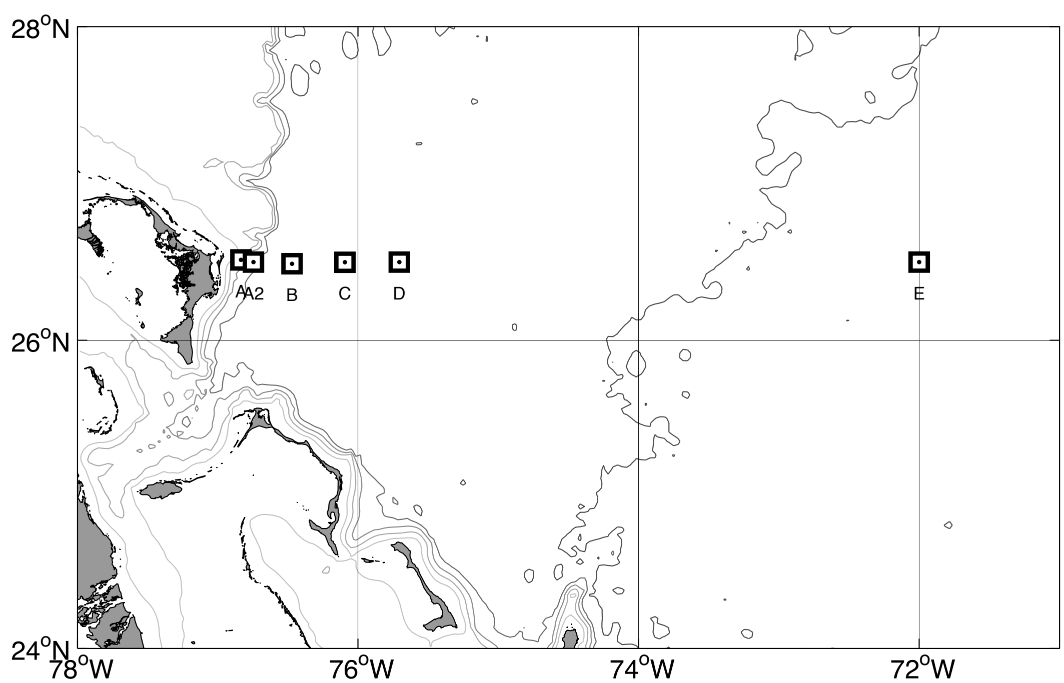

Figure 2. PIES locations along the 26.5° N Abaco line.

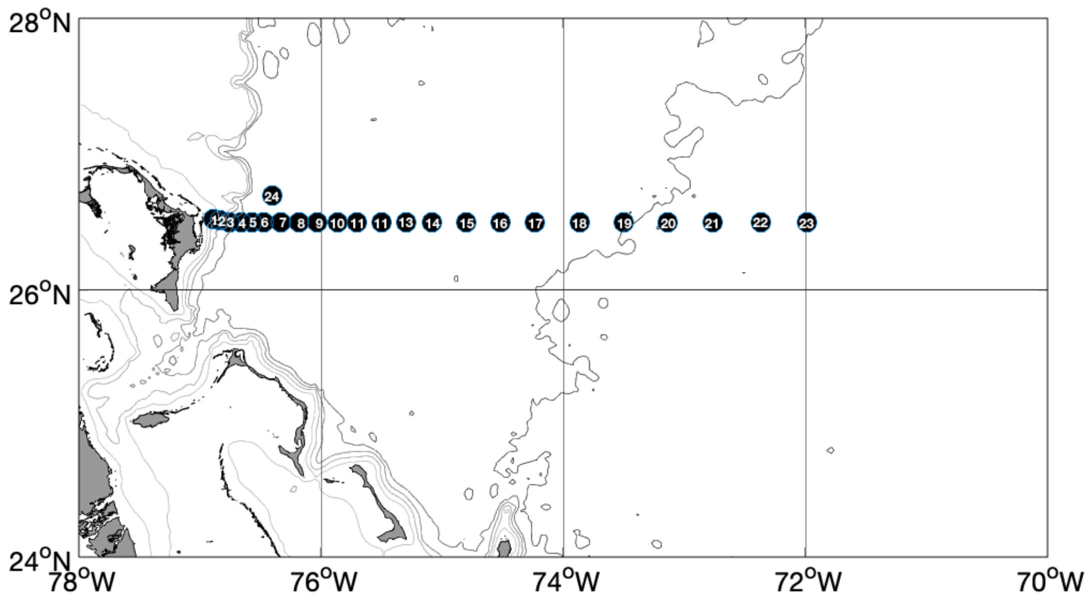

Figure 3a. CTD/LADCP stations occupied along the 26.5° N Abaco line.

