MEMBER REPORT

7th ESCAP/WMO Typhoon Committee
Integrated Workshop on “Effective Warning”

Nanjing, China
26 – 30 November 2012

(Hong Kong, China)

“Annual activities covering the period from
1 January 2012 to 30 November 2012”

CONTENTS

I. Overview of tropical cyclones which have affected/impacted Member's area in 2012

1. Meteorological Assessment (highlighting forecasting issues/impacts)

Five tropical cyclones affected Hong Kong, China during 2012 and their tracks are shown in Figure 1. They were Severe Tropical Storm Talim (1205) and Tropical Storm Doksuri (1206) in June, Severe Typhoon Vicente (1208) in July, Typhoon Kai-tak (1213) and Severe Typhoon Tembin (1214) in August.

The Hong Kong Observatory (HKO) issued the Hurricane Signal No. 10 in the small hours on 24 July 2012 during the passage of Severe Typhoon Vicente. This was the first No. 10 Signal in Hong Kong since Typhoon York 13 years ago in September 1999. Vicente was the farthest tropical cyclone that had necessitated the issuance of the No. 10 Signal since 1946. Vicente underwent rapid intensification within around 30 hours prior to its closest approach to Hong Kong, strengthening by three categories from a tropical storm to a severe typhoon. Such rapid intensification near the territory was rather rare among the tropical cyclones that had necessitated the issuance of the No. 10 Signal since 1946. Figure 2 shows the time series of the maximum sustained wind speed near the centre of Vicente.

Besides Vicente, the No. 8 Gale or Storm Signal was issued twice in Hong Kong during the passage of Doksuri in June and Kai-tak in August. The tracks of the five tropical cyclones that affected Hong Kong and their impacts on the local weather during the year are given in the following paragraphs.

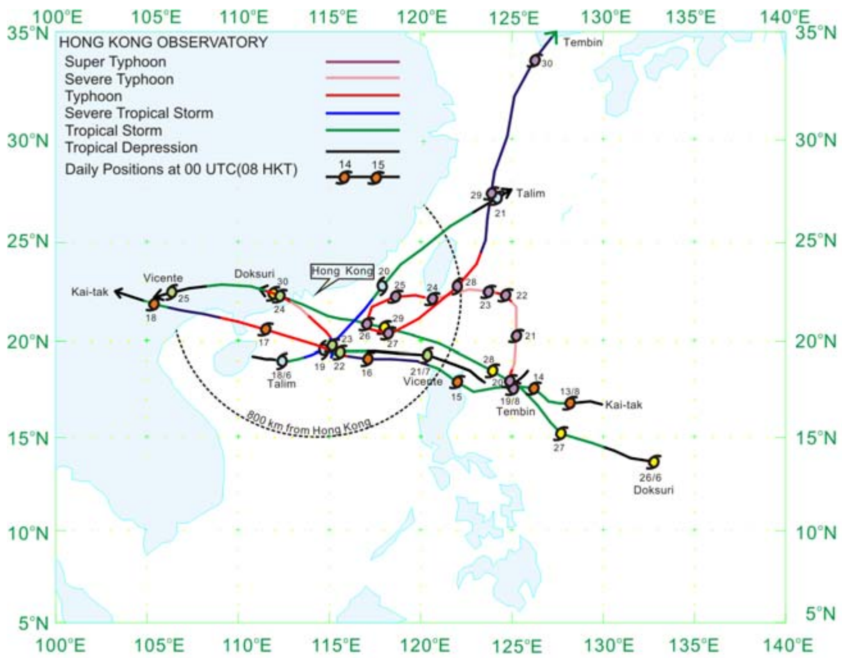

Figure 1 Hong Kong Observatory best tracks of tropical cyclones that affected Hong Kong, China from 1 January to 30 November 2012.

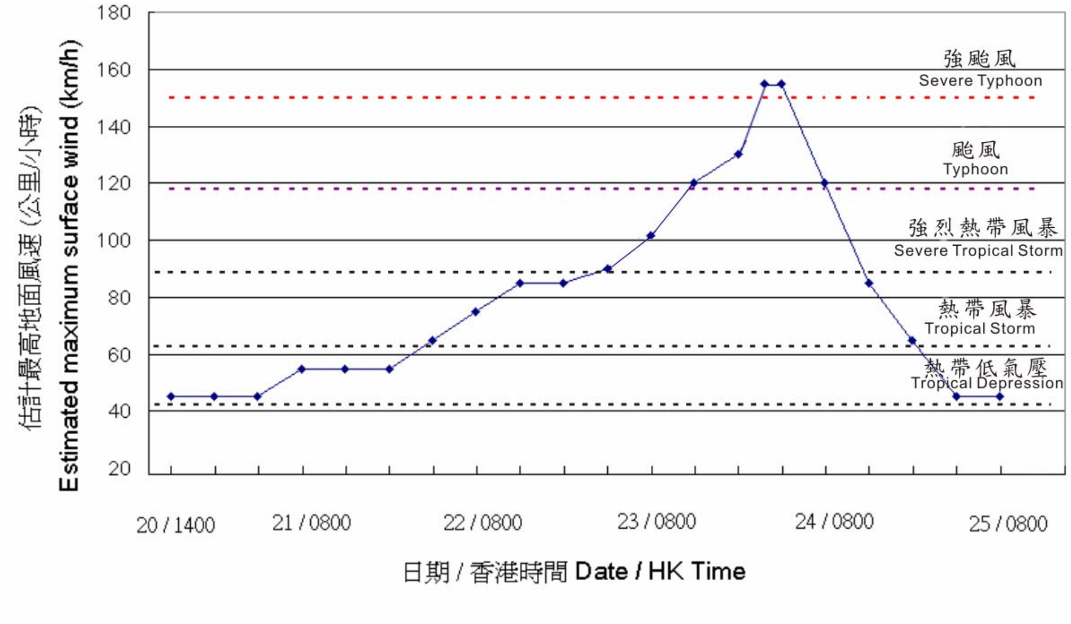

Figure 2 Time series of the maximum sustained wind speed (10-minute mean) of Vicente (1208) , according to the post analysis of the Hong Kong Observatory.

Severe Tropical Storm Talim (1205)

The track of Talim is shown in Figure 3.

In Hong Kong, the Standby Signal No. 1 was issued at 4:20 p.m. on 17 June when Talim was about 470 km southwest of Hong Kong. Local winds were moderate to fresh easterlies, occasionally strong offshore and on high ground. As Talim showed signs of strengthening into a severe tropical storm and adopting a more northerly track, moving closer to the territory, the Strong Wind Signal No. 3 was issued at 10:40 p.m. on 18 June when Talim was about 360 km south of Hong Kong. Local winds turned to northeasterly in the morning on 19 June. Due to sheltering by terrain, the chance of sustained strong winds generally affecting Hong Kong decreased and the Strong Wind Signal No. 3 was replaced by the Standby Signal No. 1 at 10:20 a.m. Talim was closest to Hong Kong at about 5 p.m. that day passing about 260 km to the southeast. Local winds subsided further during the afternoon and evening. All signals were cancelled at 8:40 p.m. as Talim started to move away from the territory.

The weather in Hong Kong was cloudy with squally showers on 17 June and 18 June. Showers continued to affect the territory at first on 19 June, but eased off later and there were sunny periods during the day.

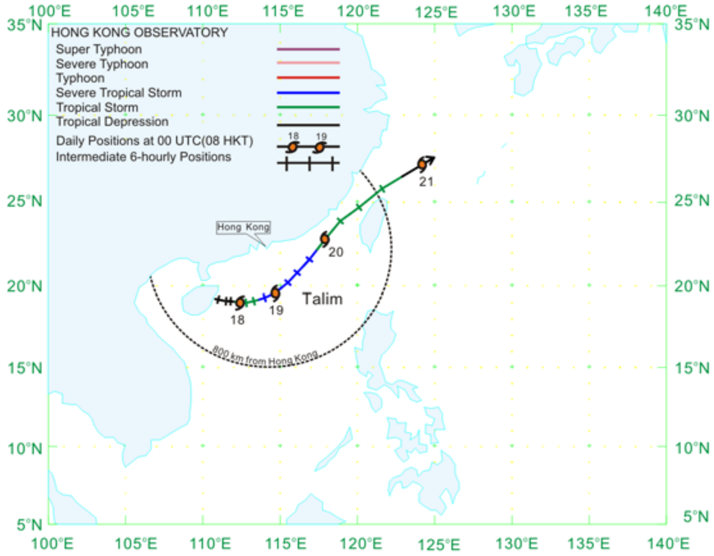

Figure 3 Track of Talim (1205) on 17 – 21 June 2012

Tropical Storm Doksuri (1206)

The track of Doksuri is shown in Figure 4.

In Hong Kong, the Standby Signal No. 1 was issued at 9:40 p.m. on 28 June when Doksuri was about 710 km east-southeast of Hong Kong. Local winds were light that evening. Doksuri was a relatively fast-moving tropical cyclone, heading towards the coast of Guangdong on 29 June. Local winds were moderate northerlies at first that day, strengthening gradually and becoming fresh northeasterlies in the late afternoon, occasionally strong offshore and on high ground. The Strong Wind Signal No. 3 was issued at 4:20 p.m. when Doksuri was about 200 km southeast of Hong Kong. Local winds continued to strengthen during the evening. Local winds strengthened further at night, becoming strong easterlies, reaching gale force over parts of Hong Kong, particularly offshore and on high ground. The No. 8 NE Gale or Storm Signal was issued at 11:05 p.m. when Doksuri was about 90 km to the south of the Hong Kong Observatory. Doksuri was closest to Hong Kong at about 1 a.m. on 30 June, passing about 70 km to the southwest of the Hong Kong Observatory. Local winds veered to the southeast on the small hours of 30 June and the No. 8 NE Gale or Storm Signal was replaced by the No. 8 SE Gale or Storm Signal at 12:40 a.m. As Doksuri made landfall to the west of Macao, local winds became south to southeasterlies and gradually subsided. The No. 3 Signal was issued at 3:25 a.m. to replace the No. 8 SE Gale or Storm Signal, followed by the Standby Signal No. 1 at 6:40 a.m. All signals were cancelled at 8:15 a.m. as Doksuri moved further away and weakened over land.

The weather in Hong Kong was fine and very hot during the day on 28 June and at first on 29 June. Showers developed over inland Guangdong moved southwards to affect Hong Kong during the afternoon of 29 June. Squally showers affected the territory that night and at first on 30 June as Doksuri moved closer to the Pearl River Estuary. Scattered showers and a few squally thunderstorms affected Hong Kong for the rest of the day on 30 June.

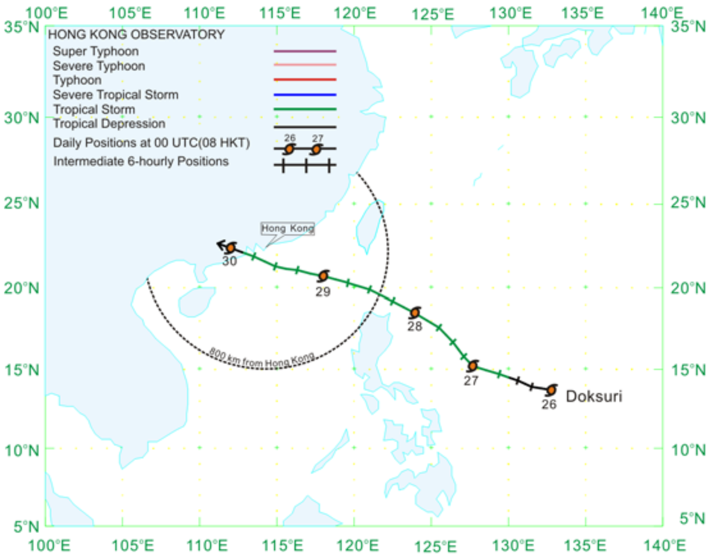

Figure 4 Track of Doksuri (1206) on 26 – 30 June 2012.

