Monitoring, Forecasting and Service of Tropical Cyclones in Guangdong

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Guangdong Meteorological Observatory, CMA

Nov.24, 2023, Guangzhou

OUTLINE

- **Climatology** of tropical cyclones in Guangdong
- Tropical cyclone **monitoring** in Guangdong
- Tropical cyclone **forecasting** in Guangdong
- Guangdong Emergency Early Warning **Release Platform**

Guangdong Province

Guangdong province:

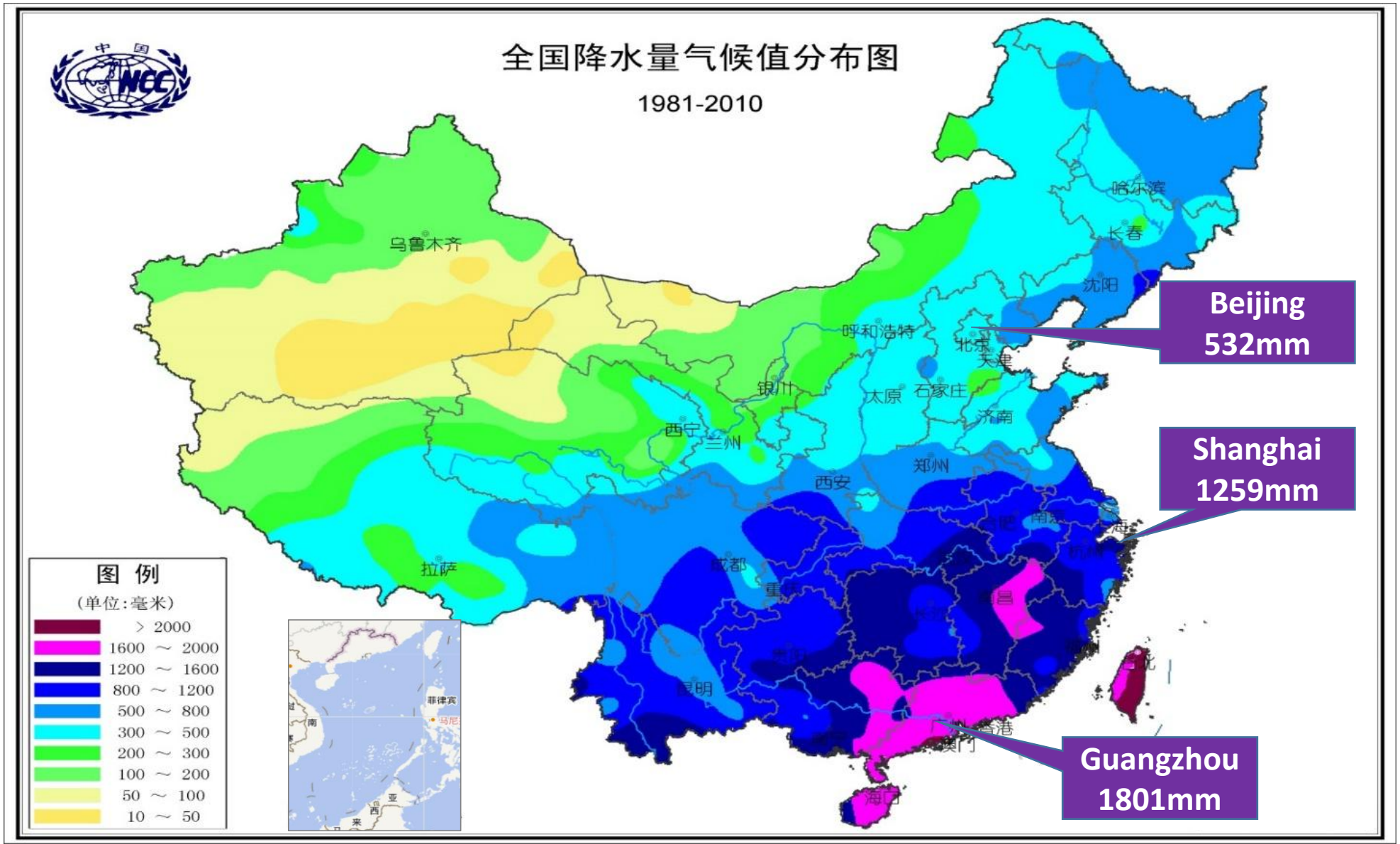
- Land: 20°09‘-25°31‘N, 109°45‘- 117°20‘E; the southmost province of Continent China ; monsoon climate; 4114km coastline; 179,800 km^2;
- **Largest resident population**（127 million）in China in 2022
- One of the **most developed** provinces in China
- **Highest GDP** in China since 1989. **12.91 trillion CNY**(1.8 trillion US dollars, **10.7%** of China(121 trillion CNY) in 2022.

The China Great Bay Area:

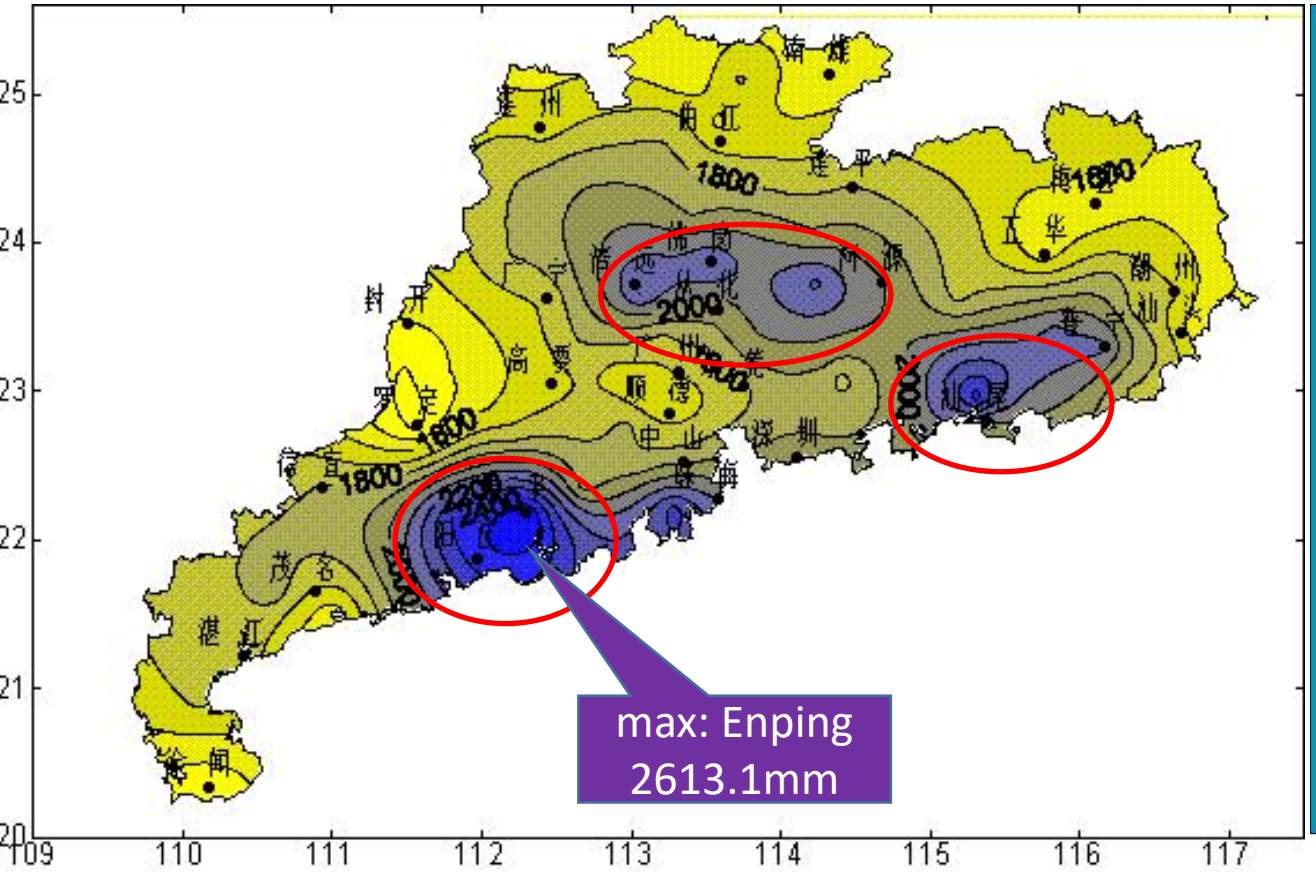
- 9 cities of Guangdong (Guangzhou, Shenzhen, …) + Hongkong China + Macao China

China average annual precipitation(mm)

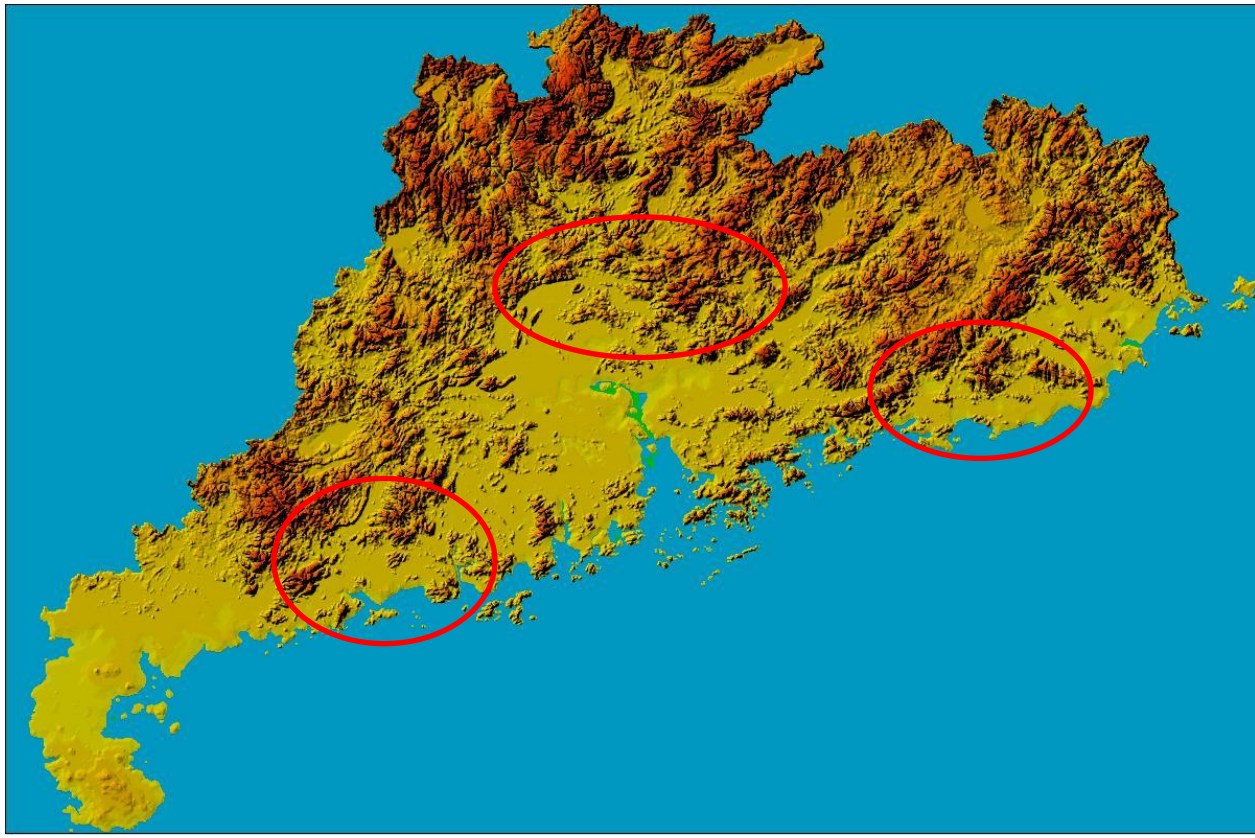
Guangdong: 1789mm, 2.8 times of national mean



Three rainstorm centers associated with terrain

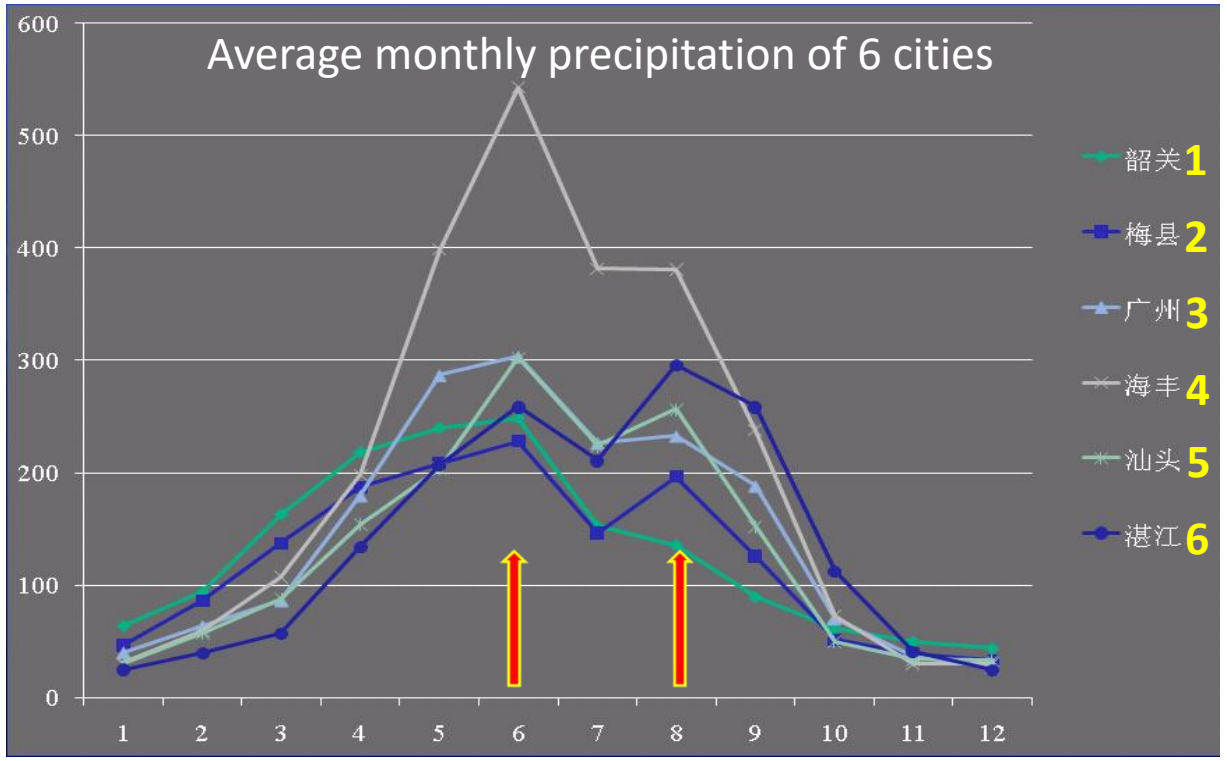


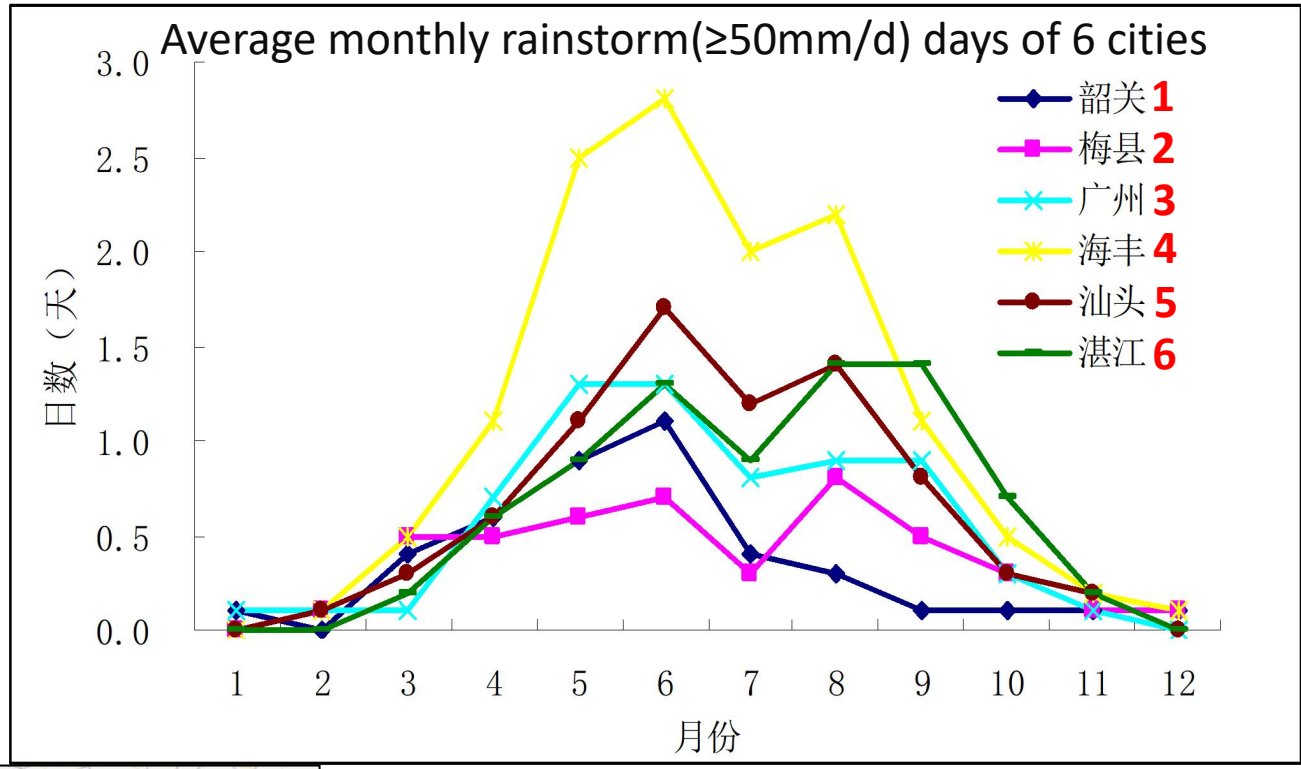
Average annual precipitation in 2000-2014
Guangdong: 1789mm



Guangdong topographic map

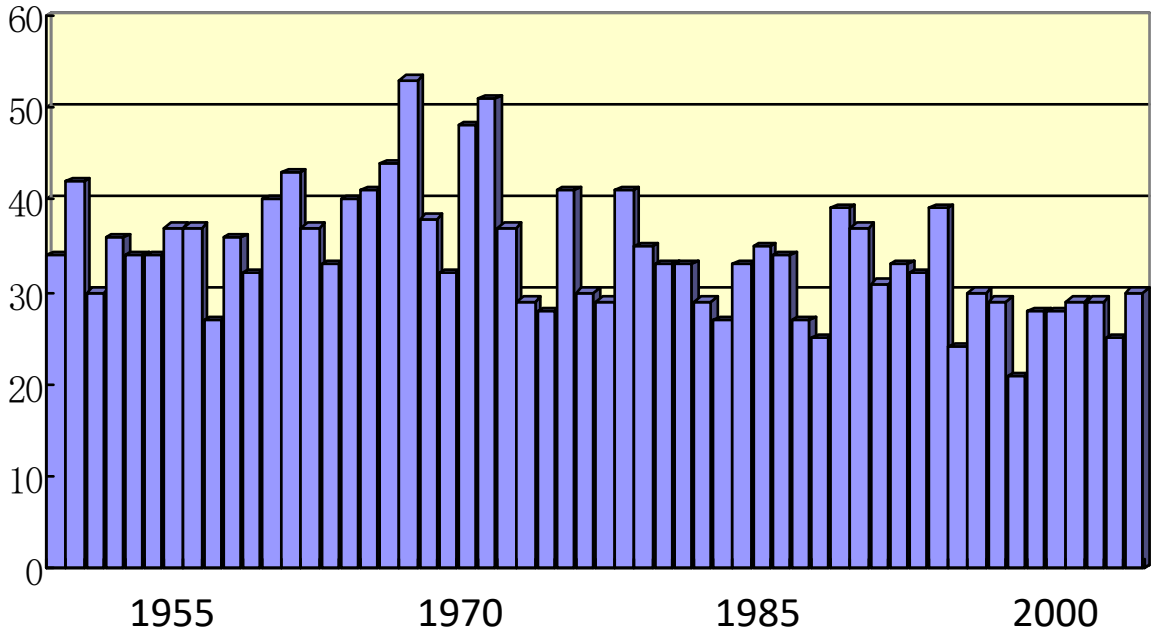
Two rainy seasons in Guangdong





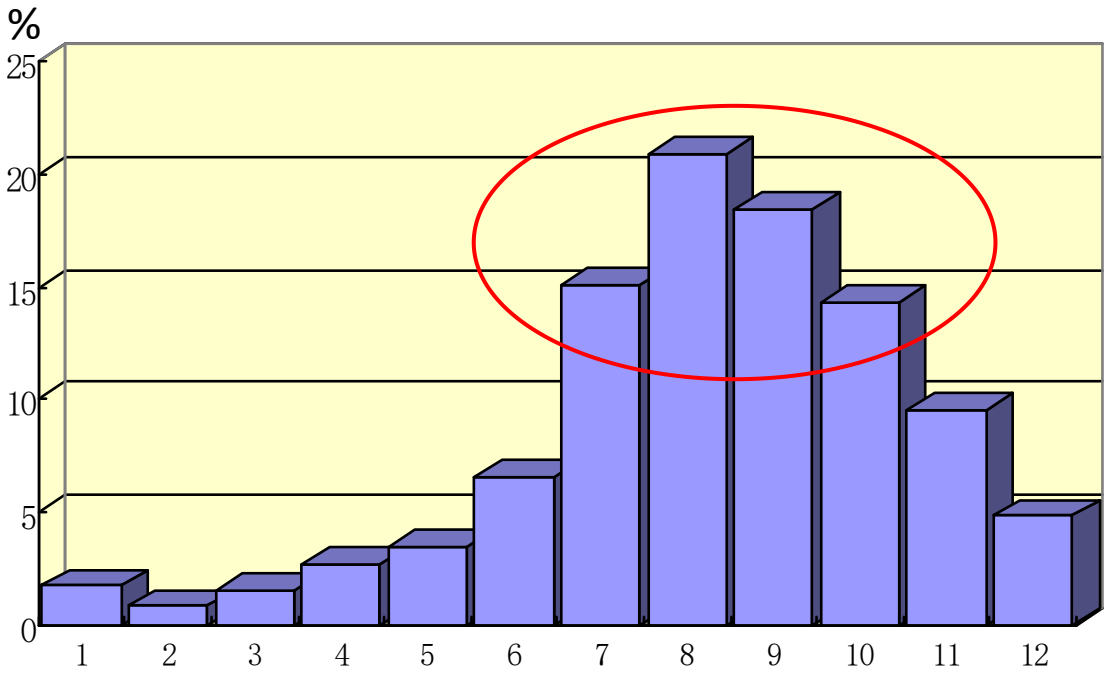
1: Shaoguan
2: Meizhou
3: Guangzhou
4: Haifeng
5: Shantou
6: Zhanjiang

Tropical Cyclone Activities in NWP and SCS in 1949-2020



Annual genesis of named TCs in NWP and SCS in 1949-2004

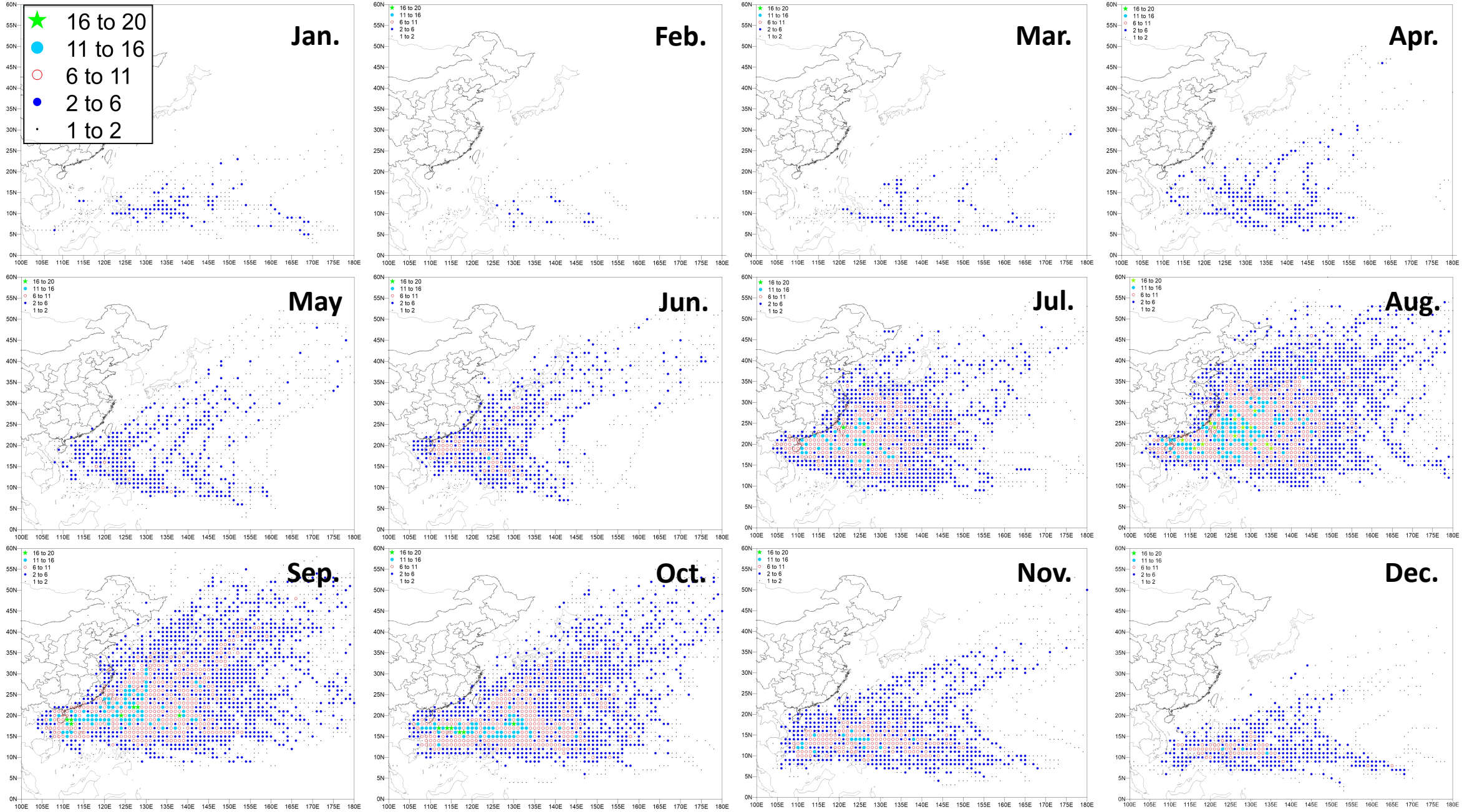
max: 40 named TCs(1967)
min: 14 named TCs(1998, 2010)



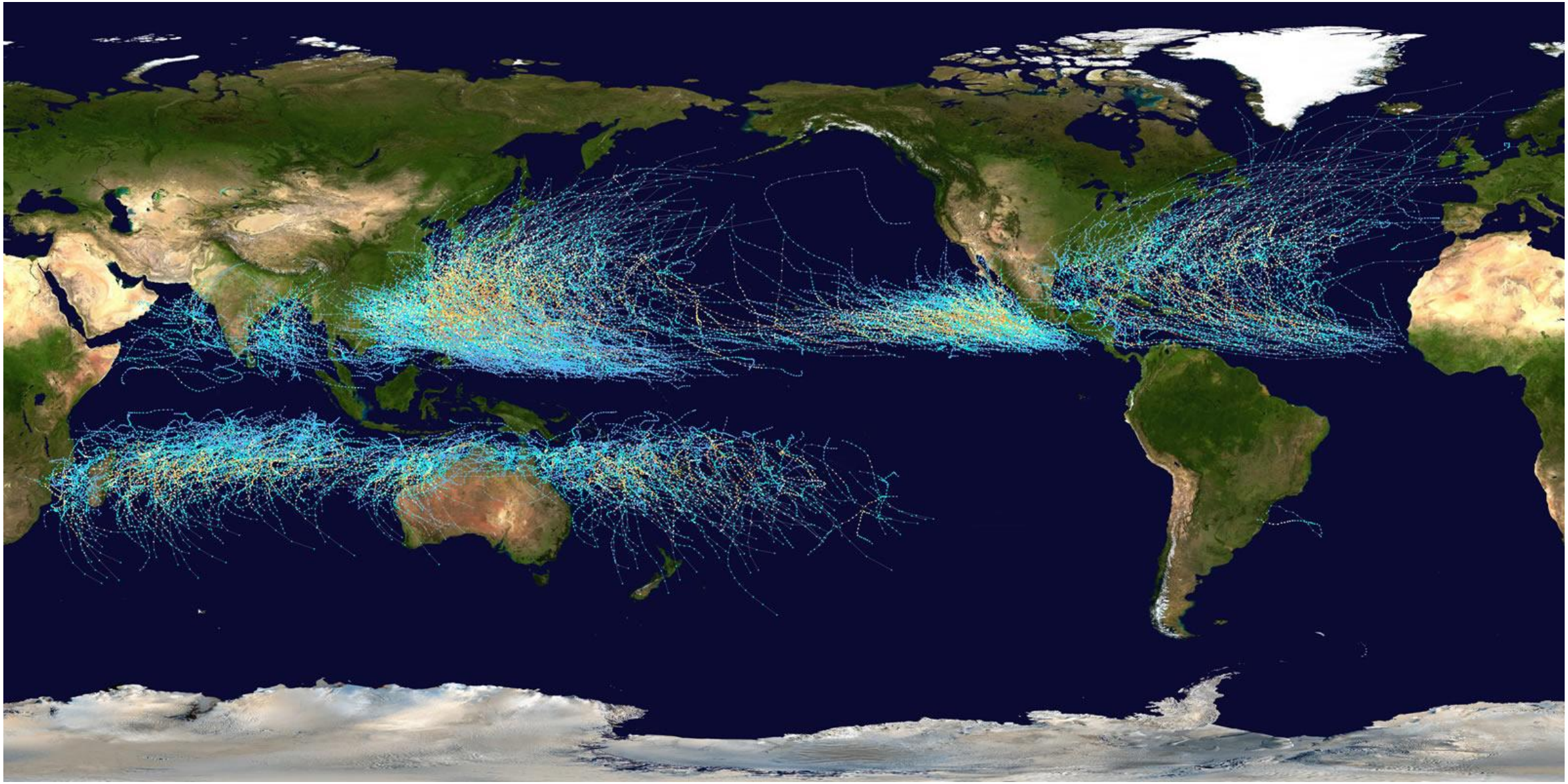
Monthly percentages of genesis of named TCs in NWP and SCS in 1949-2004

July-Oct: 68.87%

Monthly Tropical Cyclone Activities in NWP and SCS in 1949-2020



Tropical Cyclone Activities in 1985-2005



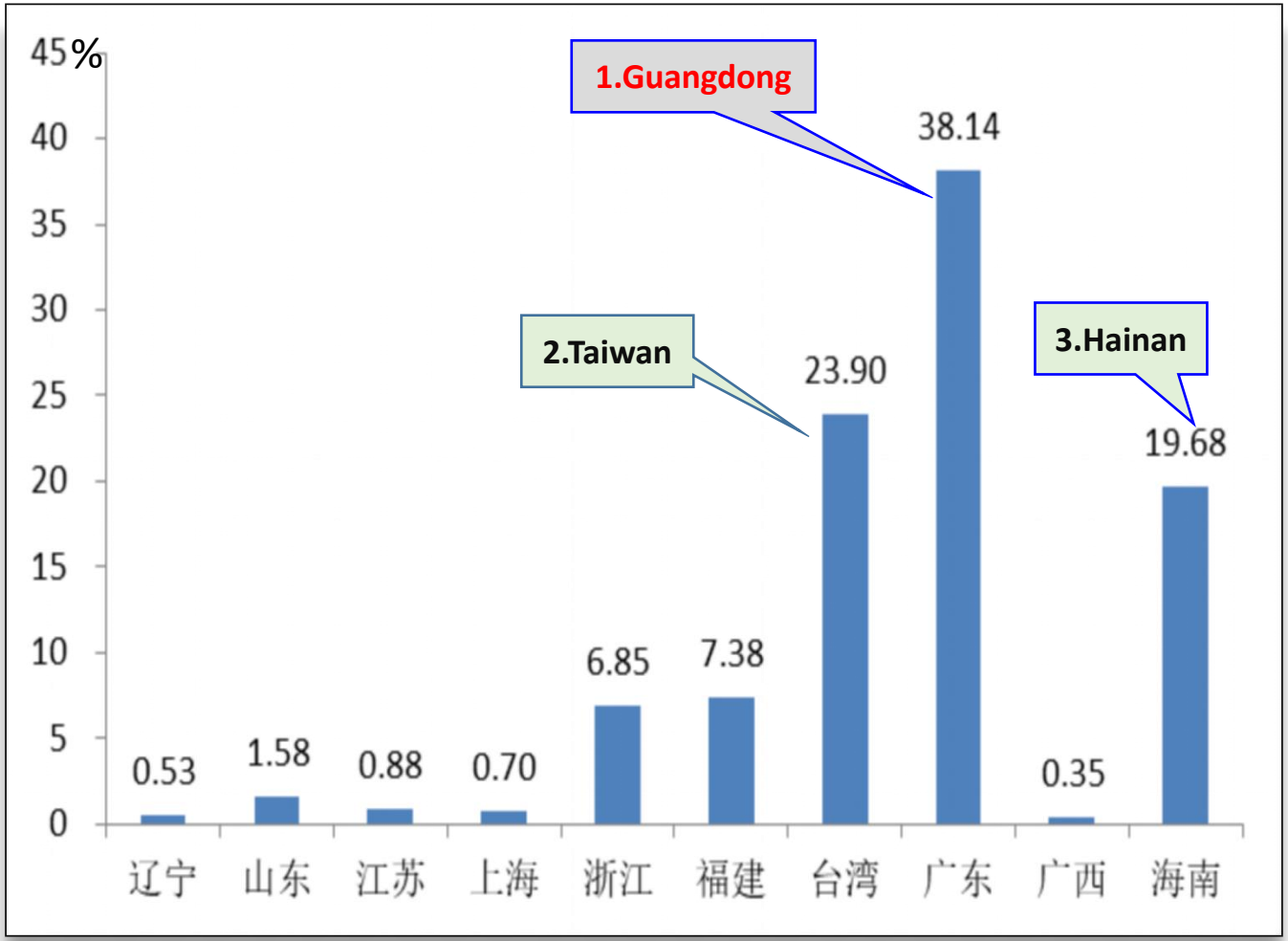
ON AVERAGE: 80 TC genesis in global basins, **34.3(42.9%)** in NWP and SCS, and **7(8.75%)** in SCS

Guangdong: highest frequency of landfalling TCs

China: ≈8 landfalling TCs every year on average

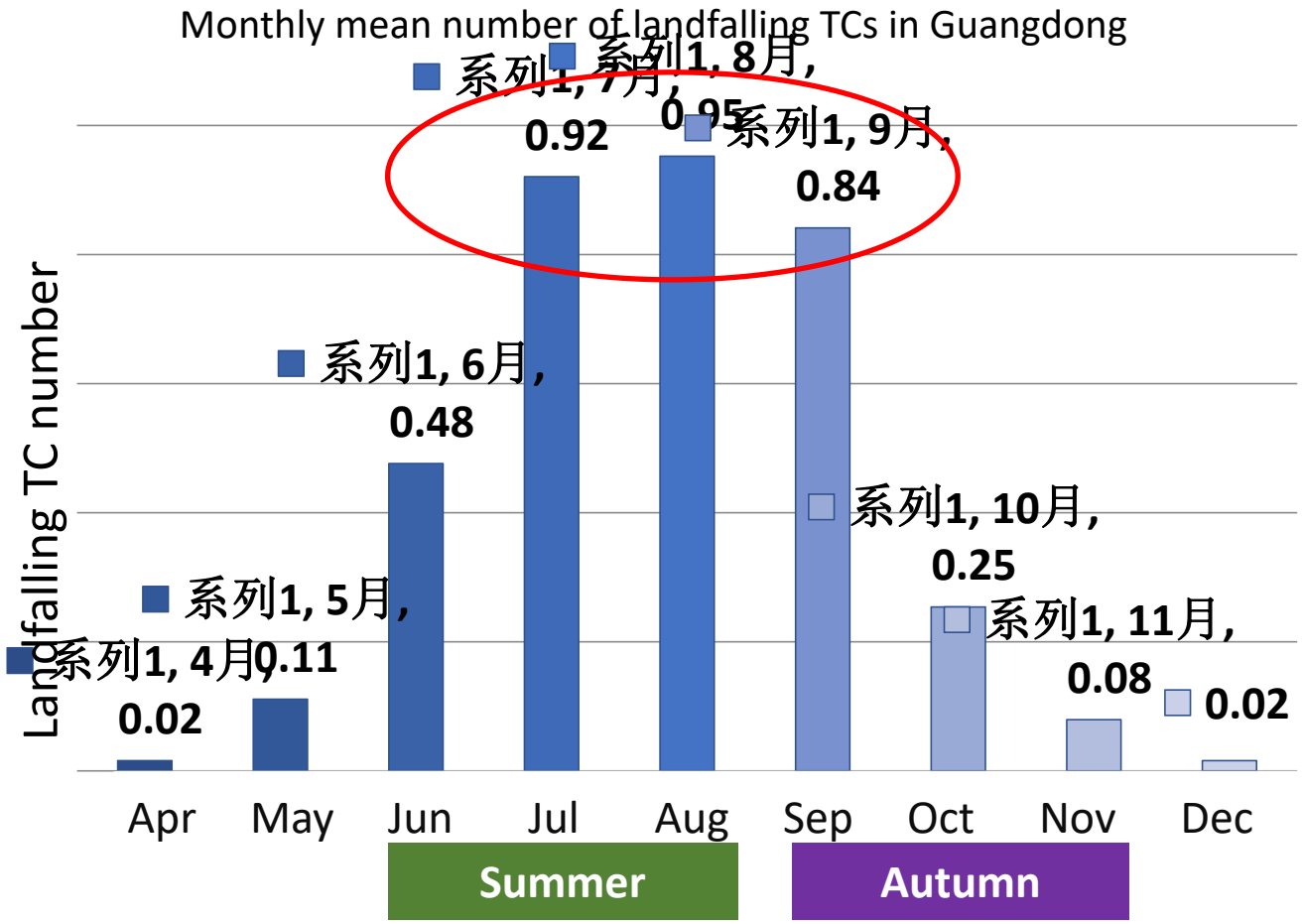
Guangdong: 3-4 landfalling TCs, **38.14%** of total landfalling TCs in 1949-2020 in China

