Procedure of Evaluating Parameters of Inland Earthquakes Caused by Long Strike-Slip Faults for Ground Motion Prediction

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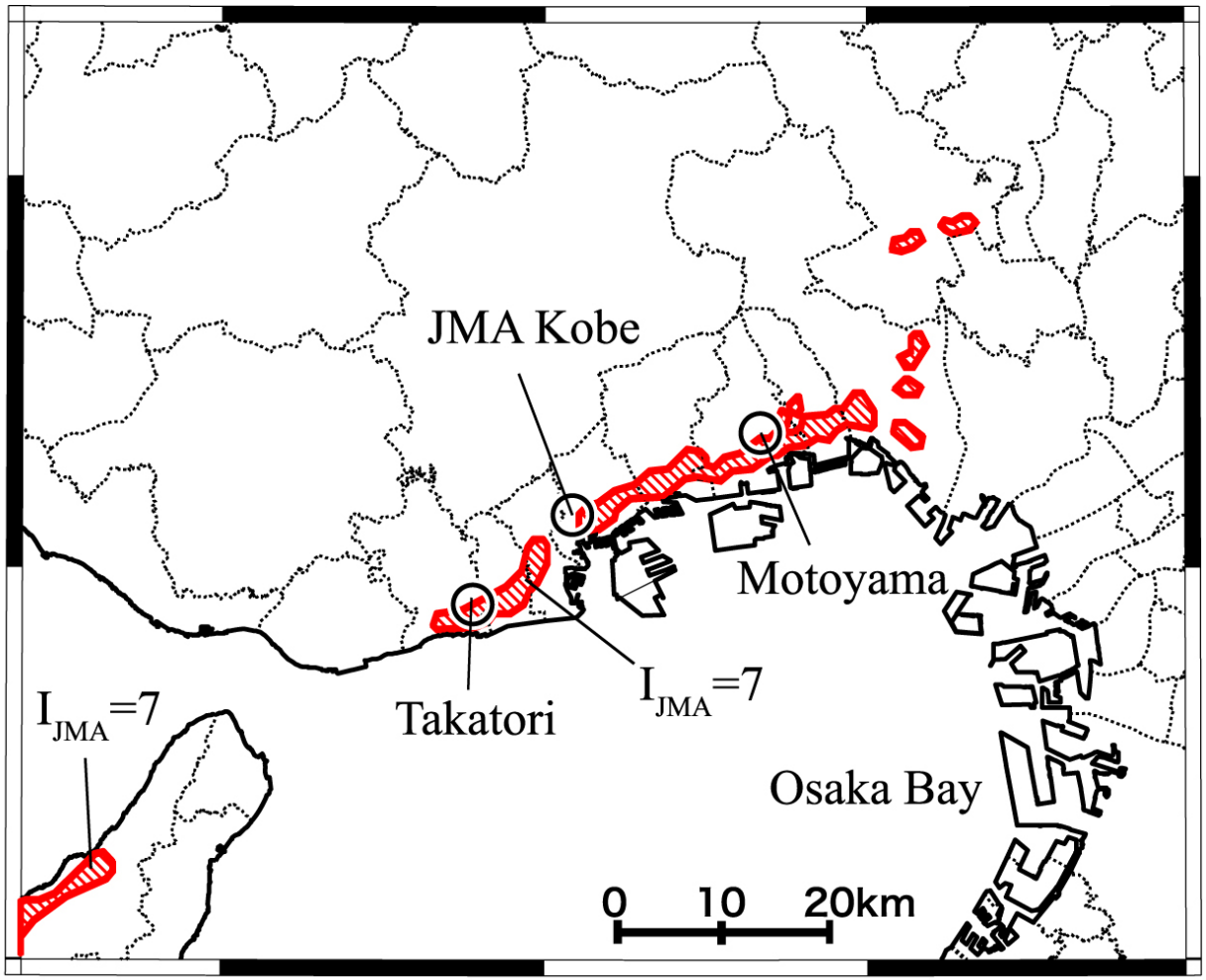
1. Introduction

(Brief Review on the Existing Procedure of Evaluating Fault Parameters in Japan)

