Monthly Highlights on the Climate System (May 2019)

Highlights in May 2019

- El Niño conditions continue in the equatorial Pacific (see El Niño Outlook updated on 10 June 2019).
- Monthly mean temperatures and monthly sunshine durations were significantly above normal in northern, eastern and western Japan.
- Monthly mean temperatures were extremely high in and around the eastern part of East Asia, from eastern Micronesia to the central part of Southeast Asia, and in and around the northwestern part of Southeast Asia.
- Convective activity was enhanced from the west of the date line to the Caribbean Sea and from the eastern North Atlantic to western Africa.
- In the 500-hPa height field, positive anomalies were seen over the northern polar region. Wave trains were dominant over the Northern Hemisphere mid- and high-latitudes, with positive anomalies over the Sea of Okhotsk and negative anomalies over the south of the Aleutian Islands.
- Temperatures at 850-hPa were above normal from the Sea of Okhotsk to northern Japan, and below normal over southern Europe.

Climate in Japan (Fig. 1):

- Monthly sunshine durations were significantly above normal in northern, eastern and western Japan, with the longest on record for May since 1946 in northern Japan and on the Sea of Japan side of eastern and western Japan, because the regions were frequently covered with high pressure systems.
- Monthly mean temperatures were significantly above normal in northern, eastern and western Japan, with the highest on record for May since 1946 in northern Japan due to the warm westerly wind and much sunshine duration.
- Monthly precipitation amounts were below normal over the most part from northern to western Japan.
- Cloudy and rainy days were dominant in Okinawa/Amami due to the Baiu-front and moist air flow.

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 +0.33°C (5th warmest since 1891) (preliminary value) (Fig. 2). On a longer time scale, global average surface temperatures have risen at a rate of about 0.73°C per century in May (preliminary value).
- Extreme climate events were as follows (Fig. 3).
    - Monthly mean temperatures were extremely high in and around the eastern part of East Asia, from eastern Micronesia to the central part of Southeast Asia, in and around the northwestern part of Southeast Asia, in and around the western Middle East, from Mauritius to Comoro, in South Africa, from the southeastern USA to southern Mexico, and from eastern to southern Brazil.
    - Monthly mean temperatures were extremely low from western Mongolia to central China, from central Europe to the northern part of Northern Africa, and from the Midwest to the western part of the USA.
    - Monthly precipitation amounts were extremely high in the southern part of Eastern Siberia, in eastern Europe, from central Europe to the northern part of Northern Africa, and from the Midwest to the western part of the USA.
    - Monthly precipitation amounts were extremely low from the southwestern UK to southern Spain and in and around southwestern Canada.

Oceanographic Conditions (Fig. 4):

- In the equatorial Pacific, positive SST anomalies were observed in almost the entire region except the area near Indonesia. In the NINO.3 region, the monthly mean SST anomaly was +0.7°C and the SST deviation from the latest sliding 30-year mean was +0.6°C (Fig.5).
- In the North Pacific, remarkably positive SST anomalies were observed from the western tropical region to

the area around Japan, from the area around the Aleutian Islands to the Gulf of Alaska and from the central part to the eastern part of the tropical region, and remarkably negative SST anomalies were observed from the area near 30°N, 145°E to the area near 30°N, 175°E.

- In the South Pacific, remarkably positive SST anomalies were observed in the central tropical region, from the southeastern coast of Australia to the area near 40°S, 140°W and off the western coast of Chile, and remarkably negative SST anomalies were observed near the western coast of Chile.
- In the Indian Ocean, remarkably positive SST anomalies were observed in almost the entire region, mainly in the western tropical part, and remarkably negative SST anomalies were observed in the western coast of Australia.
- In the North Atlantic, remarkably positive SST anomalies were observed from the Gulf of Mexico to the area near 35°N, 20°W, and remarkably negative SST anomalies were observed south of Greenland.

