

# **MEMBER REPORT**

ESCAP/WMO Typhoon Committee  
43<sup>rd</sup> Session

25 – 30 January 2011  
Jeju

**(Hong Kong, China)**

**“Annual activities covering the period from  
1 January 2010 to 31 December 2010”**

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# I. Overview of tropical cyclones which have affected/impacted Member's area in 2010

## 1. Meteorological Assessment (highlighting forecasting issues/impacts)

Five tropical cyclones affected Hong Kong from 1 January to 31 December 2010. They were:

- (a) Typhoon Conson (1002)
- (b) Typhoon Chanthu (1003)
- (c) Severe Tropical Storm Lionrock (1006)
- (d) Severe Typhoon Fanapi (1011)
- (e) Super Typhoon Megi (1013)

Conson and Lionrock necessitated the issuance of the Standby Signal No. 1 in Hong Kong, while Chanthu, Fanapi and Megi necessitated the issuance of the Strong Wind Signal No. 3 in Hong Kong. Details are given in the following paragraphs. Figure 1 shows the tracks of these tropical cyclones.

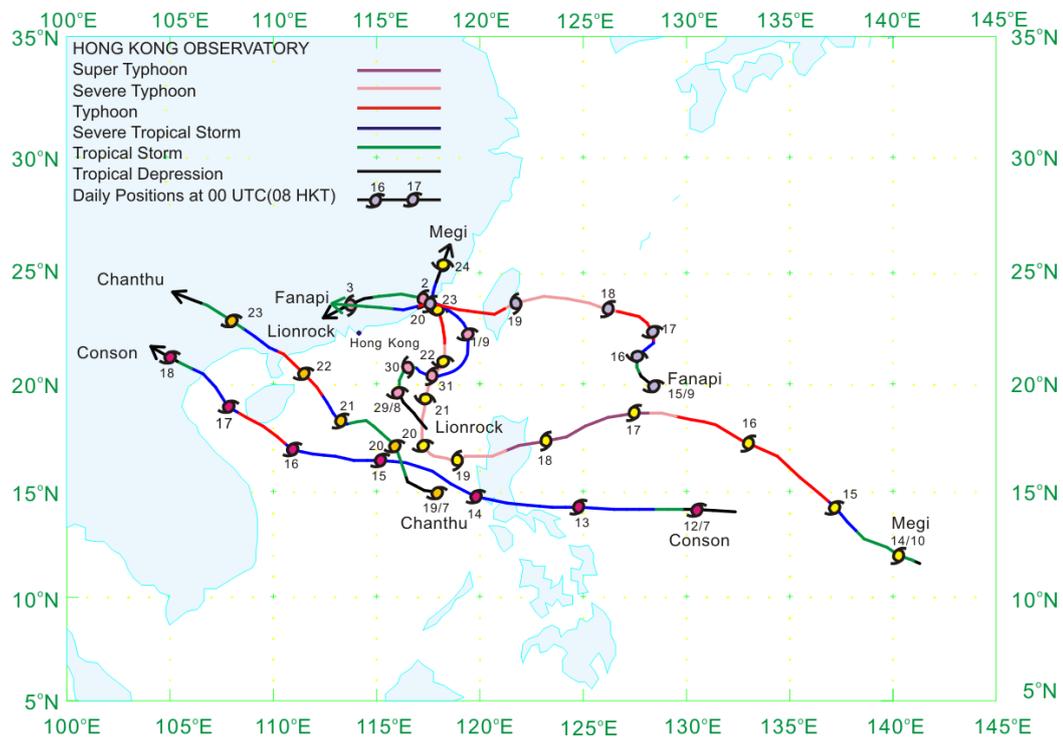


Figure 1 Hong Kong Observatory best tracks of tropical cyclones that affected Hong Kong, China from 1 January to 31 December 2010.

### Typhoon Conson (1002)

Conson formed as a tropical depression over the western North Pacific about 1 200 km east of Manila early on 12 July. Figure 2 shows the track of Conson. Conson crossed the southern part of Luzon during the night of 13 July and entered the South China Sea the following morning. It moved across

the South China Sea from 14 to 16 July and intensified into a typhoon on 16 July, reaching its peak intensity with estimated maximum winds of 120 km/h near its centre. Conson skirted the coast of southwest Hainan that night and crossed Beibu Wan on 17 July. It made landfall over the coast of northern Vietnam that evening and dissipated inland the next day.

In Hong Kong, winds were moderate easterlies on the evening of 15 July, becoming fresh offshore and strong on high ground that night. Conson was closest to Hong Kong at around 8 p.m. that evening when it was about 630 km to the south. Local winds became moderate to fresh east to southeasterlies on 16 July and were strong on high ground. Winds moderated in the evening as Conson gradually moved away from Hong Kong.

The weather in Hong Kong was cloudy with sunny intervals on 15 July, but there were also a few showers and isolated thunderstorms. Under the influence of the outer rainbands of Conson, squally showers and thunderstorms affected Hong Kong on 16 July.

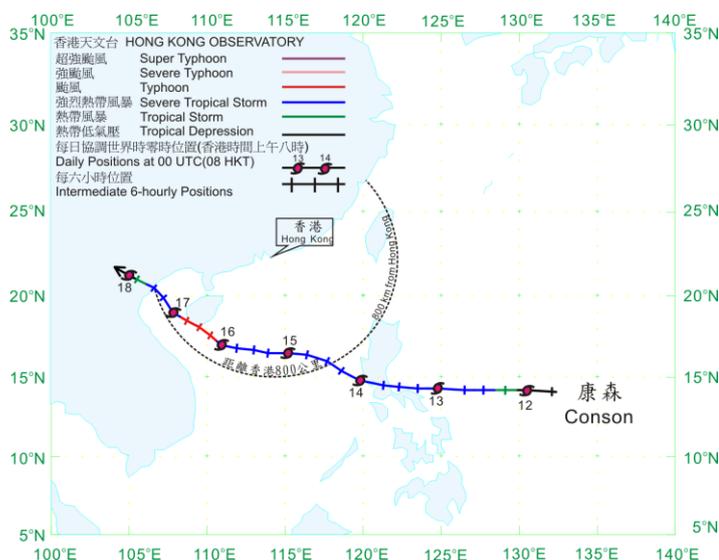


Figure 2 Track of Conson (1002) on 12 – 18 July 2010.

### Typhoon Chanthu (1003)

Chanthu formed over the central part of the South China Sea about 900 km south-southeast of Hong Kong on 19 July and moved generally northwestwards. Figure 3 shows the track of Chanthu. Chanthu intensified into a typhoon to the east of Hainan Island in the early hours of 22 July, reaching its peak intensity with estimated maximum sustained winds of 120 km/h near its centre. It made landfall near Zhanjiang that afternoon and moved across Guangxi on 23 July. Chanthu eventually dissipated inland that night.

In Hong Kong, winds were moderate easterlies on the afternoon of 20 July, occasionally strong on high ground that night. As Chanthu moved closer and intensified, winds freshened from the east on 21 July and became strong on high grounds. Chanthu was closest to Hong Kong at about 5 a.m. on 22 July passing about 330 km to the southwest. Local winds were strong offshore and on high ground in the morning on 22 July and turned to southeasterlies during the day. As Chanthu moved gradually away from Hong Kong, local winds subsided further that afternoon.

Affected by the subsidence zone ahead of Chanthu, the weather in Hong Kong was fine and very hot on 20 July. Under the influence of the outer rainbands of Chanthu, there were squally showers and thunderstorms in the following two days.

