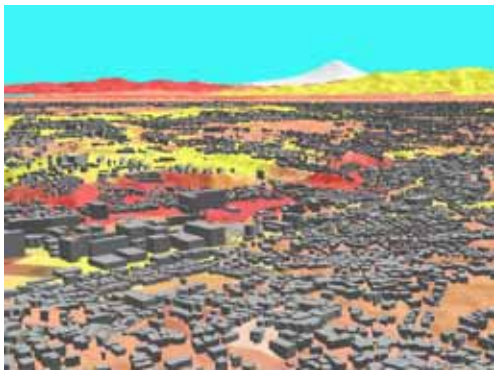
3D Seismic Hazard and Risk Maps for Earthquake Awareness of Citizens with Aids of GIS and Remote Sensing Technologies



Saburoh Midorikawa
Tokyo Institute of Technology

Tokyo Tech CUEE

In Japan, seismic hazard and risk maps have been published by central and local governments.

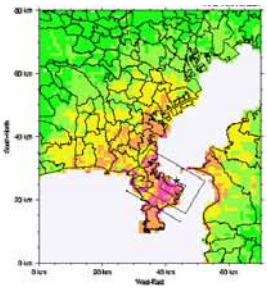
The objectives of the mapping are
for planning of earthquake mitigation programs,
for earthquake–resistant design, and
for earthquake awareness of citizens.

One of the mapping projects is the National Seismic Hazard Mapping Project of Japan by the Headquarters for Earthquake Research Promotion.

The regional mapping projects by local governments are also carried out to publish the detailed maps for citizens.

National Seismic Hazard Mapping Project

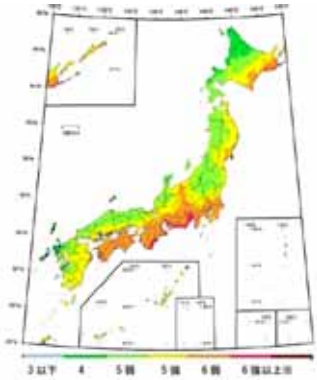
- The project started in 1999 and the maps have been published on March, 2005.



- The maps consist of

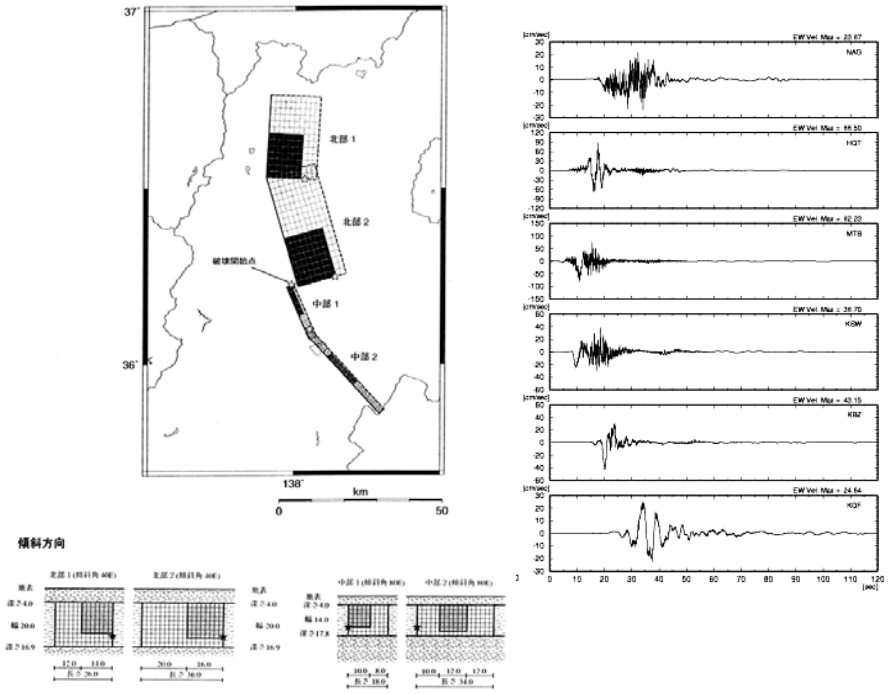
1) Deterministic Ground Shaking Map
(Scenario Earthquake Ground Shaking Map)

2) Probabilistic Ground Shaking Map
(Probabilistic Seismic Hazard Map)



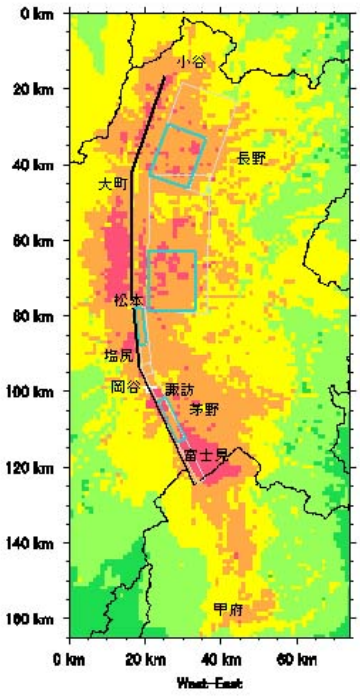
Scenario Earthquake Ground Shaking Map

The source model is established for a scenario earthquake, considering asperities with larger slip and higher stress drop on the fault plane. The time history of ground motion is computed, and then converted to the seismic intensity.



