Marine National Facility

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Australia's National Science Agency,
on behalf of the nation

RV *Investigator* ADCP Data Processing Report

Voyage ID	**IN2025_V07**
Voyage Title	SOFS Recovery
Depart	Hobart, 01 July 2025, 00:00 UTC
Return	Hobart, 05 July 2025, 23:00 UTC
Chief Scientist	Elizabeth Shadwick (CSIRO)
Data Processor	David Webb (CSIRO – E&T Data Acquisition & Processing)

Document History

Date	Version	Author	Comments
06/07/2026	1.0	David Webb	Initial version
27/08/2026	1.1	David Webb	Release version

Contents

1 Summary

The primary objective of this voyage was to recover the top section (surface float and instrumented wire directly below) of the SOFS-14 mooring, which was deployed on IN2025_V02 and begun drifting outside of its watch circle in May 2025.

An EM124 Backscatter Calibration was also conducted at the Tasman Rise on the return to Hobart along with a single CTD deployment (1200m) for a full water depth velocity profile to support the calibration.

This report describes the production of quality controlled ADCP data from RV *Investigator* voyage IN2025_V07.

The ADCP was run for most of the voyage.

ADCP data were collected using the University of Hawaii Data Acquisition System (UHDAS) and post-processed

The RDI Ocean Surveyor 150kHz ADCP, RDI Ocean Surveyor 75kHz ADCP and RDI Ocean Surveyor 38kHz ADCP were run in narrowband mode.

Internal triggering was used.

The drop keel was set at 2 m below the hull for the duration of the voyage. The nominal transducer depth is set to 6 meters, any additional changes will need to be applied by the user if they believe it is required.

To access the full voyage plan and other reports and data associated with this voyage, please see the contact information at the end of this report.

1.1 Voyage Track

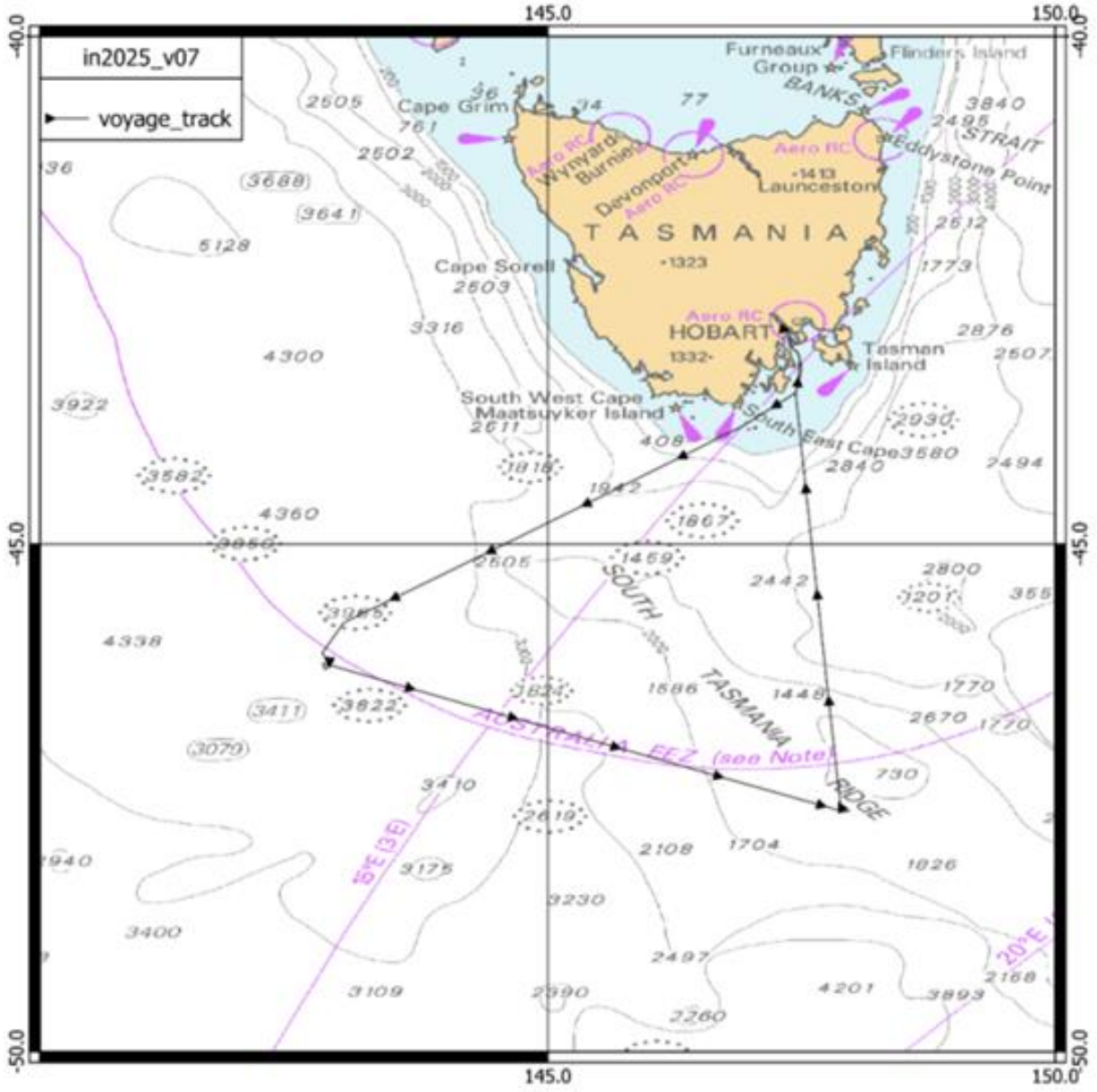

Figure 1: Voyage track

Please see the webpy folders for plots of collected data.

2 Data Processing

2.1 Background Information

The University of Hawaii's CODAS software with changeset number 3159:c22d6c40e594 was used for data post-processing.

The ADCP beam velocities are rotated into earth coordinates using the reliable source (gyro) for heading. CODAS processing corrects the reliable headings to accurate values by a timeseries of the

difference between the accurate and reliable heading devices. The accurate heading for this voyage is either the Seapath or Posmv. Errors in this timeseries will occur if the accurate heading device drops out. Patch_hcorr.py interpolates gaps in the heading correction timeseries and is run if small gaps are found.

