Monthly Highlights on the Climate System (December 2018)

Highlights in December 2018

- El Niño conditions are considered to have persisted in the equatorial Pacific (see El Niño Outlook updated on 10 January 2019).
- Monthly mean temperatures were significantly above normal in Okinawa/Amami.
- Monthly sunshine durations were significantly below normal on the Sea of Japan side of northern Japan, on the Pacific side of eastern Japan and in western Japan.
- Monthly mean temperatures were extremely high from Okinawa region of Japan to Southeast Asia, around the Kara Sea, in and around southwestern Europe, from northeastern to western Australia and from southeastern to southern Australia.
- Convective activity was enhanced from the Bay of Bengal to the Indochina Peninsula and over the latitudinal bands of 10°N over the central Pacific.
- In the 500-hPa height field, wave trains were seen from the North Atlantic to Japan with positive anomalies over southwestern Europe and from southeastern China to mainland Japan.
- The westerly jet stream shifted northward from its normal position from eastern China to the North Pacific.
- Stratospheric Sudden Warming was occurred in the Northern Hemisphere in mid-December.

Climate in Japan (Fig. 1):

- Monthly mean temperatures were significantly above normal in Okinawa/Amami, because the region was overlaid with warm air. Monthly sunshine durations were significantly below normal on the Sea of Japan side of northern Japan, on the Pacific side of eastern Japan and in western Japan as the regions were frequently affected by low pressure systems.

World Climate:

- The monthly anomaly of the global average surface temperature in December 2018 (i.e., the combined average of the near-surface air temperature over land and the SST) was +0.33°C (3rd warmest since 1891) (preliminary value) (Fig. 2). On a longer time scale, global average surface temperatures have risen at a rate of about 0.76°C per century in December (preliminary value).
- Extreme climate events were as follows (Fig. 3).
  - Monthly mean temperatures were extremely high from Okinawa region of Japan to Southeast Asia, around the Kara Sea, in and around southwestern Europe, from northeastern to western Australia and from southeastern to southern Australia.
  - Monthly mean temperatures were extremely low in the northwestern part of East Asia.
  - Monthly precipitation amounts were extremely high from western Japan to eastern China, from Myanmar to the northwestern Sumatra Island, and from central Europe to Turkey.
  - Monthly precipitation amounts were extremely low in and around southwestern Europe, in and around the northern part of South America, and from northern to eastern Australia.

Oceanographic Conditions (Fig. 4):

- In the equatorial Pacific, positive SST anomalies were observed in almost the entire region, in particular remarkably positive SST anomalies were observed west of the date line. In the NINO.3 region, the monthly mean SST anomaly was +0.9°C and the SST deviation from the latest sliding 30-year mean was +1.0°C (Fig.5).
- In the North Pacific, remarkably positive SST anomalies were observed in the central tropical region, from the South China Sea to far east of Japan, and from the Bering Sea to the western coast of North America.
- In the South Pacific, remarkably positive SST anomalies were observed from the western tropical region to the western coast of Chile and in the area near New Zealand, and remarkably negative SST anomalies were

observed off the western coast of Peru.

- In the Indian Ocean, remarkably positive SST anomalies were observed in almost northern part and from near Madagascar to the area near 35°S, 95°E, and remarkably negative SST anomalies were observed from the western coast of Australia to the area near 5°S, 80°E.
- In the North Atlantic, remarkably positive SST anomalies were observed in the equatorial area, and from the Caribbean Sea to the area near 35°N, 30°W, and remarkably negative SST anomalies were observed northeast of South America and from the eastern coast of North America to south of Greenland.

Tropics:

- Convective activity was enhanced over the central part of the tropical South Indian Ocean, from the Bay of Bengal to the Indochina Peninsula, over the western part of the tropical South Pacific, over the latitudinal bands of 10°N in the central Pacific and over the equatorial Atlantic, and was suppressed from the eastern part of the South Indian Ocean to Australia, the central part of the tropical South Pacific and from the Caribbean Sea to the tropical North Atlantic (Fig. 6).
- The active phase of equatorial intraseasonal oscillation propagated eastward with a large amplitude from Africa to the western Pacific (Fig. 7).
- In the upper troposphere, anticyclonic circulation anomalies straddling the equator were seen from the Indian Ocean to the Maritime Continent (Fig. 8).
- In the lower troposphere, cyclonic circulation anomalies straddling the equator were seen over the Indian Ocean and around the New Guinea. Anticyclonic circulation anomalies were seen from the seas south of Japan to the western coast of North America.
- In the sea level pressure field, negative anomalies were seen from the Maritime Continent to the equatorial Pacific. The Southern Oscillation Index value was +0.9 (Fig. 5).

