Short Report: Evaluation of Acceleration Response Spectra Using Observed Earthquake Records in the Seismic Event of "2011 Tohoku-Pacific Earthquake"

1. Introduction

In this report, response acceleration spectra computed by using observed records in Tohoku and Kanto regions in the seismic event of Tohoku-Pacific Earthquake having occurred at 14:46 March 11 2011 are presented. The data recorded by NIED K-NET were used in this report. To assess the intensity of the earthquake waves, response spectra used for the seismic design in Japan (Railways and Highways) are shown for comparisons.

2. Data Used

No.	Name	Observed Time	Long.	Lati.	Alti.	Epicent.	Max. Acc.	Period of Soil	Soil Type (Railway)	Soil Type (Highway)	Max. Acc. Resp. Spec.
IWA012	Kitakami	March 11-14:46:52	39.3209N	141.1378E	64.00m	212km	627.7gal	0.25s	G3	II	28.5m/s2(0.31s)-NS
IWA018	Morioka	March 11-14:46:58	39.6953N	141.1478E	125.00m	242km	259.5gal	0.17s	G2	I	10.4m/s2(0.23s)-EW
MYG004	Tsukidate	March 11-14:46:51	38.7292N	141.0217E	40.00m	183km	2933.2gal	0.13s	G0	I	129.5m/s2(0.24s)-NS
MYG012	Shiogama	March 11-14:46:50	38.3175N	141.0193E	1.73m	169km	2018.9gal	0.17s	G2	I	31.65m/s2(0.37s)-EW
MYG013	Sendai	March 11-14:46:50	38.2663N	140.9293E	5.00m	175km	1807.8gal	0.26s	G3	II	26.84m/s2(0.61s)-NS
MYG015	Iwanuma	March 11-14:46:49	38.1049N	140.8699E	3.00m	179km	433.6gal	0.42s	G3	II	17.41m/s2(0.57s)-NS
FKS001	Souma	March 11-14:46:50	37.7949N	140.9196E	9.00m	176km	682.8gal	0.26s	G3	II	18.21m/s2(0.73s)-EW
FKS002	Yanagawa	March 11-14:46:55	37.8449N	140.6013E	42.00m	203km	629.3gal	0.12s	G2	I	26.33m/s2(0.13s)-NS
FKS003	Fukushima	March 11-14:46:58	37.7613N	140.4799E	64.00m	215km	329.1gal	0.13s	G0	I	9.82m/s2(0.13s)-NS
FKS019	Nihonmatsu	March 11-14:46:57	37.6030N	140.4368E	235.00m	221km	461.4gal	0.21s	G2	I	22.12m/s2(0.35s)-NS
TCG001	Kuroiso	March 11-14:47:10	36.9417N	140.0828E	254.80m	275km	485.7gal	0.11s	G2	I	11.84m/s2(0.41s)-NS
TCG014	Moteghi	March 11-14:47:09	36.5450N	140.1742E	130.00m	291km	1291.1gal	0.17s	G2	I	51.37m/s2(0.40s)-EW
IBR003	Hitachi	March 11-14:47:05	36.5915N	140.6453E	57.50m	254km	1845.2gal	0.33s	G3	II	75.09m/s2(0.32s)-NS

＊The maximum acceleration shown above was obtained from the data where the mean value of the amplitude was subtracted from the original record.

3. Design Spectra

1. Design Standards for Railway Structures and Commentary (Seismic Design) 1999
   /L2 Spectrum I and II for soil types (G0, G1, G2, G3, G4, G5, G6, and G7)
2. Specifications for highway bridges, Part.5 Seismic design 2002
   /Level2 Type I and II for soil types (I, II, and III)

*The natural period of each soil stratum was approximately evaluated using 1/4-rule.

4. Results

Results are shown in the following part. Substantially large amplitude can be observed below 0.5sec. So far, details of damage to structures have not clearly been reported yet.

(saity@mail.saiama-u.ac.jp)

Date March 24 2011

Graduate School of Science and Engineering
Saitama University, Japan
Masato Saitoh

<Information>

Seismograph: K-NET02

Recorded Point: IWA012

Name: Kita-Kami

Observed Time: March 11-14:46:52

Longitude 39.3209N Latitude 141.1378E Altitude 64.00m

Epicentral Distance 212km

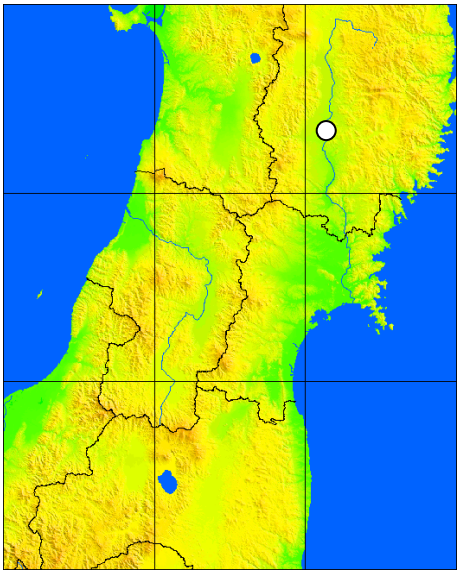
Max. ACC. 627.7gal

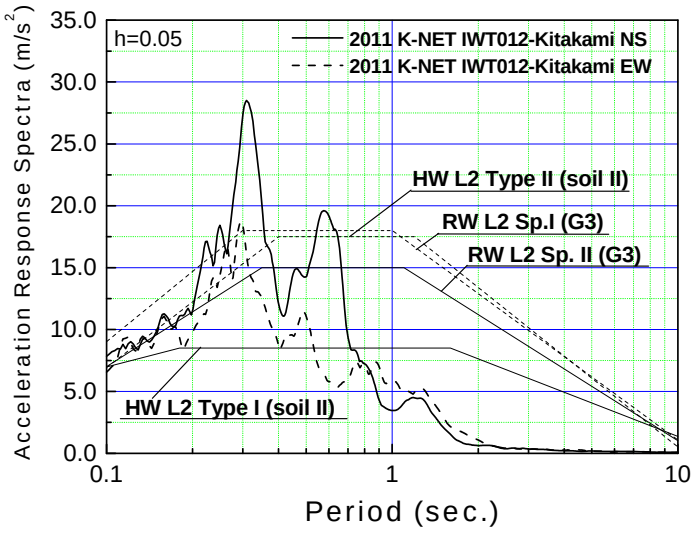
Period of Soil at Site about 0.25s

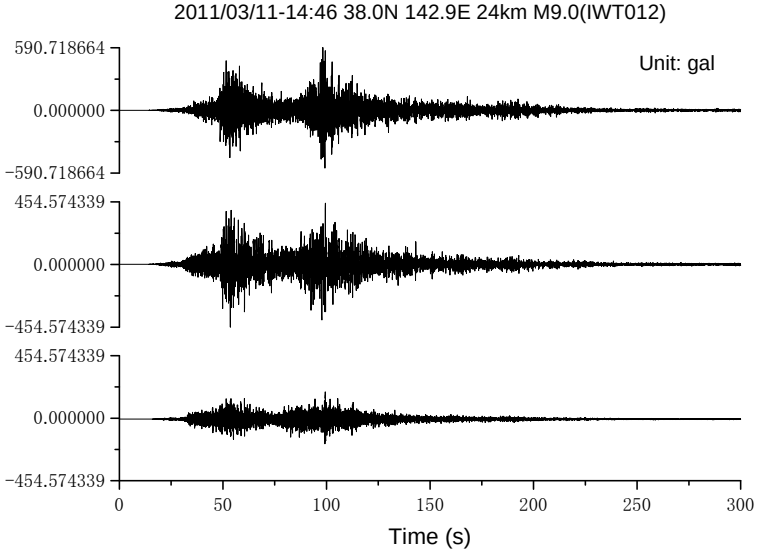
Soil Type(Railway) G3 (Highway) Type II

Acc. Response Spec. Max. 28.5m/s² (at 0.31s) (5%damping)

