Shipboard ADCP Systems and Heading Sensors

Status Reports

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Outline

- Ships with UHDAS installed
- ADCP: Lessons Learned
- ADCP Status
  - Introduction to ADCP Velocity Determination
  - ADCP Velocity Errors
  - Notes on Specific Installations
  - Heading Devices: Overview and Suitability for ADCPs
- Summary

Acknowledgements:

Sandy Shor, and
Techs who work with UHDAS

This work was supported by NSF grant number
OCE03-09966

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

UHDAS installations

Ship	Instruments	Institution	Heading Devices
N.B.Palmer	NB150, OS38	NSF	gyro, Seapath
L.M.Gould	NB150, OS38	NSF	gyro, Ashtech
Atlantis	OS75	WHOI	gyro
Knorr	NB150, OS75	WHOI	gyro, POSMV
Oceanus	NB150, OS75	WHOI	gyro, Ashtech
Revelle	NB150, HDSS(140,50)	Scripps	gyro, PHINS, Marinus, Ashtech
Melville	NB150, OS75	Scripps	gyro, Ashtech
Thompson	OS75	UW	gyro, POSMV
Wecoma	WH300, OS75	OSU	gyro, Ashtech
Kilo Moana	WH300, OS38	UH	gyro, Ashtech, POSMV
KOK	NB150	UH	gyro, Ashtech
Hi‘iakalai	OS75	NOAA	gyro, POSMV
Ka‘imimoana	OS75	NOAA	gyro, POSMV, CSI

ADCP: Lessons Learned

- ADCP Installation
  - if posssible, accessible from the dry side
  - don’t block transducers (edges)
  - window parallel to transducers, not tilted
  - bubbles can kill the data
    (seems worse at lower frequencies)

