CIBINONG STATION REPORT

1st Workshop on the International Geodynamics and Earth Tide Service (IGETS)
18-20 June 2018, Potsdam (Germany)

OUTLINE

- BRIEF HISTORY OF SG OBSERVATION IN INDONESIA
- NEW CIBINONG STATION
- SG DATA
- SG APPLICATION
- CONCLUSION

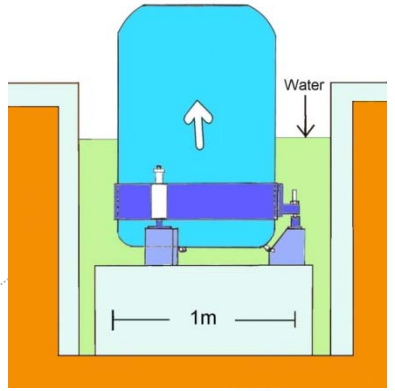
SG OBSERVATION IN INDONESIA

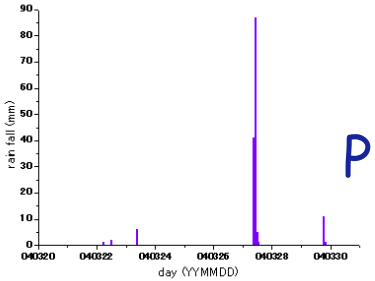
SG observation in Bandung

-From 1997 to 2004
-Only one SG station near the equator
-Various phenomena
-Geodynamics, Tectonics, Hydrology, ENSO …

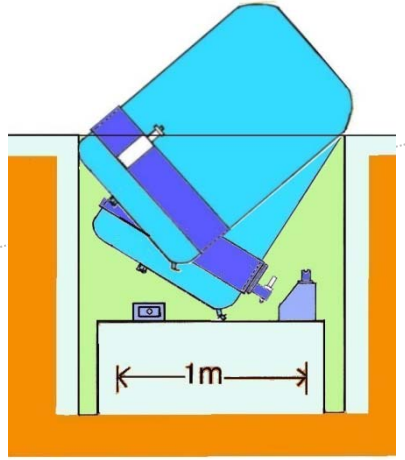
(FUKUDA, 2010)

SG DAMAGED BY FLOODING IN MARCH,2004





Precipitation



(FUKUDA, 2010)

RESTARTING SG OBS IN INDONESIA

has been desired, because it is

- indispensable for the studies of latitude dependent phenomena, and other interesting phenomena;
- important for Global Geodynamics Project.

BAKOSURTANAL (now BIG) - (National Coordinating Agency for Surveys and Mapping of Indonesia)

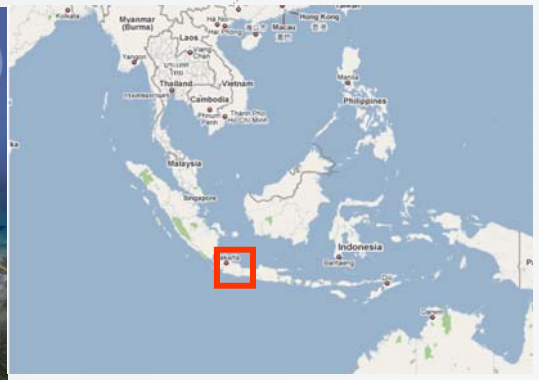
- has offered a new observation hut in Cibinong.

CT#022

- can be returned to serve after overhaul.