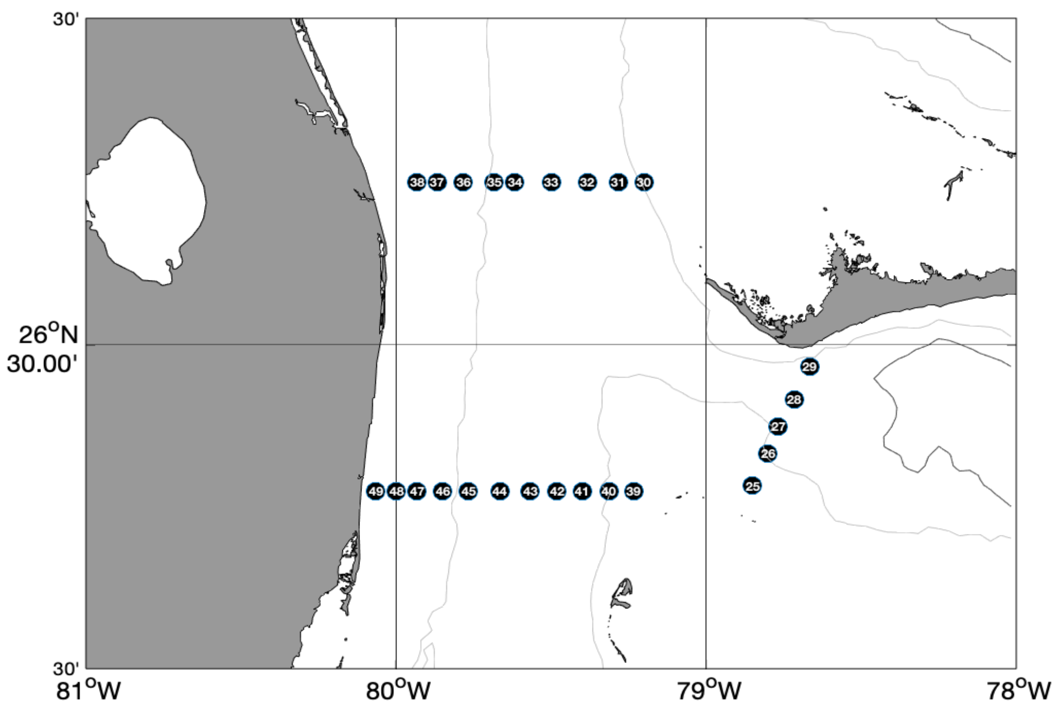

Figure 3b. CTD/LADCP stations occupied along the 26° and 27° N Straits of Florida sections and across the Northwest Providence Channel.

