# RV *Investigator*

# ADCP Processing Report

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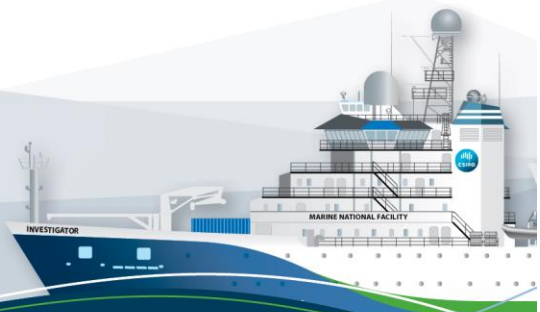
|---|---|
| **Voyage #:** | IN2018_T02 |
| **Voyage title:** | Harmful Algal Blooms and their long term sediment record in East Coast Tasmanian waters |
| **Depart:** | 08:00 Brisbane, Monday 14 May 2018 |
| **Return:** | 08:00 Hobart, Monday 21 May 2018 |
| **Voyage Manager:** | Stephen Thomas |
| **Chief Scientist:** | Prof Gustaaf Hallegraeff |
| **Affiliation:** | Institute for Marine and Antarctic Studies (IMAS) |
| **Report compiled by:** | Peter Shanks |



# Contents

# 1 Summary

Only the RDI Ocean Surveyor 75kHz ADCP was operational during this voyage. The system was turned off mid-voyage while the multi-beam instruments were being used to locate wrecks off Sydney Harbour.

The RDI Ocean Surveyor 150kHz ADCP was out of service, being replaced by a WorkHorse Quartermaster 150kHz ADCP for the duration of the voyage.

Internal triggering was used as external triggering was found to be unstable on previous voyages.

The drop keels were typically used at flush with Gondola (2m).

See the voyage computing and electronics report for more details regarding data acquisition.

# 2 Processing Background

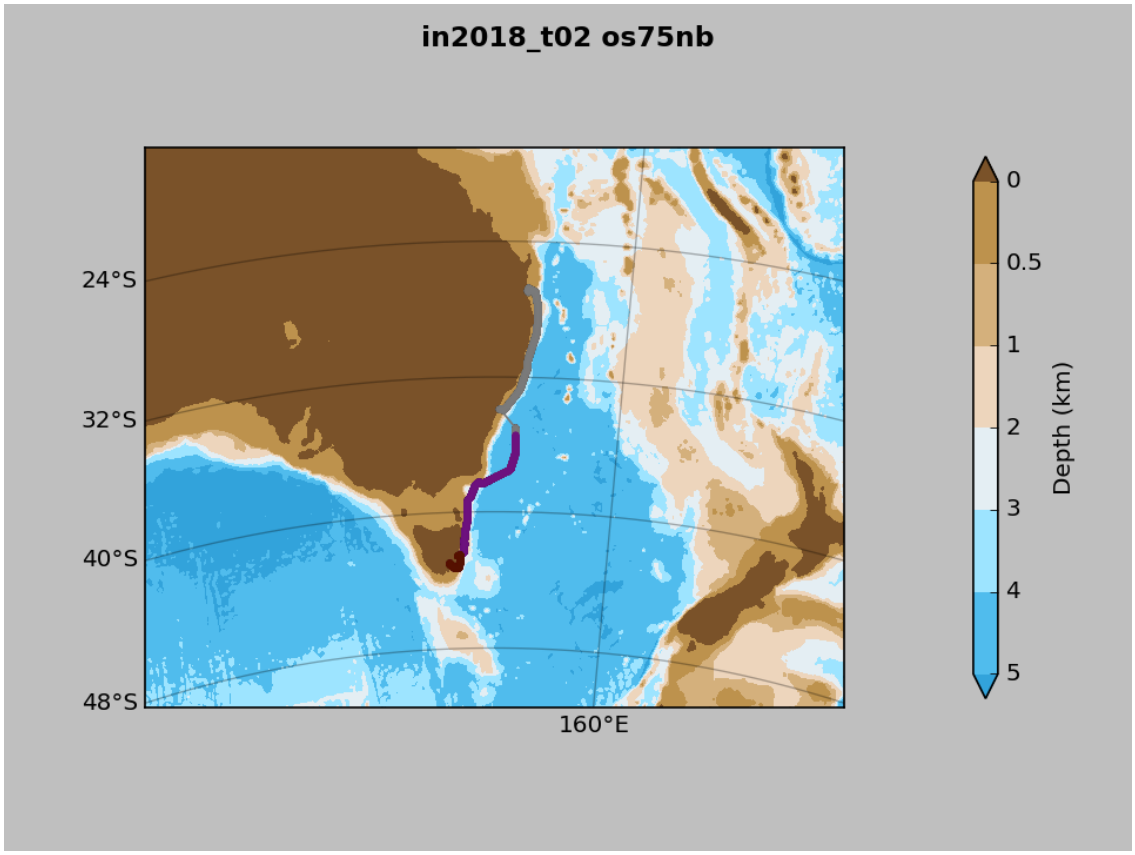
The University of Hawaii's CODAS software was used for data post-processing. UHDAS+CODAS 2017.10.01-python software was used.

