Oceanography Seminar
Naval Postgraduate School
Jan 30, 2012

ADCP Acquisition, Processing, and Monitoring on Oceanographic Research Vessels

UHDAS + CODAS Documentation

http://currents.soest.hawaii.edu/docs/adcp_doc/index.html

Outline

1. ADCP
2. Processing (“CODAS”)
3. UHDAS
    - Acquisition
    - Processing
    - Monitoring:
        - At Sea
        - On Land
4. Oceanography

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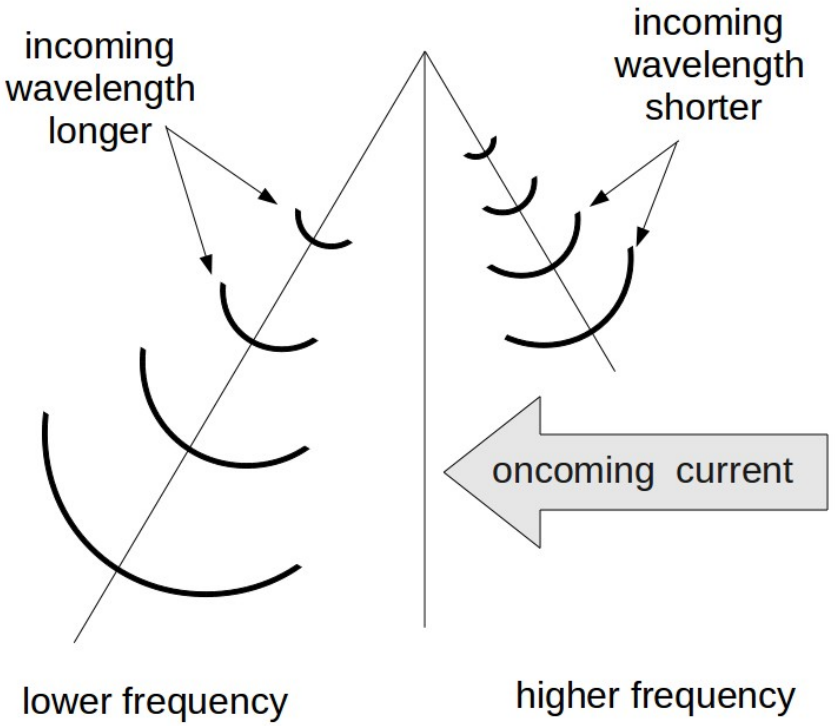
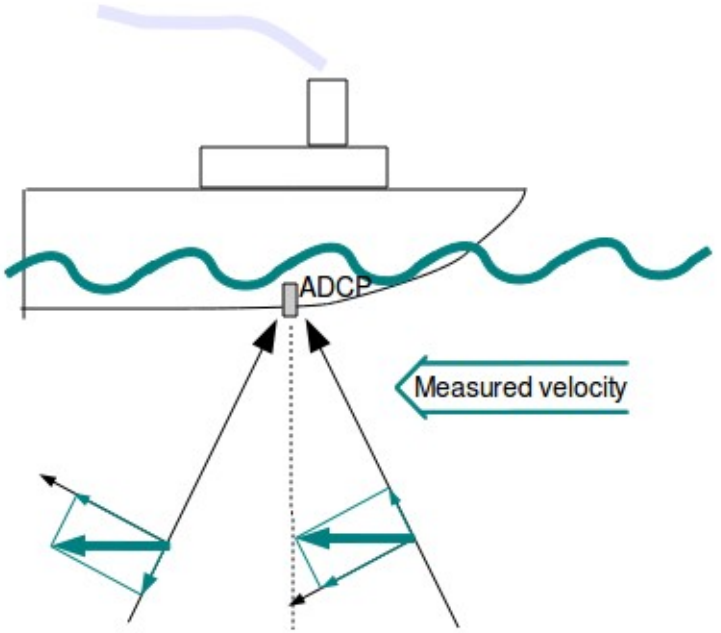
ADCP: **A**coustic **D**oppler **C**urrent **P**rofiler

Doppler Shift

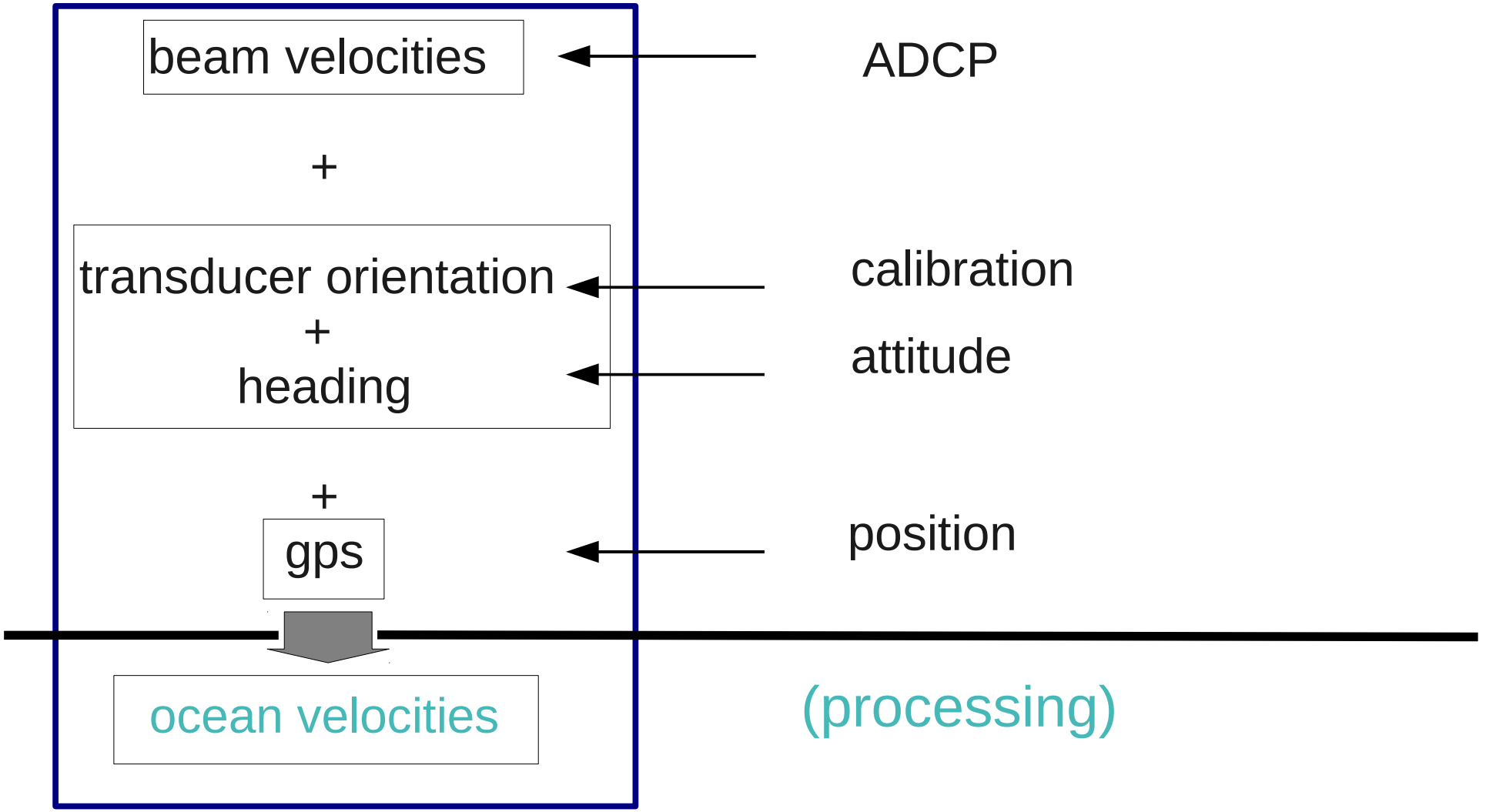


soundspeed = frequency X wavelength
(ocean) (instrument)

Hull-Mounted



ADCP: Data components



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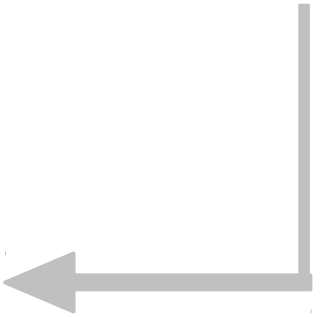
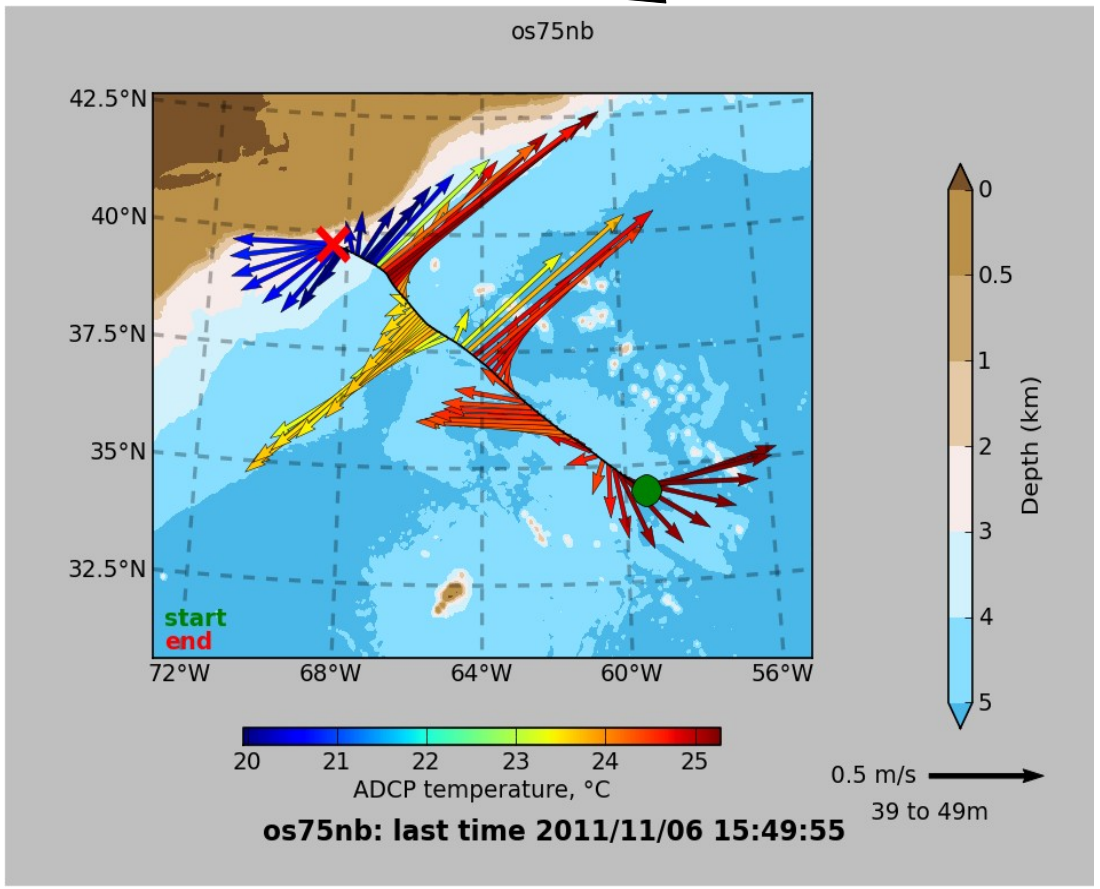
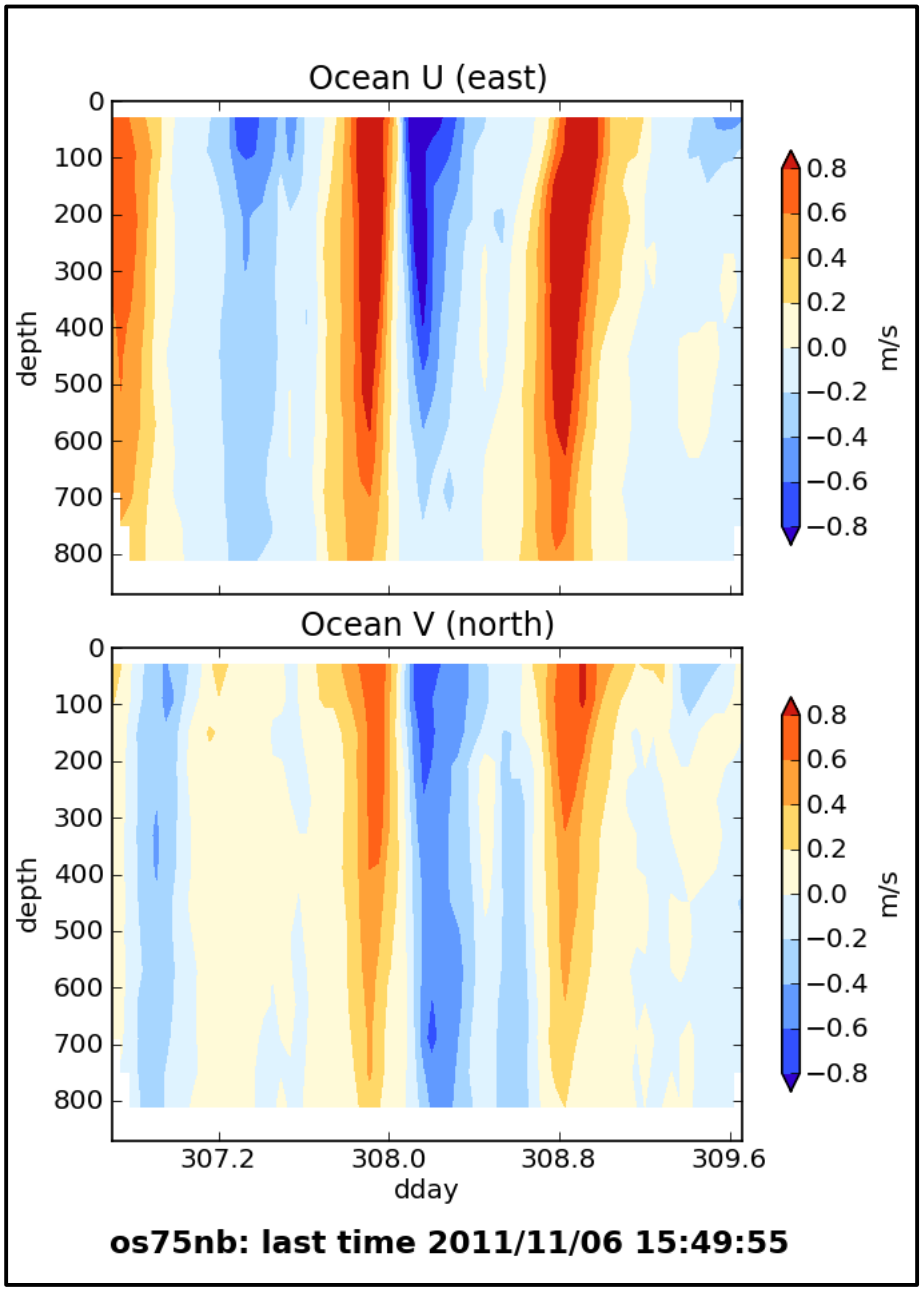


