AB0603 ADCP Report: Lisa Beal and Tania Casal

SADCP operations were run throughout the cruise without incident, beginning the moment we exited Caribbean coastal waters and were legally able to collect measurements. The instrument was configured with an 8 m blank and 50 bins of 16 m length using the command file that Beal implemented during AB0509. First-pass processing was completed on the full cruise of SADCP measurements, but a manual heading correction will be required in post-cruise processing before the final ocean velocities can be obtained.

For LADCP operations we ran a hybrid system, consisting of a down-looking 150 kHz broadband instrument (BB150) and an up-looking 300 kHz Workhorse (WH300), both instruments run on a single 60 V rechargeable battery pack. Operations were plagued with problems for several days during the cruise, resulting in the loss of ten stations of data on the eastern end of the main Deep Western Boundary Current (DWBC) section. Station 14 and following (with the exception of station 16 where BB150 data was lost due to operator error) are complete and of good quality. These stations include the core of the DWBC and the Gulf Stream sections.

Shipboard Acoustic Doppler Current Profiler (SADCP)

The SADCP aboard the NOAA Ship *Ronald H Brown* is a 75 kHz Ocean Surveyor, which was installed in mid 2005. Since the last Abaco cruise the GPS acquisition system and antenna placement has changed on the *Brown*, affecting the quality of the SADCP ocean velocities. GPS is now acquired via FURUNO, since P-code has become obsolete, with the antenna situated over the bridge rather than on the stern. This should be an advantage, producing cleaner data which no longer requires a post-processing fix for the GPS-SADCP offset.

The SADCP was configured in narrowband mode, using command file *beal_rb_nb16.txt*, with a heading correction of 22.7 degrees and ensembles times of 2 s dialed in using the VmDAS GUI. Near real-time ocean velocities are obtained using ship's gyro, which is fed into the snychro-feed on the back of the deck box. These velocities are immediately displayed by VmDAS and have order ± 10 cm s^{-1} error. Data from a MAHRS (an accelerometer assisted gyrocompass) is logged by VmDAS via a serial port for later off-line heading correction. SADCP data acquisition was started at 19:30 on the 11th March; half an hour after the ship entered international waters and ended at 03:00 on 28th March. Bottom track data for improved calibrations was obtained during the final five days of the cruise, when water depth was shallow.

Lowered Acoustic Doppler Current Profiler (LADCP)

LADCP operations were run without the aid of a knowledgeable technician, owing to the last minute replacement of Ulyses Rivero with first-timer Rigoberto Garcia (Rivero suffered an injury the weekend prior to the cruise.) The BB150 had recently been returned from Teledyne-RDI, where a transducer head was replaced (beam 2, although it was later discovered that the beam numbers were switched during repair). We ran the "hybrid" LADCP system, with a down-looking BB150 and an up-looking WH300.

Data Acquisition Set-Up: The LADCP PC was set up in the aft wet lab. Three deck leads were run out through a bulkhead conduit to the deck: one power cable with two stripped wires at one

end and a two pin sea connector at the other; one communications cable with an RS232 connector at one end and an eight pin sea connector at the other; a second communications cable with an RS232 connector at one end and a square seven pin sea connector at the other. The power cable was hooked up to the 60 V power source in the lab. There was some confusion over whether to hook the black (negative) wire into the white or black pin on the power source: the white pin was found to be correct, so the colours were switched on the box to avoid future confusion (to non-technicians!). The eight-pin comms. cable was connected into COM1 of the PC, so that communication to the BB150 was via COM1. The seven-pin comms. cable was connected to COM2, so that communication with the WH300 was via COM2.

Pre-cruise Tests: Once communications were established with the LADCP's a number of standard tests were performed to check that the instruments were healthy. For the BB150 *bbtest.exe* was opened and all tests run, including the rub beams test. All tests were passed, except the wide bandwidth ($BITest$), which was not considered significant, although RDI manuals were not available to check this. For the WH300 the command *pa* was run in $BBTALK$ which carried out a suite of tests. Again, only the wide bandwith test failed.

