

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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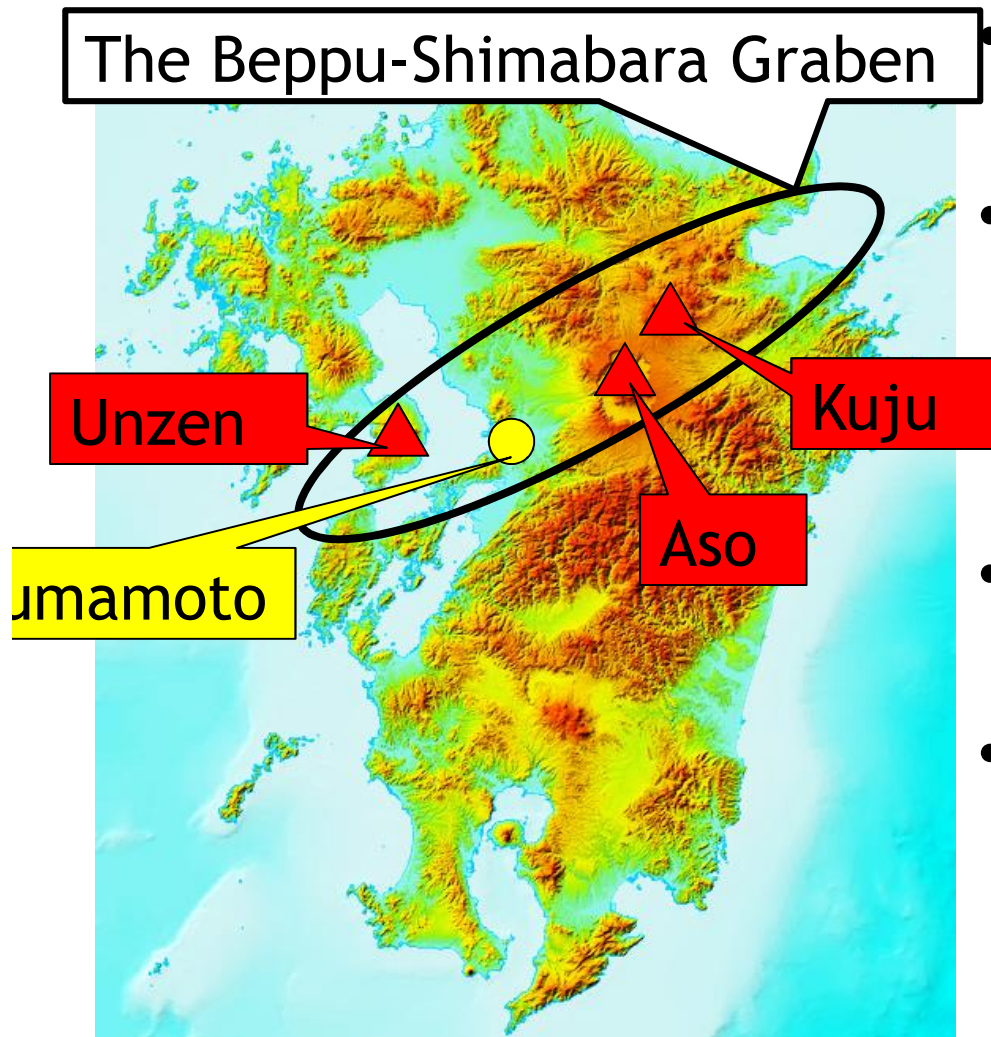
Geography of Kumamoto Prefecture