CODAS Processing

Time, ADCP, Position, Attitude

primitive (raw) data





“CODAS” ADCP Processing

Goals

- run on multiple operating systems (Windows, OSX, linux)
- open source
- now free (Python) or Matlab

Processing

- written for ADCP data
- works on most ADCP data acquisition systems
- balance real-time product with recoverable dataset
- single-ping editing
- calibration

CODAS = “**C**ommon **O**cean **D**ata **A**ccess **S**ystem”

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CODAS = “**C**ommon **O**cean **D**ata **A**ccess **S**ystem”

ADCP Single-ping Editing

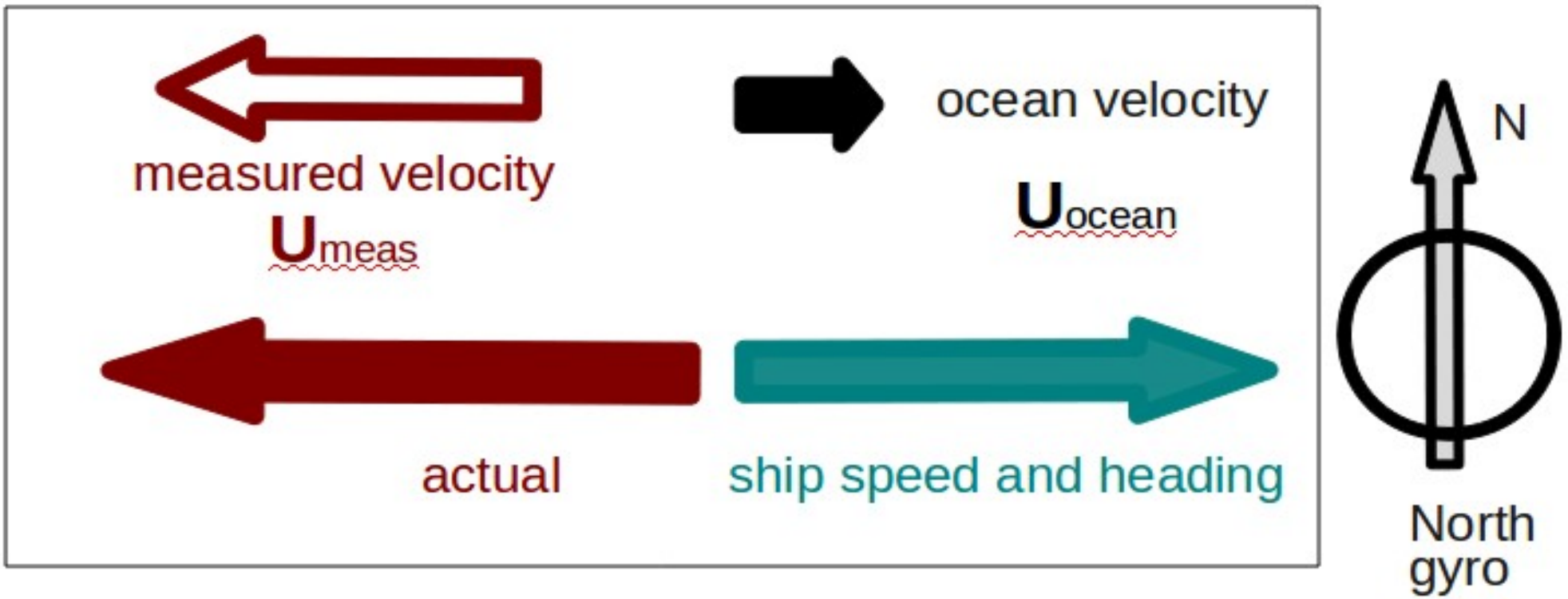
The most common causes of error
(addressed by single-ping editing)

- Acoustic Interference
- Bubbles

Both tend to cause bias towards zero
in measured velocity

Bias towards zero in measured velocity

Alongtrack bias in ocean velocity



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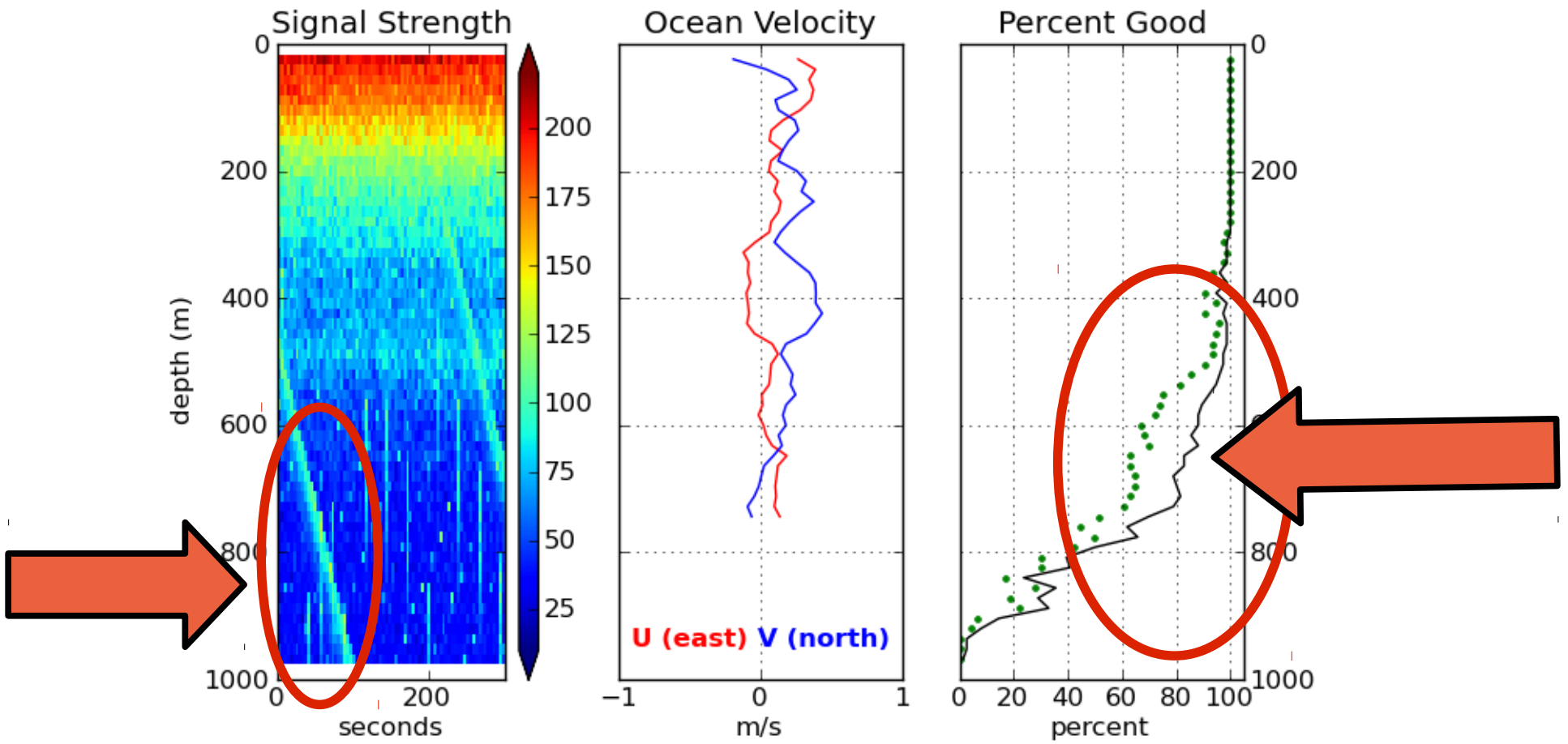
ADCP Processing

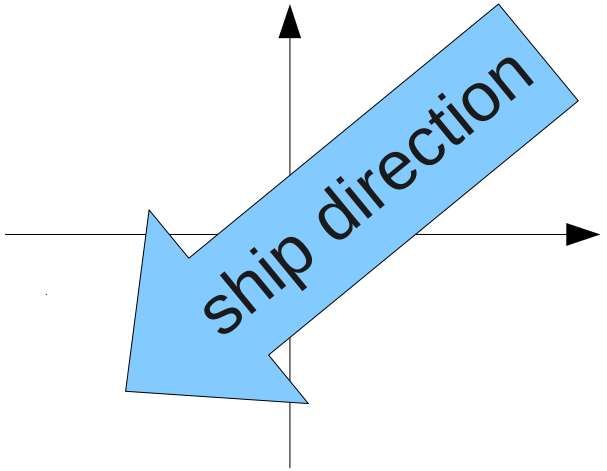
Singleping editing: acoustic interference

