APPLYING RADAR-BASED RAINFALL ESTIMATION FOR REAL TIME FLOOD FORECAST AND EARLY WARNING SYSTEM

Dr. Piyamarn Sisomphon
Hydroinformatics Modelling System Section
Hydro Informatics Institute

CONTENTS

Takhli radar station

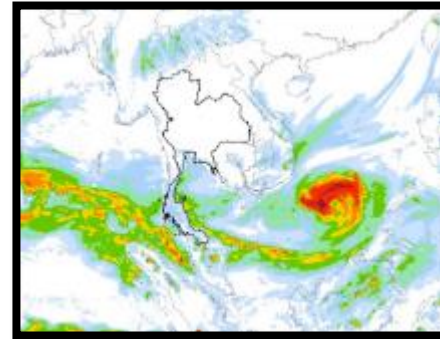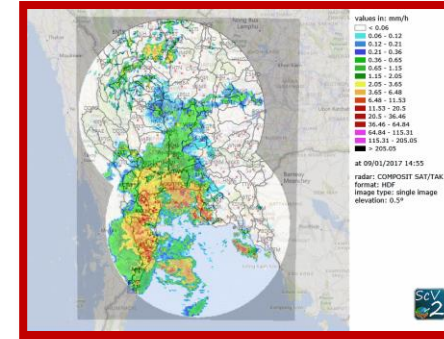สถาบันสารสนเทศทรัพยากรน้ำ (องค์การมหาชน)

INTRODUCTION

Rainfall data (temporal and spatial scale)
- Monitoring
- Forecasting
- Management & Planning

WRF-ROMS (7 days forecast)

NOWCASTING – RADAR (1-3 hrs. forecast)

