Lamont-Doherty Earth Observatory
Office of Marine Affairs
61 Route 9W
Palisades, NY 10964

R/V Maurice Ewing Data Reduction Summary

EW-0006 Transit

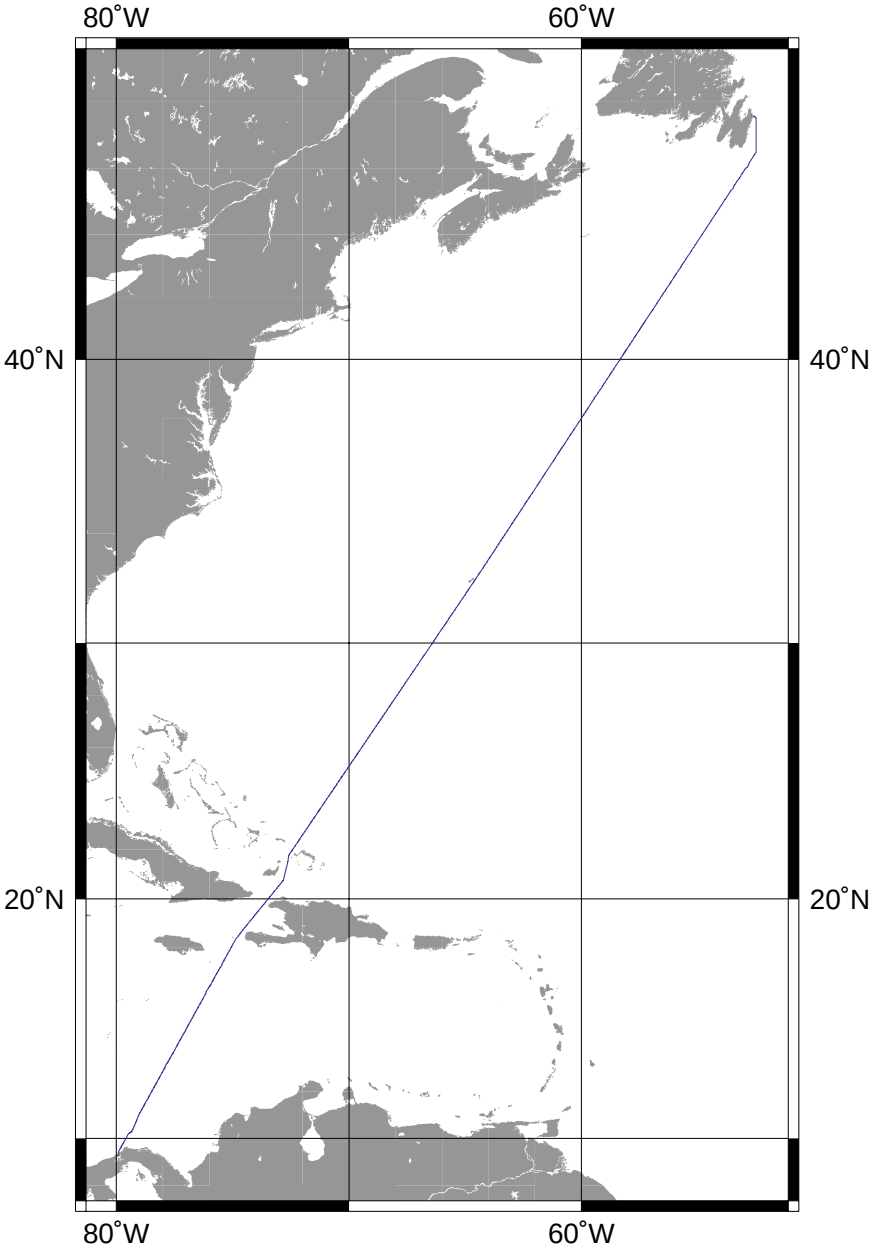
Balboa, Panama - St. John's Newfoundland

Port Dates

Date	Julian	Time	Port
30 Jun 2000	182	0500	Depart Panama
11 Jul 2000	193	1010	Arrive St. Johns

Contents

Cruise Track



Cruise Members

Ship Staff

Name	Position	Email
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Data Instruments

The following tables describe the times data was logged for all instruments. Unless otherwise noted, the tables will show the start of logging through the end of logging, with only the data interruptions described in the tables.

Time Reference

Datum StarTime 9390-1000

Used as the CPU Synchronization clock at 1/2 hour intervals. This allows a 10ms synchronization error to build up over those 30 minutes before it is fixed.

Speed and Heading

Furuno CI-30 Dual Axis Speed Log, Sperry MK-27 Gyro

Logged at 3 second intervals.

