



International Civil Aviation Organization

**The Second Meeting of ICAO Asia/Pacific Air Traffic Flow Management Steering Group (ATFM/SG/2)**

Bangkok, Thailand, 1 – 4 October 2013

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**Agenda Item 4: Review of Current CDM/ATFM Operations and Problem Areas**

**DEVELOPMENT OF METEOROLOGICAL PRODUCTS TO SUPPORT ATFM**

(Presented by Hong Kong, China)

**SUMMARY**

This paper presents the collaboration between Civil Aviation Department and Hong Kong Observatory in the development of necessary meteorological product to support the ATFM operation.

This paper relates to –

**Strategic Objectives:**

*A: Safety – Enhance global civil aviation safety*

*C: Environmental Protection and Sustainable Development of Air Transport – Foster harmonized and economically viable development of international civil aviation that does not unduly harm the environment*

**Global Plan Initiatives:**

GPI-6 Air traffic flow management

GPI-9 Situational awareness

GPI-16 Decision support systems and alerting systems

GPI-19 Meteorological Systems

**1. INTRODUCTION**

1.1 Since 2010, Hong Kong, China realized the necessity of developing ATFM mechanism to balance air traffic demand and capacity. Before a regional ATFM solution among the Asia region is established, Hong Kong needs to develop an interim local solution. Throughout the process of development, appropriate meteorological products are found to be essential. Hong Kong Civil Aviation Department and Hong Kong Observatory start the collaboration in developing the necessary meteorological products to support the ATFM operation.

**2. DISCUSSION**

Overview of the ATFM Operation

2.1 Hong Kong ATFMU will assess the runway capacity of the Hong Kong International Airport (HKIA) in the next 8 hours. By comparing the expected traffic demand with the estimated capacity, ATFMU will determine if tactical holding will be sufficient to balance the demand and capacity. If not, flow control measure will be imposed on the FIR entry fixes and promulgate through the adjacent ACCs. ATFMU will monitor the actual situation and make adjustment in due course.

### Runway Capacity

2.2 Maximum runway throughput for landing traffic can only be achieved with optimum inter-arrival spacing. Convective weather over the airport, on final approaches, and base area will significantly affect the runway capacity. As the existing met product like TAF which focus mainly on the ATZ, it will be inadequate to present the weather forecast in the approach airspace. Met forecast covering the approach airspace is required.

2.3 Another important factor affecting the AAR is the mode of the runway operation. In HKIA, the north runway is the landing runway, the south runway is the departure runway. Normally both runways are operated independently. However when weather conditions (e.g cloud ceiling, visibility...) deteriorate below specific criteria, ATC has to adapt dependent operation mode which require addition inter arrival spacing and the runway capacity is eventually reduced. We recognize a new met product to focus on these weather criteria thresholds will facilitate the ATFM operation.

### Airspace Capacity

2.4 The major airborne delays for arriving aircraft from different directions are absorbed in 3 primary holding patterns in the terminal airspace. Inclement weather in these holding areas will reduce the airspace capacity significantly. Even though Hong Kong has established various contingency holding patterns to handle the issue tactically, these measures are not adequate when weather in Hong Kong FIR is extensive. Met product to forecast the availability of these holding patterns will be necessary for the ATFMU to determine whether ATFM measure is required.

### Application of Flow Control Measures

2.5 Whenever application of flow control measures is required to balance the arriving traffic demand and airport/airspace capacity, it is always better if the aircraft can be held on ground at the departure aerodrome. With a catchment area of 1,500NM from HKIA, ATFMU will endeavour to provide 4 hours advance notice to upstream ACCs before the application of flow control measures. It is important to have the relevant ATFM supporting Met products to provide similar lead time.

2.6 Having identified the needs, Civil Aviation Department is glad to have the full support from Hong Kong Observatory (HKO) to develop corresponding Meteorological Services for the larger Terminal Area (MSTA) products, elaborated below, to support ATFM.