Address 214-1 Toribami, Futago-Chyo Kita-Kami City, Iwate Prefecture







Acknowledgements:
We used data from NIED K-NET.
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Seismograph: K-NET02

Recorded Point: IWA018

Name: Morioka

Observed Time: March 11-14:46:58

Longitude 39.6953N Latitude 141.1478E Altitude 125.00m

Epicentral Distance 242km

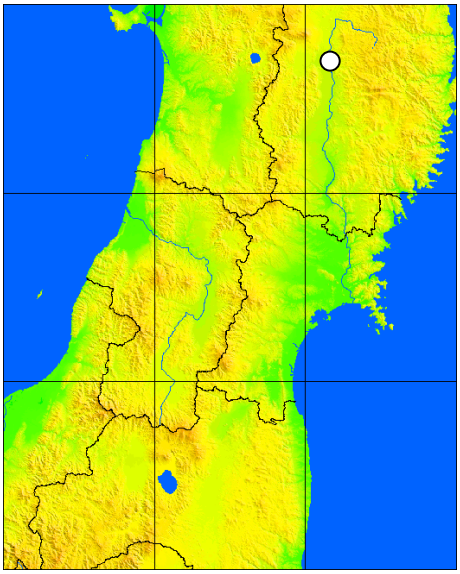
Max. ACC. 259.5gal

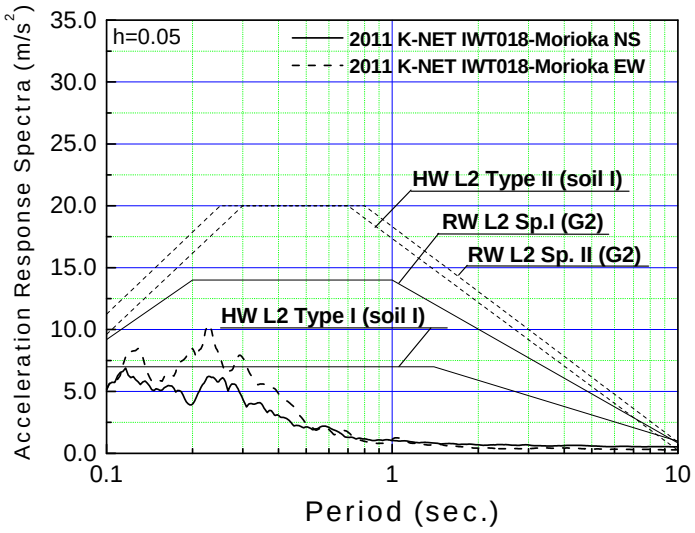
Period of Soil at Site about 0.169s

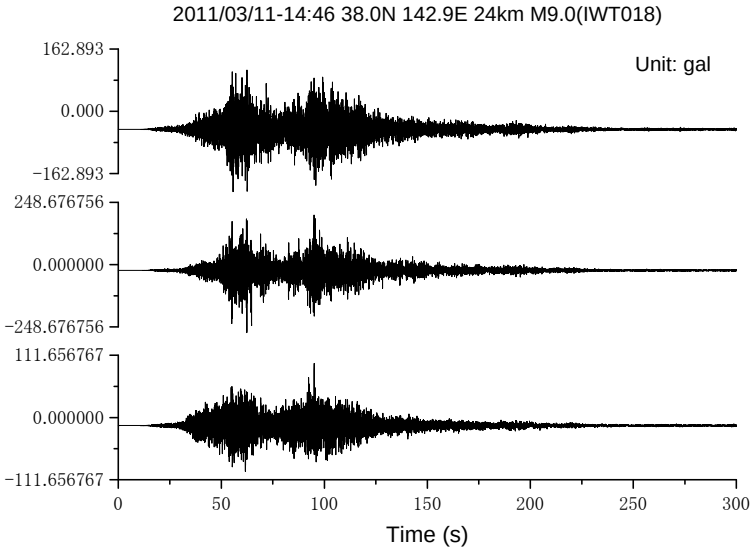
Soil Type(Railway) G2 (Highway) Type I

Acc. Response Spec. Max. 10.4m/s² (at 0.23s) (5%damping)

