Monthly Highlights on the Climate System (December 2022)

Highlights in December 2022

- Atmospheric and oceanic indicators suggest ongoing La Niña conditions in the equatorial Pacific (see El Niño Outlook updated on 11 January 2023).
- Monthly mean temperatures were below normal in eastern and western Japan. Monthly snowfall amounts were significantly above normal on the Sea of Japan side of eastern Japan.
- Monthly mean temperatures were extremely high from around the Mediterranean Sea to the northern part of Northern Africa and in the central part of South America, and extremely low in eastern Australia.
- Convective activity was enhanced from the eastern tropical Indian Ocean to near Southeast Asia, and suppressed over the western tropical Indian Ocean and the western to central tropical Pacific.
- In the 500-hPa height field over the Northern Hemisphere, the polar vortex split into the Siberian part and the North American part. Wave trains were dominant over the mid- and high-latitudes with positive anomalies near Alaska and southern Greenland, and negative anomalies near the eastern part of East Asia.
- In the sea level pressure field, the Siberian High was stronger than normal in the northwestern part, and the Aleutian Low was stronger than normal in the western part.

Climate in Japan (Fig. 1):

- Monthly mean temperatures were below normal in eastern/western Japan due to cold air inflow from the continent.
- Monthly precipitation amounts were significantly above normal on the Sea of Japan side of northern/eastern Japan due to winter monsoon. Monthly precipitation amounts were significantly above normal in Okinawa/Amami due to fronts and low-pressure systems.
- Monthly sunshine durations were significantly below normal on the Sea of Japan side of northern Japan due to winter monsoon. Monthly sunshine durations were significantly below normal in Okinawa/Amami due to pressure troughs and cold air inflow.

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 +0.20°C (9th warmest for December since 1891) (preliminary value) (Fig. 2). On a longer time scale, global average surface temperatures have risen at a rate of about 0.75°C per century in December (preliminary value).
- Extreme climate events were as follows (Fig. 3).
    - Monthly mean temperatures were extremely high from around the Mediterranean Sea to the northern part of Northern Africa, from northwestern Brazil to Peru, and in the central part of South America.
    - Monthly mean temperatures were extremely low from western Mongolia to western China, in northwestern Europe, from southwestern Canada to the northwestern USA, from Barbados to eastern Brazil, and in eastern Australia.
    - Monthly precipitation amounts were extremely high from the northwestern part of Eastern Siberia to the northeastern part of Central Siberia, from southern Oman to southern Saudi Arabia, from western Russia to central Europe, and in and around the northern USA.
    - Monthly precipitation amounts were extremely low in and around the northern part of Northern Africa, from northwestern Brazil to Peru, and in the central part of South America.

Oceanographic Conditions (Fig. 4):

- In the equatorial Pacific, negative SST anomalies were observed from the central to eastern parts. The monthly mean SST anomaly averaged over the NINO.3 region was -0.8°C and the SST deviation from the latest sliding 30-year mean over the region was -0.7°C (Fig. 5).

- In the North Pacific, remarkably positive SST anomalies were observed in the central part and the western tropical region.
- In the South Pacific, remarkably positive SST anomalies were observed from the western tropical region to the area near 30°S, 160°W.
- In the tropical Indian Ocean, negative SST anomalies were observed in the eastern part.
- In the North Atlantic, remarkably positive SST anomalies were observed in the latitude bands from 20°N to 30°N.

Tropics:

- Convective activity was enhanced from the eastern tropical Indian Ocean to near Southeast Asia, and suppressed over the western tropical Indian Ocean and the western to central tropical Pacific (Fig. 6).
- Eastward propagation of the active phase of equatorial intraseasonal oscillation was seen from the Indian Ocean to near Indonesia in the first half of December, and became obscure afterward (Fig. 7).
- In the upper troposphere, anti-cyclonic circulation anomalies straddling the equator were seen from the tropical Indian Ocean to near Indonesia, and cyclonic circulation anomalies straddling the equator were seen over the central tropical Pacific (Fig. 8).
- In the lower troposphere, anti-cyclonic circulation anomalies straddling the equator were seen over the central tropical Pacific, and cyclonic circulation anomalies straddling the equator were seen from the tropical Indian Ocean to near Indonesia.
- In the sea level pressure field over the tropics, positive anomalies were seen over the central to eastern Pacific, and negative anomalies were seen from the Indian Ocean to the western Pacific. The Southern Oscillation Index value was +1.8 (Fig. 5).