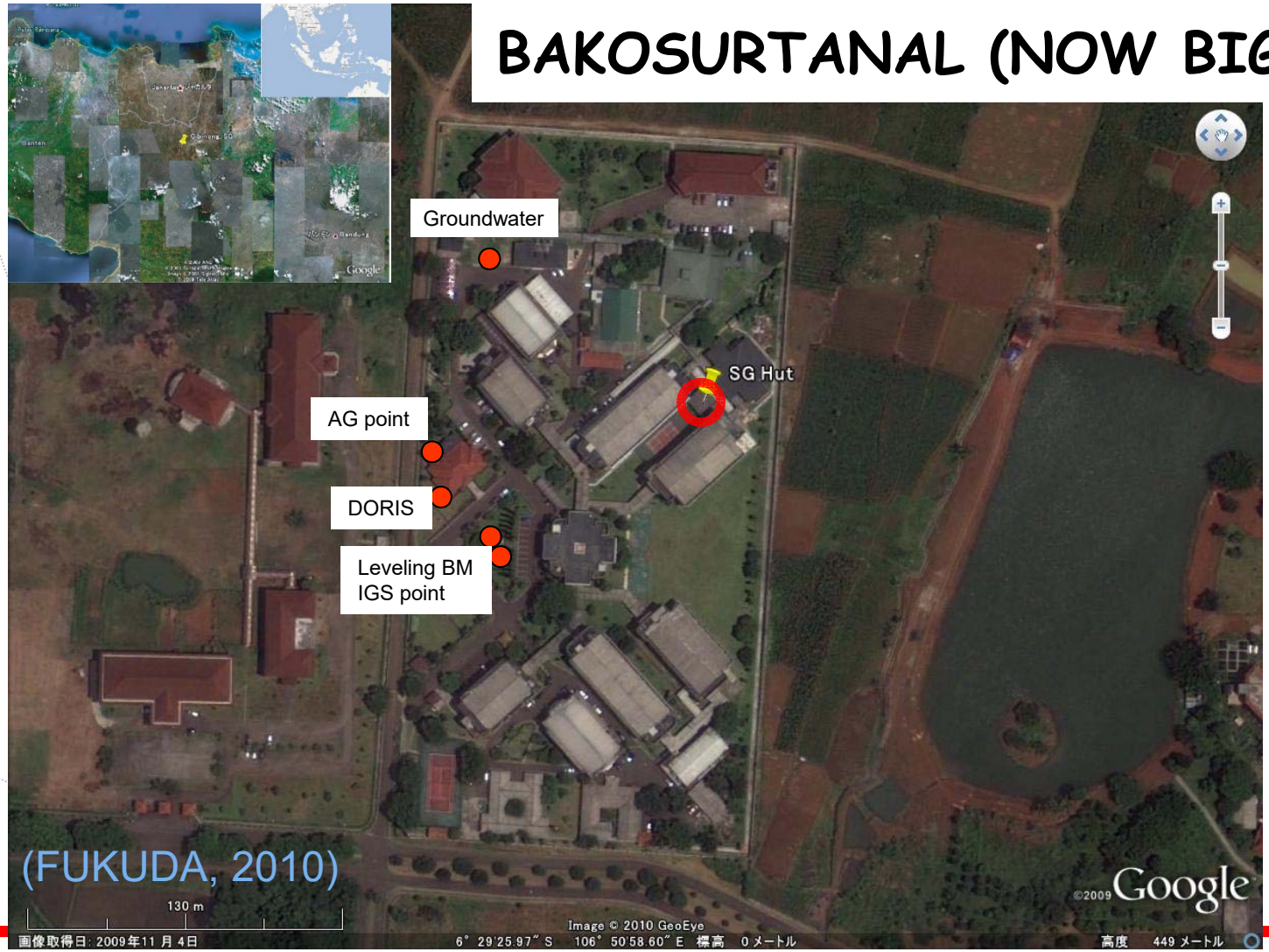
(FUKUDA, 2010)

NEW SG SITES IN CIBINONG



(FUKUDA, 2010)

BAKOSURTANAL (NOW BIG)



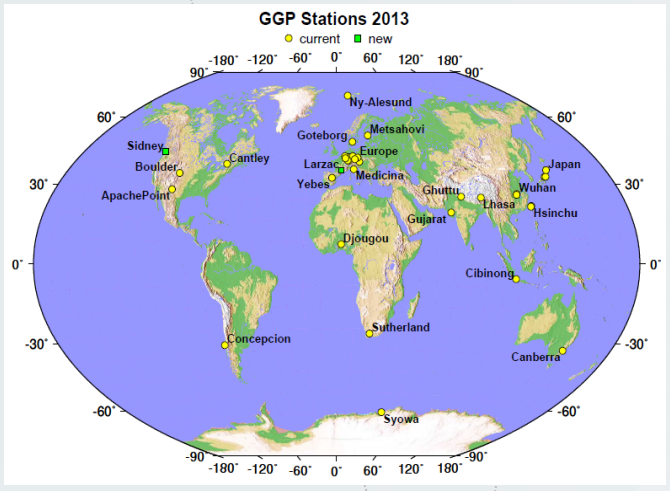
CT-022:

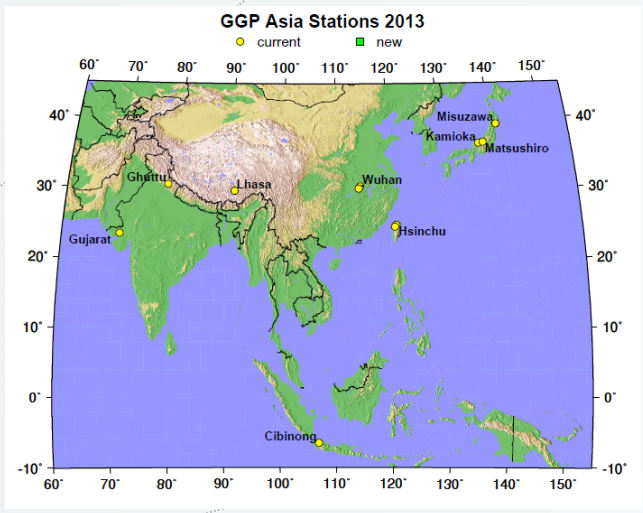
- 1995-2003: Aso Volcanological Laborato
- Jun-Dec 2007: overhaul at GWR
- Jan -Aug 2008: test measurements at Tsu
- July-Oct 2008: construction of the SG hu
- Sep. 2008: transpor
- Sep-Nov 2008: test in B
- Nov. 2008: installati
  start obs
- Mar. 2009: GPS clock,
- July 2009: update PC
- Sep. 2009: stop obser
- Aug. 2010: restart ob



(FUKUDA, 2010)

