

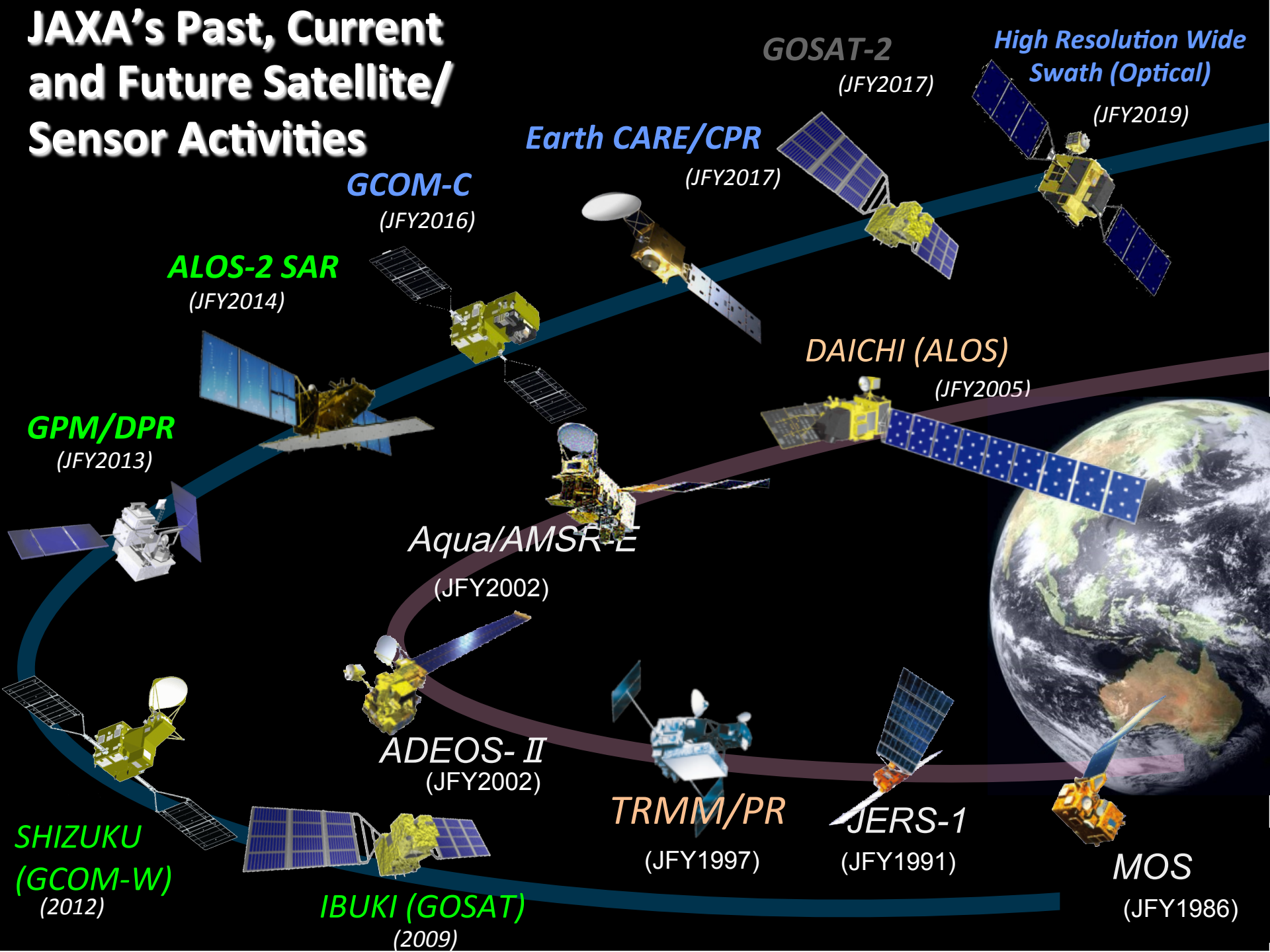


International Flood Initiative Planning Workshop,  
10 January, 2017, Tokyo

# **JAXA Earth Observation Satellites Program for Water Information**

Ko Hamamoto  
Earth Observation Research Center  
JAXA

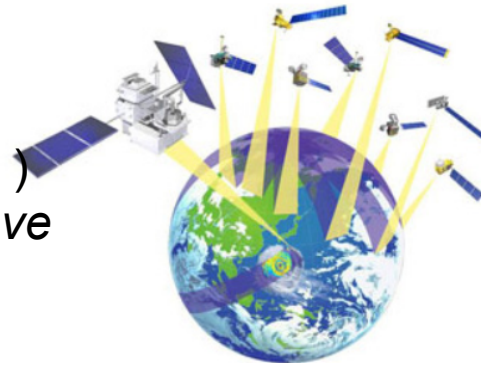
# JAXA's Past, Current and Future Satellite/Sensor Activities



**It is for the first time in the world for meteorological agencies to utilize satellite radar precipitation data such as DPR for numerical prediction.**

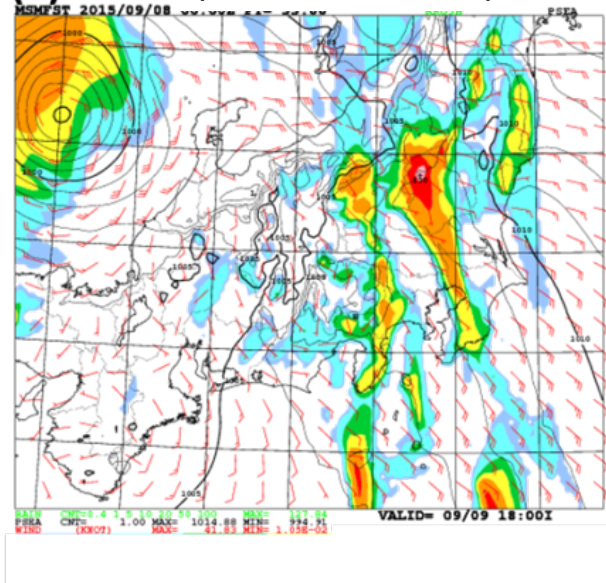
Global Precipitation Observation  
at 3 Hour Intervals  
with GPM Core Satellite (DPR + GMI )  
and Constellation Satellites (*microwave radiometers/sounders*)

