

A wide-angle photograph of a modern city skyline with numerous skyscrapers of varying heights and architectural styles. The sky is a vibrant blue, filled with large, fluffy white cumulus clouds. The buildings are reflected on a white surface below them.

Weather Modification in China

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**Department of Emergency Response, Disaster
Mitigation and Public Services**
China Meteorological Administration

Oct. 19 , 2024 Thailand



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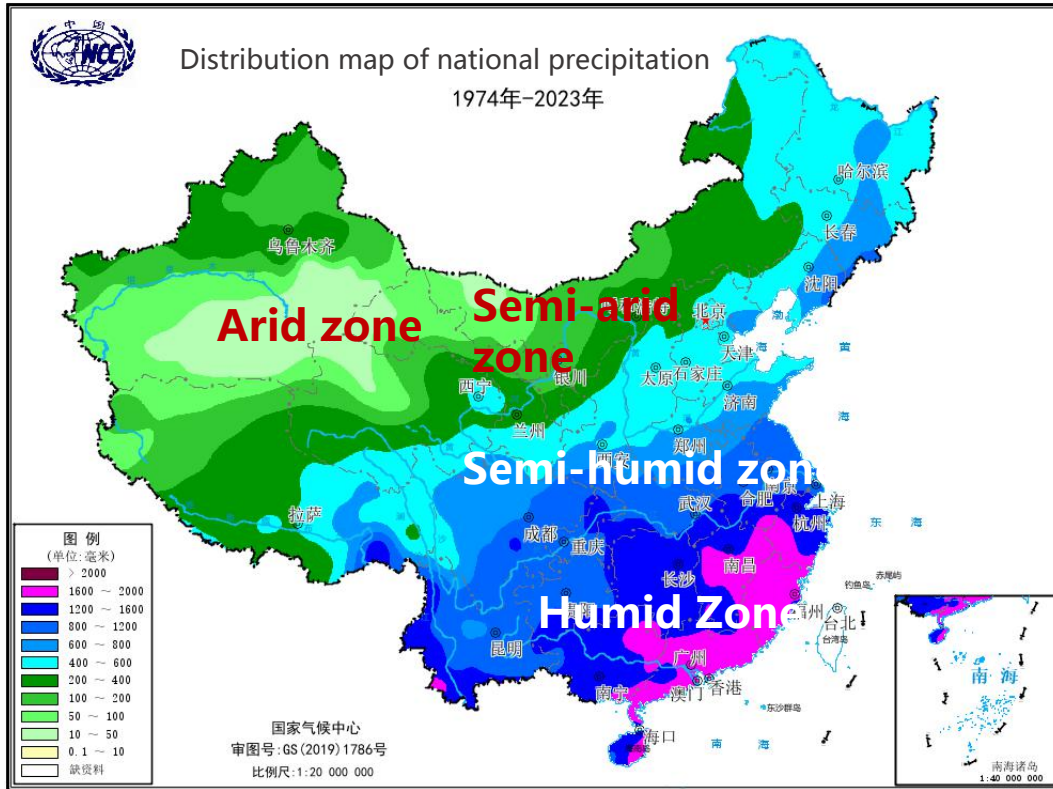
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Development in Near Future

