Improving ADCP Data Quality

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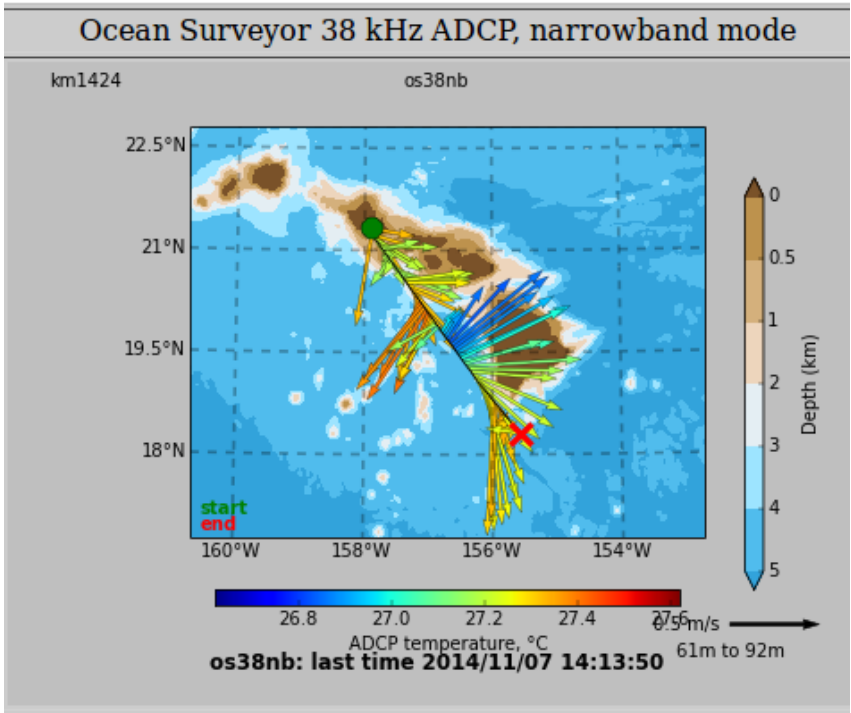
Outline:

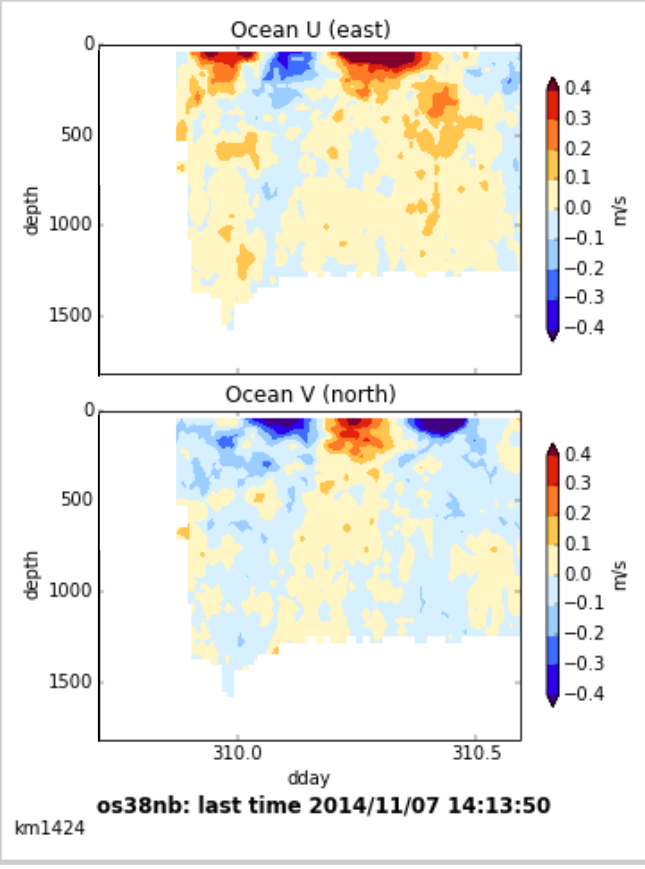
- ADCP system: required components
- Approach to Data Acquisition
- Overview of UHDAS
- Overview of CODAS processing
- Errors in ADCP data

