



香港天文台

HONG KONG OBSERVATORY

Reprint 740

CAeM Pilot Project on
Aviation-Weather Disaster Risk Reduction (ADRR)

Sandy M.K. Song & C.M. Shun

40th Session of WMO Typhoon Committee,
Macau, China, 21-26 November 2007

**CAeM Pilot Project on
Aviation-Weather Disaster Risk Reduction (ADRR)**

Sandy M.K. Song and C.M. Shun
Hong Kong Observatory
134A Nathan Road, Kowloon, Hong Kong, China

Abstract

Led by the Hong Kong Observatory (HKO), a pilot project on Aviation-weather Disaster Risk Reduction (ADRR) in RA II (Asia) and RA V (South-West Pacific) has been established by the Commission for Aeronautical Meteorology (CAeM) of the World Meteorological Organization (WMO). The objective of the pilot project is to study the feasibility and skill of tropical cyclone forecasts and warnings for 24-48 hours ahead, as well as the benefits to aviation community with a view to assist National Meteorological and Hydrological Services (NMHSs) in disaster risk reduction and to facilitate aviation stakeholders in their operational planning and decision-making.

In September 2007, a website (<http://adrr.weather.gov.hk>) was launched by HKO for trial use by WMO Members and aviation stakeholders in the regions. The website contains tropical cyclone forecast track and intensity information up to 48 hours and beyond issued by various NMHSs in RA II and RA V, advisories and forecasts issued by the Tropical Cyclone Advisory Centre (TCAC) Tokyo of Japan and the Joint Typhoon Warning Centre (JTWC) of the USA, as well as numerical tropical cyclone forecasts of the European Centre for Medium-Range Weather Forecasts (ECMWF). Using HKIA as an example, the website also provides forecasts of weather conditions, e.g. crosswind and turbulence, which might bring airport disruption. This is to demonstrate the benefits of such information to aviation stakeholders in the planning of airport operations and large-scale diversions due to tropical cyclones.

I. Introduction

The World Meteorological Organization (WMO) established in 2003 a new cross-cutting programme for National Disaster Risk Reduction (DRR) with the vision to further strengthen the contributions of the National Meteorological and Hydrological Services (NMHSs), in a more cost-effective, systematic and sustainable manner for improving safety and well being of communities.

During the period 1992-2001, natural disasters worldwide killed over 622 000 and affected over two billion people. Statistics revealed that during that period, about 90% of the natural disasters were of meteorological or hydrological origin; their economic losses were estimated at US\$ 446 billion, which accounted for about 65 per cent of damages due to all natural disasters. Tropical cyclones have the potential to leave swath of destruction from strong winds and heavy rainfalls. In 1998, Hurricane *Mitch* struck Nicaragua, Honduras and Guatemala, causing 11,000 dead and widespread flooding. In 2004, four major hurricanes in a little more than one month: *Charley*, *Frances*, *Ivan* and *Jeanne* killed scores of people and led to over US\$ 23-35 billion of property damage.

At its 13th session in 2006, the Commission for Aeronautical Meteorology (CAeM) recognized the need for improved communication and coordination between aeronautical meteorology service providers and emergency response, disaster relief and recovery agencies on a national, regional and international level, in order to improve all aspects of DRR in the areas where aviation plays a crucial role. CAeM further noted that all operational aerodrome forecasts and warnings in the field of aeronautical meteorology are currently limited to lead times of 24 hours or less. In the case of tropical cyclones, there is considerable potential skill in forecasts beyond this range.

In the area of disaster emergency response in particular, in order to allow proper planning for relief operations, longer-range aerodrome forecasts (beyond the current 24-hour limit of the ICAO-requirement for Terminal Aerodrome Forecast (TAF)) will facilitate the planning in respect of the quantity and timing of relief supplies that can be brought into the affected area. Detailed route forecasts for relief and rescue flights, with a typical time-frame of up to 6 hours, and for planning purposes out to 36-48 hours, both for fixed-wing and helicopter operations are also required.

To address the above, the 13th session of CAeM established a regional Pilot Project on Aviation-weather Disaster Risk Reduction (ADRR) in RA II (Asia) under the lead of the

Hong Kong Observatory (HKO), Hong Kong, China. In cooperation with interested WMO Members in the regions, airlines, ICAO and the WMO secretariat, the project will study:

- a. The feasibility of providing, on an operational basis, aviation weather forecasts and warnings for severe convection, floods and tropical cyclones in close cooperation with all aviation stakeholders;
- b. The skill of such forecasts and warnings for 24-48 hours ahead; and
- c. The benefits to aviation in particular, and in general to the population in the regions affected by natural disasters.

