Scenario Earthquake Shaking Maps in Japan

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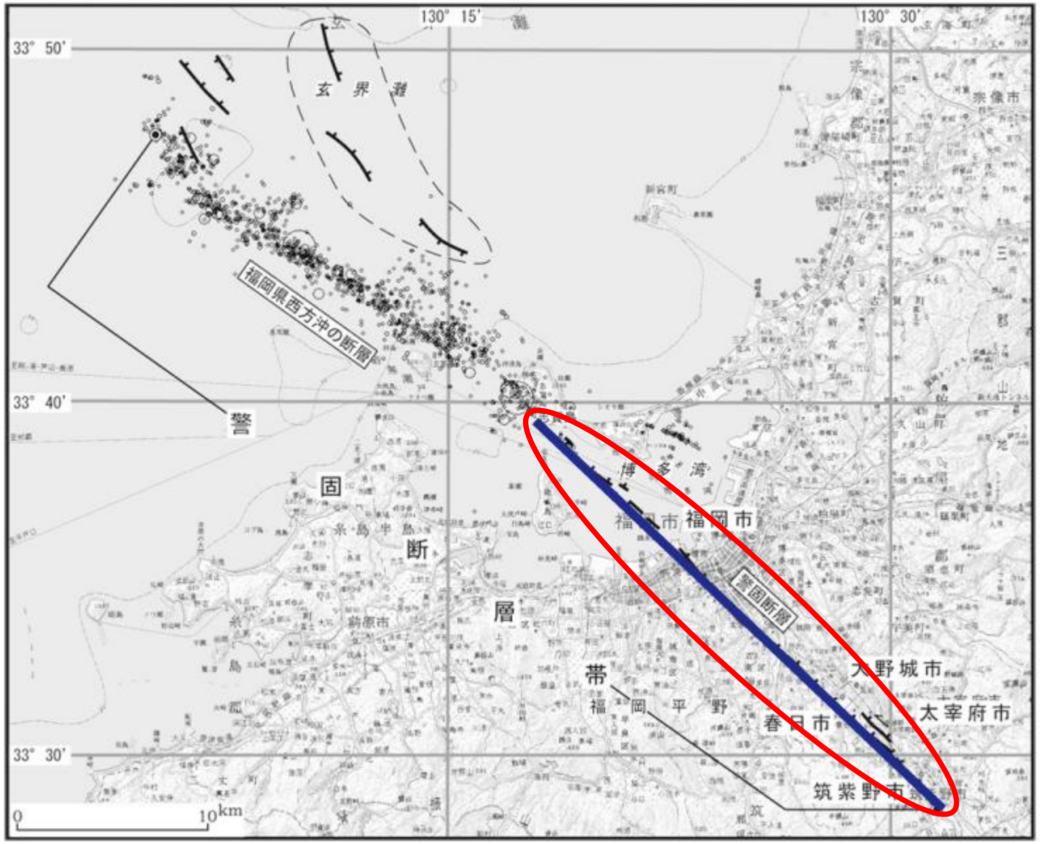
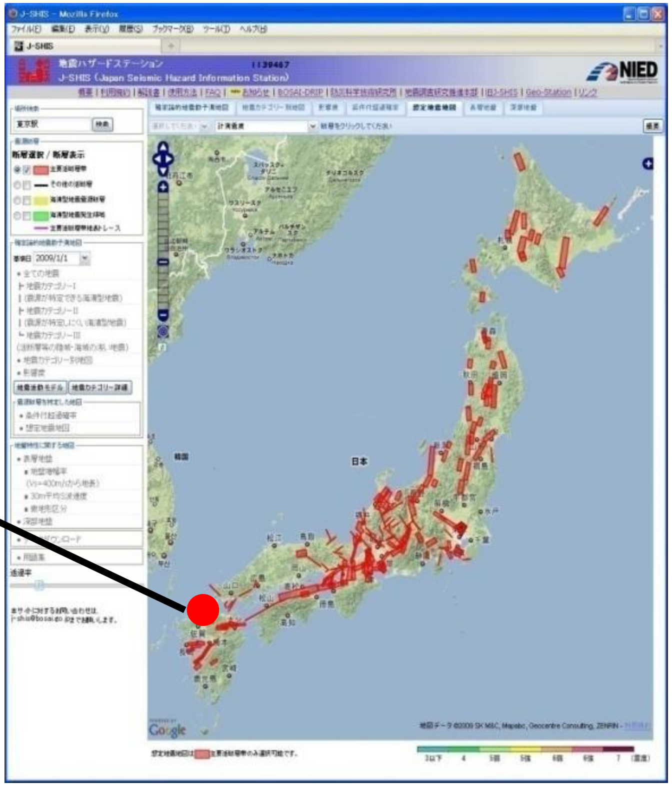
Example of SESMs

The Kego fault zone (south-east part)

・・・ The first application of the revised-version of ‘Recipe’





