OYORMS
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The 3rd annual meeting of the seismic hazard assessment for the next generation map
China-Japan-Korea cooperative program
June 17 – 21, 2013, in Sendai, Japan

Uncertainty in the assessment of seismic hazard

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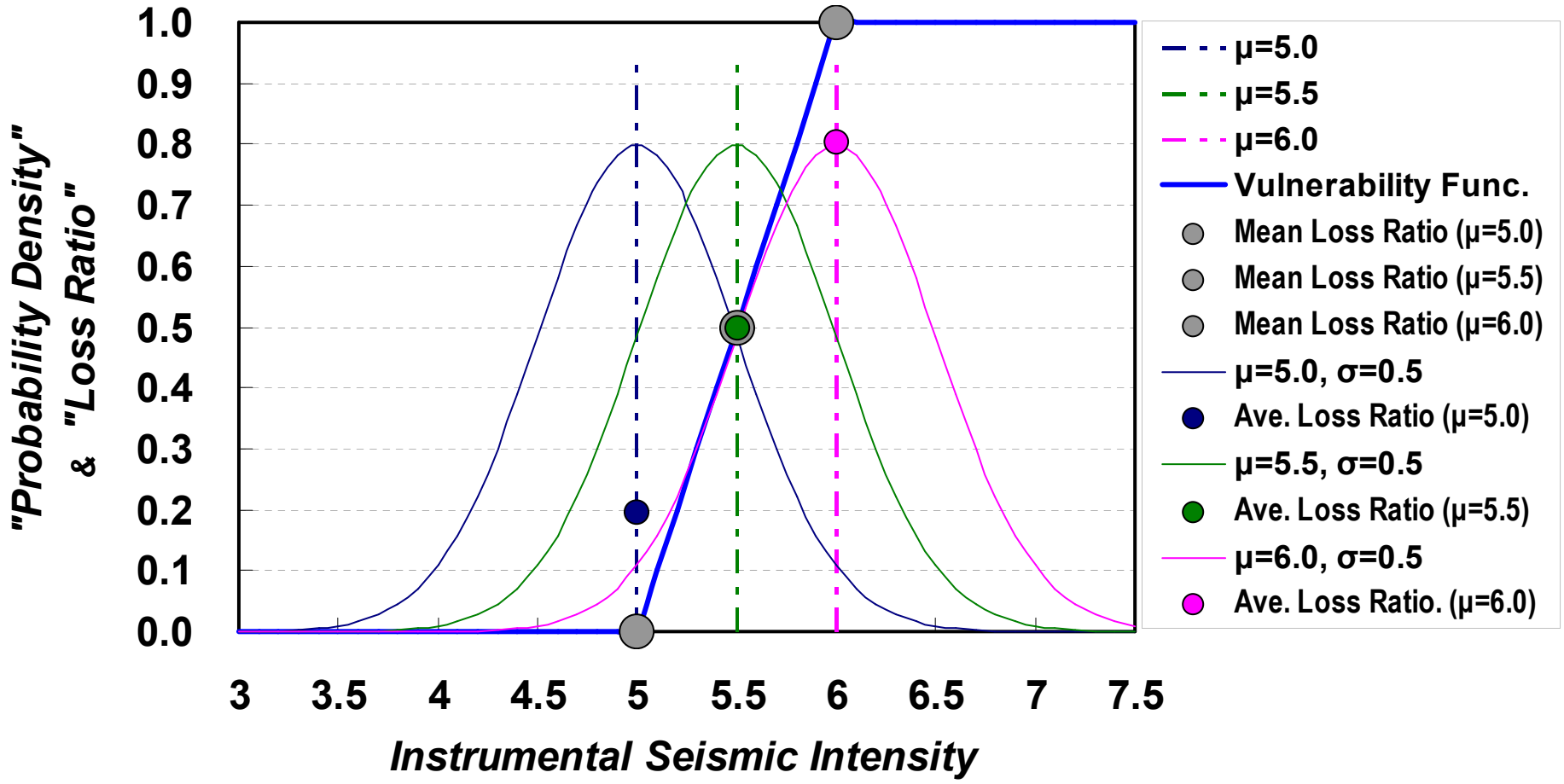
Impact of Uncertainty in the Process of SHA

- It is common for Probabilistic Seismic Hazard Assessment (PSHA) to take into account the uncertainty in the process of hazard assessment.
- On the other hand, it is not so common for Scenario (deterministic) Seismic Hazard Assessment (SSHA) to take into account the uncertainty.
- However, every process of seismic hazard assessment includes some sort of uncertainty, so that the uncertainty should be taken into account properly even for SSHA.
- Furthermore, when you assess damage or loss using the estimated seismic hazard without taking into account its uncertainty properly, it is possible that an unexpected result will be derived because of non-linearity of fragility or vulnerability of the property (see next page).

