Marine National Facility

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RV *Investigator* ADCP Data Processing Report

Voyage ID	IN2025_V05
Voyage Title	Eruption, destruction and seafloor ecosystem recovery – Tonga 2022 eruption of the century
Depart	Hobart, 10 August 2025, 00:00 UTC
Return	Brisbane, 30 October 2025, 22:24] UTC
Chief Scientist	Rebecca Carey (UTAS)
Data Processor	Francis Chui, Mark Brunton (CSIRO – E&T Data Acquisition & Processing)

Document History

Date	Version	Author	Comments
20 November 2025	1.0	Francis Chui	Initial version
30 July 2026	1.1	Mark Brunton	Minor revisions

Contents

1 Summary

This multidisciplinary research project investigates the geological and ecological impacts of submarine volcanism, using the January 15, 2022, eruption of Hunga Tonga-Hunga Ha'apai (HTHH) as a primary case study. The eruption—unprecedented in scale and intensity—produced a 58 km-high plume, a trans-Pacific tsunami, and significant seafloor modification, including an 850 m summit crater. Post-eruption surveys revealed widespread benthic ecosystem collapse, providing a baseline for long-term ecological recovery studies.

This report describes the production of quality controlled ADCP data from RV *Investigator* voyage IN2025_V05.

The ADCP was run for most of the voyage, though it was turned off when EM712 and EM2040 Mk2 surveys were being performed to avoid creating interference in the multibeam data.

ADCP data were collected using the University of Hawaii Data Acquisition System (UHDAS) and post-processed using the Common Ocean Data Access System (CODAS). Documentation for these systems can be found in (Hummon, 2009-2021).

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

External 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 metres; any additional changes will need to be applied by the user if they believe it is required.

Bottom tracking was run for the first hour of the voyage on the OS150nb to aid in calibrations.

The following processing issues were encountered for this dataset

On this voyage, it was discovered the OS75 would report signal below the bottom, which is suspected to be electrical interference. This data set was split into two cruises to accommodate for changes in positioning systems during acquisition and subsequently reprocessed using the Seapath.

