

## Monthly Highlights on the Climate System (September 2019)

### Highlights in September 2019

- Monthly mean temperatures were significantly above normal from northern to western Japan.
- Monthly mean temperatures were extremely high from eastern Japan to Mongolia, from southwestern Tajikistan to Saudi Arabia, from the western part of Western Africa to the western part of Middle Africa, from Mauritius to southern Kenya, from the eastern USA to southern Mexico, and in and around central Brazil.
- In the equatorial Pacific, remarkably positive SST anomalies were observed in the western part.
- Convective activity was enhanced from the southern part of the Middle East to the central part of South Asia, and over the western equatorial Indian Ocean, the seas northeast of the Philippines, and the latitude band of 15°N in the central to eastern Pacific, and was suppressed from the southeastern tropical Indian Ocean to the Maritime Continent.
- In the 500-hPa height field, positive anomalies were seen over the northern polar region, the northeastern part of East Asia, the seas south of Alaska, the eastern USA, and the seas west of Europe, and negative anomalies were seen over the northeast of the Caspian Sea and over Eastern Siberia.

### Climate in Japan (Fig. 1):

- Monthly mean temperatures were significantly above normal from northern to western Japan because these regions were covered with warm air and high pressure systems, which brought hot and sunny conditions.
- Five typhoons approached Japan during the month. Typhoon FAXAI (T1915) made landfall in Kanto region on 9th September and brought unprecedented strong winds in and around the Pacific side of eastern Japan, causing severe damage.

### 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 +0.44°C (2nd warmest for September since 1891) (preliminary value) (Fig. 2). On a longer time scale, global average surface temperatures have risen at a rate of about 0.67°C per century in September (preliminary value).
- Extreme climate events were as follows (Fig. 3).
  - Monthly mean temperatures were extremely high from eastern Japan to Mongolia, from southwestern Tajikistan to Saudi Arabia, from the western part of Western Africa to the western part of Middle Africa, from Mauritius to southern Kenya, from the eastern USA to southern Mexico, and in and around central Brazil.
  - Monthly precipitation amounts were extremely high from central India to Sri Lanka and in the northern USA.
  - Monthly precipitation amounts were extremely low in and around the southwestern part of Southeast Asia, and from southern Paraguay to eastern Argentina.

### Oceanographic Conditions (Fig. 4):

- In the equatorial Pacific, remarkably positive SST anomalies were observed in the western part. In the NINO.3 region, the monthly mean SST anomaly and the SST deviation from the latest sliding 30-year mean were both -0.3°C (Fig. 5).
- In the North Pacific, remarkably positive SST anomalies were widely observed except from the South China Sea to east of the Philippines, and the area near 40°N, 170°E.
- In the South Pacific, remarkably positive SST anomalies were observed from east of New Guinea to the area near 50°S, 140°W, and remarkably negative SST anomalies were observed from the western coast of Chile to the area near 15°S, 120°W.

- In the Indian Ocean, remarkably positive SST anomalies were widely observed west of 90°E, and remarkably negative SST anomalies were observed near Indonesia.
- In the North Atlantic, remarkably positive SST anomalies were widely observed south of 40°N except the western coast of Africa.

### **Tropics:**

- Convective activity was enhanced from the southern part of the Middle East to the central part of South Asia, and over the western equatorial Indian Ocean, the seas northeast of the Philippines, and the latitude band of 15°N in the central to eastern Pacific, and was suppressed from the southeastern tropical Indian Ocean to the Maritime Continent (Fig. 6).
- The active phase of equatorial intraseasonal oscillation propagated eastward from the Maritime Continent to Africa (Fig. 7).
- In the upper troposphere, anti-cyclonic circulation anomalies were seen over a wide area of both hemispheres (Fig. 8).
- In the lower troposphere, cyclonic circulation anomalies were seen near the southern part of the Middle East, over the latitude band of 15°N in the western to central Pacific, and over the tropical North Atlantic, and anti-cyclonic circulation anomalies straddling the equator were seen over the eastern tropical Indian Ocean.
- In the sea level pressure field, in the equatorial area, positive anomalies were seen from the eastern Indian Ocean via the Pacific to the western Atlantic and over Africa, and negative anomalies were seen over the eastern Atlantic and the western Indian Ocean. The Southern Oscillation Index value was -1.2 (Fig. 5).

