Healy 2013 UHDAS installation

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Revision History

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1 Introduction

USCGC Healy has two Doppler current profilers made by Teledyne RDI. These instruments are used to calculate ocean currents beneath the ship. Until 2010, data acquisition was performed by the manufacturer's software, “VmDAS”. Since then, data acquisition and processing have been performed by “UHDAS”, written at the University of Hawaii. This document describes UHDAS and the installation of the system on the Healy as of July, 2013.

1.1 ADCPs

1.1.1 History

The Healy was delivered with two Broadband ADCPs, a 300kHz and 150kHz. The 300kHz instrument never really worked, and in 2002, it was replaced with 75kHz phased array “Ocean Surveyor” ADCP.

1.1.2 2010 Field Season

During the winter inport period of 2010, the 150kHz Broadband ADCP was replaced with a 150kHz phased array “Ocean Surveyor” (loaned by Univ Alaska, Fairbanks). These are referred to as OS75 and OS150, respectively. Also during the in-port period, a new cableway was built from the transducer void to the Potable water room. The OS150 cable was routed through that new cableway in an attempt to reduce electrical noise. The previous data acquisition computers (which ran VmDAS, the software provided by the manufacturer) were not used; instead, a single computer running UHDAS was installed. The cableway helped, but biases and poor range persisted.

1.1.3 2011 Field Season

Prior the 2011 season, the deck units were temporarily relocated to a set of shelves in the aft, port corner of the MICA room. The combination of deck unit location, transducer cable run, and power source reduced electrical noise and improved range considerably. Broadband mode of the OS150 was still corrupted by bias. Broadband mode of the OS75 was also biased, but the effect was more subtle.

1.1.4 2012 Field Season

During the winter inport period, a permanent location was found for the ADCP deck units (on the aft bulhead of MICA, starboard side). At the time of the HLY12TA science sea trials cruise, the deck units were still in a small rack, and were strapped to the shelving. Initial data quality from the shakedown cruise was poor compared to 2011, but a change in the 120VAC power brought the data quality back up (increased range, decreased background noise).

The final welding of the new rack and appearance of the UPS occurred prior to the first cruise. The deck units and UPS for each were installed in the new rack, but data quality was again reduced for the entire season. With the cooperation of the Chief Scientist on HLY1203, a set of experiments was undertaken to try to determine the cause of the reduced data quality. The experiments demonstrated that better range was possible, with a suite of changes that included removing the deck units from the rack That that was not a good long-term solution, so they the deck units were returned to the rack for the winter.

1.1.5 2013 Field Season

The ship went into drydock over the winter inport. The transducers were not removed or altered. Efforts during the (extremely short) shakedown cruise concentrated on trying to improve data range. The use of an Isolation Transformer (instead of, or in line with the UPS) did not yield improvement. For the 2013 field season, each ADCP deck unit has a double-conversion UPS; AC power provided to the rack is coming from IC/Gyro.

One thing did increase range from about 200m to 400m: moving the transducer cables away from a bundle of ship's cables (details in section 1.4).

1.2 Computer

ADCP data acquisition is performed by a Dell R210 server running a recent release of Ubuntu. Prior to the shakedown cruise, Xubuntu 12.04 was installed on the computer that was used during the 2011 season (the 2012 spare). The 2012 computer was left as a spare for the 2013 season. The acquisition software (UHDAS) acquires data from the ADCP and other serial feeds through an 8-port serial-USB device (FTDI chip). UHDAS logs and timestamps ADCP data, heading (POSMV1, POSMV2, ASHTECH, gyro) and GPS positions, and writes them to disk. During the processing stage, ADCP beam velocities are transformed into horizontal velocities and referenced to earth prior to automated editing and averaging. The software includes averaging and display of various variables, accessible via ship's web.

1.3 Serial Ports

UHDAS uses one process per serial port for data acquisition. The input streams are filtered by message, timestamped, and written to a directory named after the instrument being logged. More than one NMEA string can be acquired from a given serial stream. If the rate of repetition is too high, messages may be subsampled prior to recording. The file `sensor_cfg.py` contains settings for serial acquisition, including ports, baud rates, and message strings. (NOTE that indentation must be respected when editing `sensor_cfg.py`, as it is written in Python). CODAS processing requires position and heading. We try to log all required input types from multiple sources, to allow for reprocessing (in case of gaps or failure in the primary serial feed).

