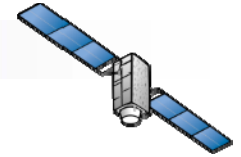


# Overview of Utilization of QZSS



Satellite Applications Mission Directorate I  
Japan Aerospace Exploration Agency



# *Outline*

## Overview

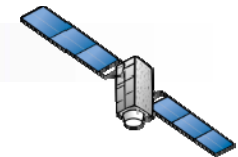
- Summary of GNSS Positioning
- QZSS : Quasi-Zenith Satellite System

## Developments and Experiments

- Development of PPP (Precise Point Positioning)
- Joint Experiments
- MGA : Multi GNSS Asia

Introduction of Application 1 – GPS Buoy

Introduction of Application 2 – Other Examples



## Overview

# ***GNSS Positioning for Disaster Mitigation***

GNSS : Global Navigation Satellite System

- GNSS positioning is utilized for some applications of Disaster Mitigation
- cm level or higher accuracy is required in many cases



**GNSS Satellites**

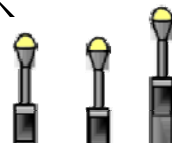
(GPS, GLONASS, Galileo, BeiDou, QZSS, IRNSS, etc)

**Tsunami**



(c) Hitachi Zosen

**Crustal Movement**



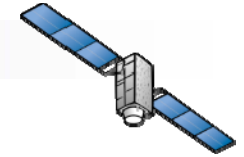
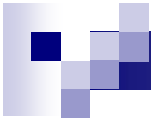
**Weather**



Geospatial Information  
Authority of Japan



**Volcano**

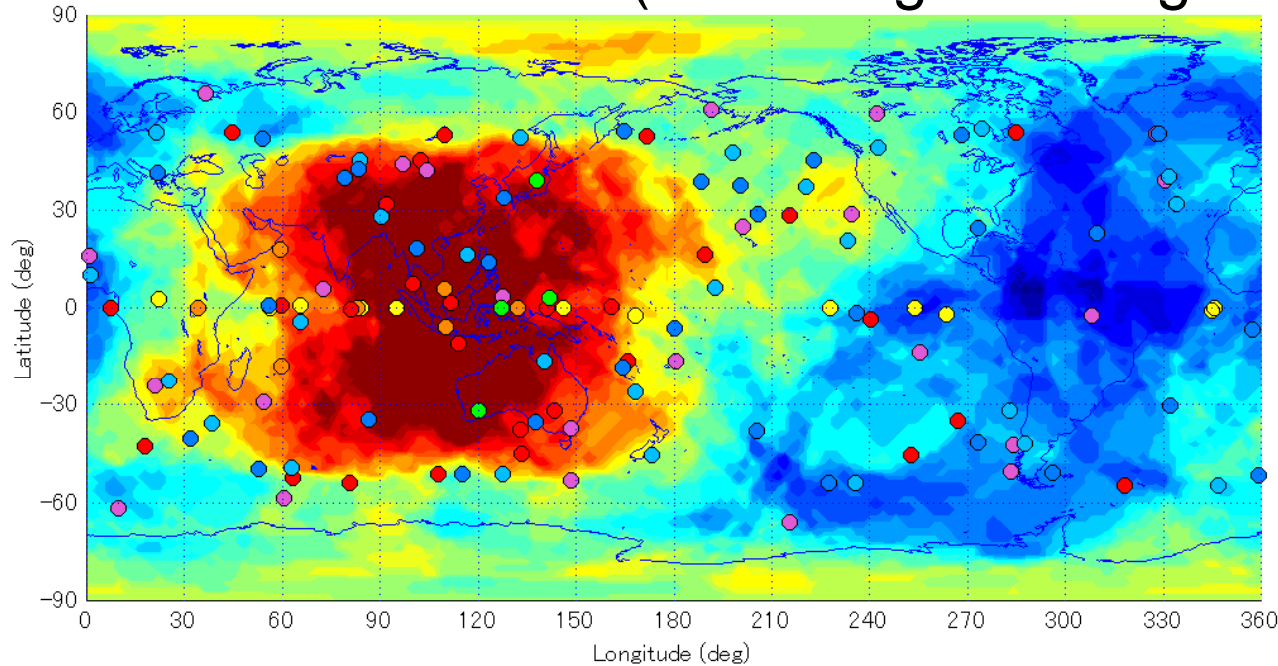


## Overview

# Visible satellite number of GNSS

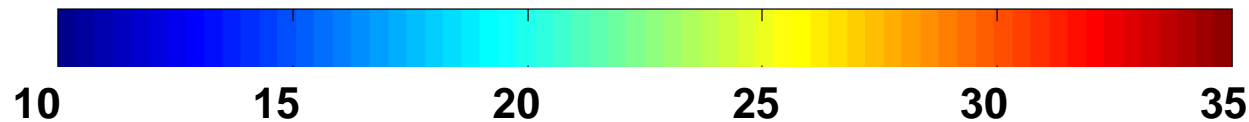
- The total number of GNSS satellites will increase to over 100 by 2018
- Asia Oceania region is well placed to obtain benefits from GNSS

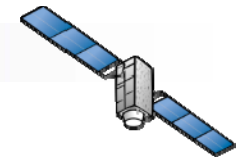
Visible satellite number (mask angle 30 degrees)