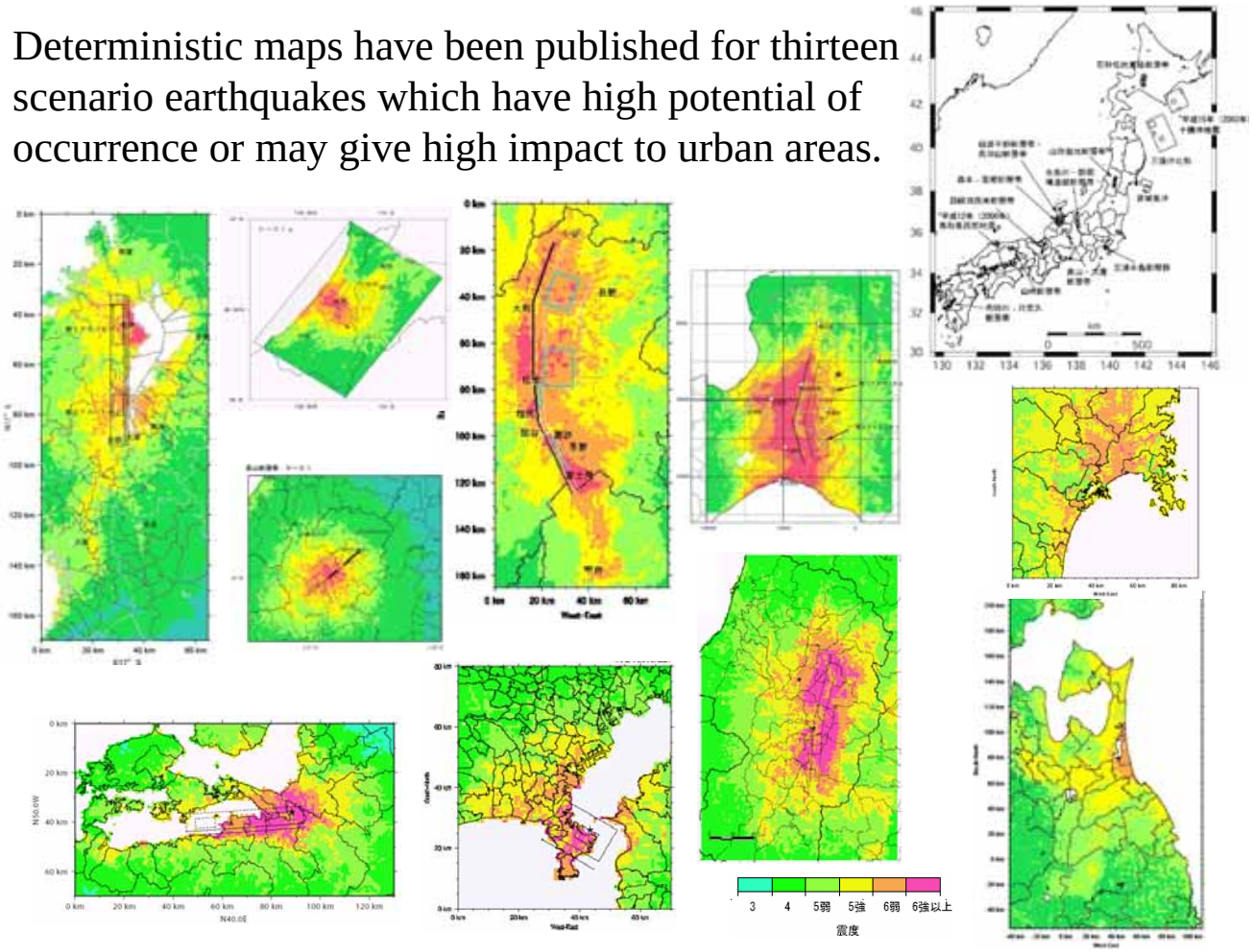
Asperity Source Model

Time History

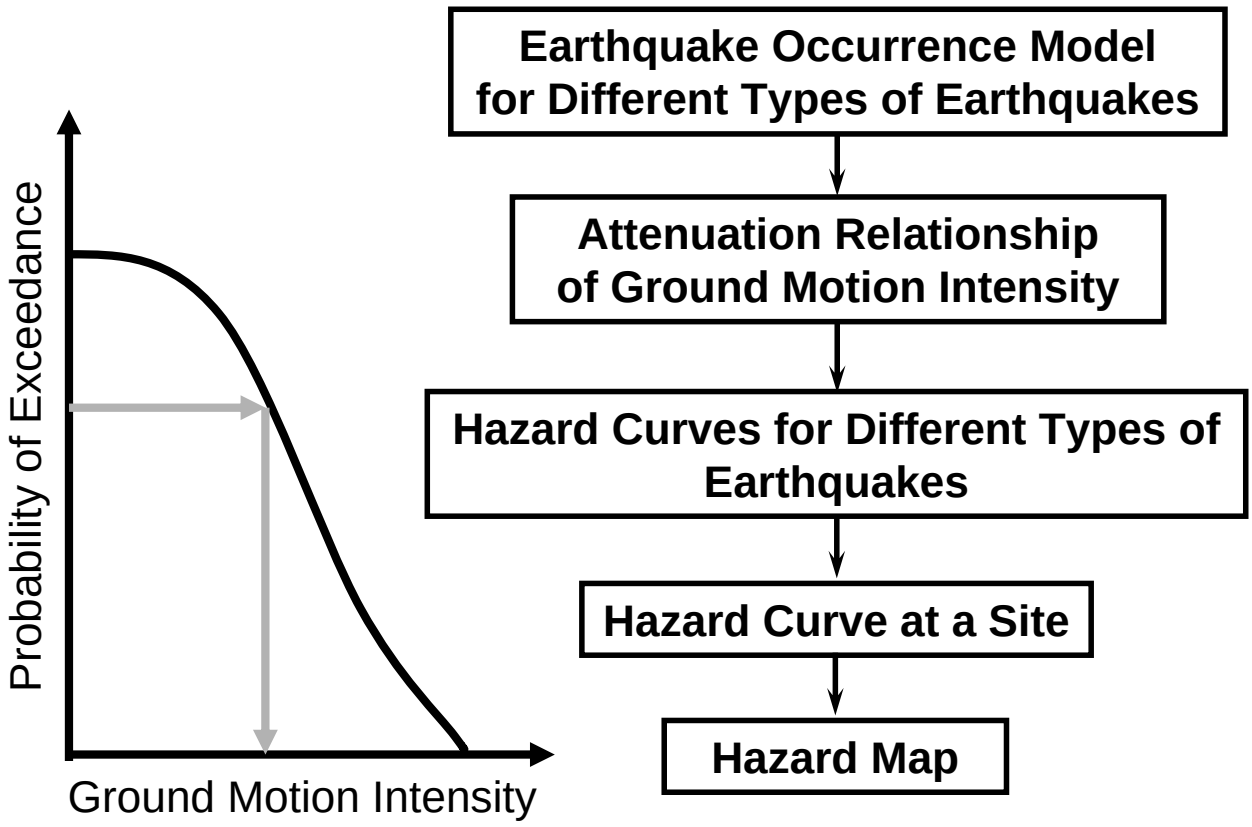


Seismic Intensity Map

Deterministic maps have been published for thirteen scenario earthquakes which have high potential of occurrence or may give high impact to urban areas.