Core sat in cooperation with NASA

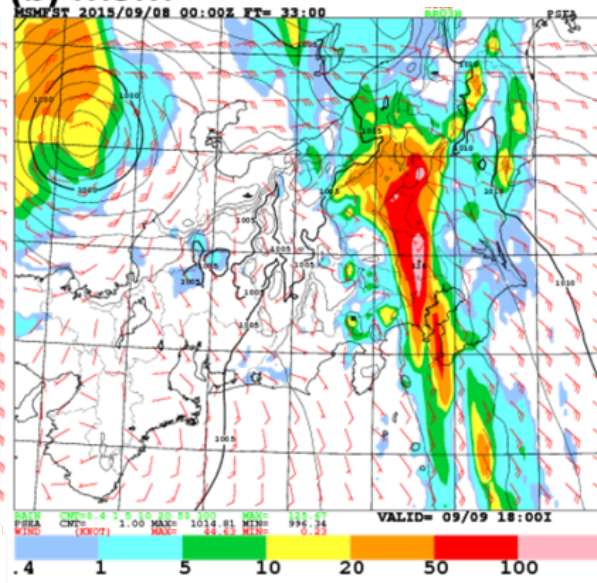


Japan  
Meteorological  
Agency

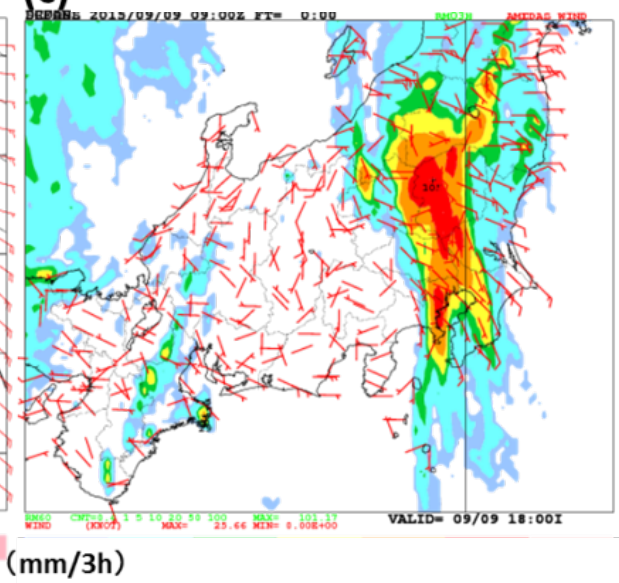
(a) MSM (Without DPR)



(b) MSM (With DPR)



(c) Ground Radar Obs.



(mm/3h)

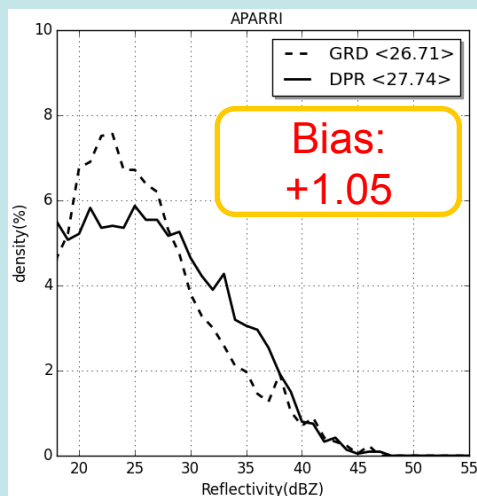


# Ground radar calibration using spaceborne precipitation radar

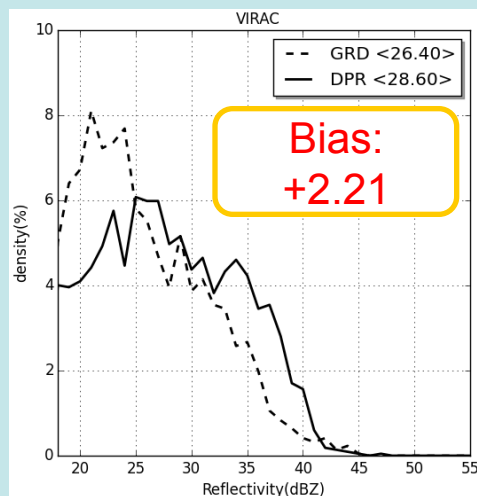
## Bias adjustment of ground radar using the spaceborne precipitation radar (GPM/DPR)

Histogram of near-surface radar reflectivity for the ground radar and the DPR using 10 cases.