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

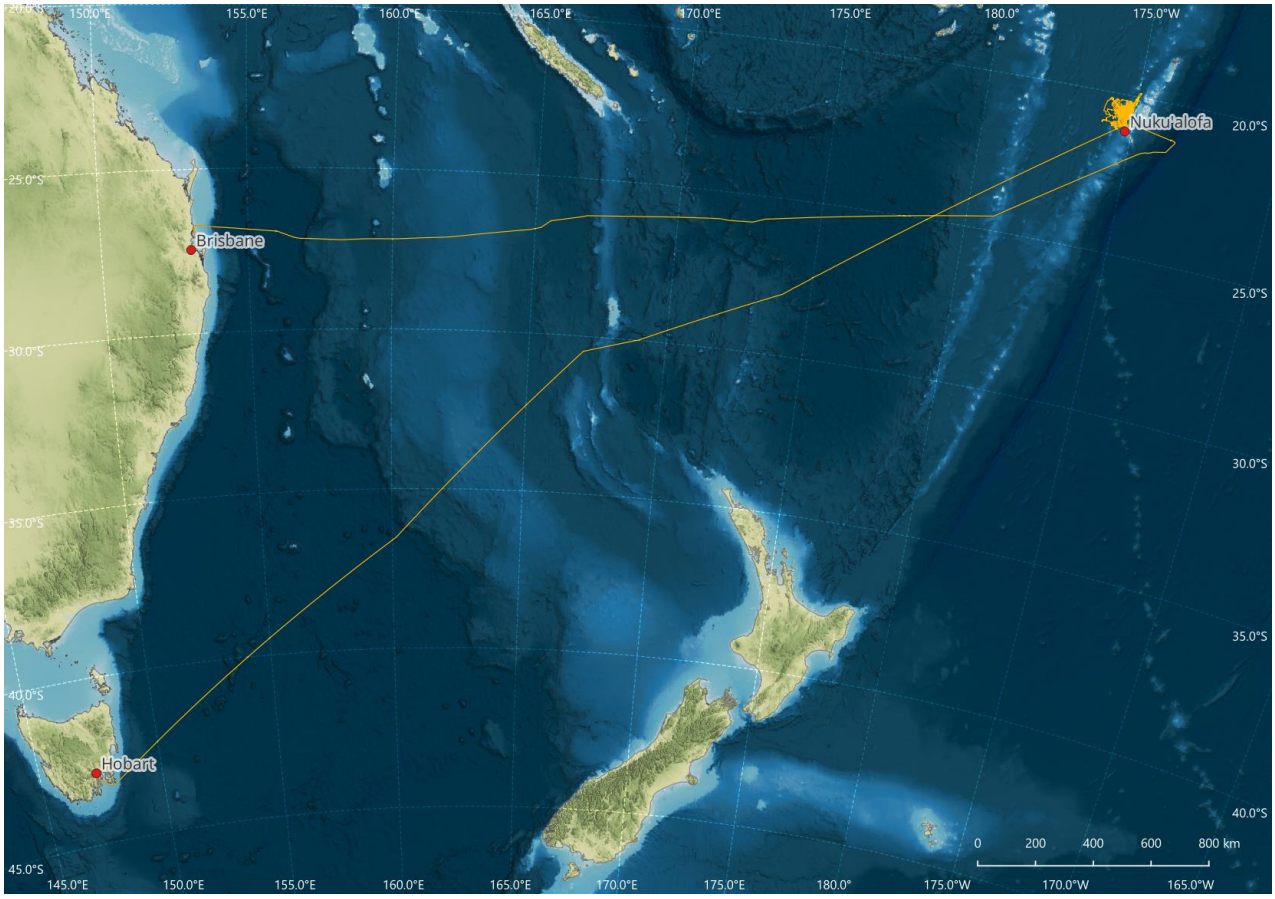

Figure 1: Voyage track

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 3389:2fa0841853b2 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 was the Seapath. 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

On this voyage, acquisition was split into two cruises as the POSMV positioning system was unreliable and the decision was made halfway through the voyage to swap to the Kongsberg Seapath 380 positioning system.

There were instances during the voyage where the OS75 would report signal below the bottom which is suspected to be due to electrical interference. An example is shown below where the signal return is near zero but there are high U/V values. These were removed in two passes, first during single ping editing of the OS75 as shown below followed by editing with OS75 vs. OS38 comparison plots to identify areas in the OS75 data near the bottom that were affected by the interference.