Severe Typhoon Vicente (1208)

The track of Vicente is shown in Figure 5.

In Hong Kong, the Standby Signal No. 1 was issued at 3:40 p.m. on 21 July when Vicente was about 540 km southeast of Hong Kong. Local winds were moderate westerlies that afternoon, becoming northeasterly in the evening. With Vicente stalling over the South China Sea but intensifying, moderate to fresh northeasterlies prevailed over Hong Kong on 22 July, with occasional strong winds over offshore waters and on high ground. As Vicente started to move towards the south China coast, the Strong Wind Signal No. 3 was issued at 5:20 a.m. on 23 July, when Vicente was about 320 km south-southeast of Hong Kong. Local winds strengthened gradually during the day, becoming generally strong northeasterlies in the afternoon, reaching gale force offshore and on high ground. The No. 8 NE Gale or Storm Signal was issued at 5:40 p.m. when Vicente was about 170 km south of Hong Kong. Local winds strengthened further that night, with gales in many parts of Hong Kong, reaching storm force over the waters in the southern part of Hong Kong. The Increasing Gale or Storm Signal No. 9 was issued at 11:20 p.m. when Vicente was about 110 km south-southwest of Hong Kong.

Vicente continued to move closer to Hong Kong and its eyewall came close to the southwestern part of Hong Kong during the small hours on 24 July. East to southeasterly gale or storm force winds affected the territory generally, reaching hurricane force over the waters in the southwestern part of Hong Kong and on high ground (Figure 6). The Hurricane Signal No. 10 was issued at 12:45 a.m. to replace the No. 9 Signal. The centre of Vicente was closest to Hong Kong between 1 a.m. and 2 a.m., passing about 100 km to the southwest of the Hong Kong Observatory. As Vicente started to move away and local winds decreased gradually, the No. 8 SE Gale or Storm Signal was issued at 3:35 a.m. to replace the No. 10 Signal. The No. 8 Signal was then replaced by the Strong Wind Signal No. 3 at 10:10 a.m., followed by the Standby Signal No. 1 at 2:40 p.m. After Vicente moved further away and its outer circulation no longer covered Hong Kong that night, all tropical cyclone warning signals were cancelled at 11:15 p.m.

The weather in Hong Kong was very hot and hazy on 21 July, but there were squally thunderstorms in the evening, bringing over 20 millimetres of rainfall to the eastern part of the territory. It was mainly cloudy with a few squally showers and thunderstorms on 22 July. The rainbands of Vicente brought heavy squally showers to Hong Kong on 23 July and in the morning on 24 July, during which more than 200 millimetres of rainfall were recorded over many parts of the territory. The showers gradually abated in the afternoon on 24 July.

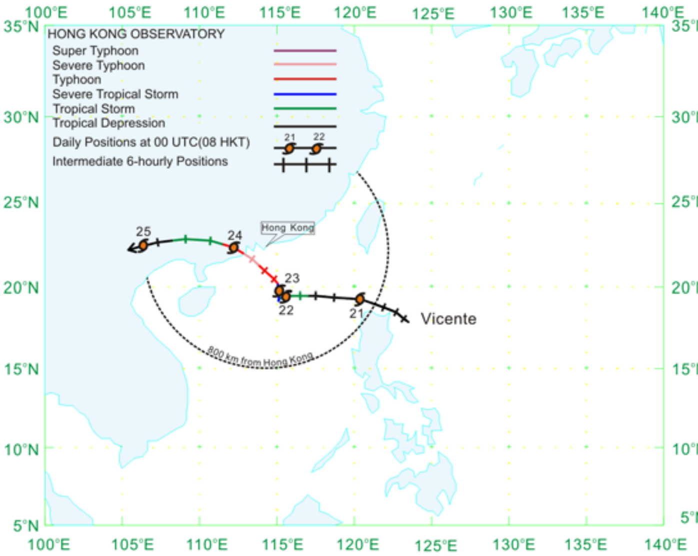

Figure 5 Track of Vicente (1208) on 20 – 25 July 2012.

Figure 6 Winds recorded at various stations in Hong Kong at 1:30 a.m. local time on 24 July 2012 when the centre of Vicente was closest to Hong Kong.

Typhoon Kai-tak (1213)

The track of Kai-tak is shown in Figure 7.

In Hong Kong, the Standby Signal No. 1 was issued at 8:10 p.m. on 15 August when Kai-tak was about 690 km east-southeast of Hong Kong. Light winds prevailed over the territory that night. As Kai-tak moved closer to the south China coast, local winds strengthened gradually on 16 August and the Strong Wind Signal No. 3 was issued at 1:40 p.m. when Kai-tak was about 380 km south-southeast of Hong Kong. Local winds were fresh northeasterlies, strong offshore and on high ground in the afternoon. With Kai-tak continued to move closer to Hong Kong at night, local winds strengthened further and became generally strong easterlies, reaching gale force on high ground. The No. 8 SE Gale or Storm Signal was issued at 10:15 p.m. when Kai-tak was about 270 km south of Hong Kong. Kai-tak was closest to Hong Kong at around midnight when it was passing about 260 km to the south-southwest. The winds gradually changed to the southeasterlies on the small hours of 17 August, with gales on high ground and over the waters in the southwestern part of Hong Kong. The winds gradually subsided before dawn as Kai-tak started to move away from Hong Kong. The Strong Wind Signal No. 3 was issued at

6:20 a.m. to replace the No. 8 Signal. Kai-tak continued to move away from Hong Kong during the day and local winds continued to weaken. The Standby Signal No. 1 was issued at 3:20 p.m and all tropical cyclone warning signals were subsequently cancelled at 4:25 p.m.

The weather in Hong Kong was generally fine and very hot on 15 August. It became mainly cloudy with a few squally showers and thunderstorms on 16 August. More than 20 millimetres of rainfall were recorded over parts of the territory. Squally showers continued to affect Hong Kong at first on 17 August, but gradually eased off during the day.

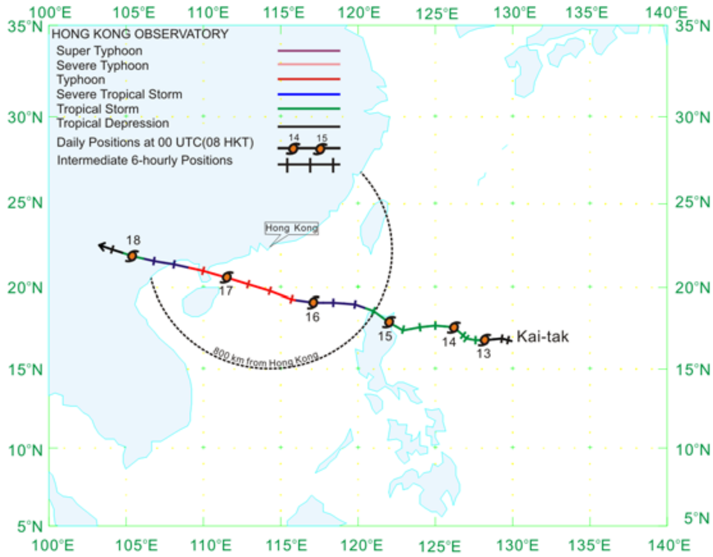

Figure 7 Track of Kai-tak (1213) on 12 - 18 August 2012.

Severe Typhoon Tembin (1214)

The track of Tembin is shown in Figure 8.

In Hong Kong, the Standby Signal No. 1 was issued at 10:40 p.m. on 24 August when Tembin was about 530 km east-southeast of Hong Kong. Local winds were moderate to fresh north to northwesterly, occasionally strong on high ground. Moving slowly southwestwards, Tembin looped over the northeastern part of the South China Sea on 25 August. It was closest to Hong Kong at around 1 a.m. on 26 August, passing about 290 km to the east-southeast. It started to move slowly away from Hong Kong on 26 August. All tropical cyclone warning signals were cancelled at 4:40 p.m. that day.

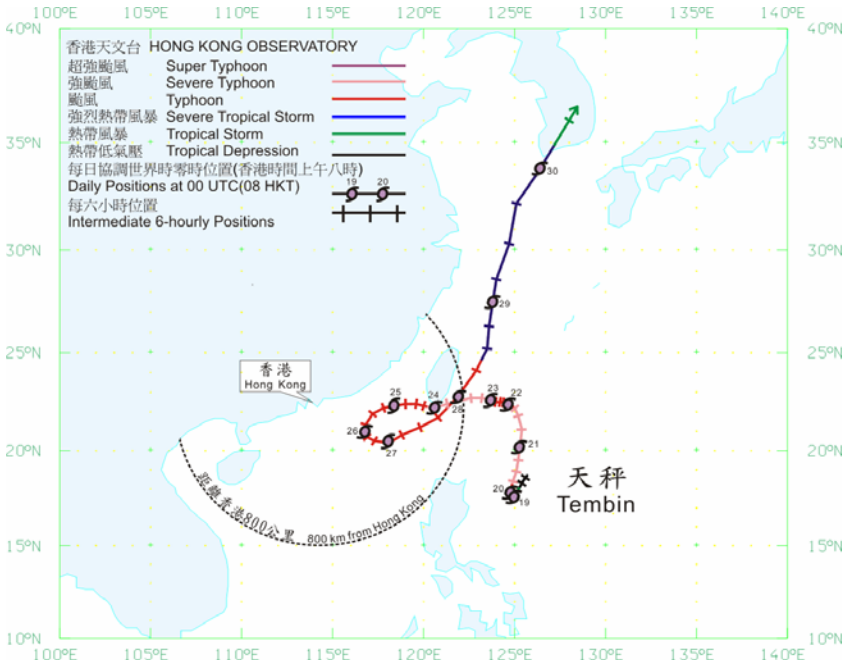

Figure 8 Track of Tembin (1214) on 18 – 30 August 2012

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

Severe Typhoon Vicente brought heavy rainfall to Hong Kong during its passage in July 2012. More than 200 millimetres of rainfall were recorded over most places on 21-24 July 2012, with over 400 millimetres in the northern part of Hong Kong. The Amber Rainstorm Warning Signal was in force between 5:35 to 6:40 p.m. on 21 July and 1:55 a.m. to 10:40 a.m. on 24 July respectively. Vicente was the wettest tropical cyclone that affected Hong Kong in 2012.

During the passage of Severe Tropical Storm Talim and Tropical Storm Doksuri on 17-19 June and 28-30 June 2012 respectively, over 50 millimetres of rainfall were recorded generally over Hong Kong. Typhoon Kai-tak brought over 20 millimetres of rainfall to parts of the territory on 15-17 August.

Severe Typhoon Tembin passed about 300 km to the east-southeast of Hong Kong. Under the influence of the subsiding continental airstream associated with Tembin, only a couple of millimetres of rainfall were recorded in parts of the territory.

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

During the passage of Talim, there were many reports of fallen trees in Hong Kong. A yacht broke off its anchor in rough seas over the waters of Sai Kung and ran aground over the shore. No one was injured during the incident.

