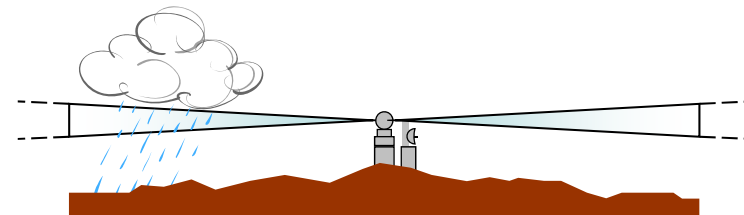
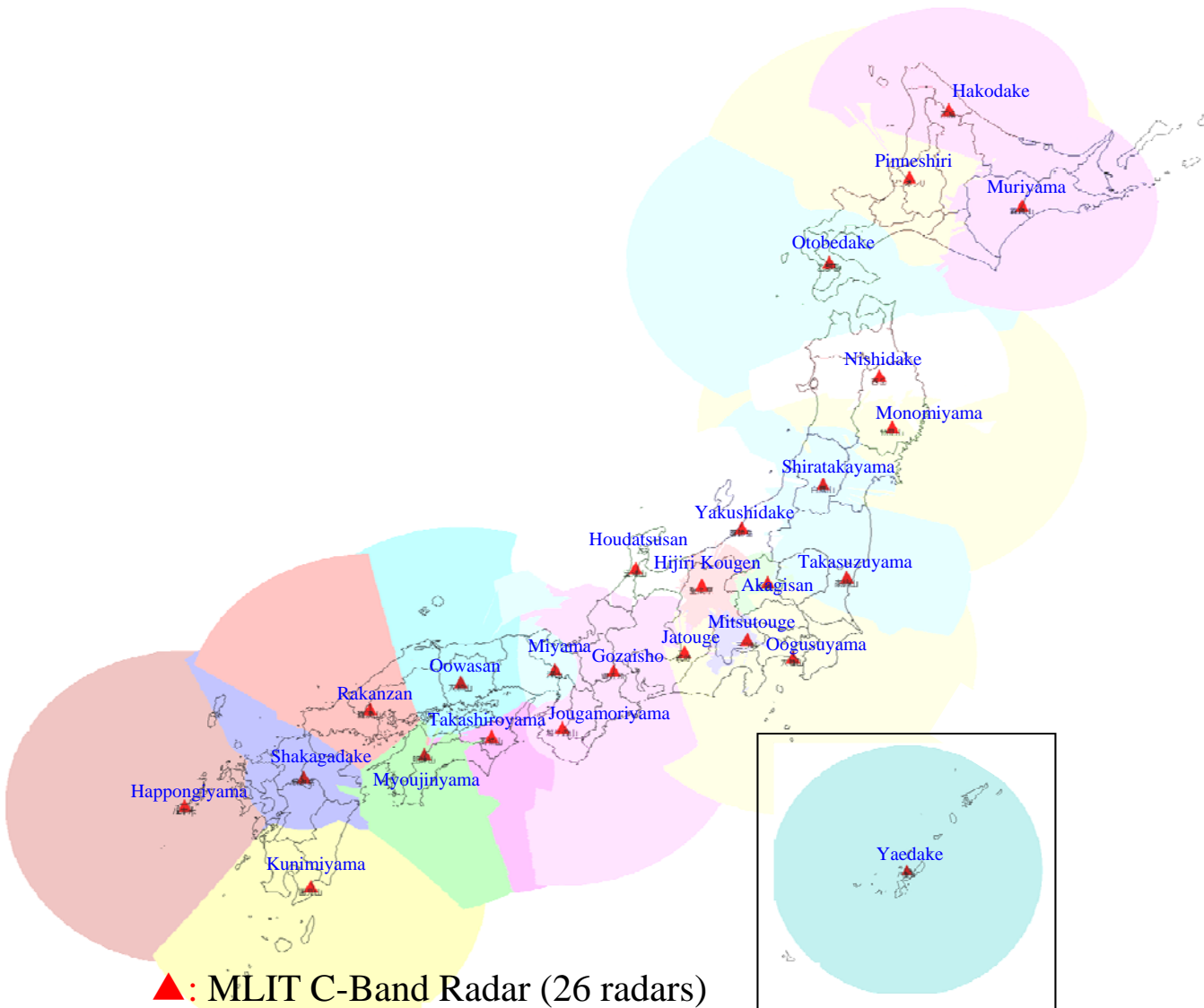


