## **MEMBER REPORT**

## ESCAP/WMO Typhoon Committee 8<sup>th</sup> Integrated Workshop/2<sup>nd</sup> TRCG Forum

## Hong Kong, China

Macao, China

2 – 6 December 2013

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# I. Overview of tropical cyclones which have affected/impacted Member's area in 2013

1. Meteorological Assessment (highlighting forecasting issues/impacts)

Seven tropical cyclones affected Hong Kong, China in 2013 (their tracks shown in Figure 1 and position errors of forecasts issued by the Hong Kong Observatory (HKO) in Table 1): Tropical Storm Bebinca (1305) in June, Severe Tropical Storm Rumbia (1306) in June-July, Tropical Storm Cimaron (1308) in July, Severe Tropical Storm Jebi (1309) in July-August, Super Typhoon Utor (1311) in August, Super Typhoon Usagi (1319) in September and Typhoon Krosa (1329) in November. Two of them, namely Utor and Usagi, necessitated the issuance of the Gale or Storm Signal in Hong Kong.

<u>Table 1</u> - Performance summary of track forecasts issued by HKO as verified against HKO's best track analyses for the seven tropical cyclones that affected Hong Kong in 2013

	24-hr position	48-hr position	72-hr position
	forecast error	forecast error	forecast error
	(km)	(km)	(km)
Bebinca	132	264	318
Rumbia	70	194	433
Cimaron	109	115	-
Jebi	67	73	164
Utor	74	105	143
Usagi	75	74	94
Krosa*	122	218	327

\* based on operational track as best track analyses not yet available

While there were impressive success stories like in the case of Usagi with 72-hr position forecast error less than 100 km, large errors exceeding 300 km were also evident. With 72-hr position forecasts now very much model-dependent, the co-existence of both reliable and less reliable forecasts in model performance is a dichotomy that requires research attention and careful interpretation in operational assessment.

 Hydrological Assessment (highlighting water-related issues/ impact)

Jebi, Utor and Usagi brought more than 100 millimetres of rainfall to parts of the territory during their passages.

In the case of Usagi, a maximum sea level of 3.4 m (above chart datum) and a maximum storm surge of 1.0 m were recorded. There was minor flooding in some low lying areas in Hong Kong with interruptions to traffic for a period of time.

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

Nine people were injured in Hong Kong during the passage of Utor. Two people were rescued and one went missing when diving in the seas offshore. There were 415 reports of fallen trees, six reports of minor flooding, as well as a number of reports of collapsed scaffolding or signboards. At the Hong Kong International Airport, 148 flights were cancelled, 663 flights delayed and 32 flights were diverted due to adverse weather. A Guangdong-bound cargo vessel sank in the waters about 80 kilometres southwest of Hong Kong, and all 21 crew members were rescued.

Seventeen people were injured, 900 trees were blown down and many incidents of fallen objects were reported in Hong Kong during the passage of Usagi. At the Hong Kong International Airport, 215 flights were cancelled and 472 flights were delayed.

Late in the season, Super Typhoon Haiyan swept past the central Philippines, the northern part of Viet Nam and the southwestern part of China with devastating impact. Although Hong Kong was not directly in its path, one person was reported missing after swimming in turbulent waves and swells whipped up by the high winds under the combined influence of Haiyan and the northeast monsoon.

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

Under the WMO RA-II pilot project to Develop Support for NMHSs in Numerical Weather Prediction, a training workshop was conducted in late 2012 and an "Asian Consortium for NWP Forecasts" (ACNF) web-based portal was established to provide model source code as well as NWP data and products, including forecasts of tropical cyclone movement, intensity and wind distribution, to support NMHSs in their provision of forecasts and warnings.

At the invitation of the Shanghai Typhoon Institute of CMA, a meteorologist from the Observatory conducted a training workshop on operational Dvorak technique for analysis of tropical cyclone intensity in Shanghai in May 2013. Among the workshop participants were forecasters and researchers from Shanghai, as well as practitioners from six provinces and two municipalities over the eastern China region.

