Session 2.4
Innovative remote sensing measurements as new data sources

Shoichiro Kojima and Katsuhiro Nakagawa

National Institute of Information and Communications Technology

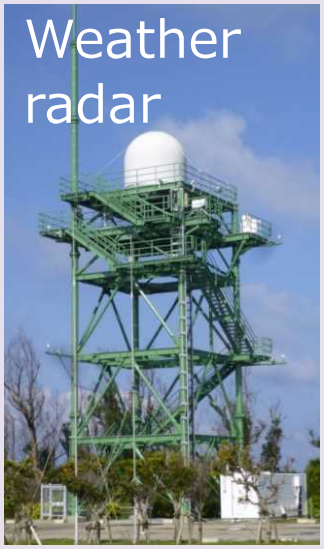
Remote sensing technology

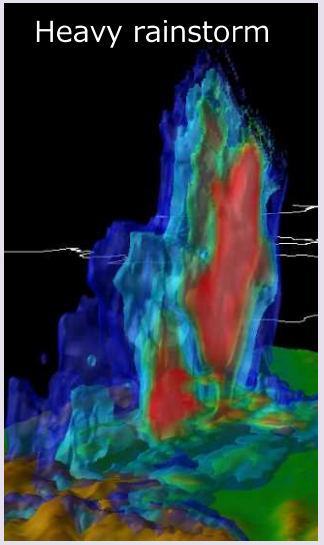
What is remote sensing?

Remote sensing is the science of obtaining information about objects or areas from a distance, typically from aircraft or satellites.

NICT target for remote sensing sensors

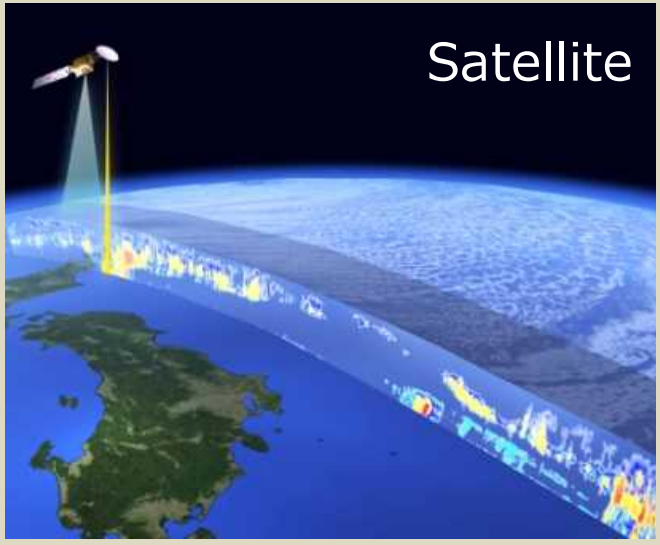
Meteorological observation





Monitoring the disaster area

Monitoring climate change

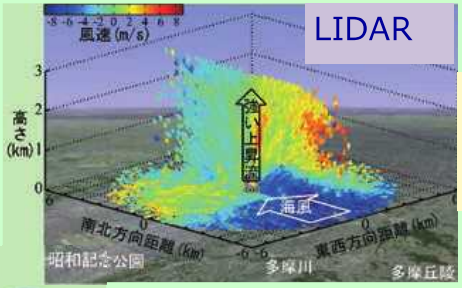


Research purpose:To contribute to society such as early detection of disasters

Our sensor under development

Data sources
- Water vapor
- Cloud
- wind
- Rain
- Groud surface

LIDAR

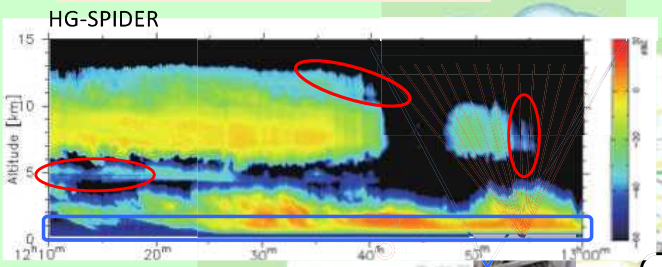


Satellite(GPM, EarthCARE)

Rain cloud development 10-20min

Airborne synthetic aperture radar (Pi-SAR)

HG-SPIDER



Cloud radar

Updraft

Beginning of rain

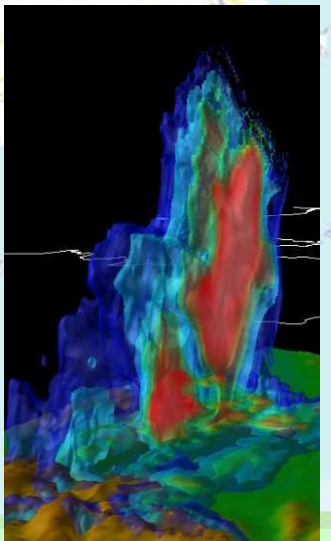
Cloud formation

Water vapor (invisible)

