



MET services in support of ATM Operations in China

MET/ATM Webinar 2022

Presented by China





Content



铂尔曼



1

MET Services and Products

2

Developments in CDM

3

ATM impacts conversion

4

Conclusion



01

MET Services and Products

- ◆ Tailored Meteorological services and products to support Air Traffic Management Operations



• MET Services and Products

Massive Delay Response
System (MDRS)
MET Services



Daily
Weather Briefing



Collaborative
Consultation



Multiple
MET Products



- Massive Delay Response System (MDRS)
MET Services

| The MDRS 30 hours Probability Forecasts of Significant Weather | | | | | |
|--|---------------------------------------|----------------------|--------------------------------------|-------------|---|
| Area: Central and southern China | | | Time of issuance: HH DD/MM/YYYY | | |
| Airports | Significant weather and the intensity | Affecting Period | Affecting areas and directions | Probability | Remarks |
| Airport Name (XXXX) | Heavy rain with thunderstorms | 10-13Z DD/MM/YYYY | Terminal area and around the airport | ≥70% | 1) The convection coverage ratio: 30%-40%; 2) Heavy rain with thunderstorms will occur during 10-11Z at the airport with visibility of 700-1000m and gust of 16-18m/s. |

Pre-tactical Stage (12-30h)

30 hours probability forecasts of significant weather are provided every day for pre-tactical ATFM decision making.

Tactical Stage (2-6h) (Regional Significant Weather Forecasts)

Regional significant weather forecasts aiming to predict the hazardous weather on the major routes are generated to support air traffic management measures.

Command Stage (<2h) (Terminal area and Aerodrome Weather Warnings and Alerts)

Terminal area warnings are issued and updated every two hours once the MDRS is initiated.



- Daily Weather Briefing

Meteorologist

- Provides daily weather briefing about the severe weather in the next 24 hours on the busy routes and the terminal areas

ATM Controller

- Analyzes the situation of expected traffic capacity decline and proposed traffic management initiatives

ATFM Controller

- Formulates CDM release policy according to the proposed flow management measures

Chief Controller

- Predict the operation situation and determine the traffic management initiatives to be taken



- On-site Collaborative Consultation



Face to face

The consultations mainly focus on the adverse weather at the airports, busy terminal sectors, air routes and key navigation points in the next 6 hours.

Higher Frequency

Conduct collaborative consultation every 2h during thunderstorm seasons to transfer information in time

Information Visualization

Develop MET and ATM information integration system to build up common situational awareness



- Multiple MET Products



Aerodrome
Weather Warning



Runway Wind
Forecast Product

02

Developments in CDM

- ◆ MET and ATM coordination
- ◆ Products in support of Collaborative Decision Making



- Collaborative Convective Forecast Product (CCFP)
 - When Issued?
Three times a day
(around 02Z, 06Z and 10Z)
 - Who Issued?
Aviation Meteorological Center or Regional Meteorological Center
Meteorologists
 - What Forecasted?
The convective weather in the next 2,4,6,8 hours
 - What it for?
in support of 2-8 hours operational
decision making