Additional adjustments to scale factor and angle are needed if water track calibration residuals are out of tolerance. The aim is to get errors due to bad angle or scale factor down to the level of 1cm/s error in the ADCP measurements, the target for residuals

- Amplitude: 0.995 to 1.005
- Phase/Angle: -0.04 to +0.04

Manual calibration corrections with quick_adcp.py (rotate_amplitude and rotate_angle) have been applied to the data if the watertrack calibration residuals have sufficient points for reasonable statistics (>12-15 edited). If there are insufficient watertrack points (eg. a transit), values from adjacent voyages are used.

Manual editing with dataviewer.py was used to remove in water artifacts (e.g. scattering layers, depth below bottom, etc). This can affect watertrack calibration residuals (mostly in scale factor), so check a final application of residuals may be applied.

2.2 Processing Notes

Relatively low data volumes due to short voyage duration resulted in low number of edited points and high standard deviation as seen in Table 1, particularly in the OS150nb. Consistent noise at the surface (top 2 bins), due to 'bubbling', was removed. ADCP Transducer to GPS location offset corrections were applied prior to applying amplitude and phase calibrations. Offset corrections applied are noted in Appendix A (Tables 4-6) and final offset values are shown in Table 2.

2.2.1 Calibration Residuals

No gaps in heading correction were found in the OS150nb, OS75nb & OS38nb data, hence Table 1 shows N/A for the residuals "After patch_hcorr.py" in Table(s) 4, 5 & 6 in Appendix A.

Table 1: Final Correction and Residual Value Summary, see Appendix A

		OS150nb		OS75nb		OS38nb	
Final Amplitude Correction		**1.02969**		**1.0165**		**1.0075**	
Final Phase/Angle Correction		**-0.1085**		**0.2120**		**-0.1045**	
		Water Track	**Bottom Track**	**Water Track**	**Bottom Track**	**Water Track**	**Bottom Track**
Number of edited points		2/4	-	2/4	-	2/4	-
Final Amplitude Residual	Mean	0.9990	-	0.9990	-	0.9995	-
	Median	0.9990	-	0.9990	-	0.9995	-

Final Phase/Angle Residual	Mean	-0.0065	-	0.0180	-	0.0385	-
	Median	-0.0065	-	0.0180	-	0.0385	-

2.2.2 Offsets

The offset from the ADCP transducer to the GPS needs to be known to avoid errors when the ship is turning, see Appendix for a visual representation of why this is important. The offsets when processing are shown in Table 2.

Table 2: GPS to ADCP Offsets

	OS150	OS75	OS38
dx (m)	-1	-1	1
dy (m)	1	4	3

2.3 Instrument Serial Numbers

Table 3: Instrument Serial Numbers

Manufacturer	Instrument	Serial Number
TRDI	ADCP 150 kHz	61315
TRDI	ADCP 75 kHz	65008
TRDI	ADCP 38 kHz	671923

3 NetCDF Data Headers

```
netcdf in2025_v07_os150nb {
dimensions:
        time = 1145 ;
        depth_cell = 60 ;
variables:
        int trajectory ;
                trajectory:standard_name = "trajectory_id" ;
        double time(time) ;
                time:long_name = "Decimal day" ;
```

time:units = "days since 2025-01-01 00:00:00" ;

time:C_format = "%12.5f" ;

time:standard_name = "time" ;

time:data_min = 181.103055555556 ;

time:data_max = 185.473159722222 ;

double lon(time) ;

lon:missing_value = 1.e+38 ;

lon:long_name = "Longitude" ;

lon:units = "degrees_east" ;

lon:C_format = "%9.4f" ;

lon:standard_name = "longitude" ;

lon:data_min = 142.780194444444 ;

lon:data_max = 147.900347222222 ;

double lat(time) ;

lat:missing_value = 1.e+38 ;

lat:long_name = "Latitude" ;

lat:units = "degrees_north" ;

lat:C_format = "%9.4f" ;

lat:standard_name = "latitude" ;

lat:data_min = -47.6337083333333 ;

lat:data_max = -42.97475 ;

float depth(time, depth_cell) ;

depth:missing_value = 1.e+38f ;

depth:long_name = "Depth" ;

depth:units = "meter" ;

depth:C_format = "%8.2f" ;

depth:positive = "down" ;

depth:data_min = 17.96f ;

depth:data_max = 489.99f ;

float u(time, depth_cell) ;

u:missing_value = 1.e+38f ;

u:long_name = "Zonal velocity component" ;

u:units = "meter second-1" ;

u:C_format = "%7.2f" ;

u:data_min = -0.3651876f ;

u:data_max = 0.3566232f ;

float v(time, depth_cell) ;

v:missing_value = 1.e+38f ;

v:long_name = "Meridional velocity component" ;

v:units = "meter second-1" ;

v:C_format = "%7.2f" ;

v:data_min = -0.804244f ;

v:data_max = 0.4582868f ;

short amp(time, depth_cell) ;

amp:missing_value = 32767s ;

amp:long_name = "Received signal strength" ;

amp:C_format = "%d" ;

amp:data_min = 23s ;

amp:data_max = 228s ;

byte pg(time, depth_cell) ;

pg:missing_value = -1b ;

pg:long_name = "Percent good pings" ;

pg:C_format = "%d" ;

pg:data_min = 0b ;

pg:data_max = 100b ;

byte pflag(time, depth_cell) ;

pflag:long_name = "Editing flags" ;

pflag:C_format = "%d" ;

pflag:data_min = 0b ;

pflag:data_max = 6b ;

float heading(time) ;

heading:missing_value = 1.e+38f ;

heading:long_name = "Ship heading" ;

heading:units = "degrees" ;

heading:C_format = "%6.1f" ;

heading:data_min = -178.9671f ;

heading:data_max = 173.8459f ;

float tr_temp(time) ;

tr_temp:missing_value = 1.e+38f ;

tr_temp:long_name = "ADCP transducer temperature" ;

tr_temp:units = "Celsius" ;

tr_temp:C_format = "%4.1f" ;

tr_temp:data_min = 9.33584f ;

tr_temp:data_max = 15.39652f ;

short num_pings(time) ;

num_pings:long_name = "Number of pings averaged per ensemble" ;

num_pings:units = "None" ;

num_pings:C_format = "%d" ;

num_pings:data_min = 143s ;

num_pings:data_max = 251s ;

float uship(time) ;

uship:missing_value = 1.e+38f ;

uship:long_name = "Ship zonal velocity component" ;

uship:units = "meter second-1" ;

uship:C_format = "%9.4f" ;

uship:data_min = -5.379858f ;

uship:data_max = 6.051846f ;

float vship(time) ;

vship:missing_value = 1.e+38f ;

vship:long_name = "Ship meridional velocity component" ;

vship:units = "meter second-1" ;

vship:C_format = "%9.4f" ;

vship:data_min = -6.011384f ;

vship:data_max = 6.352211f ;

