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Data Reduction Summary

EW 9603
Papeete, Tahiti – Balboa, Panama

May 15 – June 1, 1996

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Data Reduction Summary

Summary of Data Processing for Cruise EW 9603

Cruise Notes

This cruise has been post processed in 1998, so many of the details are gone. The original data tape for this cruise was not processed, so I processed it with the data that was available.

I am under the impression that cruises 9603 and 9604 were transit cruises: 9603 travelled from Papeete, Tahiti to Balboa, Panama, with no interim stops. There are no records of cruise 9604, so I assume the data is lost for that part of the transit, but I know it continued to San Juan, Puerto Rico; where 9605 sailed from.

Cruise Data

See *Cruise Data Instruments* for more precise definitions of these fields.

Data Type	File	Description	Log Interval	Days Collected
UTC time	tr2	Truetime UTC time clock	60 seconds	136 – 153
UTC time	td1	Truetime UTC time clock	60 seconds	136 – 153
Furuno	fu	Furuno speed and heading	3 second	136 – 153
Trimble GPS	gp1	Selective availability GPS	10 second	136 - 153
Magnavox GPS	gp3	Selective availability GPS	10 second	136 - 153
Differential GPS	gp4	Trimble Differential GPS	10 second	136 – 153
Hydrosweep	hb	Krupp Atlas Hydrosweep	variable	136 – 152
Gravity	vc	Bell gravimeter data	1 second	136 - 153
Sea Temp	ct		60 second	136 – 153
Meteorology	wx	Weather Station	60 second	136 – 153

Logging

All logged data (*except GPS data*) is synchronized to the CPU time of the logging computer, which in turn is synchronized to the UTC time.

GPS time is extracted from the GPS fix data.

Data Processing

GPS Data Reduction/Processing

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

GPS Processing Steps

1. **Check data for mutant records and non-sequential times.**
2. **If we have speed and/or DOP information, remove records that have excessive speeds or too high DOP**
3. **Convert from NMEA or proprietary format to a standard format**

   98+240:00:28:50.091 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. By performing dead reckoning, we can determine the drift of the GPS vs. the speed and heading. Any huge distances will alert us to a problem.**

Furuno Processing

Furuno speed and heading is processed by smoothing the data using a vector summing algorithm. Data is reduced and output at 1 minute intervals by taking the smoothed values and calculating the mean value for the 30 seconds before and after the whole minute.

Hydrosweep Processing

Centerbeam Processing steps

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.**

Swath Processing

Hydrosweep data was collected this cruise, but not processed.

Hydrosweep swath data is processed using a package from Lamont-Doherty Earth Observatory called MB-System.

The processing includes hand-editing the beam data to insure an accurate hydrosweep survey. This process is too involved to document here; but the source code and documentation may be found at the website:
http://www.ldeo.columbia.edu/~dale

Gravity Processing

bias = 852680.0
scale = 5.0940744
mGals = raw_gravity_count * scale + bias;

Gravity Logging

- **Gravity is read through a serial port connected to the Bell BGM-3 Gravimeter.**

- **Raw gravity is logged to disk (roughly 1 sample/second) and broadcast to the network.**

- **A "real-time" gravity process reads the sampled data and applies a 6 minute gaussian filter to the sample values and the gravity value is taken from the filtered sample and output as a real-time display**

Gravity Post Processing

- **Raw gravity is filtered using a 6 minute gaussian filter and mGals are output. The raw mGals are represented by**

  mGals = gravitycount * scale + bias;

- **A second filter is then applied; an 8 minute Gaussian filter using the GMT system for filters:**

  filter1D -G480 -R -E

- **The filtered output is then reduced to 1 minute intervals by using the mean values of all data +/- 30 seconds from the 00 second mark of the minute to output:**

```
98+254:00:07:00.000 980422.37
98+254:00:08:00.000 980422.38
```

- **The data is merged with the navigation.**
  At this point eotvos corrections are determined using *m_grv* w/ a 5 point running average. *m_grv* merges daily files of navigation and raw gravity and calculates the Eotvos correction as:

  eotvos_corr = 7.5038 * vel_east * cos(lat) + .004154 * vel*vel

- **The velocities used in the Eotvos calculation are smoothed to reduce the jitter in the corrected gravity and FAA values. The smoothing is done using a 9 point running average.**

Gravity Ties

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 a pier-side reading, a reading at the base station and an addition 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 BGM gravity reading.