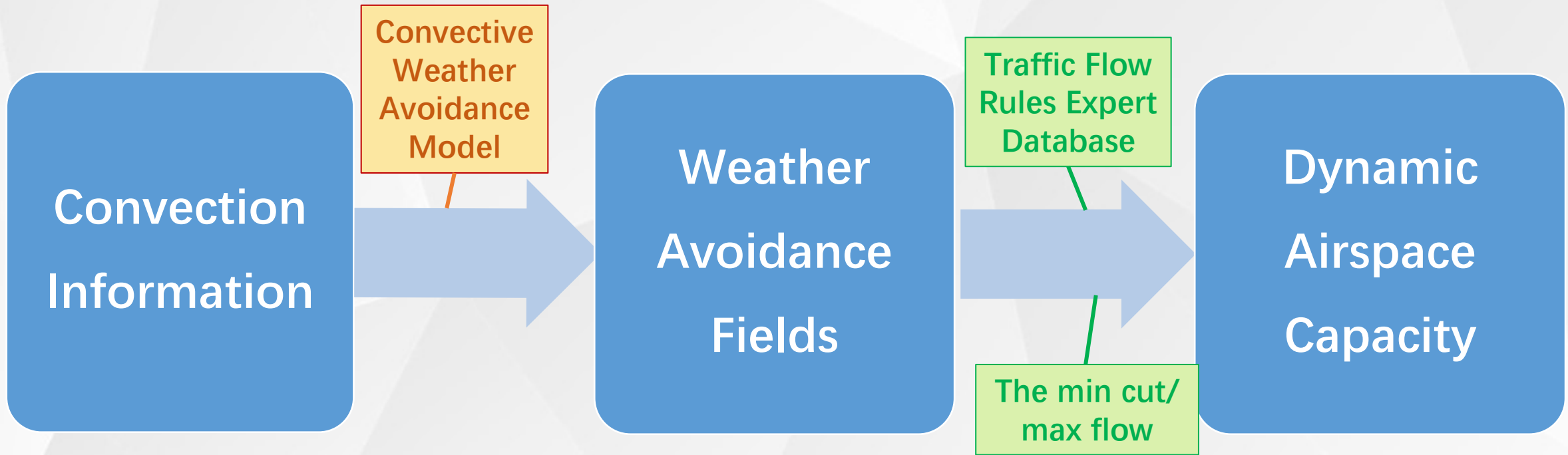
03

ATM impacts conversion

- ◆ Quantifying weather impacts on airspace capacity



- Convection Dynamic Capacity Assessment System (CDCAS)



➤ Reference: 《对流天气对航空运行区域通行能力影响研究与验证》项目

The information in this part mainly refer to the technical program called “Research and Verification of Convective Weather Impacts on Traffic Capacity in Aviation Operation Area ”



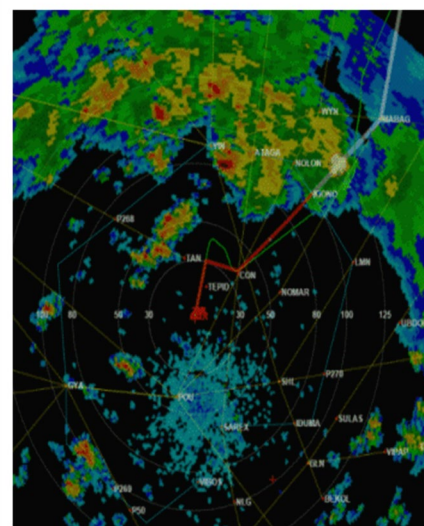
• Convective Weather Avoidance Model

The process of building a Convective Weather Avoidance Model

Select typical thunderstorm cases

| | | | |
|----|-------|-----|-------|
| 1 | 3月30日 | 系统性 | 飏线 |
| 2 | 4月26日 | 系统性 | 飏线 |
| 3 | 5月8日 | 系统性 | 大范围雷雨 |
| 4 | 5月11日 | 系统性 | 飏线 |
| 5 | 5月17日 | 系统性 | 飏线 |
| 6 | 5月18日 | 系统性 | 飏线 |
| 7 | 5月22日 | 系统性 | 飏线 |
| 8 | 5月23日 | 系统性 | 大范围雷雨 |
| 9 | 6月6日 | 系统性 | 飏线 |
| 10 | 6月20日 | 热力性 | 多单体 |
| 11 | 6月25日 | 热力性 | 多单体 |
| 12 | 7月8日 | 热力性 | 多单体 |
| 13 | 7月11日 | 热力性 | 多单体 |
| 14 | 8月13日 | 系统性 | 飏线 |
| 15 | 8月19日 | 系统性 | 大范围雷雨 |