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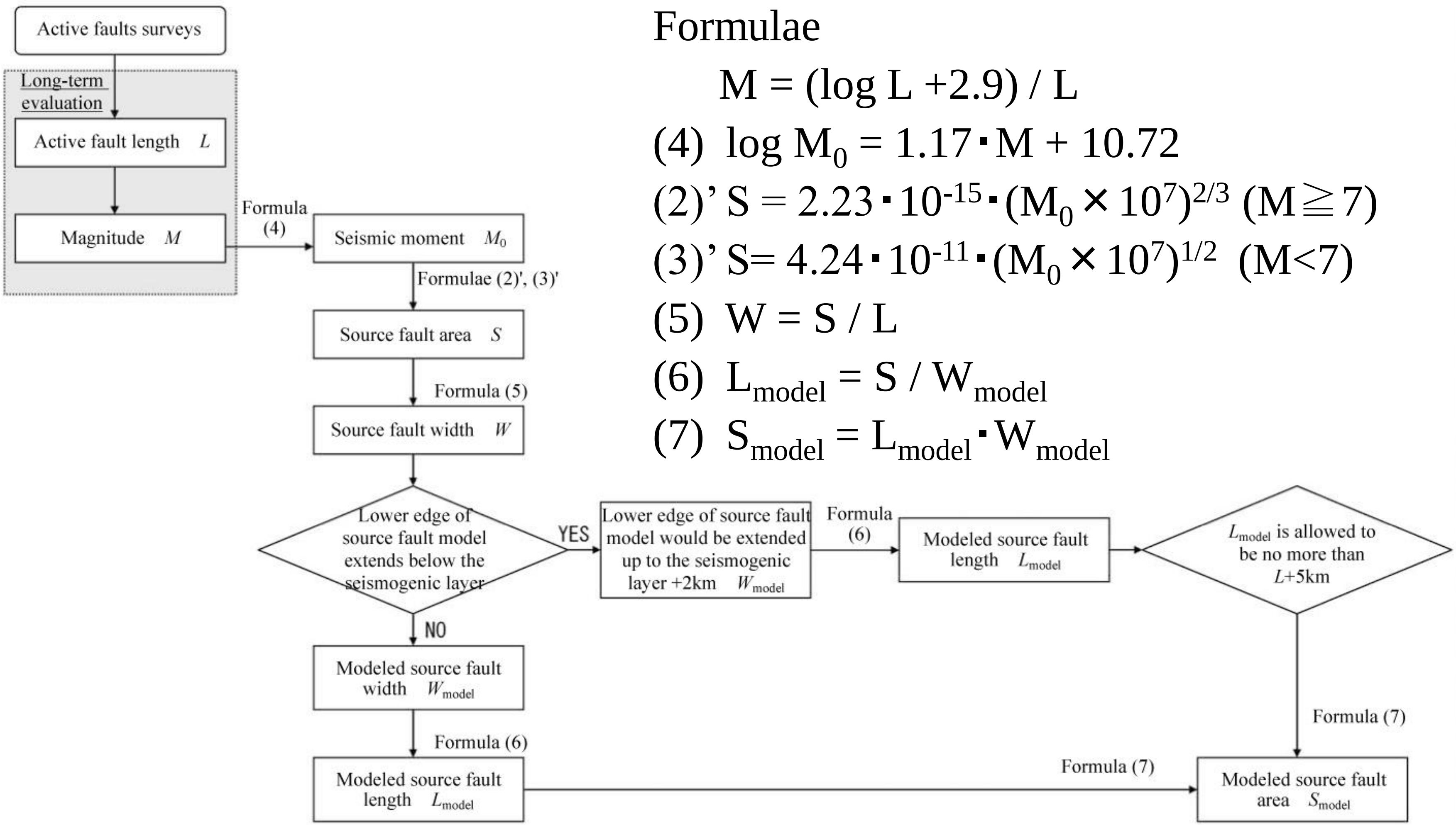
Characterized source model

Fault length (L) by the long-term evaluation ⇒ Outer source parameters
(Added to the revised-version of ‘Recipe’)



Formulae

$M = (\log L + 2.9) / L$

(4) $\log M_0 = 1.17 \cdot M + 10.72$

(2)’ $S = 2.23 \cdot 10^{-15} \cdot (M_0 \times 10^7)^{2/3}$ $(M \geqq 7)$

(3)’ $S = 4.24 \cdot 10^{-11} \cdot (M_0 \times 10^7)^{1/2}$ $(M < 7)$

(5) $W = S / L$

(6) $L_{model} = S / W_{model}$

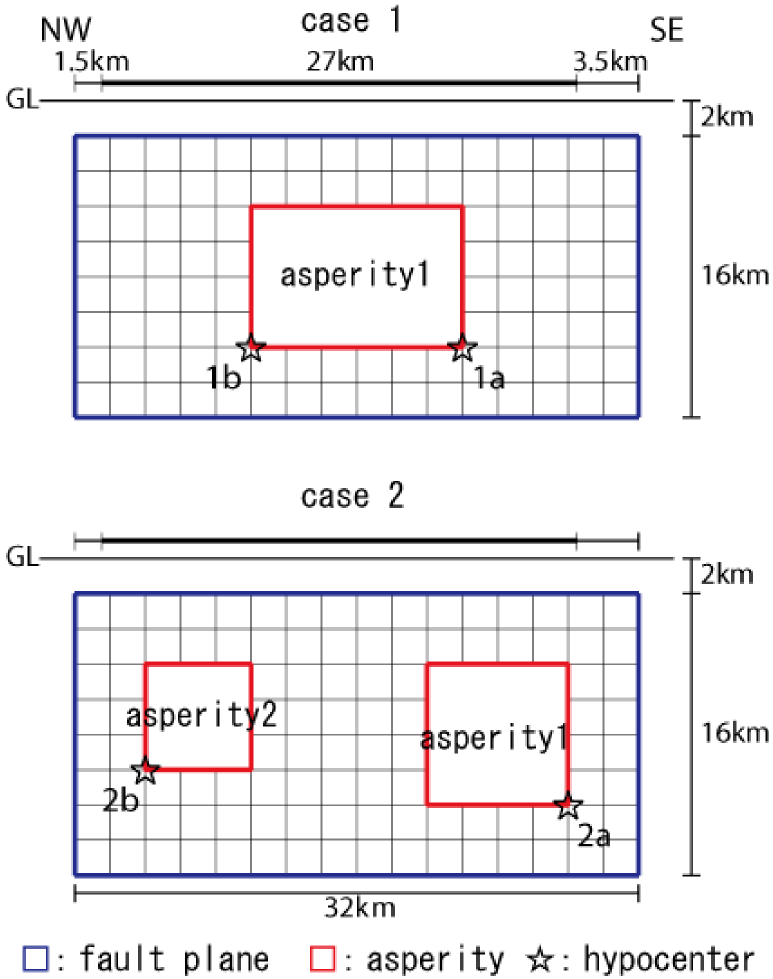
(7) $S_{model} = L_{model} \cdot W_{model}$

Characterized source model

Outer source parameters ⇒ Inner source parameters

For details, see ‘Recipe’

(http://www.j-shis.bosai.go.jp/map/JSHIS2/text/news_en.html)



	case 1	case 2
Outer source parameters		
Seismic moment [Nm]	1.47×10^{19}	
L_{model} [km]	32	
W_{model} [km]	16	
Innter source parameters		
Asperity 1		
Area [km^2]	96	64
Average slip [m]	1.8	2.0
Effective stress [MPa]	16	16
Asperity 2		
Area [km^2]	—	36
Average slip [m]	—	1.4
Effective stress [MPa]	—	16
Background region		
Area [km^2]	416	412
Average slip [m]	0.7	0.7
Effective stress [MPa]	2.8	2.8
Other source parameters		
Rupture velocity [km/s]	2.4	