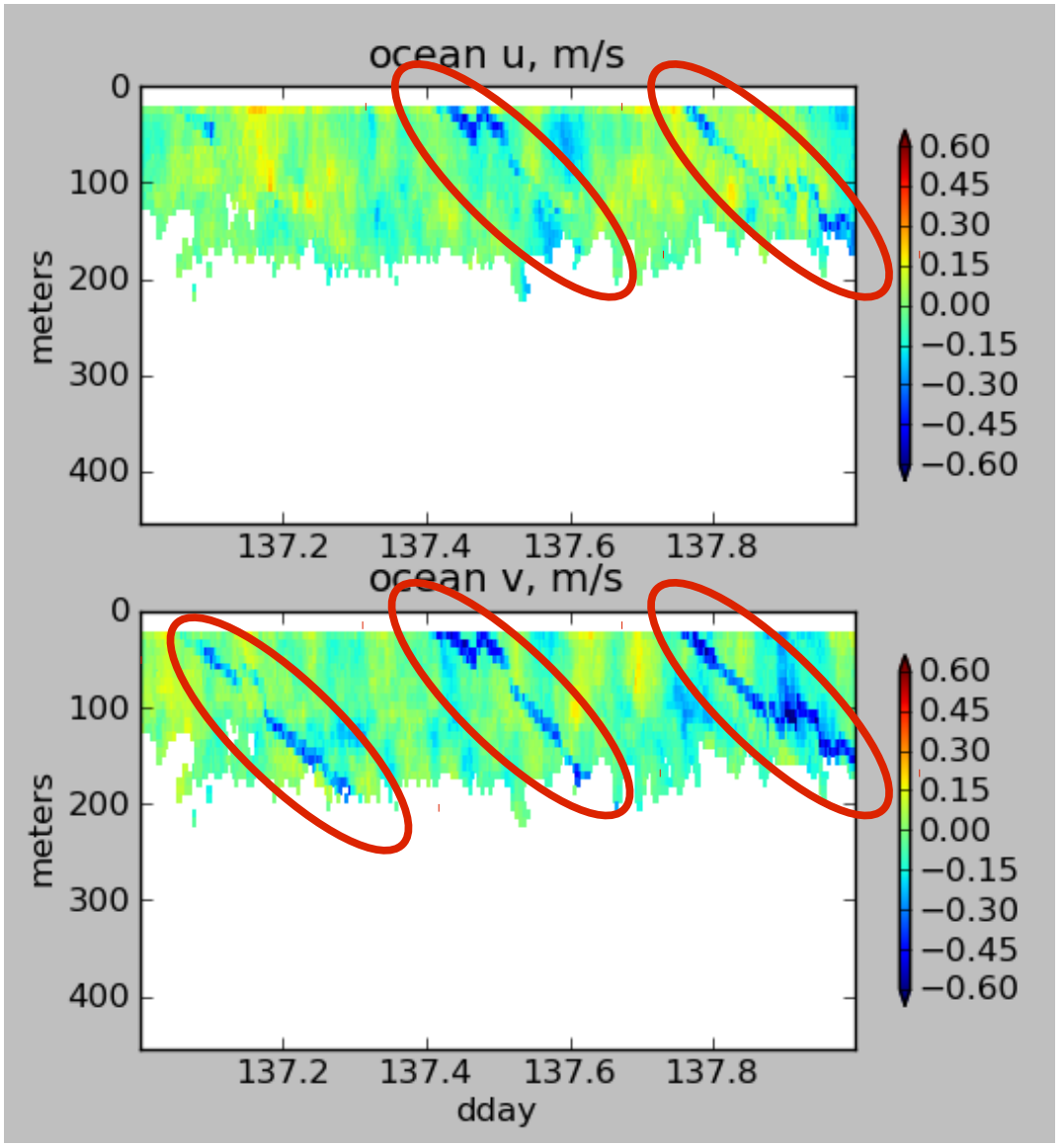


ADCP Processing **without** singleping editing

Averaged
ocean velocities

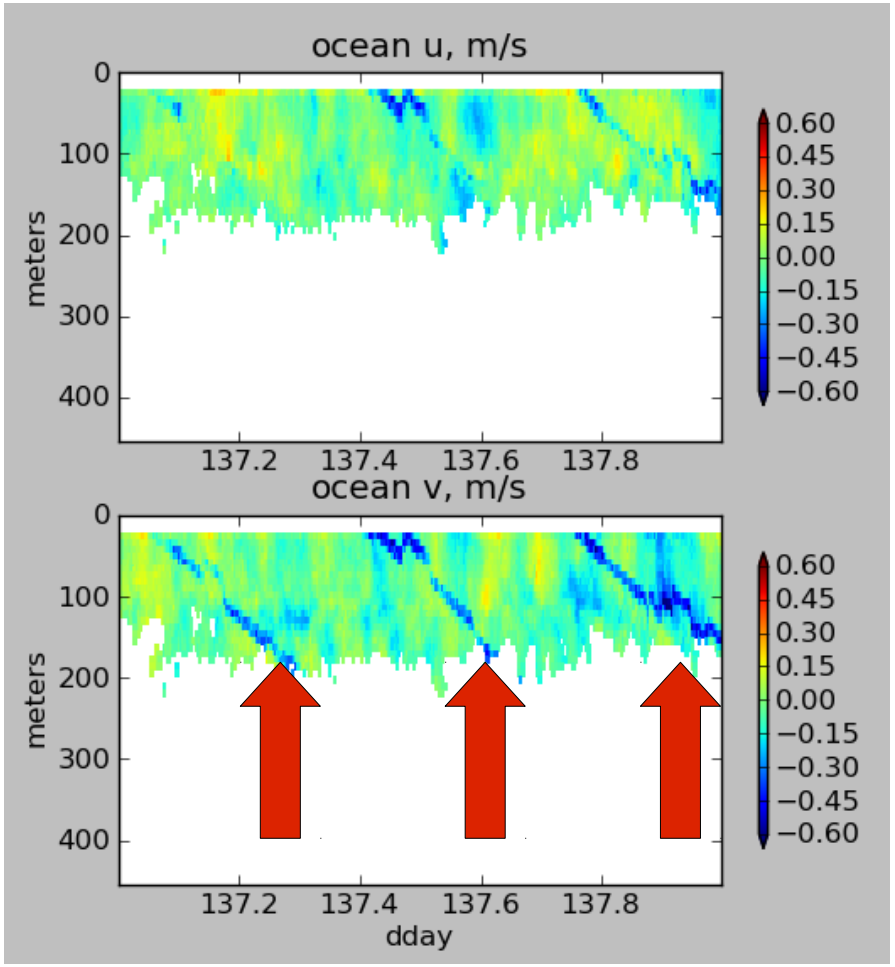
NOTE: along-track
direction bias



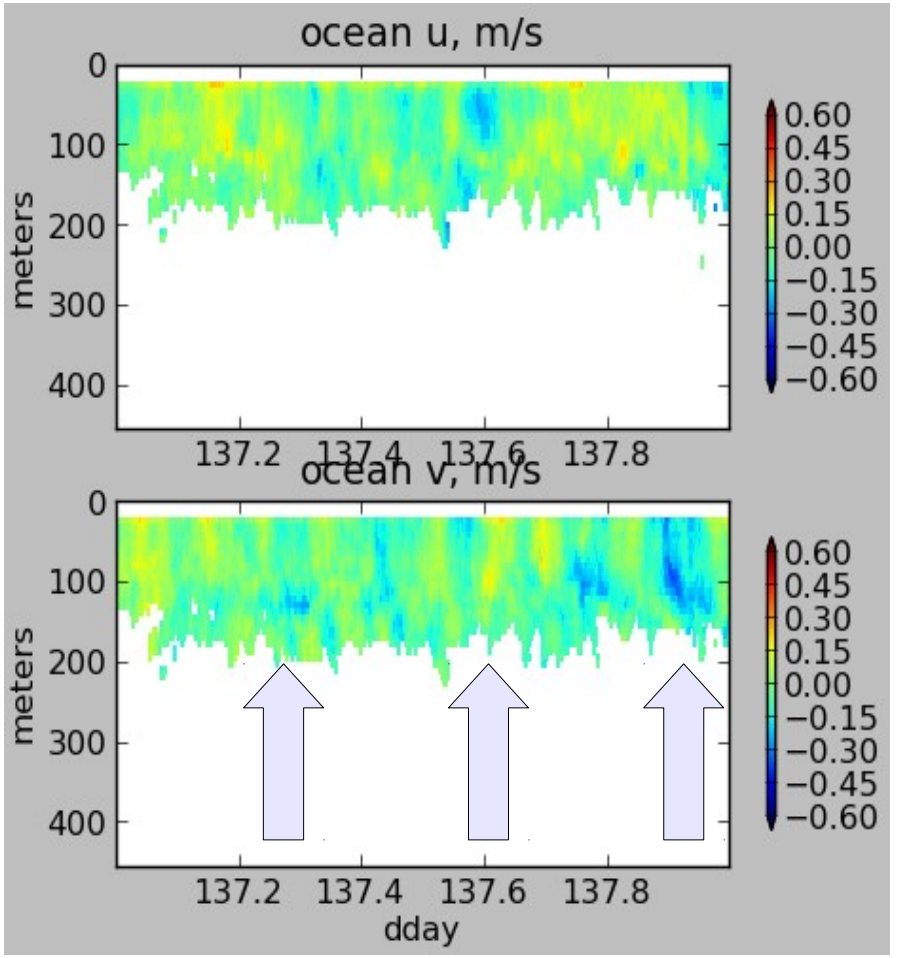


ADCP Processing: acoustic interference

WITHOUT
singleping editing



USING
singleping editing



ADCP Single-ping Editing

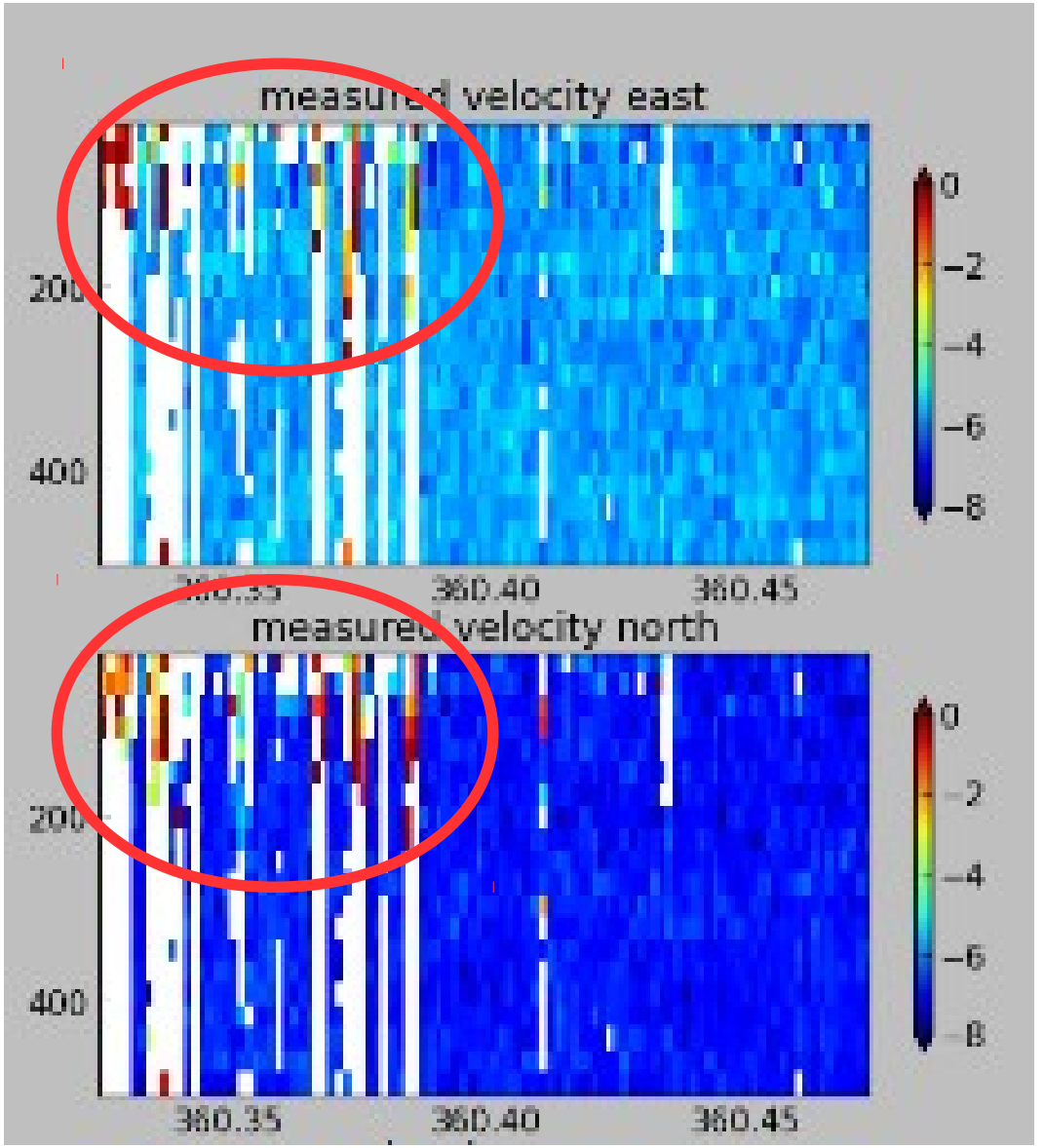
The most common causes of error (addressed by single-ping editing)