II. Project Scope and Methodology

HKO engaged local aviation users (including airlines, pilots, air traffic management, airport authority, and search and rescue units) in the development of the project right in the beginning by face-to-face briefings and meetings. With user's inputs and review of previous weather disasters, it was revealed that tropical cyclone is the dominating weather bringing economic loss and affecting flight operations at the Hong Kong International Airport (HKIA). It was therefore decided that the pilot project would initially be focused on tropical cyclones.

At HKIA, tropical cyclones could bring high crosswinds and severe turbulence, making aircraft landing and take-off difficult or even prohibitive. In the most significant events, the disruption in flight operations took a few days to recover, bringing significant economic loss. Forecast products on the occurrence of high impact weather conditions such as high crosswinds and severe turbulence under tropical cyclone situation to alleviate the difficulties could be developed making use of tropical cyclone forecast track and intensity generated by numerical weather prediction (NWP) models.

Tropical cyclone forecast track and intensity information up to 48 hours and beyond is already available from national and regional centres as well as on the Severe Weather Information Centre (SWIC) website of WMO (<http://severe.worldweather.wmo.int/>). Apart from deterministic forecasts, ensemble tropical cyclone track forecasts based on NWP models are also becoming available. Provision of these tropical cyclone forecasts by participating centres and Members will be key to the success of the Pilot Project. Based on these forecasts, the probability of occurrence of the high impact weather conditions could then be generated and made available to users. The track and intensity forecasts up to 48 hours and

beyond will also be useful in planning of large-scale diversions due to tropical cyclones by the air traffic management authorities and airlines.

Based on the above considerations, HKO developed a project outline together with a proposed project website layout and presented it to representatives of aviation users in Hong Kong, China. With very positive feedback from the users, the development of the website started following the project outline.

III. Participation of Members and Aviation Users

To demonstrate the benefits of the project to developing countries, and considering the significant impact of tropical cyclones to countries over the western North Pacific, the Philippines was also invited to participate with the project extended to also cover RA V (South-west Pacific). With concerted effort among the HKO, WMO and ICAO secretariats, a number of Members and centres have agreed to provide tropical cyclone forecast products for the pilot project:

- a. NMHSs of China; Japan; Hong Kong, China; and the Philippines, providing the official tropical cyclone forecasts and warnings;
- b. Tropical Cyclone Advisory Centre (TCAC) Tokyo of Japan and Joint Typhoon Warning Centre (JTWC) of the USA, providing regional tropical cyclone advisories and warnings;
- c. European Centre for Medium-Range Weather Forecasts (ECMWF), providing numerical forecasts of tropical cyclone including ensemble products.

Other interested Members in the regions who wish to share their tropical cyclone forecasts on the website are invited to participate in the pilot project.

IV. ADRR website

Based on user's inputs and contributions of forecasts and products from Members, HKO has developed a dedicated website named "Aviation-weather Disaster Risk Reduction" (ADRR) for the pilot project (<http://adrr.weather.gov.hk>). The website contains tropical cyclone warnings issued by the contributing Members, advisories and warnings issued by the TCAC Tokyo and JTWC, and numerical forecasts of the ECMWF (Figures 1). Apart from

deterministic forecast, users can also refer to strike probability issued by ECMWF in accessing the chance of tropical cyclone affecting certain area or airports (Figure 2).

The Hong Kong International Airport (HKIA) is used as an example to demonstrate the benefits of enhanced weather information to the aviation operators in the planning of airport operations and large-scale diversions due to tropical cyclones. Forecasts of aviation-specific weather conditions, e.g. crosswind, headwind and turbulence, which might bring airport disruption, are also provided on the website. For example, extended take-off forecasts (Figure 3) providing hourly take-off forecasts, including wind information, temperature, QNH and any significant weathers, up to the next 18 hours are made available to facilitate airline users' flight planning purpose. Crosswind or headwind forecasts which are not explicitly mentioned in TAF are also available through this product and would be highlighted if certain thresholds are reached to facilitate flight operations and planning.