Probabilistic Seismic Hazard Map



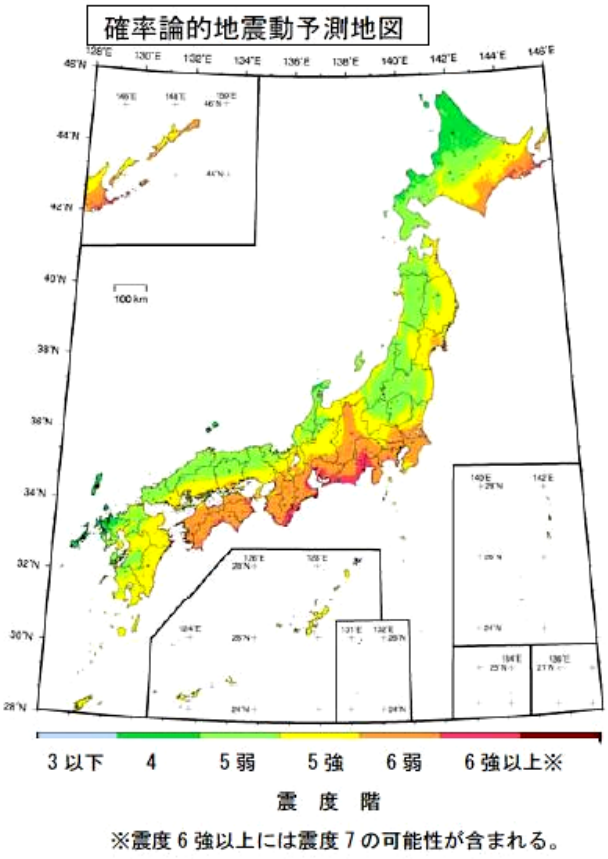
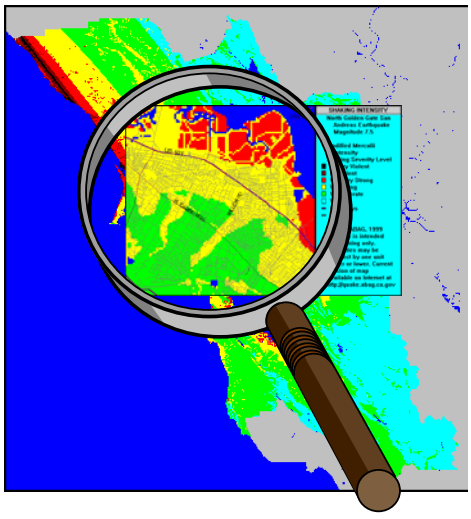


図 3. 3. 1-4 (b)　今後 50 年以内に 10%の確率で一定の震度以上の揺れに見舞われる領域



When a citizen look the seismic hazard map, he thinks that;

1) Is my house in the red zone ?