BASIN SCALE

LOCAL SCALE

Higher data resolution is needed for smaller scale flood modeling

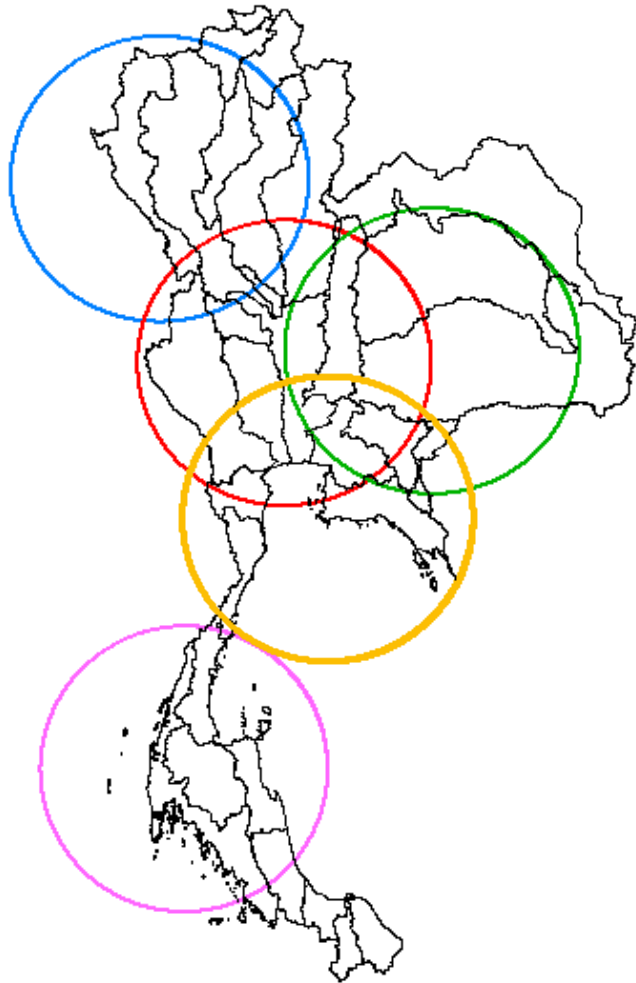RESERVOIR OPERATION

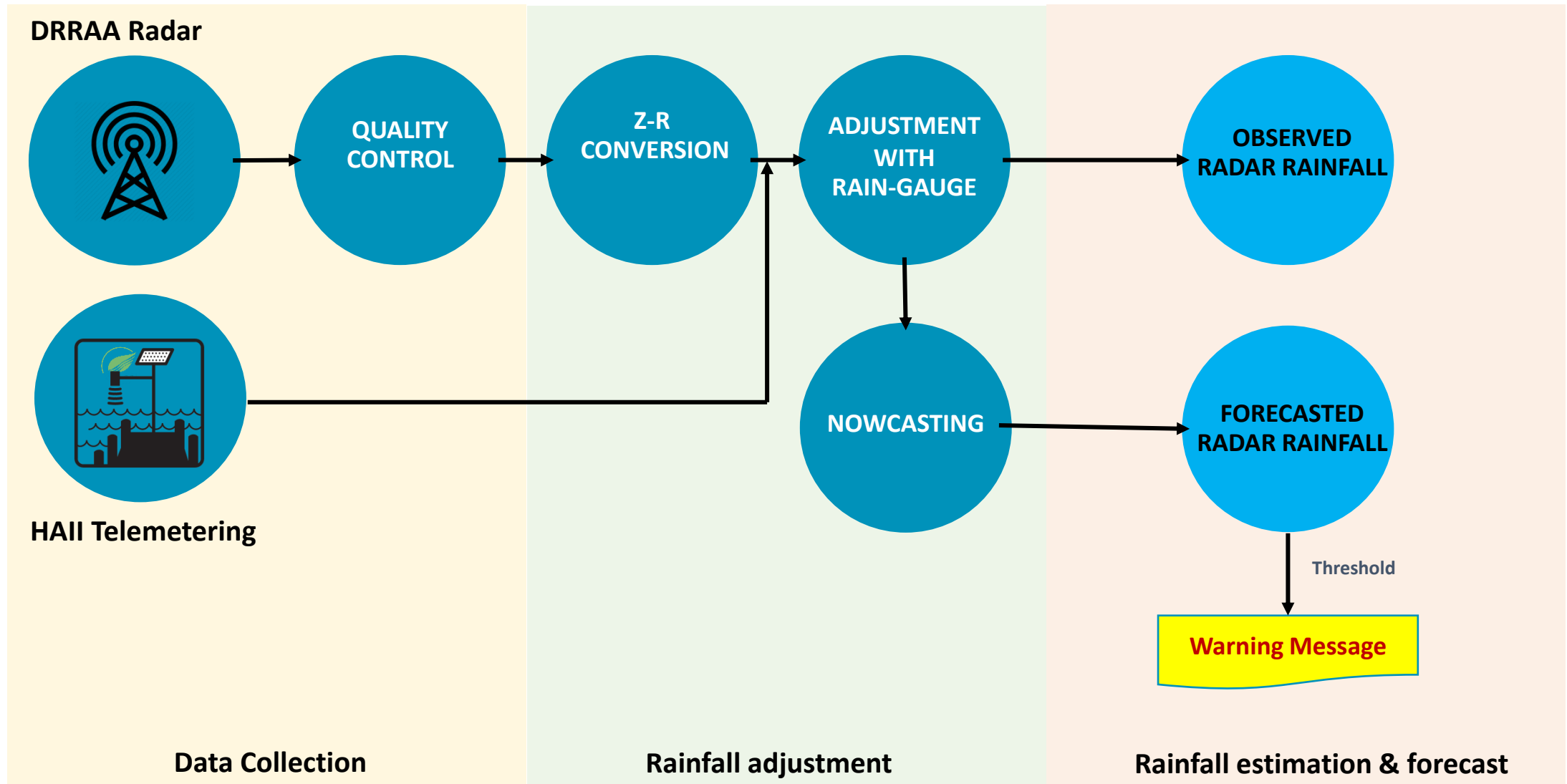RIVERINE FLOOD

FLASH FLOOD

URBAN FLOOD

OBJECTIVE

- **Best Available Rainfall Information [RADAR + RAIN-GAUGE]**

- **Real-time System [FULLY AUTOMATED ON-LINE SYSTEM]**

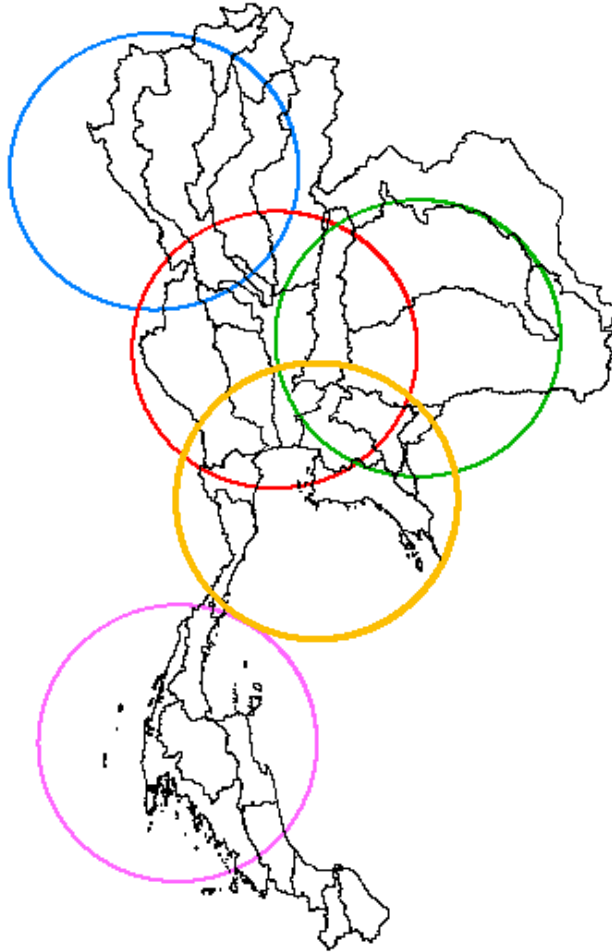- **Near Real-time Forecast and Warning (1 to 3 hours ahead)**

CONCEPT OF ON-LINE SYSTEM

DRRAA Radar

QUALITY CONTROL → Z-R CONVERSION → ADJUSTMENT WITH RAIN-GAUGE → OBSERVED RADAR RAINFALL

HAII Telemetering

NOWCASTING → FORECASTED RADAR RAINFALL

Threshold

Warning Message

Data Collection

Rainfall adjustment

Rainfall estimation & forecast

สถาบันสารสนเทศทรัพยากรน้ำ (องค์การมหาชน)

DATA AND METHODS

- ## RADAR DATA

5 stationary weather radars operated by DRRAA

	Omkoi	Inburi	Pimai	Satthahip	Phanom
Type	S-band Dual polarization	C-band Doppler	S-band Doppler	S-band Doppler	S-band Doppler
Range	240 km	240 km	240 km	240 km	240 km
Angular Step	1.3°	1.2°	1°	1°	1°
Range Step	250 m	500 m	500 m	500 m	250 m
Data Format	UF file	UF file	Volume file	Volume file	Volume file