**2018:**

GPS(32)+Glonass(24)+Galileo(26)+BeiDou(29)+IRNSS(7)+QZSS(4)+SBAS(13)

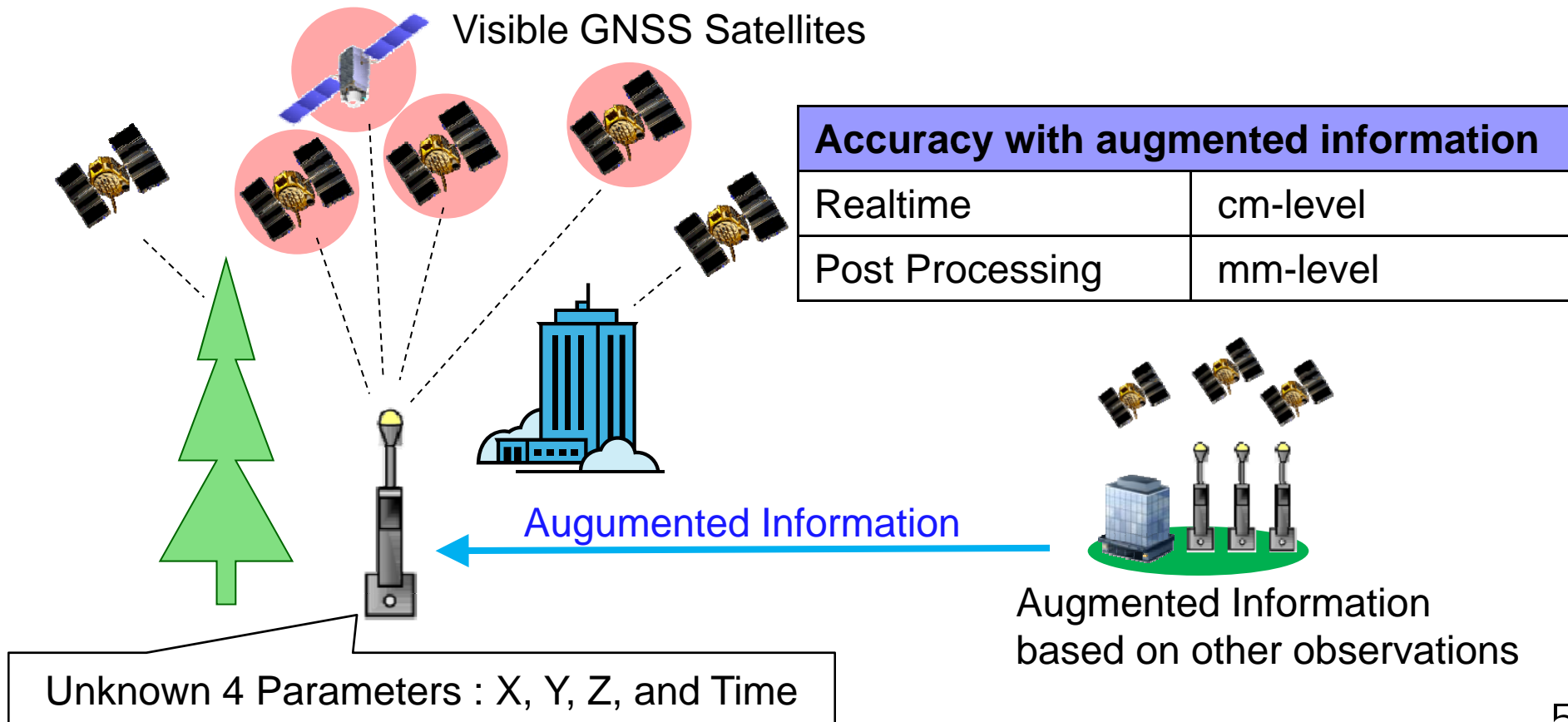




## Overview

# Summary of GNSS Positioning

- At least 4 satellites must be tracked at the same time
- High accuracy positioning is possible by augmented information

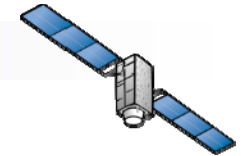
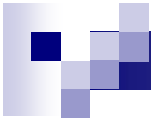


## Overview

# Quasi-Zenith Satellite System

- **Functional Capability:**
  - GNSS Complementary
  - GNSS Augmentation
  - Messaging Service
- **Coverage:** Asia and Pacific region
- **Signals:**
  - L1C/A, L1C, L2C and L5
  - L1S (L1-SAIF) on 1575.42 MHz
  - L6 (LEX) on 1278.75MHz
- **First QZSS satellite “MICHIBIKI” (QZS-1) was launched in 2010**
- **Japanese Cabinet Office has announced that four satellites constellation shall be established and the service will start in 2018.**



