UNESCAP/WMO Typhoon Committee

United Nations ESCAP

WMO OMM

# Typhoon Committee Roving Seminar 2011

## Topic B(1) :

# Operational QPE/QPF Systems – An Overivew

香港天文台 Hong Kong Observatory

Linus H.Y. Yeung, Scientific Officer, Hong Kong Observatory

21 September 2011

Petaling Jaya, Malaysia

UNESCAP/WMO
Typhoon Committee

United Nations
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# International Synergy

# Forecasting Synergy for the Olympic

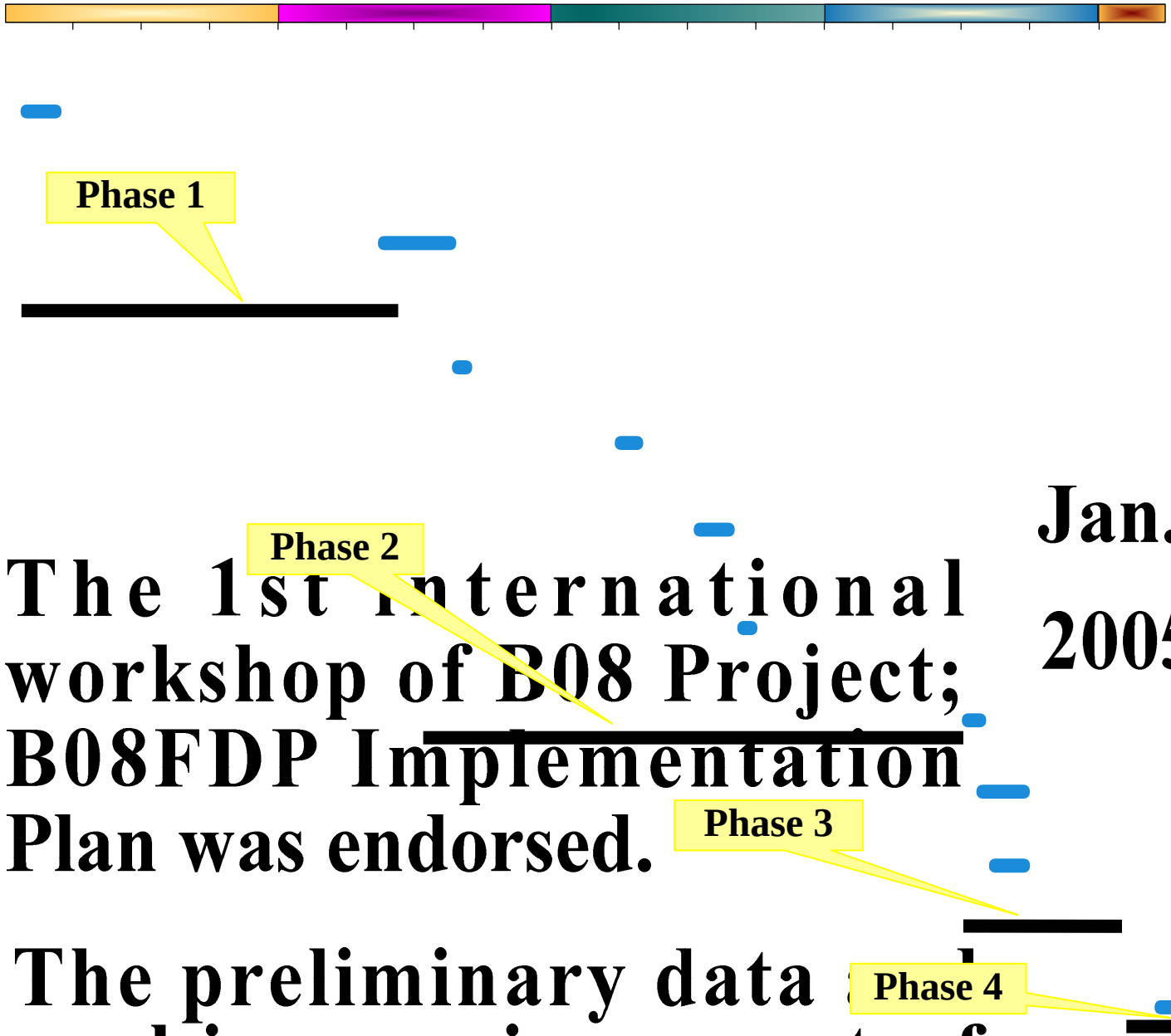
## The WWRP/WMO Beijing 2008 Olympic Forecast Demonstration Project (B08FDP) & Research Development Project (B08RDP)

# B08FDP Goals

## Quoted from "B08FDP Proposal":

- ***To implement*** **advanced nowcast systems, processes and science for the B08 Olympics**
- ***To demonstrate and optimize*** **technology transfer, its implementation, and subsequent use in advanced nowcast systems and forecast operations**
- ***To develop and implement*** **new verification techniques for assessing the effectiveness of HIW nowcasts and quantitative precipitation nowcasts**
- ***To quantify*** **the impact of the implementation of operationally focused nowcast systems on the quality of HIW forecasts, forecasters and end-users**
- ***To promote*** **the implementation of nowcasting techniques in China and for the benefit of WMO countries**

# MILESTONES FOR B08FDP




1. The 1st International workshop of B08 Project; B08FDP Implementation Plan was endorsed. Jan. 2005

2. The preliminary data ... working environment of

# Participating Nowcasting Systems

BJANC (BMB&NCAR, China)

CARDS (MSC, Canada)

GRAPES-SWIFT (CMA, China)

MAPLE (McGill & WDT, Canada)

NIWOT (NCAR, USA)

STEPS (BOM, Australia)

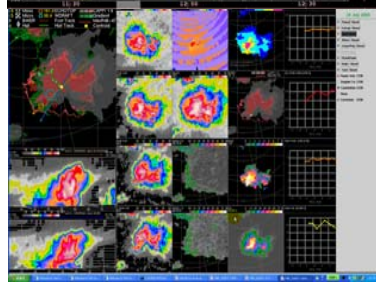
SWIRLS (HKO, Hong Kong, China)

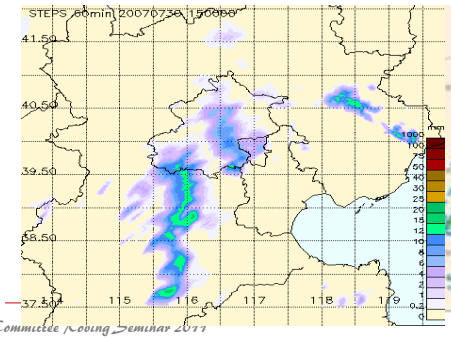
TIFS (BOM, Australia)

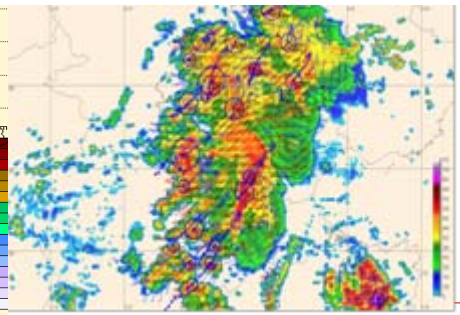
+

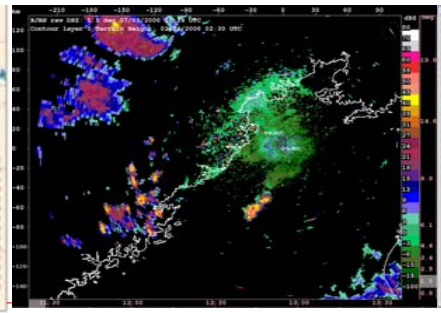
Verification (RTFV)

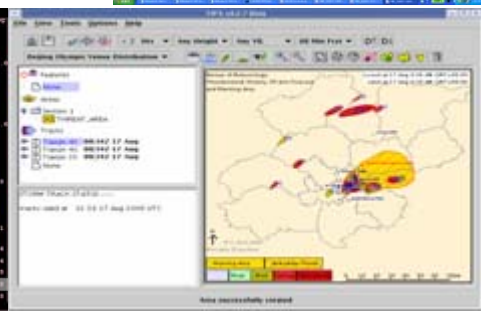
& SEIA

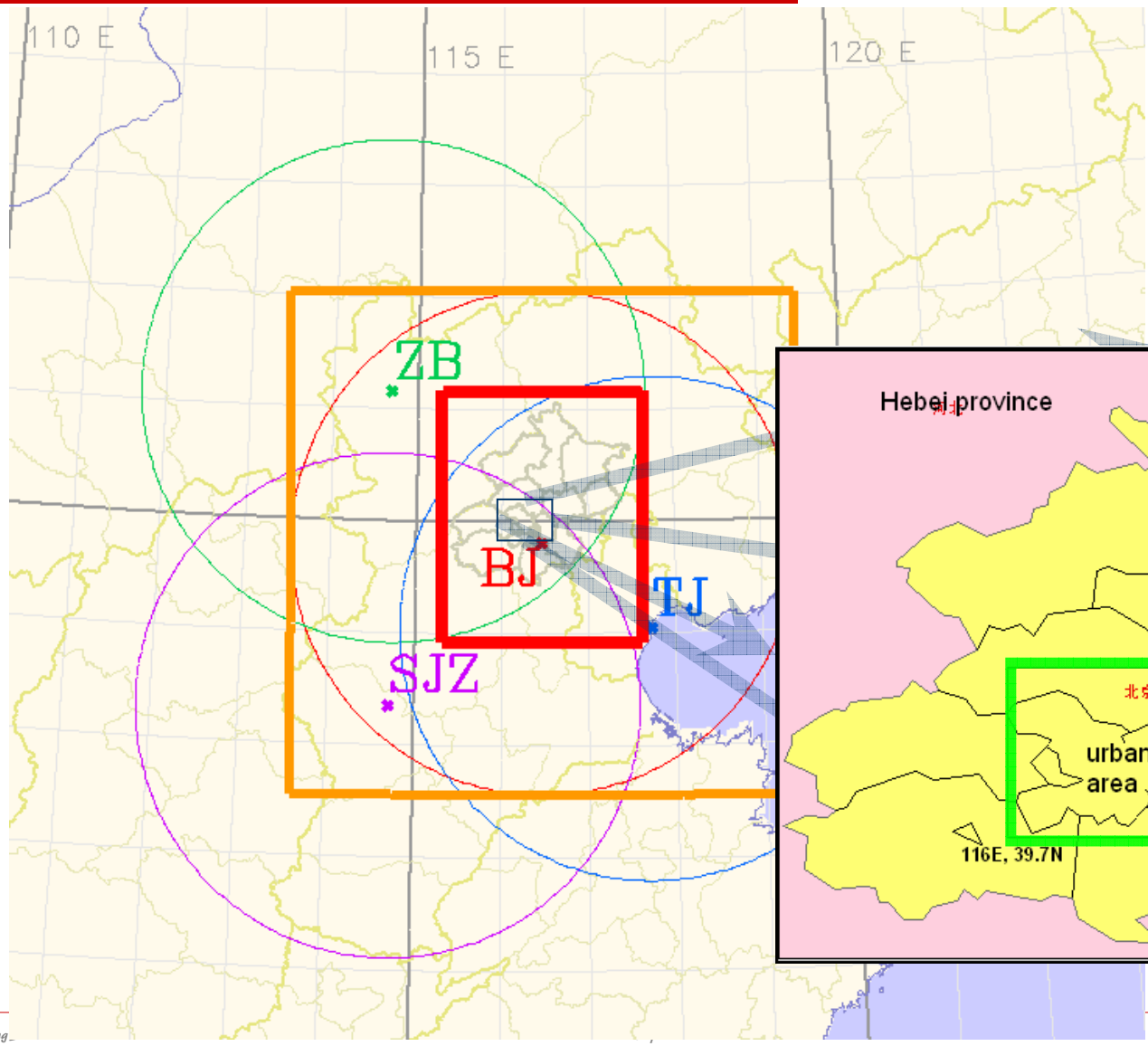


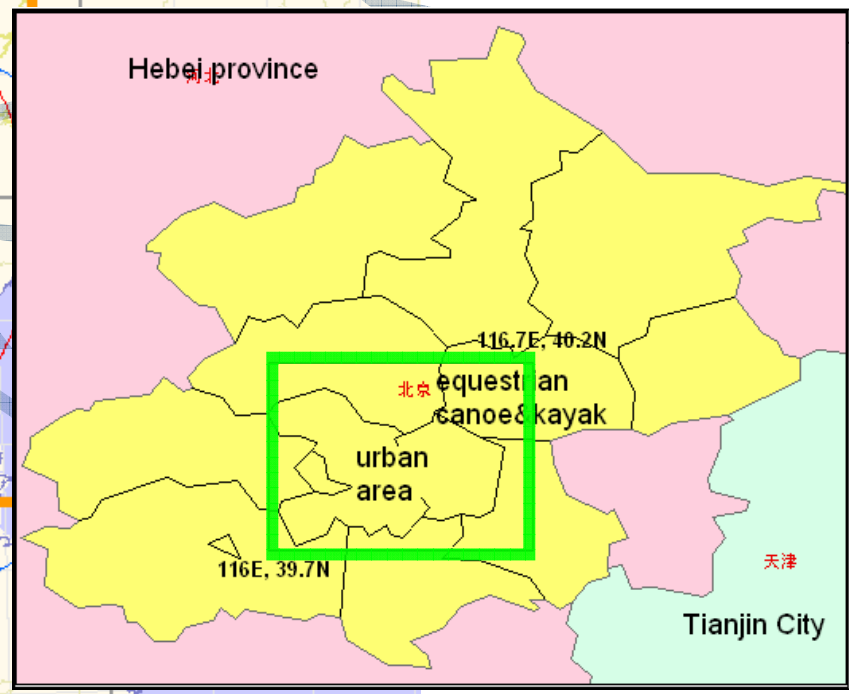







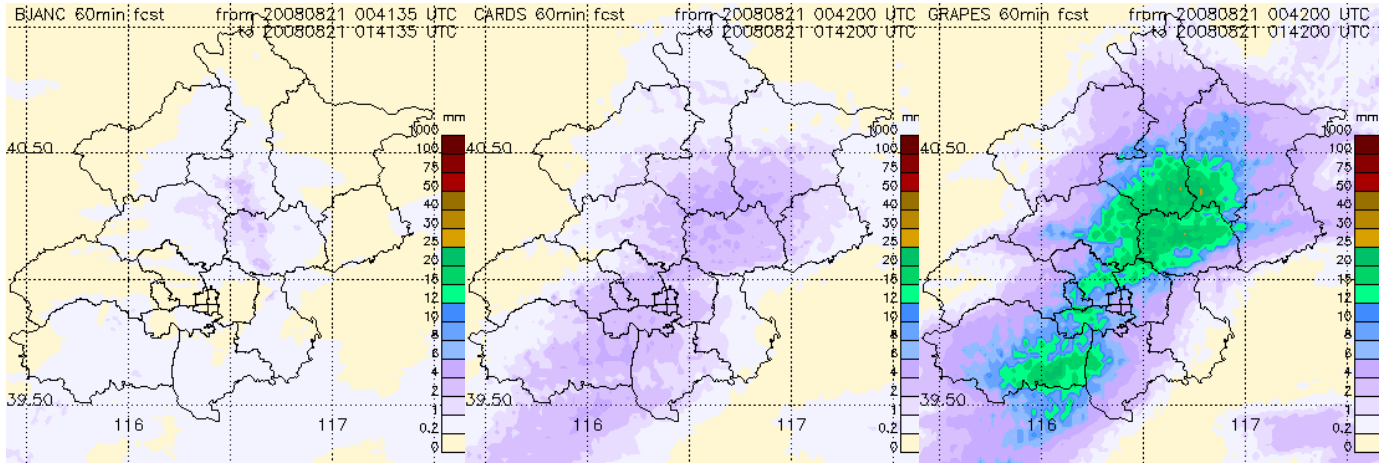
# B08FDP for Beijing Olympic

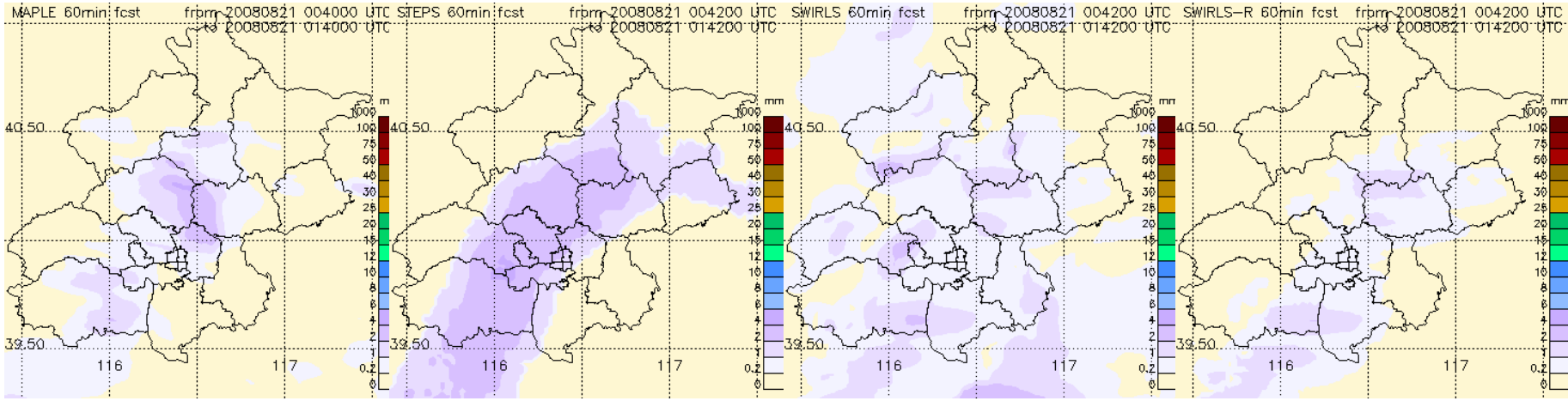


# B08FDP common products

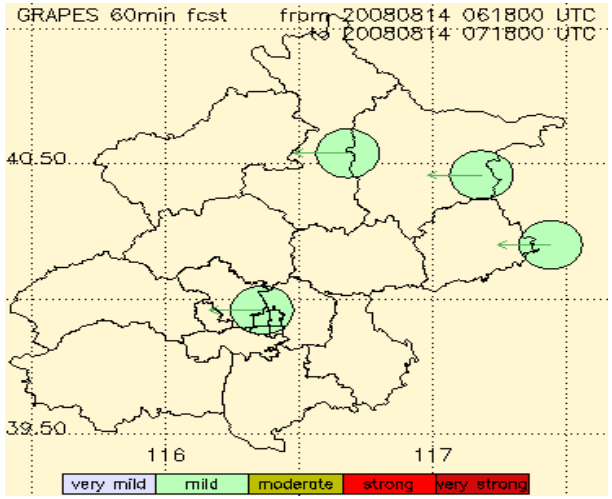
## --- *1h QPF guidance (all participants)*

