International Civil Aviation Organization

FOURTEENTH MEETING OF THE COMMUNICATIONS/NAVIGATION/SURVEILLANCE AND METEOROLOGY SUB-GROUP OF APANPIRG (CNS/MET SG/14)

Jakarta, Indonesia, 19 – 22 July 2010

Agenda Item 14: Regional MET support to ATM

2) Exchange of information on MET support for operations at aerodromes, terminal areas and en-route

TRIAL OPERATION OF THE AVIATION THUNDERSTORM NOWCASTING SYSTEM (ATNS) IN SUPPORT OF ATM

(Presented by Hong Kong, China)

SUMMARY

This paper provides an update of the latest development of aviation thunderstorm nowcasting system for Air Traffic Management (ATM) and airline users in Hong Kong, China.

This paper relates to:

Strategic Objectives:
A. Safety – Enhance global civil aviation safety
D. Efficiency – Enhance the efficiency of aviation operations

Global Plan Initiatives:
GPI-18 Aeronautical Information
GPI-19 Meteorological Systems

1. Introduction

1.1 In CNS/MET SG/13, we presented the Hong Kong Observatory's development of an aviation thunderstorm nowcasting system (hereafter ATNS) to support ATM and airline operations in the terminal area of the Hong Kong International Airport (HKIA). This paper provides an update of the latest development of this project.

2. Latest development of ATNS

2.1 As described in CNS/MET SG/13, ATNS is a radar-based nowcasting system built on the technology of the Observatory's Short-range Warnings of Intense Rainstorm in Localized System (SWIRLS). The prototype ATNS has been provided to local ATM since mid-2009 for collecting users' feedback. Based on the feedback, a number of new features have been introduced, including (i) extending the areal coverage of the 1-hour forecast of thunderstorms out to 256 km from HKIA, and (ii) inclusion of lateral sector boundaries within HK FIR. Meanwhile, the prototype was also enhanced with a special feature, i.e., automatic grouping of contiguous radar pixels into polygons overlaid with motion vectors.

2.2 The above-mentioned polygon feature is developed as an initiative to support the demonstration projects of the Meteorological Services for Terminal Area (MSTA), previously known as New Terminal Forecast, under the Commission for Aeronautical Meteorology (CAeM) of the World Meteorological Organization (http://www.msta.weather.gov.hk/). In the spirit of MSTA, there will be 3-tier convective products, namely, (i) nowcast of 0-1 hour of convective weather based on weather radar data, (ii) short-term convective forecast up to 6 hours, and (iii) convective outlook up to two days ahead. The ATNS falls into the category of nowcast. Figure 1 shows the ATNS product of 0, 6, 12, ..., up to 60-min nowcast of 3-km CAPPI radar echo intensity within 256 km of HKIA. The 0-min image represents the actual radar reflectivity distribution. The polygons and their associated motion vectors in Figure 1 are simple objects which can be transmitted efficiently over any modern communication link and could serve as an example for future uplink of actual and forecast convection information to the cockpit. Apart from actual positions of the polygons, the forecast positions of the polygons are made available by way of linear extrapolation based on past movement of the radar echoes. Taking advantage of the low bandwidth requirement for uplinking polygons, a pilot project for demonstrating the uplink concept via the Electronic Flight Bag (EFB) technology using the convection polygons of ATNS was being developed under the cooperation between the Observatory and a local airline. Pending the evaluation results after the demonstration period, the EFB might be extended to cover more weather products in the future.

2.3 Another new feature of ATNS is the capability of reviewing archived events up to 1 week ago. This new feature can serve as a real-time verification function for the user and the system developer to monitor the performance of ATNS and to appreciate the strength and weakness of the system, thus facilitating more efficient use of the products and hopefully strengthening the confidence of the users on the ATNS product. More cases are being collected for conducting comprehensive verification.

2.4 One area of development of the ATNS is to quantify the impact of convective weather to air traffic. The flight position data of the aircraft arriving and departing HKIA and flying over the HKIA air space were provided by the local Air Traffic Flow Management (ATFM). The flight positions were overlaid onto the radar images with a view to identifying the correlation between the aircraft flight path patterns and the radar parameters (including 3-km CAPPI reflectivity, echo top, vertically integrated liquid, and vertically maximum intensity core) and establishing the criteria for avoidance of severe convective weather. Figure 2 shows a snapshot of the aircraft flight paths within a 6-minute interval overlaid on the corresponding 3-km radar CAPPI reflectivity image. While many of the aircraft avoided flying into the most severe convection zone (colored in red), some opted to fly through the gaps between the red areas. More flight position data are being collected to further this study. The study results would be used to fine-tune the alert levels of the radar parameters to make the pilots/ATM aware of the potential impact of severe convection to the aircraft and avoid flying into the alerted zones to achieve safer and more efficient air traffic over HKIA. We also understand from aviation users that a linkage between weather parameters and their impact to air traffic is highly desirable to facilitate the use of the new MSTA services without the need of interpretation by the users.

3. Trial operation and on-going development

3.1 The real-time prototype ATNS has been put into operational trial since mid-Apr 2010. Local ATM and ATFM could gain access to the ATNS product for evaluation under real-time weather conditions.

3.2 Work is also being conducted to further enhance ATNS to improve its performance. In particular, ways to forecast the trend of the growth and dissipation of thunderstorms would be explored by introducing more sophisticated techniques such as blending nowcasting information with high-resolution numerical weather prediction (NWP) products.

