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COMMITTEE A

Agenda Item 2: Enabling the global air navigation system

2.3: Future provision of aeronautical meteorological service

MET INFORMATION AND SERVICES FOR ATM IN JAPAN

(Presented by Japan)

EXECUTIVE SUMMARY

In Japan, Japan Meteorological Agency (JMA) has operated meteorological services in support of air traffic management (ATM) more than ten years. JMA established Air Traffic Meteorology Center (ATMetC) and its subsidiary team, i.e. Tokyo Metropolitan Area Team (TMAT), to support ATM operations by Air Traffic Management Center (ATMC) and Traffic Management Units (TMUs) of Japan Civil Aviation Bureau (JCAB), through the provision of ATM-tailored weather briefings and meteorological information. This paper introduces how ATMetC and TMAT provide meteorological (MET) support for ATM.

1. INTRODUCTION

1.1 Over the decades, the amount of air traffic in Fukuoka flight information region (FIR) has been so increasing that Japan Civil Aviation Bureau (JCAB) established the Air Traffic Management Center (ATMC) in Fukuoka in October 2005. According to ICAO global ATM operational concept, the original purpose of ATMC's operation was to keep safe and efficient flights through air traffic management in close cooperation with airspace management (ASM), air traffic flow management (ATFM), and Oceanic ATM. To accomplish this purpose, ATMC asked for detailed information on meteorological conditions which would impact on air traffic management (see Figure 1).

1.2 To meet the above requirements, Japan Meteorological Agency (JMA) established Air Traffic Meteorology Center (ATMetC) in the same place as ATMC to directly support their ATM operation with dedicated meteorological information and services. ATMetC forecasters in ATMC's operations room (Figure 2) collect wide range of meteorological information for both airspace and airports and provide necessary information in support of ATMC and other ATM stakeholders, such as airline companies.

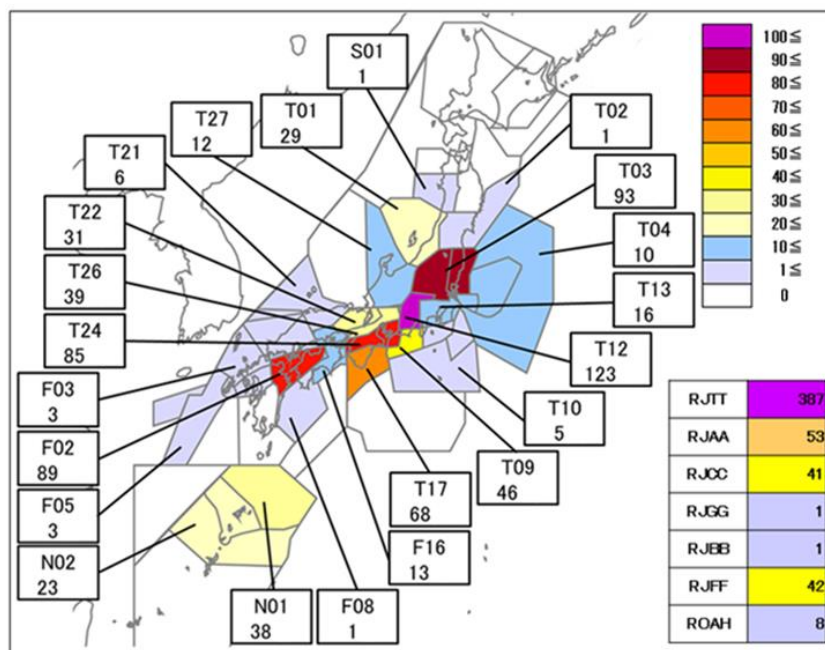


Figure 1. Number of times of air traffic flow control related to weather in every ACC's sector from April 2013 to March 2015.