Extratropics:

- In the 500-hPa height field (Fig. 9), wave trains were seen from the North Atlantic to Japan with positive anomalies over southwestern Europe and from southeastern China to mainland Japan. Positive anomalies from western Russia to Western Siberia and negative anomalies over Mongolia were seen along the polar front jet stream. Positive anomalies over the Middle East and negative anomalies over the Black Sea and northern India were seen along the subtropical jet stream.
- The westerly jet stream was stronger than normal from the Middle East to the North Pacific and the North Atlantic to western Europe, and shifted northward from its normal position from eastern China to the North Pacific (Fig. 10).
- In the sea level pressure field (Fig. 11), the Icelandic Low, the Aleutian Low and the Siberian High were stronger than normal. Zonally elongated positive anomalies were seen from mainland Japan to the latitudinal bands of 30°N in the Pacific.
- Temperatures at 850-hPa were above normal over the northern part of North America, western Europe, Western Siberia and from southern China to the seas south of Japan, and below normal over a wide area of East Asia (Fig. 12).
- Zonal mean temperatures in the troposphere were above normal over the tropics and the latitudinal bands of 70°N. Above-normal temperatures were clearly seen in the high-latitudes of the Northern Hemisphere stratosphere.
- In the 30-hPa height field, the stratospheric polar vortex shifted toward Siberia in association with positive height anomalies clearly seen over northern Canada, and Stratospheric Sudden Warming was occurred in mid-December.

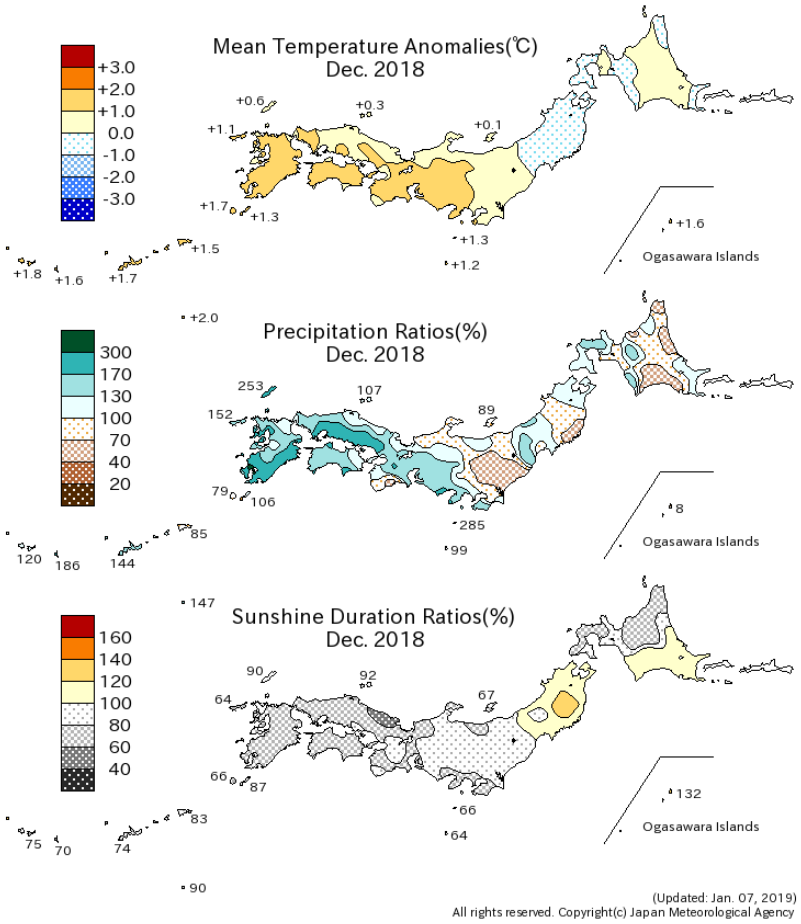

Fig. 1 Monthly climate anomaly/ratio over Japan (December 2018)
Top: temperature anomalies (degree C)
Middle: precipitation ratio (%)
Bottom: sunshine duration ratio (%)
The base period for the normal is 1981-2010.