In collaboration with PAGASA, real-time nationwide radar mosaics data of the Philippines is routinely received by HKO for more effective monitoring of tropical cyclones. This is a good example of regional exchange of radar data to promote Members' capability in the monitoring and warning of tropical cyclones and the development of nowcasting techniques for tropical cyclone forecasts.

### II. Summary of Progress in Key Result Areas

TC Members' Report Summary of Progress in KRAs

Title of item (1): Tropical Cyclone Surveillance Flight

#### Main text:

Reconnaissance flights in collaboration with the Hong Kong Government Flying Service (GFS) continued in 2013 to collect meteorological observations for tropical cyclones over the South China Sea. A total of seven flights were conducted, including a low pressure system (14 June), Bebinca (21, 22 June), Rumbia (1 July), Jebi (1, 2 August), and Utor (13 August). In particular, the centre of Utor was traversed a couple of times to collect wind and pressure data, aiding operational determination of the location of the system (Figure 2).

In recognition of its contribution towards mitigating effort against weather hazards, GFS was awarded the Dr. Roman L Kintanar Award 2012 during the Typhoon Committee 45<sup>th</sup> Session held in Hong Kong in early 2013. HKO and GFS together also won the bronze award under the Team Award in the Civil Service Outstanding Service Award Scheme, organized by the Civil Service Bureau of the Government of the Hong Kong Special Administrative Region, in 2013 for their joint effort in Tropical Cyclone Surveillance Flight.

Identified opportunities/challenges, if any, for further development or collaboration:

A dropsonde system for collection of vertical atmospheric profiles would be installed on a new GFS Bombardier aircraft in 2014. Discussion with international and regional agencies is underway on data exchange over the GTS. It is planned that additional reconnaissance flights would be conducted during the Intensive Observation Period of the WMO Southern China Monsoon Rainfall Experiment (SCMREX) between April and June 2014.

KRA =	1	2	3	4	5	6	7
Meteorology	~	$\checkmark$				$\checkmark$	
Hydrology							
DRR							
Training and research							
Resource mobilization or						✓	
regional collaboration							

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## TC Members' Report Summary of Progress in KRAs

#### Title of item (2):

**Operational Mesoscale Numerical Model for Tropical Cyclone and Aviation Forecasts** 

#### Main text:

HKO operates a mesoscale numerical prediction suite, the Atmospheric Integrated Rapid-cycle (AIR) forecast system based on the Non-hydrostatic Model, providing forecasts over East Asia and the western North Pacific at 10-km resolution up to 72 hours ahead, as well as over southern China and the northern part of the South China Sea at 2-km resolution up to 15 hours ahead (RAPIDS-NHM).

In April 2013, operational boundary conditions of Meso-NHM was switched from the global model of JMA to that of ECMWF following experiments in 2011 and 2012 indicating potential reduction in tropical cyclone track error by 20% - 30%. Twice-daily runs of Meso-NHM with JMA boundary conditions were retained to continue providing to forecasters in real time alternative scenarios of tropical cyclone tracks and high-impact weather, e.g. heavy rain and high winds. Assimilation of radar reflectivity data in RAPIDS-NHM has also begun in 2013, bringing improvements in short-term precipitation forecasts, particularly in the 0 - 6hour range, both in terms of rainfall location and intensity.