During the passage of Doksuri, two people were injured in Hong Kong and there were over 100 reports of fallen trees, collapsed scaffoldings and sign-boards blown loose. There were also reports of interruption to traffic due to fallen trees in various parts of Hong Kong. A large tree was uprooted in Happy Valley on Hong Kong Island, damaging the electric wire installations of the tram and interrupting tram services. The windscreen of a vehicle passing by was also damaged. A sampan sank in rough seas off the seas at Hebe Haven in Sai Kung. At the Hong Kong International Airport, nine flights were delayed and two others cancelled.

In Hong Kong, at least 138 people were injured during the passage of Vicente. The number of fallen trees amounted to about 8 800. There were two reports of landslip and 7 reports of flooding. Dangerous signboards or fallen scaffoldings were reported in many parts of the territory, resulting in closure of some roads and damage to many vehicles. During the storm, the East Rail line of the Mass Transit Railway (MTR) had to halt service because of damage of overhead cables by toppling trees. As a result, hundreds of commuters were forced to spend the night in trains or at the MTR stations. Crops were damaged by flood waters in some farmlands. A small craft ran aground and was damaged. Seven containers fell overboard from a freighter in waters nearby and about 150 tons of plastic pallets drifted over the sea or were washed ashore. At the Hong Kong International Airport (HKIA), at least 90 flights were cancelled, over 446 flights delayed and 50 flights diverted on 23-24 July.

During the passage of Kai-tak, one person was injured in Hong Kong and the number of fallen trees amounted to 493. At the Hong Kong International Airport, 34 flights were delayed, six flights were cancelled and another six flights diverted.

During the passage of Tembin, two people were swept away by waves in the sea front in Sai Kung with one person drowned and the other returned to safety.

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 position errors of forecasts issued by HKO for the five tropical cyclones that affected Hong Kong in 2012 are shown in Table 1. The long-term trend for the position forecast errors (Figure 9) was generally decreasing, with the latest 72-hr and 48-hr position forecast accuracy reaching the respective levels of accuracy of the 48-hr and 24-hr position forecasts about a decade ago.

Table 1 Performance summary of track forecasts issued by HKO for the five tropical cyclones that affected Hong Kong in 2012

	24-hr position	48-hr position	72-hr position
Position forecast error (km)	97	140	218

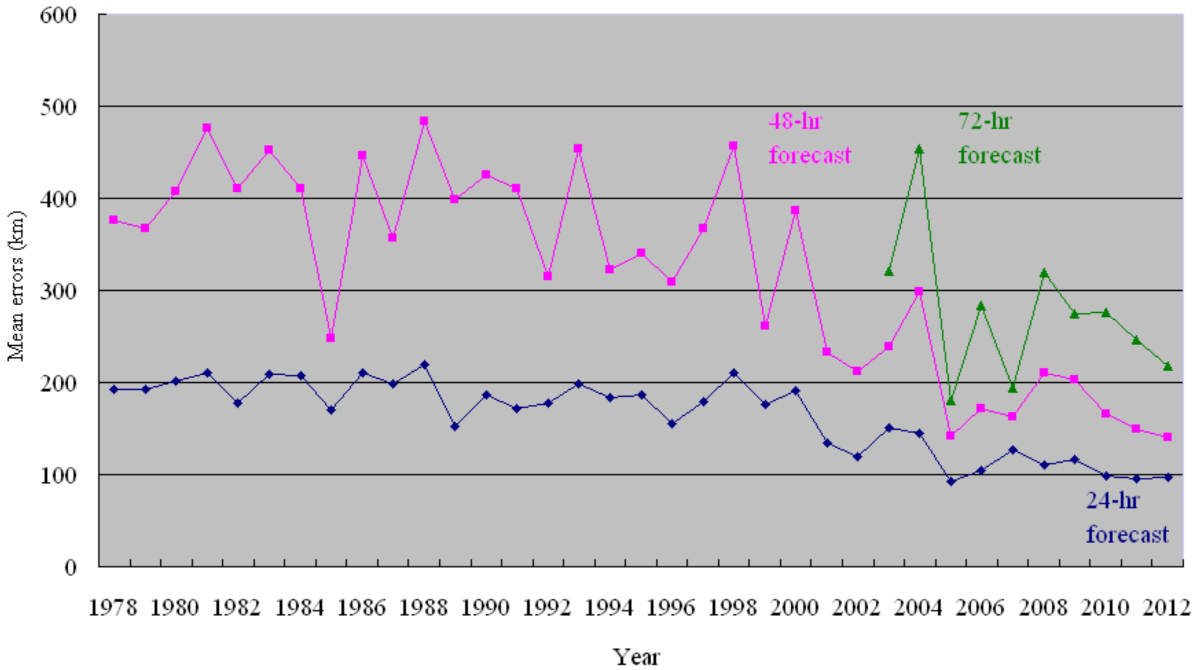

Figure 9 Long term trend of mean errors of HKO tropical cyclone position forecasts. The figures are based on warnings for tropical cyclones within the HK Shipping Warning Area, except for 2012 which refers to warnings for the five tropical cyclones that affected Hong Kong.

Reconnaissance flights were continued in collaboration with the Hong Kong Government Flying Service (GFS) to collect meteorological observations for tropical cyclones over the South China Sea including Talim (19 June 2012), Vicente (22 July), Kai-tak (16 August) and Tembin (26 August). The collected data provided useful information on tropical cyclone location and the wind distribution in the vicinity of storms (Figure 10), for monitoring their development and assessment of the impact of the associated weather system. Work is underway to streamline the quality control process of reconnaissance flight data with a view to making such data available for international exchange.

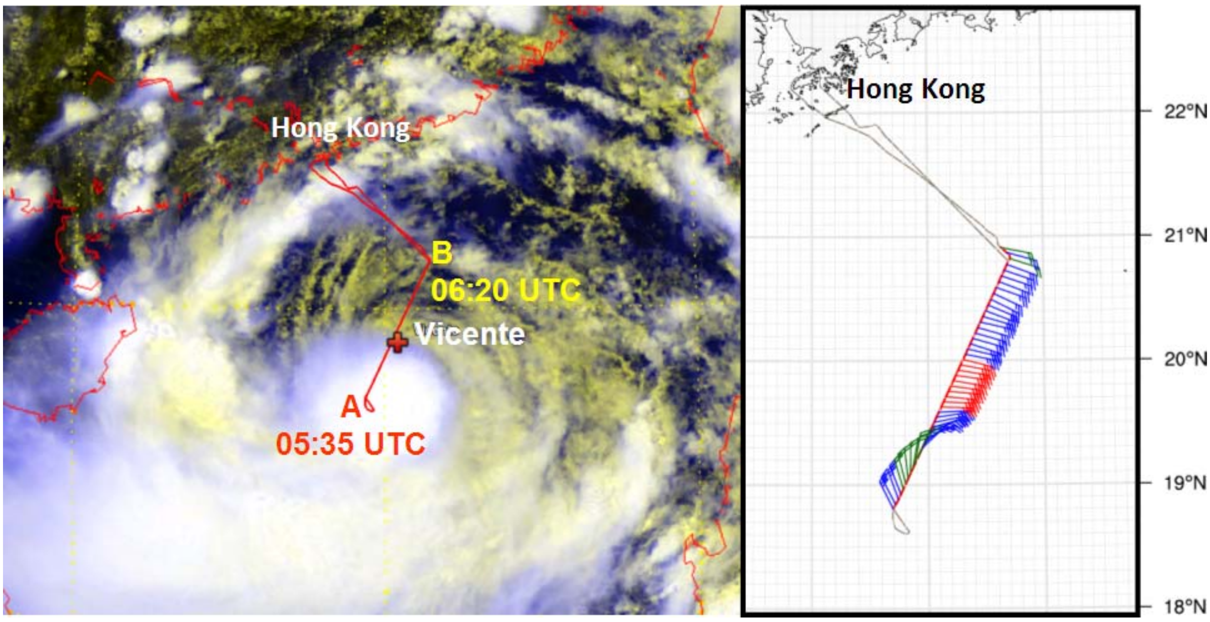

Figure 10 The flight path of the GFS fixed-wing aircraft on 22 July 2012 (red lines on left panel), overlaid on the MTSAT visible satellite imagery at 0532 UTC on that day. It could be seen that the aircraft had once flown very close to the centre of the tropical cyclone Vicente. The winds near sea surface estimated from the flight data from point A to point B are shown on the right panel.

Three-hourly Tropical Cyclone Warning for Shipping would be issued by HKO to the marine community whenever a tropical cyclone comes within the area of 10°N to 30°N and 105°E to 125°E). Commencing 2012, the issue time of the warning was advanced by half an hour, that is 1 hour and 15 minutes after observation time. Moreover, the corresponding forecast track was also posted on the HKO webpage around half an hour earlier. The earlier issuance of the warning and information aimed at assisting the marine and aviation sectors to take early precautions against the approach of tropical cyclones.

HKO has acquired full-resolution ECMWF short to medium range model data since April 2011. More EPS data up to a forecast range of 360 hours has become available in 2012 to help forecasters predict the change of weather due to tropical cyclones in advance.

b. Hydrological Achievements/Results

There are coastal low-lying spots in territory of Hong Kong that are vulnerable to sea flooding during typhoons. To address the problem, HKO, the Drainage Services Department (DSD) and the Home Affairs Department (HAD) jointly established an Early Alert System for Predicted Storm Surges at Low-lying areas. The system targets for 5 coastal low-lying areas which are prone to sea flooding, namely Luen On San Tsuen and Kar Wo Lei in Tuen Mun, Nam Wai in Sai Kung, Sham Tseng and Lei Yue Mun (Figure 11). Under the alert system, HKO would estimate the forecast sea levels when Tropical Cyclone Warning Signal No. 3 or above is hoisted. HKO would issue storm surge alerts to District Offices of HAD and DSD when the forecast sea levels reach certain triggering levels. DSD would take emergency flood mitigation actions and District Offices would inform concerned villagers to take necessary precautionary measures.

Figure 11 Map of Hong Kong showing flood-prone areas (circled)

Tai O, Lantau is also vulnerable to sea flooding during typhoon. An Early Alert System, Emergency Relief & Services for Serious Flooding in Tai O, was set up under the lead of HAD. During tropical cyclones, HKO would issue early warning to parties concerned if forecasted sea level of Tai O would increase to the alert level or above. DSD and other concerned parties would mobilize staff to standby / prepare for tackling possible flooding. Meanwhile, DSD would also monitor and report the real time tide and would send

SMS/Voicemail to alert parties concerned for evacuation when the triggering level is reached.

HKO provided DSD with guidance on the likelihood of 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/emergency 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 nowcasting system and historical rainstorm data.

DSD provided a 24-hour manned hotline so that flooding complaints or other emergencies could be dealt with promptly. Cases received were recorded by a computerized system so that data could be managed and analyzed for subsequent improvement of the drainage systems. When the situation warranted, an Emergency Control Centre under the charge of senior professionals would be activated.

c. Disaster Prevention and Preparedness Achievements/Results

HKO, as in past years, continued to participate in regular exercises and drills on tropical cyclone disaster prevention and preparedness with relevant government departments and organizations. In addition, HKO also carried out public educational activities to enhance preparedness against tropical cyclones with a view to minimizing casualties and damage. The loss of life remains low this year, even though five tropical cyclones including Severe Typhoon Vicente affecting Hong Kong (Figure 12). Briefing sessions were organized for residents living in locations vulnerable to flooding due to storm surge (Figure 13). Relevant local organizations also attended the briefings to familiarize themselves with the emergency response plan so that prompt actions may be taken to evacuate residents as well as minimize the impacts caused by storm surge, upon the issuance of an early alert by HKO. Moreover, pamphlets on the threats of storm surge were distributed to the residents for educational purpose.

