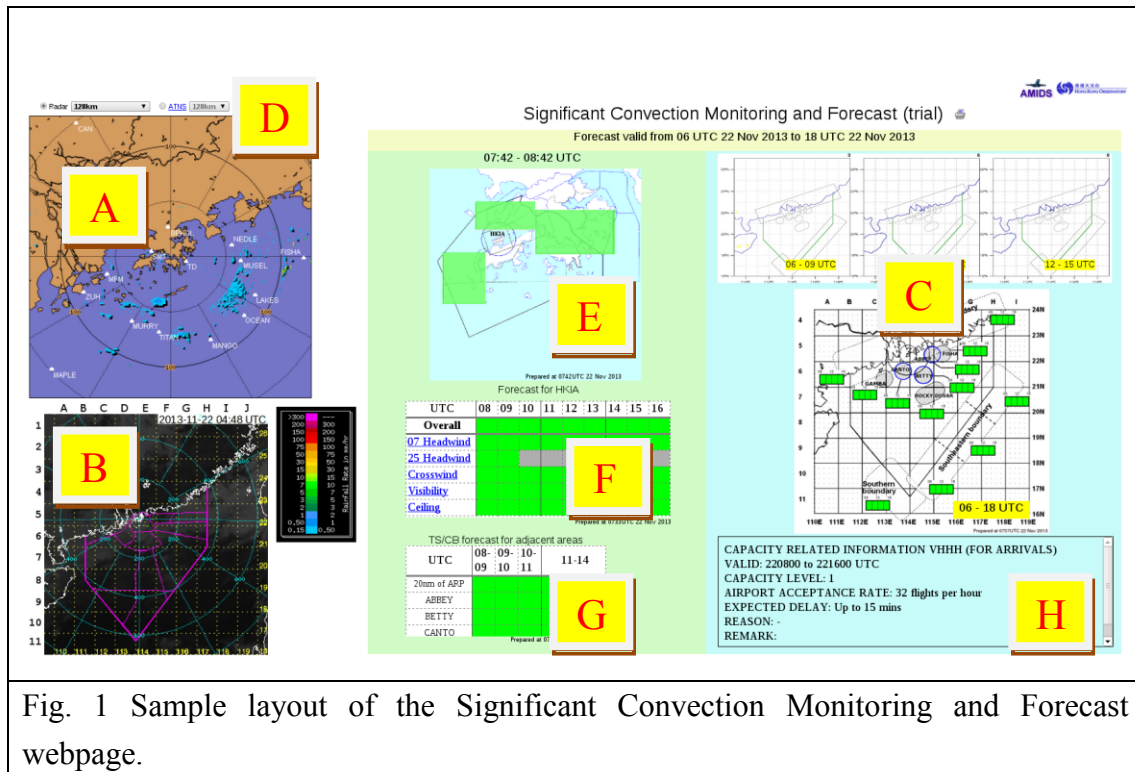


## Information Note on the Webpage for Significant Convection Monitoring and Forecast

The webpage displays both the real-time products for monitoring of significant convection and forecast products for significant convection. In addition to information on convection, the webpage also contains 9-hour performance-based terminal area forecast. The layout of the display is shown in Fig 1, with detailed description of each product given below.



1. Radar images showing the estimated rainfall rate of rain areas at 3 km above mean sea level, and echo top height of 33 dBZ radar reflectivity for the past hour at 6-minute intervals are animated continuously. The time mark is given in Hong Kong Time (HKT) indicating the end time of the radar scan. The colour scale of the rainfall rate can be found in the legend below the radar image, whereas the colour scale of the echo top height is indicated by flight level at the upper left corner of the image.
2. Users can select animation sequence of radar image of 64-km, 128-km and 256-km range with or without overlay of lightning location data onto the radar image. The lightning locations for the past 6 minutes ending at the radar image time are denoted by hollow white squares. Since the measurements of radar and lightning location system differ in both time and space, the location of lightning strikes may not fall exactly on the depicted rain area.
3. The ATC sector boundaries are overlaid on the base map for 256-km radar image while checkpoints are overlaid on the 128-km and 64-km radar images.
4. Weather radar may occasionally pick up reflected signals from sources other than rain, such as reflections from clouds, trees, buildings, birds, hills, sea waves and even distant land mass. Please exercise care when viewing the image, as these non-rain signals may occasionally show up on the radar image.

