Monthly Highlights on the Climate System (December 2017)

Highlights in December 2017

- It is considered that La Niña conditions continue in the equatorial Pacific (see El Niño Outlook updated on 11 January 2018).
- Monthly mean temperatures were below normal all over Japan, especially in western Japan.
- Monthly mean temperatures were extremely high from Alaska to the northeastern part of Eastern Siberia, from the southwestern USA to northwestern Mexico, and in southeastern Australia.
- Convective activity was enhanced from the South China Sea to the seas east of the Philippines.
- In the lower troposphere, cyclonic (anti-cyclonic) circulation anomalies straddling the equator were observed over the Maritime Continent (over the eastern Pacific).
- In the 500-hPa height field, wave trains were clearly observed over northern Eurasia and the mid-latitudes in the Northern Hemisphere with positive (negative) anomalies over the western part of North America and southern China (the eastern part of North America and the eastern part of East Asia). The polar vortex in the Northern Hemisphere was weaker than normal.

Climate in Japan (Fig. 1):

- Monthly mean temperatures were below normal all over the country, especially in western Japan, since significant cold air intermittently flowed in the country.
- Monthly precipitation amounts were above normal on the Sea of Japan side of northern and eastern Japan, since the regions were often affected by low-pressure systems. Heavy snows were sometimes observed in northern Japan and on the Sea of Japan side of eastern Japan due to the developed low-pressure systems and the ensuing strong winter monsoon.
- The prevailing winter monsoon also brought below normal monthly sunshine durations on the Sea of Japan side of northern to western Japan and Okinawa/Amami.

World Climate:

- The monthly anomaly of the global average surface temperature in December 2017 (i.e., the combined average of the near-surface air temperature over land and the SST) was +0.27°C (6th 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 Alaska to the northeastern part of Eastern Siberia, from the southwestern USA to northwestern Mexico, and in southeastern Australia.
  - Monthly mean temperatures were extremely low in the southern part of Arabian Peninsula.
  - Monthly precipitation amounts were extremely high from western Russia to southwestern Europe.

Oceanographic Conditions (Fig. 4):

- In the equatorial Pacific, remarkably positive SST anomalies were observed in the western part and remarkably negative SST anomalies were observed in the eastern part. In the NINO.3 region, the monthly mean SST anomaly and the SST deviation from the latest sliding 30-year mean were both -1.2°C (Fig.5).
- In the North Pacific, remarkably positive SST anomalies were observed in the western tropical region, from the area near 10°N, 155°W to the western coast of Central America, and from the area near 40°N, 175°E to the area near 45°N, 160°W.
- In the South Pacific, remarkably positive SST anomalies were observed from the southeastern coast of Australia to the area near 45°S, 165°W, and from the area near 30°S, 125°W to the area near 40°S, 85°W, and remarkably negative SST anomalies were observed from the area near 20°S, 125°W to the western

coast of Chile.
- In the Indian Ocean, remarkably positive SST anomalies were observed from the area near Madagascar to the area near 40°S, 100°E, and in the Bay of Bengal, and remarkably negative SST anomalies were observed in the Arabian Sea.
- In the North Atlantic, remarkably positive SST anomalies were observed in the Caribbean Sea, in the Gulf of Mexico, and in almost the entire region south of 55°N.

Tropics:
- Convective activity was enhanced from the South China Sea to the seas east of the Philippines and was suppressed over the eastern part of the equatorial Indian Ocean and the central equatorial Pacific (Fig. 6).
- The active phase of equatorial intraseasonal oscillations was observed in the western Pacific from early through mid-December, but after that it propagated eastward from South America to the western Indian Ocean (Fig. 7).
- In the upper troposphere, wave trains were clearly observed in mid-latitudes in the Northern Hemisphere (Fig. 8), with anti-cyclonic (cyclonic) circulation anomalies over southern China (over the Arabian Peninsula).
- In the lower troposphere, cyclonic (anti-cyclonic) circulation anomalies straddling the equator were observed over the Maritime Continent (over the eastern Pacific). Cyclonic circulation anomalies also prevailed over the North Indian Ocean.
- In the sea level pressure field, positive anomalies were observed from the central equatorial Pacific to the eastern Pacific, and negative anomalies were observed from the central North Indian Ocean to the western Pacific, and over the subtropical region of the central South Pacific. The Southern Oscillation Index value was -0.1 (Fig. 5).

