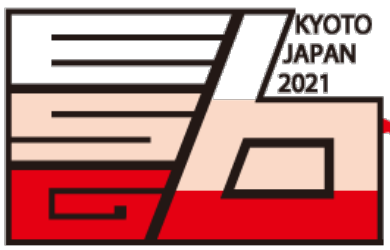


THE 6TH IASPEI / IAEE INTERNATIONAL SYMPOSIUM:
THE EFFECTS OF SURFACE GEOLOGY ON SEISMIC MOTION
MARCH 15-17, 2021 KYOTO, JAPAN

July 1st 2019

Documentation for Blind Prediction Study Step 1

We thank you for accepting our invitation to participate as an analyst in Step 1 of the blind prediction for the soil-model estimation using non-invasive data. Your analytic contributions will be consisted of the processed data and the soil model including the relevant parametric information. For your participation, you will be acknowledged directly when the report on the blind test is presented. However, your identity will remain masked from your specific analytic contributions as results will be codified. The test data consist of unpublished recordings at the site. The data were collected by the local organizing committee of ESG6 and contain surface recording in arrays include nested-triangle arrays for microtremor measurements and in line arrays for active source measurement with varying inter-receiver spacings. We are currently at Step 1 of the blind test and your instructions are as follows :

(1) Download the data (DataBPstep1.zip), metadata (DocumentBPstep1.pdf) & report template (Step1-dispersion.AbeK.xlsx, Step1-structure.AbeK.xlsx, Step1-procedure.AbeK.docx) from the web site http://sds.dpri.kyoto-u.ac.jp/esg6-bp/
The data include both passive and active data. Passive data contain three-component microtremor records of the nested-triangle arrays. We also distribute the vertical records of the active source measurements.

(2) You are requested to analyze the vertical component data of the microtremors in the arrays and/or seismic waves in the active source measurement to obtain a dispersion curve for Rayleigh-wave using algorithm(s) of your choice. A 1D structural model estimated using the dispersion curve for Rayleigh-wave is also requested. Furthermore, you are welcomed to use the data of the horizontal component(s) of microtremors for a better estimation, as an optional analysis for an additional soil model.

(3) Document your parameters and results by filling the columns for each tab in the respective Step1-structure.xlsx and Step1-dispersion.xlsx report template file provided in (1). Please also describe your procedure of the analysis in a word-file within about 1000 words.

(4) Attach and reply with your files to esg6-bp@jaee.gr.jp (please write “BP Step1 results <Surname>” in the subject). Append your surname and first name's initial to the files containing your results, e.g., Step1-structure.Abe.K.xlsx. Please note the scheduled deadline for the completion of Step 1 is 6th December 2019, at 23:59:59 (Japan Standard Time).

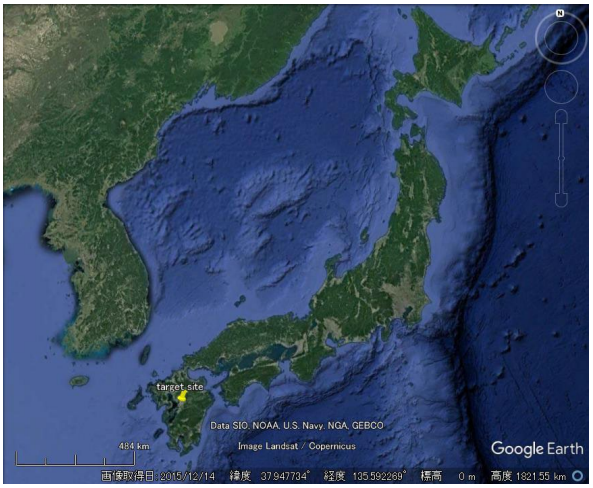
(5) The participants are encouraged to submit abstracts of your results to the Blind Prediction Special Session during ESG6 (http://esg6.jp/index.html) by 6th December 2019, and present your results.