Extratropics:

- In the 500-hPa height field (Fig. 9), the polar vortex in the Northern Hemisphere split into the Siberian part and the North American part. Wave trains were dominant over the Northern Hemisphere mid- and high-latitudes with positive anomalies near Alaska, near southern Greenland and over Western Siberia, and negative anomalies over the northwestern part of North America, west of Europe and near the eastern part of East Asia.
- The subtropical jet stream shifted southward from its normal position near Africa and was stronger than normal from the northern part of South Asia to near Japan (Fig. 10).
- In the sea level pressure field (Fig. 11), positive anomalies were seen from Alaska via Greenland to Western Siberia, and negative anomalies were seen over west of Europe and near Eastern Siberia. The Siberian High was stronger than normal in the northwestern part, and the Aleutian Low was stronger than normal in the western part.
- Temperatures at 850-hPa were above normal near the date line, over northeastern Canada and near the Mediterranean Sea, and below normal over western Canada, east of Greenland and East Asia (Fig. 12).
- In the zonal mean zonal wind, the subtropical jet stream in the Northern Hemisphere was stronger than normal. The zonal mean temperatures in the troposphere were above normal in the Northern Hemisphere high-latitudes, and below normal in the tropics.
- In the 30-hPa height field, positive anomalies were seen over Siberia and the stratospheric polar vortex in the Northern Hemisphere shifted toward North America.

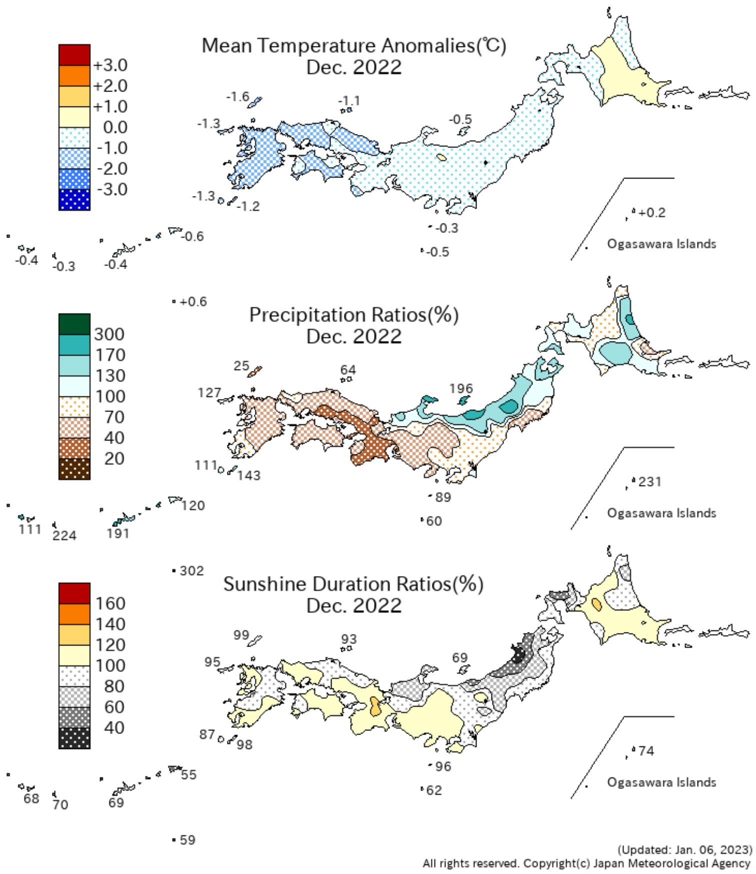

Fig. 1 Monthly climate anomaly/ratio over Japan (December 2022)
Top: temperature anomalies (degree C)
Middle: precipitation ratio (%)
Bottom: sunshine duration ratio (%)
The base period for the normal is 1991-2020.

