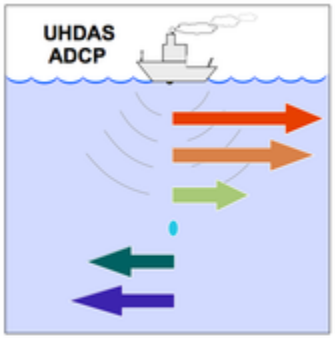

UHDAS

Maximizing the quality of Shipboard ADCP ocean current data

April 20, 2023
OCN 664 Oceanographic Instrumentation and Technology

Overview

1) What is “shipboard ADCP”?
2) How is SADCP data used?
3) UHDAS: What does it do?

(**U**niversity of **H**awaii **D**ata **A**cquisition **S**ystem)

- Data Acquisition
- Processing
- Monitoring
- Stewardship

Keeping in mind

- Who are the users we are supporting?
- Why are we making these decisions?

We want

- software to be
  - reliable (starts up, predictable)
  - robust (handles problems without failing)
  - maintainable (move forward as libraries change)
- data to be
  - as close to science-ready as feasible (for an automated system)
  - immediately useful
  - useful in the future

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ADCP: Getting Ocean Velocity

Acoustic (it pings along beams at a frequency)

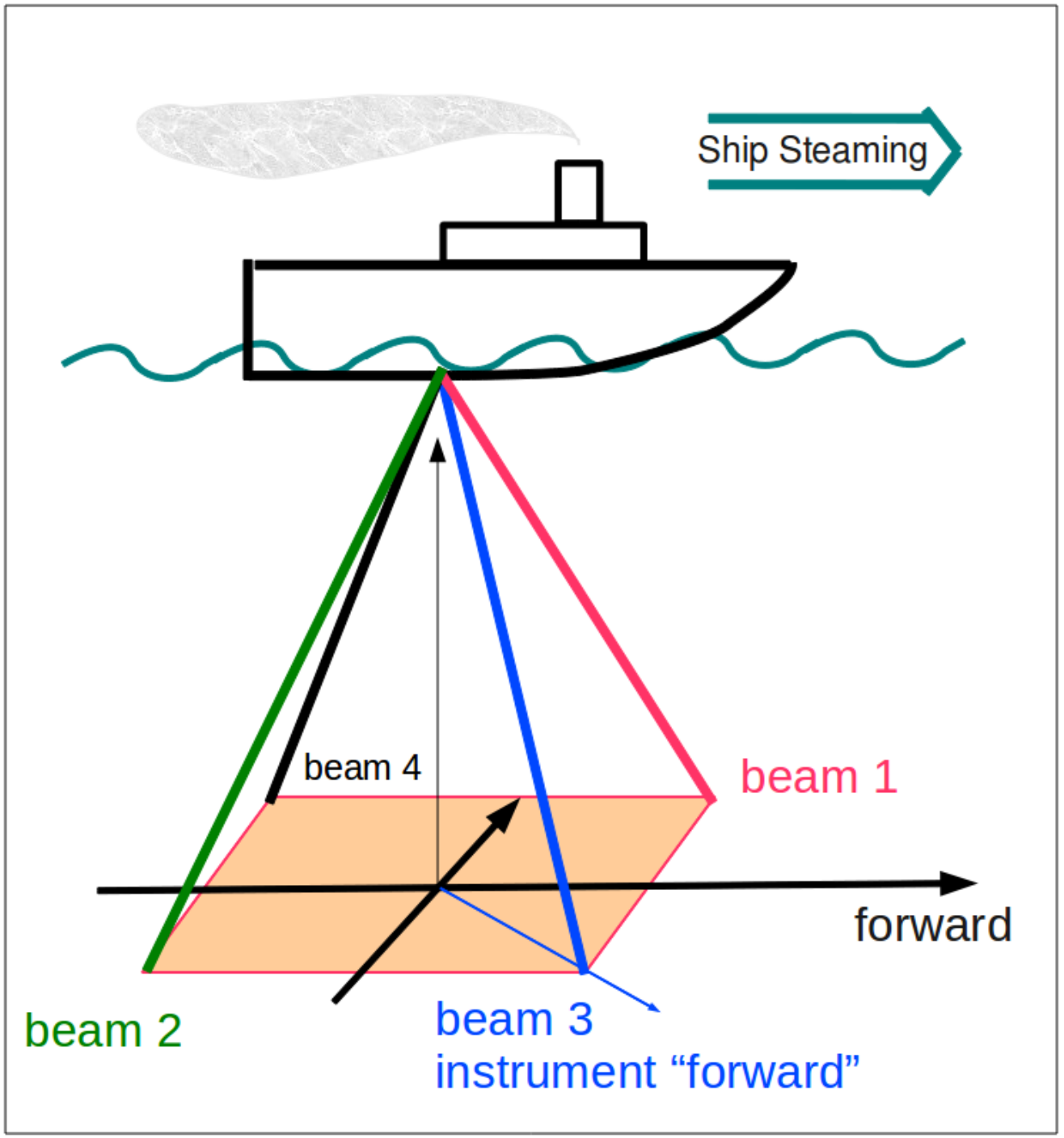
Doppler (uses frequency shift to get velocity along the beam)

Current (include many more steps to get ocean velocity)