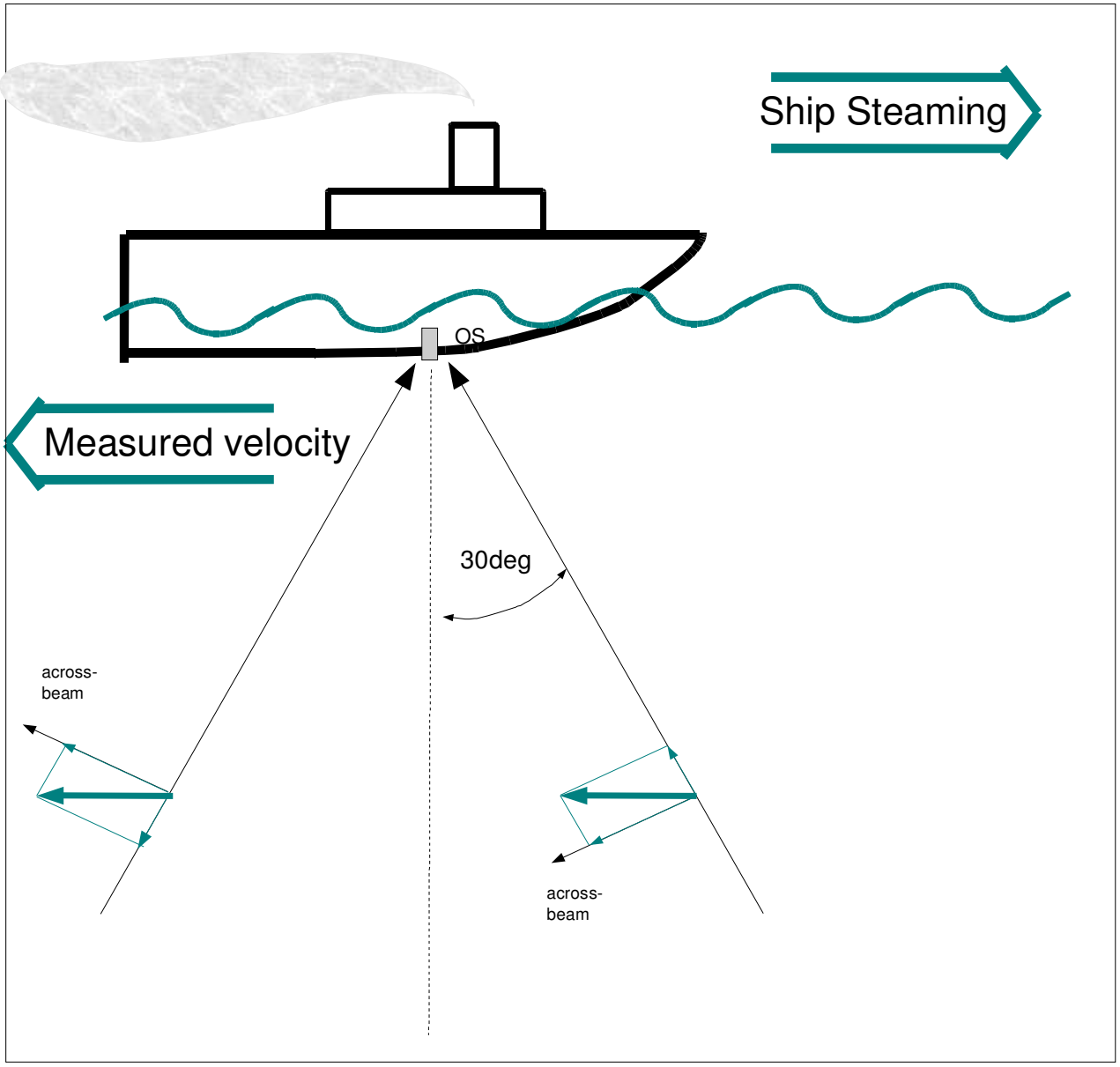
ADCP: Lessons Learned

- Acquisition and Processing
  - BB mode has higher resolution but shorter range than NB mode
  - bubbles: for some ships, single-ping editing is necessary
  - accurate and reliable heading necessary
  - issues with clocks:
    - do not change the PC clock time during data acquisition
    - perhaps turn off "Windows Time Service"

ADCP: Lessons Learned

- ADCP Velocity Errors: Causes and Solutions
  - gps: (pretty good now)
  - ringing:
    - increase blank
    - change installation
  - bubbles:
    - change installation
    - single-ping editing of velocities is sometimes sufficient
  - instrument errors
  - heading (correct gyro to other device)
  - scale factor (eg. temperature correction for BB or NB, not OS)

