

# **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 Recorded Intensity 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)

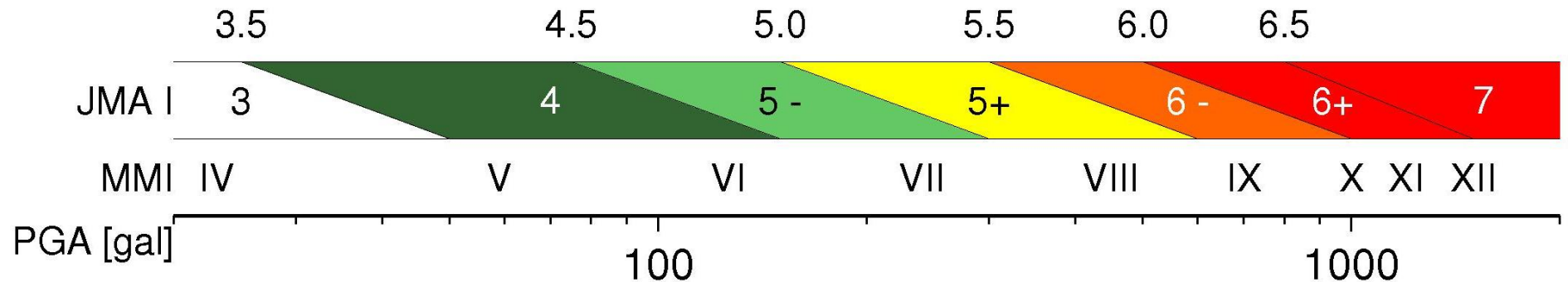
# Historical records



(Tsuji et al., 1998)

# Intensity scales

## JMA Instrumental Intensity

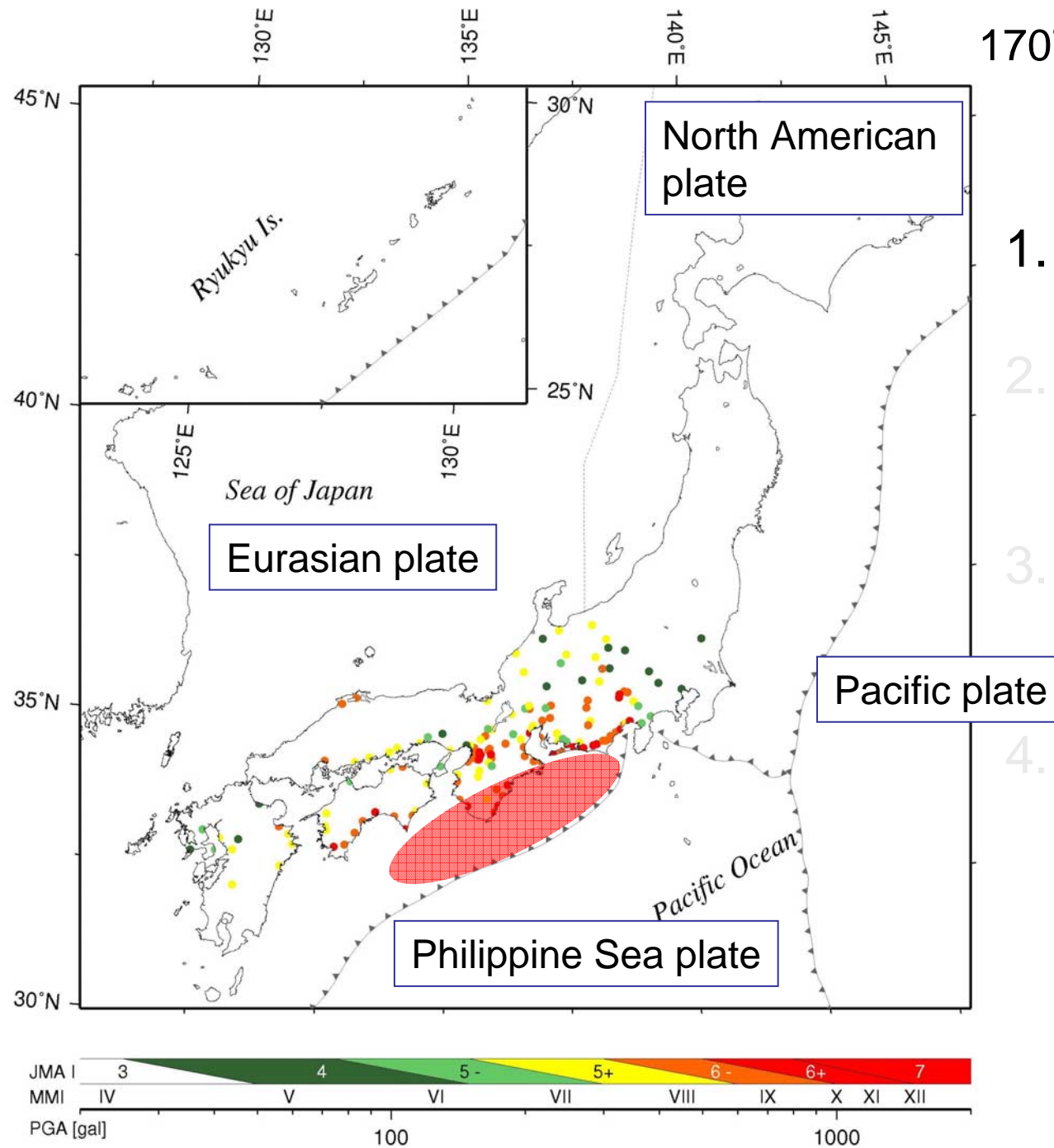


JMA: Japan Meteorological Agency  
MMI: Modified Mercalli Intensity

# 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 Hiei earthquake (M=8.6)



1. records

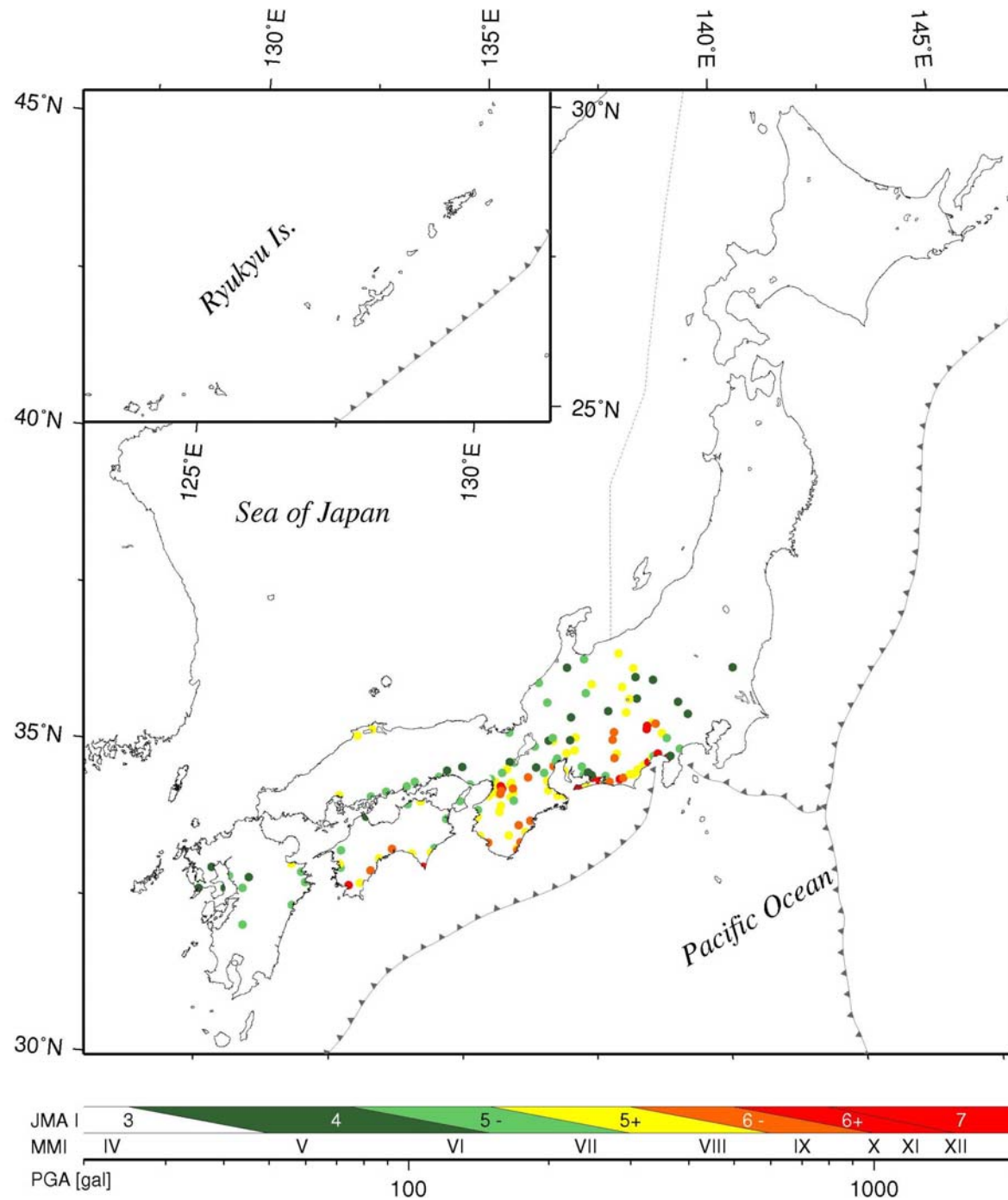
2. reference intensity  
w/o site-amplification