Serial messages logged during 2013 seasons:

Serial (raw) directory	instrument	suffix	messages	serial port /dev/tty/
ashpaq5	Ashtech adu5	paq	$GPGGA,$GPPAT	USB1
gpsnav	A-GPS gps	gps	$GPGGA	USB4
gyro39	Sperry mk39	hdg	$INHDT	USB5
gyro27	Sperry mk27	hdg	$HEHDT	USB6
os150	RDI adcp (150kHz)	raw, log, log.bin	(binary adcp data + log files)	USB0
os75	RDI adcp (75kHz)	raw, log, log.bin	(binary adcp data + log files)	USB7
posmv1	POSMV 1	pmv	$PASHR,$INGGA	USB3
posmv2	POSMV 2	pmv	$PASHR,$INGGA	USB2

1.3.1 CODAS processing settings

Settings for heading and position source, and transducer angle are:

heading (reliable)	best position	heading correction (accurate)	transducer angle os75	transducer angle os150
posmv1 $PASHR	posmv $GPPGA	(none)	43.4	28.4

If necessary, processing of UHDAS data can be redone at a later date using different supporting serial strings. Reprocessing of UHDAS data on the Healy should be able to use appropriate settings chosen from:

instrument	position/time	reliable heading	accurate heading
Ashtech	$GPGGA		$GPPAT
A-GPS	$GPGGA		
POSMV	$INGGA	$PASHR	$PASHR
mk39		$INHDT	

1.4 ADCP Installation

Initially, range was poor, consistent with the 2012 installation. Data were evaluated with different configurations of UPS and Isolation Transformer, with no change in background noise. In the limited time available, the other experiment was to pull back the transducer cables to their entry point (into MICA) and try different cable cable runs to see if that would help. It did. The cruise started with the transducer cables secured in the overhead (above the rack) near a bundle of ship cables. It was clearly demonstrated (next figures) that moving the transducer cables away from these ship cables was a key ingredient in improving the ADCP range. That was all time permitted in terms of testing. The cables were secured farther away from the power lines and it appears this has improved things considerably from the 2012 season.

