

全球灾害性天气监测月报

—2023 年 5 月—

世界气象中心（北京）

2023 年 5 月 19 日

Rwanda and the Democratic Republic of the Congo have experienced heavy rainfall and flooding

The super cyclonic storm "MOCHA" made landfall in Myanmar (Burma), near the Bay of Bengal

Abstract: In May 2023, global heavy rainfall and flood disasters occurred frequently, with Central Africa being particularly affected. Countries such as the Democratic Republic of Congo, Rwanda, and Uganda experienced floods, landslides, and dam breaches caused by heavy rainfall, resulting in severe human casualties. The global subtropical high pressure system showed a trend of being stronger than usual, leading to widespread hot weather in Central America, Central Africa, southern West Asia, southern India, and the Indochinese Peninsula. Some areas in the Indochinese Peninsula recorded record-breaking high daily temperatures. In May, there were a total of three tropical cyclone activities worldwide. Among them, the super cyclonic storm "MOCHA" in the Bay of Bengal was one of the strongest storms to hit Myanmar (Burma) in this century, causing significant human casualties and

economic losses in the country. In May, Canada experienced significantly higher temperatures compared to the average for the same period, resulting in the most severe wildfire season since the 21st century.

Global Weather Overview

1. Temperature

In May 2023, average temperatures were below normal by 1-3°C in southern Europe, western Siberia, Mongolia, western China, South Asia, northern Africa, parts of Alaska and southeastern United States, large parts of Australia, and most of Antarctica. Some regions, including northern India, western Mongolia, and northern parts of Antarctica, experienced temperatures that were 4-5°C below normal (Figure 1). In May, above-normal temperatures were observed in northern and eastern Europe, Siberia, the Indochinese Peninsula, central and northern parts of North America, central and southern parts of South America, and central and southern parts of Africa. These regions experienced temperatures that were 1-3°C above normal. In some areas, such as parts of northern and eastern Europe, large parts of Canada, and northern parts of the United States, temperatures were 4-6°C above normal, with localized areas in northeastern Canada experiencing deviations of 7-9°C. The above-normal temperatures in Canada contributed to a severe wildfire season, with over 1,600 wildfires reported and a burned area exceeding 2 million hectares, making it the most severe wildfire season in Canada since the beginning of the 21st century. The smoke from the wildfires extended into the

airspace of the United States and even reached Greenland, Iceland, and Norway.

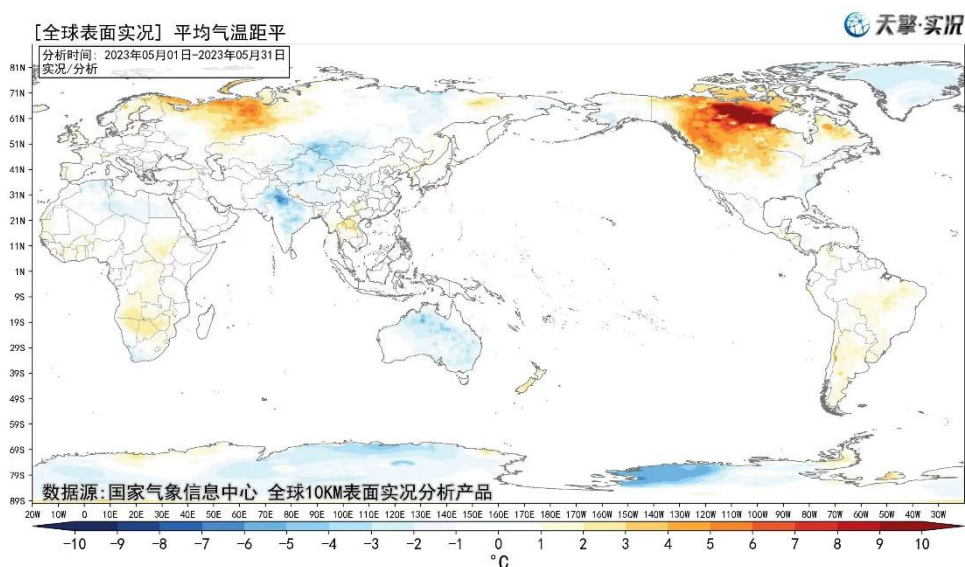


Figure 1 Global average temperature anomalies in May 2023 (unit: °C).

2. Precipitation

In May 2023, the main areas of heavy precipitation were located in southern Europe, the Bay of Bengal, western and southern parts of the Indochinese Peninsula, the tropical islands of Southeast Asia, southern regions of China, southern parts of Japan, central parts of Africa, and northern parts of South America. In these regions, the accumulated precipitation ranged from 100 to 200 millimeters, with some areas in Myanmar, the tropical islands of Southeast Asia, and northern South America receiving accumulations of 250 to 400 millimeters, and localized areas experiencing over 500 to 800 millimeters (Figure 2a). Compared to normal conditions, the accumulated precipitation in these regions was 20% to 70% above normal, with certain areas in Myanmar, southern parts

of the Indochinese Peninsula, Indonesian archipelago, northern South America, and central parts of Africa experiencing 100% to 300% above-normal precipitation. In other parts of the world, precipitation was below normal or close to normal levels during the same period (Figure 2b).