Another product “HKIA Weather Summary” provides aviation forecaster's assessment of the latest weather situation at the airport (Figure 4). This product supplements the Terminal Area Forecast (TAF) by providing synoptic background, other likely alternative scenario and an outlook up to 48 hours ahead. Forecasts of other weather conditions that may affect aviation safety such as windshear, cross winds and turbulence which are not available in TAF will be included as necessary. The page also includes the latest HKIA weather report, forecast and SIGMET.

The ADRR website also contains a page showing the en-route significant weather (SIGMET) (Figure 5). This webpage was developed by HKO at ICAO's invitation for real-time monitoring of all types of SIGMET, including SIGMET for tropical cyclones, issued by the Meteorological Watch Offices (MWOs) within the Asia/Pacific Region. Other information provided on the website include satellite imageries, weather of HKIA neighbouring aerodromes and alternates, and hyperlinks to useful Internet resources such as the Severe Weather Information Centre (SWIC) of the WMO.

V. Evaluation

The ADRR website is now available for access by all WMO Members in RA II and RA V on a trial basis. As the website contains aviation-specific weather information, access to the website is currently limited using username/password control. A letter has been sent by the secretariat to Members inviting free subscription to HKO (application form in Appendix) for access to the website. Apart from the WMO and ICAO secretariats, 25 international users (NMHSs, civil aviation authorities, regional centres) and 57 local aviation users (airlines, civil aviation, airport authority, search and rescue units) have obtained access

to the website.

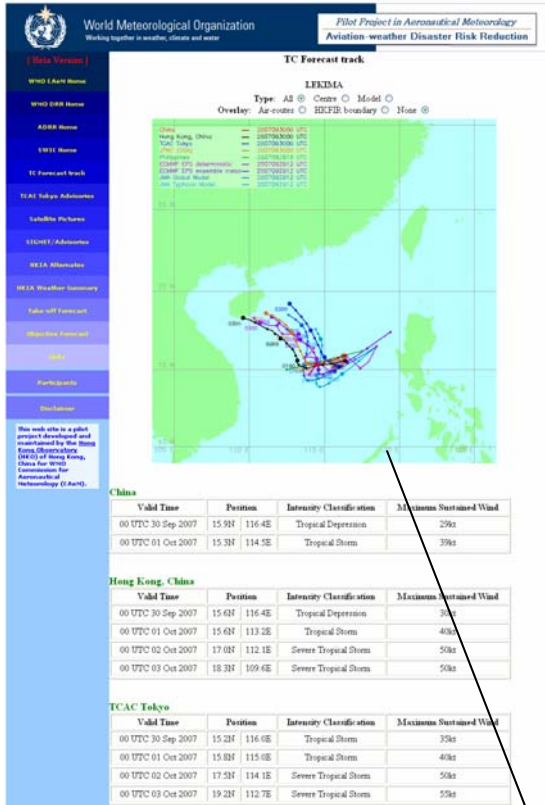
Since the launch of the ADRR website in September 2007, several tropical cyclones affected the South China Sea and Western North Pacific, even though they did not pose direct threats to the operation of HKIA. While the evaluation of the pilot project website will be conducted using a questionnaire after the 2007 typhoon season, preliminary feedback has already been received from airline users and pilots:

“I am very happy with the information and presentation of the ADRR products, particularly the Weather Summary for HKIA.” [Captain, Cathay Pacific Airways]

“This is an excellent product. I think that this is extremely helpful for planning purposes and enabling crews to avoid, as far as possible, typhoon areas in flight and providing essential information on the typhoons that may be affecting (or about to affect) destination or alternate airports.” [Captain, International Federation of Air Line Pilot Associations (IFALPA)]

VI. Summary

Led by HKO, a regional pilot project on Aviation-weather Disaster Risk Reduction (ADRR) in RA II and RA V has been established by the CAeM of WMO to assist NMHSs in disaster risk reduction and to facilitate aviation stakeholders in their operational planning and decision-making. Under the project, HKO has developed a website containing official tropical cyclone warnings issued by NMHSs, advisories and warnings issued by TCAC Tokyo, JTWC, numerical forecasts of ECMWF and aviation specific forecasts for HKIA. All interested Typhoon Committee Members are welcome to participate in the pilot project as users of the website and/or to share their official tropical cyclone forecasts and products on the website. The website is now available to participating aviation users and Members for trial use and evaluation. Subject to users’ feedback and evaluation of benefits, documentation will be prepared and training will be planned to share best practices with Members. The possibility of extending the pilot project to other airports in the regions would be also explored.



