# Impact-based meteorological information to support ATM operation

Japan Civil Aviation Bureau Japan Meteorological Agency

ICAO APAC MET/ATM Seminar 28 April 2025

# **Contents**

#### 1. Introduction

- Drivers of ATM-tailored MET services provision
- MET services to support ATM in Japan
- 2. Translation from MET condition to impact on ATM
- 3. Case Study: operational capacity management utilizing impactbased MET information

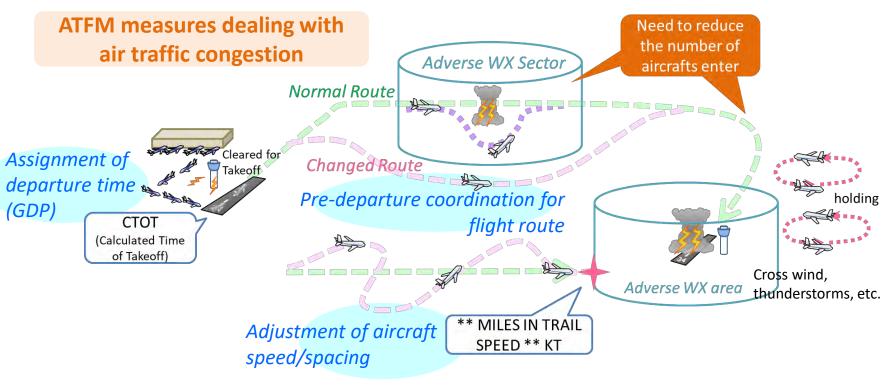
#### 1. Introduction

### **Drivers of ATM-tailored MET services provision**

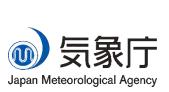
# Chart 14: Global air passenger journeys, billion Upside potential: Air passenger demand benefits from more favourable mecro-economic conditions Downside risk: Weaker macro-economic conditions limit growth Basaline 2 2 2020 2025 2030 2035 2040 2043

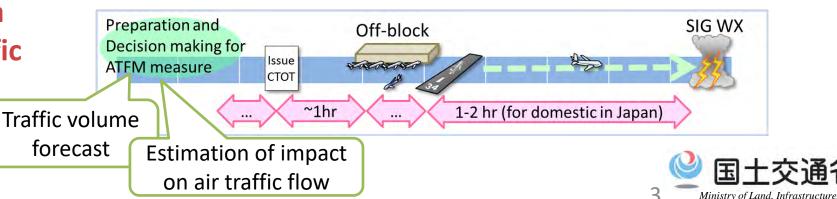
Global Outlook for Air Transport (IATA 2023)

Source: Air Passenger Forecasts, February 2024 update



Meteorological condition is a major factor which affect traffic flow forecast uncertainty.



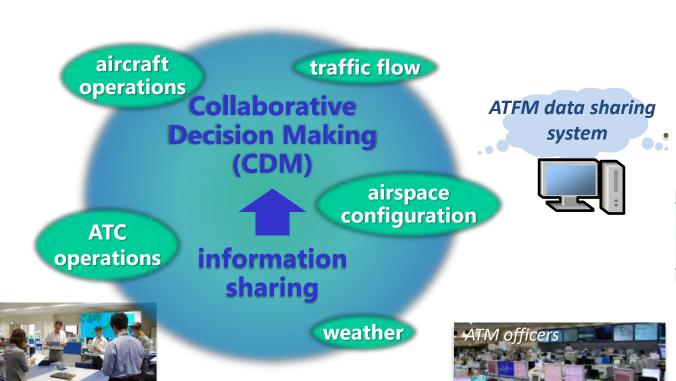


Transport and Tourism

#### 1. Introduction

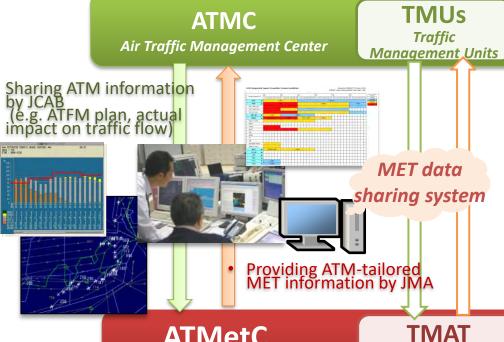
### MET services to support ATM in Japan

Contribution to the CDM for ATM decision making



Dedicated MET services for ATFM units

ATFM units (JCAB)



**ATMetC** 

Air Traffic Meteorology Center

Tokyo Metropolitan Area Team

MET service provider (JMA)



ATMetC forecasters are stationed in the ATMC operation room.

