*International Civil Aviation Organization*

**NINETEENTH MEETING OF THE METEOROLOGY SUB-GROUP (MET SG/19) OF APANPIRG**

Bangkok, Thailand, 3 – 6 August 2015

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**Agenda Item 6: Research, development and implementation issues in the MET field**

6.5) MET/ATM coordination (including MET/R TF Report)

# METEOROLOGICAL SERVICES FOR THE TERMINAL AREA

(Presented by Japan)

**SUMMARY**

This paper presents the outline of the services of ATMetC Tokyo Metropolitan Area Team (TMAT) of the Japan Meteorological Agency (JMA), newly implemented MET services to support ATM operation in the Tokyo metropolitan area.

## 1. Introduction

1.1 The Japan Meteorological Agency (JMA) established the Air Traffic Meteorology Center (ATMetC) at Fukuoka in October, 2005 and started its operation in February, 2006 to support operations of the Air Traffic Management Center (ATMC) of the Japan Civil Aviation Bureau (JCAB) with providing weather briefings and ATM-tailored meteorological information. (See MET/ATM Seminar 2013 IP/3)

1.2 After runways expansion at both Tokyo International Airport (Haneda Airport) and Narita International Airport (Narita Airport) which are located in the Tokyo metropolitan area, air traffic volume in the area is still growing more and more. Accordingly, new flight procedures have been introduced to deal with such increasing air traffic demands.

1.3 In response to the situation above, JCAB organized the Traffic Management Units (TMUs) as a branch of ATMC in October, 2011 and they were placed at Haneda Airport (called Haneda TMU) and Tokyo Area Control Center (called Tokorozawa TMU) in order to conduct tactical and flexible Air Traffic Flow Management (ATFM) in and around the Tokyo metropolitan area.

1.4 To contribute to appropriate ATM through weather service provision to TMUs, JMA organized the Tokyo Metropolitan Area Team (TMAT) in Haneda Airport as a branch of ATMetC in April, 2014.

1.5 TMAT provides TMUs of meteorological information and detailed briefings focused on significant weather which affects air traffic flow in and around the Tokyo metropolitan area, including the approach control area of Haneda/Narita Airport and its neighboring area. As the information helps them conduct effective ATFM operations, TMAT indirectly contributes to forming safe and efficient air traffic flow.

## 2. Meteorological services of TMAT

*Operational collaboration between TMUs and TMAT in close coordination with relevant parties*

2.1 TMUs are responsible for setting up the appropriate capacity value (CAPA) in each jurisdiction area to secure optimum volume of air traffic flows up to six hours ahead. Therefore ATM officers of each TMUs work with air traffic controllers of each Tokyo ACC and Tokyo International Airport in the same operations room, sharing information about situation expected to affect traffic capacities with each other.

2.2 Since CAPA is mostly determined by the degree of influence by weather on the ATC operation, TMAT provides TMUs of information on weather phenomena expected to cause reduction of ATC capacity.

2.3 Forecasters of TMAT work in the same operations room as forecasters of Tokyo Aviation Weather Service Center, in order to detect sudden changes of weather conditions immediately and obtain amended forecast scenarios as soon as possible. Furthermore, forecasters of TMAT often get in touch with other relevant offices in JMA, such as ATMetC and Narita Aviation Weather Service Center, using telephone and chat facility, to share information about significant weather conditions. Through such operational coordination, TMAT can provide appropriate meteorological information to TMUs in a timely manner.