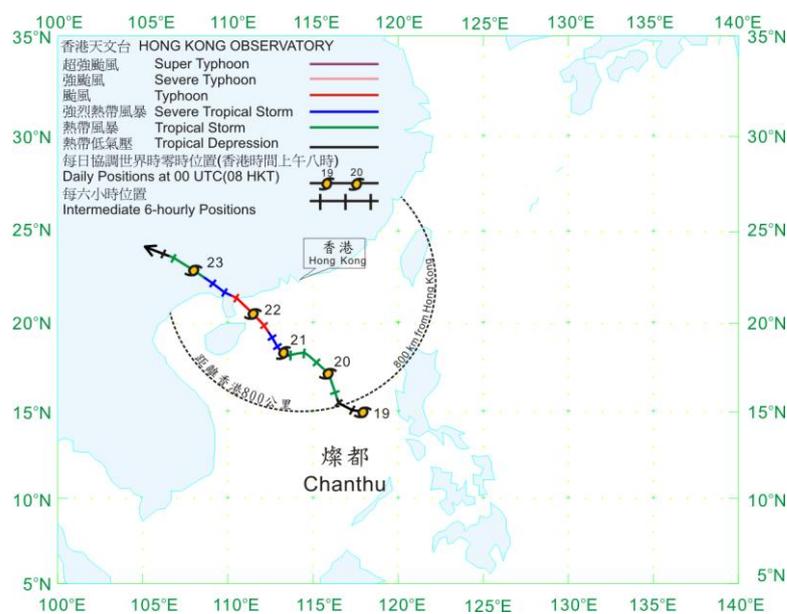


Figure 3 Track of Chanthu (1003) on 19 – 23 July 2010.

### Severe Tropical Storm Lionrock (1006)

Lionrock formed as a tropical depression over the northern part of the South China Sea about 600 km south-southeast of Hong Kong on 28 August and moved northwestwards. Figure 4 shows the track of Lionrock. It took a north to northeasterly track the next day and drifted east to east-southeastwards on 30 August. It intensified into a severe tropical storm that evening, reaching its peak intensity with estimated maximum sustained winds of 90 km/h near its centre. On 31 August, Lionrock speeded up and gradually changed its course to the north-northeast. It adopted a northwesterly course the following day and traversed the northeastern part of the South China Sea. After making landfall over the coast of southern Fujian on 2 September morning, Lionrock weakened

into a tropical storm. It then moved generally westwards and subsequently dissipated over Guangdong on 3 September afternoon.

In Hong Kong, winds were moderate northerlies on 29 August and became occasionally strong on high ground the next day. Light to moderate northerlies generally prevailed for 31 August – 1 September. The winds turned to moderate westerlies on 2 September. Lionrock edged closer to Hong Kong once more on 2 September and local winds turned to the south on 3 September and were occasionally fresh offshore. Lionrock was closest to Hong Kong at about 2:00 p.m. on 3 September passing about 150 km to the north-northwest.

Under the influence of the outer rainbands of Lionrock, there were isolated squally thunderstorms on 29 August and 30 August. Under the subsidence ahead of Lionrock, it was very hot with sunny periods in the following two days. The weather turned cloudy with a few showers on 2 September. Rain became heavy at times with a few squally thunderstorms the following day.

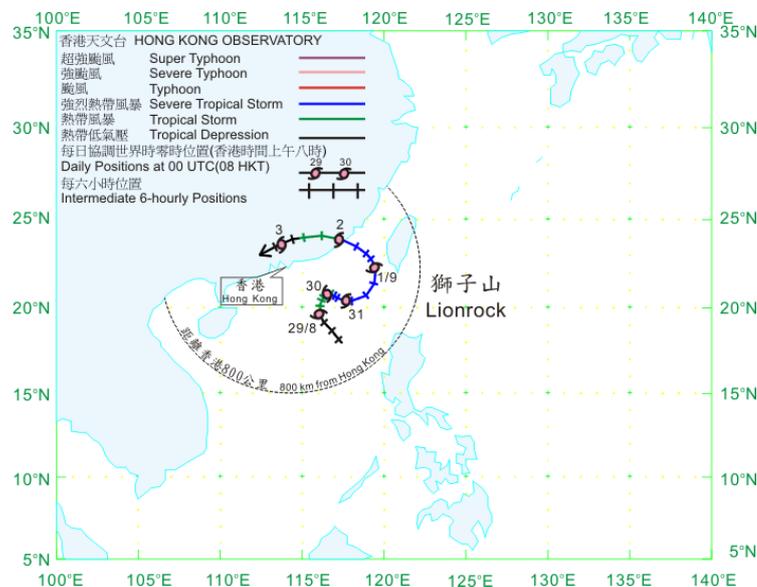


Figure 4 Track of Lionrock (1006) on 28 August – 3 September 2010.

### Severe Typhoon Fanapi (1011)

Fanapi formed as a tropical depression over the western North Pacific about 750 km south of Okinawa on 15 September and moved northwestwards. Fig. 5 shows the track of Fanapi. Fanapi moved northeastwards slowly on 16 September and resumed a northwesterly track on 17 September and intensified into a typhoon over the western North Pacific to the east of Taiwan. Fanapi intensified further into a severe typhoon on 18 September, reaching its peak intensity with estimated maximum sustained winds of 165 km/h near its centre and turning to move generally westwards. It crossed Taiwan on 19 September and weakened into a typhoon. Fanapi crossed the Taiwan Strait that night. It made landfall over the coastal areas of southern Fujian on 20 September and

weakened into a severe tropical storm. Fanapi then tracked westwards across Guangdong and dissipated near Guangzhou on the morning of 21 September.

In Hong Kong, winds were moderate westerlies on 19 September and freshened on 20 September with occasionally strong winds on high ground. Local winds turned to the southwest and strengthened further that night to become strong over offshore waters, occasionally reaching gale force on high ground. Fanapi was closest to Hong Kong between 1 and 2 a.m. on 21 September passing about 150 km to the north of the Hong Kong Observatory's Headquarters. As Fanapi weakened overland, local winds moderated that morning

Under the influence of the subsiding air ahead of Fanapi, the weather was generally fine and very hot on 19 September. The rainbands of Fanapi started to affect Hong Kong during the afternoon of 20 September and there were heavy rain with squally thunderstorms. Heavy rain with a few squally thunderstorms continued to affect Hong Kong on 21 September.

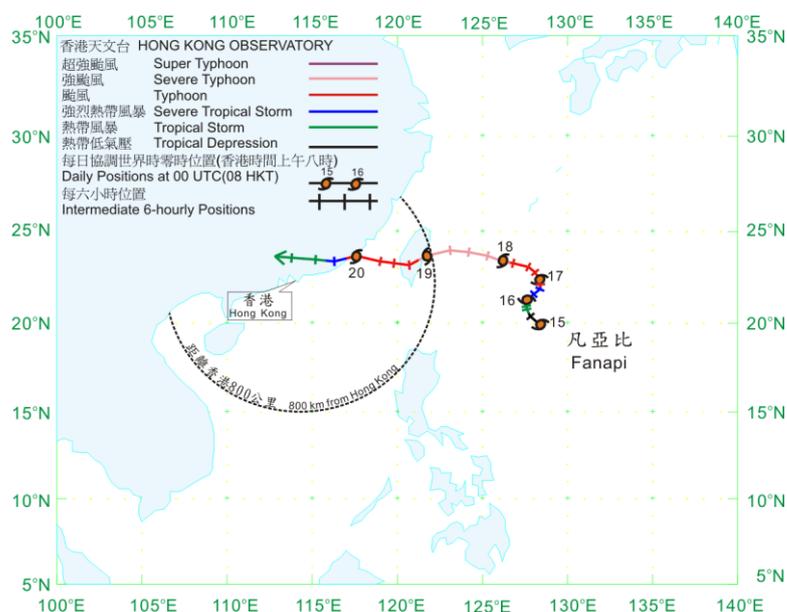


Figure 5 Track of Fanapi (1011) on 15 -21 September 2010.

### Super Typhoon Megi (1013)

Megi was the first super typhoon over the western North Pacific in 2010. It was also one of the most intense tropical cyclones over the western North Pacific since 1980s.

Megi formed as a tropical depression over the western North Pacific about 450 km west-southwest of Guam on 13 October and moved west-northwest to northwestwards. Figure 6 shows the track of Megi. On 15 October, Megi gradually intensified into a typhoon over the Pacific to the east of the Philippines. It turned to move west-southwestwards and became a

super typhoon on 17 October, reaching its peak intensity with maximum sustained winds of about 270 km/h near its centre. Megi crossed Luzon on 18 October and weakened into a severe typhoon. It slowed down and moved generally westwards on 19 October, but turned to move generally northwards the next day. Megi weakened into typhoon over the northeastern part of the South China Sea on 22 October. It made landfall over the coast of Zhangpu, Fujian on 23 October and dissipated over Fujian on the morning of 24 October.