- Acoustic Interference
- Bubbles

ADCP Data: effect of bubbles

Bubbles:
- short profiles
- strongly biased towards zero

Untreated:
- biased ocean velocities

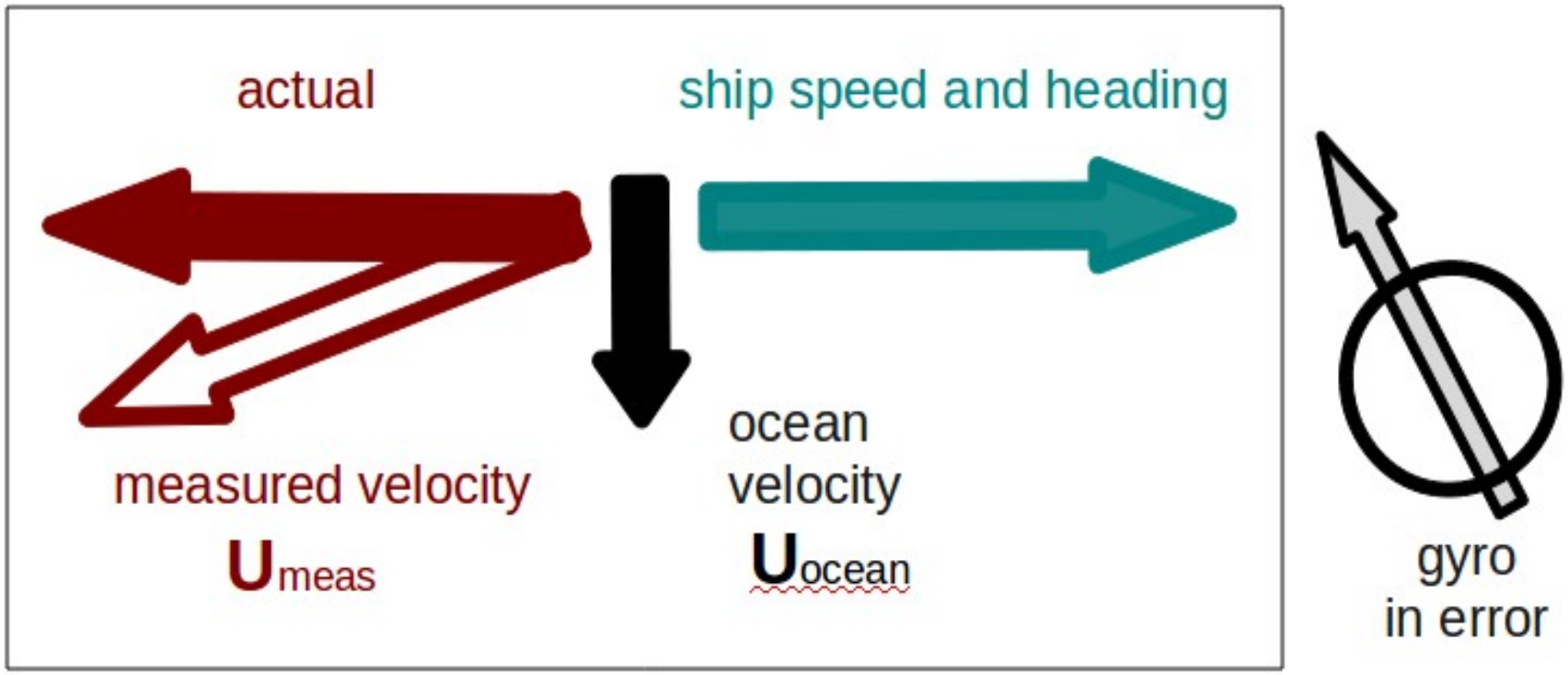


CODAS Processing: Calibration

- After single-ping editing, create averages
- Calibration of averaged data:
  - (remaining) alongtrack bias (scale factor)
    - Soundspeed (single-ceramic transducers only)
  - Cross-track error (angle error)
    - Incorrect transducer angle (constant)
    - Inaccurate heading (time-varying)

Calibration: Angle Error

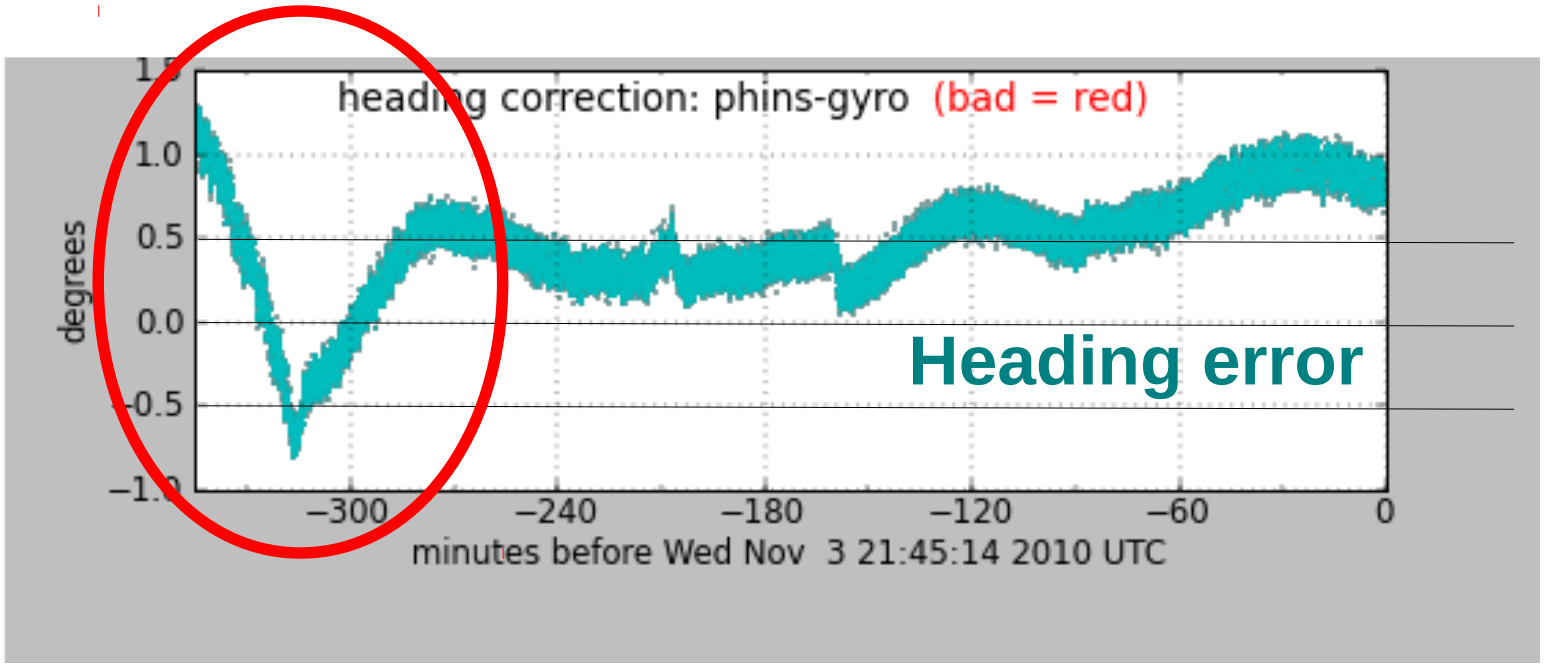
Cross-track bias in ocean velocity from angle error:
(heading + transducer angle)



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



0.5 deg
0.0 deg
-0.5 deg

Changes in ship's heading affect heading error

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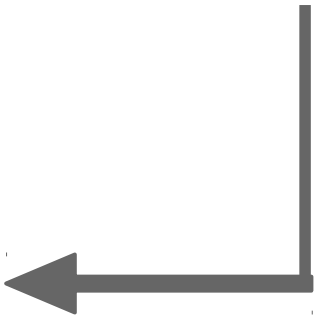


UHDAS: What it does

- **(1) Data Acquisition**
  - Gather and timestamp data
    - ADCP
    - Position, attitude
- **(2) Processing**
  - parse NMEA messages
  - grid NMEA messages
  - all CODAS processing

UHDAS: What it does:

(3) Data Access...

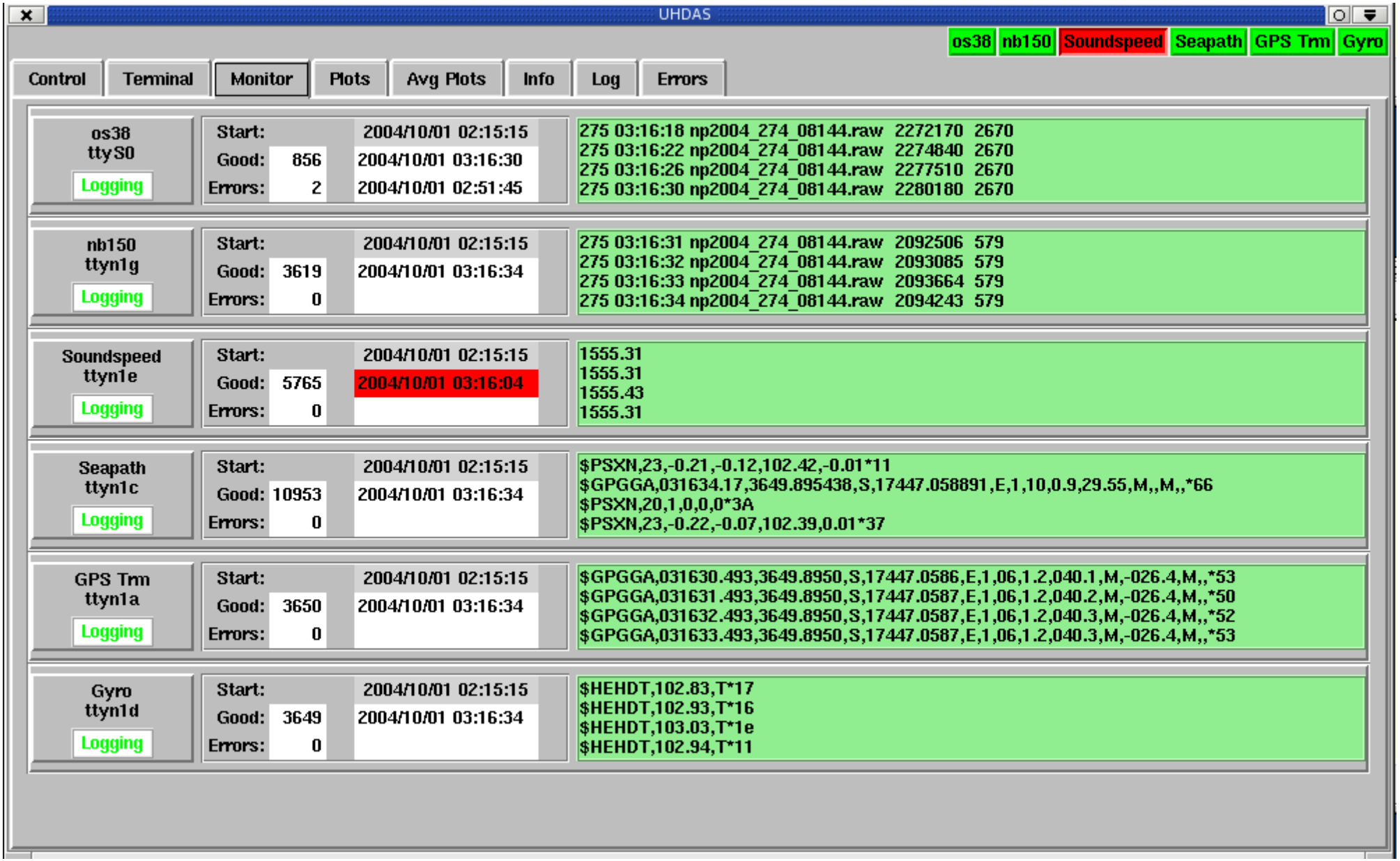
- web site on ship with
  - 5-minute profile (updated 5min)
  - 3-day vector and contour plot (updated 15-30min)
  - matlab files via web (used in 3-day plots)
  - full-resolution data (matlab, netcdf, CODAS)
- on land
  - full-resolution data (matlab, netcdf, CODAS)
  - archive of figures from cruise