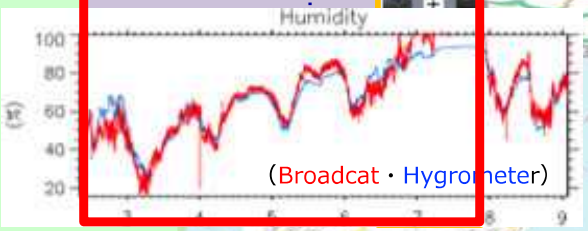
Detecting the source of heavy rain

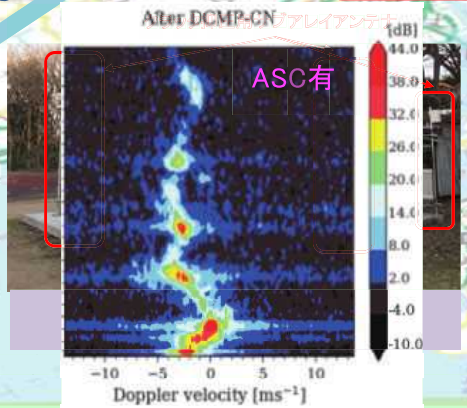
Rain observation

Multi-parameter phased array weather radar



Water vapor measurement





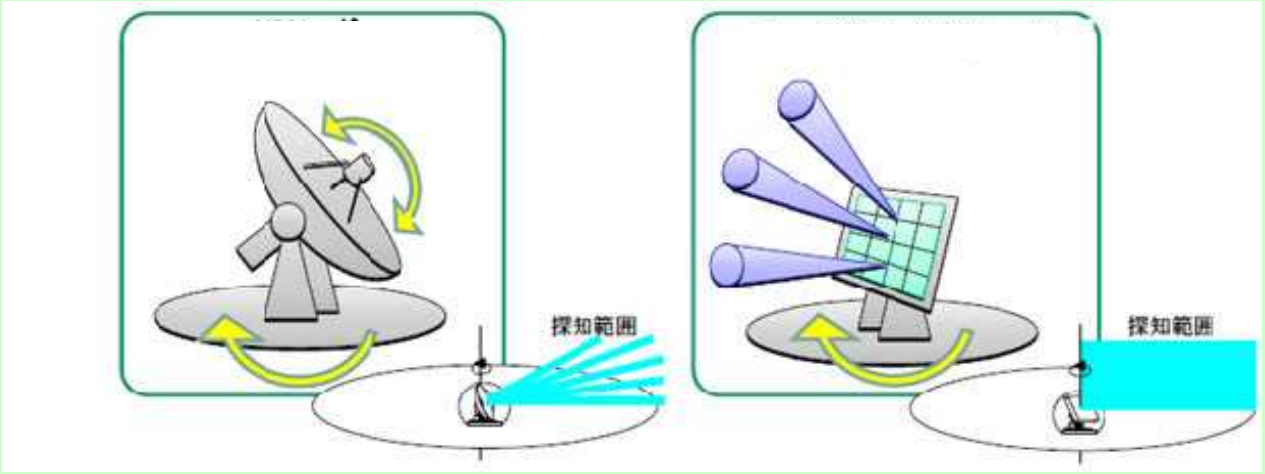
Dashboard

Rain observation for guerilla heavy rain

- The conventional weather radar takes time to perform a volume scan of rain.
- The time scale of guerilla heavy rain is very short.
- To observe rain clouds at high speed in three dimensions, NICT is developing new weather radar.
- This radar utilizes phased array technology.

