

Review of the Tropical Cyclone Warning System in 2006 and New Measures in 2007

INTRODUCTION

Under the Tropical Cyclone Warning System (TCWS) operated by the Hong Kong Observatory (HKO), the wind condition in the Victoria Harbour has served as the sole reference for the issue of No.3 and No.8 signals for many years. In the light of experience learned and public comments received after the passage of Typhoon Prapiroon in early August 2006, the HKO has conducted a comprehensive review of the TCWS with a view to better reflecting and communicating the wind condition in different areas of Hong Kong. This paper briefly describes the review process, summarises results of the review and gives an account of the new measures to be implemented in the tropical cyclone season of 2007.

BACKGROUND

2. Since the 1970's, wind speeds in the Victoria Harbour have been used as the reference for the issue of both No.3 and No.8 signals. At that time, the choice of Victoria Harbour was self-evident since the areas on both sides of the harbour were the centre of all major economic and social activities. As for No.9 and No.10 signals, they are normally meant to warn of direct or near direct hit of a typhoon. As there is enormous spatial variation of wind direction and speed near the eye of a typhoon, there is little point in making reference to winds at a single location in the consideration of signals. Thus, the HKO has all along made reference to the wind condition of the whole territory in deciding on the issue of No.9 and No.10 signals.

3. On 3 August 2006, Typhoon Prapiroon passed about 260 km to the southwest of Hong Kong. The southern part of Hong Kong was affected by gales while the harbour area and the northern part generally experienced strong winds. The disparity in regional wind condition persisted for a rather prolonged period of time as Typhoon Prapiroon moved along a circular arc about Hong Kong on that day. The HKO issued No.3 signal based on the prescribed criterion. As some members of the public experienced severe wind condition and the resulting disruption in various parts of Hong Kong on that day, the decision prompted discussions on whether the prescribed criteria for the issue of No.3 and No.8 signals could reflect the actual wind condition in Hong Kong.

4. Subsequent to Typhoon Prapiroon, the HKO received a lot of comments that the criterion for the issue of No.8 signal should be updated to reflect the much dispersed population nowadays and to alert the public to potential significant disruptions to air traffic due to tropical cyclones. Against this background, the HKO has conducted a comprehensive review of the TCWS.

THE REVIEW EXERCISE

Public Views

5. In conducting the review, the HKO formed an Academic Advisory Committee comprising scholars and experts (membership listed at **Annex A**) to advise it from the perspectives of physical and social sciences disciplines. To reach out to different sectors of the community, the HKO held many seminars and focus group meetings with representatives of federations of parent-teacher associations, airlines, insurance, transportation, construction and several other industries, as well as the academia, marine and fishermen organizations, public bodies, human resources management

professionals and weather enthusiasts to consult their views. The HKO has also carefully considered the media commentaries and correspondences from individual members of the public. Moreover, as part of the review process, the HKO commissioned a public opinion survey to gauge the needs and expectations with respect to the TCWS and to identify the salient features of an effective TCWS from the public point of view.

6. With reference to the views collected, the HKO has concluded that the key public expectations about the review of the TCWS are as follows –

- (a) the TCWS should reflect the general wind condition of the whole territory and continue to be based on data and science;
- (b) safety is the key concern and the public should be provided with information required to formulate appropriate response;
- (c) the TCWS should not result in excessive over-warning so as to avoid diminishing its value as an alert and causing unnecessary disruptions to society; and
- (d) the TCWS should be as simple as possible and changes should require minimal adjustment by the public.

Modifications to the TCWS

Reference for the Issue of No.3 and No.8 Signals

7. The HKO has studied the impact of those tropical cyclones for which No.3 signal or above were issued in the period from 1998 to 2006. The analysis reveals that the wind condition in the Victoria Harbour is mostly close to the average wind condition over the territory (based on the

maximum 10-minute mean wind speeds recorded at near-sea level anemometer stations) and is thus a reasonable reference for the wind condition in Hong Kong. This notwithstanding, the HKO recognizes that the selection of indicators for consideration of signals may be expanded to cover different parts of Hong Kong in addition to the Victoria Harbour. This change would better cater for those occasional tropical cyclones that have more peculiar characteristics in terms of their track and proximity. It will also address the public concern about over-reliance on the wind condition in the Victoria Harbour as the sole reference for the issue of No.8 signal. Furthermore, there is merit in having additional reference stations in different parts of Hong Kong in view of the gradual decreasing trend of wind speeds in the areas around the harbour due to urban development.

8. Having reviewed past meteorological data and considered various options, the HKO decided to expand the reference for the issue of No.3 and No.8 signals from the Victoria Harbour to a network of eight near-sea level reference anemometers covering the whole of Hong Kong, as depicted in **Annex B**. These anemometers have been selected on account of their good exposure and geographical distribution, taking into account the natural separation by Hong Kong's mountain ranges. Together, they should provide a broad picture of the wind condition in Hong Kong.

