

Sixth Plenary Meeting of UN-GGIM-AP

**Special Session on
Geospatial Information for Disaster Response**

-Case Study on 2016 Kumamoto Earthquake-

**Part 2
Outset of the 2016 Kumamoto Earthquake**

4:45pm-5:30pm, 17th October 2017



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2-1

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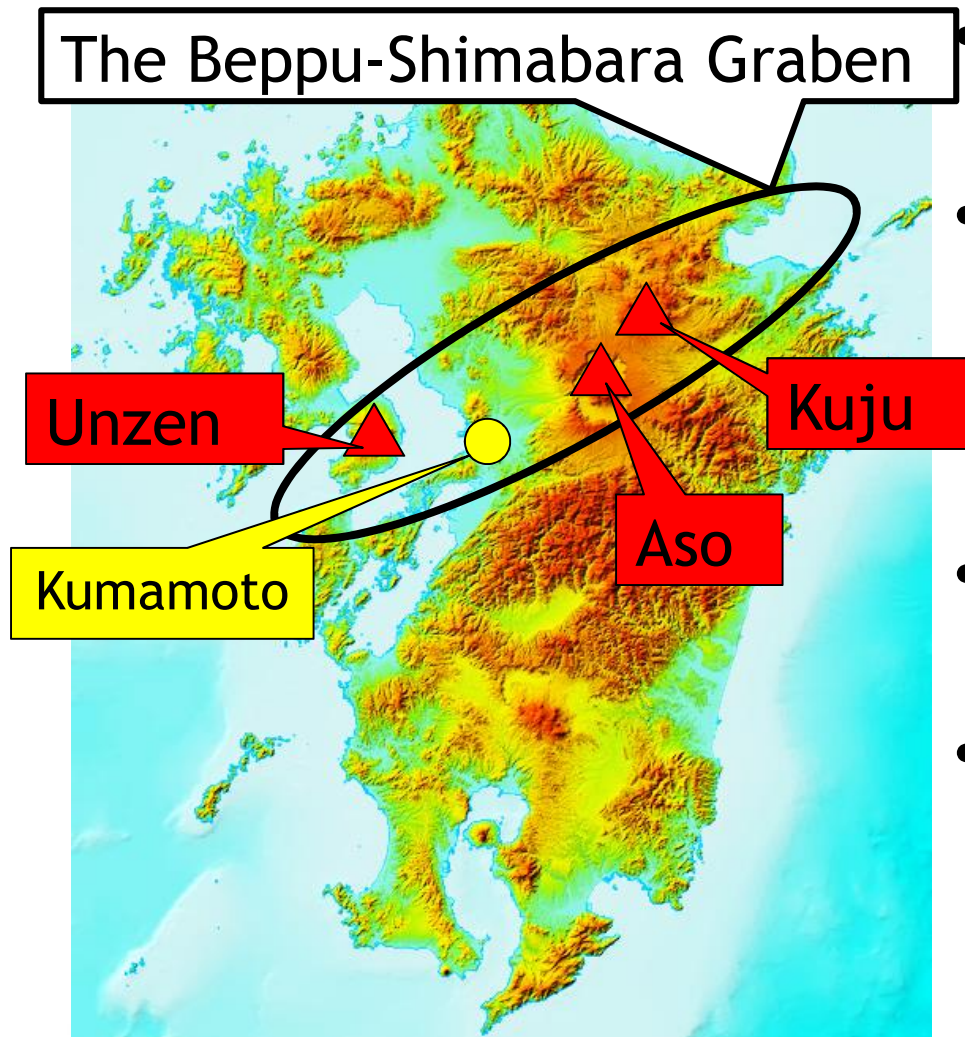
Geography of Kumamoto Prefecture



- In Kyushu island
- 900km WSW of Tokyo
- 120km S of Fukuoka
- Population: 1.76 mil.
- Area: 7,400 sq. km
- Capital: Kumamoto city