Radar Observation of Precipitation for River Management in Japan

Water and Disaster Management Bureau,
Ministry of Land, Infrastructure, Transport and Tourism

Radar Observation Network in Japan (MLIT C-Band Radar)

- Since the first installation of C-band radar in Japan in 1976, the radars has installed all parts of Japan gradually. Now 26 C-band radars cover and monitor rainfall of all Japan.



Wide monitoring of rainfall

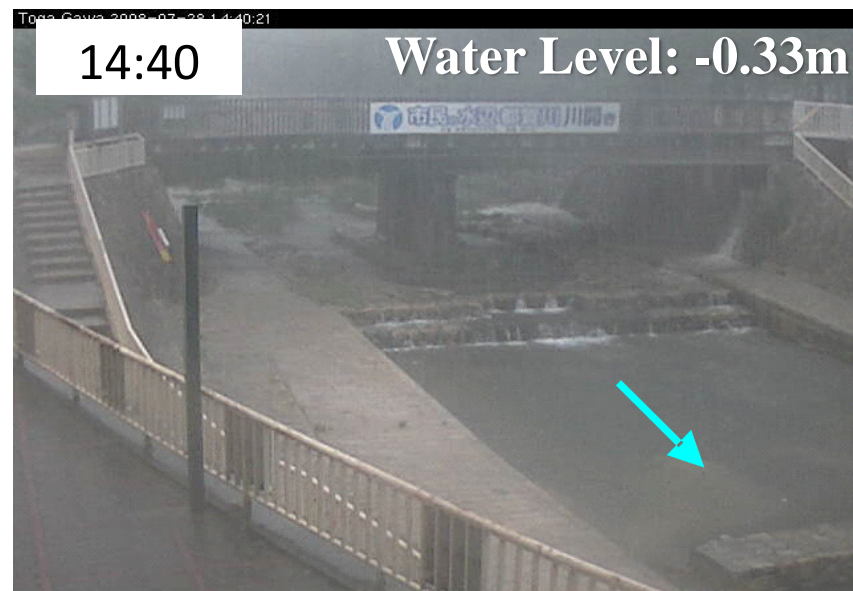


C-band radar
(Mt. Akagi)

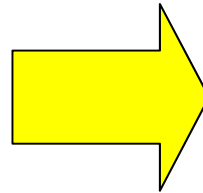
Background of Development the XRAIN

- In case of the flood disasters in July, 2008 in Toga River in Kobe City & Asano River in Kanazawa City, water accident and river flooding were caused by localized heavy storm which couldn't observe by conventional radars.
- Recently, such patterns of heavy rainfall are increasing. Also, it is concern that the global warming-led climate change will lead this type of storm to increase in the future.
- To enhance the monitoring capacity for localized heavy rain and torrential downpour, the MLIT has started to develop the XRAIN.

■ Flood damage in Toga River in Kobe City on 28th July, 2008.
(Dead:5, Rescued:11, Evacuated:41)