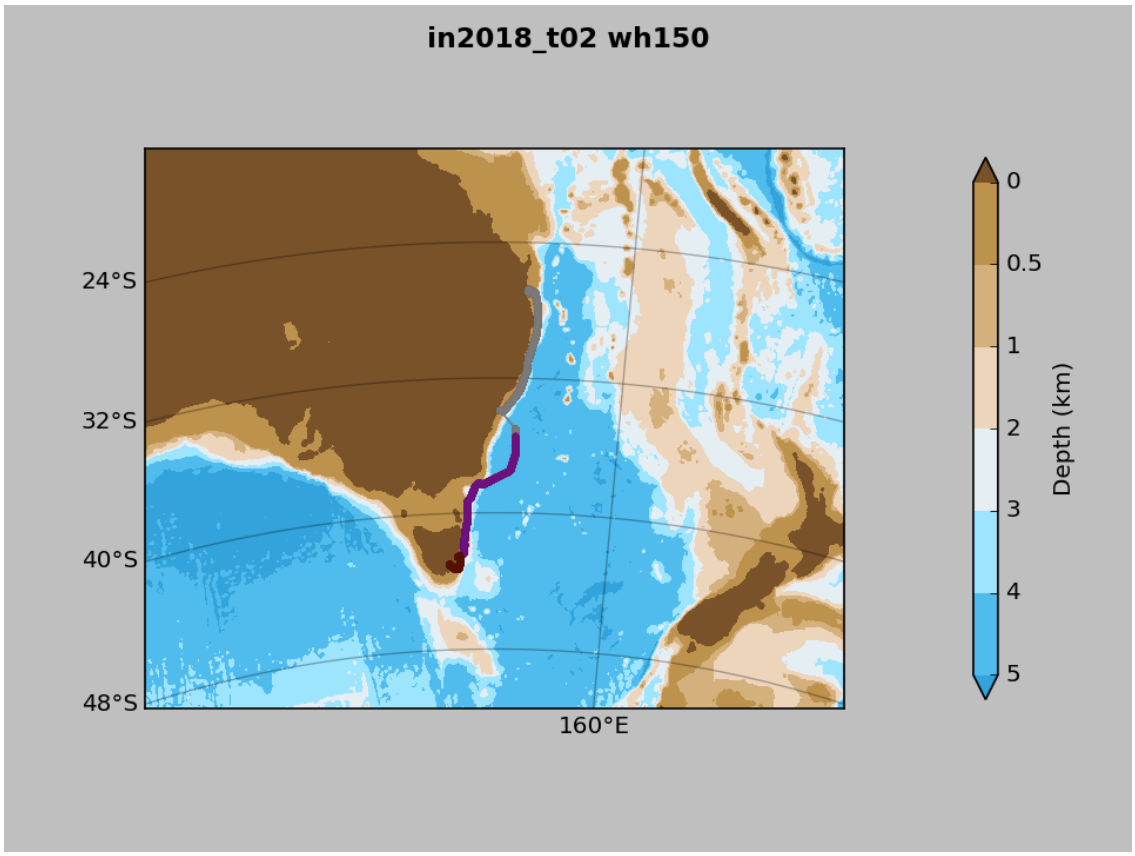
# 3 Processing Notes

Two NetCDF files were produced, one for each instrument in2018_t02_os75nb.nc and in2018_t02_wh150.nc (both zipped into in2018_t02_adcp.zip).

Please see the webpy_os75nb and webpy_wh150 folders for overview plots of collected data.