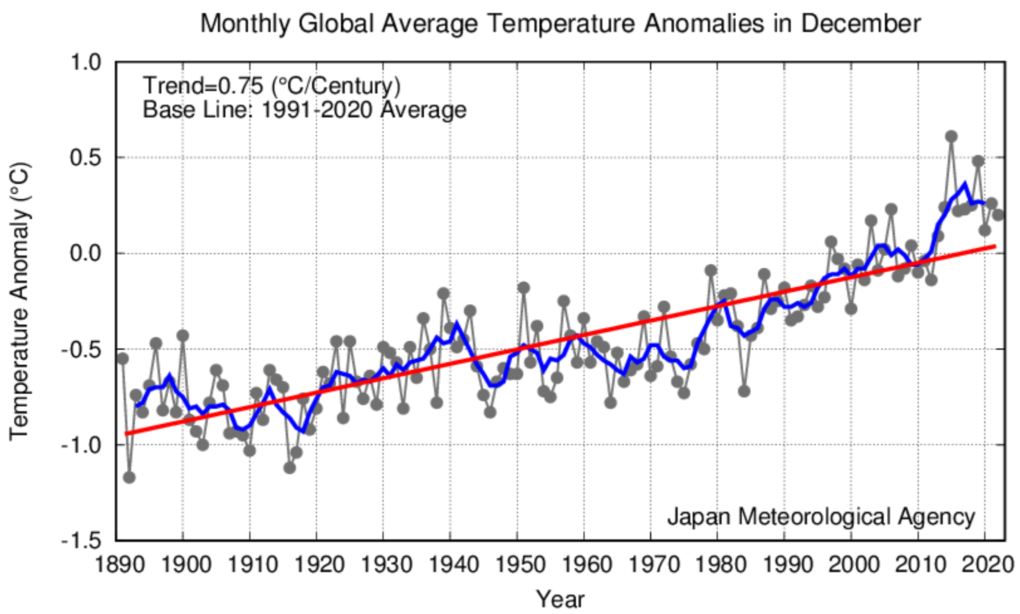

Fig. 2 Long-term change in monthly anomalies of global average surface temperature in December
The thin black line indicates anomalies of the surface temperature in each year. The blue line indicates five-year running mean, and the red line indicates a long-term linear trend. Anomalies are deviations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