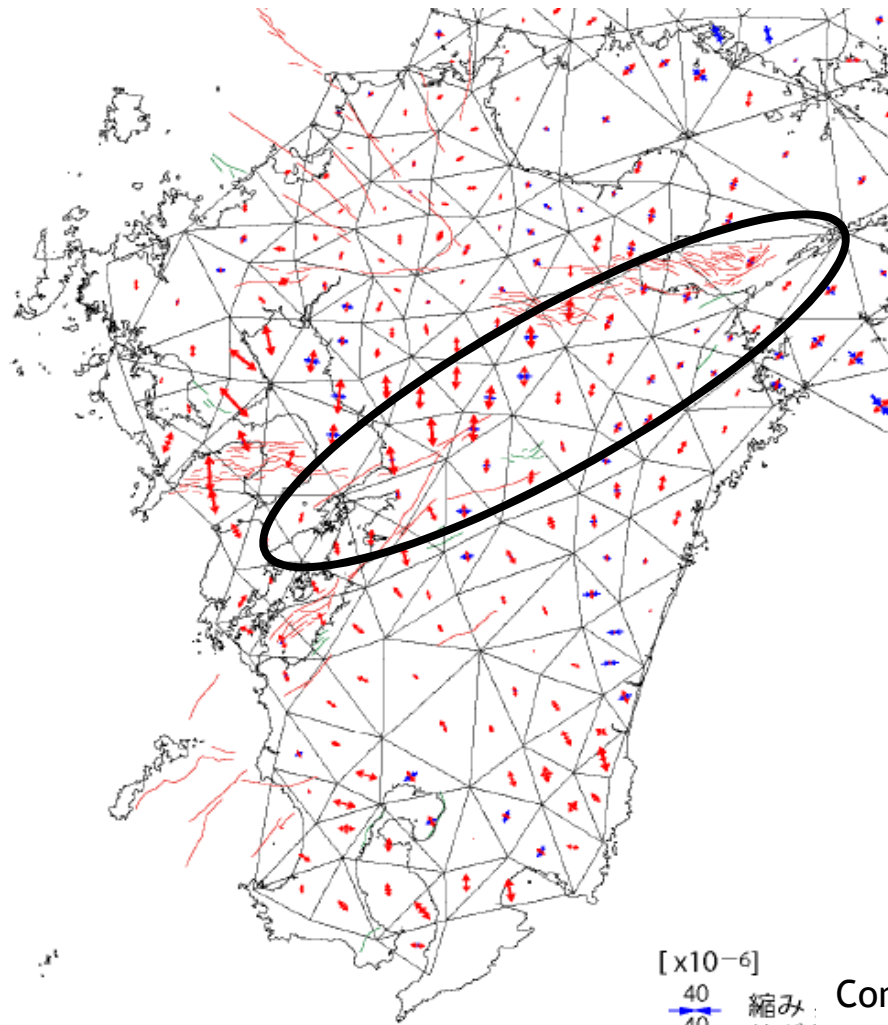
The Beppu-Shimabara Graben



- Tectonic zone: length 200km, width 20-30km
- Pulling Kyushu island apart, north and south
- Right-slip and normal faults develop in the zone
- Volcanoes develop: Kuju, Aso and Unzen
- Thick layer of volcanic deposit, topographically high despite the sinking structure



The separating Kyushu



- Horizontal strain distribution map
- Based on geodetic Survey 1883-1994
- Extension Axes (Red Arrows) dominate around the Beppu-Shimabara Graben
- Northern and Southern parts of Kyushu are pulled apart

[$\times 10^{-6}$]

40 縮み
40 伸び

Contraction
Extension

Principal Axes of Strain

Ref. The Headquarters For Earthquake Research

Promotion http://www.jishin.go.jp/main/chousa/13feb_chi_kyushu/k_honbun.pdf



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2-4

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**You are now in Kumamoto
The time is supposed to be
9:25pm, 14 April 2016 (Thursday)**



