International Civil Aviation Organization

INFORMATION PAPER

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Twelfth Meeting of the Meteorological Requirements Working Group (MET/R WG/12)

Bangkok, Thailand, 02 to 05 May 2023

Agenda Item 3: Review of follow-up from previous meetings

THE IMPLEMENTATION EXAMPLE FROM NORTH CHINA FOR TAILORED METEOROLOGICAL INFORMATION AND SERVICES TO SUPPORT AIR TRAFFIC MANAGEMENT OPERATIONS

(Presented by China)

SUMMARY

This paper presents briefly the service system of aviation meteorology in China, and Tailored Meteorological Information and Services to Support Air Traffic Management Operations in North China and its post-assessment methods, hoping to support the post operational service analysis.

1. INTRODUCTION

1.1 The meeting is invited to consider formulating the following Decision in updating the *Regional Guidance for Tailored Meteorological Information and Services to Support ATM Operations*: MET/R WG/11–WP/05 point out MET/R WG/10 meeting suggested a task for the ad hoc group to consider expanding the MET-ATM Guidance to define a framework to capture the post operational analysis on the impact of tailored MET information on ATM decisions.

1.2 Decision MET/R WG/11/01：the MET/R WG members are invited to provide the ICAO RO MET, by 30 November 2022, their State's example on post-operational analysis to enhance the post-operational analysis framework in the MET-ATM Guidance. Therefore China Submit this paper, hoping to help ICAO RO MET to enhance the post-operational analysis framework in the MET-ATM Guidance.

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2. DISCUSSION

China Aviation Meteorological Service System

2.1 ATMB of CAAC include 7 regional ATMB which established 7 Regional Aviation Meteorological Center (RAMC): North China, Northeast China, East China, South China, Northwest China, Southwest China and XinJiang RAMC. The seven RAMCs are subject to the business management of the AMC of CAAC. Although the AMC of CAAC does not provide aviation meteorological services directly, it is responsible for providing support of data communication to regional meteorological centers and airport aviation meteorological offices (stations), issuing guidance products for national aviation weather forecast, exchanging aviation meteorological information at home and abroad and so on.

2.2 RAMCs and Airport Meteorological Office (Station) provide aviation meteorological services to users. The contents of the services include basic meteorological services in accordance with Annex 3 and tailored meteorological services according to users' needs. ATM is one of the main users, and whose need of products and services are tailored.

Aviation Weather Services Facing Air Traffic Management

2.3 RAMCs provide regional aviation meteorological services to regional ATM in their respective regions. Meteorological offices within the region not only provide meteorological services for tower controller, but also for terminal area used by the airports where they are located. If multiple airports use the same terminal area, for example, Beijing Capital International Airport and DaXing International Airport share the same terminal area, and Beijing Capital International Airport is responsible for the weather service in the terminal area, which mainly depends on the location of the terminal control department.

Meteorological Services for Regional ATM

2.4 The North China Aviation Meteorological Center, for example, first set up Meteorological Desk in hall of the North China ATM Center of in 2005. Forecasters provide weather forecast conclusions to the chief controllers of each sector at 7:00 AM, 11:00 AM and 17:00 PM (local time) every day, and introduce the regional weather according to different sectors. The main content of the weather conclusion sheet covers: the important dangerous weather forecast in the North China ATM area by the form of picture and text in next 12 hours; the main domestic airports weather forecast by the form of text. In addition, the on-duty forecaster provide round-the-clock face-to-face weather advice service from the regional controller, especially regarding the occurrence, development, movement and dissipation of thunderstorms.

Meteorological Services for Regional Tower Control

2.5 The meteorological service for tower control needs are obviously different from that of regional control. In addition to thunderstorm, another weather such as snowfall, low cloud, low surface visibility, changes in runway wind direction and speed, and runway status changes which would affect the operational strategy and airport efficiency. Therefore, it is not only pay attention to different meteorological elements, but also require the forecast products of high resolution and accuracy of spatiotemporal. In Beijing Capital International Airport , the North China Meteorological Center will not only provide weather phenomena and visibility forecast, but also provide forecast of change of wind, especially when the wind speed is greater than 5 m/s, direction change time will be provided to the tower controller, so as to help the controllers decide the direction of runway in-use.