3. reference intensity  
map

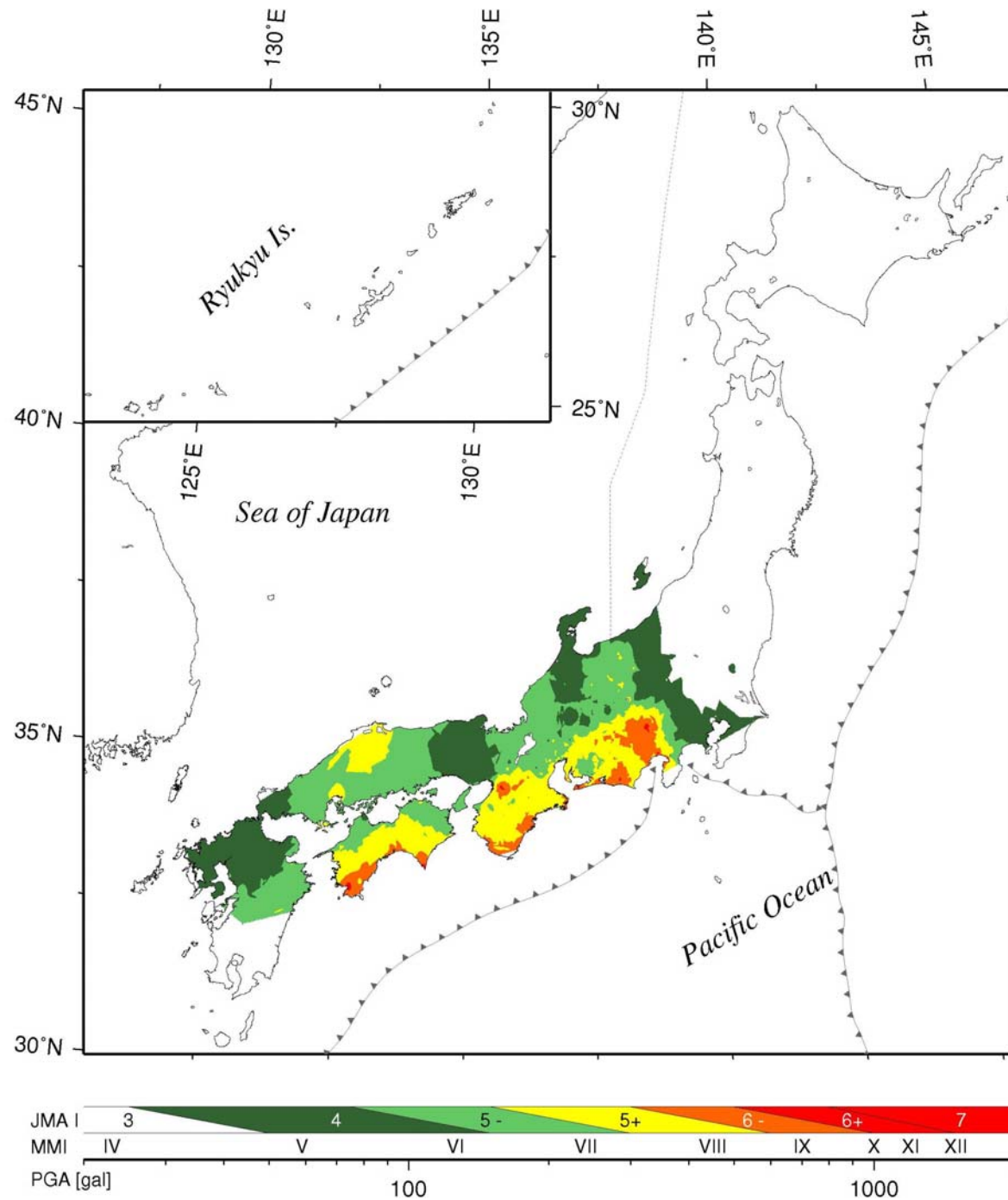
4. intensity map  
w/ site-amplification



## 1707 Hiei earthquake (M=8.6)



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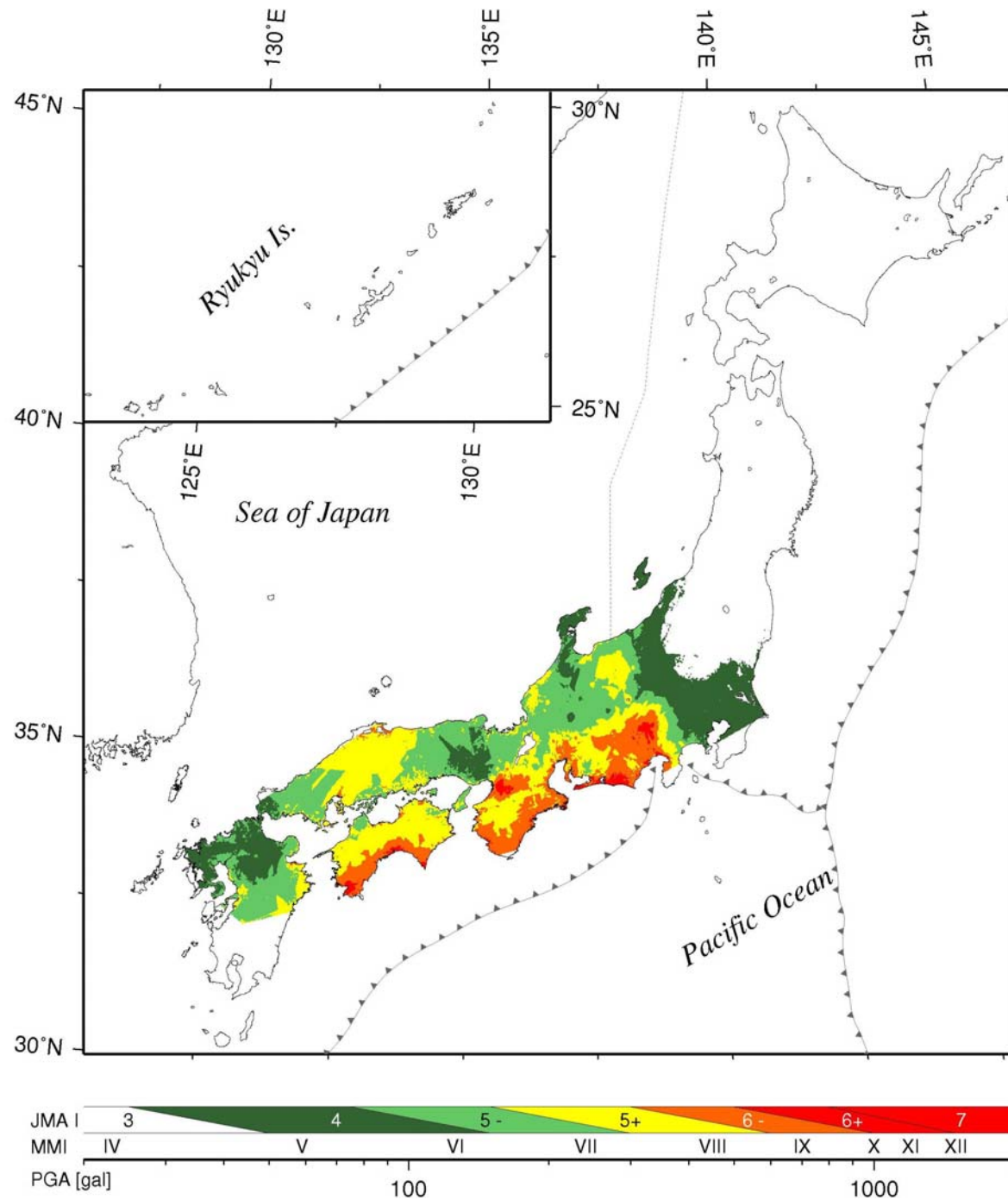
1. records