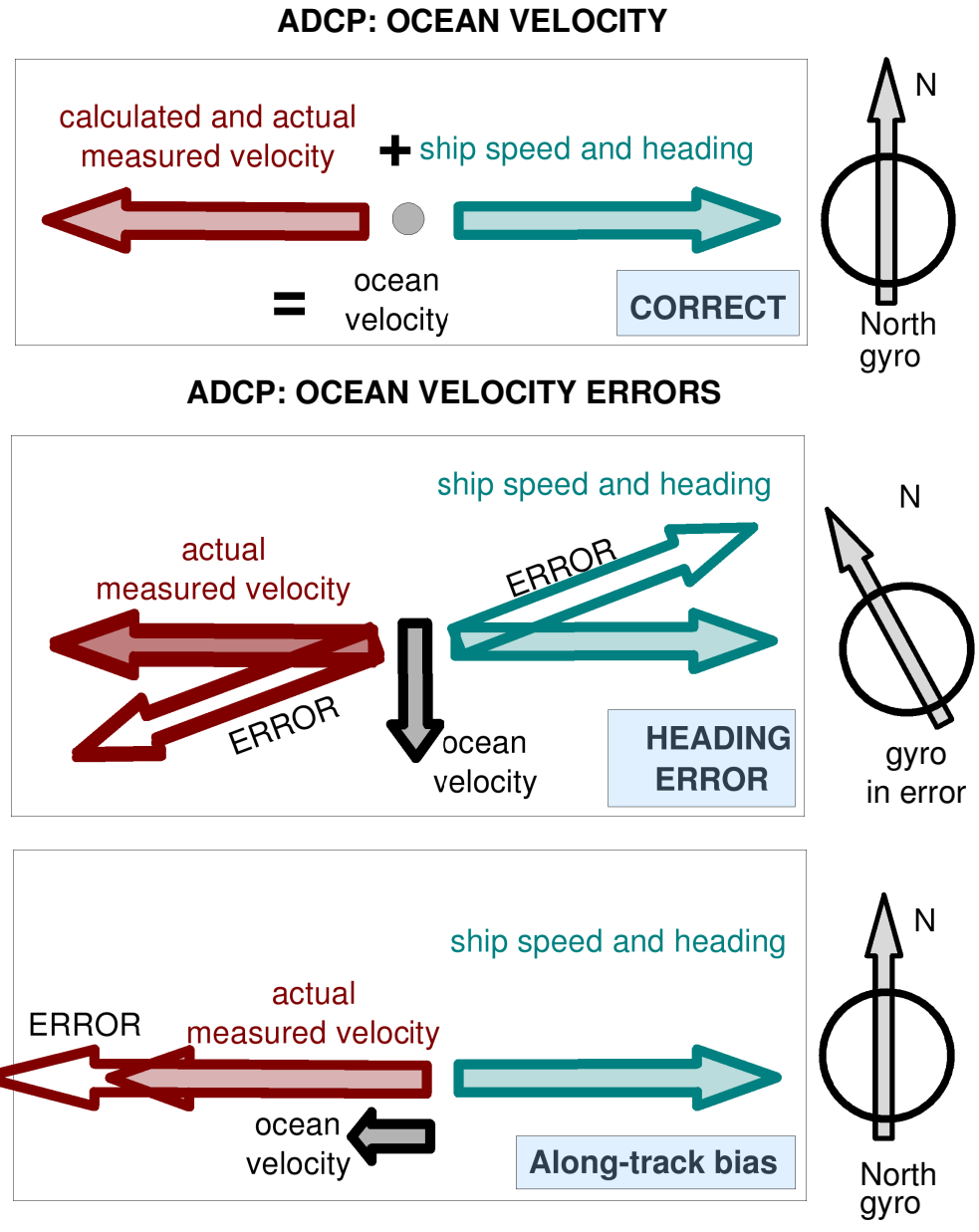
ADCP Measured Velocity



ADCP:Determining Ocean Velocities

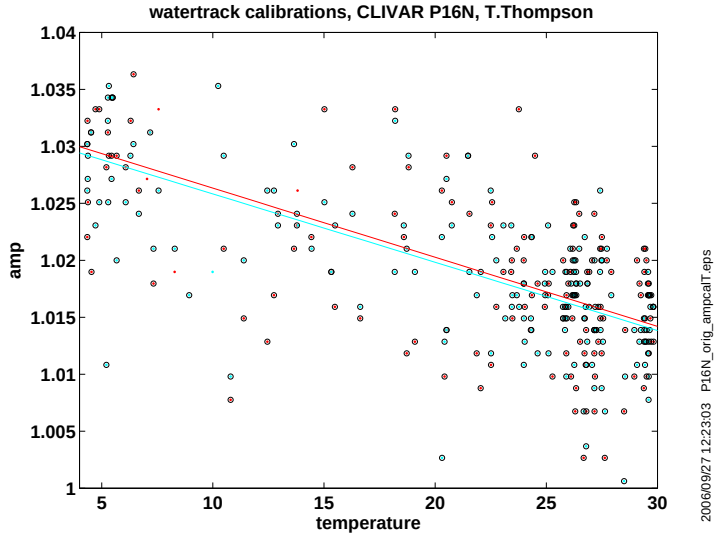
- 4 beams of sound measure Doppler frequency shift
- obtain horizontal velocities from opposing beams
- use transducer angle to bow to get SHIP coordinates
- use heading of bow to orient with Earth
- use positions to take out ship's speed
- show two kinds of errors:
  - heading error: 1 degree = 10cm/s underway
  - underway bias: 2% scale factor = 10cm/s underway