In Hong Kong, winds were fresh north to northeasterlies, occasionally strong over offshore waters and on high ground on 20 October. With Megi edging closer to the south China coast and under the combined effect of Megi and the northeast monsoon, winds strengthened to become fresh northerlies, strong offshore and occasionally reaching gale force on high ground on 21 October. Megi came as close as 430 km to the east-southeast at about 2 a.m. on 22 October. It weakened into a typhoon towards the evening and local winds also decreased gradually.

Under the combined influence of the northeast monsoon and Megi, it was mainly cloudy and dry in Hong Kong on 20 October. There were a few showers on 21 and 22 October under the influence of the outer rainbands of Megi.

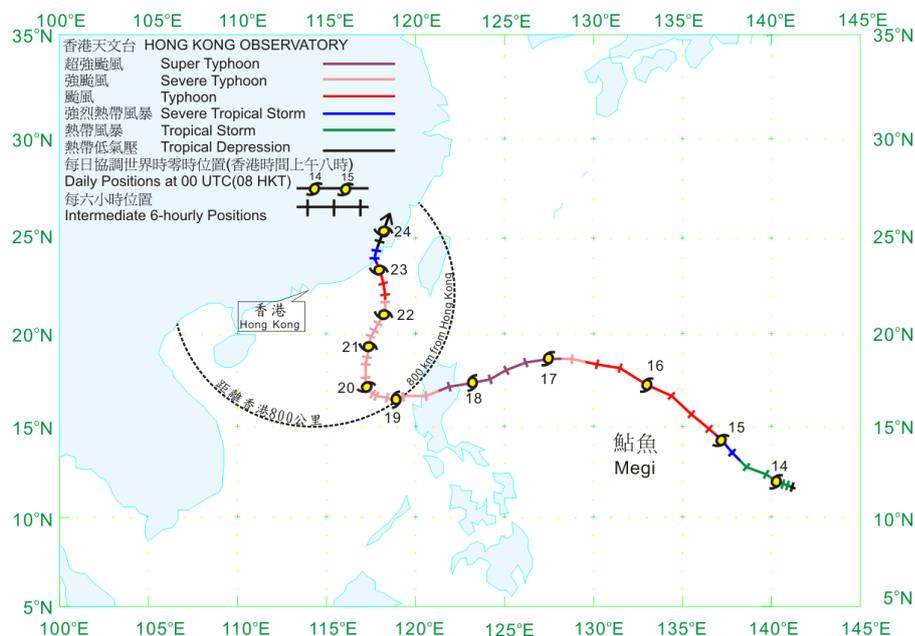


Figure 6 Track of Megi (1013) on 13 -24 October 2010.

## 2. Hydrological Assessment (highlighting water-related issues/impact)

During the passage of Conson, over 20 millimetres of rainfall were recorded in most parts of Hong Kong, locally up to 60 millimetres of rainfall were recorded in the western part of Hong Kong Island.

During the passage of Chanthu, heavy rain affected Hong Kong in the afternoon on 22 July and the first Black Rainstorm Warning Signal this year was issued. The Special Announcement on Flooding in the northern New Territories and the Landslip Warning were also issued. Over 100 millimetres of rainfall were recorded generally in Hong Kong with over 250 millimetres of rainfall recorded in parts of the New Territories.

During the passage of Lionrock, 50-100 millimetres of rainfall were recorded in most parts of Hong Kong. Locally, over 200 millimetres of rainfall were recorded in southern part of Lantau Island.

During the passage of Fanapi, over 150 millimetres of rainfall were recorded in most parts of Hong Kong. Locally, more than 300 millimetres of rainfall were recorded in parts of Hong Kong Island. The Amber Rainstorm Warning was issued for about 2 hours in the evening on 20 September. Heavy rain with a few squally thunderstorms continued to affect Hong Kong with the Amber and Red Rainstorm Warnings in force in the early hours of 21 September.

During the passage of Megi, only around 10 millimetres were recorded over the northeastern part of Hong Kong.

### 3. Socio-Economic Assessment (highlighting socio-economic and DPP issues/impacts)

During the passage of Conson, apart from the windscreen of a van being damaged by a fallen tree trunk in the New Territories, there was no significant damage in Hong Kong.

During the passage of Chanthu, the heavy rain during the afternoon on 22 July resulted in at least 42 reports of flooding and seven reports of landslips. There were widespread flooding in Hong Kong and the flooding was most severe in the northern part of the New Territories. Four people were killed by the flood waters in the New Territories and tens of people were injured. At the Hong Kong International Airport, two flights were diverted due to adverse weather. A passer-by was injured by fallen objects blown off by winds in Kowloon, Hong Kong. A section of a 20-metre tall tree fell in Tsuen Wan on 21 July, fortunately no one was injured.

No significant damage was reported in Hong Kong during the passage of Lionrock.

Affected by the rainbands associated with Fanapi, there were three reports of flooding in Hong Kong on the morning of 21 September. In one case on Hong Kong Island, villagers were trapped by flood waters and had to be rescued by firemen. There were 47 reports of fallen trees, damaging a few vehicles, but fortunately no one was injured.

There were at least 10 reports of fallen trees in Hong Kong during the approach of Megi, affecting the traffic in various parts of the territory. A 50-metre crane on a construction site in Tsing Yi collapsed, fortunately with no one injured.

4. Regional Cooperation Assessment (highlighting regional cooperation successes and challenges)  
Nil.

**II. Summary of progress in Key Result Areas** (For achievements/results which apply to more than one Key Result Area, please describe them under the most applicable Key Result Area. Then, at the end of the description, place in parentheses ( ) the other applicable Key Result Areas)

1. **Progress on Key Result Area 1: Reduced Loss of Life from Typhoon-related Disasters.** (List progress on the Strategic Goals and Associated Activities in the Strategic Plan and progress on the 2008 Typhoon Committee Annual Operating Plan goals)

- a. Meteorological Achievements/Results

The Tropical Cyclone Information Display and Processing System (TIPS), the major system for TC forecast operations, was enhanced with incorporation of the Observatory's mesoscale non-hydrostatic model (meso-NHM), the ensemble mean track of China Meteorological Administration, UK Met. Office and Korea Meteorological Administration based on data available from the THORPEX GIFS-TIGGE project, and the overlay of tropical cyclone strike probability information derived from the CMA EPS, in addition to ECMWF EPS and JMA One-week EPS, to facilitate the formulation of the subjective warning track.

The new generation numerical weather prediction (NWP) system of the Observatory has been put into operation since June 2010. The system, named as the Atmospheric Integrated Rapid cycle (AIR) forecast model, was developed with the kind support of JMA based on their Non-hydrostatic Model (NHM). It provides 72 hours and 15 hours of forecasts at horizontal resolution of 10 km and 2 km respectively. With the improved model physics and higher horizontal resolution comparing to the previous NWP system, AIR forecast model shows improvement in the weather forecasts on both surface and upper levels. To support the prediction of high-impact weather due to tropical cyclones, new products like distribution of surface wind and gusts have been developed for reference by forecasters to assess the change of wind intensity over coastal areas of southern China (Figure 7).

