Global Disastrous Weather Report in December 2022

Abstract: In December 2022, cold wave weather occurred in many places in the Northern Hemisphere, such as Europe, East Asia and North America. The United States experienced extremely cold and freezing weather, which local media called "epic" cold wave. Historic heavy snowfall has hit most parts of Japan. Moscow has suffered the strongest snowfall in more than 80 years. Besides, many parts of Europe have also experienced cold waves and heavy snow. For rainfall, the cumulative amount of precipitation in parts of Bangladesh, Mexico, Brazil, Liberia, Nigeria, Congo, and eastern Australia was 40% to 70% higher than that in the same period of the year, and more than twice as high as in local areas. During December, a total of 4 tropical cyclones were generated and the number of generated and landing typhoons was less than that in the same period of the year.

1. Overview of global weather

In December, there were large differences in global temperature (Fig. 1). The temperature in southern Europe, northwestern and eastern Siberia, northwestern and eastern North America, northern Africa, southwestern China, Indo-China Peninsula and southern Indian Peninsula was 1－2 ℃ higher than that in the same period of the year, and the temperature in northeastern Siberia and eastern North America is 3－5 ℃ higher. The temperature in northern Europe, Central Asia, Russia, Mongolia, Canada, the United States was 2－4 ℃ lower than that in the same period of the year, and the local temperature is more than 5 ℃ lower. The minimum temperature of above areas has reached or exceeded the historical extreme value in the same period of the year (Fig. 2).

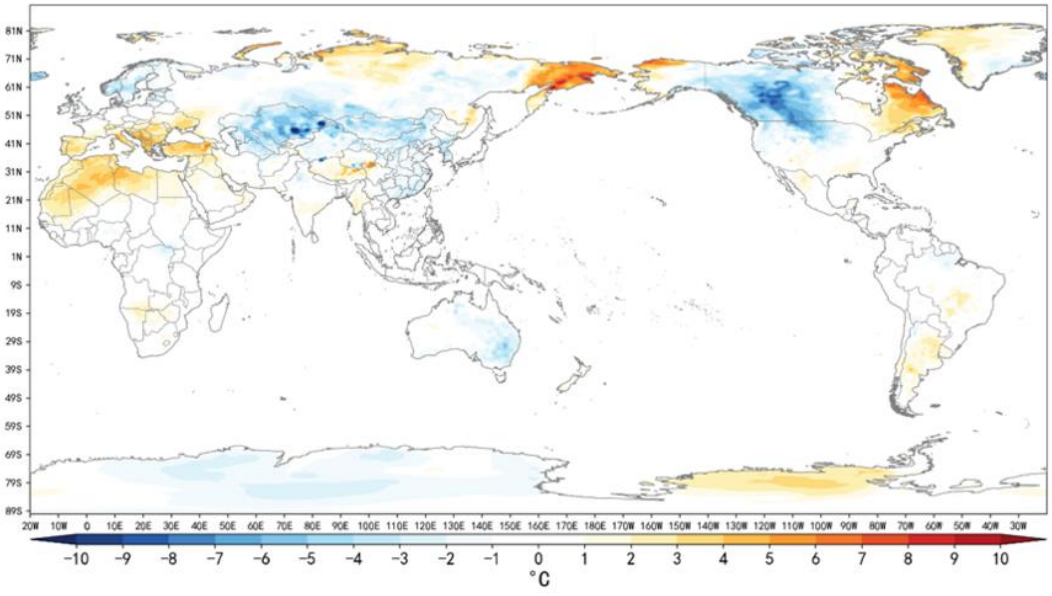

Fig.1 Monthly 2m temperature anomaly in December 2022 (unit:℃)