Tropics:

- Convective activity was enhanced from the west of the date line to the Caribbean Sea and from the eastern North Atlantic to western Africa, and was suppressed from North Indian Ocean to the north of New Guinea and from the central to eastern part of South Indian Ocean (Fig. 6).
- The active phase of equatorial intraseasonal oscillation propagated eastward from the Maritime Continent to Africa (Fig. 7).
- In the upper troposphere, cyclonic circulation anomalies were seen around the Arabian Peninsula and over the tropical South Indian Ocean, and anti-cyclonic circulation anomalies were seen over a wide area from southeastern China to the tropical North Pacific (Fig. 8).
- In the lower troposphere, cyclonic circulation anomalies straddling the equator were seen from the western to central tropical Pacific, and anti-cyclonic anomalies straddling the equator were seen over the tropical Indian Ocean.
- In the sea level pressure field, positive anomalies were seen from the Indian Ocean to the Pacific and negative anomalies were seen over the Atlantic. The Southern Oscillation Index value was -0.7 (Fig. 5).

Extratropics:

- In the 500-hPa height field (Fig. 9), positive anomalies were seen over the northern polar region, over the Sea of Okhotsk, in and around the western coast of Canada and over western Europe, and negative anomalies were seen over the south of the Aleutian Islands, the southwestern USA, the seas south of Greenland and southern Europe. Wave trains were dominant in the Northern Hemisphere mid- and high-latitudes.
- The subtropical jet stream shifted southward from its normal position from Northern Africa to South Asia. The westerly jet stream shifted southward from its normal position over Japan, and was stronger than normal over the central and eastern parts of North Pacific, and the mid-latitudes of the North Atlantic (Fig. 10).
- In the sea level pressure field (Fig. 11), the developed cyclone was seen over the seas south of Greenland. Positive anomalies were seen over the northern polar region, the western part of East Asia, the seas east of Japan, and the seas west of Canada, and negative anomalies were seen over the northeastern part of East Asia, the southeast of the Aleutian Islands, and the USA.
- Temperatures at 850-hPa were above normal from the Sea of Okhotsk to northern Japan, from the seas west of Canada to the seas north of Canada, over the seas west of Europe and over the Caspian Sea, and below normal over the south of the Aleutian Islands, from the southwestern USA to the seas south of Greenland, over southern Europe and the western part of East Asia (Fig. 12).
- Zonal mean temperatures in the troposphere were above normal from the tropics to the mid-latitudes of the Southern Hemisphere and over the high-latitudes of the Northern Hemisphere. In the high-latitudes of the Northern Hemisphere, above-normal temperatures were seen in the stratosphere.