### Meso-NHM Forecast Wind Gusts and Wind Vectors at 10 m level

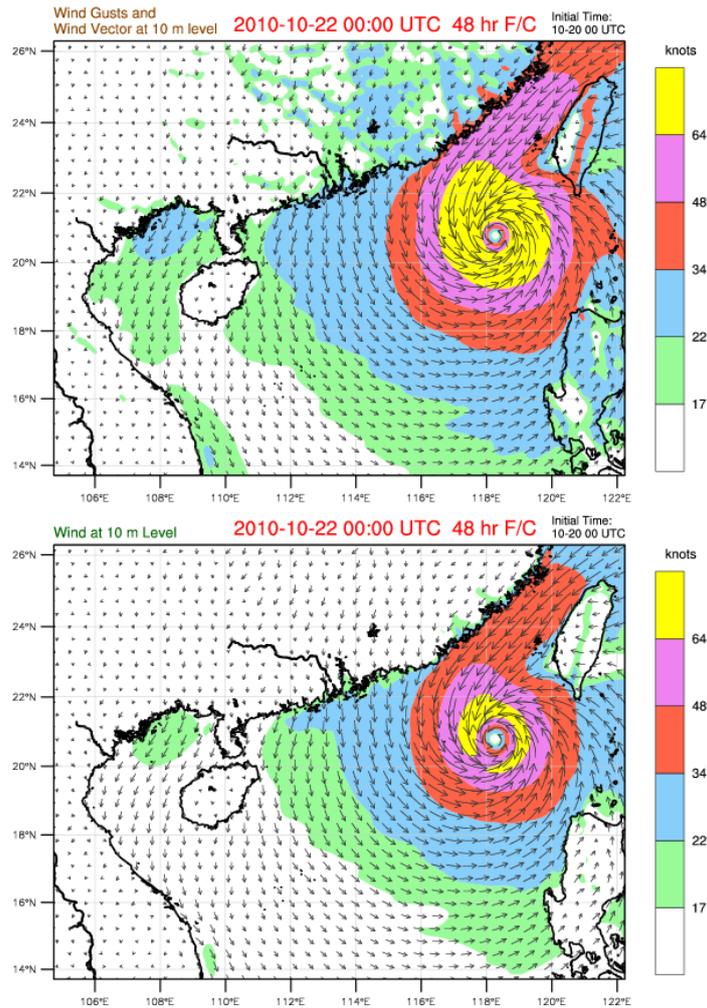


Figure 7. 48 hr forecast of surface wind gusts (upper panel) and winds at 10 m level (lower panel) from 10 km NHM for Super Typhoon Megi (1013) at 00 UTC, 22 October 2010. Wind speeds (in knots) are represented by color shading and areas of strong force wind (blue) are forecast to cover the coastal waters in the vicinity of Hong Kong.

### b. Hydrological Achievements/Results

The radar tracking algorithm of the SWIRLS (Short-range Warning of Intense Rainstorms in Localized Systems) nowcasting system was upgraded from correlation-based to optical flow-based. The verification results for 2010 showed that the optical flow-based quantitative precipitation forecasts (QPF) were more skilful in general. A grid-based real-time QPF verification system was set up for effective performance monitoring and algorithm tuning. For better rainfall analysis in support of hydrological applications, especially over gauge sparse areas, a new quantitative precipitation estimation (QPE) technique based on radar-rain gauge co-Kriging was under development. The same QPE technique was also being explored for application to quality control of rain gauge data.

The Observatory provided support to the Drainage Service Department in their review of the Drainage Master Plans in Yuen Long & North Districts and feasibility study of applying integrated water resources management system in real-time flood forecasting. Results showed that direct output from SWIRLS nowcasting system agreed reasonably well with the measurement at the nearest rain gauge but did not serve as a good predictor of flooding over a small catchment due to spatial variation and time fluctuation. Further studies would be conducted where opportunities arise.

The Observatory provided the Drainage Service Department with a forecast guidance on the likelihood of having rainstorms (widespread and persistent heavy rain with hourly rainfall at 30 mm or higher) in Hong Kong in the next couple of hours to facilitate their flood control operations. It was presented in iconic form, with intuitive graphical content flipping between two possible states: “(80%” or “<80%” (meaning high chance or not). The probability guidance was based on the rainfall forecasts generated by the SWIRLS (Short-range Warning of Intense Rainstorms in Localized Systems) nowcasting system and historical rainstorm data.

### c. Disaster Prevention and Preparedness Achievements/Results

In order to facilitate the flood related operations of relevant government departments, Short Message Service (SMS) was arranged to alert key operational personnel upon the real-time regional rainfall exceeding the thresholds of 50 mm/hr and 70 mm/hr.

With the successful implementation of a localized alert system on storm surge flooding for a small rural village community in 2009, similar early alert system was implemented for five more vulnerable areas in Hong Kong in 2010. Early alerts would be communicated to key operational personnel using the Short Message Service (SMS). Super Typhoon Megi (1013) posed severe threats to countries along its path in October 2010. In Hong Kong, localized storm surge alerts were activated during the approach of Megi. Necessary precautions were taken in time for preventing flooding caused by possible storm surge (Figure 8).



Figure 8. Precautions taken at one of the flood-prone locations during the passage of Severe Typhoon Megi

#### d. Research, Training, and Other Achievements/Results

An Observatory's officer lectured on tropical cyclone wind and rainfall forecasting in a training workshop at Shanghai organized under the WMO Typhoon Landfall Forecast Demonstration Project. The objective of the workshop is to enhance the ability of weather forecasters in tropical cyclone forecasting, especially the provision of better forecast services for the World Expo 2010.

A training course on "Automated Weather Station Network" was provided to 11 meteorologists from 11 WMO Members by the Observatory from 29 November to 3 December 2010. It covered, amongst other topics, applications of automated weather station network in monitoring weather situation during the passage of tropical cyclones. Data on wind, rain, water levels, etc. gathered from local automatic weather stations is made available in real-time on the Internet, providing detailed and timely weather information to government personnel and the public for mitigation of damage and casualties caused by tropical cyclones.

#### e. Regional Cooperation Achievements/Results

Please refer to Key Result Area 2(e).

#### f. Identified Opportunities/Challenges for Future Achievements/Results

Nil.

2. **Progress on Key Result Area 2: Minimized Typhoon-related Social and Economic Impacts.** (List progress on the Strategic Goals and Associated Activities in the Strategic Plan and progress on the 2008 Typhoon Committee Annual Operating Plan goals)

a. **Meteorological Achievements/Results**

Please refer to Key Result Area 1(a).

b. **Hydrological Achievements/Results**

The Drainage Service Department liaised closely with other relevant Government departments and persons in charge of construction sites to avoid flooding due to blockage of roadside gullies, drains or watercourses by garbage or construction waste. Television announcements were broadcast from time to time soliciting the support of the public to keep the drainage system from blockage.

The Drainage Service Department provided a 24-hour hotline to facilitate reception of flooding complaints and to mobilize their labour force and contractors. Complaints received by the department were recorded by a computerized Drainage Complaints Information System so that data could be retrieved and analyzed later. When the situation warranted, an Emergency Control Centre under the charge of senior professionals would be activated.

Please also refer to Key Result Area 5(b).

c. **Disaster Prevention and Preparedness Achievements/Results**

Typhoon related information on Hagupit (2008) and Koppu (2009) were prepared and provided to NIDP, Republic of Korea for the production of brochures. The information highlights the impact of the storm surge during the passage of Hagupit and the new alerting system on storm surge during the passage of Koppu.

Damage figures brought about by tropical cyclones and rainstorms were collected from selected Government departments and public utility companies for the compilation of damage statistics. The results were provided in the annual tropical cyclone publication of the Observatory.

d. **Research, Training, and Other Achievements/Results**

Nil.

e. **Regional Cooperation Achievements/Results**

As one of the contributions to the WMO Typhoon Landfall Forecast Demonstration Project in assessing the social and economic impacts of an improved tropical cyclone forecast service, the Observatory shared the experience of conducting public and customer opinion surveys with the Shanghai Typhoon Institute.

f. Identified Opportunities/Challenges for Future Achievements/Results  
Nil.

**3. Progress on Key Result Area 3: Enhanced Beneficial Typhoon-related Effects for the Betterment of Quality of life.** (List progress on the Strategic Goals and Associated Activities in the Strategic Plan and progress on the 2008 Typhoon Committee Annual Operating Plan goals)

a. Meteorological Achievements/Results  
Nil.

b. Hydrological Achievements/Results  
Nil.

c. Disaster Prevention and Preparedness Achievements/Results  
Nil.

d. Research, Training, and Other Achievements/Results  
Nil.

A paper on the benefits of typhoons from the Hong Kong perspective was presented in the 5th ESCAP/WMO Typhoon Committee's Integrated Workshop "Urban Flood Risk Management in a Changing Climate: Sustainable and Adaptation Challenges" held in September 2010. The study revealed that the rainfall associated with tropical cyclones accounted for a significant portion of Hong Kong's annual total rainfall and would help alleviate the prevailing drought. Furthermore, based on data in 2007-2009, tropical cyclones provided a net cooling effect in Hong Kong. Tropical cyclones could also enhance potential wind energy in Hong Kong.

e. Regional Cooperation Achievements/Results  
Nil.

f. Identified Opportunities/Challenges for Future Achievements/Results  
Nil.