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

More detail is contained in the UHDAS/CODAS Documentation

Shipboard ADCP cartoon



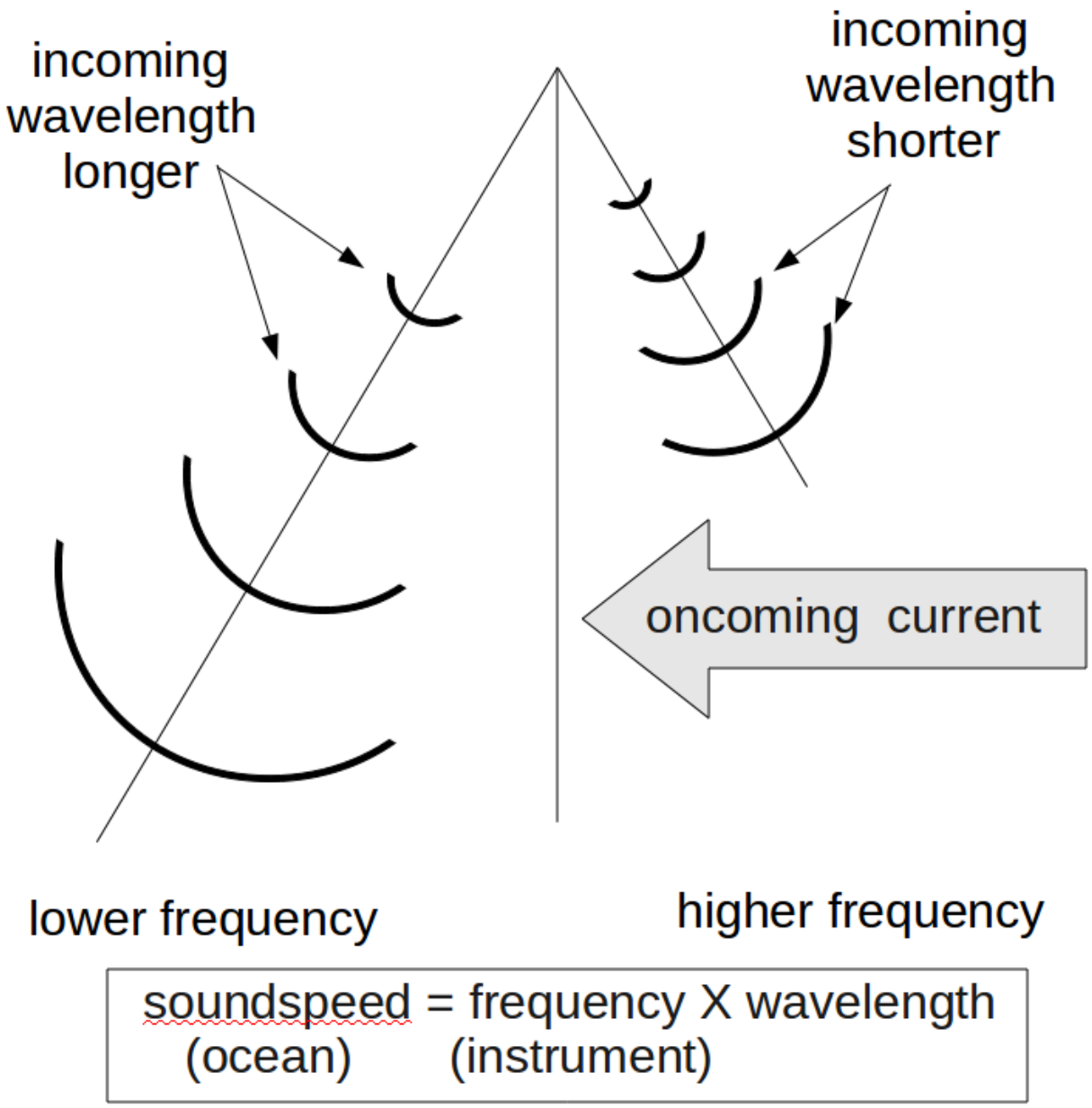
Acoustic

Vessel-mounted ADCPs are historically made by Teledyne R.D.Instruments
older technology = 4 ceramic “hockey pucks
newer technology = phased array