MET officers

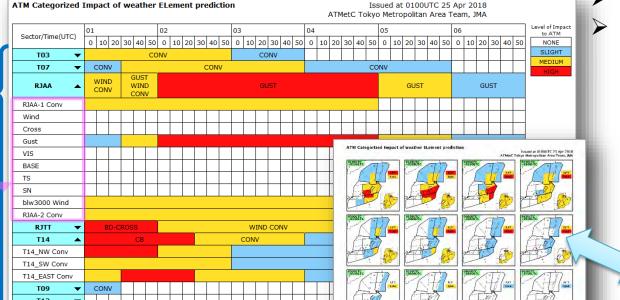
Regular CDM meeting

# **Contents**

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- 2. Translation from meteorological condition to impact on ATM
  - Impact based MET information to support ATM/ATFM decision making
  - How to translate
- 3. Case Study: operational capacity management utilizing impactbased MET information

#### Impact based MET information to support ATM decision making

ATM CIEL (ATM Categorized Impact of weather Element prediction)



on capacity management

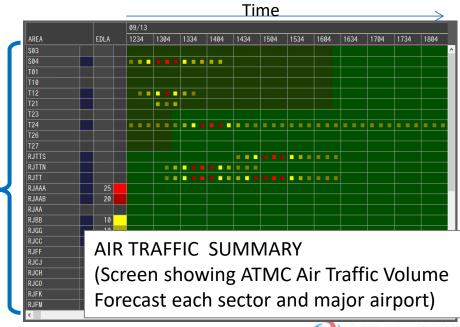
- Forecast for next 6 hours in 10-min resolution
- Target phenomena:

ATC sectors

& airports

**ATC sectors:** Convective clouds including CBs, other types of clouds that affect air traffic flow **Approach control areas:** 

CBs, Convective clouds and Wind Airports: Thunderstorms, Visibility, Ceiling, Wind, etc.



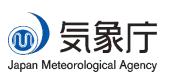
Level of expected impact on ATM (capacity reduction)

High Need to reduce Capacity significantly

Need to reduce Capacity

Slight Need to reduce Capacity slightly

None Not need to reduce Capacity



**ATC** sectors

& airports

Phenomena

Sub-sectors

of approach control area

T13

Medium

Criteria for the Categories – ATM CIEL

Airports

**Approach** 

Control

Area

**ATC** 

Sectors •

The criteria for ATM Categorized Impact of weather Element prediction (ATM CIEL)

As of 19th JUL 2025

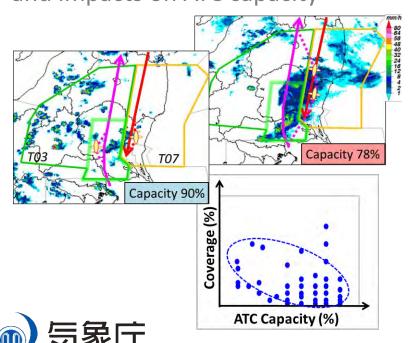
Criteria are set for each airport and its Approach Control Area, as weather conditions that affect ATM depend on characteristics of local meteorological condition, airspace and runway configurations, etc.

