INTERNATIONAL CIVIL AVIATION ORGANIZATION

ASIA/PACIFIC REGIONAL GUIDANCE FOR TAILORED METEOROLOGICAL INFORMATION AND SERVICES TO SUPPORT AIR TRAFFIC MANAGEMENT OPERATIONS

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[Adopted by MET SG/26, Decision MET SG/26/02: *Update to Regional Guidance for Tailored Meteorological Information and Services to Support ATM Operations*]

RECORD OF AMENDMENTS AND CORRIGENDA

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1. INTRODUCTION

1.1. Purpose and overview of the guidance

1.1.1. This guidance aims to foster States' implementation and enhancement of meteorological (MET) information and services for air traffic management (ATM)[1] within Asia/Pacific (APAC) region.

1.1.2. The guidance captures most of the necessary processes from preparatory to operational phases. Furthermore, it provides detailed operational services, with specific examples and an operational scenario on ATM-tailored MET information and services. Information in this guidance can also be used to facilitate further improvement by the States who have already implemented ATM-tailored MET services.

1.1.3. A stepwise (process-wise) structure of the guidance is expected to allow each State to refer to chapters, sections or subsections useful for the commencement, implementation or improvement of its MET information and services to support effective ATM.

1.2. Development of the regional implementation guidance

1.2.1. ICAO APAC Meteorological Requirements Task Force (MET/R TF) 4th meeting, held in July 2015 in Tokyo, noted that so-called 'ATM-tailored' MET information, when provided to support international air navigation, is still required to comply with the Annex 3 - Meteorological Service for International Air Navigation, 'General Provisions'. However, the detailed technical specifications for the information has not yet been specified in Annex 3. The meeting also noted that specific regional guidance material is necessary to assist States in developing and implementing tailored meteorological information and services to support effective ATM and agreed to develop the regional guidance material.

1.2.2. An ad-hoc group consisting of Australia, China, Hong Kong, China, Japan (rapporteur), New Zealand, Republic of Korea, Singapore, Thailand and Vietnam was tasked to develop a regional guidance material for tailored meteorological information to support ATM operations.

1.2.3. Detailed historical background of efforts for implementation and enhancement of MET information and services for ATM in APAC Region is described in section 1.4.

1.3. Importance of ATM-tailored MET information and services

1.3.1. With unprecedented growth in air traffic movements in the Asia/Pacific Region, ATM is paramount for the continued assurance of safe, efficient and timely aircraft operations. Recognizing the importance, various States have continued to evolve their ATM systems and procedures to meet the growing demand and to maintain safety as the priority. Additionally, neighbouring States are increasingly collaborating on activities such as Air Traffic Flow Management (ATFM2), which are enhanced by the incorporation of dedicated support from MET services.

[1] ATM is defined in PANS-ATM (Doc 4444) as follows: The dynamic, integrated management of air traffic and airspace including air traffic services, airspace management and air traffic flow management – safely, economically and efficiently – through the provision of facilities and seamless services in collaboration with all parties and involving airborne and ground-based functions.
[2] ATFM is defined in PANS-ATM (Doc 4444) as follows: A service established with the objective of contributing to a safe, orderly and expeditious flow of air traffic by ensuring that ATC capacity is utilized to the maximum extent possible, and that the

1.3.2. Information sharing and collaborative decision-making (CDM) by relevant stakeholders are indispensable for the successful provision of effective and efficient ATM. Aircraft operations are influenced by atmospheric conditions and meteorological phenomena, and so adverse conditions can have a significant impact on ATFM planning and provision.

1.3.3. In APAC, we experience diverse weather features on a daily basis as the region is influenced by climates varying from tropic to sub-polar and is further complicated by geography including both broad land masses and wide oceanic areas. It is therefore critical that the region's ATM, and particularly ATFM operations are supported by tailored MET information and services to ensure safe, efficient and orderly aircraft operations.

