Monthly Highlights on the Climate System (July 2019)

Highlights in July 2019

- The monthly anomaly of the global average surface temperature was the warmest for July since 1891.
- Monthly precipitation amounts were significantly above normal on the Pacific side of eastern and western Japan.
- Monthly mean temperatures were extremely high in and around the southern part of Central Asia, from central Europe to the northern part of Northern Africa, in and around Alaska, and from the southern part of North America to the northwestern part of South America.
- In the equatorial Pacific, remarkably positive SST anomalies were observed in the area near the date line.
- Convective activity was enhanced over the latitude band of 15°N in Africa, the western equatorial Indian Ocean, and the central tropical Pacific except the equatorial region, and was suppressed from the central tropical Indian Ocean to the Maritime Continent.
- In the 500-hPa height field, wave trains were dominant over the Northern Hemisphere mid- and high-latitudes, with positive anomalies around northern Greenland, over Western to Central Siberia, and Alaska, and negative anomalies over the East Siberian Sea, western Canada and Western Russia.
- The subtropical jet stream shifted southward from its normal position over East Asia.

Climate in Japan (Fig. 1):

- From the beginning of the month to the first half of the last ten days, cloudy and rainy days were dominant all over Japan, due to the Baiu front and the Okhotsk High. In addition, due to the effects of Tropical Storm DANAS (T1905) and NARI (T1906), monthly precipitation amounts were significantly above normal on the Pacific side of eastern and western Japan.
- Around the end of the month, sunny and hot days were dominant nationwide since the North Pacific Subtropical High increased its strength and enlarged its area to the mainland of Japan.

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 +0.43°C (tied with 2016 as the warmest for July since 1891) (preliminary value) (Fig. 2). On a longer time scale, global average surface temperatures have risen at a rate of about 0.70°C per century in July (preliminary value).
- Extreme climate events were as follows (Fig. 3).
    - Monthly mean temperatures were extremely high from the central to southern part of Central Siberia, from the central part of Southeast Asia to the southern part of South Asia, in and around the southern part of Central Asia, from central Europe to the northern part of Northern Africa, in and around Alaska, from the southern part of North America to the northwestern part of South America, and from eastern to southeastern Australia.
    - Monthly precipitation amounts were extremely high around the Mediterranean Sea.
    - Monthly precipitation amounts were extremely low from the northwestern to southern part of Southeast Asia and from northern to central Europe.

Oceanographic Conditions (Fig. 4):

- In the equatorial Pacific, remarkably positive SST anomalies were observed in the area near the date line. In the NINO.3 region, the monthly mean SST anomaly was +0.1°C and the SST deviation from the latest sliding 30-year mean was 0.0°C (Fig.5).
- In the North Pacific, remarkably positive SST anomalies were observed in almost the entire area of the tropical region, east of the Kurile Islands and from the area around the Aleutian Islands to the western coast of North America.

- In the South Pacific, remarkably positive SST anomalies were observed in almost the entire region west of 140°W, and remarkably negative SST anomalies were observed from the western coast of Chile to the area around 15°S, 115°W.
- In the Indian Ocean, remarkably positive SST anomalies were observed in almost the entire region, while remarkably negative SST anomalies were observed south of Java and in the southwestern coast of Australia.
- In the North Atlantic, remarkably positive SST anomalies were observed from the Gulf of Mexico to the area near 35°N, 25°W and south of Greenland.

Tropics:

- Convective activity was enhanced over the latitude band of 15°N in Africa, the western equatorial Indian Ocean, and the central tropical Pacific except the equatorial region, and was suppressed from the central tropical Indian Ocean to the Maritime Continent, over the western tropical North Pacific, and around the Caribbean Sea (Fig. 6).
- The active phase of equatorial intraseasonal oscillation propagated eastward from South America to the Maritime Continent. From mid-July, another active phase propagated eastward from the western Pacific to the Atlantic (Fig. 7).
- In the upper troposphere, anti-cyclonic circulation anomalies were seen over a wide area from the tropical North Atlantic to the tropical North Pacific (Fig. 8).
- In the lower troposphere, cyclonic circulation anomalies straddling the equator were seen around the date line of the tropical Pacific, and anti-cyclonic circulation anomalies straddling the equator were seen over the eastern tropical Indian Ocean.
- In the sea level pressure field, near the equator, positive anomalies were seen over the Maritime Continent, and negative anomalies were seen over the western Indian Ocean and around the date line. The Southern Oscillation Index value was -0.7 (Fig. 5).

