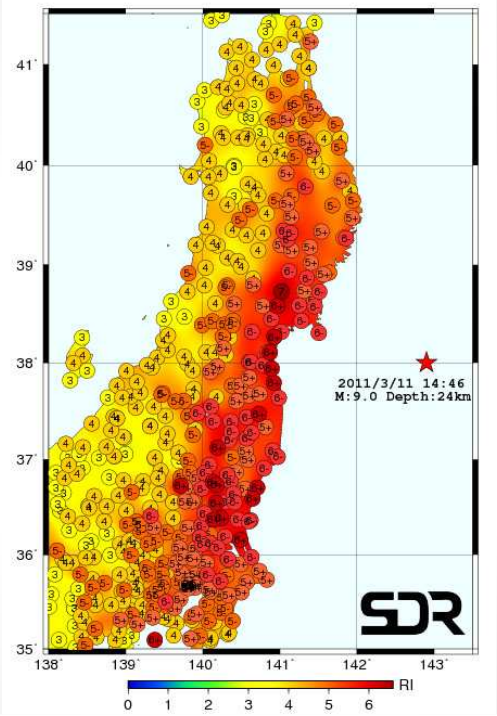
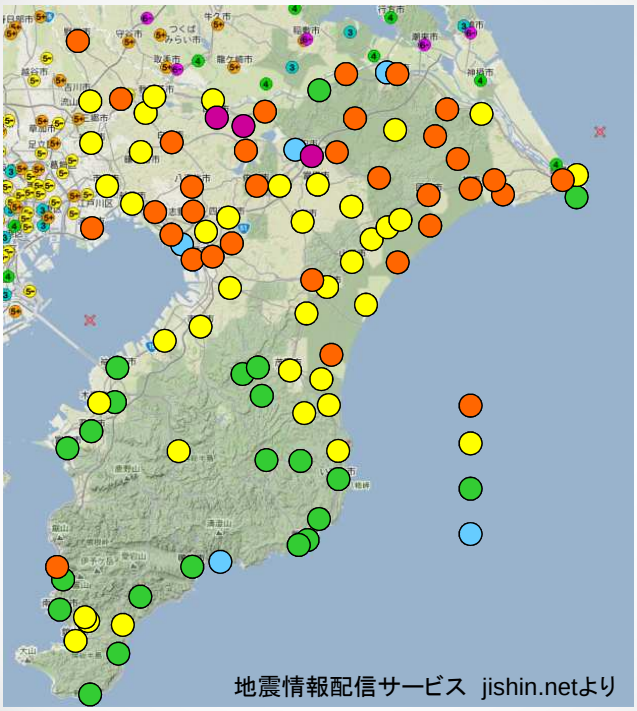
Outline of the Damage in Chiba Area due to The 2011 off the Pacific coast of Tohoku Earthquake

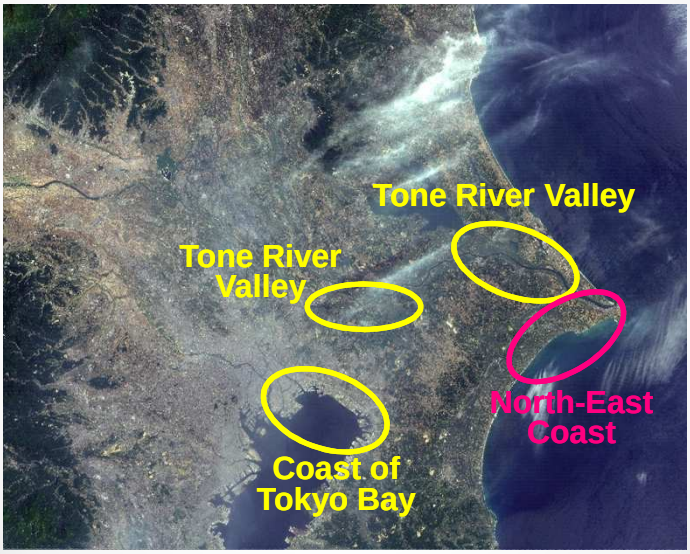
June 28, 2011

Shoichi Nakai, Chiba University





Affected Areas in Chiba Pref.



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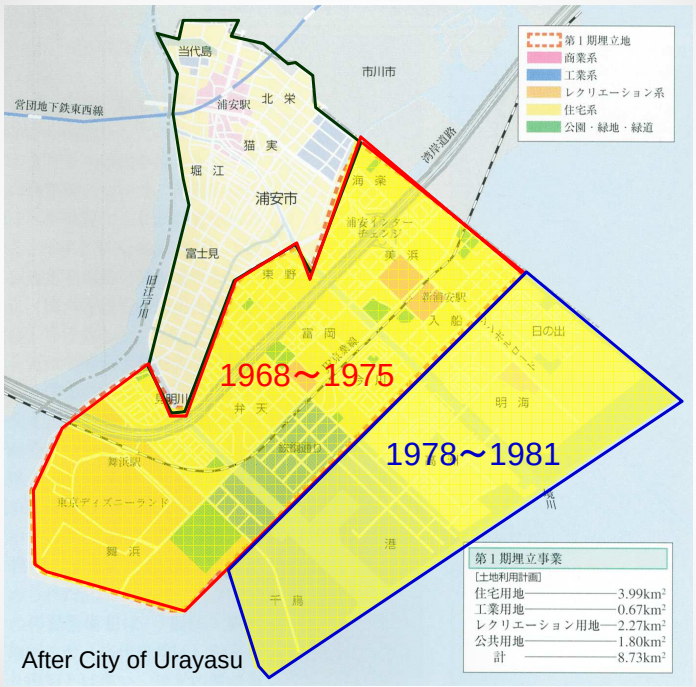
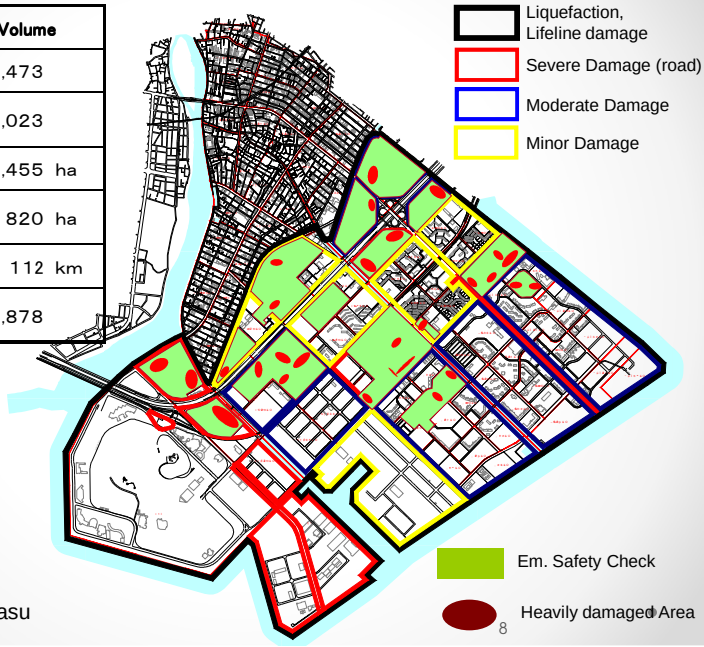


