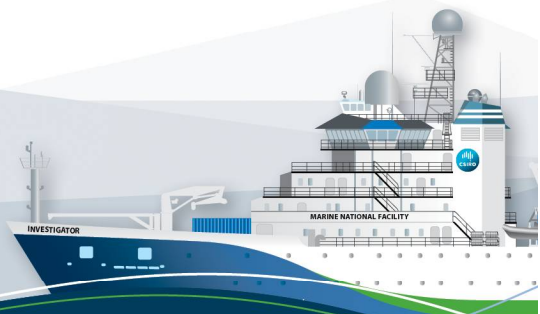
RV *Investigator*

ADCP Processing Report

Voyage:	in2019_v05
Voyage title:	Integrated Marine Observing System: monitoring of East Australian Current property transports at 27º S
Depart:	Brisbane Monday 09 September, 2019
Return:	Brisbane Sunday September 29 2019
Chief Scientist:	Bernadette Sloyan
Affiliation:	CSIRO
Report compiled by:	Peter Shanks



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1 Summary

Data was collected during in2019_v05 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.

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.

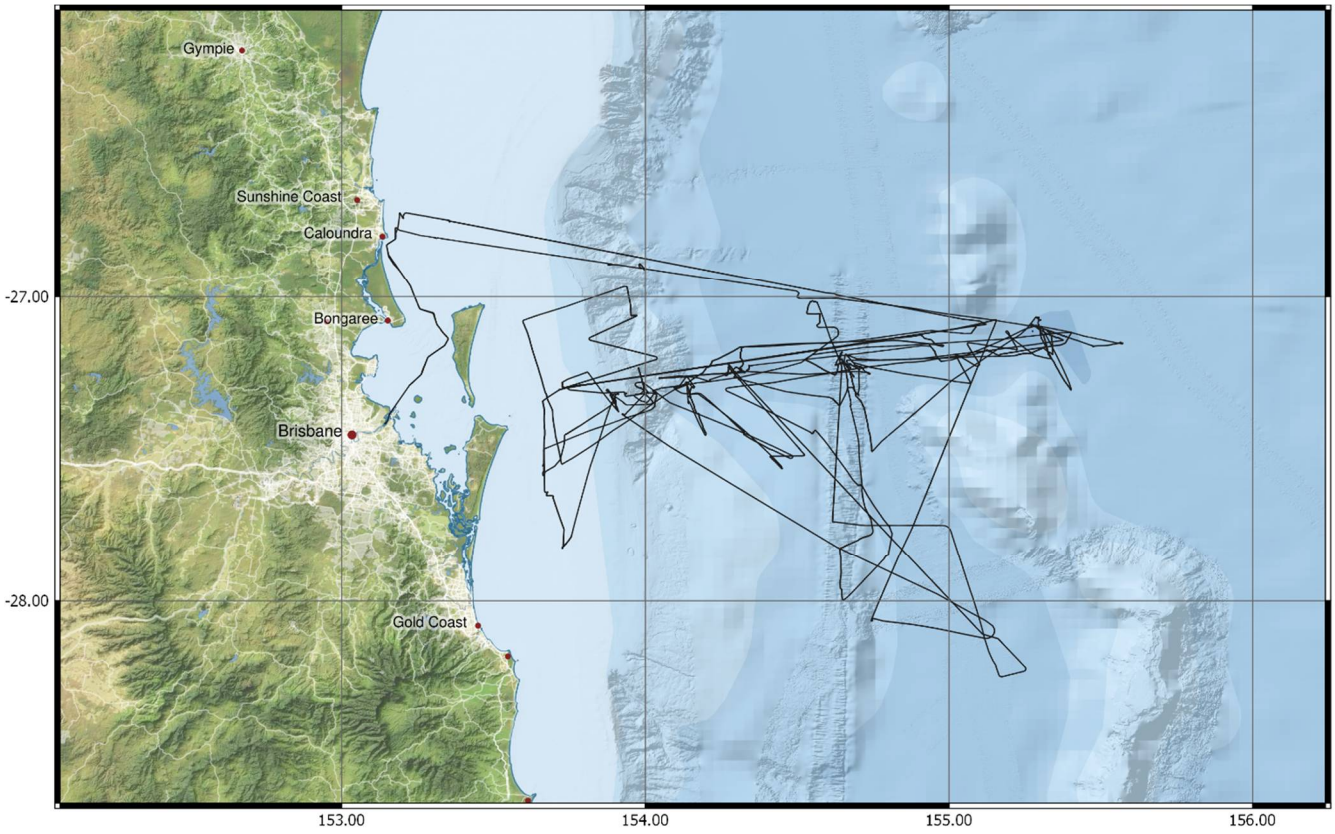
2 Processing Background

The University of Hawaii's CODAS software dated 2017-10-01 was used for data post-processing.