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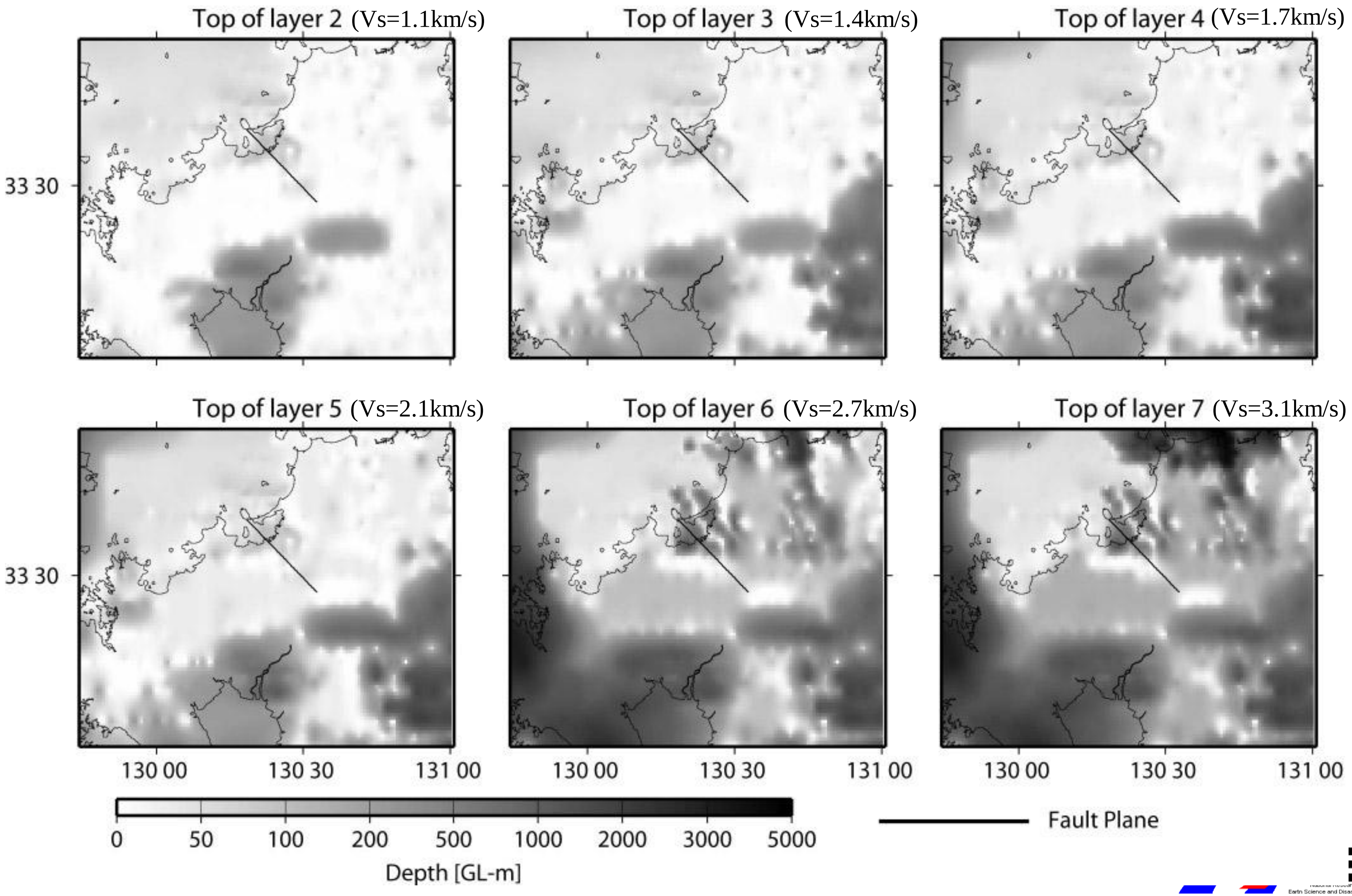
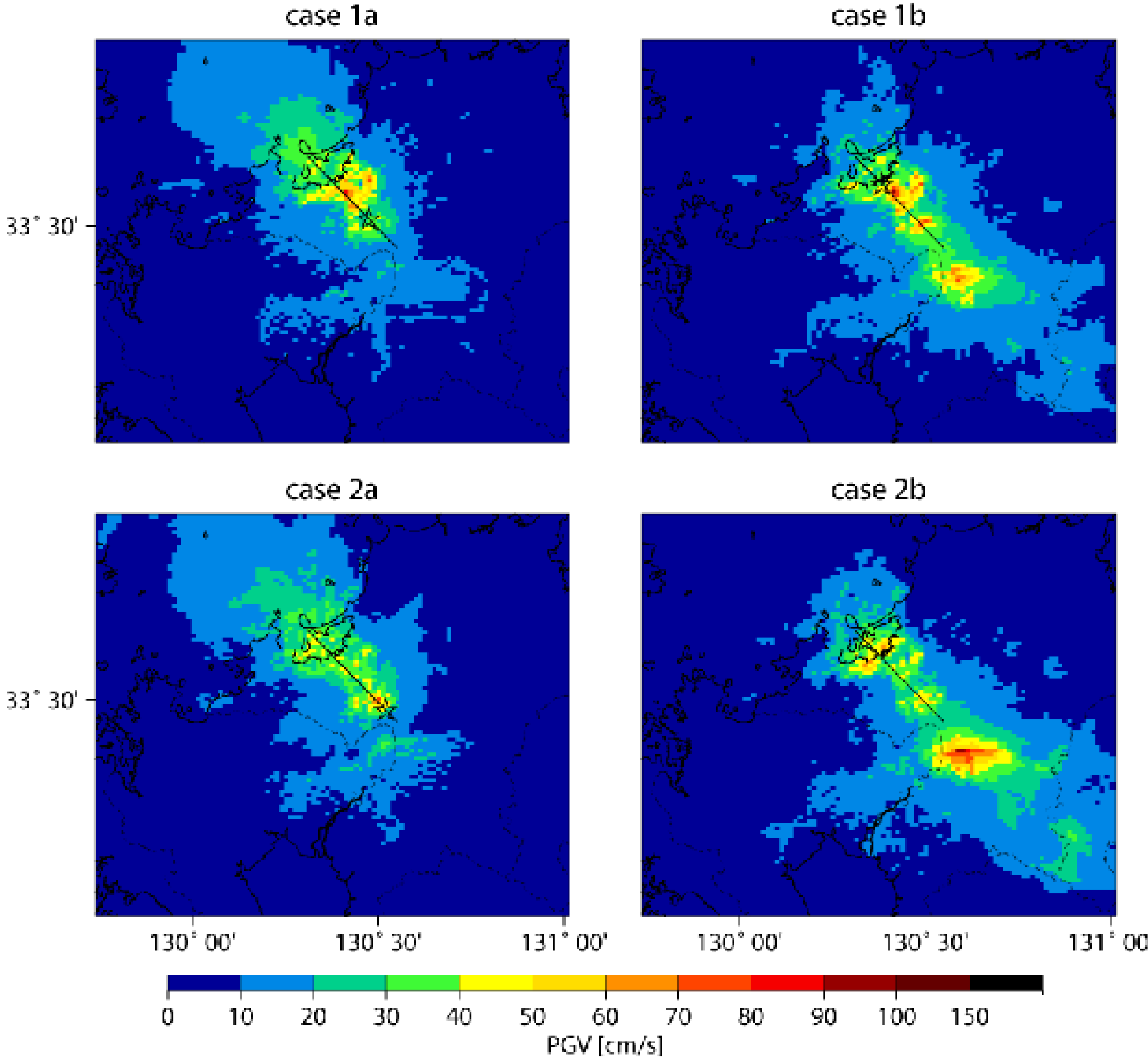
Deep sediments structure model