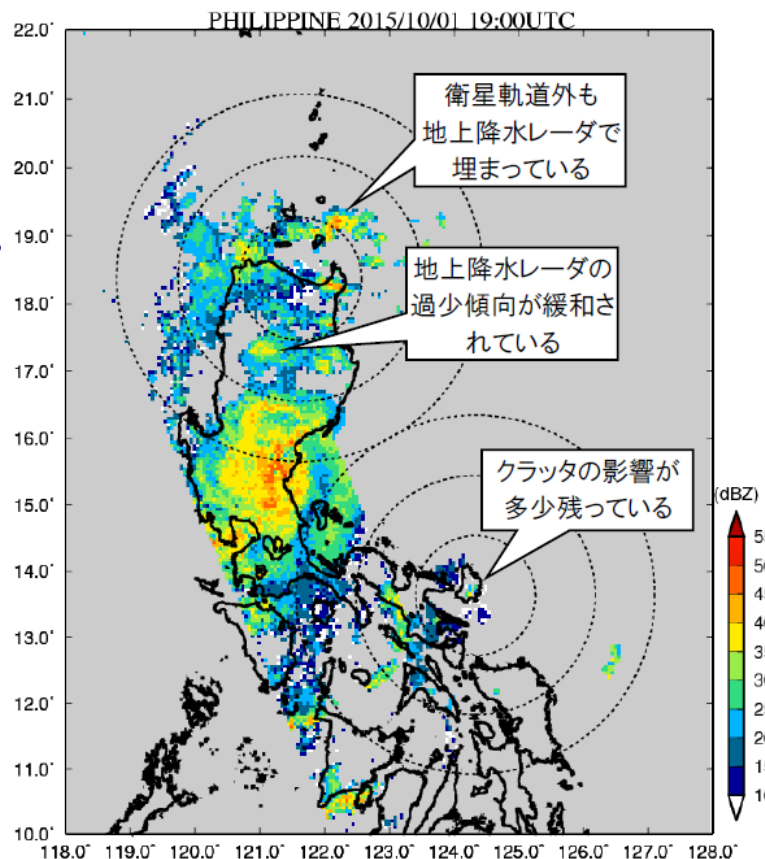
APPARI site



VIRAC site



Composite of Satellite Radar and Ground Radar Data in the PHILIPPINES

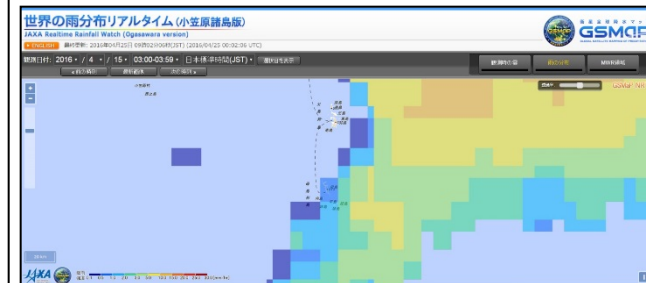




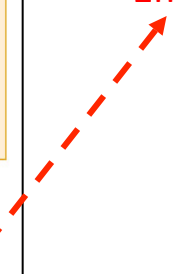
- After the meeting with the village officers, the Homepage of the Ogasawara Village started to link to the JAXA/EORC GSMaP Homepage on April 2016.

<http://www.vill.ogasawara.tokyo.jp/>

## JAXA/EORC GSMaP Homepage



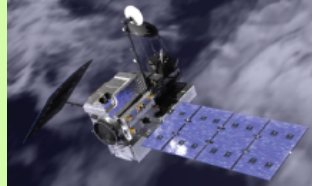
about 700 visits during 1month (Aug. 2016)



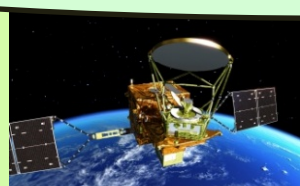
# Overview of GSMaP



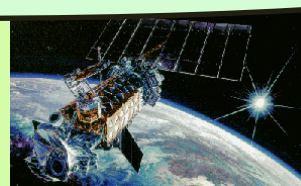
## Microwave Imagers & Sounders



**GPM-Core  
GMI**



**GCOM-W  
AMSR2**



**DMSP  
SSM/I, SSMIS**



**NOAA/MetOp  
AMSU**

Good: high-frequent  
(wide swath, multi-satellites)  
Bad: cannot measure vertical structure (need info. from radar)

GSMaP Microwave Radiometer Retrieval Algorithm

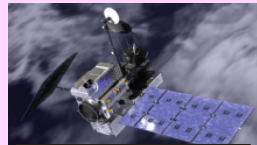
Rainfall Data from each Microwave Radiometer

Merged Microwave Rainfall Data

Precipitation Radars



**TRMM  
PR**



**GPM-Core  
DPR**

Data Base

IR Imagers



**Geostationary Satellites**

Microwave-IR Merged Algorithm (CMV, K/F)

**Global Rainfall Map + Gauge-calibrated Rainfall Map**  
(0.1 degree grid, Hourly)

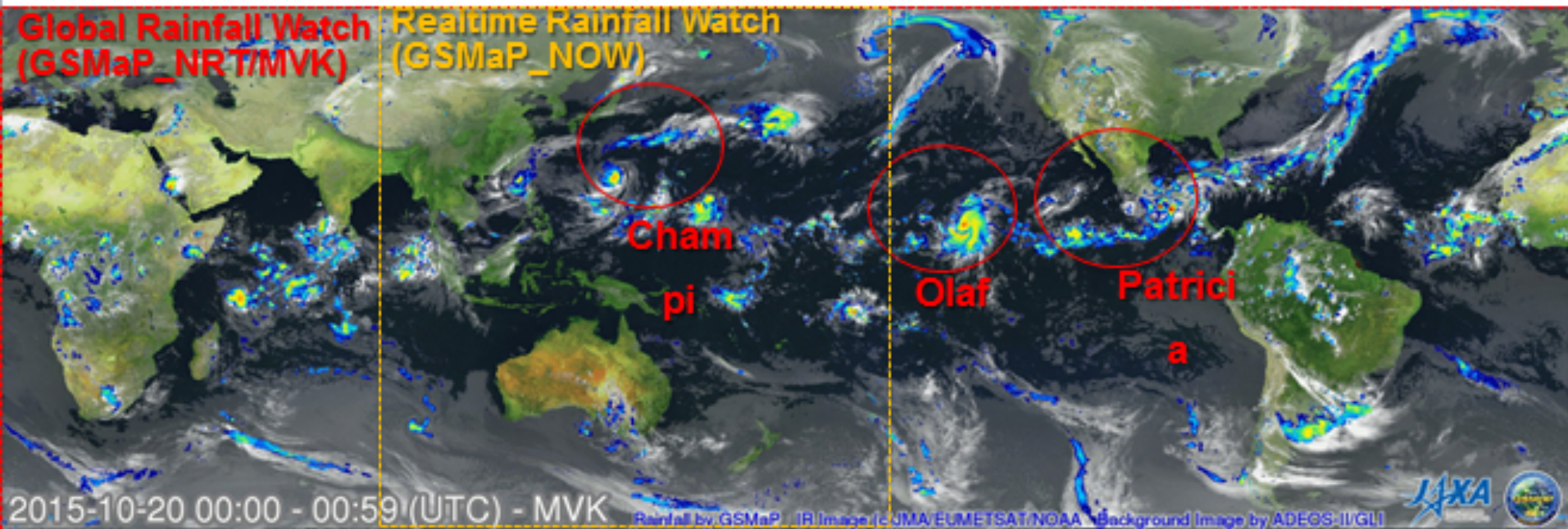
(Okamoto et al. 2005, Kubota et al, 2007, Aonashi et al. 2009, Ushio et al. 2009, Shige et al. 2009, Kachi et al. 2011)





