6th EWA / JSWA / WEF Joint Conference
„The Resilience of the Water Sector“
15-18 May 2018, Munich, Germany

# Demonstration study on using stormwater management technology to mitigate flood damage from heavy rainfall in urban areas

S. Oki, Y. Odake, R. Matsuoka

METAWATER Co., Ltd.

T. Matsuura

National Institute for Land and Infrastructure Management (NILIM),

Ministry of Land, Infrastructure, Transport and Tourism (MLIT)

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# Introduction

Frequency of localized torrential rain has been increasing.

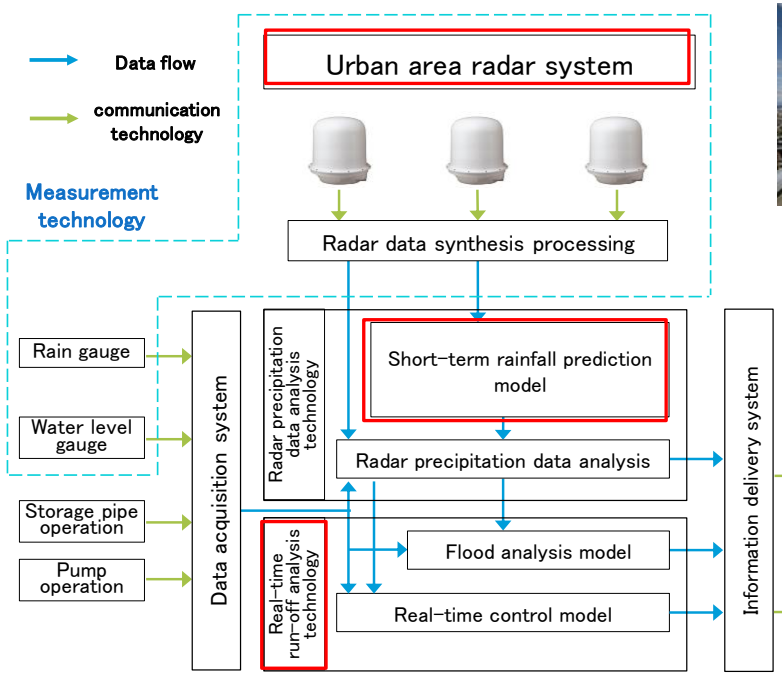
- Structural measures (such as stormwater storage pipe)
- Non-structural measures
  - ✔ Early realization of creating cites that is resistant to rain.
  - ✔ Promotion of adequate and efficient inundation measures.

Provide information such as:
- Facility operation support information
- Self-help and mutual assistance information

**to minimize flood damage**

# Composed technologies

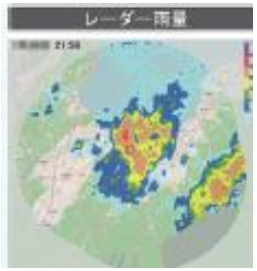
1. Urban area radar (multiple small XMP area radar)
2. Short-term rainfall prediction (incorporating ensemble prediction)
3. Real-time runoff analysis (enabling high-speed analysis)




As-installed state

OUTPUTS(Info through the website)

