*International Civil Aviation Organization*

**Eleventh Meeting of the Air Traffic Management Sub-Group (ATM/SG/11) of APANPIRG**

Singapore, 2 – 6 October 2023

**Agenda Item 7: AOP, MET, AIM, SAR**

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

(Presented by MET SG)

**SUMMARY**

This paper presents updates on the *Asia/Pacific Regional Guidance for Tailored Meteorological Information and Services to Support Air Traffic Management Operations* to enhance the contents related to improvement process of the meteorological (MET) information and services including post operational analysis on the effect of tailored MET information on air traffic management (ATM) decisions. The updates were approved by the MET SG/27 in September 2023.

## 1. INTRODUCTION

1.1 The *Asia/Pacific regional guidance for tailored meteorological information and services to support Air Traffic Management operations (referred to as the Guidance Document in this paper),* is aimed at fostering States' implementation and enhancement of meteorological (MET) information and services for air traffic management (ATM) in the Region. It captures necessary processes from preparatory to operational phases. The stepwise (process-wise) structure of the guidance is expected to allow each State to refer to suitable chapters, sections or subsections depending on its status of implementation of MET information and services to support ATM. Furthermore, it provides details of operational service practices with some examples and operational scenarios in its Appendices.

1.2 This Guidance Document is maintained by a subsidiary working group of Meteorological Subgroup (MET SG), Meteorological Requirements Working Group (MET/R WG), with the ad-hoc group consisting of Australia, China, Hong Kong, China, Japan (rapporteur), Republic of Korea, Singapore, Thailand, Vietnam and IATA, and available on the ICAO APAC eDocuments website (https://www.icao.int/APAC/Pages/eDocs.aspx). States are encouraged to provide updates on their MET services in support of ATM such as the latest examples of the services and operational scenarios to enrich the cases included in the Appendices. The maintenance procedures and means of publication of the guidance are provided in the Guidance Document as "Note for Appendix 1 and 2".

## 2. DISCUSSION

2.1 The latest updates of the Guidance Document, as approved by METSG/27 includes the enhancement of the guidance with contents on improved processes and post operational analysis of the MET information and services. This work was based on the analysis of practices in the Region, and the results are summarised in the Section 3.7 of the Guidance Document, providing common and useful practices.

2.2 It is to be noted that ATFM SG considered the previous versions of this document and supported its usefulness and inclusions in the relevant ATFM documentations. As a result, the Guidance Document has been referred by the *Asia/Pacific Regional Framework for Collaborative ATFM* (Version 4.0) developed by ATFM SG in October 2022, as the reference for ATM parties. Contents of joint-post operational analysis was also included in the ATFM document based on the discussion in the MET/ATM Webinar in 2022. It is essential to have common understanding between MET and ATM communities for States' implementation and enhancement of ATM-tailored MET services and therefore, it is encouraged that the Guidance Document is utilised by each community.

2.3 The final version of the Guidance Document (except its appendices), including the post-operational analysis and continuous service improvement and the latest implementation example from Australia, as approved by MET SG/27, is presented as Attachments to this paper.

- Attachment A: Guidance Document (except its appendices)
- Attachment B: Implementation example of Australia for Appendix 1 of the Guidance

The updates will soon be available on the ICAO APAC eDocuments website.

2.4 The MET SG/27 Meeting noted the importance of the awareness of the document by not only ATFM/SG but by wider communities. The Meeting recommended to present a paper at ATM/SG/11 to further promote the document.

## 3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper.

b) note the recommendation by MET SG/27 under Paragraph 2.4.

…….

Attachment A

**INTERNATIONAL CIVIL AVIATION ORGANIZATION**

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

Fourth Edition, XXX 2023

[Adopted by MET SG/27, Decision MET SG/27/05: *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.

1.1.4. This Guidance is intended to be referred by the MET and ATM communities to ensure common understanding for the implementation and/or enhancement of ATM-tailored MET services.

## 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 have 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

[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.

Management (ATFM[2]), which are enhanced by the incorporation of dedicated support from MET services.

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, in particular adverse conditions can have significant impacts on ATFM planning and provision.