Instrument Configuration: The BB150 was configured with an 8 m blank, 16× 16 m bins, and a staggered ping cycle to minimise bottom interference layer problems (see command file *bblisa.cmd* in LADCP directory for all set-up details). The WH300 was configured with 16× 10 m bins, a 1 second ensemble, and zero blank-after-transmit, which has been shown to reduce bias problems in the close bins (see *whlisa.cmd*). The first bin, which is contaminated by ringing, is then discarded during processing.

Deployment and Recovery: Deployment and recovery were achieved by using the RDI $BBTALK$ software to communicate with the instruments and send command files etc, except downloading of the BB150 which was achieved using a shortcut called $BBRecovery$. Upon deployment and recovery of the first ten casts battery voltage was checked via the power supply, but this was found to be of limited use. Subsequently, instrument voltages were checked directly using commands $PT2$ for BB150 and $PT4$ for WH300 (this has been done in past cruises and was initially forgotten). Moreover, after some recharging problems, instrument voltages were checked BEFORE the power supply was reconnected to recharge the battery after a cast. This was found to provide voltages more representative of the remaining charge left on the instruments at the end of a deployment. A copy of the LADCP log sheet is included at the end of this section.

Processing: Version 9 of Visbeck's software was used to process all LADCP data. This version is the same as 8b in terms of the modal energy cascade and in terms of the close agreement in the amplitude of the top-to-bottom shear to Firing's shear method. However, version 9 has some added editing (from Thurnherr) that better suits BB150 processing. For first pass processing only ancillary navigation data was used to obtain a realistic barotropic current; CTD and bottom-tracking velocities were not used in the initial inversion. In this way the first pass gives a true representation of the quality of the profile and the operator can easily diagnose poor signal-to-noise and bias error problems. After station 30, first pass processing was performed without navigation data, since the acquisition PC took far too long to parse the ship's 1-second (cruise-long) navigation file. (This is not a limitation on a linux or MAC OSX, where the use of awk scripts can parse a 50 MB file in less than one minute). Hence, first-pass profiles are referenced to zero mean in the NW Providence Channel and Gulf Stream sections and should not be expected to match the shown bottom-tracking velocities.