Conventional radar

New radar

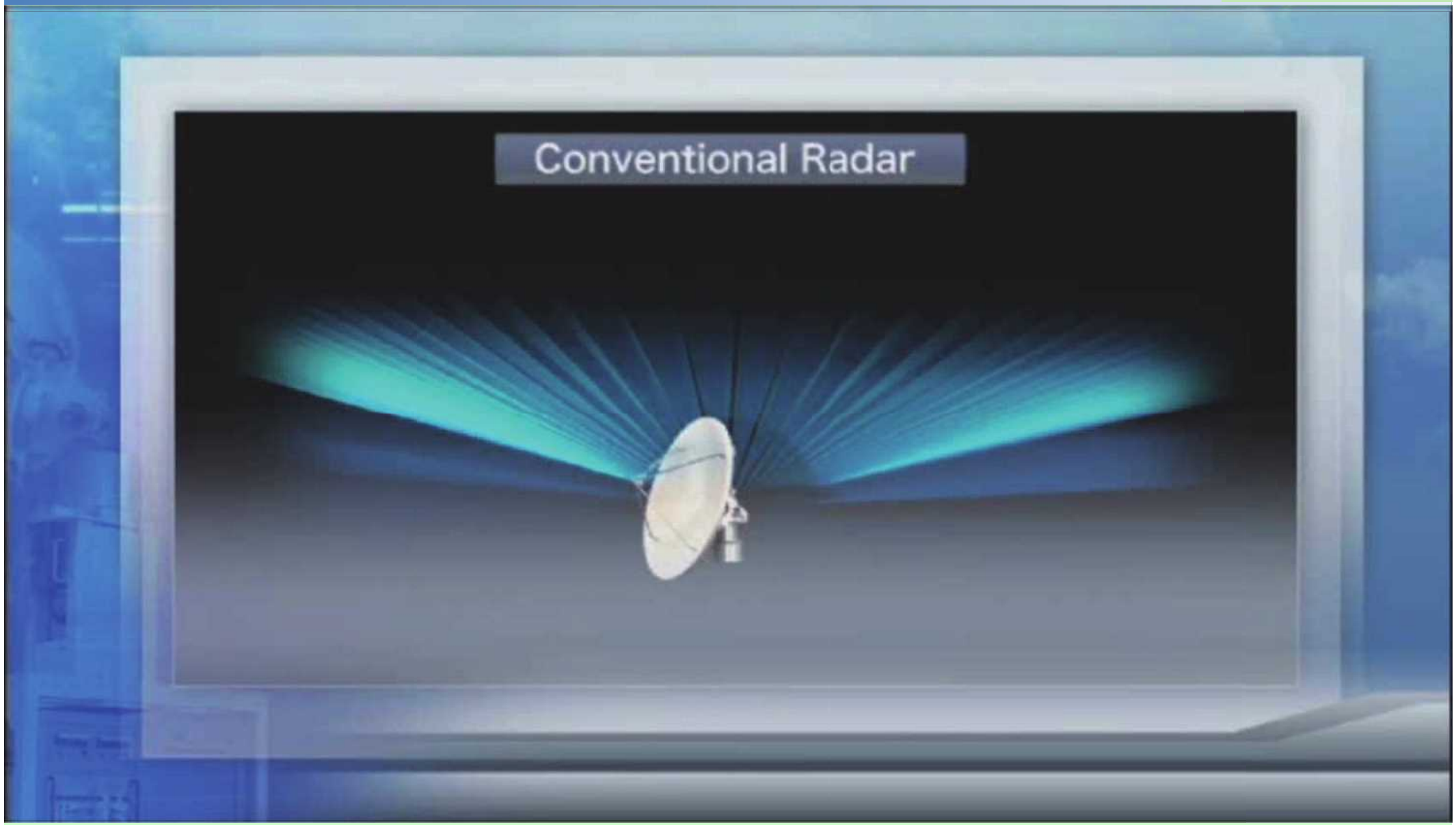


New radar is

- 10 times faster
- 10 times higher density

than conventional radar

Conventional radar VS New radar

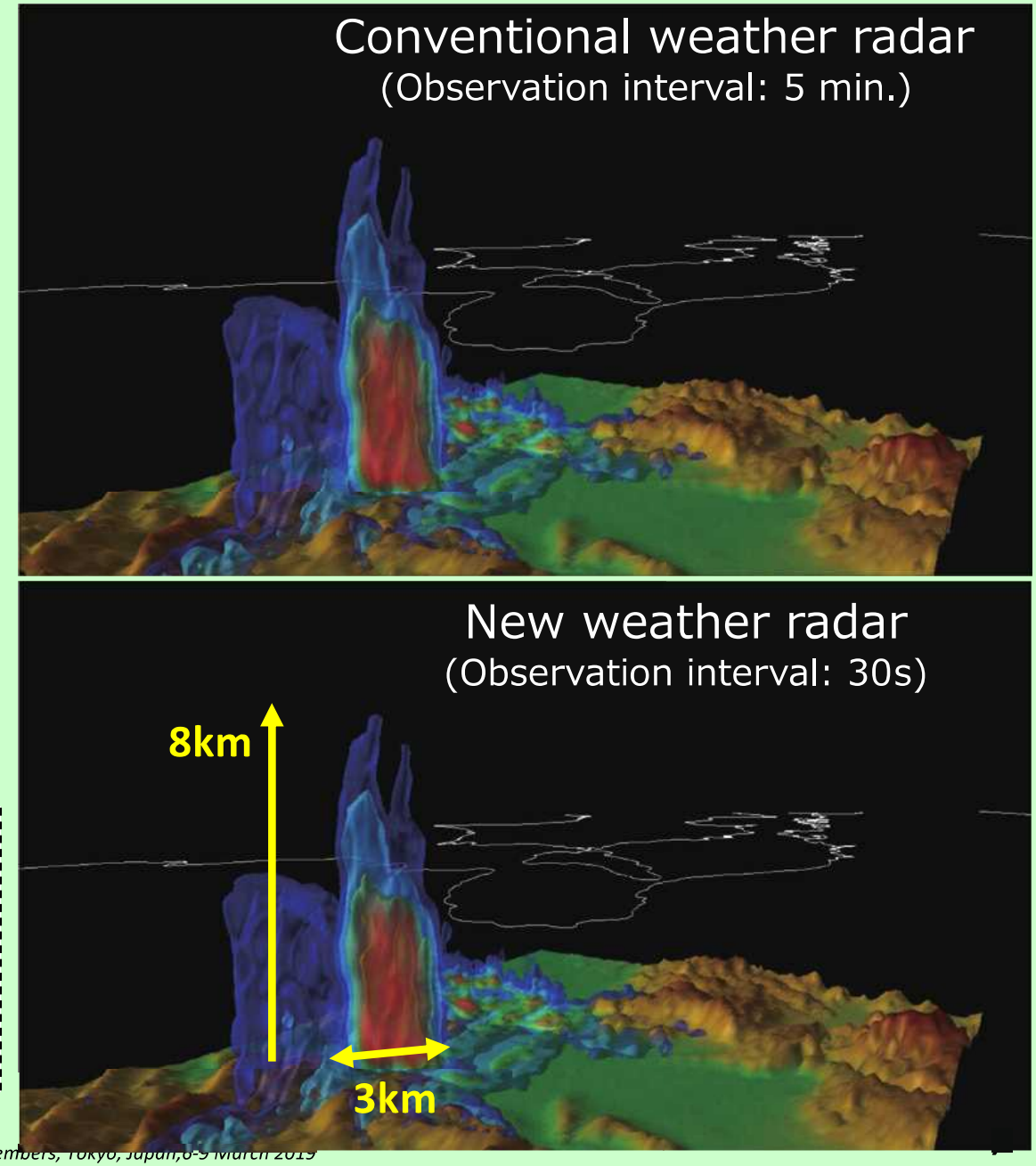


©Prof. Ushio

Observation area

Observation result 1

- The right figure is a comparison of rainfall observations of phased array weather radar and conventional weather radar.
- The phased array weather radar observed the formation process of strong precipitation (red part) in detail.



Three-dimensional structure of rainfall viewed from the northeast direction Grid interval 100m ）

- Date：July 26, 2012 17:20:16～18:10:46
- Location：around Keihanna
- Color：Red color shows strong precipitation