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



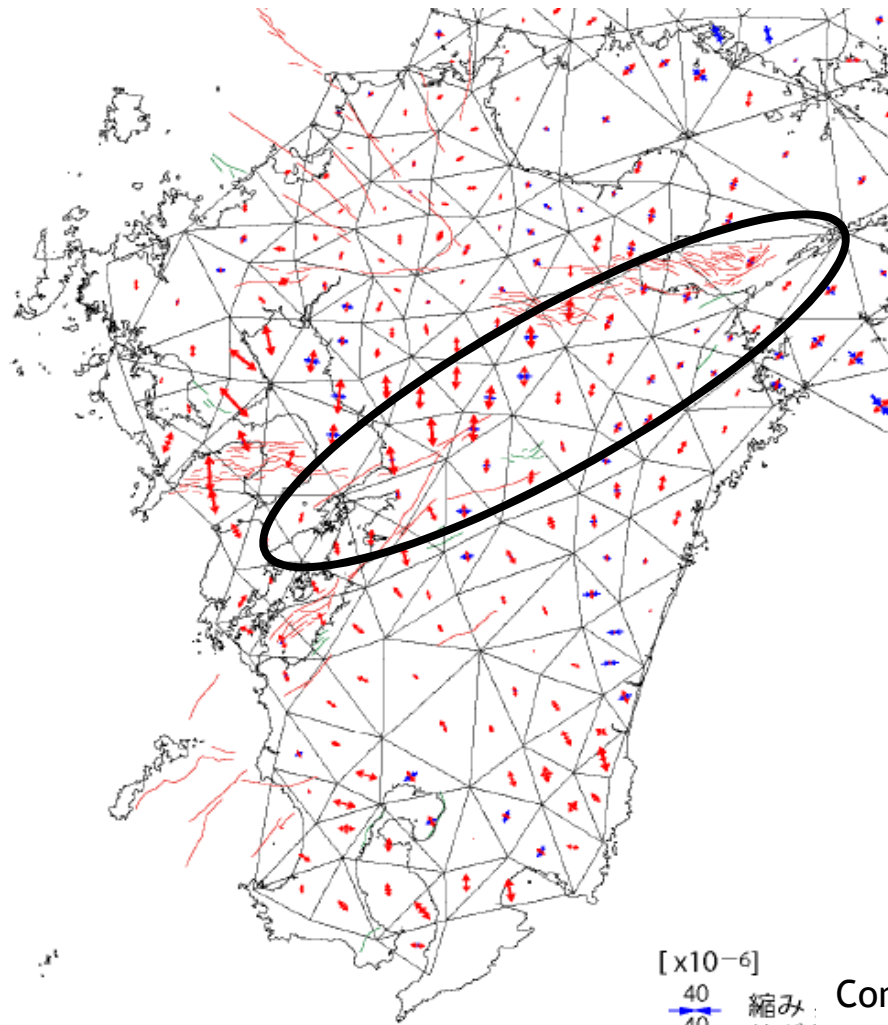
The Beppu-Shimabara Graben



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



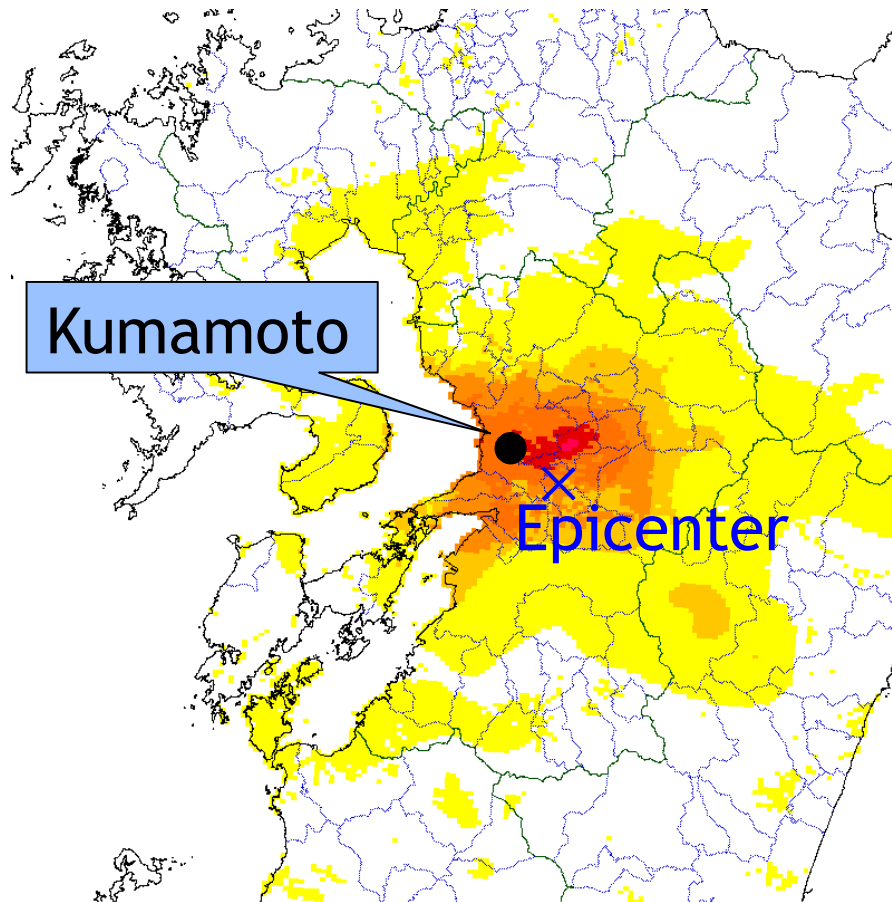
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The first shock came



