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 November 2020

Agenda Item 5: Research, development and other initiatives

DETECTION AND NOWCASTING OF THUNDERSTORMS WITH METEOROLOGICAL SATELLITE DATA FOR EN ROUTE AERONAUTICAL OPERATIONS

(Presented by Singapore)

SUMMARY

This paper outlines the ongoing initiatives undertaken at the Meteorological Service Singapore (MSS) in developing an automatic detection and nowcasting system for thunderstorms affecting en route aeronautical operations using high-resolution meteorological satellite data.

1. INTRODUCTION

1.1 Thunderstorms and the associated phenomena such as airframe icing, severe turbulence and lightning strikes are detrimental to safe operations of aircraft and pose immense challenges to efficient management of en route air traffic in congested airspace.

1.2 Aircraft often traverse oceanic airspace where ground-based observations are scarce. Hence, geostationary meteorological satellite data are particularly useful in this regard owing to their extensive geographical coverage.

2. DISCUSSION

2.1 In monitoring and forecasting thunderstorms affecting en route operations, an operational meteorologist typically identifies thunderstorms from the standard weather satellite data (e.g. infrared channel imageries, true colour imageries, etc.) and forecasts the short-term evolution of the thunderstorms based on the available weather observation and numerical weather prediction (NWP) model output.

2.2 To facilitate and streamline the aforementioned operational process, the Meteorological Service Singapore (MSS) has been developing a suite of products to provide automatic diagnostic assessment and prediction of thunderstorms. These are:

2.2.1 **Identification of Thunderstorms** – Algorithms were developed to automatically detect thunderstorms based on multi-channel data from the Advanced Himawari Imager (AHI) on the Himawari-8 satellite. The output of the product is a binary field of observed thunderstorms (see Figure 1 in the Appendix).

2.2.2 **Classification of Significant Convection** – By applying geospatial analyses on the thunderstorms identified in accordance to the criteria specified in ICAO Asia/Pacific Regional SIGMET Guide, Appendix I, polygons outlining thunderstorm systems that warrant SIGMET issuance and containing information such as the cloud top height and SIGMET-like messages are produced automatically (see Figure 2 in the Appendix).

2.2.3 **Nowcast of Significant Convection** – The observed binary field of thunderstorms is ingested into a nowcasting algorithm, of which the nowcast output is analysed and categorised into polygons of significant convection with information of speed and direction of movement (see Figure 3 in the Appendix). Further development and fine-tuning of the product will be conducted.

2.3 The suite of products has been integrated into MSS' operational data visualisation platform to provide real-time guidance to the operational meteorologists in their weather assessment and forecast. Feedback during the developmental phase has helped to further improve and fine-tune the products.

3. ACTION BY THE MEETING

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

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APPENDIX

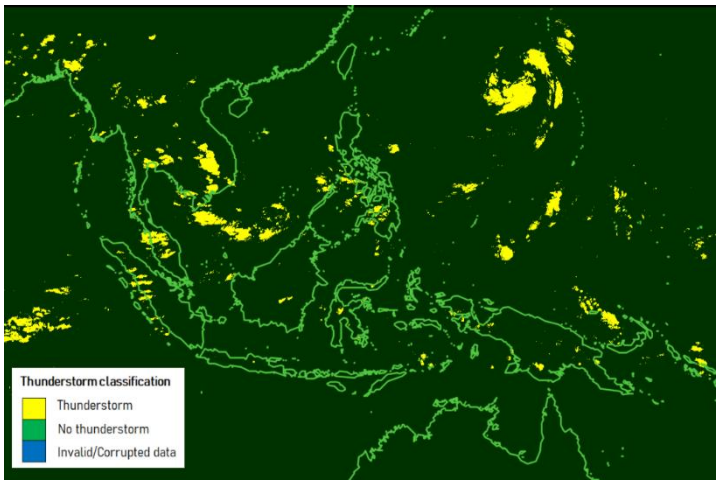

Figure 1 *SatTS – satellite data-derived binary observation of thunderstorms*

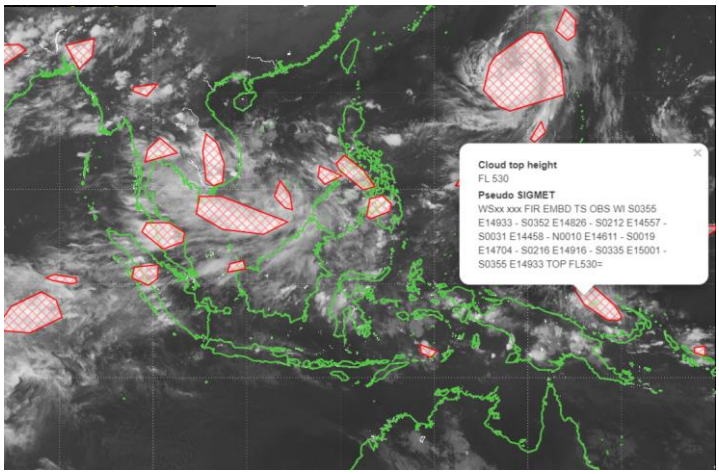

Figure 2 *SatSC – Polygons of significant convection that warrants SIGMET issuance and the associated cloud top height and SIGMET-like messages*

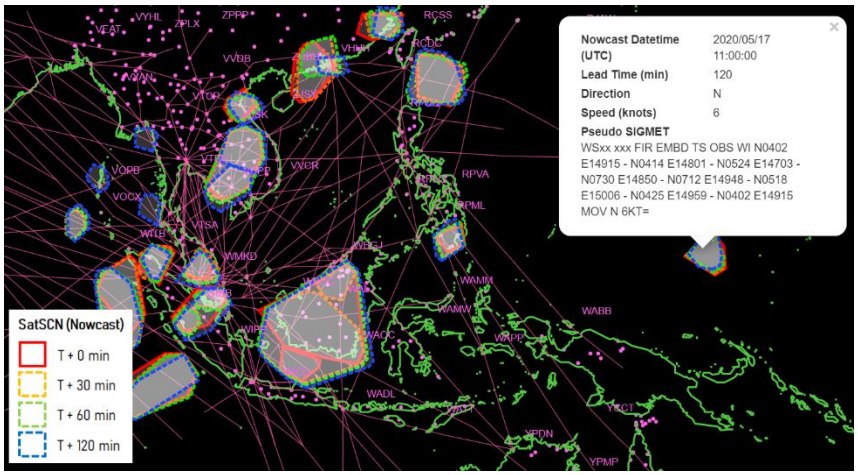

Figure 3 *SatSCN – Nowcast of thunderstorms in significant convection polygons and the associated speed and direction of movement*