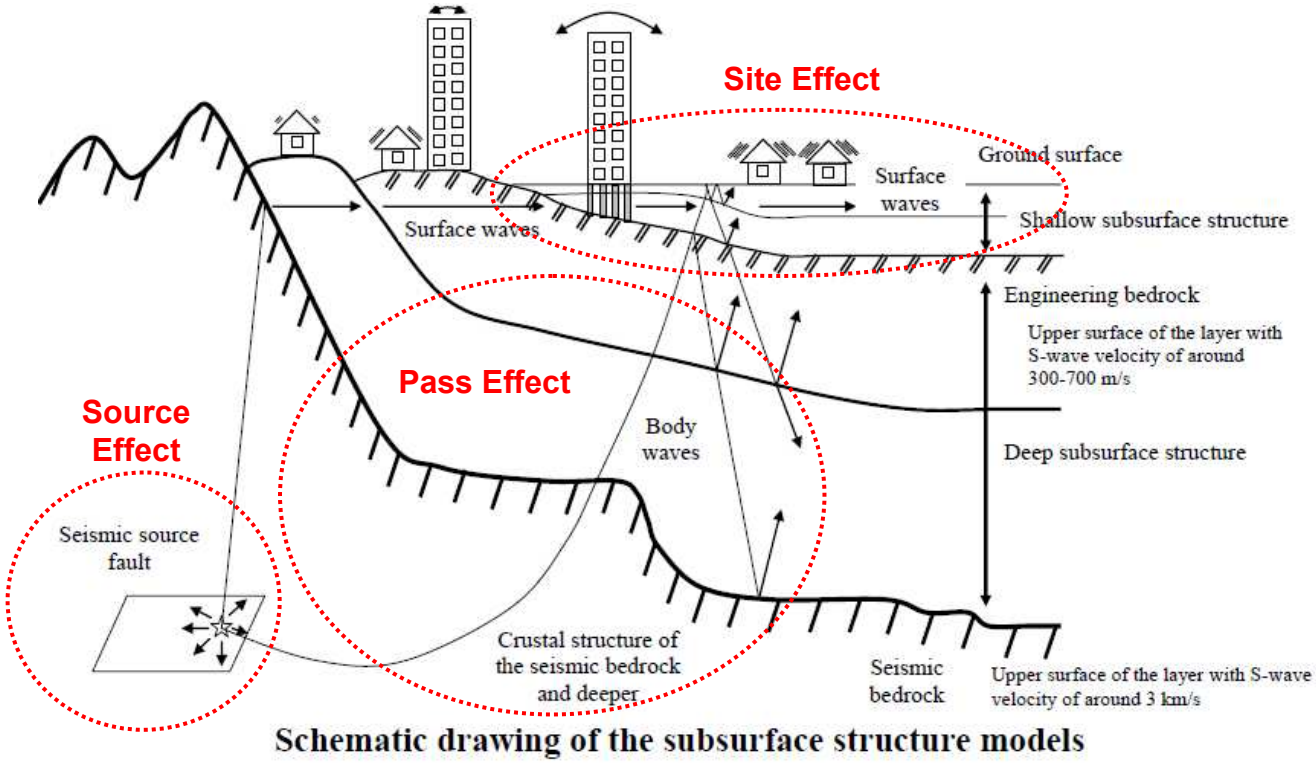
Mean loss and Average loss

- The mean loss estimation is not coincide with the average loss estimation considering uncertainty of seismic intensity.



Cause of uncertainty in the process of SHA

- **Source Effect:** Magnitude, Asperity, etc.
- **Pass Effect:** Structure and physical property of the ground, etc.
- **Site Effect:** Surface geology, etc.

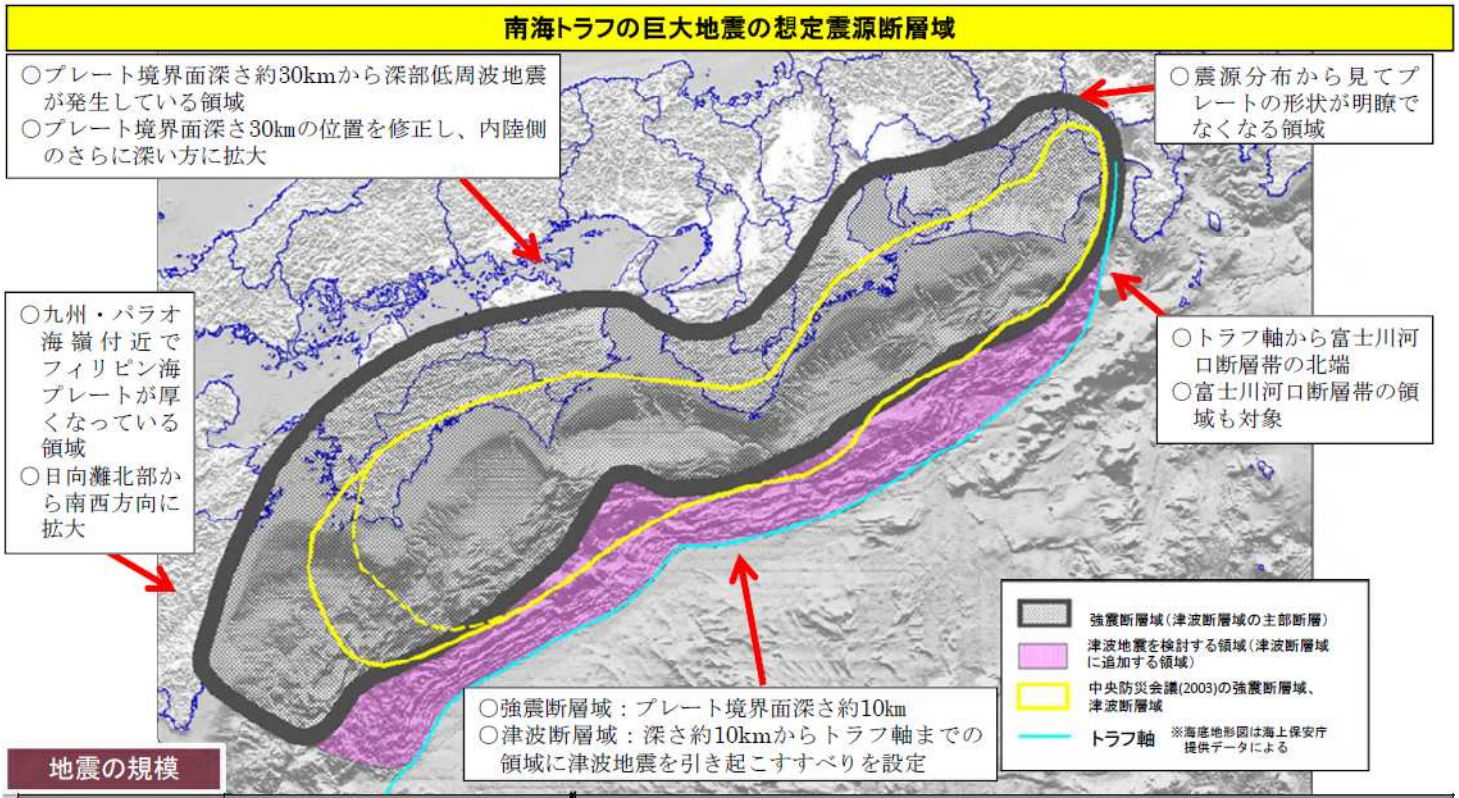


Schematic drawing of the subsurface structure models

Technical Reports on National Seismic Hazard Maps for Japan (2009), NIED

Effect of Magnitude (1/3)