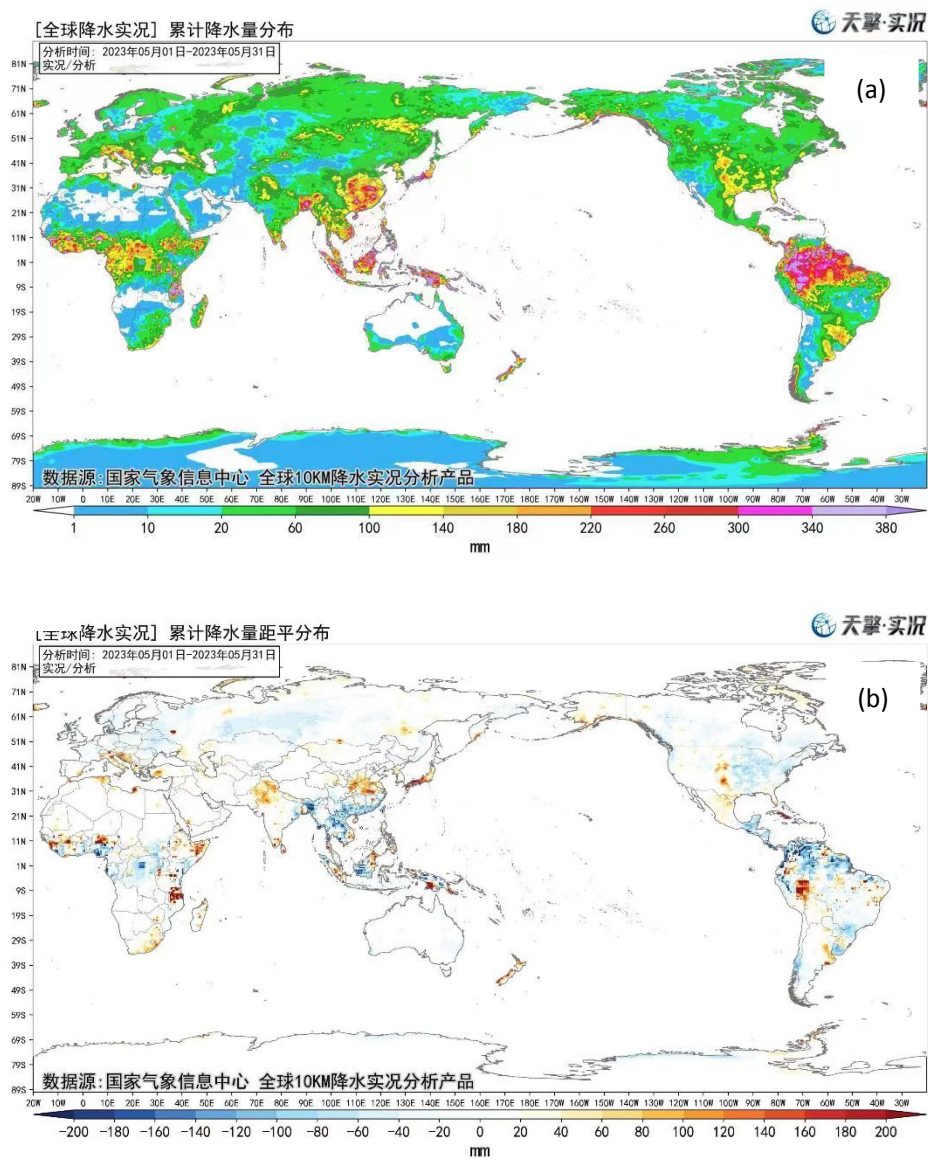


Figure 2 (a) Accumulated precipitation and (b) precipitation anomalies worldwide in May 2023.

Summary of Major Weather Disasters and Tropical Cyclones

In May 2023, there were frequent global incidents of heavy rainfall and flooding, with Central Africa being particularly affected. From May 1 to 3, Central Africa experienced continuous heavy rainfall, leading to secondary disasters such as floods, landslides, and dam breaches. More than 400 people died in the Democratic Republic of Congo, over 100 in Rwanda, and more than 10 in Uganda. On May 12, Ethiopia suffered from a flood that caused 45 deaths. In Somalia, the floods in May displaced approximately 200,000 people. In Southern Europe, some areas also experienced flooding due to heavy rainfall. For example, on May 29, Spain was hit by heavy rain and subsequent flooding, and on May 16, heavy rain in northern Italy caused floods that resulted in 9 deaths. On May 9, New Zealand's North Island was hit by heavy rain and floods. In May, the Indian Peninsula and parts of Southeast Asia experienced persistent heatwaves, with some areas reaching record-breaking high temperatures. On May 14, Super Cyclonic Storm "MOCHA" made landfall in Myanmar, causing widespread damage and claiming the lives of over 140 people, with 180,000 houses destroyed and at least 800,000 people in urgent need of emergency food assistance. The United Nations described "MOCHA" as one of the strongest storms to hit the region in this century. On the evening of May 24, Super Typhoon "MARWAR" grazed the northern part of the US territory of Guam, bringing strong

winds and heavy rain, causing widespread power outages. Additionally, on May 19, a severe sandstorm and snowstorm in Inner Mongolia resulted in the death of 290,000 livestock, and the dust storm spread to Northwestern and North China.