Valid Time	Position	Intensity Classification	Maximum Sustained Wind
00 UTC 30 Sep 2007	15.5N 116.3E	Tropical Depression	25kt
00 UTC 01 Oct 2007	15.4N 113.9E	Tropical Storm	40kt
00 UTC 02 Oct 2007	17.4N 112.8E	Severe Tropical Storm	50kt
00 UTC 03 Oct 2007	18.6N 111.1E	Severe Tropical Storm	60kt

Valid Time	Position	Intensity Classification	Maximum Sustained Wind
18 UTC 29 Sep 2007	16.2N 117.5E	-	-
18 UTC 30 Sep 2007	15.0N 112.5E	-	-

Valid Time	Position	Intensity Classification	Maximum Sustained Wind
12 UTC 29 Sep 2007	16.5N 118.5E	Tropical Storm	35kt
12 UTC 30 Sep 2007	15.4N 114.7E	Tropical Storm	45kt
12 UTC 01 Oct 2007	16.4N 114.3E	Typhoon	70kt
12 UTC 02 Oct 2007	17.9N 111.9E	Typhoon	75kt

Valid Time	Position	Intensity Classification	Maximum Sustained Wind
12 UTC 29 Sep 2007	17.4N 119.4E	Tropical Storm	35kt
12 UTC 30 Sep 2007	14.7N 114.9E	Tropical Storm	47kt
12 UTC 01 Oct 2007	16.1N 114.3E	Severe Tropical Storm	60kt
12 UTC 02 Oct 2007	17.6N 112.5E	Typhoon	70kt

Valid Time	Position	Intensity Classification	Maximum Sustained Wind
12 UTC 29 Sep 2007	16.5N 118.5E	Tropical Depression	30kt
12 UTC 30 Sep 2007	14.3N 113.9E	Tropical Storm	34kt
12 UTC 01 Oct 2007	16.0N 113.9E	Tropical Storm	34kt
12 UTC 02 Oct 2007	18.5N 112.6E	Tropical Storm	35kt

Valid Time	Position	Intensity Classification	Maximum Sustained Wind
12 UTC 29 Sep 2007	16.5N 118.5E	-	-
12 UTC 30 Sep 2007	13.9N 114.7E	-	-
12 UTC 01 Oct 2007	16.0N 114.8E	-	-
12 UTC 02 Oct 2007	17.6N 114.4E	-	-