1.3.3. In the APAC Region, diverse weather conditions are experienced on a daily basis, as the region is influenced by climate 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 in 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 TF[3] 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 towards implementation)

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

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 and ATM organizations through periodic meetings, sharing ideas, familiarisation visits such as to operational centres, etc.. To develop and facilitate an implementation plan, it is recommended to exchange views and information and build mutual understanding of each other's services, through regular consultations and meetings with clear objectives.

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. Furthermore, it is encouraged to include any other directly affected parties including airspace users[4], such as major airlines, in the CDM process.

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 to meet these requirements, including any constraints.

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 of the types of MET information and services required to effectively support ATM. One practical approach, in cooperation with airlines, is to compare operational records (including causes of delay, where 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.

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

*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. The proposed plan could be conceptual process with specific explanation and prototypes of MET information or services.

*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 matured, 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. In addition, these products including MET information tailored to the specific ATM service provider could be made available to the airspace users, to ensure all stakeholders are in possession of the same information in a timely fashion at the same time when making decisions through CDM process.

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.

Trial run of the system and service

2.1.11. 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 learned should be well documented to assist with future requirements.

Service provision agreement

2.1.12. 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 outlining the operational processes, 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 should be developed in accordance with the process described in 2.1, and 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 requirements. Also, when a meteorological condition has a significant impact on ATM, it is recommended that stakeholders conduct a post-event analysis to identify any opportunities to improve the process..

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 provision of information and services. These meetings should draw from the results of verification and evaluation as well as lessons learned from significant events, to identify challenges and opportunities 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 recommended 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 meteorological factors affecting aviation operations 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 effective and immediate action(s) in a collaborative manner, to mitigate any impacts.

## 3.3. Weather briefing in support of ATM

3.3.1. Direct weather briefings for ATM officers are 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 what is being 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 (OPMET) information such as Aerodrome Weather Reports (METAR/SPECI), Aerodrome Forecast (TAF), etc.
- 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/or 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. Therefore, it is desirable to establish dedicated system(s) for information sharing between MET and ATM organizations, to ensure ATC officers and aviation forecasters can effectively and efficiently exchange operational information.

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, such as Aeronautical Fixed Telecommunication Network (AFTN) and Aeronautical Message Handling System (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

## 3.7. Continuous improvement of MET information and services

ICAO Annex 3 notes that State shall ensure that the designated meteorological authority establishes and implements a properly organized quality system comprising procedures, processes and resources necessary to provide for the quality management of the meteorological information to be supplied to the users. It is also recommended that the quality system should conform to ISO 9000 family. Continuous improvement is a key point of ISO 9001.

In order to conduct continuous improvement of MET information and services, as mentioned in chapter 2, it is required to verify regularly and evaluate the MET information and services to ensure that it practically supports ATM. Close coordination between MET and ATM is important not only in daily operations but also in post-operational analysis and continuous improvement of MET information and services in support of ATM operations. Joint post-operational analysis conducted by MET and ATM, as well as input from other stakeholder, is beneficial to improve the effectiveness of MET information and services in support of ATM operations.

### 3.7.1 Records of operations

3.7.1.1 It is important that each MET and ATM keeps daily records of its operations to enable case reviews. The records should be shared as necessary for joint post-operational analysis. The following are examples of the types of record that could form the basis of the case review:

- MET
  - Daily logs
    (e.g. Contents of briefings and ATFM measures)
  - Impact on air traffic flow and ATFM measures taken, as feedback from ATM (e.g. ATC capacity value and deviation with their time and location)
  - All products provided for ATM
- ATM
  - Daily logs
    - Impact on air traffic flow
      (e.g. appropriate capacity value and divert situations)
    - Significant weather affecting ATC capacity
  - Control and coordination logs for ATFM
  - All products provided by MET

### 3.7.2 Joint post-operational analysis between MET and ATM

3.7.2.1 Post-operational analysis can be conducted on a regular basis (e.g. yearly, monthly, etc.) and/or as required as post-event analysis following any significant impact to air traffic flow due to a weather event. Specifically, effectiveness of MET information and services to ATM operations can be reviewed and evaluated in the meeting attended by MET and ATM. The meeting with all stakeholders including airspace users (airlines) is also beneficial to collect user input such as the impact on the aircraft operations. The results of the analysis can be summarised as the joint investigation reports.