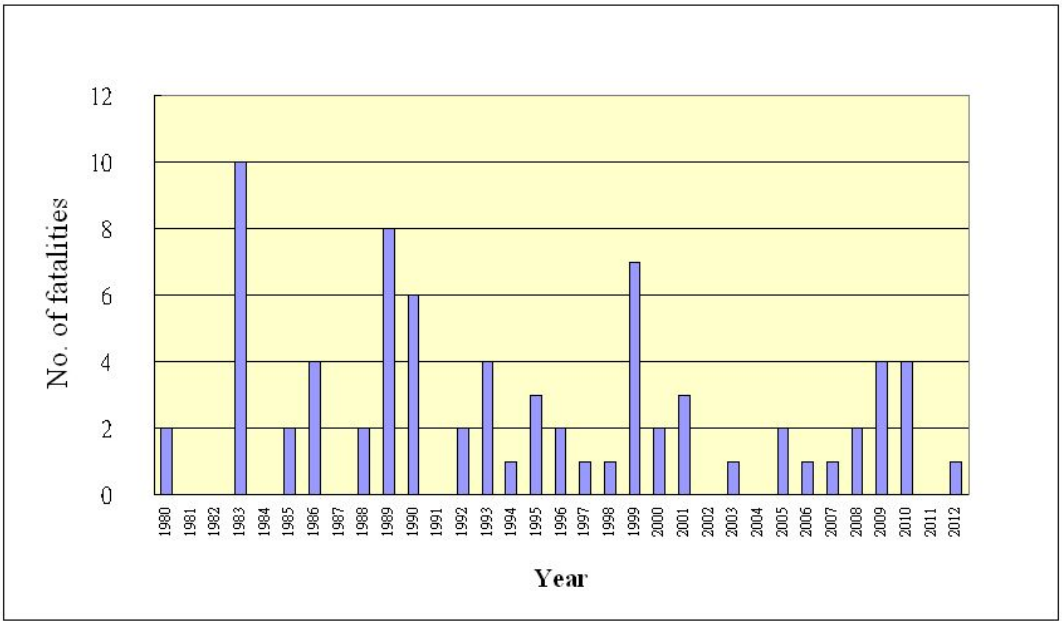

Figure 12 Number of fatalities in Hong Kong, China during the passage of tropical cyclones from 1980 to 2012

In 2012, localized storm surge alerts were activated during the approach of tropical cyclones Talim (1205), Doksuri (1206), Vicente (1208) and Kai-tak (1213). In these events, appropriate measures were taken by the Government against possible flooding caused by storm surges, such as piling up sandbags.

Figure 13 HKO officer presenting the operation of the early storm surge alert system for local residents and organizations at Sham Tsang, a sub-urban community in Hong Kong, China.

d. Research, Training, and Other Achievements/Results

Nil.

e. Regional Cooperation Achievements/Results

Following the direct hit of Severe Typhoon Vicente over southern China, delegations from the nearby regional authorities of mainland China paid visits to HKO to learn about (a) HKO's experience in operating weather warning signals; (b) the coordination in emergency response management among other government departments and related organizations in Hong Kong, and (c) media communication. The visits strengthened regional exchange and sharing of experience on emergency management (Figure 14), thereby contributing to the enhancement of emergency response plans to safeguard lives and property in the region.

Figure 14 Dr. C.M. Cheng (rightmost), Assistant Director of the Hong Kong Observatory, providing a briefing on the operation of the Meteorological Centre of HKO to the delegation from the Emergency Management Office of the Guangdong Province.

f. Identified Opportunities/Challenges for Future Achievements/Results

Research and development are underway to enhance the future forecast of severe weather related to tropical cyclones for better disaster risk preparedness and management. They include: (i) data assimilation of ground-based remote sensing observations over wider coverage including weather radar and GPS water vapour data in the region through real-time data exchange, for improving the analysis and forecast of significant convection using HKO's NHM system; and (ii) development of the Aviation Model (AVM) running at sub-kilometre horizontal resolution in order to better simulate the wind flow and weather conditions over Hong Kong, especially in the vicinity of the Hong Kong International Airport

The interpretation of probabilistic forecasts and their combined use with forecasters' subjective forecasts may pose a challenge to the users in their weather-related decision-making process. Engagement of users should be enhanced so as to better understand how they utilise the weather information and the thresholds of significant weather they are operating. This will help improve the presentation and effectiveness of the probabilistic forecast products.

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

HKO rendered support to the Building Department in the review of the Code of Practice on Wind Effects in Hong Kong. Tropical cyclone records, extreme wind speed data, and HKO's expert views on the wind climate of Hong Kong and the potential impacts of climate change on tropical cyclone activity in the region have been provided for the review.

One HKO officer participated in the Expert Team of the Typhoon Committee, in the compilation and publication of the "2nd Assessment Report in the Impact of Climatic Change on tropical cyclone track and Impact Area in TC region". He was invited by the Typhoon Committee to present the major findings of the 2nd Assessment Report on behalf of the Expert Team during the 44th Session of Typhoon Committee in February 2012. The findings have also been published in two journal papers in the 'Tropical Cyclone Research and Review'.

b. Hydrological Achievements/Results

HKO provided support to DSD in their review of the Drainage Master Plans in the flood prone areas in the northern part of the territory and feasibility study of applying real-time flood forecasting. Results showed that direct output from SWIRLS (Short-range Warning of Intense Rainstorms in Localized Systems) nowcasting system agreed reasonably well with the rainfall 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 when opportunities arise.

HKO rendered support to the Geotechnial Engineering Office in their study to update the Probable Maximum Precipitation (PMP) for Hong Kong. Extreme rainfall data and expert views from HKO have been provided for the study that will update the existing PMP estimates and explore how the PMP estimates could be further adjusted with due consideration of the effects of climate change.

DSD liaised closely with other relevant Government departments and persons in charge of construction sites in the rain season to carry out flooding preventive measures such as clearance of blockage of roadside gullies, drains or watercourses by garbage or construction waste.

APIs and publicity messages were issued by the Government from time to time to promote public general awareness of flooding hazards and to advise on the steps, which can be taken to reduce flood losses.

c. Disaster Prevention and Preparedness Achievements/Results

HKO continued to reach out to various sectors of the society such as the transport sector, marine sector, container terminal operators, fishermen, etc. to better understand their concerns and needs in respect of tropical cyclone information and services. Enhanced service in providing more frequent assessment on tropical cyclone warning signals would be put on trial in the latter part of 2012, with the aim to help relevant sectors take early precautions in their operations during the approach as well as departure of tropical cyclones.

Damage figures brought about by tropical cyclones and rainstorms were collected from selected government and public utility companies for the compilation of damage statistics (an example is given in Figure 15), for publication in the HKO annual tropical cyclone report.

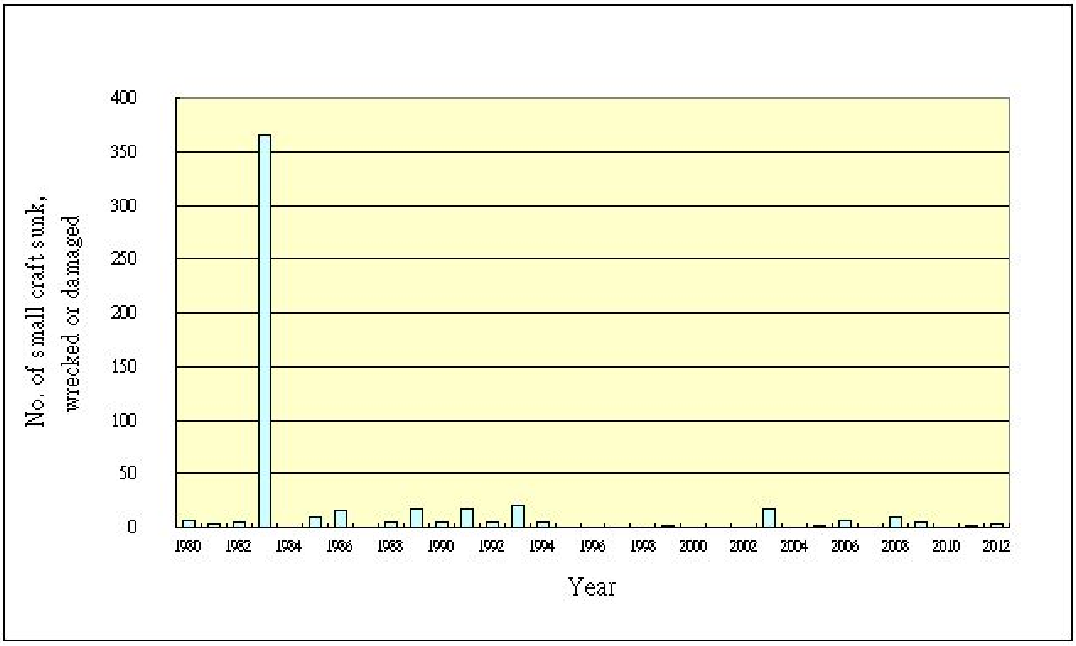

Figure 15 Small craft sunk, wrecked or damaged in Hong Kong during the passage of tropical cyclones from 1980 to 2012. A total of 360 small crafts were sunk, wrecked or damaged during the passage of Typhoon Ellen in 1983.

d. Research, Training, and Other Achievements/Results

A paper on "Long term variations of tropical cyclone activities in the South China Sea and the vicinity of Hong Kong" has been prepared and accepted for publication in Tropical Cyclone Research and Review. The study results show that there exist significant inter-annual and inter-decadal variations in the tropical cyclone activities in the South China Sea and the vicinity of Hong Kong. For the long-term trend, there is a decrease in the number of tropical cyclones affecting Hong Kong in the last few decades, although the trend is not statistically significant.

e. Regional Cooperation Achievements/Results

At the invitation of CMA, a meteorologist from HKO conducted a training workshop on operational Dvorak technique for analysis of tropical cyclone intensity in Beijing in February 2012 for more than 20 personnel from CMA. It has enhanced mutual understanding on tropical cyclone monitoring over the western North Pacific and the South China Sea.

One HKO officer lectured in the assessment of social and economic impacts of improved tropical cyclone forecast service in the 'Workshop and Training Course on Operational Tropical Cyclone Forecast' organized by WMO, the East China Regional Meteorological Centre/CMA and the Shanghai Typhoon Institute/CMA in Shanghai, China on 12-14 June 2012. Another

HKO officer attended as a trainee to get acquainted with forecasting techniques of tropical cyclone, verification of related model output products which were introduced in the WMO Typhoon Landfall Forecast Demonstration Project (TLFDP).

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.

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

A study to estimate extreme rainfall intensities for various locations over the whole territory using a regional frequency analysis (RFA) approach was being carried out in January 2010 and was completed in August 2012. The study aimed at updating and retrieving extreme rainfall data of different durations at 122 rain gauges with record length of 10 years or longer. The study concluded that the use of Hosking-Wallis method would give better extreme rainfall intensity estimates by performing at-site rainfall frequency analysis with the use of RFA techniques to establish the updated rainfall depth-duration frequency (DDF) relationship in Hong Kong.