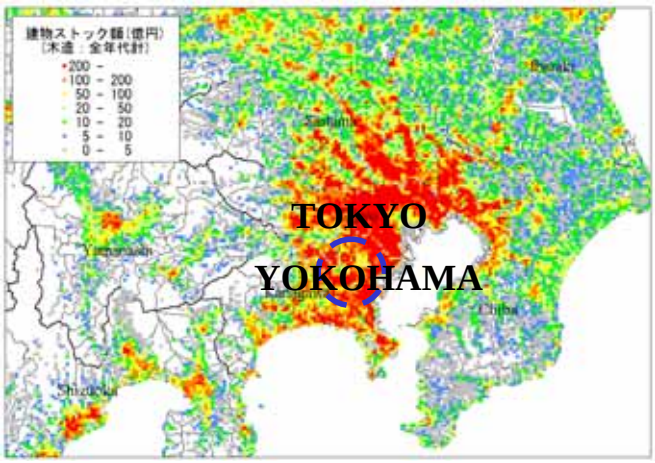
2) If my house is in the red zone, what should I do ?

(after Olshansky, 2000)

The national seismic hazard maps are too large in scale, and difficult to catch citizen's strong interest.

BASIC MAP
National Seismic Hazard Map
↓
ADVANCED MAP
Yokohama Shake Map Project 2001

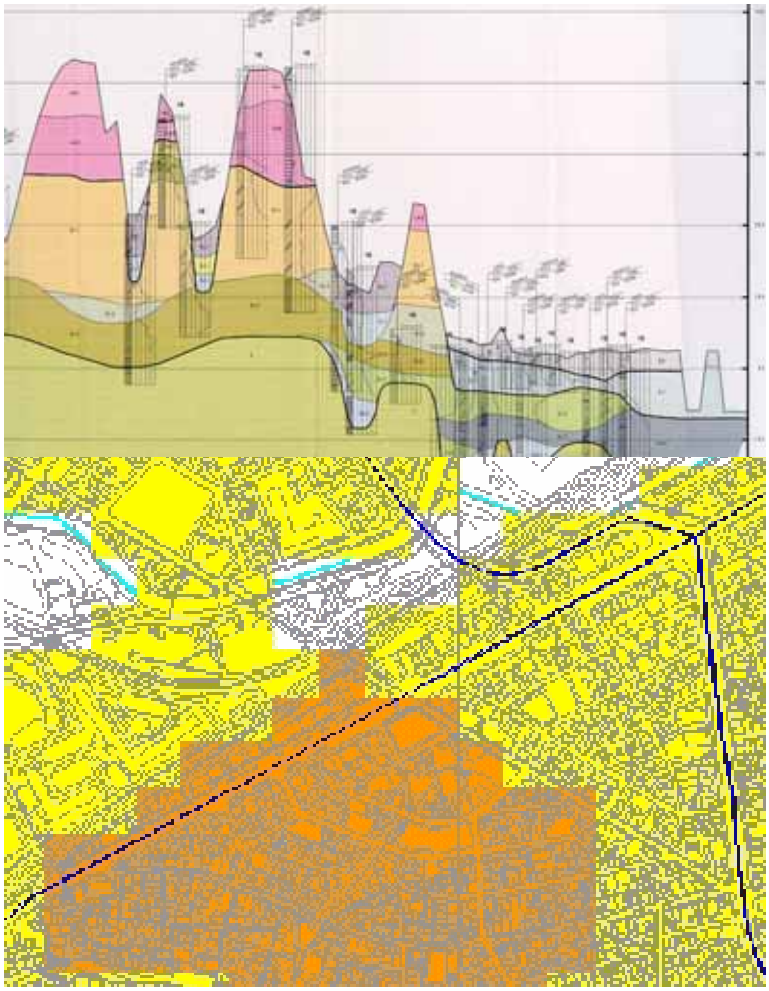
Yokohama City Population 3,500,000



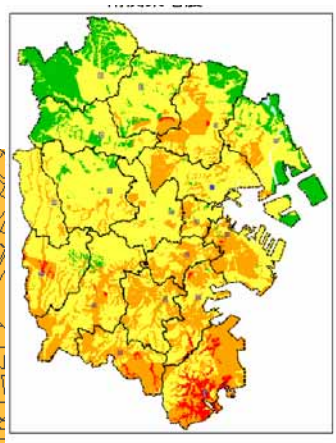
Collection and Compilation of Boring Data (more than 15,000 data)