// global attributes:

:featureType = "trajectoryProfile" ;

:history = "Created: 2026-07-06 09:01:58 UTC" ;

:Conventions = "COARDS" ;

:software = "pycurrents" ;

:hg_changeset = "3159:c22d6c40e594" ;

:title = "Shipboard ADCP velocity profiles" ;

:description = "Shipboard ADCP velocity profiles from in2025_v07 using instrument os150nb - Short Version." ;

:cruise_id = "in2025_v07" ;

:sonar = "os150nb" ;

:yearbase = 2025 ;

:ship_name = "RV Investigator" ;

:CODAS_variables = "\n",

"Variables in this CODAS short-form Netcdf file are intended for most end-user\n",

"scientific analysis and display purposes. For additional information see\n",

"the CODAS_processing_note global attribute and the attributes of each\n",

"of the variables.\n",

"\n",

"\n",

"==========
==========\n",

"time Time at the end of the ensemble, days from start of year.\n",

"lon, lat Longitude, Latitude from GPS at the end of the ensemble.\n",

"u,v Ocean zonal and meridional velocity component profiles.\n",

"uship, vship Zonal and meridional velocity components of the ship.\n",

"heading Mean ship heading during the ensemble.\n",

"depth Bin centers in nominal meters (no sound speed profile correction).\n",

"tr_temp ADCP transducer temperature.\n",

"pg Percent Good pings for u, v averaging after editing.\n",

"pflag Profile Flags based on editing, used to mask u, v.\n",

"amp Received signal strength in ADCP-specific units; no correction\n",

" for spreading or attenuation.\n",

"==========
==========\n",

"\n",

```
                "" ;
        :CODAS_processing_note = "\n",
                "CODAS processing note:\n",
                "======================\n",
                "\n",
                "Overview\n",
                "--------\n",
                "The CODAS database is a specialized storage format designed for\n",
                "shipboard ADCP data.  \"CODAS processing\" uses this format to hold\n",
                "averaged shipboard ADCP velocities and other variables, during the\n",
                "stages of data processing.  The CODAS database stores velocity\n",
                "profiles relative to the ship as east and north components along with\n",
                "position, ship speed, heading, and other variables. The netCDF *short*\n",
                "form contains ocean velocities relative to earth, time, position,\n",
                "transducer temperature, and ship heading; these are designed to be\n",
                "\"ready for immediate use\".  The netCDF *long* form is just a dump of\n",
                "the entire CODAS database.  Some variables are no longer used, and all\n",
                "have names derived from their original CODAS names, dating back to
the\n",
                "late 1980\'s.\n",
                "\n",
                "Post-processing\n",
                "---------------\n",
                "CODAS post-processing, i.e. that which occurs after the single-ping\n",
                "profiles have been vector-averaged and loaded into the CODAS
database,\n",
                "includes editing (using automated algorithms and manual tools),\n",
                "rotation and scaling of the measured velocities, and application of a\n",
                "time-varying heading correction.  Additional algorithms developed
more\n",
                "recently include translation of the GPS positions to the transducer\n",
                "location, and averaging of ship\'s speed over the times of valid pings\n",
                "when Percent Good is reduced. Such post-processing is needed prior to\n",
                "submission of \"processed ADCP data\" to JASADCP or other archives.\n",
```

```
"\n",
"Full CODAS processing\n",
"--------------------\n",
"Whenever single-ping data have been recorded, full CODAS processing\n",
"provides the best end product.\n",
"\n",
"Full CODAS processing starts with the single-ping velocities in beam\n",
"coordinates.  Based on the transducer orientation relative to the\n",
"hull, the beam velocities are transformed to horizontal, vertical, and\n",
"\"error velocity\" components.  Using a reliable heading (typically from\n",
"the ship\'s gyro compass), the velocities in ship coordinates are\n",
"rotated into earth coordinates.\n",
"\n",
"Pings are grouped into an \"ensemble\" (usually 2-5 minutes duration)\n",
"and undergo a suite of automated editing algorithms (removal of\n",
"acoustic interference; identification of the bottom; editing based on\n",
"thresholds; and specialized editing that targets CTD wire interference\n",
"and \"weak, biased profiles\".  The ensemble of single-ping velocities\n",
"is then averaged using an iterative reference layer averaging scheme.\n",
"Each ensemble is approximated as a single function of depth, with a\n",
"zero-average over a reference layer plus a reference layer velocity\n",
"for each ping.  Adding the average of the single-ping reference layer\n",
"velocities to the function of depth yields the ensemble-average\n",
"velocity profile.  These averaged profiles, along with ancillary\n",
"measurements, are written to disk, and subsequently loaded into the\n",
"CODAS database. Everything after this stage is \"post-processing\".\n",
"\n",
"note (time):\n",
"------------\n",
"Time is stored in the database using UTC Year, Month, Day, Hour,\n",
"Minute, Seconds.  Floating point time \"Decimal Day\" is the floating\n",
"point interval in days since the start of the year, usually the year\n",
"of the first day of the cruise.\n",
```

```
"\n",
"\n",
"note (heading):\n",
"---------------\n",
"CODAS processing uses heading from a reliable device, and (if\n",
"available) uses a time-dependent correction by an accurate heading\n",
"device.  The reliable heading device is typically a gyro compass (for\n",
"example, the Bridge gyro).  Accurate heading devices can be POSMV,\n",
"Seapath, Phins, Hydrins, MAHRS, or various Ashtech devices; this\n",
"varies with the technology of the time.  It is always confusing to\n",
"keep track of the sign of the heading correction.  Headings are written\n",
"degrees, positive clockwise. setting up some variables:\n",
"\n",
"X = transducer angle (CONFIG1_heading_bias)\n",
"    positive clockwise (beam 3 angle relative to ship)\n",
"G = Reliable heading (gyrocompass)\n",
"A = Accurate heading\n",
"dh = G - A = time-dependent heading correction
(ANCIL2_watrk_hd_misalign)\n",
"\n",
"Rotation of the measured velocities into the correct coordinate system\n",
"amounts to (u+i*v)*(exp(i*theta)) where theta is the sum of the\n",
"corrected heading and the transducer angle.\n",
"\n",
"theta = X + (G - dh) = X + G - dh\n",
"\n",
"\n",
"Watertrack and Bottomtrack calibrations give an indication of the\n",
"residual angle offset to apply, for example if mean and median of the\n",
"phase are all 0.5 (then R=0.5).  Using the \"rotate\" command,\n",
"the value of R is added to \"ANCIL2_watrk_hd_misalign\".\n",
"\n",
"new_dh = dh + R\n",
```

```
                "\n",
                "Therefore the total angle used in rotation is\n",
                "\n",
                "new_theta = X + G - dh_new\n",
                "         = X + G - (dh + R)\n",
                "         = (X - R) + (G - dh)\n",
                "\n",
                "The new estimate of the transducer angle is: X - R\n",
                "ANCIL2_watrk_hd_misalign contains: dh + R\n",
                "\n",
                "=================================================\n",
                "\n",
                "Profile flags\n",
                "-------------\n",
                "Profile editing flags are provided for each depth cell:\n",
                "\n",
                "binary    decimal    below    Percent\n",
                "value     value      bottom   Good      bin\n",
                "-------+----------+--------+----------+-------+\n",
                "000       0\n",
                "001       1                    bad\n",
                "010       2              bad\n",
                "011       3              bad      bad\n",
                "100       4       bad\n",
                "101       5       bad            bad\n",
                "110       6       bad     bad\n",
                "111       7       bad     bad      bad\n",
                "-------+----------+--------+----------+-------+\n",
                "" ;
}
netcdf in2025_v07_os75nb {
dimensions:
        time = 1053 ;
```