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

 <p>0 【震度0】 人は揺れを感じない。</p>	 <p>1 【震度1】 屋内で静かにしている人の中には、揺れをわずかに感じる人がいる。</p>	 <p>2 【震度2】 屋内で静かにしている人の大半が、揺れを感じる。</p>	 <p>3 【震度3】 屋内にいる人のほとんどが、揺れを感じる。</p>	<p>Scale 1,2,3: Mild shake, no damage</p>
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4 **【震度4】**

- ほとんどの人が驚く。
- 電灯などのつり下げ物は大きく揺れる。
- 座りの悪い置物が、倒れることがある。




5弱 **【震度5弱】**

- 大半の人が、恐怖を覚え、物につかまりたいと感じる。
- 棚にある食器類や本が落ちることがある。
- 固定していない家具が移動することがあり、不安定なものは倒れることがある。



5強 **【震度5強】**

- 物につかまらないうちで歩くことが難しい。
- 棚にある食器類や本で落ちるものが増える。
- 固定していない家具が倒れることがある。
- 補強されていないブロック塀が崩れることがある。



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

6弱 **【震度6弱】**


- 立っていることが困難になる。
- 固定していない家具の大半が移動し、倒れるものもある。ドアが開かなくなることがある。
- 壁のタイルや窓ガラスが破損、落下することがある。
- 耐震性の低い木造建物は、瓦が落下したり、建物が傾いたりすることがある。倒れるものもある。



耐震性が高い 耐震性が低い

6強 **【震度6強】**


- はわなと動くことができない。飛ばされることもある。
- 固定していない家具のほとんどが移動し、倒れるものが増える。
- 耐震性の低い木造建物は、傾くものや、倒れるものが増える。
- 大きな地割れが生じたり、大規模な地すべりや山体の崩壊が発生することがある。



耐震性が高い 耐震性が低い

7 **【震度7】**

- 耐震性の低い木造建物は、傾くものや、倒れるものがさらに増える。
- 耐震性の高い木造建物でも、まれに傾くことがある。
- 耐震性の低い鉄筋コンクリート造の建物では、倒れるものが増える。



耐震性が高い 耐震性が低い

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: <http://okoya.seesaa.net/article/164511396.html>

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?



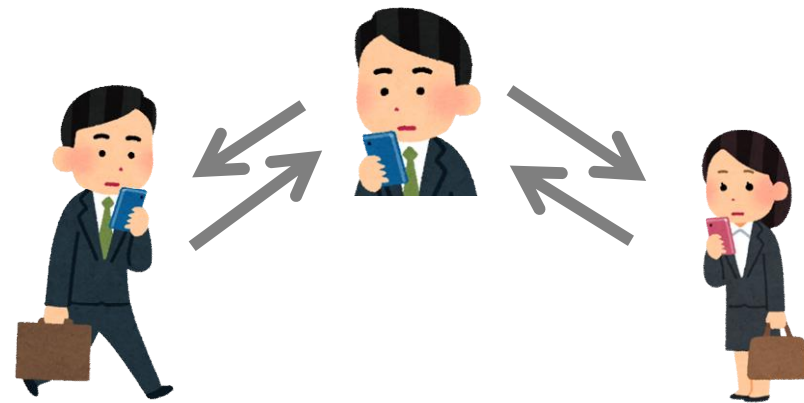
Starting initial responses

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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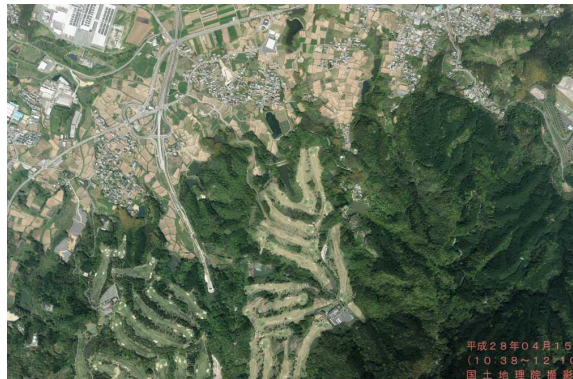
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Initial response (1) : areal photography