Facility operation support information



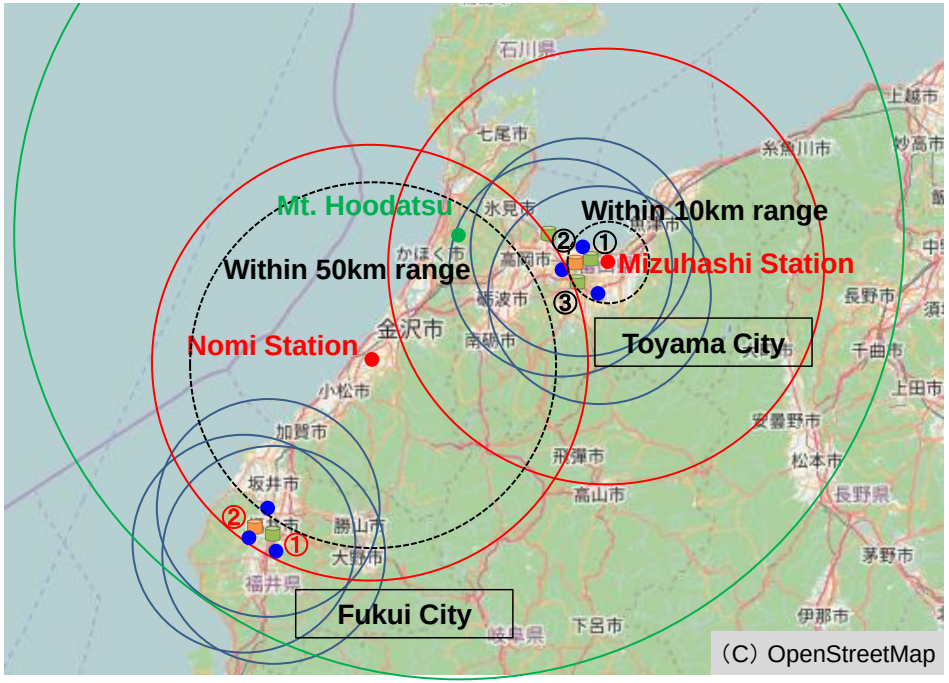
Radar rainfall

Water level in a sewage pipeline

# Urban area radar system setups

Radar installation sites:

1. Fukui city (locates XMP observation range limit)
2. Toyama city (close to the XMP station)




- Urban area radar
- XMP (Nomi and Mizuhashi stations)
  - Installed : 2009
  - Observation start : 2010
- C-band radar (Mt. Hoodatsu)
- Rain gauge
- Rain gauge of Japan Meteorological Agency

Observation range of urban area radar
(Observation range: radius 30km)

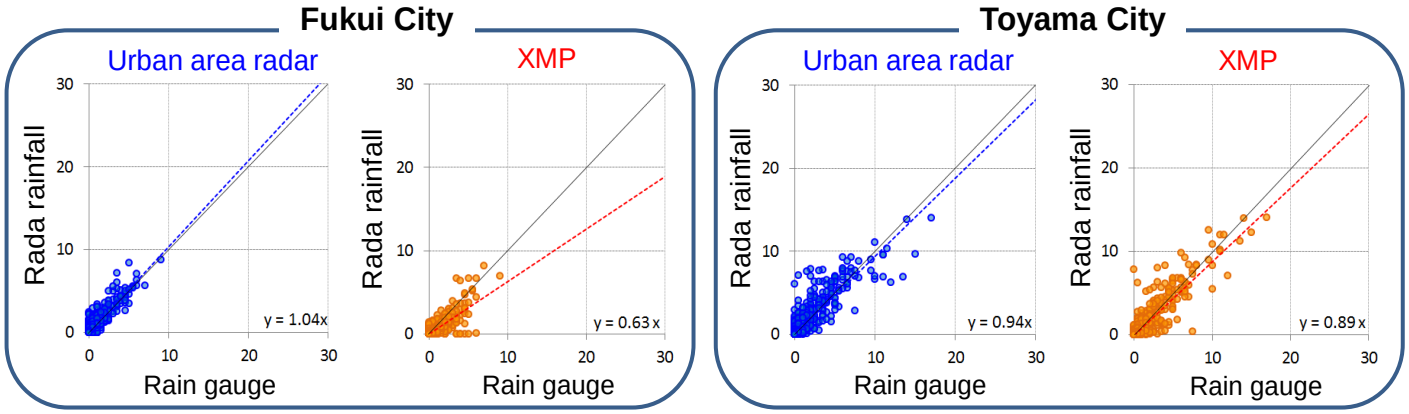
XMP observation range
( Observation range : radius 60km)

C-band radar observation range
(Observation range: radius120km)

[Rain gauge] ①Toyama ②Kureha sewage drainage district ③Akigashima
①Fukui ②Drainage district No.6