2. reference intensity  
w/o site-amplification

3. reference intensity  
map

4. intensity map  
w/ site-amplification

## 1707 Hiei earthquake (M=8.6)



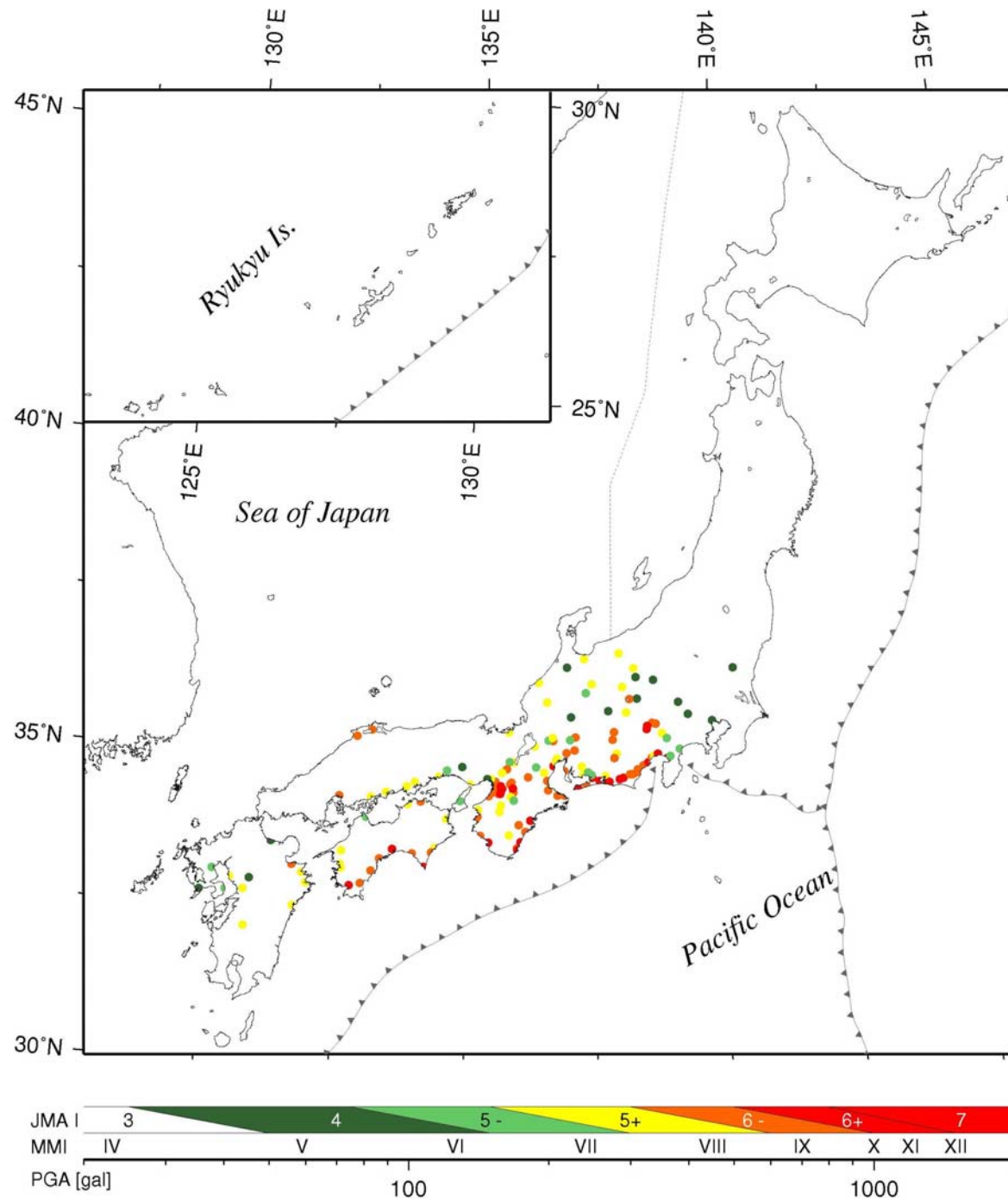
1. records

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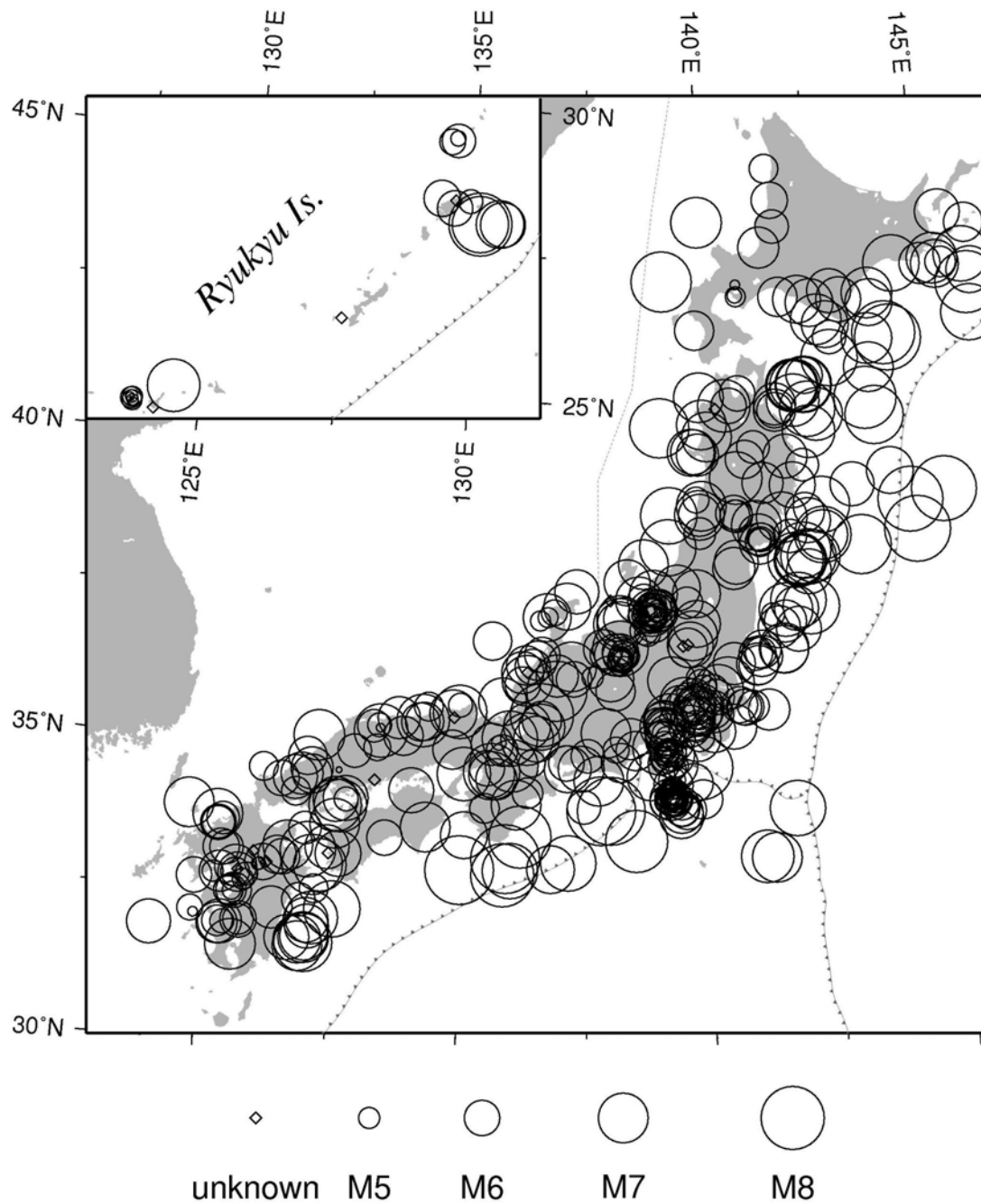


1. records

2. reference intensity  
w/o site-amplification

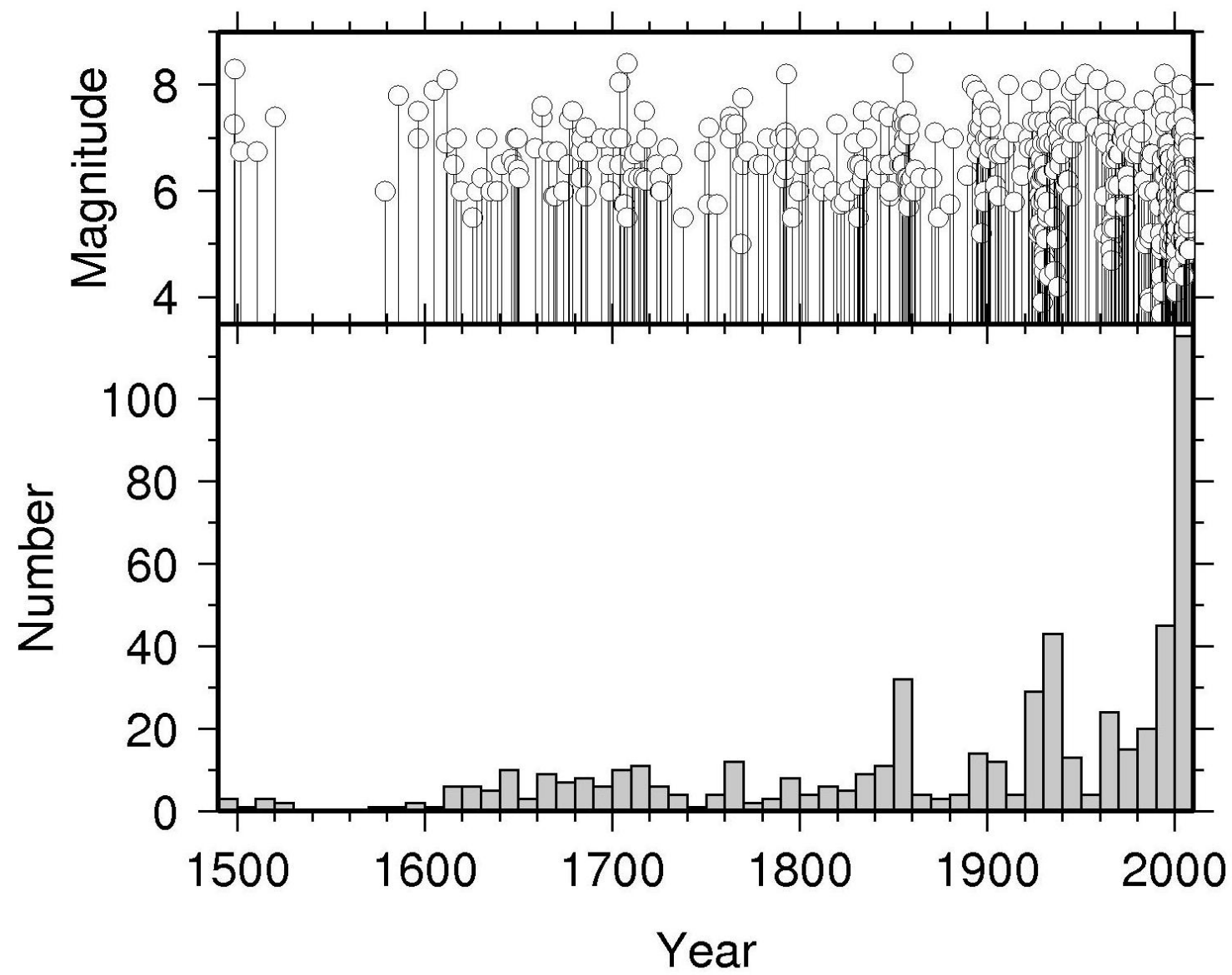
3. reference intensity  
map

4. intensity map  
w/ site-amplification



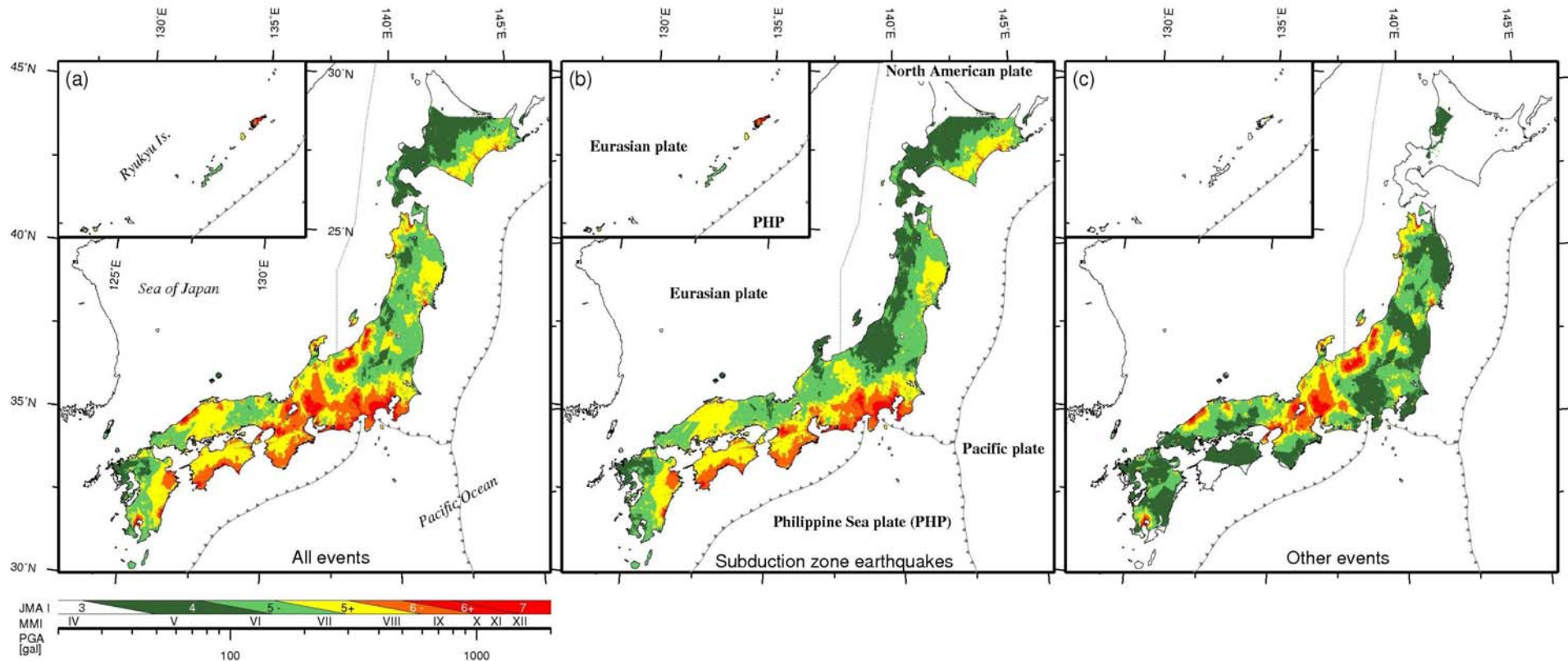
N = 551

Max JMA I  $\geq$  5-  
(or MMI  $\geq$  VI)



# Maximum Recorded Intensity Maps

for the last 500 years (1498-2007)



All events (n=551)