ADCP Velocity Errors



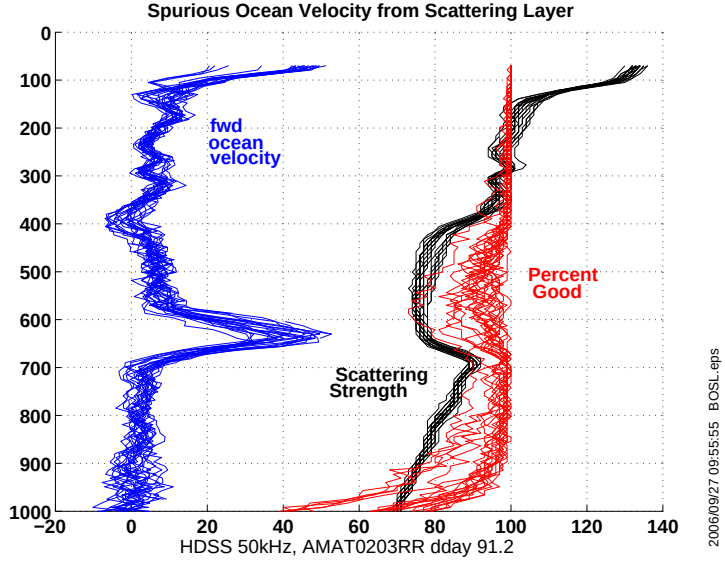
Specific Issues/Instruments, RDI

- WH300 (Kilo Moana and Wecoma)
  - depth range disappointing (but in spec)
  - synchro gyro input (converter, not input to data)
- Scale Factor Errors:
  - Wecoma: BB only; up to 3-4%)
  - Thompson;up to 3-4 percent