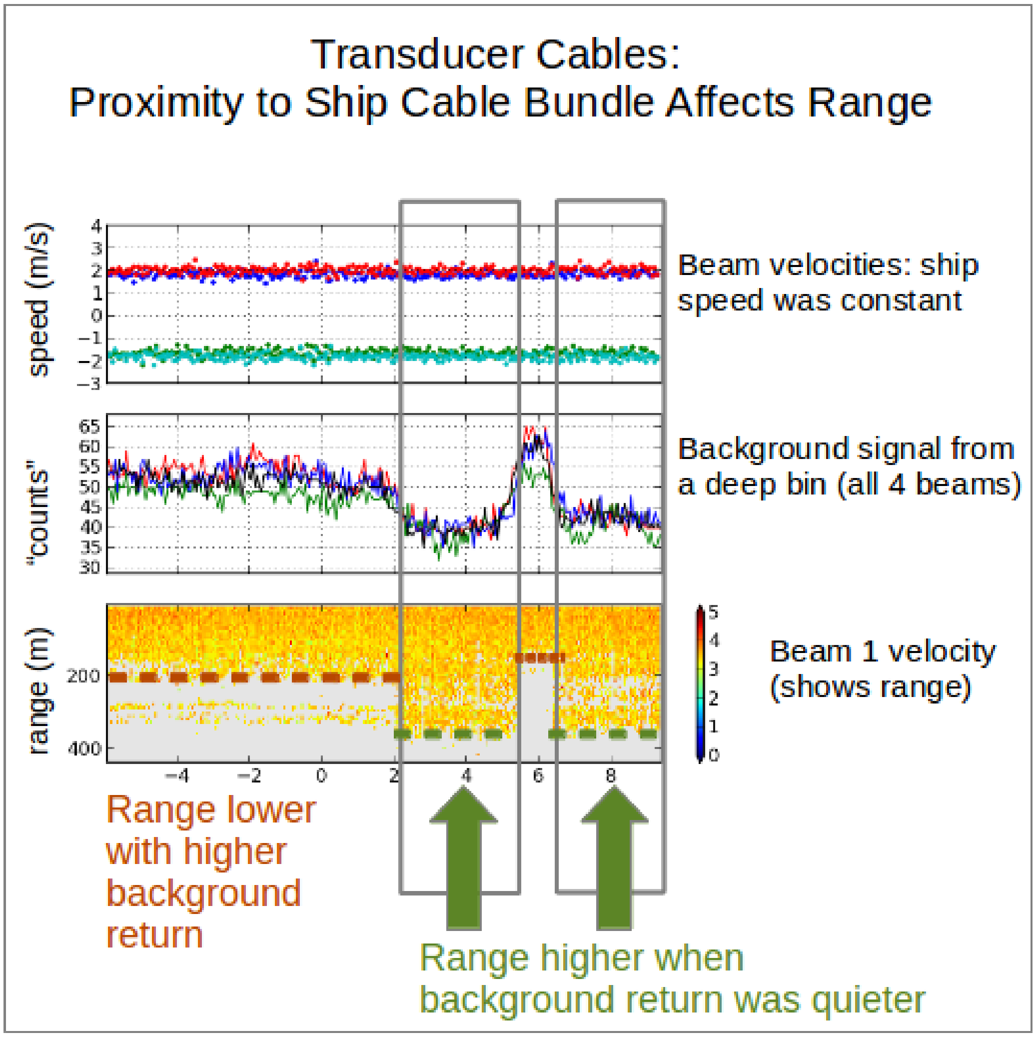

*Figure 1: Cable test: At a constant speed, the transducer cables were moved away, adjacent, and again away from the power cables. Background noise decreased as the cables were separated, and instrument range increased during those times. The time range is marked by the letter "**B**" in Figure 4.*

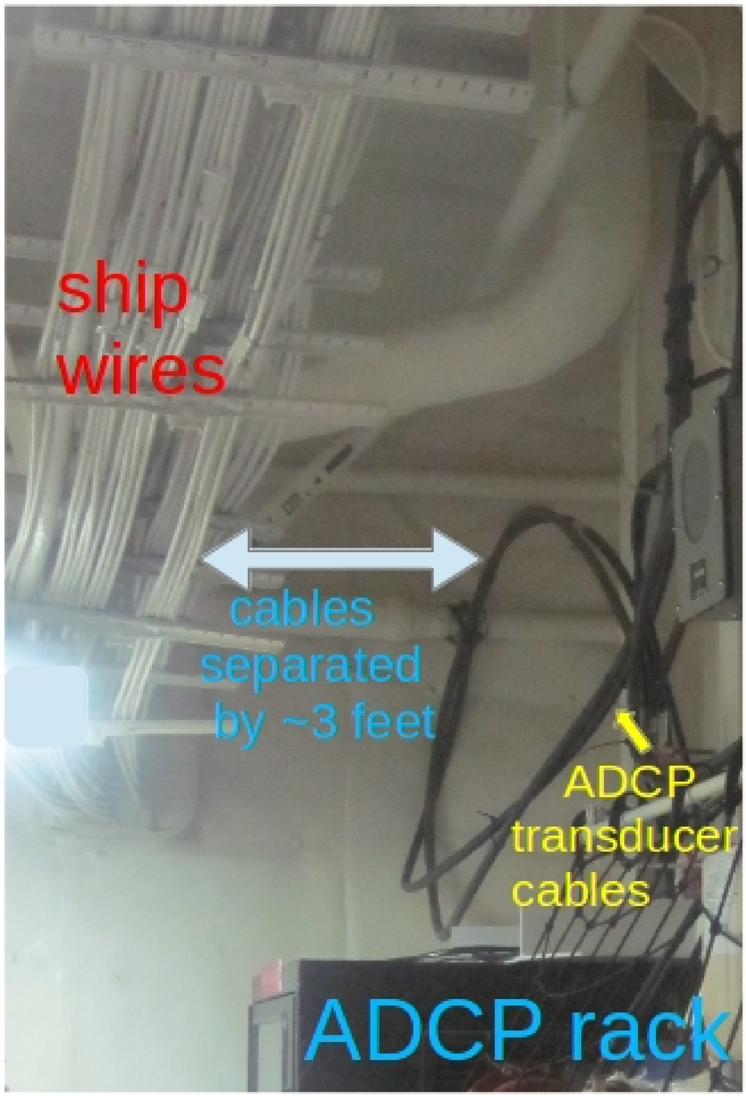

Figure 2: This pictures shows the configuration of the cables after transducer cables were moved (about 3feet) away from the ship's cables. Separating the transducer cables from the ship cables made a huge difference in range (especially the OS75) by reducing background noise. It also reduced bias in the OS75BB mode.

Figure 3: These photos show 'before' and 'after' positions of the cable near the through-hole from below the deck into MICA. The effect of this aspect of the transducer cable move was not investigated due to lack of time.

