International Civil Aviation Organization

INFORMATION PAPER

**Twenty-Fourth Meeting of the Meteorology Sub-group
(MET SG/24) of the Asia and Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG)**

Web Conference 16-20 Nov 2020

Agenda Item 5: Research, development and other initiatives related to implementation of meteorological service

Updates to tailored MET information supporting ATM

(Presented by Singapore)

SUMMARY

This paper presents the on-going collaborative study between Meteorological Service Singapore and Civil Aviation Authority of Singapore on the Meteorology – Air Traffic Management (MET-ATM) impact translation as part of the future plan to enhance the existing tailored meteorological information services to support ATM decision making and planning.

1. INTRODUCTION

1.1 Aeronautical meteorological (MET) information is a crucial element in ensuring flight safety and enhancing efficiency of air traffic management. Given that thunderstorms are a common weather phenomenon in the deep tropics and an aviation hazard, Meteorological Service Singapore (MSS) and the Civil Aviation Authority of Singapore (CAAS) have jointly collaborated to develop ATM-tailored MET information services and have been delivering a categorical forecast called 'Weather Window' since 9th July 2018. The 'Weather Window' provide forecasts of the occurrence of thunderstorms in a tabular format, and is delivered via a dedicated internet web portal for CAAS' Air Traffic Controllers.

1.2 As part of Singapore's continuous efforts to improve the provision of aeronautical meteorological services, the MSS and CAAS have been conducting a collaborative study on the translation of weather impact to support seamless ATM operations.

2. DISCUSSION

ATM-tailored MET information

2.1 The enhanced categorical forecast augments the provision of ICAO Annex 3 products and provides information on the forecast of the occurrence of thunderstorms and their areal extent in various

air traffic control (ATC) sectors for the next 24 hours. The varying temporal resolution within the forecast period balances the precision required and challenges in forecasting tropical convective weather. In addition, local knowledge and expertise of operational meteorologists remain essential and continue to be integrated in the analysis to enhance the accuracy of forecasts from numerical weather prediction (NWP) models.

2.2 The ATM-tailored MET information is made available through a dedicated internet web portal where there is an integrated view of current observations and 'Weather Window' forecast products to promote situational awareness for ATC, and to aid planning in other aspects of ATM such as air traffic flow management (ATFM). For ease of visualization, thunderstorm forecasts are also presented on geospatial maps. In addition, the visual interface on this web portal enhances interaction between the operational meteorologists and the air traffic controllers to establish a common appreciation of the weather situation, especially during daily weather briefings.

2.3 This suite of tailored MET information and services enable users to access vital information for capacity-assessment, in a timely manner which is a key component in efficient ATM operations.

Future Plan

2.4 While the 'Weather Window' products aids the air traffic controllers in making informed decisions, progressive enhancements can better support ATM operations. Hence, a two-part collaborative study between MSS and CAAS on impact translation had recently commenced. The study aims to establish a correlation between MET information (with focus on thunderstorms) and flight behaviour which can form an objective basis for ATM decision making. Each part of the study would be conducted independently of the other. The paragraphs below describe each part of the joint MSS-CAAS collaborative study with details in the appendix.

2.5 The first of the two-part study is to analyse the correlation between the occurrence of thunderstorms and its impact on ATC operations over the aerodrome. The approach to this

- Considers the aerodrome arrival throughput to the sector flow rate. It uses the declared, demand and operational throughput values in combination as an indicator of impact of weather. The severity of the impact will be determined in consultation with CAAS.
- Studies the occurrence of adverse weather phenomena over 'bottleneck' areas (defined to be areas where occurrences of adverse weather will cause great impact on ATM). These areas are strategically identified together with CAAS and will be constantly reviewed for an effective analysis.

2.6 The second part of the two-part study is to analyse pilots' response to thunderstorms to provide better insights of the impact of thunderstorms in en-route operations. The pilot's response to en-route thunderstorms can be interpreted via comparison of planned flight route (Filed flight plans) and actual flight route (surveillance data), with the focus on segments of the planned flight route with occurrence of thunderstorms.