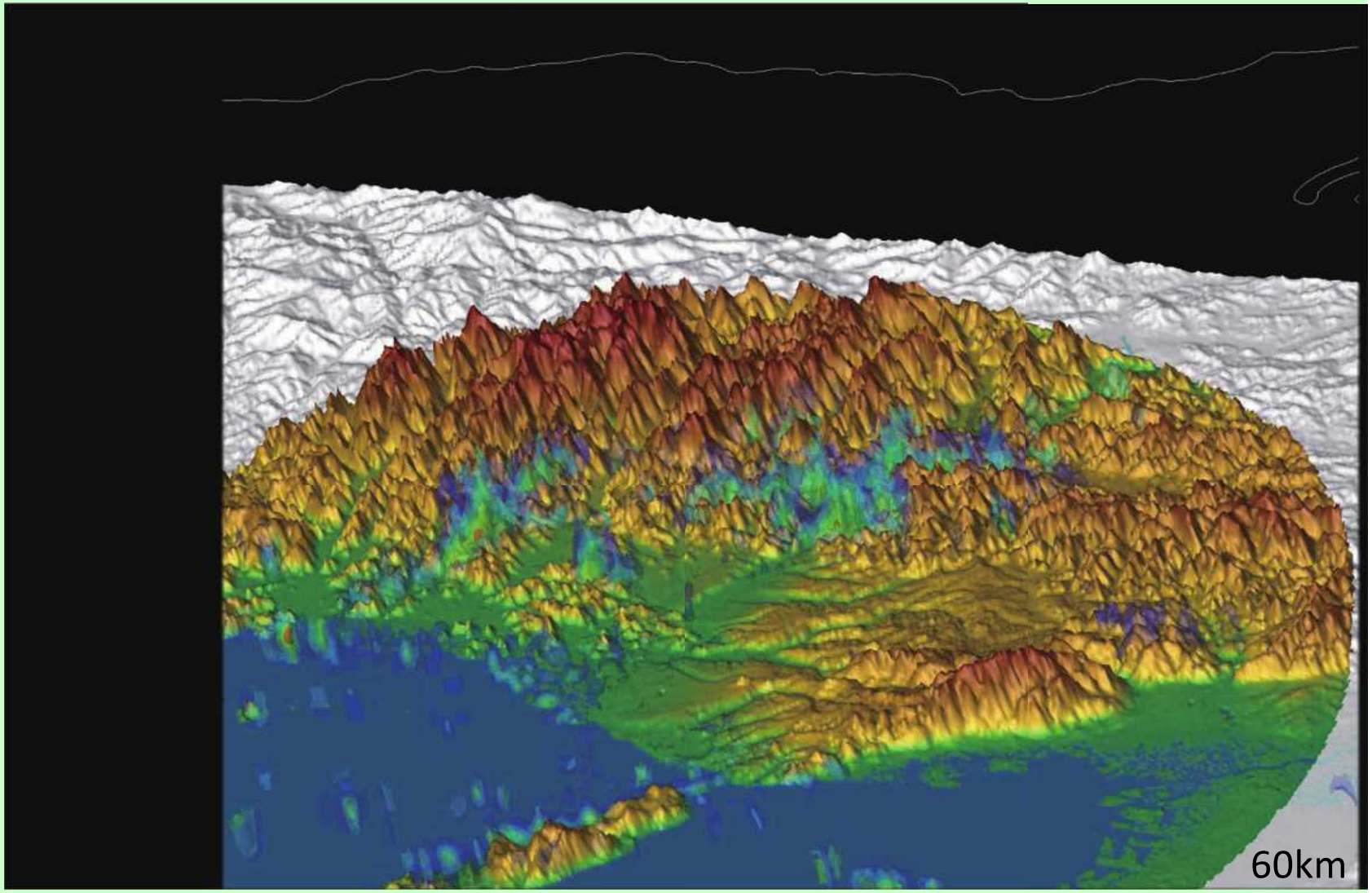
3. Observation result 2

This movie shows a state of extremely heavy rainfall due to the influence of warm moist air flowing toward the front line. 48 hour rainfall at two rain observatory stations updated the first place in observation history.

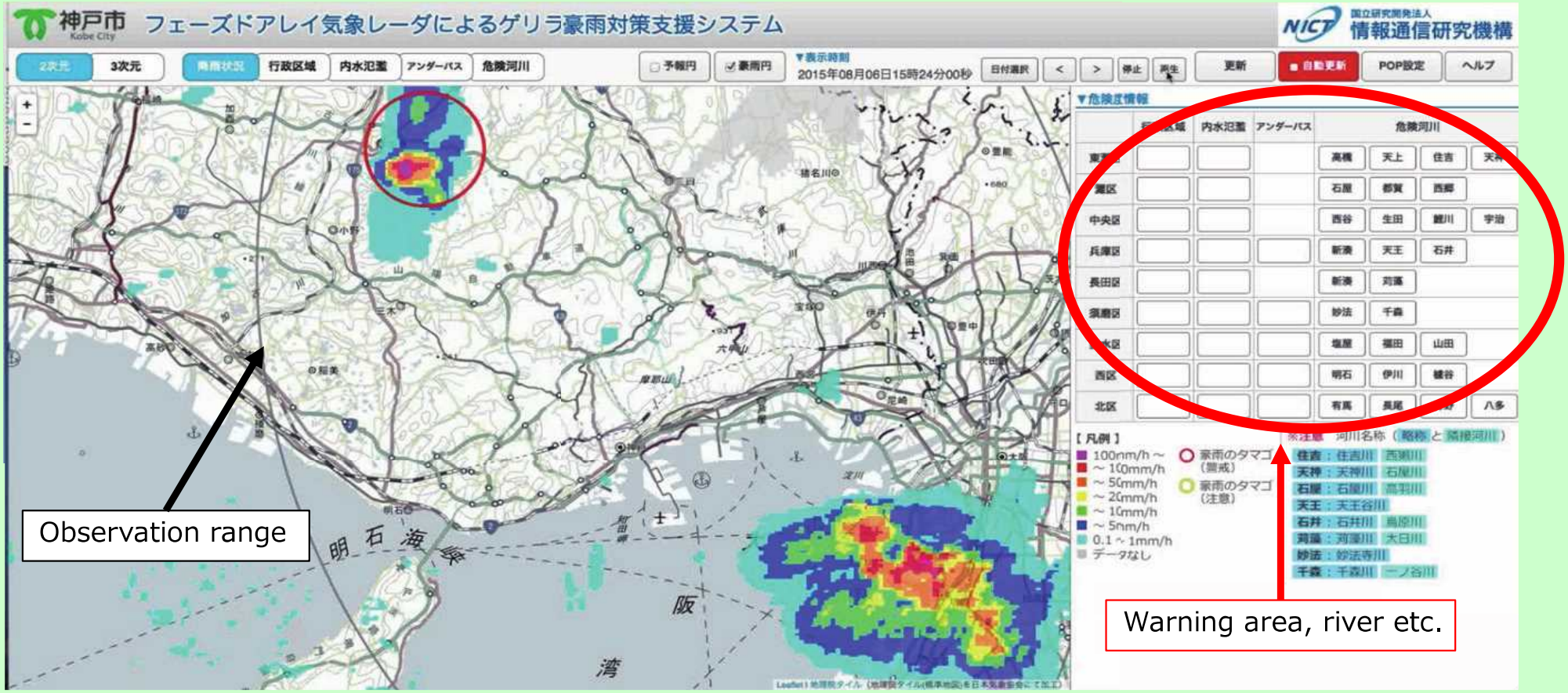
While rain clouds develop along the valley lines, they are approaching Tamba City and Fukuchiyama City. By performing high-speed three-dimensional observation, it is possible to confirm the state of heavy rain.