## B. Composite of latest radar and deep convection satellite image

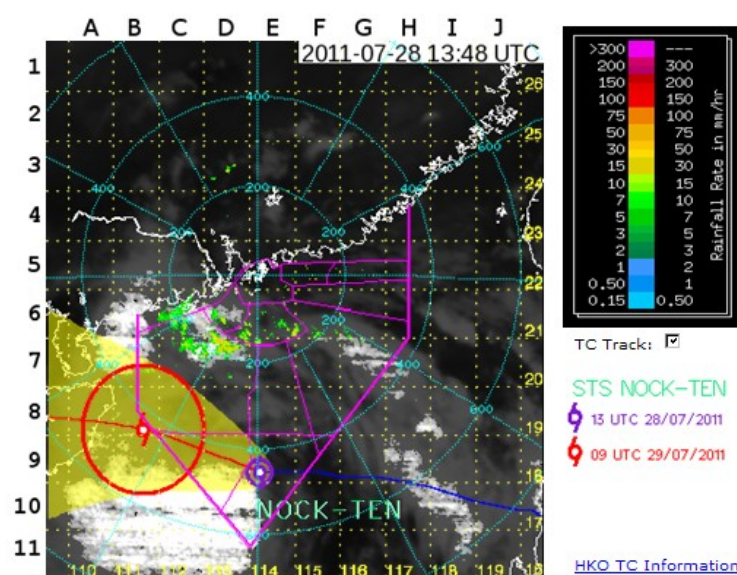


Fig.3 Composite of 512-km and 256-km radar image overlaid on deep convection

satellite product. When a tropical cyclone is observed or forecast within the area of the image, its position and the latest HKO's tropical cyclone forecast track will be overlaid on the composite image.

1. Composite of 512-km and 256-km radar image overlaid on the satellite image of potential deep convection areas in bright white colour are displayed in an animation loop for the past 3 hours at half-hourly intervals. When the corresponding satellite image is not available, the radar image will be shown against a dark background.
2. The ATC sector boundaries and the HKFIR boundary are overlaid on the base map. Coordinate grid labels are marked on the horizontal and vertical axes to aid specifying area of concern during communication between aviation meteorological personnel and the users. The same coordinate grid system is also applied to the significant convection forecast product (Fig.4).
3. Due to curvature of the earth, the altitude of the radar beam changes with range. In general, the farther the radar beam, the higher the altitude. Typically, radar echoes at radar range of 300 km, 400 km and 500 km range are located roughly at an altitude of 6 km, 10 km and 16 km above mean sea level respectively. Please note that beyond about 400 km, the radar beam will exceed the height of most rain and thus few rain echoes will appear on the image.
4. Deep convections are identified as extensive and thick clouds reaching the top of the troposphere. Please note that deep convection satellite product may fail to depict convections associated with narrow squall lines or very isolated and small area of convection. False alarms may occur particularly in mid-latitude regions during spring and late winter seasons.
5. In tropical cyclone situations, the HKO's tropical cyclone forecast track and the observed tropical cyclone positions will be overlaid on the composite image. The centre of the green circle is the analysed position of the tropical cyclone, whereas the centres of the red, blue and grey circles indicate the forecast positions at different times as shown in the legend on the right of the image. The radii of the circles show the respective forecast uncertainties. The forecast track will normally be updated every three hours. Users can uncheck the checkbox "TC Track" to remove the display of the tropical cyclone track on the image. The details of the tropical cyclone will be displayed on a pop-up window by clicking the hyperlink "HKO TC Information" at the bottom of the image.