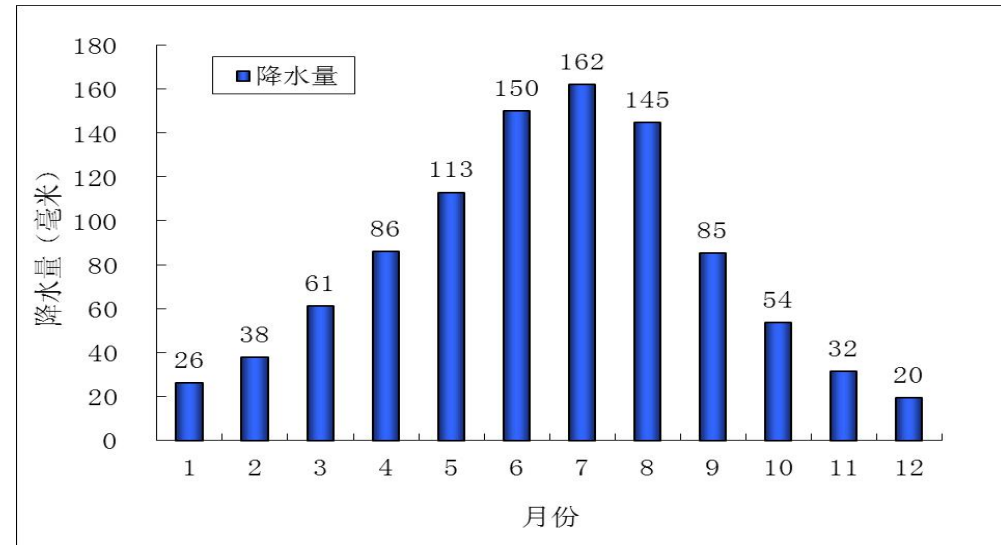


PART

1 Requirements and Demands



Precipitation

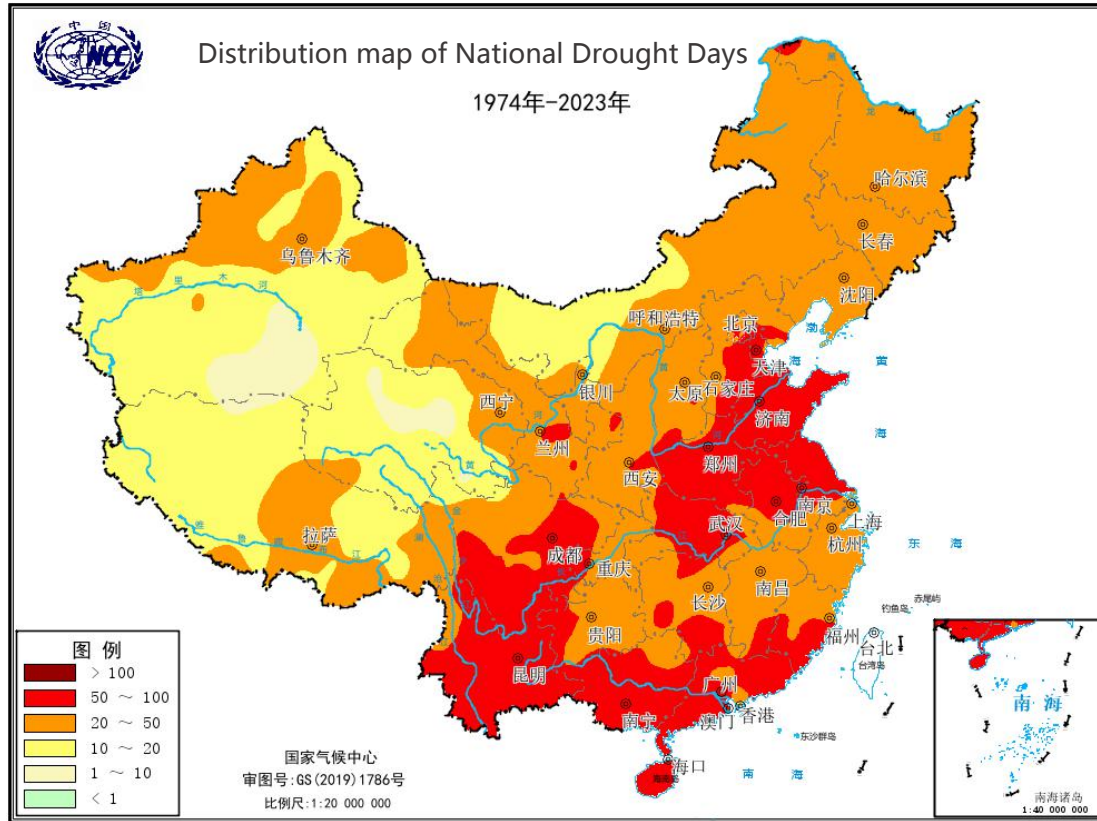


Annual precipitation
distribution

Max: 2782 mm
Min: 8.8 mm

Monthly average precipitation amount :
Wetter in Summer; drier in autumn & winter.

China is a typical monsoon country, with remarkable seasonal precipitation changes and interannual variability, as well as alternate droughts and floods.



Droughts

The most serious meteorological disaster in China.

With climate change, the pattern of southern flooding and northern drought in China is changing.

The perennial average area of arid climate is 689 thousand km², accounting for 8.1% of the total area in China.

Frequency of Drought Occurrence

59 million hectares of farmland affected by drought.

26 million hectares of farmland suffered from severe drought Grain loss amounted to 62% of total grain loss.



Hailstorm



1.7 million hectares of farmland affected
Hailstorms cause serious economic losses.

Artilleries and rocket launchers are implemented in hail suppression.

Ecological restoration



Specific target areas (ecologically fragile areas, water sources and catchment areas, lakes and wetlands, etc.) require WM operations.



Forest fires fighting and prevention



Different region has different climate resources. The requirement of high mobility and highly integrated operating force for forest and grassland fire suppression.

Other requirements



- **Snow and ice enhancement in winter for Glacier retreat areas**
- **Mitigate the heat waves in megcities**
- **Protect wetlands from degradation**
- **Services for major activities and events**



Well-organized weather modification activities in China started in 1958.

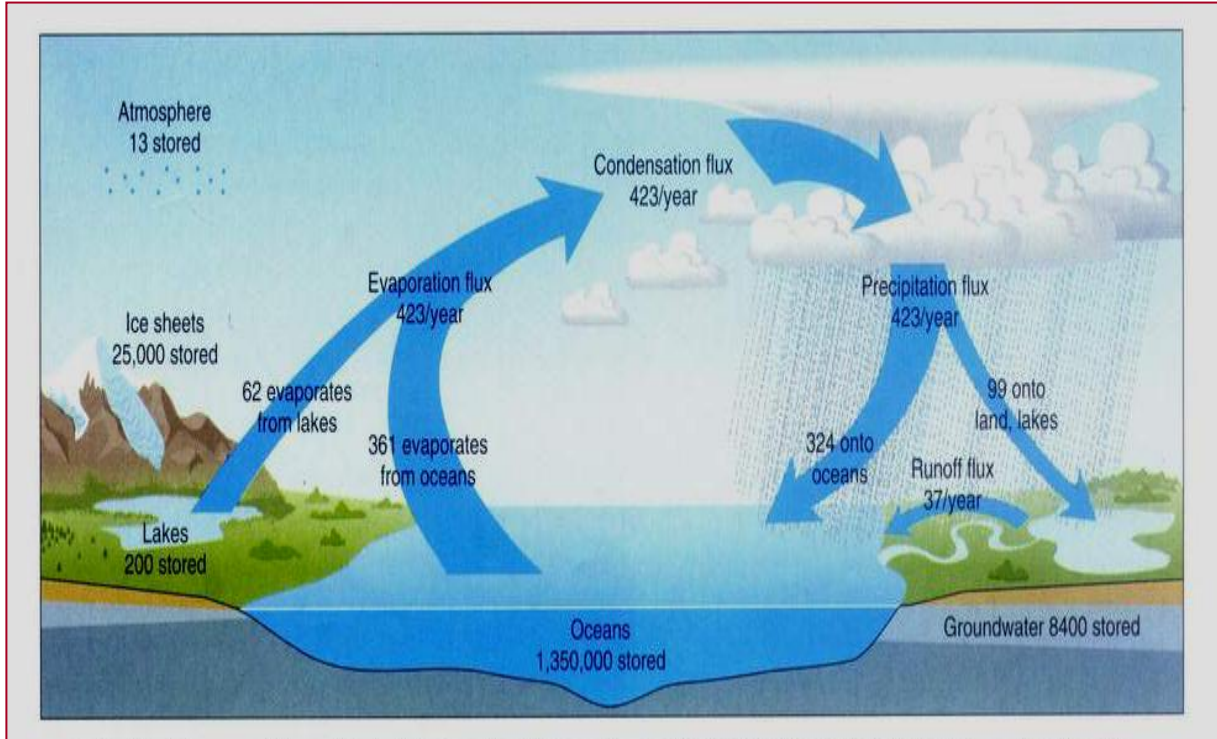


Mr. Zhou, The first pilot



The aircraft utilized on the experiment

The first plane and the first pilot in China flew for rain enhancement experiment in Jilin Province.