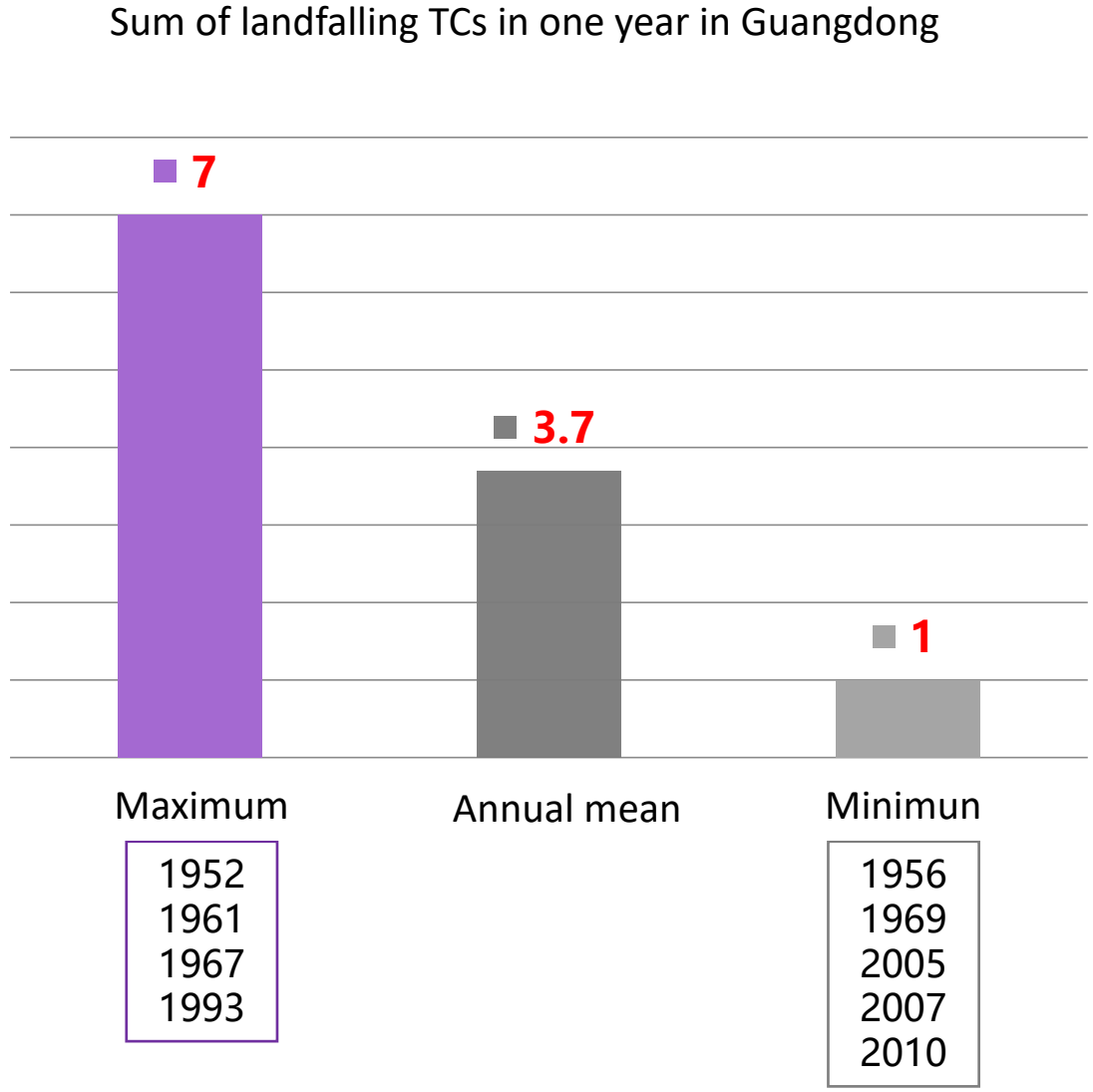
Top 3 provinces in landfalling TCs in China



Percent of landfalling TCs for each province in China

July-September: the peak of TC landfalling in Guangdong



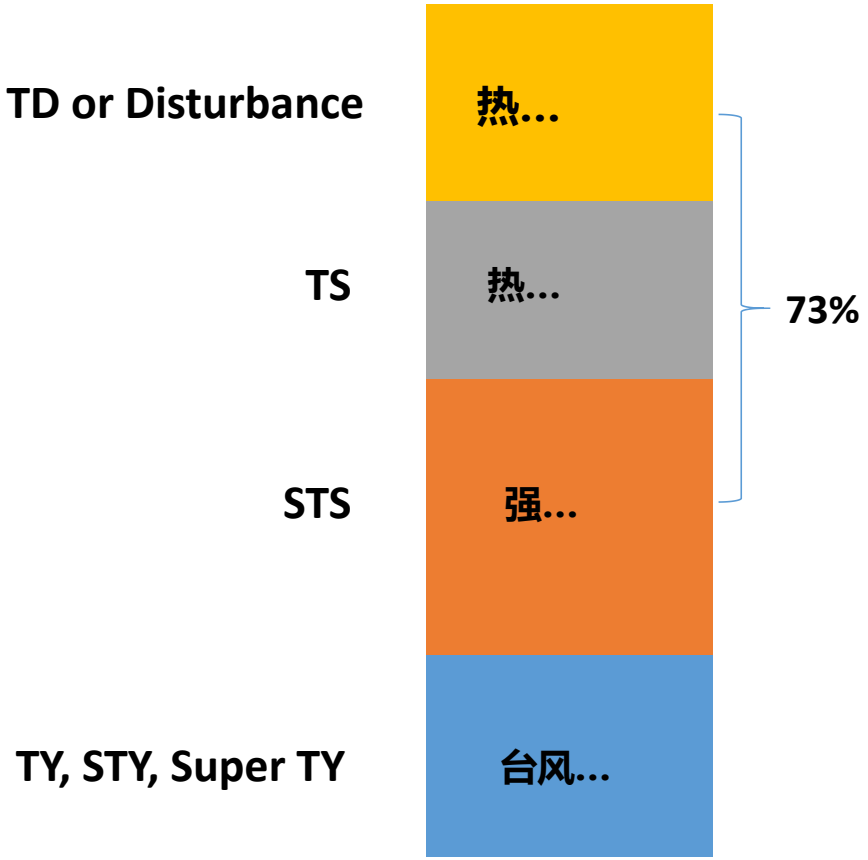


Earliest landfalling： Apr.19,2008, Neoguri(0801)

Latest landfalling： Dec.2,1974, Irma(7427)

Landfalling TCs on Guangdong

- **Weak** landfalling TCs take up a large percentage because of the special distribution of land and sea.



Percentages of landfalling TC Categories in Guangdong

TC Classification in NWP and SCS (Chinese National Standard)

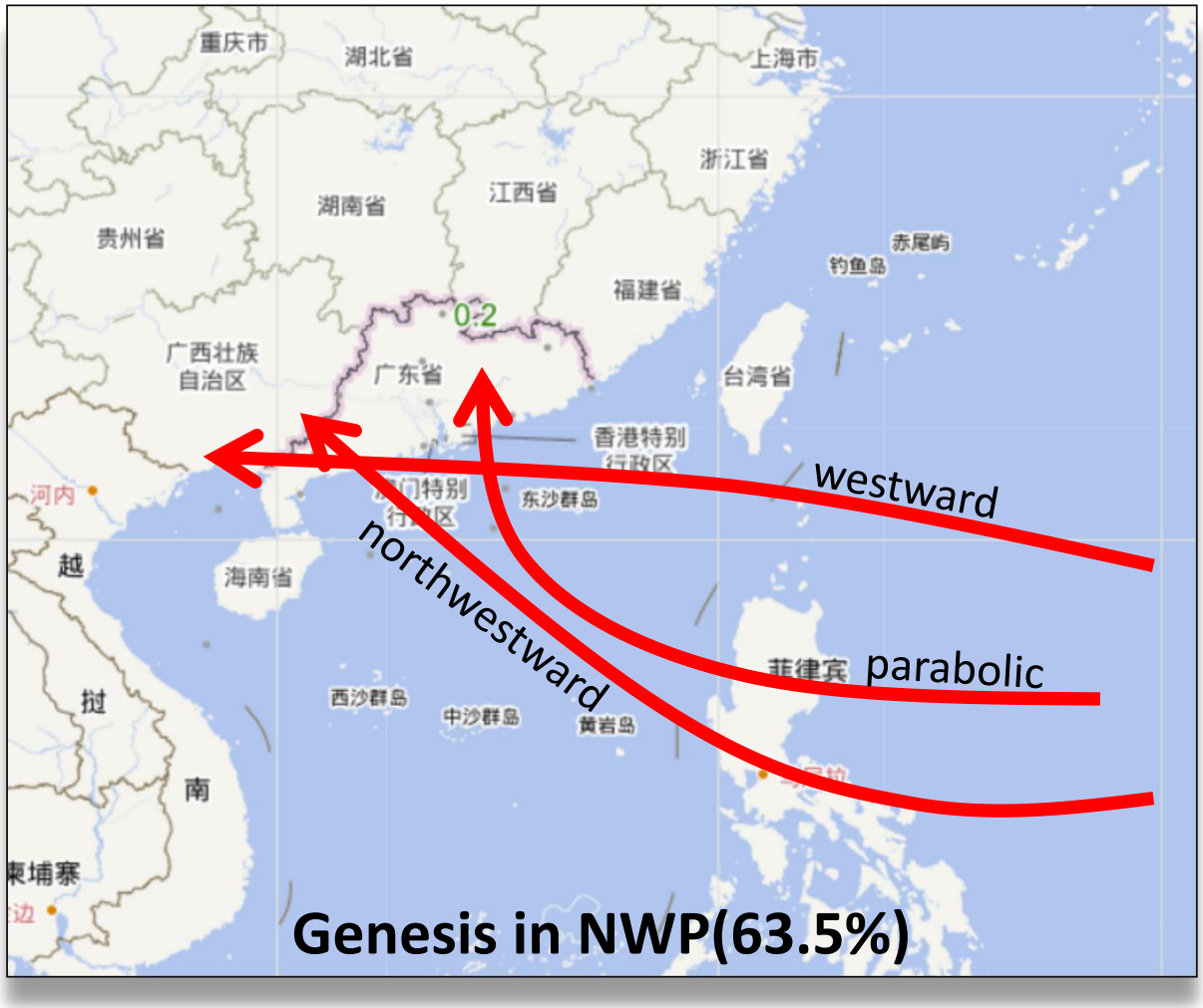
TC Category	Maximum 2-minute sustained wind near bottom center		
	m/s	kn	Beaufort scale
Tropical Depression (TD)	10.8 ~ 17.1	22 ~ 33	6~7
Tropical Storm (TS)	17.2 ~ 24.4	34 ~ 47	8~9
Severe Tropical Storm (STS)	24.5 ~ 32.6	48 ~ 63	10~11
Typhoon (TY)	32.7 ~ 41.4	64 ~ 80	12~13
Severe Typhoon (STY)	41.5 ~ 50.9	81 ~ 99	14~15
Super Typhoon (SuperTY)	≥51.0	≥100	≥16

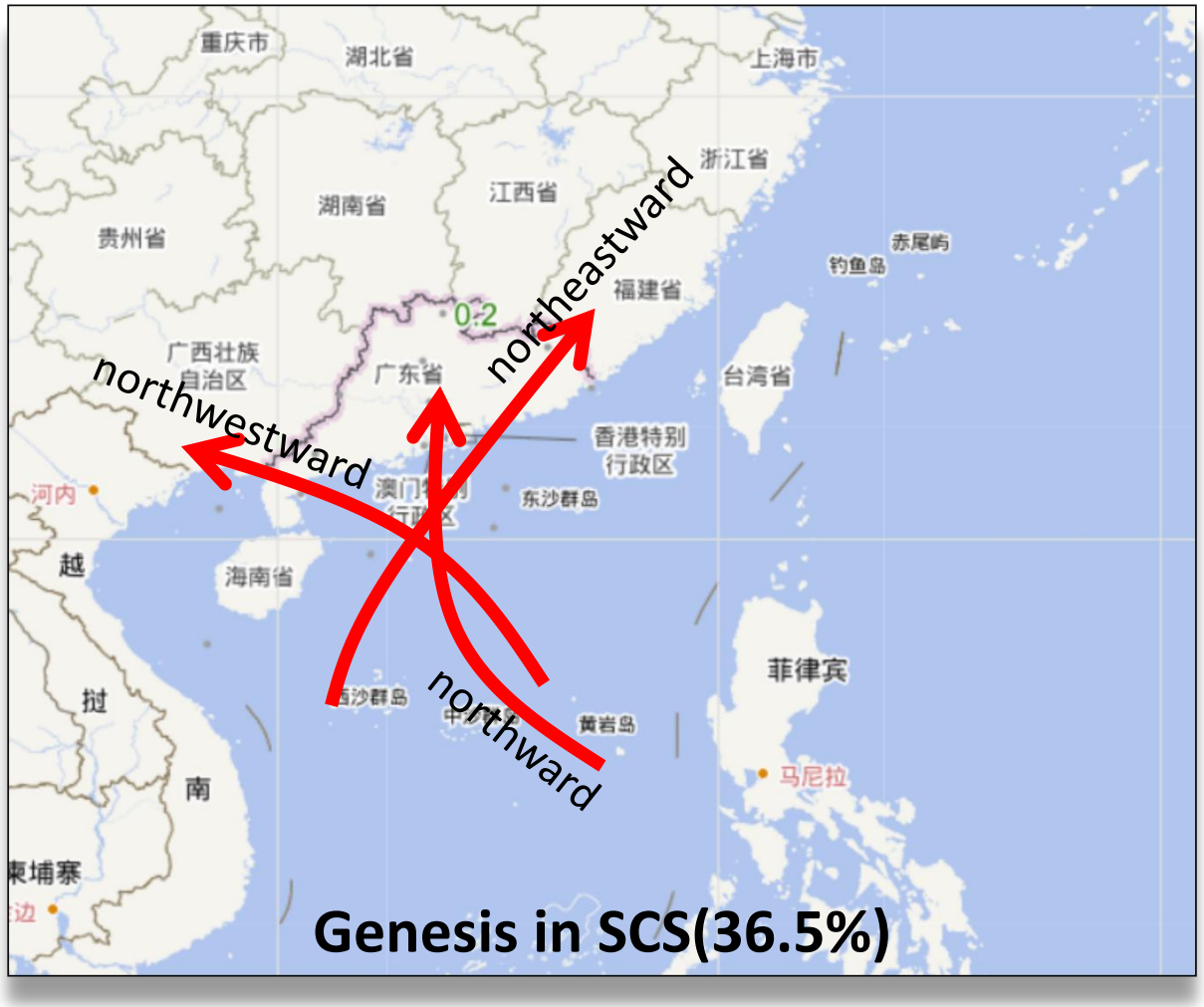
More stronger TCs make landfall?

List of landfalling **STY** or **SuperTY** in South China(Guangdong+Guangxi+Hainan) since 1970

	TY number	TY name	Minimal SLP on landfall	Maximal wind on landfall(m/s)	Landfalling province
2020s(1)	2309	Saola	950	45	Guangdong
2010s(9)	1822	Mangkhut	955	45	Guangdong
	1713	Hato	945	50	Guangdong
	1622	Haima	960	42	Guangdong
	1608	Nida	965	42	Guangdong
	1522	Mujigae	935	52	Guangdong
	1409	Rammusun	890	70	Hainan, Guangdong, Guangxi
	1319	Usagi	935	45	Guangdong
	1311	Utor	955	42	Guangdong
	1117	Nesat		42	Hainan, Guangxi
2000s(2)	0814	Hagupit	950	48	Guangdong
	0518	Damery		45	Hainan
1990s(1)	9615	Sally	935	50	Guangdong
1980s(1)	8105	Kelly	965	45	Hainan
1970s(2)	7314	Marge	925	60	Hainan
	7013	Joan	963	50	Hainan. Guangdong

Typical Landfalling TCs in Guangdong

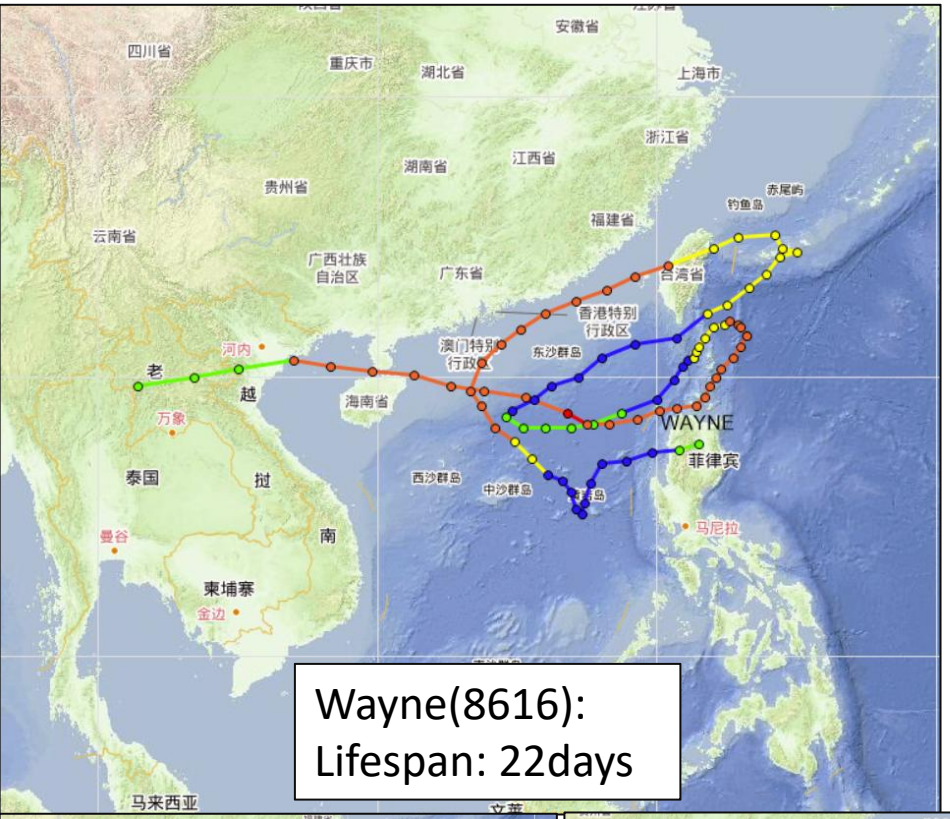




Tropical Cyclones in SCS:

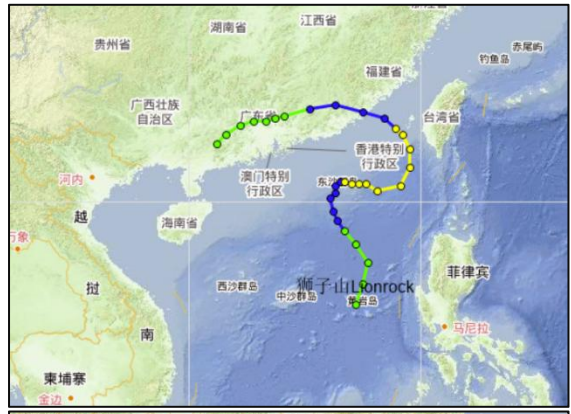
- Smaller size, Weaker intensity, slower moving speed, shorter lifespan
- More asymmetric and loose structure
- Poor regularity in movement(weak steering)

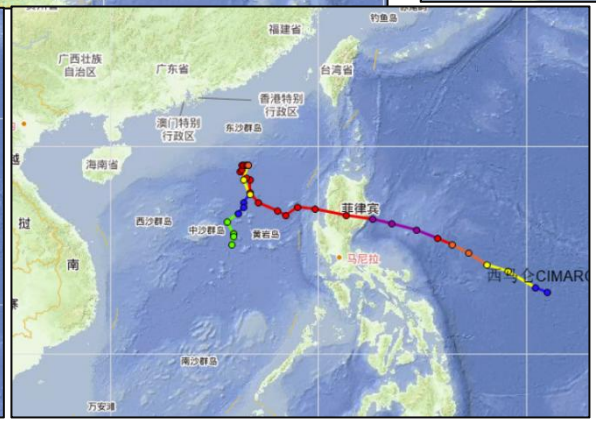
Curved TC tracks are common in SCS

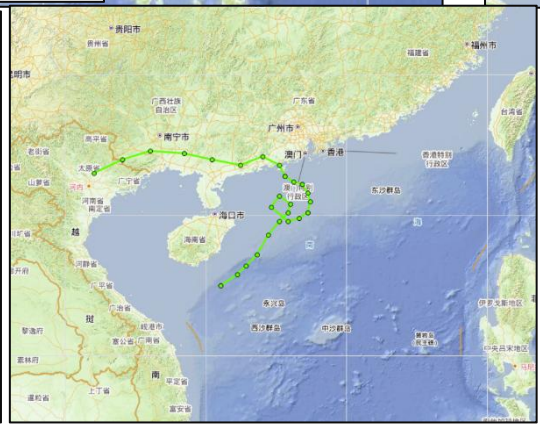


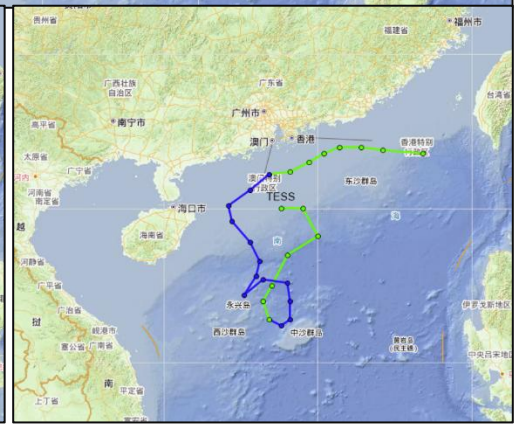
Wayne(8616):
Lifespan: 22days

NAT（9122）



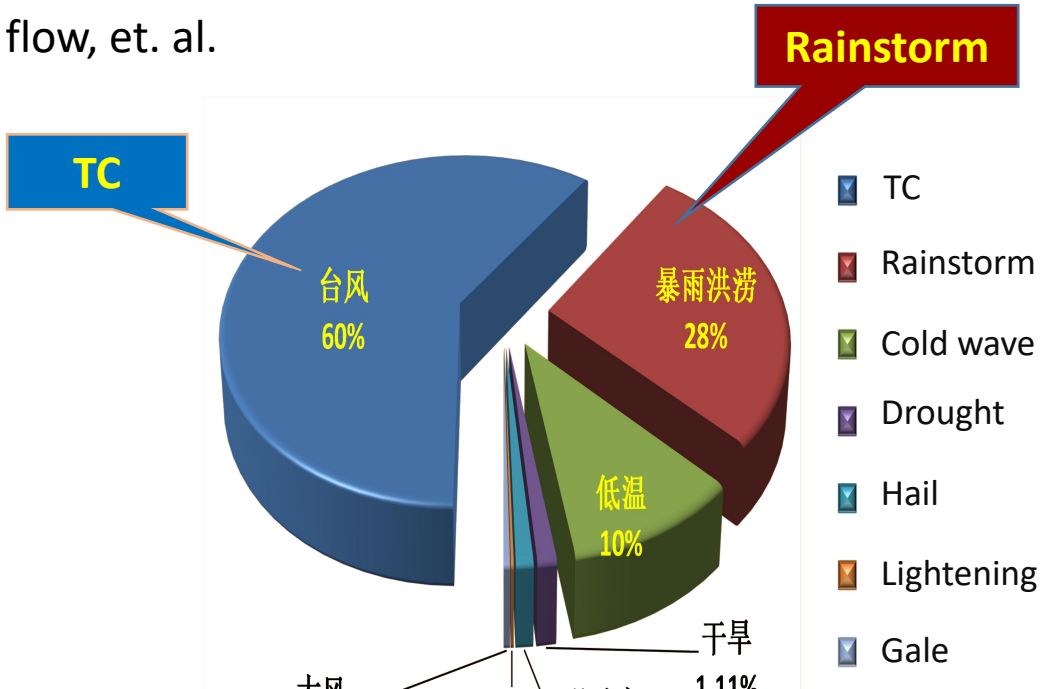




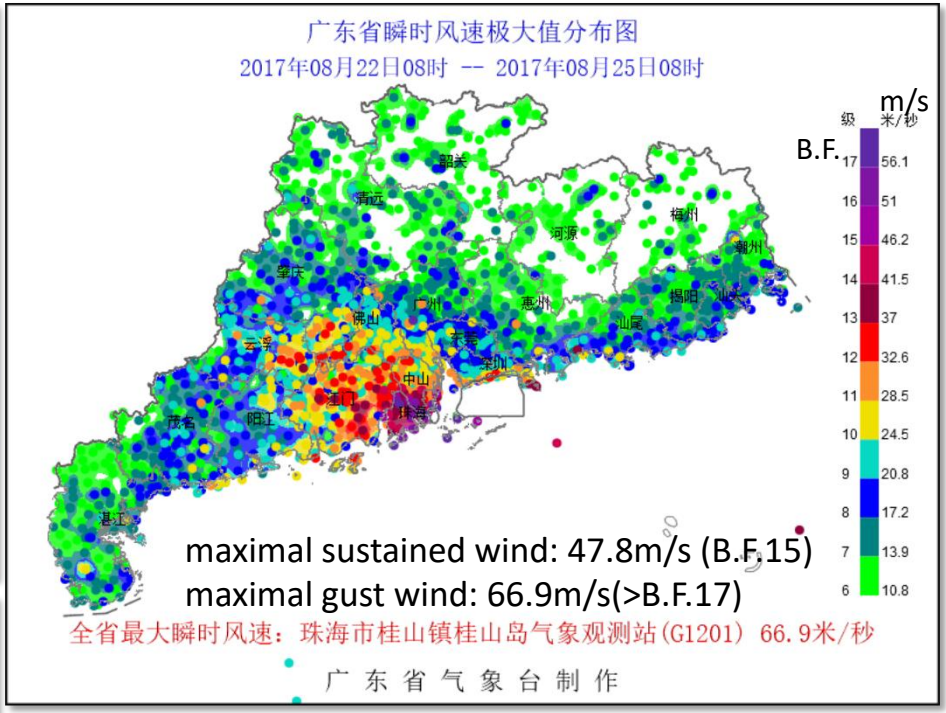


TCs cause the most serious meteorological disasters in Guangdong

- On average, **tropical cyclones** result in the most serious meteorological disasters In Guangdong.
  - ✓Economic loss : **6 billion CNY/year**; **60%**
  - ✓Death: **80 death/year**, **33%**
- Rainstorms and induced disasters
  - ✓flood, inundation, landslides, debris flow, et. al.
- Lightning
- Gale
- Hail
- Heat wave
- Cold wave



TC-induced disaster: destructive gales



Hato（No.1713）

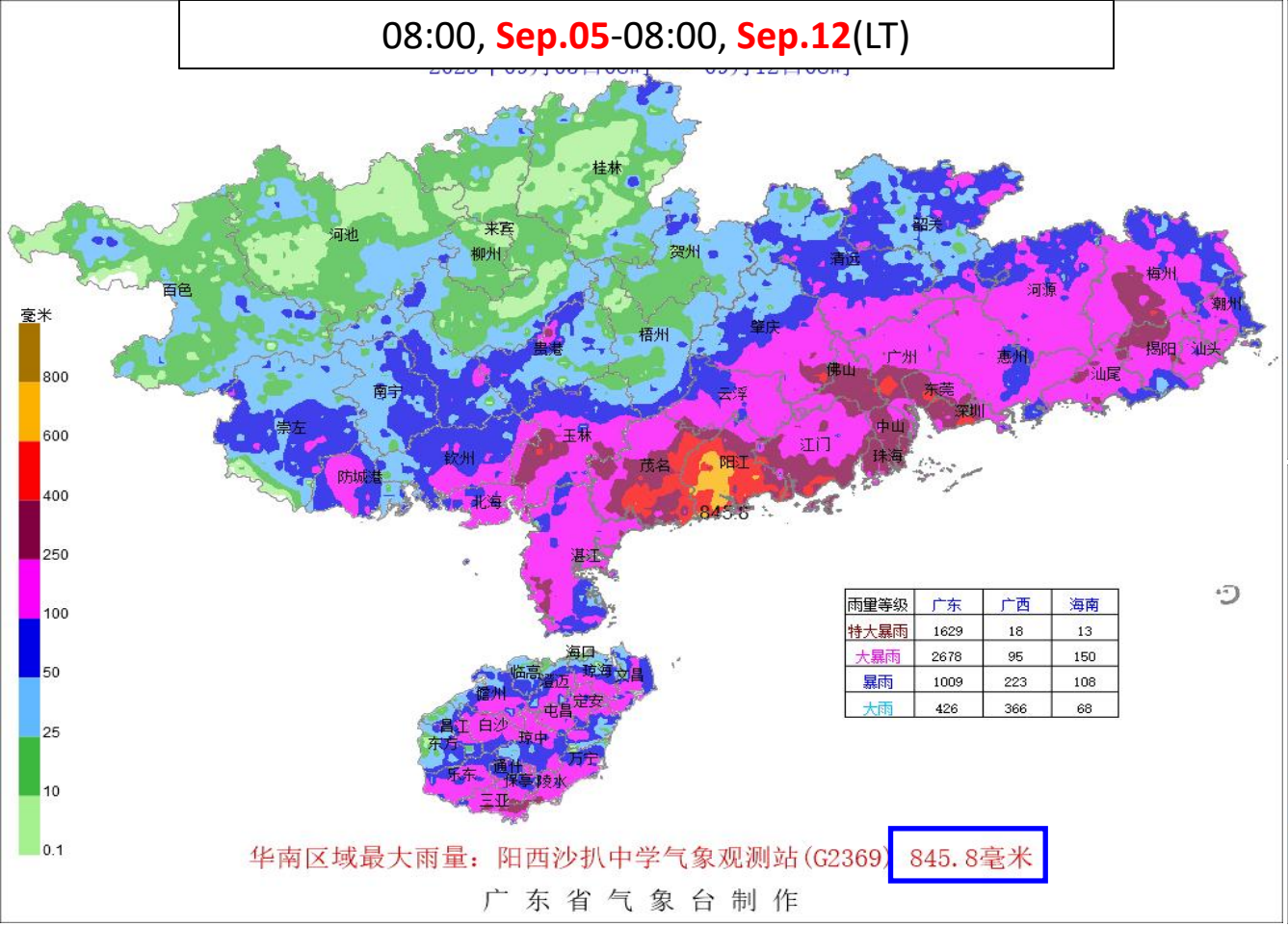
Death: **12**

Evacuated people: 556,175

House collapsed: 7,314

Direct economic loss: **CNY 19.5 billion**

08:00, Sep.05-08:00, Sep.12(LT)

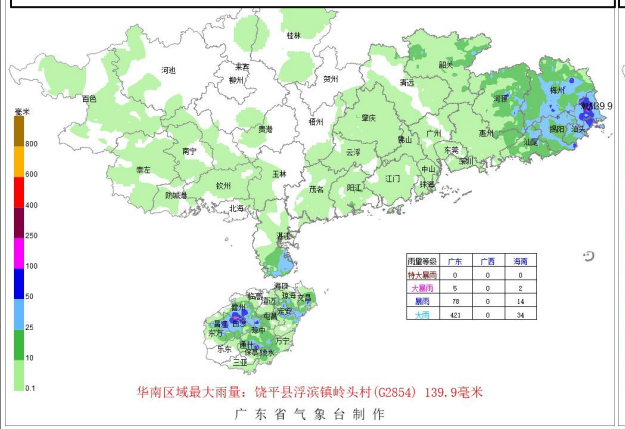


雨量等级	广东	广西	海南
特大暴雨	1629	18	13
大暴雨	2678	95	150
暴雨	1009	223	108
大雨	426	366	68

华南区域最大雨量：阳西沙扒中学气象观测站(G2369) 845.8毫米

广 东 省 气 象 台 制 作

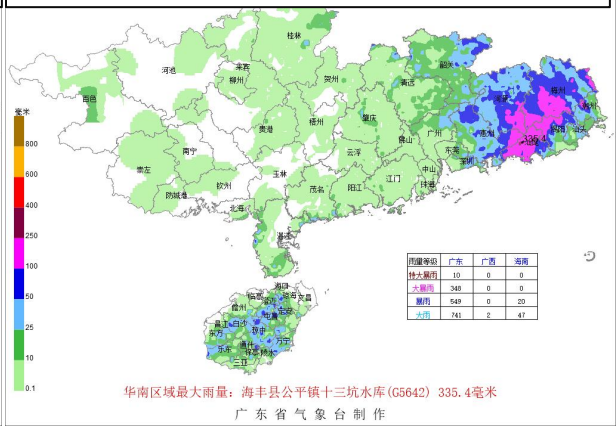
DAY1: 08:00, Sep.05-08:00, Sep.06



华南区域最大雨量：饶平县浮滨镇岭头村(G2854) 139.9毫米

广 东 省 气 象 台 制 作

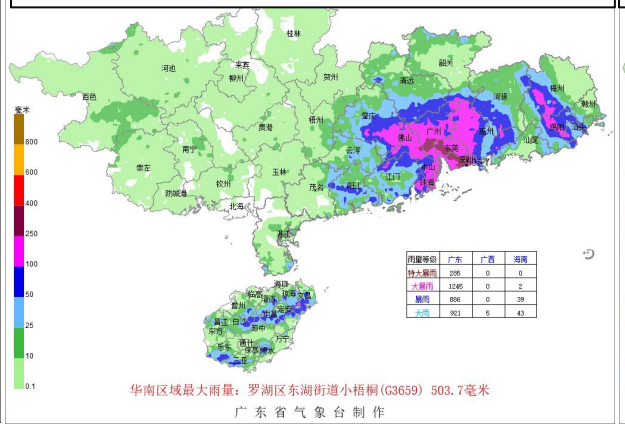
DAY2: 08:00, Sep.06-08:00, Sep.07



华南区域最大雨量：海丰县公平镇十三坑水库(G5642) 335.4毫米

广 东 省 气 象 台 制 作

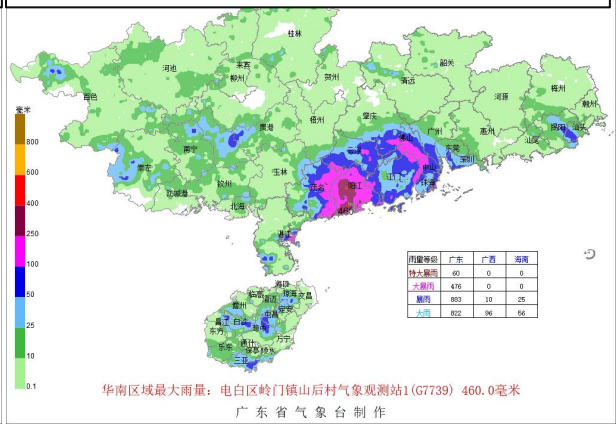
DAY3: 08:00, Sep.07-08:00, Sep.08



华南区域最大雨量：罗湖区东湖街道小梧桐(G3659) 503.7毫米

广 东 省 气 象 台 制 作

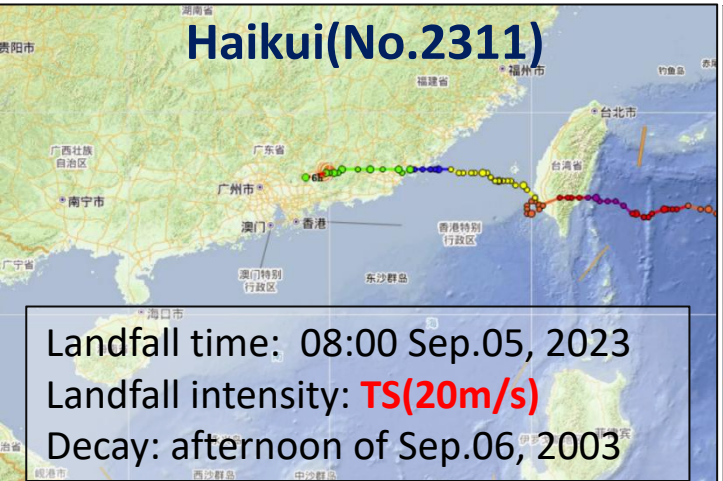
DAY4: 08:00, Sep.08-08:00, Sep.09



华南区域最大雨量：电白区岭门镇山后村气象观测站1(G7739) 460.0毫米

广 东 省 气 象 台 制 作

Haikui(No.2311)