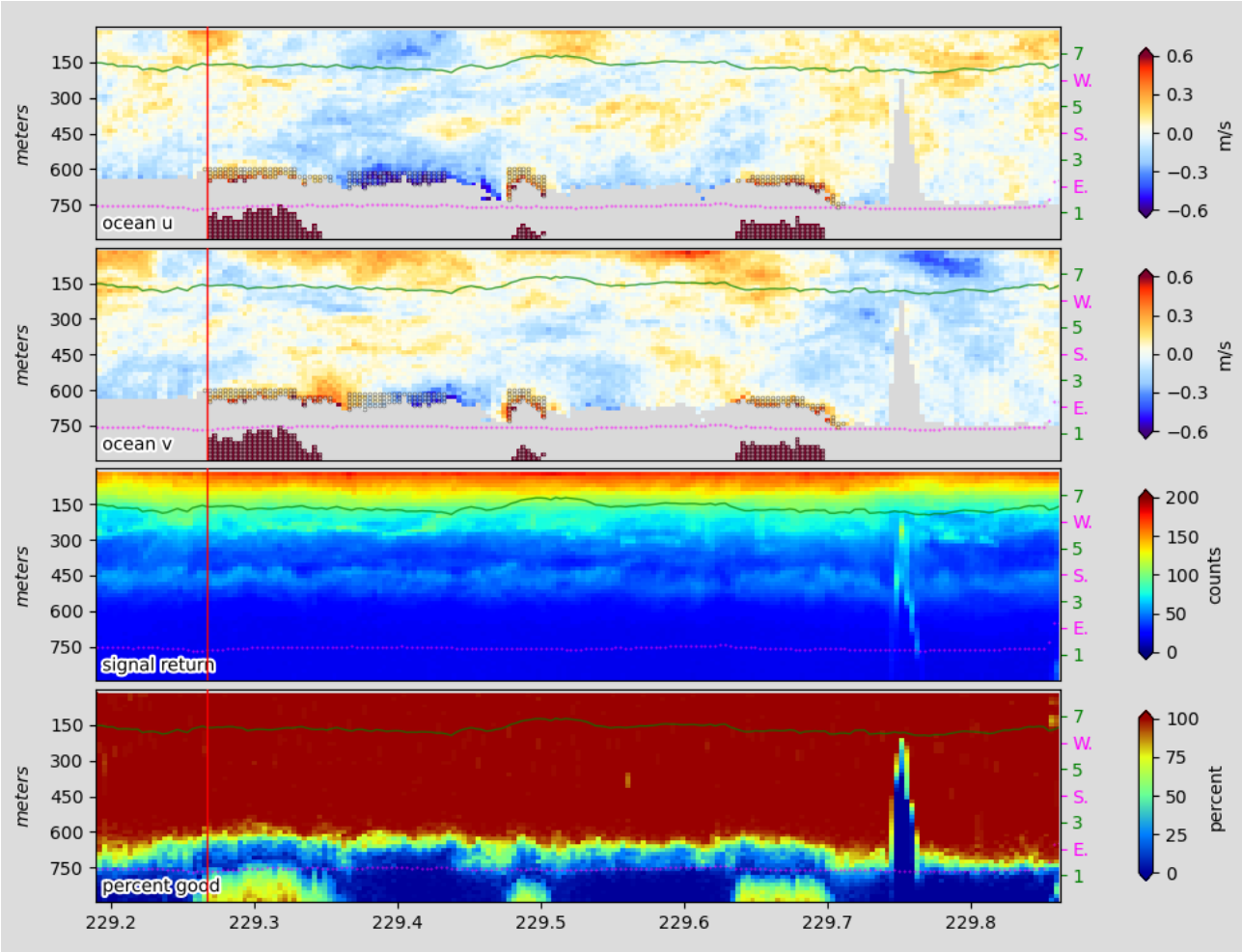

Figure 2 Electrical interference observed on the os75

2.2.1 Calibration Residuals

Small gaps of lost data in the accurate heading device were found in the OS150nb, OS75nb & OS38nb data, hence Table(s) 4, 5 & 6 of Appendix A shows the changes to the residual before and after “patch_hcorr.py” was run to interpolate the heading correction through the gaps.

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

		OS150nb		OS75nb		OS38nb	
Final Amplitude Correction		**1.0075**		**1.00525**		**1.00291**	
Final Phase/Angle Correction		**-0.117**		**0.3558**		**-0.0559**	
		Water Track	**Bottom Track**	**Water Track**	**Bottom Track**	**Water Track**	**Bottom Track**
Number of edited points		**203/233**	**11/25**	**175/188**	-	**153/173**	-
Final Amplitude Residual	Mean	**1.0007**	**0.9996**	**1.0002**	-	**1.0000**	-
	Median	**0.9990**	**1.0004**	**1.0000**	-	**1.0000**	-
Final Phase/Angle Residual	Mean	**0.0153**	**0.0058**	**-0.0135**	-	**-0.0100**	-
	Median	**0.002**	**0.0034**	**0.0070**	-	**-0.0226**	-

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 Table 6: OS38nb Water **Track and Bottom Track Working Calibrations and Residuals**

Water Track	**Bottom Track**
Preliminary	
Number of edited points: 173 out of 185 median mean std amplitude 1.0050 1.0059 0.0086 phase 0.3550 0.3523 0.4516	N/A
After patch_hcorr.py	
Number of edited points: 172 out of 184 median mean std amplitude 1.0050 1.0055 0.0082 phase 0.3610 0.3461 0.4502	N/A
After applying calibration corrections	
Number of edited points: 175 out of 188 median mean std amplitude 1.0000 1.0002 0.0081 phase 0.0050 -0.0106 0.4439	N/A
After manual single ping editing	
Number of edited points: 157 out of 174 median mean std amplitude 1.0030 1.0028 0.0087 phase -0.0470 -0.0648 0.5071	N/A
Calibrations correction values applied (delete if not needed)	

rotate_amplitude: 1.0029	
rotate_angle: -0.0559	
Final calibration correction (delete if not needed)	
Number of edited points: 153 out of 173 median mean std amplitude 1.0000 1.0000 0.0089 phase 0.0100 −0.0226 0.5022	N/A

OS38nb_total_rotate_amplitude = **1.0029**
OS38nb_total_rotate_angle = **-0.0559**

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	671918
TRDI	ADCP 38 kHz	671923