### C. Significant convection forecast for air traffic flow management

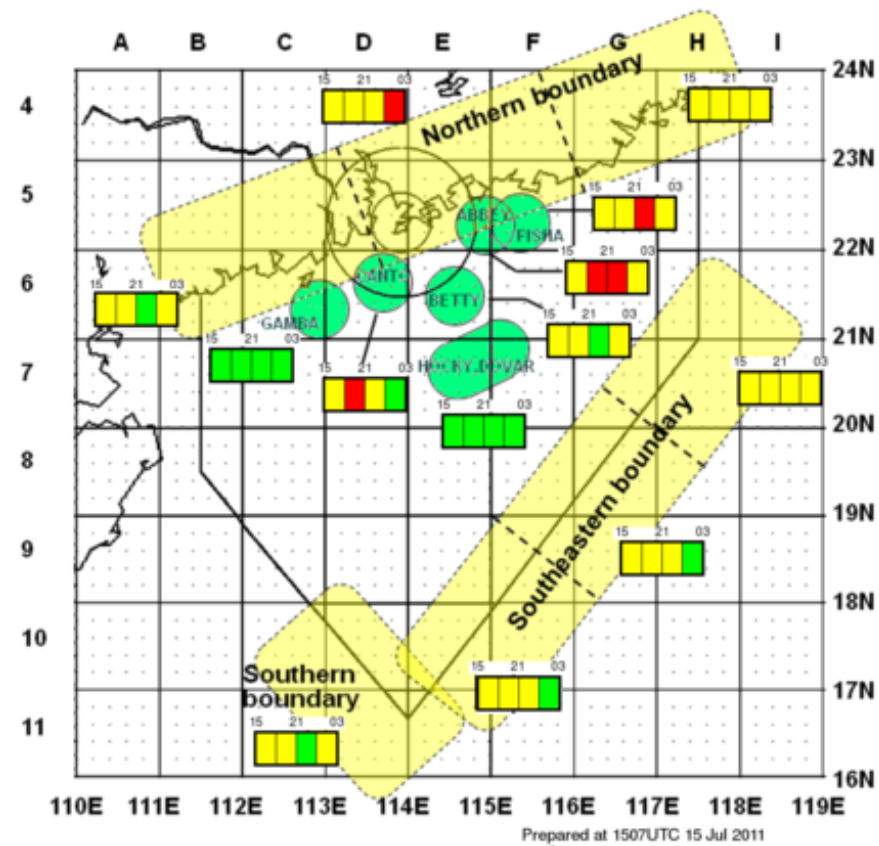


Fig.4 Significant convection time series forecast for the coloured areas at 3-hourly intervals up to 12 hours ahead. Different colours (green / yellow / red) indicate various levels of chance (low / medium / high) of significant convection bringing significant air traffic disruption over the specified area within the 3-hour time block.

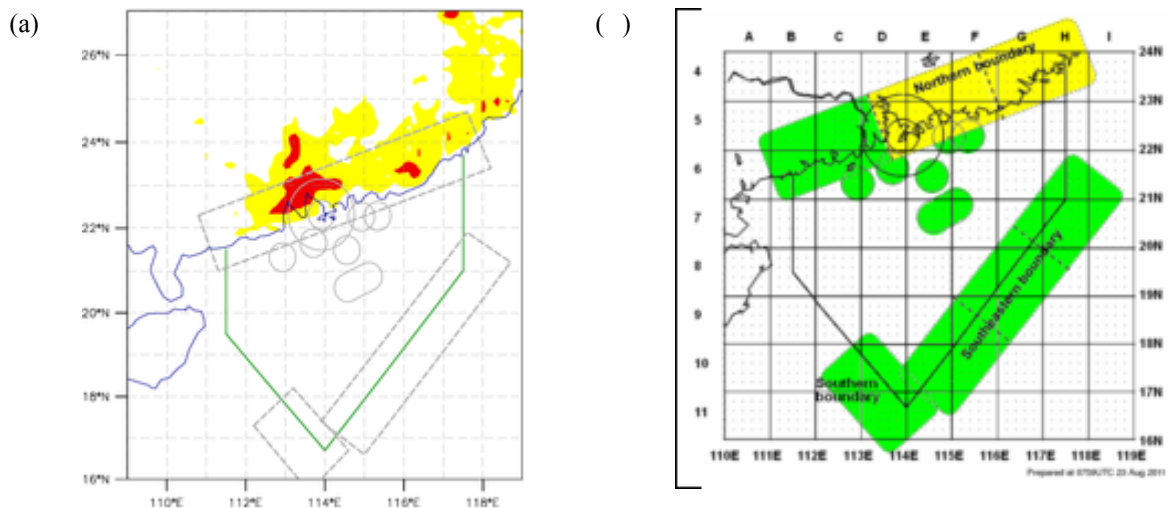


Fig.5 Significant convection forecast for the next 3 hours (red and yellow indicate high and medium chance over the coloured regions respectively). The presentation in (a) mimics the convective weather pattern while (b) shows the overall chance of significant convection within each boxed or circled area.

