香港天文台
HONG KONG OBSERVATORY

MET Support for the Runway Condition Report System

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Hong Kong Observatory

ICAO APAC MET/ATM Seminar
1 May 2023

Runway Condition Report

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Requirement stated in ICAO Doc 9981

Effective from 4 November 2021

Assessing and reporting the runway condition is necessary in order to provide the flight crew with the information needed for safe operation of the aeroplane.

Runway condition assessment matrix (RCAM)			
Assessment criteria		Downgrade assessment criteria	
Runway condition code	Runway surface description	Aeroplane deceleration or directional control observation	Pilot report of runway braking action
6	• DRY	---	---
5	• FROST • WET (The runway surface is covered by any visible dampness or water up to and including 3 mm depth) ***Up to and including 3 mm depth:*** • SLUSH • DRY SNOW • WET SNOW	Braking deceleration is normal for the wheel braking effort applied AND directional control is normal.	GOOD
4	***−15°C and Lower outside air temperature:*** • COMPACTED SNOW	Braking deceleration OR directional control is between Good and Medium.	GOOD TO MEDIUM
3	• WET ("slippery wet" runway) • DRY SNOW or WET SNOW (any depth) ON TOP OF COMPACTED SNOW ***More than 3 mm depth:*** • DRY SNOW • WET SNOW ***Higher than −15°C outside air temperature[1]:*** • COMPACTED SNOW	Braking deceleration is noticeably reduced for the wheel braking effort applied OR directional control is noticeably reduced.	MEDIUM
2	***More than 3 mm depth of water or slush:*** • STANDING WATER • SLUSH	Braking deceleration OR directional control is between Medium and Poor.	MEDIUM TO POOR
1	• ICE [2]	Braking deceleration is significantly reduced for the wheel braking effort applied OR directional control is significantly reduced.	POOR
0	• WET ICE [2] • WATER ON TOP OF COMPACTED SNOW [2] • DRY SNOW or WET SNOW ON TOP OF ICE [2]	Braking deceleration is minimal to non-existent for the wheel braking effort applied OR directional control is uncertain.	LESS THAN POOR

Runway Condition Report

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ICAO Doc 9981

Effective from 4 November 2021

2.1.1.3 The philosophy of the RCR is that the aerodrome operator assesses the runway surface conditions whenever water, snow, slush, ice or frost are present on an operational runway. From this assessment, a runway condition code (RWYCC) and a description of the runway surface are reported which can be used by the flight crew for aeroplane performance calculations. This format, based on the type, depth and coverage of contaminants, is the best assessment of the runway surface condition by the aerodrome operator; however, all other pertinent information will be taken into consideration and be kept up to date and changes in conditions reported without delay.

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Airport Authority Hong Kong has invited HKO

(1) to develop an automatic system monitoring rainfall; and

(2) to suggest real-time Runway Condition Report (RCR) for HKIA.

Runway Condition Report

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(ICAO Doc 9981)