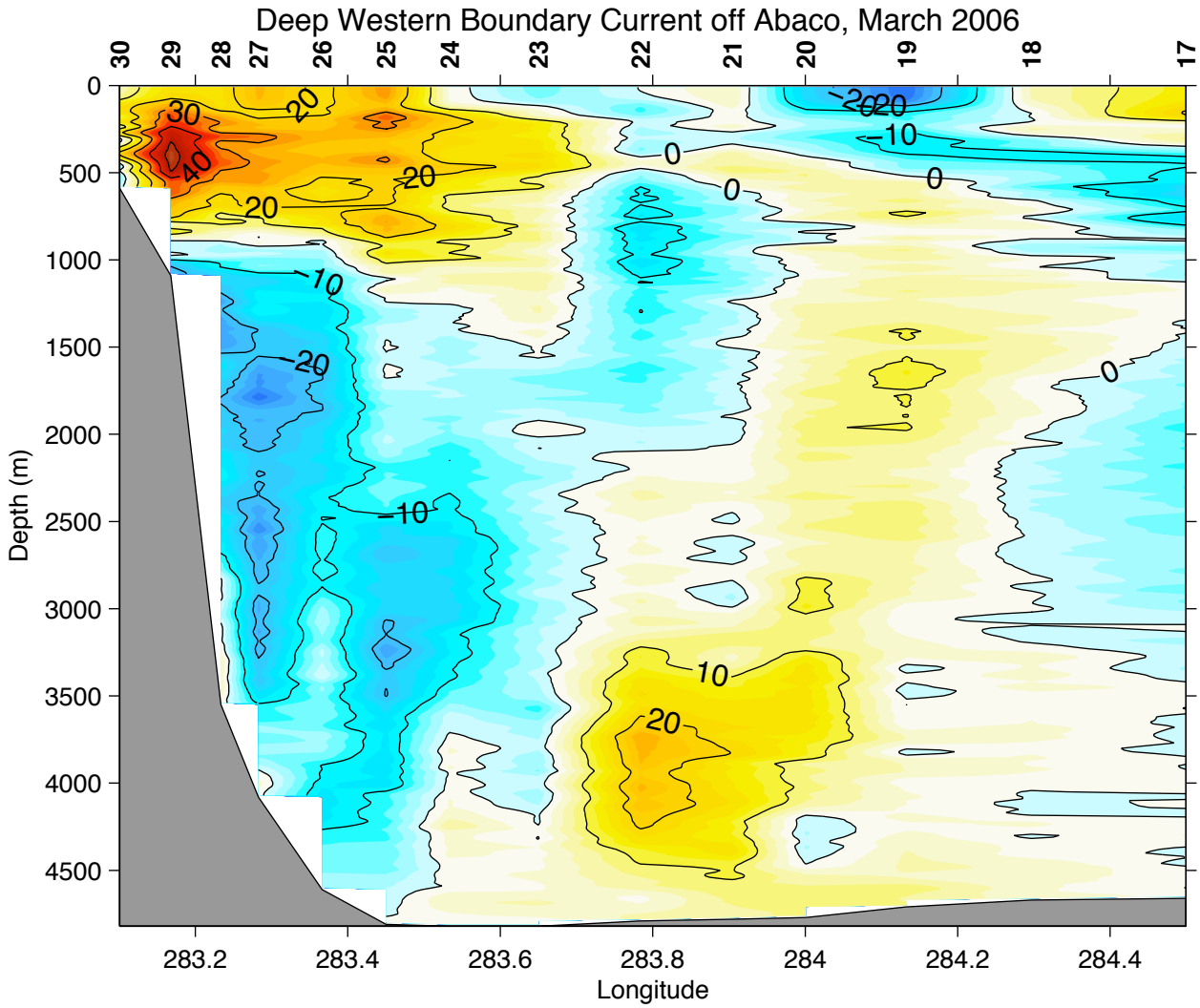
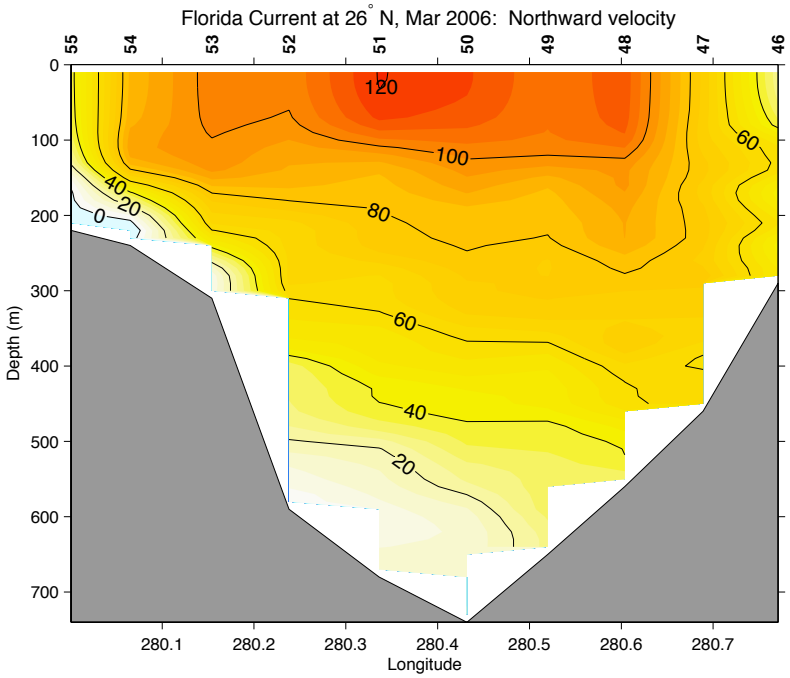