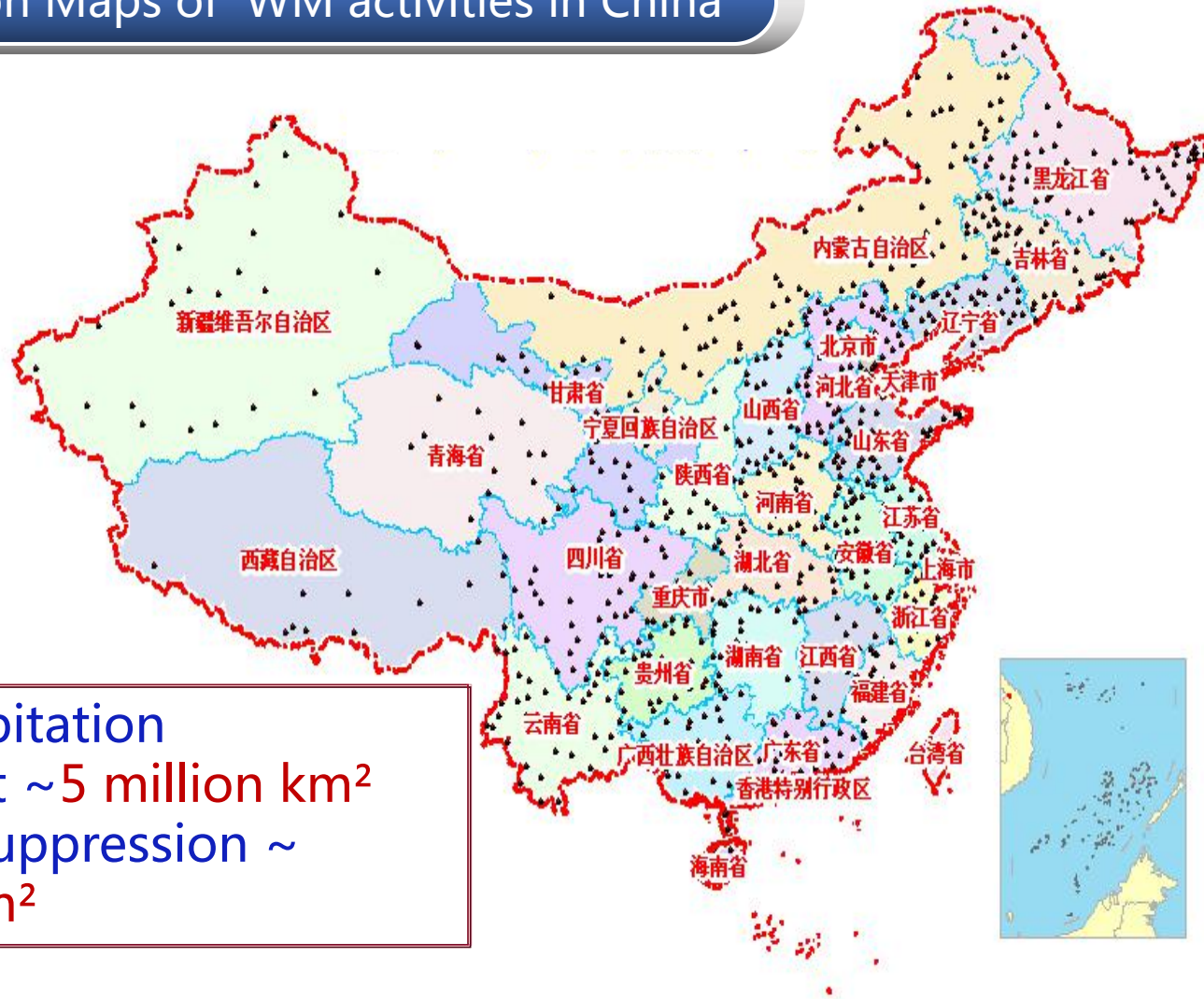


Under the promotions and supports of government, there has been a great development for WM activities. A three-dimensional operating system of **57 manned aircraft**, thousands of rockets and ground generator has been basically built.

WM operations have been carried out all over the country, thus creating significant social and economic benefits.



Distribution Maps of WM activities in China



Annual precipitation enhancement ~5 million km²
Annual hail suppression ~0.5 million km²



Over 50 specialized airplanes



Rocket launchers



Artilleries



PART **2** Law and Regulations



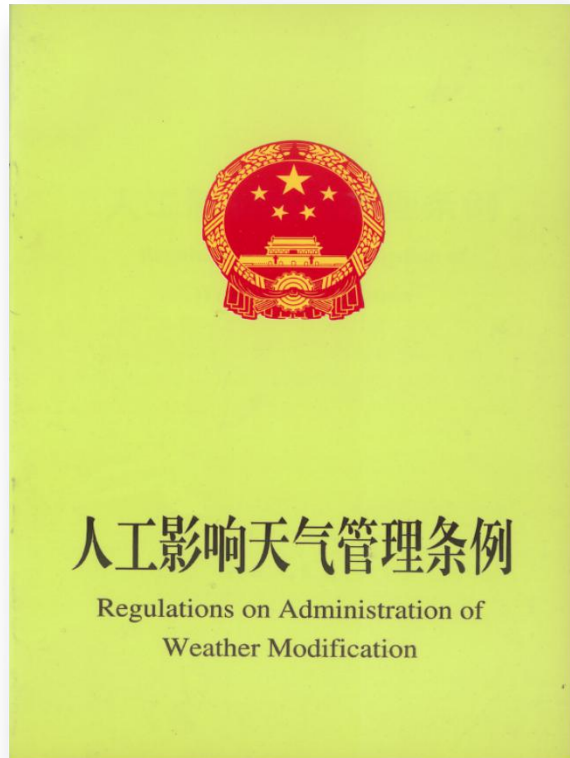
1999, Chinese government issued the Meteorological Law



- **Local government:** Lead and organize WM work.
- **CMA:** Management and guidance.
- **Local meteorological service:** Organize and operate.
- **Relative Department:** Provide corresponding support, Equipment supply, airspace, safety, operation site, training ect.



2022, “Regulations on Administration of WM” adopted by the State Council



Lead & management: Local government and meteorological department responsibility.

Working plan: Local meteorological department should draw up a plan on this work. Local government provides budget support.

Assessment & appraisal: Local government organizes assessment on WM result (CMA provides technical methods).

Site selection: Confirmed by meteorological department and airspace management department.

Operation request: Training, and abide relative regulation and standard.

Airspace apply & utilizing: In accordance with air traffic control regulation.

Equipment & facilities: CMA and relative ministry assign enterprise to produce facilities.



Policy

Chinese government has released 3 important documents to support the development on WM.