3.7.2.2 The following are examples of content that can be included in the joint investigation reports or focused at the post-event analysis meetings;

- ✈ Overview and necessary details of weather assessment impacting air traffic flow

  (e.g. METAR/SPECI, radar, surface wind, lidar, air-reports, lightning detection system, rain, snow depth)
- ✈ Air traffic flow management status
  - ✧ Details of air traffic flow (e.g. capacity values adopted, spacing time)
  - ✧ Details of flow controls (e.g. time, measures, etc.)
- ✈ MET information and services provided
  - ✧ Contents of weather briefings (e.g. timing, phenomena, expected scenario)
  - ✧ Contents of products, such as impact-based MET information
- ✈ Evaluation of the effectiveness of MET information and services for the ATM decision making
- ✈ Identify any challenges and opportunities and discuss any relevant matters.

### 3.7.3 Verification of impact-based MET information to support ATM operation

3.7.3.1 Objective and continuous verification is desirable for the impact-based information, and it would be ideal to develop some index or scheme for verification. In order to perform objective verification, it is necessary to identify the target to be evaluated. These targets need to be agreed by all relevant stakeholders in advance. However, verification for the prediction of meteorological impacts on ATM can be challenging and should be carried out carefully, as it includes following factors to be assessed:

- ✈ Accuracy of the forecast of weather phenomena – to be evaluated by MET
- ✈ Impact to the air traffic flow or ATM operations by the actual meteorological condition – to be evaluated by MET and ATM jointly

The former could be conducted in 'steps' manner (e.g. level of accuracy plotted against the lead time of the forecast) in consideration of the nature of weather conditions prediction, the accuracy could be different depending on its lead-time. The latter is sometime still challenging to verify objectively and it would be supplemented by post-event analysis in coordination with ATM officers.

### 3.7.4 Meetings for continuous improvement

3.7.4.1 It is recommended that the key lessons learned from the results of the post-operational analysis be consolidated and reviewed periodically (e.g. in the same season each year) in the study meeting between MET and ATM so that best practices can be integrated into the daily operations of each party. The latest developments in aviation weather services can also be shared and discussed in such meeting to further enhance the MET information and services to effectively support ATM operations.

## 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.

– END OF SECTION –

[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/)
- ICAO Asia/Pacific Regional Framework for Collaborative ATFM


– END OF SECTION –

## 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 WG[8].
- 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.

– END OF DOCUMENT –

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

# Australia

## 1. ATM-tailored MET information and services

### 1.1. Air Traffic Flow Management (ATFM) overview

ATFM is provided by Airservices Australia (Airservices) aimed at achieving a balance between forecast air traffic capacity and actual demand. Airservices Network Coordination Centre (NCC) operates as the Australian ATFM Centre. The NCC plan strategic flow management and coordinate pre-tactical and tactical operations. To achieve this, the NCC collaborates with relevant stakeholders, including the Australian Bureau of Meteorology (Bureau), Air Traffic Control (ATC), airports and domestic airlines. The NCC Bureau of Meteorology Unit (NCCMET) was embedded within the coordination centre to enhance overall capability.

The ATFM process is outlined below:

- Australian airlines send their flight schedules to the NCC on the day prior to operations. Airports Coordination Australia (ACA) manages the allocation of slots for specific Australian airports upon which airline flight schedules are then based.
- Airservices establishes the projected airport capacity, using set procedures and parameters to guide the collaborative process. Programmed works, unserviceability's, and adverse weather such as fog, thunderstorms and strong and/or gusty winds are considered.
- Airservices publishes an agreed-industry plan, known as a Ground Delay Program (GDP). This is applied to Australian domestic scheduled flights, to balance the demand with the available capacity. The GDP instructs aircraft to delay pushback and taxi, on the ground, for their turn to depart, aiming to reduce excessive airborne holding at destination aerodromes. The intent is then to optimise runway capacity. ATFM provides increased predictability for airlines, giving them a greater understanding of available air traffic capacity, and provides an improved basis for their operational planning. This aligns with the importance of ATM-tailored MET information services.
- Throughout the actual day of operations, industry stakeholders work collaboratively to monitor the aviation network performance to respond to any events which put the network plan at risk. These include unforeseen adverse weather events and reduced service delivery/infrastructure or system failures. In instances when these events impact the network performance to a sufficient degree to warrant action, an updated GDP will be agreed-upon by industry.