Figure 1: Deep Western Boundary Current and Antilles Current with sub-surface core. Off Abaco Island, March 2006, stations AB0603: 17 - 30

For second pass processing time series CTD data (standard SeaBird output: $*WE\text{-}CTM\text{-}Filt.cnv$), bottom-tracking velocities, and navigation data were used to constrain the LADCP full-depth ocean velocity profile. Second-passed LADCP profiles are available as of cruise end. The remaining processing step, to utilise SADCP velocities in the inversion, is left for after the cruise when SADCP final data will be available.

Problems: On station 4 the BB150 was diagnosed with a broken beam (no. 2) during first-pass processing. Prior to this, the echo amplitude had been decreasing steadily. On station 5 beam 2 was "broken" and beam 3 "bad". In addition, the up-looking WH300 (S/N 1856) stopped pinging during the cast. The BB150 was swapped out for a down-looking WH300 (S/N 1410) and the package redeployed with 1410 slaved to 1856. Both instruments stopped pinging after about half an hour. For station 7 the package was deployed with 1856 slaved to 1410 and this time 1410 collected good data, but 1856 still failed. On cast 8 the star cable was switched around where it connects into each instrument to test whether cabling issues were causing a lack of power. Still 1856 failed. On


Florida Current at 26° N, Mar 2006: Northward velocity
55
54
53
52
51
50
49
48
47
46
0
100
200
300
400
500
600
700
Depth (m)
120
100
80
60
40
20
0
280.1
280.2
280.3
280.4
280.5
280.6
280.7
Longitude

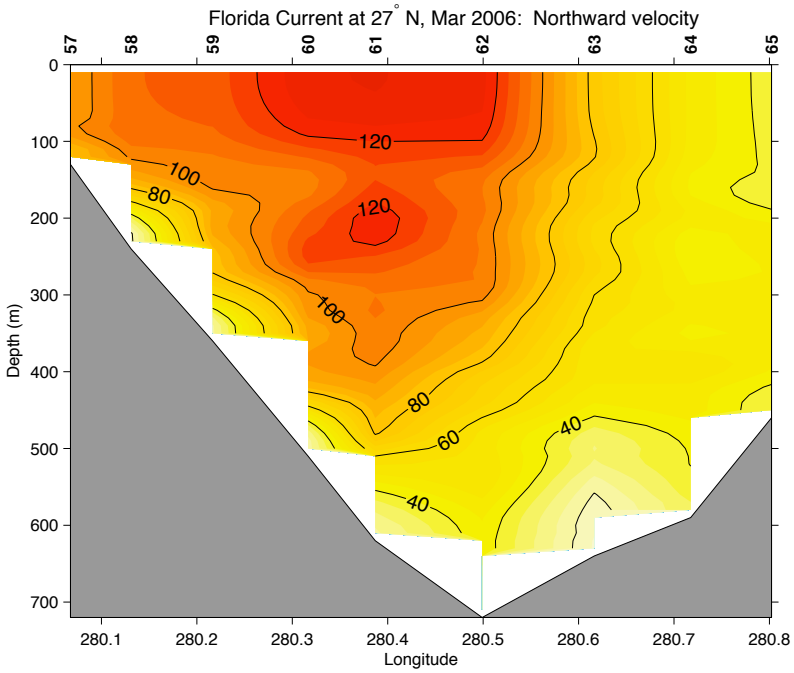

Florida Current at 27° N, Mar 2006: Northward velocity
57
58
59
60
61
62
63
64
65
0
100
200
300
400
500
600
700
Depth (m)
120
100
80
120
100
80
60
40
40
280.1
280.2
280.3
280.4
280.5
280.6
280.7
280.8
Longitude

