EASCOF-11

6th Nov.2023

Climate Events and Impacts over China in 2023

Mei Mei

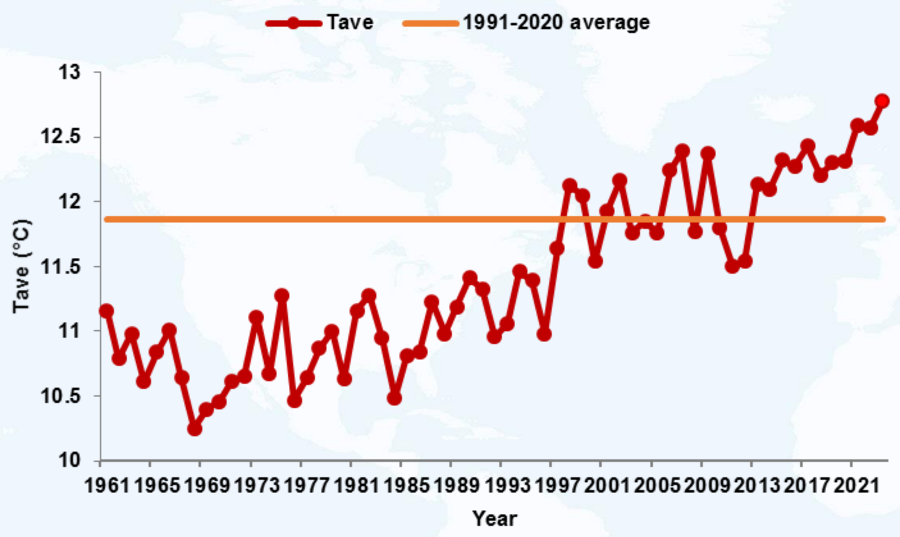
Being Climate Center，China

Outlines

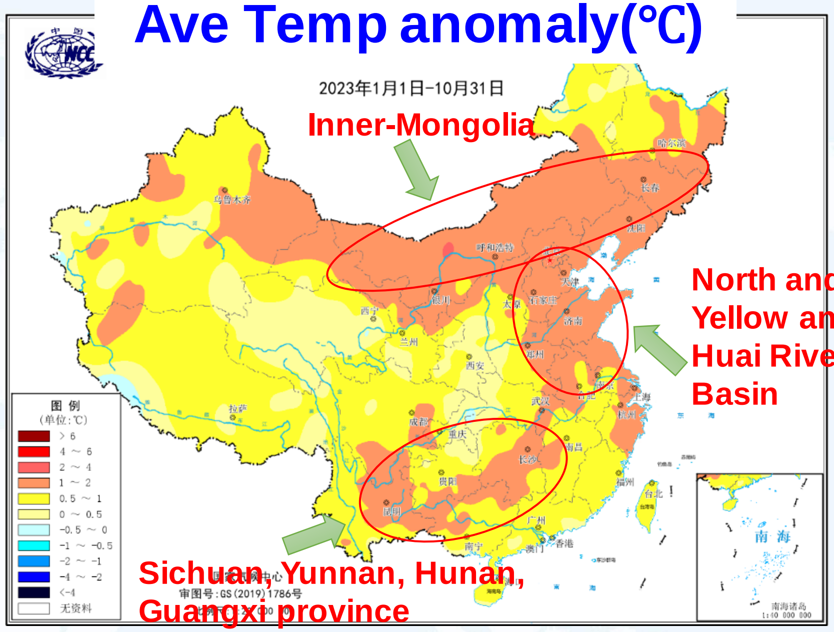
1. Climate features
2. Disaster Loss features
3. Major high impact events

Temperature: Warm

Annul Ave Temp in 1961-2023



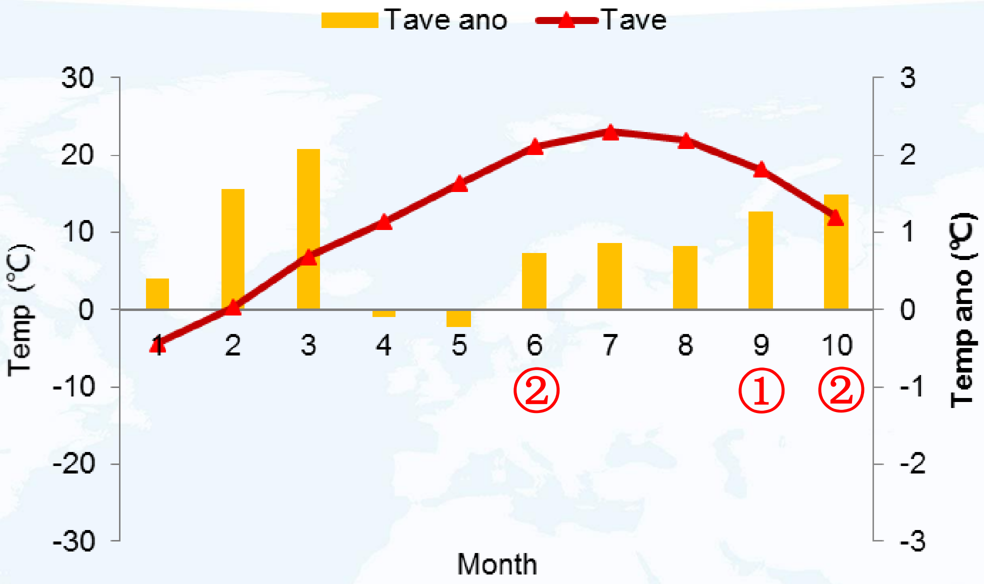
Ave Temp anomaly(℃)



Period: from Jan to Oct, 2023
Normal: average over 1991-2020

- **From Jan to Oct, the mean temperature was 12.8℃, 0.9℃ warmer than the normal, ranking the first since 1961.**
- **Ave Temp anomaly was within 1 ℃ over most part of China, except North, Yellow and Huai River Basin, most part of Inner-Mongolia and parts of Sichuan, Yunnan, Hunan and Guangxi province, where it was 1～2℃ higher than normal.**

Temperature: Warm autumn

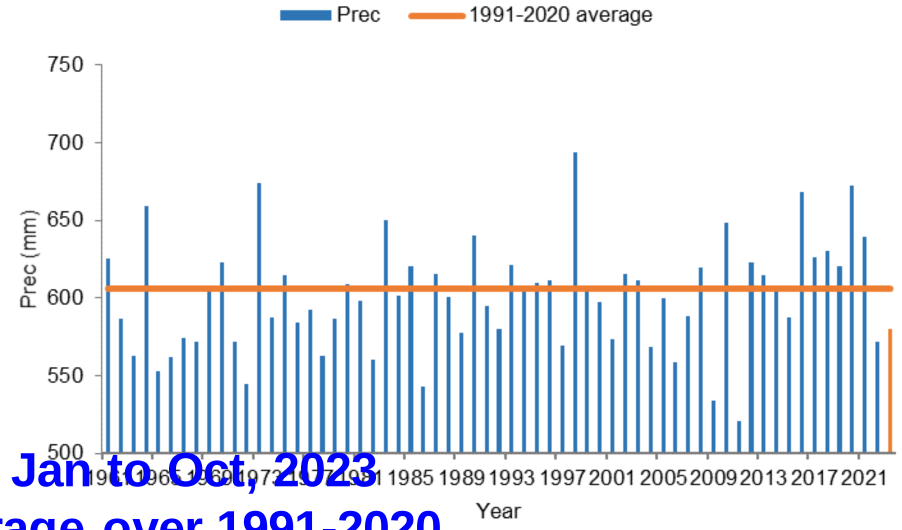


Monthly Ave Temp and anomalies (℃) over China in 2023

- Except the colder Apr and May, the mean temperatures in all months were above normal.
- Particularly, the temperatures in Sep, Jun and Oct were 1.3, 0.7 and 1.5℃ warmer than the normal, ranking the first, second and second since 1961 respectively.