Address 77-9 141-3 Baba-Chyo Morioka City, Iwate Prefecture







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Saitama Univ. M. Saitoh

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Seismograph: K-NET02

Recorded Point: MYG004

Name: Tsukidate

Observed Time: March 11-14:46:51

Longitude 38.7292N Latitude 141.0217E Altitude 40.00m

Epicentral Distance 183km

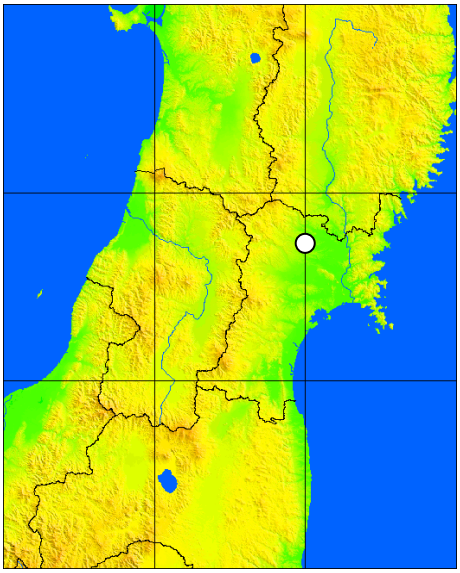
Max. ACC. 2933.2gal

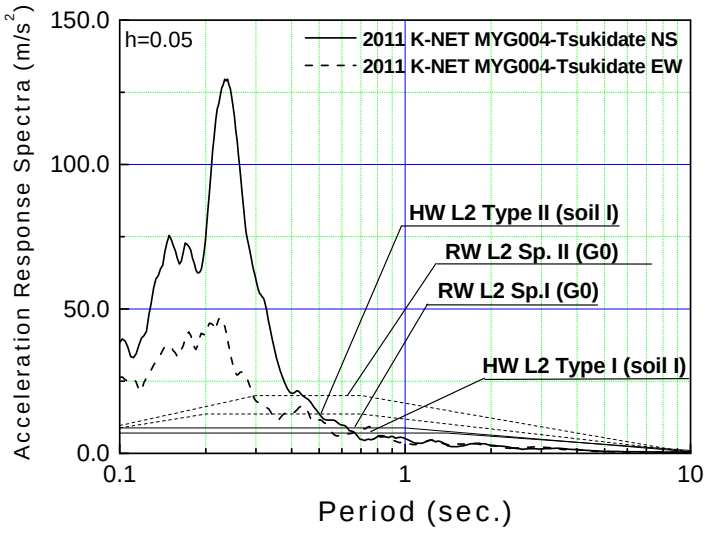
Period of Soil at Site about 0.134s

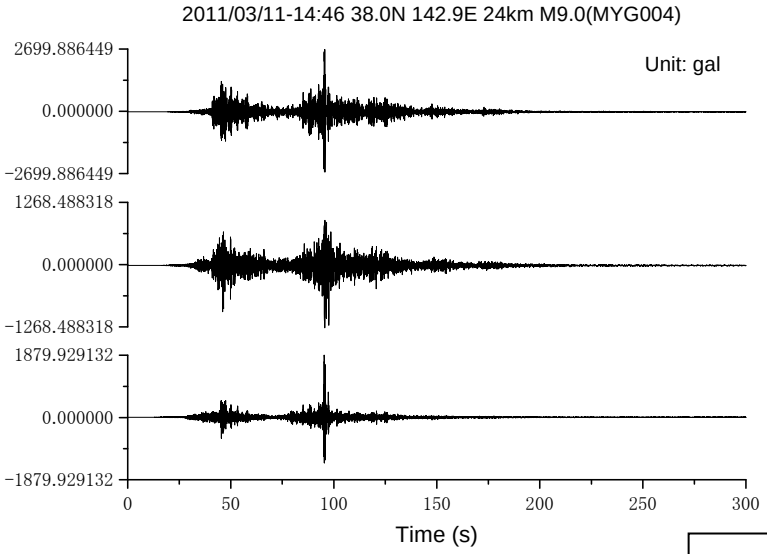
Soil Type(Railway) G0 (Highway) Type I

Acc. Response Spec. Max. 129.5m/s2 (at 0.24s) (5%damping)

Address 2-15 Tsukidate-Takada, Kurihara City, Miyaghi Prefecture







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<Information>

Seismograph: K-NET02

Recorded Point: MYG012

Name: Shiogama

Observed Time: March 11-14:46:50

Longitude 38.3175N Latitude 141.0193E Altitude 1.73m

Epicentral Distance 169km

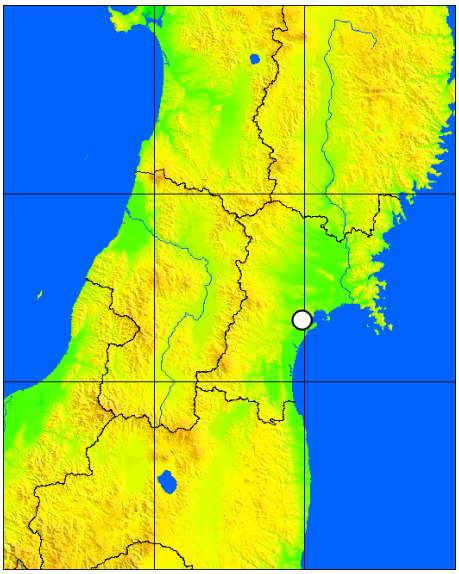
Max. ACC. 2018.9gal

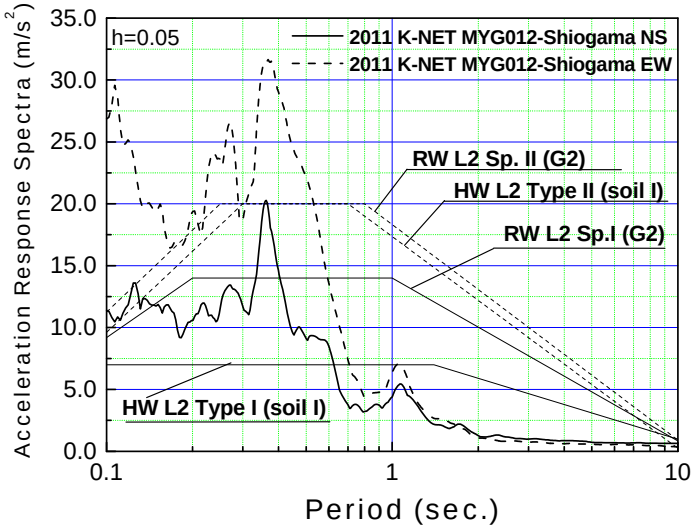
Period of Soil at Site about 0.17s

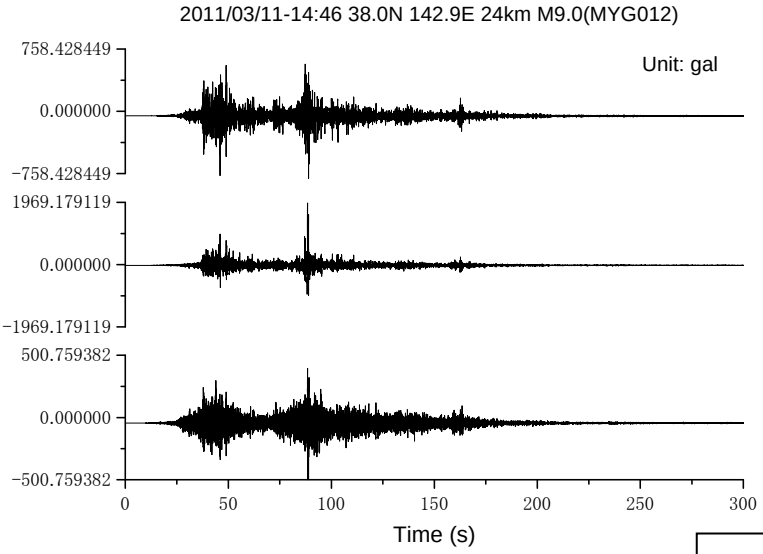
Soil Type(Railway) G2 (Highway) Type I

Acc. Response Spec. Max. 31.65m/s2(at 0.37s) (5%damping)

Address 1-1, Asahi-Chyo, Shiogama City Miyaghi Prefecture







Acknowledgements:
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Seismograph: K-NET02