Department of Royal Rainmaking and Agriculture Aviation

สถาบันสารสนเทศทรัพยากรน้ำ (องค์การมหาชน)

DATA AND METHODS (OFFLINE ANALYSIS)

Quality control for radar data
- **Beam blockage**
- **Ground clutter**

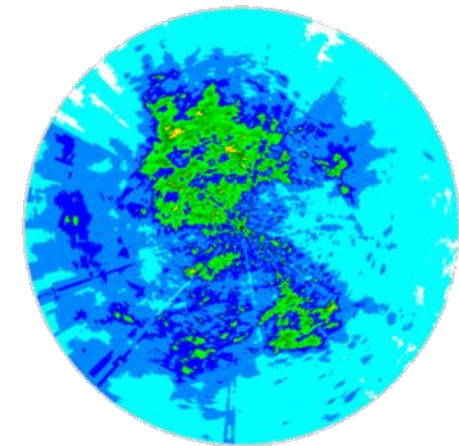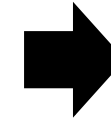**Select only one elevation angle of radar scan to use (the lowest with no beam blockage)**
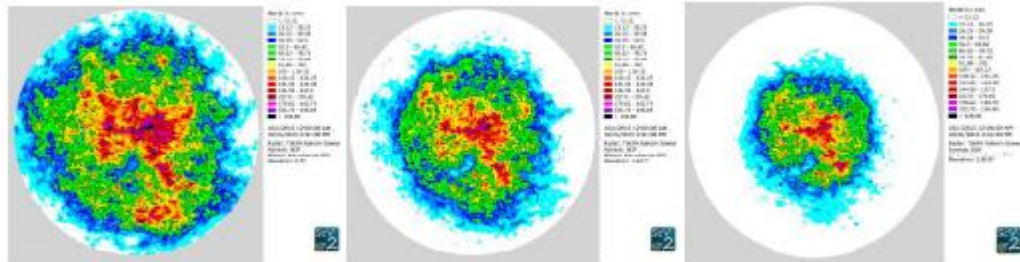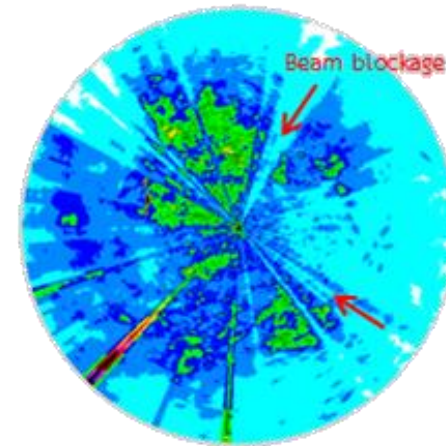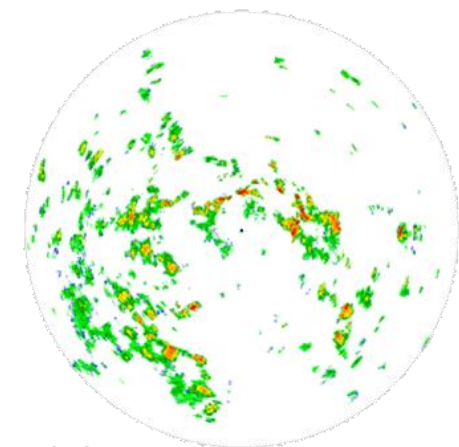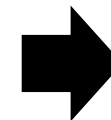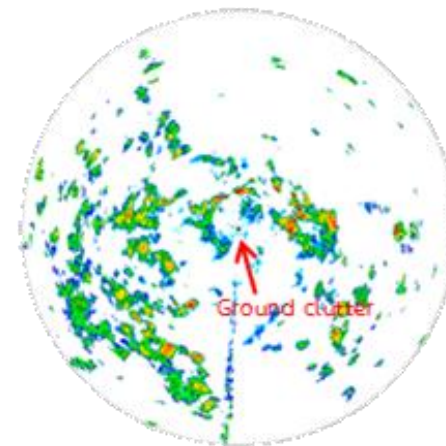