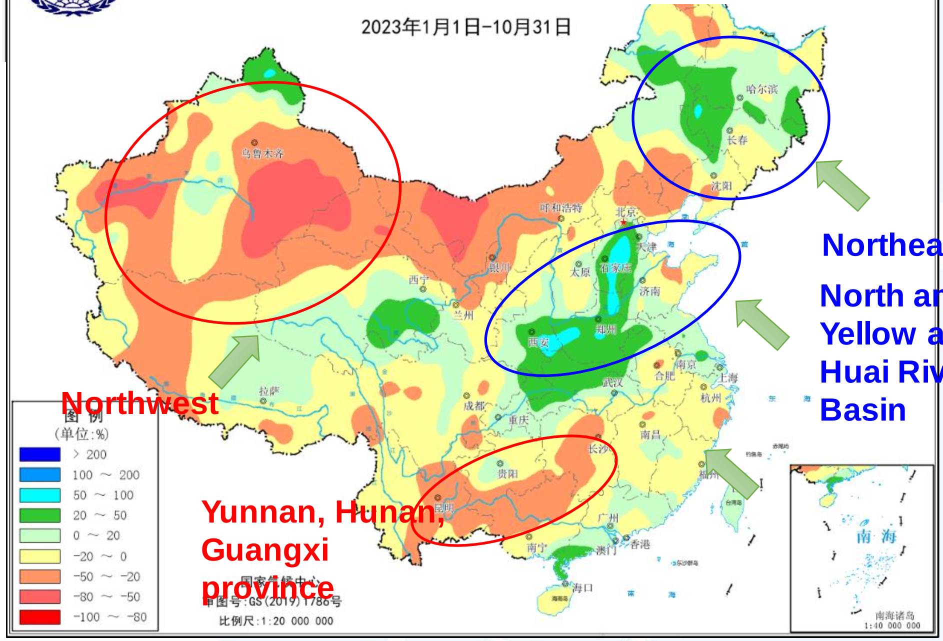
Precipitation: Less

Prec in 1961-2023 (mm)



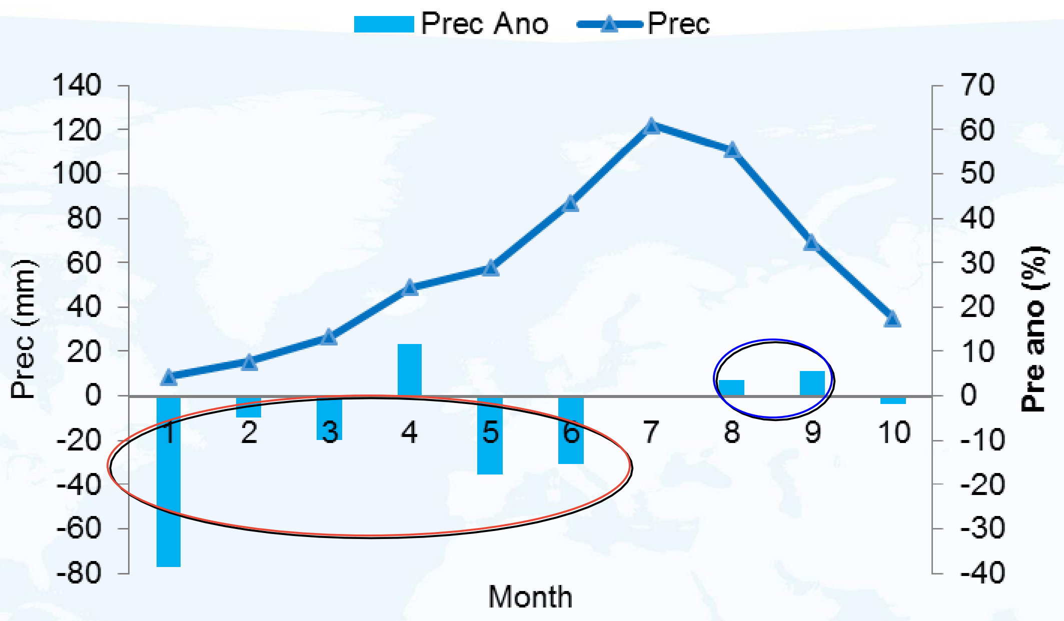
Period: from Jan to Oct, 2023
Normal: average over 1991-2020

Prec Anomaly (%)



- The Jan-to-Oct mean total precipitation over China was 579.9 mm, and 4.3% less than the normal (605.9 mm).
- Precipitation was more (20-100%) in North, Yellow and Huai River Basin and Northeast China, and less (20-80%) in Northwest, middle and west part of Inner-Mongolia and parts of Yunnan, Hunan, Guangxi province in the southwest of China.

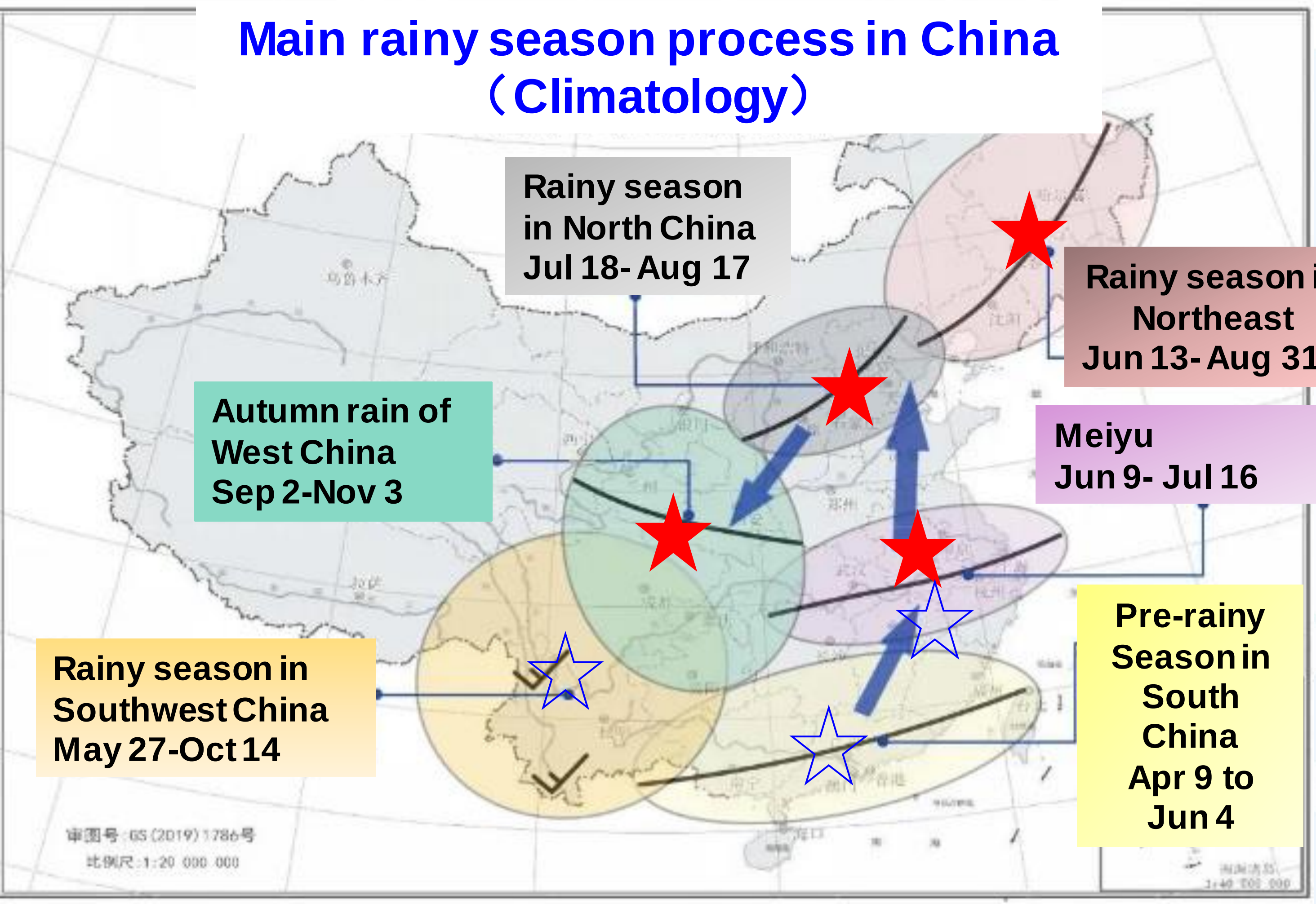
Precipitation: Less



Monthly prec (mm) and anomalies (%) over China in 2023

- **The precipitation was less than the normal in 6 months from Jan to Oct, particularly in Jan (38.6%). Whereas in Apr, Aug and Sep, the precipitation was more than normal.**

Main rainy season process: Later



Abnormal Date:2023.10.31

Rainy season		Start	End	Duration	Accu. pre.
South		-14	-6	+8	-14%
Southwest		+14		+3	-10%
Meiyu	South of YR	+ 7	-8	-15	-50%
	LMR of YR Basin	+2	+8	+6	+15%
	YR-HR Basin	+2	+11	+9	+13%
North		+4	-2	-6	+14%
Northeast		+7	+4	-3	+11%
West		-10		+7	+17%

Earlier (below): '-' *Later (above): '+'*
YRB: Yangtze River Basin
HRB: Huai River Basin
LMR: Lower and Middle reaches

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3. Major high impact events

Overall situation of loss

In the first three quarters， the natural disasters caused:

•Affected people: 89 million (↓ 17%); Deaths or missing people: 499 (↓ 5%);

•Houses collapsed: 118 thousand ;

•Affected crop area: 9.7 million hectares (↓ 16%);

•Direct economic losses: 308.3 billion RMB

•(compared with the same period of 2022)

Source: National Disaster Reduction Center of China

Serious rainstorm and flood

In the first three quarters, northern and eastern parts of China had heavier disaster losses compared to southern and western parts of China:

At the beginning of 2023 , there was a continuous winter-spring drought in the Southwest China;

During late July to early August, flood triggered by extreme precipitation over North and Northeast China brought serious impact.

From July to September, Fujian and Guangdong province suffered heavier losses due to the landing typhoons.

Compared with the past 5 years, the disaster losses are heavier in North and Northeast China, while lighter in Southwest and Northwest. The economic loss caused by rainstorm, flood and its secondary disasters accounted for 78 % of the total disaster loss.