# (Results) Urban area radar

## Rainfall observation accuracy (vs. rain gauge)




Observation period Fukui : June 7,2017～September 30,2017 Toyama : June 1,2017～September 28,2017

| | | Fukui City | | Toyama City | |
|---|---|---|---|---|---|
| | | Urban area radar | XMP | Urban area radar | XMP |
| Data counts (*) | | 6336 | 6336 | 12528 | 12528 |
| Evaluation indices | Regression coefficient | 1.04 | 0.63 | 0.94 | 0.89 |
| | Coefficient of correlation | 0.89 | 0.79 | 0.88 | 0.90 |
| | RMSE | 0.27 | 0.32 | 0.32 | 0.27 |

**Rainfall unit**: mm/10min

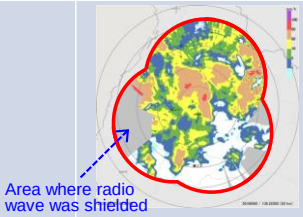
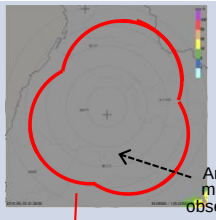
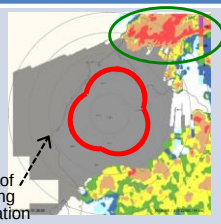
* The number of data in which the rainfall value exists in both the rain gauge and the radar rain gauge at a time when the 10 minute data is the same.

An observation accuracy is approximately equivalent to XMP

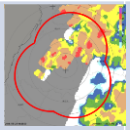
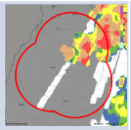
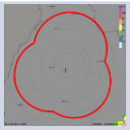
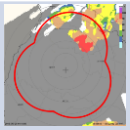
# (Results) Urban area radar

## Rainfall observation accuracy (signal decay)

Fukui City: Time of missing observation with XMP: June 25, at 1:36 (time at which the area of mixing observation with XMP becomes maximum)

| | Urban area radar | XMP | |
|---|---|---|---|
| Observation image |   |   |  |
| Observation elevation | Altitude: 500m | Altitude: around 2000m | |
| Range of observation image | Radius: 20km | Radius 20km | Radius 40km |
| Area of observation missing ($km^2$) | 0 $km^2$ | 689.375 $km^2$ | |
| Time of observation missing | 0 minute | 44 minutes (6/25 01:18-02:01) | |

Extremely heavy rainfall between Nomi Station and Fukui City caused dissipation of radio wave, resulting in missing observation above Fukui City

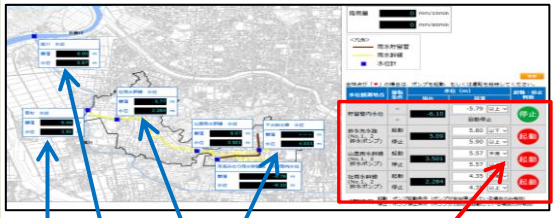
| Time | 1:26 | 1:31 | 1:36 | 1:41 | 1:46 |
|---|---|---|---|---|---|
| Observation image with XMP |  |  |  |  |  |

: Observation area of urban area radar at 500 m above the sewage drainage districts of Fukui City

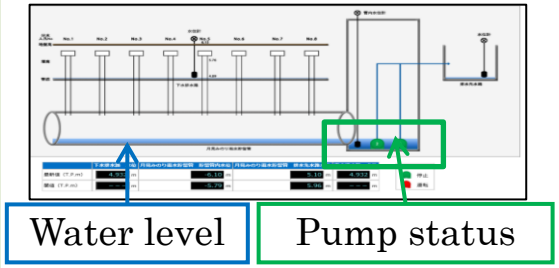
Time of missing observation due to signal decay caused by heavy rainfall (50mm/h) were zero

