

## MIRAI MR16-09 Leg1 Gravity

Last Modified: 2019-08-30

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Cruise ID: [MR16-09 Leg1](#)

Gravity: Processed (DMO)-Corrected

Data Policy: [JAMSTEC](#)

Observation Items: Absolute gravity

Science Keywords:

OCEANS > MARINE GEOPHYSICS > MARINE GRAVITY FIELD  
SOLID EARTH > GEODETICS/GRAVITY > GRAVITY

### Cruise Report

[http://www.godac.jamstec.go.jp/catalog/data/doc\\_catalog/media/MR16-09\\_leg1-4\\_all.pdf](http://www.godac.jamstec.go.jp/catalog/data/doc_catalog/media/MR16-09_leg1-4_all.pdf)

#### For Using Data

##### Principal Investigator

Data Management Office

##### Use Constraints

See [Terms and Conditions](#) about constrain of use.

##### Data Citation

See [Terms and Conditions](#) about data citation.

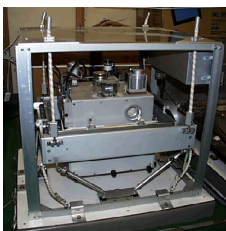
### Period (UTC)

2016-12-28 18:46 – 2017-01-15 06:10

### Instrument

Instrument:

Shipboard gravimeter



Instrument:

Microgravimeter (MR11-06 - )



### Overview

The data provided here are quality-controlled absolute gravity data and free-air anomalies. The absolute gravity data are a combination of relative gravity data measured by the shipboard gravity meter and the absolute gravity data of the ports in departure and arrival. Drift corrections and the Eotvos corrections were done before converting into absolute gravity. As a quality control, low reliability data were removed (see Quality control of data for the judging criteria). The absolute gravity values of the ports are referenced to those of the Japan Gravity Standardization Net of the Geographical Survey Institute of Japan.

### Measurement System

#### (1) Shipboard gravity meter

The system consists of two main assemblies; the gyro-stabilized platform including the gravity sensor and the data handling & control system.

Manufacturer : LaCoste & Romberg

Model : S-116

Measuring range : 12,000 mGal

Accuracy : 1.0 mGal

Drift rate : < 3.0 mGal/month

Installation : Gravity meter room

Reference: 「Model "S" Air-Sea Dynamic Gravity Meter SystemII」 INSTRUCTION MANUAL LaCoste and Romberg Gravity Meters, Inc. 2004

#### (2) Portable gravity meter

The portable gravity meter consists of two modules; the data acquisition/control module and the gravity sensor module. The gravity sensor is enclosed in a thermostatically controlled vacuum chamber. The portable gravity meter is used to calculate the absolute gravity of the port with reference to the gravity station of the Japan Gravity Standardization Net of the Geographical Survey Institute of Japan.

Manufacturer : SCINTREX

Model : CG-5

Measurement range : 8,000 mGal

Standard deviation : 0.005 mGal

Drift rate : < 0.02 mGal/day

Reference: "CG-5 OPERATION MANUAL", SCINTREX

### Absolute gravity in Ports

Date (UTC)	Port	Absolute gravity (mGal)	Sea level (cm)	Draft shipboard (cm)	Absolute gravity at sensor position (mGal)	Reading of shipboard gravity meter (mGal)
2016/11/25 04:41:20	SHIMIZU/OKITSU1	979729.63	146	655	979730.35	12016.6
2017/03/28 07:53:17	SEKINEHAMA	980371.93	245	605	980372.86	12657.8

\* see [Term description](#)

### Data processing

According to the filter process of the gravity meter system, the gravity data has a time lag of 120 seconds between the measurement and its output. After adjustment of this lag time, the following corrections and calculations were performed.