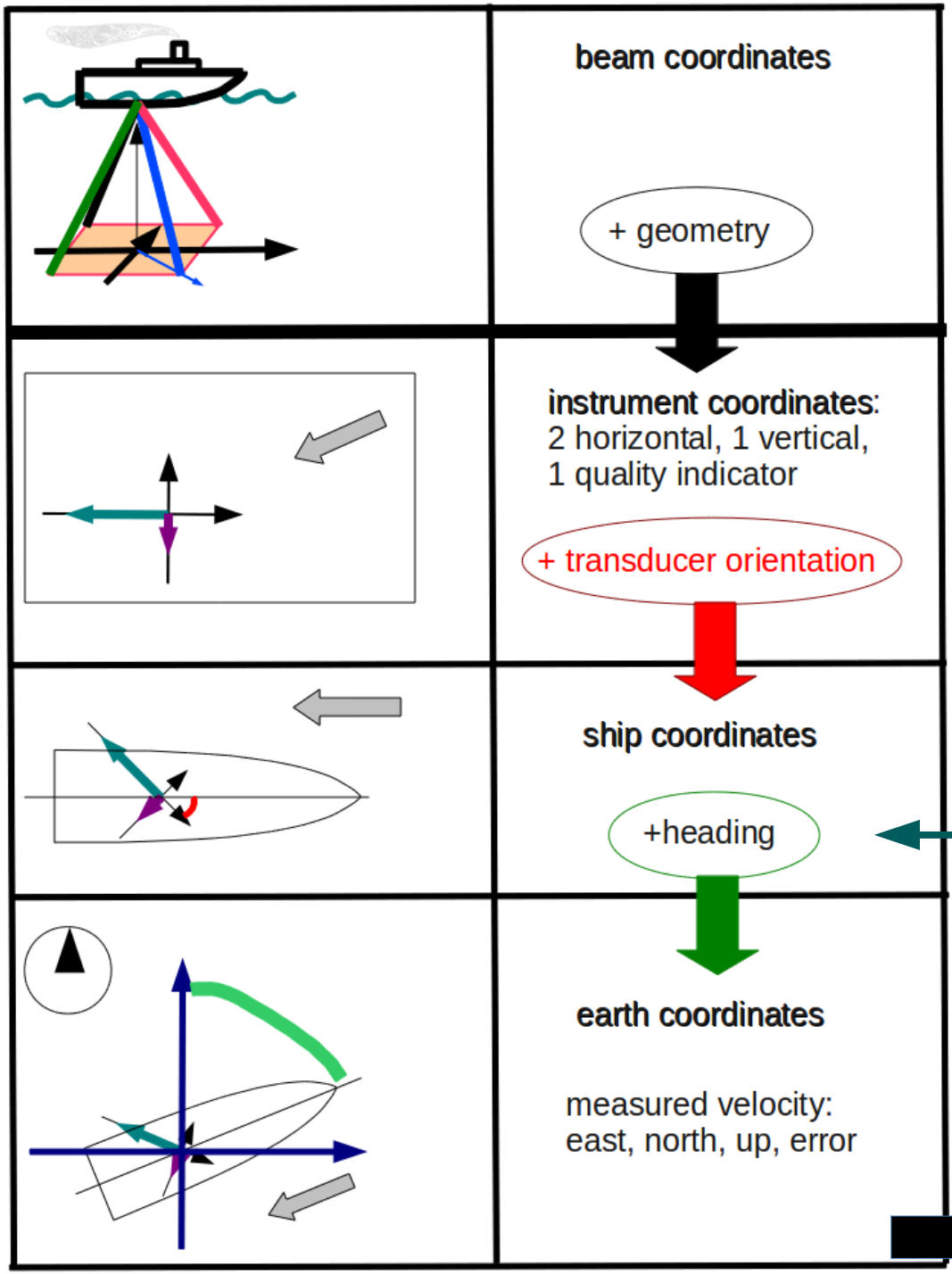
frequency (kiloHertz)	wavelength	resolution (narrowband bin size)	range
38	4cm	32m	1200m
75	2cm	16m	700m
150	1cm	8m	300m
300	.5cm	4m	80m

ADCP

Acoustic
Doppler
Current
Profiler



more details: Calculating ocean currents from ADCP



Transformations resulting in
- horizontal
- measured velocity
- in earth coordinates