1. The trial significant convection forecast time series product (Fig.4) provides 12-hour forecast of significant convection over key air traffic control areas including holding areas for arrival flights and specific areas over the northern and southern boundary of the Hong Kong Flight Information Region (HKFIR) at 3-hourly intervals.
2. The 12-hour forecast range is divided into four time blocks, each 3 hours, with the starting time (in UTC) marked beside the block. Different colours (green / yellow / red) shown in the block indicate various levels of chance (low / medium / high) of significant convection bringing significant air traffic disruption over the specified area within the 3-hour time block.
3. The trial significant convection forecast product is basically generated automatically from objective guidance including nowcasting system, numerical weather prediction (NWP) model outputs from HKO and the European Centre for Medium-Range Weather Forecasts (ECMWF). The first three hours forecast will normally be updated every 12 minutes based on nowcasting method, the next 3-6 hours updated every hour, and the next 6-12 hour updated every 3 hours at around 00, 03, ... 21 UTC based on NWP method.
4. Hazardous convection is typically associated with thunderstorm activities which could be sporadic and their life cycles may range from several ten minutes to several hours. Due to changeable weather condition and unavoidable model errors, the forecast timing, intensity, and location of significant convection may not turn out to agree well with the actual weather condition, especially for those

rapidly evolving or shorter-lived isolated storms.

5. Subject to availability of human resources and where situation warrants, ad-hoc human intervention to the trial significant convection forecast product may be made based on meteorological observations and conceptual models.
6. The significant convection forecasts for the next 9 hours are also presented in a pictorial format (Fig.5 (a) or (b)). Normally, the presentation format in (a) will be used. If there is human intervention to the forecast product as mentioned in para.5 above, the presentation format in (b) may be used.
7. For finer temporal resolution products, please also make reference to the radar-based HKO's Aviation Thunderstorm Nowcasting System (ATNS), which provides the present position and 1-hour forecast position of thunderstorms affecting HKIA and its vicinity at 6-minute intervals (see Section D below). For those regions within the Hong Kong territory, please also refer to the 1-hour significant convection forecast for the arrival and departure corridors (see Section E below).
8. The trial significant convection forecast product is intended for use in planning for air traffic flow management. It is a supplement to, but does NOT substitute for, the report and forecast information contained in SIGMETs and medium and high level Significant Weather Charts.
9. Due to differences in validity period, availability schedule, temporal resolution and generation process (with or without human intervention) of different products (e.g. Significant Weather Charts, ATNS output), consistency of significant convection forecast product with the others is not fully guaranteed.
10. More air traffic flow data for significant events are needed for tuning the trial product in coordination with ATMD/CAD. Tuning of the algorithms for defining the colour scale is an on-going effort with a view to transforming the significant convection forecast to impact forecast with different levels of impact to air traffic (low / medium / high) delineated by different colours (green / yellow / red).