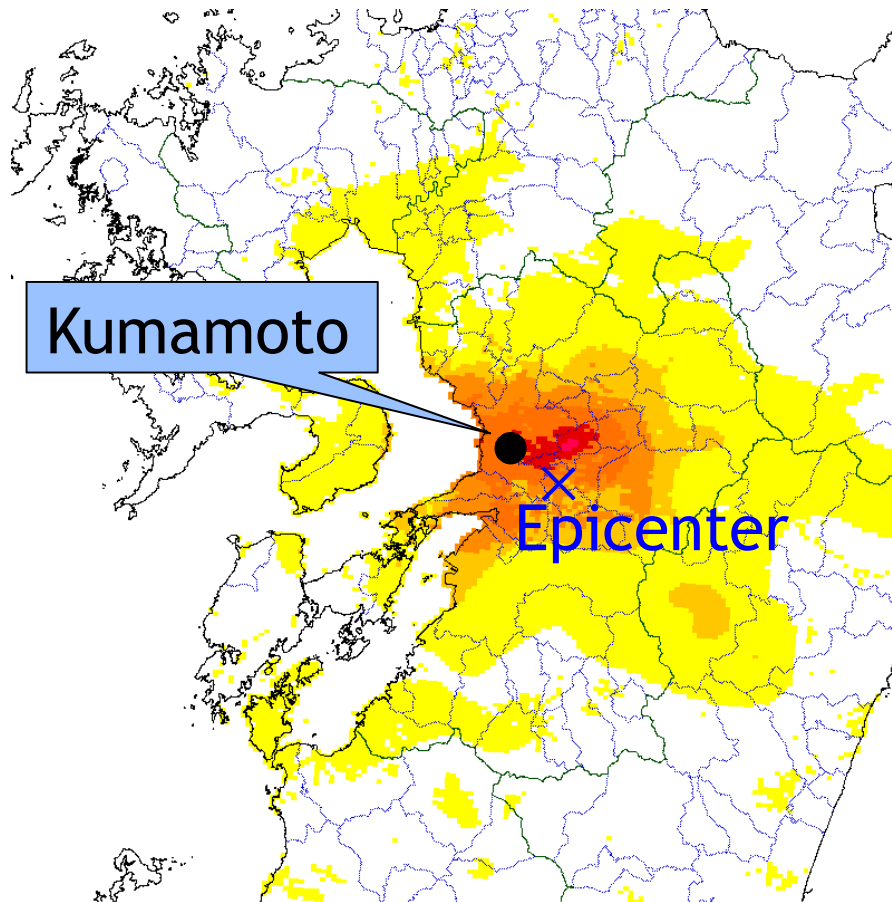
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The first shock came



Ref. Japan Meteorological Agency

Japanese seismic
intensity scale



- Occurred 9:26pm, 14 April 2016
- Magnitude (Mj): 6.5
- Focal Depth: 11km
- By the movement of the Hinagu Fault
- Terrible shock felt in large parts of Kumamoto Prefecture
- Scale 7 in Mashiki town



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Japanese seismic intensity scale

	0 Imperceptible to people.		1 Felt slightly by some people keeping quiet in buildings.		2 Felt by many people keeping quiet in buildings.		3 Felt by most people in buildings.
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Scale 1,2,3: Mild shake, no damage

4



- Most people are startled.
- Hanging objects such as lamps swing significantly.
- Unstable ornaments may fall.

5 Lower



- Many people are frightened and feel the need to hold onto something stable.
- Dishes in cupboards and items on bookshelves may fall.
- Unsecured furniture may move, and unstable furniture may topple over.


5 Upper



- Many people find it difficult to walk without holding onto something stable.
- Dishes in cupboards and items on bookshelves are more likely to fall.
- Unsecured furniture may topple over.
- Unreinforced concrete-block walls may collapse.

Scale 4,5-,5+: Middle shake, small damage may occur

6 Lower



- It is difficult to remain standing.
- Many unsecured furniture moves and may topple over. Doors may become wedged shut.
- Wall tiles and windows may sustain damage and fall.
- In wooden houses with low earthquake resistance, tiles may fall and buildings may lean or collapse.

High earthquake resistance Low earthquake resistance

6 Upper



- It is impossible to move without crawling. People may be thrown through the air.
- Most unsecured furniture moves, and is more likely to topple over.
- Wooden houses with low earthquake resistance are more likely to lean or collapse.
- Large cracks may form, and large landslides and massif collapses may be seen.

High earthquake resistance Low earthquake resistance

7



- Wooden houses with low earthquake resistance are even more likely to lean or collapse.
- Wooden houses with high earthquake resistance may lean in some cases.
- Reinforced-concrete buildings with low earthquake resistance are more likely to collapse.