Figure 3 Schematic diagram of major catastrophic weather events worldwide in May 2023.

In May 2023, there were a total of three tropical cyclone activities worldwide, which is close to the average for the same period. These cyclones occurred in different regions: Cyclone "MOCHA" in the North Indian Ocean, Cyclone "FABIEN" in the Southwest Indian Ocean, and Typhoon "MARWAR" in the Northwest Pacific. Specifically, "MOCHA" made landfall in Rakhine State, Myanmar (Table 1).

Table 1: Tropical Cyclone Activity Information Worldwide in May 2023
(Intensity levels are determined based on the "Global Tropical Cyclone Intensity Classification Standards" (GB/T 32935-2016))

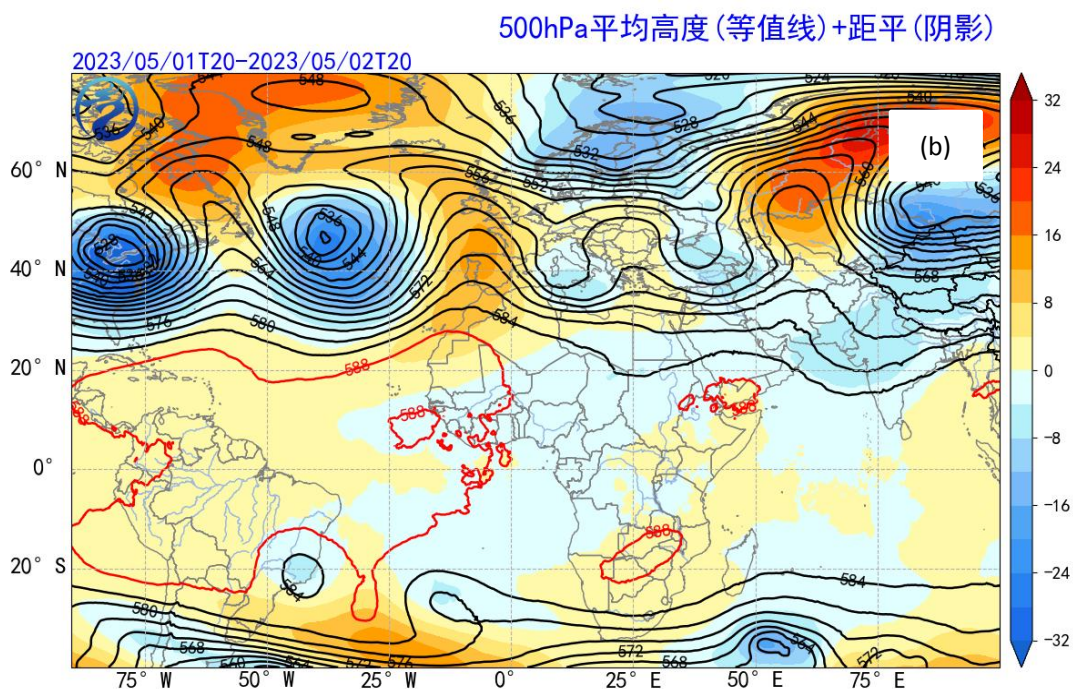
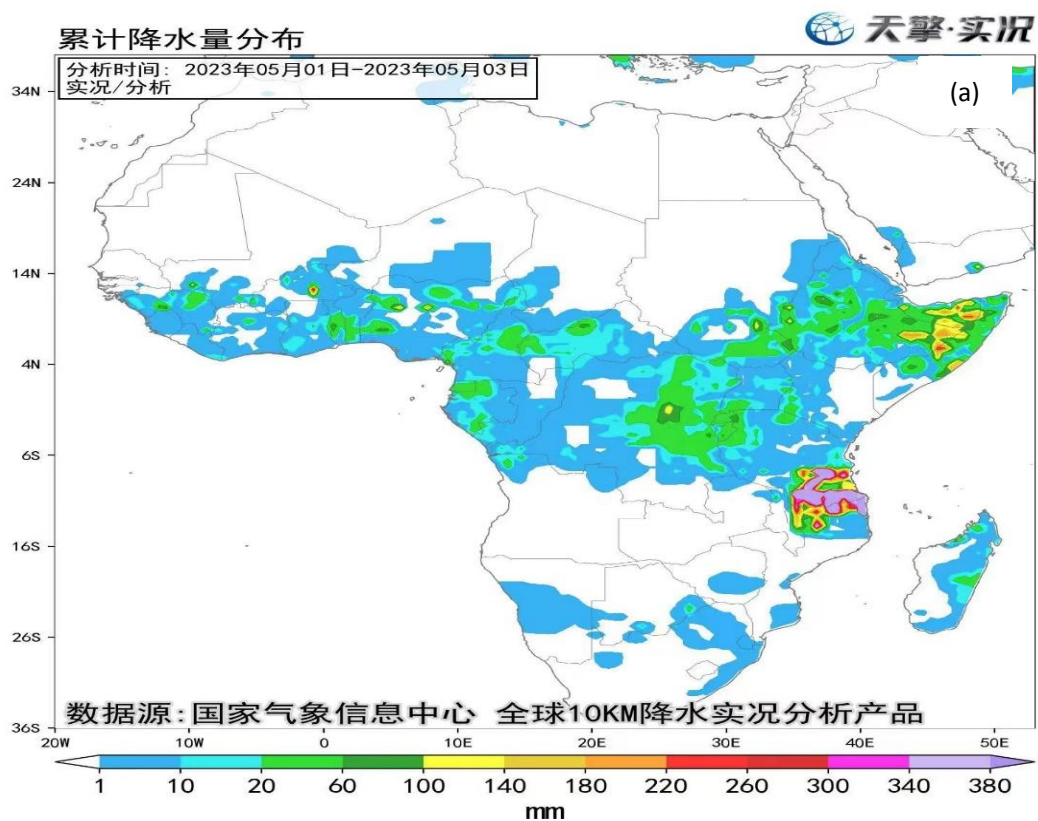
Ocean	Name	Intensity Levels	Duration of Impact	Landfall Information (UTC+8)
North Indian Ocean	穆查/MOCHA	Super Cyclonic Storm	May 10th-15th	Landed in Rakhine State, Myanmar on May 14th.
Southwest Indian Ocean	法比安/FABIEN	Tropical Cyclone	May 14th-21st	
Northwest Pacific	玛娃/MARWAR	Super Typhoon	May 20th –June 2rd	