3 NetCDF Data Headers

```
netcdf in2025_v05_os150nb {
dimensions:
        time = 13964 ;
        depth_cell = 60 ;
        num_configs = 21 ;
variables:
        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:calendar = "proleptic_gregorian" ;
                time:axis = "T" ;
                time:data_min = 221.024675925926 ;
                time:data_max = 272.717523148148 ;
        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 = 147.375416666667 ;
                lon:data_max = 186.492605555556 ;
        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 = -43.2800027777778 ;
                lat:data_max = -19.865675 ;
        float depth(time, depth_cell) ;
                depth:missing_value = 1.e+38f ;
                depth:long_name = "Depth" ;
                depth:units = "meter" ;
                depth:C_format = "%8.2f" ;
                depth:data_min = 17.93f ;
                depth:data_max = 490.f ;
        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 = -0.8810904f ;
                u:data_max = 1.0213f ;
        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 = -1.641002f ;
            v:data_max = 1.025723f ;
short amp(time, depth_cell) ;
            amp:missing_value = 32767s ;
            amp:long_name = "Received signal strength" ;
            amp:units = "" ;
            amp:C_format = "%d" ;
            amp:data_min = 22s ;
            amp:data_max = 229s ;
byte pg(time, depth_cell) ;
            pg:missing_value = -1b ;
            pg:long_name = "Percent good pings" ;
            pg:units = "" ;
            pg:C_format = "%d" ;
            pg:data_min = 0b ;
            pg:data_max = 100b ;
byte pflag(time, depth_cell) ;
            pflag:long_name = "Editing flags" ;
            pflag:units = "" ;
            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 = -179.9917f ;
            heading:data_max = 179.99f ;
float tr_temp(time) ;
            tr_temp:missing_value = 1.e+38f ;
            tr_temp:long_name = "ADCP transducer temperature" ;
            tr_temp:units = "degree_Celsius" ;
            tr_temp:C_format = "%4.1f" ;
            tr_temp:data_min = 11.0414f ;
            tr_temp:data_max = 26.23852f ;
short num_pings(time) ;
            num_pings:long_name = "Number of pings averaged per ensemble" ;
            num_pings:units = "" ;
            num_pings:C_format = "%d" ;
            num_pings:data_min = 11s ;
            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 = -6.708234f ;
            uship:data_max = 6.522803f ;
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 = -5.175364f ;
                vship:data_max = 4.568134f ;
        int index_config_start(num_configs) ;
                index_config_start:long_name = "First zero-based time index of each configuration" ;
                index_config_start:units = "" ;
        float ensemble_seconds(num_configs) ;
                ensemble_seconds:long_name = "Ensemble average duration" ;
                ensemble_seconds:units = "s" ;
        short num_depth_bins(num_configs) ;
                num_depth_bins:long_name = "Number of depth bins" ;
                num_depth_bins:units = "" ;
        float transducer_depth(num_configs) ;
                transducer_depth:long_name = "Transducer depth" ;
                transducer_depth:units = "m" ;
        float depth_bin_length(num_configs) ;
                depth_bin_length:long_name = "Vertical averaging length" ;
                depth_bin_length:units = "m" ;
        float pulse_length(num_configs) ;
                pulse_length:long_name = "Vertical span of sonar ping" ;
                pulse_length:units = "m" ;
        float blank_length(num_configs) ;
                blank_length:long_name = "Vertical delay between ping and first reception" ;
                blank_length:units = "m" ;
        float ping_interval(num_configs) ;
                ping_interval:long_name = "Typical time between pings" ;
                ping_interval:units = "s" ;
        float transducer_orientation(num_configs) ;
                transducer_orientation:long_name = "Approximate transducer orientation, clockwise rotation of beam 3 from forward" ;
                transducer_orientation:units = "degrees" ;

// global attributes:
                :history = "Created: 2026-07-30 05:45:23 UTC" ;