WL rise up to
1.34m
in 10 min

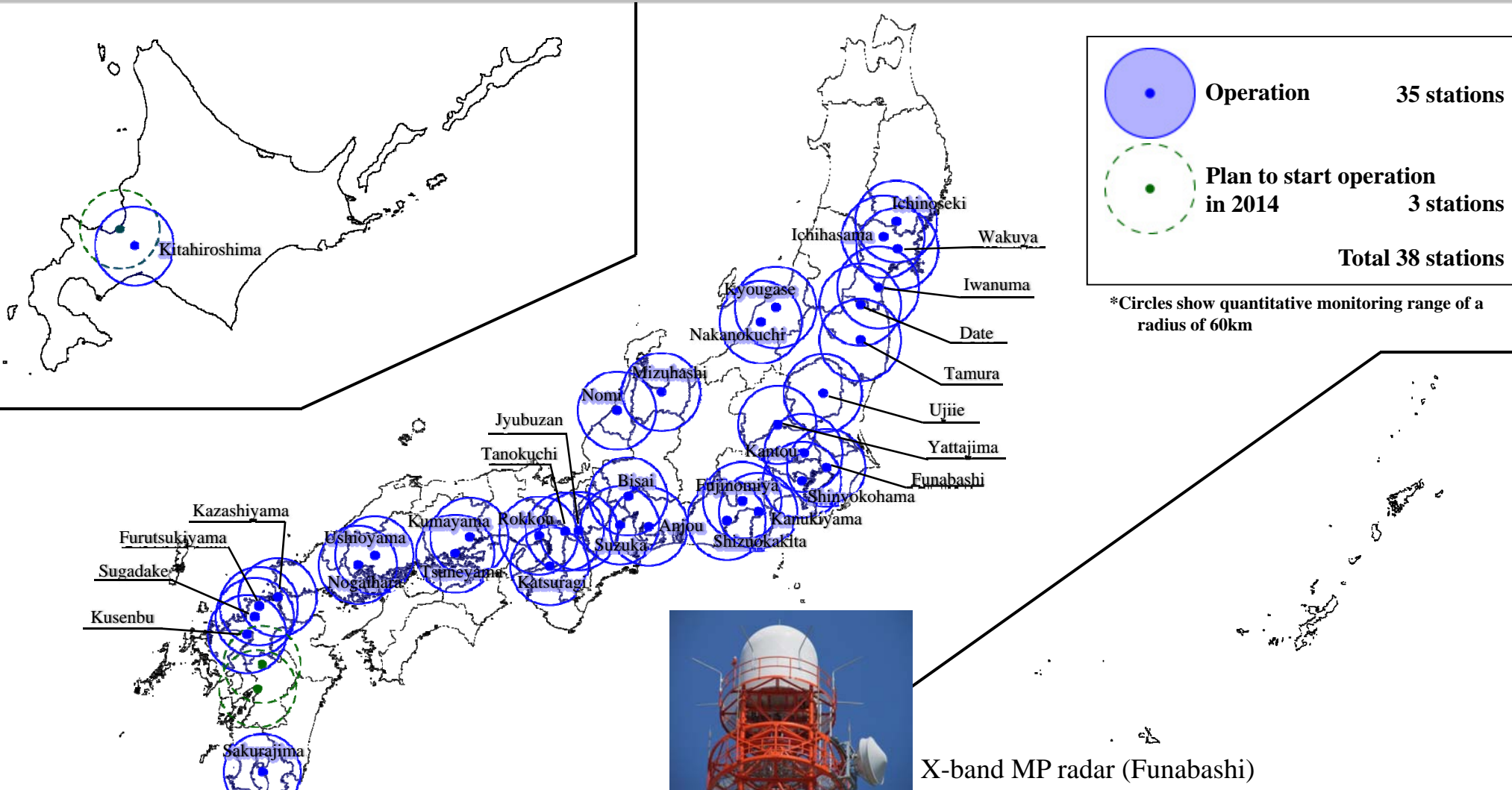


(Captures of River Monitoring Camera by Kobe City)

Rise in water level at Kabuto Bridge of Toga River

Radar Observation Network in Japan (XRAIN: MLIT X-Band MP Radar Network)

- The MLIT is installing X-band MP radars called XRAIN, which has high resolution and quasi real-time observation, in urban areas to reduce damage from localized heavy rain and torrential downpour.
- Operation started in 2010, there are 35 radars in Japan as of September 2013.