Damage Belt Zone of the 1995 Kobe, Japan, Earthquake

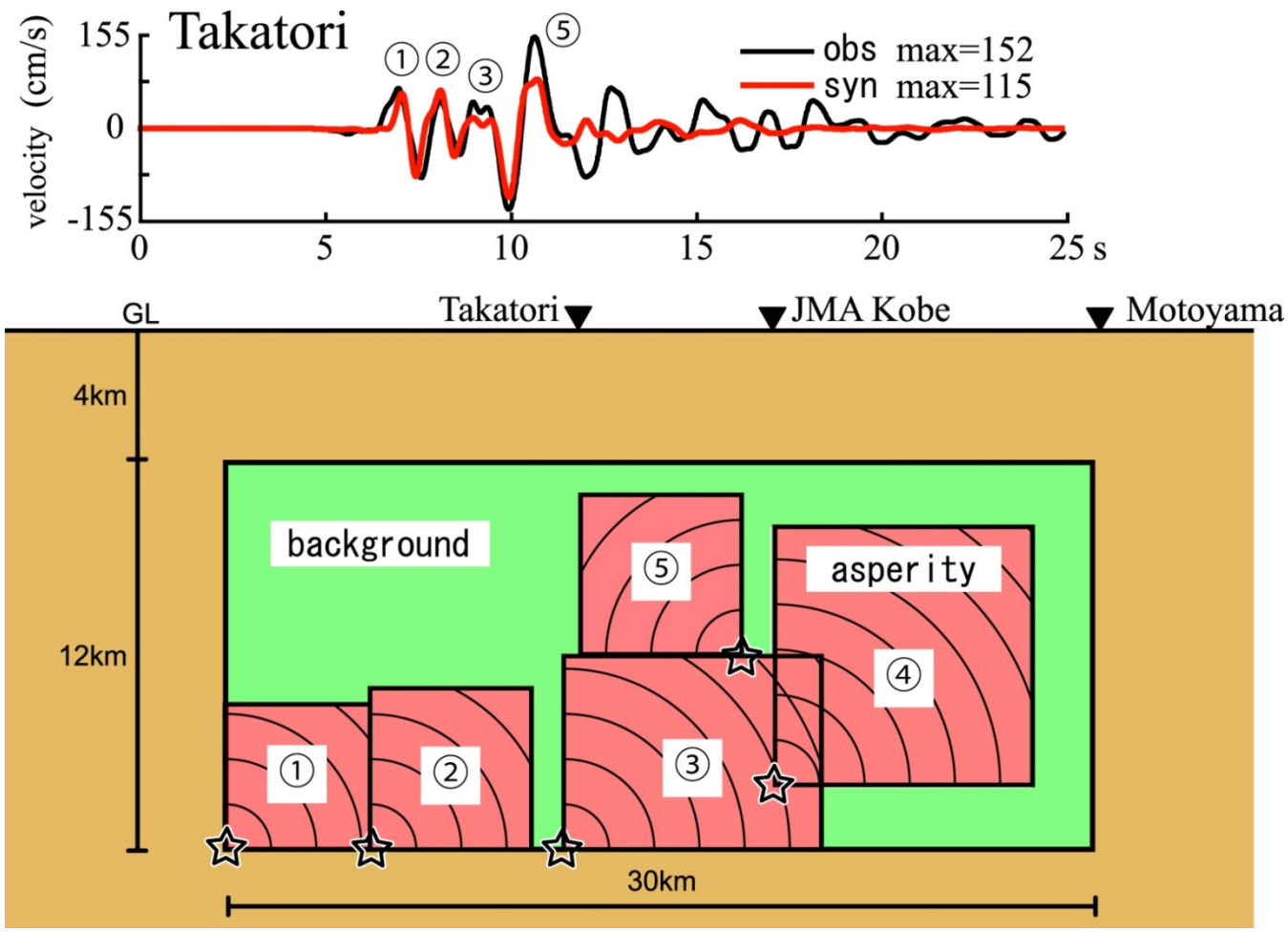


M_W 6.8

: Damage Belt Zone

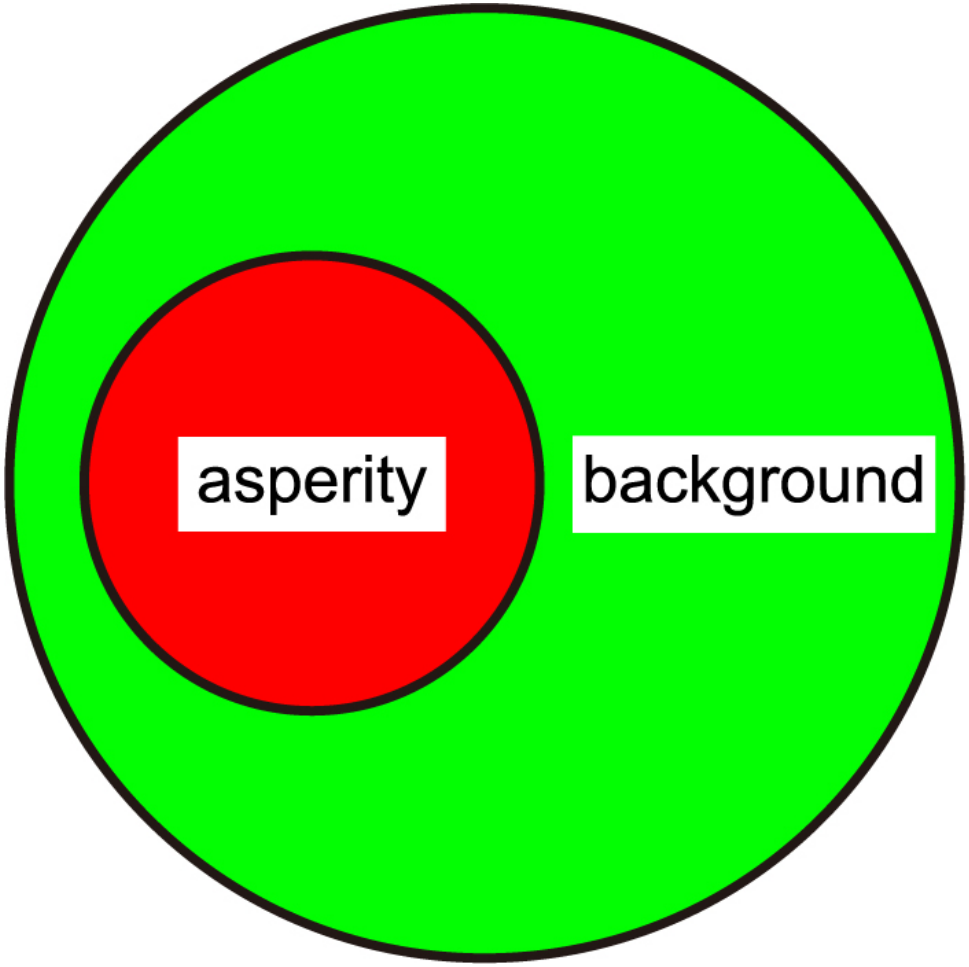
Modified Matsushima and Kawase (2006)

Killer Pulses and Asperities of the 1995 Kobe Earthquake, Japan



Matsushima and Kawase (2006)