#### (1) Drift correction

$D = ((Vg-Vgs)-(Age-Ags))/(Te-Ts)$   
D: Drift value (mGal/day)  
Vgs: The shipboard gravity at the start of the cruise (mGal)  
Vge: The shipboard gravity at the end of the cruise (mGal)  
Ags: The absolute gravity at the shipboard sensor position at the start of the cruise (mGal)  
Age: The absolute gravity at the shipboard sensor position at the end of the cruise (mGal)  
Ts: The start time of the cruise (day)  
Te: The end time of the cruise (day)

(2) Eotvoes correction  
 $E = 7.503 \times S^2 \times \cos(\phi) \times \sin(\alpha) + 0.004154 \times S^2$   
E: Eotvoes correction (mGal)  
S: Ground speed of the ship (knot)  
 $\phi$ : Latitude (radian)  
 $\alpha$ : Course of the ship (radian, measured clockwise from the north)

Reference: Blakely, R.J., Potential theory in gravity & magnetic applications, Cambridge University Press, New York, 441pp, 1995

\* The navigation data such as S,  $\phi$  and  $\alpha$  are the 4-min average values. Before average processing, following data were removed from each dataset. If the number of data used for a 4-min average calculation did not include more than 50% of good data, the processed average value was considered as a missing value.

- Time error (inversion of time, continuation of same timestamps)
- Ship speed exceeding 20 knot
- Course of the ship except 0-360°

(3) Calculation of the absolute gravity  
 $G = Ags + (Vg - Vgs) \cdot D \cdot (T - Ts) + E - H \cdot (\beta - 4\pi \cdot k \cdot pw)$   
G: The absolute gravity at sea surface (mGal)  
Ags: The absolute gravity at the shipboard sensor position at the start of the cruise (mGal)  
Vgs: The shipboard gravity at the start of the cruise (mGal)  
Vg: The shipboard gravity at the measurement time (mGal)  
D: Drift value (mGal/day)  
Ts: The start time of the cruise (day)  
T: The measurement time (day)  
E: Eotvoes correction (mGal)  
H: Height from sea surface of the shipboard sensor position (m)  
 $\beta$ : Free-air gradient 0.3086 (mGal/m)  
k: Gravitational constant  
pw: Density of sea water  
 $4\pi \cdot k \cdot pw = 0.0864$

(4) Calculation of the Free-air anomaly  
 $Gf = G - \gamma + \delta$   
Gf: The Free-air anomaly (mGal)  
G: Absolute gravity at sea surface (mGal)  
 $\gamma$ : Normal gravity (mGal)  
\*The normal gravity formula of the Geodetic Reference System 1980  
 $\gamma = 978032.67715(1 + 0.0052790414 \sin^2 \phi + 0.0000232718 \sin^4 \phi + 0.0000001262 \sin^6 \phi + 0.0000000007 \sin^8 \phi)$   
 $\delta$ : Atmospheric correction at sea surface  
 $\delta = 0.87 - 0.0000965 \cdot 0$  (mGal)

(5) Output of the data  
Time (UTC)  
Latitude (degree)  
Longitude (degree)  
Processed absolute gravity at sea surface (mGal)  
Free-air anomaly (mGal)

#### Quality control of data

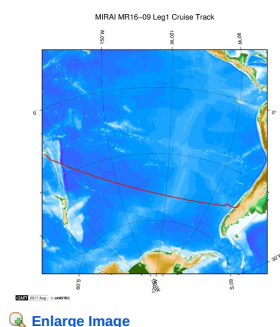
Following criteria were used for removal of low reliability data:

- Abrupt free-air anomaly change exceeding 10 mGal/km
- Change in Eotvoes correction exceeding 3 mGal/min
- Ground speed of the ship below 3 knot

#### Note

- (1) File naming rule: Cruise ID\_corr.grv
- (2) Sampling rate: ten seconds
- (3) Geodetic system: WGS84
- (4) If you would like the raw data set, please contact us from "Contact Us" above.