9. To better match with the wind condition experienced by the public at various locations of the territory while avoiding the issue of excessive over-warning, the HKO will issue No.3 or No.8 signal if half or more of the anemometers in the reference network meet or are expected to meet the respective wind speed threshold values and the wind condition is forecast to persist. Revised definitions of the various tropical cyclone signals are at **Annex C**. The signal will be supplemented by enhanced dissemination of regional wind information. With the expanded reference, the mechanism for the issue of No.3 and No.8 signals will be analogous to the operation of the Rainstorm Warning System, in which the exceedance of

threshold rainfall rates at a pre-specified number of rain gauges in the territory's rain gauge network is used as a reference for the issue of rainstorm warnings.

10. Applying the revised indicators to the 46 tropical cyclones that have affected Hong Kong and necessitated the issue of No.1 signal or above during the period from 1998 to 2006, the changes would have resulted in an estimated increase of four days with No.8 signal over a nine-year timeframe. As a reference, under the modified TCWS, No.8 signal will be issued in situations similar to Typhoon Prapiroon.

Enhanced Dissemination of Regional Wind Information

11. Due to local topography and the built environment, wind condition in different parts of Hong Kong can vary appreciably. A numbered tropical cyclone signal can provide a general warning for the public, but it has an inherent limitation in communicating varying wind speeds at different locations. The public would benefit from supplementary information on regional wind condition in formulating their response actions to the threat of a tropical cyclone. Currently, the HKO provides information on regional wind condition on its website and through the Dial-a-Weather service. It also has special arrangements with individual sectors, such as the marine and aviation sectors, to meet their specific needs. The HKO will further enhance dissemination of regional wind information through the following means –

- (a) the HKO to highlight in media broadcast of its tropical cyclone bulletins those areas with wind speeds significantly higher than the general wind condition of Hong Kong;
- (b) the HKO to promote understanding of the modified TCWS and the uneven wind distribution during tropical cyclones, and to encourage the public to make good use of the full range of

weather information on the HKO website and its Dial-a-Weather system; and

- (c) the Education and Manpower Bureau and the Labour Department to help reinforce the message in their existing guidelines that schools, parents and employers should take a flexible approach in dealing with cases of leave or late for school and work due to inclement weather condition in individual localities (such as landslips, rainstorms and high winds).

The enhanced regional wind information will enable the public to take appropriate precautionary measures and hence reduce possible damage and economic loss.

New Advisory for Air Passengers

12. Typhoon Prapiroon brought southeasterly winds across the hills on Lantau Island to the Hong Kong International Airport (HKIA), causing strong crosswinds and turbulence over the runways. Hundreds of flights were cancelled or delayed. As airlines were already operating at full capacity in the summer holiday peak season, the clearance of backlog passengers had taken a few days and many passengers were stranded at the airport for hours even after flights were resumed after the typhoon. There were suggestions that the TCWS should be modified to better cater for the operational needs of the airport. It should however be pointed out that flight operations at the HKIA are not necessarily affected by high wind speeds, particularly if the winds are blowing in a direction parallel to the runways. Decisions on flight cancellation or diversion are made by the airlines concerned taking into account detailed meteorological information and forecasts provided by the HKO, particularly those on crosswinds and turbulence near the runways. In other words, the signal issued under the

TCWS is not the primary determining factor in flight operations.

13. Against the above background, the HKO, the Airport Authority and airlines have reviewed the operational arrangements at the airport with a view to minimizing similar problems in the future. After discussions, the HKO decided to add an advisory to its tropical cyclone bulletin that the traveling public check with airlines before departing for the airport when weather conditions likely to cause significant disruptions to air traffic are expected. Moreover, it will continue to offer briefings to both ground and flight operations staff of airlines to prepare them for planning their operations and communicating with their customers.

Other Suggestions Considered

14. In the aftermath of Typhoon Prapiroon, the HKO received a number of specific suggestions as to whether and how the TCWS should be modified. The HKO has carefully assessed each of these suggestions. The above changes generally represent the main stream views. Other suggestions include an additional signal to signify gale/storm force winds in areas other than the Victoria Harbour; an additional signal to signify gale/storm force winds at the airport; regional signals; and a colour-coded system in place of the existing numbered system. These suggestions involve more substantial changes to the existing TCWS with which the public are familiar. Their implementation would require both public and private organizations to revise their contingency plans. Apart from requiring the public to adjust to the changes, they may also cause other problems. For example, the proposed regional signals might cause confusion to those who have to commute to another region for work or school. In comparison with these suggestions, the new measures to be adopted will address the concerns raised while requiring minimal adjustment by the public.