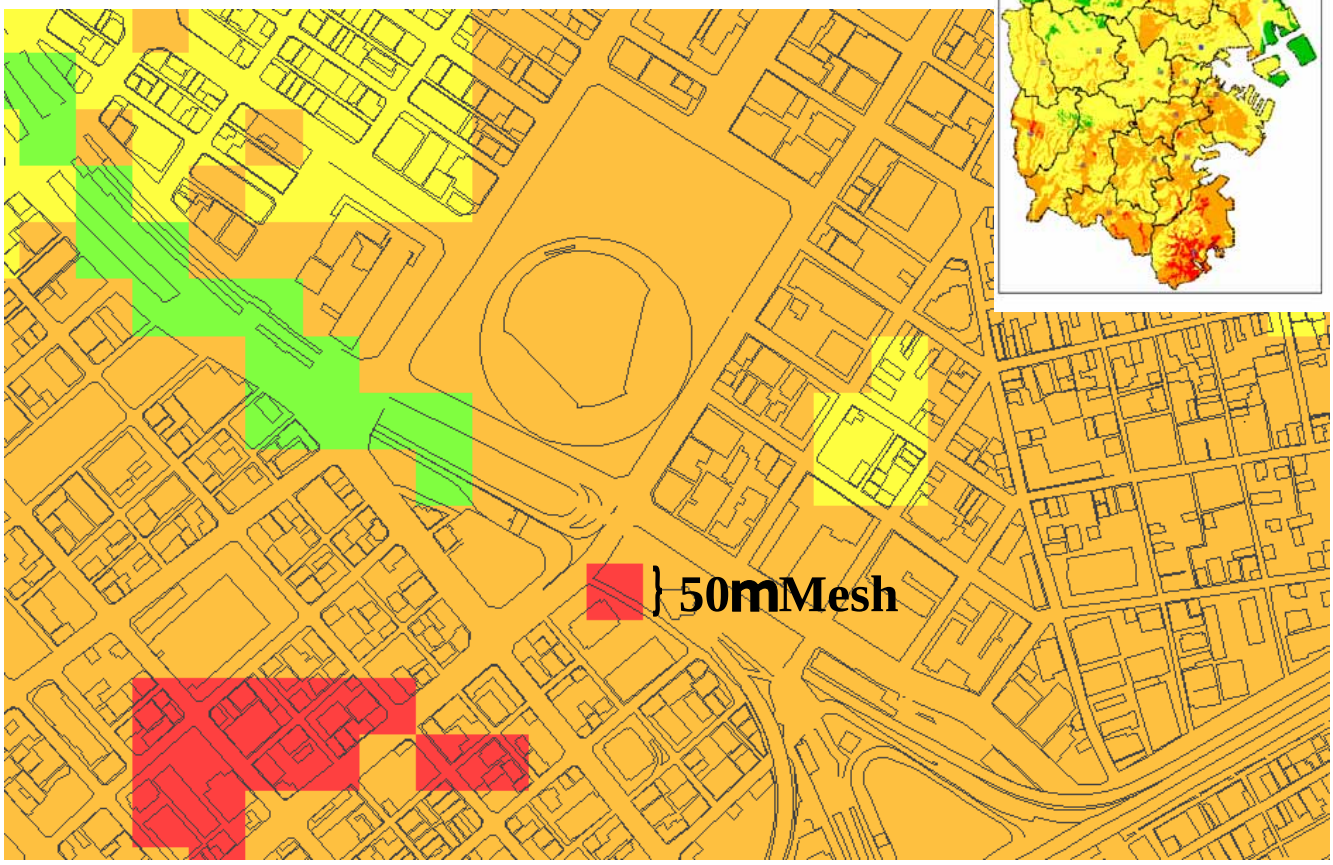
Construction of Soil Profile Model for 50m Micro-Mesh

Shake Map with 50m Micro-Mesh



Close-up of Shake Map





INCENTIVE POLICIES OF YOKOHAMA FOR SEISMIC RETROFIT

1. FREE SEISMIC PERFORMANCE APPRAISAL FOR OLDER WOODEN HOUSES

2. SEISMIC RETROFIT SUBSIDIES
(up to ¥1,700,000 for average income household and ¥4,500,000 for low-income household)

EFFCTS OF SHAKE MAP

- Seismic Performance Appraisal

  Before 1,000 applicants per year,

  After 2,000 applicants per year.