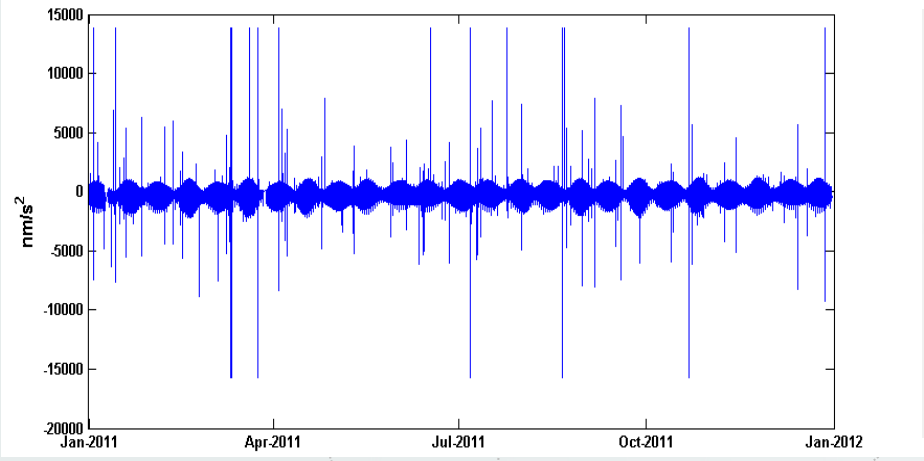
NEW CIBINONG SG STATION

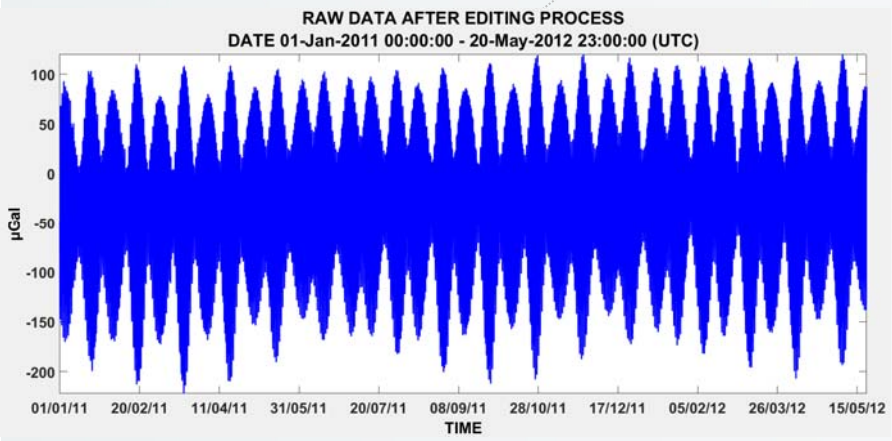




CIBINONG STATION POSITION :
IT WAS AN UNIQUE SG STATION AMONG ALL OF GGP SG STATIONS
THE ONE AND ONLY SG STATION NEAR THE EQUATOR

SG DATA

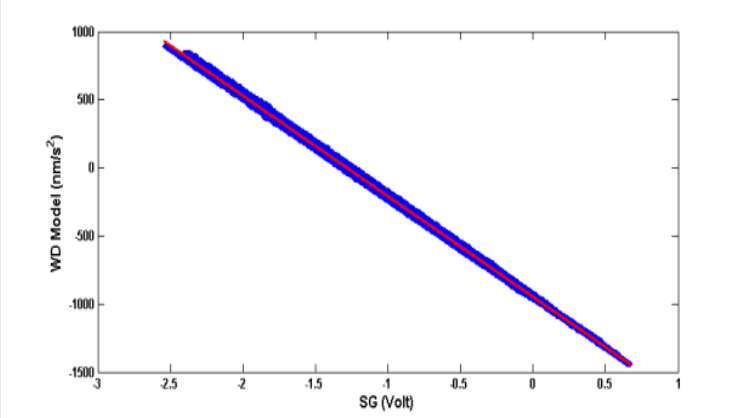


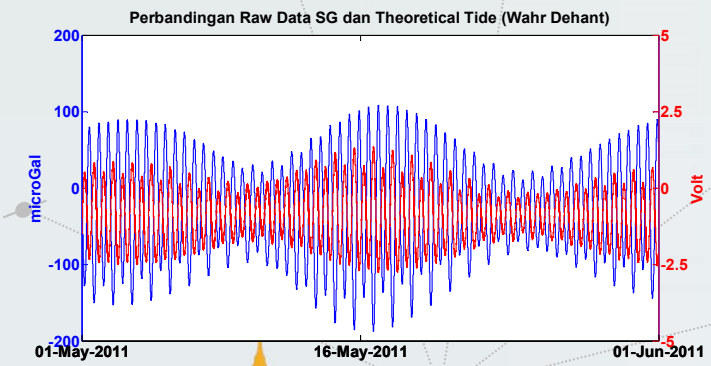


Cibinong Station has recorded almost 3 years SG data in seconds interval.

The data during 2011-2012 period were considered as the best data with minimum gaps.

SG DATA





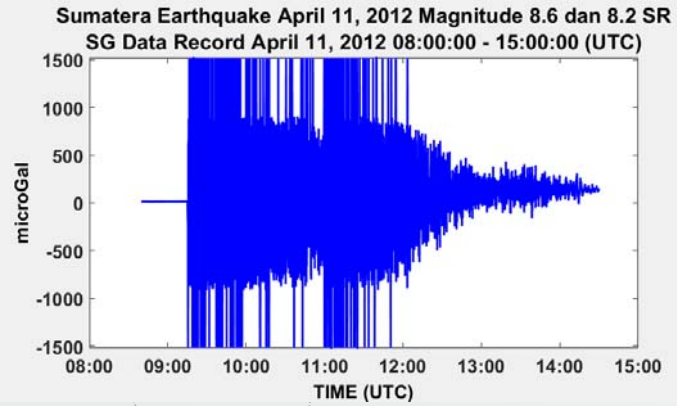
- Calibration factor was computed by linear regression between raw data SG and theoretical model WDD
- The regression function from fitting process:

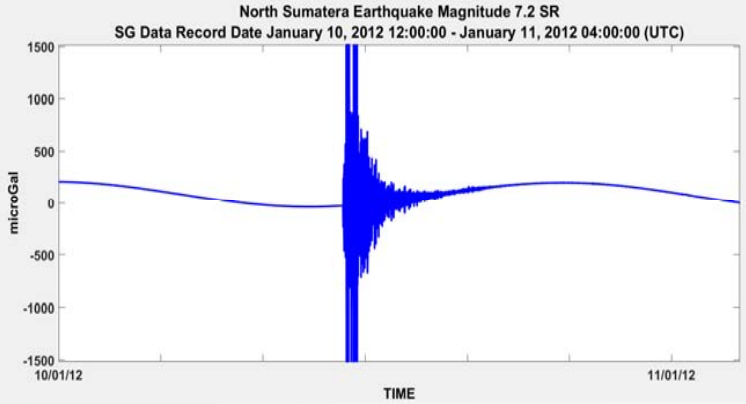
  $y_i = -738.1424\ x_i - 948.7721$

- Calibration value (scale factor): -738.0157 nms-2/Volt / -73.80157 µGal
- Shifting value = -948.7721 nm/s2 -94.87721 µGal.
- Standard deviation for calibration factor and shifting: ±0.0294 and ±0.0383 with correlation -0.9997.

EARTHQUAKE STUDIES

SOME EARTHQUAKE SIGNAL RECORDED BY SG

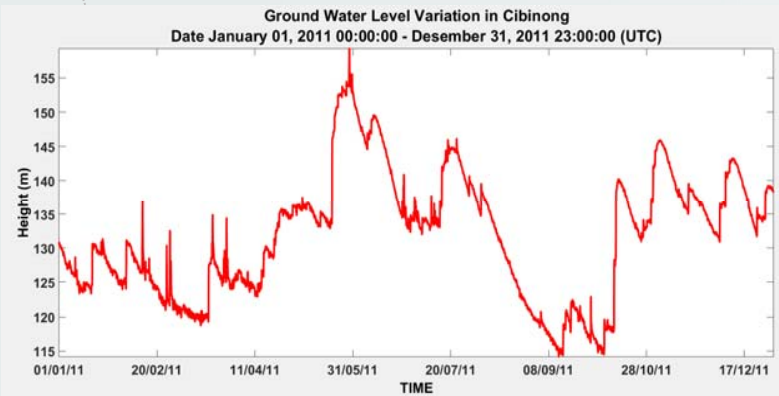


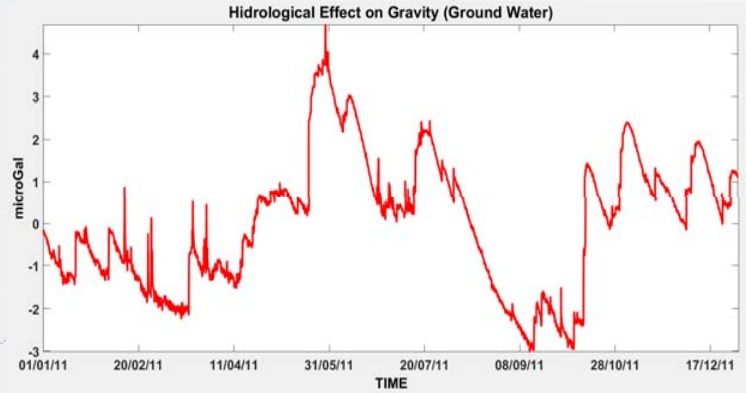


Some of research about earthquake signal detected by SG data has been conducted by **Meteorological Climatological and Geophysical Agency** of Indonesia (BMKG) especially to investigate anomalous gravity change before the earthquake:

(Priyambada, Fajar Rahmadi., Yusuf, Mahmud., and Variandy, Erfan Dany. 2016. *Anomali Sinyal Sebelum Gempabumi Signifikan Di Indonesia Yang Terdeteksi Oleh Superconducting Gravimeter Studi Kasus: Gempabumi Mw > 6 Selama Tahun 2011 (Anomalous Signal Before Indonesia's Significant Earthquakes Detected by Superconducting Gravimeter Case Study: Earthquakes with Mw > 6 during 2011).* Jurnal Geomatika-BIG Volume 22 No. 2 November 2016: 47-56)

SG DATA APPLICATION IN HIDROLOGY





The ground water level data obtained from borehole with 15 m depth located 200 m from Cibinong SG station (shallow aquifers)

Regression beetwen ground water level and SG data that done by Bramanto (2014) showed admittance value 1,7061 nms-2/m or 0,17061 µGal/m.

The hydrological effect on gravity computed with admittance value range from -3 – 5 µGal

TIDAL ANALYSIS OF SG DATA

Tidal analysis was computed using BAYTAP-G (Tamura. 1991)

RAW DATA

NO	GROUP	SYMBOL	FACTOR (μGal)	RMSE (μGal)	PHASE (deg°)	RMSE (deg°)	AMPL (μGal)	RMSE (μGal)
DIURNAL (1 DAY)								
1	1-143	Q1	1.00427	0.00722	11.404	0.411	1.339	0.01
2	144-201	O1	1.08484	0.00129	9.794	0.068	7.557	0.009
3	202-249	M1	1.17232	0.00843	2.929	0.412	0.642	0.005
4	250-256	PI1	1.07439	0.03366	4.745	1.796	0.204	0.006
5	257-266	P1	1.11824	0.00243	9.643	0.125	3.624	0.008
6	267-270	S1	0.93677	0.05312	16.938	3.275	0.072	0.004
7	271-288	K1	1.11356	0.0008	10.624	0.041	10.909	0.008
8	289-292	PSI1	1.11177	0.05179	9.263	2.669	0.085	0.004
9	293-305	PHI1	1.14191	0.0404	7.004	2.028	0.159	0.006
10	306-345	J1	1.25852	0.0138	9.669	0.629	0.689	0.008
11	346-450	OO1	1.2858	0.01886	9.475	0.84	0.385	0.006
SEMI DIURNAL (12 HOURS)								
12	451-549	2N2	1.17601	0.00079	0.352	0.038	2.206	0.001
13	550-599	N2	1.17448	0.00016	-0.116	0.008	16.65	0.002
14	600-612	ALPHA2	1.19295	0.0072	1.812	0.346	0.304	0.002
15	613-631	M2	1.16364	0.00003	-0.796	0.002	86.162	0.002
16	632-655	BETA2	1.17311	0.01033	-3.078	0.505	0.263	0.002
17	656-663	LAMBDA2	1.16344	0.00415	-0.526	0.204	0.635	0.002
18	664-681	L2	1.1547	0.00124	-0.79	0.062	2.417	0.003
19	682-701	T2	1.12935	0.00113	-1.543	0.057	2.274	0.002
20	702-710	S2	1.13175	0.00008	-1.739	0.007	38.989	0.003
21	711-827	K2	1.1354	0.00025	-1.514	0.013	10.633	0.002
TERDIURNAL (8 HOURS)								
22	828-909	M3	1.04525	0.00094	-0.288	0.052	1.509	0.001

