

# Application of Satellite Remote Sensing to Natural Disaster Management and The role of Center for Research and Application of Satellite Remote Sensing (CRASS)



Yamaguchi University  
Vice president (Foreign Relations)  
Director of CRASS  
Fusanori Miura

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# About YU



Sapporo

Yamaguchi University

Tokyo

Kyoto

Osaka

First Prime Minister  
**Mr. Hirofumi Ito**



Present Prime Minister  
Mr. Shinzo Abe



- Mr. Abe, the prime minister of Japan, **promised to support adaptation planning and actions in developing countries** in his speech of the UN Climate Summit 2014
  - **“Japan’s Adaptation Initiative”**



UN Climate Summit 2014

# About YU

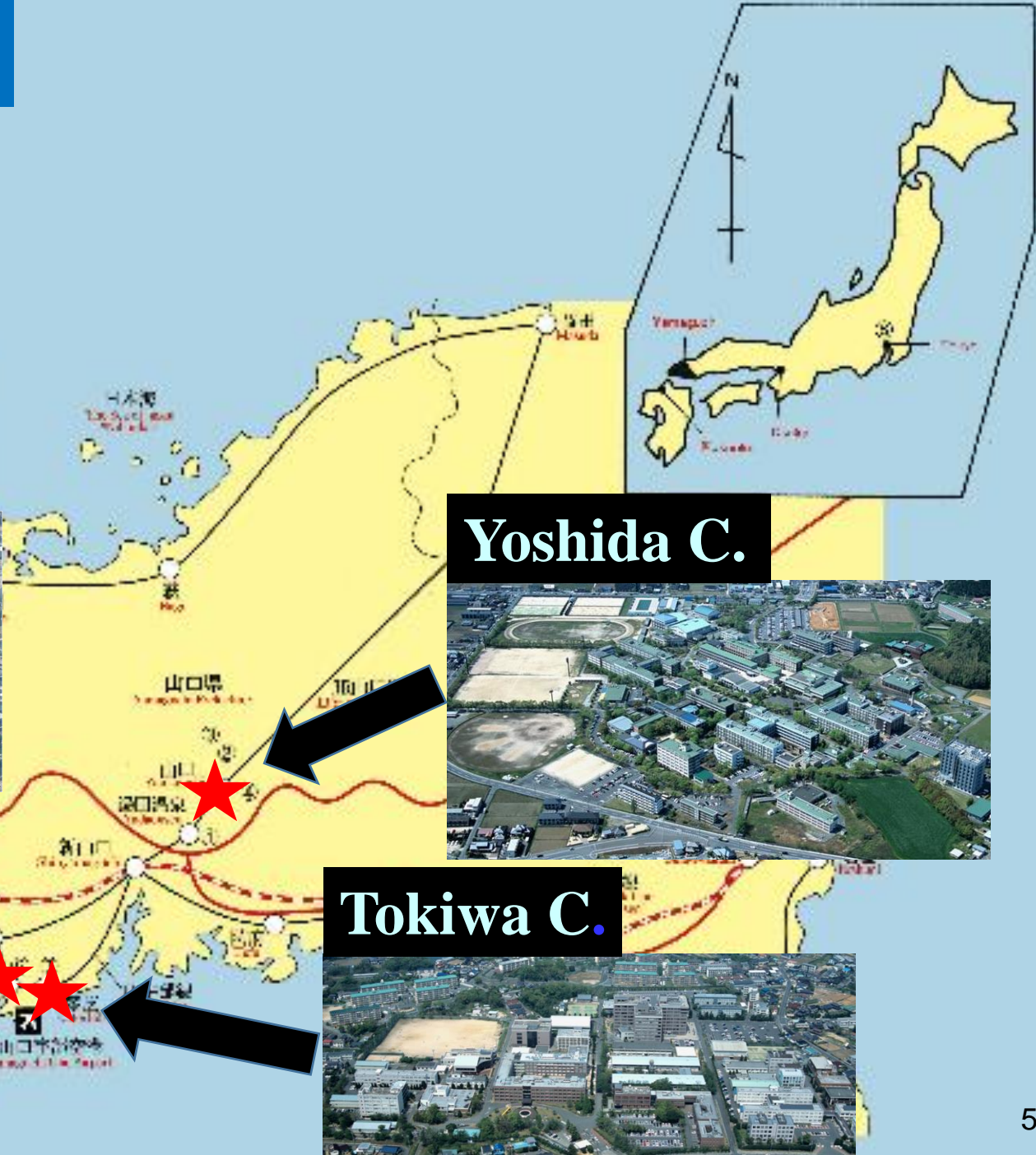
**Kogushi C.**



**Yoshida C.**



**Tokiwa C.**



# Faculties

Faculty of Humanities

Faculty of Science

Faculty of Education

Faculty of Economics

Faculty of Medicine and Health Science

[Faculty of Engineering](#)

Faculty of Agriculture

United Faculty of Veterinary

Faculty of Global and Science

# Graduate School

Graduate School of Humanities

Graduate School of Education

Graduate School of Economics

Graduate School of Medicine

[Graduate School of Science and Engineering for Innovation](#)

Graduate School of Agriculture

Graduate School of East Asian Studies

Graduate School of Innovation and Technology Management.

United Graduate School Veterinary Science

# Statistics of Yamaguchi University

Number of Students:	11,000
Undergraduate Student :	9,000
Graduate Students :	2,000
Number of Research Staff:	1,000

Budget : 40 billion yen



1. The effectiveness of satellite remote sensing technology in disaster management
2. Some examples of the application of satellite remote sensing technology to obtain the damaged area
3. Future plan of CRASS especially international activities.



# Why Satellite Remote Sensing Technology?

- We had very severe earthquakes in 1995 and 2011 in Japan:
  - 1) the 1995 Hanshin-Awaji (Hyogo-ken Nanbu) earthquake known also as Kobe earthquake, and
  - 2) the 2011 earthquake off the Pacific coast of Tohoku earthquake known as Great East Japan earthquake.
- More than 6,400 and 18,500 people, respectively, lost their lives in these earthquakes.
- The central and local governments could not grasp the area and details of the damage.

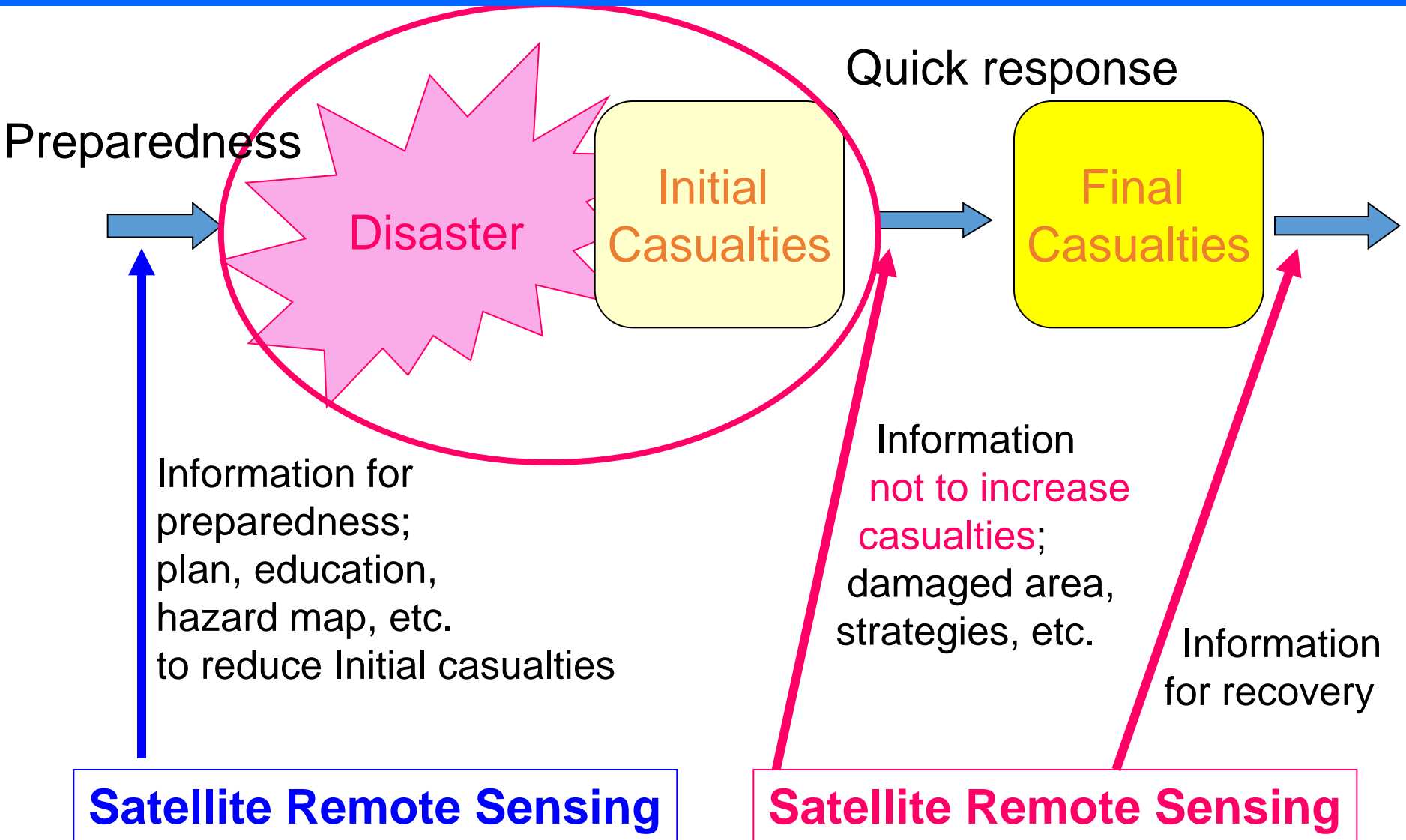
Therefore, the effective decision making, search and rescue activities and so on were not possible because the damaged areas were so wide.
- This is the same in foreign Countries!