Recorded Point: MYG013

Name: Sendai

Observed Time: March 11-14:46:50

Longitude 38.2663N Latitude 140.9293E Altitude 5.00m

Epicentral Distance 175km

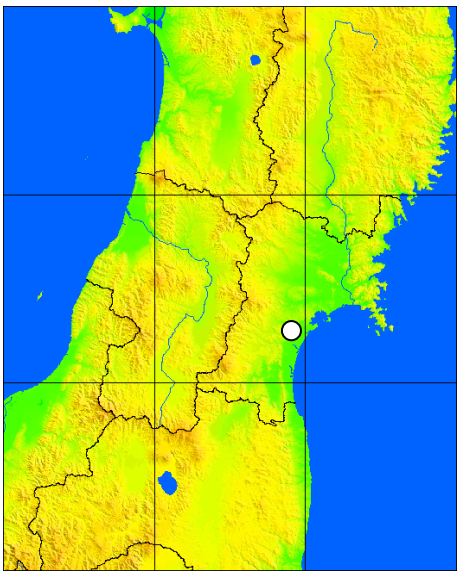
Max. ACC. 1807.8gal

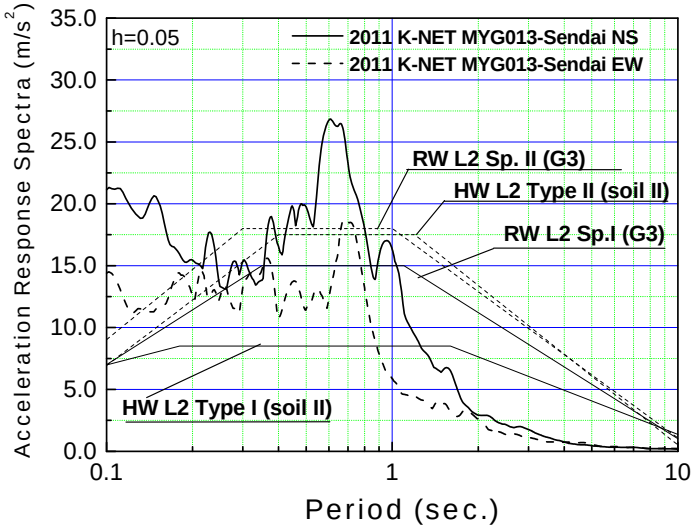
Period of Soil at Site about 0.26s

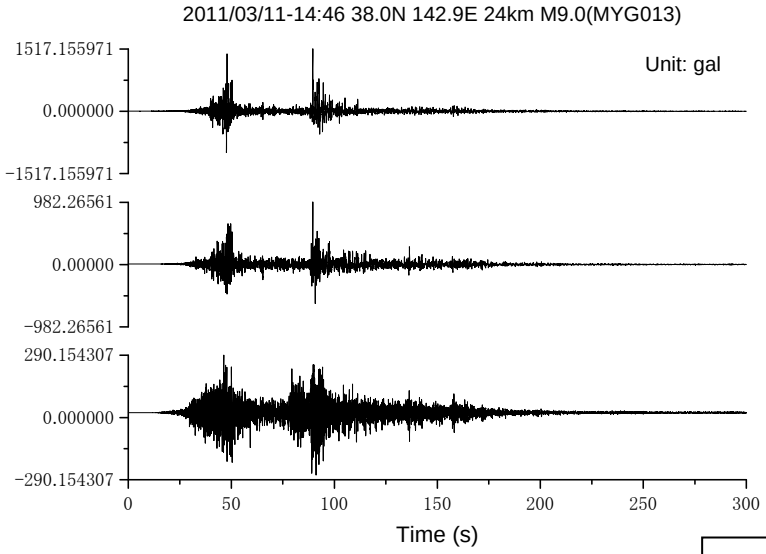
Soil Type(Railway) G3 (Highway) Type II

Acc. Response Spec. Max. 26.84m/s2 (at 0.61s) (5%damping)

Address 3-6-1, Nigatake, Miyaghino-Ku, Sendai, Miyaghi Prefecture







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Seismograph: K-NET02

Recorded Point: MYG015

Name: Iwanuma

Observed Time: March 11-14:46:49

Longitude 38.1049N Latitude 140.8699E Altitude 3.00m

Epicentral Distance 179km

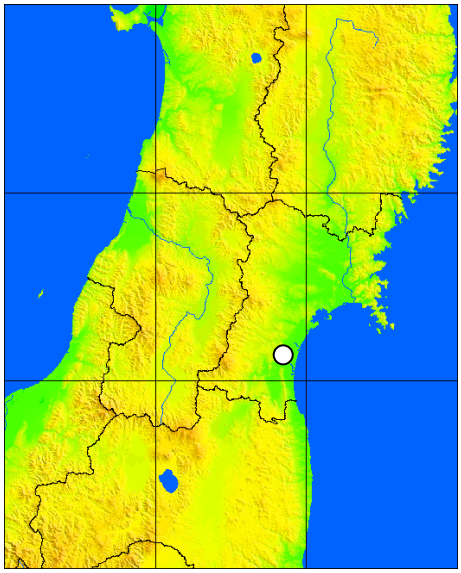
Max. ACC. 433.6gal

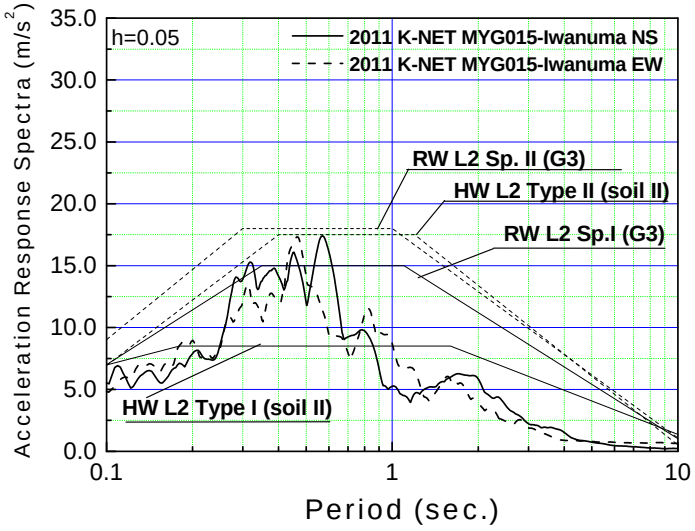
Period of Soil at Site about 0.42s

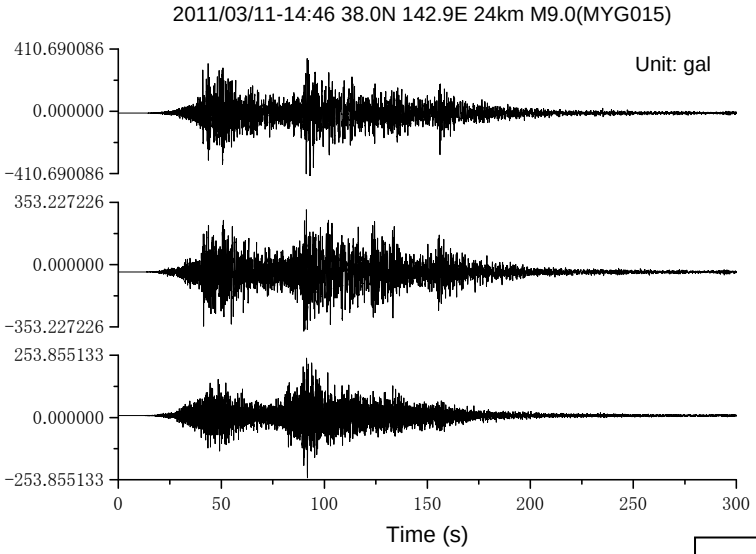
Soil Type(Railway) G3 (Highway) Type II

Acc. Response Spec. Max. 17.41m/s2(at 0.57s) (5%damping)

Address 230-3, 1, Sakura, Iwanuma, Miyaghi Prefecture







Acknowledgements:
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Seismograph: K-NET02