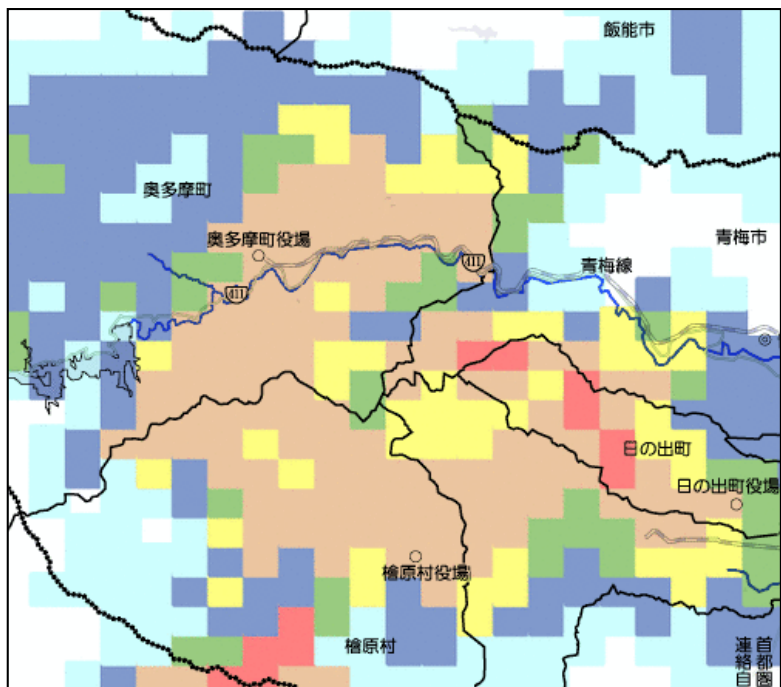


Comparison of C-Band Radar and XRAIN

- XRAIN rainfall information has **at a higher frequency (5 times higher) and a higher resolution (16 times higher)** compared to conventional radar (C-band radar)
- **Delivery takes only 1 to 2 minutes(5 times faster compared to C-band radar).**

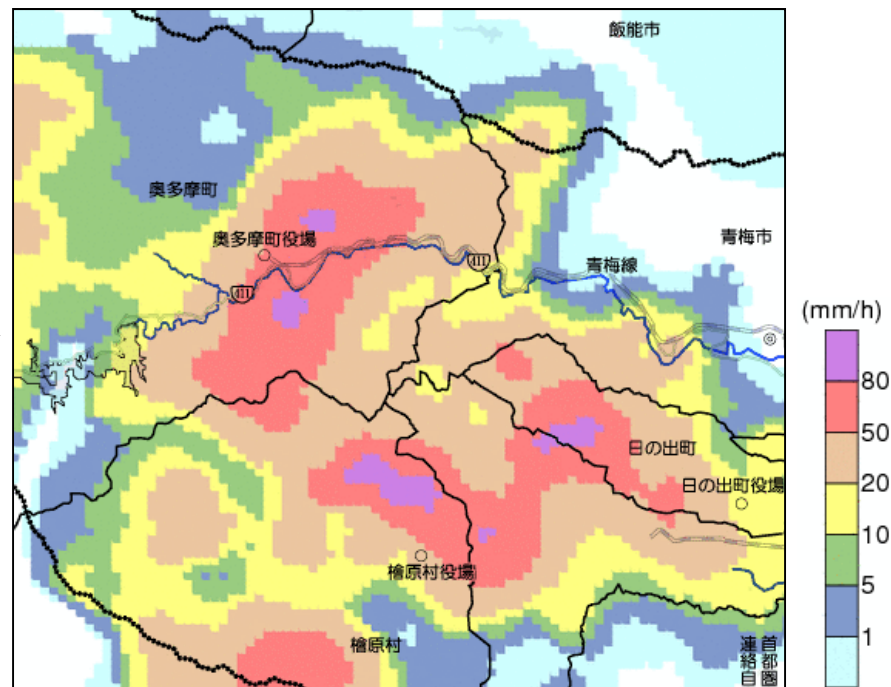
Conventional Radar (C-Band Radar)

(Spatial resolution: 1km mesh, update cycle: 5 mins
Time required to deliver from observation 5-10 mins)



XRAIN (X-Band MP Radar Network)

(Spatial resolution: 250m mesh, update cycle: 1 min
Time required to deliver from observation 1-2 mins)



• 5 times higher frequency
• 16 times higher resolution

*While C-band radar (quantitative monitoring range radius 120km) is suitable to observe rainfall over a wide area, XRAIN (quantitative observation range radius 60km) is able to observe details about localized heavy rain in real time in spite of the small observable area.