*Overview of information and services provided by TMAT*

2.4 In order to help TMUs conduct appropriate air traffic flow control based on prediction of future air traffic flow and weather conditions, TMAT provides following dedicated information and services to TMUs:

- Weather Briefings (regular/extra)

  - Providing methods: Video conference, telephone and online chat
  - Regular briefings: 0510, 1130, 2030 and 2250UTC
  - Extra briefings: As necessary (24 hours/everyday)
  - Target areas: Control area of Tokyo ACC and Tokyo approach control area

- Tokyo Metropolitan Area Weather Bulletin for ATM (an example is shown in Figure 1)

  - Target areas: Haneda Airport, Narita Airport, Tokyo approach control area and ATC sectors around Tokyo metropolitan area
  - Contents: Brief comments on phenomena expected to affect air traffic flow, and appropriate images to explain weather conditions and forecast
  - Issuance time: 00 and 06UTC (two times/day)
  - Forecast time: up to 6 hours

- ATM Categorized Impact of weather ELement prediction (ATM CIEL) (an example is shown in Figure 2)

- Target areas: Haneda Airport, Narita Airport, Tokyo approach control area and ATC sectors around Tokyo metropolitan area
  - Contents: Level of expected impact of significant weather on ATC operations
  - ✧ High : Need to reduce CAPA significantly
  - ✧ Medium : Need to reduce CAPA
  - ✧ Slight : Need to reduce CAPA slightly
  - ✧ None : Not need to reduce CAPA
  - Issuance time: every hour (except from 14 to 16UTC)
  - Forecast time : up to 6 hours (temporal resolution: 10 minutes to 1 hour)
  - Targeted weather phenomena:
  - ✧ Haneda Airport and Narita Airport: Thunderstorm, Visibility, Ceiling, WIND, etc.
  - ✧ In and around the Tokyo approach control area: CBs and convective clouds

*Difference in temporal/spatial scale between ATMetC and TMAT services*

2.5 At the MET/ATM seminar 2013 in Bangkok, Japan reported the case that even small CBs and convective clouds affected air traffic in the Tokyo approach control area. (See MET/ATM Seminar 2013 IP/6)

2.6 ATMet Category Forecast issued by ATMetC (See MET/ATM Seminar WP/9, MET/ATM Seminar 2013 IP/5), provides information on whether convective clouds are expected to present in the Tokyo approach control area. There are considerable differences in the impact of the convective clouds on air traffic flow even when they exist in the same approach control area, according to their location and altitude. Therefore, TMUs need more precise information on the location of convective clouds, namely, whether they would block Standard Terminal Arrival Route (STAR).

2.7 In order to meet this demand, the targeted areas in the ATM CIEL are defined smaller than those of ATMet Category Forecast. The areas are the subdivisions of the Tokyo approach control area and its surrounding sectors (subdivided areas are shown in Figure 3). In addition, forecasters of TMAT predict the phenomenon up to one hour with 10-minutes temporal resolution in ATM CIEL by utilizing the JMA's very-short-time forecast products, such as TREND and precipitation nowcasts.

*Difference in the impact of significant weather conditions on the ATC operations according to its scale and location.*

2.8 Standard arrival and departure routes of Haneda Airport and Narita Airport (toward North) are shown in Figure 4. As it can be seen from this Figure, sector T03 and T07 are one of the highest density air traffic areas where a large number of aircraft, which departed from and head to Haneda and Narita Airports, pass through. When CBs exist in this area, many aircraft head to particular airspace than usual in order to avoid the CBs, and controllers become less able to handle those increased number of flights. As a result, the ATC capacity in this area decreases. The case studies how CBs or convective clouds in T03 and T07 affected the air traffic flows are shown in the following.

(1) Influence of CB location (See Figure 5)

On 12 August 2014, many flights both departed from and heading to Haneda airport were forced to deviate due to the expansion of CBs located over the standard departure / arrival routes. In this case, TMUs started to reduce CAPA from 2200UTC 11th due to the occurrence of CBs. Many flights heading to Haneda airport deviated to the eastern part of T07 at 0320UTC 12th, since CBs widely expanded in the western part of T07. As a result, such flights took a route which overlaps with the other route which was used by the aircraft heading to Narita airport, and consequently, ATC capacity in the sector T07 greatly reduced.