calibration values

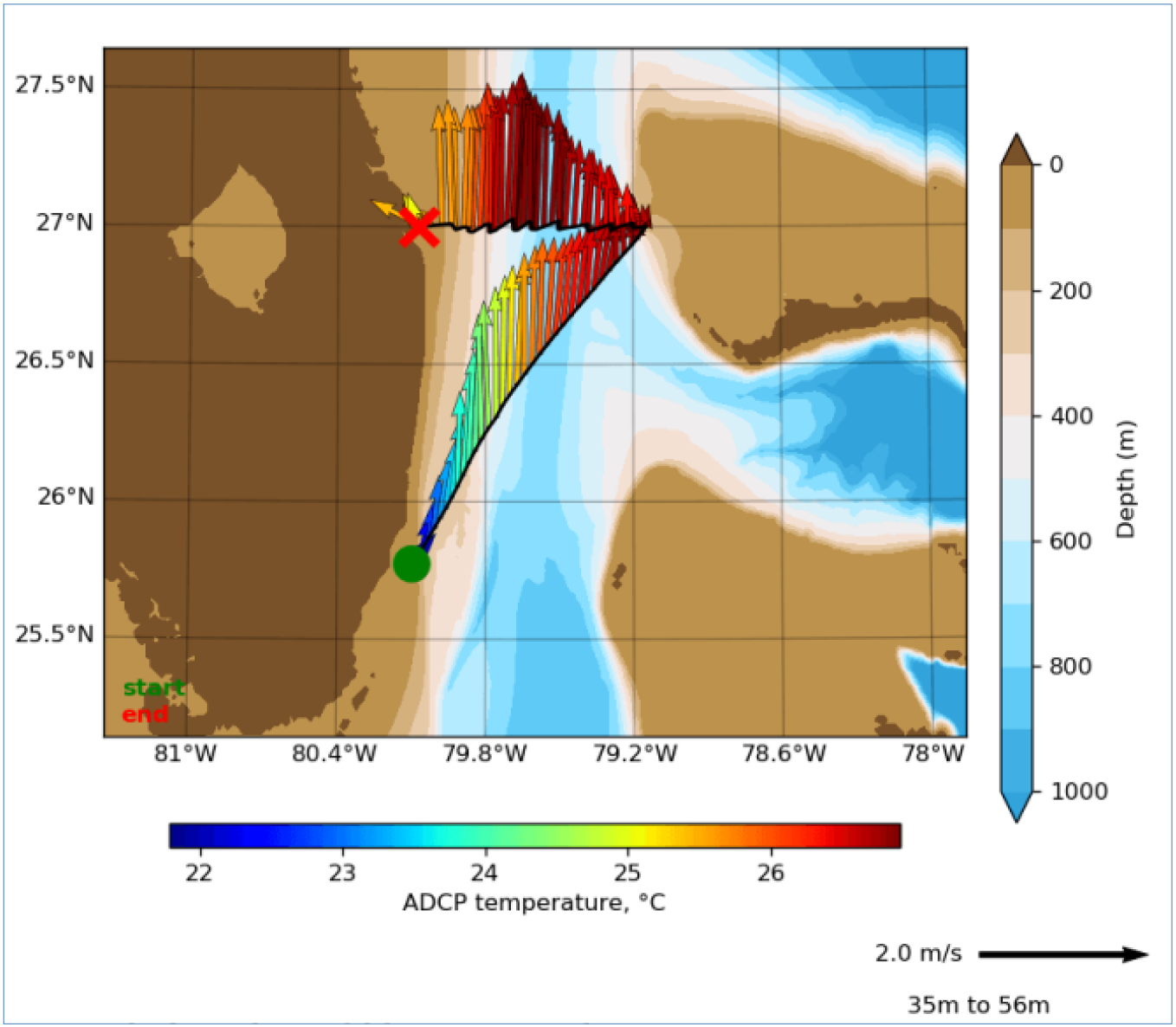
accurate heading

Then add ship speed from GPS to get **ocean currents**

more details: Calculating ocean currents from ADCP

ADCP data to ocean currents

Time,
ADCP
Position
Attitude



primitive data

ocean velocities

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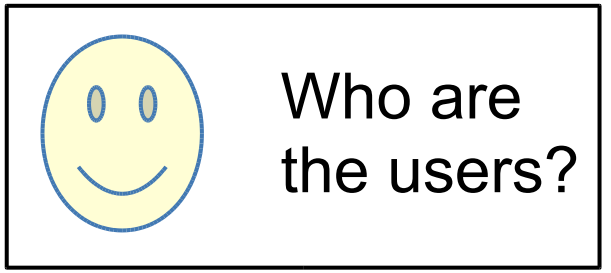
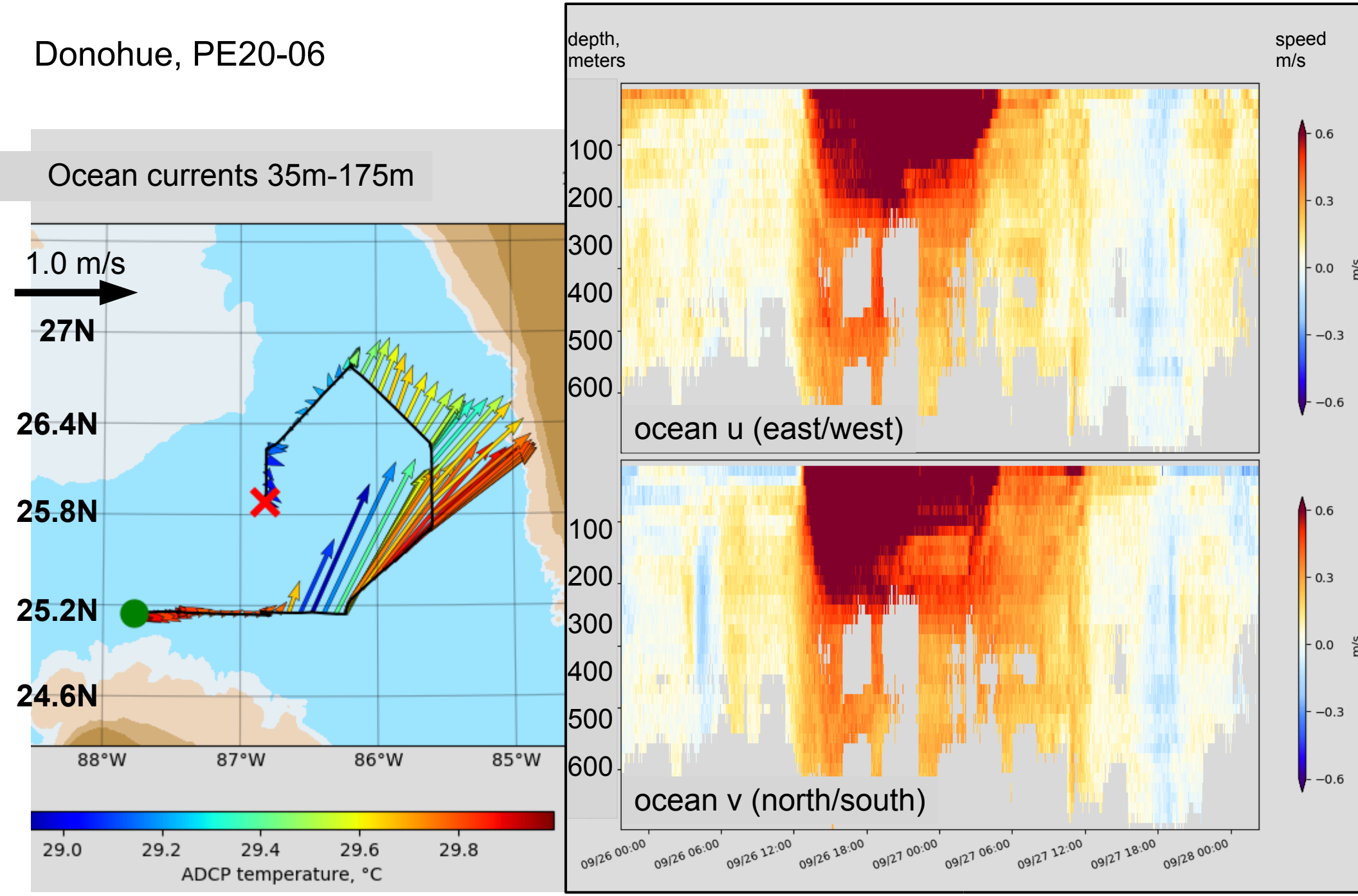