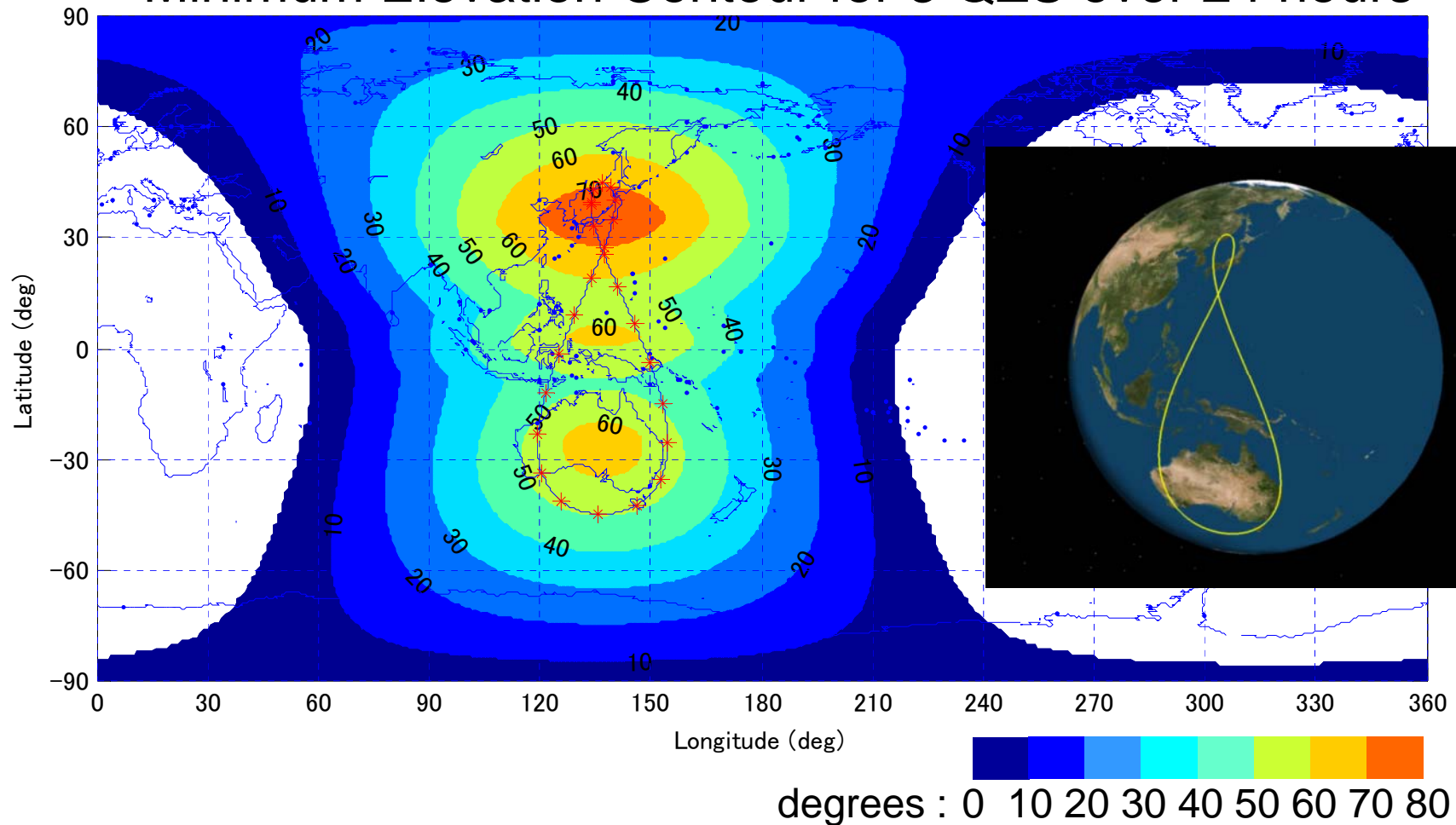


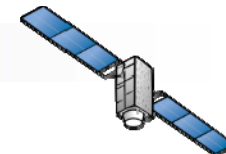
## Overview

# QZSS Ground Track and Visibility

Visible at high elevation angle in Asia Oceania Region

Minimum Elevation Contour for 3 QZS over 24 hours



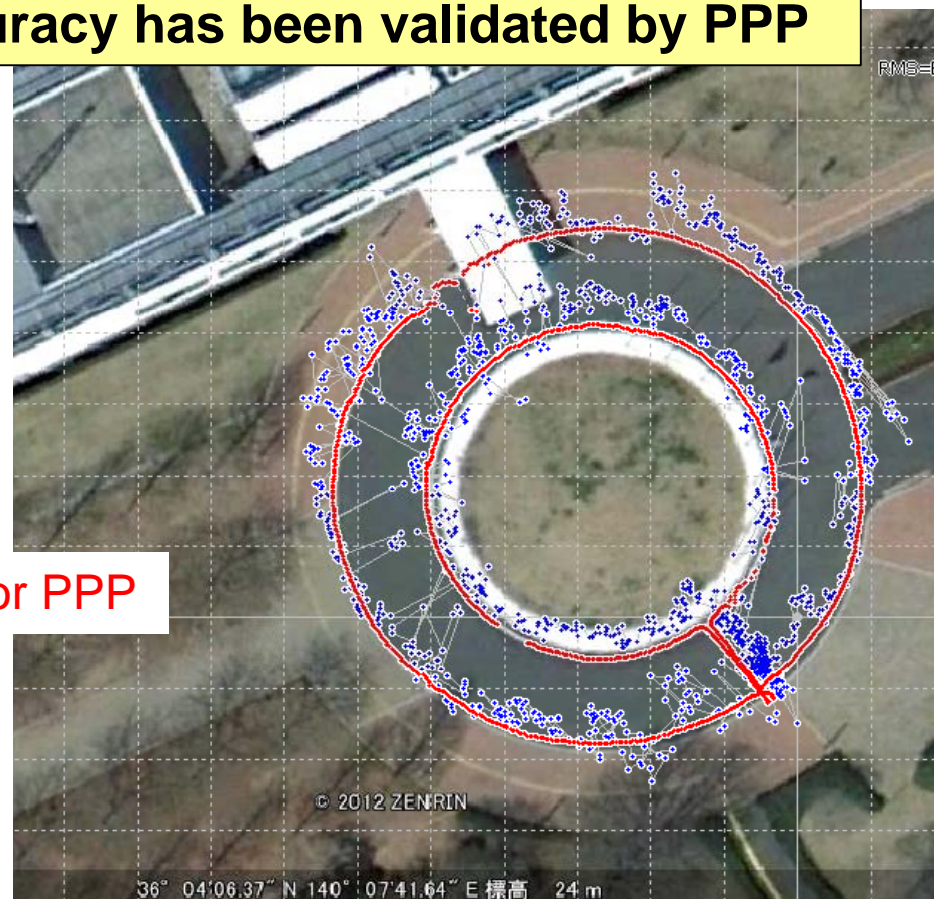
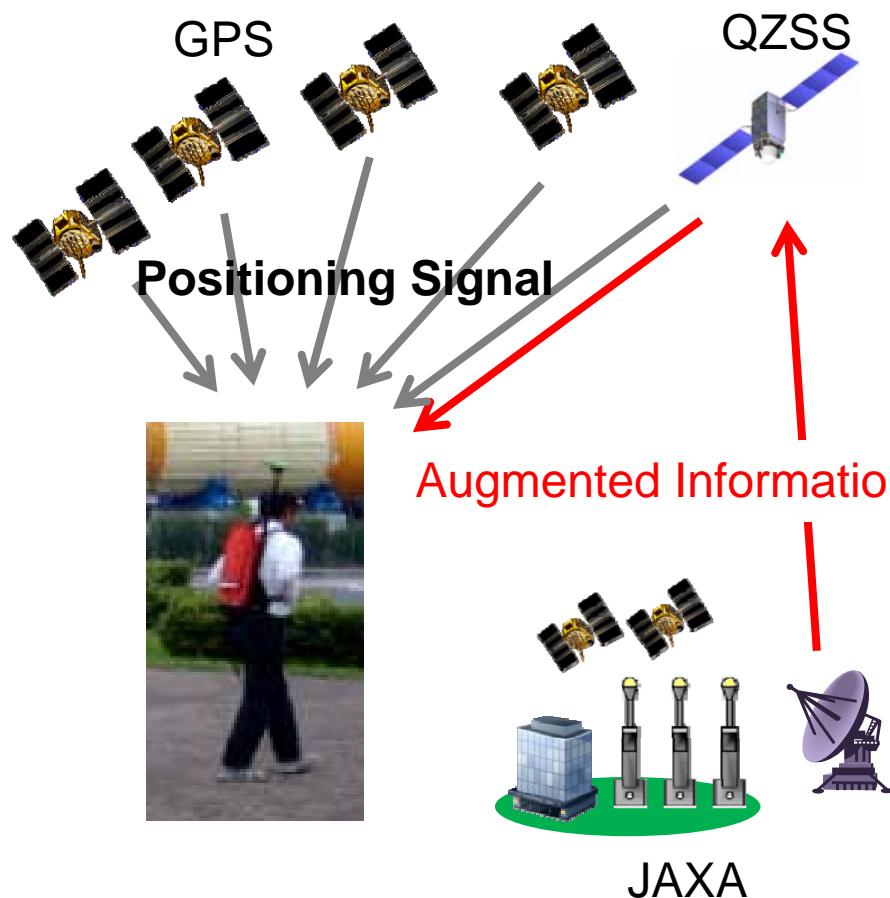


## Developments and Experiments

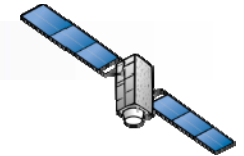
# Development of PPP using QZSS

PPP : Precise Point Positioning

- Less than 10cm (H/V RMS) accuracy has been validated by PPP







## Developments and Experiments

# Joint Experiments of QZSS

- JAXA has been promoting QZSS utilization and applications
- Achieved various results by joint experiments

Automatic Driving



Ocean Buoy Positioning



Agriculture Automation



Train Positioning

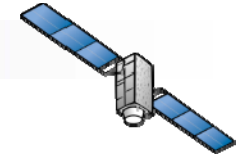


Vehicle Positioning



## *Developments and Experiments*

# ***MGA: Multi GNSS Asia***



- MGA is an international organization to promote and support activities of the “Asia Oceania Multi-GNSS Demonstration Campaign”

## **Multi-GNSS Demonstration Campaign**

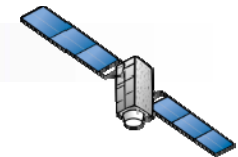


Secretariat:  Supported by :



Campaign consists of three main activities:

- Establishment of Multi-GNSS Monitoring Network
- Application Demonstration
- Regional Workshop