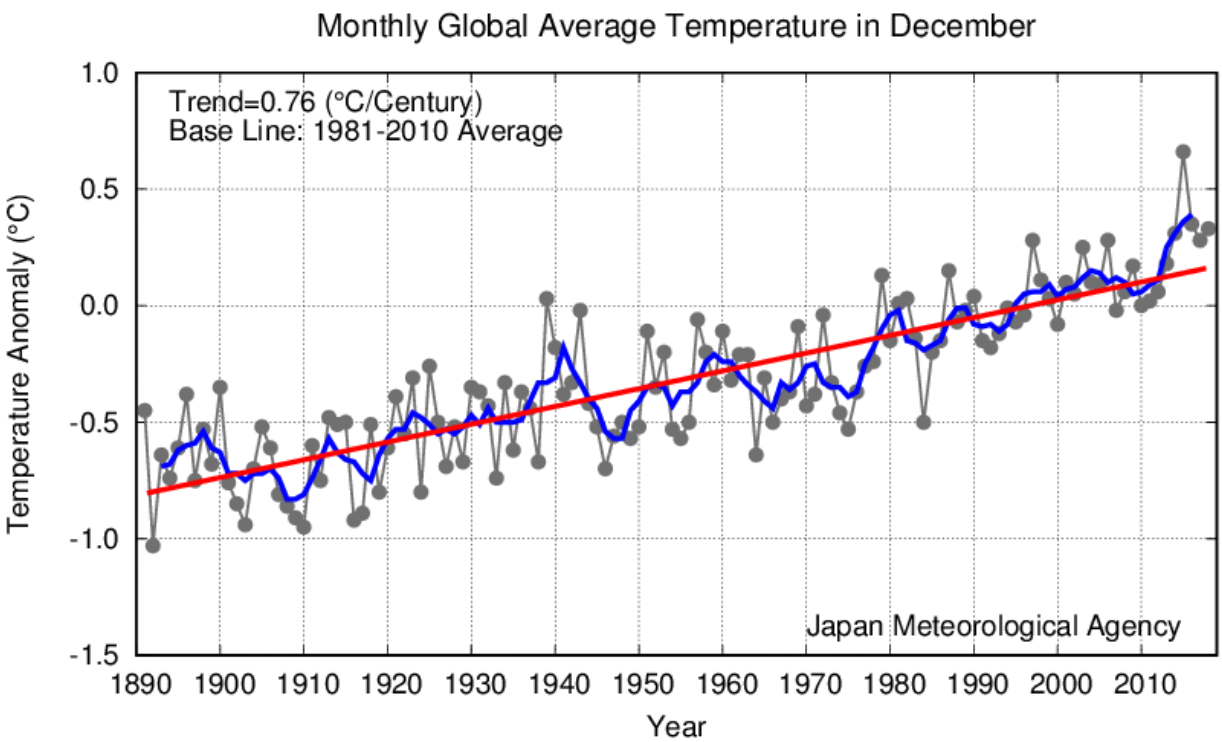

Fig. 2 Long-term change in monthly anomalies of global average surface temperature in December
The thin black line indicates anomalies of the surface temperature in each year. The blue line indicates five-year running mean, and the red line indicates a long-term linear trend. Anomalies are deviations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