After City of Urayasu

Outline of the Damage in Urayasu City

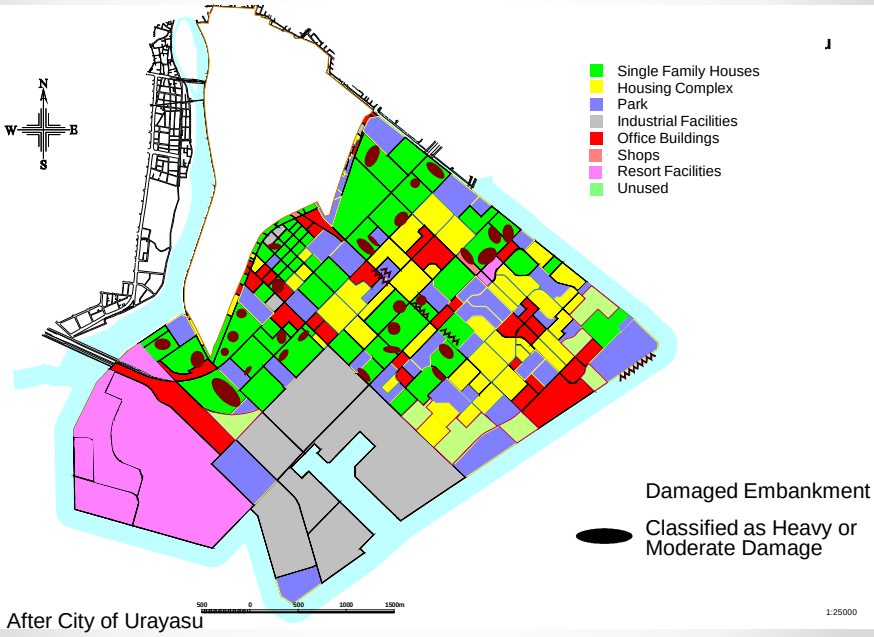
Damage	Volume
No. of Victims	96,473
No. of Suffered Household	37,023
Liquified Area	1,455 ha
Damaged Sewage Systems	820 ha
Damaged Roads	112 km
Emergency Safety Check	8,878



After City of Urayasu

8

Land Use of Affected Area



After City of Urayasu

Damage Details


Irifune District


Irifune District


Maihama District

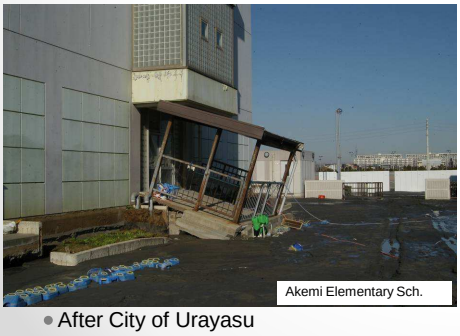

Maihama District

After City of Urayasu

10


Miakegawa Junior High


Takasu District


Akemi Elementary Sch.


Private School

● After City of Urayasu


Maihama District


Central Park


Chidori District


Takasu District

● After City of Urayasu


Hinode District (Embankment)

Takasu Central Park (Water Tank)


Akemi District (Utility Entrance)


Akemi District (Utility Entrance)