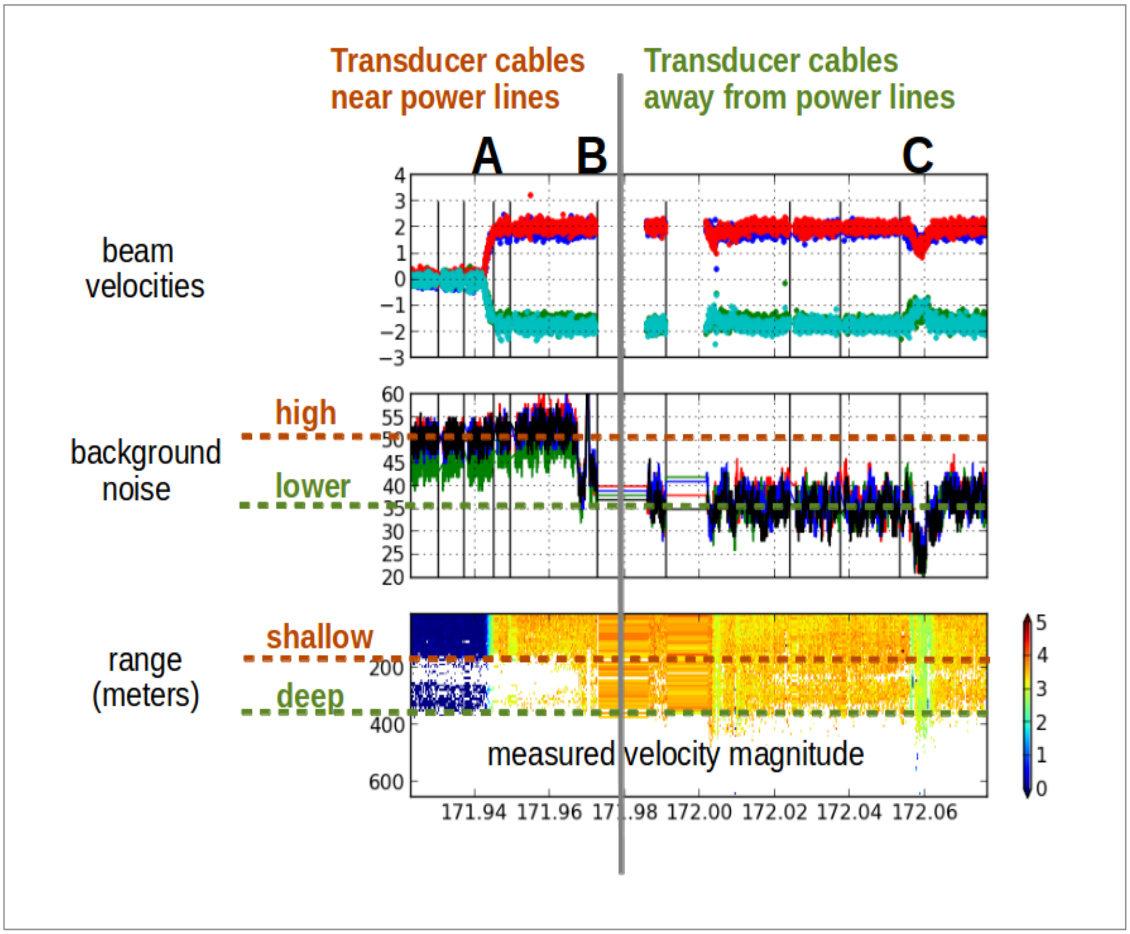

Figure 4: Background noise and velocity range in three cable configurations: ***A*** *(adjacent),* ***B*** *(cable location experiment),* ***C*** *(cables separated).* ***A****: high background noise, shallow range (200m), regardless of ship speed.* ***B****: Constant ship speed; range increased and background noise decreased when transducer cables were moved away from ship's cables.* ***C****: transducer cables are separated from ship's cables; range increased and background noise decreased. Reduction of ship speed further reduced noise and increased range. Ship speed, background noise, and ADCP range are shown in Figure 5.*

