# NOAA 2015 ADCP

Part I: ADCP

Part II: UHDAS introduction...

Part III: Signatures of problems...

# NOAA 2015 ADCP

## Part I: ADCP

- (1) Getting Ocean Velocity
- (2) ADCP Acquisition Systems (UHDAS,VmDAS)

## Part II: UHDAS...

## Part III: Signatures of problems...

# NOAA 2015 ADCP

## Part I: ADCP...

## Part II: UHDAS

- (1) ADCP Processing with CODAS
- (2) UHDAS:
    - What it does
    - Operations
- (3 Monitoring
    - At sea
    - On Land
- (4) What can be changed, tested

## Part III: Signatures of problems...

# NOAA 2015 ADCP

Part I: ADCP...

Part II: UHDAS...

Part III: Signatures of problems:

- (1) ADCP systems (components)
- (2) Data flow (where is the problem)
- (3) Ocean Velocity signatures

# Links to the documentation

## Part I: ADCP

- Getting Ocean Velocity
- ADCP Acquisition Systems:
  - VmDAS (TRDI),UHDAS

## Part II: UHDAS

- ADCP Processing with CODAS
- UHDAS: What it does
- Monitoring (at sea, from shore)
- UHDAS GUI Tour

## Part III: How things can go wrong

- What can go wrong

# NOAA 2015 ADCP

## Part I: ADCP

- (1) Getting Ocean Velocity
- (2) ADCP Acquisition Systems (UHDAS,VmDAS)

## Part II: UHDAS...

## Part III: Signatures of problems...

# NOAA 2015 ADCP

## Part I: ADCP

- (1) Getting Ocean Velocity
- (2) ADCP Acquisition Systems:

  UHDAS, VmDAS

# (1) ADCP: Getting Ocean Velocity

**ADCP** :

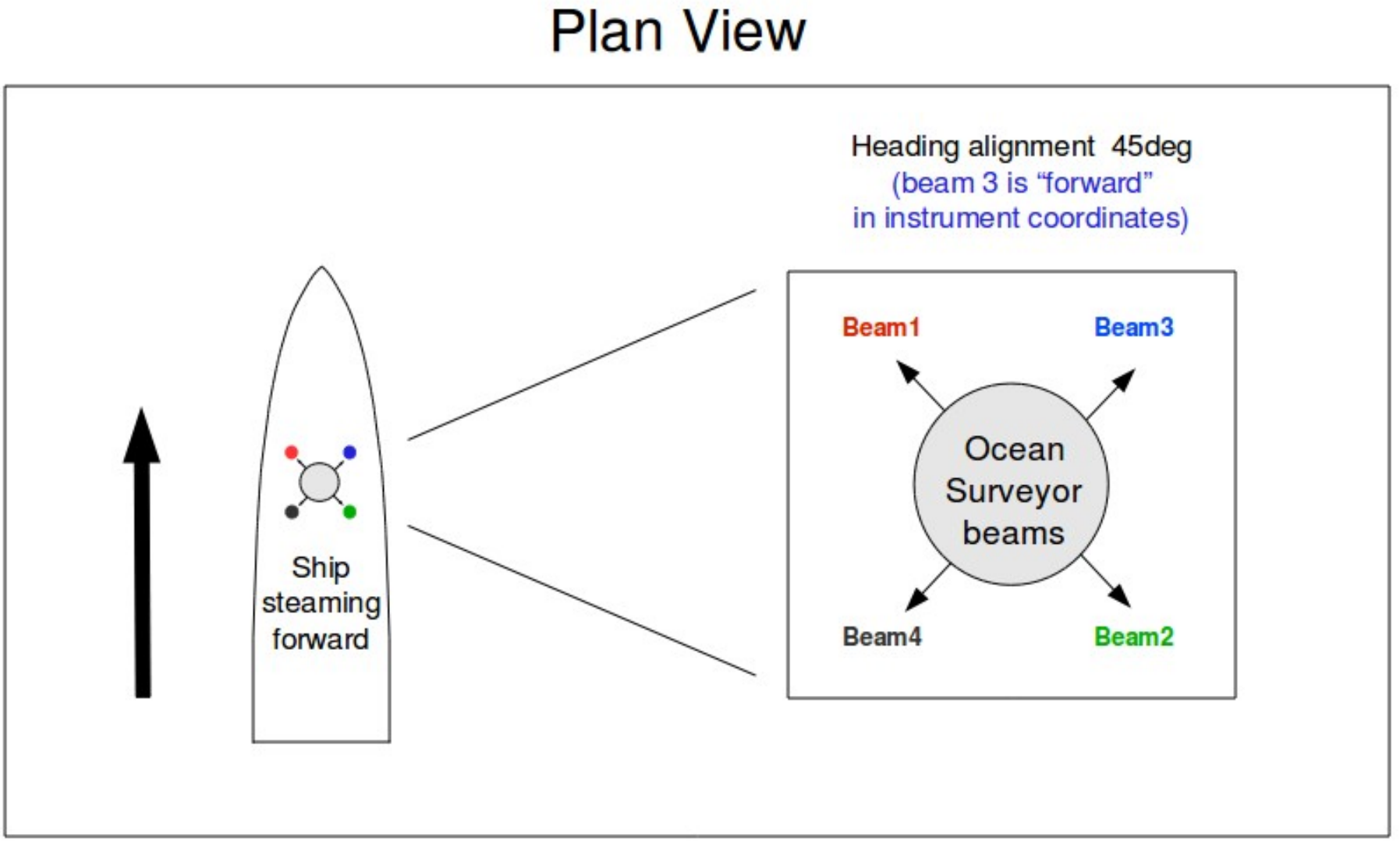
**A**coustic (it pings along beams at a frequency)

**D**oppler (uses frequency shift to get velocity along the beam)

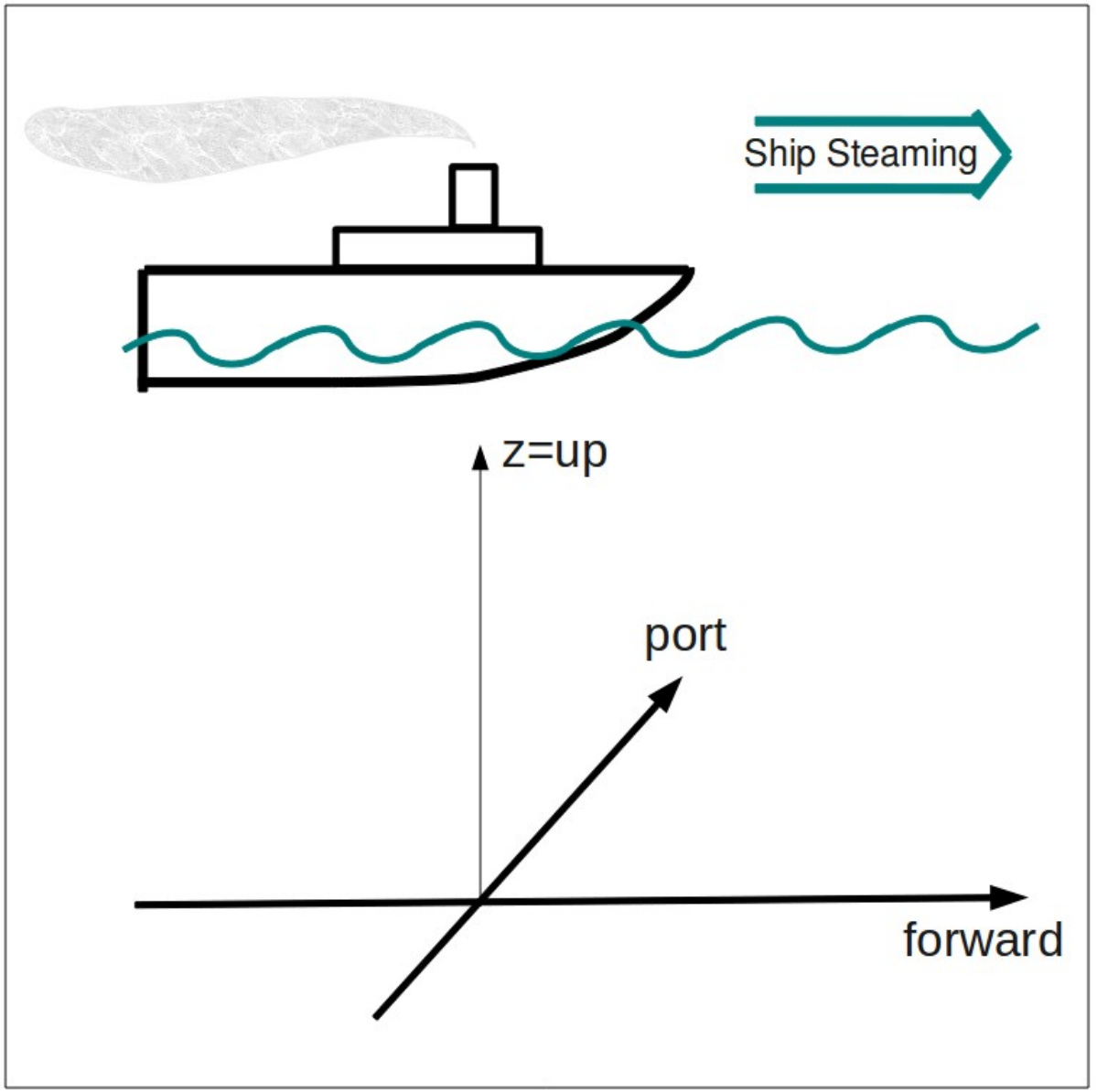
**C**urrent (include many more steps to get ocean velocity)

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

# ADCP : Getting Ocean Currents



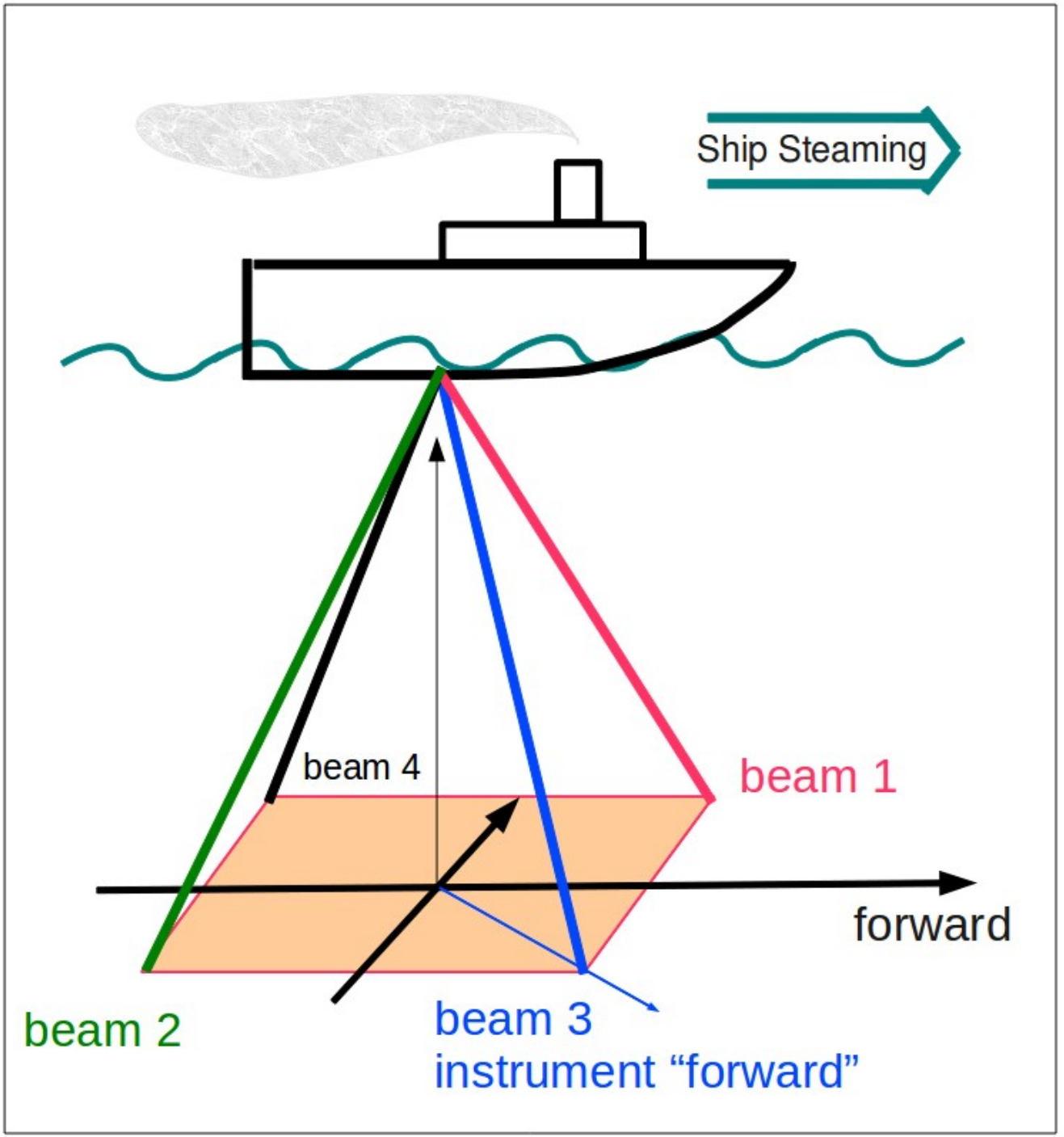
# ADCP : Getting Ocean Currents



# 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

## Getting Ocean Currents

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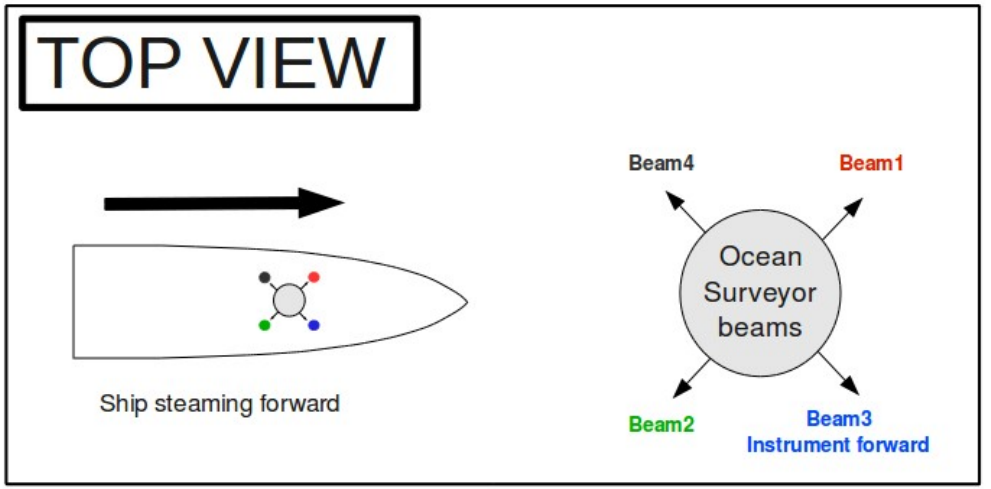
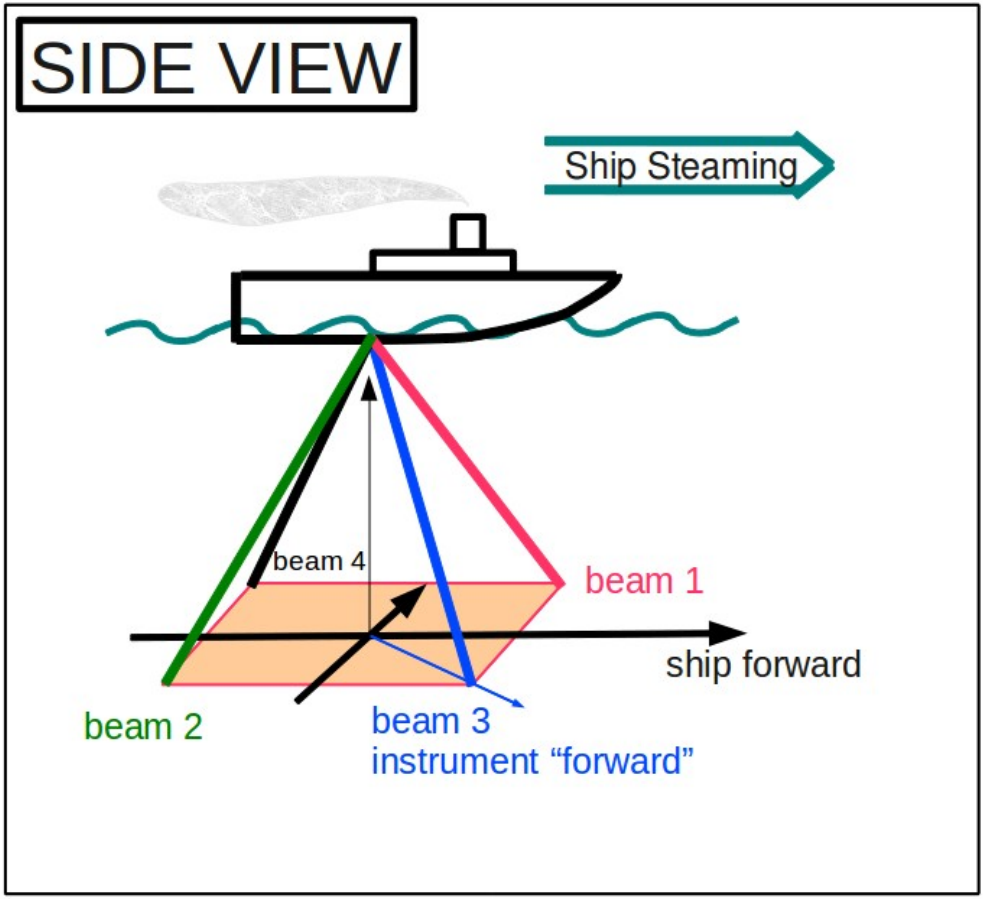
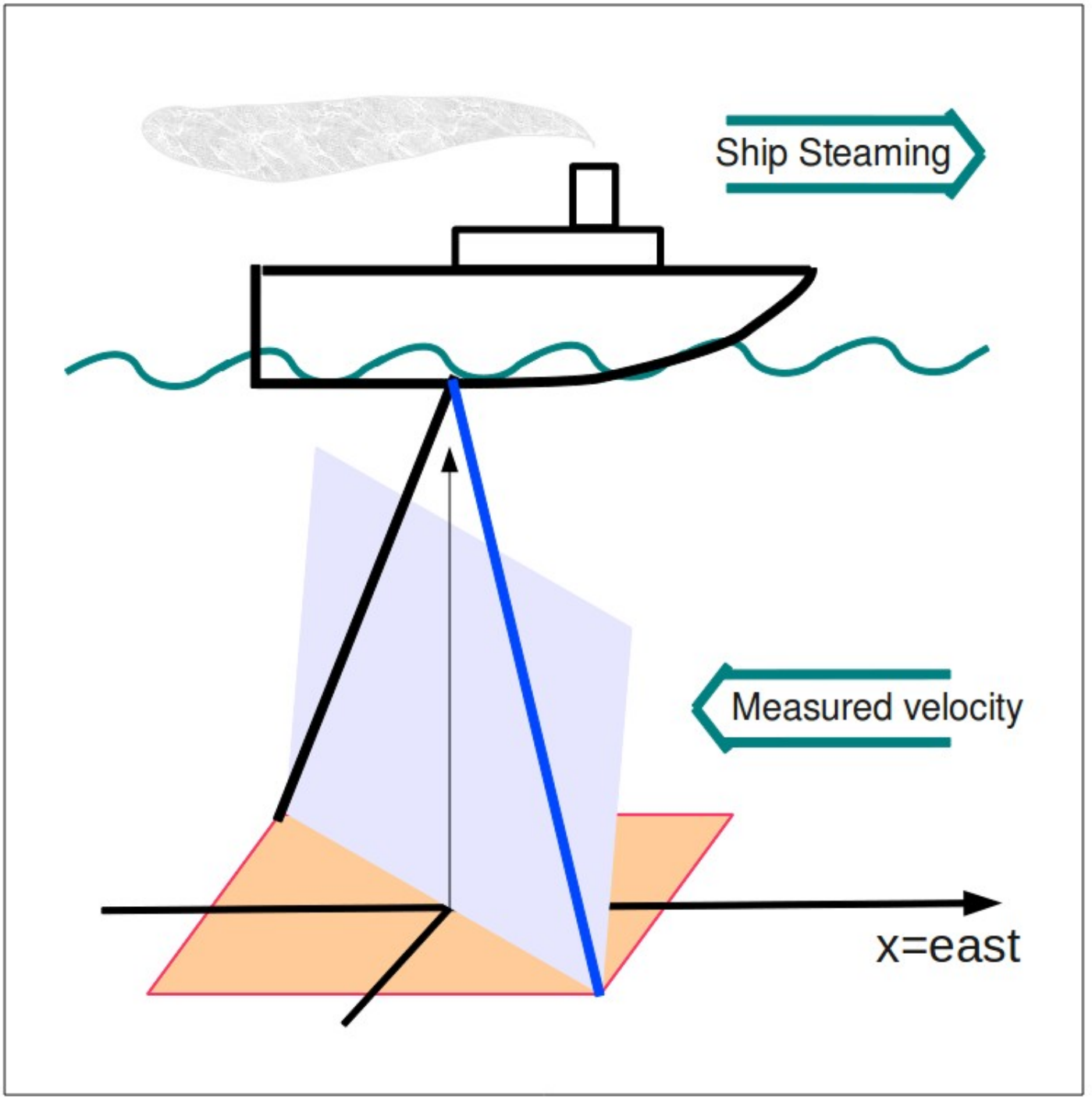


# ADCP

## Getting Ocean Currents

Two opposite beams make a vertical plane



# ADCP

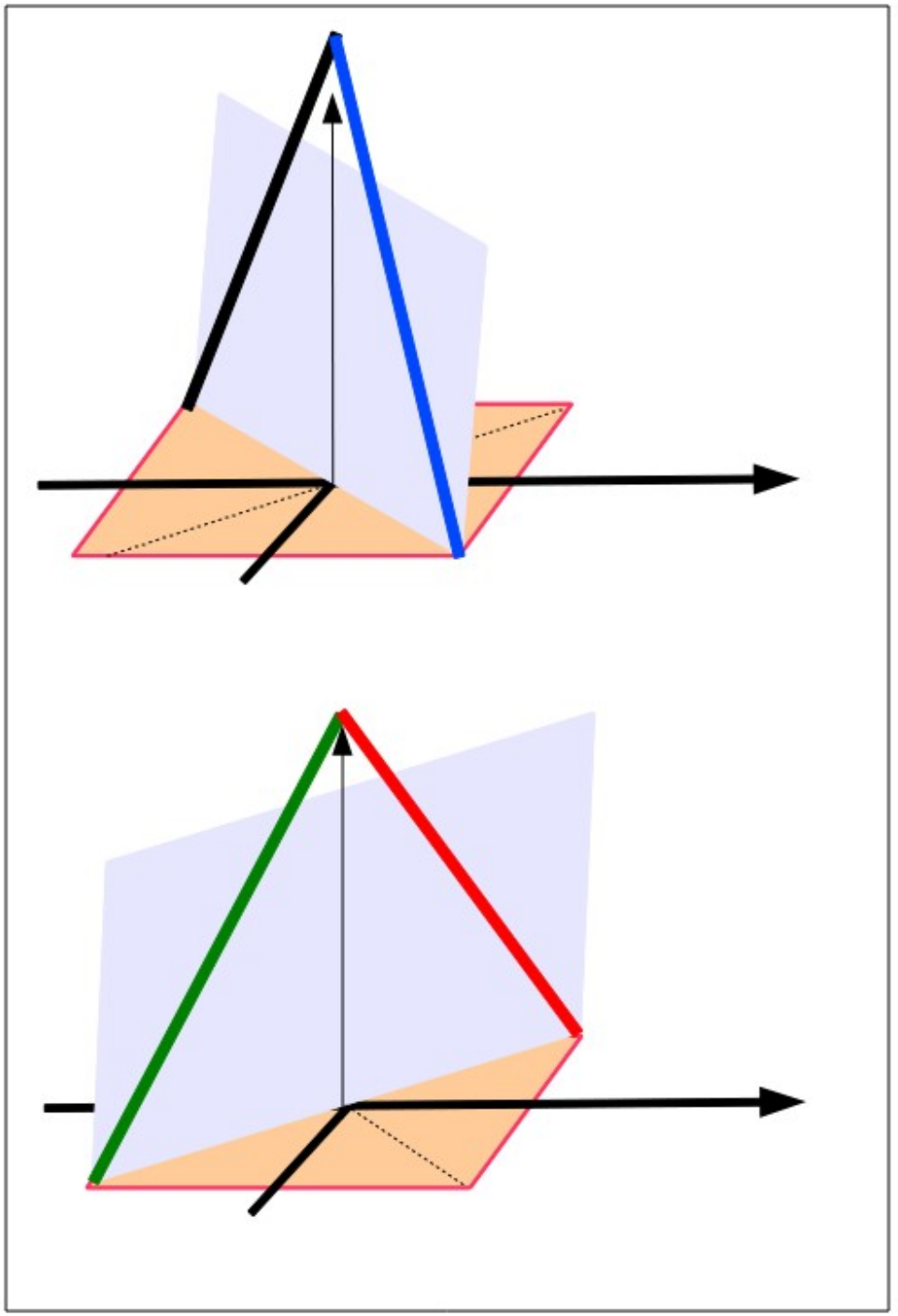
## Getting Ocean Currents

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



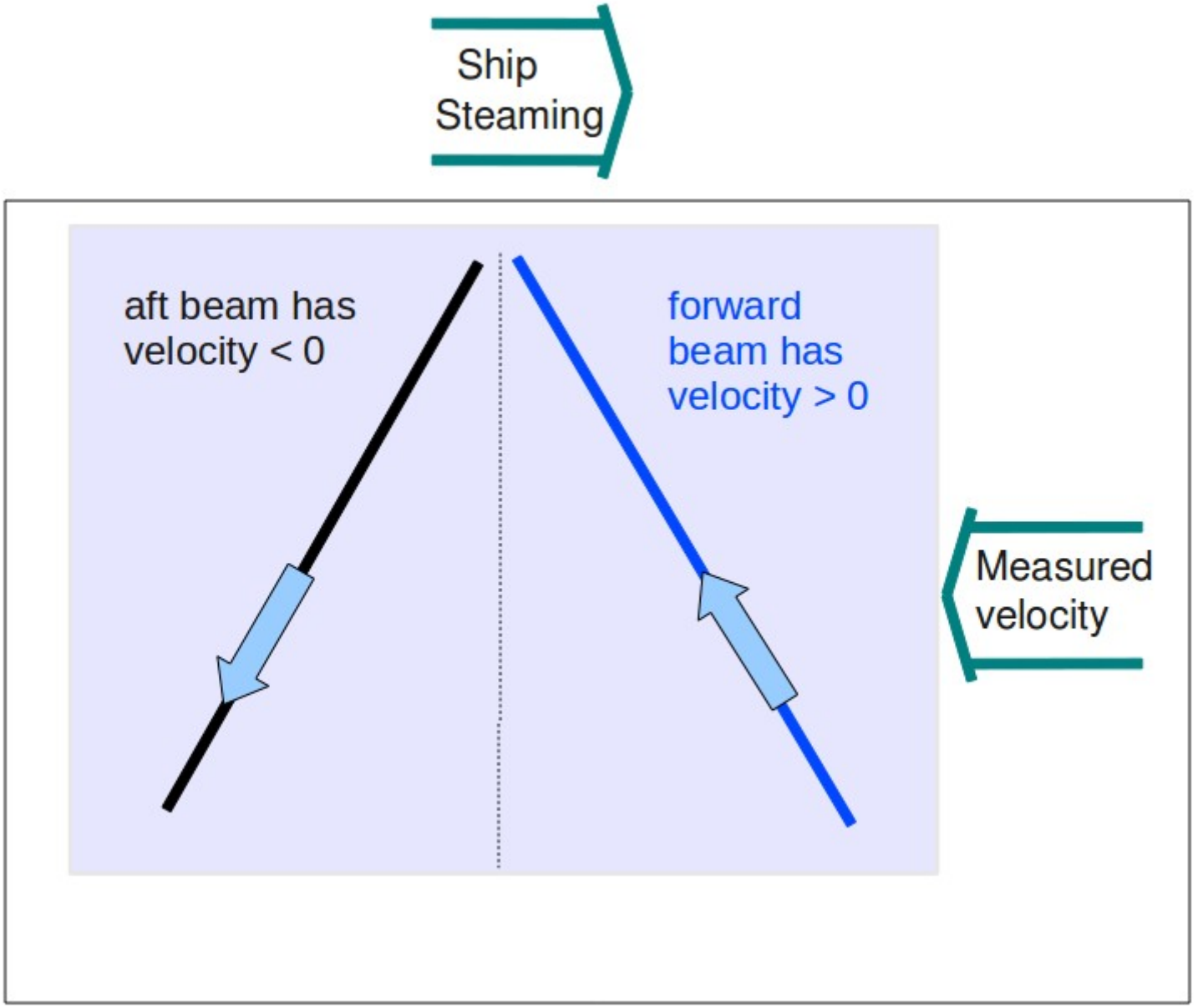
# ADCP

## Getting Ocear Currents

Two beams make one vertical plan

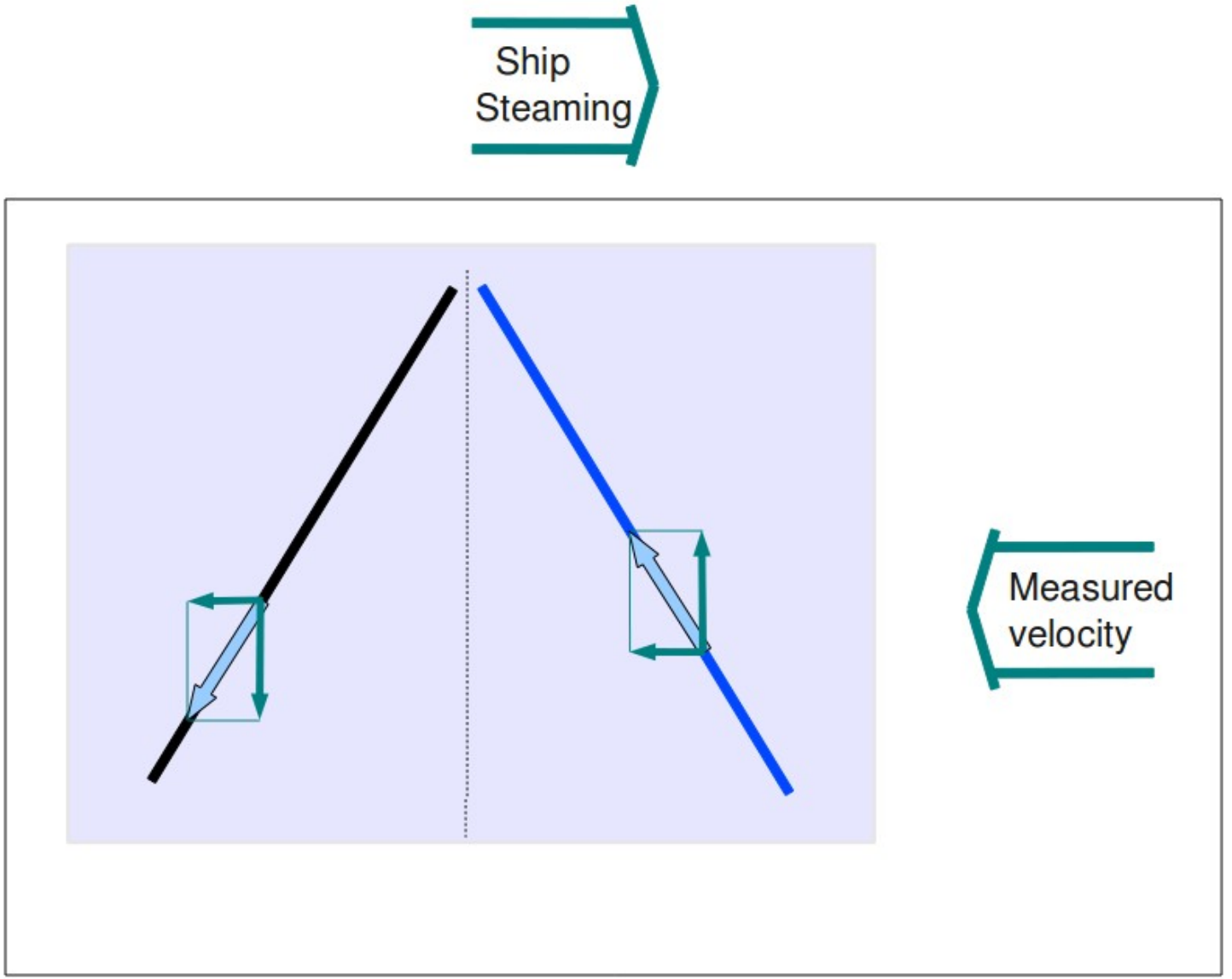
This shows the velocities determine by the Doppler shift

**“beam velocities”**



# ADCP: Getting Ocean Currents

Interpret the two beam velocities one horizontal and one vertical velocity

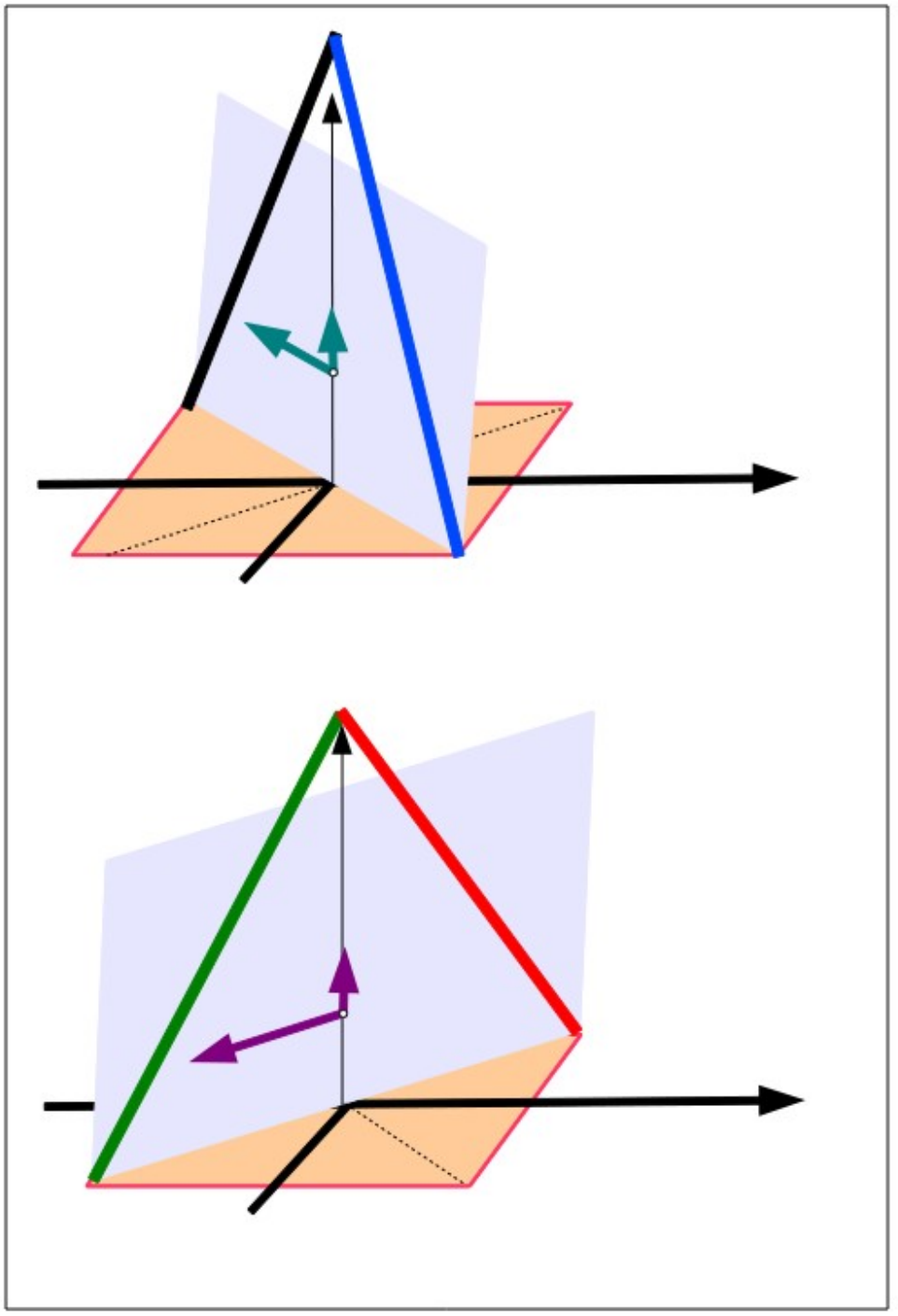


# ADCP:

## 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.

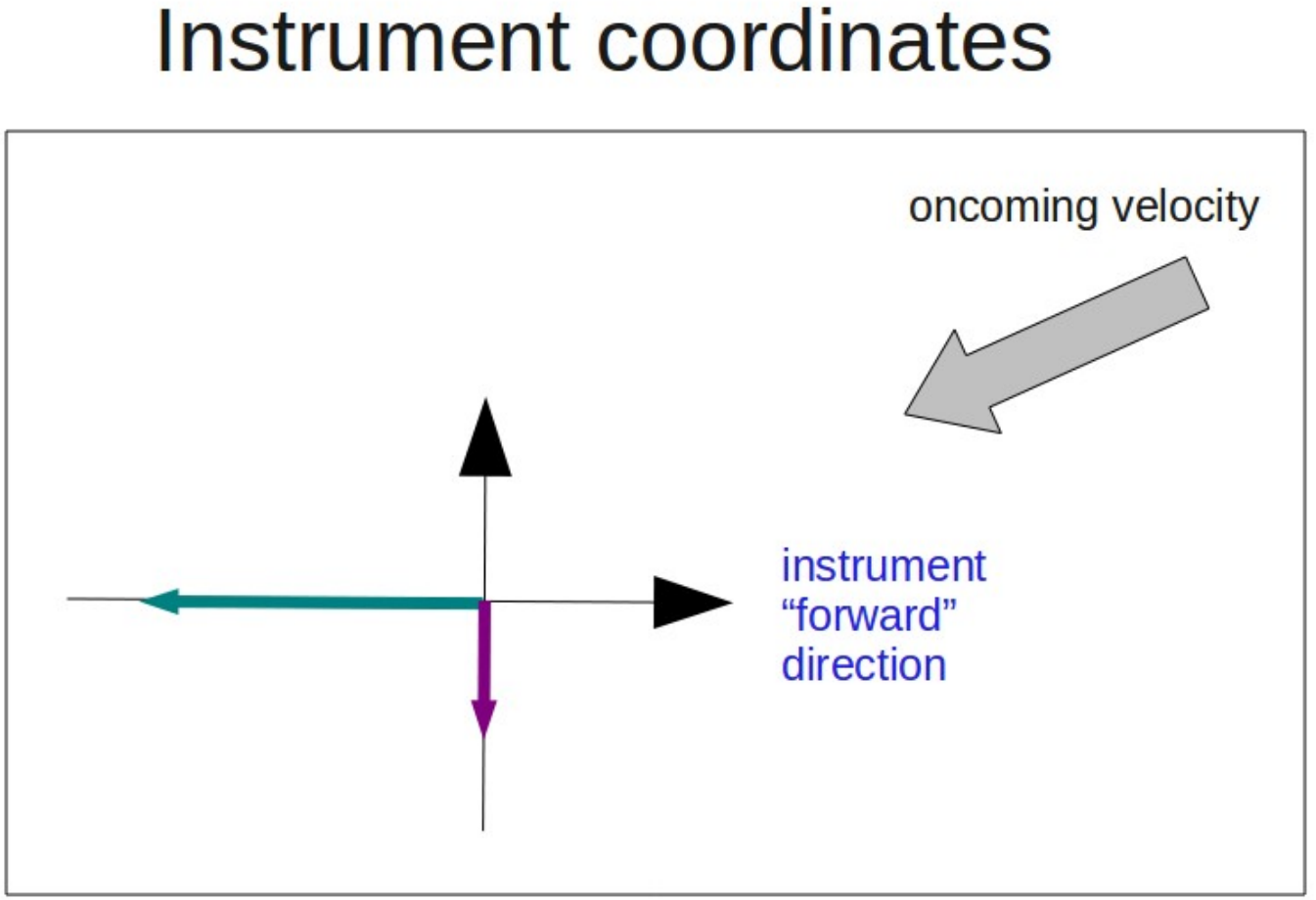


# ADCP:

Getting Ocean Currents

This is a top-down view of the measured horizontal velocity in **instrument coordinates** (from the two planes made by the beams)