Asperity Model and Six Major Parameters



causes: source

S_{seis}: seimic fault area

$\Delta\sigma$: average stress drop

S_{asp}: area of asperity

$\Delta\sigma_{asp}$: stress drop on asperity

⇩

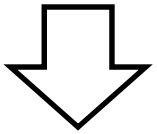
results: seismic waves

M_0: seismic moment

A: short-period level

Problem in the Existing Procedure in Japan

fault width W_{max} , fault length→very long



slip on the background = negative

unable to set the fault model

Cause of the Negative Slip on the Background and Solutions to the Problem

circular crack equation

$$\Delta\sigma = \frac{7}{16}\frac{M_0}{(S_{seis}/\pi)^{3/2}}$$

Eshelby (1957)

⇩

dynamic stress drop equation

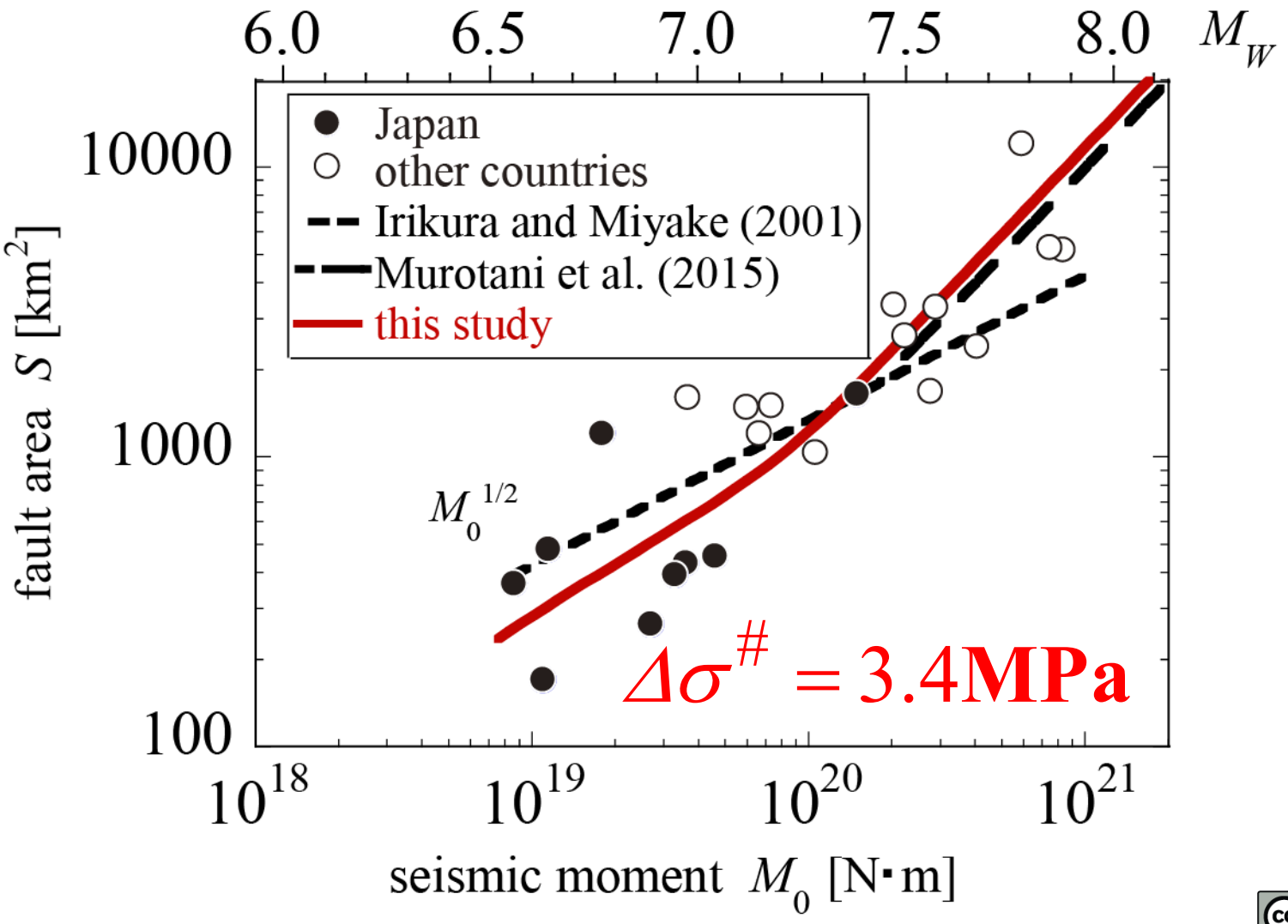
$$\Delta\sigma^{\#} = c\frac{M_0}{S_{seis}W_{seis}}$$

Irie *et al.* (2010)