- **Nankai Trough M8.7 EQ: Central Disaster Prevention Council (2003)**
- **Nankai Trough M9.0 Earthquake: Cabinet Office (2012)**

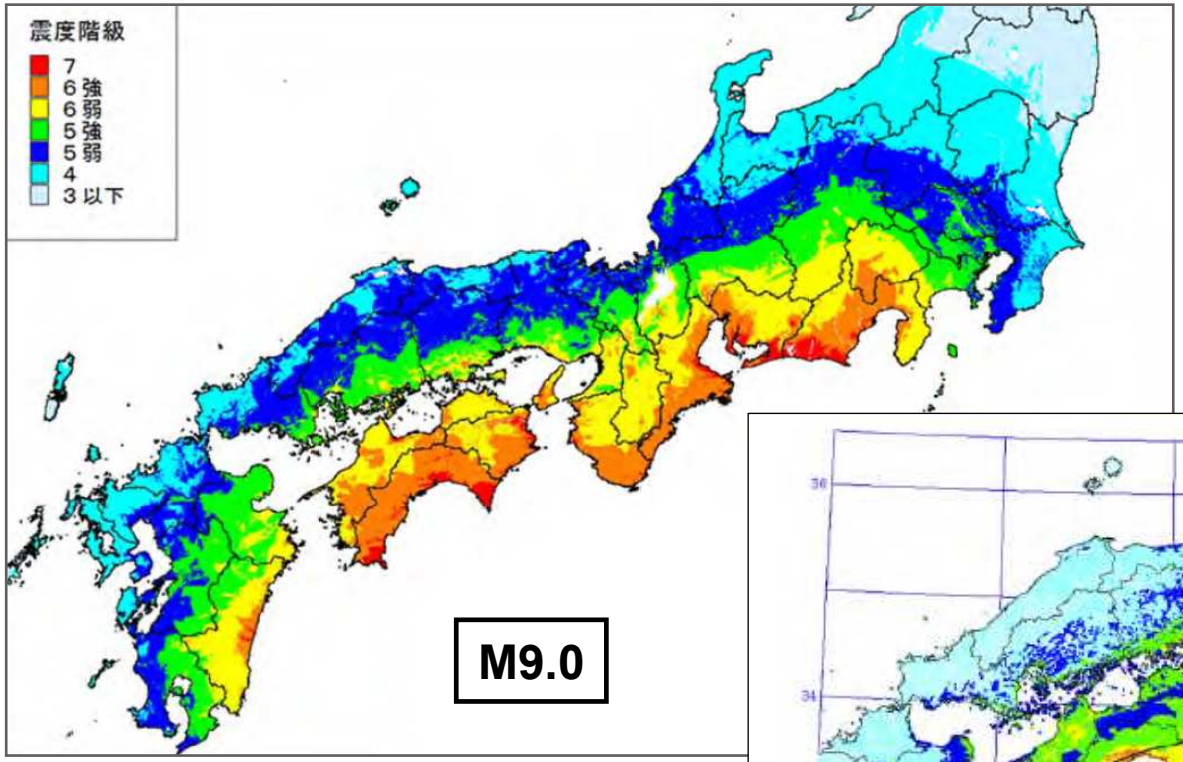


地震の規模

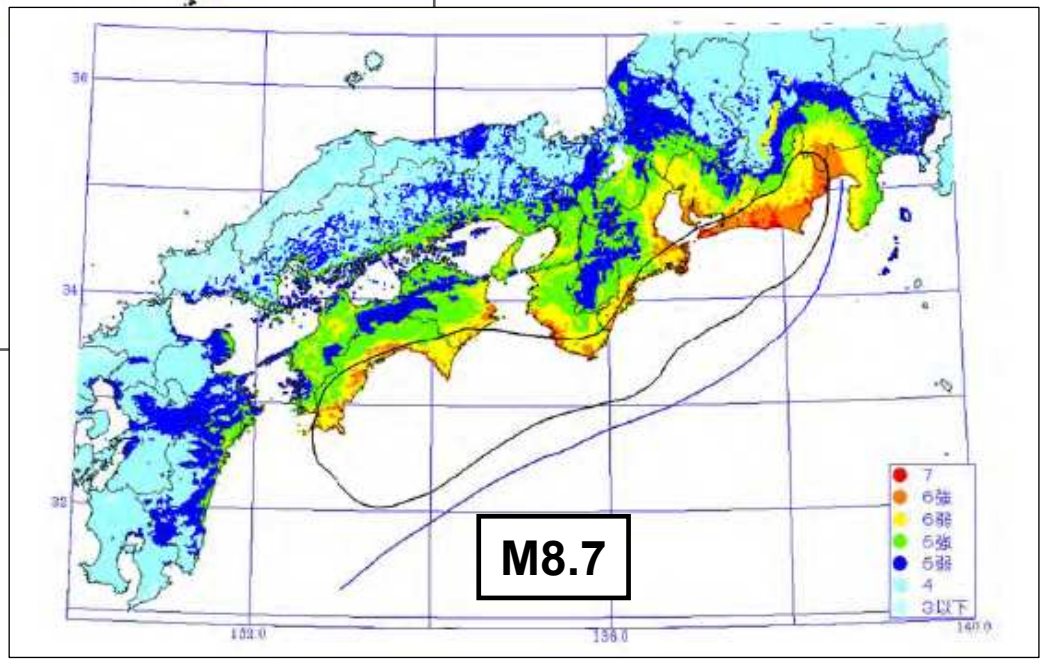
	南海トラフの巨大地震		参考			
	（津波断層モデル）	（強震断層モデル）	2011年 東北地方太平洋沖地震	2004年 スマトラ島沖地震	2010年 チリ中部地震	中央防災会議(2003) 強震断層域
面積	約14万km^2	約11万km^2	約10万km^2（約500km×約200km）	約18万km^2（約1200km×約150km）	約6万km^2（約400km×約140km）	約6.1万km^2
モーメントマグニチュード Mw	9.1	9.0	9.0（気象庁）	9.1（Ammon et al., 2005）[9.0（理科年表）]	8.7（Pulido et al., in press）[8.8（理科年表）]	8.7