At 1000UTC 12th, CBs moved to the eastern part of the T07. In this area, influence of ATC operation became relatively lower and finally CAPA was reset to the standard value as "100%".

(2) Influence by the scale of CB (See Figure 6.)

In the case of 20 July 2014, small CBs occurred in T03 and T07. In order to avoid the CBs, many flights both departed from and heading to Haneda airport were forced to deviate to westward and eastward. However, in this case, since the areas covered by the CBs were limited, those flights did not need to deviate into another ATC sectors. As a result, the influence of the CBs on air traffic flow was not large and TMUs slightly reduced CAPA. This case corresponds to the category "Medium" or "Slight" in the ATM CIEL.

In the case of 17 July 2014, large-scale CBs occurred in T03 and T07. Flights departed from Haneda airport were forced to deviate more greatly than the previous case. As the aircraft moved from T03 (where the standard departure route from Haneda airport is included) to T07 (where the standard arrival route is included) in order to avoid CBs, aircrafts departed from and heading to Haneda airport were required to alter their routes ( "Head-on", which has significant influence on ATC operation). In particular, since this area is close to Haneda airport, those aircrafts were forced to pass through same region and same altitude. As a result, the influence of the CBs on the air traffic flow greatly increased and TMUs reduced CAPA significantly. This case corresponds to the category "High".

2.9 CBs have different influences on the air traffic flow depending on their locations, scales and altitudes. The precise meteorological information, such as the locations and scales of CBs, is required for effective operations of TMUs like CAPA setting.

2.10 The targeted areas of ATM CIEL were decided in consideration of ATC procedures with the cooperation of ATM service provider. TMAT can provide ATM-tailored meteorological information which TMUs need through ATM CIEL.

*Next steps for the future*

2.11 TMAT aims to improve its meteorological information in closer consideration of flight operations in the target areas and establish verification methods for the information. Furthermore, the criteria of ATM CIEL which are currently defined uniformly in all sub-sectors will be reviewed to be more appropriate and specific values for each sub-sector.

## 3. Requirements of meteorological services for terminal area

3.1 The MET Divisional meeting in 2014 (MET DIV/14) agreed to develop meteorological services for the terminal area in ASBU Block1. Though the definition of the terminal area has not maturely specified yet, the target area of TMAT (in and around the Tokyo approach control area) should be a good reference for the development of the concept of meteorological services for the terminal area.

3.2 Toward ASBU Block 1, through the experience of TMAT, requirements for meteorological services and information for the terminal area should include the following:

- Coordinate with ATM parties in determining the target area for prediction in consideration of flight operation procedures.
- Predict weather phenomena with consideration for the characteristics of ATC operations in the target area
  - Airport: Thunderstorm, Visibility, Ceiling, Wind (Cross Wind/ Tail Wind), etc.
  - Terminal area: CBs and convective clouds, Strong wind at the lower level
- Provide forecasts with precise time scale. (In the Tokyo metropolitan area, ten minutes interval forecast is required for at least one hour ahead. )

## 4. Summary

4.1 JMA has organized TMAT to provide TMUs of tailored meteorological information specialized in the Tokyo metropolitan area. TMAT helps TMUs to conduct effective ATM operations with such information. In accordance with requirements from the TMUs, the time and spatial scale of ATM CIEL are more precise (10 minutes to 1 hour) than those of ATMet Category Forecast (1hour) issued from ATMetC. The target areas in ATM CIEL were also decided with the cooperation of TMUs.

4.2 Through the experience of TMAT, some of the possible requirements for meteorological services for the terminal area have been derived. In order to provide appropriate information for the terminal area, the following points should be taken into consideration:

- It is important to coordinate with ATM service provider to determine the suitable target area in consideration of ATC and aircraft operations.
- Weather phenomena to be predicted should be specifically defined for each target area with consideration for the characteristics of ATC operations in the area, e.g. congestive aerodrome or the terminal area.
- Meteorological information for the terminal area would necessarily have precise time scale, like the ATM CIEL has minimum 10 minutes temporal resolution.