(**U**niversity of **H**awaii **D**ata **A**cquisition **S**ystem)

- Data Acquisition
- Processing
- Monitoring
- Stewardship

R/V Pelican Mooring cruise, Gulf of Mexico

Donohue, PE20-06



Operational uses of shipboard ADCP data

at sea:

- operations, eg:
  - currents for over-the-side work (moorings, CTD)
  - backscatter levels for targeted biological sampling
  - currents for ROV operators
- dynamic sampling, eg:
  - where is the front?
  - when did we cross the front?
  - which direction will the instrument drift after deployment?

Scientific relevance of shipboard ADCP data

- **backscatter (even if uncalibrated)**
- **process studies:**
  - ocean physics, eg. context for small-scale mixing studies
  - ocean features, eg. deep eddies
- **time series**
  - dedicated, on station (HOT, BATS)
  - transects: Drake Passage, Bermuda to New Jersey
  - after the fact: equatorial Pacific (servicing TAO moorings)
- **comparison with satellites**

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Maximizing quality of SADCP ocean current data

- collect good quality data
- collect it properly
- process components to meaningful data
- get it working well, keep it working well
- support the users at all stages
- support the use of the data in the future

How does UHDAS address these aspects?

Overview

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Acquisition: Basic Requirements:

- Control ADCP settings
- Acquire ADCP data
- Acquire ancillary data
  - Position
  - Attitude (heading)
- Timestamp incoming data

- **collect good quality data**
  - ADCP installation (free of bubbles, no electrical interference)
  - reliable and accurate heading and position
- **collect it well**
  - good timestamps, good acquisition practices
  - multiple feeds, record QA messages, use checksums
  - be able to return to known-working parameters

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Data Processing and access to data products

automated processing ("**preliminary processing**" at sea)

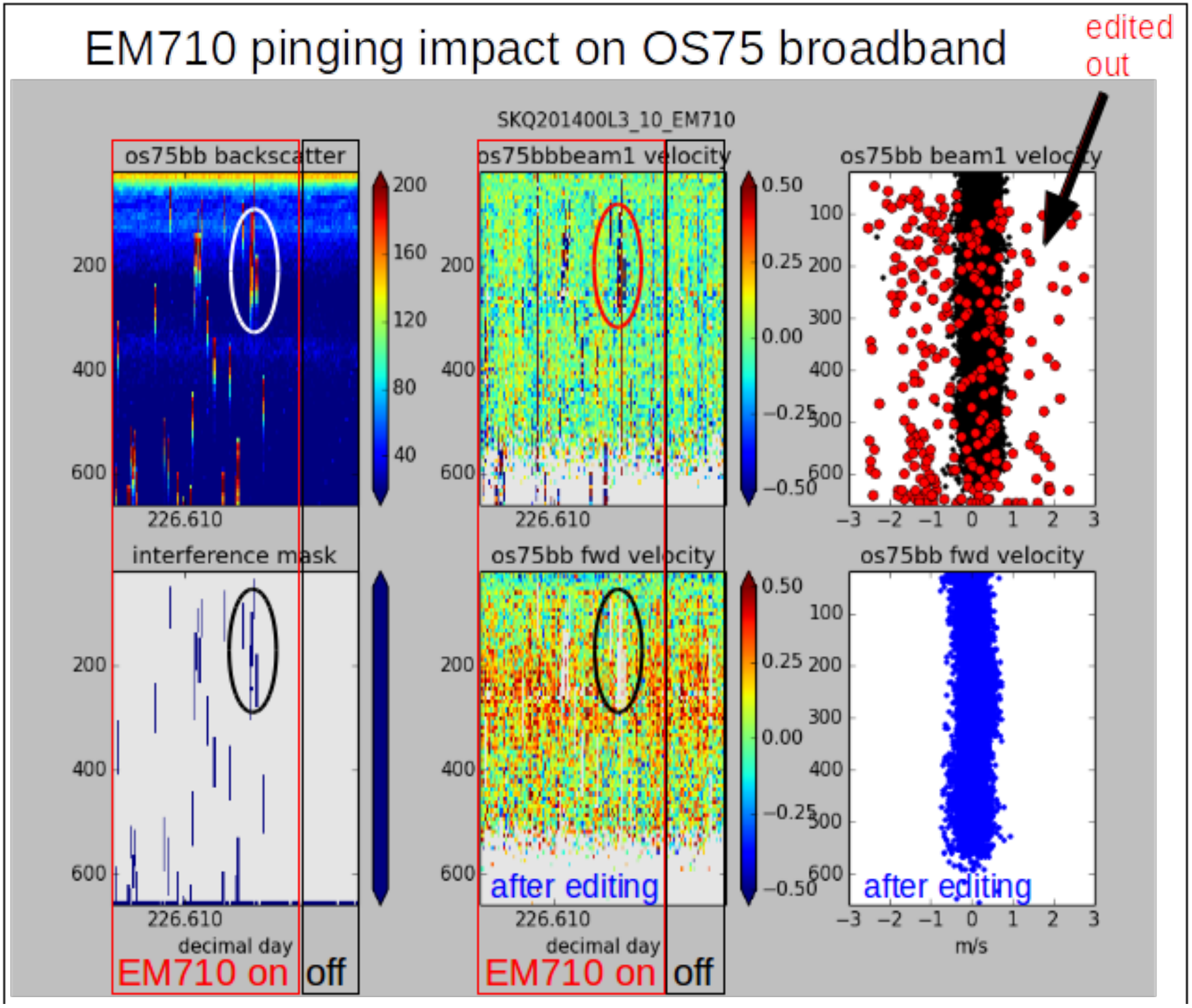
- single-ping editing prior to averaging
- provide data products for immediate and future use (at-sea web site)