Change of wind direction WiND-CHG Wind speed Crosswind component of Wind speeds to runway (3000m) B RWY 04-22 (2500m) B RWY 05-23 (2500m) D RWY 05-23 (2500m) D RWY 05-20 (2500m) Crosswind component of Wind speeds to runway D RWY 05-20 (2500m) Crosswind component of Wind speeds to runway D RWY 05-20 (2500m) Crosswind component of Wind speeds to runway D RWY 05-20 (2500m) Crosswind component of Wind speeds to runway Crosswind component of Wind speeds to runway D RWY 05-20 (2500m) Crosswind component of Wind speeds to runway D RWY 05-20 (2500m) Crosswind component of Wind speeds to runway D RWY 05-20 (2500m) Crosswind component of Wind speeds to runway D RWY 05-20 (2500m) Crosswind component of Wind speeds to runway D RWY 05-20 (2500m) Crosswind component of Wind speeds to runway D RWY 05-20 (2500m) Crosswind component of Wind speeds to runway Crosswind component of		Target area	Elements	Abbreviations	Color code			
RJTT A RWY34L-16R (3000m) B RWY 04-22 (2500m) C RWY34R-16L (3360m) D RWY 05-23 (2500m) Tokyo Approach Control Area A RWY34L-16R A RWY34L-16R (3000m) D RWY 05-23 (2500m) D RWY 05-23 D Cloud Base D BASE D CONV D VIS D Cloud Base D BASE D CONV D VIS D Cloud Base D BASE D CONV D VIS D CONV D CONV D VIS D CONV D		Target area			SLIGHT		HIGH	
RJTT A RWY 34L-16R (3000m) B RWY 04-22 (2500m) C RWY 34R-16L (3360m) D RWY 05-23 (2500m) C RWY 34R-36L (3360m) D RWY 05-23 (2500m) Tokyo Approach Convective clouds A RWY 34L-16R (3000m) D RWY 34R-36L (3360m) Tokyo Approach Convective Convective Convective Convertion of Wind speeds to runway with moderate or heavy precipitation Tokyo Approach Convective Conv		RJTT A RWY 34L-16R (3000m) B RWY 04-22 (2500m) C RWY 34R-16L (3360m) D RWY 05-23 (2500m)	Change of wind direction	WIND-CHG		_		
RJTT A RWY 341-16R (3000m) B RWY 04-22 (2500m) C RWY 34R-16L (3360m) D RWY 05-23 (2500m)  Tokyo Approach Convective clouds  RITS sector R			Wind speed	WIND			≧ 40kt	
A RWY 34L-16R (3000m) B RWY 042-2 (2050m) C RWY 34R-16L (3360m) D RWY 05-23 (2500m) C RWY 34R-16L (3360m) D RWY 05-23 (2500m)  Tokyo Approach (3000m) D RWA 05-20 (2000m) D RWY 05-23 (2500m)  Tokyo Approach (3000m) D RWA 05-20 (2000m) D RWY 05-23 (2500m) D RWY 05-23			Crosswind component of Wind speeds to runway	AC-CROSS		≧ 29kt	≧ 33kt	
Converting the property of			Crosswind component of Wind speeds to runway	or				
B RWY 04-22 (2500m)   Crosswind component of Wind speeds to runway (1360m)   D RWY 93-23 (2500m)   D RWY 05-23 (2500m)   C RUNY 34R-16L (1360m)   C RUNY 34			with moderate or heavy precipitation				for non-grooved runway ≧ 20kt	
C RWY 34R-16L (3360m)   C RWY 5-23 (2500m)   C RWY 05-23 (2500m			Crosswind component of Wind speeds to runway			≧ 29kt		
(3360m) D RWY 05-23 (2500m)  Visibility Vis			Crosswind component of Wind speeds to runway	(for DEP		≧ 25kt		
DRWY 05-23 (2500m)   Cloud Base   BASE   SCT < 200ft   BKN or OVC < 2			with moderate or heavy precipitation	only)		for non-grooved runway $\geqq$ 20kt		
