59th CONFERENCE OF DIRECTORS GENERAL OF CIVIL AVIATION ASIA AND PACIFIC REGIONS

Cebu, Philippines
14 to 18 October 2024

AGENDA ITEM 4: AIR NAVIGATION

UTILISATION OF ADVANCED TECHNOLOGIES TO ENHANCE WEATHER-RELATED COLLABORATIVE DECISION MAKING IN AIR TRAFFIC MANAGEMENT

(Presented by Hong Kong, China)

SUMMARY

The utilisation of advanced technologies and weather forecasting models allows air traffic control personnel to determine appropriate pre-tactical and tactical strategies to be implemented when adverse weather conditions affect airports and airspace. These strategies mitigate the risk of aircraft encountering convective activity or severe turbulence while ensuring the orderly flow of air traffic during adverse weather situations.

This paper shares the experience of Hong Kong, China in integrating an advanced tool which provides real-time weather radar information at different altitudes into the air situational display for enhancing tactical decision making by air traffic control officers during adverse weather situations, and encourages States/Administrations to consider doing so if considered beneficial and justified.

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1. INTRODUCTION

1.1 Adverse weather conditions, such as intense convective activity and tropical cyclones, pose significant threats to the safety of aircraft operation and contribute to flight delays and disruptions to airport operations. The Asia Pacific region, in particular, is geographically predisposed to these adverse weather phenomena. It is thus desirable for air traffic management (ATM) personnel in this region to have access to real-time and accurate weather forecasts to facilitate both tactical and pre-tactical decision making. This enables the enhancement of flight safety and the implementation of measures to address capacity constraints under such conditions.

2. DISCUSSION

Constant Altitude Plan Position Indicator (CAPPI) to Support Tactical Decision Making

2.1 Hong Kong, China has integrated the Constant Altitude Plan Position Indicator (CAPPI), an advanced tool which provides real-time weather radar information at different altitudes, into the air situational display of its Air Traffic Management System (ATMS) to facilitate Air Traffic Control Officers (ATCOs) in making informed tactical decisions during adverse weather situations.

2.2 CAPPI consists of horizontal cross-sections of weather radar images provided by the Hong Kong Observatory (HKO), with a range of up to 256 km. The data are superimposed on the ATMS air situational display. ATCOs can select an altitude band in CAPPI from 10 distinct layers, each in 1 km increments up to 10 km above mean sea level, to assist them in understanding the weather situations at different altitudes for making operational decisions and meeting air traffic control (ATC) needs. Each layer displays the magnitude of rainfall in three color-coded levels: green (light), yellow (moderate) and red (intense). Figure 1 of the Appendix shows a snapshot of CAPPI superimposed on the ATMS air situational display when a super typhoon approached Hong Kong.

Experience sharing from CAPPI Utilisation

2.3 Based on Hong Kong, China's experience, CAPPI provides valuable insights to ATCOs regarding pilot responses to adverse weather conditions. For instance, fewer than 10% of flights deviated around areas marked by green (light) rainfall levels, while over 30% and 50% of flights deviated around areas marked by yellow (moderate) and red (intensive) rainfall levels respectively.

2.4 The integration of CAPPI into the air situational display has significantly enhanced both flight and ATC operations by providing real-time weather references to pilots and suggesting viable alternate flight path in advance to avoid convective weather areas. The information provided by CAPPI enhances pilots' situational awareness, reduces radio transmissions requesting route deviations and assists ATCOs in anticipating traffic flow in weather-impacted areas. CAPPI data are also instrumental in strategic planning, allowing ATC supervisory personnel to apply precise Air Traffic Flow Management (ATFM) measures to address capacity issues and airspace constraints.

