TOGA/TAO Shipboard ADCP Data Format, 1991-1995

March 31, 1999

Eric S. Johnson and Patricia E. Plimpton

The collection and processing of the PMEL ADCP data from the NOAA ship Discoverer are detailed in a separate data report. What follows is the information necessary to unpack the binary files and to use the data itself.

Data Format

The cleaned data are recorded in a binary format of 100 byte records which is written and read by the FORTRAN routines DOPOUT and DOPIN, respectively. Both routines use identical variables declarations and common blocks, which are documented below. Source code is available on request from Eric Johnson, and the relevant code fragment from DOPIN is included below. Additional code to bin, average, and depth-adjust the data are also available.

Velocity, AGC, and percent good are recorded from the shallowest bin to the deepest: the shallowest bin is centered at 19 m depth, with each succeeding bin located 8 m deeper. The combination of 8 m bin width and 8 m pulse length results in a triangular response function spanning 16 m. Thus the response functions of the successive bins overlap by 50% in depth.

Definitions of DOPIN format variables

```
c  Header parameters from DOPIN: one header begins each disk file.  Variables
c  are defined at the first read of that file.
c  ...transducer characteristics
      character*2 trans        U/D for up/down looking instrument,
                               A/X for concave/convex transducers.

c  ...profiler setup commands from AD menu
      integer*2 epings Pings per internal ensemble (usually 1).
      byte      nbins,         number of depth bins.
                binwid,        Bin length, (0-5, length=2**binwid in meters).
                pulwid,        pulse length, meters.
                blank,         blank length after transmit before receiving
                               (to reduce transients).
                pcntmin        percent good threshold.
      real*4    avgint         data averaging interval, seconds.
c  ...date and cruise ID
      byte      iyr,imo,idy,ihr,imn,isc,ihd     Calendar date and time.
```

```
      character*60 cruise      Cruise ID of some sort.
      character*20 notes       extra block used for notes; see below.

      common /trancom/trans
      common /setupcom/avgint,epings,nbins,binwid,pulwid,blank,pcntmin
      common /datecom/iyr,imo,idy,ihr,imn,isc,ihd,cruise,notes

c  Data parameters from DOPIN: returned for each data block read.
c  ...Raw date, corrected date, # of pings, recent headingX100, ave tempX1000
c  ...Note that dates are recorded in year,month,day,etc. and converted to decimal
c      form by DOPIN/DOPOUT.
      integer*2 npings,        Number of ping ensembles averaged into data block.
                irechead,      last ship's heading received during averaging.
                iavetemp       last temperature received during averaging.

c  ...Velocity data relative earth (mm/s): values greater than 19000 indicate
c    bad or missing data
      parameter (vmax=64)
      integer*2 vx(vmax),      Eastward velocity.
                vy(vmax),      Northward velocity.
                vz(vmax),      Upward velocity (generally useless).
                ve(vmax)       Residual after removing 3 velocities from 4 beams.
      byte      agc(vmax),     Automatic gain control setting: varies from 256
                               to zero as return weakens with depth (note byte
                               interpretation gives numbers from +128 to -127).
                pct(vmax)      Percent of pings judged good and included in
                               average.

c  ...Bottom tracking and navigation data
      integer*2 vxbot,         East and North ships velocity (mm/s) and water
                vybot,         depth (m) from bottom track mode; 30000 if
                depth,         undefined.
                vxship,        Ship's velocity from navigation process,
                vyship         in mm/s.
      real*8    lat,long       Ship's position in middle of average, decimal degrees.

c  ...Calibration factorX10000 and heading bias(degrees)X1000
      integer*2 calib,         Calibrations from navigation process: measured
                headbias       water velocities are scaled by 1+calib/10000
                               and rotated headbiasX1000 degrees counterclockwise.

      common /cdatecom/rdate,cdate,npings,irechead,iavetemp
```

```
common /velcom/vx,vy,vz,ve,agc,pct
common /trackcom/lat,long,vxbot,vybot,depth,vxship,vyship
common /calibcom/calib,headbias
```

The header character variable "notes" contains characters added with the completion of each processing step:

t	Times corrected for clock drift.
T	Thermistor temperatures calibrated.
C	Velocities corrected for estimated speed-of-sound at transducer.
h,s	Velocities rotated and scaled for heading and scaling calibration.
a	Navigation complete, velocities converted to earth-reference frame.
An	Navigated data averaged in blocks of n profiles.

The last two characters of notes may contain the first bin center depth in meters.

Fortran Code Fragment

The data may be read with the following code fragment housed in a suitable subroutine. The passed counter *irec* is used to keep track of the last ADCP record number read in the current file. Each read/write transfers 100 bytes of data. Disk files begin with a 100-byte header record containing cruise name, instrument settings, and the like. Subsequent ADCP records each begin with a 100-byte header specifying time, location, navigation information, and the first five depth bins of velocity data. Data records of ten depth bins each follow until the profile is filled out.

```
c  Get new file if one not already opened
       if(irec.gt.0)go to 100
       irec=0
c      ...Get filename
   10 write(*,*) ' Enter input binary ADCP file: '
       read(*,*)name
   15 open(idsk,iostat=iflag,file=name,access='sequential',
     +      form='unformatted',err=200,status='old')

c  Read in 100 byte header record from newly opened file
   30 read(idsk)iyr,imo,idy,ihr,imn,isc,ihd,int1,cruise,                68bytes
     +          trans,nbins,binwid,pulwid,blank,pcntmin,int1,avgint,    12bytes
     +          notes                                                   20bytes
       if(int1.ne.99)stop ' ****Format error in DOPIN'

c  Read in data records for one ADCP record
  100 continue
```

```
      i1=1
      i2=5
      read(idsk,err=200,end=210)
     +                iyr1,imo1,idy1,ihr1,imn1,isc1,ihd1,                    7bytes
     +                iyr2,imo2,idy2,ihr2,imn2,isc2,ihd2,                    7bytes
     +                npings,irechead,iavetemp,                              6bytes
     +                vxbot,vybot,depth,vxship,vyship,lat,long,              26bytes
     +                calib,headbias,                                        4bytes
     +                (vx(i),vy(i),vz(i),ve(i),agc(i),pct(i),i=i1,i2)        50bytes
  110 i1=i2+1
      i2=i1+9
      if(i1.gt.nbins)go to 120
      read(idsk,err=200,end=210)
     +                (vx(i),vy(i),vz(i),ve(i),agc(i),pct(i),i=i1,i2)        100bytes
      go to 110
  120 irec=irec+1
      return
```

Acceptance Criteria for Data

The general quality of the data has been explored by comparing the vertical shears of adjacent profiles as a function of depth and the various quality indicators. On the basis of those results, the following rejection criteria for individual profiles are recommended:

if(vxship.gt.29000)reject	Data unnavigated: velocities will be relative to ship, position suspect. If(vxship.ge.31000) even relative velocities suspect.
if(int(pct(ibin)).lt.minpct)reject	Data quality is poor in regions of low acoustic return; recommended value of minpct is 35.

One might also reject data during rapid ship's turns as indicated by a large change in irechead since the preceding data record, but it hasn't seemed necessary for extracting large-scale velocities.