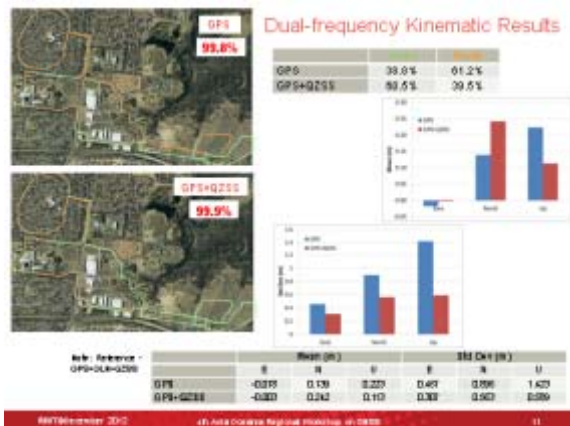


# Developments and Experiments Application Demonstrations

## Working Groups of Demonstration Campaign

Precise Positioning	Disaster Mitigation and Management
Intelligent Transportation System (ITS)	Location Based Services (LBS)

## Demonstrations started in 2012



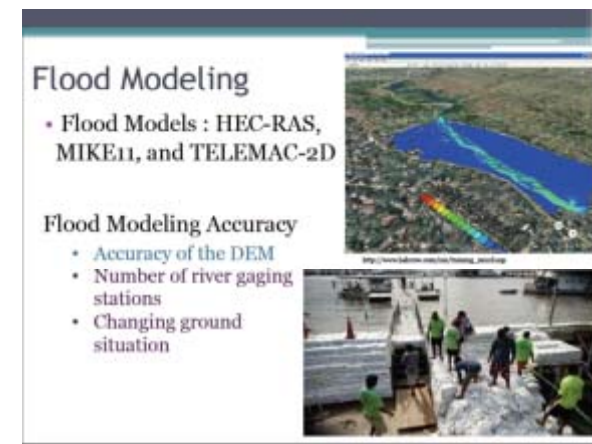
(c) RMIT (Australia)

Fix rate improvement of Kinematic positioning by Multi-GNSS



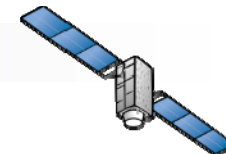
(c) UPM (Malaysia)

Utilization of precise positioning for Oil Palm Plantation, Soil ECa Mapping



(c) AIT (Thailand)

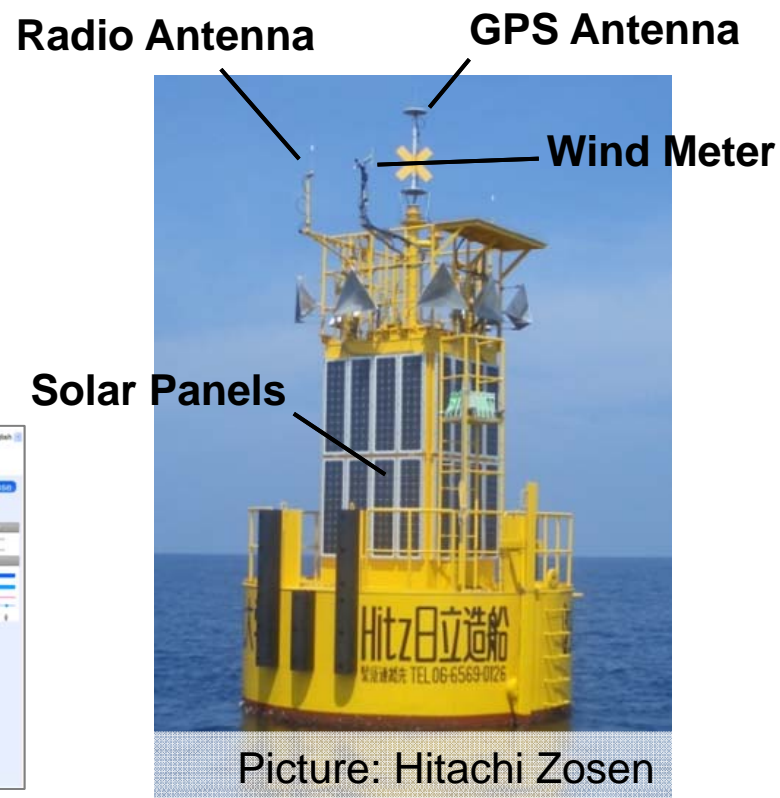
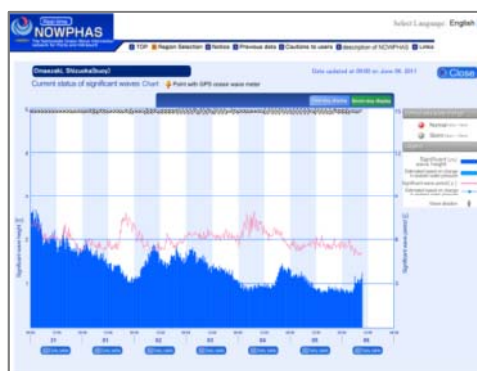
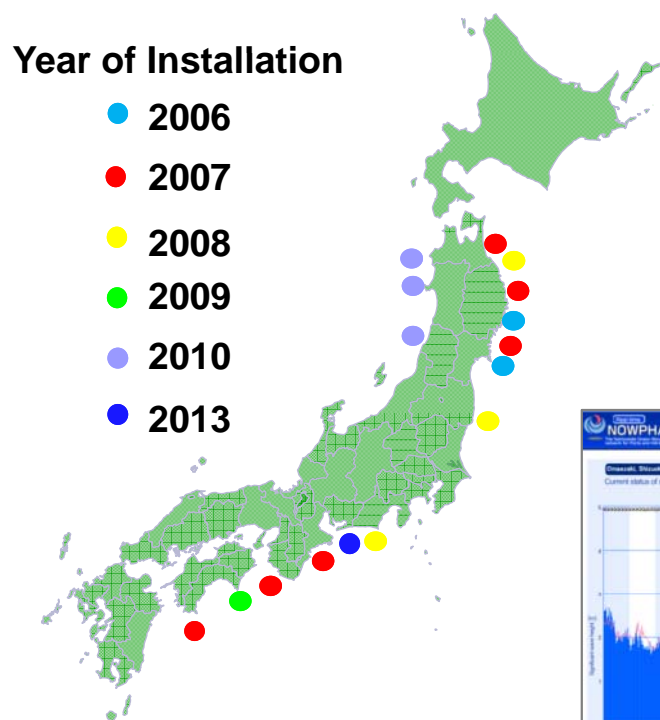
Utilization of precise positioning for flood monitoring system