ADCP System:
Required Components

- ADCP, GPS position, Heading
- Data Acquisition System
  (eg. VmDAS, UHDAS)
  - acquire and timestamp data
- Processing
  - match serial to ADCP
  - transform into E/W coords
  - edit, average
  - display

Result: Ocean Currents

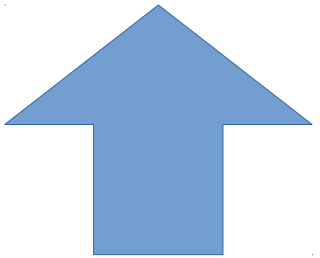




Approach to ADCP data

(1) Physical Components are competent

- ADCP installation (reduce bubbles, noise)
- GPS (no big drifts or jumps)
- Accurate heading device (0.1-0.2 degree error)



important

Approach to ADCP data

(2) Data acquisition is competent

- log multiple serial devices for each component
- good timestamp
- serial feed straight from the instrument (NO computer-generated messages)
  - 2 GPS feeds
  - 2 headings:
    - reliable (eg. gyro)
    - accurate (eg. POSMV, Seapath, Ashtech, CODA-F185)

Approach to ADCP data

(3) Keep these goals in mind:

- Ensure everything requested is actually logged
- At-sea system should be
  - **repeatable** (can get back to good settings)
  - **reliable** (all components are there, no gaps or glitches)
  - **reasonable** (at-sea values = good working values)
- After the cruise, more work can be done to make the data better (post-processing/re-processing)

Approach to ADCP data

(4) Monitor: (Something will break)

- minimize downtime (gaps)
- have a fallback (switch to other feeds)
- catch mistakes (eg. bad settings) quickly

Overview of UHDAS

- UHDAS (**U**niv. **H**awaii **D**ata **A**cquisition **S**ystem)
- written, developed, maintained at Univ. Hawaii
- installed on 24 ships (19 UNOLS, 1 USCG, 2 NOAA[(*)]+2)
- first installed 2003 (Kilo Moana)
- supports RDI ADCPs (multiple, same computer)
- presently using Xubuntu 14.04
- written in C, Python
- leverages CODAS processing (also Univ. Hawaii)

(*) Funded to expand to NOAA ships

UHDAS:
What does it do?

- Data Acquisition
- Data Processing **(CODAS**)

  http://currents.soest.hawaii.edu/docs/adcp_doc/index.html
- Create and display data products (on ship)

  http://currents.soest.hawaii.edu/uhdas_fromships/kilomoana_atseaweb/index.html
- Monitoring (at sea and on shore)