## 3.1 Area Covered



# 4 NetCDF Data Headers

## 4.1 in2018_t02_os75nb

```
netcdf in2018_t02_os75nb {
dimensions:
      time = 1575 ;
      depth_cell = 60 ;
variables:
      int trajectory ;
            trajectory:standard_name = "trajectory_id" ;
      double time(time) ;
            time:long_name = "Decimal day" ;
            time:units = "days since 2018-01-01 00:00:00" ;
            time:C_format = "%12.5f" ;
            time:standard_name = "time" ;
            time:data_min = 133.079270833333 ;
            time:data_max = 139.86337962963 ;
      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 = 147.375252777778 ;
            lon:data_max = 153.875188888889 ;
      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 = -43.2720222222222 ;
            lat:data_max = -26.7096444444444 ;
      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 = 29.94f ;
            depth:data_max = 973.99f ;
      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 = -1.298817f ;
            u:data_max = 0.6748419f ;
      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 = -1.31514f ;
            v:data_max = 1.006697f ;
      short amp(time, depth_cell) ;
```

```
            amp:missing_value = 32767s ;
            amp:long_name = "Received signal strength" ;
            amp:C_format = "%d" ;
            amp:data_min = 8s ;
            amp:data_max = 218s ;
      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 = 7b ;
      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 = -179.9236f ;
            heading:data_max = 179.9981f ;
      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 = 13.0182f ;
            tr_temp:data_max = 25.46921f ;
      byte 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 = -124b ;
            num_pings:data_max = 127b ;
      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 = -5.874565f ;
            uship:data_max = 5.520724f ;
      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 = -6.546887f ;
            vship:data_max = 6.537319f ;

// global attributes:
            :featureType = "trajectoryProfile" ;
            :history = "Created: 2018-08-06 23:43:56 UTC" ;
            :Conventions = "COARDS" ;
            :software = "pycurrents" ;
            :hg_changeset = "2417:49ecfa0cc6c5" ;
```

```
            :title = "Shipboard ADCP velocity profiles" ;
            :description = "Shipboard ADCP velocity profiles from
in2018_t02 using instrument os75nb" ;
            :cruise_id = "in2018_t02" ;
            :sonar = "os75nb" ;
            :yearbase = 2018 ;
            :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",
                "" ;
}
```

## 4.2 in2018_t02_wh150

```
netcdf in2018_t02_wh150 {
dimensions:
      time = 1575 ;
      depth_cell = 70 ;
variables:
      int trajectory ;
            trajectory:standard_name = "trajectory_id" ;
      double time(time) ;
            time:long_name = "Decimal day" ;
            time:units = "days since 2018-01-01 00:00:00" ;
            time:C_format = "%12.5f" ;
            time:standard_name = "time" ;
            time:data_min = 133.081157407407 ;
            time:data_max = 139.86337962963 ;
      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 = 147.375233333333 ;
            lon:data_max = 153.875186111111 ;
      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 = -43.2720277777778 ;
            lat:data_max = -26.7095944444444 ;
      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 = 14.16f ;
            depth:data_max = 290.19f ;
      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 = -1.282473f ;
            u:data_max = 0.625309f ;
      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 = -1.281799f ;
            v:data_max = 1.04729f ;
      short amp(time, depth_cell) ;
            amp:missing_value = 32767s ;
            amp:long_name = "Received signal strength" ;
            amp:C_format = "%d" ;
```

```
            amp:data_min = 35s ;
            amp:data_max = 214s ;
      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 = 7b ;
      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 = -179.9948f ;
            heading:data_max = 179.9981f ;
      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 = 12.3974f ;
            tr_temp:data_max = 24.67982f ;
      byte 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 = -97b ;
            num_pings:data_max = 102b ;
      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 = -5.88672f ;
            uship:data_max = 5.525727f ;
      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 = -6.541688f ;
            vship:data_max = 6.533475f ;

// global attributes:
            :featureType = "trajectoryProfile" ;
            :history = "Created: 2018-08-07 00:04:17 UTC" ;
            :Conventions = "COARDS" ;
            :software = "pycurrents" ;
            :hg_changeset = "2417:49ecfa0cc6c5" ;
            :title = "Shipboard ADCP velocity profiles" ;
            :description = "Shipboard ADCP velocity profiles from
in2018_t02 using instrument wh150" ;
```

```
            :cruise_id = "in2018_t02" ;
            :sonar = "wh150" ;
            :yearbase = 2018 ;
            :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",
                "" ;
}
```