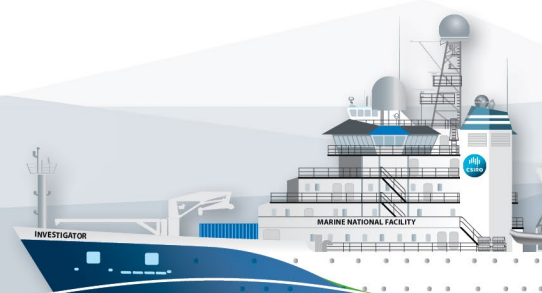


## *RV Investigator*

### ADCP Processing Report

<b>Voyage:</b>	in2019_v04
<b>Voyage title:</b>	Hotspot dynamics in the Coral Sea: connections between the Australian plate and deep Earth
<b>Depart:</b>	Cairns, 0700 Wednesday, 7 August 2019
<b>Return:</b>	Brisbane, 0800 Tuesday, 3 September 2019
<b>Chief Scientist:</b>	Joanne Whittaker
<b>Affiliation:</b>	UTAS
<b>Report compiled by:</b>	Karl Malakoff



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## 1 Summary

Data was collected during in2019\_v04 for the duration of the voyage. Data was collected using UHDAS and post-processed using CODAS.

Both the RDI Ocean Surveyor 150kHz ADCP and the RDI Ocean Surveyor 75kHz ADCP were run in narrowband mode for the duration of the voyage.

Internal triggering was used.

The drop keel was at 2m below the waterline for the duration of the voyage.

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

## 2 Processing Background

The University of Hawaii's CODAS software version 2833:145c35feab49 was used for data post-processing.

## 3 Processing Notes

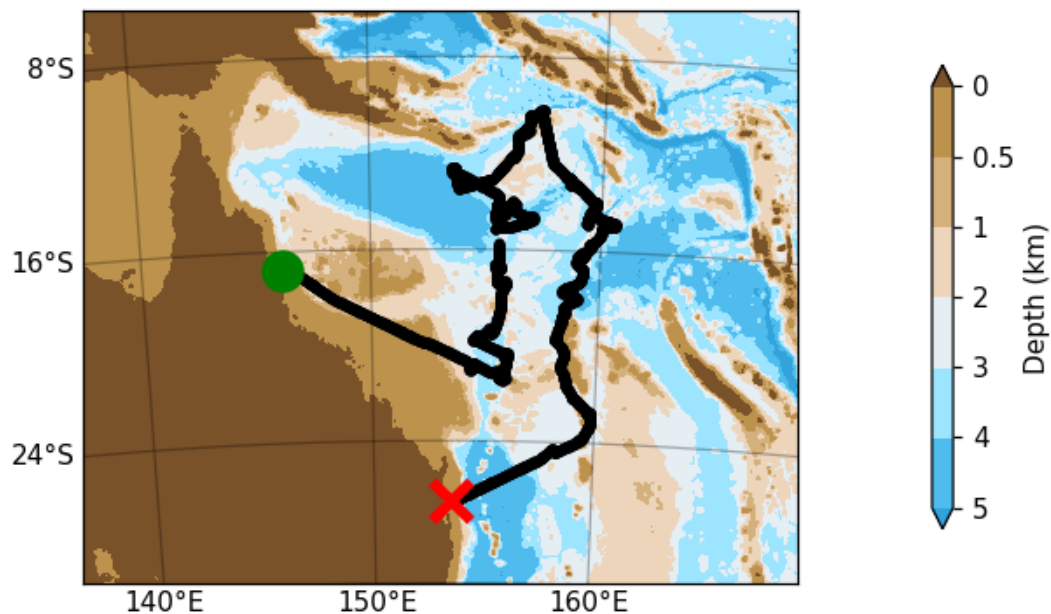
The data from both the os150 and os75 were of generally high quality.

Some manual editing was required to remove bottom data when transiting over seamounts.

Some ringing was observed and removed on the os75 data.

Some data is missing from the 9<sup>th</sup> of August when a software error interrupted both datastreams.

## 4 Area Covered



Please see the webpy\_nb folders for plots of collected data.