# Introduction of Application 1 – GPS Buoy

## Operation of GPS Buoys in Japan

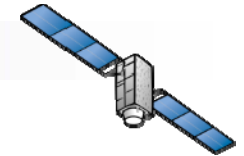
- 16 buoys operated at the coast of JAPAN by the Ministry of Land, Infrastructure, Transport and tourism (MLIT).



Picture: Hitachi Zosen

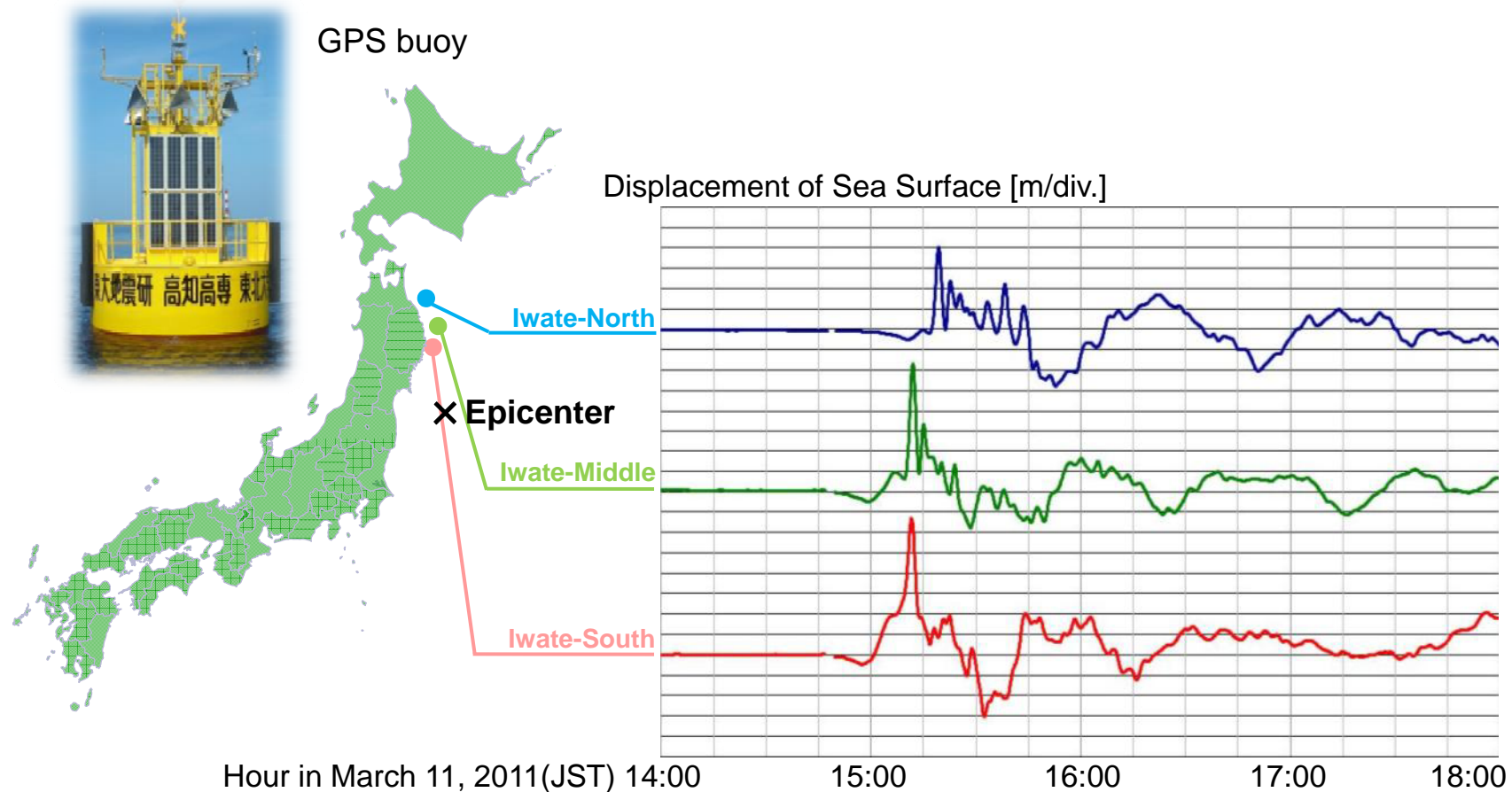
GPS buoy in Muroto  
April 21, 2008 – November 25, 2011

