UNOLS Ocean Surveyor ADCP Overview

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Outline

- ADCP: recent history
- Installations surveyed
- Data and conditions
- Performance
  - Installation
  - Depth coverage
  - Side lobes
  - Errors in velocity
- Specific problems
- Conclusions and Recommendations

ADCP: Recent History

- 4 acoustic beams; interpret Doppler shift
- Use heading and position to remove ship motion
- 1980's: Narrowband (150KHz)
- 1990's: Broadband
- 2000: Phased Array (150KHz, 75KHz, 38KHz)
- Comparison: NB150 vs OS75 (Hummon and Firing, JTECH 2003)

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This report is online at:
http://currents.soest.hawaii.edu/reports

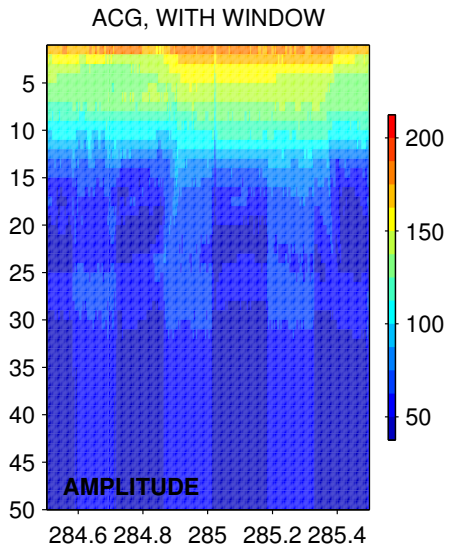
Installations Surveyed

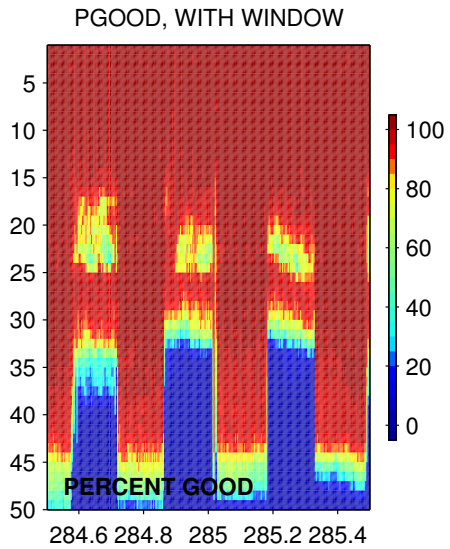
	150KHz	75KHz	38KHz
UNOLS	Barnes	Endeavor	
	Walton Smith	Knorr	
		Oceanus	
		Pelican	
		Seward Johnson II	Seward Johnson I
		Wecoma	
SEA		C. Cramer	
		R.C. Seamans	
USCG		Healy	
NOAA		Sette	
LoveBoat	Explorer of the Seas		Explorer of the Seas
JAMSTEC			Kaiyo