Recorded Point: FKS001

Name: Souma

Observed Time: March 11-14:46:50

Longitude 37.7949N Latitude 140.9196E Altitude 9.00m

Epicentral Distance 176km

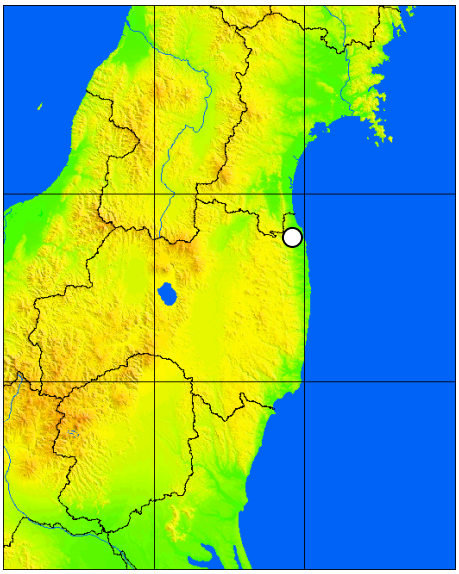
Max. ACC. 682.8gal

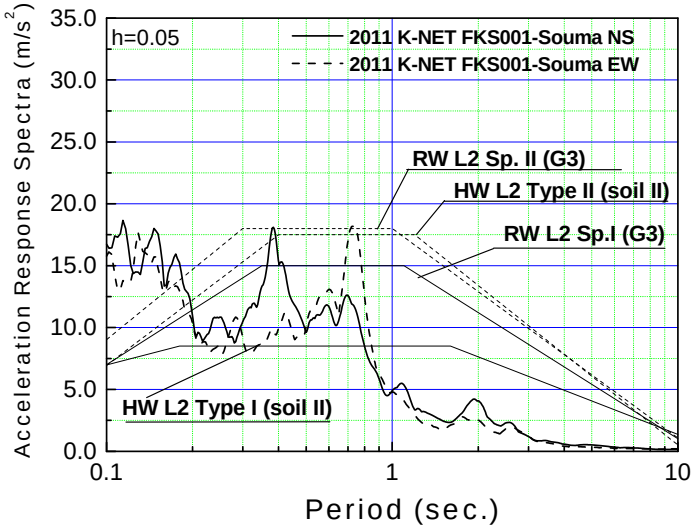
Period of Soil at Site about 0.26s

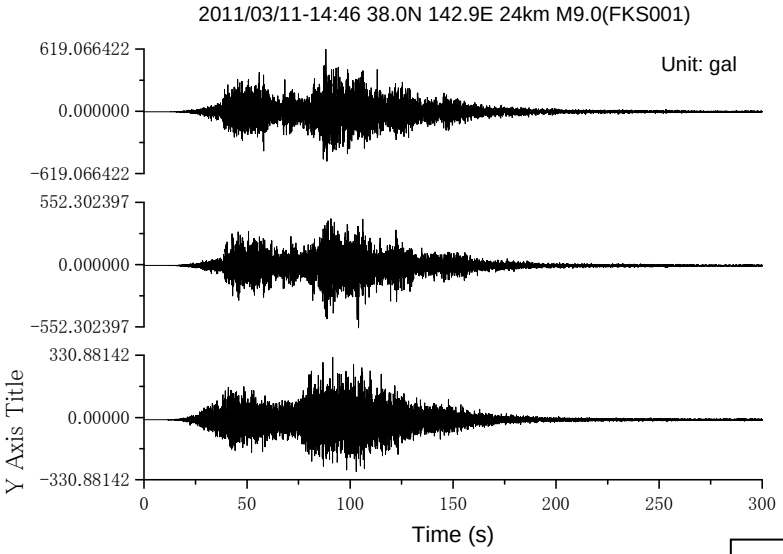
Soil Type(Railway) G3 (Highway) Type II

Acc. Response Spec. Max. 18.21m/s2 (at 0.73s) (5%damping)

Address 65-1 Kawaramachi, Aza, Nakamura, Souma, Fukushima Prefecture







Acknowledgements:
We used data from NIED K-NET.
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<Information>

Seismograph: K-NET02

Recorded Point: FKS002

Name: Yanagawa

Observed Time: March 11-14:46:55

Longitude 37.8449N Latitude 140.6013E Altitude 42.00m

Epicentral Distance 203km

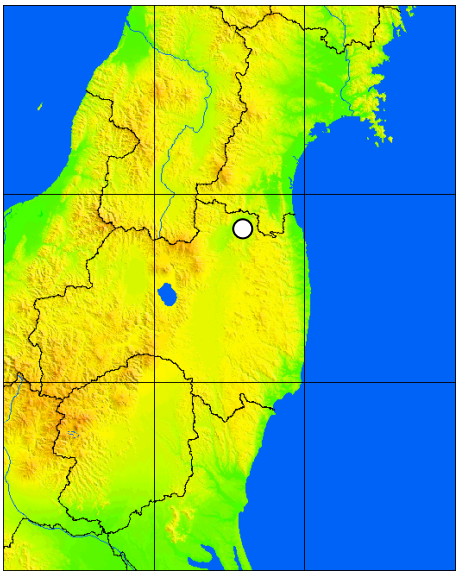
Max. ACC. 629.3gal

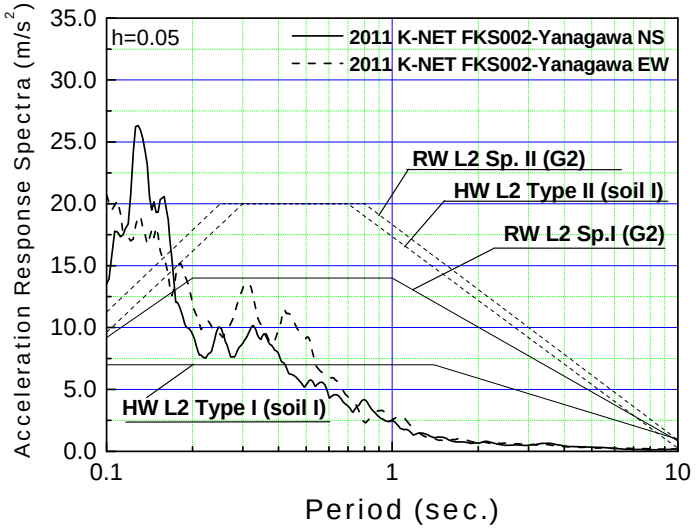
Period of Soil at Site about 0.12s

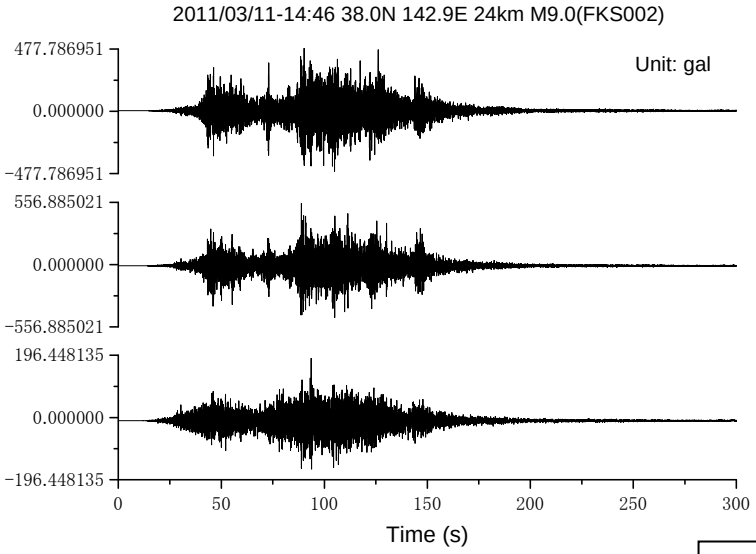
Soil Type(Railway) G2 (Highway) Type I

Acc. Response Spec. Max. 26.33m/s2(0.13s) (5%damping)