For climate in HKIA, HKO system only suggests RCR6, RCR5 and RCR2 to AAHK

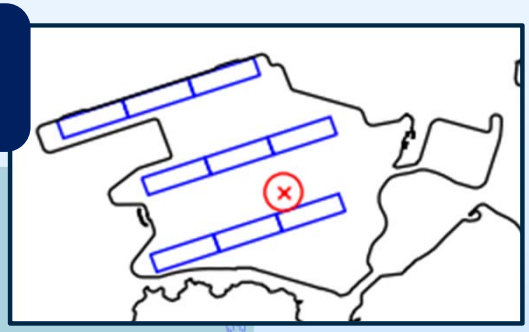
RCR 6 DRY

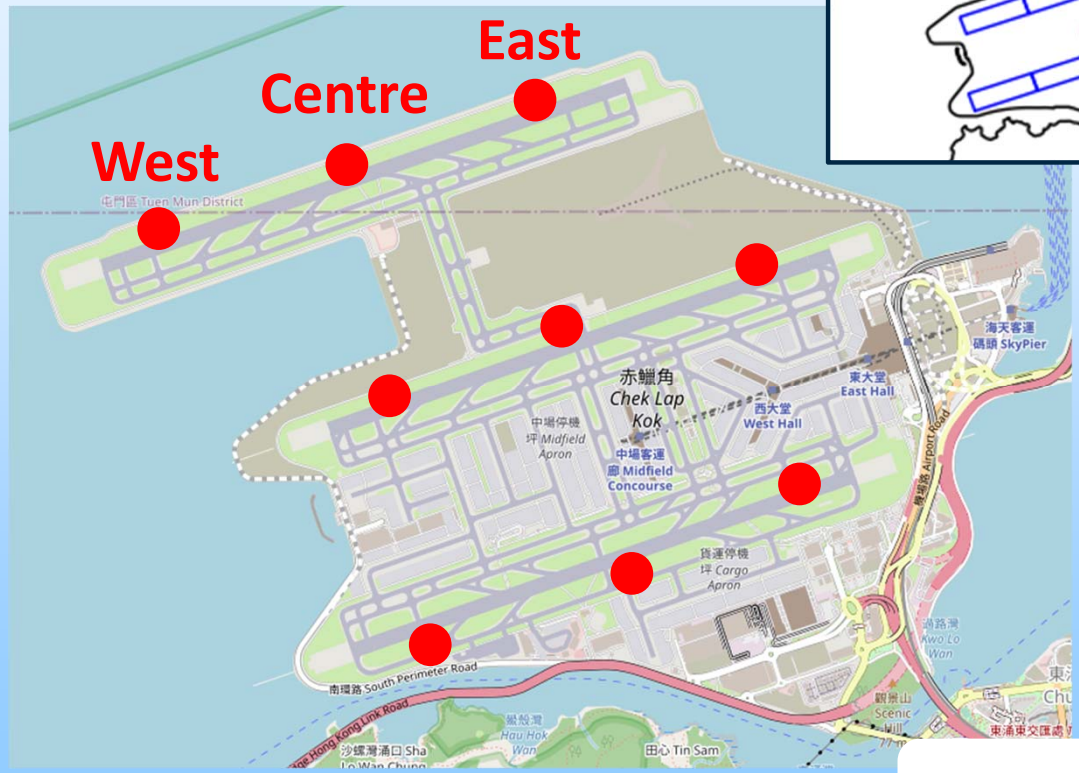
RCR 5 WET

RCR 2 Standing Water Depth >3mm

Instruments used in HKO RCR System

One sensor on each of the runway thirds





Radar

Present Weather Sensor

Instruments used in HKO RCR System

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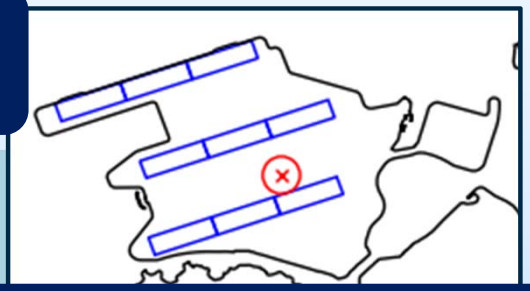

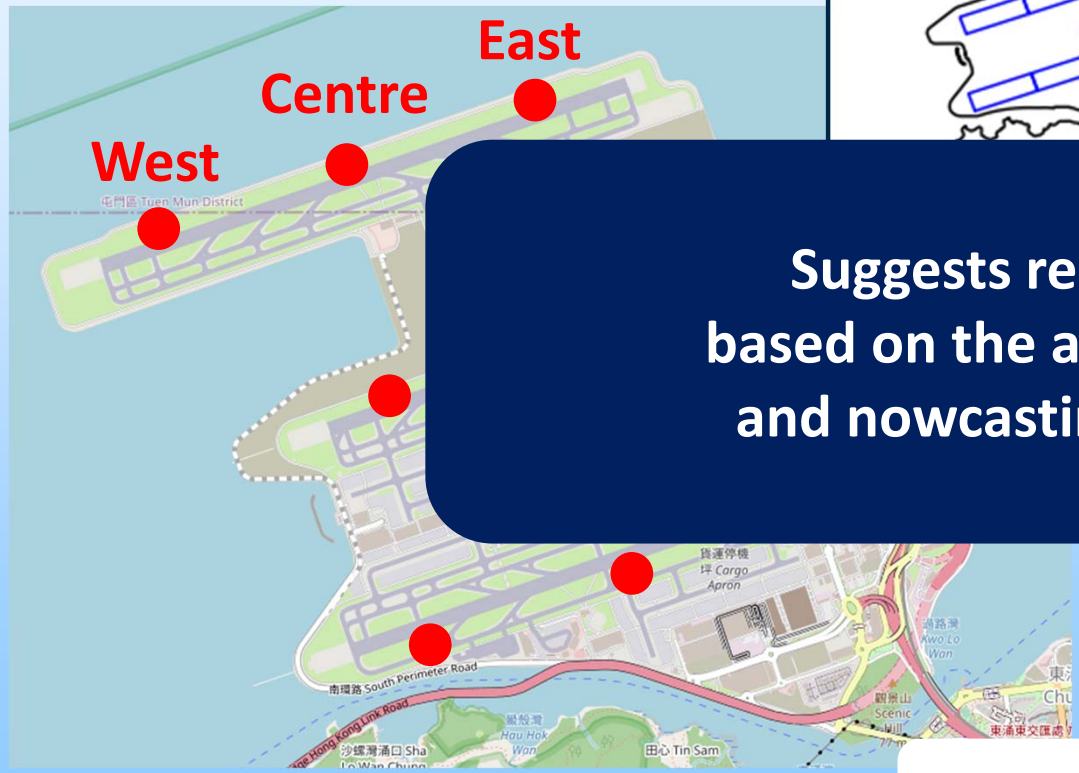

Suggests real-time RCR based on the actual rain rates and nowcasting techniques

Radar

Present Weather Sensor

RCR on ATIS

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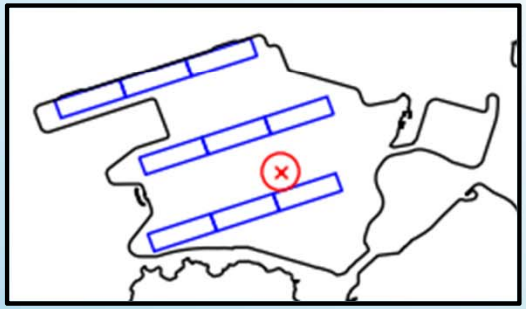
Report on each of the runway thirds



Hong Kong International Airport (HKIA)
Automatic Terminal Information Service (ATIS)

Arrival

VHHH ARR INFO ECHO, ISSUED AT 1821Z.

ARRIVALS, RWY 07R.

RWY 07 RUNWAY CONDITION REPORT AT 1815Z.

RWY 07R RUNWAY CONDITION CODES 2 , 2 , 2 .

RWY SFC FIRST PART 25 PERCENT 04 MILLIMETERS STANDING WATER , SECOND PART 25 PERCENT 04 MILLIMETERS STANDING WATER , THIRD PART 25 PERCENT 04 MILLIMETERS STANDING WATER.

RWY 07C IS CLSD FOR MAINT.

SIG WS FCST.

SPECIAL VHHH 291809Z WIND 110/05KT VIS 7KM FBL SHRA CLD FEW CB 1500FT SCT 3000FT T28 DP26 QNH 1003HPA TREND TEMPO VIS 4000M MOD SHRA=

ACKNOWLEDGE INFO ECHO ON FIRST CTC WITH APP.

Suggestion made by HKO RCR system

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RCR 2 (7mm)	Standing Water of 7mm Depth
RCR 2 (6mm)	Standing Water of 6mm Depth
RCR 2 (5mm)	Standing Water of 5mm Depth
RCR 2 (4mm)	Standing Water of 4mm Depth
RCR 5	WET
RCR 6	DRY

How to deduce the water depths on runway?