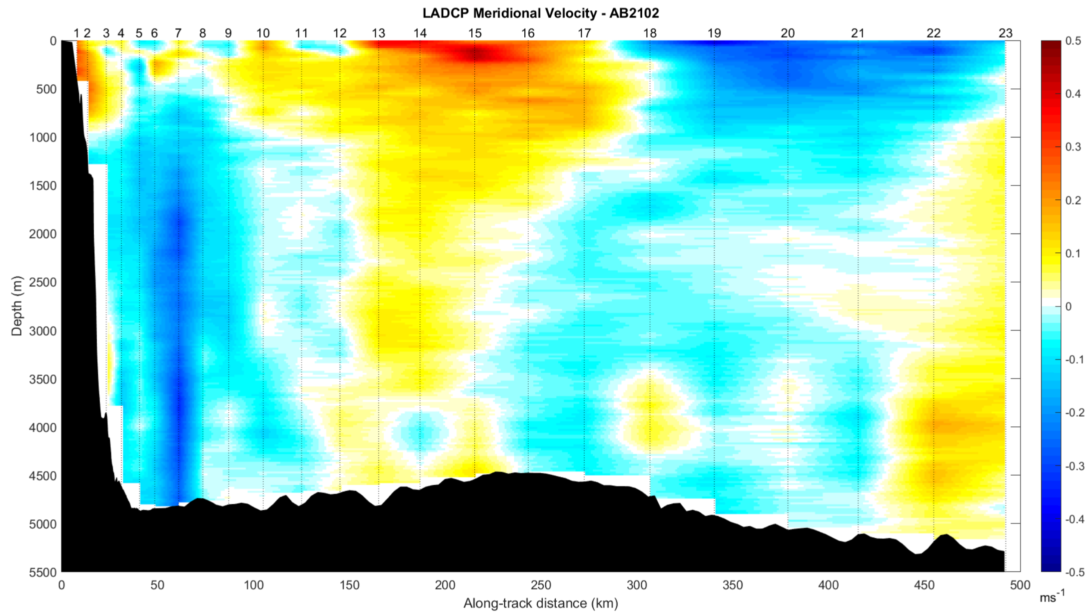

Figure 4a. Meridional velocity section for the Abaco line, from Lowered-ADCP profiles collected at the CTD stations.

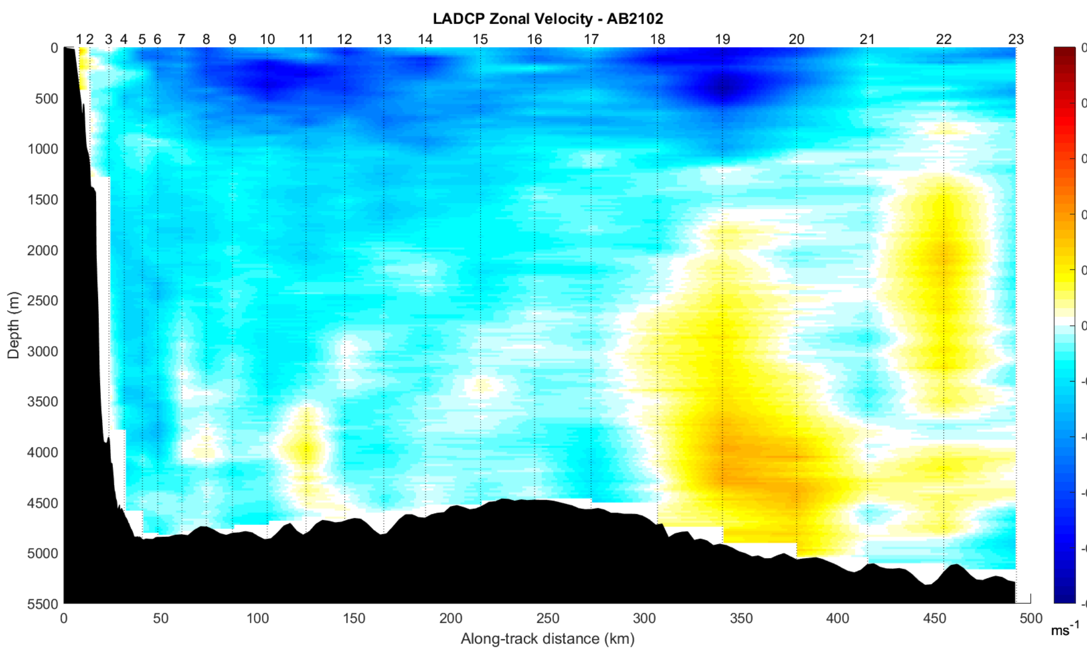

Figure 4b. Zonal velocity section for the Abaco line, from Lowered-ADCP profiles collected at the CTD stations.

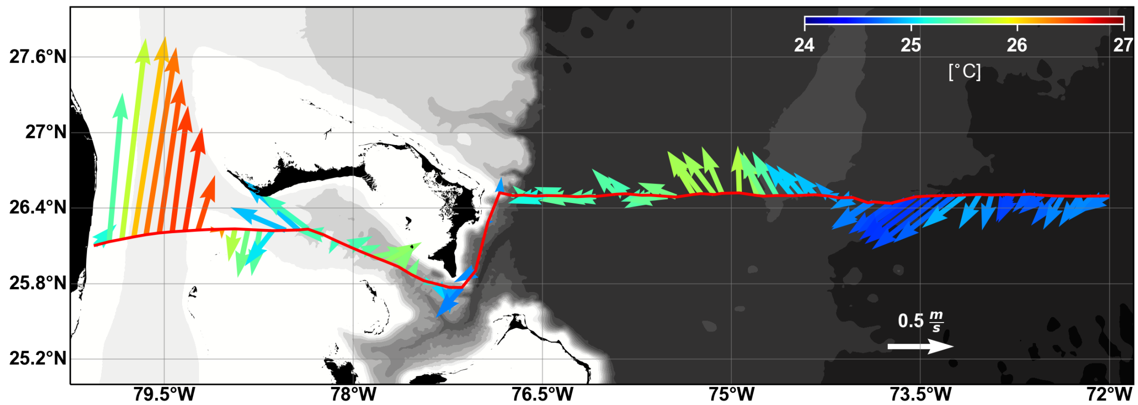

Figure 5. Near-surface currents (average over top 100m, color coded by sea-surface temperature) along the outbound cruise track and Abaco CTD line (Feb. 27- Mar. 5), derived from the vessel-mounted ADCP.