#### Related Information



#### MR16-09 Leg1

Ship Name: MIRAI  
Period: 2016-12-26 - 2017-01-17  
Chief Scientist: Akihiko Murata (JAMSTEC)  
Proposal ▶ Ship-borne measurements of aerosols in the marine atmosphere: Investigation of potential influence of marine aerosol particles on the climate;

#### Update History

2019-08-30	An observation data was registered.
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CHIKYU  
KAIMEI  
SHINSEI MARU  
HAKUHO MARU

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SHINKAI 6500  
DEEP TOW  
HYPER-DOLPHIN  
URASHIMA  
YOKOSUKA DEEP TOW  
6K Camera DEEP TOW  
6K Sonar DEEP TOW  
KM-ROV  
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Cruise ID: [MR16-09 Leg1](#)

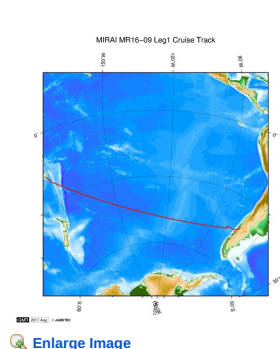
Gravity: Processed (DMO)-Corrected

Data Policy: [JAMSTEC](#)

### Gravity Corrected

No.	Column	Content	Format	Unit	Remarks
1	1 - 8	Date	i4,i2,i2		YYYYMMDD (UTC)
2	10 -15	Time	i2,i2,i2		hhmmss (UTC)
3	17 -25	Latitude	f9.5	degree	No sign for the northern hemisphere. Negative for the southern hemisphere.
4	27 -36	Longitude	f10.5	degree	No sign for eastern hemisphere. Negative for the western hemisphere.
5	38 -45	Absolute gravity	f8.1	mGal	
6	48 -53	Free-air anomaly	f6.1	mGal	

### Related Information



#### MR16-09 Leg1

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Period: 2016-12-26 - 2017-01-17

Chief Scientist: Akihiko Murata (JAMSTEC)

Proposal ▶ Ship-borne measurements of aerosols in the marine atmosphere: Investigation of potential influence of marine aerosol particles on the climate;

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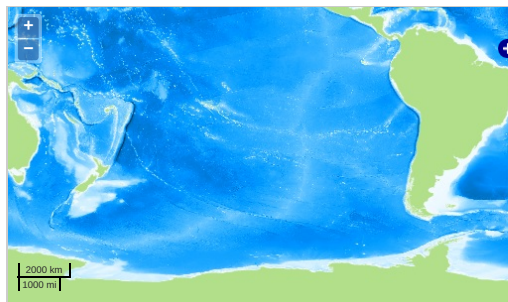
Data Policy: **JAMSTEC**

Observation Items: Absolute gravity

Science Keywords:

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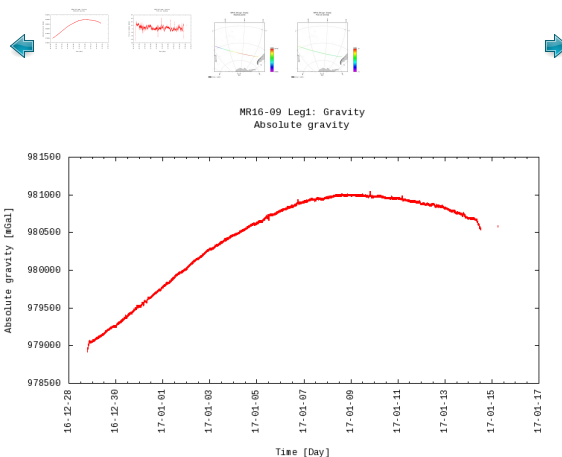
### Observation Map



— ... Observation Line — ... Navigation ● ... Observation, Dive Point, Hole

Imagery reproduced from ...

### Figures



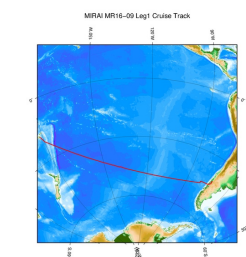
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File names

☐ MR16-09\_1\_corr.grv

### Related Information



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#### MR16-09 Leg1

Ship Name: MIRAI

Period: 2016-12-26 - 2017-01-17

Chief Scientist: Akihiko Murata (JAMSTEC)

Proposal ▶ Ship-borne measurements of aerosols in the marine atmosphere: Investigation of potential influence of marine aerosol particles on the climate;

Title: influence of marine aerosol particles on the climate;

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