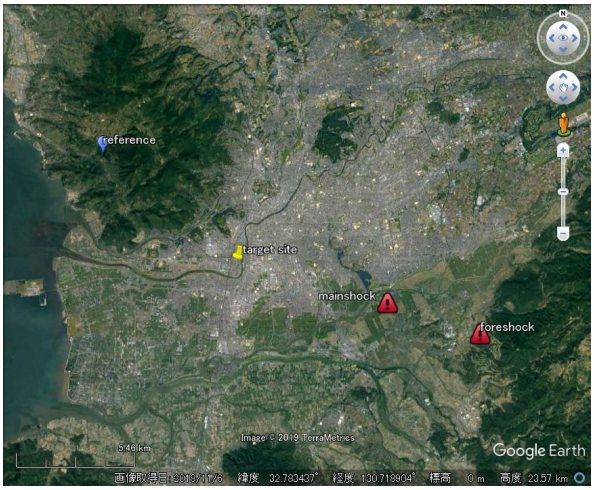
1. Information of target station site

1.1. Station location :

Rendaiji 4-chome, Nishi ward, Kumamoto City, Kumamoto Prefecture, Japan

32.775679N, 130.687920E, Elevation 9.4m（From GSI map）





1.1.1. Strong motion station

A strong motion recorder has been installed on the surface as shown in the following figures.

1.2. A priori geological information :

Surface geology at the station is Late Pleistocene to Holocene marine and non-marine sediments from Seamless geological map display system by GSJ, AIST

GeomapNavi (https://gbank.gsj.jp/geonavi/)

2. Existing models

2.1. Profile from J-SHIS (Japan Seismic Hazard Information System) by NIED

J-SHIS Version2 (http://www.j-shis.bosai.go.jp/map/?lang=en) provides a 1D profile of deep part of sedimentary layers as shown in the following table. Shallow soil part is not included in the system. The information for surface geology, Vs30, amplification factor from the seismic bedrock, is also available in the system.

Vp(m/s)	Vs(m/s)	Density(g/cm3)	Thickness(m)
2600	1200	2.15	466
5000	2700	2.50	498
5500	3200	2.65	1041
6000	3400	2.75	-

2.2. Profile from HERP (The Headquarters of Earthquake Research Promotion) by MEXT (Ministry of Education, Culture, Sports, Science and Technology) of Japan

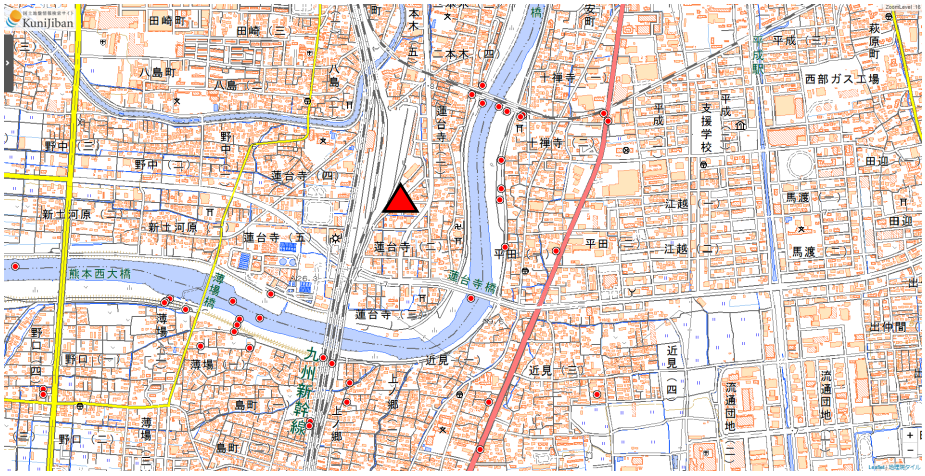
Vp(m/s)	Vs(m/s)	Density(g/cm3)	Thickness(m)
1700	350	1.80	26
1800	500	1.95	142
2200	800	2.07	263
2700	1300	2.20	127
3500	2000	2.35	397
4200	2400	2.45	488
5500	3200	2.65	1757

Profile of JIVSM (Japan Integrated Velocity Structure Model)

JIVSM (Japan Integrated Velocity. Structure Model) was established for estimating long-period strong ground motion due to mega-thrust earthquakes occurring around the island of Japan. The report of the long-period ground motion estimation was distributed by HERP (only in Japanese) (https://www.jishin.go.jp/evaluation/seismic_hazard_map/lpshm/12_choshuki_dat/). See Koketsu et al. (2014) for details about JIVSM.

Koketsu, K., H. Miyake, H. Suzuki (2012). Japan Integrated Velocity Structure Model Version 1, Proceedings of the 15th World Conference on Earthquake Engineering, Lisbon, Portugal, Oct. 12–17, Paper No. 1773.

2.3. Profiles available in KuniJiban



Kuni-jiban (http://www.kunijiban.pwri.go.jp/jp/index.html) (in Japanese) is an information about the subsurface structure of Japan Islands distributed by the Ministry of Infrastructure, Land and Transportation.