1.4. Historical background

1.4.1. Since ICAO endorsed the Global Air Traffic Management Operational Concept (GATMOC, Doc 9854) in 1996, States have worked on the enhancement of ATM. In the APAC Region, since the late 1990s, ATM (and ATFM) has evolved significantly in many States. Subsequently, tailored MET information and services has been recognised as critical information for the effective provision of ATM and subsequently has been incorporated as part of the strategic and tactical ATM operations of those States. For example, in Japan, the Air Traffic Meteorology Center (ATMetC) of the Japan Meteorological Agency (JMA) was established in February 2006, as a specialized MET service provider for the Air Traffic Management Center (ATMC) of the Japan Civil Aviation Bureau (JCAB).

1.4.2. In 2001, the ICAO APANPIRG Communications/Navigation/Surveillance and Meteorology Sub-Group (CNS/MET SG) formed the MET/ATM Task Force (TF) to facilitate regional implementation of meteorological services in support of ATM. The first Regional MET/ATM Seminar was held at the ICAO Regional Office in Bangkok, Thailand, in February 2006. In order to enhance regional implementation, in 2009, APANPIRG agreed to call for the 1st meeting of the MET/ATM TF3 to plan the 2nd Regional MET/ATM Seminar and TF Meeting in the 2010 timeframe. In February 2011, the Seminar and the 2nd meeting of the TF were held in Fukuoka, Japan, where experts from MET, ATM and other international organizations in the APAC region gathered to discuss their plans and best practices on the development and implementation of meteorological services in support of ATM. The meeting also included a technical tour to the ATMetC to provide an example of the collaborative work undertaken between MET and ATM organisations. Subsequent TF meetings, and later the MET/R Working Group, successor to the MET/ATM TF, continued the important work of developing regional guidance to assist Asia/Pacific States with implementation or improvement of MET information and services to support ATM.

2. IMPLEMENTATION PROCEDURES

2.1. Preparatory phase (processes toward implementation)

Communication channel establishment

2.1.1. The most important step in the implementation of ATM-tailored MET information and services is to establish a good communication channel for mutual collaboration between MET

traffic volume is compatible with the capacities declared by the appropriate ATS authority.
[3] Meteorology/Air Traffic Management Task Force

and ATM organizations through periodic meetings, tours to each operation room and so on. To develop and facilitate an implementation plan, it would be useful to exchange views and information and build mutual understanding of each other's services, through regular consultations and meetings with clear focus.

2.1.2. In addition, consultation with collaborative decision-making (CDM) stakeholders from the initial stage will be desirable for smoother and better planning. This will further assist in the implementation process, given that CDM is an essential element in the ATM operational concept and concerned parties including airspace users[4], such as major airlines, are encouraged to participate in CDM.

Service Identification

Understanding ATM and aircraft operations

2.1.3. ATM operations vary in each State depending on its technical capabilities and characteristics of their responsible airspace. Better understanding of the State's ATM system is necessary to determine the scope of MET information and services to support ATM. This aspect will assist in understanding the local ATM requirements and determining the most appropriate process.

2.1.4. Additionally, procedures for aircraft operations adopted by airlines are also important in defining ATM-tailored MET information and services. The safety and efficiency of aircraft operations are fundamentally dependent on weather conditions. For example, each aircraft has maximum crosswind threshold values for take-off and landing. Adverse weather conditions may force aircraft to fly irregular flight routes and conduct unusual operations, which could result in significant diversion from the normal and planned distribution of air traffic. In this context, understanding aircraft operational procedures is helpful in designing a fit-for-purpose MET information and services**.**

Past Events and Case Studies

2.1.5. Investigation of MET-related impacts on air traffic flow is essential to determine what kind of MET information and services are required to effectively support ATM. One practical approach, in cooperation with airlines, is to compare operational records (including causes of delay, if available) with past weather data.

2.1.6. Once ATFM is implemented, focus could be on more direct ways to use the flow management records in the ATFM process in addition to the aircraft operations records for the comparison with past MET data.

Service proposal (Proposal from MET organization)

2.1.7. Through the process mentioned in 2.1.3. to 2.1.6., it is expected to obtain better understanding of the ATM processes based on aircraft operational procedures and possible weather impact on air traffic flow. The next step would be to develop a draft plan for MET information and services in support of ATM and to provide a proposal to the ATM organization.

[4] Airspace users is defined in Global Air Traffic Management Operational Concept (GATMOC) (Doc 9854) as follows: The term airspace users mainly refers to the organizations operating aircraft, and their pilots.