关于关于加强人工影响天气工作的通知

各省、自治区、直辖市人民政府，国务院各部委、各直属机构

人工影响天气是人类运用现代科学技术，对局部大气施加影响，实现增雨雪、防雹、消雨、消雾、防霜等趋利避害目的。

在抗灾减灾、缓解旱情等方面发挥了重要作用。但在一些地区和部门，还存在协调和指挥机制不健全、影响天气工作经费投入不足等问题。

一、充分认识人工影响天气工作的重要性。世界上气象灾害频发，是20世纪90年代以来最严重的自然灾害之一。随着全球气候变暖，极端天气气候事件频发，水资源短缺、水污染、水生态破坏等问题日益突出，严重影响经济社会发展和人民生命财产安全。人工影响天气作为防灾减灾救灾的重要手段，在农业抗旱和防雹减灾、生态建设和保护等方面发挥了重要作用。

国

关于推进人工影响天气工作高质量发展的意见

各省、自治区、直辖市人民政府，国务院各部委、各直属机构：

近年来，我国人工影响天气工作快速发展，作业能力和管理水平不断提升，在服务农业生产、支持防灾减灾救灾、助力生态文明建设和保障重大活动等方面发挥了重要作用。为推进人工影响天气工作高质量发展，经国务院同意，现提出以下意见。

一、总体要求

- **2005, Responsibility of local government.**
- **2012, To improve operation and research ability by constructing infrastructure, including aircraft, aircraft base, commanding system, field experiment base ect.**
- **2020, Specified service area, improve capacity, scientific study.**



PART **3** **Organization
and Operation**

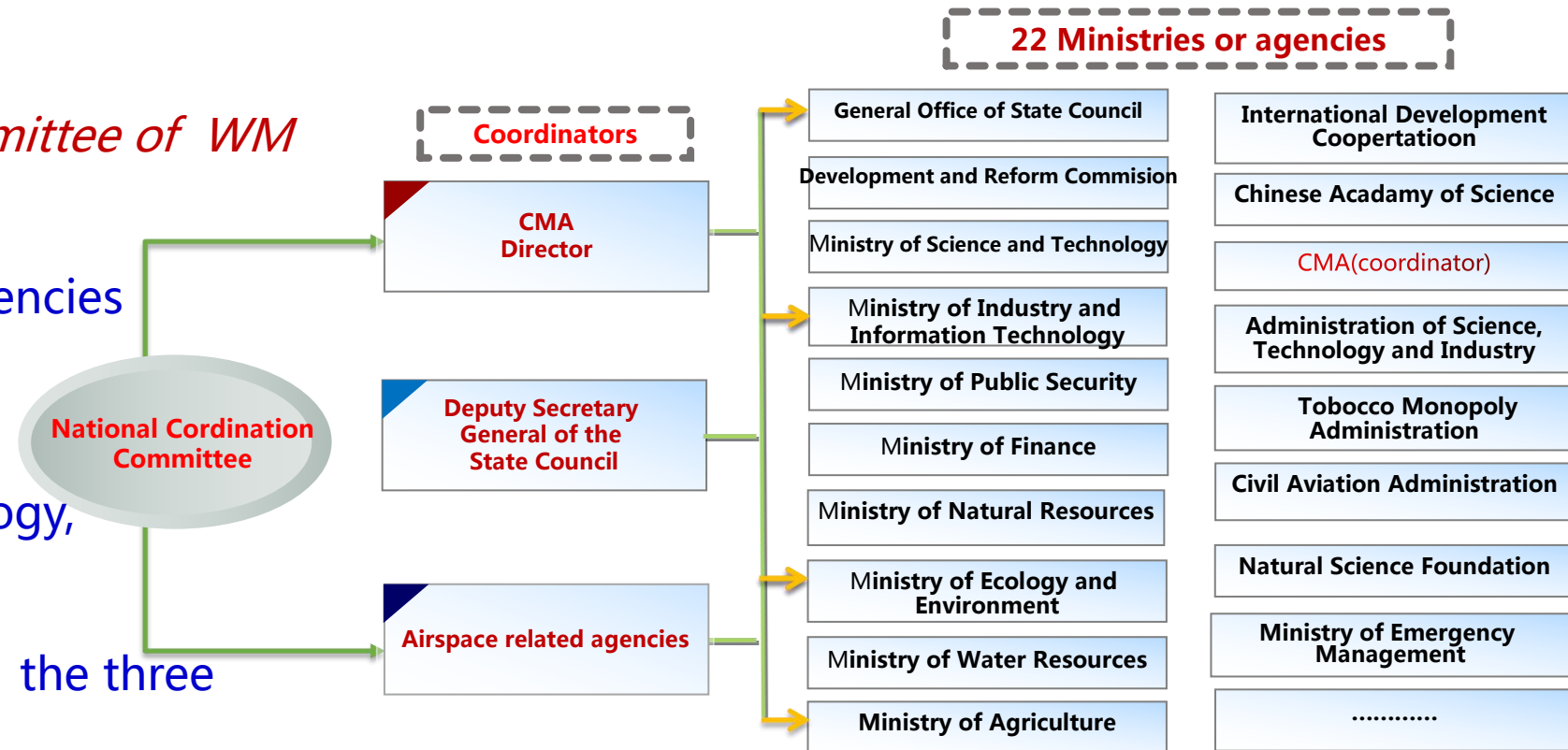


Organizing and Coordination Mechanism

**CMA is the leading agency responsible for the management of all WM activities in China:
Management, Operation guidance, equipment licence, training and capacity building**