Address 20, Gotanda, Yanagawa-Chyo, Date, Fukushima Prefecture







Acknowledgements:
We used data from NIED K-NET.
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<Information>

Seismograph: K-NET02

Recorded Point: FKS003

Name: Fukushima

Observed Time: March 11-14:46:58

Longitude 37.7613N Latitude 140.4799E Altitude 64.00m

Epicentral Distance 215km

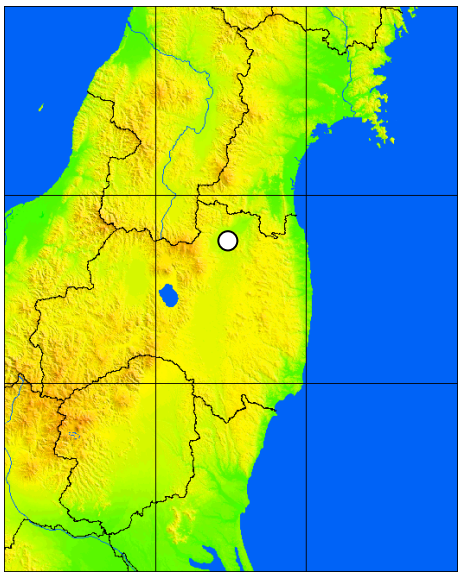
Max. ACC. 329.1gal

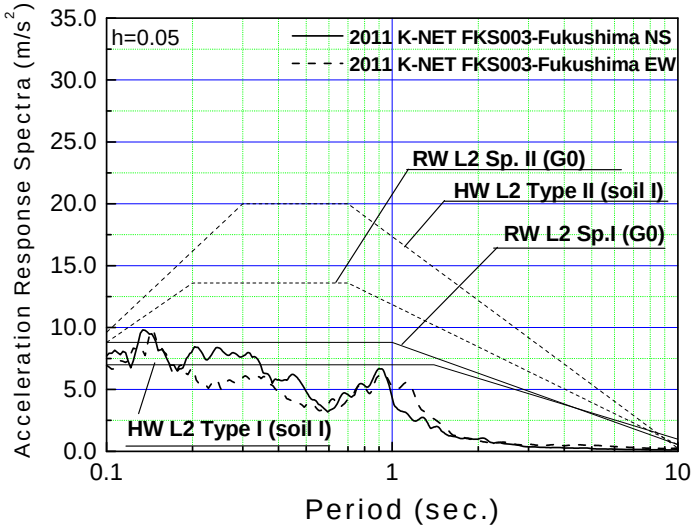
Period of Soil at Site about 0.13s

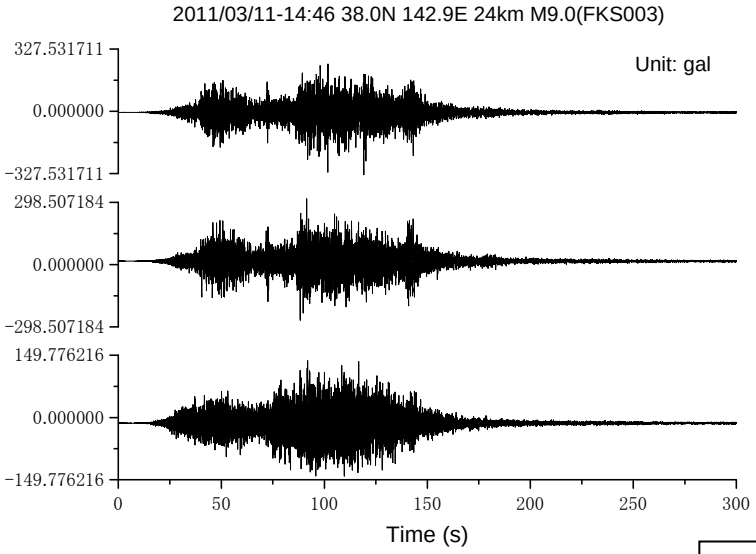
Soil Type(Railway) G0 (Highway) Type I

Acc. Response Spec. Max. 9.82m/s2 (at 0.13s) (5%damping)

Address 5-20, Sakuraghi-Chyo, Fukushima, Fukushima Prefecture







Acknowledgements:
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<Information>