Major catastrophic weather events and their primary impact weather systems

1. Rwanda, Democratic Republic of Congo, and other countries experienced heavy rainfall and flooding.

From May 1st to 3rd, 2023, there was heavy rainfall in countries such as Democratic Republic of Congo, Uganda, Kenya, and Rwanda. The maximum 24-hour precipitation reached 50-100 millimeters, with some areas exceeding 100 millimeters. The accumulated precipitation in most areas ranged from 200 to 400 millimeters, and in some areas, it exceeded 500 millimeters (Figure 4a). The continuous heavy rainfall triggered floods, landslides, and breaches in riverbanks. Due to the occurrence of the disasters during the nighttime, many residents were

unable to evacuate in time, resulting in a significant number of casualties.



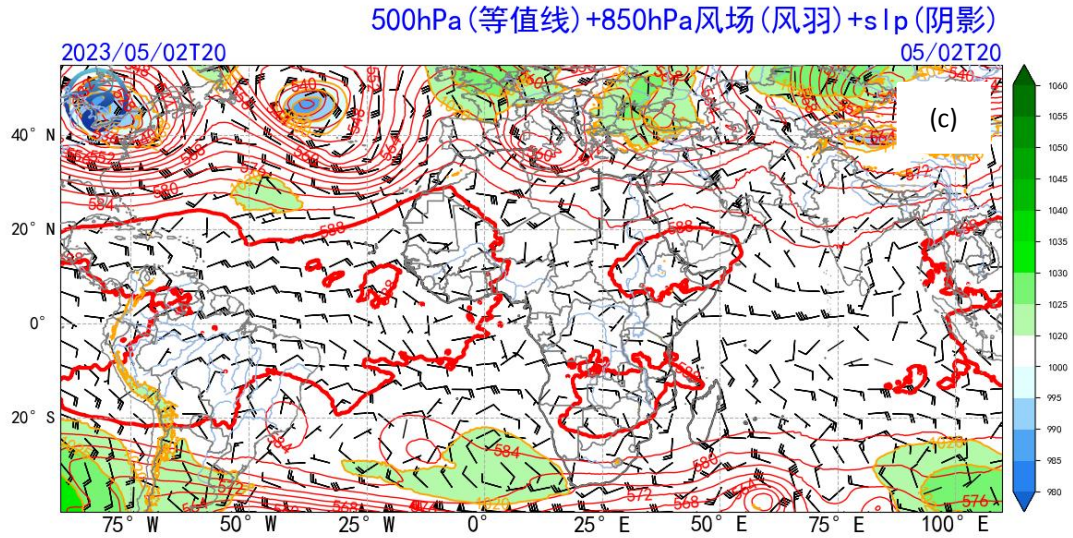


Figure 4 (a) Accumulated precipitation in the African region from May 1st to May 3rd.(b) Average 500hPa geopotential height and anomaly from May 1st to May 2nd.(c) 850hPa wind field on May 2nd in the African region.