Marking features of flights rerouting



Setting factors for the model

Range scale(km):
6,8,10,12,16,20,24,30,36,
40,50,60;
Coverage Rate(%):
5,10,20,30,40,50,60,70,80,
90
**Reflectivity
Intensity(dBZ):**
15,20,25,30,35,40,45

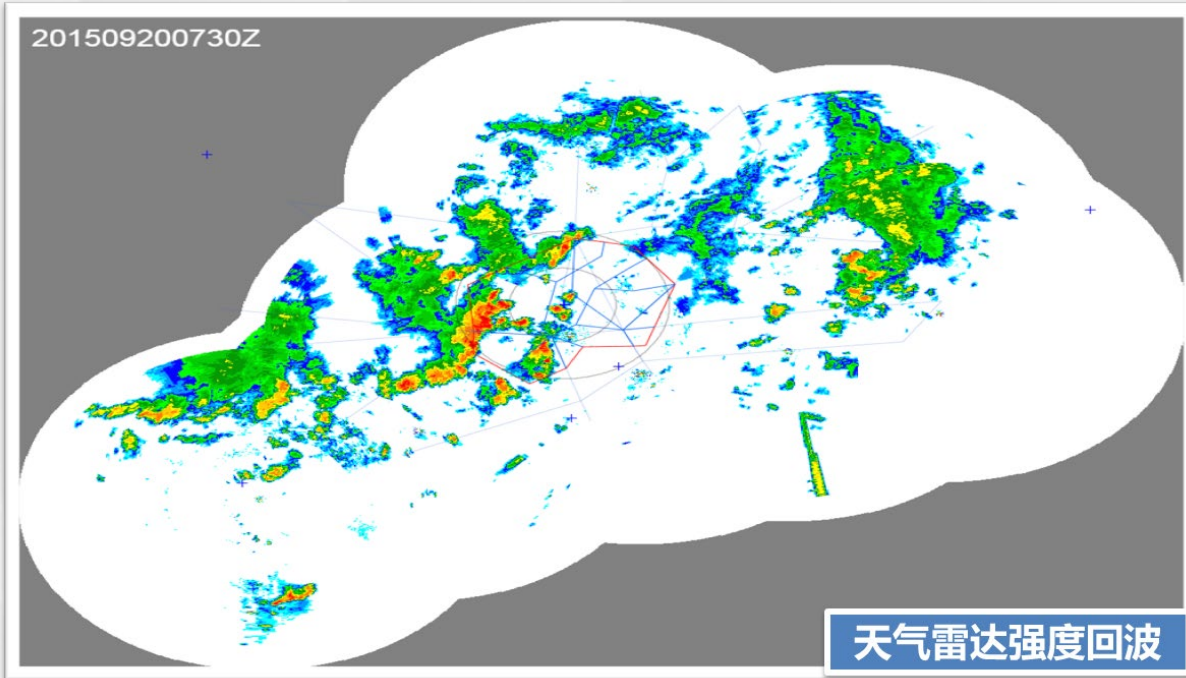
Gaussian Classification Method

Get the output: Weather Avoidance Fields

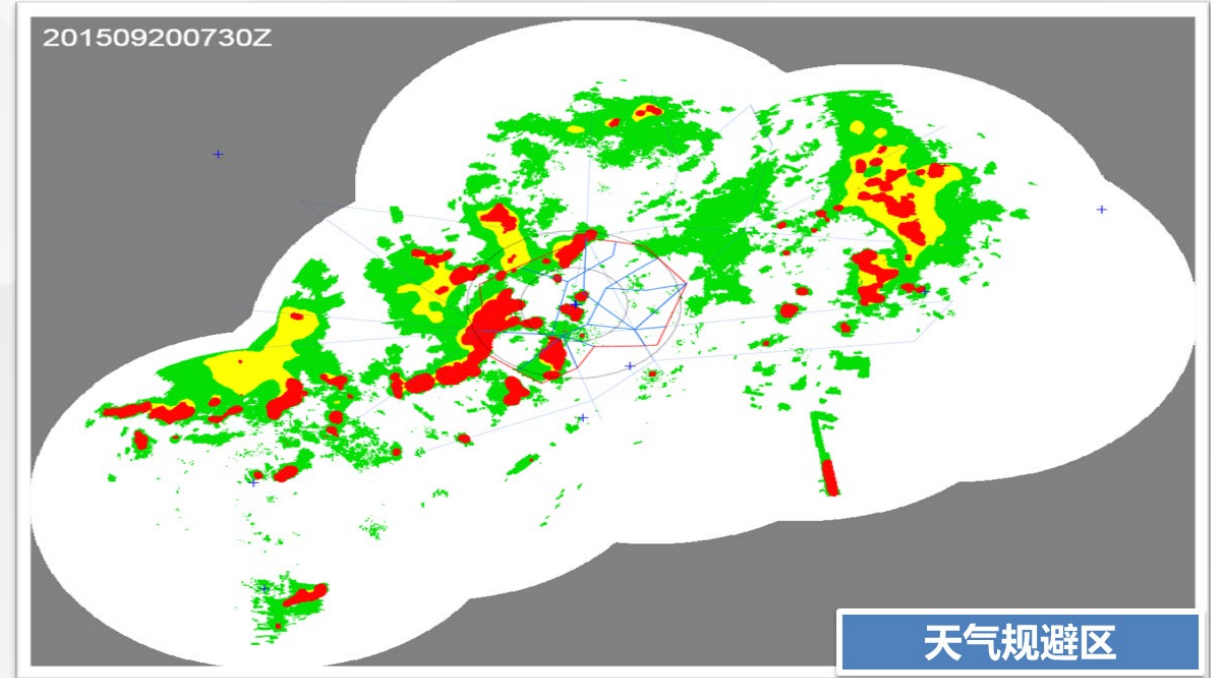
Range: 8*8km
Coverage rate: $\geq 20\%$
**Radar products
type:** CAPPI(3km);
Intensity: $\geq 35\text{dBZ}$