Source: National Disaster Reduction Center of China

Outlines

1 Climate features

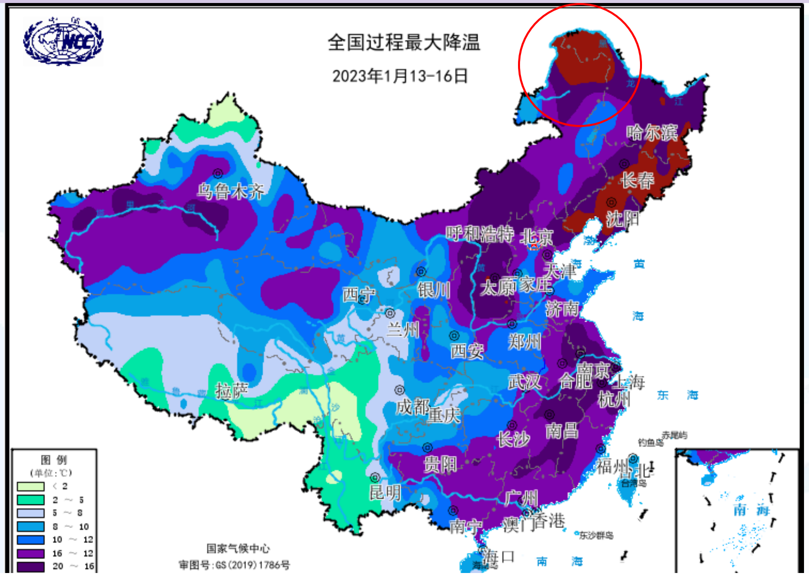
2 Disaster Loss features

3 Major high impact events

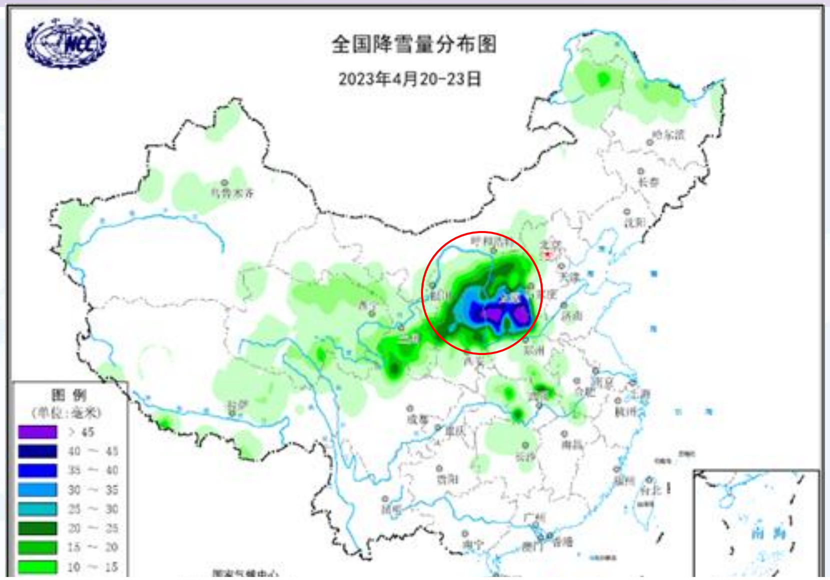
Major high impact events and features

- **Cold waves:** 4 strong cold waves intruded into China from Jan to May.
- **Rainstorms**: North China and Northeast China had encountered intensive rainstorms and floods during this rainy season.
- **High temperature events** : Earliest, extremely in North China.
- **Droughts:** Severe winter and spring drought in Southwest China; mid-summer droughts in Northwest and North.
- Landing **TCs**: Less, but with destructive power.
- **Dust** weather: The number was the highest since 2011.
- **Convective weather**: Scattered across the country with strong disaster-causing.

Cold wave: 4 strong cold waves



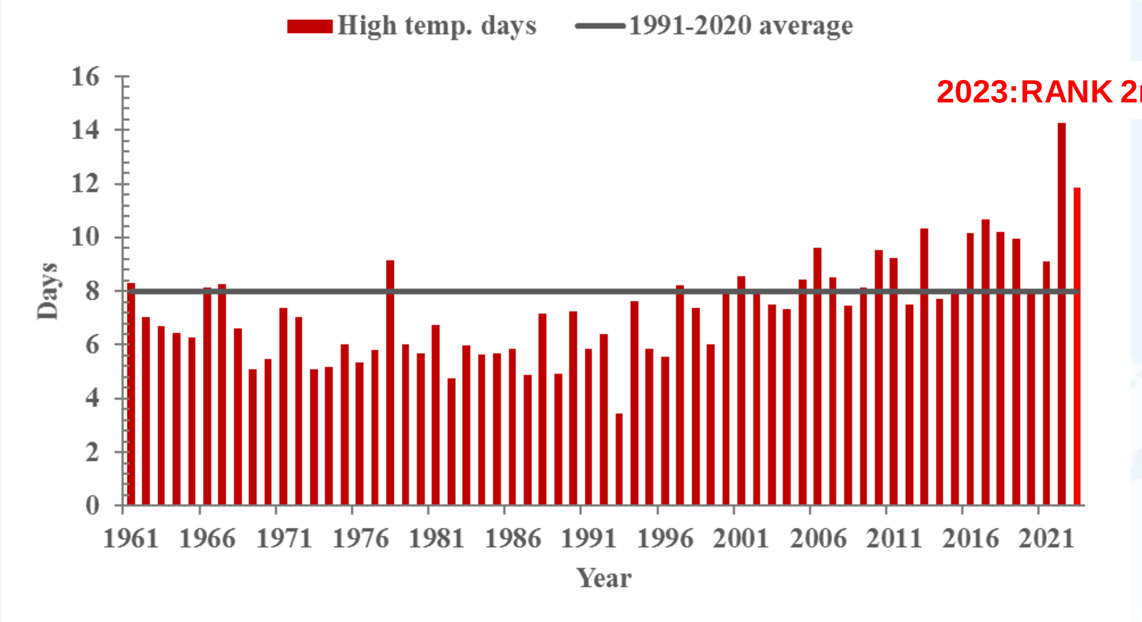
Maximum temp. drop amplitude from Jan 13rd -16th



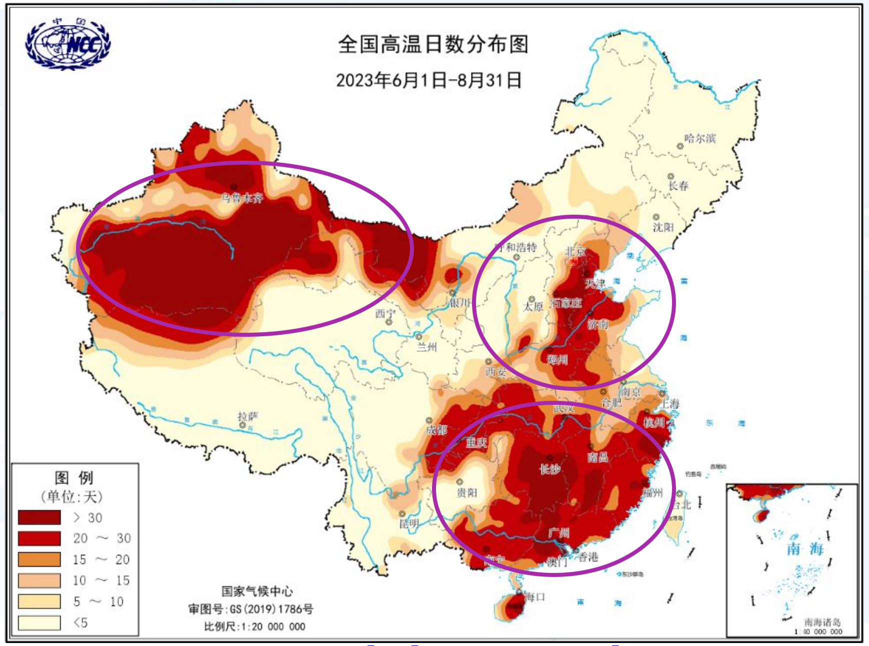
Total snowfall during Apr 20th -24th

- From Jan to May, 19 cold air processes(3.8 abnormal) intruded into China, 4 of which were strong cold waves (2.5 abnormal).
- The comprehensive intensity of the event from Jan 13th to 16th ranked the 7th strongest since 1961. Over almost 1/3 of the country total area, the temp. fell by more than 14 ℃, locally more than 18 ℃. The largest temp. drop of 25 ℃ appeared in Mohe of Heilongjiang province.On Jan 17th , 28 people died in an avalanche on the Paimo Highway in Linzhi of Tibet.
- From Apr 20th -24th, moderate to heavy snow and local blizzard appeared in parts of Northwest and North China.