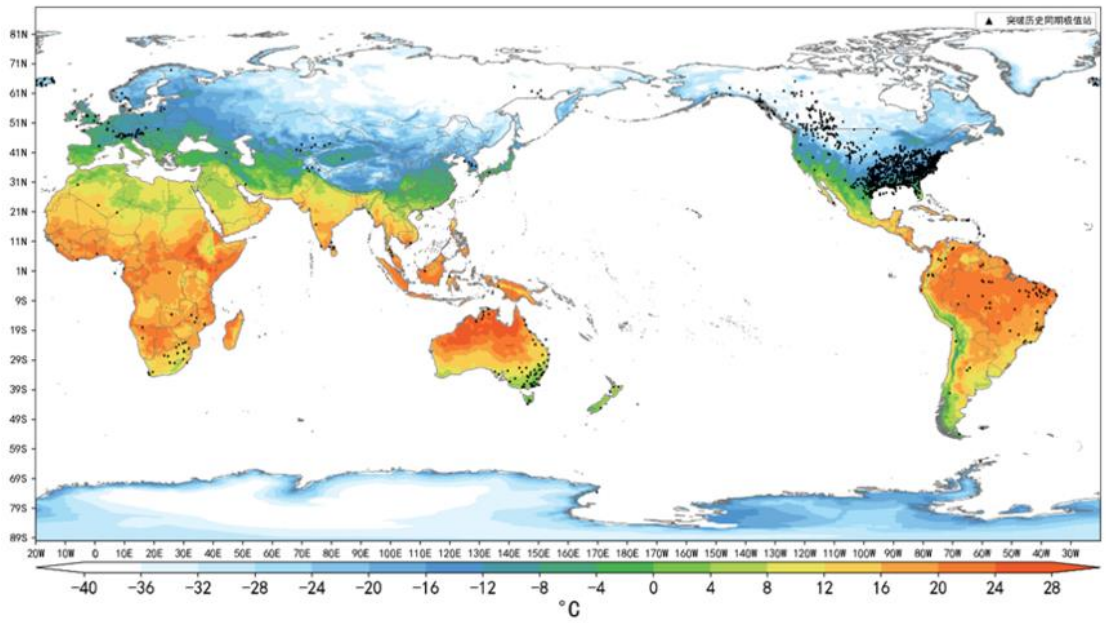

Fig.2 Minimum 2m temperature in December 2022 (unit:℃) and the stations breaking the historical extreme value in the same period (green circle)

In December 2022, the accumulated precipitation in southeast Asia, northern South America, west-central Africa and southern Africa was 200–300 mm, among which some parts of Bangladesh, Mexico, Brazil, Liberia, Nigeria, Congo and eastern Australia had precipitation of 350 – 500 mm, with local rainfall exceeding 500 mm (Fig. 3). The accumulative precipitation in most of the above areas was 40% – 70% higher than that in the same period of the year and more than 2 times higher in local areas (Fig. 4).

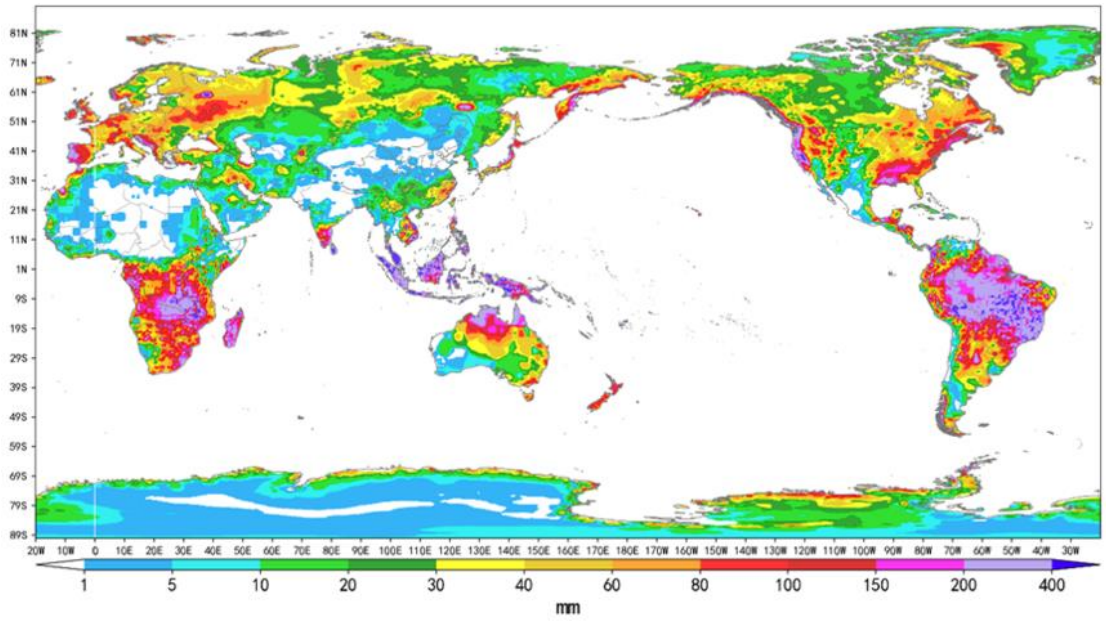

Fig.3 Monthly total accumulated precipitation in December 2022 (unit: mm)