## D. Aviation Thunderstorm Nowcasting System (ATNS)

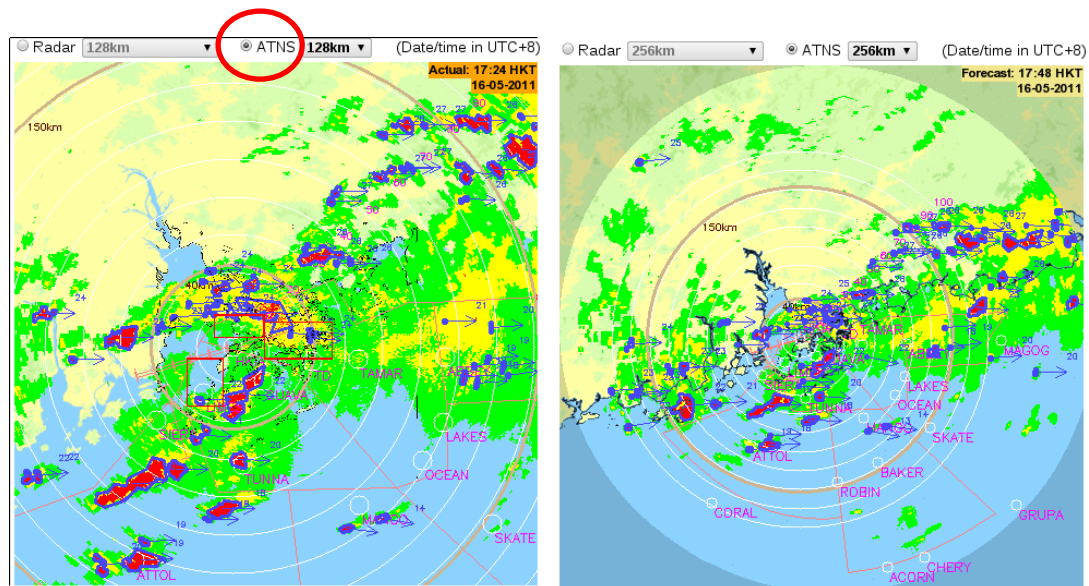


Fig.6 Images of the 60-minute storm motion forecast at 128 km (left) and 256 km (right) range from the centre of HKO's weather radar at Tai Mo Shan.

1. ATNS is a weather radar-based nowcasting system which automatically tracks and predicts the future movement of thunderstorms over the Pearl River Delta and the northern part of the HKFIR. Using linear extrapolation technique, it produces forecasts for the future locations of thunderstorms up to 60 minutes ahead at 6-minute time step. It should be noted that ATNS considers the movement of the thunderstorms only and does not take into account their development/decay.
2. Each ATNS animated sequence is composed of the actual radar reflectivity distribution map at 3 km above mean sea-level and 10 subsequent forecast reflectivity maps for the next 6, 12, 18, ... up to 60 minutes at 6-minute time intervals.
3. The ATNS product, including the actual and forecast images, will be updated every 6 minutes. Under rapid development situations, thunderstorm intensity and movement could change quickly and therefore users are encouraged to make reference to the latest actual/forecast images as frequent as possible.
4. On the ATNS images, red areas represent potential thunderstorm areas with radar reflectivity value at a height of 3 km  $\geq 41$  dBZ (equivalent to a rainfall rate of 13 mm/hr), yellow areas  $\geq 33$  dBZ (4mm/hr) and  $< 41$  dBZ while green areas  $\geq 20$  dBZ (0.6mm/hr) and  $< 33$  dBZ. The associated arrows represent the

movement directions and speeds (in knots) of the respective storm cells in red colour.

5. User can select between the two coverage ranges, namely 128 and 256-km range from the centre of the Observatory's weather radar at Tai Mo Shan, by clicking the selection box at the top of the images.
6. Each actual/forecast image contains range circles of the radii of 10, 20, ... up to 100 nautical miles, at 10-nautical mile interval, from the centre of HKIA for ease of reference.
7. On the 128-km range ATNS images, ATC strategic areas corresponding to the arrival and departure corridors of HKIA are highlighted in red boxes (Fig. 6).
8. The significant ATC points, such as way-points, holding points, as well as ATC sector boundaries are overlaid onto the actual/forecast images to provide graphical depiction of when and where thunderstorms would impact on these points/sectors. A full version of the ATNS with a time series alert at selected way-points and GIS function can be accessed by clicking the link "ATNS" on the top left selection bar (circled in red in Fig.6) and inputting username and password.
9. Similar to the radar image products, ATNS might occasionally pick up reflected signals from sources other than rain and therefore the ATNS forecast might also contain artificial storms. Please exercise care when viewing the images and seek Observatory's advice in case of doubt.
10. Similar to the significant convection forecast for the key ATC areas, more air traffic flow data for significant events are needed for fine-tuning the alert levels (colour levels) of the ATNS products.