This intense rainfall event is closely related to abnormal changes in atmospheric circulation (Figure 4b, c). On one hand, the atmospheric circulation in the Northern Hemisphere exhibited large-scale fluctuations with significant amplitude, generating multiple high-pressure ridges and low-pressure troughs. The meridional component of these fluctuations directed cold air from the polar regions to move southward through Western Asia and Eastern Europe, and even across the equator. In places like Rwanda, the cold air mass interacted with warm and moist air streams from the Southern Hemisphere, leading to the convergence and ascent of the moisture, resulting in precipitation.

On the other hand, Rwanda is located between the subtropical highs of the Northern and Southern Hemispheres. Within the control range of the subtropical highs, there is a predominance of descending air masses. However, being situated between the two subtropical highs, Rwanda experiences an ascent of the air flow in the intermediate zone, forming a complete secondary circulation. This enhances the convergence and ascent of the air mass, further favoring precipitation amplification.

Thirdly, the strong warm and moist airflow associated with the heavy rainfall is linked to the early establishment of a high-energy and high-humidity Somali jet stream originating from the equatorial Indian Ocean. Furthermore, Rwanda's varied topography, with altitudes ranging from 1000 to 4500 meters, exhibits a west-high, east-low pattern, which promotes the uplift of moisture. Additionally, its complex terrain contributes to the occurrence of geological hazards such as landslides.

2. The super cyclonic storm "MOCHA" made landfall in Myanmar (Burma) in the Bay of Bengal

On the morning of May 11, 2023, the super cyclonic storm "MOCHA" formed over the southern Bay of Bengal (Figure 5a). After formation, it moved in a northerly direction and gradually intensified. From the night of the 12th, it gradually turned towards the northeast and continued to strengthen. By the evening of the 13th, it had intensified into a super cyclonic storm, with maximum wind speeds near the center over

the sea surface reaching 17 or higher on the Beaufort scale (62 meters/second). Around noon on the 14th, it approached the coast of Myanmar (Burma) and slightly weakened in intensity. It made landfall in the coastal areas of Rakhine State in northwest Myanmar around 3:30 pm, with maximum sustained winds near the center of 16 on the Beaufort scale (52 meters/second) and gusts of 17 or higher (Figure 5b). After landfall, it rapidly weakened due to friction with the terrain. By the morning of the 15th, "MOCHA" had weakened to a deep depression in northern Myanmar (Figure 5c).

From May 13 to 15, the influence of "MOCHA" brought heavy rainfall to western and northern Myanmar, southern Bangladesh, and eastern India, with some areas experiencing heavy or extremely heavy rainfall. In China, moderate to heavy rain occurred in the central and western parts of Yunnan Province, southeastern Tibet, and southwestern Sichuan Province.