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

Overview of CODAS Processing

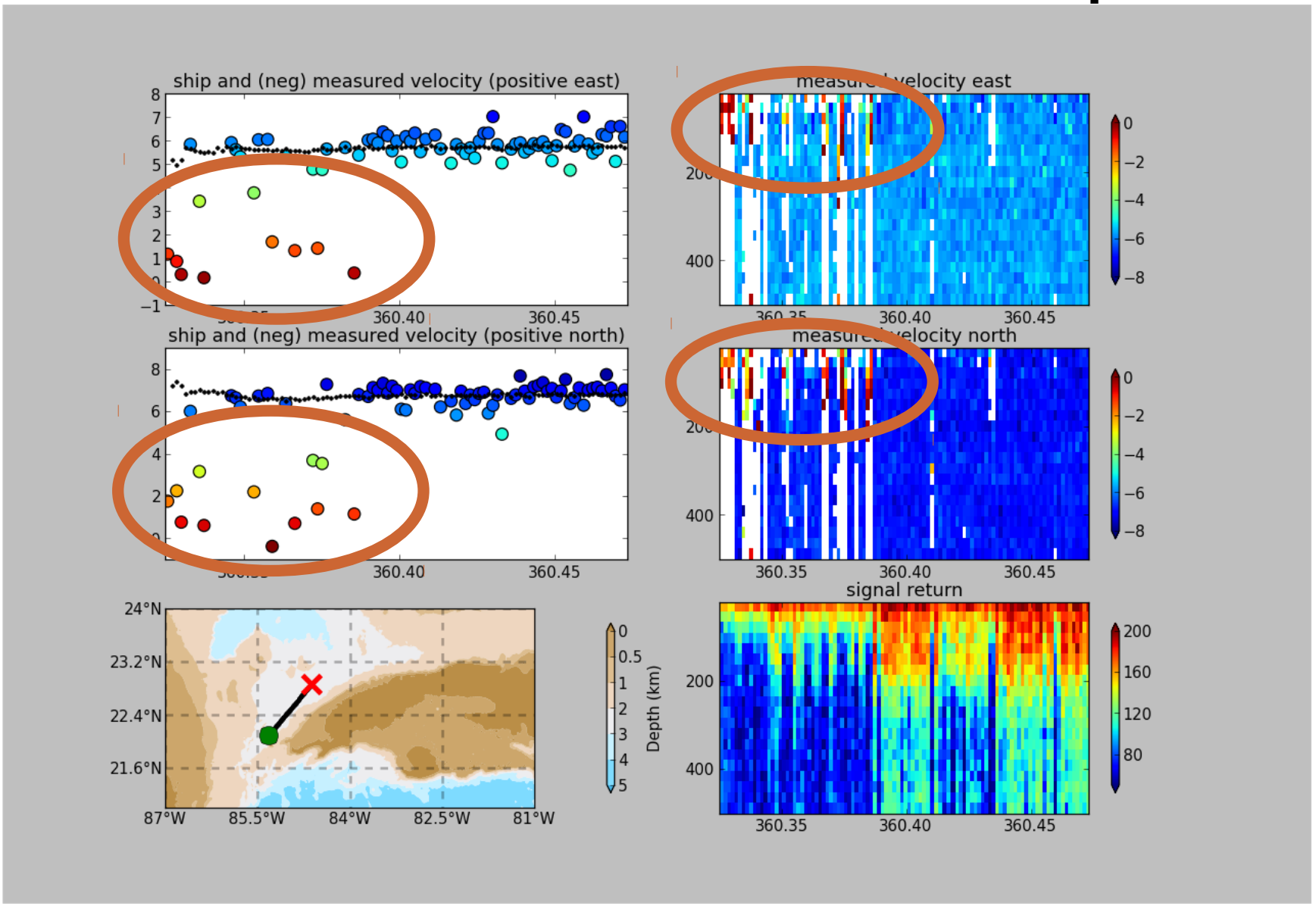
- Open-Source; runs on Linux, Mac OSX, Windows
- Automated single-ping editing before averaging:
  - thresholds
  - acoustic interference from other instruments
  - short, biased profiles (bubbles/bad weather)
- Time-dependent heading correction
  - gyro is reliable, accurate devices are (often) less reliable
- calibration of transducer angle
  - watertrack, bottomtrack
- graphical editor used in postprocessing

Errors in ADCP data

- Random:
  - solution: average more pings for good resolution
  - (decreased ping rate makes fuzzy velocities)
- Non-Random:
  - electrical noise (try to remove it at the source)
  - acoustic interference:
    - CODAS can often edit out before averaging
    - (come to Acoustic Interference session for more discussion)
  - short, biased profiles (bubbles)

Example...