Extratropics:
- In the 500-hPa height field (Fig. 9), wave trains were clearly observed over northern Eurasia and the mid-latitudes in the Northern Hemisphere. Positive anomalies were observed over the western part of North America, the northeastern part of North Atlantic, from Western Russia to Western Siberia and southern China, and negative anomalies were observed over the eastern part of North America, northern Europe and the eastern part of East Asia. The polar vortex in the Northern Hemisphere was weaker than normal.
- The subtropical jet stream was stronger than normal and displaced northward from East Asia to the south of the Aleutian Islands, while meandered southward over Japan. The subpolar jet stream in the Northern Hemisphere was clearly observed over northern Eurasia (Fig. 10).
- In the sea level pressure field (Fig. 11), positive anomalies were observed to the south of the Aleutian Islands, over the western North America, the northeastern part of North Atlantic and around the Laptev Sea, and negative anomalies are observed over the eastern part of North America, northern Europe and around the Sakhalin. The Siberian High was stronger than normal.
- Temperatures at 850-hPa were above normal over the western North America and Western Siberia, and below normal over the central and eastern parts of North America and the eastern part of East Asia (Fig. 12).
- Zonal mean temperatures in the troposphere were above normal except over the latitudinal band of 50°N and the high-latitudes in the Southern Hemisphere.

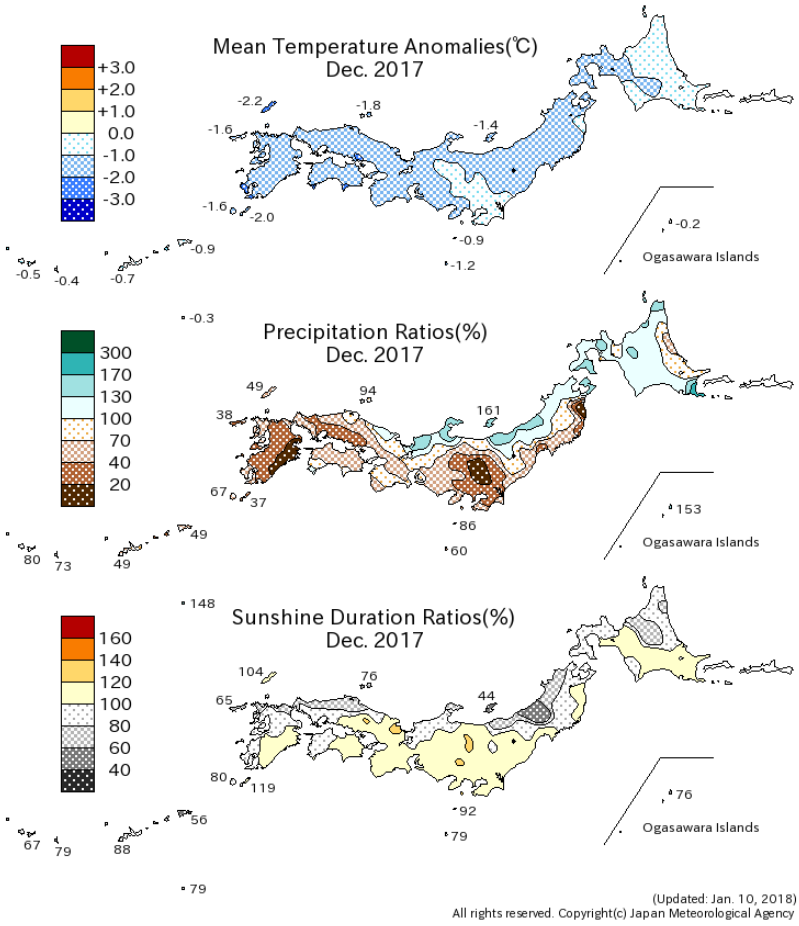

Fig. 1 Monthly climate anomaly/ratio over Japan (December 2017)
Top: temperature anomalies (degree C)
Middle: precipitation ratio (%)
Bottom: sunshine duration ratio (%)
The base period for the normal is 1981-2010.