3D rainfall distribution with a radius of 60 km (Grid spacing 250 m) played at 300 times speed

Period :
Aug. 16, 2014 21:00～
Aug. 17 2014 5:00

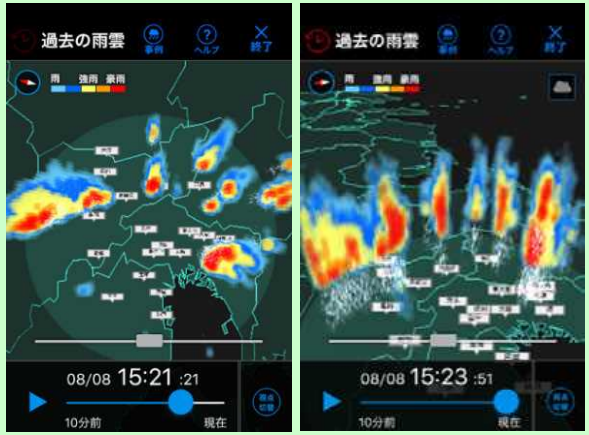


Toward the practical use of new weather radar



Guerrilla heavy rain countermeasure support system

- A guerrilla heavy rain countermeasure support system using the observation data of the new radar was developed and demonstration experiments are being carrying out in Kobe City.
- Observation data can be viewed on the smartphone in real time. The application name is 3D Rain Cloud Watch ~ Phased Array Radar ~ (https://pawr.life-ranger.jp/)

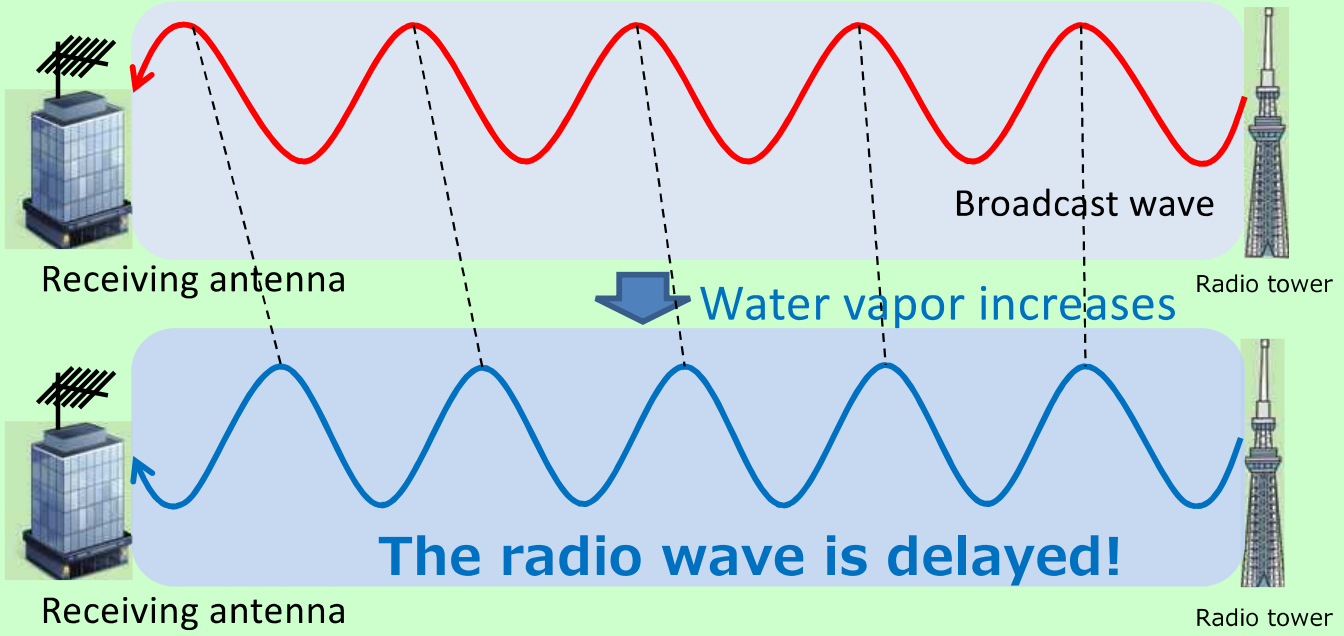


Q2.4-1 Are you interested in measurement technology for surface water vapor using television broadcast wave?

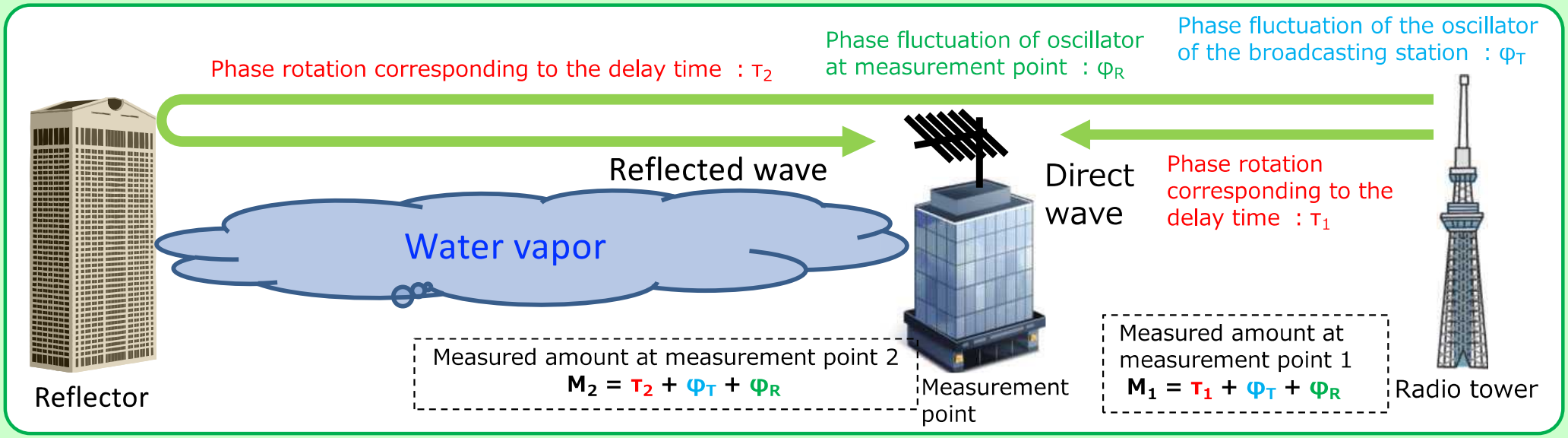
Many practitioners are interested in water vapor observation using broadcasting wave.