(determining ocean velocities requires more steps)



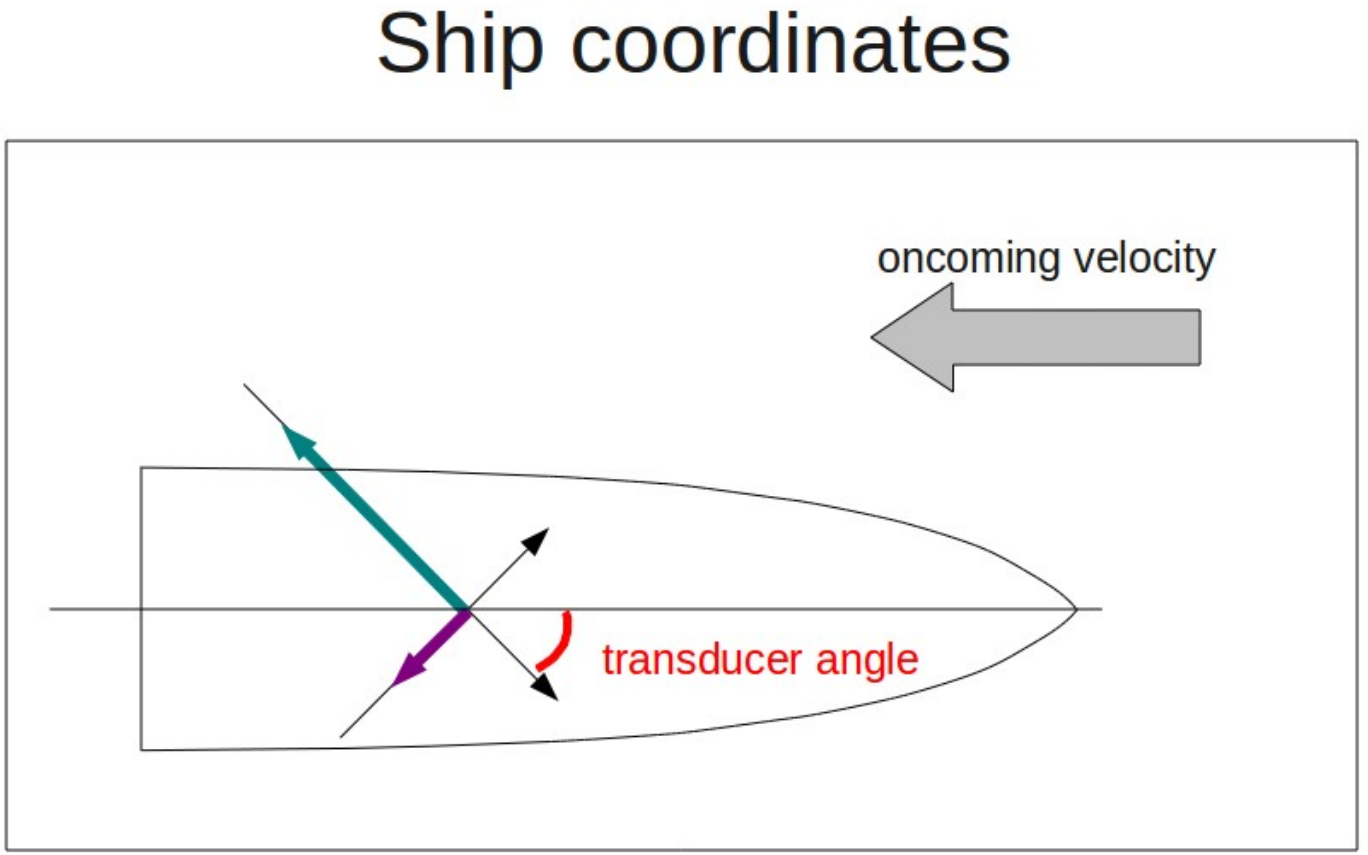
# ADCP:

## Getting Ocean Currents

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

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

(determining ocean velocities requires more steps)



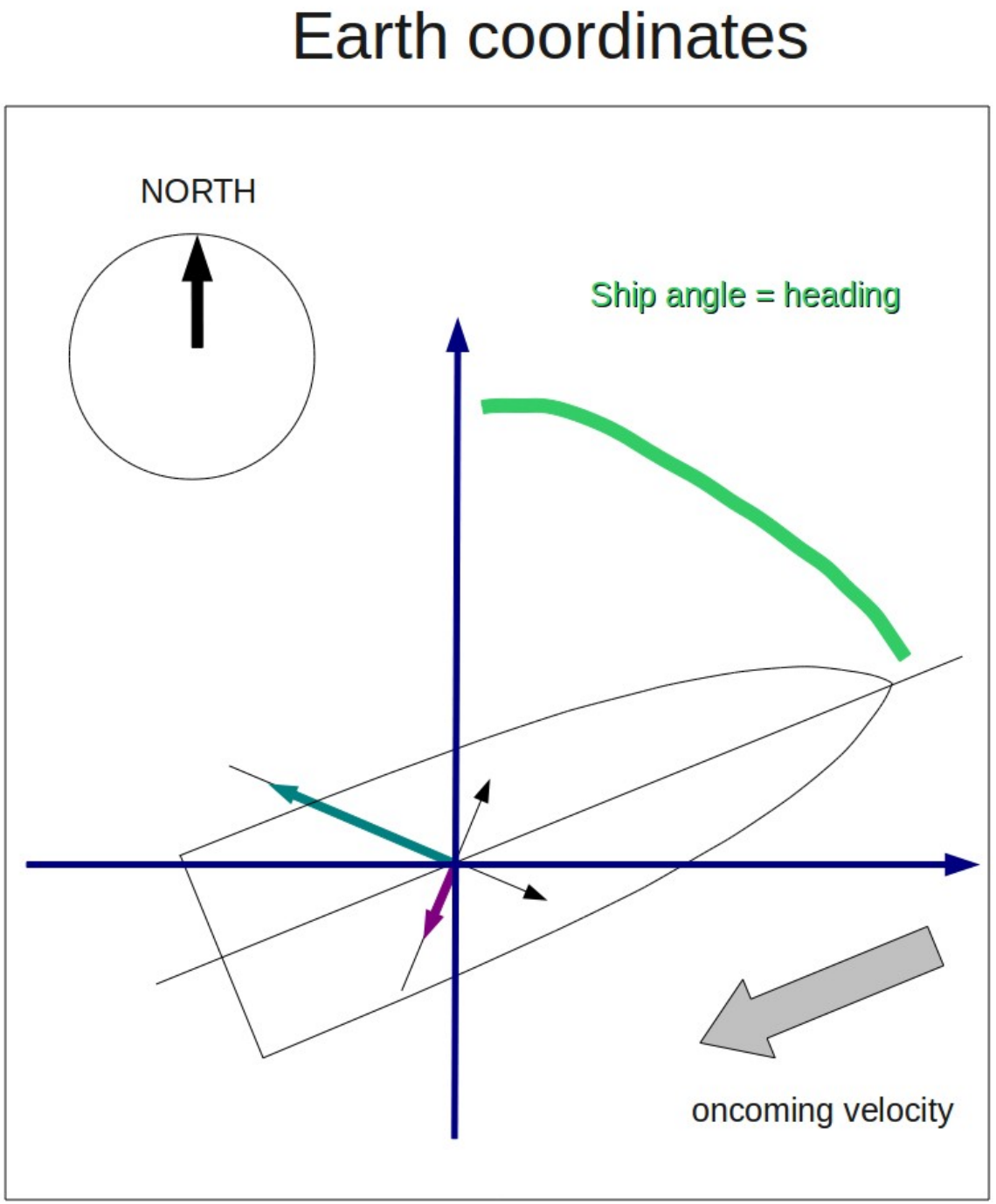
# ADCP:

## 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:

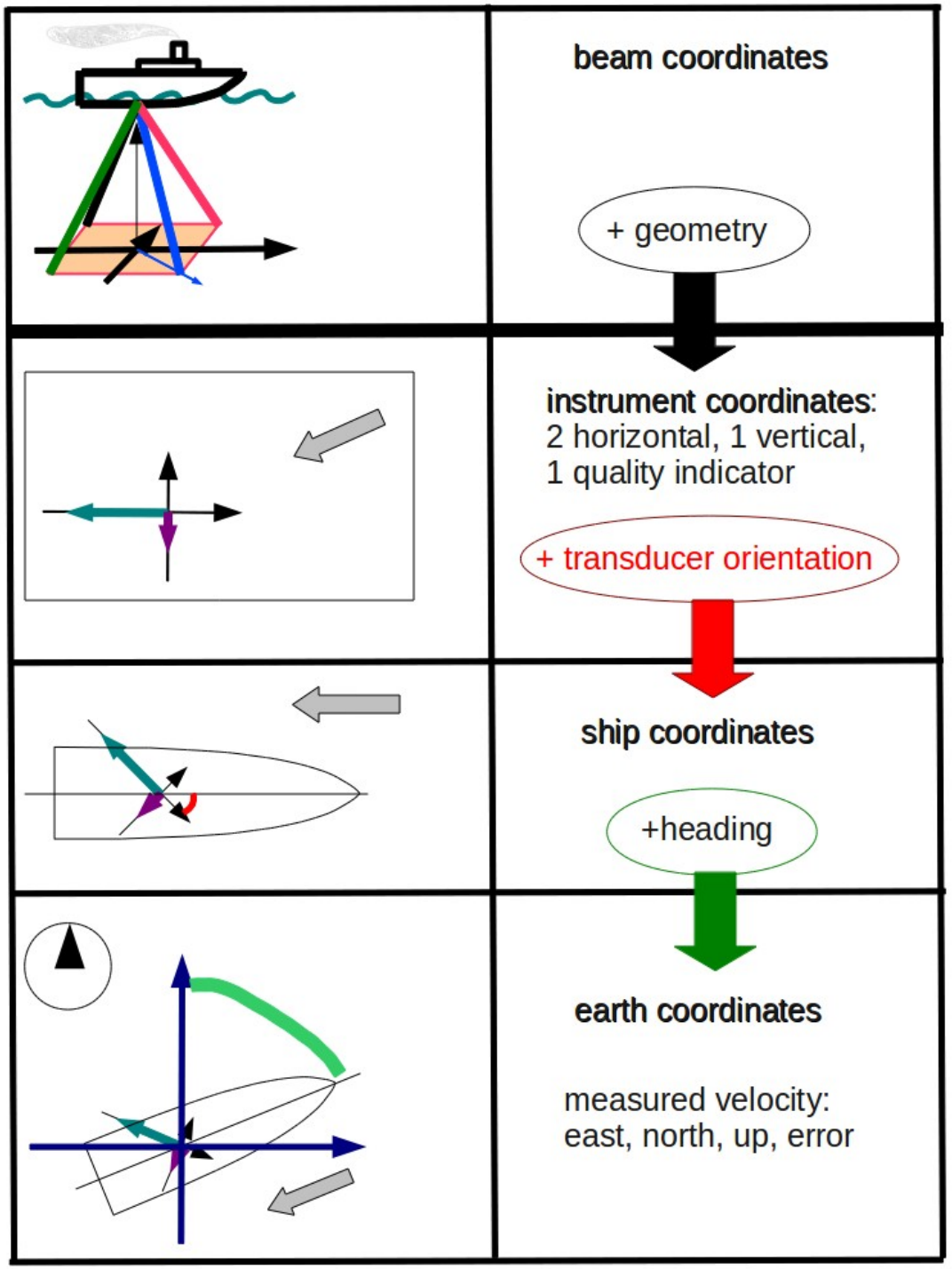
## Getting Ocean Currents

Summary of steps:

Doppler to beam
(not shown)

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

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



# ADCP:

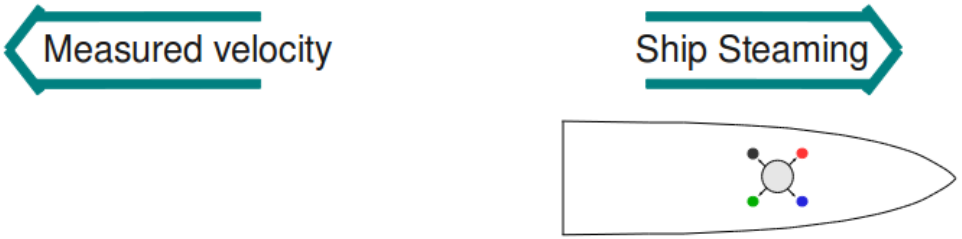
Getting Ocean Currents

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:**

beam velocities

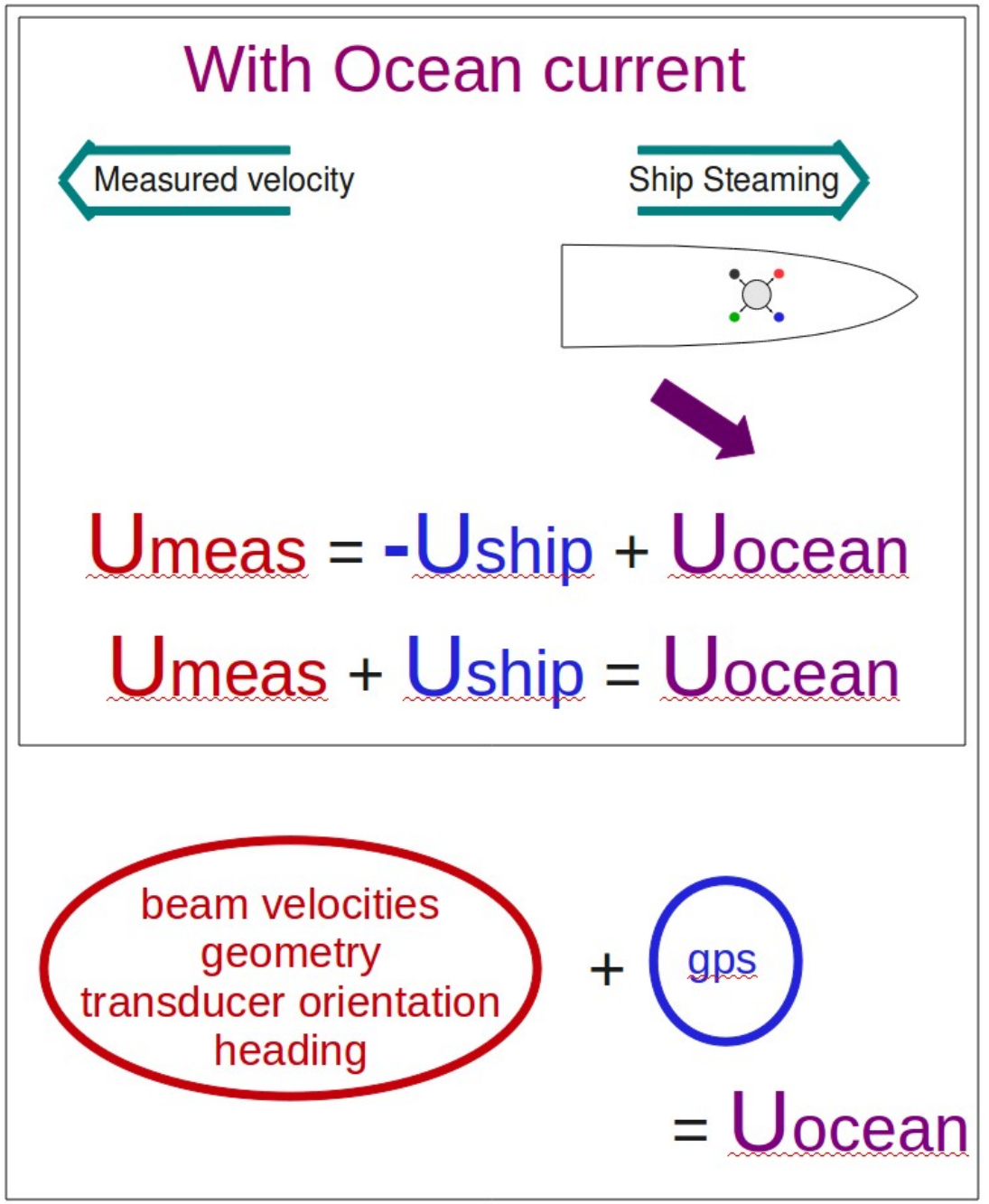
+

transducer orientation +
+ heading

+

gps

ocean velocities



# NOAA 2015 ADCP

## Part I: ADCP

- (1) Getting Ocean Velocity
- (2) ADCP Acquisition Systems:

  UHDAS, VmDAS

# (2) ADCP Acquisition systems

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

Core

- Processing
- Monitoring

Extra

# (2) ADCP Acquisition systems

- Basic requirements

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

# (2) ADCP Acquisition systems

- Basic requirements

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

# (2) ADCP Acquisition systems

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

# (2) 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 |

# (2) Acquisition: Serial Setup

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

# (2) Acquisition: Data Logging

| | UHDAS | VmDAS |
|---|---|---|
| data logging | separate processes | one big program |
| time tagging | buffered<br>tag every line | unbuffered<br>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 | text file elsewhere |

# (2) 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:<br>- profiles (E,N)<br>- vector (+topo)<br>- contour<br>- operational | profile (speed, dir)<br>vector<br>WinADCP? |

# Accessing Data Products

| | UHDAS | VmDAS |
|---|---|---|
| access plots | ship's web<br>console | console only |
| data formats | TRDI<br>Matlab<br>netCDF | TRDI |
| access data | ship's web<br>windows share<br>NFS | acquisition PC<br>windows share |
| documentation | ship's web<br>www | acquisition PC<br>www |
| speedlog out | yes (serial, web) | yes |

# (2) ADCP Acquisition systems

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

# (2) Acquisition Systems: Monitoring

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

# NOAA Norfolk 2015 ADCP

Part I: ADCP...

## Part II: UHDAS

- UHDAS: What it does
- Operational introduction
- Monitoring
- What can be changed

Part III: Signatures of problems...

# Part II: UHDAS

- (1) UHDAS: What it does
  - at-sea “CODAS” processing
  - overview
- (2) Operational Introduction
  - computer
  - UHDAS GUI
- (3) Monitoring
  - at sea
  - on land
- (4) What can be changed

# Part II: UHDAS

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# UHDAS: 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

# UHDAS: CODAS Processing Steps

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

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- 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

At Sea

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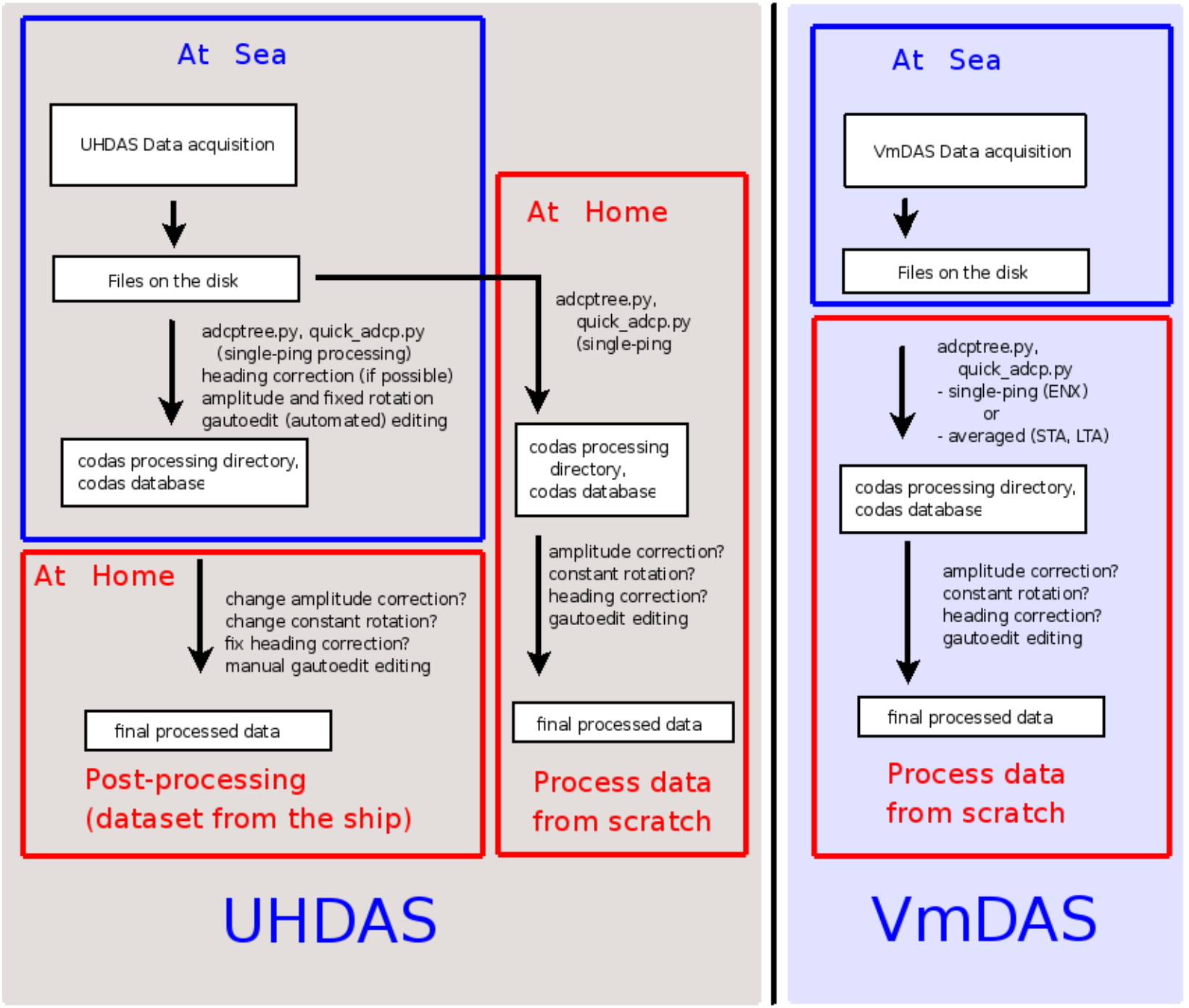
At Home



# Part II: UHDAS

- (1) UHDAS: What it does
  - at-sea “CODAS” processing
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- (2) Operational Introduction
  - computer
  - UHDAS GUI
- (3) Monitoring
  - at sea
  - on land
- (4) What can be changed

# UHDAS: what it does (overview)

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

# UHDAS: what it does (overview)

## 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 (overview)

## Data Access for science

- 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 )

Example at-sea web site

# UHDAS: What it does (overview)

## 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

# Part II: UHDAS

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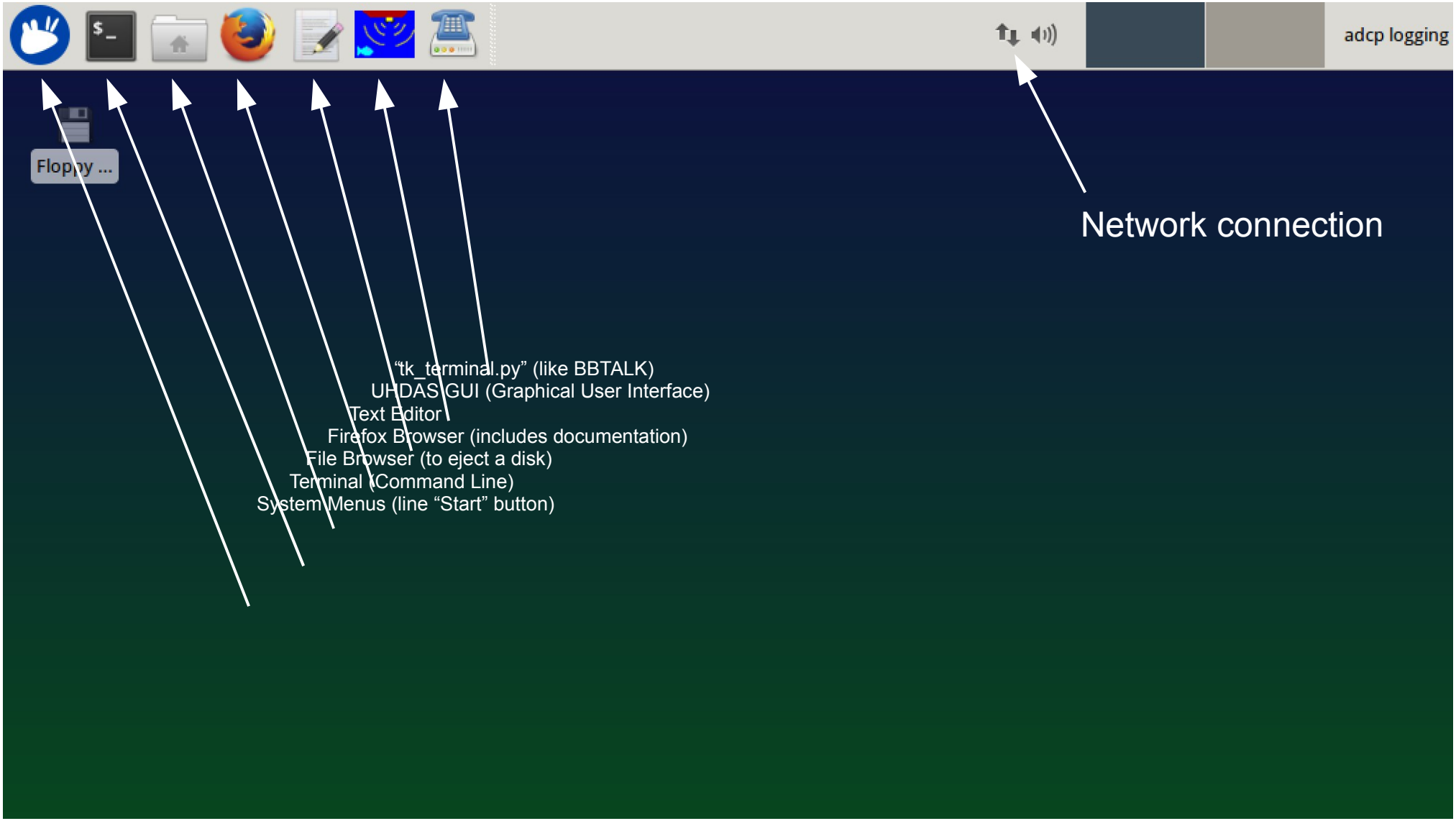
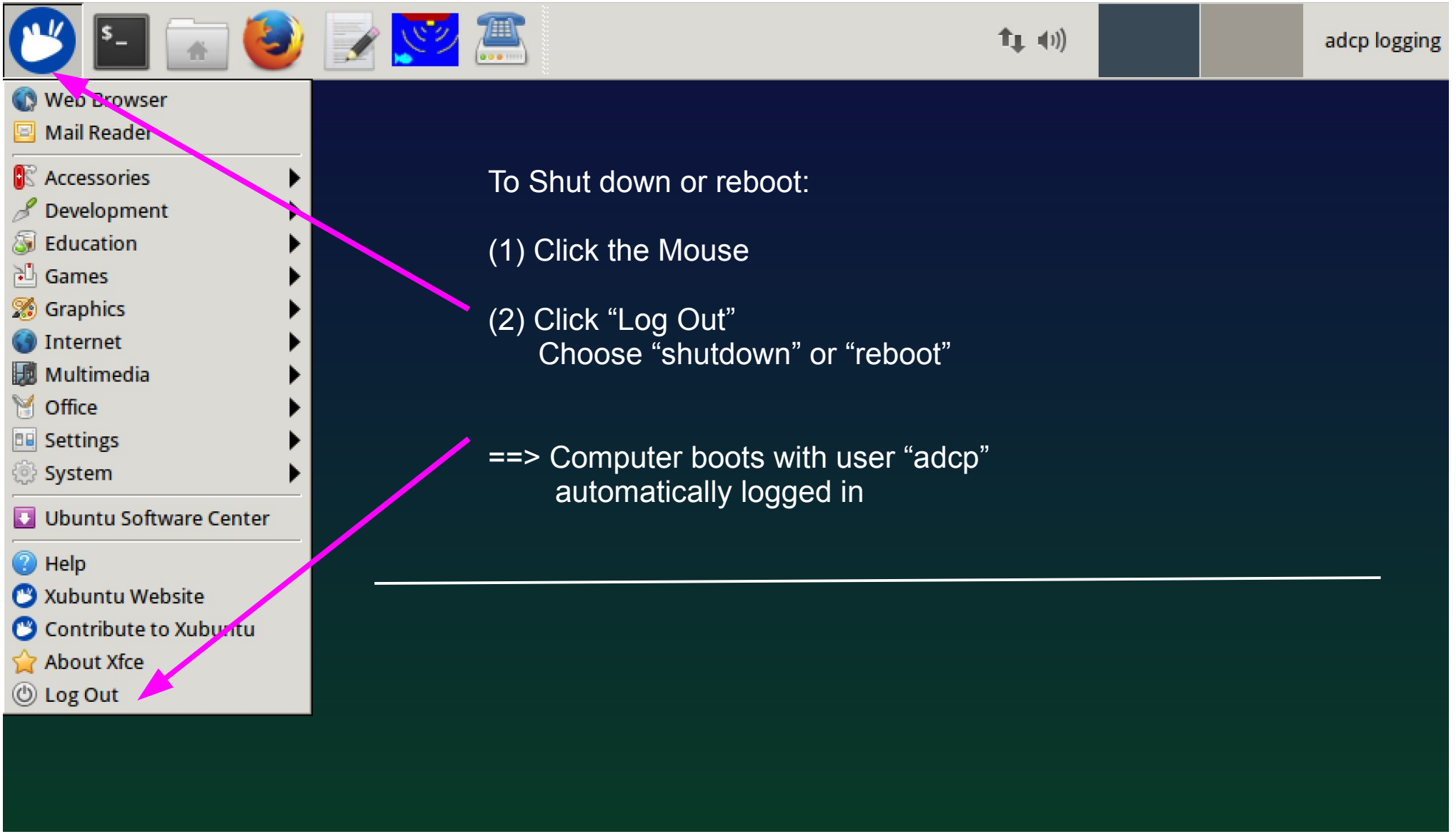
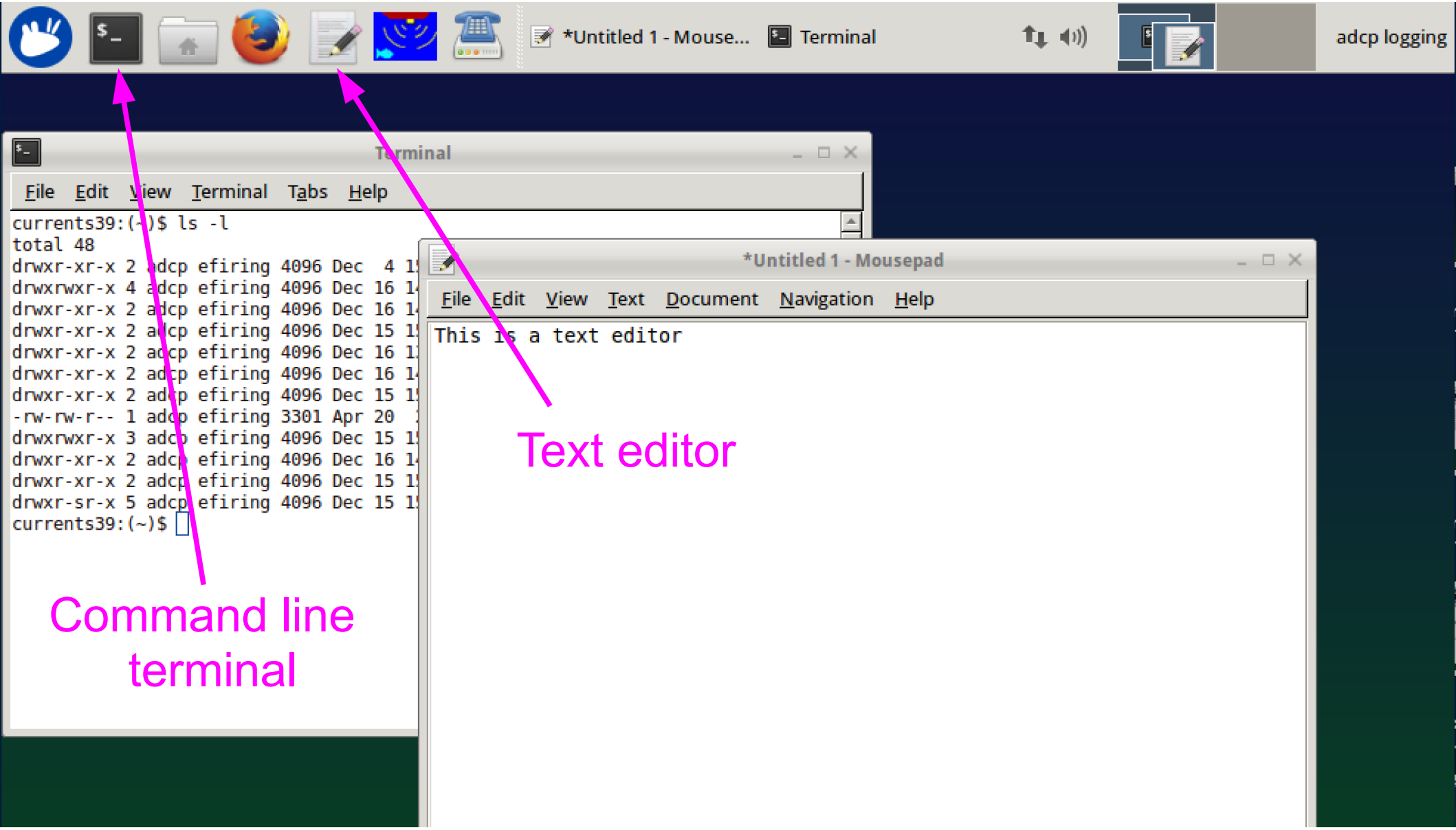
# UHDAS computer intro: Desktop



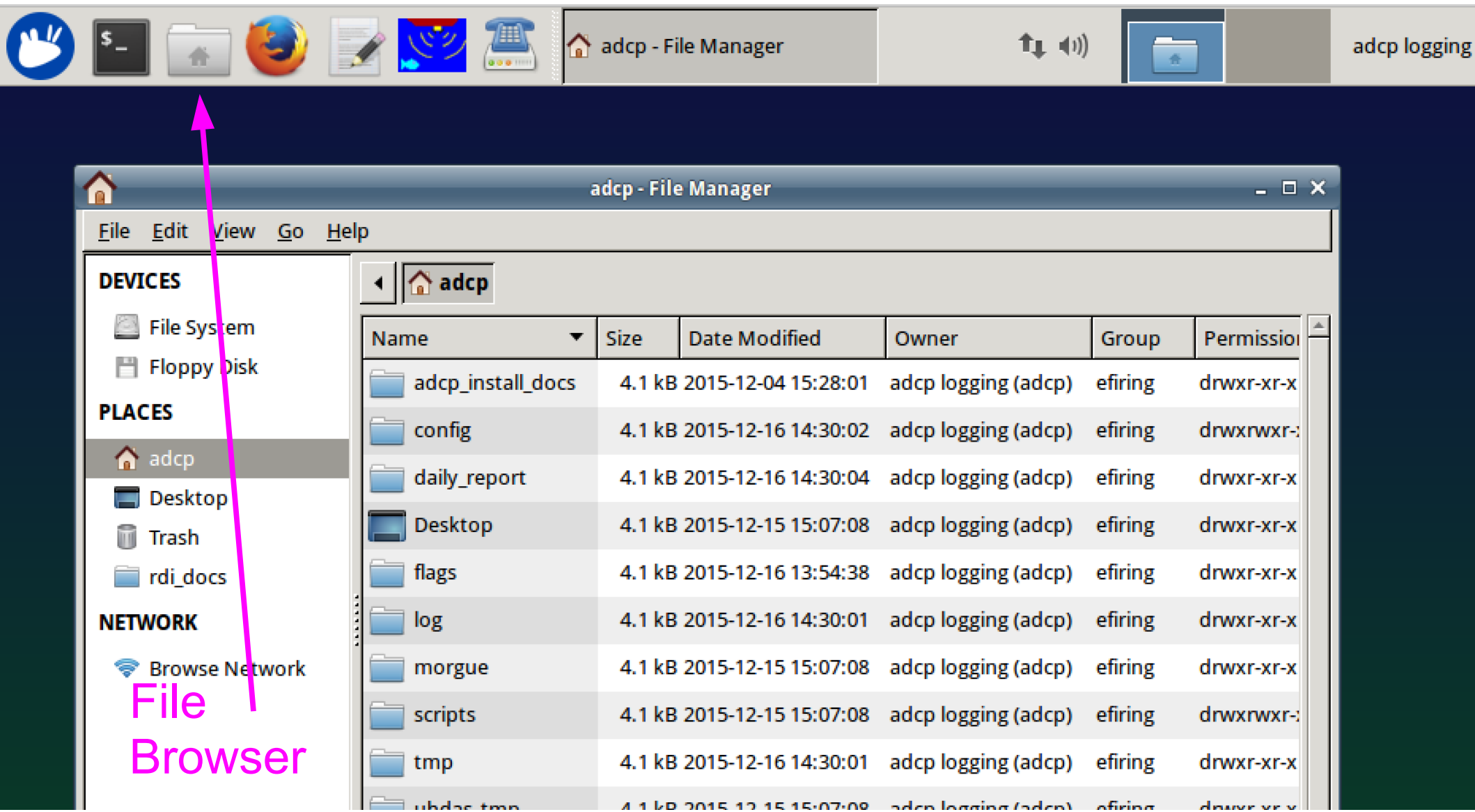
# UHDAS computer intro: Shutdown



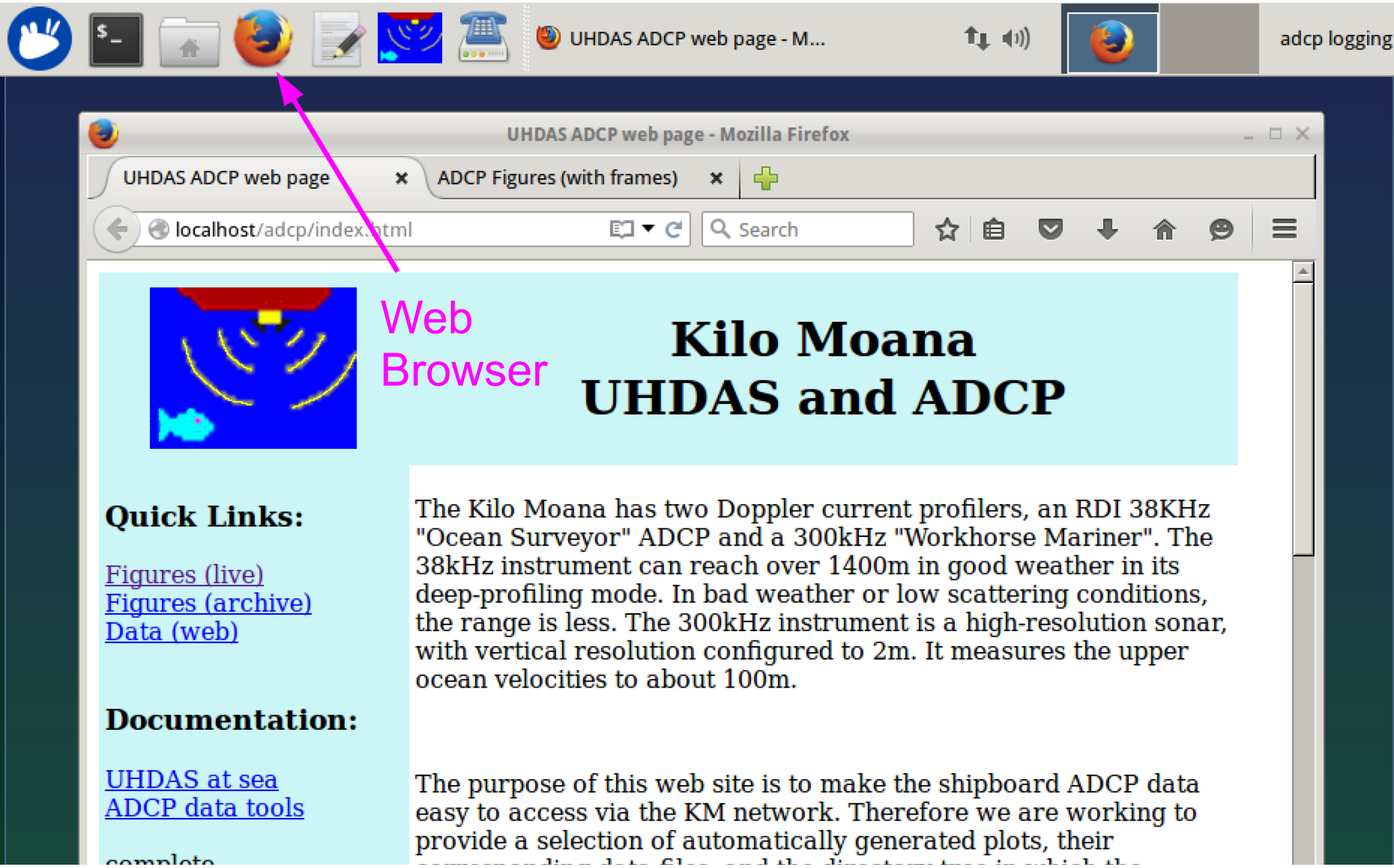
# UHDAS computer intro: Command-line terminal and text editor