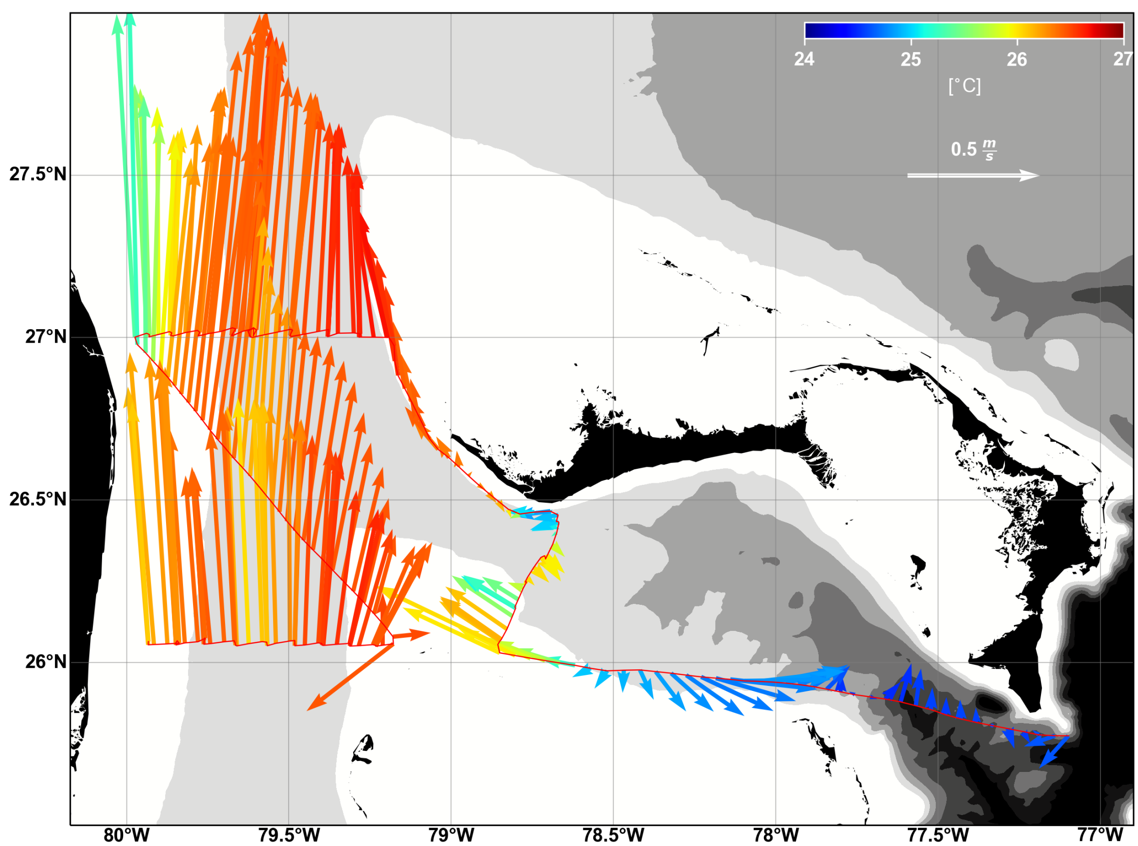

Figure 6. Near-surface currents in the Straits of Florida and Northwest Providence Channel on March 13-16, derived from the vessel-mounted ADCP.