## E. Significant convection forecast for air traffic control

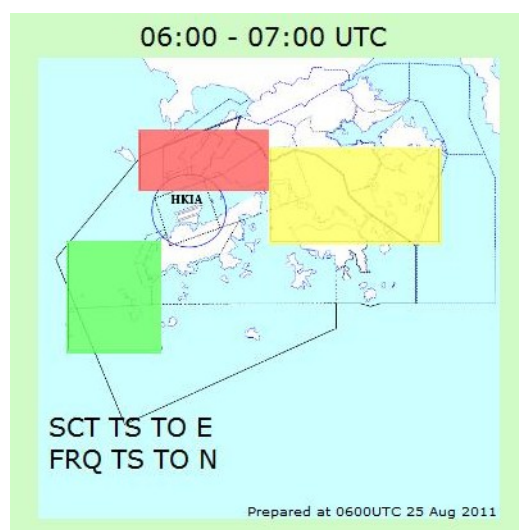


Fig.7 Graphical and text display of significant convection forecast for the arrival and departure corridors of HKIA for the next hour. The circle marks the aerodrome area.

1. Forecasts of significant convection over the arrival and departure corridors for the next hour are provided in pictorial and text format (Fig.7). The text message(s) is/are given below the pictorial display if significant convection is forecast over any marked areas to the east (E), north (N) and west (W) of HKIA (coloured box in Fig.7). This is to facilitate input of the message to ATIS by ATC for onward transmission to pilots and supplement the 2-hour TREND forecast for the aerodrome area (within 8 km of ARP).
2. The wordings of the text are standardised in accordance with the template shown in Table 1 below as agreed with ATC. For simplicity sake, the code “TS” is used to represent significant convection. In the pictorial presentation, “green” means either “no” or “isolated” convection forecast over the area, while “yellow” and “red” respectively represent “scattered” (SCT) and “frequent” (FRQ) convection forecast over the specified region.
3. The forecast is basically generated based on radar-based nowcasting systems including HKO's Aviation Thunderstorm Nowcasting System (ATNS) and the Short-range Warning of Intense Rainstorms in Localized Systems (SWIRLS) with human input as necessary.
4. The forecast will be updated every 6 minutes. Subject to availability of human resources and where situation warrants, manual adjustment may be made at half-hourly intervals when there is a significant change in weather leading to a change in the status of the colour-based alert which is not captured by automated

forecast.

**Table 1: Format of significant convection forecast for arrival and departure corridors**

{Status<sup>2</sup>} {Weather descriptor} TS {Location indicator} [Intensity change (optional)]  
[movement <sup>1</sup> (optional)] [validity period <sup>2</sup> (optional)]

Element	Template	Meaning
Status	FCST	Forecast weather No descriptor means observed and forecast
Weather descriptor	SCT FRQ SQL	Scattered Frequent Squall line
Weather type	TS	Thunderstorm or significant convection
Location indicator	TO E  TO W  TO N	To the east of the aerodrome (green in Fig.7; approach runway 25R, 25L; departure 07L, 07R)  To the west of the aerodrome (red in Fig.7; approach runway 07L, 07R; departure 25L, 25R; missed approach 25L)  To the north of the aerodrome (yellow in Fig.7; missed approach 25R, 07L )
Intensity change  (optional)	INTSF WKN	Intensify Weaken
Movement  (optional, normally not included.)	MOV N/NE/E/SE/S/SW/W/NW [nnKT] STNR	Direction of movement (8-point compass) Speed of movement (in knots) [optional]  Quasi-stationary or slow moving (< 5 KT)
Validity period  (optional, normally not included.)	FR HHmm TL HHmm	From <hour><minutes> UTC Till <hour><minutes> UTC (minutes normally expressed in 00 or 30)

Notes :

- (i) If validity period is specified, information on movement will be omitted.
- (ii) When thunderstorms have been observed over the region, the status descriptor “FCST” will be omitted. The temporal descriptor “FR” will also be omitted if the validity period is specified.

## F. Performance-based Terminal Area Forecast

1. Forecast of weather elements including headwind (with respect to Runway 07 and Runway 25), crosswind, visibility, cloud ceiling are given for the next 9 hours at hourly intervals in tabular form (Fig.8) and highlighted in green/yellow/red according to the thresholds in Table 2 as agreed with ATC. These thresholds are related to airport capacity and hence performance of the airport in handling aircraft. There will be no restriction of change group criteria in this forecast and it serves to supplement TAF forecast for the aerodrome area (within 8 km of ARP). It will be consistent with the takeoff forecast.