- The number of **the victims** unfortunately increased with time during the period without sufficient information.
- If the governments could grasp the whole situation, many people's lives might be saved.

We will surely have so called **the Nankai-trough huge earthquake** (Tokai + Tonankai+ Nankai earthquake) and **the Tokyo bay chooka earthquake** in the near future, in Japan.

We **must not repeat the same thing** in the future disasters such as the Nankai trough earthquake or the earthquake that is expected in Tokyo area and so forth.

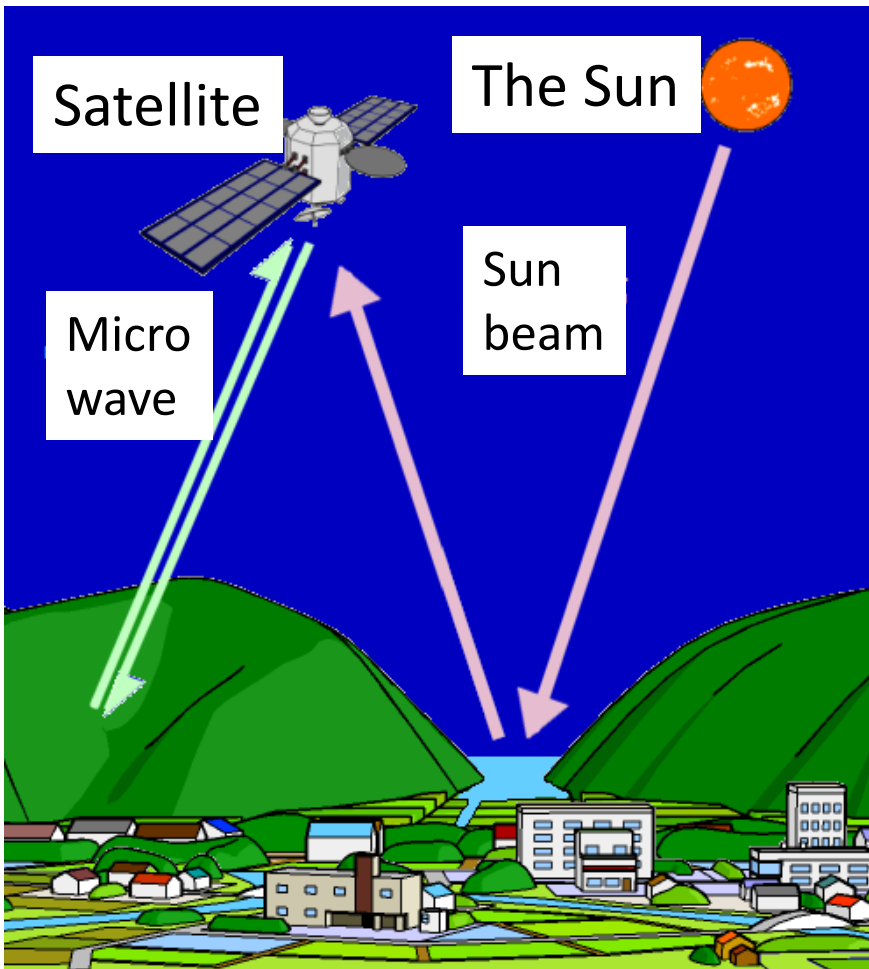
# Roll of Satellite Remote Sensing for Disaster Management



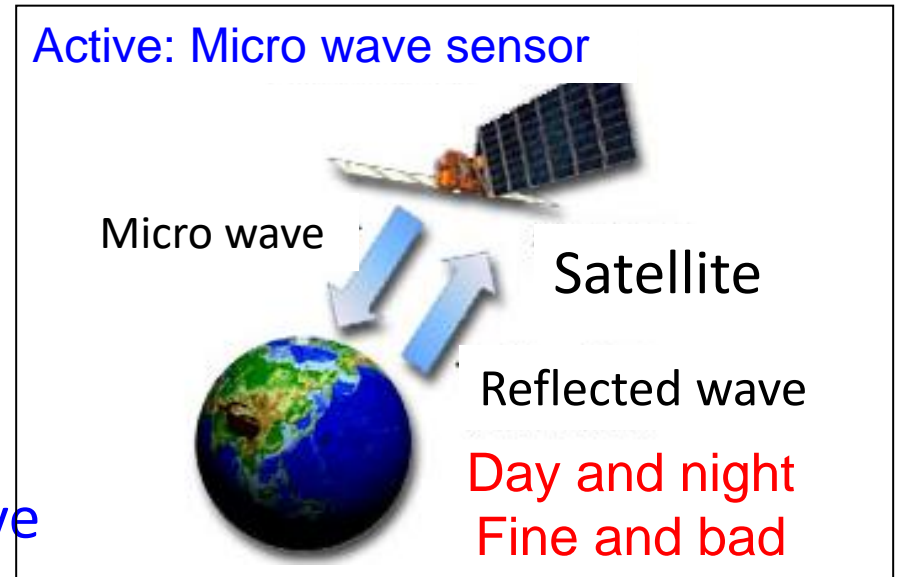
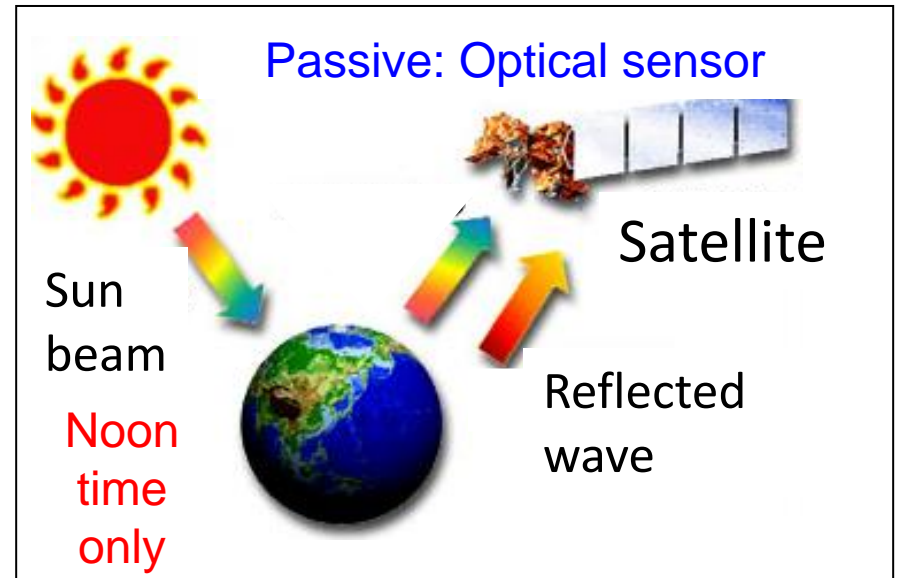
# Application of Satellite Remote Sensing to Disaster Management

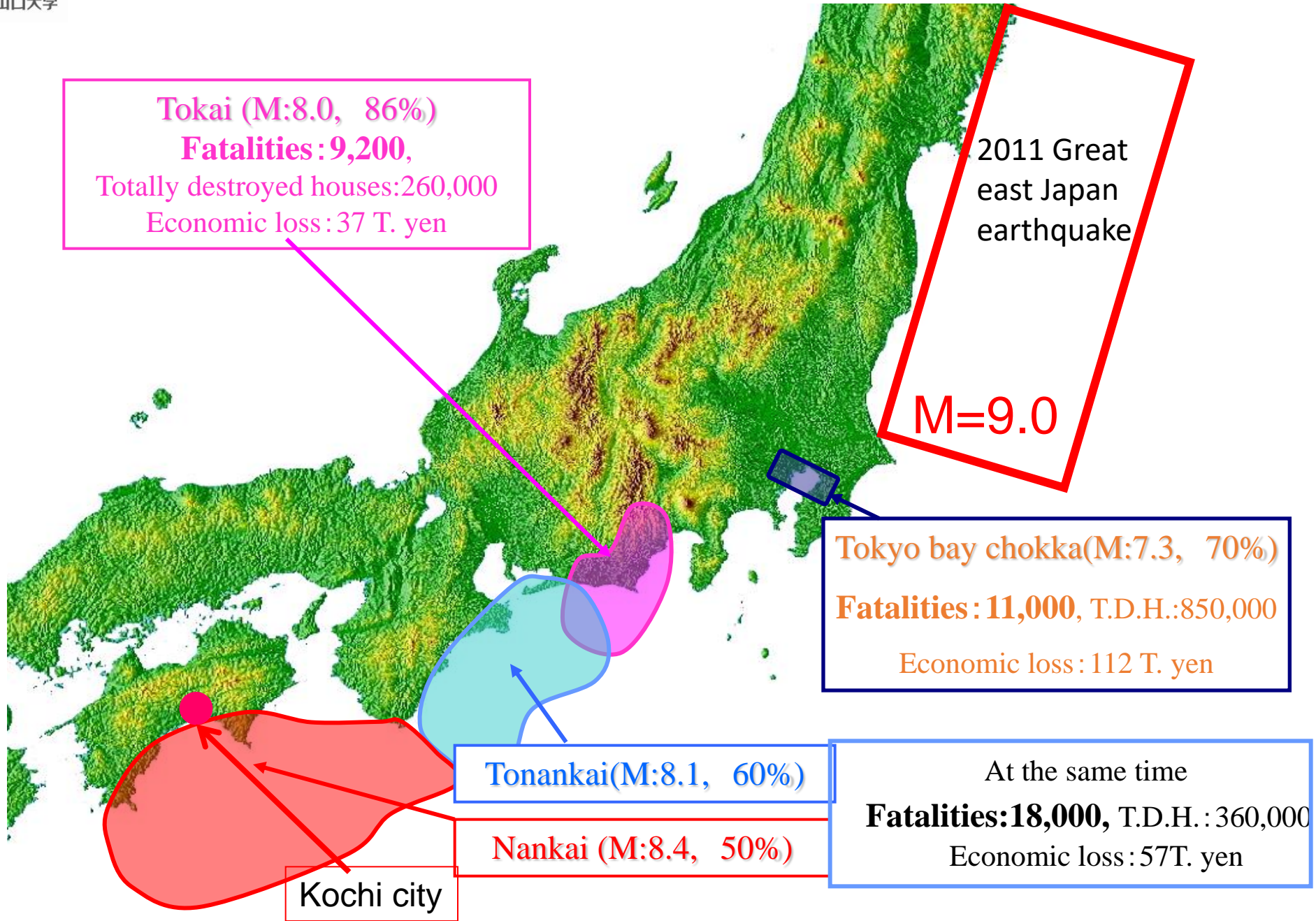
- It is possible to get information about the situation of damaged area **widely and instantly**, even when surface information network systems in the damaged area are damaged.
- It is possible to get information even **at night**.
- Information acquisition is possible **fair or foul** (rain or shine).
- **Long term monitoring** is possible for the same area before and after the disaster under the same condition, therefore, the change of the damaged area with time can be observed.  
(Recovery, Re-vegetation, etc.)
- Using the **3D data**, it is possible to make **detailed hazard maps** for Tsunami, Flood, Landslide etc. even where detailed map is not available.