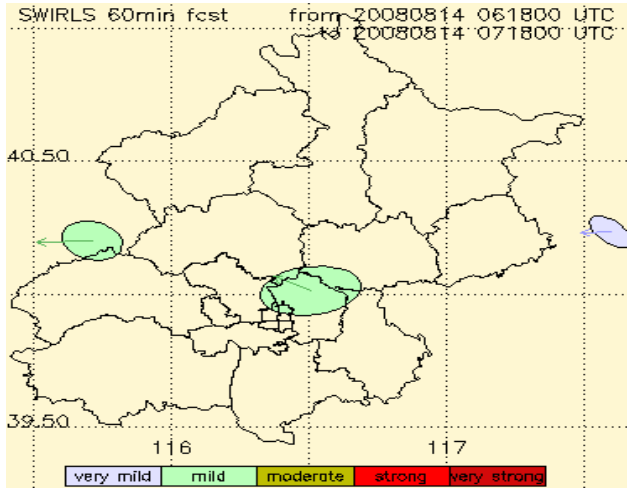


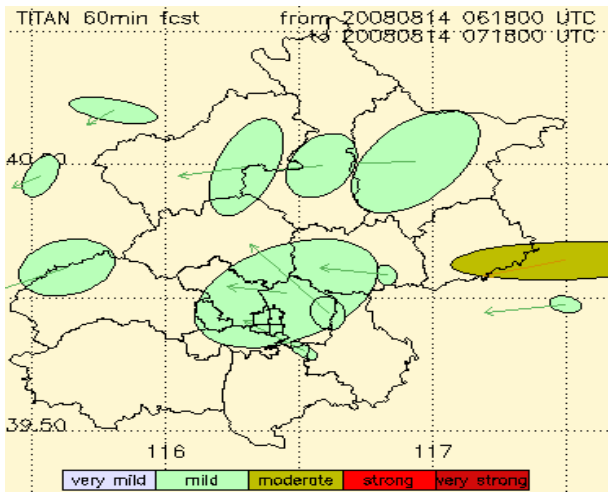



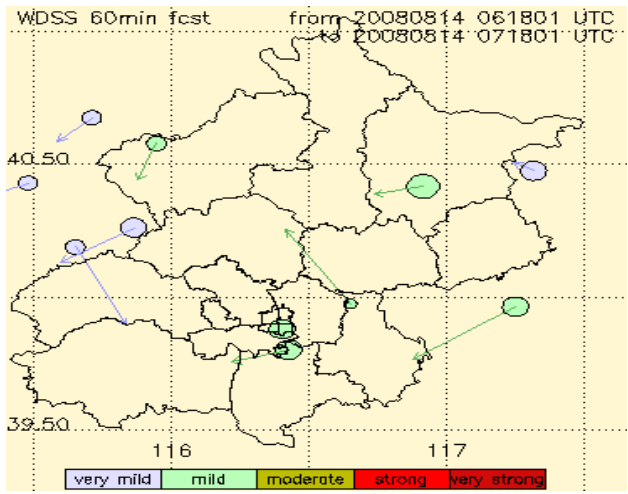
# B08FDP common products

## --- *Storm track guidance (some participants)*



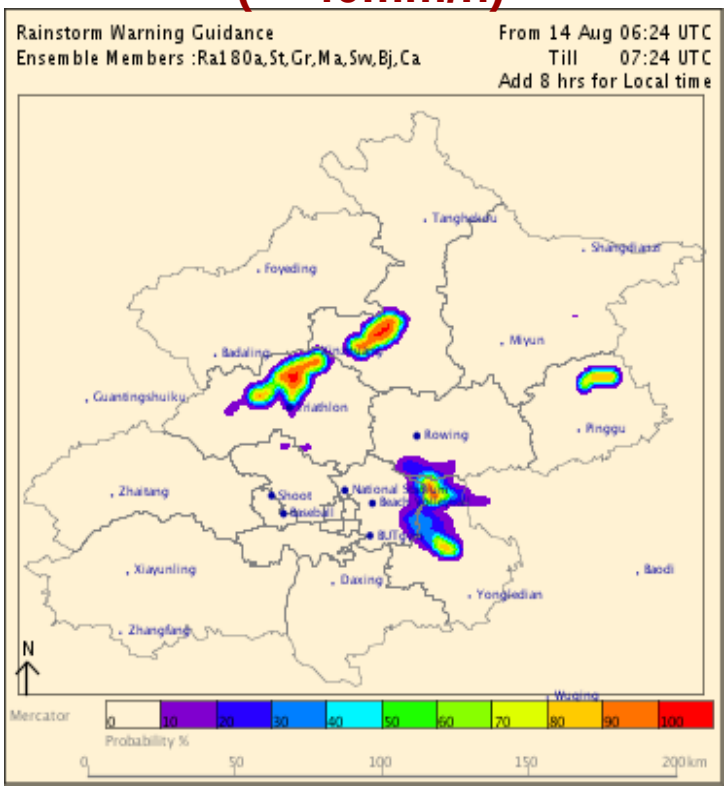



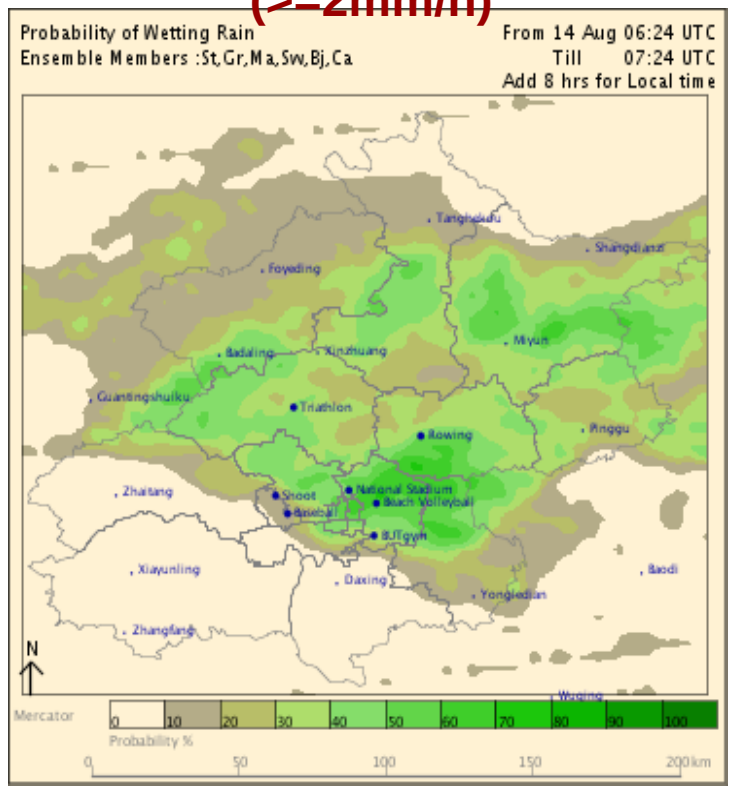
# B08FDP special products

## --- TIFS' *ensemble forecast*

### Probability of rainstorm warning (>=40mm/h)




### Probability of Wetting rain (>=2mm/h)

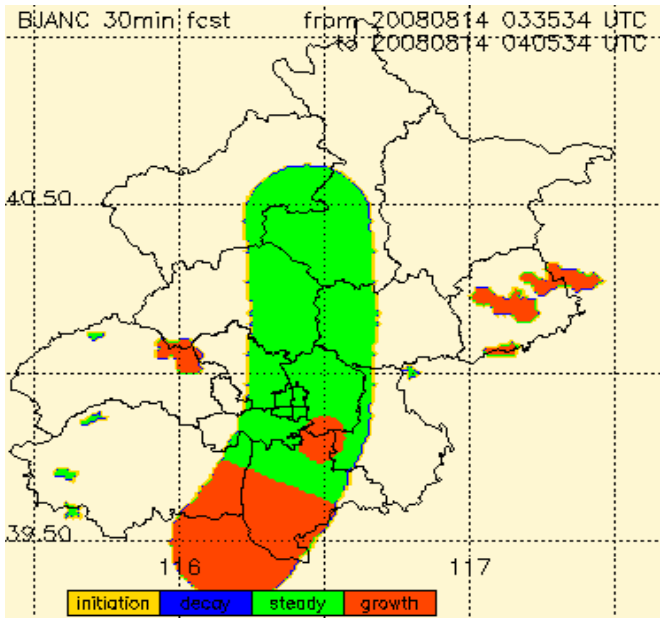


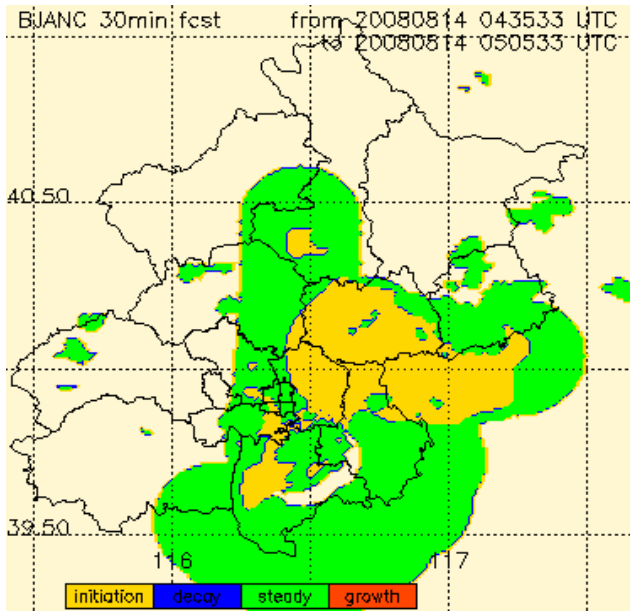
# B08FDP special products

## --- BJ-ANC's forecast guidance

0-1h forecast on the variation of echo strength

(*3:35- 4:05UTC*) (*4:35- 5:05UTC*)



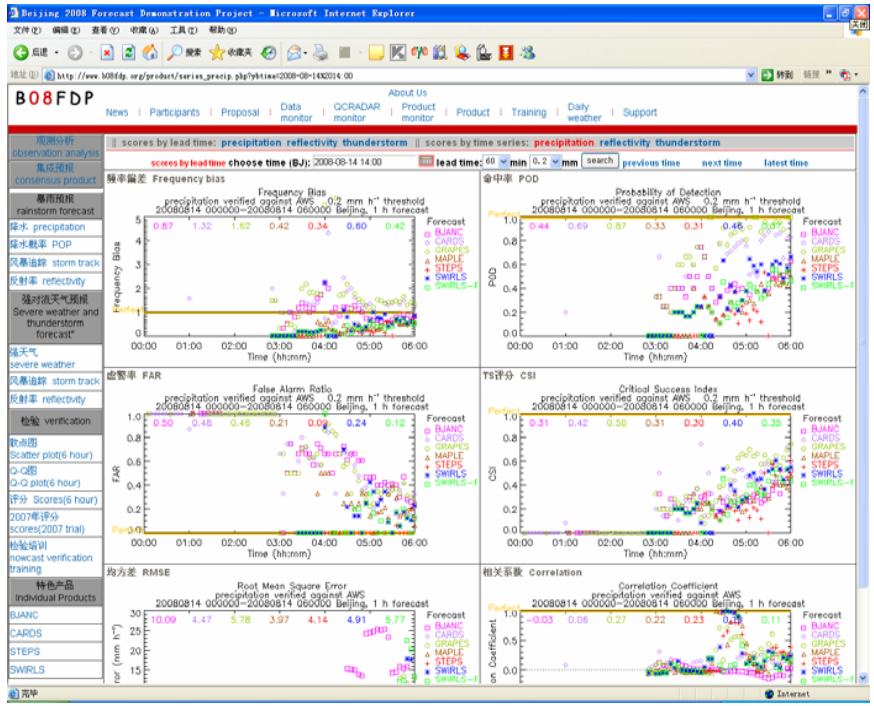



# Real-time Forecast Verification

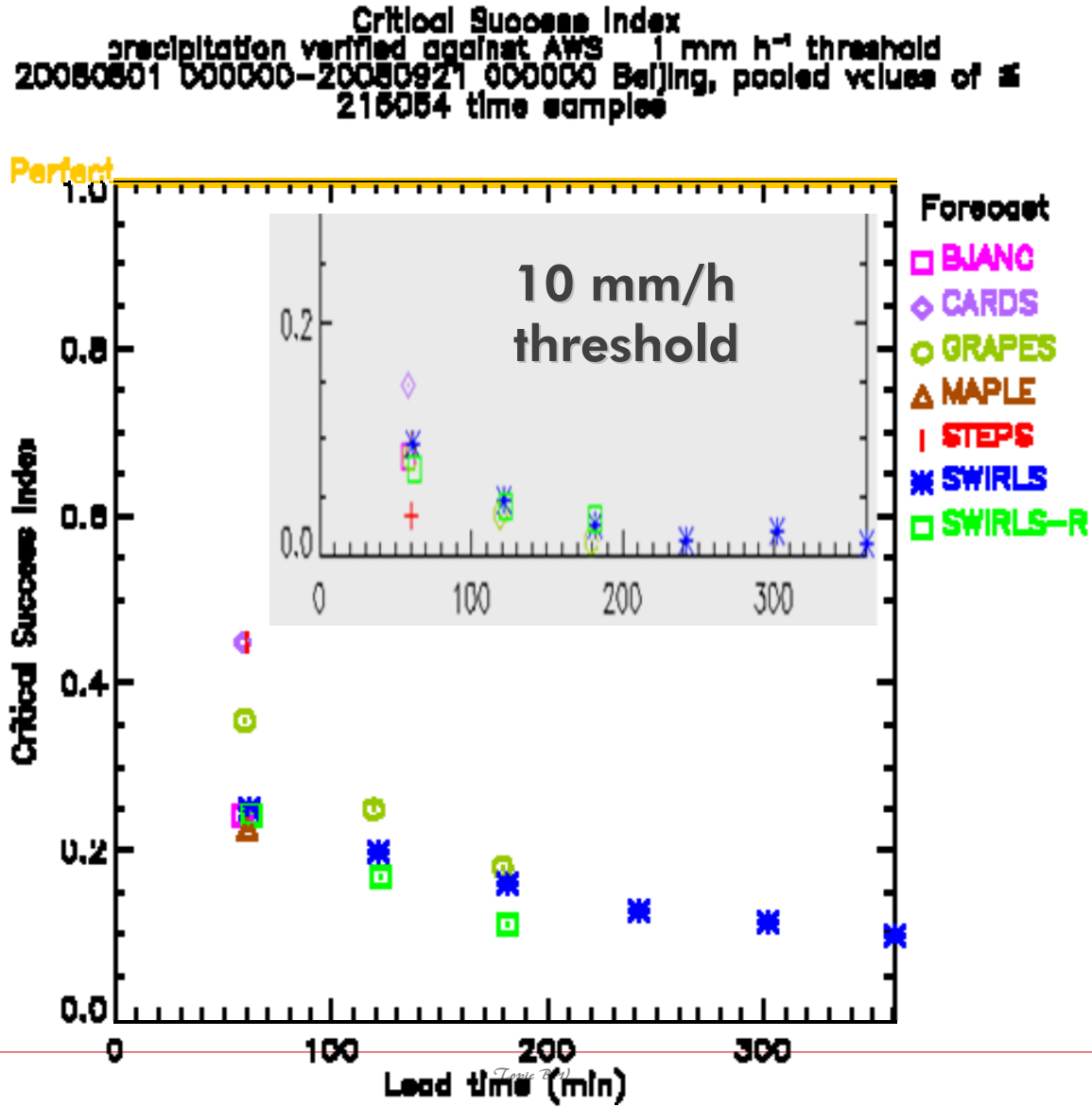
| | | |
|---|---|---|
| Scatter plots for the past 6 hours | Precipitation | 30 min forecast, 60 min forecast |
| | Reflectivity | |
| Q-Q plots for the past 6 hours | Precipitation | 30 min forecast, 60 min forecast |
| | Reflectivity | |
| Statistic scores for the past 6 hours | Precipitation | Frequency bias, POD, FAR, CSI, RMSE, Correlation Coefficient, Distance Error |
| | Reflectivity | |
| | thunderstorm | |

✓Three aspects of thunderstorms
✓Three verification items

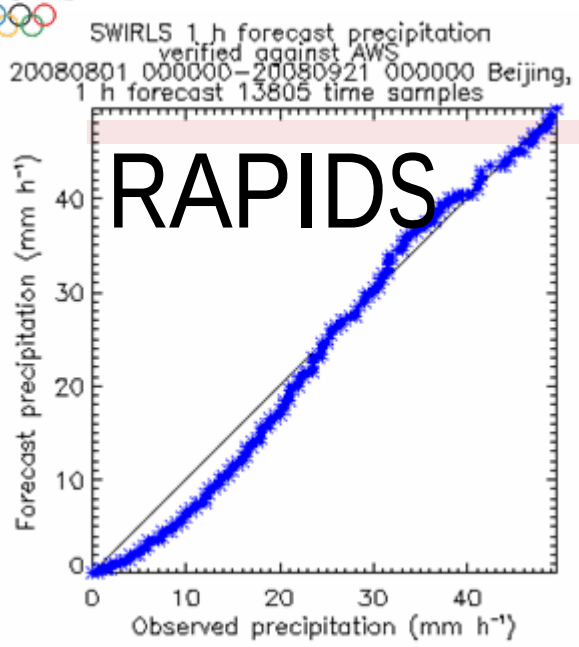
**Examples of real-time products on web**