0.5 deg   1.1 deg   1.8 deg

**Accumulated monthly rainfall from Takli station
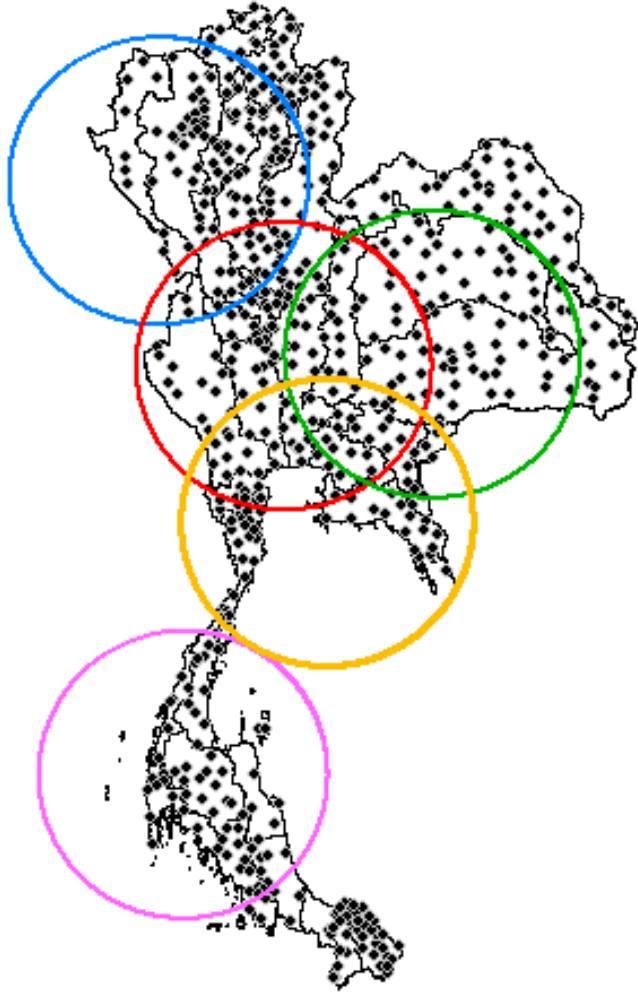(0.5 deg was selected)**

Adjustment of beam blockage

Adjustment of ground clutter

DATA AND METHODS
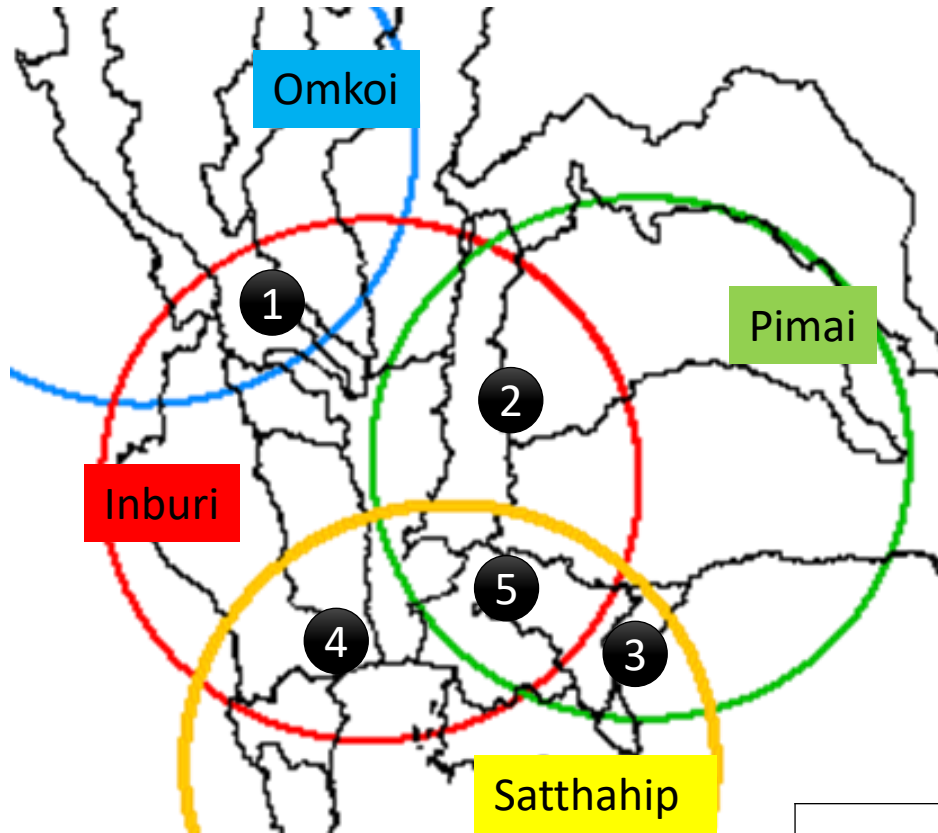
Quality control for Rain-gauge data

Select the reliable rain-gauge station from 547 stations under the radar coverage (missing value < 30%)

Use double mass curve to check the consistency between the nearby stations (<50 m)

503 stations are selected for calibration

สถาบันสารสนเทศทรัพยากรน้ำ (องค์การมหาชน)

Rainfall Estimation - Composite

		Z composite		Z single	
	Radar	**Omkoi - Inburi**		Omkoi	Inburi
Zone1	RMSE	**9.275**		12.226	10.593
	Radar	**Inburi - Pimai**		Inburi	Pimai
Zone2	RMSE	**4.159**		5.773	4.414
	Radar	**Satthahip - Pimai**		Pimai	Satthahip
Zone3	RMSE	**4.583**		5.353	4.716
	Radar	**Satthahip - Inburi**		Inburi	Satthahip
Zone4	RMSE	**5.613**		5.853	5.632

12% ⬆
6% ⬆
3% ⬆
<1% ⬆

		Z composite				Z single		
	Radar	Zone4	Zone2	Zone3	**Zone5**	Inburi	Pimai	Satthahip
Zone5	RMSE	4.850	5.248	4.556	**4.546**	6.769	4.991	4.634

2% ⬆

สถาบันสารสนเทศทรัพยากรน้ำ (องค์การมหาชน)