### **Extratropics:**

- In the 500-hPa height field (Fig. 9), positive anomalies were seen over the northern polar region, the northeastern part of East Asia, the seas south of Alaska, the eastern USA, and the seas west of Europe, and negative anomalies were seen over the northeast of the Caspian Sea and over Eastern Siberia. Wave trains were seen from Western Russia to East Asia and over the mid-latitudes in the North Pacific.
- The westerly jet stream was stronger than normal over the Caspian Sea and northern Japan, and shifted northward from its normal position over the central part of East Asia and the seas west of Europe (Fig. 10).
- In the sea level pressure field (Fig. 11), positive anomalies were seen over the northern polar region, Japan, the seas south of Alaska, eastern Canada, and the seas west of Europe, and negative anomalies were seen from Western Siberia to the Bering Sea, and over the central USA and the west of Greenland.
- Temperatures at 850-hPa were above normal over the northern polar region, the northern part of East Asia, the seas south of Alaska, the eastern USA, and the seas west of Europe, and below normal over the northeast of the Caspian Sea (Fig. 12).
- Zonal mean temperatures in the troposphere were generally above normal except the high latitudes in the Southern Hemisphere.

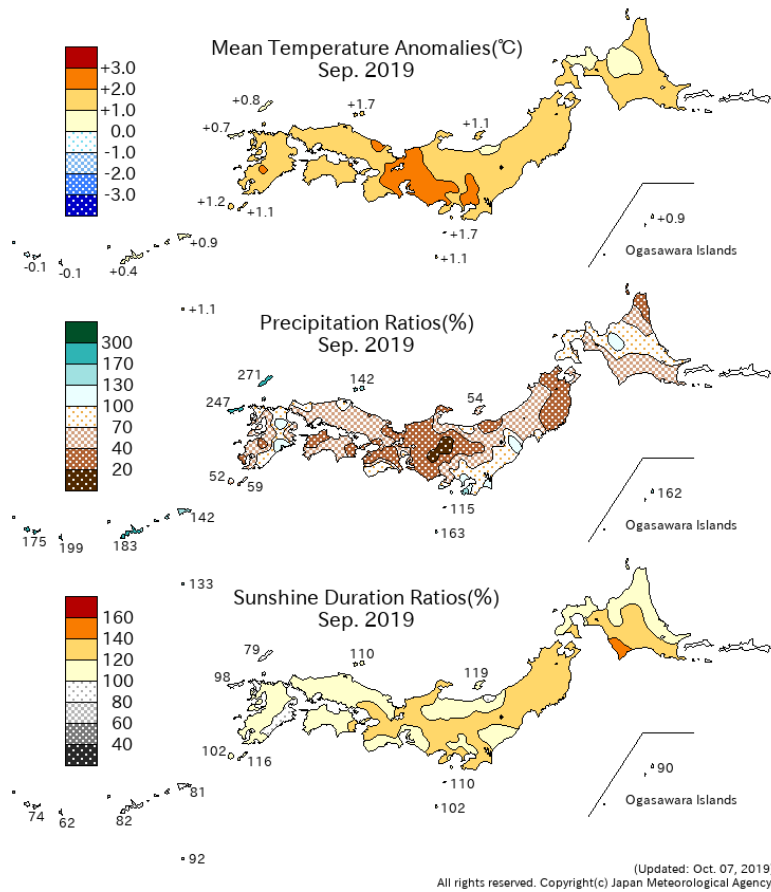


Fig. 1 Monthly climate anomaly/ratio over Japan (September 2019)  
Top: temperature anomalies (degree C)  
Middle: precipitation ratio (%)  
Bottom: sunshine duration ratio (%)  
The base period for the normal is 1981-2010.