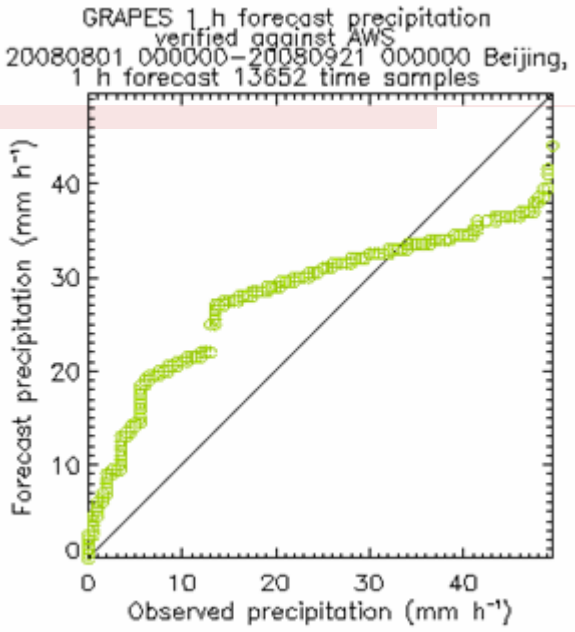


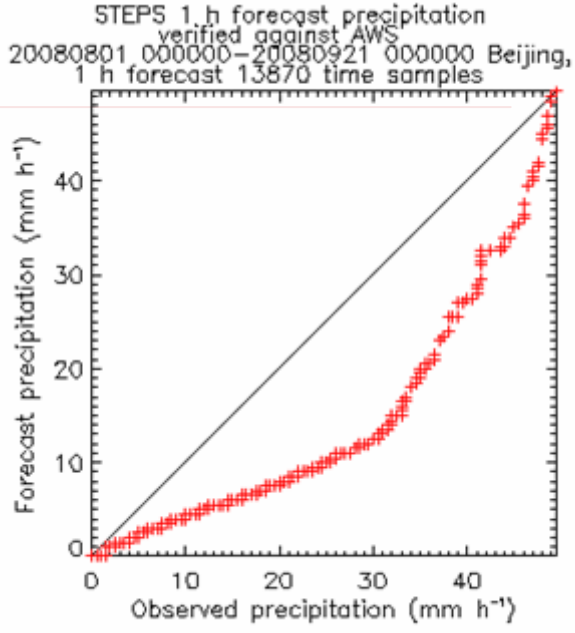
# B08FDP Forecast Verification

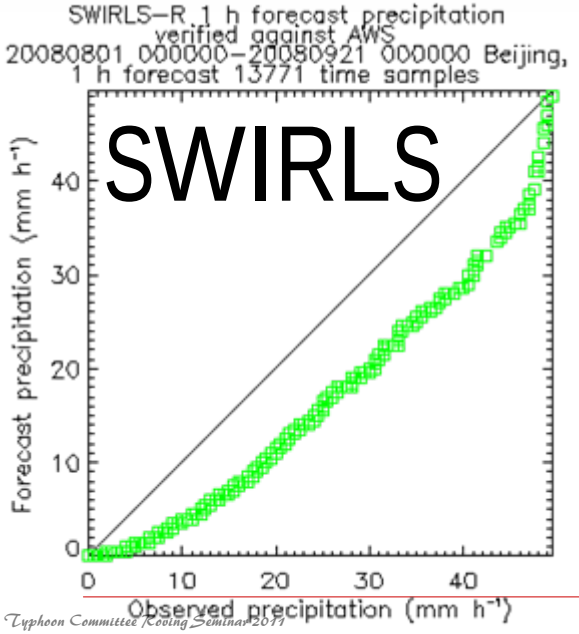


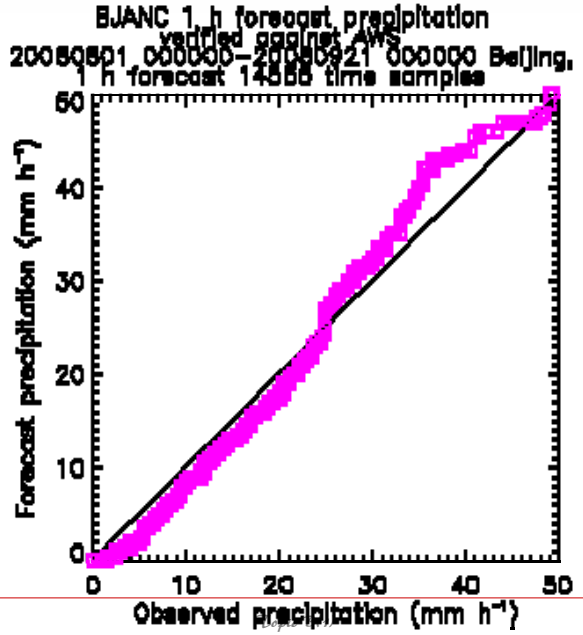
# B08FDP Forecast Verification

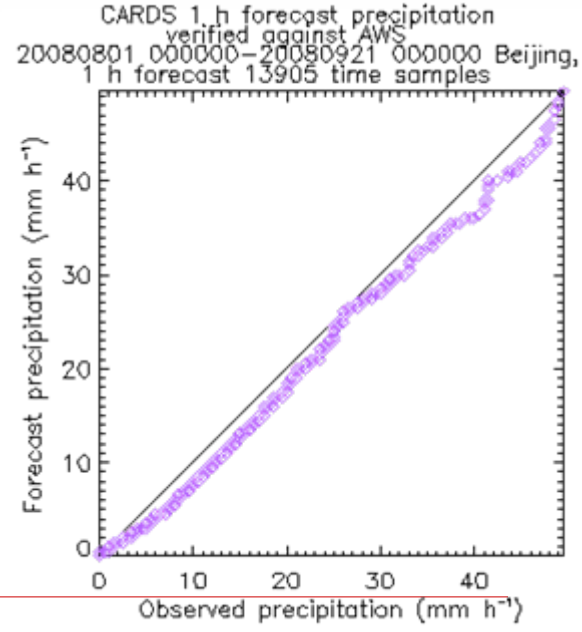


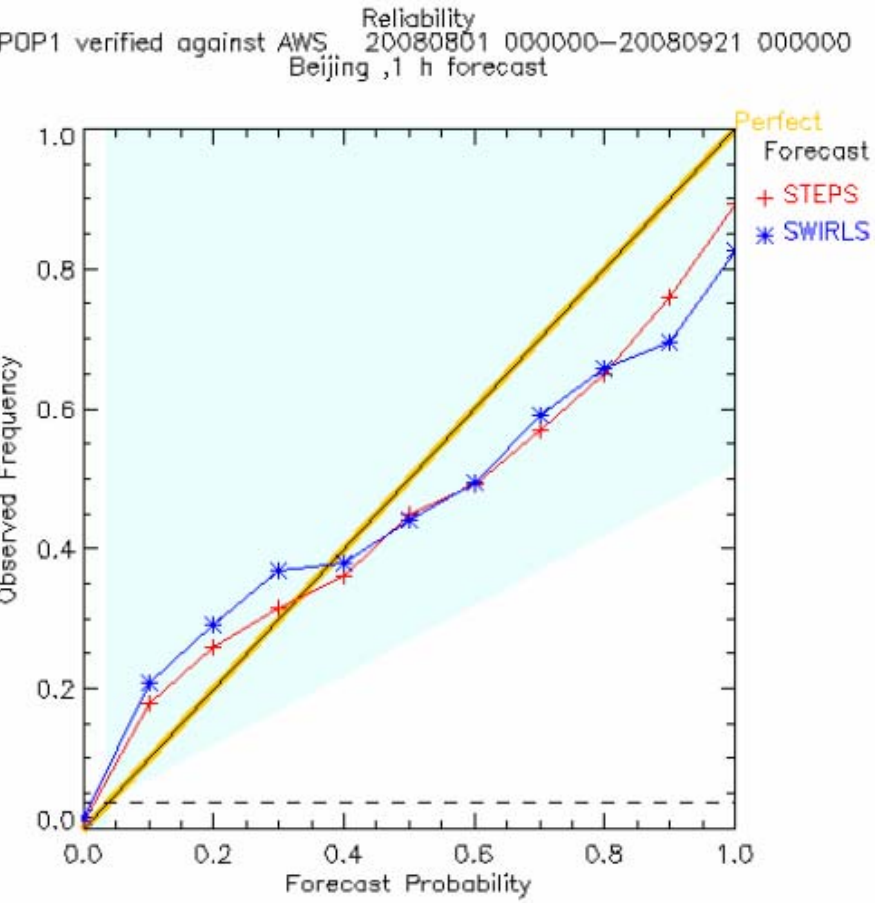



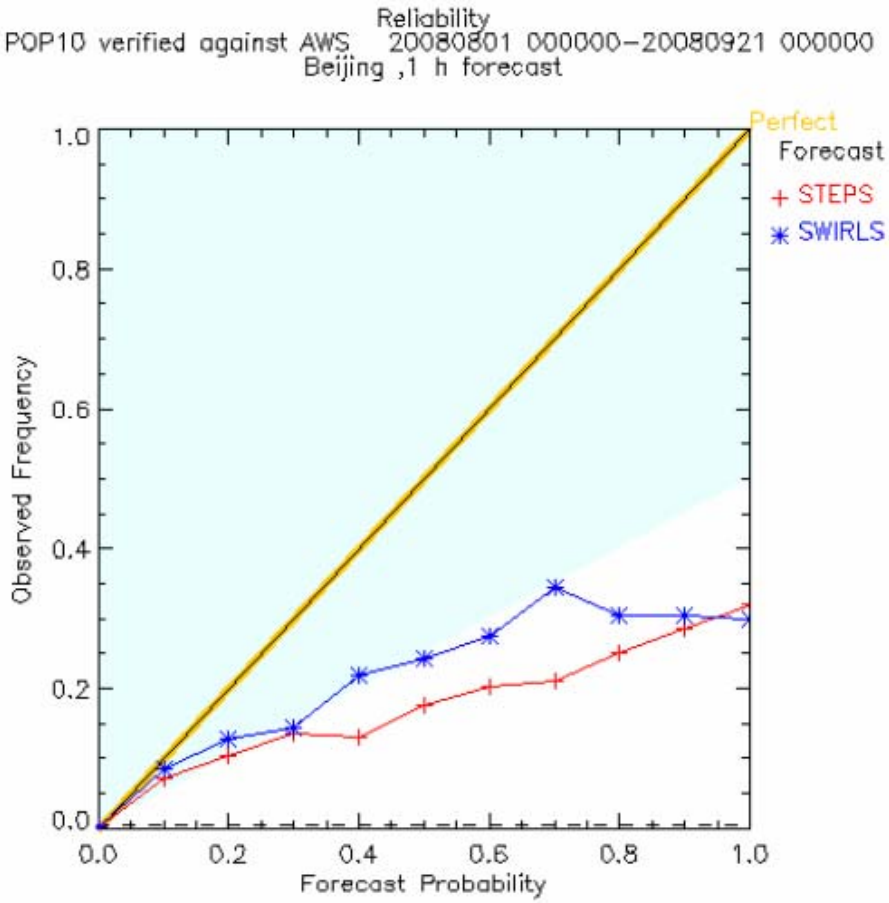



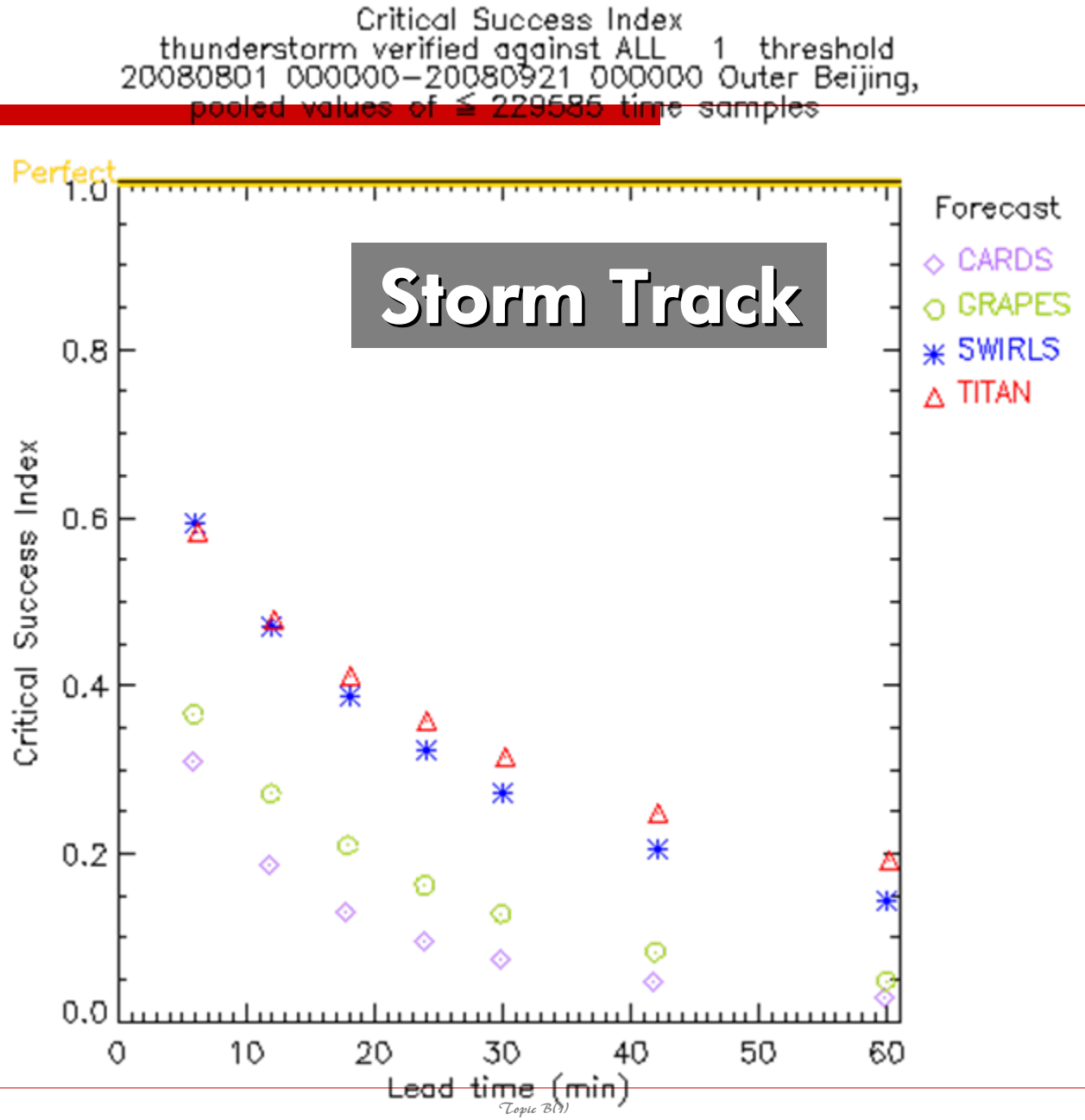



# B08FDP Forecast Verification

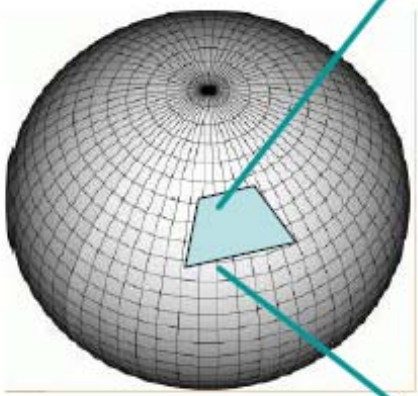


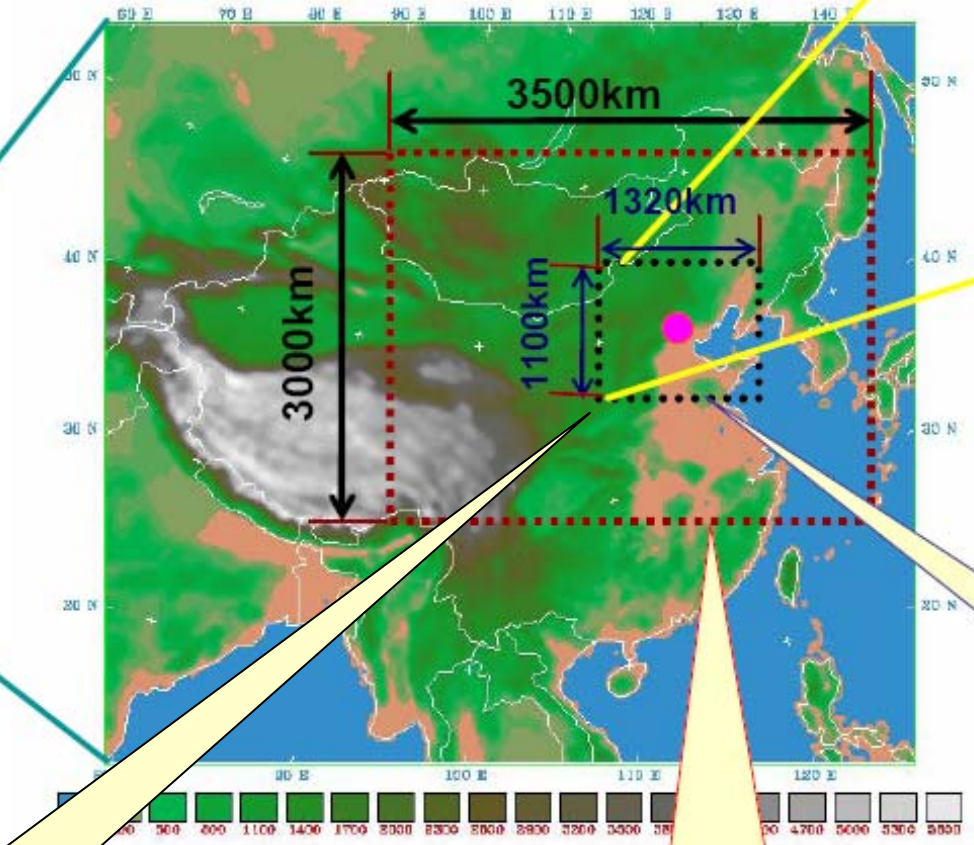



# B08FDP Forecast Verification



# General Requirements on Configuration of B08RDP







3. B08FDP support 3hour Rapid Update Cycle System

Tier 1
15 km mesoscale ensemble up to 36 hour

Tier 2
2-3 km CRM experiments case study

# Mesoscale EPS

- **LAM_EPS participating systems:**
  - *MRI/JMA LAM-EPS*
  - *Canada (EC) LAM-EPS*
  - *NCAR/BMB WRF-RUC system*
  - *NCEP new version Short-Range Ensemble Forecast (SREF)*
  - *ZAMG and Météo-France joint LAM-EPS*
  - *NMC LAM-EPS (CMA)*
  - *CAMS LAM-EPS (CMA)*

# System characteristics

| Participants | Model | IC | Initial Perturbation | LBC | Lateral Perturbation | Physical Perturbation |
|---|---|---|---|---|---|---|
| NCEP | WRF-ARW (5)<br>WRF-NMM (5)<br>GEFS-Downscaled<br>(T284L60, 5)<br>(L60M15) | NCEP 3DVAR | Breeding | NCEP Global EPS | NCEP Global EPS | Multi-model |
| MRI/JMA | NHM<br>(L40M11) | Meso 4DVAR<br>(20kmL40) | Targeted Global SV<br>(T42L40) | JMA Global Forecast<br>(TL959L60) | Forecast of Global model initiated by targeted SV | non |
| EC | GEM<br>(L28M20) | MSC Global EnKF | MSC Global EnKF | MSC Global EPS | MSC Global EPS | Physical tendency perturbation with Markov chain, surface perturbation |
| ZAMG & Meteo-Fr. | ALADIN<br>(L37M17) | ECMWF Global 4DVAR | Blending ECMWF SV with ALADIN Bred Mode | ECMWF Global Forecast | ECMWF EPS forecast | Multi-physics |
| NMC /CMA | WRF-ARW<br>(L31M15) | WRF-3DVAR | Breeding | CMA Global EPS | CMA Global EPS | Multi-physics |
| CAMS /CMA | GRAPES<br>(L31M9) | GRAPES-3DVAR | Breeding | CMA Global EPS | CMA Global EPS | Multi-physics |

# Modify B08RDP Verification System

- **Continues parameters:**

  **2m temperature** **2006 first trial**

  **2m relative humidity** **2007 increased**

  **10m U,V wind,**

  **500hPA Geopotential Height**

  **250, 850hPa U,V wind**

  **250, 500, 850hPa Temperature**

  **850hPa Relative Humidity**

  **Economic Value($P_{T2M>32^{o}}$)** **2008 increased**

  **Spread, RMS, Talagrand,**

  **Relative error, Absolute Error, Bias,**

- **Precipitation,**

  **0.1 mm** **2006 first trial**

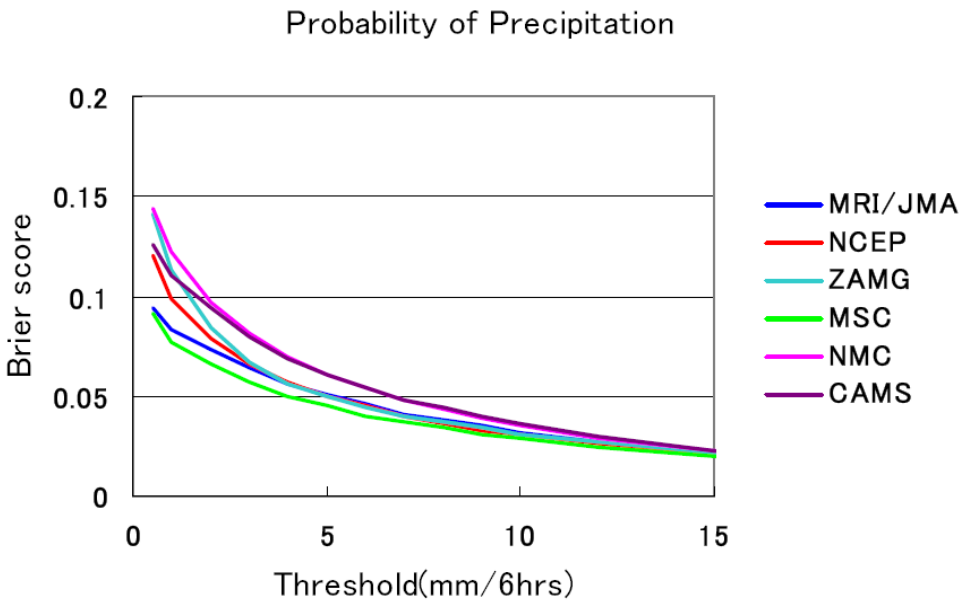
  **0.1, 1, 2, 6 mm** **2007 increased**

  **Brier score, Brier skill score, ROC, Reliability Diagram, Bias**

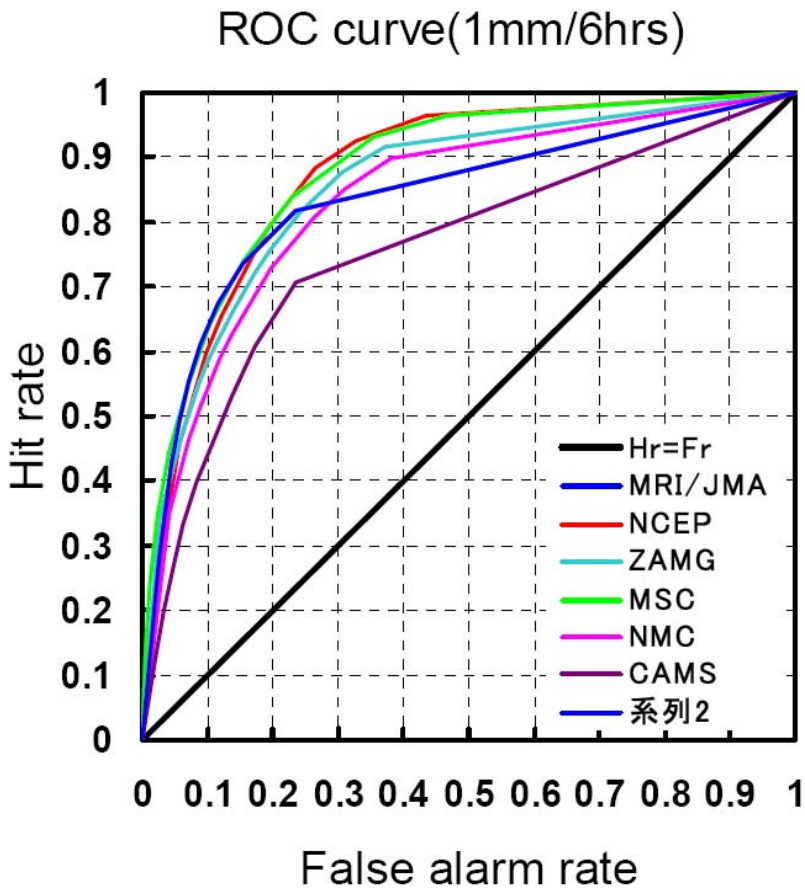
  **Economic Value** **2008 increased**

# Verification Samples

## Relative Operating Characteristic Curve



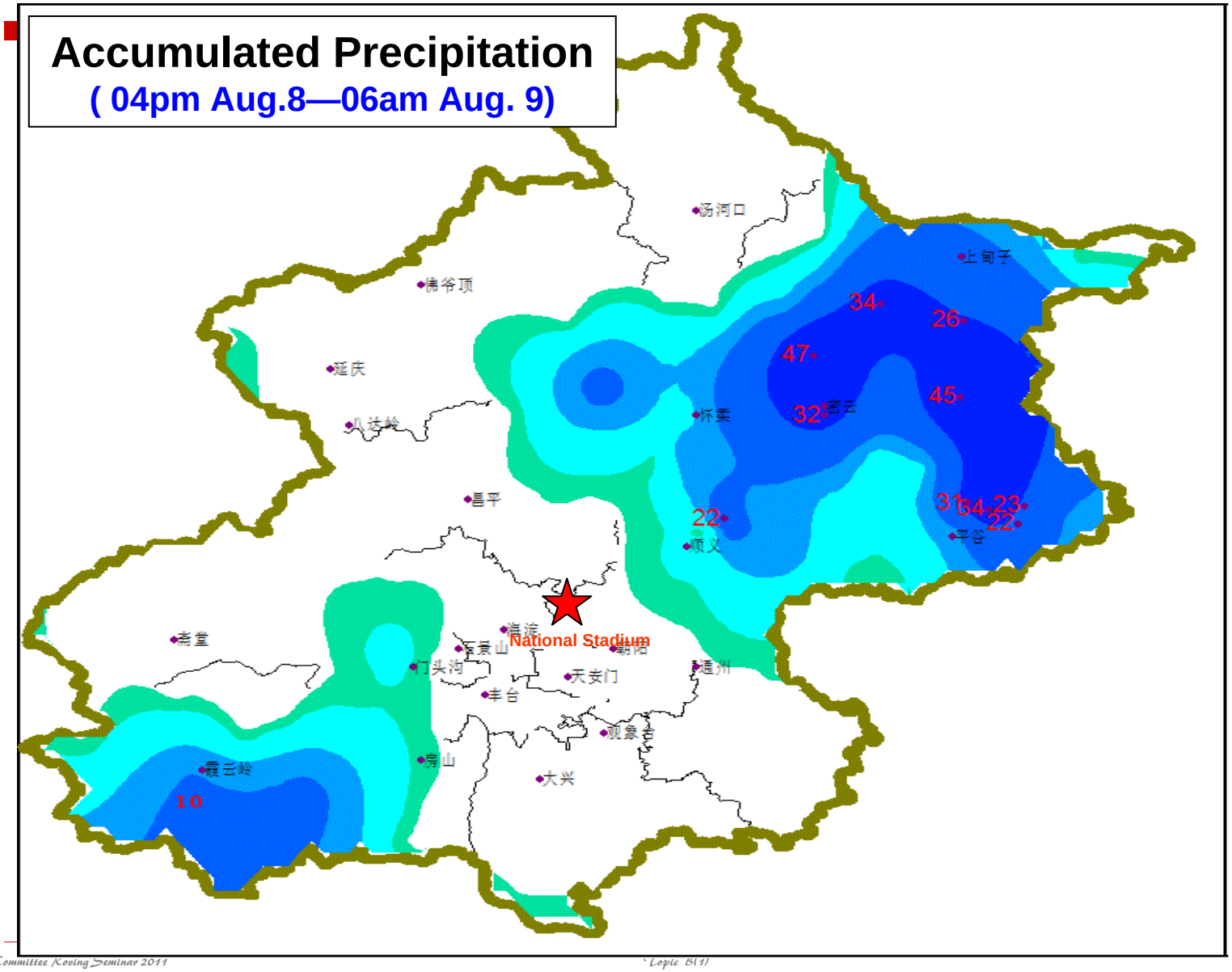

Brier Scores 0725~0823



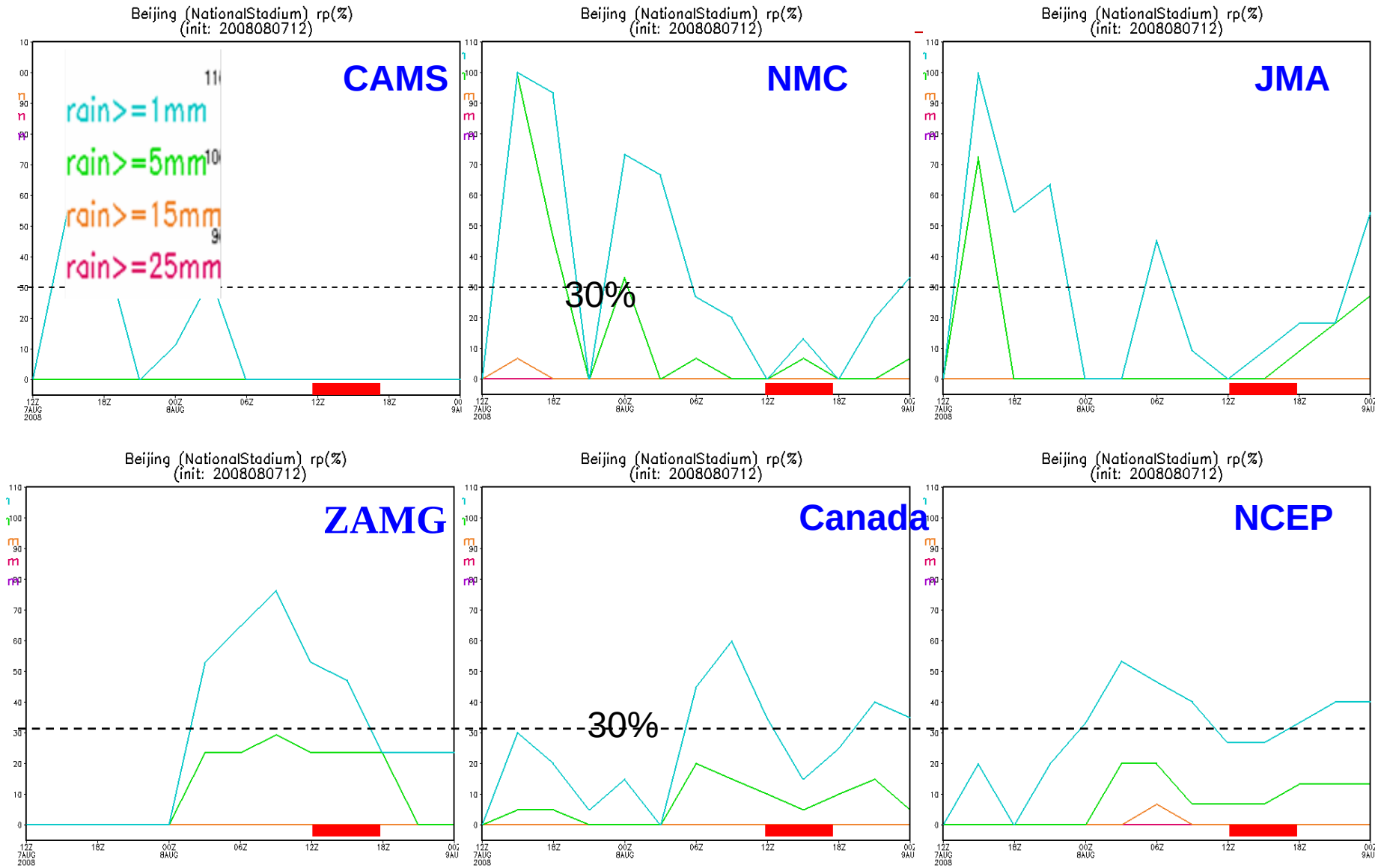

By Dr. Kazuo Saito

ROC curve 0725~0823

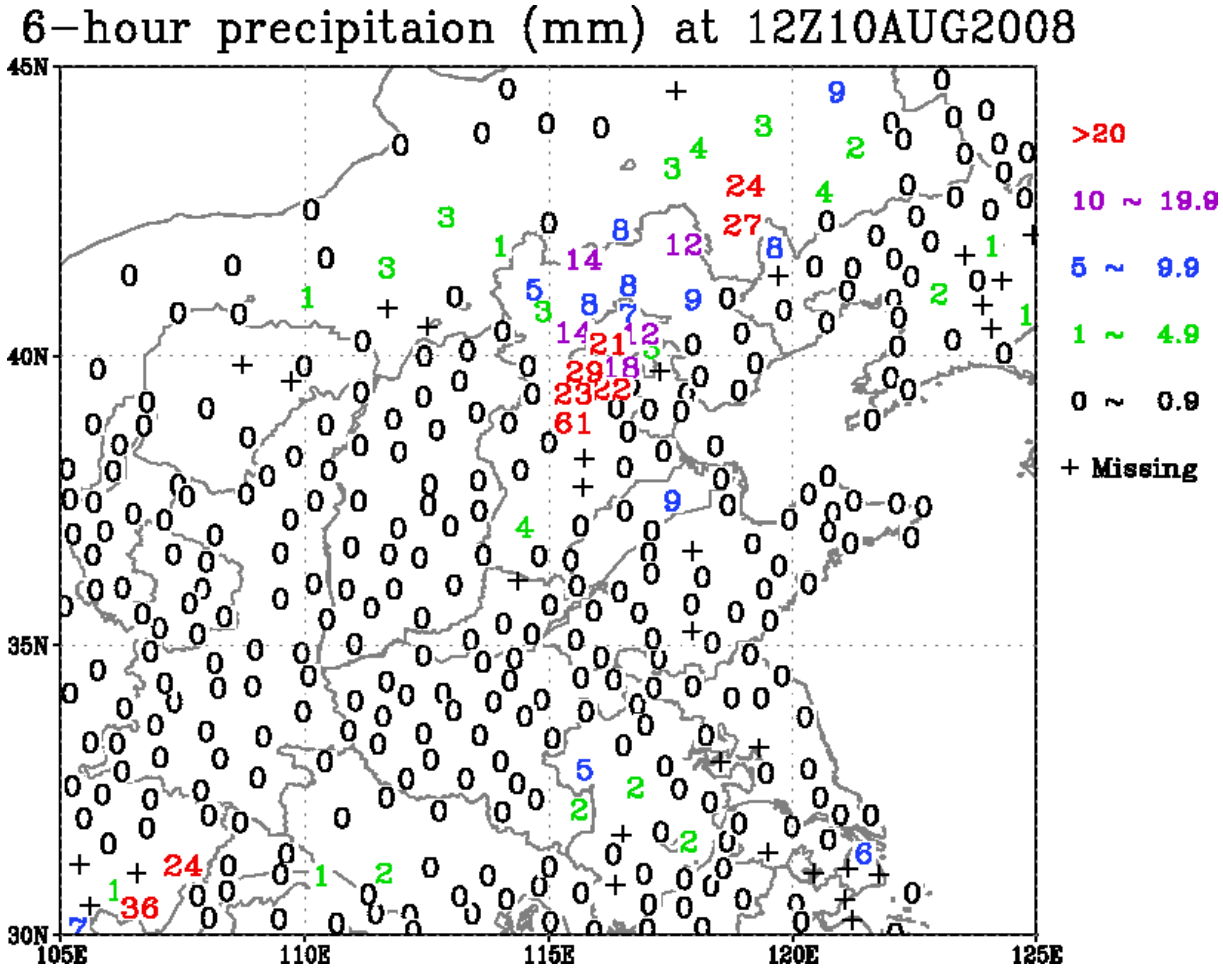
# Example 1: Successful service for opening ceremony (National Stadium)