High earthquake resistance Low earthquake resistance

Scale 6-,6+,7: Serious shake, large damage occurs

Ref. Japan Meteorological Agency



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Earthquake Early Warning (EEW)

- Issues a warning in several to several tens of second before the arrival of large shock
- Operated by Meteorological Agency, broadcast by various kinds of media



Compulsory
broadcast through
mobile phones



TV (National Broadcast
Corporation):
Earthquake warning
Screen



Search Engine
(Yahoo! JAPAN):
Notice of the
earthquake

Sound Ref: www.youtube.com/watch?v=kG1o2pbca2Q

Ref: Japan Broadcasting Corporation web site/Yahoo Japan Corporation



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Topics for discussion #2

- What kind of initial responses should or could be made by NGIAs immediately after the outset of a disaster?
- For example, how should the employees be informed and summoned to the office, and what kind of responses should they make?
- What kind of decisions should be made by an organization immediately after a disaster?



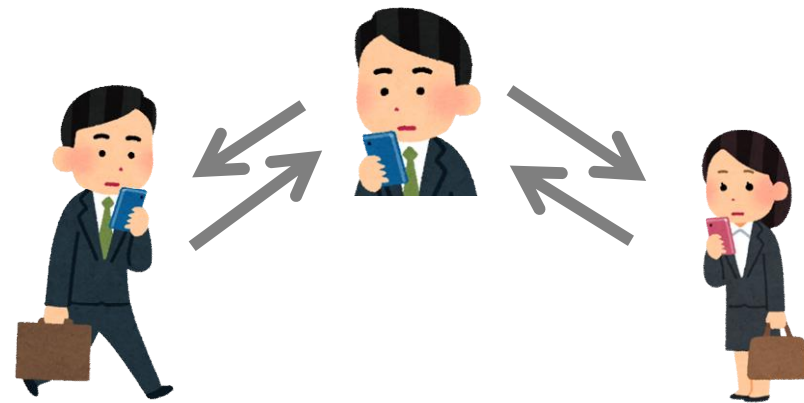
Starting initial responses

Safety check of GSI staff and family members



- Answer via mobile phone
- Auto collection of results
- All respondents in Kyushu region were safe

Staff availability check “Ten-minutes rule”



- GSI-DRM office sends availability check e-mail message
- Senior officials and related staff need to acknowledge the receipt within 10 minutes.



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Starting initial responses

**Teleconference
(1st GSI DMHQ meeting)
10:15pm 14 April**



**2nd Headquarters meeting
00:30am 15 April**



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2-11

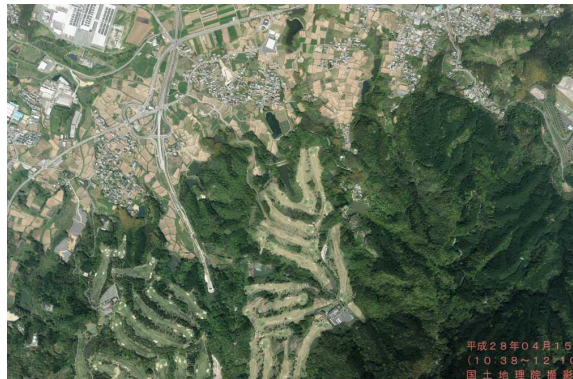
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Initial response (1) : areal photography

- GSI Aircraft was 1,000km away from Kumamoto, unavailable for immediate response
- Private company aircraft took initial photographs based on the partnership agreement



Vertical Photo
Coverage



Vertical Photo
From 10am 15 April



Oblique Photo
From 7am 15 April



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2-12

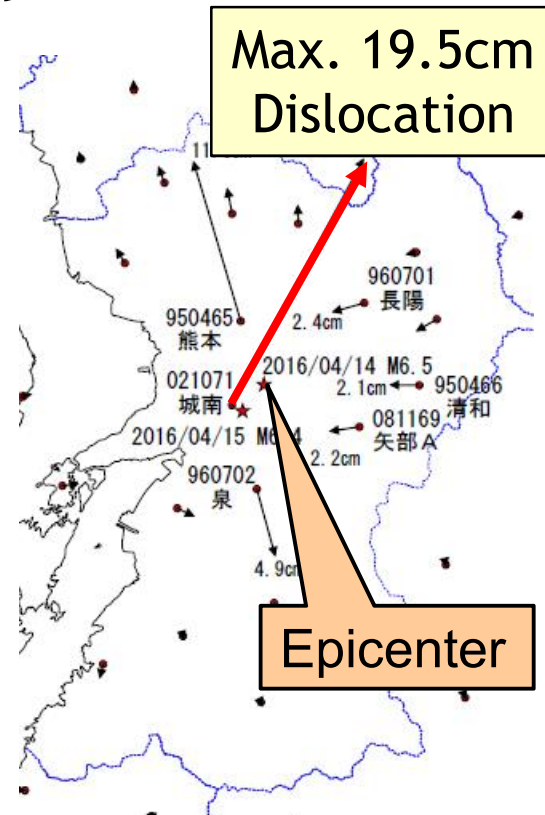
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Initial response (2) : crustal movement