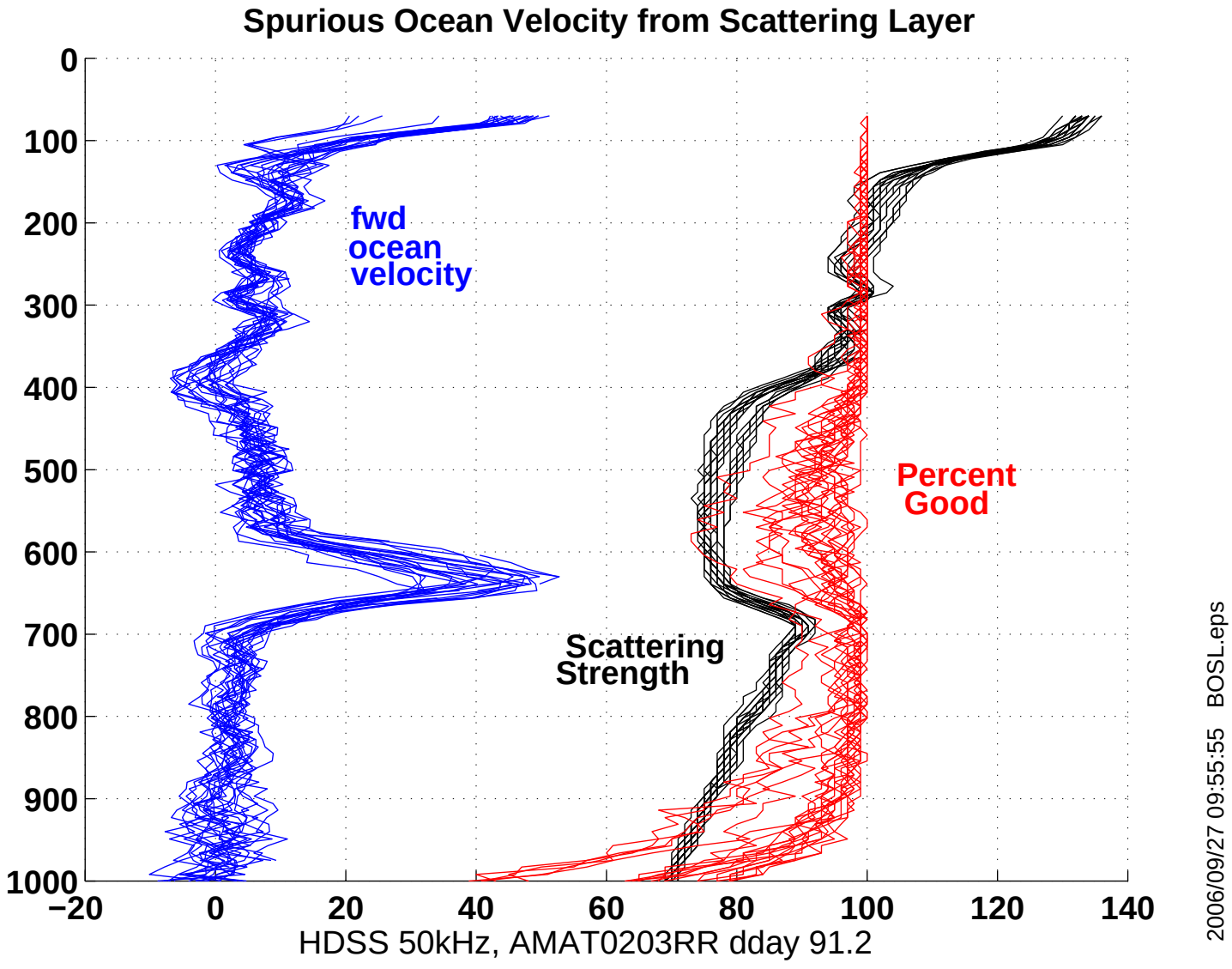


Specific Issues/Instruments, HDSS

- NB150 vs/ HDSS evaluation (link to report)
  - HDSS 50kHz: new transducers in January 2006
  - HDSS new electronics of some kind
  - very high scale factor required for 140kHz (3-4%)
  - 50kHz: strong biases (scattering layers)
  - biases at low speeds in both instruments



ADCP Velocity Errors



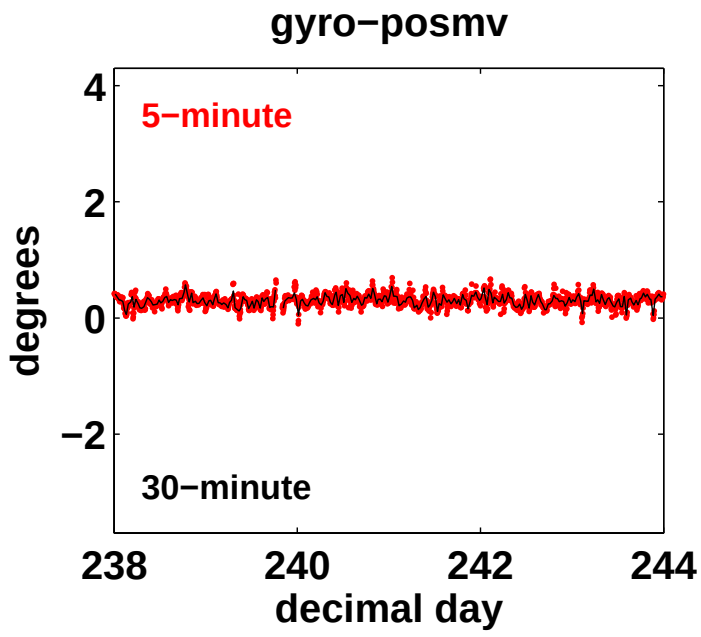
Heading Devices

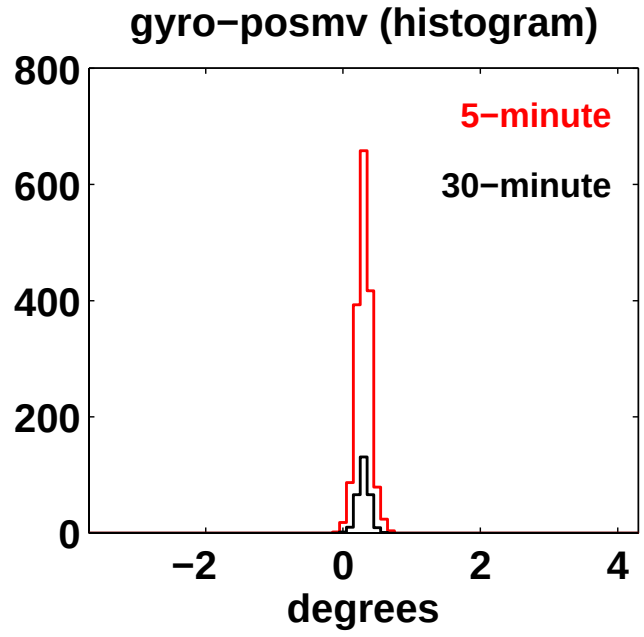
- Overview and Suitability for ADCPs
  - POSMV (description, installations; failures)
  - Ashtech (description, failure modes)
  - Seapath (description, failure modes)
  - gyro; gyro with gps
  - gps compass (eg. Furuno, CSI)