NEW MEASURES TO BE IMPLEMENTED IN 2007

15. The HKO will implement the following new measures starting from the tropical cyclone season of 2007 –

- (a) expand the reference for the issue of No.3 and No.8 signals from the Victoria Harbour to a network of eight reference anemometers near sea level covering the whole of Hong Kong;
- (b) issue No.3 or No.8 signal (as the case may be) when half or more anemometers in the reference network register or are expected to register strong winds or gale/storm force winds and the wind condition is forecast to persist;
- (c) enhance dissemination of regional wind information; and
- (d) issue an advisory in tropical cyclone bulletins that the traveling public check with airlines before departing for the airport when weather conditions likely to cause significant disruptions to flight operations are expected.

16. The new measures to be introduced in respect of the tropical cyclone warning system involve only revising the technical reference the HKO uses in deciding on the issue of No.3 and No.8 signals. To the general public, the same set of signals will continue to be used. We expect that there is no need for changes to tropical cyclone-related response plans or guidelines by both the Government and the private sector.

WORK IN 2007

17. In the coming months, the HKO will enhance its technical capabilities in preparation for the implementation of the new measures in the tropical cyclone season this year. After the tropical cyclone season, the HKO will reach out to relevant government departments and community sectors, keep an open mind while gathering views from various channels and carefully assess the effectiveness of the modifications to the tropical cyclone warning system. In the light of practical experience and comments received, the HKO will make further improvement to the tropical cyclone warning services if necessary.

Hong Kong Observatory

26 February 2007

(Revised on 2 March 2007)

Membership of the Academic Advisory Committee

(in alphabetical order)

1. Prof. Johnny CHAN Chung-leung, Professor (Chair) of Applied Physics, Department of Physics and Materials Science, City University of Hong Kong.
2. Dr. HUNG Ching-tin, commentator.
3. Prof. KO Jan-ming, Vice President (Research Development), Chair Professor of Structural Engineering, The Hong Kong Polytechnic University.
4. Dr. K. E. KUAH-PEARCE, Head, Department of Sociology, The University of Hong Kong.
5. Prof. LAM Kin-che, Professor, Department of Geography and Resource Management, The Chinese University of Hong Kong.
6. Prof. Julia TAO LAI Po-wah, Professor, Department of Public and Social Administration, City University of Hong Kong.

Network of Reference Anemometers



Changes to the Definitions of Tropical Cyclone Signals

(Changes are marked up)

(A) Definitions of Signals

Signals	Meaning
No.1 (Standby Signal)	A tropical cyclone is centred within about 800 km of Hong Kong and may affect the territory
No.3 (Strong Wind Signal)	Strong wind is expected or blowing in Victoria Harbour <u>generally in Hong Kong near sea level</u> , with a sustained speed of 41-62 km/h, and gusts which may exceed 110 km/h, and the wind condition is expected to persist
No.8 (Gale or Storm Signal)	Gale or storm force wind is expected or blowing in Victoria Harbour <u>generally in Hong Kong near sea level</u> , with a sustained wind speed of 63-117 km/h from the quarter indicated and gusts which may exceed 180 km/h, and the wind condition is expected to persist
No.9 (Increasing Gale or Storm Signal)	Gale or storm force wind is increasing or expected to increase significantly in strength
No.10 (Hurricane Signal)	Hurricane force wind is expected or blowing with sustained speed reaching upwards from 118 km/h and gusts that may exceed 220 km/h

(B) Important Points to Note

- The weather in different parts of Hong Kong cannot be simply inferred from the signal issued. Simply knowing what signal is issued is not enough. You should take note of the latest tropical cyclone information and related announcements broadcast on radio and TV, and given in the Hong Kong Observatory's internet website (www.hko.gov.hk and www.weather.gov.hk) and Dial-a-Weather system (Tel. No.: 1878 200) to decide on the actions to take in response to the signal issued.
- Tropical cyclone warning signals are to warn the public of the threat of winds associated with a tropical cyclone.
- Owing to local topographical conditions or the presence of buildings nearby, winds at your locality may be substantially different from ~~those in the harbour areas~~ the general wind strength over Hong Kong. Winds are often stronger over offshore waters and on high ground. Winds are less strong in areas sheltered from the prevailing wind direction.
- The Hong Kong Observatory provides to the public detailed information on regional wind and rain through a diversity of channels, especially the internet. Members of the public should consider their own circumstances and level of acceptable risk when taking precautions in response to warnings.
- When the No.1 signal is issued, you should take the existence of the tropical cyclone into account in planning your activities and beware that strong winds may occur over offshore waters.
- When the No.3 signal is issued, secure all loose objects, particularly on balconies and roof tops. Secure hoardings, scaffoldings and temporary structures. Winds are normally expected to become generally strong in

~~the harbour areas~~ Hong Kong within 12 hours after this signal is issued. Winds over offshore waters and on high ground may reach gale force.

- When the No.8 signal is issued, complete all precautions before gales commence. Winds are normally expected to reach gale force generally in ~~the harbour areas~~ Hong Kong within 12 hours after No.8 signal replaces No.3 signal.
- When the No.9 or No.10 signal is issued, all precautions should be completed. Stay indoors and away from exposed windows and doors to avoid flying debris.