On a trial basis, HKO's co-Kriging based radar-raingauge QPE and quality-checked raingauge data were supplied in real time to the Geotechnical Engineering Office for landslide studies and application.

An improved optical-flow based radar echoes tracking algorithm was developed for SWIRLS. Trial results in 2012 showed that the forecast performance of the new QPF was generally superior to those from the operational version, especially for lead times beyond the first hour. The forecast reflectivity fields, an intermediate product from the new algorithm, were also applied to significant convection nowcasting for aviation with similar improved performance noted.

b. Hydrological Achievements/Results

Dynamic hydrological and hydraulic computer models for the drainage systems in Hong Kong managed by DSD were developed to provide information on the risk of flooding, impacts of development and the performance of various flood protection options. In particular, all the trunk and major branch river channels within the river basins in the northern and north-western part of Hong Kong had been digitized into the computational hydraulic models. Raingauges were installed in the concerned area for the monitoring of the hydrological data for the release of basin-wide flood warning in the region. In the past years, DSD 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, a sensitivity analysis of effects of climate change on stormwater drainage systems in Yuen Long and North District, 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.

Since 1997, about HK$9.5 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 about 6km of drainage channels and stormwater drains were in progress. For the urban area, the construction of about 22 km of stormwater drains was also in progress. Hong Kong West Drainage Tunnel and Lai Chi Kong Drainage Tunnel have been commissioning. The construction of Tsuen Wan Drainage Tunnel, which was scheduled for completion in 2013, was underway.

Data from rain gauges operated by DSD and Geotechnical Engineering Office were relayed to HKO 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. About 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 2,700 km of drains and watercourses were maintained by DSD and about $112 million was spent on maintenance works in 2010-2011. 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 put emphasis on close monitoring of flooding conditions and swiftly deploy adequate resources to carry out immediate relief measures during adverse weather situations.

c. Disaster Prevention and Preparedness Achievements/Results

Nil.

d. Research, Training, and Other Achievements/Results

Staff of DSD 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.

e. Regional Cooperation Achievements/Results

Nil.

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

HKO's in-house developed weather app, MyObservatory, available on iOS and Android platforms (http://www.hko.gov.hk/myobservatory_e.htm) to deliver location-based personalized weather service in Hong Kong continued to be highly popular. In the first three quarters of the 2012, the visitor statistics of the MyObservatory soared to 5.4 billions, which was 3 times that of the figure recorded in 2011. Featuring with a suit of weather service including real-time weather information and push notification of weather warnings, the MyObservatory was enhanced with "Location-based Rain Forecast" service in September 2012. Users could easily get hold of the rainfall forecast in the coming two hours specific to their actual or selected locations in Hong Kong. The new service was presented in different formats including text, weather icon sequence (Figure 16(a)) and animated rainfall forecast maps (Figure 16(b)). Notification message would also be sent to users automatically (Figure 16(c)) whenever rain is forecast at their actual or selected locations in the next two hours.

Figure 16 Sample screens for (a) Location-based Rain Forecast service: (a) text and weather icon sequence (b) animated rainfall forecast map (c) notification message

The weather information delivery service through the micro-blog websites, Twitter and Weibo, remained very well-received with the number of followers exceeding a hundred thousand by September 2012. In 2012, the service was enhanced with regular tweets about popular science articles, written by HKO officers. The “Special Weather Tips”, a new service to better alert members of the public of impending inclement weather that launched in early 2012, was also available to users by following the Observatory’s accounts through the micro-blog websites.

To enhance the weather services for mariners, HKO launched the “Weather information for the Marine Community” website in early 2012 (Figure 17), providing a one-stop portal to marine weather information. Mariners may access the latest weather forecasts and warnings in a handy manner for their operations, especially during the approach of tropical cyclones over the South China Sea or the western North Pacific.

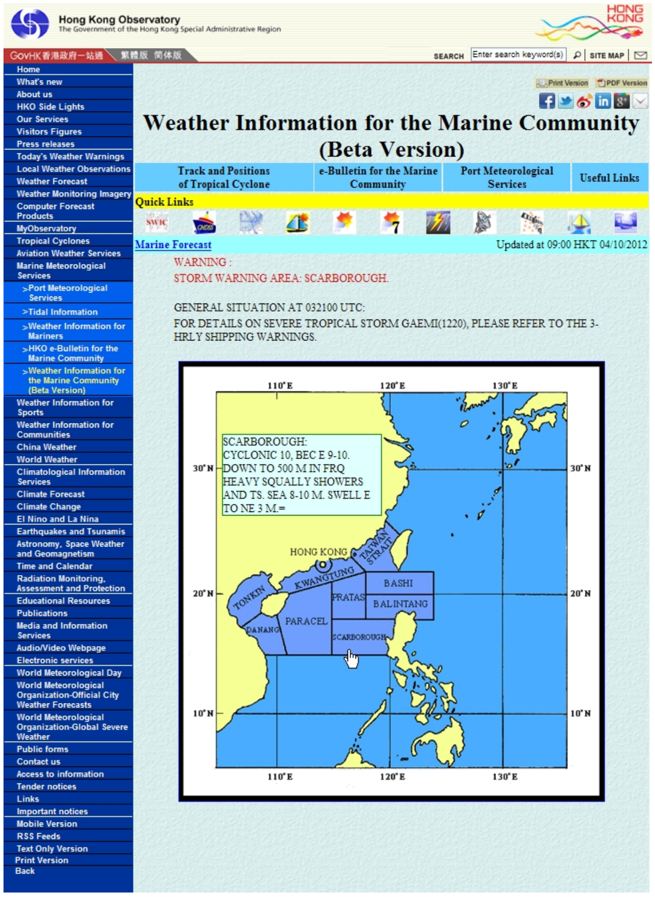

Figure 17 The “Weather information for the Marine Community” website

Real-time weather photos from one more strategic site in Hong Kong were launched on HKO website in 2012, making the total of such sites to 18. The weather photos allowed the public to better appreciate the weather conditions in real time particularly during the approach of tropical cyclones when local weather begins to deteriorate. To meet the needs of the public, higher resolution weather photos already provided in some of the sites would be expanded in phases to cover the entire HKO camera network.

Significant convection associated with rain-bands of tropical cyclones could bring disruption to air traffic. An integrated webpage on forecasts for significant convection for key air traffic control (ATC) areas (Figure 18) within the Hong Kong Flight Information Region (FIR) have been provided for trial use by ATC personnel since June 2010. The webpage was enhanced in 2011/12 to include forecasts of high impact weather parameters such as crosswind and cloud ceiling at the aerodrome. Weather briefing using the integrated webpage is provided to ATC twice a day to support air traffic capacity forecast.

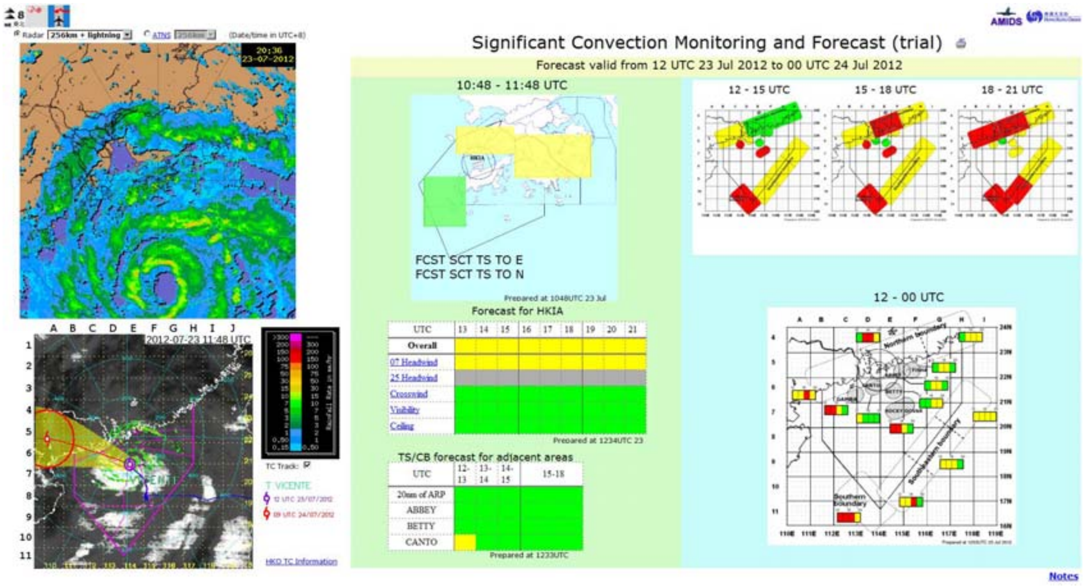

Figure 18 Trial Significant Convection Monitoring and Forecast webpage showing real-time observations and various forecast products at different lead time and coverage over the Hong Kong FIR and terminal area.

A pilot project on "Aviation Weather Disaster Risk Reduction" (ADRR) was established in the WMO Commission for Aeronautical Meteorology (CAeM) session in 2006 with a focus on tropical cyclone hazards. An ADRR website has been developed under the lead of the HKO as a regional Pilot Project in RAII and RA V under CAeM. Noting the success of the pilot project, the ADRR website was put into operation in April 2011.

A new product - “Position Probability Map”, which provides the probability distribution of the T+24, T+48 and T+72 hour forecast positions of a tropical cyclone, was launched on the ADRR website in May 2012 (Figure 19). This product supplements the existing “Strike Probability Map” which indicates the probability distribution of the forecast movement of a tropical cyclone.

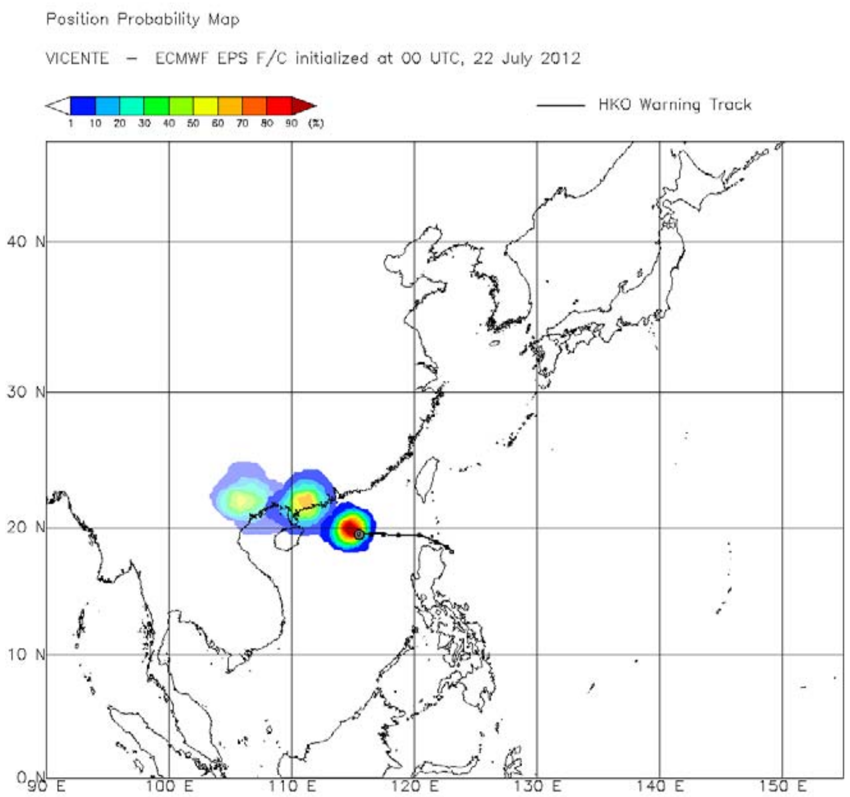

Figure 19 Position Probability Map showing the probability of positions of Tropical Cyclone Vicente at T+24, T+48 and T+72 hours at 00UTC on 22 July 2012.

b. Hydrological Achievements/Results

Please refer to Key Result Areas 2(b) and 4(b).

c. Disaster Prevention and Preparedness Achievements/Results

The "Community Weather Information Network (Co-WIN)", started in 2007 in collaboration with the Hong Kong Polytechnic University, saw further expansion in the number of community weather stations to over 115, with relevant weather data made available to the public via the Internet. HKO also developed and implemented the "Community Weather Observing Scheme" (CWOS), providing opportunities for community members to gain first-hand experience in making weather observations, particularly about the change of weather during the passages of tropical cyclones. Weather data obtained through Co-WIN and observations made via CWOS are applied by school children in various educational projects and studies. Both Co-WIN and CWOS help to raise awareness of severe weather, including tropical cyclones.