Trial operation of a high-resolution numerical weather prediction system in support of aviation weather services at the Hong Kong International Airport (HKIA) began in 2013, providing detailed wind, temperature and precipitation information around the greater Pearl River Estuary region (at resolution of 600 m) as well as in the vicinity of the HKIA (at resolution of 200 m). High spatial resolution has allowed the inner domain of AVM to capture terrain-disrupted flow features associated with passage of tropical cyclones, a known cause of low-level windshear at HKIA. Forecast guidance for assessing likelihood of windshear and intensity of low-level turbulence is being developed with a view to assuring aviation safety. Identified opportunities/challenges, if any, for further development or collaboration:

Development is underway on the assimilation of radar reflectivity data into Meso-NHM as well as assimilation of regional radar mosaic data over southern China. Expansion of Meso-NHM forecast domain is planned in 2014 following hardware upgrade. Both offer potential benefits in the forecasting of tropical cyclones and associated adverse weather.

KRA =	1	2	3	4	5	6	7
Meteorology	>	$\checkmark$				>	
Hydrology							
DRR							
Training and research						$\checkmark$	
Resource mobilization or						$\checkmark$	
regional collaboration							

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#### Title of item (3):

Hydrological Achievements and Results on Risk Management and Impact Mitigation associated with Typhoon-related Hazards

#### Main text:

Rain gauges operated by Drainage Services Department (DSD) and Geotechnical Engineering Office continued to relay rainfall data to HKO to support the operation of various weather warning systems.

HKO, DSD and Home Affairs Department continued to operate jointly an "Early Alert System for Predicted Storm Surges" for six coastal low-lying areas in Hong Kong.

To facilitate DSD flood control/emergency operations, HKO provided DSD with guidance information on the likelihood of heavy rainstorms in Hong Kong in the next couple of hours. Before the onset of rainy season, DSD liaised closely with other relevant government departments and persons in charge of construction sites to implement precautionary measures to prevent flooding arising from blockage of drainage systems. DSD has compiled a list of flooding black spots to put emphasis on close monitoring of flooding conditions and swiftly deploy adequate resources to carry out immediate relief measures during adverse weather situations. At four locations where flooding might cause high risks to local residents, flood warning systems were successfully implemented to monitor the flooding situations and alert residents about the arrival of flood water.

Since 1989, DSD has completed a series of major flood protection works in the rural areas, including over 100 kilometres of trained rivers, over 23 kilometres of storm-water drains and 27 village flood water pumping schemes. For urban areas, some major flood protection projects have also been commissioned during the past few years.

Dynamic hydrological and hydraulic computer models for the drainage systems managed by DSD were developed to provide information on the risk of flooding,

impacts of development and the performance of various flood protection options. These models would be updated under various ongoing and planned Drainage Master Plan (DMP) Review Studies. To cope with the latest development in the community and also the effects of changing weather patterns, DSD has commenced the review studies for DMPs of different regions in phases.

DSD staff attended various training classes, workshops and conferences both local and overseas to acquire the latest knowledge in 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 on advanced hydraulic modelling techniques for drainage systems.

Identified opportunities/challenges, if any, for further development or collaboration:

Nil

KRA =	1	2	3	4	5	6	7
Meteorology							
Hydrology	$\checkmark$	>		$\checkmark$	~		
DRR							
Training and research				$\checkmark$			
Resource mobilization or							
regional collaboration							

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#### Title of item (4):

#### Climate Service Support for Policy Planning and Disaster Risk Management

#### Main text:

HKO continued to provide climate data and expert advice in support of the following government departments in Hong Kong: (a) Drainage Services Department on the study of River Flood Risk and the review of the drainage master plan in Hong Kong; (b) Geotechnical Engineering Office of the Civil Engineering and Development Department on the Probable Maximum Precipitation Updating Study; and (c) Water Supplies Department for water resources planning and management; and (d) Building Department on the consultancy study for the Review of the Code of Practice on Wind Effects in Hong Kong. Information provided included tropical cyclone records, extreme wind speed, rainfall and sea level data, as well as HKO's expert views on climate change issues and their potential implications for Hong Kong.

Identified opportunities/challenges, if any, for further development or collaboration:

Latest climate change assessments from the UN IPCC Fifth Assessment Report (AR5) and the updated projections of climate change in Hong Kong in the 21st century based on the AR5 results will be prepared and provided for reference by government departments and other professional bodies.