Seismic bedrock (Vs=3.1 km/s) ~ engineering bedrock (Vs = 0.6 km/s)



Results-1

Peak velocity distribution on the engineering bedrock



- peak velocities at near source fault in cases 1a and 1b are larger than cases 2a and 2b
- large peak velocity region extends to southeastern of the source fault in cases 1b and 2b (forward directivity effect and amplifications by sediments)

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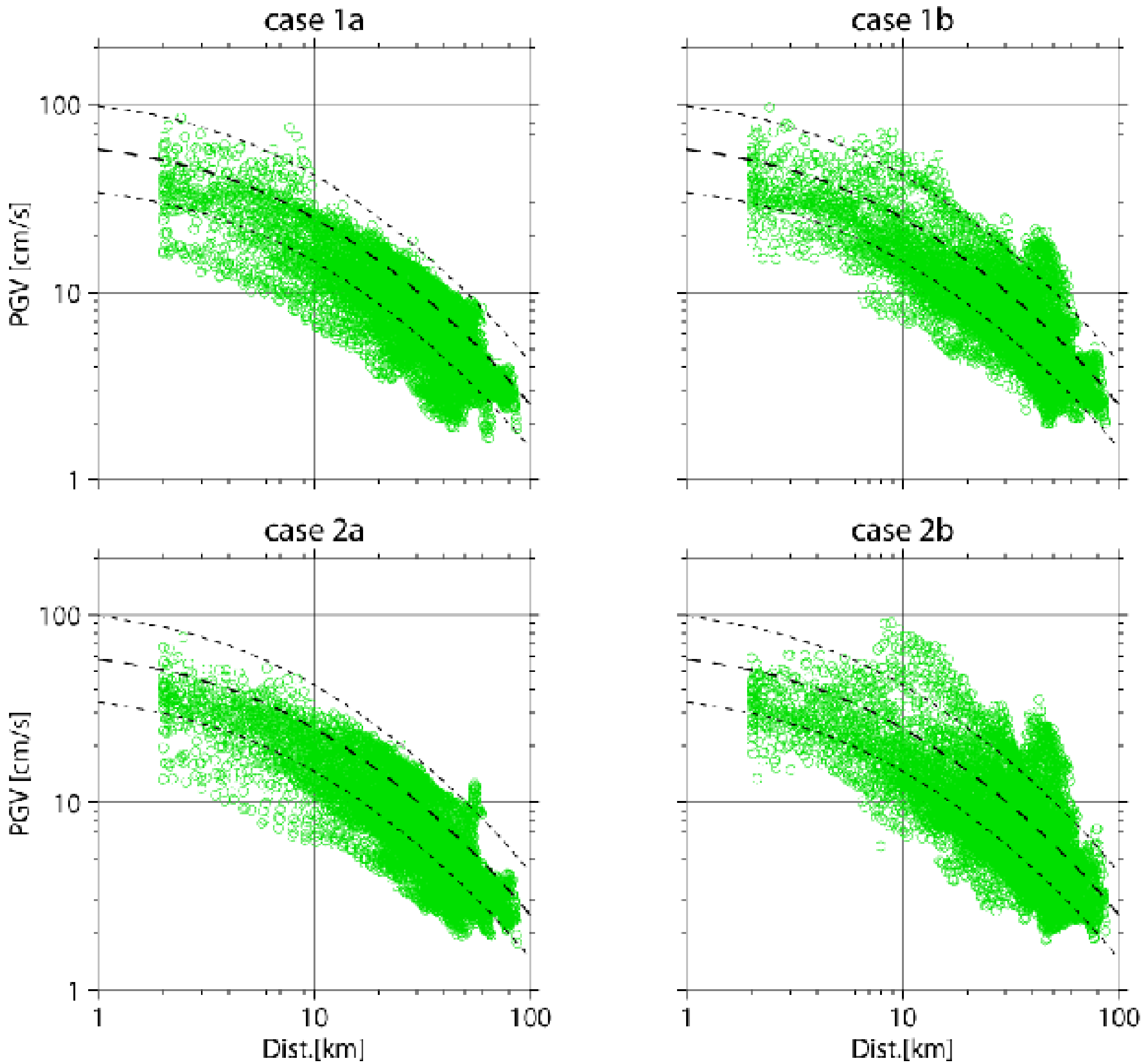
Results-2

Comparison of calculated peak velocity on the engineering bedrock with an empirical attenuation relation by Si and Midorikawa (1999)



- Calculated peak velocities have a tendency small compared with the attenuation relation. The depth to seismic bedrock is shallow (200m or less) at most of the calculated region.
- Forward directivity effect and amplifications by sediments causes some large velocities in cases 1b and 2b.