Simulation of standing water

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Hydraulics Team of University of Hong Kong

conducted a field experiment using a mocked runway surface with same grooving, inclination and material of the HKIA runway

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THE UNIVERSITY OF HONG KONG

Established the empirical relationship between rain rate and water depth

Simulation of standing water

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>100mm/hr rain rate could produce water depths of >3mm

Established the empirical relationship between rain rate and water depth

Need for nowcasting of RCR

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Suggest

香港機場管理局 AIRPORT AUTHORITY HONG KONG

Confirm and Issue
(Apron Control Centre)

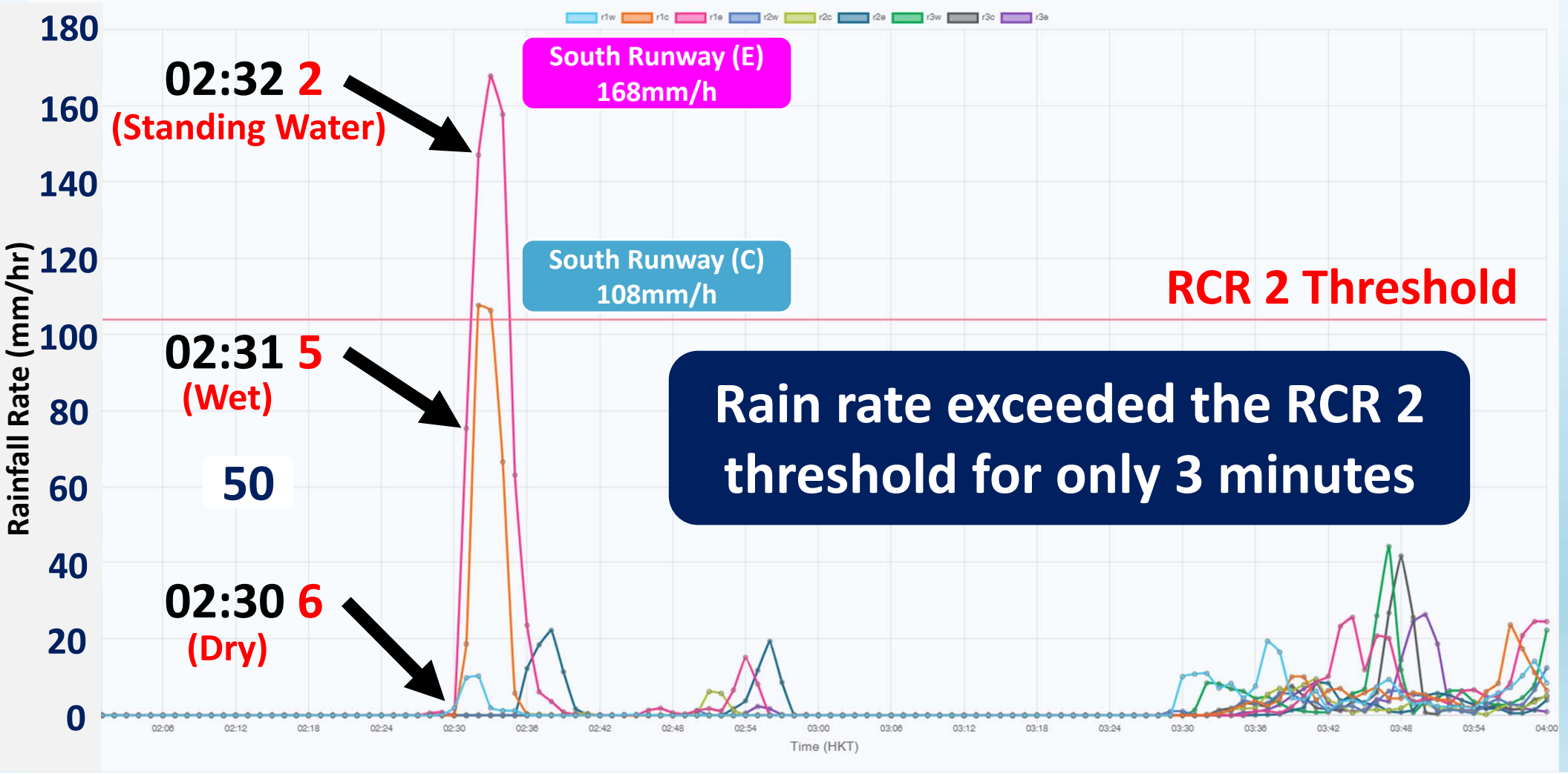
民航處 CIVIL AVIATION DEPARTMENT

Broadcast and Update ATIS
(ATC)

10-15 minutes

Heavy rain with rain rate >100mm/hr is transient
More than 60% cases only sustained 1-3 minutes