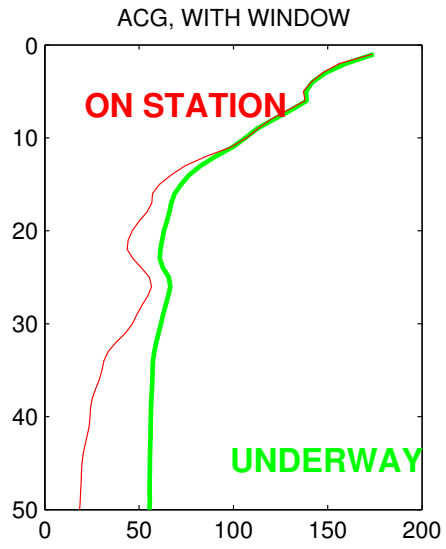
Data Description

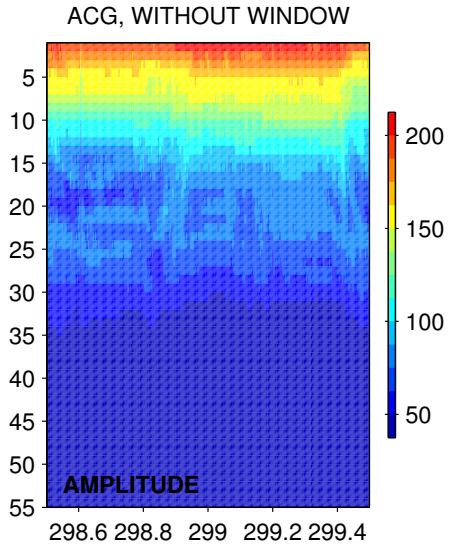
- Conditions varied:
  - Acquisition mode (nb or bb, cell size)
  - Water depth, topographic slope
  - Speed of ship (many or no stations, transit, ice)
  - Weather conditions
- specific comparisons
  - Depth coverage in different modes
  - Bottom return shape from OS vs BB, OS vs NB
  - Same instrument, two different installations
  - Same instrument and ship, with and without window

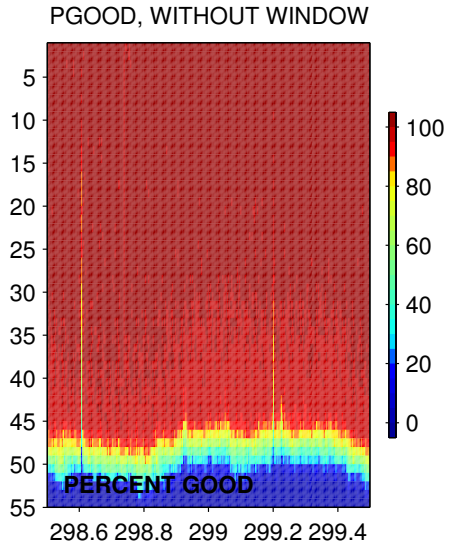
Performance: Installation

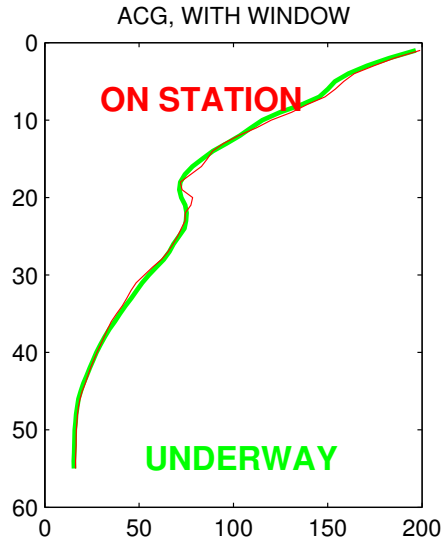












Knorr: AGC and Percent Good in two installations

Depth coverage summary

	best	worst (bubbles)
150KHz	up to 230m (NB8) up to 200m (BB8)	0m
75KHz	up to 750m (NB16, NB8) up to 600m (BB10, BB8)	0m 0m
38KHz	up to 1200m (NB16, NB24)	0m

Performance: Depth coverage ...

... depends on signal/noise:

- Number of scatterers
  - Location: biological activity varies
  - Diurnal cycle: up at night, deep during day
  - Depth of scattering layers, some strong
- Ambient noise
  - Faster ship increases ambient noise
  - Faster ship in heavy weather increases bubbles

Performance: Side lobes

AGC bottom return shape shows OS side lobes worse than NB or BB:

- Shows up in all frequencies, (least evident in 38KHz)
- Difficult to compare between instruments
- Visible as “shoulder” or increased thickness
- velocity effect is visible

Performance: Errors in velocity

- Cross-track error:
  - 1 degree heading error at 10kts gives 10cm/s error
  - Use gyro as the primary heading source (reliable)
  - GPS-aided heading should go into serial port
- along-track error:
  - Top bin bias:
    (up to 1+ m/s) edit out bins or fix installation
  - Anomalous shear:
    (5-15cm/s) from scattering layers: BE AWARE
  - Unflagged bad bins:
    (5-15cm/s) EDIT prior to averaging

Performance Concerns

All ADCPs:

- Bubbles
- Ringing
- No gps-aided heading

Ocean Surveyor

- Increased sidelobe strength (vs NB or BB)

Acquisition concerns

Concerns:

- Bottom track bug (fixed in firmware version XX?)
- Problems with serial inputs:
  - Binary garbage in serial data
  - Binary message in serial data
  - Too many unnecessary messages
- File names not consistent
- Heading comes in through serial port (versus chassis)
- Timeserver problems
- Thermistors can fail

Conclusions (I)

- Combination of VmDAS and Ocean Surveyor works
- Increased depth range of OS75 and OS38 will be very valuable for scientific studies
- So far, no ambiguity wraps in velocity

Conclusions (II)

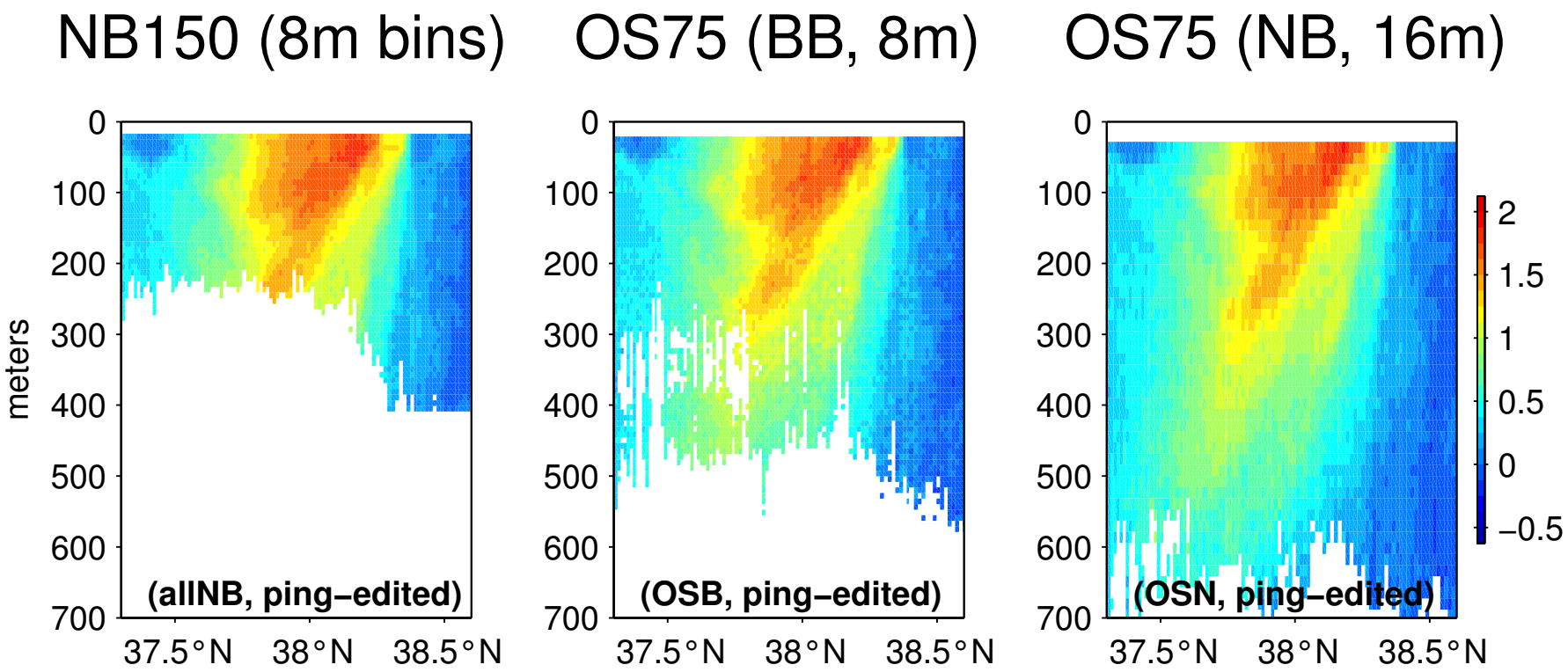
- Beam side lobes
  - OS sidelobes higher than BB and NB
  - Difficult to compare between instruments (installations)
- Velocity errors (all ADCPs)
  - Averaged data can include obvious and subtle biases
  - Scattering layers do cause a visible effect in velocity
- Installation quality is critical
  - Gyro errors induce cross-track velocity errors
  - Ringing causes bias in top bins
  - Bubbles are BAD, affecting depth penetration and accuracy