Meteorological Services for Terminal ATM

2.6 Meteorological requirements of terminal ATM are more comprehensive than which for regional ATM and tower control. On the one hand, terminal ATM and regional ATM pay more attention

to thunderstorm weather, on the other hand, terminal control is connected with tower control, once the tower control strategy changes, the control strategy of terminal area will change accordingly. Terminal controllers will pay special attention to changes in meteorological factors which are of great concern to tower controllers, such as wind direction and speed of runway, snowfall, low cloud and low visibility, although which do not directly affect terminal control. Moreover, due to the airspace height limit of terminal ATM, wind shear and aircraft ice accumulation are high in the terminal ATM area. So terminal ATM not only controls more meteorological elements, but also requires high spatial and temporal accuracy.

2.7 Just for the above reasons, when the Terminal Management Center of the ATMC of North China ATMB put into use in 2019, the North China Aviation Meteorological Center set up a meteorological desk in the new Terminal Management Center to provide 24-hour face-to-face consulting services. In particular, the forecaster will attend the hand-over meeting of controllers, during the meeting forecaster will present the weather prediction of the terminal area and Beijing International Airport briefly.

Meteorological Services for Traffic Flow Management

2.8 In 2013, the concept of flow management was popularized in ATMB of CAAC. Regional ATMCs established their own traffic flow management departments, and meteorological information to support regional and airport flow assessment has become more important.

2.9 In long-term cooperation with traffic flow management, it is found that the flow management demand for meteorological services has two characteristics:

1. Since flow management often associate with hub airports, if the flight operation plan can be made well before passengers go to the airport and can be informed the passengers, the risk of passengers staying at the airport for a long time can be avoided and the experience of passengers can be effectively improved. Therefore, the early warning of important dangerous weather more than 6 hours in advance is urgently needed; and

2. Regional flow management is concerned with a larger scope and more elements, and its impact of weather is much higher than that of regional and terminal ATM.

2.10 So the weather service of flow management has become one of the most serious challenges for China's aviation forecasters. For presenting briefly the service system of aviation meteorology in China, and Tailored Meteorological Information and Services to Support Air Traffic Management Operations in North China and its post-assessment methods, hoping to support the post operational service analysis, a proposed draft of implementation examples from North China for incorporation in the MET-ATM Guidance was prepared and given in **Appendix A**.

2.11 The information provided in this paper, on China’s example on post-operational analysis on the impact of tailored MET information on ATM decisions, is intended to support the ad hoc group to enhance the MET-ATM Guidance, as invited by MET/R WG/11 in Decision MET/R WG/11/01: *Update the Regional Guidance for Tailored Meteorological Information and Services to Support ATM Operations*.

3. ACTION BY THE MEETING

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

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Appendix A Specific Implementation Example from North China

1. TAILORED SERVICES OF NORTH CHINA AMC FOR FLOW MANAGEMENT

1.1 Weather advice and interpretation

1.1.1 The Capital Airport Tower, BeiJing Terminal ATM Center, the North China Regional ATM Center and the Flow Management Office of the North China ATMB are located in different places, and the farthest distance is more than 15 kilometers. Due to the limitation of staffing, it is impossible to set up forecasting service desk in all places to provide face-to-face consulting services. Therefore, after 2020, the North China AMC would only retain the face-to-face service for flow management, and which in Terminal ATM Centers and Regional ATM Centers have been eliminated. But the demand for advice and interpretation services result in Collaborative Consultation Meteorological Service system. The system contains several video terminals, all users can participate in the video conference by the way of connecting the video terminals.

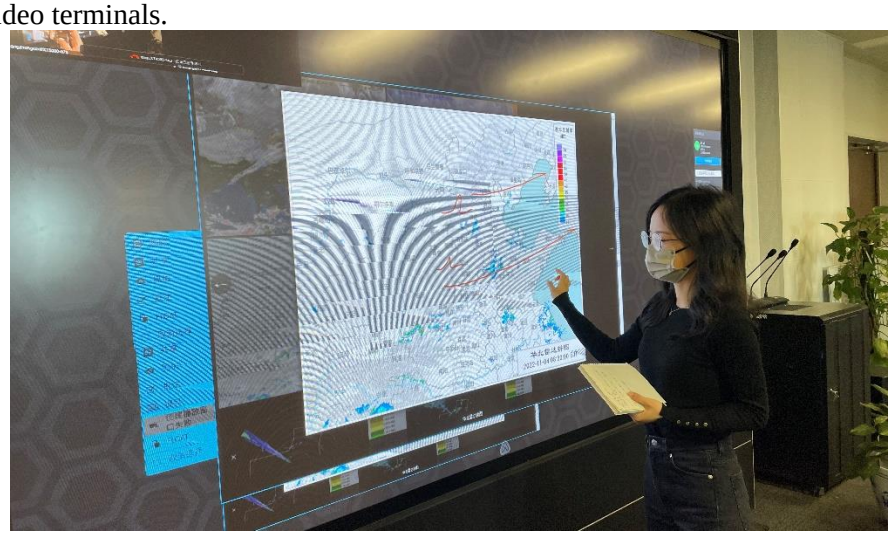

Figure 1. Routine Collaborative Consultation Meteorological Service meeting is taking place and the forecaster is presenting the weather brief.