Case study – 7 June 2022



Case study – 7 June 2022

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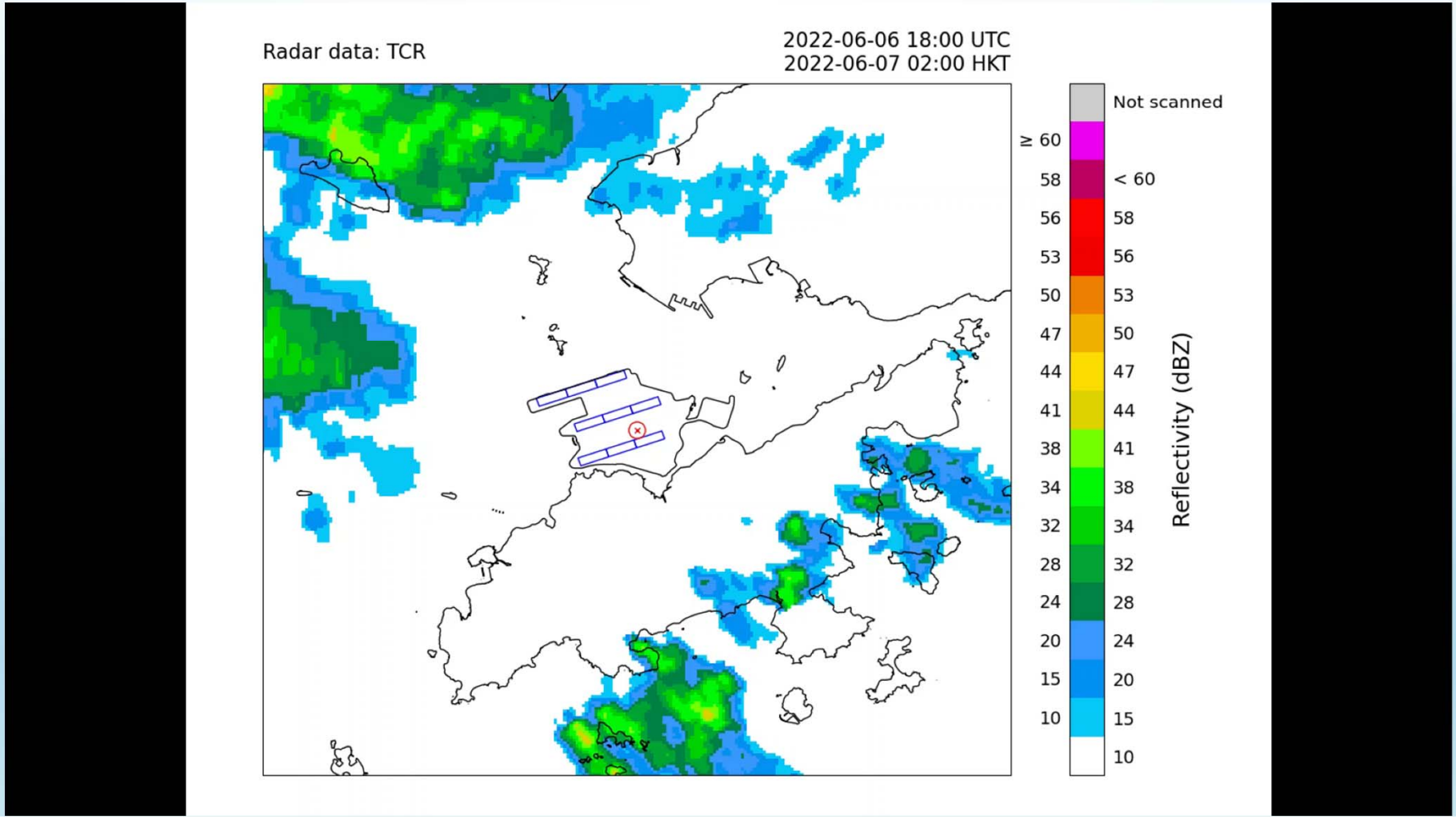

User response when RCR2 is issued

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User response when RCR2 is issued

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民航處
CIVIL AVIATION DEPARTMENT

ATC

Assign farther separation between aircraft in air during approaches

CATHAY PACIFIC

Pilots

To be fully prepared of poor braking actions

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User response when RCR2 is issued

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HONG KONG OBSERVATORY

民航處
CIVIL AVIATION DEPARTMENT

ATC

Assign farther separation between aircraft in air during approaches

The RCR level, especially RCR2, should not be fluctuated, otherwise, inconvenience will be caused to users when taking response.

CATHAY PACIFIC

Pilots

To be fully prepared of poor braking actions

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Nowcasting for RCR

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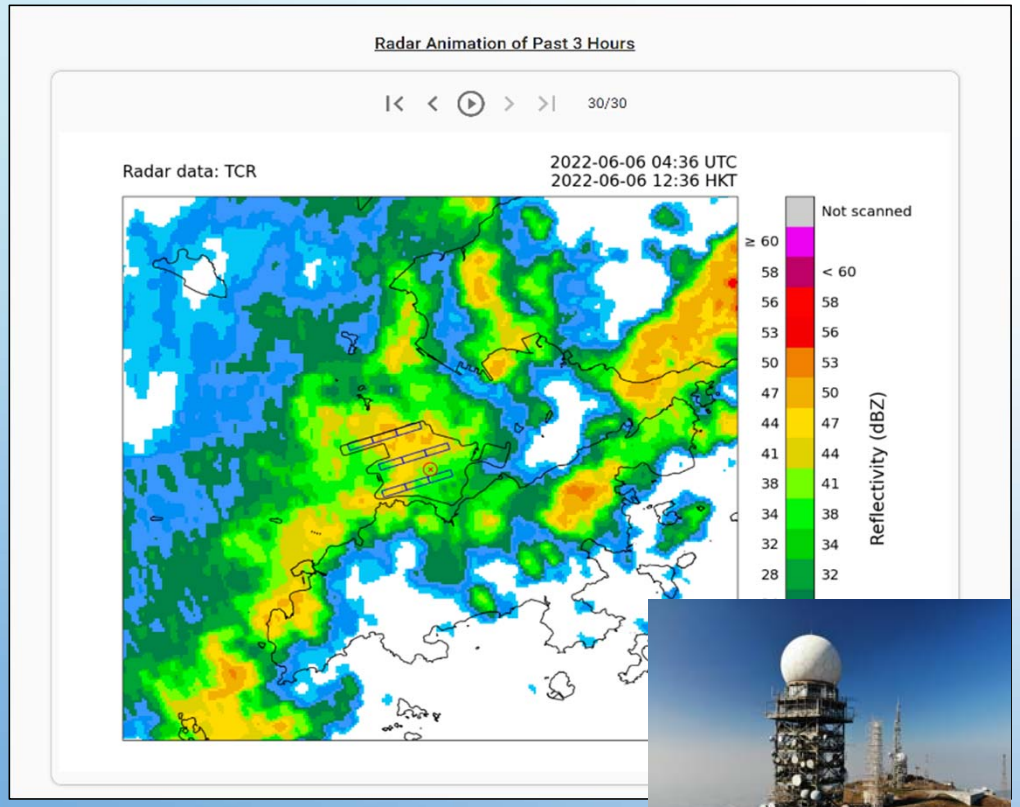