depth_cell = 55 ;

variables:

int trajectory ;

trajectory:standard_name = "trajectory_id" ;

double time(time) ;

time:long_name = "Decimal day" ;

time:units = "days since 2025-01-01 00:00:00" ;

time:C_format = "%12.5f" ;

time:standard_name = "time" ;

time:data_min = 181.426724537037 ;

time:data_max = 185.476643518519 ;

double lon(time) ;

lon:missing_value = 1.e+38 ;

lon:long_name = "Longitude" ;

lon:units = "degrees_east" ;

lon:C_format = "%9.4f" ;

lon:standard_name = "longitude" ;

lon:data_min = 142.780152777778 ;

lon:data_max = 147.900330555556 ;

double lat(time) ;

lat:missing_value = 1.e+38 ;

lat:long_name = "Latitude" ;

lat:units = "degrees_north" ;

lat:C_format = "%9.4f" ;

lat:standard_name = "latitude" ;

lat:data_min = -47.6336722222222 ;

lat:data_max = -43.483375 ;

float depth(time, depth_cell) ;

depth:missing_value = 1.e+38f ;

depth:long_name = "Depth" ;

depth:units = "meter" ;

depth:C_format = "%8.2f" ;

depth:positive = "down" ;

depth:data_min = 29.93f ;

depth:data_max = 893.99f ;

float u(time, depth_cell) ;

u:missing_value = 1.e+38f ;

u:long_name = "Zonal velocity component" ;

u:units = "meter second-1" ;

u:C_format = "%7.2f" ;

u:data_min = -0.3653304f ;

u:data_max = 0.3337201f ;

float v(time, depth_cell) ;

v:missing_value = 1.e+38f ;

v:long_name = "Meridional velocity component" ;

v:units = "meter second-1" ;

v:C_format = "%7.2f" ;

v:data_min = -0.7869897f ;

v:data_max = 0.5235083f ;

short amp(time, depth_cell) ;

amp:missing_value = 32767s ;

amp:long_name = "Received signal strength" ;

amp:C_format = "%d" ;

amp:data_min = 24s ;

amp:data_max = 215s ;

byte pg(time, depth_cell) ;

pg:missing_value = -1b ;

pg:long_name = "Percent good pings" ;

pg:C_format = "%d" ;

pg:data_min = 0b ;

pg:data_max = 100b ;

byte pflag(time, depth_cell) ;

pflag:long_name = "Editing flags" ;

pflag:C_format = "%d" ;

pflag:data_min = 0b ;

pflag:data_max = 6b ;

float heading(time) ;

heading:missing_value = 1.e+38f ;

heading:long_name = "Ship heading" ;

heading:units = "degrees" ;

heading:C_format = "%6.1f" ;

heading:data_min = -157.7465f ;

heading:data_max = 171.3059f ;

float tr_temp(time) ;

tr_temp:missing_value = 1.e+38f ;

tr_temp:long_name = "ADCP transducer temperature" ;

tr_temp:units = "Celsius" ;

tr_temp:C_format = "%4.1f" ;

tr_temp:data_min = 9.34382f ;

tr_temp:data_max = 16.12993f ;

short num_pings(time) ;

num_pings:long_name = "Number of pings averaged per ensemble" ;

num_pings:units = "None" ;

num_pings:C_format = "%d" ;

num_pings:data_min = 82s ;

num_pings:data_max = 144s ;

float uship(time) ;

uship:missing_value = 1.e+38f ;

uship:long_name = "Ship zonal velocity component" ;

uship:units = "meter second-1" ;

uship:C_format = "%9.4f" ;

uship:data_min = -5.10511f ;

uship:data_max = 6.051634f ;

float vship(time) ;

vship:missing_value = 1.e+38f ;

vship:long_name = "Ship meridional velocity component" ;

vship:units = "meter second-1" ;

vship:C_format = "%9.4f" ;

vship:data_min = -3.885824f ;

vship:data_max = 6.355308f ;

// global attributes:

:featureType = "trajectoryProfile" ;

:history = "Created: 2026-07-06 09:02:12 UTC" ;

:Conventions = "COARDS" ;

:software = "pycurrents" ;

:hg_changeset = "3159:c22d6c40e594" ;

:title = "Shipboard ADCP velocity profiles" ;

:description = "Shipboard ADCP velocity profiles from in2025_v07 using instrument os75nb - Short Version." ;

:cruise_id = "in2025_v07" ;

:sonar = "os75nb" ;

:yearbase = 2025 ;

:ship_name = "RV Investigator" ;

:CODAS_variables = "\n",

"Variables in this CODAS short-form Netcdf file are intended for most end-user\n",