UHDAS: What it does

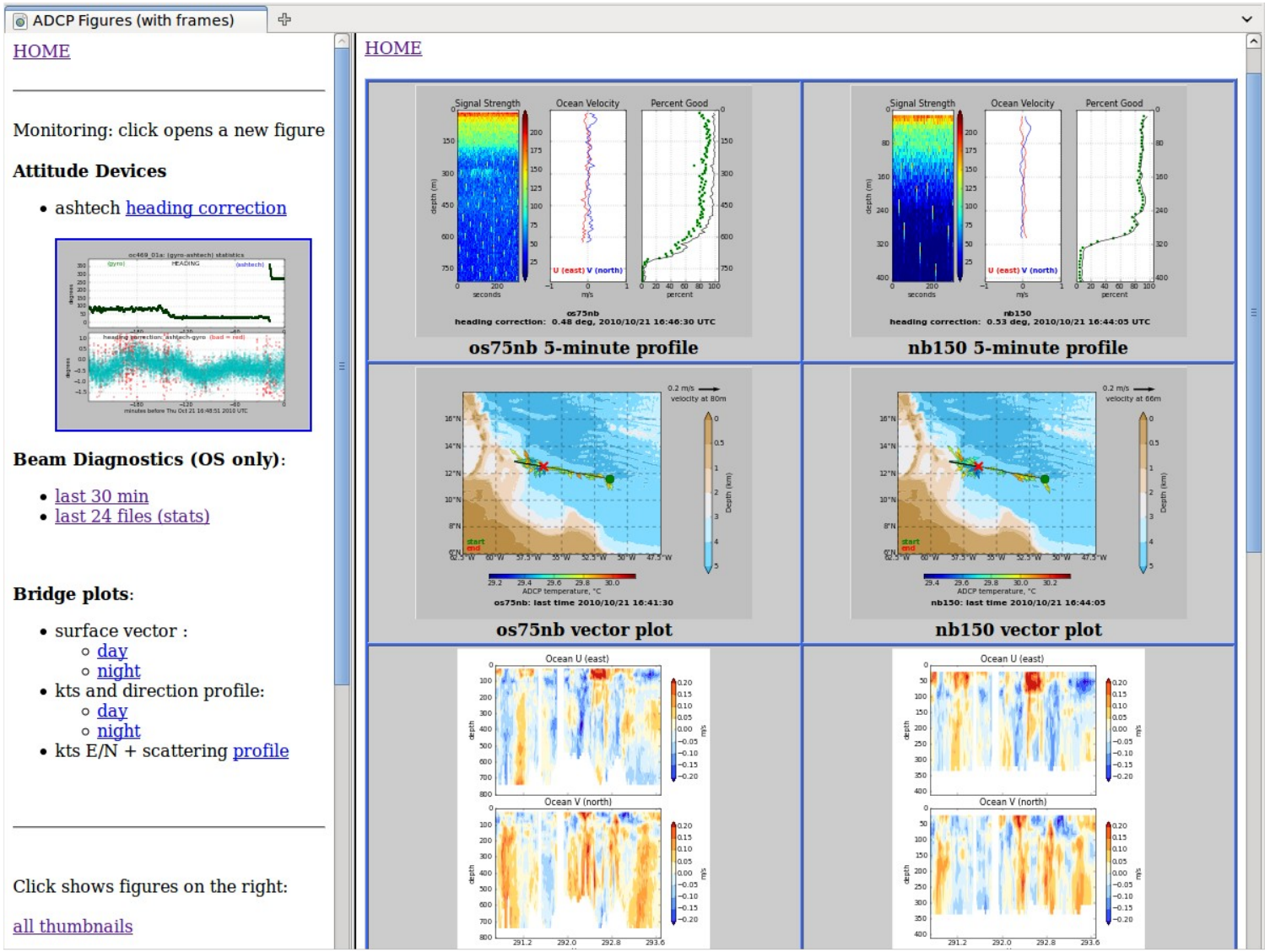
(4) Monitoring...

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

Monitoring at Sea



Monitoring At Sea: UHDAS web site



UHDAS: Monitoring from shore

Link to on-shore monitoring: UHDAS ships

- text email
- figures
- diagnostic files

Monitoring: on Land

- **from the text email**:
  - CODAS Processing
  - health of components (Ashtech)

- **data snippets for figures**
- **from the diagnostic files**:
  - data acquisition
  - processing
  - troubleshooting

tarball

Summary: Benefits of UHDAS

- At sea
  - real-time operations
  - navigation and deployment of instruments
  - science: predict trajectory, identify feature, calculate flow
  - happy techs
- On land
  - monitor for error or failure (or poor decision in setup)
  - after the cruise: tools for calibration, editing
  - beautiful data, happy and productive scientists

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Oceanography

- **Features**
  - Eddies
    - 20S Eddy
    - Chile coast
  - Subsurface flow
    - Lau Basin
- **Energy: Internal waves**
    - Coastal Oregon
- **Repeat Sampling**
  - Equatorial Pacific

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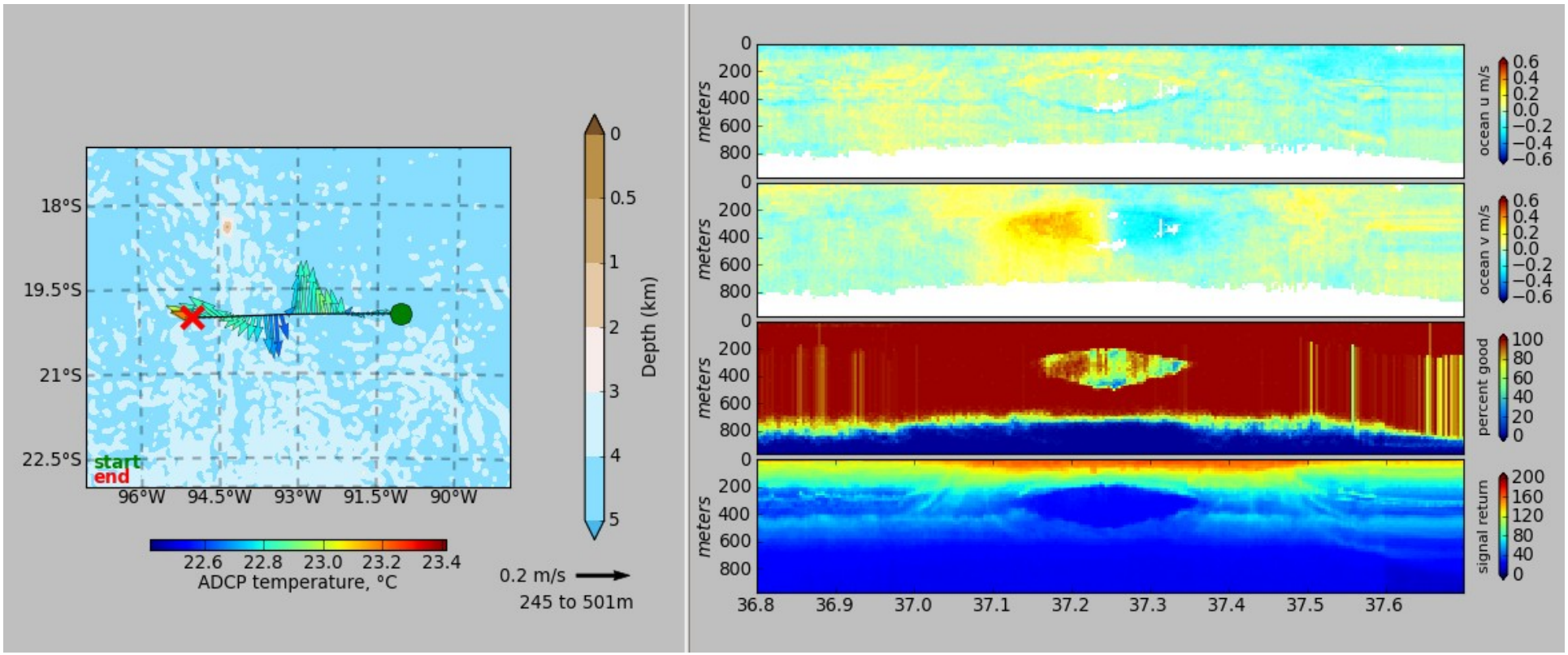
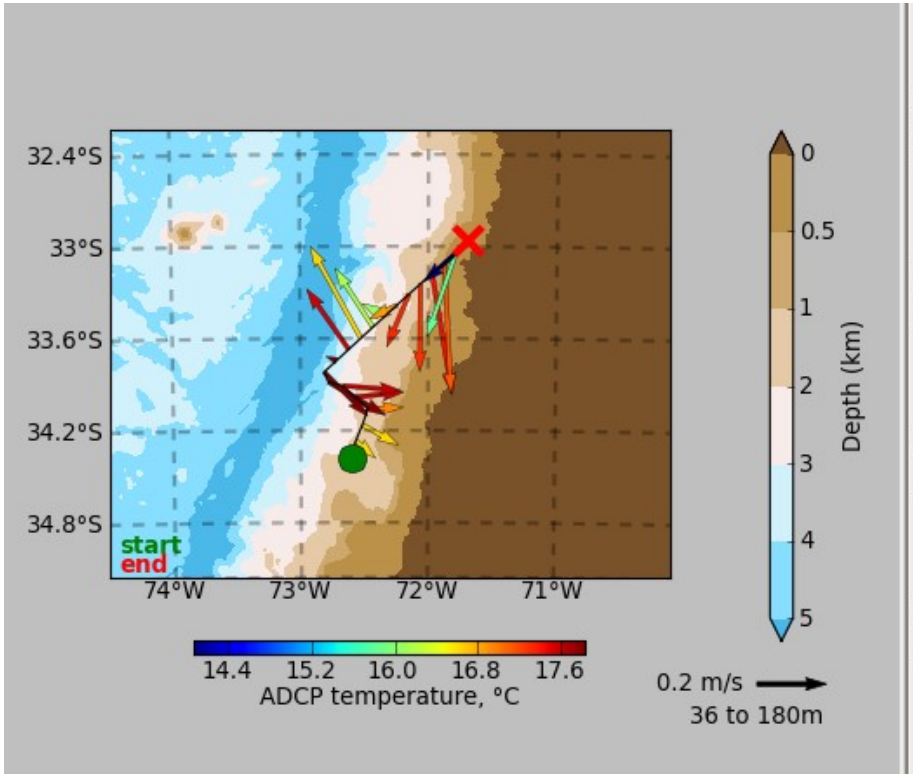
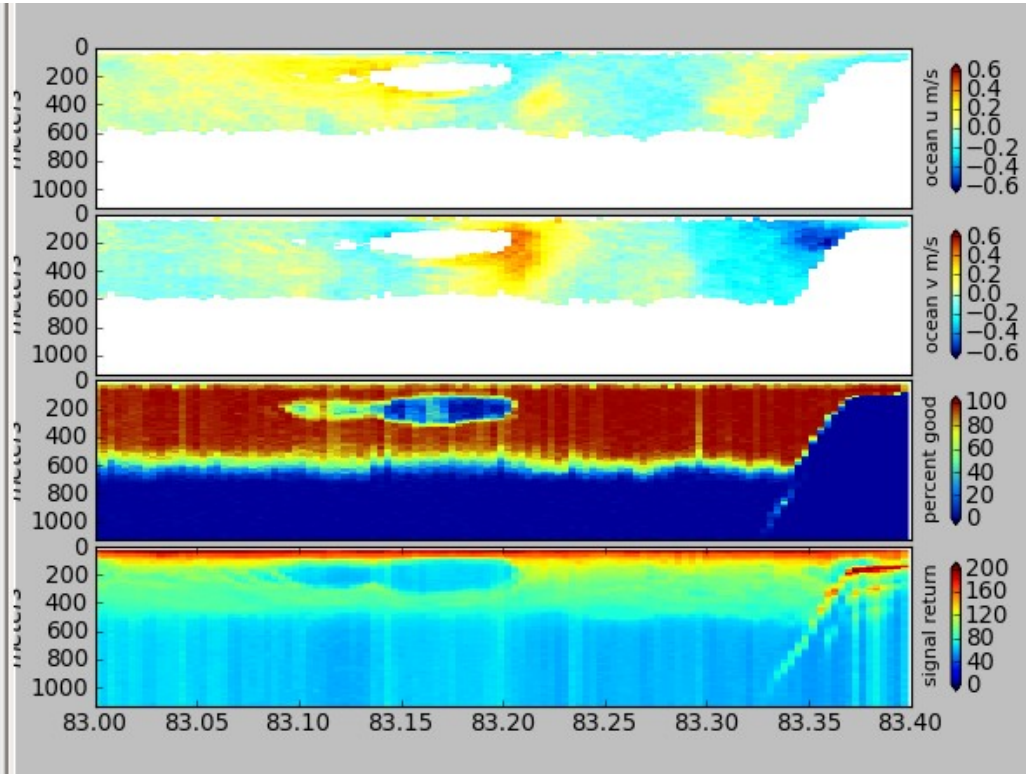
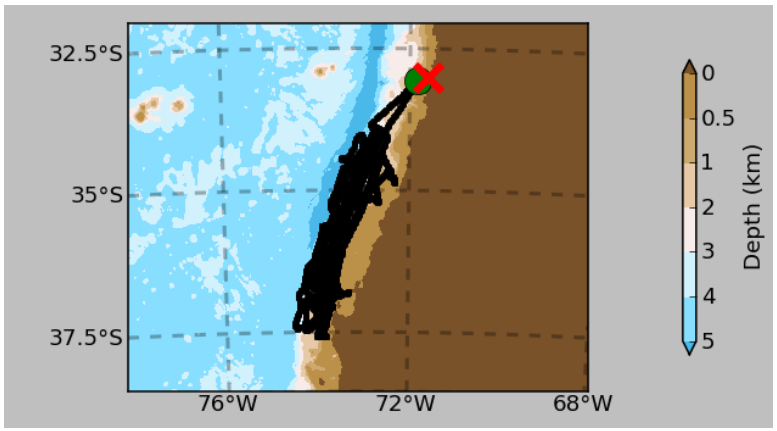
Features (eddies), 20S Eddy