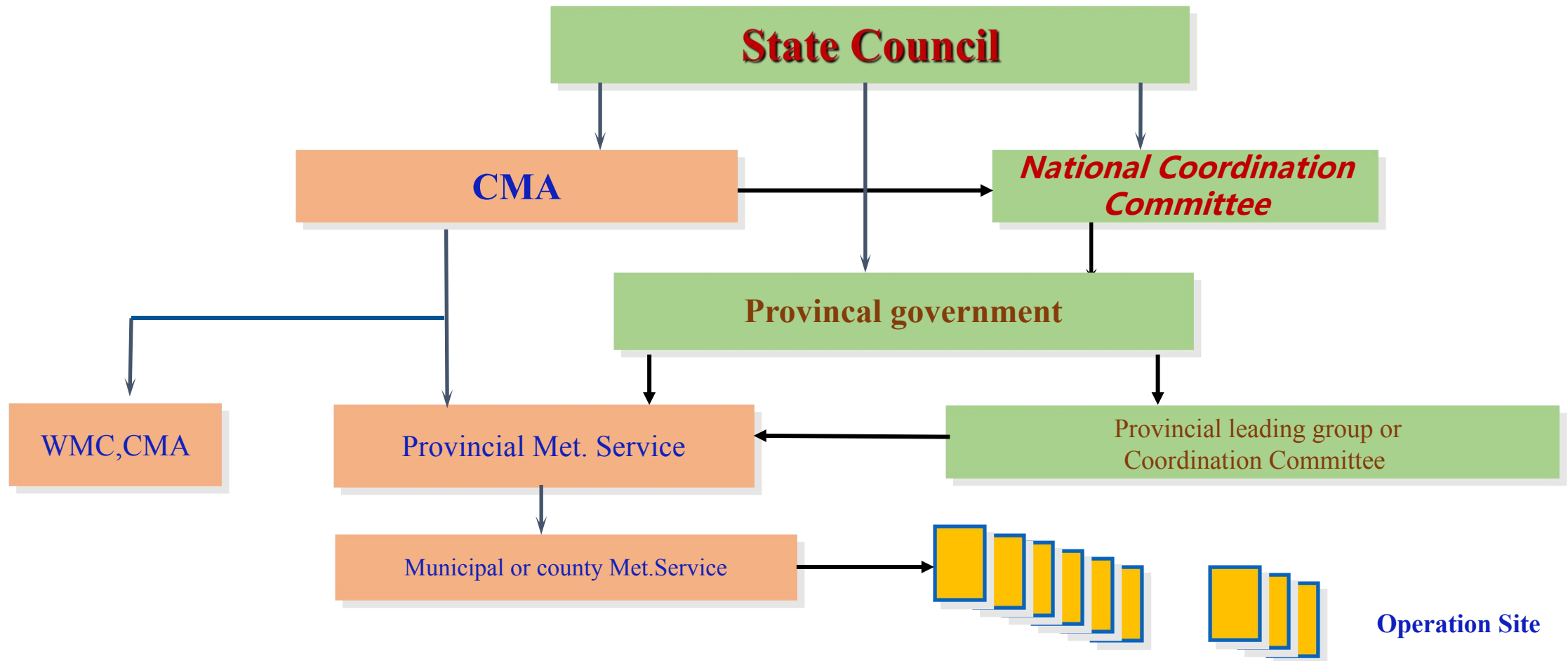
China National Coordination Committee of WM

- Established in 1994
- Consisted of 22 Ministries or agencies
State Development and Reform Commission,
Ministry of Water Resource,
Ministry of Science and Technology,
Ministry of Agriculture,
Ministry of Finance
- Administrator of CMA — one of the three coordinators





The Management System of WM in China



Similar organizations at provincial and different local levels.



Division and layout of WM in China

National and provincial department

developing plan, research, forecast , operation guidance, transregional coordination, aircraft operation

Municipal and county Met.Service

observation, operation, airspace apply and utilizing, ground and aircraft operation etc.

7 experiment bases :
rain enhancement,
hail suppression,
fog dispersal



Cooperation

- **Institute & university** : research, training
- **Enterprise** : aircraft and ground equipment, technology, seeding agent



Five-year Plan and achievements

During past decade, China has launched two five-year plans to support WM development.

国家发展改革委 中国气象局关于印发《全国人工影响天气发展规划(2014~2020年)》的通知

各省、自治区、直辖市、新疆生产建设兵团发展改革委、气象局：

为贯彻落实党中央、国务院关于做好人工影响天气工作的一系列指示精神，落实《国务院办公厅关于进一步加强人工影响天气工作的意见》(国办发〔2012〕44号)要求，国家发展改革委和中国气象局在开展广泛调查研究、科学深入分析、充分征求意见的基础上，组织编制完成了《全国人工影响天气发展规划(2014~2020年)》(以下简称《规划》)。《规划》确定了全国人工影响天气的指导思想、发展目标、总体布局、主要任务、实施安排，提出了人工影

- 1 -



Overall layout map of national weather modification



Establish WM operational flow ——process management



Seven steps: 1 week predication, 72h forecast, 48h operation preparation(equipment, airspace), 3h scheme design, operation, result assessment, security management

- Observation ability ; —Operation ability ;
- Commanding ability ; —Result assessment ability





Modern cloud seeding force



Establish an operation system represented by high-performance aircraft.





Regulations and standards

Form a relatively complete institutional system and standard specification system.

Institutional system ——

- 18 Law and regulations , policies and institutions
- 8 Engineering management , safety management
- 30+ Operation rules: Operation site construction and management, aircraft operation

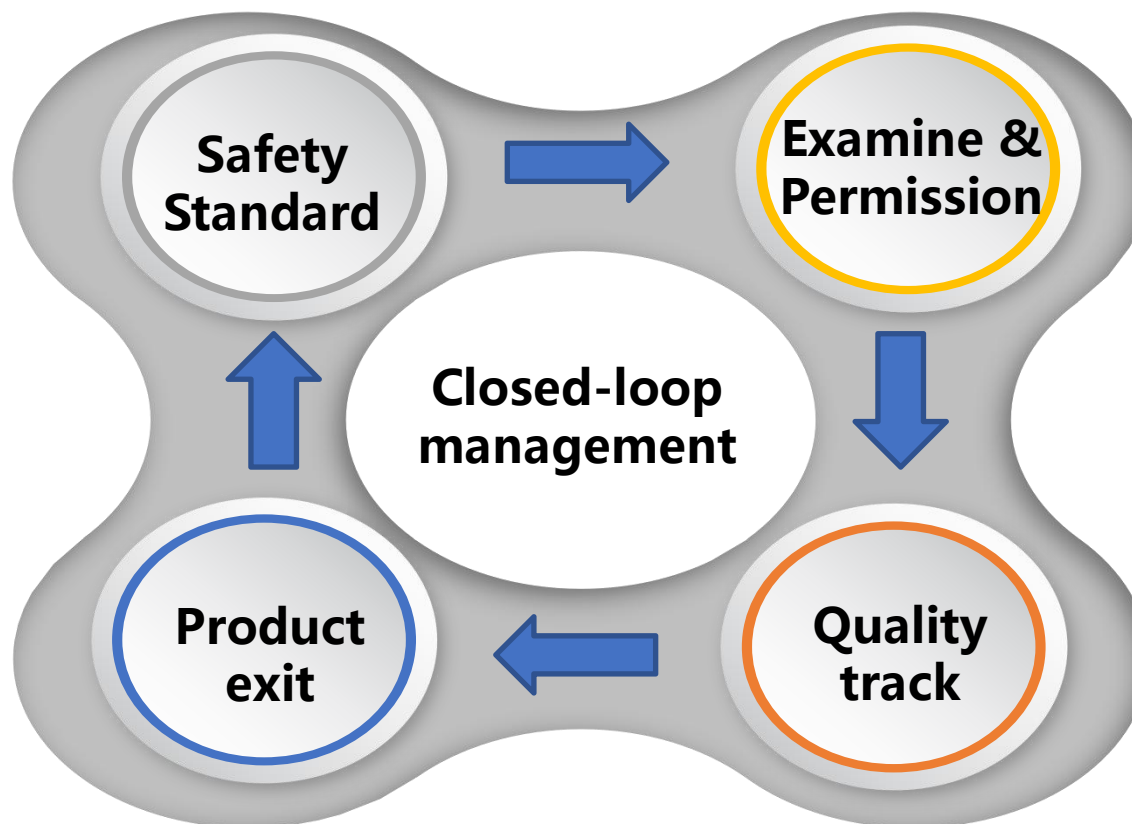
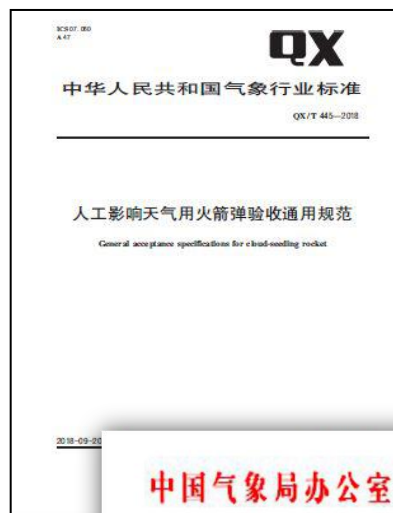
Standard specification system ——