2.7 A close collaboration between MSS and CAAS is expected as the expertise of both MET and ATM are essential for impact translation, particularly in addressing the challenges that may arise. Such challenges include:

i. *Modelling the complex ATM procedures:*
Deviation off intended route does not necessarily attribute to the presence of adverse weather since there are other possible contributing factors. Hence, the guidance from ATM

experts in CAAS is required for MSS to understand these procedures better and make appropriate assumptions to simplify the ATM procedures for the analysis.

ii. *Preparation of data:*
Familiarity with data formats from flight plans which are textual information about the flights including the planned route, surveillance data which consists of the recorded (actual) flight path (each position is reported in lat/lon and altitude) and MET data (such as RADAR and satellite data) could assist in the formation of the analyses information database. As respective agencies are the domain experts for their data set and operations, constant and close collaboration could accelerate the process of parsing and pre-processing of the data.

iii. *Harmonising MET information and air traffic data*
The methodology for analysing the impact is to investigate the correlation between the MET observations and air traffic data. Oversimplification in the methodology would lead to a less robust result while a complicated methodology would make the analysis difficult. Hence, it is crucial to constantly review the methodology and results for an effective analysis.

3. ACTION BY THE MEETING

3.1 The meeting is invited to note the information contained in this paper.

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APPENDIX

1. Analysis of the correlation between the occurrence of thunderstorms and its impact on ATC operations over the aerodrome

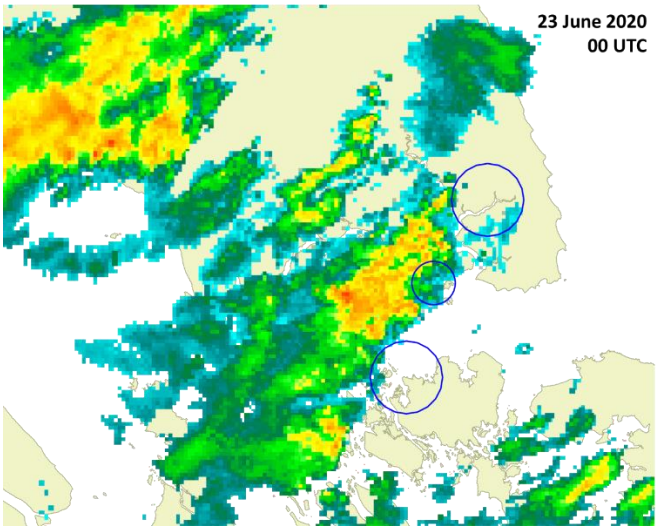

Figure 1: Example of adverse weather affecting Singapore

Figure 1 shows an example of adverse weather affecting Singapore, in particular areas of interest ('bottlenecks' as well as the aerodrome). The weather system will be analysed and its impact on the aerodrome arrival throughput to the sector flow rate will be investigated.

2. Analysis of pilots' response to en-route thunderstorms

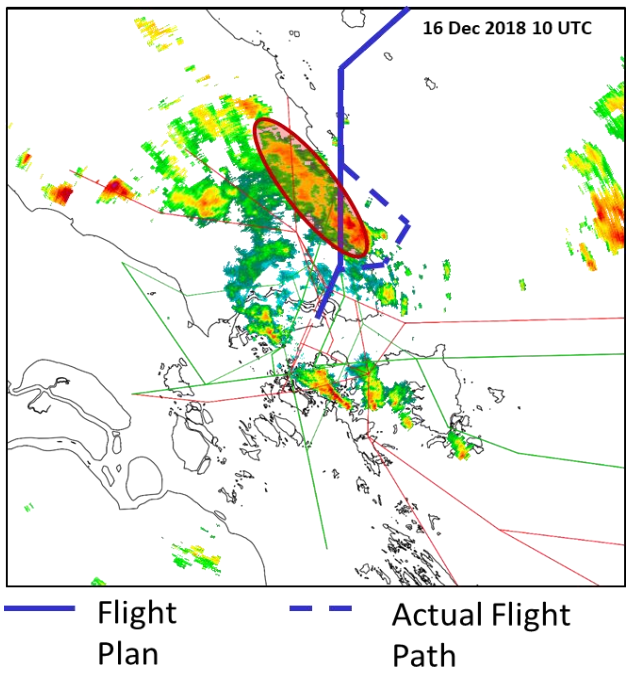

Figure 2: Example of a pilot encountering adverse weather

Figure 2 is an example where the pilot encounters en-route adverse weather. The pilots' response to en-route thunderstorms would be analysed. For instance, the likelihood of the pilot to request for a flight deviation (to take the dotted path as in the figure) would be studied.

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