International Civil Aviation Organization

INFORMATION PAPER

Twenty-fifth Meeting of the Meteorology Sub-group (MET SG/25)

Online, 18 – 22 October 2021

Agenda Item 5: Research, development and other initiatives

MET-ATM INTEGRATION INITIATIVES IN SINGAPORE

(Presented by Singapore)

SUMMARY

This paper updates on the initiatives undertaken by the Meteorological Service Singapore in strengthening Meteorology – Air Traffic Management (MET-ATM) integration to ensure continuous support in the safety and efficiency of air traffic in the region.

1. INTRODUCTION

1.1 Within the ICAO Annex 3 (Meteorological Service for International Air Navigation), it is stipulated for MET services to be provided in support of aerodrome operations (e.g., Aerodrome Forecast (TAF), Trend-type Landing Forecast (TREND), Aerodrome Warnings) and in support of FIR, regional and global operations (e.g., AIRMET/SIGMET).

1.2 However, MET services will need to evaluate the products and services required with reference to the unique needs of individual ANSPs. Meteorological Service Singapore (MSS) is regularly reviewing the requirements and priorities in the development of MET-ATM integration for the continual support of flight safety and efficiency in the region.

1.3 MSS and the Civil Aviation Authority of Singapore (CAAS) have jointly collaborated to develop ATM-tailored MET information services via a platform known as ‘Weather Window’ since July 2018. The ‘Weather Window’ supplements MSS’ suite of meteorological products that meet the ICAO Annex 3 requirements. Such products include forecasts of the occurrence of thunderstorms in various air traffic control (ATC) sectors, delivered via an internet web portal dedicated for CAAS in the provision of Air Traffic Services. This suite of tailored MET information and services enable users to access vital information to support decision making for pre-tactical Air Traffic Flow Management measures which is a key component in efficient ATM operations.

2. DISCUSSION

2.1 With technological advancements envisaged to enhance the air traffic management system capabilities, automation to provide better decision support tools will require the availability of more advanced, interoperable, timely and reliable information. Noting that aeronautical meteorological information remains as one of the key enablers of the modernised ATM system, MSS has been undertaking initiatives to strengthen MET-ATM integration.

Research and Development (R&D) efforts

2.2 The R&D projects support MET-ATM integration in several aspects including:

2.2.1 **Enhancing Forecasting Capabilities** – As tropical thunderstorms and its related phenomena such as turbulence pose a hazard to aviation, it is important to continue advancing the suite of forecasting tools to provide timely and reliable MET information. To address the challenges in forecasting tropical thunderstorms, MSS has been working on a multi-year project to develop a convective-scale high resolution Numerical Weather Prediction (NWP) model (SINGV) specifically for the tropics and a Nowcasting system to improve nowcasting capability for Singapore. SINGV provides weather forecasts up to 48 hours and the Nowcasting system adopts a radar-NWP blend approach providing nowcast of up to three hours. A version upgrade of SINGV was introduced in 1Q2021 with key changes in cloud microphysics and dynamics and improvements observed in convective rainfall and low-level wind forecasts. The on-going initiatives to enhance forecasting capabilities play a pivotal role in supporting ATM decision-making.

2.2.2 **Application of Machine Learning** – While there are advancements and improvements in NWP models, it remains a challenge to forecast tropical weather due to its dynamic nature. Apart from Human-in-the-loop (HITL) to value-add raw NWP output, machine learning algorithms have been explored to reduce forecasting errors in NWP outputs. MSS has also been strengthening its capabilities in data analytics, artificial intelligence/machine learning (AI/ML). MSS has embarked in developing AI/ML applications on HImawari-8 satellite imagery for automated, objective detection of aviation hazards, and the use of ML techniques to identify local weather regimes to improve weather forecasting capabilities.

2.2.3 **Impact Translation Study on En-route operations** – MSS commenced a joint-collaboration with CAAS in January 2020 to understand aircraft deviations in relation to en-route thunderstorms by analysing the planned flight route against the corresponding actual routes. The objective of the study is to provide better insights into the impact of thunderstorms in en-route operations. The study has fostered a closer collaboration between MSS and CAAS, with experts discussing and sharing knowledge and skills to address challenges such as modelling the complex ATM procedure, preparation of data, and harmonising MET information with air traffic data. The preliminary studies showed a good correlation between aircraft

deviations and presence of en-route thunderstorms. A more in-depth study with more data and finetuning is currently in progress.

Communication with users

2.3 It is crucial to effectively communicate and deliver the benefits of the developmental efforts to the stakeholders. These communication channels include:

2.3.1 **Operations** – A dedicated web portal, which provides an integrated view of the current observations and Weather Window forecast products which provide air traffic controllers with enhanced situational awareness of the observed and forecast weather conditions. This aids in their pre-tactical air traffic flow management planning. In addition, weather briefings via this web portal allows operational meteorologists and air traffic controllers establish a common weather situational awareness to effectively communicate and discuss the expected adverse weather that may affect air traffic control operations. Furthermore, a dedicated communications line has been established to facilitate timely exchange of information and enable quick responses to real-time issues and situations.

2.3.2 **User Engagements** – Regular meetings or workshop with stakeholders (such as CAAS) facilitate discussions to gather requirements and feedback. The discussions are opportunities for MSS and the stakeholders to share on respective MET and ATM development roadmaps for alignment and to synergise on the R&D efforts. Since early this year, a series of discussions/workshops has shown good progress in aligning requirements across stakeholders and in shaping the future R&D roadmap for MET.

3. ACTION BY THE MEETING

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

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