**4. Progress on Key Result Area 4: Improved Typhoon-related Disaster Risk Management in Various Sectors.** (List progress on the Strategic Goals and Associated Activities in the Strategic Plan and progress on the 2008 Typhoon Committee Annual Operating Plan goals)

## a. Meteorological Achievements/Results

The convective weather associated with a tropical cyclone may have adverse effects on flight operations, with implications on both aviation safety and efficiency. In support of air traffic management (ATM), an Aviation Thunderstorm Nowcasting System (ATNS) was developed and put into trial operation since May 2010 to forecast the location of thunderstorms in the next 60 minutes by extrapolation based on artificial intelligence technique. ATNS automatically determines the movement of thunderstorms from the radar image sequence every 6 minutes and forecasts their future locations at 6-minute time steps. It is found to be useful in forecasting the thunderstorms in the outer rain bands of tropical cyclones. Alerts on severity of thunderstorms affecting the vicinity of HKIA (Figure 9) are generated for reference by aviation weather forecasters and air traffic controllers. Based on 5 tropical cyclone cases in 2010, ATNS demonstrates a 30-minute nowcasting skill with probability of detection (POD) larger than 70% and false alarm rate (FAR) under 30%.

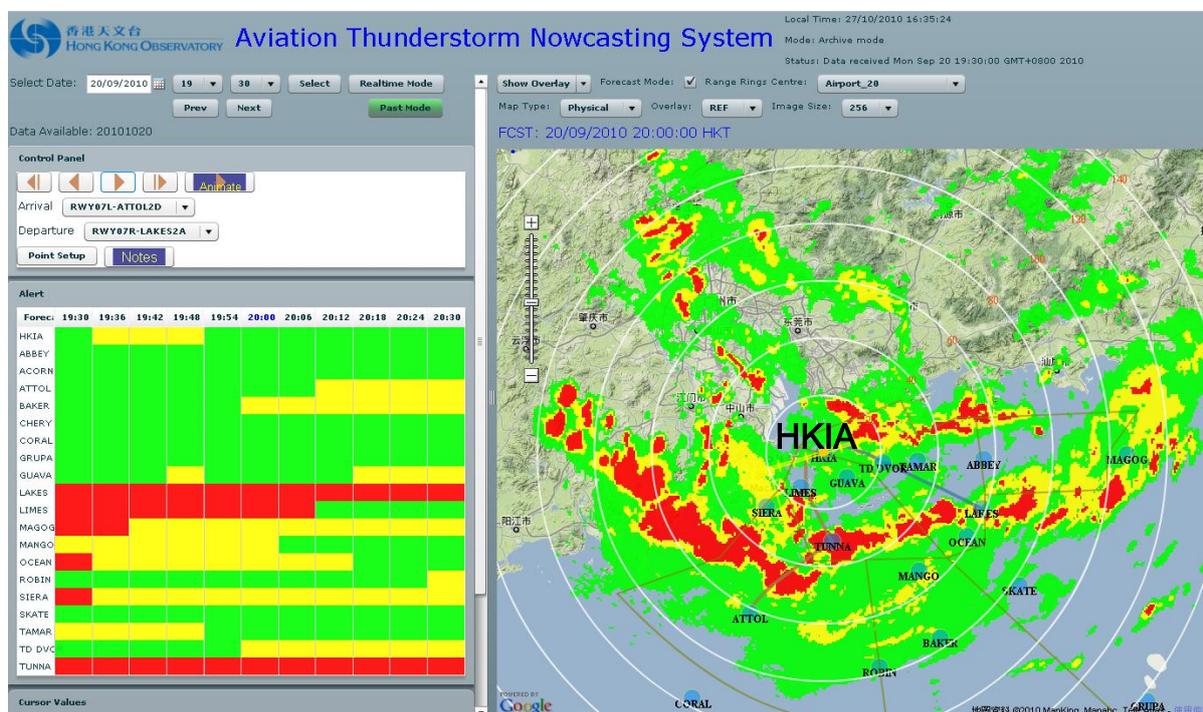


Figure 9. A web-based interface showing the forecast locations of thunderstorms around HKIA (right panel with different colors indicating the intensity of forecast radar reflectivity) and the corresponding alerts at selected locations (left panel) for the case of Severe Typhoon Fanapi (1011) at 12:00 UTC on 20 September 2010.

High crosswind may have adverse impact on flight operations. To support the forecasting of high crosswinds, objective probabilistic wind speed and crosswind forecasts for the Hong Kong International Airport (HKIA) were generated based on ECMWF EPS outputs for reference by aviation users

and forecasters on a trial basis. Figure 10 shows the probabilistic products during the passage of Severe Typhoon Megi in October 2010. To facilitate near real-time verification, 10-minute mean wind observations ending on the hour from the anemometers on the runways of HKIA are overlaid and denoted by vertical black segments spanning the range of wind speed observations from various anemometers. The wind observation in METAR report is marked with a cross in the figure. New products of probabilistic forecast of tropical cyclone distance from HKIA and probability map of tropical cyclone positions would also be generated and put on trial in 2011 with a view to facilitating users' understanding of the spread in the probabilistic wind forecasts.

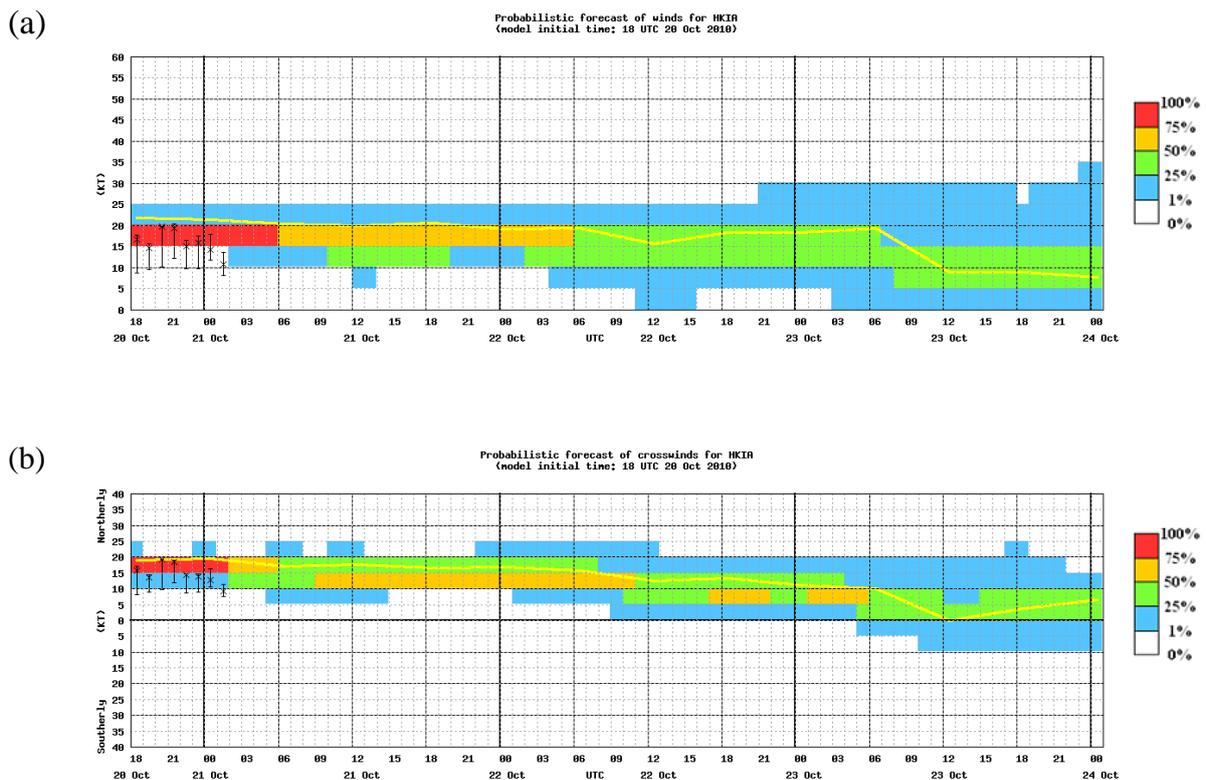


Figure 10 Objective probabilistic forecast of (a) wind speed; (b) crosswind for HKIA during the passage of Severe Typhoon Megi in October 2010.