The proposed plan could be conceptual process with specific explanation and prototypes of MET information or services, should be sought on the proposal.

Service development (Requirements from ATM organization)

2.1.8. With the feedback from the ATM organization described in 2.1.7., the MET and ATM organisations could modify and make necessary changes to the proposed plan. This will ensure that both parties (MET and ATM) are aware of the requirements and limitations and are able to adopt a practical plan for the region. This would be an iterative process, until the proposed plan for MET information and services becomes matured.

Service definition

2.1.9. Once the proposed plan is mature, the provision of MET information and services in support of ATM can be formalized. The plan should also describe how the ATM tailored MET products will be utilised in conjunction with the other MET products, are made available to the airspace users in a timely fashion so that all stakeholders are in possession of the same information at the same time. It may be that bespoke MET information solutions, tailored to the specific ATM service provider, are also made available to the airspace users as part of CDM arrangements.

System development

2.1.10. The next step is to develop a system and associated software applications necessary to provide ATM-tailored information and services defined in section 2.1.9.
2.1.11.

Trial run of the system and service

2.1.12. It is essential to conduct a trial of the system and procedures to test secure delivery of the defined MET information and services. If any issues are identified through the trial, they should be resolved through close consultation with the stakeholders concerned (mainly the ATM organizations), before the service becomes operational. In addition, the trial process will assist in determining the system reliability. The outcomes of the trial and lessons learnt should be well documented to assist with future requirements.

Service provision agreement

2.1.13. In parallel with the system development, to ensure that continuous provision of the defined MET information and services is maintained, it is important to formalize a written agreement (or to amend an existing agreement, if applicable) between the MET and ATM organizations. The Agreement should include the MET and ATM capabilities, and outline the operational processes, the working relationship and the communication channels. When such an agreement is later implemented with airlines or other stakeholders, existing agreements should also be amended accordingly.

2.2. Operational phase (processes for continuous improvement)

Operational trial

2.2.1. Before MET information and services are provided operationally, an operational trial should be conducted so that forecasters and ATM officers can familiarize themselves with the provision and usage of the new information and services. The trial period should be set based on

agreement between the parties concerned. A post implementation of the operational trial should be conducted to ensure lessons learned from the process are documented and improvements are made prior to implementation.

Provision of MET information and services

2.2.2. MET information and services developed according to the process described in 2.1 are provided to ATM officers in accordance with the service provision agreement between the MET and ATM organizations.

Verification and evaluation

2.2.3. After the implementation of ATM-tailored MET information and services, it is required to regularly verify and evaluate its quality to ensure that it practically supports ATM. Also, when a meteorological condition has a significant impact on ATM, it is also recommended that stakeholders conduct a post-event analysis to identify lessons learnt.

Continuous improvement

2.2.4. Regular evaluation meetings between relevant parties such as airspace users, ATM and MET organizations are one of the basic approaches to continuously improve the implemented information and services. These meetings should draw from the results of verification and evaluation as well as lessons learnt from significant events, to identify changes and innovations to continually improve MET information and services.

3. MET INFORMATION AND SERVICES IN SUPPORT OF ATM

3.1. Introduction

3.1.1. In this chapter, some examples of MET information and services that are effective for supporting ATM operations are discussed. As it will require budget, resources, technology, and time to introduce relevant MET information and services, some of which may not be defined in ICAO Annex 3, it is worthwhile to consider implementing them in a stepwise manner, depending on the situation in each State.

3.1.2. Examples of MET information and services for ATM in some States are described in Appendix 1. In addition, operational scenarios of MET/ATM collaboration, such as how MET information and services are provided to ATM officers, are described in Appendix 2.

3.2. Participation of MET organizations in CDM

3.2.1. CDM is an approach where relevant stakeholders share necessary information in order to make decisions collaboratively to enable enhanced ATM operations. This process involves a collaboration of stakeholders to generate products suitable for better pre-tactical traffic management strategies and optimised use of available capacity. The expected role of a MET organization in CDM is for aviation forecasters with an understanding of the effects of meteorology on ATM to provide necessary meteorological information at and around relevant aerodromes and air routes in a timely manner.