## 5. Action by the meeting

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

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# Attachment

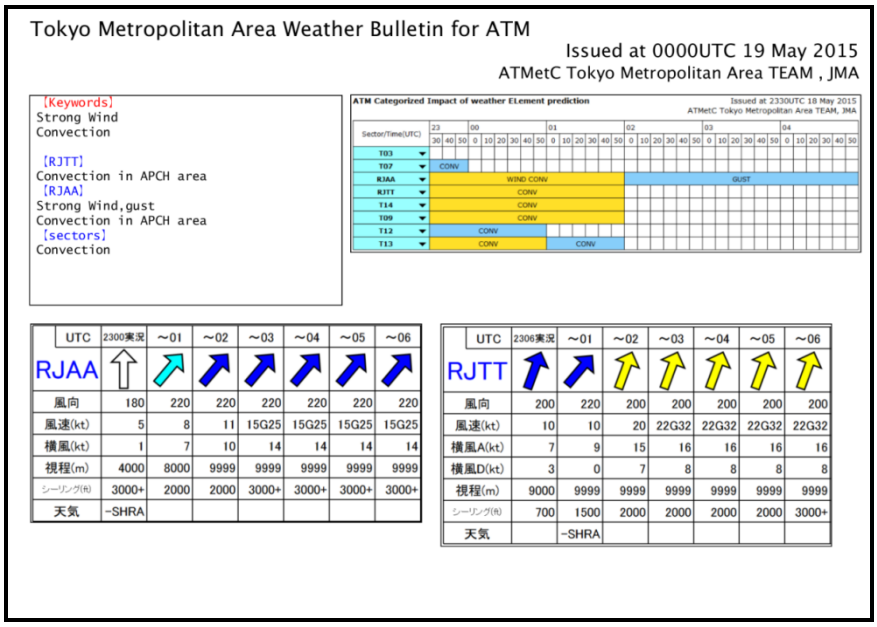