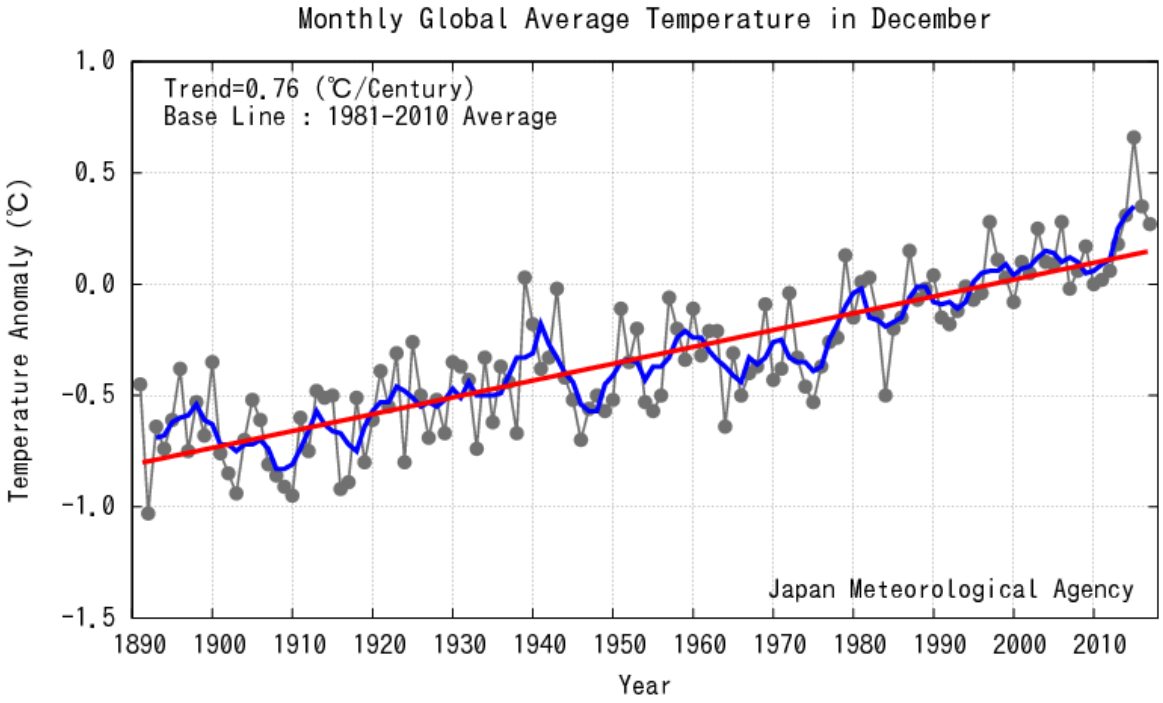

Fig. 2 Long-term change in monthly anomalies of global average surface temperature in December
The thin black line indicates anomalies of the surface temperature in each year. The blue line indicates five-year running mean, and the red line indicates a long-term linear trend. Anomalies are deviations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

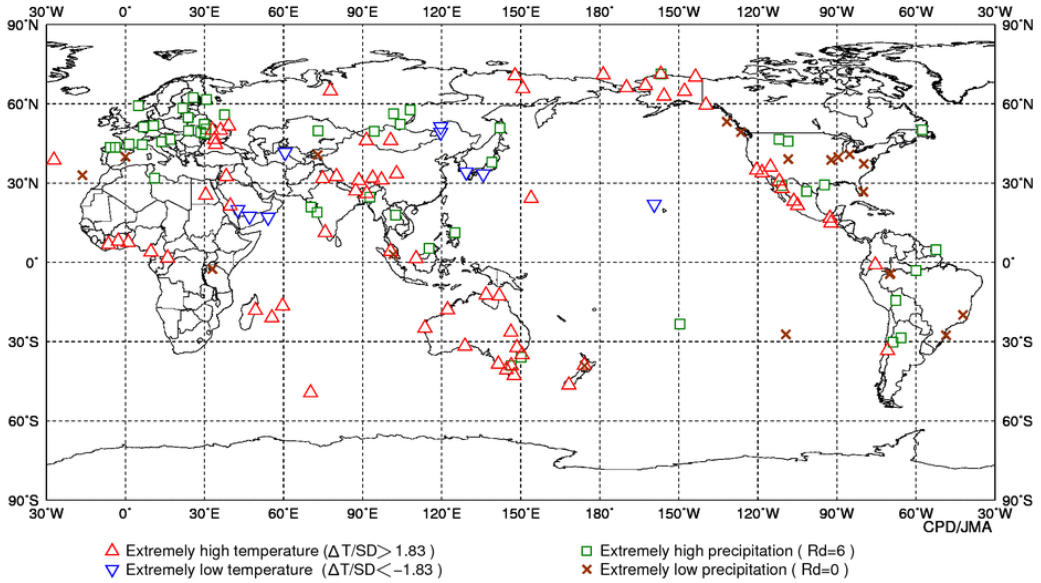

Fig. 3 Distribution of extreme climate events (December 2017)