- Goals:
  - Data should be useful for science and operations
  - Data should be as close to "final" as possible (for an automated system)
  - Require minimal post-processing for science

after the cruise

- provide software and support
- goal:
  - ease of post-processing
  - reprocessing if necessary (new algorithms, different feeds)
- discovery/evaluation in the future

CODAS single-ping editing based on acoustic interference



Monitoring

- **on ship**:
  - via web site on ship (science and diagnostic figs)
  - documented here
- **on land:**
  - automated daily emails to UHDAS Team
  - monitoring dashboard with
    - cruise status
    - links to figures, diagnostic files
  - Ticketing system (internal): first pass at identifying problems:
    - notifies the UHDAS team of a problem
    - mechanism for tracking problems – eg, based on
      - cruise, ship, instrument
  - UHDAS Team provides feedback to technicians on the ship

UHDAS: Troubleshooting and feedback

- problems with ADCP instrument
- problems with data acquisition:
  - computer: timestamps are bad
  - serial (or UDP) NMEA feeds glitchy or fail
    - switch to another feed for at-sea processing
  - quality of ancillary data is poor
    - can the shipboard technicians do anything?
- problems with preliminary processing:
  - a bug, or timestamp problems
  - change in calibration (instrument replacement)
  - bad beam

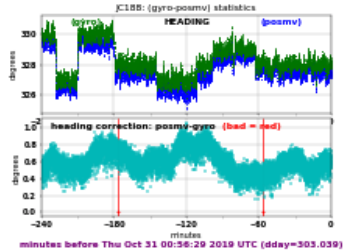
At-sea web site overview

HOME

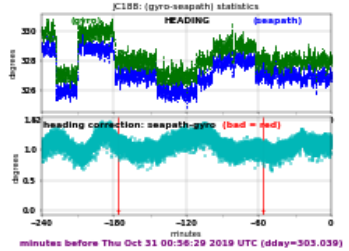
Monitoring: click opens a new figure

Attitude Devices

- posmv-gyro comparison (thumbnail)



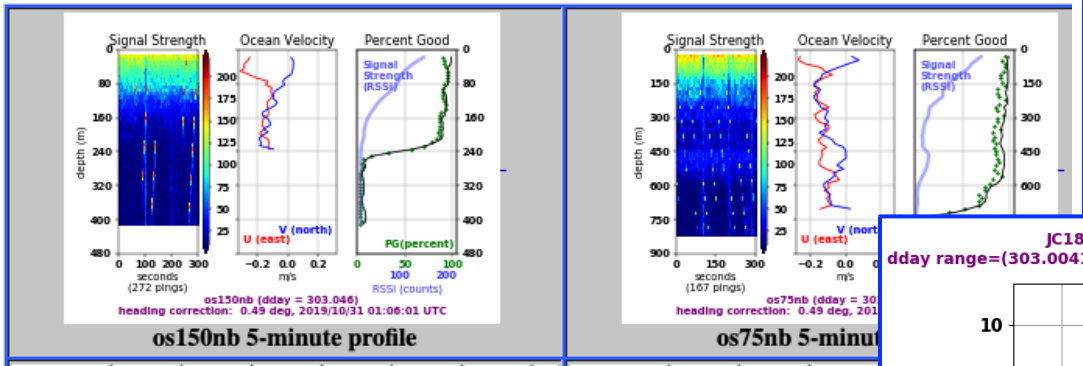
- seapath-gyro comparison (thumbnail)



Bridge plots:

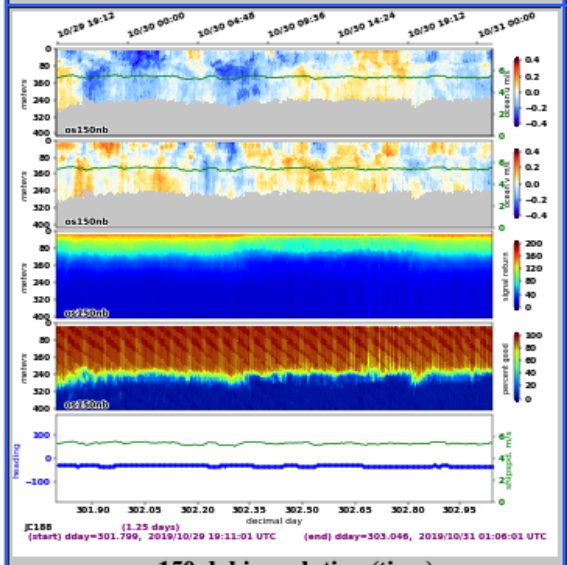
- surface vector :
  - day
  - night
- kts and direction profile:
  - day
  - night
- kts E/N + scattering profile