# Two kinds of Sensors

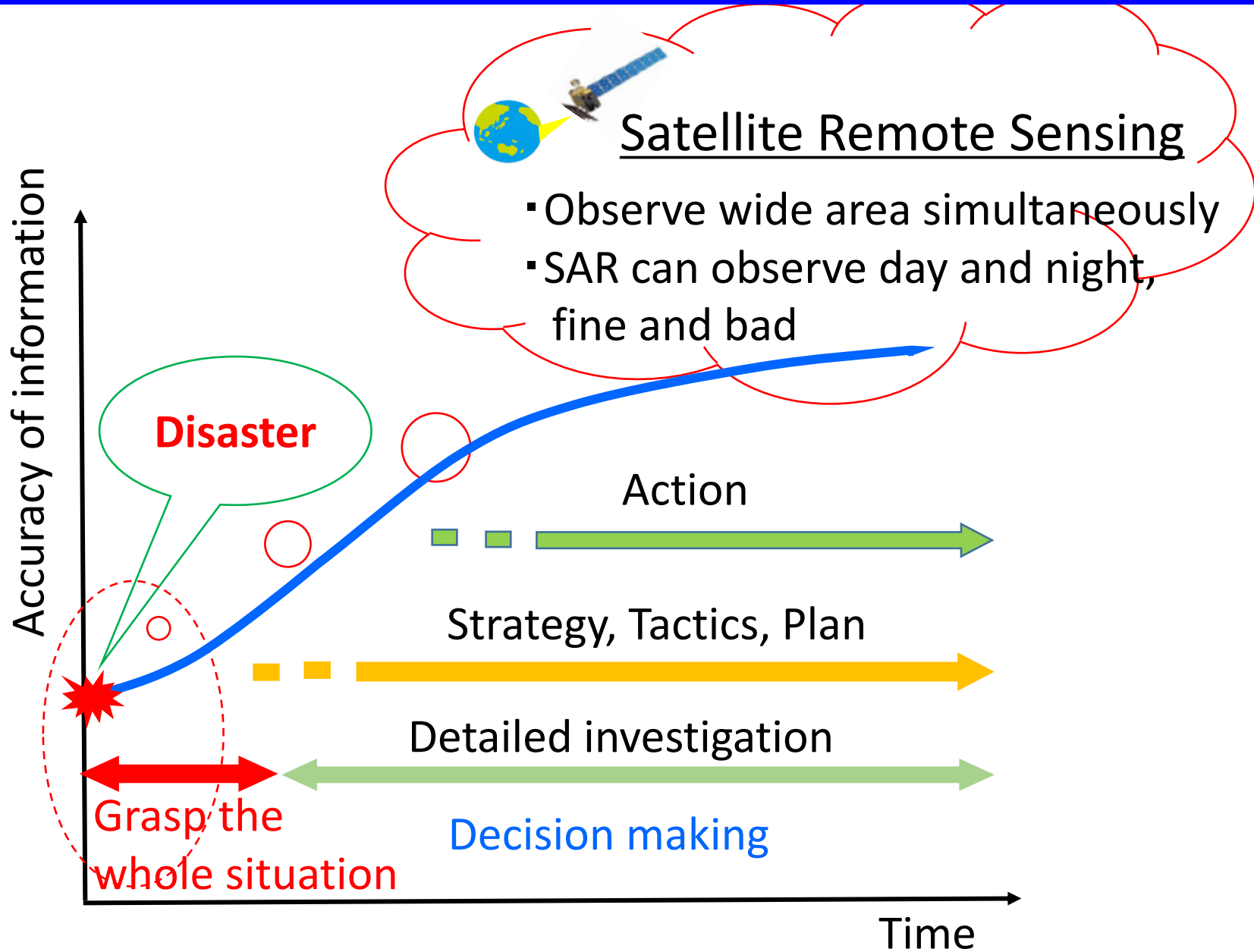


Sensors on the Satellite catch the reflected sunbeam and/or micro wave





# Relationship between accuracy of information and time

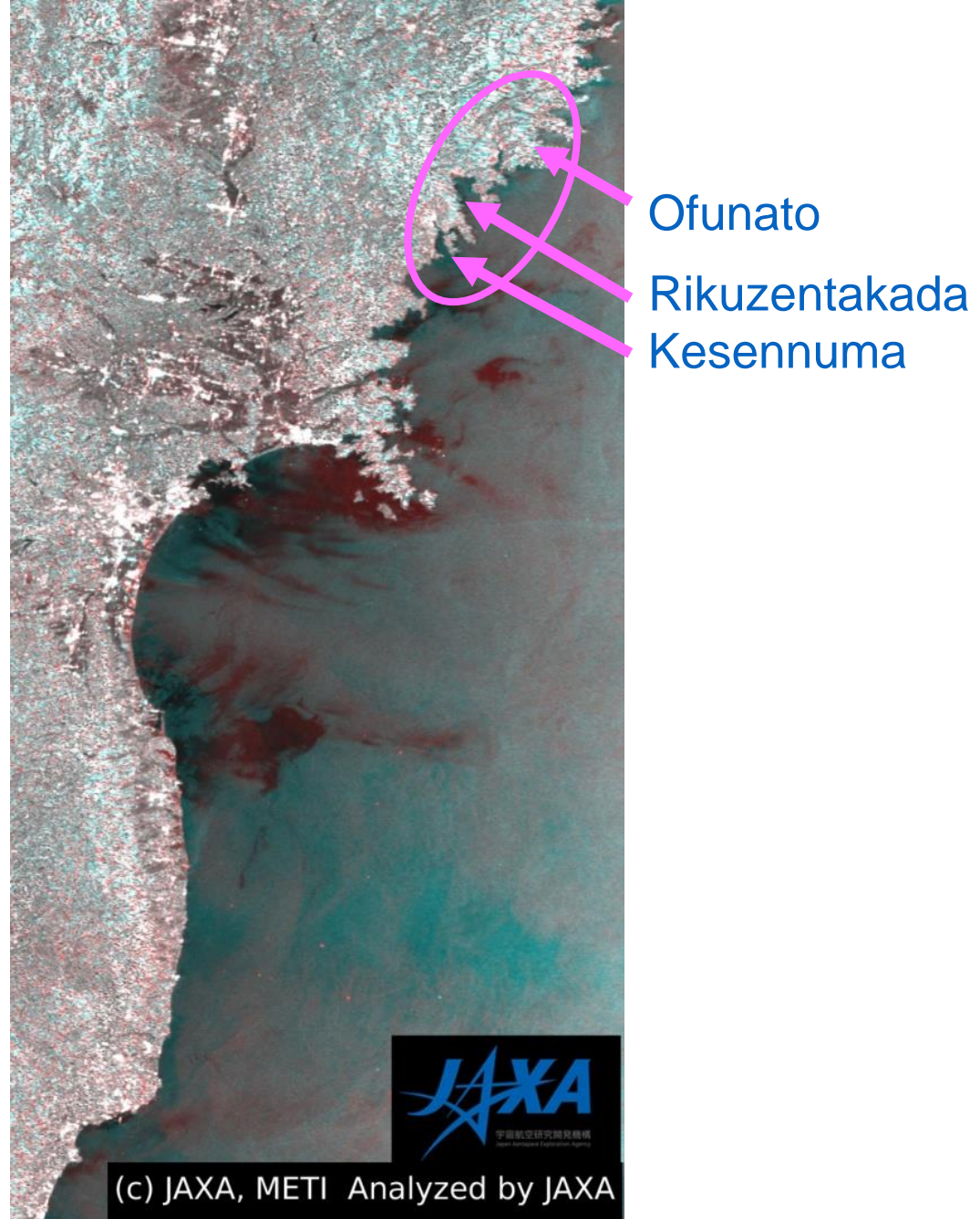


# Contents

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- Earthquake Disasters
  - Tsunami Disasters
  - Landslides, Large Earth Mass Movement Disasters
  - Flood, Inundation Disasters
- 
- Immediate grasp of the damaged area and the situation
  - Basic information for rescue, relief, first aid, recovery, reconstruct, etc. after the disaster.
  - Search for potential disaster-prone (danger) areas
  - Supply basic information for hazard maps