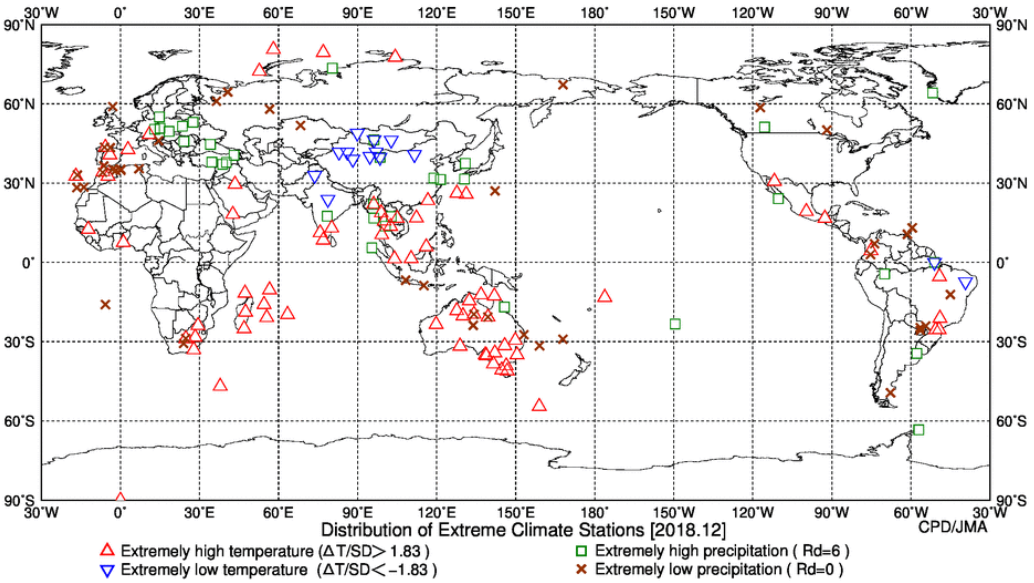

Fig. 3 Distribution of extreme climate stations (December 2018)

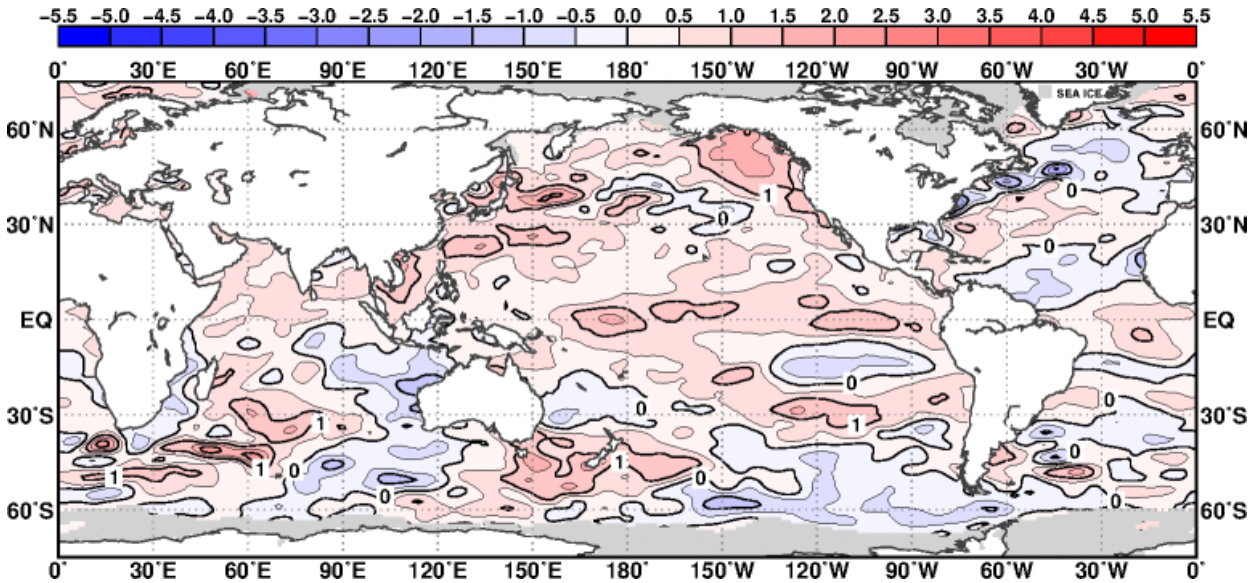

Fig. 4 Monthly mean sea surface temperature anomaly (December 2018)
The contour interval is 0.5 degree C. The base period for the normal is 1981-2010. Maximum coverage with sea ice is shaded in gray.