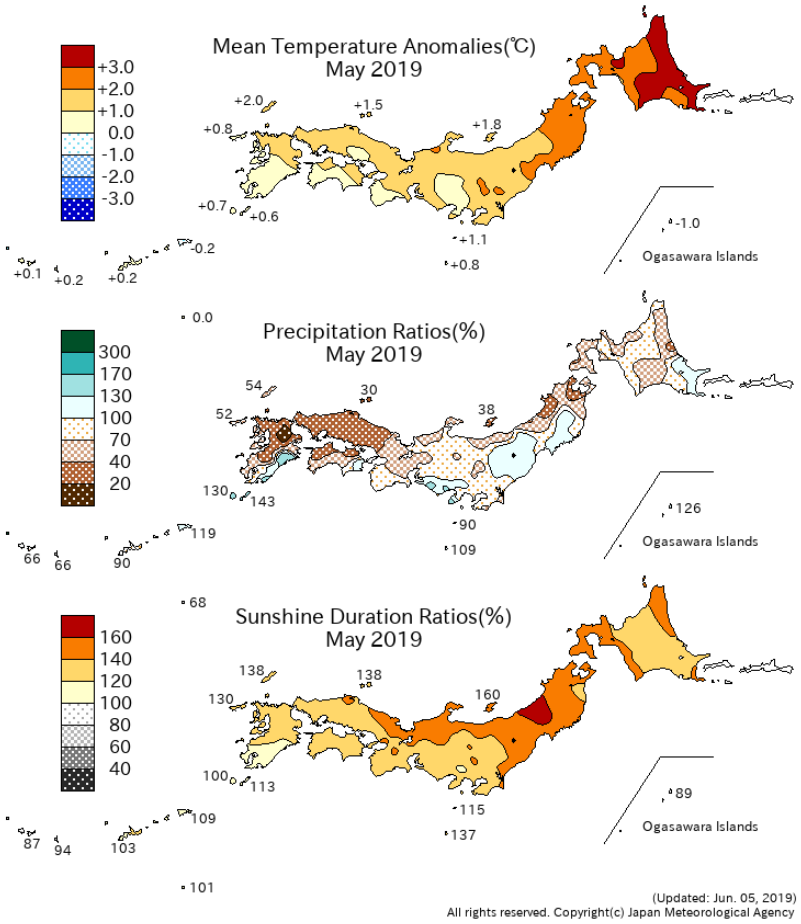

Fig. 1 Monthly climate anomaly/ratio over Japan (May 2019)
Top: temperature anomalies (degree C)
Middle: precipitation ratio (%)
Bottom: sunshine duration ratio (%)
The base period for the normal is 1981-2010.