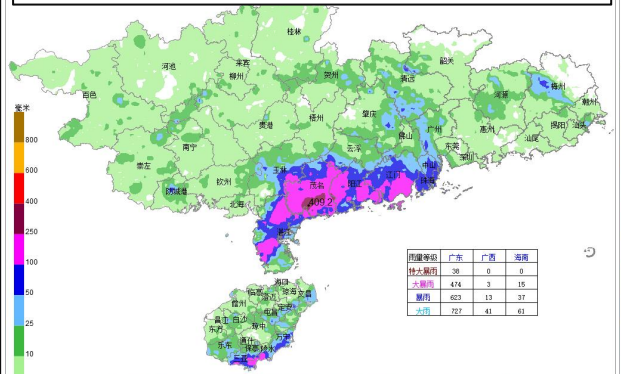


Landfall time: 08:00 Sep.05, 2023

Landfall intensity: TS(20m/s)

Decay: afternoon of Sep.06, 2003

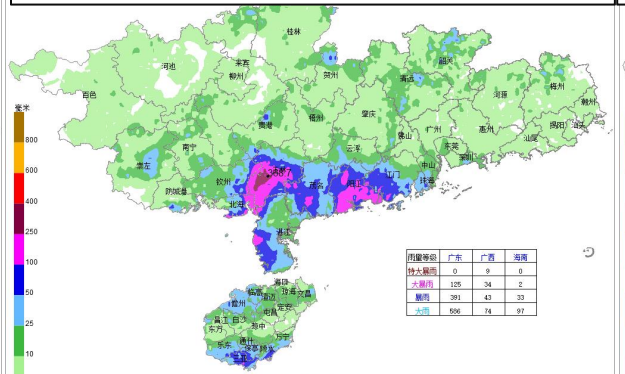
DAY5: 08:00, Sep.09-08:00, Sep.10



华南区域最大雨量：茂南区公馆镇塘边街气象观测站(G7914) 409.2毫米

广 东 省 气 象 台 制 作

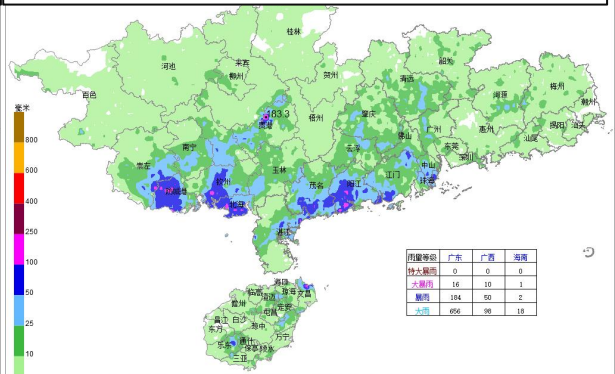
DAY6: 08:00, Sep.10-08:00, Sep.11



华南区域最大雨量：博白(59449) 368.7毫米

广 东 省 气 象 台 制 作

DAY7: 08:00, Sep.11-08:00, Sep.12



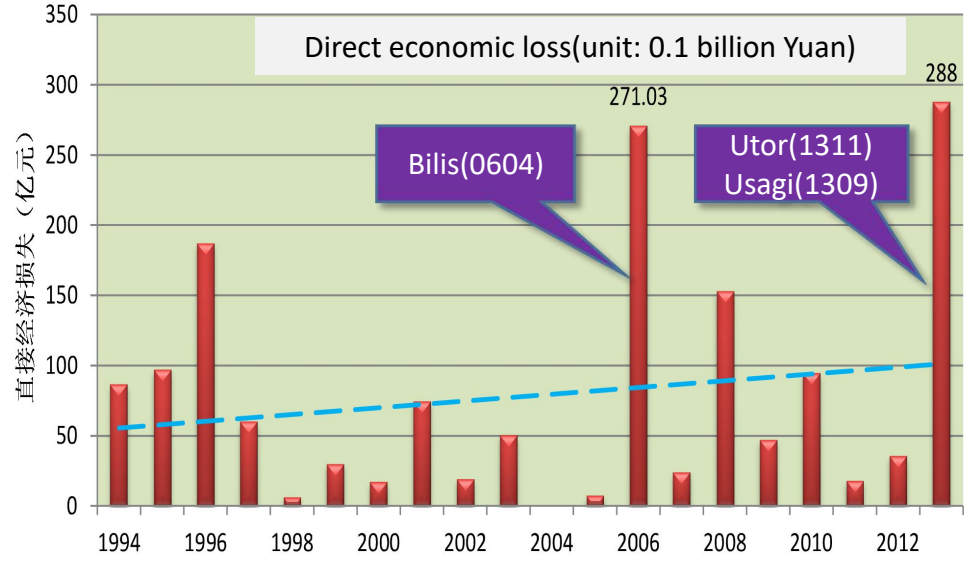
华南区域最大雨量：桂贵港桂平南木镇龙潭森林公园(N5254) 183.3毫米

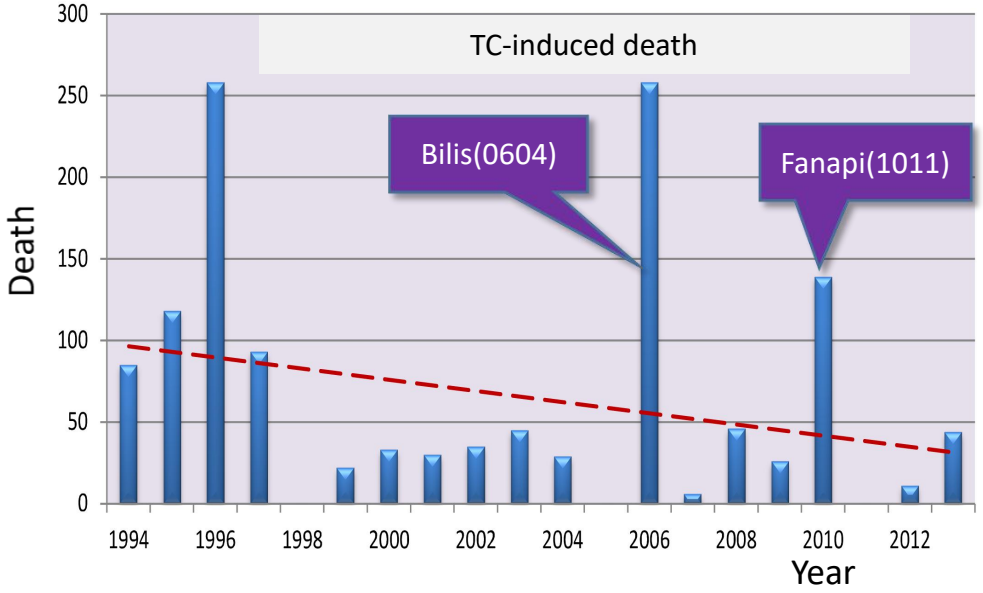
广 东 省 气 象 台 制 作

TC-induced disaster: extreme rainstorms

Death: 1
Evacuated people:177,500
Direct economic loss: CNY 3.8 billion.

Increase of direct economic loss and decrease of death induced by TCs in 1994-2013 in Guangdong





Economic loss:

9.4 billion CNY/year in 2004-2013, about **50% more that** that in 1994-2003 (6.28 billion CNY/year).

The first and second most economic loss in 2013 and 2006.

Death:

56 death/year in 2004-2013, **22% fewer** than that in 1994-2003 (72 death/year).

OUTLINE

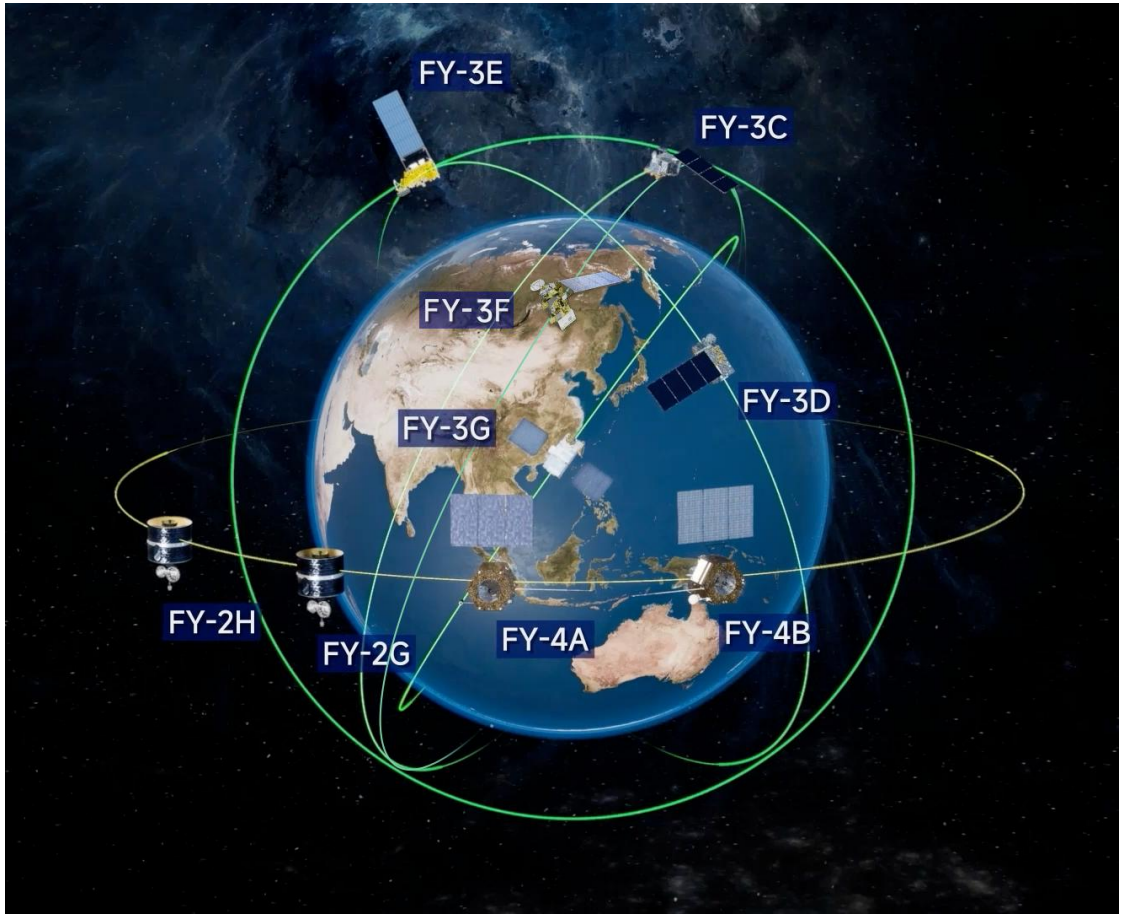
- Climatology of tropical cyclones in Guangdong
- **Tropical cyclone monitoring in Guangdong**
- Tropical cyclone forecasting in Guangdong
- Guangdong Emergency Early Warning Release Platform

TC Monitoring

- Far away from continent:
  - ✓Satellites, ships
- Near land:
  - ✓Radars, satellites, buoys, AWSs, wind profilers, lightening location systems
- On land:
  - ✓AWSs, Radars, satellites, buoys, wind profilers, lightening location systems
- For scientific research:
  - ✓More special monitoring

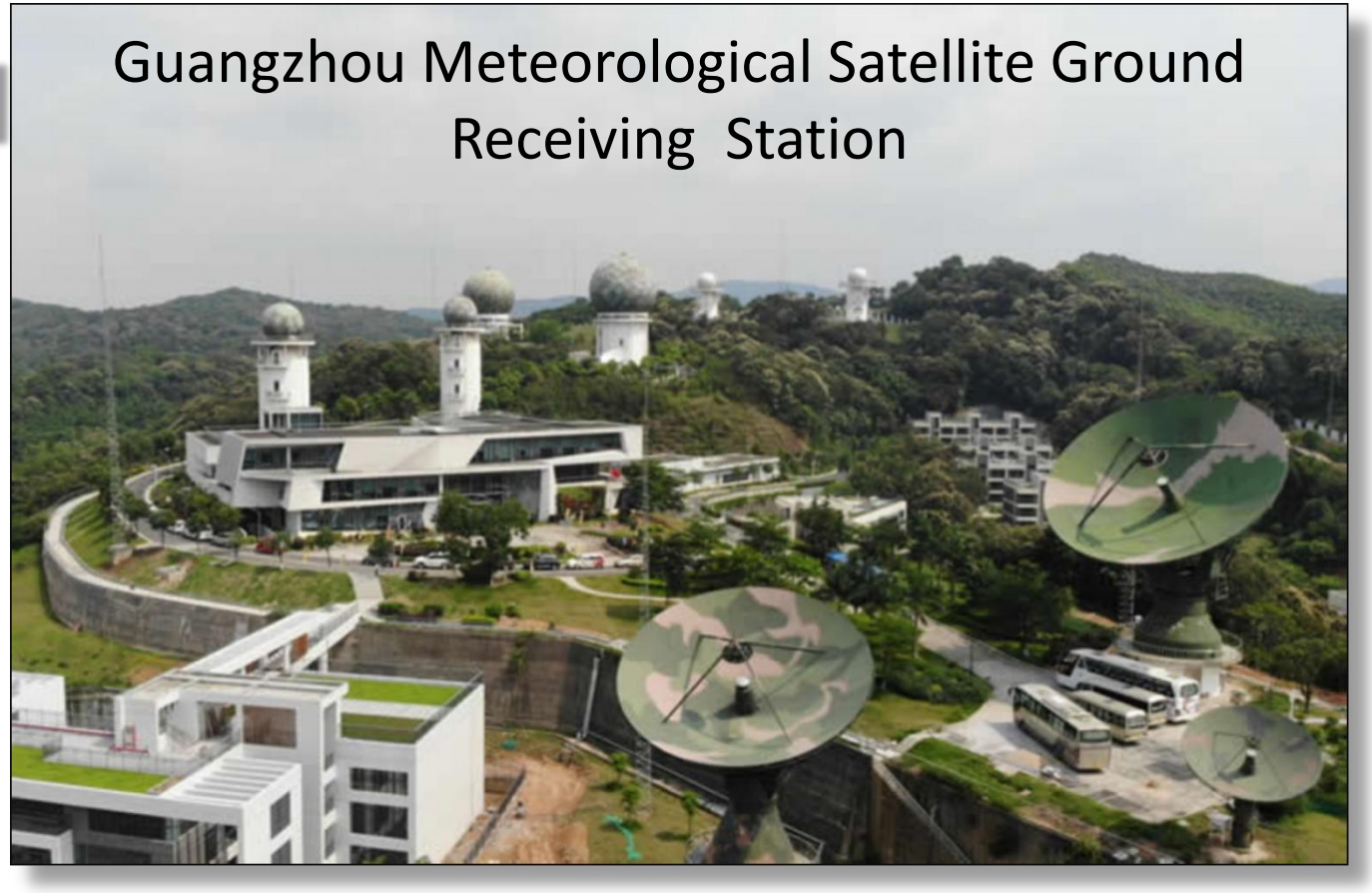
Satellite Monitoring

- 8 operational meteorological satellites in China:
  - ✓ 4 geostationary satellites: FY-2G, FY-2H, FY-4A, FY-4B
  - ✓ 4 polar satellites: FY-3D, FY-3E, FY-3F, FY-3G



5 Meteorological Satellite ground receiving Stations in China

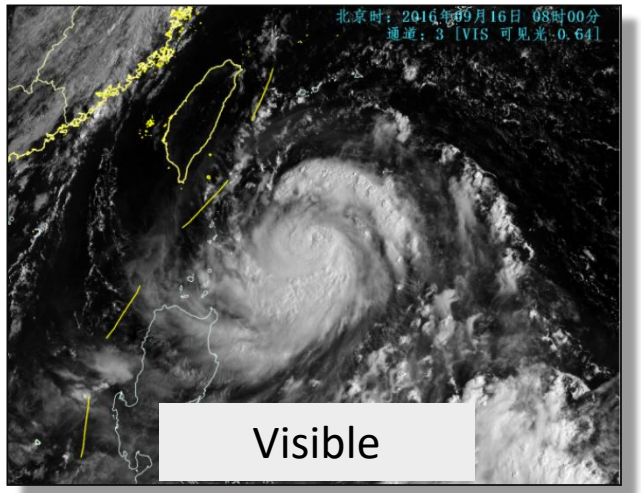
(Beijing, Jiamusi, Urumqi Kishi and **Guangzhou**)

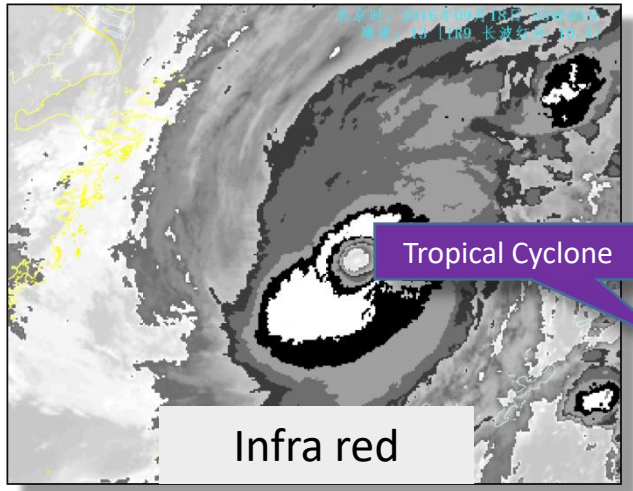


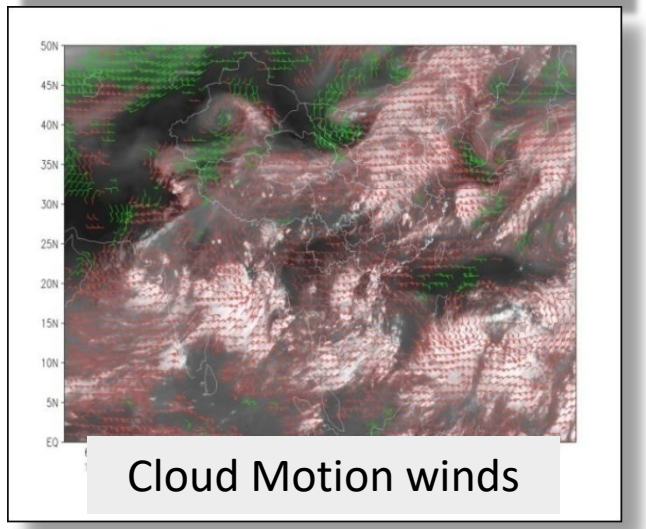
One important task is: to receive satellite data every day and provide products for operation.

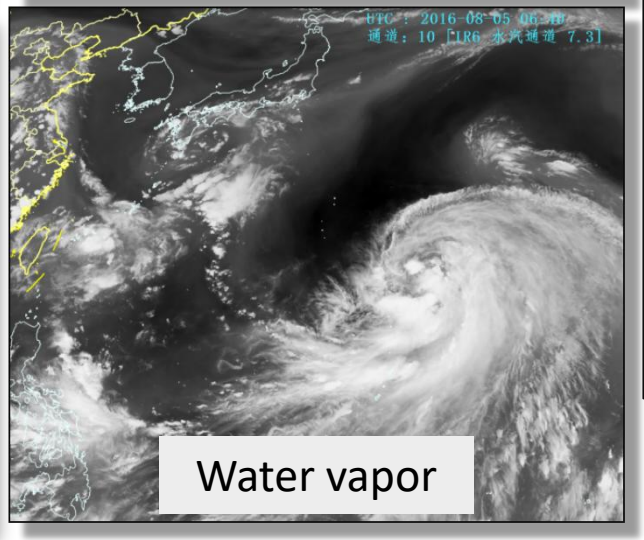
Geostationary Satellite products for TC monitoring

Products: Visible, infrared , water vapor, Sea surface temperature, TBB, cloud motion wind, high-level divergence, …—for direct TC observation and atmospheric circumstance analysis.

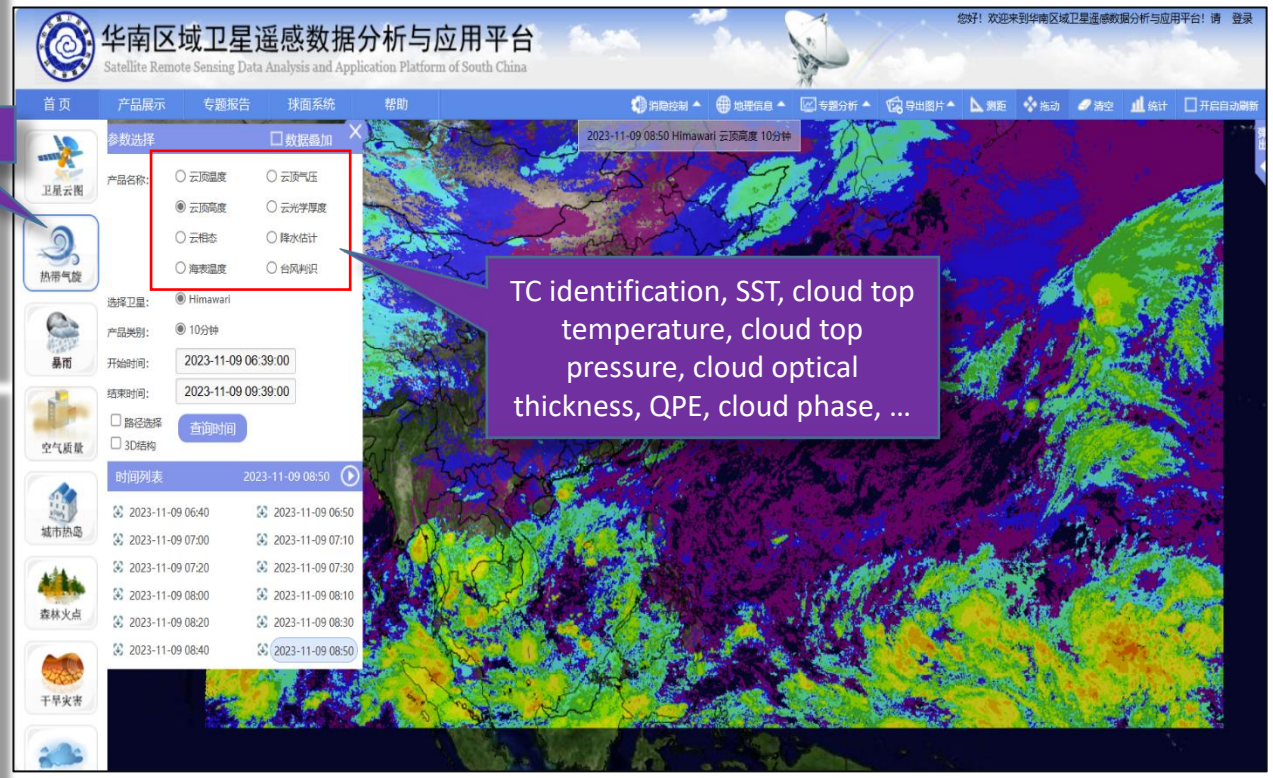






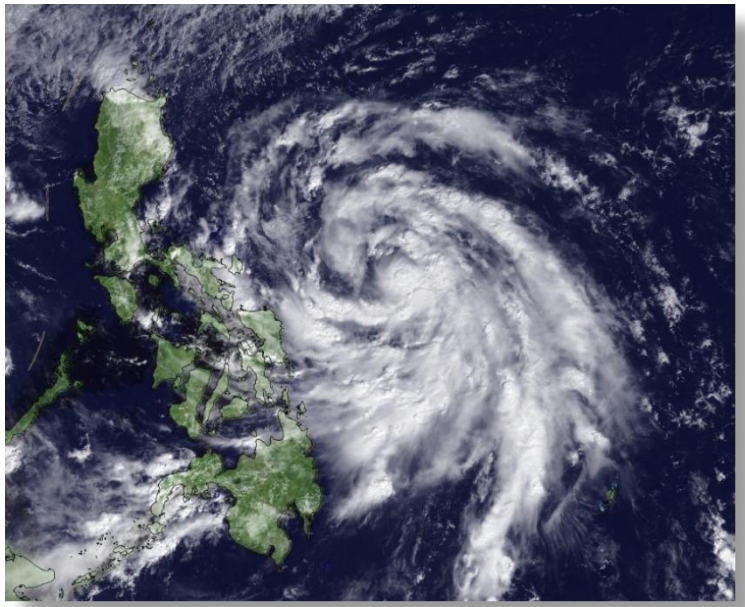


Tropical Cyclone

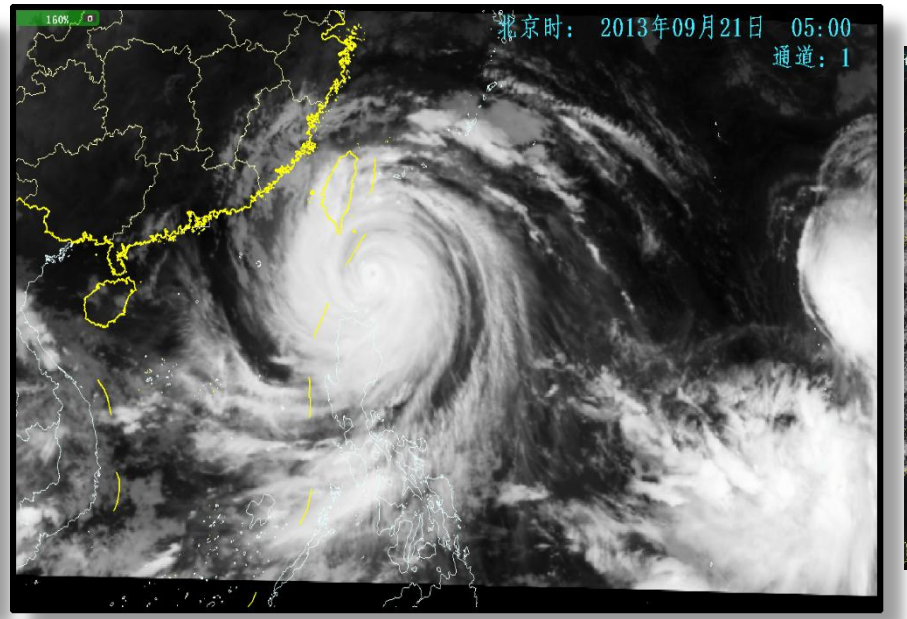


Satellite Remote Sensing Data Analysis and Application Platform of South China

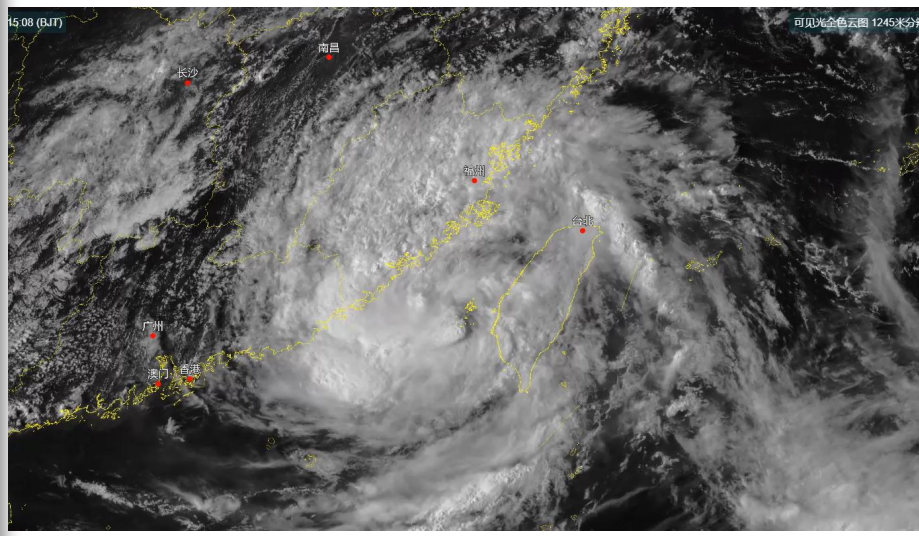
Geostationary Satellite products



2020, Vamco(FY-4A Vis), 500m

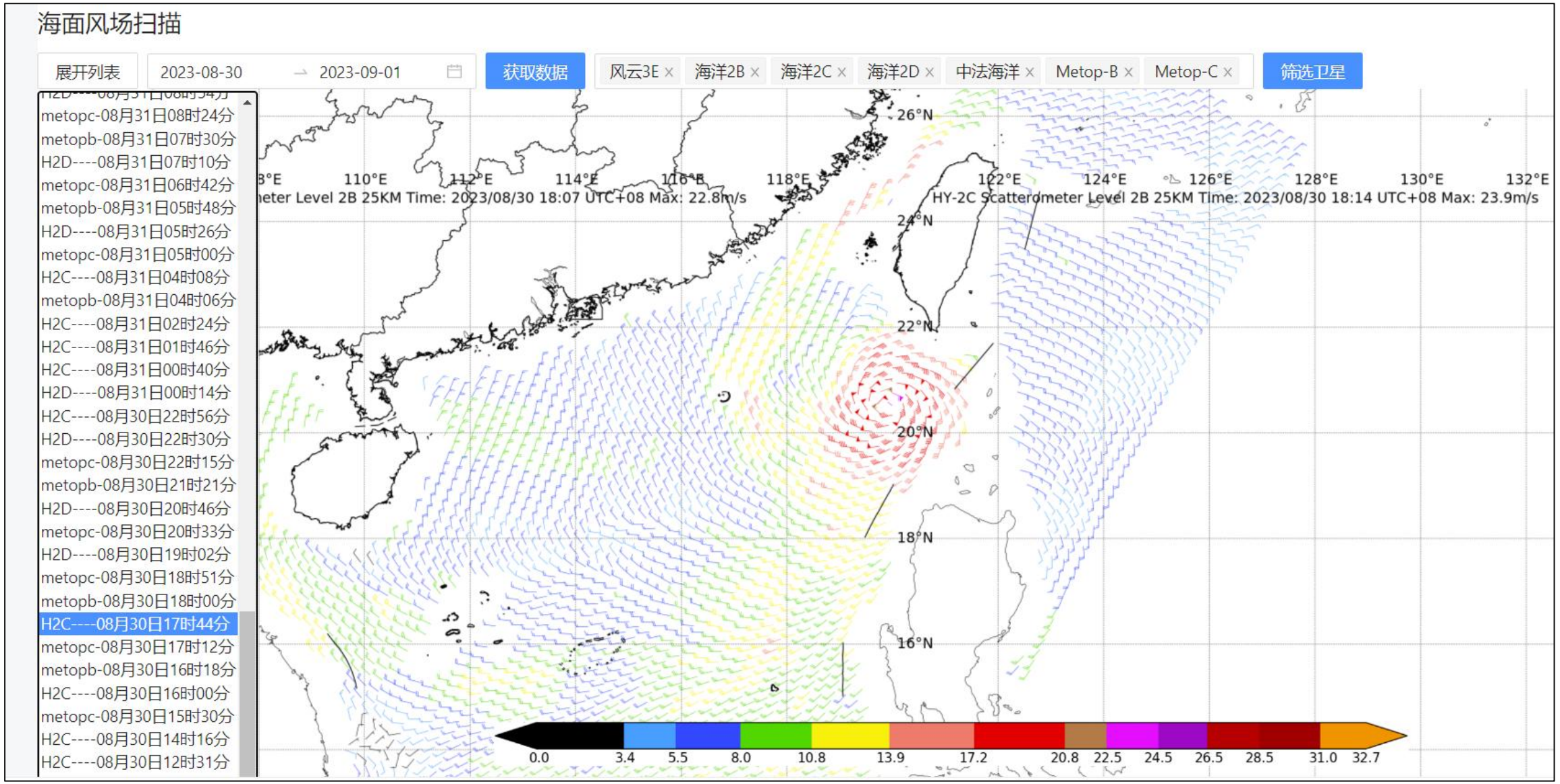


2013, Usagi (FY-2F IR), 6min



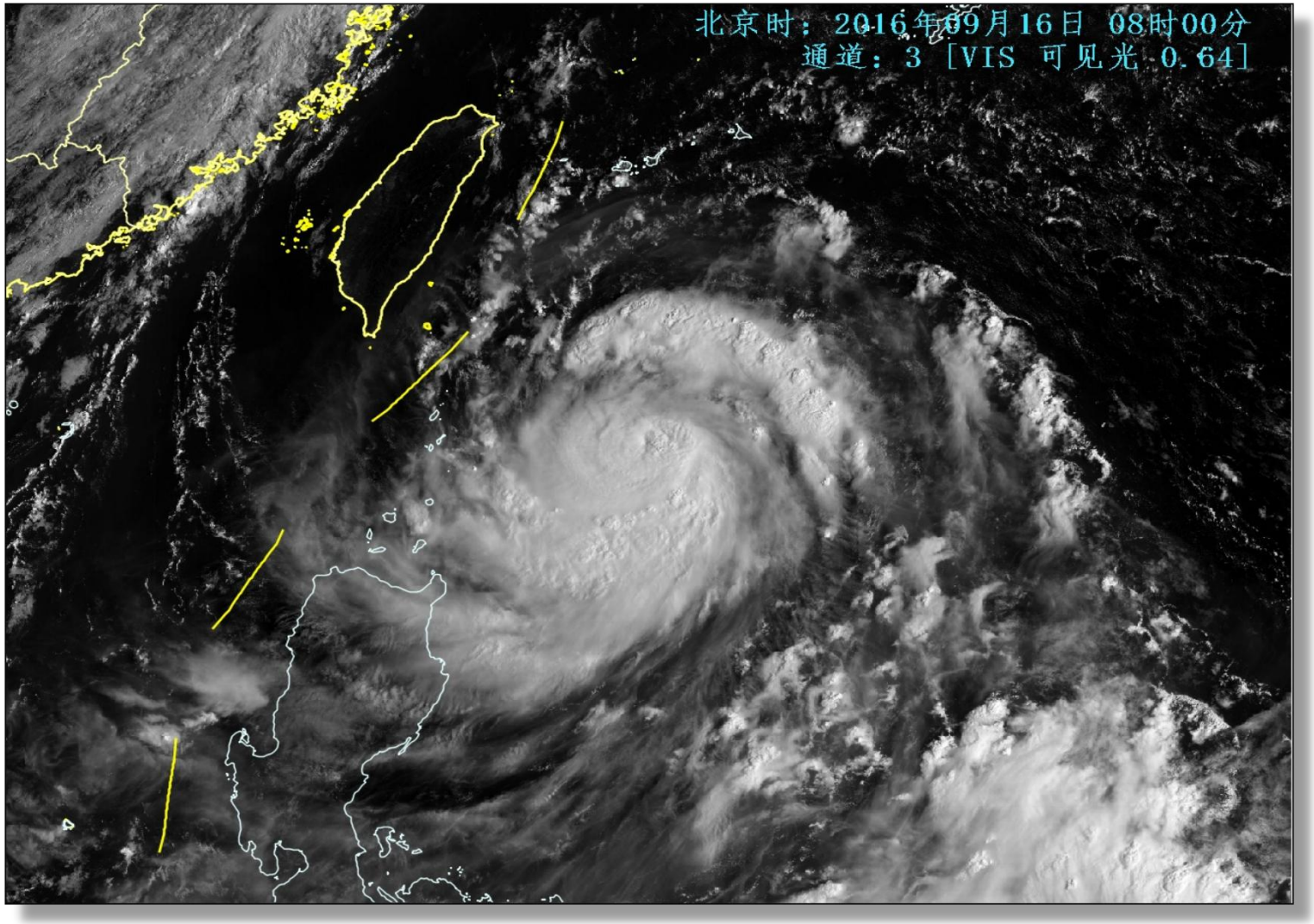
2023, Haikui (AI), 1min

Polar Satellite products-retrieved winds



Receiving foreign satellite data

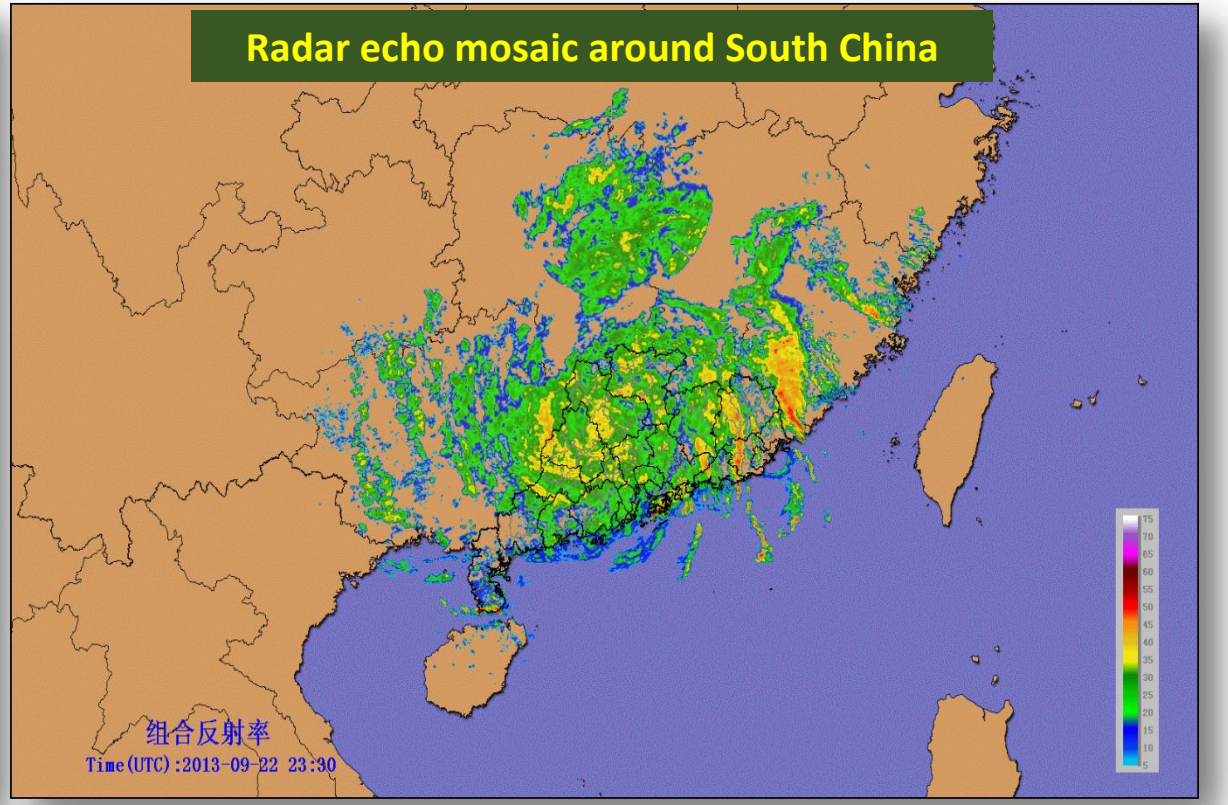
(NOAA series, MTSAT series, EOS, Himawari, et al)



Himawari

Doppler Weather Radar Network

Exchange of Doppler radar data with adjacent provinces



12 Doppler weather radars along the coast:

Xiamen、Shantou、Shanwei、Shenzhen、Guangzhou、Zhuhai、Yangjiang、Zhanjiang、Beihai、Haikou、Sanya、Xisha(every 6 minutes)

(All radars in Guangdong are upgraded to **dual polarized Doppler** weather radars)

Automatic Weather Stations(AWS) near Shore

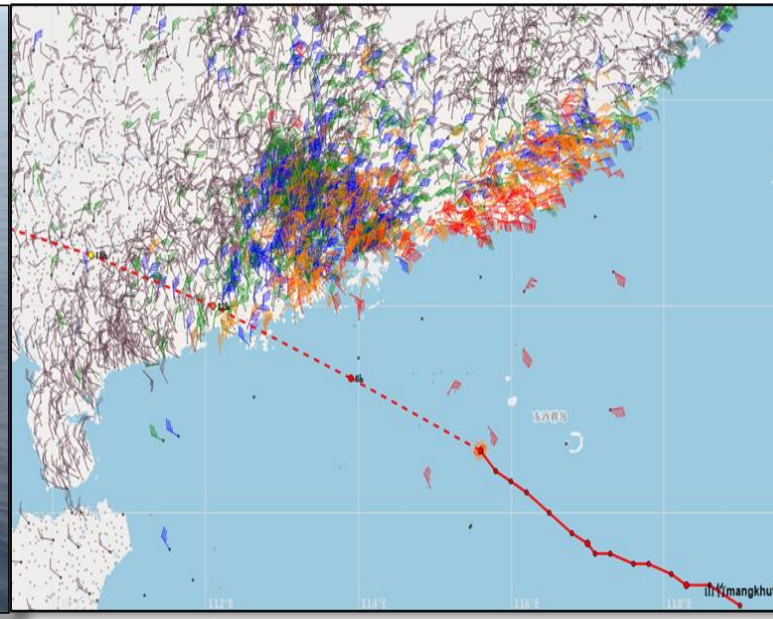
- 194 AWS on islands near shore: every 5 minutes(close to coastline)
- 30 buoys: every 5 minutes(100-200km away from coastline)-satellite communication
- 30 AWS on offshore petrol platforms: every 5 minutes(200-300km away from coastline)-satellite communication

30 AWS on petrol platforms

Most of petrol platforms are **200-300km** away from coastline.