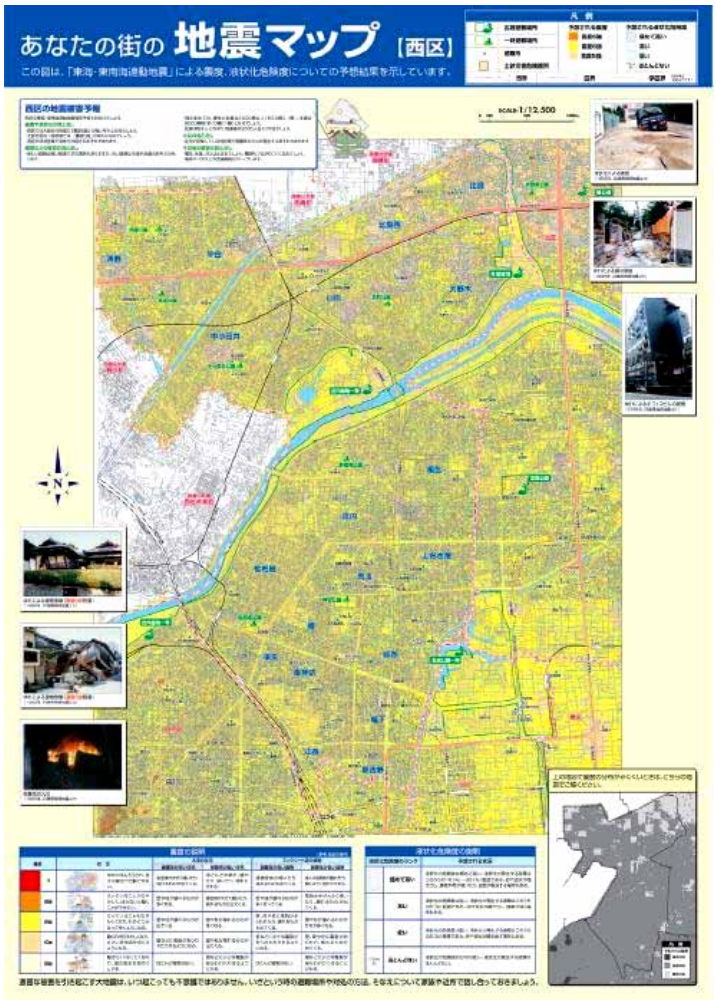
- Seismic Retrofit Subsidies

  Before 70 applicants per year,

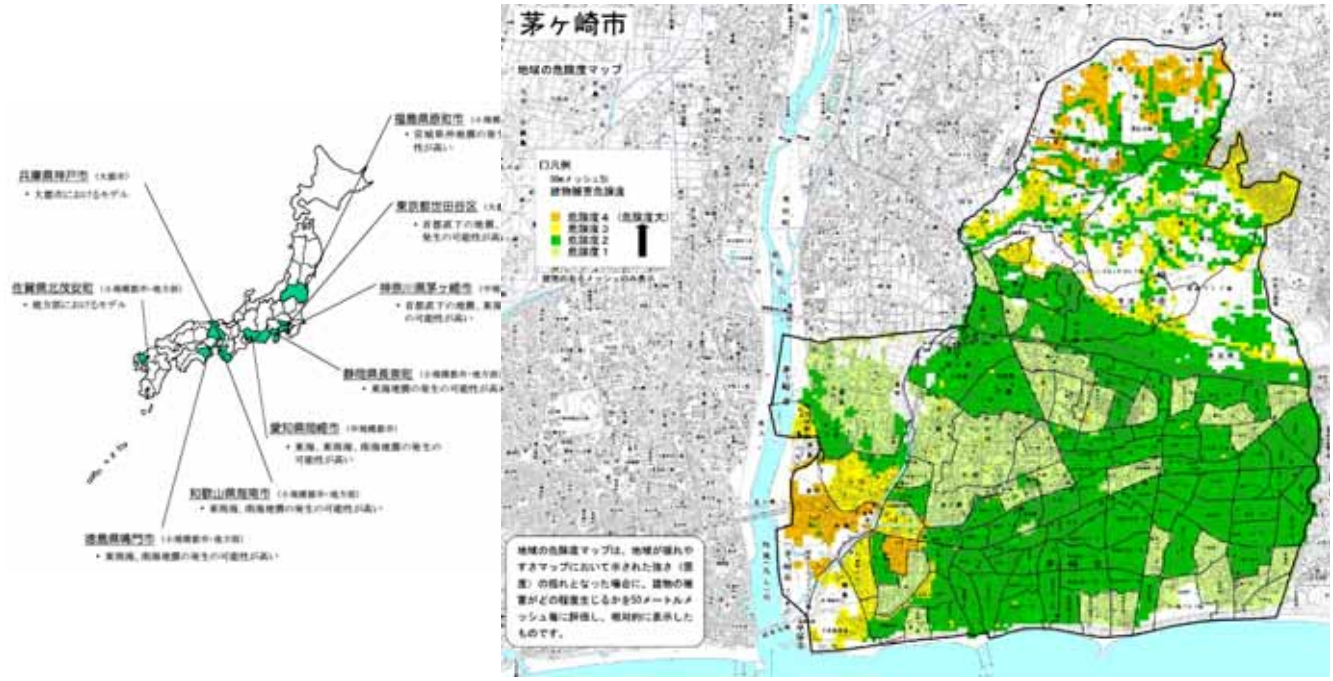
  After 150 applicant per year.

Success of the Yokohama map stimulated the other governments.

