Print

Beaufort Gyre Exploration Project: Mooring data description

1) BPR (bottom pressure recorders)

Related Files

» BGFE 2003-04 MMP EMCTD and ACM Data Processing
PDF 2.6MB

» BGOS ULS Data Processing Procedure
PDF 1.6MB

On the BG moorings, bottom pressure measurements are being made using either Sea-Bird Electronics SBE-16plus temperature and salinity recorders or SBE-53 BPR bottom pressure recorders, both with precision Paroscientific Digiquartz (6000 psia) pressure sensors. The recovered data processing procedure is fundamentally the same for either instrument.

Accuracy of the pressure sensor is 0.01% full-scale (~0.4 m for 6000 psia sensor), and the long term drift is on the order of 1 ppm per year. The resolution of the pressure measurement depends on the sensitivity of the sensor and the resolution of the counter. Integrating the pressure measurements increases the resolution of the pressure measurement, although this may be limited somewhat by sensor drift, recorder time base drift, and background noise. For the SBE-16plus recorders, a measurement integration of 70 seconds should resolve better than 1 mm. The SBE-53 BPR provides higher quality data by continuously powering the pressure sensor and ovenized reference oscillator to reduce startup transients, hence a measurement integration of 1 minute should resolve better than 0.2 mm. Battery life considerations dictate the configured sampling rate for each instrument so that the frequency of SBE16plus measurements is either 25 or 30 minutes between readings, and the frequency of the SBE 53 BPR measurements is 15 minutes.

After recovering the BPR, Sea-Bird SeaTerm software is used to download the data from the SBE16plus recorders in single binary hexadecimal (HEX) files, while SeaTermW software is used for the SBE53 BPRs. The hex files are converted to ASCII CNV files using the Sea-Bird Data Processing program for the SBE16plus recorders and using Seasoft for waves for the SBE53 BPRs. During this step, the instrument specific calibration adjustments are applied to the raw data. The CNV files include header information with all of the instrument specific information including the calibration coefficients used in the conversion, followed by the specific output data in columns. These data were plotted using the Sea-Bird software to visually check for obvious errors. Subsequently, the CNV files are imported into MATLAB, where deployment specific script routines operate on the data from every instrument in a single year.

The MATLAB routines truncate the time series for the period when the BPR is deployed on the ocean bottom, and output the data in ASCII files. The filename format is bgXXYY_bpr_Z.dat, where *XXYY* indicates the observation years and *Z* is the mooring identifier. The first two lines of the file are header information (preceded by a % character), the data follow in 3 columns, and the file terminates with %endofdat. The first line of the header includes the observation years, the mooring identifier and location, and the second line indicates the data variables and units [%date time(UTC) pressure(dbar) temperature(C) salinity(PSU)]. Dates and times are given in UTC, and temperature is determined according to the ITS-90 scale.

2) MMP (McLane Moored Profilers)

The results of the BGFE 2003-04 MMP EMCTD and ACM Data Processing [PDF] are digitally archived in three formats that are being made publicly available here along with documentation thoroughly describing the processing procedure. The data are identical regardless of the format.

The first format stores all of the processed data from all profiles from a single MMP into single Matlab-format files ending in .mat, where a, b, and c identify the mooring. Each file contains the following variables:

DPDT: array of profiling speeds cm/s
S: array of salinity pss
SIGTH: array of sigma-theta kg/m3
T: array of temperature deg C
THETA: array of potential temperature
TIME: array of time of each measurement (encoded with datenum.m)
U: array of east velocity cm/s
V: array of north velocity cm/s
W: array of measured vertical velocity (includes profiling velocity) cm/s
dates: vector string with profiler start date
day: vector of decimal year day (2003)
location: string with location of mooring
name: string with dataset name
number: vector of profile number
pgrid: vector of pressure grid m

The remaining two formats contain the same information in multiple ASCII text files with all the data from each profile in a single file, but differ in the method of storage to accommodate both PC and UNIX computer systems. In either case, the individual ASCII profile data files are named bg0304_mmp_a###.mat, bg0304_mmp_b###.mat, and bg0304_mmp_c###.mat, where a, b, and c identify the mooring and ### is the profile number. For PC systems, all of the files from a single MMP are zipped into single files that end in .zip. For UNIX systems, all of the files from a single MMP are compressed and tarred into single files ending in .Z. Each individual data files includes two lines of header information.

The first line provides general information:
project and mooring name: profile number, start date and time, location

The second line describes the columns of data:
hr:min:sec P(Dbar) T(degC) S(PSU) U(cm/s) V(cm/s) W(cm/s) DPDT(cm/s)

The remaining lines comprise the processed data from the profile in the following format:
'%02d:%02d:%02.0f %4d %6.3f %6.3f %6.2f %6.2f %6.2f %6.2f\n'

The lines of data increase sequentially based on the time of the observation, so downgoing profiles start at the shallowest depth and upgoing profiles start at the deepest depth. Grid points with no data (that were filled with NANs) are omitted in the ASCII files.