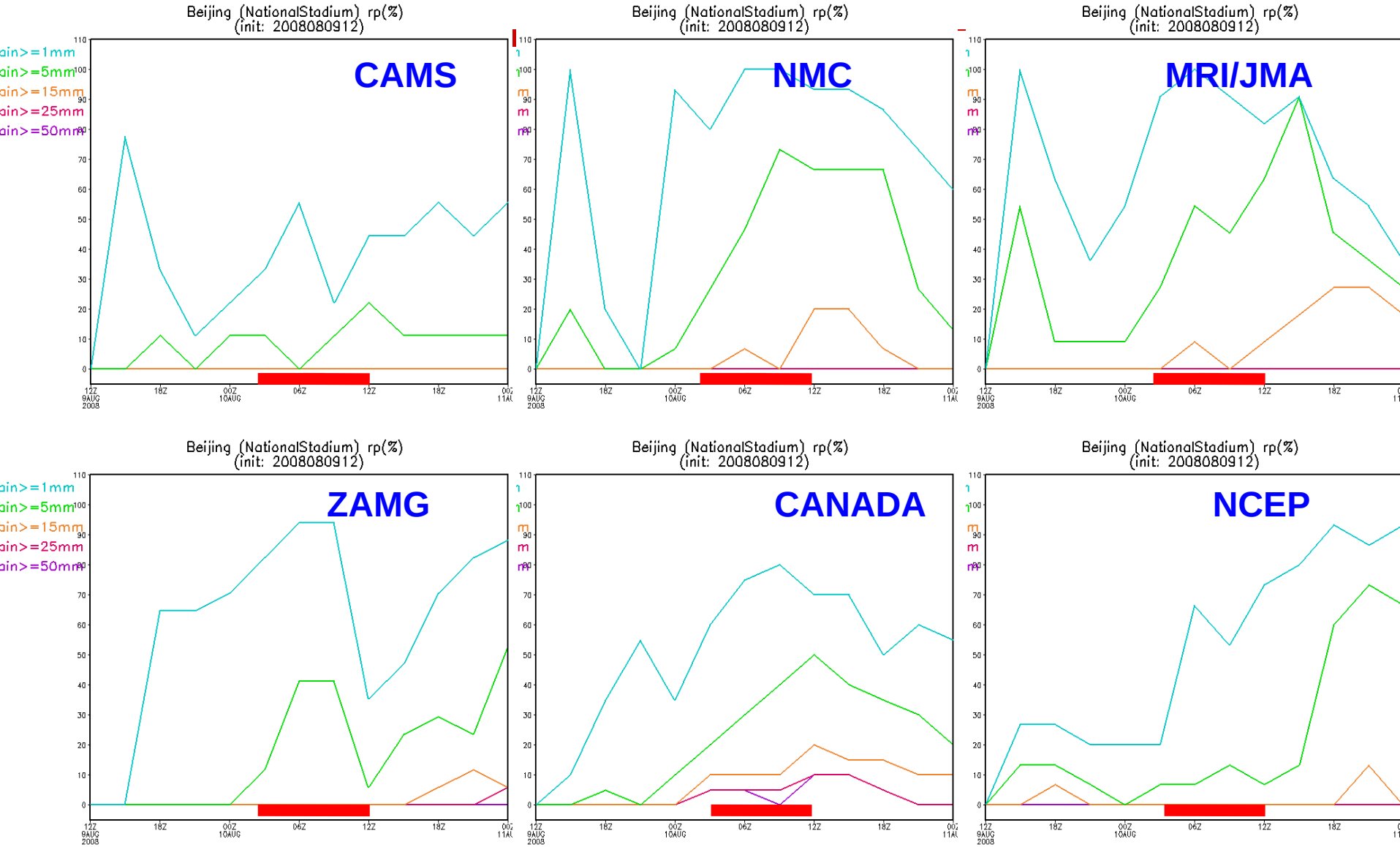
# During the Opening Ceremony, 5 RDP participants forecast a probability of less than 30% for 1mm,and 10mm<=10%



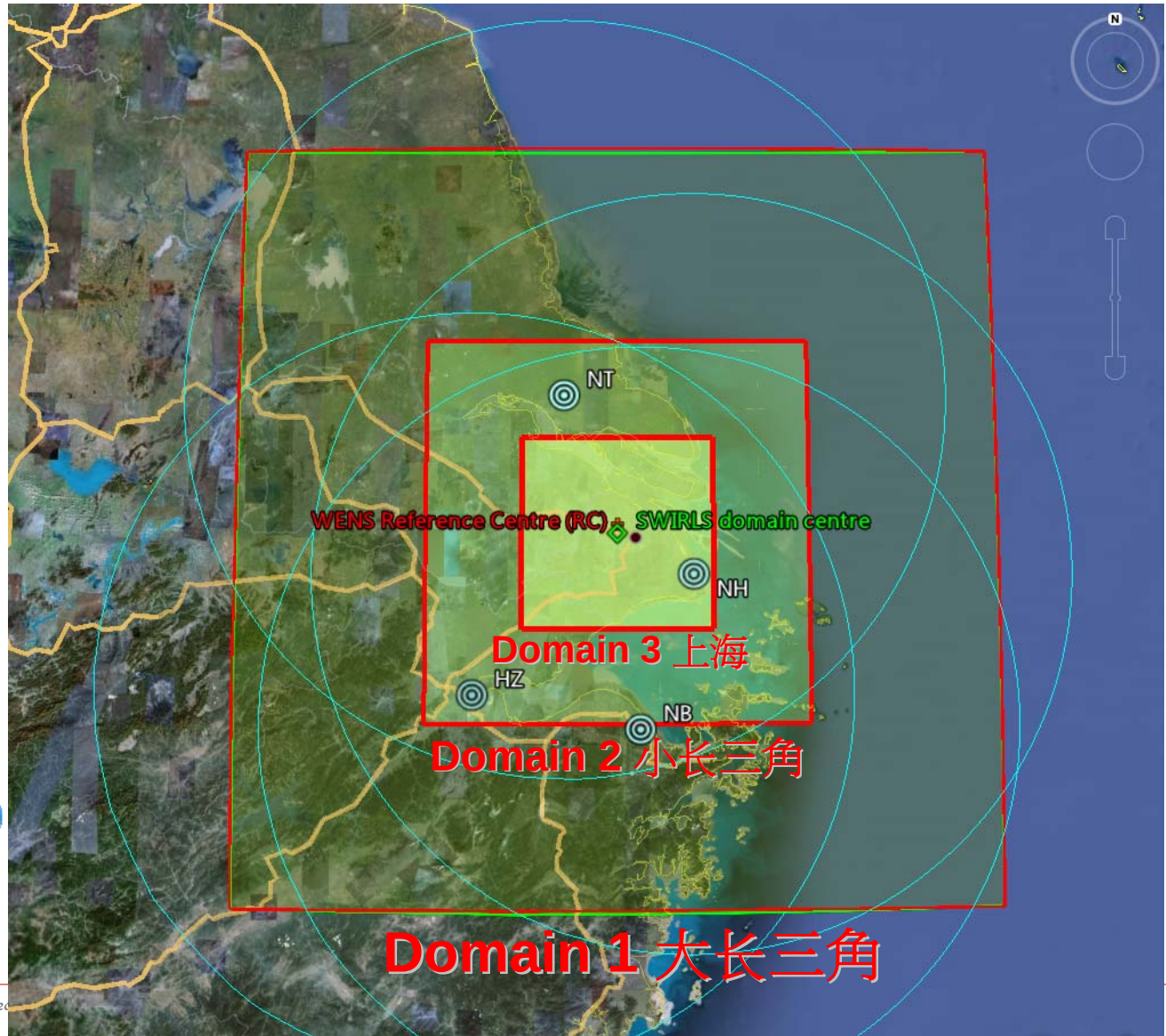
# Example 2: The strong precipitation during Olympic Games



# *RDP percentage of rainfall forcast（Nation Stadium）(0-36h)，Initial:08080912*

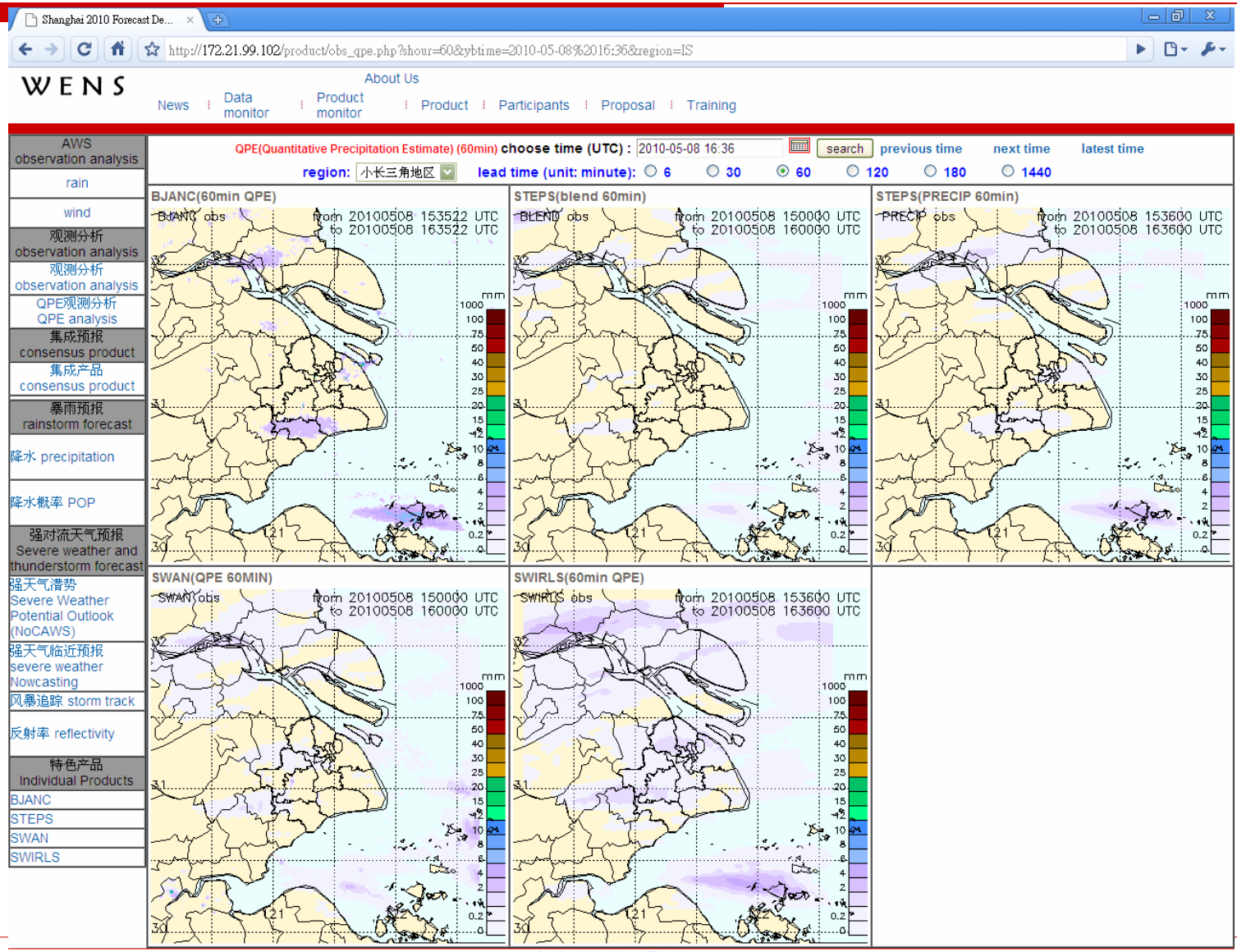


# WENS for Shanghai World Expo




EXPO 2010 SHANGHAI CHINA

# WENS Internal Web Site

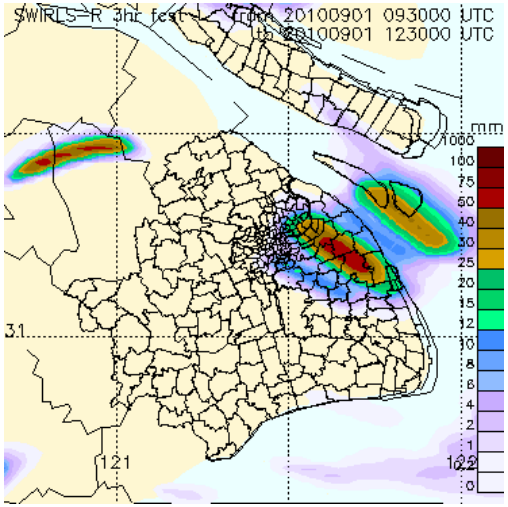



Contact: Mr. Yuan Zhaohong
ADD: No.166, Puxi Road, Xuhui Dist., Shanghai, P.R.China 200030

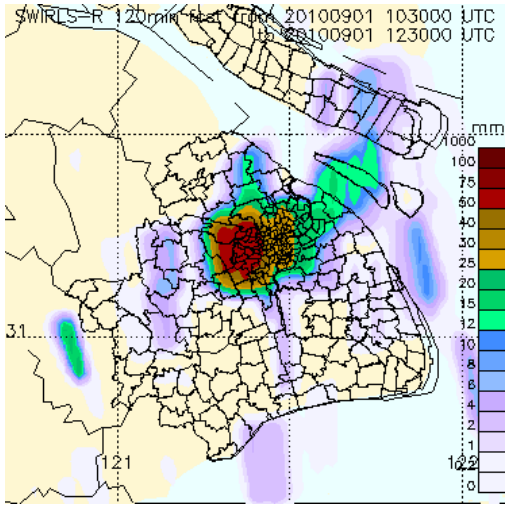
# WENS Public Website

- selected products
- for special users
- URL at
  - *http://www.expoweather.com/wens/*

# A Localized Heavy Rain Case

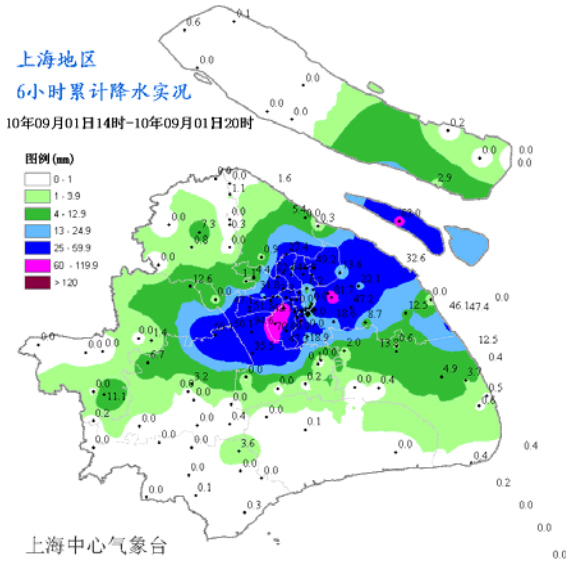


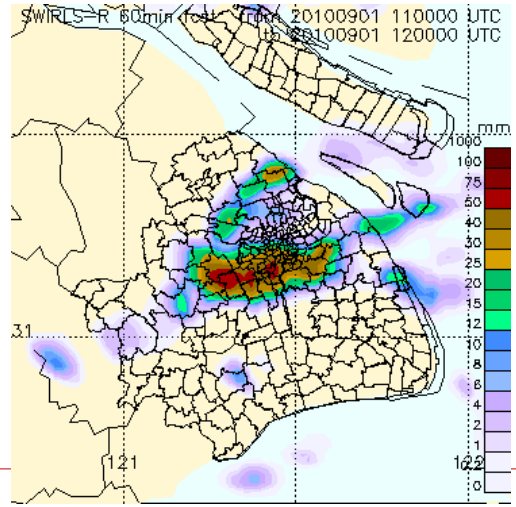

3-h rainfall f/c
issued at 5:30 pm




2-h rainfall f/c
issued at 6:30 pm

Actual 6-h rainfall
distribution from 2-8 pm




1-h rainfall f/c
issued at 7:00 pm

# 2010 Commonwealth Games

- 3-14 October 2010
- New Delhi, India
- SWIRLS software provided to India Met. Dept.
- implementation plan to be fixed
- case study performed with Kolkata radar data

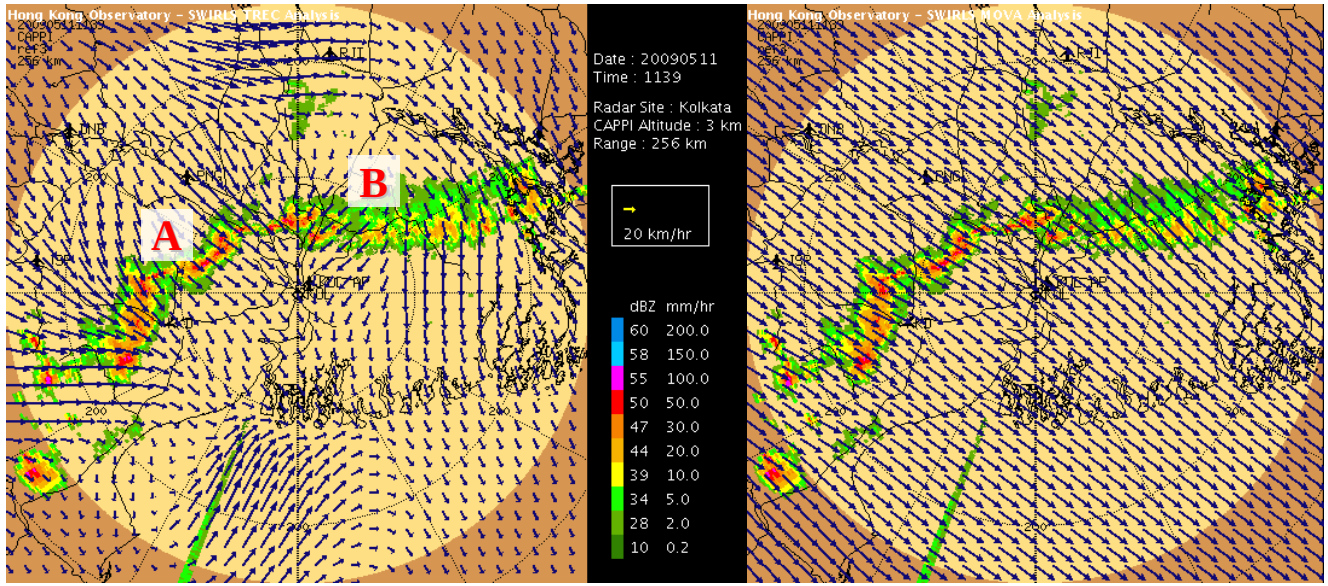
DELHI 2010™©
XIX COMMONWEALTH GAMES

# 2010 Commonwealth Games

- **Kolkata radar data**
  - *updated every 15 min!!!*
  - *big challenge to radar tracking*
- **2009-05-11 case study result -**
  - *speed of band A:*
    - TREC~40 vs actual~50 vs MOVA~55 km/h

**TREC**

(search radius doubled)




**MOVA**

(FFT for top-level scale)

# Universiade Shenzhen 2011

- **sharing of SWIRLS data products based on Hong Kong radars:**
  - *radar QPE*
  - *1-, 2-, and 3-hour QPF*
  - *storm nowcast track*
  - *severe weather nowcast tracks*

UNESCAP/WMO
Typhoon Committee

United Nations
ESCAP

WMO OMM

# Hong Kong Experience

# Rainstorms in Hong Kong

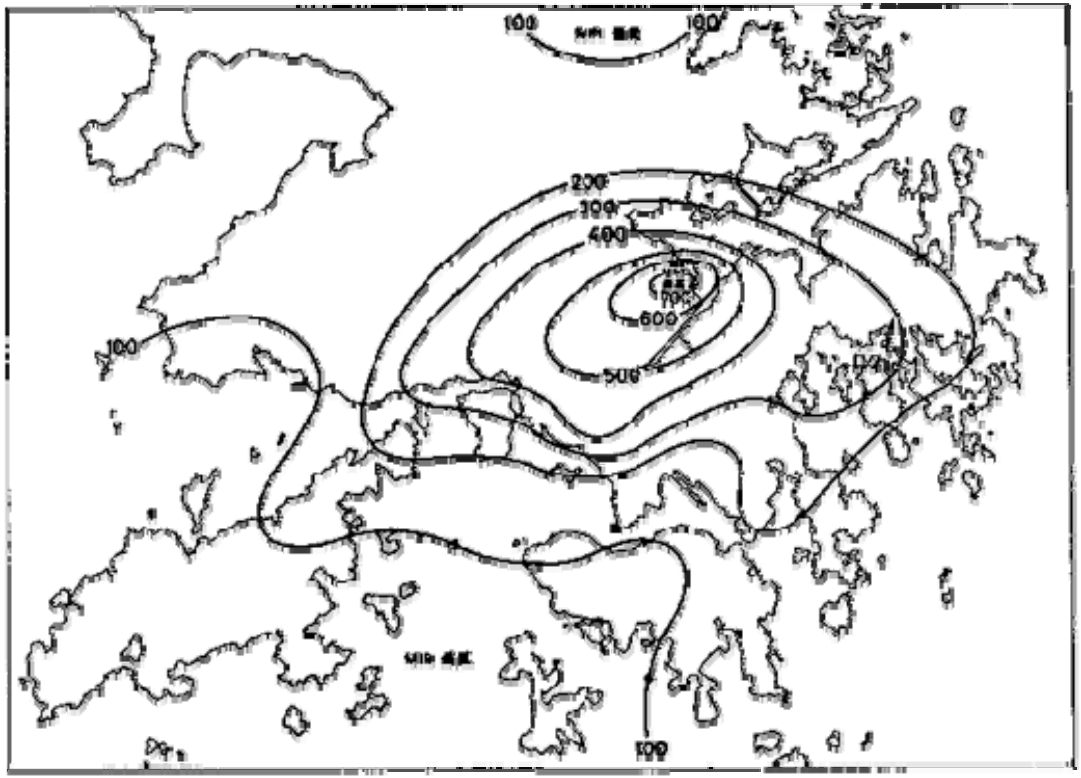



圖3.6 一九九七年七月二日香港的雨量分佈（雨量以毫米為單位）

Fig. 3.6 Rainfall distribution (mm) over Hong Kong on 2 July 1997

- destructive street rapids
- landslides at man-made / natural slopes
- flash floods over low-lying areas

# Destructive Street Rapids

Flooding in Hong Kong, 12 Jun 1966
Casualties from 11-13 Jun 1966
Dead / Missing: 112
Injured: 29

# Landslides

Po Shan Road landslide in 1972

Kotewall Road landslide in 1972

Casualties from 16-18 Jun 1972

Dead: 150

Injured: 93

# Flooding

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1998年5月24日，消防員於沙頭角拯救被洪水困困的村民。
Firemen rescuing villagers trapped by flooding at Sha Tau Kok on 24 May 1998.