2. MET INFORMATION AND SERVICES PROVIDED BY ATMETC

2.1 ATMetC has continuously provided the following dedicated services to support ATMC and ATM concerning bodies, since its formal operation started in 2006:

a) Briefings;

- 1) ATMetC forecasters work closely together with ATMC officers and representatives of the Ministry of Defense in ATMC operations room;
- 2) ATMetC forecasters make regular briefings four times a day to share weather conditions of the day and expected impact on air traffic flow. Each briefing is provided to ATM officers before their starting daily shift;
- 3) when significant changes of meteorological condition are identified or forecast is amended, ATMetC forecasters provide special briefings as necessary;

b) provision of ATM-tailored information;

- 1) ATMetC Category Forecast (Figure 3);
 - i) it contains probability which weather conditions impact on air traffic flow. Target areas are air traffic control (ATC) sectors and seven major airports in Japan;

- 2) SIGWX Briefing Sheet;
 - i) more detailed “scenario-based” forecast information of air traffic disturbance caused by typical significant weather phenomena at major aerodrome. Currently this is issued only for strong wind condition at Tokyo International Airport (RJTT) and heavy snow condition at New-Chitose Airport (RJCC);
- c) ATM information-sharing system: dedicated display system allocated at each ATM controller’s desk. ATM controllers can easily check weather conditions within the area of responsibility. This is also used for special weather briefings provided by ATMetC forecasters under paperless circumstances;
- d) sharing ATM and MET information;
 - 1) ATM and MET information are shared on eight very-large screens in front of the operations room. ATMetC can show necessary weather information on four of their screens in response to request from ATM officers;
 - 2) ATMetC forecasters can see air traffic flow information on a dedicated terminal called “ATM terminal” at their desks;
 - 3) ATMC controllers can check meteorological information on a dedicated terminal called “ATMet information sharing system”; and
- e) collaborative decision-making (CDM) conference: ATMC has attempted video conferences called “CDM conference” to share information on air traffic management. ATMC holds the regular CDM conferences twice a day to share information for six hours and extra CDM conferences if necessary, with ATMetC, TMAT and some Air Traffic Control centers, and three airlines. ATMetC explains weather observations and forecasts at each CDM conference.



Figure 2. ATMetC forecasters in ATMC operation room

3. MET INFORMATION AND SERVICES PROVIDED BY TOKYO METROPOLITAN AREA TEAM (TMAT)

3.1 In 2011, to deal with significantly increasing air traffic demands in Tokyo metropolitan airspace, JCAB organized branch offices of ATMC, named traffic management units (TMUs), at Tokyo International Airport (Haneda TMU) and Tokyo Area Control Center (Tokorozawa TMU), in order to conduct tactical and flexible ATFM for congestive airspace in and around the Tokyo metropolitan area. In response, JMA organized TMAT at Tokyo International Airport in 2014 as a branch office of ATMetC to provide TMUs with meteorological information and detailed briefings focusing on significant weather which affects air traffic flow in approach control area of both Tokyo and Narita International Airport and the surrounding area.

3.2 TMAT forecasters support TMU officers through the provision of following information and services:

a) briefings;

- 1) TMAT forecasters provide regular briefings four times a day to share weather conditions of the day and expected impact on air traffic flow. Each briefing is provided to ATM officers before their starting daily shift;
- 2) when significant changes of meteorological condition are identified or forecast is amended, TMAT forecasters provide special briefings;
- 3) target areas are Tokyo approach control area and Tokyo area control centre's (ACC) area of responsibility.

b) ATM-tailored meteorological information

- 1) ATM categorized impact of weather element prediction (ATM CIEL) (Figure 4) indicates degree of expected impact by significant weather on ATFM operations. Target areas are Tokyo approach control area, ATC sectors around Tokyo metropolitan area, and Tokyo and Narita International Airport;
- 2) WX Bulletin contains brief comments on weather conditions expected to affect air traffic flow and the relevant weather images to explain such adverse weather conditions. Target areas are the same as ATM CIEL; and

c) web chat system to support prompt decision-making required for ATFM within the terminal area, TMAT forecasters coordinate with officers of both Haneda and Tokorozawa TMUs, using online chat tool. On this online chat tool, not only text information but also graphical information can be posted.

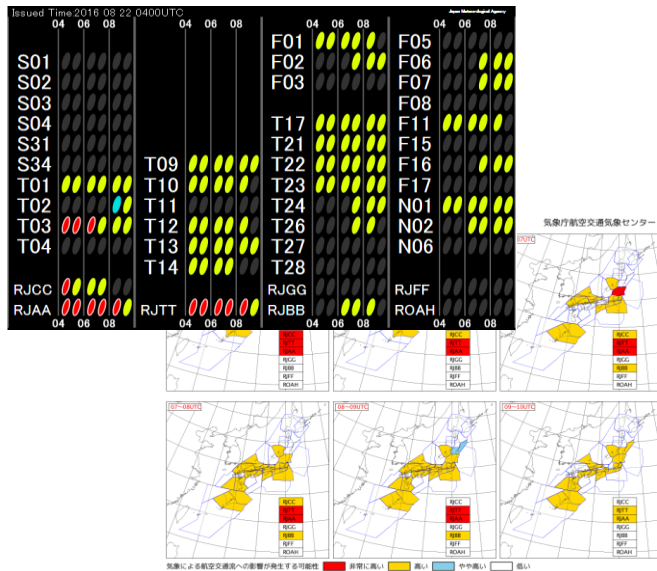


Figure 3. ATMet category forecast (tabular form and map form)