Cloud Base   BASE   SCT < 200ft   BKN or OVC < 2			Visibility	VIS			< 550m	
Thunderstorm  Tokyo Approach Control Area RIT Sector  Wind speed below 5000ft Convective clouds  Wind speed  Wind speed  Crosswind component of Wind speeds to runway Crosswind component of Wind speeds to runway With moderate or heavy precipitation B RWY 34L-16R (4000m) B RWY 34L-16L (2500m)  Tokyo Approach Control Area RIAA Sector  Tokyo Approach Convective clouds  Tokyo Approach Control Area RIAA Sector  Tokyo Approach Convective clouds  Toky	7		Cloud Base	BASE	SCT < 200ft		BKN or OVC < 200ft	
Snow SN (snow cover) heavy wet snow.  Tokyo Approach Control Area RJTT Sector  RJTT Sector  RJTA A RWY 34L-16R (4000m) B RWY 34R-16L (2500m)  B RWY 34R-16L (2500m)  Tokyo Approach Control Area RJAA Sector  Ta4, 135, T36, T38, T39, T40, detection area of each ATC sector  Ta4, T35, T36, T38, T39, T40, detection area of each ATC sector  Wind speed below 5000ft WIND  CONV Out of STARS  On STARS  WIND  CONV Out of STARS  On STARS  CONV  Out of STARS  On STARS  CONV  Out of STARS  On STARS  Square  ACONV  Out of STARS  Shot  CONV  Out of STARS  Spokt  Convective clouds  CONV  Out of STARS  SlG-CLD  ≥ 1%  ≥ 30% including the spow of spoinficant clouds in the detection area of each ATC sector  CRS  SN  SN  SN  SN  SN  SN  SN  SN  SN			Thunderstorm	TS		TS	TS OHD	
Control Area RITT Sector  Convective clouds  Convective clouds  Wind speed  Crosswind component of Wind speeds to runway CROSS  RIAA  A RWY 34L-16R (4000m)  B RWY 34R-16L (2500m)  Cloud Base  Thunderstorm  Tokyo Approach Control Area RIAA Sector  ATC sectors:  T34, T35, T36, T36, T38, T39, T40,  T38, T39, T40,  Convective clouds  CONV  Out of STARS  On STARS   A Out of STARS  On STARS  CONV  Out of STARS  On STARS   CROSS			Snow	SN			heavy wet snow fall	
RJAA A RWY 34L-16R (4000m) B RWY 34R-16L (2500m)  Tokyo Approach Control Area RIAA Sector RIAA Sector RIAA Sector Star, RIAA, T35, T36, T38, T39, T40, T38, T39, T40, T49.  ATC sectors:  Tak, T35, T36, T36, T38, T39, T40, T35, T36, T38, T39, T40, T45 RIAA Sector RIAA, T35, T36, T38, T39, T40, T38, T39, T40, RIAA Sector RIAA RIA SECTOR RIAA SECTOR RIAA SECTOR RIAA SECTOR RIAA SECTOR RIAA RIAA SECTOR RIAA SECTOR RIAA SECTOR RIAA SECTOR RIAA SECTOR RIAA RIAA SECTOR RIAA SECTOR RIAA SECTOR RIAA SECTOR RIAA SECTOR RIAA RIAA SECTOR RIAA SECTOR RIAA RIAA RIAA RIAA RIAA RIAA RIAA RI		Control Area	Wind speed below 5000ft	WIND		≧ 50kt		
Wind speed   Wind   ≥ 40kt   ≥ 40kt   ≥ 33kt   ≥ 29kt   ≥ 33kt   ≥ 25kt   ≥ 33kt   ≥ 37kt	1		Convective clouds	CONV	out of STARs	on STARs		
RJAA A RWY 34L-16R (4000m) B RWY 3AR-16L (2500m)  Tokyo Approach Control Area RJAA Sector  ATC sectors: T34, T35, T36, T38, T39, T40,  Crosswind component of Wind speeds to runway with moderate or heavy precipitation Maximum wind gust speeds when wind direction 360 - 060° or 180 - 250°  GUST  ≥ 25kt ≥ 31kt ≥ 37kt  ≥ 37kt  ≥ 37kt  ≥ 37kt  ≥ 25kt ≥ 31kt ≥ 37kt ≥ 31kt ≥ 37kt ≥ 37kt ≥ 37kt ≥ 31kt ≥ 37kt ≥ 35kt ≥ 30ki	<b>/'</b>	RJAA A RWY 34L-16R (4000m) B RWY 34R-16L (2500m)	Wind speed	WIND			≧ 40kt	