"scientific analysis and display purposes. For additional information see\n",

"the CODAS_processing_note global attribute and the attributes of each\n",

"of the variables.\n",

"\n",

"\n",

"==========
==========\n",

"time Time at the end of the ensemble, days from start of year.\n",

"lon, lat Longitude, Latitude from GPS at the end of the ensemble.\n",

"u,v Ocean zonal and meridional velocity component profiles.\n",

"uship, vship Zonal and meridional velocity components of the ship.\n",

"heading Mean ship heading during the ensemble.\n",

"depth Bin centers in nominal meters (no sound speed profile correction).\n",

"tr_temp ADCP transducer temperature.\n",

"pg Percent Good pings for u, v averaging after editing.\n",

```
                "pflag       Profile Flags based on editing, used to mask u, v.\n",
                "amp         Received signal strength in ADCP-specific units; no correction\n",
                "            for spreading or attenuation.\n",
                "=============
==========================================================================\n",
                "\n",
                "" ;
        :CODAS_processing_note = "\n",
                "CODAS processing note:\n",
                "======================\n",
                "\n",
                "Overview\n",
                "--------\n",
                "The CODAS database is a specialized storage format designed for\n",
                "shipboard ADCP data.  \"CODAS processing\" uses this format to hold\n",
                "averaged shipboard ADCP velocities and other variables, during the\n",
                "stages of data processing.  The CODAS database stores velocity\n",
                "profiles relative to the ship as east and north components along with\n",
                "position, ship speed, heading, and other variables. The netCDF *short*\n",
                "form contains ocean velocities relative to earth, time, position,\n",
                "transducer temperature, and ship heading; these are designed to be\n",
                "\"ready for immediate use\".  The netCDF *long* form is just a dump of\n",
                "the entire CODAS database.  Some variables are no longer used, and all\n",
                "have names derived from their original CODAS names, dating back to
the\n",
                "late 1980\'s.\n",
                "\n",
                "Post-processing\n",
                "---------------\n",
                "CODAS post-processing, i.e. that which occurs after the single-ping\n",
                "profiles have been vector-averaged and loaded into the CODAS
database,\n",
                "includes editing (using automated algorithms and manual tools),\n",
                "rotation and scaling of the measured velocities, and application of a\n",
```

"time-varying heading correction. Additional algorithms developed more\n",

"recently include translation of the GPS positions to the transducer\n",
"location, and averaging of ship\'s speed over the times of valid pings\n",
"when Percent Good is reduced. Such post-processing is needed prior to\n",
"submission of \"processed ADCP data\" to JASADCP or other archives.\n",
"\n",
"Full CODAS processing\n",
"--------------------\n",
"Whenever single-ping data have been recorded, full CODAS processing\n",
"provides the best end product.\n",
"\n",
"Full CODAS processing starts with the single-ping velocities in beam\n",
"coordinates. Based on the transducer orientation relative to the\n",
"hull, the beam velocities are transformed to horizontal, vertical, and\n",
"\"error velocity\" components. Using a reliable heading (typically from\n",
"the ship\'s gyro compass), the velocities in ship coordinates are\n",
"rotated into earth coordinates.\n",
"\n",
"Pings are grouped into an \"ensemble\" (usually 2-5 minutes duration)\n",
"and undergo a suite of automated editing algorithms (removal of\n",
"acoustic interference; identification of the bottom; editing based on\n",
"thresholds; and specialized editing that targets CTD wire interference\n",
"and \"weak, biased profiles\". The ensemble of single-ping velocities\n",
"is then averaged using an iterative reference layer averaging scheme.\n",
"Each ensemble is approximated as a single function of depth, with a\n",
"zero-average over a reference layer plus a reference layer velocity\n",
"for each ping. Adding the average of the single-ping reference layer\n",
"velocities to the function of depth yields the ensemble-average\n",
"velocity profile. These averaged profiles, along with ancillary\n",
"measurements, are written to disk, and subsequently loaded into the\n",
"CODAS database. Everything after this stage is \"post-processing\".\n",
"\n",

```
"note (time):\n",
"------------\n",
"Time is stored in the database using UTC Year, Month, Day, Hour,\n",
"Minute, Seconds.  Floating point time \"Decimal Day\" is the floating\n",
"point interval in days since the start of the year, usually the year\n",
"of the first day of the cruise.\n",
"\n",
"\n",
"note (heading):\n",
"---------------\n",
"CODAS processing uses heading from a reliable device, and (if\n",
"available) uses a time-dependent correction by an accurate heading\n",
"device.  The reliable heading device is typically a gyro compass (for\n",
"example, the Bridge gyro).  Accurate heading devices can be POSMV,\n",
"Seapath, Phins, Hydrins, MAHRS, or various Ashtech devices; this\n",
"varies with the technology of the time.  It is always confusing to\n",
"keep track of the sign of the heading correction.  Headings are written\n",
"degrees, positive clockwise. setting up some variables:\n",
"\n",
"X = transducer angle (CONFIG1_heading_bias)\n",
"    positive clockwise (beam 3 angle relative to ship)\n",
"G = Reliable heading (gyrocompass)\n",
"A = Accurate heading\n",
"dh = G - A = time-dependent heading correction
(ANCIL2_watrk_hd_misalign)\n",
"\n",
"Rotation of the measured velocities into the correct coordinate system\n",
"amounts to (u+i*v)*(exp(i*theta)) where theta is the sum of the\n",
"corrected heading and the transducer angle.\n",
"\n",
"theta = X + (G - dh) = X + G - dh\n",
"\n",
"\n",
```

```
"Watertrack and Bottomtrack calibrations give an indication of the\n",
"residual angle offset to apply, for example if mean and median of the\n",
"phase are all 0.5 (then R=0.5).  Using the \"rotate\" command,\n",
"the value of R is added to \"ANCIL2_watrk_hd_misalign\".\n",
"\n",
"new_dh = dh + R\n",
"\n",
"Therefore the total angle used in rotation is\n",
"\n",
"new_theta = X + G - dh_new\n",
"         = X + G - (dh + R)\n",
"         = (X - R) + (G - dh)\n",
"\n",
"The new estimate of the transducer angle is: X - R\n",
"ANCIL2_watrk_hd_misalign contains: dh + R\n",
"\n",
"=================================================\n",
"\n",
"Profile flags\n",
"-------------\n",
"Profile editing flags are provided for each depth cell:\n",
"\n",
"binary    decimal    below    Percent\n",
"value     value      bottom   Good      bin\n",
"-------+----------+--------+----------+-------+\n",
"000       0\n",
"001       1                    bad\n",
"010       2              bad\n",
"011       3              bad      bad\n",
"100       4       bad\n",
"101       5       bad            bad\n",
"110       6       bad     bad\n",
"111       7       bad     bad      bad\n",
```

```
                    "-------+----------+--------+----------+-------+\n",
                    "" ;
}
netcdf in2025_v07_os38nb {
dimensions:
        time = 1053 ;
        depth_cell = 75 ;
variables:
        int trajectory ;
                trajectory:standard_name = "trajectory_id" ;
        double time(time) ;
                time:long_name = "Decimal day" ;
                time:units = "days since 2025-01-01 00:00:00" ;
                time:C_format = "%12.5f" ;
                time:standard_name = "time" ;
                time:data_min = 181.426747685185 ;
                time:data_max = 185.476643518519 ;
        double lon(time) ;
                lon:missing_value = 1.e+38 ;
                lon:long_name = "Longitude" ;
                lon:units = "degrees_east" ;
                lon:C_format = "%9.4f" ;
                lon:standard_name = "longitude" ;
                lon:data_min = 142.780111111111 ;
                lon:data_max = 147.900361111111 ;
        double lat(time) ;
                lat:missing_value = 1.e+38 ;
                lat:long_name = "Latitude" ;
                lat:units = "degrees_north" ;
                lat:C_format = "%9.4f" ;
                lat:standard_name = "latitude" ;
                lat:data_min = -47.63365 ;
                lat:data_max = -43.4833944444444 ;
```