3.2.2. To achieve effective CDM, aviation forecasters should have a basic understanding of ATM and Air Traffic Control (ATC) procedures, such as, inter alia, runway weather minima and

aircraft operating criteria so that they would be able to foresee aviation impacting weather and provide appropriate briefings to ATM and ATC in a timely manner.

3.2.3. Where an event or phenomena has a significant impact on normal air traffic flows (e.g.: mass deviation of aircraft), it is vital to ensure that common situational awareness is maintained at all times among affected stakeholders. Rapid identification of the possible cause of such a situation (e.g. adverse meteorological conditions, runway closure) allows both ATM and MET organizations to take immediate action in a collaborative manner to mitigate the impact.

3.3. Weather briefing in support of ATM

3.3.1. Direct weather briefings for ATM officers is an effective method to share current and expected weather assessments in and around major aerodromes and air routes, including any expected impacts on aircraft operation and air traffic flow.

3.3.2. Regular weather briefings in support of ATM may be provided several times per day. Depending on rostered shift arrangements in ATC centres, MET briefings may be scheduled for groups of controllers just prior to commencing their operational duty.

3.3.3. Where unexpected weather phenomena may affect aircraft operation and/or air traffic flow, or the actual weather deviates significantly from that forecast, a special briefing should be provided by aviation forecasters. Special briefings can be either proposed by aviation forecasters or requested by ATM officers.

3.4. ATM-tailored meteorological information

Impact-based weather information

3.4.1. Tailored MET information that shows possible impact on air traffic flow (e.g. when and where the weather phenomenon affects air traffic flow) can be useful to support the management of air traffic capacity in each ATC sector and execution of air traffic flow controls.

3.4.2. Information that is relevant to the impact to air traffic flow will be extremely valuable; for example, a probabilistic forecast of impact to ATFM may provide a quantitative estimate of reduction in air traffic capacity. To develop such impact-based information, consensus among stakeholders has to be developed regarding relationships between specific meteorological conditions and their possible impacts on air traffic flow.

Information for common situational awareness

3.4.3. It would be helpful for ATM representatives and other relevant stakeholders to understand the background of relevant meteorological conditions (e.g. occurrence process and characteristics), as well as the associated forecast confidence, which would facilitate risk assessment to enable more effective and efficient ATM operations. It is desirable to provide relevant graphical information which can explain meteorological conditions effectively, such as pressure distribution charts, weather radar and satellite imagery, and/or weather advisories with simple associated descriptions.

3.5. Information and products developed for other use

3.5.1. Existing meteorological information may also be useful to support ATM. Some examples are listed below:

- Operational meteorological information (OPMET)
- Volcanic ash advisory (VAA) and tropical cyclone advisory (TCA)
- World Area Forecast System (WAFS) products, i.e., Wind and Temperature (WINTEM) chart, Significant Weather (SIGWX) chart, and gridded global forecast of wind, temperature, cumulonimbus clouds, icing and turbulence
- Real-time observational data at congested aerodromes
- Weather radar imagery
- Specific phenomena based information, such as thunderstorm and lightning information
- Satellite imagery and derived products
- "Nowcasting" products
- Numerical weather prediction data and derived products
- Earthquake and tsunami information
- Space weather information

3.6. Means of provision

Dedicated information sharing system

3.6.1. To facilitate CDM, information sharing among all relevant stakeholders in MET and ATM is necessary, to ensure common situational awareness is maintained. In order to support ATM operations, a system should be acquired or developed which enables ATM officers to utilize MET information at any time. Similarly, aviation forecasters need an environment through which they can look at ATM-related information to provide appropriate MET information. It is thus required that dedicated systems for information sharing between MET and ATM organizations be established, so that ATC officers and aviation forecasters can effectively exchange information operationally.

Means of communication

3.6.2. Listed below are some examples of how ATM stakeholders can communicate and share necessary information:

- The aeronautical fixed service (i.e. AFTN/AMHS)
- Hotline (direct phone line)
- Web-chatting system
- Telephone or video conference system
- Use of common CDM software/application
- Joint use of an operation room
- Information sharing web-portal

4. FUTURE PROGRESS IN MET/ATM SERVICES

4.1. Global Air Navigation Plan (GANP)

4.1.1. In 2014, the 38th Session of the ICAO Assembly amended the Global Air Navigation Plan (GANP) and formulated the Aviation Systems Block Upgrades (ASBUs), the implementation plan of the GANP, as proposed by the twelfth ICAO Air Navigation Conference (AN-Conf/12). The ICAO Meteorology Panel (METP) was established in September 2014 is

tasked with providing standard and recommended practices for MET information and services in support of ATM for the terminal area and in line with the aviation system block upgrades (ASBU).