- After City of Urayasu


Sakai River Bank


Sakai River Bank


Sakai River Bank


Sakai River Bank

- After City of Urayasu


Hinode Enbankment

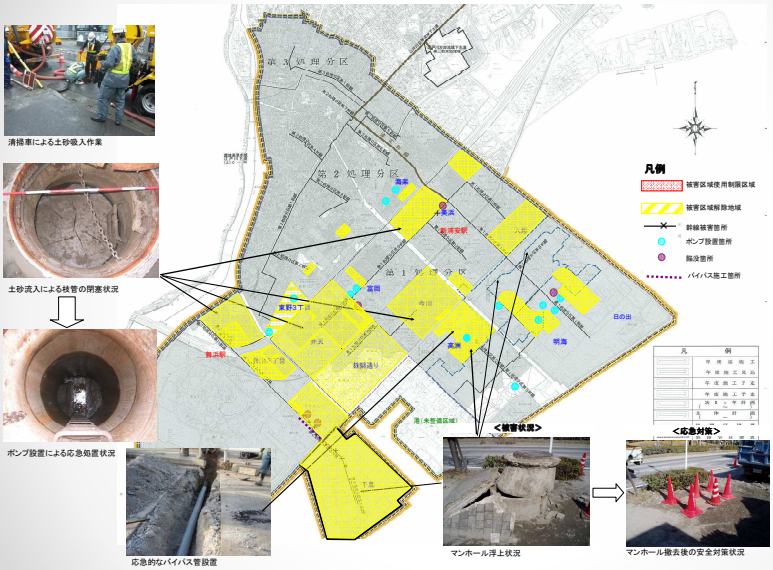

Hinode Enbankment


Hinode Enbankment


Temporary Storage of Sand

- After City of Urayasu

Damage of Sewage System



清掃車による土砂吸入作業

土砂流入による枝管の閉塞状況

ポンプ設置による応急処置状況

応急的なバイパス管設置

マンホール浮上状況

マンホール撤去後の安全対策状況

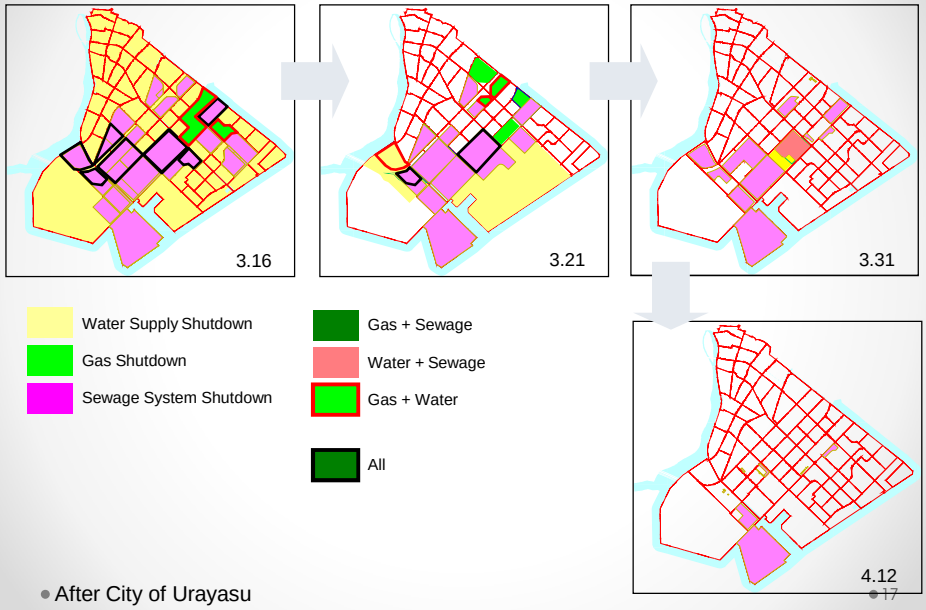

マンホール躯体のずれ


躯体のずれによる道路陥没応急復旧状


道路陥没応急復旧後

- After City of Urayasu

Recovery Process of Lifeline



● After City of Urayasu

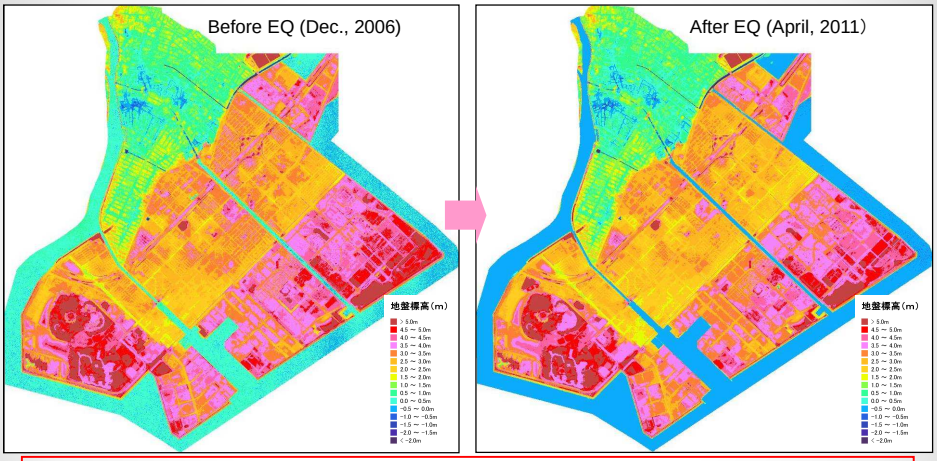
Number of Damaged Houses

	Damage Criteria	
	Previous Std	New Standard
Total Collapse	8	14
Near Collapse	0	1,419
Half Collapse	33	1,939
Partial Collapse	7,930	5,153
No Damage	1,028	1,270
合　計	8,999	9,795

● After City of Urayasu

Change of Elevation before and after the Quake

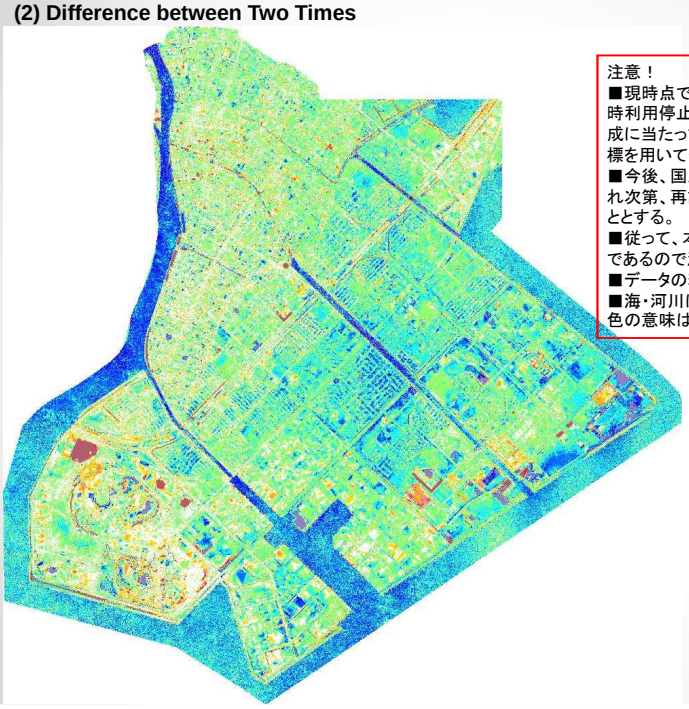
(1) Comparison between Two Times



注意！
■現時点で国土地理院が基準点成果を一時利用停止していることから、本図面の作成に当たっては、震災前の基準点位置座標を用いて作成している。
■今後、国土地理院から新座標が公開され次第、再計算を行い改めて作成を行うこととする。
■従って、本図面については、暫定のものであるので注意をすること。
■データの精度は±15cm
■海・河川は計測外となっているので特に色の意味はない。