RJAA A RWY 34L-16R (4000m) B RWY 3AR-16L (2500m)  Tokyo Approach Control Area RJAA Sector  ATC sectors: T34, T35, T36, T38, T39, T40,  Crosswind component of Wind speeds to runway with moderate or heavy precipitation Maximum wind gust speeds when wind direction 360 - 060° or 180 - 250°  GUST  ≥ 25kt ≥ 31kt ≥ 37kt  ≥ 37kt  ≥ 37kt  ≥ 37kt  ≥ 25kt ≥ 31kt ≥ 37kt ≥ 31kt ≥ 37kt ≥ 37kt ≥ 37kt ≥ 31kt ≥ 37kt ≥ 35kt ≥ 30ki	<b>\</b> .		Crosswind component of Wind speeds to runway			≧ 29kt	≧ 33kt	
A RWY 34L-16R (4000m) B RWY 34R-16L (2500m) Cloud Base Thunderstorm Snow  Tokyo Approach Control Area RJAA Sector RJAA Sector RJAA Sector  T34, T35, T36, T38, T39, T40,  Maximum wind gust speeds when wind direction 360 - 060° or 180 - 250° GUST  ≥ 25kt ≥ 31kt ≥ 37kt ≥ 37kt ≥ 37kt ≥ 25kt ≥ 31kt ≥ 37kt ≥ 37kt ≥ 25kt ≥ 31kt ≥ 37kt	7		Crosswind component of Wind speeds to runway	CROSS				
A RWY 34L-16R (4000m) B RWY 34R-16L (2500m) Cloud Base Thunderstorm Snow  Tokyo Approach Control Area RJAA Sector T34, T35, T36, T38, T39, T40, T38, T39, T40,  A RWY 34L-16R (4000m) SI RWY 34R-16L (2500m) GUST  ≥ 25kt ≥ 31kt ≥ 37kt ≥ 37kt ≥ 25kt ≥ 31kt ≥ 37kt ≥ 25kt ≥ 31kt ≥ 37kt	١						for non-grooved runway ≧ 20kt	
Visibility   Vis   BR without precipitation   SRN witho			= :	GUST		≧31kt	≧37kt	
Thunderstorm  Snow  SN  Wet snow (snow cover)  Wind speed below 3000ft  Control Area RJAA Sector  ATC sectors: T34, T35, T36, T38, T39, T40,  Coverage of significant clouds in the detection area of each ATC sector  CB  TS  TS  TS  Wet snow (snow cover)  Wind speed below 3000ft  CONV  Out of STARS  SIG-CLD  ≥ 1%  ≥ 10%  ≥ 30% including			Visibility				< 550m	
Snow  Solet  Convector  Snow  Snow  Snow  Snow  Snow  Snow  Snow  Solet  Solet  Snow  Snow  Snow  Snow  Snow  Snow  Snow  Snow  Solet  Snow  Sn			Cloud Base	BASE	SCT < 250ft		BKN or OVC < 200ft	
Snow			Thunderstorm	TS		TS	TS OHD	
Tokyo Approach Control Area RJAA Sector  ATC sectors: T34, T35, T36, T38, T39, T40,  T38, T39, T40,  Tokyo Approach Convective deleuw 3000ft  WIND  CONV Out of STARS  SIG-CLD  ≥ 1%  ≥ 10%  CR  ≥ 30% including	١.		Snow	SN			heavy wet snow fall	
RIAA Sector Convective clouds CONV out of STARS on STARS  ATC sectors: T34, T35, T36, T38, T39, T40, detection area of each ATC sector  CONV out of STARS on STARS  SIG-CLD ≥ 1%  ≥ 10%  CR	4		Wind speed below 3000ft	WIND		≧ 50kt		
ATC sectors: T34, T35, T36, T38, T39, T40, detection area of each ATC sector  CB  SIG-CLD ≥ 1% ≥ 10% ≥ 30% including		Control Area	Convective clouds	CONV	out of STARs	on STARs		
T38, T39, T40, detection area of each ATC sector ≥ 30% including	7	ATC sectors:	Coverage of significant clouds in the	SIG-CLD	≧ 1%	≧ 10%		
		T38, T39, T40,	5 0	СВ			≧ 30% including CB	