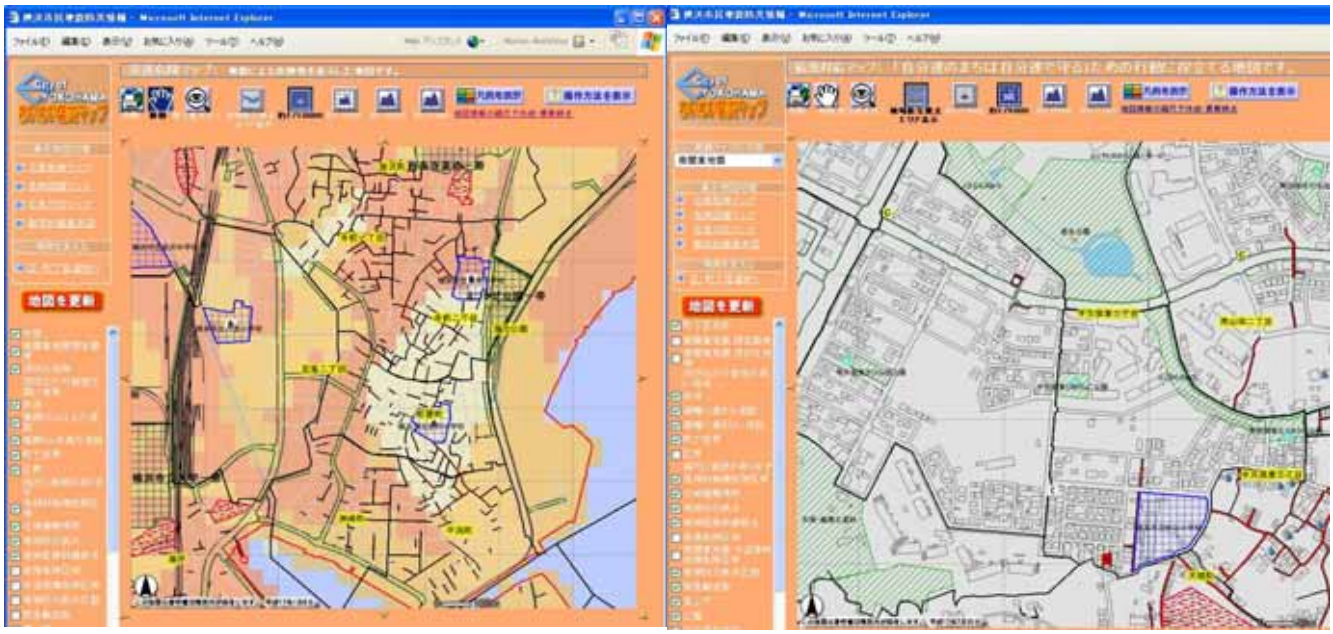
On August 2004, the city of Nagoya published “Seismic Hazard Town Map” and distributed to all households in the city.



The department of disaster management at the Cabinet Office has also published the detailed maps for nine municipalities as the case studies on January 2005.

