NOAA Newport 2012 ADCP

Part I: ADCP

- Getting Ocean Velocity
- ADCP Acquisition Systems:

  UHDAS, VmDAS
- What can go wrong

Part II: UHDAS

NOAA Newport 2012 ADCP

Part II: UHDAS

- ADCP Processing with CODAS
- UHDAS: What it does
- Monitoring
    - At sea
    - On Land
- What can be changed, tested

NOAA Newport 2012 ADCP

Part I: ADCP

- Getting Ocean Velocity
- ADCP Acquisition Systems:

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(I) ADCP: Getting Ocean Velocity

ADCP :

Acoustic (it pings along beams at a frequency)

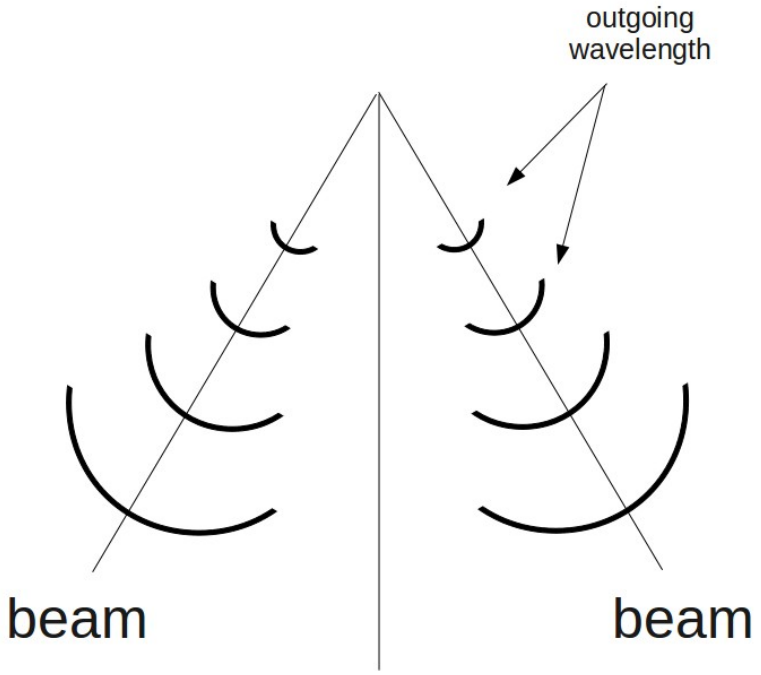
Doppler (uses frequency shift to get velocity along the beam)

Current (include many more steps to get ocean velocity)

Profiler (listen for the return in small chunks of time to create a vertical profile)

(I) ADCP: Getting Ocean Velocity

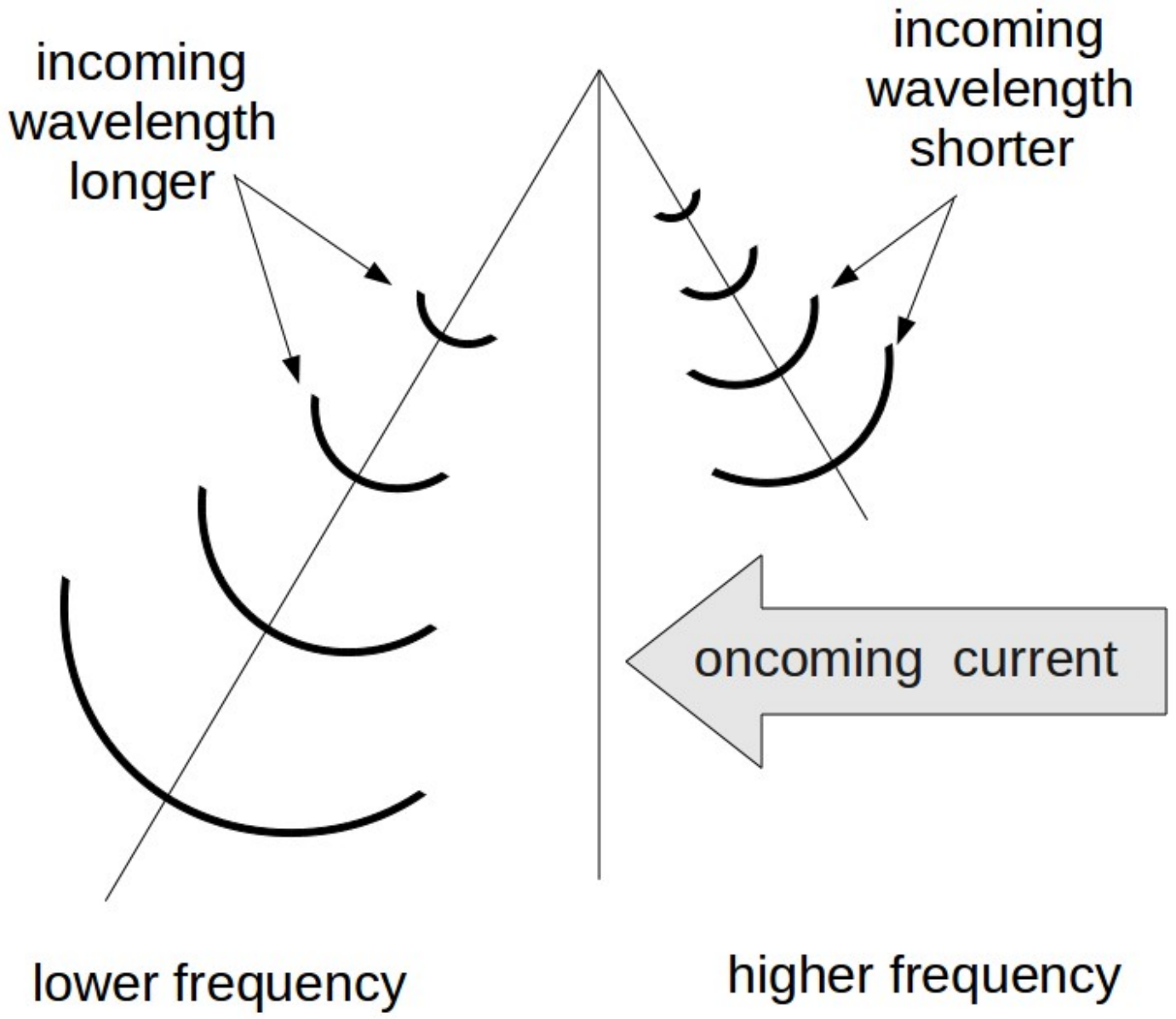
ADCP : **A**coustic



soundspeed = frequency X wavelength
(ocean) (instrument)

ADCP :

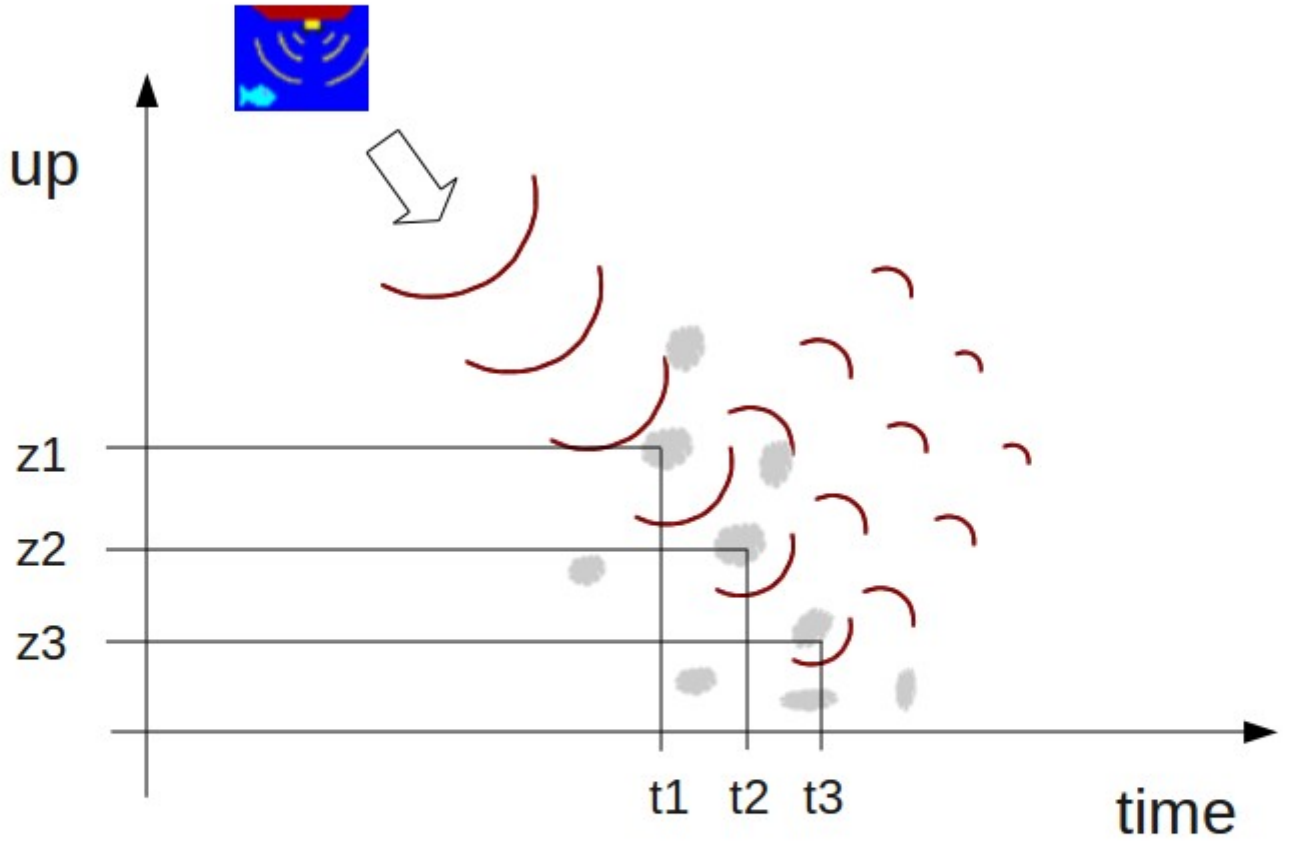
Acoustic
Doppler



soundspeed = frequency X wavelength
(ocean) (instrument)

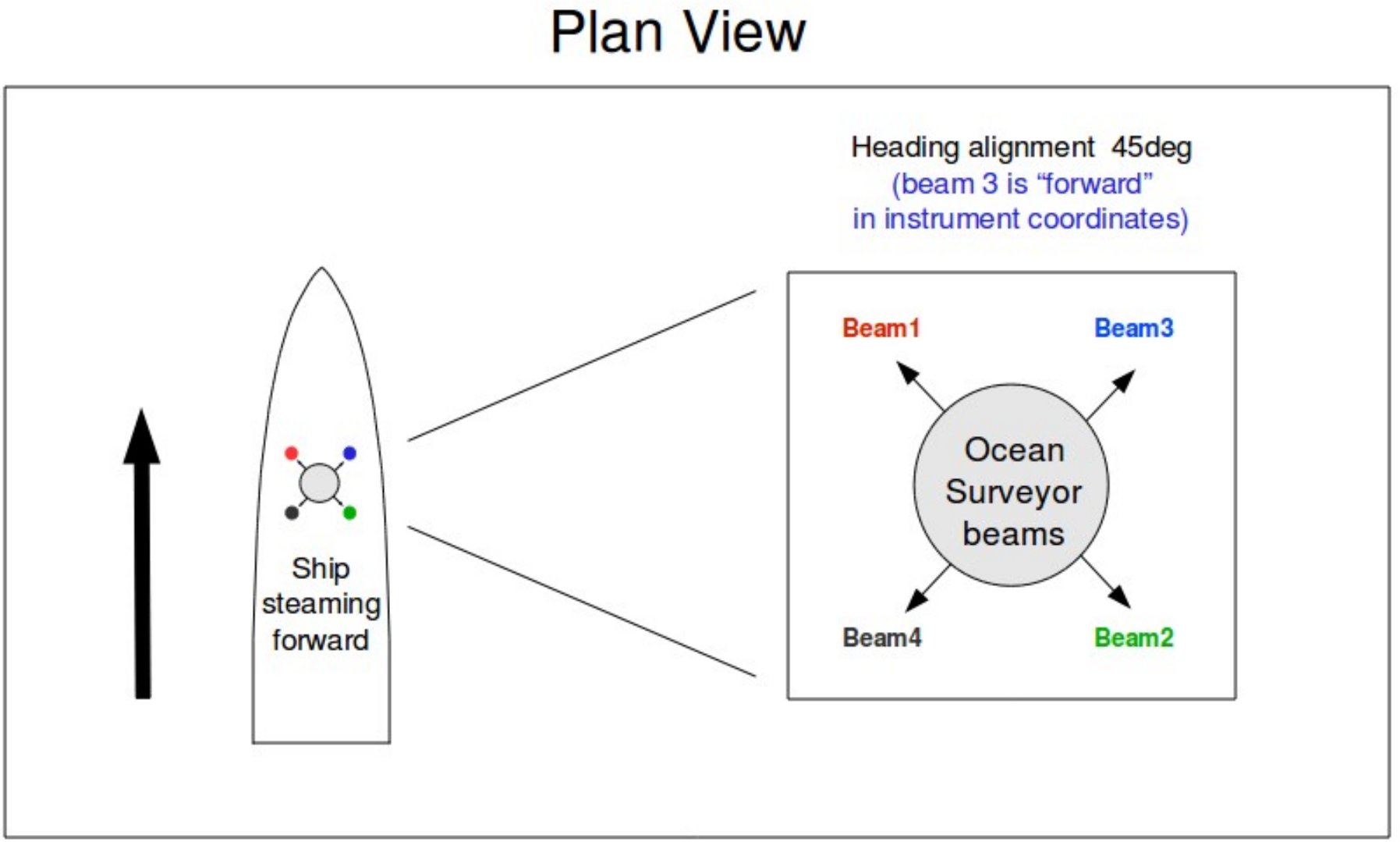
ADC**P**:

Acoustic
Doppler
Current
Profiler

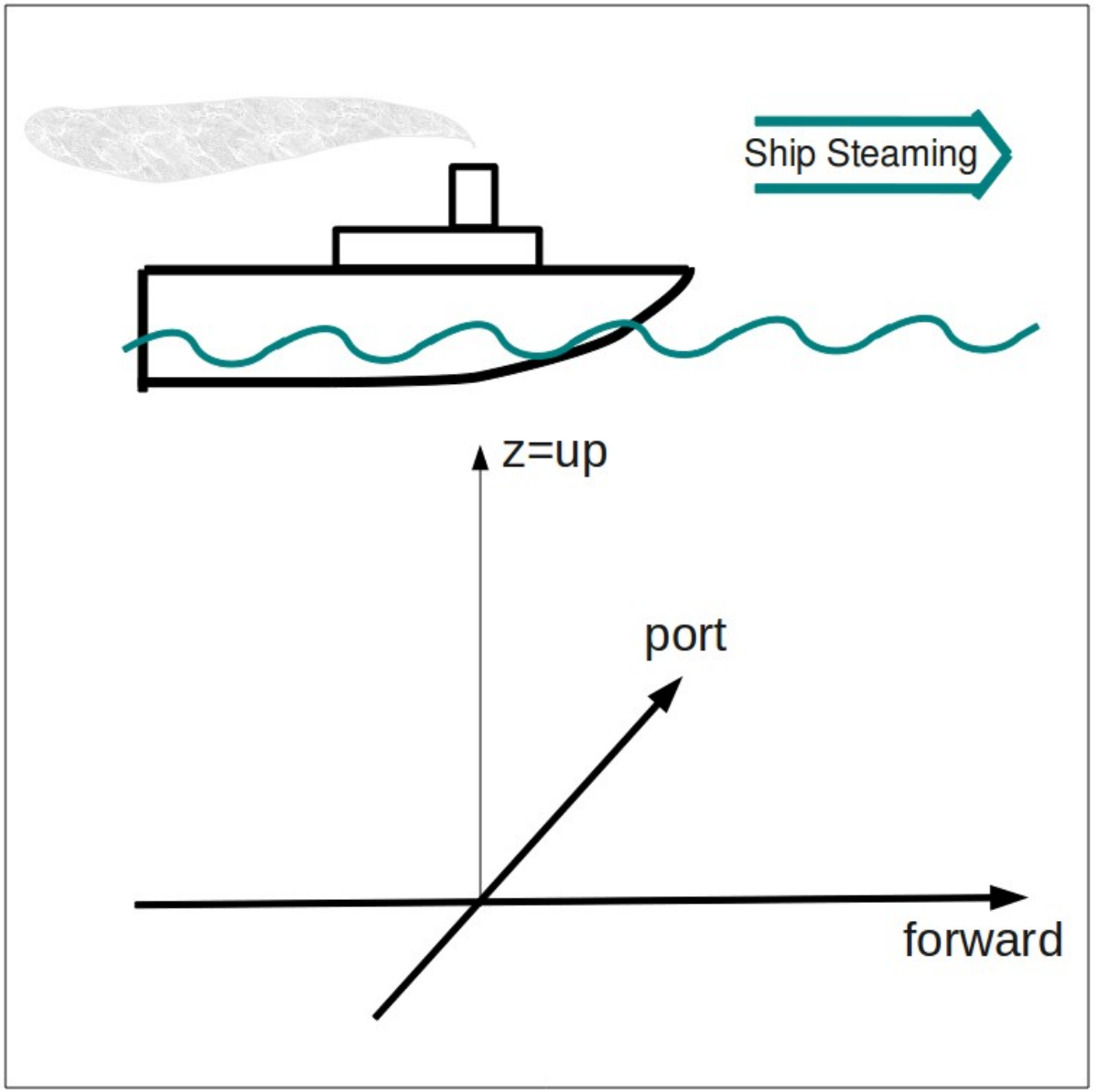


"Gating" the return over time results in "bins" in the vertical, creating a profile of information

ADCP : Getting Ocean **C**urrents



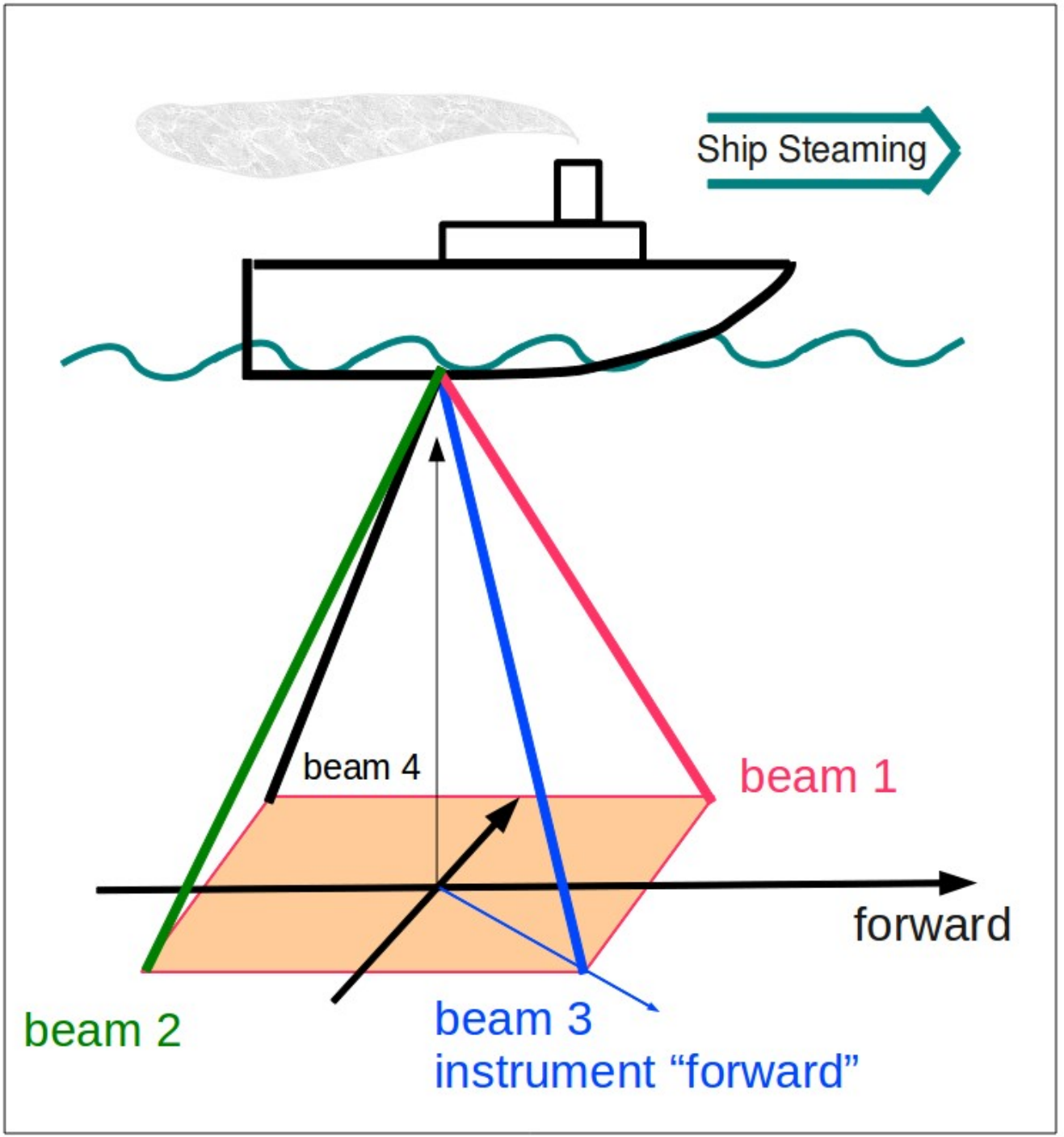
ADCP : Getting Ocean Currents



ADCP

Getting Ocean Currents

Four beams
- 90deg apart
- 30 (or 20)deg up from vertical
- “forward beam” is #3
- usually 45deg starboard of forward



ADCP

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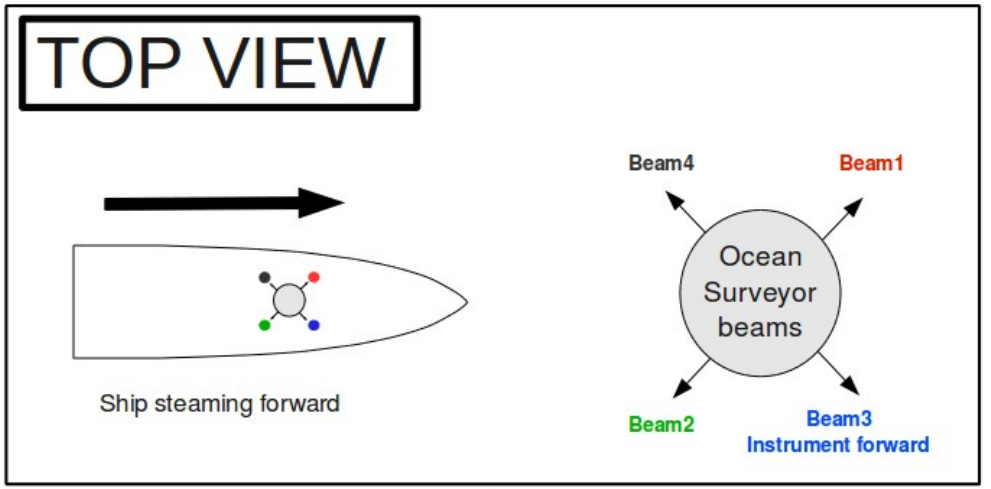
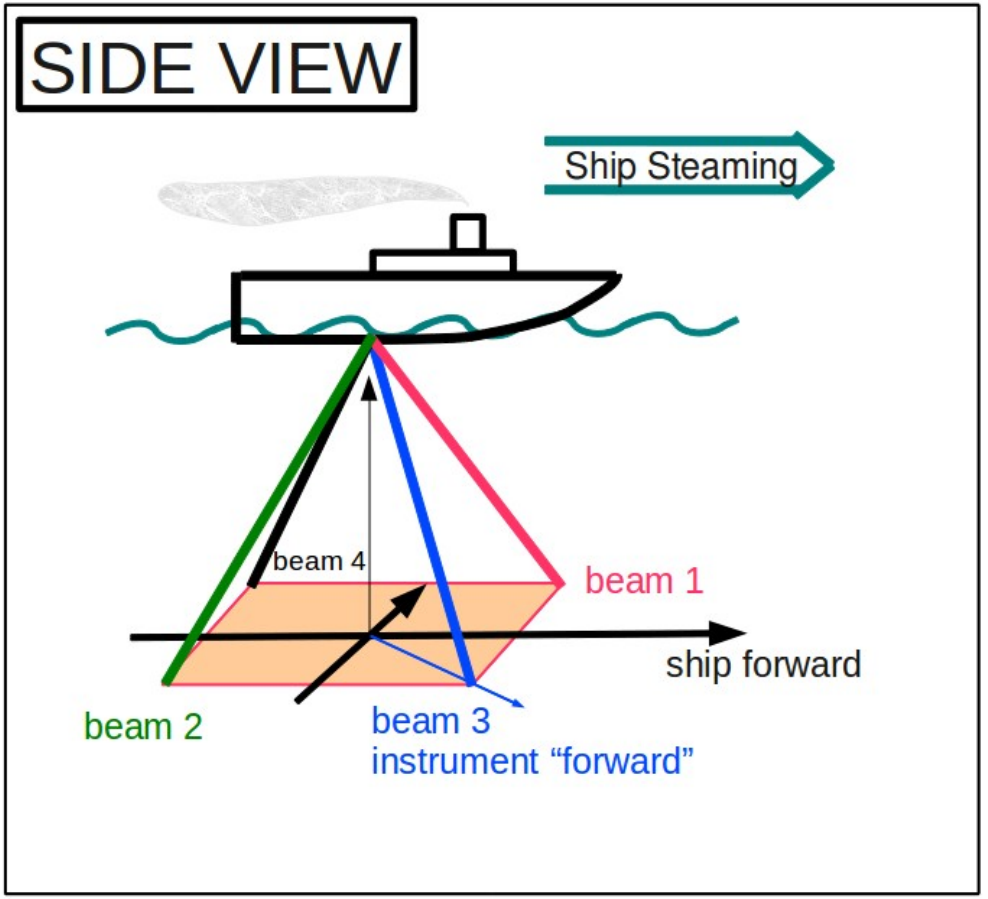
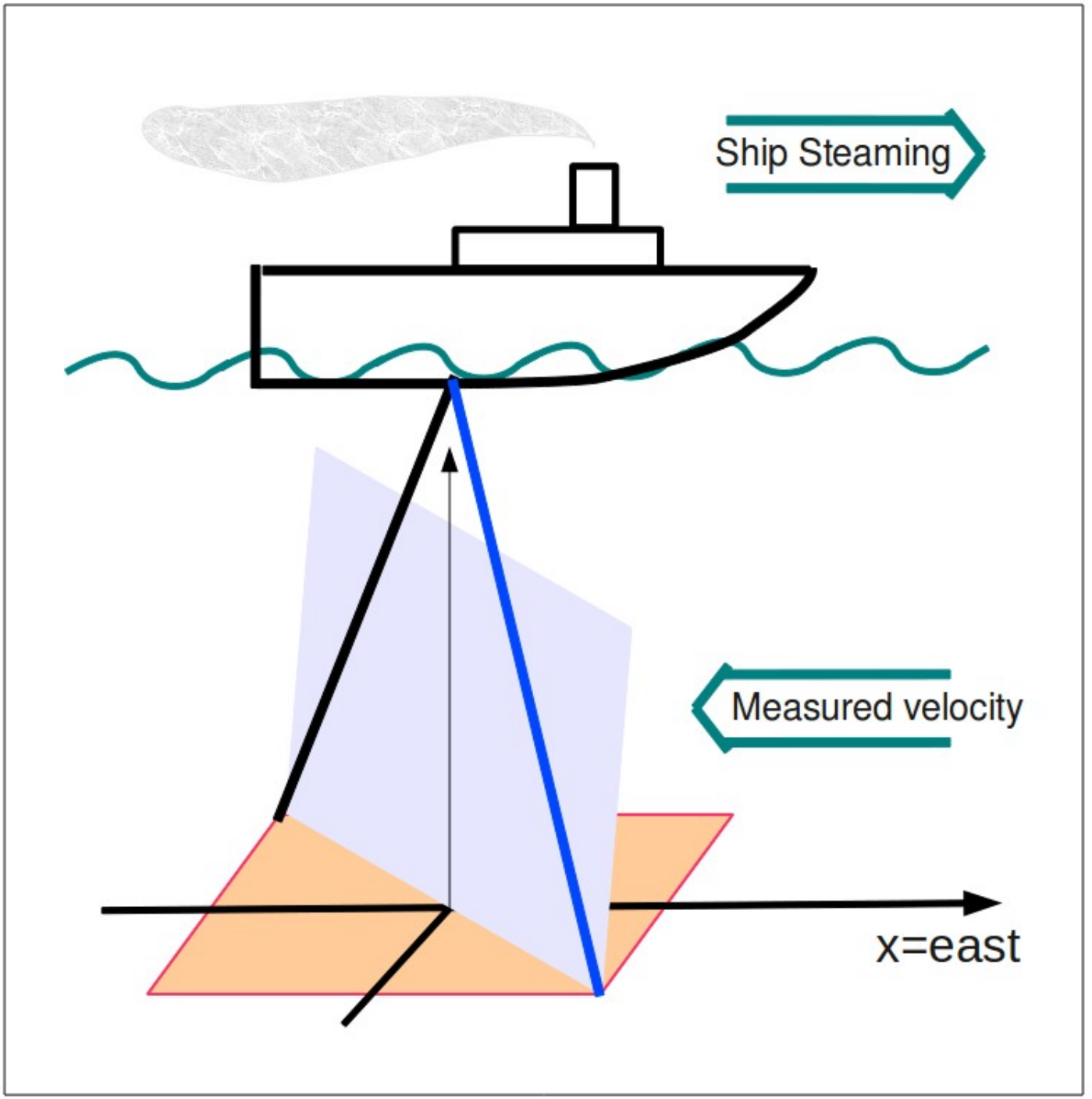