CORRECTED WITH GLOBAL OCEAN MODEL NAO99B

NO	GROUP	SYMBOL	FACTOR (μGal)	RMSE (μGal)	PHASE (deg°)	RMSE (deg°)	AMPL (μGal)	RMSE (μGal)
DIURNAL (1 DAY)								
1	1-143	Q1	1.09536	0.00926	1.302	0.484	1.461	0.012
2	144-201	O1	1.11861	0.00166	-0.007	0.085	7.792	0.012
3	202-249	M1	1.1518	0.01075	-1.969	0.535	0.631	0.006
4	250-256	PI1	1.08409	0.03738	1.124	1.977	0.205	0.007
5	257-266	P1	1.11188	0.00311	-0.182	0.16	3.604	0.01
6	267-270	S1	0.99771	0.05009	3.194	2.887	0.076	0.004
7	271-288	K1	1.09899	0.00102	0.306	0.053	10.766	0.01
8	289-292	PSI1	1.10695	0.05178	2.824	2.68	0.085	0.004
9	293-305	PHI1	1.12127	0.04452	2.977	2.277	0.156	0.006
10	306-345	J1	1.15641	0.01738	1.3	0.862	0.634	0.01
11	346-450	OO1	1.29145	0.02363	0.968	1.048	0.387	0.007
SEMI DIURNAL (12 HOURS)								
12	451-549	2N2	1.13452	0.00097	-0.362	0.049	2.128	0.002
13	550-599	N2	1.13459	0.0002	-0.074	0.01	16.085	0.003
14	600-612	ALPHA2	1.19177	0.00875	1.794	0.42	0.303	0.002
15	613-631	M2	1.13221	0.00004	-0.096	0.002	83.835	0.003
16	632-655	BETA2	1.16996	0.01247	-2.871	0.611	0.262	0.003
17	656-663	LAMBDA2	1.16435	0.00504	-0.537	0.248	0.636	0.003
18	664-681	L2	1.13217	0.00152	0.245	0.077	2.37	0.003
19	682-701	T2	1.12563	0.00138	-0.551	0.07	2.267	0.003
20	702-710	S2	1.12909	0.0001	-0.76	0.008	38.897	0.003
21	711-827	K2	1.13275	0.0003	-0.538	0.015	10.608	0.003
TERDIURNAL (8 HOURS)								
22	828-909	M3	1.04525	0.00103	-0.286	0.057	1.509	0.001

TIDAL ANALYSIS OF SG DATA

DEVIATION FROM WDD SOLID EARTH TIDE MODEL

			Corrected by					
			Observation		NAO 99b		WDD 99	% perbedaan
O1	δ-Factor		1.08484 ± 0.00129		1.11861		1.1541	3.08
	Phase(°)		9.794 ± 0.068		-0.007			
K1	δ-Factor		1.11356 ± 0.0008		1.09899		1.13591	3.25
	Phase(°)		10.624 ± 0.041		0.0306			
M2	δ-Factor		1.16364 ± 0.00003		1.13221		1.16164	2.53
	Phase(°)		-0.796 ± 0.002		-0.096			
S2	δ-Factor		1.13175 ± 0.00008		1.12909		1.16164	2.80
	Phase(°)		-1.739 ± 0.007		-0.76			
K2	δ-Factor		1.1354 ± 0.00025		1.13275		1.16164	2.49
	Phase(°)		-1.514 ± 0.013		-0.538			

CONCLUSION

Some reason that SG measurement in Cibinong should be continued:

- **Cibinong station is the one and only SG measurement near the equator, so could des cribe gravity variations in this zone.**
- **The equator zone like Indonesia has strong geodynamic activity like earthquake, volc ano, land subsidence, etc, therefore SG measurement could help researcher around t he world to investigate these geophysical phenomena.**
- **Cibinong Station could help us to support the development of disaster mitigation syst em**
- **SG measurement will promote many research in microgravity, hydrology and geophy sics.**

"We are very wellcome for any potential partner who want to install SG (especially iGrav that doesn't need liquid helium filling) in Indonesia."


thank you
danke
謝謝
ngiyabonga
شكراً جزيلاً
рахмат
teşekkür ederim
Баярлалаа
спасибо
gracias
merci
obrigado
dziękuję
bedankt
go raibh maith agat
sukriya
kop khun krap
terima kasih
grazie
arigatô
dakujem
mochchakkeram
tapadh leat
dank je
takk
hvala
mauruuru
sagolun
감사합니다
ありがとう
ευχαριστώ
мерси
хвала
mersi
kia ora
barka
welalin
tack
spas
faafetai lava
vinaka
спасибі
blagodaram
misaotra
matondo
paldies
grazzi
mahalo
asante
manana
obrigada
tenki
murakoze
kiitos
dankie
dhanyavad
nanni
nandri
bayarlalaa
gracie
köszönöm
enkosi
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djiere dieuf
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gratias ago
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sulpáy
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sobodi
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