To celebrate the World Meteorological Day on 23 March, the HKO Headquarters was opened to the public on 25 March, 2012, attracting 16,000 people of all ages. The theme of the Open Day was "Powering our Future with Weather, Climate and Water". Through words, pictures and exhibits, the Observatory introduced various services including weather, climate, aviation meteorology, geophysical science and radiation monitoring to the public.

To raise public awareness on possible impact of climate change, HKO issued two blog articles in its website before the commencement of the typhoon season in 2012, highlighting respectively the long term variations of the number of tropical cyclones affecting Hong Kong and the potential risk of the return of the Hurricane Signal No. 10, the highest tropical cyclone signal in Hong Kong.

Experience gained in the Co-WIN project in Hong Kong was shared with Typhoon Committee members in the setting up of the Typhoon Committee Community Weather Station Project under WGDRR to raise awareness of the community, particularly students about weather and climate. Progress in the pilot project was made in 2012. Arrangement had been made for an expert from HKO to visit Guam and the Philippines in December 2012 to install weather stations there.

The Severe Weather Information Centre (SWIC) website (http://severe.worldweather.wmo.int), operated by Hong Kong, China for WMO, continued to serve as a popular channel for dissemination of real-time official tropical cyclone warnings and information worldwide. The SWIC website was enhanced with a new service to provide official fog observations reported all over the world in early 2012 (Figure 20).

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 Typhoon Committee recommended in 2009 a feasibility study of employing an Internet web based platform for real-time transmission of severe weather warnings from participating members. Hong Kong, China coordinated the project and developed the SWIdget service in 2010, utilizing SWIC as the platform. Through the SWIdget service, a PC user may, after a simple installation of a piece of software, receive real-time weather warnings on his/her machine. In 2012, the SWIdget was upgraded to version 2.1 providing weather warnings from seven meteorological services, viz. Hong Kong, China; Macao, China; Guam, USA; Republic of Korea; Singapore; Malaysia; and the Guangdong province of China in a near real-time manner.

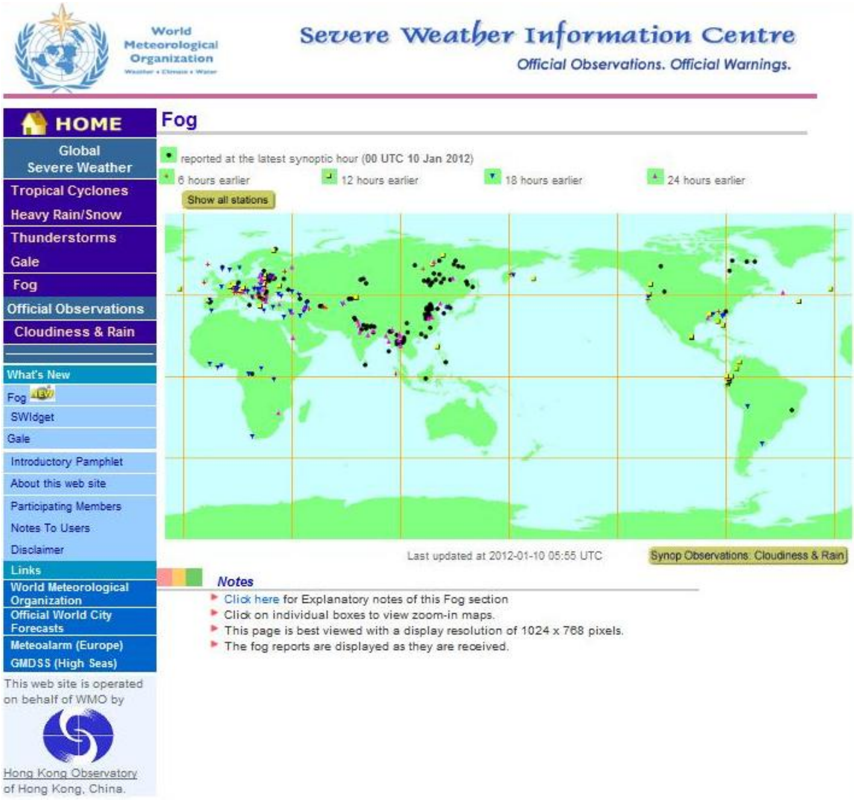

Figure 20 SWIC's fog webpage showing the distribution of fog observations around the world

d. Research, Training, and Other Achievements/Results

Two training sessions were organized by the HKO for media personnel to strengthen participants' understanding of tropical cyclone forecasting techniques and emergency response management in Hong Kong, with a view to more effective media delivery of warnings and forecasts on tropical cyclones issued by HKO.

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

High crosswinds have adverse impact on flight operations. To facilitate aviation forecasters' assessment, in probabilistic terms, of the maximum wind at HKIA during the entire tropical cyclone episode, a new forecasting tool based on ECMWF EPS output (10 day forecast) was developed and put under trial during the 2012 tropical cyclone season (Figure 21). Time-lagged ensemble and post-processing of the output are being explored to further improve the forecasting tool.

2012-Jul-25 00UTC

	20/07 00Z	20/07 12Z	21/07 00Z	21/07 12Z	22/07 00Z	22/07 12Z	23/07 00Z	23/07 12Z	24/07 00Z	24/07 12Z	25/07 00Z
48-50kt											
46-48kt											
44-46kt											
42-44kt											
40-42kt											1%
38-40kt					1%	1%	1%				
36-38kt			1%		5%	1%	1%				
34-36kt				1%			1%				
32-34kt	1%			1%	3%	11%	1%	3%			
30-32kt			1%	1%	3%	3%	11%	17%			
28-30kt			1%	1%	11%	13%	21%	15%			
26-28kt				3%	9%	19%	19%	28%	1%		
24-26kt	3%	1%	3%	7%	7%	11%	19%	15%	7%		
22-24kt	1%	1%	5%	19%	17%	11%	7%	15%	30%	3%	
20-22kt	11%	9%	9%	17%	13%	9%	5%	1%	46%	1%	3%
18-20kt	26%	25%	25%	30%	11%	3%	3%	1%	11%	17%	1%
16-18kt	36%	48%	40%	11%	13%	11%	3%		1%	59%	11%
14-16kt	11%	9%	7%	1%						15%	13%
12-14kt	3%	1%								1%	55%
10-12kt	1%	1%	1%								11%

Figure 21 EPS-based probabilistic forecast of maximum wind at HKIA for the entire tropical cyclone episode. Vertical axis is the wind speed range and each column represents the probability distribution of maximum wind forecast for a particular EPS model run.

In addition to running the Meso-NHM model using the JMA global model as boundary condition, the HKO conducted trial runs of a new Meso-NHM since May 2011, following the acquisition of full-resolution ECMWF model data using the ECMWF data as boundary condition. The model configuration was the same in both versions. The two sets of Meso-NHM outputs were made available to forecasters in real-time to assess alternative scenarios of the tropical cyclone forecast and related high-impact weather such as heavy rain and high winds (Figure 22). The verification statistics of forecast tracks in 2011 and 2012 showed that the position errors could be reduced by 20-30% throughout the 72 hours forecasts in the Meso-NHM using the ECMWF data as boundary condition.

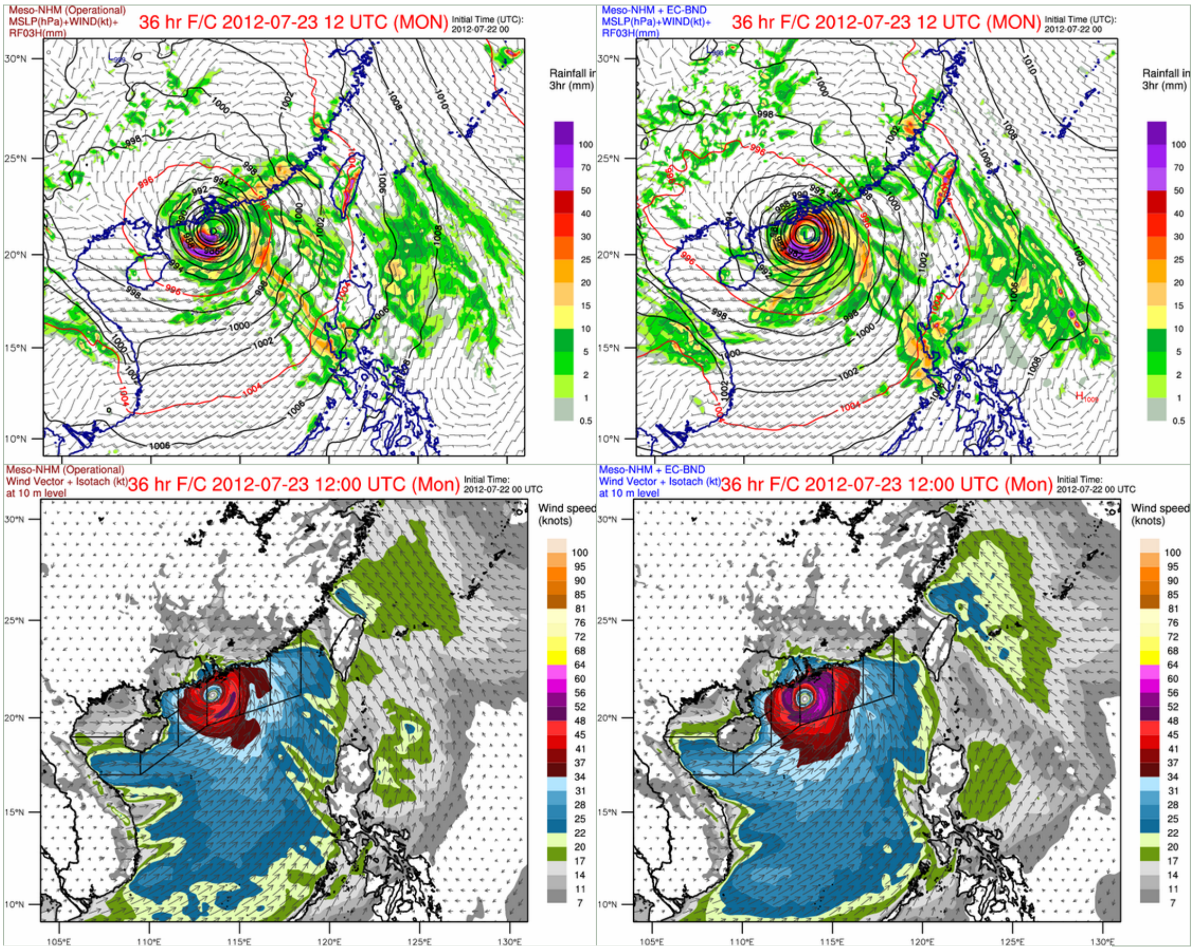

Figure 22 A sample panel display of the two Meso-NHM forecasts for tropical cyclone Vicente at 1200 UTC on 23 July 2012. Meso-NHM forecasts from the operational version (JMA data as boundary) are shown on the left column, and the model results from using ECMWF data as boundary condition given on the right. 30-hr forecasts of the surface wind, 3-h accumulated rainfall and surface isobars are depicted in the upper row. The forecast surface wind vectors with wind speed in colour are shown in the lower two figures.