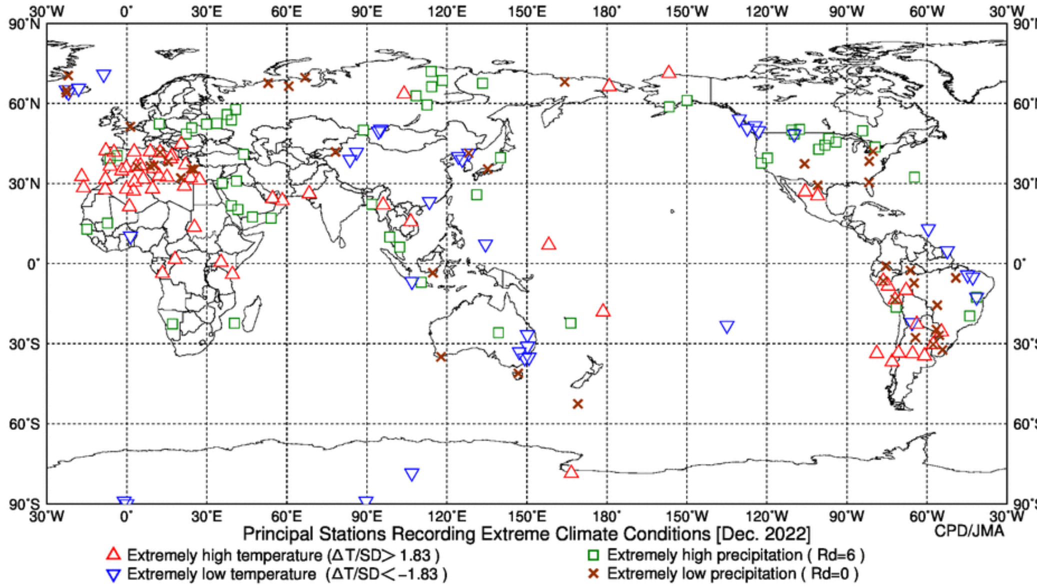

Fig. 3 Distribution of extreme climate stations (December 2022)

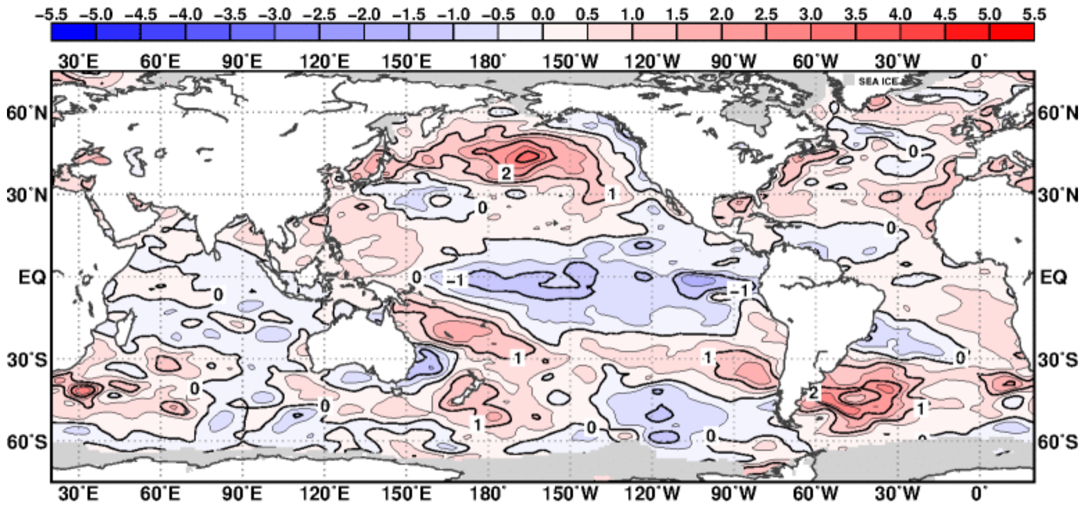

Fig. 4 Monthly mean sea surface temperature anomaly (December 2022)
The contour interval is 0.5 degree C. The base period for the normal is 1991-2020. Maximum coverage with sea ice is shaded in gray.

