International Civil Aviation Organization

INFORMATION PAPER

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Agenda Item 5: Research, development and other initiatives

AUTOMATED TAKE-OFF FORECASTS IN THE REPUBLIC OF KOREA

(Presented by the Republic of Korea)

SUMMARY

In order to prepare for the unmanned and automated future aviation system, the Republic of Korea is preparing to automatically produce and provide take-off forecasts based on multiple numerical weather prediction models.

1. INTRODUCTION

1.1 The Aviation Meteorological Office (AMO) of the Korea Meteorological Administration (KMA) produces and provides take-off forecasts at 13 airports in accordance with ICAO ANNEX3 6.4.

1.2 Since June 2023, AMO has been providing a pilot service to support the safety of take-offs and improve the efficiency of aviation weather services by automatically producing take-off forecasts and providing them to users.

1.3 This information paper introduces the development of an automated take-off forecasts service in the Republic of Korea.

2. DISCUSSION

Background

2.1 AMO provides take-off forecasts to 13 airports in the Republic of Korea, including Incheon, Gimpo, and Jeju airports. Currently, take-off forecasts are manually produced by forecasters every hour, which can sometimes lead to human errors, such as typographical errors or omissions. These errors may reduce the efficiency of work and the reliability of weather information. To address this, a take-off forecast guidance was developed based on multiple models, with the intention of automating the production and provision of these forecasts.

Multi-Model-Based Take-off Forecast Guidance Overview

2.2 Input data - Five types of numerical prediction models are utilized, including the global

model of the Unified Model (UM) by the Met Office, global model of the Korean Integrated Model (KIM) by KMA, UM local model, ECMWF, and Statistical Model (MOS), which serve as input data. Numerical prediction model data is produced four times a day (00, 06, 12, 18 UTC); however, only +00H to +14H prediction data is used. ECMWF and Statistical Model (MOS) production data is produced twice a day (00 and 12 UTC). Among the prediction data, +00H to +05H prediction data is used to calculate RMSEs and bias for each airport and weather factor by comparing observations.

2.3 Calculation method - Five predictive methods, such as weight application and deviation correction, are used for calculation, and the specific methods are as follows. The value with the minimum RMSE of each method is determined as the final predicted value.

Calculation Method	Explanation
ENS1	Model values with minimum RMSE for +00H to +05H predictions
ENS2	Value calculated by ENS1 method and corrected for deviation for each element
ENS3	Average with equal weight for each model prediction
ENS4	Model-specific predictions divided by weighting them according to RMSE
ENS5	Model-specific deviations calculated using the ENS4 method for corrected predictions
ENSB (Final Forecast)	Minimum value of RMSE in ENS1 to ENS5 methods

2.4 Utilization – The final predicted value, calculated by the supercomputer, is automatically transmitted to the take-off forecast input system and presented. In the event that the final predicted value differs from the current weather condition, it can be modified by forecasters.

Verification Results and Forecast Accuracy

2.5 Verification results - The verification method was evaluated using RMSE, and the verification period ranged from January to December 2022. The verification results of the comparison between the automated take-off forecasts and the forecasts issued by forecasters are as follows. For wind direction, wind speed, and temperature, the accuracy of the take-off forecasts issued by forecasters was slightly higher. However, the accuracy of air pressure was higher in the automated take-off forecasts.

RMSE	Wind Direction	Wind Speed	Temperature	Air Pressure
Multi-Model-Based Automated Forecasts	3.59	3.10	1.40	1.52
Forecasts by Forecasters	3.39	3.05	1.25	2.18

2.6 Forecast accuracy – The take-off accuracy of major international airports is as follows, based on the results of June 2023, calculated in accordance with ICAO ANNEX 3 Operatively Desirable Accuracy of Forecasts. Wind speed and air pressure were evaluated above the minimum reference value (90%). However, the accuracy of wind direction and temperature was the lowest, indicating a need for improvement. For other factors, it is considered possible to use the take-off forecast guidance.

June 2023.	RKSI (Incheon)	RKSS (Gimpo)	RKPC (Jeju)	RKPK (Gimhae)
Wind Direction	85.56	87.71	88.33	83.33
Wind Speed	92.22	98.19	92.60	91.58

Air Temperature	75.97	78.61	75.56	74.01
Pressure Value	94.86	92.64	90.97	93.33

Expected Effect

2.7 The aim is to reduce errors caused by human factors and increase work efficiency by automatically producing take-off forecasts. It also aims to provide consistently objective forecasts by reducing deviations caused by different forecasters issuing take-off forecasts. This is expected to contribute to supporting the safe operation of aircraft.

Future Plan

2.8 In 2023, automated take-off forecasting is being tested, and in 2024, the performance of the test operation will be analysed. Based on the analysed results, it will be regularly operated. In addition, we plan to continuously improve the calculation method to enhance the accuracy of the take-off forecasts.

3. ACTION BY THE MEETING

3.1 Note the information contained in this paper.

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