3) ULS (upward looking sonars)

A complete description of the processing used to derive ice drafts from the ULS data is given in BGOS ULS Data Processing Procedure [PDF]. The output of the processed ULS data is available in two formats: 1) the complete 2-second ice draft time series, and 2) daily averages draft statistics, temperature, water level, and sound speed. With velocities provided from an outside source, the complete draft time series can be converted to a spatial distribution, and the features in the ice cover can be clearly discerned and described. If high resolution is not required, the daily average ice draft (and ancillary) data provide a synopsis of the results in a convenient abbreviated format.

The complete draft time series are saved in separate ASCII text files for each mooring and year. The filename includes the deployment year and mooring identifier (for example uls03a_draft.dat). The first two lines of the file includes the experiment year, mooring location and data variable names (with units):

%BG 2003-2004 Mooring A: 75 00.449 N, 149 58.660 W
%date time(UTC) draft(m)

The remainder of the file includes all 15 million (2-second) draft estimates processed for the full year. Compressed versions of the text file are saved in .ZIP and TAR.Z formats.

Daily average draft, betas, temperature, and water level information for each mooring and year are saved in MATLAB format files (e.g. uls03a_daily.mat) with the following variables:

dates: date string timeseries
name: name of the mooring and dataset
yday: year day timeseries
BETA: final beta adjustment timeseries used in ice draft calculations
BTBETA: initial beta timeseries based on bottom temperature
ID: number of ice drafts binned daily every 0.1 m from 0.05 to 29.95 m
IDS: daily ice draft statistics: number, mean, std, minimum, maximum, median
OWBETA: beta timeseries determined from open water events
T: temperature timeseries (°C)
WL: water level timeseries (m)

3) ADCP (Acoustic Doppler Current Profilers)

A 600kHz RD Instruments ADCP was installed on the top flotation package on mooring D in 2005 and two other 600kHz ADCPs (with pressure sensors) were added to moorings A and B in 2010. All have been maintained on an annual basis since. The configuration of the instruments has varied from year to year in order to extend the duration of the sampling with alkaline battery packs, or increase the standard deviation of the ensemble measurements with lithium battery packs, but all of the processed data consist of hourly profiles in 2 m bins. Waves software was included on the ADCP on mooring A from 2012-2013 which required additional processing not described here.

The data are adjusted for speed of sound and depth variations to vertically center the depth bins, converted to Earth-referenced velocities, and corrected for magnetic declination using the IGRF model. The archived products are in Matlab format files named according to start year and mooring letter: *e.g.* BGY05_D_Final1.mat.

The same structure naming of variables is applied in all files. The variable adcp includes six structures: settings, velocity, sensor, bottom_track, iceV, and beam_prop.

adcp.settings includes metadata on the configuration, location, and other information of the particular dataset.

adcp.velocity includes the Earth referenced velocity profiles in matrix variables u, v, (in cm/s) and time ([yr mo da hr mn ss]). u and v velocity were corrected for magnetic declination. The declination correction convention used here was the following: TB = MB - D (for declination West), where

TB=true bearing
MB=magnetic bearing
D=declination West

For declination West, D=adcp.sensor.magvar is negative, therefore: TB = MB +(-D) = MB - abs(D)

adcp.sensor includes the data from the orientation and environmental sensors. Speed of sound was calculated using the ADCP temperature sensor and salinity of 35 psu. External ULS data was used for the depth of the transducer, except in 2005 where depth was determined using ADCP surface tracking. The variables in this structure are:

w is ADCP vertical velocity profile array
e is ADCP error velocity profile array
depth is true bin depths array
dz is distance from ADCP transducer to center of each bin
days is ADCP year day (Jan 1 = 1)
julian is ADCP julian day
pitch is ADCP pitch (deg)
roll is ADCP roll (deg)
heading is ADCP beam 3 heading (deg)
temp is ADCP temperature in deg C (from ADCP)
salt is ADCP salinity (if available)
soundV is ADCP speed of sound at transducer
current is ADCP current
pressure is ADCP pressure in dbar (if available)
datenumT is ADCP datenum
tr_depth is transducer depth in m (from ULS)
magvar is magnetic variation (deg)
adc is instrument ADC (1,2,3,4,5,6,7,8)
cc is compass calibration correction (if available)

adcp.bottom_track includes the bottom track data collected with the ADCP Surface Tracking feature to estimate the ice velocity using water track pings. The variables in this structure are: bt_range is vertical range to surface corrected for beam angle to the surface (ice or seawater surface), bt_vel is bottom track velocity (east, north, up, error) corrected for magnetic variations in the same manner as the U and V water velocities, bt_corr is the bottom track correlations, and bt_pg is the bottom track percent good.

adcp.iceV are the Earth-referenced ice velocity estimates (VU, VV, VW, and VE=error velocity at max seawater bin) in cm/s from the bottom track data.

adcp.beam_prop includes the instrument beam property information: for echo intensity in echo1, echo2, echo3, and echo4; for target strength in ts1, ts2, ts3, and ts4; and for percent good in pg1, pg2, pg3, and pg4. The 4-beam means for each property are in variables mn_ea, mn_ts, and mn_pg, respectively.

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