### MSTA Products to support Runway Capacity Estimation

2.7 Aviation Thunderstorm Nowcasting System (ATNS) - is a system specifically tailored for aviation use. The core of ATNS is a nowcasting system developed by the HKO to automatically track the past movement and forecast the future location of weather cells that may block the intended flight path or significant points in the air space for the next 60 minutes at 6-minute intervals (**Appendix 1, Figure 1**). The output of the system is disseminated to CAD for display on the new generation of flight control system.

2.8 1hr convection nowcast for arrival/departure corridors (**Appendix 1, Figure 2**) – As discussed in para. 2.2 above, convection in the arrival, departure, and miss-approach areas would significantly affect runway capacity. The ATNS forecast discussed above is further tailored to provide a 1-hour significant convection forecast over these critical areas. The automatic forecast is updated every 6 minutes and could be adjusted manually by the aviation weather forecaster where necessary.

2.9 9hr performance-based weather forecast for the aerodrome (**Appendix 1, Figure 3**) – Apart from nowcasting of significant convection to support tactical decision making, a 9hr performance-based forecast of the weather conditions at the aerodrome, such as headwind, crosswind, visibility and cloud ceiling, is also provided to CAD/ATFMU to support strategic decision making. While the same information is given in the TREND forecast and/or TAF, the values given in TREND/TAF are subject to the limitations such as change group criteria. The 9hr performance-based forecast instead is adapted with local thresholds (**Appendix 1, Figure 4**). The information provided is on one hand consistent with the TREND/TAF, while on the other hand highlights the meteorological conditions that are directly relevant to the operation of the aerodrome facilitating CAD/ATFMU to fine tune the capacity notification on the expected airport arrival rate.

#### MSTA Products to support Airspace Capacity Estimation

2.10 12hr/6hr significant convection forecast time series for key areas in the HKFIR (**Appendix 1, Figure 5**) - this forecast product is designed to warn the occurrence of significant convections in the holding areas, plus over those busy air routes such as to the southern and northern boundary of the HKFIR. The 12hr forecast time series for each area is divided into 4 slots at 3 hourly intervals to give a broad brush picture of the expected weather over the HKFIR for the next 12 hours. The forecast is generated automatically from numerical weather prediction output and could be adjusted manually. As the crucial decision time for ATFMU is around 4 to 6 hours ahead, there is a 6hr forecast product (**Appendix 1, Figure 6**) which focuses only the aerodrome area and three critical zones (namely ABBEY, BETTY and CANTO). The 6hr forecast product is finer in temporal resolution with hourly forecast for the next 3 hours.

2.11 For the sake of convenience to the users, all the above products/systems use three levels of colour code to indicate the impact to air traffic, viz GREEN for mild or no impact, AMBER for medium impact and RED for significant impact. Though the actual criteria for defining the colour codes are different across different forecast products, the above simple three levels of colour code are adopted uniformly in all the forecast/nowcast products described above after consultation with ATFMU/ATC. This helps the users to quickly assimilate the potential impact to air traffic caused by adverse weather so that they can take immediate responsive actions in short period of time.

2.12 For easy access to all of the above products, a web-based integrated display, named Significant Convection Monitoring and Forecast, has been developed to provide a “one-stop shop” to ATFMU/ATC (**Appendix 1, Figure 7**). Based on the information available on the integrated display, aviation weather forecasters will conduct weather briefings twice a day with ATFMU on the possible weather impact to air traffic in the HKFIR to facilitate flow management and the issuance of the capacity notification.