KRA =	1	2	3	4	5	6	7
Meteorology							
Hydrology							
DRR		$\checkmark$	$\checkmark$	~			
Training and research							
Resource mobilization or							
regional collaboration							

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## TC Members' Report Summary of Progress in KRAs

Title of item (5): Further Expansion of the "Community Weather Information Network (Co-WIN)"

Main text:

The "Community Weather Information Network (Co-WIN)", started in 2007 by HKO and the Hong Kong Polytechnic University, saw further expansion with the official launch of the "Typhoon Committee Community Weather Information Network Project" at the opening ceremony of the Typhoon Committee 45th Session on 29 January 2013. With the inclusion of the two community weather stations at schools in the Philippines and Guam respectively, the number of community weather stations of Co-WIN rose above 130.

Under the "Community Weather Observing Scheme" (CWOS), an initiative of Co-WIN, a new mobile application, named "iCWeatherOS", was launched on the iPhone platform in August 2013 for users to take weather photos as well as reports and upload weather observations to their Facebook or Weibo personal pages. These information can be displayed on the CWOS website, the mobile app as well as the corresponding Facebook Page (Figure 3).

Identified opportunities/challenges, if any, for further development or collaboration:

CWOS will be further developed to facilitate more participation at the community level.

Summary Table of relevant KRAs and components [please tick boxes, can be more than one, as appropriate]:

KRA =	1	2	3	4	5	6	7
Meteorology							
Hydrology							
DRR					$\checkmark$		
Training and research							
Resource mobilization or							
regional collaboration							

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## TC Members' Report Summary of Progress in KRAs

#### Title of item (6):

# Communication of Information for Strengthening Resilience of Communities to Typhoon-related Disasters

#### Main text:

HKO launched an enhanced version of the regional weather webpage in 2013. Based on a Geographical Information System (GIS) platform, the webpage (<u>http://maps.weather.gov.hk/index\_e.html</u>) integrates the display of different meteorological elements as well as radar and lightning information on the same map to facilitate easier appreciation of the regional weather variations in Hong Kong.

The provision of tropical cyclone forecast tracks to the public was enhanced in 2013 with an earlier issuance of the forecast tracks for tropical cyclones within the storm watch area as well as for distant tropical cyclones. The associated Tropical Cyclone Track Information webpage on HKO website was also enriched with satellite images and track accuracy cones (Figure 4).

The conveyance of timely weather information such as tropical cyclone warnings is very much facilitated by the increasingly popular use of personal mobile devices. In 2013, usage of HKO's in-house developed weather app, "MyObservatory", exceeded that of the Observatory's website for the first time, suggesting that more and more users made use of mobile platform to gain access to weather information. HKO continued to enhance the features on "MyObservatory" for the benefits of users, e.g. track accuracy cones for tropical cyclone forecast tracks on the app.

To better serve mobile users worldwide, HKO enhanced the WMO's weather app, "MyWorldWeather", to provide official weather forecast worldwide in nine languages, and also launched the Android version of the app in 2013.

HKO continued to reach out to various sectors of the society, such as the transport sector and marine sector, to better understand their concerns and needs in respect of tropical cyclone information and warning services. The trial implemented in the latter part of 2012 to issue more frequent assessment on tropical cyclone warning

signals became operational in the 2013 tropical cyclone season. Feedback received showed that the enhancement helped decision-makers to take earlier precautions in their operations during the approach and passage of tropical cyclones.

Identified opportunities/challenges, if any, for further development or collaboration:

HKO's mobile app, "MyObservatory", now available on iOS and Android platforms, will be extended to Windows 8 mobile platform, with a view to delivering tropical cyclone related weather information to a wider group of people.