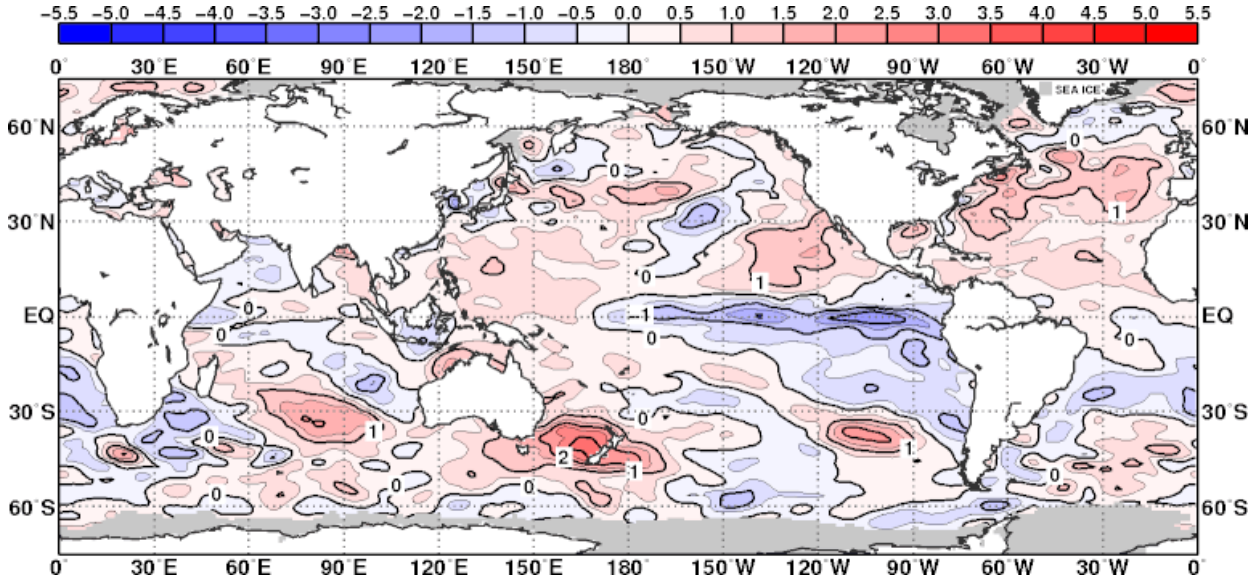

Fig. 4 Monthly mean sea surface temperature anomaly (December 2017)
The contour interval is 0.5 degree C. The base period for the normal is 1981-2010. Maximum coverage with sea ice is shaded in gray.

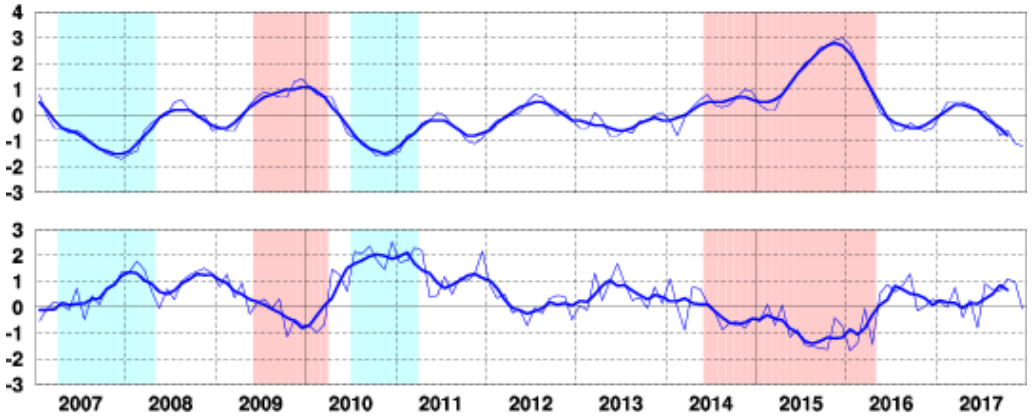

Fig. 5 Time series of monthly mean SST departure (degree C) from the reference value defined as the immediate past 30-year mean SST averaged over the NINO.3 region (upper). Time series of the Southern Oscillation Index with respect to the 1981-2010 base period (lower).
Thin blue lines represent monthly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