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1999年8月23日颱風森姆吹襲期間，上水天平山村受大雨影響而嚴重水浸。
Tin Ping Shan Village in Sheung Shui was inundated as a result of heavy rain during the passage of Typhoon Sam on 23 August 1999.

# Severe Weather Climatology

- **Major convective weather systems in HK :**
  - *cold front, convergence line, SW monsoon, monsoon trough, tropical cyclone, land-seabreeze*
- **occurrence of severe weathers/warnings:**

| Weather Hazards | Period | | Duration | Total Number | Frequency |
|---|---|---|---|---|---|
| | start | end | (years) | | (no. / year) |
| Thunder/Lighting | 1977 | 2010 | 34 | 2741 warnings | 80.6 |
| Amber Rainstorm | 1997 | 2010 | 14 | 310 warnings | 22.1 |
| Severe Squalls | 1987 | 2006 | 20 | 214 days | 10.7 |
| Red Rainstorm | 1997 | 2010 | 14 | 66 warnings | 4.7 |
| Flooding | 1998 | 2010 | 13 | 61 announcements | 4.7 |
| Landslip | 1983 | 2010 | 28 | 94 warnings | 3.4 |
| Black Rainstorm | 1997 | 2010 | 14 | 17 warnings | 1.2 |
| Hail | 1977 | 2010 | 34 | 32 reports | 0.9 |
| Waterspout | 1977 | 2010 | 34 | 24 reports | 0.7 |
| Tornado | 1982 | 2010 | 29 | 8 reports | 0.3 |

# Severe Weather Warnings

## Tropical Cyclone

T1

TC within 800 km of HK

⊥3

Winds blowing 41-62 km/hr within 12 hours over Harbour

▲8 ▲▲8 ▼8 ▼▼8

NW 西北 NE 東北 SW 西南 SE 東南

Winds blowing 63-117 km/hr over Hourbour

⧗9

Increasing gale or storm force winds

✚10

Winds blowing 118 km/hr or above

## Strong Monsoon

季候風 Monsoons

## Rainstorm & related


⩾ 30 mm/hr


⩾ 50 mm/hr


⩾ 70 mm/hr

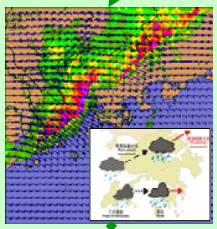
## Thunderstorm Warning


- **Rainstorm Warnings**
  - *intense, widespread & persistent heavy rain*
- **Landslip Warning**
  - *resulted from prolonged rainfall*
  - *will be issued if 15 or more major landslides is expected*
- **Special Announcement of Flooding**
  - *specific for low-lying areas in northern part of Hong Kong*
- **Thunderstorm warnings**
  - *with special reports on severe weather of high gust, hail, waterspout or tornado, if available*
- **Tropical Cyclone Warnings**
  - *No.1, 3, 8, 9, 10 for standby, strong winds, gales, increasing gales & hurricane force*
- **Strong Monsoon Signal**
  - *to warn high winds associated with monsoon*

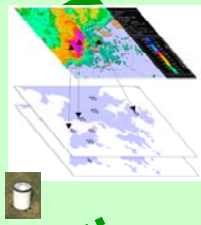
# HKO Nowcasting System - SWIRLS

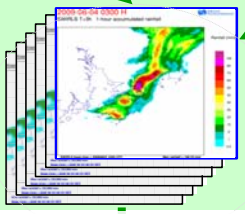
## 雷達追蹤、分析及預測
## Radar Tracking, Analysis and Forecast


「小渦旋」臨近預報系統 SWIRLS Nowcasting System



利用雷達自動追蹤及估計雨帶的移動路徑
Automatic tracking and prediction of rainband movement from radar





電腦製作未來1至6小時的雷達降雨預測圖
Computer-generated forecast rainfall map hours ahead based on radar

電腦模擬大氣物理過程
Computer Simulation of Physical Processes in the Atmosphere

遙感及常規天氣觀測資料
Remote-sensing and conventional weather observation data

高分辨率風暴模式，直接模擬未來15小時雨雲的演變過程
High-resolution storm model to directly simulate the evolution of precipitating clouds up to 15 hours ahead

電腦製作未來15小時的模擬降雨預測圖
Computer-generated forecast rainfall maps for the next 15 hours based on simulation

「小渦旋」特別版 Special Editions of SWIRLS

利用密集的雨量站數據，實時訂正雷達探測降雨率
Real-time calibration of radar-detected rainfall rate using the dense raingauge network

強風暴單體識別及雷達特徵分析
Cell identification and radar signature analysis for severe storms

電腦製作狂風、閃電、冰雹及大雨預測圖
Computer-generated forecast map of squalls, lightning, hail and heavy rain

臨近預報產品及服務
Nowcast Products & Services

支援國際盛事
In support of Important International Events

支援雷暴警告系統
In support of Thunderstorm Warning System

支援暴雨及相關警告系統
In support of Rainstorm and Related Warning Systems

融合雷達臨近預報及電腦模擬結果的未來1至6小時雨量預測圖
Forecast rainfall maps up to 6 hours ahead blended from radar nowcast and computer simulation results

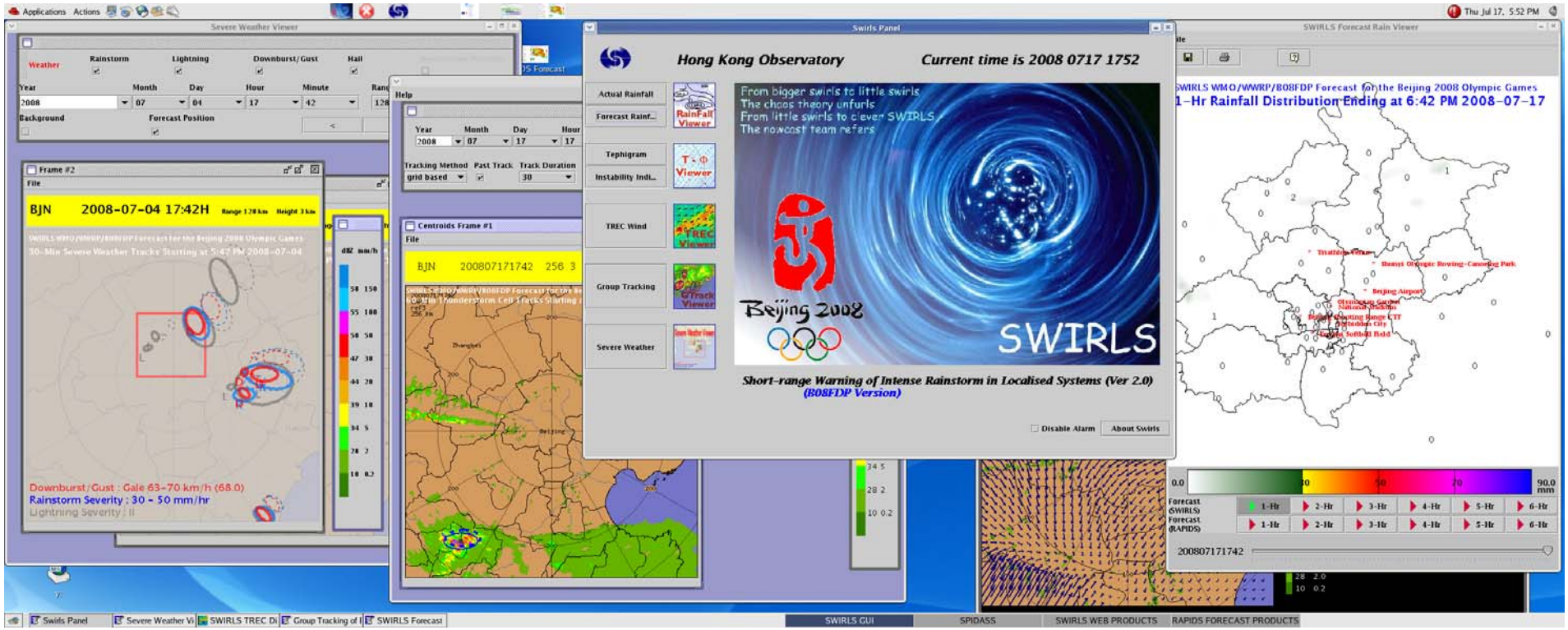
「珠三角」降雨臨近預測圖在天文台網站公開發放
Public dissemination of nowcast rainfall maps for the Pearl River Delta region via HKO Internet website

降雨預測資料透過四維立體地圖展示
Forecast rainfall information visualized with 4-dimensional map of the globe

# SWORLS-2 Product Suite

| | Product Type | Format | Forecast Element |
|---|---|---|---|
| experts; nowcasters; downstream systems | **interactive GUI** | image | QPE, QPF-radar, QPF-blended, echo-motion field, storm tracks, severe weathers, Tephigram, stability indices, etc. |
| | **QPF** | NetCDF (B08FDP) | (a) radar-based f/c rainfall accumulations (1-3 h)<br>(b) NWP QPF blended with (a) by ***RAPIDS (1-6 h)*** |
| | **storm track** | XML (B08FDP) | - motion vectors of storm cells, intensity, …<br>- tracking by the brand new MOVA algorithm |
| | **severe wx.** | XML (B08FDP) | - ***rainstorm, lightning, downburst/gust and hail***<br>-(also flooding & landslide for Hong Kong) |
| | **probabilistic** | NetCDF (B08FDP) | - probability of precipitation (PoP)<br>- ***probability of lightning threat*** (PoL) |
| forecasters; educated users | **SPIDASS** | html, image | compact display of alert status of various severe weather types, severe weather maps, … |
| site manager; general public | **GIS** | KML, html, image | - rainfall maps and 3D lightning locations<br>- based on open GIS standards, viewable by Google Earth<br>- Internet product "Rainfall Nowcast for PRD" in HK |

# User Interface



# Integrated Warning Panel

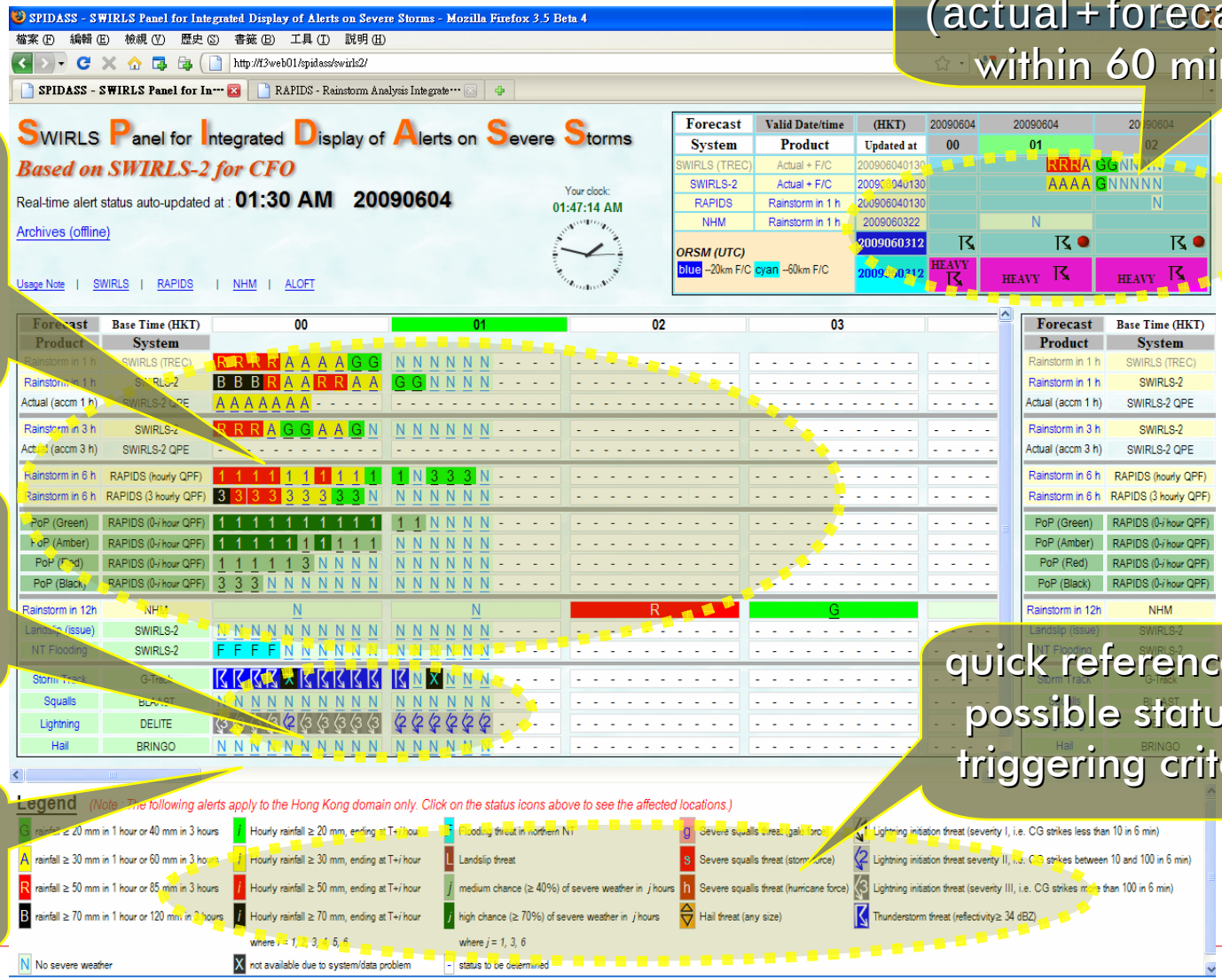
Rainstorm alerts (actual+forecast) within 60 min

Rainstorm-related alerts:
- 1-6 hours
- auto-updated every 6 min

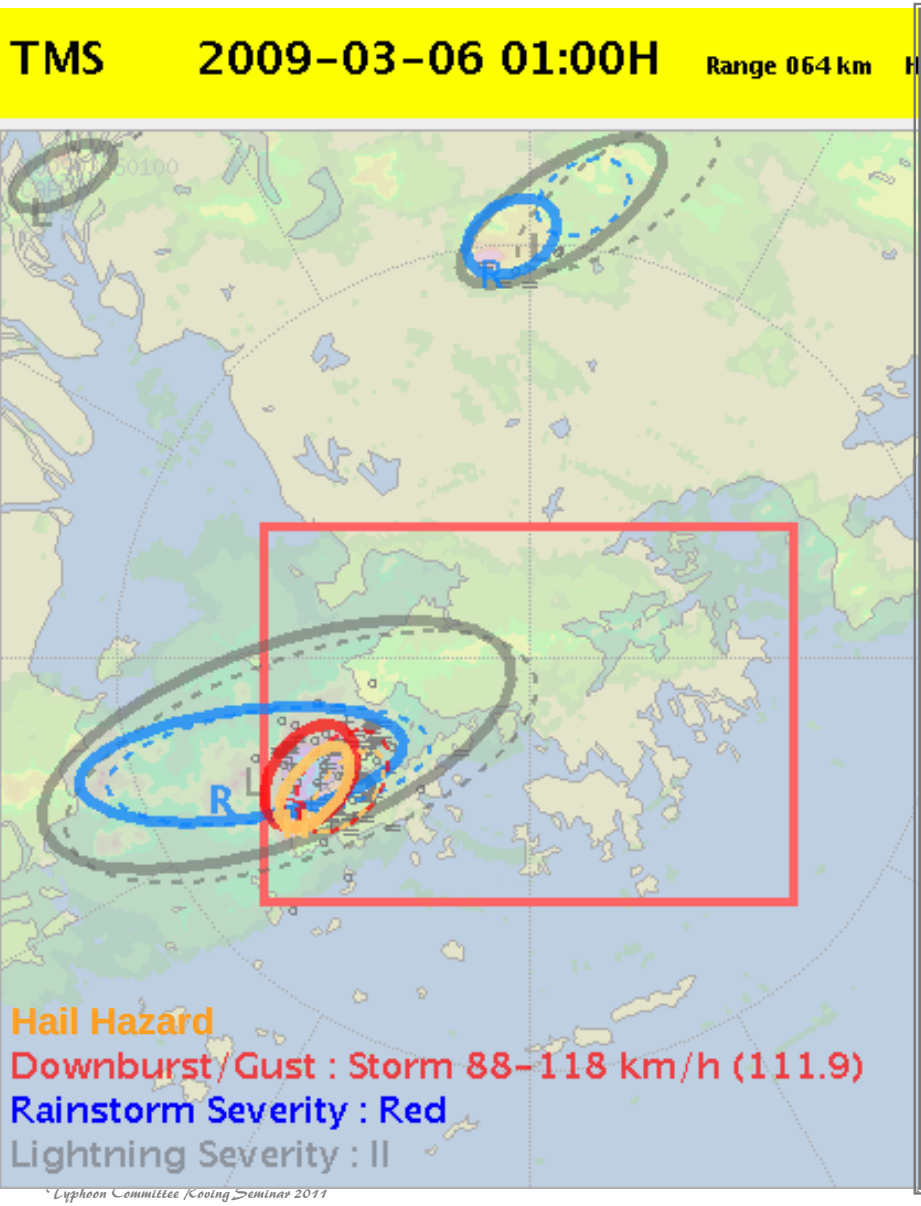
Severe weather alerts associated with thunderstorms

Severe weather map available on mouse click

quick reference on possible status & triggering criteria



# Severe Weather Map




## Legend

- area with hail potential
- 30-min forecast location of hail
- area with severe gust potential
- 30-min forecast location of severe gust
- area with rainstorm potential
- 30-min forecast location of rainstorm
- area with lightning potential
- 30-min forecast location of lightning
- =/+ detected -ve CG lightning location
- 0 detected CC lightning location
- Warning area