Water vapor observation using broadcasting wave

- When we receive radio waves 5 km away, the arrival of radio waves will be delayed by about 17 picoseconds (17 x 10^{-12} s) as the water vapor increases by 1%
- This sensor measures the delay time of radio waves and estimates the amount of water vapor



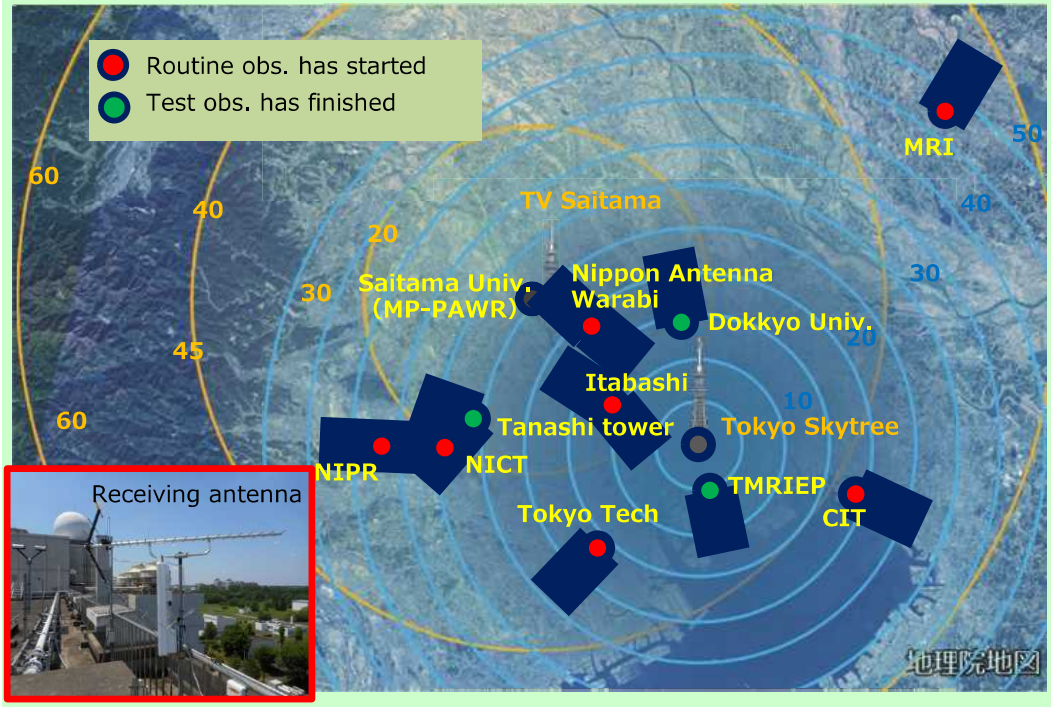
Method（Reflection method）



There are restrictions on the arrangement condition, but when there is a reflector, it can observe without synchronization

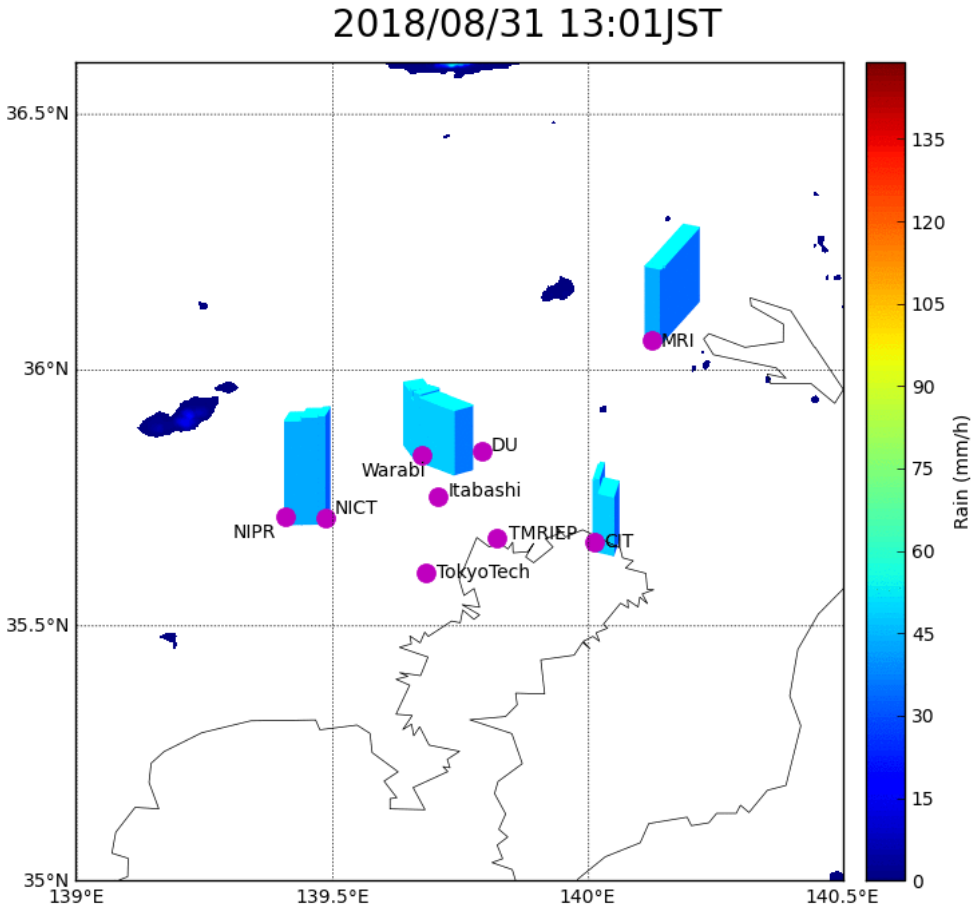
Water vapor observation using digital broadcast wave2

Water vapor observation network in Tokyo



- The demonstration experiments for water vaper observation using broadcasting wave is being carried out at Tokyo area.
- In addition, the Meteorological Research Institute and NICT are conducting research on meteorological forecasts that assimilated the amount of water vapor.