ADCP Thumbnails

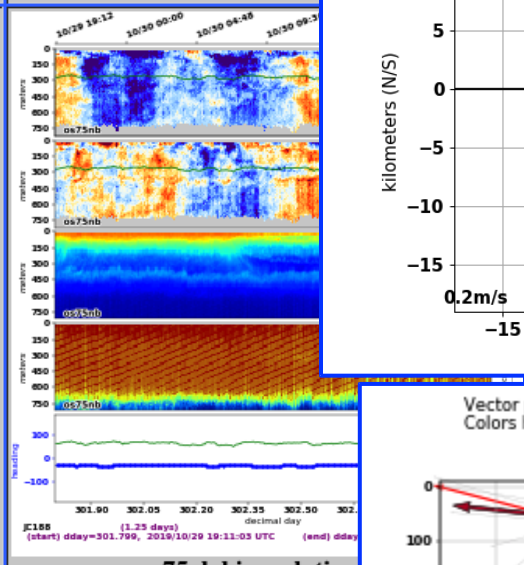


os150nb 5-minute profile

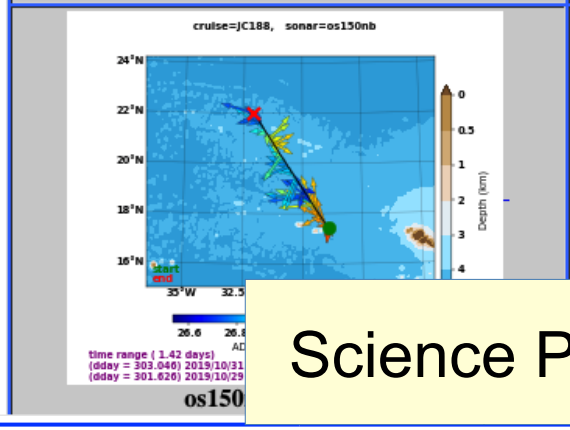
os75nb 5-minut



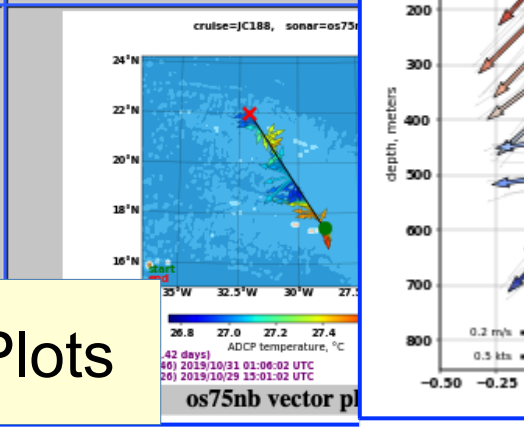
os150nb hi-resolution (time)