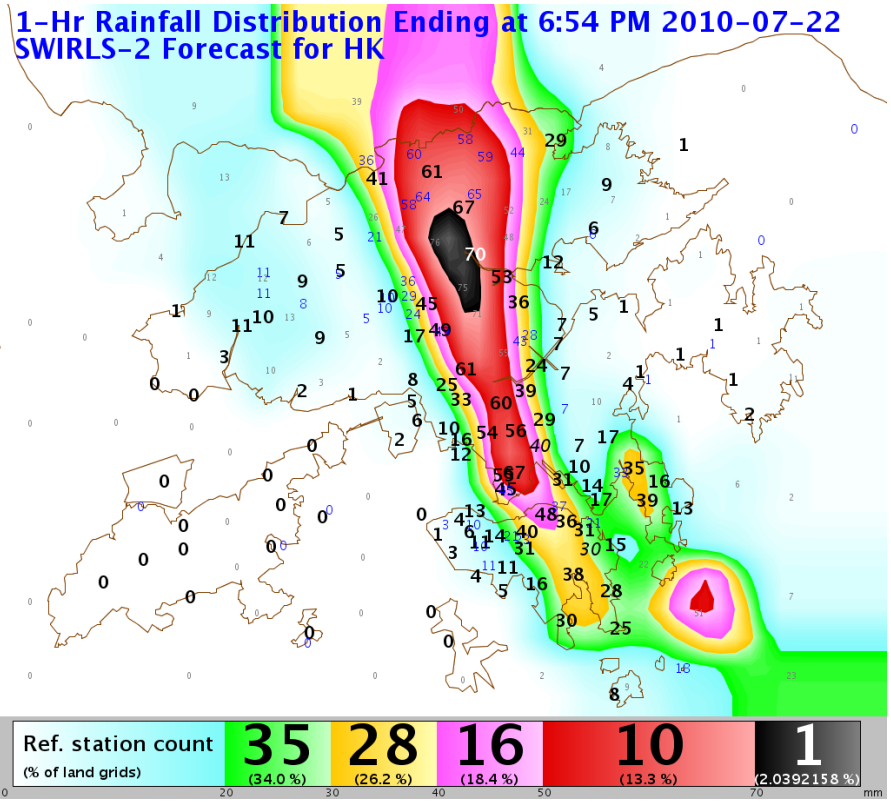
UNESCAP/WMO
Typhoon Committee

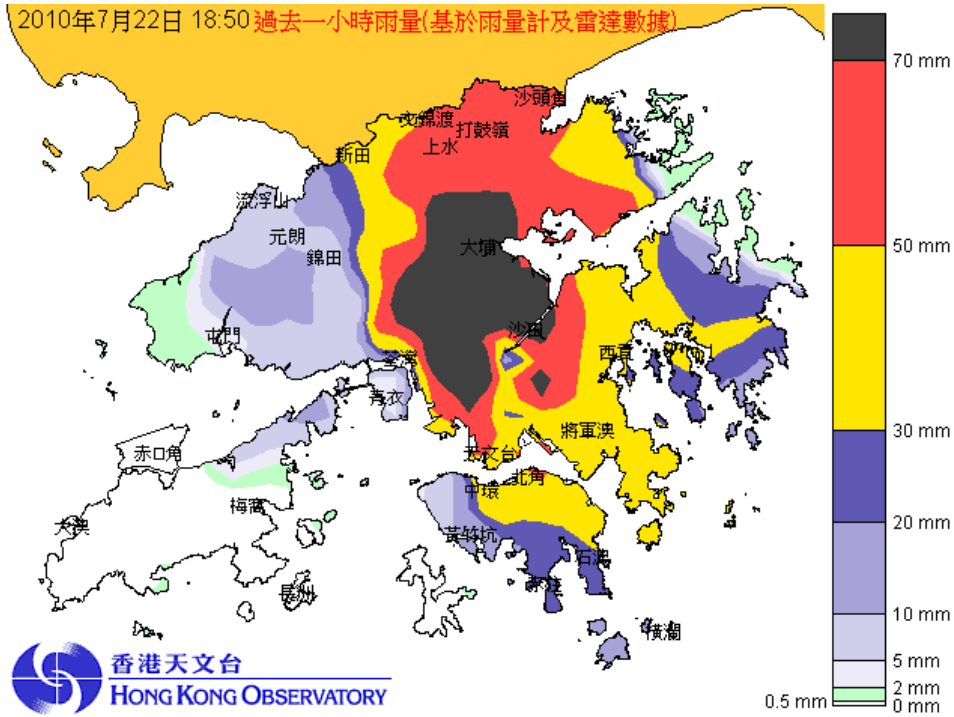
United Nations
ESCAP

WMO OMM

# Local Applications

# "Black" Rainstorm on 22-07-2010

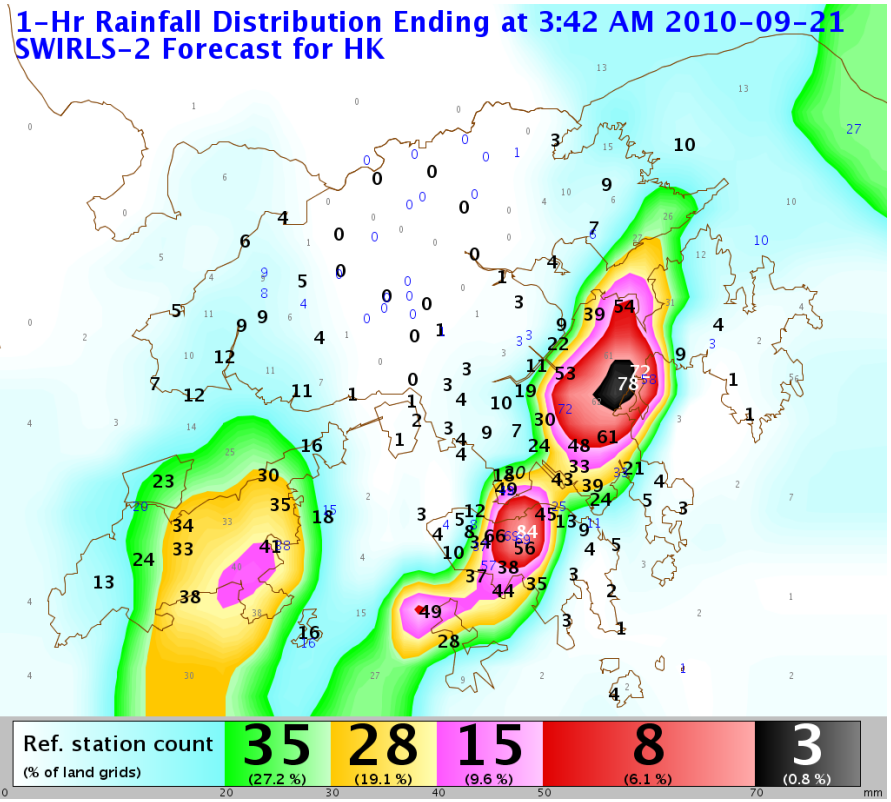


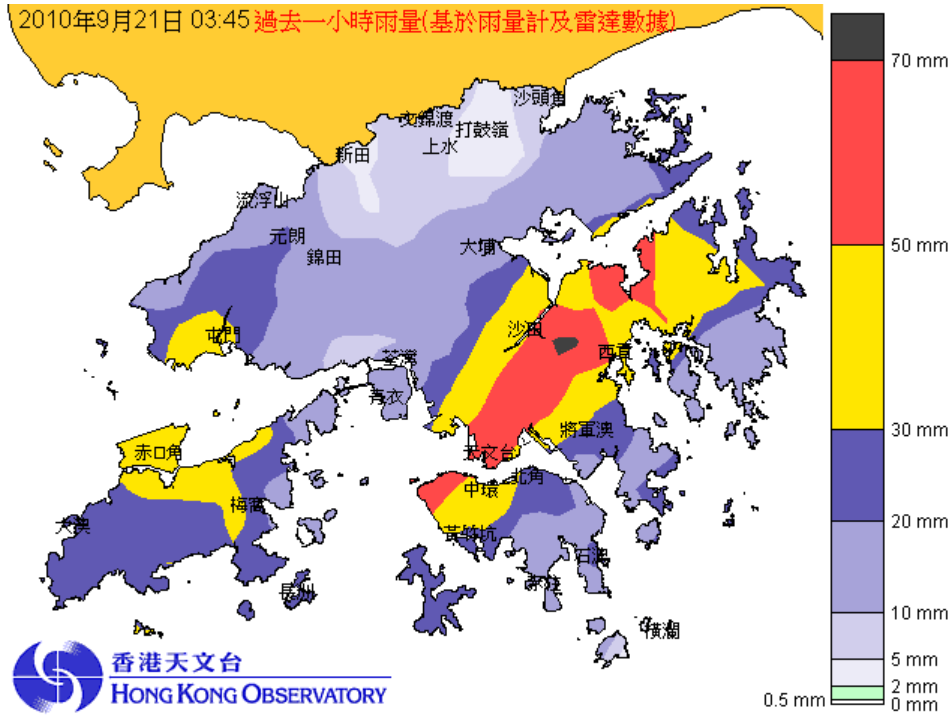




warnings issued:



# "Red" Rainstorm on 21-09-2010



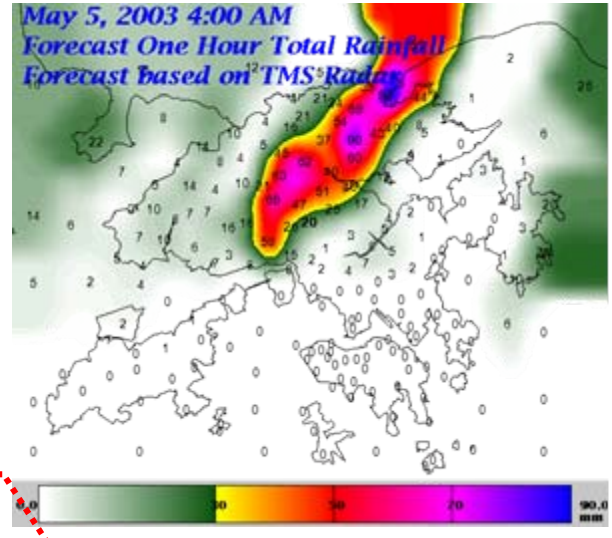




- warnings issued:

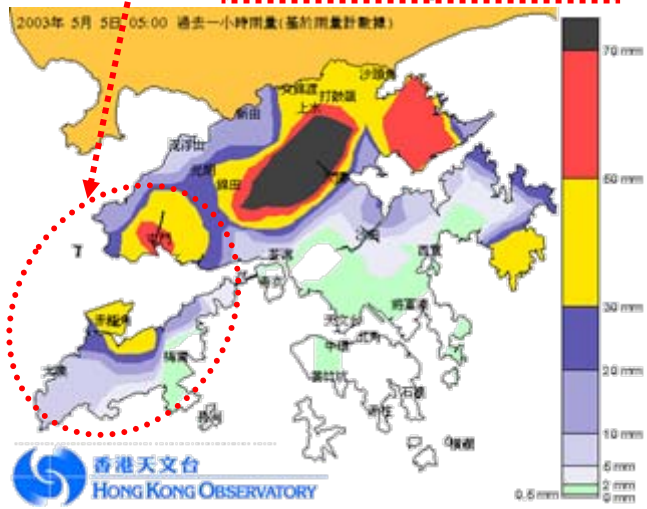


# Real Cases in 2003 & 2004 (1-h f/c)

- 5 May 2003
- SAF and Red RW
- SWIRLS 1-h fc (left)
- actual at 5 am (right)

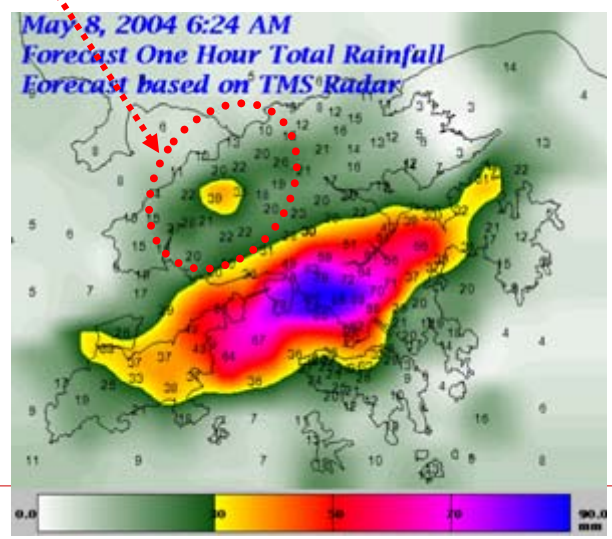


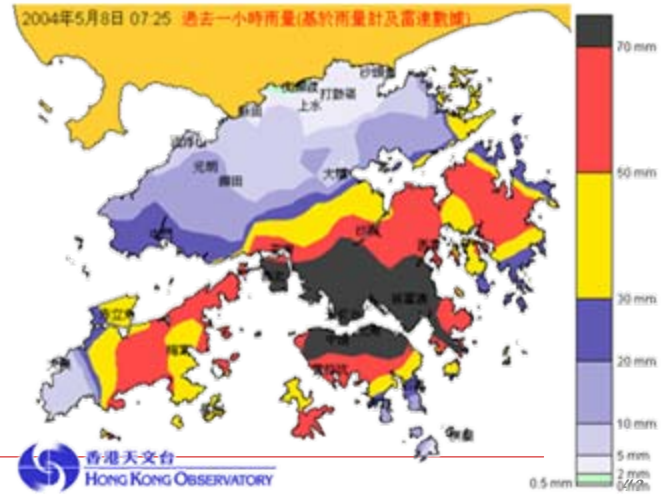

rapid development



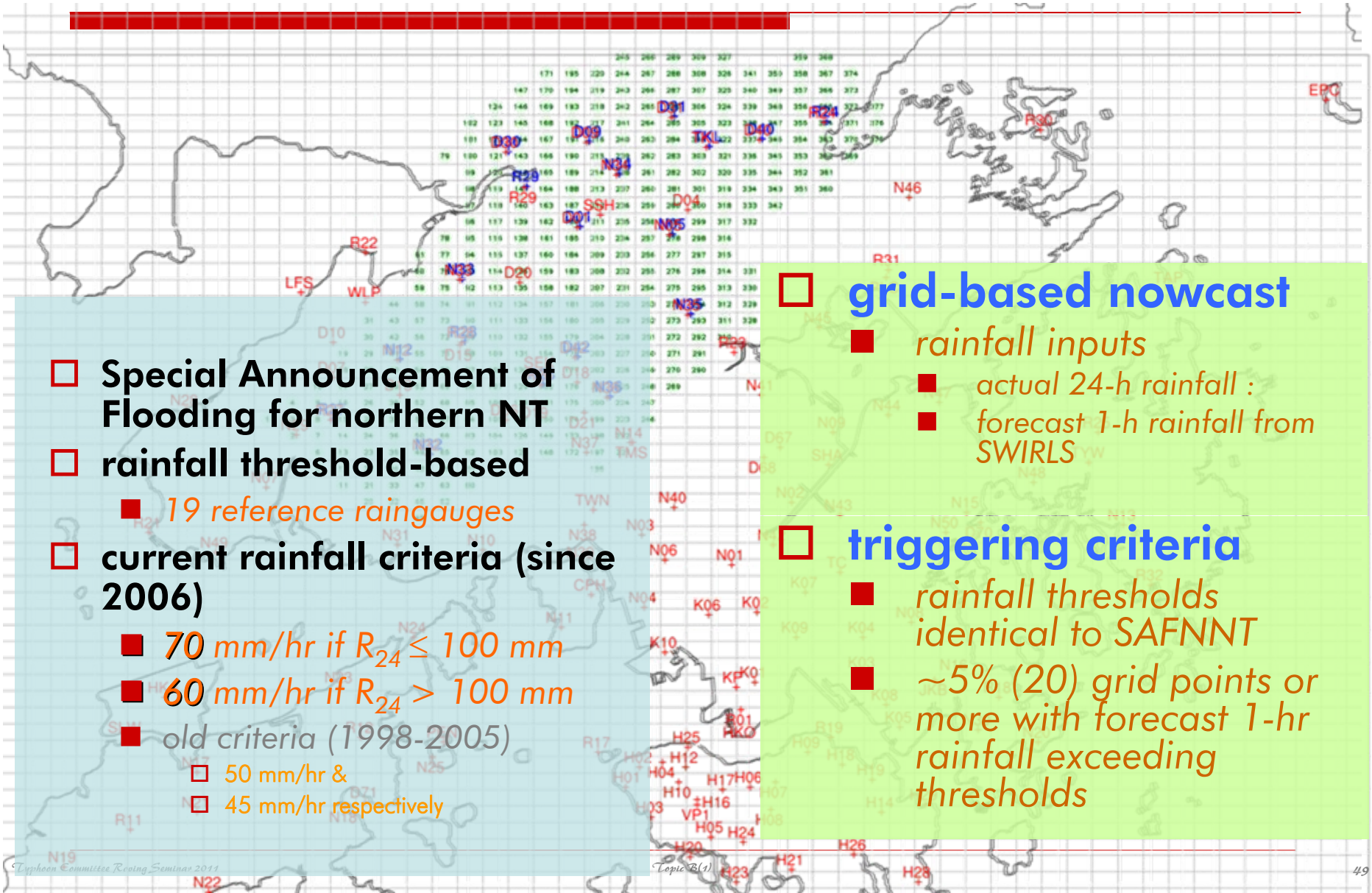

dissipation

- 8 May 2004
- Black RW
- SWIRLS 1-h fc (left)
- actual at 7:25 am



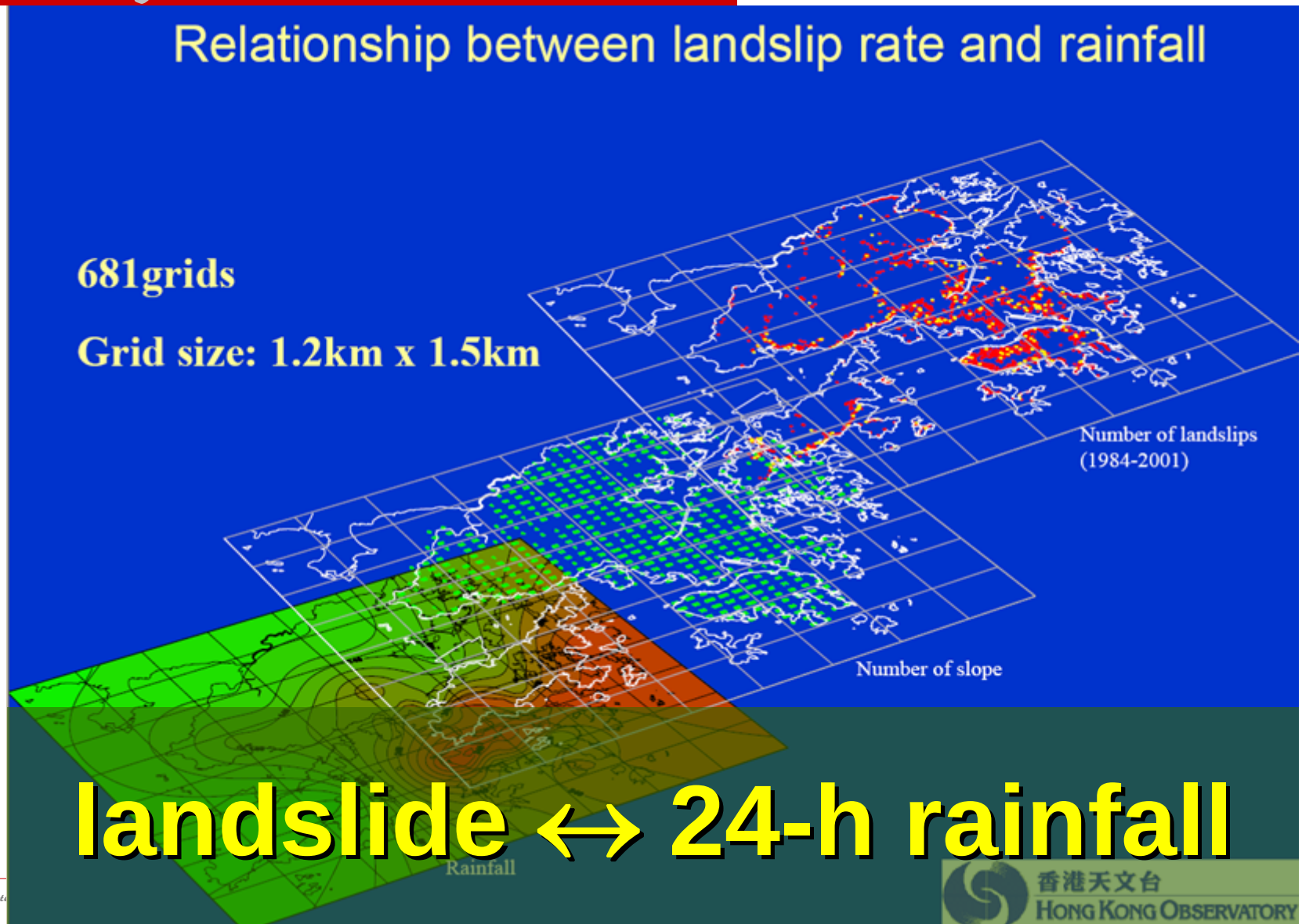
# Special Announcement of Flooding (DSD)



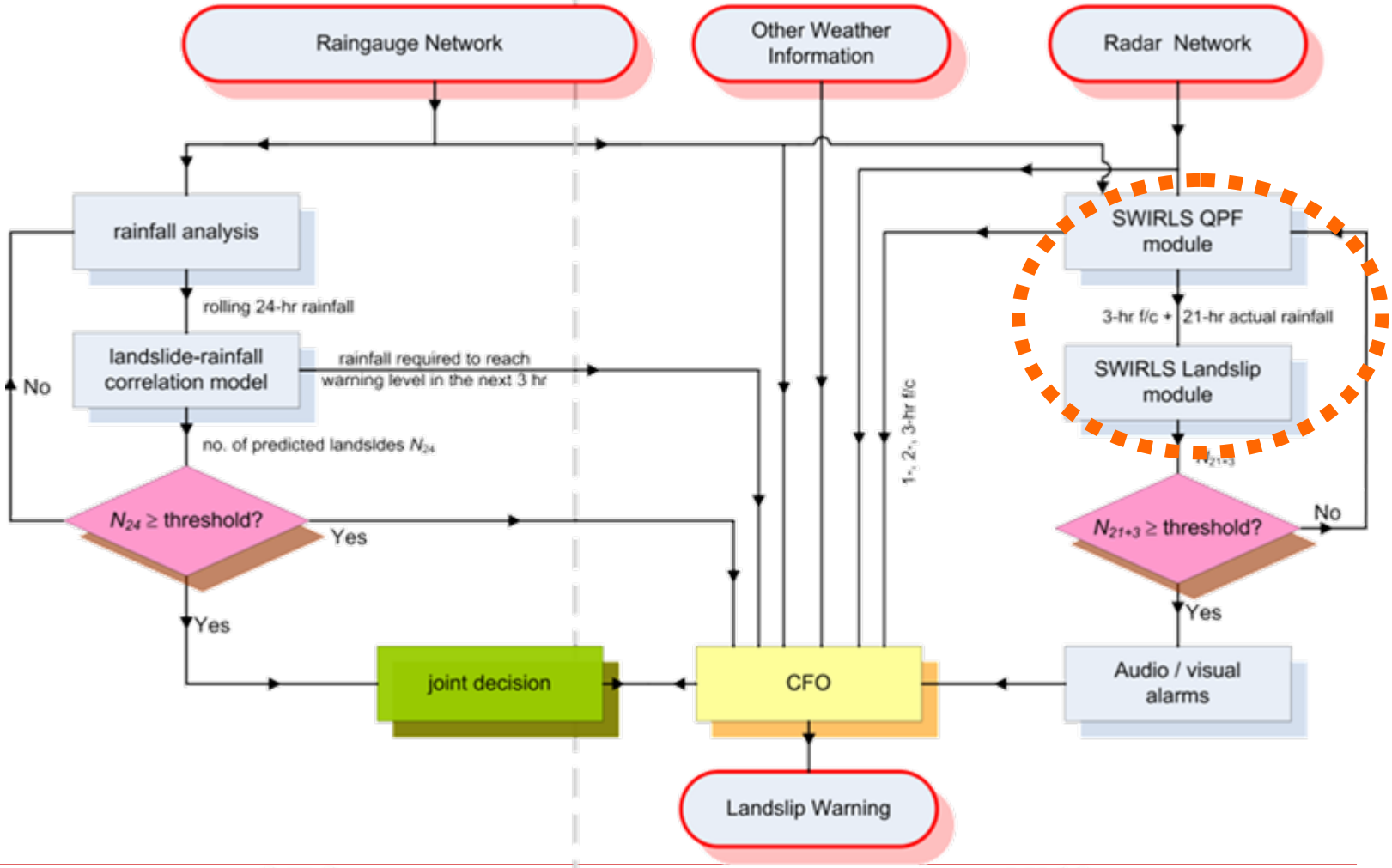
- **Special Announcement of Flooding for northern NT**
- **rainfall threshold-based**
  - *19 reference raingauges*
- **current rainfall criteria (since 2006)**
  - *70 mm/hr if $R_{24} \leq 100$ mm*
  - *60 mm/hr if $R_{24} > 100$ mm*
  - *old criteria (1998-2005)*
    - 50 mm/hr &
    - 45 mm/hr respectively

- **grid-based nowcast**
  - *rainfall inputs*
    - *actual 24-h rainfall :*
    - *forecast 1-h rainfall from SWIRLS*
- **triggering criteria**
  - *rainfall thresholds identical to SAFNNT*
  - *~5% (20) grid points or more with forecast 1-hr rainfall exceeding thresholds*

# Rainfall-Landslide Relation (GEO)



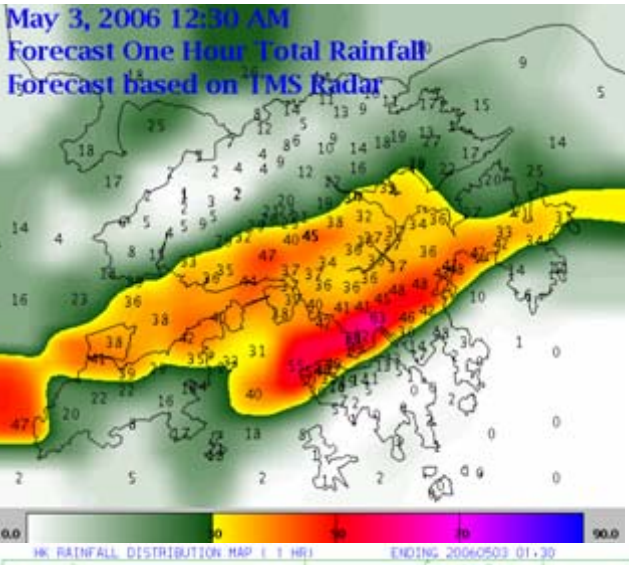
# Landslip Warning System

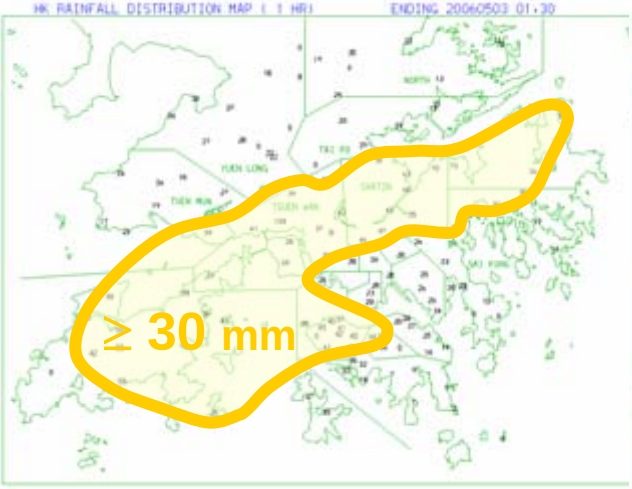


# Real Case in 2006

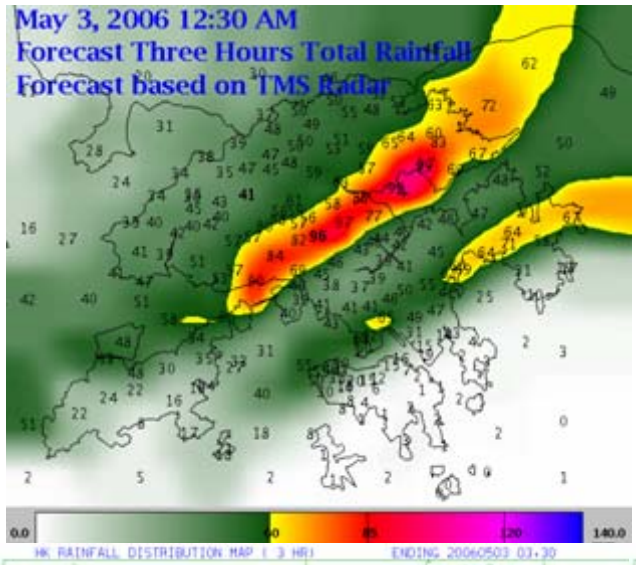
- 3 May 2006
- Red RW, Landslip & Flooding
- SWIRLS (top), actual (bottom)