GPS Receivers

gp1 = Trimble Tasman Y-Code **gp2 = Trimble NT200D** **tb1 = Tailbuoy**

GPS receivers were logged at 10 second intervals. Navigation is processed and reduced to 60 second intervals which is then applied to the magnetics, gravity, bathymetry, and shot data. All data for this cruise was processed with the Tasman (gp1).

Gravimeter

The **Bell BGM-3 Gravimeter** is logged at 1-second intervals.

Hydrosweep Bathymetry

The **Krupp Atlas Hydrosweep-DS** full swath data is logged for each ping, and the centerbeam data is extracted and processed separately. The hydrosweep operates at varying intervals based on water depth.

The full swath data can be read and processed using the MB-System software which can be downloaded from the web site: http://www.ldeo.columbia.edu/MB-System

MB-System 4.6.10 is necessary to process data after Jan 1, 2000.

Hydrosweep data was logged continuously throughout the cruise.

Sea Temperature

The sea temperature was logged during the entire cruise with no interruptions.

Weather Station

The **R.M. Young Precision Meteorological Instruments; 26700 series** is used to log a variety of weather conditions at 1-minute intervals.Seismic Logging

Balboa, Panama

EW0005 Balboa, Panama

Pier/Ship	Latitude	Longitude
	N 08 57.2277	W 79 34.0239

3rd Bollard from end of pier

Reference	Latitude	Longitude
	N 08 57.60	W 079 33.81

Port Captain Office, under awning in front of building on sidewalk
WH 1013

	Id	Julian	Date	Mistie	Drift/Day	Prev Mistie
Pre Cruise	EW0002	62	3/2/00	1.26	0.07	1.26
Post Cruise	EW0005	179	6/27/00	2.63	0.012	1.26
Total Days			117.00	1.37		

Time	Entry	Value	
18:40	CDeck Level BELOW Pier	2.00	
18:40	Pier 1 L&R Value	1915.55	L&R
19:07	Reference L&R Value	1915.45	L&R
19:39	Pier 2 L&R Value	1915.50	L&R
11/1/71 0:00	Reference Gravity	978224.17	mGals
18:40	Gravity Meter Value (BGM Reading)	978242.80	mGals
	Potsdam Corrected	1	1 if corrected

Gravity meter is ***5.5*** *meters below CDeck*

Difference in meters between Gravity Meter and Pier: 7.50 meters

Height Cor = Pier Height*	FAA Constant				
7.50	0.31			2.33	mGals/min

Difference in mGals between Pier and Gravity Meter

Pier (avg) -	Reference *	1.06 L&R/mGal		Delta L&R	
1915.53	1915.45	1.06		0.08	mGals

Gravity in mGals at Pierside

Reference +	Delta mGals [+ Potsdam]			Pier Gravity	
978224.17	0.08	13.60		978237.85	mgals

Gravity in mGals at Meter

Pier Gravity+	Height Correction			Gravity@meter	
978237.85	2.33			978240.17	mGals

Current Mistie

BGM Reading-	Calculated Gravity			Current Mistie	
978242.80	978240.17			2.63	mGals

St. John’s, Newfoundland

EW-0006 St. John's Newfoundland

Pier/Ship	Latitude	Longitude
	47 33.852N	52 42.306W
Wharf 11		

Reference	Latitude	Longitude
Wharf 11		

	Id	Julian	Date	Mistie	Drift/Day	Prev Mistie
Pre Cruise	EW0005	179	6/27/00	2.63	0.012	1.26
Post Cruise	EW0006	194	7/12/00	2.80	0.011	2.63
Total Days			15.00	0.17		

Time	Entry	Value	
18:40	CDeck Level BELOW Pier	0.00	
18:40	Pier 1 L&R Value	0.00	L&R
19:07	Reference L&R Value	0.00	L&R
19:39	Pier 2 L&R Value	0.00	L&R
11/1/71 0:00	Reference Gravity	980828.60	mGals
18:40	Gravity Meter Value (BGM Reading)	980846.70	mGals
	Potsdam Corrected	1	1 if corrected

*Gravity meter is **5.5** meters below CDeck*

Difference in meters between Gravity Meter and Pier: 5.50 meters

Height Cor =	Pier Height*	FAA Constant			
	5.50	0.31			1.71 mGals/min

Difference in mGals between Pier and Gravity Meter

	Pier (avg) -	Reference *	1.06 L&R/mGal		Delta L&R
	0.00	0.00	1.06		0.00 mGals

Gravity in mGals at Pierside

	Reference + Delta mGals [+ Potsdam]				Pier Gravity
	980828.60	0.00	13.60		980842.20 mgals

Gravity in mGals at Meter

	Pier Gravity+	Height Correction			Gravity@meter
	980842.20	1.71			980843.91 mGals

Current Mistie

	BGM Reading-	Calculated Gravity			Current Mistie
	980846.70	980843.91			2.80 mGals

Data Processing

GPS Processing

Navigation data is post-processed in order to accurately determine the position and remove GPS accuracy errors. We perform slightly different processing depending on the type of receiver.