ADCP

Getting Ocean Currents

Two opposite beams make a vertical plane



ADCP

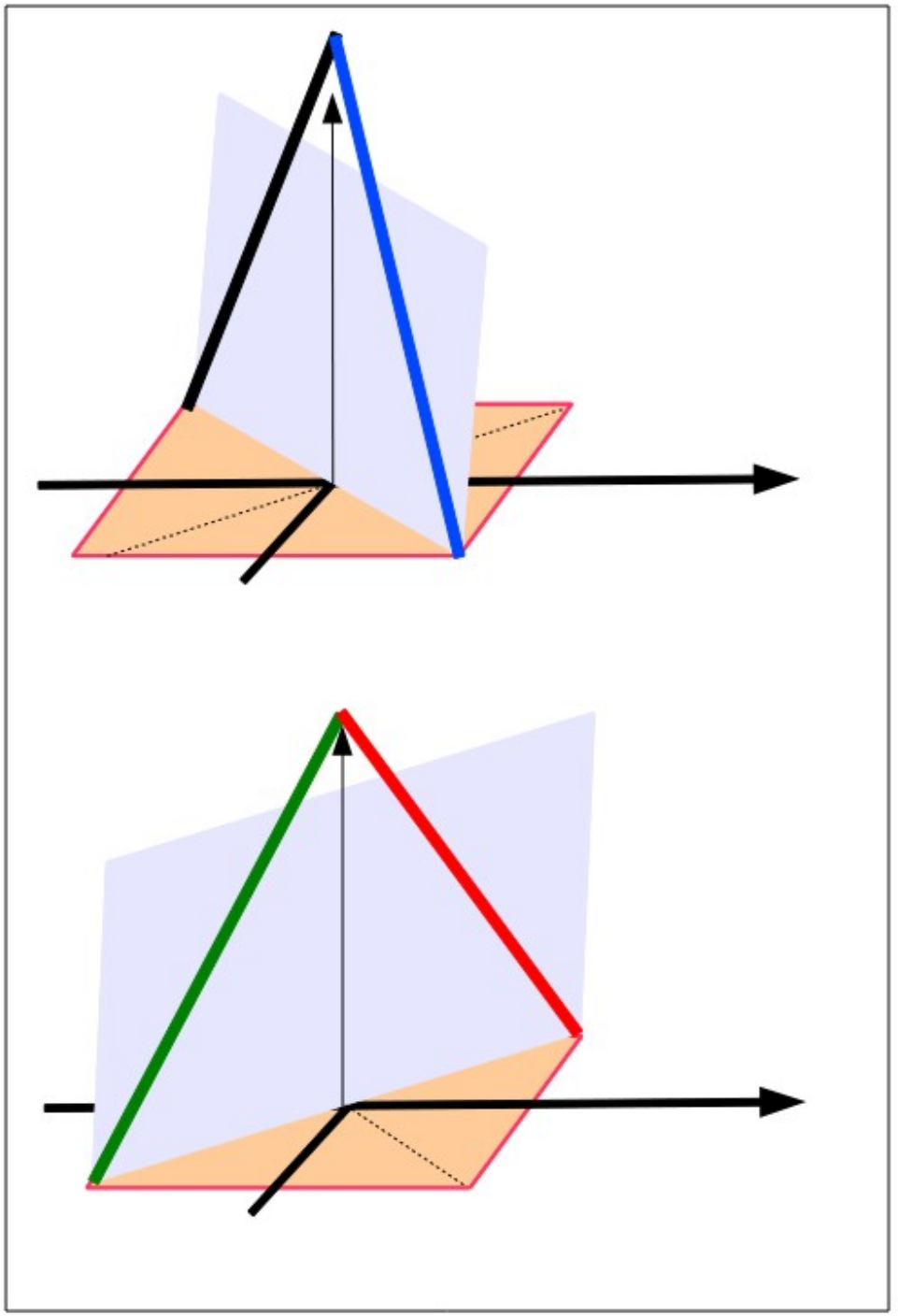
Getting Ocean Currents

Now we have two vertical pla
at 90deg to each other

These are the basis of the
horizontal and vertical velociti

Horizontal velocities will be us
To get ocean velocities

Vertical velocities will be used
error-checking



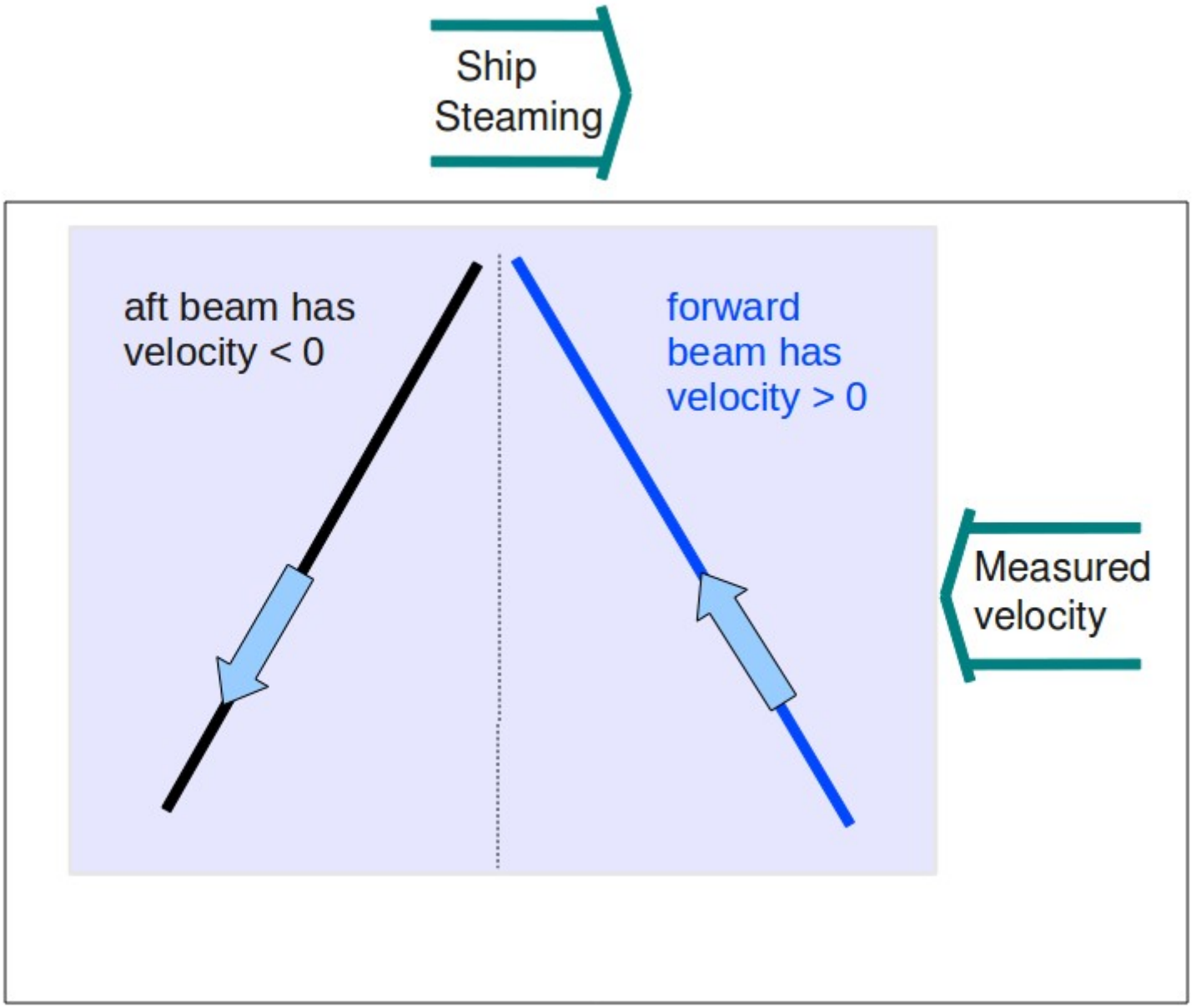
ADCP

Getting Ocear Currents

Two beams make one vertical plan

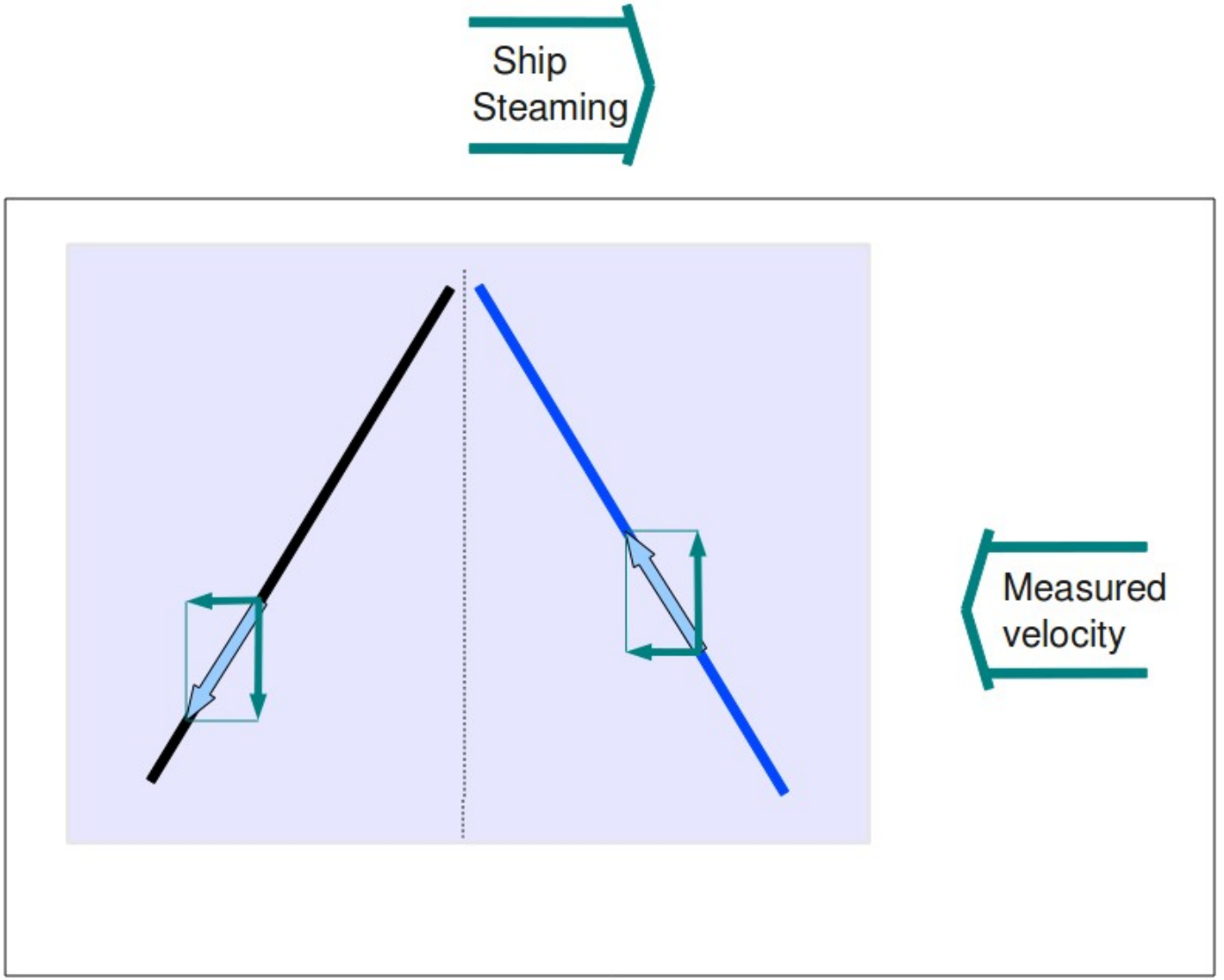
This shows the velocities determine by the Doppler shift

“beam velocities”



ADCP: Getting Ocean Currents

Interpret the two beam velocities one horizontal and one vertical velocity

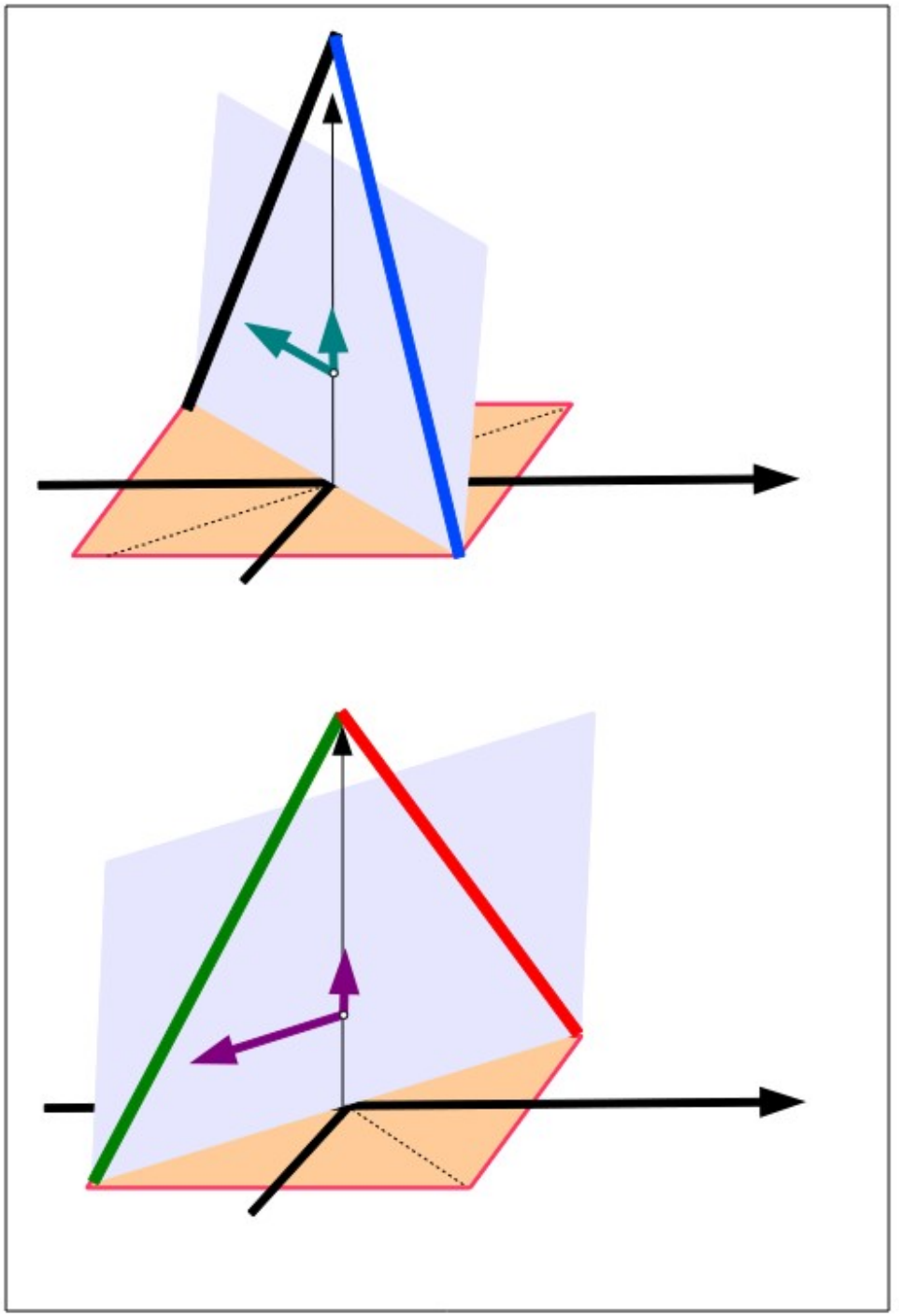


ADCP:

Getting Ocean Currents

Now we see the horizontal and vertical velocities on the two planes

Use the horizontal velocities for determining ocean velocities requires more steps.

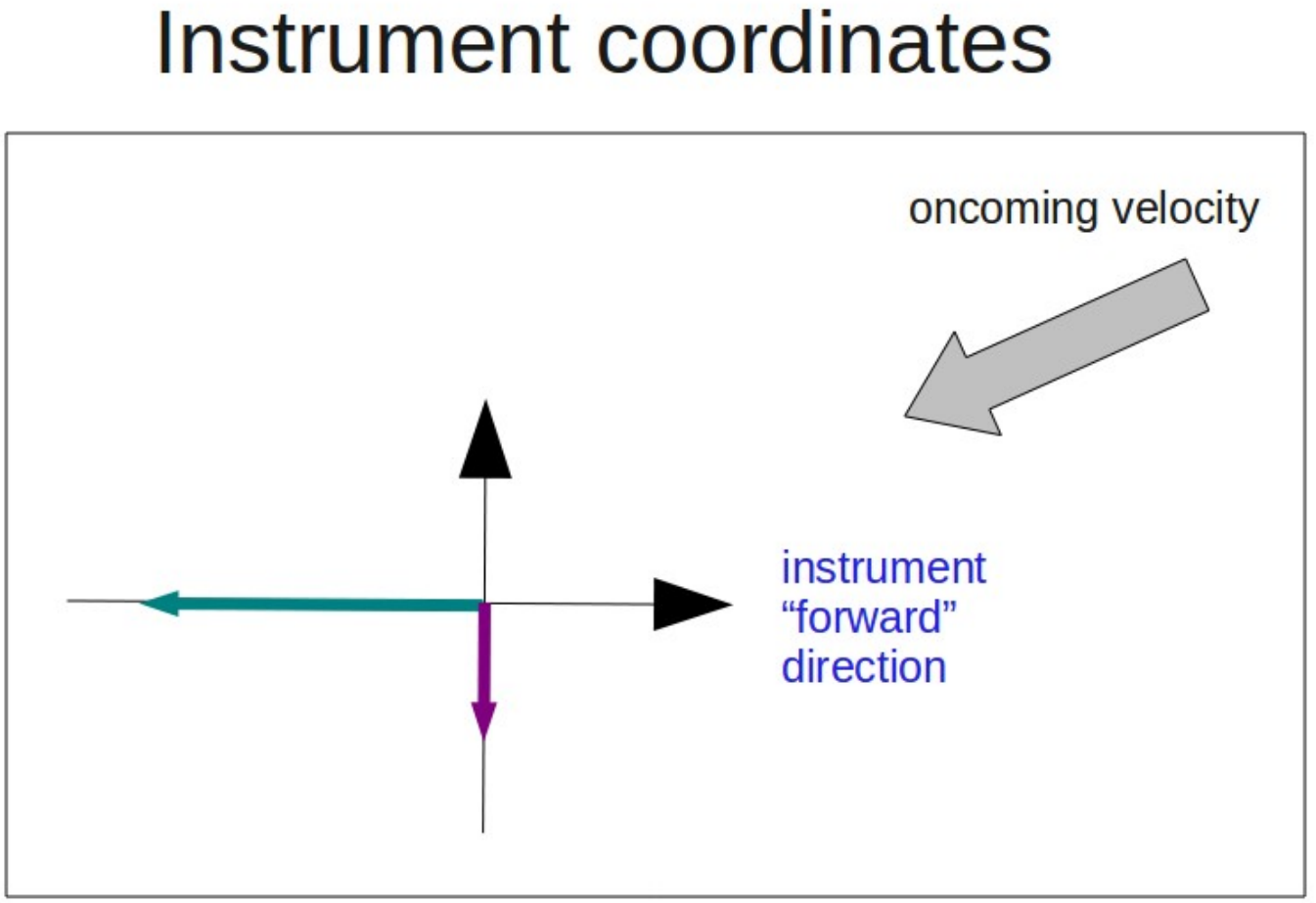


ADCP:

Getting Ocean Currents

This is a top-down view of the measur horizontal velocity ir **instrument coordinates** (from the two plane made by the beams

(determining ocean velocities requires more steps)



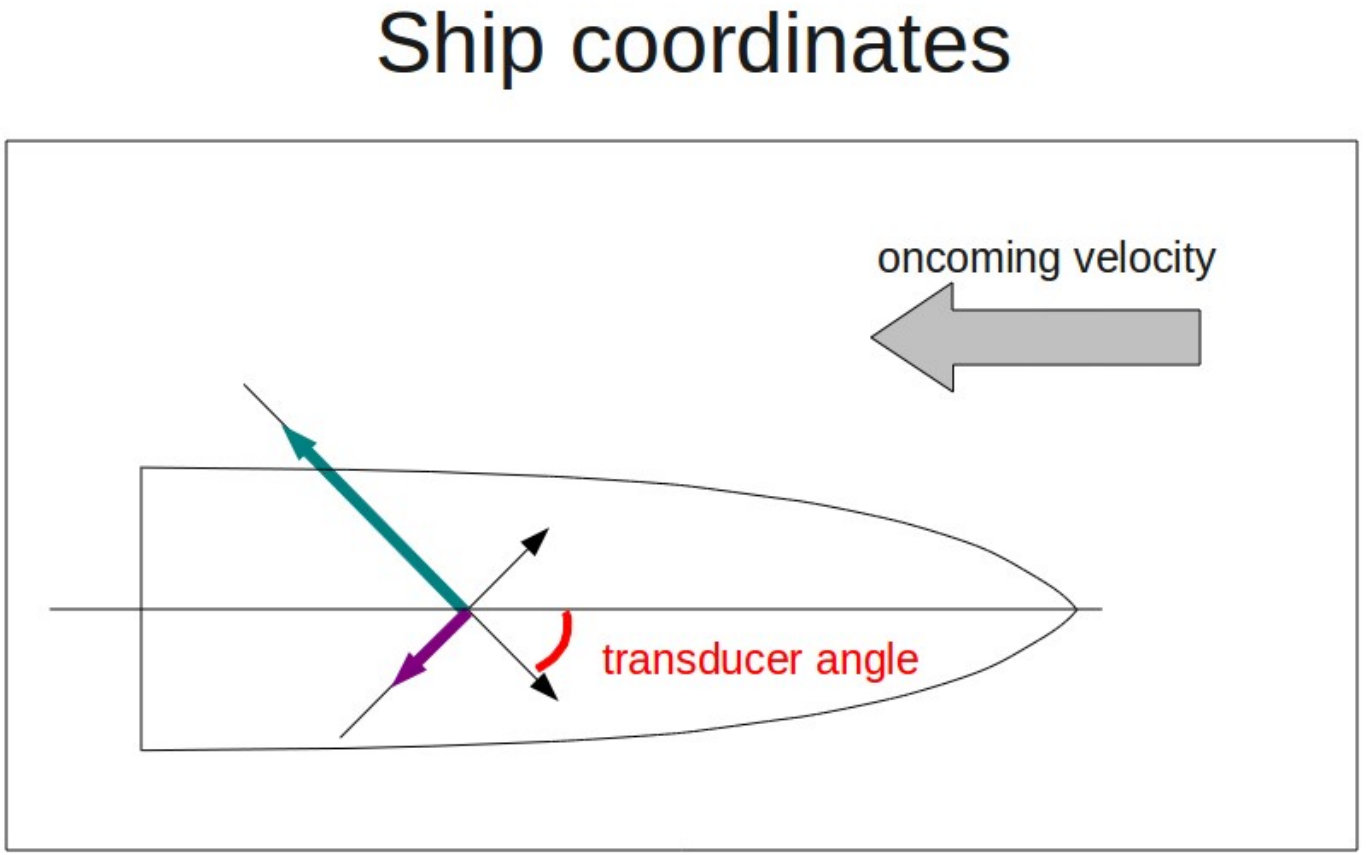
ADCP:

Getting Ocean Currents

This is a top-down view of the measure horizontal velocity in ship coordinates.

The instrument coordinates values are rotated by the **transducer angle**.

(determining ocean velocities requires more steps)



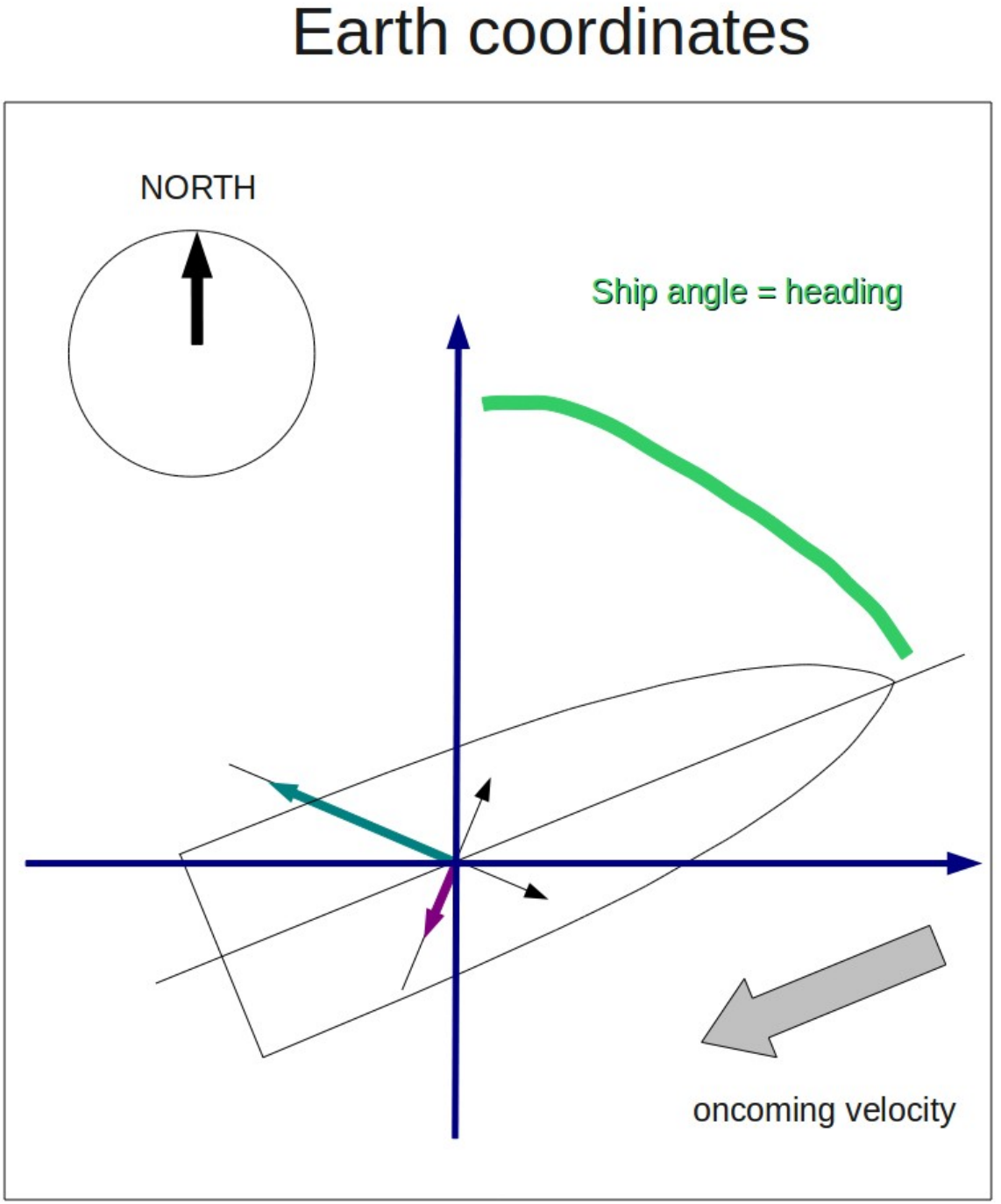
ADCP:

Getting Ocean Currents

This is a top-down view of the measured horizontal velocity in earth coordinates.

The instrument coordinates values are rotated by the **ship's heading**.

(determining ocean velocities requires more steps)



ADCP:

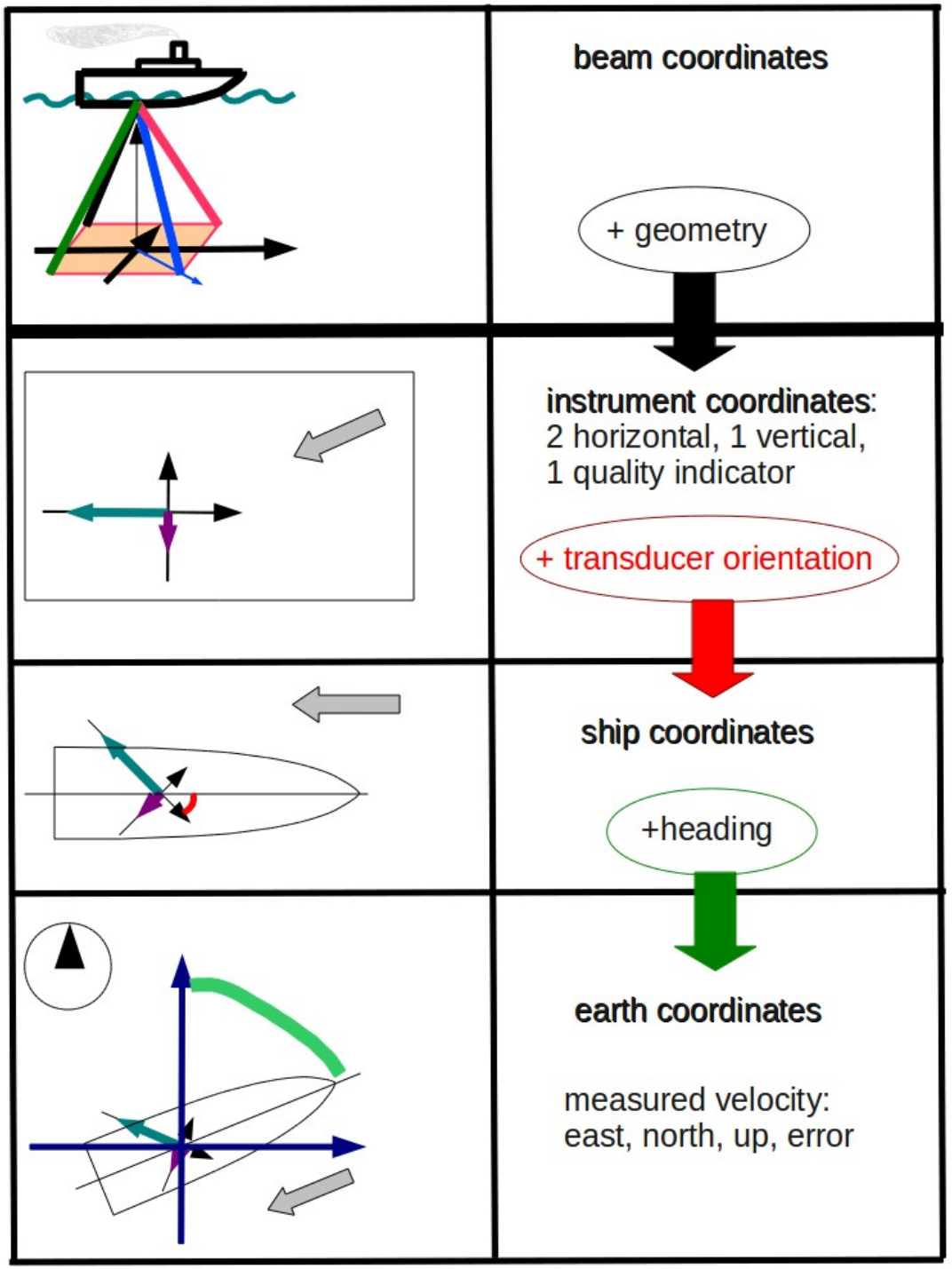
Getting Ocean Currents

Summary of steps:

Doppler to beam
(not shown)

<u>below here: horizontal+vertical</u>

- beam to instrument
- instrument to ship
- ship to earth



ADCP:

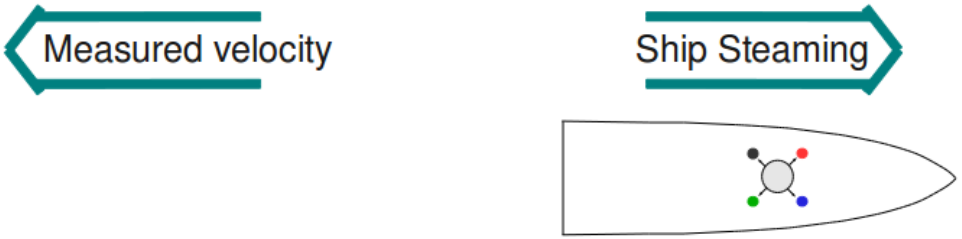
Getting Ocean Currents

Earth coordinates + **GPS** gives ship speed

add ship speed to measured velocity to get ocean velocity

Earth coordinates

If no ocean currents:



$U_{meas} = -U_{ship}$

With Ocean current

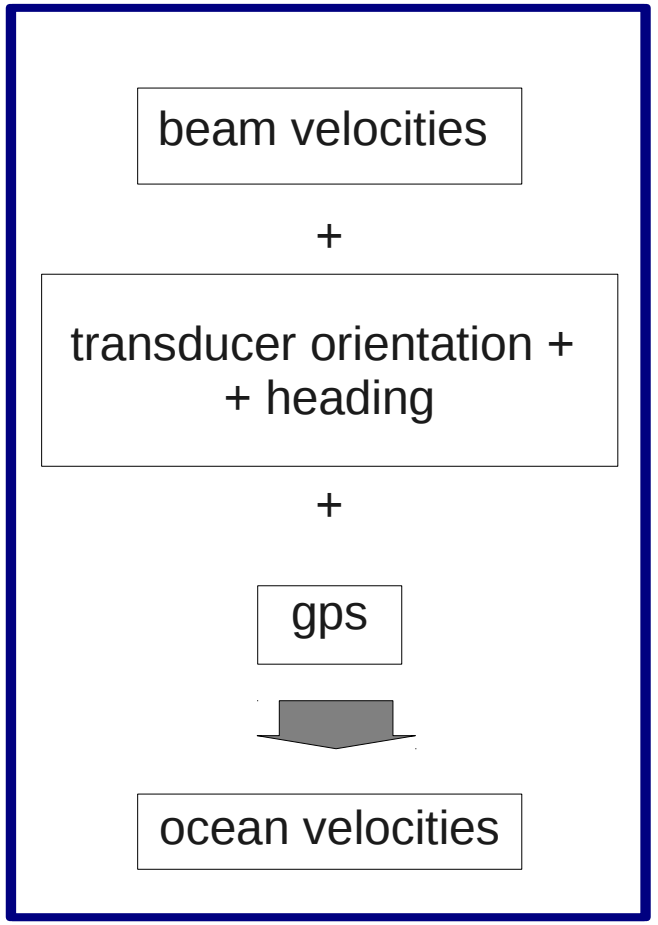
$U_{meas} = -U_{ship} + U_{ocean}$

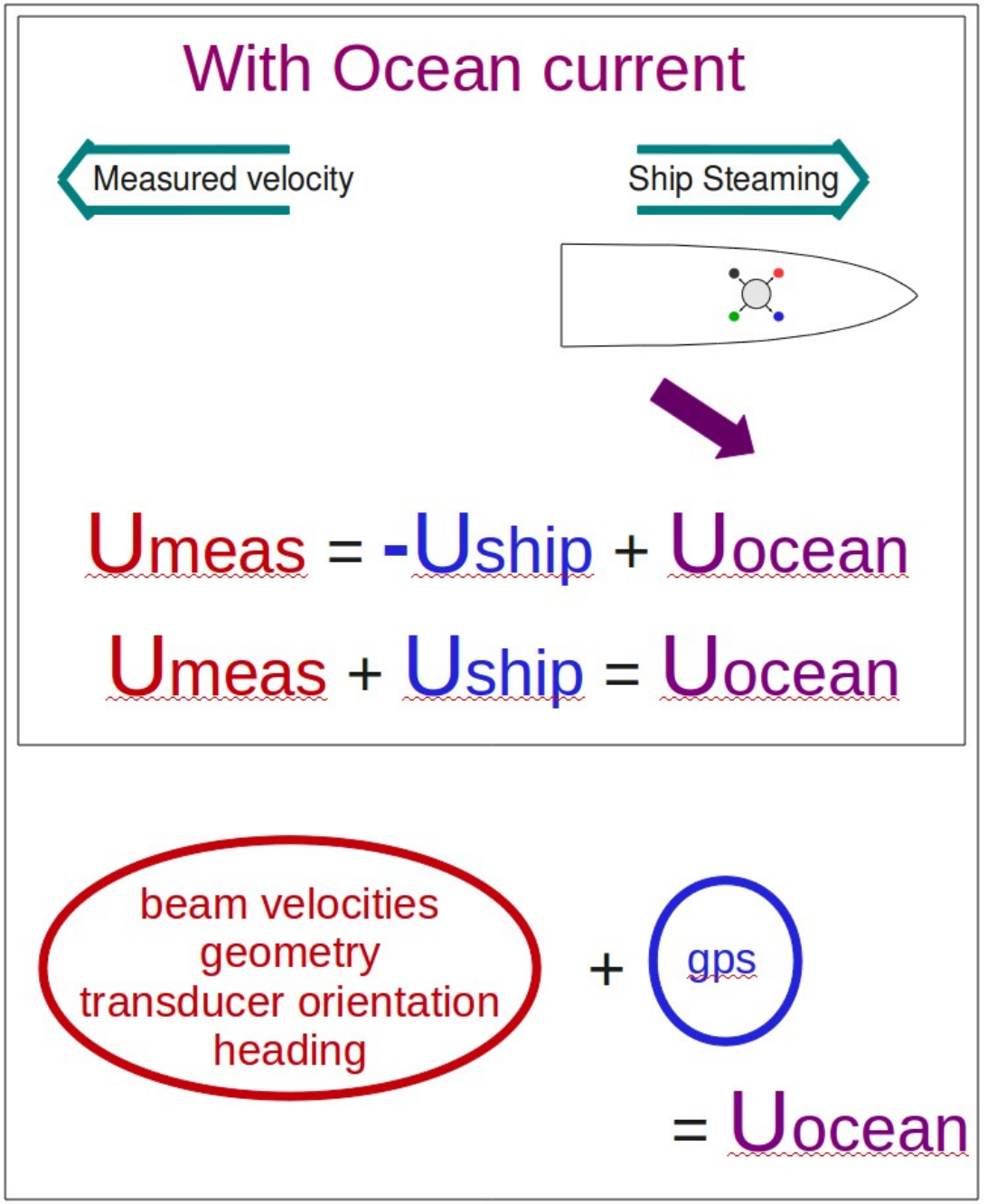
$U_{meas} + U_{ship} = U_{ocean}$

ADCP:

Getting Ocean Currents

Complete summary:





NOAA Newport 2012 ADCP

Part I: ADCP

- Getting Ocean Velocity
- ADCP Acquisition Systems:

  UHDAS, VmDAS
- What can go wrong

ADCP Acquisition systems

- Basic requirements:
  - Control ADCP settings
  - Acquire ADCP data
  - Acquire ancillary data
    - Position
    - Attitude (heading)
  - Timestamp all

Core

- Processing
- Monitoring

Extra

ADCP Acquisition systems

- Basic requirements

- Processing
  - Coordinate transformation
  - Editing
  - Averaging
  - Graphical Displays
- Monitoring

ADCP Acquisition systems

- Basic requirements
- Processing
- Monitoring
  - Computer system
  - Data acquisition
  - Processing
  - Access to data

ADCP Acquisition systems

- Basic requirements
  - Overview
  - Serial setup
  - Data logging
- Processing
- Monitoring

ADCP Acquisition Systems- Overview

	UHDAS	VmDAS
developer	Univ Hawaii	TRDI
style	linux system	windows application
source	open source	executable
purpose	seagoing oceanographers	all-purpose
goals	maximize usefulness at sea long-term value for research	off-the-shelf
evolution	continuous	incremental
setup	complex	confusing

Acquisition: Serial Setup

	UHDAS	VmDAS
ADCPs	multiple	one (per instance)
feeds	any number	3 (older version=2)
messages	many types can add more subsample feed choose messages	fewer types record all record all
gui controls operation	instrument settings simple	everything simple/confusing
protected	serial Processing	nothing protected

Acquisition: Data Logging

	UHDAS	VmDAS
data logging	separate processes	one big program
time tagging	buffered tag every line	unbuffered tag ensemble
data formats	multiple	TRDI ADCP
data directory	heirarchical	flat
time range	match per file	match for one logging period
filenames sort (time=ascii)	always	one logging period
metadata	stored with data	ascii files elsewhere

ADCP Acquisition systems

- Basic requirements
  - Overview
  - Serial setup
  - Data logging
- Processing
  - Processing components
  - Accessing data products
- Monitoring

Processing

	UHDAS	VmDAS
editing	CODAS	minimal
heading	reliable	primary
secondary heading	corrected to accurate	replaced by fallback
pings	interleaved	first
configure plots??	no	yes
plots	oceanographic: - profiles (E,N) - vector (+topo) - contour - bridge (mariner)	profile (speed, dir) vector WinADCP?