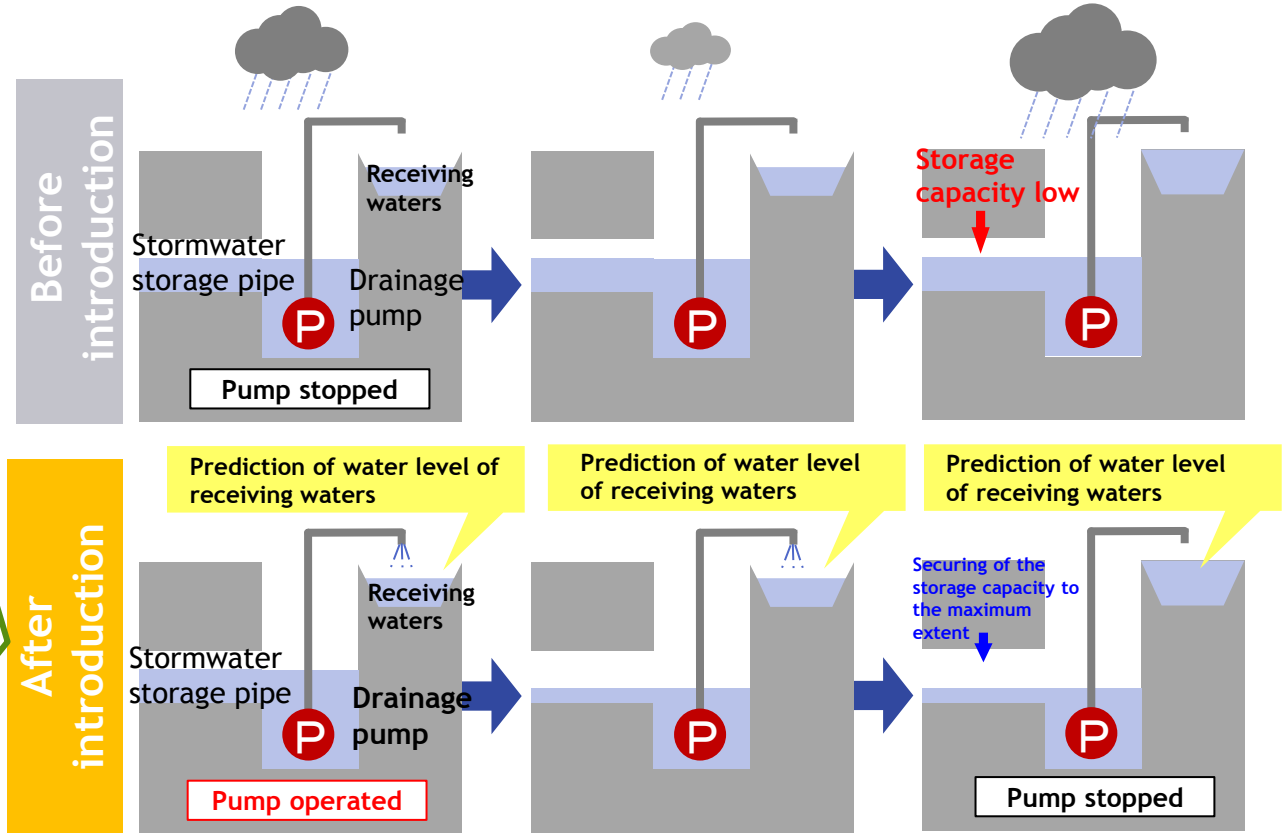
# Improved operation of stormwater storage pipe drainage pumps