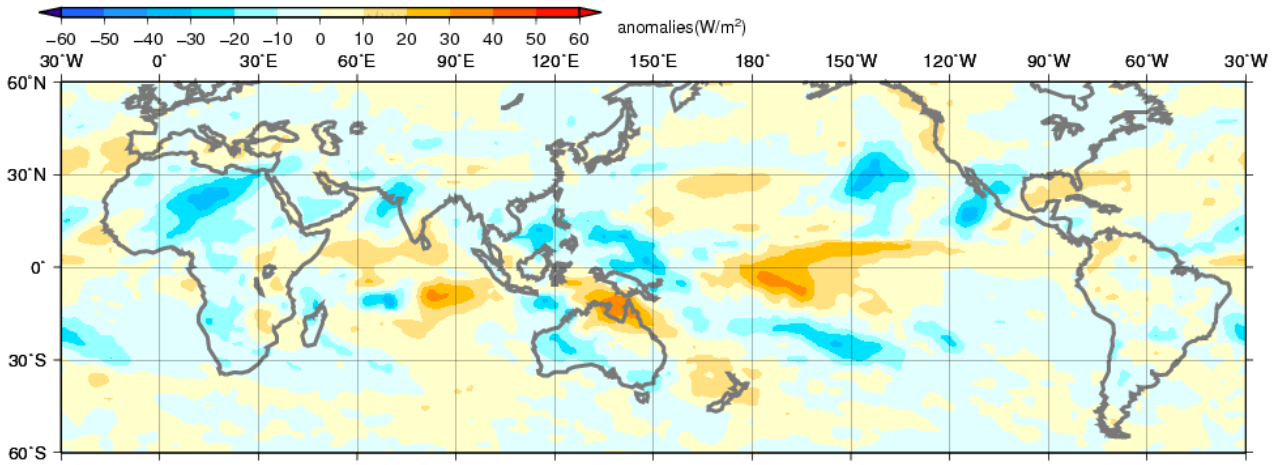

Fig. 6 Monthly mean Outgoing Longwave Radiation (OLR) anomaly (December 2017)
The contour interval is 10 W/m^2. The base period for the normal is 1981-2010. Original data provided by NOAA.