RESULTS

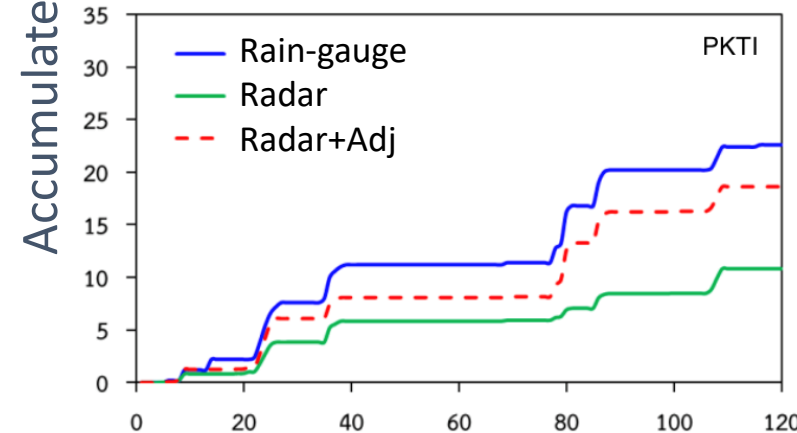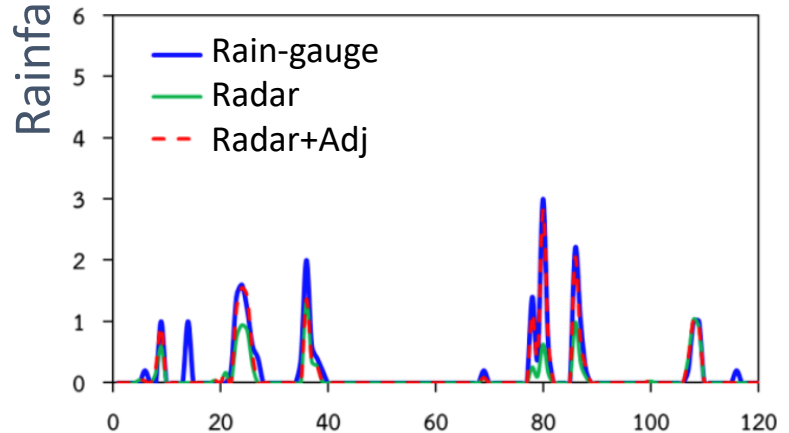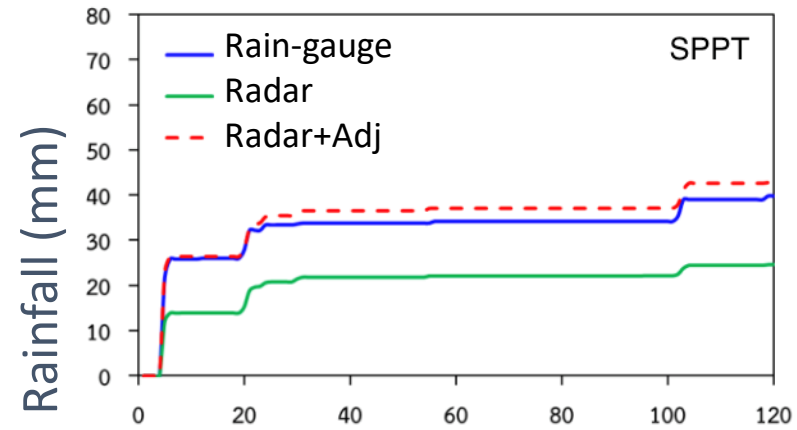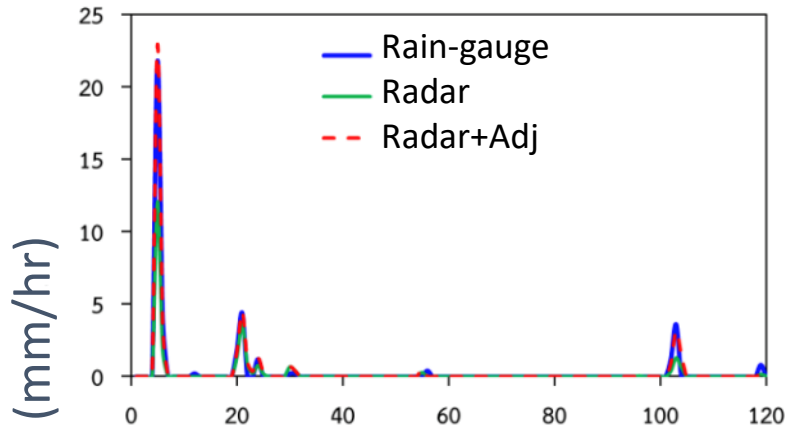**On-line adjustment with rain-gauge**

43 events in Jun-Aug 2017
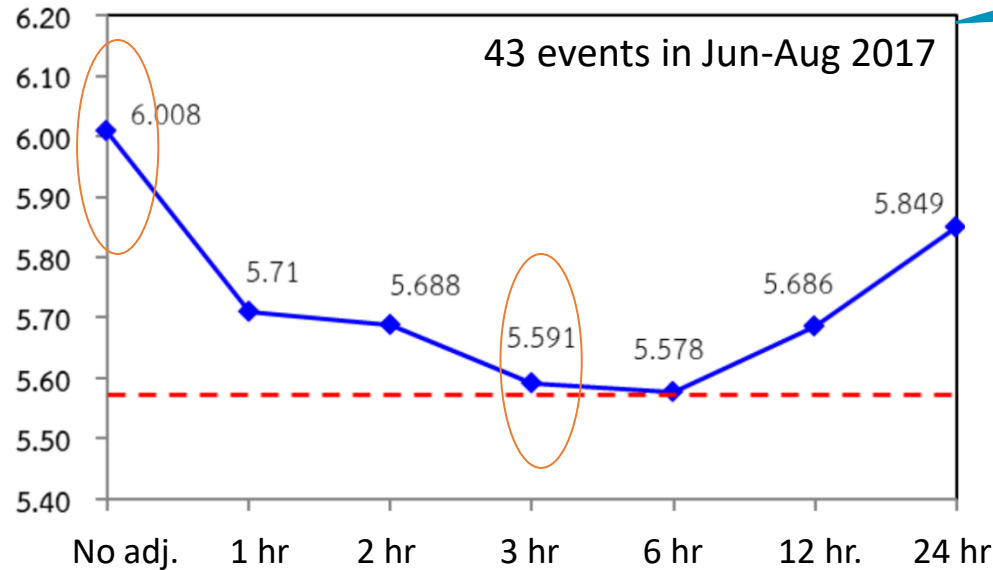
~ 6.9 % RMSE reduced