KRA =	1	2	3	4	5	6	7
Meteorology	>	$\checkmark$		$\checkmark$	$\checkmark$		
Hydrology							
DRR							
Training and research							
Resource mobilization or							
regional collaboration							

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## TC Members' Report Summary of Progress in KRAs

#### Title of item (7):

Training on Tropical Cyclone Forecasting and Effective Communication to the Media and the Public

Main text:

A 1.5-day in-house Training Workshop on "Effective Communication to the Media and the Public" was organized for HKO staff to enhance communication skills in conveying forecast and warning messages to the media and the public, particularly in tropical cyclone situations.

One HKO officer attended the WMO RA-IV Workshop on Hurricane Forecast and Warning and Public Weather Services in Miami, USA on 11-22 March 2013 to enrich his knowledge in tropical cyclones, and the associated forecasting techniques and operational issues.

Identified opportunities/challenges, if any, for further development or collaboration:

Nil.

Summary Table of relevant KRAs and components [please tick boxes, can be more than one, as appropriate]:

KRA =	1	2	3	4	5	6	7
Meteorology						>	
Hydrology							
DRR						$\checkmark$	
Training and research						$\checkmark$	
Resource mobilization or							
regional collaboration							

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Title of item (8): Data Exchange with Members

#### Main text:

Following the completion of internal trials, the integrated portal for the input of Dvorak analysis and issuance of HKO SAREP in BUFR format was launched and HKO began to disseminate SAREP reports (Report of Synoptic Interpretation of Cloud Data obtained by a Meteorological Satellite) over the GTS in June 2013. The issuance of 3-hourly SAREP reports through the Global Telecommunication System for tropical cyclones within the area of 10°N to 30°N and 105°E to 125°E enhanced information sharing among meteorological centre for the monitoring of tropical cyclones in the region.

To facilitate exchange of weather warnings between alerting technologies, the Observatory compiled the warning bulletins, including those for tropical cyclones, into Common Alerting Protocol (CAP), an XML-based format promoted by WMO.

Identified opportunities/challenges, if any, for further development or collaboration:

The CAP format needs to be promoted among WMO members as well as other public warning/alert authorities to facilitate timely exchange of tropical cyclone warnings which is critical to disaster risk reduction.

Summary Table of relevant KRAs and components [please tick boxes, can be more than one, as appropriate]:

KRA =	1	2	3	4	5	6	7
Meteorology	>					>	
Hydrology							
DRR							
Training and research							
Resource mobilization or						$\checkmark$	
regional collaboration							

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#### Title of item (9): System and Product Development to Support Tropical Cyclone Operation

#### Main text:

The Tropical Cyclone Assessment Information tool, which assimilates forecasts from various warning centres and NWP models and computes critical parameters such as timing of onset of strong / gale force winds over Hong Kong and the times when the tropical cyclone is closest to Hong Kong, was revamped in 2013 to present all the parameters in a timeline format (Figure 5). The new presentation enables the forecasters to appreciate the sequence of events in a succinct and intuitive way rather than viewing them as separate and unrelated events.

The Integrated Meteorological Information Display, a GIS-enabled visualization and data analysis system, was enhanced to include the Inflow Angle Method for the identification of the tropical cyclone centre based on surrounding wind reports.

More new NWP products, including spaghetti plots of ECMWF EPS MSLP and 500 hPa geopotential height, vertical wind shear charts based on the ECMWF deterministic model, KMA EPS meteorogram at grid points near Hong Kong and a suite of prognostic charts generated from KMA's UM-based Global Data Assimilation and Prediction System data, were made available to forecasters for predicting the evolution of weather during the approach of tropical cyclones.

Two enhanced NWP products were made available to forecasters to predict changes in local wind and tropical cyclone structure: (a) a new station-specific multi-model ensemble products based on direct model output and post-processed model forecasts from the deterministic NWP models (ECMWF, JMA, NCEP, CMA and HKO Meso-NHM) and ECMWF EPS; and (b) extension of the tropical cyclone structure forecasting tool to display ECMWF model forecast to show the evolution of the wind structure of tropical cyclones, presented in both textual and graphical formats for users' interpretation (Figure 6). Identified opportunities/challenges, if any, for further development or collaboration: Nil.