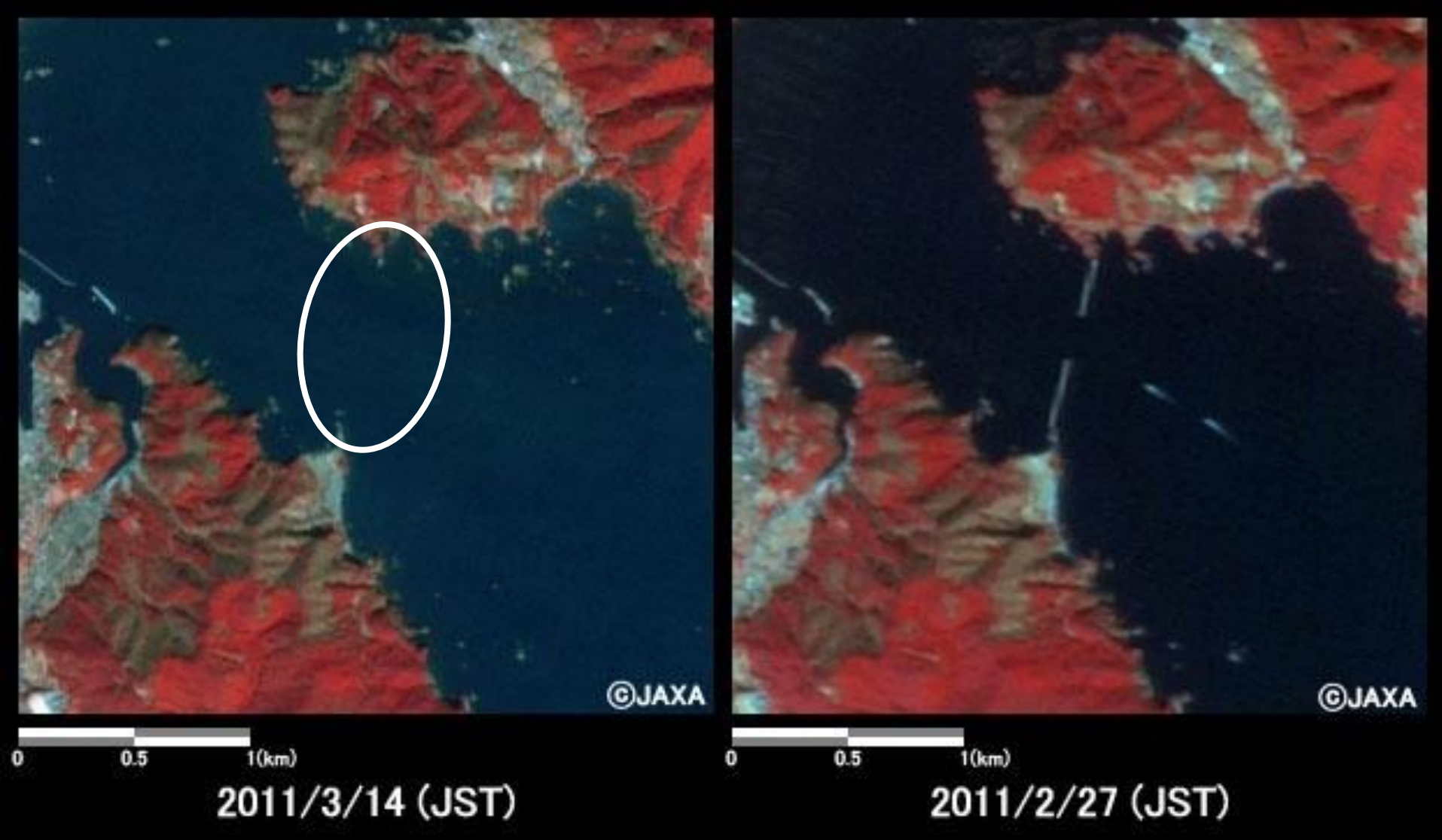


Before 2010.9



After 2011.9

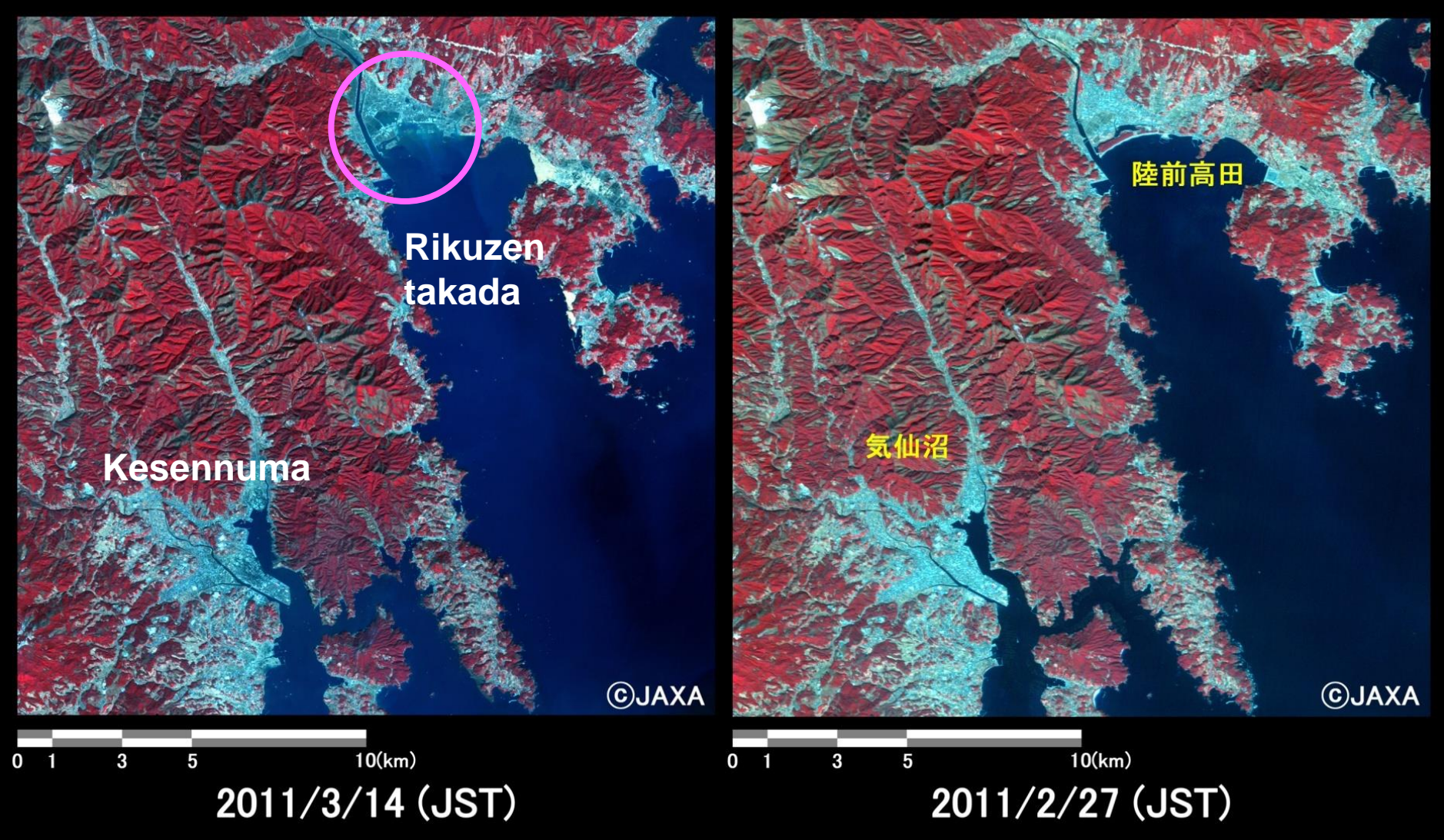
Water break at the mouth of the Ofunato gulf



Images of the entrance of Gulf of **Ofunato city**, Iwate pref.  
(about 3kmX3km area) **AVNIR-2**

Left: After the event (2011.3.14)、 Right: Before the event (2011.2.27)

[http://www.eorc.jaxa.jp/ALOS/img\\_up/jdis\\_opt\\_tohokueq\\_110314-2.htm](http://www.eorc.jaxa.jp/ALOS/img_up/jdis_opt_tohokueq_110314-2.htm)



Images of **Rikuzentakada** and **Kesennuma cities**, Iwate prefecture.  
(about 20kmX20km area) **AVNIR-2**

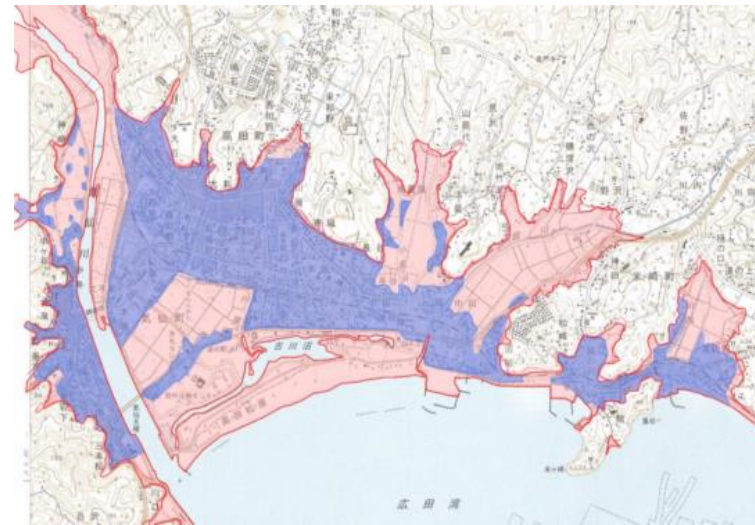
Left: After the event (2011.3.14)、 Right: Before the event (2011.2.27)

[http://www.eorc.jaxa.jp/ALOS/img\\_up/jdis\\_opt\\_tohokueq\\_110314.htm](http://www.eorc.jaxa.jp/ALOS/img_up/jdis_opt_tohokueq_110314.htm)