float depth(time, depth_cell) ;
depth:missing_value = 1.e+38f ;
depth:long_name = "Depth" ;
depth:units = "meter" ;
depth:C_format = "%8.2f" ;
depth:positive = "down" ;
depth:data_min = 45.92f ;
depth:data_max = 1821.99f ;
float u(time, depth_cell) ;
u:missing_value = 1.e+38f ;
u:long_name = "Zonal velocity component" ;
u:units = "meter second-1" ;
u:C_format = "%7.2f" ;
u:data_min = -0.3383818f ;
u:data_max = 0.3399333f ;
float v(time, depth_cell) ;
v:missing_value = 1.e+38f ;
v:long_name = "Meridional velocity component" ;
v:units = "meter second-1" ;
v:C_format = "%7.2f" ;
v:data_min = -0.7062814f ;
v:data_max = 0.480525f ;
short amp(time, depth_cell) ;
amp:missing_value = 32767s ;
amp:long_name = "Received signal strength" ;
amp:C_format = "%d" ;
amp:data_min = 3s ;
amp:data_max = 213s ;
byte pg(time, depth_cell) ;
pg:missing_value = -1b ;
pg:long_name = "Percent good pings" ;
pg:C_format = "%d" ;
pg:data_min = 0b ;

pg:data_max = 100b ;

byte pflag(time, depth_cell) ;

pflag:long_name = "Editing flags" ;

pflag:C_format = "%d" ;

pflag:data_min = 0b ;

pflag:data_max = 6b ;

float heading(time) ;

heading:missing_value = 1.e+38f ;

heading:long_name = "Ship heading" ;

heading:units = "degrees" ;

heading:C_format = "%6.1f" ;

heading:data_min = -157.7701f ;

heading:data_max = 171.011f ;

float tr_temp(time) ;

tr_temp:missing_value = 1.e+38f ;

tr_temp:long_name = "ADCP transducer temperature" ;

tr_temp:units = "Celsius" ;

tr_temp:C_format = "%4.1f" ;

tr_temp:data_min = 9.204f ;

tr_temp:data_max = 15.0418f ;

short num_pings(time) ;

num_pings:long_name = "Number of pings averaged per ensemble" ;

num_pings:units = "None" ;

num_pings:C_format = "%d" ;

num_pings:data_min = 57s ;

num_pings:data_max = 101s ;

float uship(time) ;

uship:missing_value = 1.e+38f ;

uship:long_name = "Ship zonal velocity component" ;

uship:units = "meter second-1" ;

uship:C_format = "%9.4f" ;

uship:data_min = -5.113289f ;

uship:data_max = 6.052724f ;

float vship(time) ;

vship:missing_value = 1.e+38f ;

vship:long_name = "Ship meridional velocity component" ;

vship:units = "meter second-1" ;

vship:C_format = "%9.4f" ;

vship:data_min = -3.891531f ;

vship:data_max = 6.357559f ;

// global attributes:

:featureType = "trajectoryProfile" ;

:history = "Created: 2026-07-06 09:02:33 UTC" ;

:Conventions = "COARDS" ;

:software = "pycurrents" ;

:hg_changeset = "3159:c22d6c40e594" ;

:title = "Shipboard ADCP velocity profiles" ;

:description = "Shipboard ADCP velocity profiles from in2025_v07 using instrument os38nb - Short Version." ;

:cruise_id = "in2025_v07" ;

:sonar = "os38nb" ;

:yearbase = 2025 ;

:ship_name = "RV Investigator" ;

:CODAS_variables = "\n",

"Variables in this CODAS short-form Netcdf file are intended for most end-user\n",