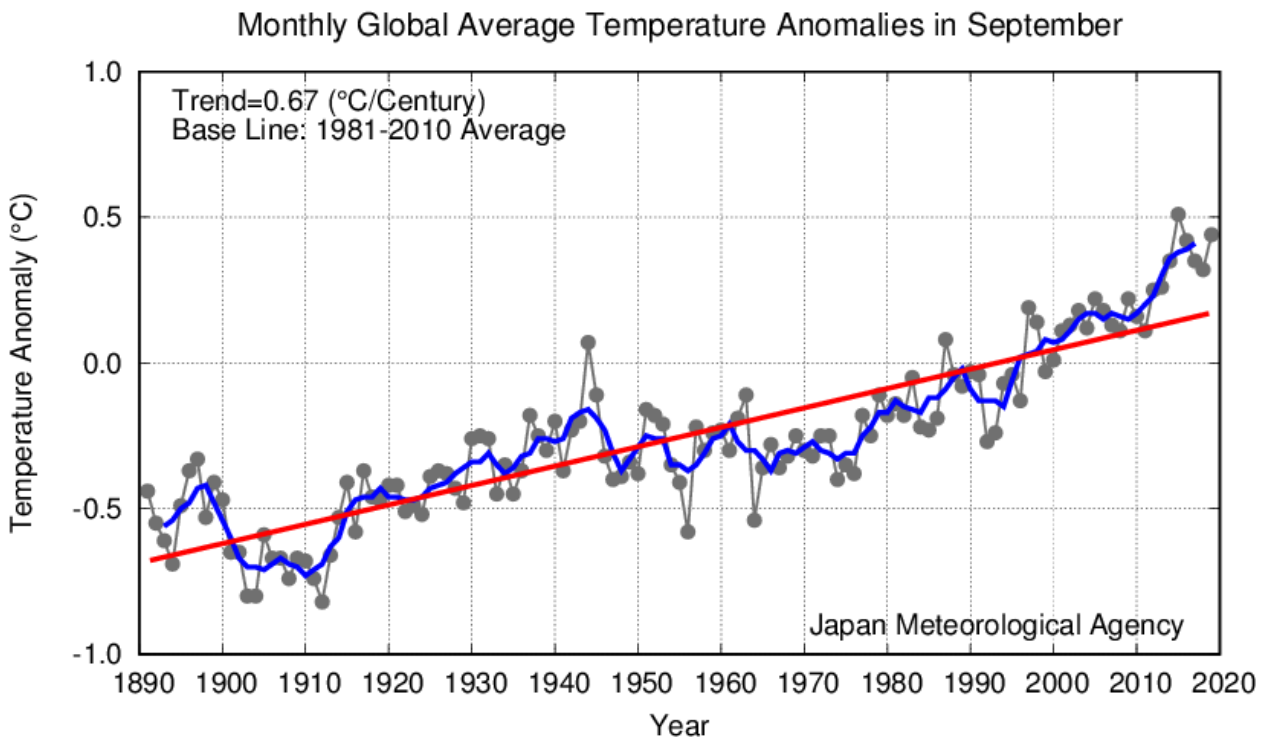


Fig. 2 Long-term change in monthly anomalies of global average surface temperature in September. The thin black line indicates anomalies of the surface temperature in each year. The blue line indicates five-year running mean, and the red line indicates a long-term linear trend. Anomalies are deviations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