b

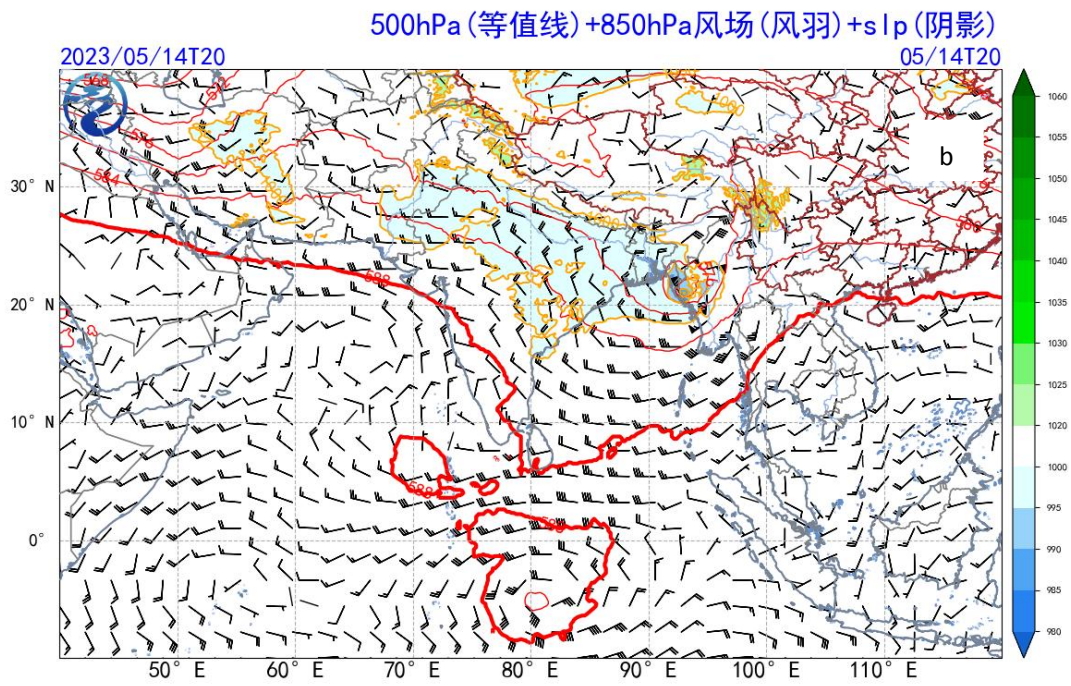
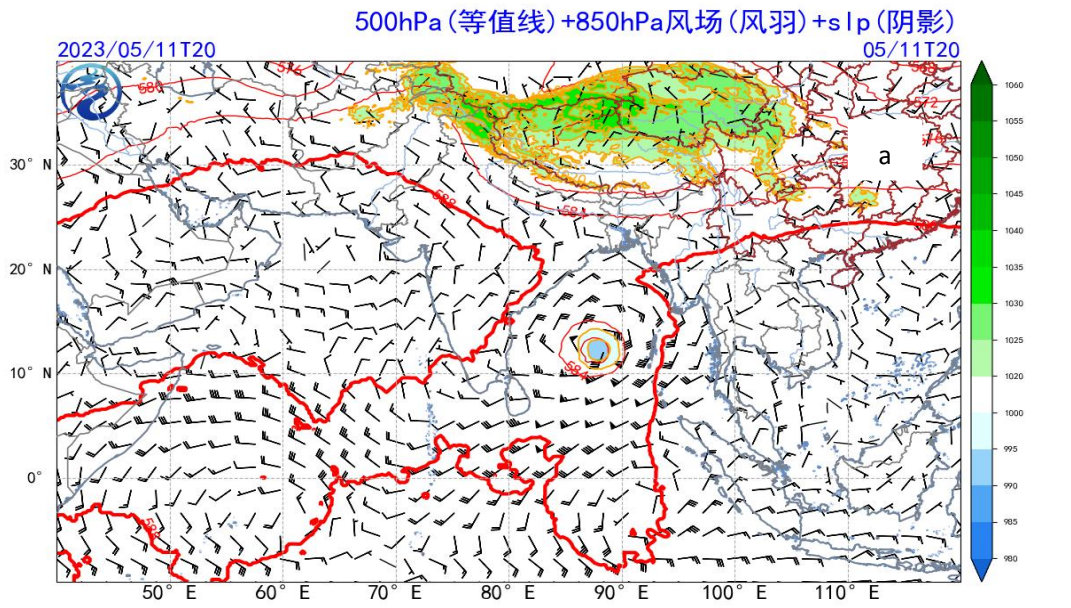




Figure 5 (a), (b) and (c) depict the 500hPa geopotential height and 850hPa wind field, as well as the track of the super cyclonic storm "MOCHA" on May 11th and 14th, 2023.

3. Extreme heatwaves occur in Southeast Asia

In July, the subtropical high-pressure systems globally showed a tendency of being stronger. Central America, South America, central Africa, southern parts of Western Asia, southern regions of the Indian subcontinent, southern parts of the Indochinese Peninsula, Indonesian archipelago, and northern Australia were all under the influence of the subtropical high-pressure systems. Due to factors such as clear-sky radiation and warming from subsidence, there was widespread hot weather with daily maximum temperatures exceeding 35°C. Central

Africa, southern parts of the Arabian Peninsula, the Indian subcontinent, western parts of the Indochinese Peninsula, and some regions in Central America experienced 25 to 31 days of high temperatures, with daily maximum temperatures reaching 40 to 46°C. In some parts of Southeast Asia, the daily maximum temperatures even broke historical records.