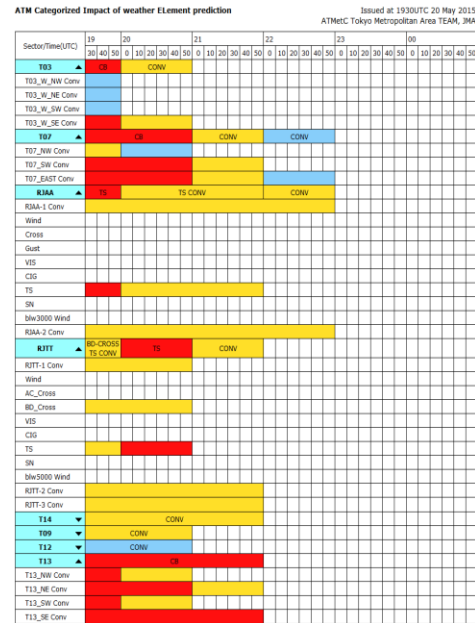


Figure 4. ATM CIEL

4. CONTINUOUS IMPROVEMENT OF ATM-TAILORED INFORMATION IN COORDINATION WITH ATM

4.1 Meteorological information in support of ATM operations need to be adapted to various operational conditions including ATC procedures, airway settings and aircraft types, which would be subject to change by their nature. It is therefore highly important to ensure close and continuous coordination with ATM officers and verify ATM-tailored meteorological information in consideration of ATM operational requirements. Through continuous improvement, the gap between ATM operational requirements and MET capability can be closed. Through close coordination with JCAB, JMA has continuously improved weather information and services including ATM-tailored information.

4.2 In order to confirm operational requirements from ATM, ATMetC/ATMC and TMA/TMUs hold regular meetings to exchange their views. In addition, they conduct case studies of significant air traffic flow disturbances affected by weather conditions. The continuous coordination is a key for the improvement of MET information and services provided by ATMetC/TMAT. In addition, ATMetC and ATMC are working together to train forecasters and ATM officers, so that operational collaboration becomes more efficient through better understandings of each other's operation.

5. IMPROVEMENT OF ATM SIGNIFICANT WEATHER INDEX

Improvement of ATMet category forecast

5.1 JMA has developed and improved ATM significant weather index, which is automatically derived mainly from numerical weather prediction (NWP) system of JMA to support forecasters in creating ATMet category forecast and ATM CIEL. The index is calculated for each ATC sector and used as a first guess for those ATM-tailored meteorological information. JMA coordinates closely with JCAB to review and modify the criteria used for color-coding of possible weather impact in

the ATM-tailored meteorological information. Sample of ATM Significant Weather Index is shown in Figure 5.

要素/日時(UTC)	07/07			07/08			07/09			07/10			07/11			07/12			07/13											
	30	40	50	00	10	20	30	40	50	00	10	20	30	40	50	00	10	20	30	40	50	00	10	20	30	40	50	00	10	20
F05_A593																														
F06_																														
F06_A1																														
F06_M750																														
F07_																														
F07_A1																														
F07_M750																														
F08_																														
降短最大降水量	26.0			24.0			19.0			20.0			12.0			6.0														
降短平均降水量	3.2			2.9			2.1			1.2			0.9			0.7														
基準降水強度以上の面積率	1.8			1.5			0.2			0.3			0.0			0.0														
基準高度以上のCBTOP面積率	8.1			8.3			8.2			3.0			2.1			0.0														
セクター高度内 最大風速・風向	290/078KT			280/071KT			280/069KT			270/068KT			280/068KT			270/070KT														
F08_A1																														
降短最大降水量	22.0			21.0			16.0			11.0			4.0			2.0														
降短平均降水量	8.2			8.4			6.2			2.0			1.0			0.3														
基準降水強度以上の面積率	1.4			9.9			0.0			0.0			0.0			0.0														
基準高度以上のCBTOP面積率	5.2			48.4			24.1			0.0			0.0			0.0														
セクター高度内 最大風速・風向	280/074KT			280/071KT			280/070KT			280/066KT			270/067KT			270/068KT														
F08_M750																														