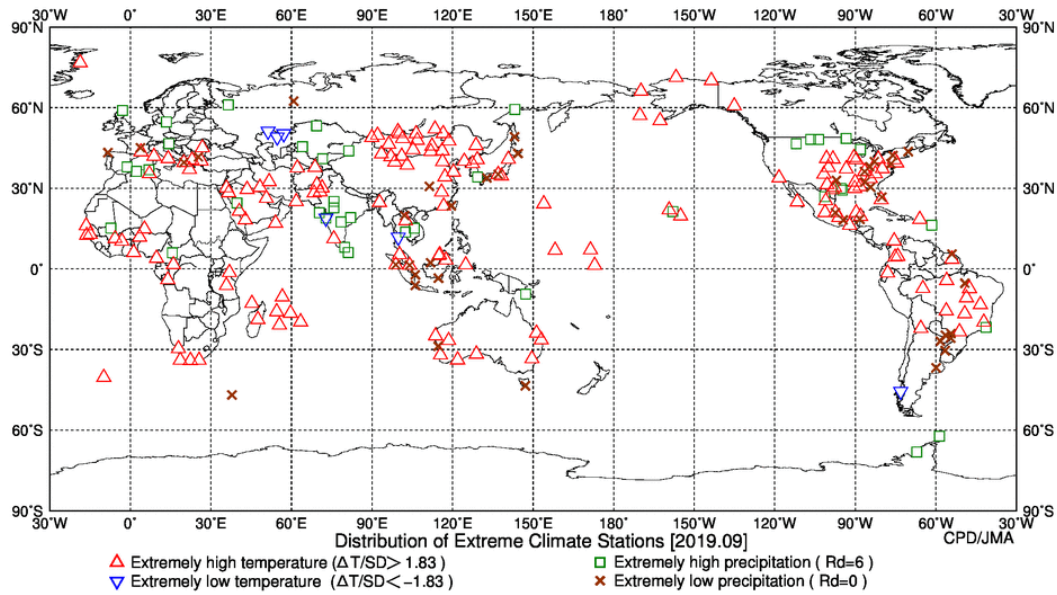


Fig. 3 Distribution of extreme climate stations (September 2019)

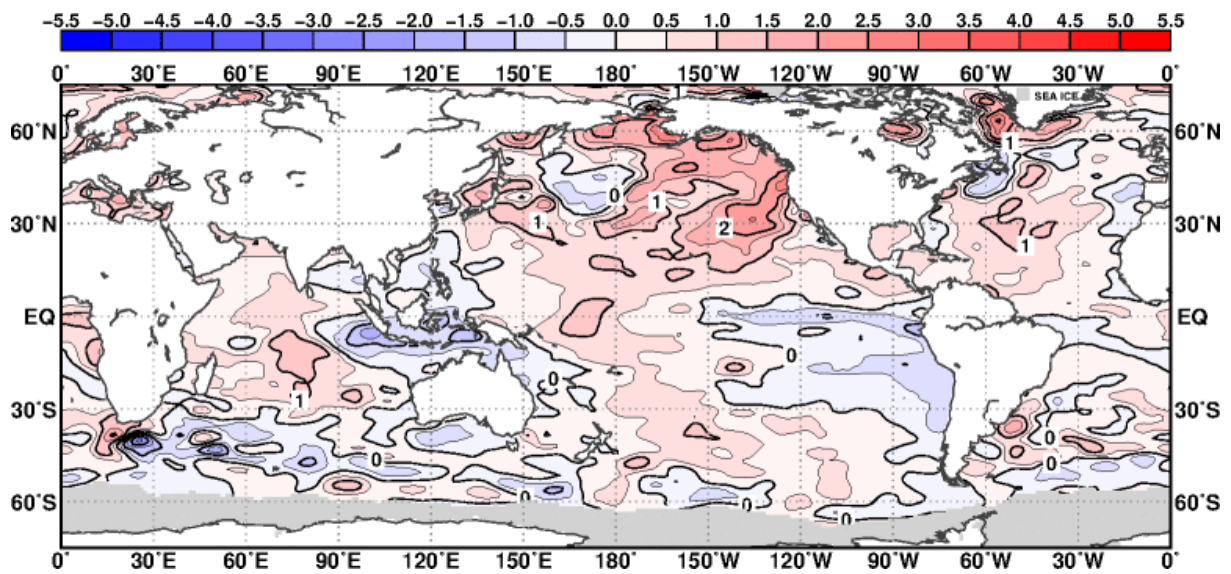


Fig. 4 Monthly mean sea surface temperature anomaly (September 2019)

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.

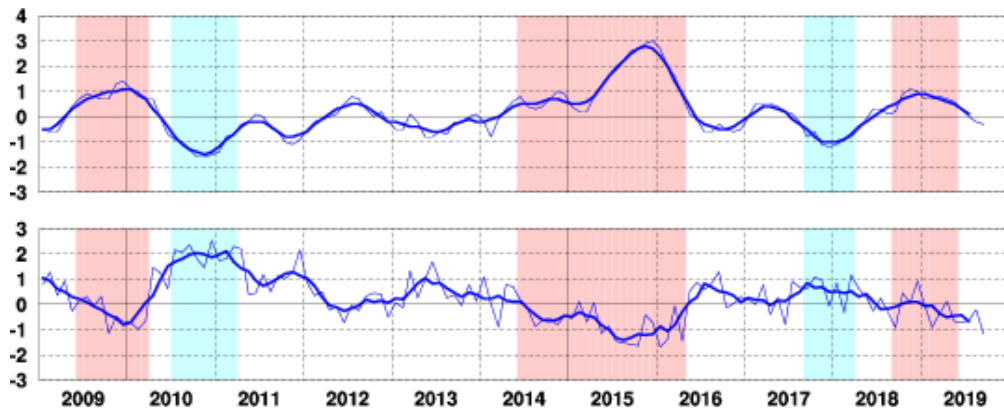


Fig. 5 Time series of monthly mean SST departure (degree C) from the reference value defined as the immediate past 30-year mean SST averaged over the NINO.3 region (upper). Time series of the Southern Oscillation Index with respect to the 1981-2010 base period (lower).