The biggest highlight of this system compared with ordinary video conferencing is that all users can share one desktop, and everyone can touch the shared desktop to "mark" and "draw", to help everyone eliminate the communication barrier caused by network conferencing. For example, it is difficult to describe the movement of a weather system in words, but by drawing clouds on a satellite image to illustrate the speed of the movement, and then mapping the areas where the convection will occur in the future, the controllers and decision makers at the meeting can easiest understanding the forecast with no description. Not only that, when the controller asks questions, those difficult of remembering the position of navigational points is no longer a problem for the forecaster who only needs to answer the questions according to the position the controller draws. The system also sends live images of the attendees to other attendees' desktops, as if they were discussing issues around a conference table in the one conference room. This is the communication and electronic technology to bring convenience to our work.

The system is used to hold regular collaborative decision-making meetings twice a day, respectively at 9:00 AM and 13:30 PM. Besides the ATM users, the meeting include decision-makers from the Operation Control Center (AOC) of Beijing International Airport.

1.1.2 The Collaborative Consultation Meteorological Service system can only connect the ATM users and the AOC users in Beijing due to network security and link of lines. However, the regional flow management system must also comprehensively consider the operation of other airports in the region and the weather impact. Therefore, the flow management department has to hold North China Regional Flow Management Coordination Conference (FMCC) for all ATM departments of major

airports in the region every day. Although the conferencing system does not have "desktop interaction", its role in operation should not be underestimated. The routine meeting is held twice a day at 7:00 AM and 17:00 PM respectively. Different from the "Collaborative Consultation Meteorological meeting" in 4.1.1, which is initiated by the meteorological department, and the focus is to comprehensively understand the impact of the weather on the operation, the FMCC is initiated by the flow management department and uses the internal network of North China. Except for presenting weather information, the top of the agenda is making air traffic management strategy collaboratively to ensure flight safety and efficiency.

Figure 2. Routine North China Regional Flow Management Coordination Conference: a) Video conference screen; b) Regional forecast auxiliary display at FMCC, the impact of thunderstorms on key air routes is clearly marked

Another point to note is that when significant changes of the weather occur or are expected to occur, besides the routine meetings above, the Collaborative Consultation Meteorological meeting and North China Regional FMCC can be held at any time just according to the need. The North China Regional FMCC can even maintain a long-term connection state, and any participant can, whenever he/she needed, exposit requirements to the meeting.

1.1.3 There is also interim conference when significant weather events are expected to occur. The conference is jointly initiated by the ATM department and the airport AOC, using external network. Participants including the ATM department, the AOC of Beijing Capital Airport and the airlines. The forecast will first make a detailed explanation of the situation and important impact of weather changes, and then the flow management will put forward the preliminary restriction strategy, the airlines will negotiate with the AOC to decide the flight reduction plan.

1.2 Meteorological Tailored-service For Flow Management

1.2.1 Convective Cooperative Forecast Products（CCFP）

At the beginning of the establishment of the Flow Management Office in North China in 2013, there were almost no meteorological tailored products and services, so it was urgent to develop meteorological support products for flow management. Within a short time, CCFP were put into operation. Based on the numerical model, the product was released in the form of graphics and annotated text, mainly including the location, scope, coverage, top height, development trend, moving direction and speed of the convective cloud in the region.