Errors in ADCP data:
Bubbles cause short, biased profiles

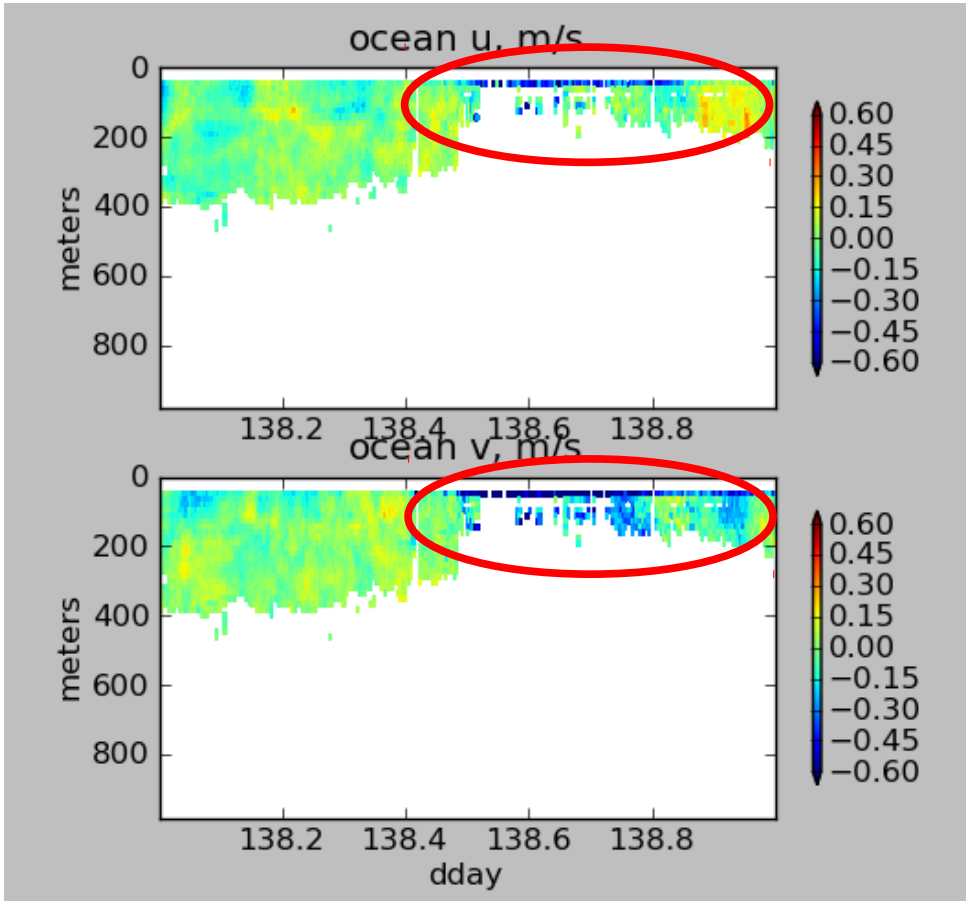


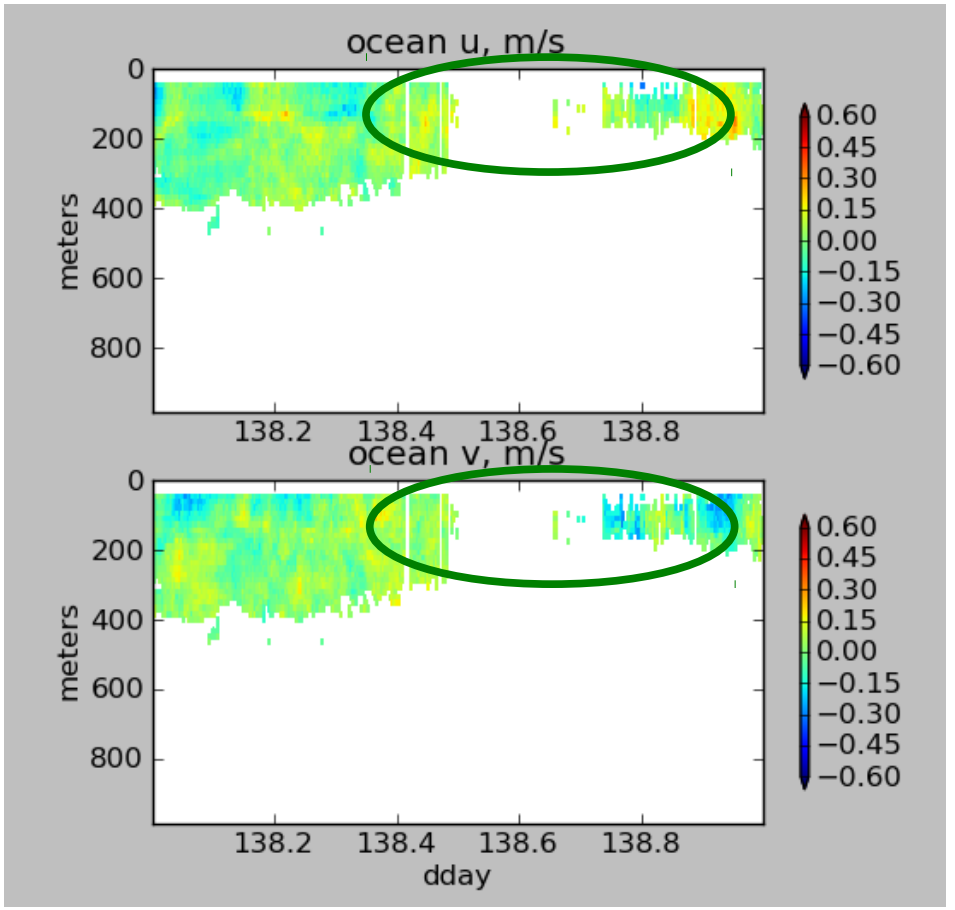
VmDAS LTA averages

(no single-ping editing)