Seismograph: K-NET02

Recorded Point: FKS019

Name: Nihonmatsu

Observed Time: March 11-14:46:57

Longitude 37.6030N Latitude 140.4368E Altitude 235.00m

Epicentral Distance 221km

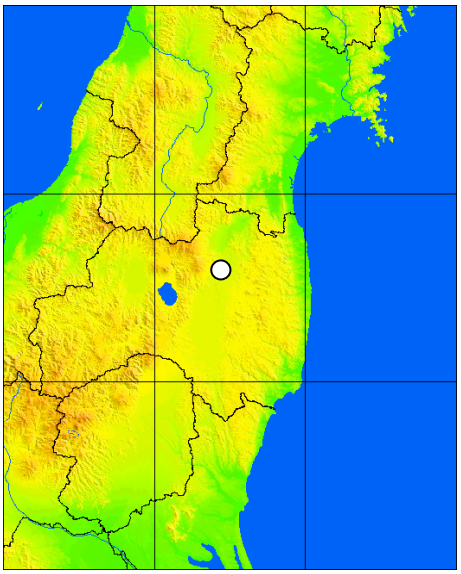
Max. ACC. 461.4gal

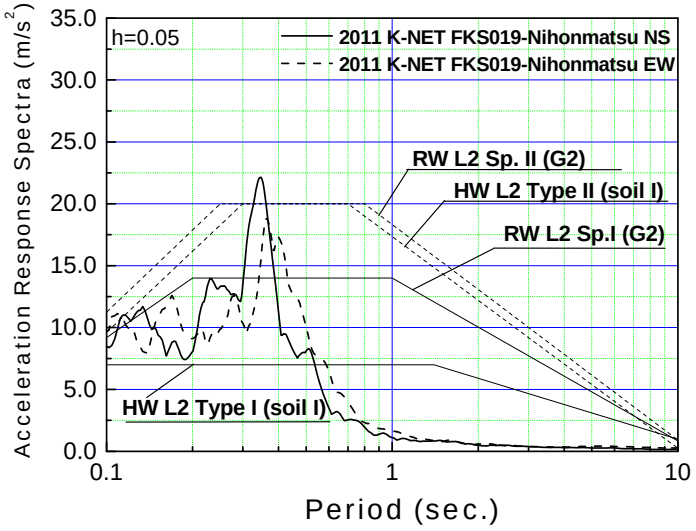
Period of Soil at Site about 0.21s

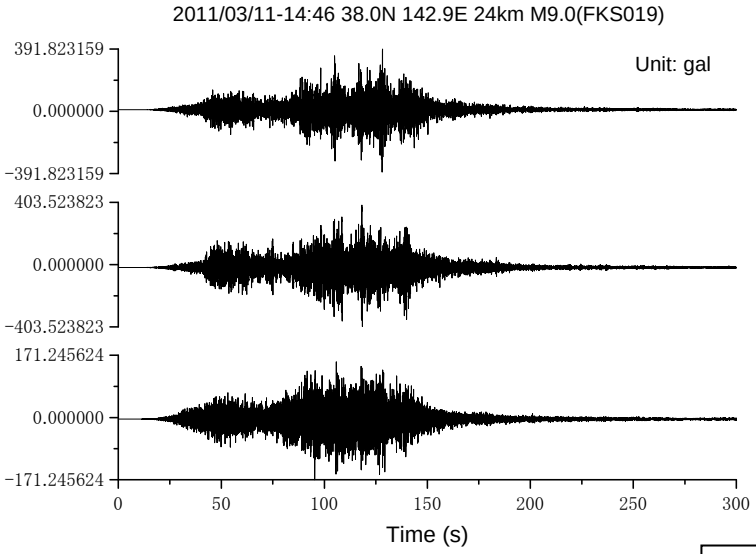
Soil Type(Railway) G2 (Highway) Type I

Acc. Response Spec. Max. 22.12m/s2(at 0.35s) (5%damping)

Address 2-22, Kakunai, Nihonmatsu, Fukushima Prefecture







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Saitama Univ. M. Saitoh

<Information>

Seismograph: K-NET02

Recorded Point: TCG001

Name: Kuroiso

Observed Time: March 11-14:47:10

Longitude 36.9417N Latitude 140.0828E Altitude254.80m

Epicentral Distance 275km

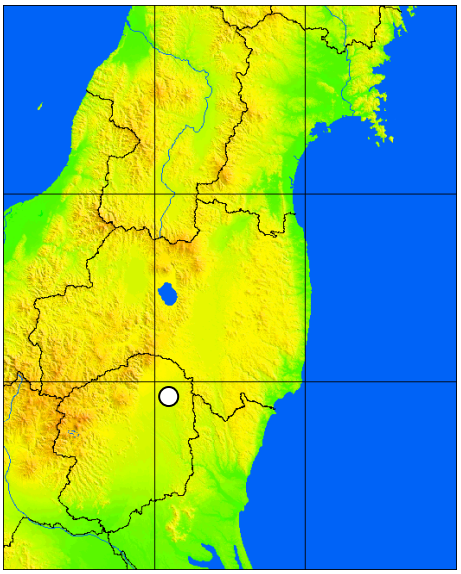
Max. ACC. 485.7gal

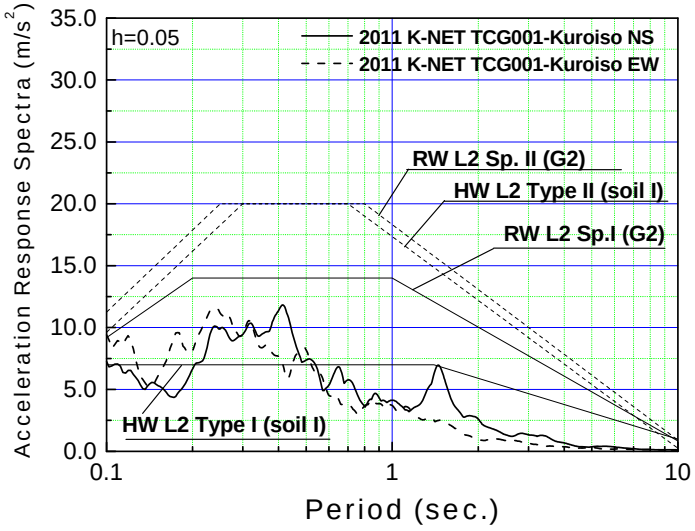
Period of Soil at Site about 0.11s

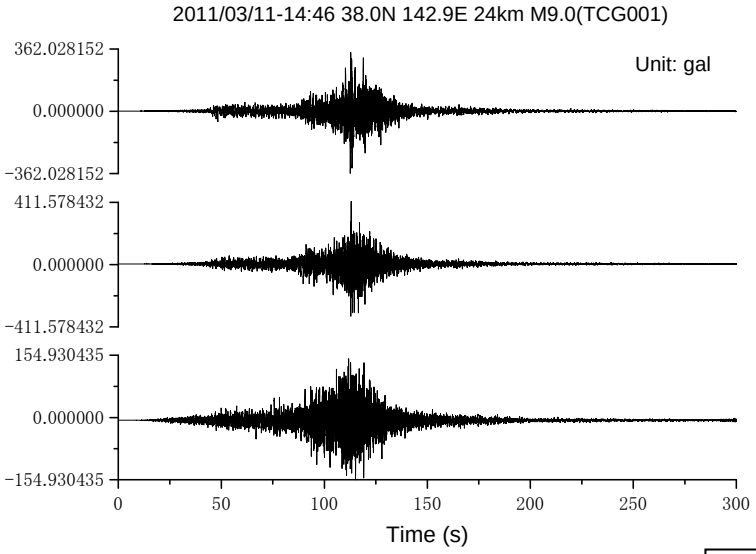
Soil Type(Railway) G2 (Highway) Type I

Acc. Response Spec. Max. 11.84m/s2(at 0.41s) (5%damping)