VHYL7

SWIRLS Nowcasting System

- Nowcast rainfall for every 6-minute radar scan using Optical Flow technique

- Alerts users when 'Heavy rain' will be expected

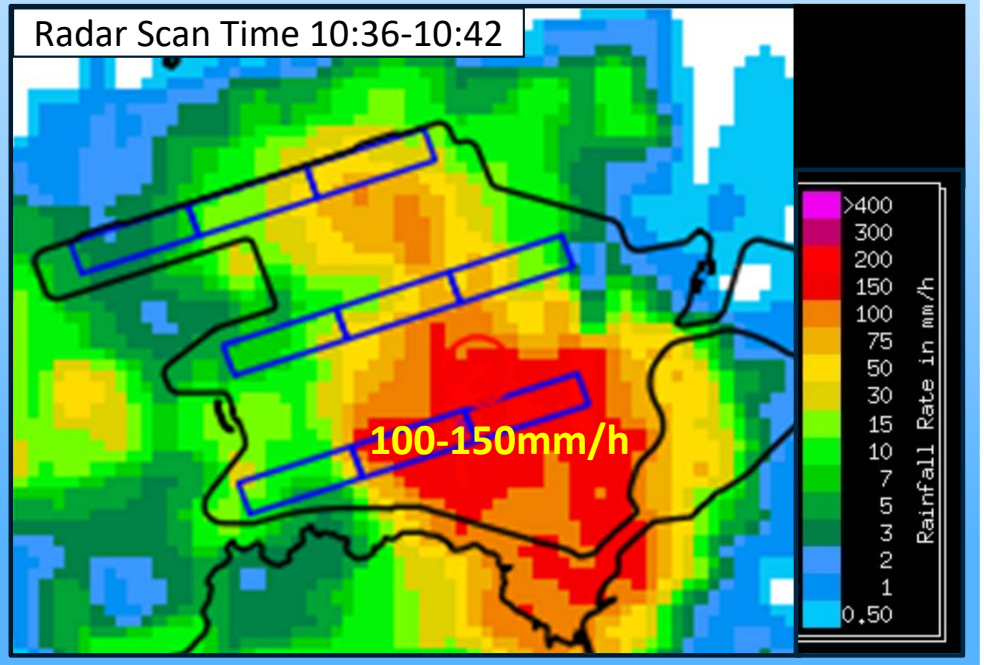
Slide 17

VHYL7 change to TCR

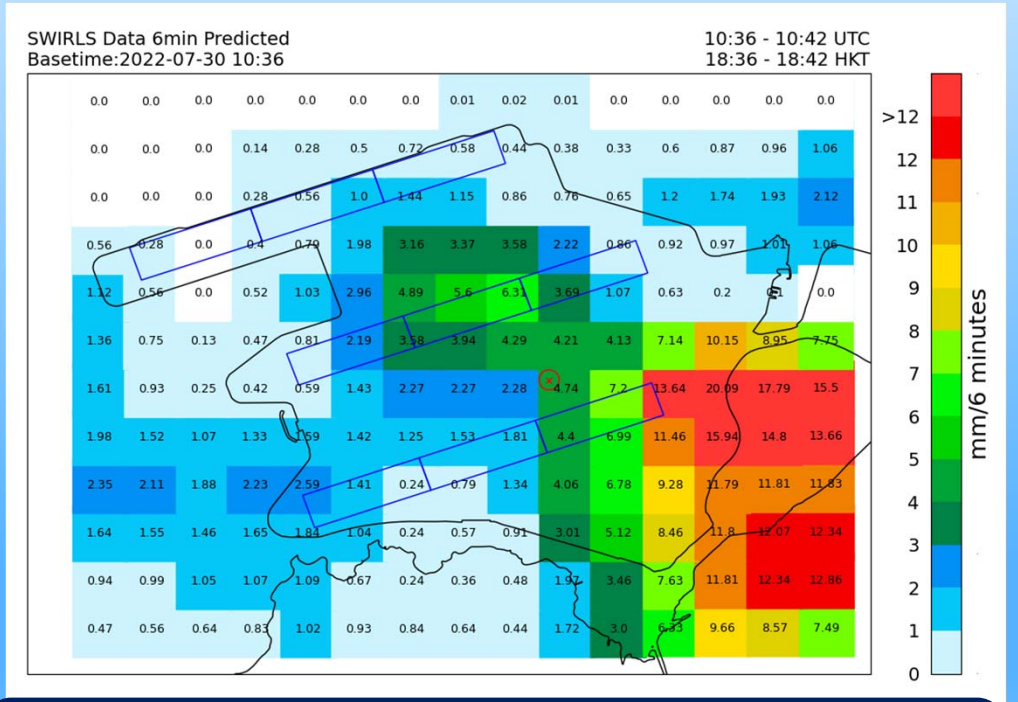
Vivian Hiu Yan LI, 7/7/2022

Nowcasting for RCR

Actual Radar Scan



SWIRLS Output



>10mm rain in 6 minutes will trigger an alert of RCR2

RCR2 events > 6 minutes in 2022

Date	HKT (Hour)	3rd Max Rainrate (mm/h)	Duration over RCR2 Threshold (min)
6/6	12-13	124	7
8/6	14-16	179	21
10/6	18-19	138	7
12/6	04-05	190	16
30/7	10-12	223	24
4/8	08-10	143	13
5/8	03-04	214	11
10/8	21-22	141	6