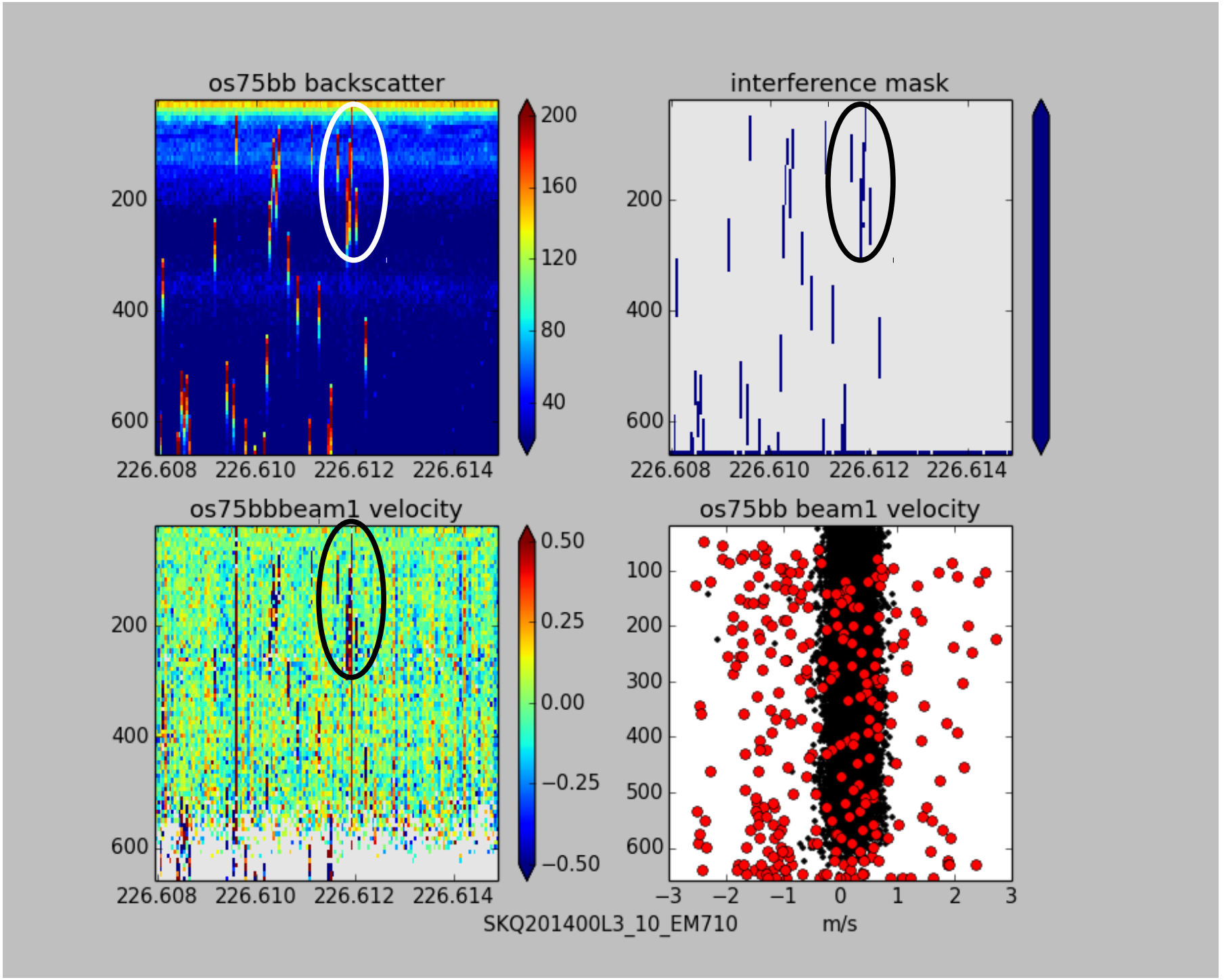
UHDAS (CODAS) averages