## b. Hydrological Achievements/Results

Dynamic hydrological and hydraulic computer models for the drainage systems in Hong Kong managed by the Drainage Service Department were developed to provide quantitative information on the risk of flooding, impacts of development and the performance of various flood loss mitigation options. In particular, all the trunk and major branch river channels in the most flood-prone river basins in the northern part of Hong Kong had been digitized into the computational hydraulic model which was used for the review of the hydrological criteria for the release of basin-wide flood warning in the region. A computerized stormwater drainage asset inventory and maintenance system

had been developed. In the past year, the Drainage Service Department had completed several research studies including a review on the triggering criteria for the Special Announcement on Flooding in the northern New Territories, a sensitivity analysis of the hydraulic effect of mangrove growth in river estuary, an analysis of effects of climate change on stormwater drainage system, the use of local rainfall forecasts to mobilize maintenance staff to deal with flooding, and a study to identify the critical input parameters of the MIKE11 model and to quantify their uncertainties and sensitivities on the flood risk assessment.

A study to estimate extreme rainfall intensities for various locations over the whole territory using a regional frequency analysis approach was being carried out and would be completed in early 2012.

c. Disaster Prevention and Preparedness Achievements/Results

Nil.

d. Research, Training, and Other Achievements/Results

An Observatory's officer attended the Workshop on "Space Application to Reduce Water-related Disaster Risk in Asia" organized by ESCAP and supported by WMO Typhoon Committee and Japan Space Exploration (JAXA) in Bangkok from 7 to 9 December 2010.

Please also refer to Key Result Area 2 (d).

e. Regional Cooperation Achievements/Results

A pilot project on "Aviation Weather Disaster Risk Reduction" (ADRR) in RA II was established in the WMO Commission for Aeronautical Meteorology session in 2006 with a focus on tropical cyclone hazards.

Under the project, dedicated website (<http://adrr.weather.gov.hk>) for the pilot project developed by the Observatory was being extended to cover the Bay of Bengal and the Arabian Sea (see Figure 11) with the official tropical cyclone forecasts, advisories (TCAC New Delhi), numerical weather prediction products and satellite imageries of that area provided by India Meteorological Department.

Noting the success of the pilot project, it is planned that the ADRR website would become operational in early 2011. Training will also be organized for sharing best practice with Members.

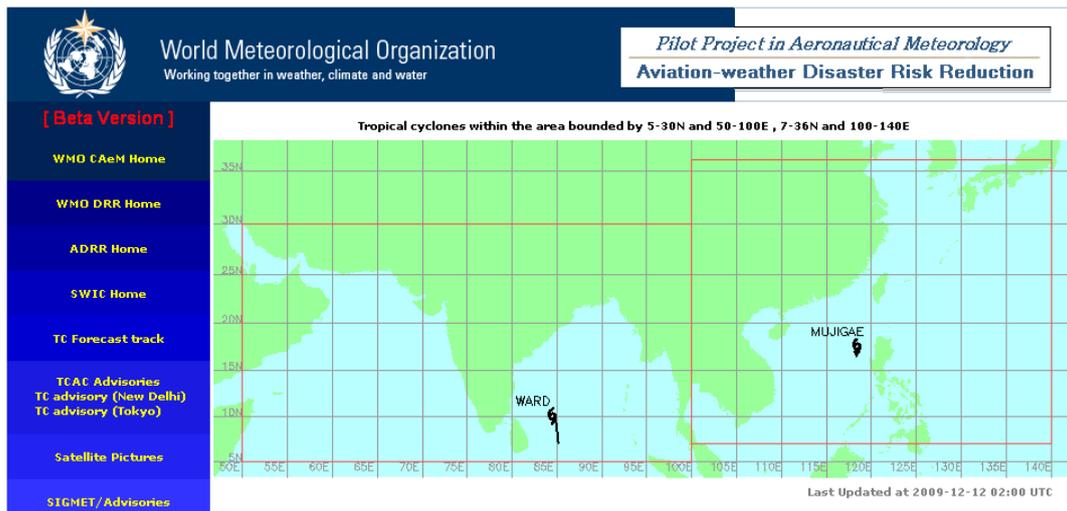


Figure 11 Coverage of ADRR website will be extended to the Bay of Bengal and the Arabian Sea.

f. Identified Opportunities/Challenges for Future Achievements/Results  
Nil.

5. **Progress on Key Result Area 5:** Strengthened Resilience of Communities to Typhoon-related Disasters. (List progress on the Strategic Goals and Associated Activities in the Strategic Plan and progress on the 2008 Typhoon Committee Annual Operating Plan goals)

a. Meteorological Achievements/Results

To enable the public to identify more easily the areas affected by tropical cyclones, the Observatory enhanced its tropical cyclone track information webpage employing Google Map. The track is displayed on a base map with detailed geographic information. Information on the tropical cyclone is provided when the user mouses over the analysed and forecast positions.

Real-time weather photos from three more strategic sites in Hong Kong were launched on the Observatory website in June 2010, making the total of such sites to 15. These weather photos allowed the public to better appreciate the weather conditions in real time. Among these sites, some were located near the seaside to monitor the sea conditions. A new pan-tilt-zoom camera was also installed at the southeastern part of Hong Kong Island in mid-2010 to assist forecasters to monitor the high waves and swells arising from approaching tropical cyclones.

Exposure information of the reference wind stations of the Observatory's Tropical Cyclone Warning System was provided on the Observatory website starting from July 2010. The information could help the public to learn more about the geographical characteristics of the wind stations

so that they could make sensible interpretation of the wind information at these sites.

Two new products were launched on the Observatory's web page based on the outputs of the new suite of high-resolution NWP models that came into operation in mid-2010. The new products are, namely, "Computer Forecast Weather Map" and "Wind Forecast for Water Sport Activities". The former provides prediction up to three days ahead of the evolution of weather patterns over East Asia and the western North Pacific; and the latter provides detailed site- and time-specific forecasts for a number of water sport hotspots in Hong Kong. The new products will enable the public to gain more insight into the possible development of hazardous weather such as tropical cyclones affecting Hong Kong and the driving mechanisms behind them.

To publicize the Observatory's warning systems, a video series introducing the severe weather warnings (including tropical cyclone) in Hong Kong, was launched on YouTube ( <http://www.youtube.com/watch?v=5ZO2wTTS6Po> ) from May to July in 2010. Apart from providing the definitions and factors affecting the issuance of our warnings, the videos also demonstrate the possible disasters brought by severe weather. Members of the public are reminded on the suitable precautions to take to minimize damage when severe weather warnings are in force.

With the rapid increasing popularity of smartphones in the market, the Observatory developed an iPhone application (named as MyObservatory, Figure 12) in 2010 to provide individuals with a comprehensive and personalized weather service any time and anywhere. MyObservatory automatically provides the latest location-specific information, e.g. temperature, wind and weather photos from the weather stations closest to the user. In addition, the application also provides the latest tropical cyclone warnings as well as the forecast track, which is implemented on Google map with rich geographical information. "MyObservatory" has been well received by the public, and its visit figures exceeded 100 million in three months. Plans are underway for this popular application to be extended to other mobile platforms.



Fig. 12 Sample displays of “MyObservatory” showing the current weather, 7-day forecasts and tropical cyclone forecast track.

To reach out to the younger generation, the Observatory started experimenting with the use of social networking services for the dissemination of weather warnings and information. The Hong Kong Observatory Twitter service was launched in September 2010. Tropical cyclone warnings, in a form of ‘tweets’, are published on the Observatory’s Twitter profile “HKObservatory” and distributed to all ‘followers’, viz. users subscribing to the tweets of HKObservatory. The advantages of using these popular social networking platforms include its cost-effectiveness for implementation and maintenance as well as the ability to reach out to international travelers to Hong Kong.

#### b. Hydrological Achievements/Results

Since 1997, about HK\$8 billion worth of major river-training works and flood-control projects had been completed in the New Territories over the northern part of Hong Kong. As a result, the flooding in the New Territories had reduced.

To alleviate flooding in low-lying villages, the Government completed 27 village flood pumping stations to protect 35 villages where river-training works could not be effectively undertaken due to topography.

For the rural areas, the construction of 25 km of drainage channels and 3 km of stormwater drains were in progress. For the urban area, the

construction of 32 km of stormwater drains and 14 km of drainage tunnels were underway.