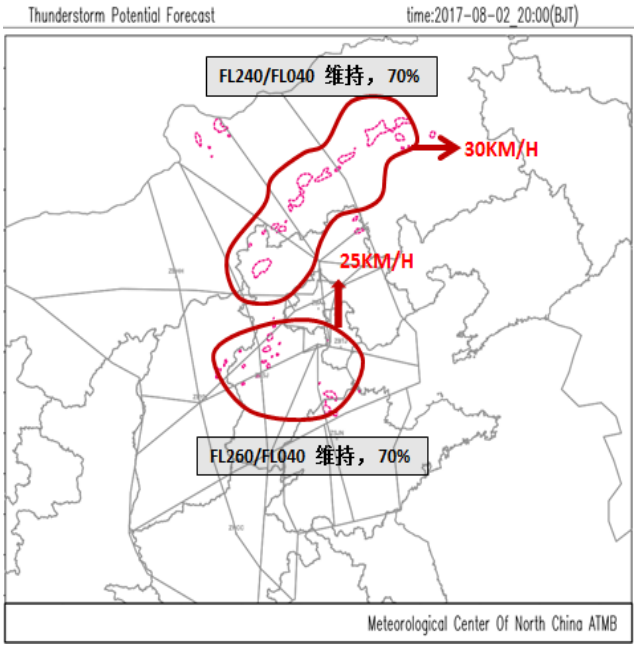

Figure 3. Convective Cooperative Forecast Products of Sup.2 2012. Areas circled pink-line present echoes with intensity greater than 35dBz which come from NWP. Areas circled red-line present echoes with intensity greater than 35dBz which come from forecaster. The text in the box indicates the top and bottom heights, development status and coverage probability of the storm clouds.

1.2.2 Probability Notification of significant weather that trigger MDRS (Massive Delay Response System)

Before 17:00 p.m. every day, forecaster will routinely fill Probability Notification of Significant Weather that trigger MDRS, and the valid time will cover 0-54 hours (17:00 on the same day to 23:00 on the third day). It will not only be uploaded to the Civil Aviation Meteorological Center through the network, but also be informed to the Civil ATM Operation Control Center, and be provided to the flow management of the North China ATMC enter. If the Probability Notification needs to be revised, it can be revised at 22:00 p.m. of the same day and 7:00 a.m. and 10:00 a.m. the next day. If there is a sudden change of conclusion, it can also be revised at any time. However, only the Probability Notification issued at 17:00, 22:00, 7:00 and 10:00 should be evaluated.

MDRS重要天气发生概率通报表

地区:华北地区　　制作时间：2022年06月12日16时14分

机场四字代码	重要天气及强度描述	出现时段	影响方位、范围和覆盖率	重要天气发生概率	备注
ZBAA	首都机场雷雨	12日20时-24时 13日18-21时	首都机场	≥70%	
	北京终端区雷雨	13日04时前； 13日15-22时；	13日04时前终端区自西向东带状雷雨回波，覆盖率25%； 13日15-22时终端区自西向东带状雷雨，覆盖率15%	≥70%	
ZBAD	-tsra	12日21时-13日01时	大兴机场	≥70%	
	-tsra	13日16时-19时	大兴机场	≥70%	
ZBTJ	中雷雨	12日23时-13日04时	本场及整个进近区，覆盖率70%	≥70%	01-04时可能会有短时强雷雨（30%-40%概率）
ZBYN	机场雷雨	13日16：00-19时	机场雷雨	≥70%	

Figure 4. Probability Notification of significant weather that trigger MDRS on June 11, 2022. Table mainly contents: airport code, SIG weather and intensity, occurrence and duration, coverage direction and area, coverage probability, occurrence probability.

Figure 4. is the Probability Notification of significant weather that trigger MDRS, which released at 16:09 on June 11, 2022. Major airports in China will release this product. The Notification includes: the area of influence, time of occurrence and duration, characteristics and influence process, occurrence probability of significant weather, and some supplementary information. Probability Notification is the main basis for the ATM to flow management due to weather.

1.2.3 The North China Meteorological Centre Rapid Refresh Predict System (NCM-RAP)

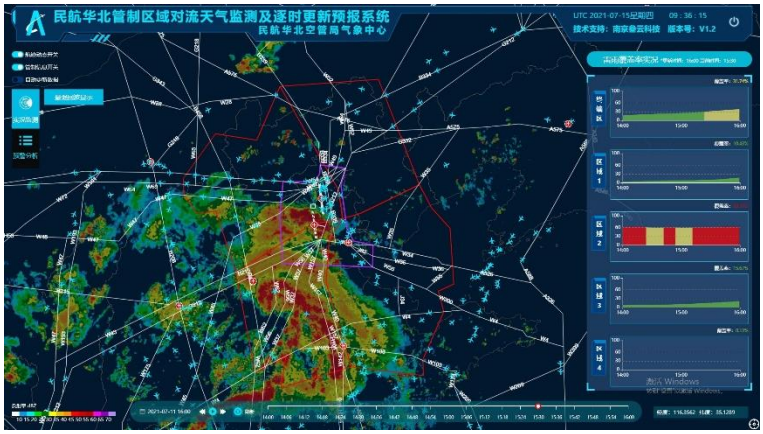

Figure 5. Last upgrade of The North China Meteorological Centre Rapid Refresh Predict System. The right graphics shows the echo coverage probability in the KMA, red indicates echoes with high intensity.