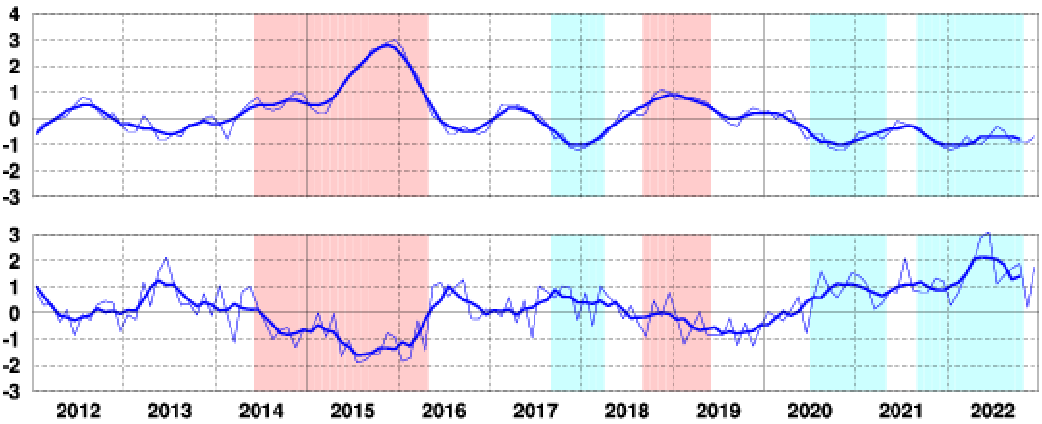

Fig. 5 Time series of monthly mean SST departure (degree C) from the reference value defined as the immediate past 30-year mean SST averaged over the NINO.3 region (upper). Time series of the Southern Oscillation Index with respect to the 1991-2020 base period (lower).
Thin blue lines represent monthly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

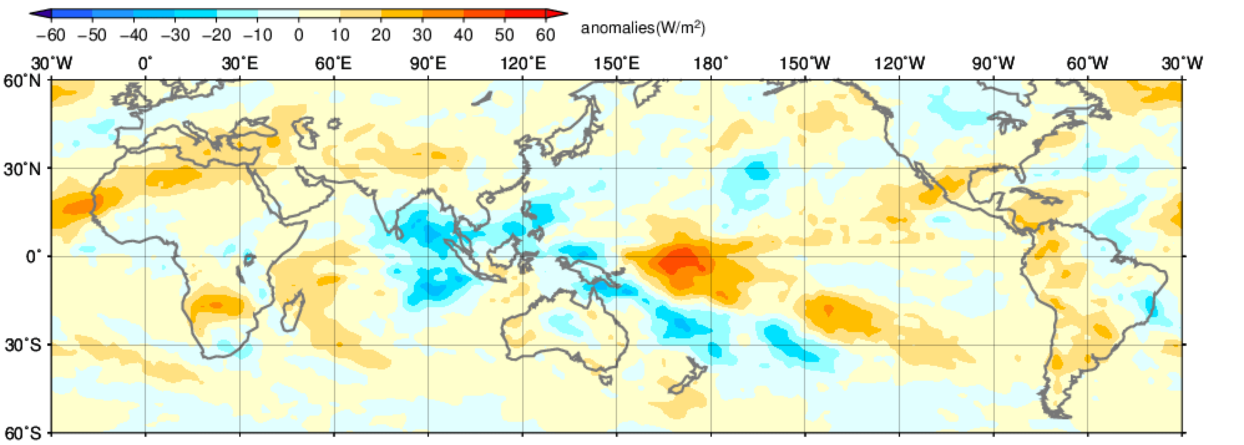

Fig. 6 Monthly mean Outgoing Longwave Radiation (OLR) anomaly (December 2022)
The shading interval is 10 W/m^2. The base period for the normal is 1991-2020. Original data provided by NOAA.