#### MSTA Products for situation awareness

2.13 TS/WX CELLS message on ATIS for pilots (**Appendix 1, Figure 8**) – Apart from MSTa products to support ATFMU, additional textual information is provided on the ATIS broadcast to heighten pilot’s situation awareness. For example, significant thunderstorms or weather cells within 50 NM of HKIA which are affecting or expected to affect the approach and departure areas will be included in the ATIS broadcast to alert inflight pilots of adverse weather that is not readily available from the METAR (which covers weather up to 16 NM only). The Arrival ATIS will include information about the TS/WX CELLS affecting the approach and missed approach areas while the Departure ATIS will include information about the TS/WX CELLS over the departure areas. The messages include the approximate distance and bearing of the TS/WX CELLS from the airport, and their respective direction of movement.

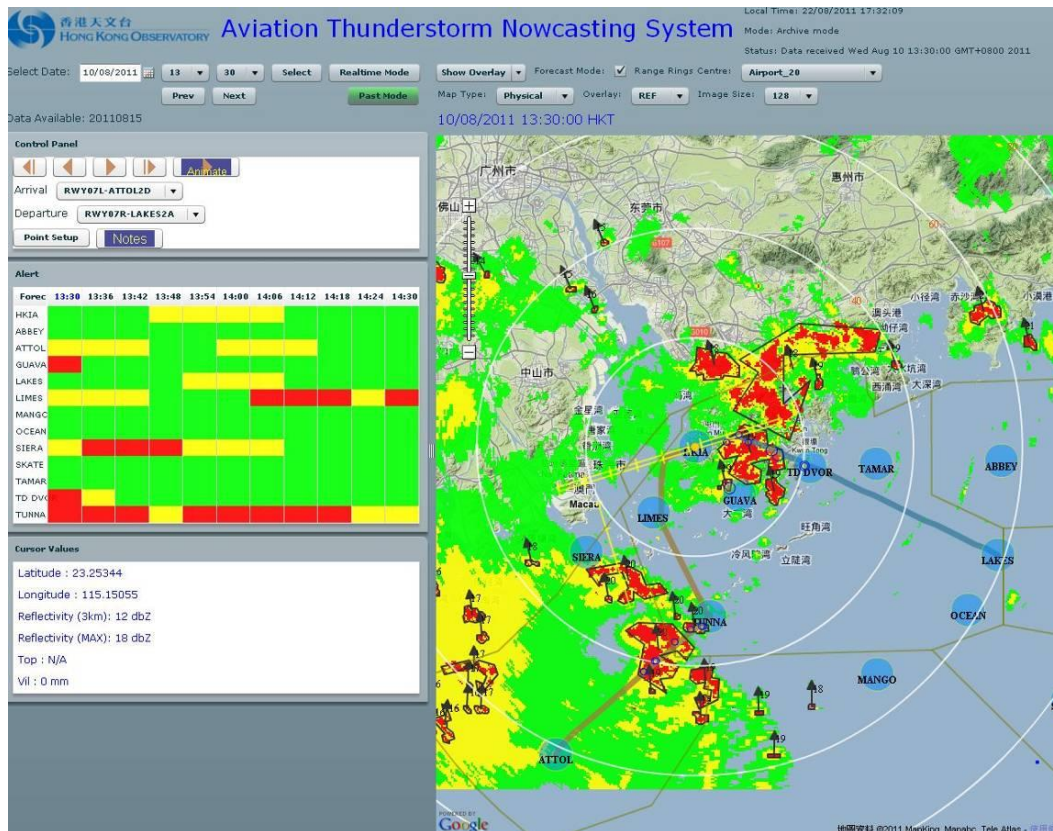
**3. ACTION BY THE MEETING**

3.1 The meeting is invited to:

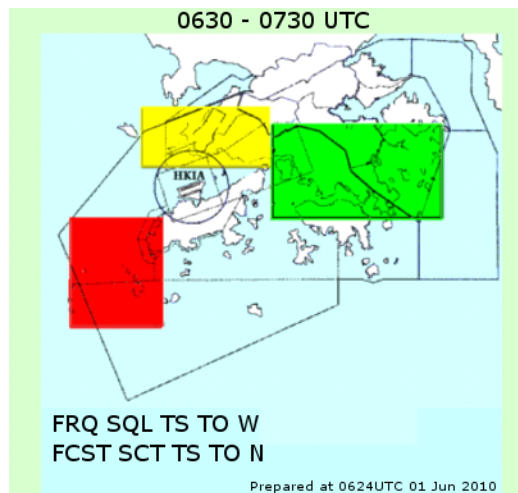
- a) note the information contained in this paper; and
- b) consider the development of suitable meteorological products to support ATFM.