Effect of Magnitude (2/3)

- **Difference in JMA Seismic Intensity**



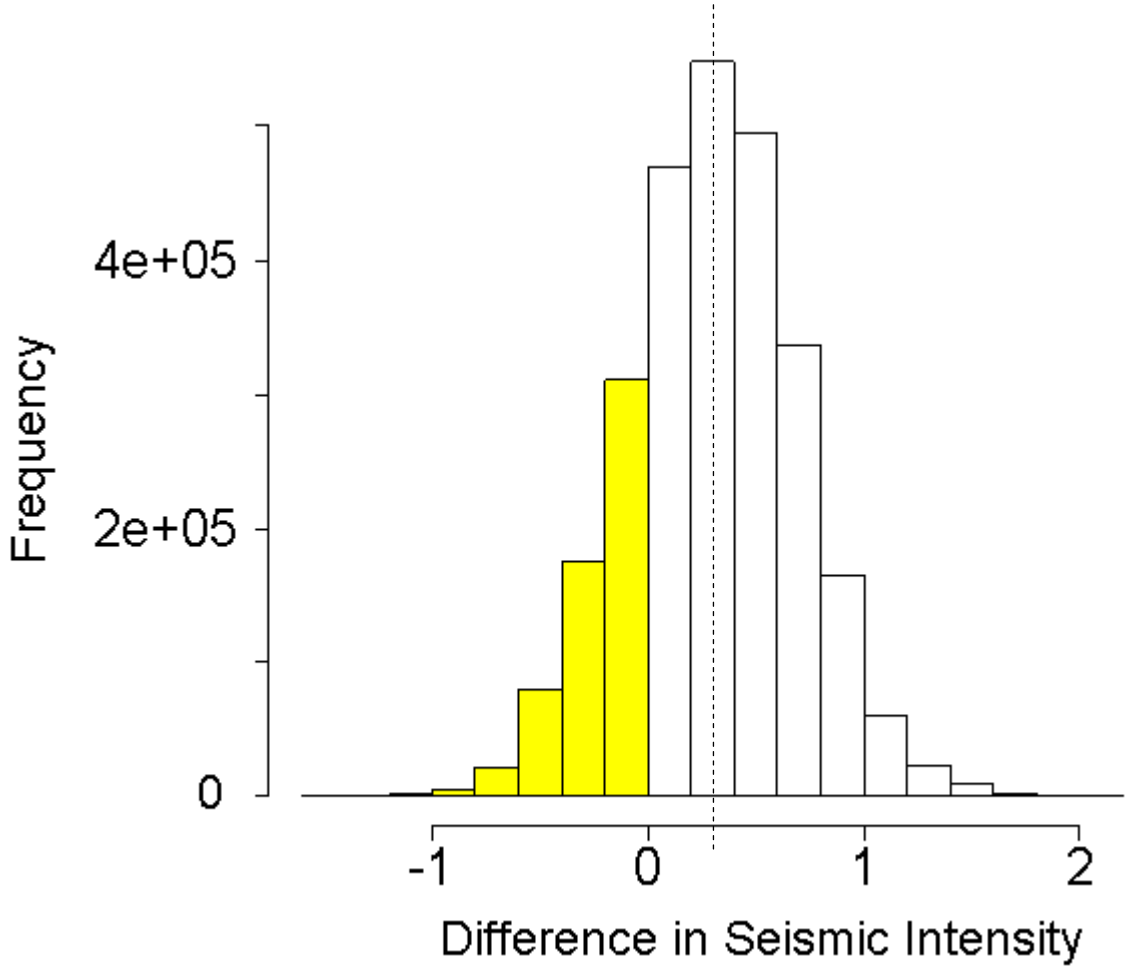
M9.0



M8.7

Effect of Magnitude (3/3)