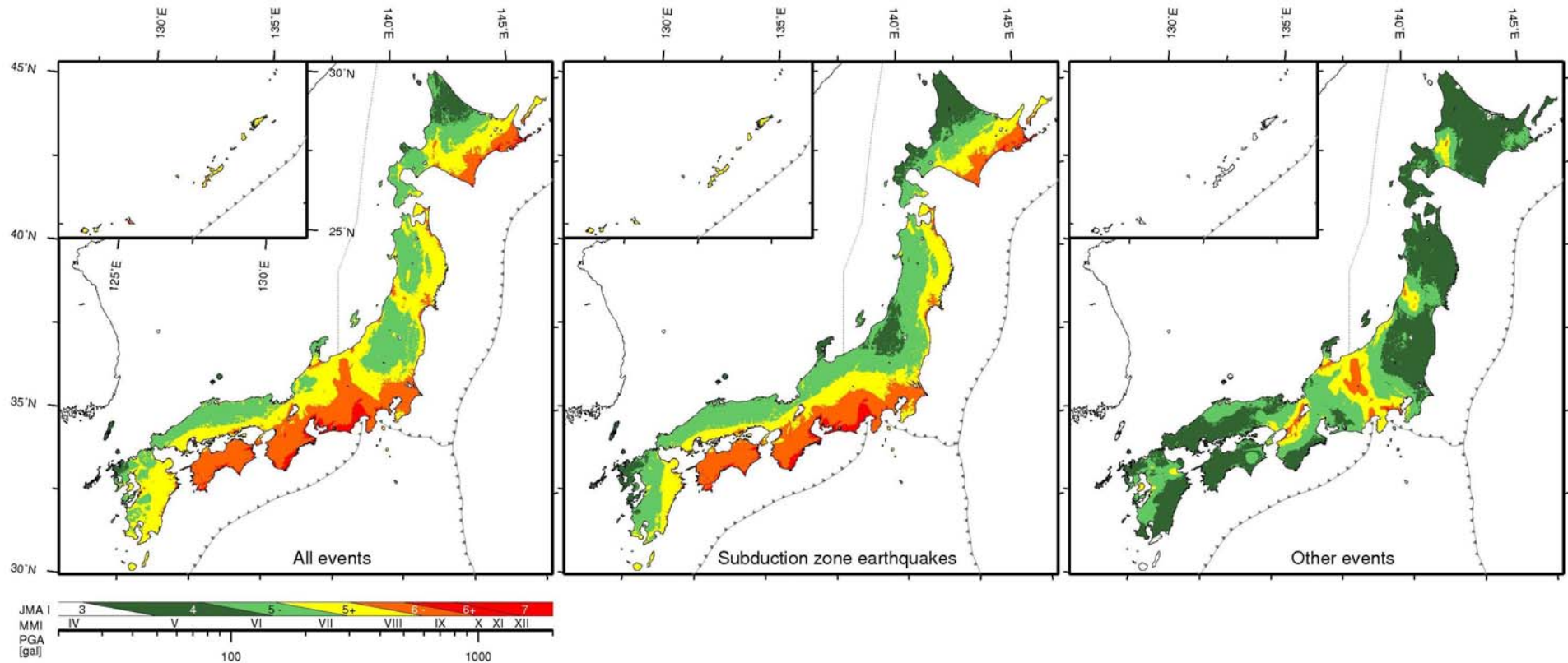
Subduction zone earthquakes  
(n=200)

Other events (n=351)