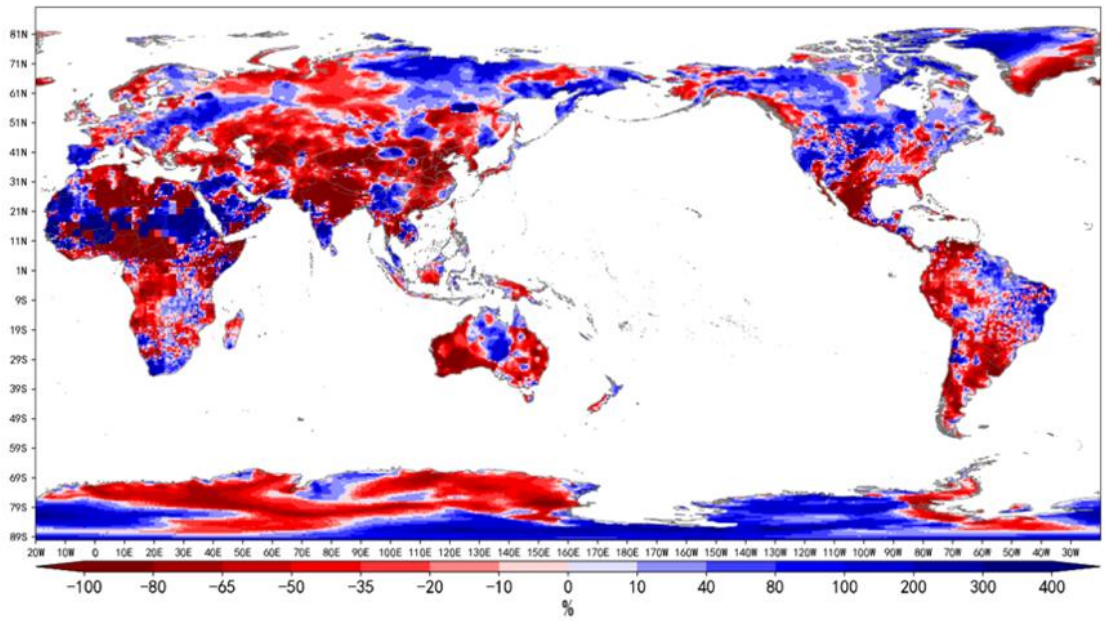

Fig.4 Monthly total accumulated precipitation percentage anomaly in December 2022（unit:%）

In December 2022, the main disastrous weather in the northern hemisphere is cold wave, snowstorm, rainstorm and flood, etc. The southern hemisphere is mainly dominated by rainstorm, flood and high temperature heat wave. In addition, there are four tropical cyclone activities in the world (Fig. 5), and the number of them is less than usual.

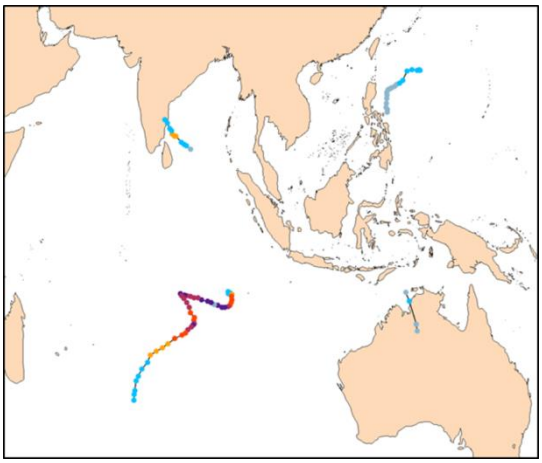

Fig.5 Global tropical cyclones in December 2022

2. Severe weather

2.1 Extreme cold wave and snowstorm in North America

From 21 to 26 December, under the influence of the extreme cold wave and the “bomb cyclone”, most parts of the United States experienced severe cooling, and many places in the northern and eastern parts of the United States were hit by severe snowstorms. The minimum temperature fell below the record lowest value in the same period in history, resulting in traffic disruptions and widespread power outages in many places, affecting natural gas production and supply, and causing heavy

casualties. This extreme weather process was characterized by drastic cooling, extreme low temperature, violent snowstorm and serious impact.