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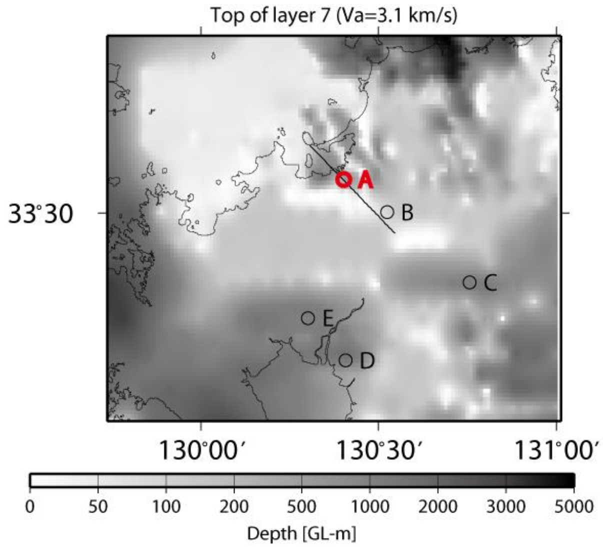
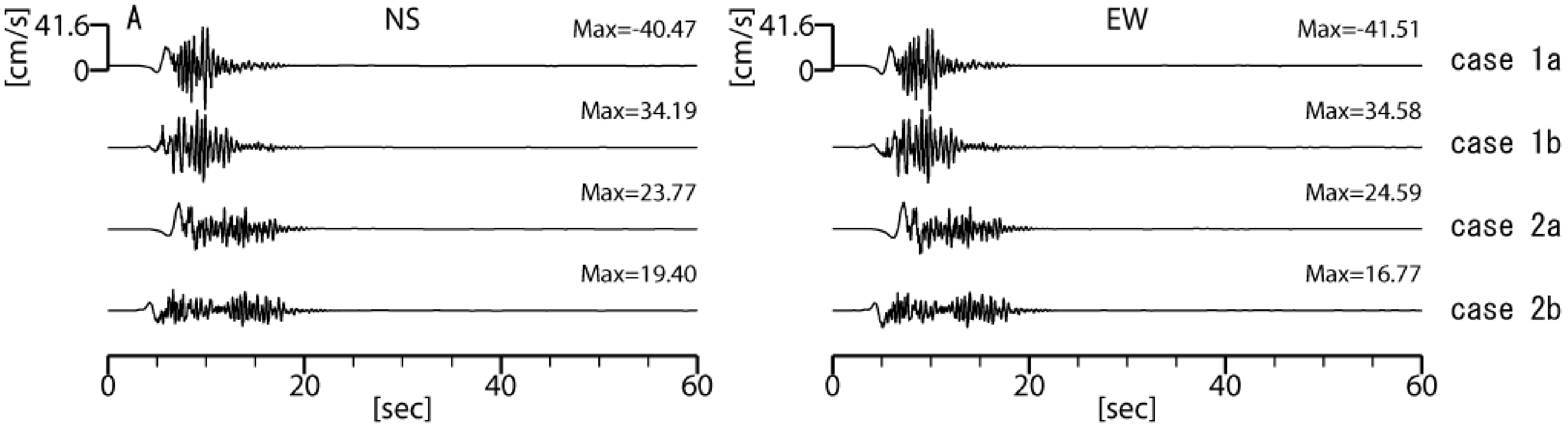
Results-3

Examples of velocity waveforms on the engineering bedrock
(point A: Locate just on the source fault)



- ○ cases 1a & 1b (1 asperity model)
  large amplitudes with short duration
- ○ cases 2a & 2b (2 asperities model)
  relatively small amplitudes with long duration



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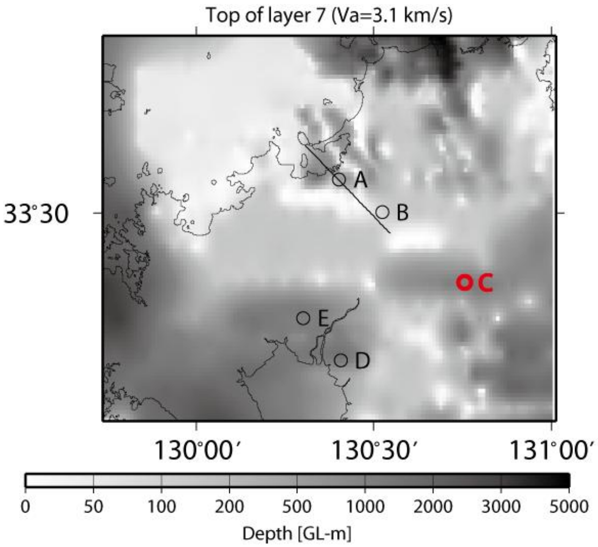
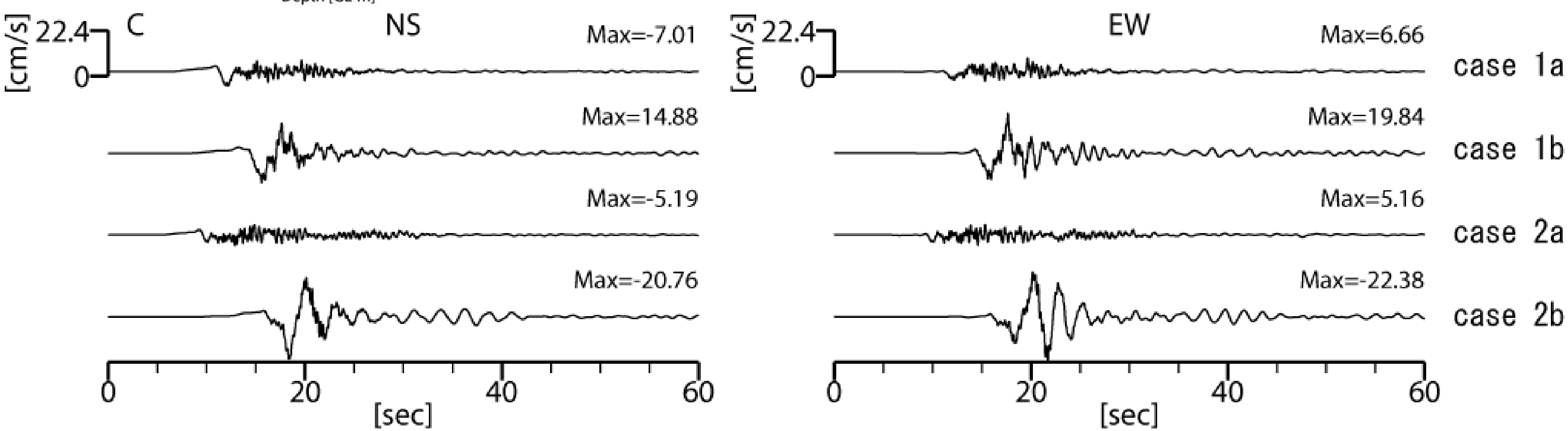
Results-4