- 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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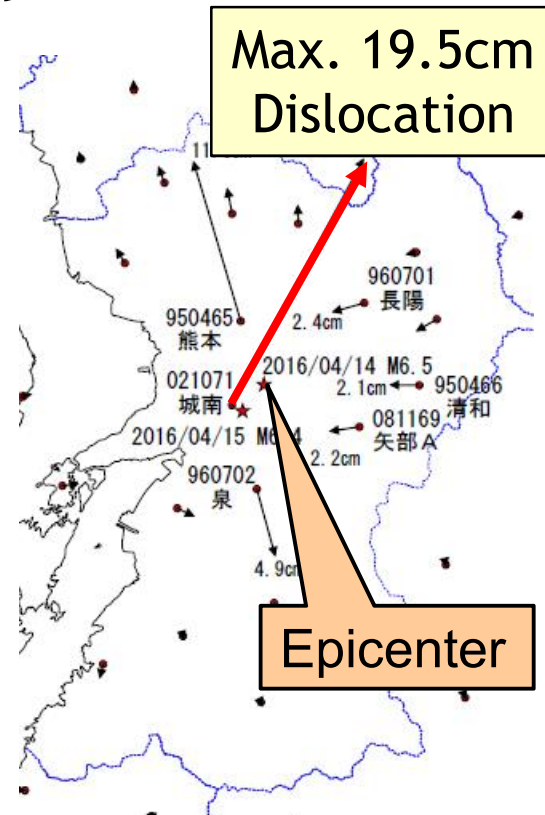
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Initial response (2) : crustal movement

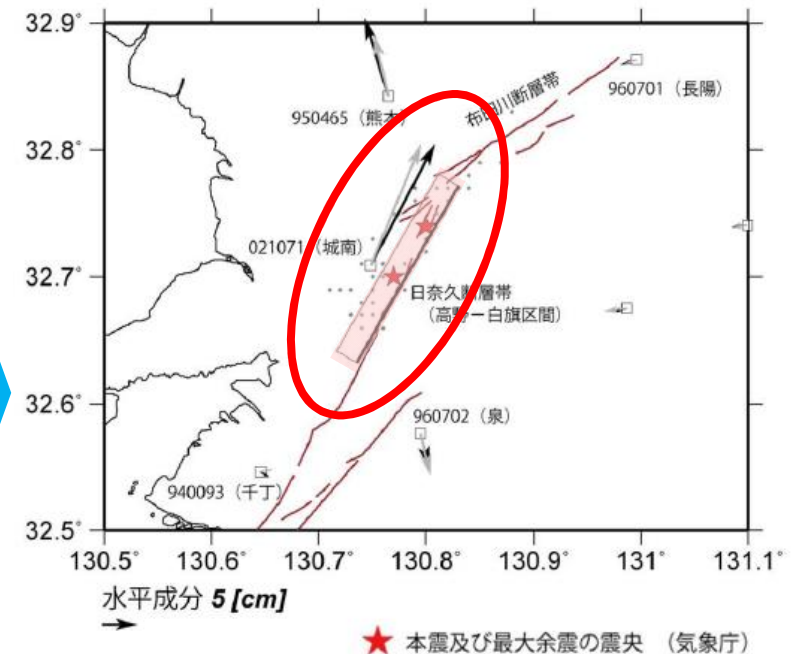
- CORS analysis and fault modelling were conducted