- NOWPHAS operated by Port and Airport Research Institute.  
NOWPHAS: Nationwide Ocean Wave information network for Ports and Harbors



# Introduction of Application 1 – GPS Buoy

## Observation Results of the 2011 Tsunami

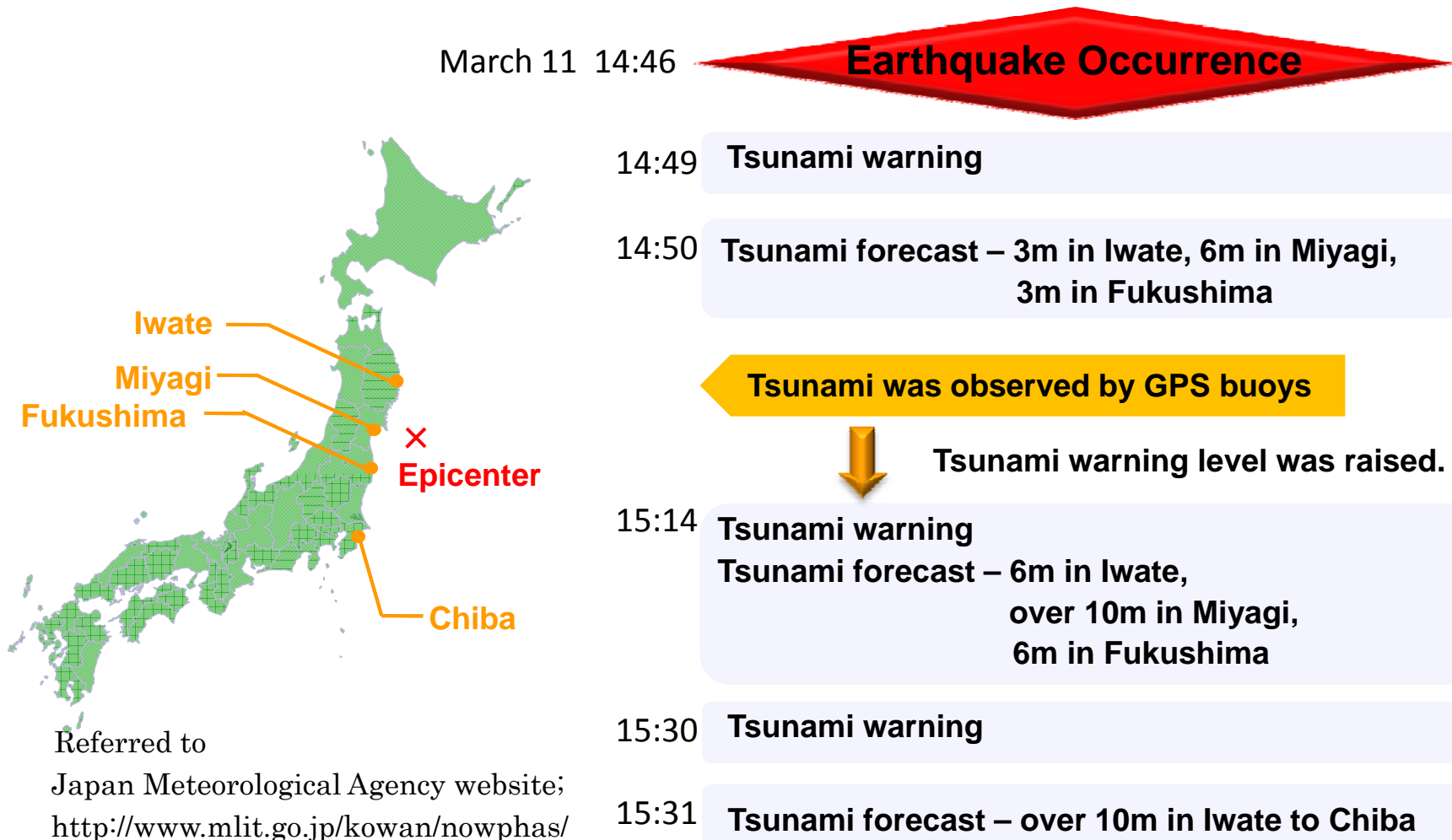
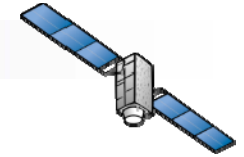


The data are provided by The Ministry of Land, Infrastructure and Tourism

Supported by Grant-in-Aid for Scientific Research (S) 21221007

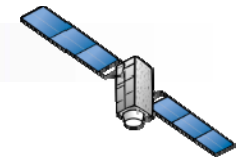
# Introduction of Application 1 – GPS Buoy