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.

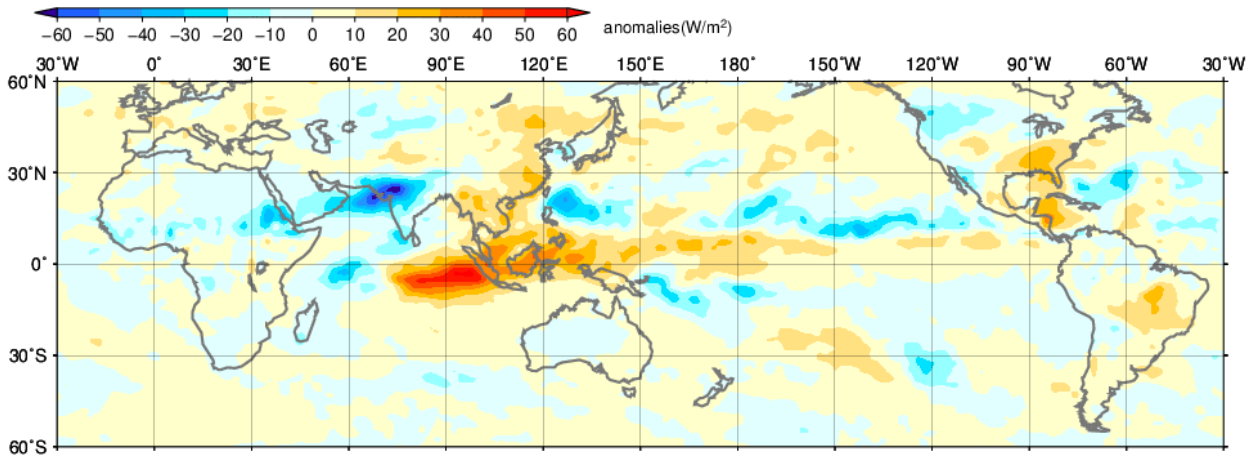


Fig. 6 Monthly mean Outgoing Longwave Radiation (OLR) anomaly (September 2019)  
The contour interval is 10 W/m<sup>2</sup>. The base period for the normal is 1981-2010. Original data provided by NOAA.