Recommendations

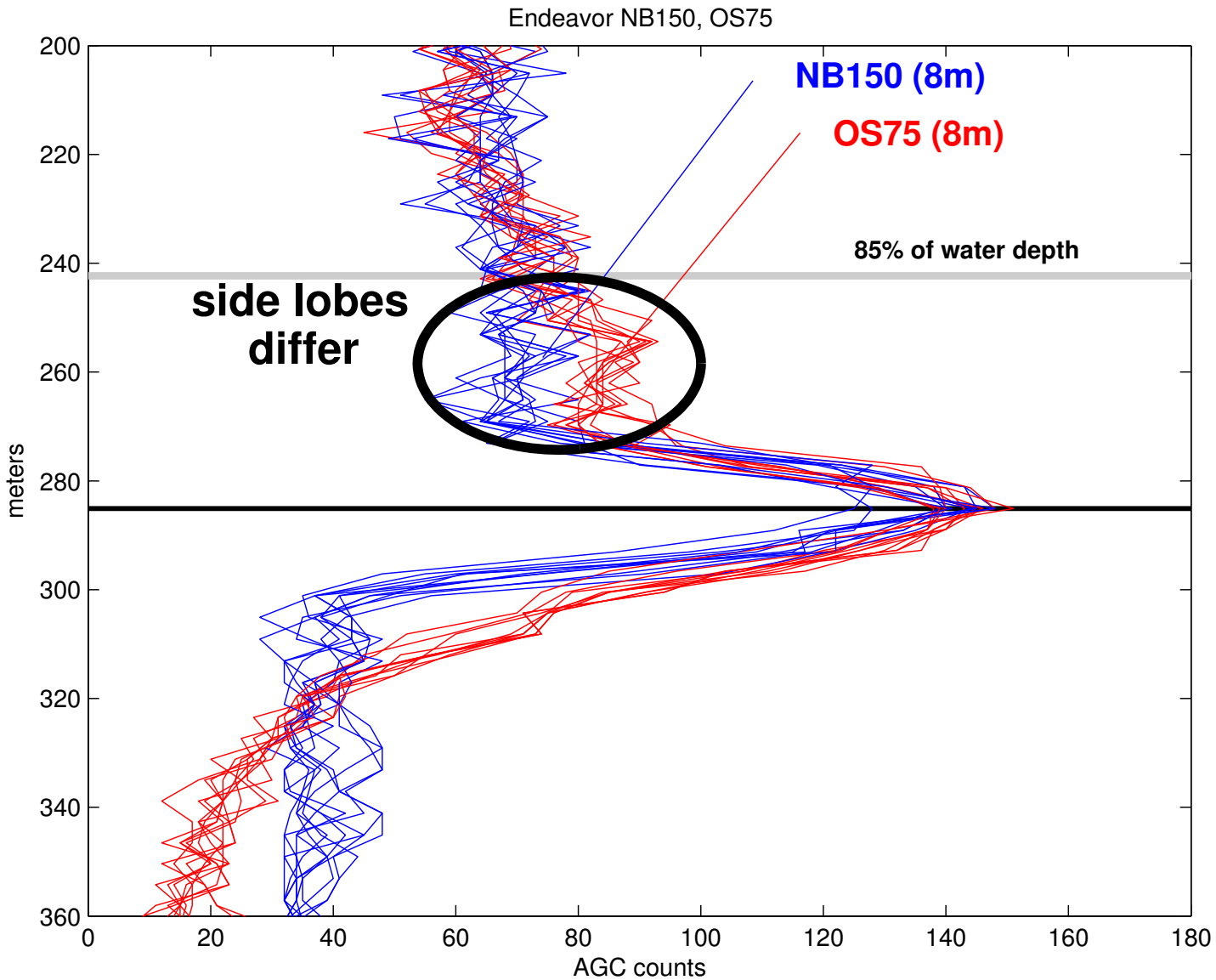
- Every installation needs oversight
- Designate a central repository of ADCP installation information
- Deep water installations (frequently out of bottomtrack range) should have gps-aided heading
- Improved automated editing needed
- Monitor instrument quality over time and compare instruments with each other. Need to:
  - Determine data parameters, site characteristics, test procedure
  - Identify locations and manage scheduling