                :Conventions = "COARDS CF-1.8" ;
                :software = "pycurrents" ;
                :hg_changeset = "3389:2fa0841853b2" ;
                :title = "Shipboard ADCP velocity profiles" ;
                :summary = "Shipboard ADCP velocity profiles from in2025_v05 using instrument os150nb - Short Version." ;
                :cruise_id = "in2025_v05" ;
                :sonar = "os150nb" ;
                :yearbase = 2025 ;
                :platform = "RV Investigator" ;
                :time_coverage_start = "2025-08-10T00:35:32Z" ;
                :time_coverage_end = "2025-09-30T17:13:14Z" ;
                :geospatial_lat_min = -43.28f ;
                :geospatial_lat_max = -19.86567f ;
                :geospatial_lat_units = "degrees_north" ;
                :geospatial_lon_min = 147.3754f ;
                :geospatial_lon_max = 186.4926f ;
                :geospatial_lon_units = "degrees_east" ;
                :geospatial_vertical_min = 17.93f ;
                :geospatial_vertical_max = 490.f ;
                :geospatial_vertical_units = "m" ;
```

```
:geospatial_vertical_positive = "down" ;
: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 eastward and northward velocity component profiles.\n",
          "uship, vship  Eastward and northward 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 after editing in vector-averaged velocities.\n",
          "pflag         Profile Flags based on editing, used to mask velocities.\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       s  bad      bad\n",
"111         7         bad      bad       bad\n",
"-------+----------+--------+----------+-------+\n",
"" ;
}
```

```
netcdf in2025_v05_OS75nb {
dimensions:
          time = 11990 ;
          depth_cell = 55 ;
          num_configs = 32 ;
variables:
          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:calendar = "proleptic_gregorian" ;
                    time:axis = "T" ;
                    time:data_min = 221.2340740740074 ;
                    time:data_max = 272.6168402777778 ;
          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 = 147.9666916666667 ;
                    lon:data_max = 186.4926055555556 ;
          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 = -43.27961388888889 ;
                    lat:data_max = -19.87058888888889 ;
          float depth(time, depth_cell) ;
                    depth:missing_value = 1.e+38f ;
                    depth:long_name = "Depth" ;
                    depth:units = "meter" ;
                    depth:C_format = "%8.2f" ;
                    depth:data_min = 29.93f ;
                    depth:data_max = 894.f ;
          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 = -0.837522f ;
                    u:data_max = 0.9755554f ;
          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 = -1.660762f ;
                    v:data_max = 2.508541f ;
          short amp(time, depth_cell) ;
```

```
            amp:missing_value = 32767s ;
            amp:long_name = "Received signal strength" ;
            amp:units = "" ;
            amp:C_format = "%d" ;
            amp:data_min = 16s ;
            amp:data_max = 214s ;
byte pg(time, depth_cell) ;
            pg:missing_value = -1b ;
            pg:long_name = "Percent good pings" ;
            pg:units = "" ;
            pg:C_format = "%d" ;
            pg:data_min = 0b ;
            pg:data_max = 100b ;
byte pflag(time, depth_cell) ;
            pflag:long_name = "Editing flags" ;
            pflag:units = "" ;
            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 = -179.9806f ;
            heading:data_max = 179.9952f ;
float tr_temp(time) ;
            tr_temp:missing_value = 1.e+38f ;
            tr_temp:long_name = "ADCP transducer temperature" ;
            tr_temp:units = "degree_Celsius" ;
            tr_temp:C_format = "%4.1f" ;
            tr_temp:data_min = 13.31789f ;
            tr_temp:data_max = 26.36405f ;
short num_pings(time) ;
            num_pings:long_name = "Number of pings averaged per ensemble" ;
            num_pings:units = "" ;
            num_pings:C_format = "%d" ;
            num_pings:data_min = 10s ;
            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 = -6.708004f ;
            uship:data_max = 6.525989f ;