- **Delay of transmitting rain-gauge data**
- **At 20th minutes of hour, the data arrived at > 80%**

3 hours accumulated rainfall >>> G/R >>> adjustment factor
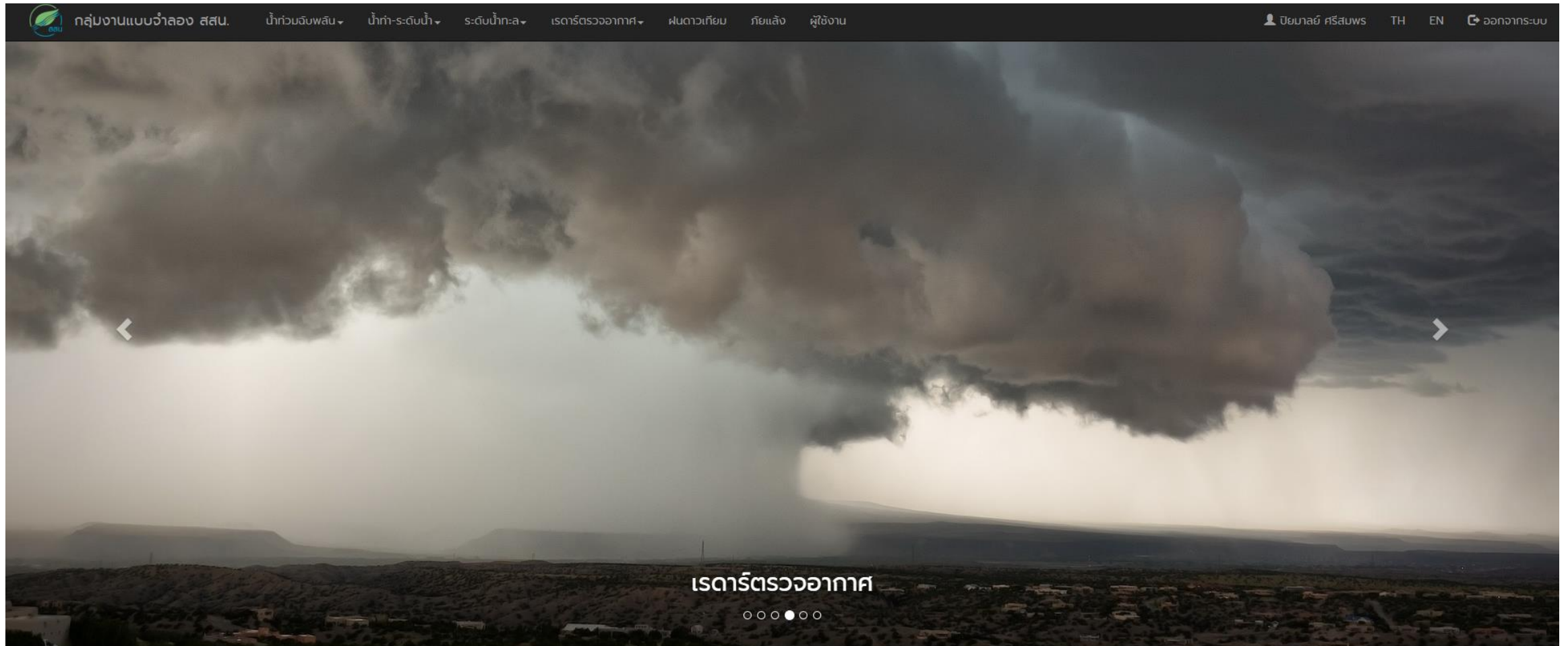
RESULTS

On-line adjustment with rain-gauge

CONCLUSION

The Z-R calibration is needed for a better rainfall estimation

Composited Z can improve the accuracy of rainfall estimation (4% of RMSE reduced)

Adjusting radar estimates with rain-gauge can improve accuracy (6.9% RMSE reduced)

On-line radar-based rainfall estimation and forecasting system

On-line radar-based rainfall estimation and forecasting system

DATA VISUALIZATION

23rd July 2019
Heavy Rainfall Warning
in Muang District, Puket

URBAN RAINFALL (BANGKOK)