MET-ATM Collaboration in Pre-Tactical Decision Making

2.5 To assist ATCOs in pre-tactical decision making, the HKO has developed a suite of specialised meteorological (MET) forecasting tools that help determine appropriate ATFM measures when the airport and airspace capacities are expected to be impacted by adverse weather. HKO provides a range of forecasts including a 2-hour convection nowcast for arrival/departure corridors, a 6-hour convection forecast for the aerodrome (within 20 NM) and major waypoints, a 9-hour performance-based weather forecast for the aerodrome and a 12-hour significant convection forecast

time series for key areas in the Hong Kong FIR. These predictive tools are crucial in determining the daily airspace capacity plan. Samples of these products relevant to pre-tactical ATFM planning are shown in Figure 2 of the Appendix.

2.6 When airport operation is affected by tropical cyclone, the HKO issues probabilistic wind forecasts for the airport for up to 36 hours in advance (see Figure 3 of the Appendix). These forecasts include the strength of the crosswind component, which is an important factor in determining the airport's arrival rate.

2.7 Based on these predictive MET services together with three daily on-line weather briefings provided by the HKO, the runway and airspace capacity plan for the upcoming hours can be determined and appropriate ATFM measures can be applied if required. Timely updates are also provided by the HKO through a hotline, should there be significant changes in weather conditions.

Conclusion

2.8 Through the adoption of advanced technologies and collaborative efforts between ATM personnel and MET service provider, ATCOs are now better equipped to monitor adverse weather and provide pilots with routes suggestions that avoid convective weather areas wherever possible. This enhances situational awareness, reduces the risk of aircraft encountering severe turbulence, and enables more accurate tactical and pre-tactical decision making to better balance demand and capacity during adverse weather situations. This in turn can facilitate improvements in flight safety and ATC operational efficiency.

3. ACTION BY THE CONFERENCE

3.1 The Conference is invited to:

a) note the experience shared by Hong Kong, China in integrating the Constant Altitude Plan Position Indicator (CAPPI) into the air situational display for enhancing tactical decision making by air traffic control officers (ATCOs) during adverse weather situations, and encourage States/Administrations to consider doing so if considered beneficial and justified; and

b) promote MET-ATM collaboration on convective activity forecast and airspace capacity prediction to enhance pre-tactical decision making by ATCOs and/or Air Traffic Flow Managers.