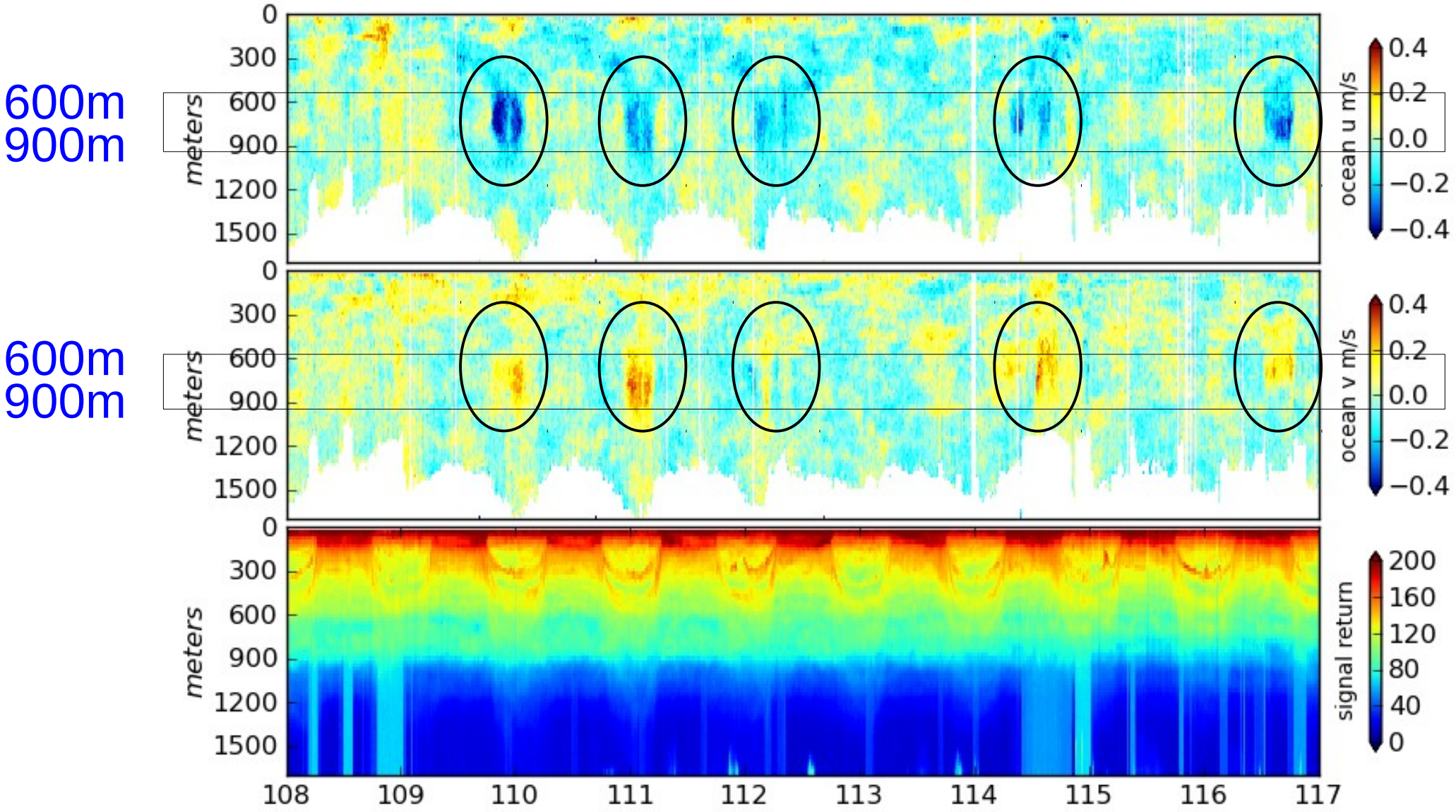
Features (eddies), Chilean Coast







Features (subsurface flow): Lau Basin



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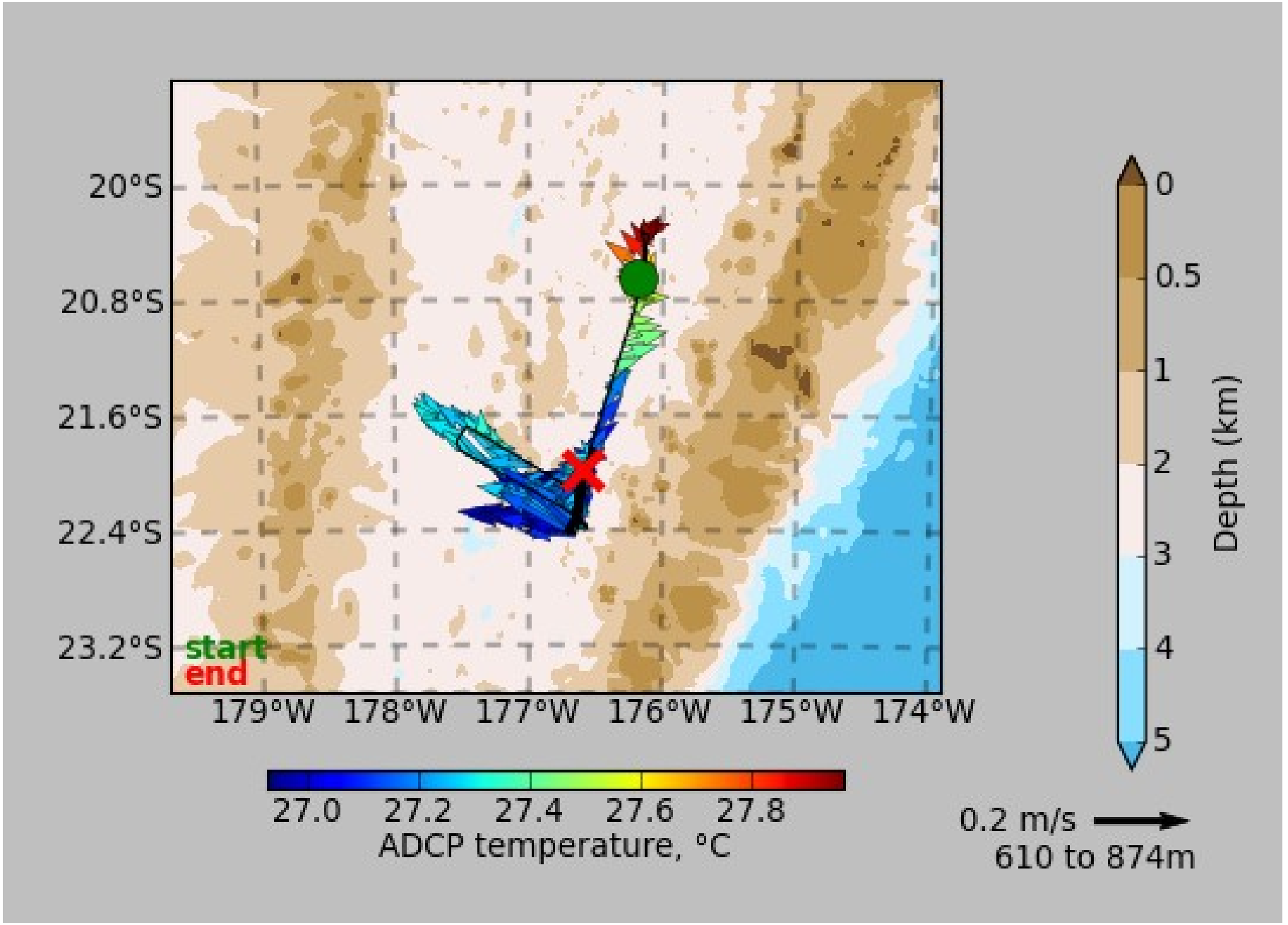

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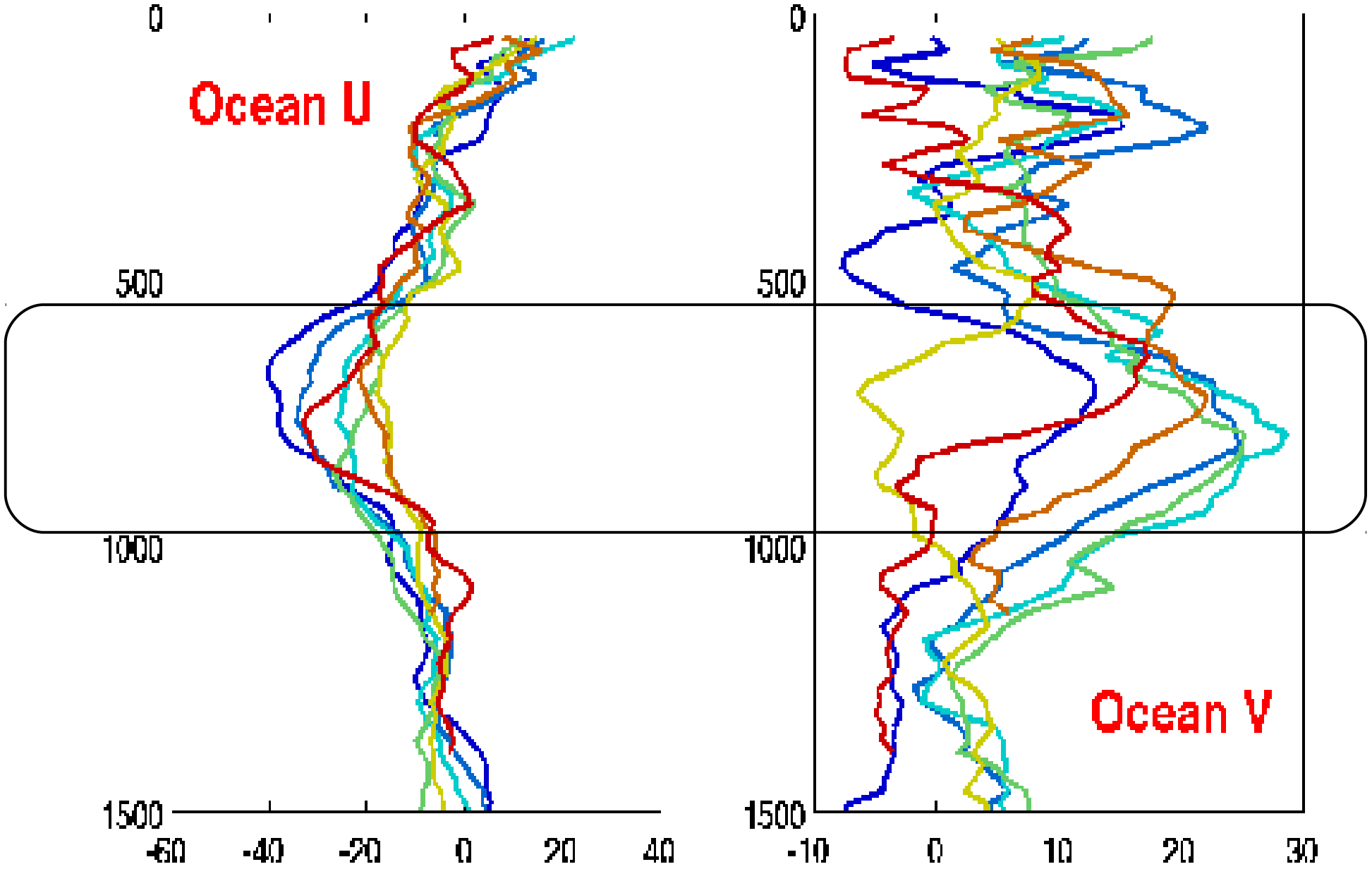