High temperature events : rank second



from 1st Jun to 31th Aug

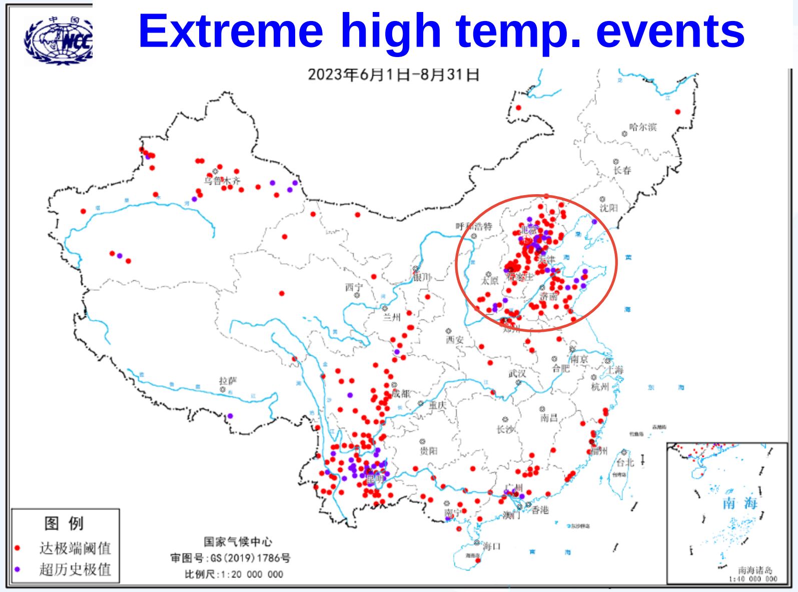


Aver. High temp. days

- In summer, the mean high temp. days over China was 11.9 days, 3.9 days more than the normal, resulting in the second hottest summer on record with the aver. temp. 0.8℃ abnormal.
- Three high temp. belts located in North, Yellow and Huai River Basin, the southeast and northwest of China. The number of high temp. days in the six provinces (Beijing, Hebei, Shandong, Guangxi and Yunnan) ranked the 1st since 1961.
- It had experienced 14 high temp. events during this summer. The first one from May 28 to Jun 5 started 16 days earlier than normal .

High temperature events : North China

Extreme high temp. events



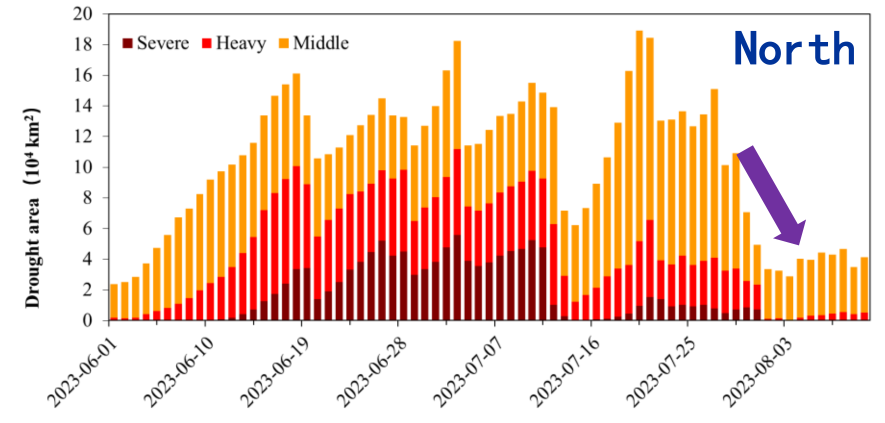
from 1st Jun to 31th Aug

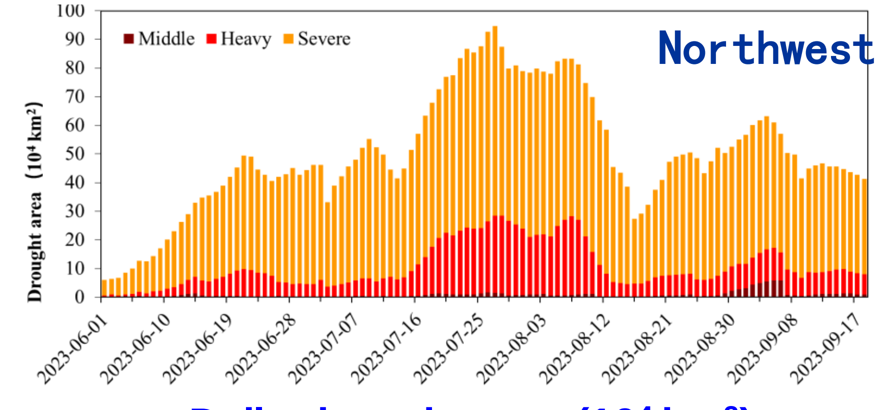
Top 5
Regional high temp. events in North China

Begin Date	End Date	Duration (days)	Tmax	Number of sta. ≥37°C	The largest affected area (sta.)	Integrated intensity index
20230620	20230712	23	43.7	342	382	51.89
20220613	20220626	14	44.2	339	370	47.09
20050611	20050625	15	43.2	341	373	41.98
19720531	19720617	18	43.7	326	360	37.6
20090620	20090705	16	44.4	340	378	37.49

- Eight high temp. events occurred in North, Yellow and Huai River Basin. The daily Tmax of 201 stations exceeded 40℃, 26 stations such as Pingshan (43.7 ℃), Jingxing (43.3 ℃) and Wu'an (43.3 ℃) in Hebei province broke the historical extreme values.
- On Jun 20th –Jul 12th , North China, Yellow and Huai River Basin had experienced the most extensive and long-lasting regional heatwave with the top 1 integrated intensity index since 1961.

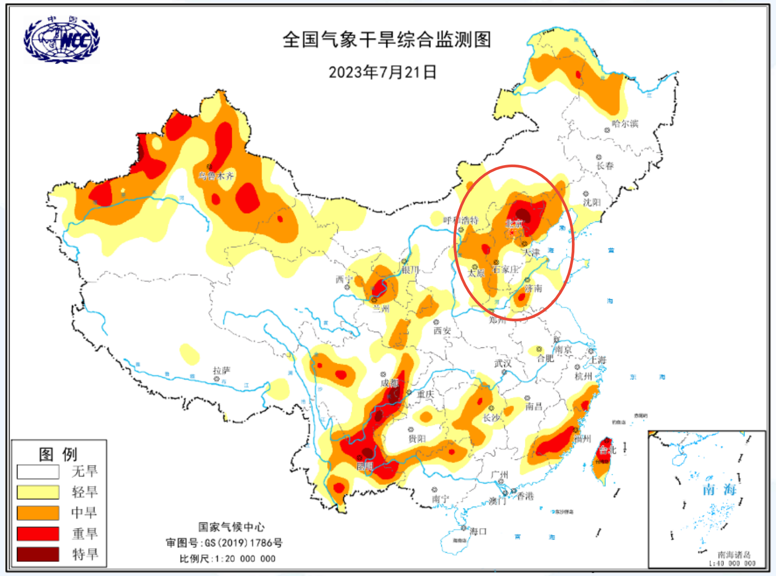
Droughts: North China and Northwest China



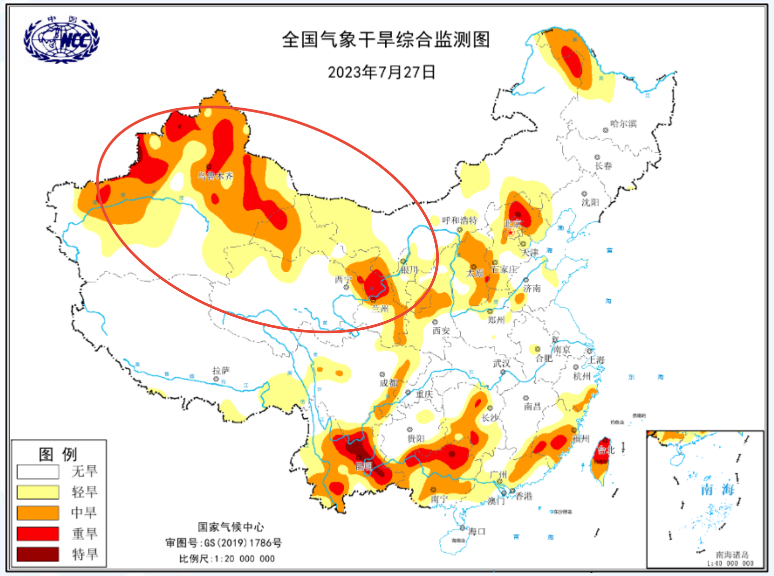


Daily drought area (10^4 km^2)

21^{st} Jul



27^{th} Jul



China daily meteorological drought monitoring map

- **Due to the persistent dry and warm anomalies, the summer drought developed in most of North China and Northwest China, and reached their peak on July 21^{st} and July 27^{th}, respectively.**
- **Affected by several heavy rainfall processes, a sharp turn from drought to flood occurred in North China during late July to early August.**

Droughts: Winter-spring drought in Southwest

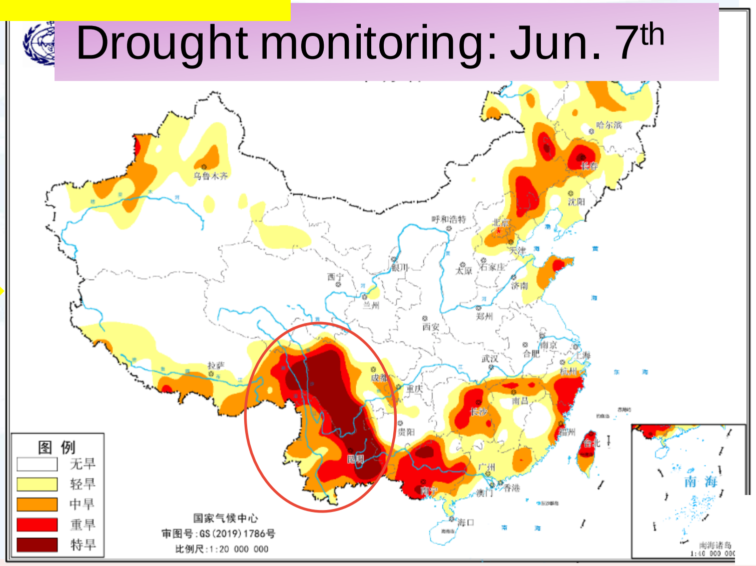
Climatology: dry season Nov to Apr.