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 = -5.165463f ;
            vship:data_max = 4.597081f ;
```

```
        int index_config_start(num_configs) ;
                index_config_start:long_name = "First zero-based time index of each configuration" ;
                index_config_start:units = "" ;
        float ensemble_seconds(num_configs) ;
                ensemble_seconds:long_name = "Ensemble average duration" ;
                ensemble_seconds:units = "s" ;
        short num_depth_bins(num_configs) ;
                num_depth_bins:long_name = "Number of depth bins" ;
                num_depth_bins:units = "" ;
        float transducer_depth(num_configs) ;
                transducer_depth:long_name = "Transducer depth" ;
                transducer_depth:units = "m" ;
        float depth_bin_length(num_configs) ;
                depth_bin_length:long_name = "Vertical averaging length" ;
                depth_bin_length:units = "m" ;
        float pulse_length(num_configs) ;
                pulse_length:long_name = "Vertical span of sonar ping" ;
                pulse_length:units = "m" ;
        float blank_length(num_configs) ;
                blank_length:long_name = "Vertical delay between ping and first reception" ;
                blank_length:units = "m" ;
        float ping_interval(num_configs) ;
                ping_interval:long_name = "Typical time between pings" ;
                ping_interval:units = "s" ;
        float transducer_orientation(num_configs) ;
                transducer_orientation:long_name = "Approximate transducer orientation, clockwise rotation of beam 3 from forward" ;
                transducer_orientation:units = "degrees" ;

// global attributes:
                :history = "Created: 2025-11-19 04:58:01 UTC" ;
                :Conventions = "COARDS CF-1.8" ;
                :software = "pycurrents" ;
                :hg_changeset = "3389:2fa0841853b2" ;
                :title = "Shipboard ADCP velocity profiles" ;
                :summary = "Shipboard ADCP velocity profiles from in2025_v05 using instrument OS75nb - Short Version." ;
                :cruise_id = "in2025_v05" ;
                :sonar = "OS75nb" ;
                :yearbase = 2025 ;
                :platform = "RV Investigator" ;
                :time_coverage_start = "2025-08-10T05:37:04Z" ;
                :time_coverage_end = "2025-09-30T14:48:15Z" ;
                :geospatial_lat_min = -43.27961f ;
                :geospatial_lat_max = -19.87059f ;
                :geospatial_lat_units = "degrees_north" ;
                :geospatial_lon_min = 147.9667f ;
                :geospatial_lon_max = 186.4926f ;
                :geospatial_lon_units = "degrees_east" ;
                :geospatial_vertical_min = 29.93f ;
                :geospatial_vertical_max = 894.f ;
                :geospatial_vertical_units = "m" ;
                :geospatial_vertical_positive = "down" ;
                :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 eastward and northward velocity component profiles.\n",
            "uship, vship  Eastward and northward 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 after editing in vector-averaged velocities.\n",
            "pflag         Profile Flags based on editing, used to mask velocities.\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",
"" ;
}

"-------+----------+--------+----------+-------+\n",
"" ;
}
```

```
netcdf in2025_v05_os38nb {
dimensions:
        time = 9204 ;
        depth_cell = 75 ;
        num_configs = 35 ;
variables:
        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:calendar = "proleptic_gregorian" ;
                time:axis = "T" ;
                time:data_min = 221.338402777778 ;
                time:data_max = 263.949965277778 ;
        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 = -211.509458333333 ;
                lon:data_max = -174.906455555556 ;
        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 = -43.0249027777778 ;
                lat:data_max = -19.8709361111111 ;
        float depth(time, depth_cell) ;
                depth:missing_value = 1.e+38f ;
                depth:long_name = "Depth" ;
                depth:units = "meter" ;
                depth:C_format = "%8.2f" ;
                depth:data_min = 45.87f ;
                depth:data_max = 1822.f ;