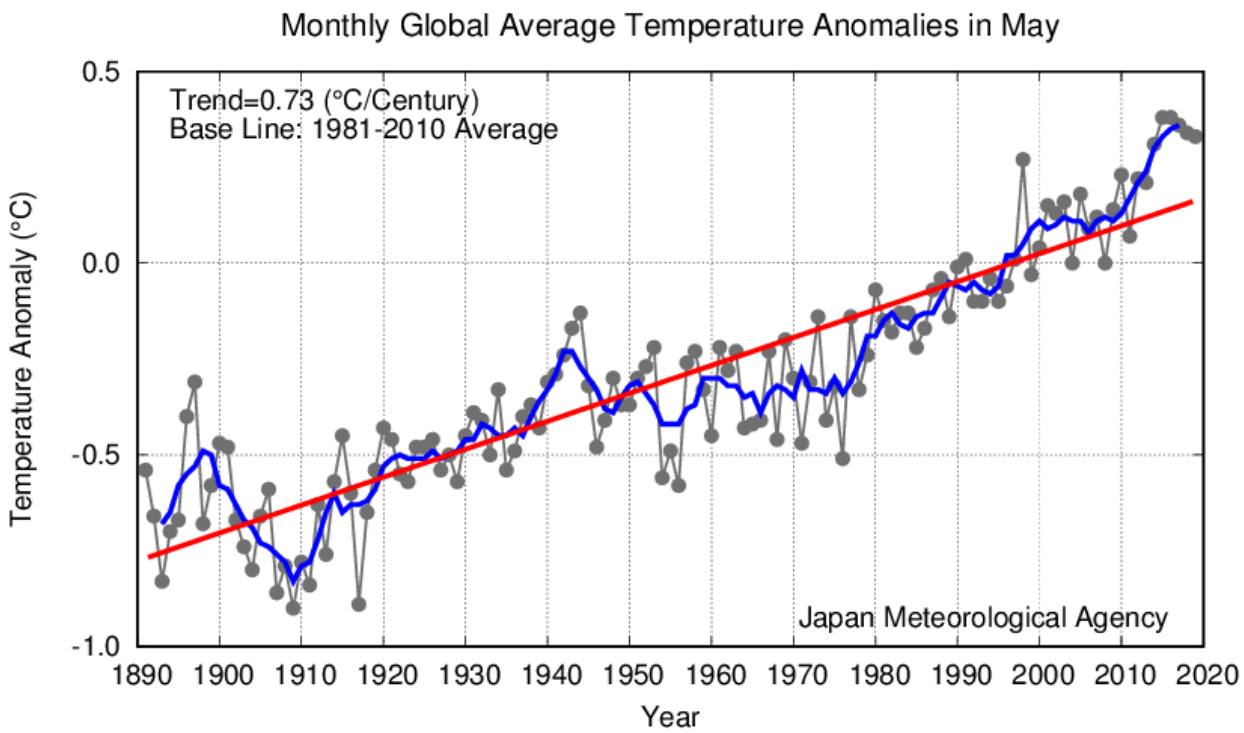

Fig. 2 Long-term change in monthly anomalies of global average surface temperature in May
The thin black line indicates anomalies of the surface temperature in each year. The blue line indicates five-year running mean, and the red line indicates a long-term linear trend. Anomalies are deviations from the 1981-2010 average.

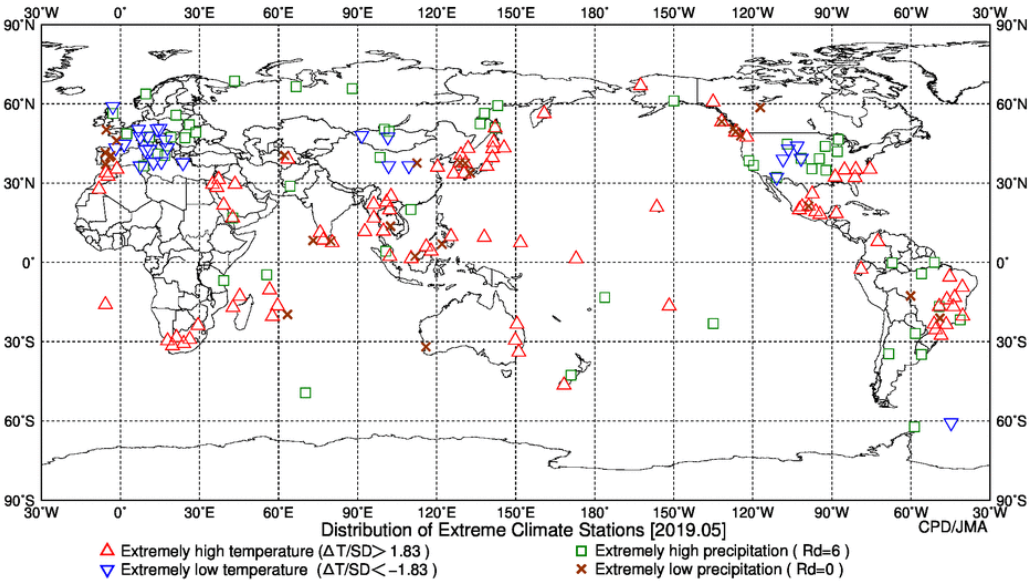

Fig. 3 Distribution of extreme climate stations (May 2019)