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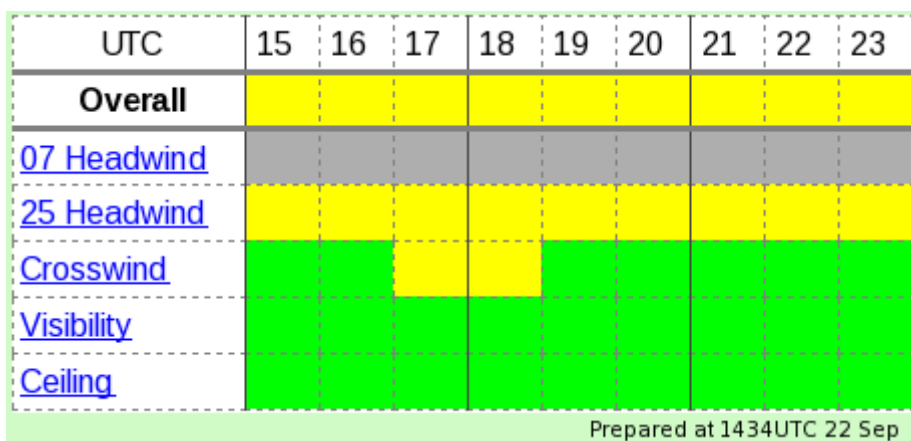
**APPENDIX 1 – Meteorological Services for the larger Terminal Area (MSTA)**  
**Functional Displays**



**Figure 1:** The display panel of the Aviation Thunderstorm Nowcasting System (ATNS).



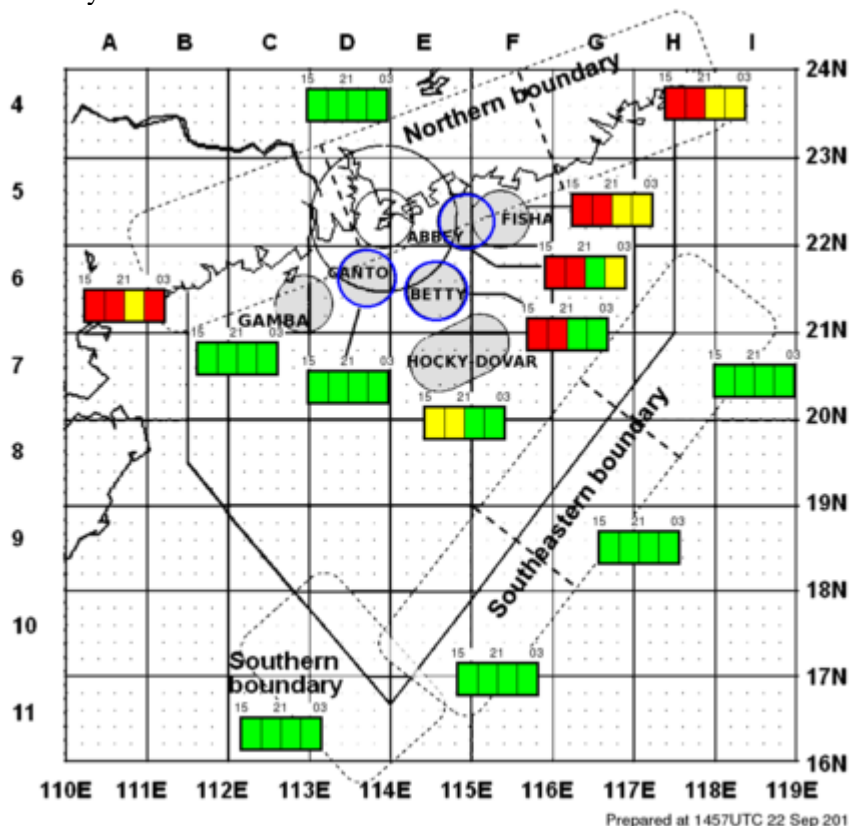
**Figure 2:** 1hr convection nowcast for arrival/departure corridors. The box to the West has changed to Red, indicating that intense convection is affecting or to affect the arrival (departure) area for runway 07(25). The box to the North has changed to Amber, indicating that less intense convection is affecting or to affect the miss-approach area for the northern runway (07L/25R). The box to the East remains in Green, suggesting that no significant convection will affect the arrival (departure) corridor for runway 25(07).