During this process, there were two warm high ridges and one through in the middle and high latitudes in North America. The two warm high ridges were in the west coast of North America and the east of Canada, while the deep low trough controlled the western Canada to the United States. The strong meridional circulation led to the strong southward invasion of cold air in the Arctic from Canada to the United States, caused a wide range of cold wave weather. Meanwhile, the generated extratropical cyclone in front of the trough led the warm and wet air from the Gulf of Mexico and the Atlantic Ocean to meet the cold air. Coupled with the Great Lakes effect, the cyclone rapid developed and strengthened into a “bomb cyclone”, which brought a large range of snowstorm weather to the United States and Canada.

2.2 Cold waves and snowstorms in many places in the northern hemisphere

On December 17 – 18, heavy snowfall appeared in western Russia, with accumulative precipitation of 15 – 30mm in most areas and 30 – 50mm in local areas. The accumulated precipitation in many regions exceeded the historical extreme value of the same period. The capital Moscow has suffered the strongest snowfall in more than 80 years, with a snow thickness of 38 cm, and the 24-hour snowfall amounts reached 1/3 of the average precipitation in Moscow in December.

On December 18-19, there was a heavy snowfall in the north of central Japan. The accumulated precipitation in most areas was 30 – 50 mm, and the local area was more than 50 mm. The maximum thickness of the snow was 2.3 m, causing many deaths and injuries, and affecting traffic and communications.

Since December, cold waves have occurred frequently in the middle and high latitudes of the Northern Hemisphere, accompanied by large-scale storms and other disaster weather processes. This "multi-point occurrence" situation was not common. The direct reason for the frequent occurrence of cold waves in the Northern Hemisphere is that since November 27, the Arctic has been occupied by high pressure. The position of the northern branch front area was correspondingly southward, on which there were continuous activities of low eddies and low troughs, affecting countries and regions in the middle and high latitudes of the Northern Hemisphere, bringing frequent cooling and precipitation weather. When the Siberian high ridge developed strongly and the East Asian trough deepened significantly, the polar cold air was guided by the blocking high pressure to move southward in a large scale, affecting the eastern Asia and causing severe cooling. At the same time, the meridional circulation made it possible for the cold air to penetrate into the south and affect the south of China and even Southeast Asian countries. In addition, some regions with sufficient water vapor, such as parts of Japan, were also accompanied by large-scale heavy snowfall.

2.3 The impact of Severe Cyclonic Storm “Mandus” on southeast India

The “Mandus” was generated on the Bay of Bengal in the Northern India Ocean

on the morning of December 8, and then moved to the northwest, gradually strengthening. It intensified into a strong cyclone storm on the evening of the 8th, and gradually weakened in the afternoon of the 9th. It landed at the northern coast of Tamil Nadu, India, around 4:30 a.m. on the 10th (BJT), with a maximum wind force of 8 near the center (20 m s-1) and lowest pressure of 995 hPa at the center. After landing, it continued to move to the northwest, and the intensity further weakened. On the afternoon of the 10th, it weakened to a Deep Depression at the northern part of Tamil Nadu.

Affected by the Severe Cyclonic Storm "Mandus", on December 8-11, more than 100 mm precipitation occurred in southern India and Sri Lanka, and the maximum precipitation in the area near the landing point in the southeast coast of India reached 317 mm.

3. Outlook

It is predicted that in the next two weeks, the cumulative precipitation in Western Europe, Southern Europe and Northern Europe, Southeast Asia, the eastern and western coasts of North America, the northern and eastern coasts of South America, central Africa and northern Australia will be 100–200 mm, of which the Philippine Islands, Malaysia, northern Australia, eastern Brazil and other places will be more than 300 mm and accompanied by severe convective weather. The accumulated precipitation in most of the above regions will be 30% to 50% higher than that in the same period of the year, and the precipitation in the rest of the world is close to that in the same period of the year. The average temperature in Eastern Europe, most of Siberia, northwest of North America, northern Australia and North Africa will be 1–3 ℃ lower than that in the same period of the year, while the temperature in Western Europe and Northern Europe, eastern Siberia, most of East Asia, southern Australia and most of North America will be 2–4 ℃ higher than that in the same period of the year.

Editor: Ma Jie, Huang Yiwu, Li Nina, Cai Xiangning