Accessing Data Products

	UHDAS	VmDAS
access plots	ship's web console	console only
data formats	TRDI Matlab	TRDI
access data	netCDF ship's web windows share NFS	acquisition PC windows share
documentation	ship's web www	acquisition PC www
speedlog out	NB150 only	yes

ADCP Acquisition systems

- Basic requirements
  - Overview
  - Serial setup
  - Data logging
- Processing
  - Processing components
  - Accessing data products
- Monitoring

Monitoring

monitor	**UHDAS**	**VmDAS**
computer	daily report	?
serial	daily_report	LOG and console messages configure tables
ADCP	beam plots	configure plots
Processing	daily_report plots calibration ping rate bottom track	configure plots no ? no
remotely	email to anyone	no

NOAA Newport 2012 ADCP

Part I: ADCP

- Getting Ocean Velocity
- ADCP Acquisition Systems:

  UHDAS, VmDAS
- What can go wrong
  - Perspective: systems
  - Perspective: data flow
  - Perspective: symptoms in ocean current
  - Perspective: VmDAS

ADCP: what can go wrong

Viewed from the perspective of:

- ADCP systems (components)
  - Computer
  - ADCP
  - Ancillary: GPS, Heading
- Data flow (where does the problem occur)
- Manifestation in ocean velocities – examples
  - Cross-track error (transducer angle)
  - Along-track error (scale factor)
  - Data loss (4 recent examples)

ADCP: what can go wrong

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What can go wrong: ADCP System (Computer)

- PC clock is erratic
- PC clock is set to local time
- Poor quality serial feed
  - Too many messages
  - Low baud rate
  - Multiple unbuffered devices

Partial loss, Garbled messages

Bad Serial Feeds

VmDAS is vulnerable to bad serial feeds

Demonstration follows...

VmDAS: Timestamping a serial feed

(1) serial port

```
$PRDID,+000.68,-000.77,273.37
```

Message name | Heading | Pitch | Roll

```
$PRDID,+000.68,-000.77,273.37
$PRDID,+000.16,-000.49,273.48
$PRDID,-000.43,-000.54,273.85
$PRDID,-000.45,-000.72,274.12
$PRDID,+000.08,-000.67,274.13
$PRDID,+000.27,-000.45,274.12
$PRDID,-000.26,-000.46,274.35
$PRDID,-000.68,-000.49,274.65
$PRDID,-000.23,-000.25,274.88
```

$PADCP

(2) VmDAS timestamp

```
$PADCP,1,20100620,223211.66
```

Message name | Ensemble number | YYYYMMDD | HHMMSS.SS

VmDAS serial feed: when it works

```
$PRDID,+000.16,-000.49,273.48
$PRDID,-000.43,-000.54,273.85
$PADCP,1,20100620,223211.66
$PRDID,-000.45,-000.72,274.12
$PRDID,+000.08,-000.67,274.13
$PRDID,+000.27,-000.45,274.12
$PRDID,-000.26,-000.46,274.35
$PRDID,-000.68,-000.49,274.65
$PRDID,-000.23,-000.25,274.88
$PADCP,2,20100620,223218.16
$PRDID,+000.56,+000.05,275.00
$PRDID,+000.84,-000.15,275.05
$PRDID,+000.48,-001.15,275.15
$PRDID,+000.07,-002.38,275.28
$PRDID,-000.01,-002.76,275.33
$PRDID,-000.02,-001.75,275.43
$PADCP,3,20100620,223223.64
$PRDID,-000.26,+000.05,275.72
$PRDID,-000.51,+001.37,276.10
$PRDID,-000.35,+001.45,276.35
$PRDID,+000.26,+000.24,276.31
$PRDID,+000.81,-001.25,276.07
$PADCP,4,20100620,223229.13
$PRDID,+000.70,-002.05,275.85
$PRDID,+000.09,-002.04,275.74
```

UHDAS serial timestamping

```
$UNIXD,87.6667280,12.9128355
$AGHDT,092.0,T
$UNIXD,87.6667395,12.9128470
$AGHDT,092.0,T
$UNIXD,87.6667511,12.9128586
$AGHDT,092.4,T
$UNIXD,87.6667627,12.9128701
$AGHDT,092.4,T
$UNIXD,87.6667743,12.9128817
$AGHDT,092.0,T
$UNIXD,87.6667858,12.9128933
$AGHDT,091.7,T
$UNIXD,87.6667974,12.9129049
$AGHDT,091.7,T
$UNIXD,87.6668090,12.9129164
$AGHDT,092.0,T
$UNIXD,87.6668206,12.9129280
$AGHDT,092.2,T
$UNIXD,87.6668321,12.9129396
$AGHDT,092.4,T
$UNIXD,87.6668437,12.9129512
```

VmDAS serial feed: a common problem

```
$HEROT,010.9,A*23
$HEHDT,157.4,T*28
$HEROT,011.0,A*2B
$HEHDT,1$PADCP,1,20111111,154915.01,0.00
57.7,T*2B
$HEROT,014.2,A*2C
$HEHDT,157.9,T*25
$HEROT,014.0,A*2E
$HEHDT,158.2,T*21
$PADCP,2,20111111,154917.04,0.00
$HEROT,015.6,A*29
$HEHDT,158.4,T*27
$HEROT,016.7,A*2B
$HEHDT,158.7,T*24
$HEROT,015.5,A*2A
$HEHDT,159.0,T*22
$PADCP,3,20111111,154920.06,0.00
$HEROT,015.0,A*2F
```

VmDAS serial feed: a common problem

```
$HEROT,010.9,A*23
$HEHDT,157.4,T*28
$HEROT,011.0,A*2B
$HEHDT,1$PADCP,1,20111111,154915.01,0.00
57.7,T*2B
$HEROT,014.2,A*2C
$HEHDT,157.9,T*25
$HEROT,014.0,A*2E
$HEHDT,158.2,T*21
$PADCP,2,20111111,154917.04,0.00
$HEROT,015.6,A*29
$HEHDT,158.4,T*27
$HEROT,016.7,A*2B
$HEHDT,158.7,T*24
$HEROT,015.5,A*2A
$HEHDT,159.0,T*22
$PADCP,3,20111111,154920.06,0.00
$HEROT,015.0,A*2F
```

Rudely inserted

Compromised serial data

- multiple feeds
- messages with no checksum
- low baud rate
- coming from a computer (SCS)

$GTG,A,054,35,27209.679,N7.5500.C
8,01HDT,354.5,-2.4,M8685.4,8507.0,03,W*6D
$GPM,0,356,13358,M
$H.4,N,3543,K*
$
$GPG,3505453572727..5,5,N,.6,00.45
$GW,2,,0501.0,272$PADCP,4910,20110507,054659.19,70.00
5,M,94,.4,M,00.0,01,W,65
,01HDT,354.3,-2
$GPM,0,355,13358,M
$H.3,N,3542,K*
$
$GPG,3505453582727..4,1,N,.5,00.45
$GW,2,,0501.0,2726,M,20,.4,M,00.0,01,W,64
,01HDT,354,M,T
$GPVTG,354,T,356,M,09.3,N,17.2,KT

Partial $GPGGA position messages

Partial $HEHDT heading messages

SUMMARY: For the best VmDAS Serial data....

(1) DO NOT

push multiple sources into one port
use long RS232 cables
send too extra many messages
use a high repetition rate (eg 10Hz)

(2) DO

get data directly from the instrument
(not a computer)
choose a higher baud rate

(3) use feeds with a checksum

checksum:
helps Q/C

3022.078N ?
08833.792W ?
014.7 ?

BAD

$GPVTG,082,T,084,M,00.1,N,00.1,K*48

What can go wrong – ADCP

- ADCP loss or degradation
  - Loss of range (loud while underway, weak beam)
  - Loss of one beam (not good)
  - Loss of multiple beams (repair/replace)
  - Acoustic interference (another pinger)
  - Ice
  - Bubbles
  - Acoustic noise (results in loss of range)
  - Electrical noise

What can go wrong – ancillary

- Heading
  - Heading device fails
  - Inaccurate heading device (old mechanical gyro)
- Position
  - Position device fails; gappy
- Any: serial feed problems
  - Cable falls out
  - Instrument fails

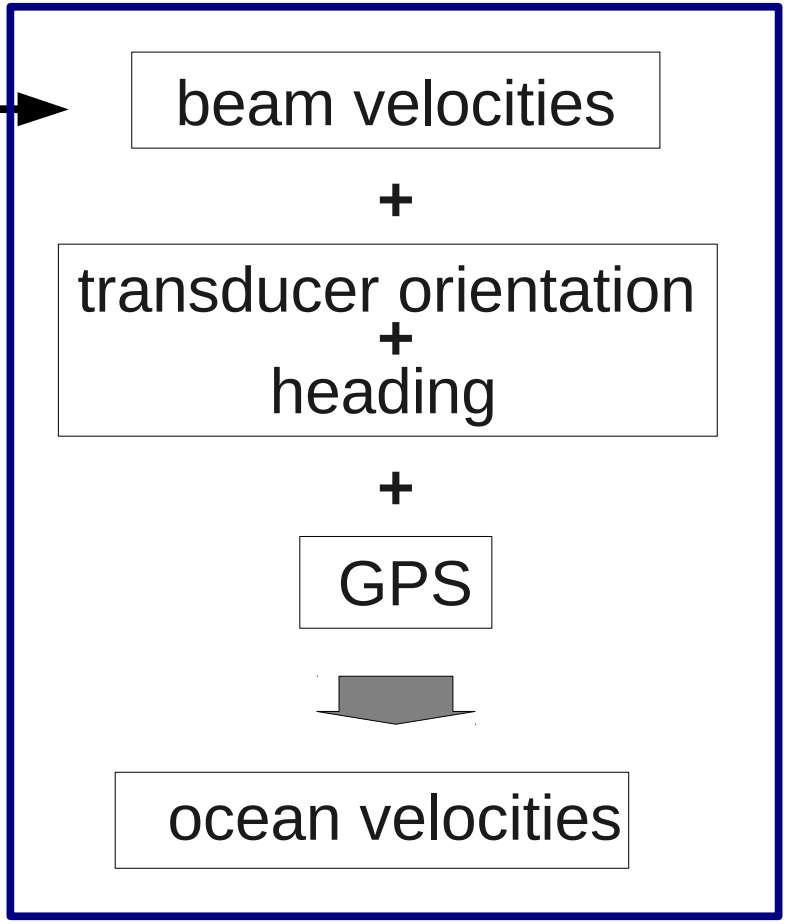
ADCP: what can go wrong

Viewed from the perspective of:

- ADCP systems (components)
  - Computer
  - ADCP
  - Ancillary: GPS, Heading
- Data flow (where does the problem occur)
- Manifestation in ocean velocities – examples
  - Cross-track error (transducer angle)
  - Along-track error (scale factor)
  - Data loss (4 recent examples)

ADCP: data loss, degradation
(1) degraded range and coverage

Bubbles
Electric Noise
Acoustic noise
Lost or weak beam
Thick window
Ringing
Ice

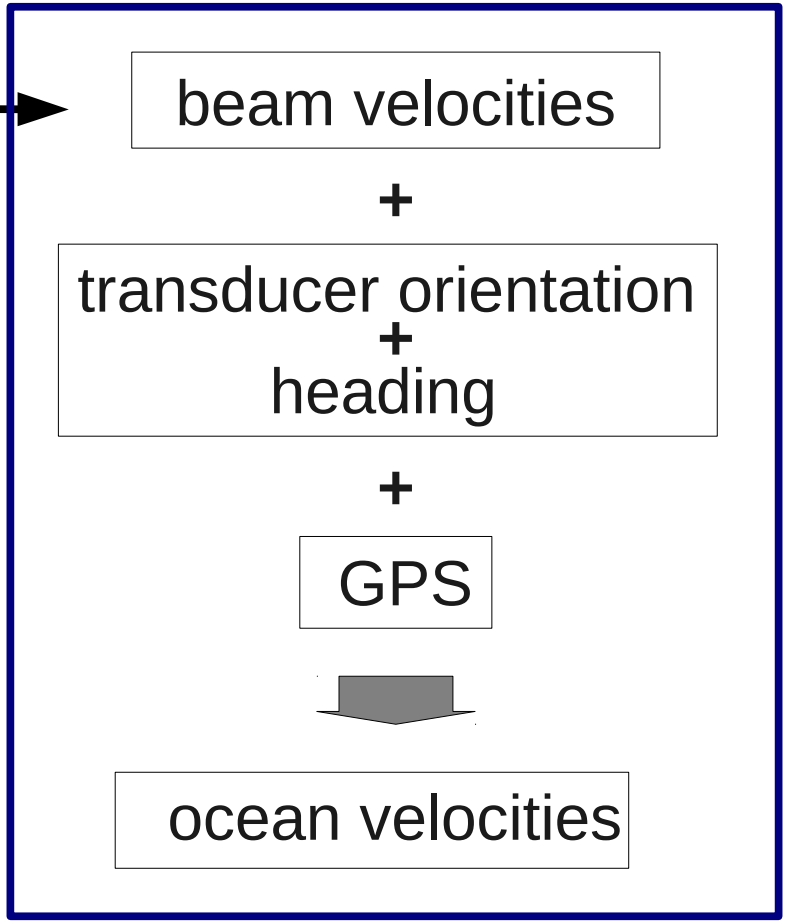


Solution:

Improve the installation

ADCP: data loss, degradation
(2) remaining data compromised

Bubbles
Electronic noise
Acoustic noise
Lost or weak beam
Thick window
Ringing
Ice



Solution:

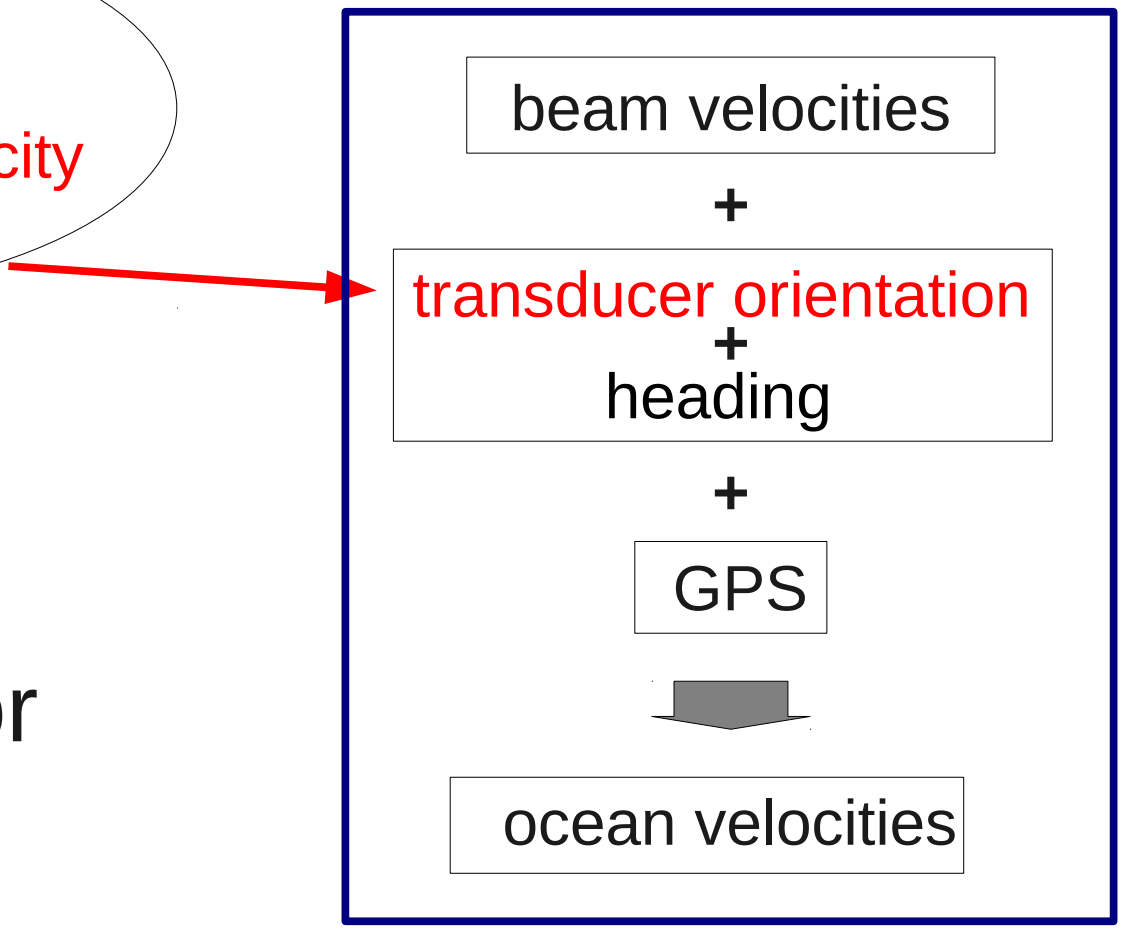
Edit out bad data

Review what remains

Transducer misalignment
(1) angle off by <10deg

1deg error in heading

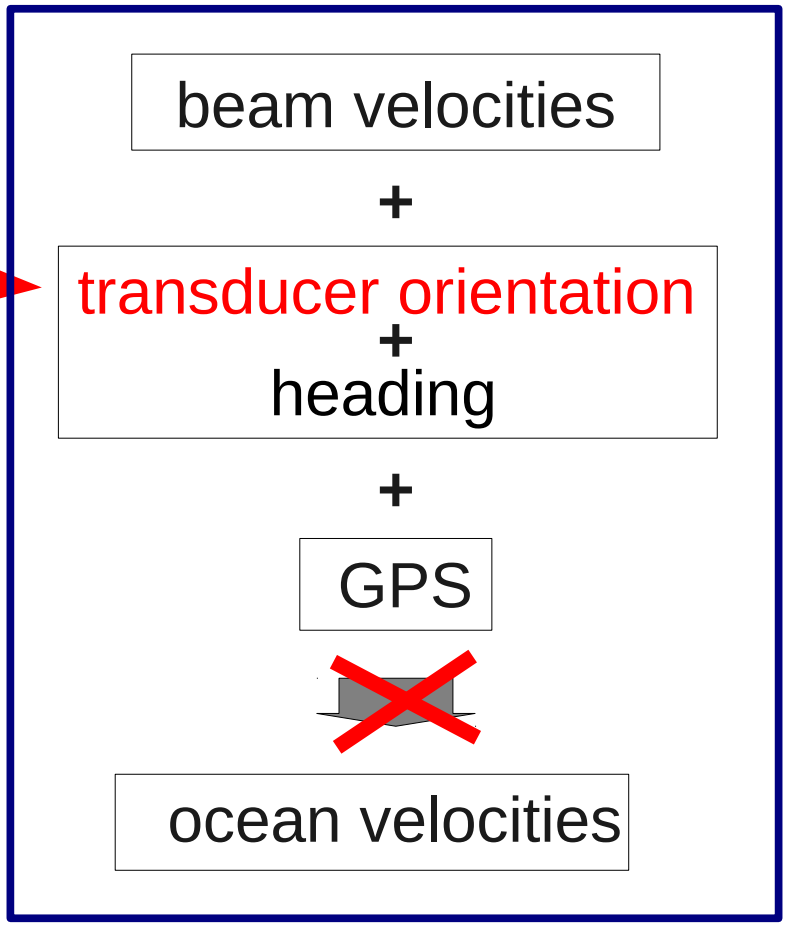
10cm/s error in ocean velocity



Diagnostic:
Cross-track error

Transducer misalignment
(2) angle off by >90deg (*)

Ocean Surveyor acquires data using **EA** in the calculation of BEAM VELOCITIES. Gross error could irrevocably ruin the data



Diagnostic:
beam velocities corrupted (wrap)

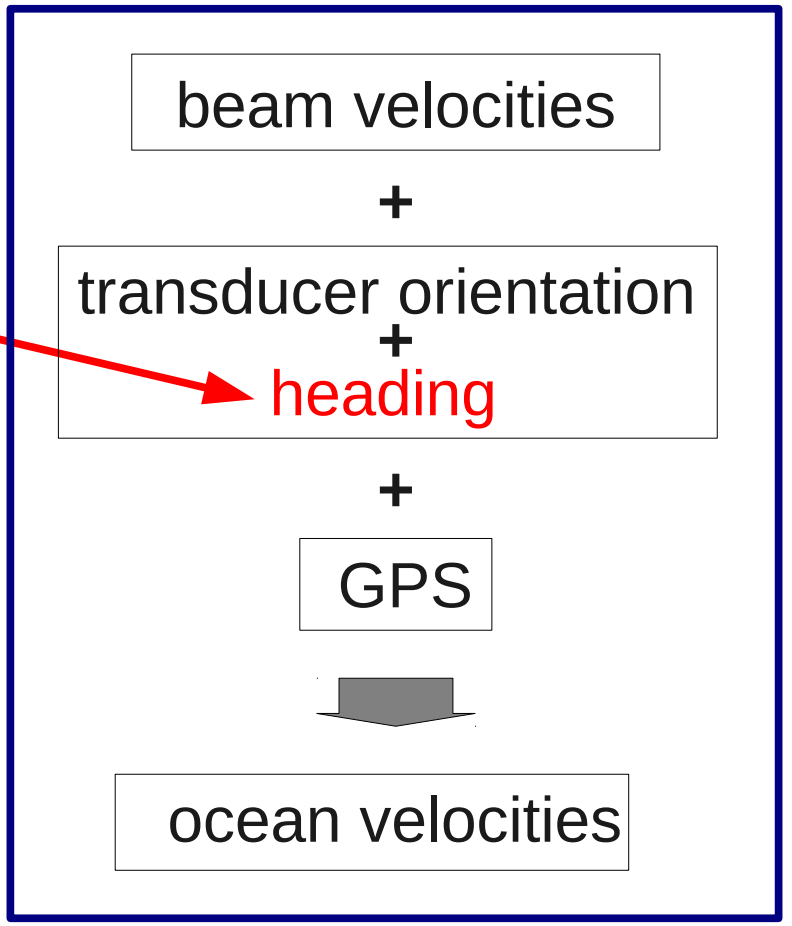
(*) actual value varies with ship

Headings are inaccurate

1deg error in heading

⇕

10cm/s error in ocean velocity

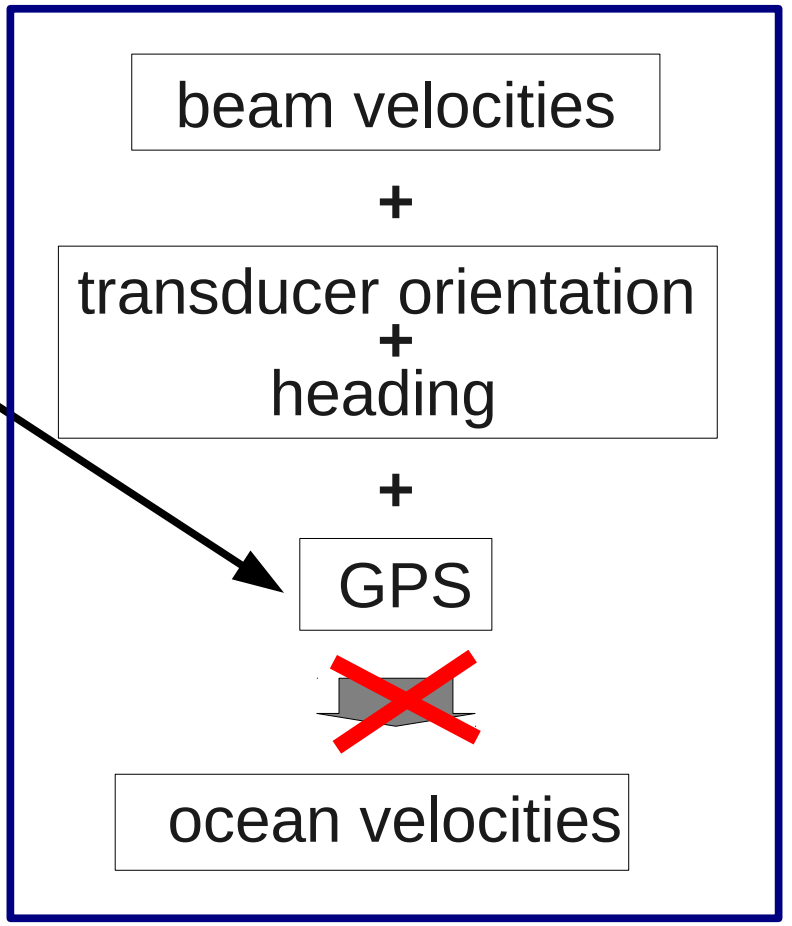


Diagnostic:

Cross-track error

Failure of ancillary (heading, gps)

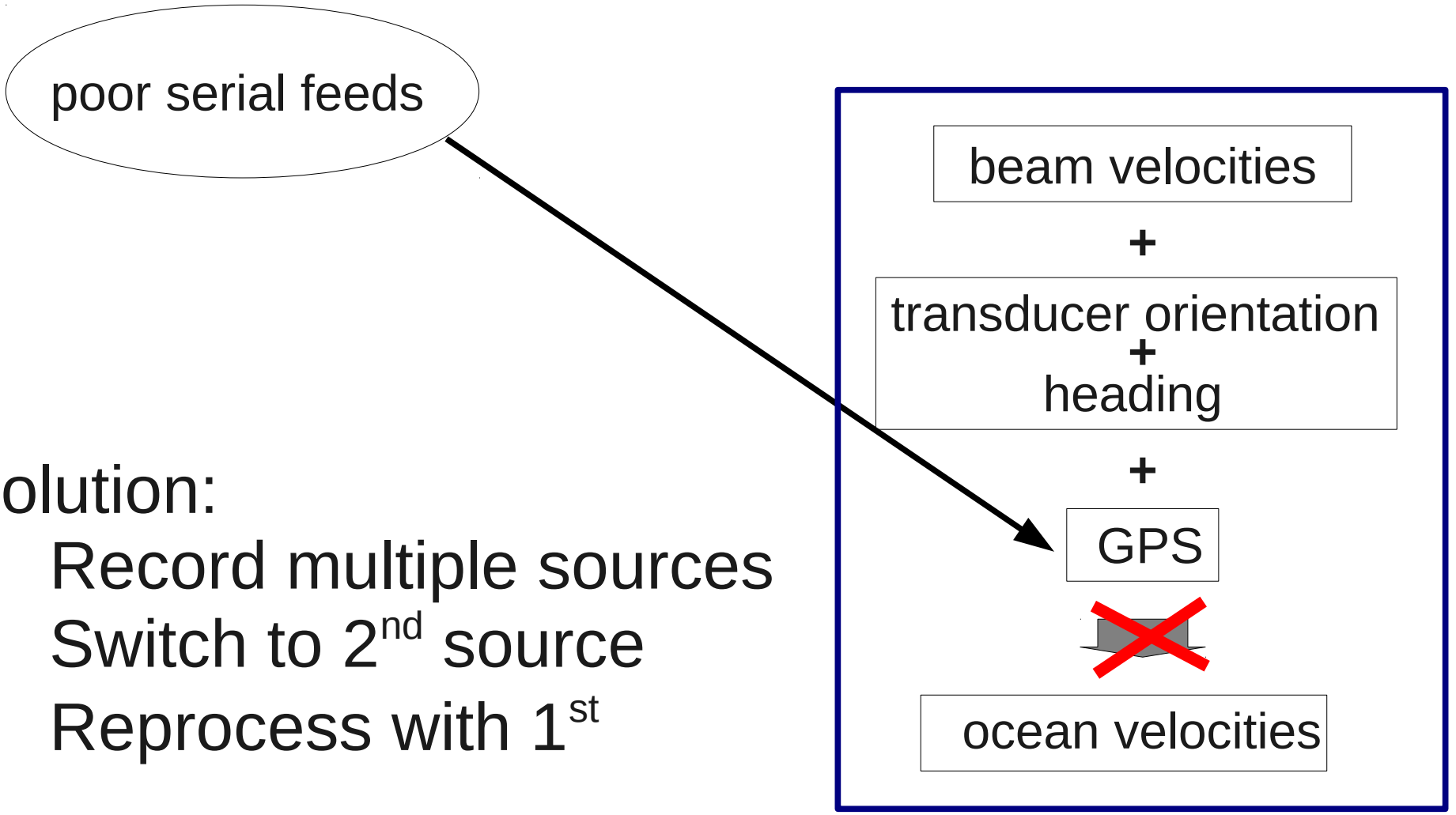
Instrument failure
Communications failure



Solution:

- Record multiple sources
- Switch to 2nd source
- Reprocess with 1st

Intermittent loss or corruption of ancillary data



Solution:

- Record multiple sources
- Switch to 2nd source
- Reprocess with 1st

ADCP: what can go wrong

Viewed from the perspective of:

- ADCP systems (components)
  - Computer
  - ADCP
  - Ancillary: GPS, Heading
- Data flow (where does the problem occur)
- Manifestation in ocean velocities – examples
  - Cross-track error (transducer angle)
  - Along-track error (scale factor)
  - Data loss (4 recent examples)

What can go wrong: “manifestation in ocean velocities”

(1) Cross-track error:

- recovery requires accurate heading

(2) Along-track error:

- may indicate a serious problem
- recovery may be possible, incomplete, ambiguous

(3) Other:

- Acoustic interference
- Underway bias (bad weather)
- Bad Setup (4 examples)

What can go wrong: “manifestation in ocean velocities”

(1) Cross-track error:

- recovery requires accurate heading

(2) Along-track error:

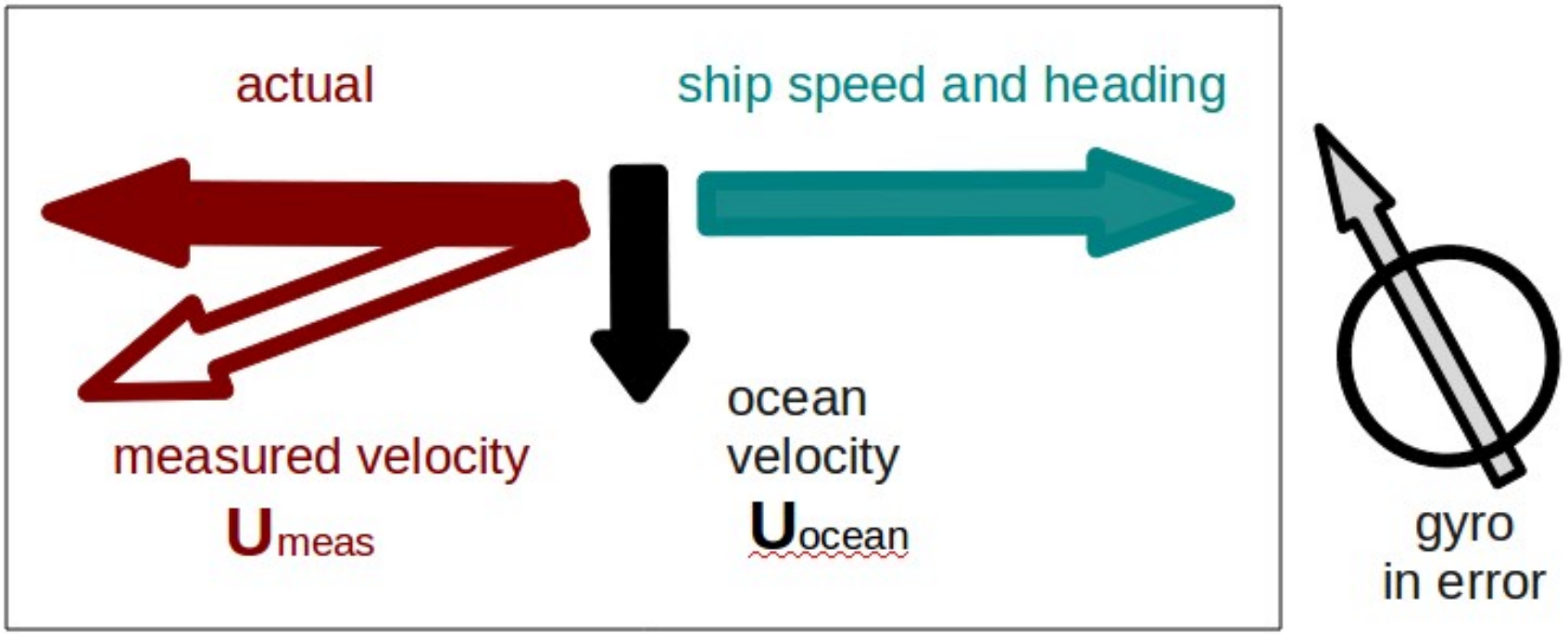
- may indicate a serious problem
- recovery may be possible, incomplete, ambiguous

(3) Other:

- Acoustic interference
- Underway bias (bad weather)
- Bad Settings (3 examples)

Symptom = Cross-Track Error
Cause = incorrect angle applied

Cross-track bias in ocean velocity from angle error:
(heading + transducer angle)



Symptom = Cross-Track Error
Cause = incorrect **angle applied**

Angle applied comes from

- Transducer angle (beam “3” clockwise from bow)
- Heading of ship
- If UHDAS,
  - Reliable heading for each ping (eg gyro)
  - Heading correction for each averaging period
  - Calculated relative to devices such as Ashtech, POSMV, Seapath, Mahrs, Phins

Symptom = Cross-Track Error
Cause = incorrect **angle applied**

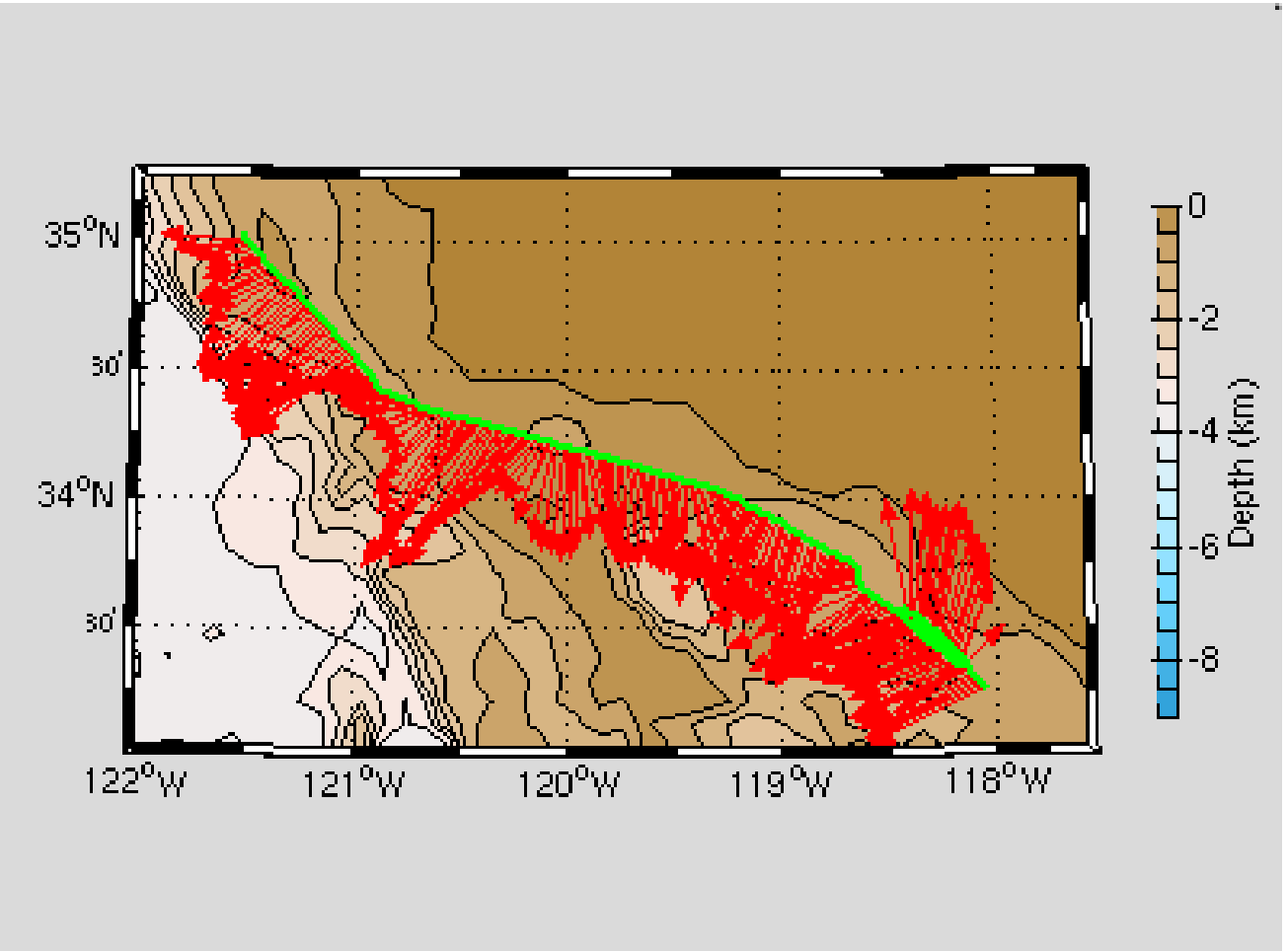
Angle applied comes from

- Transducer angle (beam “3” clockwise from bow)

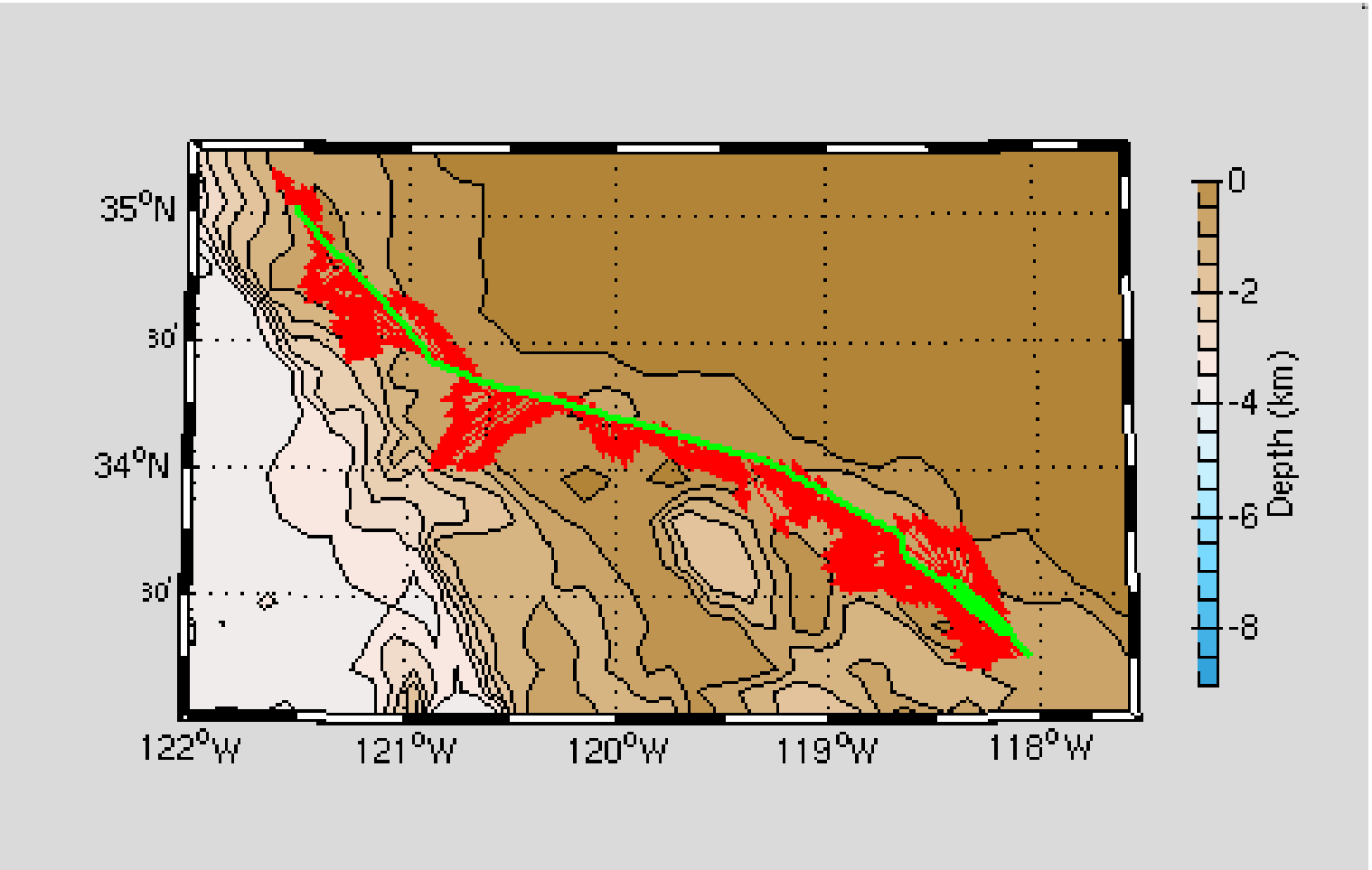
This is a constant value for the whole cruise

Examples of error in transducer angle follow...

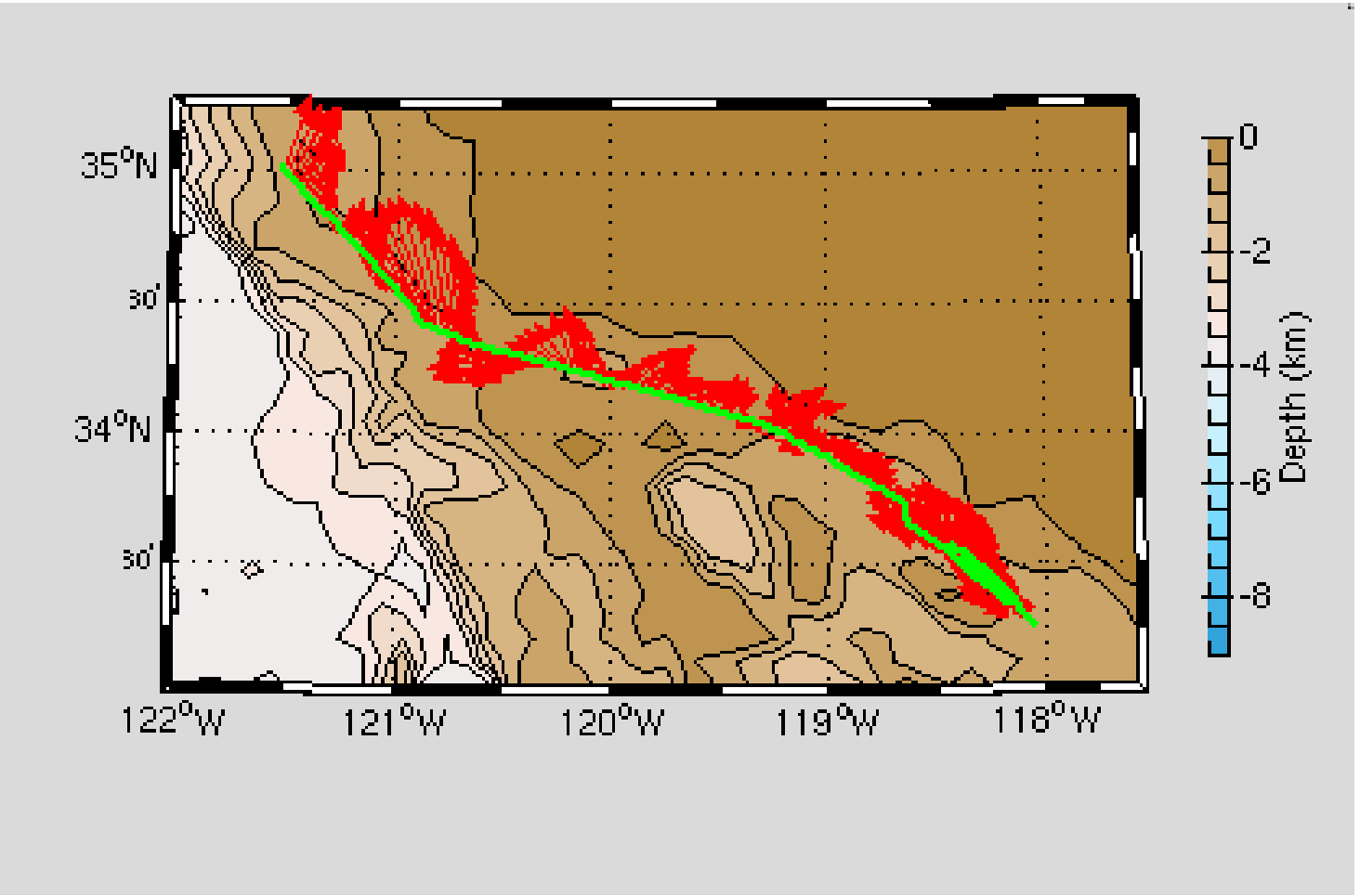
Calibration: angle error -3.6deg



Calibration: angle error -1.6



Calibration: angle error 0.4



Symptom = Cross-Track Error
Cause = incorrect **angle applied**

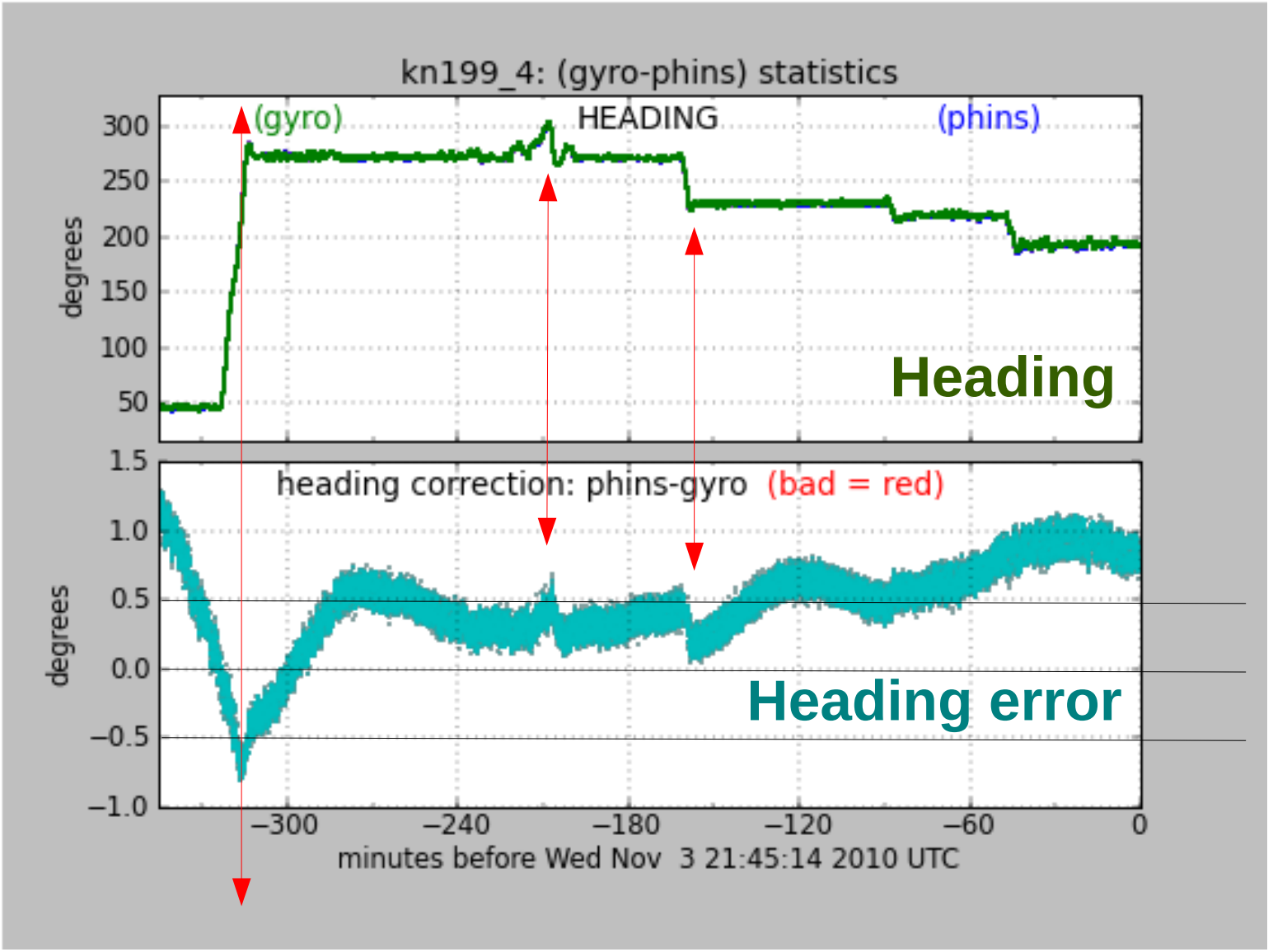
Angle applied comes from

Heading, which may be in error by

- A constant offset
- A time-dependent offset

Example follows ...

Phins-Gyro difference varies with time



360 deg

180 deg

0 deg

0.5 deg

0.0 deg

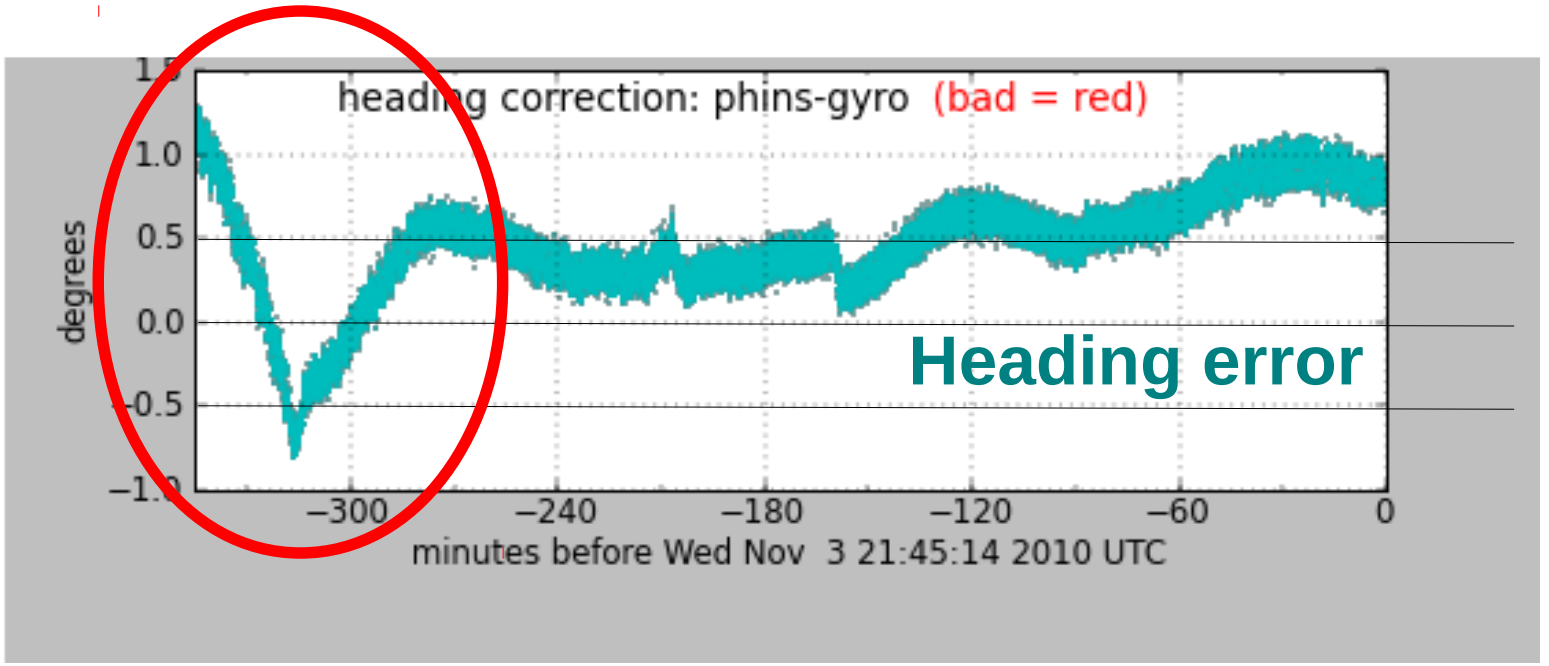
-0.5 deg

Changes in ship's heading affect heading error

Effect of Time-Dependent Heading Error on Ocean Velocties

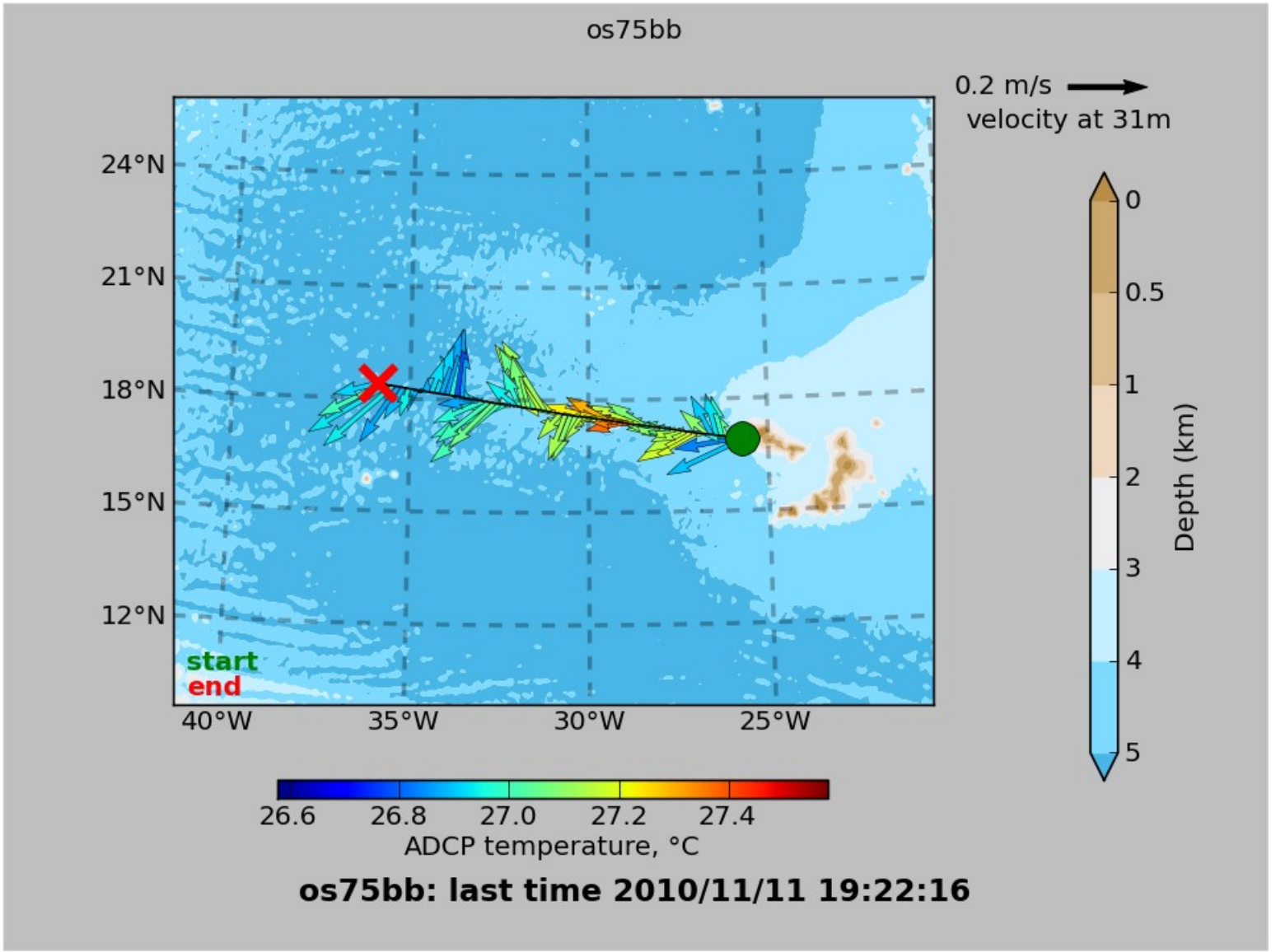
1 degree error in heading means:

- 0.1m/s error in ocean velocity
- in the cross-track direction



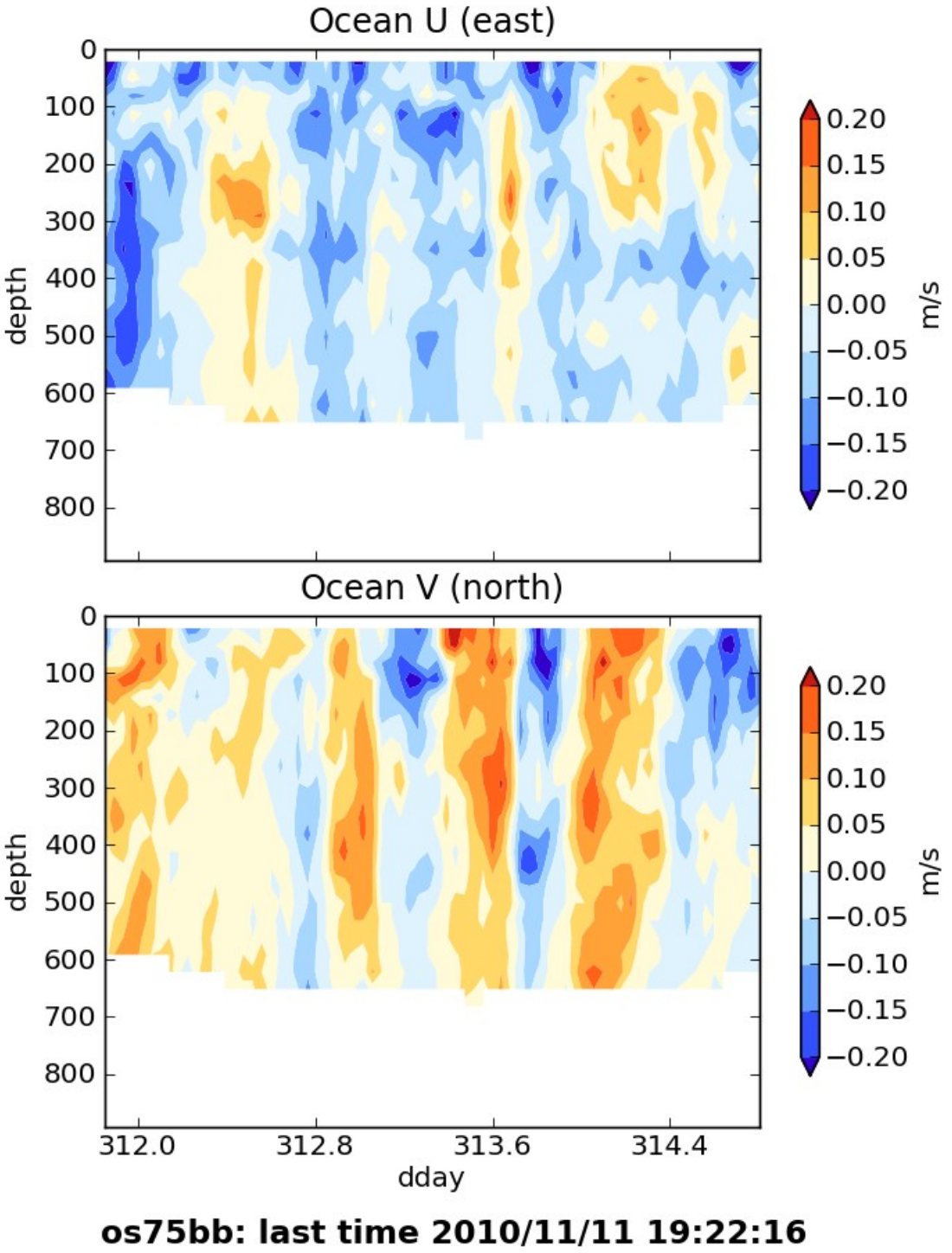
Changes in ship's heading affect heading error

Is this a heading error?



Contour plot:

Is this cross-track signal (stripes in N/S ocean velocity) due to a heading error?



Answer

Actually, it's really the ocean, but we can't tell without knowing the quality of the accurate heading device.