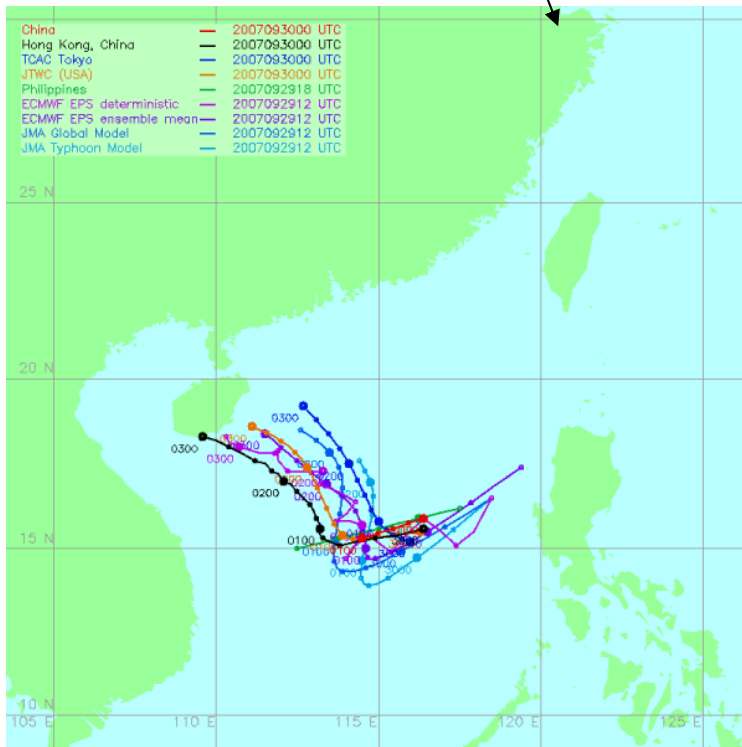
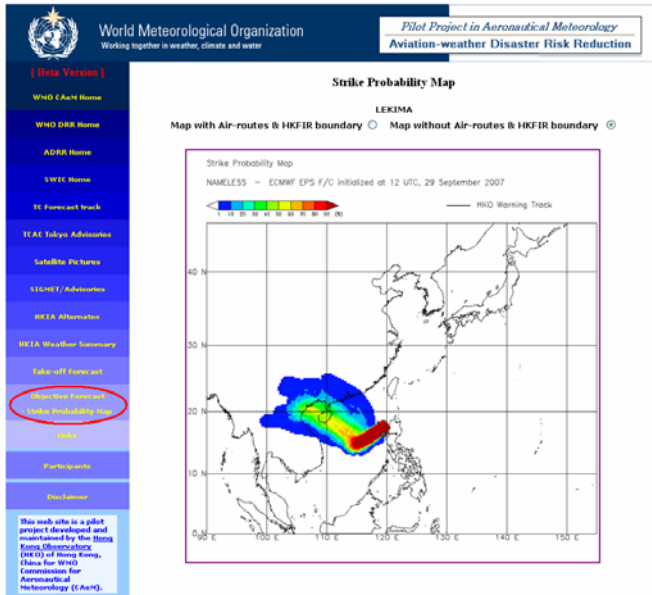
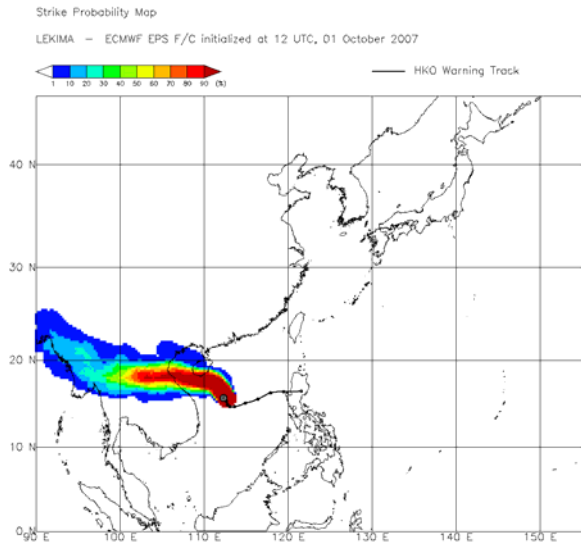


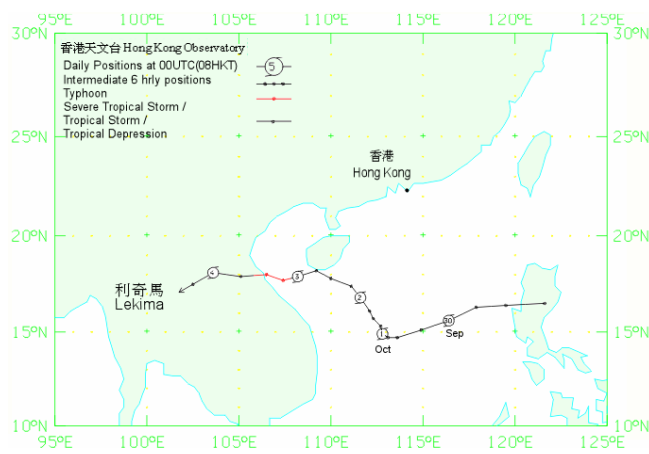
Figure 1. Tropical cyclone forecasts based on official warnings issued by Members as well as advisories and numerical forecasts issued by the TCAC Tokyo of Japan, JTWC of the USA and ECMWF.



(a)



(b)



(c)

Figure 2. Strike probability objective forecast issued by ECMWF at (a) 12 UTC, 30 September 2007, (b) 12 UTC, 1 October 2007 and (c) actual track of Lekima. The two turns of Lekima on 1 October and 2-3 October are well predicted by ECMWF strike probability more than 24 hours in advance.