Figure 1. Tokyo Metropolitan Area Weather Bulletin for ATM

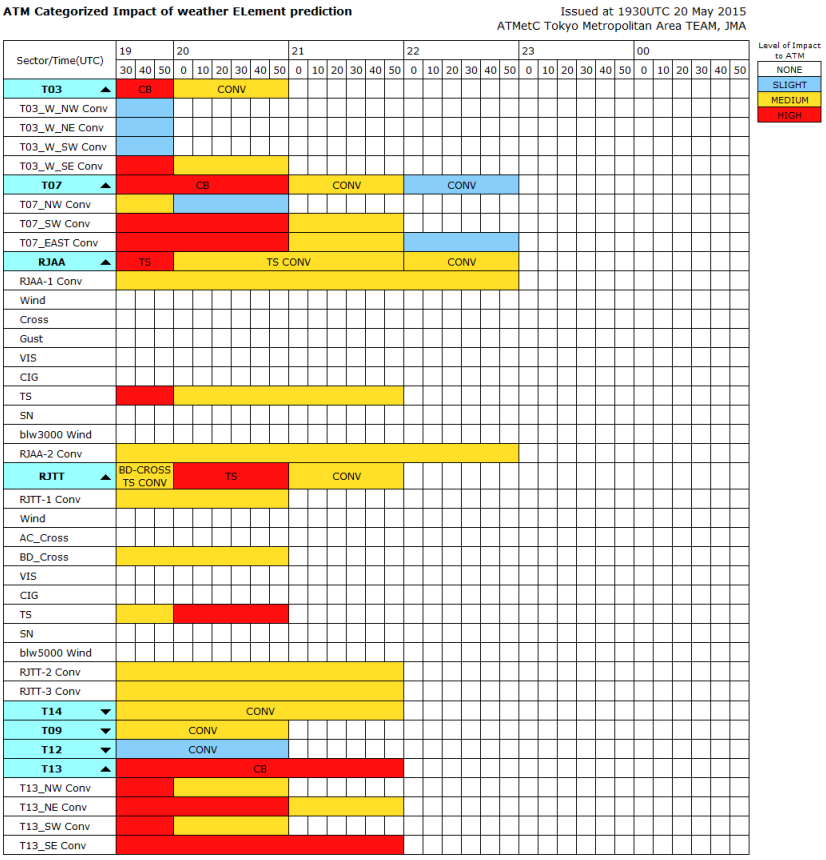


Figure 2. ATM Categorized Impact of weather Element prediction

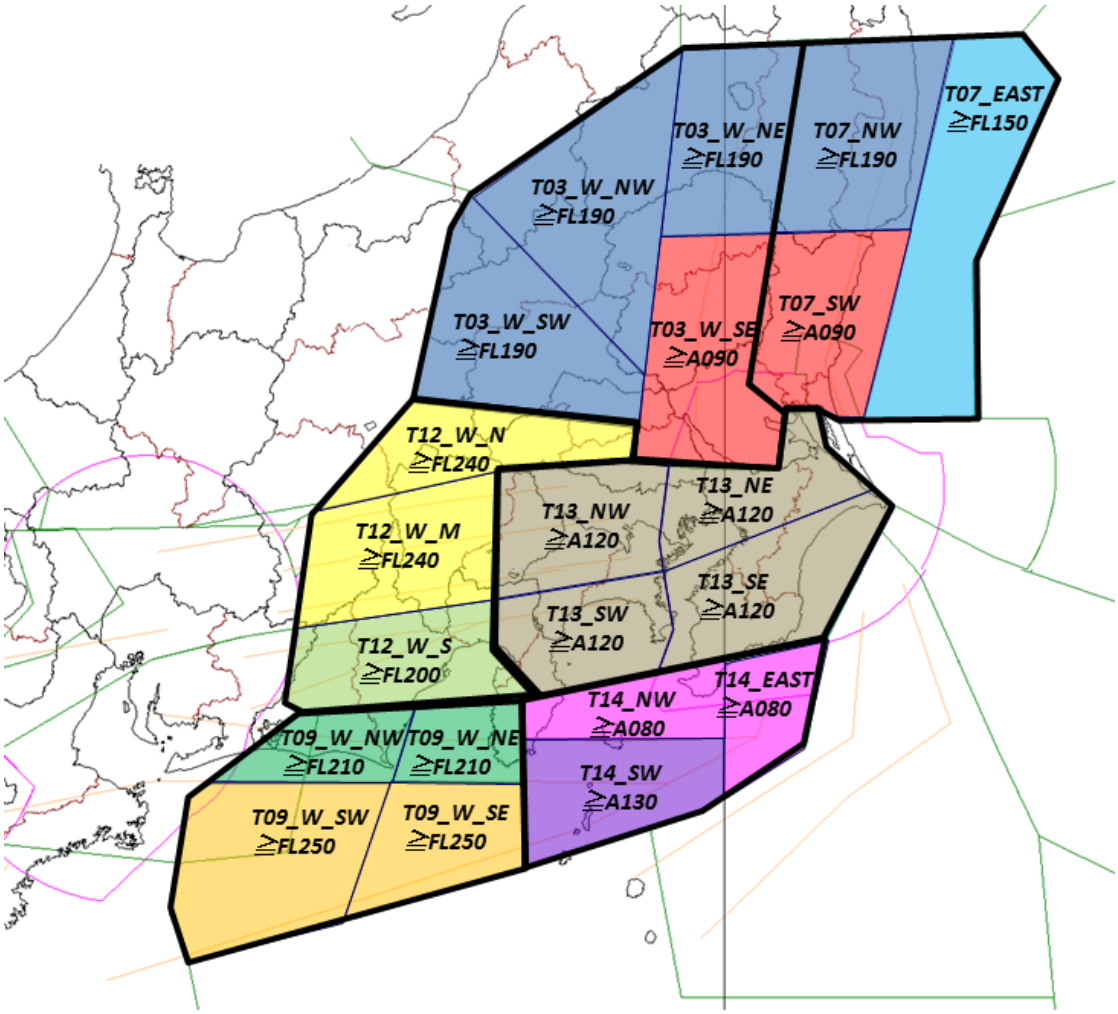