Gulf Stream Cross-section

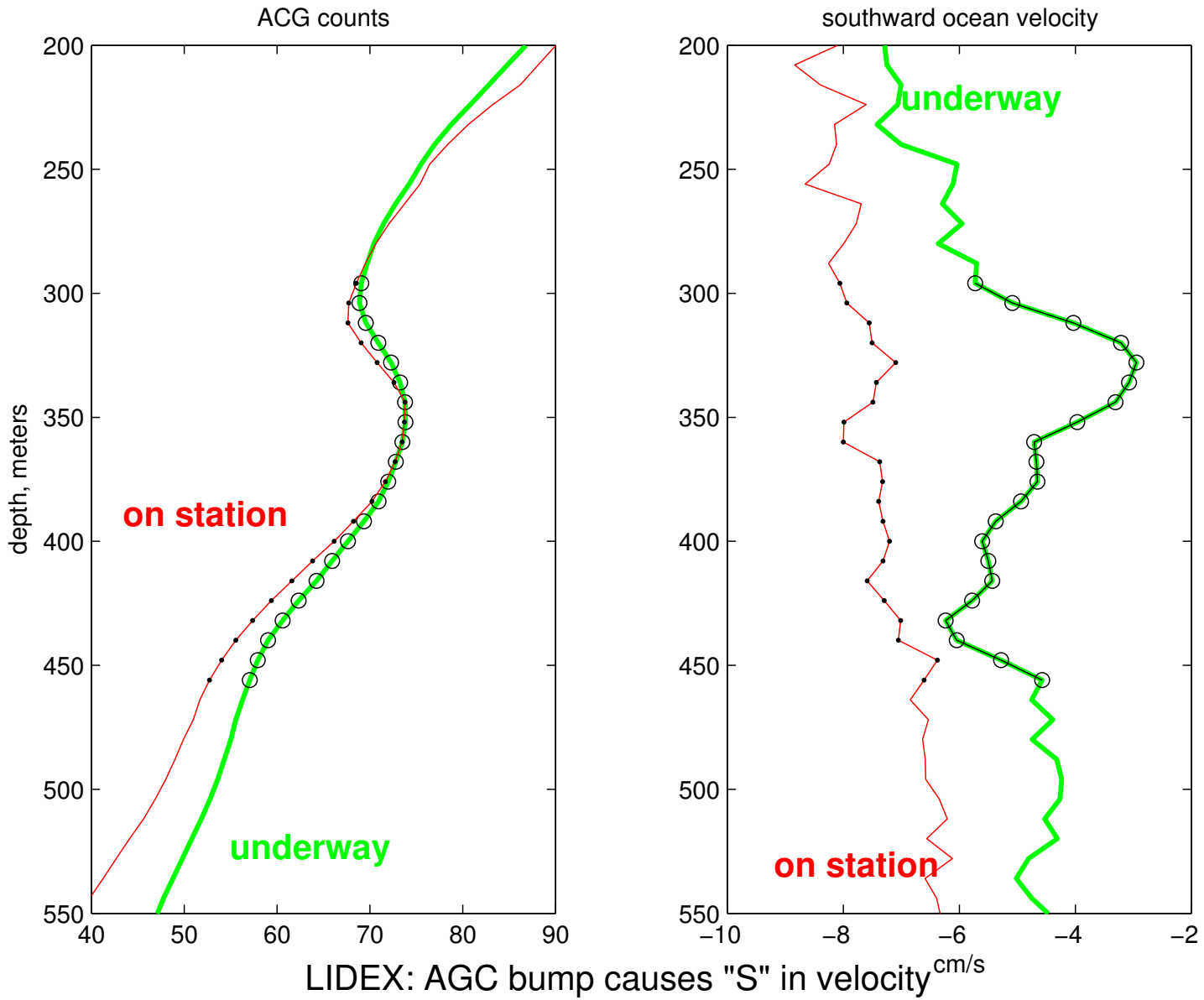
simultaneously logged



side lobes

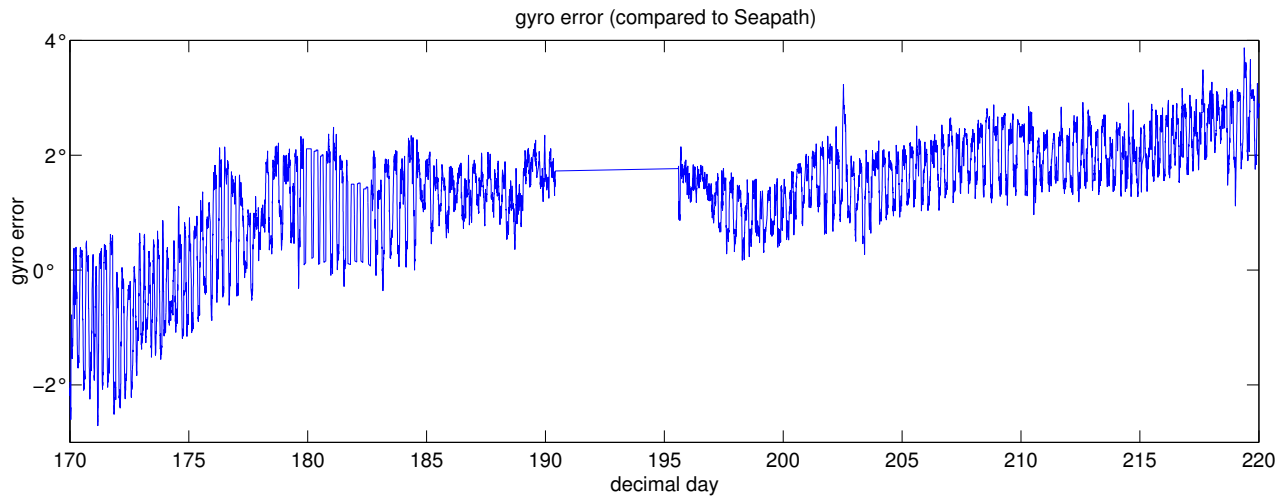

Endeavor NB150, OS75
NB150 (8m)
OS75 (8m)
85% of water depth
side lobes
differ
meters
AGC counts
200
220
240
260
280
300
320
340
360
0
20
40
60
80
100
120
140
160
180