Extratropics:

- In the 500-hPa height field (Fig. 9), wave trains were dominant over the Northern Hemisphere mid- and high-latitudes with positive anomalies around northern Greenland, over Western to Central Siberia, and Alaska, and negative anomalies over the East Siberian Sea, western Canada and Western Russia.
- The polar front jet stream meandered northward from Western Siberia to the north of Japan, and the subtropical jet stream shifted southward from its normal position over East Asia (Fig. 10).
- In the sea level pressure field (Fig. 11), positive anomalies were seen over the northern polar region, the southwestern part of East Asia, and the seas southwest of the Kamchatka Peninsula, and negative anomalies were seen over the East Siberian Sea, central Canada, the mid-latitudes in North Atlantic, and Western Russia.
- Temperatures at 850-hPa were above normal around Greenland, over western Europe, east of the Caspian Sea, Western to Central Siberia, Alaska, and the central part of North Pacific, and below normal over Western Russia, the East Siberian Sea, western Canada, and the East China Sea (Fig. 12).
- Zonal mean temperatures in the troposphere were generally above normal except around 55°S.

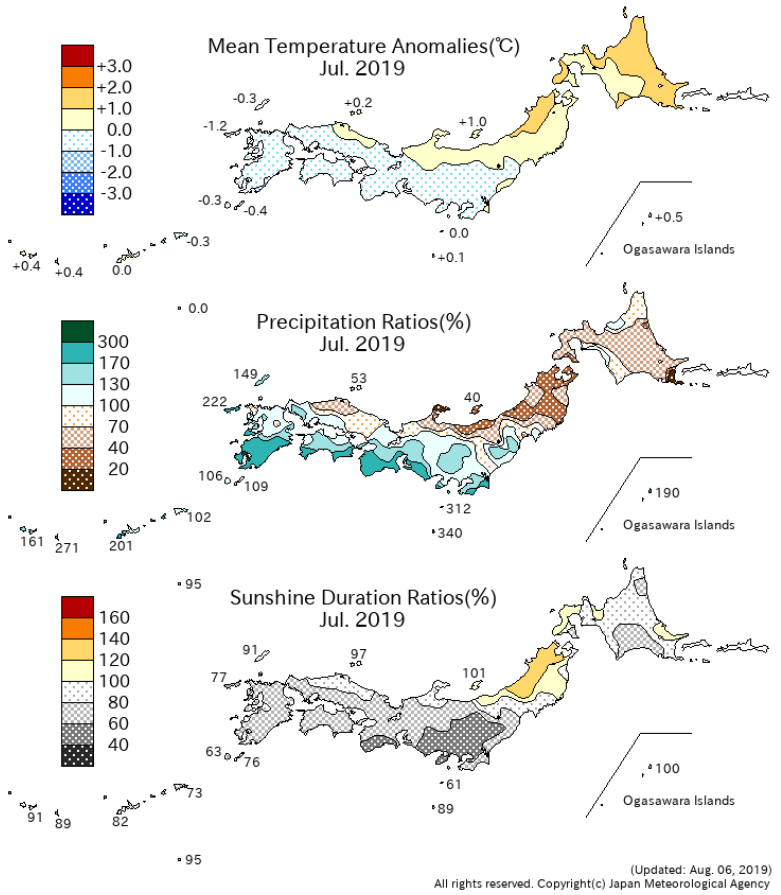

Fig. 1 Monthly climate anomaly/ratio over Japan (July 2019)
Top: temperature anomalies (degree C)
Middle: precipitation ratio (%)
Bottom: sunshine duration ratio (%)
The base period for the normal is 1981-2010.