## Given information




## Stormwater storage pipe



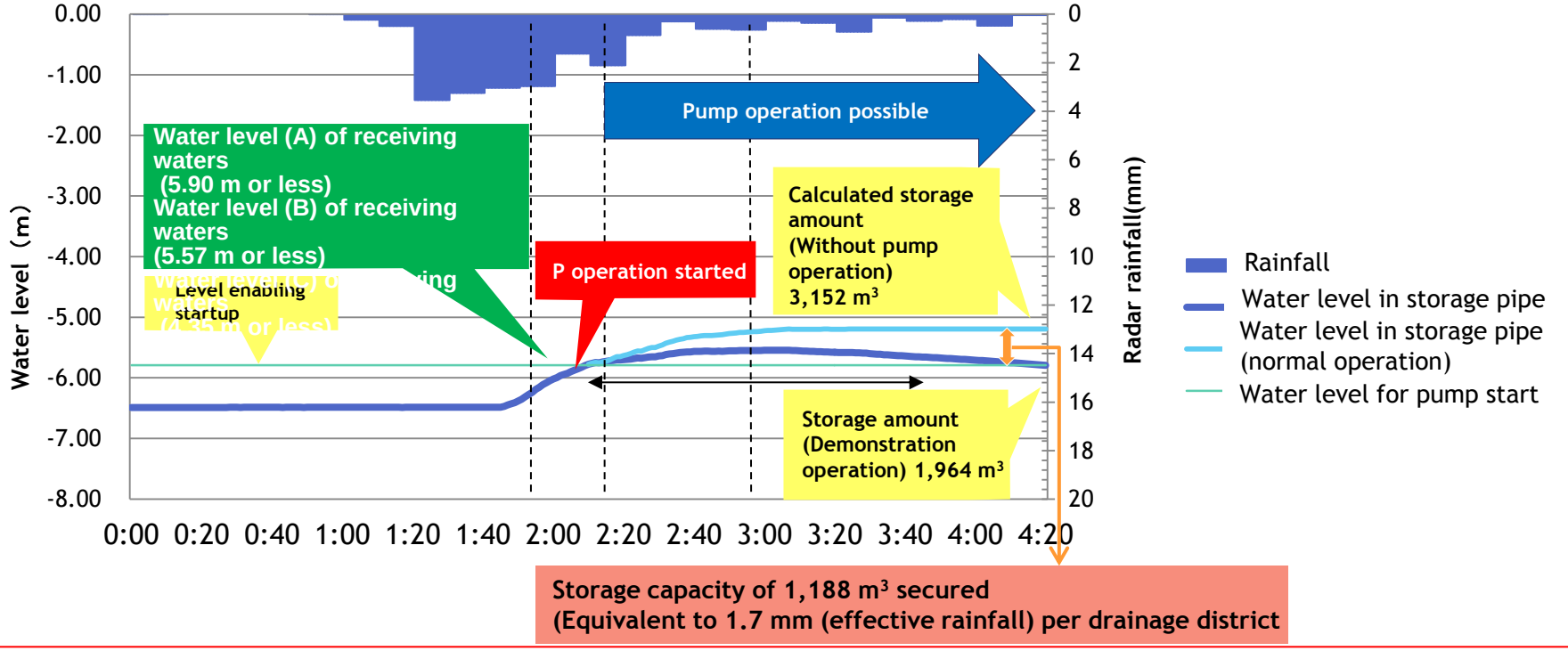




Based on predicted water level of receiving waters, pump operated continuously within a range not promoting flood at downstream side

# (Result) Improved operation of stormwater storage pipe drainage pumps

[Example of operation results (Tsukimi Minori Stormwater storage pipe)]

Rainfall in Fukui City, October 9, 2016

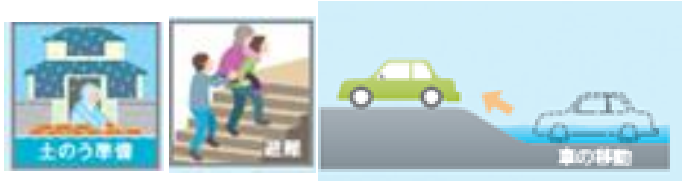



Demonstration operation was during period from start of pump operation to end of rainfall. Results indicated that storage capacity of 1,188 m³/min could be secured. (about 10% of the full stormwater storage pipe capacity)

# Securing time needed for flood damage mitigation activities by residents

## Process

Flood and pipeline water level comes to the limit water level, e-mail is sent to residents.



## Lead time (time to be needed in Fukui case)

**Lead time = Actual flood time – Time of delivering prediction information**

**Lead time necessary for demonstration study**
(Calculated based on results of resident questionnaires)

- Provision of sand bags・・・15min.
- Vehicle movement・・・・・5min.
- Evacuation ・・・・・・・・11 min.