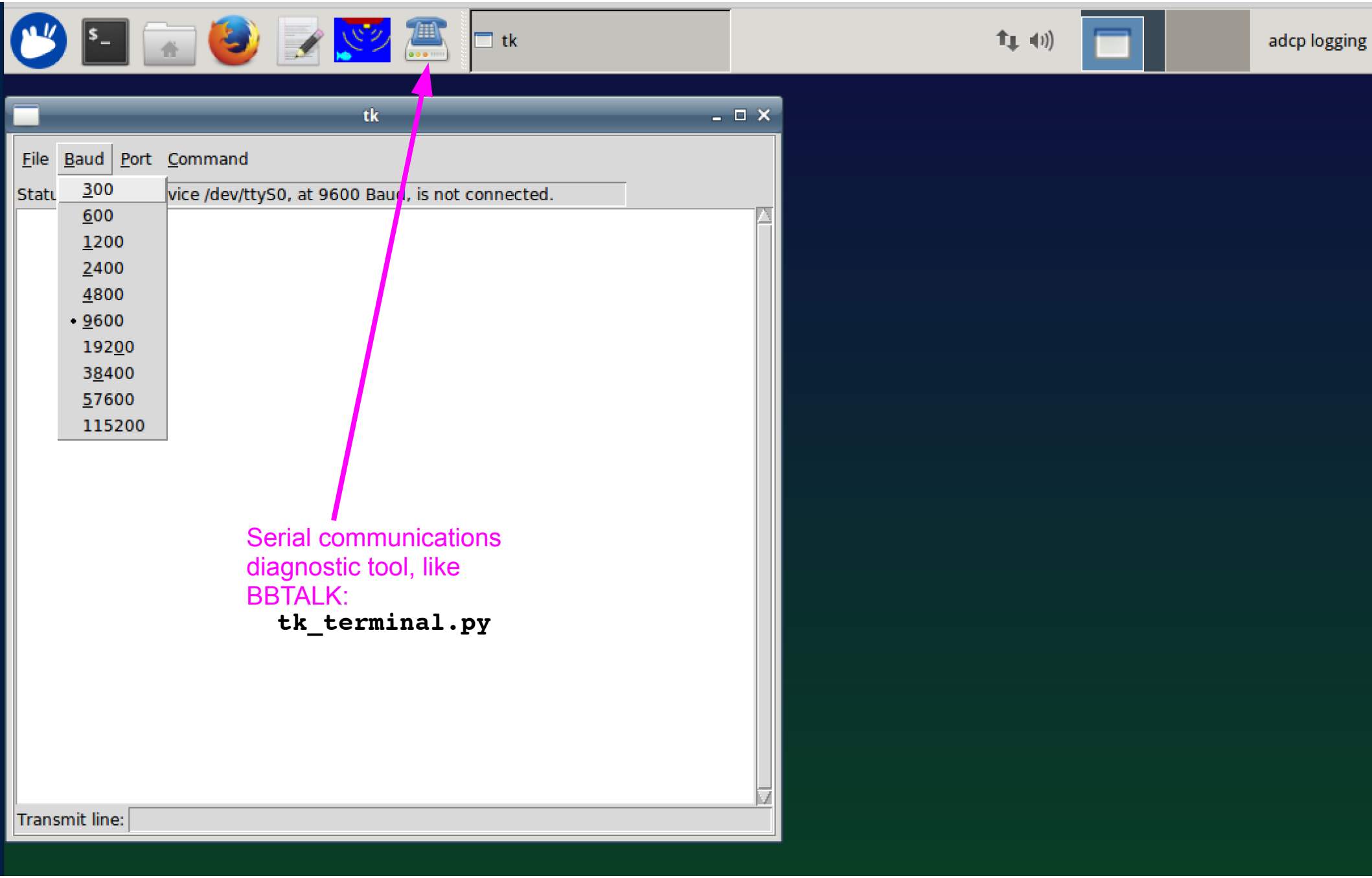
# UHDAS computer intro: File Browser



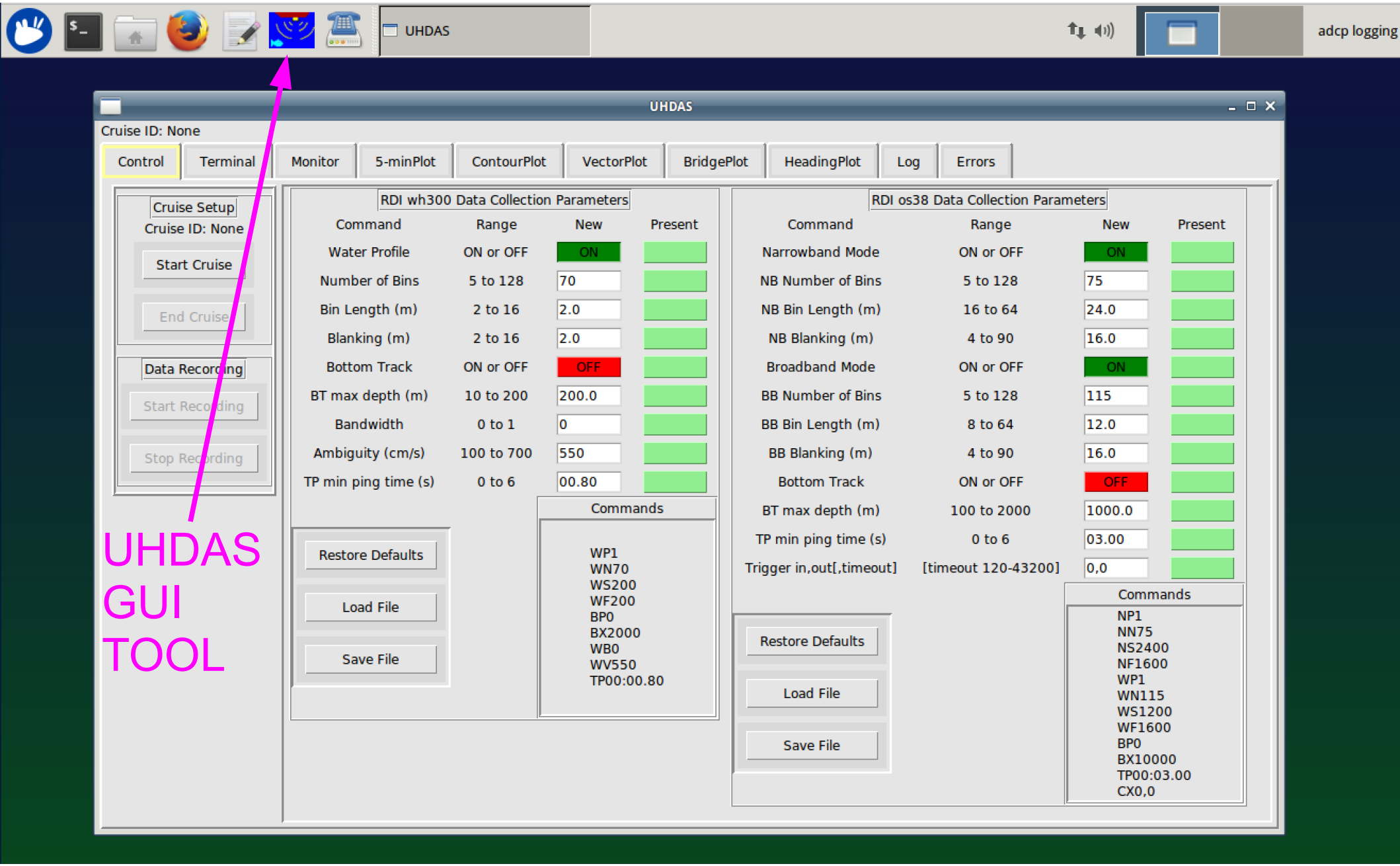
# UHDAS computer intro: Web Browser



# UHDAS computer intro: “Terminal emulator”



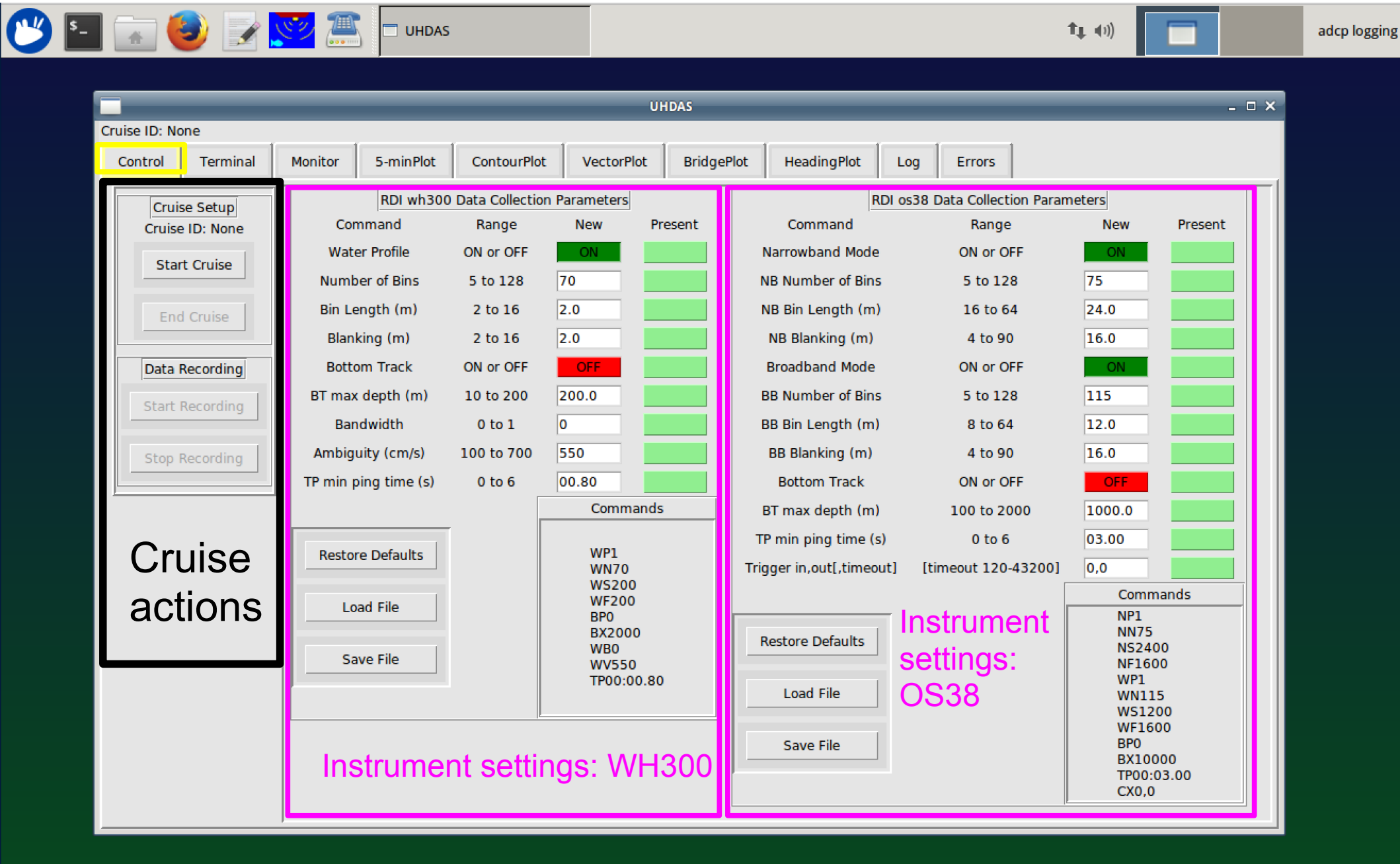
# UHDAS computer intro: UHDAS GUI



# Part II: UHDAS

- (1) UHDAS: What it does
  - at-sea “CODAS” processing
  - overview
- (2) Operational Introduction
  - computer
  - UHDAS GUI (Graphical User Interface)
- (3) Monitoring
  - at sea
  - on land
- (4) What can be changed

# Running UHDAS GUI



# Cruise Sequence (for operator)

- Start UHDAS GUI
- Start cruise
- Start logging

- Cruise data goes in **`/home/data/CRUISEID`**:
  - **`raw`**
  - **`rbin`**
  - **`gbin`**
  - **`proc`**
  - **`reports`**

# UHDAS cruise directory structure

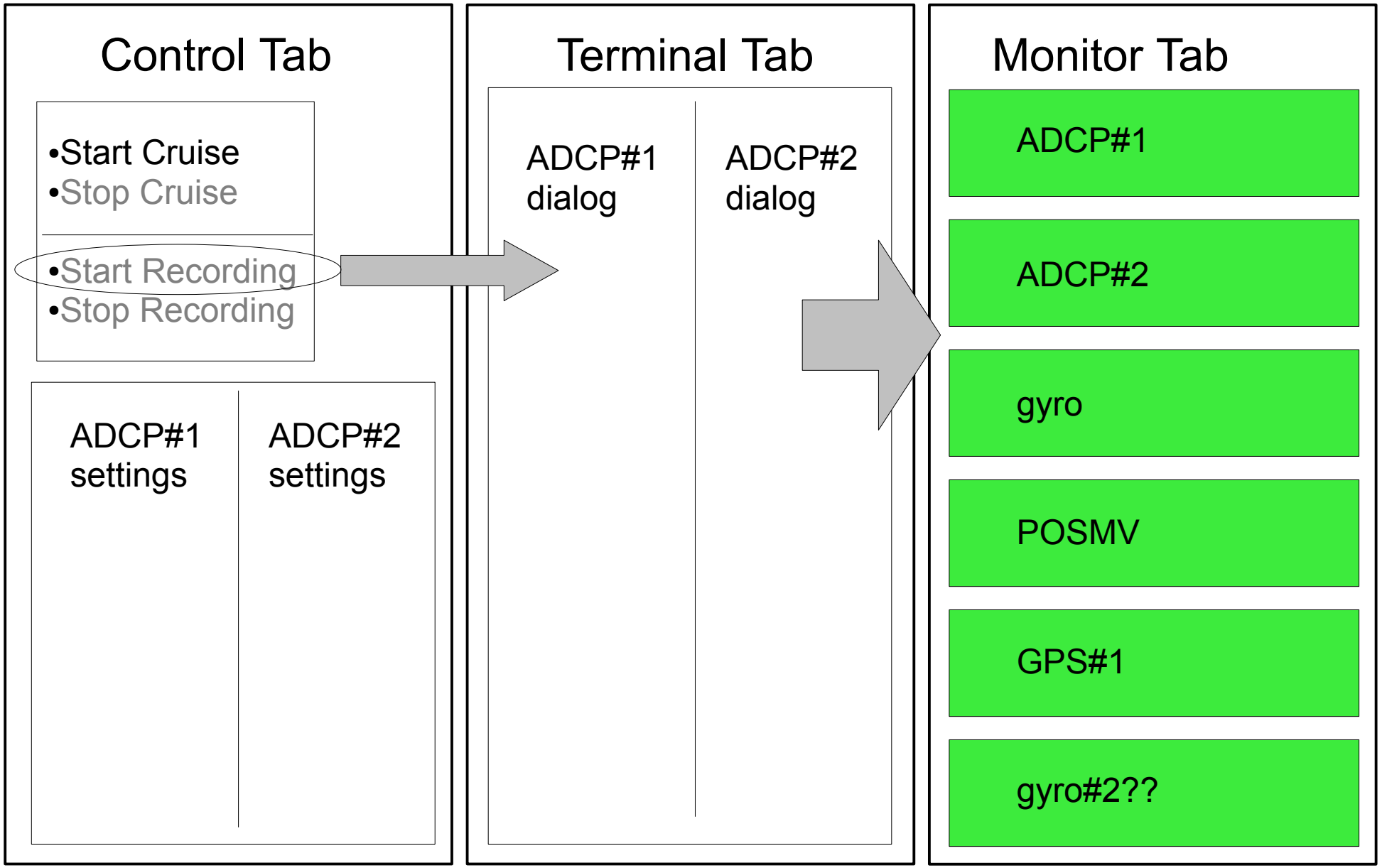
Data for scientists:

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<br>◦ 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<br>◦ codas database<br>◦ underway figure archive<br>◦ matlab files | final product | science CDs after cruise |
| **reports** | collection of diagnostics | nice to have | |

# Running UHDAS (the UHDAS GUI tool)

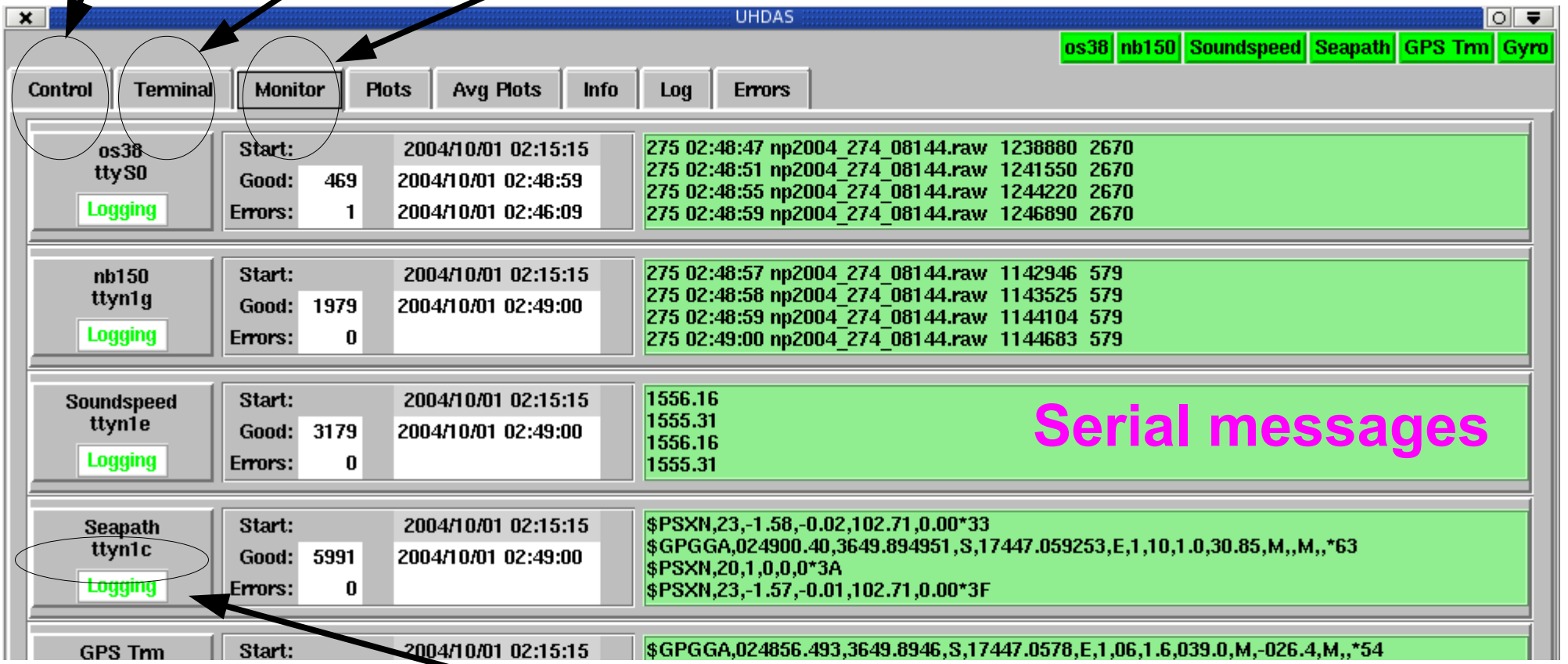


# UHDAS data logging: Green is Good

Control Tab

Terminal Tab

Monitor Tab




Serial device name, eg. ttyUSB3

# Cruise Sequence (for operator)

- ...[cruise occurs]

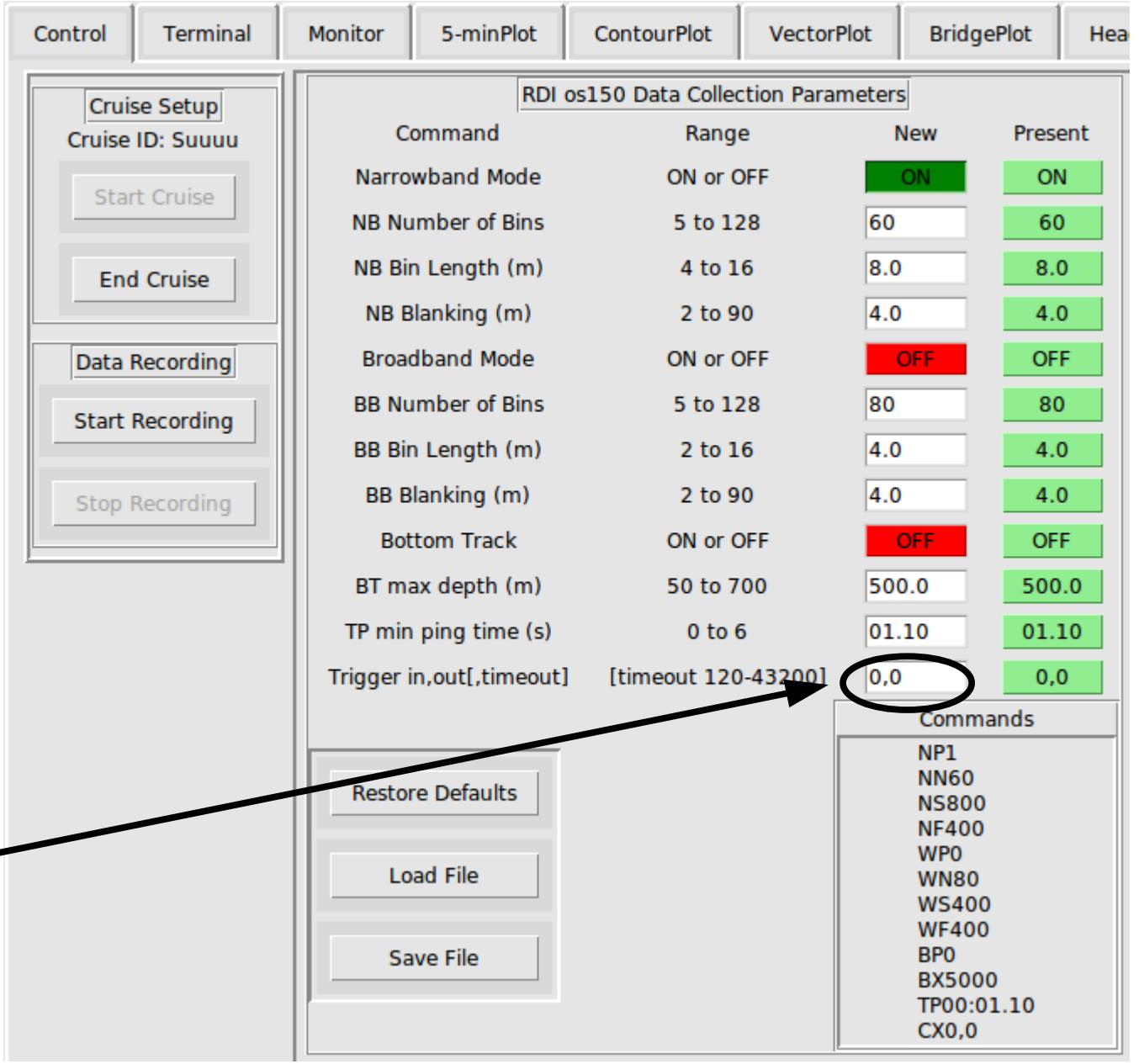
- may change settings:
  - Bottom track On/Off
  - Triggering On/Off

# Autonomous Pinging (no trigger)

- Stop Recording
- (change settings)
- Start Recording

No trigger in
No trigger out

(0,0)

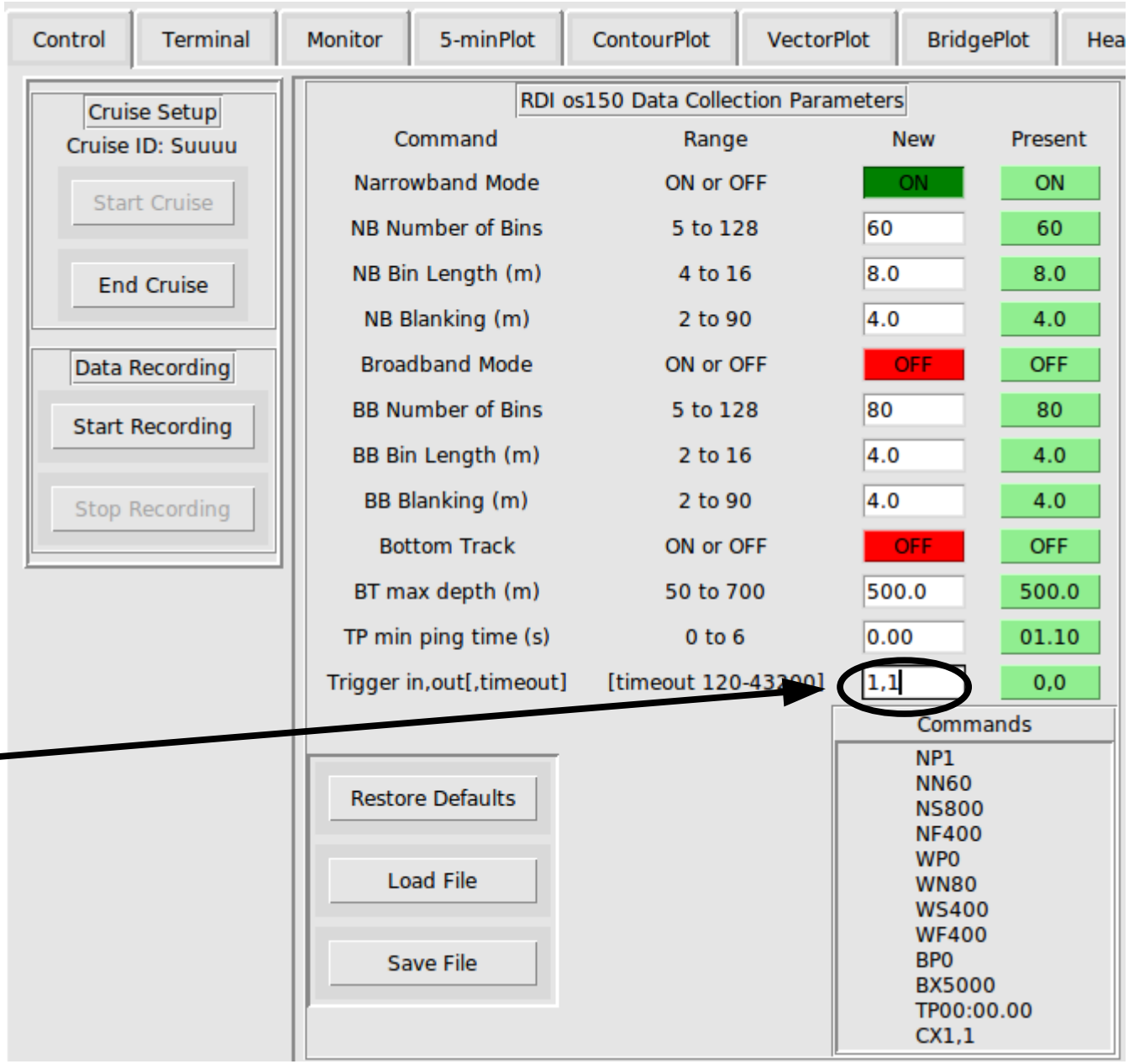


# Trigger in, Trigger out (i.e. response)

- Stop Recording
- (change settings)
- Start Recording

Yes trigger in
Yes trigger out

(1,1)

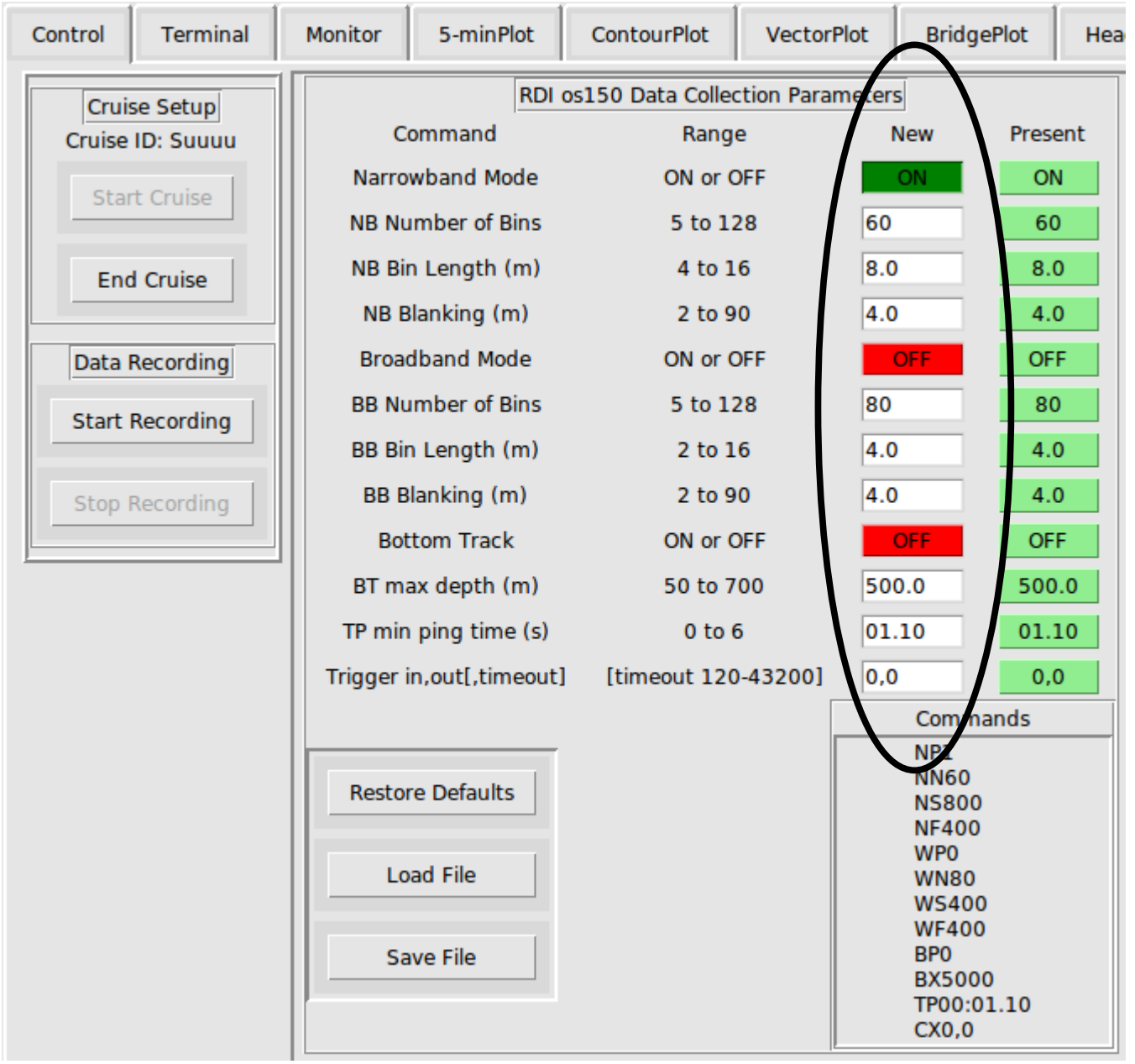


# Other settings for ADCPs

- Stop Recording
- (change settings)
- Start Recording

- Toggle modes
  - broadband
  - narrowband
  - bottomtrack

- shorter bins = shallower range (increase #bins)



# Cruise Sequence (for operator)

- ...[cruise occurs]

- Stop recording (logging)
- End Cruise

- Back up /home/data/CRUISEID

# Part II: UHDAS

- UHDAS: What it does
  - at-sea “CODAS” processing
  - overview
- Operational Introduction
  - computer
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- Monitoring
  - at sea
  - on land
- What can be changed

# UHDAS: Monitoring

## Monitoring...

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

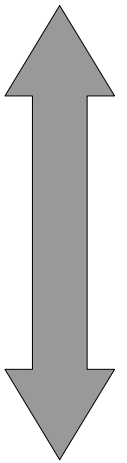
# Monitoring: At Sea

There are three categories of monitoring:

(1) data acquisition

(2) health of components (heading)

(3) CODAS Processing



Least refined

Most refined

Example at-sea web site

# Monitoring: At Sea

There are three categories of monitoring:

(1) data acquisition (UHDAS GUI only)

(2) health of components (heading)

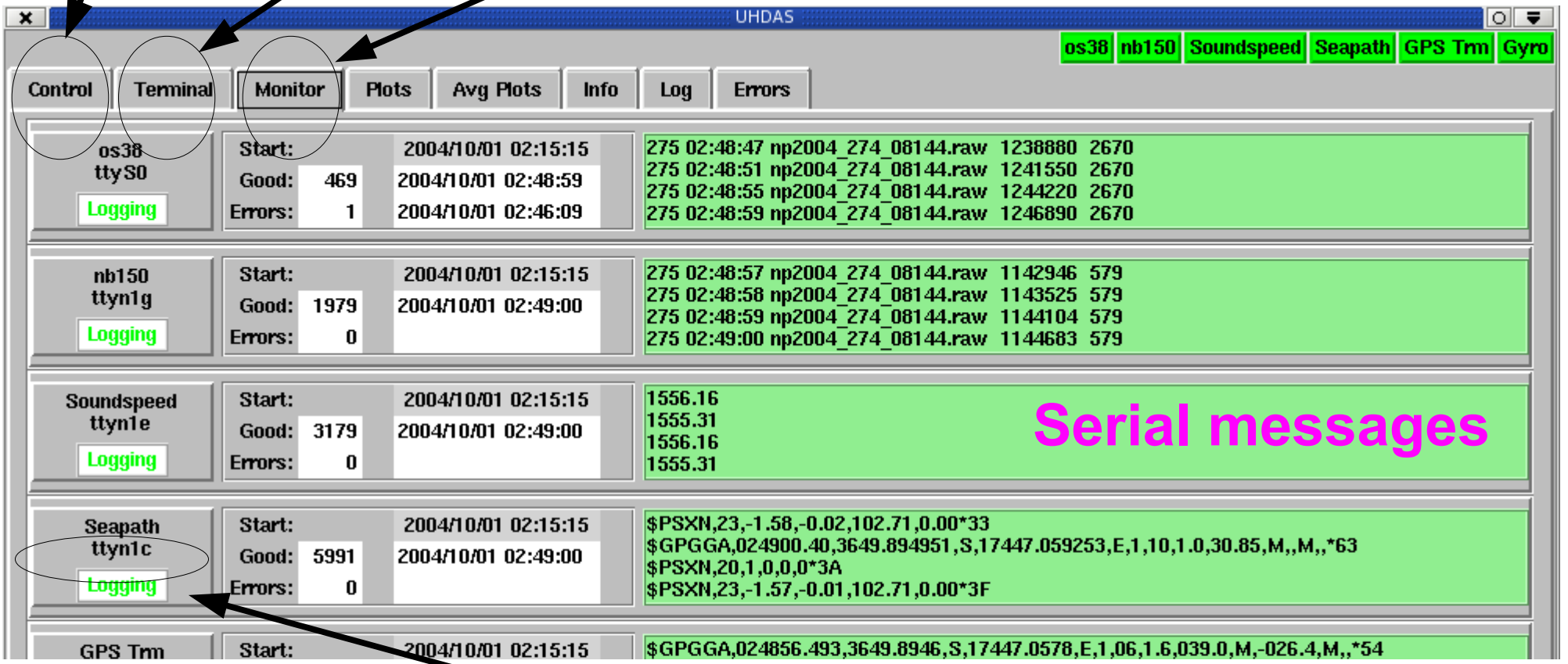
(3) CODAS Processing

# UHDAS data logging: Green is Good

Control Tab

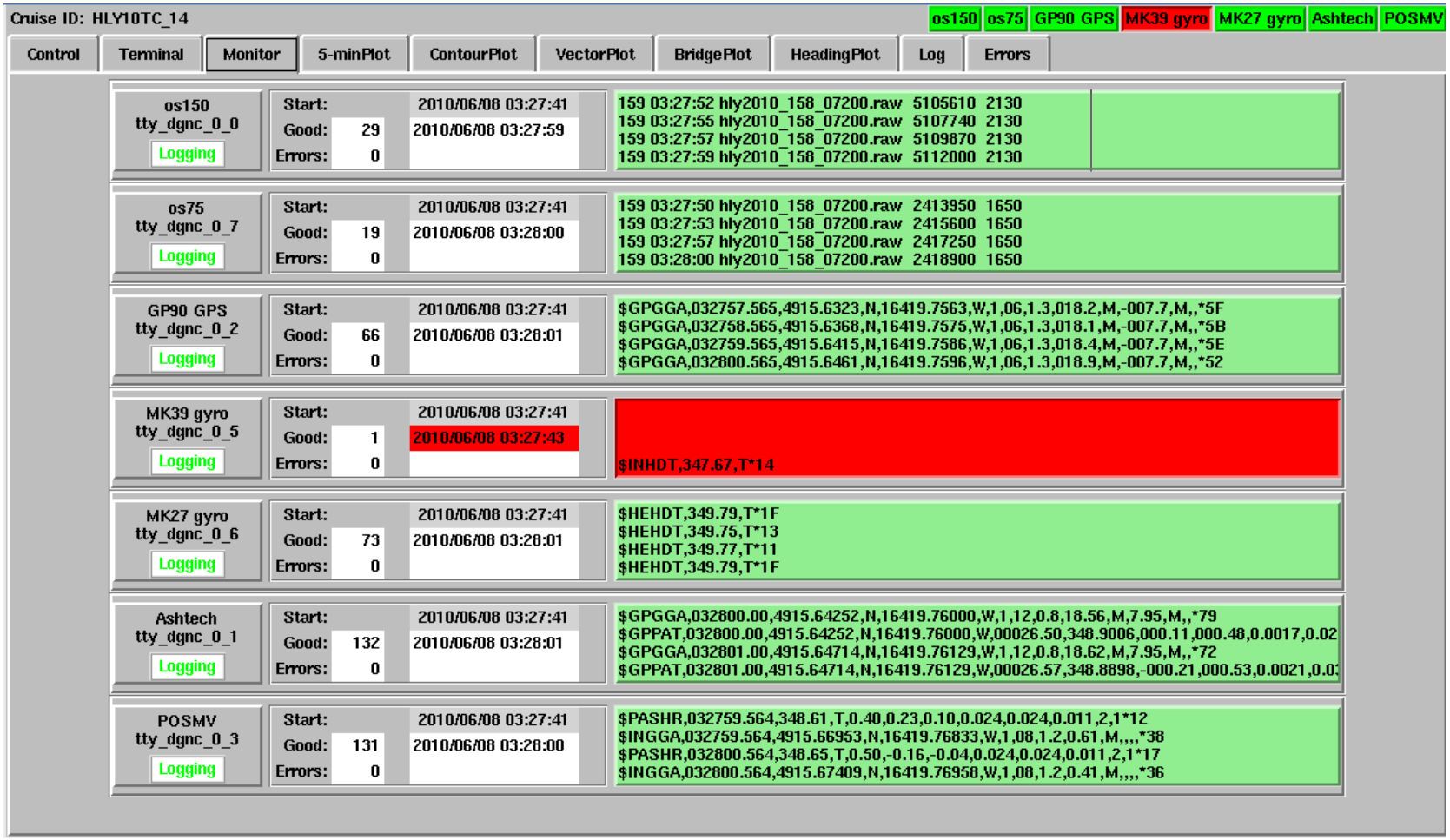
Terminal Tab

Monitor Tab




Serial device name, eg. ttyUSB3

# Monitoring At Sea: data Acquisition




Solution: Verify the source has the right messages and baud rate,
Plug back into USB-serial box.