Figure 5. Sample of ATM Significant Weather Index (tabular format)
(F05 – 08: ATC sectors, A593/A1/M750: air-routes)

5.2 NWP and very short range forecast (VSRF) systems operated by JMA are used for the computation of ATM Significant Weather Index. VSRF system calculates very short range precipitation forecast products. The five weather elements derived from NWP and VSRF systems are converted to the index that indicates the impact of weather on ATM. In 2016, JMA changed the NWP model used for calculation of the index from Meso-Scale Model (MSM) to Local Forecast Model (LFM), which is JMA's high-resolution NWP model (2x2 km grid), as the LFM can predict convective clouds more accurately than MSM.

5.3 Most of the weather elements used for the calculation of the index are related to convective activity, such as precipitation intensity. In addition, maximum wind speed and its direction within each ATC sector are used because wind above major airports affects separation management of approaching aircraft. This weather element was introduced in 2014.

5.4 The index is calculated for each ATC sector and sub-sectors in the Tokyo metropolitan airspace. These sub-sectors are subdivisions of the Tokyo approach control area and its surrounding sectors introduced in 2014. ATM CIEL provides the forecast for each sub-sector. In addition, JMA started to calculate the index for smaller areas within specific congested airspaces since February 2018, such as particular air-routes and way-points. Significant weather occurring within such congested airspace would have great impact on ATM even if the significant weather does not cover large area of the ATC sector. If NWP and/or VSRF forecast significant weather within those smaller areas, the index indicates higher impact for the ATC sector. Setting such smaller areas for the calculation of the index leads to the improvement of accuracy of ATM-tailored meteorological information (see Figure 6).

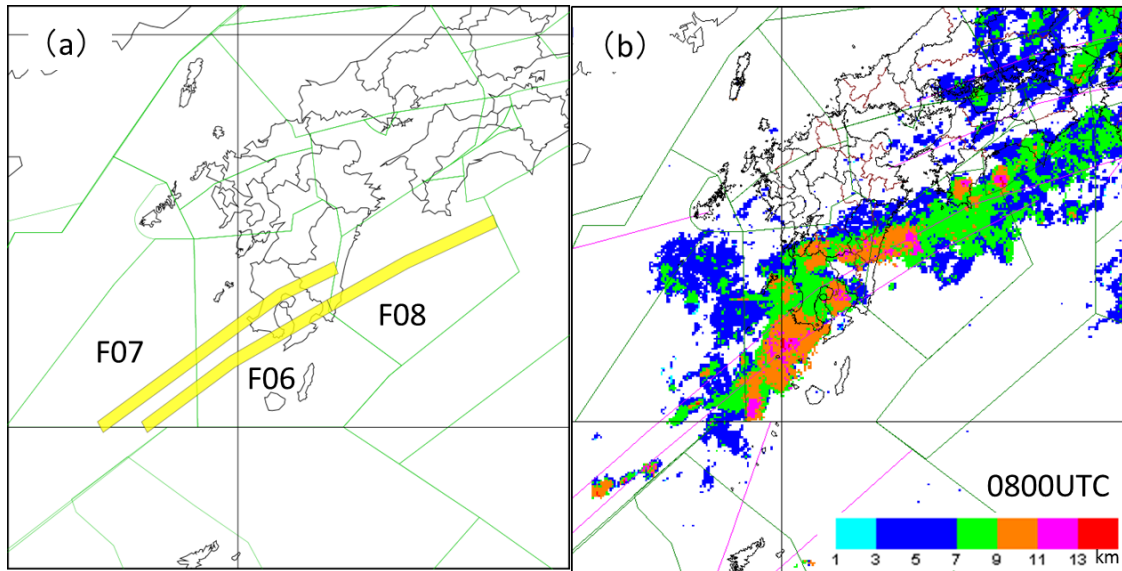


Figure 6. (a) ATM Significant Weather Index and (b) radar echo top at 0800UTC on 7th May 2018

- Green line: ATC sector boundary, Magenta line: major air route
- Yellow polygons in (a) indicates the “smaller areas” (near major air routes, in this case).