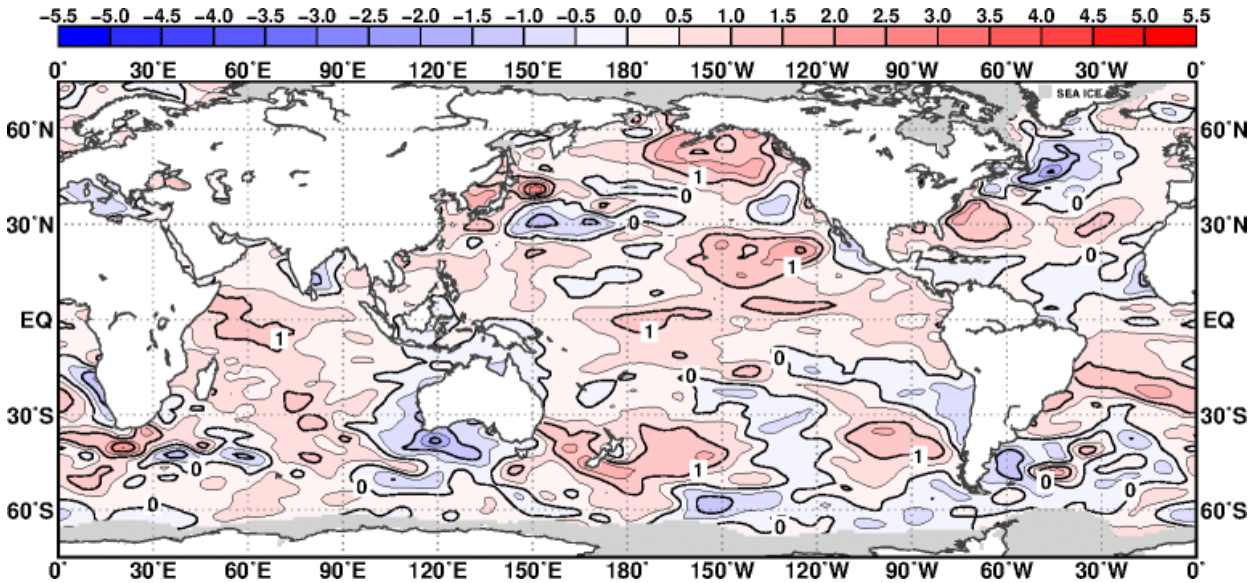

Fig. 4 Monthly mean sea surface temperature anomaly (May 2019)

The contour interval is 0.5 degree C. The base period for the normal is 1981-2010. Maximum coverage with sea ice is shaded in gray.

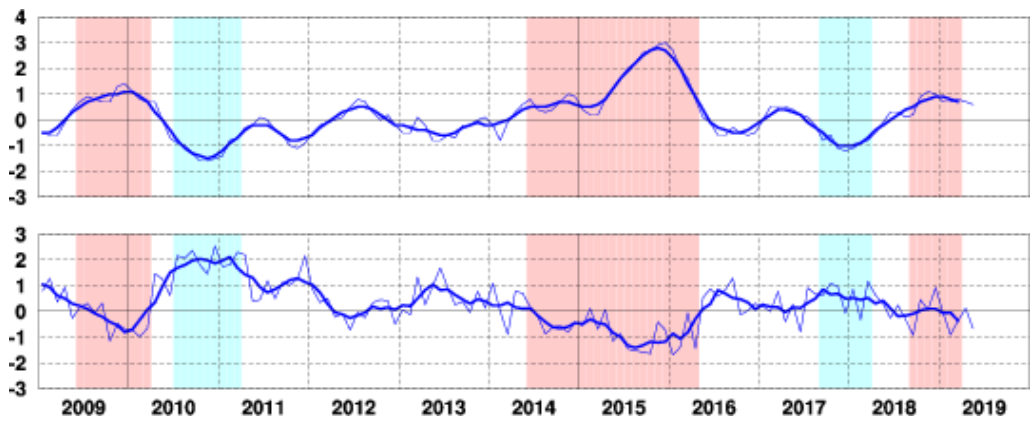

Fig. 5 Time series of monthly mean SST departure (degree C) from the reference value defined as the immediate past 30-year mean SST averaged over the NINO.3 region (upper). Time series of the Southern Oscillation Index with respect to the 1981-2010 base period (lower).

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.