# Global Satellite Mapping of Precipitation (GSMaP)

using GCOM-W, GPM, and others (European and US satellites)



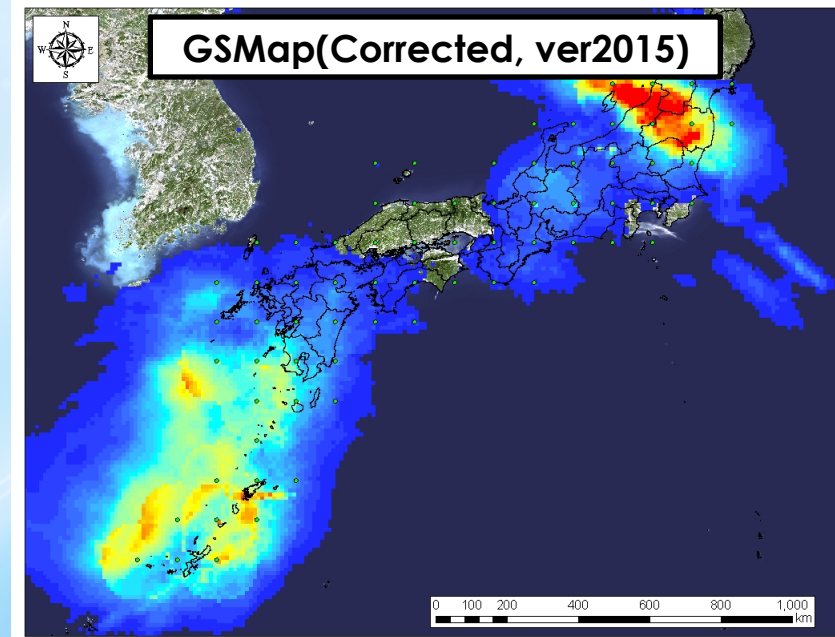
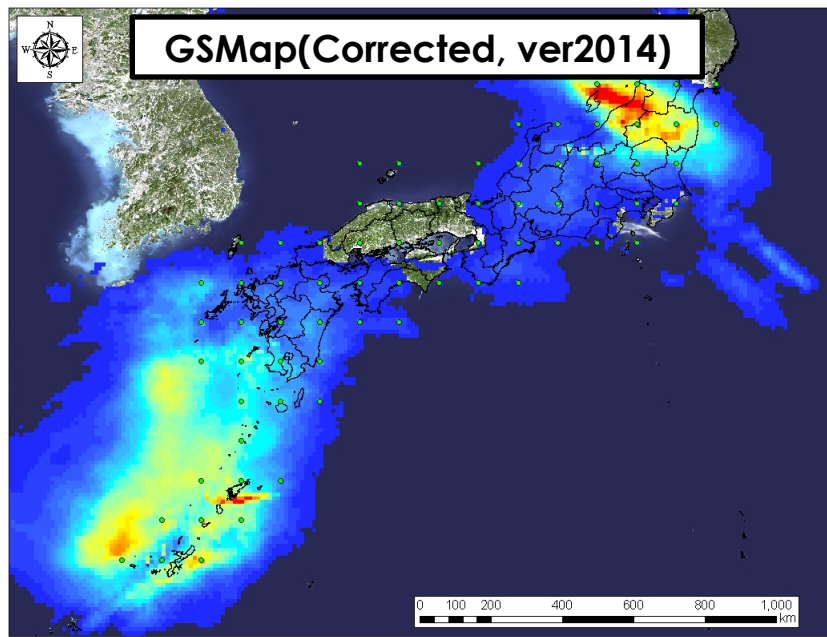
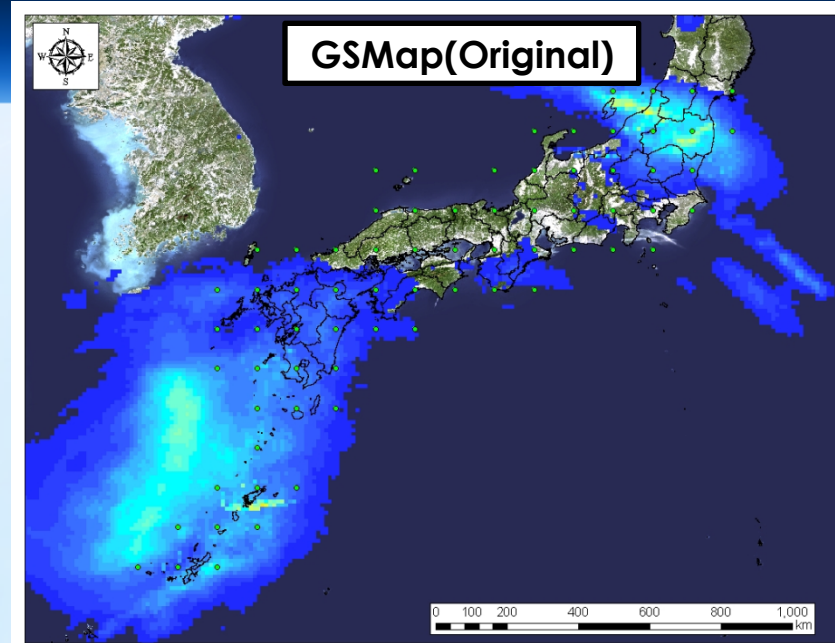
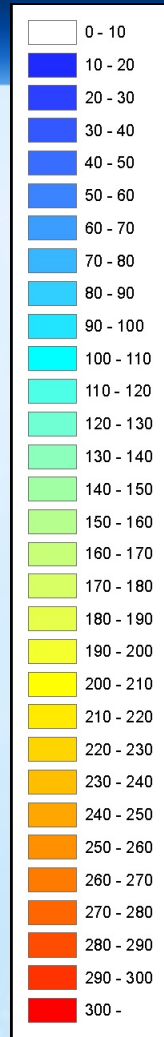
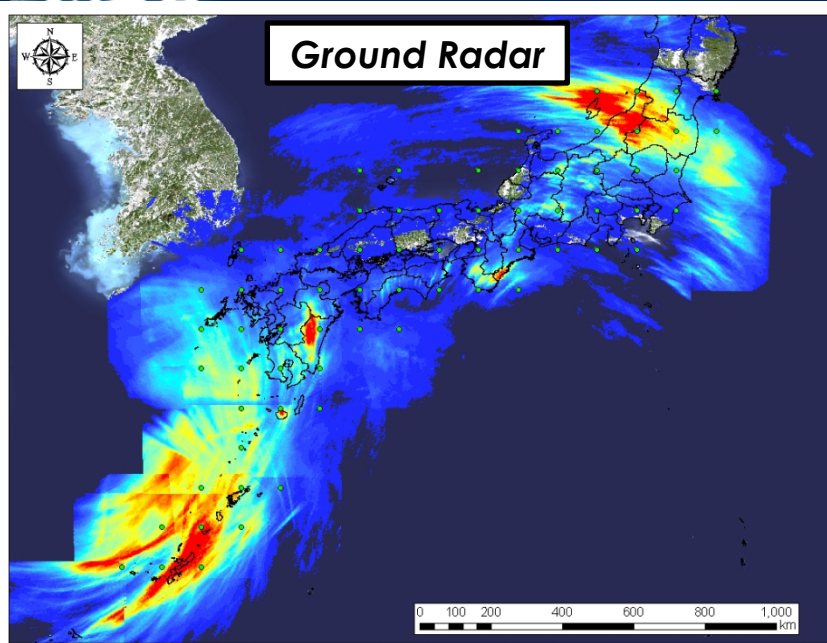
GSMaP (Global) observed Hurricane Patricia and Olaf, and Typhoon Champi: 20-24 Oct. 2015, hourly animation