Examples of velocity waveforms on the engineering bedrock
(point C: Located in a direction extending from the source fault)



- ○ cases 1a & 2a
  small amplitudes
- ○ cases 1b & 2b
  large pulse with period of about 3s
  (forward directivity effect
  + amplification by sediments)



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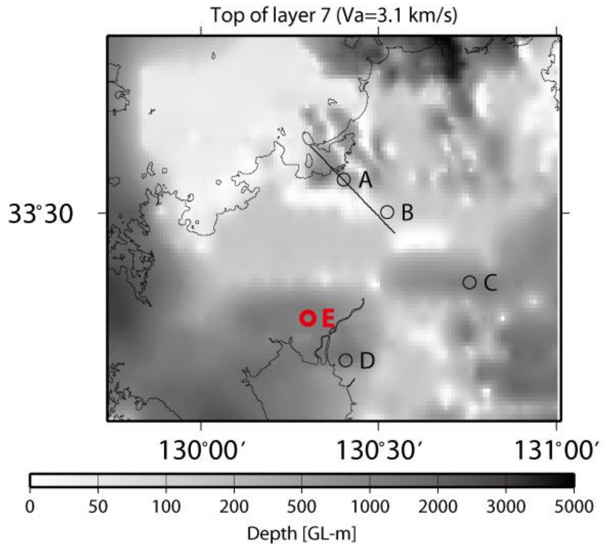
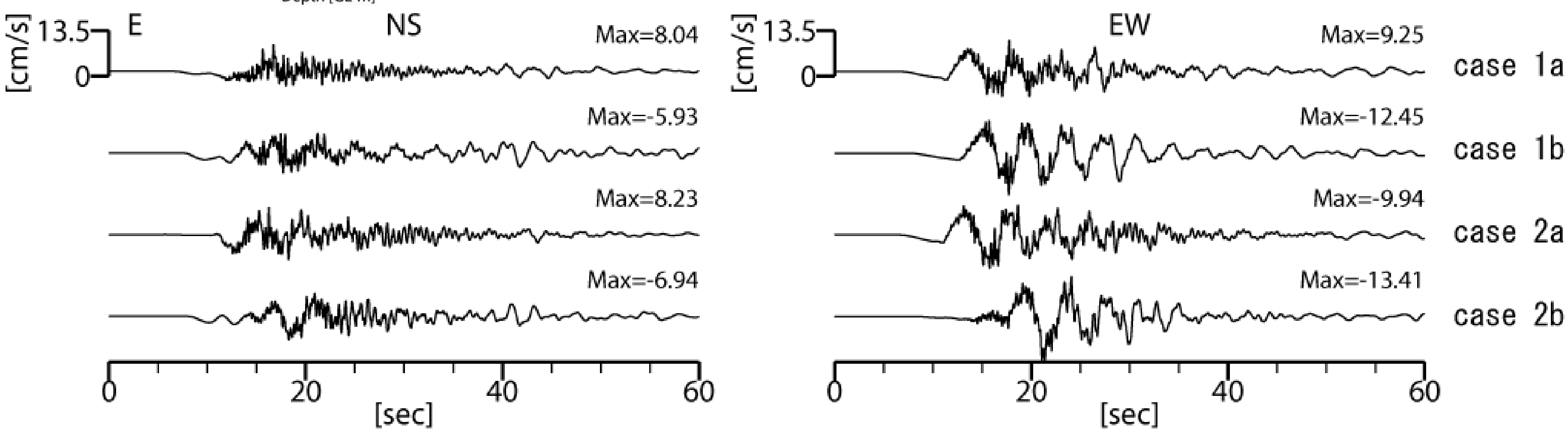
Results-5

Examples of velocity waveforms on the engineering bedrock
(point E: Located on very thick sediments)



○ all cases
remarkable later phases with large amplitudes and periods of 5s

○ cases 1b & 2b
relatively large amplitude
(forward directivity effect)



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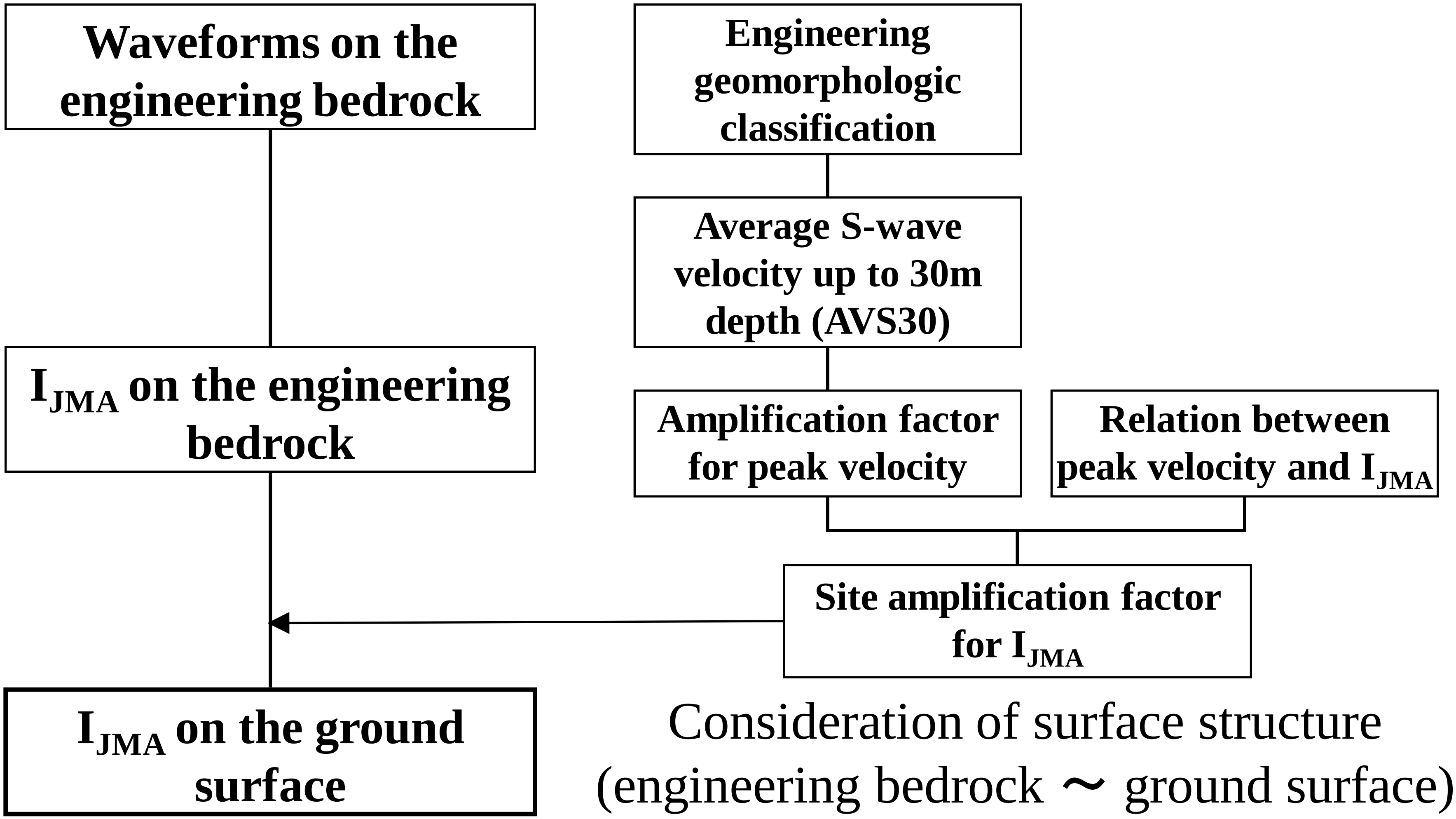
Calculation of JMA seismic intensity (I_{JMA}) on the ground surface