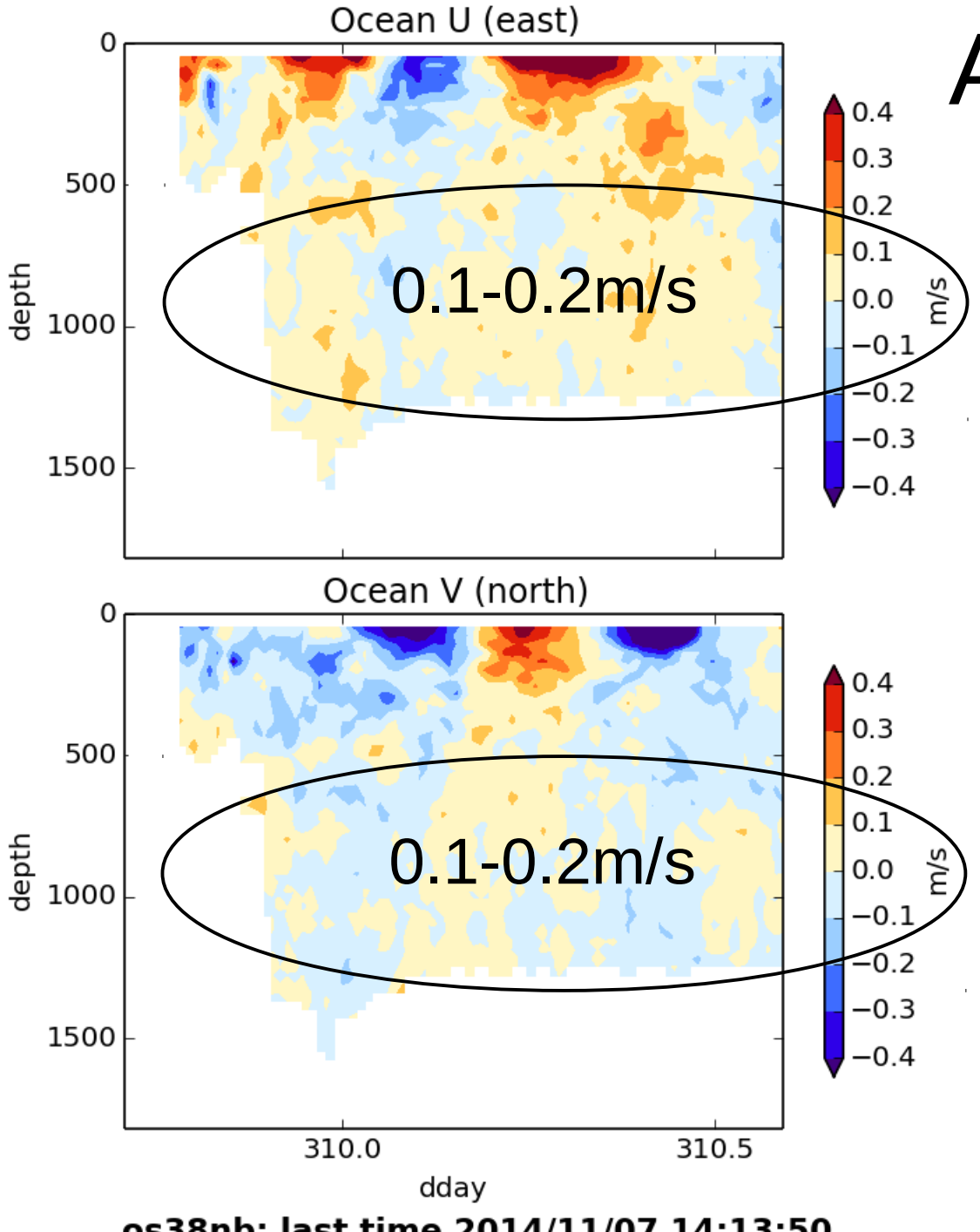
(after single-ping editing)