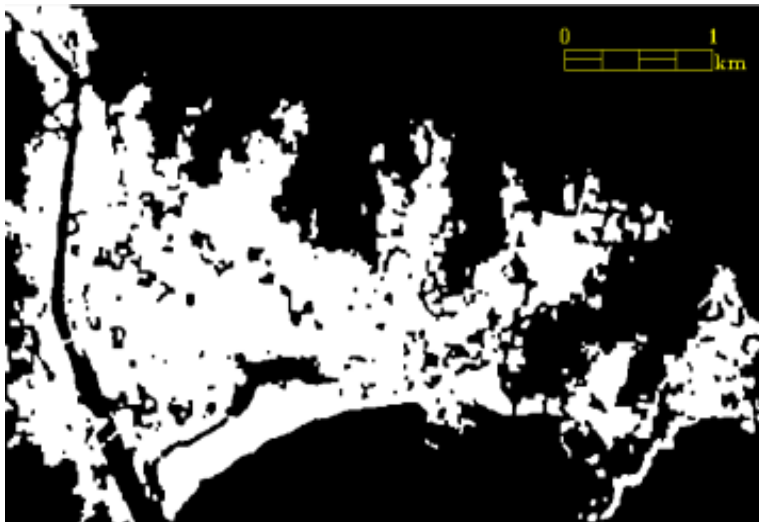
# Tsunami Inundation Area in Rikuzentakata City



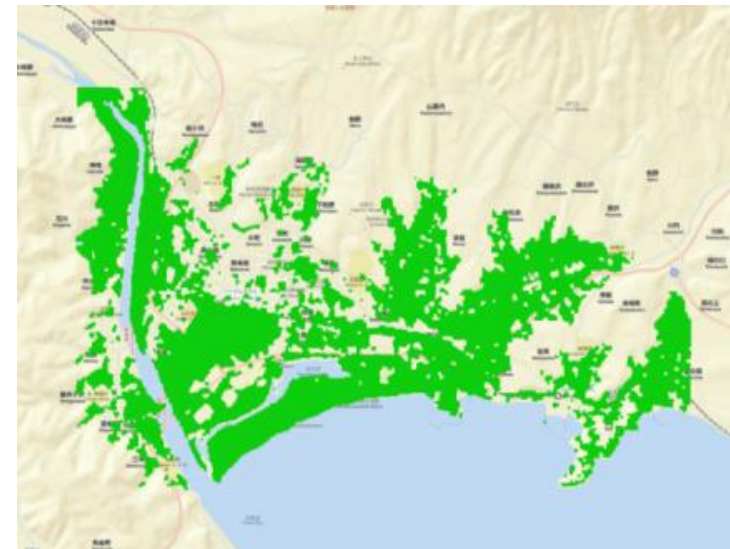
After the event True color(AVNIR-2)



In-situ Observed inundation area



Inundation area obtained from SAR image



Inundation area using NDVI



From HP of JAXA

## Sensor of ALOS-2: Synthetic Aperture Radar (SAR)

- Space resolution 3x3m
- Temporal resolution within 24hours
- Day and night
- Fine and bad weather

⇒ Change in Disaster Mitigation



JAXA established the committee to examine how to make use of the images of ALOS-2 in 2013.12.

Generally, **two satellite images**, i.e., an image taken **before** the occurrence of disaster and one taken **after** the event, are compared to detect the damaged area.

However, it is not easy to get the image taken before the event at the same point, and even if both wished images are available, it may be difficult to exactly superimpose them.

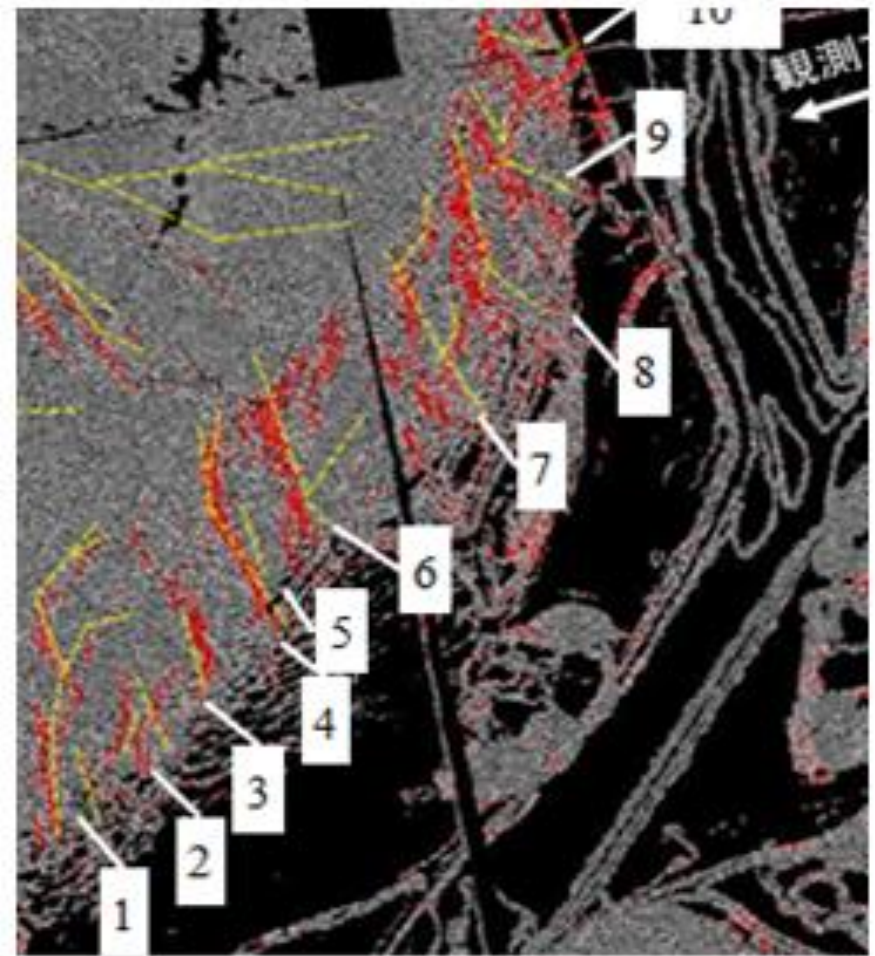
Therefore, we try to detect the damaged area **only from the image taken after the disaster.**





Courtesy of PASCO CLT.

***Analysis site, Hiroshima city***



This Figure shows the comparison of the results obtained from **optical sensor (left) and SAR sensor(right)**.

There are 10 failure zones and the **locations are in good agreement**

# Detection of Flooded Areas of Watarase and Kinu Rivers Caused by 2015 18<sup>th</sup> by ALOS-2/PALSAR-2



<http://www.bing.com/images/search?q=%e5%8f%b0%e9%a2%a818%e5%8f0725619000&thid=OIP.Md907f4674ce3328fa7c8d8056361d76bo0&mode=overlay&first=1>



<http://mainichi.jp/graph/2013/09/16/20130916org00m040002000c/image/044.jpg>

# Watarase River and Reservoir



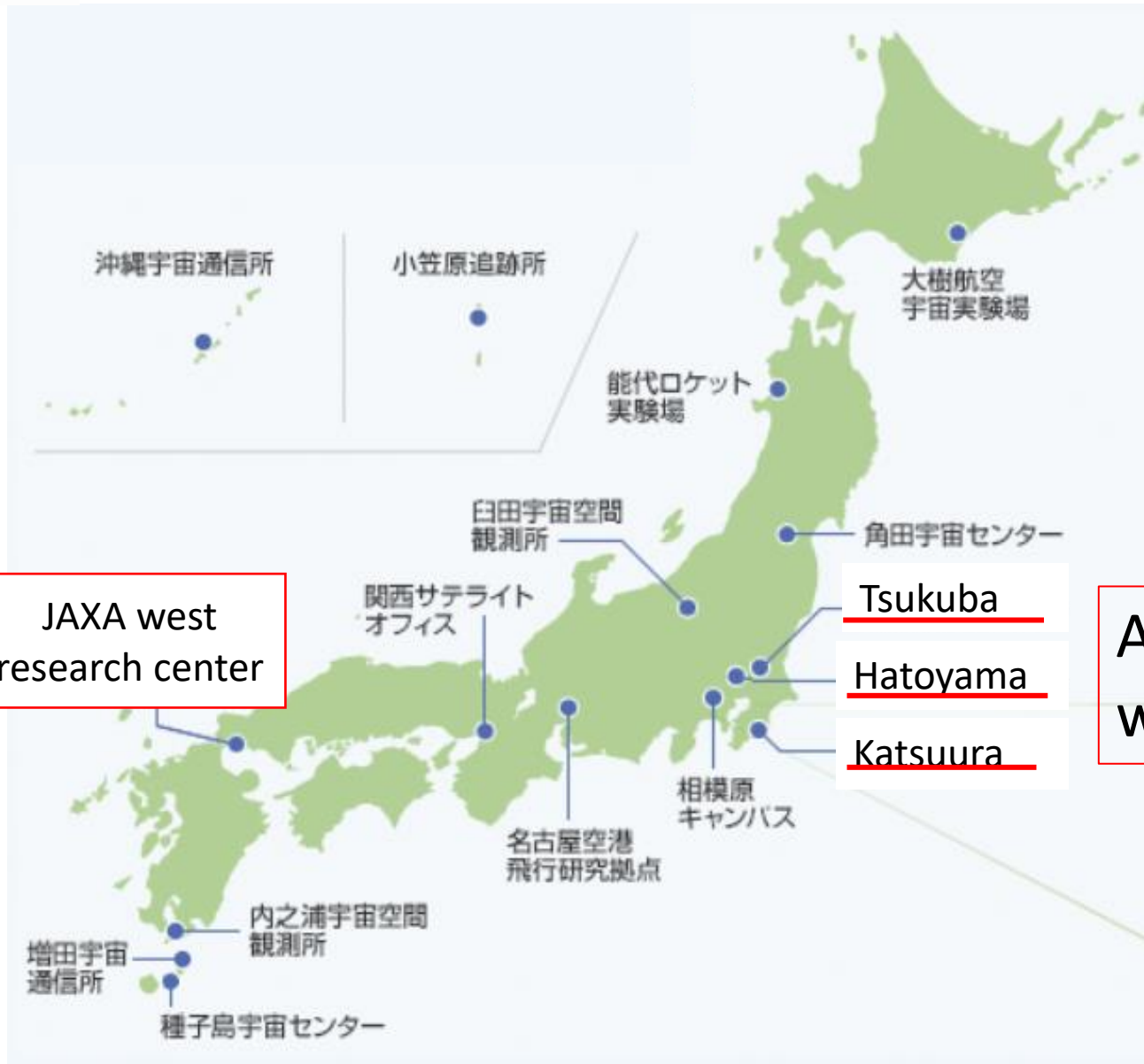
<https://ja.wikipedia.org/wiki/%E6%B8%A1%E8%89%AF%E7%80%AC%E9%81%8A%E6%B0%B4%E5%9C%B0>



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# Institutions and Facilities of JAXA



JAXA west  
research center

Tsukuba  
Hatoyama  
Katsuura

All receiving center  
were in east Japan

# Agreement between JAXA・ Yamaguchi Prefectural Government and Yamaguchi University



From left,  
Okumura JAXA Chairperson,  
Muraoka Governor,  
Oka President

2016 September 14

**JAXA,  
Yamaguchi Prefectural Government  
and Yamaguchi University**  
concluded cooperative agreement  
for making use of Satellite data to  
Disaster management, and other  
Purposes.