Check CORS status
Data acquisition



Quick Solution
(Q3 Analysis)
Horizontal

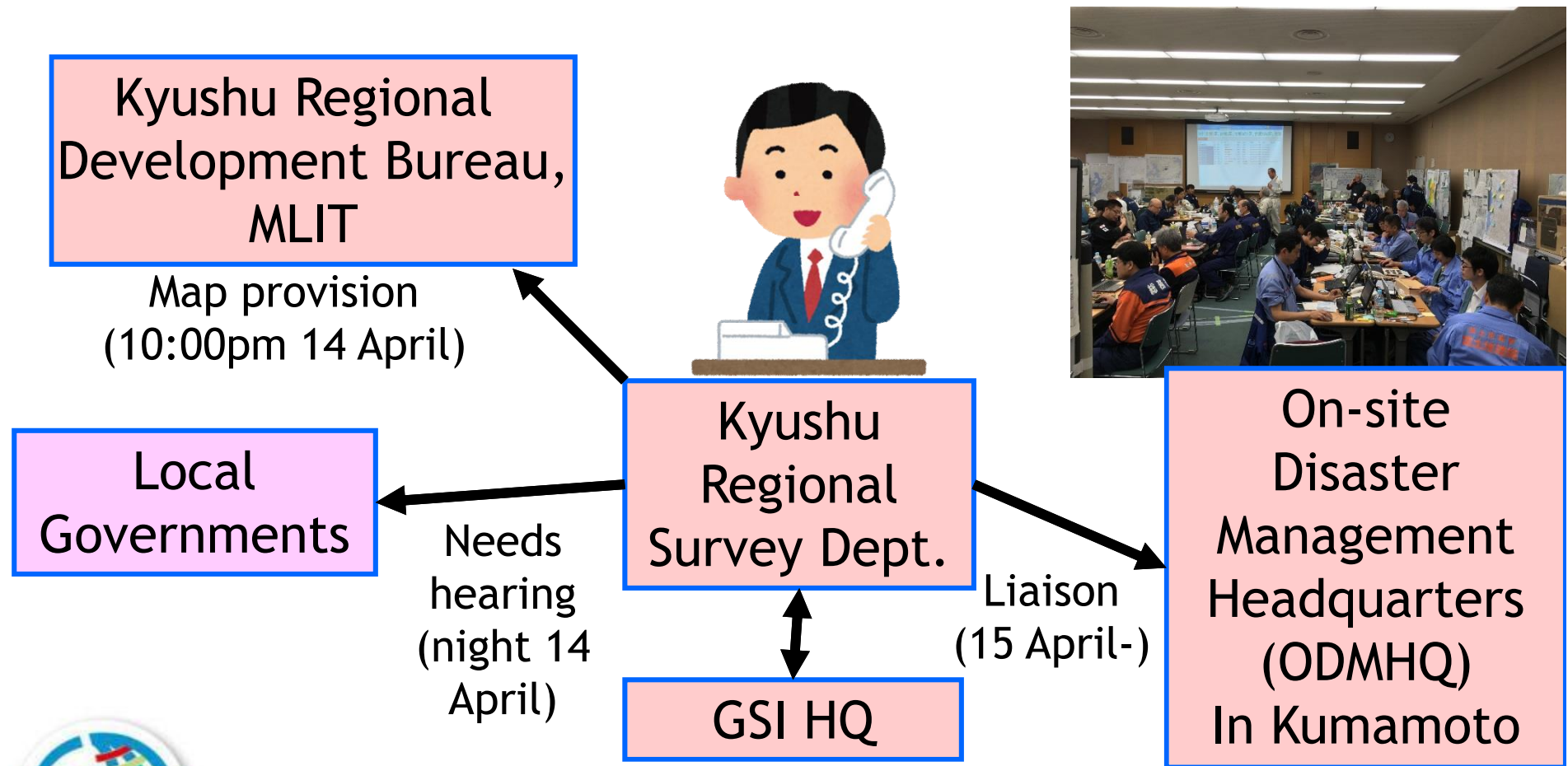


Estimated Fault Model
(Along Hinagu Fault)
Max. slip 60cm



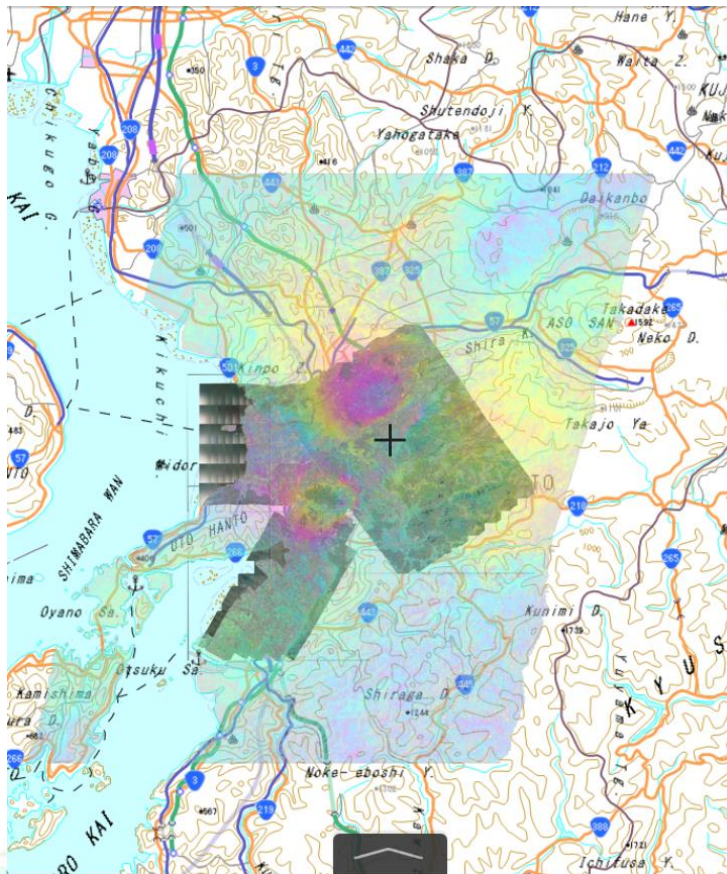
Initial response (3) : channel establishment

- Quick action of Kyushu Regional Survey Dept.



Initial response (4) : information provision