AWS on petrol platform *Liuhua*

AWS on petrol platform *HZ21-1*



For monitoring of weather and atmospheric status and research

- 47GNSS/MET
- 28 wind profiler radars along coast
- 22 lightening location systems
- Raindrop size meters

Wind profiler radar

Lightening location system

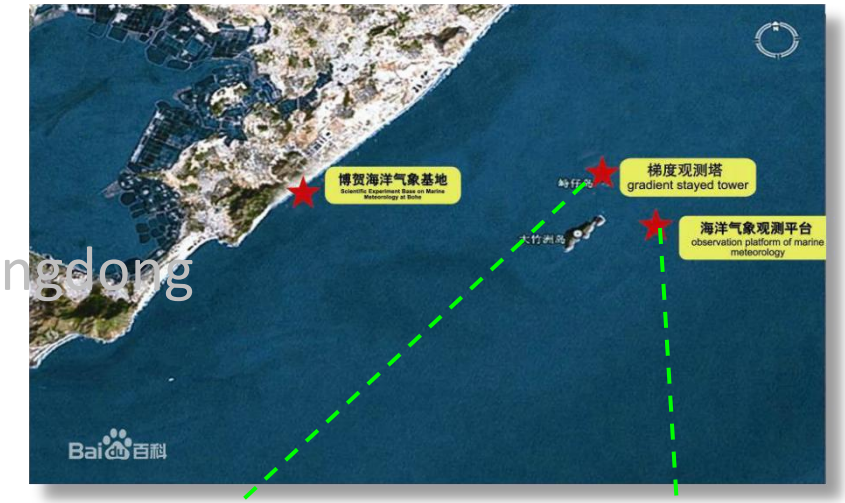
GNSS/MET

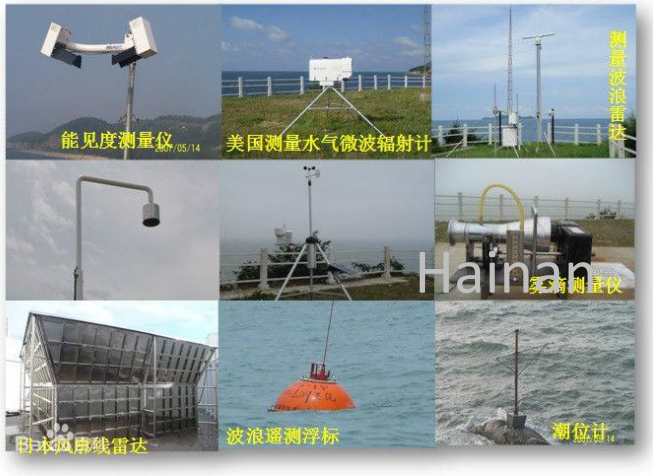
Raindrop size meter

Scientific Experiment Base on Marine Meteorology at Bohe, Maoming (Constructed in 2004)

(Mainly for scientific research besides TC monitoring)

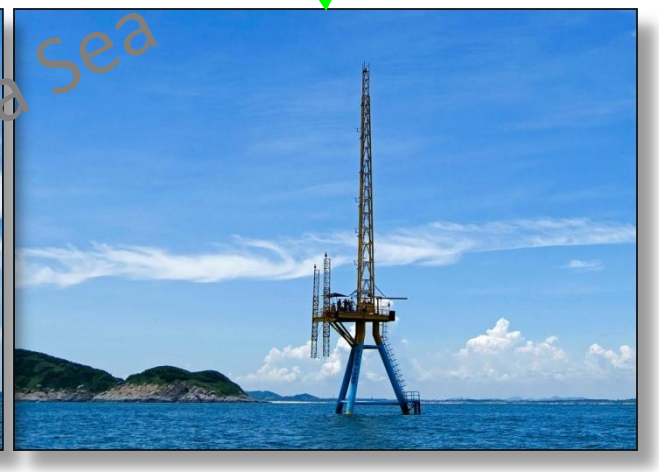
Guangdong





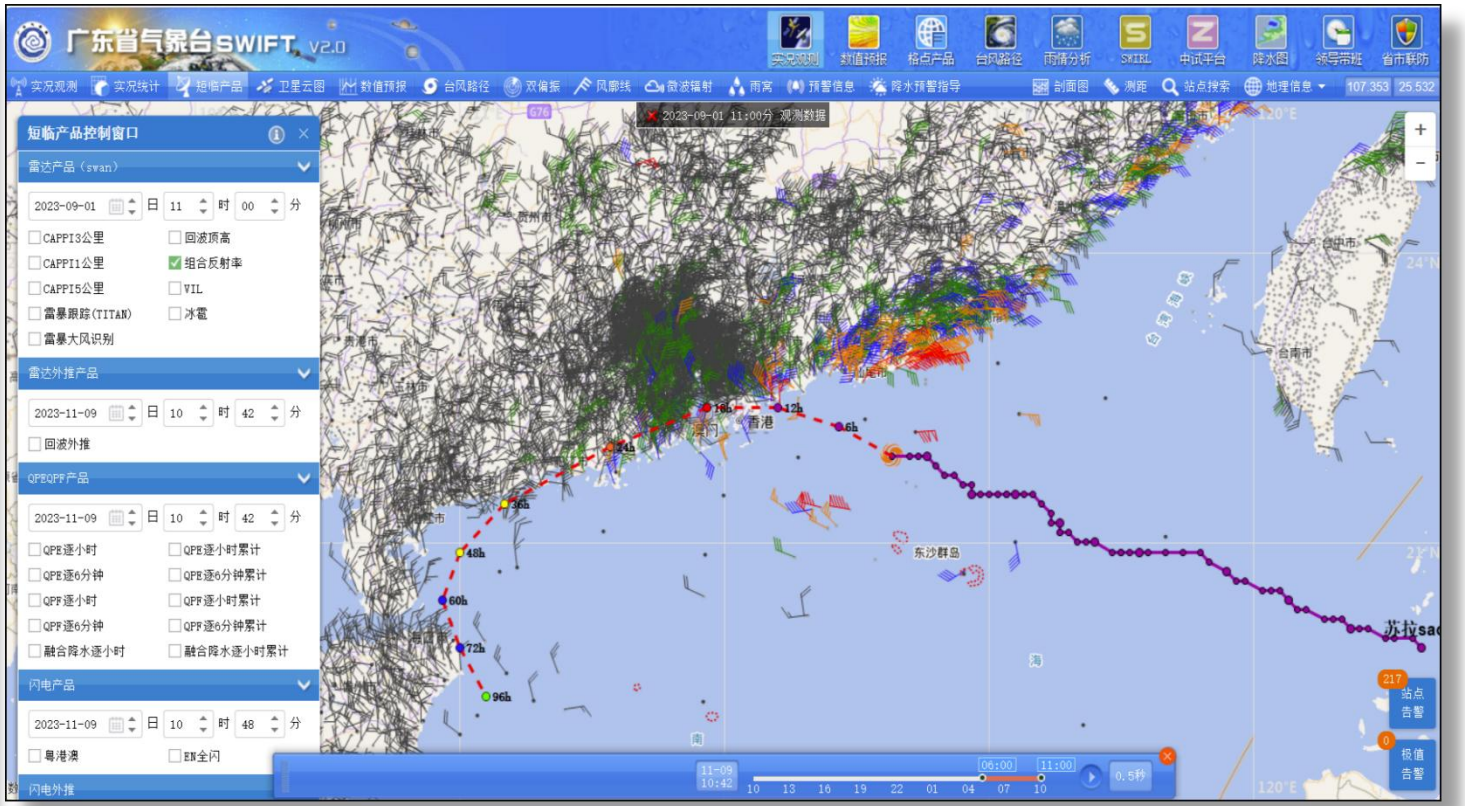
Other devices

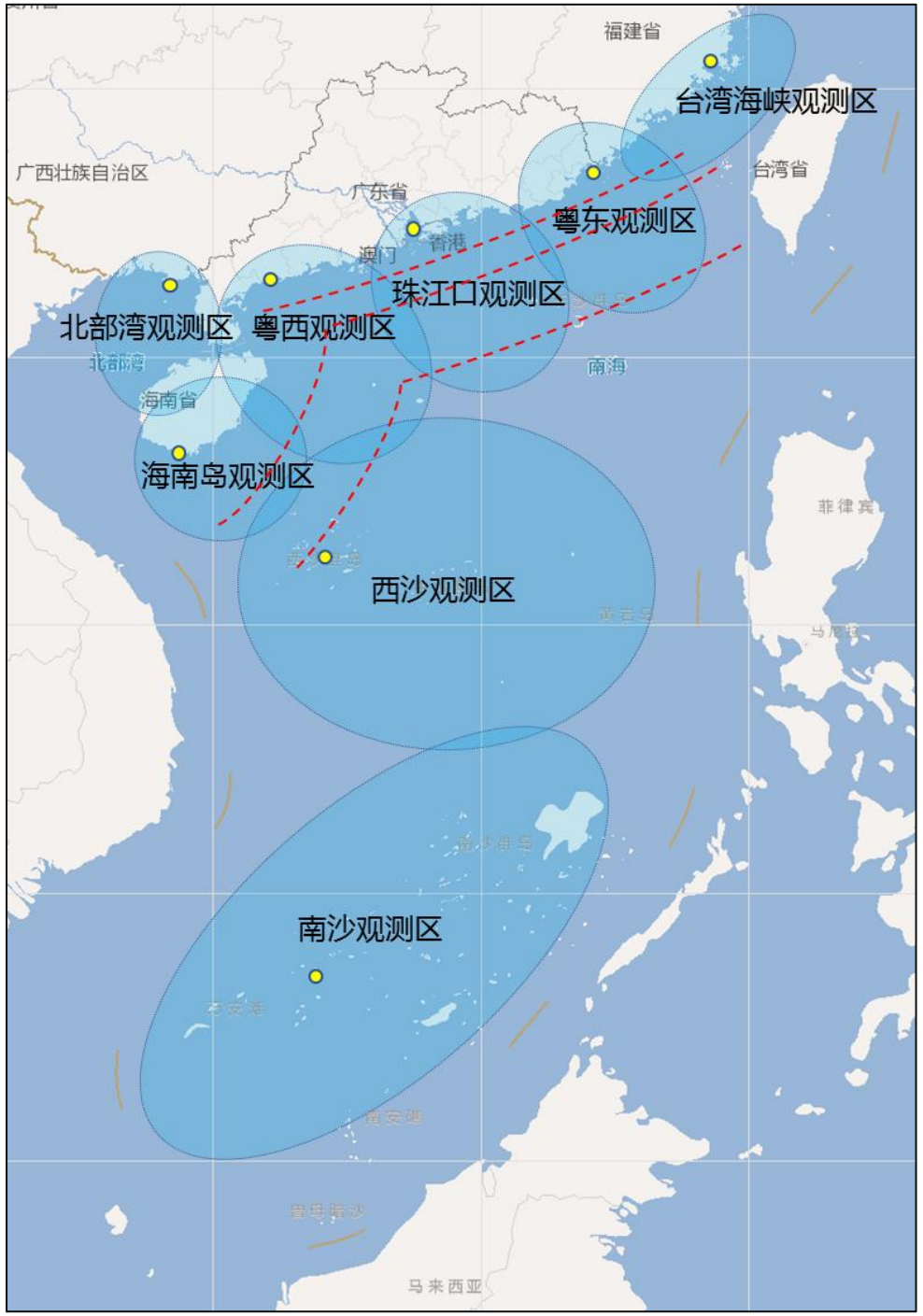
Gradient stayed tower



Observation platform on marine meteorology

Operational LAN network in Guangdong Meteorological Service





Marine meteorological monitoring network in South China Sea

S-band Doppler radar: 19
X-bank weather radar: 24
High-frequency ground wave radar: 1

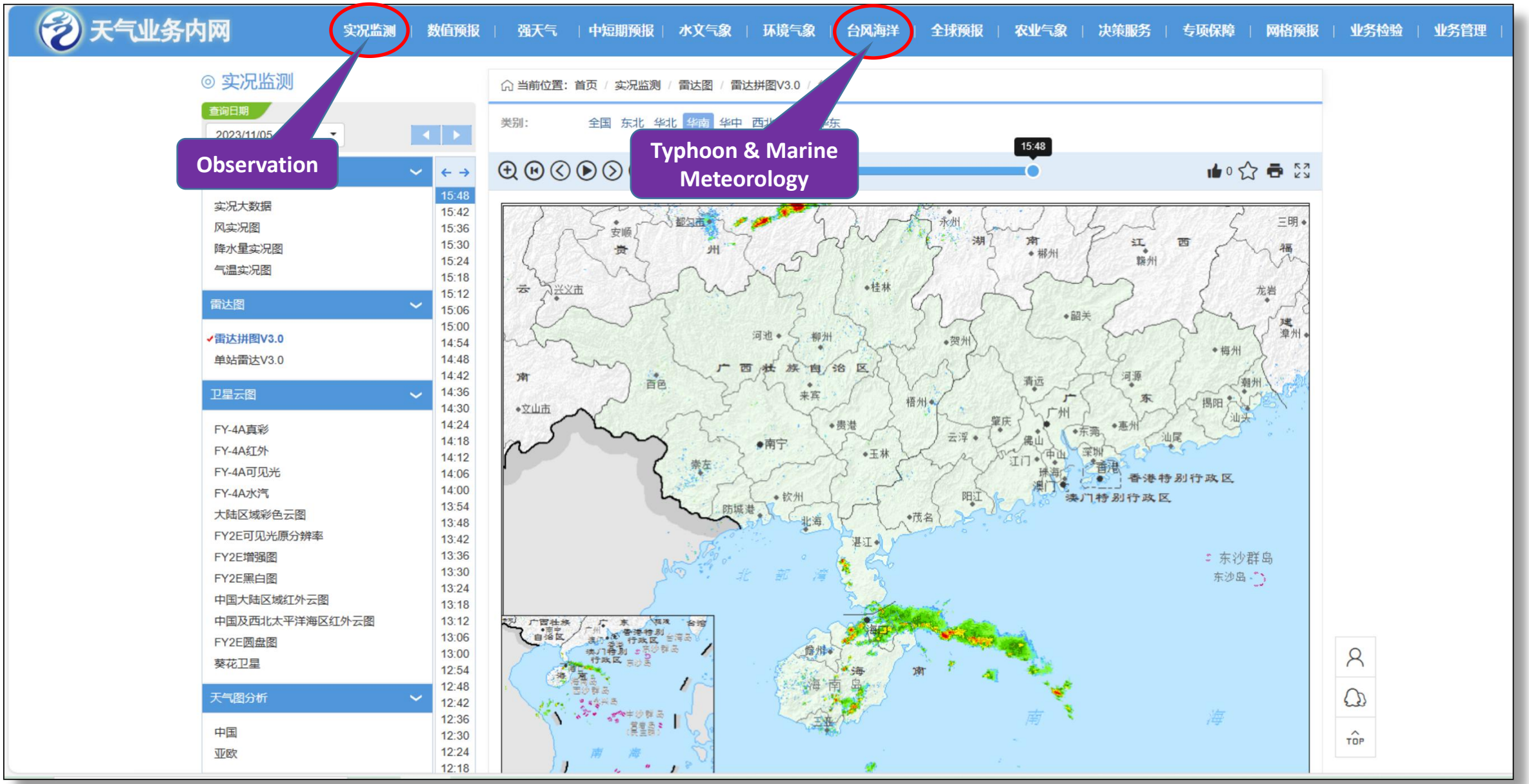
Marine meteorological buoys: 20(5 are weather buoys)

AWS on land: >4000
AWS on islands: 194
AWS on petrol platforms: 30
Shipborne AWS: 12

wind profiler radars along coast: 28
GNSS/MET: 47
Lightening monitoring stations: 51

National operational LAN network in CMA

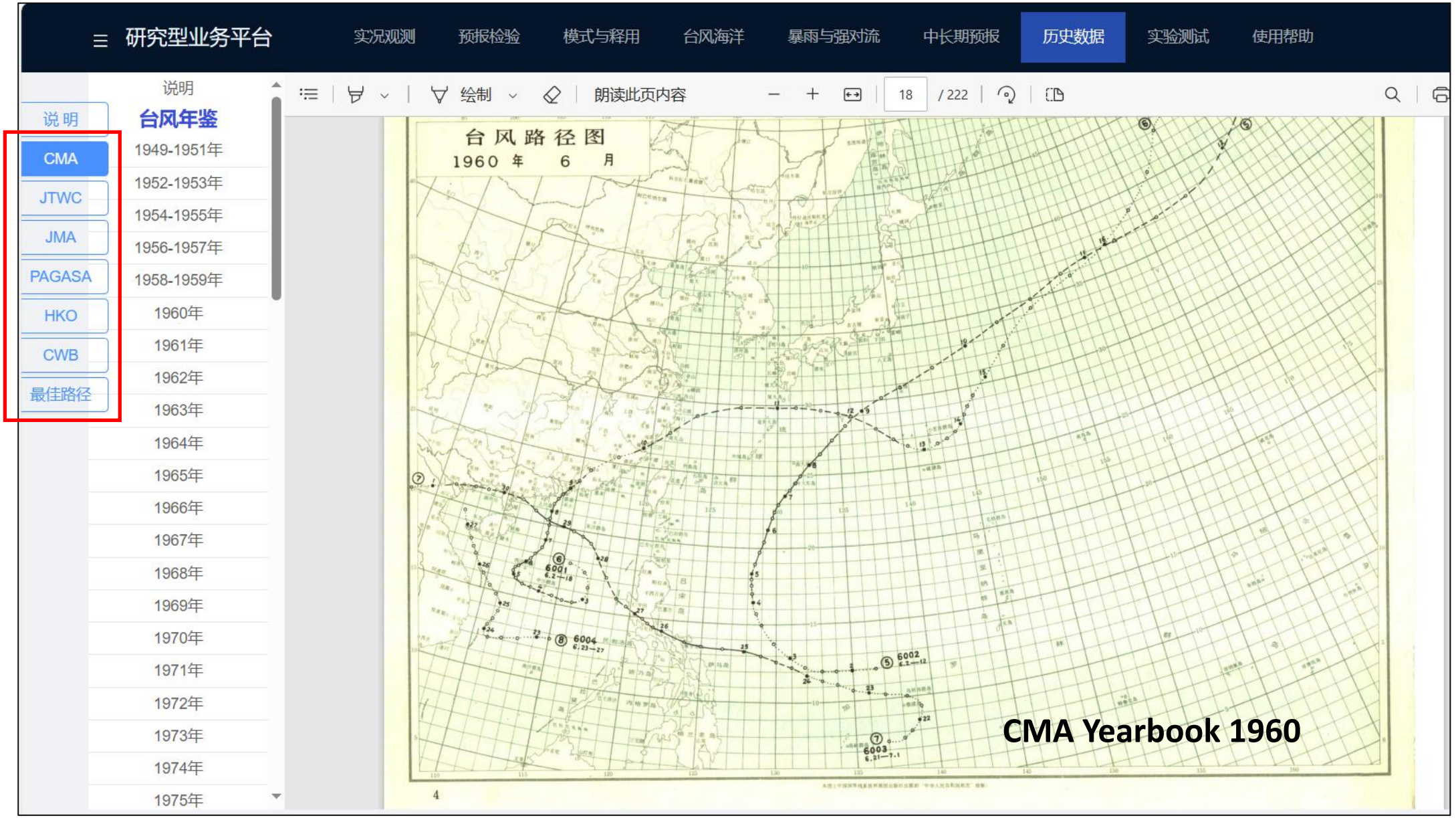
(Open to all provincial, municipal and county meteorological bureaus)



OUTLINE

- Climatology of tropical cyclones in Guangdong
- Tropical cyclone monitoring in Guangdong
- **Tropical cyclone forecasting in Guangdong**
- Guangdong Emergency Early Warning Release Platform

Historic Tropical Cyclone Data Collected



Historic TC Ensemble Messages Collected

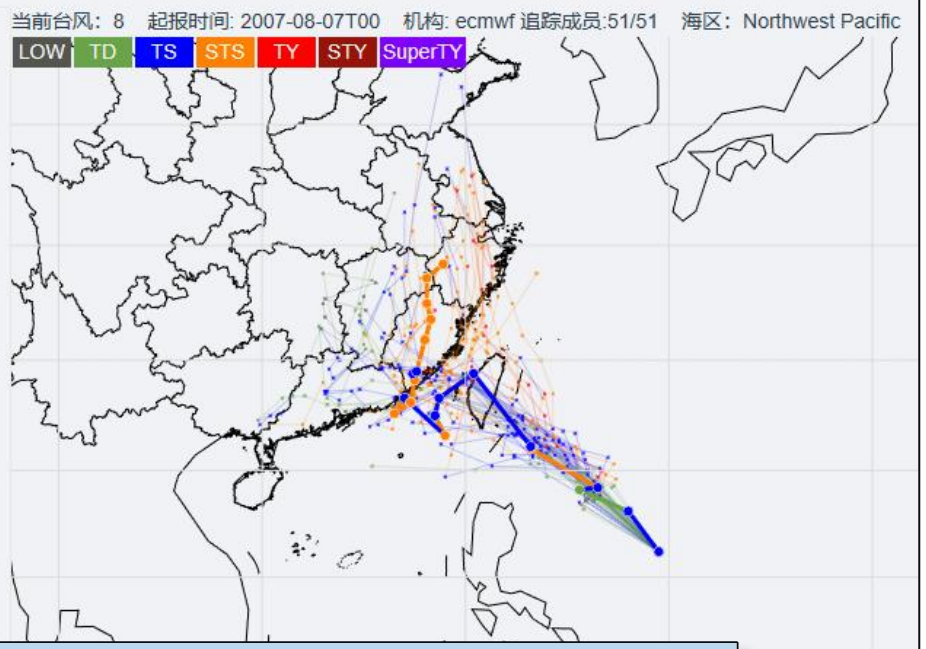
研究型业务平台 | 实况观测 | 预报检验 | 模式与释用 | 台风海洋 | 暴雨与强对流 | 中长期预报 | 历史数据 | 实验测试 | 使用帮助

切换预报机构: 欧洲中心-西太检测 | 筛选海区: 西北太平洋 | 日期: 2006-10-01 ~ 2023-11-20 | 年份筛选

历史台风集合预报

日期	机构	name	innerID	所在海区	文件	BstID	台风编号	BstName	error
2007080608	ecmwf	Pabuk	7	Northwest-Pacific	预览 下载	200707	0707	Pabuk,2007	
2007080620	ecmwf	6	6	Northwest-Pacific	预览 下载	200706	0706	(nameless)0706,2007	1
2007080620	ecmwf	Pabuk	7	Northwest-Pacific	预览 下载	200707	0707	Pabuk,2007	
2007080708	ecmwf	6	6	Northwest-Pacific	预览 下载	200706	0706	(nameless)0706,2007	1
2007080708	ecmwf	8	8	Northwest-Pacific	预览 下载	200708	0708	Wutip,2007	
2007080708	ecmwf	Pabuk	7	Northwest-Pacific	预览 下载	200707	0707	Pabuk,2007	
2007080720	ecmwf	6	6	Northwest-Pacific	预览 下载	200706	0706	(nameless)0706,2007	1
2007080720	ecmwf	8	8	Northwest-Pacific	预览 下载	200708	0708	Wutip,2007	
2007080720	ecmwf	Pabuk	7	Northwest-Pacific	预览 下载	200707	0707	Pabuk,2007	
2007080808	ecmwf	Pabuk	7	Northwest-Pacific	预览 下载	200707	0707	Pabuk,2007	

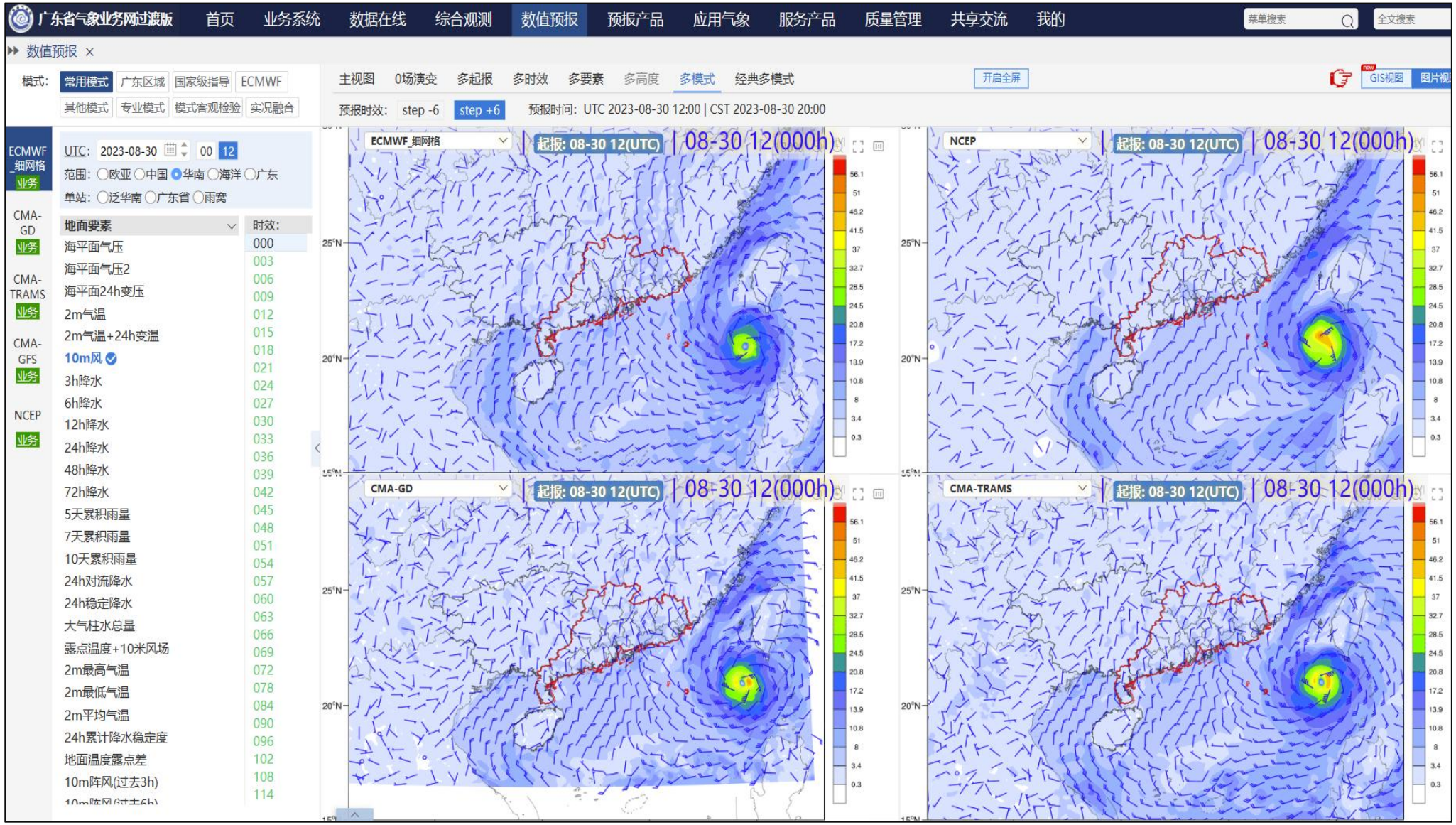
< 1 ··· 18 19 20 21 22 ··· 483 >



Historic EPS data from ECMWF, NCEP, UKMO, Canada are collected.