After City of Urayasu

(2) Difference between Two Times



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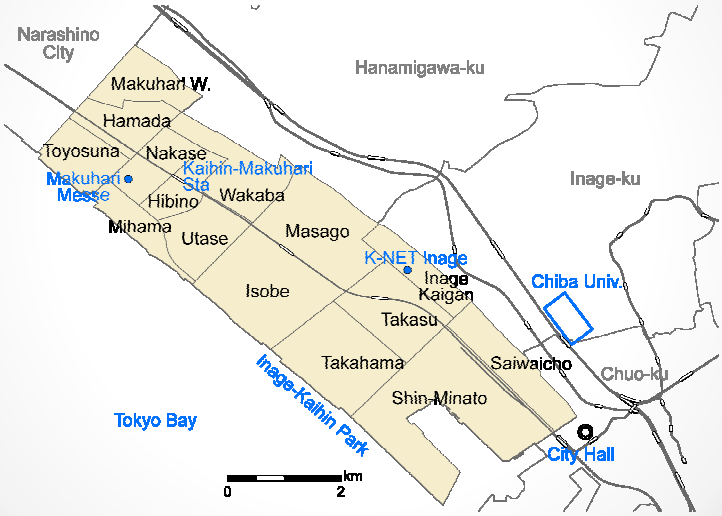
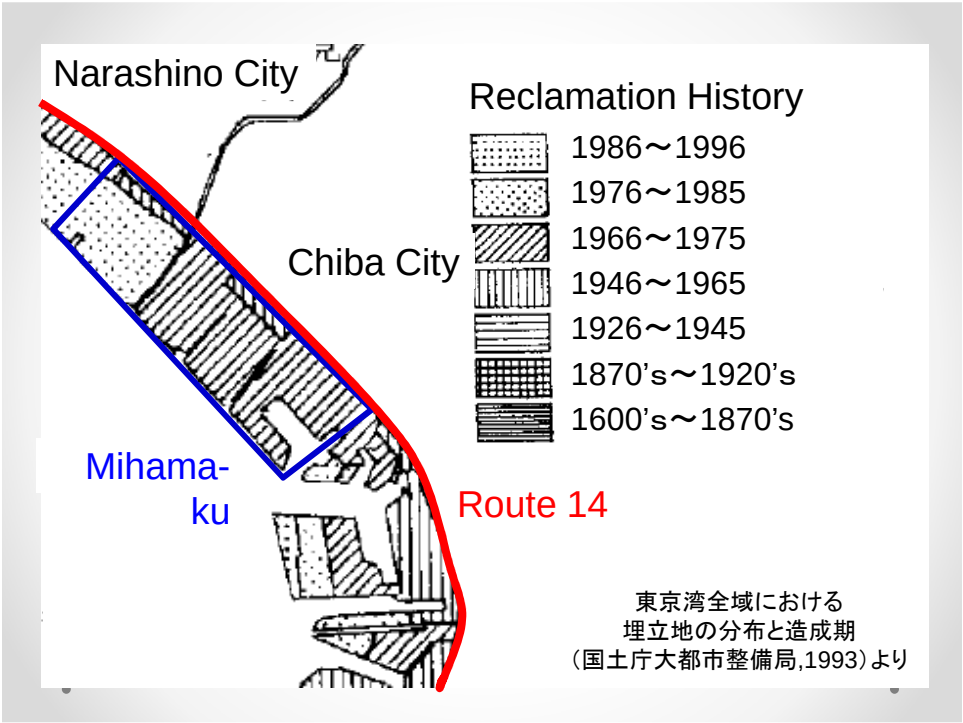
変化量（m）
- ＞0.9
- 0.7 ～ 0.9
- 0.5 ～ 0.7
- 0.3 ～ 0.5
- 0.1 ～ 0.3
- −0.1 ～ 0.1
- −0.3 ～ −0.1
- −0.5 ～ −0.3
- −0.7 ～ −0.5
- −0.9 ～ −0.7
- ＜−0.9

After City of Urayasu

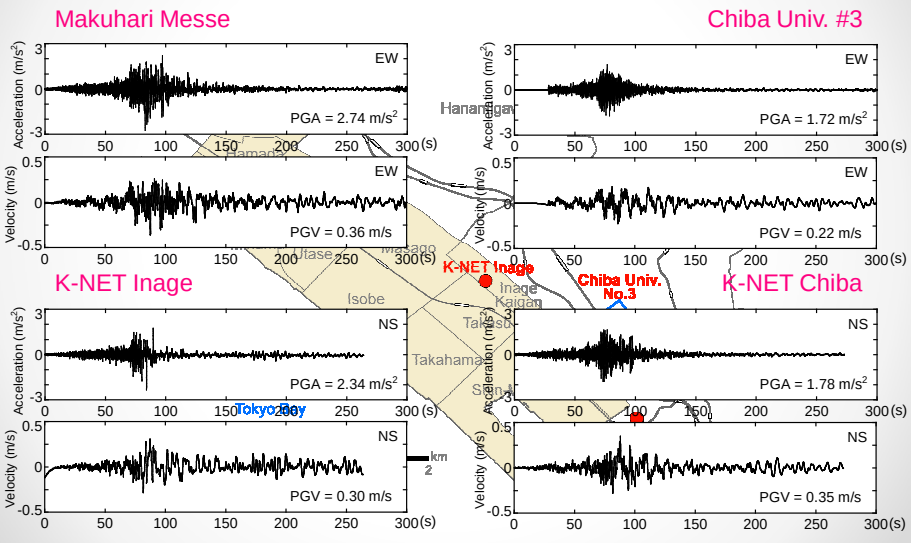
Affected Areas in Chiba Pref.