4. Action by the Meeting

4.1 The meeting is invited to note the information provided in this paper.

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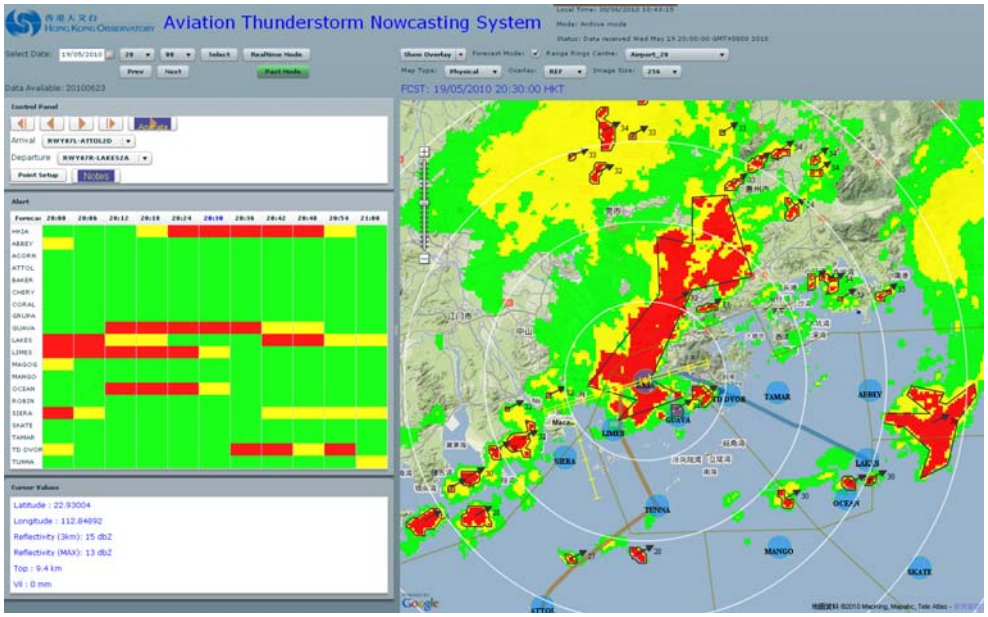

Fig.1 Sample display of the ATNS 30-min radar 3-km CAPPI reflectivity intensity nowcast product. The forecast radar echo intensity image is shown on the right hand side while the forecast time-series (up to 1 hour at 6-minute intervals) of the radar echoes to affect various way-points are shown on the left hand side. The black lines enclosing the red areas represent the polygons and the black arrows are the respective motion vectors. Radar echoes with intensity between 10 and 33 dBZ are shown in green colour, between 34 and 40 dBZ in amber and from 41dBZ onwards in red.

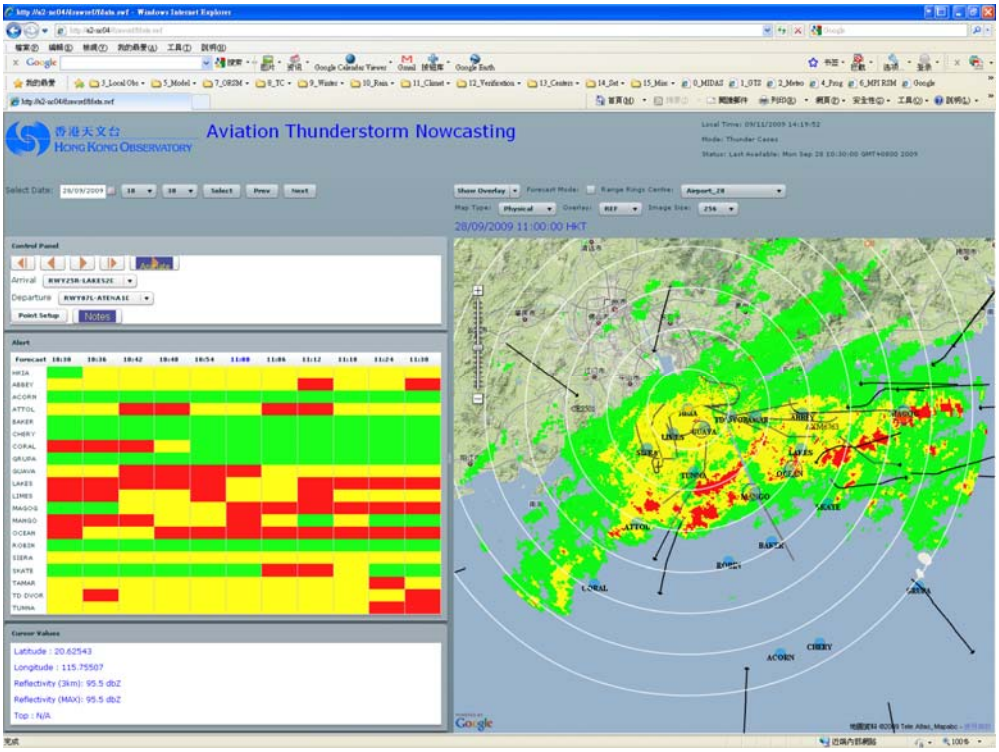

Fig.2 Sample display of the aircraft flight position data (black curves) overlaid onto the radar reflectivity image.