Characteristics of XRAIN (X-Band MP Radar)

- XRAIN composed of the X-Band MP (Multi-Parameter) Radars have high accuracy, high resolution and deliver information close to real time.

1. High Resolution (X-Band Characteristic)

- X-band radar has a **shorter wave length and can observe at a higher resolution** compared to C-band radar (X-band: 8 - 12GHz, C-band 4 - 8GHz)



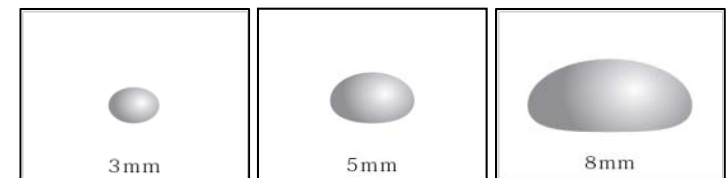
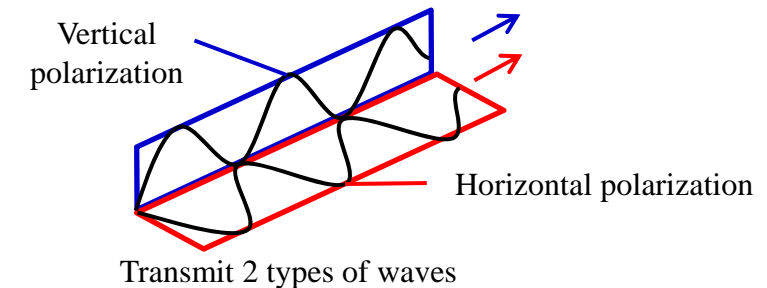
XRAIN (Nomi)



Radar antenna (Saitama)

2. Real Time (MP Radar Characteristic)

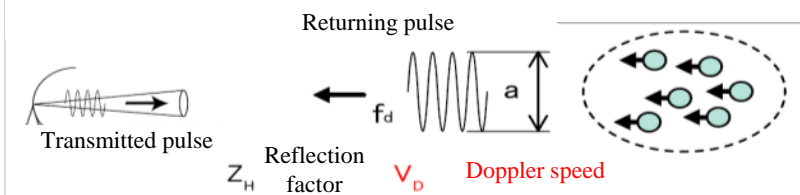
- **Measure shape of raindrops** by transmitting 2 types of waves (horizontal and vertical) and **estimates rainfall from flattening of raindrops**.
- **Possible to estimate rainfall accurately without calibrate by gauges**. Since no calibrate by gauges, possible to deliver the information close to real time



Recognizing the shape of raindrops

3. Enable to observe raindrop of move direction and Speed (Doppler Effect)

- To expect utilize for rainfall prediction.



Technologies for Observing Precipitation Amount with XRAIN

- Technologies developed by the NIED were put to practical use as a radar observation network by the NILIM.
- It is necessary to have advanced knowledge to convert the values observed by the radar into rainfall amount. Besides the both institutes, committees organized by hydrometeorological scholars, construction consultants, radar manufacturers, and the MLIT are collaborating to develop a highly precise rainfall conversion method.

* NIED: National Research Institute for Earth Science and Disaster Prevention
NILIM: National Institute for Land and Infrastructure Management
MLIT: Ministry of Land, Infrastructure, Transport and Tourism



National Research Institute for Earth Science and Disaster Prevention (NIED)



National Institute for Land and Infrastructure Management (NILIM)



Initial development stage of MP Radar (NIED, 2000)