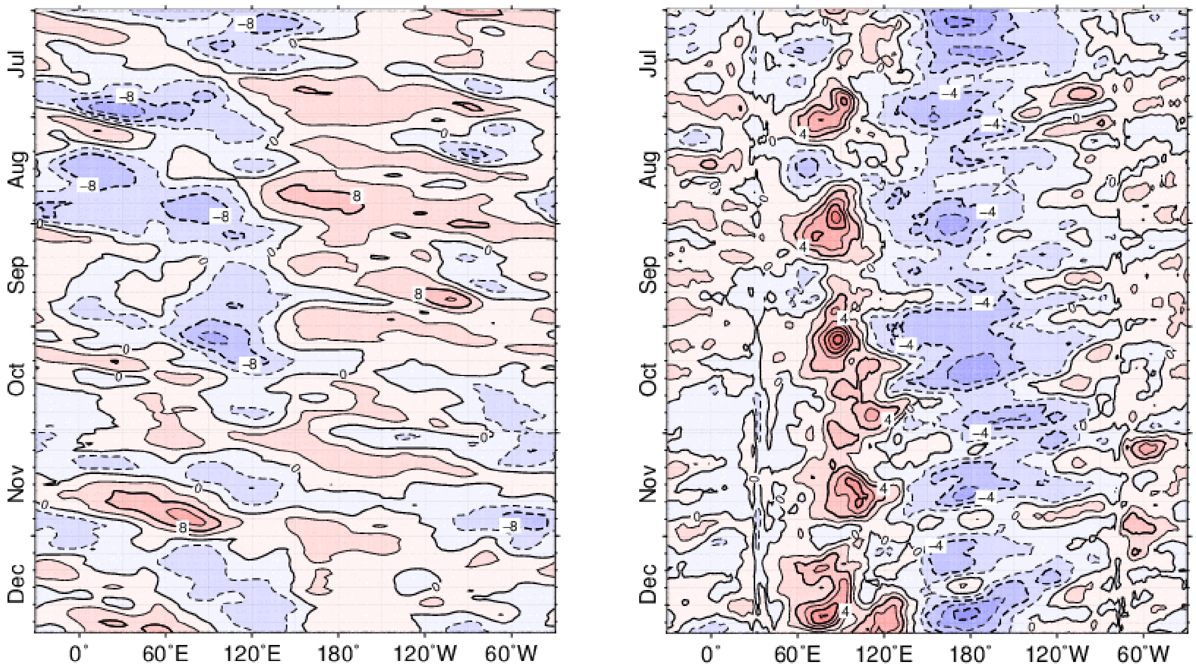

Fig. 7 Time-Longitude cross section (5°N-5°S) of five-day running mean 200-hPa velocity potential anomaly (left) and 850-hPa zonal wind anomaly (right) (July 2022 – December 2022)
The contour intervals are 4x10^6 m^2/s (left) and 2 m/s (right). The base period for the normal is 1991-2020.

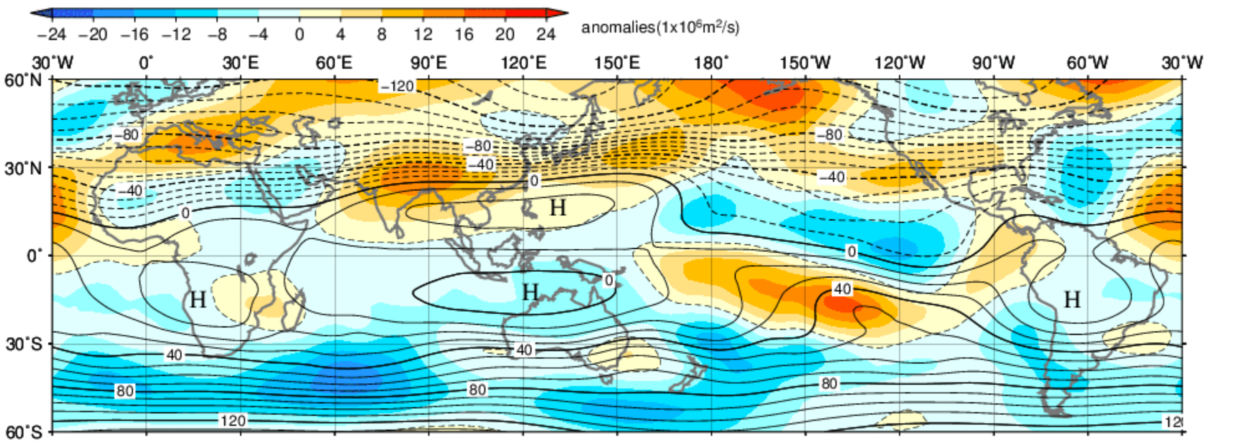

Fig. 8 Monthly mean 200-hPa stream function and anomaly (December 2022)
The contour interval is 10x10^6 m^2/s. The base period for the normal is 1991-2020.

