Monthly Highlights on the Climate System (March 2024)

Highlights in March 2024

- Oceanic and atmospheric conditions over the equatorial Pacific indicate that El Niño conditions were gradually weakening (see El Niño Outlook updated on 10 April 2024).
- Monthly precipitation amounts were significantly above normal on the Sea of Japan side and on the Pacific side in eastern/western Japan.
- Convective activity was enhanced from the equatorial Indian Ocean to the tropical western South Pacific, and suppressed over the Philippines. In the lower troposphere, anti-cyclonic circulation anomalies straddling the equator were seen from the Maritime Continent to the western Pacific.
- In the 500-hPa height field, a wave train was dominant from North America to Central Siberia through Europe. Negative anomalies were seen from Japan to the Aleutian Islands.
- The polar-front jet stream exhibited a meandering structure from Europe to Central Siberia. The subtropical jet stream from Northern Africa to the seas east of Japan generally shifted southward from its normal position.

Climate in Japan (Fig. 1):

- Monthly mean temperatures were above normal in northern/western Japan, because warm-air often covered the regions.
- Monthly precipitation amounts were significantly above normal on the Sea of Japan side and on the Pacific side in eastern/western Japan, because the regions were well affected by low-pressure systems and fronts.
- Monthly sunshine durations were above normal on the Sea of Japan side and on the Pacific side in northern Japan and in Okinawa/Amami, because the regions were well covered by high-pressure systems. On the other hand, monthly sunshine durations were below normal on the Sea of Japan side in eastern Japan, because the region was well affected by low-pressure systems, fronts, and winter monsoon.

World Climate:

- The monthly anomaly of the global average surface temperature (i.e., the combined average of the near-surface air temperature over land and the SST) was +0.66°C (the warmest for March since 1891) (preliminary value) (Fig. 2). On a longer time scale, global average surface temperatures have risen at a rate of about 0.89°C per century in March (preliminary value).
- Extreme climate events were as follows (Fig. 3).
    - Monthly mean temperatures were extremely high in Southeast Asia, from central Europe to the northern part of Northern Africa, in southern Western Africa, in eastern Canada, from Central America to central South America, and in southeastern Australia.
    - Monthly precipitation amounts were extremely high in and around southwestern Russia, in western Europe, from eastern Canada to the southeastern USA, and in the western USA.
    - Monthly precipitation amounts were extremely low from Western Russia to Turkey.

Oceanographic Conditions (Fig. 4):

- In the equatorial Pacific, remarkably positive SST anomalies were observed in the central part. Both the monthly mean SST anomaly averaged over the NINO.3 region and the SST deviation from the latest sliding 30-year mean over the region were +1.2˚C (Fig. 5).
- In the North Pacific, remarkably positive anomalies were observed from the western to central mid-latitudes.
- In the South Pacific, remarkably positive anomalies were observed from the western to central part of the tropics.
- In the Indian Ocean, remarkably positive anomalies were observed in the western part of the tropics.
- In the Atlantic, remarkably positive anomalies were observed in the tropics.

Tropics:

- Convective activity was enhanced from the equatorial Indian Ocean to the tropical western South Pacific, and suppressed over the Philippines and South America (Fig. 6).
- The active phase of equatorial intraseasonal oscillation propagated from the Indian Ocean to Africa through the Pacific with a large amplitude (Fig. 7).
- In the upper troposphere, a wavy anomaly pattern was seen with anti-cyclonic circulation anomalies over the Middle East and southern China and cyclonic circulation anomalies over India and to the east of Japan (Fig. 8).
- In the lower troposphere, anti-cyclonic circulation anomalies straddling the equator were seen from the Maritime Continent to the western Pacific, and cyclonic circulation anomalies were seen over Australia.
- In the sea level pressure field, positive anomalies were seen from the Indian Ocean to the Pacific in the equator, and negative anomalies were seen over northwestern Australia. The Southern Oscillation Index value was +0.1(Fig. 5).
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Extratropics:

- In the 500-hPa height field (Fig. 9), a wave train was dominant from North America to Central Siberia through Europe, with positive anomalies from northern Europe to Western Russia, and negative anomalies from Western to Central Siberia. Negative anomalies were seen also from Japan to the Aleutian Islands.
- The subtropical jet stream from Northern Africa to the seas east of Japan generally shifted southward from its normal position (Fig. 10). The polar-front jet stream exhibited a meandering structure from Europe to Central Siberia.
- In the sea level pressure field (Fig. 11), negative anomalies were seen over western Europe and a wide area from Central Siberia to the Aleutian Islands including Japan, and positive anomalies to the east of Greenland. The Siberian High was generally weaker than normal.
- Temperatures at 850-hPa were above normal from Europe to Western Russia and over eastern North America, and below normal to the south of Greenland and over Western Siberia (Fig. 12).
- In the zonal mean zonal wind, westerly wind anomalies were seen over the latitude bands of 20ºN and 30ºS in the troposphere. The polar night jet stream in the Northern Hemisphere stratosphere was weaker than normal. The zonal mean temperatures were above normal over a wide area in the troposphere, in particular in the tropics, and at high-latitudes in the Northern Hemisphere stratosphere.
- In the 30-hPa height field, the polar vortex shifted toward western Eurasia and positive anomalies were seen over the arctic region. The major stratospheric sudden warming occurring in mid-February continued through the month.

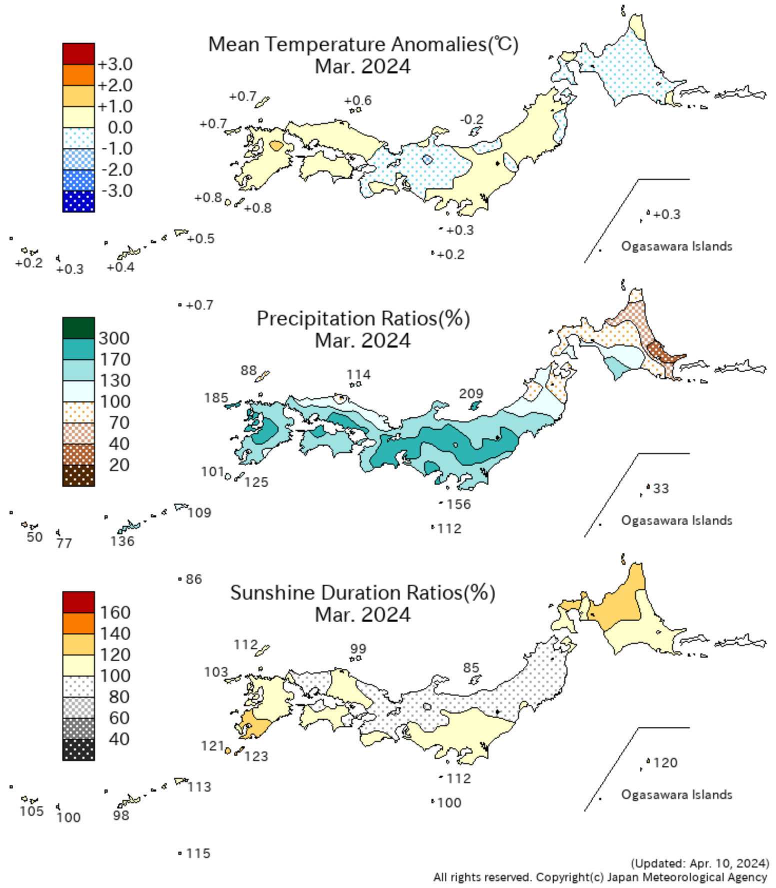

Fig. 1 Monthly climate anomaly/ratio over Japan (March 2024)
Top: temperature anomalies (degree C)
Middle: precipitation ratio (%)
Bottom: sunshine duration ratio (%)
The base period for the normal is 1991-2020.