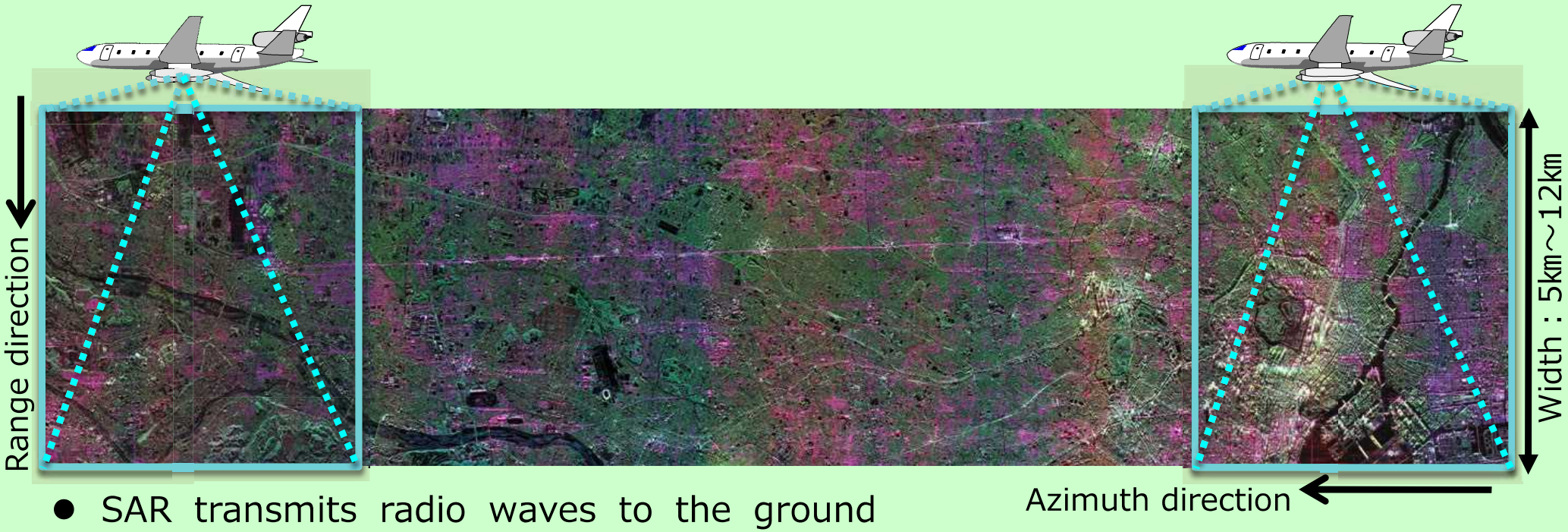
Simulation of rainfall that assimilates measured water vapor



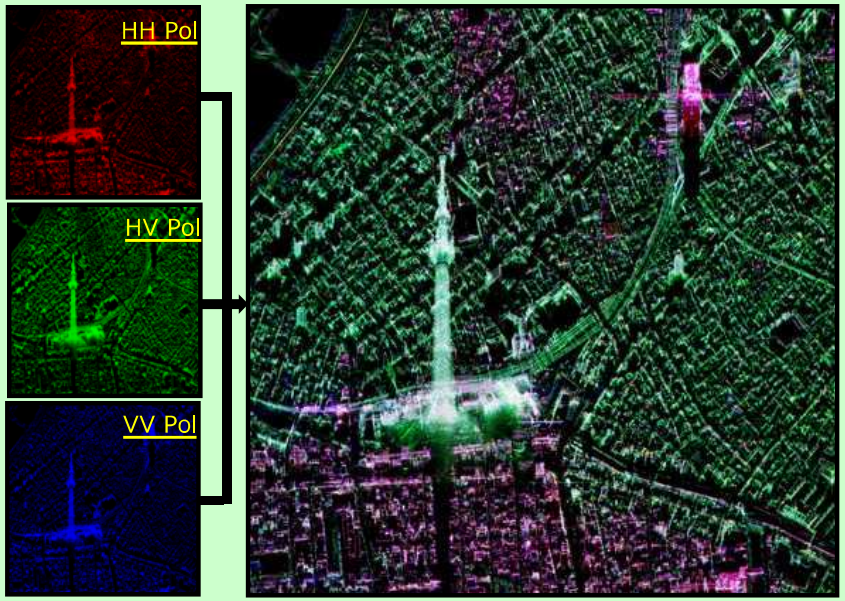
Q2.4-2 Are you interested in technology that enables you to quickly grasp landslides by airborne radars?

Many practitioners are interested in quickly grasp landslides by airborne radars. I’d like to introduced the landslide observations.

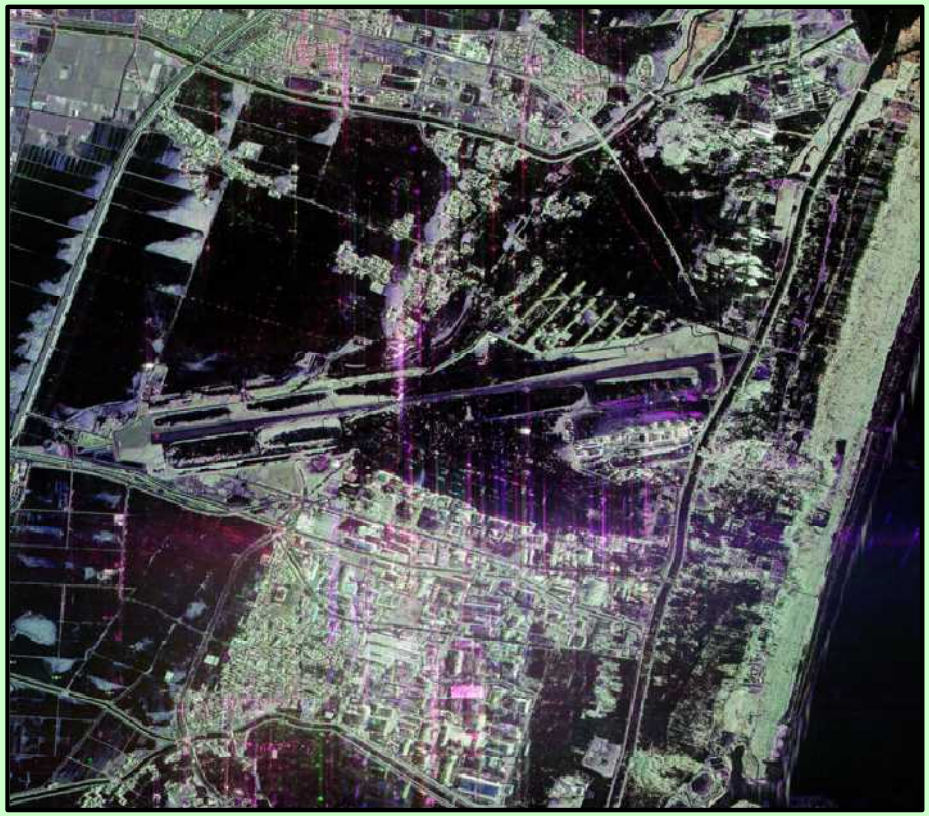
Synthetic aperture radar (Pi-SAR X2)



