Test of Seismic Hazard Map from 500 years of Recorded Intensity Data in Japan

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How to test it?

• Probabilistic Seismic Hazard Map
  – e.g.
    • Seismic intensity for a 10% probability of exceedance in 50 yrs
    • Maximum seismic intensity for the next 500 yrs

• Comparison with maximum recorded intensity for the last 500 yrs
Maximum RecordedIntensity Map

• Model independent hazard map
  – recorded intensity including
    • site-effect (G’s function)
    • source mechanism & location

(if the earthquake repeatedly occurs)
Recorded Intensity Data in Japan

• Historical
  – Usami’s catalogue
  – Compiling the intensities and seismic damages from written documents since AD416

• Modern (1926-)
  – Intensity catalogue by Japan Meteorological Agency (JMA)

• More recent
  – JMA seismic intensity meters
  – Strong ground motion seismic networks (K-NET, KiK-net)
Historical records

(Tsuji et al., 1998)
Intensity scales

JMA: Japan Meteorological Agency
MMI: Modified Mercalli Intensity

JMA Instrumental Intensity

PGA [gal]  100  1000

JMA I 3 4 5 - 5+ 6 - 6+ 7

MMI IV V VI VII VIII IX X XI XII
Maximum Recorded Intensity Map

- Seismic intensity map for each earthquake
  - Maximum intensity is larger than 5

- Maximum intensity map from the earthquakes that occurred from 1498 to 2007
1707 Hoei earthquake (M=8.6)

1. records

2. reference intensity w/o site-amplification

3. reference intensity map

4. intensity map w/ site-amplification

North American plate

Eurasian plate

Pacific plate

Philippine Sea plate
1707 Hoei earthquake (M=8.6)

1. records

2. reference intensity w/o site-amplification

3. reference intensity map

4. intensity map w/ site-amplification
1707 Hoei earthquake (M=8.6)

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1707 Hōei earthquake (M=8.6)

1. records
2. reference intensity w/o site-amplification
3. reference intensity map
4. intensity map w/ site-amplification
N = 551
Max JMA I >= 5-
(or MMI >= VI)
Maximum Recorded Intensity Maps
for the last 500 years (1498-2007)

All events (n=551)  Subduction zone earthquakes (n=200)  Other events (n=351)
Probabilistic Seismic Hazard Maps
for the next 500 years (as of Jan. 1, 2008)
Probabilistic Seismic Hazard Maps

for the next 500 years (as of Jan.1, 2008)
All events

Subduction zone earthquakes

Other events
PSHM intensity

Maximum recorded intensity

All events

Subduction zone earthquakes

Other events
Conclusions

• Maximum recorded intensity map for the last 500 yrs
• Good agreement with Probabilistic Seismic Hazard Map
  – for All & Subduction zone earthquakes
    • Specific location
  – for Other events
    • Amount of area
    • Long earthquake recurrence time
    • Underestimation?
Number of times of occurrence $\geq 5$- and $\geq 6$-
Recurrence of Great Tokai-Nankai EQ: What’s Next?

Nankai

A

B

Tonankai

C

D

Tokai

E

Hakuho 684

Ninna 887

Eicho 1096

Kowa 1099

Shohel 1361

Meio 1498

Keicho 1605

Hoei 1707

Ansei 1854

Showa 1946

Heisei 20XX

Simulation

HD, Maritime Agency

Documents

Archeological data

Ishibashi and Satake (1998)

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