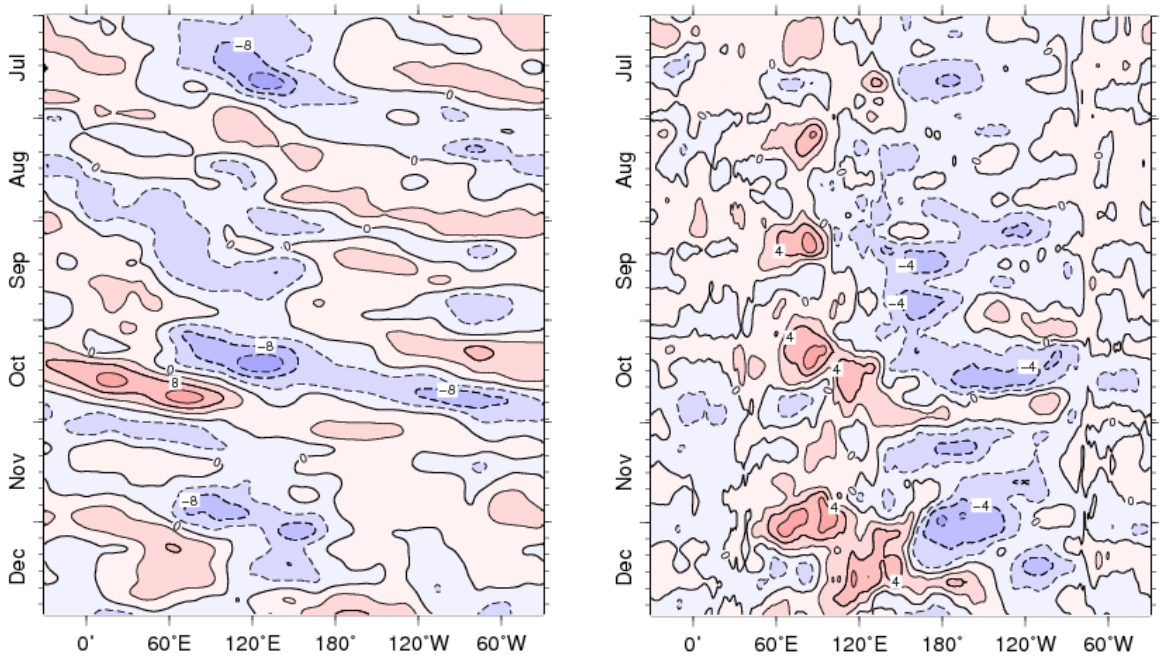

Fig. 7 Time-Longitude cross section (5°N-5°S) of five-day running mean 200-hPa velocity potential anomaly (left) and 850-hPa zonal wind anomaly (right) (July 2017 – December 2017)
The contour intervals are 4x10^6 m^2/s (left) and 2 m/s (right). The base period for the normal is 1981-2010.

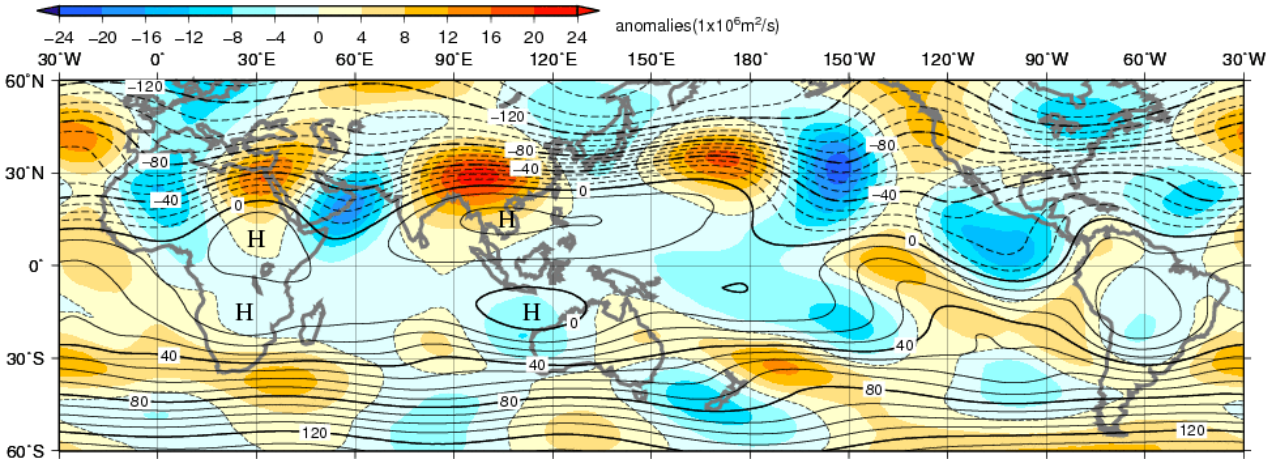

Fig. 8 Monthly mean 200-hPa stream function and anomaly (December 2017)
The contour interval is 10x10^6 m^2/s. The base period for the normal is 1981-2010.

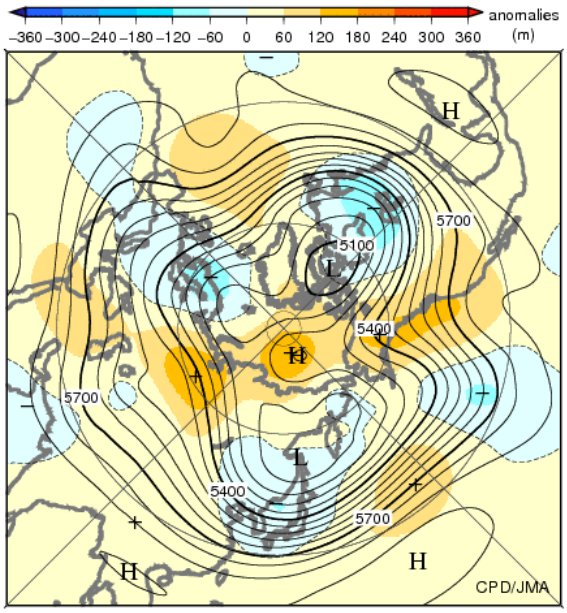

Fig. 9 Monthly mean 500-hPa height and anomaly in the Northern Hemisphere (December 2017)

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.