If it the ADCP, check that it has power, then **Stop recording**,
**Start recording**

# UHDAS serial data flow

- Positions come in a serial port
- Positions are split via an internal data stream
  so we can monitor them continually
- The mechanism is called “ZMQ”
- It is newly-added and not well
  documented for UHDAS … yet...

## Linux serial port names

- start with ZERO
- always start with letters “tty”
- always named **`/dev/ttyXXX`**
- named during the boot process
  or discovered on hot-plug
- find out if the serial ports are there:

```
ls -ltr /dev/ttyUSB*
```

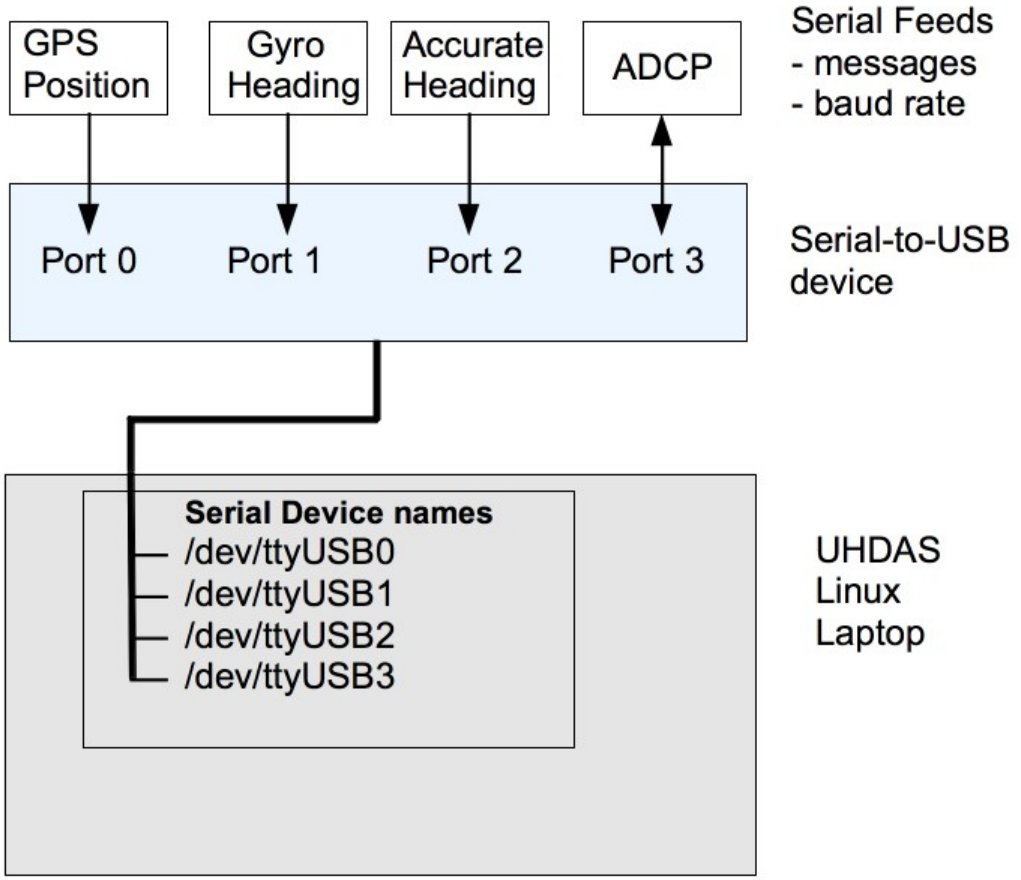
```
crw-rw---- 1 root dialout 188, 4 Nov 10 17:53 /dev/ttyUSB4
crw-rw---- 1 root dialout 188, 5 Nov 10 17:53 /dev/ttyUSB5
crw-rw---- 1 root dialout 188, 0 Nov 10 17:53 /dev/ttyUSB0
crw-rw---- 1 root dialout 188, 6 Nov 10 17:53 /dev/ttyUSB6
crw-rw---- 1 root dialout 188, 1 Nov 10 17:53 /dev/ttyUSB1
crw-rw---- 1 root dialout 188, 2 Nov 10 17:53 /dev/ttyUSB2
crw-rw---- 1 root dialout 188, 3 Nov 20 02:21 /dev/ttyUSB3
crw-rw---- 1 root dialout 188, 7 Nov 20 02:21 /dev/ttyUSB7
```

## UHDAS and serial data

Kill UHDAS GUI tool before:

- using another serial tool like
  **`tk_terminal.py`**
- unplugging the USB-serial device
- making any changes to
  **`sensor_cfg.py`**

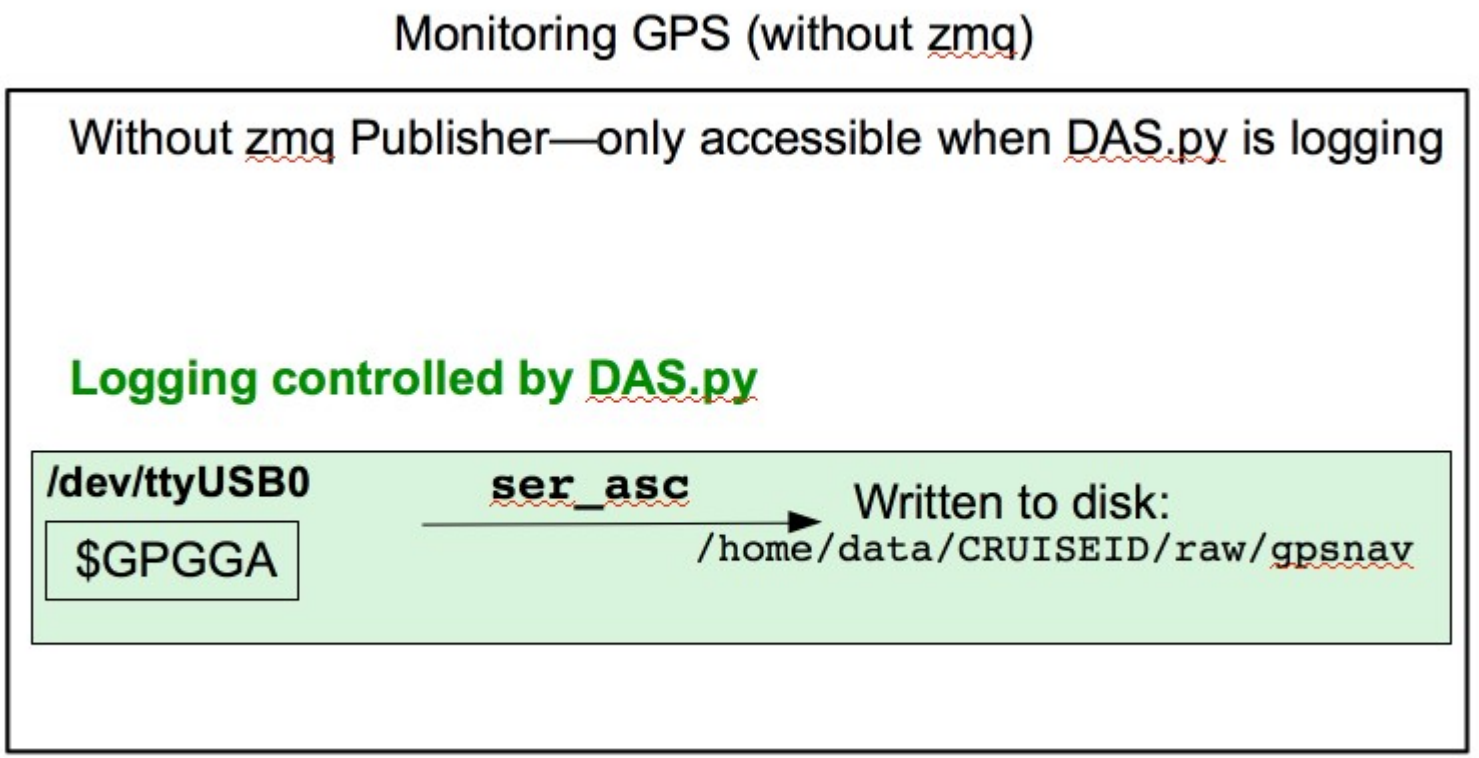
Serial logging: Physical layout and serial devices



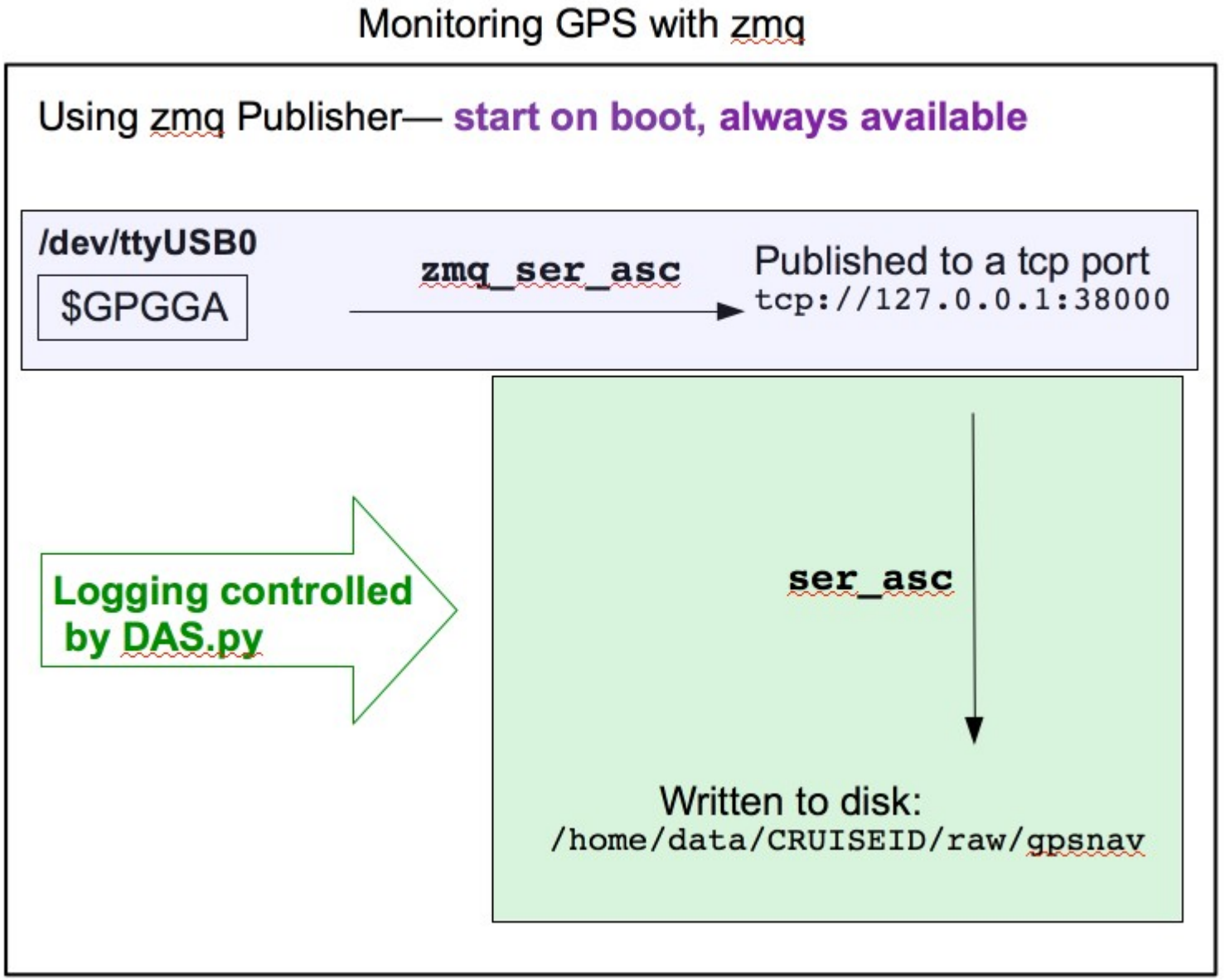

- Serial device names are determined by the type of serial hardware
- Serial feed : Physically plugging a serial instrument into a plug
- Serial Logging: Software talking to the serial ports must know
  - device name
  - baud rate
  - messages to expect

Serial port setup for UHDAS is done in
**`/home/adcp/config/sensor_cfg.py`**

# Serial GPS data flow



# Serial GPS data flow



# Monitoring: At Sea

There are three categories of monitoring:

(1) data acquisition

(2) health of components (heading)

(3) CODAS Processing

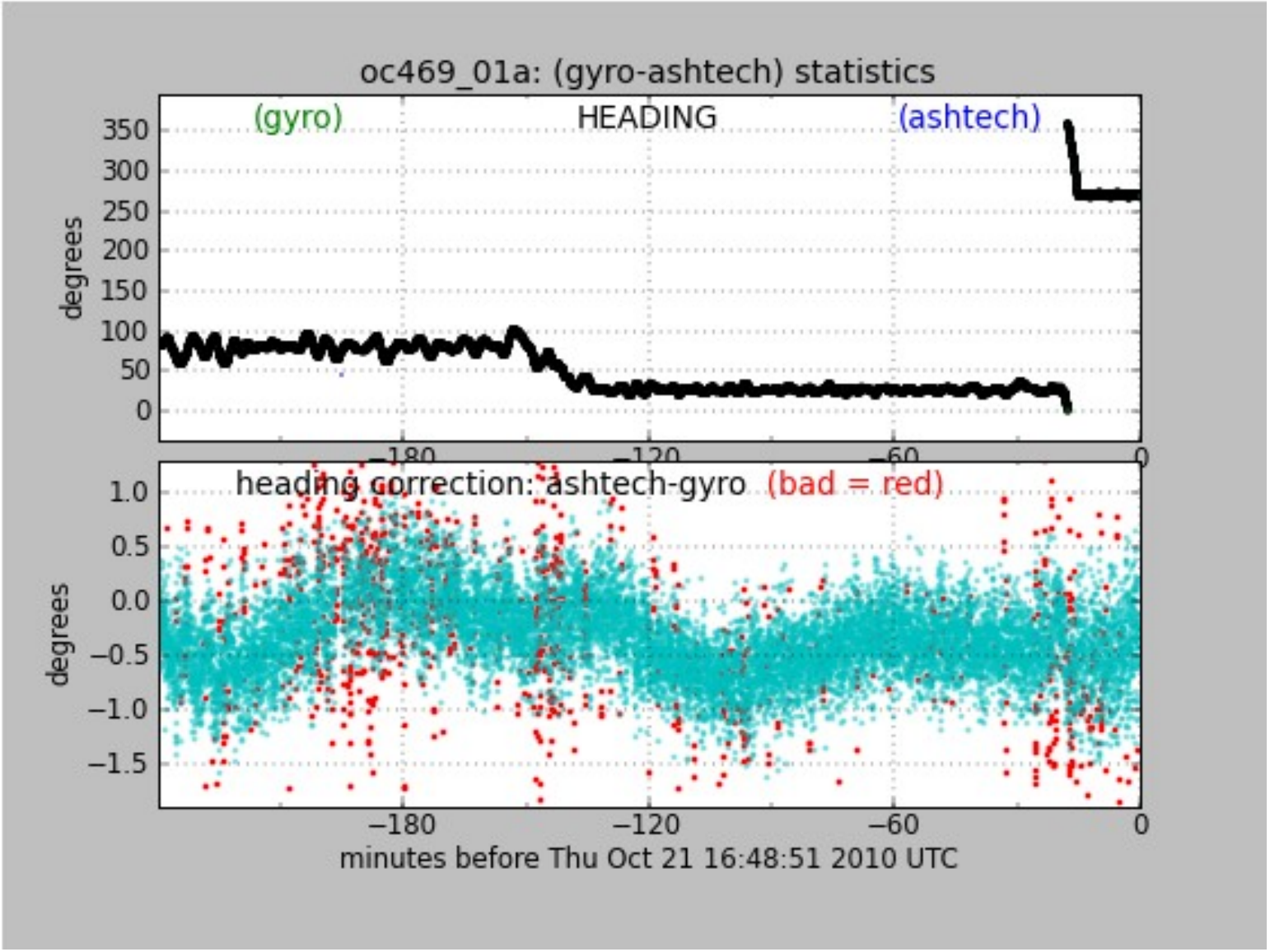
# Monitoring Heading Quality

- Heading is required to convert beam to earth coordinates and get ocean velocity
- **A 1-degree error in heading is a 10cm/s error in ocean velocity (cross-track), which is about 1/2 the open ocean signal**
- Incorrect  transducer angle must be fixed (ADCP calibrated) when re-installed
- heading or transducer angle errors will result in errors in ocean velocity, sometimes subtle

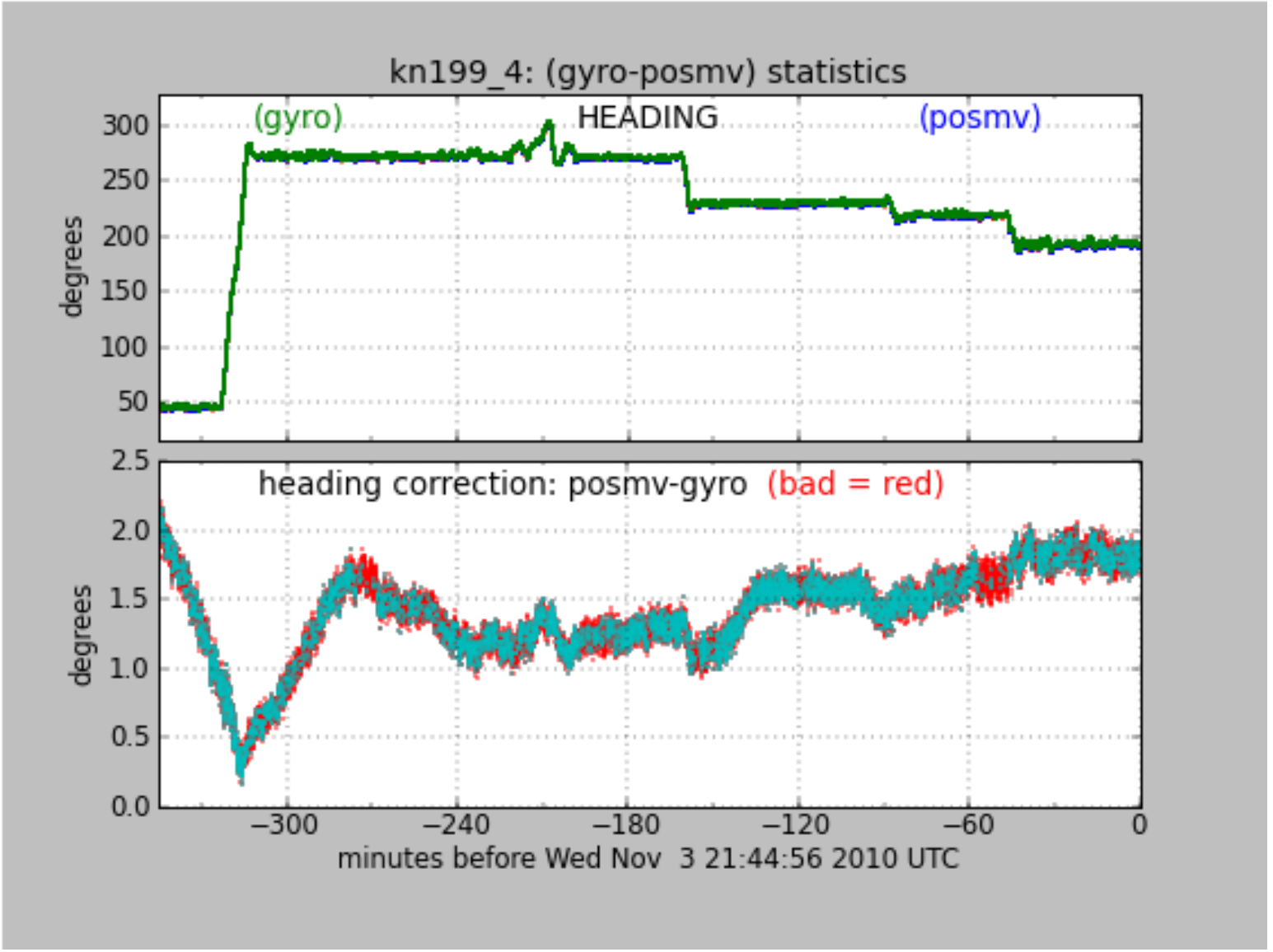
# Attitude Health

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

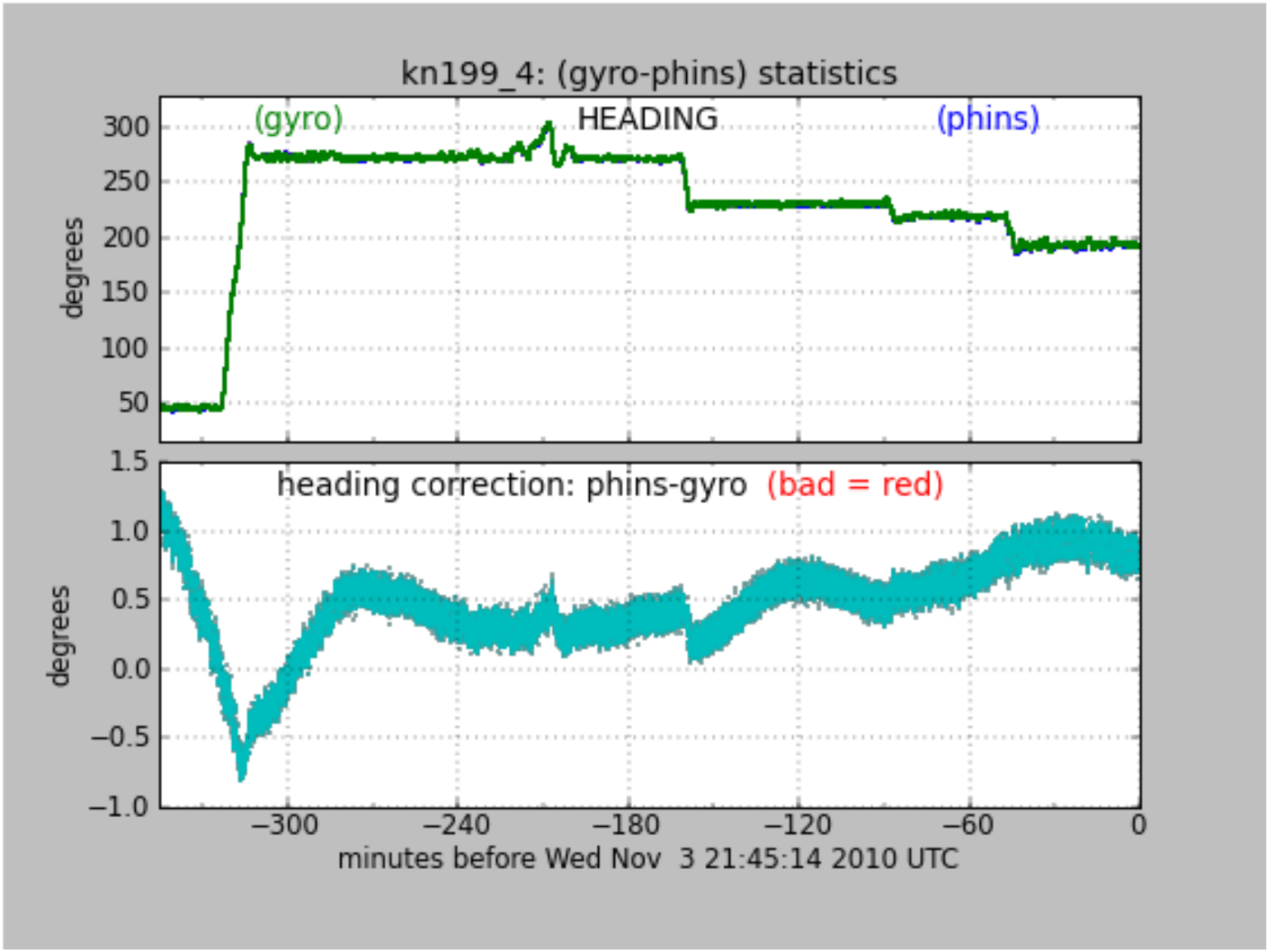
# Ashtech


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

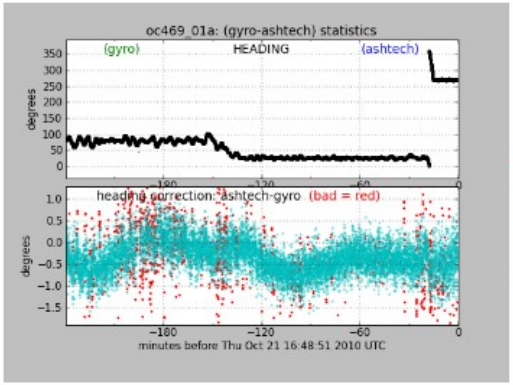

kn199_4: (gyro-posmv) statistics
(gyro)
HEADING
(posmv)
degrees
300
250
200
150
100
50
heading correction: posmv-gyro (bad = red)
degrees
2.5
2.0
1.5
1.0
0.5
0.0
−300
−240
−180
−120
−60
0
minutes before Wed Nov 3 21:44:56 2010 UTC

# Phins

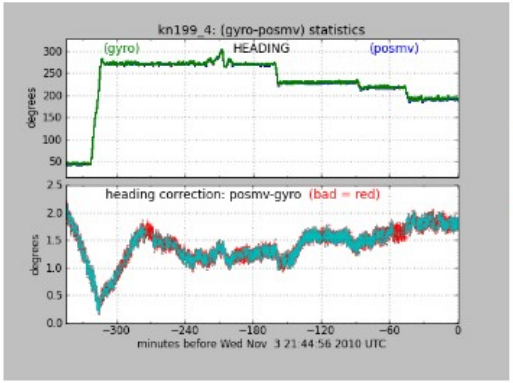

kn199_4: (gyro-phins) statistics
(gyro)
HEADING
(phins)
degrees
300
250
200
150
100
50
heading correction: phins-gyro (bad = red)
degrees
1.5
1.0
0.5
0.0
−0.5
−1.0
−300
−240
−180
−120
−60
0
minutes before Wed Nov 3 21:45:14 2010 UTC

# Accurate heading device: examples

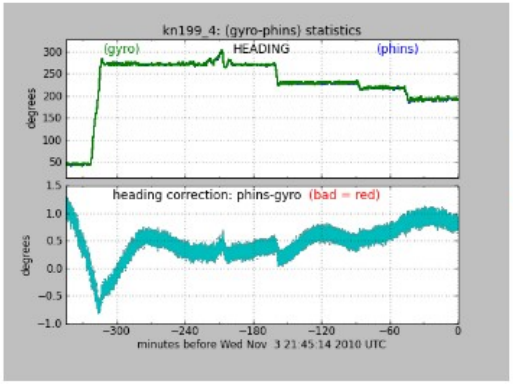
Statistics generated in daily email for three cases




```
==========================
------ 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
```

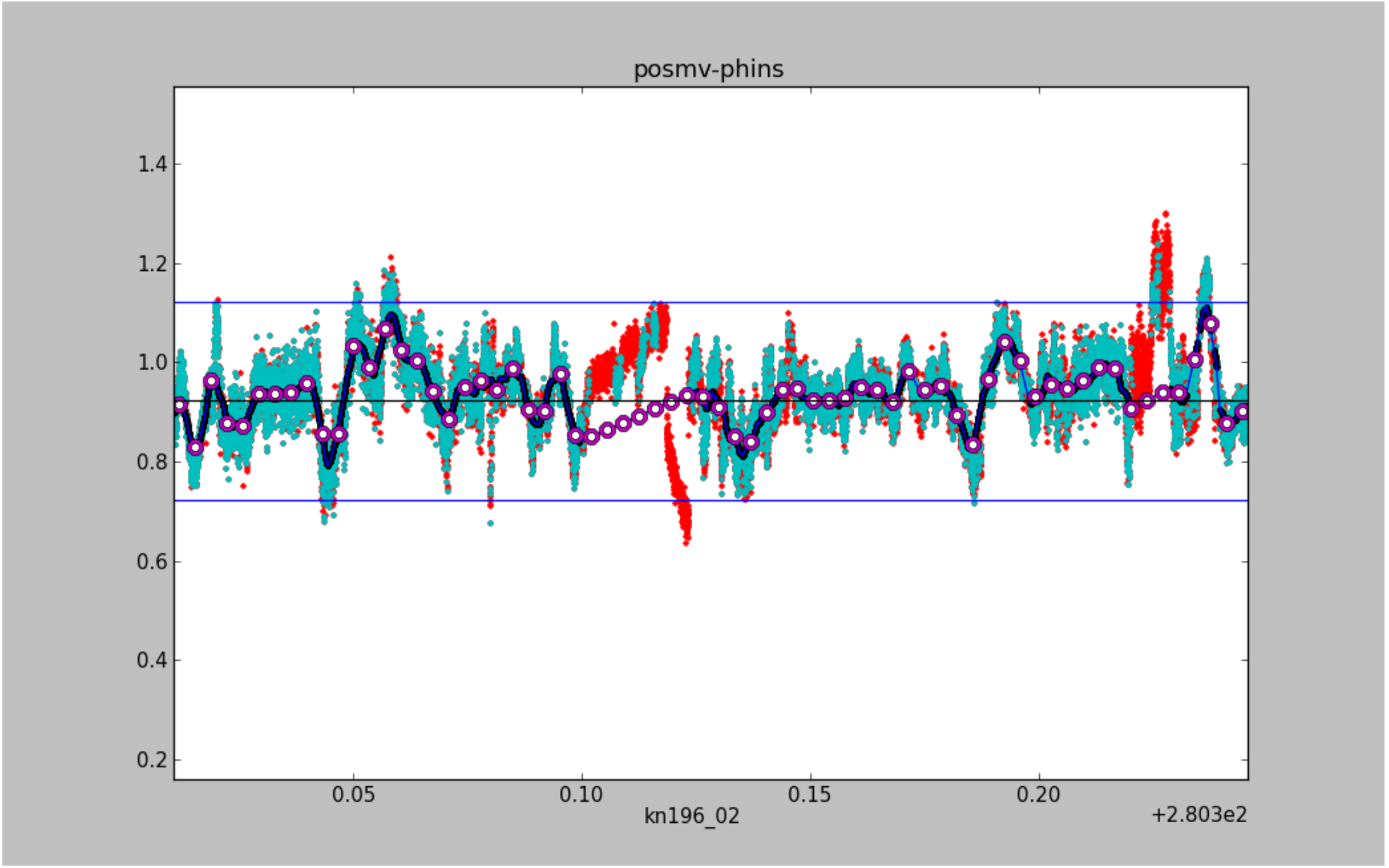



```
==========================
------ posmv statistics ------
==========================
posmv-gyro statistics (pycurrents)
ddrange: 305.8333642 to 306.8577969
(2010/11/02 20:00:03 to 2010/11/03 20:35:14)
number of good points: 182 out of 294 (62%)
min dh = 0.37,   max dh = 1.85
mean dh = 0.80
stddev 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

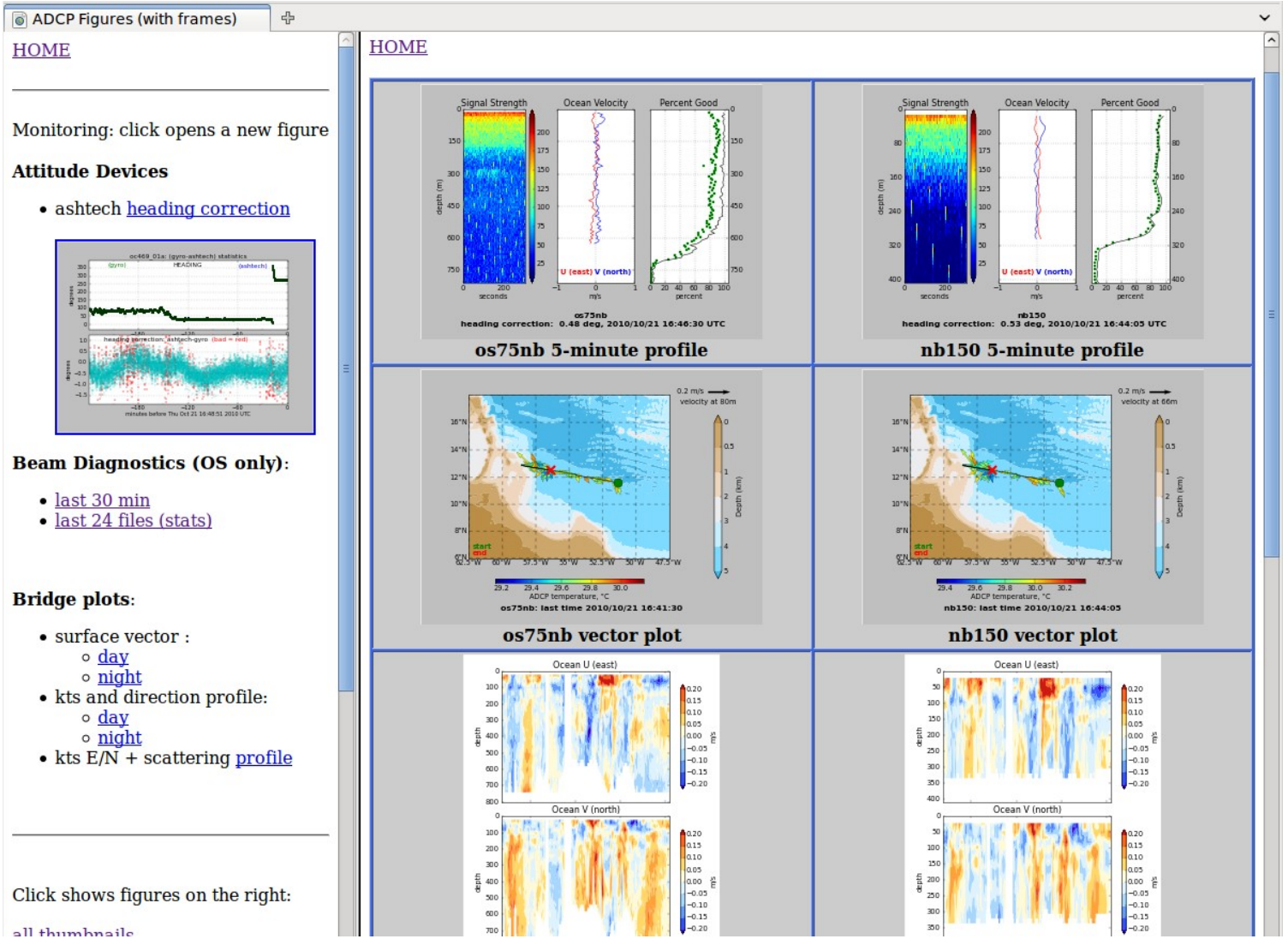
There are three categories of monitoring:

(1) data acquisition

(2) health of components (heading)

(3) CODAS Processing

# Monitoring At Sea: UHDAS web site



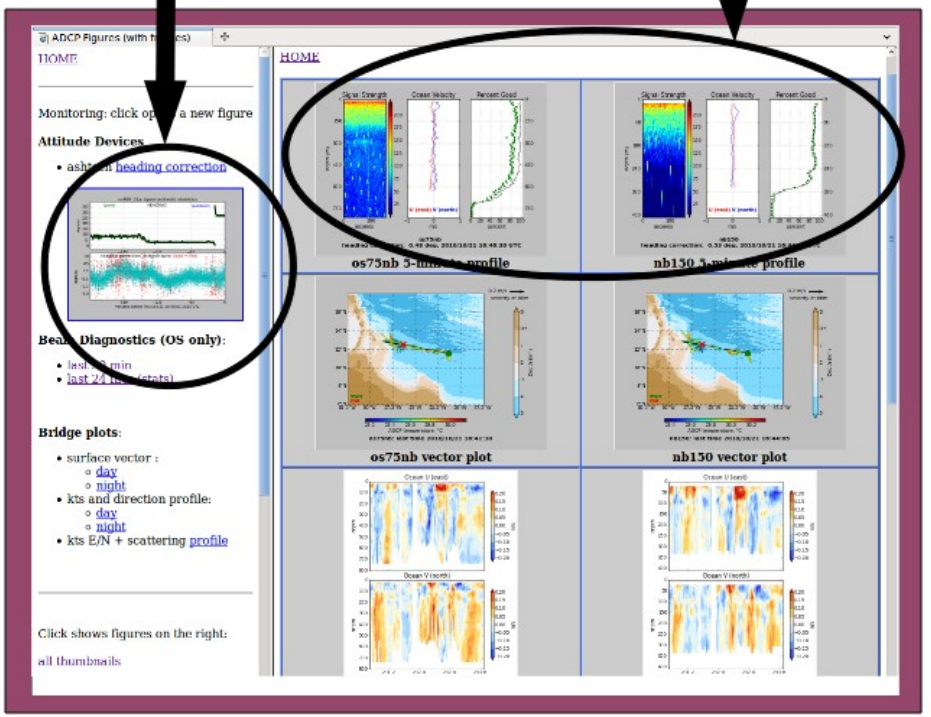

Example at-sea web site

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

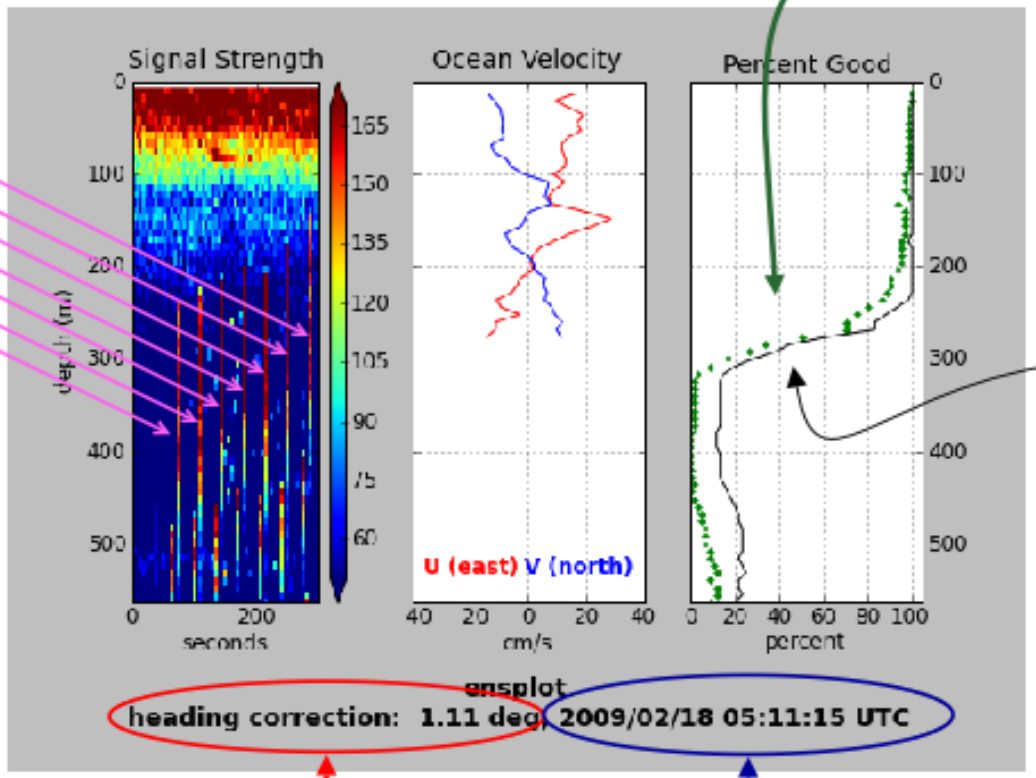
**Accurate Heading Device**

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)

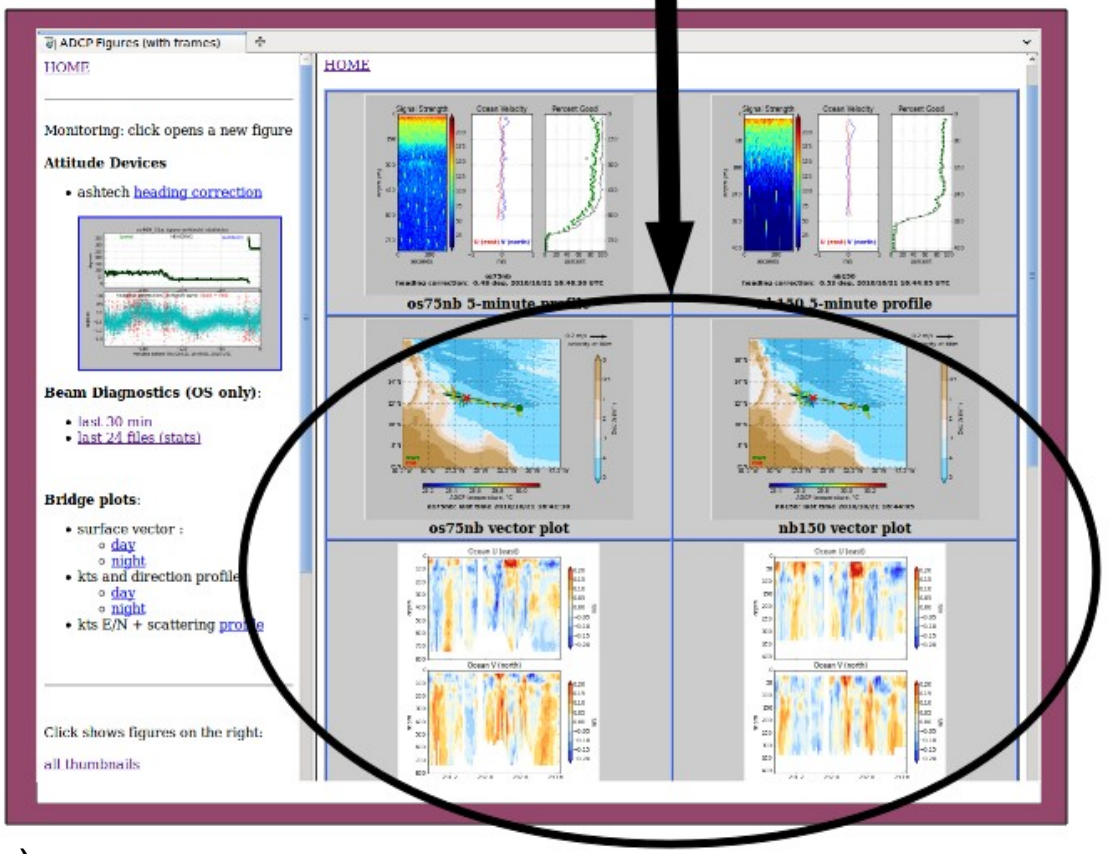
percent good before UHDAS editing

heading correction (ashtech - gyro)

UTC time of last sample

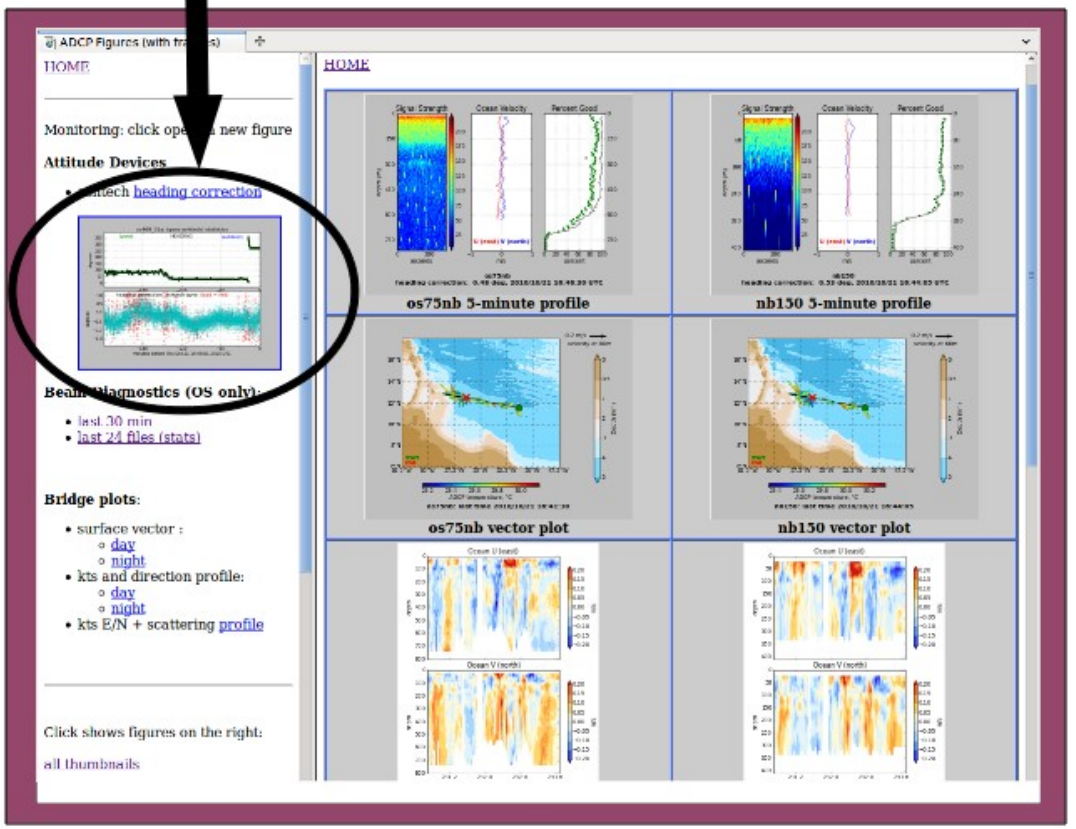
# Monitoring the 30-minute timer: Check: less than 1 hour old?

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.



# Part II: UHDAS

- UHDAS: What it does
  - at-sea “CODAS” processing
  - overview
- Operational Introduction
  - computer
  - UHDAS GUI
- Monitoring
  - at sea
  - on land
- What can be changed

# 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: Monitoring from shore

Link to on-shore monitoring: UHDAS ships

- daily email with attachment
- figures from data snippet (3 days)
- diagnostic files
  - 10 single pings from each instrument
  - calibration information
  - configuration files

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

Actual link

# UHDAS monitoring

screenshot

| letters | ship name | figures | last email | cruise name | status | daily report | daily email |
|---|---|---|---|---|---|---|---|
| ae | Atlantic Explorer | figs | 9hr | AE1531_A | logging | dir | email |
| ar | Neil Armstrong | figs | NA | NA | NA | dir | email |
| at | Atlantis | figs | 5d | (not set) | | dir | email |
| en | Endeavor | figs | 9hr | SerialGearTest2 | logging | dir | email |
| ex | Okeanos Explorer | figs | 73d | (not set) | | dir | email |
| fh | Ferdinand Hassler | figs | NA | NA | NA | dir | email |
| fk | Falkor | figs | 9hr | FK151121 | logging | dir | email |
| gu | Gordon Gunter | figs | NA | NA | NA | dir | email |
| hb | Henry Bigelow | figs | NA | NA | NA | dir | email |
| hi | Hi`ialakai | figs | 9hr | (not set) | | dir | email |
| hly | Healy | figs | 25d | (not set) | | dir | email |
| kk | Ka`imikai O Kanaloa | figs | 9hr | Post_kok1516 | logging | dir | email |
| km | Kilo Moana | figs | 9hr | km1520 | logging | dir | email |
| lg | L.M.Gould | figs | 9hr | LMG1510 | logging | dir | email |
| mgl | M.G.Langseth | figs | 301d | MGL1405 | (not logging) | dir | email |
| nf | Nancy Foster | figs | 9hr | (not set) | | dir | email |
| nh | New Horizon | figs | 223d | (not set) | | dir | email |
| np | N.B.Palmer | figs | 9hr | nbp1511 | logging | dir | email |
| oc | Oceanus | figs | 9hr | (not set) | | dir | email |
| olr | Oleander | figs | 3d | (not set) | | dir | email |
| pc | Pisces | figs | NA | NA | NA | dir | email |
| pe | Pelican | figs | 9hr | PE16_Trimm | logging | dir | email |
| ps | Point Sur | figs | 8d | (not set) | | dir | email |
| rb | Ron Brown | figs | 9hr | RB1507_TAO | logging | dir | email |
| rr | Roger Revelle | figs | 27d | (not set) | | dir | email |
| se | Sette | figs | 61d | (not set) | | dir | email |
| sh | Bell Shimada | figs | 9hr | (not set) | | dir | email |
| skq | Sikuliaq | figs | 10d | (not set) | | dir | email |
| sp | R.G.Sproul | figs | 6hr | SP1532 | (not logging) | dir | email |
| tt | Thomas G. Thompson | figs | 9hr | TN334 | logging | dir | email |
| ws | Walton Smith | figs | 9hr | (not set) | | dir | email |

# Monitoring: From Shore

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

**(1) Time**

**(2) logging status**

**(3) position**

**(4) heading quality**

**(5) bottom track**

**(6) timeserver**

**(7) ping rate**