Table 1: Summary of LADCP Data problems

Station(s)	Configuration	Outcome
1, 2, 3	Hybrid	**good data**
4, 5	Hybrid	no BB150 data
6	Dual WH	no data
7, 8	Dual WH	no up-looker data
9	Dual WH	no data
10, 11	Dual WH	**good data**
12, 13	Dual WH	no up-looker data
14	Hybrid	BB150 wrong date
15	Hybrid	**good data**
16	Hybrid	BB150 no data
17 onwards	Hybrid	**good data**

station 9 both instruments failed and it was clearly diagnosed as a power problem. The batteries appeared to be holding charge, yet the instruments were not recharging. WH300 voltages were found to be 41.5 V and 45 V - but due to the lack of documentation we were not sure what their voltage should be. (Power supply voltage is $\pm 30V$.) Intermittent communication with the uplooker was also a problem.

Before station 10 a disposable battery pack was fitted to the frame and both WH300's re-cabled to receive power from it. Good data was collected from both WH300s for stations 10 and 11. After two casts in 5000 m of water the disposable batteries were run down to about 40 V and needed replacing. However, communications problems with the up-looker meant that the data was not downloaded successfully. By stations 12 and 13 communication with the up-looker even for deployment was not reliable and the down-looker was deployed alone. Deck leads were swapped out, connector pins cleaned, and finally the COM port on the PC was thought to be faulty. The PC was rebooted, but communications problems persisted. Eventually they were traced to a bent pin on the up-looking instrument connector.

Between stations 12 and 13 tests were run on the BB150 in the hangar and all beams were found to be working. The diagnosis of a broken beam was incorrect. During this test the beams were identified and labelled for easier testing in the future. A lesson learned: the Visbeck software should not be relied upon to accurately diagnose instrument problems. At the least, a beam rub test should have been carried out before removing the instrument from the package. In addition, the spare rechargeable battery pack was tested (50 V) and charged. Finally, the power supply in the lab was checked and the stripped connectors re-secured.

Before station 14 the disposable battery pack and down-looking WH300 (S/N 1410) were removed from the frame and replaced with the spare rechargeable battery pack and the BB150. At last both instruments worked with no problems and good data was collected for the remainder of the cruise. This is with the exception of station 16, for which the BB150 data was lost due to operator error. It should be noted that on station 14 the date and time on the BB150 is incorrect, also due to operator error. A summary of data availability for each station is given in Table 1.

L A D C P L O G S H E E T

Operator Name:

Instrument set-up (e.g. dual workhorse, BB down-WH up, BB):_____

Station No._____ Nominal Latitude_____ Longitude_____

Date (dd/mm/yyyy)_____ Decimal Day_____ Depth (m)_____

Deployment

	Down-looker (e.g. BB or WHM)	Up-looker (e.g. WHM or WHS)
Time at wake-up (`BBTALK <END>`)		
Instrument Voltage (`PT4 or PT2`)		
Memory Remaining (`RS`): Erased?		
Check LADCP clock (`TS?`): Reset?		
Load Command File (`F2`)		
Log File		
Time at start pinging		

Exit `BBTALK`. Power down, disconnect cables, plug in dummies.

At the Bottom note: Time_____ Latitude_____ Longitude_____

CTD max. depth (m)_____ Height off Bottom (m)_____

Recovery

At **END** of cast note: Time_____ Latitude_____ Longitude_____

Rinse connectors with fresh water and DRY. Remove dummies, connect comms, wake up instruments and check voltages. Connect power cable, place cover on up-looker, and switch on POWER supply.

	Down-looker (e.g. BB or WHM)	Up-looker (e.g. WHM or WHS)
Time stop pinging (`BBTALK B`)		
Instrument Voltage (`PT4 OR PT2`)		
No. of deployments (`RA?`)		
Download filename and size (Kb)		
Copied to station filenames		
Processed? Script name.		
Check Max. Depth from intW		

Comments:

Lisa Beal Mar 2006