        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 = -0.824126f ;
                u:data_max = 0.9100327f ;
        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 = -0.805661f ;
                v:data_max = 0.6912467f ;
        short amp(time, depth_cell) ;
```

```
            amp:missing_value = 32767s ;
            amp:long_name = "Received signal strength" ;
            amp:units = "" ;
            amp:C_format = "%d" ;
            amp:data_min = 2s ;
            amp:data_max = 213s ;
byte pg(time, depth_cell) ;
            pg:missing_value = -1b ;
            pg:long_name = "Percent good pings" ;
            pg:units = "" ;
            pg:C_format = "%d" ;
            pg:data_min = 0b ;
            pg:data_max = 100b ;
byte pflag(time, depth_cell) ;
            pflag:long_name = "Editing flags" ;
            pflag:units = "" ;
            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 = -179.9965f ;
            heading:data_max = 179.9851f ;
float tr_temp(time) ;
            tr_temp:missing_value = 1.e+38f ;
            tr_temp:long_name = "ADCP transducer temperature" ;
            tr_temp:units = "degree_Celsius" ;
            tr_temp:C_format = "%4.1f" ;
            tr_temp:data_min = 13.04923f ;
            tr_temp:data_max = 26.13062f ;
short num_pings(time) ;
            num_pings:long_name = "Number of pings averaged per ensemble" ;
            num_pings:units = "" ;
            num_pings:C_format = "%d" ;
            num_pings:data_min = 11s ;
            num_pings:data_max = 100s ;
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 = -4.573127f ;
            uship:data_max = 6.452532f ;
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 = -4.476263f ;
            vship:data_max = 4.58288f ;
```

```
        int index_config_start(num_configs) ;
                index_config_start:long_name = "First zero-based time index of each configuration" ;
                index_config_start:units = "" ;
        float ensemble_seconds(num_configs) ;
                ensemble_seconds:long_name = "Ensemble average duration" ;
                ensemble_seconds:units = "s" ;
        short num_depth_bins(num_configs) ;
                num_depth_bins:long_name = "Number of depth bins" ;
                num_depth_bins:units = "" ;
        float transducer_depth(num_configs) ;
                transducer_depth:long_name = "Transducer depth" ;
                transducer_depth:units = "m" ;
        float depth_bin_length(num_configs) ;
                depth_bin_length:long_name = "Vertical averaging length" ;
                depth_bin_length:units = "m" ;
        float pulse_length(num_configs) ;
                pulse_length:long_name = "Vertical span of sonar ping" ;
                pulse_length:units = "m" ;
        float blank_length(num_configs) ;
                blank_length:long_name = "Vertical delay between ping and first reception" ;
                blank_length:units = "m" ;
        float ping_interval(num_configs) ;
                ping_interval:long_name = "Typical time between pings" ;
                ping_interval:units = "s" ;
        float transducer_orientation(num_configs) ;
                transducer_orientation:long_name = "Approximate transducer orientation, clockwise rotation of beam 3 from forward" ;
                transducer_orientation:units = "degrees" ;

// global attributes:
                :history = "Created: 2026-07-30 05:36:01 UTC" ;
                :Conventions = "COARDS CF-1.8" ;
                :software = "pycurrents" ;
                :hg_changeset = "3389:2fa0841853b2" ;
                :title = "Shipboard ADCP velocity profiles" ;
                :summary = "Shipboard ADCP velocity profiles from in2025_v05 using instrument os38nb - Short Version." ;
                :cruise_id = "in2025_v05" ;
                :sonar = "os38nb" ;
                :yearbase = 2025 ;
                :platform = "RV Investigator" ;
                :time_coverage_start = "2025-08-10T08:07:18Z" ;
                :time_coverage_end = "2025-09-21T22:47:57Z" ;
                :geospatial_lat_min = -43.0249f ;
                :geospatial_lat_max = -19.87094f ;
                :geospatial_lat_units = "degrees_north" ;
                :geospatial_lon_min = -211.5095f ;
                :geospatial_lon_max = -174.9064f ;