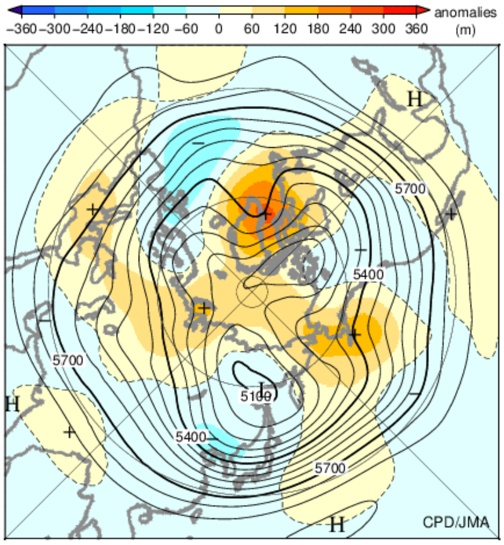

Fig. 9 Monthly mean 500-hPa height and anomaly in the Northern Hemisphere (December 2022)

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.

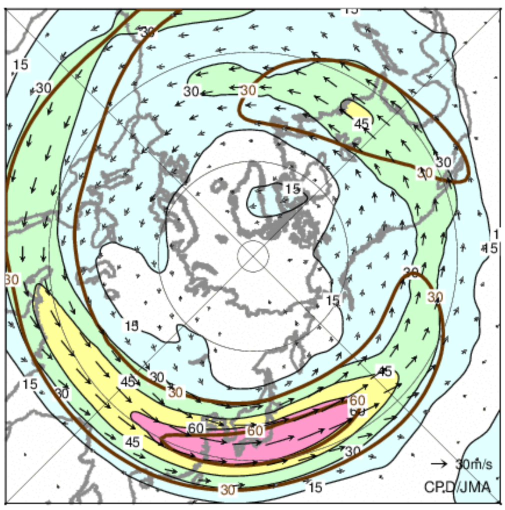

Fig. 10 Monthly mean 200-hPa wind speed and vectors in the Northern Hemisphere (December 2022)

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.

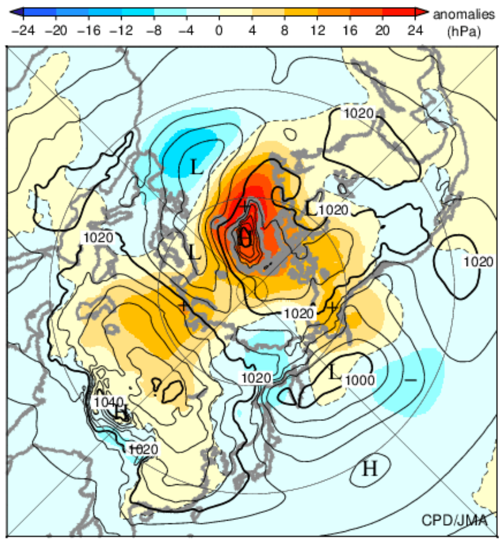

Fig. 11 Monthly mean sea level pressure and anomaly in the Northern Hemisphere (December 2022)

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.

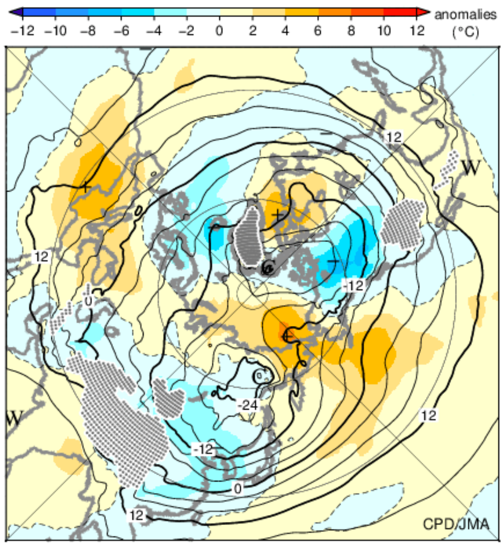

Fig. 12 Monthly mean 850-hPa temperature and anomaly in the Northern Hemisphere (December 2022)

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.