#### **How to translate?**

#### Statistical assessment

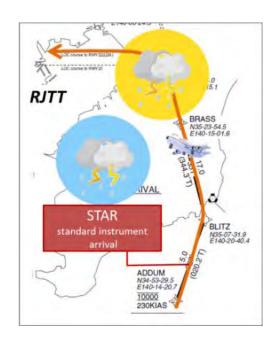
e.g., correlation between convective clouds coverage rate in the specific airspace of ATC sector and impacts on ATC capacity



Japan Meteorological Agency

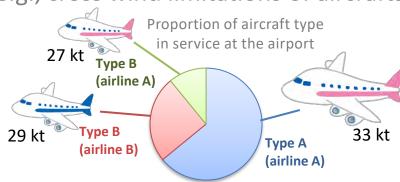
# Based on the situation that affect aircraft operations

e.g., whether convective clouds are on the arrival route or not



# Utilizing threshold of aircraft operations

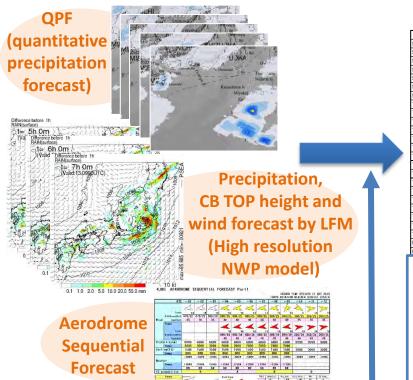
e.g., cross wind limitations of aircrafts

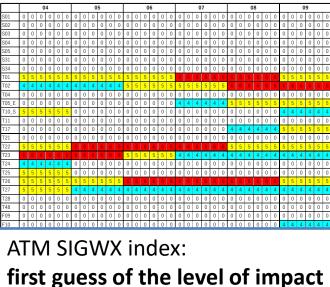


Level of	Cross wind component to the RWY (Tokyo Int'l)				
impact	Dry condition	Wet condition			
High	33 kt or above	25 kt or above			
Medium	29 kt or above	-			
Slight	-	-			
None	Below 29 kt	Below 25 kt			



Procedure of creating category forecast to show SIGWX impact to ATFM

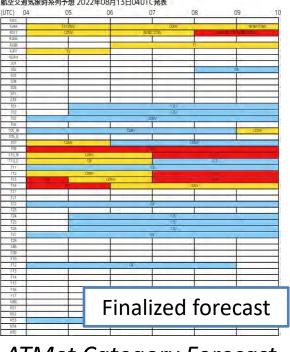




to ATC sectors, terminal areas,

Forecaster's input

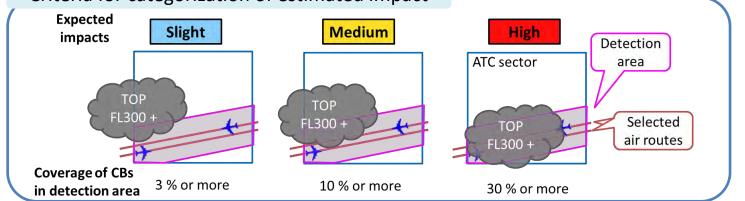




ATMet Category Forecast

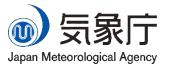
#### Criteria for categorization of estimated impact

and airports



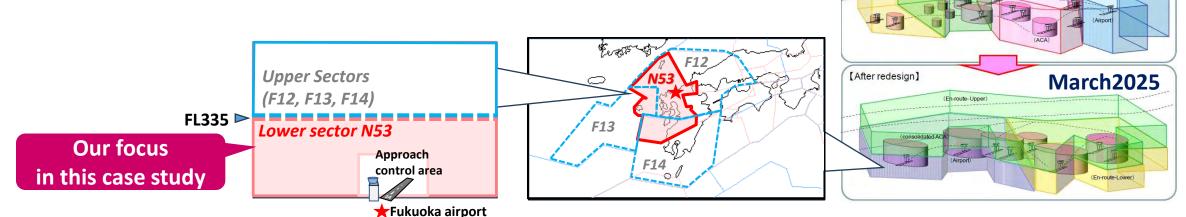
Ref.
ICAO APAC MET/R WG/7 IP/05
ICAO APAC MET/R WG/12 IP/03, SP/12





# **Contents**

- Introduction
- 2. Translation from meteorological condition to impact on ATM
- 3. Case Study: operational capacity management utilizing impact-based MET information
  - Stage 1. WX briefing before the ATMO on duty
  - Stage 2. Beginning of ATMO duty
  - Stage 3. Taking ATFM measures



Enroute airspace redesign has been

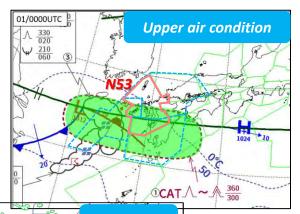
completed March 2025.