Mihama-ku of Chiba City

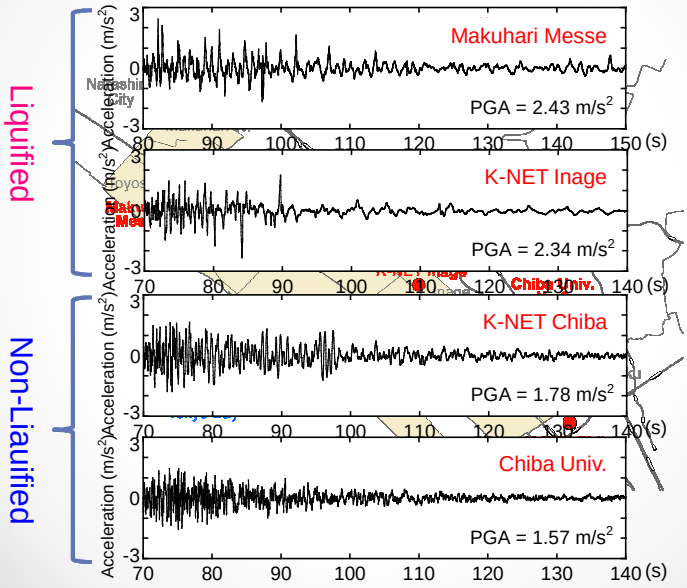




Recorded Ground Motions



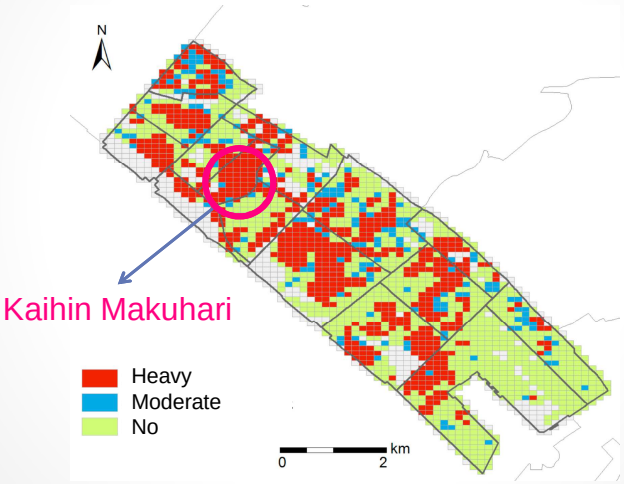
Recorded Ground Motions (Liq.)



Summary of Ground Motions

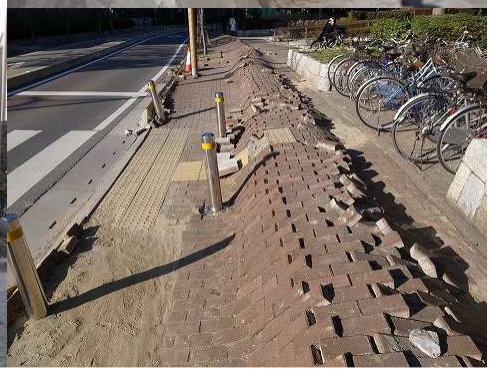
Sites		PGA (cm/s/s)			PGV (cm/s)		
		NS	EW	UD	NS	EW	UD
C08	K-NET Urayasu	125.1	157.5	75.2	28.4	27.5	11.6
C09	K-NET Chiba	178.7	139.7	77.1	35.0	22.1	10.7
C24	K-NET Inage	234.4	202.5	85.6	30.7	31.5	14.0
kor	Upland (Inage)	185.0	202.5	139.2	24.9	22.1	13.9
Low	Lowland (Inage)	203.5	246.3	175.6	40.0	49.2	21.0
MAK	Makuhari Messe	244.0	274.1	128.0	29.4	36.1	12.2
mam	Inage-dai	188.2	206.4	147.0	24.3	21.5	12.6
nis	Slope shoulder	480.5	343.6	203.3	29.8	23.5	14.6
No3	Chiba Univ. No.3	157.6	172.1	90.7	22.8	22.6	11.1
No4	Chiba Univ. No.4	149.2	148.5	108.2	26.1	23.0	11.0
TDA	TEPCO Anesaki	83.5	74.5	53.6	19.4	21.2	9.7

Liquefaction (Sand Boiling)



Near Kaihin-Makuhari station

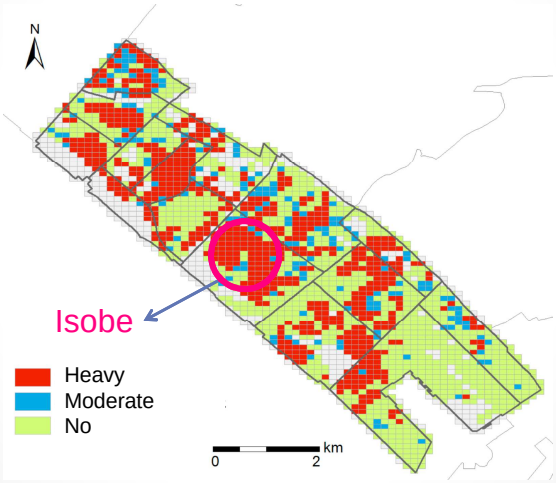
Heavy sand boiling and ground deformation along the sidewalk were observed.