1. Check data for mutant records and non-sequential times.
2. If we have speed and/or DOP information, remove records that have excessive speed or too high of a DOP[1]
3. Convert from NMEA or proprietary format to a standard format
   2000+009:00:28:50.091 N 42 14.1536 W 063 25.5897 P-trimble
4. If we are processing known differential data, remove non-differential fixes from the file.
5. Interpolate and reduce data. Fixes are reduced to 30 second fixes and any minor gaps (< 3 minutes) are linearly interpolated.
6. Smooth data using a 9 point running average algorithm and further reduce data to 60 second fixes.
7. Perform dead reckoning using the smoothed Furuno speed and heading to fill in major gaps (> 3 minutes) and to insure the accuracy of the GPS data

Furuno Processing

Furuno speed and heading is processed by smoothing the data using a vector summing algorithm. Data is reduced and output at 60 second intervals by taking the smoothed values and calculating the mean value for the 30 seconds before and after the whole minute.

Hydrosweep Processing

Center Beam Processing

1. Remove all survey and calibration records from the raw data and all 0 level depths
2. Reduce data to one minute intervals on 00 seconds of the minute by computing the median values from the raw values that lie between +-30 seconds of 00 seconds of the minute.
3. Merge the data with the processed navigation to end up with one minute hydrosweep centerbeam fixes with navigation.

Full Swath Processing

Hydrosweep swath data is processed using the MB-System software, and consists primarily of hand-editing the beam data. Source code and documentation for MB-System may be found at the Web site: http://www.ldeo.columbia.edu/MB-System.

1. Dilution of Precision, a term used to measure the accuracy of the fix based on the number of Satellites the GPS receiver is tracking, and the position of the satellites.

bias	*= 852645.3;*	*Dec 5, 1997*
scale	*= 5.0940744*	*July 9, 1992*
mGals	*= raw_gravity_count * scale + bias;*	

Logging

- Raw gravity is logged to disk at a rate of 1 sample/second.

Reduction

1. Raw gravity is filtered using a 6 minute gaussian filter and mGals are output. The raw mGals are represented by, outputting a gravity count once every 6 seconds.
   `mGals = gravitycount * scale + bias;`
2. A second filter is then applied; an 8 minute Gaussian filter using the GMT system:
   `filter1D -G480 -R -E`
3. The filtered output is then reduced to 1 minute intervals by using sample1d to tie the gravity values to the processed navigation.
4. The results from step 3 are used to calculate the velocities between Nav fixes, which are smoothed using a 9-minute averaging window. The smoothed velocities are used to calculate the Eotvos correction. At this point, the drift corrections are applied and the the final faa value calculated using the 1980 theoretical gravity formula.

```
corrected_grv = raw_grv + eotvos_corr - drift - dc_shift
faa = corrected_grv - theoretical_grv
```

Gravity Tie

It is usual practice to have a gravity "tie" to a gravity reference base station during the port stay. A portable gravity meter, e.g. the Lacoste Model G #70, is used to make 1) a pier-side reading; 2) a reading at the base station; 3) an additional pier-side reading. The pier-side gravity value, adjusted in value to correspond to the height of the BGM gravity meter, is compared to the real-time BGM Gravity Reading discussed previously.

The practice is not to adjust the BGM-3 so that its reading agrees with the pier-side gravity value, but to establish a *bgm-offset*, which represents a constant correction to be applied to all gravity values on the next cruise.

For example, suppose the pier-side value equaled 980274.7 mGal and the BGM reading was 980279.9, the *bgm-offset* would be 5.2 mGal. In other words, the BGM is 5.2 mGal high. This value is subtracted from observed values of gravity following the cruise as a constant correction. The "drift" of the Bell gravity meter is determined from the two in-port gravity station ties. In the pre-cruise tie the BGM might have been found to be 5.3 mGal high and during the post-cruise tie it is 8.4 mGal high. The drift during the cruise is therefore equal to 3.2 mGal (8.4 - 5.2). The amount of drift per day is then calculated and gravity data is processed with the drift values corrected for the length of the cruise.

Thus, for daily reduction at sea the drift correction option cannot be used. However, the drift rate of the Bell gravimeter is very low, usually much less than 0.1 mGals/day; thus useful analysis of the FAA values while at sea.