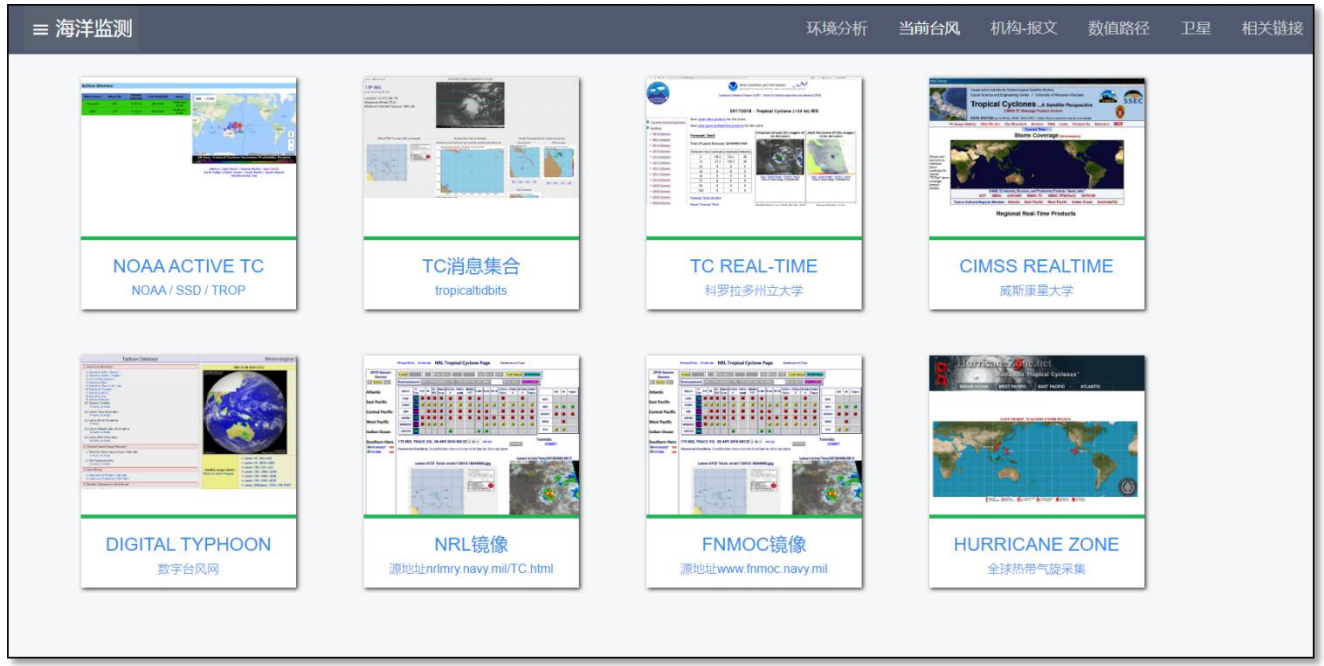
Numerical products in LAN network of Guangdong Meteorological Service

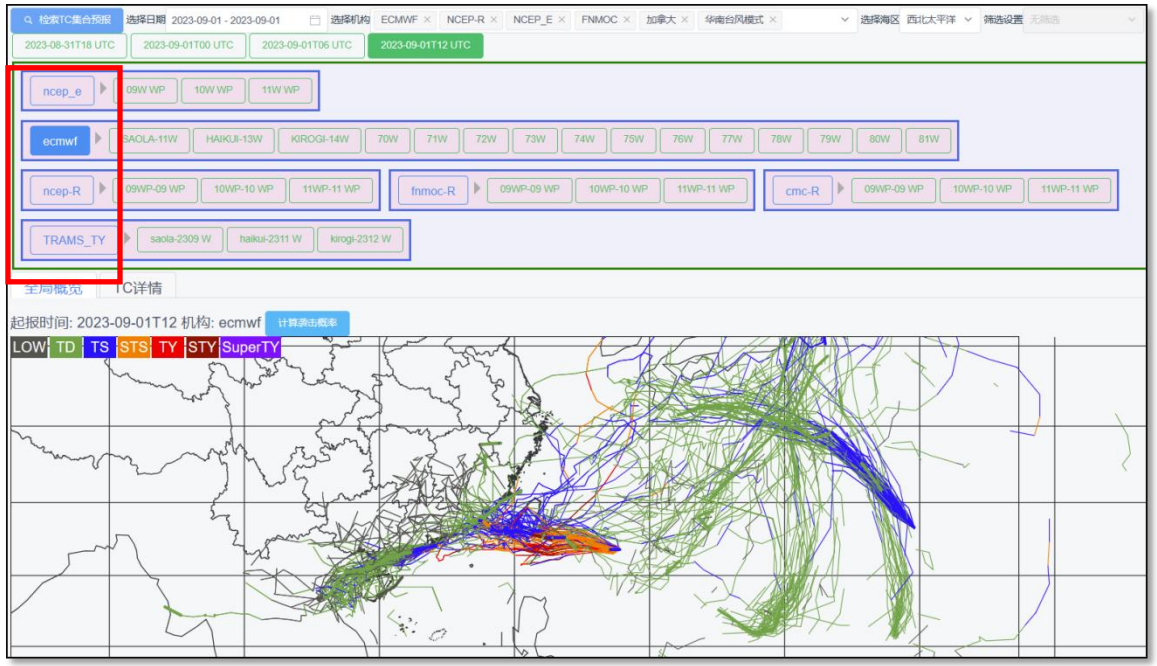
(Shared within all municipal and county meteorological bureaus all over Guangdong Province)

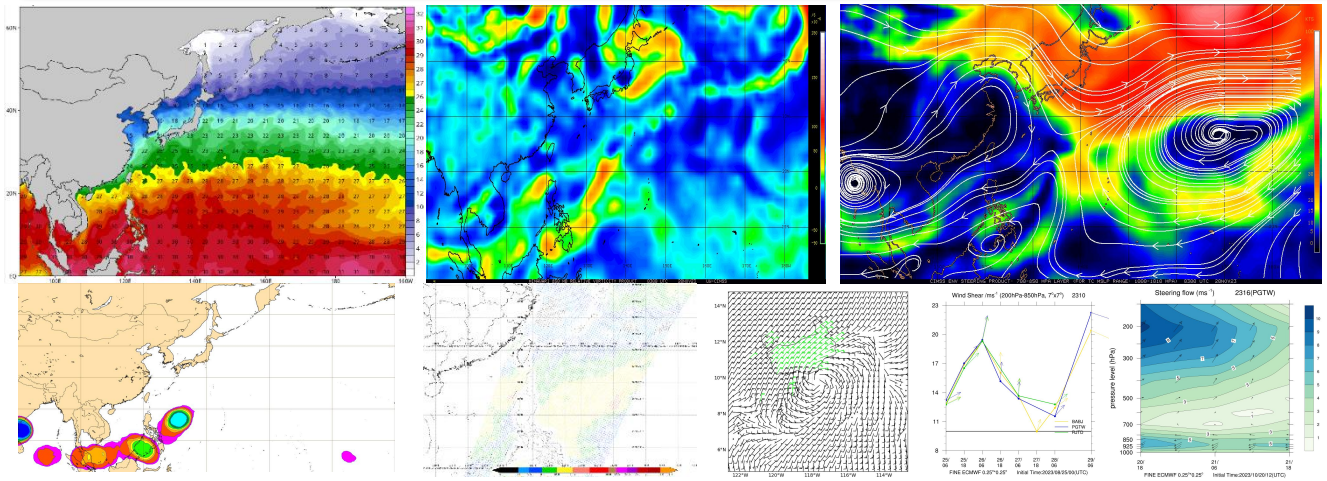


- **CMA:**
  - ✓ CMA-GFS
  - ✓ CMA-meso
- **Guangdong:**
  - ✓ CMA-TRAMS
  - ✓ CMA-GD
  - ✓ CMA-TRAMS-EPS
  - ✓ SEA WAVE
  - ✓ SEA FOG
  - ✓ CIRCUMSTANCE
  - ✓ STORM SURGE
- **ECMWF**
  - ✓ ECMWF_thin
  - ✓ ECMWF-EPS
  - ✓ ECMWF-32days
  - ✓ ECMWF-46days
  - ✓ ECMWF-C3Y
- **NCEP**
  - ✓ NCEP-GPS
- **CMA LAN operational PLATFORM(open to all provincial meteorological services)**
  - ✓ More models

TC analysis platform

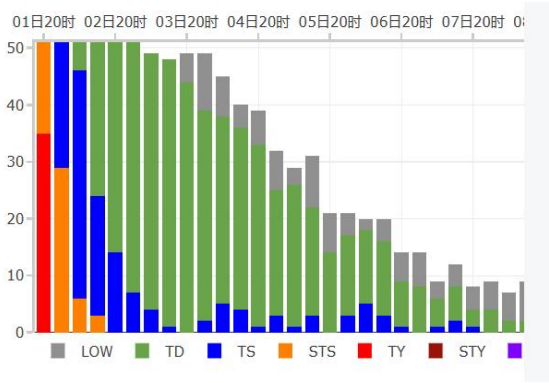


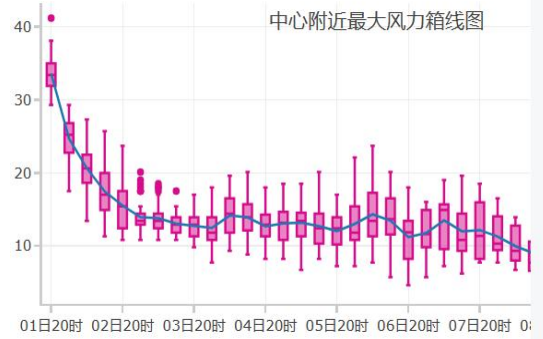




TC data platform

(SST, circulation analysis; TC genesis probability; current TC information; GTS message; EPS; satellite products; AWS; Radar images; …)



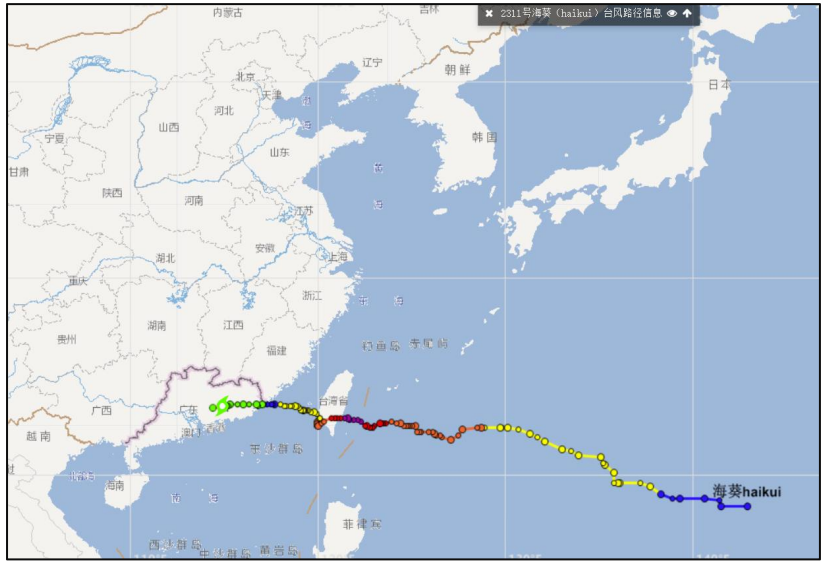


EPS products

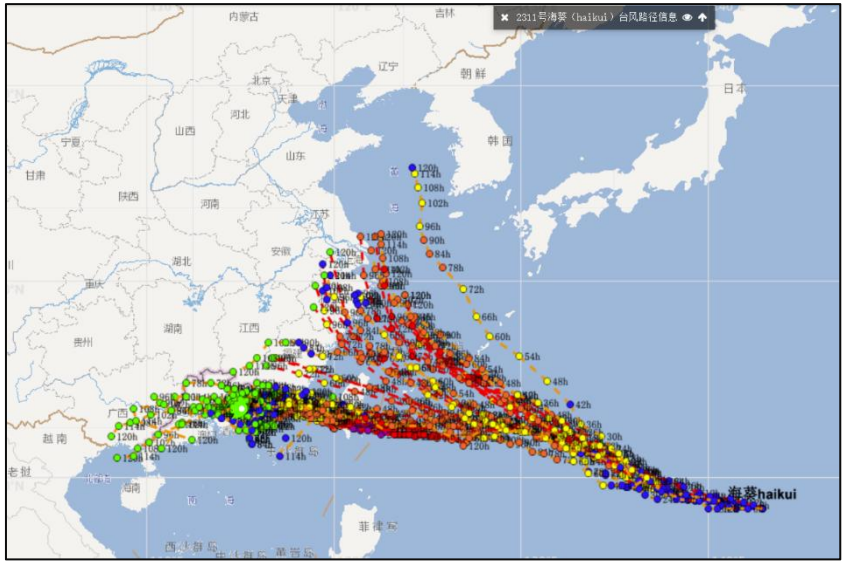
(**Grapes-EPS**, ECMWF-EPS, NCEP-EPS, UKMO-EPS, CMC-EPS,…)

24-72h track errors of CMA-TRAMS in 2012-2022

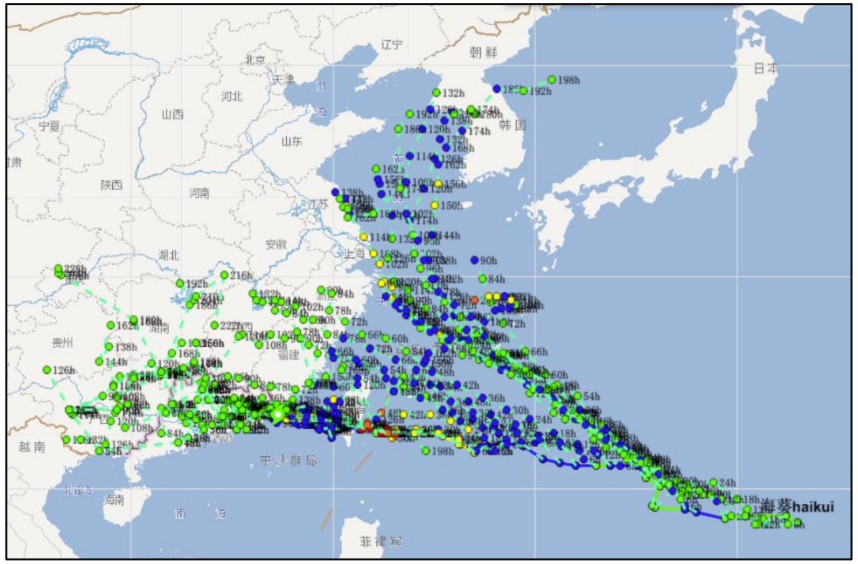
Models are not always correct



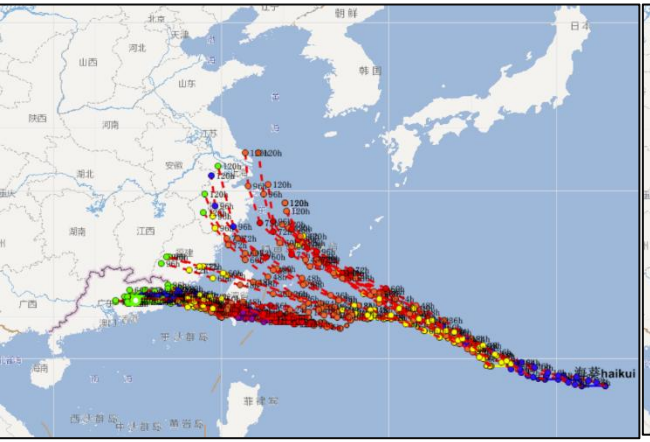
Track of Haikui(No.2311)



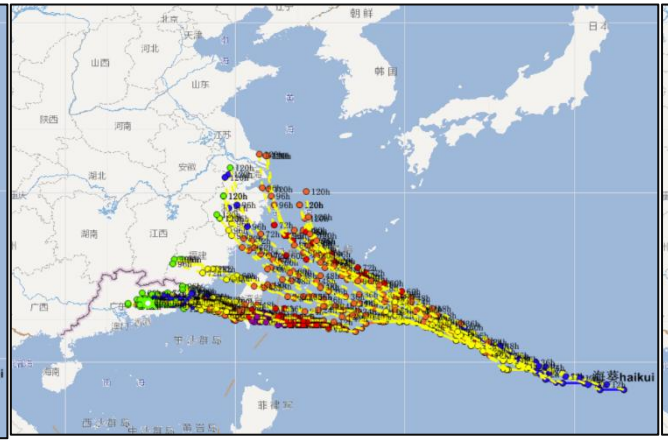
ALL track predictions of Haikui(No.2311) of **CMA-TRAM**



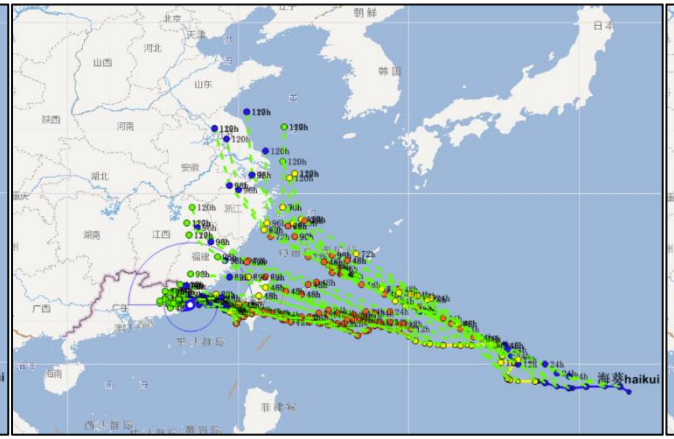
ALL track predictions of Haikui(No.2311) of **ECMWF**



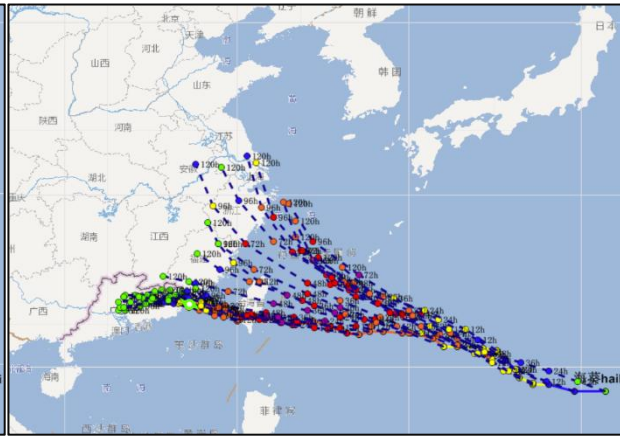
Subjective forecasts: GuangZhou



Subjective forecasts: Beijing

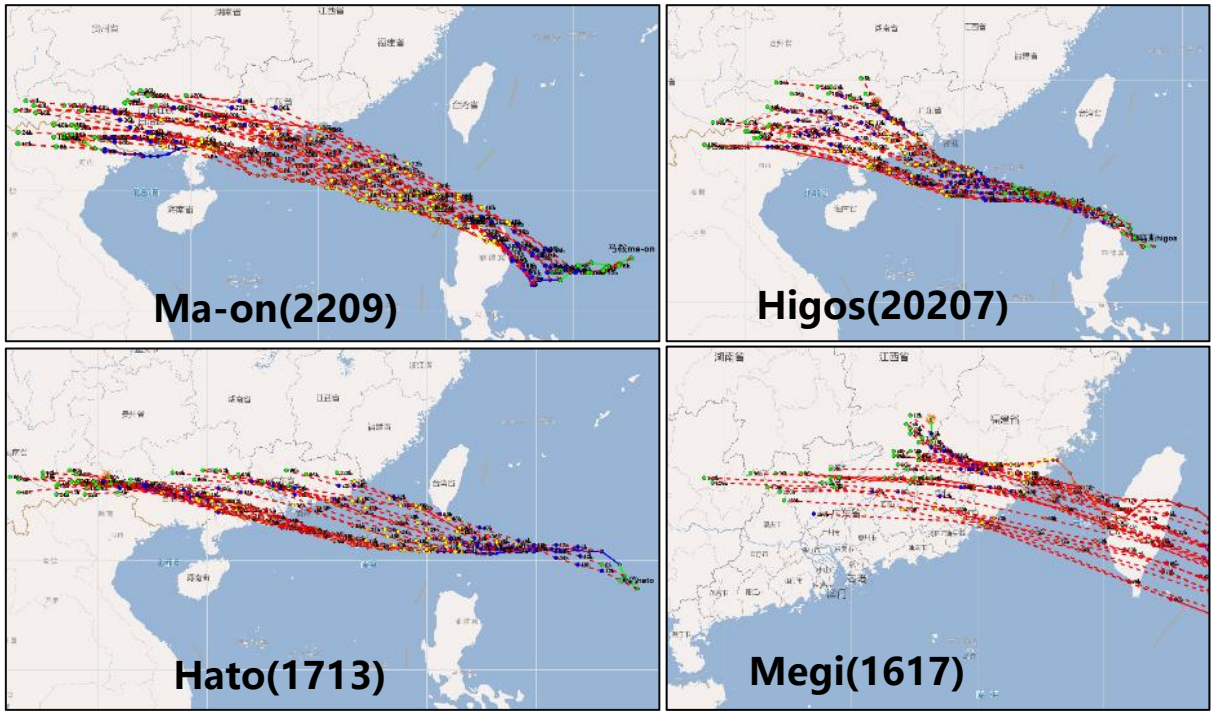


Subjective forecasts: Tokyo

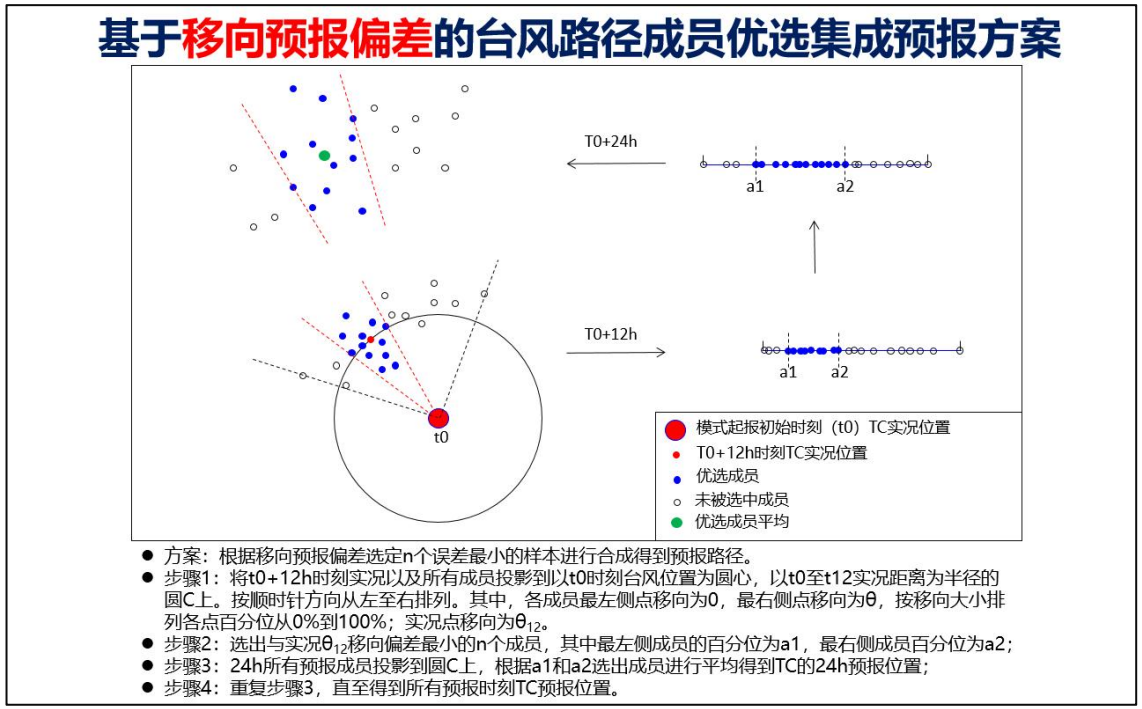


Subjective forecasts: JTWC

Ensemble Forecasting for Typhoon tracks based on Moving Direction Deviation(EFTyMoDD)



Continuous moving direction forecast deviation is common in South China

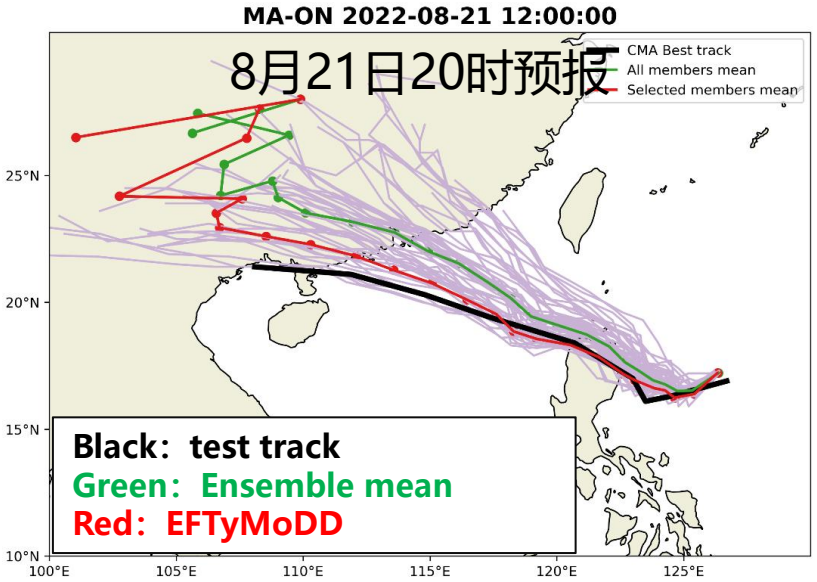


Forecasting technical proposal of EFTyMoDD

- For Guangdong, westward typhoons are inclined to cause higher track forecast errors and more service difficulties.

EFTyMoDD Experiment (Ma-on, No.2209)

Forecasting center	24h forest error (distance/km; direction/°)		48h forest error (distance/km; direction/°)		72h forest error (distance/km; direction/°)	
Guangzhou	95.2;	9.1	191.9;	9.1	342.3;	10.0
Beijing	85.5;	8.5	193.4;	8.2	360.8;	9.3
RSMC Tokyo	109.7;	10.9	213.3;	8.7	355.1;	9.8
JTWC	89.4;	8.3	161.2;	7.2	308.6;	10.3
ECMWF ensemble mean	74.0;	6.8	192.5;	8.4	320.0;	10.0
EFTyModd	**66.2;**	**5.0**	**168.9;**	**6.2**	**234.3;**	**6.9**

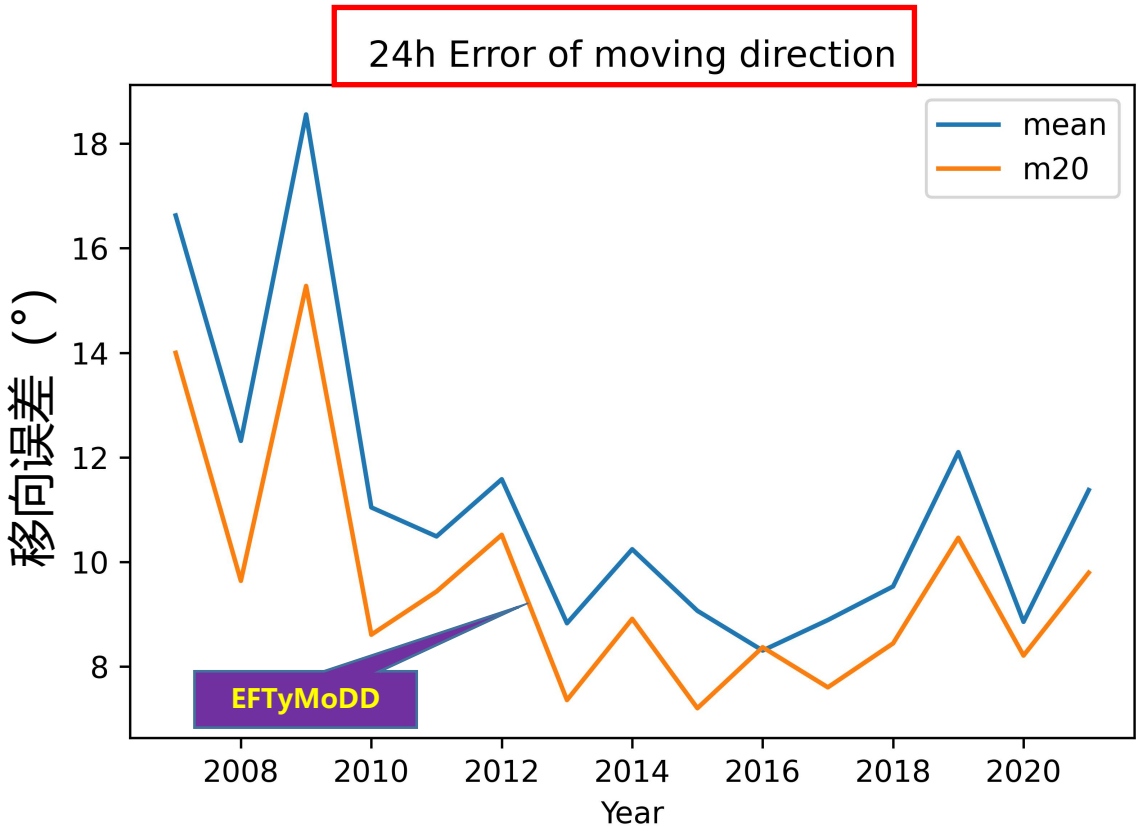


Results:

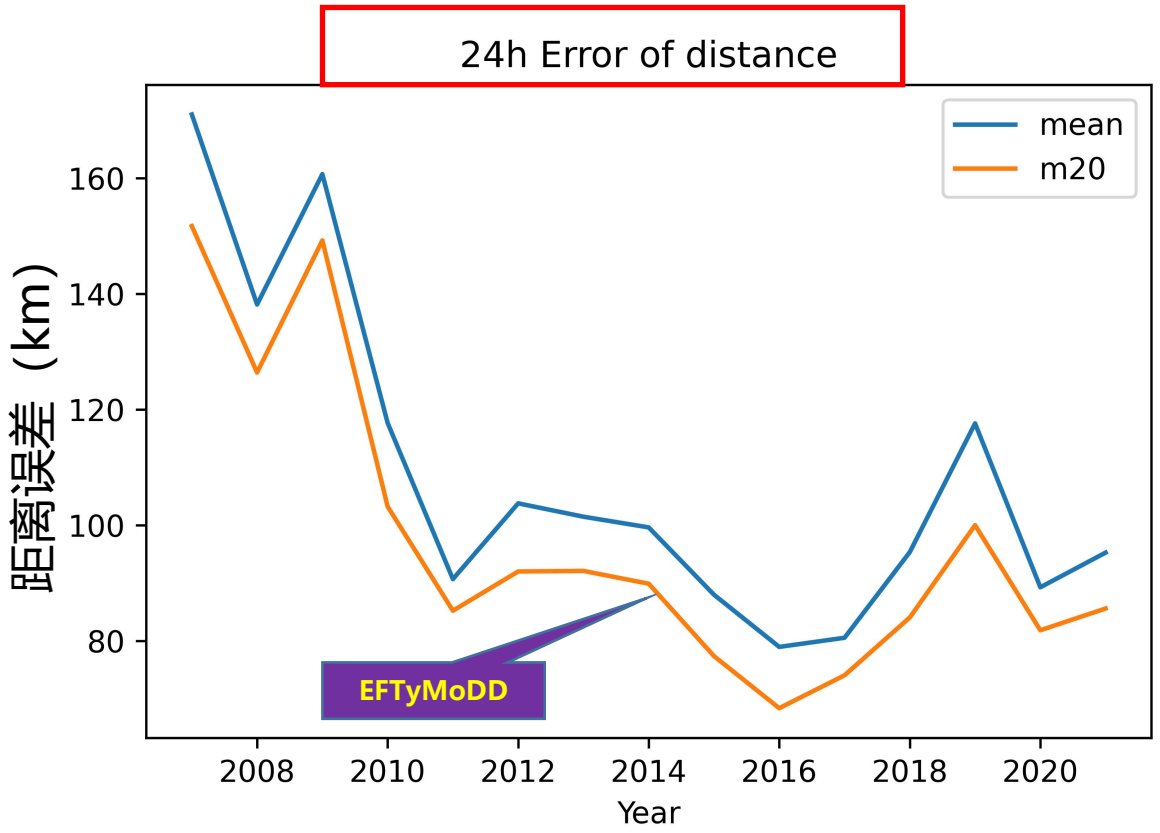
- Much lower **moving direction forecast** error than ECMWF ensemble mean and forecasting centers.
- Much lower **track forecast** error than ECMWF ensemble mean and forecasting centers.

Sample experiments: 2007-2021

Data: 2007-2021 ECMWF ensemble forecast; CMA best track.

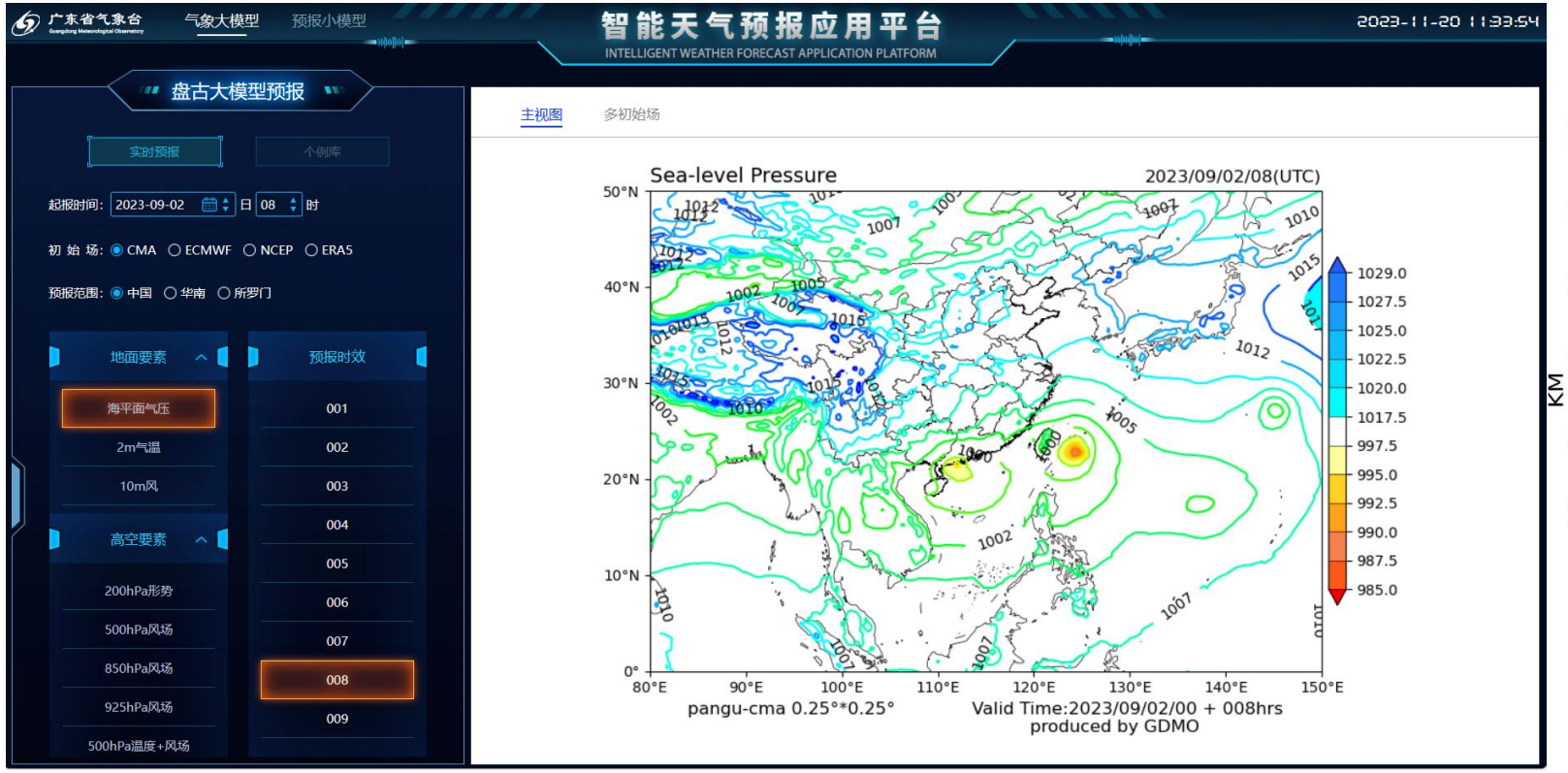


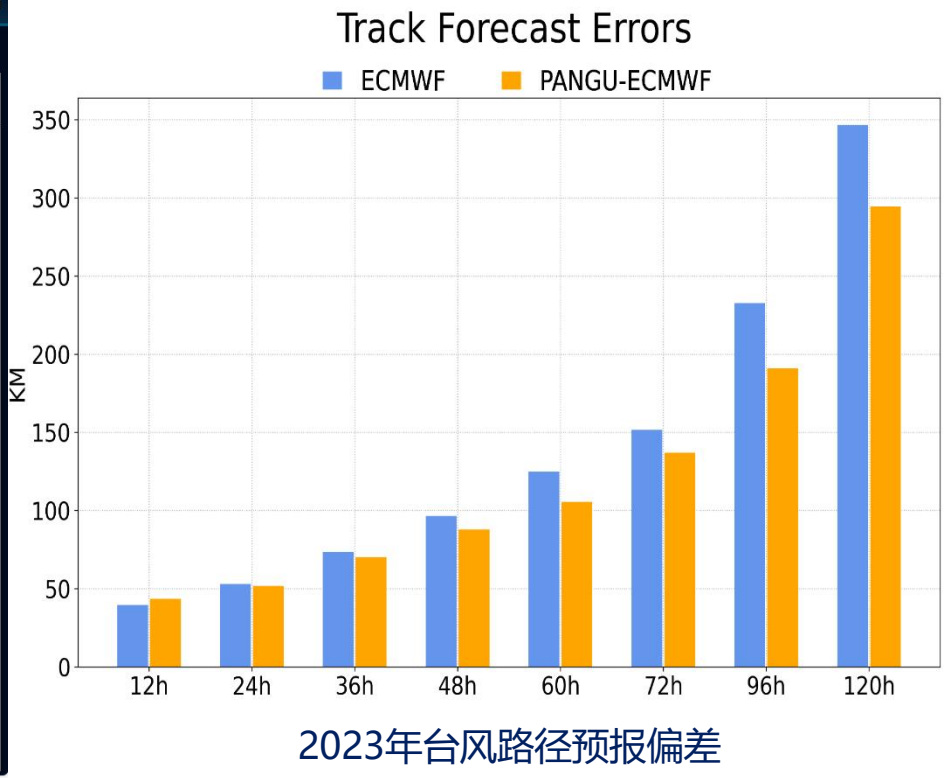
ECMWF ensemble mean: 11.2°
EFTyMoDD: 9.6°



ECMWF ensemble mean: 108.5km，
EFTyMoDD: 97.4km

PANGU machine learning model





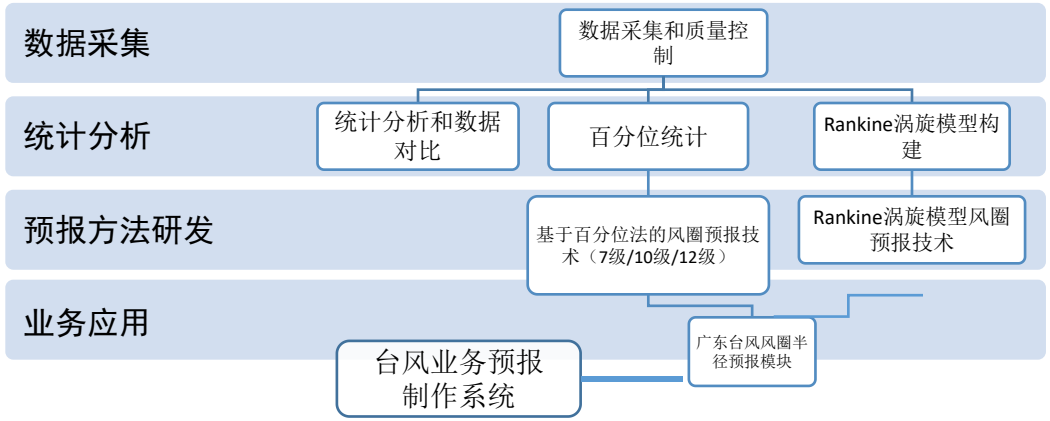
2023年台风路径预报偏差

PANGU machine learning model operated in Guangdong Meteorological Observatory

TC track error for PANGU and ECMWF in 2023

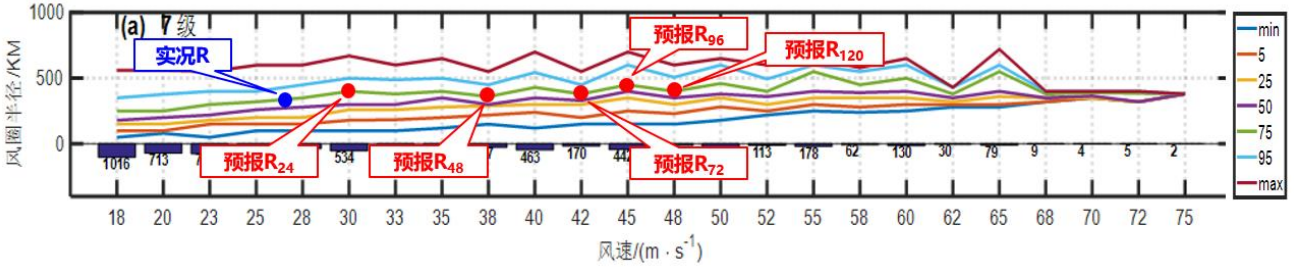
TC wind radii forecast technique for B.F. 7, 10, and 12