Generally the BGM is found to be reading "too high". The practice is not to adjust the BGM-3 so that its reading agrees with the pier-side gravity value, but to establish a "dc shift", 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 dc shift would be 5.2 mGal. In other words, the BGM is 5.2 mGal high. This value is subtracted from observed values of 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 drift rate is expressed in mGal per day.

Thus, for daily reduction at sea the drift correction option cannot be used. However, the drift rate of the Bell gravimeter is very low and thus useful analysis of the FAA values while at sea is possible

A corrected gravity value is computed as:

> ***corrected_grv = raw_grv + eotvos_corr - drift - dc_shift***

The theoretical gravity value is based upon different models for the earth's shape.

> ***1930 = 1930 International Gravity Formula***
> ***1967 = 1967 Geodetic Reference System Formula***
> ***1980 = 1980 Gravity Formula***

The FAA is computed as:

> ***faa = corrected_grv - theoretical_grv***

Cruise Data Instruments

The following times are specified in GMT time.

Datum UTC Time Clock

The Datum 9390-1000 Startime GPS clock is logged at 60 second intervals. CPU time is synchronized every 60 seconds to this clock.

Date	Comment
136:2240	Start EW9603
153:1817	End EW9603

Furuno Speed and Heading

The Furuno CI-30 2 axes doppler speed log and Sperry MK-27 gyro are logged at 3 second intervals.

Date	Comment
136:2240	Start EW9603
153:1817	End EW9603

GPS Receivers

- **gp1 = Tasman YCode**
- **gp2 = Trimble SA**
- **gp3 = Magnavox 4200**
- **gp4 = Trimble Differential**

are logged at 10 second intervals. Navigation is processed and reduced to 1 minute intervals, which is later applied to hydrosweep bathymetry and gravity. All data has been processed using gp4, differential navigation. When differential navigation is not available, YCode is used as the navigation fix.

Date	Comment
136:2240	Start EW9603
153:1817	End EW9603

Krupp Atlas Hydrosweep

Date	Comment
136:0000	Start EW9603
152:1817	End EW9603

Bell Gravimeter

Date	Comment
136:2240	Start EW9603
153:1536	End EW9603

Weather Station

R.M. Young Precision Meteorological Instruments 26700 Series is used to log a variety of meteorological events at 60 second intervals.

Date	Comment
136:2240	Start EW9603
153:1536	End EW9603

Omega DP-10 Sea Temperature

Date	Comment
136:2240	Start EW9603
153:1536	End EW9603

Gravity Ties

EW9603

EW-9603 PAPEETE, TAHITI

Pier/Ship	Latitude	Longitude
	17 32.35 S	149 34.58 W

Cargo liner pier; warehouse #3 between bollards 2 and 3

Reference	Latitude	Longitude
	N	W

Commercial pier/passenger ship wharf between the post office and Tourist Board

	Id	Date	Mistie	Drift/Day	DC Shift
Pre Cruise	EW9602	3/13/96	19.90	0.00	19.90
Post Cruise	EW9603	5/11/96	21.18	0.02	21.18
Total Days		59.00	1.28		

Time	Entry	Value	
21:01	CDeck Level BELOW Pier	-0.50	meters
21:01	Pier 1 L&R Value	2366.08	L&R
21:23	Reference L&R Value	2367.71	L&R
21:41	Pier 2 L&R Value	2366.07	L&R
	Reference Gravity	978699.30	mGals
21:41	Gravity Meter Value (BGM Reading)	978733.90	mGals
	Potsdam Corrected	1	1 if corrected

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

Difference in meters between Gravity Meter and Pier: 5.00 meters

Height Cor = Pier Height* FAA Constant

Pier Height*	FAA Constant			
5.00	0.31			1.55 mGals/min

Difference in mGals between Pier and Gravity Meter

Pier (avg) -	Reference * 1.06 L&R/mGal			Delta L&R
2366.08	2367.71	1.06		-1.73 mGals

Gravity in mGals at Pierside

Reference + Delta mGals [+ Potsdam]				Pier Gravity
978699.30	-1.73	13.60		978711.17 mgals

Gravity in mGals at Meter

Pier Gravity+	Height Correction			Gravity@meter
978711.17	1.55			978712.72 mGals

Current Mistie

BGM Reading-	Calculated Gravity			Current Mistie
978733.90	978712.72			21.18 mGals