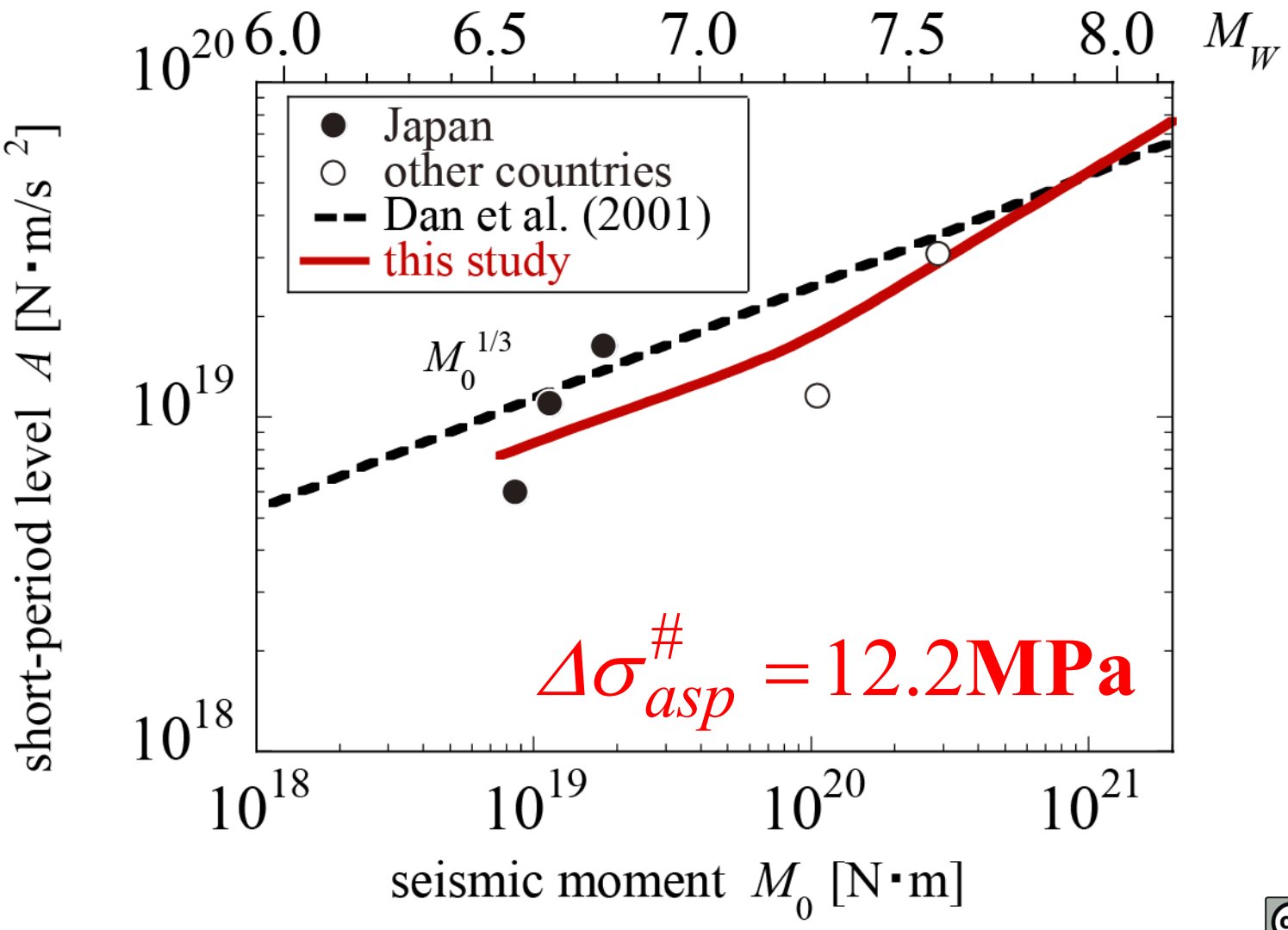
$$c = 0.5 + 2\exp[-L_{seis}/W_{seis}]$$

2. Scaling Laws of Fault Parameters for Inland Earthquakes Caused by Long Strike-Slip Faults

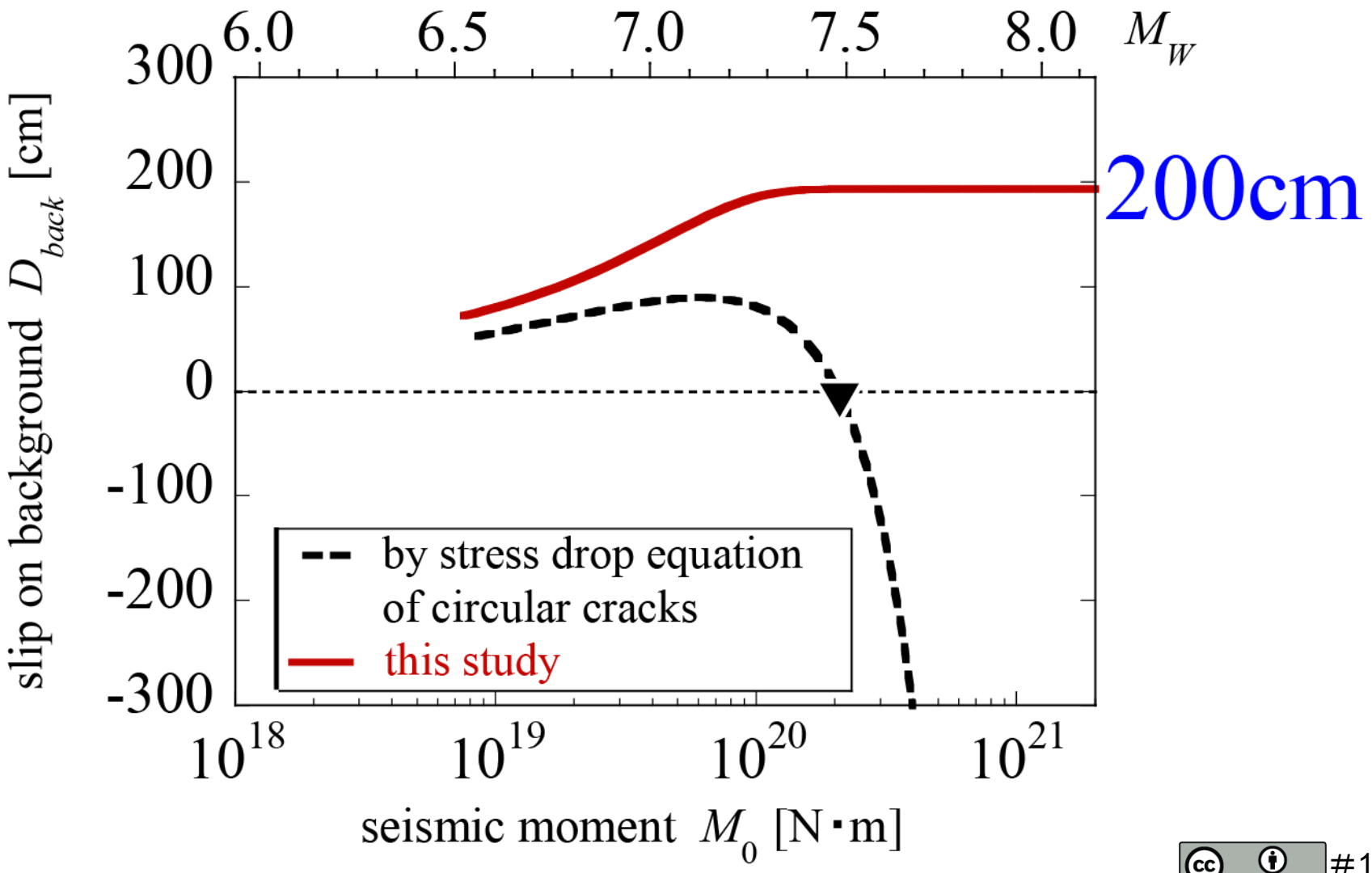
Re-evaluation of Empirical Relationship between the Fault Areas and the Seismic Moment