http://www.youtube.com/watch?v=70zIypNs098

http://www.youtube.com/watch?v=9x_kS3Bm6fA

Liquefaction (Sand Boiling)



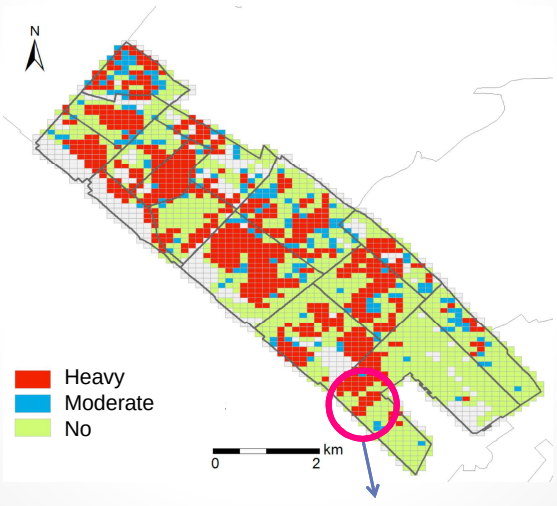
Isobe district

Inside the residential area, a wide-spread sand boiling was observed.

Isobe district

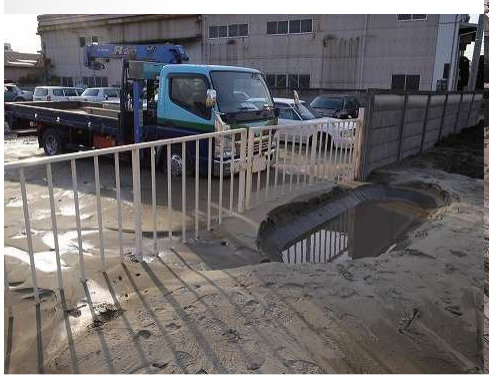
Several houses were tilted due to liquefaction.

Liquefaction (Sand Boiling)



Shinminato district

In an industrial area, a large amount of sands were blown off from the gap of the road surface.



Shin-Minato

The utility pole settled about 1 m.

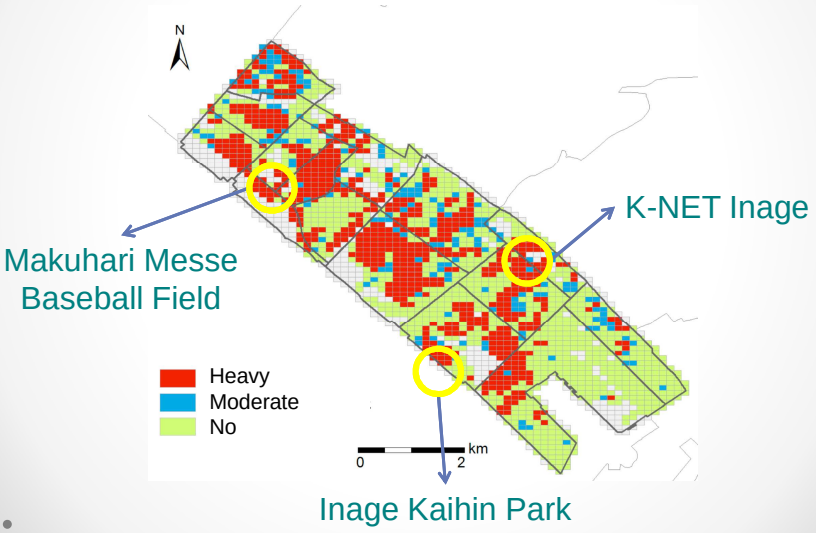
Shin-Minato

Settlement of nearby ground

Shin-Minato

Settlement of nearby ground

Liquefaction (Sand Boiling)



Makuhari Messe (Convention center)

Strong motions were recorded near the event hall.

QVC Marine Field (Baseball field)

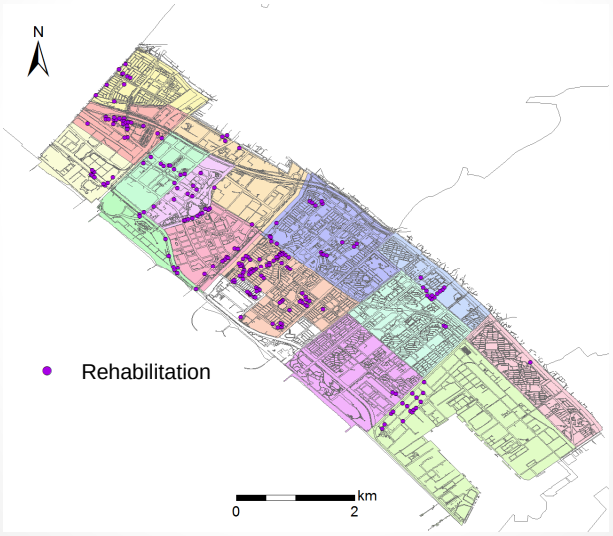
The facility underwent restoration work until April 12, the opening day of the professional baseball game.

K-NET Inage (Strong motion station)

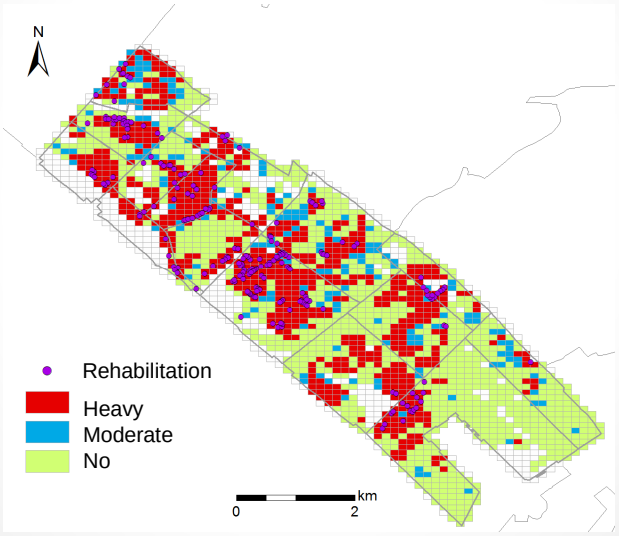
Heavy sand boiling and several tilted utility poles were found around the strong motion station.