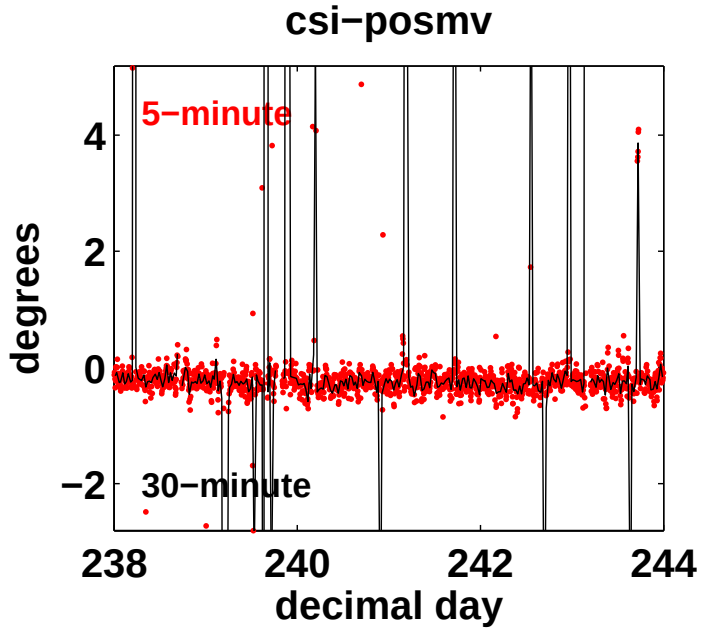
POSMV installations

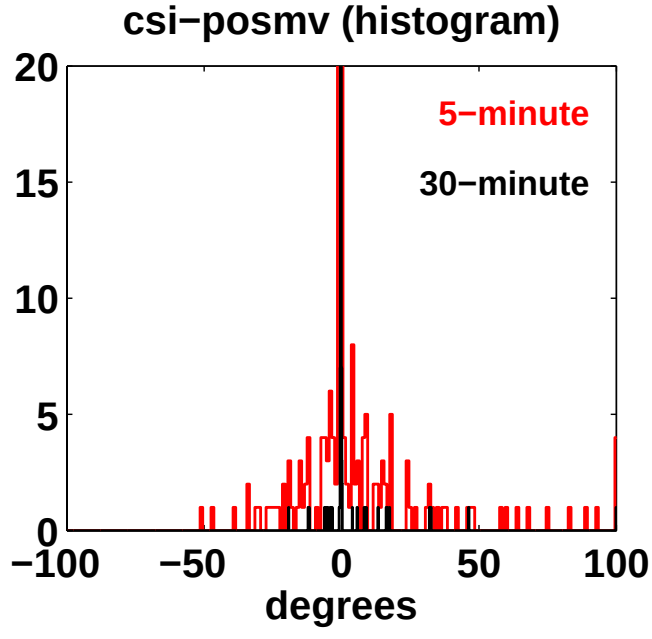
Ship	accuracy cutoff (from data)	overall percent GAMS	percent not perfect accuracy	comment
Kilo Moana(1)	.013	$>$95	10	very good
Kilo Moana(2)	.013	$>$99	1	excellent
Knorr	.018	75	17	good
Kaʻimimoana	.015	60	15	good
Thompson	.055	80	1	very good
Hiʻialakai(1)	.018	50	50	bad
Hiʻialakai(2)	.018	50	35	less flakey