— END —

Appendix

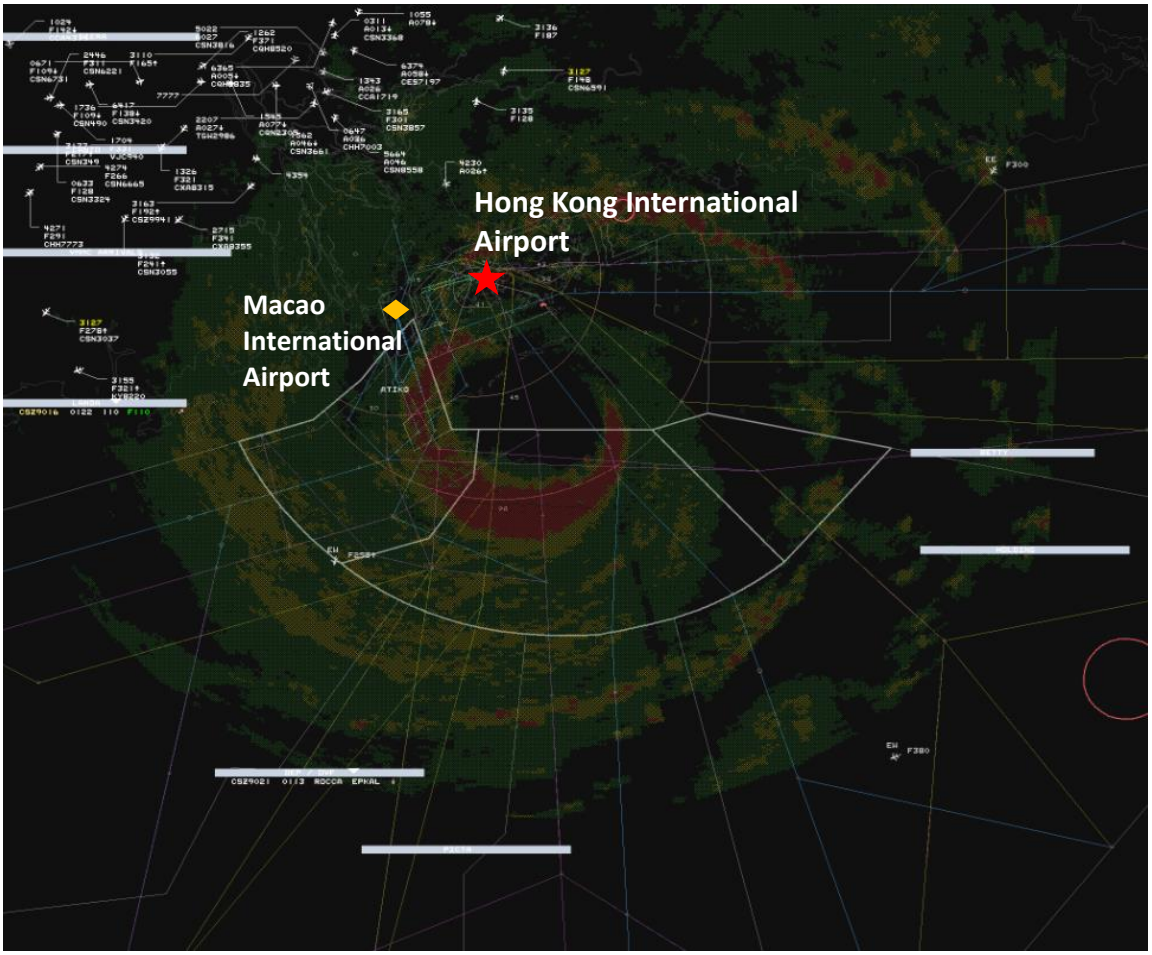

Figure 1: CAPPI superimposed on ATMS air situational display with different rainfall intensities