Inage Kaihin Park

Damaged Road (Emergency Rehabilitation)

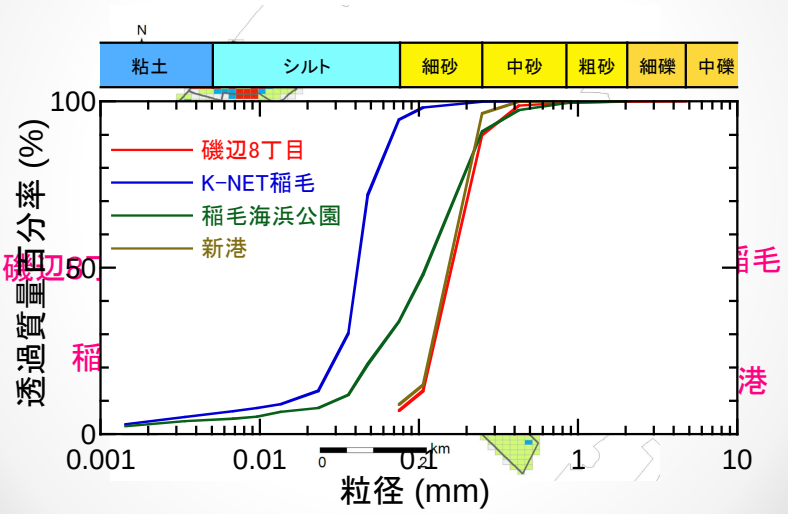


Damaged Road (Emergency Rehabilitation)