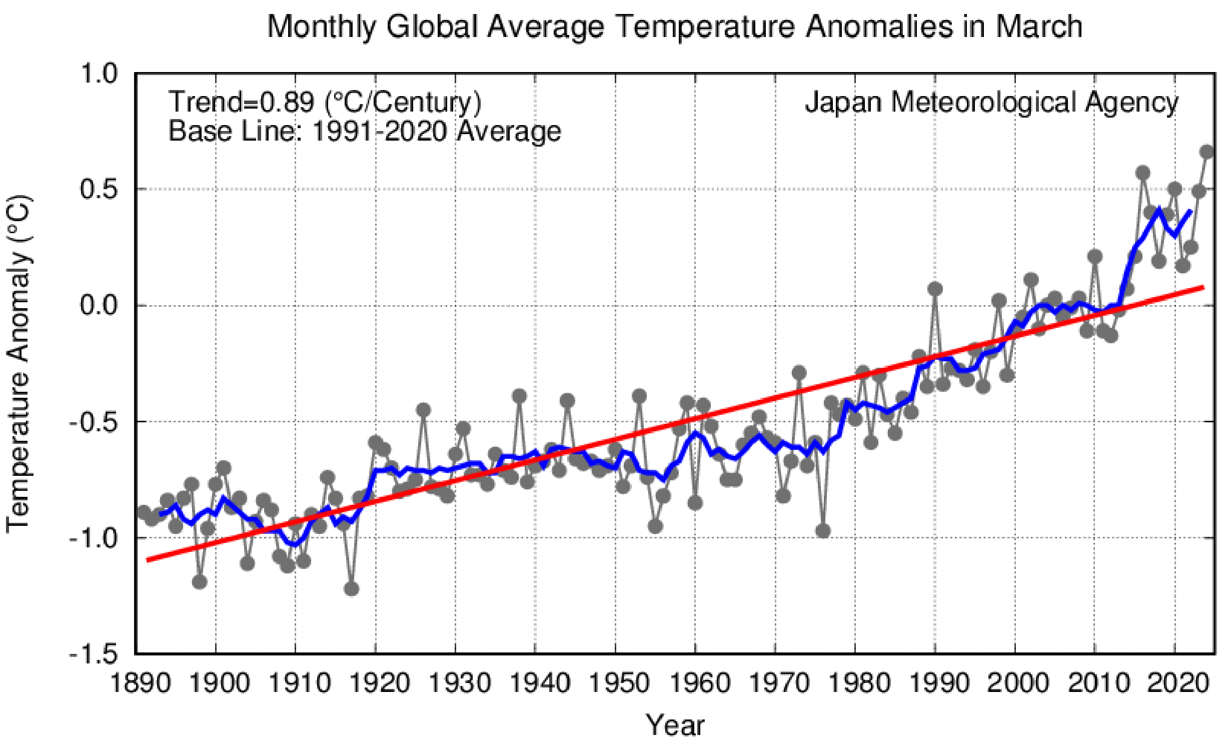

Fig. 2 Long-term change in monthly anomalies of global average surface temperature in March
The thin black line indicates anomalies of the surface temperature in each year. The blue line indicates five-year running mean, and the red line indicates a long-term linear trend. Anomalies are deviations from the 1991-2020 average.