- **Difference in JMA Seismic Intensity between M9.0 & M8.7**

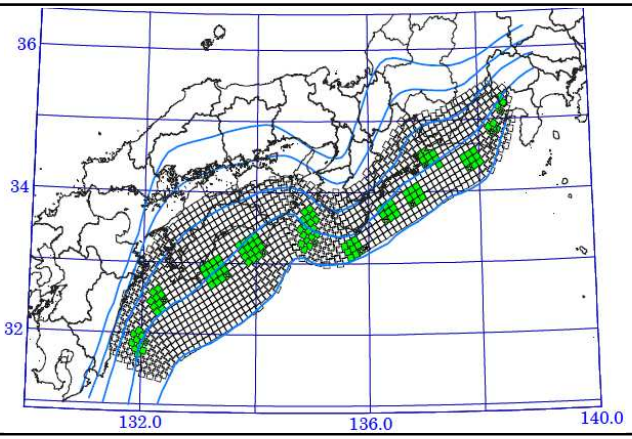
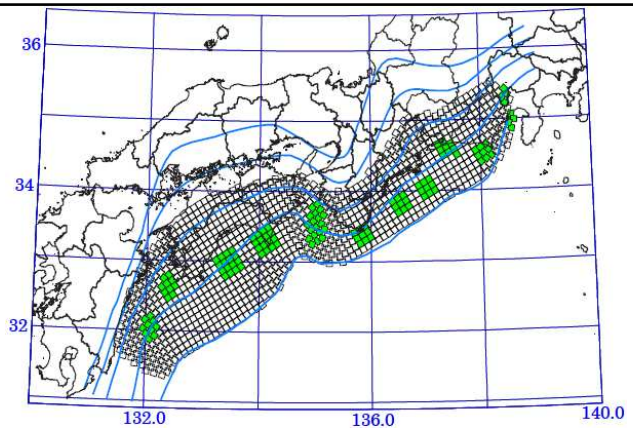
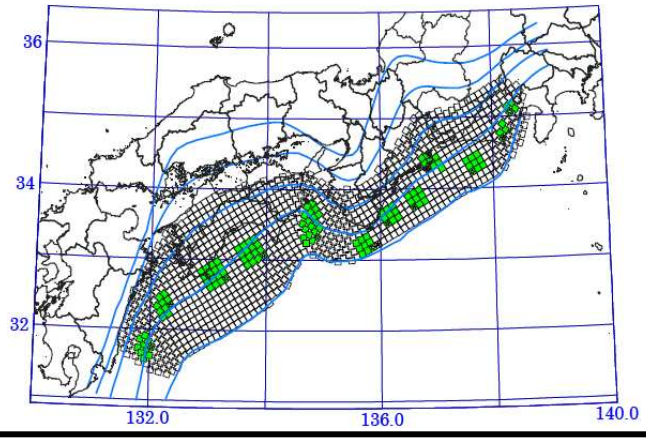
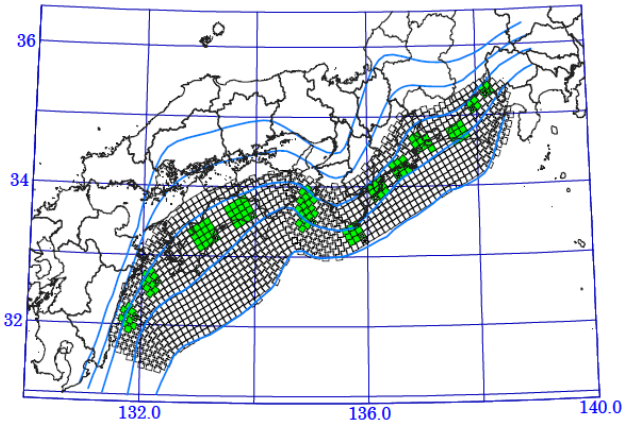


(M9.0 － M8.7)

mean		**0.302**
σ		0.394
quartile	min	-1.459
	25%tile	0.042
	median	0.308
	75%tile	0.565
	max	2.196

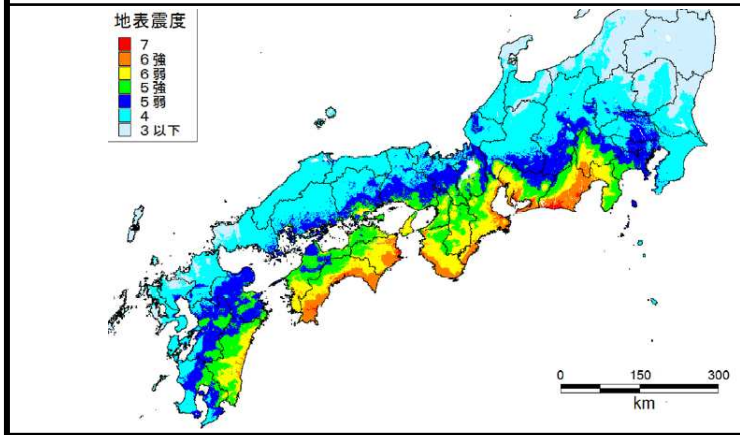
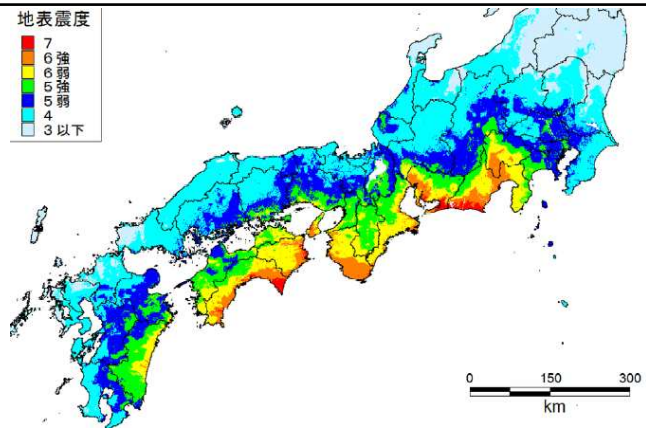
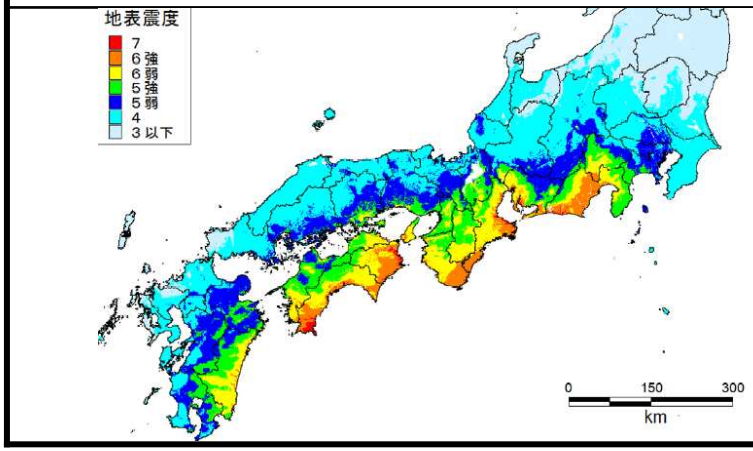
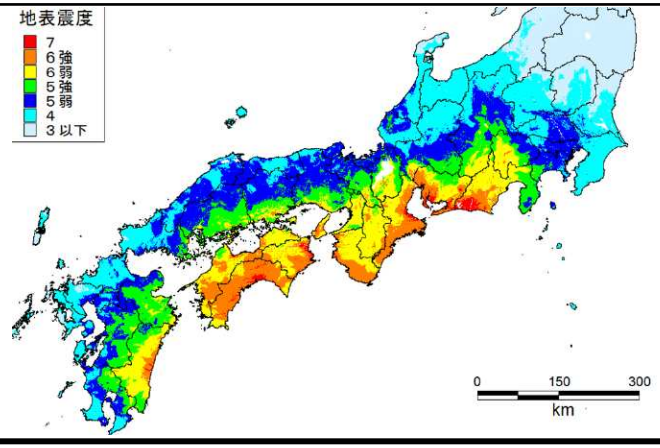
Effect of Asperity (1/3)