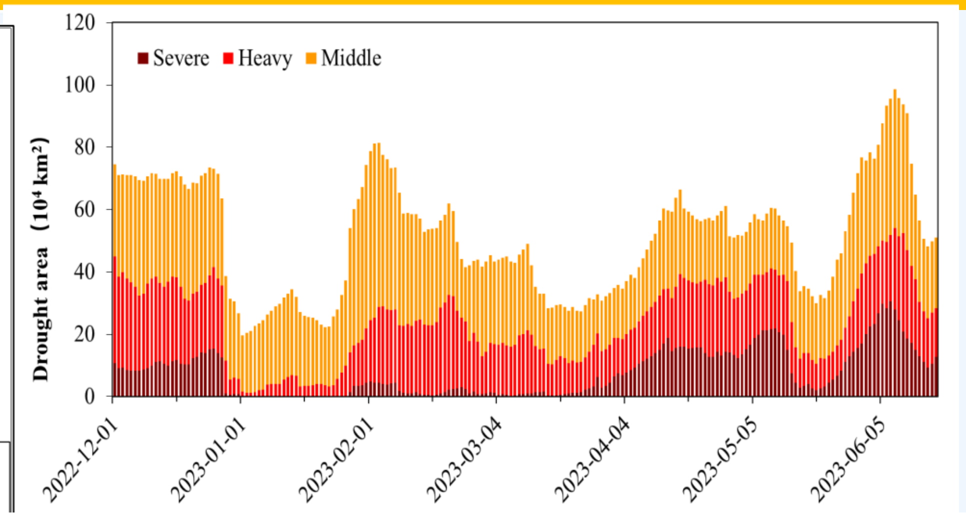
Local circulation
- Weak Indian and Burma trough
- Lower soil moisture In last wet season

External forcing
- La Niña ending earlier
- Below-normal winter snow cover over TP, Q1 ↑

(Liu et al.,2023)

Drought monitoring: Jun. 7th

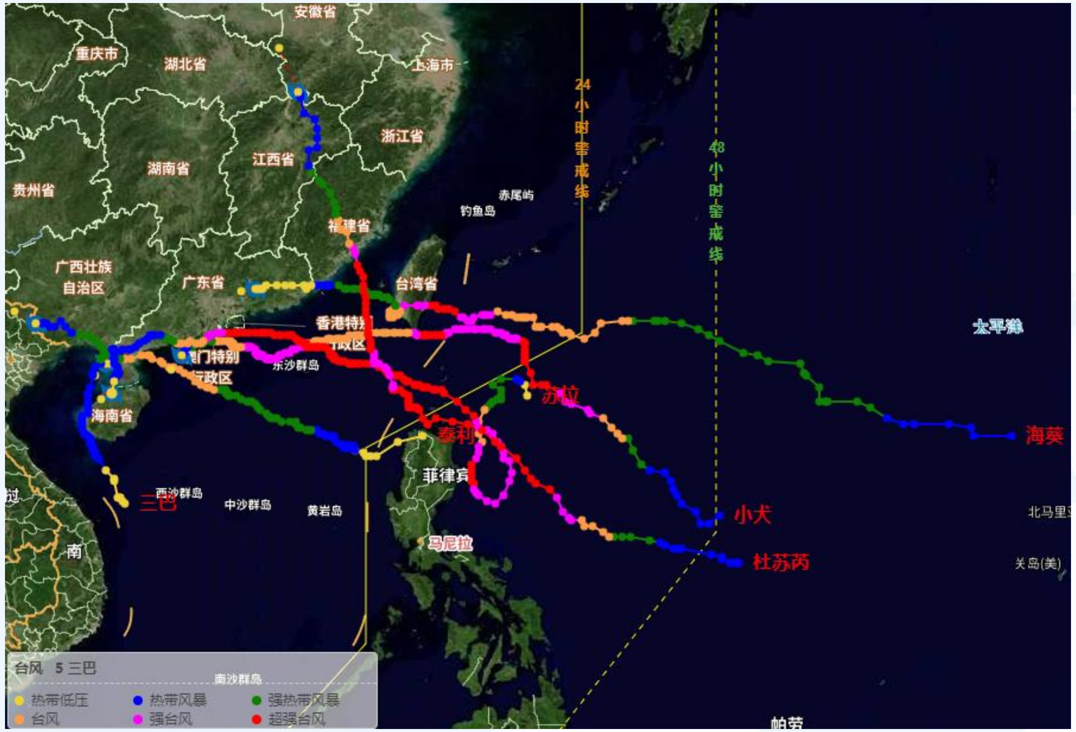




Daily drought area (10^4 km^2)

- **From the Jan 1st to Jun 18th , Southwest China had the rainfall of 197.7 mm (the least) and the meteorological drought days of 106.9 days (the 3rd most). The drought developed very soon and persisted from winter to spring, even to early summer. Especially Yunnan province experienced the most severe drought since 1961.**
- **Because of the easterly in front of the continental high, or the westerly from the south of TP, Southwest China has less pre. and larger evaporation in Nov to Apr which is dry season in climatology. Continuous deficit of SM, related to severe drought in Yangtze River Basin in last summer and autumn, exacerbated the winter and spring drought in Southwest China. Weak Indian and Burma trough is adverse to the vapor transport. Large Q1 in TP in previous winter induces the dry northerly in Southwest. La Niña ending earlier in late winter and early spring are beneficial for the dry condition.**

Landing TCs: less than normal, extremely destructive power



5 Landing TCs:

2304 TALIM (TY)

2305 DOKSURI (STY)

2309 SAOLA (STY)

2311 HAIKUI (STY)

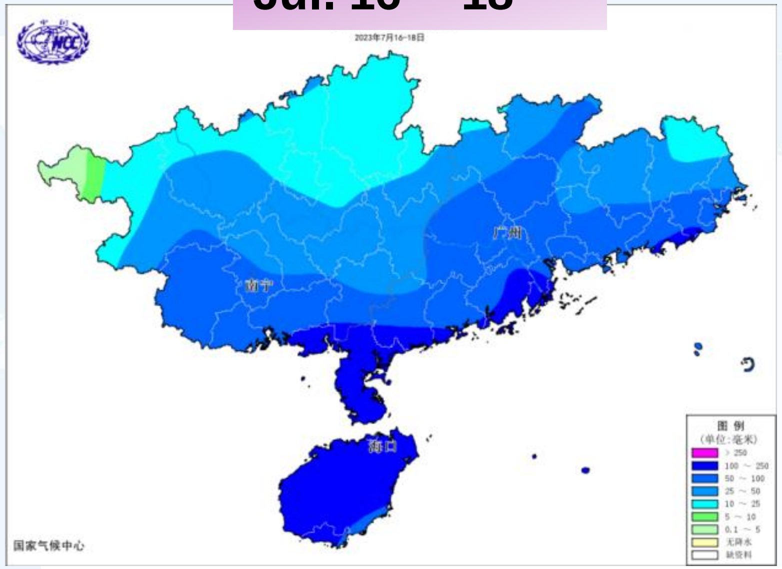
2314 KOINU (STY)

2316 SANBA (TS)

- Heretofore, 15 TCs generated over the WNP and SCS, 7 less than the normal (22) . 6 TCs made landfall over China, 1 less than the normal (7).
- The landing locations: Southern coast of China.
- The landing intensity: TALIM , SAOLA, HAIKUI and KOINU were STY with maximum wind scale of 14 to 15.
- Due to their strong intensity, long duration and successive landings, the destructive power were extremely strong.