- 7 National standards: Airspace apply and utilizing.....
- 37 Industry standards: Equipment operating rules, Training.....
- 82 Local standards





Equipment licence



人工影响天气弹药质量通报

2022年第4期
中国气象局上海物资管理处 2022年05月30日

2022年4月全国人影弹药质量通报

为进一步强化人工影响天气（以下简称人影）的安全管理，促进人影弹药质量不断提高，确保更加安全、科学、高效实施人影作业，中国气象局上海物资管理处依据《人工影响天气弹药质量通报管理办法（试行）》（气政函[2017]46号），发布2022年4月全国人影弹药的质量通报，具体情况如下：

一、人影弹药出厂验收情况

2022年4月，上海物资处共验收合格炮弹6个批次111280发，火箭弹9个批次13730枚，结余3个批次4776枚，具体见下表：

出厂验收情况					
生产企业	型号	类别	批次数	批次号	数量
3365厂	JD-17	炮弹	6	17-21-71	111280
				1-22-71~4-22-71 4-22-71	0
9394厂	HJH-62B	火箭弹	3	1-22-3305~3-22-3305	5978
				1-22-3305~3-22-3305	0
9394厂	BL-1A	火箭弹	4	1-22-4-22	4782
856厂	RY1-6300	火箭弹	2	2022-03~2022-04	3000

Quality Notification



Investment

Funded by government:

Central and **Local** government

NSFC: National Natural Science Foundation of China

MOST: the Ministry of Science and Technology

CMA: China Meteorological Administration

To support:

Ground and aircraft operation

Field experiment

Technology development

Theoretical study

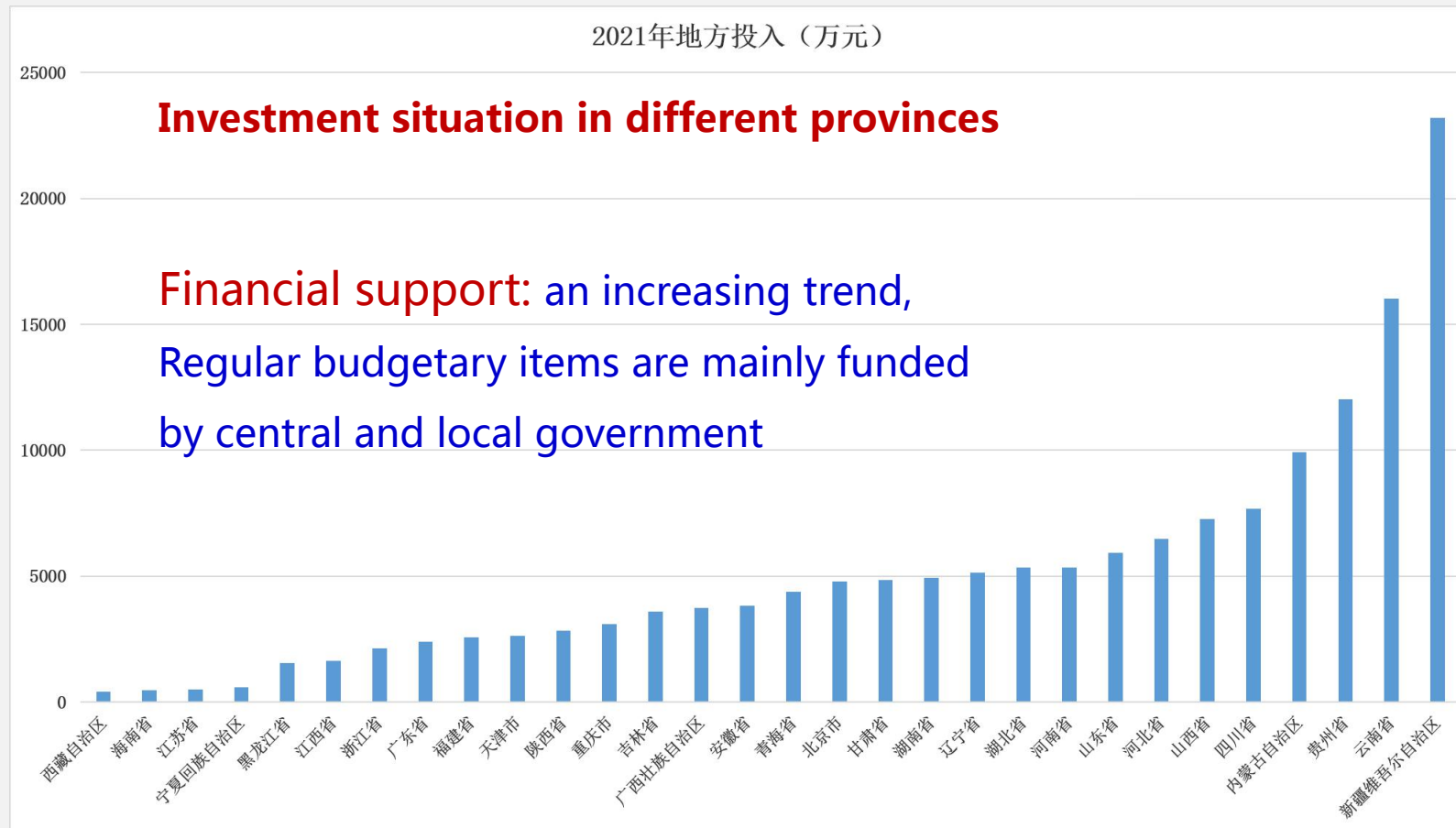
Laboratory research





Investment

2021 : Central government 3.1 billion+Local governments 16.6 billion , Total 19.7 billion





Main service areas

Agriculture , Ecology , Emergency Service etc.

WM in China has developed rapidly with its operation capacity and management level being continuously improved.

It has been playing more and more important role in reducing the risks of drought, lightning hailstorm disaster, mitigating shortage of water resources, and improving environments.





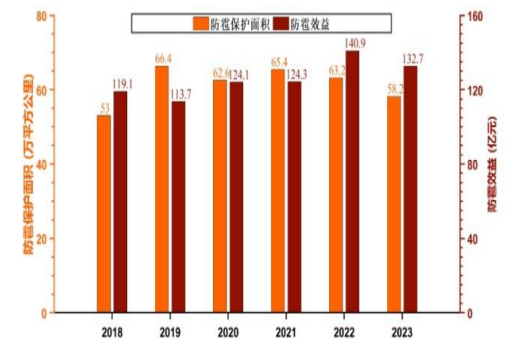
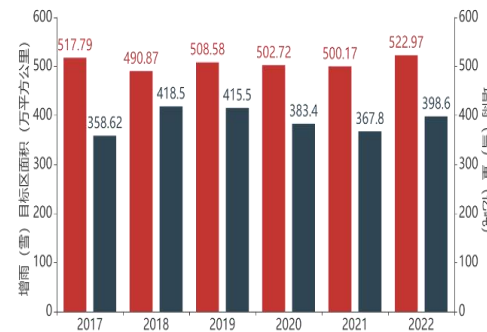
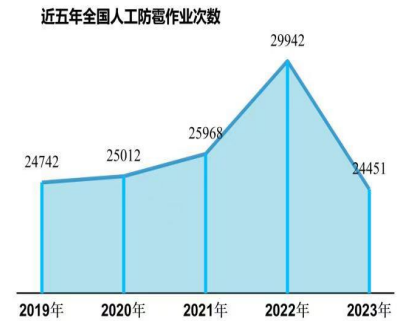
Benifits

Aircraft operation in China, 2023



The impact area of WM activities has expanded to **5 million km²**, and the protection area of hail suppression operations is about **500,000 km²**. The direct economic benefits of WM are nearly **50 billion RMB** every year.

Times and benefits of rain enhancement and hail prevention in recent 5 years

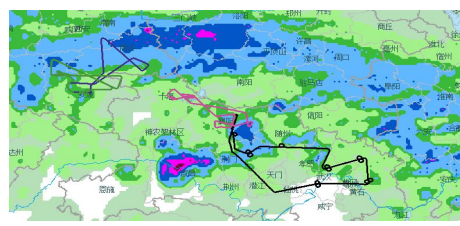




Benifits

➤ Rain enhancement and drought relief

In 2022, there was a widespread drought in south of China. CMA joined forces with local meteorological departments to implement large-scale artificial rainfall enhancement operations in many places to alleviate the drought.



中国气象局 为缓解旱情 多地开展人工增雨作业 调用飞机为南水北调蓄水工程开展增雨作业

央视网 2022-08-27 17:18:33 132301次观看

央视新闻 我用心你放心



中国气象局 在四川组织实施大型无人机人工增雨作业

次数达到42万次,同比增长15%。 农业农村部:2021年我国水



河南 增雨飞机抵达 开展抗旱增雨作业

8月26日 14:11 法国总统马克龙25日访问阿尔及利亚,意图缓解双边紧张关系并进行



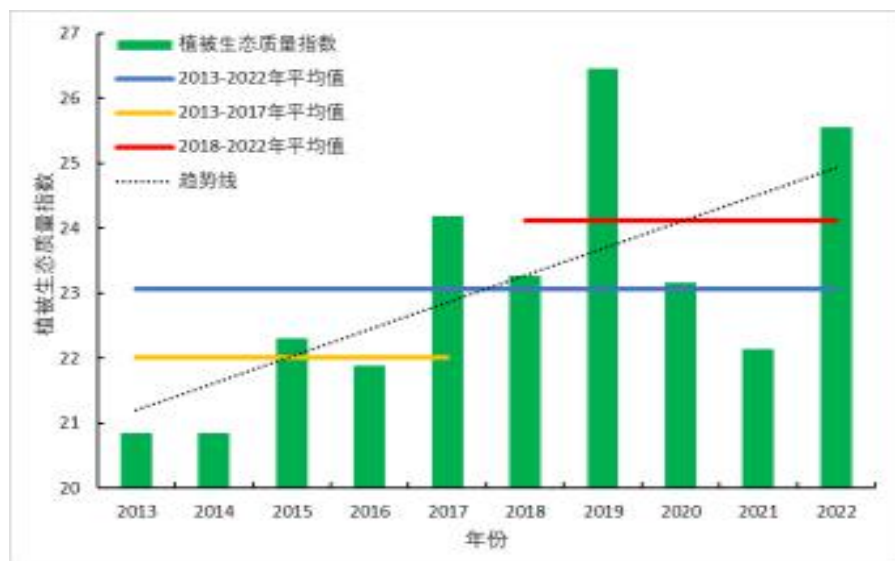
封面新闻



Benifits

➤ Ecological restoration

WM work has assisted ecological restoration in most of China. The ecological quality of vegetation in the Qilian Mountain Ecological Protection Zone has generally improved in recent years, and the area of Qinghai Lake has been increasing year by year.