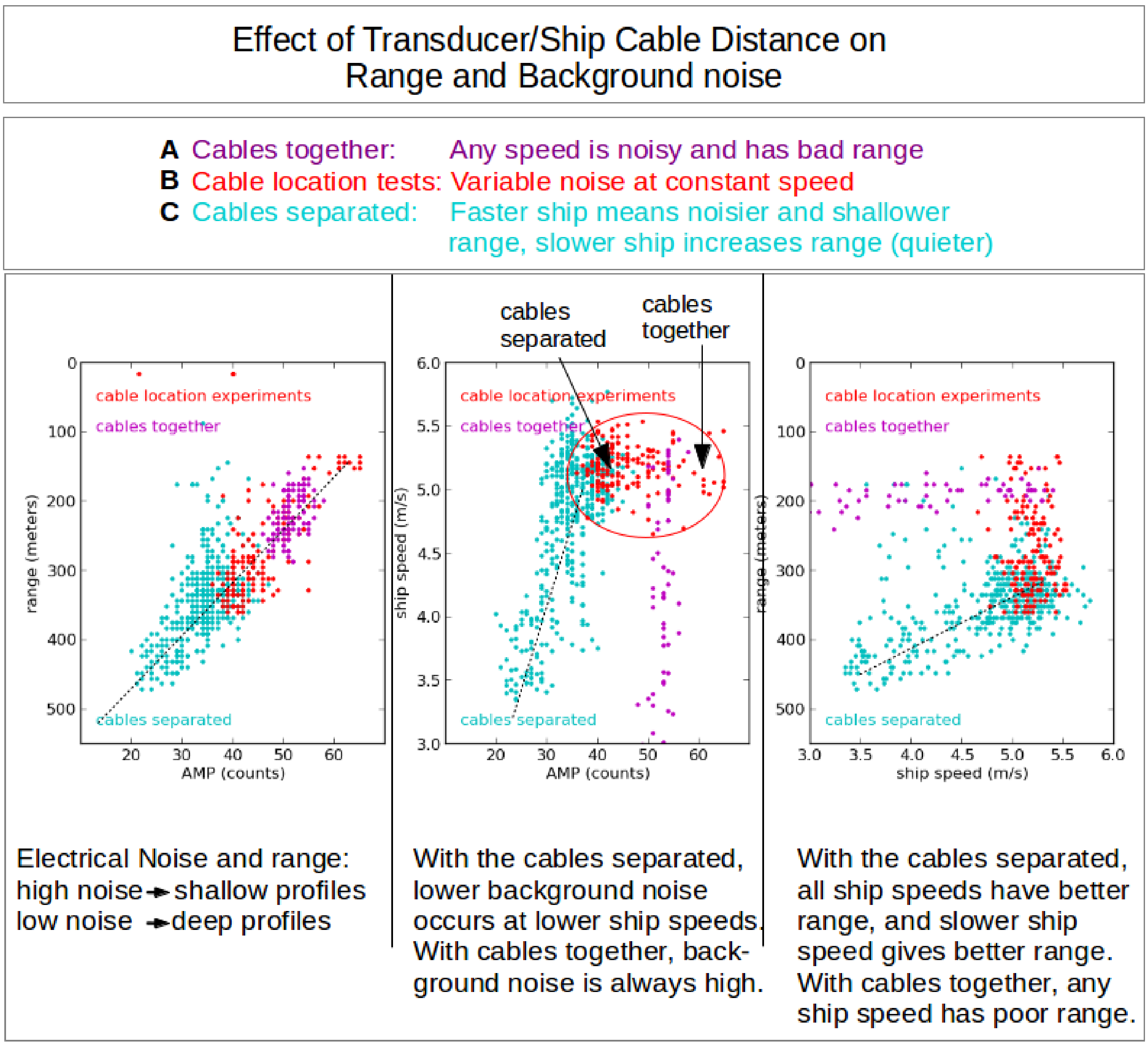

Figure 5: Background noise, ship speed, and range, in three cable configurations: ***A*** *(adjacent),* ***B*** *(cable location experiment),* ***C*** *(cables separated). See Figure 4 for context*

1.5 Biases

During the Sea Trials, ADCP data were collected with both instruments using interleaved mode (BB and NB pings), with 4-m bins (for OS150) and 8-m bins (for OS75). Comparisons between pingtypes and instruments suggest that the OS150BB mode is biased and should not be used. The OS150NB mode and OS75NB mode differ in the along-track direction, suggesting a small scale factor may need to be applied to one or both datasets. OS75BB and OS75NB did not exhibit the same strong biased differences that were present in earlier years. Perhaps the relocation of the transducer cables away from the ship power cables decreased the bias present in the OS75BB mode data.