Re-evaluation of Empirical Relationship between the Short-Period Level and the Seismic Moment



Relationship between the Slip on the Background (Off Asperity) and the Seismic Moment



3. Procedure of Evaluating Fault Parameters for Long Strike-Slip Faults

Procedure of Evaluating Parameters of Vertical Strike-Slip Faults for Strong Motion Prediction

Seismic Fault Length $L_{seis} = L$

Seismic Fault Width W_{seis}

Average Stress Drop $\Delta\sigma^{\#} = 3.4\text{MPa}$

Asperity Stress Drop $\Delta\sigma^{\#}_{asp} = 12.2\text{MPa}$

Seismic Moment $M_0 = \Delta\sigma^{\#} \dfrac{S_{seis} W_{seis}}{c}$

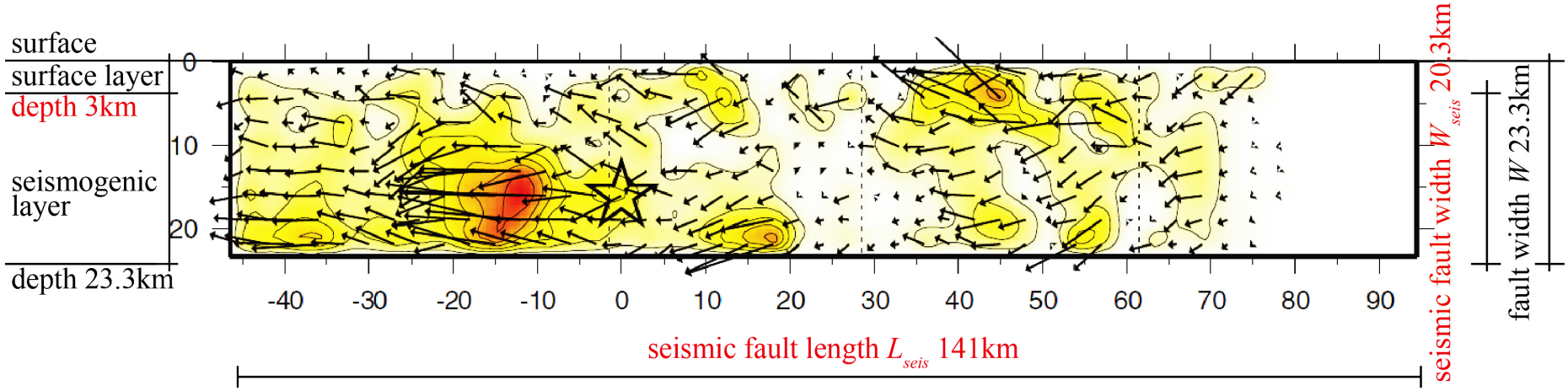
Asperity Area $S_{asp} = \dfrac{\Delta\sigma^{\#}}{\Delta\sigma^{\#}_{asp}} S_{seis}$

Short-period Level $A = 4\pi\beta^2 \sqrt{\dfrac{S_{asp}}{\pi}} \Delta\sigma^{\#}_{asp}$

4. Validation of the Proposed Procedure by Strong Ground Motion Simulation for the 1999 Kocaeli, Turkey, Earthquake

Final Slip Distribution of the 1999 Kocaeli, Turkey, Earthquake

Sekiguchi and Iwata (2002)



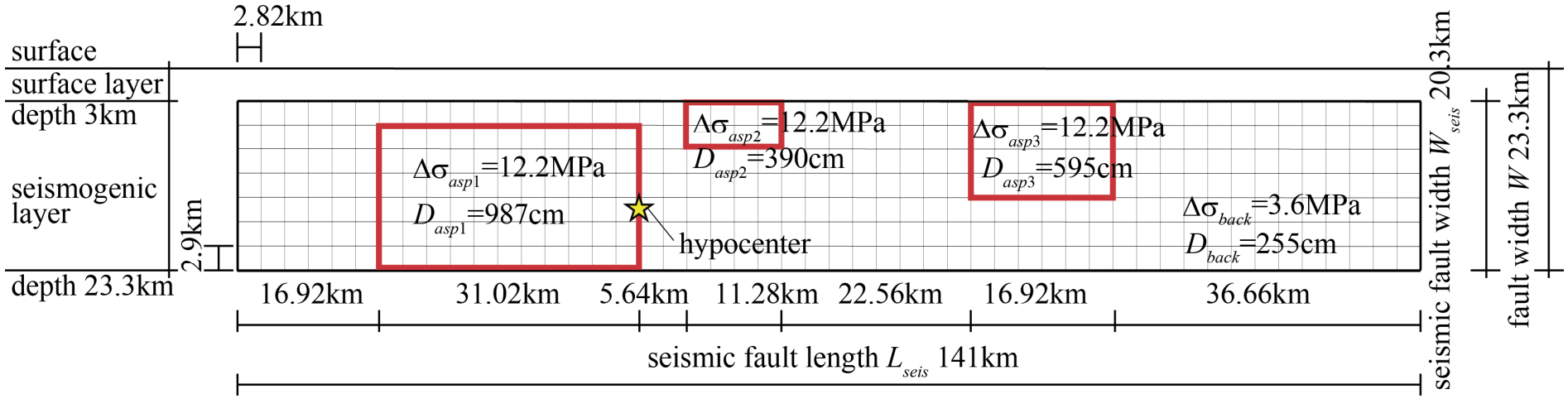
Seismic Fault Length $L_{seis} = L = 141\text{km}$