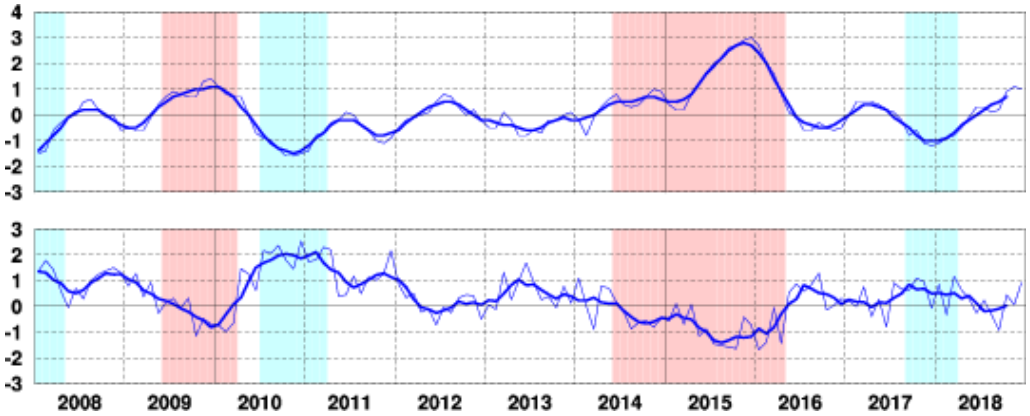

Fig. 5 Time series of monthly mean SST departure (degree C) from the reference value defined as the immediate past 30-year mean SST averaged over the NINO.3 region (upper). Time series of the Southern Oscillation Index with respect to the 1981-2010 base period (lower).
Thin blue lines represent monthly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

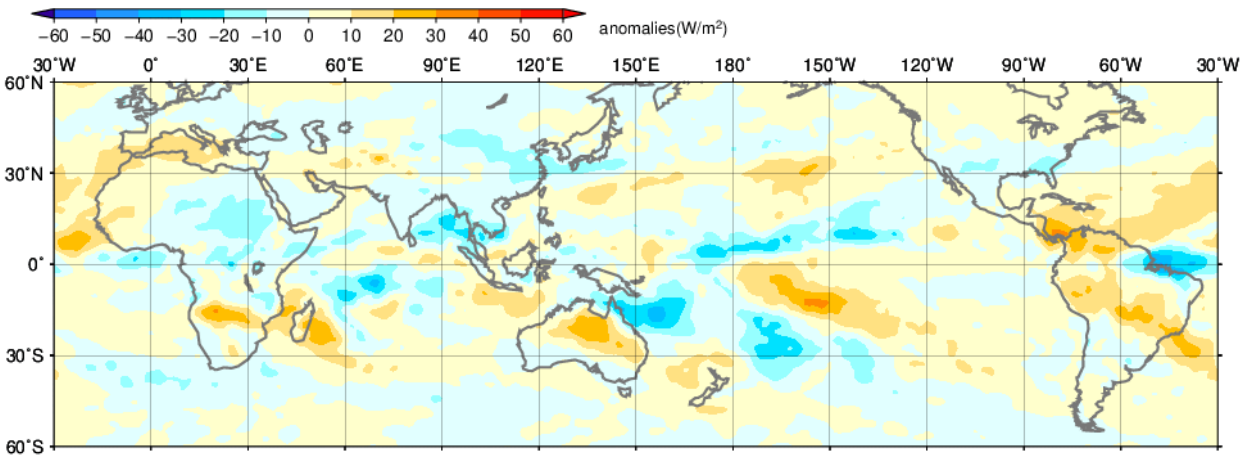

Fig. 6 Monthly mean Outgoing Longwave Radiation (OLR) anomaly (December 2018)
The contour interval is 10 W/m^2. The base period for the normal is 1981-2010. Original data provided by NOAA.