                :geospatial_lon_units = "degrees_east" ;
                :geospatial_vertical_min = 45.87f ;
                :geospatial_vertical_max = 1822.f ;
                :geospatial_vertical_units = "m" ;
                :geospatial_vertical_positive = "down" ;
                :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 eastward and northward velocity component profiles.\n",
                "uship, vship  Eastward and northward 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 after editing in vector-averaged velocities.\n",
                "pflag         Profile Flags based on editing, used to mask velocities.\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

Carey, R. (2025). *The RV Investigator. Voyage Plan* IN2025_V05. 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: 199 out of 227 median mean std amplitude 1.0070 1.0080 0.0096 phase −0.1190 −0.1245 0.5370	unedited: 13 points edited: 11 points, 2.0 min speed, 2.5 max dev median mean std amplitude 1.0077 1.0072 0.0018 phase −0.1158 −0.1103 0.0710
After patch_hcorr.py	
Number of edited points: 199 out of 227 median mean std amplitude 1.0070 1.0079 0.0095 phase −0.1200 −0.1156 0.5895	unedited: 13 points edited: 11 points, 2.0 min speed, 2.5 max dev median mean std amplitude 1.0079 1.0071 0.0018 phase −0.1051 −0.1042 0.0702
Calibrations correction values applied	
rotate_amplitude: 1.0075	
rotate_angle: -0.117	
After applying calibration corrections	
Number of edited points: 206 out of 233 median mean std amplitude 0.9990 1.0007 0.0098 phase 0.0005 0.0073 0.5892	unedited: 14 points edited: 11 points, 2.0 min speed, 2.5 max dev median mean std amplitude 1.0004 0.9996 0.0020 phase 0.0034 0.0058 0.0707
After manual single ping editing	
Number of edited points: 203 out of 231 median mean std amplitude 0.9990 1.0007 0.0100 phase 0.0020 0.0153 0.6041	unedited: 14 points edited: 11 points, 2.0 min speed, 2.5 max dev median mean std amplitude 1.0004 0.9996 0.0020 phase 0.0034 0.0058 0.0707

OS150nb_total_rotate_amplitude = 1.0075
OS150nb_total_rotate_angle = -0.117

Table 5: OS75nb Water Track and Bottom Track Working Calibrations and Residuals

Water Track	Bottom Track
Preliminary	
Number of edited points: 175 out of 188 median mean std amplitude 1.0000 1.0002 0.0081 phase 0.0050 -0.0106 0.4439	N/A
After patch_hcorr.py	
Number of edited points: 172 out of 184 median mean std amplitude 1.0050 1.0055 0.0081 phase 0.3660 0.3455 0.4494	N/A
Calibrations correction values applied	
rotate_amplitude: 1.00525	
rotate_angle: 0.3558	
After applying calibration corrections	
Number of edited points: 175 out of 188 median mean std amplitude 1.0000 1.0002 0.0081 phase 0.0070 -0.0135 0.4442	N/A
After manual single ping editing	
Number of edited points: 175 out of 188 median mean std amplitude 1.0000 1.0002 0.0081 phase 0.0070 -0.0135 0.4442	N/A

OS75nb_total_rotate_amplitude = 1.00525
OS75nb_total_rotate_angle = 0.3558

Table 6: OS38nb Water Track and Bottom Track Working Calibrations and Residuals

Water Track	Bottom Track
Preliminary	
Number of edited points: 173 out of 185 median mean std amplitude 1.0050 1.0059 0.0086 phase 0.3550 0.3523 0.4516	N/A
After patch_hcorr.py	
Number of edited points: 172 out of 184 median mean std amplitude 1.0050 1.0055 0.0082 phase 0.3610 0.3461 0.4502	N/A
After applying calibration corrections	
Number of edited points: 175 out of 188 median mean std amplitude 1.0000 1.0002 0.0081 phase 0.0050 -0.0106 0.4439	N/A
After manual single ping editing	
Number of edited points: 157 out of 174 median mean std amplitude 1.0030 1.0028 0.0087 phase -0.0470 -0.0648 0.5071	N/A
Calibrations correction values applied (delete if not needed)	
rotate_amplitude: 1.0029	
rotate_angle: -0.0559	
Final calibration correction (delete if not needed)	
Number of edited points: 153 out of 173 median mean std amplitude 1.0000 1.0000 0.0089 phase 0.0100 -0.0226 0.5022	N/A

OS38nb_total_rotate_amplitude = **1.0029**
OS38nb_total_rotate_angle = **-0.0559**

6 Appendix B

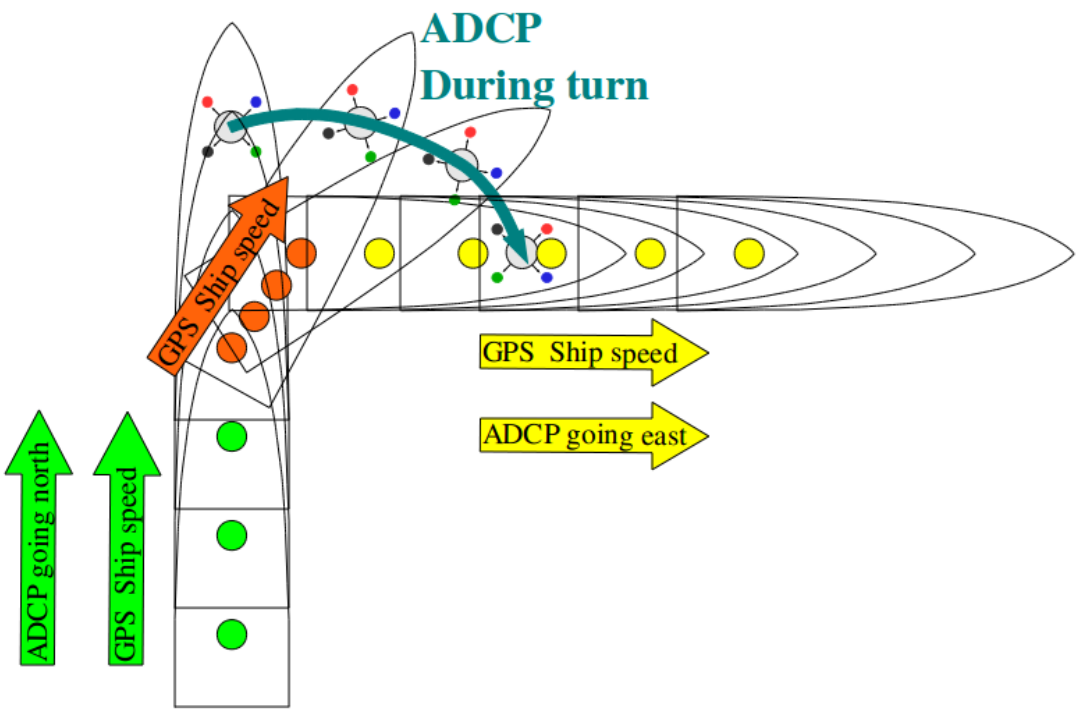

Figure 3: The horizontal offset between the ADCP transducer and the GPS (used to calculate ship speed) can cause errors in the calculated ocean velocity.
https://currents.soest.hawaii.edu/docs/adcp_doc/codas_doc/dataviewer/xducer_dxdy.html

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