## Process of Tsunami Warning

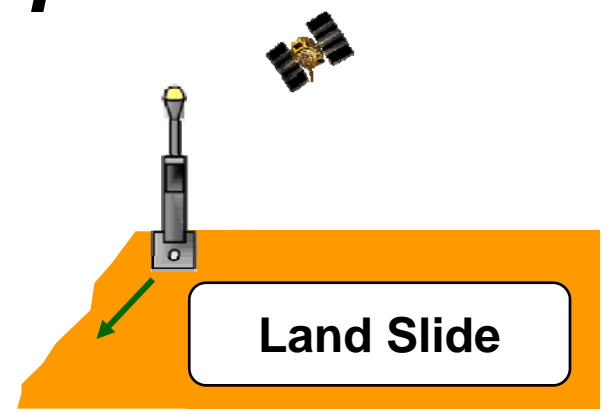
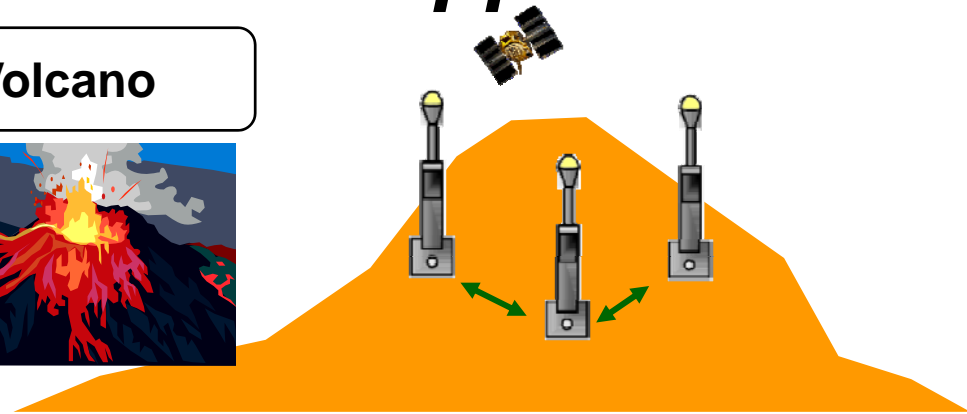


# Introduction of Application 2 – Other Examples

## GPS/GNSS Application Examples

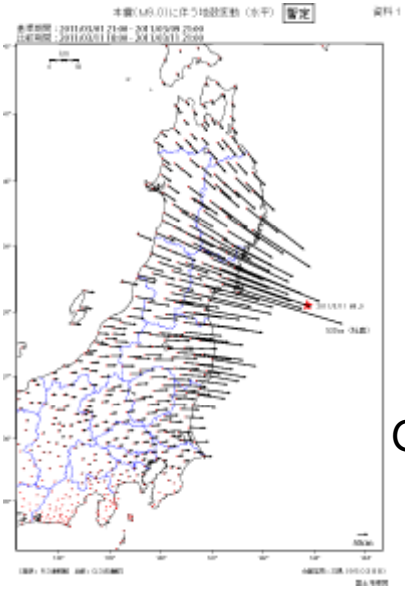


**Volcano**



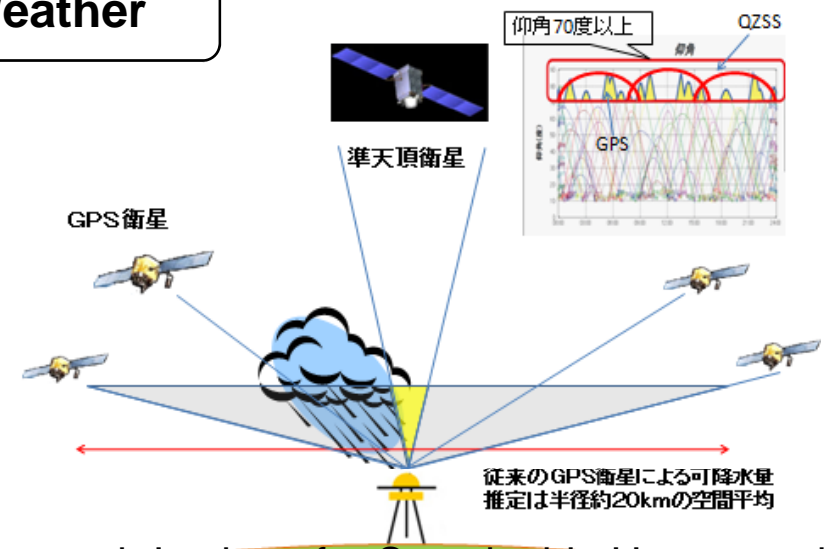
**Land Slide**

**Crustal Movement**

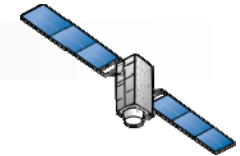


Geospatial Information Authority of Japan

**Weather**



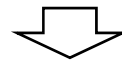
Research Institute for Sustainable Humanosphere, Kyoto Univ.



## *Introduction of Application 2 – Other Examples*

### ***Future Possibility***

- The availability of satellite positioning will be expanded with the significant increase of GNSS satellites.
- cm level positioning will be available with the augmentation signal from QZSS



Expansion of application possibility



# *Our Planet from QZS-1 'MICHIBIKI'*



Souvenir from Michibiki / Earth

# QZ-vision



*Thank you for your attention*