```
2015/12/16 14:30:01
currents01en 3.13.0-24-generic

Current cruise: SerialGearTest3     ** is logging **
Database time ranges:
       wh300 2015/12/15  20:43:14 to 2015/12/16  14:25:13  (4 min. ago)

approximate lat, lon, depth:   41 35.22200 N   71 24.66500 W   depth=4
position from zmq


---- heading correction ----
(heading correction from "ashpaq2")
============================
------ ashpaq2 statistics ------
============================
ashpaq2-gyro statistics (comment=rangeslice, dday)

ddrange: 348.8619676 to 349.6017593
(2015/12/15 20:41:14 to 2015/12/16 14:26:32)
all ashpaq2 messages:  (99%)  were good

(300sec) ensemble heading corrections:
   212 out of 213   (100%) were good
statistics of good data:
   mean N = 297, stddev N =  18.8
   min  = -0.47, max = 0.95
   mean = 0.27, stddev = 0.26

---bottom track status--------
wh300: BT is off

---------- ntpq -p ------------
     remote           refid      st t when poll reach   delay   offset  jitter
==============================================================================
 192.168.1.2     .INIT.          16 u    - 1024    0    0.000    0.000   0.000

------------- pings per ensemble -----------
wh300 recent ping statistics

(2015/12/16 14:23:14) ens = 120 sec, 93 pings, (1.29 sec/ping)
```

**(8) Warnings follow at the bottom**

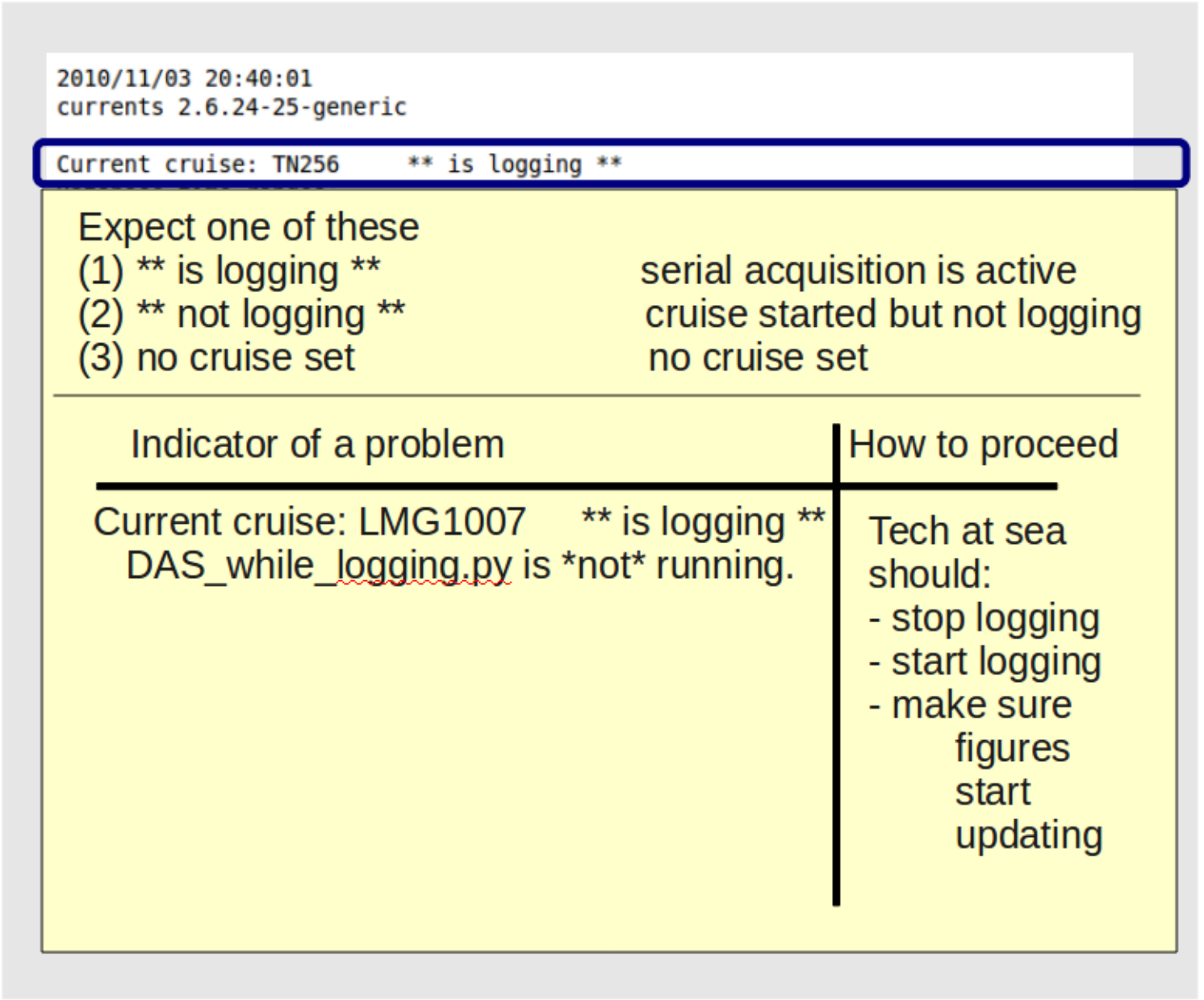
2010/11/03 20:40:01

(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:<br>- are they in port for a long time? (computer may be off)<br>- 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; |

# Cruise status: when to be worried

```
2015/12/15 14:30:01
currents1673 3.13.0-32-generic

no cruise set

approximate lat, lon, depth:   44 37.58190 N  124 2.83080 W   depth=-2
position from zmq
```

**No active cruise**
**Position from zmq**

```
2015/12/15 14:30:02
currents01en 3.13.0-24-generic

Current cruise: SerialGearTest2     ** is logging **
Database time ranges:
       wh300 2015/12/14  18:05:21 to 2015/12/15  14:17:21 (12 min. ago)

approximate lat, lon, depth:   41 35.22500 N   71 24.66300 W   depth=4
position from zmq
```

**Active cruise**
**Position from zmq**
**Recent database**

```
2015/12/15 14:30:01
currents 3.13.0-24-generic

Current cruise: Post_kok1516     ** is logging **
Database time ranges:
       wh300 2015/12/11  19:46:24 to 2015/12/11  23:54:24 (5195 min. ago)

approximate lat, lon, depth:   21 18.97391 N  157 53.17322 W   depth=-2
position from zmq
```

**Active cruise**
**Position from zmq**
**OLD database**

```
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

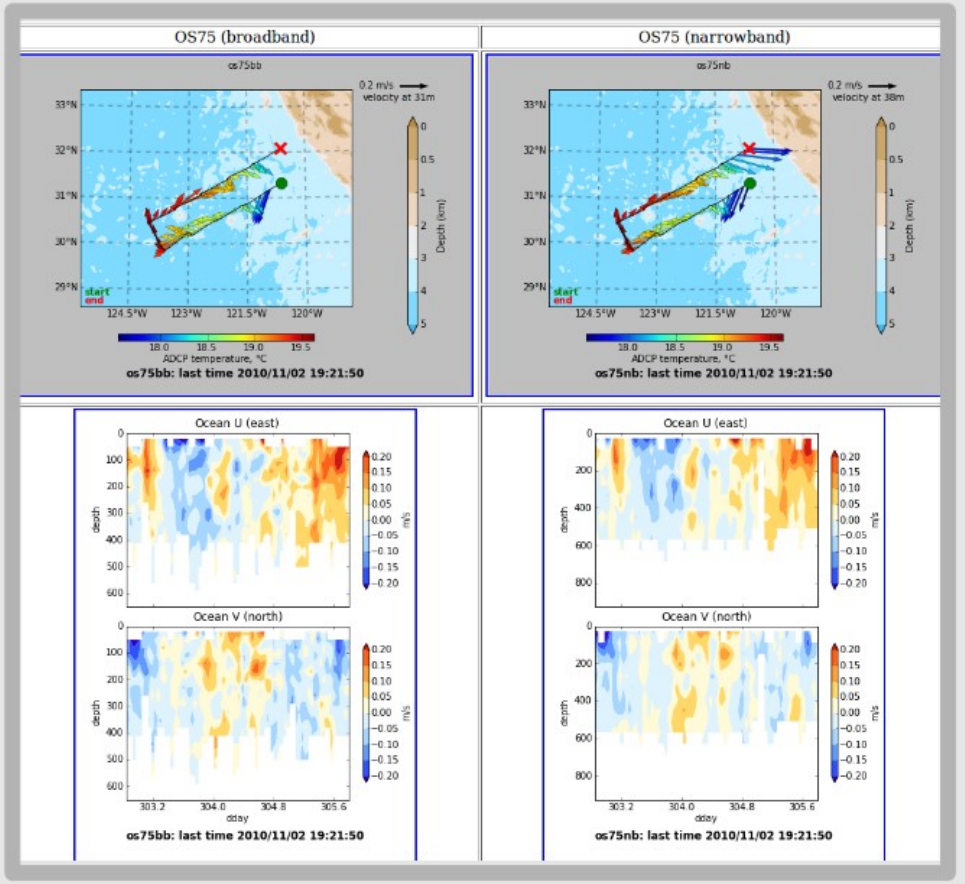
Problem: if numbers are all 0.000

```
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:
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/

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<br>◦ 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<br>◦ codas database<br>◦ underway figure archive<br>◦ 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)

# Example using tails.txt

## Email shows a problem:

(1) cruise is named

(2) UHDAS is logging

(3) database is old!

```
2015/12/15 14:30:01
currents 3.13.0-24-generic

Current cruise: Post_kok1516     ** is logging **
Database time ranges:
       wh300 2015/12/11  19:46:24 to 2015/12/11  23:54:24  (5195 min. ago)

approximate lat, lon, depth:   21 18.97391 N  157 53.17322 W   depth=-2
position from zmq
```

# Example using tails.txt

## Follow the link in the email:

```
---------- uptime ------------
 14:30:02 up 7 days, 20:10,  1 user,  load average: 0.14, 0.13, 0.14
==============================
figures:  http://currents.soest.hawaii.edu/uhdas_fromships/kok/figs/
daily report: http://currents.soest.hawaii.edu/uhdas_fromships/kok/daily_report/
```

Click
Opens directory
Click on **tails.txt**

| | | |
|---|---|---|
| sonar_summary.txt | 2015-12-15 04:30 | 154 |
| status_str.txt | 2015-12-15 04:30 | 2.8K |
| stderr.txt | 2015-12-15 04:30 | 1.5K |
| tails.txt | 2015-12-15 04:30 | 14K |
| wh300_pingstats.txt | 2015-12-15 04:18 | 797 |
| wh300_tsstats.txt | 2015-12-15 04:18 | 368 |
| zmq_tails.txt | 2015-12-15 04:30 | 2.0K |

# Example using tails.txt

$UNIXD timestamp does not match:
The GPS used for processing is out of date

```
------- gpsnav2: -------

$UNIXD,348.6041314,7.8406799
$GPGGA,142605,2118.969,N,15753.174,W,1,9,1.7,27,M,,M,,*55
$UNIXD,348.6041546,7.8407031
$GPGGA,142607,2118.969,N,15753.174,W,1,9,1.7,27,M,,M,,*57
$UNIXD,348.6041777,7.8407262
$GPGGA,142609,2118.968,N,15753.173,W,1,9,1.7,27,M,,M,,*5F
$UNIXD,348.6042009,7.8407494
```

This is new
348.60....

This is old:
344.977....

```
------- gpsnav: -------

$UNIXD,344.9779365,4.2144850
$GPGGA,232426.00,2118.97390478,N,15753.17321184,W,2,08,1.7,26.076,M,4.715,M,4.0,0138*59
$UNIXD,344.9779596,4.2145081
$GPGGA,232428.00,2118.97390454,N,15753.17321153,W,2,08,1.7,26.075,M,4.715,M,6.0,0138*52
$UNIXD,344.9779712,4.2145197
$GPGGA,232429.00,2118.97390442,N,15753.17321137,W,2,08,1.7,26.074,M,4.715,M,7.0,0138*56
```

# Example using tails.txt

Serial feed “gpsnav” failed 4 days ago (!).

- Restore it; perhaps start a new cruise segment.
- Keep a close eye out when the next email comes.

```
------- gpsnav2: -------

-rw-r--r-- 1 adcp efiring 315903 Dec 14 17:59 kk2015_347_57600.gps
-rw-r--r-- 1 adcp efiring 315959 Dec 14 19:59 kk2015_347_64800.gps
-rw-r--r-- 1 adcp efiring 316409 Dec 14 21:59 kk2015_347_72000.gps
-rw-r--r-- 1 adcp efiring 315415 Dec 14 23:59 kk2015_347_79200.gps
-rw-r--r-- 1 adcp efiring 315952 Dec 15 01:59 kk2015_348_00000.gps
-rw-r--r-- 1 adcp efiring 313793 Dec 15 03:59 kk2015_348_07200.gps
-rw-r--r-- 1 adcp efiring 314772 Dec 15 05:59 kk2015_348_14400.gps
-rw-r--r-- 1 adcp efiring 314820 Dec 15 07:59 kk2015_348_21600.gps
-rw-r--r-- 1 adcp efiring 315258 Dec 15 09:59 kk2015_348_28800.gps
-rw-r--r-- 1 adcp efiring 313243 Dec 15 11:59 kk2015_348_36000.gps
-rw-r--r-- 1 adcp efiring 314837 Dec 15 13:59 kk2015_348_43200.gps
-rw-r--r-- 1 adcp efiring  79531 Dec 15 14:30 kk2015_348_50400.gps

------- gpsnav: -------

-rw-r--r-- 1 adcp efiring  82836 Dec 11 19:59 kk2015_344_71290.gps
-rw-r--r-- 1 adcp efiring 755865 Dec 11 21:59 kk2015_344_72000.gps
-rw-r--r-- 1 adcp efiring 514569 Dec 11 23:28 kk2015_344_79200.gps