- Convective Weather Avoidance Fields



Weather Radar Reflectivity

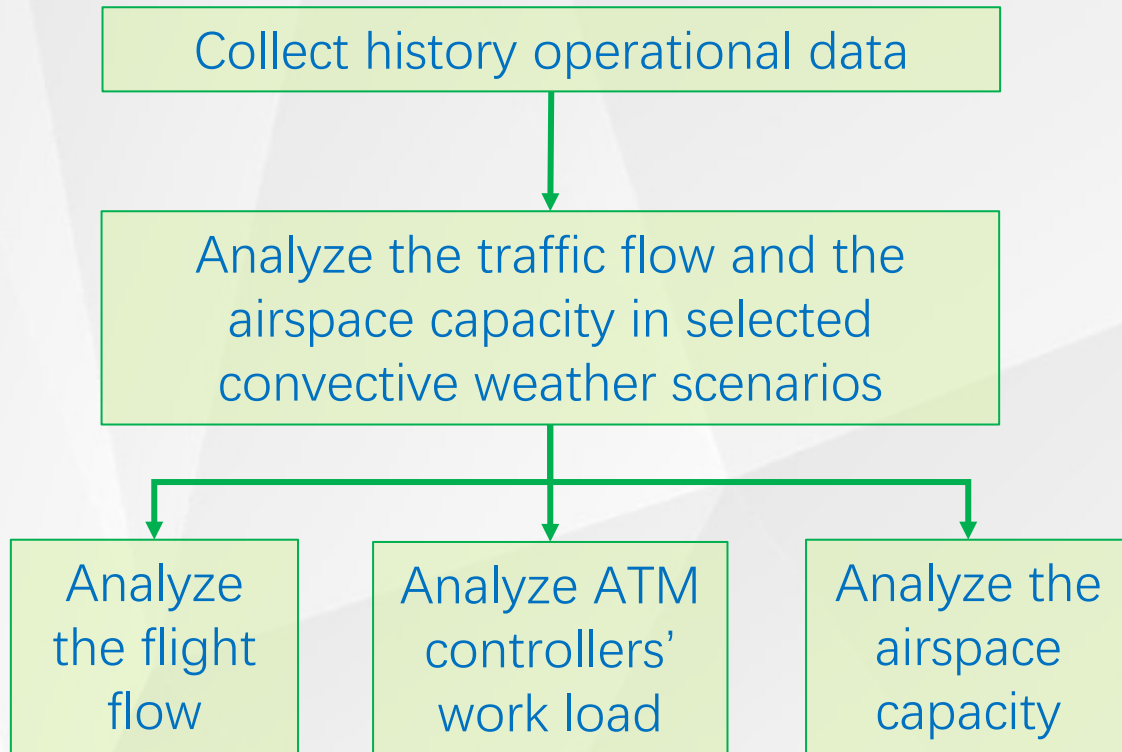


Convective Weather Avoidance Fields

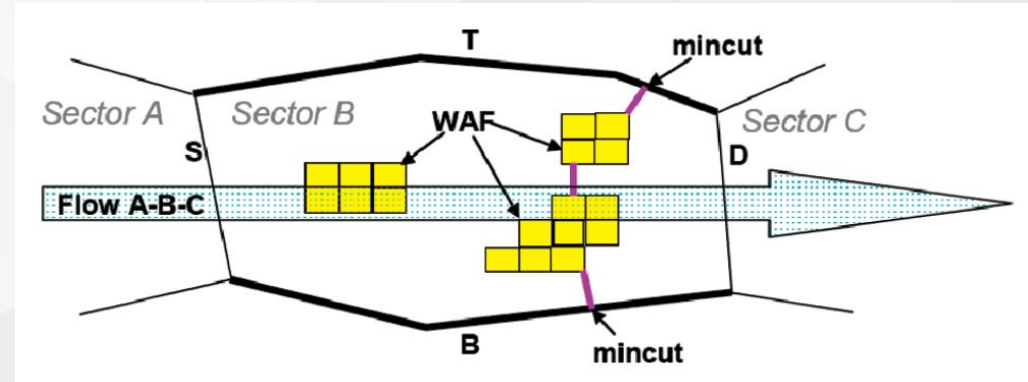
The WAF is defined as an area where the greater than 35dBZ convection coverage rate exceeds 20%.



- Establishment of the traffic flow rules expert database



- Objective assessment of capacity



The Min. cut/Max. flow theorem was applied to obtain the dynamic, quantitative and objective assessment and 2-hour prediction of airspace capacity



- Convection Dynamic Capacity Assessment System (CDCAS)