# Probabilistic Seismic Hazard Maps

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



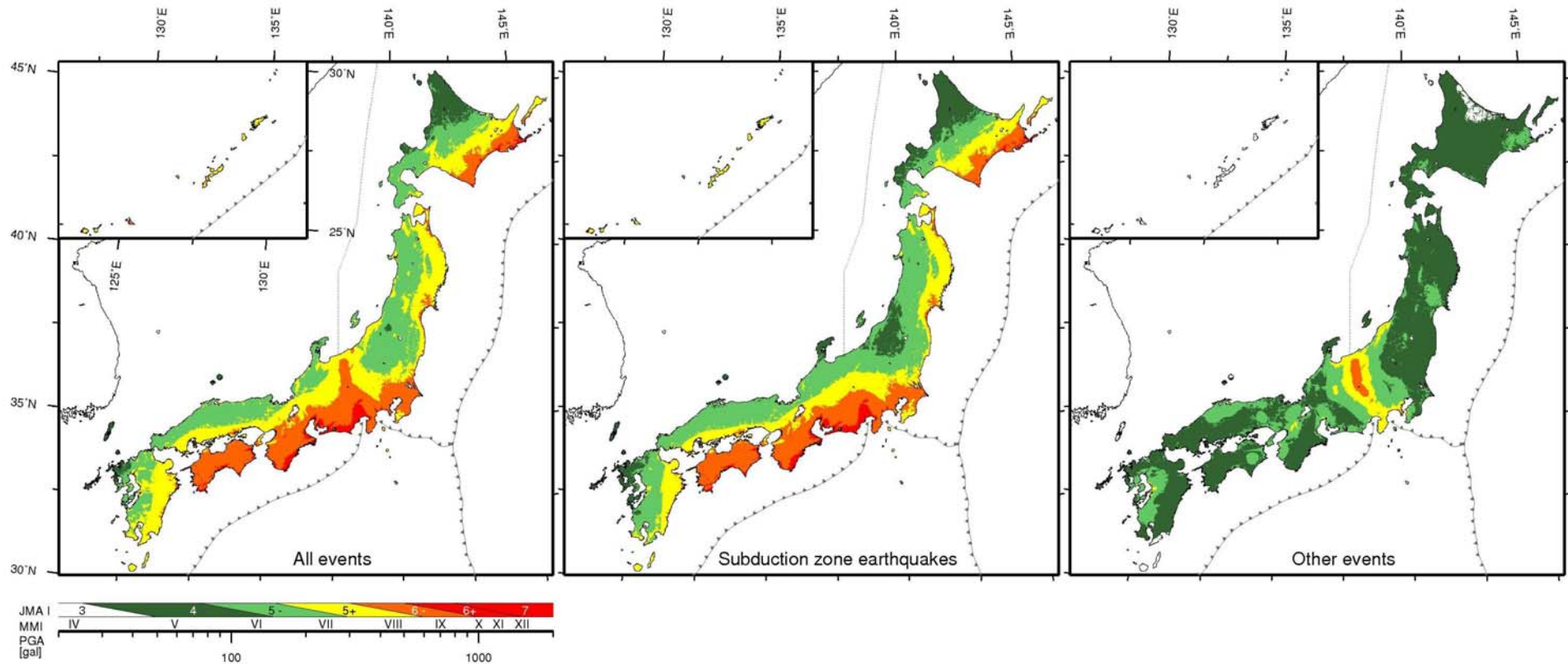
MAX

MAX



# Probabilistic Seismic Hazard Maps

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

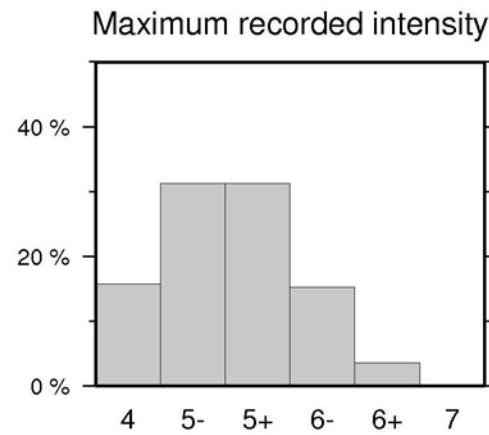


AVR

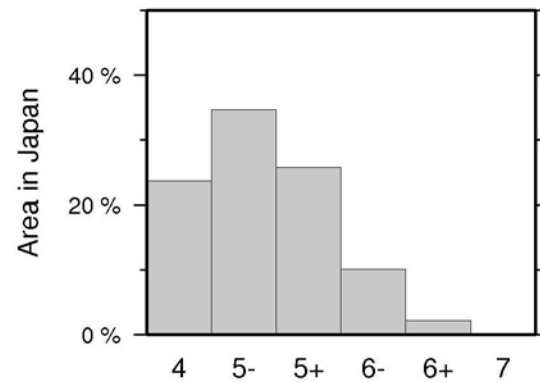
AVR



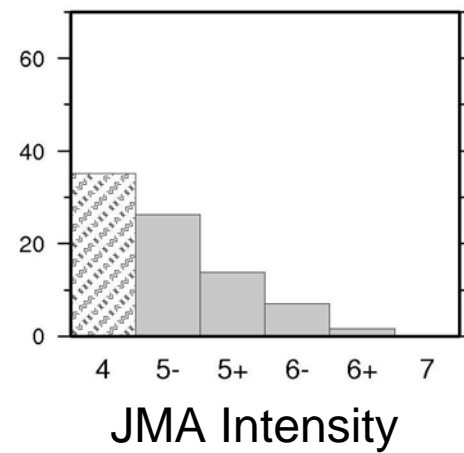
All events



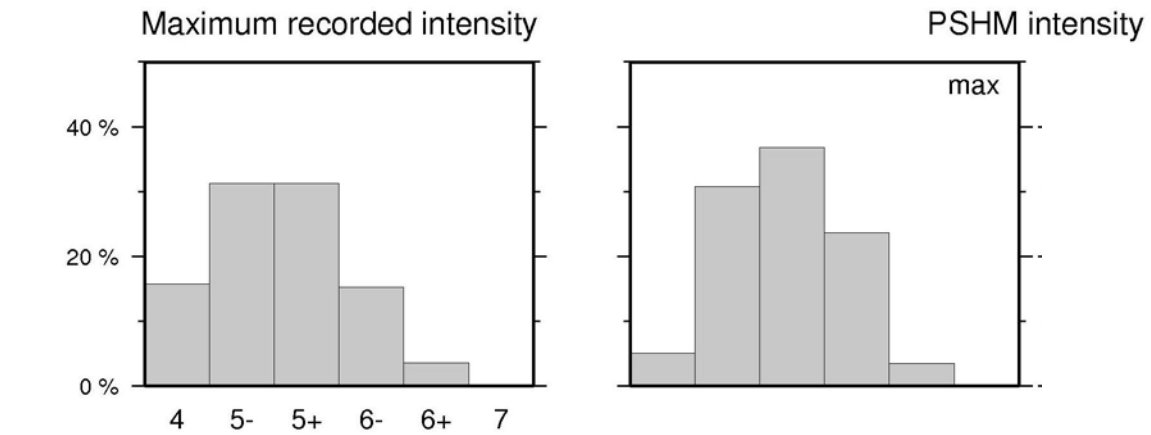
Subduction  
zone  
earthquakes



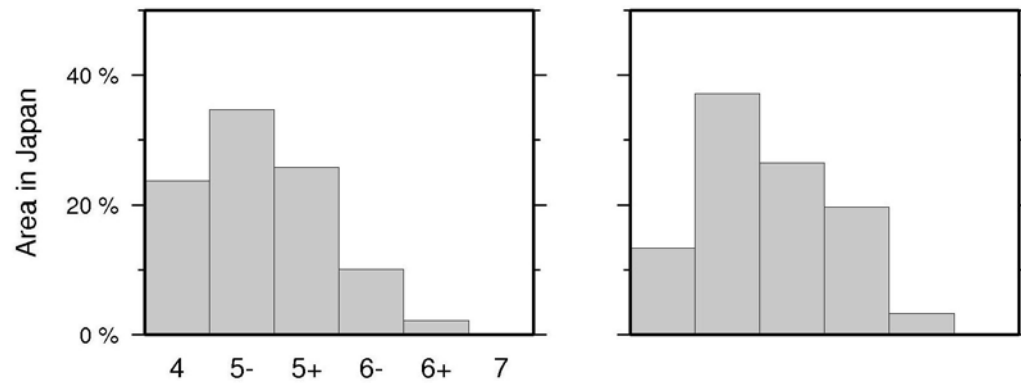
Other events



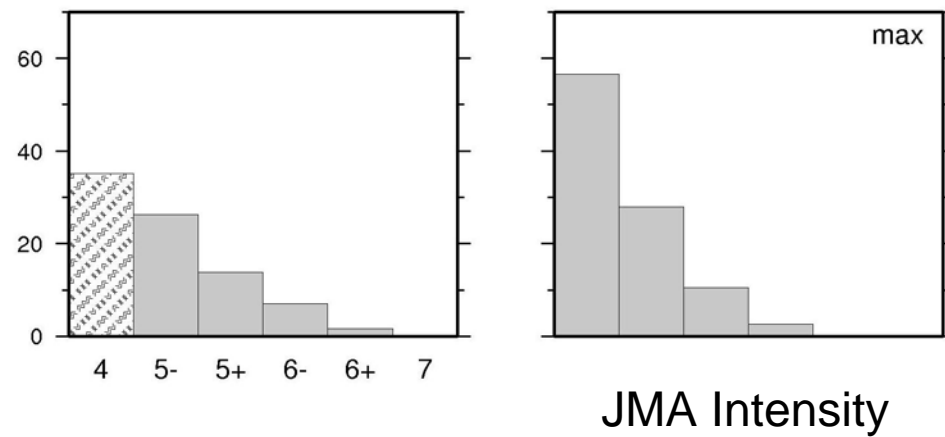
All events



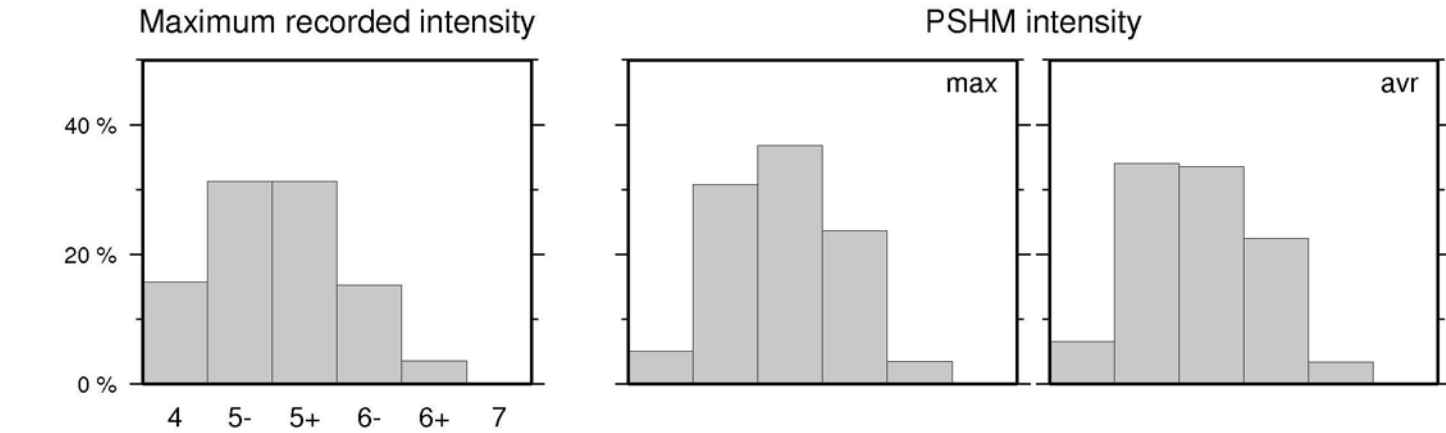
Subduction  
zone  
earthquakes



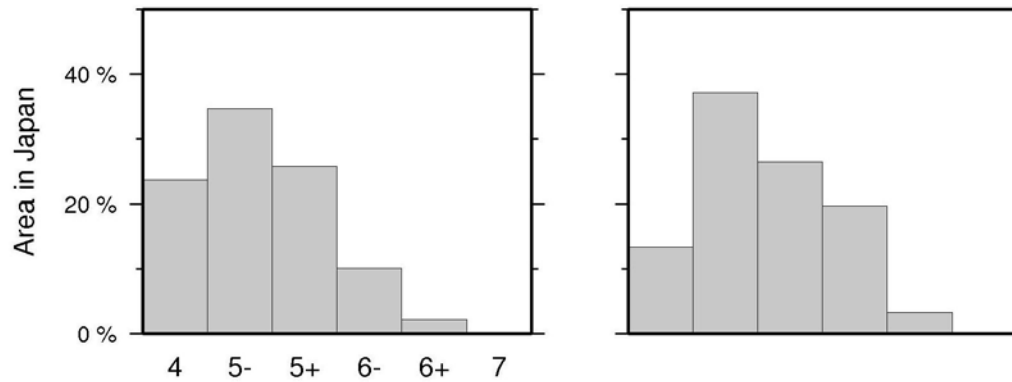
Other events



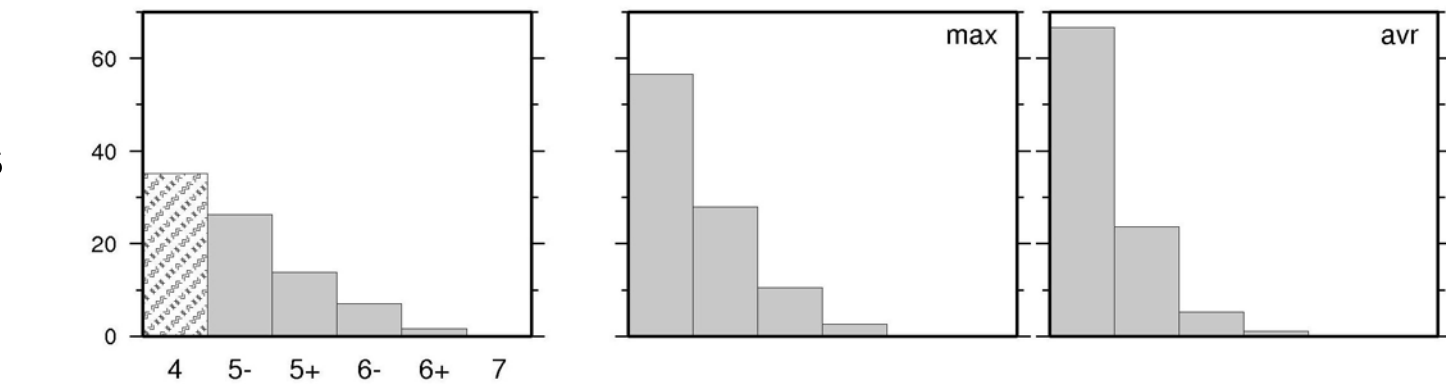
All events



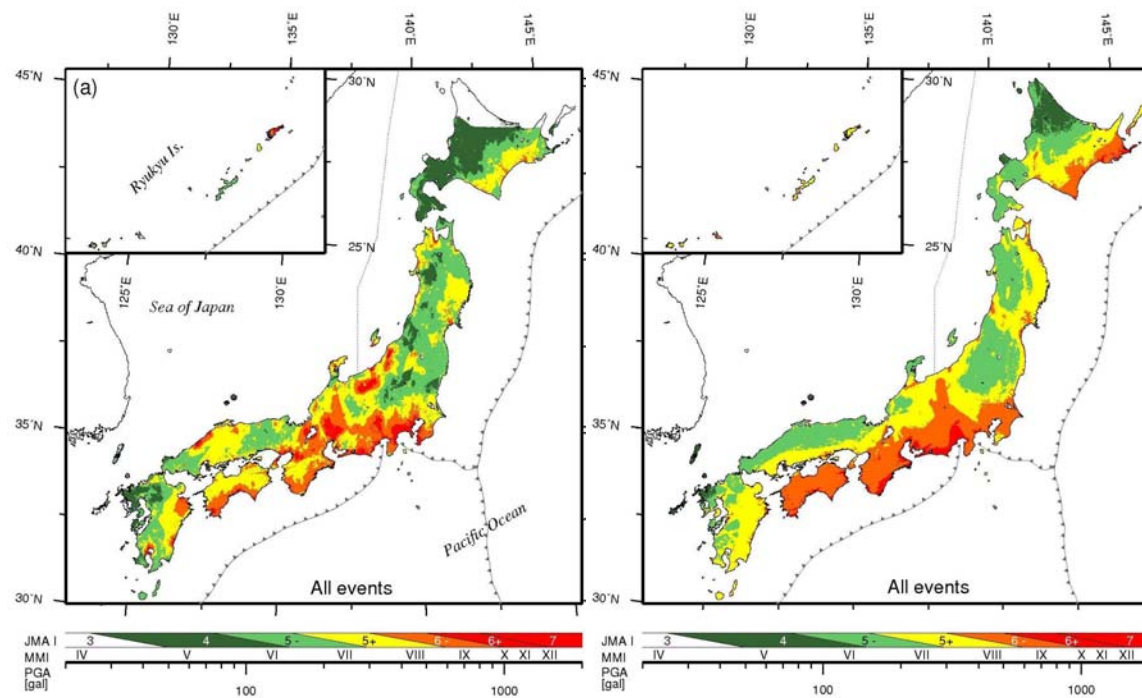
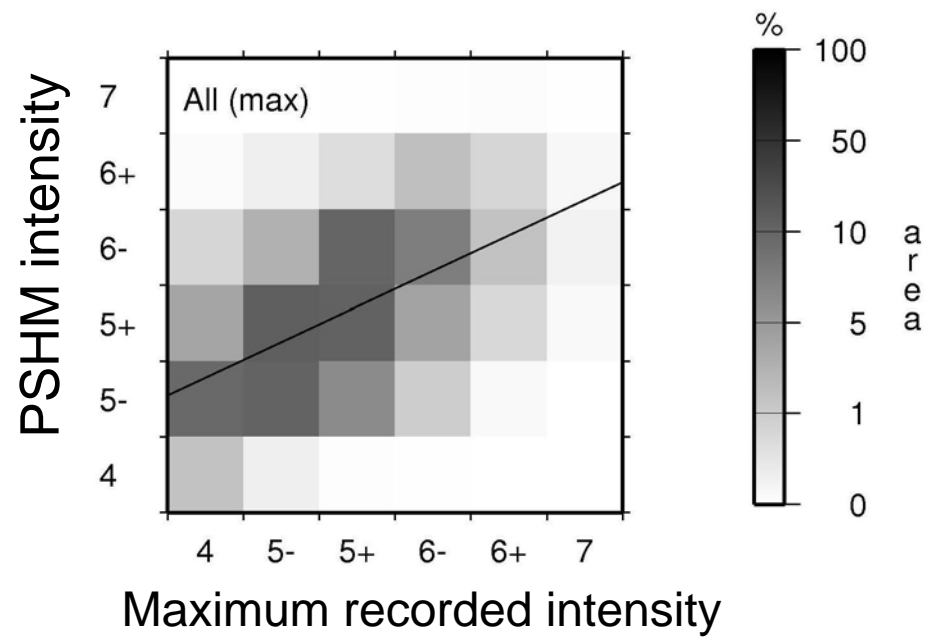
Subduction  
zone  
earthquakes