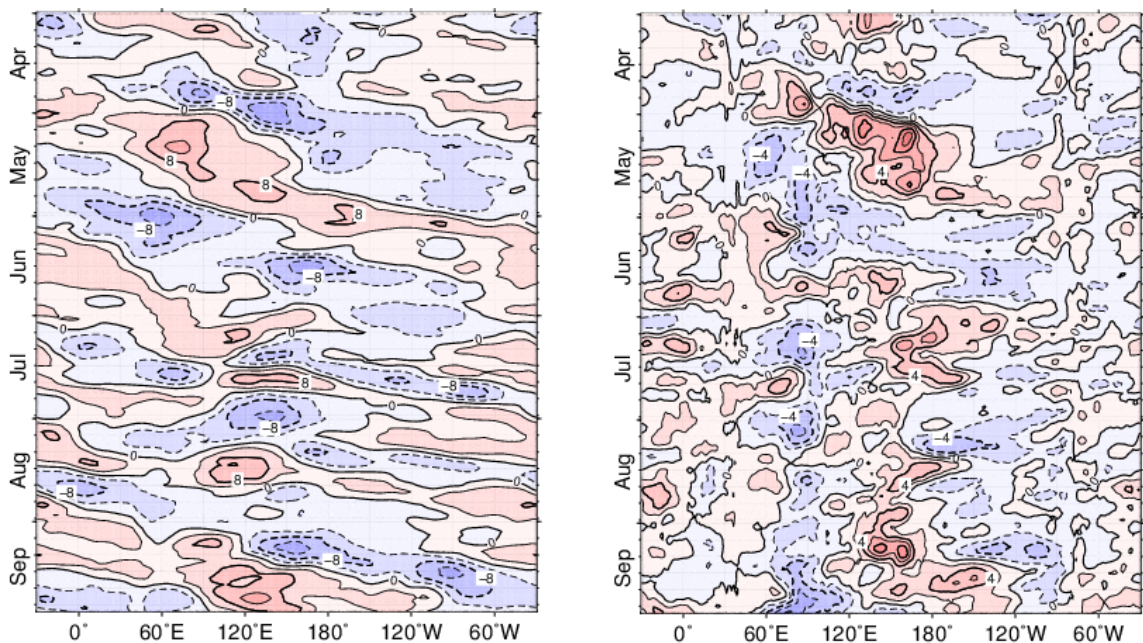


Fig. 7 Time-Longitude cross section (5°N-5°S) of five-day running mean 200-hPa velocity potential anomaly (left) and 850-hPa zonal wind anomaly (right) (April 2019 – September 2019)  
The contour intervals are 4x10<sup>6</sup> m<sup>2</sup>/s (left) and 2 m/s (right). The base period for the normal is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

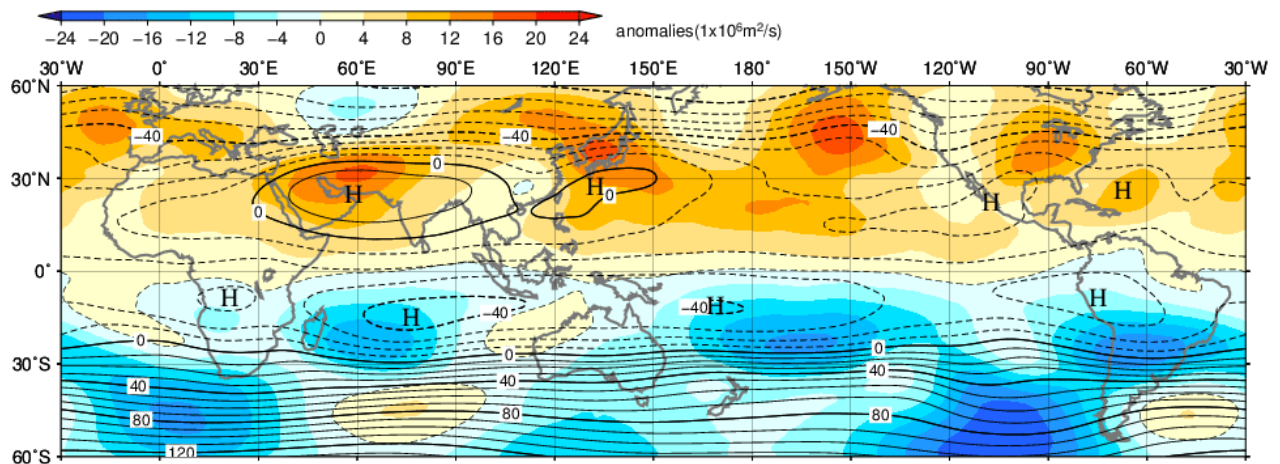


Fig. 8 Monthly mean 200-hPa stream function and anomaly (September 2019)  
The contour interval is 10x10<sup>6</sup> m<sup>2</sup>/s. The base period for the normal is 1981-2010.

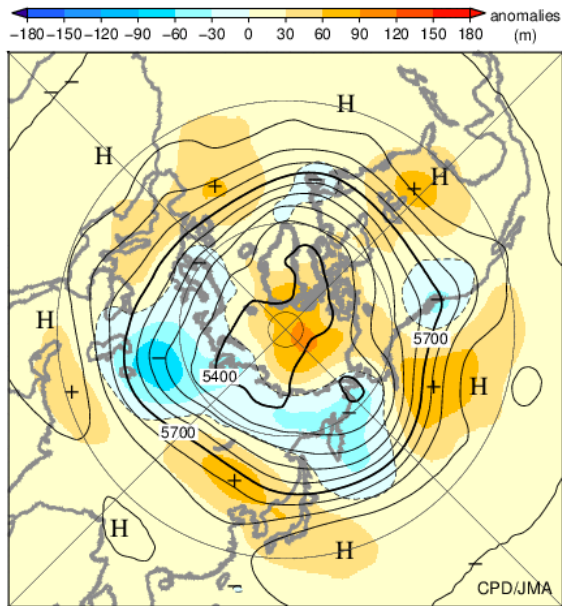


Fig. 9 Monthly mean 500-hPa height and anomaly in the Northern Hemisphere (September 2019)

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.