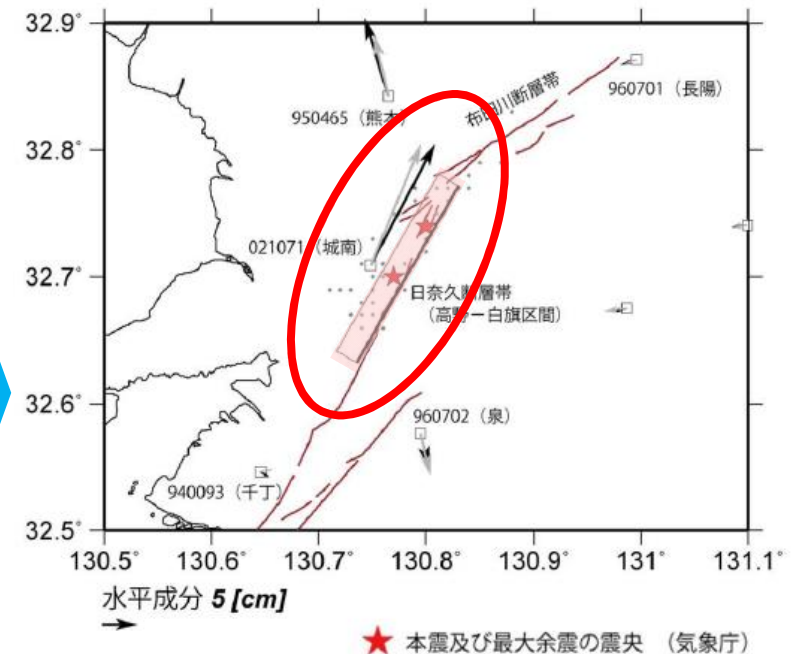
- CORS analysis and fault modelling were conducted