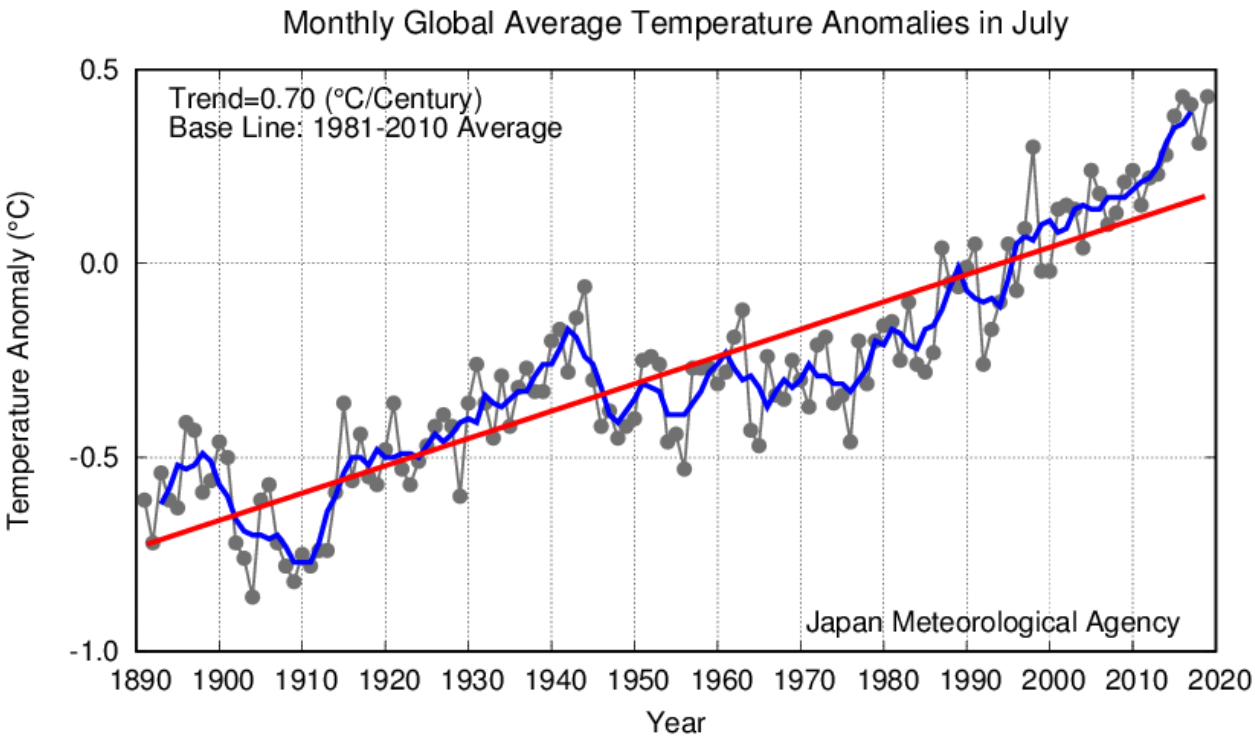

Fig. 2 Long-term change in monthly anomalies of global average surface temperature in July
The thin black line indicates anomalies of the surface temperature in each year. The blue line indicates five-year running mean, and the red line indicates a long-term linear trend. Anomalies are deviations from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