JAXA Global Rainfall Watch (4-hr delay) : <http://sharaku.eorc.jaxa.jp/GSMaP>

JAXA Realtime Rainfall Watch (Himawari-area): [http://sharaku.eorc.jaxa.jp/GSMaP\\_NOW](http://sharaku.eorc.jaxa.jp/GSMaP_NOW)



# Typhoon No.8, July 8, 2014 (Daily Rainfall) calibrated by NTT-D (GSMap-IF)

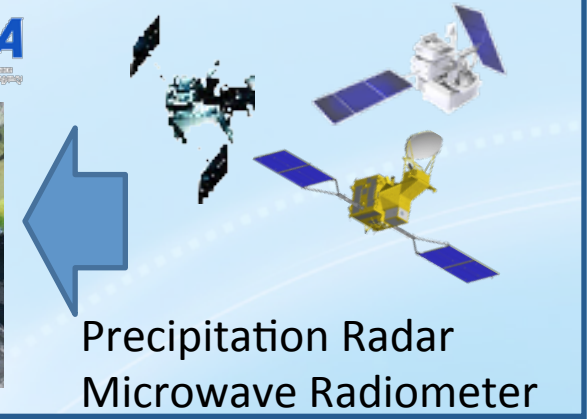
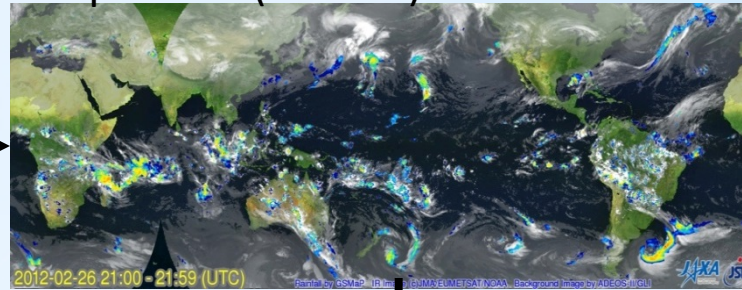


# Flood Warning System (ADB TA project)

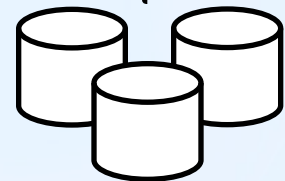
Participating countries: Bangladesh, the Philippines, and Viet Nam

*JAXA contributes to flood forecasting using space technology*

Global Satellite Mapping of Precipitation (GSMaP)



Calibration



Rain Gauges

**Flood Forecasting System**

Input to the **flood forecasting model of GSMaP Precipitation data** calibrated by rain gauges on the ground

**SMS distribution system**

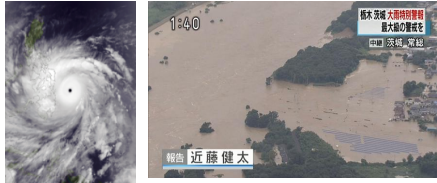
**Flood Warning**



- Improvement of the flood warning lead time from 3 days to 5 days. → **Mitigation of loss of assets and damages**
- Direct distribution of information to the people by using cellular phones

## <Background>

### 1. Water Disasters; Shared issue in Asia



Typhoon, Heavy Rain, Flood, and Drought

### 2. Lack of Sustainable Ground-based Rainfall Measurement in Emerging Countries

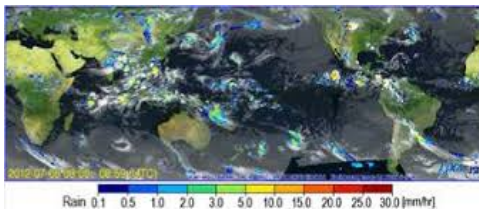


Lack of archive, maintenance and calibration, and power shortage

### 3. Improved Capacity on Satellites in Emerging Countries

- > 1000 kg : THEOS 1(Thailand), Razaksat 1(Malaysia), Lotusat 1(Viet Nam), TeLEOS1(Sinagapore)
- > 100 kg: LAPAN A2 (Indonesia), Diwata-1 (Philippines)

### 4. Available Satellite-based Rainfall Data

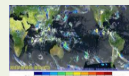


Free hourly rainfall data for 10 km x 10 km grid

Global Satellite Mapping of Precipitation (GSMaP)

## <Step 1> Asian Satellite Water Information Center

- Establishment of regional center which provides satellite based information and applications for water disaster management.
- Headquartered at XXX(TBD)
- Funding from donors and member countries



GSMaP



Ground Data

**ASWI**  
**C**

- Capacity development
- Knowledge Sharing

GSMaP Calibration for Whole region

Applications for water disaster mgt.