All the above events were captured by SWIRLS Nowcasting System

All-in-one rainfall monitoring platform

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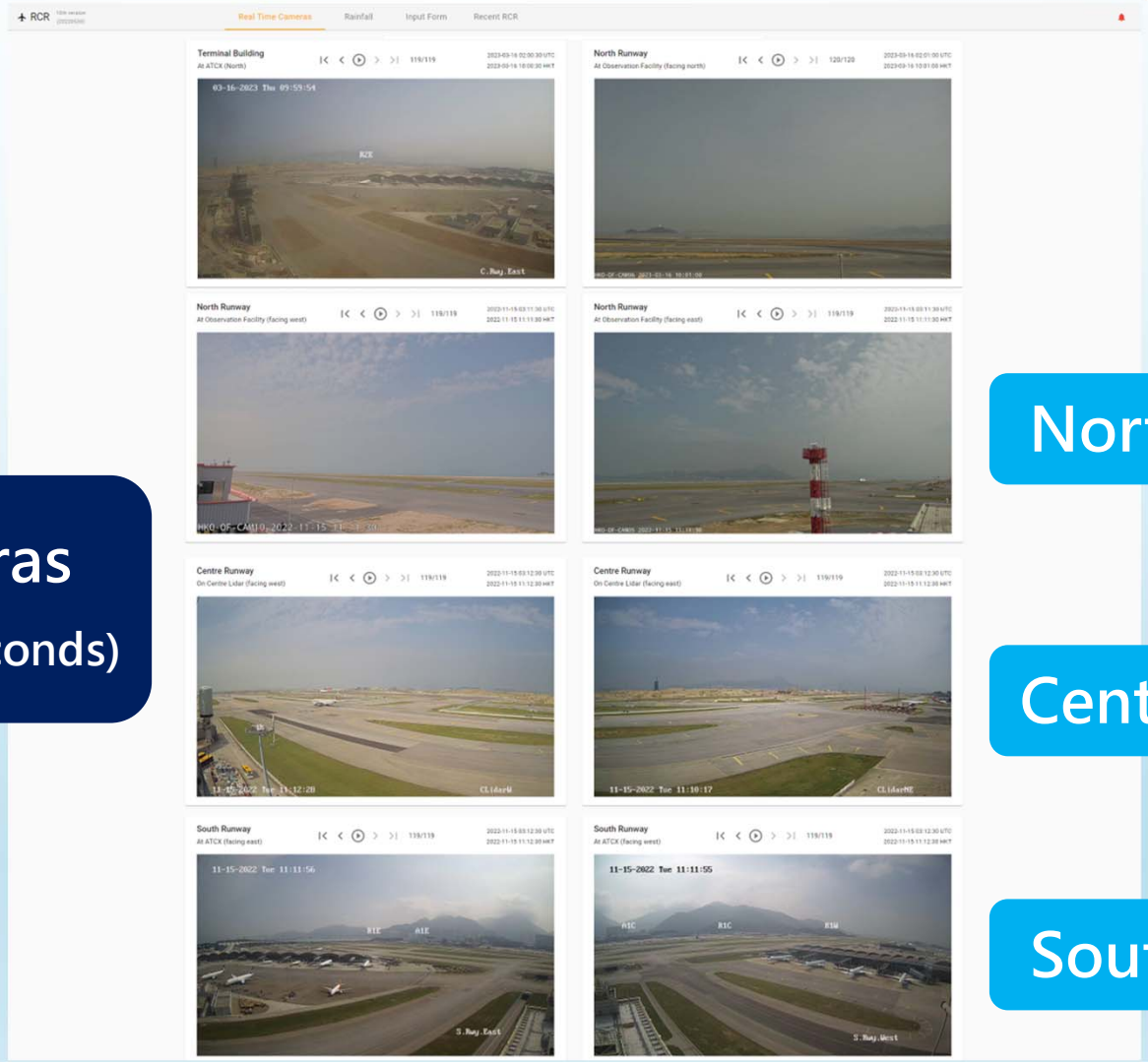

Weather cameras

(Update at every 30 seconds)

North Runway

Centre Runway

South Runway

All-in-one rainfall monitoring platform

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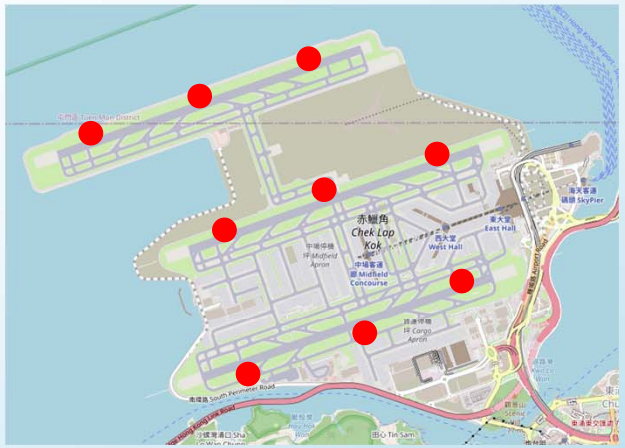
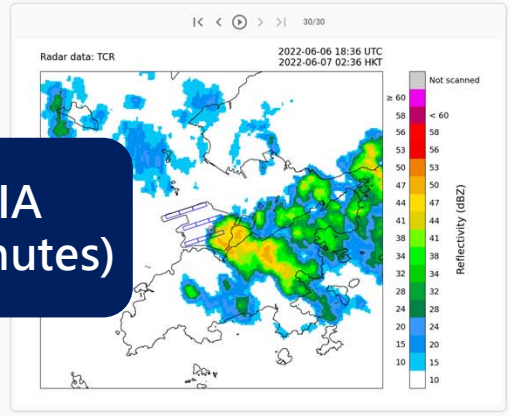
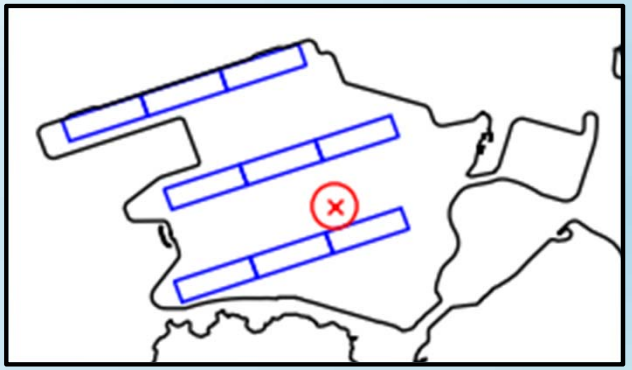
Real-time rain rates
(Update at every 1 minute)





Radar scan over HKIA
(Update at every 6 minutes)