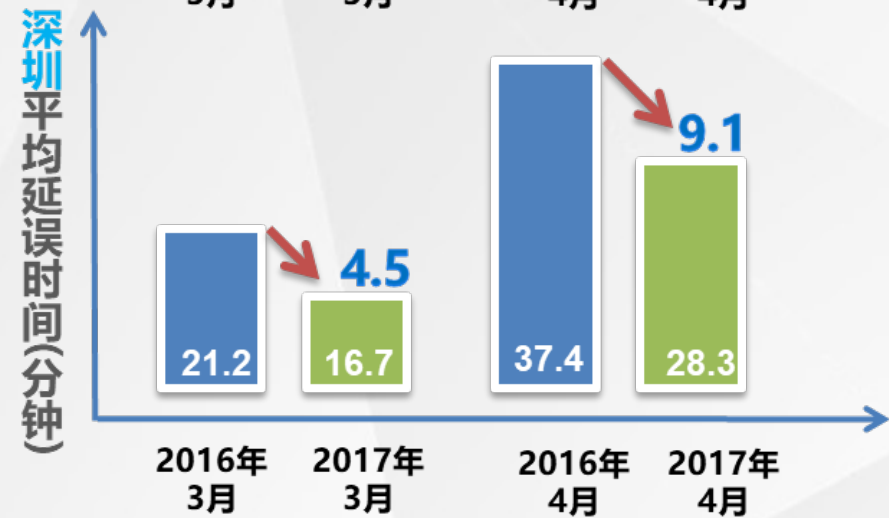
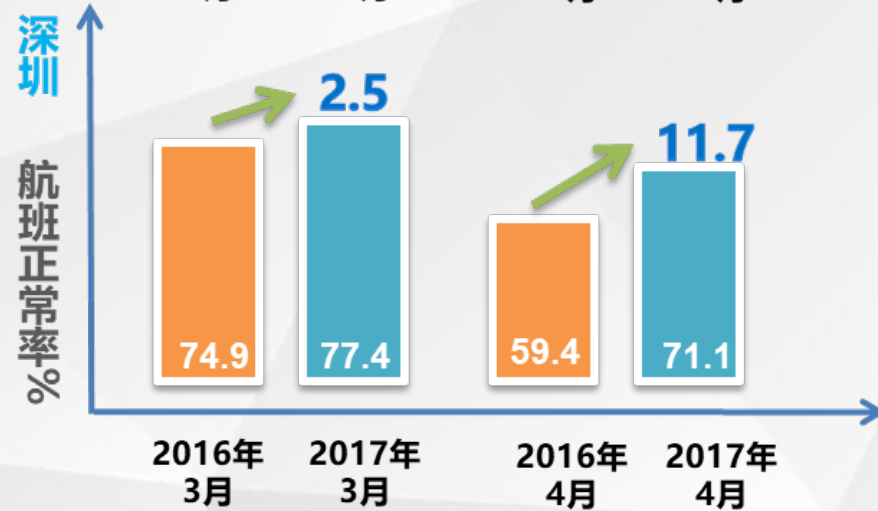
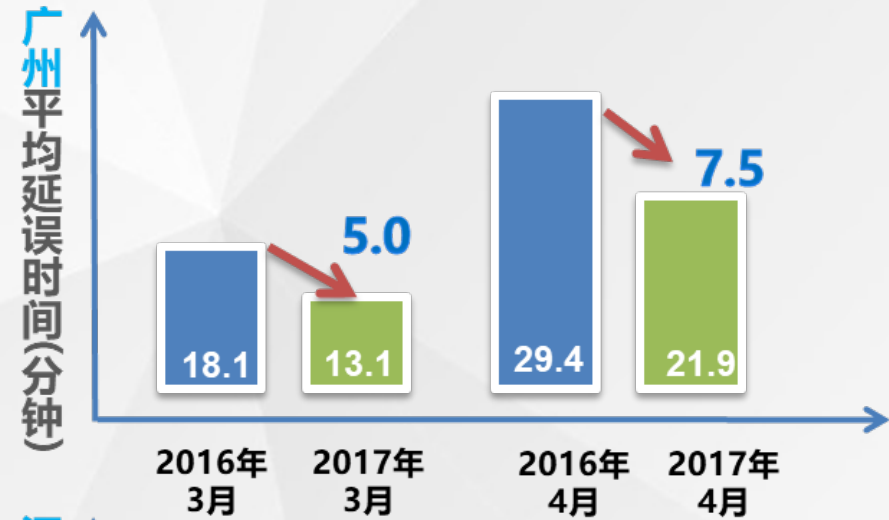
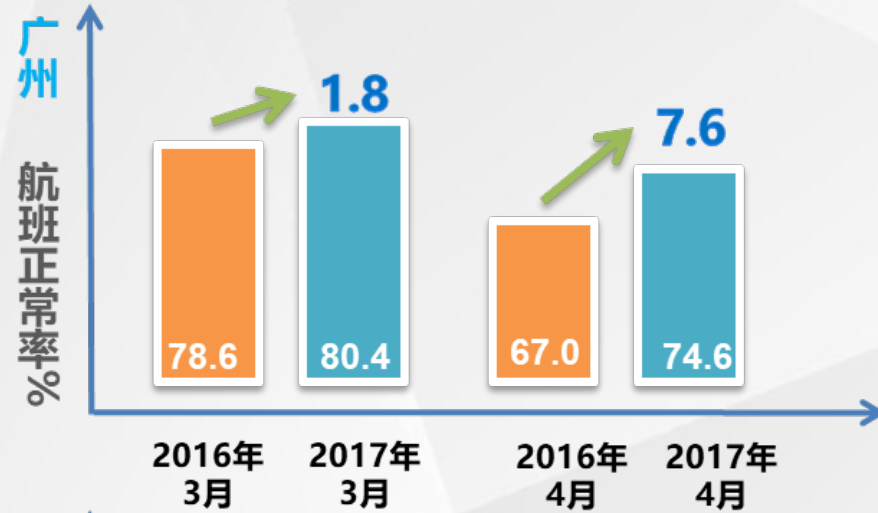
| 对流天气动态容量评估系统(CDCAS) | | | | | | | | | | | | | | | | | | | |
|------------------------------|------------------|------------------|-----------|------------------|-----------|------------------|-----------|------------------|-----------|------------------|-----------|------------------|-----------|------------------|-----------|------------------|-----------|------------------|----------|
| 类别 | 空域单元 / 15分钟静态能力值 | 2016/08/09 0800Z | | 2016/08/09 0815Z | | 2016/08/09 0830Z | | 2016/08/09 0845Z | | 2016/08/09 0900Z | | 2016/08/09 0915Z | | 2016/08/09 0930Z | | 2016/08/09 0945Z | | 2016/08/09 1000Z | |
| | | 动态评估值 | 15分钟计划流量 | 动态评估值 | 15分钟计划流量 | 动态评估值 | 15分钟计划流量 | 动态评估值 | 15分钟计划流量 | 动态评估值 | 15分钟计划流量 | 动态评估值 | 15分钟计划流量 | 动态评估值 | 15分钟计划流量 | 动态评估值 | 15分钟计划流量 | 动态评估值 | 15分钟计划流量 |
| Airport-ARR 进终端区 且广州降落 | GYA / 4 | 1 | 0 | 1 | 2 | 0 | 2 | 0 | 6 | 0 | 3 | 0 | 4 | 1 | 1 | 2 | 4 | 4 | 1 |
| | ATAGA / 2 | 1 | 1 | 0 | 2 | 0 | 2 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | IGONO / 2 | 1 | 4 | 0 | 3 | 0 | 1 | 0 | 5 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | P270 / 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| | IDUMA / 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 合计 / 10 | 4 | 6 | 2 | 7 | 0 | 5 | 0 | 16 | 0 | 9 | 0 | 4 | 1 | 1 | 2 | 4 | 4 | 1 | |
| Airport-DEP 出终端区 且广州起飞 | P268 / 2 | 1 | 1 | 0 | 3 | 0 | 1 | 0 | 1 | 1 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | YIN / 4 | 2 | 1 | 0 | 3 | 0 | 1 | 0 | 2 | 1 | 4 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | LMN / 3 | 1 | 4 | 0 | 2 | 0 | 2 | 0 | 4 | 1 | 7 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | VIBOS / 2 | 1 | 2 | 0 | 1 | 0 | 3 | 0 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 合计 / 11 | 4 | 8 | 0 | 9 | 0 | 7 | 0 | 9 | 3 | 15 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Border-ARR 进终端区 | GYA / 9 | 4 | 6 | 3 | 12 | 3 | 12 | 5 | 12 | 5 | 12 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ATAGA / 4 | 2 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | IGONO / 2 | 1 | 4 | 1 | 3 | 1 | 1 | 1 | 5 | 1 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | P270 / 2 | 2 | 1 | 2 | 0 | 2 | 0 | 2 | 1 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | IDUMA / 5 | 5 | 2 | 5 | 1 | 5 | 1 | 5 | 2 | 5 | 2 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 合计 / 22 | 