### 1.2. About Ground Delay Program

#### 1.2.1. GDP – Arrivals (GDP-A)

Implementation of GDP-A at Sydney, Brisbane, Perth, and Melbourne airports reduce airborne holding for airlines. For example, when weather conditions change (for better or worse) GDP-A revisions provide new arrival rates.

#### 1.2.2. GDP – Departures (GDP-D)

Implementation of GDP-D at Perth regulates departure timings on weekdays between 2130 to 0030 UTC. The process commences at 0815 UTC the day before, using a similar process as GDP-A to determine capacity based on meteorological and airport conditions.

#### 1.2.3. GDP Revisions

When weather conditions at a GDP airport change or unforeseen situations occur such that the airport acceptance rate will be significantly different, the GDP may be revised.

There are 3 levels of GDP Revisions:

- **Level 1 –** is a standard revision, consistent with set criteria, such as an improvement or deterioration of the weather forecast, and the planned rates need to be amended.
- **Level 2** – is used when circumstances are deteriorating rapidly and the GDP airport is no longer able to maintain the rates derived from the ATFM pre-tactical plan, and/or airborne holding is unsustainable. For example, un-forecast weather/storms or any other operational restriction resulting in sudden decrease in Airport Acceptance Rate (AAR).

- **Level 3 –** is used when the GDP airport is critically constrained for a period of time, and as a result unsustainable airborne holding and airspace congestion occurs or anticipated to happen. For example, runway flooding, unexpected fog, or a slow-moving severe storm overhead stoppings all arrivals and significantly increasing congestion and airborne holding.

## 1.3. Meteorological Collaborative Decision Making (MET CDM)

Historically, GDP rates were determined by weather products that were not specifically tailored to enhance ATFM, for example, the Terminal Area Forecast (TAF). MET CDM, in Australia, has evolved to purposely consider a pre-tactical period, that is the day before operations. MET CDM aims to optimise runway capacity by closing the gap between planned and actual arrival rates. The process uses enhanced weather forecast information to determine arrival rates that aim to better suit weather conditions on the day.

MET CDM entails collaboration between Airservices and relevant stakeholders to generate a forecast product used to inform pre-tactical traffic management strategies. The MET CDM process analyses aviation-related weather criteria contained in weather forecasts, assesses other meteorological requirements, obtains expert advice from NCCMET, Bureau Forecasters and Airline Meteorologists (AVMET) to assess the potential impact on the arrival rates used for ATFM. The final MET CDM product is produced after consulting with NCC Line Managers, ATC Shift and Traffic Managers to ensure planned arrival rates best suit the enhanced forecast used to determine the GDP.

The program delivers scheduled ATFM measures to reduce airborne delays via GDP at Melbourne, Sydney, Brisbane, and Perth airports. The aim is to provide predictability and minimise alterations to published GDP. The planning process aims to optimise runway capacity by closing the gap between planned and actual arrival rates.

## 1.4. About Network Coordination Centre Meteorology Unit (NCCMET)

NCCMET provides Airservices with meteorological intelligence to support all operational decision making. NCCMET manages, develops, and delivers tailored meteorological products and services to enhance safety and optimise air traffic delivery.

### 1.4.1. NCCMET supports pre-tactical planning with:

- MET CDM products and services.
- a 72-hour rolling forecast (today, tomorrow and the following day), with a focus on prediction of major weather event(s) likely to cause disruptions or impact airport capacity, an example is provided in Figure 1.
- three-day forecast as part of the ATFM Daily Plan are issued three times a day each morning, midday, and evening, or as otherwise amended, an example is provided in Figure 2.
- seven-day meteorological impact outlook for the Network Operations Weekly Debrief and teleconference.
- The NCC is open 24 hours a day 7 days a week with the above information made publicly available on the Airservices NCC website and via secure industry portals managed by Airservices.