Vegetation Ecological Quality Index of Qilian Mountain Ecological Guarantee Area



Changes in lake area of Qinghai Lake



Benifits

➤ Hail suppression and disaster reduction

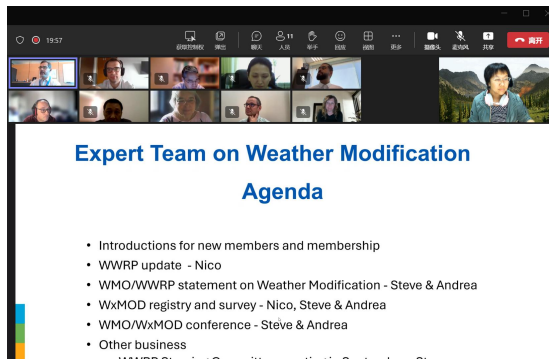
Hail suppression increase the income of cash crops.

The disaster rate of flue-cured tobacco and hail in Yunnan Province's control areas is about **1.5%**, and the disaster rate outside the control areas exceeds **10%**, reducing losses by more than **1.6 billion** RMB on average.

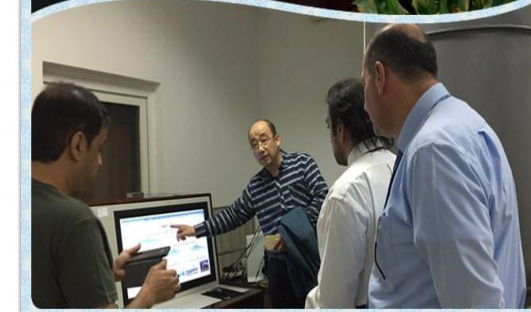
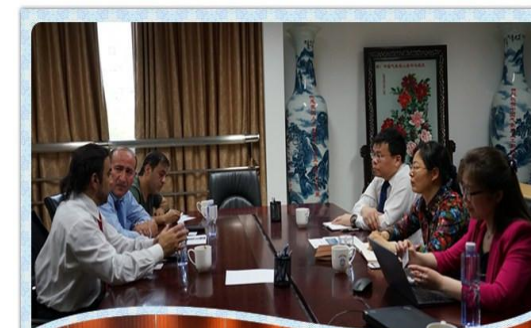




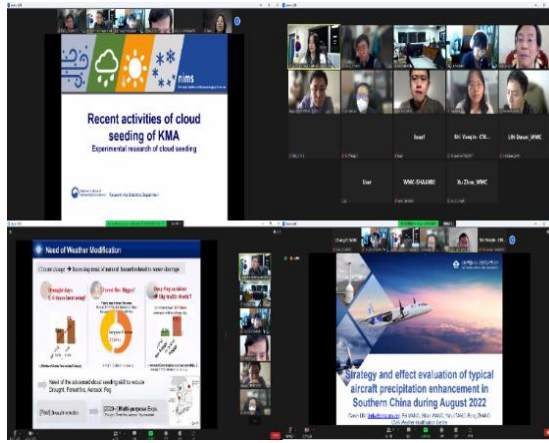
International Exchange and Cooperation



2011, CMA visited Oman



2018, National Meteorological and Earthquake Center of the United Arab Emirates came to China



2016, CMA visited India

2015,2024, DRRAA of Thailand visited CMA

2022, 2023, Korea-China online conference on weather modification

Since 2007, CMA has carried out a series of exchanges and cooperation with many countries, and conducted experimental research studies, technical exchanges with Thailand and other countries.



PART **4** **Development
in Near Future**



Concentrate efforts in these fields :

- **Improvement Management systems:** Strengthen leadership, regional centers
- **Integrated operation system:** sounding, commanding systems, air and ground-based seeding
- **Working mechanisms:** coherent agency actions , international exchange and cooperation
- **Service efficiency:** Annual precipitation enhancement ~ **5.8 million km²**,
Annual hail suppression ~ **540,000 km²**

PART **4** *Development in Near Future*



Integrated operation system: aircraft and drone (Equipped with sounding, seeding and communication system)



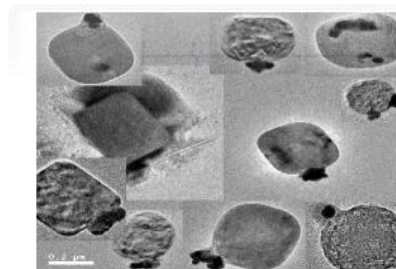
PART 4 *Development in Near Future*



Integrated operation system: ground equipment , motility and flexible



High efficiency seeding agent



Silver iodide



Dry ice



liquid nitrogen

4 *Development in Near Future*

PART



Integrated operation system: sounding and observation systems



Wind profile radar



Microwave Radiometer



Frog droplet spectrum



Detecting airships



GNSS sounding instrument



Cloud particle detector



Phased-Array Radar





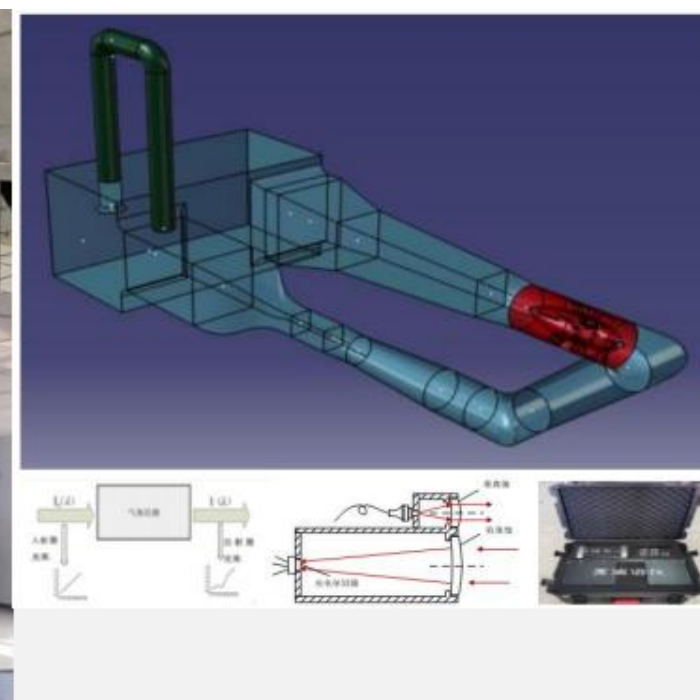
Enhance scientific basis: laboratory building, field experiments, instrument development



Expansion cloud chamber



cloud chamber



Return-flow wind tunnel



Thanks for your attention!

19 October 2024