What can go wrong: “manifestation in ocean velocities”

(1) Cross-track error:

- recovery requires accurate heading

(2) Along-track error:

- may indicate a serious problem
- recovery may be possible, incomplete, ambiguous

(3) Other:

- Acoustic interference
- Underway bias (bad weather)
- Bad Settings (3 examples)

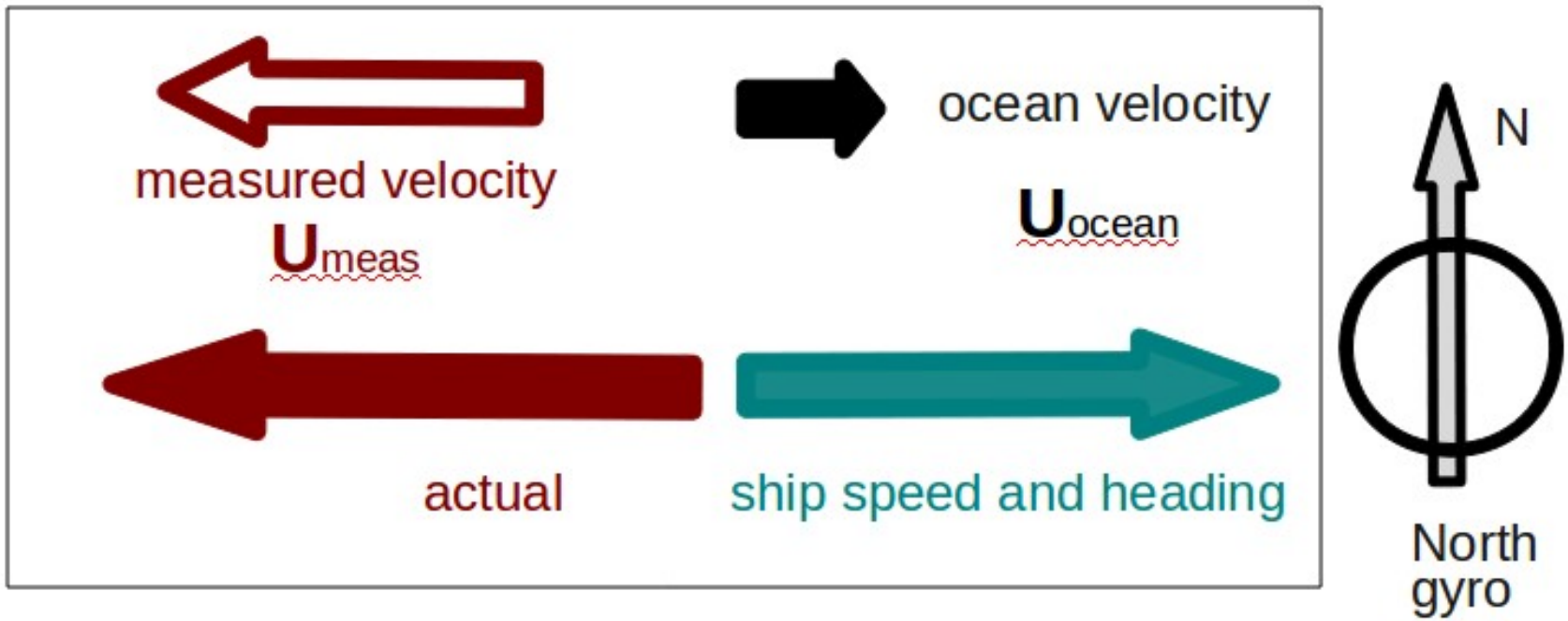
Examples of along-track error

- Acoustic interference
- Underway bias (bad weather)
- Scale factor (NB150 soundspeed correction)
- (things that look like scale factor)

Along-track Error

Bias towards zero in measured velocity

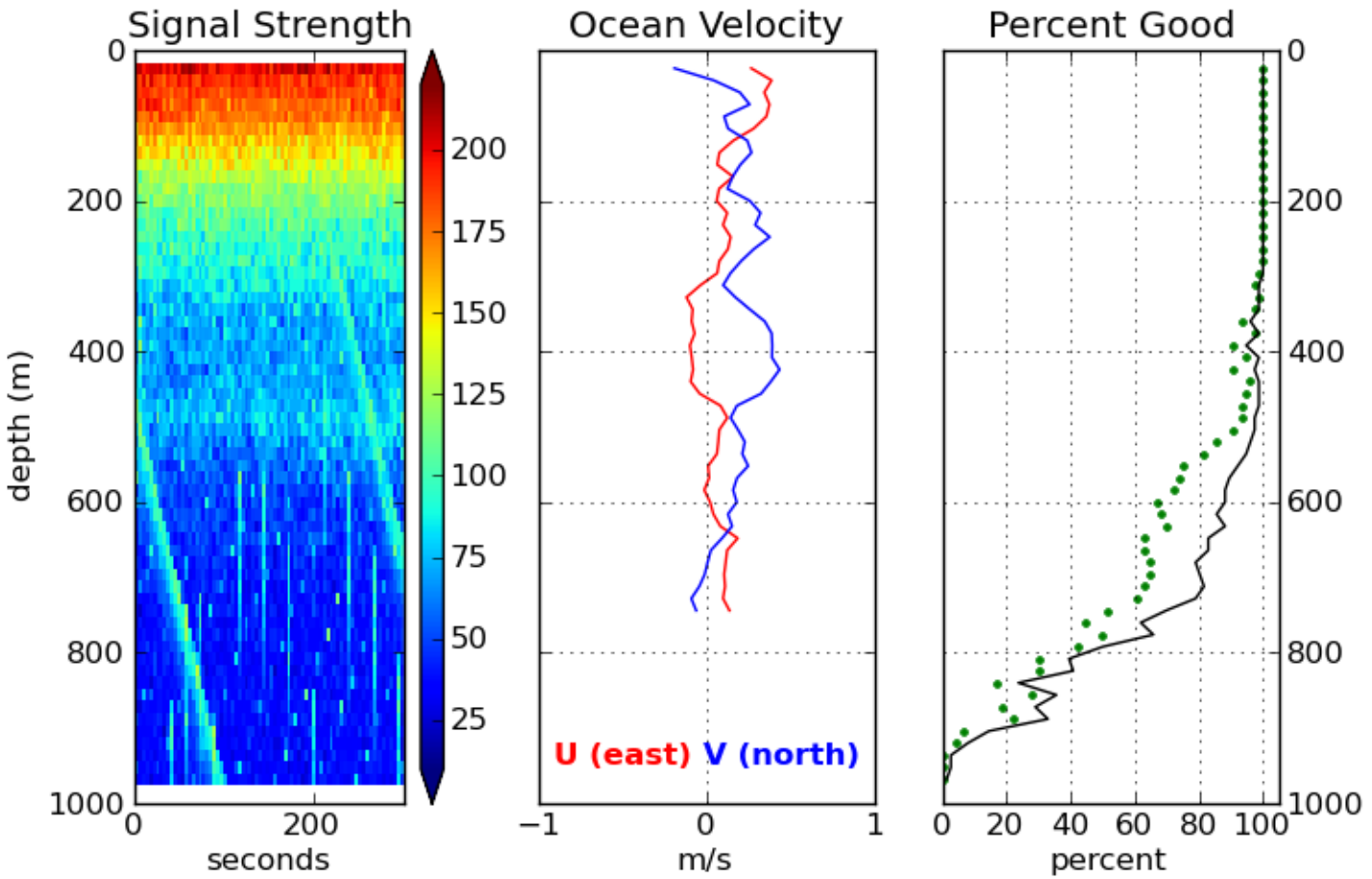
Alongtrack bias in ocean velocity



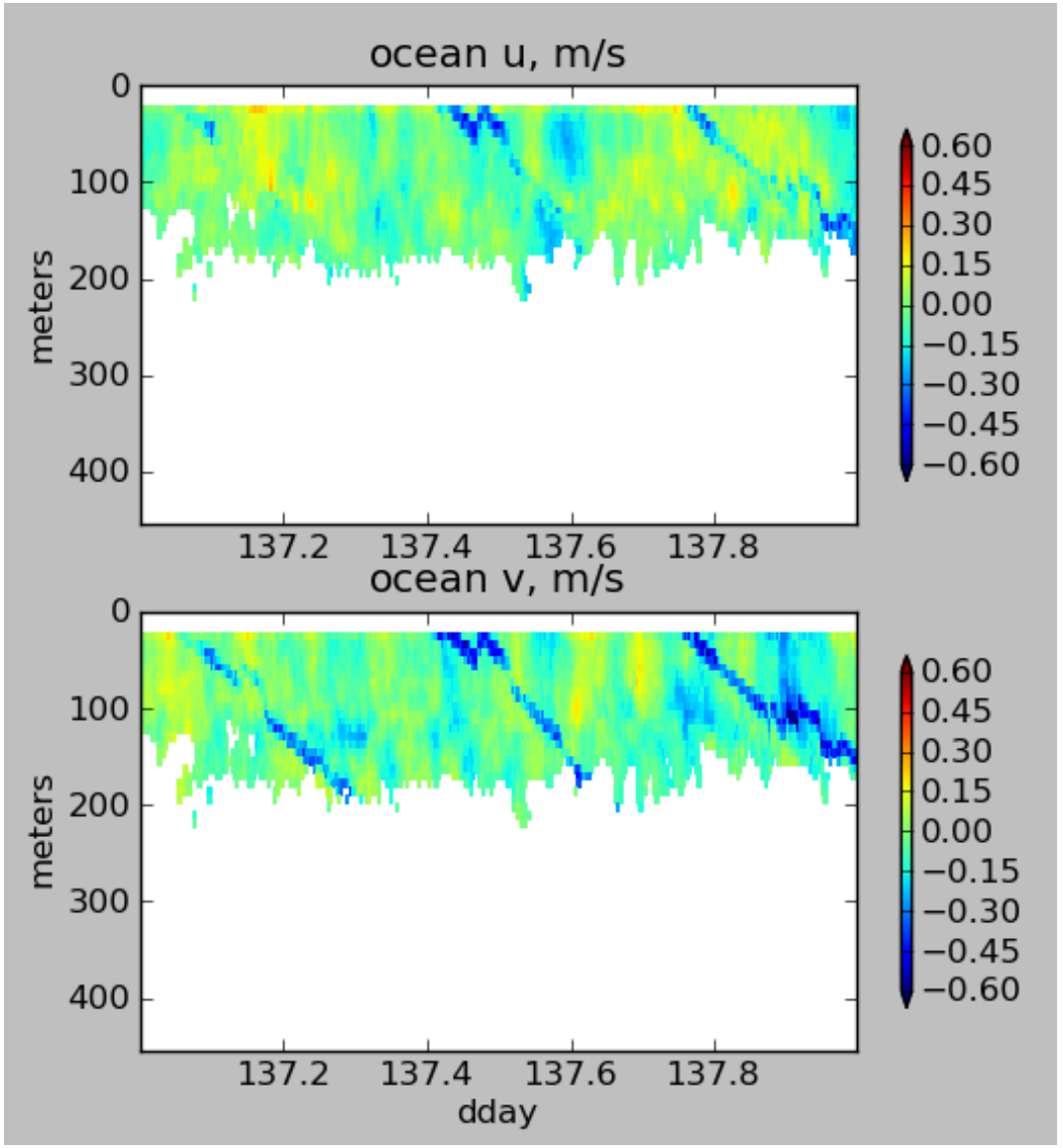
Examples of along-track error

- Acoustic interference
- Underway bias (bad weather)
- Scale factor (NB150 soundspeed correction)
- (things that look like scale factor)

Acoustic Interference: single ping



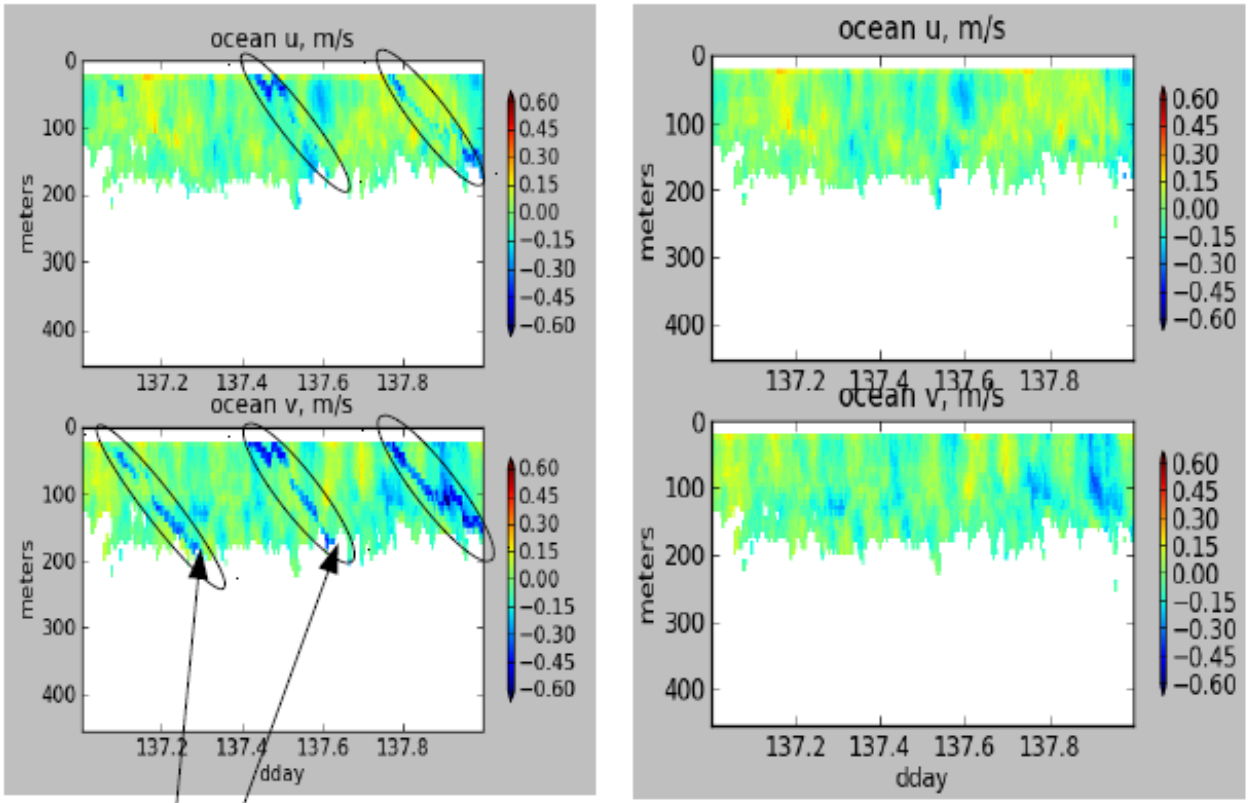
Acoustic Inference: averaged



Acoustic interference removed by CODAS processing

VmDAS LTA files:
Unedited prior to averaging

VmDAS ENX files:
Single-ping editing applied
Prior to averaging

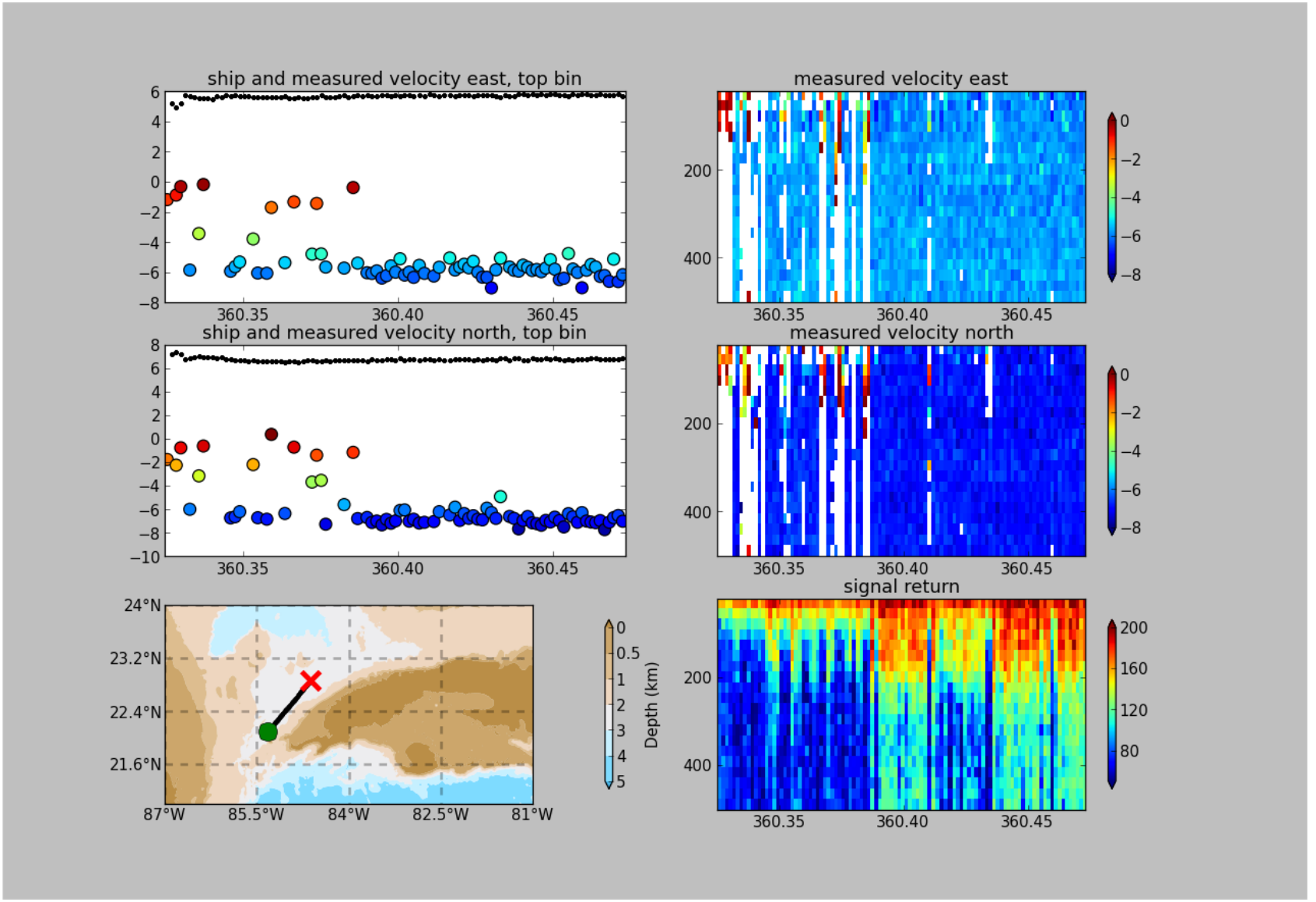


- interference from OS75 on OS150
- bias towards zero in measured velocity results in
  Bias “in the direction of motion” in ocean velocity
- ship was traveling Seattle-Honolulu, i.e. mostly southwest

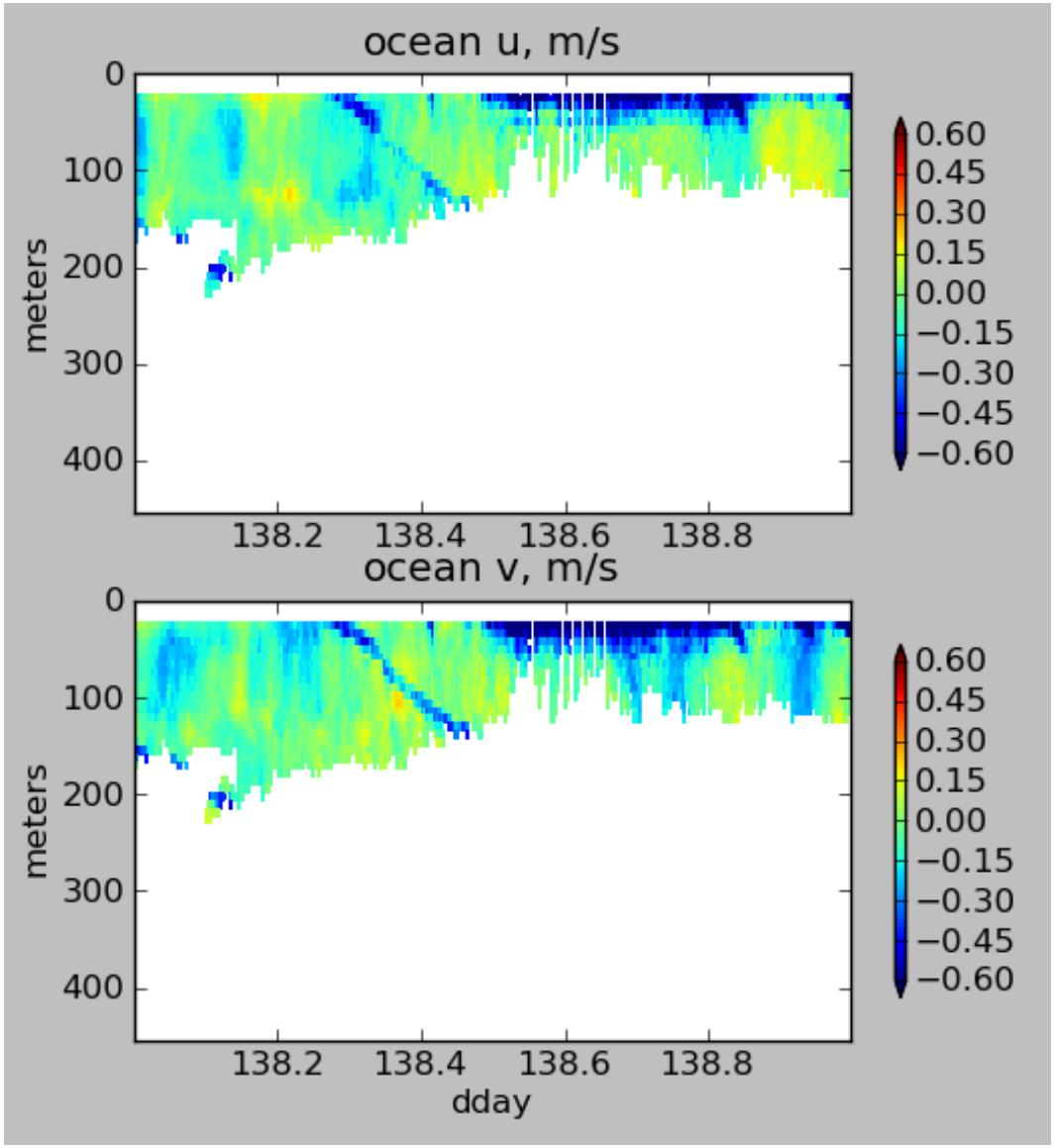
Examples of along-track error

- Acoustic interference
- Underway bias (bad weather)
- Scale factor (NB150 soundspeed correction)
- (things that look like scale factor)

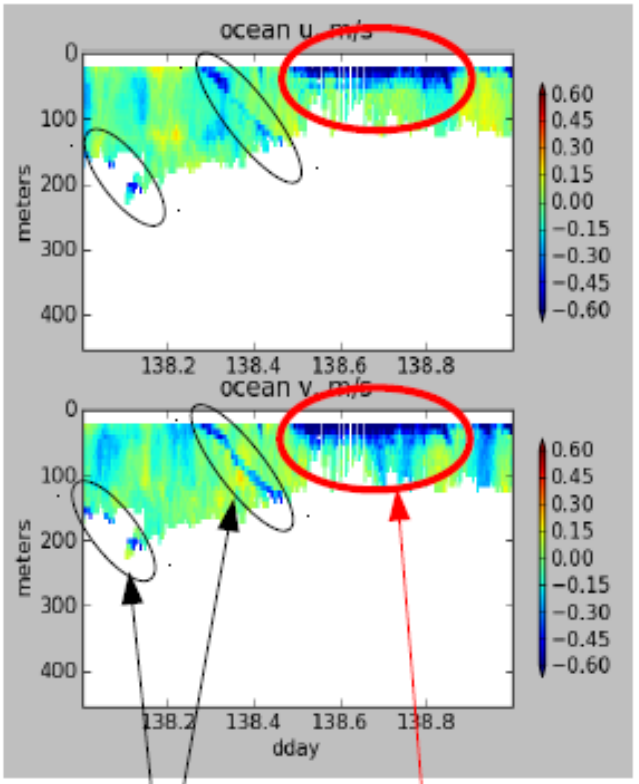
single-ping editing:underway bias

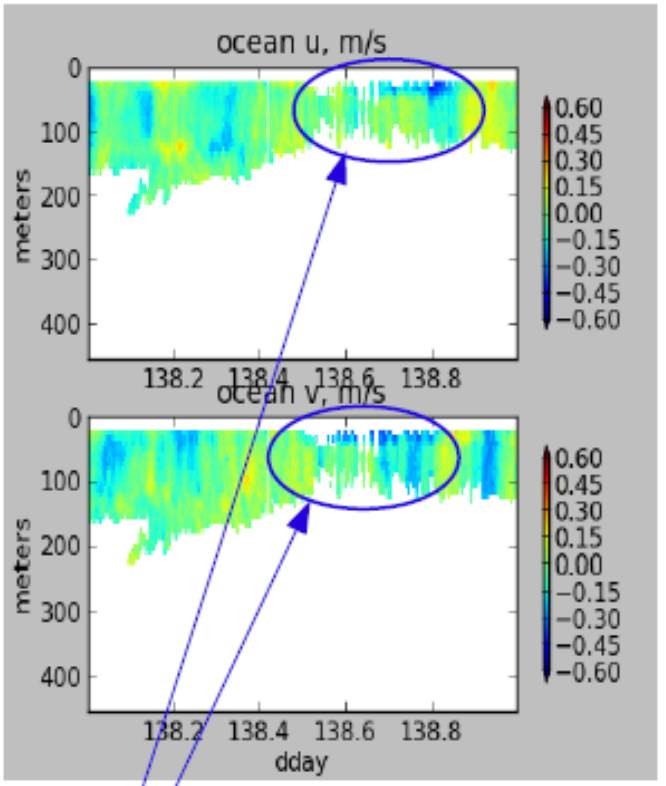


Averaged (unedited) data:
Acoustic interference and underway bias (bubbles)



OS150 underway bias due to poor weather conditions





acoustic Interference from OS75 on OS150

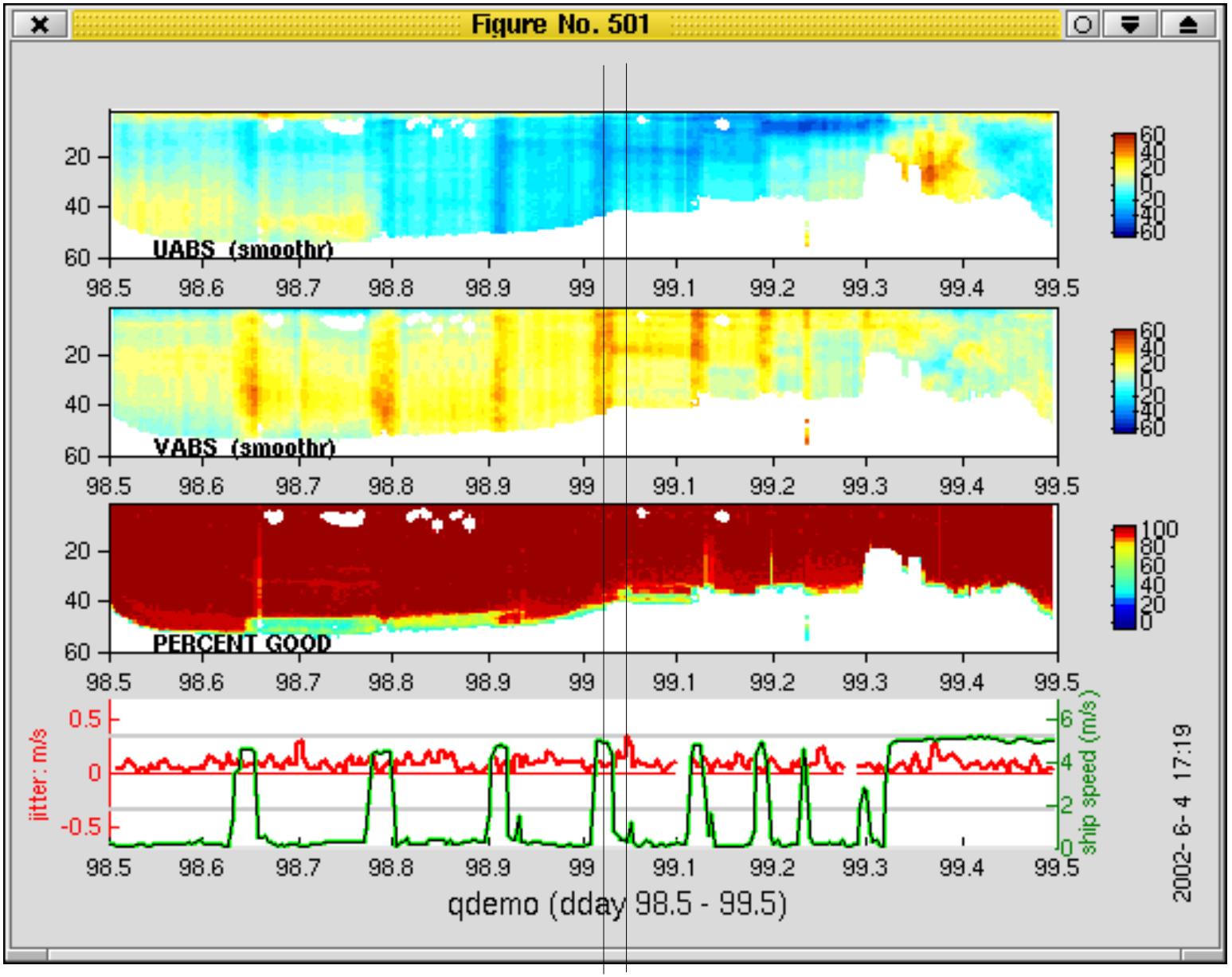
Biased pings mostly edited out, but manual post-processing is required

Biased pings, due to bad weather
- bias towards zero in measured velocities
- bias in direction of motion in ocean velocities
- shorter profiles (degraded quality)

Examples of along-track error

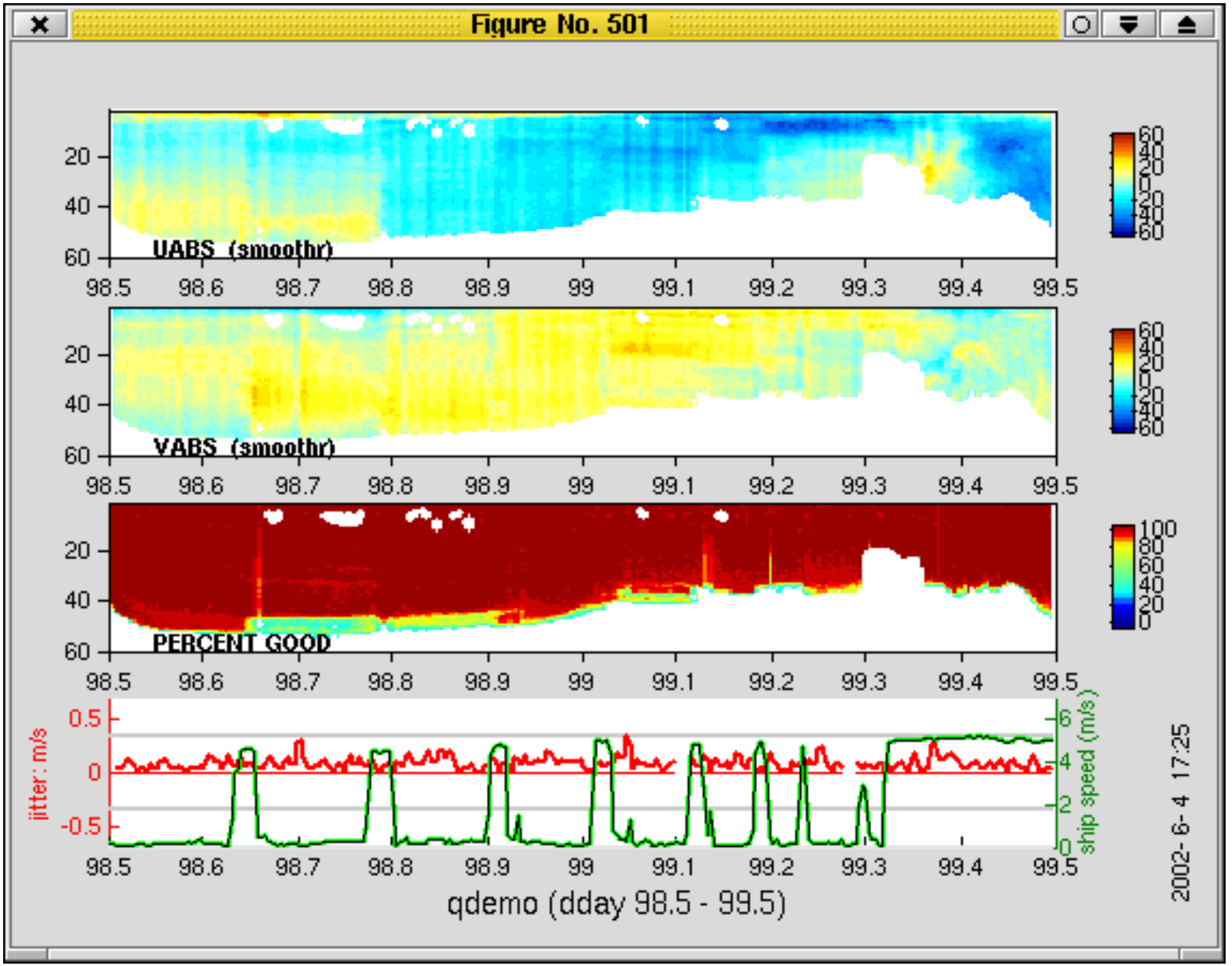
- Acoustic interference
- Underway bias (bad weather)
- Scale factor (NB150 soundspeed correction)
- (things that look like scale factor)

scale factor: alongtrack bias



85: Things go wrong (scale factor, before)

After scale factor applied



86: Things go wrong (scale factor, after)