Seismic Fault Width $W_{seis} = W - 3\text{km} / \sin(\delta, \text{Dip:}90^\circ)$

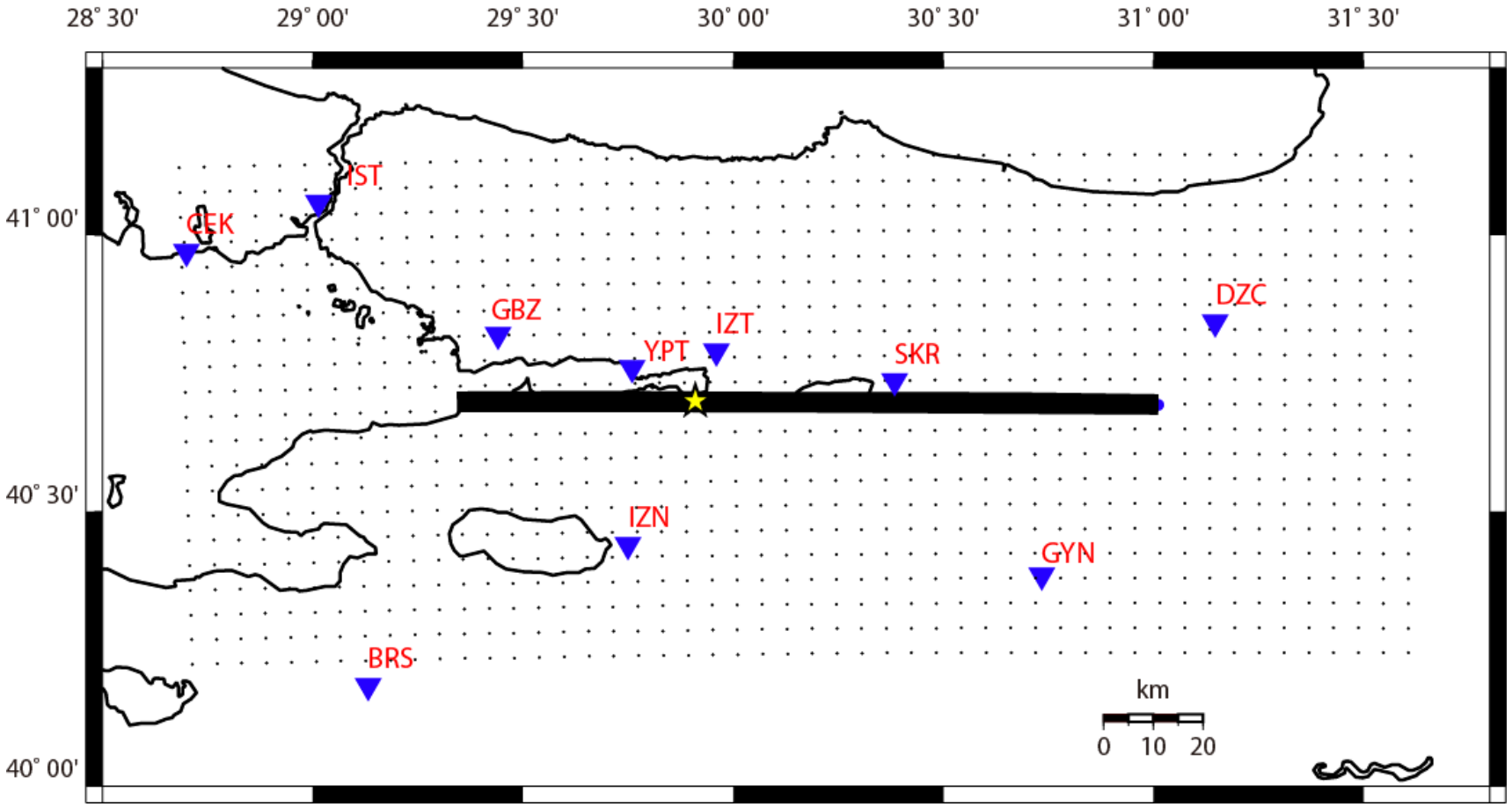
$= 23.3\text{km} - 3\text{km}$

$= 20.3\text{km}$

Asperity Model for the 1999 Kocaeli, Turkey, Earthquake

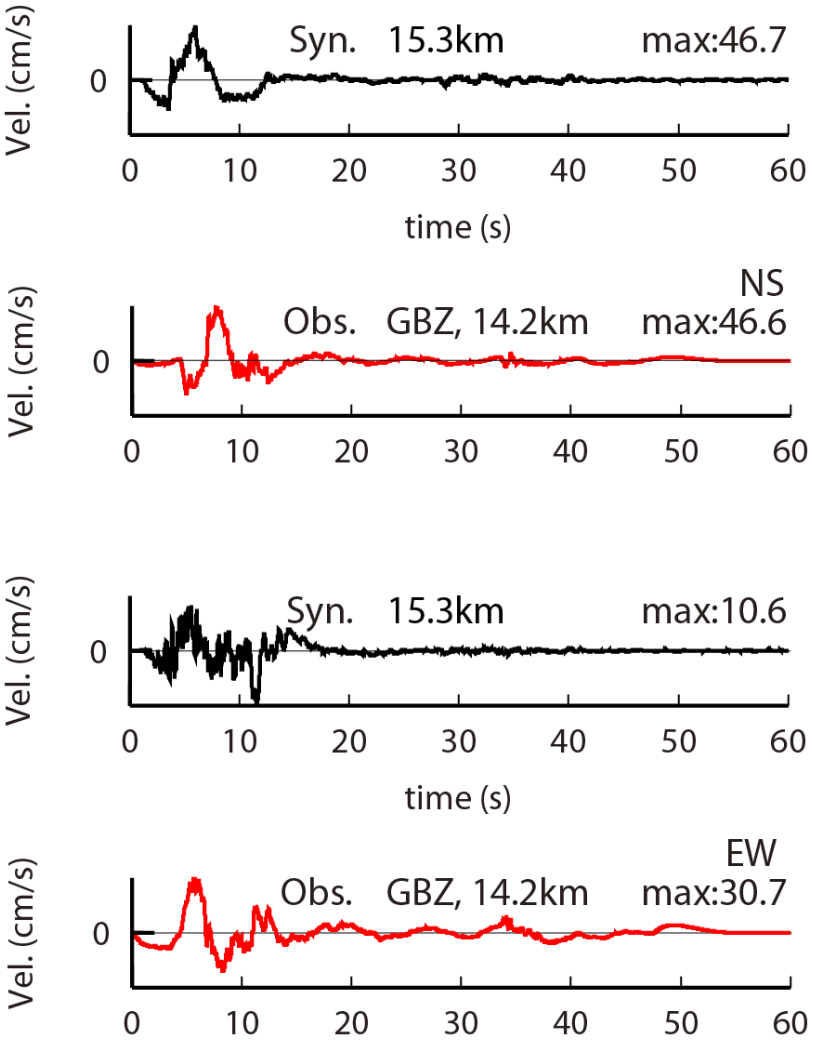