3 Processing Notes

The shipboard ADCPs were turned off during triangulation efforts at the completion of each mooring deployment. There were two occurrences of the Seapath positioning system losing tracking, which resulted in short gaps in the ADCP data for pitch, roll and yaw. Position data was added from the ship's POSMV.

4 Area Covered



Please see the webpy_bb and webpy_nb folders for plots of collected data.

5 netCDF Data Headers

5.1 netcdf in2019_v05_os75nb

```
netcdf in2019_v05_os75nb {
dimensions:
        time = 5672 ;
        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 = 251.0471875 ;
        time:data_max = 271.155671296296 ;
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 = 153.141925 ;
        lon:data_max = 155.571766666667 ;
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 = -28.2497277777778 ;
        lat:data_max = -26.72285 ;
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 = -0.5814148f ;
      u:data_max = 1.275536f ;
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 = -1.395074f ;
      v:data_max = 0.6713585f ;
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 = 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 = -179.9373f ;
```

```
            heading:data_max = 179.9673f ;
      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 = 18.9804f ;
            tr_temp:data_max = 23.88306f ;
      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 = -125b ;
            num_pings:data_max = 110b ;
      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 = -6.307244f ;
            uship:data_max = 6.756647f ;
      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 = -6.404348f ;
            vship:data_max = 6.295221f ;

// global attributes:
            :featureType = "trajectoryProfile" ;
```

```
            :history = "Created: 2019-10-17 05:18:12 UTC" ;

            :Conventions = "COARDS" ;

            :software = "pycurrents" ;

            :hg_changeset = "2417:49ecfa0cc6c5" ;

            :title = "Shipboard ADCP velocity profiles" ;

            :description = "Shipboard ADCP velocity profiles from
in2019_v05 using instrument os75nb" ;

            :cruise_id = "in2019_v05" ;

            :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",

                "" ;

           :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",
"" ;
```

5.2 netcdf in2019_v05_os150nb

```
netcdf in2019_v05_os150nb {
dimensions:
      time = 5672 ;
      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 = 251.047152777778 ;
            time:data_max = 271.15568287037 ;
      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 = 153.141972222222 ;
      lon:data_max = 155.571883333333 ;
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 = -28.2496972222222 ;
      lat:data_max = -26.7228694444444 ;
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 = 489.96f ;
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 = -0.6062908f ;
      u:data_max = 1.305109f ;
```

```
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 = -1.434244f ;
      v:data_max = 0.7209581f ;
short amp(time, depth_cell) ;
      amp:missing_value = 32767s ;
      amp:long_name = "Received signal strength" ;
      amp:C_format = "%d" ;
      amp:data_min = 20s ;
      amp:data_max = 229s ;
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 = -179.9667f ;
```

```
            heading:data_max = 179.9574f ;
      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 = 18.89068f ;
            tr_temp:data_max = 23.02555f ;
      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 = -128b ;
            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 = -6.301961f ;
            uship:data_max = 6.766609f ;
      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 = -6.318995f ;
            vship:data_max = 6.237233f ;
```

```
// global attributes:
            :featureType = "trajectoryProfile" ;
            :history = "Created: 2019-10-17 05:17:21 UTC" ;
            :Conventions = "COARDS" ;
            :software = "pycurrents" ;
            :hg_changeset = "2417:49ecfa0cc6c5" ;
            :title = "Shipboard ADCP velocity profiles" ;
            :description = "Shipboard ADCP velocity profiles from
in2019_v05 using instrument os150nb" ;
            :cruise_id = "in2019_v05" ;
            :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
\"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",
                "" ;
}
```