แผนที่พื้นที่เสี่ยงน้ำท่วมฉับพลัน ▶ ภาพเรดาร์

Detail of Risk Area 1 hour

Detail of Risk Area 2 hours

Detail of Risk Area 3 hours
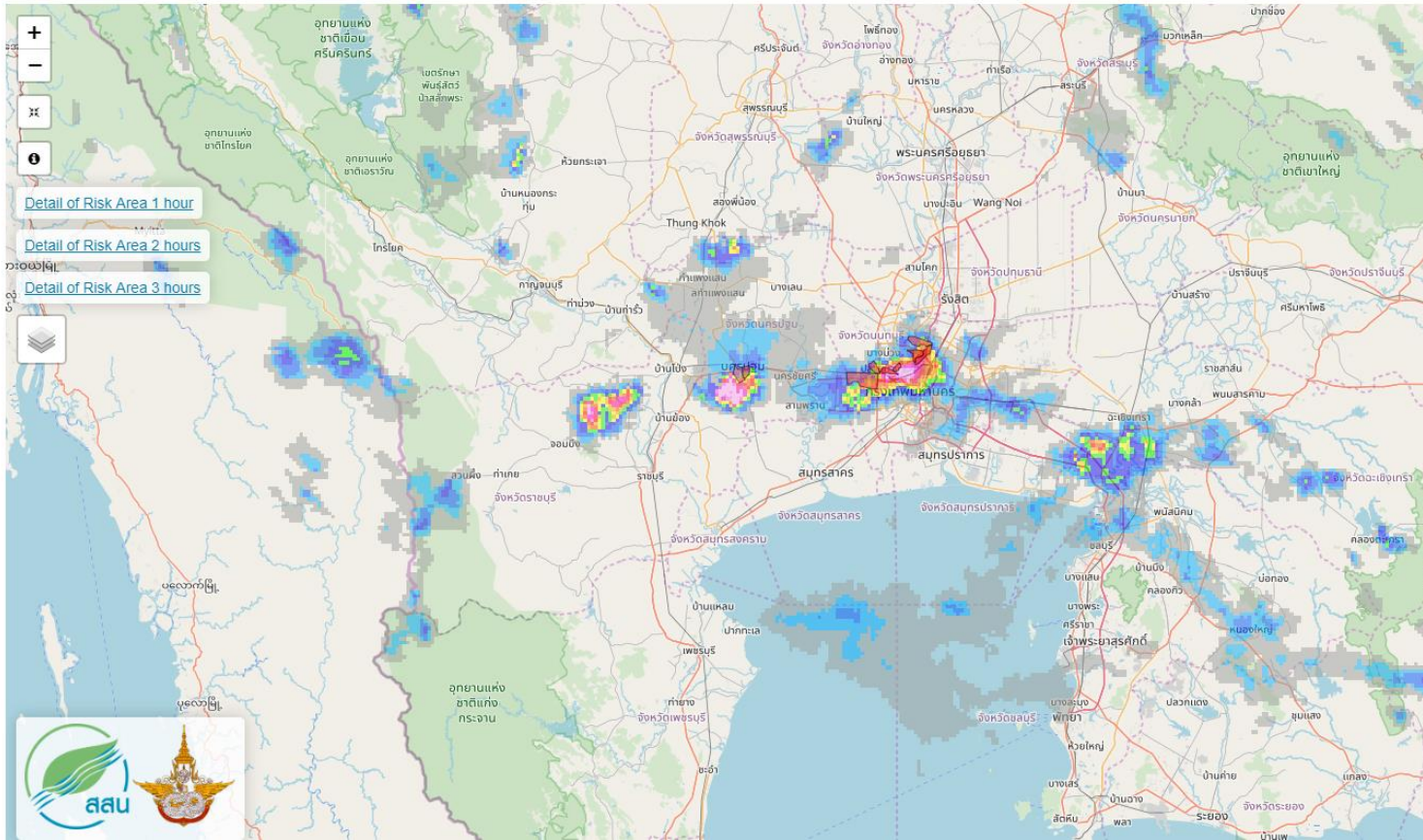
ฝนตกถล่มกรุง ทั่วทุกพื้นที่ น้ำท่วมขังหลายจุด

7 มิถุนายน 2562

ฝนตกถล่มกรุง ทั่วทุกพื้นที่ น้ำท่วมขังหลายจุด

เมื่อเวลา 15.30 น. วันที่ 7 มิถุนายน 2562 ผู้สื่อข่าวรายงานว่า ในพื้นที่กรุงเทพมหานครเกิดฝนตกหนักอย่างต่อเนื่อง ทำให้ในหลายพื้นที่มีน้ำขัง และส่งผลให้สภาพการจราจรในหลายเส้นทางติดขัดต่อเนื่องกัน ส่วนภาพดังกล่าวเป็น บรรยากาศฝนตกบริเวณถนนอังรีดูนังต์ ต่อเนื่องถนนพระราม 4 ซึ่งสภาพการจราจรยังสามารถเคลื่อนตัวได้ดี
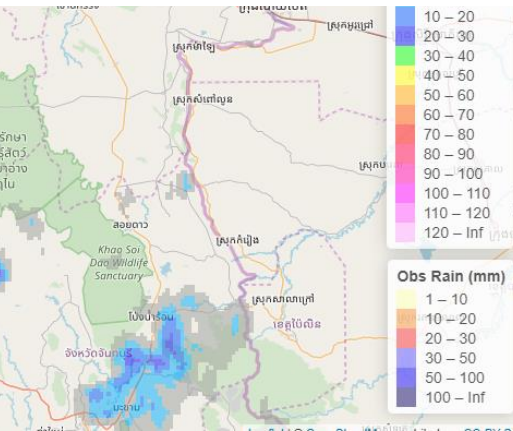
		POD	FAR	SR	ACC
	F1	0.525	0.456	0.544	0.827
7-Jul-19	F2	0.433	0.619	0.381	0.736
	F3	0.400	0.684	0.316	0.692