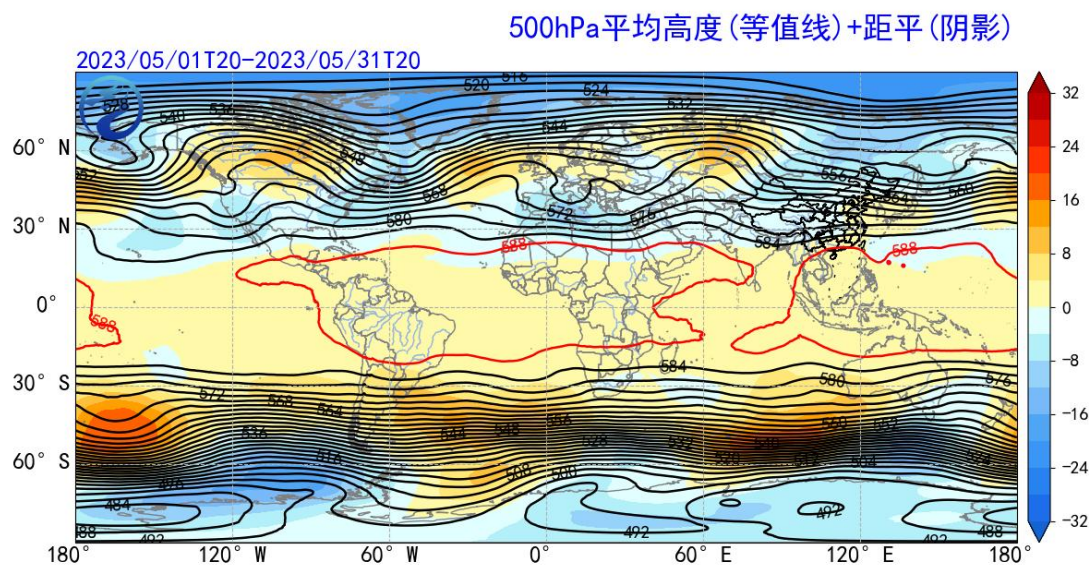
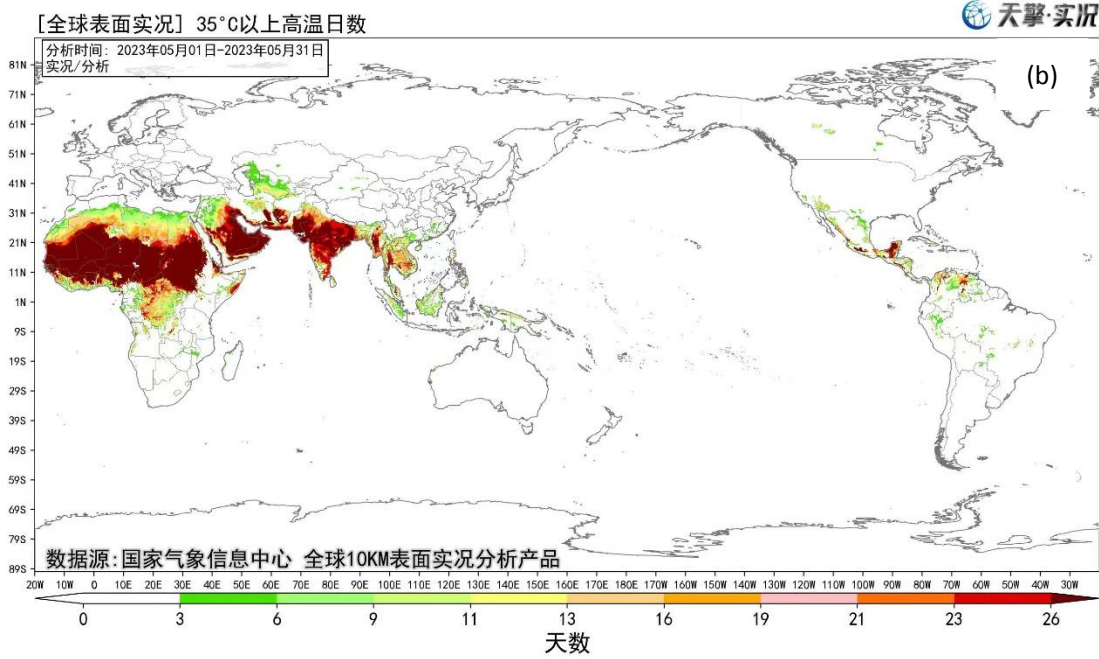
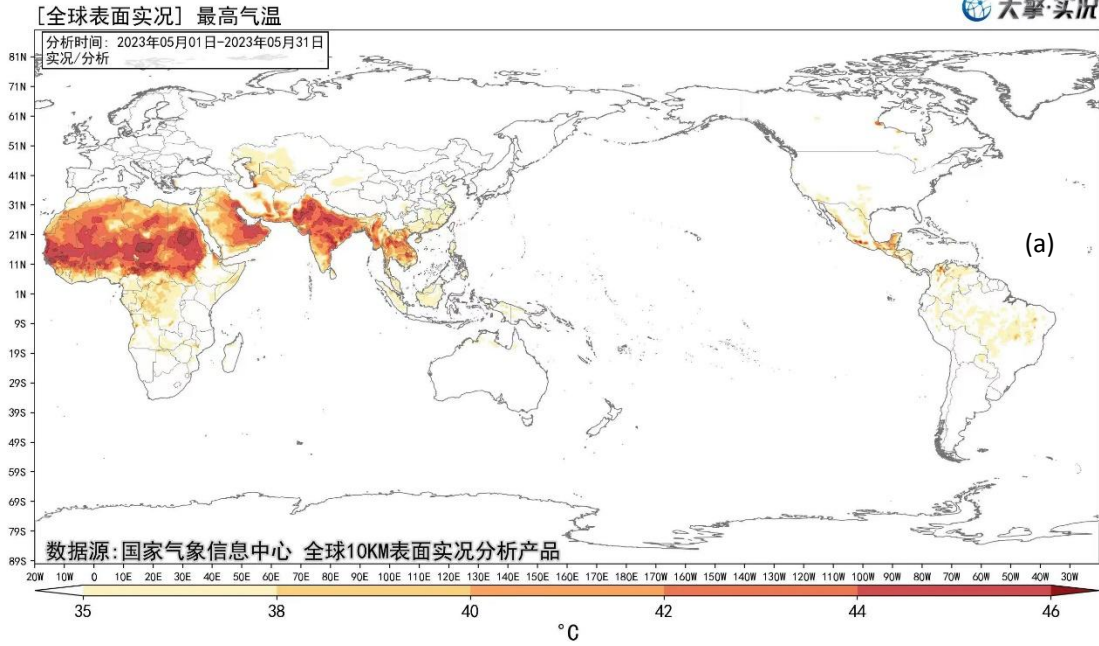


Figure 6 displays the 500hPa geopotential height field (contour lines) and anomalies (shading) worldwide in July 2022. The units of the anomalies

are in decameters

(dagpm).