Problems that “look like” alongtrack bias

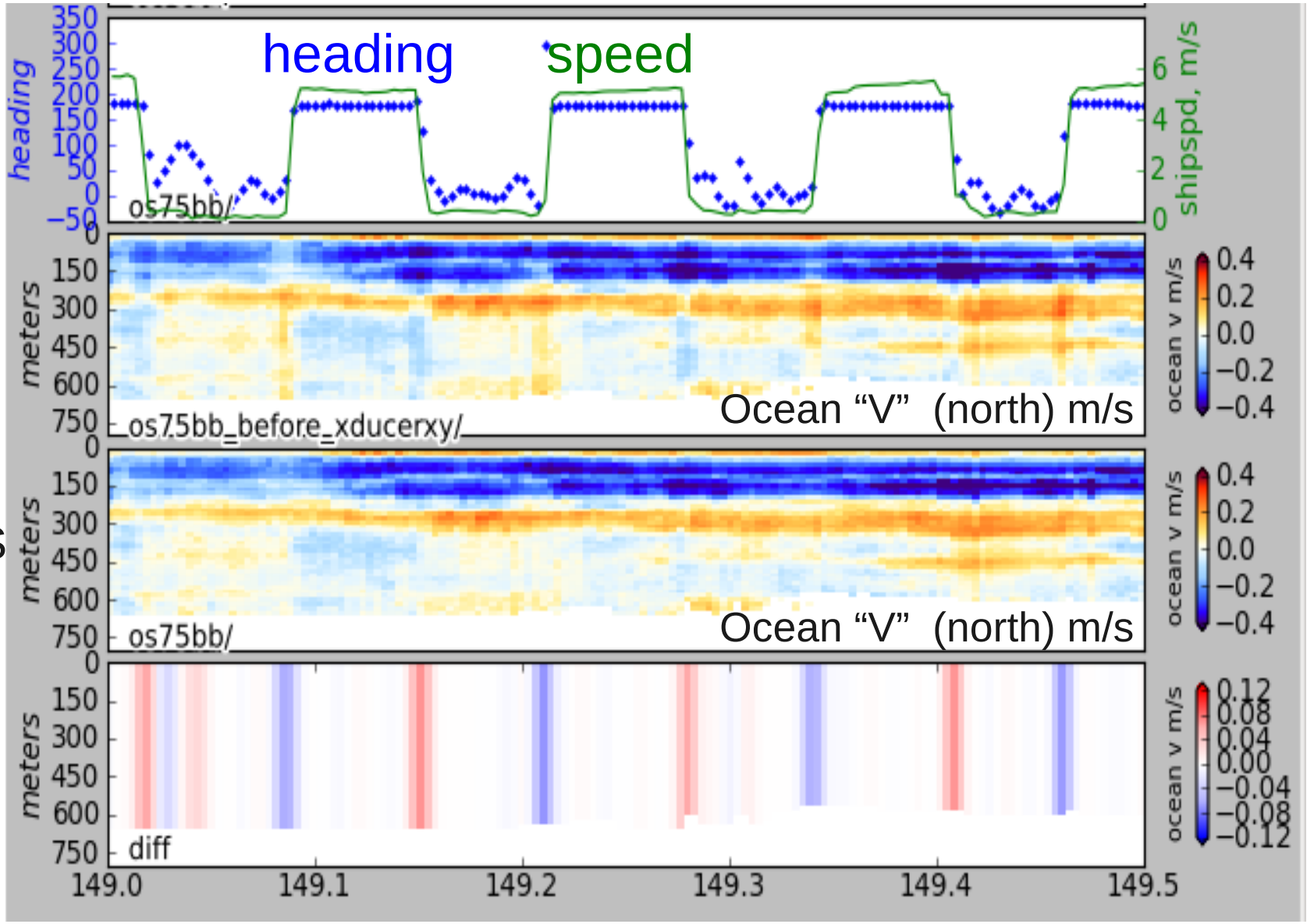
- Time lag between ADCP and heading
- Time lag between ADCP and GPS
- Transducer very different fore/aft from GPS (example)

Transducer not aligned with GPS

...using actual location

...using shifted GPS location

difference



8: alongtrack bias

Things go wrong: VmDAS examples

- Problem Exists
- Solution, for previous data
  - Rely on reprocessing
  - Might require new software
  - Might be able to fix...
  - Might NOT be able to fix
- Solution, for future cruises
  - (fix it)

Things go wrong: VmDAS examples

- (1) **Bad Processing settings**:
  - Sette: acquiring heading, not using it
- (2) **Serial Snafu**
  - Gordon Gunter: intermittently awful serial data
- (3) **Bad setup**
  - (a) Walton Smith: POSMV
    - the ONLY heading source
    - Poor quality
  - (b) MacArthur2: not acquiring heading at all
- (4) **Bad luck**
  - several: 3 beams

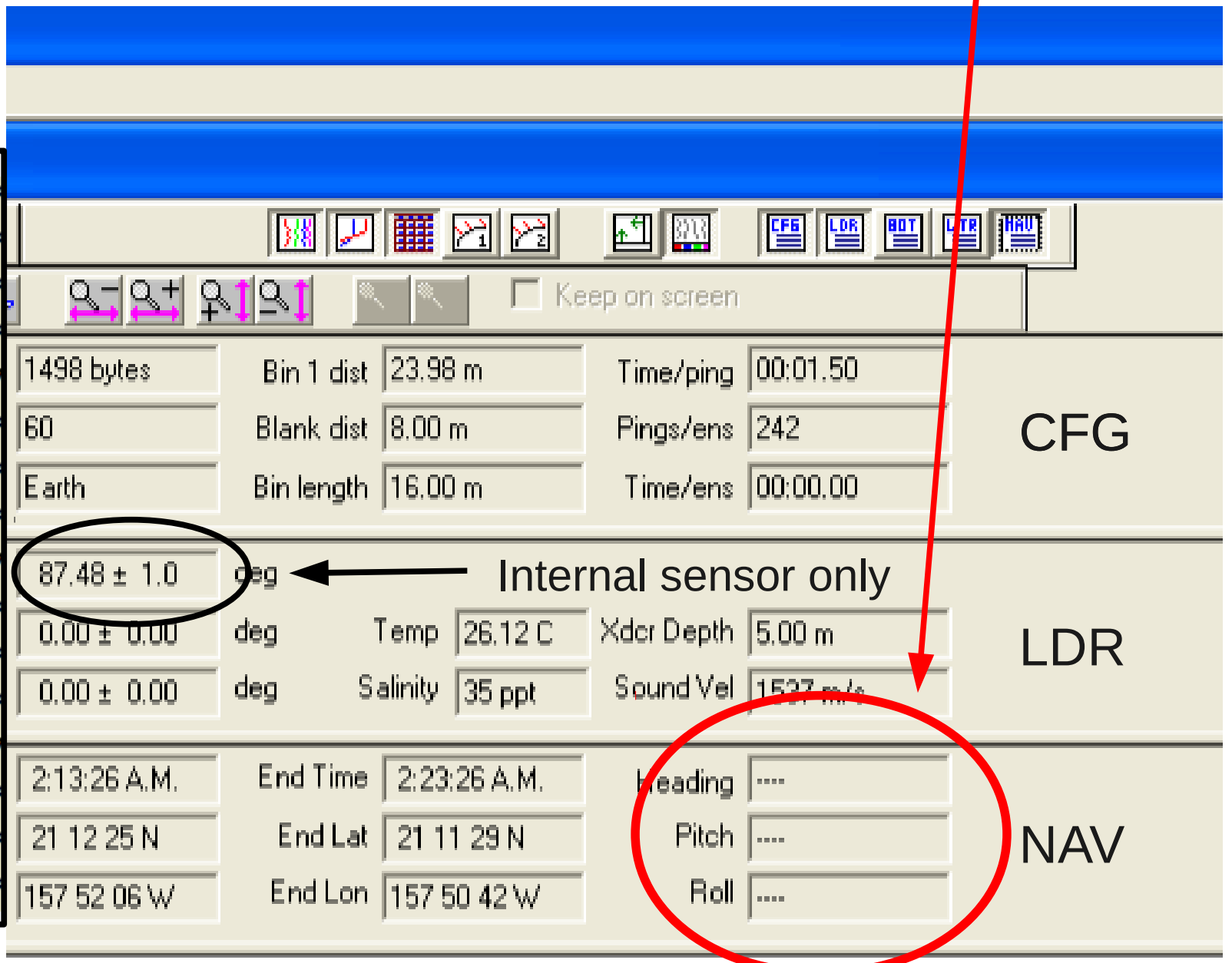
Things go wrong: VmDAS example (1)

- Problem: **Bad Processing settings**:
  - Sette: acquiring heading, but not using it

Acquiring headings, but not using...

N2R file

```
$HEHDT,318.3,T*
$HEHDT,318.5,T*
$HEHDT,318.4,T*
$HEHDT,318.0,T*
$PADCP,6,201107
$HEHDT,317.8,T*
$HEHDT,317.8,T*
$HEHDT,317.9,T*
$PADCP,7,201107
$HEHDT,317.8,T*
$HEHDT,317.7,T*
$HEHDT,317.7,T*
$HEHDT,317.7,T*
$PADCP,8,201107
$HEHDT,317.6,T*
$HEHDT,317.4,T*
$HEHDT,317.3,T*
```



Things go wrong: VmDAS example (1)

- Problem: **Bad Processing Settings**:
  - Sette: acquiring heading, but not using it
- Solution (1):
  - Reprocess with VmDAS; use heading (10 hours)
  - Run through CODAS matlab processing (2 hours)
- Solution (2):
  - Write additional CODAS software (many hours)
  - Stage VmDAS in UHDAS format (5 min)
  - Process as UHDAS data; use heading (15 min)

Things go wrong: VmDAS example (2)

- Problem: **Serial Snafu**
  - Gordon Gunter: intermittantly awful serial data

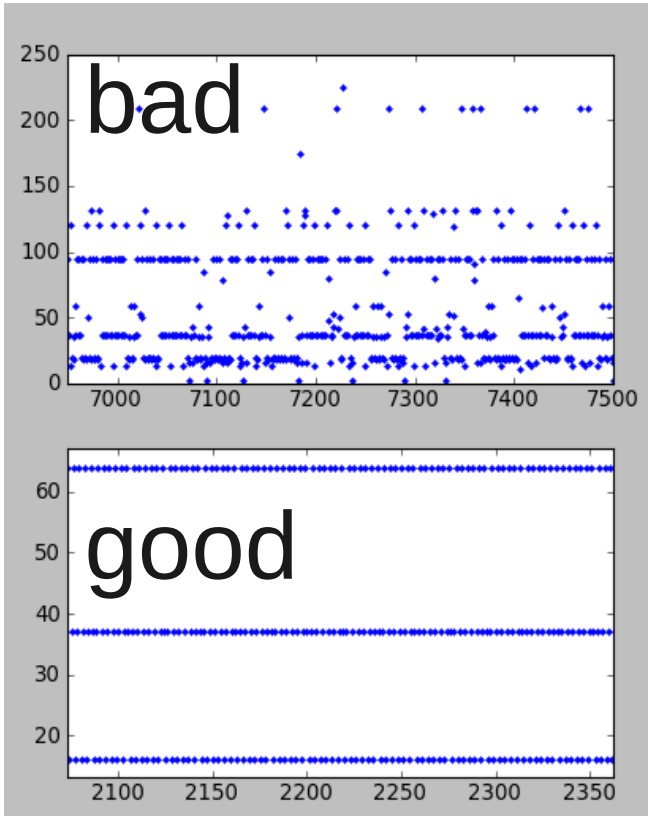
Things go wrong: VmDAS example (2)

```
$GTG,A,054,35,27209.679,N7.5500.C
8,01HDT,354.5,-2.4,M8685.4,8507.0,03,W*6D
$GPM,0,356,13358,M
$H.4,N,3543,K*
$
$GPG,3505453572727..5,5,N,.6,00.45
$GW,2,,0501.0,272$PADCP,4910,20110507,054659.19,70.00
5,M,94,.4,M,00.0,01,W,65
,01HDT,354.3,-2
$GPM,0,355,13358,M
$H.3,N,3542,K*
$
$GPG,3505453582727..4,1,N,.5,00.45
$GW,2,,0501.0,2726,M,20,.4,M,00.0,01,W,64
,01HDT,354,M,T
$GPVTG,354,T,356,M,09.3,N,17.2,KT
```

Partial $GPGGA position messages

Partial $HEHDT heading messages

Number of characters per line



Things go wrong: VmDAS example (2)

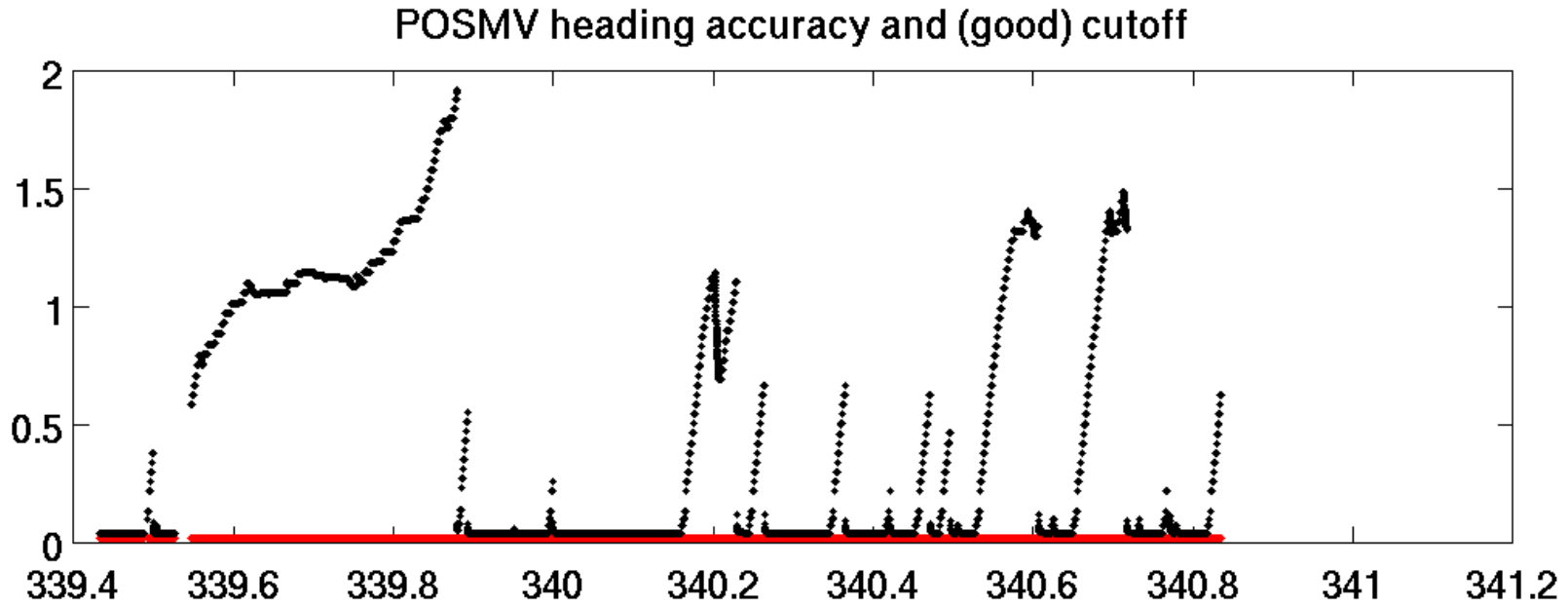
Gordon Gunter: intermittantly awful serial data

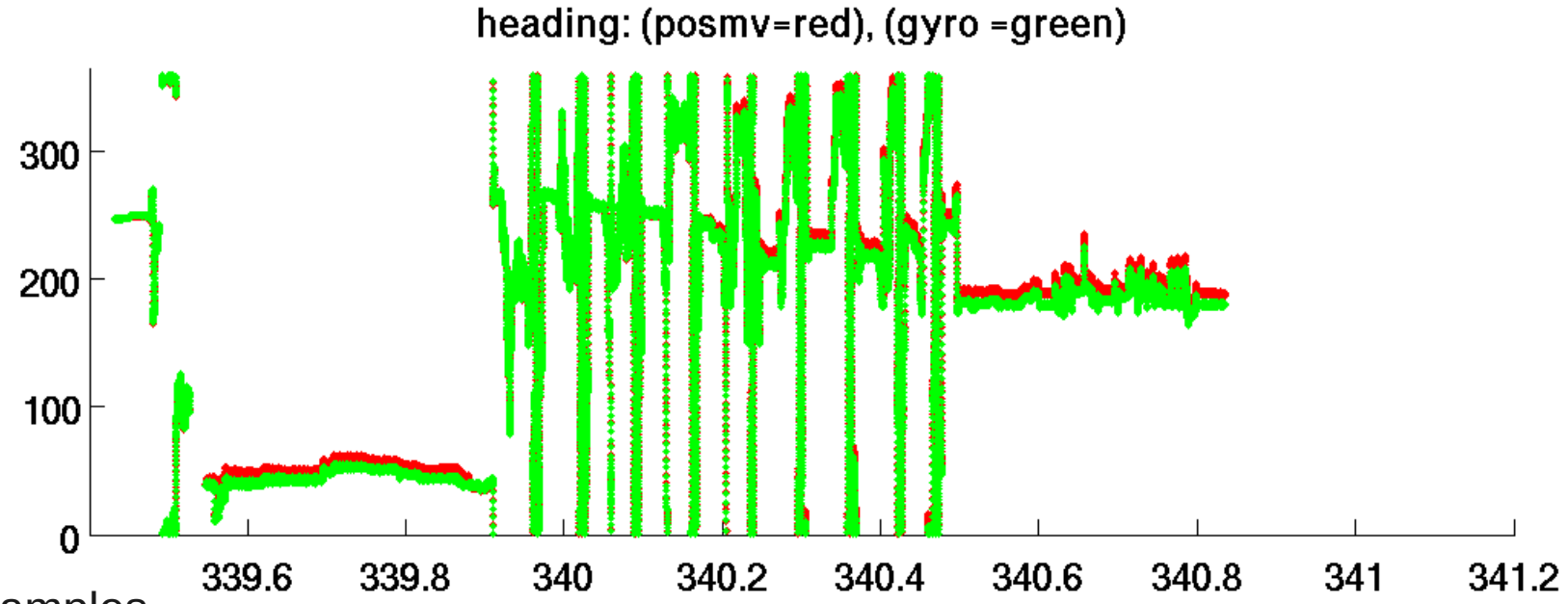
- Solution for future cruises:
  - Fix it: direct serial feeds from GPS and gyro
- Solution: past cruises
  - Expert: use other data to patch in position, heading
  - MIGHT NOT WORK
  - Resulting Data quality: unknown
    - NOT TESTED; expert level processing; timeconsuming

Things go wrong: VmDAS example (3a)

- Problem: **Bad setup**
  - Walton Smith: POSMV = the ONLY heading source
    and not rock solid (heading errors)

Things go wrong: VmDAS example (3a)





Things go wrong: VmDAS example (3a)

POSMV is unhealthy and is the only heading source

- Solution for future cruises:
  - Log gyro as well
- Solution for past cruises:
  - Expert: use other data to patch in position, heading
  - MIGHT NOT WORK
  - Resulting Data quality: unknown
    - NOT TESTED; expert level processing; timeconsuming

Things go wrong: VmDAS example (3b)

- Problem: **Bad Acquisition Setup**
  - MacArthur2: not acquiring heading at all

Heading is not being logged at all

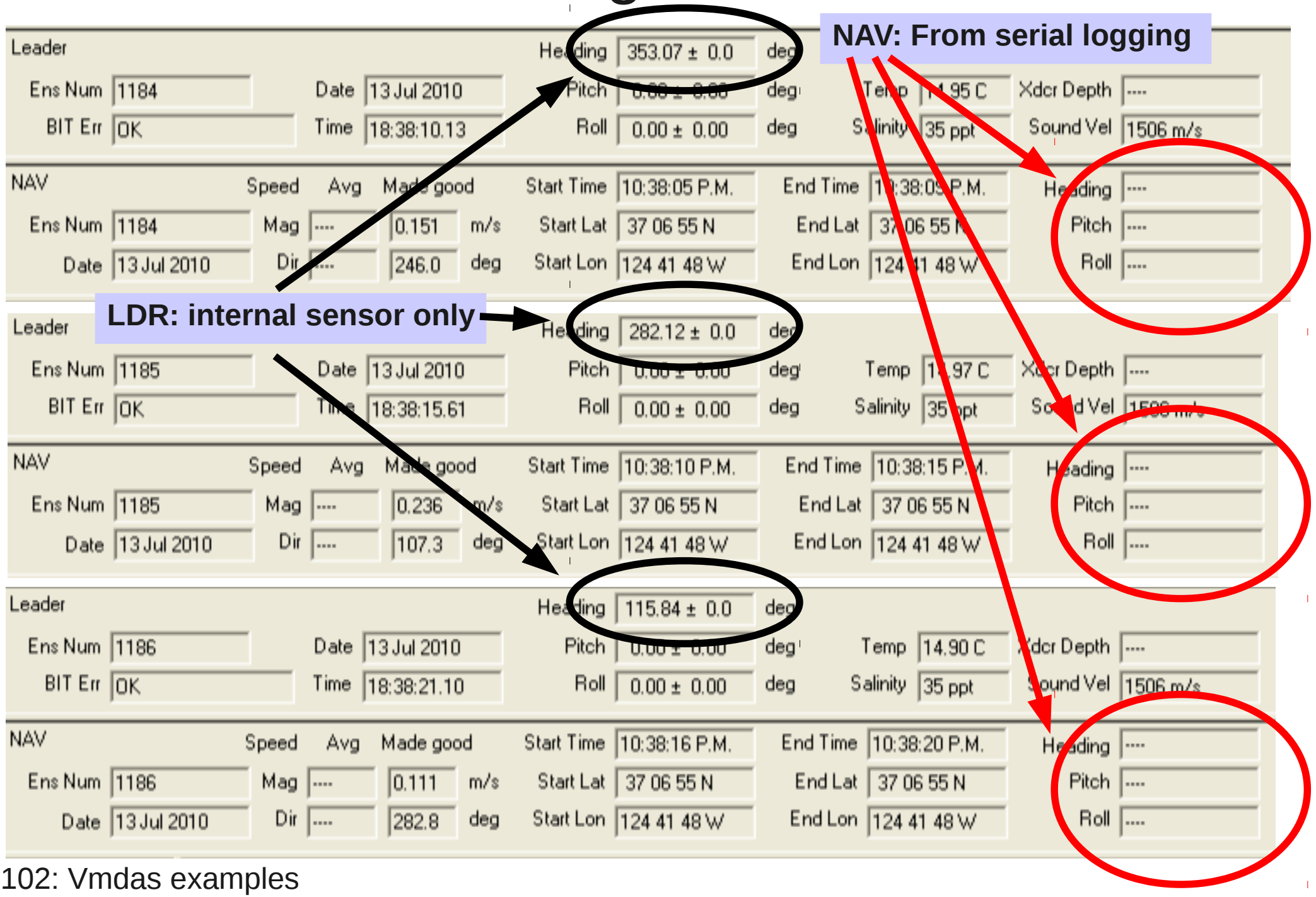
(1) Only N1R files

(2) No heading field here:

```
$GPGGA,230053,3642.4520,N,12214.4982,W,1,8,2.0,19,M,-30,M,,
$GPVTG,20.4,T,5.4,M,2.1,N,3.8,K
$GPZDA,230053,17,07,2010,0,0
$GPRMC,230053,A,3642.4520,N,12214.4982,W,2.1,20.4,170710,15,E*7F
$GPGLL,3642.4524,N,12214.4982,W,230054,A
$GPGGA,230054,3642.4524,N,12214.4982,W,1,8,2.0,19,M,-30,M,,
$GPVTG,18.0,T,3.0,M,2.0,N,3.7,K
$GPZDA,230054,17,07,2010,0,0
$GPRMC,230054,A,3642.4524,N,12214.4982,W,2.0,18.0,170710,15,E*72
$GPGLL,3642.4530,N,12214.4981,W,230055,A
$GPGGA,230055,3642.4530,N,12214.4981,W,1,8,2.0,19,M,-30,M,,
```

(3) VmDAS “Transform” Tab – nothing selected!

Heading not used



Things go wrong: VmDAS example (3b)

MacArthur 2 – not logging heading at all

- Solution for future cruises:
  - Fix it: Acquire Heading
- Solution for past cruises:
  - Expert: use other data to patch in position, heading
  - MIGHT NOT WORK
  - Resulting Data quality: unknown
    - NOT TESTED; expert level processing; timeconsuming

Things go wrong: VmDAS examples

- Problem: Bad luck
  - Various ships: 3 beams (for many months)
- Solution for past cruises:
  - Process data using 3-beam solutions
  - Data quality reduced
- Solution for future cruises:
  - Replace/repair instrument

NOAA Newport 2012 ADCP

Part II: UHDAS

- ADCP Processing with CODAS
- UHDAS: What it does
- Monitoring
    - At sea
    - On Land
- What can be changed, tested

NOAA Newport 2012 ADCP

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- What can be changed, tested

CODAS Processing Overview

CODAS: Common Ocean Data Access System

- Portable
- Self-descriptive
- aggregated files (vs/ netCDF which is one file)
- designed for ADCP data

“CODAS Processing” → produce ocean velocities

- tools to access and modify CODAS files

CODAS Processing Steps

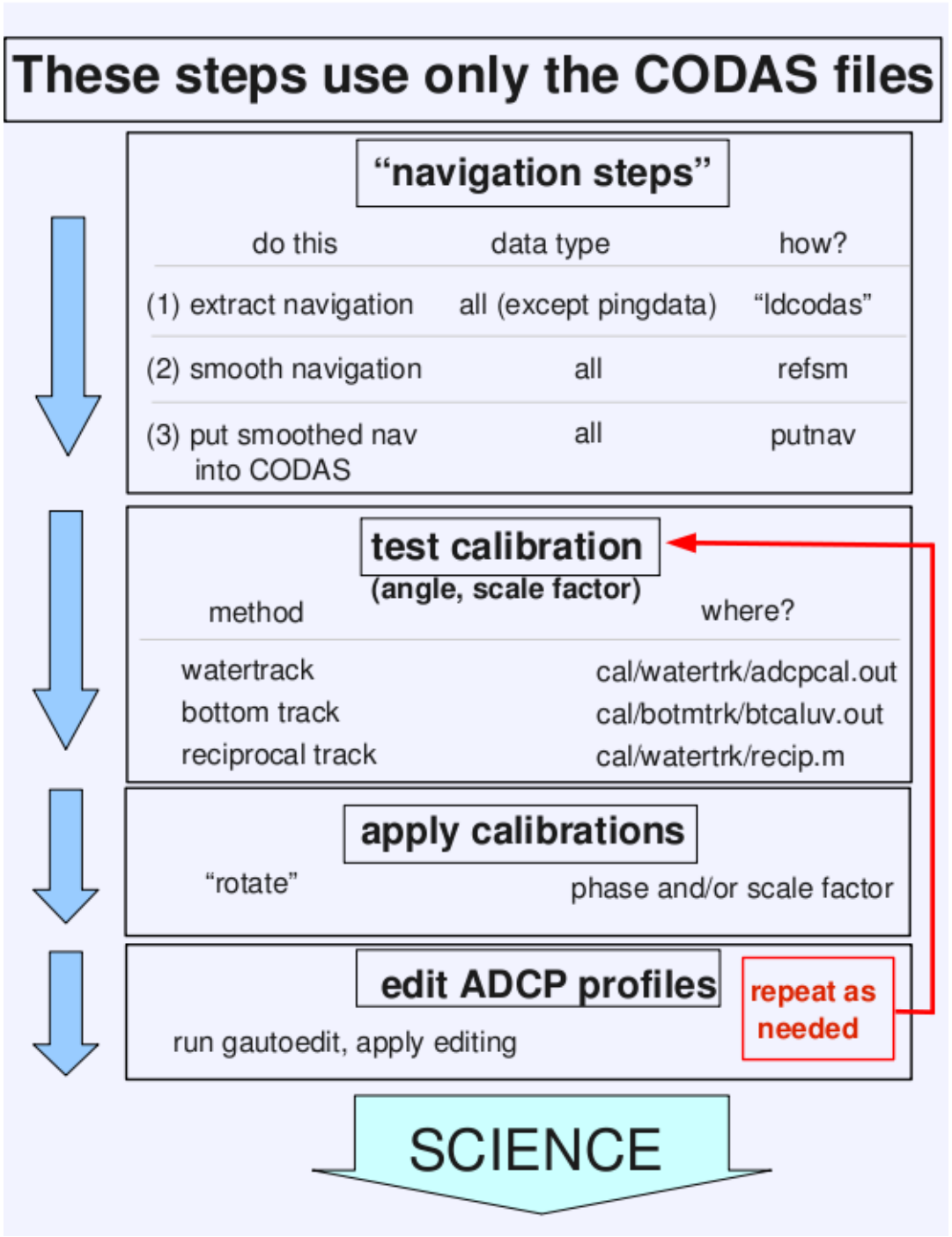
- read ADCP + ancillary data
- [transform, edit single-pings, average]
- load into CODAS database

- nudge positions to get smooth reference layer
- apply heading corrections (calculated from difference between gyro and accurate heading)
- determine calibration values (angle, scale factor),
  - apply angle and scale factor
- edit out bad profiles of averaged data

Acquire the data, write to disk → Fill the CODAS database

acquisition	data stored to disk		load the database	
program name	averaged	singleping	translate to *.bin + *.cmd	executable (to load)
DAS2.48	pingdata.*		(no)	loadping
VmDAS	*.STA *.LTA		load_lta.m	ldcodas
VmDAS		*.ENR *.ENS *.ENX	load_ens.m	ldcodas
UHDAS		*.raw	load_uhblk	ldcodas

All subsequent steps use
only the data in the CODAS files

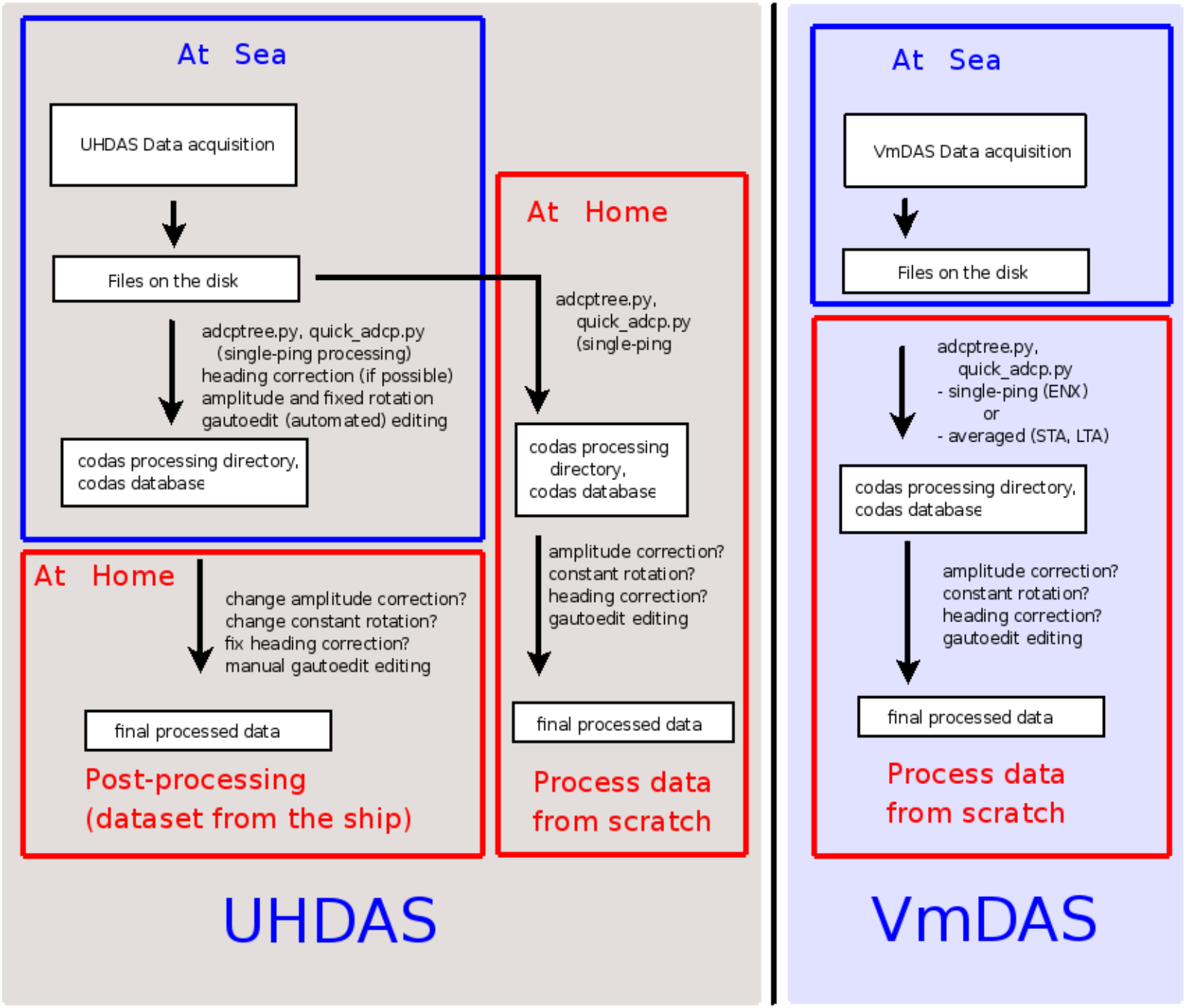

These steps use only the CODAS files
"navigation steps"
do this
data type
how?
(1) extract navigation
all (except pingdata)
"ldcodas"
(2) smooth navigation
all
refsm
(3) put smoothed nav into CODAS
all
putnav
test calibration
(angle, scale factor)
method
where?
watertrack
cal/watertrk/adcpcal.out
bottom track
cal/botmtrk/btcaluv.out
reciprocal track
cal/watertrk/recip.m
apply calibrations
"rotate"
phase and/or scale factor
edit ADCP profiles
run gautoedit, apply editing
repeat as needed
SCIENCE

CODAS Processing Supports...

Acquisition program	instrument	ping type		file type (suffix)	Averaged? or raw?		procesing in matlab? python?	
DAS2.48	NB150	nb		pingdata	avg		matlab	
VmDAS	Broadband or Workhorse		bb	LTA, STA	avg		matlab	python
				ENS, ENX		raw	matlab	
	Ocean Surveyor	nb		LTA, STA	avg		matlab	python
				ENS, ENX		raw	matlab	
				ENR(N1R,N2R)		raw		python
			bb	LTA, STA	avg		matlab	python
				ENS, ENX		raw	matlab	
				ENR(N1R,N2R)		raw		python
		nb	bb	ENS, ENX		raw	matlab	
				ENR(N1R,N2R)		raw		python
UHDAS	NB150,NB300	nb		raw		raw	matlab	python
	Ocean Surveyor	nb		raw		raw	matlab	python
			bb	raw		raw	matlab	python
		nb	bb	raw		raw	matlab	python
	WH300		bb	raw		raw	matlab	python

At
Sea

At
Home



NOAA Newport 2012 ADCP

Part II: UHDAS

- ADCP Processing with CODAS
- UHDAS: What it does
- Monitoring
    - At sea
    - On Land
- What can be changed, tested

UHDAS: what it does

- Data acquisition and processing
- Data access (for scientist at sea)
- Monitoring tools
  - at sea
  - from shore

UHDAS: what it does:

Data acquisition …

- logs and timestamps data
- parses NMEA data (Matlab, Python)

.... and processing

- transforms (ADCP), grids (ancillary), edits (pings)
- averages, loads (into CODAS database)
- all CODAS processing

UHDAS: What it does:

Data Access...