CODAS processing algorithm removes **acoustic interference** for FREE-RUNNING ADCP





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Accurate Heading

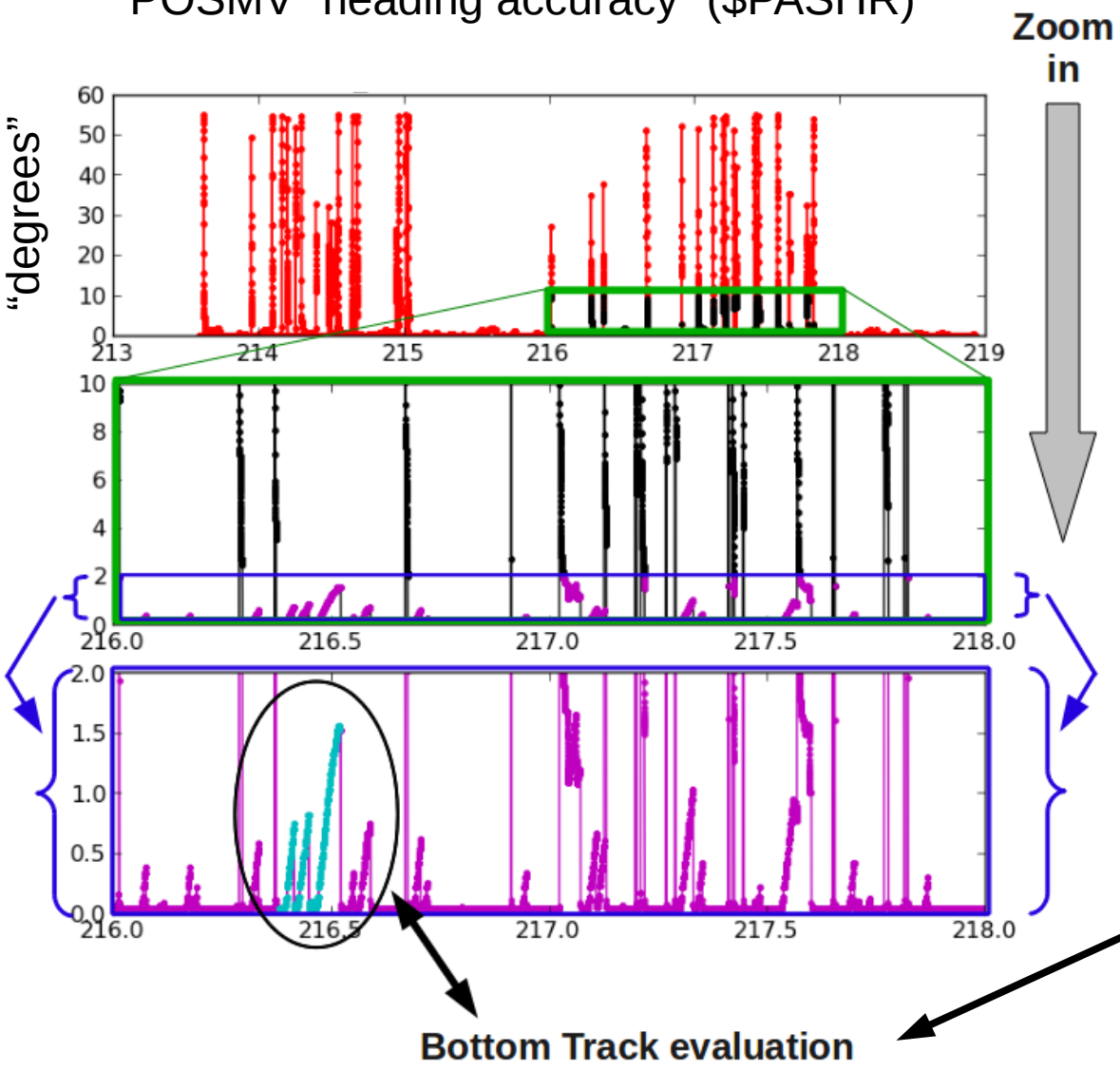
Typical subsurface open ocean speeds 0.1-0.2m/s