------- mahrs: -------

-rw-r--r-- 1 adcp efiring 314562 Dec 14 17:59 kk2015_347_57600.tss
-rw-r--r-- 1 adcp efiring 314665 Dec 14 19:59 kk2015_347_64800.tss
-rw-r--r-- 1 adcp efiring 314665 Dec 14 21:59 kk2015_347_72000.tss
```

Last file
Dec 15 14:40

Last file
Dec 11 23:28

# Transducer alignment

- Transducer angle is used in two places
  - processing angle: "**`h_align`**" in **`proc_cfg.py`**
  - EA command in "**`sensor_cfg.py`**" (Ocean Surveyor)
- Processing angle should be within 0.1deg relative to accurate heading device (POSMV)
- BUILD IN TIME after a new install or re-install
- Procedure is documented (here), but

  **Consult UH personnel first!!**

# 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

# Part II: UHDAS

- UHDAS: What it does
  - at-sea “CODAS” processing
  - overview
- Operational Introduction
  - computer
  - UHDAS GUI
- Monitoring
  - at sea
  - on land
- What can be changed

# UHDAS: what can be changed
## (not much, and only with care)

with the UHDAS tool:

- bb, nb mode (OS75, OS150)
- bottom tracking on/off
- bin size, number of bins

If using smaller bin size
don't forget to increase
the number of bins
(to keep the range the same)

if required (carefully edit **`sensor_cfg.py`**)

- serial port, baud rate

# UHDAS: behind the scenes

**Consult UH personnel first!!**

- If required, changes might be made to

  **`sensor_cfg.py`**

  - serial port, baud rate
  - new serial feed
  - temporarily disable one ADCP

  **`proc_cfg.py`**

  - change transducer angle
  - add a different heading device

# 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 Toby/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
  - GPS-ADCP offset
  - specify serial inputs (position, heading, accurate heading) used for transformations

- calibration after (new) or re-install of ADCP
- requires some bottom track or some reciprocal tracks

- **`uhdas_cfg.py`**
  - averaging interval
  - timers (5min, 30min)
  - bin range for bridge plots and vector plot
  - email
- **`sensor_cfg.py`**
  - serial setup: ports, baud rates, messages
  - speedlog configuration
  - zmq publisher

# NOAA 2015 ADCP

Part I: ADCP...

Part II: UHDAS...

Part III: Signatures of problems:

- (1) ADCP systems (components)
- (2) Data flow (where is the problem)
- (3) Ocean Velocity signatures

# (III) ADCP System: 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)
  - Transition/maneuvering errors (lags in time or space)
  - depth-dependent bias (electrical noise)
  - surface bias (ringing)

# (III) ADCP System: what can go wrong

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  - depth-dependent bias (electrical noise)
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# What can go wrong: system=acquisition

- 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**

Solution: FIX IT

- Clock set to UTC, do not use bad timeserver
- ONLY send serial data from the original instrument

# 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

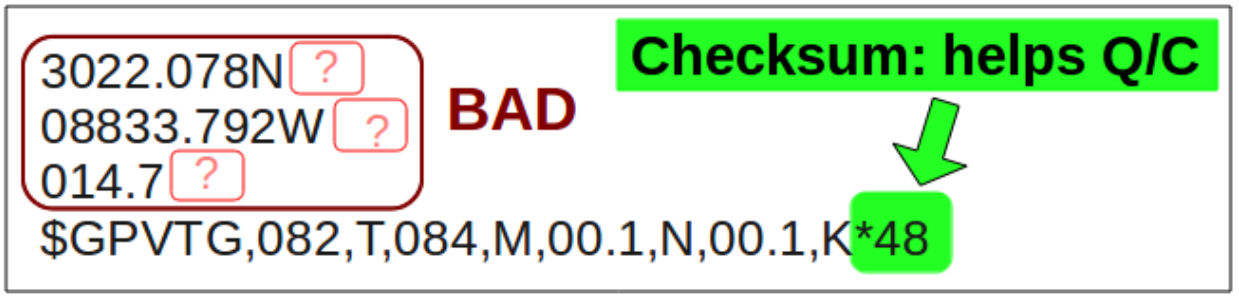
Partial $HEHDT heading messages

# Serial Data Logging Rules

(1) DO NOT
- push multiple sources into one port
- use long RS232 cables
- send too many extra messages

(2) DO
- get data directly from the instrument
  - NOT a computer-generated message
  - NOT a switched feed (eg. Various GPS)

(3) IF POSSIBLE
- avoid unnecessarily high repetition rate
- choose a higher baud rate
- use feeds with a checksum



# What can go wrong: system=ADCP

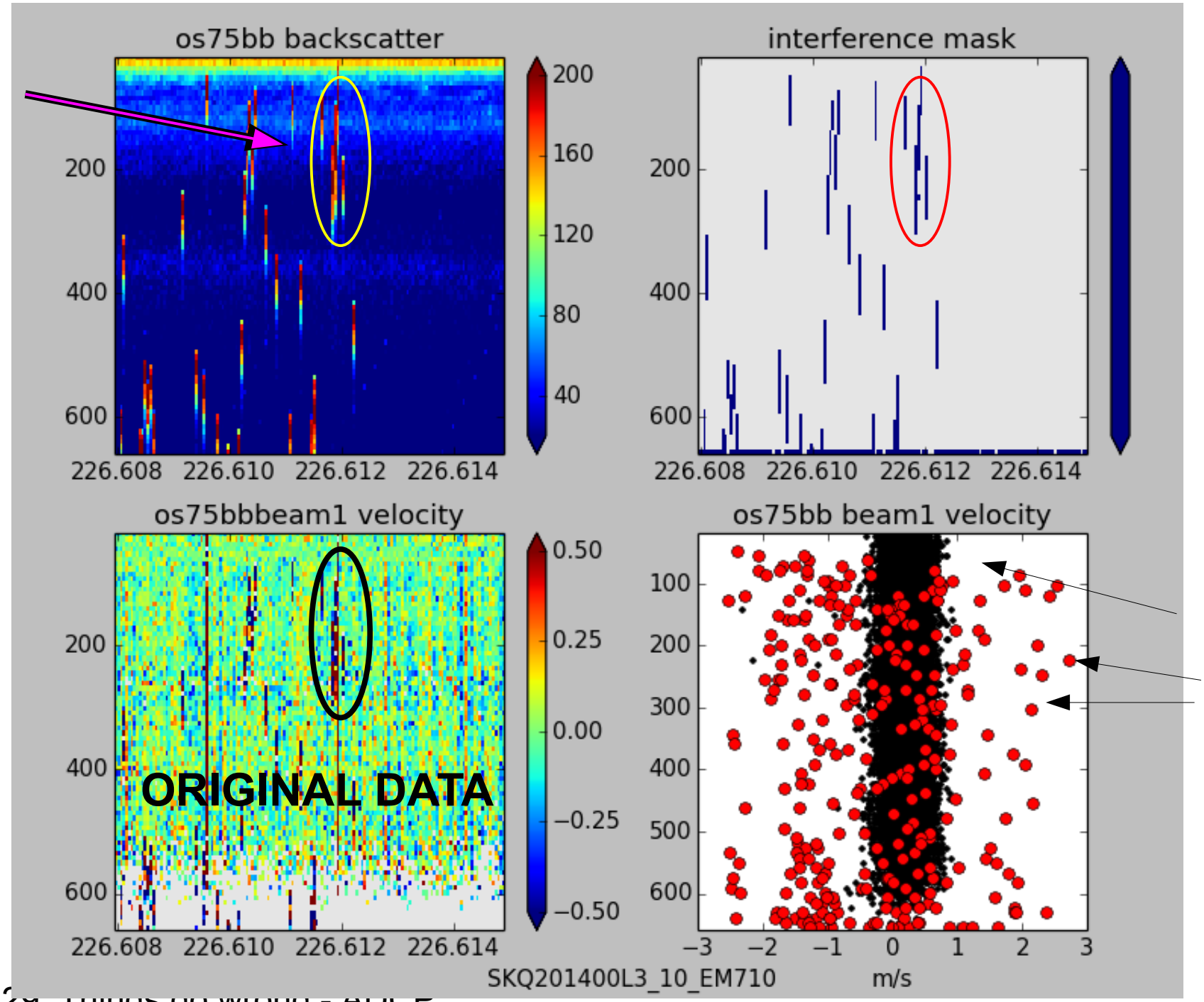
- ADCP loss or degradation
  - Loss of range (loud while underway, weak beam)
  - Loss of one beam (not good)
  - Loss of multiple beams (repair/replace)
  - Acoustic interference (another pinger)
  - Triggering (reduced ping rate, damage to pings)
  - Ice
  - Bubbles
  - Electrical noise

multiple examples
of problematic data
(link)

# What can go wrong: system=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)
  - Triggering (reduced ping rate, damage to pings)
  - Ice
  - Bubbles
  - Electrical noise

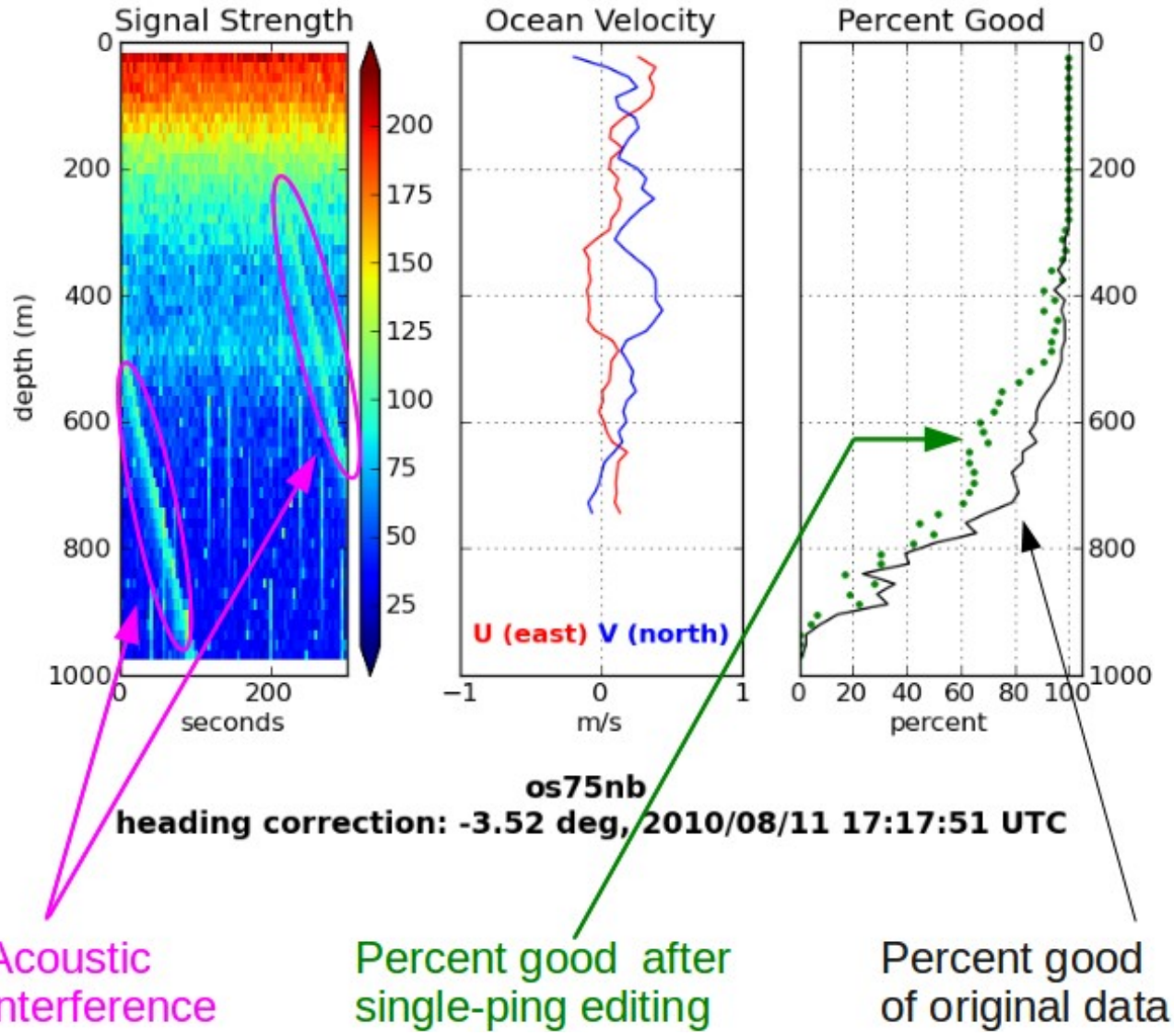
# Acoustic interference (single-ping editing)




**IDENTIFY acoustic interference using backscatter**

**FLAG and remove before averaging**

# Acoustic interference after editing



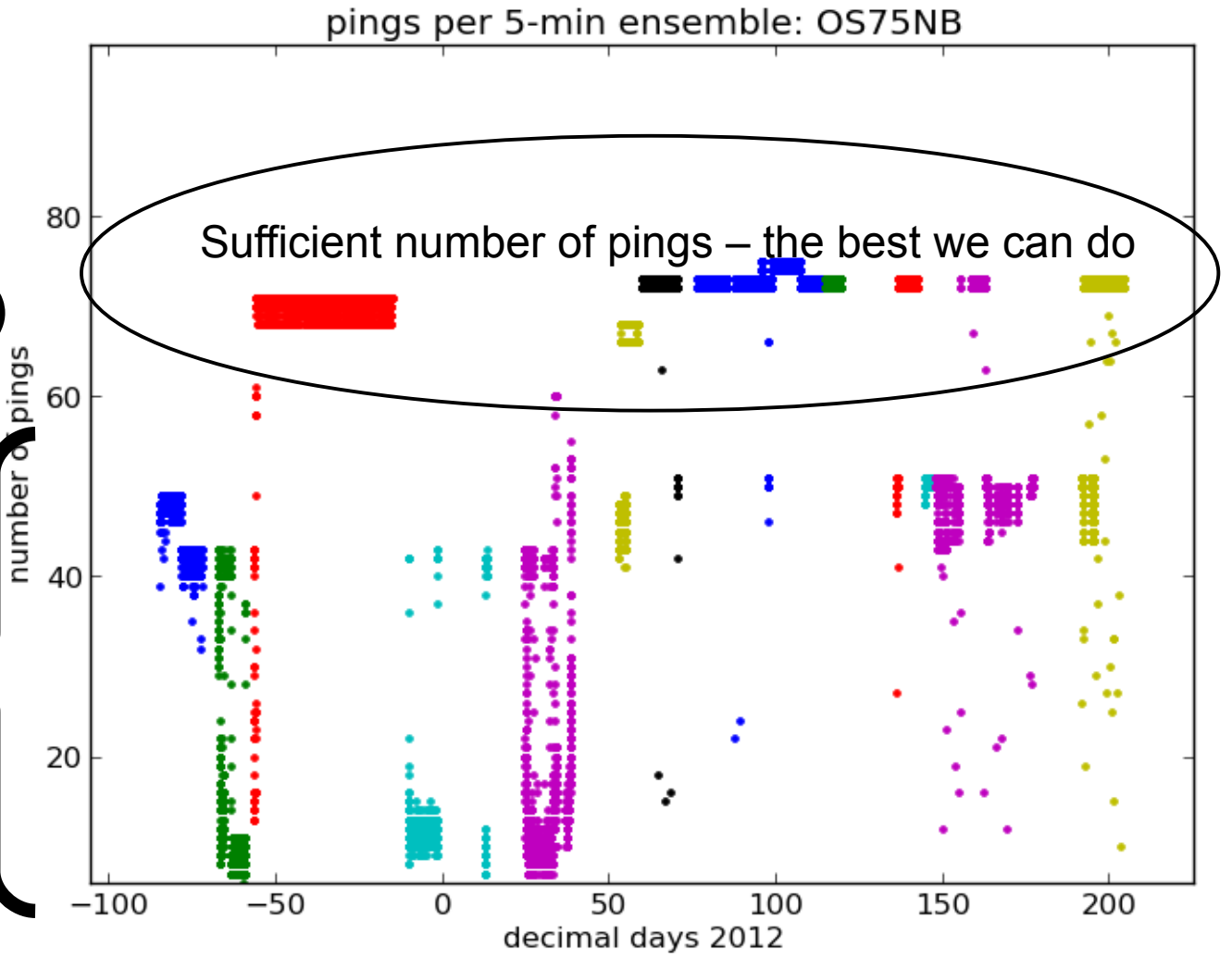
# What can go wrong: system=ADCP

- 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)
  - Triggering (reduced ping rate, damage to pings)
  - Ice
  - Bubbles
  - Electrical noise

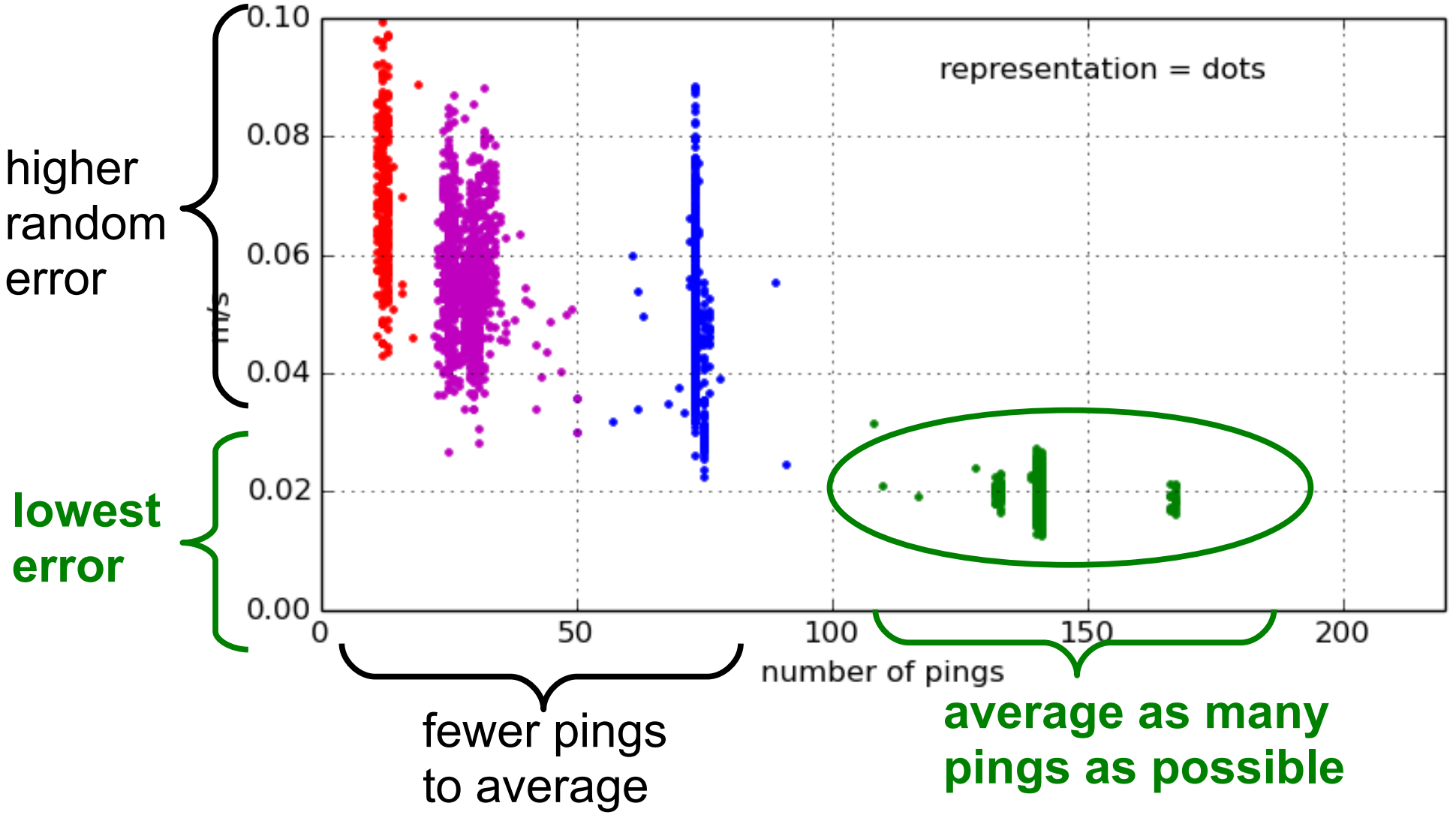
# Triggering: reduced ping rate

- 300-sec averages
- 2-second ping rate
- interleaved (BB+NB)
- expecting 70 pings

REDUCED number of pings due to triggering



# Triggering: reduced ping rate (increased errors)



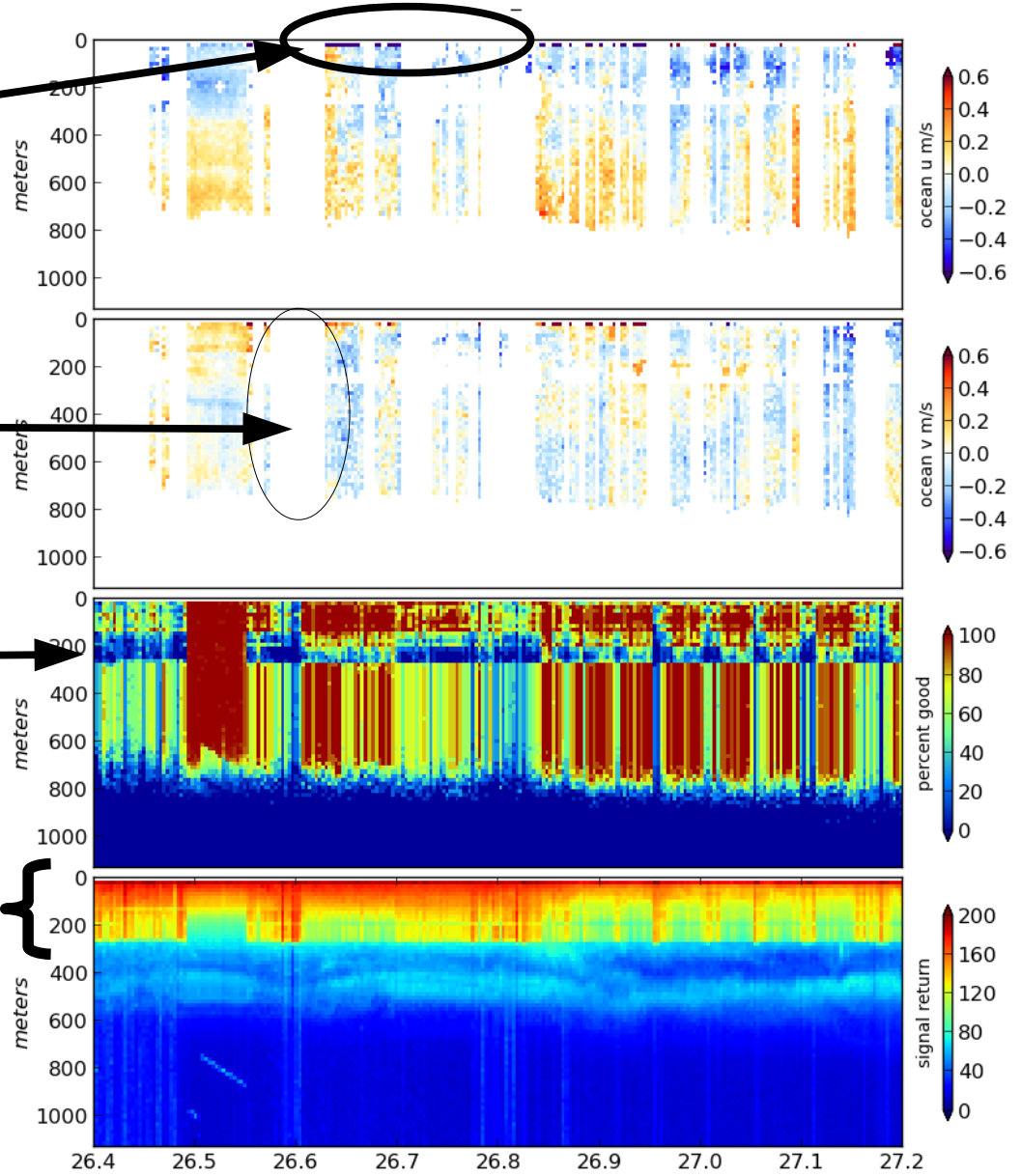
# Triggering: damage to pings

- bias in top bin(s)

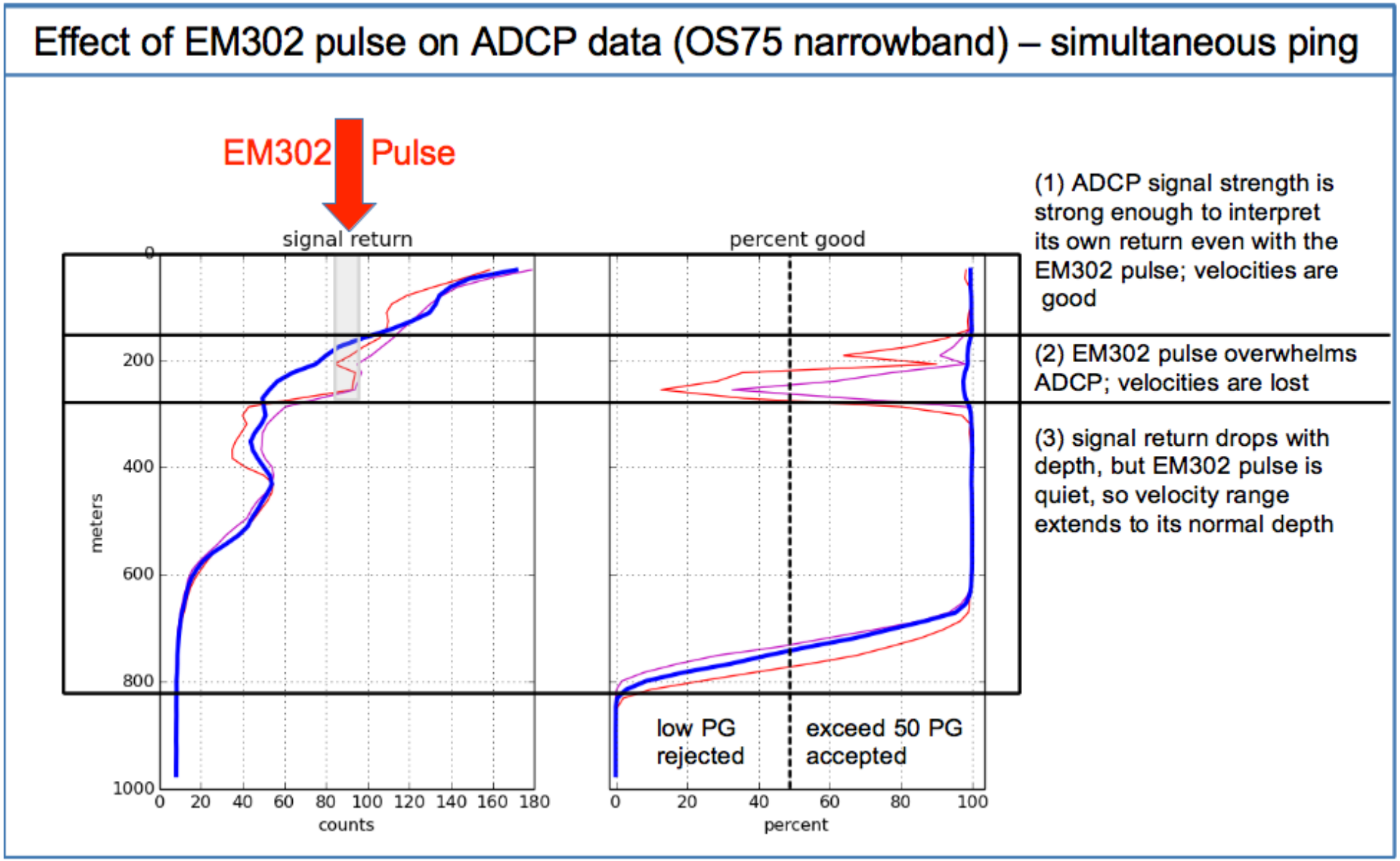
- gaps due to decreased ping rate

- Scarring where the master's pulse kills the ADCP signal

- Long pulse damages the top 250m of ADCP data



# Triggering: damage to data



# What can go wrong: system=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

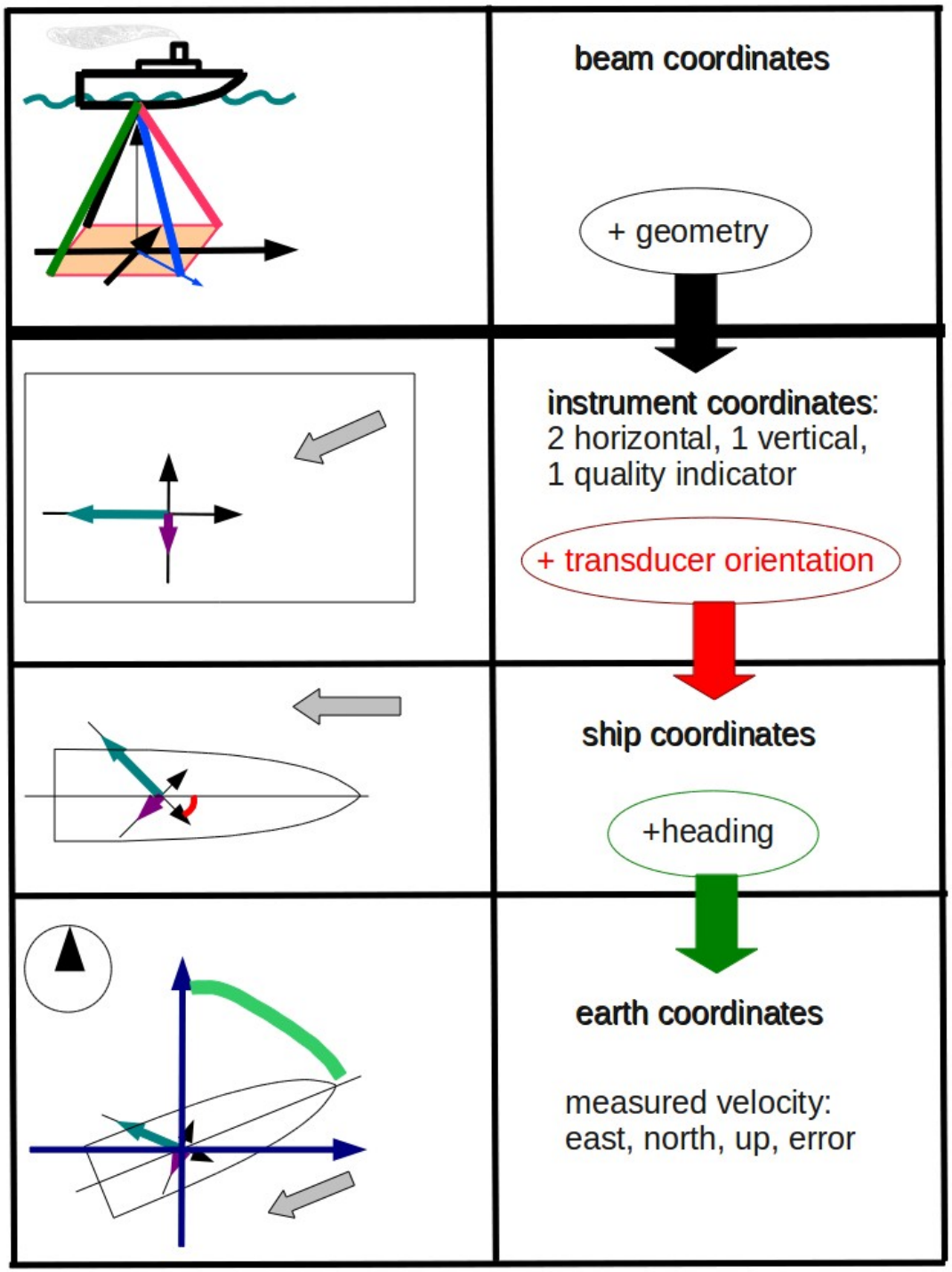
# ADCP: what can go wrong

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)
  - Transition/maneuvering errors (lags in time or space)
  - depth-dependent bias (electrical noise)
  - surface bias (ringing)

# ADCP:

## Getting Ocean Currents




beam velocities

+

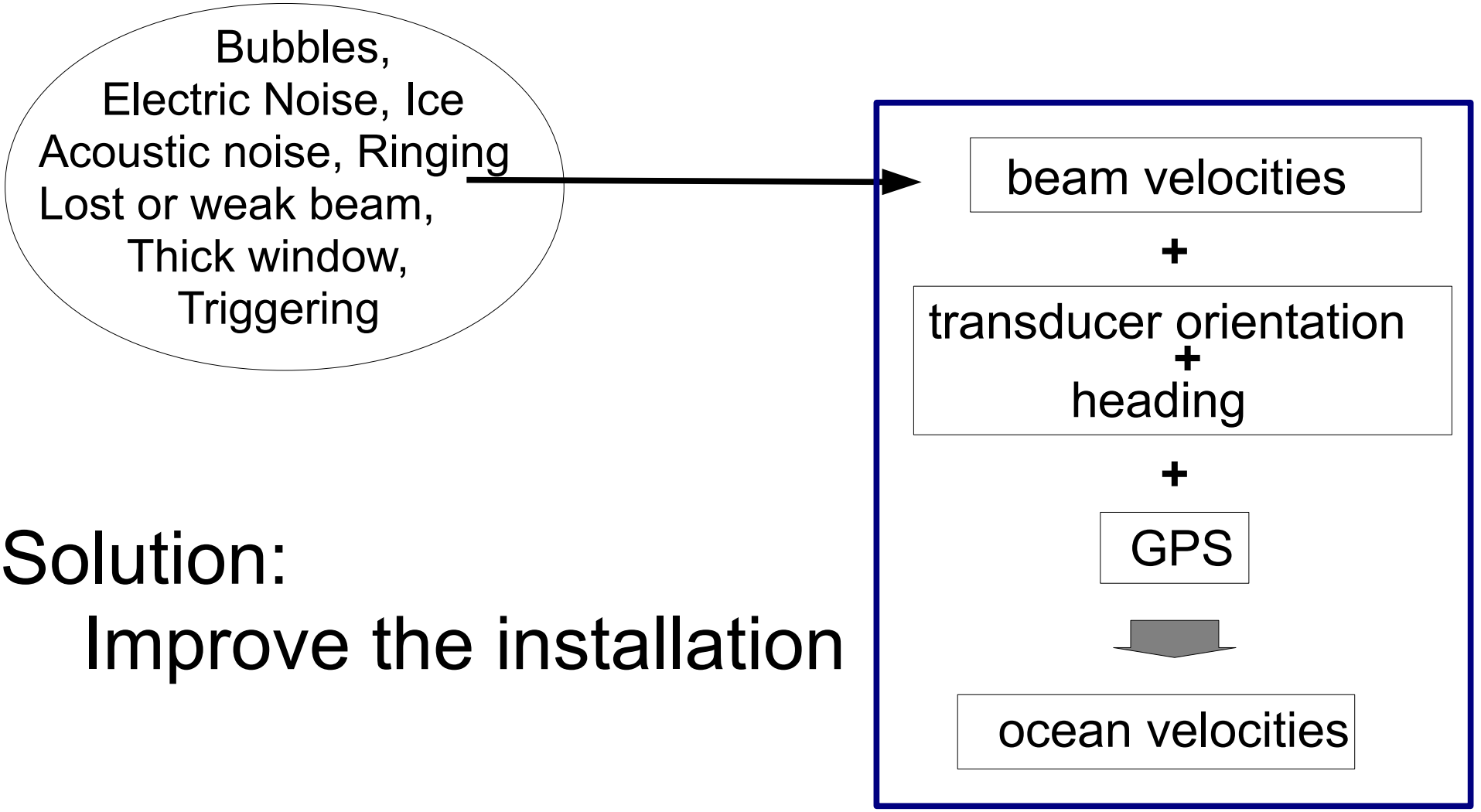
transducer orientation
+
heading

+

GPS

ocean velocities

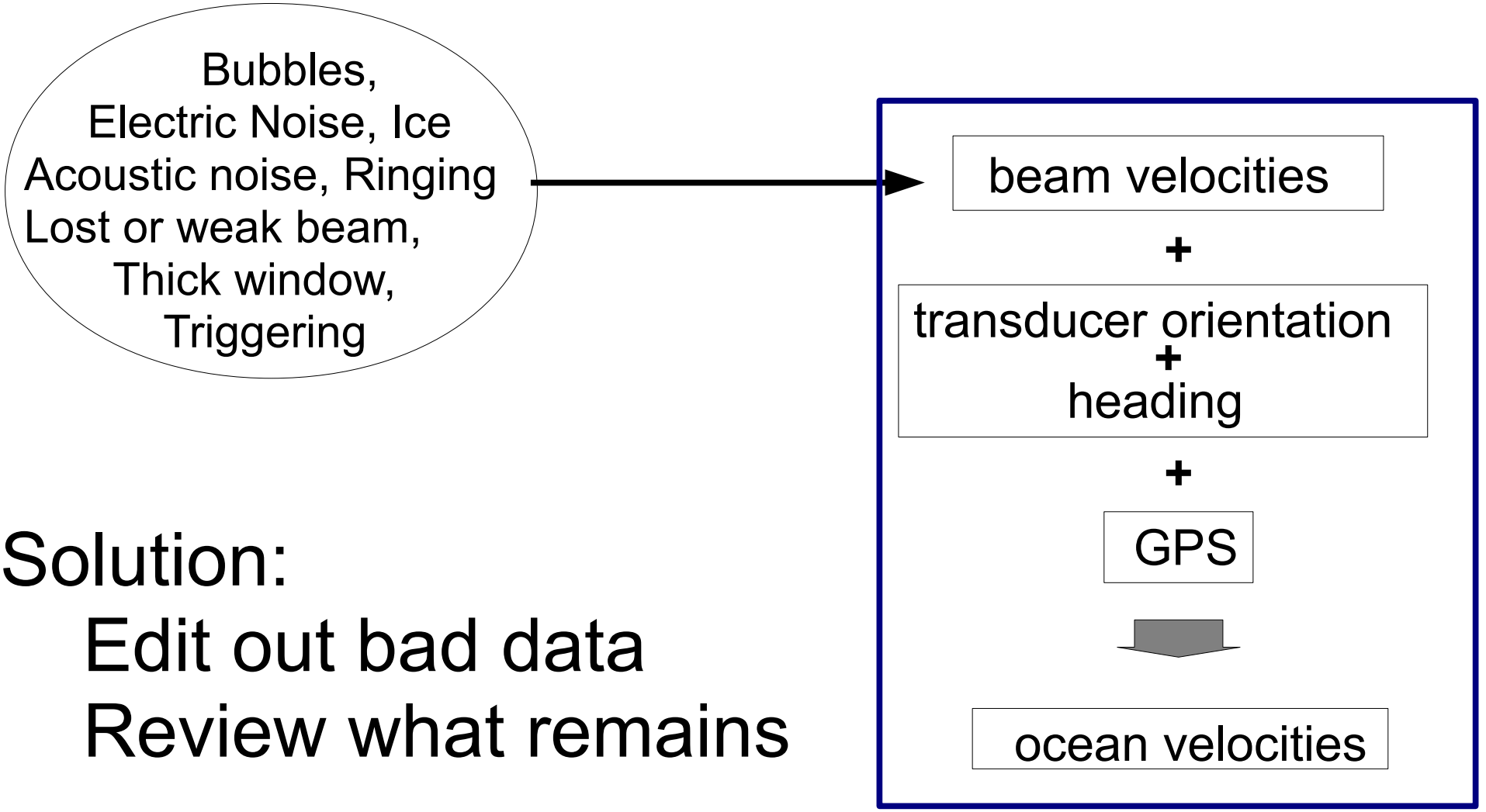
# ADCP: data loss, degradation
## degraded range and coverage....




Solution:

Improve the installation

# ADCP: data loss, degradation
## .... remaining data compromised



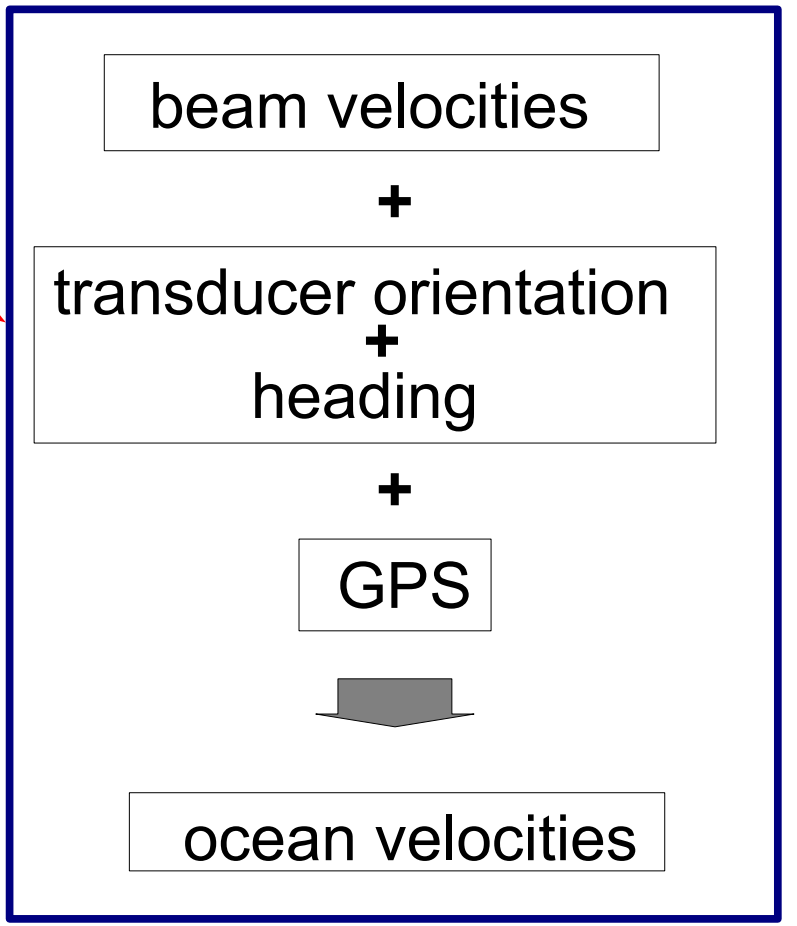

Solution:

- Edit out bad data
- Review what remains

# Transducer misalignment
## angle off by <10deg ....

1deg error in heading

10cm/s error in ocean velocity



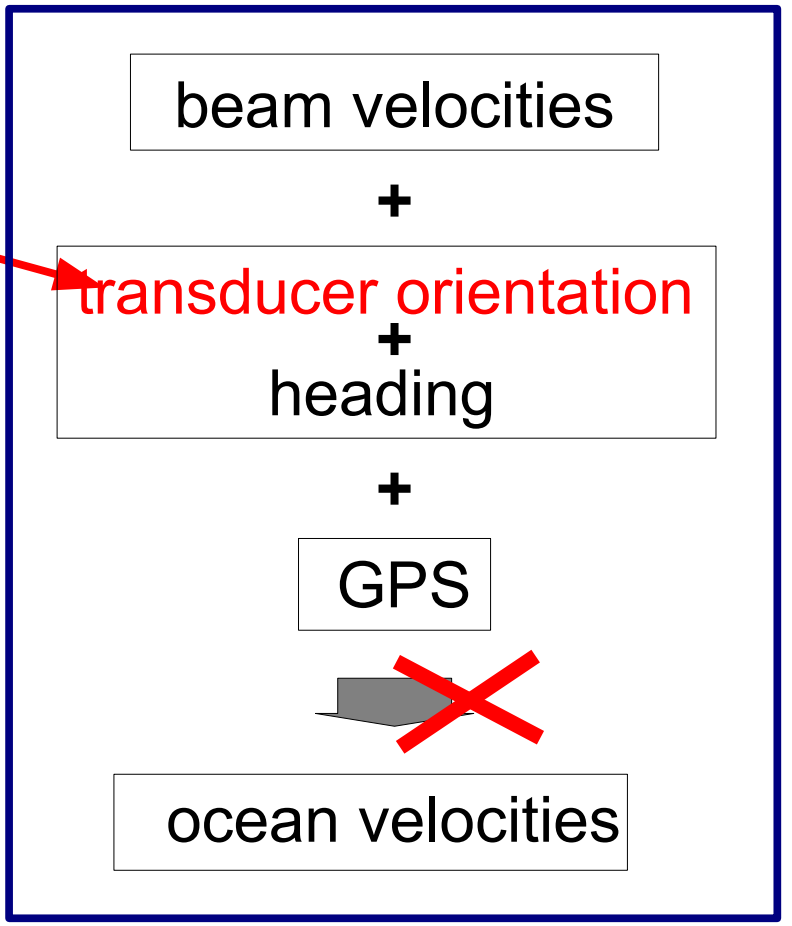

Diagnostic:

Cross-track error looks different on-station vs/ underway

# Transducer misalignment

## ..... angle off by >90deg (*)

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



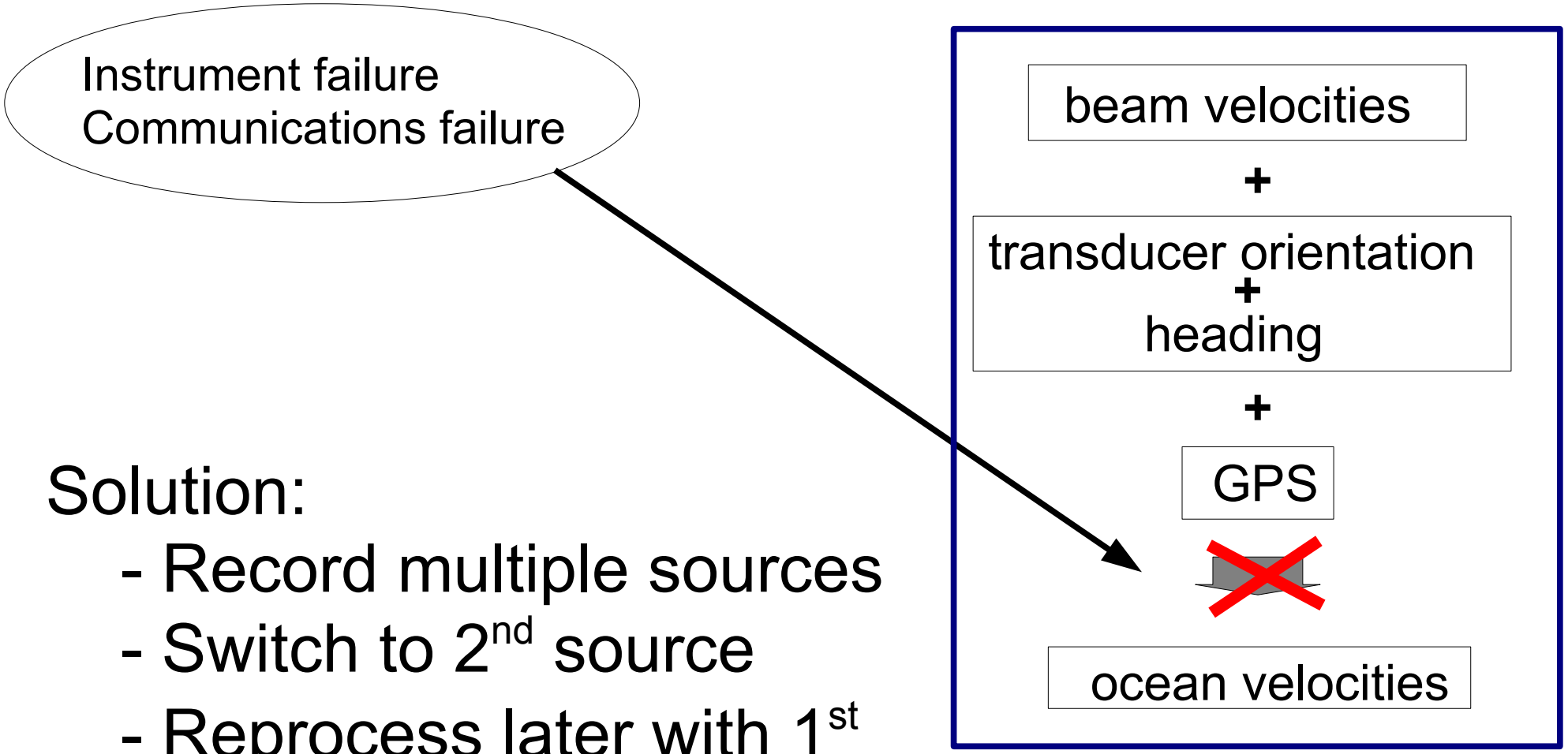

Diagnostic:

beam velocities corrupted (wrap)



(*) actual value varies with ship

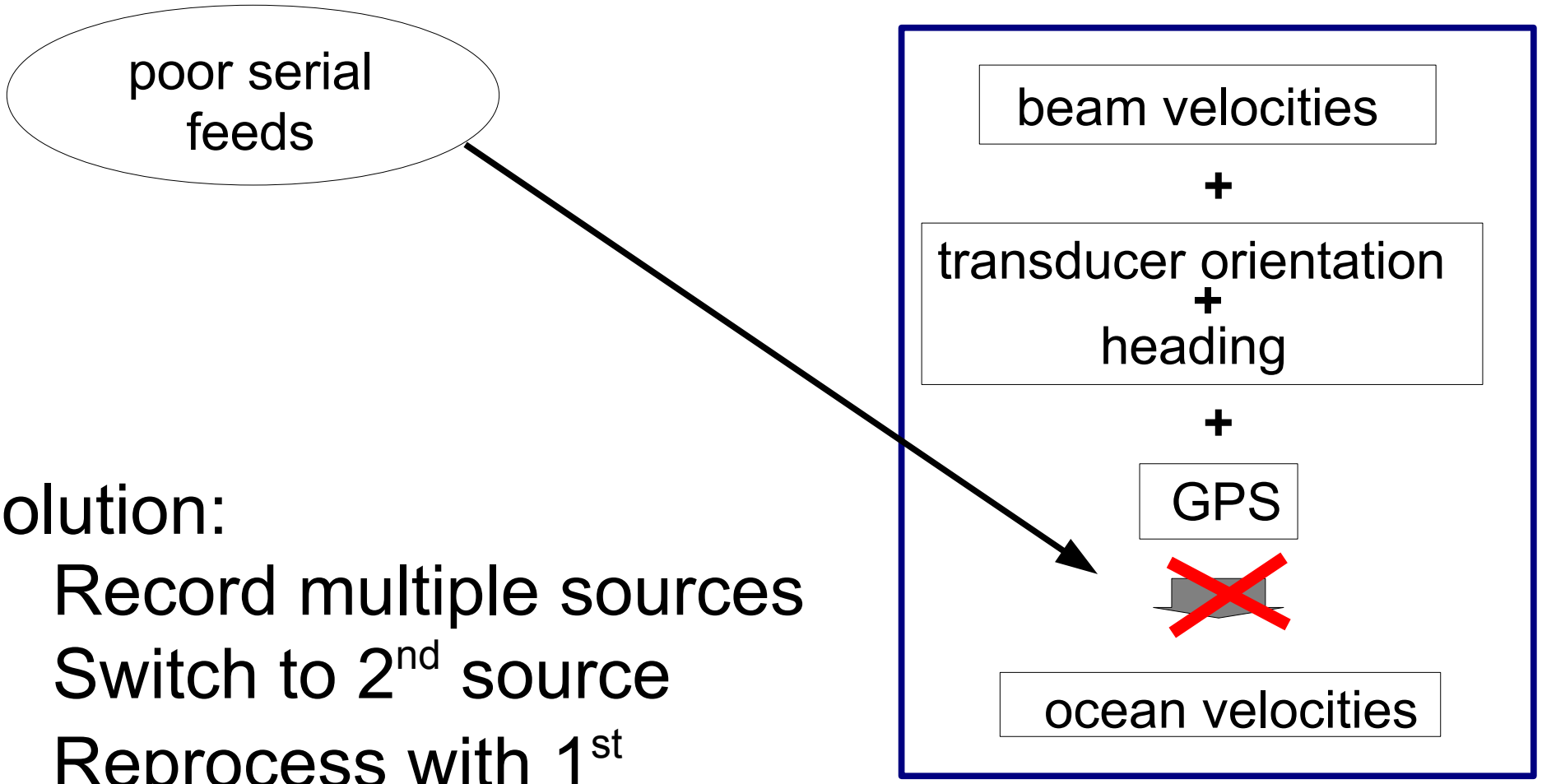