3. Available References

3.1. “Comprehensive research project for the major active faults related to the 2016 Kumamoto earthquake" by MEXT, FY2016 Progress Report
https://www.jishin.go.jp/main/chousakenkyuu/kumamoto_sogochousa/h28/h28kumamoto_sogochousa_3_2.pdf
Cross-section in pp.199-200

3.2. Chimoto et al. (2016) Estimation of shallow S-wave velocity structure using microtremor array exploration at temporary strong motion observation stations for aftershocks of the 2016 Kumamoto earthquake, Earth, Planets and Space, **68**: 206, https://doi.org/10.1186/s40623-016-0581-3

KC04(32.78440/130.70602) about 2km NE to the target site

Vp(m/s)	Vs(m/s)	Density(g/cm3)	Thickness(m)
279	161	1.60	16.3
862	497	1.80	1.0
1180	500	1.90	-

4. DATA

4.1. Passive data

4.1.1. File format for Passive data

```
SITE CODE= DOUBLE TRIANGULAR KUM-LL
LAT.= 32.775586
LON.= 130.687404
SAMPLING RATE= 200Hz
UNIT    = kine(cm/s)
INITIAL TIME = 2019 01 24 15:45:00
UD NS EW
  0.9029162E-01   0.5159521E-02   0.2740995E-02
  0.1464014E+00 -0.2676501E-01   0.1338251E-01
  0.9238768E-01   0.3547171E-02   0.1112522E-01
…continue…
```

The Sampling rate, Unit, initial time of the records are described in a header of each file.
The location information in the header indicates latitude and longitude of the central point of the array.

4.1.2. Instruments

4.1.2.1. Receiver :

Tokyo Sokushin, SE-321

Natural period, 10 seconds

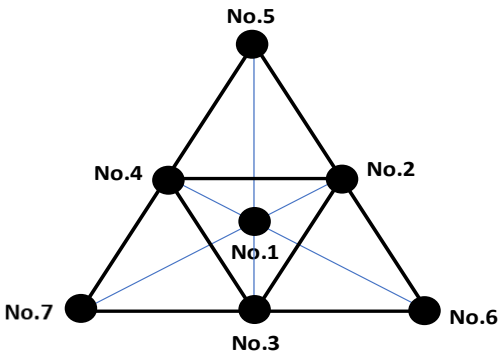
Sensitivity, 5V/kine

Three channels (UD, NS, and EW) are available. Therefore it is possible to use Horizontal/Vertical Spectral Ratio as well as the dispersion result.

4.1.2.2. Data logger :

Hakusan Corporation, LS8800

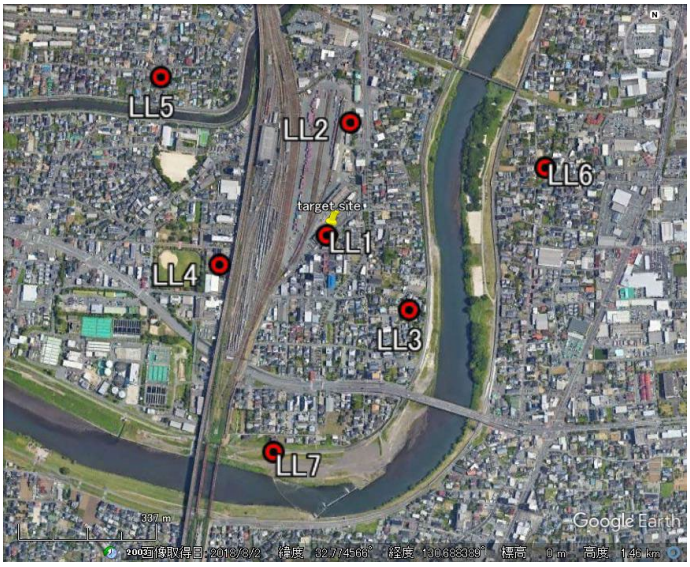
200 Hz sampling with 24bit precision. The dynamic range is 128dB. Time correction was done at every 1 hour during the measurements.