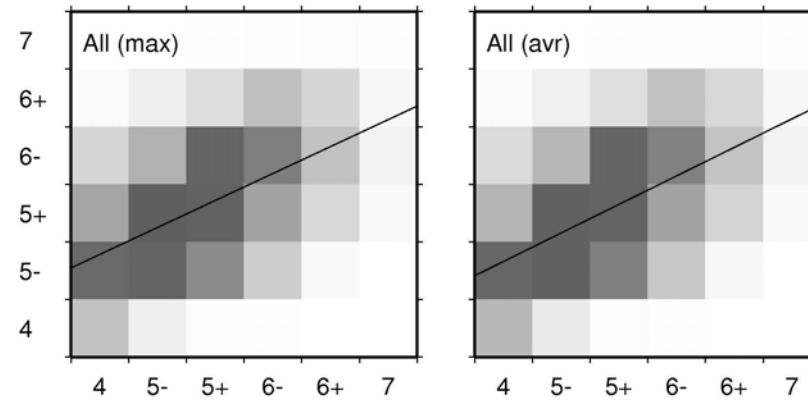
Other events



JMA Intensity

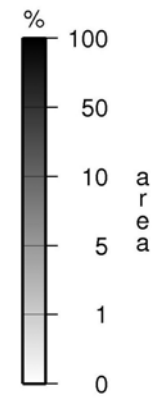
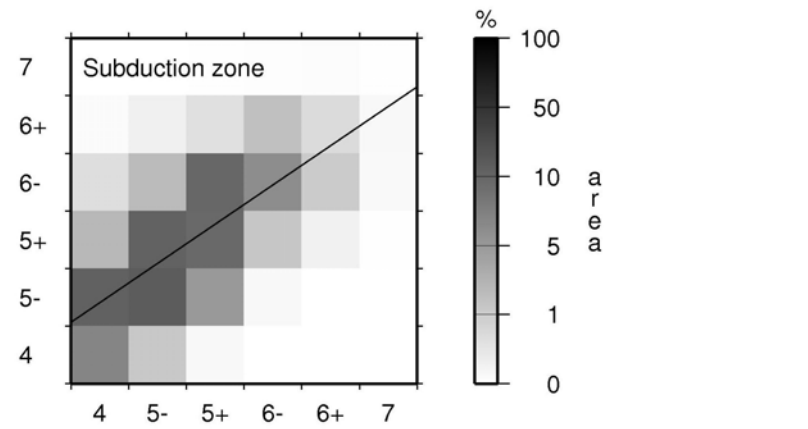