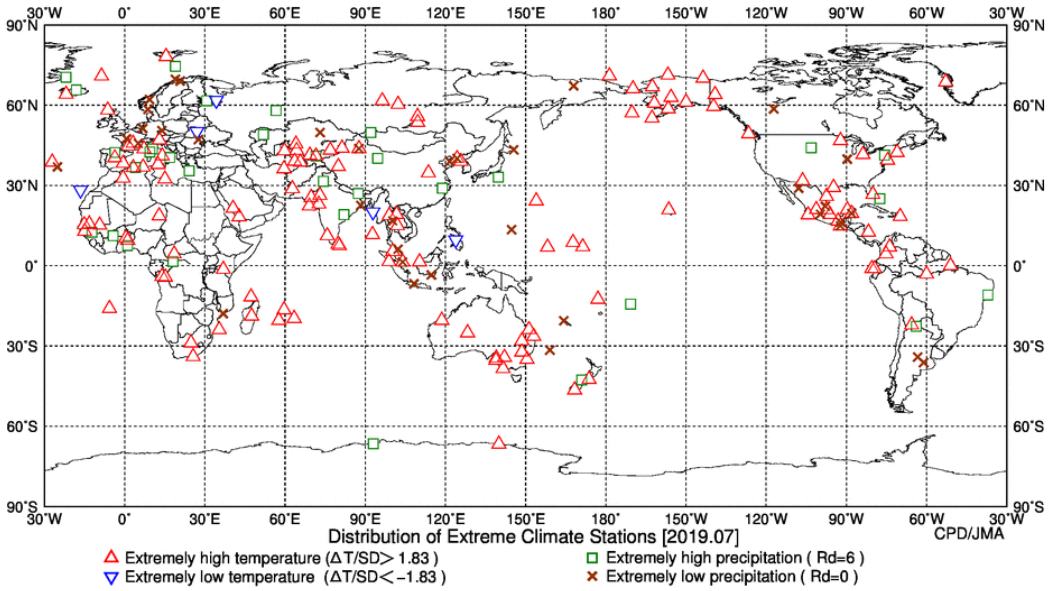

Fig. 3 Distribution of extreme climate stations (July 2019)

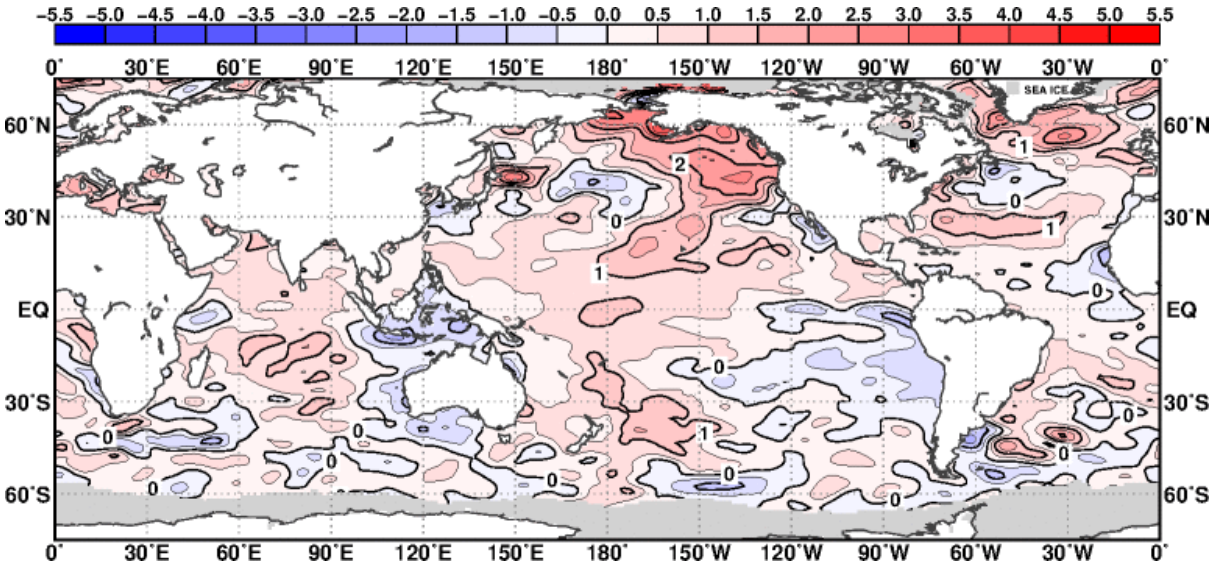

Fig. 4 Monthly mean sea surface temperature anomaly (July 2019)
The contour interval is 0.5 degree C. The base period for the normal is 1981-2010. Maximum coverage with sea ice is shaded in gray.