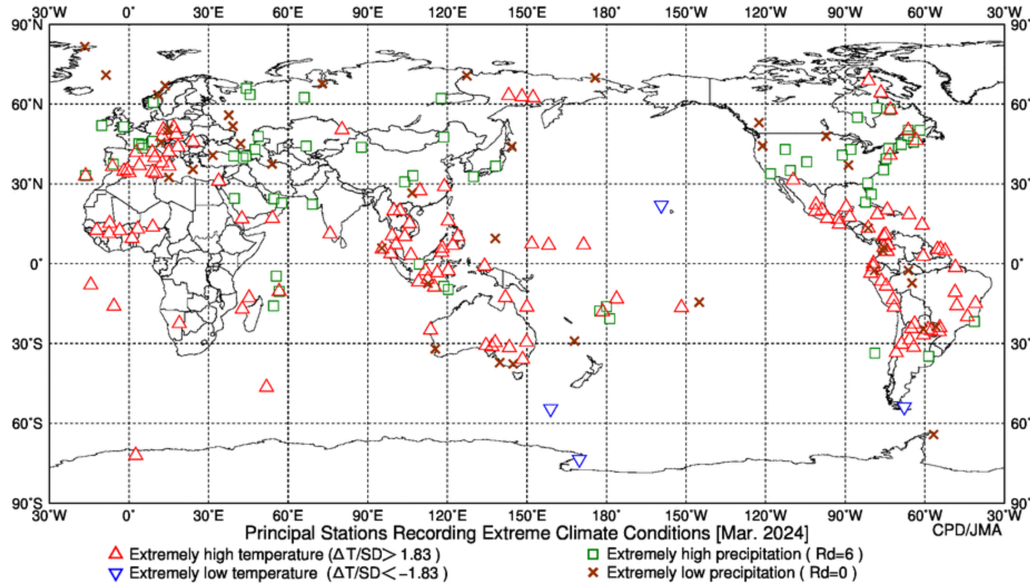

Fig. 3 Distribution of extreme climate stations (March 2024)

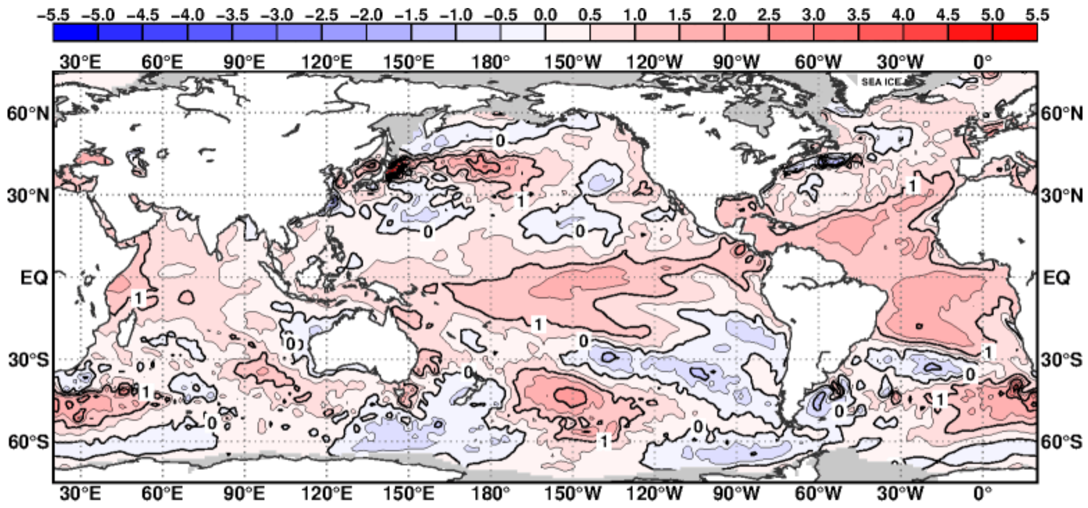

Fig. 4 Monthly mean sea surface temperature anomaly (March 2024)

The contour interval is 0.5 degree C. The base period for the normal is 1991-2020. Maximum coverage with sea ice is shaded in gray.