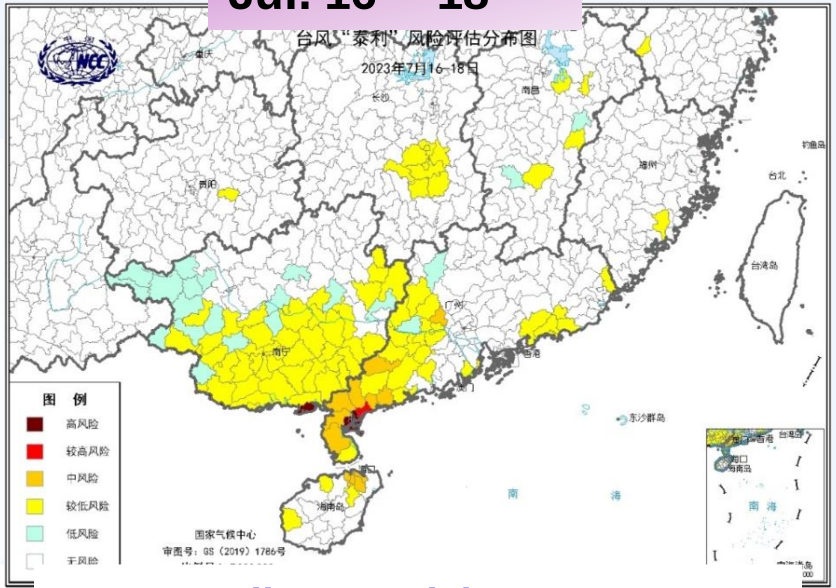
Landing TCs: less than normal, extremely destructive power

Jul. 16th -18th



Process accumulated prep. (mm)
In South China

Jul. 16th -18th

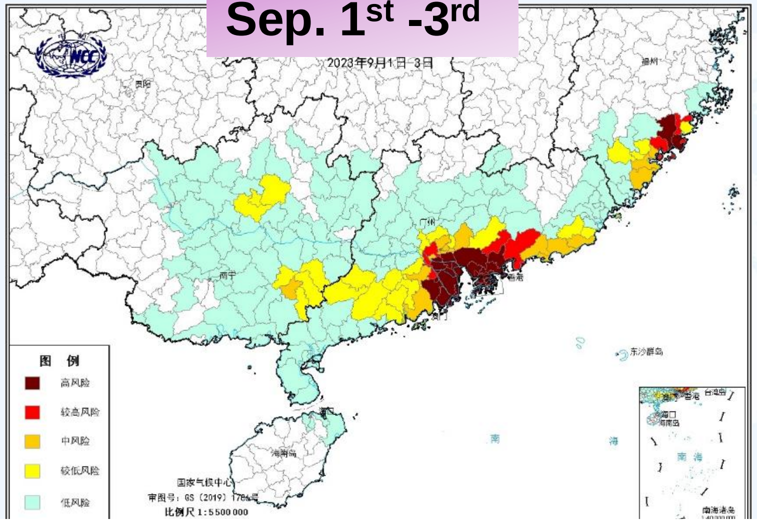


TALIM disaster risk assessment
(red: high-level)

- The first landing TC TALIM in 2023 (Jul 17th) was 20 days later than that in the normal years, which is the latest since 2004.
- Although it ranked third for first landing strength since 2000, disaster losses were lighter due to its westward path with short influencing period of wind and precipitation, and effective early-warning and disaster prevention measures taken by the government also played important roles.

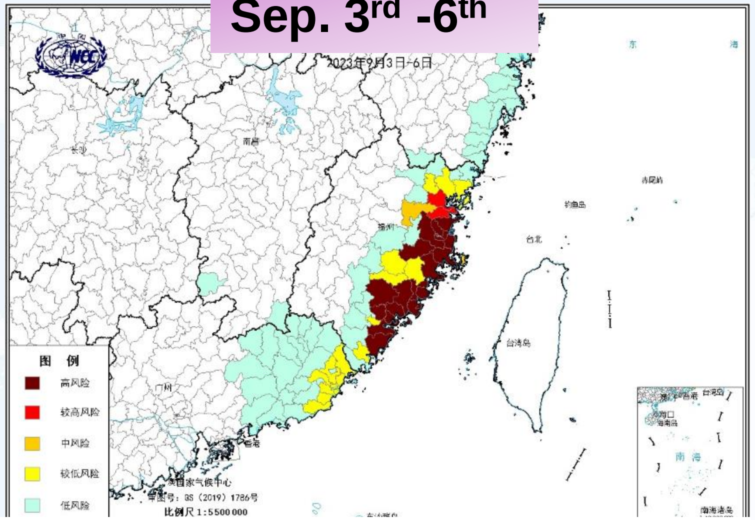
Landing TCs: less than normal, extremely destructive power

Sep. 1st -3rd



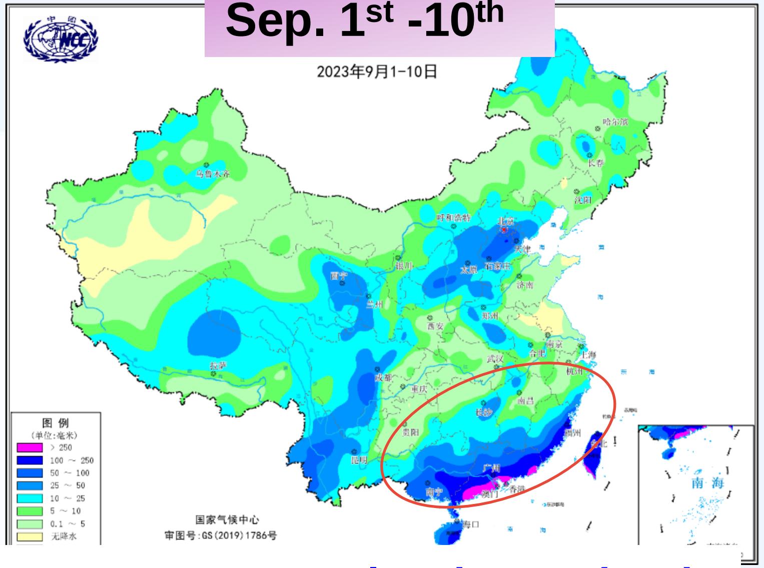
SAOLA disaster risk assessment (red: high-level)

Sep. 3rd -6th



HAIKUI disaster risk assessment (red: high-level)

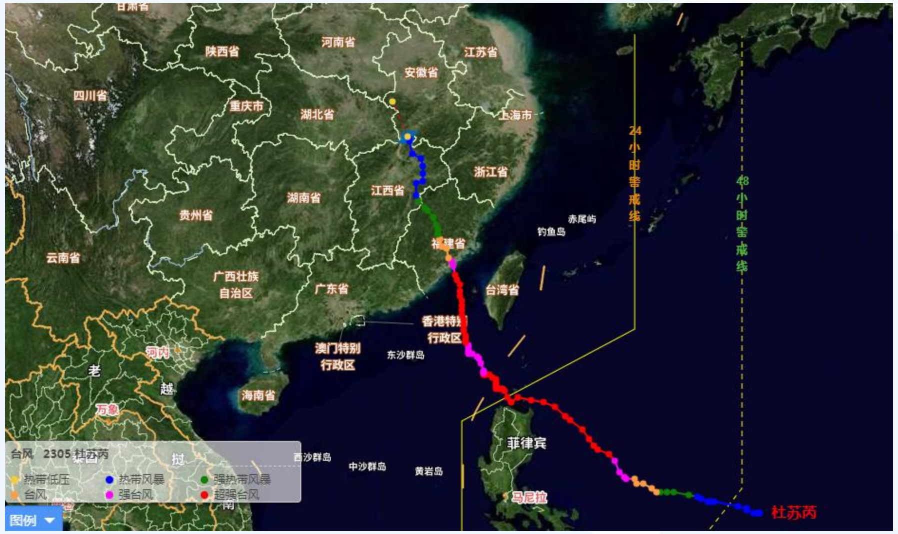
Sep. 1st -10th



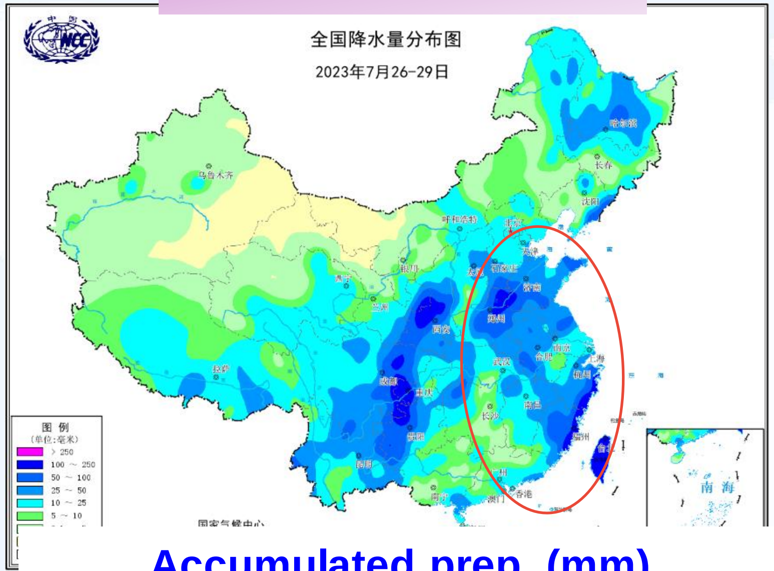
Process accumulated prep. (mm)

- On Sep 2nd, **SAOLA** made landfall on the southern coast of **Zhuhai city of Guangdong** province with a landfall intensity of **45 m/s**. On Sep 3rd to 5th, **HAIKUI** made **3 times successive landfalls** on the coast of South China with the **maximum** landfall intensity of **50 m/s**.
- Because of the direct impact of TCs and its residual circulation, from Sep 1st to 10th, continuous heavy rainfall with the maximum daily precipitation of **8 national stations** such as Fuzhou (395.9 mm), Changle (385.1 mm) and Fanyu (361.9 mm) **breaking the historical extreme values**, resultted in the superposition of waterlogging risks.
- Many small and medium-sized rivers had over-alert floods. Waterloggings, landslides, road interruptions and other disasters had occurred in the cities such as Guangzhou, Shenzhen, Zhuhai, Dongguan, Zhaoqing, Foshan etc..