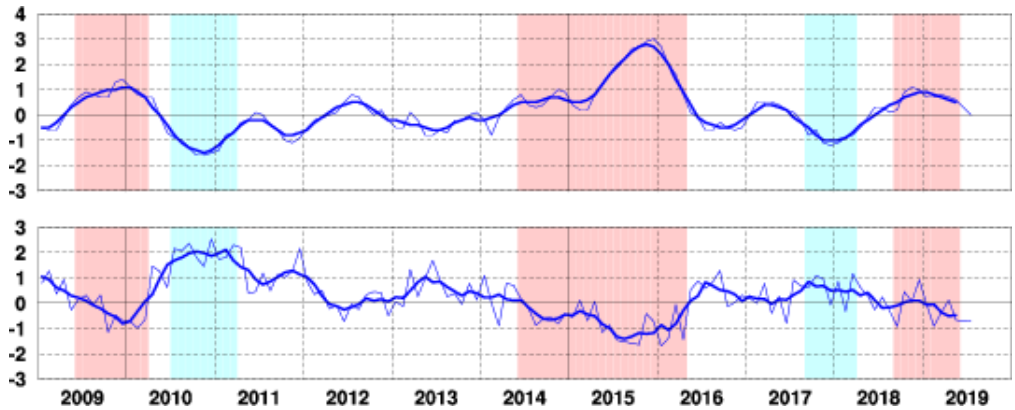

Fig. 5 Time series of monthly mean SST departure (degree C) from the reference value defined as the immediate past 30-year mean SST averaged over the NINO.3 region (upper). Time series of the Southern Oscillation Index with respect to the 1981-2010 base period (lower).
Thin blue lines represent monthly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

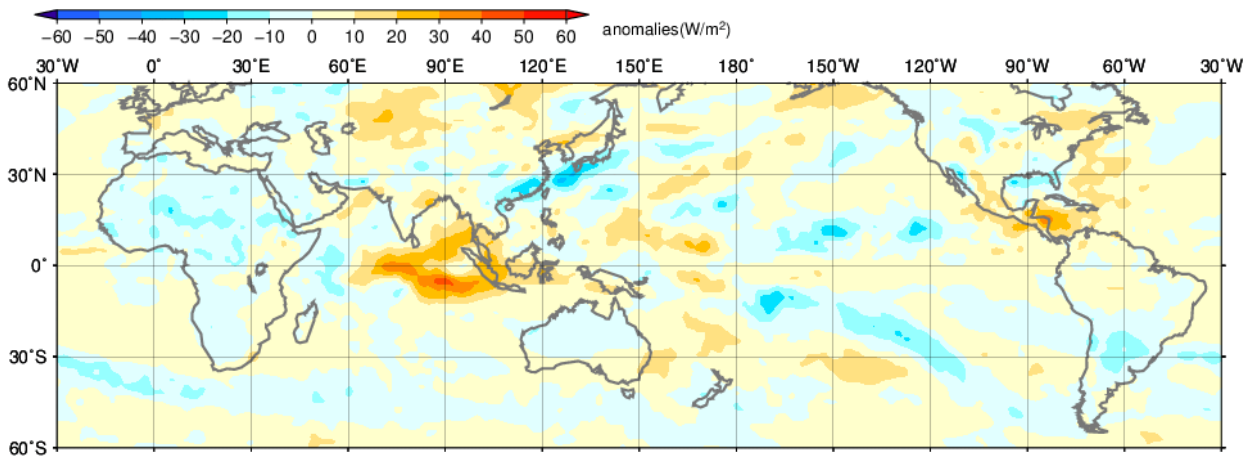

Fig. 6 Monthly mean Outgoing Longwave Radiation (OLR) anomaly (July 2019)
The contour interval is 10 W/m^2. The base period for the normal is 1981-2010. Original data provided by NOAA.

