

## README for Gravity Data

### Measurement System

Name: Shipboard Gravity-meter  
Manufacturer: LaCoste & Romberg LLC  
Type: S-116  
Range: 12,000 mGal  
Accuracy: 1.0 mGal  
Drift rate: better than 3.0 mGal/month

Name: Portable Gravity-meter  
Manufacturer: Scintrex Ltd.  
Type: CG-5  
Range: 8,000 mGal  
Accuracy: STD 0.01 mGal  
Drift rate: better than 0.02 mGal/day

### Absolute gravity at the port "Sekinehama"

Absolute gravity is measured by a portable gravity-meter before/after the cruise at the Mirai's mother port "Sekinehama". This system refers the value taken at the gravity station of the Geospatial Information Authority of Japan.

#### << Pre-cruise >>

Date (UTC): 01:13:13 05 Aug 2011  
Absolute gravity (mGal): 980368.16  
Sea level (cm): 262  
Draft (cm): 630  
Absolute gravity at sensor position (mGal): 980371.94  
Value of Shipboard gravity meter (mGal): 12722.23

#### << Post-cruise >>

Date (UTC): 04:27:28 09 Feb 2012  
Absolute gravity (mGal): 980368.16  
Sea level (cm): 265  
Draft (cm): 605  
Absolute gravity at sensor position (mGal): 980371.94  
Value of Shipboard gravity meter (mGal): 12684.90

## Data Processing

The following procedures have been conducted.

### <1> Drift correction

$$D = ((V_{ge} - V_{gs}) - (A_{ge} - A_{gs})) / (T_e - T_s)$$

where

D: Drift value (mGal/day)

V<sub>gs</sub>: Shipboard-sensor measured gravity at the cruise start (mGal)

V<sub>ge</sub>: Shipboard-sensor measured gravity at the cruise end (mGal)

A<sub>gs</sub>: Absolute gravity at the shipboard sensor position at the cruise start (mGal)

A<sub>ge</sub>: Absolute gravity at the shipboard sensor position at the cruise end (mGal)

T<sub>s</sub>: Cruise start time (day)

T<sub>e</sub>: Cruise end time (day)

### <2> Eoetvoes correction

$$E = 7.503 \times S \times \cos(\phi) \times \sin(\theta) + 0.004154 \times S^2$$

where

E: Eoetvoes correction (mGal)

S: Ground speed of the ship (knot)

ϕ: Latitude (radian)

θ: Course of the ship (radian)

### Remarks.

The navigation data such as S, ϕ, θ are the 4-min average values. Before calculating the average, if data show the following values, such data were removed from each data set; (1) apparent time record error, (2) ship speed over 20 knot, and (3) indication of ship course beyond 0-360 degree range. If the number of data used for a 4-min average calculation did not occupy more than 50% of good data, the average was expressed as a missing value.

### <3> Absolute gravity calculation

$$G = A_{gs} + (V_g - V_{gs}) - D \times (T - T_s) + E - H \times 2n \times k \times w$$

where

G: Absolute gravity at the sea surface (mGal)

V<sub>g</sub>: Shipboard-sensor measured gravity (mGal)

T: Measurement time (day)

H: Sensor position from sea surface (m)

k: Gravitational constant

w: Density of sea water

$$(2n \times k \times w) = 0.0431$$

<4> Calculation of free-air anomaly

$$G_f = G - y +$$

where

G<sub>f</sub>: Free-air anomaly (mGal)

y: Normal gravity (mGal)

$$= 978032.67715(1 + 0.005279041 \sin^2 + 0.0000232718 \sin^4 + 0.0000001262 \sin^6 + 0.0000000007 \sin^8)$$

: 0.87 - 0.0000965 x 0 (mGal)

<5> Quality control of processed data

In case data show any of the followings, those data have been removed.

- (a) Abrupt free-air anomaly change exceeding 10 mGal/km
- (b) Change of Eoetvoes correction exceeding 3 mGal/min
- (c) Ground speed of the ship below 3 knot.

Data Format

Date in UTC	(yyyymmdd)	i8
Time in UTC	(hhmmss)	1x,i6
Latitude	(degree North)	f10.5
Longitude	(degree East)	f11.5
Absolute gravity at sea surface (mGal)		f10.2
Free-air anomaly	(mGal)	f8.2

Observation Period

Leg-1 12:00 25 Sept 2011 - 23:57 25 Oct 2011  
Leg-2 00:00 29 Oct 2011 - 11:12 16 Nov 2011

Remarks

WGS84 was adopted as a geodetic system.

For more information

Contact to Kunio Yoneyama (yoneyamak [at] jamstec.go.jp)

or

[http://www.godac.jamstec.go.jp/darwin/data/mirai/mr11-07\\_leg1/gravity/e](http://www.godac.jamstec.go.jp/darwin/data/mirai/mr11-07_leg1/gravity/e)

[http://www.godac.jamstec.go.jp/darwin/data/mirai/mr11-07\\_leg2/gravity/e](http://www.godac.jamstec.go.jp/darwin/data/mirai/mr11-07_leg2/gravity/e)