Figure 3. Target areas/altitudes for ATM CIEL

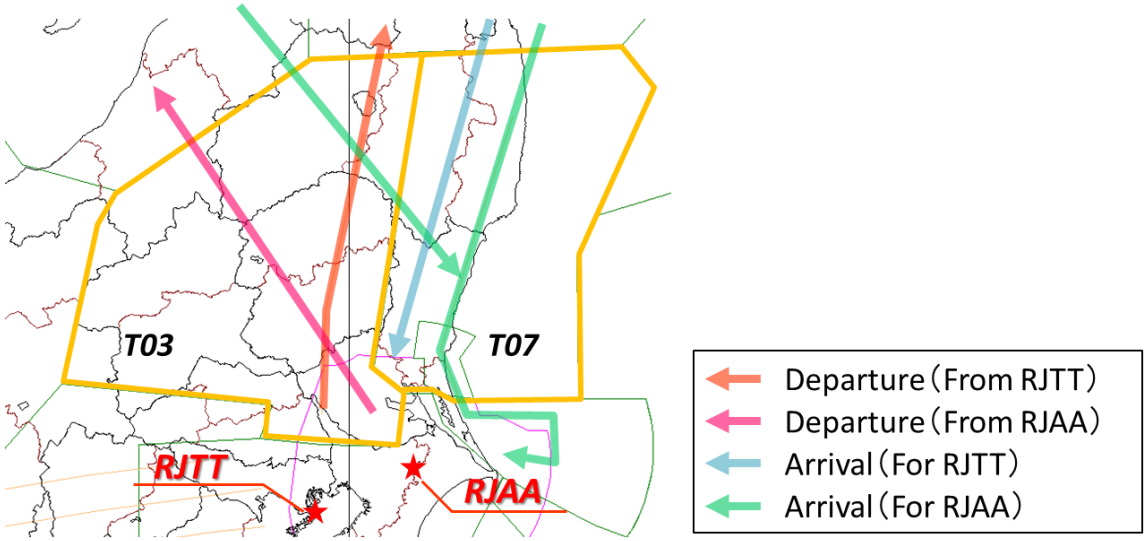


Figure 4. Standard arrival and departure routes of Haneda Airport and Narita Airport (toward North)