HKO's Tropical Cyclone Information Display and Processing System (TIPS), one of the major systems for tropical cyclone forecast operations, was enhanced to display more ensemble tracks and EPS strike maps for forecasters' reference.

A webpage displaying the latest tropical cyclone assessment information based on the forecast TC tracks from different centres and NWP models became available in mid-2012 (Figure 23). The webpage calculates and shows the onset times of strong or gale force winds over different localities in Hong Kong under different forecast track and intensity scenarios, as well as the times when the tropical cyclone is closest to Hong Kong or makes landfall. The tool helps forecasters to better assess the impact of tropical cyclone affecting Hong Kong.

TC Assessment Information Page

(HK-TCID 1210) VICENTE ▾ Centre - HKO ▾ Tracks are updated at: 15:46 HKT 23-Jul

		Latest Assessment 06 Z (23-Jul)	Previous Assessment 03 Z (23-Jul)
Closest Approach to HKO		2224 HKT 23-Jul (Mon) 143 km (SSW), 21.1N 113.5E	2112 HKT 23-Jul (Mon) 159 km (SSW), 21.0N 113.6E
500km	In	N/A	N/A
	Out	2034 HKT 24-Jul (Tue)	1755 HKT 24-Jul (Tue)
800km	In	N/A	N/A
	Out	1004 HKT 25-Jul (Wed)	0447 HKT 25-Jul (Wed)

Typhoon | STS | TS | TD | Landfall | Analysis ☐10% ☐20% ☐30% ☐40% ☑50% ☐60% ☐70% ☐80% ☐90% ☐100%

		Latest Assessment 06 Z		Previous Assessment 03 Z	
Probability: 50%		In	Out	In	Out
Strong	Waglan	N/A	1224 HKT 24-Jul (Tue)	N/A	1035 HKT 24-Jul (Tue)
	Cheung Chau	N/A	1427 HKT 24-Jul (Tue)	N/A	1244 HKT 24-Jul (Tue)
	Chek Lap Kok	N/A	1642 HKT 24-Jul (Tue)	1320 HKT 23-Jul (Mon)	1512 HKT 24-Jul (Tue)
	Victoria	N/A	1408 HKT 24-Jul (Tue)	1237 HKT 23-Jul (Mon)	1227 HKT 24-Jul (Tue)
	3/8	N/A	N/A	N/A	N/A
	4/8	N/A	1036 HKT 24-Jul (Tue)	1413 HKT 23-Jul (Mon)	0915 HKT 24-Jul (Tue)
Gale	Waglan	N/A	0728 HKT 24-Jul (Tue)	1354 HKT 23-Jul (Mon)	0512 HKT 24-Jul (Tue)
	Cheung Chau	1541 HKT 23-Jul (Mon)	0935 HKT 24-Jul (Tue)	1657 HKT 23-Jul (Mon)	0935 HKT 24-Jul (Tue)
	Chek Lap Kok	2357 HKT 23-Jul (Mon)	0807 HKT 24-Jul (Tue)	2302 HKT 23-Jul (Mon)	0650 HKT 24-Jul (Tue)
	Victoria	2026 HKT 23-Jul (Mon)	0448 HKT 24-Jul (Tue)	2055 HKT 23-Jul (Mon)	0301 HKT 24-Jul (Tue)
	3/8	N/A	N/A	N/A	N/A
	4/8	N/A	N/A	N/A	N/A

Figure 23 Sample of the tropical cyclone assessment webpage

An integrated portal for the input of D'vorak analysis and issuance of HKO SAtellite REPort (SAREP) in BUFR format was developed and put into internal trial use, in preparation of the official launch of HKO SAREP in 2013.

Using the 10-km Non-Hydrostatic Model (Meso-NHM) and a tropical cyclone tracker, a new forecast product on tropical cyclone structure based on the model was developed and put into operation for the 2012 tropical cyclone season.

The product showed the evolution of various wind radii of a tropical cyclone in the form of time series, together with a zoom-in snapshot of the surface wind forecast around the centre of the tropical cyclone. A sample forecast product for Severe Typhoon Vicente (1208) from the model run initialized at 12UTC on 22 July 2012 is shown in Figure 24. The time series shows an increase in the maximum wind (and a decrease in central pressure) in the first half of the forecast period, indicating the strengthening of Vicente before landfall. The forecast snapshot of the structure of Vicente shows that Hong Kong would come within the storm radius of Vicente in the early morning of 24 July 2012 as the tropical cyclone edges closer.

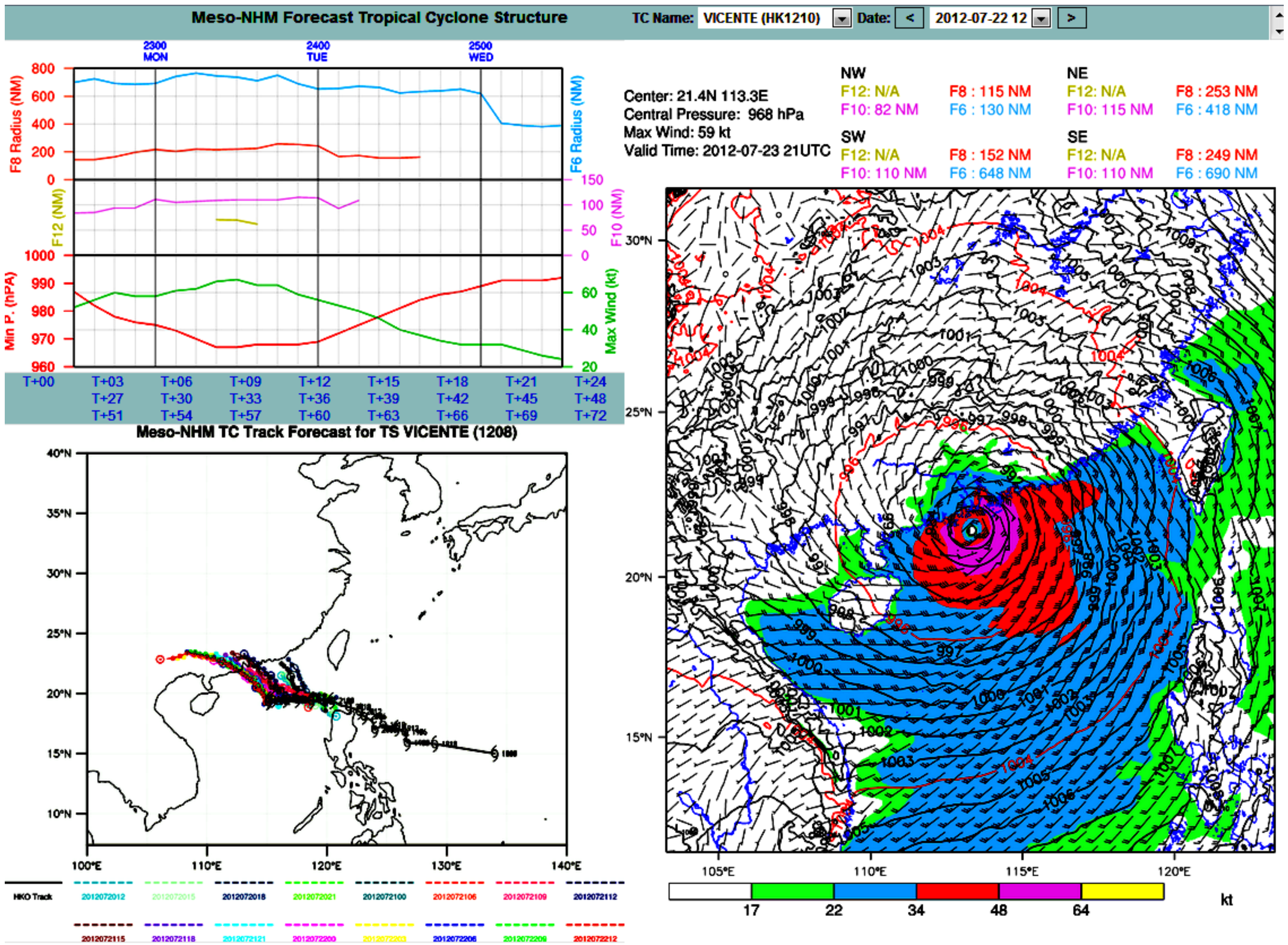

Figure 24 New product on forecasting the evolution of tropical cyclone structure. This sample display is extracted from the case of Vicente (1208). Based on the forecast structure of Vicente from Meso-NHM, Hong Kong would be located within the storm radius of Vincete in the early morning of 24 July 2012.

A post-processing technique combining multiple linear regression and rolling bias-removal to downscale the wind forecasts from ECMWF EPS to various locations within Hong Kong was developed and implemented in 2012. The product is displayed in the forms of time series and spatial distribution maps. Sample time series forecast and spatial distribution map for the case of Vicente (1208) are shown in Figure 25 and Figure 26 respectively.

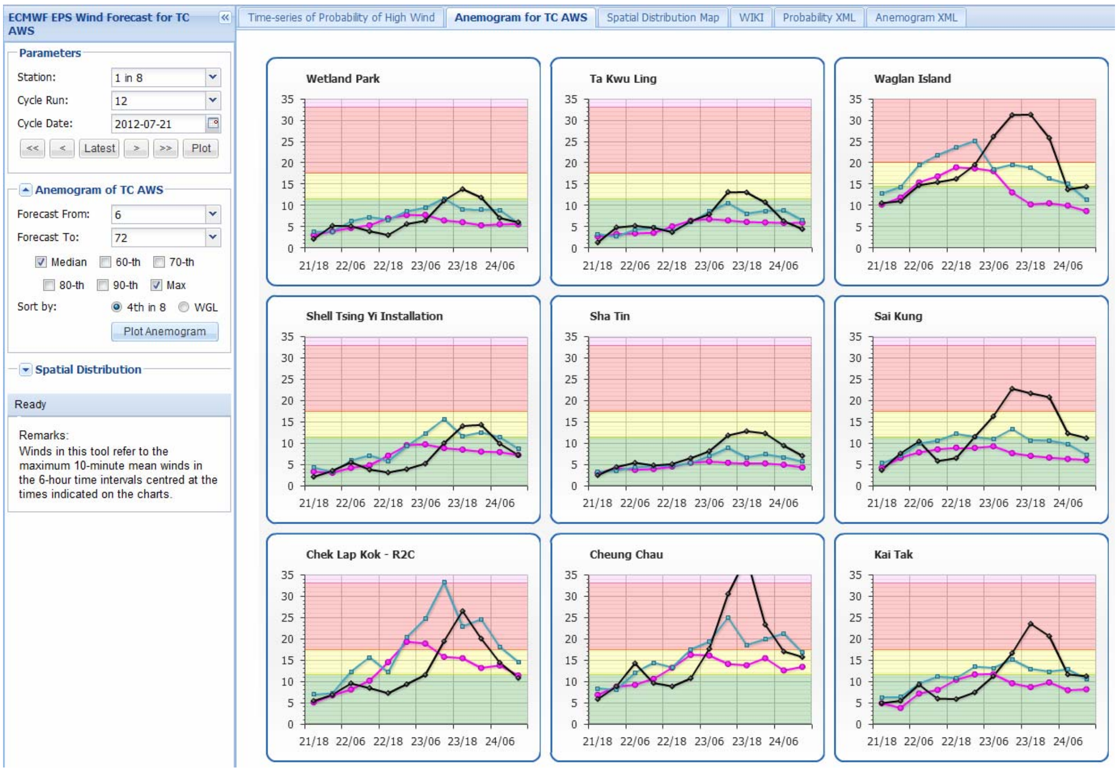

Figure 25 New local wind forecast based on calibrated ECMWF EPS data in the form of time series display. The black curve shows the actual wind speed observations as they become available; and the red and blue curves show the median and maximum of the calibrated EPS wind speed respectively.