Check CORS status
Data acquisition



Quick Solution
(Q3 Analysis)
Horizontal

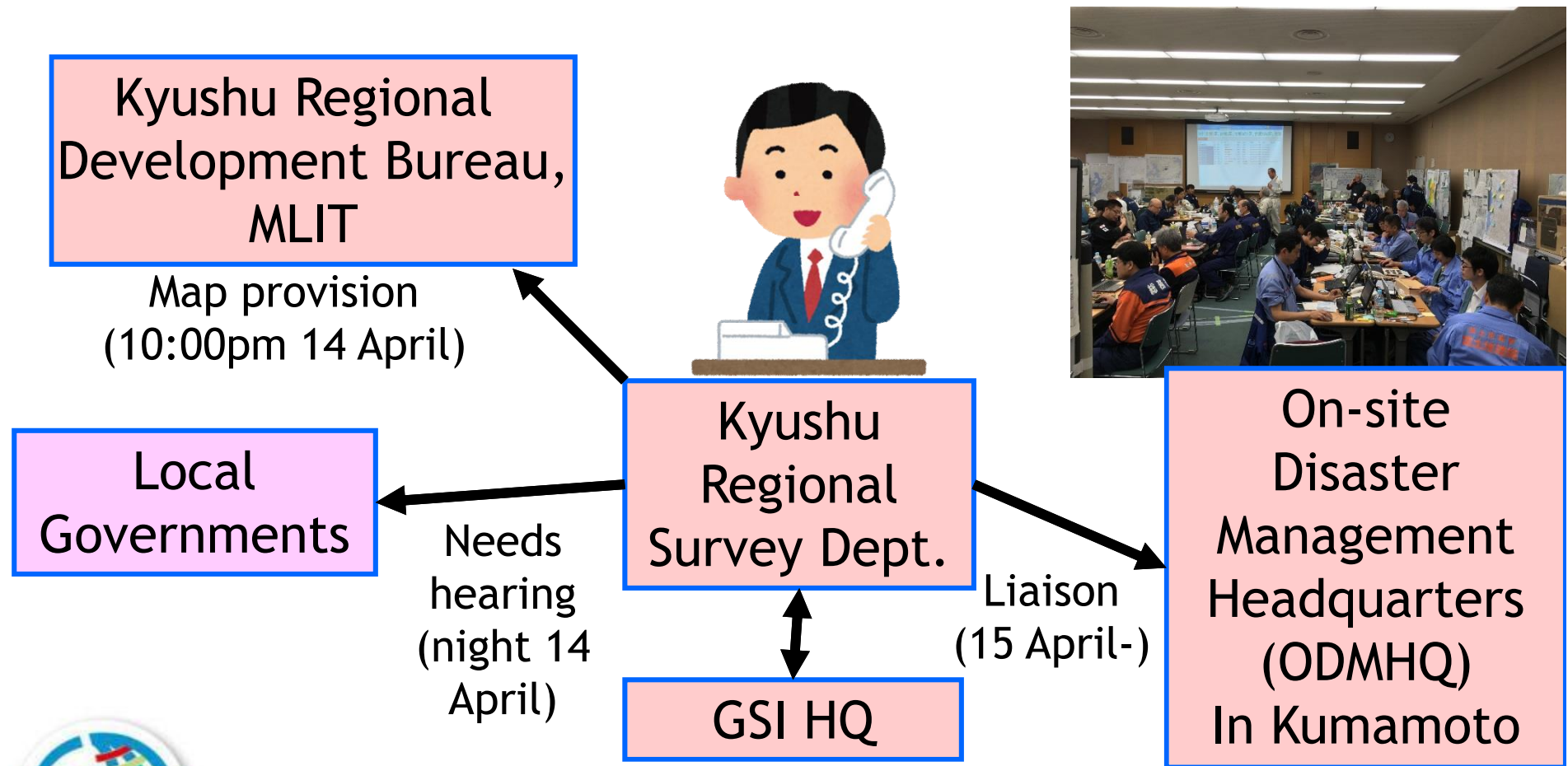


Estimated Fault Model
(Along Hinagu Fault)
Max. slip 60cm



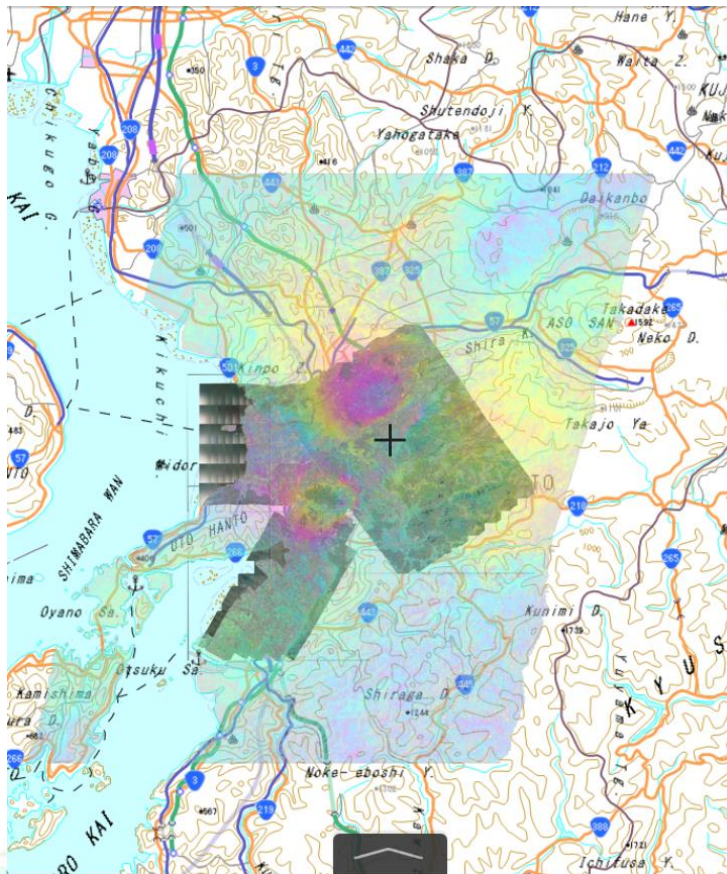
Initial response (3) : channel establishment

- Quick action of Kyushu Regional Survey Dept.