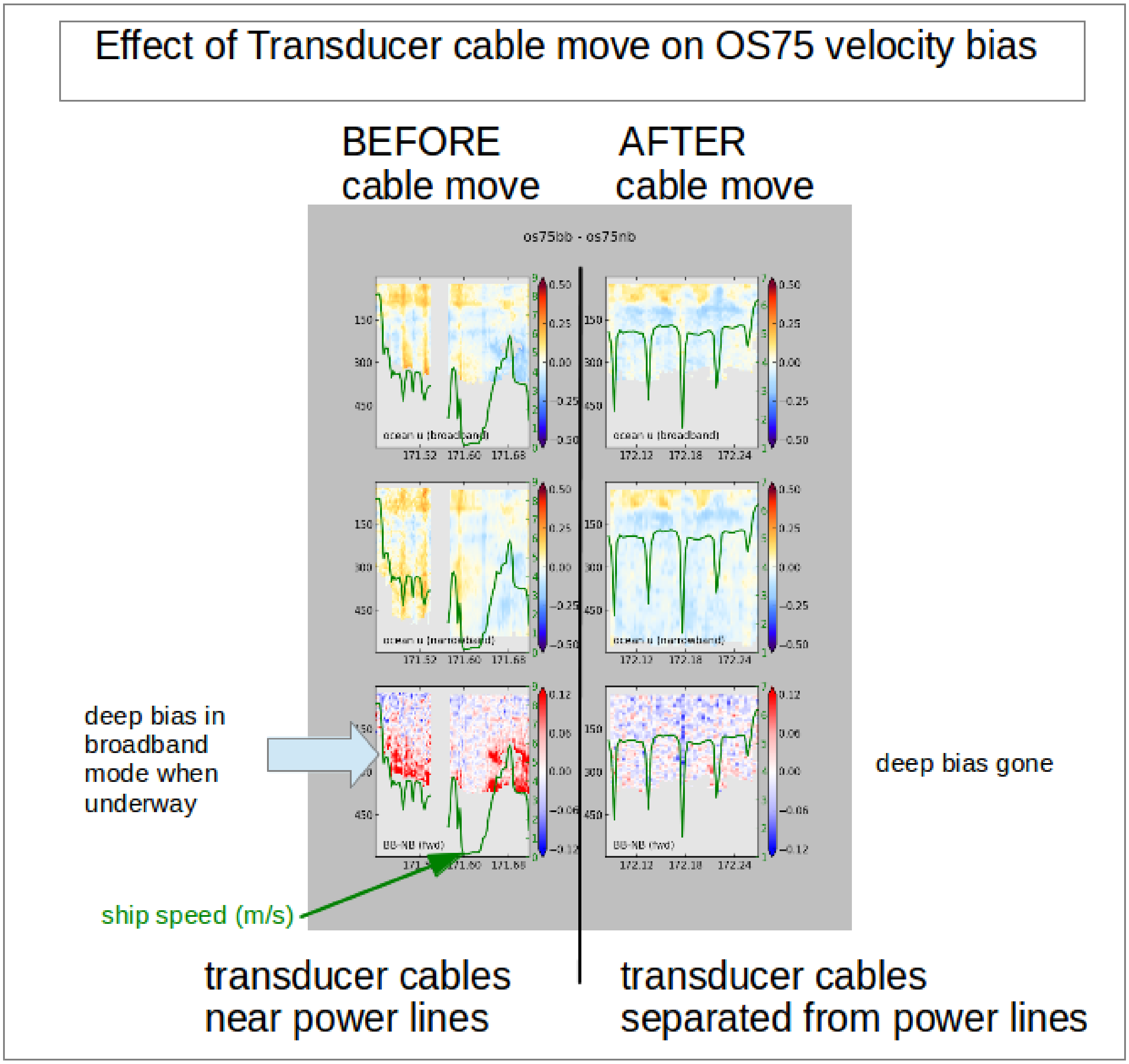

Figure 6: Bias between OS75BB and OS75NB modes was obvious before the transducer cables were moved, and disappeared after the move.

1.6 Recommendations

Because both OS150NB and OS75NB appear to be working, there is no particular benefit to using OS75 in BB mode. Recommended defaults for the 2013 season are the same as in recent years: OS150NB (4m bins), OS75NB (8m bins); Do not use OS15BB at all. OS75BB mode is optional, but there may be no call to use it.

(1) Do not trigger the ADCPs unless the scientific mission requires it

(2) Do not use OS150 broadband mode

(3) Default settings for OS150: 4-m bins, narrowband mode

(4) Default settings for OS75: 8-m bins, narrowband mode