Data from rain gauges operated by the Drainage Service Department and Geotechnical Engineering Office were relayed to the Observatory to support the operation of the Rainstorm Warning System, the Special Announcement on Flooding in the northern New Territories and the Landslip Warning System. Savings in operational cost were achieved by using the government data network instead of commercial leased lines. General Packet Radio Services (GPRS) mobile networks and solar panels were used for data acquisition in some out-stations where land-based telemetry and electricity supply were unreliable. Over 80 automated gauging stations were installed at major river channels in the territory to provide round-the-clock real-time monitoring of water depth, rainfall and video surveillance.

Over 1600 km of drains and watercourses were inspected and about \$109 million was spent on such maintenance works in 2008-2009. At locations where flooding might cause high risks to local residents, local flood warning systems were installed to monitor the flooding situations and to alert them about the arrival of floodwater. A list of flooding blackspots was also compiled to facilitate the deployment of resources to carry out immediate relief measures during adverse weather situations. Also refer to Key Result Areas 2(b) and 4(b)

Staff of the Drainage Service Department attended various training classes, workshops and conferences (both local and overseas) to acquire the latest knowledge on advanced technology relating to flood prevention, including flooding caused by tropical cyclones. Overseas experts were also invited to Hong Kong to provide in-house training to staff of the department on advanced hydraulic modelling techniques for the drainage systems.

### c. Disaster Prevention and Preparedness Achievements/Results

Seminars to promote public understanding of severe weather warnings and proper response actions were conducted by the Hong Kong Observatory for government bureaux/departments as well as the education, transport and other sectors.

The "Safer Slopes Safer Living Fiesta 2010" was jointly organized by the Civil Engineering and Development Department, Hong Kong Observatory, Hong Kong Red Cross and the Hong Kong Association of Property Management Companies (Figure 13). It was the first carnival event in Hong Kong featuring slope safety and reducing natural disasters. It aimed to enhance public knowledge and awareness on slope safety and disaster. Apart from quizzes, booth games, performances and exhibitions, a 'Disaster Adventure Pavilion' was set up for people to experience the power of various natural

disasters such as landslides and typhoons. The Fiesta attracted more than 5,000 people.



Figure 13 Honourable guests officiating the opening ceremony of the Fiesta

To enhance public awareness of mountaineering safety, the Civil Aid Service joined hands with 16 government departments and non-governmental organizations to hold the "Mountaineering Safety Promotion Day" on 31 October 2010. As in the past years, the Observatory rendered full support to the activity by setting up booth and delivering talks to introduce weather phenomena including tropical cyclones which would affect mountaineering and hiking. Precautions under various severe weather conditions were also highlighted.

The "Hong Kong Community Weather Information Network" started in 2007 in collaboration with the Hong Kong Polytechnic University and the Hong Kong Joint-school Meteorological Association saw further expansion in the number of community weather stations to a total of 92, with relevant weather data made available to the public via the Internet. Weather data obtained through the Network was applied by school children in various educational projects and studies. The network also helped raise awareness of severe weather, including tropical cyclones.

To celebrate the World Meteorological Day on March 23, the Hong Kong Observatory was open to the public on 27 and 28 March, 2010. Around 10,000 people of all ages visited the Observatory headquarters. The theme of the Open Day was "Braving the storm together for over a hundred years". Through words, pictures and various exhibits, it introduced how the Observatory had evolved to cope with societal changes, protect the safety of the public with science and technology, and contribute towards the well-being

of Hong Kong, its neighbouring areas and the international community.

d. Research, Training, and Other Achievements/Results

A series of public talks on "Weather and Everyday Life" was held at various districts in Hong Kong in April 2010. The talks elaborated on weather phenomena affecting daily life and the precautionary measures to be taken during tropical cyclones and severe weather situations. Similar talks on different topics were held in April, May and August 2010 to cater for the needs of specific clients. Please also refer to Key Result Areas 4(d)

e. Regional Cooperation Achievements/Results

Nil.

f. Identified Opportunities/Challenges for Future Achievements/Results

Nil.

6. **Progress on Key Result Area 6: Improved Capacity to Generate and Provide Accurate, Timely, and understandable Information on Typhoon-related Threats.** (List progress on the Strategic Goals and Associated Activities in the Strategic Plan and progress on the 2008 Typhoon Committee Annual Operating Plan goals)

a. Meteorological Achievements/Results

Tropical cyclone predictions encoded in CXML format made available under the THORPEX/TIGGE project were routinely acquired and processed. Maps of the ensemble tracks (Figure 14) and strike probability derived from such data were generated in real time for reference of the forecasters.

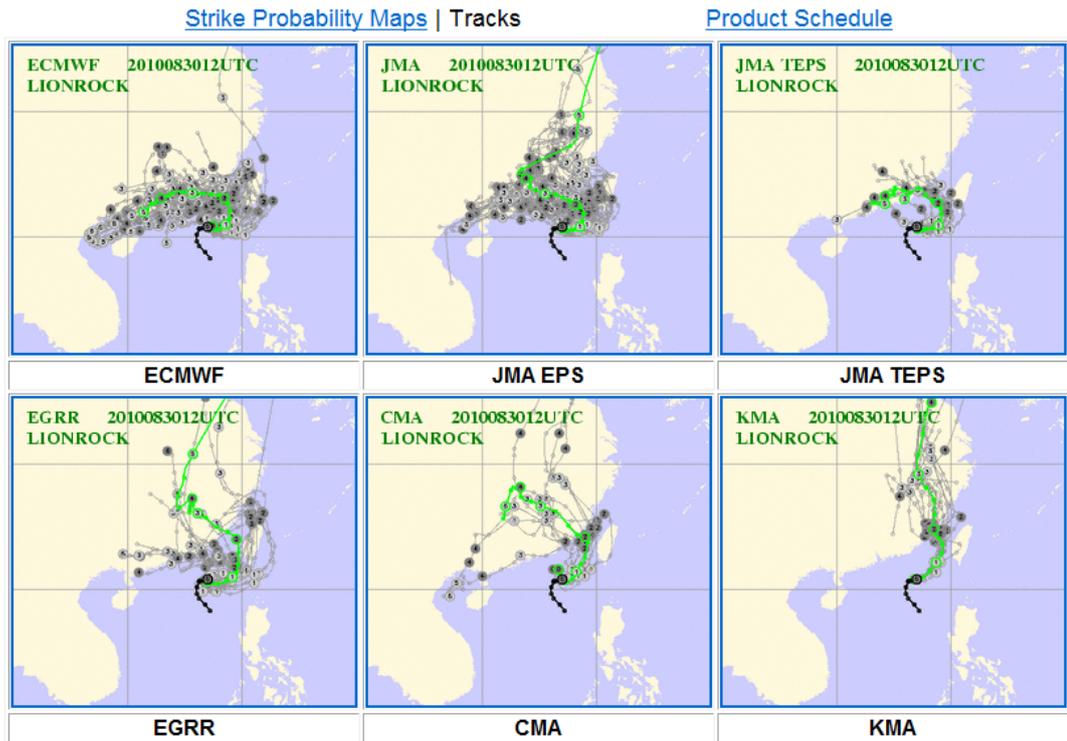
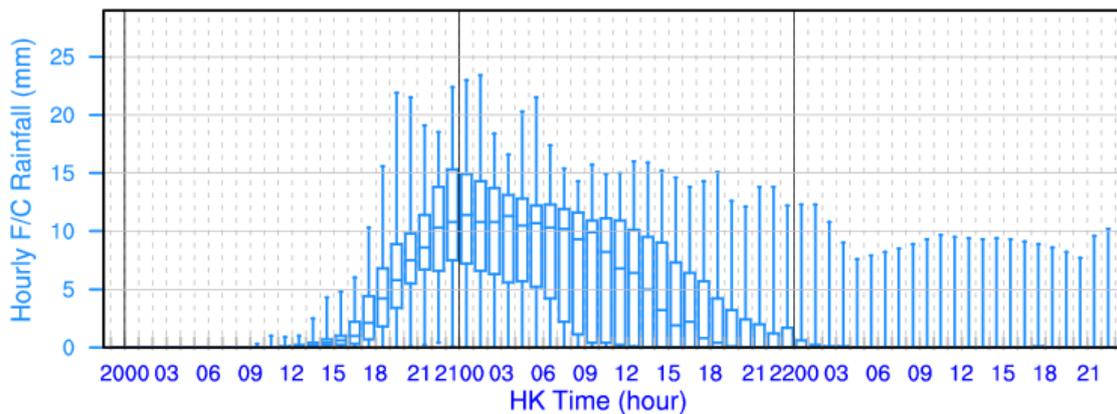


Figure 14. EPS predictions from various centres generated from CXML data during Severe Tropical Storm Lionrock (1006).