CSI-POSMV error distribution

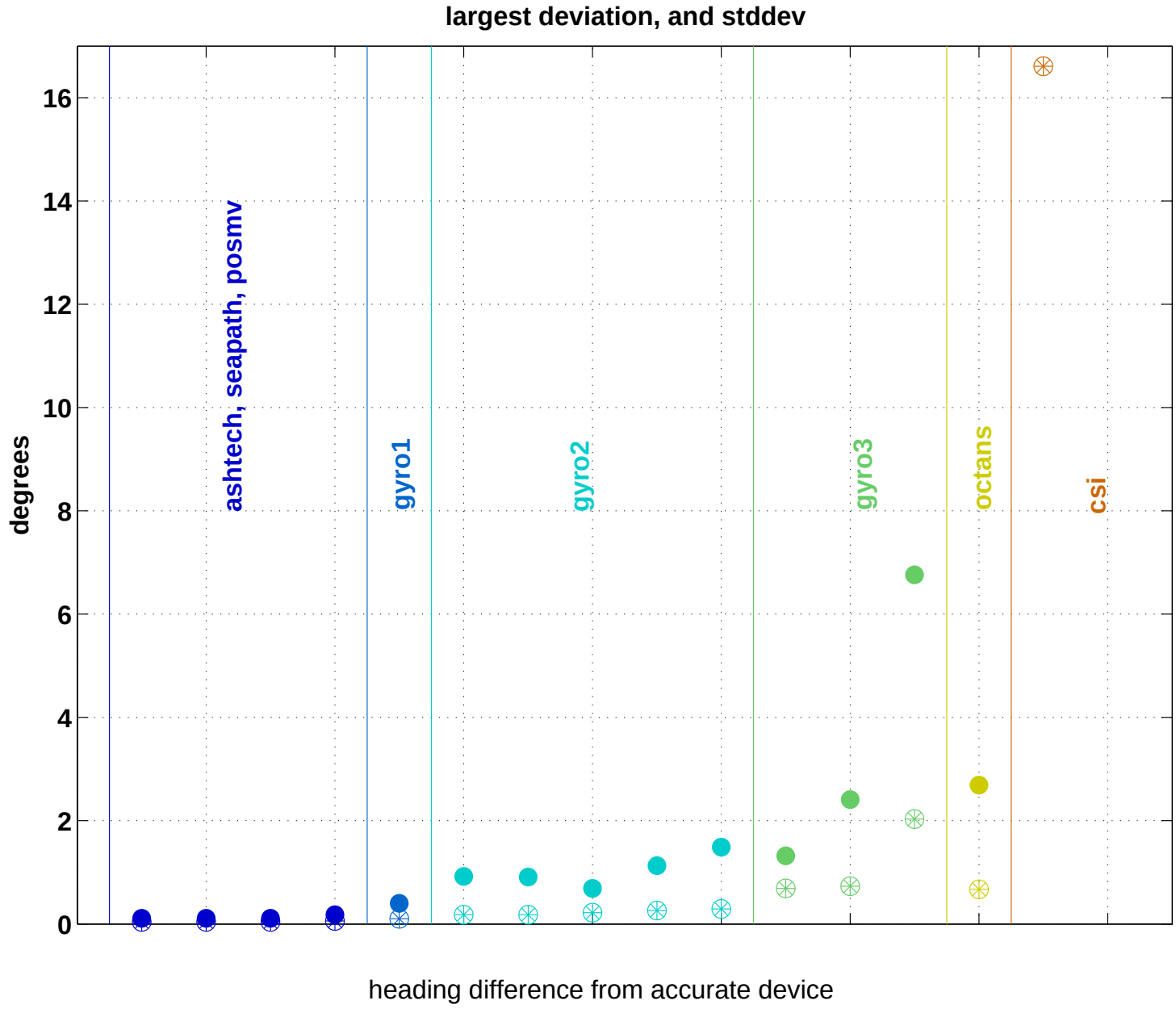








Heading Quality



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Comparison to POSMV and/or Ashtech

ship	instrument comparison	max 30min deviation	stddev	location	comment
Kilo Moana(2)	Ashtech/Posmv	0.11	0.04		2 generations
N.B.Palmer	Seapath/Ashtech	0.18	0.06		
Kaʻimimoana	gyro/Posmv	0.40	0.10	10S-10N	new gyro
R.Revelle	Marinus/Ashtech	0.92	0.18	20-35N	marinus
R.Revelle	Phins/Ashtech	0.91	0.18	20-35N	phins
Kilo Moana	gyro/Posmv	0.69	0.22	Hawaii (22N)	new gyro
Tioga	gyro/Ashtech	1.13	0.26	40N	furuno
R.Revelle	gyro/Ashtech	1.49	0.29	20-35N	sperry
Kilo Moana	gyro/Posmv	1.32	0.69	Hawaii (21N)	old gyro
Atlantis	gyro/Ashtech	2.41	0.73	N.Atlantic	
N.B.Palmer	gyro/Ashtech	6.76	2.03	S.Ocean	high latitude.
Atlantis	Octans/Ashtech	2.69	0.67	N.Atlantic	no gps input
Kaʻimimoana	CSI/Posmv	269.09	16.61		

Summary

- Ocean Surveyors are generally doing well
- Indicator of a problem:
  “Bias of ocean velocities in the ship’s direction”
- Furuno and CSI GPS Compasses are NOT accurate enough for high-quality ADCP velocities.
  - Furuno may be as good as an older mechanical gyro
  - CSI comparison was worthwhile: don’t use it.