Landing TCs: less than normal, extremely destructive power

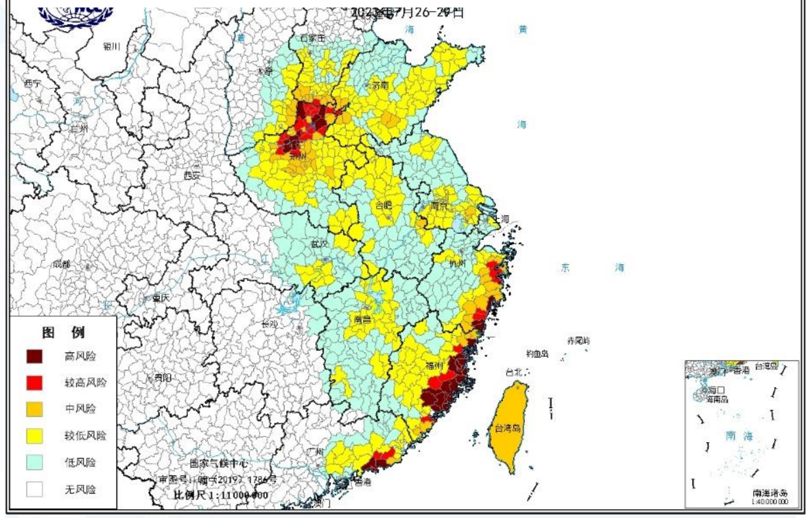


Jul. 26th to Jul. 29th



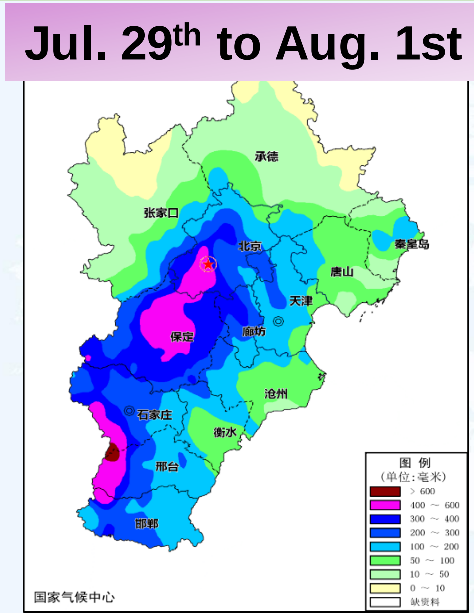
Accumulated prep. (mm)

DOKSURI disaster risk assessment (red: high-level)

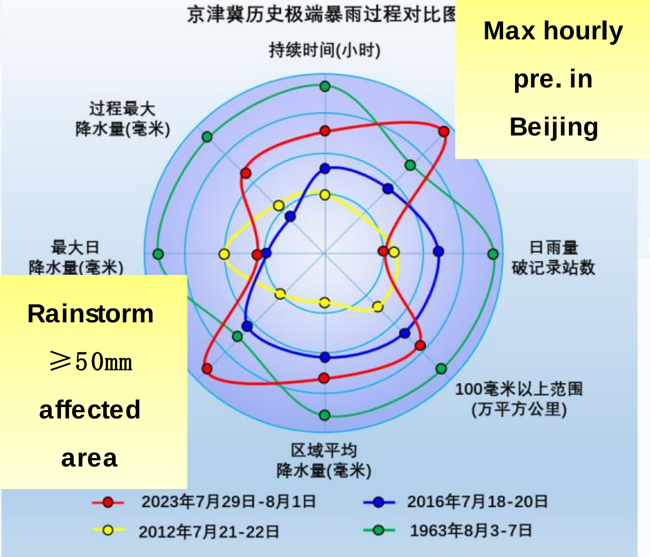


- On Jul 28th, DOKSURI landed in Jinjiang of Fujian province with the intensity of 50 m/s which is the second strongest landing intensity in Fujian province since 1949, which is preceded only by MERANTI in 2016 (52 m/s).
- From Jul 26th to 29th, it had brought torrential rain resulting in high-level disaster risk to the southeast coast and some inland provinces. The maximum daily precipitation of 2 national stations in Fujian province broke the historical extreme value.
- For red alert for typhoon, cities in Fujian and Guangdong province suspended classes, flights, business as DOKSURI approached. Over-alert or over-guaranteed floods in many small and medium-sized rivers and waterlogging disasters occurred in Fujian, Zhejiang, Guangdong and Jiangxi province.

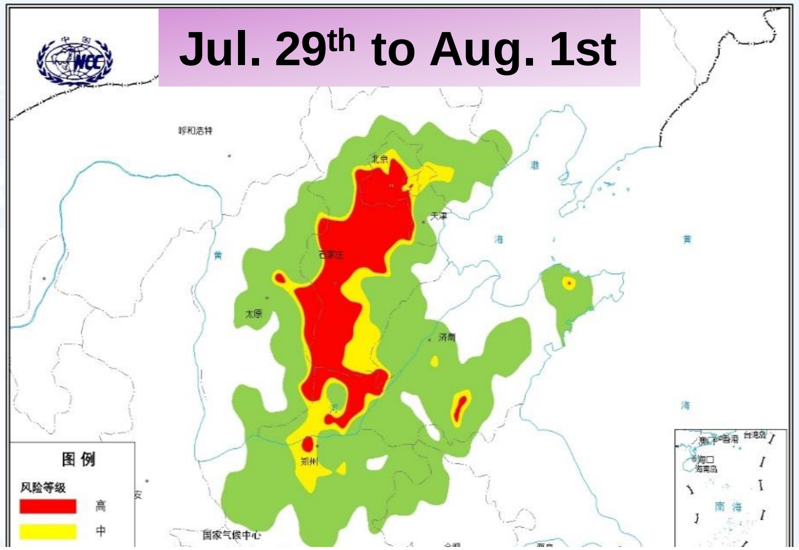
Rainstorms: Beijing-Tianjin-Hebei (BTH) region



Accumulated prep. (mm)



Comparison with 1963, 2012 and 1963 extreme pre. events

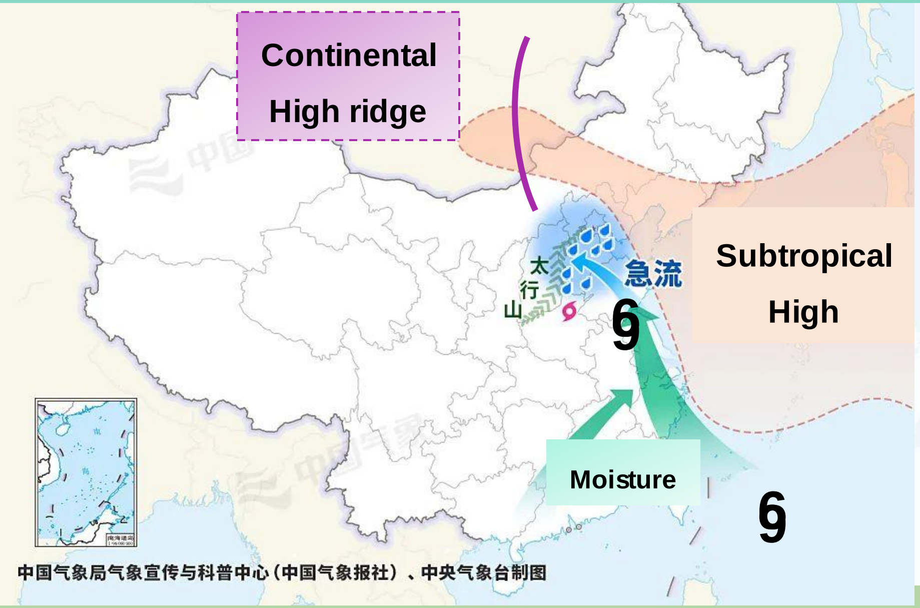


Rainstorm disaster risk assessment (red: high-level)

- From Jul. 29th to Aug. 1st, DOKSURI's residual circulation as a tropical depression led to heavy rainstorm in the north of China, with 16 national stations rewriting their daily pre. records. It had the most maximum hourly precipitation in Beijing and broadest impacted area among 4 extreme rainstorm events in the Beijing-Tianjin-Hebei (BTH) region since 1961, triggering the largest flood of Hai River Basin since 1963.
- According to the assessment, high-level rainstorm risk existed in the middle and southern part of the BTH region, accompanied by serious floods leading to 62 deaths and huge economic losses.