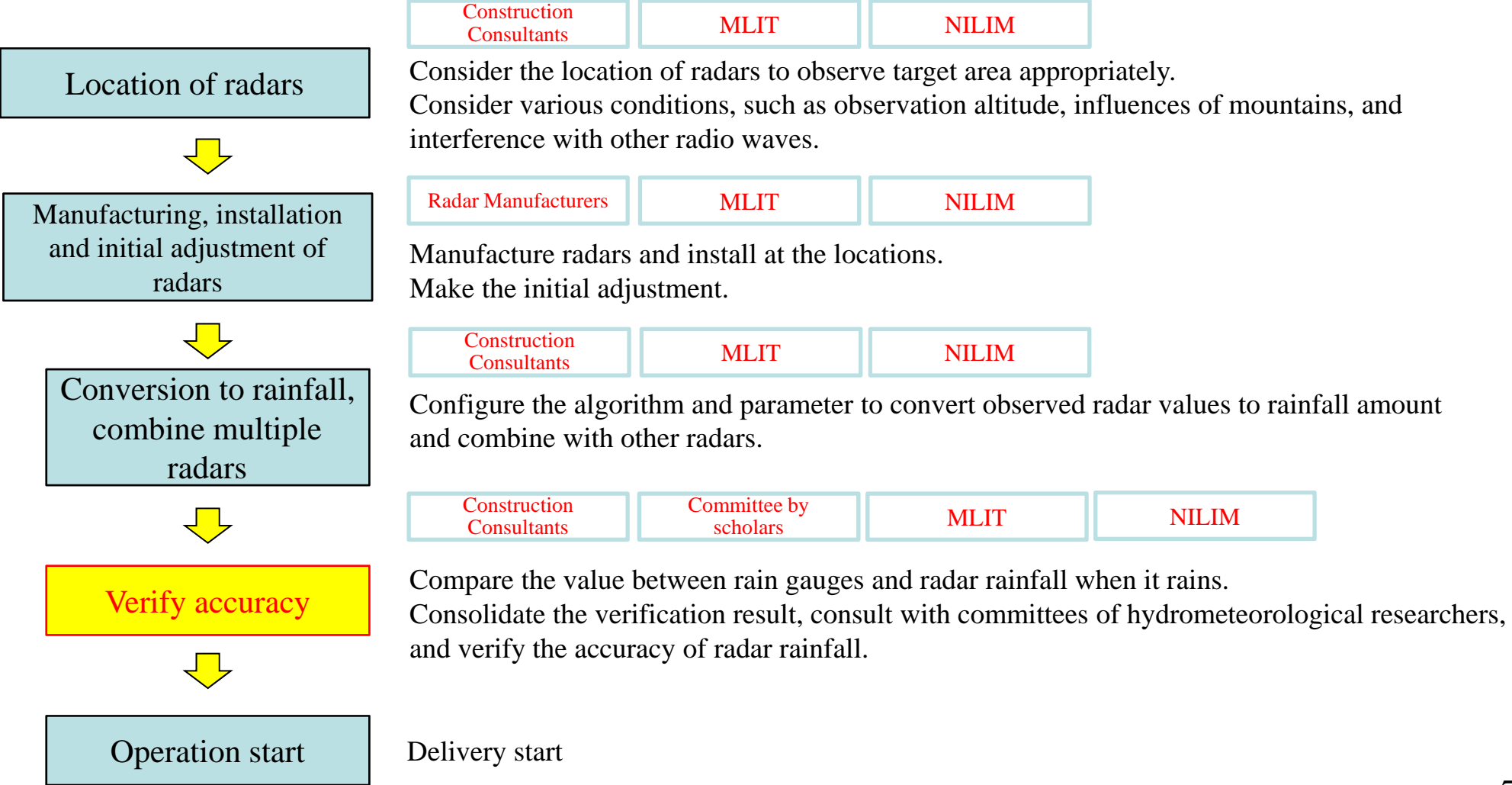
Committee of scholars

Committee composed of hydrometeorological scholars, and radar specialists.

Under instruction from research institutes and committees, the MLIT technological department, construction consultants, and radar manufacturers collaborated to build the XRAIN system.

From Installing the New XRAIN Radar to Observation of Precipitation

- When installing a new radar, the **MLIT and NILIM** consider the location, adjust equipment, and verify the observation accuracy **together with construction consultants, radar manufacturers, and committees of scholars** to achieve highly precise observation of precipitation.