13 | 14 | 12 | 18 | 12 | 16 | 15 | 22 | 16 | 19 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Border-DEP 出终端区 | P268 / 4 | 2 | 2 | 1 | 4 | 1 | 1 | 2 | 3 | 2 | 5 | 2 | 0 | 2 | 4 | 2 | 3 | 2 | 2 |
| | YIN / 9 | 4 | 10 | 3 | 12 | 3 | 10 | 5 | 6 | 5 | 9 | 5 | 4 | 5 | 7 | 4 | 5 | 4 | 3 |
| | LMN / 7 | 7 | 7 | 7 | 5 | 7 | 8 | 7 | 10 | 7 | 9 | 2 | 8 | 0 | 12 | 0 | 7 | 0 | 5 |
| | VIBOS / 3 | 3 | 2 | 3 | 1 | 3 | 3 | 2 | 2 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 3 |
| 合计 / 23 | 15 | 21 | 15 | 22 | 14 | 22 | 15 | 21 | 16 | 23 | 11 | 13 | 7 | 24 | 6 | 17 | 6 | 13 | |
| OVER-FLY 各航段流量 | P50-GYA / 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| | GYA-SAREX / 12 | 7 | 8 | 6 | 5 | 5 | 9 | 5 | 7 | 4 | 8 | 3 | 10 | 2 | 12 | 1 | 5 | 1 | 9 |
| | IDUMA-TEPID / 4 | 4 | 3 | 4 | 2 | 4 | 2 | 3 | 2 | 3 | 2 | 2 | 4 | 2 | 2 | 2 | 5 | 2 | 5 |
| | MIPAG-TEPID / 4 | 4 | 5 | 4 | 5 | 4 | 5 | 3 | 1 | 3 | 1 | 2 | 3 | 2 | 1 | 2 | 2 | 2 | 1 |
| | TEPID-SAREX / 10 | 10 | 4 | 10 | 2 | 10 | 5 | 8 | 6 | 7 | 4 | 6 | 7 | 5 | 8 | 4 | 3 | 4 | 3 |
| | IDUMA-LMN / 6 | 5 | 5 | 5 | 6 | 5 | 8 | 5 | 5 | 4 | 3 | 4 | 9 | 3 | 4 | 3 | 8 | 3 | 8 |
| 合计 / 36 | 31 | 25 | 29 | 20 | 28 | 29 | 24 | 21 | 20 | 18 | 16 | 33 | 14 | 27 | 11 | 23 | 11 | 26 | |