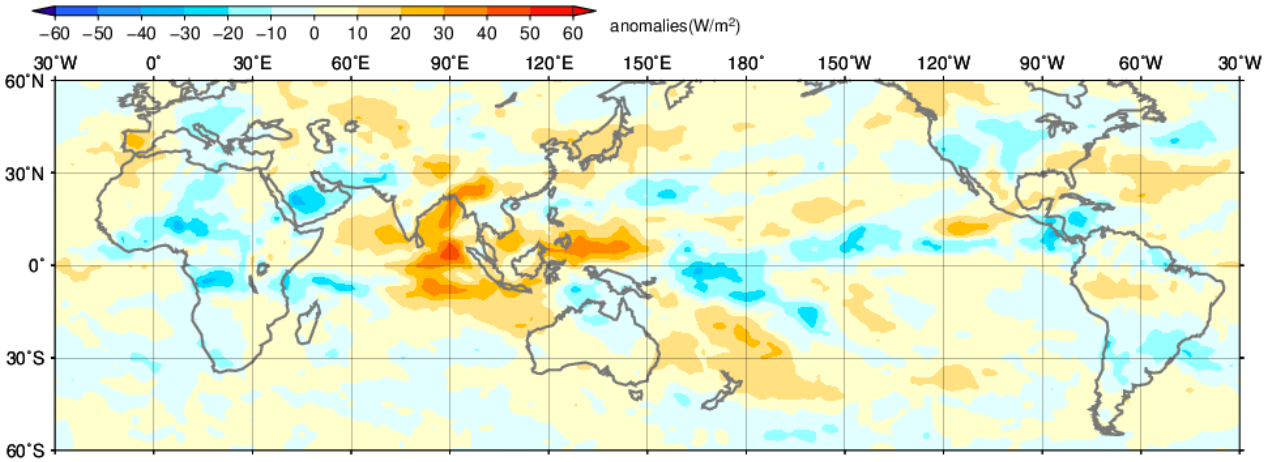

Fig. 6 Monthly mean Outgoing Longwave Radiation (OLR) anomaly (May 2019)
The contour interval is 10 W/m^2. The base period for the normal is 1981-2010. Original data provided by NOAA.

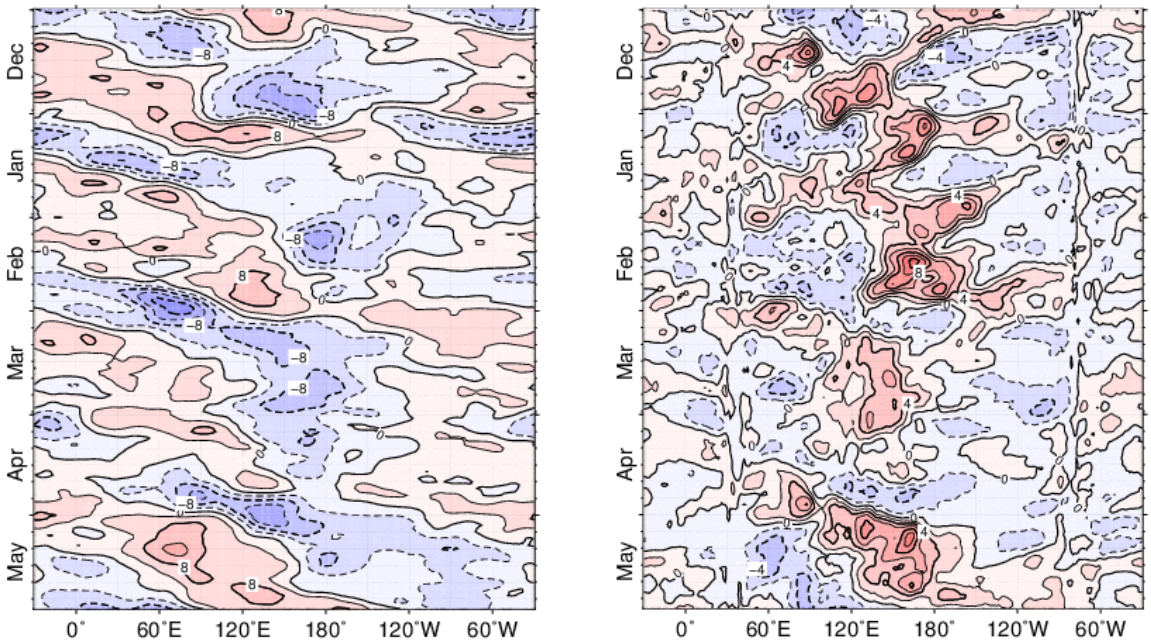

Fig. 7 Time-Longitude cross section (5°N-5°S) of five-day running mean 200-hPa velocity potential anomaly (left) and 850-hPa zonal wind anomaly (right) (December 2018 – May 2019)
The contour intervals are 4x10^6 m^2/s (left) and 2 m/s (right). The base period for the normal is 1981-2010.