All-in-one rainfall monitoring platform

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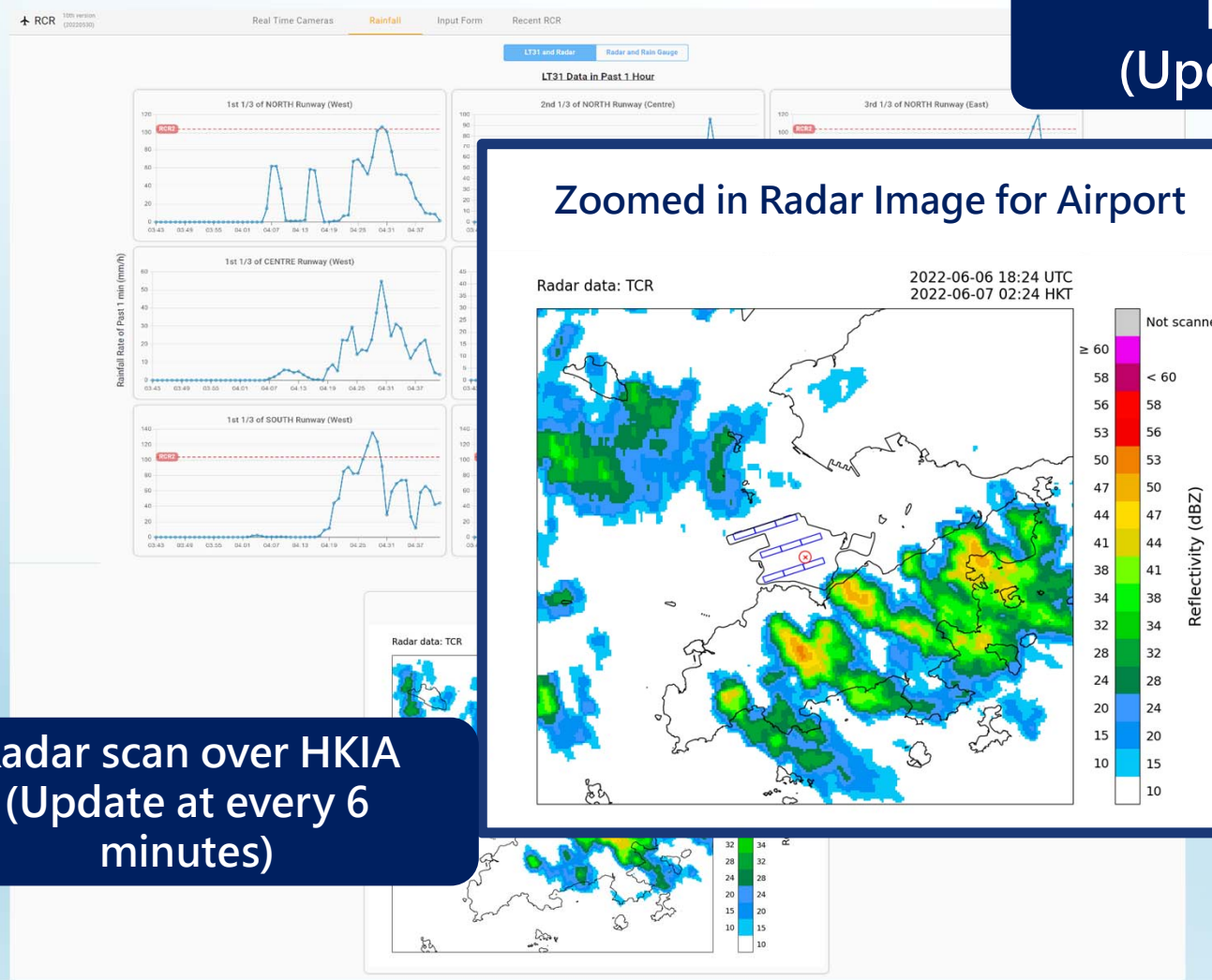
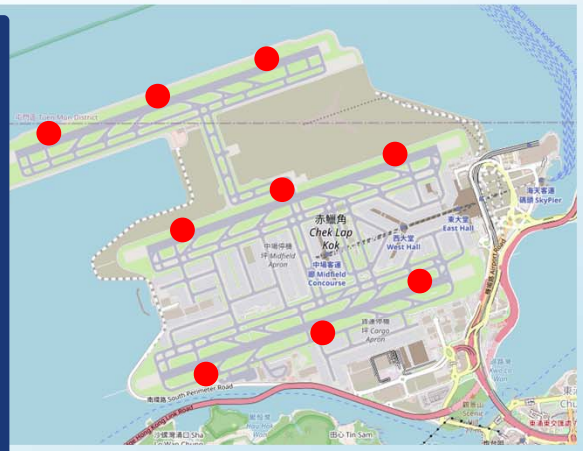
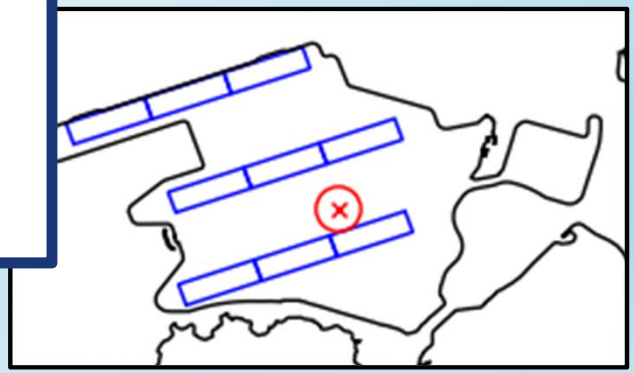