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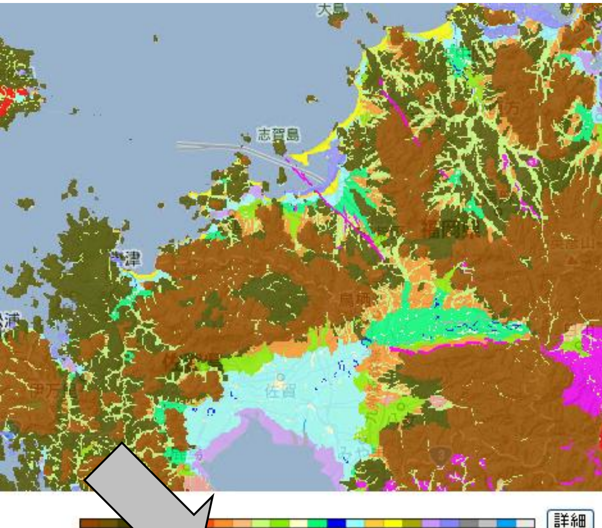
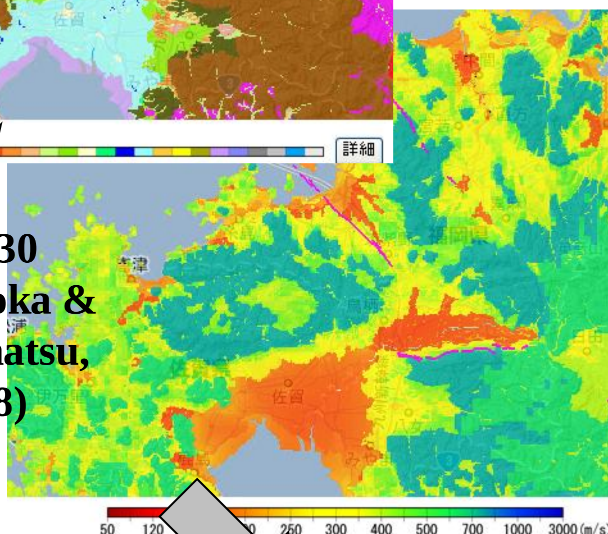
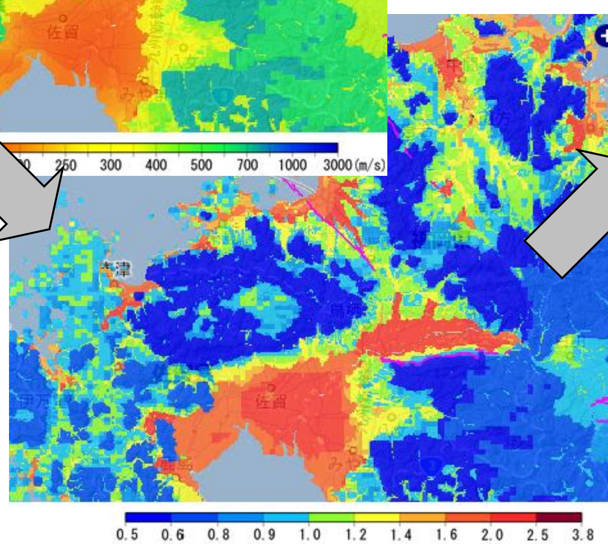
Surface structure model



Engineering geomorphologic Classification (Wakamatsu & Matsuoka, 2008)