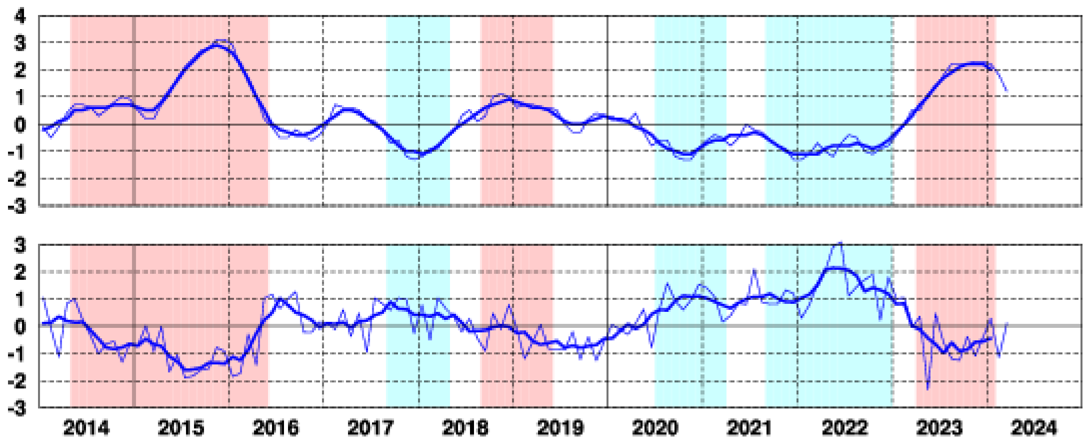

Fig. 5 Time series of monthly mean SST departure (degree C) from the reference value defined as the immediate past 30-year mean SST averaged over the NINO.3 region (upper). Time series of the Southern Oscillation Index with respect to the 1991-2020 base period (lower).

Thin blue lines represent monthly means and thick blue lines five-month running means. Periods of El Niño and La Niña events are shown as red-colored and blue-colored boxes, respectively.

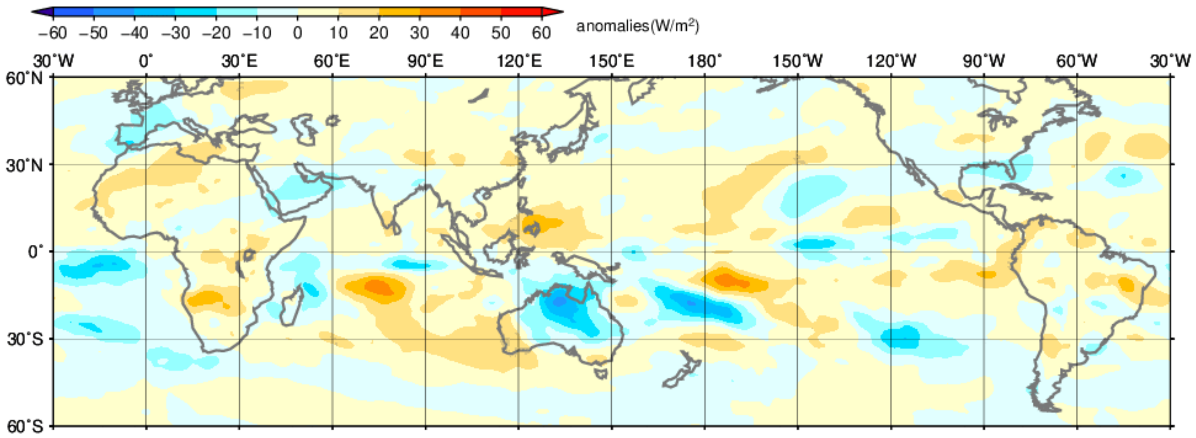

Fig. 6 Monthly mean Outgoing Longwave Radiation (OLR) anomaly (March 2024)
The shading interval is 10 W/m^2. The base period for the normal is 1991-2020. Original data (CPC Blended OLR) are provided by NOAA.