Up to now, The NCM-RAP has been running stably for more than 7 years since 2015 (The development process of the system can be seen in MET/R WG/11 -- IP/06). In 2021, the system interface was upgraded again, as shown in Figure 5. The new interface has three important upgrades over the old version: First, the new interface adds concatenation of 26 radars echo images in North China; second, the real-time track information is superimposed; Thirdly, according to the gridded flyover scheme which was established by North China ATM Center, the Key Management Areas (KMA) in North China are redefined, and the thunderstorm coverage probability in the KMA is provided and displayed by diagram. This system can not only be updated hour by hour to forecast the changes of thunderstorm echoes in 0-9 hours by 6 minutes interval, but also can calculate the coverage rate of echoes with intensity greater than 35dBz in the KMA at interval of 6 minutes.

The results of system come from numerical model, it can provide the basis for continuous decision-making. However, it is just like all numerical forecasting products, there is also a problem of accuracy, so the current application of the system by the flow management is still limited to the selective reference use under the revised guidance of the forecaster, which is also a supplementary service for Probability Notification in summer.

2. POST-ASSESSMENT OF TAILORED-SERVICE FOR FLOW MANAGENMENT BY NORTH CHINA AMC

2.1 POST-ASSESSMENT OF CCFP

As CCFP was gradually replaced by the NCM-RAP, the post-assessment of CCFP had been broken up. Before 2017, the North China AMC evaluated the forecast accuracy of CCFP every year. The post-assessment takes thunderstorm occurrence in Capital Airport as the assessment sample, and then makes subjective evaluation by comparing the CCFP with the real radar images. It can be seen that this post-assessment has two main shortcomings: 1) lack of objectivity, and there was no assessment of the empty-forecast case; 2) lack of the participation of the ATM, and the supports of the flow management was not taken into account.

2.2 POST-ASSESSMENT FOR ANOTHE PRODUCTS AND SERVICES

In Section 4 above, it presents that the NCM-RAP, Weather advice and Probability Notification how to supporting flow management. In summary, forecasters release Probability Notification after data analysis, and then evaluate the availability of information provided by NCM-RAP, in order to help the ATM get the most accurate and direct meteorological auxiliary decision information within the scope of forecasters' ability. After integrating the information, the flow ATM decide the traffic management strategy and input it into the traffic flow management system to complete a traffic management process.

Therefore, it is difficult to objectively evaluate the process of comprehensive meteorological service for flow management.

At present, during the thunderstorm season (June-August), the North China ATM Center will hold a review meeting weekly, and the important issue of the meetings is to review and evaluate the meteorological service of the week. If there is a significant weather that seriously affects the regional flow, the meeting will review comparatively the flow management strategies and meteorological services during weather processes, focusing on evaluating whether Probability Notification, weather explanation services and NCM-RAP of key nodes of meteorological services play a positive role in flow decision-making or not. When they do not play a positive role, the meeting will identify the problems of the meteorological and ATM departments by founding out the direct causes, and then improve the work on the basis of communication. In particular, the meeting will be attended by all the ATM departments of the North China ATM Center, including regional, terminal, tower and flow controllers.

In addition to the review meeting in North China, the Operation Control Center of the ATMB of CAAC, which is the brain of the national flow management, also holds the National Flow Operation Coordination Meeting every week to review the events and weather that affected the traffic flow in the previous week nationwide. For typical cases (successful and failed), the Regional ATM Center and the corresponding meteorological service department would be invited to do the flow management and meteorological service process review.

3. SUMMARY

3.1 There are two main post-assessment methods at present. One is the assessment of forecast accuracy in the meteorological field, the biggest shortcoming of this assessment is that not thinking of service effect. The other is the assessment of the service effect in the form of a review, the biggest disadvantage of this assessment is that there is no objective standard.

3.2 The post-assessment in the form of review is mainly because the meteorological auxiliary decision-making information is not connected to the flow management system in an objective form, so it cannot be evaluated objectively.

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