# Opening Ceremony of JAXA West Japan Research Center for Application of Satellite data to Disaster Management



Okumura JAXA Chairperson,  
And Mr. Kawamura, former  
Minister



Kawamura former Minister  
of Education, Culture, Sports,  
Science and Technology



President Oka

2017, February 9

Opening Ceremony of JAXA west Japan  
research center was held in Ube city



Commemorative Photo

# Unveiling Ceremony of CRASS



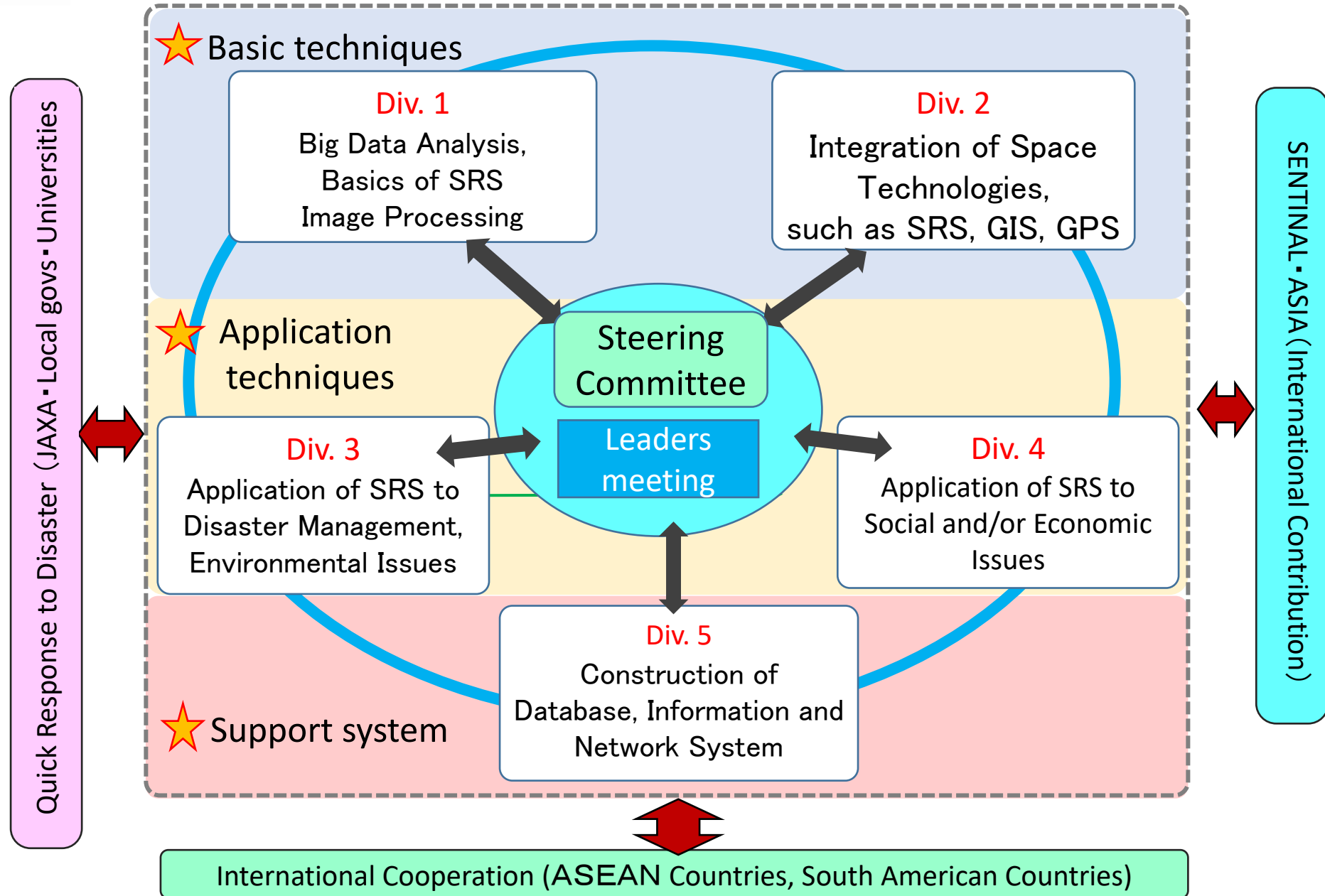
Address by the Director of CRASS  
Prof. F. [Miura](#)

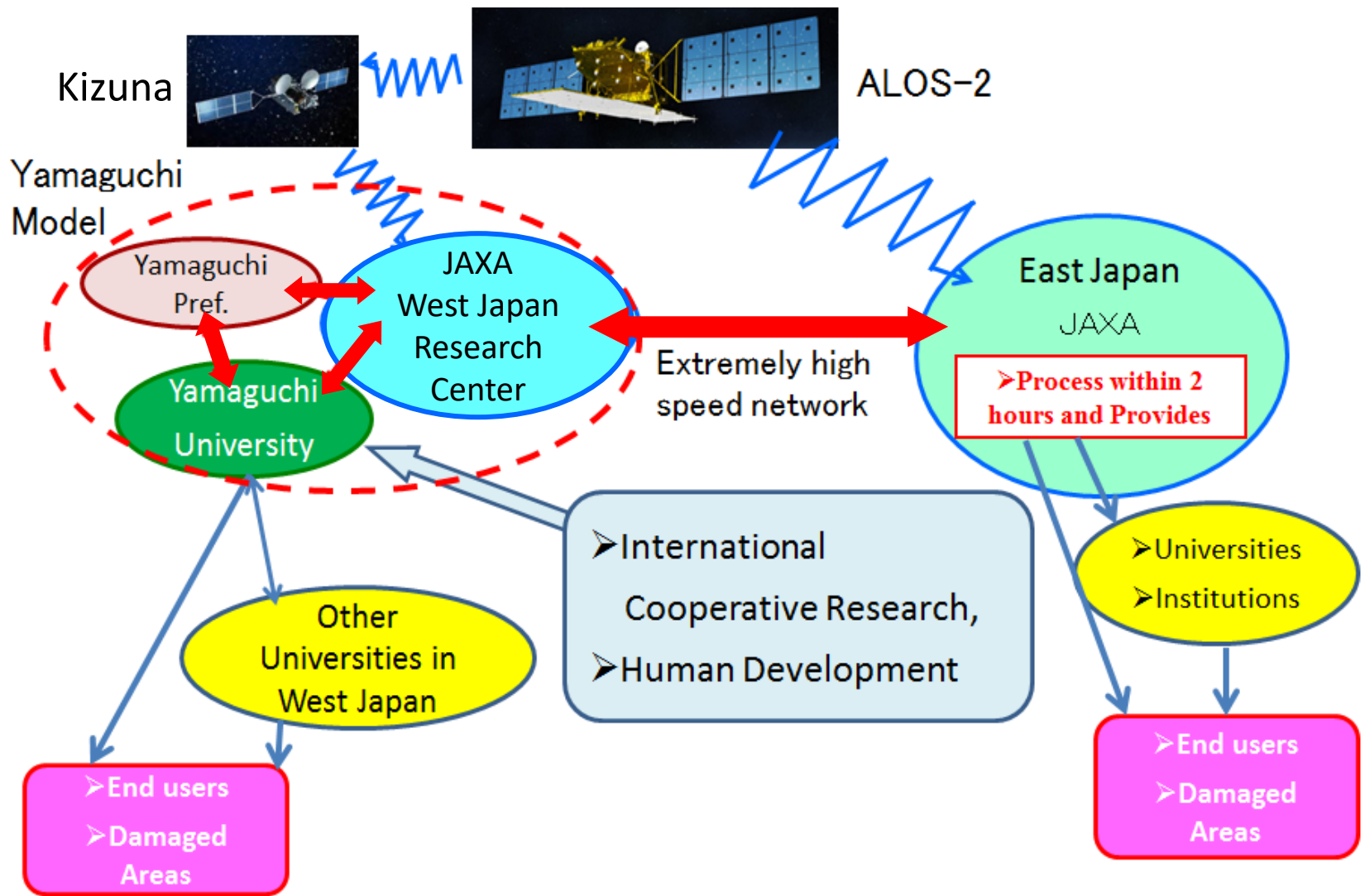
**2017, February 9**

Unveiling Ceremony of **CRASS**  
was held in YU



Unveiling: from left  
[Tanaka](#) Chief of the Ministry of education,  
[Okumura](#) JAXA chairperson,  
[Kawamura](#) former Minister of Education,  
[Oka](#) YU President,  
[Muraoka](#) YP Governor  
[Kubota](#) Ube city Mayor





The future network regarding the usage of satellite data, i.e., research and human development. YU will cooperate with other universities and research institutions. In addition, we will accelerate and expand international cooperation.