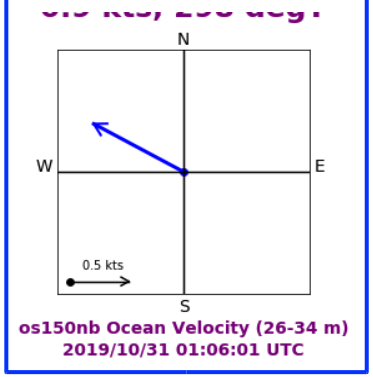
os75nb hi-resolution

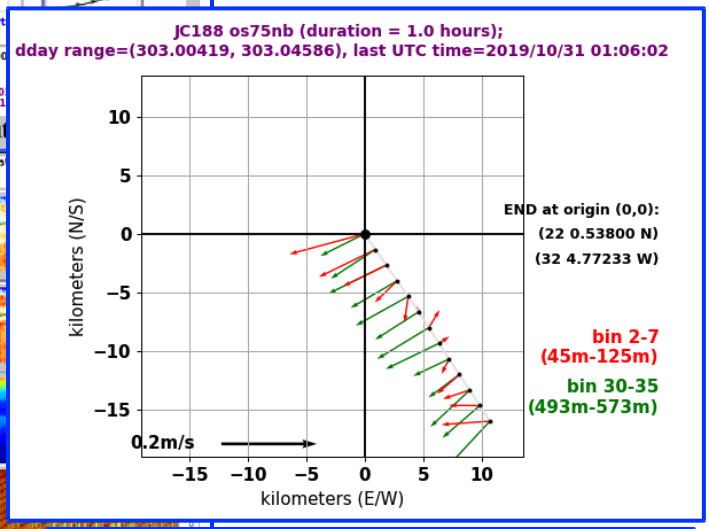


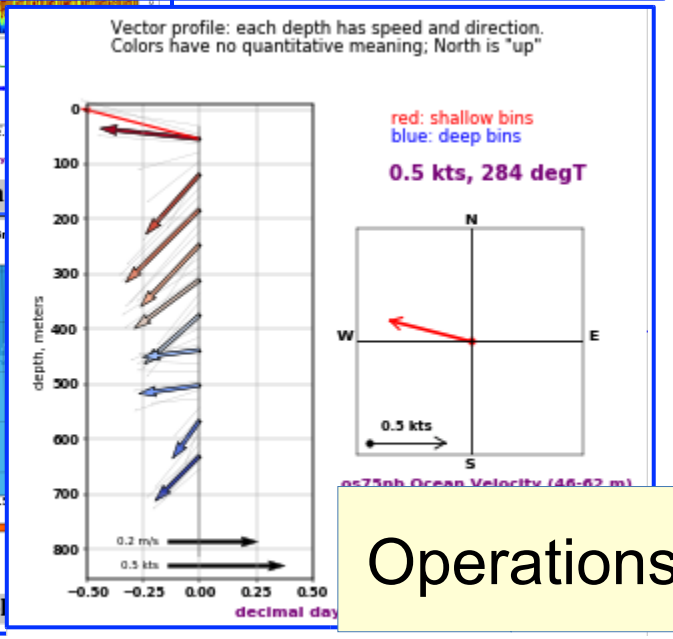
os150



os75nb vector pl







Diagnostic Plots

Science Plots

Operations

letters	ship name	figures	last email	cruise name	status	daily report	daily email	OS	last update
ae	Atlantic Explorer	figs	6hr	Pierside_PostAE2016	logging	dir	email	18.04	2020-Apr-23
ar	Neil Armstrong	figs	6hr	ar47	(not logging)	dir	email	18.04	2020-May-30
at	Atlantis	figs	210d	(not set)		dir	email	16.04	2018-Aug-02
bh	Blue Heron	figs	6hr	(not set)		dir	email	18.04	2020-Aug-01
en	Endeavor	figs	6hr	(not set)		dir	email	18.04	2020-May-30
hly	Healy	figs	43d	(not set)		dir	email	18.04	2020-May-30
hs	Hugh Sharp	figs	6hr	(not set)		dir	email	18.04	2020-May-30
km	Kilo Moana	figs	6hr	km2012	logging	dir	email	18.04	2020-May-25
lg	L.M.Gould	figs	6hr	(not set)		dir	email	18.04	2018-Dec-23
mgl	M.G.Langseth	figs	6hr	(not set)		dir	email	16.04	2017-Aug-15
np	N.B.Palmer	figs	1d 6hr	nbp2010a	logging	dir	email	18.04	2018-Dec-19
oc	Oceanus	figs	6hr	(not set)		dir	email	18.04	2020-Apr-23
pe	Pelican	figs	6hr	PE21_06_Fugro_ADCP	(not logging)	dir	email	18.04	2020-Aug-01
rr	Roger Revelle	figs	0hr	RR2002a	(not logging)	dir	email	18.04	2020-Aug-01
skq	Sikuliaq	figs	6hr	SKQ202014S	logging	dir	email	18.04	2020-May-02
sp	R.G.Sproul	figs	3hr	(not set)		dir	email	14.04	2015-Mar-25
sr	Sally Ride	figs	6hr	(not set)		dir	email	18.04	2020-Aug-01
sv	Savannah	figs	6hr	(not set)		dir	email	18.04	2020-May-30
tt	Thomas G. Thompson	figs	17d	TN384	logging	dir	email	18.04	2020-Apr-25
ws	Walton Smith	figs	6hr	(not set)		dir	email	18.04	2020-Aug-01

NOAA ships

letters	ship name	figures	last email	cruise name	status	daily report	daily email	OS	last update
dy	Oscar Dyson	figs	6hr	(not set)		dir	email	18.04	2020-Aug-01
ex	Okeanos Explorer	figs	205d	EX-Transit-2020-03-23	logging	dir	email	18.04	2020-Jan-14
fh	Ferdinand Hassler	figs	6hr	(not set)		dir	email	14.04	2017-Jan-17
gu	Gordon Gunter	figs	35d	(not set)		dir	email	18.04	2020-May-30
hb	Henry Bigelow	figs	6hr	(not set)		dir	email	18.04	2020-Aug-01
nf	Nancy Foster	figs	3d	(not set)		dir	email	18.04	2020-May-30
pc	Pisces	figs	6hr	PC2020_atpier_october	logging	dir	email	18.04	2020-Aug-01
rb	Ron Brown	figs	6hr	RB2006	logging	dir	email	18.04	2020-Aug-01
rl	Reuben Lasker	figs	6hr	(not set)		dir	email	18.04	2020-Aug-01
se	Oscar Elton Sette	figs	6hr	(not set)		dir	email	18.04	2020-Aug-01
sh	Bell Shimada	figs	6hr	(not set)		dir	email	18.04	2020-Aug-01

Other UHDAS ships

letters	ship name	figures	last email	cruise name	status	daily report	daily email	OS	last update
fk	Falkor	figs	6hr	(not set)		dir	email	18.04	2020-May-25
inv	Investigator	figs	6hr	in2020_v06	logging	dir	email	18.04	2020-May-30
kb	Kristine Bonnevie	figs	6hr	KB2020620	logging	dir	email	14.04	2017-Mar-09
nor	Norrona	figs	6hr	(not set)		dir	email	16.04	2018-Jul-05
olr	Oleander	figs	6d	(not set)		dir	email	18.04	2020-May-30
ps	Point Sur	figs	6hr	(not set)		dir	email	18.04	2020-May-30
ukdy	Discovery	figs	8hr	DY120	logging	dir	email	18.04	2020-Aug-01
ukjc	James Cook	figs	8hr	JC209	(not logging)	dir	email	18.04	2020-Aug-01

- NSF funds the Academic Research Fleet ships;
- NOAA funds the NOAA ships;
- Various institutions or projects fund the “other” ships

We also have some science funding to process SADCP data, eg. GOSHIP

Monitoring Page (link)

data stewardship

- support the archive process
- help make the data findable
- provide software and support to users

UHDAS: supporting the users

- Technicans (operationally useful, easy)
- Scientists (good data; free software)
- Managers
  - data managers (predictable, documented)
  - ship operations (monitored, useful displays)
  - funding (happy scientists, techs, ship ops)

Kilo Moana (45N) off the Oregon Coast: internal tide beam, energy downward (phase upward) below 600m