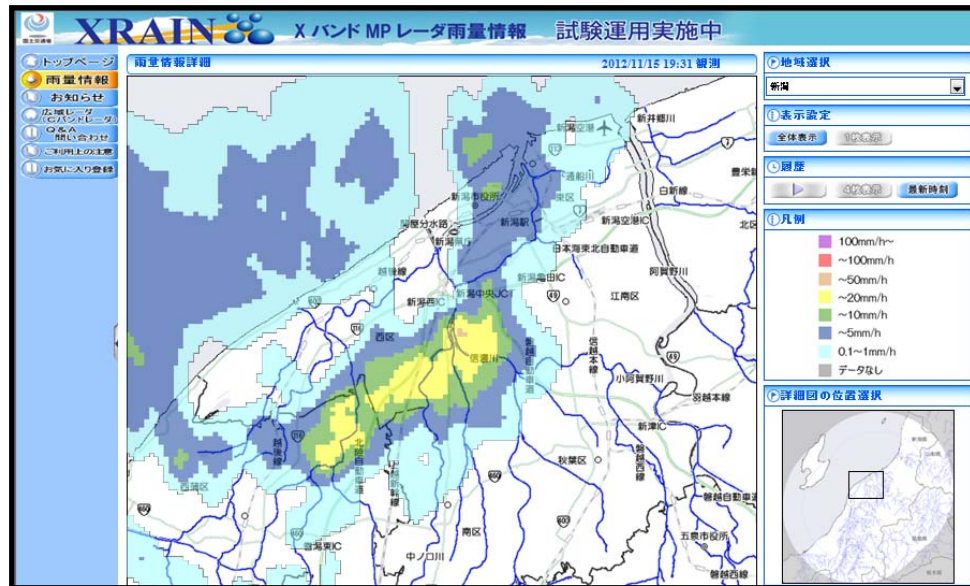


Delivery of Observed XRRAIN Data to Citizens

- XRRAIN information is delivered to public in real time through the MLIT website.
- Applications and contents for mobile devices are developed by the private sector and are widely used.

Delivery through MLIT Website

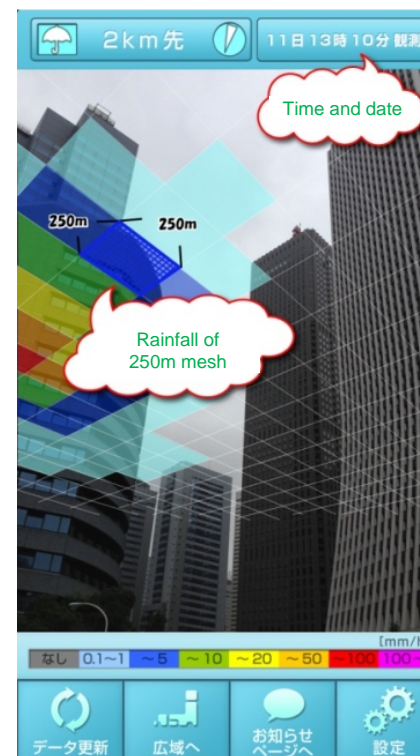
- XRRAIN information is delivered in real time through the MLIT website.



<http://www.river.go.jp/xbandradar/>

Contents and applications for mobile phones developed by the private sector

- Applications for mobile phones and contents for forecasting information of rainfall are developed by the private sector.



Alert Email Delivery to Mobile Phones Using XRAIN

- When observing heavy rain exceeding a set value, MLIT delivers alert emails to concerned individuals and uses for disaster prevention.

From Rokko Sabo Office
To xxx@xxx.xx.ne.jp
Sub Alert/Evacuation Information

Rainfall information for Toga and Ikuta rivers
2009/ 7/28 09:10

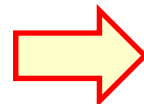
Strong rain clouds have been observed in the Toga and Ikuta river areas

Time	Precipitation
09:01:00	0.2mm/h
09:02:00	0.6mm/h
09:03:00	0.7mm/h
09:04:00	1.0mm/h
09:05:00	3.0mm/h
09:06:00	2.0mm/h
09:07:00	4.2mm/h
09:08:00	6.1mm/h
09:09:00	5.0mm/h
09:10:00	21.3mm/h

Press the following link to see more detailed information

[Http://xxx.xxx.xxx/xxx-xx/xxx.html](http://xxx.xxx.xxx/xxx-xx/xxx.html)