- 4 Asperity Models for Nankai Trough M9.0 Earthquake

Standard Case	East Case
	
West Case	**Near Land Case**
	

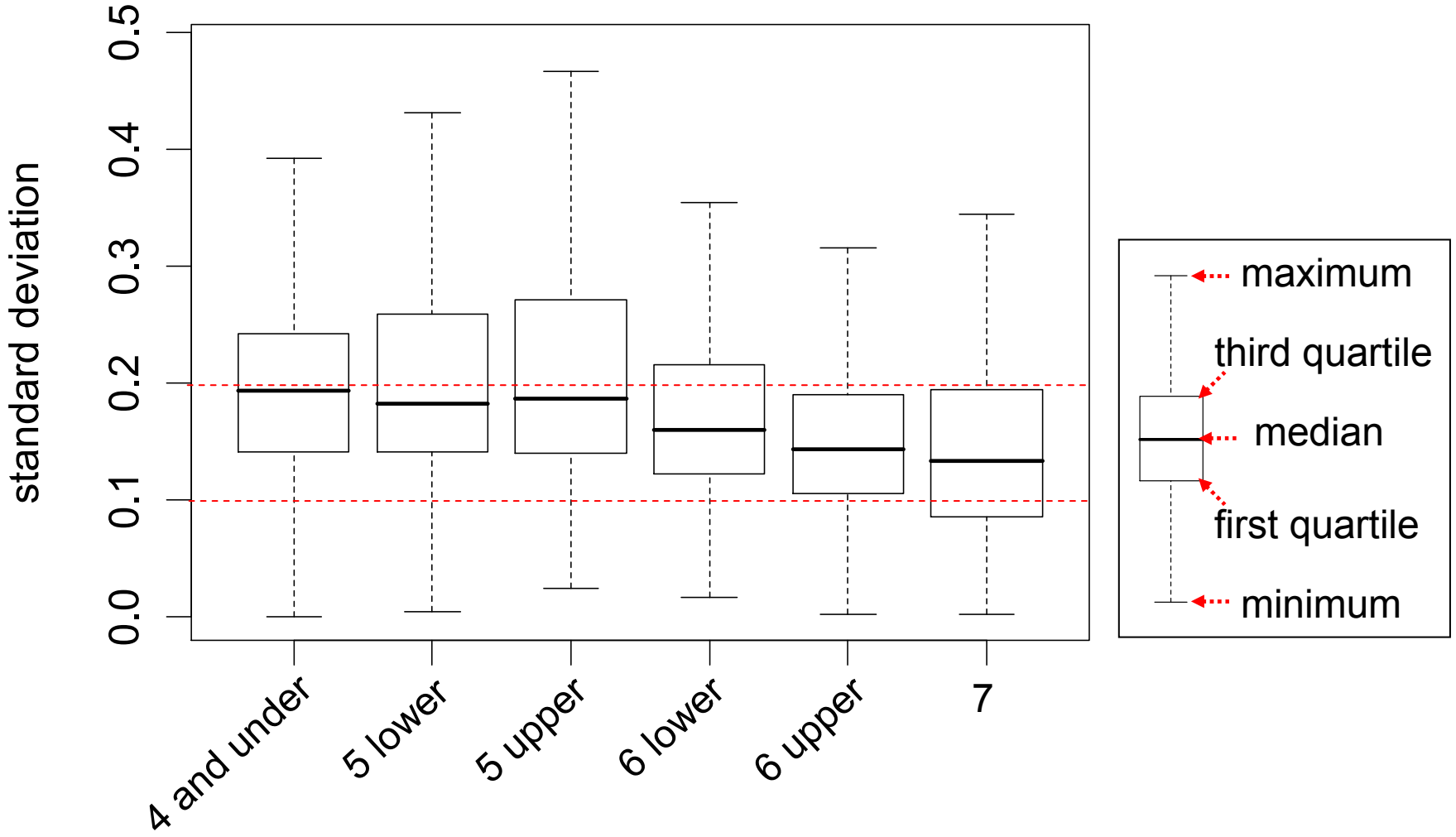
Effect of Asperity (2/3)

- **Difference in JMA Seismic Intensity distribution**

Standard Case	East Case
	
West Case	**Near Land Case**
	

Effect of Asperity (3/3)