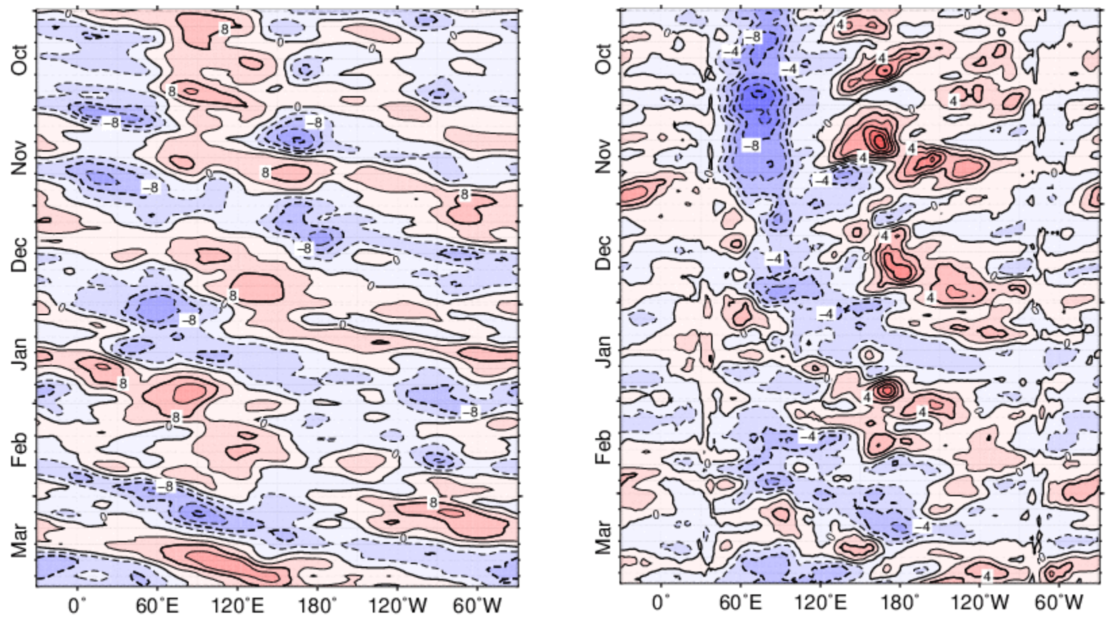

Fig. 7 Time-Longitude cross section (5°N-5°S) of five-day running mean 200-hPa velocity potential anomaly (left) and 850-hPa zonal wind anomaly (right) (October 2023 – March 2024)
The contour intervals are $4x10^6$ m^2/s (left) and 2 m/s (right). The base period for the normal is 1991-2020.

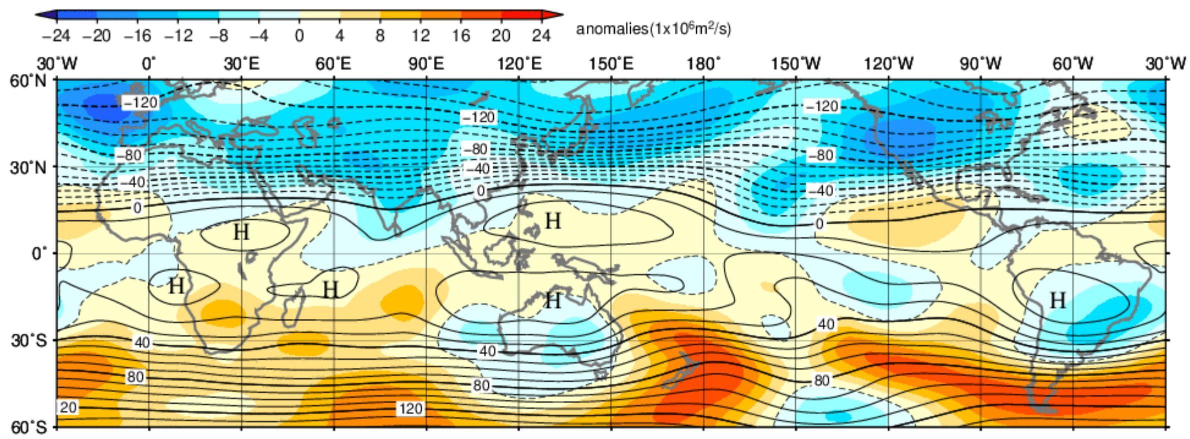

Fig. 8 Monthly mean 200-hPa stream function and anomaly (March 2024)
The contour interval is $10x10^6$ m^2/s. The base period for the normal is 1991-2020.