4.1.3. Geometry

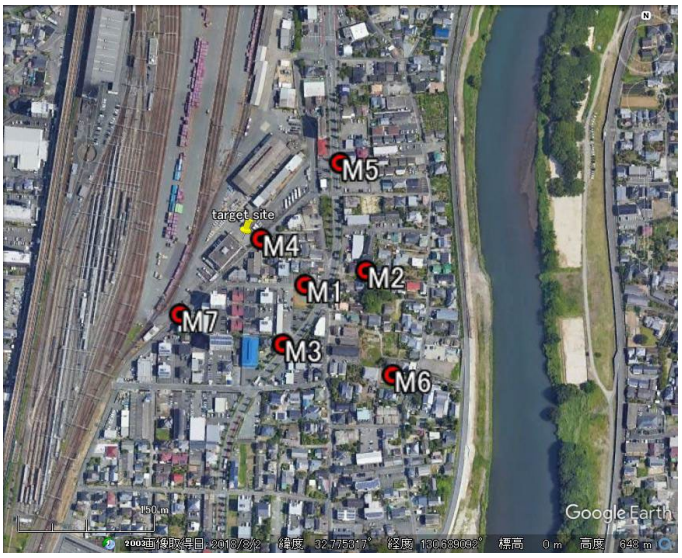
We used 7 sensors to simultaneously collect pair of triangles.

We performed the measurements of microtremors with the arrays of 5 different sizes (KUM-SS1, S, SM, M, LL). The side lengths (L) of two triangles of each array are as follows, L=(1, 2), (10,20), (39, 78), (122, 243), (481, 962) meters.



KUM-LL	No.1	32.775641	130.687920
KUM-LL	No.2	32.778120	130.688534
KUM-LL	No.3	32.774002	130.690078
KUM-LL	No.4	32.774997	130.685110
KUM-LL	No.5	32.779120	130.683571
KUM-LL	No.6	32.777128	130.693645
KUM-LL	No.7	32.770884	130.686522

KUM-LL　Average side lengths of double triangles are (481, 962)m



KUM-M	No.1	32.775272	130.688678
KUM-M	No.2	32.775412	130.689396
KUM-M	No.3	32.774681	130.688416
KUM-M	No.4	32.775728	130.688157
KUM-M	No.5	32.776484	130.689090
KUM-M	No.6	32.774377	130.689710
KUM-M	No.7	32.774978	130.687201

KUM-M　about (122, 243)m

KUM-SM	No.1	32.775625	130.688028
KUM-SM	No.2	32.775573	130.688264
KUM-SM	No.3	32.775494	130.687871
KUM-SM	No.4	32.775808	130.687999
KUM-SM	No.5	32.775910	130.688372
KUM-SM	No.6	32.775244	130.688212
KUM-SM	No.7	32.775738	130.687579

KUM-SM　about (39, 78)m

KUM-S　(10, 20)m

KUM-SS1 (1, 2)m

4.2. Active source data

4.2.1. File format for Active source data

The file format for active source data is shown in the followings.24 channels recordings of vertical seismic waves were observed in a one-line with a sampling rate of 0.001 sec.

1ch, 2ch, 3ch, … , 24ch

-0.88164286976 -0.9456672688 -0.96543836672 -1.04571761632 -1.16149712816 -1.05792668992 -1.02323097104 -0.8981547984 -0.7809472648 -0.55077142368 -0.51569094176 -0.42999639792 -0.45298011776 -0.4311844232 -0.52921316336 -0.41222128496 -0.319922183184 -0.26066073208 -0.238191680848 -0.253591981664 -0.32727512872 -0.41030131312 -0.51758998864 -0.57401606496

…continue…

4.2.2. Instruments

Instruments used are;

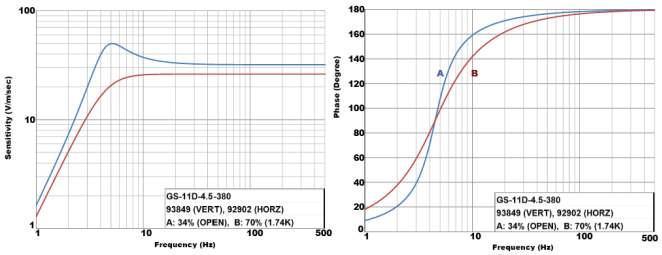
Geode (OYO Corp.) for the recording unit and 24 geophones with a natural frequency of 4.5 Hz (GS-11D, GEOSPACE).