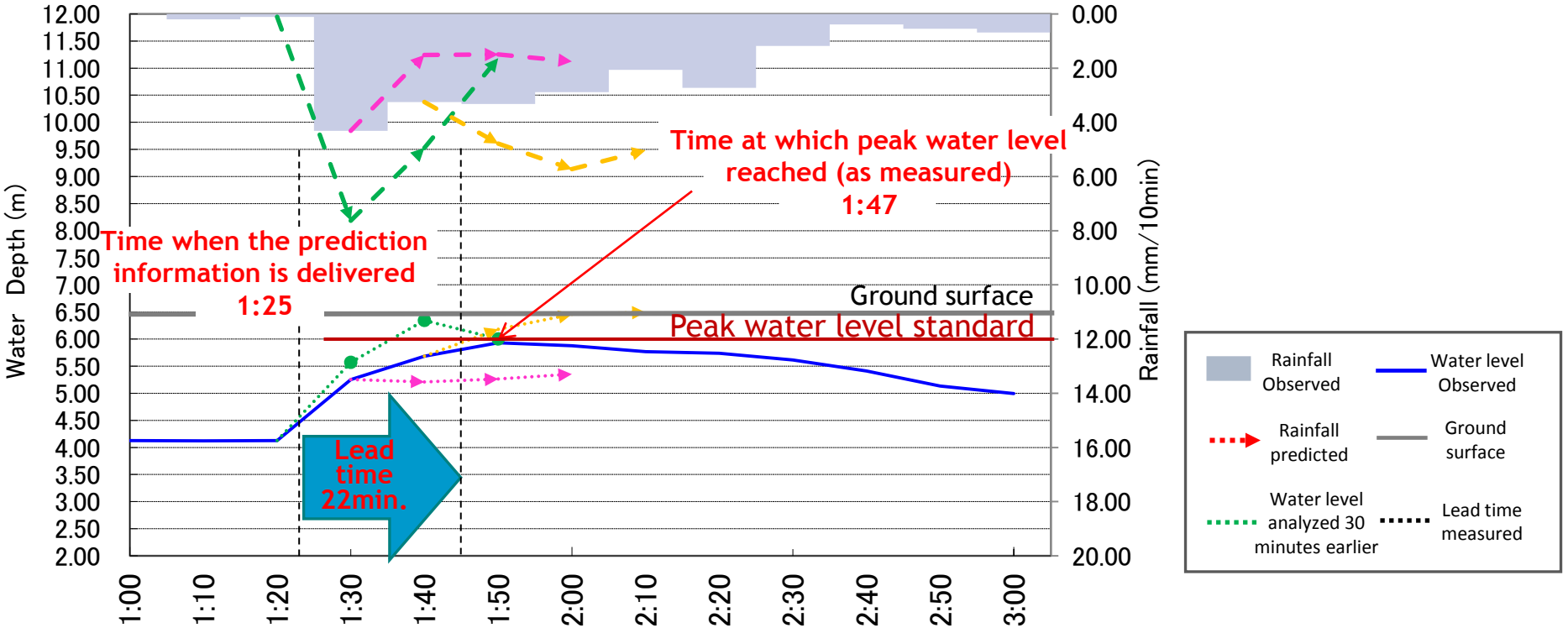
Max. around **20 min.** necessary

(Evaluation done with peak water level because rainfall leading to flood did not occur during demonstration study period)

# (Results) Securing time needed for flood damage mitigation activities by residents

## Example of the lead time that could be secured

Rainfall in Fukui, October 9, 2016




A lead time of about 20 min. were secured in five rainfall events (w/peak water level)
(No inundation occured during the demonstration period)

# Conclusions

- Storm water management system (combining the use of urban area radar, short-term rainfall prediction, and real-time analysis in the sewage works) were evaluated first ever in Japan.

- Urban area radar
  - observation accuracy equivalent to that of XMP
  - no missing observation area due to signal decay (observation range at an altitude of 500m)

- Mitigation effects of flood damage by using the given information
  - about 10% of the total capacity of stormwater storage pipe were increased.
  - about 20 min. of the lead time (needed for doing resident’s self-help and mutual action) was secured.

- So far, no landside inundation occurred at both Toyama and Fukui city.
- Further evaluation will be continued untill the end of 2019.

- A guideline of the system is about to be issued by the MLIT, for application and dissemination to local authorities across the country.

# Any questions??

## Acknowledgement:

The content of this presentation is based on the results of research contracted by the National Institute for Land and Infrastructure Management of MLIT for 2015 to 2016 in the Breakthrough by Dynamic Approach in Sewage High Technology Product (B-DASH Project) sponsored by the Sewerage and Wastewater Management Department, MLIT.