Precipitation Alert Email



Rokko Sabo
Rokko Sabo Office
Alert/Evacuation Information System

Southern Hyogo
Warning/Advisery
Published 09:02 December 1

Kobe City
Heavy rain Flooding Thunder

Ashiya
Heavy rain Flooding Thunder

Nishinomiya
Heavy rain Flooding Thunder

Radar Image
Toga/Ikuta River regions

Observed 09:10 28th
Display

[All regions](#)
[Rain cloud development index](#)

Indicates weather warnings /advisories for the controlled area

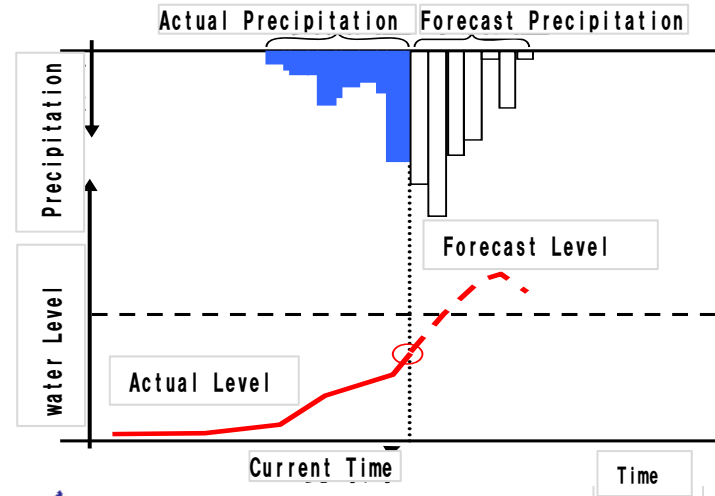
Displays XRAIN image for set mountain stream areas

Improvement of Flood Forecasting accuracy Using XRAIN

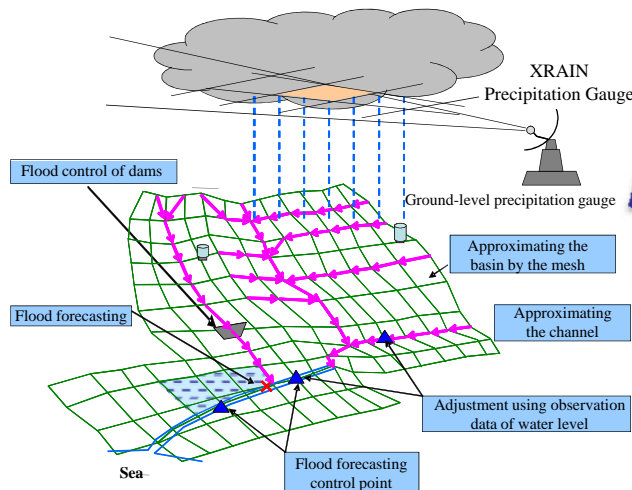
- MLIT inputs XRAIN data into flood forecasting systems for each river and uses it to improve the accuracy of flood forecasting.



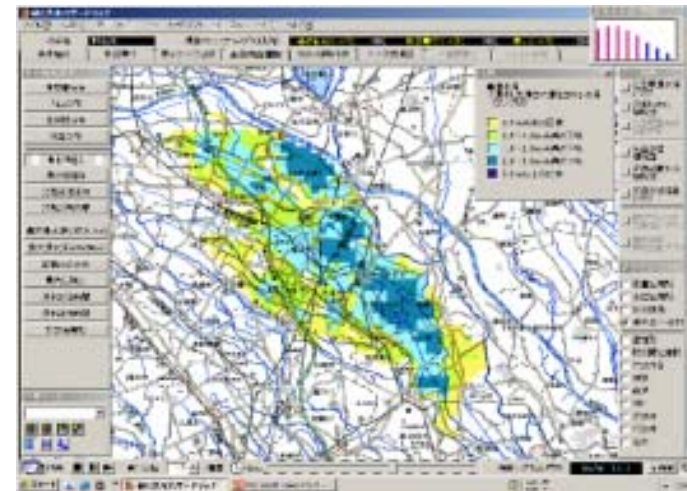
XRAIN



Water Level Forecast Information



Distributed Flood Forecast Model



Inundation Forecast Information