KRA =	1	2	3	4	5	6	7
Meteorology						$\checkmark$	
Hydrology							
DRR							
Training and research							
Resource mobilization or							
regional collaboration							

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#### Title of item (10):

#### **Educational Blog Articles on Tropical Cyclone Risks for Public Education**

Main text:

HKO published a number of blog articles on its website to promote public awareness on the risk and potential impacts of tropical cyclones. Topics of the blog articles included the "Geng-Zi" typhoon disaster in November 1900 which brought catastrophic havoc and desolation to the ill-prepared society in Hong Kong at the time, a phenomenal rainstorm event in July 1926 associated with a typhoon landing to the east of Hong Kong, and the potential risk of severe storm surges in Hong Kong using the case of Severe Typhoon Usagi in September 2013.

Identified opportunities/challenges, if any, for further development or collaboration:

Nil.

Summary Table of relevant KRAs and components [please tick boxes, can be more than one, as appropriate]:

KRA =	1	2	3	4	5	6	7
Meteorology							
Hydrology							
DRR		$\checkmark$			$\checkmark$		
Training and research							
Resource mobilization or							
regional collaboration							

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## TC Members' Report Summary of Progress in KRAs

#### Title of item (11):

Drill and Exercises with Government Departments and Organizations in Preparation for Storm Surge

Main text:

HKO continued to participate in regular exercises and drills on tropical cyclone disaster prevention and preparedness with relevant government departments and organizations. Moreover, HKO also carried out public education activities to enhance preparedness against tropical cyclones with a view to minimizing casualties and damage (Figure 7).

A government-wide drill in preparation for possible storm surge was conducted at a flood-prone village in April 2013 (Figure 8). Briefing sessions were also organized for local residents living in other locations of Hong Kong vulnerable to flooding due to storm surge. Through the drill and briefings, relevant government departments and local organizations became more familiar with the related emergency response plan for taking prompt actions, such as evacuation of residents, to minimize the impact caused by storm surge upon the issuance of early alerts by HKO.

In 2013, localized storm surge alerts were activated during the approach of tropical cyclones Usagi (1319) and Krosa (1329) and appropriate precautions were taken by the relevant government departments against possible flooding caused by storm surges.

Identified opportunities/challenges, if any, for further development or collaboration:

Nil.

KRA =	1	2	3	4	5	6	7
Meteorology							
Hydrology							
DRR	$\checkmark$	✓			✓		
Training and research							
Resource mobilization or							
regional collaboration							

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Figure 1 Hong Kong Observatory best tracks of tropical cyclones that affected Hong Kong, China from 1 January to 15 November 2013 (Operational track for Krosa).



Figure 2 Wind observation data collected during the reconnaissance flight for Utor (centre highlighted by red sign) on 13<sup>th</sup> August 2013 overlaid on MTSAT false colour image of the tropical cyclone (left). Image on the right shows cloud bands observed on-board at 10:01 UTC (marked on the left).



Figure 3 The Community Weather Observing Scheme (CWOS)



Figure 4 Tropical Cyclone Track Information webpage



Figure 5 Tropical Cyclone Assessment Information Page



Figure 6 Enhanced product on forecasting the evolution of tropical cyclone structure using ECMWF model forecasts. T+96 hour forecast for tropical cyclone Usagi (1319) at 00 UTC 22 September 2013 is shown with the predicted maximum wind at 71 knots and gale winds (red) over the coastal areas of eastern Guangdong.



Figure 7 Number of fatalities in Hong Kong during the passage of tropical cyclones from 1980 to 2013.



Figure 8 A government-wide drill in preparation for possible storm surge was conducted at a flood-prone village in Hong Kong in April 2013.