Raw Compass Block cb1.d*jjj*

Official Shot Time	Line	Shot	GPS1 Position	
2000+009:00:01:29.572	LAU1	021144	S 19 26.4331	W 176 16.3491

GPS2 Position *Trimble*	Tailbuoy Position	Gyro	Compass#	Position
S 19 26.4393 W 176 16.3198	S 19 25.2864 W 176 19.7897	107.0	C01	97.8...

No processing is performed on compass block data.

Raw Furuno Log fu.d*jjj*

CPU Time Stamp	Track	Speed	Heading	Gyro
2000+009:00:01:53.091	-	4.4	140.5	148.3

Hydrosweep Center Beam merged w/ Navigation hb.n*jjj*

CPU Time Stamp	Position				Depth
2000+009:09:55:00.000	N 13	6.6206	W	59 39.3908	3409.1

Hydrosweep is median filtered at 1 minute intervals, then merged with navigation at 1 minute intervals.

Merged Data m.*jjj*

CPU Time Stamp	Position				GPS	Set	Drift	Depth
2000+009:14:08:00.000	N 13	54.3859	W	59 43.5175	gp1	0.0	0.0	732.9

Magnetic Total Intensity	Gravity Anomaly	FAA	GRV	EOTVOS	Drift	Shift
0.01	0.0	31.3	978370.7	-3.9	0.0	4.5

Temperature	Salinity	Conductivity
0.0	0.0	0.0

The gravity drift and shift are values that have been added to the raw gravity logged to make up for drift in the meter that has been lost in accordance with a gravity check at each port stop.

Temp, salinity and conductivity are only valid when the thermosalnograph is being logged.

Navigation File n.*jjj*

CPU Time Stamp	Position				Used	Set	Drift
2000+009:00:03:00.000	N 13	6.2214	W	59 37.9399	gp1	0.0	0.0

Time Shot File — ts.n*jjj*

Official Shot Time	Shot #	Shot Position		Line Name
2000+009:00:15:00.000	000295	N 16 11.8600	W 59 48.0157	strike1

Navblock File (processing file) — nb.r*jjj*

Official Shot Time	Shot Number	CPU Time Stamp	Official Shot Position	
2000+103:00:00:05.150	012016	2000+103:00:00:05.138	N 02 33.4911	W 094 16.3357

Depth	Sea Temp	Wind Speed	Wind Direction	Tailbuoy Position	Tailbuoy Distance	Tailbuoy Bearing
2444.2	27.7	2.5	52	N 02 33.8605 W 094 19.7385	6338.9	96.2

Line Name	Speed	Course
gsc-AA2	4.9	100.0

Gravity File merged with navigation — vt.n*jjj*

```
eotvos_corr = 7.5038 * vel_east * cos(lat) + .004154 * vel*vel
faa = corrected_grv - theoretical_grv
```

CPU Time Stamp	Position		Model	FAA	Raw
2000+009:00:15:00.000	N 16 11.8600	W 59 48.0157	1980	-175.9	978253.6

Eotvos Smooth	Drift Total	DC Shift	Raw Velocity North	Raw Velocity East	Smooth Velocity North	Smooth Velocity East
9.7	0.0	4.5	-4.350	1.282	-4.333	1.329

Raw Weather File Format — wx.d*jjj*

CPU Time Stamp	True Speed	True Dir	Bird 1 Wind Speed Instant	60secAvg	60minAvg	60secMax
2000+175:01:49:00.288	17.5	62	19.6	21.3	24.6	29.3

Bird1 Wind Direction Current	60secAvg	60minAvg
303	302	2

Bird2 Wind Speed Instant	60secAvg	60minAvg	Max	Bird2 Wind Direction Current	60secAvg	60minAvg
0.0	0.0	0.0	0.0	0	0	0

Temperature Current	60minAvg	60minMin	60minMax
28.7	28.7	28.6	28.8

Humidity Current	60minMin	60minMax	Barometric Pressure
69	67	75	1011.3

Bird 2 is deactivated.

True wind speed and direction are calculated based on the heading and speed of the ship.

Tape Contents

- *EW0006.pdf*
  this cruise report (Adobe Acrobat 3 PDF file)
- *ew0006.cdf*
  final one-minute processed data tied to navigation (NetCDF files) for LDEO MG&G database
- *ew0006.cdf_nav*
  final one-minute processed navigation (NetCDF files) for LDEO MG&G database
- *docs/*
  FileFormats for all the files included on tape, hydrosweep info, etc.
- *processed/*
  final processed data tied to navigation (daily files) plus trackplots, scripts, summary files
- *raw/*
  original logged data (daily files) including hydrosweep.
- *reduction/*
  intermediate processed data (daily files), including daily PS plots of various reduction parameters: gravity plots, magnetics plots, hydrosweep centerbeam, etc. These postscript plots can be found for each day in the directories *d**jjj**.ps/*, where ***jjj*** is the julian day.