"scientific analysis and display purposes. For additional information see\n",

"the CODAS_processing_note global attribute and the attributes of each\n",

"of the variables.\n",

"\n",

"\n",

"==========
==========\n",

"time Time at the end of the ensemble, days from start of year.\n",

"lon, lat Longitude, Latitude from GPS at the end of the ensemble.\n",

"u,v Ocean zonal and meridional velocity component profiles.\n",

```
                    "uship, vship  Zonal and meridional velocity components of the ship.\n",
                    "heading      Mean ship heading during the ensemble.\n",
                    "depth        Bin centers in nominal meters (no sound speed profile
correction).\n",
                    "tr_temp      ADCP transducer temperature.\n",
                    "pg           Percent Good pings for u, v averaging after editing.\n",
                    "pflag        Profile Flags based on editing, used to mask u, v.\n",
                    "amp          Received signal strength in ADCP-specific units; no correction\n",
                    "             for spreading or attenuation.\n",
                    "=============
============================================================\n",
                    "\n",
                    "" ;
               :CODAS_processing_note = "\n",
                    "CODAS processing note:\n",
                    "======================\n",
                    "\n",
                    "Overview\n",
                    "--------\n",
                    "The CODAS database is a specialized storage format designed for\n",
                    "shipboard ADCP data.  \"CODAS processing\" uses this format to hold\n",
                    "averaged shipboard ADCP velocities and other variables, during the\n",
                    "stages of data processing.  The CODAS database stores velocity\n",
                    "profiles relative to the ship as east and north components along with\n",
                    "position, ship speed, heading, and other variables. The netCDF *short*\n",
                    "form contains ocean velocities relative to earth, time, position,\n",
                    "transducer temperature, and ship heading; these are designed to be\n",
                    "\"ready for immediate use\".  The netCDF *long* form is just a dump of\n",
                    "the entire CODAS database.  Some variables are no longer used, and all\n",
                    "have names derived from their original CODAS names, dating back to
the\n",
                    "late 1980\'s.\n",
                    "\n",
                    "Post-processing\n",
```

```
                "---------------\n",
                "CODAS post-processing, i.e. that which occurs after the single-ping\n",
                "profiles have been vector-averaged and loaded into the CODAS
database,\n",
                "includes editing (using automated algorithms and manual tools),\n",
                "rotation and scaling of the measured velocities, and application of a\n",
                "time-varying heading correction.  Additional algorithms developed
more\n",
                "recently include translation of the GPS positions to the transducer\n",
                "location, and averaging of ship\'s speed over the times of valid pings\n",
                "when Percent Good is reduced. Such post-processing is needed prior to\n",
                "submission of \"processed ADCP data\" to JASADCP or other archives.\n",
                "\n",
                "Full CODAS processing\n",
                "---------------------\n",
                "Whenever single-ping data have been recorded, full CODAS processing\n",
                "provides the best end product.\n",
                "\n",
                "Full CODAS processing starts with the single-ping velocities in beam\n",
                "coordinates.  Based on the transducer orientation relative to the\n",
                "hull, the beam velocities are transformed to horizontal, vertical, and\n",
                "\"error velocity\" components.  Using a reliable heading (typically from\n",
                "the ship\'s gyro compass), the velocities in ship coordinates are\n",
                "rotated into earth coordinates.\n",
                "\n",
                "Pings are grouped into an \"ensemble\" (usually 2-5 minutes duration)\n",
                "and undergo a suite of automated editing algorithms (removal of\n",
                "acoustic interference; identification of the bottom; editing based on\n",
                "thresholds; and specialized editing that targets CTD wire interference\n",
                "and \"weak, biased profiles\".  The ensemble of single-ping velocities\n",
                "is then averaged using an iterative reference layer averaging scheme.\n",
                "Each ensemble is approximated as a single function of depth, with a\n",
                "zero-average over a reference layer plus a reference layer velocity\n",
```

```
"for each ping.  Adding the average of the single-ping reference layer\n",
"velocities to the function of depth yields the ensemble-average\n",
"velocity profile.  These averaged profiles, along with ancillary\n",
"measurements, are written to disk, and subsequently loaded into the\n",
"CODAS database. Everything after this stage is \"post-processing\".\n",
"\n",
"note (time):\n",
"------------\n",
"Time is stored in the database using UTC Year, Month, Day, Hour,\n",
"Minute, Seconds.  Floating point time \"Decimal Day\" is the floating\n",
"point interval in days since the start of the year, usually the year\n",
"of the first day of the cruise.\n",
"\n",
"\n",
"note (heading):\n",
"---------------\n",
"CODAS processing uses heading from a reliable device, and (if\n",
"available) uses a time-dependent correction by an accurate heading\n",
"device.  The reliable heading device is typically a gyro compass (for\n",
"example, the Bridge gyro).  Accurate heading devices can be POSMV,\n",
"Seapath, Phins, Hydrins, MAHRS, or various Ashtech devices; this\n",
"varies with the technology of the time.  It is always confusing to\n",
"keep track of the sign of the heading correction.  Headings are written\n",
"degrees, positive clockwise. setting up some variables:\n",
"\n",
"X = transducer angle (CONFIG1_heading_bias)\n",
"    positive clockwise (beam 3 angle relative to ship)\n",
"G = Reliable heading (gyrocompass)\n",
"A = Accurate heading\n",
"dh = G - A = time-dependent heading correction
(ANCIL2_watrk_hd_misalign)\n",
"\n",
"Rotation of the measured velocities into the correct coordinate system\n",
```

```
"amounts to (u+i*v)*(exp(i*theta)) where theta is the sum of the\n",
"corrected heading and the transducer angle.\n",
"\n",
"theta = X + (G - dh) = X + G - dh\n",
"\n",
"\n",
"Watertrack and Bottomtrack calibrations give an indication of the\n",
"residual angle offset to apply, for example if mean and median of the\n",
"phase are all 0.5 (then R=0.5).  Using the \"rotate\" command,\n",
"the value of R is added to \"ANCIL2_watrk_hd_misalign\".\n",
"\n",
"new_dh = dh + R\n",
"\n",
"Therefore the total angle used in rotation is\n",
"\n",
"new_theta = X + G - dh_new\n",
"         = X + G - (dh + R)\n",
"         = (X - R) + (G - dh)\n",
"\n",
"The new estimate of the transducer angle is: X - R\n",
"ANCIL2_watrk_hd_misalign contains: dh + R\n",
"\n",
"=====================================================\n",
"\n",
"Profile flags\n",
"-------------\n",
"Profile editing flags are provided for each depth cell:\n",
"\n",
"binary    decimal    below    Percent\n",
"value     value      bottom   Good      bin\n",
"-------+----------+--------+----------+-------+\n",
"000       0\n",
"001       1                   bad\n",
```

```
"010      2           bad\n",
"011      3           bad     bad\n",
"100      4      bad\n",
"101      5      bad          bad\n",
"110      6      bad    bad\n",
"111      7      bad    bad     bad\n",
"-------+----------+--------+----------+-------+\n",
"" ;
}
```

4 References

Shadwick. (2025). *The RV Investigator. Voyage Plan* IN2025_V07. Retrieved from Marine National Facility: Voyage Plans and summaries: https://www.marine.csiro.au/data/reporting/

Hummon, J. (2009-2021). *CODAS+UHDAS Documentation*. Retrieved February 1, 2023, from https://doi.org/10.5281/zenodo.8371260