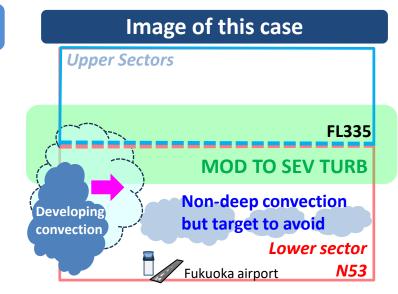
[Before redesign- En-route and ACA]

#### Stage 1. WX briefing before the ATMO on duty

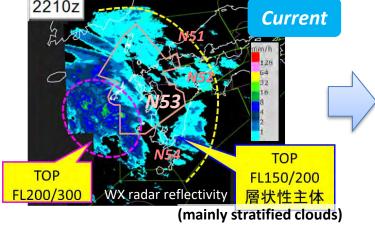
JMA forecasters input to ATMO about overview of current and forecast meteorological situation within their duty:

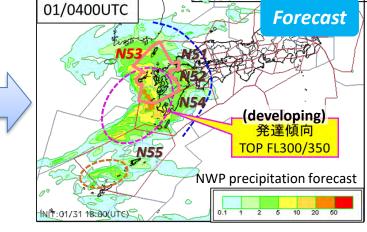
✓ SIG-CLOUDs and turbulence was estimated to impact on lower sectors' air traffic.





- Developing convective clouds and non-deep convection at middle level of atmosphere was expected to be obstacles for the flights in lower altitude.
- Turbulence could affect aircrafts to select flight altitude.





#### ATMet Category forecast 23 UTC 31 Jan 2025 issue

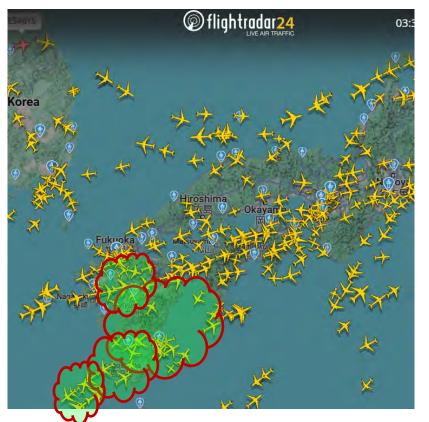
N51	T			
N52	10			
N53			2(G-CLD	
N54	11.		5IG+CLD.	

TMAT to TMU @Tokyo

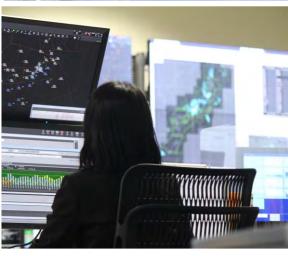


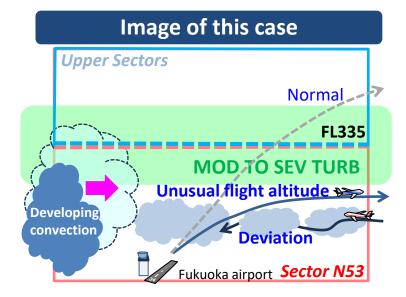
@Fukuoka

#### Stage 2. Beginning of ATMO duty





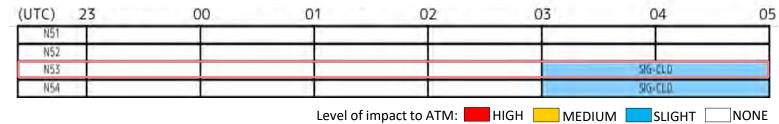




Being aware of possible congestion and increase in ATCO workload within the lower sector N53, ATMO on duty:

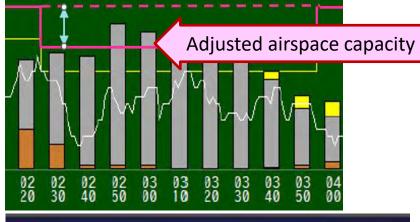
- ✓ checked actual impact on ATCO operations
- ✓ adjusted the Airspace Capacity

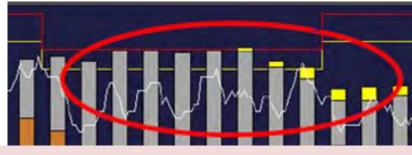
ATMet Category forecast 23 UTC 31 Jan 2025 issue



Hourly refresh "at-a-glance information" to grasp overview of MET impact to multiple ATC sectors/airports within the target period.

#### **Stage 3. Taking ATFM measures**

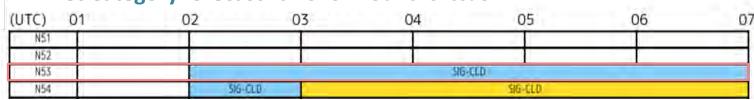




An ATFM measure was implemented according to the adjusted airspace capacity.

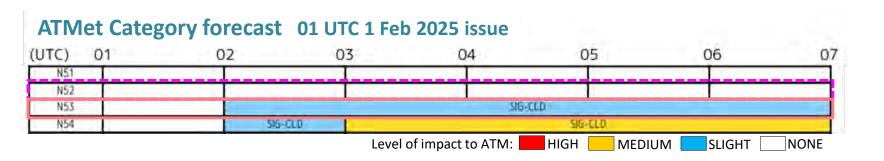
# Updated MET info TOP FL200/300 層状性主体 (一部強L) stratified (partially high reflectivity) TOP FL200/300 一部FL300超 Partially ABV FL300 TOP FL200/250 SEV TURB FL310/360 ~06UTC頃

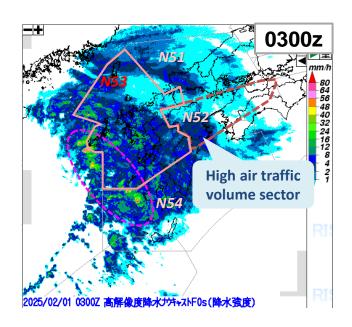
#### ATMet Category forecast 01 UTC 1 Feb 2025 issue



- ✓ ATMO consider severe weather forecasts and real-time information provided by MET, as well as aircraft flight status and plans, and determined airspace capacity in coordination with ATCO.
- ✓ After coordination with the ATCO, the ATMO will implement the ATFM measures for ACC sectors that are expected to exceed airspace capacity.
- ✓ ATMO consider restoring airspace capacity based on weather recovery forecasts and real-time information provided by MET, and restore airspace capacity while checking the actual operational status of ATCO.
- ✓ If the actual weather conditions differ from the forecast, MET will update the forecast. In addition to updating the forecast, ATMO also adjusts airspace capacity by taking into account the pre-forecast commentary, realtime weather information, and aircraft flight status.

#### **Stage 3. Taking ATFM measures**





#### **MET/ATM** joint review

N53: Forecast of meteorological impact was reasonable.

N52: There was a room for refinement; the forecast did not show possible meteorological impact, but ATFM measure was taken.



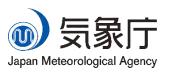
#### **Conclusion**

- JMA has developed impact-based MET information in coordination with JCAB and related stakeholders.
- Currently, the impact-based MET information (e.g. ATMET Category Forecast) support ATMO's overviewing the situation within the target period.
- Forecaster's verbal weather briefing provide necessary focus of adverse weather condition which affect to ATM. This essentially supports ATMO's decision making on adjustment of ATC capacity and taking effective ATFM measures.
- Based on the identified issue through the MET/ATM joint review, two parties are working together to refine the criteria for conversion of meteorological condition to the impact on ATM operation, aiming at more accurate MET/ATM translation.

Close coordination between MET/ATM is essential to deliver effective ATFM.







Thank you!