40cm/s

25cm/s

Oceanography

- **Features**
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    - Coastal Oregon
- **Repeat Sampling**
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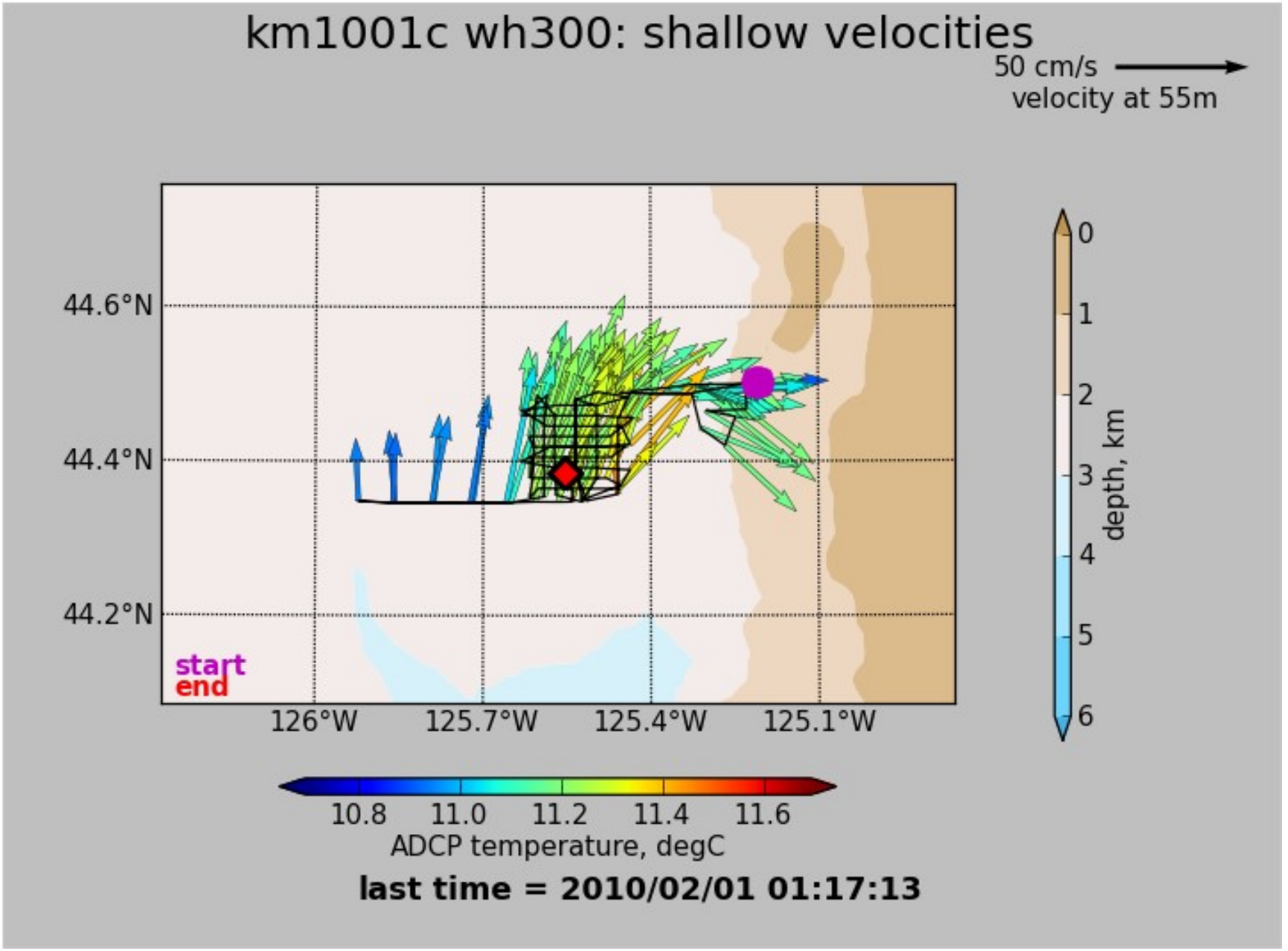
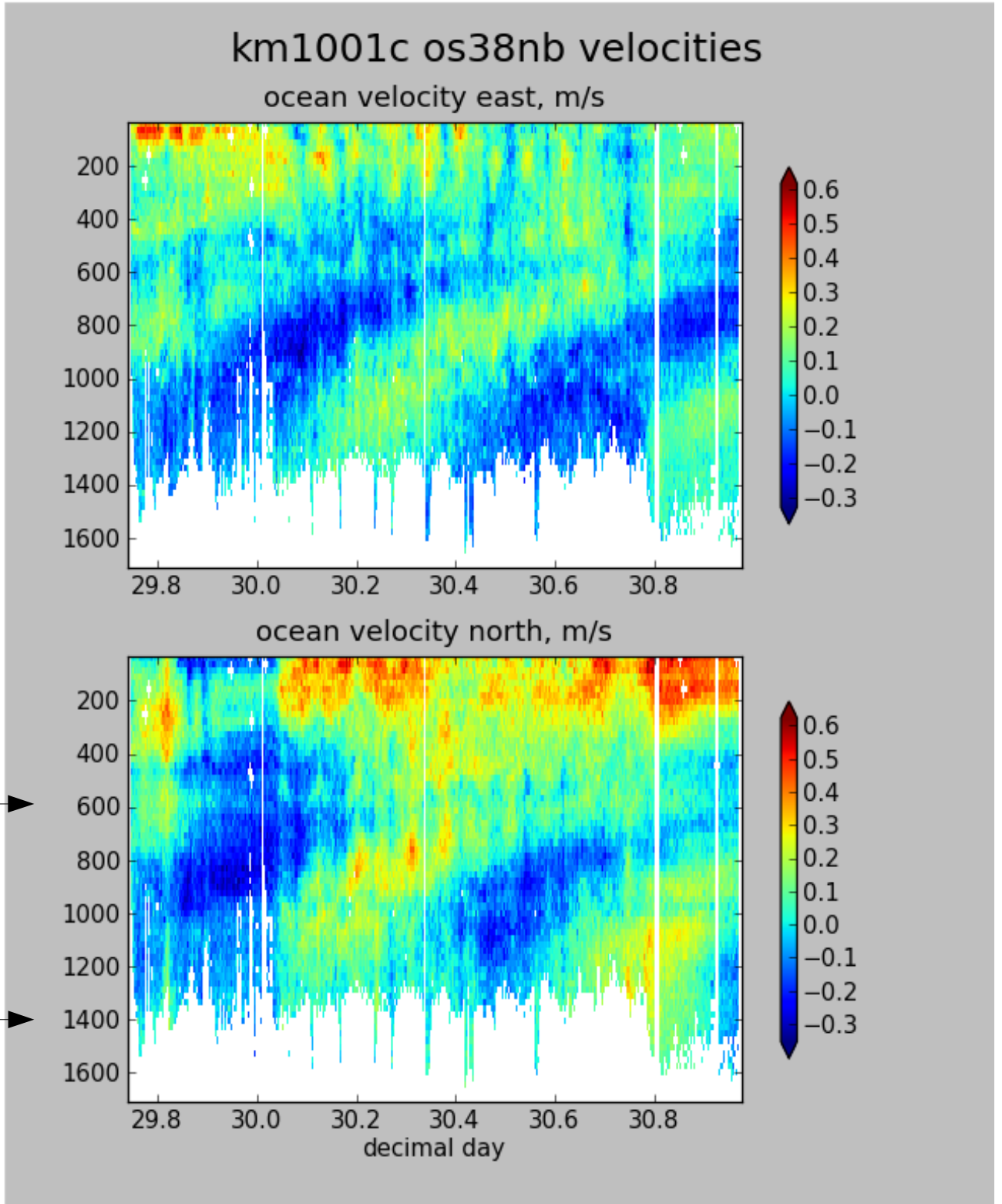
Energy: Surface Coastal Eddy Oregon Coast



Energy:
Deep Internal Waves
Oregon Coast



600m

1400m

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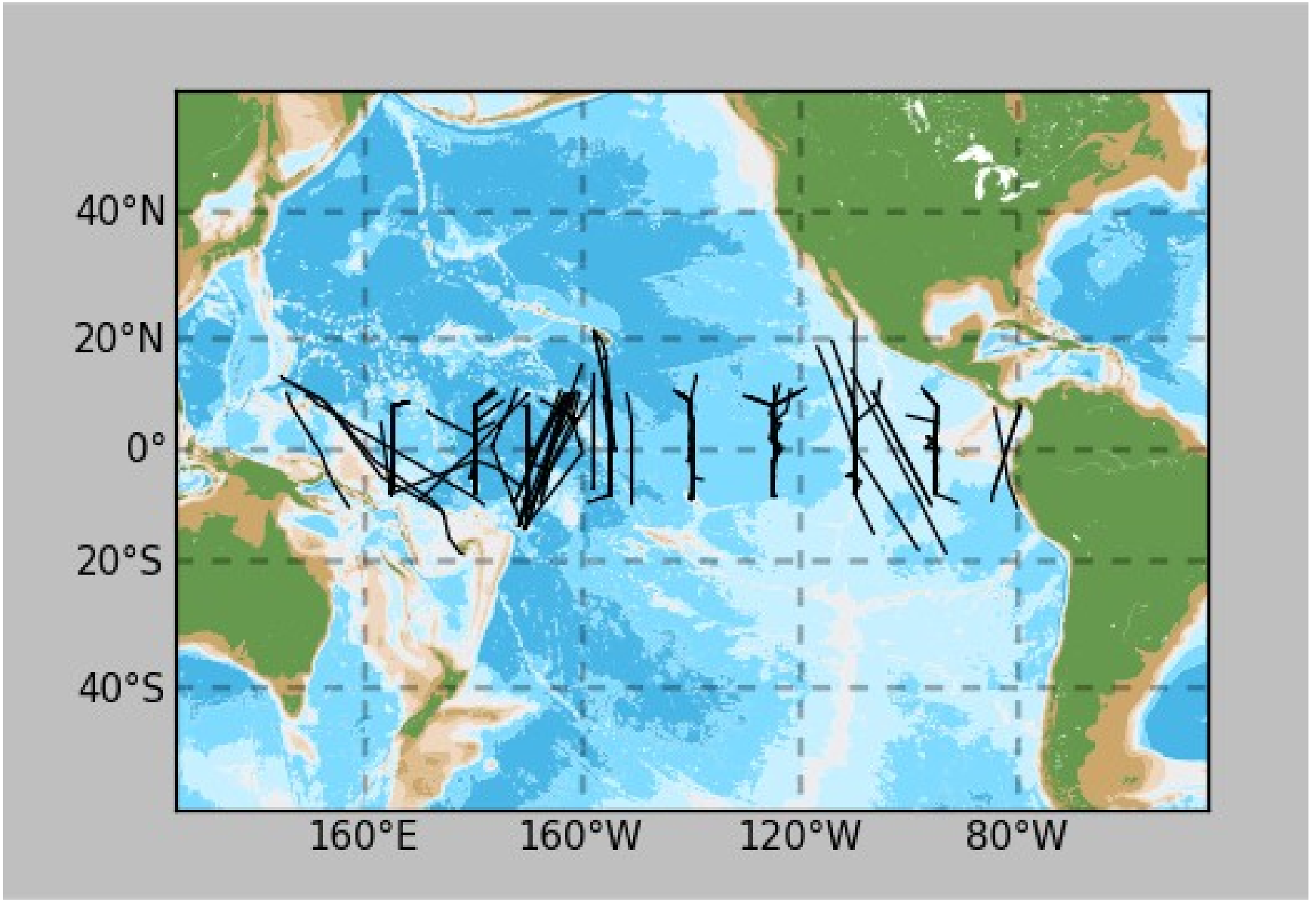
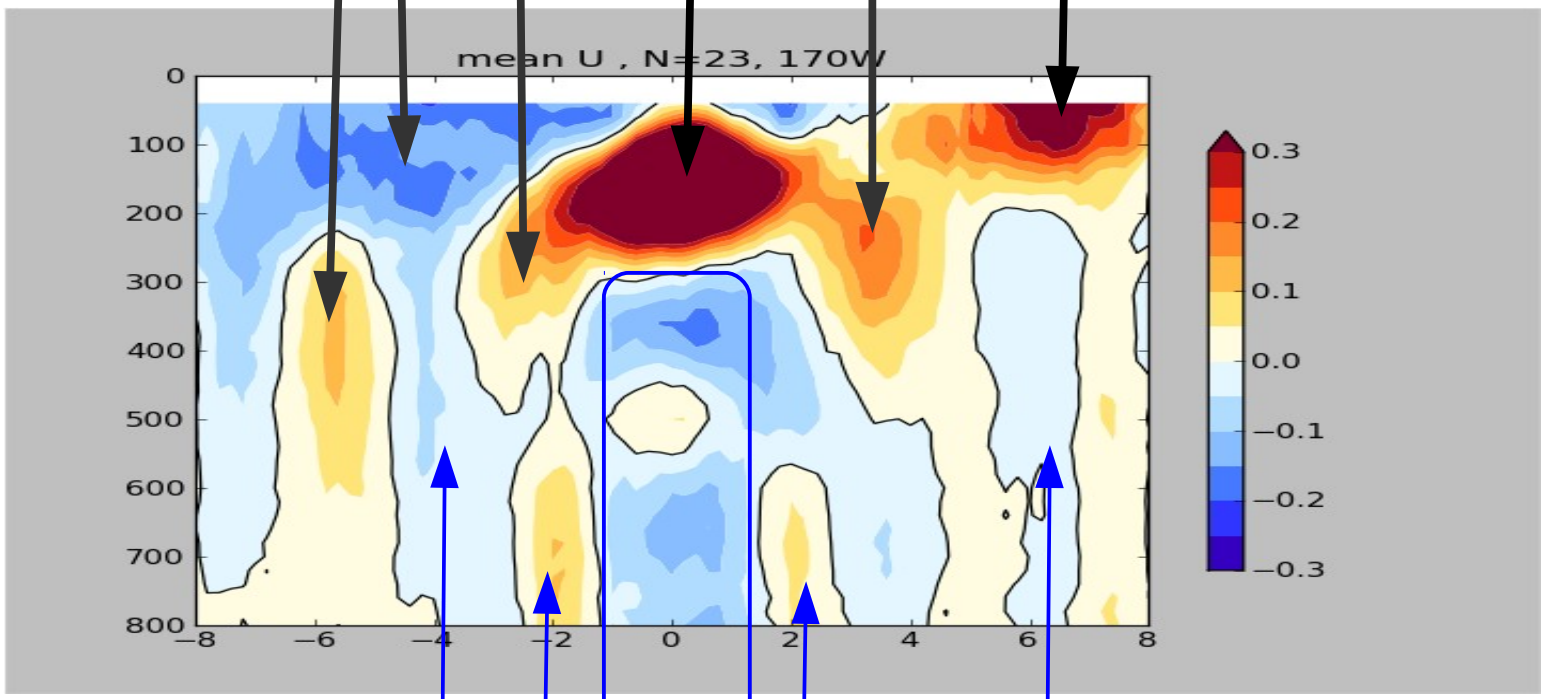
Repeat Sampling: Equatorial Pacific