Forecast for HKIA									
UTC	10	11	12	13	14	15	16	17	18
<b>Overall</b>									
<a href="#">07 Headwind</a>									
<a href="#">25 Headwind</a>									
<a href="#">Crosswind</a>									
<a href="#">Visibility</a>									
<a href="#">Ceiling</a>									
Prepared at 0902UTC 19 Sep 2011									

Fig.8 Tabular display of performance-based terminal area forecast for the next 9 hours.

Level	Head wind	Cross wind	Visibility	Ceiling
1	=< 20 kt	< 30 kt	> 1000 m	> 400 ft
2	21 - 40 kt	30 - 35 kt	600 – 1000 m	200 – 400 ft
3	> 40 kt	> 35 kt	< 600 m	< 200 ft
-	< -5 kt	-	-	obscured sky

Table 2 Thresholds for Performance-based Terminal Area Forecast

2. The forecasts are basically generated automatically based on actual observations, latest weather information and forecasts including TREND and TAF forecasts. They will normally be updated hourly. The value of the forecast weather elements can be accessed by clicking on the title of the elements in Fig.8. A sample of the detailed forecasts is given in Fig.9. Subject to availability of human resources and where situation warrants, human adjustment may be made to fine tune the forecasts at hourly intervals when significant changes are expected.

3. TEMPO group in the forecast will also be used in addition to the main group when determining the colour level. However, headwind and crosswind components will not be resolved for wind gusts.
4. Considering that normally the tailwind on the runway in use should not be greater than 5 kt, grey color will be shown under “Headwind” in cases when the headwind is less than -5 kt (i.e. tailwind greater than 5 kt).
5. When variable winds are given in the forecast, the resolved headwind and crosswind components will pick the full wind strength given. For example, “VRB25G35KT” will be resolved to give 25 kt headwind and 25 kt crosswind.
6. Ceiling is the cloud base below 5000 ft (cloud of operational significance) covering more than half of the sky (BKN or OVC). When the sky is obscured, grey colour will be shown under “Ceiling”.

#### Detailed Terminal Area Forecast for the next 9 hours

Issue time: 190902Z

Time (UTC)	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800
Overall										
Wind TEMPO	010/03 --	VRB/03 020/15 G25	VRB/03 020/15 G25	080/10 --	080/10 --	080/10 020/10	080/10 020/10	020/10 --	020/10 --	020/10 --
07 Headwind (kt) TEMPO	2 --	10 -- #	10 -- #	10 --	10 --	10 6	10 6	6 --	6 --	6 --
25 Headwind (kt) TEMPO	-2 --	-10 -- #	-10 -- #	-10 --	-10 --	-10 -6	-10 -6	-6 --	-6 --	-6 --
Crosswind (kt) TEMPO	N 3 --	N 11 -- #	N 11 -- #	S 2 --	S 2 --	S 2 N 8	S 2 N 8	N 8 --	N 8 --	N 8 --
Visibility TEMPO	10km --	10km 2000 m	10km 2000 m	7000 m 3000 m	7000 m 3000 m	7000 m --	7000 m --	7000 m --	7000 m --	7000 m --
Ceiling (ft) TEMPO	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --

Fig.9 Detailed terminal area forecast for the next 9 hours appearing on a pop-up window after clicking on the title of the elements in Fig.8.

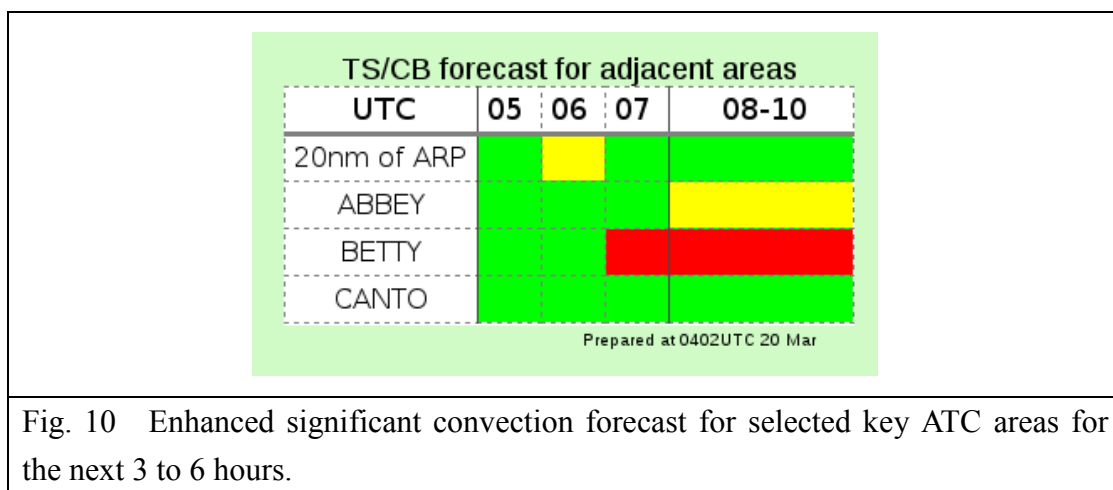
Notes :