| 类别 | 空域单元 / 15分钟静态能力值 | 2016/08/09 0800Z | |
|------------------------------|------------------|------------------|----------|
| | | 动态评估值 | 15分钟计划流量 |
| Airport-ARR 进终端区 且广州降落 | GYA / 4 | 1 | 0 |
| | ATAGA / 2 | 1 | 1 |
| | IGONO / 2 | 1 | 4 |
| | P270 / 1 | 0 | 1 |
| | IDUMA / 1 | 1 | 0 |
| 合计 / 10 | 4 | 6 | |

The airspace capacity of the flights entering the terminal area and planning to land at the Airport.



- Improvements in the on-schedule rate of flights





04

Conclusion

- ◆ MET Services and Products
- ◆ Developments in CDM
- ◆ ATM impacts conversion



- **Conclusions**

- Based on numerical weather prediction models and convection nowcasting systems, multiple tailored ATM meteorological services and products are provided in China.
- Meteorological products supporting collaborative decision making like CCFP have been issued and will be improved in the future.
- A Convection Dynamic Capacity Assessment System (CDCAS) has been developed to estimate the weather impacts on airspace capacity.
- Quantitative and objective assessment of the weather impacts helps ATM and ATFM operate in a more efficient way.



Thank you
very much!

MET/ATM WEBINAR 2022