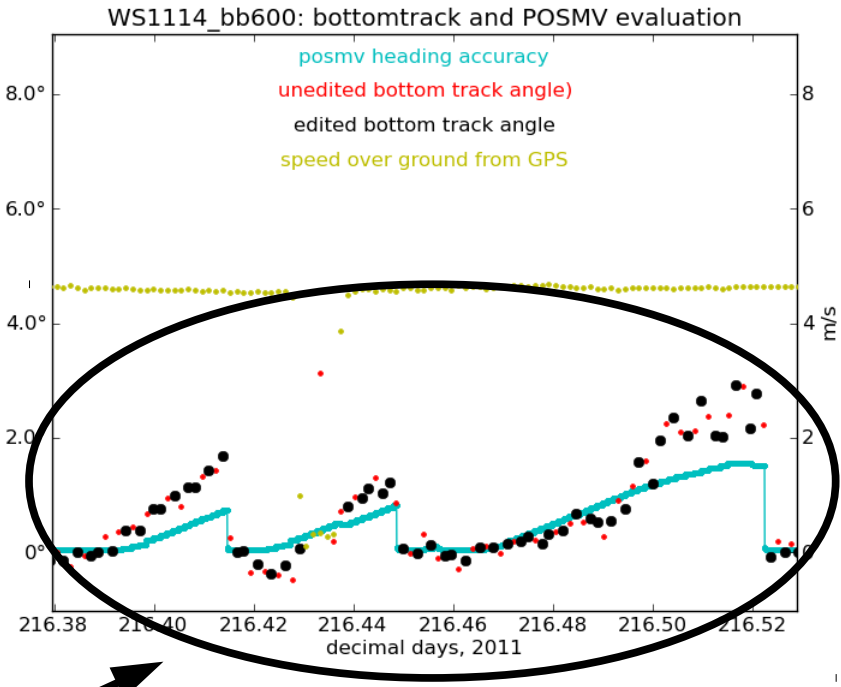
At 10kts:
1 degree heading error:
- cross-track direction
- 0.1m/s

REDUCE cross-track biases by using an accurate heading device, good to 0.1deg

Always record Quality Flags

POSMV “heading accuracy” ($PASHR)





Summary

- Improve the components
- Log multiple sources for ancillary data
- Get an accurate heading device
- Monitor the system
- post-processing can improve final data (eg. CODAS processing)