Initial response (4) : information provision

GSI Maps (GSI's webmap platform)



GSI Twitter



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2-15

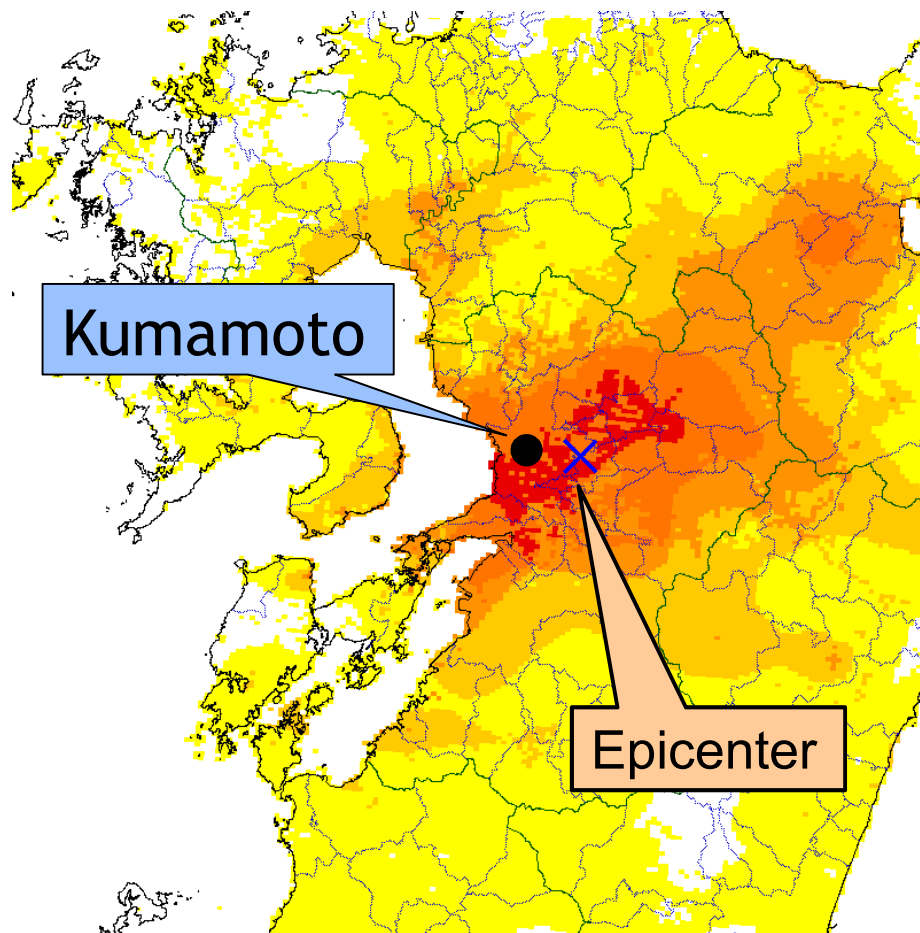
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At the end of 15 April 2016

- 27 hours after the first shock
- GSI had four Headquarters meetings
- Initial Response seemed to have been set on the right path
- Most staff got back home and were about to sleep



But, the Second Shock Came



Ref. Japan Meteorological Agency
Japanese seismic
intensity scale



- Occurred 1:25am, 16 April 2016
- Magnitude (Mj): 7.3
- Focal depth: 11km
- By the movement of the Hinagu and Futagawa Faults
- Much larger than the first shock
- SI-7: Mashiki town and Nishihara village



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Re-Starting Initial Responses

Teleconference
(5th GSI HQ meeting)
2:19am 16 April



6nd Headquarters meeting
6:00am 16 April



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Renewing Response Strategy

Ordered by Director-General of GSI

- 1) Personnel Assignment
- 2) Information Sharing
- 3) Aerial Photography
- 4) Interpretation of aerial photographs
- 5) CORS data analysis
- 6) Interferometric SAR data analysis
- 7) Shooting videos with drones
- 8) Provision of geospatial information



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**The time is supposed to be at
7:00am, 16 April 2016 (Saturday)**
**Re-starting Response, based on the
renewed strategy**



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2-20

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