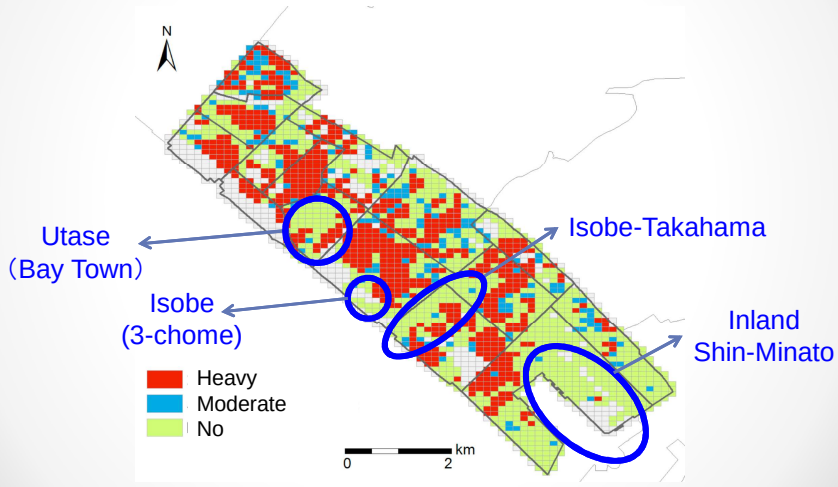


Preliminary Study

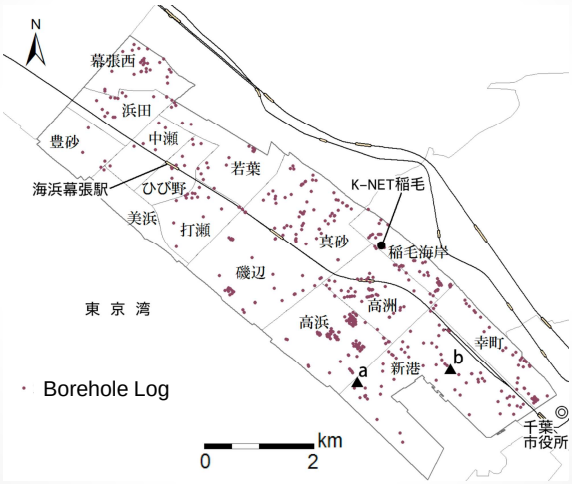
Grain Size Distribution of Boiling Sand

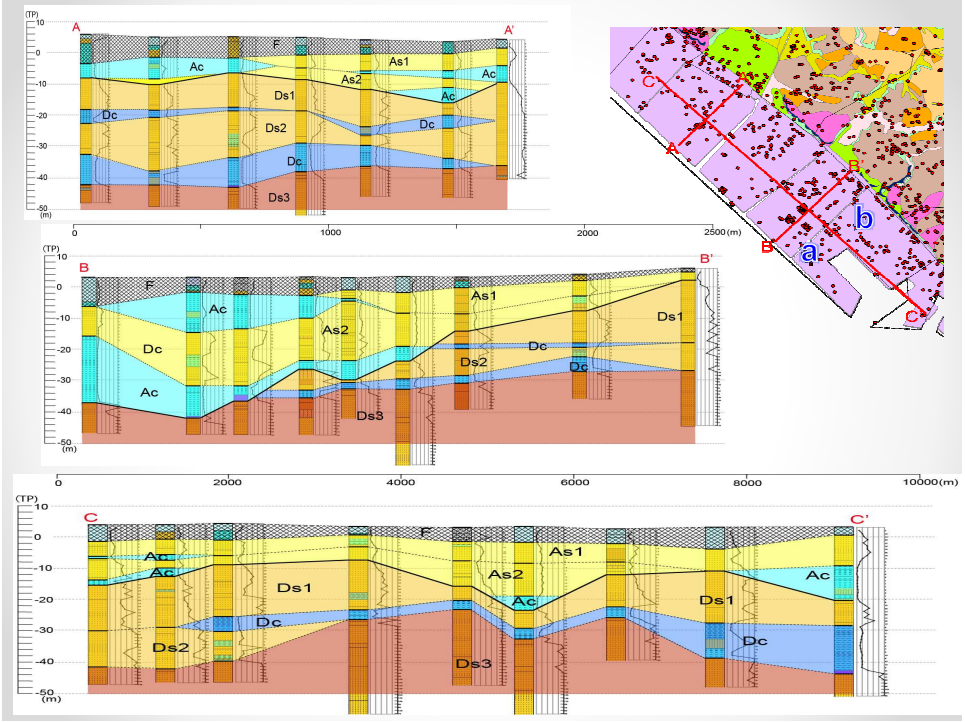


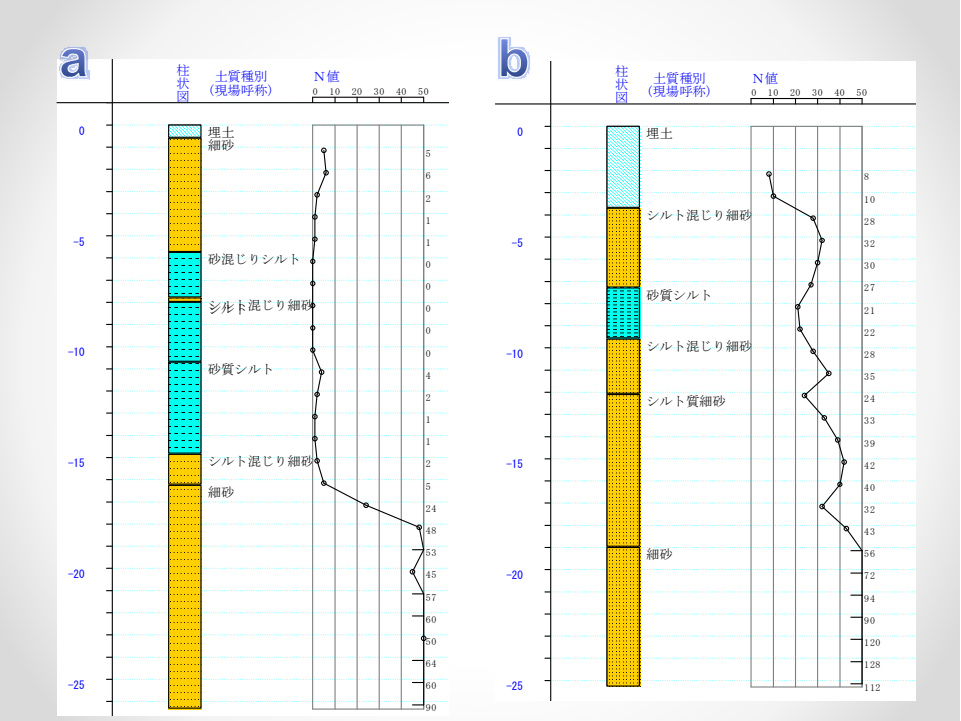
Non-Liquified Areas



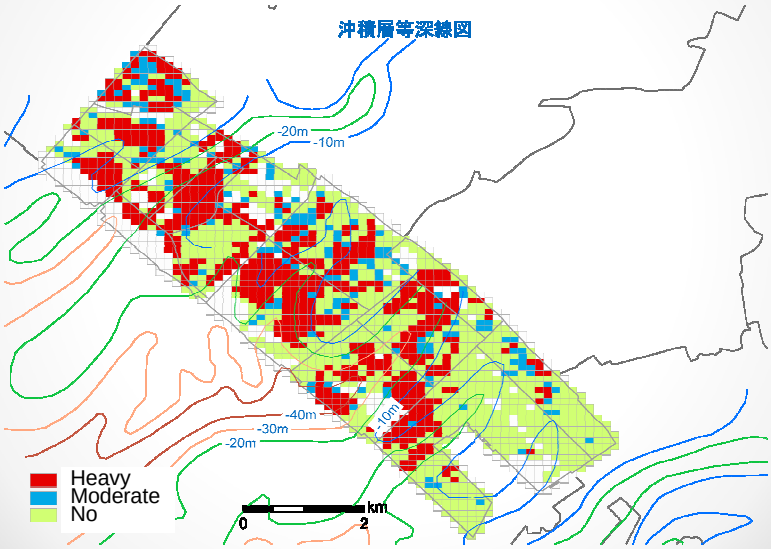
Soil Profile and Liquified Area



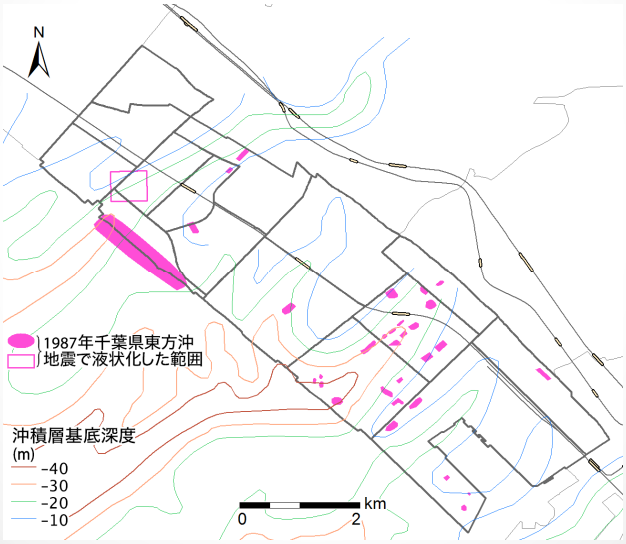




Depth of Alluvium and Lq. Area



Liquefaction in Prev. EQ



Summary

- In Chiba area located east of Tokyo, it was observed that
  - Liquefaction occurred extensively, especially in the reclaimed ground along the sea and along the river.
  - A large number of houses were damaged (tilted) due to liquefaction.
  - Lifelines were shutdown and roads were closed due to liquefaction.