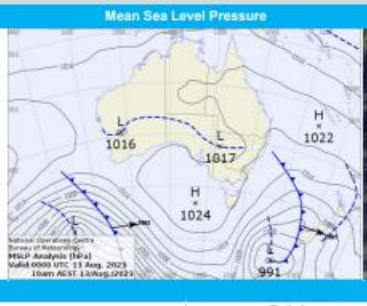
## Network Weather Overview

From now to +72 hours

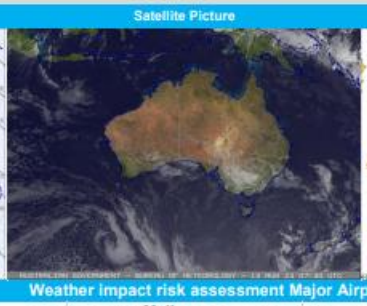
## Monday 14 August 2023

### Weather Overview

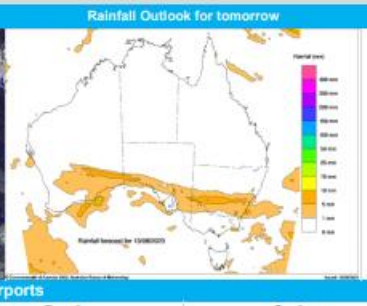
Mean Sea Level Pressure




Satellite Picture



Rainfall Outlook for tomorrow



### Weather impact risk assessment Major Airports

| | Brisbane | Melbourne | Perth | Sydney |
|---|---|---|---|---|
| AM Monday | Shallow fog early, then CAVOK. Light SW winds. | Patchy early fog in the TMA, likely shallow at the airport, then mostly CAVOK. Light W winds, tending S late morning. | Slight chance early fog. Cloud 3000-4000ft. Light NE winds, tending NW late morning. | Rain easing for a period late morning. Cloud 1000-2000ft. |
| PM Monday | CAVOK. Moderate NE winds, tending lighter NW in the evening. | Possible light showers, clearing in the evening. Cloud 4000-5000ft. Moderate S winds, tending lighter WSW in the evening. | Possible light shower early afternoon. Cloud 4000-5000ft. Moderate NW winds, tending lighter NE in the evening. | Showers increasing. Possible afternoon thunderstorms, mainly W and N TMA, slight chance at the airport. Cloud 1000-2000ft, lifting 1500-2500ft in the evening. |
| AM Tuesday | CAVOK. Light SW winds. | Cloud 2000-3000ft. Light W to NW winds | Showers, mostly offshore. Cloud 1500-2500ft. Light NE winds, becoming light to moderate late morning. | Showers, mainly sea/coast. Cloud 2000-3000ft, lowering to 1000ft in showers. Light to moderate SW winds. |
| PM Tuesday | Showers increasing. Chance of storms. Cloud 2500-3500ft in the afternoon. Winds variable, becoming moderate SE during the afternoon. | Cloud 3000-4000ft. Light SW to SE winds. | Showers. Cloud 2500-3500ft, lowering to 1500ft in showers. Moderate NW winds. | Showers. Cloud 2000-3000ft, lowering to 1000ft in showers. Moderate S winds, easing in the evening. |
| AM Wednesday | Showers, mostly offshore. Cloud 2500-3500ft. Light SW winds. | CAVOK. Light to moderate NW winds. | Showers, clearing early. Patchy cloud 1500-2500ft, lower in showers, lifting to 3000-5000ft by late morning. Light E to SE winds, becoming moderate SE during the morning. | Showers, mainly sea/coast. Cloud 2000-3000ft, lower in showers. Light SW to NW winds. |
| PM Wednesday | Showers sea/coast, easing in the afternoon. Cloud 3500-4500ft. Light to moderate E to SE winds. | CAVOK. Moderate NW to NE winds. | Mostly CAVOK. Moderate SE winds, easing in the evening. | Showers easing and moving offshore. Cloud 3000-4000ft, becoming patchy. Light E to NE winds, turning N to NW in the evening. |

**Figure 1 - Weather impact risk assessment**

## ATFM Daily Plan - Monday 14 August 2023

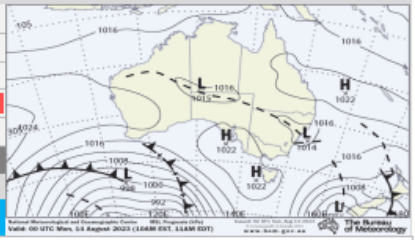
ADP Version 1

airservices

| Airport | Planned GDPs | Total Arr/Dep | Affected Flights | Total Ground Delay | Av. Ground Delay |
|---|---|---|---|---|---|
| YSSY | YSSY GDP-A 2000-1200 | 927 | 337 | 3,917 | 11.60 |
| YMML | YMML GDP-A 2000-1300 | 685 | 265 | 1,758 | 6.90 |
| YBBN | NONE | 606 | n/a | 0 | 0.00 |
| YPPH-A | YPPH GDP-A 0030-0600 | 452 | 78 | 1,143 | 14.70 |
| YPPH-D | YPPH GDP-D 2130-0030 | | 99 | 797 | 8.10 |
| Totals | | 2670 | 779 | 7,615 | 8.29 |