- (i) The actual observations in the first column are updated half hourly and the forecasts in the following columns are normally updated hourly.
- (ii) The colours highlighted are based on the thresholds in Table.2. TEMPO group, when given, will also be used when determining the colour levels.
- (iii) The winds are for the central part of the North Runway. “G” refers to gust. “07” and “25” indicate respectively Runway 07 and Runway 25.
- (iv) Grey colour will be shown under “Headwind” in cases when the headwind is

less than -5 kt (i.e. tailwind greater than 5 kt).

- (v) “N” and “S” in crosswind represent northerly crosswind and southerly crosswind respectively.
- (vi) “--” in cloud ceiling means no cloud or cloud ceiling above 5000 ft. Obscured sky will be indicated by grey colour.
- (vii) Gusts (G) will not be indicated in the headwind or crosswind row in view of their nature. Instead, a symbol “#” will be displayed.
- (viii) Winds which are highly variable in wind direction will be displayed as VRB. VRB winds will be indicated in the headwind and crosswind in full strength.

## G. Significant convection forecast for selected key ATC areas



1. More detailed significant convection forecasts for key ATC areas including 20 nm of ARP and three critical holding areas for arrival flights, namely ABBEY, BETTY and CANTO. which are around 80 nm away from the HKIA, in support of air traffic management and air traffic flow management.
2. Hourly forecasts are updated every 12 minutes for the first 3 hours and 3-hourly forecast basically updated every hour for the following 4-6 hours (Fig. 10). They are generated from automatic blending of radar-based nowcasting system with high-resolution NWP model.
3. Forecasters may adjust the forecast subject to availability of resources and where situation warrants. Consistency with the significant convection forecast time series will be ensured.
4. Forecast for the next 4-6 hours will be provided at hourly intervals in the future after tuning and review of forecast results.

## H. Air Traffic Flow Capacity Notification

CAPACITY RELATED INFORMATION VHHH (FOR ARRIVALS)  
VALID: 220800 to 221600 UTC  
CAPACITY LEVEL: 1  
AIRPORT ACCEPTANCE RATE: 32 flights per hour  
EXPECTED DELAY: Up to 15 mins  
REASON: -  
REMARK:  
Prepared at: 0503UTC 22 Nov 2013

Fig. 11 Capacity Notification issued by the Civil Aviation Department, Hong Kong, China.

1. Based on the weather and air traffic operational constraints, especially the development of significant convections over HKIA and the larger terminal area, the Air Traffic Flow Management Unit of the Hong Kong Civil Aviation Department will issue the Capacity Notification Message to various stakeholders which include Airport Authority Hong Kong, Japan and Singapore Air Navigation Service Providers and more than 100 airline operators. The message will provide an estimate on the Airport Acceptance Rate (AAR) for arrival flights with expected delay time.
2. There are totally five capacity levels, namely from 1 to 5, each covering the following AAR range:
  - Capacity Level 1: 29-33 arrivals per hour, expected 15 min delay
  - Capacity Level 2: 23-28 arrivals per hour, expected 30 min delay
  - Capacity Level 3: 18-22 arrivals per hour, expected 40 min delay
  - Capacity Level 4: 12-17 arrivals per hour, expected 50 min delay
  - Capacity Level 5: 11 arrivals or below per hour, expected 60 min delay
3. The capacity notification message is normally issued twice a day in the morning and early afternoon (shortly after 6am and 1pm). Under rapidly changing weather condition, the capacity notification message will be updated whenever necessary based on the latest assessment on the evolution of significant convection.