# Failure of ancillary (heading, gps)




Solution:

- Record multiple sources
- Switch to 2nd source
- Reprocess later 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)
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  - Transition/maneuvering errors (lags in time or space)
  - Depth-dependent bias (electrical noise or ringing)

# What can go wrong: in the ocean velocities

(1) Cross-track error:

- recovery requires accurate heading
- could be related to bad transducer angle

(2) Along-track error:

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

(3) Transition/maneuvering error

- Lag or offset in time or space.
- might need to input the GPS-ADCP offset

(4) Depth-dependent bias

- Surface along-track bias: ringing
- Surface? Deep? Could be electrical noise, could be acoustic

# What can go wrong: in the ocean velocities

(1) Cross-track error:

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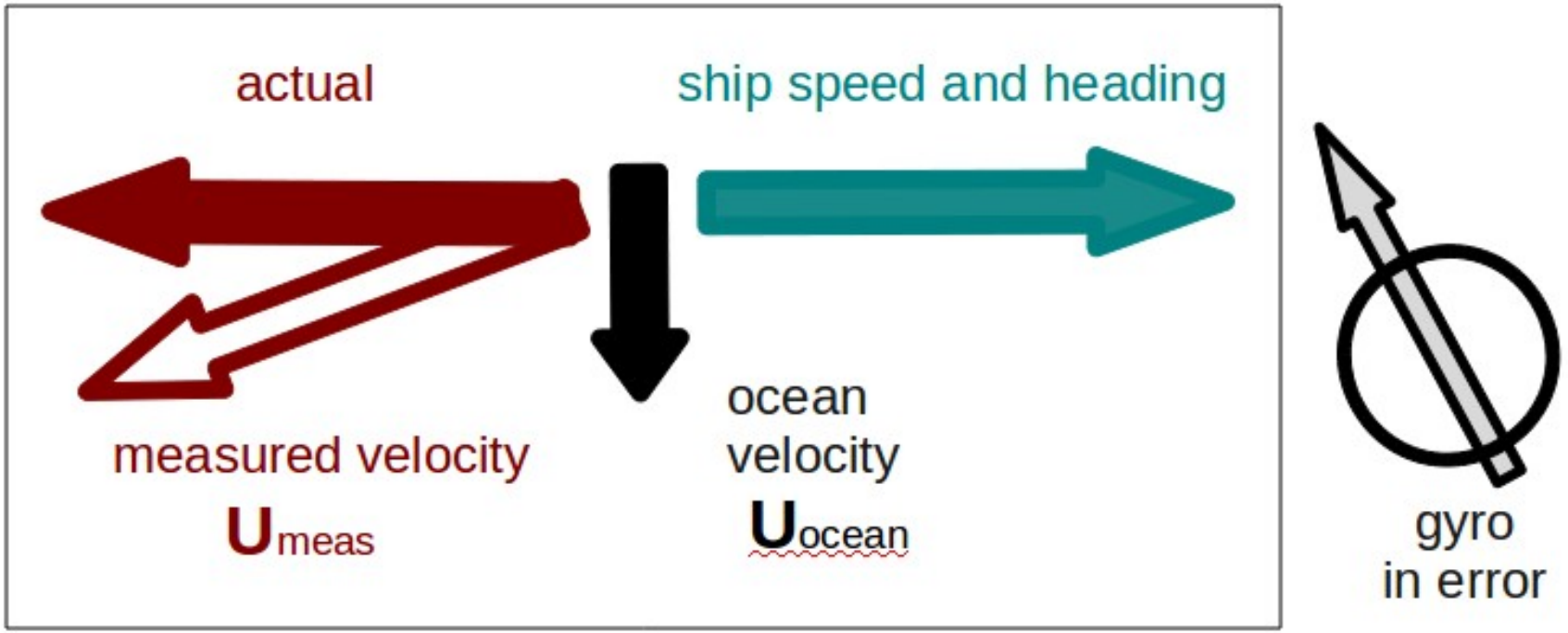
- Surface along-track bias: ringing
- Surface? Deep? Could be electrical noise, could be acoustic

# 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**

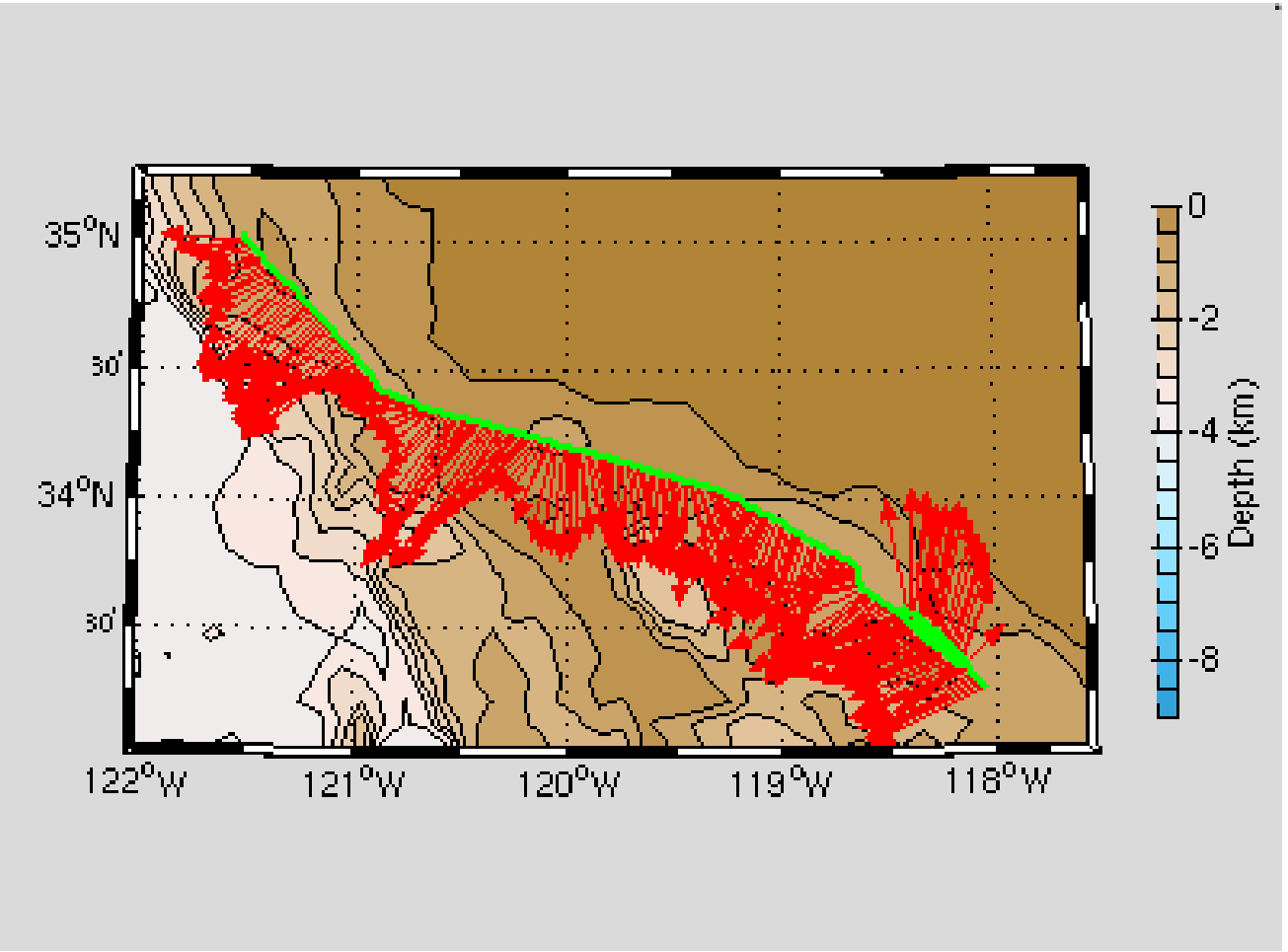
Angle applied comes from

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

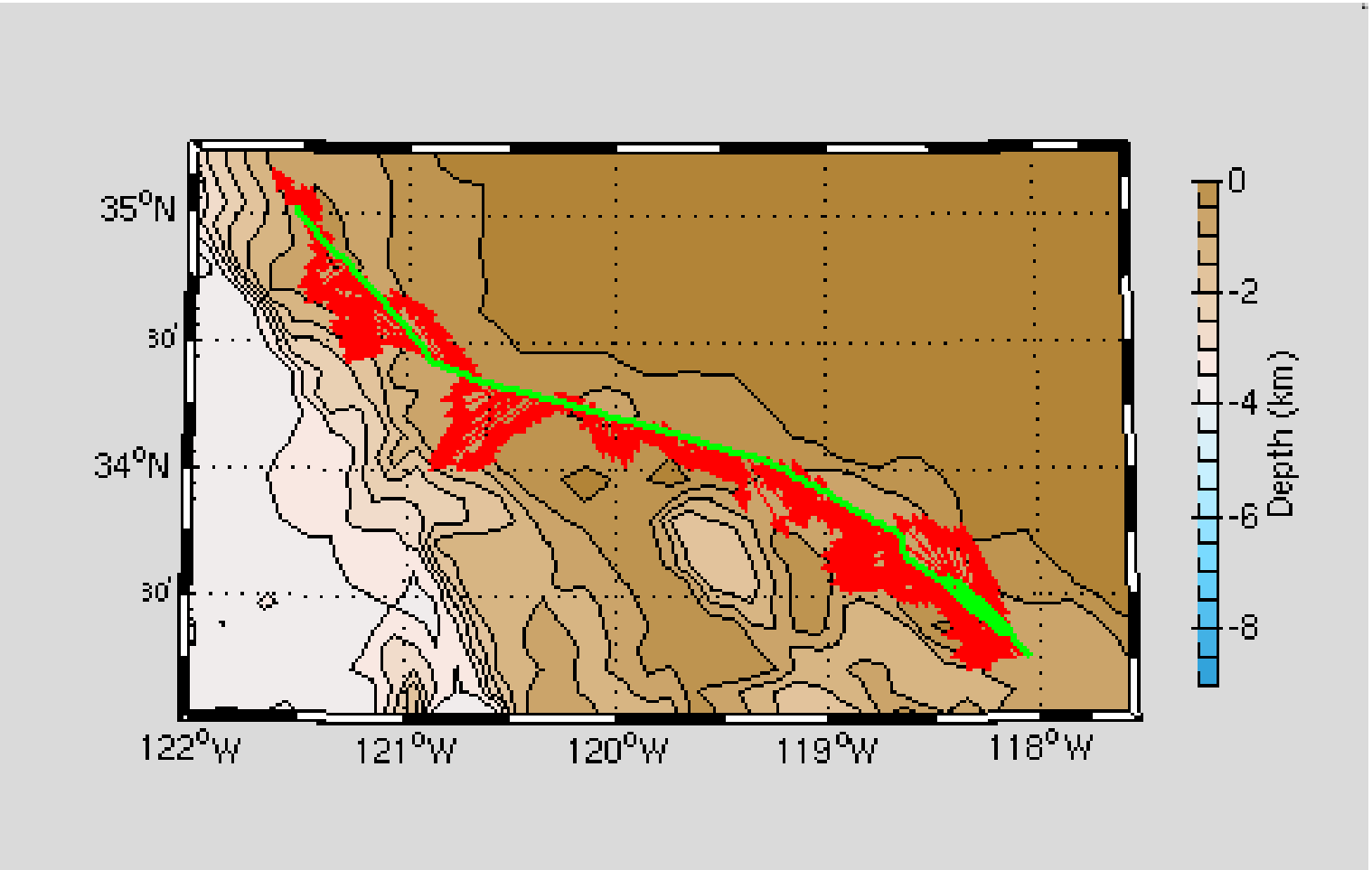
This is a **constant value** for the whole cruise

Examples of error in transducer angle follow...

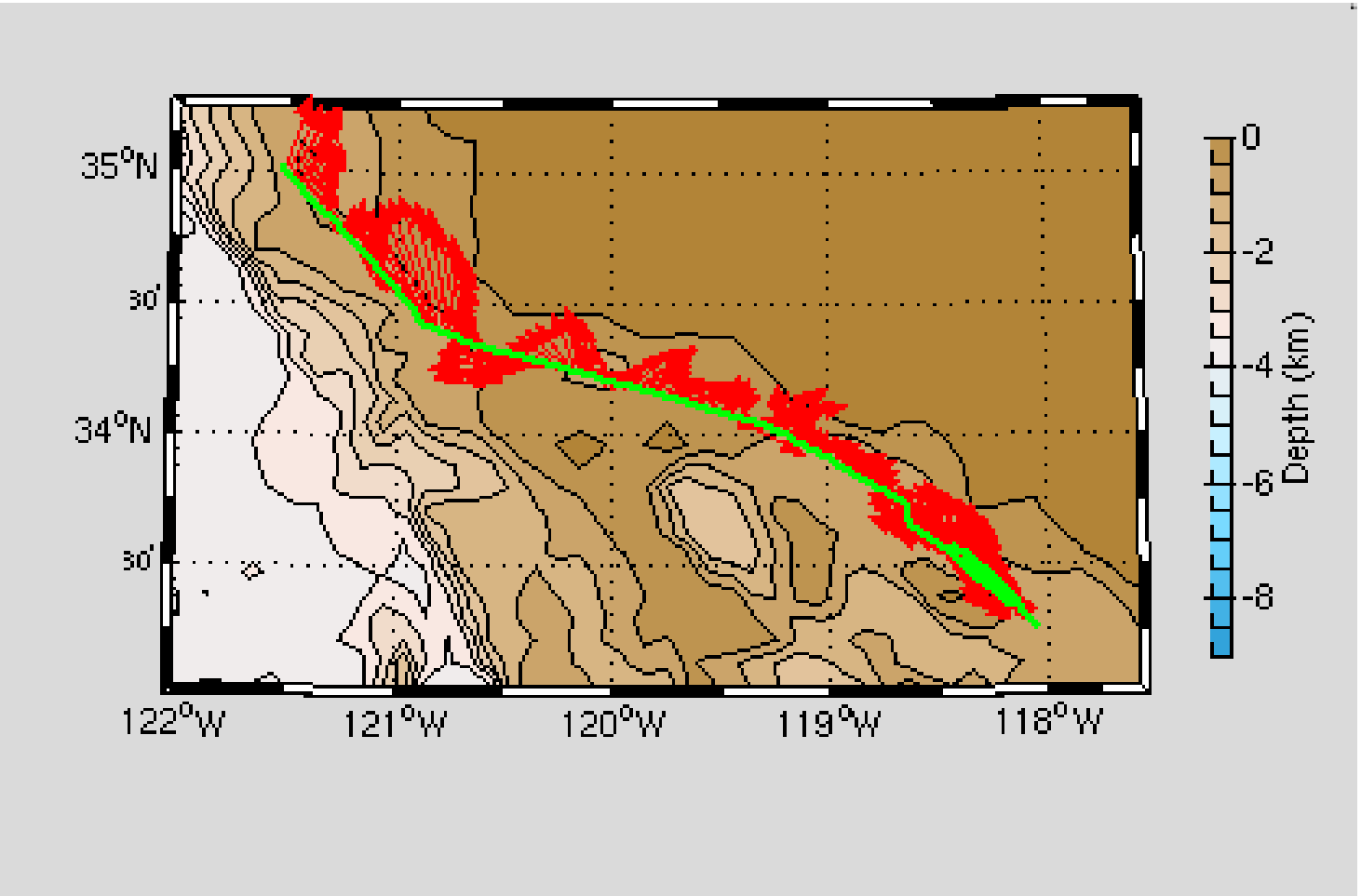
# Calibration: angle error -3.6deg



# Calibration: angle error -1.6



# Calibration: angle error 0.4



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

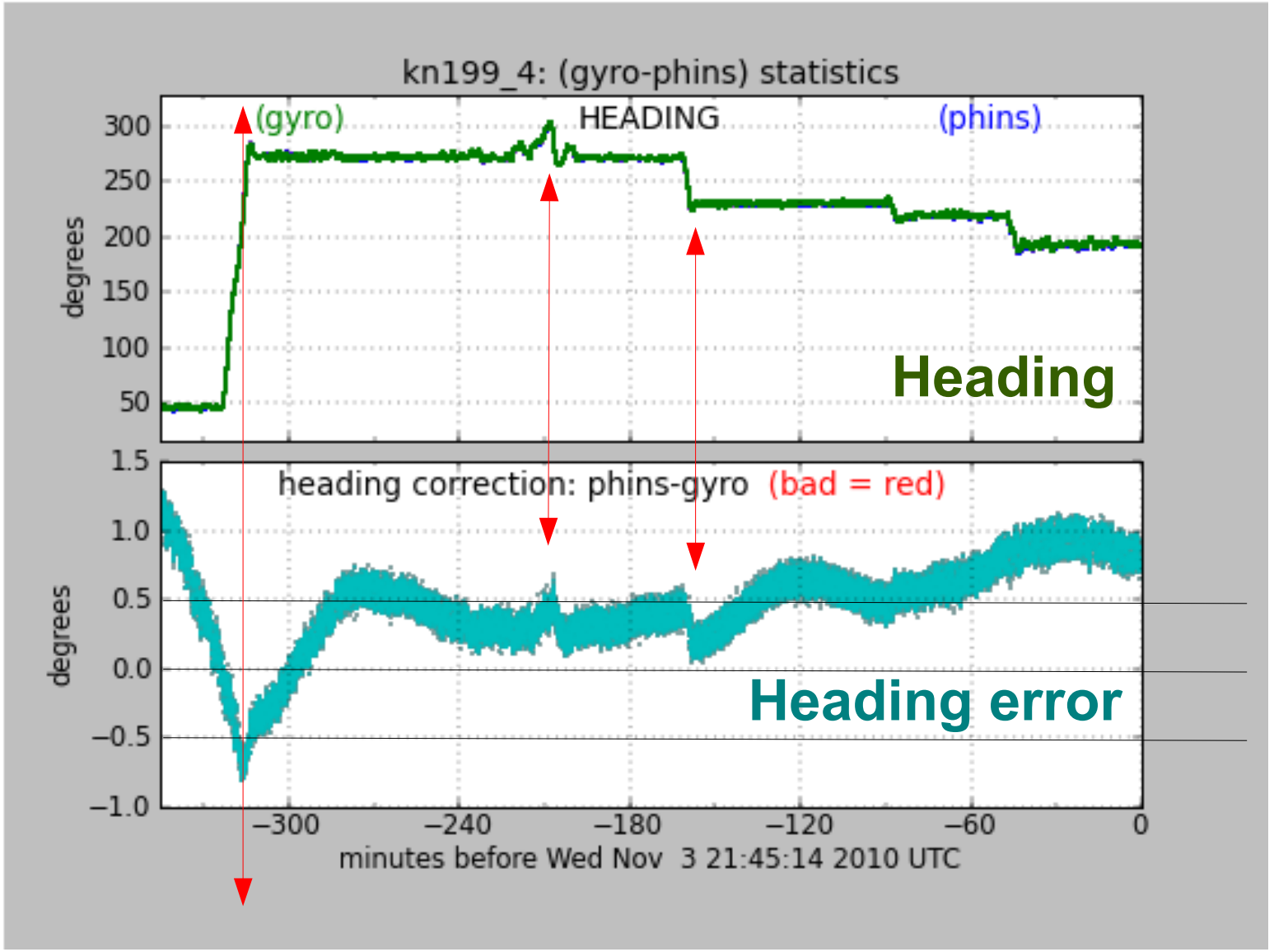
Angle applied comes from

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

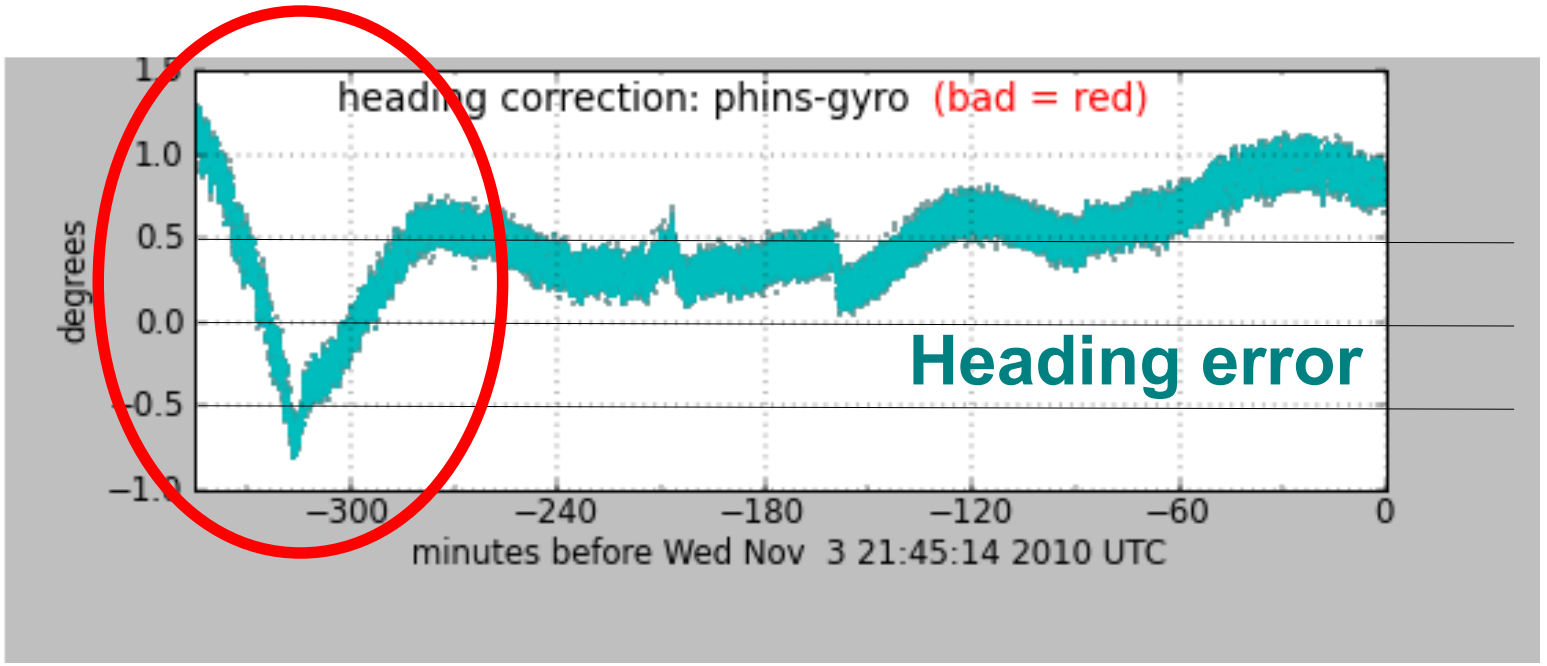
-0.5 deg

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

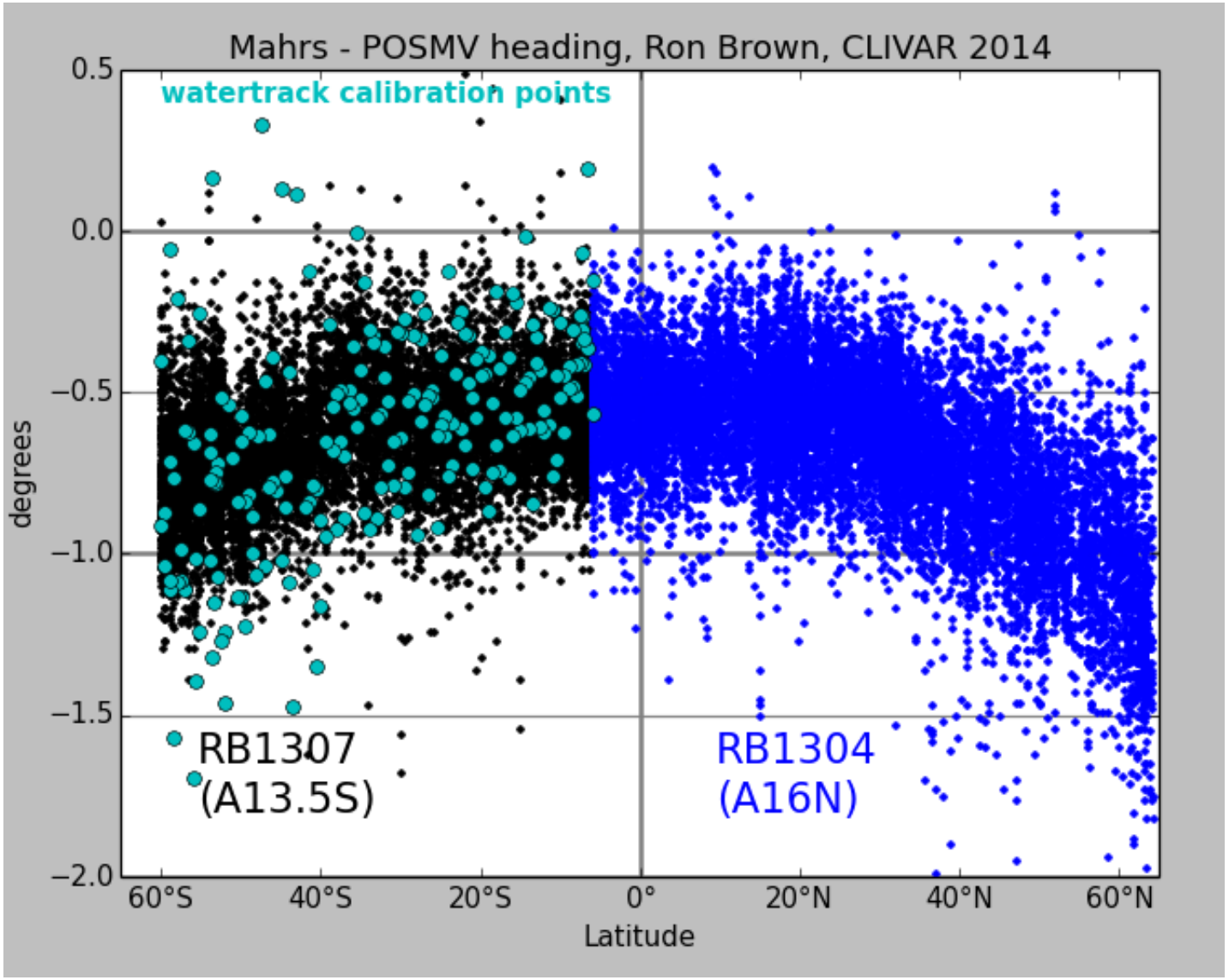



Changes in ship's heading affect heading error

# Heading error with latitude

MAHRS
- reliable
- not accurate

POSMV
- should be accurate
- but has glitches
- still good enough to show the error in MAHRS over latitude




157: Things go wrong (angle, variable)

# What can go wrong in the ocean velocities

(1) Cross-track error:

- recovery requires accurate heading
- could be related to bad transducer angle

(2) Along-track error:

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

(3) Transition/maneuvering error

- Lag or offset in time or space.
- might need to input the GPS-ADCP offset

(4) Depth-dependent bias

- Surface along-track bias: ringing
- Surface? Deep? Could be electrical noise, could be acoustic

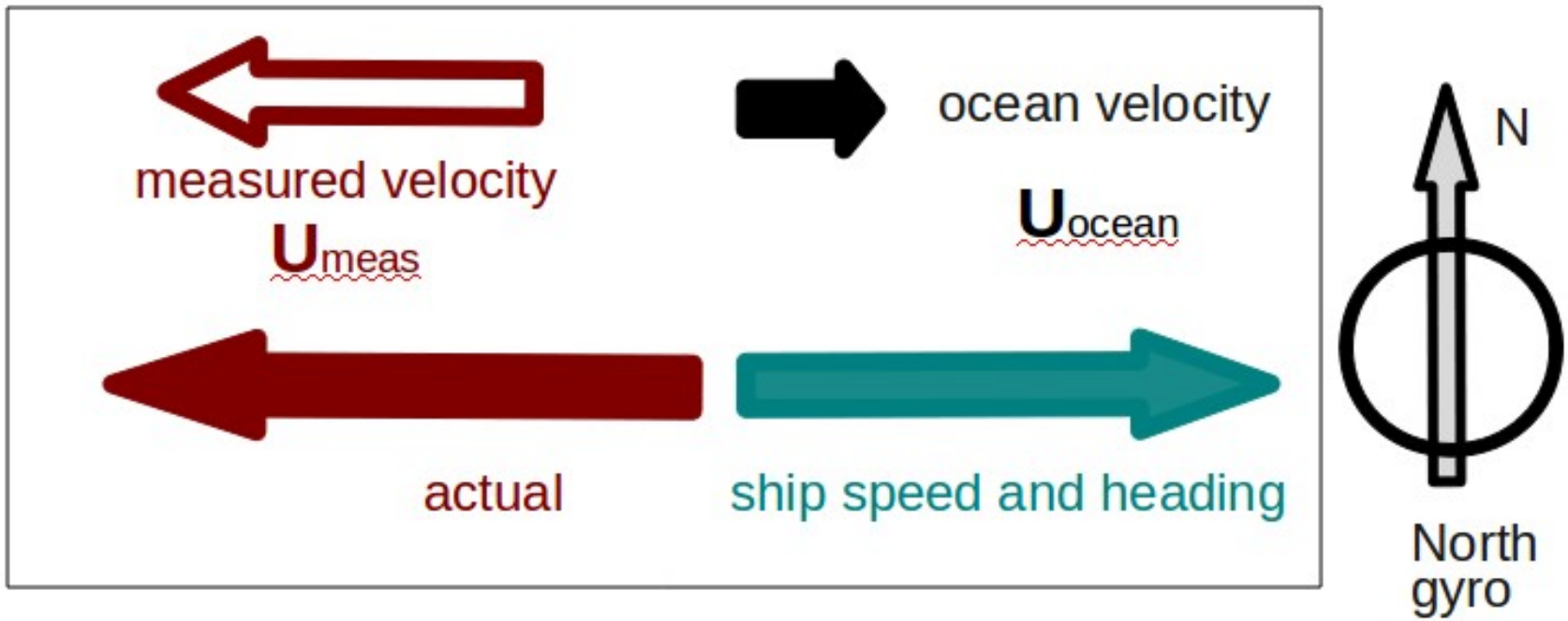
# Examples of along-track error

- Acoustic interference
- Underway bias (bad weather)
- Scale factor (NB150 soundspeed correction)

# Along-track Error

Bias towards zero in measured velocity

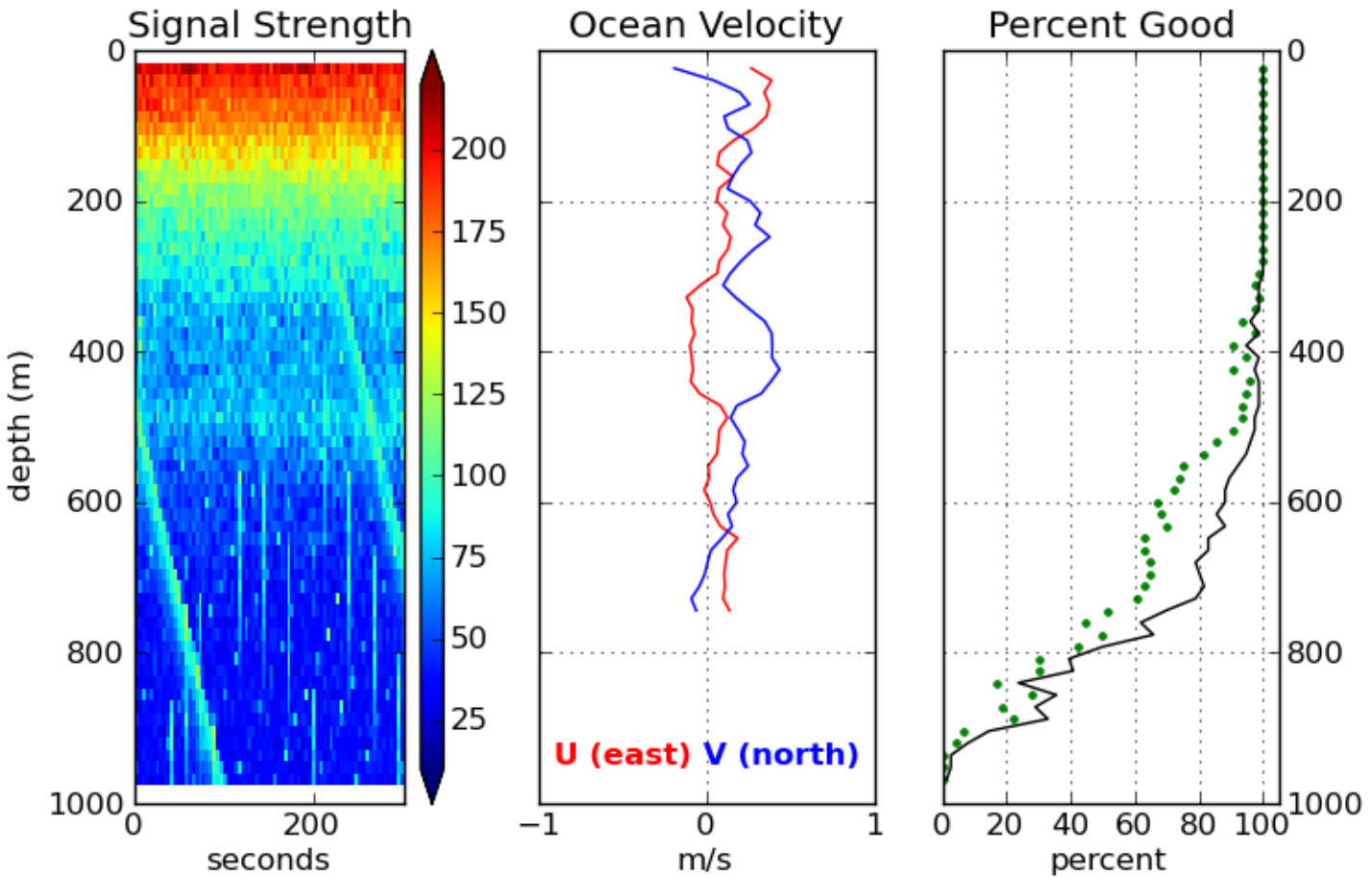
Alongtrack bias in ocean velocity



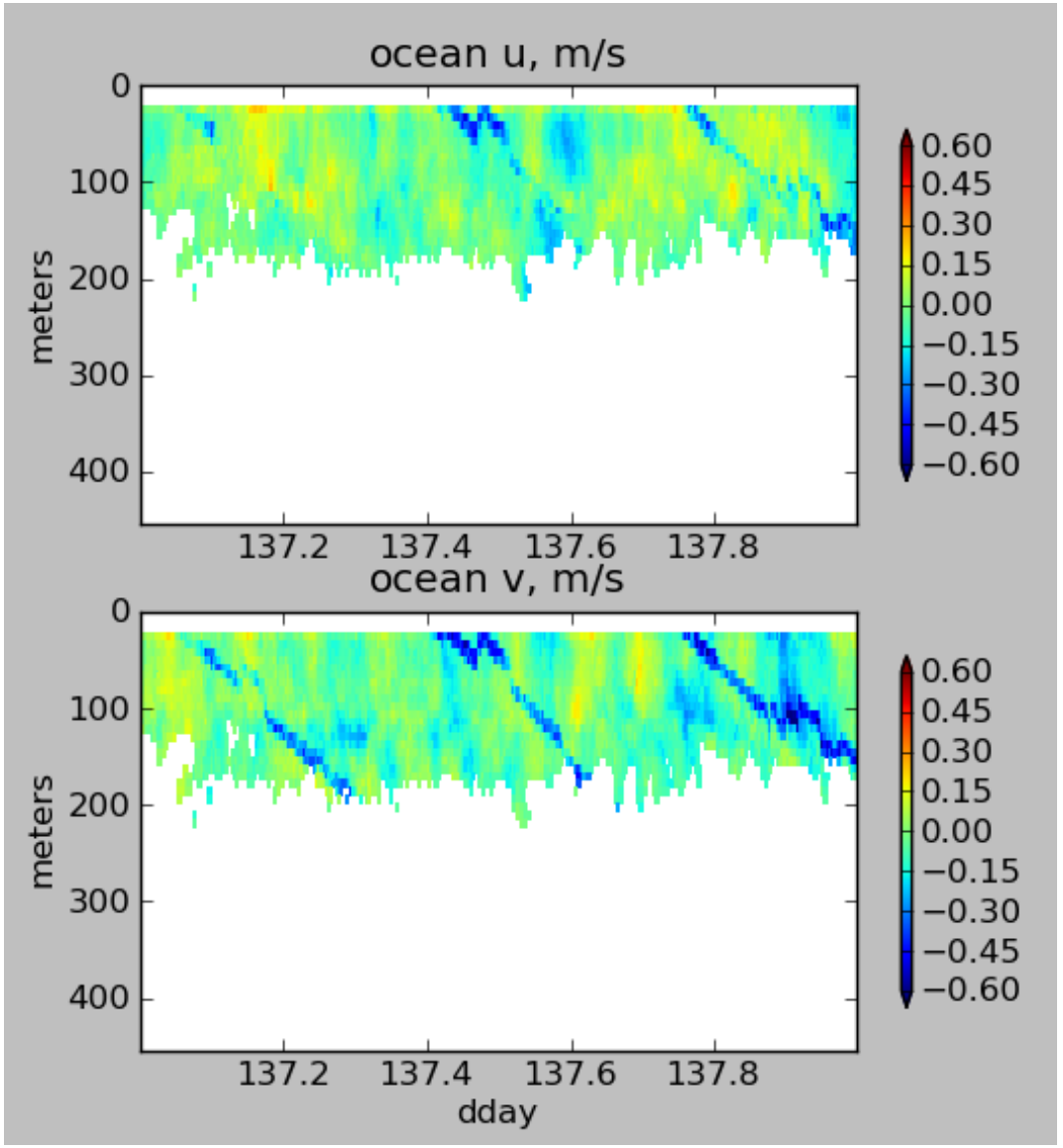
# Examples of along-track error

- Acoustic interference
- Underway bias (bad weather)
- Scale factor (NB150 soundspeed correction)

# Acoustic Interference: single ping



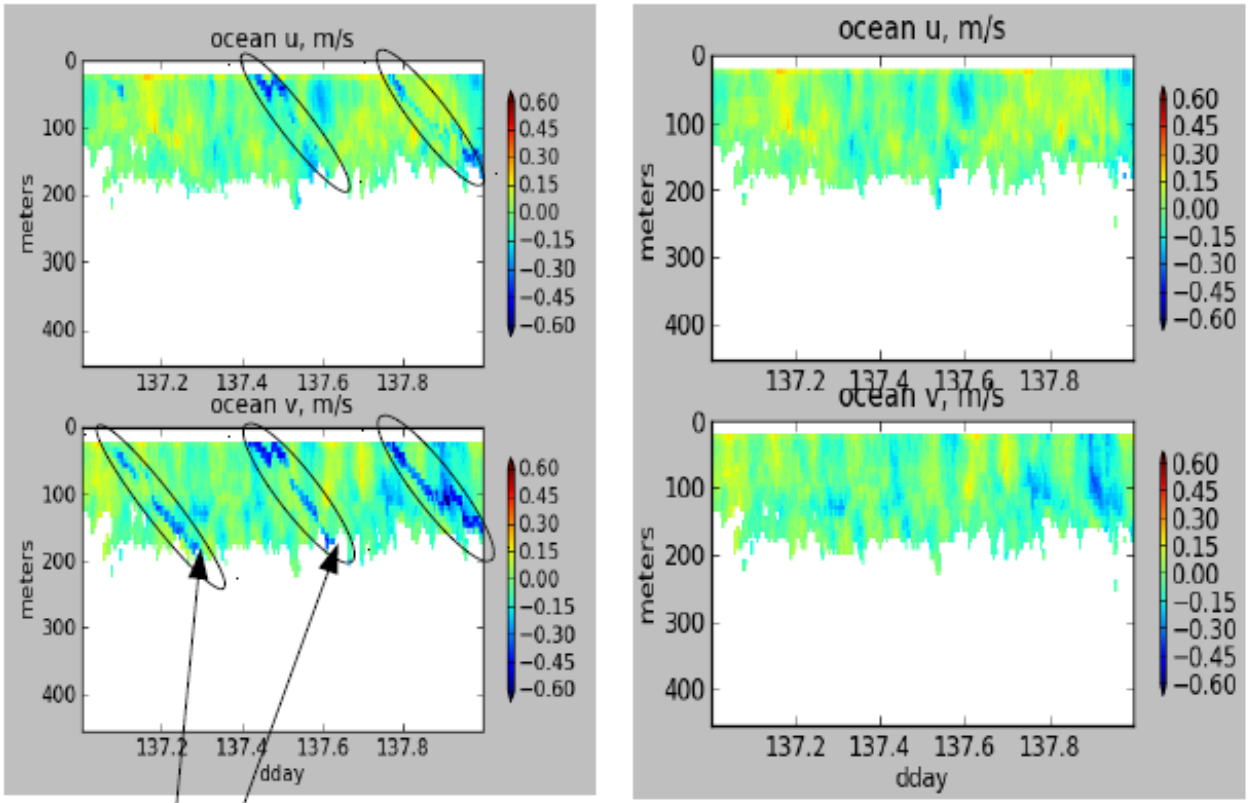
# Acoustic Inference: averaged



# Acoustic interference removed by CODAS processing

VmDAS LTA files:
Unedited prior to averaging

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

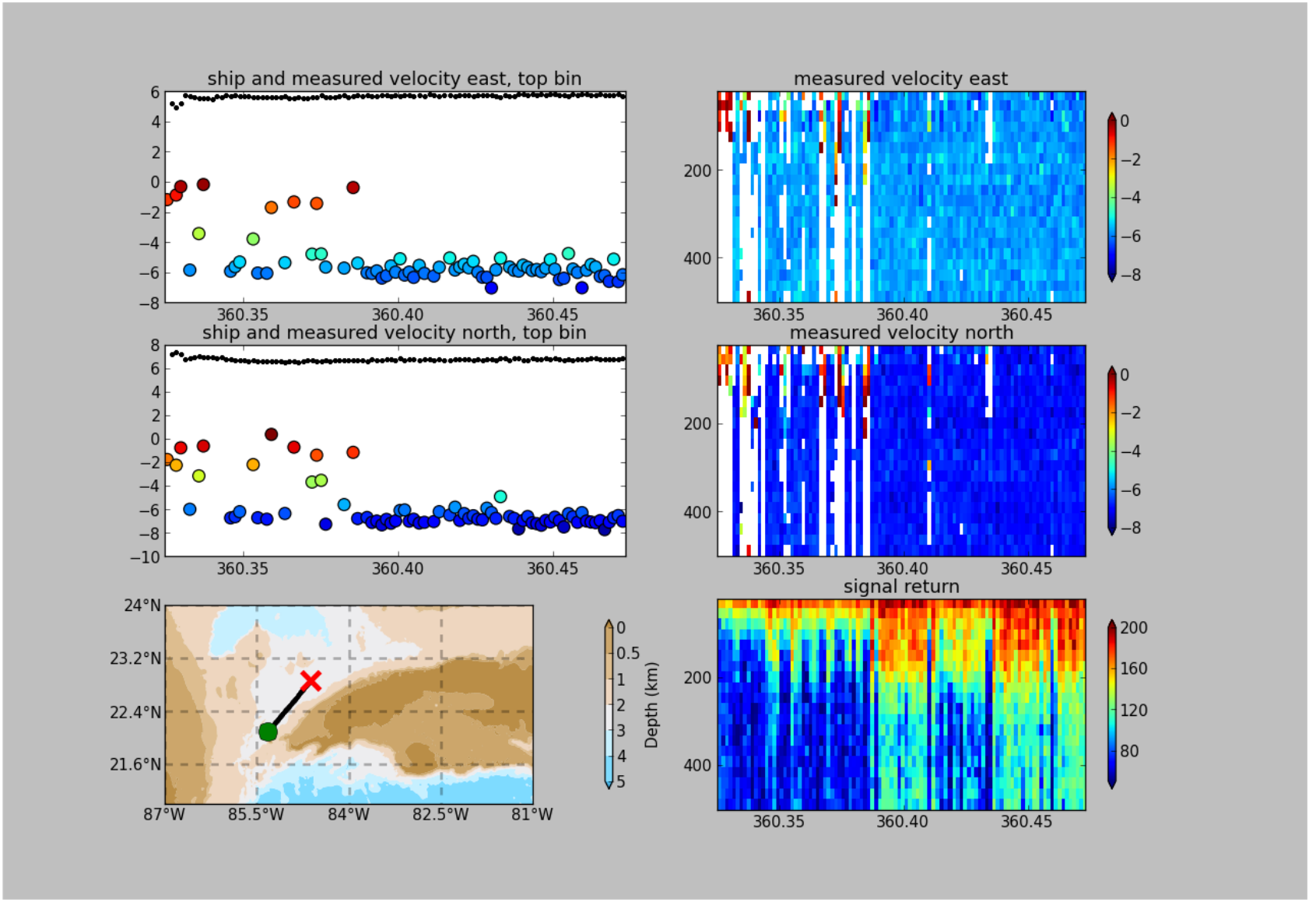



- interference from OS75 on OS150
- bias towards zero in measured velocity results in
  Bias “in the direction of motion” in ocean velocity
- ship was traveling Seattle-Honolulu, i.e. mostly southwest

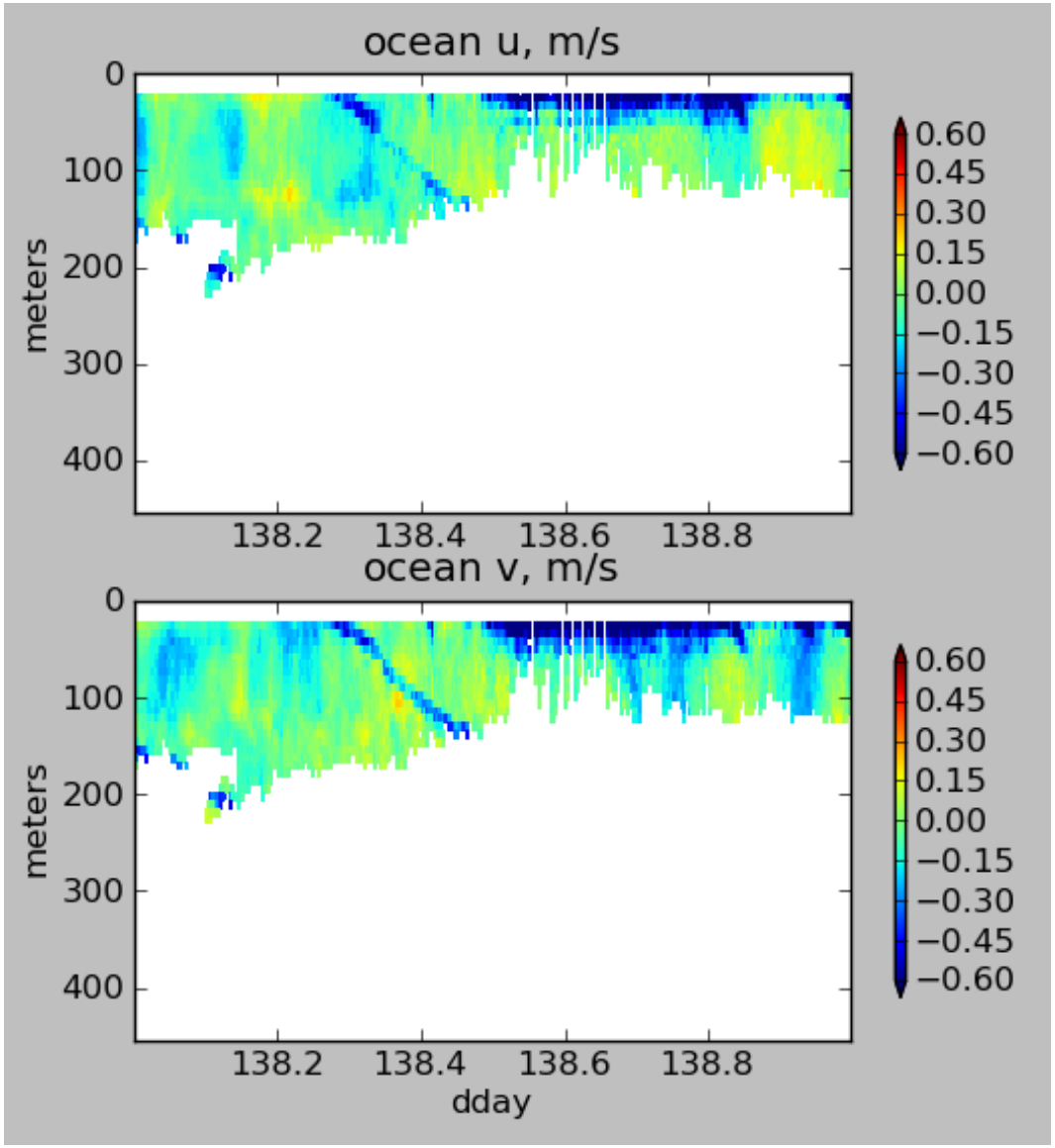
# Examples of along-track error

- Acoustic interference
- Underway bias (bad weather)
- Scale factor (NB150 soundspeed correction)

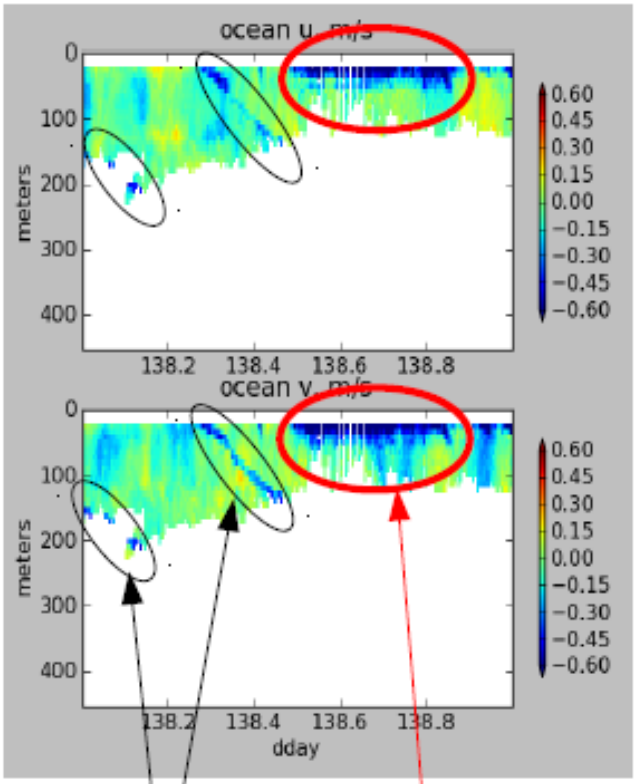
# single-ping editing:underway bias

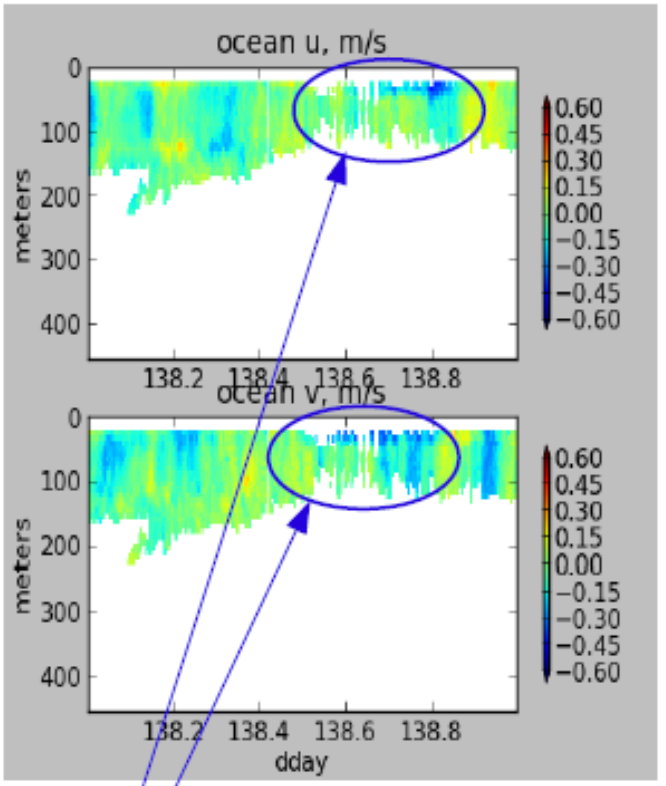


# Averaged (unedited) data:
# Acoustic interference and underway bias (bubbles)



# OS150 underway bias due to poor weather conditions




acoustic Interference from OS75 on OS150

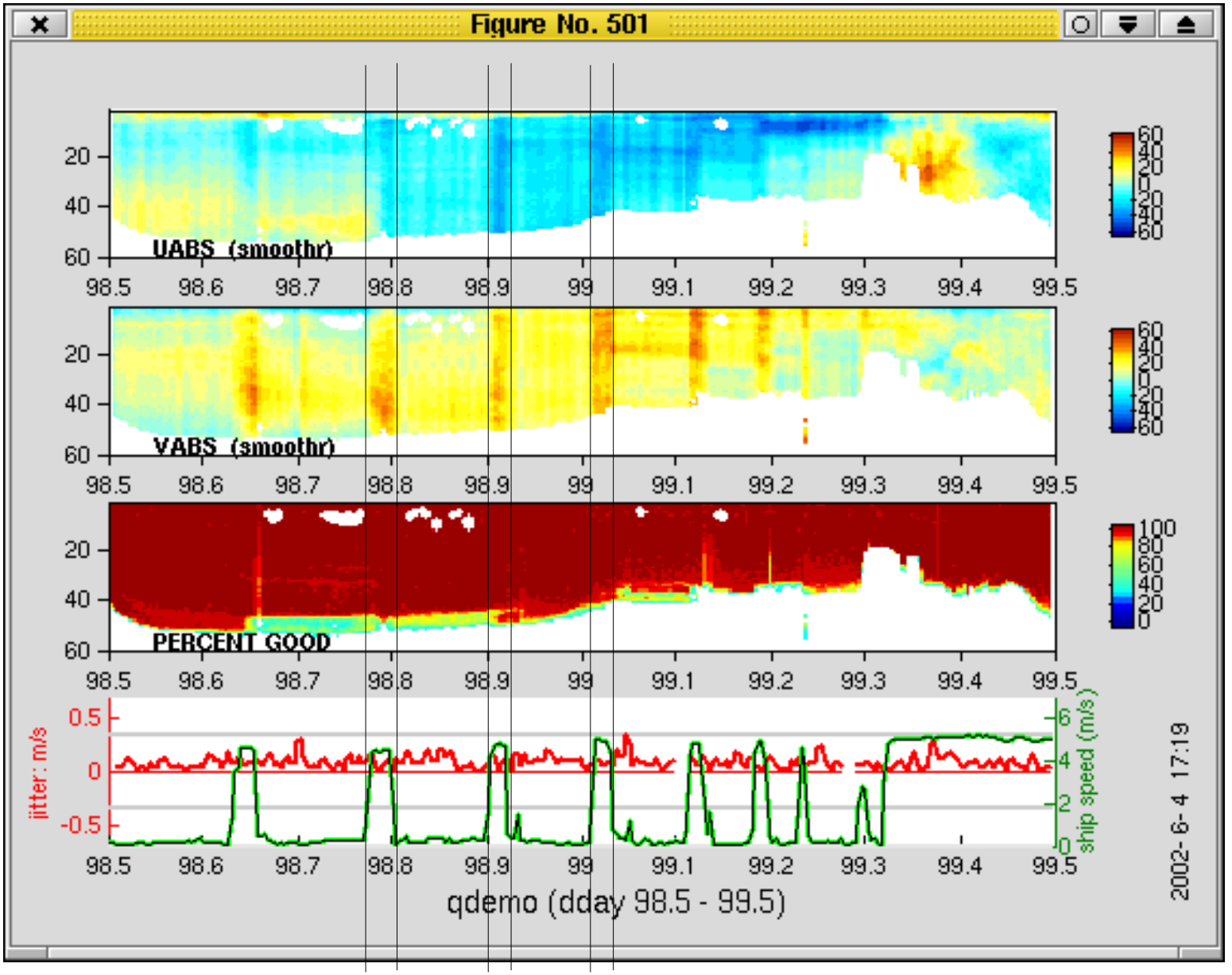
Biased pings mostly edited out, but manual post-processing is required

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

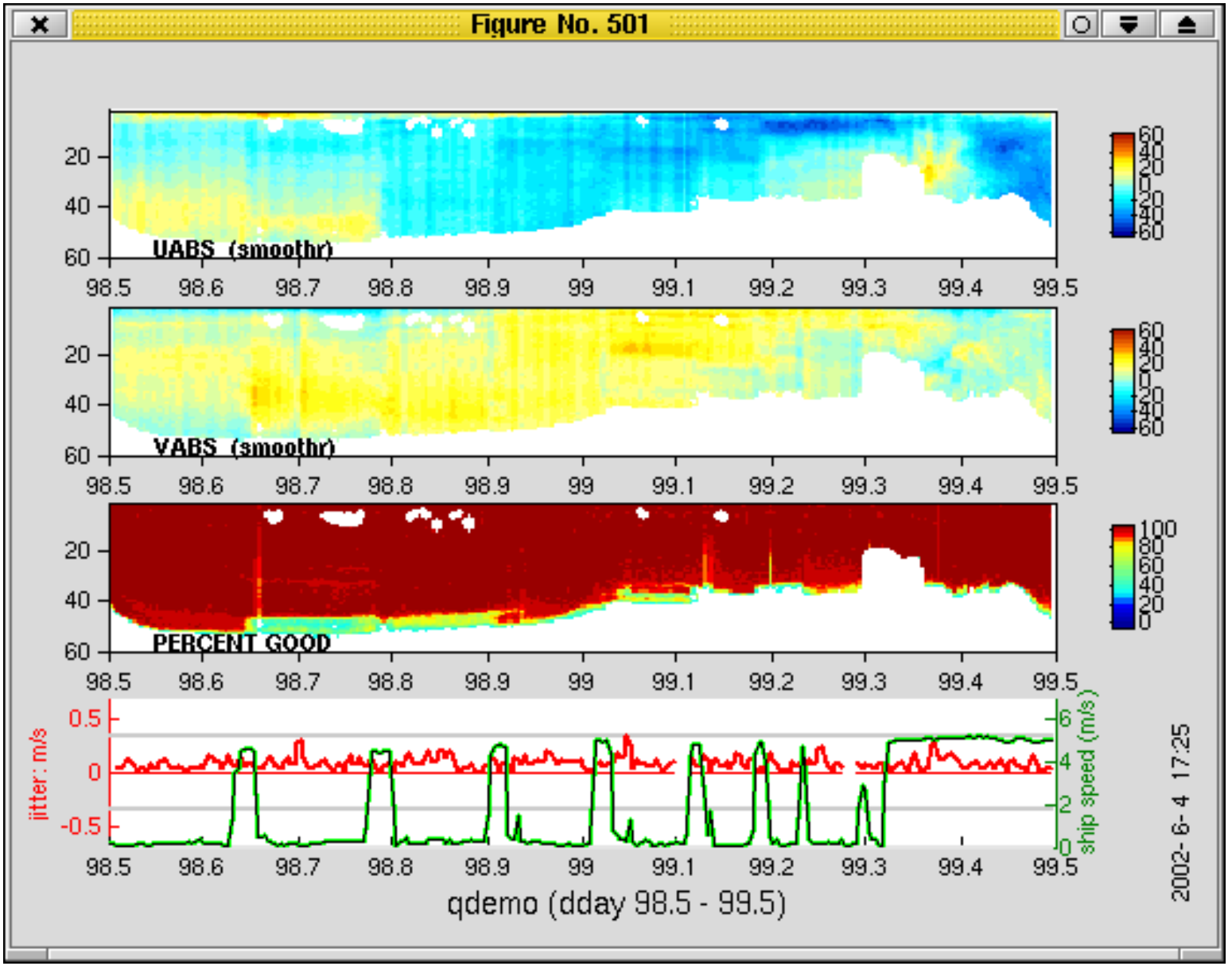
- Acoustic interference
- Underway bias (bad weather)
- Scale factor (NB150 soundspeed correction)

# scale factor: alongtrack bias




170: Things go wrong (scale factor, before)

# After scale factor applied




171: Things go wrong (scale factor, after)

# What can go wrong in the data product

(1) Cross-track error:

- recovery requires accurate heading
- could be related to bad transducer angle

(2) Along-track error:

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

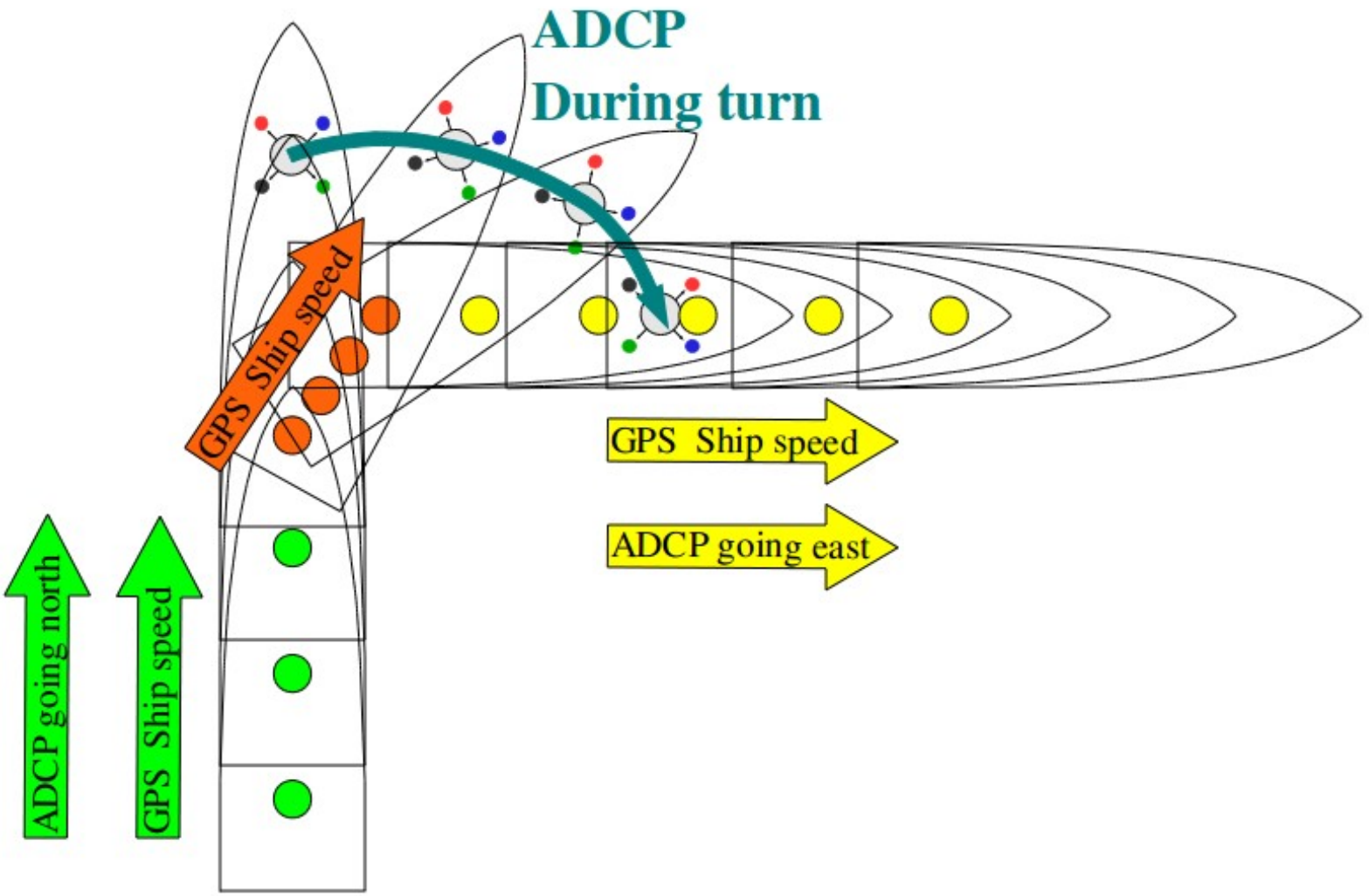
(3) Transition/maneuvering error

- Lag or offset in time or space.
- might need to input the GPS-ADCP offset

(4) Depth-dependent bias

- Surface along-track bias: ringing
- Surface? Deep? Could be electrical noise, could be acoustic

# Example: offset between ADCP and GPS creates an artifact during maneuvering

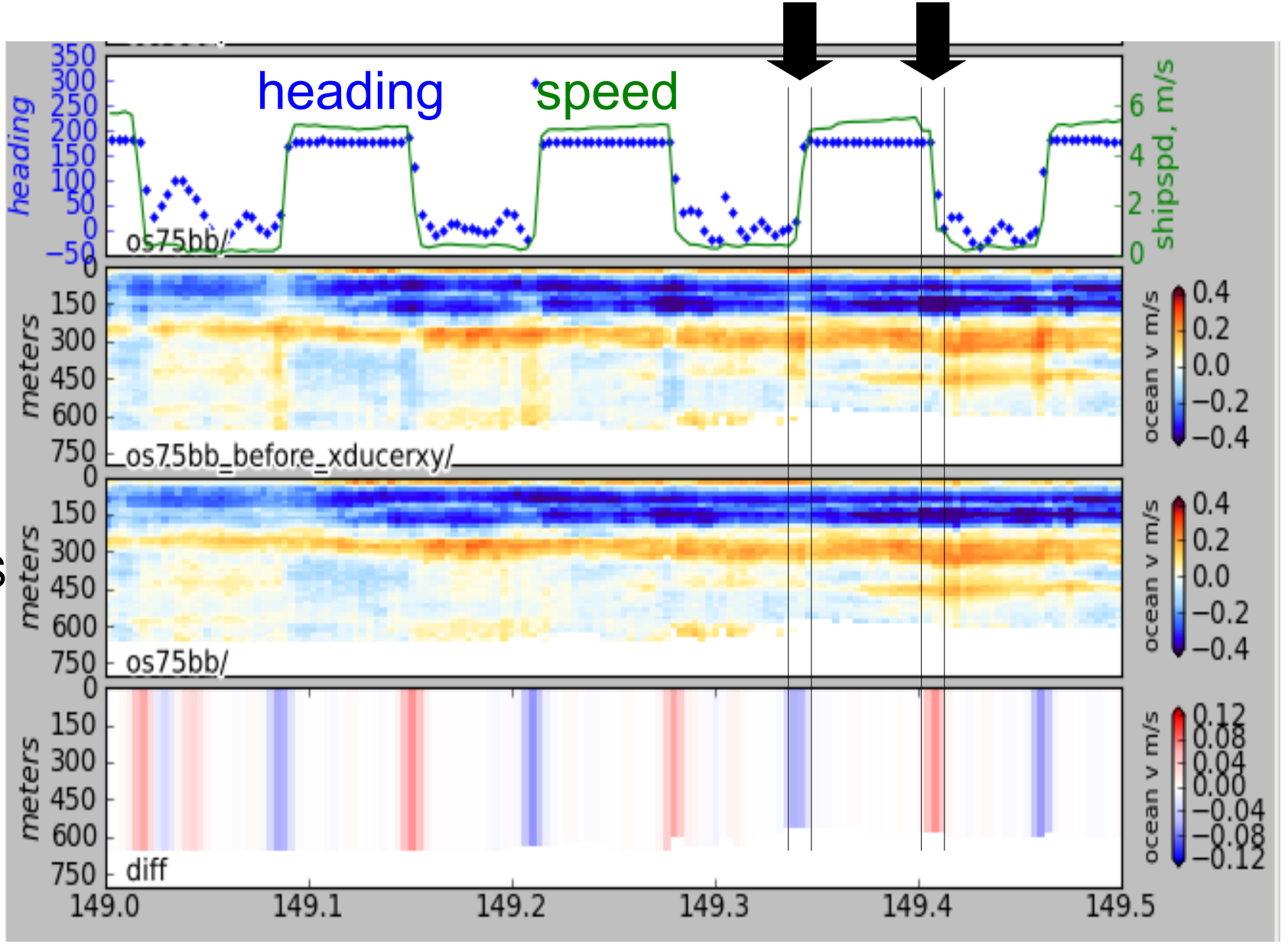


# Transducer offset from GPS--error occurs: **transition** between on-station and underway

...using actual location

...using shifted GPS location

difference



# What can go wrong in the data product

(1) Cross-track error:

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- may indicate a serious problem
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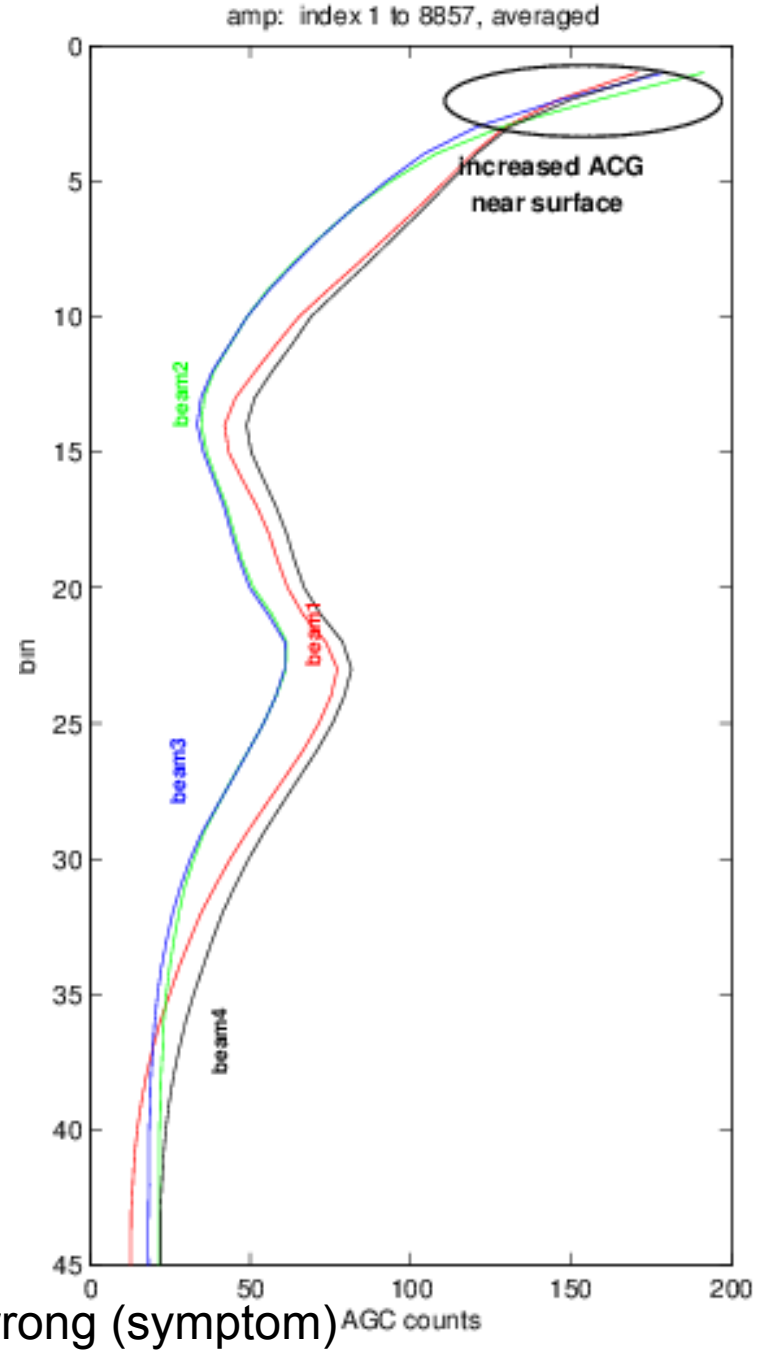
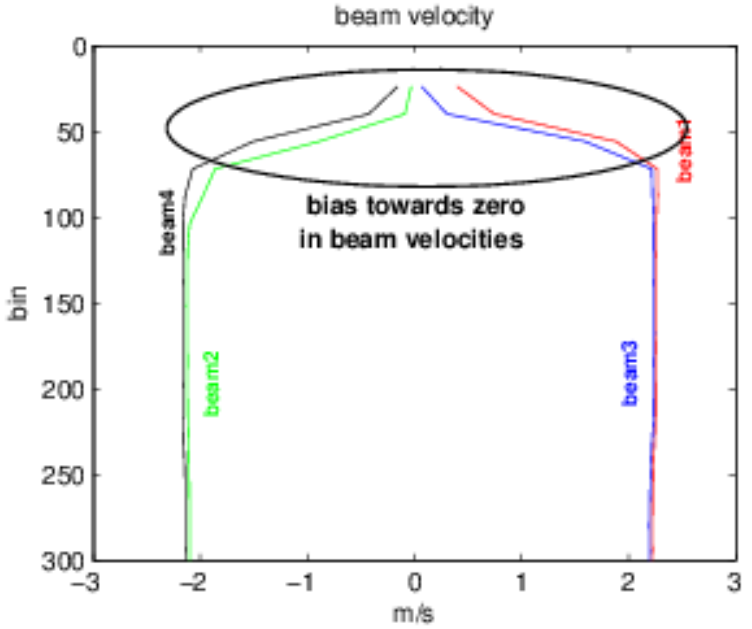
- Lag or offset in time or space.
- might need to input the GPS-ADCP offset

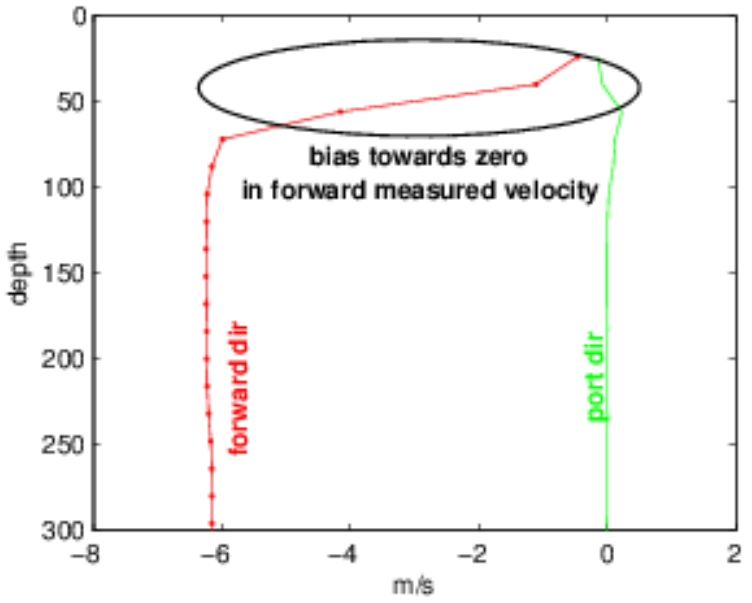
(4) Depth-dependent bias

- Surface along-track bias: ringing
- Surface? Deep? Could be electrical noise, could be acoustic

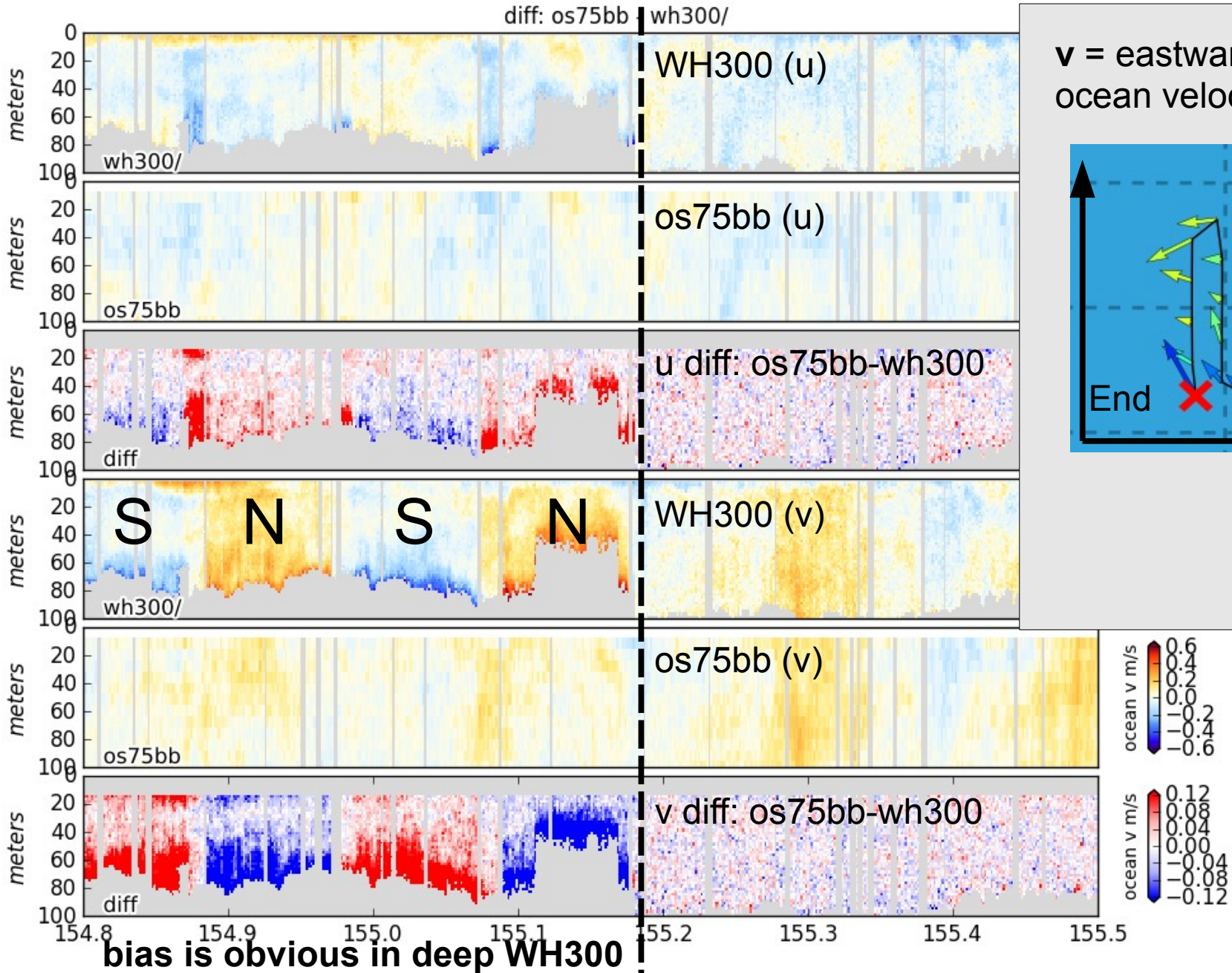
# Example of bias due to ringing



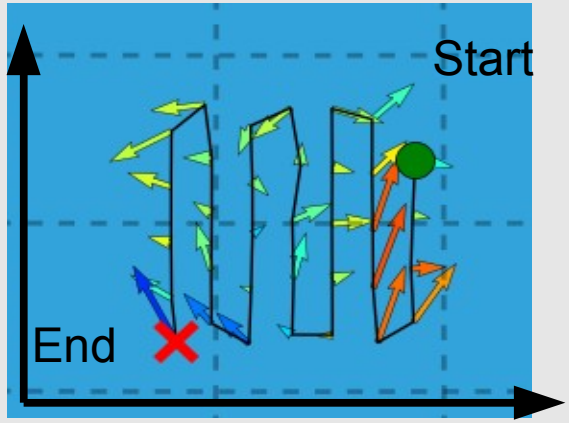



# Example of bias due to Electrical Noise




**v** = eastward ocean velocity



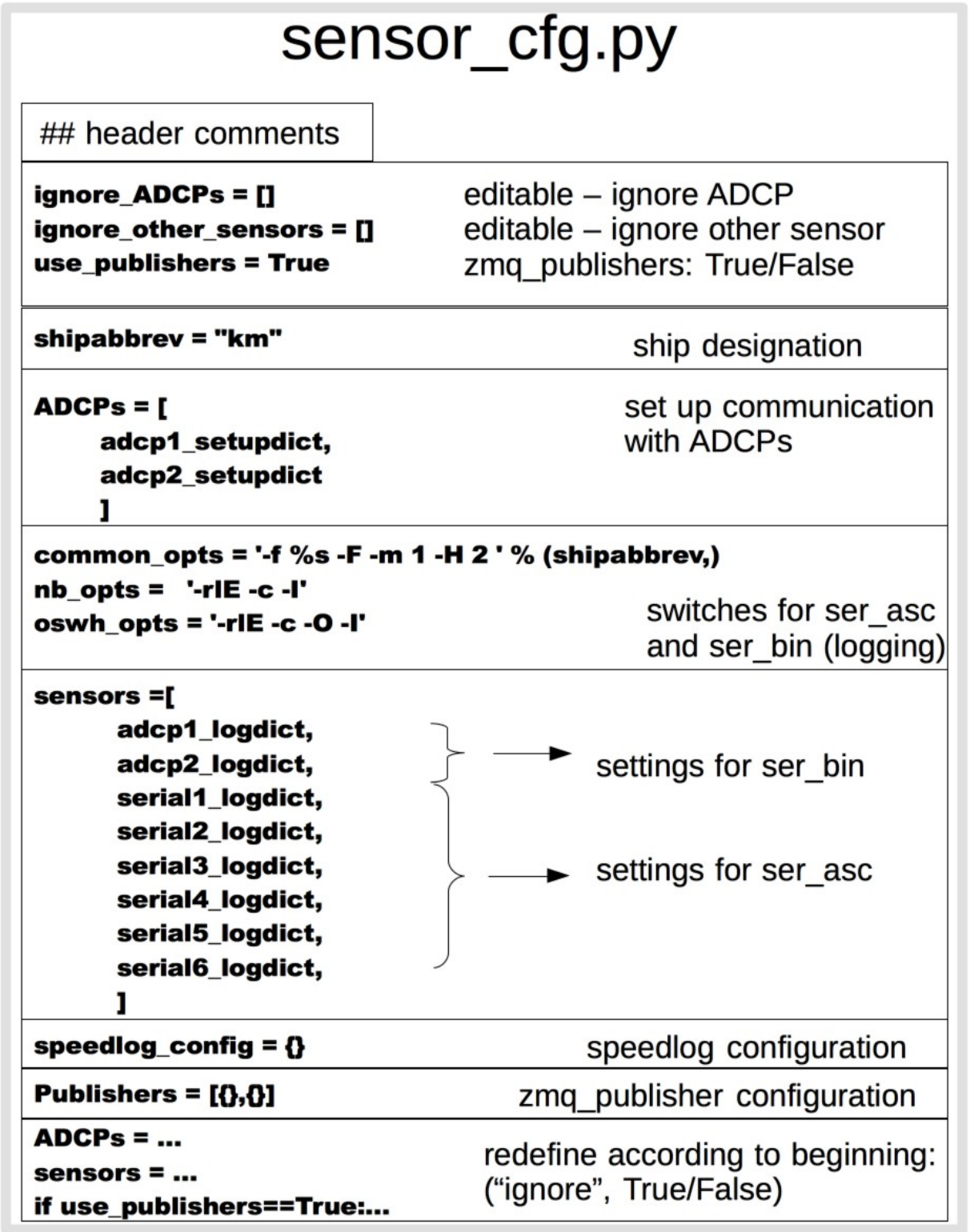

**u** = eastward ocean velocity

# Appendix

- **`sensor_cfg.py`** block diagrams

Block diagram of sensor_cfg.py

This is a python program.
Python is sensitive to
- Case
- Indentation
- Punctuation



# sensor_cfg.py : ADCP communications setup