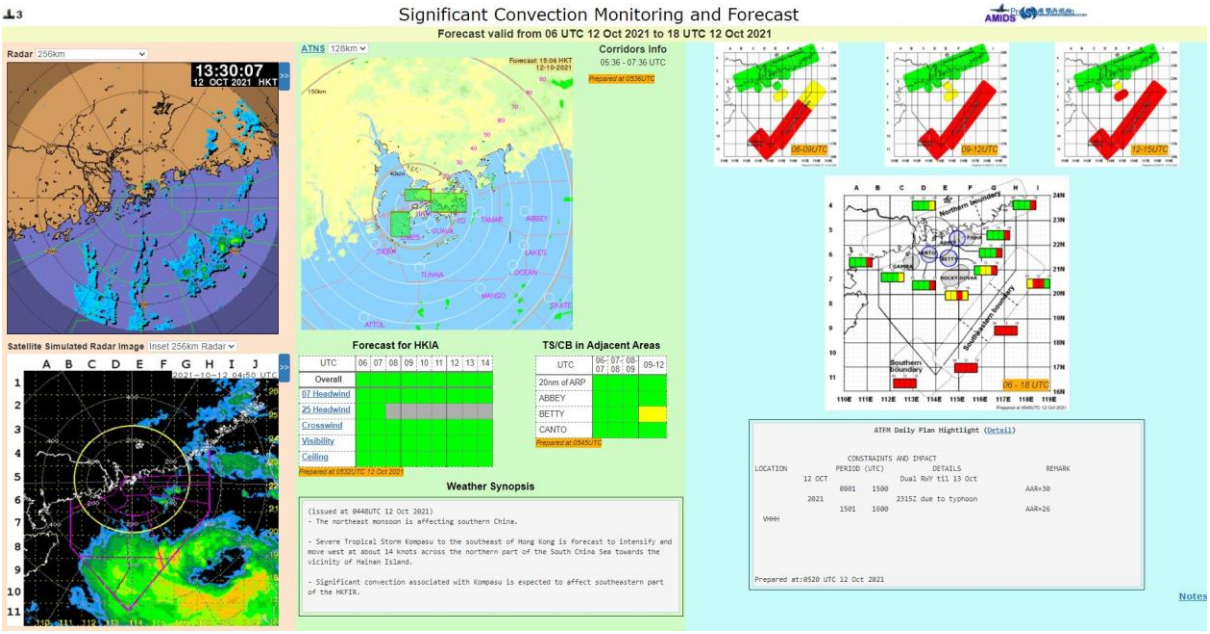

Figure 2: Significant Convection Monitoring and Forecast

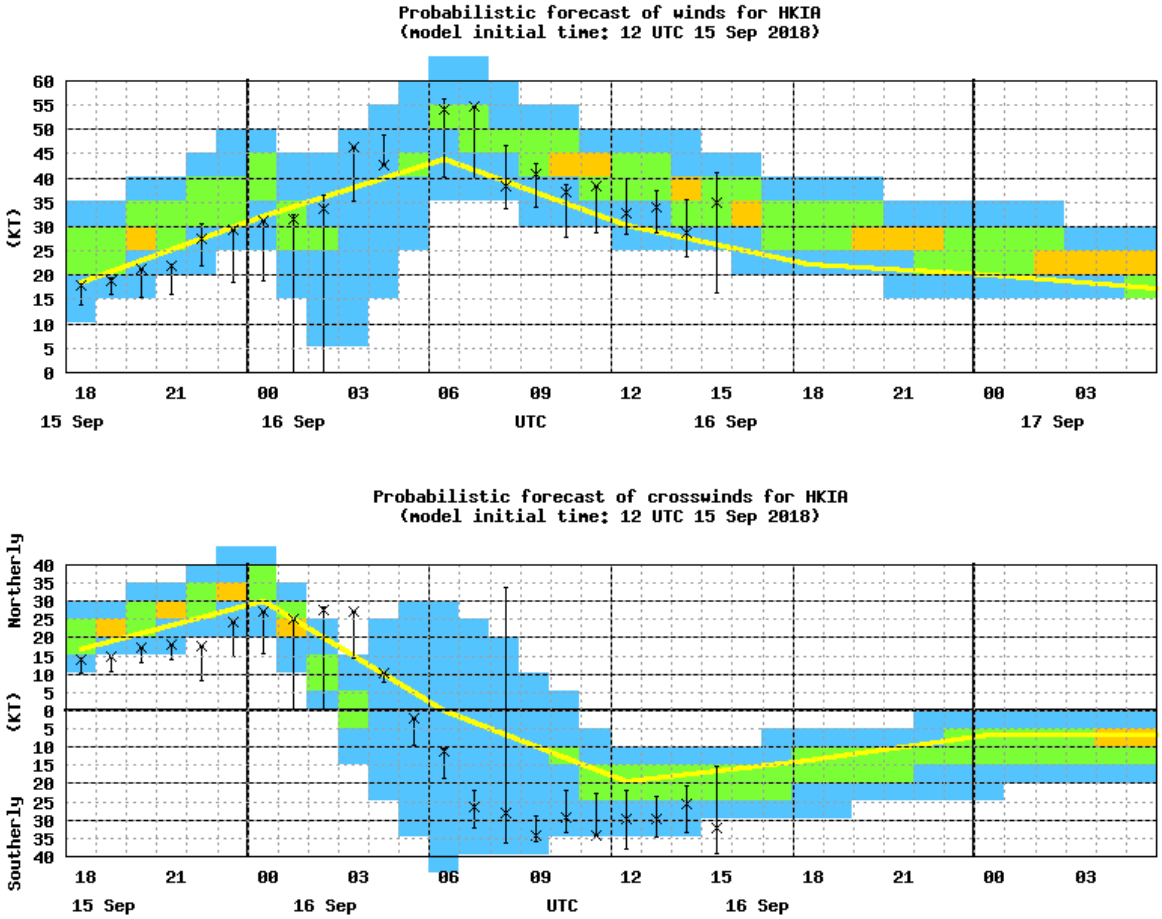

Figure 3: Probability Wind Forecast at HKIA (including cross wind component)