4.1.2. In the future, States in a position to do so would be required to provide ATM-tailored MET services based on globally consistent requirements. Since this global standardization is being welcomed among users such as airlines and pilots, the States in the APAC Region may adapt their systems accordingly when such standards are available.

4.2. Future integration of MET information into ATM decision-making

4.2.1. The ICAO Air Traffic Management Requirements and Performance Panel (ATMRPP), in coordination with the METP and other panels concerned, has discussed future integration of MET information into ATM decision-making system, along with the Global Air Traffic Management Operational Concept (GATMOC) (ICAO Doc 9854). The "Concept for the integration of Meteorological information for ATM" has been developed by the ATMRPP and other bodies concerned. It provides guidance on methods and procedures to interpret MET information as it relates to possible constraints on air traffic flow. It supports estimation of the potential impact of the meteorological condition to ATM and provides ATM officers with possible actions to be taken, e.g. selecting the safest routes while minimising diversions.

4.3. Next generation air transportation system developments

4.3.1. To deal with growing air traffic congestion, some States or Regions have been planning the development of next generation air transportation systems. These include NextGen[5] (United States), SESAR[6] (Europe) and CARATS[7] (Japan). It is important for MET organizations to make the best effort to improve their capability in the provision of MET information and services to meet such future requirements and facilitate the development of a new generation air transportation system.

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[5] Next Generation Air Transportation System
[6] Single European Sky ATM Research
[7] Collaborative Actions for Renovation of Air Traffic Systems

REFERENCES

- ICAO Annex 3 – *Meteorological Service for International Air Navigation*
- ICAO Doc 9854 – *Global Air Traffic Management Operational Concept*
- ICAO Doc 9377 – *Manual on Coordination between Air Traffic Services, Aeronautical Information Services and Aeronautical Meteorological Services*
- ICAO Doc 4444 – *Procedures for Air Navigation Services, Air Traffic Management*
- ICAO GANP Portal (https://www4.icao.int/ganpportal/)

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NOTES FOR APPENDIX 1 AND APPENDIX 2

a) The example from each State for Appendix 1 should follow the format below:

1) ATM-tailored MET information and services
- MET information and services for ATM, excluding OPMET information.
- One sub-section for each MET information and service, e.g.: Dedicated MET information; Participation in CDM; Briefing for ATM officers; etc.

2) Means of Provision
- Means of MET information provision for ATM officers, such as dedicated information provision system.

3) Other useful information (if any)
- Collaboration with ATM officers for MET information and/or services improvement (e.g. regular meeting, collaborative post event analysis).
- Verification of MET information described in section 1) ATM-tailored MET information and services.
- Implementation history of ATM-tailored MET information and services, including how long it took to implement such information and services.

b) Number of pages in Appendix 1 and Appendix 2

- Each State's example for Appendix 1 should be up to four (4) pages. Five (5) pages are allowed in the cases that the post-operational analysis is included in the contents.
- To avoid increasing the pages, states are encouraged to provide general and/or essential information.
- States may include links to WPs/IPs and/or their public website in their examples to show supplemental or advanced information.
- The operational scenario from each State for Appendix 2 should be up to four (4) pages.

c) Maintenance procedure for Appendix 1 and Appendix 2

- States that wish to add or update their own examples or operational scenarios in Appendix 1 and Appendix 2 should submit detailed proposals (describing the drafts of examples or operational scenarios) in the form of working papers for discussion and adoption by the MET/R WG8.
- The designated ad hoc group of the MET/R WG will then consolidate the adopted changes and seek the MET SG's[9] endorsement for updating the guidance.

d) Means of publication of Appendix 1 and Appendix 2

- Each example and operational scenario in Appendix 1 and Appendix 2 is published on the ICAO APAC website (APAC eDocuments), in separate PDF files considering the user's accessibility to the information.

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[8] Meteorological Requirements Working Group
[9] Meteorology Sub-Group