Appendix 1. Lowered ADCP Operations

Pedro Pena
15 Mar 2021

LADCP Setup:

Full water column velocity profiles for the MOCHA February-March 2021 cruise were collected using a hybrid 150/300kHz Workhorse configuration. The instruments, cables, and related equipment were supplied by NOAA AOML's physical oceanography group. The primary downward-looking 150 kHz ADCP was S/N 18145. The upward-looking 300 kHz ADCP was S/N 13493 for the first 3 casts and S/N 15329 for the remaining casts. Custom-made 48-volt lead-acid battery packs were supplied by AOML. The two Workhorse ADCPs were mounted on AOML's 24-bottle CTD rosette. The upward-looking ADCP was mounted near the outer edge of the rosette, situated above the upper rim of the frame. The downward-looking 150 kHz ADCP was mounted in the center of the frame adjacent to the SBE9 CTD, with the transducer face about 10 cm above the bottom of the frame. The battery pack was secured adjacent to the downward-looking ADCP using brackets bolted to the bottom of the rosette frame. Both ADCP's were wired to run off a single battery pack and communicate with each other using a standard star-cable.

Data Acquisition Setup:

The 150 kHz ADCP was configured for 16 16-meter bins, 16 meter blanking distance, and an ambiguity velocity of 350 cm s^{-1}. The 300 kHz ADCP was configured for 20 8-meter bins, zero blanking distance, and an ambiguity velocity of 250 cm s^{-1}. The units were configured for staggered single-ping ensembles; the upward-looking ADCP was set to 1 sec ensembles, and the downward-looking ADCP was set to burst-sample every 2 seconds with 0.8 seconds between pings. Measurements were saved in beam coordinates, with 3-beam solutions and bin-mapping disabled. Both ADCP's were running firmware version 50.40.

Inside the main lab of the R/V Endeavor, a dedicated PC laptop running MX Linux with a two-port USB-serial hub was set up as the primary data acquisition platform. A dual-terminal program written in Python ('ladcp2.py' which is included in the UH-DAS ADCP software package) was used to communicate with the instruments. Data files downloaded to the acquisition PC were transferred to the ship's public network drive for processing and archiving. A single cable with dual serial port lines, along with power leads connected to the power supply, was run outside to the CTD rosette where it plugged into the star-cable wiring.

A Siglent SPD3303X-E programmable DC power supply was used for charging the battery pack. Voltage channels 1 and 2 were each set to 28 volts and bridged in order to provide a total of 56 volts. The power supply provided a digital readout of the current being consumed by the battery pack and aided in making the decision of whether or not to swap the battery pack before a cast.

Initially it was decided that if the current was above .25 amps before a cast, the battery pack would be swapped for a fully charged one. However, a 4800 meter cast was successfully completed when the current draw was showing .70 amps before a cast. The ability to control the voltage and monitor the current was very helpful and as a result there were no LADCP dropouts during any of the casts.

The two raw ADCP data files were processed on the acquisition computer and a second computer with uncorrected one-second time-series CTD data provided by the CTD operator. The initial processing of the raw ADCP data was done using a compiled version of M. Visbeck version 10.20 & A. Thurnherr MATLAB toolbox, modified by G. Krahmann.

Operational Issues:

Cabling issues

The primary deck lead was working intermittently so it was swapped for the spare deck lead after station 10.

Equipment issues

The upward-looking 300 kHz ADCP S/N 13493 was communicating intermittently but never actually failed. Downloading the cast after station 3 was done with a communications cable made by Adam Houk while at sea.
The ADCP itself seems to be functional but there may be issues with the seven pin bulkhead connector used for communications and power.

Configuration issues

The secondary deck lead was not properly labeled after installation and as a result the profiles for station 10 were swapped after the download. This was caught during processing and the files were renamed. The cast processed correctly because the ADCPs were deployed with the correct command files but for station 11, the ADCPs were deployed with the command files swapped so the cast did not process correctly.

Command files for the WH300 and WH150:

```
Workhorse 150 kHz Downward-looking ADCP (MASTER) Command File
Filename: AB2102_150kHz_down_master.cmd
PS0
OL
rnMASTR
CR1
WM15
TC2
TB 00:00:02.00
TE 00:00:00.80
TP 00:00.00
```

```
WP 1
WN016
WS1600
WF1600
WV350
EZ0011101
EX00100
CF11101
SM1
SA011
SW05000
T?
L?
TS?
CS
```

```
Workhorse 300 kHz Upward-looking ADCP (SLAVE) Command file
Filename: AB2102_300khz_up_slave.cmd
PS0
OL
CR1
rnSLAVE
WM15
CF11101
EX00100
EZ0011101
WP1
TE 00:00:01.0
TP 00:00.01
SM2
SA011
WN020
WS0800
WF0000
WV250
LZ30,220
CK
T?
L?
CS
```