- **Variation in JMA Seismic Intensity for each mesh**

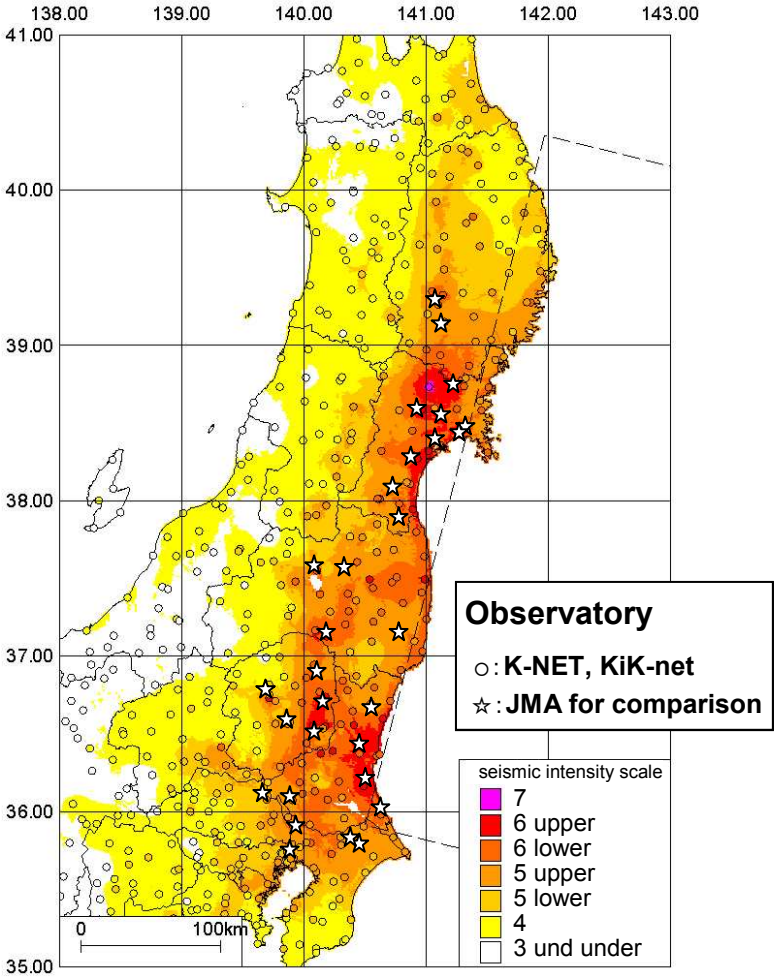


Standard Deviation of Attenuation Curves

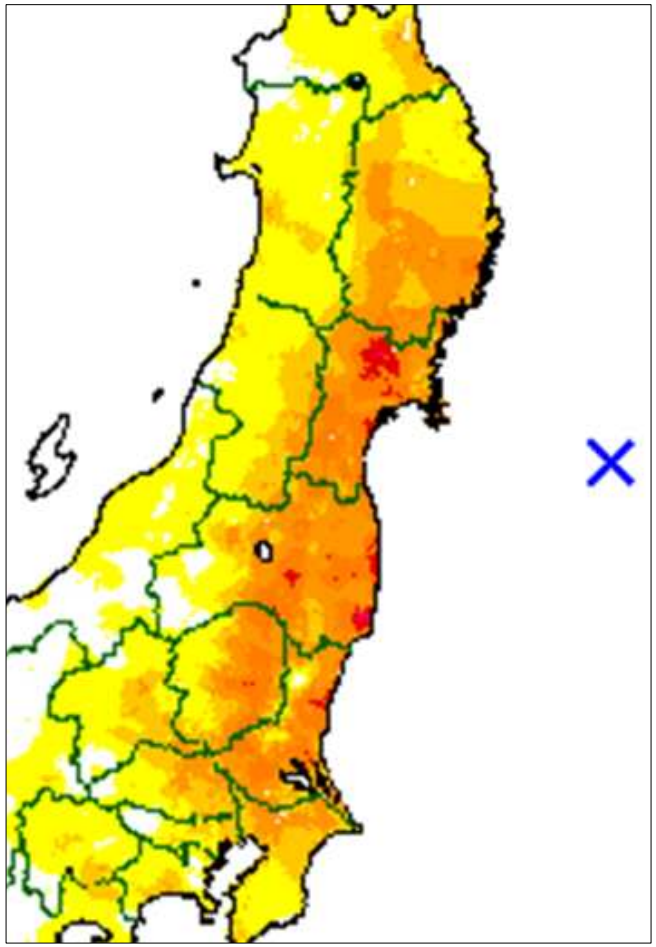
Research	Data Source	σ
Shabestari & Yamazaki (1999)	K-NET 94 events, 6,017 records, 1996~1998	0.535
	JMA 1,020 events, 3990 record, 1988~1996	0.544
	JMA (M = 4 and over)	0.511
Matsuzaki et al. (2006)	JMA, Local Government etc. 554 events, 27,531 records, 1926~2005 ※	0.701
Morikawa et al. (2010)	K-NET, JMA, Local Government etc. 194 events, 11,919 records, 1963~2003	0.36

※ The database by Ishigaki & Takagi (2000) is used. The database covers 93,148 events during 1926 to 1999. 6 recent events are added to data set in the study.

Spatial Interpolation of SI for Tohoku EQ



K-NET + KiK-net + RASMO※



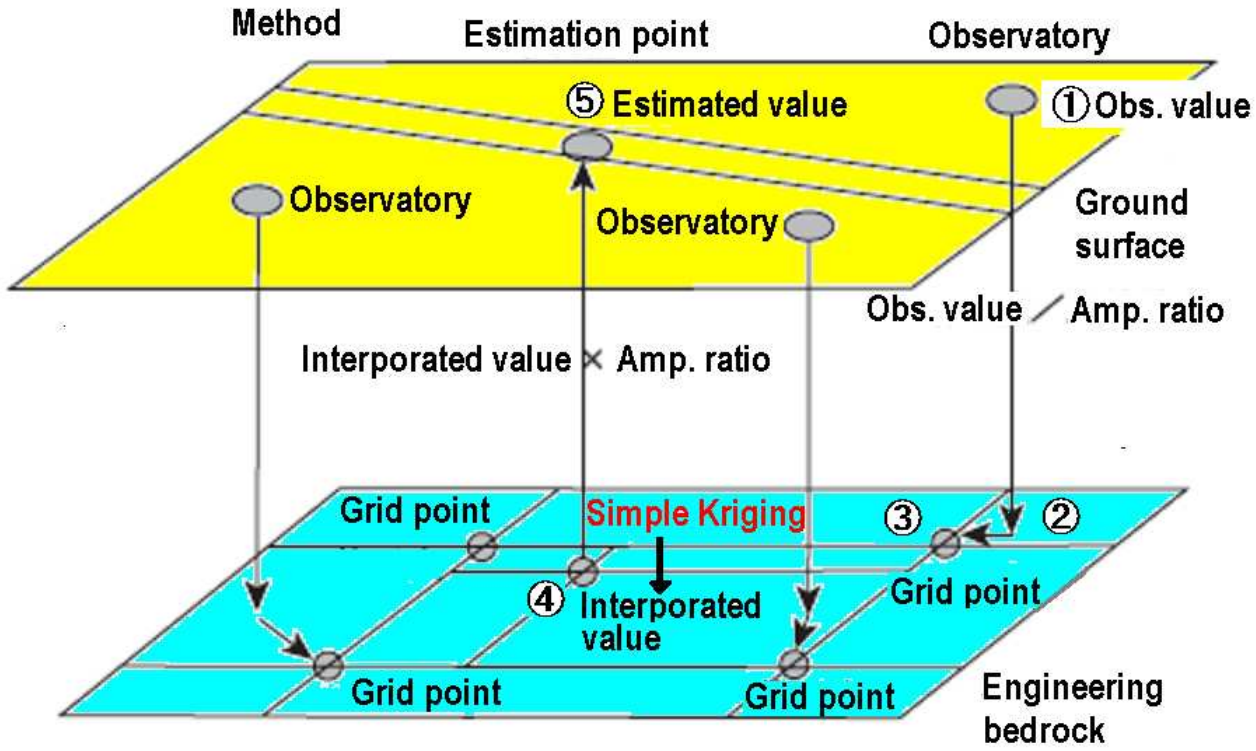
Estimated Seismic Intensity Map (JMA)