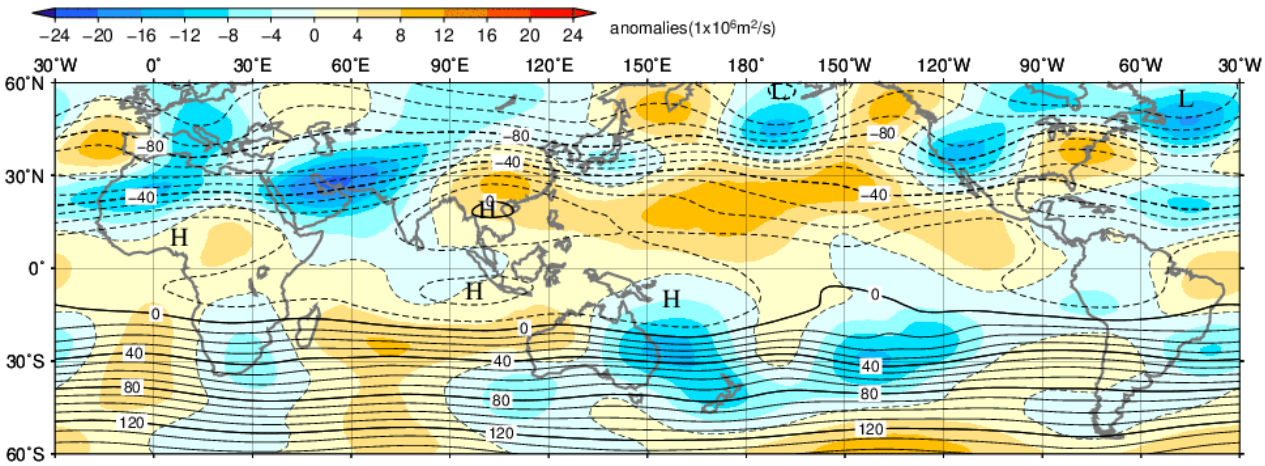

Fig. 8 Monthly mean 200-hPa stream function and anomaly (May 2019)
The contour interval is 10x10^6 m^2/s. The base period for the normal is 1981-2010.

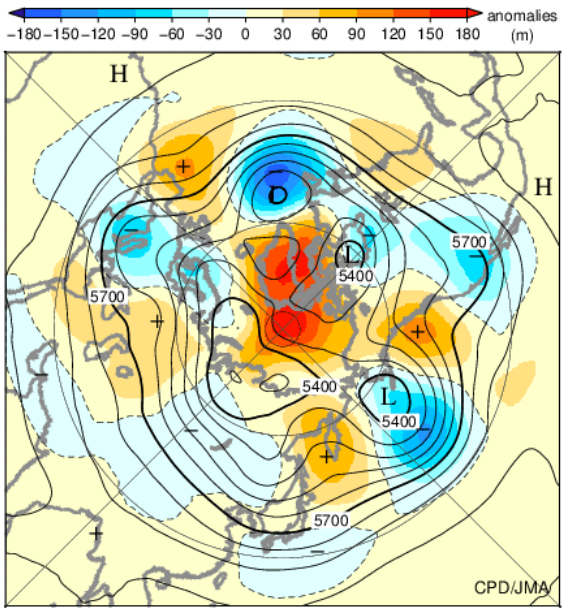

Fig. 9 Monthly mean 500-hPa height and anomaly in the Northern Hemisphere (May 2019)

The contours show 500-hPa height at intervals of 60 m. The shading indicates its anomalies. The base period for the normal is 1981-2010.