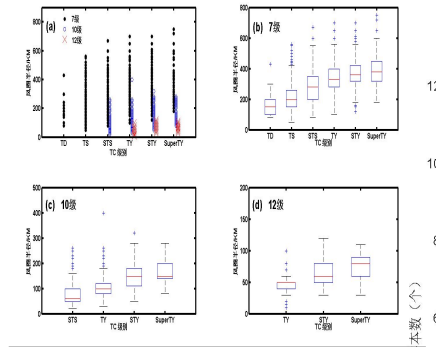
	实况	预报
日本 （RSMC Tokyo）	7/10级 （东西/南北象限）	×
美国 （JTWC）	8/10/12级 （四象限）	12/24.../120h 各象限/各级
北京 （JMA）	7/10/12 （四象限）	×
广州	6/7/8/10/12 （不分象限）	6/7/8/10/12 （不分象限）

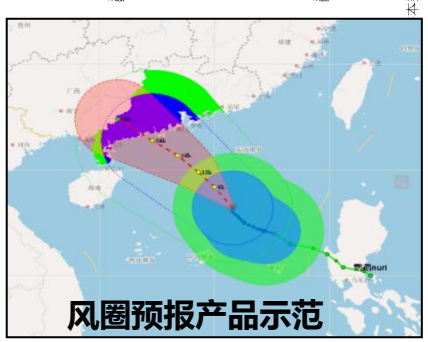


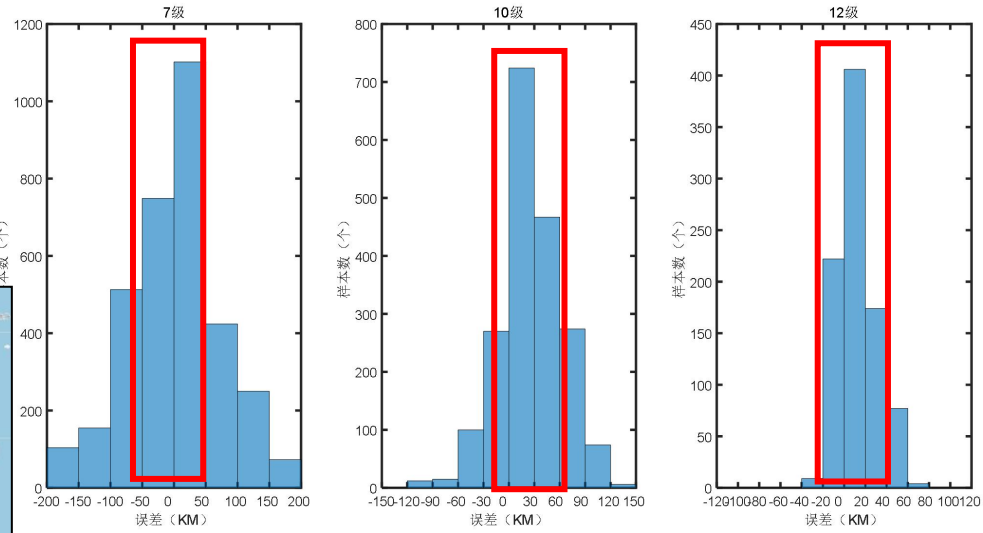
Technique routine

Wind radii forecast technique



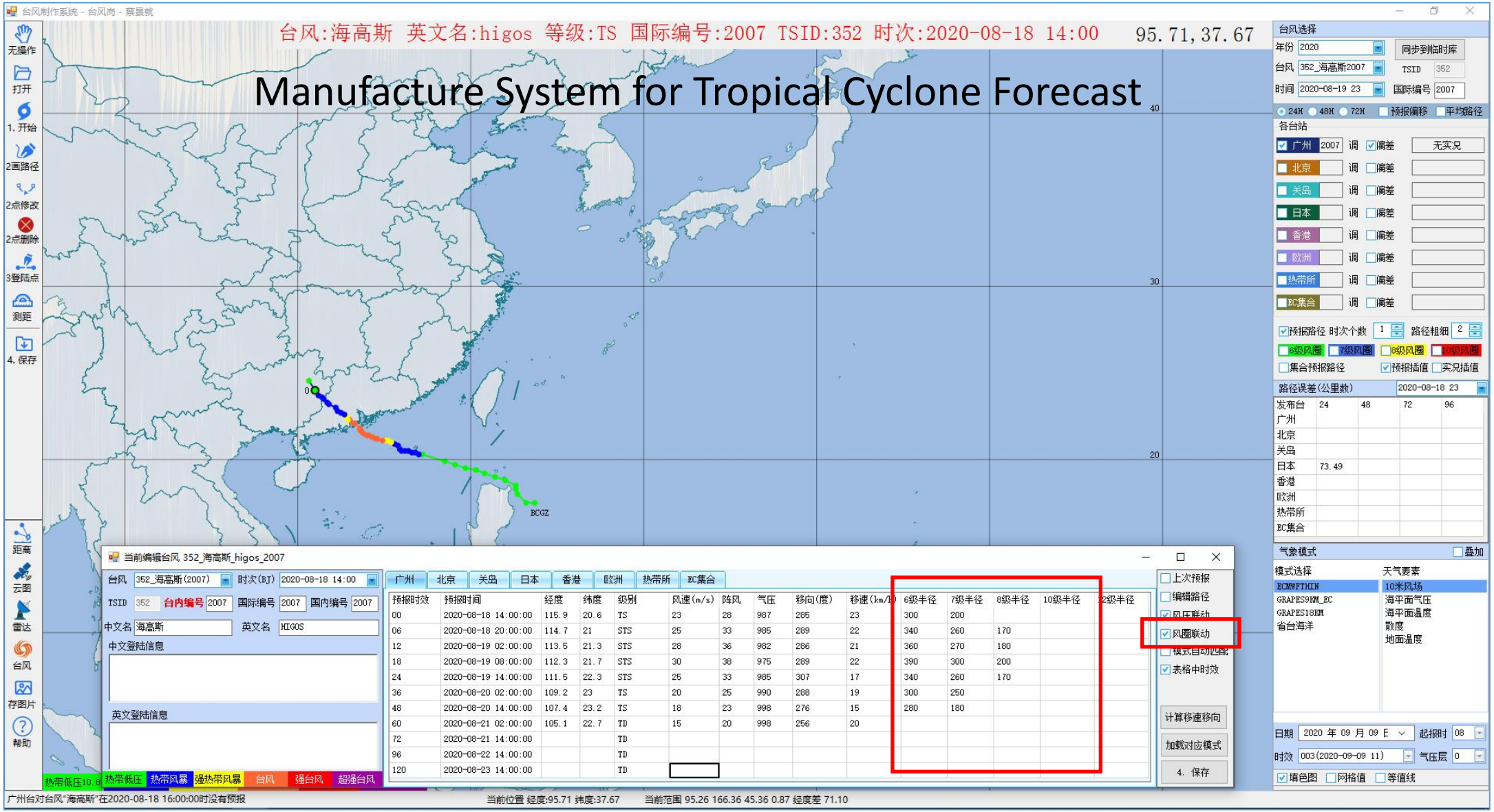






Forecasting error distribution

One click to load in wind radii forecast



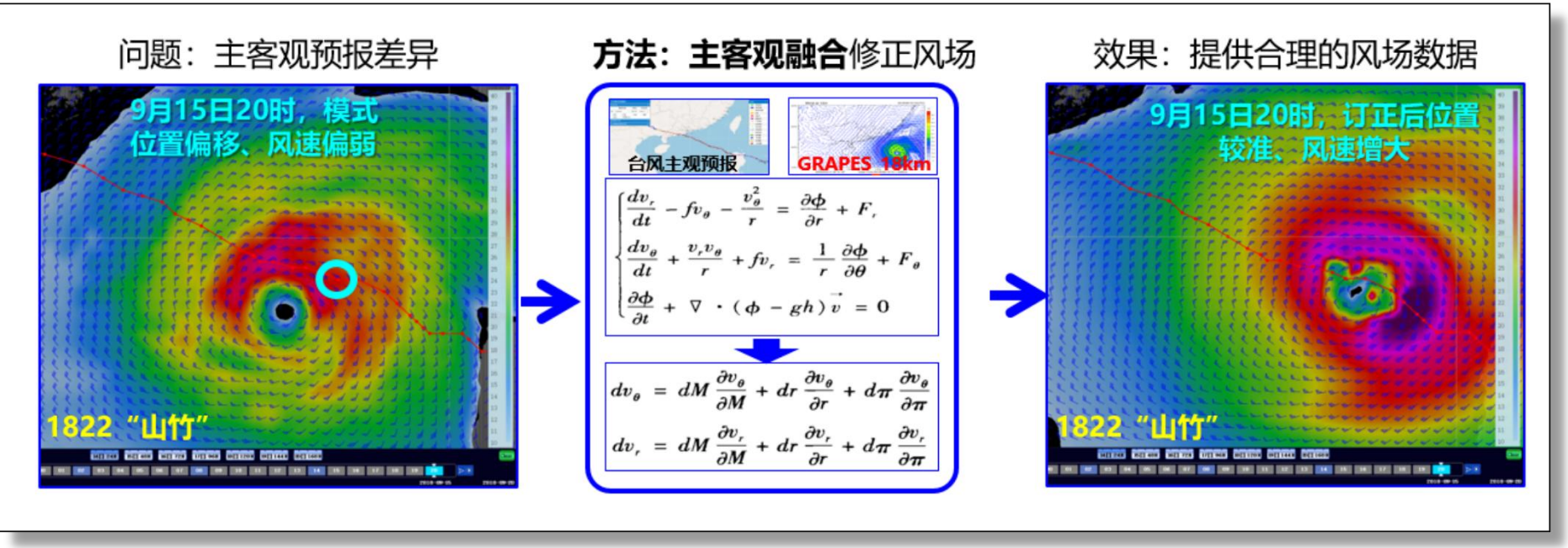
Fine gridded TC winds forecasting techniques

Difficulties in TC winds forecast operation before:

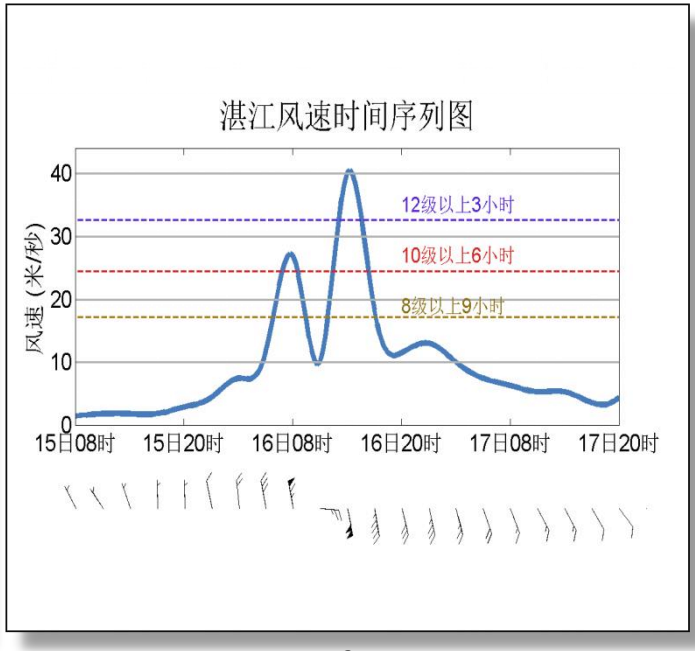
(1)Inconsistency of TC tracks and intensity of models and subjective forecasts.

(2)Hand revision needs heavy work.

A technique called TCWIND is applied to automatically revise TC wind fields base on model CMA-TRAMS and local topography data.



TCWIND based on CMA-TRAMS output



Wind serial for one point

Fine gridded TC rainfall forecasting techniques

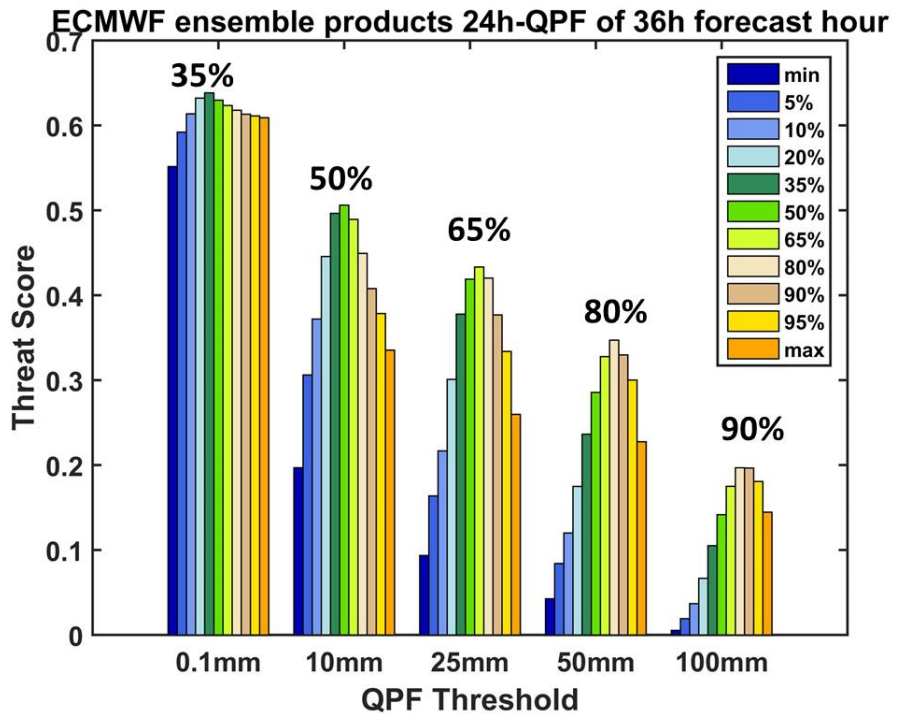
- Multi Statistic Fusion Method and Frequency Matching Method are applied to revise the model precipitation output.

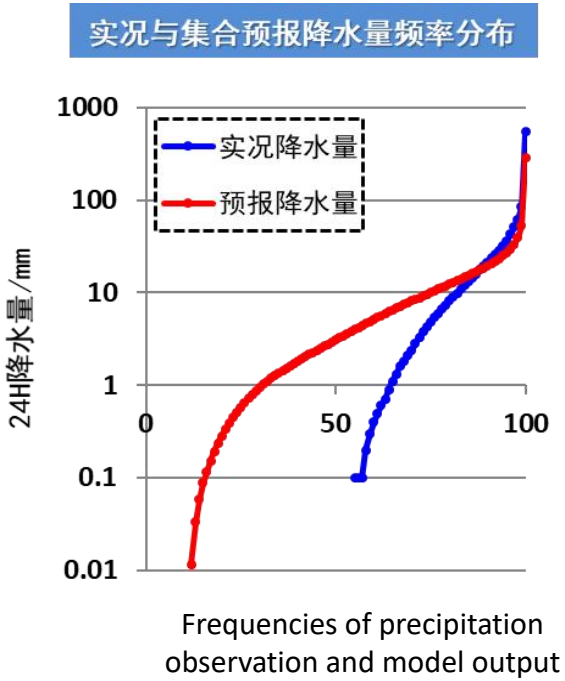
Multi Statistic Fusion Method. In the 51 ECWMF ensemble members:

- ✓ R = 90% percentile if it > 100mm
- ✓ R = 80% percentile if it > 50mm
- ✓ R = 65% percentile if it > 25mm
- ✓ R = 50% percentile if it > 10mm
- ✓ R = 10% percentile in other cases

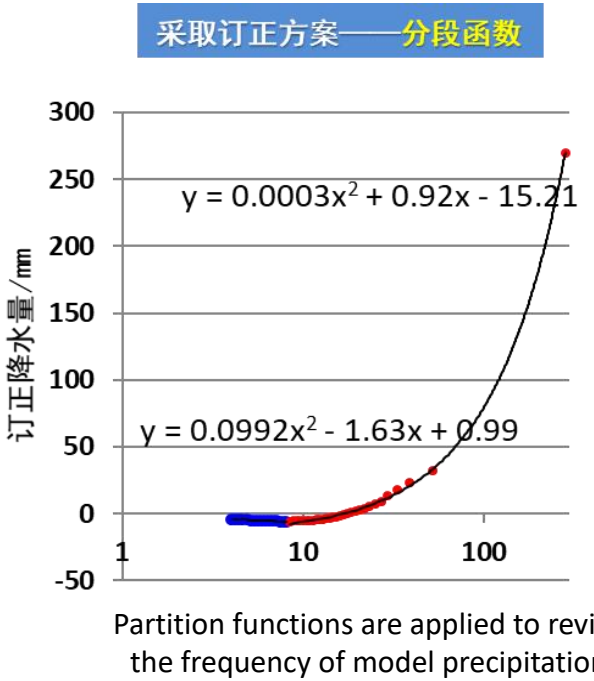
Frequency Matching Method

- ✓ Partition functions are applied to revise different grades of model precipitation frequencies, and match them with that of rainfall observation





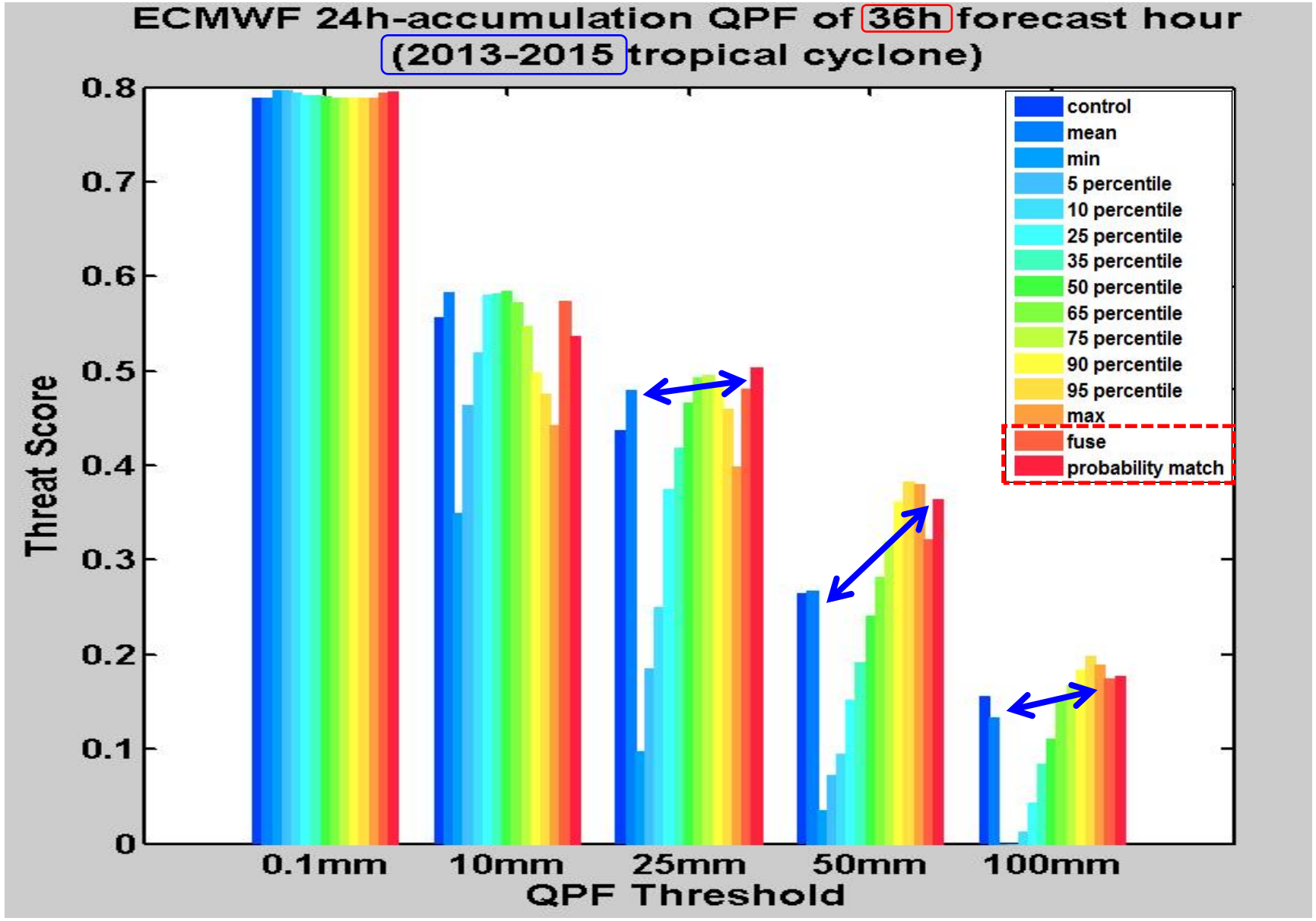
Frequencies of precipitation observation and model output



Partition functions are applied to revise the frequency of model precipitation

Verification of TC precipitation of ensemble forecast

(Multi Statistic Fusion Method and Frequency Matching Method)



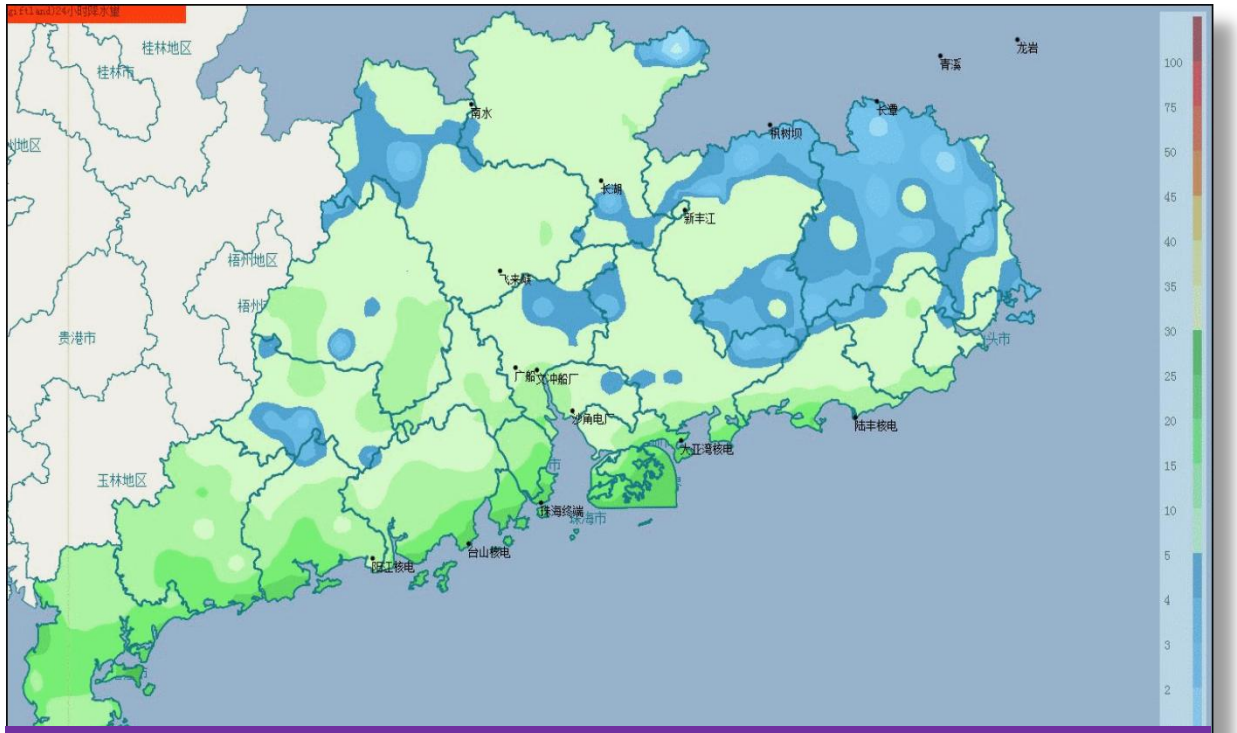
- Both are better than deterministic and ensemble mean.
- Each method behaves different in different situations.

Fine gridded forecast operation since 2012

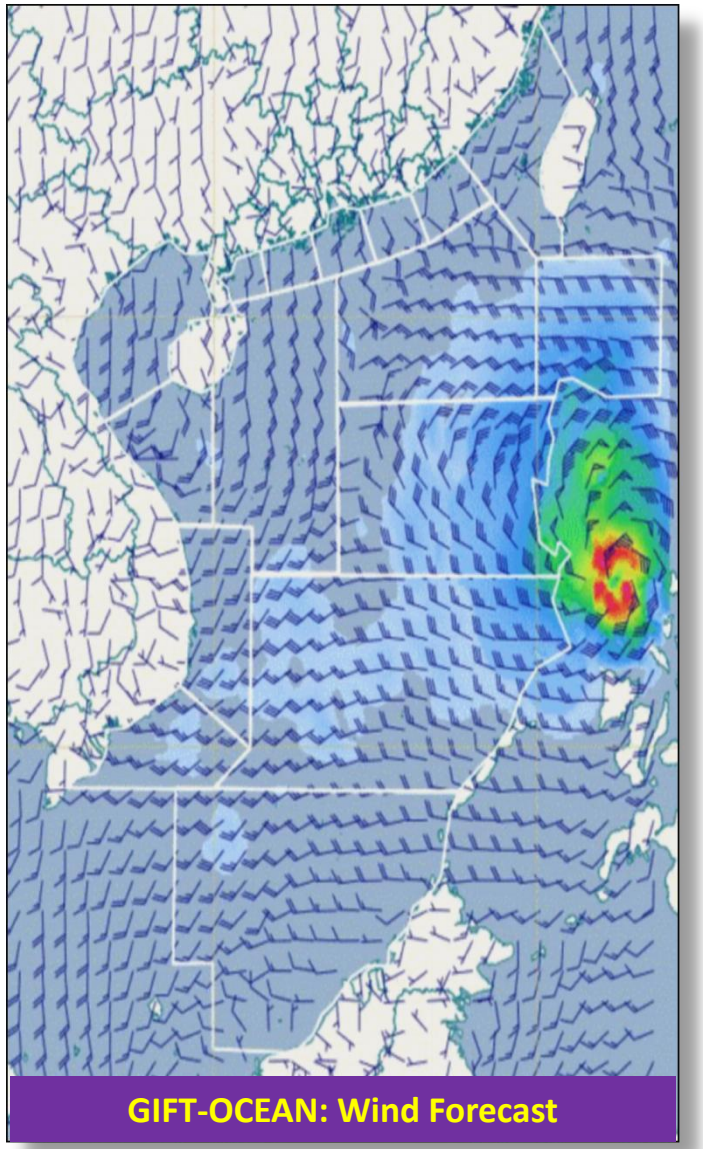
Operational platform: Graphical Interactive Forecast Tuner(**GIFT**)

Land: **Elements**: surface wind, visibility, precipitation, temperature, RH, cloud cover
Forecast time length: 10 days
Resolution: 2.5km×2.5km, 1h in 0-72h, 6h in 96-120h, 12h in 144-240h

Ocean: **Elements**: surface wind, visibility, precipitation, temperature, RH, cloud cover
Forecast time length: 7 days
Resolution: 10km×10km, 6h in 0-120h, 12h in 144-168h



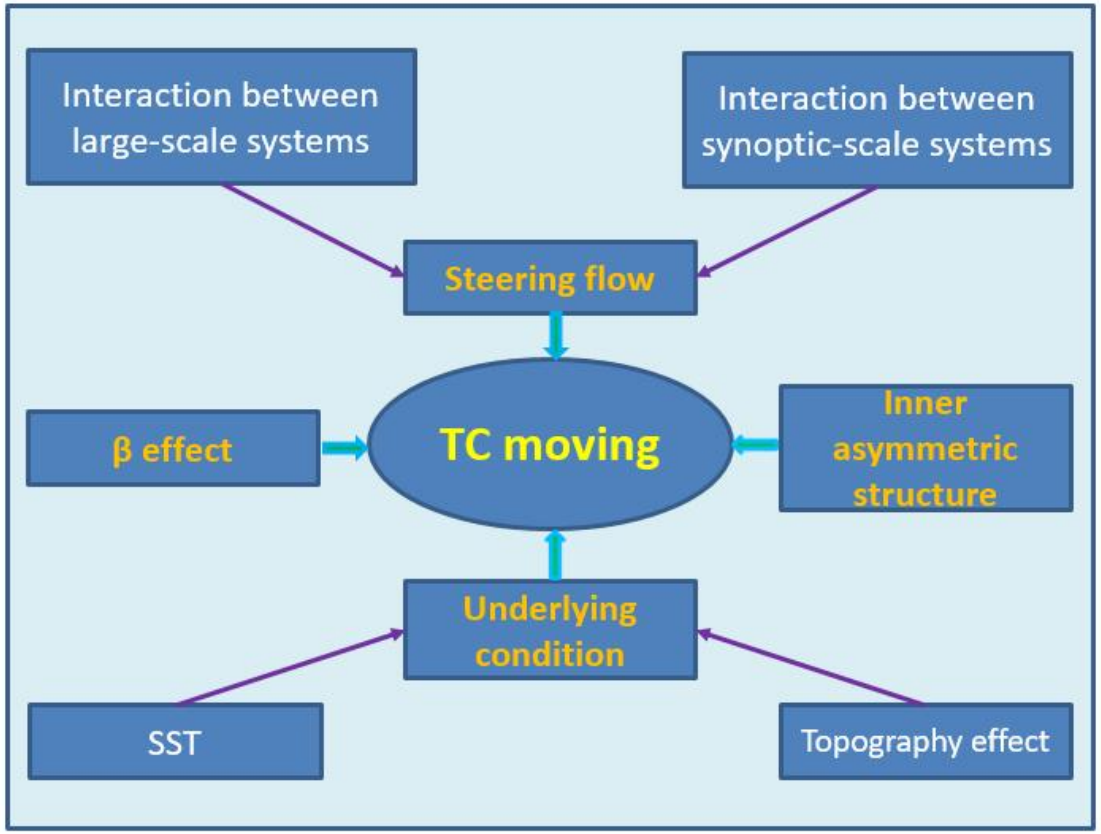
GIFT-LAND: Accumulated Precipitation Forecast



GIFT-OCEAN: Wind Forecast

Experienced forecasters are still important!

(Comprehensive analysis of atmospheric circulations, observations, numerical products, EPS, personal experience, ...)



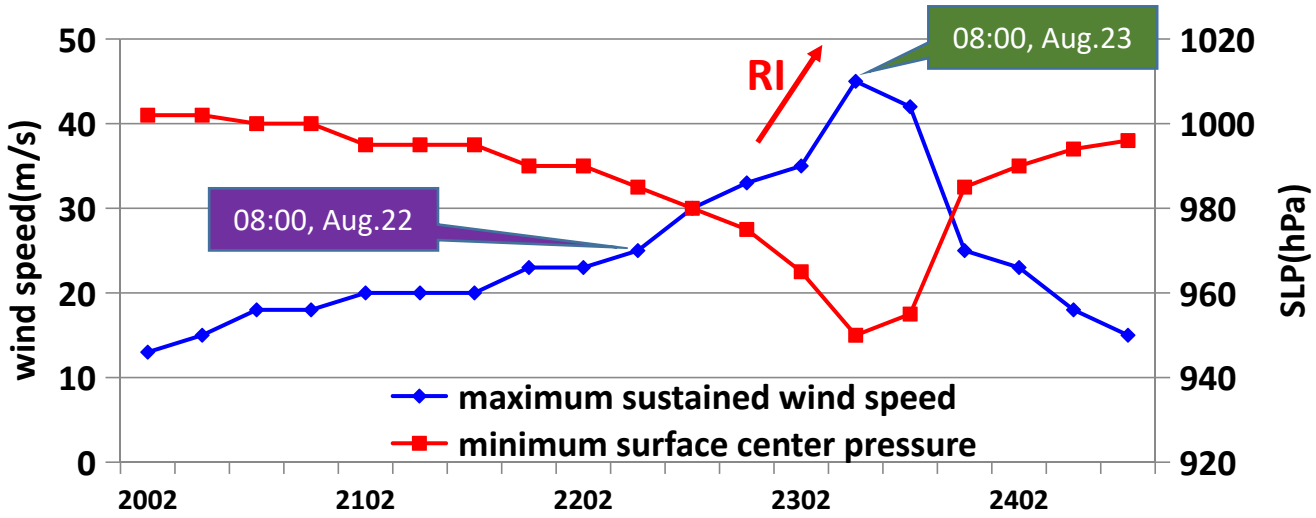
Factors of TC moving

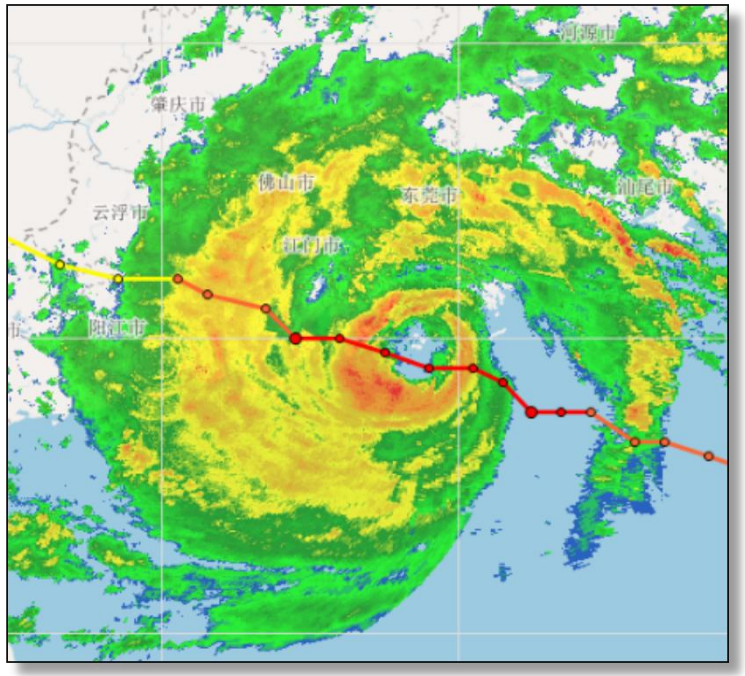
- SST
- Low Level Jet; Cross-equatorial flow
- Downstream instability analysis
- Involvement of outer weak cold air
- Vertical wind shear
- Upper air flow(Upper divergence)

Factors of TC intensity change

Experienced forecasters are still important!

(Comprehensive analysis of atmospheric circulations, observations, numerical products, EPS, personal experience, ...)