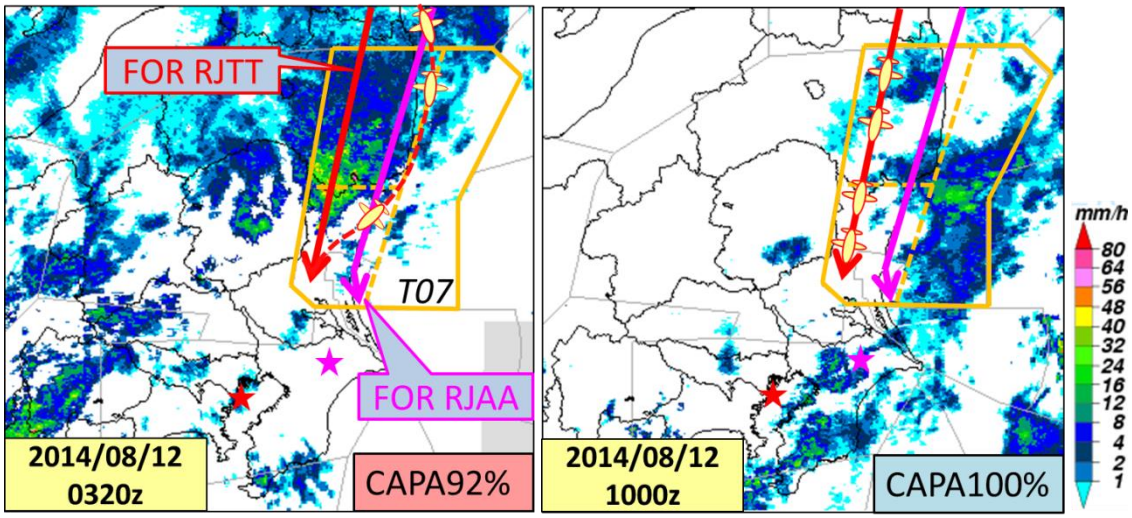


Figure 5. Influence of CB location (12 August 2014)
Red solid arrow shows the standard arrival route of Haneda airport (RJTT), and pink solid arrow shows the standard arrival route of Narita airport (RJAA). At 0320z (left), the aircraft heading to RJTT greatly deviated to eastward to avoid CBs (it is shown a red dashed arrow) and intersect the course for RJAA. Therefore, ATC capacity greatly reduced. At 1000UTC (right), CBs moved to the eastern part of the T07. The aircraft for RJTT was flying standard arrival route, influence of ATC operation became lower and CAPA was reset to standard value "100%".

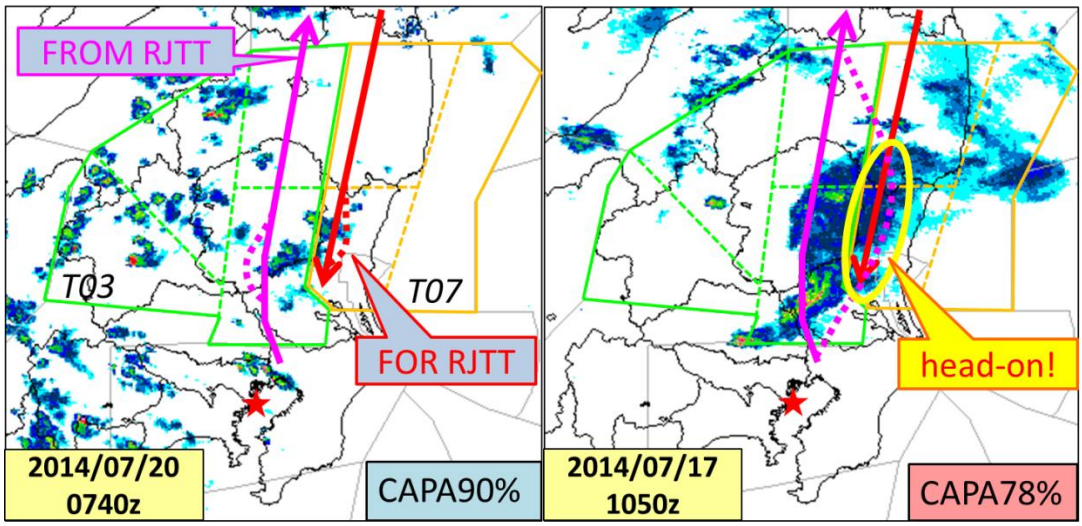


Figure 6. Influence of CBs scale (left: 20 July, 2014, right: 17 July, 2014)
Red solid arrow shows the standard arrival route of RJTT, pink solid arrow shows the standard departure route from RJTT. In the case of the left figure, aircraft slightly deviated to avoid CBs and deviation area was limited within the sectors. In the case of the right figure, the aircraft departed from RJTT flew from T03 to T07 (pink dashed arrow). Aircraft departed from and heading to RJTT were required to alter their routes ("head-on"). In particular, since this area is close to RJTT, each aircraft passed through same region and same altitude. As a result, the influence of air traffic flow was greatly increased.