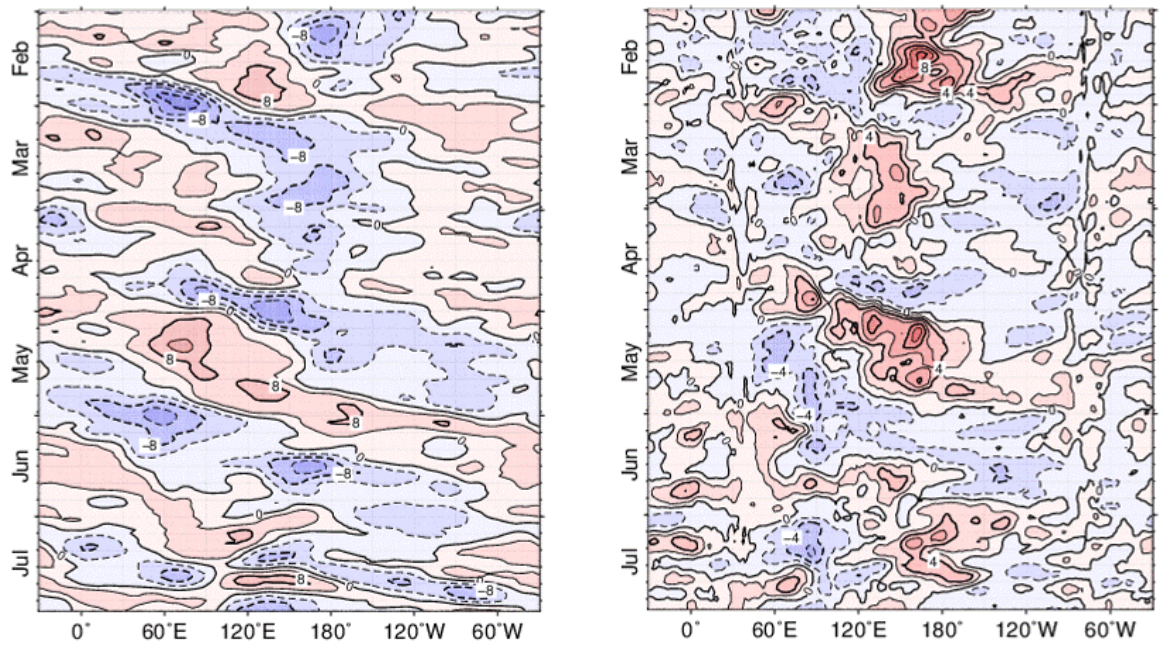

Fig. 7 Time-Longitude cross section (5°N-5°S) of five-day running mean 200-hPa velocity potential anomaly (left) and 850-hPa zonal wind anomaly (right) (February 2019 – July 2019)
The contour intervals are 4x10^6 m^2/s (left) and 2 m/s (right). The base period for the normal is 1981-2010.

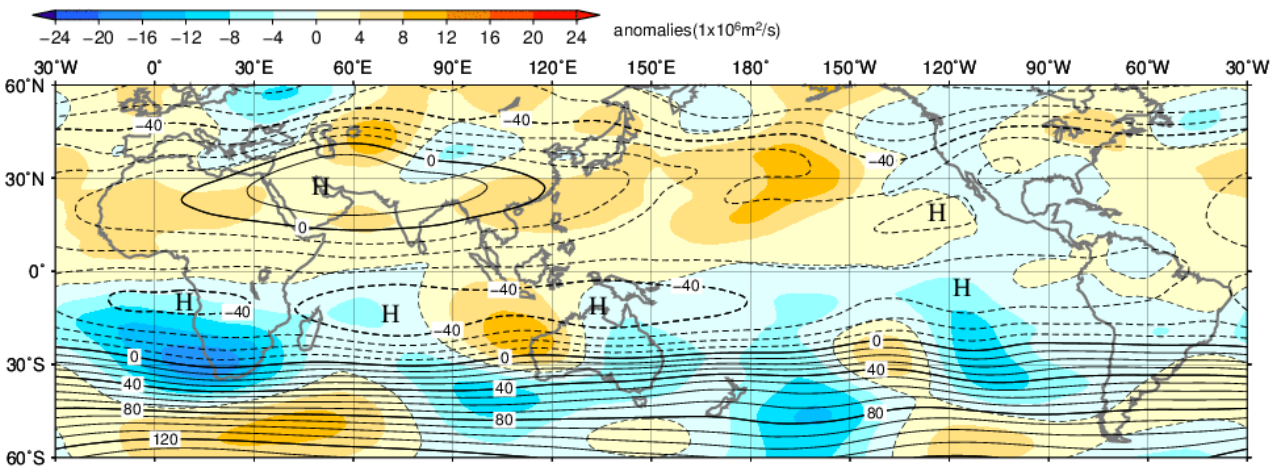

Fig. 8 Monthly mean 200-hPa stream function and anomaly (July 2019)
The contour interval is 10x10^6 m^2/s. The base period for the normal is 1981-2010.