- web site on ship with
  - 5-minute profile (updated 5min)
  - 3-day vector and contour plot (updated 30min)
  - matlab files via web (used in 3-day plots)
- full-resolution processed (5min averages) via
  - samba (windows share), NFS
  - Files in Matlab, NetCDF, or CODAS (+access tools)

UHDAS: What it does

Monitoring...

- **at sea:**
  - processing (web plots)
  - health of accurate heading device (web plots)
  - data acquisition (UHDAS tool)
- **from shore:**
  - sends daily email with attachment
  - diagnostic files
  - data snippet
  - shore-based figures generated from snippet

UHDAS cruise directory structure

Data for scientists:

There are three categories of data, all located in the logging directory, /home/data/[CRUISEID]:

ADCP logging directories

subdirectory	contents	importance	back up for...
raw	all raw data	critical	◦ archiving ◦ scientists who ask for it
rbin	intermediate files	nice to have	anyone who gets **raw**
gbin	intermediate files	nice to have	anyone who gets **raw**
proc	◦ final processing ◦ codas database ◦ underway figure archive ◦ matlab files	final product	science CDs after cruise

Cruise Sequence (for operator)

- Start UHDAS gui
- Start cruise
- Start logging; directory contents of..
  - **`raw`**
  - **`rbin`**
  - **`gbin`**
  - **`proc`**

UHDAS gui tool

NOAA Newport 2012 ADCP

Part II: UHDAS

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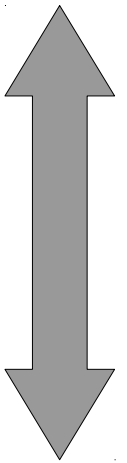
Monitoring: At Sea

There are three categories of monitoring:

(1) CODAS Processing

(2) health of components (Ashtech)

(3) data acquisition



Example at-sea web site

Monitoring: At Sea

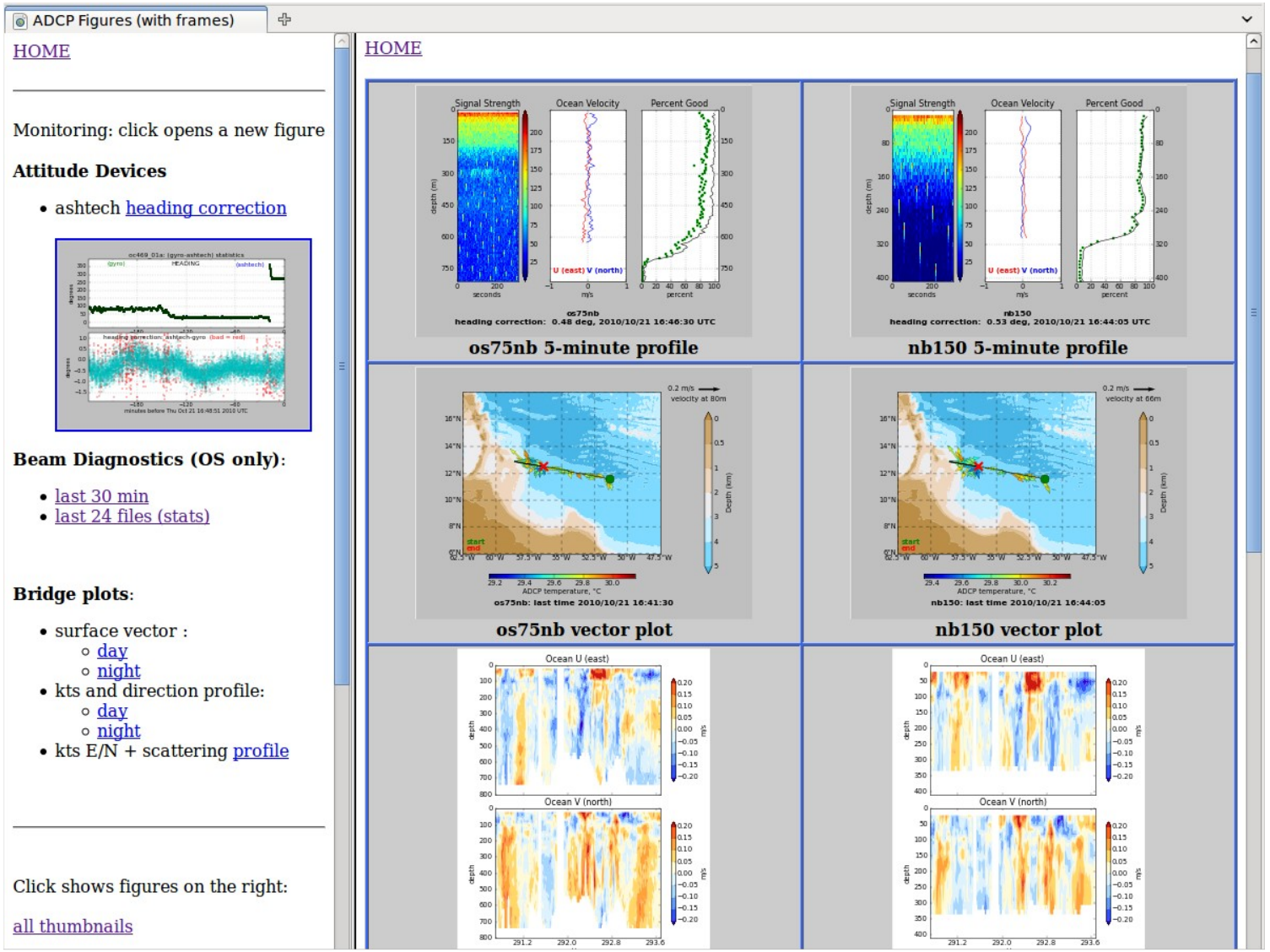
There are three categories of monitoring:

(1) CODAS Processing

(2) health of components (Ashtech)

(3) data acquisition

Monitoring At Sea: UHDAS web site

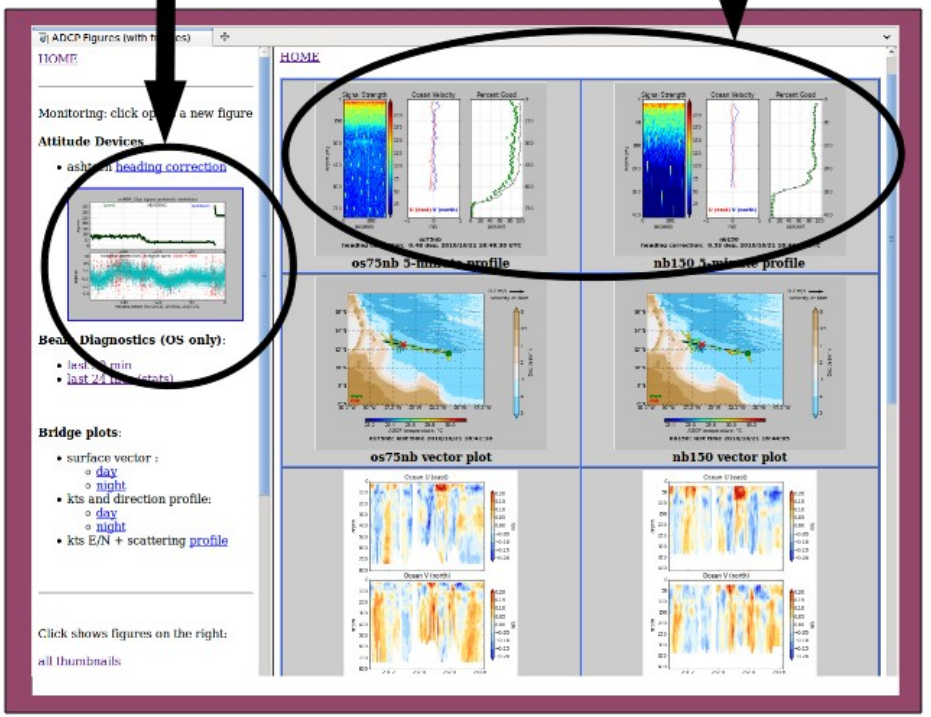


Monitoring the 5-minute timer: Check: less than 10 minutes old?

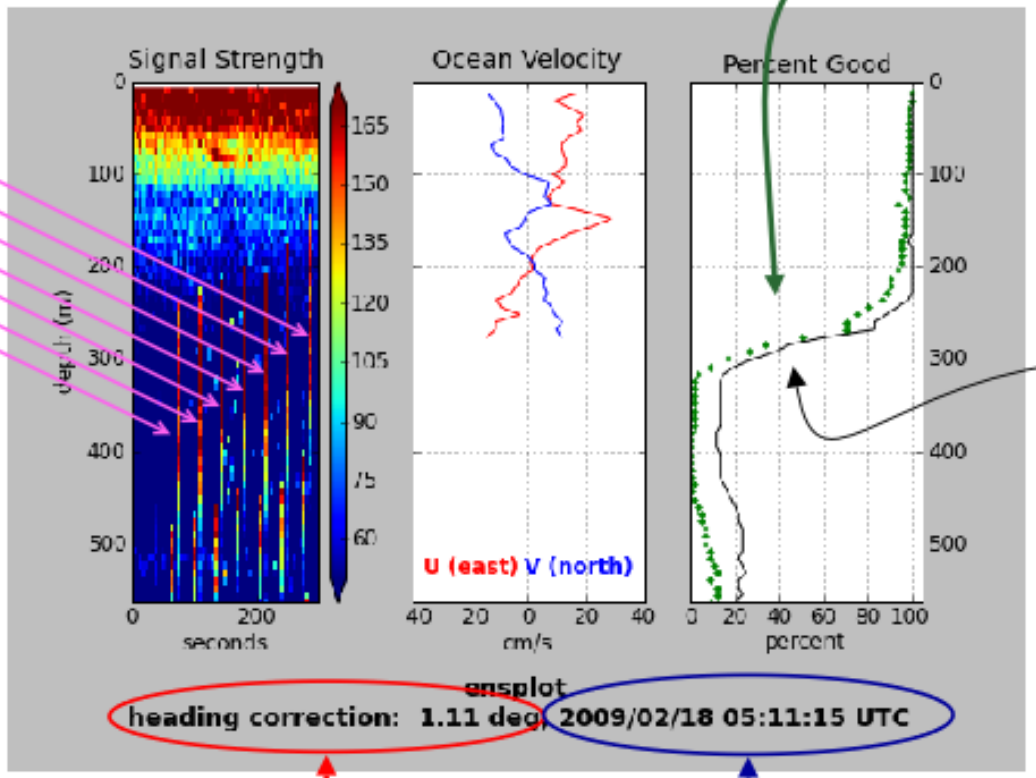
Accurate Heading Device

Ashtech, POSMV, Seapath
Phins, Mahrs

5-minute profile
of each
ADCP+Pingtype



UHDAS average (5-minute) profile plot



percent good in this 5-minute average, after UHDAS editing

Acoustic interference (edited out; decreases percent good)

percent good before UHDAS editing

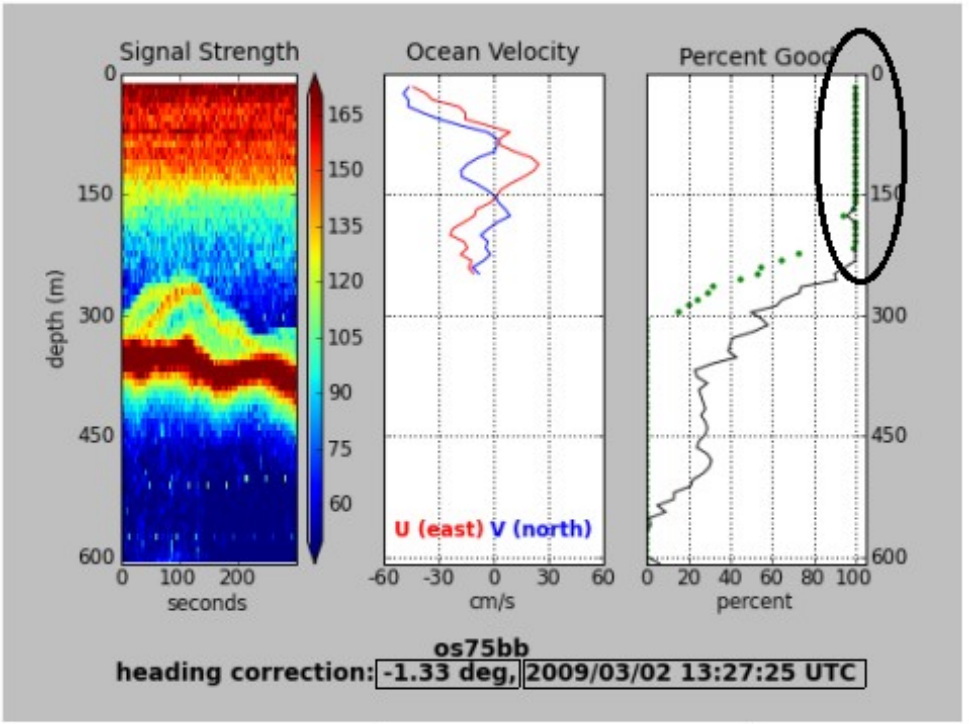
heading correction (ashtech - gyro)

UTC time of last sample

Signal strength ("amplitude") in counts. Note the bottom at 350-400m

velocity

Percent of pings considered "good" in each bin. Cutoff is 50% or better.



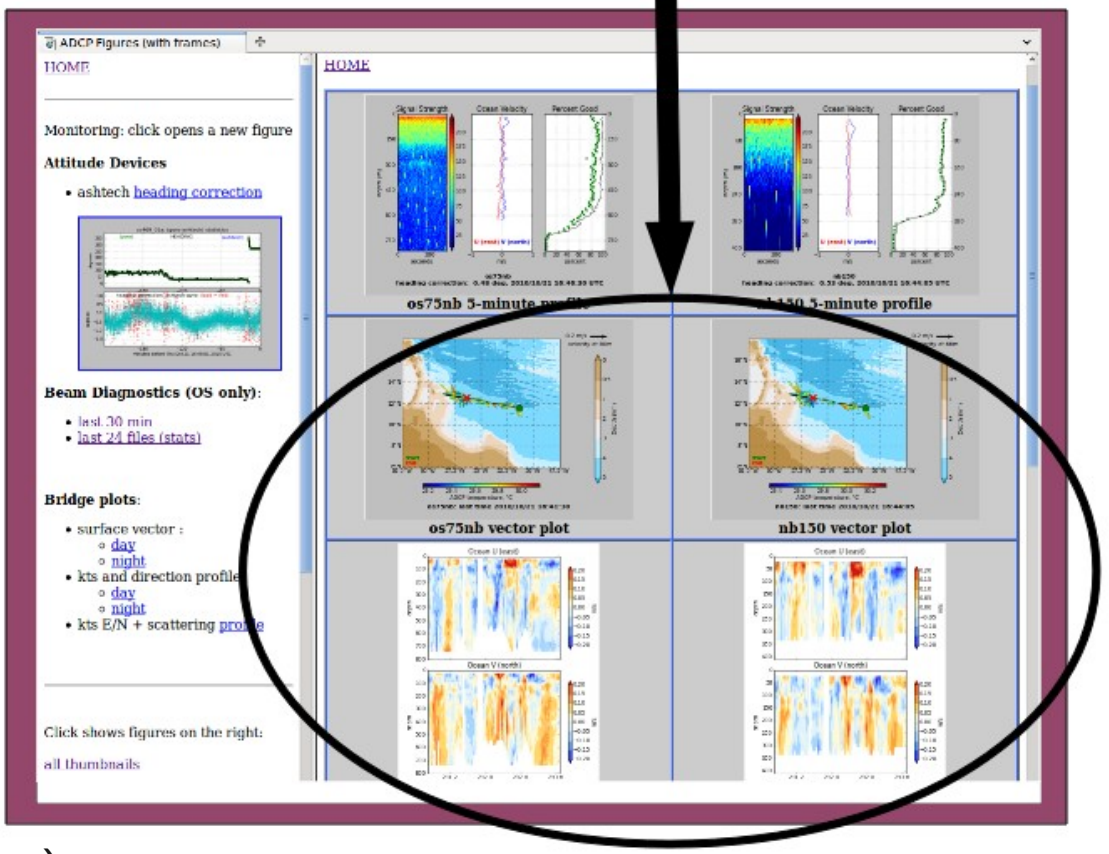
Data are considered "good" if the are
- better than 50PG
- out of range of bottom interference (bottom 15% for an instrument with 30deg beams)

If an accurate heading device exists, and is working, the correction to the gyro is written here for every averaging interval. Values are typically a few degrees or less.

Timestamp should be within 10 minutes of the present

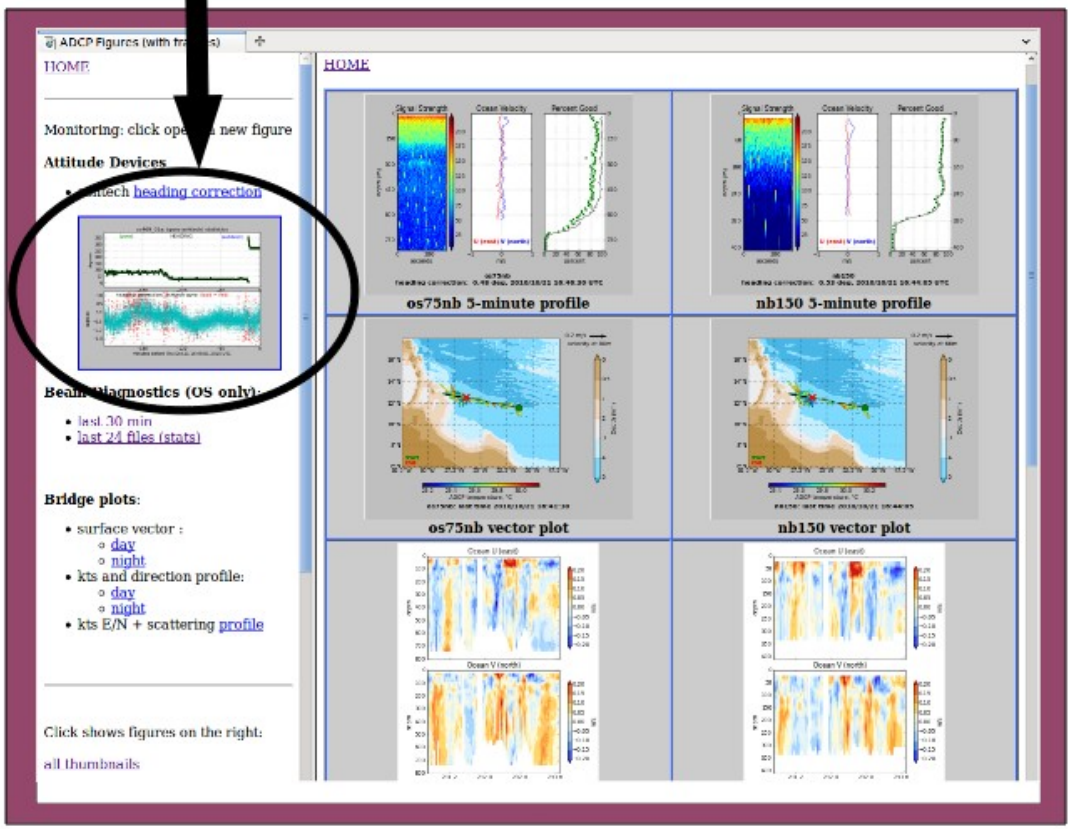
Monitoring the 30-minute timer: Check: less than 1 hour old?

plot of last 3 days of data
generated every 30 minutes
one for each ADCP+Pingtype



Monitoring the accurate heading device: Is it working?

Accurate but possibly intermittent attitude device: figure updates every 5 minutes.



Monitoring: At Sea

There are three categories of monitoring:

(1) CODAS Processing

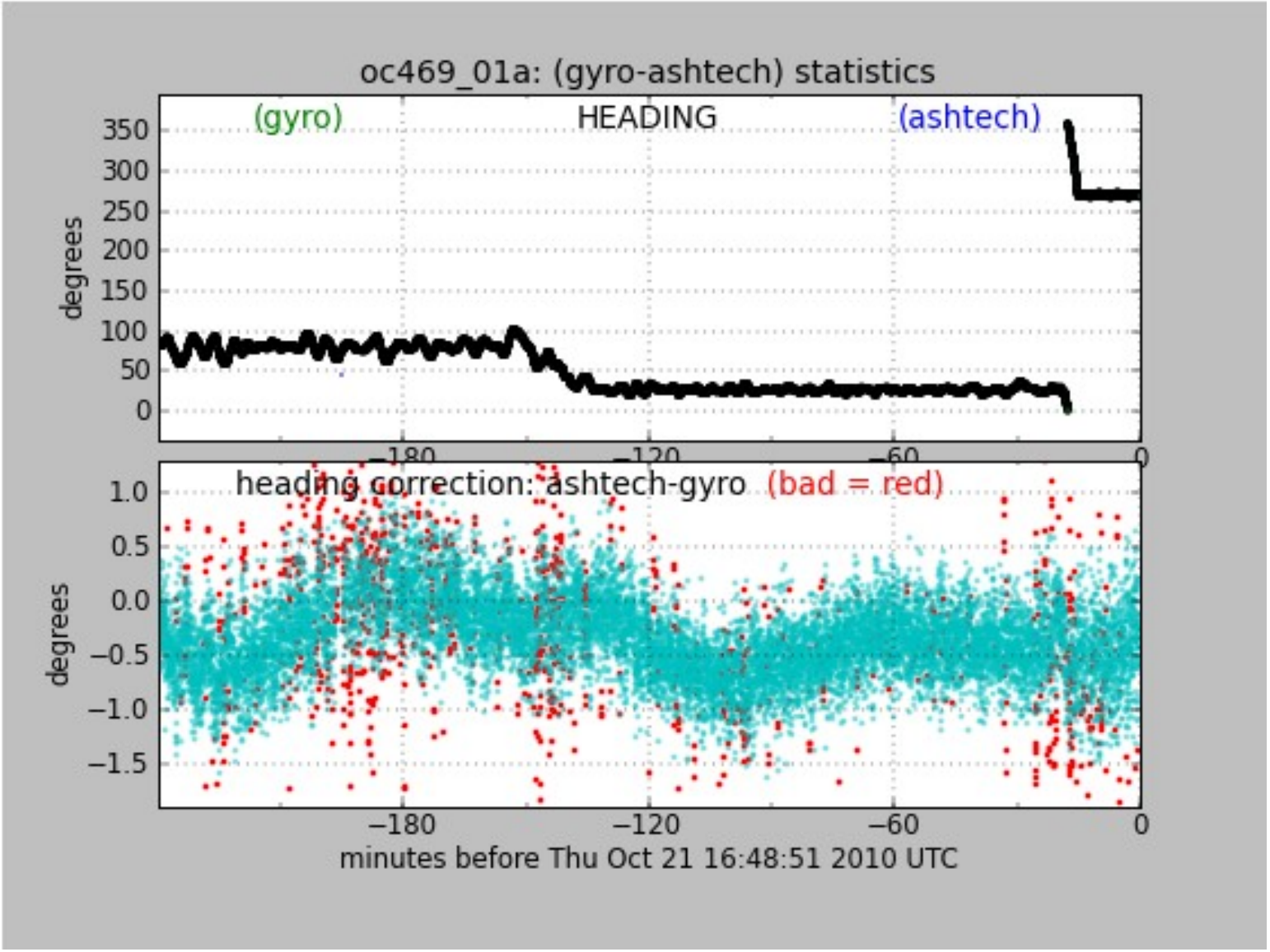
(2) health of components (Ashtech)

(3) data acquisition

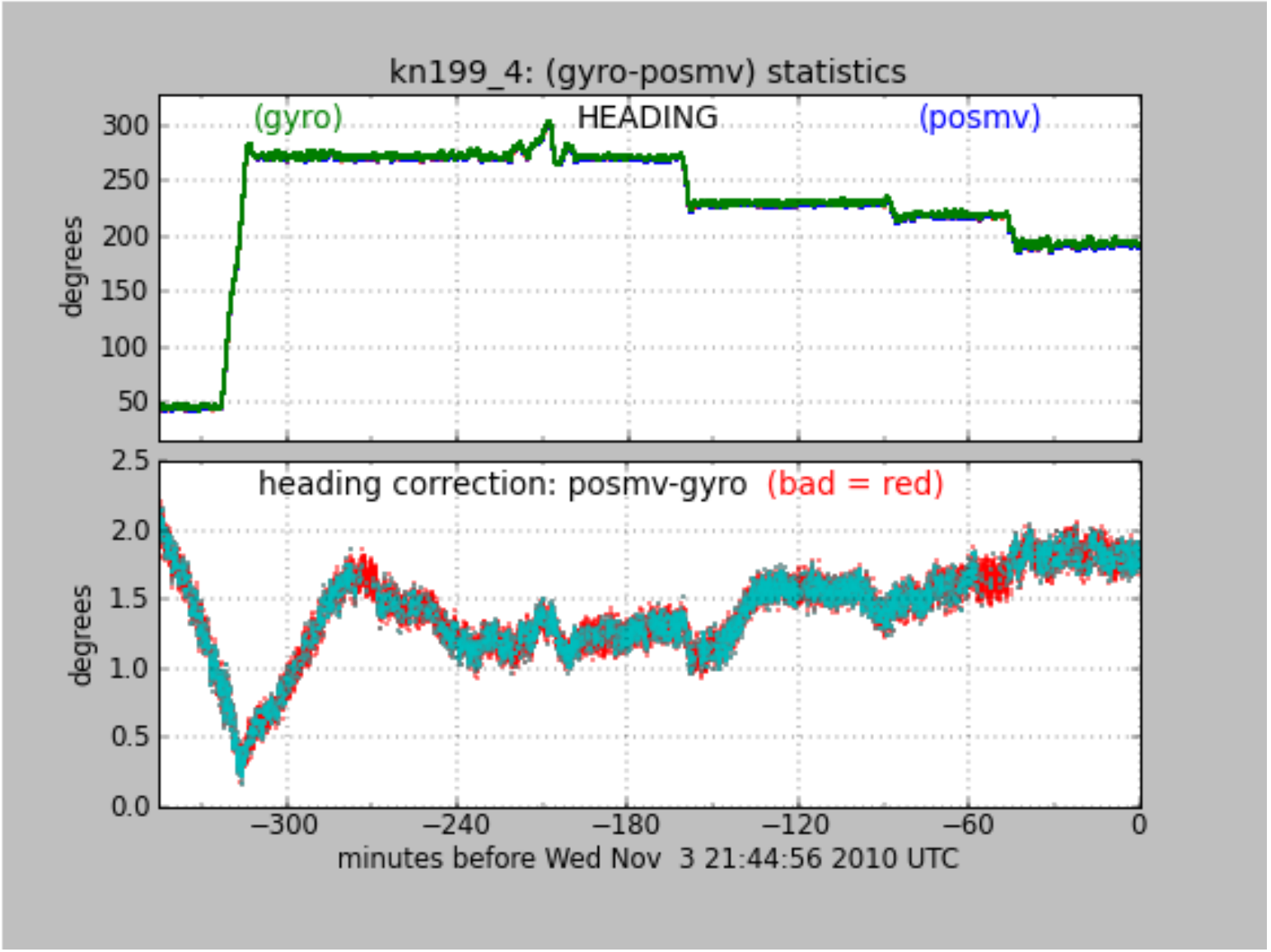
Attitude Health

- Examples of
  - Ashtech
  - POSMV
  - Phins
- Statistics generated for all 3
- Example of POSMV in trouble

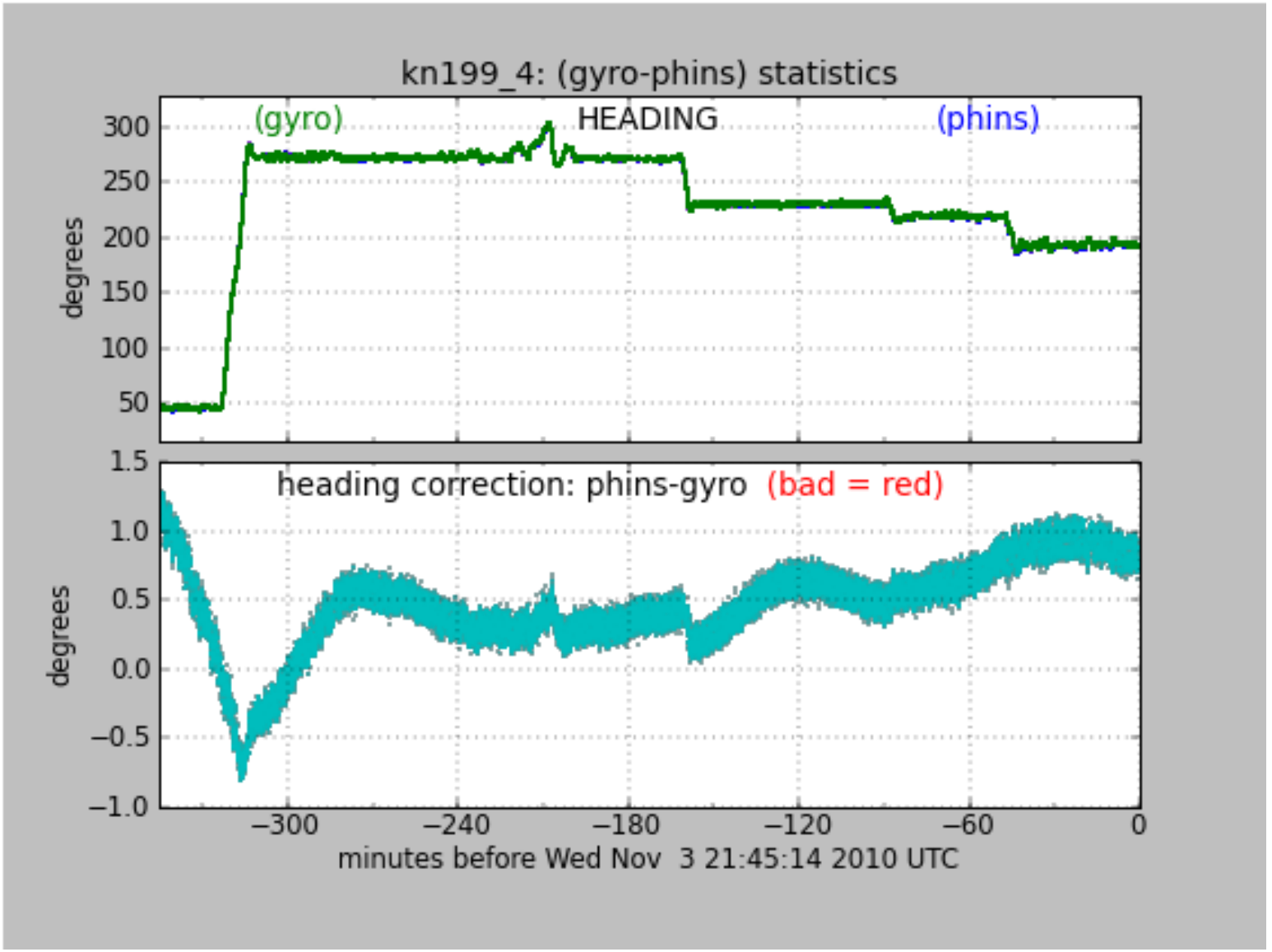
Ashtech


oc469_01a: (gyro-ashtech) statistics
(gyro)
HEADING
(ashtech)
degrees
350
300
250
200
150
100
50
0
−180
−120
−60
0
heading correction: ashtech-gyro (bad = red)
degrees
1.0
0.5
0.0
−0.5
−1.0
−1.5
−180
−120
−60
0
minutes before Thu Oct 21 16:48:51 2010 UTC

POSMV

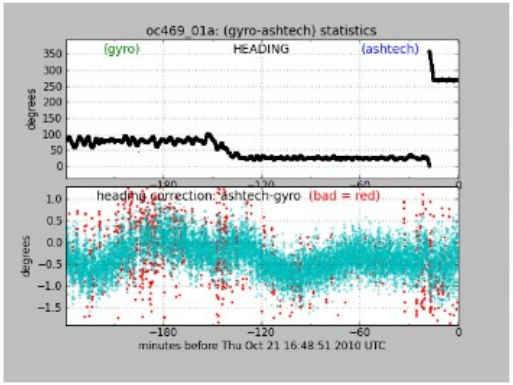

kn199_4: (gyro-posmv) statistics
(gyro)
HEADING
(posmv)
degrees
300
250
200
150
100
50
heading correction: posmv-gyro (bad = red)
degrees
2.5
2.0
1.5
1.0
0.5
0.0
−300
−240
−180
−120
−60
0
minutes before Wed Nov 3 21:44:56 2010 UTC