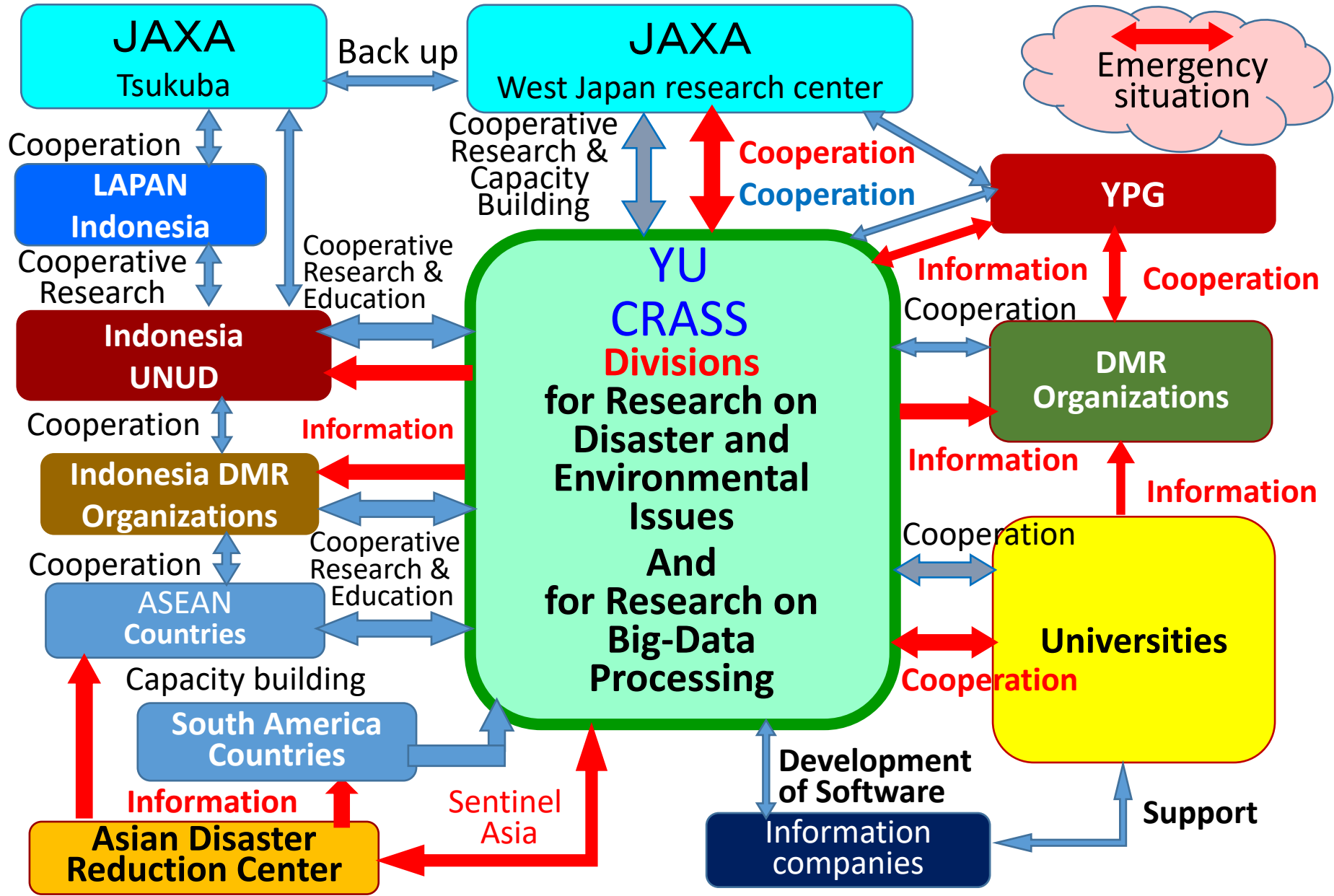
Data obtained by satellite ALOS-2 /PALSAR-2 of JAXA and other data have come to Yamaguchi University (YU).

JAXA and Yamaguchi Prefectural government (YPG) and YU cooperate to use these data in the time of disasters.

JAXA provides YU with data observed urgently and analyse them with YU, then send the products to YPG and other organization related to disaster management.

YPG will make use of them for decision making in taking the countermeasures as well as search and rescue activities and so forth.

# Activities and Network of CRASS



- ◆ **Joint Master course** between YU and Udayana University (UNUD)
  - Started with the support of Grant from Japanese Ministry of Education, Culture, Sports, Science and Technology (**MEXT**) in 2009.
  - Expanded the program to **Double Degree (DD) program** in 2011.
  - In the DD program, some UNUD students **move to YU** and study in the second year and write the **1<sup>st</sup> Master thesis** then go back to UNUD and finish the **2<sup>nd</sup> Master thesis**.
  - Some of them go to **Ph.D. course in YU** after finishing DD program.

1. Space engineering and satellite remote sensing
2. Digital image processing
3. Disaster mitigation
4. Advanced geo-informatics
5. Environmental fluid mechanics
6. Environmental remote sensing
7. Oceanography
8. Climate change
9. Land, water & vegetation conservation
10. Lake & coastal environment
11. Meteorology
12. Environmental Policy and Planning





# Number of the DD program students

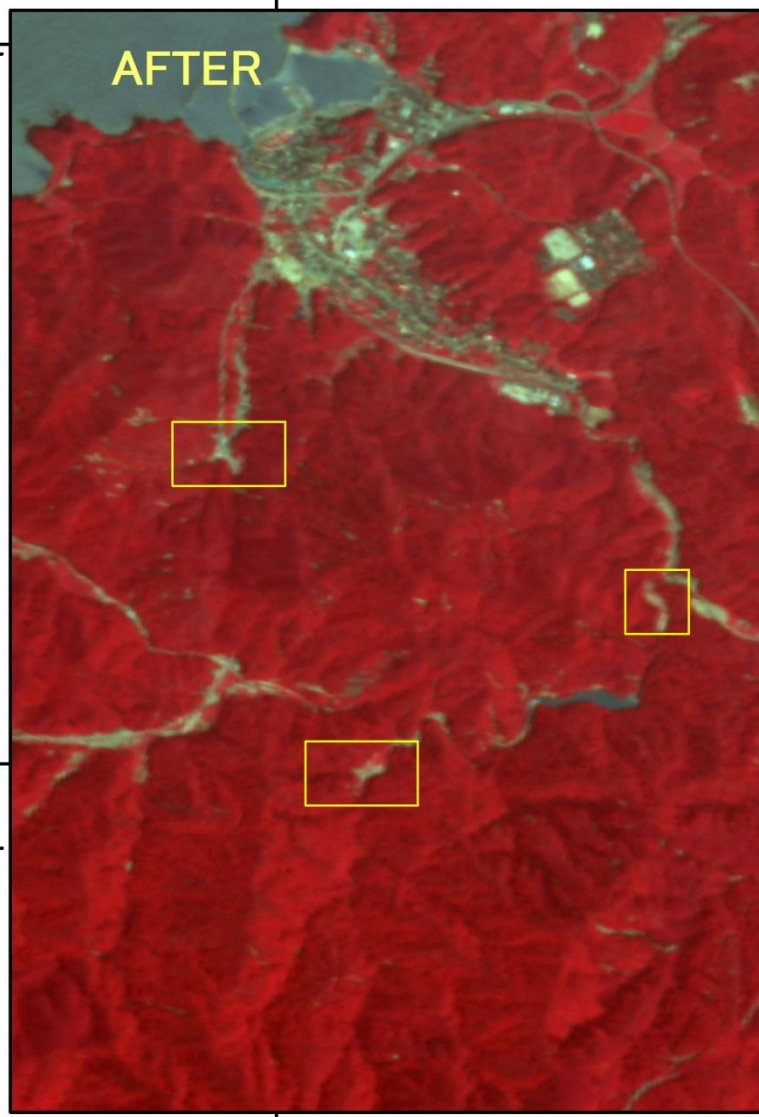
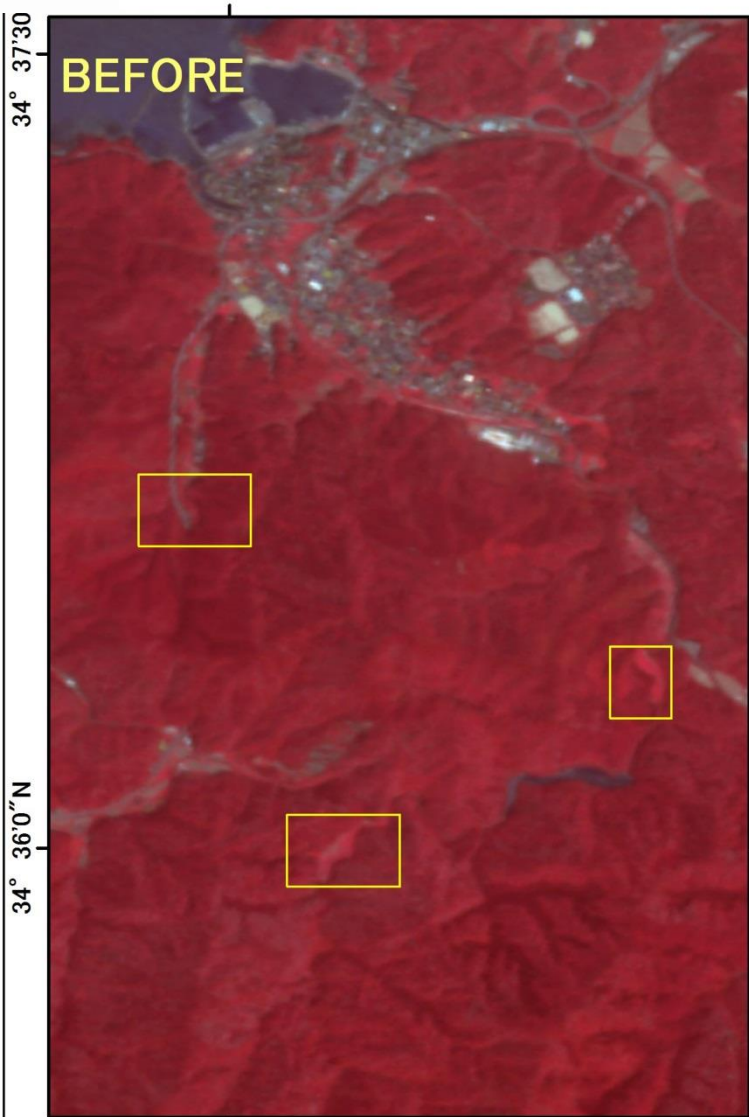
- Class 2010: 3 students
  - 2 Ph.D. students in YU
- Class 2011: 3 students
  - 2 Ph.D. students in YU
- Class 2012: 3 students
  - 2 Ph.D. students in YU
- Class 2013: 3 students
- Class 2014: 0 students
  - 2 Ph.D. students
- Class 2015: 2 students (from Thailand and Vietnam want to go to Ph.D. course)
- Class 2016: 2 students (expected)

◆ 3 Ph.D. students of DD program students have received Doctor Degree from YU,

In addition to the DD program students,

5 students from Indonesia received Doctor Degree from YU.