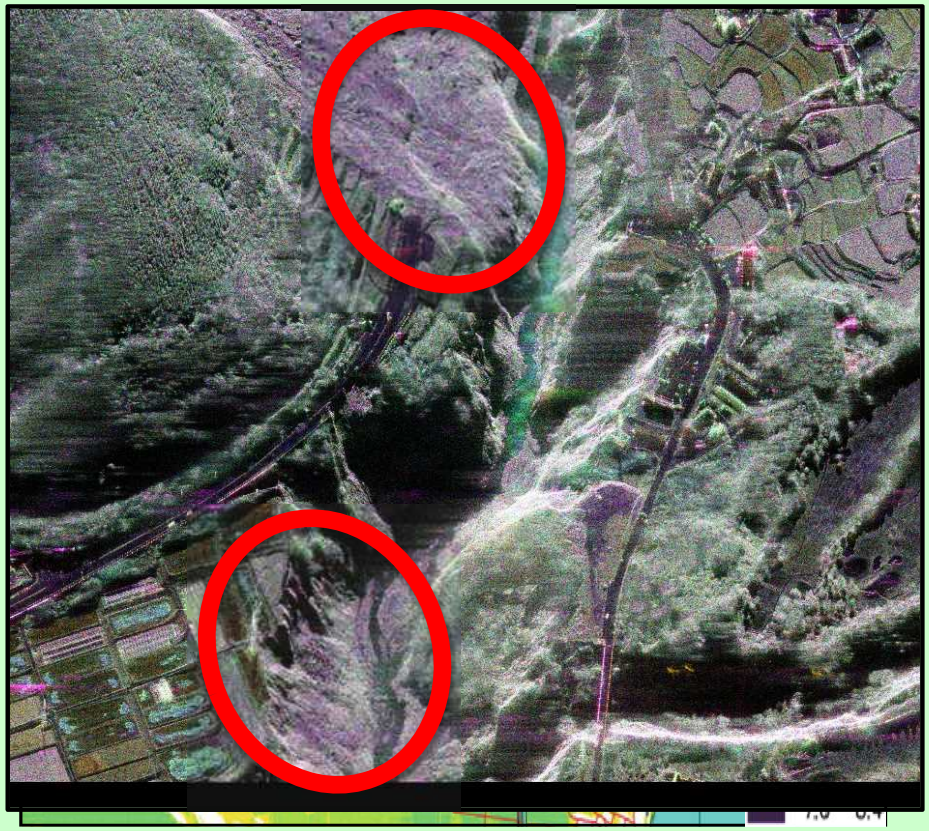
- SAR transmits radio waves to the ground surface and receives the backscattered echoes.
- SAR uses the relative motion between the antenna and the target region. Backscattered echoes received successively and coherently at different antenna positions are stored and post-processed to realize high resolution.
- The spatial resolution in Pi-SAR X2 is 30cm.



Flood and landslide disaster observed by Pi-SAR X2

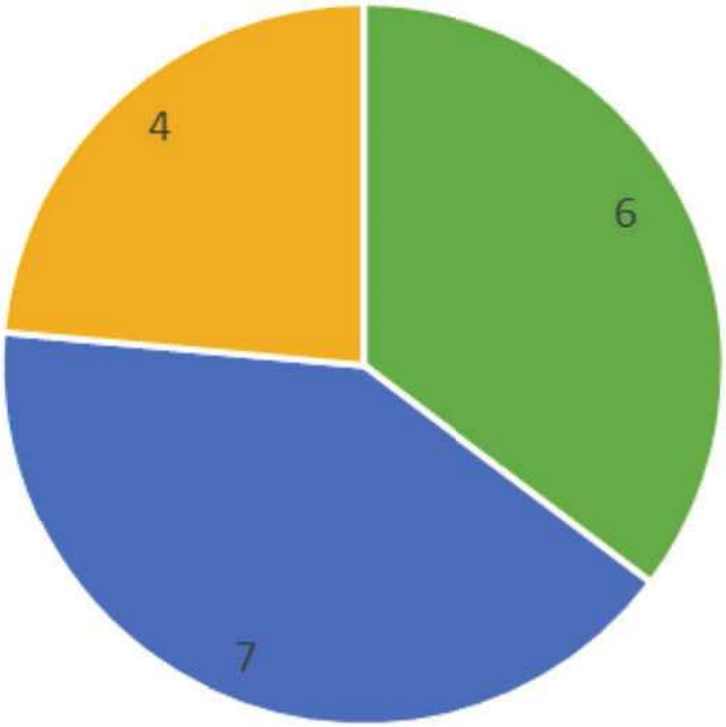


The run-up height of Tsunami is 5.7m at Sendai Airport. The black color shows the flooded areas. The rubble can be seen there. Tsunami reached about 5.5km inland from coastline.



This image shows landslides that occurred after a huge earthquake on April 17, 2016. The red circle shows landslide area.

Q2.4-3 How can you introduce the latest observation technology effectively?



- 1. With technical guidance
- 2. With human resource development
- 3. By technology transfer

I don’t have an answer to this problem. But I think that our laboratory can provide technical information and technical advice.