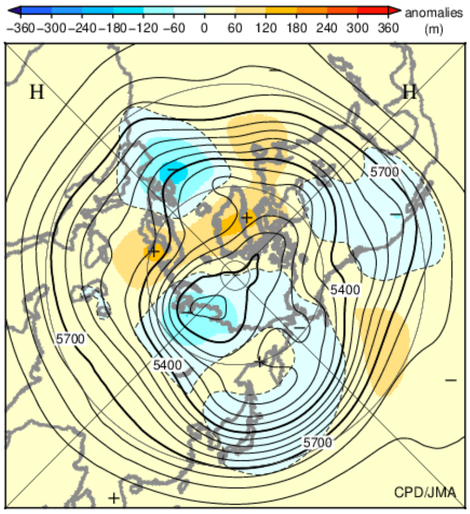

Fig. 9 Monthly mean 500-hPa height and anomaly in the Northern Hemisphere (March 2024)

The contours show 500-hPa height at intervals of 60 m. The shading indicates its anomalies. The base period for the normal is 1991-2020.

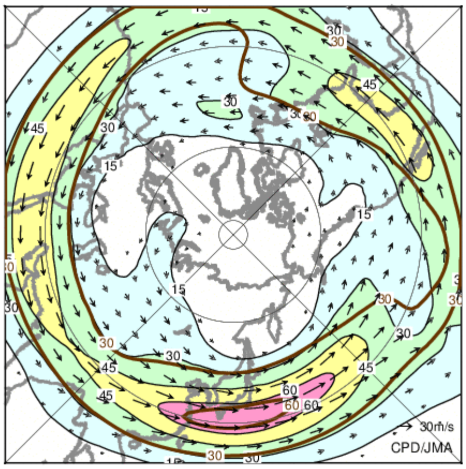

Fig. 10 Monthly mean 200-hPa wind speed and vectors in the Northern Hemisphere (March 2024)

The black lines show wind speed at intervals of 15 m/s. The brown lines show its normal at intervals of 30 m/s. The base period for the normal is 1991-2020.

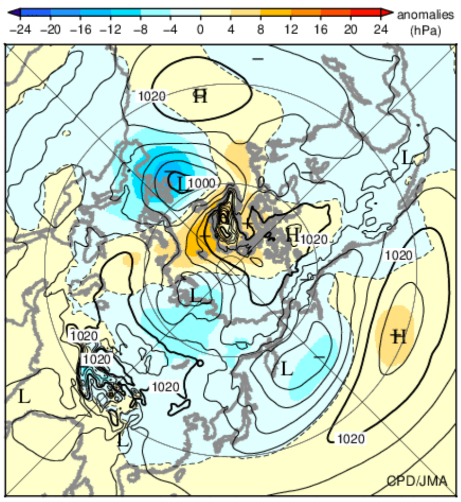

Fig. 11 Monthly mean sea level pressure and anomaly in the Northern Hemisphere (March 2024)

The contours show sea level pressure at intervals of 4 hPa. The shading indicates its anomalies. The base period for the normal is 1991-2020.

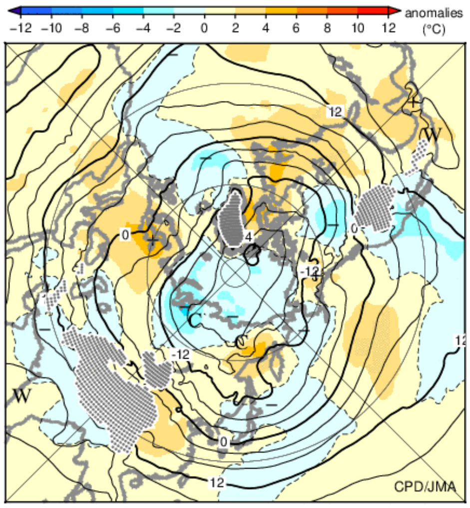

Fig. 12 Monthly mean 850-hPa temperature and anomaly in the Northern Hemisphere (March 2024)

The contours show 850-hPa temperature at intervals of 4 degree C. The shading indicates its anomalies. The base period for the normal is 1991-2020.

Detailed information on the climate system is available on the Tokyo Climate Center's website.
https://www.data.jma.go.jp/tcc/tcc/index.html
This report is prepared by the Tokyo Climate Center, Climate Prediction Division, Atmosphere and Ocean Department, Japan Meteorological Agency.