GSI Maps (GSI's webmap platform)



GSI Twitter



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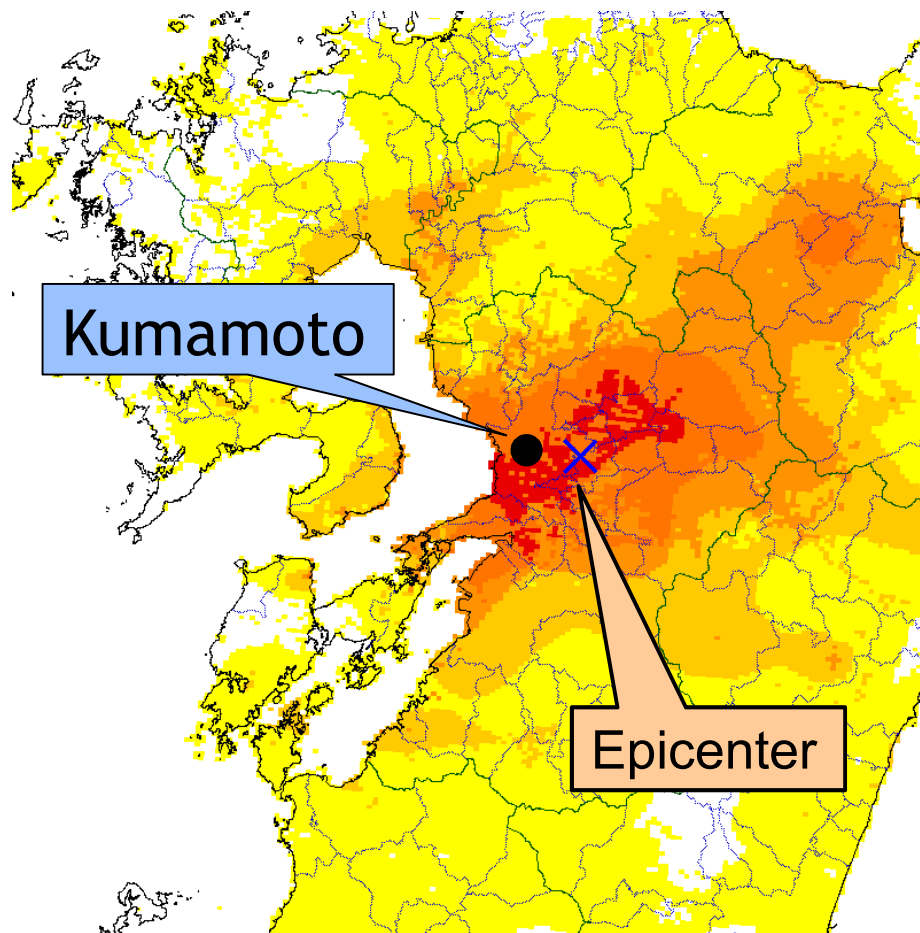
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At the end of 15 April 2016

- 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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