Phins

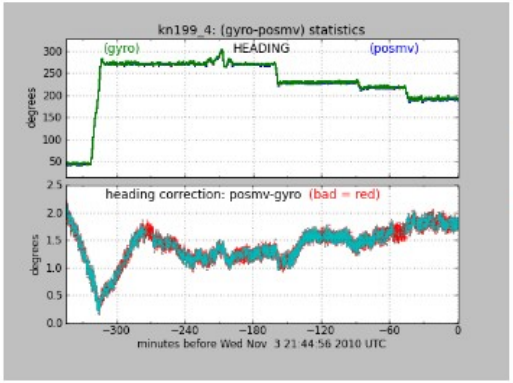

kn199_4: (gyro-phins) statistics
(gyro)
HEADING
(phins)
degrees
300
250
200
150
100
50
heading correction: phins-gyro (bad = red)
degrees
1.5
1.0
0.5
0.0
−0.5
−1.0
−300
−240
−180
−120
−60
0
minutes before Wed Nov 3 21:45:14 2010 UTC

Accurate heading device: examples

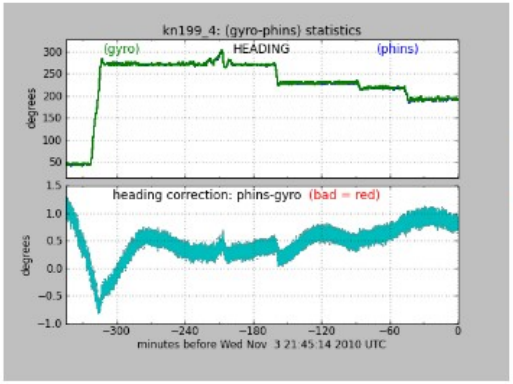
Statistics generated in daily email for three cases




```
=========================
------ ashtech statistics ------
=========================
ashtech-gyro statistics )
ddrange: 304.7901512 to 305.7901506
(2010/11/01 18:57:49 to 2010/11/02 18:57:49)
all ashtech messages:  (89%)  were good
(300sec) ensemble heading corrections:
   288 out of 288   (100%) were good
statistics of good data:
   mean N = 270, stddev N =  27
   min  = -0.25, max = 0.61
   mean = 0.15, stddev = 0.22
```

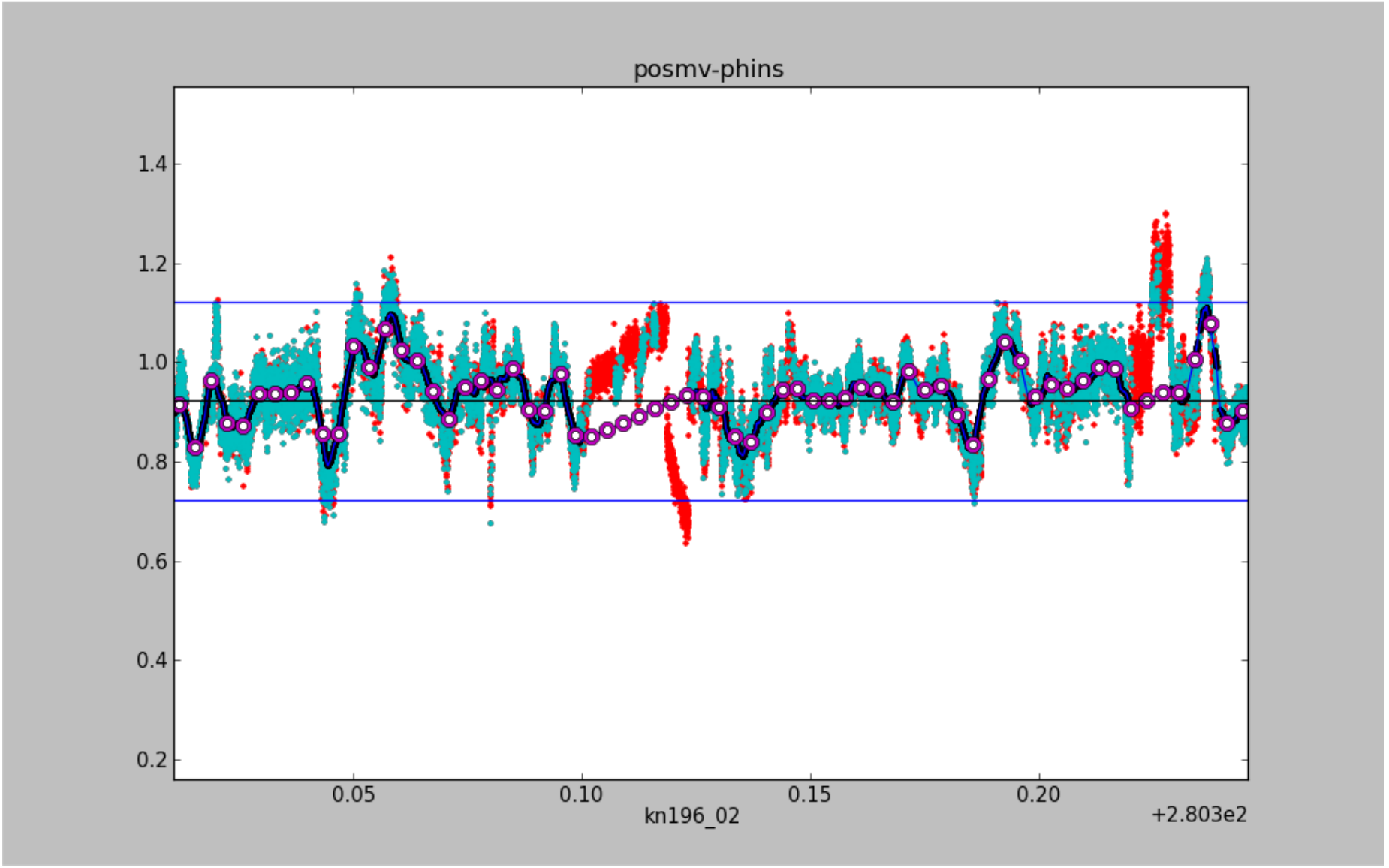



```
=========================
------ posmv statistics ------
=========================
posmv-gyro statistics (pycurrents)
ddrange: 305.8333642 to 306.8577969
(2010/11/02 20:00:03 to 2010/11/03 20:35:14)
number of good points: 182 out of 294 (62%)
min dh = 0.37,   max dh = 1.85
mean dh = 0.80
stddev dh = 0.35
heading correction quality:
mean N in ensemble = 120
stddev N in ensemble = 40
(one ensemble looks like 300 seconds)
```




```
=========================
------ phins statistics ------
=========================
phins-gyro statistics (pycurrents)
ddrange: 305.8333642 to 306.8579936
(2010/11/02 20:00:03 to 2010/11/03 20:35:31)
number of good points: 295 out of 295 (100%)
min dh = -0.63,   max dh = 1.07
mean dh = -0.12
stddev dh = 0.38
heading correction quality:
mean N in ensemble = 301
stddev N in ensemble = 0
(one ensemble looks like 300 seconds)
```

POSMV in trouble



Monitoring: At Sea

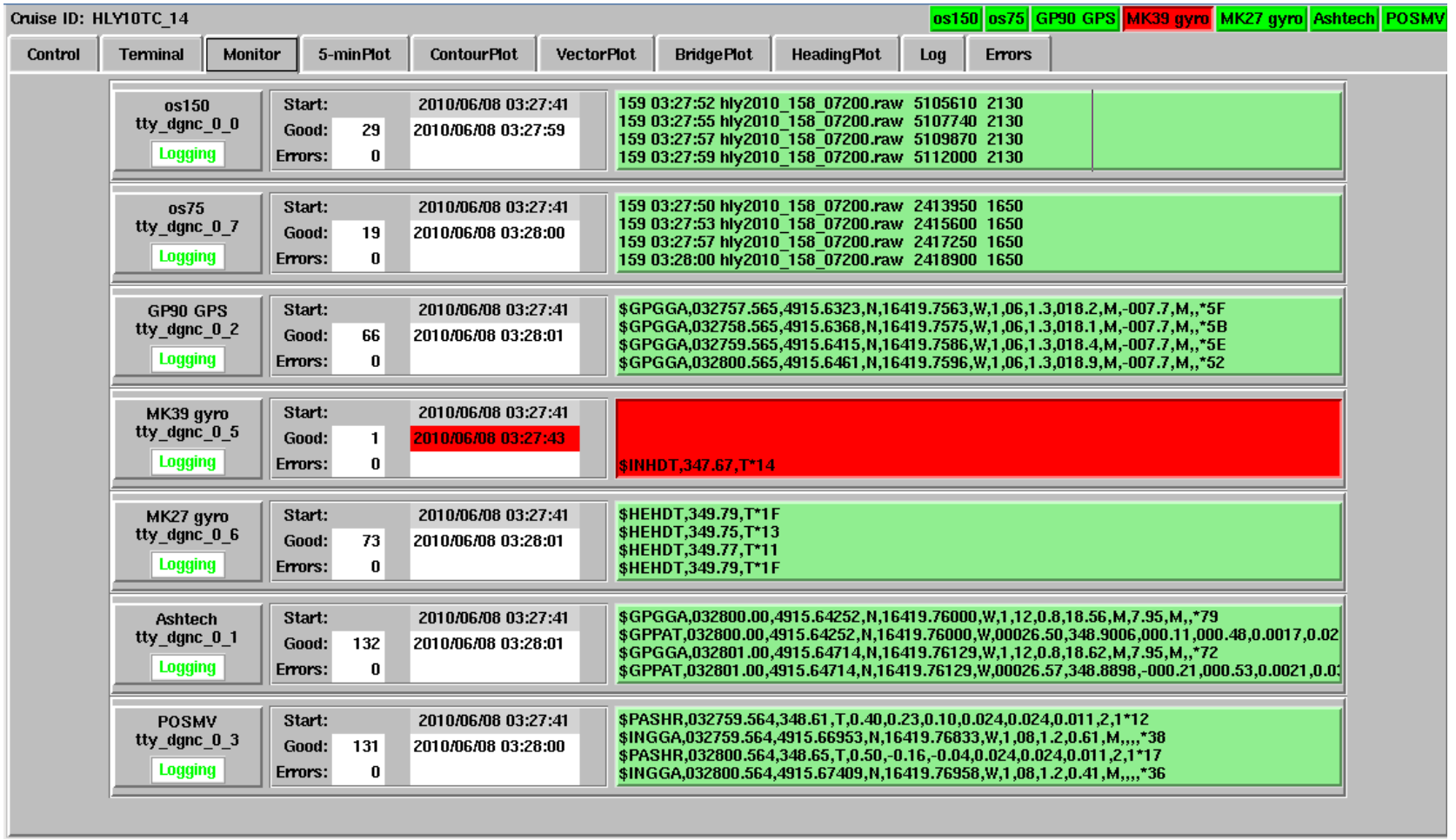
There are three categories of monitoring:

(1) CODAS Processing

(2) health of components (Ashtech)

(3) data acquisition

Monitoring At Sea: data Acquisition



UHDAS: Monitoring from shore

Link to on-shore monitoring: UHDAS ships

- text email
- figures
- diagnostic files

UHDAS:

http://currents.soest.hawaii.edu/uhdas_fromships.html

Actual link

screenshot

ship	schedules	figure links	daily report	daily email	instruments
N.B.Palmer	schedule	figs	dir	email	NB150, OS38
L.M.Gould	schedule	figs	dir	email	NB150, OS38
Atl. Explorer	2011, 2012	figs	dir	email	OS75
Atlantis	2011, 2012	figs	dir	email	OS75
Endeavor	2011, 2012	figs	dir	email	WH300, OS75
Kilo Moana	2011, 2012	figs	dir	email	WH300, OS38
Knorr	2011, 2012	figs	dir	email	WH300, OS75
Langseth	2011 2012	figs	dir	email	OS75
Melville	2011, 2012	figs	dir	email	OS150, OS75
New Horizon	2011, 2012	figs	dir	email	OS75
Oceanus	2011, 2012	figs	dir	email	NB150, OS75
Revelle	2011, 2012	figs	dir	email	NB150, OS75
Sproul	2011, 2012	figs	dir	email	NB300
Thompson	2011, 2012	figs	dir	email	OS75
Wecoma	2011, 2012	figs	dir	email	WH300, OS75
Hi`ialakai		figs	dir	email	OS75
Ka`imimoana		figs	dir	email	OS75
Ron Brown		figs	dir	email	OS75
Healy		figs	dir	email	OS150, OS75
Ka`imikai O Kanaloa		figs	dir	email	NB150

Monitoring: From Shore

- **from the text email**:
  - CODAS Processing
  - health of heading device (eg. Ashtech)
  - PC clock
  - Bottom track (on/off), ping rate (triggered)
- **from the diagnostic files**:
  - data acquisition
  - processing
  - troubleshooting

Monitoring: From Shore

- **from the text email**:
  - CODAS Processing
  - health of heading device (eg. Ashtech)
  - PC clock
  - Bottom track (on/off), ping rate (triggered)

Description follows...

```
2010/11/03 20:40:01
currents 2.6.24-25-generic

Current cruise: TN256     ** is logging **
Database time ranges:
      os75bb 2010/10/23  18:14:25 to 2010/11/03  20:17:14  (22 min. ago)

---- heading correction ----
(heading correction from "posmv")
------ posmv ------
posmv_gyrodh.asc

ddrange: 305.8656494 to 306.8552328
(2010/11/02 20:46:32 to 2010/11/03 20:31:32)

number of good points: 286 out of 286 (100%)
heading correction statistics:
min dh  =  -2.17,  max dh  =  -0.41
mean dh   =  -1.14
stddev dh =  0.08

---------- uptime ------------
 20:40:02 up 184 days, 22:13,  3 users,  load average: 0.03, 0.22, 0.24
---------- ntpq -p ------------
     remote           refid      st t when poll reach   delay   offset  jitter
==============================================================================
*ntpserver.thomp .GPS.            1 u  862 1024  377    0.427   -2.542   2.255
------------------------------------------

figures are at http://currents.soest.hawaii.edu/uhdas_fromships/thompson/figs/
```

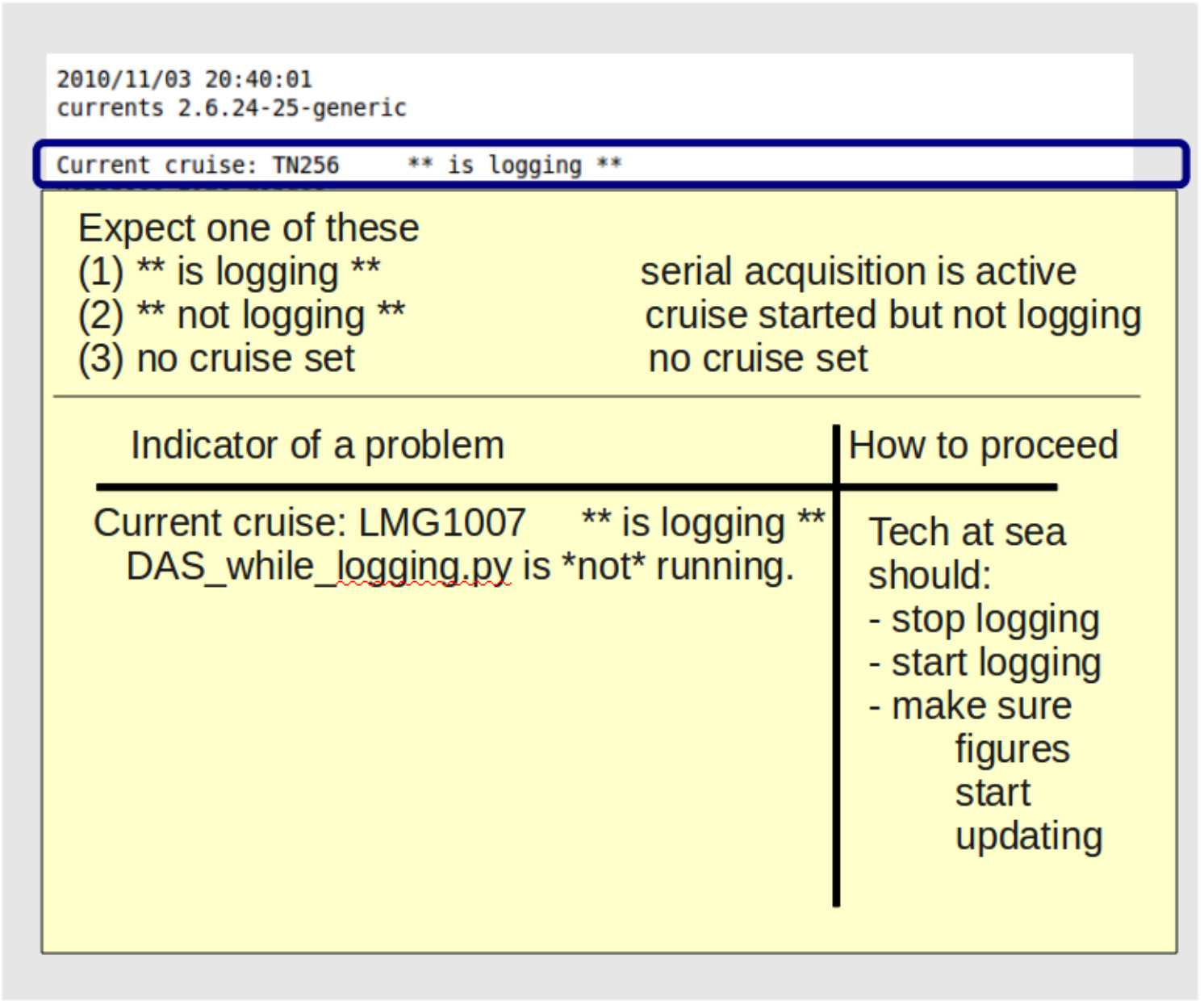
2010/11/03 20:40:01

(1) Check the time of the email (this is UTC time)

This email was generated on the ship at 20:40 and mailed out shortly after that.

Expect: email is generated daily, sent shortly after creation

Indicator of a problem	How to proceed
email is over 24hrs old	check ship schedule: - are they in port for a long time? (computer may be off) - are they at sea? check with techs: is email and networking up?


2010/11/03 20:40:01
currents 2.6.24-25-generic
Current cruise: TN256 ** is logging **
Expect one of these
(1) ** is logging ** serial acquisition is active
(2) ** not logging ** cruise started but not logging
(3) no cruise set no cruise set
Indicator of a problem
How to proceed
Current cruise: LMG1007 ** is logging **
DAS_while_logging.py is *not* running.
Tech at sea should:
- stop logging
- start logging
- make sure figures start updating

```
2010/11/03 20:40:01
currents 2.6.24-25-generic

Current cruise: TN256     ** is logging **
Database time ranges:
      os75bb 2010/10/23  18:14:25 to 2010/11/03  20:17:14  (22 min. ago)
```

Expect: all database times should be under 30min old

Indicator of a problem	How to proceed
data are much older than 30min and DAS_while_logging.log is **not** running	Tech at sea should restart logging
data are much older than 30 min and no other clue is given	look in daily_report directory for clues;

```
2010/11/03 20:40:01
currents 2.6.24-25-generic

Current cruise: TN256     ** is logging **
Database time ranges:
      os75bb 2010/10/23  18:14:25 to 2010/11/03  20:17:14  (22 min. ago)

---- heading correction ----
(heading correction from "posmv")
------ posmv ------
posmv_gyrodh.asc

ddrange: 305.8656494 to 306.8552328
(2010/11/02 20:46:32 to 2010/11/03 20:31:32)

number of good points: 286 out of 286 (100%)
heading correction statistics:
min dh  =  -2.17,  max dh  =  -0.41
mean dh   =  -1.14
stddev dh =  0.08
```

Check the percentage of good points.
If less than 80, tech at sea should check the device

```
2010/11/03 20:40:01
currents 2.6.24-25-generic

Current cruise: TN256     ** is logging **
Database time ranges:
      os75bb 2010/10/23  18:14:25 to 2010/11/03  20:17:14  (22 min. ago)

---- heading correction ----
(heading correction from "posmv")
------ posmv ------
posmv_gyrodh.asc

ddrange: 305.8656494 to 306.8552328
(2010/11/02 20:46:32 to 2010/11/03 20:31:32)

number of good points: 286 out of 286 (100%)
heading correction statistics:
min dh  =  -2.17,  max dh  =  -0.41
mean dh   =  -1.14
stddev dh =  0.08

---------- uptime ------------
 20:40:02 up 184 days, 22:13,  3 users,  load average: 0.03, 0.22, 0.24
---------- ntpq -p ------------
     remote           refid      st t when poll reach   delay   offset  jitter
==============================================================================
*ntpserver.thomp .GPS.           1 u  862 1024  377    0.427   -2.542   2.255
```

Expect
(1) floating point numbers
(2) ntp not active

Problem: if numbers are all 0.000

```
2010/11/03 20:40:01
currents 2.6.24-25-generic

Current cruise: TN256     ** is logging **
Database time ranges:
      os75bb 2010/10/23  18:14:25 to 2010/11/03  20:17:14  (22 min. ago)

---- heading correction ----
(heading correction from "posmv")
------ posmv ------
posmv_gyrodh.asc

ddrange: 305.8656494 to 306.8552328
(2010/11/02 20:46:32 to 2010/11/03 20:31:32)

number of good points: 286 out of 286 (100%)
heading correction statistics:
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mean dh   =  -1.14
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---------- uptime ------------
 20:40:02 up 184 days, 22:13,  3 users,  load average: 0.03, 0.22, 0.24
---------- ntpq -p ------------
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==============================================================================
*ntpserver.thomp .GPS.            1 u  862 1024  377    0.427   -2.542   2.255
------------------------------------------

figures are at http://currents.soest.hawaii.edu/uhdas_fromships/thompson/figs/
```
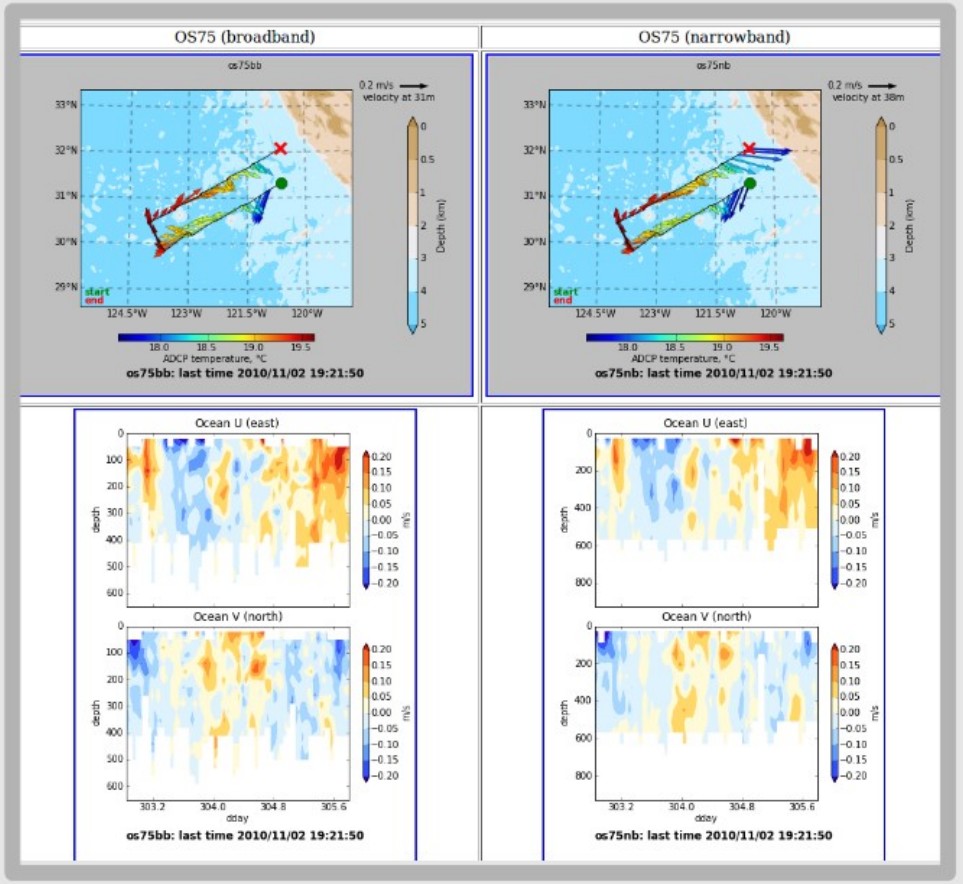

check the figures in the link

Steps to check daily email:



Observations:
(1) two ping types (OS75 interleaved mode)
(2) data from different types are consistent
(3) data are physically reasonable
- no big gaps
- no big outliers
- no deep strong currents
- depth ranges are reasonable

Check: (text email)
BOTTOM TRACK should be **OFF**

Monitoring: From Shore

- **from the diagnostic files**:

  “**tails.txt**”

  - data acquisition
  - processing
  - troubleshooting

  “**cals.txt**”

  - calibration

Diagnostics reminder: UHDAS cruise directory structure

Data for scientists:

There are three categories of data, all located in the logging directory, /home/data/[CRUISEID]:

ADCP logging directories

subdirectory	contents	importance	back up for...
raw	all raw data	critical	◦ archiving ◦ scientists who ask for it
rbin	intermediate files	nice to have	anyone who gets **raw**
gbin	intermediate files	nice to have	anyone who gets **raw**
proc	◦ final processing ◦ codas database ◦ underway figure archive ◦ matlab files	final product	science CDs after cruise

File **tails.txt** shows recent contents of raw, rbin, gbin

UHDAS diagnostic file: **tails.txt**

- last 12 lines of each NMEA (or log) file
- last 12 raw files (each kind)
- last 12 rbin files (each kind)
- last 12 gbin files (each kind)

UHDAS diagnostic file: **cals.txt**

keep an eye on calibration

Good ADCP Calibration numbers

```
2010/11/05 20:40:02


---------- BOTTOM TRACK ------------

unedited: 310 points
edited:   214 points, 2.0 min speed, 2.5 max dev
             median      mean       std
amplitude    1.0020    1.0033    0.0118
phase        0.0358    0.0679    0.3278

---------- WATER TRACK -----------

Number of edited points:  85 out of  90
             median      mean       std
amplitude    0.9990    1.0004    0.0116
phase       -0.0200   -0.0989    0.7160
```

Phase (angle misalignment)
should be between
-0.5 and +0.5 degrees

NOAA Newport 2012 ADCP

Part II: UHDAS

- ADCP Processing with CODAS
- UHDAS: What it does
- Monitoring
    - At sea
    - On Land
- What can be changed, tested

UHDAS: what can be changed (not much)

with the UHDAS tool:

- bb, nb mode (OS75, OS150)
- bottom tracking on/off
- bin size (and blank)

if required (carefully edit `sensor_cfg.py`)

- serial port, baud rate

UHDAS: what they'll ask for

“It's up to you but I don't recommend it”

- smaller bins than the default
- bottom tracking on
  - Does not solve anything
  - Most useful for troubleshooting

UHDAS: what they'll ask for

"I think the answer is '**no**' but ask Jules"

- more rapid updating of the database
- finer grain than 5min averages

The answer is '**no**', in order to preserve the reliability of the UHDAS installation

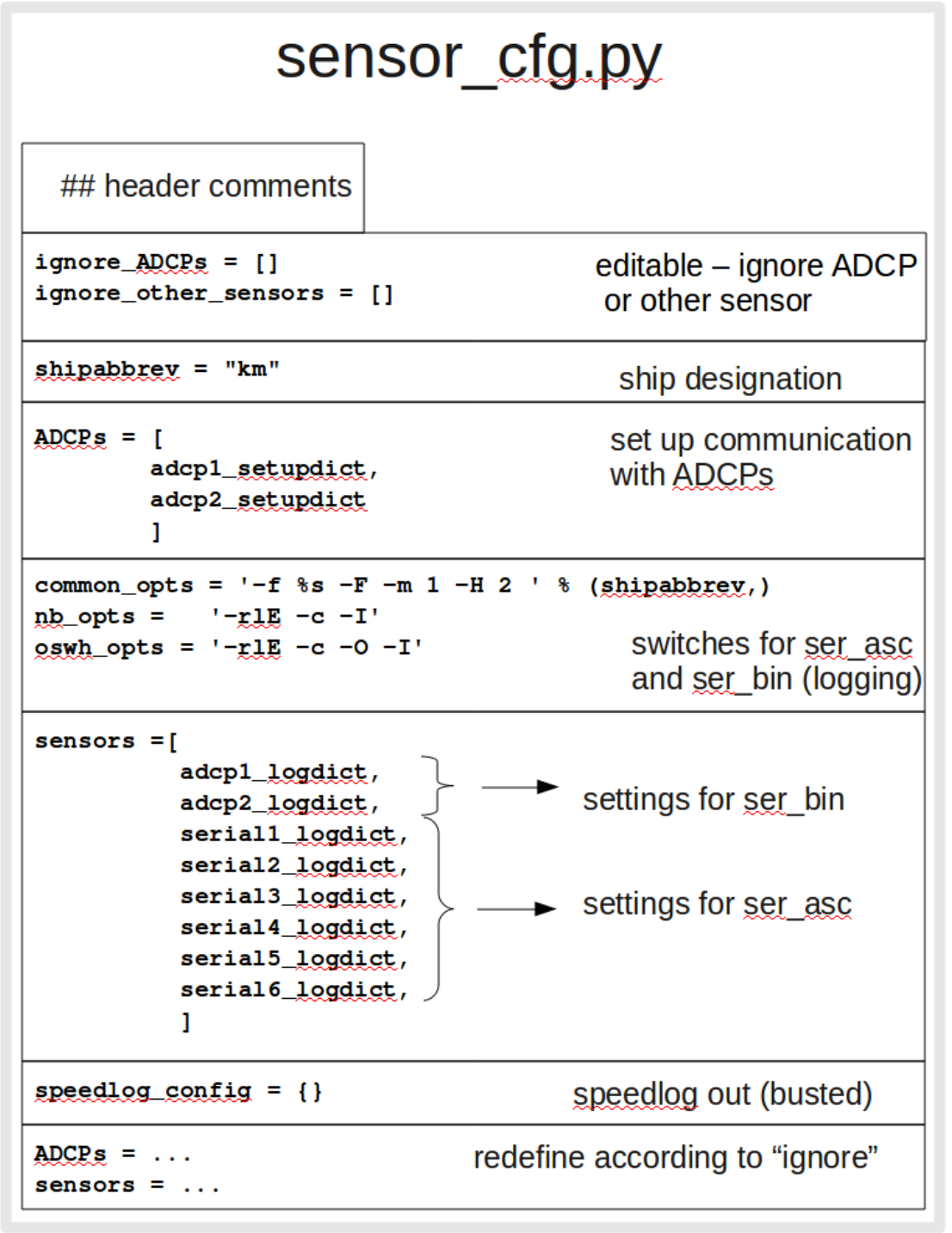
Configuration Files (expert)

- `proc_cfg.py`
  - transducer angle
  - serial inputs used for transformations
- `uhdas_cfg.py`
  - averaging interval
  - timers (5min, 30min)
  - bin range for bridge plots and vector plot
  - email
- `sensor_cfg.py`
  - ports
  - baud rates
  - messages

Block diagram of sensor_cfg.py

This is a python program. Python is sensitive to

- Case
- Indentation
- Punctuation



sensor_cfg.py : ADCP setup

```
ADCPs = [
        adcp1_setupdict,
        adcp2_setupdict
        ]
```

set up communication with ADCPs

```
adcp1_setupdict = {
    'instrument'   :   'wh300',
    'setup'        :   'rdi_setup',
    'terminal'     :   'oswh_term',
    'defaultcmd'   :   'wh300_default.cmd',
    'commands'     :   ('EA04500',),
    'datatypes'    :   ('wh300',),
    'wakeup_baud'  :   9600
    }
```

Only one editable field in this block: This “EA” command must be similar to (within 5-10deg) of the transducer angle, i.e. the angle beam 3 makes from the bow (viewed clockwise from above).

It is CRITICAL to get the EA command in the right ballpark. A bad specification can irrevocably damage the data

sensor_cfg.py: serial logging setup

```
sensors =[
          adcp1_logdict,
          adcp2_logdict,
          serial1_logdict,
          serial2_logdict,
          serial3_logdict,
          serial4_logdict,
          serial5_logdict,
          serial6_logdict,
          ]
```

settings for ser_bin

settings for ser_asc

Two editable fields:

```
adcp1_logdict = {
    'instrument'   :  'os38',
    'device'       :  'ttyR3',
    'baud'         :  38400,
    'format'       :  'binary',
    'subdir'       :  'os38',
    'ext'          :  'raw',
    'opt'          :  oswh_opts
    }
```

serial port

baud rate

Two editable fields:

```
serial3_logdict = {
     'instrument'   :  'ADU5',
     'device'       :  'ttyR6',
     'baud'         :  9600,
     'format'       :  'ascii',
     'subdir'       :  'ashtech',
     'ext'          :  'adu',
     'strings'      :  ('$PASHR,ATT', '$GPGGA'),
     'messages'     :  ('gps', 'adu'),
     'opt'          :  '-tc'}
```

serial port

baud rate

These are related to processing... TAKE CARE

UHDAS/CODAS NOAA Presentation: Links to the documentation

Part `I`: ADCP

- Getting Ocean Velocity
- ADCP Acquisition Systems:
  - VmDAS (TRDI),UHDAS
- What can go wrong

Part `II`: UHDAS

- ADCP Processing with CODAS
- What it does
- Monitoring (at sea, from shore)
- What can be changed, tested