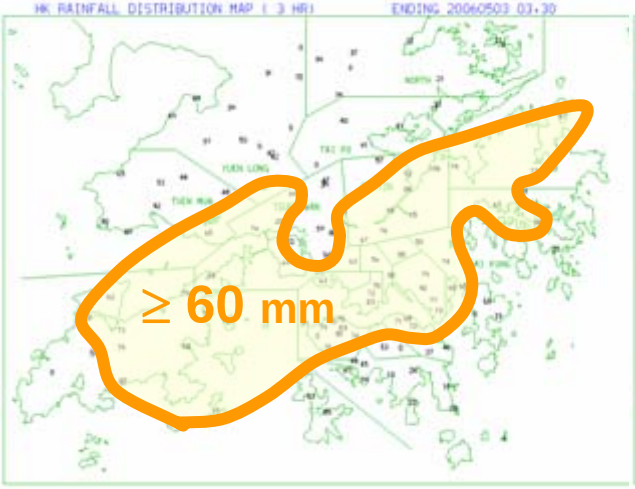
## 1-hour



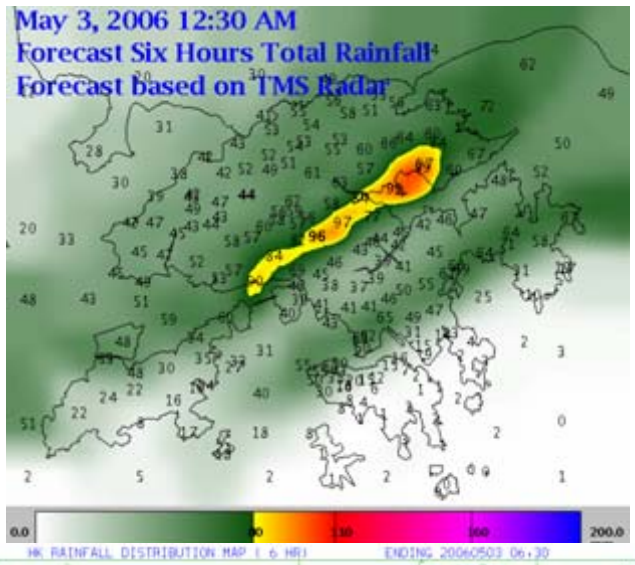



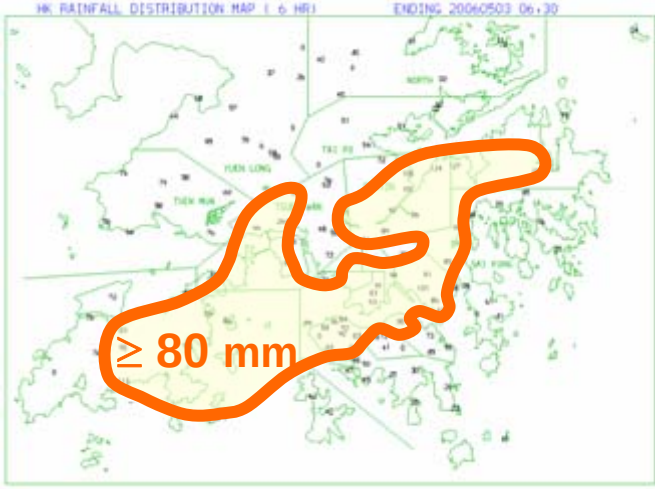

## 3-hour



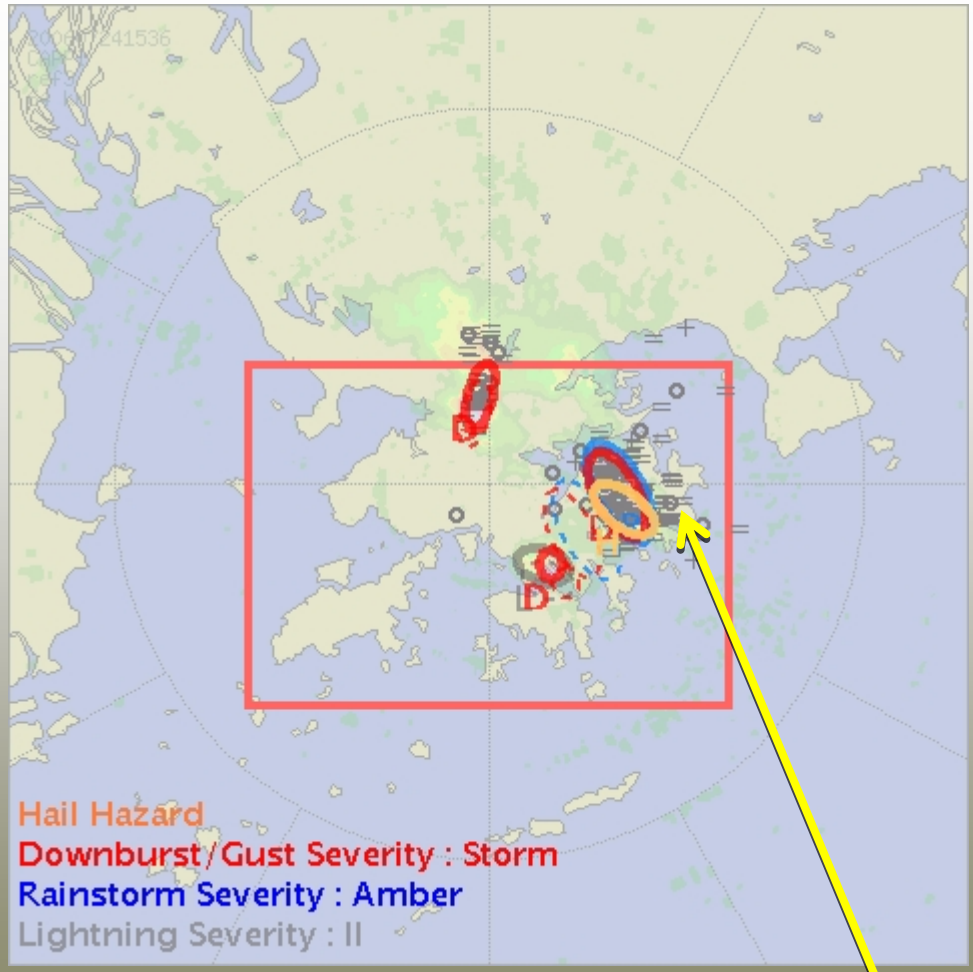




## 6-hour



# Lightning Initiation Nowcast



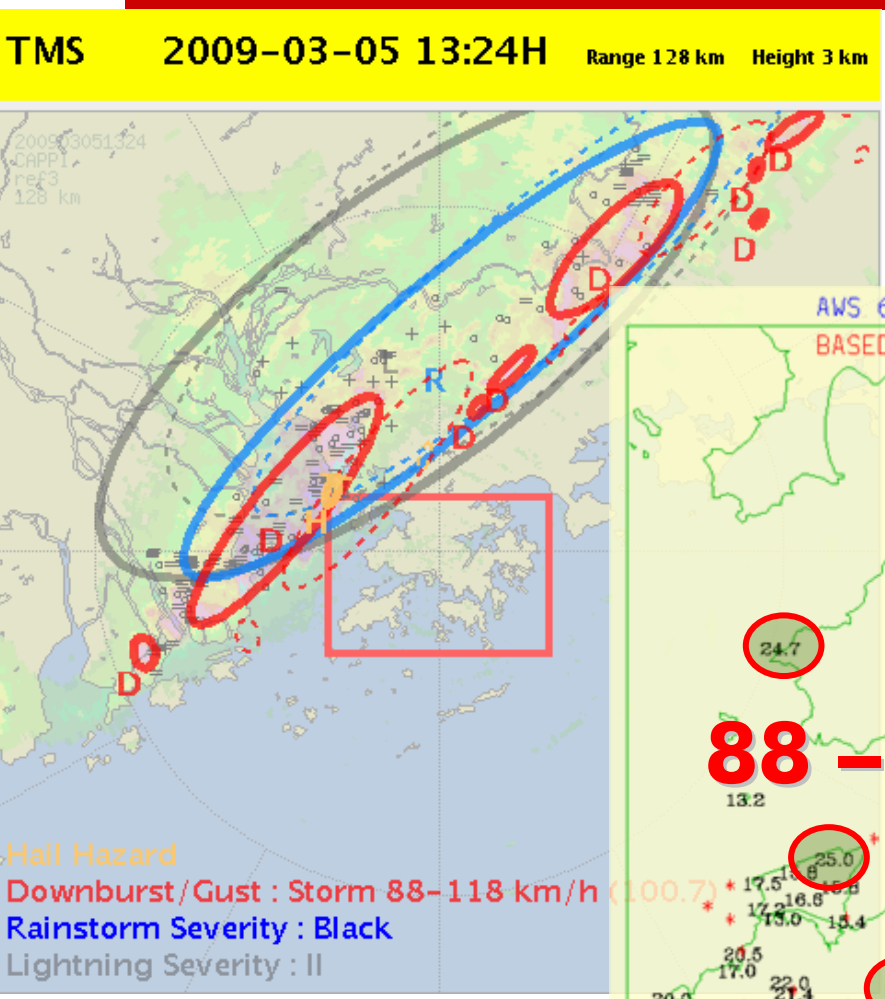

- *hailstorm in Hong Kong on 24 July 2006*
- *first CG lightning alert issued at 3:00 pm*
  - see gray ellipse inside the red rectangular warning zone
- *CG lightning first detected ("=" symbols) during 3:12-3:18 pm*
  - threat areas for downburst/severe gust and heavy rain are marked by red and blue ellipses respectively