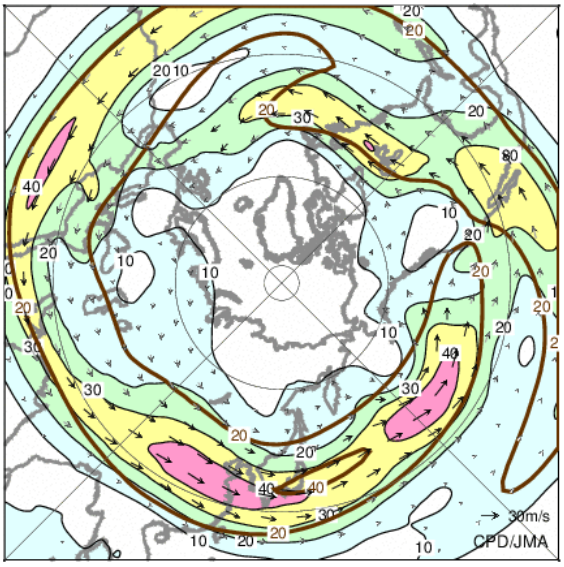

Fig. 10 Monthly mean 200-hPa wind speed and vectors in the Northern Hemisphere (May 2019)

The black lines show wind speed at intervals of 10 m/s. The brown lines show its normal at intervals of 20 m/s. The base period for the normal is 1981-2010.

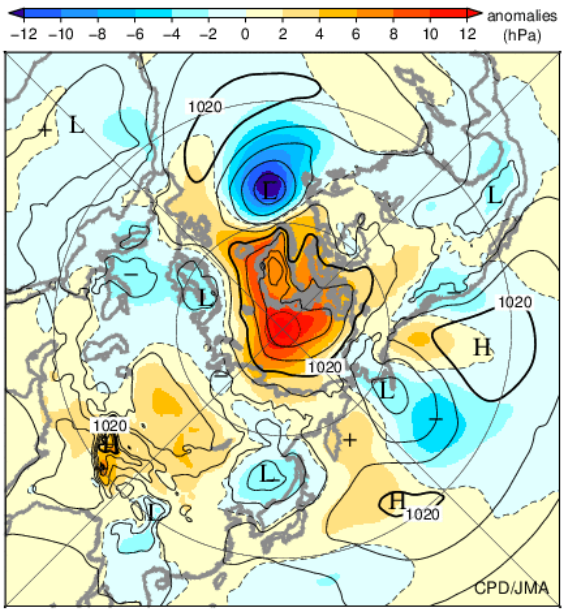

Fig. 11 Monthly mean sea level pressure and anomaly in the Northern Hemisphere (May 2019)

The contours show sea level pressure at intervals of 4 hPa. The shading indicates its anomalies. The base period for the normal is 1981-2010.

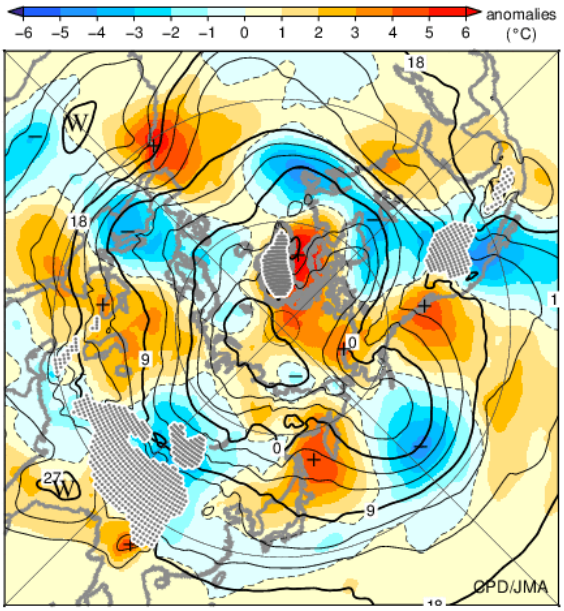

Fig. 12 Monthly mean 850-hPa temperature and anomaly in the Northern Hemisphere (May 2019)

The contours show 850-hPa temperature at intervals of 3 degree C. The shading indicates its anomalies. The base period for the normal is 1981-2010.

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