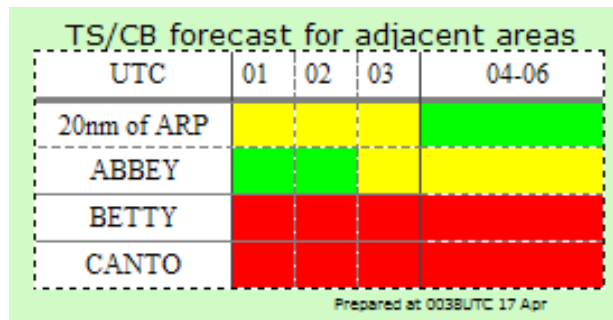
**Figure 3:** 9hr performance-based weather forecast for the aerodrome.

| 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 |

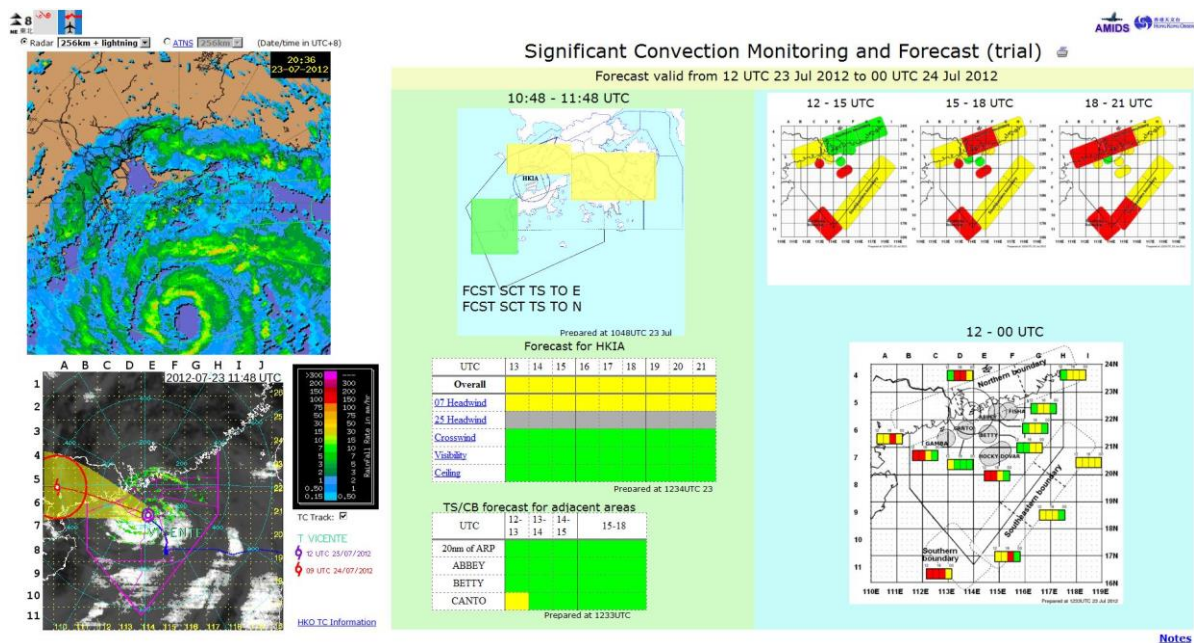
**Figure 4:** Thresholds for the 9hr performance-based weather forecast. The headwind condition is related to the aircraft separation, the crosswind condition is related to the operation threshold of aircraft, while the visibility and ceiling thresholds are associated with the Low Visibility Procedures of HKIA.