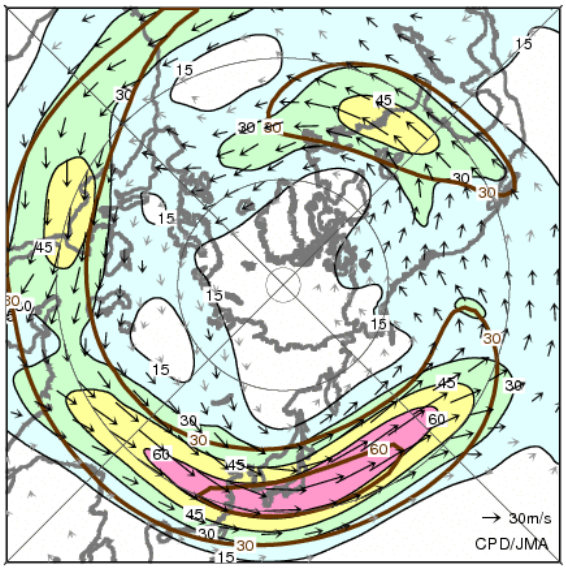

Fig. 10 Monthly mean 200-hPa wind speed and vectors in the Northern Hemisphere (December 2017)

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.

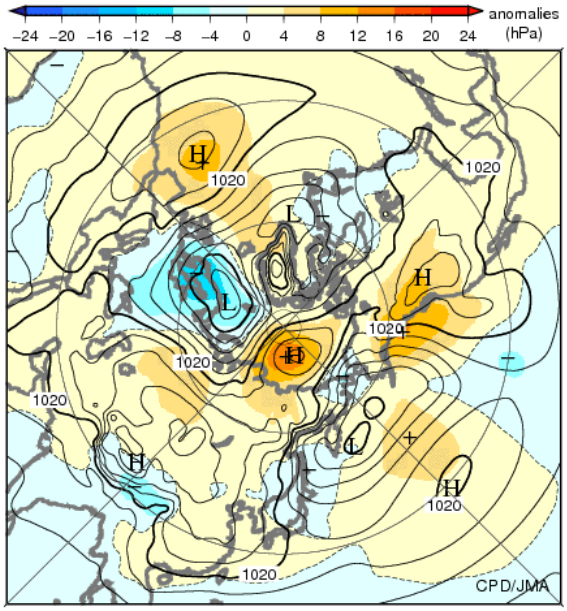

Fig. 11 Monthly mean sea level pressure and anomaly in the Northern Hemisphere (December 2017)

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.

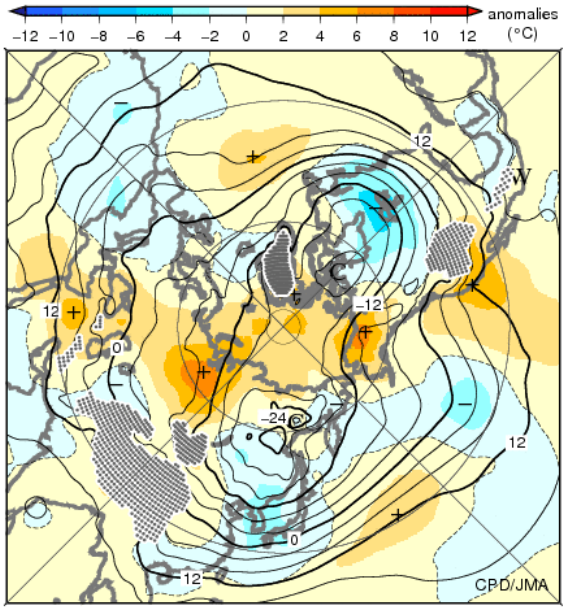

Fig. 12 Monthly mean 850-hPa temperature and anomaly in the Northern Hemisphere (December 2017)

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.
http://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.