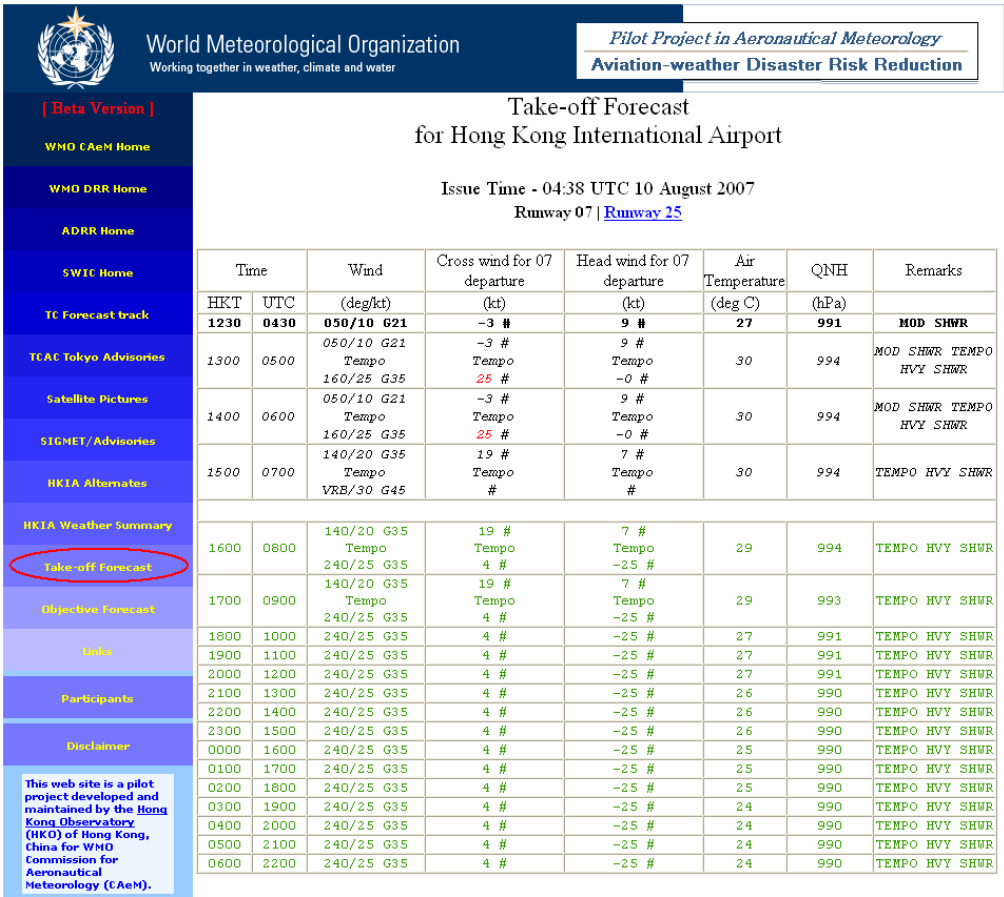


Figure 3. Extended take-off forecast for HKIA

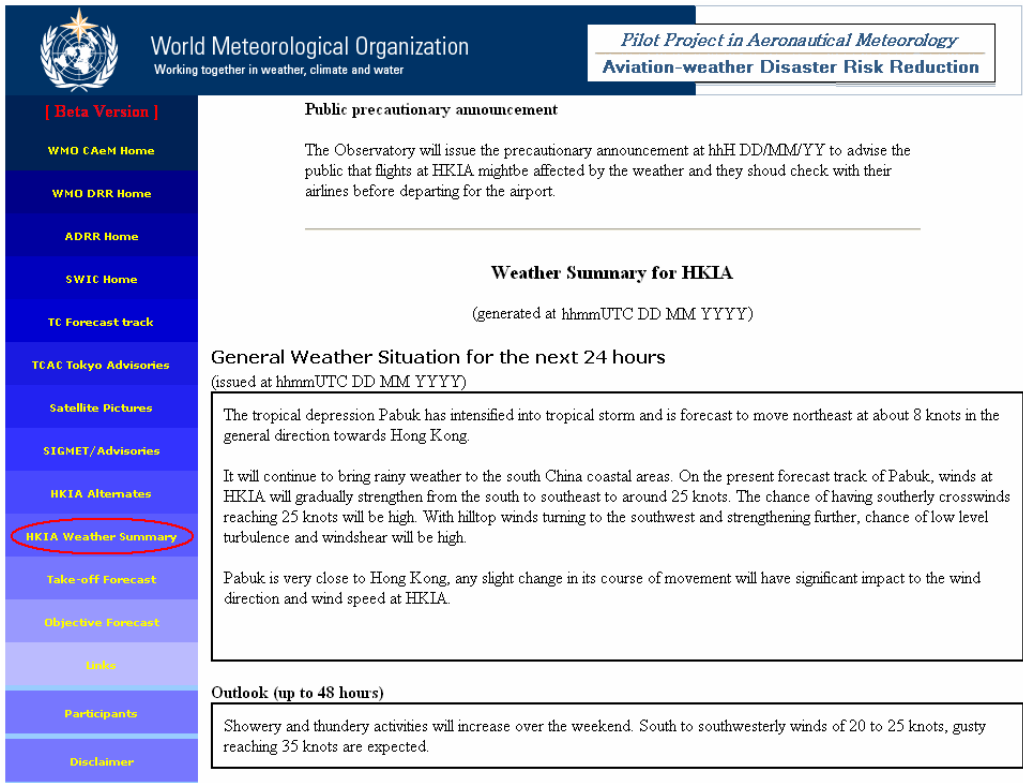



Figure 4. Weather summary for HKIA

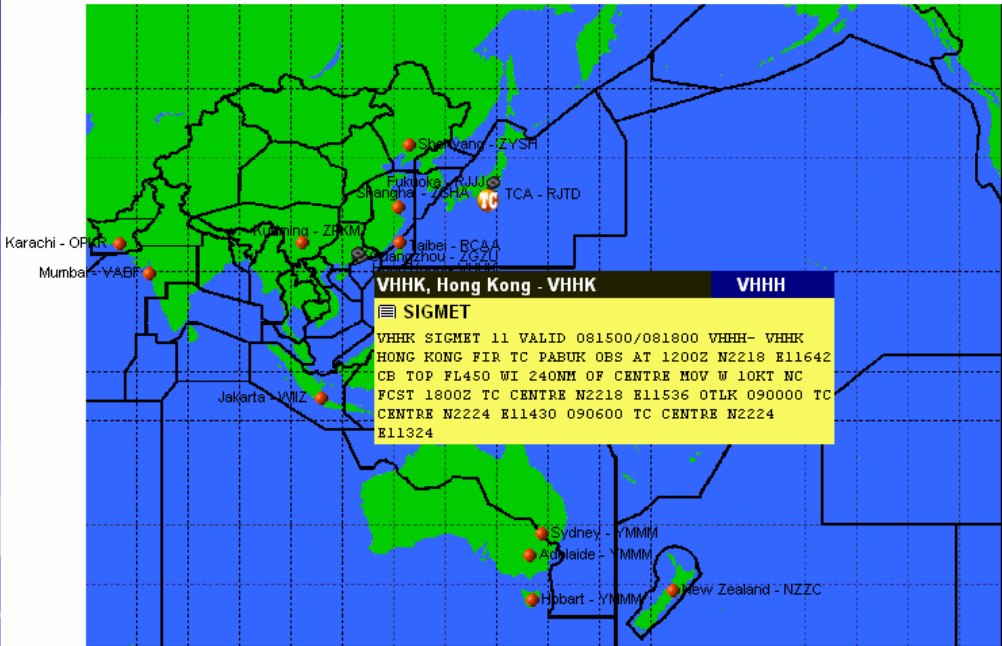


World Meteorological Organization
Working together in weather, climate and water


Pilot Project in Aeronautical Meteorology


Disaster Prevention & Mitigation


Real-time SIGMET Monitoring System





Click on map to zoom in area you need. [\(All MWOs and advisory centres in this Region\)](#)

 [SIGMET Other than TC and Volcanic Ash](#)

 [TC SIGMET](#)

 [Volcanic Ash SIGMET](#)

 [Volcanic Ash Advisory](#)

 [TC Advisory](#)

***Important:** Please note that all bulletins contained in this section are provided "as received". Only SIGMETs with valid ICAO designators for centre and FIR are displayed.*

This web site is a pilot project developed and maintained by the **Hong Kong Observatory (HKO)** of Hong Kong, China for WMO Commission for Aeronautical Meteorology (CAeM).

Figure 5 SIGMET monitoring webpage

To: Director of the Hong Kong Observatory (Attn.: Mr. C.Y. Hong)
Fax No. (852) 2375 2645 Email: cyhong@hko.gov.hk
Mail address: 134A Nathan Road, Kowloon, Hong Kong

**WMO CAeM Pilot Project in RA II and RA V
Application for Access to the Website on
“Aviation-weather Disaster Risk Reduction” (ADRR)**

Name _____

Organization _____

Job title _____

Mail address _____

E-mail address _____ Tel _____ Fax _____

Date

Signature