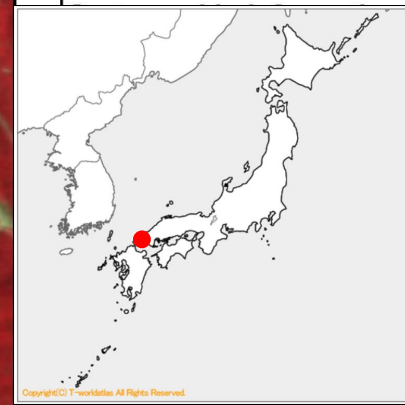
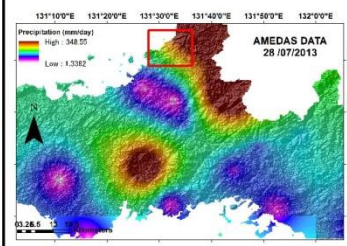
# LANDSLIDE IN SUSA CITY YAMAGUCHI PREFECTURE



131° 36'0"E  
SPOT-5 FALSE COLOR  
24th April 2012  
8 meter

131° 36'0"E  
SPOT-5 FALSE COLOR  
10th August 2013  
8 meter

34° 37'30"N



34° 36'0"N

CNES 2012 and 2013  
distribution Spot Image S.A.  
all rights reserved

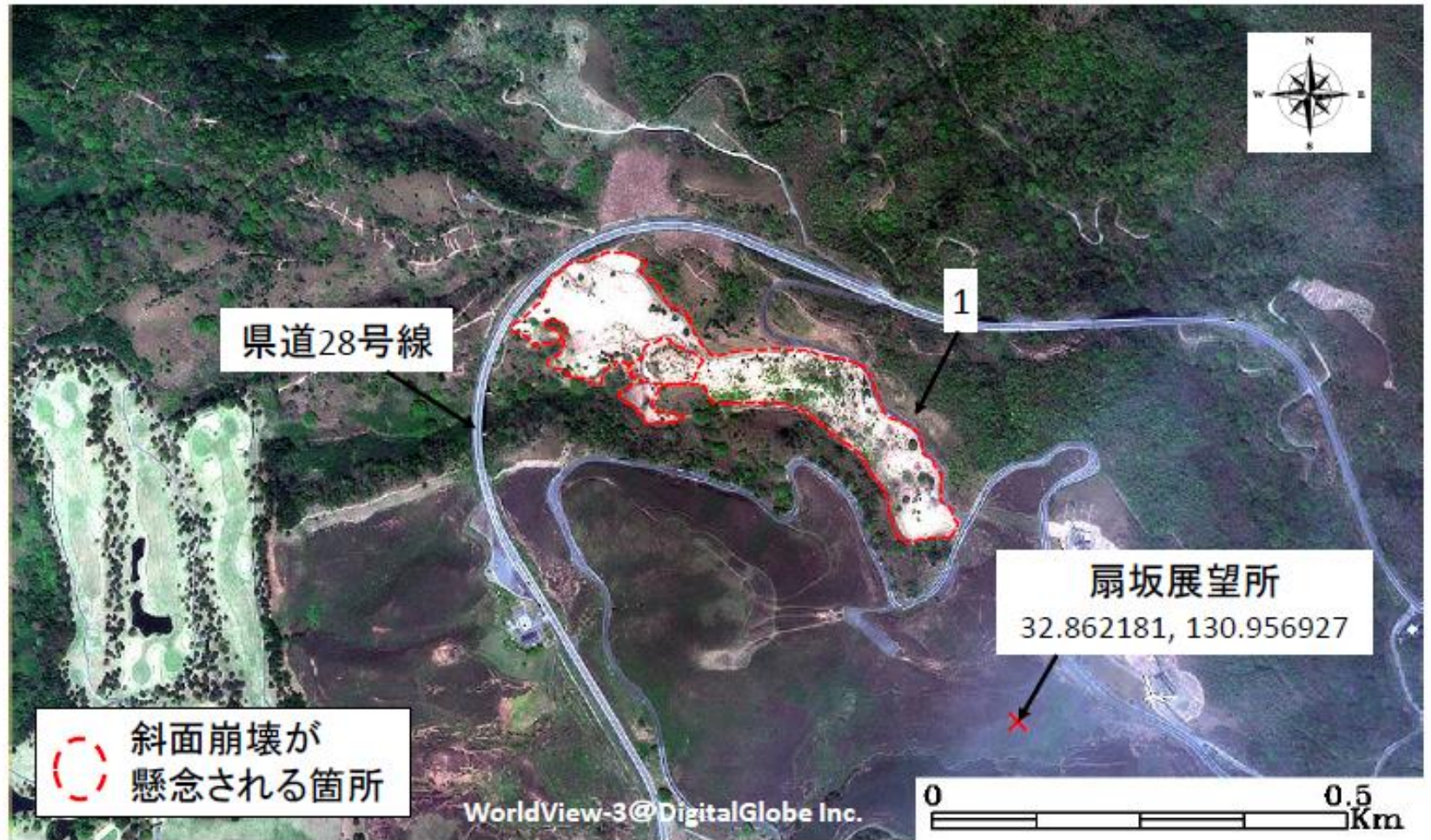


# The 2016 Kumamoto Earthquake



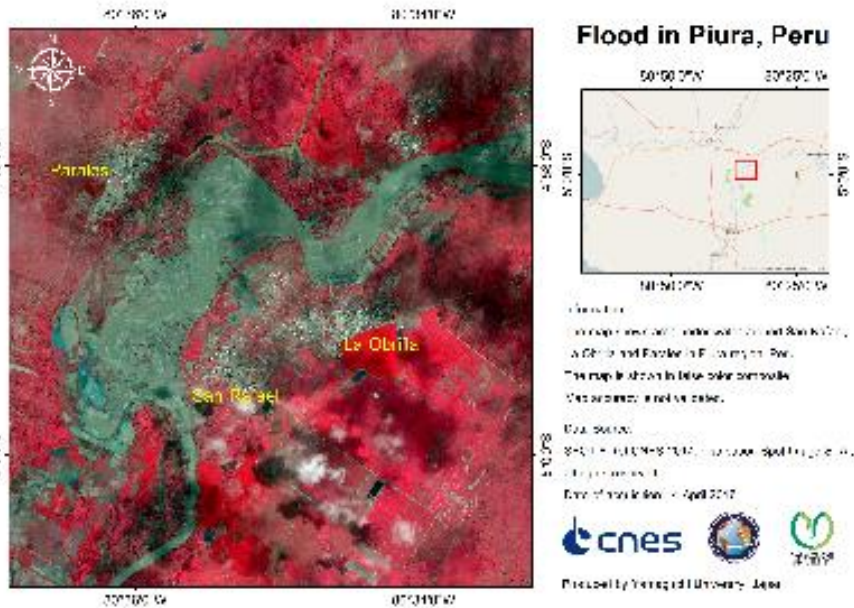
# The 2016 Kumamoto Earthquake

使用データ: WorldView-3 (WV03N32\_847638E130\_9101382016041500000000MS00\_GU0040)  
観測日 : 2016年4月15日 (災害発生後)

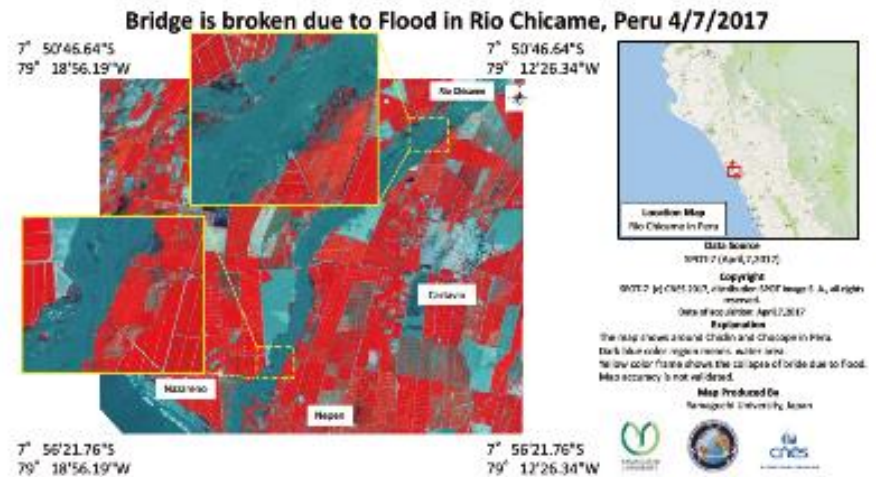


# Contribution to Peru

There was a severe flood disaster this spring in Peru.  
YU-CRASS analyzed the inundation (damaged) areas  
And sent the products.



解析結果1



解析結果2

★ We want to contribute to reduce and mitigate disasters using Satellite Remote Sensing.

★ We want to be  
a bridge  
between foreign  
countries and Japan.



# Seismic activities in western Japan

Active term

1649-1718  
(70years)



Calm term

1719-1788  
(70years)

1789-1858  
(70years)



1859-1890  
(32years)

1891-1948  
(57years)



1949-1994  
(45years)



# Earthquakes (M>6) occurred after 1995