The satellite-based tropical cyclone rainfall forecast tool combining the QMORPH precipitation analysis from the Climate Prediction Center of NOAA and subjective tropical cyclone forecast track was enhanced prior to the start of the typhoon season in 2010. Perturbed tropical cyclone tracks output from the EPS of ECMWF were employed to generate probabilistic rainfall predictions with respect to various rainfall thresholds using the same technique. Figure 15 shows a sample of the new product during the passage of Severe Typhoon Fanapi in September 2010.

ECMWF EPS-based QMORPH Rainfall for HKO (2010091923-2010092223 HKT)



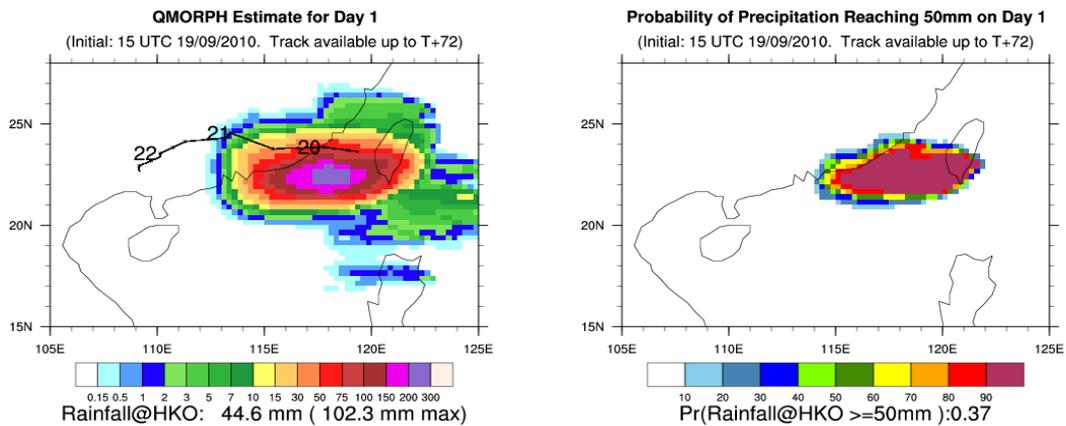


Figure 15 Predictions of rainfall associated with Severe Typhoon Fanapi (1011).

b. Hydrological Achievements/Results

Nil.

c. Disaster Prevention and Preparedness Achievements/Results

Nil.

d. Research, Training, and Other Achievements/Results

Verification of the track predictions from the multi-model ensemble (MMC) and each of the member models, namely ECMWF, JMA, UKMO and NCEP, was conducted using all cases of tropical cyclones at or above tropical depression strength within the western North Pacific during 2008-2009. The results showed that ECMWF outperformed all other members from 24-hour forecasts to 120-hour forecasts with a wide margin (at 0.05 level of significance and serial correlation removed). The ECMWF track position errors were even smaller than those of MMC for 72-hour forecasts, 96-hour forecasts and 120 hour forecasts. However, the differences were not statistically significant.

A method using principal components of dynamical climate model data as predictors to forecast the monthly/seasonal number of tropical cyclones coming within a certain range of a city has been developed. A keynote lecture on the subject was given by a member staff of the Observatory at the 5th ESCAP/WMO Typhoon Committee Integrated Workshop “Urban Flood Risk Management in a Changing Climate: Sustainable and Adaptation Challenges”.

An officer of the Observatory attended the 10th Training attachment to RSMC Tokyo Typhoon Centre in Japan from 21 to 30 July 2010 under one of the capacity building initiatives of the 33rd Session of ESCAP/WMO Typhoon Committee.

Three officers of the Observatory separately attended (1) the International Training Course on “Multi-hazard Early Warning” at WMO Regional Training Centre at Nanjing, China from 10 to 28 May 2010; (2) the International Training Course on “Satellite Meteorology” at WMO Regional Training Centre at Beijing, China from 22 June to 2 July 2010; (3) the International Training Course on “Numerical Weather Prediction” at WMO Regional Training Centre at Nanjing, China from 13 to 24 Sep 2010.

e. Regional Cooperation Achievements/Results

An officer of the Observatory served as a member in the Typhoon Committee’s Expert Team on the Assessment of Change of Frequency and Intensity of Tropical Cyclones in the Typhoon Committee Region. Observatory’s input of providing reference material and assessments had been communicated to the focal point of the Expert Team.

f. Identified Opportunities/Challenges for Future Achievements/Results

Nil.

**7. Progress on Key Result Area 7: Enhanced Typhoon Committee’s Effectiveness and International Collaboration.** (List progress on the Strategic Goals and Associated Activities in the Strategic Plan and progress on the 2008 Typhoon Committee Annual Operating Plan goals)

a. Meteorological Achievements/Results

Please refer to Key Result Area 2(e).

b. Hydrological Achievements/Results

Nil.

c. Disaster Prevention and Preparedness Achievements/Results

Nil.

d. Research, Training, and Other Achievements/Results

An Observatory staff served as a resource person and delivered lectures on tropical cyclone genesis and seasonal tropical cyclone forecasting in the Typhoon Committee Roving Seminar in 2010.

Please also refer to Key Result Area 4 (d).

e. Regional Cooperation Achievements/Results

As part of the Observatory's contribution to the WMO Landfall Typhoon Forecast Demonstration Project (WMO-LTFDP), the in-house developed satellite-based tropical cyclone rainfall forecast tool was adapted to the eastern China region and being supplied in real-time to the Shanghai Typhoon Institute for evaluation since September 2010.

A forecaster from the National Meteorological Centre of CMA attached to the Observatory under the Typhoon Committee Research Fellowship 2010 for 2 months starting from late October 2010. The research topic was, "Can the extreme rainfall associated with Typhoon Morakot (0908) happen in Hong Kong?". The study involved the conduct of numerical experiments by transplanting the storm vortex of Morakot and the associated environmental conditions to the South China Sea in order to estimate the amount of rainfall that would thus fall in Hong Kong.

The Severe Weather Information Centre (SWIC) website, operated by Hong Kong, China for WMO, continues to serve as a popular channel for dissemination of real-time official tropical cyclone warnings and information worldwide. To facilitate the dissemination of severe weather warnings within the local community and to enhance their availability to interested parties anywhere on the globe, the ESCAP/Typhoon Committee recommended in 2009 a feasibility study of employing an Internet web based platform for real-time transmission of severe weather warnings. Hong Kong, China coordinated the project and undertook necessary software development. In June 2010, a new service known as SWIidget was successfully launched by the Observatory. With this SWIidget service, local as well as international users can obtain severe weather warnings issued by participating official weather services in near realtime in SWIC platform. Up to October 2010, warnings of the three participating weather services, namely, Hong Kong, China; Macao, China; and Guam, the USA, are available. Development was underway to disseminate warnings from two Typhoon Committee members, viz Singapore and Republic of Korea with target completion date in Jan 2011. Plans are in hand to invite more official weather services to participate.

The WMO RA II Pilot Project on the Provision of City-Specific Numerical Weather Prediction (NWP) Products to Developing Countries was making steady progress. Up to October 2010, 19 RA II Members, 8 of which were Typhoon Committee Members, participated in the project. In addition to the forecast time series for the existing 160 cities, arrangement is being made to generate forecast products to Pakistan and Thailand.

#### f. Identified Opportunities/Challenges for Future Achievements/Results

Two meteorologists from the Observatory attended the Seventh WMO International Workshop on Tropical Cyclones (IWTC-VII) held in La Reunion, France from 15-20 November 2010 and presented a rapporteur report on

“Operational Warning Strategies”. Apart from presenting a review of the latest developments on the topic, a number of recommendations had been put forward for discussion at the workshop.

### **III. Resource Mobilization Activities**

Nil.

### **IV. Update of Members’ Working Groups representatives**

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4. Training and Research Coordinating Group –  
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5. Resource Mobilization Group  
Nil.