※ **RA**pid **S**hake **M**ap simulator with **O**bserved records

http://www.seisvol.kishou.go.jp/eq/suikei/eventlist.html

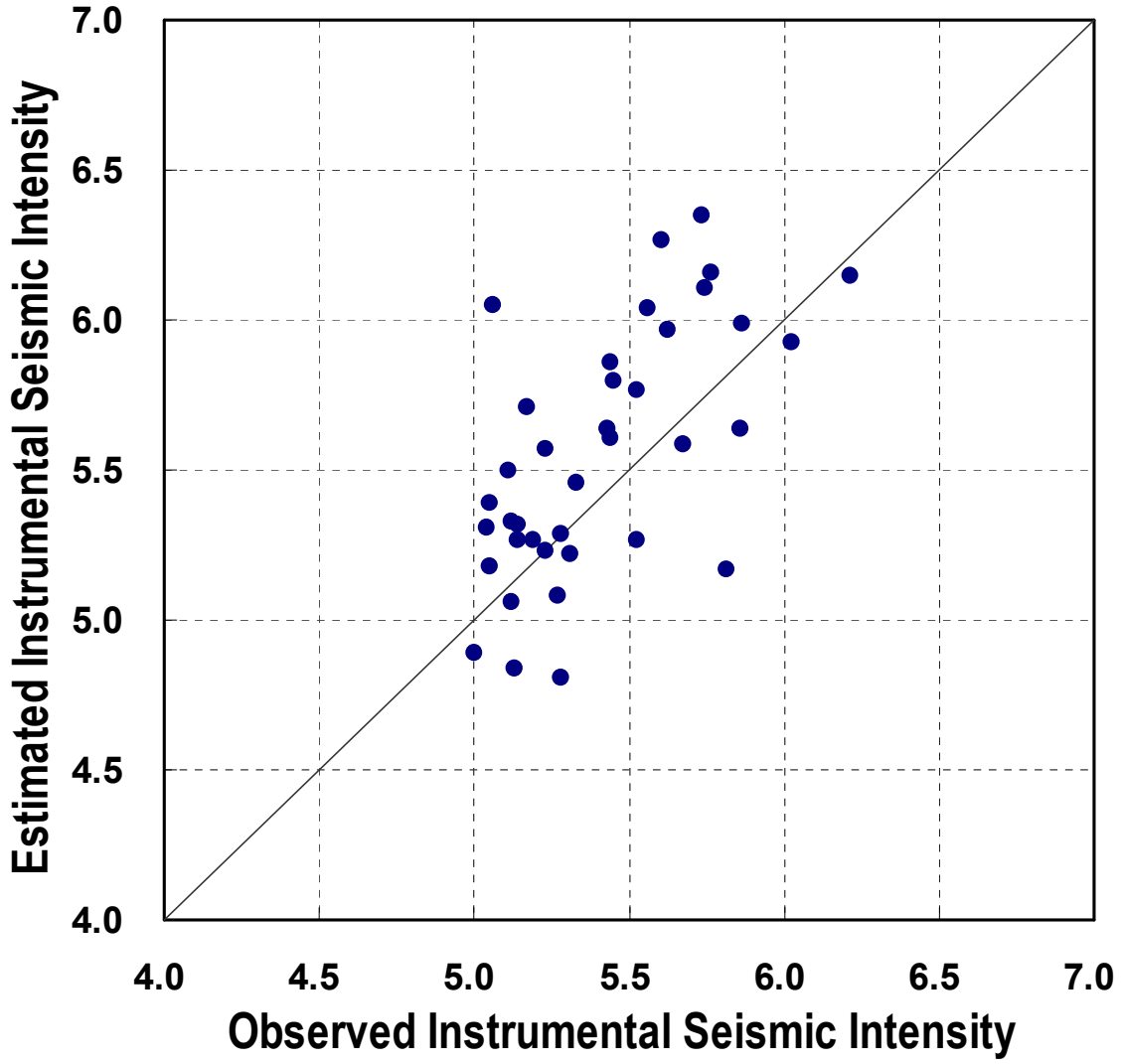
Spatial Interpolation Method (RASMO)

- **RASMO: RA**pid **S**hake **M**ap simulator with **O**bserved records
- The program was developed by NIED Kawasaki Laboratory in the "Special Project for Earthquake Disaster Mitigation in Urban Areas (2002 – 2006)"



Prediction Error of Spatial Interpolation

Prediction Error: Standard Deviation = **0.323**



Thank you !

謝謝!

감사합니다!

Acknowledgements
We used K-NET and KiK-net data and RASMO for spatial interpolation study of seismic intensity. We would like to express our deepest gratitude to NIED and those involved.

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