Address 1477-1, Aza-Nabekakehara, Nabekake, Nasushiobara, Tochighi Prefecture







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Saitama Univ. M. Saitoh

<Information>

Seismograph: K-NET02

Recorded Point: TCG014

Name: Moteghi

Observed Time: March 11-14:47:09

Longitude 36.5450N Latitude 140.1742E Altitude130.00m

Epicentral Distance 291km

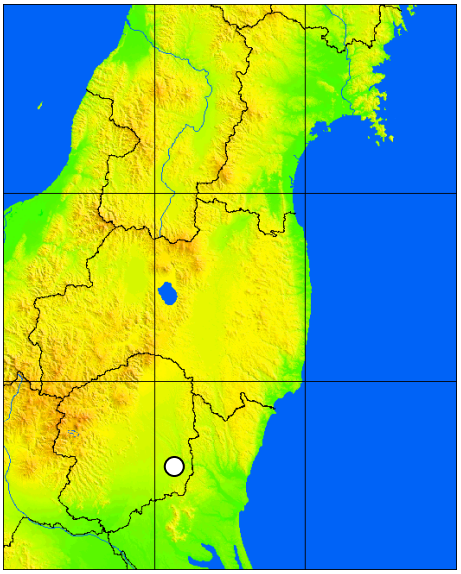
Max. ACC. 1291.1gal

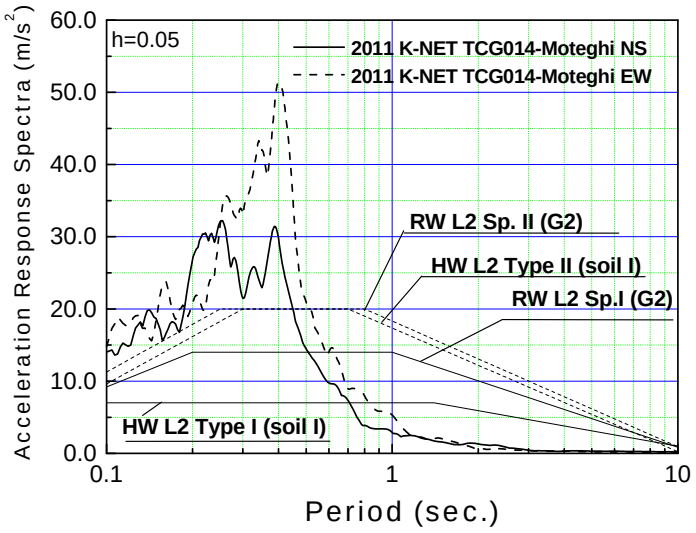
Period of Soil at Site about 0.17s

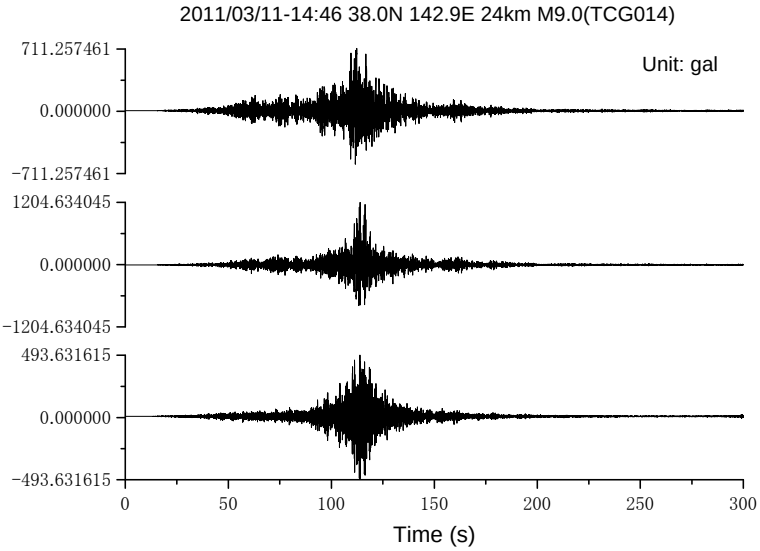
Soil Type(Railway) G2 (Highway) Type I

Acc. Response Spec. Max. 51.37m/s2(at 0.40s) (5%damping)

Address 2758, Aza-Namimatsu, Oaza-Koido, Moteghi-Chyo, Haga-Gun, Tochighi Prefecture







Acknowledgements:
We used data from NIED K-NET.
Saitama Univ. M. Saitoh

<Information>

Seismograph: K-NET02

Recorded Point: IBR003

Name: Hitachi

Observed Time: March 11-14:47:05

Longitude 36.5915N Latitude 140.6453E Altitude57.50m

Epicentral Distance 254km

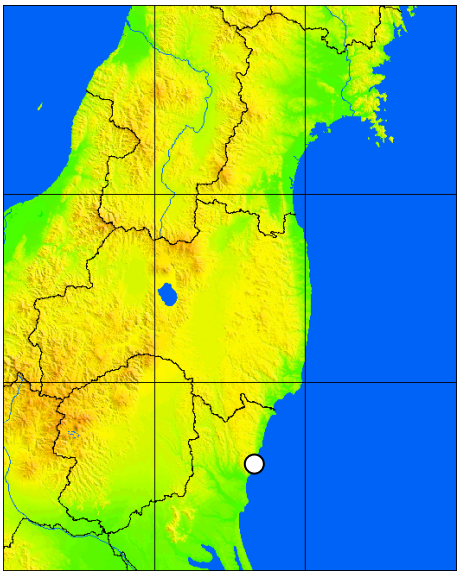
Max. ACC. 1845.2gal

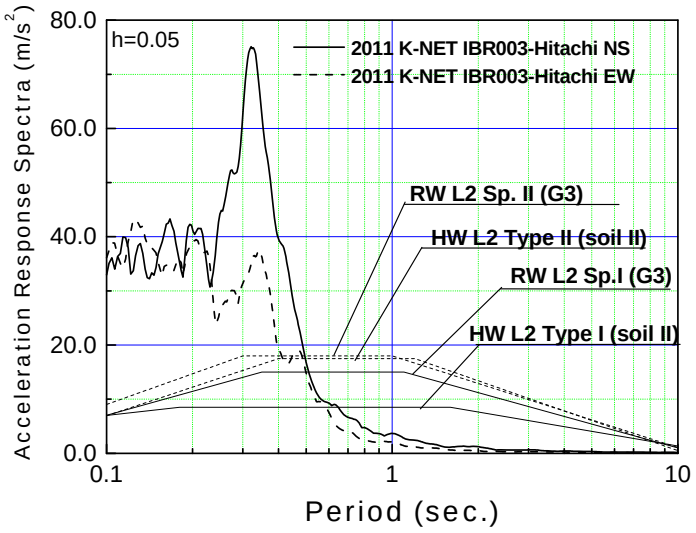
Period of Soil at Site about 0.33s

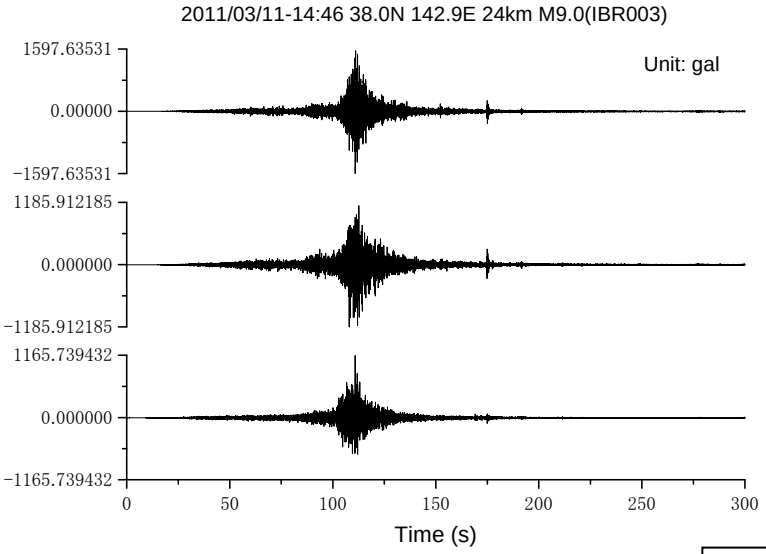
Soil Type(Railway) G3 (Highway) Type II

Acc. Response Spec. Max. 75.09m/s2(at 0.32s) (5%damping)

Address 2-15, Sukegawa-Chyo, Hitachi, Ibaraki Prefecture







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