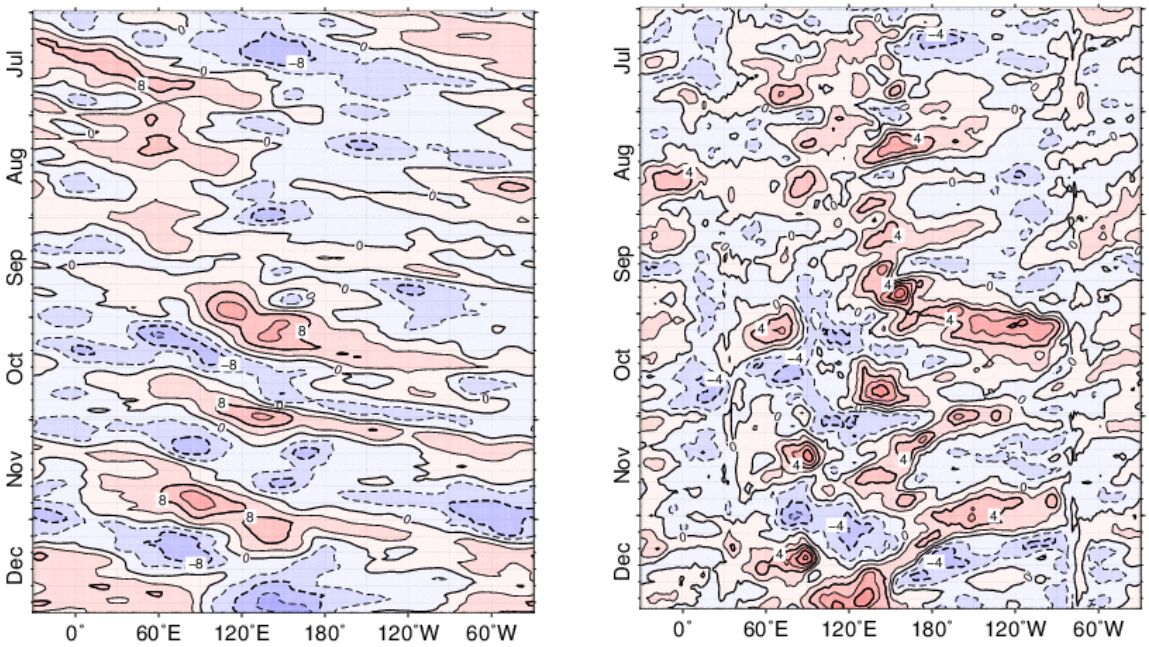

Fig. 7 Time-Longitude cross section (5°N-5°S) of five-day running mean 200-hPa velocity potential anomaly (left) and 850-hPa zonal wind anomaly (right) (July 2018 – December 2018)
The contour intervals are 4x10^6 m^2/s (left) and 2 m/s (right). The base period for the normal is 1981-2010.

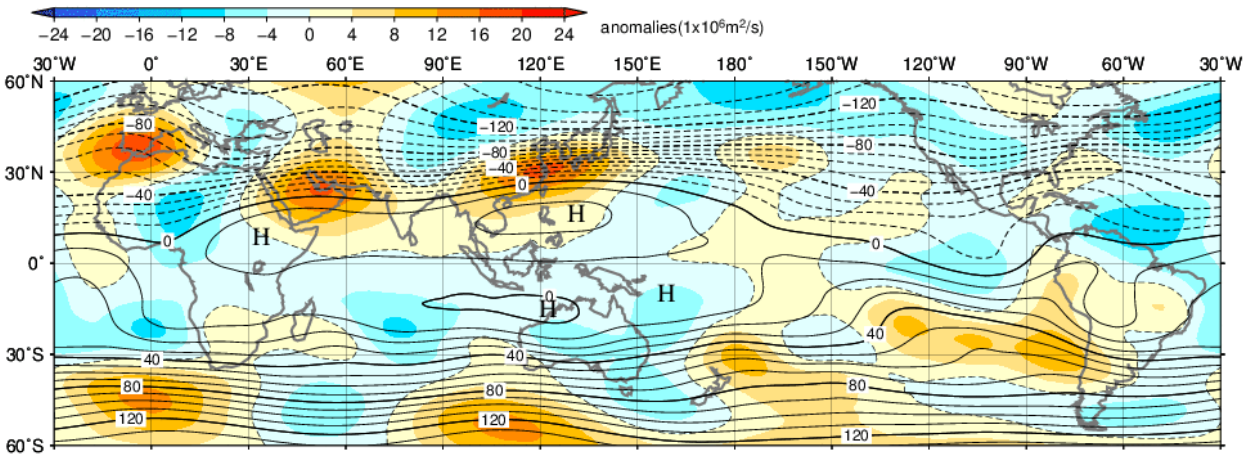

Fig. 8 Monthly mean 200-hPa stream function and anomaly (December 2018)
The contour interval is 10x10^6 m^2/s. The base period for the normal is 1981-2010.

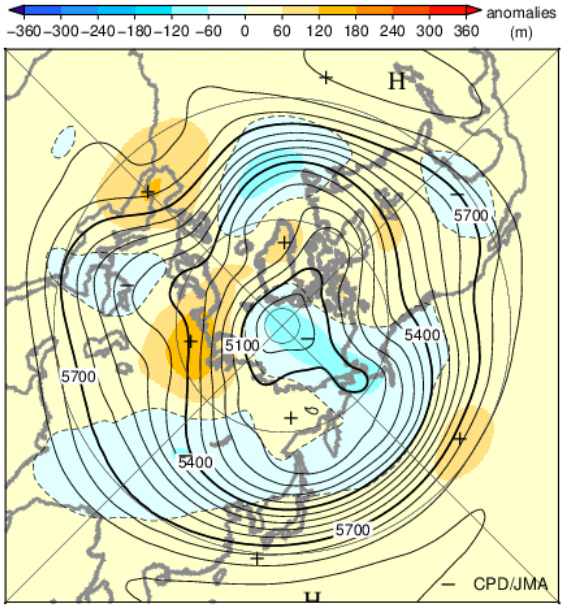

Fig. 9 Monthly mean 500-hPa height and anomaly in the Northern Hemisphere (December 2018)

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.