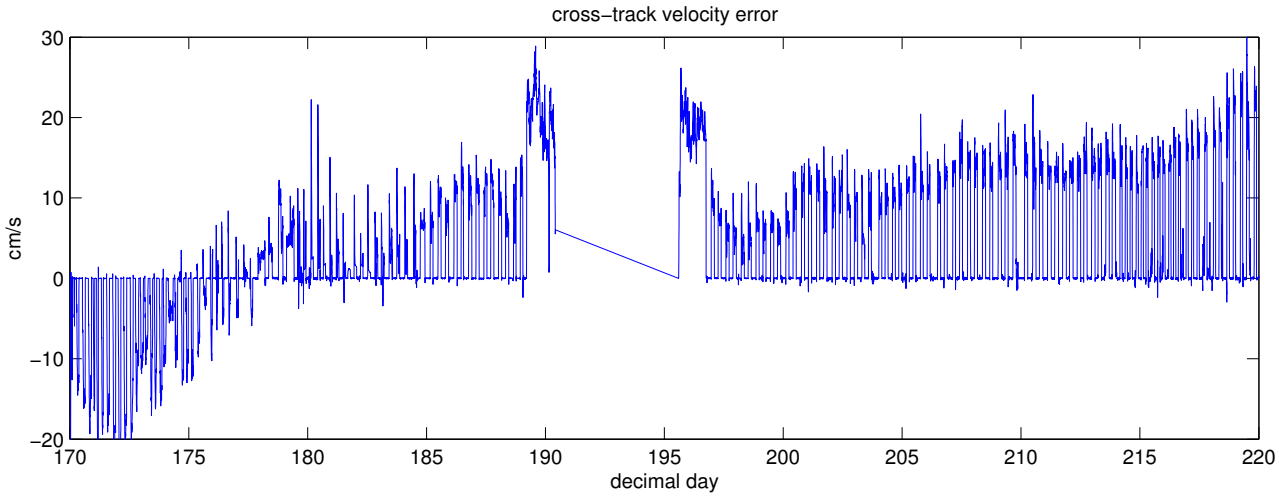
side lobes affect velocity



LIDEX: AGC bump causes "S" in velocity

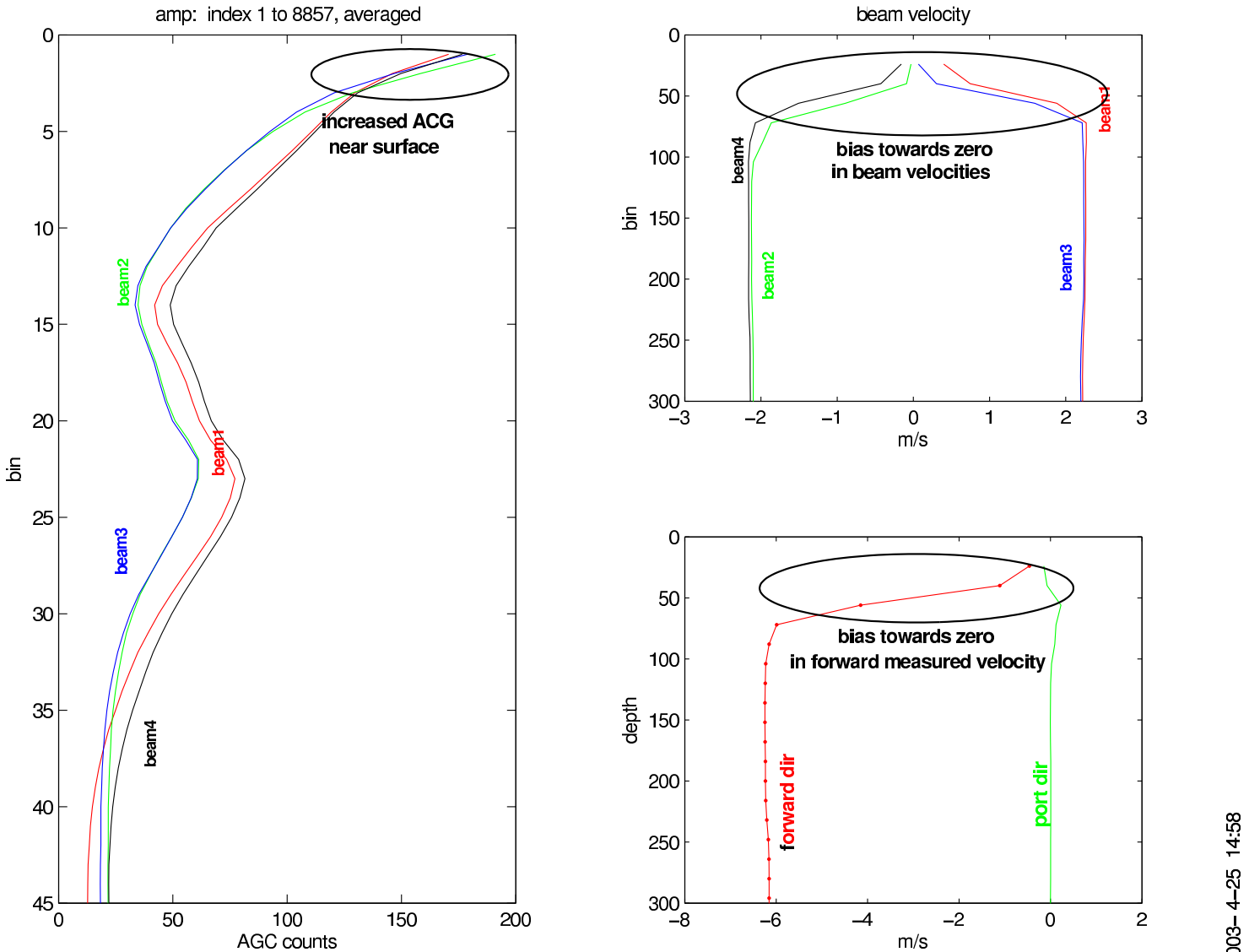
heading error





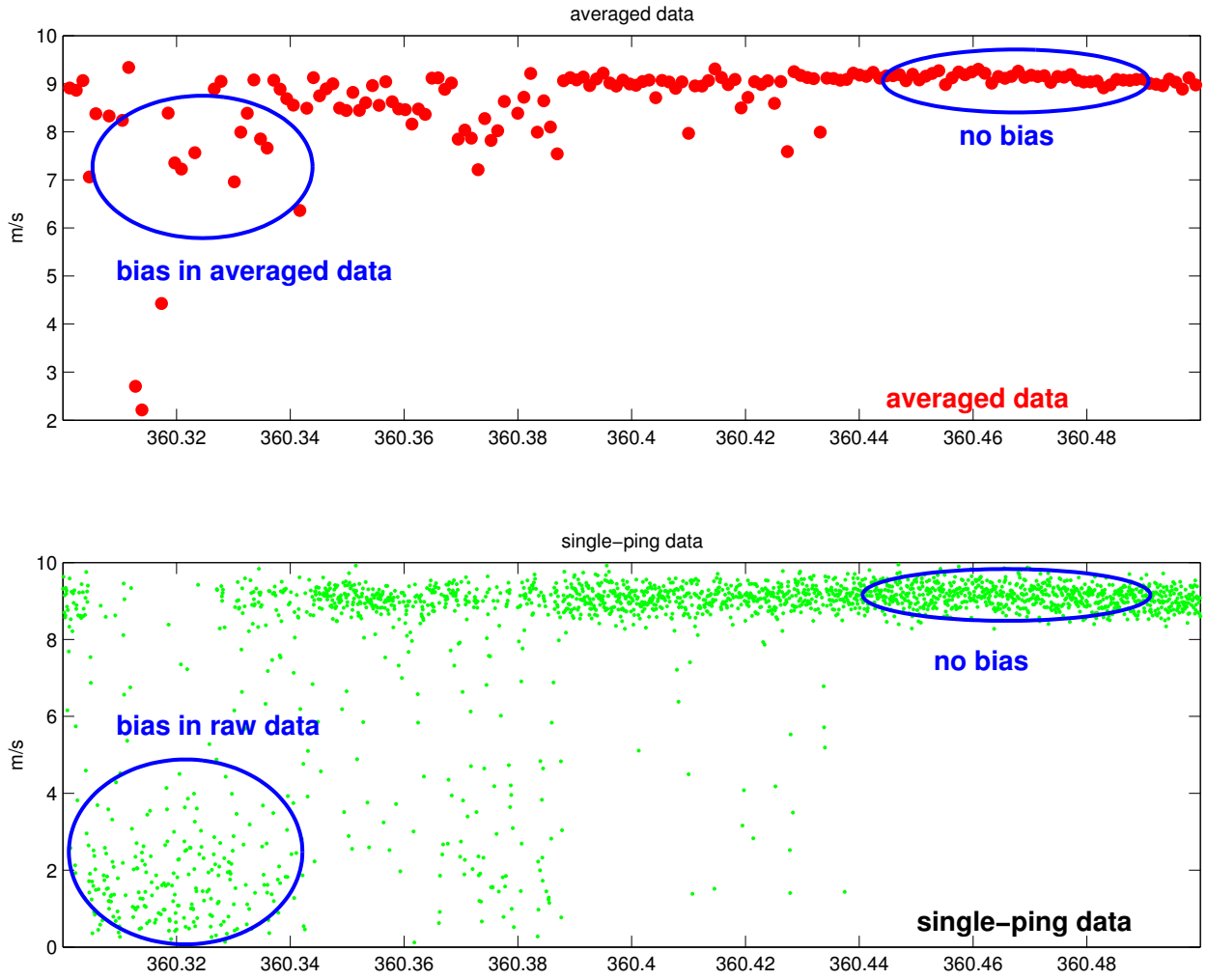
RB0304, A16N CLIVAR repeat line

top bin bias



KNORR: test1/junk0009_00000.LTA, dday 59.37–59.58 (2003), Med Sea

edit before averaging



EX0251 bin 3 abs measured velocity: underway bias towards zero