* denotes a revision has taken place

36 Hr Synoptic Forecast



ATFM Daily Plan Summary Notes

| | |
|---|---|
| YSSY | Heavily compacted peak periods due to poor weather all day. Compliance with COBTs required to prevent further issues around compression in poor conditions. |
| YMML | Compacted morning and afternoon peak periods, with the afternoon having few available slots around and through the peak period. Compliance with COBTs is required to mitigate any further compression or airborne delay. |
| YBBN | Nil significant network risk(s) identified at this time. |
| YPPH | Nil significant network risk(s) identified at this time. |
| Other Significant | Refer NOTAM for latest estimated airborne traffic delay advice. |
| Change Summary: | [05:41pm] Version 1: Initial. |

**Figure 2 - ATFM Daily Plan**

## 1.5. MET CDM Process

MET CDM was identified as a priority by Airservices, the Bureau and airlines in Australia, and forms part of the ICAO Global Air Navigation Plan (GANP). An overview of the process is depicted below, in Figure 3:

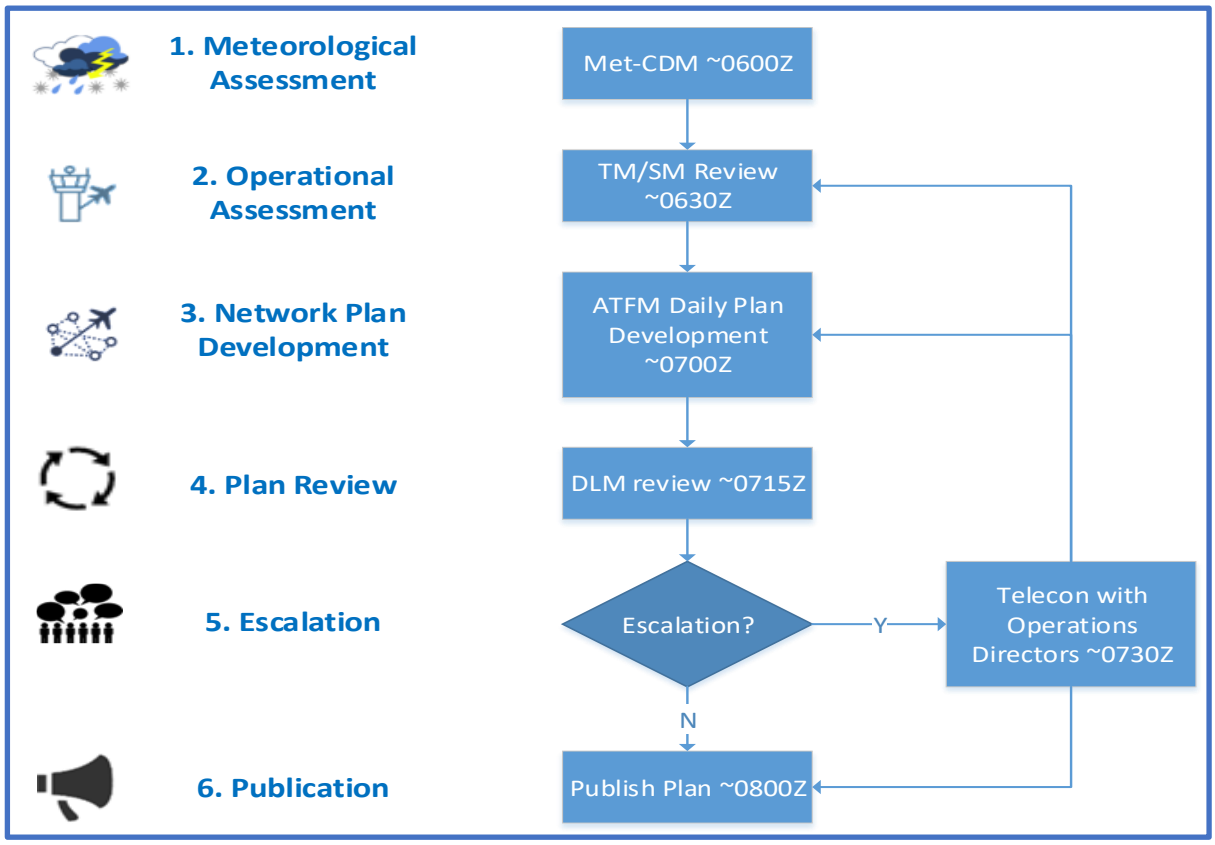



**Figure 3 - MET CDM process**

Step 1:

- NCCMET, in partnership with AVMET, conduct a meteorological assessment via MET CDM. The collaborative process makes allowance to incorporate local operational knowledge and expertise. An enhanced weather forecast is formulated, for the next day of operations, to provide NCC. The NCC uses this information to model Airport Arrival Rates (AAR) using pre-agreed Business Rules with reference to location specific Airport Reference Cards.

Step 2:

- ATC review MET CDM proposed AAR and may make further adjustments based on operational restrictions, for example airport works, facility availability and staffing.

Step 3:

- NCC develop a Network Plan for the next day which includes proposed ATFM measures. This will take into consideration the expected demand against declared AAR to determine any requirement for GDP. Any airport capacity constraints and en-route airspace capacity issues, such as forecast enroute weather, are incorporated as necessary.

Steps 4 - 6:

- the plan is reviewed;
- discussed, and escalated as required; and
- published with GDP run for the next day.
- if required the process is repeated throughout the day of operations.

### 1.6. Benefits of MET CDM

The benefits of MET CDM process, used in Australia, include:

- enhanced weather forecast information used to determine pre-tactical arrival rates that will better suit the weather conditions on the day. This results in fewer GDP revisions, less wasted capacity and less restriction where not required.
- greater operational predictability, which provides a better basis for planning.