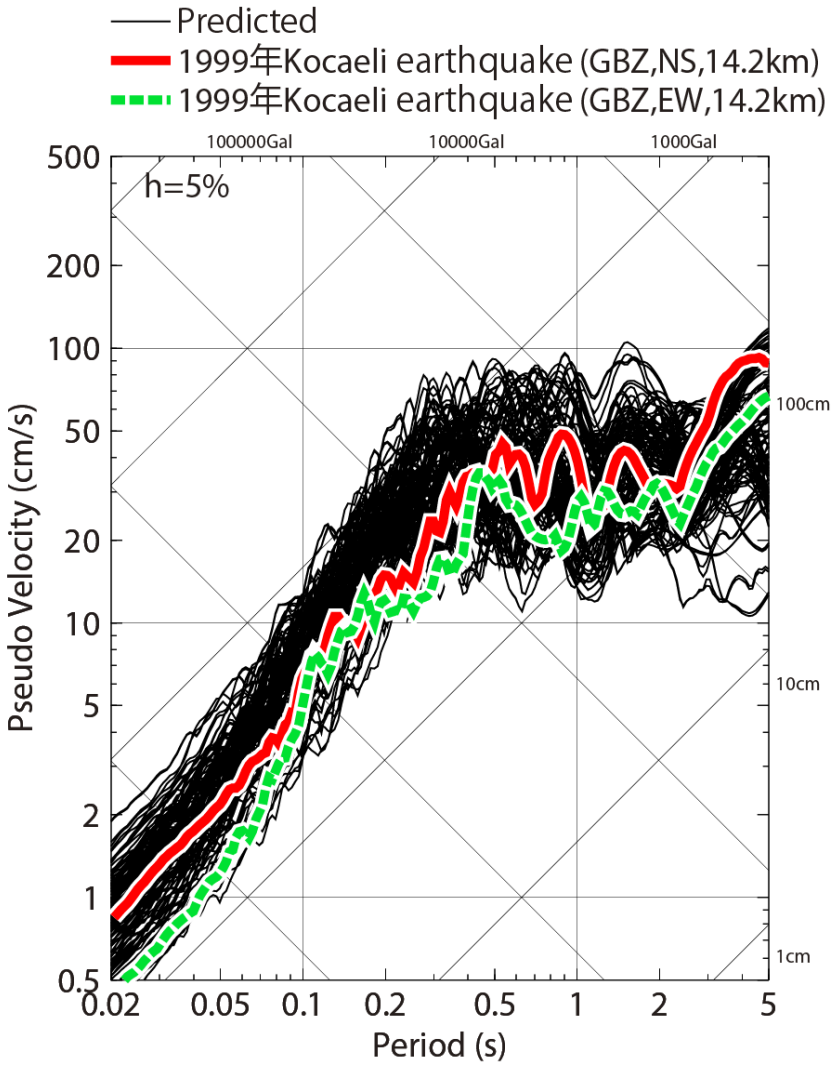
Locations of Fault Model, the Observation Stations, and Strong Motion Estimation Points



Bold line : Fault plane, ☆: Nucleation point,
▼ : Observation Stations, ●: Strong Motion Estimation Points