Users in each country (Meteorological agencies, Hydrological agencies, etc.)

## <Step 2> Asian Small Precipitation Radar Constellation

### ODA projects in each



- (i) Small Precipitation Radar Satellite System
- (ii) Strengthening ground-based sensor network

- (iii) User applications for meteorology, hydrology, etc.
- (iv) Capacity Development

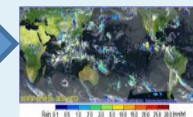
### ASPRC by Asian country



- Orbit : Alt. 800km, inclination 20 deg.
- Mass : Smaller than 800kg
- Lifetime : More than 5 years
- Payload : Ku band precipitation radar
- Data : Precipitation intensity (mm/h)
- Swath : around 800km
- Resolution : around 10km x 10km
- Minimum detection : around 1mm/h
- Frequency : ave. 4-6 times/ day by four satellites



Existing GPM Constellation



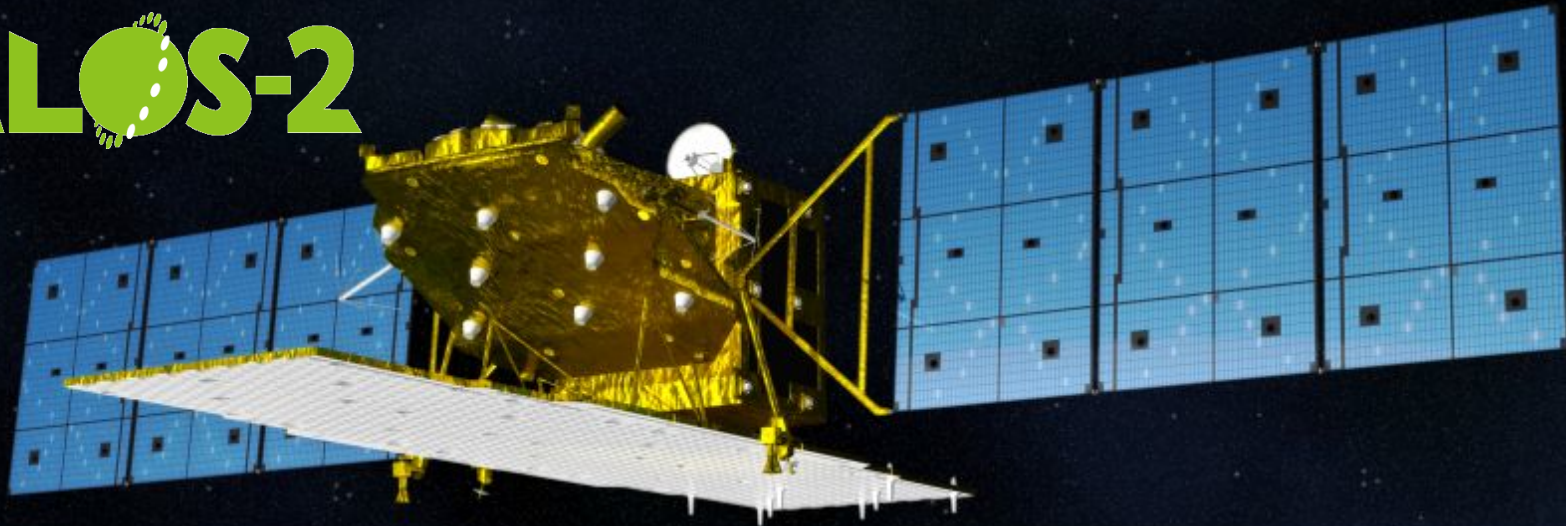
Improved GSMaP

ASWIC

Users



## ALOS-2



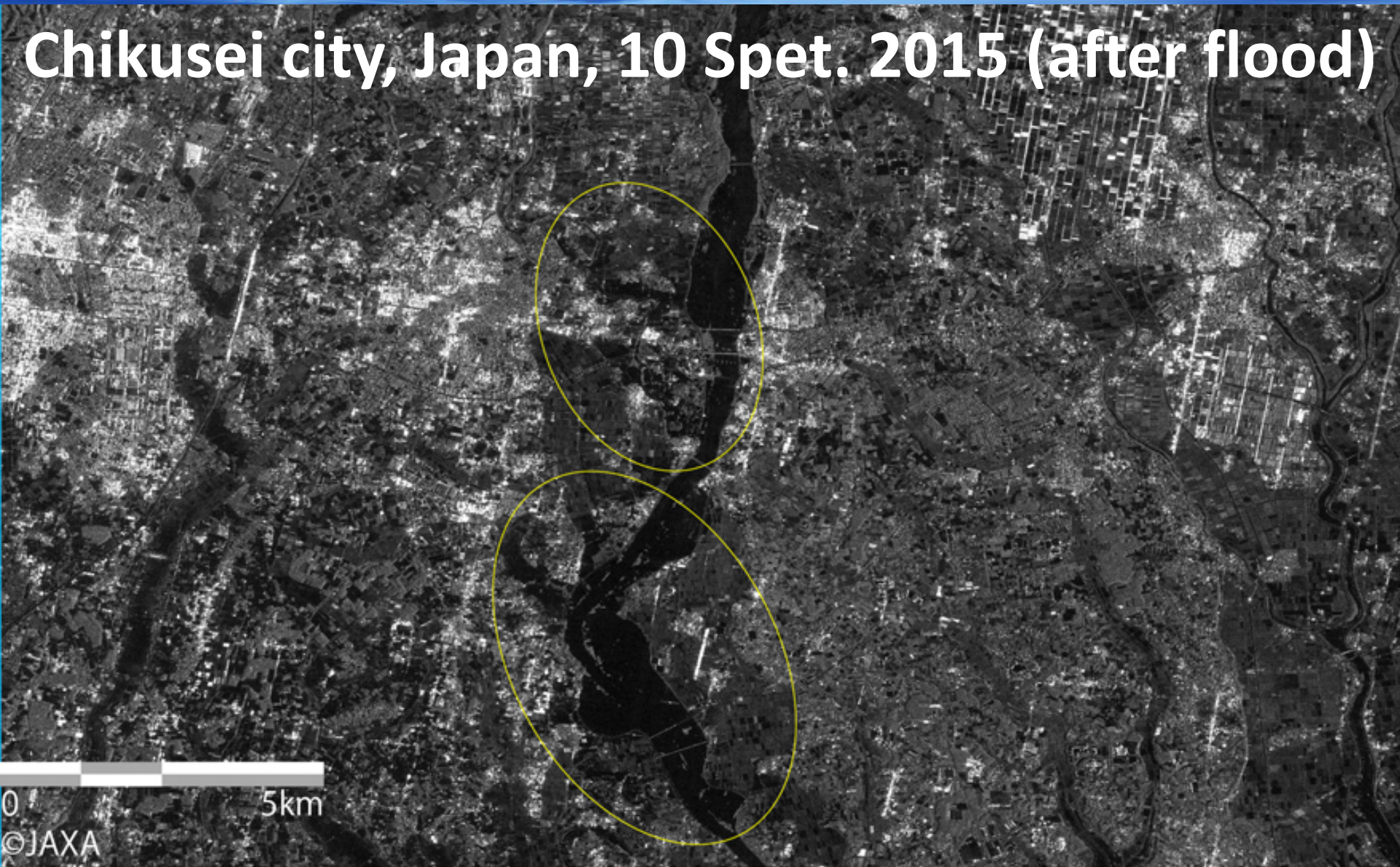
### Mission Objectives

- Disaster monitoring
- Land and infrastructure management
- Agriculture monitoring
- Environment monitoring
- Natural resources,
- Sea ice & Ship safety, etc.

L-band SAR (PALSAR-2)	Stripmap: 3 to 10m res., 50 to 70 km swath ScanSAR: 100m res., 350km/490km swath Spotlight: 1 × 3m res., 25km swath
Orbit	Sun-synchronous orbit Altitude: 628km Local sun time : 12:00 +/- 15min Revisit: 14days Orbit control: ≤ +/- 500m
Life time	5 years (target: 7 years)
Launch	CY2014, H-IIA launch vehicle
Downlink	X-band: 800Mbps(16QAM) 400/200Mbps(QPSK) Ka-band: 278Mbps (Data Relay)
Experimental Instrument	Compact InfraRed Camera (CIRC) Space-based Automatic Identification System Experiment 2 (SPAISE2)