- collaboration between meteorological experts across stakeholders has built understanding and consensus on the aviation implications of forecasting, with the aim to provide more predictability and to minimise the risk of GDP revisions.
- the process and business rules have more flexibility and responsiveness regarding setting AAR to maximise runway throughput in consideration of weather constraints.
- reduction in airborne delay (holding) saving fuel and money for airlines.

## 2. Means of Provision

As NCCMET is located within the NCC it assists Airservices in its management of air traffic flow within the Australian Flight Information Region (FIR), and particularly to:

- conducting comprehensive tailored meteorological assessments using the MET CDM process, see Figure 3.
- maintain a national weather watch for the Australian Flight Information Regions (FIR) and provide timely advice on significant changes that could impact on operations both en-route and at aerodromes.
- provide regular scheduled and ad-hoc weather briefings.
- maintain and promote close liaison between the meteorological community and the aviation industry, including working closely with AVMET.
- provide a pivotal point of contact into the Bureau for real-time meteorological issues.
- provide training to Airservices staff on meteorological issues.
- provide meteorological support, as necessary.

## 3. Other useful information

### 3.1. Cooperation Agreement

A formal framework of cooperation was established between Airservices (ATS authority) and the Bureau of Meteorology (Australia's meteorological authority) to provide ICAO Annex 3 services.

### 3.2. Harmony software

Airservices uses a software-based tool called 'Harmony' to operate the GDP. Harmony accepts real-time updates to schedule data, either via flight plan submission, airline day of operations changes to scheduled departure times, or ATC live data. In accepting real-time updates, Harmony can display the most up-to-date demand/capacity information for any monitored airport, which in turn provides airlines, airports, and ATC with an enhanced capability to predict traffic management issues. Further details are available via the Airservices AFTM website. Aircraft and airport operators can view the GDP information for affected flights via web-based access to the Harmony tool.

### 3.3. Continuous improvement

A formal process of review was created between Airservices, the Bureau and major airlines using a Letter of Agreement – *Meteorological Collaborative Decision-Making Incident Reporting (METCDMIR)*. This formalises agreed protocols to identify the cause of any deficits and recommend corrective actions to continuously improve MET CDM procedures over time.