24h maximal wind speed forecast for Hato(1713), issued at 08:00, Aug. 22, 2017(BT):

- ✓ **Operational models: 25-33m/s(STS-TY)**
- ✓ RSMC Tokyo: 28m/s(STS)
- ✓ JTWC: 31m/s(STS)
- ✓ **CMA: 42m/s(STY)**

Observation at 08:00, Aug. 22, 2017(BT) : 25m/s(STS)
Observation at 08:00, Aug. 23, 2017(BT) : 45m/s(STY)

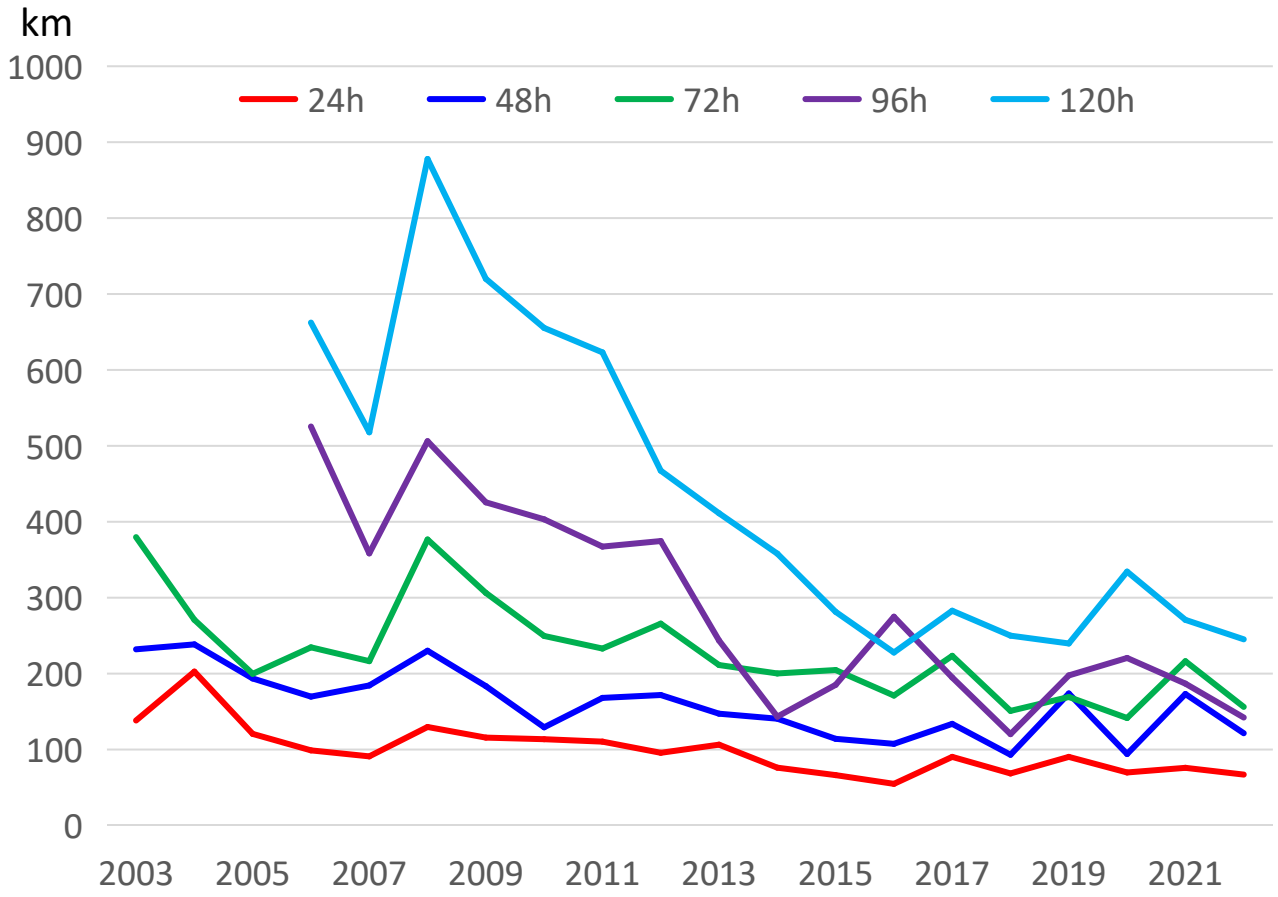
Weather Consultation Mechanism

Weather consultation with CMA

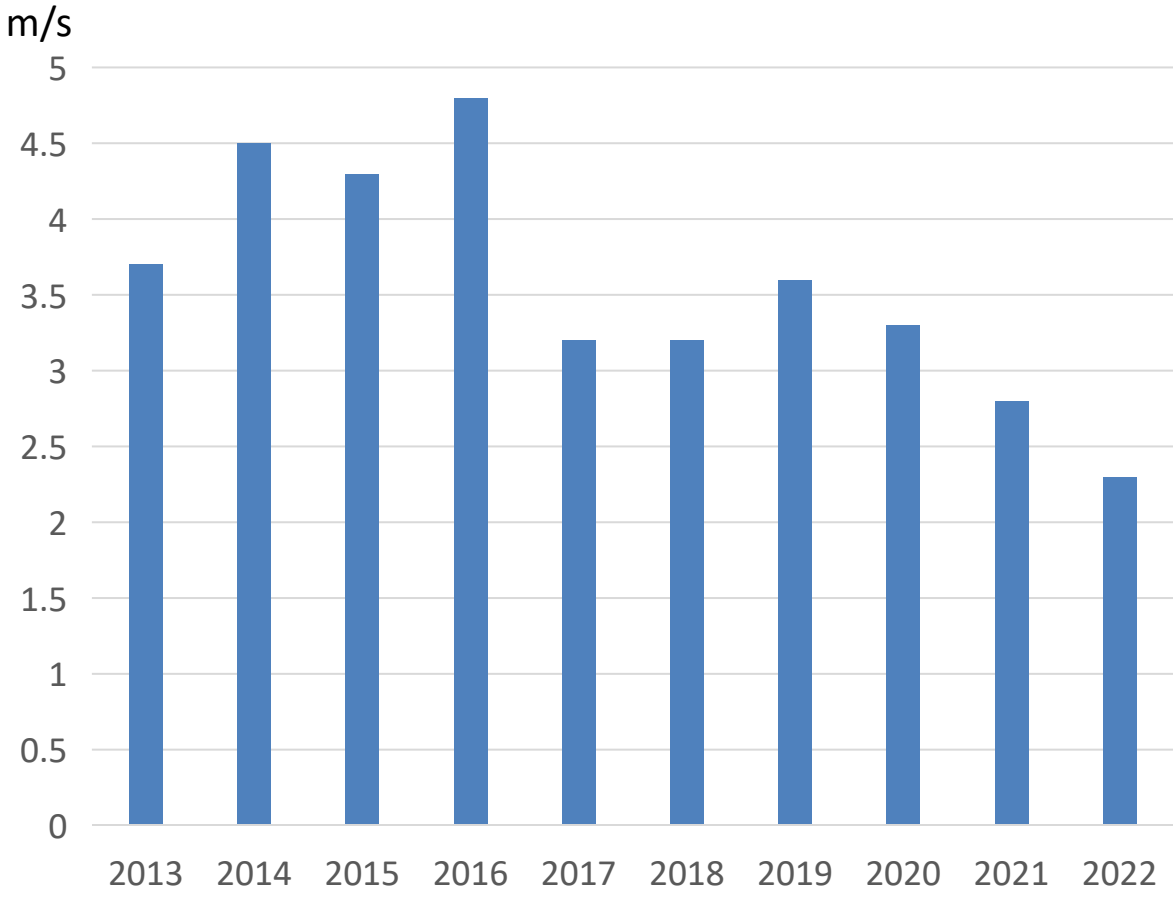

Daily weather consultation in Guangdong

- GMO would participate in the national video weather consultation organized by CMA at 08:00 LT if a TC would affect Guangdong in the next days.
- Consultation with Hongkong Observatory and Macao Meteorological and Geophysical Bureau according to need
- Consultation with Guangxi, Hainan, Fujian Observatory, et al according to need
- Video weather consultation all over whole province at 09:30 every day.

Progress in TC forecast in Guangdong



24-120h **track error(unit: km)** in 2003-2022
in Guangdong Meteorological Observatory



24h **intensity error(unit: m/s)** in 2013-2022
in Guangdong Meteorological Observatory

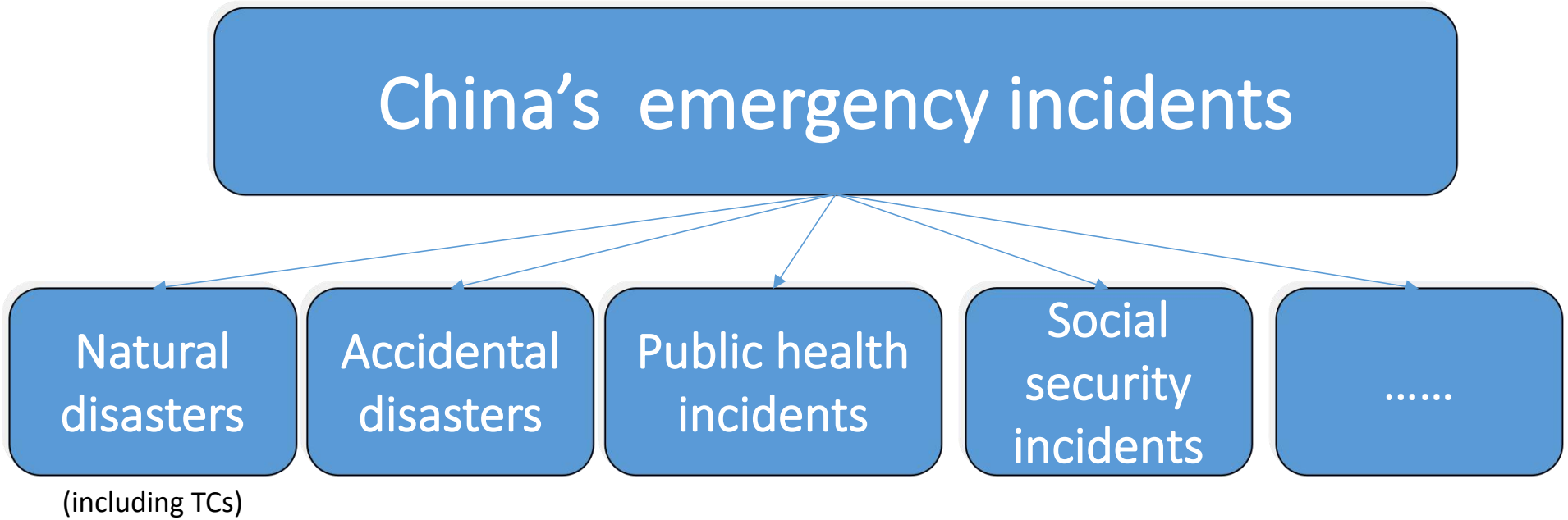
OUTLINE

- Climatology of tropical cyclones in Guangdong
- Tropical cyclone monitoring in Guangdong
- Tropical cyclone forecasting in Guangdong
- **Guangdong Emergency Early Warning Release Platform**

WHAT?

- Public institutions entrusted by Government, managed by CMA, provincial, municipal and county meteorological services.
- To perform **government functions** of releasing emergency warnings.
- To gather emergency warnings from responsible government departments, and release them effectively and timely when an emergency happens. A trigger for social response.
- Mechanism of Government Leading, Departments Linkage, Unified Release and Social Participation.

WHY?



Status many years ago:

- ✓ Different abilities of warning release…
- ✓ Barrier of information among different departments…

WHY?

- In August, 2007, **a rumor** about **earthquake** in Zhanjiang(a coastal city in Guangdong province) spread on social communication platforms.
- Zhanjiang Meteorological Bureau together with Zhanjiang Earthquake Bureau sent out 2.8 million SMS to **refute the rumor**.
- The State Council and Guangdong Provincial Government was satisfied and realized **the importance and necessity** of establishing a unified & efficient emergency warning release platform.
- **CMA** proactively undertake the responsibility of it, and decided to carry out pilot work first in **Guangdong province**.

Zhangjiang, 684mm/24h, associated with TC Pabuk (0706)

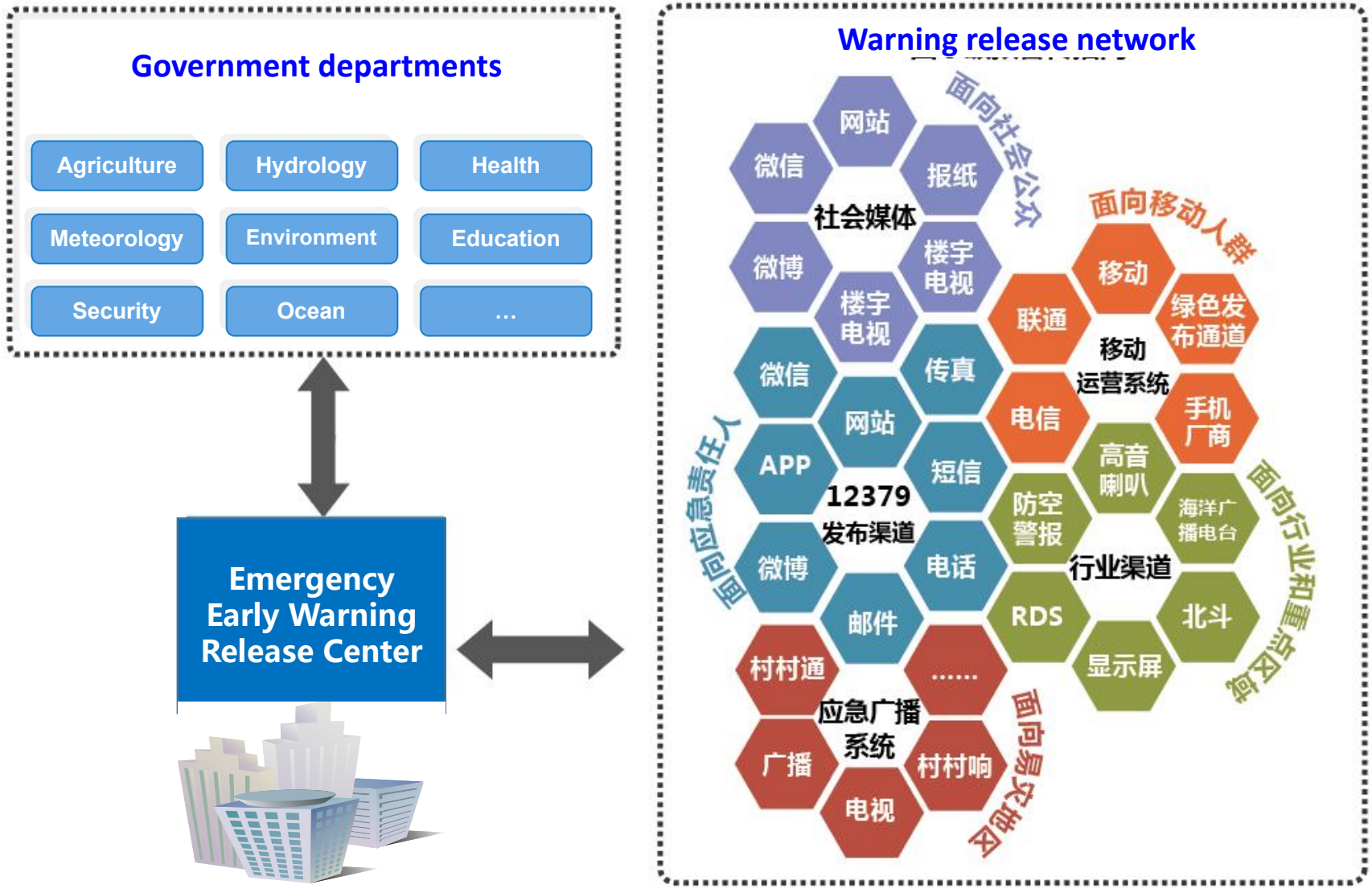
SMS to refute rumor

Signing ceremony of cooperation between Guangdong Government and CMA

OUTLINE

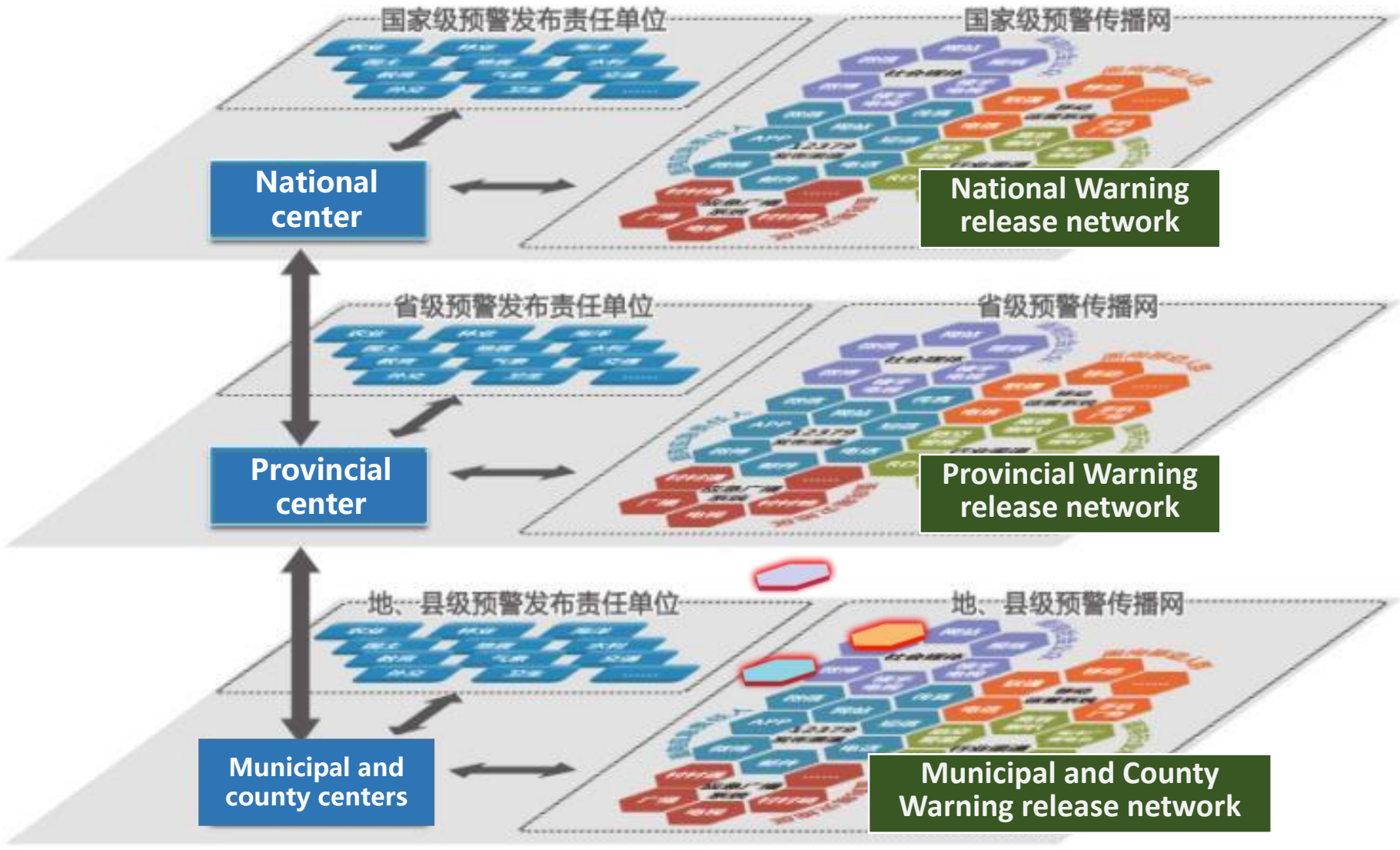
- Background
- **Present situation**
- Guangdong Emergency Early Warning Release Center

Omnimedia release of early warning



national dissemination network: social media, Business & Operating Support System, 12,379 distribution channels, industry channels, and Emergency broadcasting system

Horizontal sharing, vertical connection



Emergency Warning Release Centers

OUTLINE

- Background
- Present situation
- Guangdong Emergency Early Warning Release Center

Brief introduction

- Since the pilot work started, Guangdong continued to explore the mechanism and functions of the EWRC during its construction. The Guangdong provincial EWRC was put into application officially in 2015.
- Now Guangdong has established **102** branches of the EWRC all over the province.
- Information is delivered and shared among these branches.

102 EWRC all over the province

Mr. Zhu Xiaodan, Governor of Guangdong province, is unveiling the plaque of EWRC in 2015.

The Provincial emergency early warning release center (in Guangzhou)

101 Municipal and county centers

Ownership and Duty

Guangdong Province Government

China Meteorological Administration

Department of Supervision

- Department of Science and Technology
- Department of Land and Resources
- Department of Water Resources
- Department of Agriculture
- Department of Health
- Environmental Protection Bureau
- ……

Guangdong Meteorological Service

GD EWRC

Public Weather Service

weather disaster

Emergency early warning

- Natural Disaster
- Public Health
- Accident Disaster

GD EWRC: managed by GMS under the commission of Government

Government draws attention

Many provincial conferences to deploy

Relevant Law and Legal Regulations be published to standardize our operation

Standard First, Release Normalized.

Providing : code of conduct ; decision-making proof

Launching : the management of reserve plan


QX

中华人民共和国气象行业标准

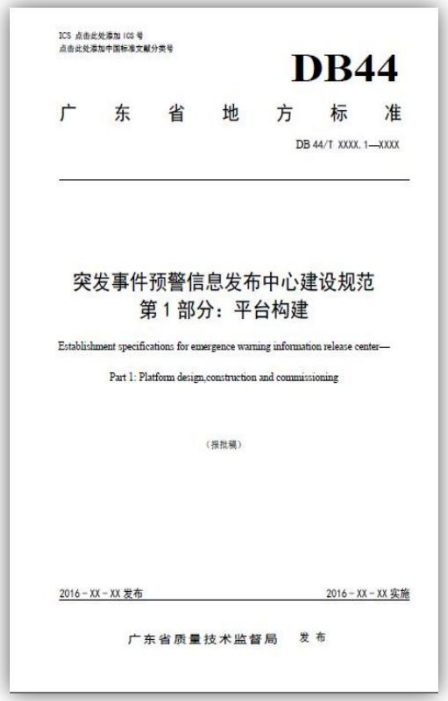
QX/T 314—2016

气象信息服务单位备案规范

Specifications for meteorological information service unit registration

2016-02-03 发布　　2016-06-01 实施

中国气象局　发布


DB44

广东省地方标准

DB 44/T XXXX. 1—XXXX

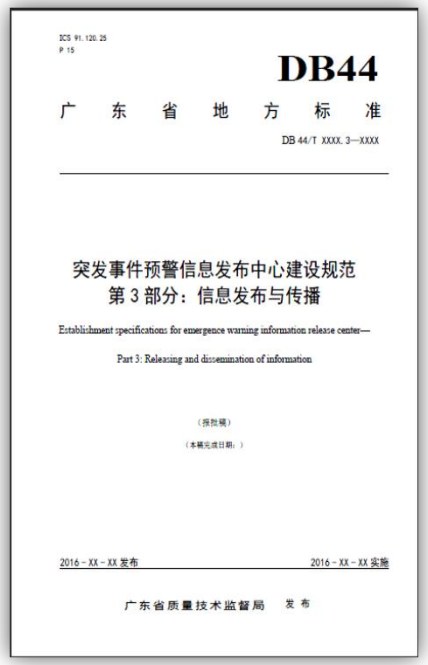
突发事件预警信息发布中心建设规范
第 1 部分：平台构建

Establishment specifications for emergence warning information release center—
Part 1: Platform design,construction and commissioning

（报批稿）

2016－XX－XX 发布　　2016－XX－XX 实施

广东省质量技术监督局　发布


DB44

广东省地方标准

DB 44/T XXXX. 3—XXXX

突发事件预警信息发布中心建设规范
第 3 部分：信息发布与传播

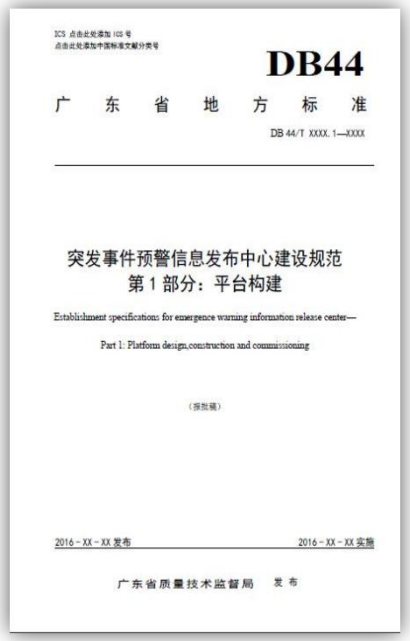
Establishment specifications for emergence warning information release center—
Part 3: Releasing and dissemination of information

（报批稿）

（本稿完成日期：）

2016－XX－XX 发布　　2016－XX－XX 实施

广东省质量技术监督局　发布


DB44

广东省地方标准

DB 44/T XXXX. 1—XXXX

突发事件预警信息发布中心建设规范
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2016－XX－XX 发布　　2016－XX－XX 实施

广东省质量技术监督局　发布

Several national professional standards and local standards are constructed for platform construction, emergency warning release and propagation, …

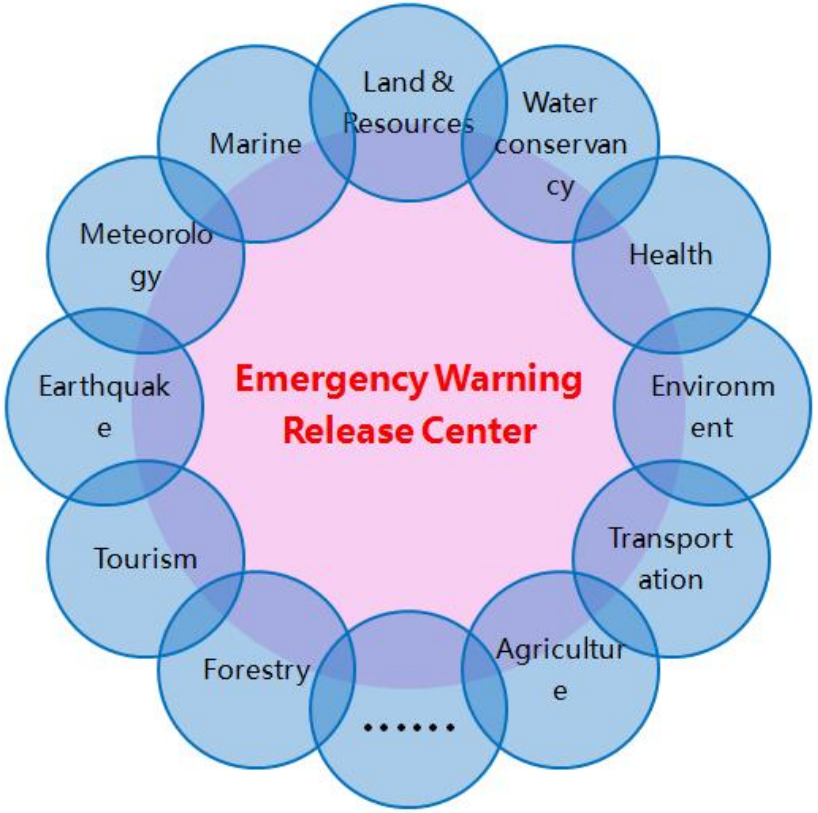
Operational System

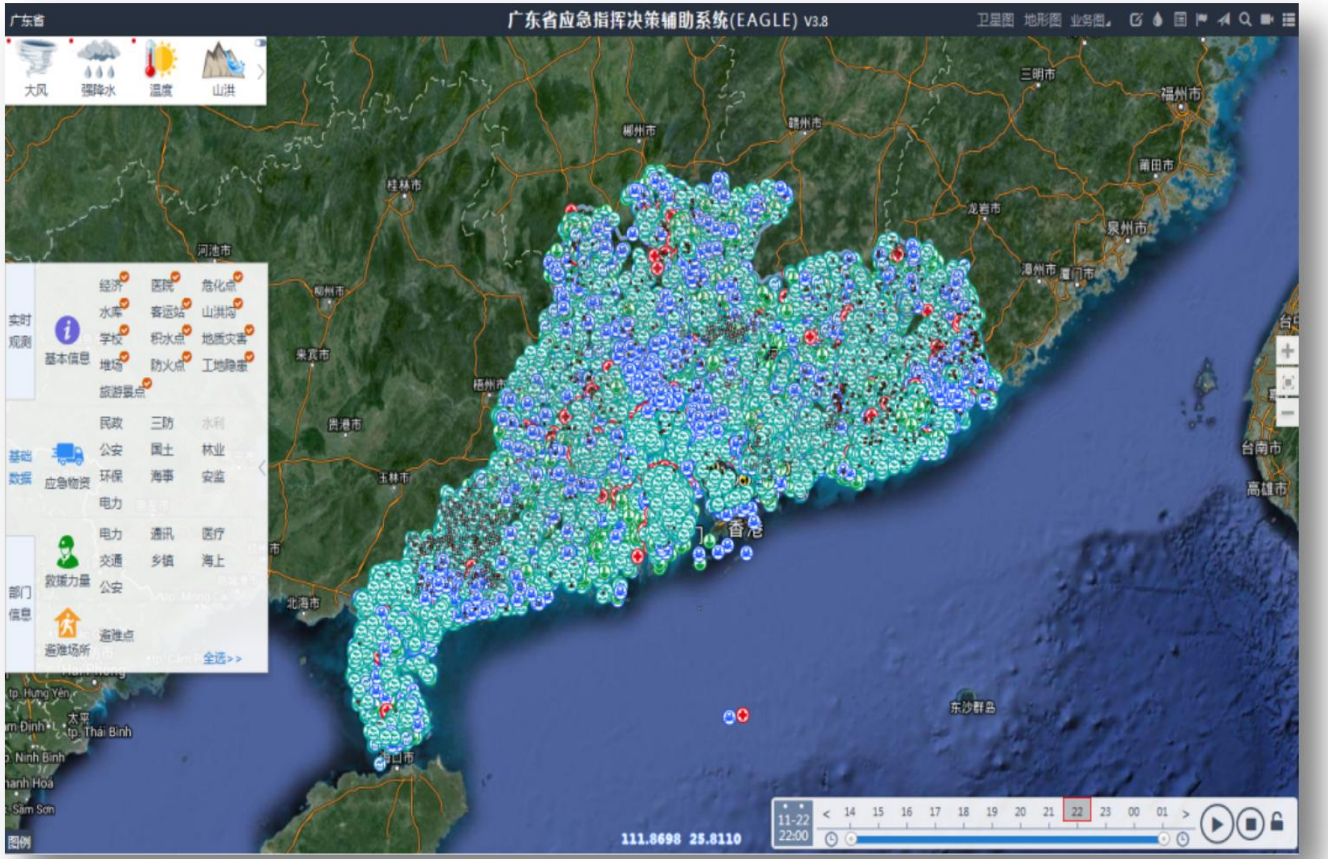
To release early warning effectively and accurately,

1. Risk Analysis & Judgement System (Analyse)
2. Emergency Early Warning Release System (Release)

Analyse

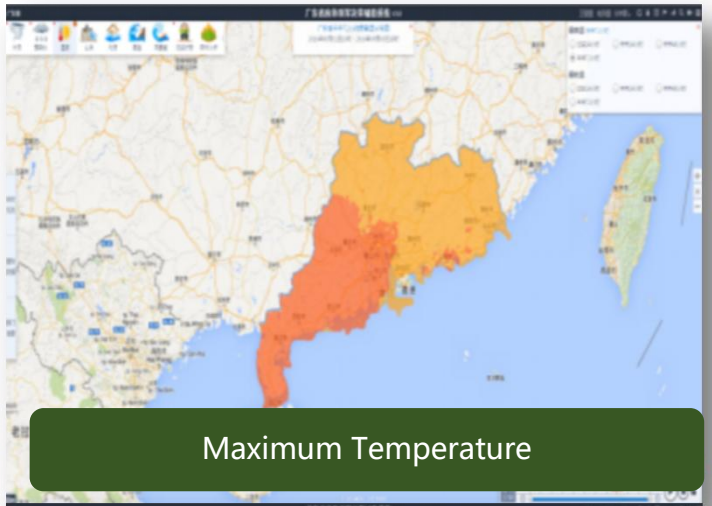
- The Risk Analysis & Judgement System analyzes and aggregates mass of digital data from different departments of government to one GIS map, We call it “One Atlas”.
- 44 kinds of information from 14 different departments on the Atlas(including population, economy, schools, hospitals, dangerous chemical storages, reservoirs location ,real-time ship information etc.

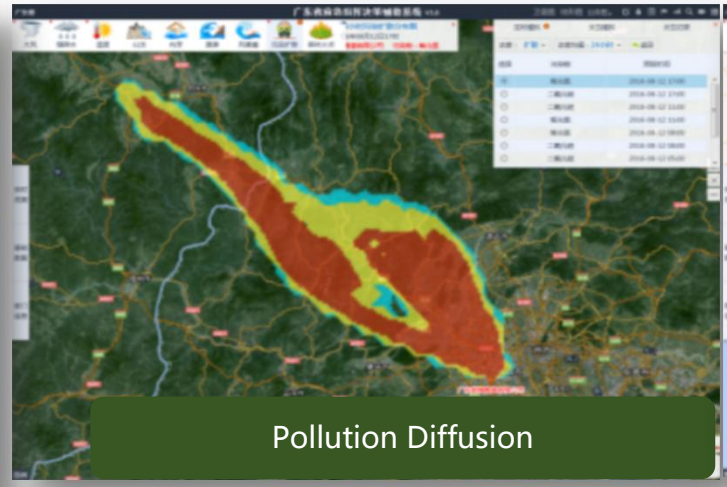


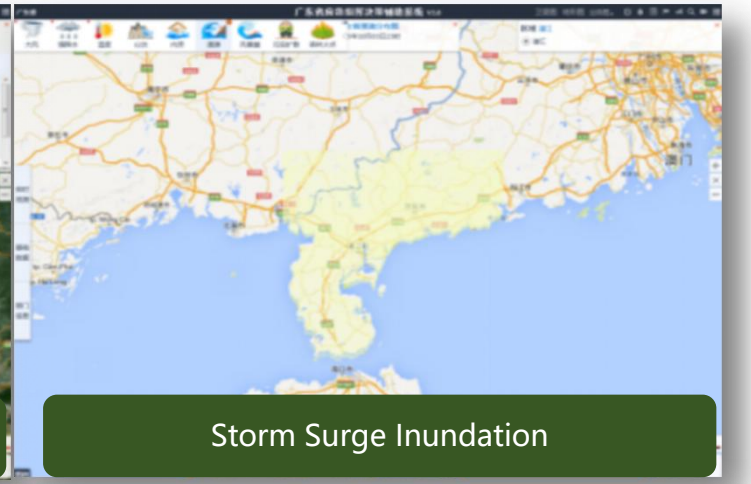


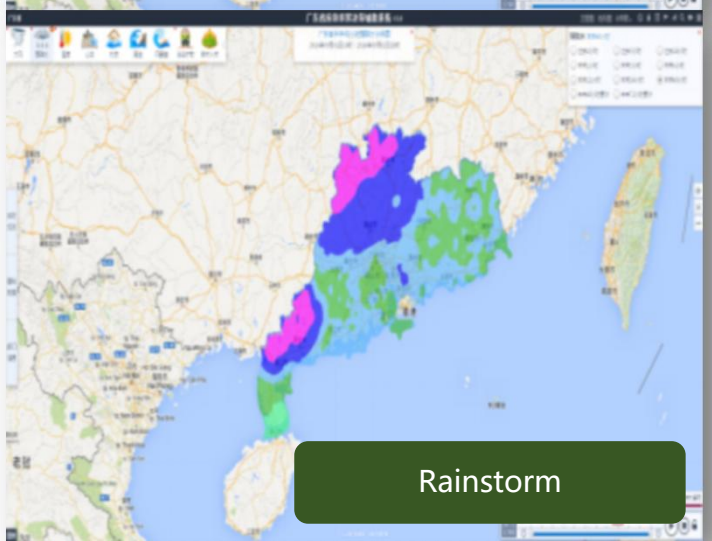
Analyse

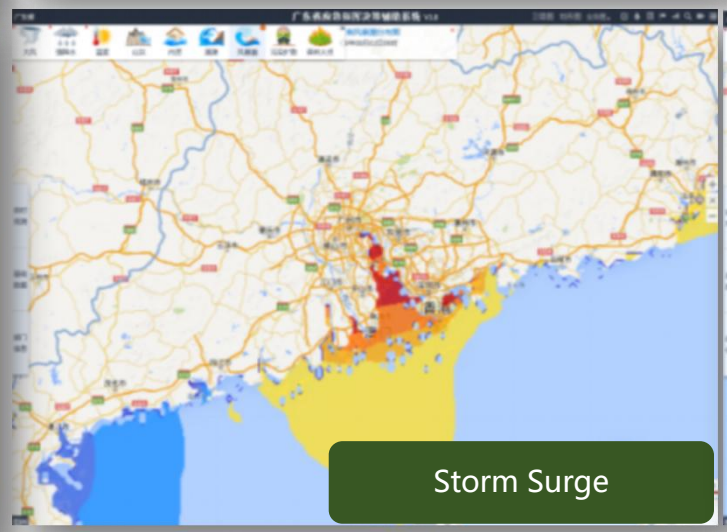
- One Grid
- Have developed multiple professional disaster models,such as City Waterlogging Model
- Determination of type and category of disaster risk and warning is based on the ONE ATLAS and ONE GRID

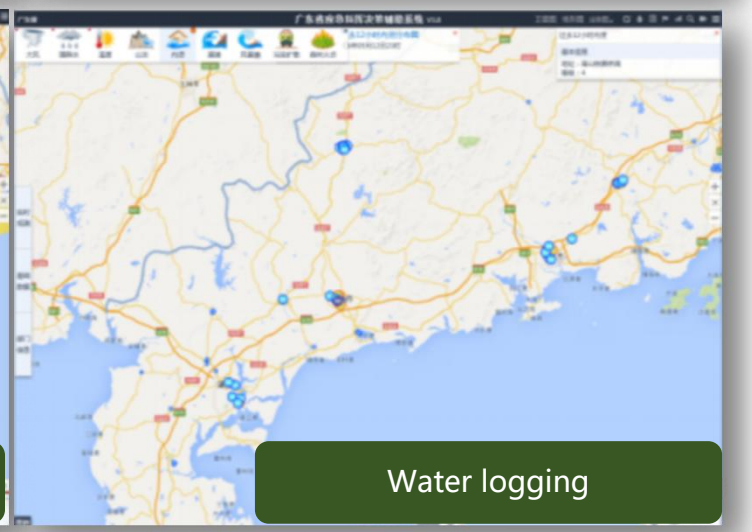




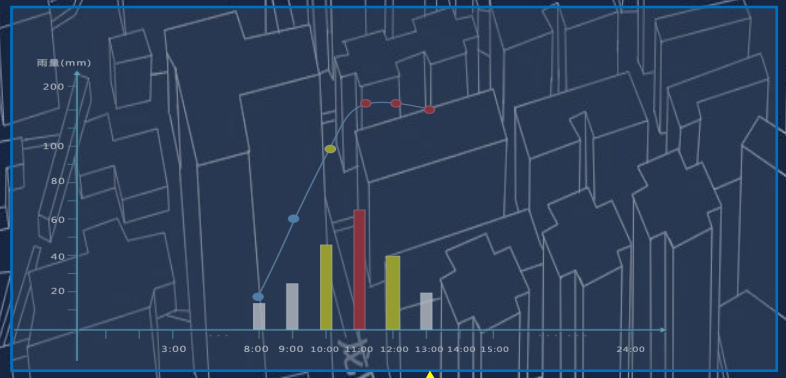








City Waterlogging Monitoring and early warning based on radar quantitative precipitation estimation and forecast



龙口东路

岗顶

龙口西路

中山大道

Early Warning info

Type: urban waterlogging
Age: next 6 hours
Condition: Sliding precipitation exceeded
Model: Urban flood and waterlogging model