Effectiveness 75% False alarm 30%

Forecast accuracy 1st to 3rd hour 80% - 70% - 60%
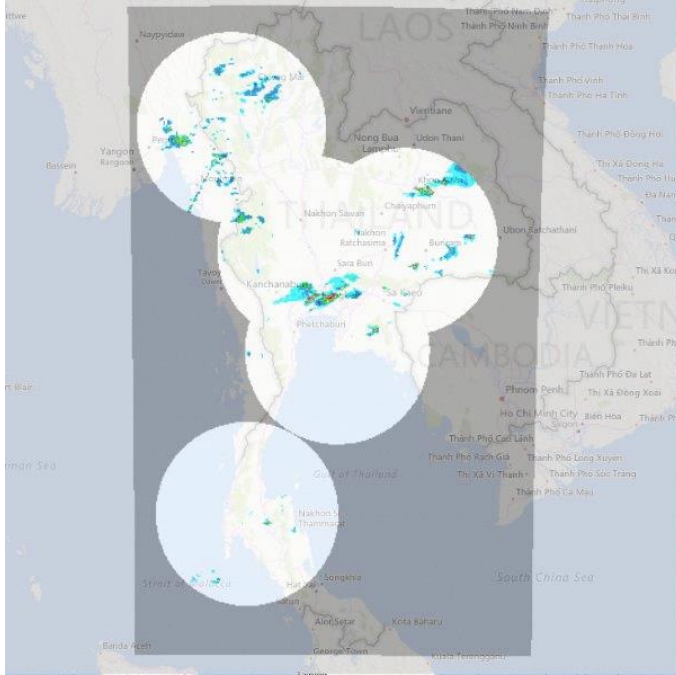
COMPOSITE RADAR ON LINE APPLICATION

Composite Radar

Features:
- Push rainfall warning message
- Reply user request message
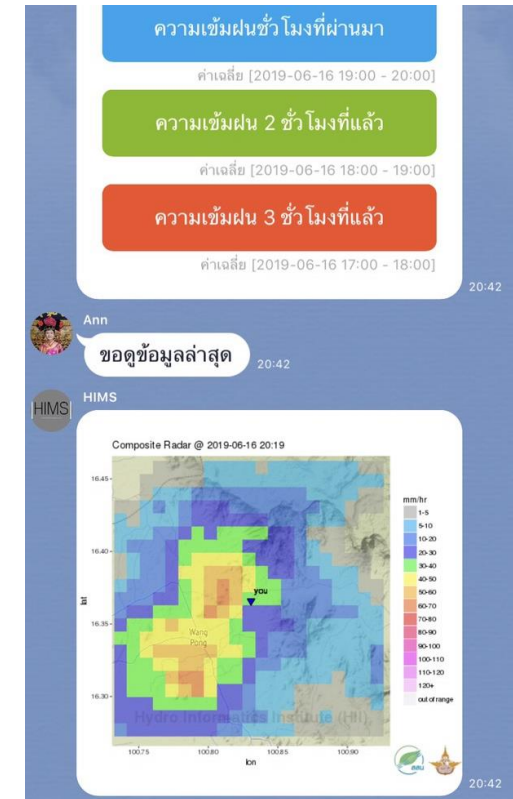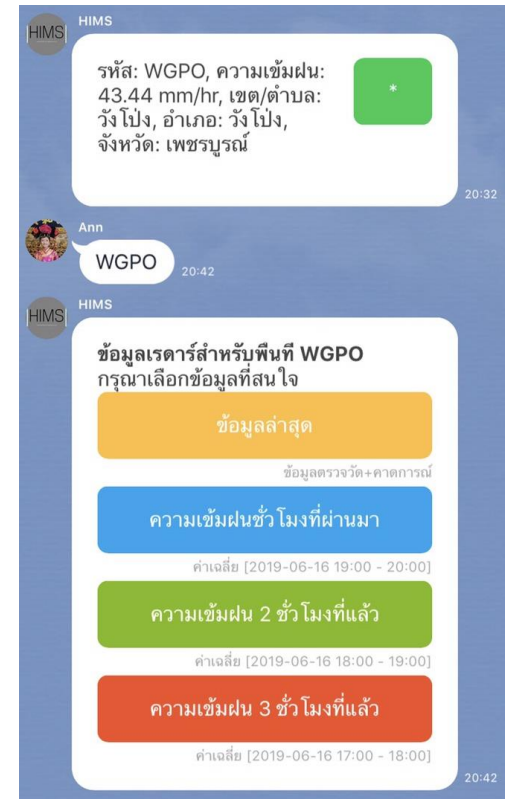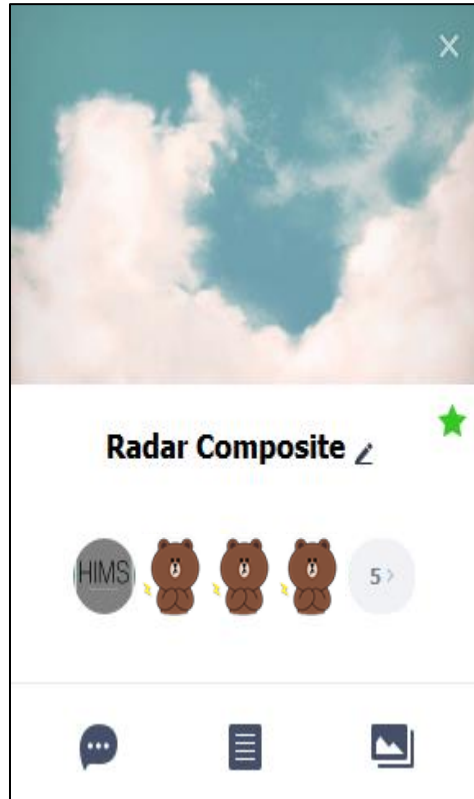
23ʳᵈ July 2019 Heavy rainfall event in Bangkok

**BMA reported highest rainfall observed in Nongjok and Klong Samwa

THANK YOU