Rainstorms: Beijing-Tianjin-Hebei (BTH) region

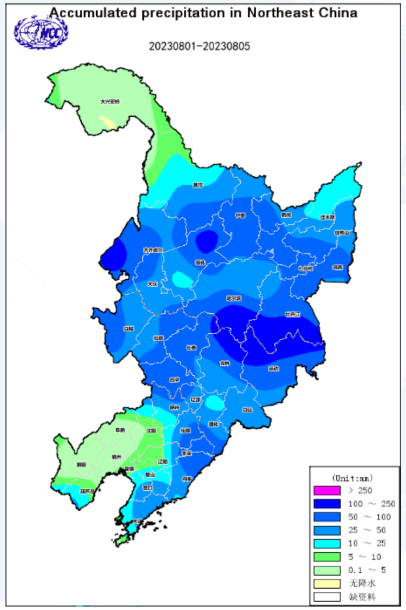
The schematic diagram of causes

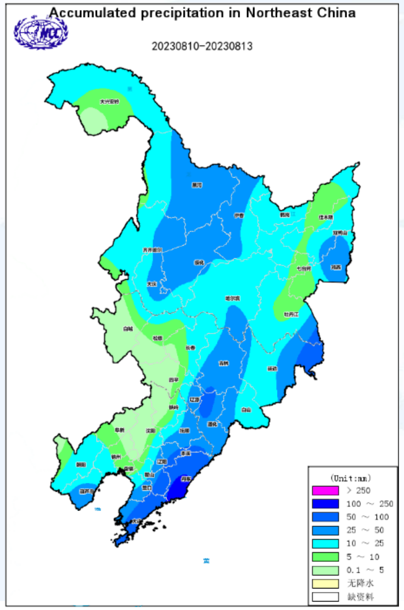


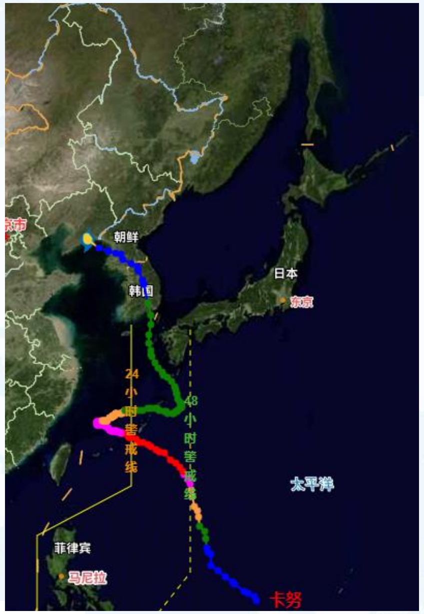
- The abundant water vapor transported to BTH region by the TC system including the weakening and northward DOKSURI's depression system and the approaching TC KHANUN on Pacific Ocean, and the southwesterly of monsoon , forming a low-level jet in front of the Taihang and Yan mountains.
- The subtropical high and the northern continental high ridge are located on the east and north sides, respectively, merging to a high pressure dam to block the precipitation system, resulting in persistent heavy rainfall in the BTH region.
- The lifting effect of mountain terrain also triggered the extreme precipitation.

Rainstorms: Northeast China

8. 1—8. 5	8. 10—8. 13





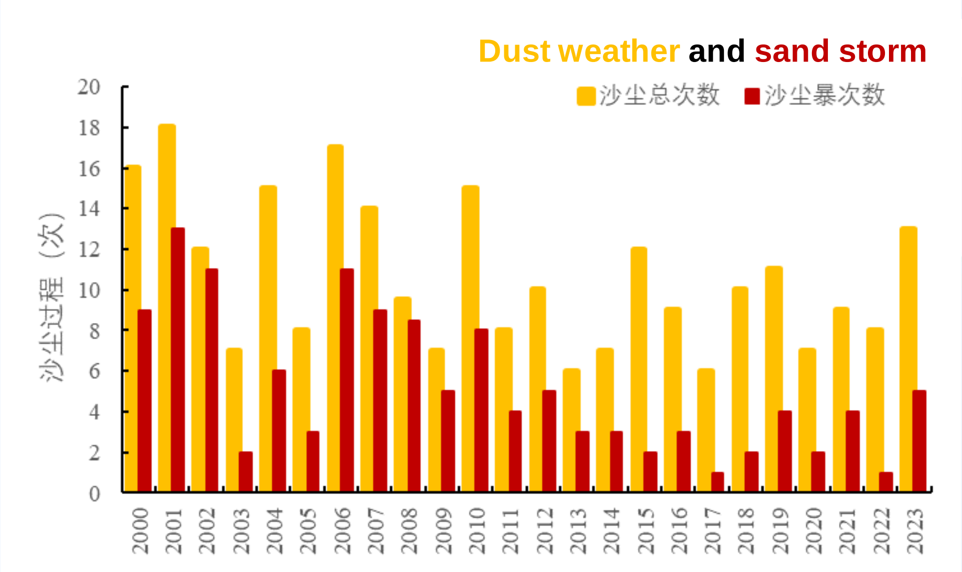


Process accumulated prep. (mm)

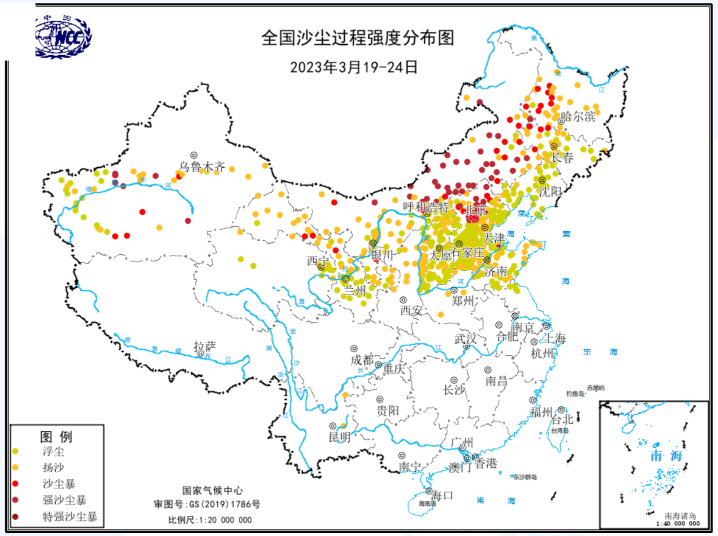
No. 2306 KHANUN

- After 15 days of its generation, TC KHANUN moved along a 'Zigzag' path and made landfall on Zhuanghe in Liaoning province with the intensity of tropical depression (below the standard of TC) on Aug. 11th .
- Strong winds and rains brought by KHANUN increased the flooding risk in Northeast China, where had been seriously impacted by the previous rainstorm process from Aug. 1st to 5th . There were floods occurring in the Song-Liao River Basin.

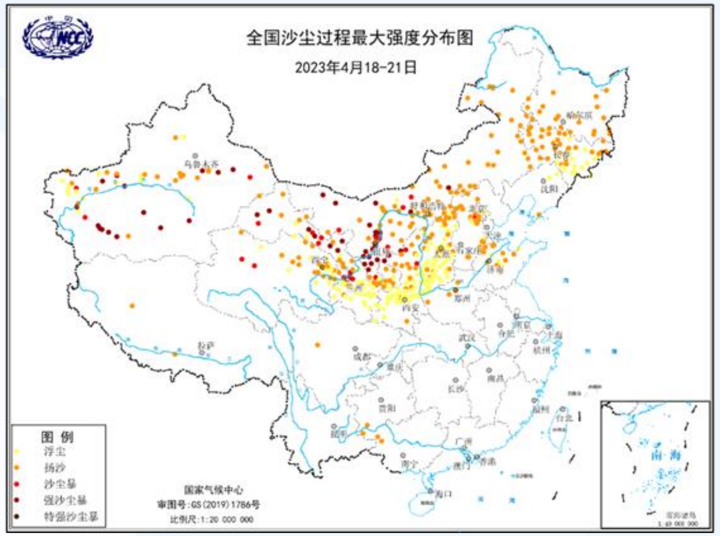
Dust weather:15 processes affecting China



Dust weather process number in spring



Sand storm on March 19-24



Sand storm on April 18-21

- Due to frequent cold air processes, 15 dust weather processes occurred in the northern China from Jan to May, and the number was the highest since 2011.
- On Jan 12^{th} to 13^{th} , the first sand storm process occurred, 33 days earlier than the mean value of 2000-2022.
- In spring, the number of dust weather process (13) is 2.5 more than the mean value of 2000-2022.
- The strong sand storms on March 19-24 and April 18-21 had a great impact on air quality, transportation and human health.

Convective weather: less but with strong disaster-causing

- In the first three quarters, 33 convective weathers occurred in China, which is less than the latest 5 years mean, with a high frequency in spring.
- The convective weathers scattered across the country with strong disaster-causing. More than 980 counties (cities, districts) were affected, which were mainly distributed in North, Northwest, Southwest China and Yellow and Huai River Basin.
- On September 19th , strong tornados attacked Yancheng and Suqian of Jiangsu province resulting in a few casualties.


Thank You