Yellow means medium impact of the significant weather on ATM. No-colour means no impact. In this case, the impact of the convective clouds on ATM was predicted in the congested airspaces although no impact was expected in whole ATC sectors.

Improvement of ATM CIEL

5.5 TMAT provides ATM CIEL to TMUs. ATM CIEL is an ATM-tailored meteorology product and indicates the impact of significant weather on ATM such as setting ATC capacity value (CAPA) within the Tokyo metropolitan area. Samples are shown in Figure 7 and 8. ATMetC also provides similar categorized information, ATMet category forecast, but the temporal and spatial resolutions are more precise than those of ATMet category forecast as more detailed information is required from TMUs for prompt decision making within Tokyo metropolitan area.

ATM Categorized Impact of weather ELEMENT prediction

Issued at 0100UTC 25 Apr 2018
ATMetC Tokyo Metropolitan Area Team, JMA

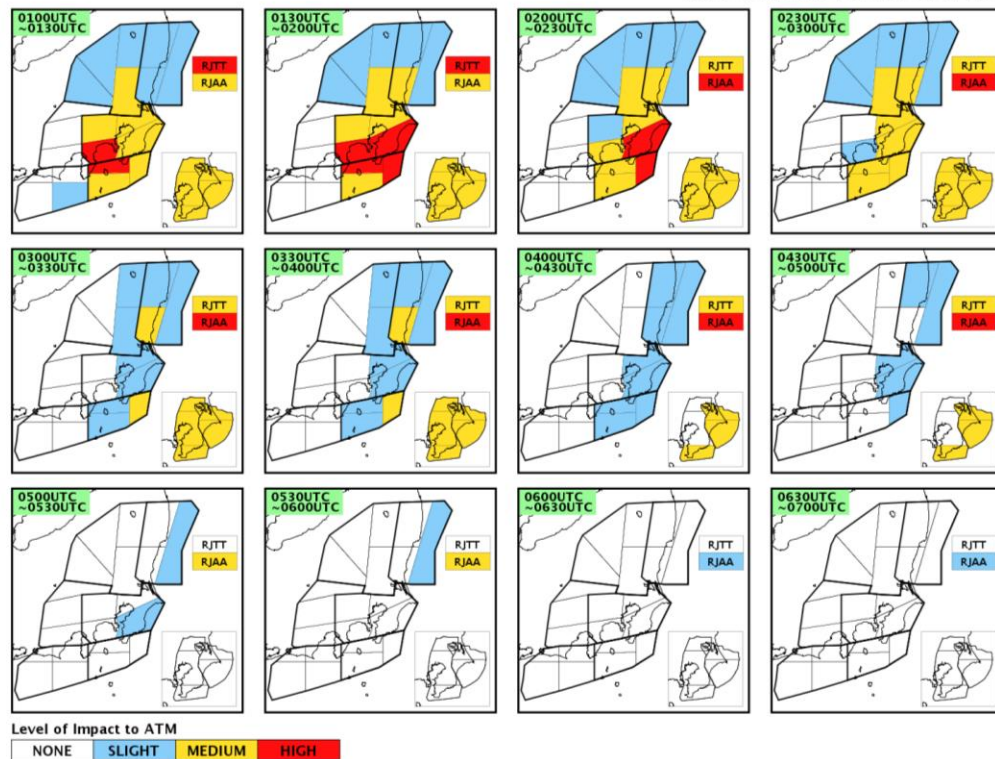


Figure 7. ATM CIEL (tabular format)

On clicking each sector name in the left end column, the information on each sub-sector appears. On clicking each airport name in the column, the rows of weather elements appear. This function enables TMUs' officers to easily grasp which element will affect ATM operation at the airport.

ATM Categorized Impact of weather ELEMENT prediction

Issued at 0100UTC 25 Apr 2018
ATMetC Tokyo Metropolitan Area Team, JMA

Sector/Time(UTC)	01					02					03					04					05					06									
	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50					
T03 ▼	CONV										CONV																								
T07 ▼	CONV					CONV												CONV																	
RJAA ▲	WIND CONV					GUST WIND CONV					GUST										GUST										GUST				
RJAA-1 Conv																																			
Wind																																			
Cross																																			
Gust																																			
VIS																																			
BASE																																			
TS																																			
SN																																			
blw3000 Wind																																			
RJAA-2 Conv																																			
RJTT ▼	BD-CROSS					WIND CONV																													
T14 ▲	CB					CONV										CONV																			
T14_NW Conv																																			