## 5 netCDF Data Headers

### 5.1 os75nb

```
netcdf os75nb {
dimensions:
    time = 7545 ;
    depth_cell = 60 ;
variables:
    int trajectory ;
        trajectory:standard_name = "trajectory_id" ;
    double time(time) ;
        time:long_name = "Decimal day" ;
        time:units = "days since 2019-01-01 00:00:00" ;
        time:C_format = "%12.5f" ;
        time:standard_name = "time" ;
        time:data_min = 217.990590277778 ;
        time:data_max = 244.410717592593 ;
    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 = 146.111755555556 ;
        lon:data_max = 160.644255555556 ;
    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 = -26.5454444444444 ;
        lat:data_max = -10.1911777777778 ;
    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 = 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 = -0.85814f ;
u:data_max = 0.7477317f ;
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 = -0.8368702f ;
v:data_max = 0.9170008f ;
short amp(time, depth_cell) ;
amp:missing_value = 32767s ;
amp:long_name = "Received signal strength" ;
amp:C_format = "%d" ;
amp:data_min = 10s ;
amp:data_max = 217s ;
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 = -179.8801f ;
heading:data_max = 179.9556f ;
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 = 21.45181f ;
tr_temp:data_max = 28.55305f ;
short num_pings(time) ;
ensemble" num_pings:long_name = "Number of pings averaged per
num_pings:units = "None" ;
num_pings:C_format = "%d" ;
```

```
num_pings:data_min = 34s ;
num_pings:data_max = 141s ;
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 = -6.279406f ;
    uship:data_max = 6.162856f ;
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 = -6.302362f ;
    vship:data_max = 6.226226f ;

// global attributes:
:featureType = "trajectoryProfile" ;
:history = "Created: 2019-09-10 01:57:56 UTC" ;
:Conventions = "COARDS" ;
:software = "pycurrents" ;
:hg_changeset = "2833:145c35feab49" ;
:title = "Shipboard ADCP velocity profiles" ;
:description = "Shipboard ADCP velocity profiles
from in2019_v04 using instrument os75nb" ;
:cruise_id = "in2019_v04" ;
:sonar = "os75nb" ;
:yearbase = 2019 ;
: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",
        "\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  $(u+iv) * (\exp(i*\theta))$  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",
    "\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",
"" ;
}
```

## 5.2 os150nb

```
netcdf os150nb {
dimensions:
    time = 7546 ;
    depth_cell = 60 ;
variables:
    int trajectory ;
        trajectory:standard_name = "trajectory_id" ;
    double time(time) ;
        time:long_name = "Decimal day" ;
        time:units = "days since 2019-01-01 00:00:00" ;
```

```
time:C_format = "%12.5f" ;
time:standard_name = "time" ;
time:data_min = 217.99056712963 ;
time:data_max = 244.414178240741 ;
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 = 146.111636111111 ;
lon:data_max = 160.644236111111 ;
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 = -26.5465305555556 ;
lat:data_max = -10.1911611111111 ;
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 = 17.93f ;
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 = -0.8754048f ;
u:data_max = 0.7832775f ;
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 = -0.807344f ;
v:data_max = 0.8436544f ;
short amp(time, depth_cell) ;
amp:missing_value = 32767s ;
amp:long_name = "Received signal strength" ;
amp:C_format = "%d" ;
amp:data_min = 19s ;
```

```
    amp:data_max = 224s ;
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 = -179.8888f ;
    heading:data_max = 179.9554f ;
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 = 21.26456f ;
    tr_temp:data_max = 28.34756f ;
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 = 60s ;
    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 = -6.275636f ;
    uship:data_max = 6.155192f ;
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 = -6.304852f ;
```

```
vship:data_max = 6.222255f ;

// global attributes:
:featureType = "trajectoryProfile" ;
:history = "Created: 2019-09-09 05:45:36 UTC" ;
:Conventions = "COARDS" ;
:software = "pycurrents" ;
:hg_changeset = "2833:145c35feab49" ;
:title = "Shipboard ADCP velocity profiles" ;
:description = "Shipboard ADCP velocity profiles
from in2019_v04 using instrument os150nb" ;
:cruise_id = "in2019_v04" ;
:sonar = "os150nb" ;
:yearbase = 2019 ;
: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 \n",  
"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 \n",  
"Decimal Day\n" 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  $(u+iv) \cdot (\exp(i \cdot \theta))$  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",
```

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