5 Appendix A

Table 4: os150nb Water Track and Bottom Track Working Calibrations and Residuals

Water Track	Bottom Track
Preliminary	
Number of edited points: 1 out of 3 median mean std amplitude 1.0200 1.0200 nan phase 0.4110 0.4110 nan	N/A
Transducer offset corrections applied	
xducer_dx: 1	
xducer_dy: -2	
After applying transducer offset corrections	
Number of edited points: 1 out of 3 median mean std amplitude 1.0200 1.0200 nan phase 0.4160 0.4160 nan	N/A
Calibrations correction values applied	
rotate_amplitude: 1.02	
rotate_angle: 0.4160	
After applying calibration corrections	
Number of edited points: 2 out of 4 median mean std amplitude 1.0095 1.0095 0.0134 phase -0.5245 -0.5245 0.7418	N/A
Calibrations correction values applied	
rotate_amplitude: 1.0095	
rotate_angle: -0.5245	
After applying calibration corrections	
Number of edited points: 2 out of 4 median mean std amplitude 1.0000 1.0000 0.0141 phase -0.0055 -0.0055 0.7474	N/A
After manual single ping editing	
Number of edited points: 2 out of 4 median mean std amplitude 0.9990 0.9990 0.0156 phase -0.0065 -0.0065 0.7672	N/A

os150nb_total_rotate_amplitude = 1.02969
os150nb_total_rotate_angle = -0.1085

Table 5: os75nb Water Track and Bottom Track Working Calibrations and Residuals

Water Track	Bottom Track
Preliminary	
Number of edited points: 2 out of 4 median mean std amplitude 1.0140 1.0140 0.0071 phase 0.0770 0.0770 0.6831	N/A
Transducer offset corrections applied	
xducer_dx: -2	
xducer_dy: -9	
After applying transducer offset corrections	
Number of edited points: 2 out of 4 median mean std amplitude 1.0165 1.0165 0.0092 phase 0.2120 0.2120 0.5119	N/A
Calibrations correction values applied	
rotate_amplitude: 1.0165	
rotate_angle: 0.2120	
After applying calibration corrections	
Number of edited points: 2 out of 4 median mean std amplitude 1.0000 1.0000 0.0085 phase 0.0055 0.0055 0.5042	N/A
After manual single ping editing	
Number of edited points: 2 out of 4 median mean std amplitude 0.9990 0.9990 0.0099 phase 0.0180 0.0180 0.4709	N/A

os75nb_total_rotate_amplitude = 1.0165
os75nb_total_rotate_angle = 0.2120

Table 6: os38nb Water Track and Bottom Track Working Calibrations and Residuals

Water Track	Bottom Track
Preliminary	
Number of edited points: 2 out of 4 median mean std amplitude 1.0060 1.0060 0.0014 phase -0.2265 -0.2265 0.4575	N/A
Transducer offset corrections applied	
xducer_dx: 0	
xducer_dy: -7	
After applying transducer offset corrections	
Number of edited points: 2 out of 4 median mean std amplitude 1.0075 1.0075 0.0035 phase -0.1045 -0.1045 0.2977	N/A
Calibrations correction values applied	
rotate_amplitude: 1.0075	
rotate_angle: -0.1045	
After applying calibration corrections	
Number of edited points: 2 out of 4 median mean std amplitude 0.9995 0.9995 0.0035 phase 0.0120 0.0120 0.2885	N/A
After manual single ping editing	
Number of edited points: 2 out of 4 median mean std amplitude 0.9995 0.9995 0.0035 phase 0.0385 0.0385 0.2185	N/A

os38nb_total_rotate_amplitude = 1.0075
os38nb_total_rotate_angle = -0.1045

6 Appendix B

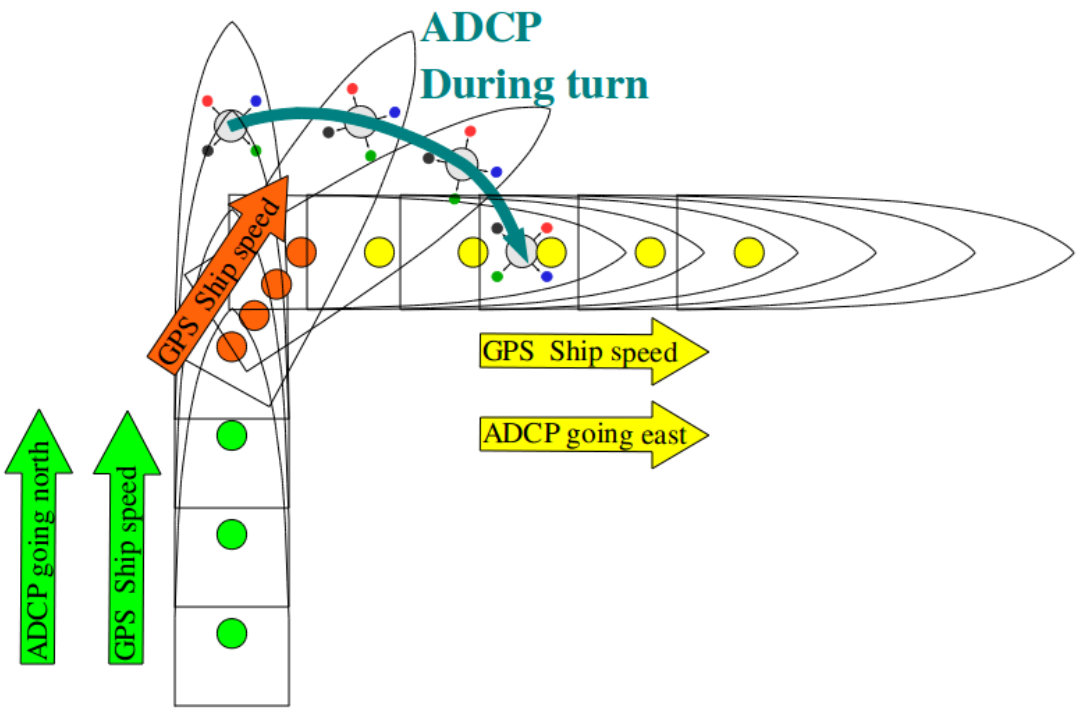

Figure 2: The horizontal offset between the ADCP transducer and the GPS (used to calculate ship speed) can cause errors in the calculated ocean velocity.
https://currents.soest.hawaii.edu/docs/adcp_doc/codas_doc/dataviewer/xducer_dxdy.html

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