GS-11D

PHYSICAL SPECIFICATIONS	
Orientation	Vertical and Horizontal available
Moving Mass	23.6 g (0.83 oz)
Maximum Coil Excursion p-p	> 2.5 mm (0.10 in.)
Diameter	3.18 cm (1.25 in.)
Height	3.35 cm (1.32 in.)
Weight	118 g (4.16 oz)
Operating & Storage Temperature Range	–45° to +85°C (–49 to +185°F)

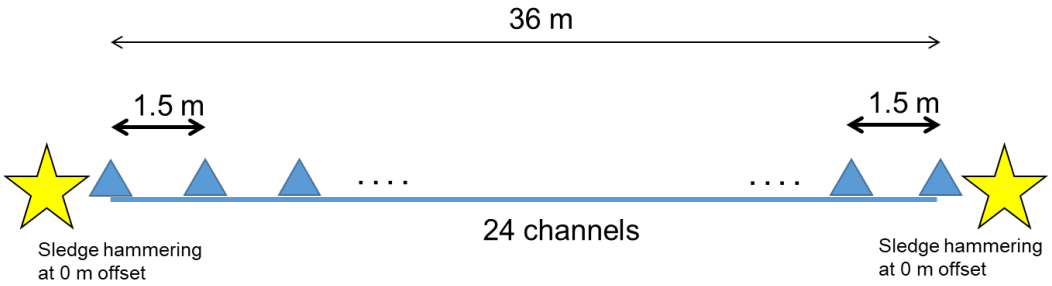
ELECTRICAL SPECIFICATIONS	@25°C
Frequency	4.5 Hz *
Spurious Frequency	N.S.
Distortion at Vertical	N.S.
Coil Resistance	380 Ω *
Open-Circuit Sensitivity	32.0 V/m/s (0.81 V/i/s)
Sensitivity at 70% damping	26.18 V/m/s (0.665 V/i/s)
Open-Circuit Damping	34%
Tilt angle when coil hits end stop	Vertical geophone = 16° | Horizontal geophone ±1.25°

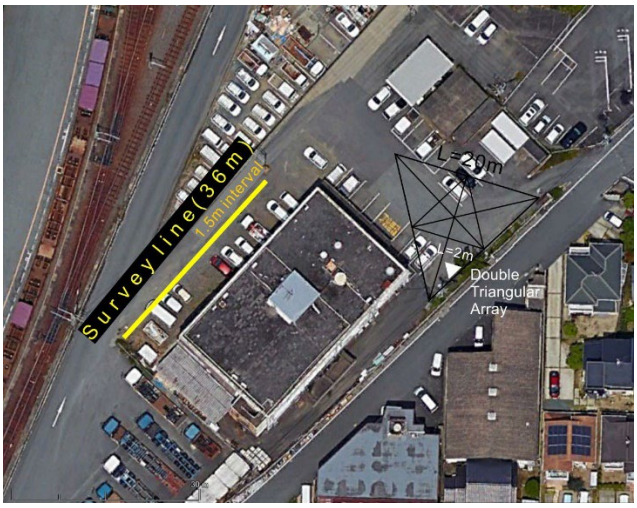
*Other frequencies and resistances available.



4.2.3. Geometry

The active source measurement was done along the 36 m survey line at the site. Vertical geophone was distributed with an interval of 1.5m. Data for 10 shots are available for each shot-receiver gather. Shot points were located at both ends of the survey line. We used a sledge hammer for the vertical impact as an artificial source. Data sampled at an interval of 1 kHz..





5. Terms of use of the distributed data

You can freely use the distributed data as long as you specify that you have used the data provided in the blind prediction of ESG6 and send a copy of your publication to the e-mail address below, when you present or publish your results derived using these data. We do not take any responsibility for any loss or disadvantage caused by using the data. The data shall not be distributed to a third-party and must be downloaded by the participants from the specified URL.

6. Presentation of results for the Blind Prediction exercise

We, local organizing committee, plan to compile and present submitted results and facilitate discussions at the ESG6 Symposium during 15-17 March 2021 in Kyoto, Japan. Please note that all the participants are acknowledged but not all participants can be listed in the authors in the publication of the compiled results at ESG6. Therefore we recommend the participants to submit abstracts of your results to the Blind Prediction Special Session of ESG6 for a presentation of your results.

7. Deadline for submission of results

Please note that the deadline for submitting your results is scheduled for no later than 6 December 2019 23:59:59 (Japan Standard Time), if you want to present at ESG6.

8. Deadline for abstract submission (option)

Please note that the deadline for submitting extended abstracts of your results for Step 1 is 30 July, 2020 23:59:59 (Japan Standard Time), if you want to present.

We thank you for your interest and participation in this blind prediction study of ESG6.

With much appreciation,

ESG6. Chair for Blind Prediction Step 1 Working Group YAMANAKA Hiroaki on behalf of
ESG6. Local organizing committee
esg6-bp@jaee.gr.jp