The forecast product in Figure 25, which is based on the 12UTC model run on 21 July 2012, indicates a potential threat of hurricane winds at the airport at 12 UTC on 23 July (Chek Lap Kok, the time-series in the lower left corner). The forecasted hurricane wind subsequently materialized at 16 UTC on 23 July at Cheung Chau, a location less than 20 km away from the airport. As shown in Figure 26, although the forecast for individual stations does not match perfectly with actual, it does show the trend of having the strongest winds in the southwestern part of the territory, indicating the skill of the calibrated forecast.

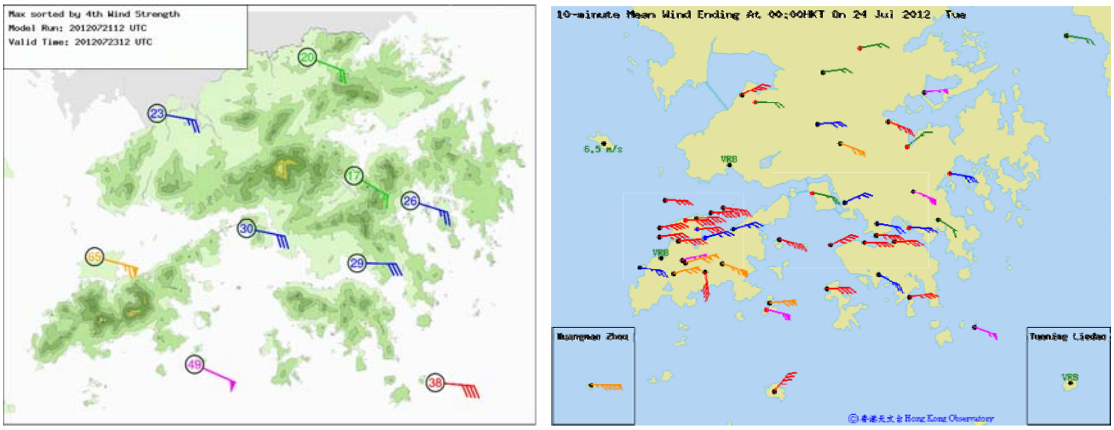

Figure 26 New local wind forecast product based on calibrated ECMWF EPS data displayed in the form of spatial distribution map valid at 12 UTC on 23 July 2012 (left) against actual observations at 16 UTC on the same day (right).

Tropical cyclone track forecasts from various ensemble prediction systems, including the One-week EPS and Typhoon EPS of JMA; the EPS of NCEP, UK Meteorological Office (UKMO) and China Meteorological Administration (CMA); as well as the grand EPS comprising all available EPS forecasts, were added to the real-time tropical cyclone track verification tool of HKO for conducting real-time verification. The tool helps the forecasters monitor the performance of various NWP models, in particular the early discovery of development of any track biases in the models.

With the view to enhancing weather observations over the ocean, the WMO Voluntary Observing Ship (VOS) Scheme was promulgated to members of the Hong Kong Shipowners Association. Subsequently, 4 container ships joined the scheme, increasing the number of ships in the HKVOS fleet to 58.

b. Hydrological Achievements/Results

Nil.

c. Disaster Prevention and Preparedness Achievements/Results

Nil.

d. Research, Training, and Other Achievements/Results

Two identical 1-day sessions of In-house Refresher Training Course on Dvorak Analysis were conducted for forecasters on 18 April and 16 May 2012.

Drills and exercises on operational forecasting techniques and procedures during severe weather and tropical cyclone situations were conducted to refresh HKO forecasters in carrying out relevant forecasting duties.

Storm surge model was acquired from RSMC Tokyo and comparison of its performance with that of HKO's operational model (SLOSH) was being conducted using past tropical cyclone cases.

Based on the new optical-flow based radar echoes tracking algorithm, an experimental ensemble rainstorm nowcasting system comprising 36 members was developed and put into real-time testing. To facilitate assessment of the likelihood of rainstorm occurrences in the coming 6 hours, an innovative ensemble meteorogram product showing the time series of a critical rainfall parameter of rainstorm warning in Hong Kong was developed and made available to forecasters.

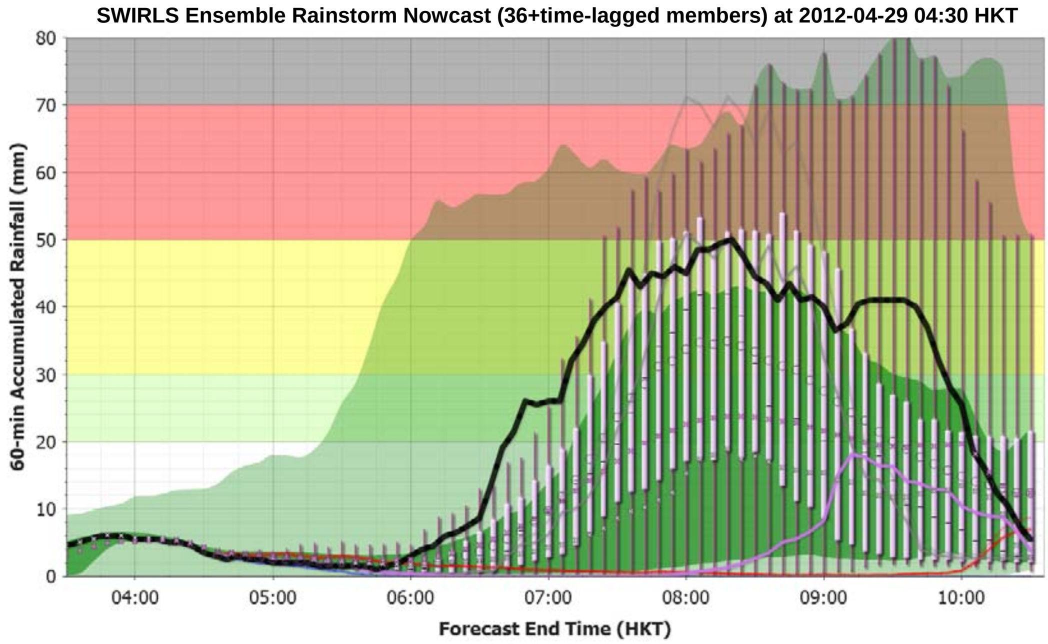

Figure 27 Example of experimental ensemble rainstorm nowcast product from SWIRLS. The y-axis refers to the value of the rainfall parameter critical to the Observatory's rainstorm warning criteria. Different background colours indicate different warning thresholds. The black curve and the light purple box-whisker diagrams represent respectively the actual and predicted values of the critical rainfall parameter. Also shown are the operational nowcast (red curve) and one selected member of the ensemble (purple curve). The green shadings on the background indicate the forecast spread due to time-lagged ensemble members.

Based on heuristic optimization techniques, including Cuckoo Search, Particle Swarm and Genetic Algorithm, an automatic parameter tuning tool has been developed for the effective tuning of the QPF module of SWIRLS, which contains 6 tunable parameters with a wide range of possible values. Results show that the Cuckoo Search is more effective in a constrained environment and the optimal parameter settings for rainfall due to squall line and monsoon trough types are different. The optimization study will be extended to rotating rainfall system typical of tropical cyclones.

e. Regional Cooperation Achievements/Results

Under the collaboration with the Guangdong Meteorological Bureau, a radar mosaic comprising a maximum of 10 radars in Guangdong and Hong Kong is routinely generated and shared in real time for more effective monitoring of distant tropical cyclones and other rainfall systems.

During the close passage of the five tropical cyclones, meteorological observations from buoys and oil rigs near the coast of southern China were made available to HKO for monitoring of the storms.

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

Nil.

b. Hydrological Achievements/Results

Nil.

c. Disaster Prevention and Preparedness Achievements/Results

Nil.

d. Research, Training, and Other Achievements/Results

Nil.

e. Regional Cooperation Achievements/Results

One HKO officer attended the Typhoon Committee Roving Seminar 2012 held in Seoul from 30 October to 1 November 2012.

Under the Typhoon Committee Research Fellowship Scheme 2012, a total of three researchers from the Philippines and Malaysia attached to HKO for two months from late October 2012 to carry out nowcasting research studies for tropical cyclone rainfall. As a follow-up to the 44th Typhoon Committee Session, a training component on QPE/QPF was included in the attachment and the research fellow from PAGASA was funded by TCTF under the Urban Flood Risk Management Project.

A research fellow from the Malaysian Meteorology Department (MMD) under the Typhoon Committee Research Fellowship 2011 completed a research study at HKO on TC intensity forecast using multiple-model ensemble techniques. Results indicated that the equally-weighted multiple-model ensemble method generally performed better than each individual model in TC intensity forecasts. A joint paper on the research result prepared by MMD and HKO will be published in the journal "Tropical Cyclone Research and Review" of Typhoon Committee.

As at October 2012, 21 RA II Members, 8 of which are Typhoon Committee Members, participated in the WMO RA II Project on the Provision of City-Specific Numerical Weather Prediction (NWP) Products to Developing Countries coordinated by HKO. City-specific forecasts covering various weather elements for the next few days for 233 cities were being provided to the participants via the Internet twice a day.

f. Identified Opportunities/Challenges for Future Achievements/Results

Nil.

III. Resource Mobilization Activities

Nil.

IV. Update of Members' Working Groups representatives

1. Working Group on Meteorology –
   Dr. C.M. Cheng – email: cmcheng@hko.gov.hk
   Facsimile: 852 23119448
   Telephone: 852 29268223

2. Working Group on Hydrology –
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   Facsimile: 852 23119448
   Telephone: 852 29268360

3. Working Group on Disaster Risk Reduction –
   Ms. Hilda Lam - email: hildlam@hko.gov.hk
   Facsimile: 852 23119448
   Telephone: 852 29268222

4. Training and Research Coordinating Group –
   Mr. Edwin S.T. Lai - email: stlai@hko.gov.hk
   Facsimile: 852 23119448
   Telephone: 852 29268224

5. Resource Mobilization Group
   Nil.