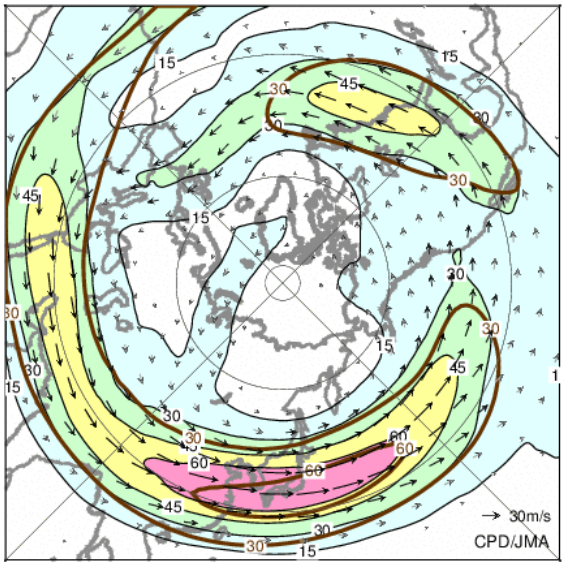

Fig. 10 Monthly mean 200-hPa wind speed and vectors in the Northern Hemisphere (December 2018)

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 1981-2010.

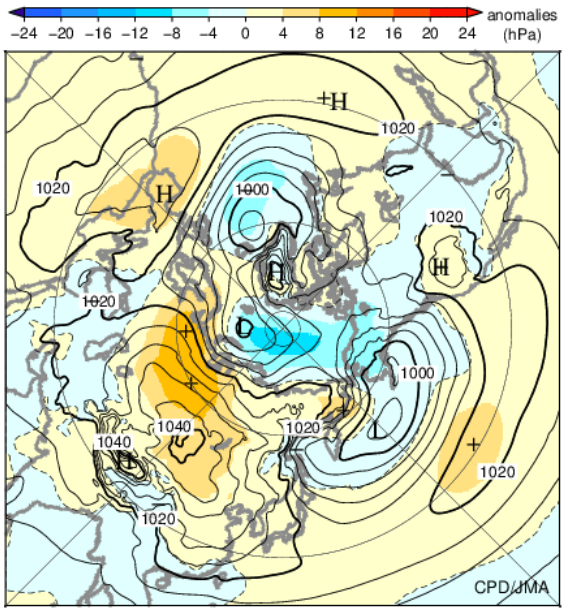

Fig. 11 Monthly mean sea level pressure and anomaly in the Northern Hemisphere (December 2018)

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.

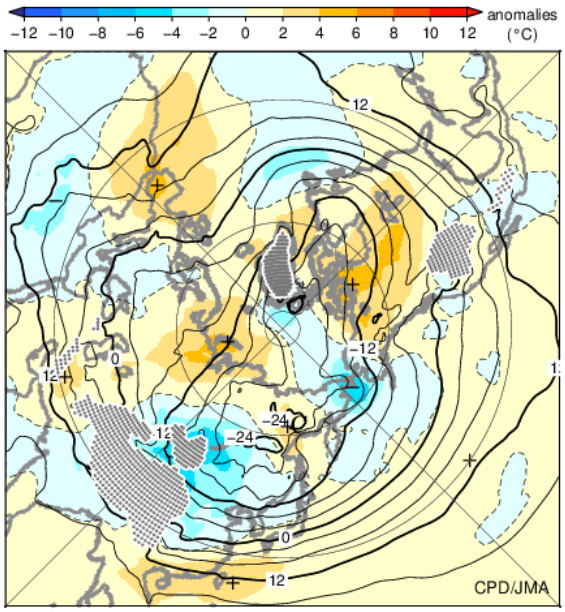

Fig. 12 Monthly mean 850-hPa temperature and anomaly in the Northern Hemisphere (December 2018)

The contours show 850-hPa temperature at intervals of 4 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.