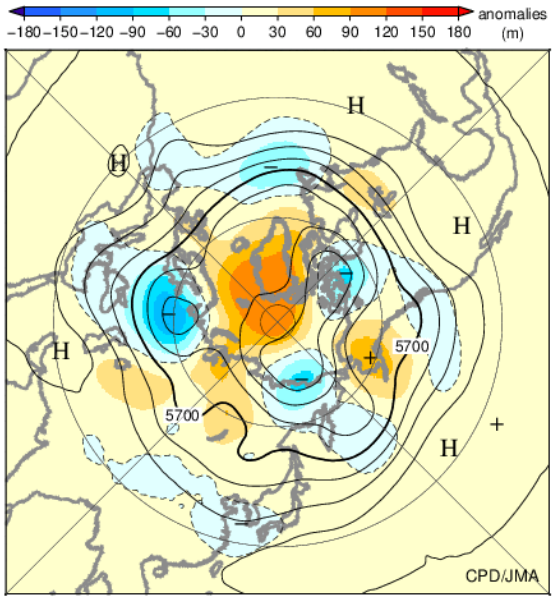

Fig. 9 Monthly mean 500-hPa height and anomaly in the Northern Hemisphere (July 2019)

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.

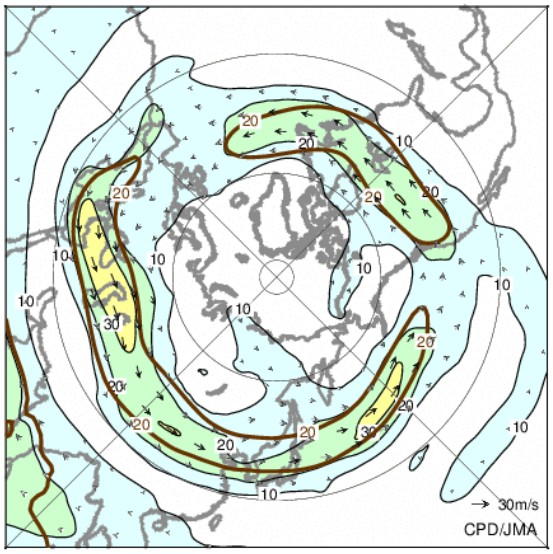

Fig. 10 Monthly mean 200-hPa wind speed and vectors in the Northern Hemisphere (July 2019)

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.

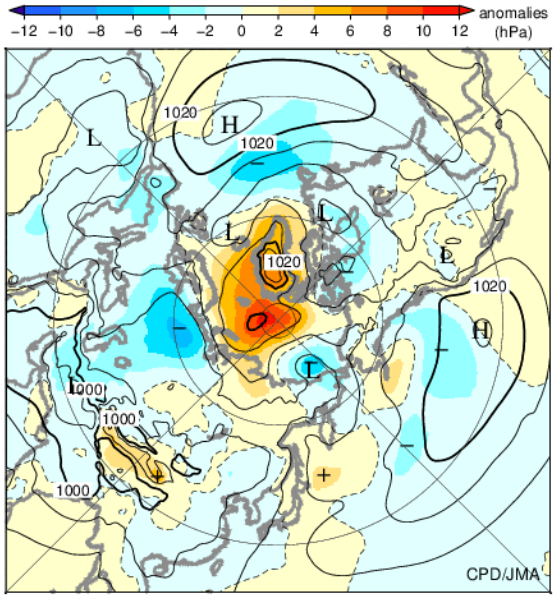

Fig. 11 Monthly mean sea level pressure and anomaly in the Northern Hemisphere (July 2019)

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.

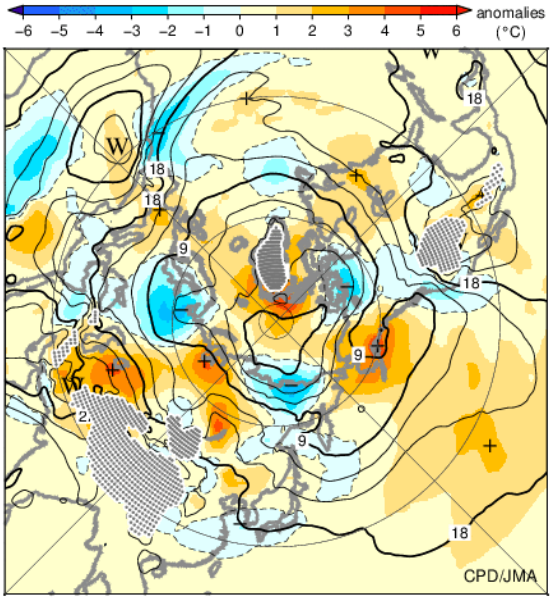

Fig. 12 Monthly mean 850-hPa temperature and anomaly in the Northern Hemisphere (July 2019)

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.