All events

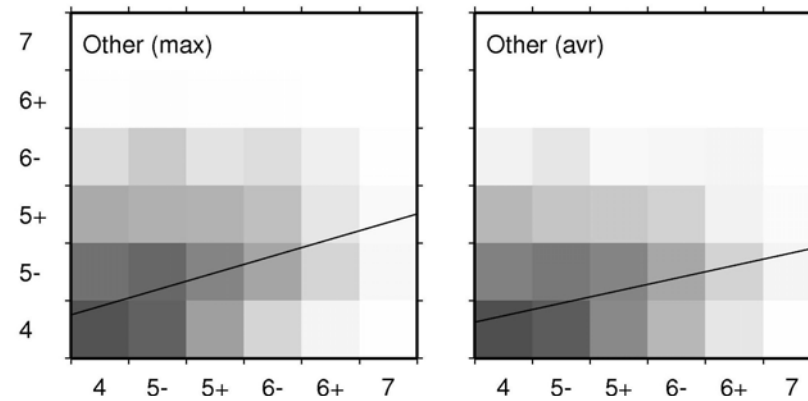


Subduction zone  
earthquakes

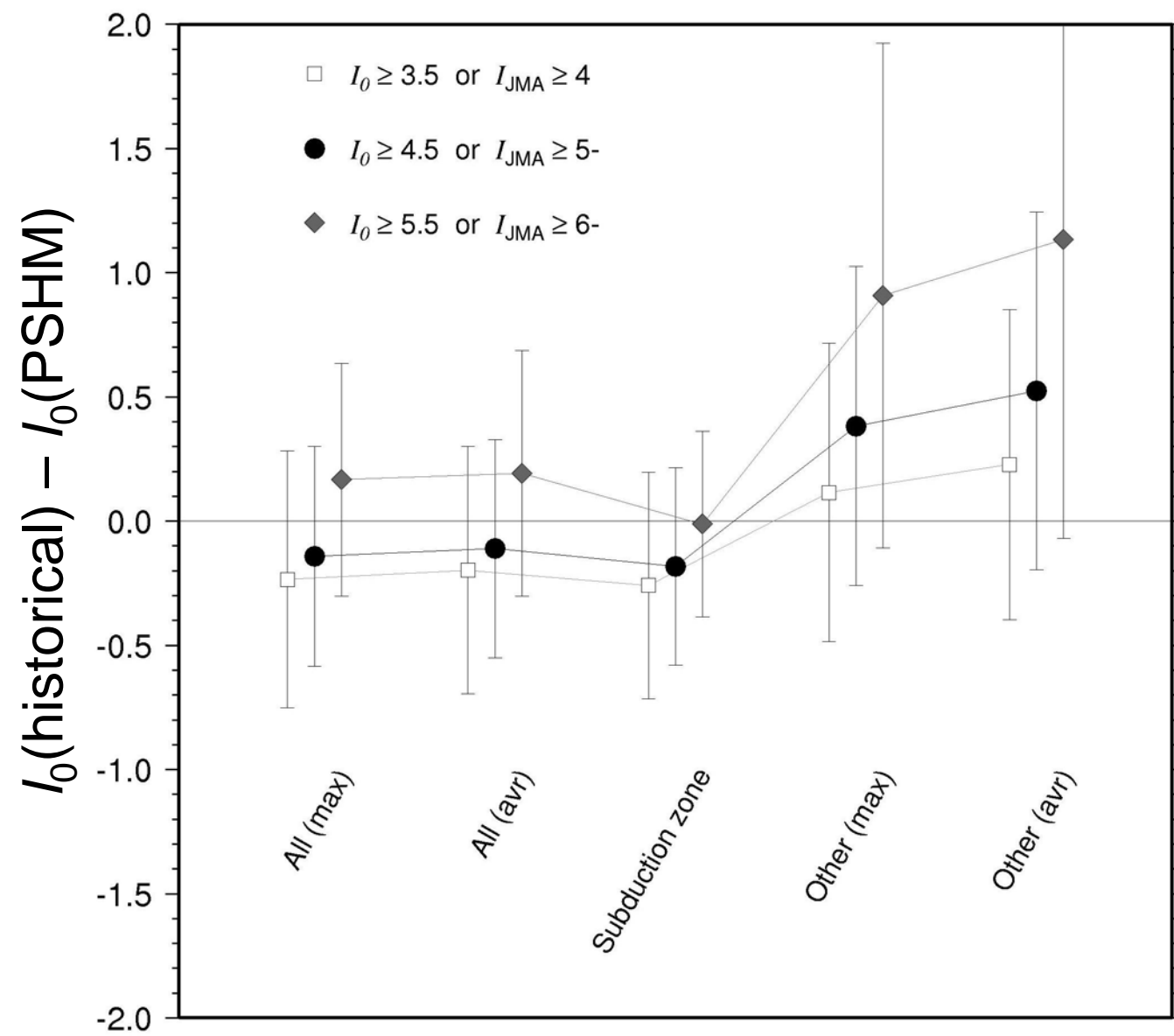
PSHM intensity



Other events



Maximum recorded intensity

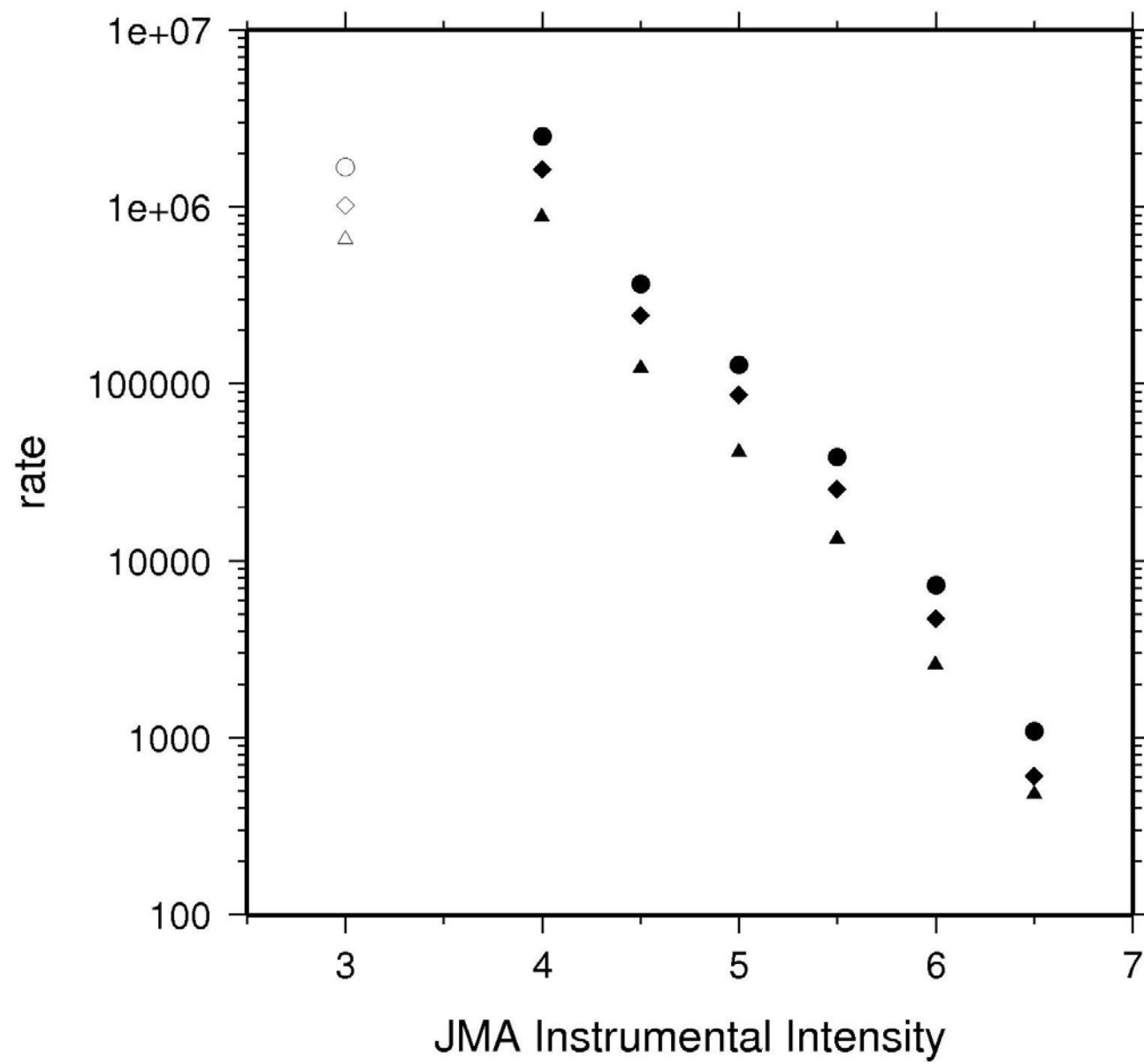




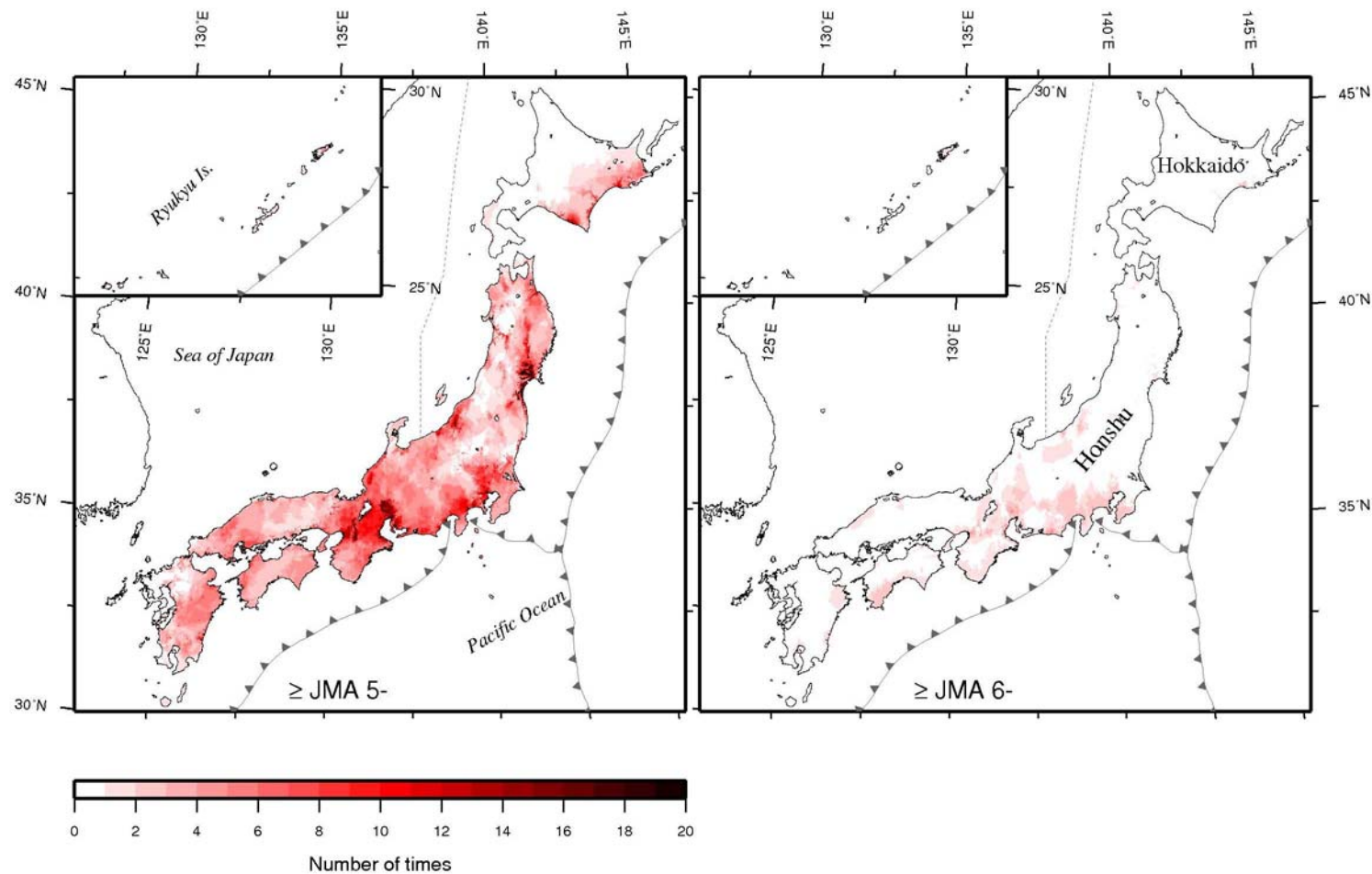
# Conclusions

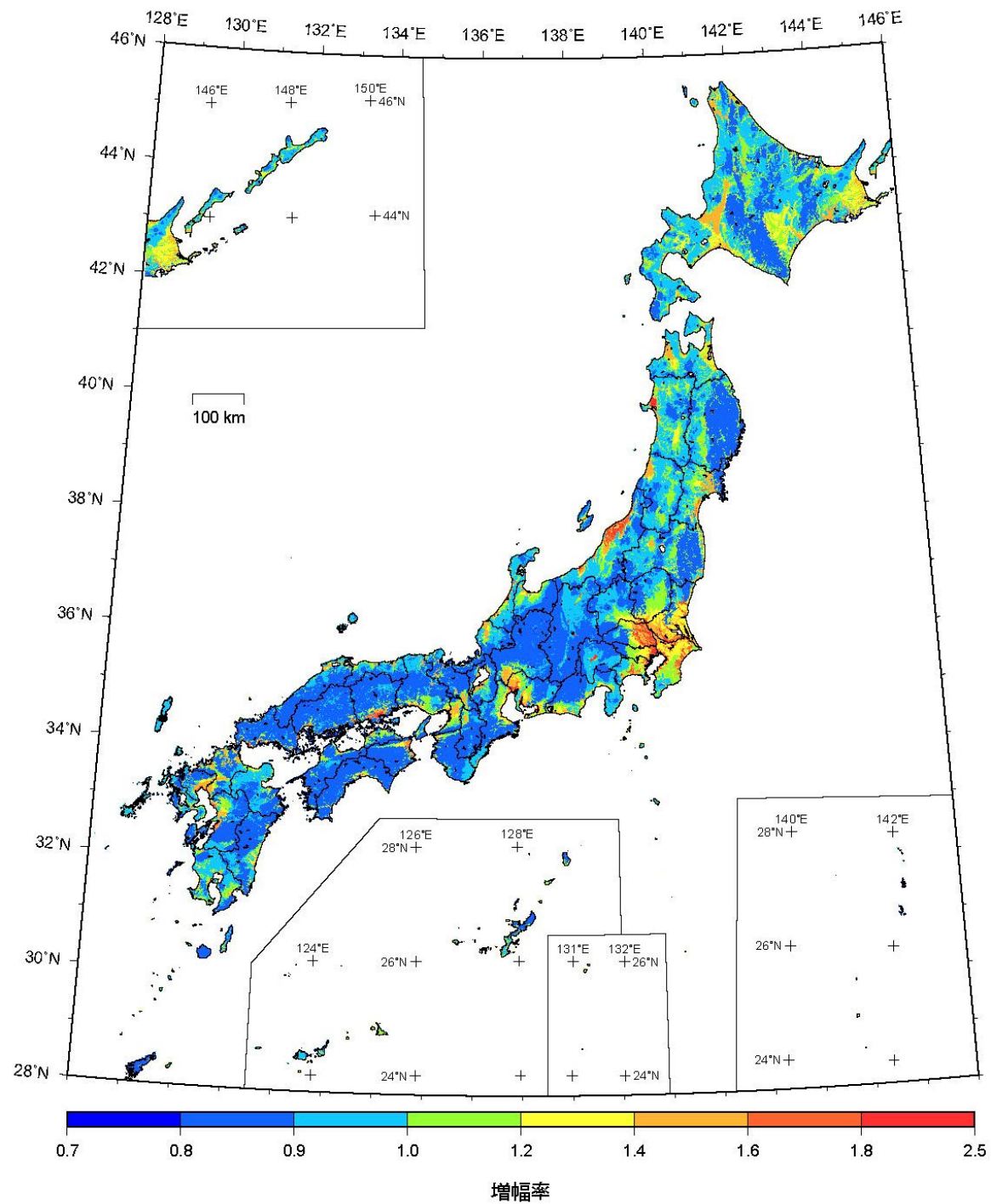
- Maximum recorded intensity map for the last 500 yrs
- Good agreement with Probabilistic Seismic Hazard Map
  - for All & Subduction zone earthquakes
    - Specific location
  - for Other events
    - Amount of area
    - Long earthquake recurrence time
    - Underestimation?