```
adcp1_setupdict = {
  'instrument'  :  'os75',
  'setup'       :  'rdi_setup',
  'terminal'    :  'oswh_term',
  'defaultcmd'  :  'os75_default.cmd',
  'commands'    :  ('EA04500',),
  'datatypes'   :  ('os75bb', 'os75nb'),
  '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).

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

set up communication with ADCPs

**It is CRITICAL to get the EA command in the right ballpark. A bad specification can irrevocably damage the data. The Python program "EA_estimator.py" may help.**

# sensor_cfg.py: diagram for passive serial logging setup

```
adcp1_logdict = {
   'instrument' : 'os75',
   'device'     : 'ttyUSB3',
   'baud'       : 38400,
   'format'     : 'binary',
   'subdir'     : 'os38',
   'ext'        : 'raw',
   'opt'        : oswh_opts
   }
```

Two editable fields:

- 'device' → serial port [0,1,2,...7]
- 'baud' → baud rate

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

Two editable fields:

- 'device' → serial port
- 'baud' → baud rate

These are related to processing... TAKE CARE

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

- adcp1_logdict, adcp2_logdict → settings for ser_bin
- serial1_logdict, serial2_logdict, serial3_logdict, serial4_logdict, serial5_logdict, serial6_logdict → settings for ser_asc