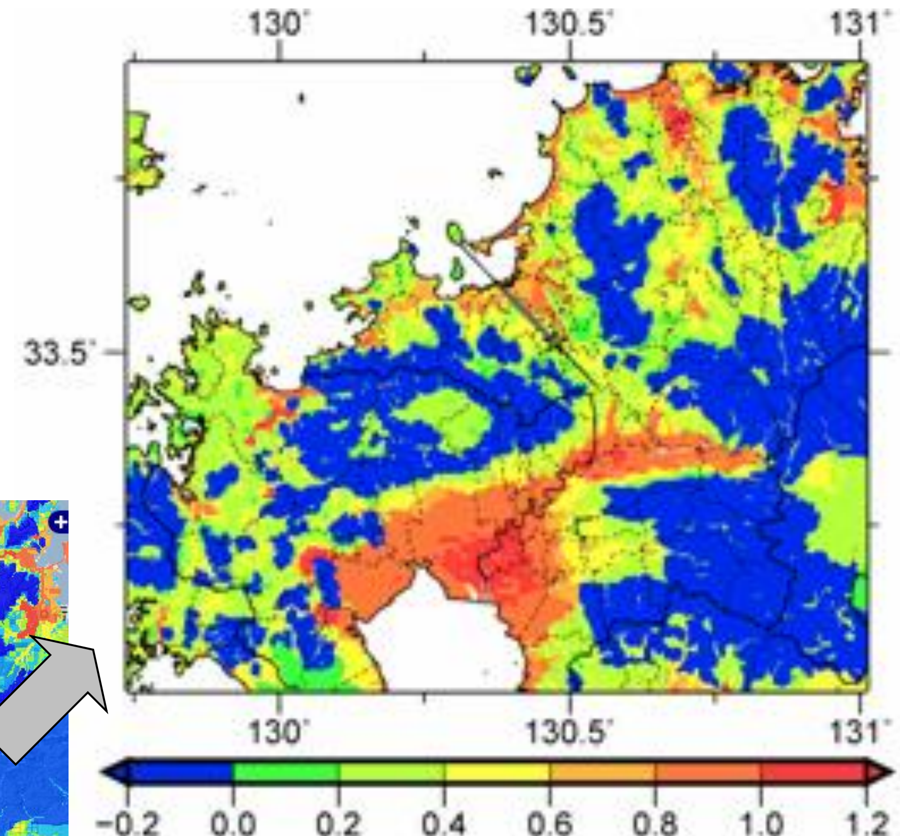


AVS30 (Matsuoka & Wakamatsu, 2008)



Amplification factor for peak velocity (Fujimoto & Midorikawa, 2006)

Site amplification factor for I_{JMA}
from engineering bedrock (Vs=0.6km/s)
to the ground surface



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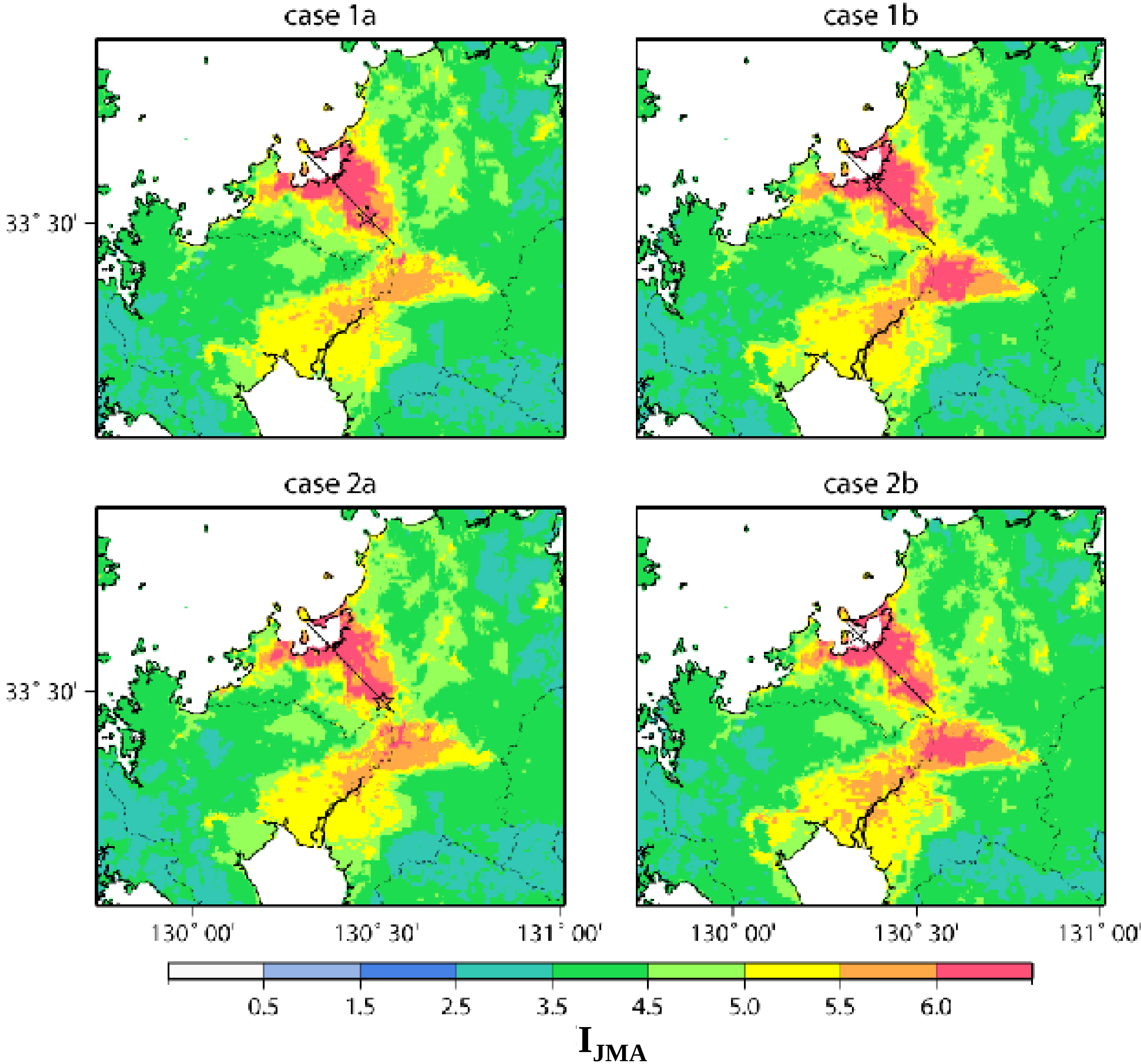
Results-6

JMA seismic intensity distribution on the ground surface



- Large amplification in basins causes very large JMA seismic intensity on the ground surface for all cases.

- Difference between basin and mountain regions is more remarkable compared with peak velocity on the engineering bedrock.

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Conclusions

Scenario Earthquake Shaking Maps

･･･can understand strong ground motion distribution if the target earthquake occurs,

･･･are considered the influences of the rupture processes of the source fault and detail underground structure, especially the deep sedimentary layers structure.

Problems remain:

･It is not enough to consider uncertainties in strong-motion evaluations because only one or few cases are carried out for a target major active fault.

･The underground structure models should be improved much more.

･SESMs for large subduction-zone earthquakes are also required.

･Forward directivity effect may be overestimated because simple rupture propagation (circular rupture propagation with a constant rupture velocity) is assumed in the simulation.

Thank you for your attention !