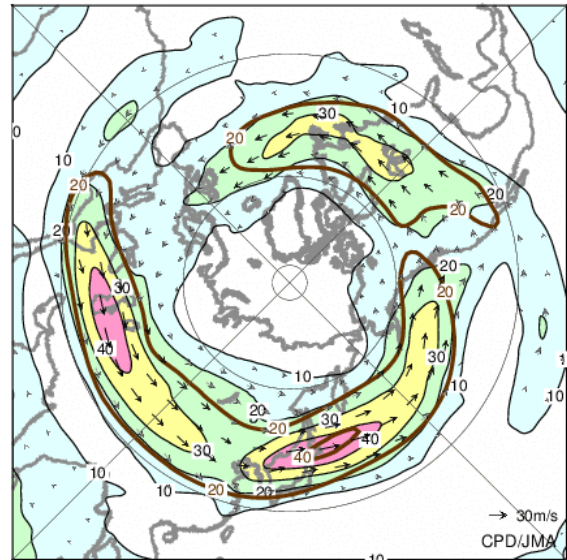


Fig. 10 Monthly mean 200-hPa wind speed and vectors in the Northern Hemisphere (September 2019)

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.

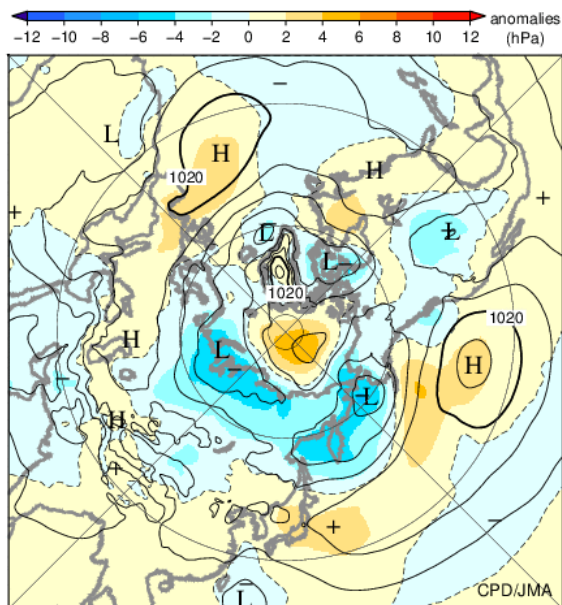


Fig. 11 Monthly mean sea level pressure and anomaly in the Northern Hemisphere (September 2019)

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.

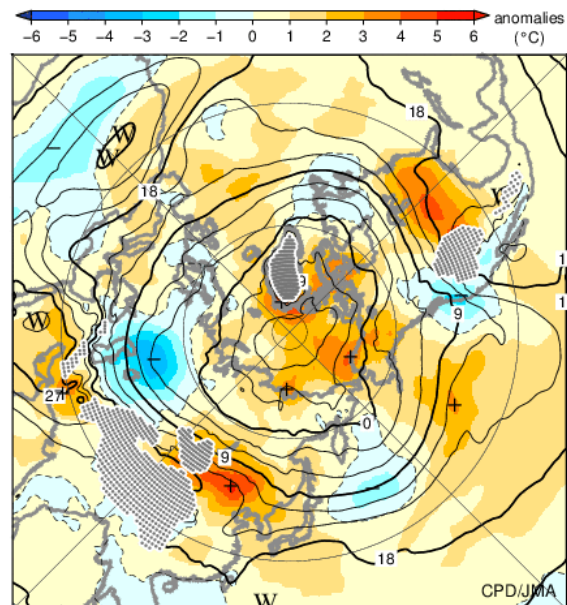


Fig. 12 Monthly mean 850-hPa temperature and anomaly in the Northern Hemisphere (September 2019)

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.