Level of Impact to ATM

NONE

SLIGHT

MEDIUM

HIGH

Figure 8. ATM CIEL (map format)

5.6 TMAT verifies ATM CIEL by comparing with actual impact on aircraft operations and CAPA. Based on the results of the verification, TMAT discuss with TMUs the changes of the criteria used for color-coding at monthly meetings. TMUs requested TMAT to change the criteria to more understandable values for TMU officers (e.g. weather minima). In addition, TMAT conducted survey on aircraft operations in typical adverse weather conditions, such as strong crosswind and heavy snow, at regular meetings with airlines. It took about one year and a half since TMAT started to coordinate with TMUs to develop the consolidated version of new criteria.

5.7 TMAT changed the criteria of ATM CIEL significantly. One of the changes is aligning the criterion for “high” impact caused by low visibility in Tokyo International Airport to the one of the weather minima applied at the airport. In addition, when the visibility is getting low near the touch down zone, CAPA would be lowered even if prevailing visibility does not meet the criteria used for colour-coding. This change helps TMAT forecasters predict possible impact of low visibility on CAPA more properly. TMAT can provide more precise ATM-tailored meteorological information which would not be necessarily expressed in TAF in consideration of operational procedures and requirements of TMUs.

5.8 TMAT applied the above new criteria in February 2018. ATM CIEL became more useful information for the officer of TMUs in setting CAPA. It is important to review the criteria for such categorized information continuously as appropriate criteria may vary if air traffic control procedures are changed.

6. SUMMARY

6.1 JMA has operated meteorological services in support of ATM more than ten years, since 2005. JMA established the ATMetC in 2005, and accordingly TMAT in 2014, to support ATM/ATFM operations conducted by ATMC and TMUs of JCAB through the provision of ATM-tailored meteorological information and services developed in close coordination with JCAB and ATM community.

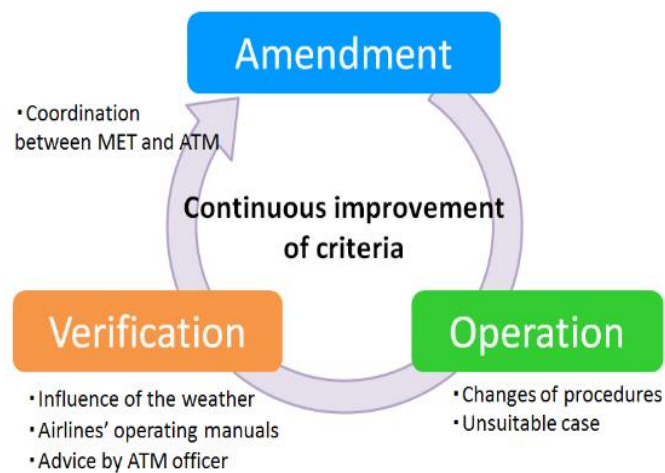
6.2 JMA has developed and improved ATM Significant Weather Index, which is used as a first guess of ATM-tailored meteorological information and enables forecasters to create the information more efficiently. The index has been utilized since 2005, when ATMetC was established, but its calculation methods have been reviewed and updated based on the requirements from JCAB. In addition, the accuracy of the index has been improved by the development of new forecast technology, such as high resolution NWP model. In addition, JMA started to calculate the index for congested smaller airspaces within an ATC sector and sub-sector in February 2018, to enable the index to represent the impact of the weather on ATM more accurately and forecasters to create ATM-tailored meteorological information more efficiently.

6.3 The following collaborative efforts has been identified through operational experience over the decade, as the key aspects for continuous improvement of meteorological information and services in support of ATM:

- a) design ATM-tailored MET information and services in consideration of requirements from ATMC and TMUs;
- b) provide precise information in a timely manner through appropriate briefing and dedicated information sharing system;

- c) participate in CDM conference in order to contribute to efficient ATM operations; and
- d) review and verify ATM-tailored MET information continuously in close consultation with ATM stakeholders.

Note. Those key aspects learned through the development and operation of ATM-tailored meteorological information and services were contributed to the development of “ASIA/PACIFIC REGIONAL GUIDANCE FOR TAILORED METEOROLOGICAL INFORMATION AND SERVICES TO SUPPORT AIR TRAFFIC MANAGEMENT OPERATIONS”.



7. ACTION BY THE MEETING

- 7.1 Note the information contained in this paper.

— END —