**Figure 5:** 12hr significant forecast time series for key ATC areas. Shaded areas are the location of key holding patterns with a 20NM radius. Dotted lines mark the other important air spaces which cover busy air routes at the southern and northern boundaries of the HKFIR.



**Figure 6:** 6hr convection forecast for the aerodrome area and critical holding areas for entering the HKIA.



**Figure 7:** Integrated web display of the forecast suite. The above screen was captured during the passage of Severe Typhoon Vicente in July 2012.



民航處  
CIVIL AVIATION DEPARTMENT

## Hong Kong International Airport (HKIA) Automatic Terminal Information Service (ATIS)

| ATIS 128                      |                               |                                 |                                 |
|-------------------------------|-------------------------------|---------------------------------|---------------------------------|
| HONG KONG ARRIVAL INFORMATION |                               | HONG KONG DEPARTURE INFORMATION |                                 |
| A-TITLE                       | HONG KONG ARRIVAL INFORMATION | D-TITLE                         | HONG KONG DEPARTURE INFORMATION |
| A-IDENT                       | J                             | D-IDENT                         | S                               |
| A-TIME                        | 0335                          | D-TIME                          | 0337                            |
| A-INFO-D1                     |                               | D-INFO-D1                       |                                 |
| A-RUNWAY                      | 07L                           | D-RUNWAY                        | 07R                             |
| A-INFO-D2                     |                               | D-WS/TURB                       |                                 |
| A-WS/TURB                     | WS AND TURB FCST              | D-SUPPL1                        | RW SFC WET                      |
| A-SUPPL1                      |                               | D-WIND                          | 130                             |
| A-WIND                        | 120                           | D-SPEED                         | 15                              |
| A-SPEED                       | 15                            | D-VRB-BTN                       |                                 |
| A-VRB-BTN                     |                               | D-AND                           |                                 |
| A-AND                         |                               | D-MAX                           |                                 |
| A-MAX                         |                               | D-MNM                           |                                 |
| A-MNM                         |                               | D-VIS                           | 5000M                           |
| A-VIS                         | 10 KM                         | D-RVR                           |                                 |
| A-RVR                         |                               | D-PRESENT-WX                    | PASSING SHOWERS                 |
| A-PRESENT-WX                  | PASSING SHOWERS               | D-CLOUD                         | FEW 1000FT SCT 3500FT           |
| A-CLOUD                       | FEW 1000FT SCT 3500FT         | D-WXCHG                         |                                 |
| A-WXCHG                       |                               | D-TEMP                          | 27                              |
| A-TEMP                        | 27                            | D-DEWPOINT                      | 25                              |
| A-DEWPOINT                    | 25                            | D-QNH                           | 1007                            |
| A-QNH                         | 1007                          | D-METINFO                       | TS 15 NM SW MOV NE              |
| A-METINFO                     | TS 15 NM SW MOV NE            | D-TREND                         |                                 |
| A-TREND                       |                               | D-SUPPL2                        |                                 |
| A-SUPPL2                      |                               | D-ACK                           | ACK INFO S                      |
| A-ACK                         | ACK INFO J                    | D-CDCGMC                        | DELIVERY                        |

Figure 8: TS/WX CELL message shown on ATIS (highlighted in red boxes).