Equatorial Pacific, 170W



Well-studied

SEC

EUC

NECC

T2S

T1S

T1N

0

200

400

600

800

8S

8N

Less studied

SICC

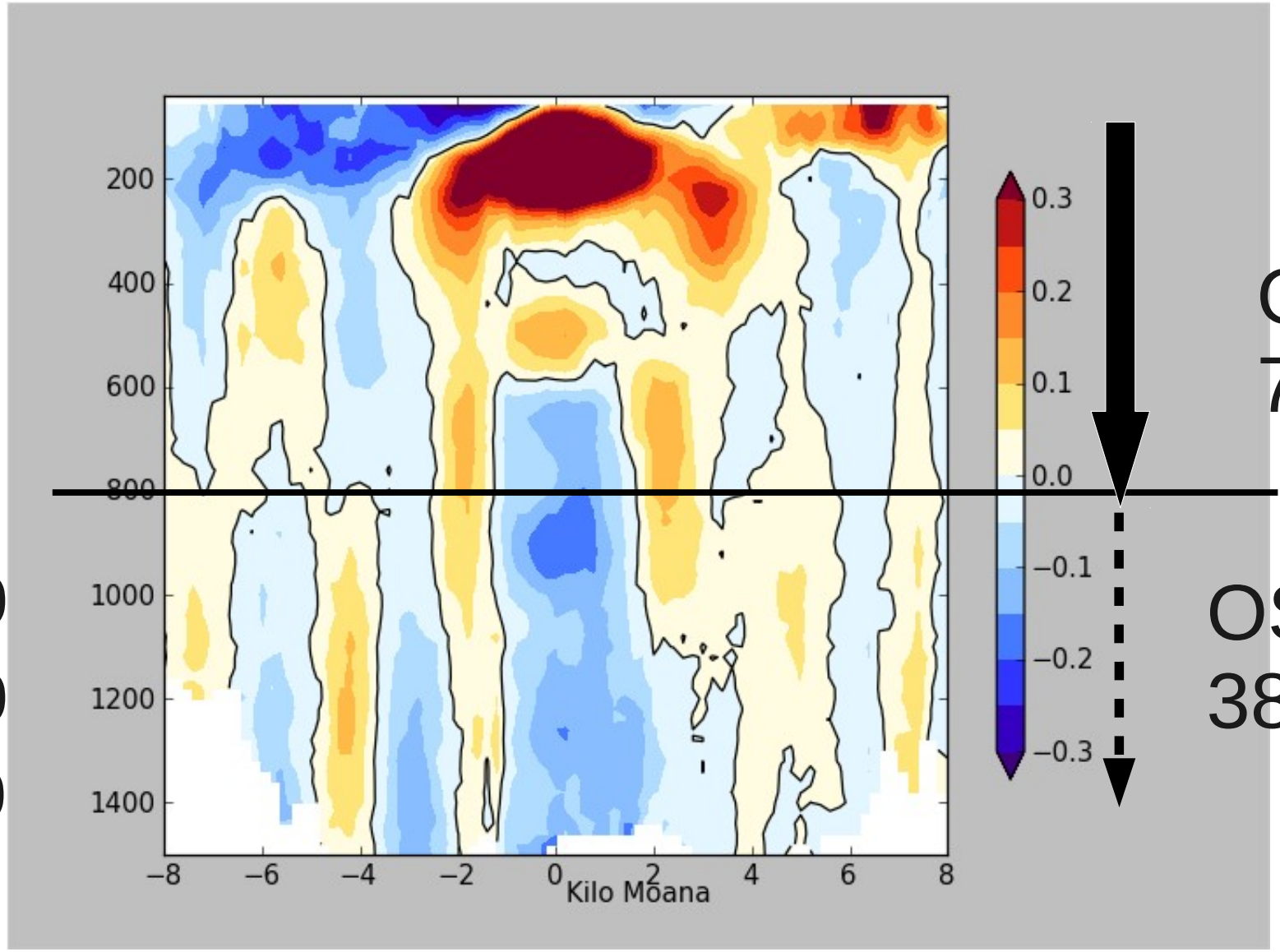
SEIC

EIC,
EDJ

NICC

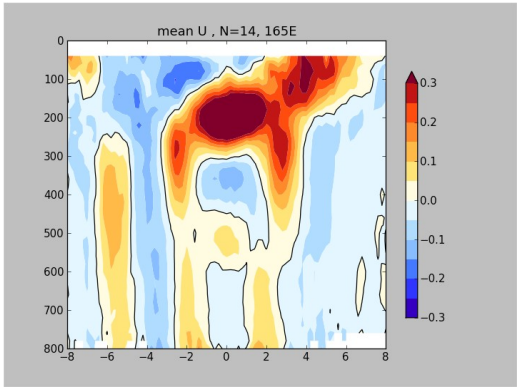
NEIC

Equatorial Pacific, 170W (38khHz)

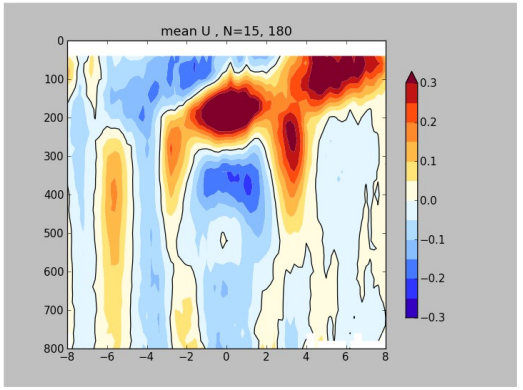


Equatorial Pacific

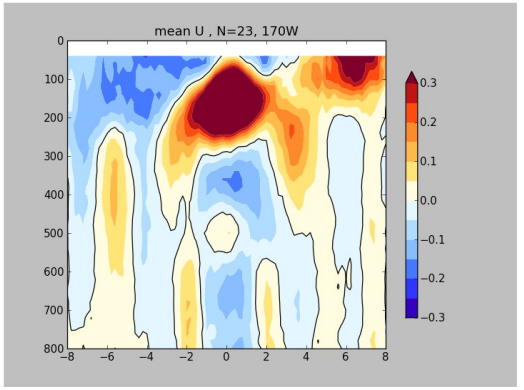
165E



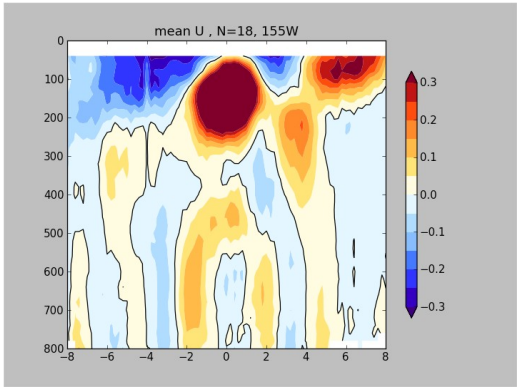
180

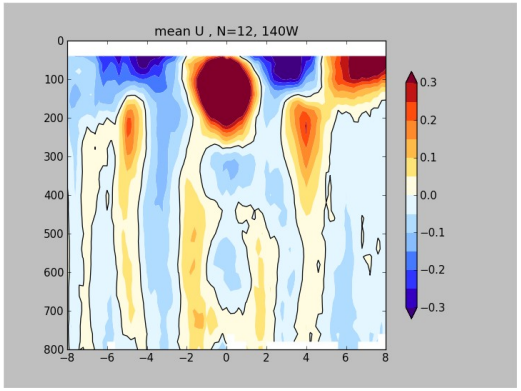


170W

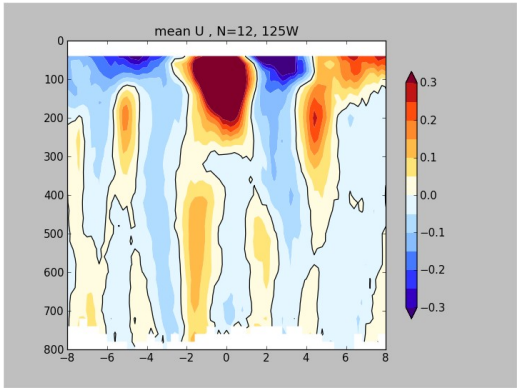


155W

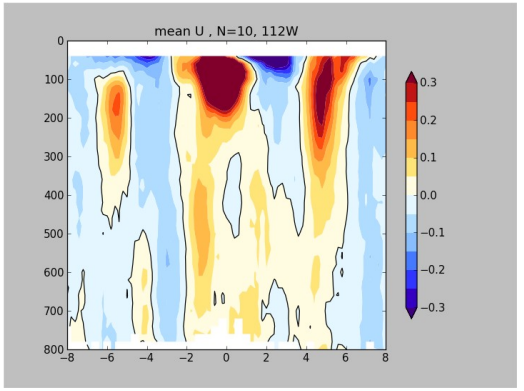




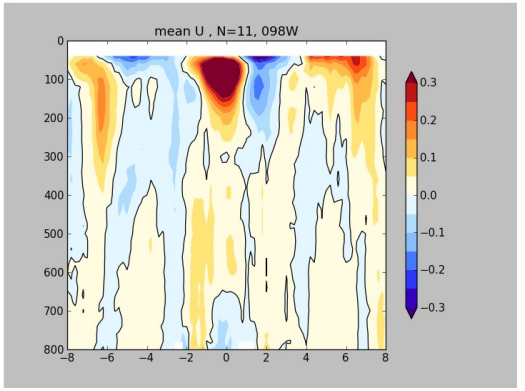
140W



125W



112W



98W