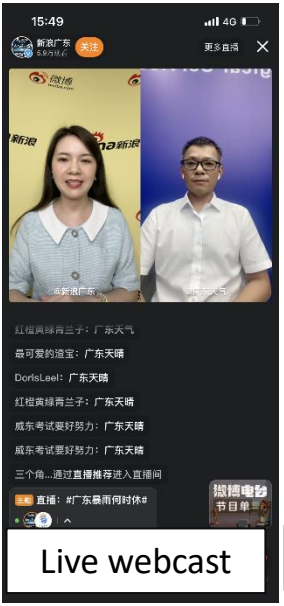
waterlogging point:
Zhongshan street-
Above Gangding bridge

Omnimedia Release - social media

- **Weather forecast, Weather warning, other emergency warnings …**

- Traditional passive channels are still important.
  Newspaper, radio, TV, …
- More passive ways in information era
  SMS from mobile communication operators
  Popup message
  Push notification
- Active ways
  Weather/Emergency column on websites, weather APP(eg. APP Moji)

A rapid way to deliver warnings – short videos



Live webcast


Live radio broadcast

Typhoon interview

Live typhoon broadcast

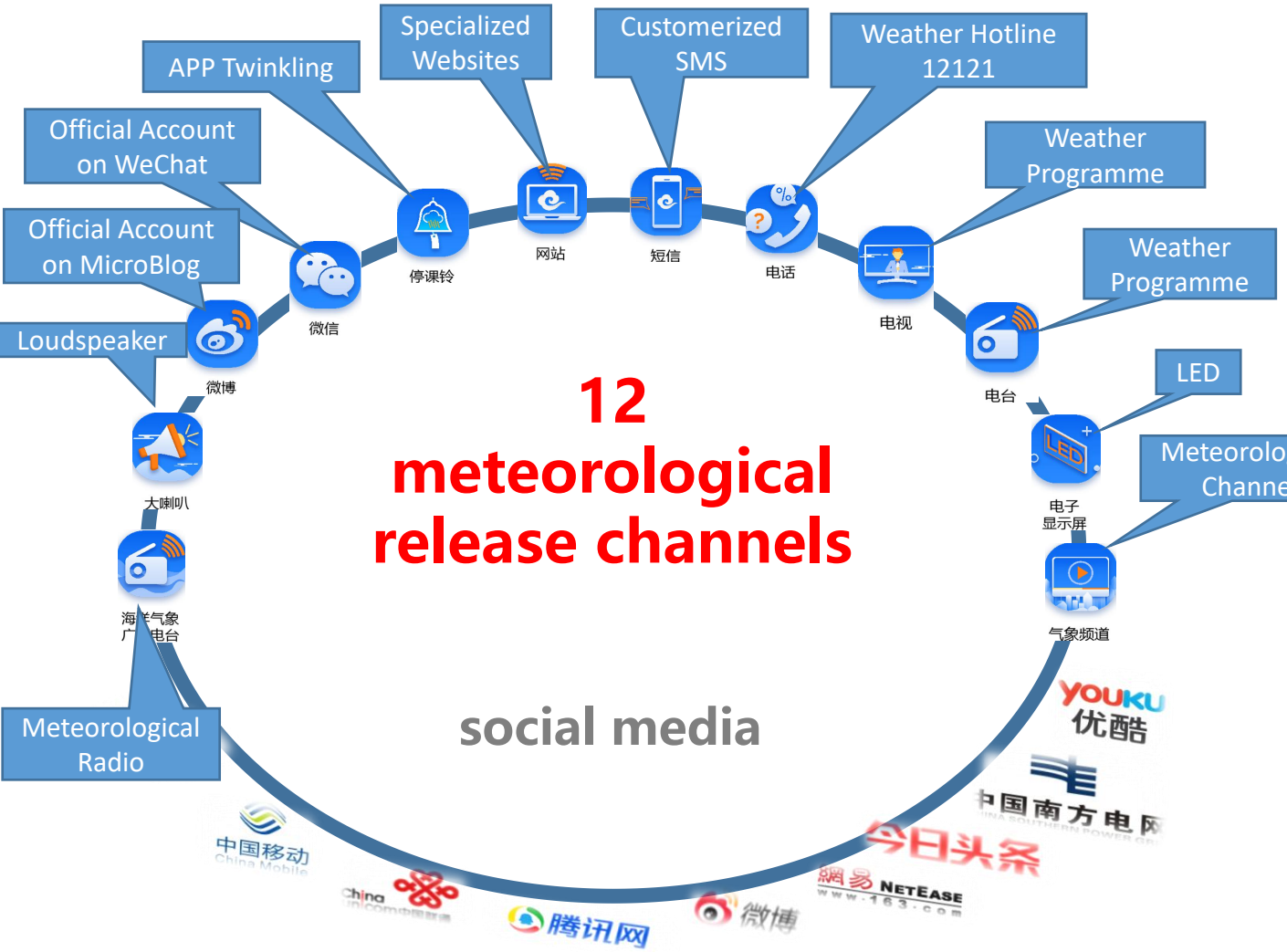

Live webcast

Live typhoon science popularization

Live typhoon news release conference


Expert interview

Omnimedia Release – specialized channels



Official account on Microblog

subscriber: 13.1 million

Official account on Wechat

subscriber: 5.35 million

Websites

page view volume of http://gd121.cn in 2022: 1.55 million

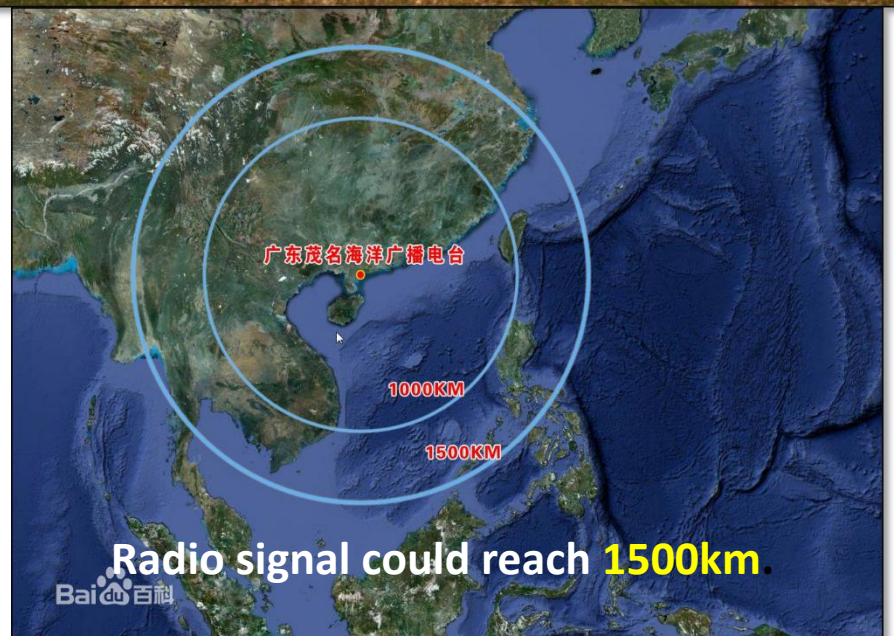
Customized SMS

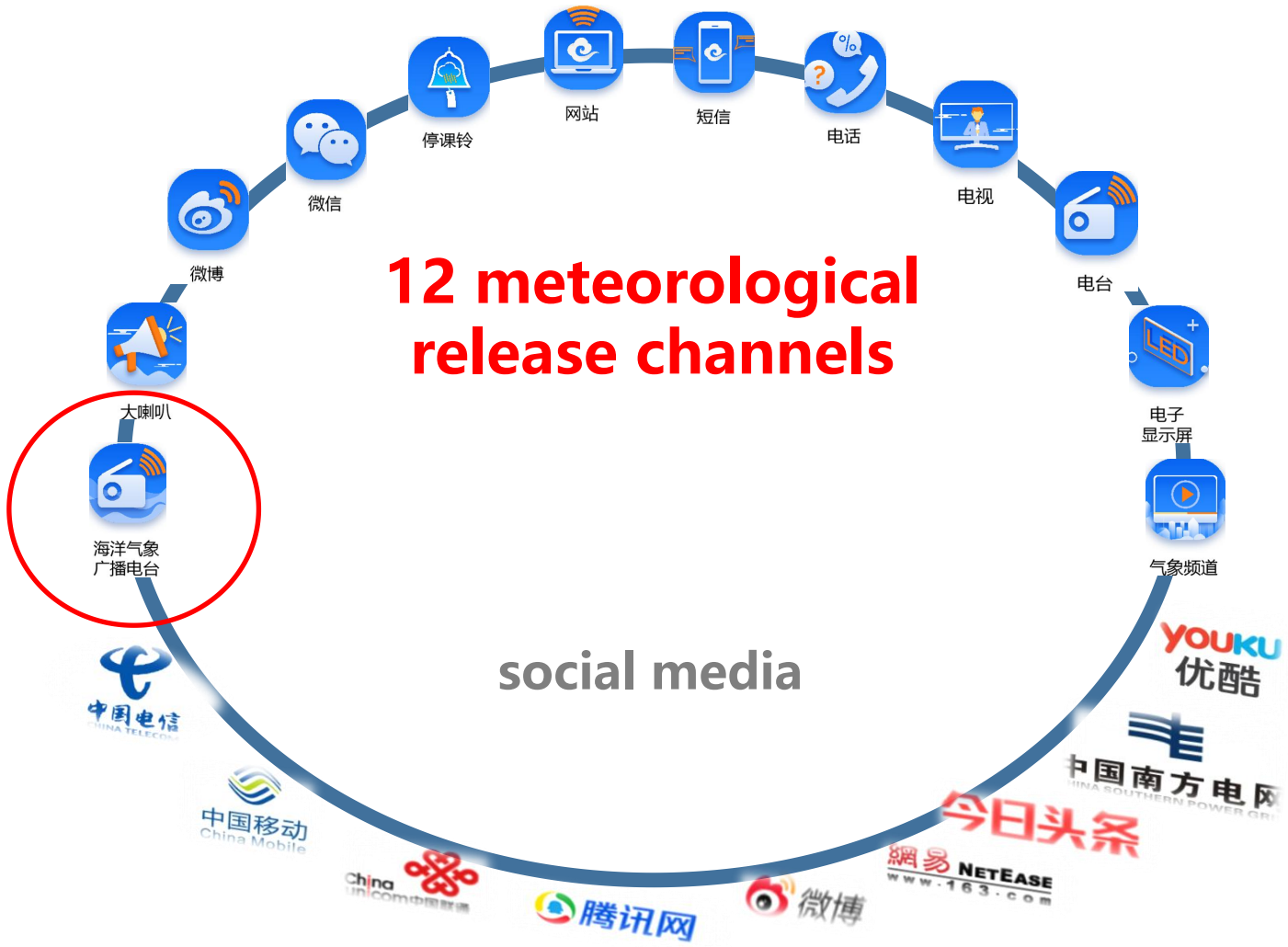
user: 3.74 million

APP Twinkling: 5.67 million
Countryside loudspeaker: 16,694
Voice outbound : 22,423
FAX: 3,128
Electronic display : 4,810

- Weather service stations in 1,551 towns; over 30,000 weather information assistants; and 16,694 countryside loudspeakers.
- At lease one way is available to get warnings in each village(19,517) all lover the province.
- 4,810 electronic displays for people in journey.

Omnimedia Release – specialized channels

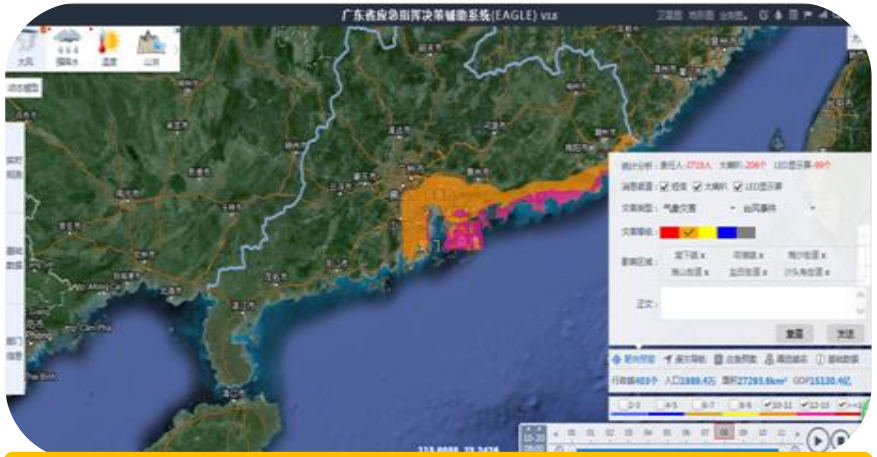




Warning released to targeted users

- **Accurate warning to targeted service object by**
  Selected areas & Specific population at different risks
- **Early and quickly warning released by**
  One Click through multiple channels
- **Warning spread channels are all**
  monitored,displayed, controlled **on line**

Targeted release

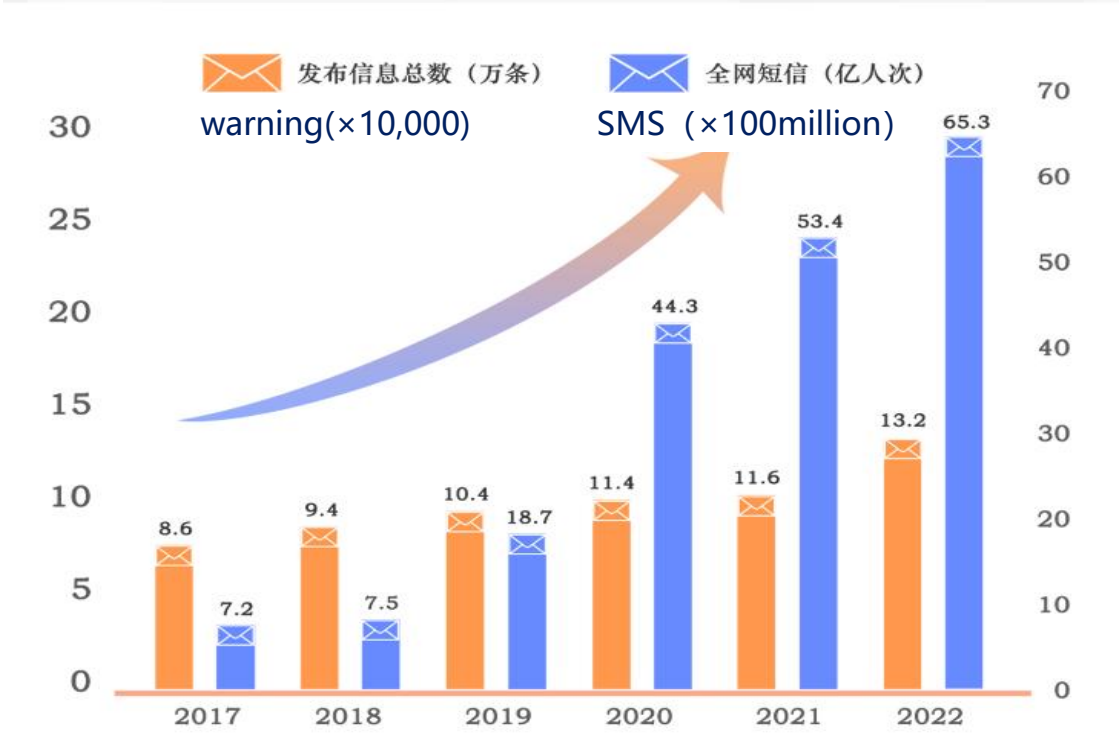


Radio	
TV	
Website	100+ million click-trough rate on emergency response website
Loudspeaker	villages, special locations, …
LCD	airports, railway/bus stations, wharfs, …
SMS	1+ billion SMS per year
Wei bo	Message push
Wechat	Message push
Broadcasting	
Etc.	

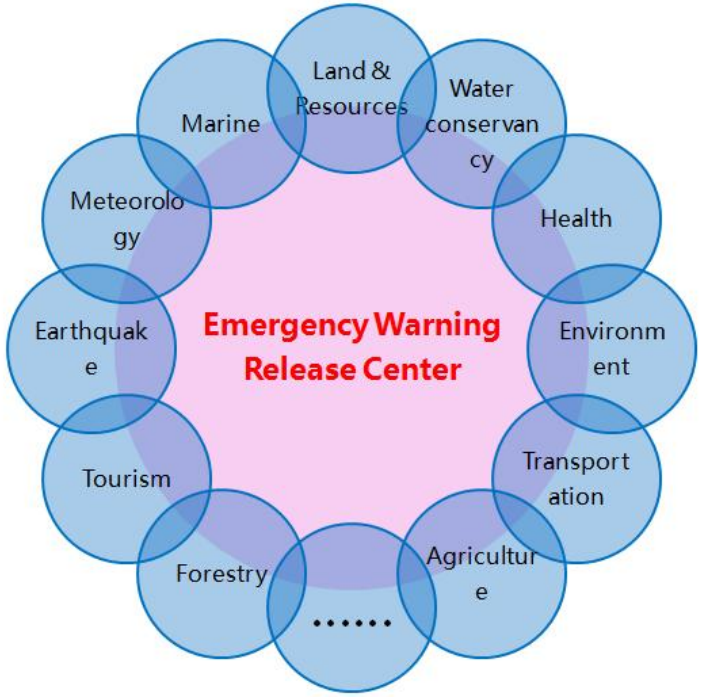
Joint Release by multiple provincial departments

- 2022: **132,000 warnings**, >6.5 billion SMS
- 2023: 2.82billion SMS

- 2022: >40% are non-weather warnings.
- joint departments: 19(2023)



Number of Warning and SMS



joint release with more departments

Joint Release by multiple municipal departments

序号	单位名称	发布数量
1	江门市环保局	1144
2	四会市疫情防控指挥部	1008
3	恩平市自然资源局	499
4	深圳市自然资源局	271
5	四会市林业局	225
6	阳江市自然资源局	205
7	惠州市农业农村局	151
8	白云区卫生健康局	134
9	肇庆市应急管理局	133
10	潮州市饶平县林业局	107
11	阳江市消防救援支队	95
12	海珠区农业农村局	87
13	中共遂溪县委宣传部	78
14	湛江市应急管理局	76
15	四会市融媒体中心	71
16	四会市教育局	63
17	梅州市自然资源局梅县分局	61
18	番禺区卫生健康局	59
19	广宁县林业局	54
20	广州市应急管理局	53
21	阳江市地震局	52
22	梅州市林业局	45
23	广州市卫生健康局	44
24	遂溪县应急管理局	32
25	韶关市自然资源局	32
26	惠州市林业局	31
27	肇庆市疫情防控指挥部	30

Warnings released by Agencies/bureau since 2015

5424 warnings have bee jointly issued since 2015. The top 3 are:

- ✓ Jiangmen Environmental Protection Bureau(1144)
- ✓ Sihui Epidemic Prevention and Control Bureau(1008)
- ✓ Enping natural resources agency(499)

Typhoon Signals in the past in Guangdong

All signal stations have been closed.

white
white
white

Typhoon signal No.1

Will be affected by TC in 48h.

white
green
white

Typhoon signal No.2

Will be affected by TC in 24h, and wind will read B.F. 6-7.

white
green
green

Typhoon signal No.3

Wind force is B.F. 6-7 now, and will increase to B.F. 8-9 in 12h.

green
green
green

Typhoon signal No.4

Wind force is B.F. 8-9 now, and will increase to B.F. 10-11.

red
green
red

Typhoon signal No.5

Wind force is B.F. 10-11 now, and will increase to B.F. ≥12.

Wind Signals in the past in Hongkong

Maximum: 42 signal stations. The last station was closed in 2002.

香港天文台爲市民發出下列的警告：

1	T1	Standby Signal No. 1
2	3	Strong Wind Signal No. 3
3	8 NE 東北	NE Gale or Storm Signal No. 8
4	8 NW 西北	NW Gale or Storm Signal No. 8
5	8 SE 東南	SE Gale or Storm Signal No. 8
6	8 SW 西南	SW Gale or Storm Signal No. 8
7	9	Increasing Gale or Storm Signal No. 9
8	10	**Hurricane Signal No. 10**

The wind signals in Hongkong

Historic photo: Workers were hoisting a real No.10 wind signal

Historic photo: a No.10 wind signal in force

The present electronic Tropical Cyclone Warning Signals in Hongkong

10 kinds of electronic meteorological disaster warning signals nowadays in Guangdong

according to: ***Regulations on the Release of Meteorological Disaster Warning Signals in Guangdong Province***

Issued at Mar.27, 2006; Amended at Nov. 2018

Typhoon

Rainstorm

Hail

Fog

Road icing

Heat Wave

Cold

Haze

Thunder Gust

Wild Fire

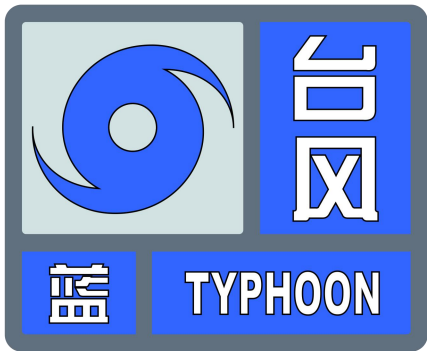
Electronic Typhoon Warning Signals in Guangdong

according to: ***Regulations on the Release of Meteorological Disaster Warning Signals in Guangdong Province***

Issued at Mar.27, 2006; Amended at Nov. 2018

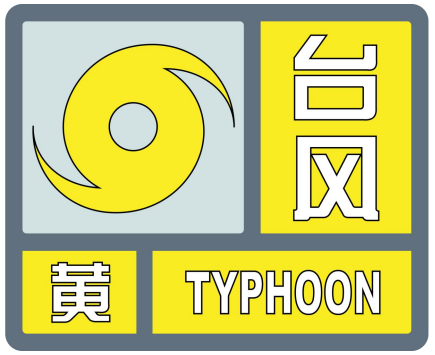
WHITE

Will be affected in 48h by typhoon.
……
(Attention signal)



BULE

Affected by typhoon, sustained wind force is B.F. **6-7**, or will reach B.F. 6-7 in 24h.
……



YELLOW

Affected by typhoon, sustained wind force is B.F. **8-9** or will reach B.F. 8-9 in 24h.
……

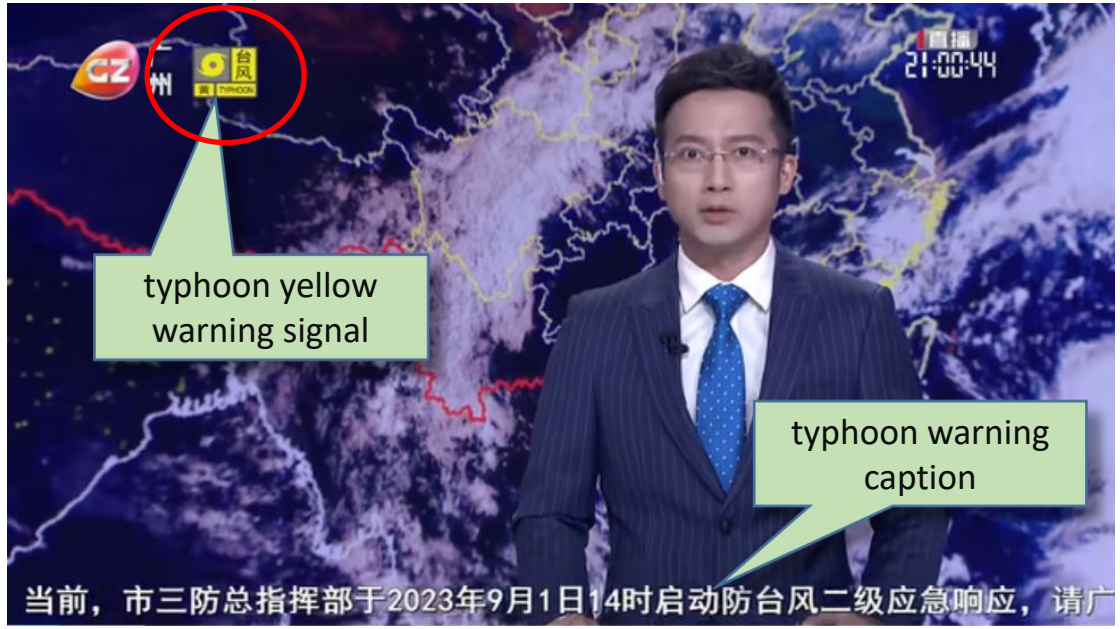
ORANGE

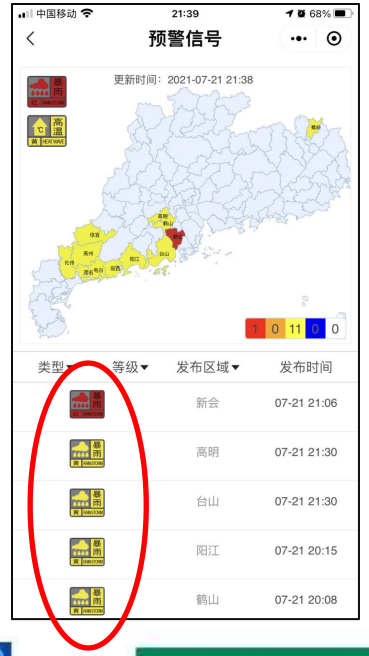
Affected by typhoon, sustained wind force is B.F. **10-11** or will reach B.F. 10-11 in 12h.
……

RED

Affected by typhoon, sustained wind force is B.F. **≥12**, or will reach B.F. ≥12 in 12h.
……

The public could not miss the typhoon warning …





The public could receive the warning from TV, radio, SMS, popup notification, APPs, websites, newspaper, radio, LCD, loudspeaker, notice on community bulletin board…

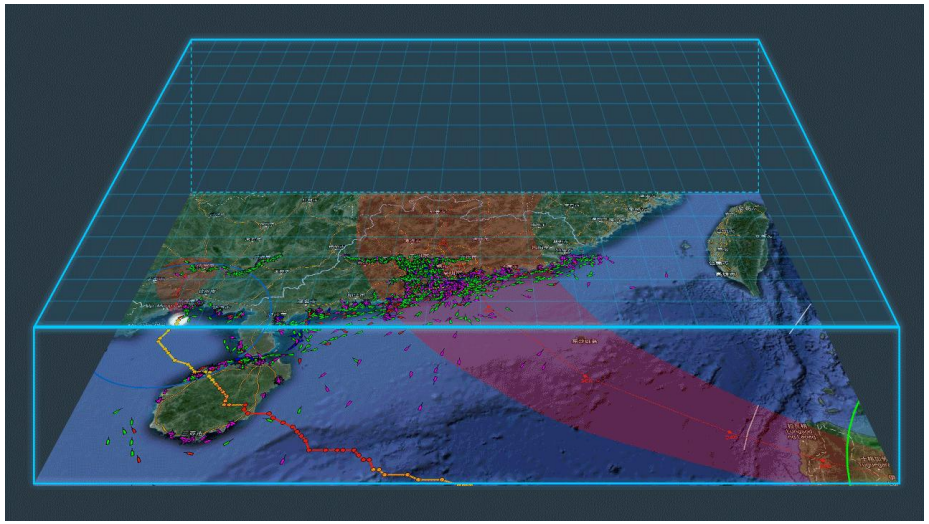
Government organizes disaster prevention and mitigation

Government will activate emergency response based on the category of Typhoon Warning Signal, and governmental departments cooperate to take actions to:

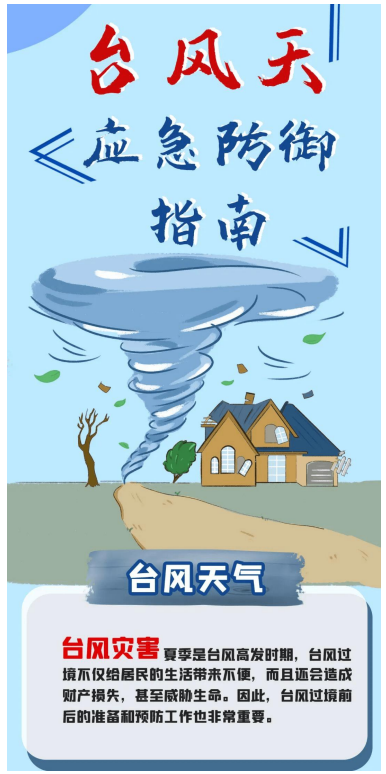
- ✓ Organize fishing vessels to return to ports
- ✓ Organize marine staff to return to land
- ✓ Close scenic spots on islands or along coastline
- ✓ Fasten …
- ✓ Call public to take actions according to instructions
- ✓ …

Organize to cut down branches of trees before a strong TC makes landfall

Close scenic spots



Fishing vessels are organized to return to ports when a TC is approaching



Defense guide for public

APP

Twinkling

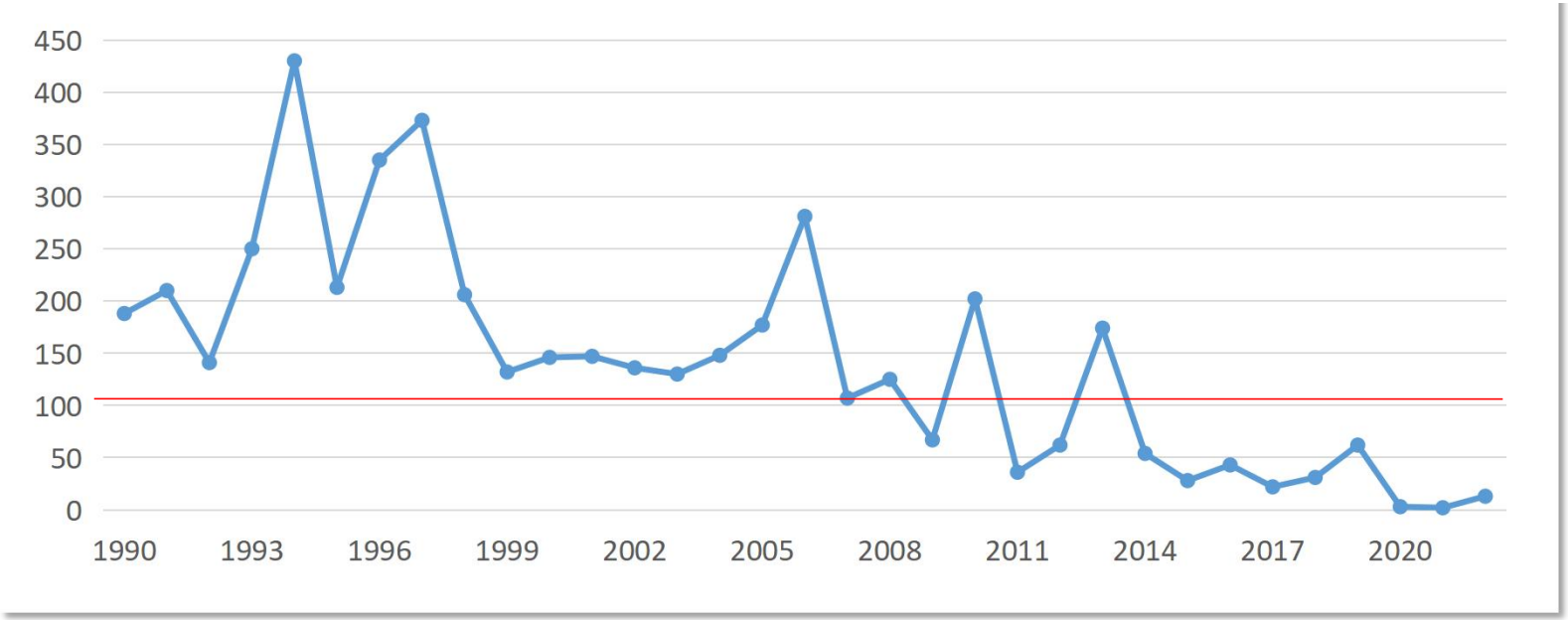
Class suspension warning signals

Function: Pushing Weather warning signals for severe weather

Purpose: Protecting students from severe weather

Improvement of Disaster Prevention and Mitigation in Guangdong Province

Influence rate of meteorological disaster to GDP	Death due to meteorological disaster	Casualties to the lowest level in typhoon-induced disasters
<0.8% in recent 10 years	Lowest in recent 30 years 2020(3); 2021(2); 2022(13)	● No death in Super/Severe Typhoon Rammasum, Kalmaegi, Nida, etc ● Comparison between No.1522 Mujigae（14deaths）and No.9615 Sally(359 deaths) ● No typhoon-induced death in 2020 and 2021.



Death due to disastrous weather in recent 30 years

WMO highly appraises Guangdong Emergency Early Warning Release System

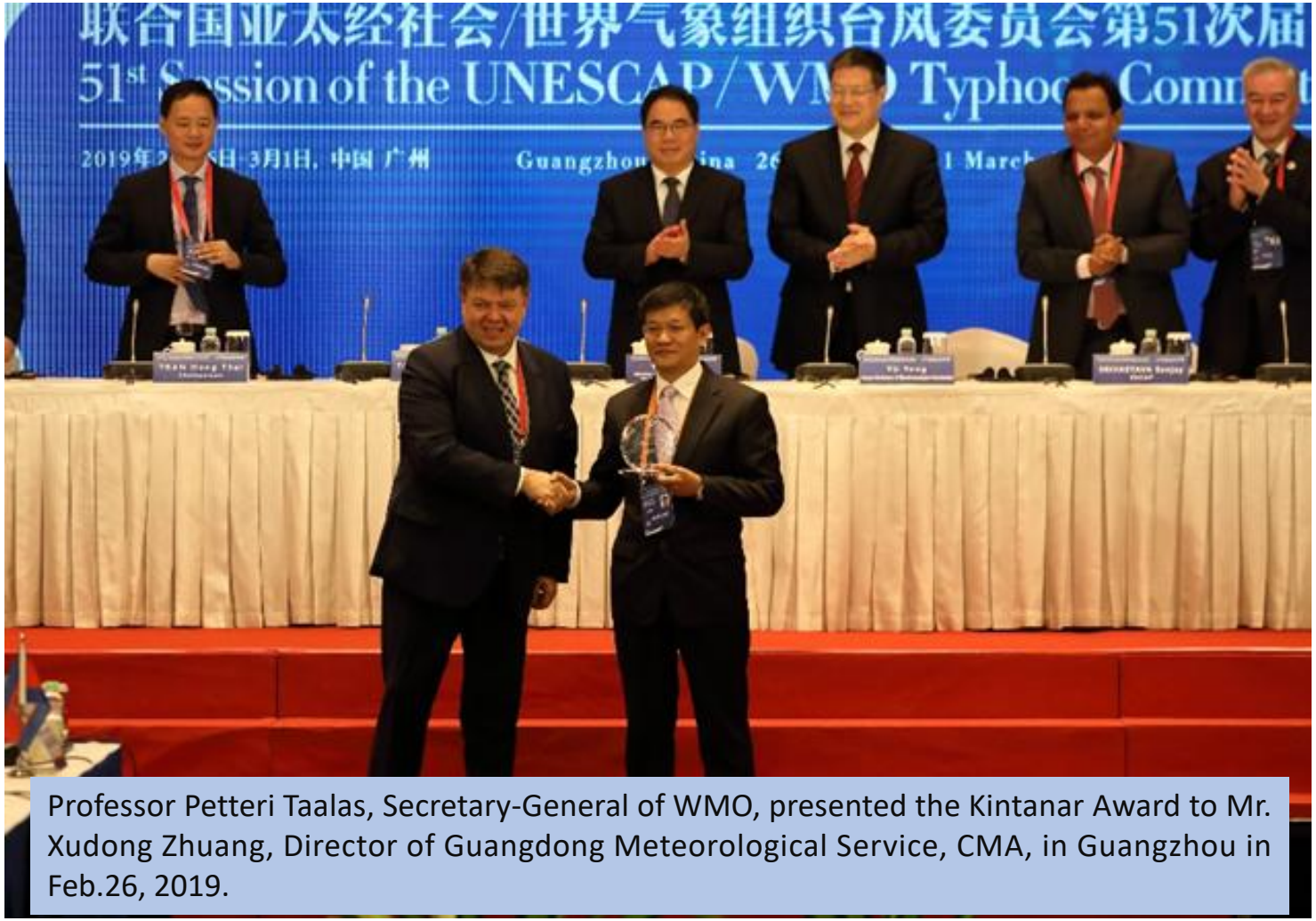
- **As a display window of China meteorological modernization, the Release Platform was visited and highly praised several times by delegates of conventions organized by WMO.**
  - The 16th Session of WMO Basic Systems Committee, 2016
  - First Lead Author Meeting of the IPCC Working Group I Sixth Assessment Report, 2018
  - the 51st Session of UNESCAP/WMO Typhoon Committee, 2019
  - …

WMO conventioneers visited Release Platform

Drill of typhoon early emergency warning release

Kintanar Award in 2019

The Kintanar Award was presented to **Guangdong Meteorological Service, CMA** for its contribution in the typhoon-induced disaster prevention and mitigation in the 51st session of the ESCAP/WMO Typhoon Committee in 2019.



Professor Petteri Taalas, Secretary-General of WMO, presented the Kintanar Award to Mr. Xudong Zhuang, Director of Guangdong Meteorological Service, CMA, in Guangzhou in Feb.26, 2019.

In the future

- **More intelligent**
- Location-based
- Customizabale
- Anywhere, anytime
- **Artificial intelligence**
- Combining with various models
- Data from all walks of life
- Be managed , analyzed

Thanks for

Your attention