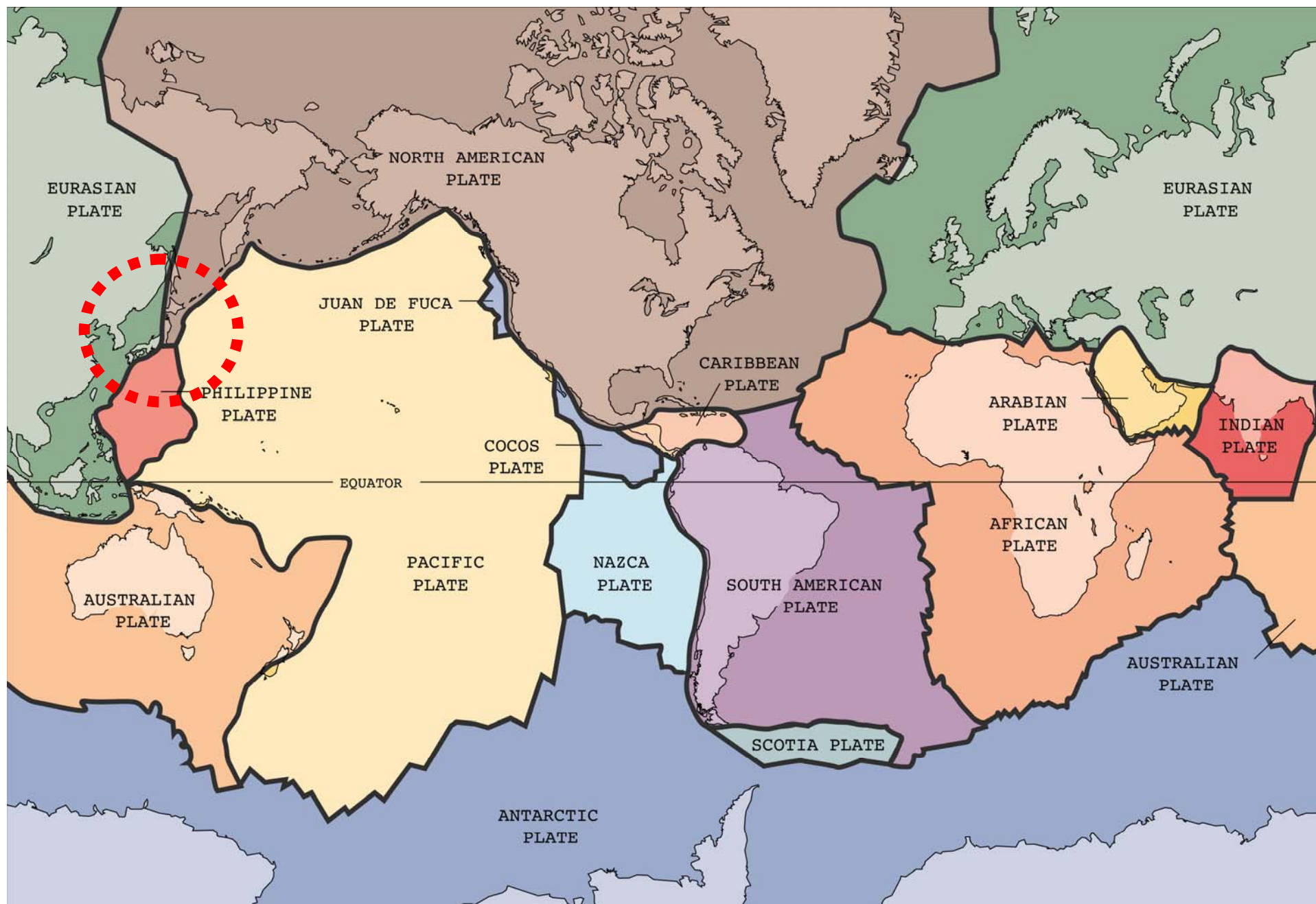


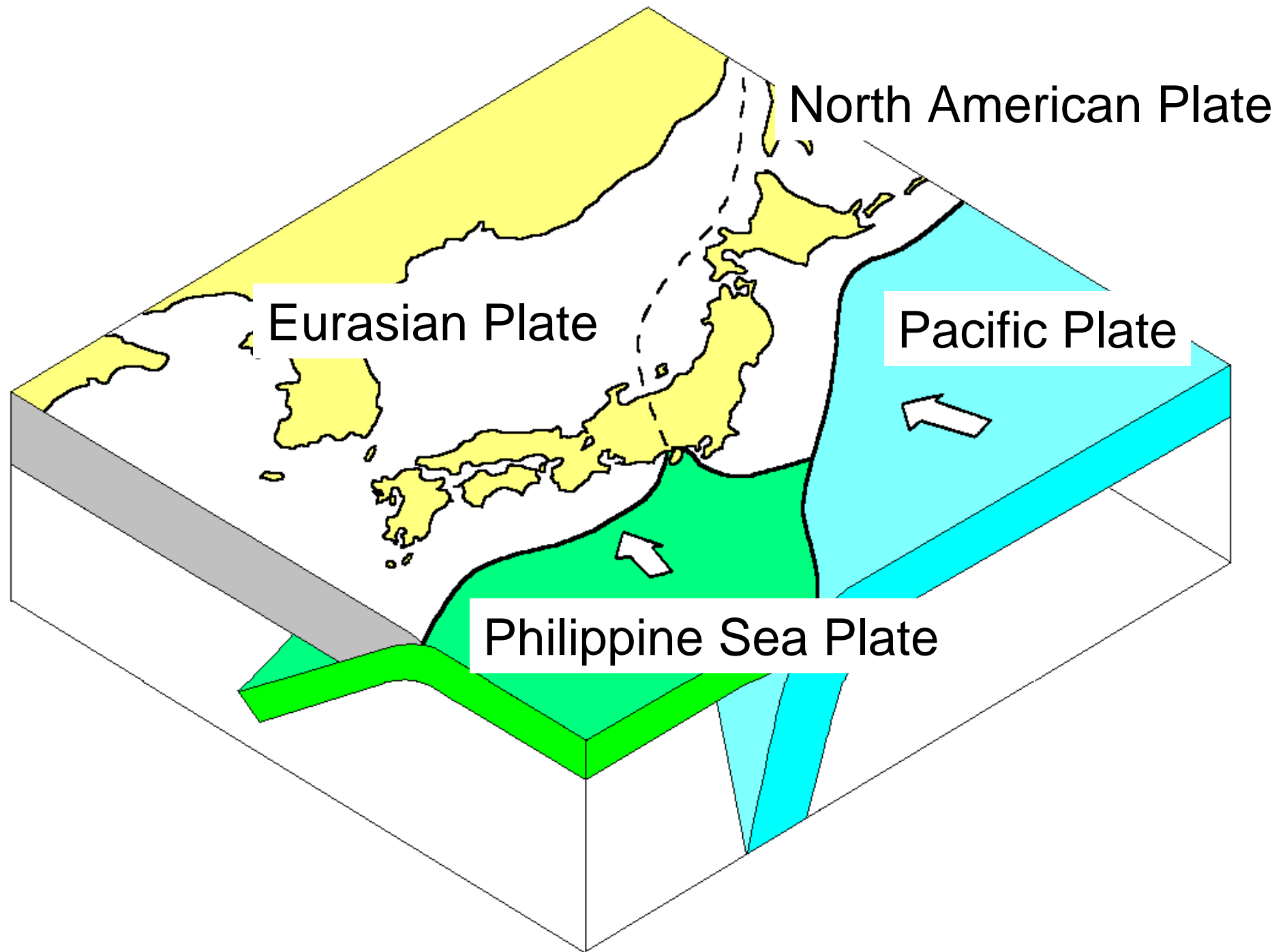


Number of times of occurrence  $\geq 5$ - and  $\geq 6$ -



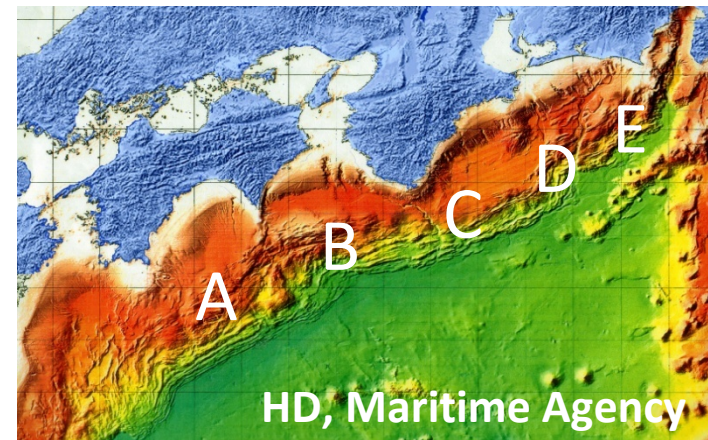
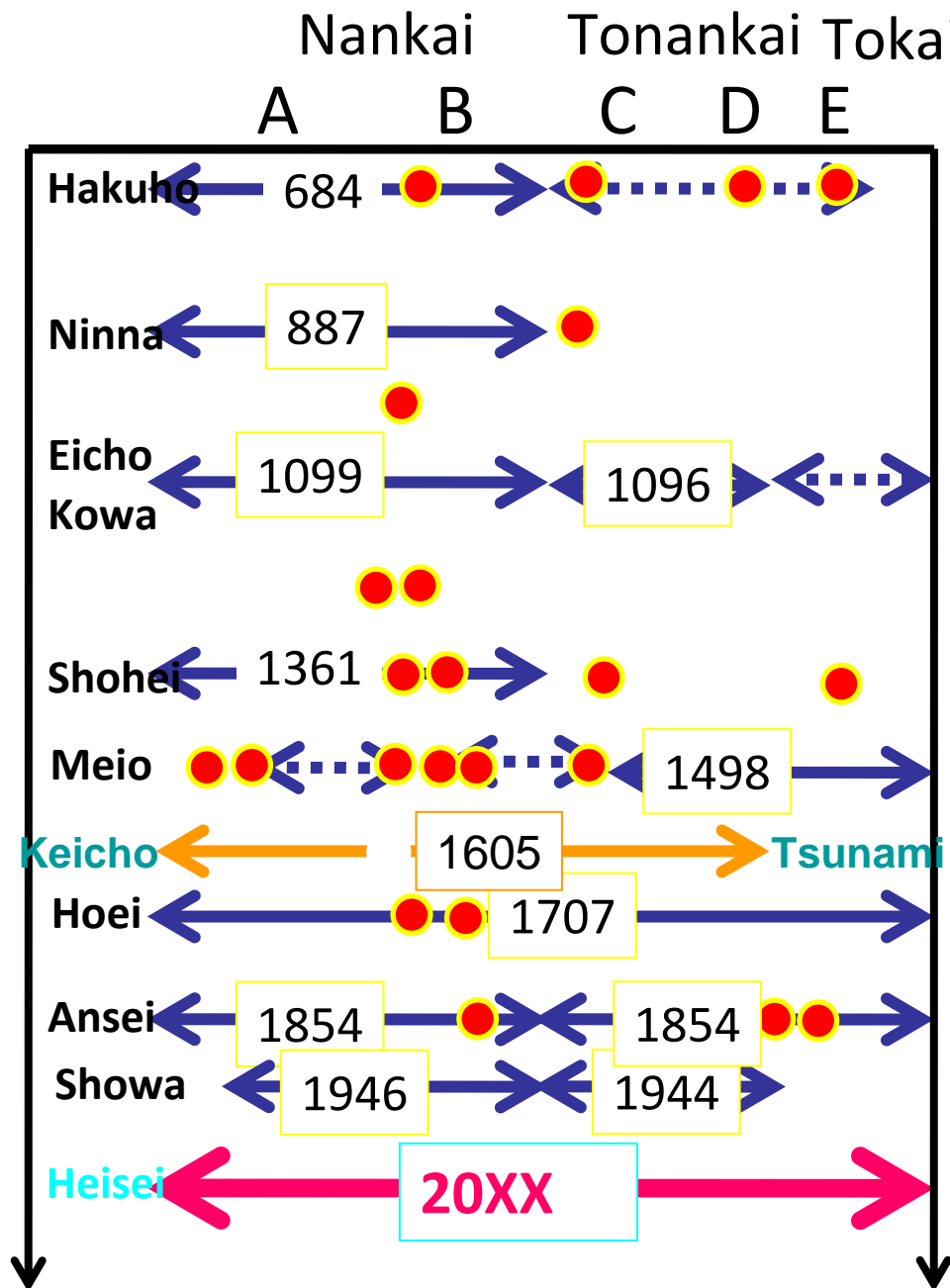




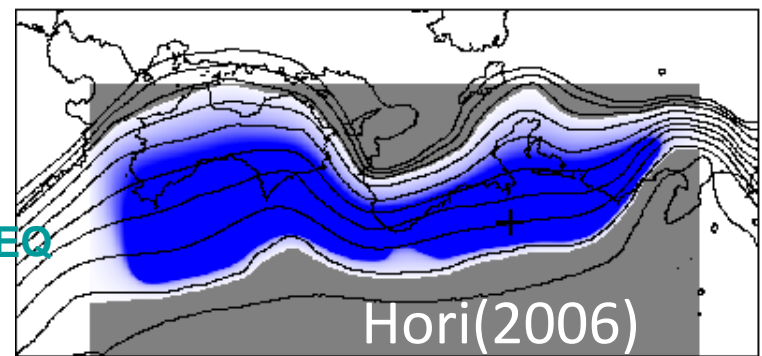




# Recurrence of Great Tokai-Nankai EQ: What's Next?



Simulation



Documents



Archeological data

Ishibashi and Satake(1998)