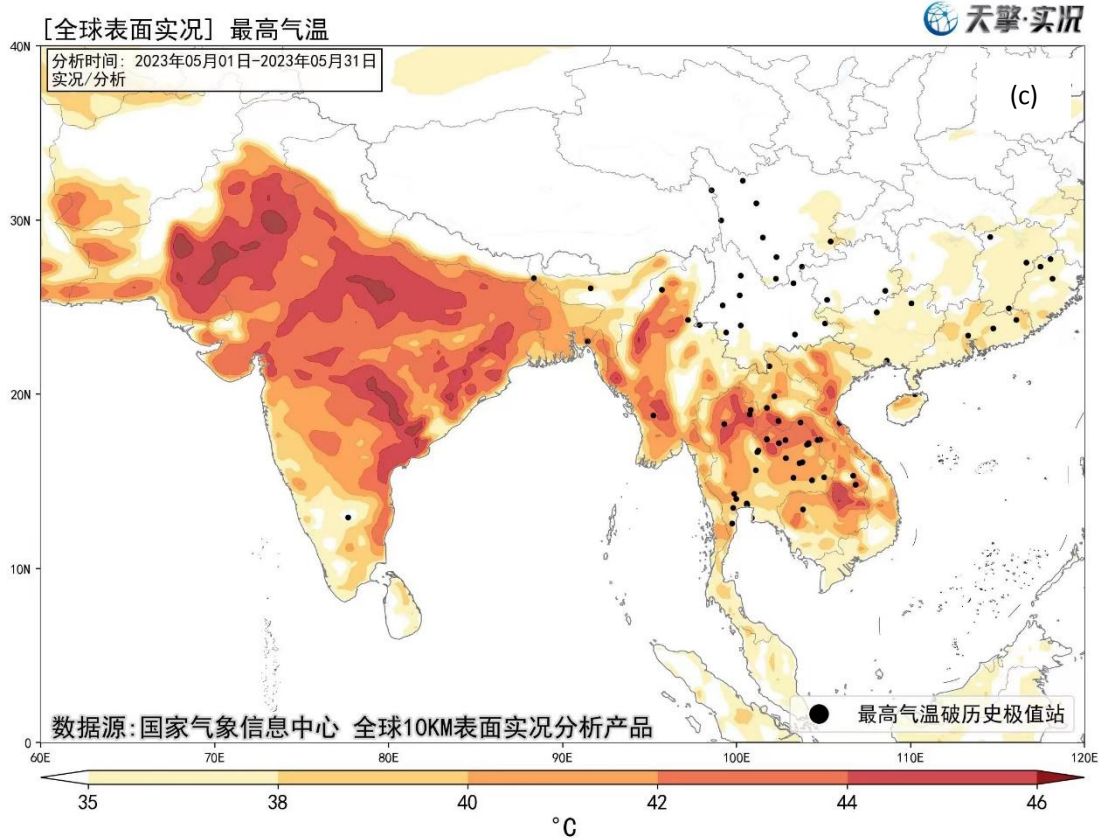


Figure 7 displays the following information for May 2023: (a) global extreme maximum temperatures in Celsius ($^{\circ}\text{C}$), (b) number of days with maximum temperatures above 35°C , and (c) highest temperatures and stations in South Asia and Southeast Asia, including those that have exceeded historical records.

Global Weather Outlook

Over the next two weeks, the subtropical high-pressure systems will remain strong globally. As a result, regions such as southern Western Europe, southern Europe, the Arabian Peninsula, northwestern India, southern China, southern United States, Mexico, northern Africa, and northern Australia will experience persistent high temperatures. In some

areas, daily maximum temperatures may reach 37-39°C, with localized areas in the Arabian Peninsula, southern United States, and Mexico experiencing temperatures exceeding 40°C.

Additionally, the average temperatures in Russia's Far East, northeastern China, central and northern Europe, and northwestern Canada will be 2-4°C above normal for this time of year. Conversely, northern West Asia, Central Asia, western Siberia, and northern parts of South America will experience average temperatures 1-3°C below normal.

Over the next two weeks, the main areas of precipitation will be concentrated in India, Bangladesh, the Indochinese Peninsula, Indonesia, the middle and lower reaches of the Yangtze River in China, northwestern parts of South China, southern regions of Japan, and northern parts of South America. Most of these areas can expect accumulated rainfall of 80-150 millimeters, with some areas receiving 200-400 millimeters and localized amounts exceeding 500 millimeters. These regions will experience above-normal rainfall compared to the long-term average, while the rest of the world will see below-normal or near-normal precipitation levels.

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