## Chikusei city, Japan, 10 Spet. 2015 (after flood)



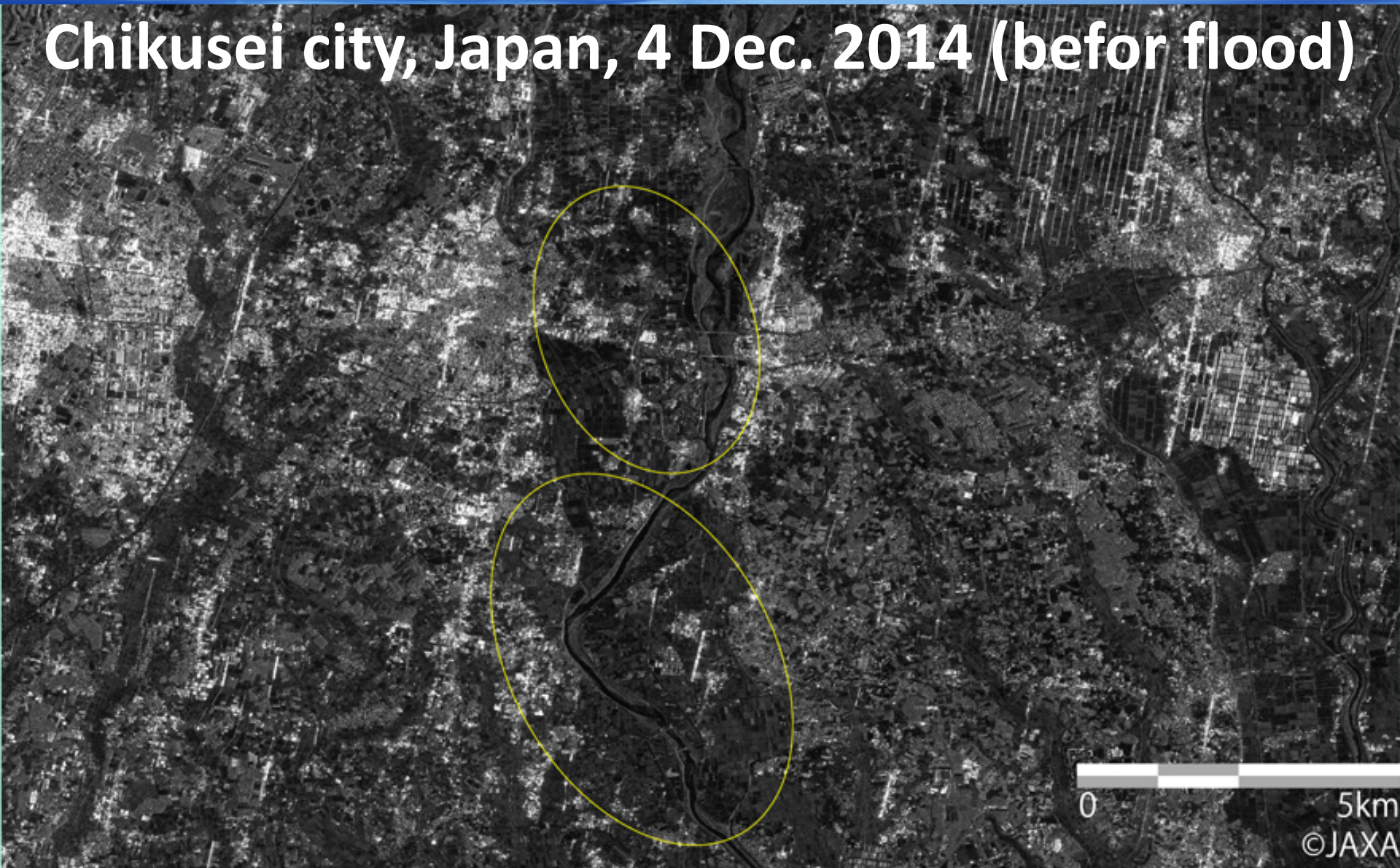
0 5km

©JAXA

2015年9月10日観測  
(洪水後)

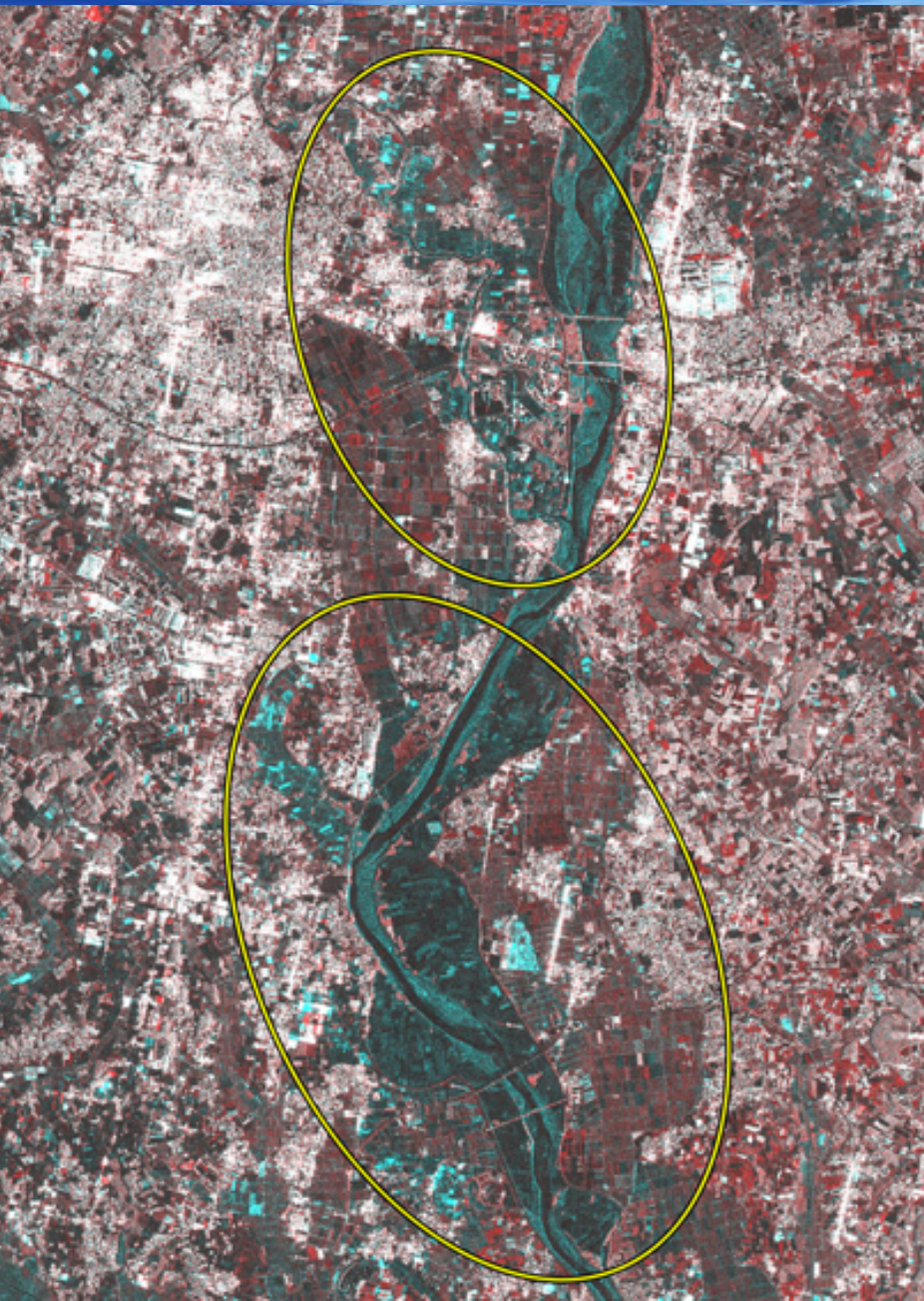


## Chikusei city, Japan, 4 Dec. 2014 (befor flood)



2014年12月4日観測  
(洪水前)





## Blue area: flooded area

- Flooded area information can be used for validation of flood inundation model.
- JAXA is planning to provide ALOS/PALSAR (2006-2011) archive data of the IFI target rivers.

- **JAXA will further strive to enhance space development activities under the new framework of the space strategy, focusing on technical innovation and international cooperation as on providing effective solutions to the society as a whole.**
- **Specifically, in the field of application, JAXA values technological advancement and continuous utilization of satellites for the improvement of the daily lives for humankind as observation infrastructure:**
  - ✓ **Long-term observations by continual satellite missions**
  - ✓ **Multiple satellite data utilization**
  - ✓ **Involvement of the private sector**
- **For the Earth Observation Satellites, JAXA will clarify our role in the society and develop the system to further collaboration with Japanese government and other implementing organizations, so that we can realize the world which utilizes satellites to provide a benefit of human society as a part of observation infrastructure.**

- **JAXA continue to provide water/precipitation information based on earth observation satellite data.**
- **As a first step, EORC/JAXA will provide ALOS/PALSAR (radar image) archive data of IFI target rivers for inundation model validation.**