Comparison of the Predicted Strong Ground Motions with the Observations





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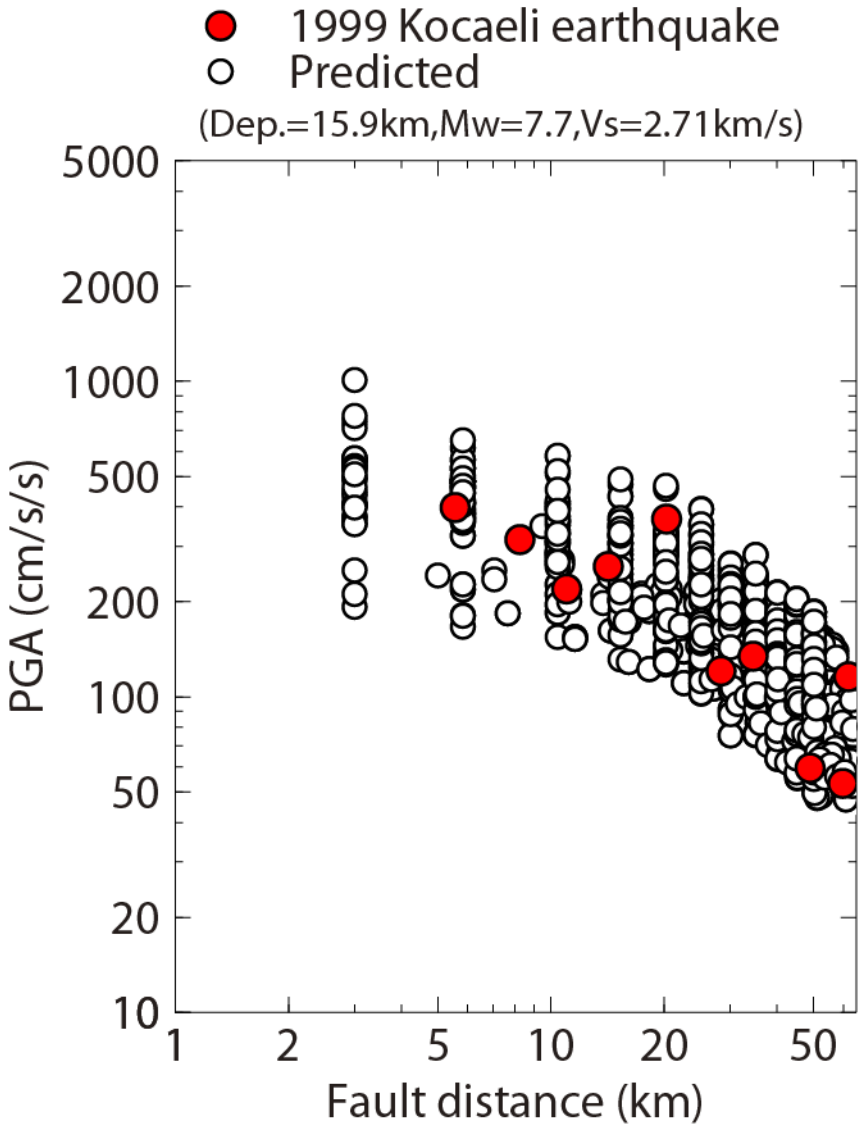

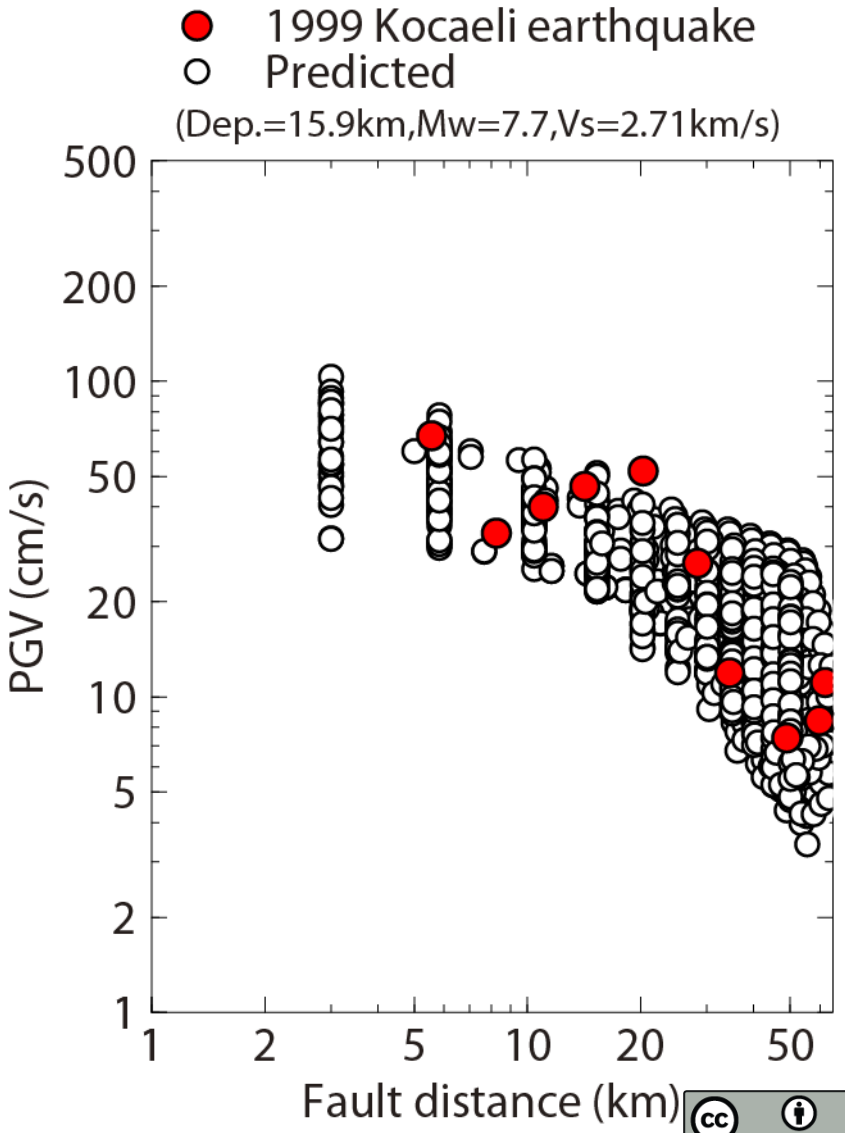

5. Conclusions

Conclusions

1. Re-evaluated the scaling laws of fault parameters for inland earthquakes caused by long strike-slip faults

2. Proposed the procedure of evaluating fault parameters for long strike-slip faults

3. Validated the proposed procedure by strong ground motion simulation for the 1999 Kocaeli, Turkey, earthquake

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