**03:36 pm**

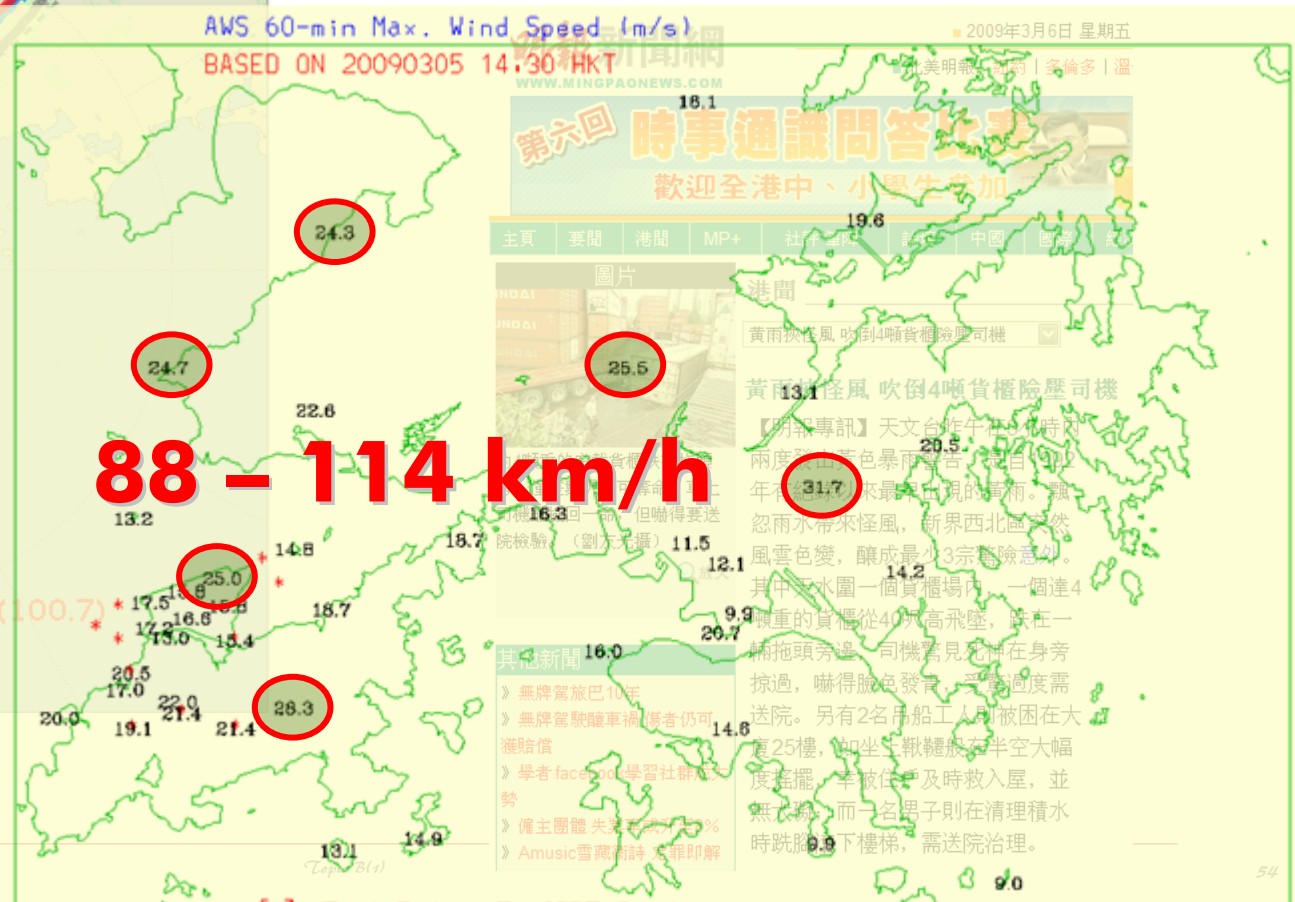
lead time = 12 min

**first CG lightning**

# Squall Nowcast – Hong Kong

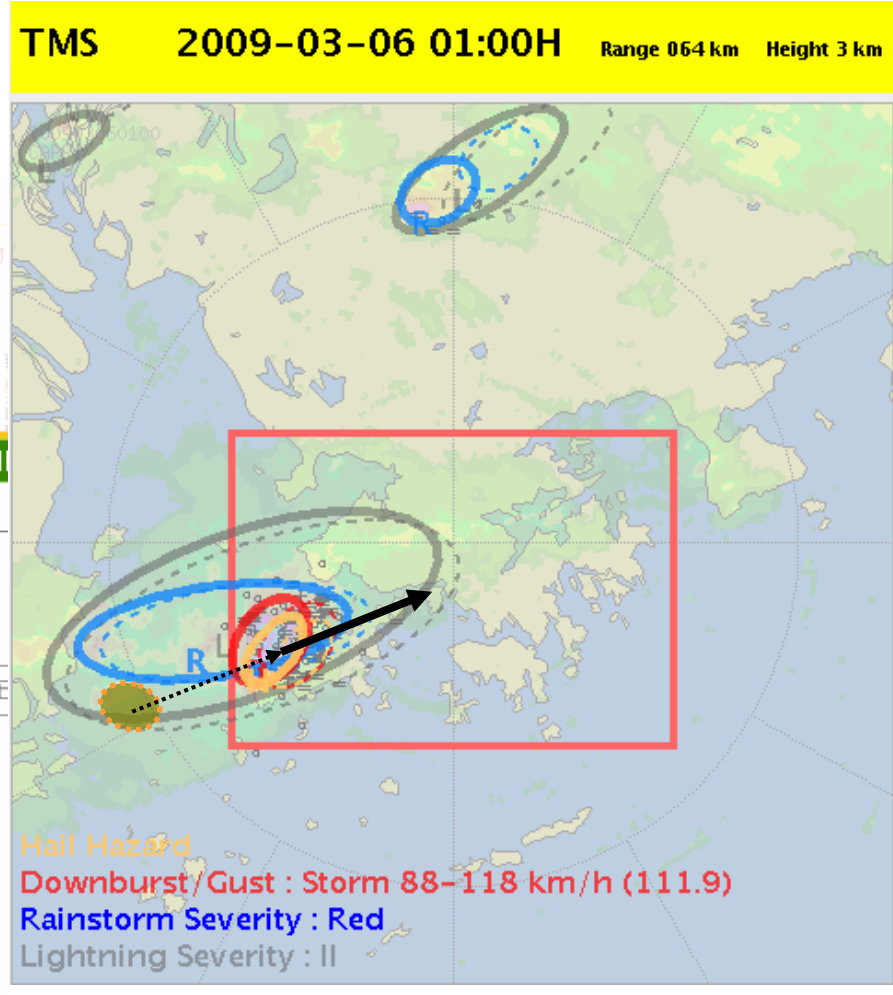



- squall line of 5 March 2009



# Hail Nowcast - Hong Kong

- case of 6 March 2009
  - time - 1:10 - 1:40 a.m.
  - hail size - 0.5-1 cm

UNESCAP/WMO
Typhoon Committee

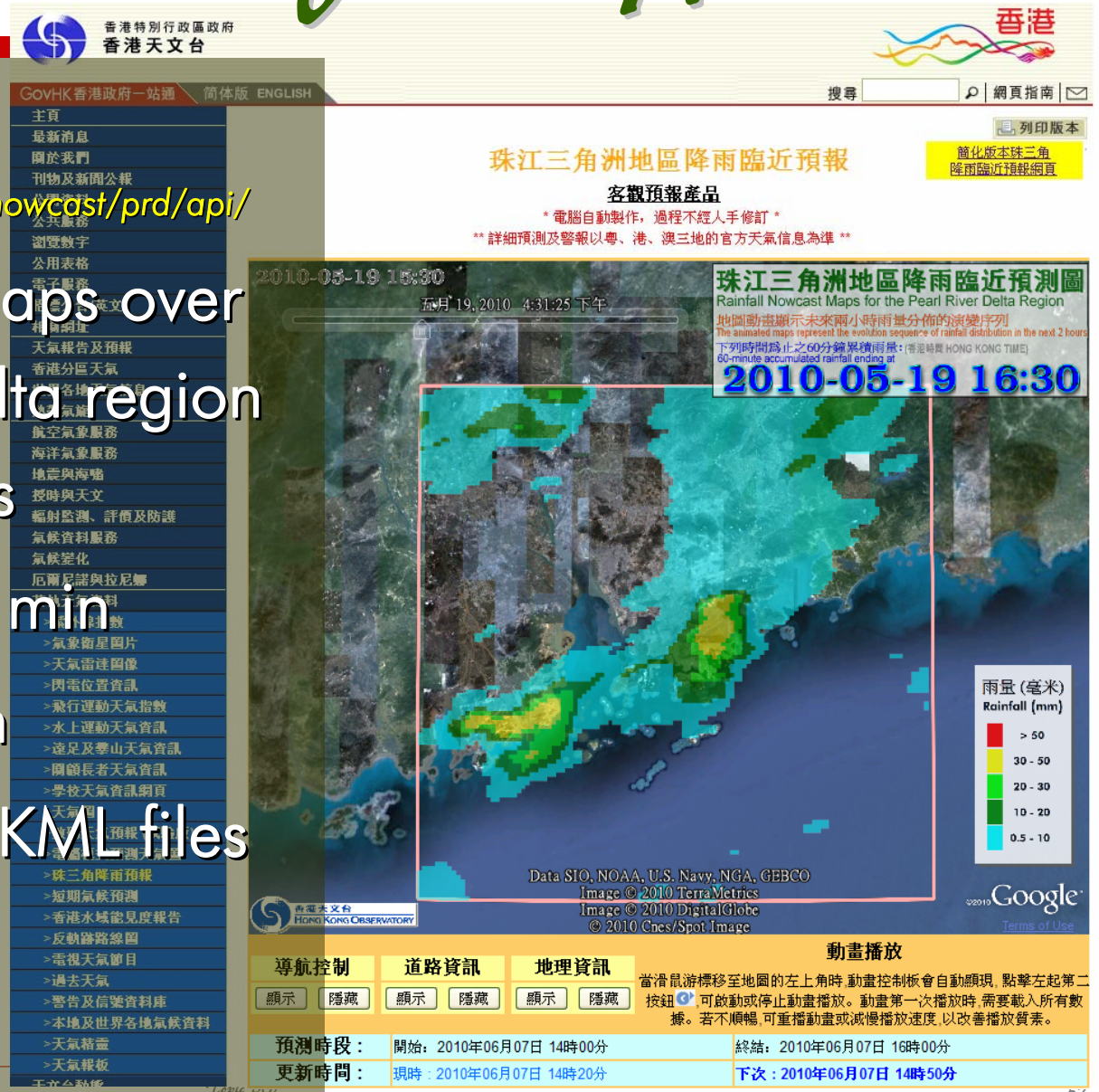
United Nations
ESCAP

WMO OMM

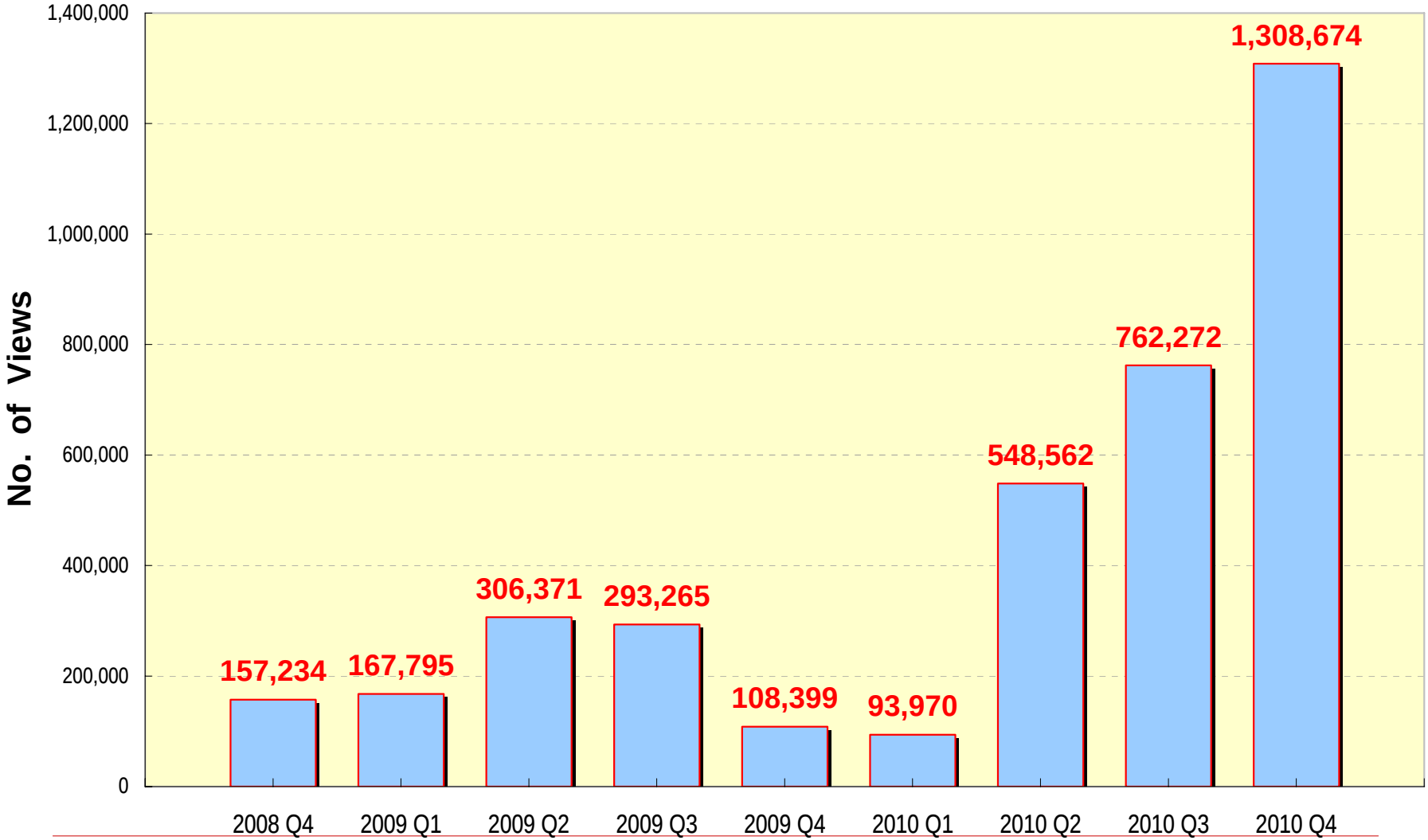
# Public Product & Service

# Rainfall Nowcast for the PRD

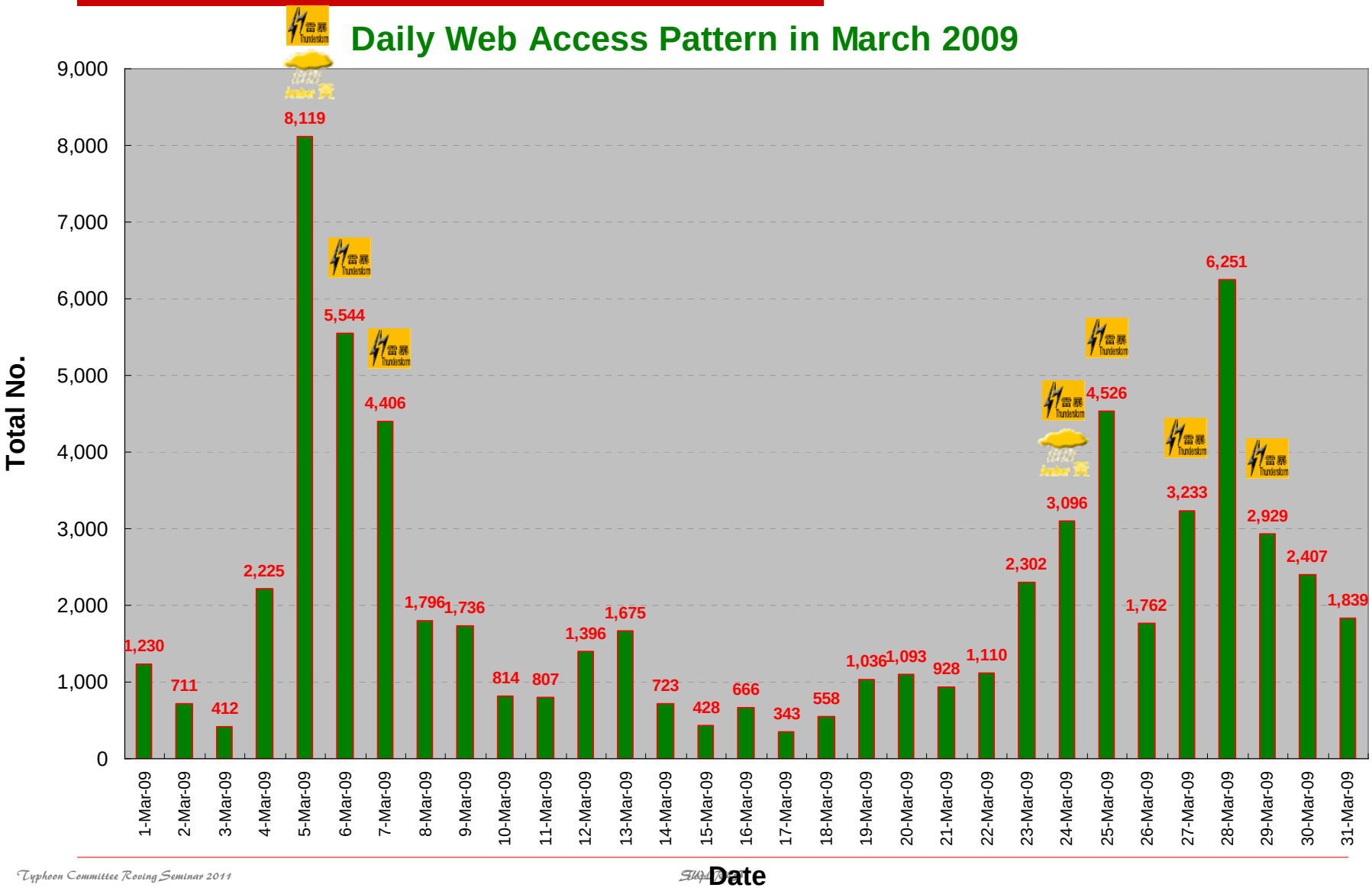
- Internet website:
  - http://www.weather.gov.hk/nowcast/prd/api/
- forecast rainfall maps over the Pearl River Delta region in the next 2 hours
- updated every 30 min
- use GE api/plugin
- downloadable as KML files



# PRD Web Page Access Statistics

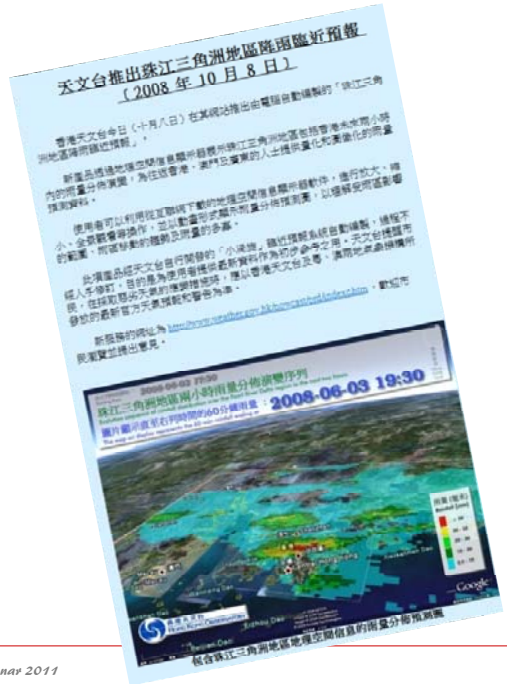


# Usage Pattern Reflects Users' Need



# Publicity & Education

- **primary target users :**
  - *general public*
- **media promotion:**
  - *press release*
  - *flyers*
  - *corporate newsletters*


# Interaction with Users

- radio programme
- fun fairs
- Observatory Open Day
- public talks

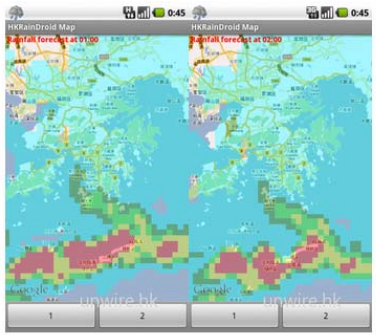


# Advanced Users (1)

- location：
  - Sun Yat-sen University
- downstream usage：
  - Site-specific nowcast tailor-made for various campuses in Guangzhou & Zhuhai
- URL:
  http://7timer.y234.cn/V3/product.php?language=zh_cn&product_id=3

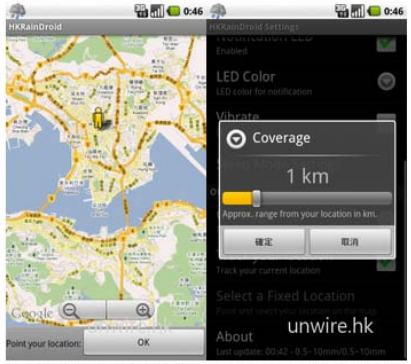
# Advanced Users (2)

- "HKRainDroid" — Android
- free:
  http://www.androidzoom.com/android_applications/news_and_weather/hkraindroid_kiul.html

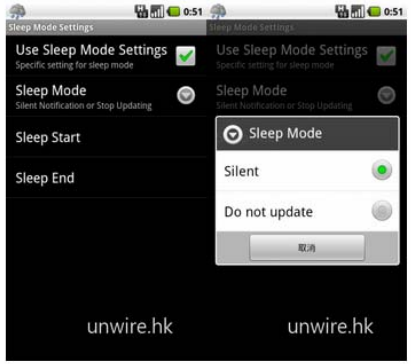




想知道什麼時候會下雨，可進入View Rainfall Map內查看，軟件會跟據香港天文台的數據再配合Google Map將下雨區域作出顯示，每隔30分鐘自動更新一次。左圖便是在凌晨1時的雨區預測，右圖是凌晨2時，可以見到最密集的紅色雨區正在離開香港，但仍然被淺藍色的雨區籠罩著。由於軟件是直接取用Google Maps，所以也會跟據你的電話提供放大縮小功能，讓你看得更加清楚。而《HKRainDroid》暫時只能夠顯示香港區域，身在其他地方便不能夠正常《HKRainDroid》使用。


既然地圖上可看到雨區，我們又應如何得到提示呢？在Notification Preferences設定可以利用Ringtone方式提示你即將有落雨來臨，暫時提供十數種鈴聲，也可以選擇靜音效果。除了聽得到外亦可以利用手機上的LED燈功能作提示，並可以自行設定不同顏色。不過可能是測試版本關係，在筆者的手機上未能正常運作。還有軟件可以設定震動提示，也算是體貼設計。




大家可能會問是否香港有落雨便會作出提示？原來軟件可以透過手機內的A-GPS定位功能自動追蹤你的位置然後再配合所設定的範圍使用。範圍可以有0-5公里設定，假如你現時身在旺角，又設定了1公里的話，代表雨區在你的1公里範圍內便會有所提示，我們亦可以定下自己的實際位置。不過筆者有個疑問就是香港地方實在太少，雨區太大，軟件的反應是否來得及作提示？




《HKRainDroid》還有一項體貼功能便是提供Sleep Mode模式，可以設定時間範圍令軟件不會更新或不會發出聲響，在睡覺時使用便可避免騷擾。既然是睡覺當然不需要知道下雨情況，除非你家中會有漏水或需要收拾衣服吧。


最後便是軟件的開啓方法，其實當《HKRainDroid》的服務打開後便可。當在落雨前1小時左右便會作出通知，Status Bar上會見到落雨圖案，並預測不同時段的降雨量資料。相再詳細看可再拉下Status Bar然後按下便會直接走入Google Maps的雨區畫面，就像右邊的畫面般。而資料經由天文台所提供，所以不準的話也是天文台的問題。

**用後感**

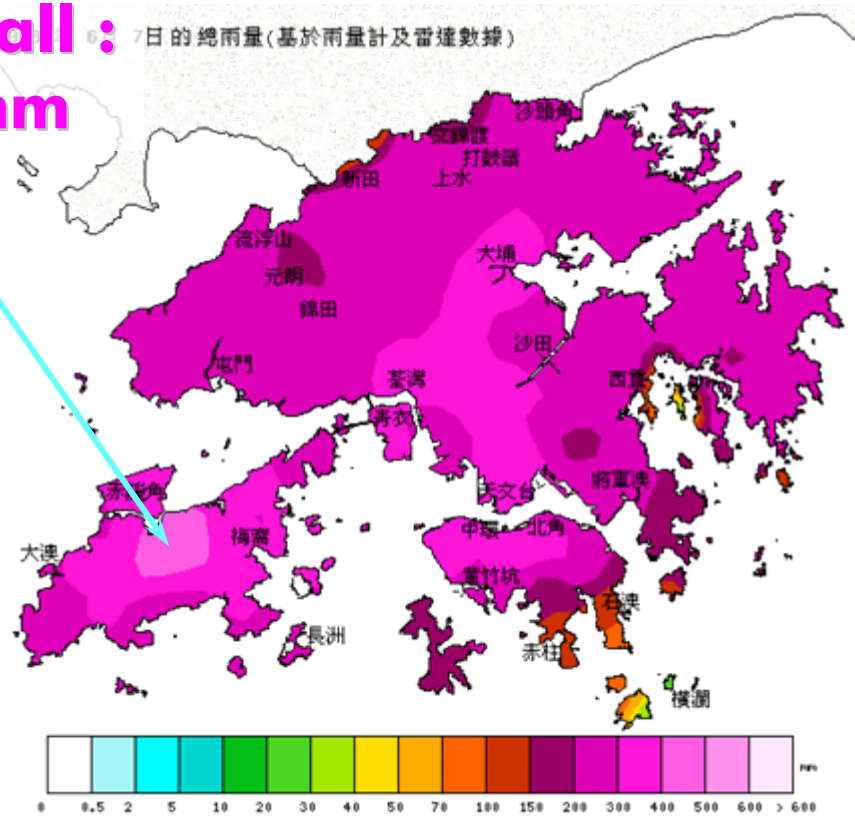
《HKRainDroid》剛推出數天，版本仍是0.1 beta，並已得到天文台授權使用資料。軟件的功能仍然十分簡單，但就十分實用，尤其是近數天突如其來的大雨有了事前通知便可以盡早作出準備。軟件是十分有創意，但仍然有一定的改善空間，除了落雨外如有雷暴顯示功能也是十分不錯。

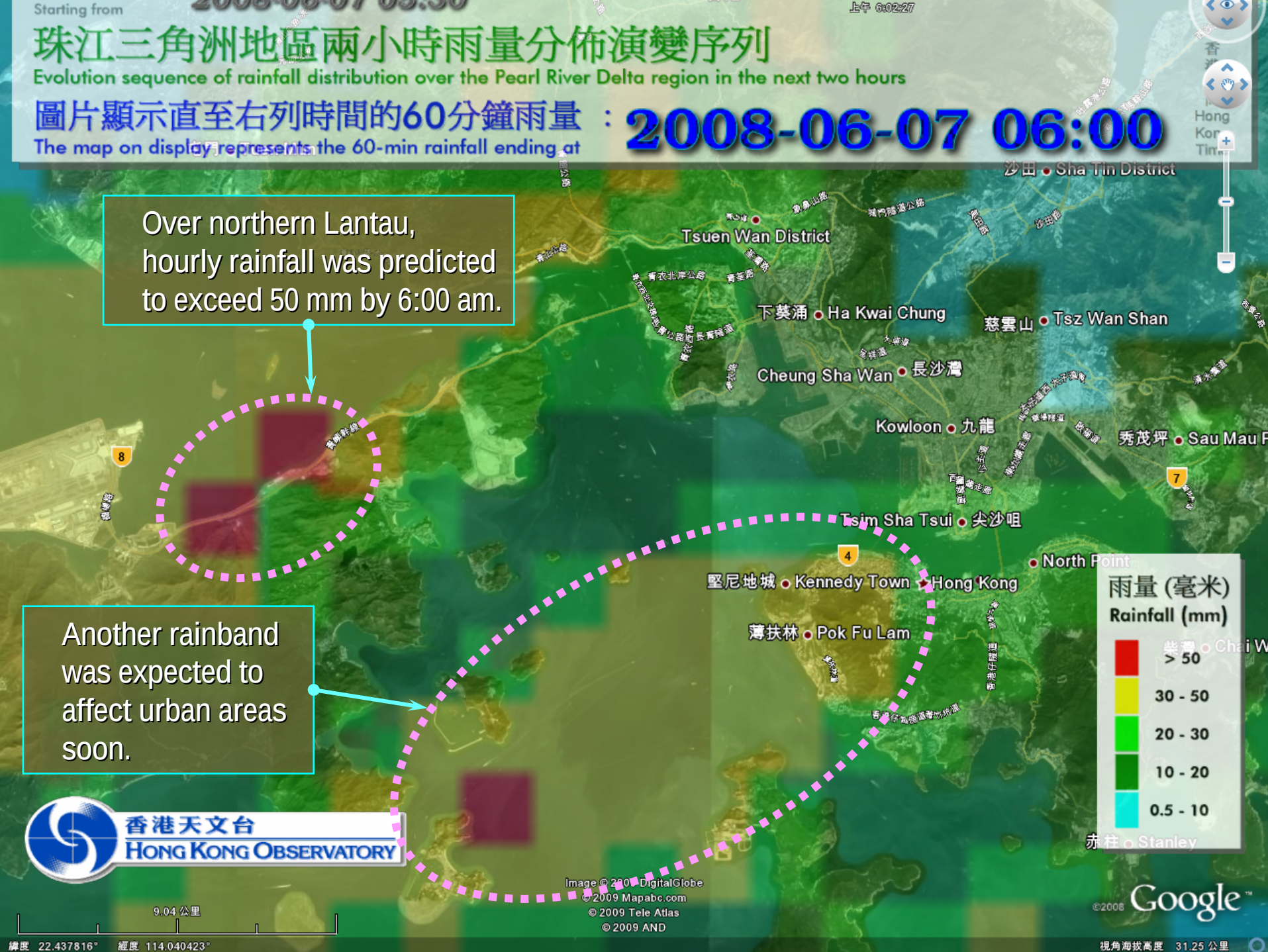
收費：免費

# Example: Black Rainstorm on 7 June 2008

- Landslip Warning issued at 1:10 am
- Black Rainstorm issued at 6:40 am
- Northern Lantau Highway closed at 8:30 am due to floods & landslides
- Serious flooding in urban areas a couple of hours later


**daily rainfall : 400-500 mm**




Starting from
珠江三角洲地區兩小時雨量分佈演變序列
Evolution sequence of rainfall distribution over the Pearl River Delta region in the next two hours
圖片顯示直至右列時間的60分鐘雨量：2008-06-07 06:00
The map on display represents the 60-min rainfall ending at
Over northern Lantau, hourly rainfall was predicted to exceed 50 mm by 6:00 am.
Another rainband was expected to affect urban areas soon.
Tsuen Wan District
下葵涌 Ha Kwai Chung
慈雲山 Tsz Wan Shan
Cheung Sha Wan 長沙灣
Kowloon 九龍
秀茂坪 Sau Mau P
Tsim Sha Tsui 尖沙咀
North Point
堅尼地城 Kennedy Town
Hong Kong
薄扶林 Pok Fu Lam
赤柱 Stanley
雨量 (毫米)
Rainfall (mm)
> 50
30 - 50
20 - 30
10 - 20
0.5 - 10
香港天文台
HONG KONG OBSERVATORY
Image © 2009 DigitalGlobe
© 2009 Mapabc.com
© 2009 Tele Atlas
© 2009 AND
Google
9.04 公里
緯度 22.437816°
經度 114.040423°
視角海拔高度 31.25 公里

Starting from

# 珠江三角洲地區兩小時雨量分佈演變序列

Evolution sequence of rainfall distribution over the Pearl River Delta region in the next two hours

圖片顯示直至右列時間的60分鐘雨量 ： 2008-06-07 06:30

The map on display represents the 60-min rainfall ending at

Over the urban areas, hourly rainfall was predicted to exceed 50 mm by 6:30 am.

Cheung Sha Wan 長沙灣

九龍 Kowloon

秀茂坪 Sau Mau Ping

Tsim Sha Tsui 尖沙咀

油塘 Yau Tong

北角 North Point

Kennedy Town 堅尼地城

Hong Kong Wan Chai

Pok Fu Lam 薄扶林

雨量 (毫米)
Rainfall (mm)

- > 50
- 30 - 50
- 20 - 30
- 10 - 20
- 0.5 - 10

香港天文台
HONG KONG OBSERVATORY

5.32 公里

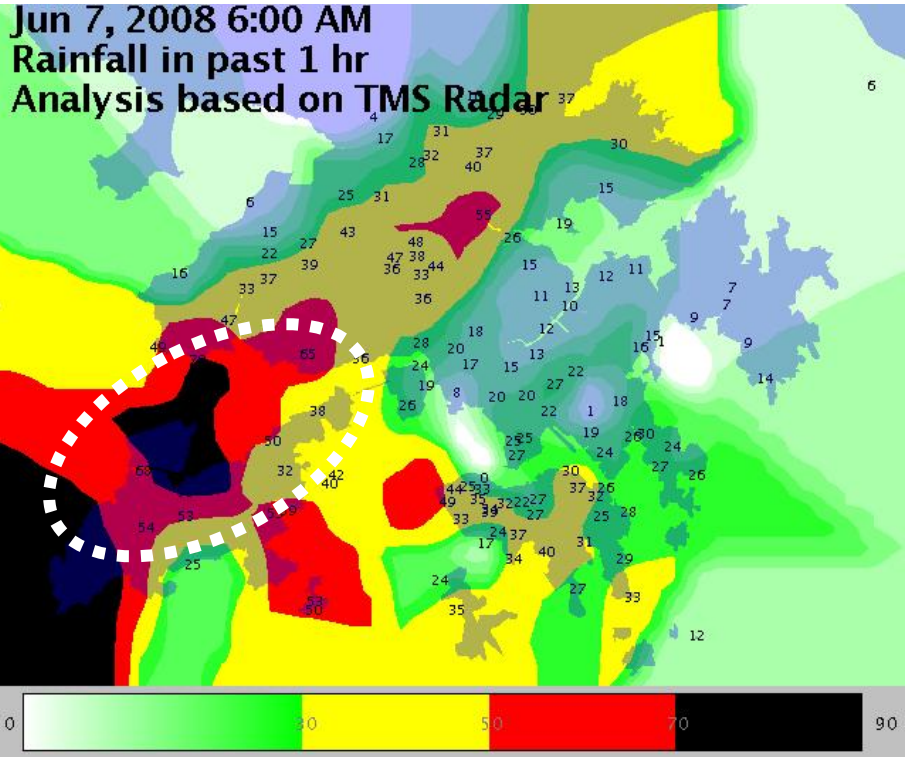
緯度 22.375803° 經度 114.144311°

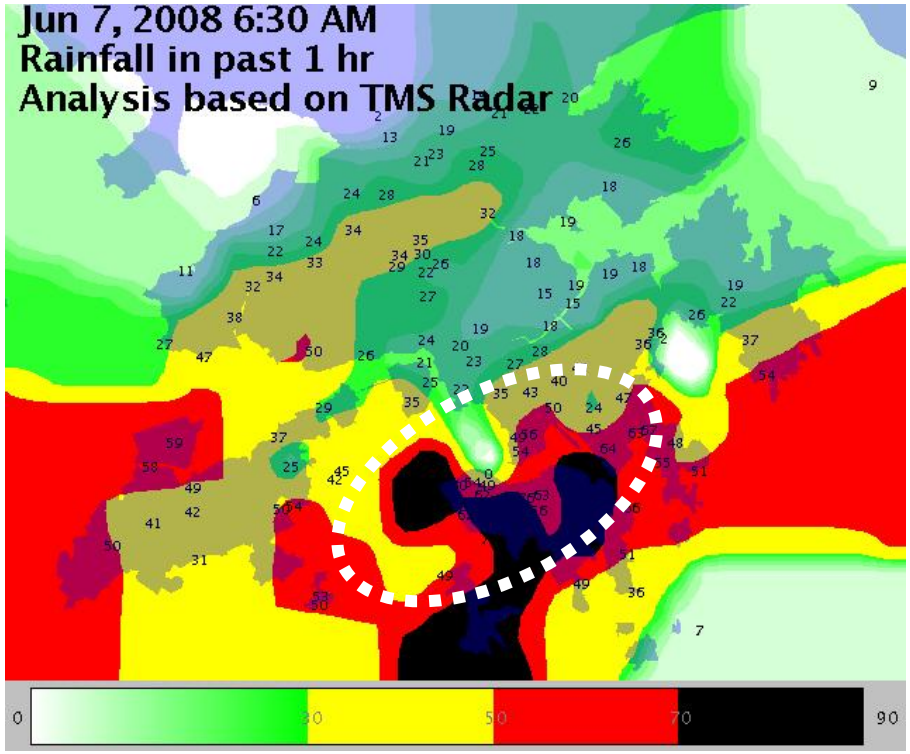
©2008 Google

視角海拔高度 18.41 公里

# Actual Rainfall Distribution

- 60-min accum. ending at 06:00 am on 7 June 2008
- 30 min later




Most parts of Lantau and Hong Kong Island recorded over 50 mm of rainfall (red & black colours)

UNESCAP/WMO Typhoon Committee

United Nations ESCAP

WMO OMM

~ End ~

**Demonstration on SWIRLS in the Tutorial on Topic B this afternoon**