Zoomed in Radar Image for Airport

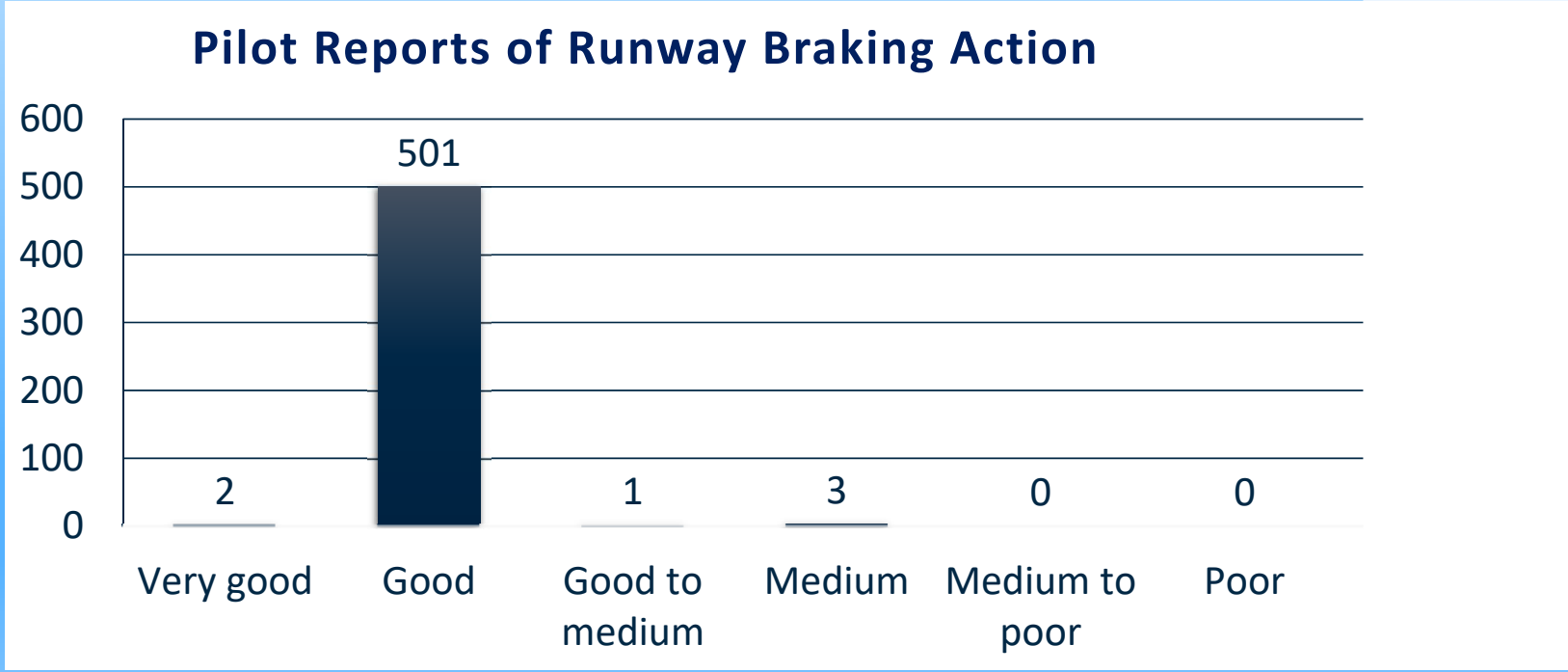




Radar scan over HKIA
(Update at every 6 minutes)

Pilot reports of runway braking action

- **Pilot Braking Action Reports were received from June 2022**
- **507 Pilot Reports were received**



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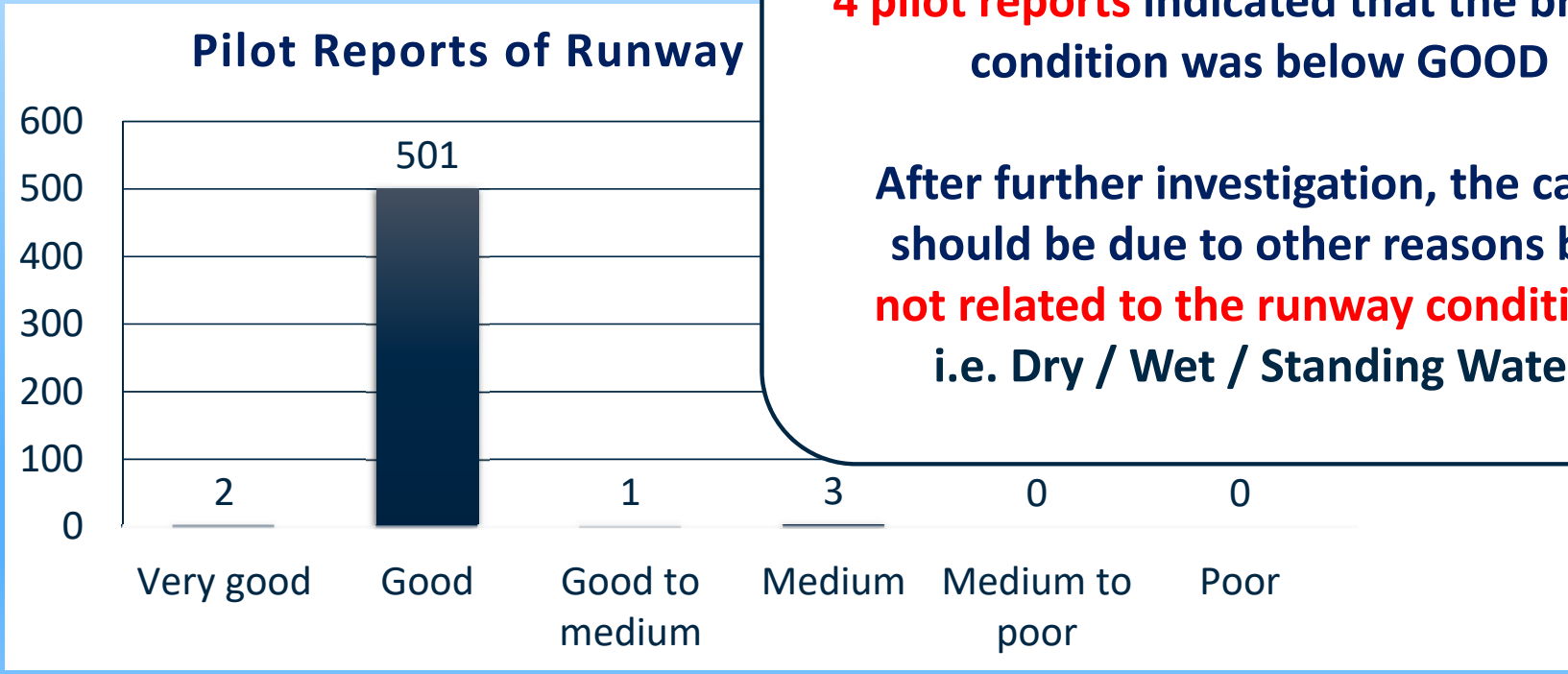

4 pilot reports indicated that the braking condition was below GOOD

After further investigation, the cases should be due to other reasons but not related to the runway conditions i.e. Dry / Wet / Standing Water

Thank you