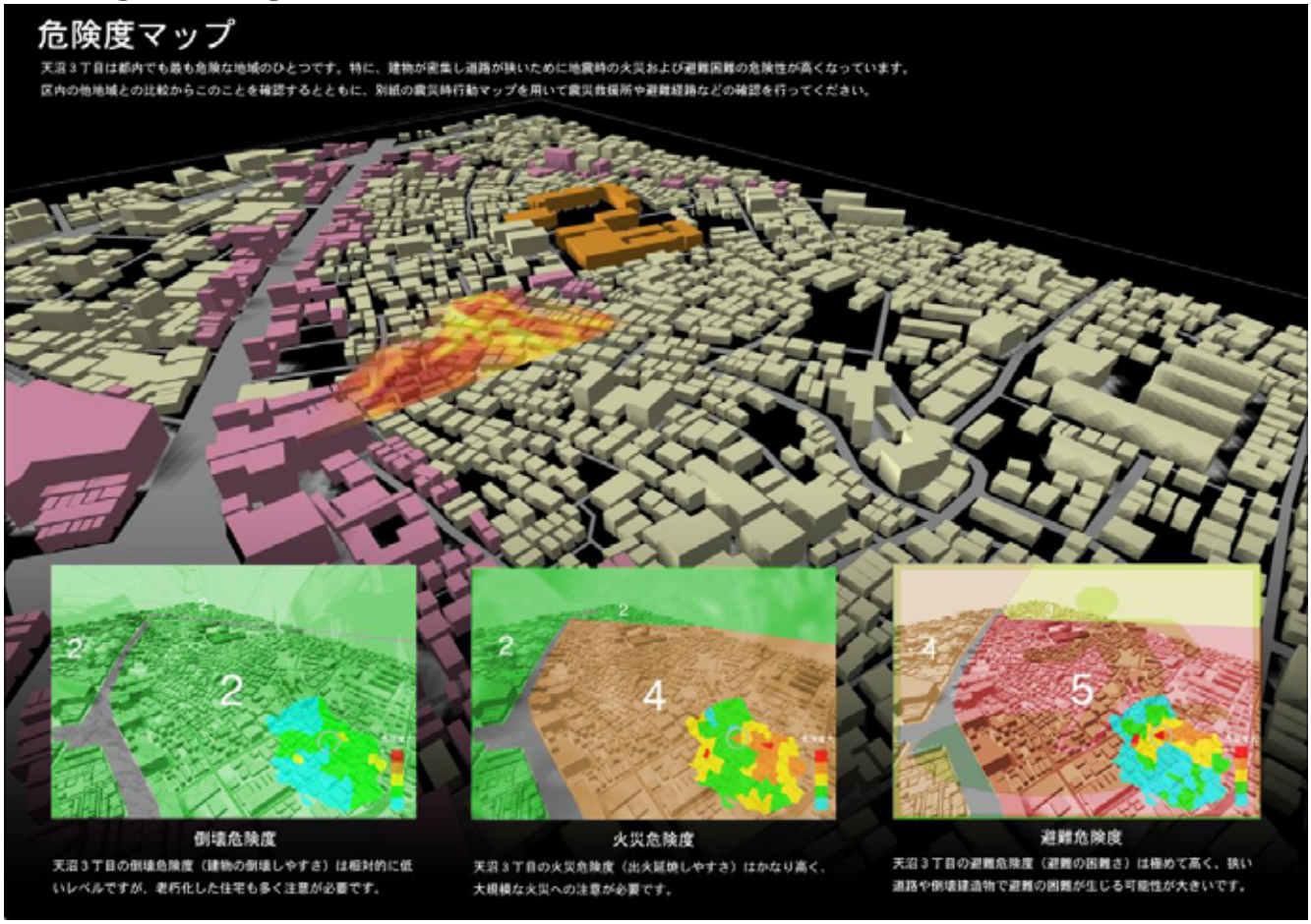


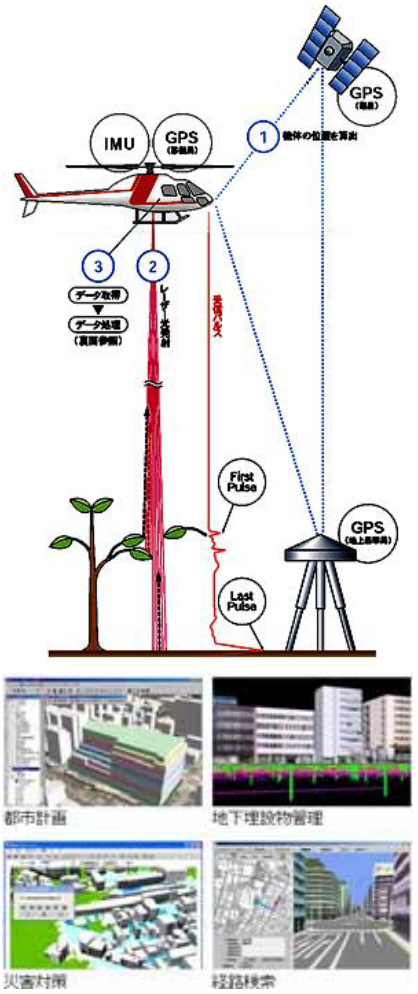
Web-GIS Yokohama Hazard & Risk Maps (January, 2005)



They print the map, and walk around our region to check their environments.
They write in hazardous points and safety facilities in the map, and paste their photos on the map to create their own disaster preparedness map.

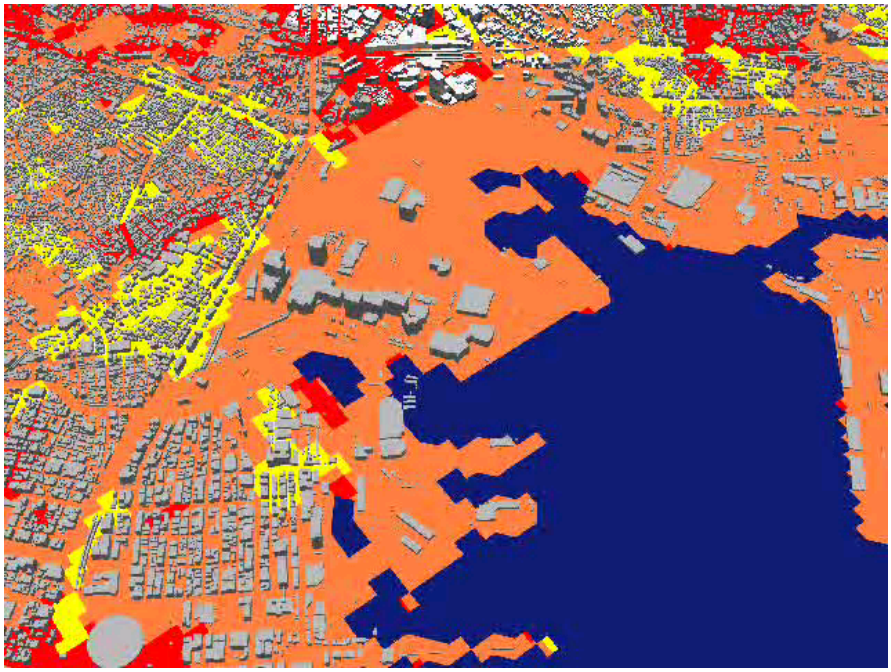
To get stronger interest of citizens, 3D Presentation will be effective.





Digital City with DEM by Laser Profiler and GIS Building Data

3D Presentation of Shake Map in Digital City



Concluding Remarks

In Japan, seismic hazard and risk maps have been published by central and local governments.

The maps, however, may not be attractive to catch strong interest of citizens.

The 3-D presentation with aids of GIS and Remote Sensing technologies will be effective to educate citizens for earthquake awareness.

Damage in the Northridge earthquake was lower when local governments paid more attention to enforcement of the seismic provisions and to public awareness (Burby, 1998).

About 100,000 copies are printed and distributed to citizens.

Seminars on the map for citizens are carried out.